Coastal Zone
Information
Center

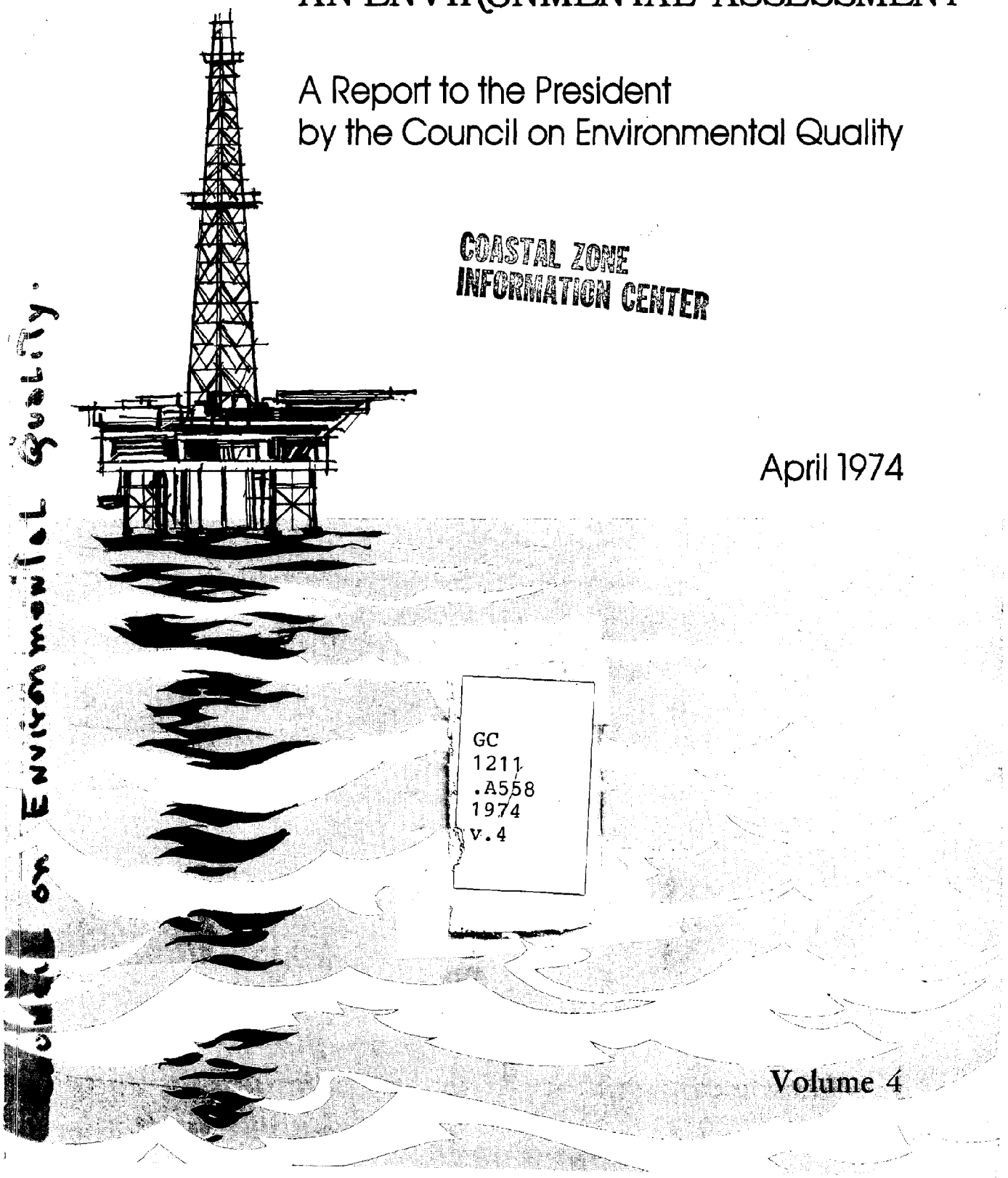
FEB 1 0 1975

OCS OIL AND GAS –

AN ENVIRONMENTAL ASSESSMENT

A Report to the President
by the Council on Environmental Quality

COASTAL ZONE
INFORMATION CENTER



April 1974

GC
1211
.A558
1974
v.4

Volume 4

OCS STUDIES:

Volume I

OCS Oil and Gas – An Environmental Assessment, A Report to the President

Issues in the Assessment of Environmental Impacts of Oil and Gas Production on the Outer Continental Shelf, A Critique, National Research Council

Volume II

Appendix A	Federal Agency Contributors
Appendix B	Contracts Issued
Appendix C	Members of Governors' Advisory Committee
Appendix D	Summary of World Oil and Gas Reserves and Production
Appendix E	Oil and Gas Resource Classification and Estimates, Bureau of Mines and U.S. Geological Survey
Appendix F	Methodology for Selecting Hypothetical Locations of Possible Oil and Gas Accumulations, U.S. Geological Survey
Appendix G	The National Energy Scene, Walter G. Dupree, Jr.
Appendix H	A National Energy Conservation Program: The Half and Half Plan
Appendix I	Environmental Impacts of Alternatives to Outer Continental Shelf Oil and Gas Production, Hittman Associates, Inc.
Appendix J	Some Environmental Considerations in the Petroleum Refining Industry, Radian Corporation
Appendix K	Summary of the Public Hearings Held by the Council on Environmental Quality on the Environmental Impacts of Potential Oil and Gas Development of the Atlantic and Gulf of Alaska OCS, September–October 1973

Volume III

The Effect of Natural Phenomena on OCS Gas and Oil Development, Tetra Tech, Inc.

Toward Resolving Problems in Outer Continental Shelf Technology, Resources for the Future, Inc.

Volume IV

Potential Onshore Effects of Oil and Gas Production on the Atlantic and Gulf of Alaska Outer Continental Shelf, Resource Planning Associates, Inc., and David M. Dornbusch & Co.

Volume V

Potential Biological Effects of Hypothetical Oil Discharges in the Atlantic Coast and Gulf of Alaska, Massachusetts Institute of Technology

Simulation of Hypothetical Offshore Petroleum Developments, Massachusetts Institute of Technology

Analysis of Oil Spill Statistics, Massachusetts Institute of Technology

Oil Spill Trajectory Studies for Atlantic Coast and Gulf of Alaska, Massachusetts Institute of Technology

03687

OCS OIL AND GAS –
AN ENVIRONMENTAL ASSESSMENT

A Report to the President
by the Council on Environmental Quality

April 1974

U.S. DEPARTMENT OF COMMERCE NOAA
COASTAL SERVICES CENTER
2234 SOUTH HOBSON AVENUE
CHARLESTON, SC 29405-2413

Property of CSC Library

GC1211 .A558 1974 v.4
FEB 25 1997

Volume 4

Property of CSC Library

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402
Price $6.65 Stock Number 4000-00325

Potential Onshore Effects of Oil and Gas Production on the Atlantic and Gulf of Alaska Outer Continental Shelf

TABLE OF CONTENTS

	Page
CHAPTER 1 PREFACE	1-1
CHAPTER 2 EAST COAST INTRODUCTION	
Sites of Analysis	2-1
Base Case Development	2-6
Offshore Production Estimates and Development Assumptions	2-9
CHAPTER 3 NEW ENGLAND	
Profile of Current Conditions	3-1
Development Assumptions	3-6
Impacts	
Economic	3-11
Social Infrastructure	3-22
Land Use	3-25
Air Pollution	3-31
Water Pollution	3-33
CHAPTER 4 MID-ATLANTIC	
Profile of Current Conditions	4-1
Development Assumptions	4-7
Impacts	
Economic	4-11
Social Infrastructure	4-23
Land Use	4-26
Air Pollution	4-30
Water Pollution	4-36
CHAPTER 5 SOUTH ATLANTIC	
A. EASTERN SOUTH CAROLINA/EASTERN GEORGIA	
Profile of Current Conditions	5A-1
Development Assumptions	5A-7
Impacts	
Economic	5A-13
Social Infrastructure	5A-23
Land Use	5A-26
Air Pollution	5A-30
Water Pollution	5A-36

CHAPTER 5 SOUTH ATLANTIC — Page

B. NORTHEAST FLORIDA/SOUTHEAST GEORGIA

Profile of Current Conditions — 5B-1
Development Assumptions — 5B-6
Impacts
Economic — 5B-12
Social Infrastructure — 5B-22
Land Use — 5B-24
Air Pollution — 5B-28
Water Pollution — 5B-34

CHAPTER 6 WEST COAST INTRODUCTION

Sites of Analysis — 6-1
Base Case Development — 6-6
Offshore Production Levels — 6-11

CHAPTER 7 ALASKA

Profile of Current Conditions — 7-2
Development Assumptions — 7-6
Impacts
Economic — 7-10
Social Infrastructure — 7-27
Land Use — 7-36
Community Profiles — 7-38

CHAPTER 8 PUGET SOUND

Profile of Current Conditions — 8-1
Development Assumptions — 8-5
Impacts
Economic — 8-11
Social Infrastructure — 8-16
Land Use — 8-23
Air Pollution — 8-28
Water Pollution — 8-34

CHAPTER 9 SAN FRANCISCO BAY

Profile of Current Conditions — 9-1
Development Assumptions — 9-7
Impacts
Economic — 9-10
Social Infrastructure — 9-21
Land Use — 9-24
Air Pollution — 9-29
Water Pollution — 9-31

		Page
APPENDIX I	OIL AND GAS RECOVERY INDUSTRY	I-1
	Introduction	I-1
	Exploration	I-4
	Platform Development	I-8
	Oil and Gas Production	I-12
	Platform Fabrication	I-15
	Transportation	I-17
	Summary	I-18
APPENDIX II	OIL REFINING INDUSTRY	II-1
	Industry Description	II-1
	Model Refinery	II-4
	Projected Regional Refinery Development	II-8
APPENDIX III	GAS PROCESSING INDUSTRY	III-1
	Industry Description	III-1
	Representative Plant	III-4
	Projected Regional Development	III-11
APPENDIX IV	PETROCHEMICAL INDUSTRY	IV-1
	Industry Description	IV-1
	Representative Complex	IV-5
	Projected Regional Development	IV-9
APPENDIX V	CONSTRUCTION	V-1
	Primary Construction	V-1
	Induced Construction	V-3
APPENDIX VI	ECONOMIC METHODOLOGY	VI-1
	Baseline Projections	VI-2
	Impact Analysis	VI-10
APPENDIX VII	SOCIAL INFRASTRUCTURE METHODOLOGY	VII-1
	Social Infrastructure Components	VII-1

		Page
	Nature of Impacts	VII-2
	Prediction Methodology and Data Sources	VII-2
APPENDIX VIII	LAND USE METHODOLOGY	VIII-1
	Land Use Inventory	VIII-1
	Undeveloped Land Capabili+ies	VIII-7
APPENDIX IY	AIR AND WATER POLLUTION METHODOLOGY	IX-1
	Air Pollution	IX-1
	Water Pollution	IX-7
APPENDIX X	WILDLIFE AND VEGETATION	X-1
	Types of Areas	X-1
	Nature of Potential Impacts	X-11
	Inventory of Significant Areas	X-13
	Bristol County, Mass.	X-14
	Eastern Mass./Rhode Island	X-18
	Cape May and Cumberland Counties, New Jersey	X-28
	Delaware River	X-32
	Charleston, S.C.	X-35
	Eastern S.C./Eastern Ga.	X-38
	Jacksonville, Fla.	X-41
	Northeastern Fla./S.E. Ga.	X-46
	Valdez, Alaska	X-49
	Alaska	X-51
	Skagit and Whatcom Counties, Washington	X-53
	Puget Sound	X-57
	Contra Costa and Solano Counties, California	X-60
	San Francisco Bay	X-62

1. PREFACE

This report of the potential onshore effects of offshore oil and gas development on the Atlantic and Gulf of Alaska Outer Continental Shelves (OCS) consists of four volumes. Volumes 1 and 2 present detailed findings for the East Coast and West Coast, respectively. Volumes 3 and 4 contain appendixes with backup detail on primary industries, i.e., those which were analyzed in depth and on the methodology used to measure onshore socio-economic and environmental impacts. Finally, two computer runs, submitted to the CEQ, supplement the detail provided in Appendixes VI and IX, and cover the detailed economic and air and water pollution findings.

BACKGROUND AND OBJECTIVES

During the last few years, development of the potential oil and gas resources on the Atlantic and Gulf of Alaska Outer Continental Shelves has received considerable attention as increasing consumption has rapidly strained existing U.S. sources of energy.

On a national basis, inadequate supplies of domestic energy have intensified U.S. dependence on foreign energy sources, raised significant questions about future trade balances, resulted in rapidly increasing fuel and gasoline prices, and now threaten to significantly constrain national economic growth. Development of OCS oil and gas resources offers one of several alternatives that could at least partially alleviate these problems between now and the end of the century.

On a regional basis, development of these offshore resources poses uncertain economic, social and environmental impacts. These potential impacts can be positive or negative. Positive aspects would include more jobs with resulting lower unemployment, higher economic output and increased income for a particular area. Negative aspects could include environmental degradation from oil spills,[1] excessive development of land that would be better used for other purposes, undue strain on local or regional infrastructure resources, and unacceptable air

---

[1]Treated in the CEQ primary effects study.

and water pollution levels. The major questions addressed in the total OCS impact study being carried out by the Council on Environmental Quality (CEQ) are: (1) What are the magnitudes of the potential benefits or adverse effects of offshore development? and (2) Do the benefits outweigh the adverse effects?

As one of a series of studies on the total effects of offshore production, this document attempts to examine, as quantitatively as possible, all significant types of secondary local and regional impacts that could be induced onshore by the development of the Atlantic and Gulf of Alaska OCS resources. The broad objectives of this study were to:

- Project the potential socio-economic and environmental conditions of onshore development, given no OCS development

- Determine the impacts that could occur if OCS resources were developed.

This study was not intended to result in recommendations regarding the advisability of proceeding with OCS development. (It could not be used for this, since it was one of several studies collectively needed to make such recommendations.) Rather, its purpose was to make findings regarding the secondary (onshore) impacts that could occur under reasonable development scenarios.

A summary of the findings of this report is contained in the CEQ's report on OCS Oil and Gas Development, Chapter VIII, entitled, "Onshore Effects of OCS Development." We suggest that readers of this report review that chapter.

On the following pages are the major related studies which were used in the preparation of this report.

MAJOR RELATED STUDIES

Arthur D. Little, Inc. Potential Onshore Effects of Deepwater Oil Terminal - Related Industrial Development. (Volumes I-IV) Cambridge, Massachusetts: Arthur D. Little, Inc., 1973.

American Petroleum Institute. The Impact of North Sea Gas on the United Kingdom Economy. Washington, D.C.: API, 1973.

Ahern, William R., Jr. Should Georges Bank Be Leased for Petroleum Development? An Analysis of the Economic and Environmental Implications of Leasing or Not Leasing Georges Bank for Oil and Gas Development. Cambridge, Massachusetts: a thesis presented to the Public Policy Ph.D. Committee, Harvard University, May 1973.

Doig, K. Socio-Economic Impact of East Coast OCS Development on U.S. and PAD District I. Washington, D.C.: Council on Environmental Quality, September 12, 1973 ... Supporting Data for Testimony at Hearings on OCS.

Kash, Don E., et al. Energy Under the Oceans: A Technology Assessment of Outer Continental Shelf Oil and Gas Operations. Norman, Oklahoma: University of Oklahoma Press, 1973.

Moore, Stephen F., et al. A Preliminary Assessment of the Environmental Vulnerability of Machias Bay, Maine to Oil Supertankers. Cambridge, Massachusetts: Massachusetts Institute of Technology Press, January 1973.

National Academy of Engineering, Marine Board. Outer Continental Shelf Resource Development Safety: A Review of Technology and Regulation for the Systematic Minimization of Environmental Intrusion from Petroleum Products. Springfield, Virginia: National Technical Information Service, December 1972.

National Petroleum Council. Environmental Conservation: The Oil and Gas Industries. (Volumes I & II) Washington, D.C.: National Petroleum Council, 1973.

Offshore Oil Task Group. The Georges Bank Petroleum Study. Cambridge, Massachusetts: MIT Press, February 1973.

Offshore Ports and Terminals. Hearings on H.R. 5091 and H.R. 5898 Before the House Committee on Merchant Marine and Fisheries. 93rd Congress, First Session, Ser. 93-15, 1973.

Rorholm, Niels, et al. Economic Impact of Marine-Oriented Activities - A Study of the Southern New England Marine Region. Kingston, Rhode Island: University of Rhode Island, Department of Resource Economics, 1967.

The Technology Assessment Group. North Sea Oil and Gas Operations: A Preliminary Report. Norman, Oklahoma: University of Oklahoma, Science and Public Policy Program, August 1973.

U.S. Department of Defense, Army Corps of Engineers. West Coast Deepwater Port Facilities Study. (Volumes I-V) Washington, D.C.: Corps of Engineers, August 1973.

U.S. Department of the Interior, Bureau of Land Management. Environmental Impact Statement, OCS Sale No. 32, Offshore Mississippi, Alabama, and Florida. (Volumes I-V) Washington, D.C.: U.S. Government Printing Office, 1973.

U.S. Department of the Interior, Bureau of Land Management. Environmental Impact Statement, 1972 OCS Sale, Offshore Louisiana. Washington, D.C: U.S. Government Printing Office, 1972.

U.S. Department of the Interior, Bureau of Land Management. Environmental Impact Statement, 1973 OCS East Texas General Oil and Gas Lease Sale. Washington, D.C: U.S. Government Printing Office, 1973.

U.S. Department of the Interior, Geological Survey. Environmental Impact Statement, Proposed Plan of Development, Santa Ynes Unit, Santa Barbara Channel. (Volumes I-III) Washington, D.C: U.S. Department of the Interior.

U.S. Department of the Interior, Office of Assistant Secretary, Program Development and Budget, Office of Economic Analysis. Environmental Impact Statement, Deepwater Ports. Washington, D.C.: U.S. Department of the Interior, June 1973.

2. EAST COAST INTRODUCTION

The East Coast, which has been defined to include the states from Maine to Florida comprising Petroleum Administrative for Defense District (PAD) I has historically been an area dependent on the Gulf of Mexico, the Midwest, and foreign countries for much of its petroleum, gas, and petrochemical needs. With the possibility of major oil and gas reserves on its Outer Continental Shelf, primarily in the Georges Bank Trough, the Baltimore Canyon, and the Georgia Embayment, East Coast areas adjacent to these reserves may play a major role in the future refining, processing, and manufacturing of oil and gas products.

To analyze quantitatively the expected impacts of OCS development on the East Coast, three major tasks were required: first, selection of specific sample sites in order to relate the analysis to actual conditions; second, postulation of a set of conditions in order to describe the potential situation without OCS development; third, projection of the levels of onshore regional activity associated directly with OCS development.

SITES OF ANALYSIS

A number of sites were considered to be possible onshore oil and gas receipt points by the year 2000, depending upon the particular location where offshore oil and gas are discovered.

In analyzing the potential onshore receiving points corresponding to the various potential offshore production locations, 22 sites were tentatively identified on the East Coast. Exhibit 2-1 shows the hypothetical locations of offshore oil and gas, based on projections by the United States Geological Survey (USGS); Exhibit 2-2 lists the possible onshore receipt sites.

From the total list of potential sites, four were chosen for analysis in this study according to the following criteria:

- At least one site in each major demand area (New England, Mid-Atlantic, and South Atlantic)

- Proximity to hypothetical offshore reserves and onshore markets

- A mix of developed and undeveloped localities and regions, especially in terms of refinery and port facilities

- Variation among the economic conditions of different sites (e.g., unemployment)

- Reasonable availability of data

- At least one region or locality analyzed in a previous deepwater terminal study conducted by the Council on Environmental Quality.

Based on the criteria listed above, the following East Coast sites were selected for analysis:

Demand Area	Locality	Region
New England	Bristol County, Mass.	Eastern Mass./R.I.
Mid-Atlantic	Cumberland/Cape May Counties, N.J.	Delaware River (Del.,Pa.,N.J.,N.Y.)
South Atlantic	Charleston, S.C. area	Eastern S.C./ Eastern Ga.
	Jacksonville, Fla. area	Northeastern Fla./ Southeastern Ga.

The localities were chosen as the one to three counties where oil and gas might be brought ashore; where a significant impact from refinery gas processing, petrochemical, and construction activities would be felt; and for which socio-economic and environmental data were readily available. The regions were chosen as areas that include the localities where the majority of the direct socio-economic and environmental impacts would occur, and for which data were readily available. For the South Atlantic, it is assumed that <u>either</u> Charleston, South Carolina, or Jacksonville, Florida, <u>but not both</u>, would be the primary receiving area for offshore oil and gas.

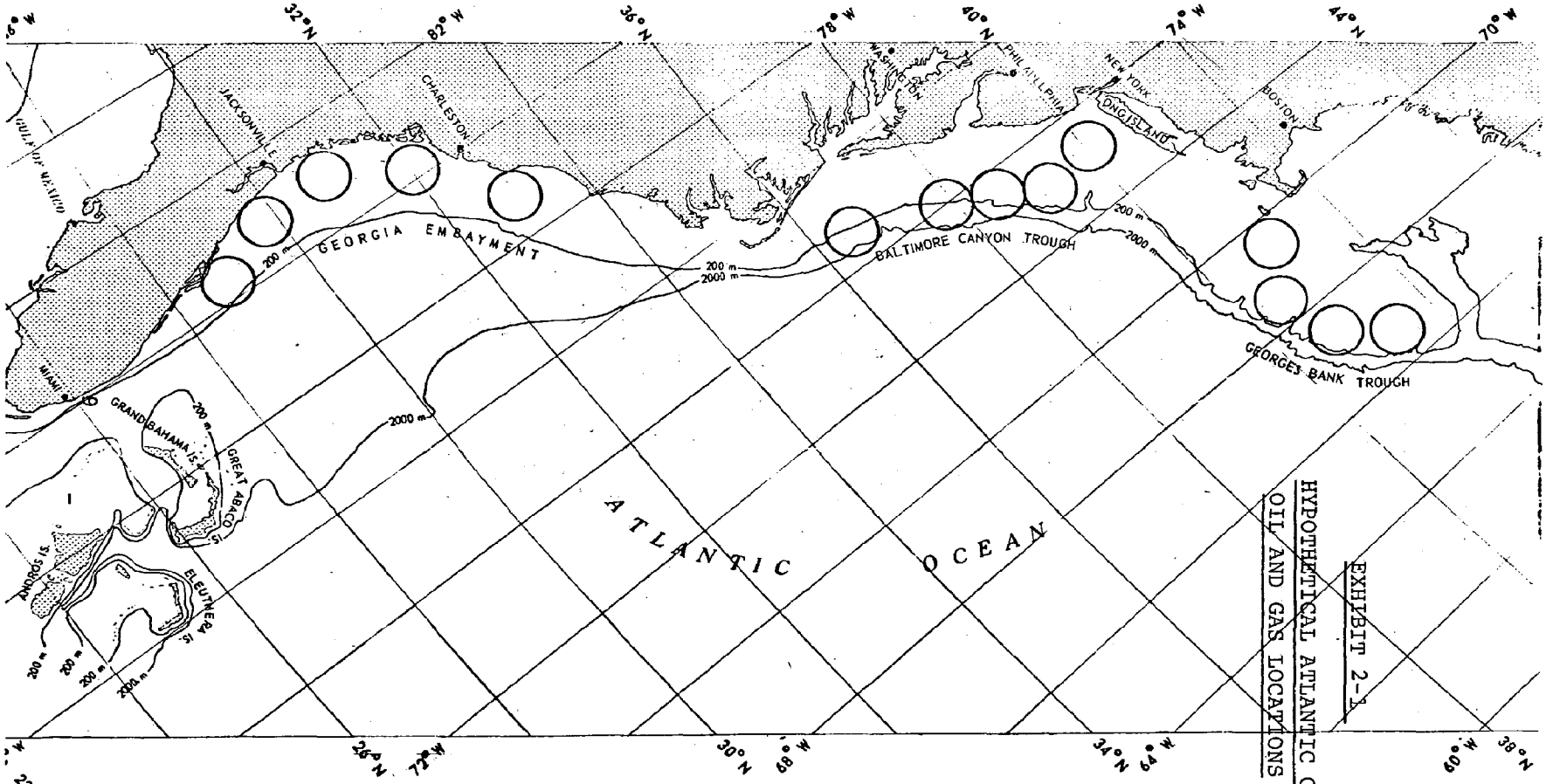


EXHIBIT 2-1

HYPOTHETICAL ATLANTIC OCS OIL AND GAS LOCATIONS

U.S. ATLANTIC OCS

HYPOTHETICAL LOCATIONS OF POSSIBLE OIL AND GAS ACCUMULATIONS

50 0 50 100 150 200
MILES

50 0 50 100 150 200
KILOMETERS

WATER DEPTH IN METERS

Source: RPA, based on projections of the U.S. Geological Survey (USGS)

EXHIBIT 2-2

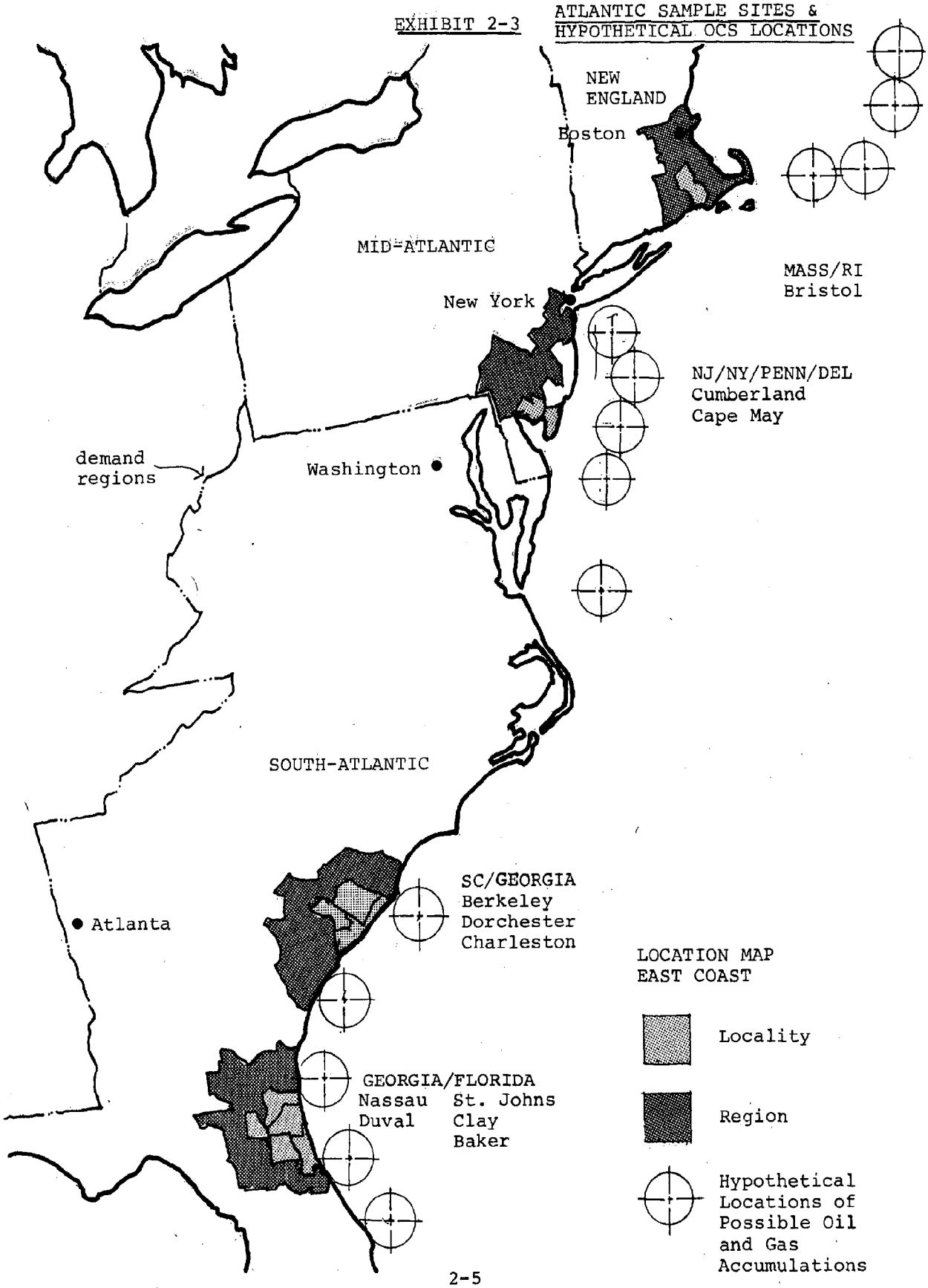
POSSIBLE EAST COAST ONSHORE RECEIPT POINTS FOR OFFSHORE OIL AND GAS PRODUCTION

Hypothetical Oil and Gas Location	Sample Receipt Points
Georges Bank Trough	Eastport, Maine Bangor, Maine Portland, Maine Boston, Massachusetts *Bristol County, Massachusetts Narragansett Bay, R.I.
Baltimore Canyon	Long Island, New York Raritan Bay, New Jersey *Cumberland/Cape May Counties, New Jersey Baltimore, Maryland Chincoteague Bay, Maryland Hampton Roads, Virginia Albemarle Sound, North Carolina
Georgia Embayment	Georgetown, South Carolina *Charleston, South Carolina Beaufort, South Carolina Savannah, Georgia St. Catherine's and Sapelo Sound, Georgia *Jacksonville, Florida Brevard County, Florida Stuard, Florida

* Sites chosen for analysis

Source: Resource Planning Associates

EXHIBIT 2-3 ATLANTIC SAMPLE SITES & HYPOTHETICAL OCS LOCATIONS



Source: RPA

These sites provide a range of sample conditions that should enable the CEQ to examine the potential impact on any specific site that may subsequently come under consideration. Since this study was not designed to recommend the best sites for onshore receipt of oil and gas, it is important to note that the sites examined here were chosen as analytic samples only. Exhibit 2-3 lays out the precise boundaries of the sample localities and regions along with the U.S. Geological Survey (USGS) offshore resource locations.

BASE CASE DEVELOPMENT

Because of the uncertainty over crude oil sources and, hence, future refinery development on the East Coast, two base cases (i.e., development without offshore production) were chosen for examination. Base Case 1 corresponds roughly to that used by the Department of Interior and the CEQ analyzing deepwater port impacts. This case assumes additions of 100 percent to existing refineries by the year 2000, but no new grass-roots refineries, and it places greater future dependence on Gulf Coast or imported refinery products. Base Case 1 may also be used to depict future conditions for the East Coast if Mid-East oil should become unavailable to the United States.

Base Case 2 includes the development of deepwater ports in each region, and it assumes that the East Coast will achieve 50 percent refining self-sufficiency by the year 2000. This is a five-fold increase over 1975 capacity. Exhibit 2-4 summarizes the refinery development assumptions for each base case.

It was assumed that each region would attempt to achieve a goal of 50 percent refinery self-sufficiency as well. However, further examination revealed that it may be difficult for New England and the South Atlantic to achieve this level of self-sufficiency without offshore production essentially for two reasons. First, environmental pressures tend to be stronger in these areas, where refineries have not previously been built. Second, the central location and existing refinery infrastructure may make the Mid-Atlantic more desirable than the other two East Coast areas for at least some future industry development. As a result, it was estimated that New England would develop a 30 percent self-sufficiency and the South Atlantic a 40 percent self-sufficiency by the year 2000, as shown in Exhibit 2-5.

EXHIBIT 2-4

EAST COAST REFINERY DEVELOPMENT ASSUMPTIONS
(millions of barrels/day)

	1975	1985	2000
Existing capacity	1.5	1.5	1.5
Base Case 1 (expansion)	0	.9	1.5
Base Case 1 (total capacity)	1.5	2.4	3.0
Base Case 2 (expansion)	0	4.0	5.8
Base Case 2 (total capacity)	1.5	5.5[a]	7.3[a]
PAD I demand	4.5	9.9	13.1

[a]50 percent of PAD I demand divided by an assumed 90 percent capacity utilization.

Source: Dept. of Interior and RPA estimates.

EXHIBIT 2-5

EAST COAST
BASE CASE 2 REGIONAL DEVELOPMENT SUMMARY
(millions of barrels/day)

Region	1975[a] Production	1985[a] Production	2000[a] Production	2000 Demand	2000 Production Demand (%)
New England	0	.5	.7	2.4	30
Mid-Atlantic	1.25	3.1	3.7	5.5	67
S. Atlantic	.1	1.4	2.2	5.2	41
Total	1.35	5.0	6.6	13.1	50[b]

[a]90 percent of capacity
[b]weighted average

Source: RPA estimates.

Gas processing development without offshore production is not expected in any East Coast region of analysis since no natural gas onshore sources are known to exist there. While liquid natural gas (LNG) imports are expected to increase in each region, they should have a relatively small impact compared to the total economic activity and environmental levels. It is assumed that no LNG receiving facility would be developed in the localities of analysis.

Synthetic natural gas (SNG) production is expected in the regions of analysis. However, it is assumed that no SNG production would develop in the localities of analysis. While some SNG production will develop in the regions by 1985, by the year 2000 much of it will probably be tied to coal mines. Since coal mines are not located in the regions of this study, SNG development beyond 1985 was not assumed to occur. It seems, then, that the effects of SNG production should be minimal relative to the total base case activity.

The location and level of petrochemical development in the East Coast regions should be affected primarily by profitability and the availability of feedstocks, which in the future should be refinery heavy liquids, either naphtha or

gas oil. Therefore, petrochemicals would probably follow the pattern of refinery development, although some petrochemical activity was assumed to be fed by natural gas liquids (which are growing scarcer) and imported refinery heavy liquids.

Exhibit 2-6 details the projected petrochemical development for the East Coast under each base case. Activity is expressed in terms of number of complexes, each of which can be considered to support a billion pounds per year of olefin production, with associated derivative plants that would tend to locate near the source of basic organic chemical production.

EXHIBIT 2-6

EAST COAST PETROCHEMICAL DEVELOPMENT ASSUMPTIONS

		East Coast		Other U.S.	
		No. of Complexes	Percent of U.S.	No. of Complexes	Percent of U.S.
1970		.5	2	23.5	98
Base Case 1	(1985)	2	3	60	97
	(2000)	4	3	124	97
Base Case 2	(1985)	14.5	23	47.5	77
	(2000)	30.5	24	97.5	76

Source: RPA estimates.

OFFSHORE PRODUCTION ESTIMATES AND DEVELOPMENT ASSUMPTIONS

Much uncertainty surrounds the level of oil and gas resources existing in the Atlantic OCS. Based on USGS estimates, this study has assumed two potential offshore production levels (low and high). These estimates are the same for each of the three major drilling areas, that is, Georges Bank, Baltimore Canyon, and Georgia Embayment, as shown in Exhibit 2-7.

EXHIBIT 2-7

OFFSHORE PRODUCTION ESTIMATES
FOR EACH MAJOR DRILLING AREA

Type of Resources		1985	2000
Oil (millions of barrels/day)	Low	.25	.5
	High	.75	1.5
Gas (billions of cu.ft./day)	Low	.3	1.8
	High	.9	3.6

Source: Estimates based on RPA/CEQ interpretation of USGS resource availability projections.

Each regional analysis assumed that these levels of resources would be brought ashore and refined or processed in the region immediately adjacent to the drilling area. No attempt was made to examine impacts under conditions where oil or gas was brought ashore, refined, or processed in regions not adjacent to the offshore drilling areas. In addition, no attempt was made to analyze a low or high production estimate for the entire East Coast. It is unrealistic to assume that all the drilling areas would reach high production estimates.

Finally, it is interesting to compare each area's high estimate with Alaskan North Slope production where oil is expected to approximate 2 million barrels per day when it reaches its initial full production condition, and gas between 3 and 6 billion cubic feet per day by 1985.

Several activities related to the development, operations, and support of offshore oil and gas production should impact in each region. Since production was assumed to be the same for each East Coast region, operations in this sector should develop similarly.

Assuming (for purposes of analysis) that lease sales start in 1976, exploratory drilling would commence in 1977 and reach a peak level in the mid 1980's. During this peak, 10 drilling platforms, supporting a total of 40 wells per year, would be in operation in the high impact case (half this number would be used in the low impact case.)

Should oil be discovered, production platforms would then be developed. In the high impact case, 68 platforms, supporting over 1,500 wells, would be required to reach the maximum oil production levels of 1.5 million barrels per day and maximum gas production of 3.6 billion cubic feet per day. The duration of production platform development is expected to be 12 years, starting in 1980, with each platform taking approximately 3 years to complete.

Operation and support would follow production platform development. With about 60 personnel assumed necessary to operate and support one platform in the year 2000, and with 68 platforms required in the high impact case, over 4,000 workers would be employed in this operation.

Two other activities that are significant to offshore oil and gas production but should exert an impact in the region are platform fabrication and transportation. Much of the former would probably take place outside the East Coast. An East Coast shipyard would possibly construct some of these platforms if the number required were significant. However, it is assumed that this shipyard would not be located in any of the regions under analysis.

Transportation includes the construction of barges and pipelines to bring the oil and gas ashore. Since barges would probably be used only briefly (during the first few years of offshore development, if at all) and pipeline construction is an extremely specialized activity of short duration that would not necessarily have an economic base in the region, no significant regional impact has been assumed.

Exhibits 2-8 and 2-9 present the timetable for exploratory drilling, platform development, and oil and gas production activities for the low and high offshore production cases. Appendix I discusses in detail the assumptions for the OCS oil and gas recovery industry.

EXHIBIT 2-8

OFFSHORE DEVELOPMENT TIMETABLE
ATLANTIC OCS-HIGH RECOVERY
(Each Drilling Area)

Exploration		Platform Development					
Year	Rigs/ Wells	Install	In place[a]	Oil Wells Drilled	Total Oil Wells Producing	Oil Produced[b] 10^3 b/d	Gas Produced 10^6 ft^3/d
1976							
77	3/12						
78	3/12						
79	6/24						
80	8/32	2	2	16	16	17	
81	10/40	4	6	48	64	67	
82	10/40	8	14	112	176	183	
83	10/40	8	22	160	336	350	
84	10/40	8	30	192	528	550	
85	10/40	8	38	192	720	750	900
86	10/40	6	44	176	896		
87	10/40	6	50	160	1056		
88	10/40	6	56	144	1200		
89	10/40	4	60	128	1328		
90	10/40	4	64	80	1408		
91	10/40	4	68	32	1440	1500	
92							
93							
94							
95							
96							
97							
98							
99							
2000			68		1440[a]	1500	3600

[a] After 1985, 8 platforms and 96 wells that produce only gas will be installed, resulting in a total of 1536 wells in the year 2000.

[b] Oil production will, of course, build up to its maximum, level off for a period, and then decline slowly as the deposits are exhausted.

Source: RPA estimates.

EXHIBIT 2-9

OFFSHORE DEVELOPMENT TIMETABLE
ATLANTIC OCS-LOW RECOVERY
(Each Drilling Area)

Exploration		Platform Development					
Year	Rigs/ Wells	Install	In place[a]	Oil Wells Drilled	Total Oil Wells Producing	Oil Produced[b] 10^3 b/d	Gas Produced 10^6 ft^3/d
1976							
77	3/12						
78	3/12						
79	5/20						
80	5/20						
81	5/20	1	1	8	8	8	
82	5/20	2	3	24	32	33	
83	5/20	3	6	48	80	83	
84	5/20	4	10	72	152	158	
85	5/20	4	14	88	240	250	300
86	5/20	3	17	88	328		
87	5/20	2	19	72	400		
88	5/20	2	21	48	448		
89	5/20	2	23	24	472		
90		2	25	8	480	500	
91							
92							
93							
94							
95							
96							
97							
98							
99							
2000			25		480[a]	500	1800

[a] After 1985, 5 platforms and 60 wells that produce only gas will be installed, resulting in a total of 540 wells in the year 2000.

[b] Oil production will, of course, build up to its maximum, level off for a period, and then decline slowly as the deposits are exhausted.

Source: RPA estimates.

3. NEW ENGLAND

The New England area, comprising the states of Maine, New Hampshire, Vermont, Massachusetts, Rhode Island and Connecticut, has historically secured its petroleum and gas products by importing from other refining and gas processing centers. With a current demand of about 1.2 million barrels per day, the area has virtually no refining, gas processing or petrochemical facilities of its own. Several refineries, in conjunction with deepwater terminals, have been proposed for Maine, New Hampshire, and Northern Massachusetts, but environmental pressures and the lack of secured long-term crude supplies have delayed any actual construction.

The Eastern Massachusetts/Rhode Island regions, which include the Boston and Providence SMSA's, is a highly urbanized area currently accounting for about one-third of New England's industrial activity and petroleum consumption. Bristol County, in the southeast portion of Massachusetts, contains several light manufacturing industries but little heavy manufacturing.

The remainder of this chapter is organized into three sections. The first describes current socio-economic and environmental conditions in Bristol County, Massachusetts and the Eastern Massachusetts/Rhode Island region. The second discusses the assumed future development by primary industry in the local and regional areas. The third considers specific impacts resulting from the assumed development.

PROFILE OF CURRENT CONDITIONS

Bristol County is in southeastern Massachusetts between the cities of Providence and Boston and lies along the urban corridor of Northeastern U.S. Most of the county's 554 square miles consist of low, level terrain with abundant marshland. Narragansett Bay in the west and Buzzards Bay in the south provide access to the Atlantic Ocean (see Exhibit 3-1 for a map of the region).

Urban development is centered around the cities of New Bedford, Fall River, and Taunton. New Bedford, located on Buzzards Bay, has a population of 102,000 and is heavily industrialized. The apparel, rubber, chemical, and plastics industries provide much of this city's employment. It is also a fishing center with catches totalling $19 million in 1970.

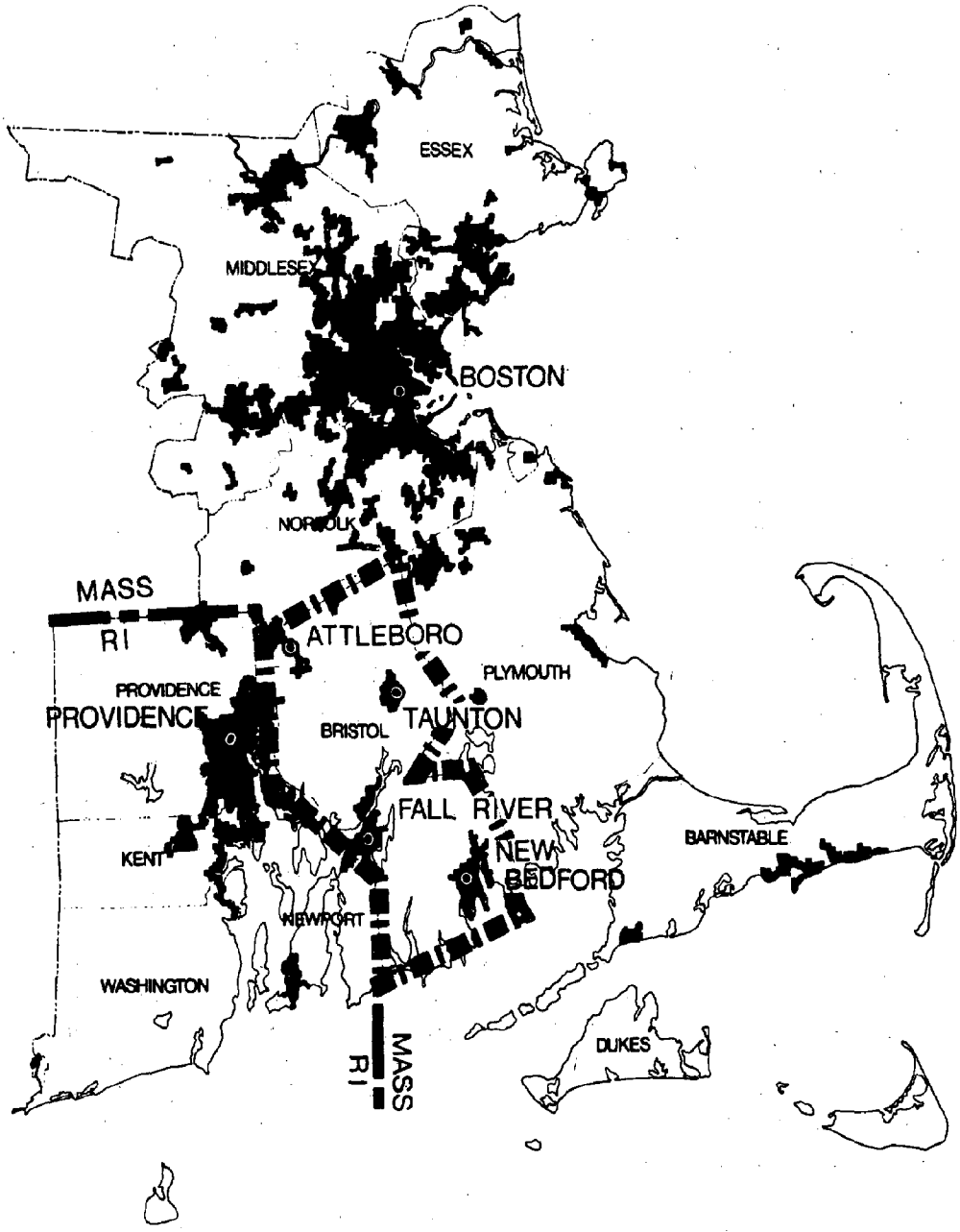


EXHIBIT 3-1
EASTERN MASSACHUSETTS/RHODE ISLAND REGION

N

RESOURCE PLANNING ASSOCIATES INC

Fall River is at the mouth of the Taunton River in Mount Hope Bay and has a population of approximately 100,000. Here the garment industry dominates as the largest single employer.

Taunton, which lies on the Taunton River, had a population of 44,000 in 1970. Silverware manufacture is its largest single industry.

Attleboro and North Attleboro, both closely linked with metropolitan Providence, are also major urban centers. Suburban development is widespread in intermediate communities, although significant portions of Bristol County are still predominately rural. The county is less densely populated than the region, with a total of 44,000 persons (801 per square mile) reported in 1970 compared to 5.2 million (1,140 per square mile) reported for the region in the same year.

In Bristol County, as in most of New England, there has recently been a low rate of economic development. Although 46 percent of its 1970 population is considered part of the work force, its unemployment rate remains consistently above the national average.

The manufacturing sector accounts for nearly 40 percent of total employment in the county, compared to the national average of 25 percent. The average per capita income was $3,602 in 1970.

The Eastern Massachusetts/Rhode Island region currently surpasses Bristol County in affluence. With manufacturing accounting for 26 percent of all jobs, the average per capita income in 1970 was $4,197. The region's two main population centers are Boston and Providence, both of which are currently facing threats to their economy due to the closure of naval facilities.

Approximately 22 percent of Bristol County's 492,000 acres is already developed. This figure closely parallels the region's percentage of developed land. Of this land, about 56 percent within the county and 52 percent within the region is developed for residential use.

Bristol County's air quality is rated as follows: Class I for particulates, sulphur oxides, and nitrogen oxides, and Class III for carbon monoxide and hydrocarbons. The Class I rating is due mainly to the widespread combustion of fossil fuels.

BRISTOL COUNTY, MASS.

WILDLIFE AND VEGETATION
PROTECTED AREAS

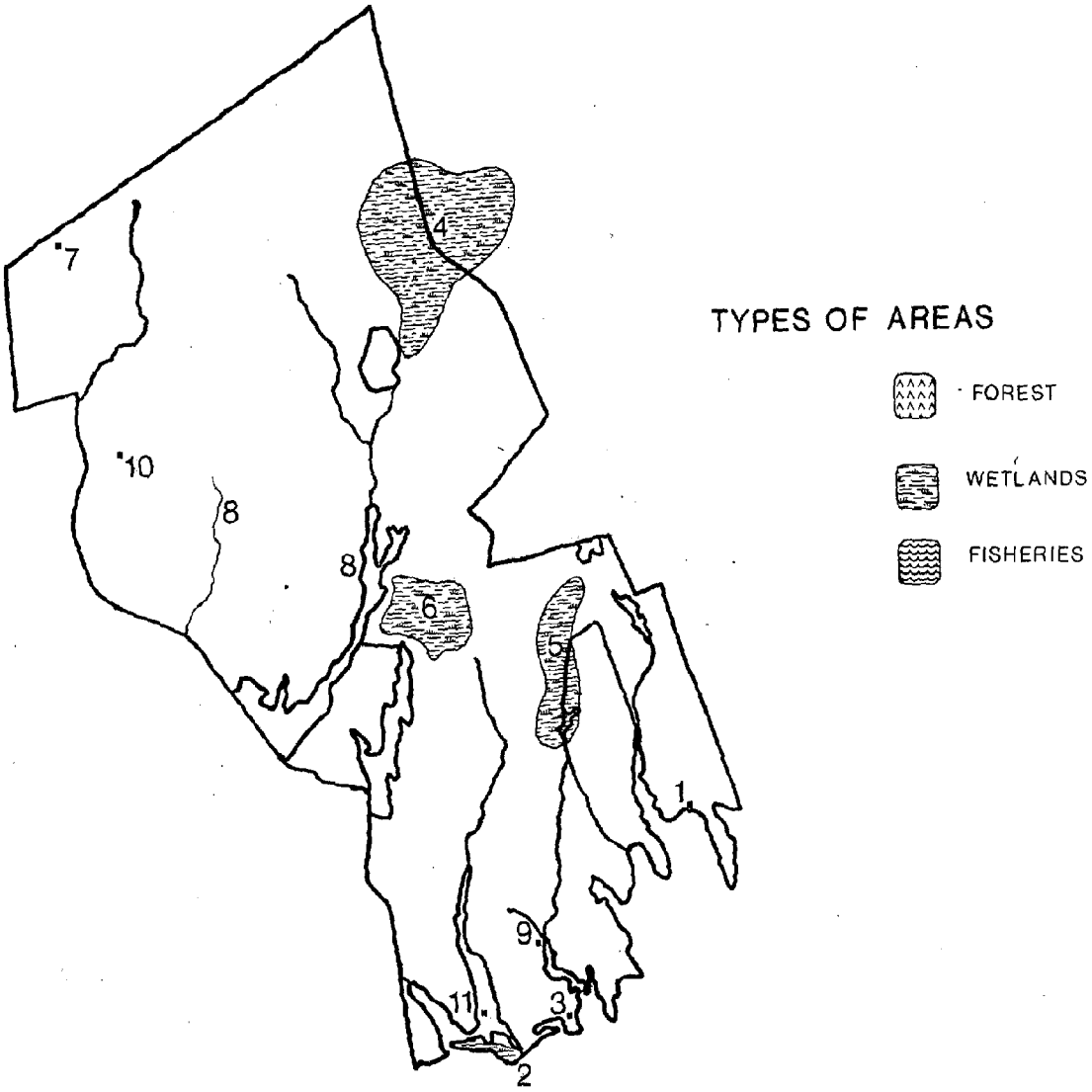


EXHIBIT 3-2

EXHIBIT 3-2 (cont.)

KEY	BRISTOL COUNTY[a]
1.	Fairhaven Wildlife Sanctuary, 20 acres
2.	Horseneck Beach State Park, 600 acres
3.	Demarest Lloyd Memorial State Park
4.	Hockomook Swamp, 6,000 acres
5.	Acushnet Cedar Swamp, 1,600 acres
6.	Freetown-Fall River State Forest and Wildlife Management Area
7.	Bungay River National Fish Hatchery
8.	Taunton and Palmer Rivers
9.	Barney's Joy Point (headlands and marsh)
10.	Caratunk Wildlife Refuge, 159 acres
11.	Osprey Nests on Little Pine Island

[a]See Appendix X for a detailed description of the wildlife and vegetation of the local area as well as the region.

Within Bristol County there are approximately 33,000 acres of wetlands, primarily wooded swamps surrounded by cedar and maple trees that serve as habitat for various forms of wildlife and vegetation (Exhibit 3-2 provides a vegetation and wildlife map for Bristol County). Some 3,000 acres of coastal wetlands line the bays and rivers of the county.

In the region overall, the coastal areas contain numerous important salt marshes and flats, particularly on Cape Cod and the north shore in Essex County, Massachusetts, as well as in Rhode Island. The Department of Interior maintains nine national wildlife refuges in the region, the largest of which are Great Meadows and Parker River in Essex County and Monomoy Island in Barnstable. The Massachusetts and Rhode Island Audubon Society own and manage numerous properties inland and along the coast as wildlife sanctuaries.

Despite its generally urbanized character, the region contains 13 state forests and wildlife management areas, one of which (the Freetown-Fall River Forest) is in Bristol County.

DEVELOPMENT ASSUMPTIONS

This section describes both the base case and OCS-induced development that could occur in the Eastern Massachusetts/Rhode Island Region for each of the following primary industrial sectors: oil refining, gas processing, petrochemicals, and construction.[1]

Oil Refining

In the oil refining sector, no development is assumed under Base Case 1 (where expansion occurs only in the Mid-Atlantic). Under Base Case 2, where a deepwater port development is assumed for the New England area, it is estimated that New England would develop 450,000 barrels per day of refinery production by 1985 and 720,000 barrels per

[1] The development of the offshore oil and gas recovery industry, which is treated similarly for each East Coast demand area, is described in Chapter 2.

day by the year 2000. In the Eastern Massachusetts region, it is assumed that 270,000 barrels per day of production would take place by 1985 and 450,000 barrels per day by the year 2000. None of this Base Case 2 production is assumed to take place in Bristol County (Exhibit 3-3).

Bristol County is assumed to account for one-third of New England's refinery development under high OCS production conditions (two large refineries by the year 2000), and for as much as 50 to 60 percent of New England production under low OCS conditions (one refinery by the year 2000).

The dispersion of refinery development throughout New England (as shown in Exhibit 3-3) recognizes the number of different demand centers in the area. Appendix II discusses the detailed assumptions for refinery development.

EXHIBIT 3-3

PROJECTED NEW ENGLAND REFINERY PRODUCTION[a,b]

(millions of barrels/day)

	Base Case 2		Low OCS		High OCS	
	1985	2000	1985	2000	1985	2000
Bristol County (locality)	0	0	.15	.25	.25	.50
Eastern Mass./ R.I. region (not incl. locality)	.27	.45	.10	.25	.25	.50
Other New England	.18	.27	0	0	.25	.50
Total	.45	.72	.25	.50	.75	1.50

[a]Refinery capacity is 10 percent larger than production, based on the assumptions that refineries will operate at 90 percent capacity.

[b]Base case production is aggregate, while low and high OCS production is incremental above base case.

Source: RPA estimates.

Gas Processing

Without offshore production there should be no gas processing activity in New England, since no developable natural gas resources are known to exist onshore. Gas processing development related to offshore production should impact most heavily in Bristol County, where the pipeline is assumed to come ashore (Exhibit 3-4). In the high impact case for the year 2000, however, some gas processing development should occur outside of the locality in the Eastern Massachusetts/Rhode Island region. No development is assumed for the rest of New England under either impact case. Appendix III discusses the detailed assumptions developed for the gas processing industry.

EXHIBIT 3-4

PROJECTED NEW ENGLAND GAS PROCESSING DEVELOPMENT FROM OFFSHORE GAS PRODUCTION

(billions of cu. ft./day)

	Low OCS		High OCS	
	1985	2000	1985	2000
Bristol County (locality)	.3	1.8	.9	1.8
Eastern Mass./R.I. Region (not incl. locality)	0	0	0	1.8
Other New England	0	0	0	0
Total	.3	1.8	0.9	3.6

Source: RPA estimates.

Petrochemicals

Petrochemical development should occur to a lesser extent in New England than in the other East Coast regions. Because it is tied mainly to refinery heavy liquids feedstocks, no development is assumed under either base case. Under Base Case 2, 700,000 barrels per day of refinery runs are projected by the year 2000. However, the refineries are expected to be dispersed enough so that no "refinery core" of a high enough output (above roughly

500,000 barrels per day) should exist in any one area to support basic organic chemical production. This condition remains true for the low offshore production case.

Under the high offshore production assumption, some petrochemical development is expected in 1985; by the year 2000, petrochemical production equivalent to about 4 billion pounds per year of olefins is expected (Exhibit 3-5).

EXHIBIT 3-5

PROJECTED NEW ENGLAND PETROCHEMICAL DEVELOPMENT FROM OFFSHORE OIL PRODUCTION HIGH CASE

(Number of 1 billion lb./yr. olefins complexes)

	1985	2000
Bristol County (locality)	0	.8
Eastern Mass./R.I. Region (not incl. locality)	.5	1.6
Other	0	1.3
Total	.5	3.7

Source: RPA estimates.

The geographic dispersion of petrochemical development indicated in Exhibit 3-5 roughly follows the refinery dispersion discussed earlier. Because refinery products should be serving a greater demand for fuels in New England, the percentage of refinery outputs allocated to petrochemical feedstocks is assumed lower (approximately 8 percent) than for other East Coast regions. Appendix IV discusses in detail the regional development assumptions for petrochemicals.

Construction

Given the development assumptions for refining, gas processing and petrochemicals, a significant amount of construction should occur during the 1980's, the peak of which should be at or near 1985 (Exhibit 3-6). The value of 1985 construction output for high OCS conditions is

EXHIBIT 3-6

VALUE OF CONSTRUCTION OUTPUT[a]
($ million)

NEW ENGLAND

Geographic Area	1970 Actual	1985 Base Case[b]	1985 Low OCS	1985 High OCS	2000 Base Case[b]	2000 Low OCS	2000 High OCS
BRISTOL COUNTY							
Refinery			38	119		0	0
Gas Processing			14	8		0	0
Petrochemical			0	29		0	0
Induced[c]			13	40		26	79
Total Local	184	365	65	196	599	26	79
TOTAL EASTERN MASS./R.I. REGION							
Refinery			38	214		0	0
Gas Processing			14	26		0	0
Petrochemical			0	70		0	0
Induced[c]			13	77		26	155
Total Region	3263	5175[d]	65	387	8181[d]	26	155

[a] Base Case total and OCS incremental. Appendix V describes the methods used in determining these values

[b] Base Case 1 for East Coast

[c] Other industrial, commercial, and residential construction activity induced by the direct industry activities

[d] Base Case 2: 1985 = 5222
2000 = 8200.

Source: RPA estimates.

expected to be 30 to 40 percent of the total direct OCS-induced economic output for Bristol County and the Eastern Massachusetts region. The main contributor to this construction activity is new refinery development, accounting for $120 million of a total $196 million in Bristol County and $214 million of $387 million in total construction expenditures for the region.

The high OCS-induced construction in 1985 would cause a 55 percent increase in Bristol County construction, and a 7 percent increase for the Eastern Massachusetts region overall. Construction activity in the year 2000, all of which is induced industrial, commercial and residential, is estimated at $80 million for the locality and $155 million in the region under high OCS conditions. Appendix V discusses in greater detail the method of developing these assumptions.

IMPACTS

This section discusses the impacts that could occur in Bristol County and the Eastern Massachusetts/Rhode Island region from the high offshore oil and gas production case. The economic, social, land use, air and water pollution impacts are discussed in turn.

Economic

The economic growth projections for the Bristol County locality do not differ substantially under the assumptions of the two base cases (Exhibit 3-7). The only significant difference between them lies in the output and employment induced in Bristol County by industrial activity in surrounding areas under Base Case 2. This industrial activity should account for approximately 3,000 more jobs than would exist under Base Case 1 in both 1985 and the year 2000.

The difference between the base case projections for the Eastern Massachusetts/Rhode Island region is somewhat greater than for Bristol County (Exhibit 3-8). With refinery development for imports (Base Case 2), the refining and petrochemicals would contribute approximately 1,000 new jobs, and total employment within the region would be larger than Base Case 1 by about 20,000 jobs in both 1985 and the year 2000. This is not, however, a substantial difference on a percentage basis.

EXHIBIT 3-7

SUMMARY OF BASE CASE ECONOMIC CONDITIONS

BRISTOL COUNTY

A. EMPLOYMENT (thousands)

Sector	Actual	Base Case 1		Base Case 2	
	1970	1985	2000	1985	2000
Construction	6.0	10.0	14.0	10.0	14.0
Ref., Gas, Petrochem.	0	0	0	0	0
Other Manufacturing	75.0	78.0	82.0	78.4	82.4
Agriculture	2.0	1.0	0	1.0	0
Utilities	8.0	9.0	10.0	9.1	10.1
Services	101.0	120.0	136.0	122.0	138.4
TOTAL	192.0	218.0	242.0	220.5	244.9

B. VALUE OF OUTPUT ($ million)[a]

Sector	Actual	Base Case 1		Base Case 2	
	1970	1985	2000	1985	2000
Construction	184	365	599	365	599
Ref., Gas, Petrochem.	0	0	0	0	0
Other Manufacturing	2084	2973	4265	2987	4285
Agriculture	25	19	0	19	0
Utilities	209	304	439	308	445
Services	1561	2309	3280	2347	3337
TOTAL	4063	5970	8583	6027	8666

Codes - * = negligible
: = infinite percentage since base case is zero

[a]All dollar figures are 1970 constant dollars.

Source: RPA estimates

EXHIBIT 3-8

SUMMARY OF BASE CASE ECONOMIC CONDITIONS

EASTERN MASS/R. I.

A. EMPLOYMENT (thousands)

Sector	Actual	Base Case 1		Base Case 2	
	1970	1985	2000	1985	2000
Construction	90.0	121.0	163.0	122.4	163.5
Ref., Gas, Petrochem.	0	0	0	0.8	1.0
Other Manufacturing	606.0	602.0	614.0	606.2	618.3
Agriculture	13.0	10.0	10.0	10.1	10.1
Utilities	105.0	136.0	158.0	137.6	159.8
Services	1423.0	1693.0	1933.0	1704.9	1946.7
TOTAL	2237.0	2562.0	2878.0	2582.0	2899.4

B. VALUE OF OUTPUT ($ million)[a]

Sector	Actual	Base Case 1		Base Case 2	
	1970	1985	2000	1985	2000
Construction	3263	5175	8181	5222	8200
Ref., Gas, Petrochem.	0	0	0	493	822
Other Manufacturing	30368	26767	37295	26950	37551
Agriculture	195	221	336	222	338
Utilities	3286	5428	8149	5490	8242
Services	35970	38539	55004	38804	55384
TOTAL	73082	76130	108965	77181	110537

Codes - * = negligible
: = infinite percentage since base case is zero

[a]All dollar figures are 1970 constant dollars.

Source: RPA estimates

Against this background, the following sections describe the anticipated primary and aggregate impacts resulting from OCS development.

Primary Impacts

By far the biggest primary employment impact in 1985 would occur in the construction sector, where 6,000 new jobs would be created in Bristol County and 12,000 in the entire region under high impact assumptions (see Exhibit 3-9). By the year 2000, construction employment is expected to fall to one-third of its 1985 level and be somewhat lower than the other primary sectors combined, with petrochemicals and refining gaining importance. Although the oil and gas recovery industry should generate a significant number of jobs--about 8,000 in 1985 and 4,000 in the year 2000--it is difficult to assign these jobs on a local or regional basis.[1]

In terms of output value, construction should account for less than one-half of incremental primary output in 1985 and less than 10 percent in the year 2000. On the other hand, the refining sector should account for approximately two-thirds of the regional output in both years under high impact assumptions, and approximately 90 percent of output under low impact assumptions.

Aggregate Impacts

In Bristol County, under high impact assumptions, there should be 19,000 new jobs in 1985 and 17,400 in the year 2000, 7 to 9 percent above base case (Exhibit 3-10). The

---

[1]For the oil and gas recovery sector all employment and output projections are shown totalled in the "area" column of Exhibit 3-9. In brief, the reason for this is simply that a large fraction of the actual employment is expected to occur offshore on the Continental Shelf. Rather than assign this employment to the locality or region it was assigned to the "area." However, when predicting impacts from population- or supplier-induced employment, estimates of the consumer expenditures of the sector's employees as well as the direct expenditures from the oil and gas recovery sector were made for the local and regional areas.

EXHIBIT 3-9

PRIMARY ECONOMIC IMPACTS

NEW ENGLAND

A. EMPLOYMENT (thousands) HIGH IMPACT

	1985			2000		
	Local	Region[a]	Area[b]	Local	Region[a]	Area[b]
Oil and Gas Rec.	0	0	7.5	0	0	4.1
Gas Processing	.1	.1	0	.1	.2	0
Refineries	.8	1.5	.8	1.1	2.2	1.1
Petrochemical	0	.9	0	1.1	3.4	1.8
Construction	5.9	11.8	1.8	2.0	4.0	.6

B. VALUE OF OUTPUT (millions 1970 dollars) HIGH IMPACT

	1985			2000		
	Local	Region[a]	Area[b]	Local	Region[a]	Area[b]
Oil and Gas Rec.	0	0	361	0	0	156
Gas Processing	24	24	0	48	95	0
Refineries	457	914	457	913	1825	913
Petrochemical	0	130	0	208	624	338
Construction	196	388	59	78	155	24

Code: * = negligible

[a] Region includes Local

[b] Area is "Demand Area" exclusive of the Region

Source: RPA estimates

EXHIBIT 3-9 (cont.)

PRIMARY ECONOMIC IMPACTS

NEW ENGLAND

C. EMPLOYMENT (thousands) LOW IMPACT

	1985			2000		
	Local	Region[a]	Area[b]	Local	Region[a]	Area[b]
Oil and Gas Rec.	0	0	3.2	0	0	1.5
Gas Processing	*	*	0	.1	.1	0
Refineries	.5	.8	0	.6	1.1	0
Petrochemical	0	0	0	0	0	0
Construction	2.0	2.0	0	.7	.7	0

D. VALUE OF OUTPUT (millions 1970 dollars) LOW IMPACT

	1985			2000		
	Local	Region[a]	Area[b]	Local	Region[a]	Area[b]
Oil and Gas Rec.	0	0	161	0	0	58
Gas Processing	8	8	0	48	48	0
Refineries	273	457	0	457	914	0
Petrochemical	0	0	0	0	0	0
Construction	65	65	0	26	26	0

Code: * = negligible

[a] Region includes Local

[b] Area is "Demand Area" exclusive of the Region

Source: RPA estimates

EXHIBIT 3-10

AGGREGATE ECONOMIC IMPACTS

BRISTOL COUNTY
HIGH IMPACT

A. EMPLOYMENT (thousands)

Sector	1985	Percent Over B.C. 1	Percent Over B.C. 2	2000	Percent Over B.C. 1	Percent Over B.C. 2
Construction	5.9	59	59	2.0	14	14
Ref. Gas, Petrochem.	.8	:	:	2.3	:	:
Other Manufacturing	2.6	3	3	2.7	3	3
Agriculture	0	0	0	0	0	0
Utilities	.6	7	6	.7	7	7
Services	9.1	8	7	9.6	7	7
TOTAL	19.0	9	9	17.3	7	7

B. VALUE OF OUTPUT ($ million)[a]

Sector	1985	Percent Over B.C. 1	Percent Over B.C. 2	2000	Percent Over B.C. 1	Percent Over B.C. 2
Construction	196	54	54	78	13	13
Ref., Gas, Petrochem.	481	:	:	1168	:	:
Other Manufacturing	97	3	3	139	3	3
Agriculture	0	0	0	0	0	0
Utilities	20	7	6	32	7	7
Services	175	8	7	231	7	7
TOTAL	969	16	16	1648	19	19

Codes - * = negligible
: = infinite percentage since base case is zero

[a]All dollar figures are 1970 constant dollars.

Source: RPA estimates

comparable figures for the low impact case are 7,000 jobs in 1985 and 6,000 jobs in the year 2000, 2 to 3 percent above base case (Exhibit 3-11). The slight reduction in new jobs between 1985 and 2000 is due entirely to reductions in the construction sector.[1]

Under high impact conditions in the Bristol County locality, construction both directly and indirectly should create 11,400 of the 19,000 new jobs (60 percent) in 1985, but only 3,700 of the 17,400 jobs (20 percent) in the year 2000.[2] Refining and petrochemicals should create the majority of new jobs in the year 2000. Independent of

HIGH OCS

Jobs Created By:	1985 Primary Jobs	1985 Induced Jobs	1985 Total Jobs	2000 Primary Jobs	2000 Induced Jobs	2000 Total Jobs
Construction	5,900	5,500	11,400	2,000	1,700	3,700
Other Primary	800	6,800	7,600	2,300	11,400	13,700
Total Primary	6,700	12,300	19,000	4,300	13,100	17,400

which primary sector creates these jobs, the largest number of them (about 9,000 under high OCS conditions) should occur in the service sector. This sector should account for about 50 percent of all jobs for both high and low OCS conditions in both 1985 and 2000.

Total new employment in the Eastern Massachusetts/ Rhode Island region under high impact conditions (Exhibit 3-12) would amount to 77,000 in 1985 and 83,000 in the year 2000. Although these figures constitute only 3 percent increase over the base case, they still represent a significant number of jobs. The construction sector would

---

[1] Since employment projections in this sector are subject to a great deal of uncertainty, the reader should examine the methodology discussed in Appendix V in order to assess the specific assumptions used here.

[2] Based on the detailed economic computer projections for Bristol County (see Annex to Appendix VI).

EXHIBIT 3-11

AGGREGATE ECONOMIC IMPACTS

EASTERN MASS./R.I.

HIGH IMPACT

A. EMPLOYMENT (thousands)

Sector	1985	Percent Over B.C. 1	Percent Over B.C. 2	2000	Percent Over B.C. 1	Percent Over B.C. 2
Construction	11.8	10	10	4.0	2	2
Ref. Gas, Petrochem.	2.5	:	307	5.8	:	583
Other Manufacturing	14.9	2	2	17.5	3	3
Agriculture	.3	3	3	.2	2	2
Utilities	4.5	3	3	6.3	4	4
Services	42.7	3	3	49.3	3	3
TOTAL	76.7	3	3	83.1	3	3

B. VALUE OF OUTPUT ($ million)[a]

Sector	1985	Percent Over B.C. 1	Percent Over B.C. 2	2000	Percent Over B.C. 1	Percent Over B.C. 2
Construction	388	8	7	155	2	2
Ref., Gas, Petrochem.	1067	:	216	2544	:	310
Other Manufacturing	648	2	2	1039	3	3
Agriculture	6	3	3	8	2	2
Utilities	174	3	3	321	4	4
Services	941	2	2	1361	2	2
TOTAL	3224	4	4	5428	5	5

Codes - * = negligible
: = infinite percentage since base case is zero

[a]All dollar figures are 1970 constant dollars.

Source: RPA estimates

EXHIBIT 3-12

AGGREGATE ECONOMIC IMPACTS

BRISTOL COUNTY
LOW IMPACT

A. EMPLOYMENT (thousands)

Sector	1985	Percent Over B.C. 1	Percent Over B.C. 2	2000	Percent Over B.C. 1	Percent Over B.C. 2
Construction	2.0	20	20	.7	5	5
Ref., Gas, Petrochem.	.5	:	:	.7	:	:
Other Manufacturing	.9	1	1	.8	1	1
Agriculture	0	0	0	0	0	0
Utilities	.2	2	2	.2	2	2
Services	3.1	3	3	3.2	2	2
TOTAL	6.7	3	3	5.6	2	2

B. VALUE OF OUTPUT ($ million)[a]

Sector	1985	Percent Over B.C. 1	Percent Over B.C. 2	2000	Percent Over B.C. 1	Percent Over B.C. 2
Construction	65	18	18	26	4	4
Ref.,Gas, Petrochem.	282	:	:	504	:	:
Other Manufacturing	33	1	1	40	1	1
Agriculture	0	0	0	0	0	0
Utilities	7	2	2	10	2	2
Services	60	3	3	78	2	2
TOTAL	447	7	7	658	8	8

Codes - * = negligible
: = infinite percentage since base case is zero

[a]All dollar figures are 1970 constant dollars.

Source: RPA estimates

EXHIBIT 3-13

AGGREGATE ECONOMIC IMPACTS

EASTERN MASS./R.I.
LOW IMPACT

A. EMPLOYMENT (thousands)

Sector	1985	Percent Over B.C. 1	Percent Over B.C. 2	2000	Percent Over B.C. 1	Percent Over B.C. 2
Construction	2.0	2	2	.7	*	*
Ref., Gas, Petrochem.	.8	:	97	1.2	:	122
Other Manufacturing	3.7	1	1	3.9	1	1
Agriculture	.1	1	1	.1	1	1
Utilities	1.3	1	1	1.6	1	1
Services	12.4	1	1	13.5	1	1
TOTAL	20.3	1	1	21.0	1	1

B. VALUE OF OUTPUT ($ million)[a]

Sector	1985	Percent Over B.C. 1	Percent Over B.C. 2	2000	Percent Over B.C. 1	Percent Over B.C. 2
Construction	65	1	1	26	*	*
Ref.,Gas, Petrochem.	465	:	94	961	:	117
Other Manufacturing	161	1	1	229	1	1
Agriculture	2	1	1	3	1	1
Utilities	49	1	1	80	1	1
Services	271	1	1	371	1	1
TOTAL	1013	1	1	1670	2	2

Codes - * = negligible
: = infinite percentage since base case is zero

[a]All dollar figures are 1970 constant dollars.

Source: RPA estimates

either account for or would induce 36,000 of the 77,000 new jobs (nearly 50 percent) in 1985, but only 11,000 of the 83,000 new jobs (less than 15 percent) in the year 2000. The direct construction impact itself, representing about 12,000 new jobs in 1985 (10 percent over base case conditions), could lead to a shortage of skilled workers. As in the locality, refining and petrochemicals should create or induce the majority of new jobs in the year 2000, 50 percent of which are expected to occur in the service sector.

Employment under low OCS conditions should be about one-fourth of that projected for high OCS conditions (Exhibit 3-13).

Social Infrastructure

The impact from offshore production is not expected to present significant problems to the systems and institutions that serve the Bristol County locality. The high impact on physical and social systems averages an additional demand of nearly 9 percent in 1985 and 7 percent for the year 2000 over Base Case 1 (Exhibit 3-14).

When examined in aggregate, this growth seems modest and manageable in terms of existing public water supply, school, hospital, and housing construction. However, when one examines specific areas of growth within the county, a slightly different picture emerges. Presently, the land comprising the cities of New Bedford, Fall River, and Taunton is almost utilized to capacity. Thus, there is little room for growth in the communities with the most well developed service systems. The majority of new population should tend to locate in smaller towns in the area, putting a significant strain on community services there.

Predicting where new populations would locate is difficult, particularly since Bristol County's many towns offer a wide range of social, cultural, and recreational alternatives. If two or three of the county's roughly 13 modest-sized communities--that is, those with a current population of roughly 10,000--receive the majority of the approximately 44,000 new inhabitants, the strain on existing facilities would be significant. For the school system, it could mean 10,000 new students, which further translates into three new high schools of 1,000 students each plus 7,000 new students in the junior high and grade schools. It seems

EXHIBIT 3-14

BRISTOL COUNTY
(Geog. Area)

SOCIAL INFRASTRUCTURE IMPACT

	1970	1985		Incr.		2000		Incr.	
		Base Case 1	Base Case 2	High Impact	Low Impact	Base Case 1	Base Case 2	High Impact	Low Impact
POPULATION (000)	440	500	506	43.6	15.1	550	557	38.8	12
Percent Change %[a]				8.7/8.6	3/2.9			7/6.9	2.2/2.1
PHYSICAL SYSTEMS									
Water Demand Mil. gallons/day	60	85	86	7	3	104	106	7	2
Elec. Demand (MW of Capacity)	NA	NA	NA	161	9	NA	NA	371	4
Structures Residential (000)	142	160	162	14	5	176	178	12	4
Commercial (millions of sq. ft.)	11	13.1	13.3	1.2	.4	14.4	14.6	1.0	.3
SOCIAL SYSTEMS									
Schools - Enrollees (000)	106	120	122	10	3	132	134	9	3
Hospitals - Beds	1658	1865	1887	164	56	2051	2078	145	45
Police - Manpower	808	910	921	80	27	1001	1014	71	22
Solid Waste - Tons/Day	1322	1500	1517	131	45	1650	1670	116	36
Sewage - Mil.gal/day	53	60	61	5	2	66	67	5	1
Gov't. OH - ($000,000)	37.5	42.2	42.7	3.7	1.3	46.4	47.0	3.3	1.0
BUSINESS & GOVERNMENT INSTIT.									
Business Services - Employee (000)	49.4	55.8	56.1	4.8	1.7	61.5	61.8	4.3	1.3
Government - Employee (000)	13.0	14.8	14.9	1.3	.5	16.3	16.4	1.1	.4

[a] The percentage changes are indicated as follows:

Impact Case over Base Case 1/ Impact Case over Base Case 2

Source: RPA estimates.

reasonable to say that the construction of even one new high school and the addition of 1,000 new high school students should have ramifications in the economic, social, political, and other spheres for a majority of the towns in the county.

The need for hospital services will also depend on where the population locates. If the communities surrounding the county's major cities absorbed most of the new population, then expansions to existing major hospitals in the cities would be sufficient. If the population were to grow rapidly in more isolated areas, then two small hospitals (80 beds) would have to be built by 1985 and these would have to be expanded by the year 2000.

The requirement for police services would change significantly if the population in one or two of the small towns doubled within a short period of time. With such an acceleration the nature and frequency of crimes would change, and not only would the police force need to be larger but also better equipped, better trained, and more carefully managed than typical small town forces today.

To the extent that major growth would occur in a few of the county's towns, these towns would have to plan, zone, expand, add services and make many more complex decisions than in previous years. These activities would require new staff and new municipal employees to match the proportionate growth in population.

Intelligent and sensitive land use planning will be essential to ensure that these towns retain their charm and character. However, planning activities would have to occur before the new population arrived and, hence, before sufficient tax revenues could be generated to support such activity.[1] Thus, state or federal planning grants would be needed in these local communities expecting large scale growth from OCS activities.

By the year 2000, electrical demand in Bristol County induced by high OCS impact would require 371 megawatts of new plant capacity. This is equivalent to 37 percent of a new power plant of average size--that is, 1000 megawatts.

---

[1] It was beyond the scope of this study to estimate what these tax revenues might be.

The demand for transportation services would be significant. Presently, no major airports service the county. Boston and Providence airports are approximately one hour from its center, so municipal general aviation airports may need expansion to facilitate air travel and freight shipment. The Fall River and New Bedford-Fairhaven harbors handle approximately 4.5 million tons of cargo annually and these ports would require expansion to handle the added activity of high offshore production. Ground transportation would also require improvement to meet the shipment needs of high impact case. Currently, Penn Central operates a limited cargo train service between cities in Bristol County and other cities in New England. This service, too, would have to be expanded.

Land Use

At both the local and regional levels, there appears to be adequate land for both base case and OCS expansion. However, looking at the entire region,[1] the acreage required for the most intensive land use (that is, Base Case 2 combined with OCS high impact levels) represents nearly 9 percent of the total undeveloped land and 14 percent of the undeveloped land actually suitable for general development.[2] This finding points to the potential difficulties of future land use planning for the entire region, particularly the task of coordinating sites for primary development.[3]

---

[1]Because it was beyond the scope of this study to be site-specific in its land use analysis, a detailed study of the suitability of undeveloped land was only done for the regions of analysis. Many of the findings in this analysis are also applicable to the localities.

[2]General development includes residential, commercial, industrial and agricultural uses.

[3]Primary development includes specialized and heavy industrial uses (e.g., refineries, petrochemical complexes). Land suited for primary development is usually also suited for general development.

In Bristol County, development under either base case is expected to reduce the amount of undeveloped land from the 1970 level of 78.2 percent to approximately 74 percent by the year 2000 (Exhibit 3-15). Land requirements necessary to support OCS development should further reduce these percentages by the year 2000 to about 71 percent under the worst possible case. This case, which corresponds to OCS high development above Base Case 2, would require nearly 23,000 acres of currently undeveloped land over the next 25 years. These 23,000 acres may be compared with the 14,000 acres required without either Base Case 2 or OCS development.

Although the Eastern Massachusetts and Rhode Island region is generally more developed than Bristol County, the land use impact would be similar (Exhibit 3-16). Undeveloped land should drop from the 1970 level of 75 percent to 69 percent by the year 2000 under Base Case 2, meaning a decrease of over 164,000 acres in actual undeveloped land. The impact from offshore oil and gas production should further reduce the undeveloped land by less than another one percentage point. It would appear, then, that sufficient land is available for the induced development from offshore production.

However, not all of the undeveloped land is actually available. Environmental constraints[1] such as existing and projected uses, coastal zones and wetlands would reduce undeveloped land by 38 percent, leaving 62 percent for general development (Exhibit 3-17). Furthermore, the locational constraints (in this case, slope) affecting primary facilities such as refineries and petrochemical plants would reduce the available land by an additional 10 percent. With this additional reduction, 52 percent of the undeveloped land would be potentially available for primary development.

Moreover, additional reductions in the amount of unavailable land have not been explicitly considered. First, the extent to which areas may be impounded in order to protect water resources is difficult to estimate, and as a result, has not been included in unavailable land due to

---

[1]For more detailed information on these constraints refer to Appendix VIII -- Land Use Methodology -- and Appendix X -- Wildlife and Vegetation.

EXHIBIT 3-15

LAND USE SUMMARY

LOCALITY : BRISTOL COUNTY

Summary in Thousands of acres		1970	Year 1985				Year 2000			
		Actual Development	Base Case 1 Development	Base Case 2 Development	OCS Low* Development	OCS High* Development	Base Case 1 Development	Base Case 2 Development	OCS Low* Development	OCS High* Development
Land Use Classification	DEVELOPED LAND	73.3	81.4	82.2	4.1 (1) 2.8 (2)	7.0 (1) 6.8 (2)	87.3	88.3	2.5 (1) 2.3 (2)	8.0 (1) 7.8 (2)
	. residential	41.4	45.6	46.0	1.1 (1) .8 (2)	2.5 (1) 2.3 (2)	48.3	48.9	.6 (1) .4 (2)	2.1 (1) 1.9 (2)
	. commercial industrial	7.5	8.3	8.4	2.2 (1) 1.2 (2)	2.1 (1) 2.1 (2)	8.8	8.8	1.2 (1) 1.2 (2)	3.8 (1) 3.8 (2)
	. other	24.4	27.5	27.8	.8	2.4	30.2	30.6	.7	2.1
	UNDEVELOPED LAND	262.9	254.8	254.0	250.7 (1) 251.2 (2)	247.8 (1) 247.2 (2)	248.9	247.9	246.4 (1) 245.6 (2)	240.9 (1) 240.1 (2)
	TOTAL ACREAGE	336.2								

* incremental acreage only. If two figures, number in parentheses refers to base case.

Summary in Percent		1970	Year 1985**				Year 2000**			
		Actual Development	Base Case 1 Development	Base Case 2 Development	OCS Low Above B.C.2	OCS High Above B.C.2	Base Case 1 Development	Base Case 2 Development	OCS Low Above B.C.2	OCS High Above B.C.2
Land Use Classification	DEVELOPED LAND	21.8	24.2	24.4	25.3	26.5	26.0	26.3	26.9	28.6
	. residential	12.3	13.6	13.7	13.9	14.4	14.4	14.5	14.7	15.1
	. commercial industrial	2.2	2.5	2.5	2.9	3.1	2.6	2.6	3.0	3.7
	. other	7.3	8.2	8.3	8.5	9.0	9.0	9.1	9.3	9.7
	UNDEVELOPED LAND	78.2	75.8	75.6	74.7	73.5	74.0	73.7	73.1	71.4

** Impacts of OCS developments indicated only above Base Case 2.

Source: RPA estimates.

EXHIBIT 3-16

LAND USE SUMMARY

REGION : EASTERN MASS./R.I.

Summary in Thousands of acres		1970	Year 1985				Year 2000			
		Actual Development	Base Case 1 Development	Base Case 2 Development	OCS Low* Development	OCS High* Development	Base Case 1 Development	Base Case 2 Development	OCS Low* Development	OCS High* Development
Land Use Classification	DEVELOPED LAND	744.6	838.1	845.7	8.4 (1) 8.1 (2)	24.3 (1) 24.7 (2)	902.0	909.0	6.9 (1) 7.0 (2)	26.9 (1) 26.5 (2)
	. residential	386.7	431.8	434.3	3.1 (1) 2.8 (2)	9.7 (1) 9.2 (2)	457.5	459.2	1.8 (1) 1.8 (2)	7.1 (1) 6.7 (2)
	. commercial industrial	52.9	56.6	59.1	2.3 (1) 2.3 (2)	3.6 (1) 4.5 (2)	60.1	62.7	2.3 (1) 2.4 (2)	8.6 (1) 8.6 (2)
	. other	305.0	349.7	352.3	3.0	11.0	384.4	387.1	2.8	11.2
	UNDEVELOPED LAND	2,211.4	2,117.9	2,110.3	2,109.5 (1) 2,102.2 (2)	2,093.6 (1) 2,085.6 (2)	2,054.0	2,047.0	2,047.1 (1) 2,040.0 (2)	2,027.1 (1) 2,020.5 (2)
	TOTAL ACREAGE	2,956.0								

* incremental acreage only. If two figures, number in parentheses refers to base case.

Summary in Percent		1970	Year 1985**				Year 2000**			
		Actual Development	Base Case 1 Development	Base Case 2 Development	OCS Low Above B.C.2	OCS High Above B.C.2	Base Case 1 Development	Base Case 2 Development	OCS Low Above B.C.2	OCS High Above B.C.2
Land Use Classification	DEVELOPED LAND	25.2	28.4	28.6	28.9	29.4	30.5	30.8	31.0	31.6
	. residential	13.1	14.6	14.7	14.8	15.0	15.5	15.5	15.6	15.8
	. commercial industrial	1.8	1.9	2.0	2.1	2.2	2.0	2.1	2.2	2.4
	. other	10.3	11.8	11.9	12.0	12.3	13.0	13.1	13.2	13.5
	UNDEVELOPED LAND	74.8	71.7	71.4	71.1	70.6	69.5	69.2	69.0	68.4

** Impacts of OCS developments indicated only above Base Case 2.

Source: RPA estimates.

EXHIBIT 3-17

UNDEVELOPED LAND CAPABILITIES

Region: EASTERN MASS./RHODE ISLAND

	Thousands of Acres		Percent
. TOTAL UNDEVELOPED LAND[a]		2,211.4	100
. UNAVAILABLE LAND DUE TO ENVIRONMENTAL CONSTRAINTS		832.1	37.6
. existing and projected uses	156.2		
. coastal zoning and improvements	389.2		
. excessive slope (> 15%)	0		
. wetlands	286.7		
. water resources	~~YES~~ - NO[h]		
. UNSUITABLE LAND DUE TO LOCATIONAL CONSTRAINTS[b]		230.4	10.4
. excessive slope (> 5%)	230.4		
. distance (> 30 minutes)	0		
. water requirements	~~YES~~ - NO[i]		
. TOTAL REMAINING DEVELOPABLE LAND[c]		1148.9	52.0
. TOTAL LAND USE REQUIREMENTS[d]		190.9	
. total direct land use[e]	10.1		
. total induced land use[f]	180.8		
residential	79.2		
commercial/industrial[g]	8.3		
other developed land	93.3		

[a]Refer to land use summary exhibits for each region. Total undeveloped land figure corresponds to 1970 data.
[b]Where overlap with land unavailable due to environmental constraints, only incremental value is considered.
[c]Land suited for primary industrial activities, e.g., refineries, petrochemical complexes, etc., but competing with other uses, e.g., residential, commercial, light industrial, agricultural, etc. ("general development").
[d]Total Land Use Requirements corresponds to worst possible case by year 2000 (in general, base case 2 combined with high level OCS development).
[e]Refer to Exhibit VIII-5, Total Direct Land Use. Corresponds to maximum primary development.
[f]Refer to land use summary exhibits for each region. Corresponds to worst possible case by year 2000.
[g]Excluding primary industrial land.
[h]"No" indicates that water resource impoundment areas have not been included in the above acreages.
[i]"No" indicates that water supply from conventional sources is likely to be inadequate.

Source: RPA estimates.

environmental constraints. Second, existing agriculture use has not been subtracted from available land. Finally, low density development such as suburban uses and small tracts (i.e., less than one square mile) have not been considered. As a result, it is probable that far less than 52 percent of the undeveloped land should be considered available for primary development or 62 percent available for general development.

Given the previously mentioned environmental and locational constraints and additional subtractions for uses difficult to quantify, the incremental 190,900 acres required in the region under combined Base Case 2 high impact OCS development represent a greater proportion of undeveloped land than seems apparent from the statistical analysis of undeveloped acreage. To be specific, these 190,900 acres appear to represent 9 percent of the presently undeveloped land, but really account for more than 14 percent of the land suitable for general use and for more than 17 percent of the land actually suitable for primary industry (see Exhibit 3-17).

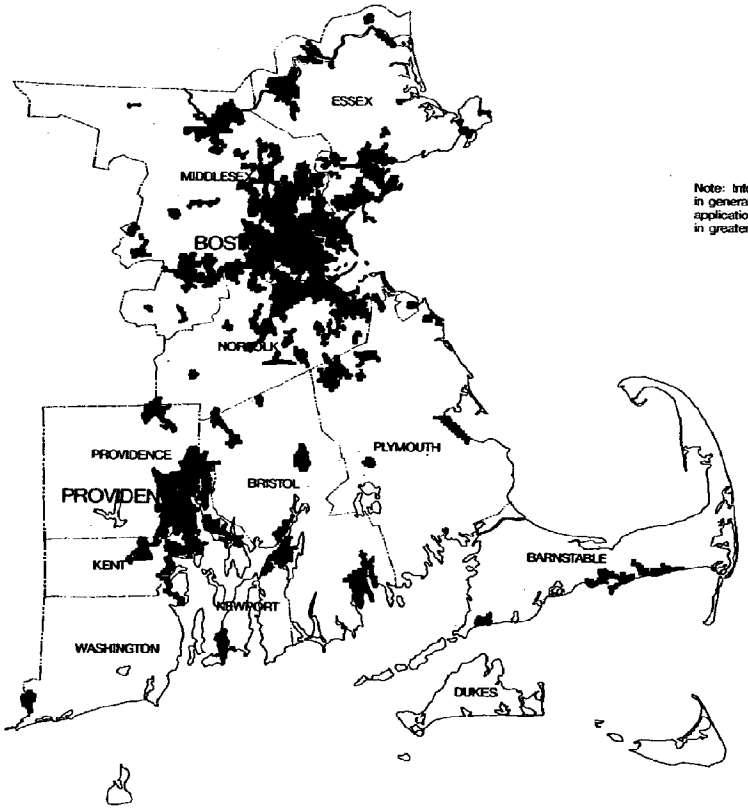
The findings which have been presented in Exhibits 3-16 and 3-17 are illustrated in Plates 1, 2 and 3. From this spatial analysis it can be concluded that adequate land suitable for OCS-related development and normal growth should be available if comprehensive regional planning is undertaken at an early date. Possible zones of location can be selected by examining Plate 3. Land requirements have been drawn to scale in the title block to aid in this evaluation.

Bearing in mind that suburban development and other small parcels are not shown and that substantial areas of impoundment to protect water resources are probable, the upper half of the region does not appear able to accommodate much of the primary industrial land requirements. Furthermore, if one considers the actual ownership of low density parcels along the shoreline of Buzzard's Bay and the South Shore and their present status as coastal resources and tourist resorts, the most likely areas for primary activity lie in Bristol County and the inland part of Plymouth County.

POTENTIAL EFFECTS OF O.C.S. OIL AND GAS DEVELOPMENT

EASTERN MASS./R.I.

PLATE 1



Note: Information presented is in generalized form. Local application will require mapping in greater detail.

UNDEVELOPED LAND

PRESENT CONDITIONS

- DEVELOPED LAND
  EXISTING LAND USES
- UNDEVELOPED LAND

RESOURCE PLANNING ASSOCIATES INC.

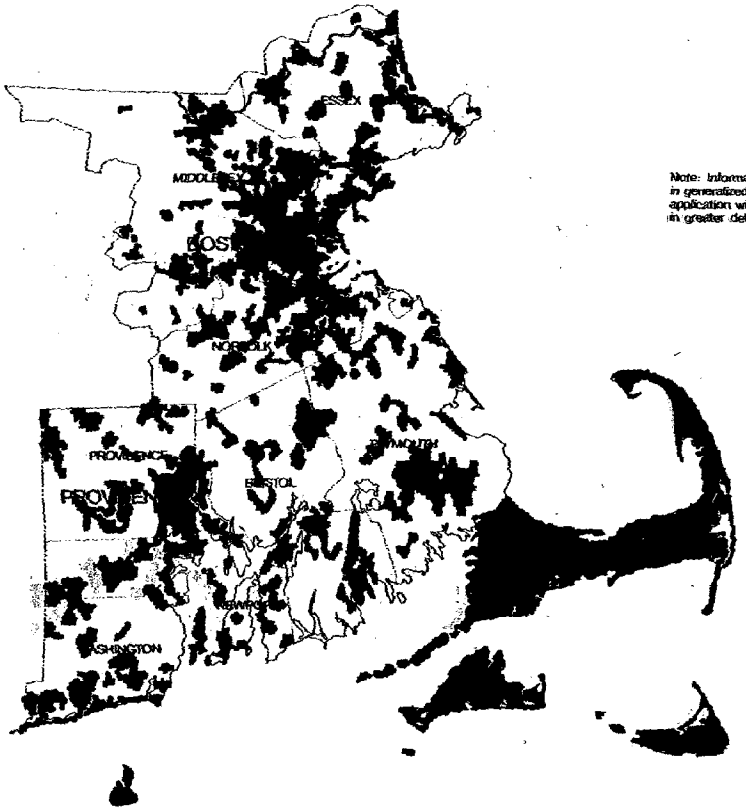
BASE MAP U.S.G.S. 1:250,000 DECEMBER 1973

miles

POTENTIAL EFFECTS OF O.C.S. OIL AND GAS DEVELOPMENT

EASTERN MASS./R.I.

PLATE 2



Note: Information presented is in generalized form. Local application will require mapping in greater detail.

LAND USE IMPACT

LAND REQUIREMENTS TO SCALE
BASE CASE 2 HIGH IMPACT YEAR 2000

BASE CASE II (NO O.C.S.)		OCS HIGH IMPACT		
PRIMARY	OTHER	PRIMARY	INDUCED	TOTAL
2400	162,000	1565 1565 1400 1400 1120 OTHER 620 7670	18,800	190,870 ACRES

SUITABLE LAND

FOR GENERAL DEVELOPMENT

- UNSUITABLE LAND
  EXISTING AND PROJECTED LAND USES
  ENVIRONMENTAL CONSTRAINTS
- SUITABLE LAND
  SUBJECT TO AVAILABILITY AND LOCAL ZONING

RESOURCE PLANNING ASSOCIATES INC.

BASE MAP U.S.G.S. 1:250,000 DECEMBER 1973

miles

N

Note: Information presented is in generalized form. Local application will require mapping in greater detail.

POTENTIAL EFFECTS OF O.C.S. OIL AND GAS DEVELOPMENT

EASTERN MASS./R.I.

PLATE 3

LAND USE IMPACT

LAND REQUIREMENTS TO SCALE
BASE CASE 2 HIGH IMPACT YEAR 2000

BASE CASE II (NO O.C.S)		O.C.S. HIGH IMPACT		
PRIMARY	OTHER	PRIMARY	INDUCED	TOTAL
2400	162,000	1565 1565 1400 1400 1120 OTHER 620 7670	18,800	190,870 ACRES

SUITABLE LAND

FOR PRIMARY DEVELOPMENT

- UNSUITABLE LAND
  EXISTING AND PROJECTED LAND USES
  ENVIRONMENTAL CONSTRAINTS
  LOCATIONAL CONSTRAINTS
- SUITABLE LAND
  SUBJECT TO AVAILABILITY AND LOCAL ZONING

RESOURCE PLANNING ASSOCIATES INC.

BASE MAP U.S.G.S. 1:250,000 DECEMBER 1973

0 10 20 30 miles

N

Air Pollution

Air quality within the Bristol County locality and the Eastern Massachusetts region is somewhat uneven. Ambient air concentrations in both Bristol County and Suffolk County presently exceed the primary standards for particulates and sulphur oxides (Exhibit 3-18).

Both Bristol County and the region were classified Air Quality Priority I for particulates, sulphur oxides, and nitrogen oxides. This high classification for particulates was due mainly to fossil fuel combustion and solid waste incineration.

Approximately 40 percent of the sulphur oxide emissions are from fossil fuel combustion in the electric utility sector and another 35 percent from commercial fuel combustion. Almost 60 percent of all nitrogen oxide emissions are from fuel combustion with the balance accounted for by transportation sources.

Both the locality and region were classified Priority III for hydrocarbons and carbon monoxide. The majority of hydrocarbons and carbon monoxide emissions are from mobile transportation sources which account for over 70 percent of the hydrocarbon emissions and 97 percent of carbon monoxide emissions.

The air pollution impact in Bristol County under high OCS conditions is most significant for hydrocarbons, resulting in loadings that would be approximately 6 times as great as the hydrocarbon loadings without offshore production (Exhibit 3-19). The major source of this pollutant is the refinery sector, which could contribute as much as 90 percent of the additional hydrocarbons and cause severe air quality changes in the area immediately surrounding the refineries. Without OCS-induced development, current loadings of hydrocarbons and carbon monoxide are projected to decline significantly, due to better emission controls in mobile sources.

Particulates, sulphur oxide and nitrogen oxides will decline slightly without OCS development as a result of new control technology. Even with high impact development in the year 2000, particulates and nitrogen oxides should only increase slightly over 1972 levels.

In the eastern Massachusetts/Rhode Island region,

EXHIBIT 3-18

AMBIENT AIR CONCENTRATION LEVELS

EASTERN MASSACHUSETTS/RHODE ISLAND REGION

	Particulates (micro-grams per cubic meter)	SO_x (parts per million
PRIMARY STANDARDS (Geometric Mean)	75	.025
MASSACHUSETTS		
Bristol County		
New Bedford	81*	.034*
Fall River	70	.035*
Attleboro	63	.088*
Plymouth County		
Plymouth	59	.01
Barnstable County		
Falmouth	54	.009
Suffolk County		
Boston	93*	.09*
Middlesex County		
Cambridge	-	.09*
RHODE ISLAND		
Bristol County		
Bristol	57	-
Washington County		
Charlestown	31	-
Providence County		
Cranston	54	.01
East Providence	58	.01

* Exceeds primary standards

Source: Environmental Protection Agency

particulates and nitrogen oxide loadings should remain approximately the same under both 1985 and 2000 base case plus impact conditions (Exhibit 3-20). Unlike particulates and nitrogen oxides, sulphur oxide emissions could decrease by 20 percent under high OCS, Base Case 2 conditions in the year 2000. Due to projected emission controls on mobile sources, hydrocarbons and carbon monoxide should decrease significantly from the 1972 emission levels in the region, even under the high impact conditions.

Water Pollution

The 1970 levels of BOD in Bristol County were due principally to discharges from municipal sewage treatment plants and the paper industry (Exhibit 3-21). The loading levels by 1985 and 2000 are projected to decrease substantially under base case conditions to approximately half of the 1970 loadings. High OCS production would result in as much as a 23 percent increase in BOD loadings over Base Case 2 development by the year 2000, with primary industry development accounting for approximately half of the impact and induced municipal loadings accounting for another third.

In the Eastern Massachusetts region the estimated discharges from paper and allied products resulted in approximately 60 percent of the estimated 1970 BOD loadings. The loadings for the region should decrease approximately 70 percent by 1985 and 2000, with the impacts of OCS production resulting in only a 5 percent increase over the base case loadings. Over half of this small impact is expected to come from induced industrial and municipal sources.

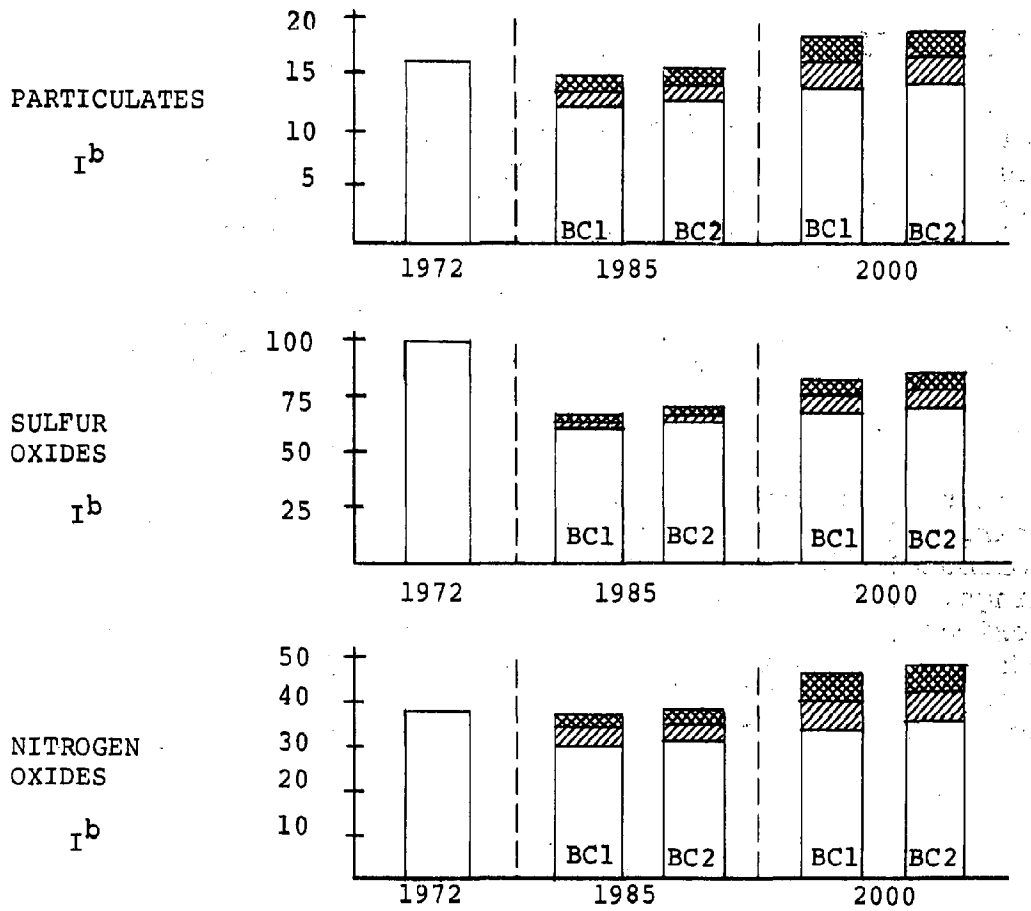
EXHIBIT 3-19

SUMMARY OF IMPACTS - AIR POLLUTION LOADINGS[a]

(Thousand tons per year)

BRISTOL COUNTY

(Geographic Area)



[a] Refer to Appendix IX for a detailed discussion of the methodology for determination of each loading source and estimation of the control factors for each pollutant by geographic area.

[b] EPA Air Quality Priority Classification

BC 1: Base Case 1
BC 2: Base Case 2

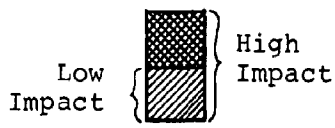
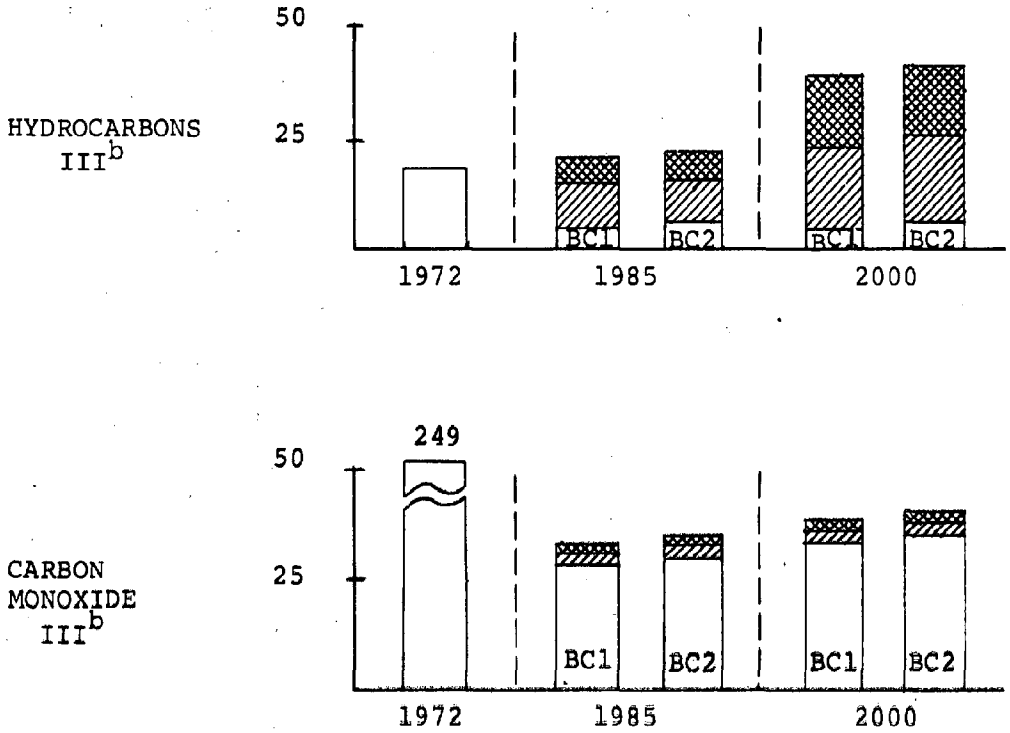


EXHIBIT 3-19

SUMMARY OF IMPACTS - AIR POLLUTION LOADINGS (CONTINUED) [a]

(Thousand tons per year)

BRISTOL COUNTY
(Geographic Area)



[a] Refer to Appendix IX for a detailed discussion of the methodology for determination of each loading source and estimation of the control factors for each pollutant by geographic area.

[b] EPA Air Quality Priority Classification

BC 1: Base Case 1
BC 2: Base Case 2

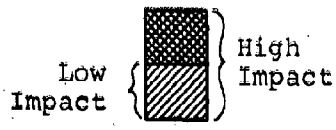


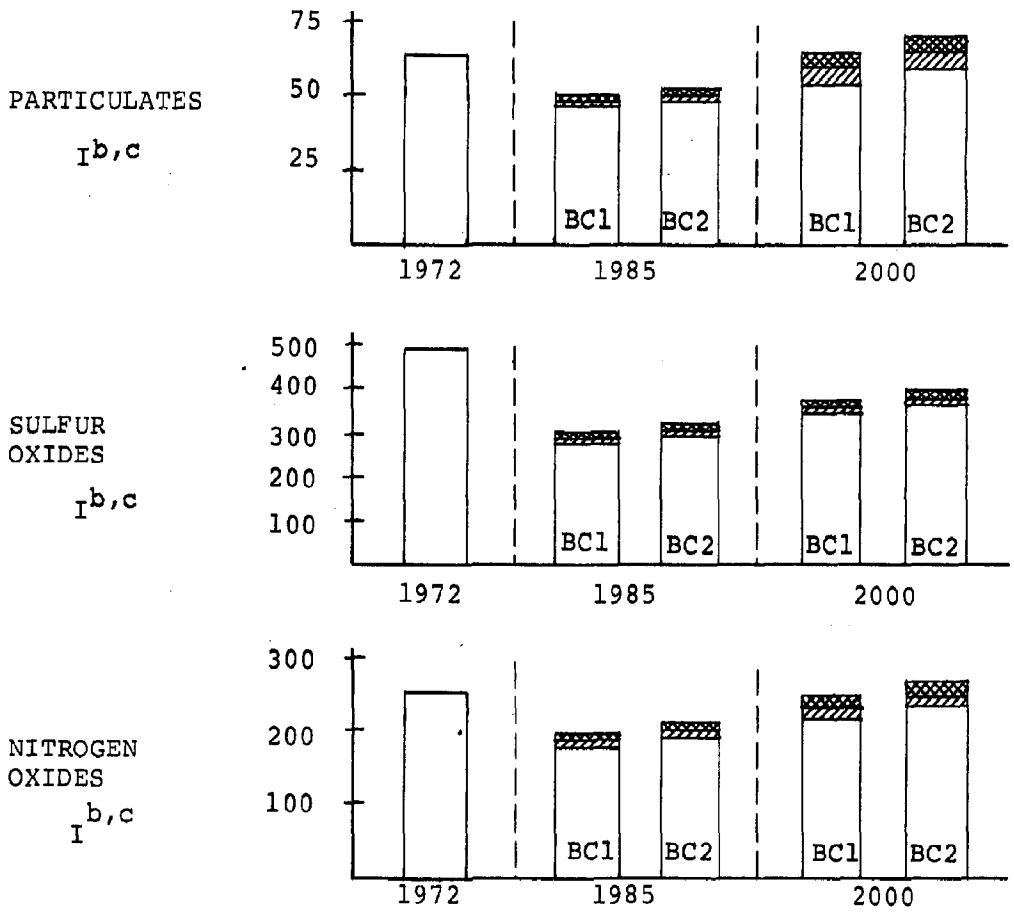
EXHIBIT 3-20

SUMMARY OF IMPACTS - AIR POLLUTION LOADINGS[a]

(Thousand tons per year)

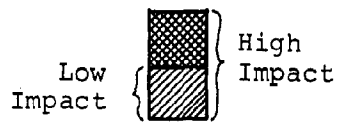
EASTERN MASS./R.I.

(Geographic Area)



[a] Refer to Appendix IX for a detailed discussion of the methodology for determination of each loading source and estimation of the control factors for each pollutant by geographic area.

BC 1: Base Case 1
BC 2: Base Case 2



EPA Air Priority Classification for:

[b]Metropolitan Providence AQCR

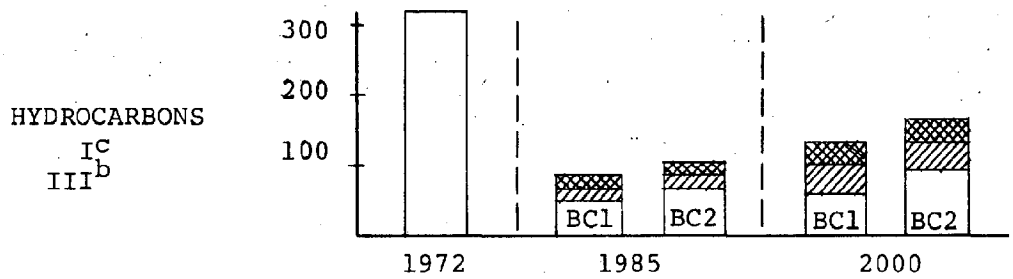
[c]Metropolitan Boston AQCR

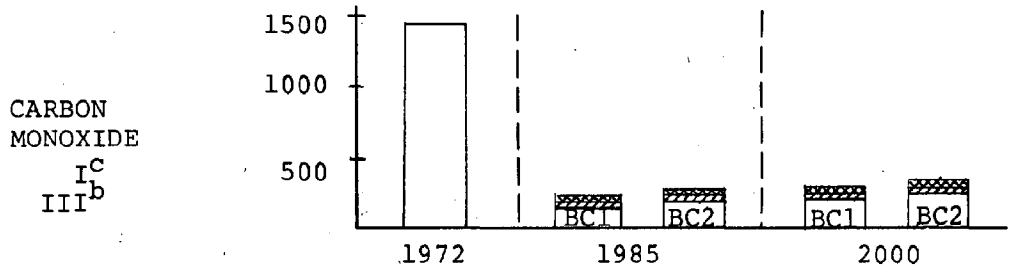
EXHIBIT 3- 20

SUMMARY OF IMPACTS - AIR POLLUTION LOADINGS (CONTINUED)[a]

(Thousand tons per year)

EASTERN MASS./R.I.
(Geographic Area)





---

[a] Refer to Appendix IX for a detailed discussion of the methodology for determination of each loading source and estimation of the control factors for each pollutant by geographic area.

EPA Air Priority Classification for:

[b] Metropolitan Providence AQCR

[c] Metropolitan Boston AQCR

BC 1: Base Case 1
BC 2: Base Case 2

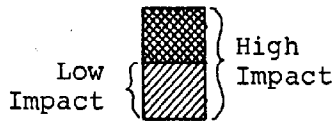
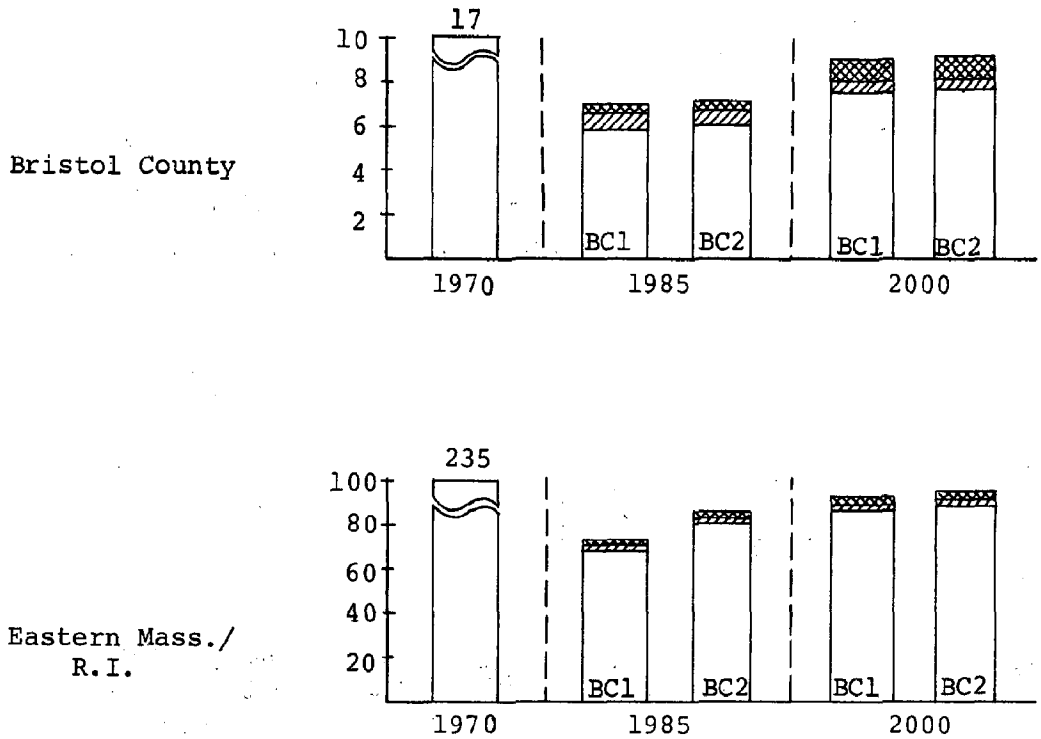


EXHIBIT 3-21

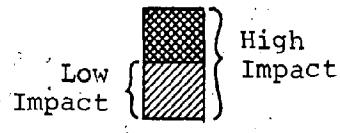
SUMMARY OF IMPACTS - BOD LOADING[a]
(Thousand tons per year)

NEW ENGLAND
(Geographic Area)



[a] Refer to Appendix IX for a detailed discussion of the methodology for determination of each loading source and estimation of the treatment factors for each region.

BC 1: Base Case 1
BC 2: Base Case 2



SOURCES OF DATA

Socio-Economic

Commonwealth of Massachusetts
- Department of Commerce and Development
  - Bureau of Research and Statistics
- Division of Employment Security
- Department of Transportation

Southeastern Massachusetts Regional Planning and Economic Development District
New England Council
New Bedford Chamber of Commerce
New Bedford Harbor Development Commission
Massachusetts Electric Company
Penn Central Railroad Company

State of Rhode Island
- Statewide Planning Program
- Department of Employment Security

Land Use

Commonwealth of Massachusetts, Department of Community Affairs. Regions.

Greater Lowell Area Planning Commission. Urban Resources Study: Existing Patterns and Trends in Land Use in the Greater Lowell Area. June, 1965.

Metropolitan Area Planning Council. Comprehensive Land Use Inventory Report. 1963.

New York Inter Agency Committee. Resources of the New England -New York Regions, Massachusetts Coastal Area, New England.

Rhode Island Statewide Planning Program. Summary Report on the State Land Use Policies and Plan. April, 1973.

University of Massachusetts. Map Down Survey.

SOURCES OF DATA (continued)

Air & Water Pollution

Mason, David. Providence-Pawtucket, New-Bedford, Fall River Air Pollutant Emission Inventory, February, 1969. Springfield, Virginia: National Technical Information Service (#PB 207-267), 1969.

Mason, David. Ambient Air Quality Data for Southeastern Massachusetts Air Pollution Control District. (Xerox) 1971.

Wildlife and Vegetation

Commonwealth of Massachusetts
Department of Natural Resources
Division of Fisheries and Game
Trustees of Reservations
Division of Forests and Parks

Massachusetts Audubon Society
New England Natural Resources Center

State of Rhode Island
Department of Natural Resources
Division of Fish and Wildlife
Audubon Society of Rhode Island

U.S. Department of Interior, Fish and Wildlife Service, Office of River Basin Studies. Wetlands of Massachusetts. October, 1954.

U.S. Department of Interior, Fish and Wildlife Service, Office of River Basin Studies, Coastal Wetlands Inventory of Massachusetts, Supplementary Report. June, 1965.

U.S. Department of Interior, Fish and Wildlife Service, Office of River Basin Studies. Wetlands of Rhode Island. January, 1954.

U.S. Department of Interior. Coastal Wetlands Inventory of Rhode Island, Supplementary Report. June, 1965.

4. MID-ATLANTIC

The Mid-Atlantic demand area includes the states of New York, New Jersey, Pennsylvania and Delaware. The area represents about 20 percent of the nation's population, but less than 5 percent of its land area. It encompasses several large urban areas, including New York, Philadelphia, and Pittsburgh. It accounts for about 19 percent of the nation's petroleum demand, or roughly 3.5 million barrels per day.

The Delaware River Region is made up of a belt of urban counties from Wilmington, Delaware north to the New Jersey suburbs of New York City. This region contains all of the 1.3 million barrels per day refining capacity that is estimated to exist in the Mid-Atlantic. It also contains a quite varied industries base, from heavy manufacturing to light service industries and agriculture. Cape May and Cumberland Counties, in Southeastern New Jersey, are relatively rural, and currently contain no refineries or petrochemical plants.

The remainder of this chapter is organized into three sections. The first describes current socio-economic and environmental conditions in Cumberland and Cape May Counties, New Jersey, and the Delaware River region. The second discusses the assumed future development by primary industry in the local and regional areas. The third estimates the specific impacts from the assumed development.

PROFILE OF CURRENT CONDITIONS

Located in southeastern New Jersey, the Cumberland/Cape May locality lies approximately 140 miles from Washington, D.C. and New York City and about 60 miles from Philadelphia. The Delaware River region covers 767 square miles and consists mostly of low coastal plain, with some gently rolling terrain in the northwest (Exhibit 4-1).

Cumberland and Cape May counties lie on a peninsula bordered on the southwest by Delaware Bay, where the Delaware River empties into the Atlantic Ocean. The Atlantic Ocean borders on the east, with Salem, Gloucester, and Atlantic counties adjoining on the north. Cape May forms the southernmost tip of the peninsula. Much of Cumberland/Cape May counties consists of coastal wetlands, with some forested areas along the coast of Cumberland County.

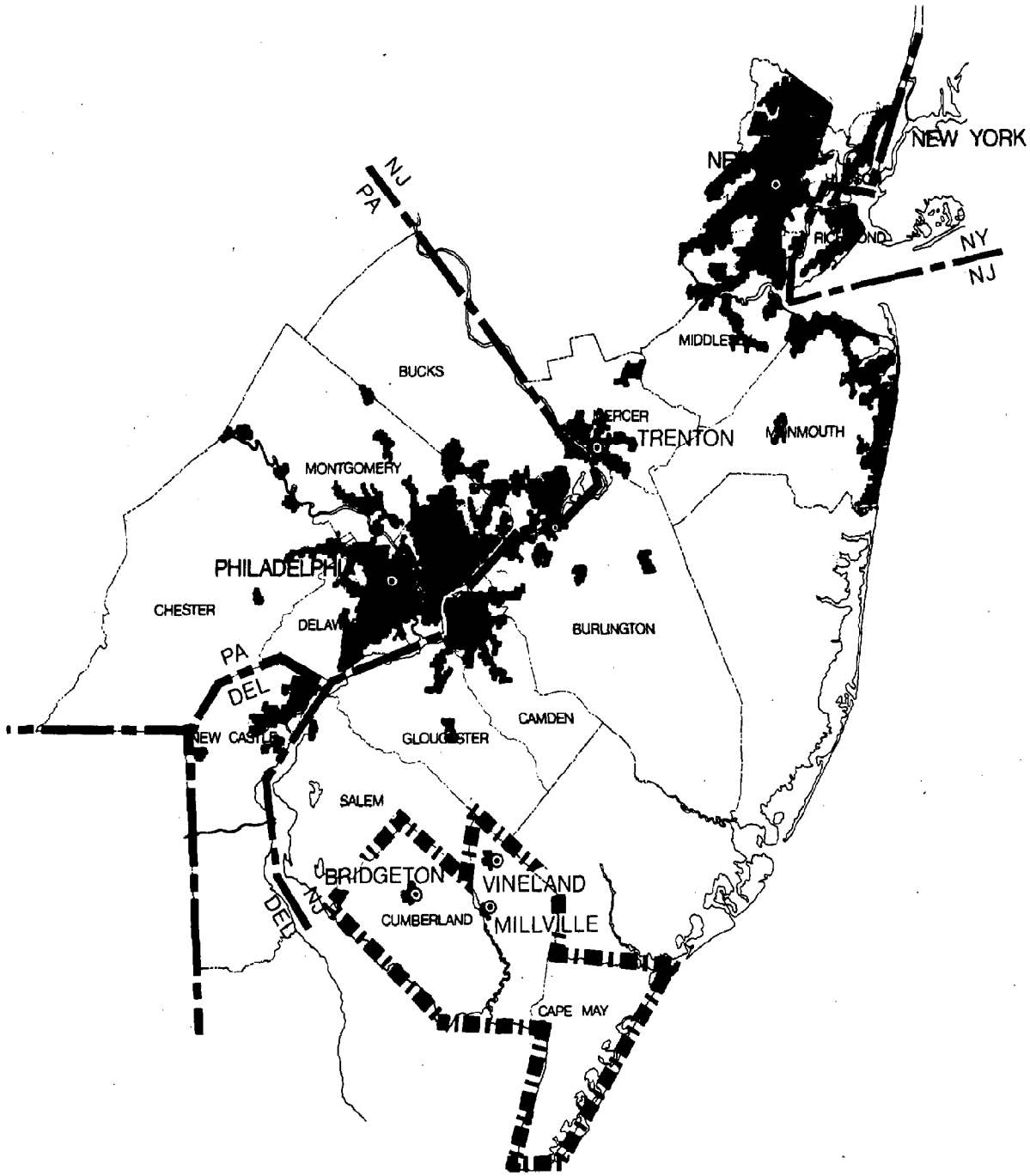


EXHIBIT 4-1
DELAWARE RIVER REGION

RESOURCE PLANNING
ASSOCIATES INC.

Urban development in Cumberland County centers around the cities of Millville, Vineland, and Bridgeton. Millville has some 22,000 inhabitants and lies at the head of the Maurice River, 41 miles from Philadelphia. Its principal industry is the manufacture of glass. Vineland is an agricultural center and the point where four counties meet--Cumberland, Atlantic, Gloucester and Salem. It has a population of 50,000. Bridgeton, the county seat, is smallest of the three cities, with a population of 20,000. Its principal industries are glass and food manufacturing.

Agriculture is a major sector in Cumberland County, and it is the leading county in New Jersey in terms of the value of agricultural products sold. In 1970, 7.2 percent of those employed were engaged in agriculture, compared with a national average of 4.4 percent. With 37 percent of the work force employed in manufacturing, Cumberland County surpassed the national average of 25 percent.

Cape May, with its pleasant climate and access to the ocean, is primarily a resort economy with large seasonal fluctuations in population and employment. The Cape May County Planning Board estimated that of the 39,000 jobs available in the tourist industry in 1970, 9,000 were filled by non-residents. High unemployment during the winter stems from the fact that many Cape May residents are either retired persons or housewives who choose not to work during the winter. Per capita income in Cape May County in 1970 was $3,588, compared with $3,926 in Cumberland County and $4,598 for the entire state of New Jersey. With regard to these figures, the local planning board points out that many Cape May residents are content to draw a lower income than those in other counties in the region in order to enjoy its relatively unspoiled environment.

In general, the area is not densely settled, with about 235 persons per square mile. Cumberland and Cape May's planning boards realize that their counties are among the few in New Jersey that have avoided heavy industrialization and urban buildup, and they hope to preserve this condition.

In contrast, the Delaware River region is densely populated, with an average of 1,417 persons per square mile. reported in 1970. The region includes the urban belt of northeastern New Jersey, as well as the cities of Philadelphia, Trenton, and part of New York (Staten Island). Along this belt lie concentrations of manufacturing activity as well as a complex network of transportation and distribution. A high proportion of the population is included in the work force--46 percent in 1970 compared with a national average

of 41 percent. Unemployment of 2.7 percent in 1970 was lower than the national average of 4.8 percent.

In 1970 per capita income was $4,197. However, the average manufacturing worker in the region earned $9,500 during this year, while his counterpart in Cumberland/Cape May earned $2,000 less, or $7,500.

In 1970, 22 percent of the land area in the locality was developed while the comparable figure for the region was 27 percent. Of the developed land, however, only 23 percent in Cumberland/Cape May was for residential use, compared to 45 percent for the region.

The current air quality within Cumberland/Cape May is rated Class III for particulates, nitrogen oxides, and hydrocarbons. Despite its "unspoiled" quality, the locality is considered Class I for carbon monoxide, the levels being higher than the federal standard. The classification for sulphur oxides is Class IA, which again is a level higher than the federal standard. Emissions from a power station in Cape May County accounts for the high level of pollution.

Cape May and Cumberland counties contain some of the most important wetlands in the Mid-Atlantic demand area. These coastal salt meadows are prime resting and feeding areas for the ducks and geese of the Atlantic Flyway. Of the over 100,000 acres considered to be wetlands, 99 percent are rated as being of high value of waterfowl. There has been a concerted effort over the past 15 to 20 years to preserve and protect these wetlands. The New Jersey Division of Fish and Game owns and manages ten wildlife areas within the wetlands of the two counties and several private conservation organizations also operate sanctuaries in the area (Exhibit 4-2). The other counties of New Jersey, Pennsylvania, and Delaware that border the Delaware River also contain important wetlands in terms of estuarine activities as well as waterfowl habitat. Many of these areas are owned by private or state organizations.

Inland in Cumberland County lies the Belleplain State Forest covering some 7,000 acres. A great percentage of the state forest lands of New Jersey lie within the counties of the Delaware River region.

CAPE MAY AND CUMBERLAND COUNTIES
NEW JERSEY

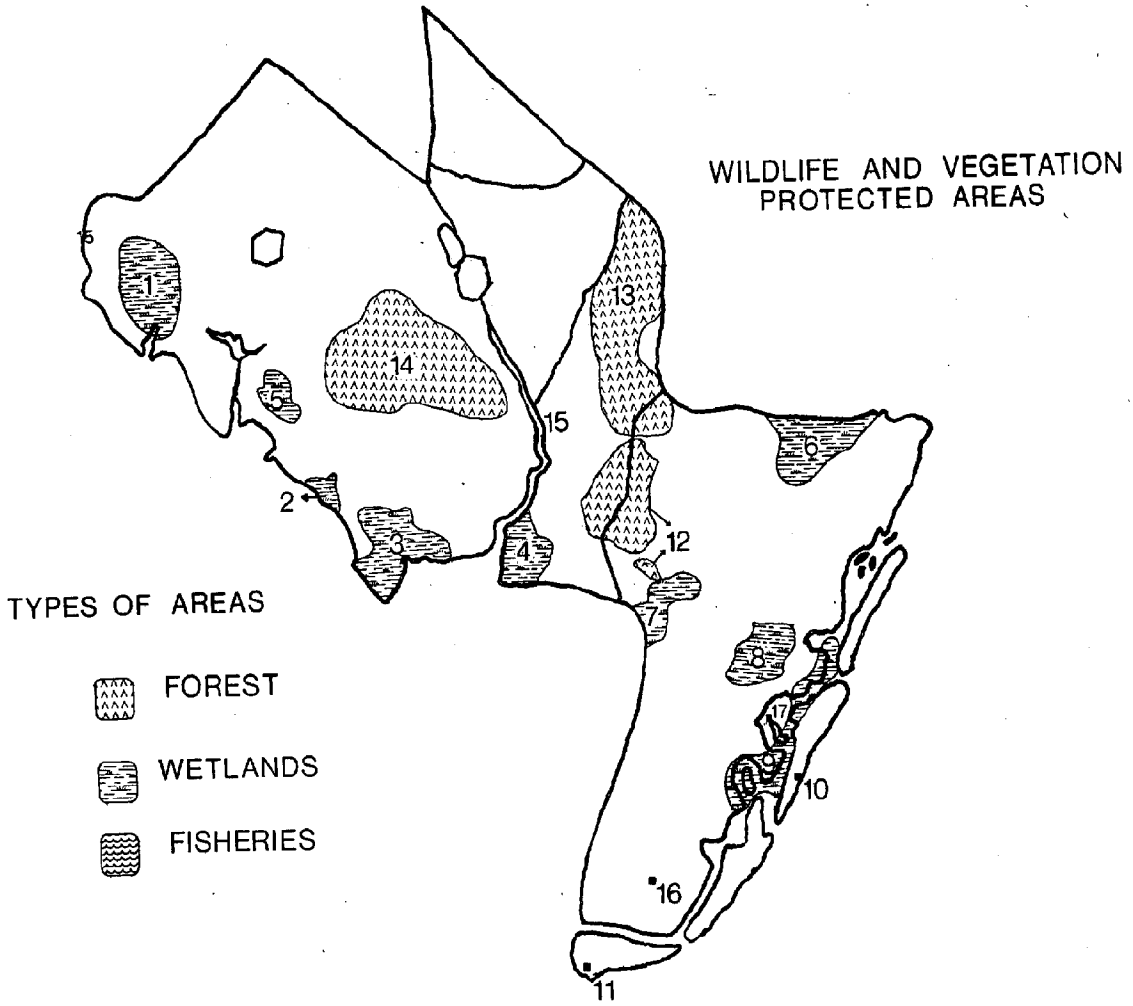


EXHIBIT 4-2

EXHIBIT 4-2 (cont.)

KEY	CUMBERLAND/ CAPE MAY COUNTIES[a]
1.	Dix Wildlife Management Area, 1,597 acres
2.	Fortescue Wildlife Management Area, 885 acres
3.	Egg Island Wildlife Management Area, 6,506 acres
4.	Heislerville Wildlife Management Area, 3,124 acres
5.	Nantuxent Wildlife Management Area, 962 acres
6.	Tuckahoe Wildlife Management Area, 2,800 acres
7.	Dennis Creek Wildlife Management Area, 1,320 acres
8.	Beaver Swamp Wildlife Management Area, 1,320 acres
9.	World Wildlife Fund South Jersey Wetlands, 5,000 acres
10.	Stone Harbor Bird Sanctuary, 22 acres
11.	Cape May Point Bird Sanctuary
12.	Belleplain State Forest, 6,792 acres
13.	Peaslee Wildlife Management Area, 9,538 acres
14.	Millville Wildlife Management Area, 11,796 acres
15.	Maurice and Cohaney Rivers
16.	Bennett Bog Wildlife Sanctuary, 10 acres
17.	Beecher Bowdish Wildlife Sanctuary, 6 acres

[a] See Appendix X for a detailed description of the wildlife and vegetation of the local area as well as the region.

DEVELOPMENT ASSUMPTIONS

This section describes both the base case and OCS-induced development that could occur in the Delaware River region for each of the following primary industrial sectors: oil refining, gas processing, petrochemicals, and construction.[1]

Oil Refining

In the oil refining sector, existing refinery capacity (none in the locality, but all in the region) is assumed to expand 60 percent by 1985 and 100 percent by the year 2000 under Base Case 1 conditions (Exhibit 4-3). Under Base Case 2 conditions, where deep water port development would occur, it is assumed that the Mid-Atlantic area would produce 3.7 million barrels per day of refinery products by the year 2000. In the Delaware River region, it is assumed that 3.0 million barrels per day of production would take place in 1985 and 3.4 million barrels per day by the year 2000, with 720,000 barrels per day of this production taking place in Cumberland/Cape May counties in 1985, and 1.1 million barrels occurring by the year 2000.

Under high OCS production conditions, 350,000 barrels per day is assumed to be refined in the locality by 1985, with 500,000 barrels per day by the year 2000. The remaining Mid-Atlantic refinery production is assumed to occur elsewhere in the region, except for 200,000 barrels per day in the year 2000, which is assumed to take place in either upstate New York or western Pennsylvania. Appendix II discusses in greater detail the Mid-Atlantic refinery development assumptions.

Gas Processing

Without offshore production there would be no gas processing activity in the Mid-Atlantic since no developable natural gas resources are known to exist onshore. Gas processing development related to offshore production should

---

[1]Development of the offshore oil and gas recovery industry, which is treated similarly for each East Coast demand area, is described in Chapter 2.

EXHIBIT 4-3

PROJECTED MID-ATLANTIC REFINERY PRODUCTION[a,b]

(millions of barrels/day)

	Base Case 1		Base Case 2		Low OCS		High OCS	
	1985	2000	1985	2000	1985	2000	1985	2000
Cumberland/ Cape May localities	0	0	0.72	1.08	.25	.25	.35	.50
Delaware River Region (not incl. locality)	1.98	2.52	2.25	2.34	0	.25	.40	.80
Other Mid-Atlantic	0	0	0.18	0.27	0	0	0	.20
Total	1.98	2.52	3.15	3.69	0.25	.50	.75	1.50

[a] Refinery capacity is 10 percent larger than production, based on the assumption that refineries will operate at 90 percent capacity.

[b] Base case production is total, while low and high OCS production is incremental above base case.

Source: RPA estimates.

impact most heavily in the Cape May/Cumberland locality where the pipeline would come ashore. In the high impact case for the year 2000, however, some gas processing development should occur in the region outside of the locality, as shown in Exhibit 4-4. Appendix III discusses in greater detail the assumptions developed for the gas processing industry.

EXHIBIT 4-4

PROJECTED MID-ATLANTIC GAS PROCESSING DEVELOPMENT FROM OFFSHORE GAS PRODUCTION

(Billions of cu. ft./day)

Area	Low OCS		High OCS	
	1985	2000	1985	2000
Cumberland/Cape May locality	0.3	1.8	0.9	1.8
Delaware River Region (not incl. locality)	0	0	0	1.8
Total	0.3	1.8	0.9	3.6

Source: RPA estimates.

Petrochemicals

With future petrochemical development likely to be tied fairly closely to the availability of refinery heavy liquids, a significant amount of petrochemical activity should take place in the Mid-Atlantic demand area, especially under Base Case 2 conditions as shown in Exhibit 4-5.

As many as 8 olefin complexes (1 billion lb./yr. each) are expected by 1985 and 13 complexes are expected by the year 2000 under Base Case 2 (deepwater terminal) assumptions.

EXHIBIT 4-5

PROJECTED MID-ATLANTIC BASE CASE PETROCHEMICAL PRODUCTION

(Number of 1 billion lb./hr. olefins complexes)

	Base Case 1		Base Case 2	
	1985	2000	1985	2000
Cumberland/Cape May locality	0	0	3.1	6.2
Delaware River Region (not incl. locality)	1.9	4.1	5.0	7.0
Total	1.9	4.1	8.1	13.2

Source: RPA estimates.

With offshore production, the petrochemical development is expected to increase roughly in proportion to refinery development and, in the high impact case, could add six complexes to the region by the year 2000, including two in the locality (Exhibit 4-6). Appendix IV discusses in greater detail the regional development assumptions for petrochemicals.

EXHIBIT 4-6

PROJECTED MID-ATLANTIC PETROCHEMICAL PRODUCTION WITH OCS DEVELOPMENT

(Number of 1 billion lb./hr. olefins complexes)

	Low OCS		High OCS	
	1985	2000	1985	2000
Cumberland/Cape May locality	0	0	1.0	1.9
Delaware River Region (not incl. locality)	0	1.0	1.2	4.1
Total	0	1.0	2.2	6.0

Source: RPA estimates.

Construction

Given the high base case projections for refining and petrochemicals activity, a significant amount of construction should occur in the 1980's, with a peak at or near 1985 (Exhibit 4-7). For the Cumberland/Cape May locality, the value of 1985 construction is projected at $102 million for Base Case 1 and $336 million for Base Case 2. For the Delaware River region overall, new construction activity is proportionately less significant because of the assumed slowdown in refinery development after 1985.

Under high OCS conditions in 1985, $118 million of incremental construction activity is projected for the locality, with $332 million for the total region. Although refinery development is the main contributor to this construction output in Cumberland/Cape May Counties, petrochemical development is the most significant for the region as a whole.

In the year 2000, local construction is assumed to decline to $48 million and the entire region should decline to $133 million. None of this 2000 construction is assumed to be heavy construction for primary industries. Appendix V discusses in greater detail the methodology used in making these assumptions.

IMPACTS

This section discusses the impacts that could occur in the Cumberland/Cape May locality and the Delaware River region from offshore oil and gas production. The economic, social, land use, and air and water pollution impacts are discussed in turn.

Economic

For the Cumberland/Cape May locality, the two base cases summarized in Exhibit 4-8 differ markedly. For example, total 1970 employment of 80,000 would grow by 39 percent to 111,000 in the year 2000 under Base Case 1, but would rise by 100 percent to 160,000 if Base Case 2 conditions were to prevail. The stimulus behind these widely disparate growth rates is the amount of new refinery, petrochemical, and construction activity assumed to occur as a result of a deepwater terminal in the Delaware Bay adjacent to the two county local area. These primary sectors alone would employ a total of 18,000 people in both 1985 and 2000.

EXHIBIT 4-7

VALUE OF CONSTRUCTION OUTPUT[a]
($ million)

MID-ATLANTIC

Geographic Area	1970 Actual	1985 Base Case[b]	1985 Low OCS	1985 High OCS	2000 Base Case[b]	2000 Low OCS	2000 High OCS
CUMBERLAND/CAPE MAY COUNTIES							
Refinery			0	53		0	0
Gas Processing			14	8		0	0
Petrochemical			0	33		0	0
Induced[c]			3	24		7	48
Total Local	116	102[d]	17	118	162[d]	7	48
DELAWARE RIVER REGION							
Refinery			118	98		0	0
Gas Processing			14	25		0	0
Petrochemical			37	142		0	0
Induced[c]			41	67		84	133
Total Region	5744	9843[e]	210	332	14201[e]	84	133

[a] Base Case total and OCS incremental. Appendix V describes the methods used in determining these values

[b] Base Case 1 for East Coast

[c] Other industrial, commercial, and residential construction activity induced by the direct industry activities

[d] Base Case 2: 1985 = 336
2000 = 256

[e] Base Case 2: 1985 = 9882
2000 = 14257

Source: RPA estimates.

EXHIBIT 4-8

SUMMARY OF BASE CASE ECONOMIC CONDITIONS

CUMBERLAND/CAPE MAY COUNTIES

A. EMPLOYMENT (thousands)

Sector	Actual	Base Case 1		Base Case 2	
	1970	1985	2000	1985	2000
Construction	4.0	3.0	4.0	10.1	6.4
Ref., Gas, Petrochem.	0	0	0	7.6	11.1
Other Manufacturing	23.0	40.0	44.0	48.7	52.0
Agriculture	5.0	3.0	3.0	3.1	3.0
Utilities	4.0	4.0	5.0	7.7	8.8
Services	44.0	47.0	55.0	71.7	78.4
TOTAL	80.0	97.0	111.0	148.9	159.7

B. VALUE OF OUTPUT ($ million)[a]

Sector	Actual	Base Case 1		Base Case 2	
	1970	1985	2000	1985	2000
Construction	116	102	162	336	256
Ref., Gas, Petrochem.	0	0	0	2120	3583
Other Manufacturing	687	1620	2446	1974	2888
Agriculture	87	79	119	81	121
Utilities	104	134	216	257	380
Services	642	866	1252	1310	1785
TOTAL	1636	2801	4195	6078	9013

Codes - * = negligible
: = infinite percentage since base case is zero

[a]All dollar figures are 1970 constant dollars.

Source: RPA estimates

In the Delaware River region, the difference between the two base cases when measured on a percentage basis is much smaller (see Exhibit 4-9). The 1970 total employment of almost 3.9 million is projected to grow 31 percent under Base Case 1 and 35 percent under Base Case 2 by the year 2000. However, even this small percentage difference translates into 135,000 extra jobs for the entire region under Base Case 2.

Against this background, the following sections describe the anticipated primary and aggregate impacts resulting from OCS development.

Primary Impacts

Although the construction sector would provide a less important source of new employment in the Mid-Atlantic demand area than in New England, it still would account for over 50 percent of the new jobs in 1985 under high OCS conditions (Exhibit 4-10). By the year 2000, however, the petrochemical sector would become the biggest primary employer, providing over 50 percent of the new jobs in both Cumberland/Cape May counties, and the Delaware River region under high impact assumptions. In contrast, if low impact conditions prevail, no petrochemical development is assumed in the locality in either 1985 or 2000; in the year 2000, the sector would contribute only 1,400 new jobs to the entire Delaware River region. In the low impact case, construction would stand as the largest primary employer in both 1985 and 2000, but would decrease in relative importance in the latter year.

The picture differs markedly if one focuses attention on the value of output as a measure of impact. For both high and low impact cases, refinery output would be the most significant primary impact, accounting for $1.4 billion in 1985 and $2.4 billion in 2000 under high OCS conditions.

Aggregate Impacts

In the Cumberland/Cape May localities under high impact assumptions, 29,000 new jobs in 1985 and 32,000 in the year 2000 are projected (see Exhibit 4-11). In the low impact case (Exhibit 4-12) nearly 9,000 new jobs would be

EXHIBIT 4-9

SUMMARY OF BASE CASE ECONOMIC CONDITIONS

DELAWARE RIVER REGION

A. EMPLOYMENT (thousands)

Sector	Actual	Base Case 1		Base Case 2	
	1970	1985	2000	1985	2000
Construction	156.7	227.0	278.0	231.2	279.5
Ref., Gas, Petrochem.	1100.7	9.3	9.4	23.2	24.2
Other Manufacturing		1214.7	1255.6	1251.8	1289.6
Agriculture	33.8	20.0	17.0	20.4	17.3
Utilities	232.4	227.0	228.0	237.3	237.6
Services	2339.0	2856.0	3289.0	2937.4	3363.4
TOTAL	3862.6	4554.0	5077.0	4701.3	5211.6

B. VALUE OF OUTPUT ($ million)[a]

Sector	Actual	Base Case 1		Base Case 2	
	1970	1985	2000	1985	2000
Construction	5744	9843	14201	9882	14257
Ref., Gas, Petrochem.	41514	4124	5686	7544	9695
Other Manufacturing		59047	83204	64508	90500
Agriculture	746	666	862	679	877
Utilities	7561	9617	12459	10021	12938
Services	43103	65014	94480	66762	96476
TOTAL	98668	148311	210892	159396	224743

Codes - * = negligible
: = infinite percentage since base case is zero

[a]All dollar figures are 1970 constant dollars.

Source: RPA estimates

EXHIBIT 4-10

PRIMARY ECONOMIC IMPACTS

MID-ATLANTIC

A. EMPLOYMENT (thousands) HIGH IMPACT

	1985			2000		
	Local	Region[a]	Area[b]	Local	Region[a]	Area[b]
Oil and Gas Rec.	0	0	7.5	0	0	4.1
Gas Processing	.1	.1	0	.1	.2	0
Refineries	1.0	2.2	0	1.1	2.9	.4
Petrochemical	1.8	3.9	0	2.7	8.5	0
Construction	3.6	10.1	0	1.2	3.5	0

B. VALUE OF OUTPUT (millions 1970 dollars) HIGH IMPACT

	1985			2000		
	Local	Region[a]	Area[b]	Local	Region[a]	Area[b]
Oil and Gas Rec.	0	0	361	0	0	156
Gas Processing	24	24	0	48	95	0
Refineries	637	1367	0	913	2373	365
Petrochemical	260	572	0	494	1560	0
Construction	118	334	0	47	134	0

Code: * = negligible

[a] Region includes Local

[b] Area is "Demand Area" exclusive of the Region

Source: RPA estimates

EXHIBIT 4-10 (cont.)

PRIMARY ECONOMIC IMPACTS

MID-ATLANTIC

C. EMPLOYMENT (thousands) LOW IMPACT

	1985			2000		
	Local	Region[a]	Area[b]	Local	Region[a]	Area[b]
Oil and Gas Rec.	0	0	3.2	0	0	1.5
Gas Processing	*	*	0	.1	.1	0
Refineries	.7	.7	0	.6	1.1	0
Petrochemical	0	0	0	0	1.4	0
Construction	.5	6.3	0	.2	2.2	0

D. VALUE OF OUTPUT (millions 1970 dollars) LOW IMPACT

	1985			2000		
	Local	Region[a]	Area[b]	Local	Region[a]	Area[b]
Oil and Gas Rec.	0	0	161	0	0	58
Gas Processing	8	8	0	48	48	0
Refineries	457	457	0	457	914	0
Petrochemical	0	0	0	0	260	0
Construction	17	209	0	7	84	0

Code: * = negligible

[a] Region includes Local

[b] Area is "Demand Area" exclusive of the Region

Source: RPA estimates

EXHIBIT 4-11

AGGREGATE ECONOMIC IMPACTS

CUMBERLAND/CAPE MAY COUNTIES

HIGH IMPACT

A. EMPLOYMENT (thousands)

Sector	1985	Percent Over B.C. 1	Percent Over B.C. 2	2000	Percent Over B.C. 1	Percent Over B.C. 2
Construction	3.6	119	35	1.2	31	19
Ref. Gas, Petrochem.	2.9	:	38	3.9	:	35
Other Manufacturing	5.3	13	11	6.2	14	12
Agriculture	*	1	1	*	1	1
Utilities	2.0	51	26	2.6	53	30
Services	15.0	32	21	18.0	33	23
TOTAL	28.8	30	19	31.9	29	20

B. VALUE OF OUTPUT ($ million)[a]

Sector	1985	Percent Over B.C. 1	Percent Over B.C. 2	2000	Percent Over B.C. 1	Percent Over B.C. 2
Construction	118	115	35	47	29	18
Ref., Gas, Petrochem.	921	:	43	1454	:	41
Other Manufacturing	213	13	11	344	14	12
Agriculture	1	1	1	2	1	1
Utilities	68	51	26	114	53	30
Services	276	32	21	409	33	23
TOTAL	1597	57	26	2370	56	26

Codes - * = negligible
: = infinite percentage since base case is zero

[a]All dollar figures are 1970 constant dollars.

Source: RPA estimates

EXHIBIT 4-12

AGGREGATE ECONOMIC IMPACTS

CUMBERLAND/CAPE MAY COUNTIES

LOW IMPACT

A. EMPLOYMENT (thousands)

Sector	1985	Percent Over B.C. 1	Percent Over B.C. 2	2000	Percent Over B.C. 1	Percent Over B.C. 2
Construction	.5	17	5	.2	5	3
Ref., Gas, Petrochem.	.8	:	10	.7	:	6
Other Manufacturing	1.6	4	3	1.7	4	3
Agriculture	*	*	*	*	*	*
Utilities	.7	16	8	.8	16	9
Services	4.9	10	7	5.5	10	7
TOTAL	8.5	9	6	8.9	8	6

B. VALUE OF OUTPUT ($ million)[a]

Sector	1985	Percent Over B.C. 1	Percent Over B.C. 2	2000	Percent Over B.C. 1	Percent Over B.C. 2
Construction	17	17	5	7	4	3
Ref.,Gas, Petrochem.	465	:	22	504	:	14
Other Manufacturing	65	4	3	96	4	3
Agriculture	*	*	*	1	*	*
Utilities	22	16	8	34	16	9
Services	91	10	7	125	10	7
TOTAL	660	24	11	767	18	9

Codes - * = negligible
: = infinite percentage since base case is zero

[a]All dollar figures are 1970 constant dollars.

Source: RPA estimates

created by both the years 1985 and 2000. These figures represent an increase in employment of between 8 and 30 percent over Base Case 1 or between 6 and 20 percent over Base Case 2, depending on whether high or low impact conditions ultimately exist.

Of all the new jobs created within the two-county area under the high impact case, construction either directly or indirectly would account for one-third, refining for one-third and petrochemicals for one-third. By the year 2000, refining and petrochemicals each directly or indirectly would account for about one-half of the total:[1]

HIGH OCS

	1985			2000		
Jobs Created by:	Primary Jobs	Induced Jobs	Total Jobs	Primary Jobs	Induced Jobs	Total Jobs
Construction	3,600	5,500	9,100	1,200	1,900	3,100
Refining	1,000	9,800	10,800	1,100	12,500	13,600
Petrochemical	1,800	5,800	7,600	2,700	11,200	13,900
Other Primary	100	1,200	1,300	100	1,200	1,300
Total Primary	6,500	22,300	28,800	5,100	26,800	31,900

As in other areas, the biggest fraction of total employment -- between 50 and 60 percent in both 1985 and 2000 -- would occur in the service sector under both the high and low impact cases. The 119 percent construction impact in 1985 under high impact assumptions is not as significant as appears at first. Since the construction impact in the region is not nearly as large, the region should be capable of supplying the necessary additional skilled labor.

Total new employment in the Delaware River region (Exhibit 4-13) under high impact conditions should equal 100,000 people in 1985 and 121,000 in the year 2000. Not surprisingly, in a region as large as this one, these

[1] Based on the detailed economic computer projections for Cumberland/Cape May County (see Annex to Appendix VI).

EXHIBIT 4-13

AGGREGATE ECONOMIC IMPACTS

DELAWARE RIVER REGION

HIGH IMPACT

A. EMPLOYMENT (thousands)

Sector	1985	Percent Over B.C. 1	Percent Over B.C. 2	2000	Percent Over B.C. 1	Percent Over B.C. 2
Construction	10.1	4	4	3.5	1	1
Ref. Gas, Petrochem.	6.2	67	27	11.5	123	48
Other Manufacturing	18.2	2	1	22.3	2	2
Agriculture	.3	2	2	.3	2	2
Utilities	6.4	3	3	9.0	4	4
Services	59.0	2	2	74.2	2	2
TOTAL	100.2	2	2	120.8	2	2

B. VALUE OF OUTPUT ($ million)[a]

Sector	1985	Percent Over B.C. 1	Percent Over B.C. 2	2000	Percent Over B.C. 1	Percent Over B.C. 2
Construction	334	3	3	134	1	1
Ref., Gas, Petrochem.	1963	48	26	4028	71	42
Other Manufacturing	883	2	1	1478	2	2
Agriculture	10	2	1	16	2	2
Utilities	255	3	3	460	4	4
Services	1279	2	2	2024	2	2
TOTAL	4724	3	3	8140	4	4

Codes - * = negligible
: = infinite percentage since base case is zero

[a]All dollar figures are 1970 constant dollars.

Source: RPA estimates

EXHIBIT 4-14

AGGREGATE ECONOMIC IMPACTS

DELAWARE RIVER REGION
LOW IMPACT

A. EMPLOYMENT (thousands)

Sector	1985	Percent Over B.C. 1	Percent Over B.C. 2	2000	Percent Over B.C. 1	Percent Over B.C. 2
Construction	6.3	3	3	2.2	1	1
Ref., Gas, Petrochem.	.8	8	3	2.6	29	11
Other Manufacturing	5.7	*	*	6.3	1	*
Agriculture	.1	1	1	.1	1	1
Utilities	1.9	1	1	2.6	1	1
Services	20.1	1	1	22.7	1	1
TOTAL	34.9	1	1	36.5	1	1

B. VALUE OF OUTPUT ($ million)[a]

Sector	1985	Percent Over B.C. 1	Percent Over B.C. 2	2000	Percent Over B.C. 1	Percent Over B.C. 2
Construction	209	2	2	84	1	1
Ref.,Gas, Petrochem.	465	11	6	1221	21	13
Other Manufacturing	278	*	1	420	1	*
Agriculture	3	1	1	5	1	1
Utilities	74	1	1	134	1	1
Services	435	1	1	619	1	1
TOTAL	1464	1	1	2483	1	1

Codes - * = negligible
: = infinite percentage since base case is zero

[a]All dollar figures are 1970 constant dollars.

Source: RPA estimates

figures represent only a 2 percent increase over either of the two base case developments. Under low impact the 35,000 new jobs (Exhibit 4-14) would account for less than 1 percent in both 1985 and 2000.

Social Infrastructure

Offshore production is expected to exert several serious pressures on the social infrastructure of Cumberland and Cape May counties. First, the infrastructure might have to expand by 75 percent of its 1970 capacity by 1985 to meet the demands of refining imports received by a deep water terminal (Base Case 2) and then by an additional 20 percent to adapt to OCS high impacts (Exhibit 4-15). This total growth of 108 percent would be considerable, and would be industrially-based, rather than based on tourism and agriculture, as in the past.

Second, the growth that the counties should experience under Base Case 2 and OCS high impacts would place a significant strain on public facilities, particularly on the water supply, schools, and hospitals. In addition, government overhead would be sharply raised.

The demand for public water should more than double between 1970 and 1985 in response to Base Case 2 and OCS high impacts. The demand should increase another 25 percent under high impact by the year 2000. At the present time, there is much concern over the local area's ability to meet current water needs. The additional demand from OCS developments could intensify an already grave problem.

A similar problem could result for schools. Under a high OCS development, the school age population would increase 19 percent over Base Case 2 growth by 1985, and would maintain this increase to the year 2000. The OCS impacts alone would require the equivalent of 5 new high schools of 1,000 students each by 1985. If the combined growth under Base Case 2 and OCS high impact occur, then the locality's school age population would more than double between 1970 and 1985. Under these conditions, 50,000 new students would be attending schools in Cumberland/Cape May counties by 1985. This translates into 16 new high schools with 1,000 students each. Building a new school of this size would take from three to five years. Therefore, planning would need to begin in the near future to meet the communities' projected educational needs.

EXHIBIT 4-15

CUMBERLAND/CAPE MAY COUNTIES
(Geog. Area)

SOCIAL INFRASTRUCTURE IMPACT

	1970	1985				2000			
				Incr.				Incr.	
		Base Case 1	Base Case 2	High Impact	Low Impact	Base Case 1	Base Case 2	High Impact	Low Impact
POPULATION (000)	181	219	318	59.6	17.9	258	354	66.0	18.4
Percent Change %[a]				27/19	8/6			26/19	7/5
PHYSICAL SYSTEMS									
Water Demand Mil. gallons/day	27	37	54	10	3	49	67	13	3
Elec. Demand (MW of Capacity)	NA	NA	NA	367	130	NA	NA	587	140
Structures Residential (000)	58	70	102	19	6	83	113	21	6
Commercial (millions of sq. ft.)	4.3	5.7	8.3	1.6	.5	6.7	9.3	1.7	.5
SOCIAL SYSTEMS									
Schools - Enrollees (000)	45	54	79	15	4	64	89	17	4
Hospitals - Beds	614	742	1078	203	61	875	1200	224	61
Police - Manpower	340	412	598	113	34	485	666	124	34
Solid Waste - Tons/Day	543	657	953	179	54	774	1062	198	55
Sewage - Mil.gal/day	22	26	38	7	2	31	42	8	2
Gov't. OH - ($000,000)	18.0	21.8	31.6	5.9	1.8	25.7	35.2	6.6	1.8
BUSINESS & GOVERNMENT INSTIT.									
Business Services - Employee (000)	16.9	20.2	29.2	5.5	1.6	23.8	32.5	6.0	1.7
Government - Employee (000)	5.3	6.1	9.0	1.7	.5	7.6	10.3	1.9	.5

[a] The percentage changes are indicated as follows:

Impact Case over Base Case 1/Impact Case over Base Case 2

Source: RPA estimates.

Expanded hospital services would be similarly required. Under an OCS high impact, major additions to existing hospitals or one new medium-sized hospital of 200 beds would be needed by 1985. By 2000, only an additional 24 beds would be needed to meet high OCS impacts. As with schools, the lead time on hospital planning and construction varies between three and five years. Under Base Case 2 and high OCS impact conditions, the two counties would need far more comprehensive and specialized medical services, in addition to larger hospital staffs.

The services previously discussed are those where the impact would probably be greatest. Building new facilities and recruiting new personnel in these sectors require a longer lead time and generally more financial investment than is required for expanding police, solid waste, and other services. Still, it must be realized that these latter services would require considerable expansion as the population increased.

To ensure that the community's needs are met is the function of the planners, mayors, county executives, and the various special agencies and commissions that develop long-term policies. Base Case 2 and OCS impacts for the years 1985 and 2000 would obviously increase the workload and hence the requirements for new talent in the local governments. These additional personnel would have to implement their programs before a majority of the new population arrived. Thus, as in Bristol County, funds would be needed to support important planning activities before tax revenues were received.

Without sensitive future planning, the two resort-agricultural counties stand in danger of losing their character and charm. The possibility of adverse aesthetic impacts on the area would be far greater if the funds were not allocated in advance to enable planners to implement their tasks.

Cape May and Cumberland's transportation network would need expansion to meet the OCS needs. Even today, the roads are inadequate for heavy traffic during the spring and summer weekends. A rail network serves the area and can be expanded. The Philadelphia airport lies within a reasonable distance from the locality. However, one or more general municipal airports would probably be necessary to facilitate air travel. The greatest need in the transportation network would lie in the improvement of highway capacity.

Land Use

Spatial analysis indicate that the undeveloped land available in Cumberland and Cape May Counties is not well-suited for primary industry location, even though on a statistical basis, an adequate number of acres in both the Cumberland/Cape May locality appear to be available. Suitable acres exist in the rest of the region, but competing demands for them will necessitate careful regional land use planning in advance of base case and OCS development.

In Cumberland and Cape May Counties, Base Case 1 development is expected to reduce the proportion of undeveloped land from 78.6 percent in 1970 to less than 71 percent by the year 2000 (Exhibit 4-16). However, under Base Case 2, where significant refinery and petrochemical development is assumed to take place to process imported crude, the percentage of undeveloped land would drop to 59 percent by the year 2000 (i.e., approximately one-fourth of the currently undeveloped land would be used).

High OCS development (above Base Case 2) would further reduce the percentage of undeveloped land to 52 percent by the year 2000. Overall, about one-third of the currently undeveloped land, or 130,000 acres, would be used. Significantly, land needs for commercial and industrial purposes would nearly triple between 1970 and 2000 under high OCS, Base Case 2 conditions, compared to a 25 percent increase for Base Case 1 development.

At the regional level the size of the area -- over 4 million acres -- tends to soften the overall land use impacts (Exhibit 4-17). The amount of undeveloped land should drop from 73.3 percent in 1970 to 64 percent under high OCS, Base Case 2 conditions by the year 2000 (i.e., a 13 percent reduction for the region compared to a one-third reduction for the locality). The impact from offshore oil and gas production would account for only a small portion of the overall use.

The 393,000 acres required regionally by high OCS, Base Case 2 conditions comprise 13 percent of 1970 undeveloped land (Exhibit 4-18). However, when the 3 million undeveloped acres are reduced by 32 percent for environmental constraints and 8 percent for locational constraints, the 393,000 acres required for development represent 21 percent of the 1.8 million acres of remaining developable land. This requirement would increase further if suburban

EXHIBIT 4-16

LAND USE SUMMARY

LOCALITY : CUMBERLAND/CAPE MAY COUNTIES

Summary in Thousands of acres		1970	Year 1985				Year 2000			
		Actual Development	Base Case 1 Development	Base Case 2 Development	OCS Low* Development	OCS High* Development	Base Case 1 Development	Base Case 2 Development	OCS Low* Development	OCS High* Development
Land Use Classification	DEVELOPED LAND	105.4	125.8	181.6	10.8 (1) 10.6 (2)	32.4 (1) 32.7 (2)	144.6	200.2	10.8 (1) 11.1 (2)	35.5 (1) 36.0 (2)
	. residential	24.1	28.1	35.5	1.6 (1) 1.4 (2)	4.5 (1) 4.8 (2)	31.2	38.3	1.2 (1) 1.4 (2)	4.8 (1) 5.4 (2)
	. commercial industrial	13.0	15.0	26.1	2.4 (1) 2.4 (2)	5.2 (1) 5.2 (2)	16.0	28.3	2.8 (1) 2.9 (2)	5.8 (1) 5.7 (2)
	. other	68.3	82.7	120.0	6.8	22.7	97.4	133.6	6.8	24.9
	UNDEVELOPED LAND	386.8	366.4	310.6	355.6 (1) 300.0 (2)	334.0 (1) 277.9 (2)	347.6	292.0	336.8 (1) 280.9 (2)	312.1 (1) 256.0 (2)
	TOTAL ACREAGE	492.2								

* incremental acreage only. If two figures, number in parentheses refers to base case.

Summary in Percent		1970	Year 1985**				Year 2000**			
		Actual Development	Base Case 1 Development	Base Case 2 Development	OCS Low Above B.C.2	OCS High Above B.C.2	Base Case 1 Development	Base Case 2 Development	OCS Low Above B.C.2	OCS High Above B.C.2
Land Use Classification	DEVELOPED LAND	21.4	25.6	37.0	39.0	43.5	23.4	40.7	42.9	48.0
	. residential	4.9	5.7	7.2	7.5	8.2	6.3	7.8	8.1	8.9
	. commercial industrial	2.6	3.0	5.3	5.8	6.4	3.3	5.7	6.3	6.9
	. other	13.9	16.8	24.4	25.8	29.0	19.8	27.1	28.5	32.2
	UNDEVELOPED LAND	78.6	74.4	63.1	61.0	56.5	70.6	59.3	57.1	52.0

** Impacts of OCS developments indicated only above Base Case 2.

Source: RPA estimates.

EXHIBIT 4-17

LAND USE SUMMARY

REGION : DELAWARE RIVER REGION

Summary in Thousands of acres		1970	Year 1985				Year 2000			
		Actual Development	Base Case 1 Development	Base Case 2 Development	OCS Low* Development	OCS High* Development	Base Case 1 Development	Base Case 2 Development	OCS Low* Development	OCS High* Development
Land Use Classification	DEVELOPED LAND	1,105.3	1,227.5	1,305.1	16.1 (1) 16.0 (2)	49.3 (1) 49.8 (2)	1,339.8	1,437.8	17.5 (1) 18.2 (2)	57.0 (1) 60.5 (2)
	. residential	495.2	540.4	554.6	3.6 (1) 3.6 (2)	10.4 (1) 11.0 (2)	578.3	599.5	2.9 (1) 3.9 (1)	10.3 (1) 13.6 (2)
	. commercial industrial	151.4	171.2	188.5	3.0 (1) 2.9 (2)	9.0 (1) 8.9 (2)	181.8	199.3	5.1 (1) 4.8 (2)	13.0 (1) 13.2 (2)
	. other	458.7	515.9	562.0	9.5	29.9	579.7	639.0	9.5	33.7
	UNDEVELOPED LAND	3,040.0	2,917.8	2,840.2	2,901.7 (1) 2,824.2 (2)	2,868.5 (1) 2,790.4 (2)	2,805.5	2.707.5	2,788.0 (1) 2,689.3 (2)	2,748.5 (1) 2,647.0 (2)
	TOTAL ACREAGE	4,145.3								

* incremental acreage only. If two figures, number in parentheses refers to base case.

Summary in Percent		1970	Year 1985**				Year 2000**			
		Actual Development	Base Case 1 Development	Base Case 2 Development	OCS Low Above B.C.2	OCS High Above B.C.2	Base Case 1 Development	Base Case 2 Development	OCS Low Above B.C.2	OCS High Above B.C.2
Land Use Classification	DEVELOPED LAND	26.7	29.6	31.5	31.9	32.7	32.3	34.7	35.1	36.1
	. residential	11.9	13.0	13.3	13.5	13.6	13.9	14.5	14.6	14.8
	. commercial industrial	3.7	4.1	4.5	4.6	4.8	4.4	4.8	4.9	5.1
	. other	11.1	12.4	13.6	13.8	14.3	14.0	15.4	15.6	16.2
	UNDEVELOPED LAND	73.3	70.5	68.5	68.1	67.3	67.7	65.3	64.9	63.9

** Impacts of OCS developments indicated only above Base Case 2.
Source: RPA estimates.

EXHIBIT 4-18

UNDEVELOPED LAND CAPABILITIES

Region: DELAWARE RIVER REGION

	Thousands of Acres		Percent
. TOTAL UNDEVELOPED LAND[a]		3,040.0	100
. UNAVAILABLE LAND DUE TO ENVIRONMENTAL CONSTRAINTS		972.4	32.0
. existing and projected uses	317.0		
. coastal zoning and improvements	N.A.		
. excessive slope (> 15%)	0		
. wetlands	655.4		
. water resources	~~YES~~ - NO[h]		
. UNSUITABLE LAND DUE TO LOCATIONAL CONSTRAINTS[b]		240.6	7.9
. excessive slope (> 5%)	240.6		
. distance (> 30 minutes)	0		
. water requirements	YES - NO[i j]		
. TOTAL REMAINING DEVELOPABLE LAND[c]		1,827.0	60.1
. TOTAL LAND USE REQUIREMENTS[d]		393.1	
. total direct land use[e]	22.3		
. total induced land use[f]	370.8		
residential	117.9		
commercial/industrial[g]	38.9		
other developed land	214.0		

[a]Refer to land use summary exhibits for each region. Total undeveloped land figure corresponds to 1970 data.
[b]Where overlap with land unavailable due to environmental constraints, only incremental value is considered.
[c]Land suited for primary industrial activities, e.g., refineries, petrochemical complexes, etc., but competing with other uses, e.g., residential, commercial, light industrial, agricultural, etc. ("general development").
[d]Total Land Use Requirements corresponds to worst possible case by year 2000 (in general, base case 2 combined with high level OCS development).
[e]Refer to Exhibit VIII-5, Total Direct Land Use. Corresponds to maximum primary development.
[f]Refer to land use summary exhibits for each region. Corresponds to worst possible case by year 2000.
[g]Excluding primary industrial land.
[h]"No" indicates that water resource impoundment areas have not been included in the above acreages.
[i]"No" indicates that water supply from conventional sources is likely to be inadequate.
[j]Insufficient data.

Source: RPA estimates.

development and as yet unknown environmental impoundment areas were considered. Thus, careful regional land use planning will be necessary to accomodate base case and OCS development.

As indicated in Plates 4, 5 and 6 most of Cape May and coastal Cumberland County is unavailable or unsuited to primary industrial development. There are over 100,000 acres of coastal salt marshes and meadows of which 35,000 acres lie within state wildlife management areas. It is expected that general environmental awareness will create pressures to preserve Cape May's open spaces for summer residences and wildlife management areas.

The spatial analysis suggests that better locations for primary industry do exist outside of Cape May and Cumberland Counties. The most likely zones appear to be located east of the Delaware River, in northern Cumberland County and in Salem County, and west of the Delaware River, in southern Newcastle County.

Air Pollution

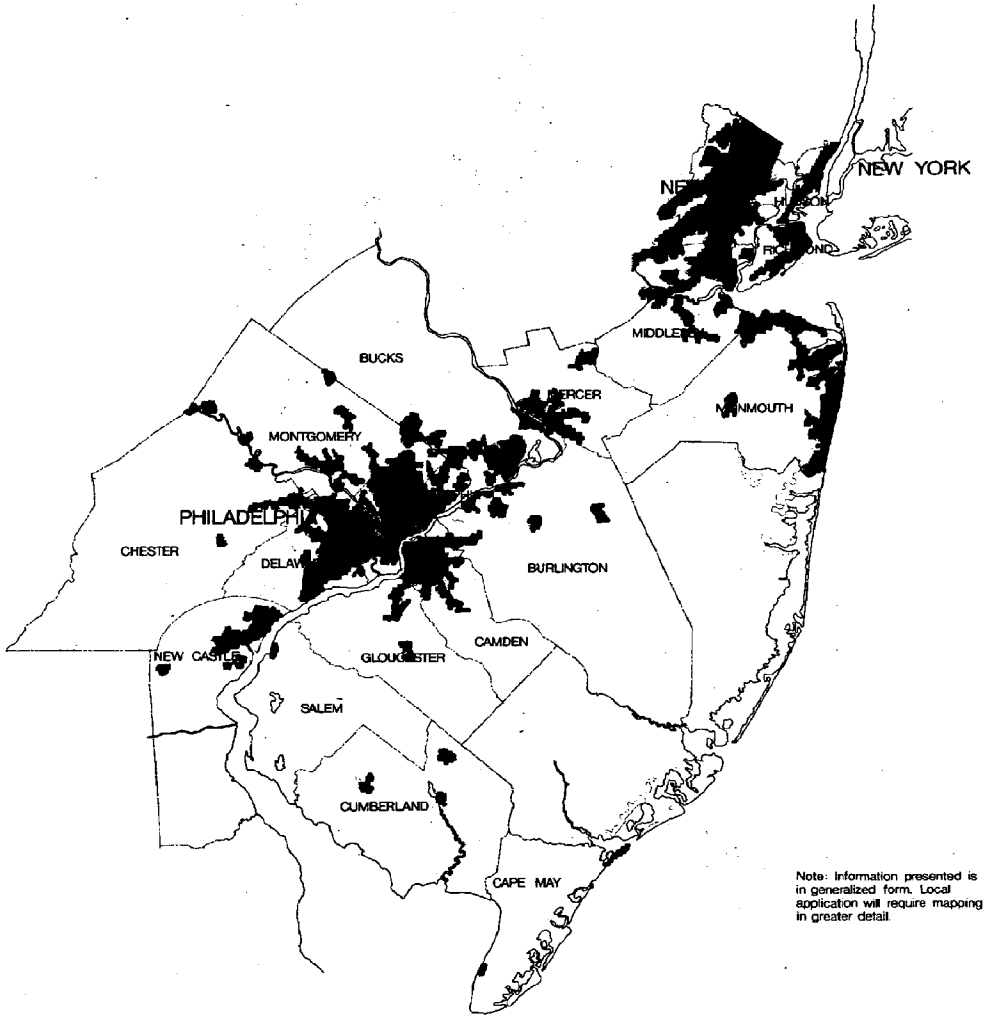
The primary air quality standards and the ambient air concentrations for particulates, sulphur oxides and carbon monoxide are shown in Exhibit 4-19 for each of the counties in the study region. Cumberland and Cape May Counties presently have air quality priority classifications of II for particulates, nitrogen oxides, and hydrocarbons. There was no data available for ambient concentrations of sulphur oxides and carbon monoxide in the Cumberland/Cape May locality, but the particulate level, 30 micrograms per cubic meter, is less than half the federal primary standard of 75 micrograms per cubic meter. The two-county area is assigned an air priority classification of I for sulphur oxides and carbon monoxide due mainly to the emissions from electric utilities and solid waste disposal facilities.

The air emissions in Cumberland/Cape May Counties in 1985 and 2000 are expected to increase moderately or decrease for all pollutants under Base Case 1 (Exhibit 4-20). Significant hydrocarbon loading increases attributable mainly to refineries and petrochemical plants are expected for both Base Case 2 and OCS impacts. Since most of the hydrocarbon loadings are from new refineries and petrochemical plants, the effects of these

POTENTIAL EFFECTS OF O.C.S. OIL AND GAS DEVELOPMENT

DELAWARE RIVER REGION

PLATE 4



Note: Information presented is in generalized form. Local application will require mapping in greater detail.

UNDEVELOPED LAND

PRESENT CONDITIONS

■ – DEVELOPED LAND
EXISTING LAND USES

□ – UNDEVELOPED LAND

RESOURCE PLANNING ASSOCIATES INC.

BASE MAP U.S.G.S. 1:250,000 DECEMBER 1973

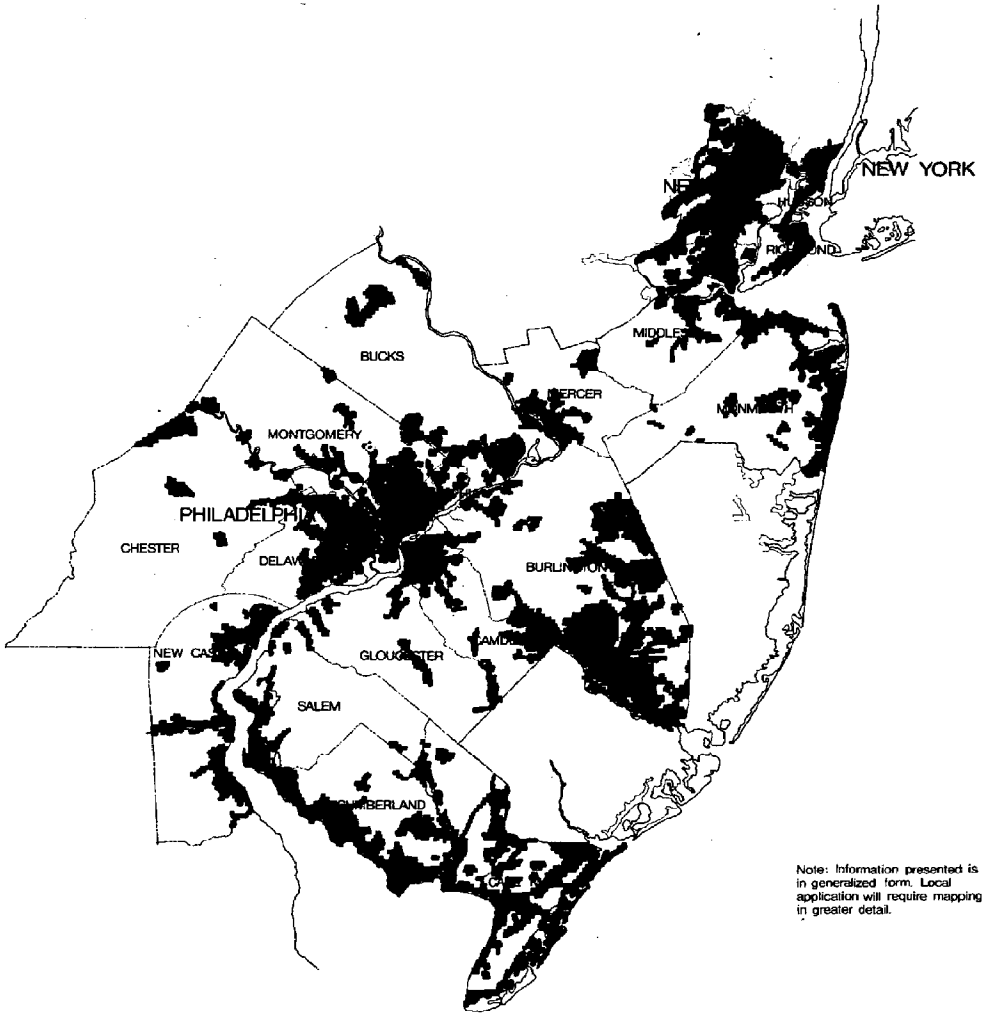
miles

N

POTENTIAL EFFECTS OF O.C.S. OIL AND GAS DEVELOPMENT

DELAWARE RIVER REGION

PLATE 5



Note: Information presented is in generalized form. Local application will require mapping in greater detail.

LAND USE IMPACT

LAND REQUIREMENTS TO SCALE
BASE CASE 2 HIGH IMPACT YEAR 2000

BASE CASE II (NO O.C.S.)		OCS HIGH IMPACT		
PRIMARY	OTHER	PRIMARY	INDUCED	TOTAL
1300		1565		381,020 ACRES
319,200		1565		
		1565		
		1565		
		1525		
		OTHER 1135		
		8920	51,600	

SUITABLE LAND

FOR GENERAL DEVELOPMENT

- UNSUITABLE LAND
  EXISTING AND PROJECTED LAND USES
  ENVIRONMENTAL CONSTRAINTS
- SUITABLE LAND
  SUBJECT TO AVAILABILITY AND LOCAL ZONING

RESOURCE PLANNING ASSOCIATES INC.

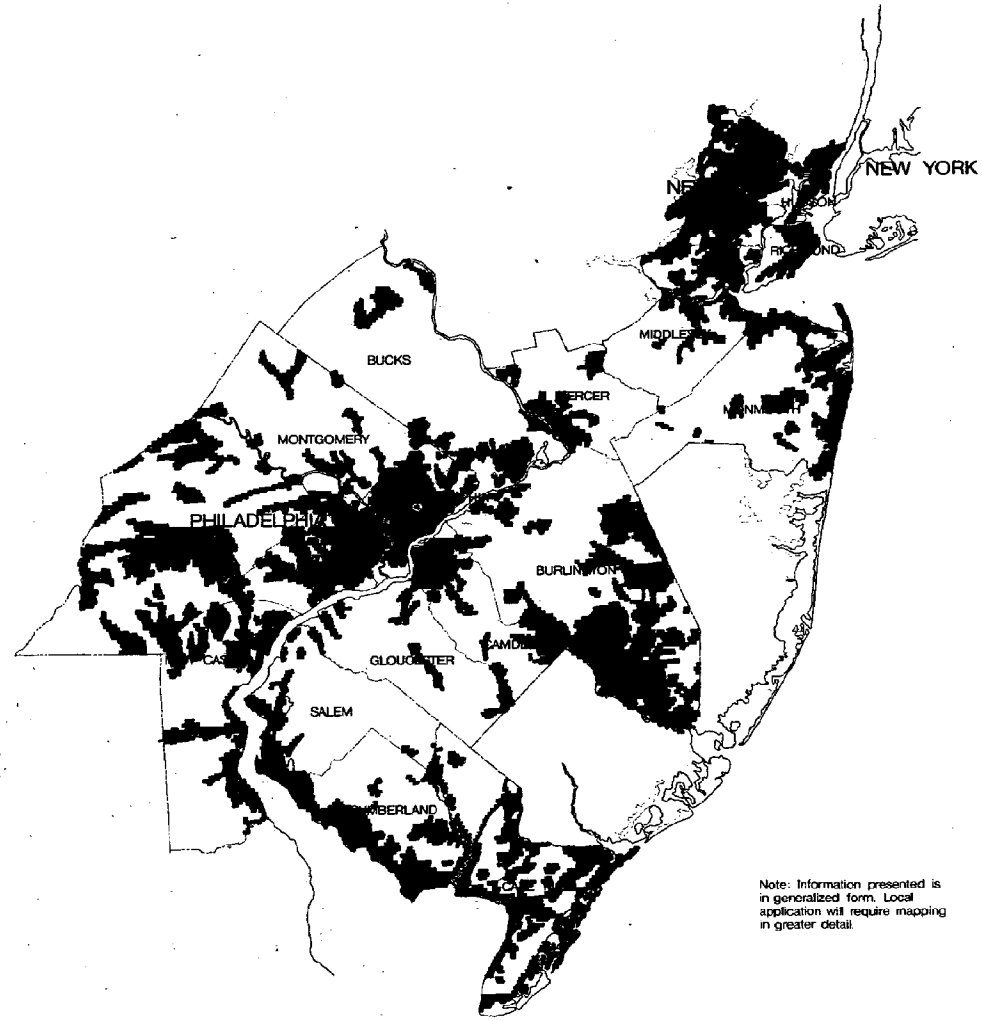
BASE MAP U.S.G.S. 1:250,000 DECEMBER 1973

miles

POTENTIAL EFFECTS OF O.C.S. OIL AND GAS DEVELOPMENT

DELAWARE RIVER REGION

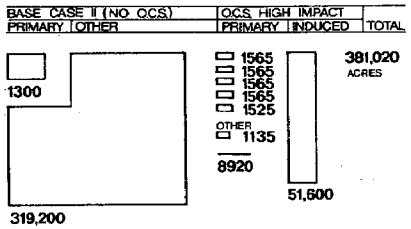
PLATE 6



Note: Information presented is in generalized form. Local application will require mapping in greater detail.

LAND USE IMPACT

LAND REQUIREMENTS TO SCALE
BASE CASE 2 HIGH IMPACT YEAR 2000



SUITABLE LAND

FOR PRIMARY DEVELOPMENT

- UNSUITABLE LAND
  EXISTING AND PROJECTED LAND USES
  ENVIRONMENTAL CONSTRAINTS
  LOCATIONAL CONSTRAINTS
- SUITABLE LAND
  SUBJECT TO AVAILABILITY AND LOCAL ZONING

RESOURCE PLANNING ASSOCIATES INC.

BASE MAP U.S.G.S. 1:250,000 DECEMBER 1973

miles

EXHIBIT 4-19

AMBIENT AIR CONCENTRATION LEVELS

DELAWARE RIVER REGION

	Particulates ($\mu g/m^3$)	SO_x (ppm)	CO (ppm)
PRIMARY STANDARDS	75	.03	9
NEW JERSEY			
Cape May	30		
Cumberland	29		
Hudson	66	.02	7.2
Camden	-	.032*	16.9*
Union	80.1*	.026	13.7*
Essex	134*	.022	17.6*
Monmouth	683*	.005	9.9*
Burlington	-	.012	21.6*
Gloucester	-	.019	12.0*
Middlesex	56	.017	21.7*
Mercer	68	.012	34.5*
PENNSYLVANIA			
Philadelphia	112	.08*	8.5
DELAWARE			
Wilmington	119*	.016	-

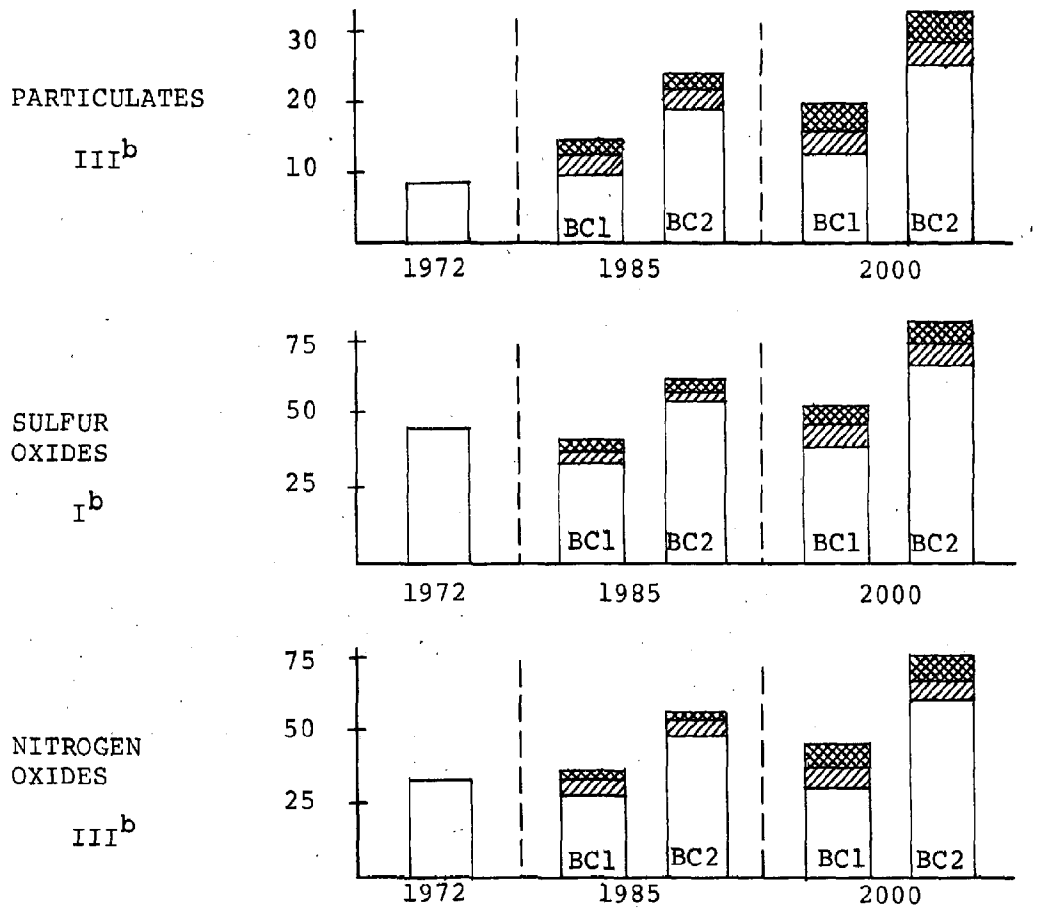
*Indicates concentration over standard.
Source: Environmental Protection Agency

EXHIBIT 4-20

SUMMARY OF IMPACTS - AIR POLLUTION LOADINGS[a]

(Thousand tons per year)

CUMBERLAND/CAPE MAY COUNTIES
(Geographic Area)



[a] Refer to Appendix IX for a detailed discussion of the methodology for determination of each loading source and estimation of the control factors for each pollutant by geographic area.

[b] EPA Air Quality Priority Classification

BC 1: Base Case 1
BC 2: Base Case 2

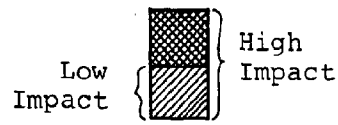


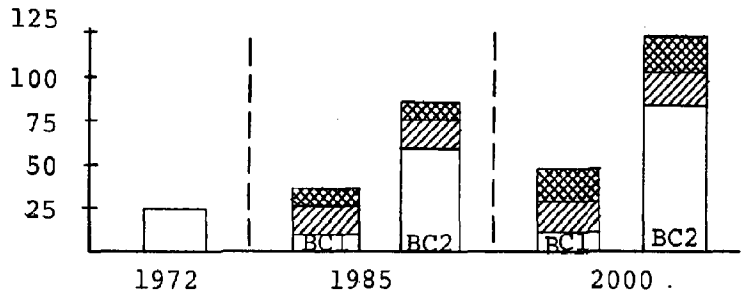
EXHIBIT 4-20

SUMMARY OF IMPACTS - AIR POLLUTION LOADINGS (CONTINUED)[a]

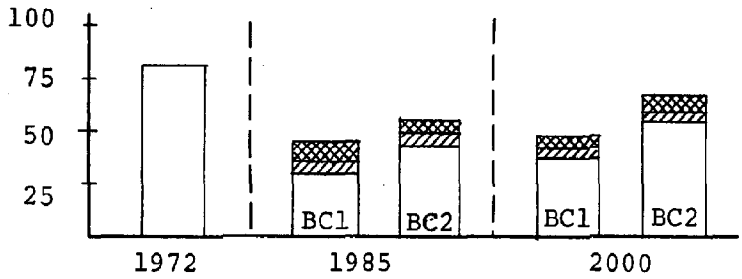
(Thousand tons per year)

CUMBERLAND/CAPE MAY COUNTIES
(Geographic Area)

HYDROCARBONS
III[b]



CARBON MONOXIDE
I[b]



[a] Refer to Appendix IX for a detailed discussion of the methodology for determination of each loading source and estimation of the control factors for each pollutant by geographic area.

[b] EPA Air Quality Priority Classification

BC 1: Base Case 1
BC 2: Base Case 2

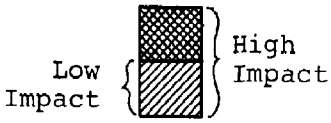


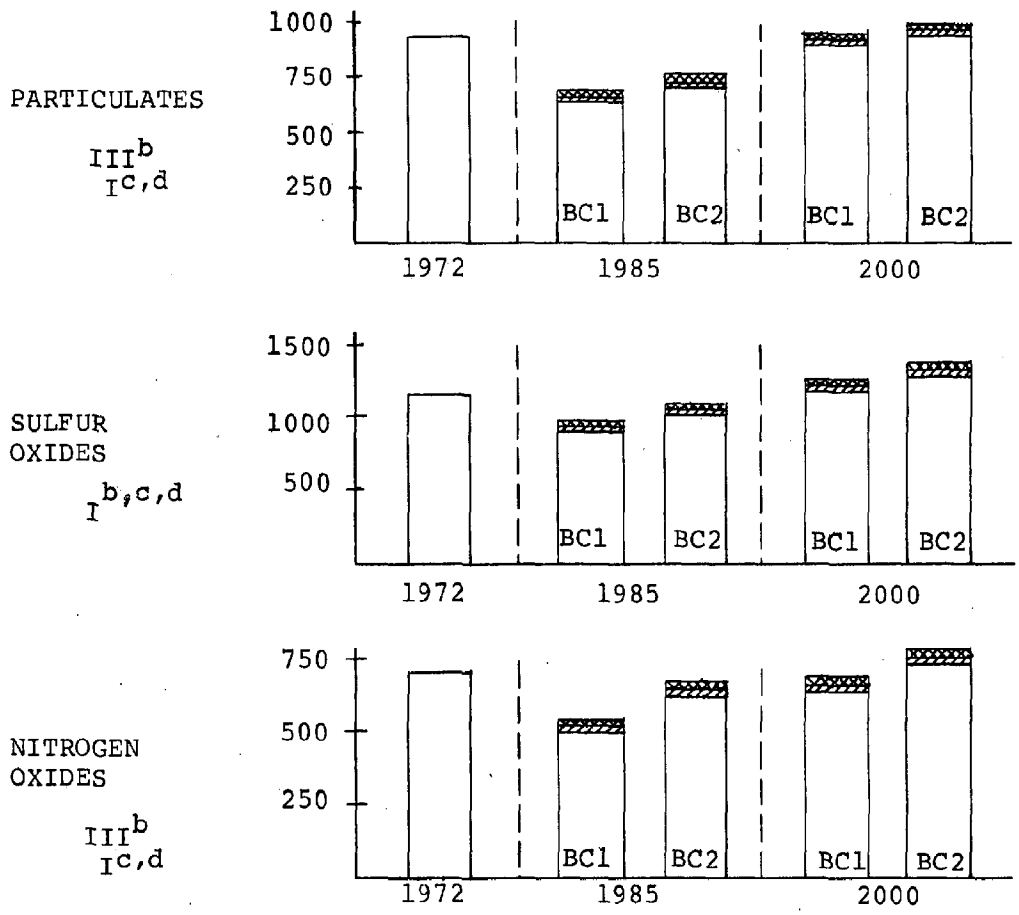
EXHIBIT 4-21

SUMMARY OF IMPACTS - AIR POLLUTION LOADINGS[a]

(Thousand tons per year)

DELAWARE RIVER REGION

(Geographic Area)



[a] Refer to Appendix IX for a detailed discussion of the methodology for determination of each loading source and estimation of the control factors for each pollutant by geographic area.

EPA Air Quality Priority Classification for: [b]New Jersey, Intrastate AQCR
[c]New Jersey, New York, Conn. Interstate AQCR
[d]Metropolitan Philadelphia AQCR

BC 1: Base Case 1
BC 2: Base Case 2

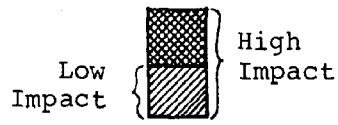


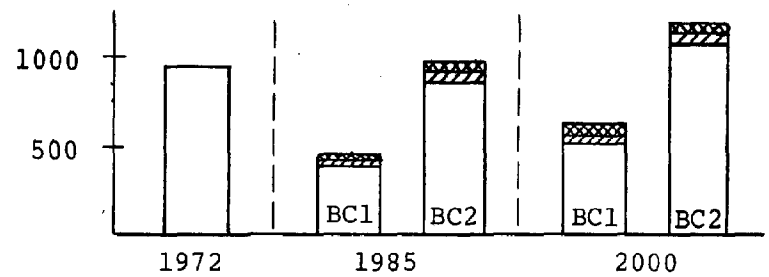
EXHIBIT 4-21

SUMMARY OF IMPACTS - AIR POLLUTION LOADINGS (CONTINUED)[a]

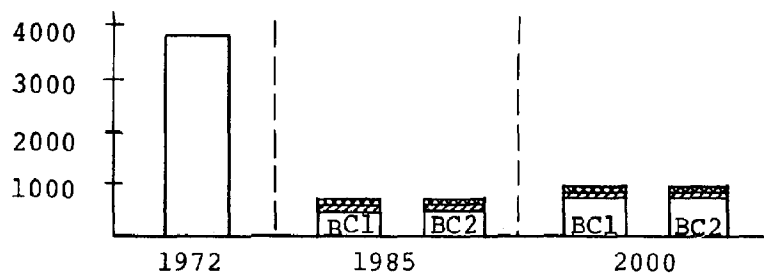
(Thousand tons per year)

DELAWARE RIVER REGION
(Geographic Area)

HYDROCARBONS
III[b]
I[c,d]



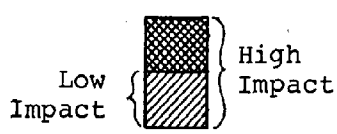
CARBON
MONOXIDE
I[b,c,d]



[a]Refer to Appendix IX for a detailed discussion of the methodology for determination of each loading source and estimation of the control factors for each pollutant by geographic area.

EPA Air Quality Priority Classification for: [b]New Jersey Intrastate AQCR
[c]New Jersey, New York, Conn. Interstate AQCR
[d]Metropolitan Philadelphia AQCR

BC 1: Base Case 1
BC 2: Base Case 2



emissions on ambient concentrations should be relatively localized to the immediate vicinity of the new facilities. Should a locality like Cumberland/Cape May actually be chosen for intensive primary development, dispersion modeling would be quite useful in determining the extent of the air quality impacts.

Even though percentage increases of OCS-induced particulates and nitrogen oxide emissions over the base cases and current loading levels are large, the absolute magnitudes are small and should not present significant concentration problems. Sulphur oxides and carbon monoxide emissions may cause localized concentration problems, and specific site locations would have to be examined in-depth to determine the extent of these problems.

Air pollution in the Delaware River region is somewhat worse than in the two-county local area, with all pollutants assigned an air quality priority classification of I for the larger metropolitan AQCRs (Exhibit 4-21). The majority of particulate and sulphur oxide emissions in the region are from fossil fuel combustion while the major sources of nitrogen oxides are attributed mainly to mobile sources and electric utility fuel combustion. Over 55 percent of hydrocarbon emissions in the region are from mobile sources while 70 percent of carbon monoxide loadings originate from mobile sources.

Future air pollution loadings in both base cases and in the impact cases are level or show small increases in the Delaware River region, due chiefly to the large base of heavy industry and large population currently existing in the region. The only pollutant emission which shows any significant change is carbon monoxide, which should decrease by as much as 80 percent due to the emission controls expected to be placed on mobile sources by 1985.

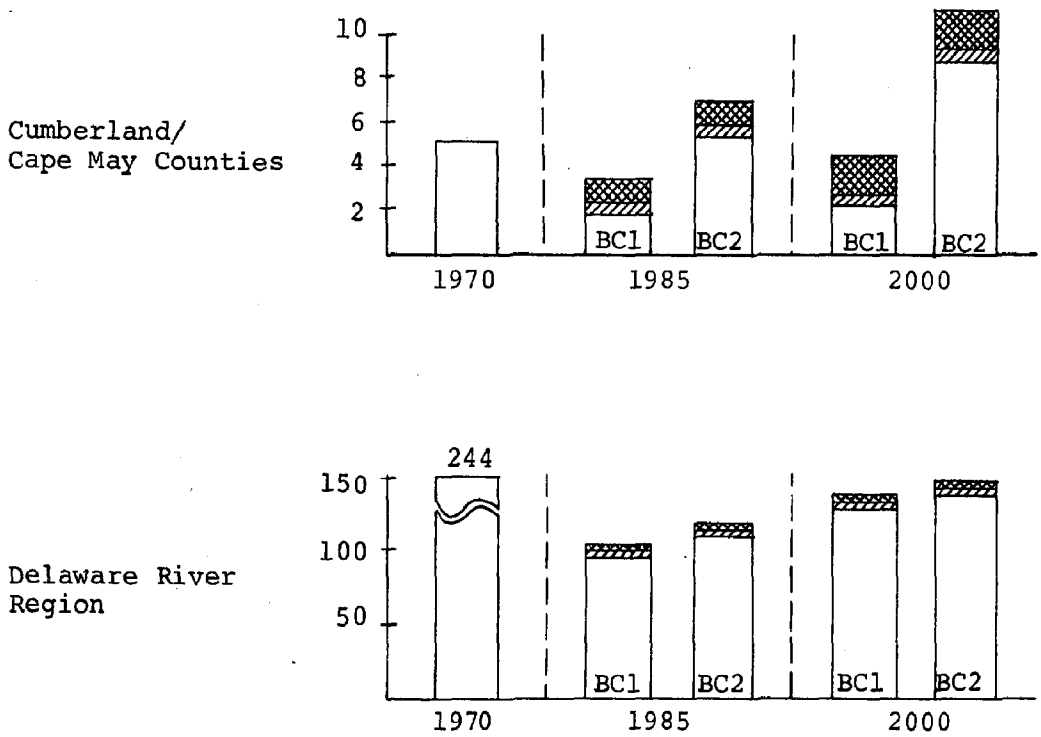
Water Pollution

In 1970 approximately 60 percent of the total BOD loadings in the Cumberland/Cape May County locality were due to industrial sources (Exhibit 4-22). Total loadings under Base Case 2 assumptions for 1985 and 2000 are projected to exceed 1970 loadings. BOD loadings under the high impact case should increase the base case totals by as much as 50 percent under Base Case 1 high conditions in the year 2000. The bulk of the BOD loadings impact under both

EXHIBIT 4-22

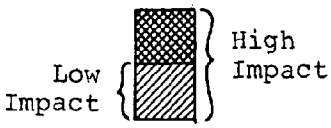
SUMMARY OF IMPACTS - BOD LOADING[a]
(Thousand tons per year)

MID-ATLANTIC
(Geographic Area)



[a]Refer to Appendix IX for a detailed discussion of the methodology for determination of each loading source and estimation of the treatment factors for each region.

BC 1: Base Case 1
BC 2: Base Case 2



Base Case 2 and high OCS conditions will be from the refinery and petrochemical industries.

For the region overall, because of the significant base of industrial development, the impact from OCS development should be small. In fact, the total BOD loadings will decrease substantially under all cases due to new treatment technologies that should be adopted by industries presently located in the region and any new industrial development projected to occur.

Because the Delaware River is so significantly tied to industrial development, it received special analysis. The Camp, Dresser, and McKee river analysis model, developed for the EPA, was used with the assumption that most of the new refineries and petrochemical plants projected for the Delaware River region would locate on the river. Given this assumption, the impact of these plants on the river's dissolved oxygen (DO) level should be small, almost below significant statistical increments from the current DO levels.

A dissolved oxygen profile of the Delaware River as a function of river mile from the river's mouth, under the lowest average monthly flow conditions, is presented in Exhibit 4-23. Below the profile is a histogram plot of present discharges and assumed locations of new refineries and petrochemical plants. The new development should have little effect on the DO level above river mile 80 and near the mouth of the river. Only when DO levels are approaching zero or the ultimate saturated oxygen level are the impacts noticeable.

Since the analysis was conducted for worst case river conditions, it is expected that DO levels would generally be better than those depicted in the profile and that the present discharges would be decreased according to future guidelines.

This analysis shows only the relative impacts of new refining and petrochemical development on river quality. In order to predict absolute DO levels more recent data on all discharges into the river are needed, along with the regulations defining legal effluent levels for the industrial discharges. Exhibit 4-24 lists the critical assumptions and references used in developing the data for the model.

EXHIBIT 4-23

IMPACT OF FUTURE REFINERY AND PETROCHEMICAL DEVELOPMENT ON THE DELAWARE RIVER

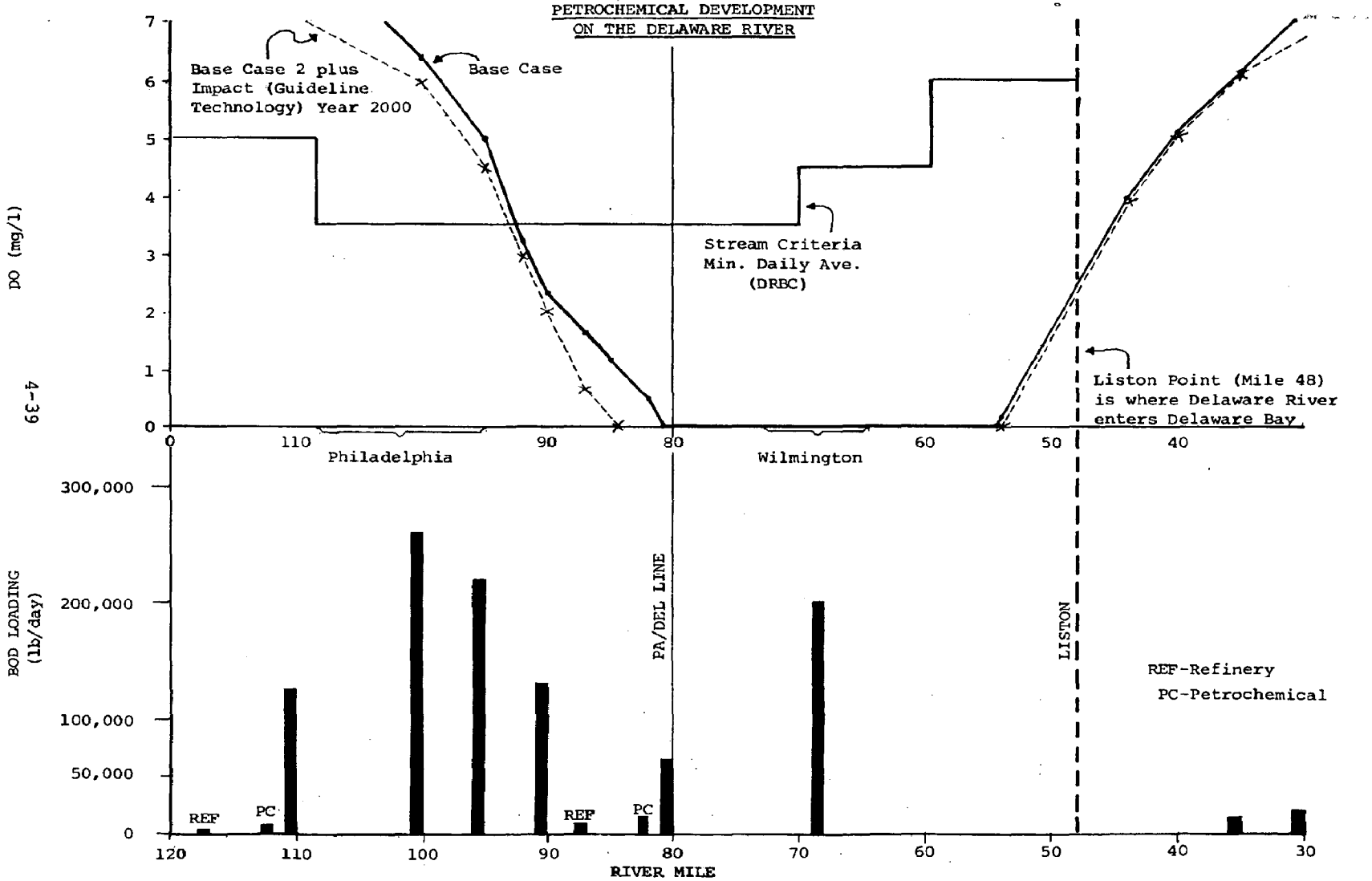


EXHIBIT 4-23 (cont.)

ASSUMPTIONS - DELAWARE RIVER DISSOLVED OXYGEN IMPACT ANALYSIS

1. USGS records of lowest average monthly flow used.

2. Two tributaries included, the Schylkill and Lehigh rivers.

3. Current waste loads used were drawn from "Delaware Estuary Comprehensive Study, Preliminary Report and Findings," July 1966.

4. Velocities used were drawn from "Delaware River Estuary Comprehensive Study, Final Report," July 1971, EPA.

SOURCES OF DATA

Socio-Economic

State of New Jersey

Department of Labor and Industry
  Division of Planning and Research
  Division of Employment Security
Department of Education
Department of Law and Public Safety
Department of Community Affairs
Department of Health
Department of Public Utilities
Department of Transportation

Southern New Jersey Development Council
Cumberland County Planning Board
Cape May County Planning Board
Atlantic City Electric Company

State of Delaware

State Planning Office
Department of Labor
  State Administrative Office

State of Pennsylvania

State Planning Board
Department of Labor and Industry
  Bureau of Employment Security

State of New York

Department of Labor
  Division of Employment

Land Use

Arthur D. Little. Potential Onshore Effects of Deepwater Terminal - Related Industrial Development. 1973

Cape May Planning Board. Comprehensive Plan for Cape May County. October, 1962.

SOURCES OF DATA (continued)

Land Use (cont.)

Cumberland County Planning Board. Land Use, 1964. October, 1965.

Delaware Valley Regional Planning Commission. 1985 Regional Land Use Plan. 1968.

Delaware Valley Regional Planning Commission. 1985 Regional Projections for the Delaware Valley. 1967.

Essex County Department of Planning, Economic Development Conservation. Existing Land Use Patterns. 1970.

Hudson County Planning Board, New Jersey.

Middlesex County Planning Board. Middlesex City Interior Master Plan #20. 1970.

Monmouth County Planning Board, N. J.

New Castle County, Delaware, Department of Planning.

New York City Planning Commission. Plan for New York City: A Proposal. (Vol. 6, Staten Island). 1969.

Salem County Planning Board. A Plan for Comprehensive Development. November, 1970.

Union County Planning Board, New Jersey.

Air & Water Pollution

Delaware River Basin Commission. Delaware Estuary and Bay Water Quality Sampling and Mathematical Modeling Project. Springfield, Virginia: NTIS, 1970.

Delaware River Basin Commission. Water Quality of the Delaware River Esterary, June to December 1967. Delaware: Delaware River Basin Commission, 1970.

Federal Water Pollution Control Administration. Delaware Estuary Comprehensive Study. Washington, D.C.: Federal Water Pollution Control Administration, July 1966 and July 1971.

SOURCES OF DATA (continued)

Air & Water Pollution (continued)

IBM Corporation. Emission Inventory for the State of New Jersey. Springfield, Virginia: NTIS (#PB-203-083) August, 1971.

Wildlife and Vegetation

State of New Jersey

Department of Environmental Protection
Bureau of Parks
Division of Parks and Forestry
Department of Conservation and Economic Development

New Jersey Audubon Society
World Wildlife Inc.
Town of Stone Harbor, Office of Clerk

State of Delaware
Department of Natural Resources and Environmental Control
Division of Fish and Wildlife

Delaware Wild Lands, Inc.

State of Pennsylvania
Department of Environmental Resources
Game Commission

U.S. Department of Interior, Bureau of Land Management. Library Research Project: Mid-Atlantic OCS Unpublished Paper. 1973.

U.S. Department of Interior, Fish and Wildlife Service, Office of R.B. Studies. Wetlands of New Jersey. March, 1954.

U.S. Department of Interior, Fish and Wildlife Service, Office of R.B. Studies. Coastal Wetlands Inventory of New Jersey. June, 1965.

U.S. Department of Interior, Fish and Wilflife Service, Office of R.B. Studies. Wetlands of Delaware. November, 1953.

U.S. Department of Interior, Fish and Wildlife Service, Office of R.B. Studies. Coastal Wetlands Inventory of Delaware. Supplementary Report. June, 1965.

U.S. Department of Interior, Fish and Wildlife Service, Office of R.B. Studies. Wetlands of Pennsylvania. June, 1954.

5. SOUTH ATLANTIC

The South Atlantic demand area comprises the Atlantic coastal states from Maryland to Florida and also includes West Virginia. The area accounts for about 15 percent of the nation's petroleum consumption, or about 2.4 million barrels per day. The area has historically secured its petroleum and gas products from Louisiana and Texas, and to a lesser extent, from imports. It has less than 100,000 barrels per day of its own capacity, located in Virginia. Although several major refineries have been proposed from time to time, chiefly in South Carolina, Georgia and Florida, none has begun construction.

In the South Atlantic, unlike the other two East Coast demand areas, two alternative impact regions have been chosen because the hypothetical resource locations projected by the USGS stretch from South Carolina to Florida. As a result, separate sections have been developed for the Eastern South Carolina/Eastern Georgia region, and its Charleston, S.C., locality, and the Northeastern Florida/Southeastern Georgia region, and its Jacksonville, Florida locality. It is assumed, however, that if OCS production is sited in one of the regions it will not take place in the other region. That is, the resource estimates developed in Chapter 2 for each demand area are projected alternatively for the two regions in the remainder of this chapter.

As with other East Coast demand areas, the regional sections have been organized as follows:

- profile of current conditions
- listing of development assumptions
- description of probable impacts.

A. Eastern South Carolina/Eastern Georgia

PROFILE OF CURRENT CONDITIONS

The central city of Charleston, South Carolina, is a long and narrow peninsula jutting into the Atlantic Ocean. Centered around it lie the counties of Berkeley, Charleston, and Dorchester. The three county area (see Exhibit 5A-1) contains 2,614 square miles and includes 91 miles of Atlantic Coastline. Its

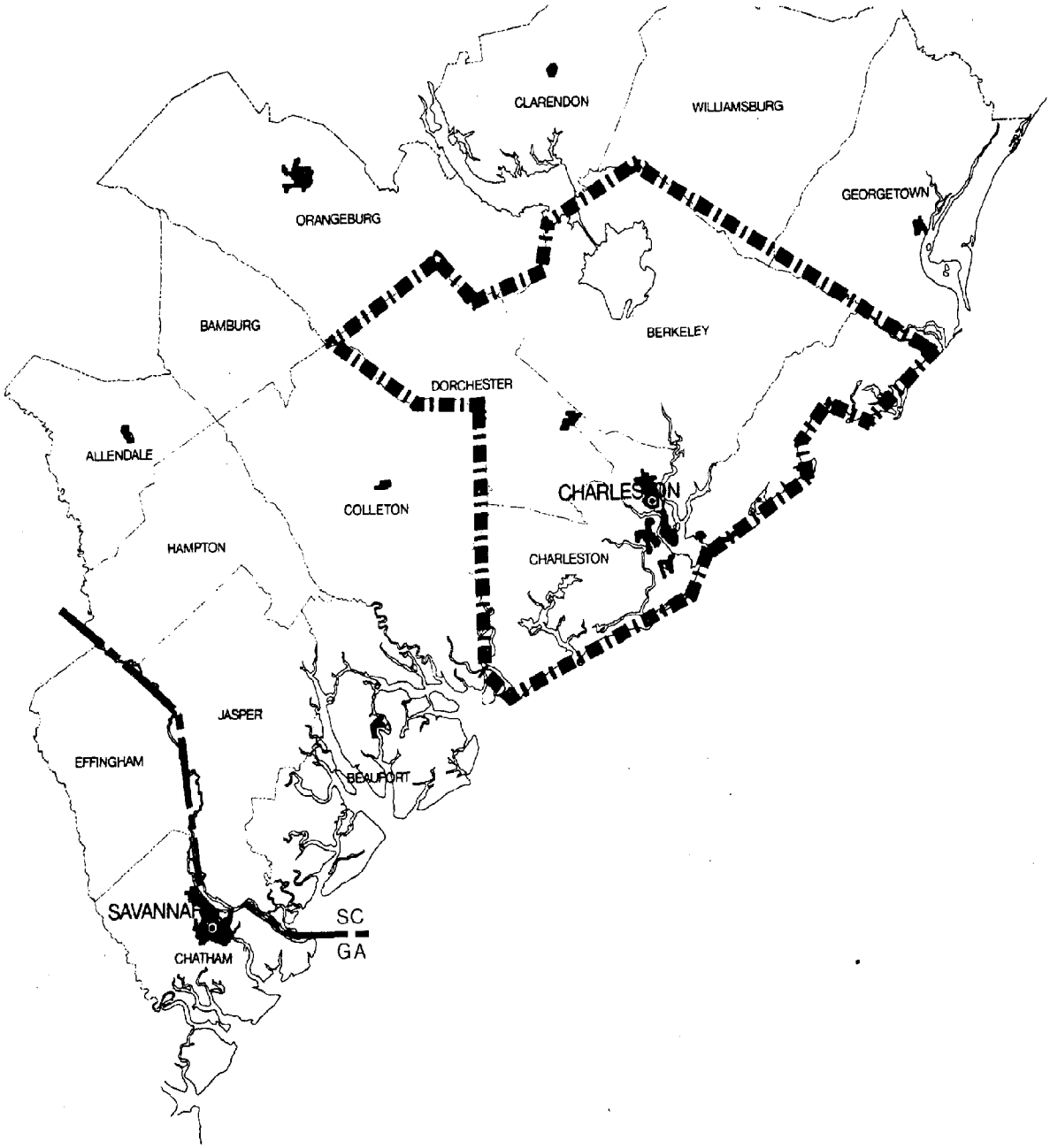


EXHIBIT 5A-1
EASTERN SOUTH CAROLINA/EASTERN GEORGIA REGION

N

RESOURCE PLANNING
ASSOCIATES INC.

topography is primarily flat, with maximum elevation reaching about 100 feet above sea level. Lake Moultrie and the lower part of Lake Marion flow into Berkeley County. The Cooper River, running south from Lake Moultrie to Charleston Bay, and the Ashley River converge at the city of Charleston.

The area supports general and vegetable farms and has large patches of wetlands, mainly wooded swamp. The climate is temperate with highs of 95° F in summer and lows of 25° F in winter. There is no marked dry season; 41 percent of the 49 inches of average annual precipitation occurs during the summer months.

Charleston County's 91 miles of Atlantic coastline provide the locality with potentially large areas of recreational beaches. In addition, many inland water ways are available for fresh-water recreation.

Urban land uses are concentrated on the highly developed Charleston peninsula. Additional development follows the Ashley and Cooper Rivers north to Goose Creek and Hanahan. A naval base occupies a large tract of land north of Charleston, and most heavy industry is located north of the base. Residential suburbs are found west and east of the central peninsula, on the shores of the two rivers.

The three-county Charleston Standard Metropolitan Statistical Area (SMSA) contains a population of 336,000 and is growing rapidly. However, the population level has been influenced by a marked out-migration of persons within the potentially productive age groups. As a result of this out-migration, population participation in the work force in 1970 fell below the national average to 35.4 percent. Some out-migration can be expected to continue although the city is attempting to expand employment opportunities. If out-migration continues at its present rate, by 1990, 45 percent of the population will be under 20 years of age and over 8 percent of the population will be 65 years of age or over.

In contrast to the heavily industrialized New England and Mid-Atlantic demand areas, manufacturing in Charleston accounted for only 16 percent of all employment in 1970, and the service sector for 71 percent. Unemployment, at 4.8 percent, was no higher than the national average, but the small labor force and the predominance of low-paid

workers in the service sector combined to lower the per capita income in 1970 to $2,976.

The economic base of the Charleston SMSA has changed a great deal in the course of the last one hundred years, from dependence on agriculture to reliance on government and defense, particularly the Navy. In 1972 these two sectors employed 26.4 percent of the civilian work force.

Attempts to broaden Charleston's economic base include the expansion and modernization of the port and harbor facilities. This should make the city a center in the state-wide transportation system. The Southern Seaboard Coast Line Railroad, 50 motor freight carriers, and six major airlines presently serve Charleston.

With the exception of the Savannah SMSA in Chatham County, the eastern South Carolina/Georgia region is even less economically developed than the Charleston SMSA. The average per capita income of the region's 833,000 people was $2,751 in 1970. Here, manufacturing accounts for 20 percent of all jobs, with the average wage in 1970 at $7,500.

Only 4 percent of both the local and regional land area was developed as of 1970. Of the developed land, about 30 percent was residential.

As in most industrial areas, the Charleston air quality varies by type of pollutant. It is rated Class I for particulates and sulphur oxides and Class III for carbon monoxide, nitrogen oxides, and hydrocarbons.

Within the Charleston locality there are two national wildlife refuges and a national forest (Exhibit 5A-2). The Francis Marion National Forest as well as the Santee and Cape Romain National Wildlife Refuges provide a nesting and wintering habitat for hundreds of thousands of migratory waterfowl. The forest covers some 250,000 acres in Berkeley County and provides habitat for other game species as well as waterfowl, most notably the eastern wild turkey and white tailed deer. The swampy areas of the forest also contain alligators, an endangered American species. In the locality are several old and famous botanical gardens where live oaks, cypress, camelias and azaleas thrive. Lakes Moultrie and Marion are well known for their populations of land-locked striped bass.

CHARLESTON, S.C. AREA

WILDLIFE AND VEGETATION
PROTECTED AREAS

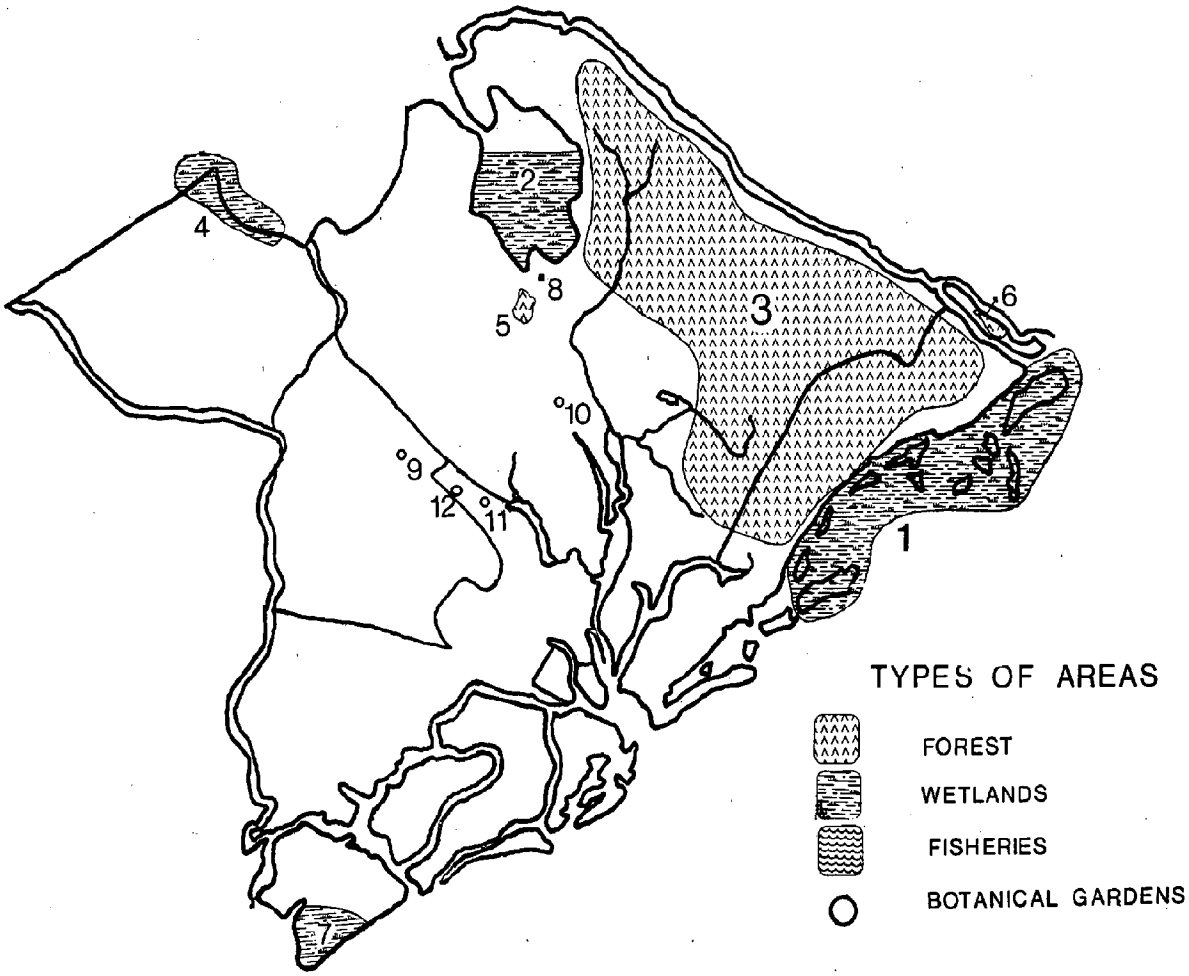


EXHIBIT 5A-2

EXHIBIT 5A-2 (cont.)

KEY	CHARLESTON[a]
1.	Cape Romain National Wildlife Refuge, 34,700 acres
2.	Santee National Wildlife Refuge, 29,500 acres
3.	Francis Marion National Forest and State Wildlife Management Area, 249,000 acres
4.	Hartley Game Management Area, 1,218 acres
5.	Santee-Delta Game Management Area, 1,501 acres
6.	Edisto Beach State Park Waterfowl Management Area
7.	Moncks Corner State Fish Hatchery
8.	Middletown Gardens
9.	Cypress Gardens
10.	Magnolia Gardens

[a] See Appendix X for a detailed description of the wildlife and vegetation of the local area as well as the region.

Along the coast, south of the Savannah River estuary, there is a cluster of three national wildlife refuges maintained primarily for waterfowl and shorebirds. Scattered through the region are some 30,000 acres of state game management lands where deer, turkey, foxes, raccoons, and other game animals abound.

DEVELOPMENT ASSUMPTIONS

This section describes both the base case and the OCS-induced development that could occur in the Eastern South Carolina/Eastern Georgia region for each of the following primary industrial sectors: oil refining, gas processing, petrochemicals, and construction.[1]

Oil Refining

In the oil refining sector (Exhibit 5A-3), virtually no development is assumed under Base Case 1 (where expansion takes place primarily in the Mid-Atlantic demand area). Under Base Case 2, where refinery development to process foreign crude and accompanying deepwater terminals are assumed for the area, the South Atlantic is projected to have 2.2 million barrels per day of refinery production by the year 2000. In the Eastern South Carolina/Eastern Georgia region, it is assumed that 720,000 barrels per day production will take place by 1985, and there will be nearly 1.1 million barrels per day production by the year 2000. Of this amount, 180,000 barrels per day in 1985 and 270,000 barrels per day in the year 2000 is expected to be produced in the Charleston locality.

Under high OCS production assumptions, 250,000 barrels per day in 1985 and 500,000 barrels per day in the year 2000 is the projected refinery production for the Charleston, S.C. locality, other Eastern S.C./Eastern Georgia (excluding Charleston), and the remaining South Atlantic area. If low OCS production occurs, the South Atlantic's total production of 250,000 barrels per day in 1985 and

---

[1] The development of the offshore oil and gas recovery industry, which is treated similarly for each East Coast demand area, is described in Chapter 2.

EXHIBIT 5A-3

PROJECTED CHARLESTON/SOUTH ATLANTIC REFINERY DEVELOPMENT[a,b]

(millions of barrels/day)

	Base Case 1		Base Case 2		Low OCS		High OCS	
	1985	2000	1985	2000	1985	2000	1985	2000
Charleston, S.C. locality	0	0	.18	.27	.15	.25	.25	.50
Eastern S.C./ Eastern Georgia Region (not incl. locality)	0	0	.54	.81	.10	.25	.25	.50
Other South Atlantic	.18	.18	.63	1.08	0	0	.25	.50
Total	.18	.18	1.35	2.16	.25	.50	.75	1.50

a Refinery capacity is 10 percent larger than production, based on the assumption that refineries will operate at 90 percent capacity.

b Base case production is total, while low and high OCS production is incremental above base case.

Source: RPA estimates.

500,000 barrels per day in the year 2000 would be approximately shared by the Charleston locality and other parts of the Eastern S.C./Eastern Georgia Region. The dispersion of refinery development throughout the South Atlantic recognizes the number of different demand centers in the area. Appendix II discusses in greater detail the regional refinery development assumptions.

Gas Processing

Without offshore production there should be no gas processing activity in the South Atlantic, since no developable natural gas resources are known to exist onshore. Gas processing development related to offshore production should impact most heavily in the Charleston locality, where OCS gas is assumed to come ashore. In the high impact case in the year 2000, however, some gas processing development is assumed to occur outside of the locality in the Eastern S.C./Eastern Georgia regions as shown in Exhibit 5A-4. Appendix III discusses in greater detail the assumptions developed for the gas processing industry.

EXHIBIT 5A-4

PROJECTED CHARLESTON/SOUTH ATLANTIC GAS PROCESSING DEVELOPMENT FROM OFFSHORE PRODUCTION

(Billions of cu. ft. per day)

	Low OCS		High OCS	
	1985	2000	1985	2000
Charleston, S.C., locality	.3	1.8	.9	1.8
Eastern S.C./Eastern Ga. Region (not incl. locality)	0	0	0	1.8
Total	.3	1.8	.9	3.6

Source: RPA estimates.

Petrochemicals

No petrochemical development is assumed in the South Atlantic under Base Case 1. Under Base Case 2 (Exhibit 5A-5) the development should occur more rapidly in the South Atlantic than in any other area of the U.S. for two reasons: (1) high anticipated availability of refinery feedstocks whereas demand for refinery fuel output should be relatively low; (2) increasing activity in intermediate petrochemical manufacturing. Between 15 and 20 one-billion pounds per year petrochemical complexes could develop by the year 2000 in the South Atlantic demand area, with 7 to 8 of these probably located in the Eastern S.C./Eastern Georgia Region (none in the locality).

Offshore production under the high impact case is expected to support additional development at the same high rate, such that the total number of complexes in the South Atlantic area could be between 25 and 30 by the year 2000. Of the 11 additional complexes projected under high OCS conditions, four should be in the local area, three in other parts of the region, and the remainder elsewhere in the South-Atlantic area.

The geographic dispersion of petrochemical development indicated for both base case and high OCS conditions roughly follows the refinery dispersion discussed earlier. Appendix IV provides in greater detail a description of petrochemical development.

Construction

The Charleston, S.C., locality and the Eastern S.C./Georgia region is expected to have an extremely high industrial growth impact from OCS development (especially in the petrochemical sector). However, the majority of the heavy construction required for new petrochemicals is expected to occur before 1985. As a result, under high OCS conditions in 1985, the construction impact should be $230 million in the locality and $400 million for the region as a whole (Exhibit 5A-6). This construction would increase total regional construction by as much as 60 to 70 percent over Base Case 1 and as much as 40 to 50 percent over Base Case 2. By the year 2000, with no heavy construction assumed, OCS-induced construction is estimated to drop to $90 million in the locality and $162 million for the region as a whole.

Low OCS construction impacts should be about one-fourth of the high impacts in the locality and one-eighth of the high impacts in the region. The largest difference between the two cases is due to a drop-off in assumed petrochemical construction. Appendix V discusses in greater detail the assumptions developed for construction.

EXHIBIT 5A-5

PROJECTED CHARLESTON/SOUTH ATLANTIC PETROCHEMICAL PRODUCTION[a]

(Number of billions of lb/yr. olefins complexes)

	Base Case 2		Low OCS		High OCS	
	1985	2000	1985	2000	1985	2000
Charleston, S.C. locality	0	0	0	0	1.2	4.2
Eastern S.C./Eastern Georgia Region (not incl. locality)	3.6	7.2	0	0	1.2	3.2
Other South-Atlantic	2.6	9.4	0	0	.7	3.2
Total	6.2	16.6	0	0	3.1	10.6

a Base Case 2 production is total, while low and high OCS production is incremental above Base Case 2.

Source: RPA estimates.

EXHIBIT 5A-6

VALUE OF CONSTRUCTION OUTPUT[a]
($ million)

SOUTH ATLANTIC/CHARLESTON

Geographic Area	1970 Actual	1985			2000		
		Base Case[b]	Low OCS	High OCS	Base Case[b]	Low OCS	High OCS
CHARLESTON							
Refinery			29	92		0	0
Gas Processing			0	7		0	0
Petrochemical			11	84		0	0
Induced[c]			10	45		20	91
Total Local	163	350[d]	50	228	524[d]	20	91
EASTERN S.C./ GEORGIA							
Refinery			29	164		0	0
Gas Processing			0	20		0	0
Petrochemical			11	140		0	0
Induced[c]			10	81		20	162
Total Region	368	572[e]	50	405	823[e]	20	162

[a] Base Case total and OCS incremental. Appendix V describes the methods used in determining these values

[b] Base Case 1 for East Coast

[c] Other industrial, commercial, and residential construction activity induced by the direct industry activities

[d] Base Case 2: 1985 = 386
2000 = 538

[e] Base Case 2: 1985 = 849
2000 = 934

Source: RPA estimates.

IMPACTS

This section discusses the impacts that could occur in the 3-county Charleston, South Carolina, locality and the Eastern South Carolina/Eastern Georgia region from the high offshore oil and gas production case. The economic, social, land use, and air and water pollution impacts are discussed in the following pages.

Economic

The economic growth projections for the Charleston SMSA differ markedly as a function of the specific base case assumptions (see Exhibit 5A-7). For example, the 86,000 new jobs projected to exist between the years 1970 and 2000 under Base Case 1 represent an increase of 76 percent. Under Base Case 2 and over the same period, 153,000 new jobs would be created--an increase of 135 percent. There are two important reasons for this difference. First, a small amount of new primary activity in the refining, petrochemical, and construction sectors is projected to exist under Base Case 2 within the locality by the years 1985 and 2000. Second, and more important, a large increase in output and employment in these same primary sectors is expected to occur within the Eastern South Carolina/Eastern Georgia region (Exhibit 5A-8). Since Charleston is the only major metropolitan area within the region, much of the region's induced economic activity in the manufacturing, utility, and service sectors is expected to occur within the three-county SMSA.

Of course, the new primary economic activity assumed under Base Case 2 conditions would also significantly affect employment and output in the Eastern South Carolina/ Eastern Georgia region itself. As a result of refinery and petrochemical development to process imports,8,500 more refining and petrochemical jobs and 8,400 more construction jobs than under Base Case 1 would be created by 1985. Total employment in Base Case 2 would be 100,000 jobs higher than in Base Case 1 in 1985 and 115,000 higher in the year 2000.

Against this background, the following sections present the anticipated primary and aggregate impacts resulting from OCS development.

EXHIBIT 5A-7

SUMMARY OF BASE CASE ECONOMIC CONDITIONS

CHARLESTON

A. EMPLOYMENT (thousands)

Sector	Actual	Base Case 1		Base Case 2	
	1970	1985	2000	1985	2000
Construction	6.0	11.0	14.0	12.1	14.4
Ref., Gas, Petrochem.	0	0	0	.5	.6
Other Manufacturing	18.0	26.0	38.0	42.7	57.7
Agriculture	3.0	3.0	3.0	3.1	3.1
Utilities	6.0	13.0	16.0	17.8	22.2
Services	80.0	93.0	128.0	126.0	168.4
TOTAL	113.0	146.0	199.0	202.2	266.4

B. VALUE OF OUTPUT ($ million)[a]

Sector	Actual	Base Case 1		Base Case 2	
	1970	1985	2000	1985	2000
Construction	163	350	524	386	538
Ref., Gas, Petrochem.	0	0	0	329	493
Other Manufacturing	536	1053	2097	1730	3184
Agriculture	53	79	119	82	123
Utilities	184	515	820	705	1139
Services	1344	1941	3330	2630	4381
TOTAL	2280	3938	6890	5862	9858

Codes - * = negligible
: = infinite percentage since base case is zero

[a]All dollar figures are 1970 constant dollars.

Source: RPA estimates

EXHIBIT 5A-8

SUMMARY OF BASE CASE ECONOMIC CONDITIONS

EASTERN S.C./EASTERN GA.

A. EMPLOYMENT (thousands)

Sector	Actual	Base Case 1		Base Case 2	
	1970	1985	2000	1985	2000
Construction	13.7	18.0	22.0	26.4	24.9
Ref., Gas, Petrochem.	0	0	0	8.5	12.6
Other Manufacturing	56.6	71.0	83.0	95.6	112.0
Agriculture	14.2	15.0	12.0	15.4	12.4
Utilities	15.6	21.0	26.0	27.8	34.9
Services	183.2	243.0	304.0	293.3	365.1
TOTAL	283.3	368.0	447.0	467.0	561.9

B. VALUE OF OUTPUT ($ million)[a]

Sector	Actual	Base Case 1		Base Case 2	
	1970	1985	2000	1985	2000
Construction	368	572	823	849	934
Ref., Gas, Petrochem.	0	0	0	2250	3844
Other Manufacturing	1671	2875	4580	3870	6180
Agriculture	336	397	478	407	494
Utilities	473	832	1333	1103	1789
Services	2591	5071	7909	6120	9497
TOTAL	5439	9747	15123	14599	22738

Codes - * = negligible
: = infinite percentage since base case is zero

[a]All dollar figures are 1970 constant dollars.

Source: RPA estimates

Primary Impacts

The biggest primary employment impact for both the locality and region would occur in the construction sector. Under high OCS conditions, in 1985, 7,000 new construction jobs would be added in the Charleston SMSA (see Exhibit 5A-9). By the year 2000, this construction employment would fall to only 2,400. However, increased employment in the petrochemical and refining industries would stabilize total primary employment at about 10,000 people in both 1985 and the year 2000. In the region, the same relative distribution of jobs between sectors has been projected, with total primary employment reaching 18,000 in 1985 and 17,000 in the year 2000.

Total primary employment under low impact conditions would be dramatically smaller, only 2000 employees in the locality by 1985 and only an additional 200 in other parts of the region. By the year 2000, only 1,800 new primary jobs are expected in that region, with all but 500 in the Charleston locality. In the low impact case, no petrochemical activity is projected for either of the years 1985 or 2000.

Aggregate Impacts

In the Charleston SMSA, under high impact assumptions, 59,000 new jobs in 1985 and 76,000 in the year 2000 are projected (see Exhibit 5A-10). The comparable figures for the low impact case (see Exhibit 5A-11) are 13,000 and 14,000 in the years 1985 and 2000, respectively. The high impacts indicate an increase of between 28 and 41 percent in the SMSA, depending on which year and base case is being analyzed. The high impacts--both on an absolute and on a percentage basis--are larger than in any other East Coast locality.

The distribution of new jobs among sectors is similar to the pattern in other areas, with services projected to grow the most on an absolute scale and construction the most percentage-wise. However, two important characteristics of these projections should be pointed out. First, the 63 percent increase in construction jobs is larger than for other East Coast areas and could easily lead to shortages of skilled labor. This possiblity is underscored by Charleston's location--a relatively undeveloped local area which may have difficulty in supplying needed construction workers. Second, the "other manufacturing" impact is also larger than those occurring in other sample areas both in

EXHIBIT 5A-9

PRIMARY ECONOMIC IMPACTS

SOUTH ATLANTIC/CHARLESTON

A. EMPLOYMENT (thousands) HIGH IMPACT

	1985			2000		
	Local	Region[a]	Area[b]	Local	Region[a]	Area[b]
Oil and Gas Rec.	0	0	7.5	0	0	4.1
Gas Processing	.1	.1	*	.1	.2	0
Refineries	.7	1.5	.7	1.1	2.2	1.1
Petrochemical	2.1	4.3	1.2	6.0	10.5	4.6
Construction	6.9	12.3	2.7	2.4	4.2	.9

B. VALUE OF OUTPUT (millions 1970 dollars) HIGH IMPACT

	1985			2000		
	Local	Region[a]	Area[b]	Local	Region[a]	Area[b]
Oil and Gas Rec.	0	0	361	0	0	156
Gas Processing	24	24	0	48	95	0
Refineries	457	914	457	913	1825	913
Petrochemical	312	624	182	1092	1924	832
Construction	228	406	88	91	162	35

Code: * = negligible

[a] Region includes Local

[b] Area is "Demand Area" exclusive of the Region

Source: RPA estimates

EXHIBIT 5A-9 (cont.)

PRIMARY ECONOMIC IMPACTS

SOUTH ATLANTIC/CHARLESTON

C. EMPLOYMENT (thousands) LOW IMPACT

	1985			2000		
	Local	Region[a]	Area[b]	Local	Region[a]	Area[b]
Oil and Gas Rec.	0	0	3.2	0	0	1.5
Gas Processing	*	*	0	.1	.1	0
Refineries	.5	.7	0	.6	1.1	0
Petrochemical	0	0	0	0	0	0
Construction	1.5	1.5	0	.5	.5	0

D: VALUE OF OUTPUT (millions 1970 dollars) LOW IMPACT

	1985			2000		
	Local	Region[a]	Area[b]	Local	Region[a]	Area[b]
Oil and Gas Rec.	0	0	161	0	0	58
Gas Processing	8	8	0	48	48	0
Refineries	273	457	0	457	914	0
Petrochemical	0	0	0	0	0	0
Construction	50	50	0	20	20	0

Code: * = negligible

[a] Region includes Local

[b] Area is "Demand Area" exclusive of the Region

Source: RPA estimates

EXHIBIT 5A-10

AGGREGATE ECONOMIC IMPACTS

CHARLESTON

HIGH IMPACT

A. EMPLOYMENT (thousands)

Sector	1985	Percent Over B.C. 1	Percent Over B.C. 2	2000	Percent Over B.C. 1	Percent Over B.C. 2
Construction	6.9	63	57	2.4	17	16
Ref. Gas, Petrochem.	3.0	:	555	7.2	:	1199
Other Manufacturing	14.3	55	34	19.2	51	33
Agriculture	.1	2	2	.1	3	3
Utilities	3.9	30	22	6.1	38	27
Services	31.0	33	25	40.8	32	24
TOTAL	59.2	41	29	75.8	38	28

B. VALUE OF OUTPUT ($ million)[a]

Sector	1985	Percent Over B.C. 1	Percent Over B.C. 2	2000	Percent Over B.C. 1	Percent Over B.C. 2
Construction	228	65	59	91	17	17
Ref., Gas, Petrochem.	793	:	241	2052	:	416
Other Manufacturing	581	55	34	1062	51	33
Agriculture	2	2	2	4	3	3
Utilities	154	30	22	310	38	27
Services	648	33	25	1063	32	24
TOTAL	2406	61	41	4582	66	46

Codes - * = negligible
: = infinite percentage since base case is zero

[a]All dollar figures are 1970 constant dollars.

Source: RPA estimates

EXHIBIT 5A-11

AGGREGATE ECONOMIC IMPACTS

CHARLESTON

LOW IMPACT

A. EMPLOYMENT (thousands)

Sector	1985	Percent Over B.C. 1	Percent Over B.C. 2	2000	Percent Over B.C. 1	Percent Over B.C. 2
Construction	1.5	14	13	.5	4	4
Ref., Gas, Petrochem.	.5	:	89	.7	:	110
Other Manufacturing	2.6	10	6	2.8	7	5
Agriculture	*	1	1	*	1	1
Utilities	.9	7	5	1.1	7	5
Services	7.4	8	6	8.5	7	5
TOTAL	12.9	9	6	13.6	7	5

B. VALUE OF OUTPUT ($ million)[a]

Sector	1985	Percent Over B.C. 1	Percent Over B.C. 2	2000	Percent Over B.C. 1	Percent Over B.C. 2
Construction	50	14	13	20	4	4
Ref.,Gas, Petrochem.	282	:	86	504	:	102
Other Manufacturing	105	10	6	156	7	5
Agriculture	*	1	1	1	1	1
Utilities	34	7	5	58	7	5
Services	154	8	6	221	7	5
TOTAL	625	16	11	960	14	10

Codes - * = negligible
: = infinite percentage since base case is zero

[a]All dollar figures are 1970 constant dollars.

Source: RPA estimates

EXHIBIT 5A-12

AGGREGATE ECONOMIC IMPACTS

EASTERN S.C./EASTERN GA.

HIGH IMPACT

A. EMPLOYMENT (thousands)

Sector	1985	Percent Over B.C. 1	Percent Over B.C. 2	2000	Percent Over B.C. 1	Percent Over B.C. 2
Construction	12.3	68	47	4.2	19	17
Ref. Gas, Petrochem.	5.9	:	68	13.0	:	102
Other Manufacturing	19.5	27	20	26.0	31	23
Agriculture	.4	2	2	.4	3	3
Utilities	5.2	25	19	8.0	31	23
Services	44.6	18	15	58.3	19	16
TOTAL	87.9	24	19	109.9	25	20

B. VALUE OF OUTPUT ($ million)[a]

Sector	1985	Percent Over B.C. 1	Percent Over B.C. 2	2000	Percent Over B.C. 1	Percent Over B.C. 2
Construction	406	71	48	162	20	17
Ref., Gas, Petrochem.	1561	:	69	3844	:	100
Other Manufacturing	790	27	20	1437	31	23
Agriculture	10	2	2	16	3	3
Utilities	205	25	19	411	31	23
Services	931	18	15	516	19	16
TOTAL	3903	40	27	6387	49	32

Codes - * = negligible
: = infinite percentage since base case is zero

[a]All dollar figures are 1970 constant dollars.

Source: RPA estimates

EXHIBIT 5A-13

AGGREGATE ECONOMIC IMPACTS

EASTERN S.C./EASTERN GA.

LOW IMPACT

A. EMPLOYMENT (thousands)

Sector	1985	Percent Over B.C. 1	Percent Over B.C. 2	2000	Percent Over B.C. 1	Percent Over B.C. 2
Construction	1.5	8	6	.5	2	2
Ref., Gas, Petrochem.	.8	:	9	1.2	:	10
Other Manufacturing	3.4	5	4	3.8	5	3
Agriculture	.1	1	1	.1	1	1
Utilities	1.1	5	4	1.5	6	4
Services	10.3	4	4	12.1	4	3
TOTAL	17.2	5	4	19.2	4	3

B. VALUE OF OUTPUT ($ million)[a]

Sector	1985	Percent Over B.C. 1	Percent Over B.C. 2	2000	Percent Over B.C. 1	Percent Over B.C. 2
Construction	50	9	6	20	2	2
Ref.,Gas, Petrochem.	465	:	21	961	:	25
Other Manufacturing	138	5	4	210	5	3
Agriculture	2	1	1	3	1	1
Utilities	44	5	4	76	6	4
Services	215	4	4	316	4	3
TOTAL	914	9	6	1586	10	7

Codes - * = negligible
: = infinite percentage since base case is zero

[a]All dollar figures are 1970 constant dollars.

Source: RPA estimates

absolute and in percentage terms. This leads to a labor supply problem similar to that for construction.

Total new employment in the Eastern S.C./Eastern Georgia region under high impact conditions would also be much larger in percentage terms (although not in absolute terms) than was true for any other East Coast demand area. The 88,000 jobs in 1985 and the 110,000 in the year 2000 represent between a 19 and 24 percent increase over base case conditions (Exhibit 5A-12). The 68 percent increase in construction jobs in 1985 over Base Case 1 is even higher than in the locality. Here again, the danger of labor shortages would apply.

The low impact conditions, on the other hand, project less than 20,000 new jobs in the region as a whole, or only about 4 percent over either of the two base cases (Exhibit 5A-13).

Social Infrastructure

OCS oil and gas production could significantly affect the social infrastructure of the Charleston locality (Exhibit 5A-14). If Base Case 2 development and high OCS conditions occured, the population would nearly double between 1970 and 1985--from 336,000 to 650,000 although 180,000 of this increase is due to Base Case 2 growth. Given all the related impacts of such population growth, this is equivalent to building a major new city in a little over a decade.

Charleston is a major city with well-developed municipal services. Thus, a structure already exists on which to build. However, there is little doubt that the outerlying counties in the Charleston locality would need and benefit from financial assistance from the state and federal government in the early stages of OCS development.

The major impacts in the locality would be in those infrastructure components requiring construction of new facilities. In other words, new electrical power plants, homes, offices, schools, and hospitals would have to be built.

By 1985, under high OCS impact, Charleston would require 491 megawatts of new plant capacity to meet the demands for electrical power. This is equivalent to 50 percent of a new power plant of average size. If Base Case 2 demand

EXHIBIT 5A-14

CHARLESTON
(Geog. Area)

SOCIAL INFRASTRUCTURE IMPACT

	1970	1985		Incr.		2000		Incr.	
		Base Case 1	Base Case 2	High Impact	Low Impact	Base Case 1	Base Case 2	High Impact	Low Impact
POPULATION (000)	336	400	512.8	137.5	32.7	476	595.6	145.4	27.2
Percent Change %[a]				34/27	8/6			31/24	6/5
PHYSICAL SYSTEMS									
Water Demand Mil. gallons/day	50.4	68	87	23	6	90	113	28	5
Elec. Demand (MW of Capacity)	NA	NA	NA	491	108	NA	NA	1107	164
Structures Residential (000)	91	108	139	37	9	129	161	39	7
Commercial (millions of sq. ft.)	8.2	9	11.5	3.1	.7	10.7	13.4	3.3	.6
SOCIAL SYSTEMS									
Schools - Enrollees (000)	97	116	149	40	10	138	173	42	7
Hospitals - Beds	1248	1528	1960	527	126	1818	2227	554	103
Police - Manpower	327	388	498	134	32	462	578	141	26
Solid Waste - Tons/Day	1008	1200	1538	412.5	98.1	1428	1787	436.2	81.6
Sewage - Mil.gal/day	40.3	48	62	17	4	57	72	17	3
Gov't. OH - ($000,000)	14.0	16.8	21.5	5.8	1.4	19.9	24.9	6.1	1.1
BUSINESS & GOVERNMENT INSTIT.									
Business Services - Employee (000)	31.4	36.8	47.1	12.6	3.0	43.8	54.8	13.4	2.5
Government - Employee (000)	8.8	10.7	13.7	3.7	.9	12.7	15.9	3.9	.7

[a] The percentage changes are indicated as follows:

Impact Case over Base Case 1/Impact Case over Base Case 2

Source: RPA estimates.

conditions were combined with OCS requirements, it is conceivable that a new power plant could be justified to meet the Charleston area's energy needs. By the year 2000, OCS high impact alone would require Megawatt capacity equivalent to another power plant (1000 Mw). A power plant generally requires a lead time of from 5 to 7 years, so planning should start not later than 1975 to ensure power availability as new refineries are built. The average cost in 1973 dollars of a 1000 Mw plant is $220 million.

The need for dwelling units would increase 26 percent by 1985 over Base Case 2 demands. This represents 37,000 new dwelling units for this locality and translates into high productivity requirements for the building trades. The projected 37,000 new dwelling units could require a total of $1 billion in mortgage money.

The need for new commercial office space would require a 75 percent increase by the year 1985 when Base Case 2 and OCS impacts are combined. The OCS need for office space alone by 1985 under high impact would require 30 ten-story office buildings with 10,000 square feet per floor. The demand for mortgage money on these structures could approximate $150 million.

The impact of the increased population should also be felt by the schools. Forty thousand students translate into 13,000 high school students and 27,000 students in grades kindergarten through eight. Thirteen thousand new high school students could require six large (2,500 student) high schools or 13 middle size (1,000 student) high schools. The construction of grade schools and junior high schools would add an even greater facility demand than the high school impact. The school impact is significant because such planning and construction would have to take place within the next ten years.

The demand for hospital services should be significant as well. By 1985, the area would need the equivalent of a major new 500-bed hospital for OCS-induced development. This is in addition to another 700 bed requirement for Base Case 2 growth.

OCS-induced demands on the water supply, the sewage system, and on solid waste disposal could be significant because of the area's marshy terrain and high water table. The requirements for these services and systems should grow proportionately to population increases.

As a result of all these activities, government overhead would rise sharply. Approximately a $5.8 million increase would be needed to support additional planners and other support personnel by 1985. Charleston presently spends $42 per capita for government operations. Jacksonville, Florida, in contrast, spends $75. Charleston would undoubtedly increase its per capita expenditure figure, expand its staff of municipal employees, and virtually double its municipal budget by 1985 to meet Base Case 2 and OCS high impact needs.

Land Use

At both local and regional levels, there appears to be adequate land for both base case and OCS-related development. Both the statistical analysis of developed acres and the spatial analysis of undeveloped acres indicated that land use planning requirements should be far less severe than for the New England or Mid-Atlantic regions.

In the Charleston locality, Base Case 2 development is expected to reduce the percentage of undeveloped land from 95.5 to 92.5 by the year 2000. The land requirements associated with high offshore production should reduce it further to 90.7 percent (Exhibit 5A-15).

The land use pattern of the Eastern South Carolina/ Eastern Georgia region is similar percentage-wise to that of the locality. Under Base Case 2 the undeveloped land should drop from 95.6 percent to 93 percent by the year 2000. The impact from offshore oil and gas high OCS production would reduce the undeveloped land by approximately another 1 percent (Exhibit 5A-16).

Although a significant portion of the currently undeveloped land is unavailable for general development or unsuitable for primary development, enough remains available to cover base case and OCS-induced growth (Exhibit 5A-17). Of the 6.5 million acres of currently undeveloped land, 2.6 million acres (40 percent) is unavailable due to environmental constraints. The Francis Marion National Forest (with nearly 250,000 acres), the Cape Romain area, and the wetlands around Charleston and Savannah account for much of this unavailable land.[1] Since most of the important

---

[1] For more detailed information on these constraints refer to Appendix VIII - Land Use Methodology and Appendix X - Wildlife and Vegetation.

EXHIBIT 5A-15

LAND USE SUMMARY

LOCALITY : CHARLESTON

Summary in Thousands of acres		1970	Year 1985				Year 2000			
		Actual Development	Base Case 1 Development	Base Case 2 Development	OCS Low* Development	OCS High* Development	Base Case 1 Development	Base Case 2 Development	OCS Low* Development	OCS High* Development
Land Use Classification	DEVELOPED LAND	75.0	88.7	110.7	6.7 (1) 6.4 (2)	26.0 (1) 26.5 (2)	103.1	125.9	5.9 (1) 5.6 (2)	29.6 (1) 29.2 (2)
	. residential	21.0	24.2	28.2	1.2 (1) 1.0 (2)	4.7 (2) 4.2 (2)	26.9	30.6	.8 (1) .9 (2)	4.5 (1) 5.2 (2)
	. commercial industrial	16.1	19.4	24.7	1.8 (1) 1.7 (2)	5.7 (1) 6.7 (2)	22.6	28.1	2.1 (1) 1.7 (2)	8.8 (1) 7.7 (2)
	. other	37.9	45.1	57.8	3.7	15.6	53.6	67.2	3.0	16.3
	UNDEVELOPED LAND	1,597.9	1,583.7	1,562.2	1,577.0 (1) 1,558.8 (2)	1,557.7 (1) 1,535.7 (2)	1,569.8	1,547.0	1,563.9 (1) 1,541.4 (2)	1,540.2 (1) 1,517.8 (2)
	TOTAL ACREAGE	1,672.9								

* incremental acreage only. If two figures, number in parentheses refers to base case.

Summary in Percent		1970	Year 1985**				Year 2000**			
		Actual Development	Base Case 1 Development	Base Case 2 Development	OCS Low Above B.C.2	OCS High Above B.C.2	Base Case 1 Development	Base Case 2 Development	OCS Low Above B.C.2	OCS High Above B.C.2
Land Use Classification	DEVELOPED LAND	4.5	5.3	6.6	7.0	8.2	6.2	7.5	7.9	9.3
	. residential	1.3	1.4	1.7	1.7	1.9	1.6	1.8	1.9	2.1
	. commercial industrial	1.0	1.2	1.6	1.6	1.9	1.4	1.7	1.8	2.1
	. other	2.3	2.7	3.5	3.7	4.4	3.2	4.0	4.2	5.0
	UNDEVELOPED LAND	95.5	94.7	93.4	93.2	91.8	93.8	92.5	92.1	90.7

** Impacts of OCS developments indicated only above Base Case 2.

Source: RPA estimates.

EXHIBIT 5A-16

LAND USE SUMMARY

REGION : EASTERN S.C./EASTERN GA.

Summary in Thousands of acres		1970	Year 1985				Year 2000			
		Actual Development	Base Case 1 Development	Base Case 2 Development	OCS Low* Development	OCS High* Development	Base Case 1 Development	Base Case 2 Development	OCS Low* Development	OCS High* Development
Land Use Classification	DEVELOPED LAND	298.5	350.2	425.9	14.4 (1) 14.1 (2)	64.6 (1) 66.8 (2)	378.4	462.1	13.9 (1) 14.0 (2)	75.4 (1) 78.2 (2)
	. residential	92.5	106.0	120.4	2.9 (1) 1.8 (2)	12.7 (1) 14.1 (2)	111.6	126.9	2.3 (1) 2.8 (2)	13.5 (1) 16.5 (2)
	. commercial industrial	55.2	65.9	81.6	3.2 (1) 3.0 (2)	10.7 (1) 11.5 (2)	72.3	91.5	3.6 (1) 3.2 (2)	16.5 (1) 16.3 (2)
	. other	150.8	178.3	223.9	8.3	41.2	194.5	243.7	8.0	45.4
	UNDEVELOPED LAND	6,521.5	6,469.8	6,394.1	6,469.5 (1) 6,380.0 (2)	6,405.2 (1) 6,327.3 (2)	6,441.6	6,357.9	6,427.7 (1) 6,343.9 (2)	6,366.2 (1) 6,279.7 (2)
	TOTAL ACREAGE	6,820.0								

* incremental acreage only. If two figures, number in parentheses refers to base case.

Summary in Percent		1970	Year 1985**				Year 2000**			
		Actual Development	Base Case 1 Development	Base Case 2 Development	OCS Low Above B.C.2	OCS High Above B.C.2	Base Case 1 Development	Base Case 2 Development	OCS Low Above B.C.2	OCS High Above B.C.2
Land Use Classification	DEVELOPED LAND	4.4	5.1	6.2	6.5	7.2	5.5	6.8	7.0	7.9
	. residential	1.4	1.6	1.8	1.8	2.0	1.6	1.9	1.9	2.1
	. commercial industrial	.8	.9	1.2	1.2	1.4	1.1	1.3	1.4	1.6
	. other	2.2	2.6	3.3	3.4	3.9	2.8	3.6	3.7	4.2
	UNDEVELOPED LAND	95.6	94.9	93.8	93.5	92.8	94.5	93.2	93.0	92.1

** Impacts of OCS developments indicated only above Base Case 2.
Source: RPA estimates.

EXHIBIT 5A-17

UNDEVELOPED LAND CAPABILITIES

Region: EASTERN S.C./EASTERN GA.

	Thousands of Acres		Percent
. TOTAL UNDEVELOPED LAND[a]		6,521.5	100
. UNAVAILABLE LAND DUE TO ENVIRONMENTAL CONSTRAINTS		2,594.9	39.8
. existing and projected uses	453.7		
. coastal zoning and improvements	N.A.		
. excessive slope (> 15%)	0		
. wetlands	2,141.2		
. water resources	~~YES~~ - NO[h]		
. UNSUITABLE LAND DUE TO LOCATIONAL CONSTRAINTS[b]		1,586.2	24.3
. excessive slope (> 5%)	0		
. distance (> 30 minutes)	1,586.2		
. water requirements	YES - ~~NO~~[i]		
. TOTAL REMAINING DEVELOPABLE LAND[c]		2,340.4	35.9
. TOTAL LAND USE REQUIREMENTS[d]		241.8	
. total direct land use[e]	20.6		
. total induced land use[f]	221.3		
residential	50.9		
commercial/industrial[g]	32.1		
other developed land	138.3		

[a]Refer to land use summary exhibits for each region. Total undeveloped land figure corresponds to 1970 data.
[b]Where overlap with land unavailable due to environmental constraints, only incremental value is considered.
[c]Land suited for primary industrial activities, e.g., refineries, petrochemical complexes, etc., but competing with other uses, e.g., residential, commercial, light industrial, agricultural, etc. ("general development").
[d]Total Land Use Requirements corresponds to worst possible case by year 2000 (in general, base case 2 combined with high level OCS development).
[e]Refer to Exhibit VIII-5, Total Direct Land Use. Corresponds to maximum primary development.
[f]Refer to land use summary exhibits for each region. Corresponds to worst possible case by year 2000.
[g]Excluding primary industrial land.
[h]"No" indicates that water resource impoundment areas have not been included in the above acreages.
[i]"No" indicates that water supply from conventional sources is likely to be inadequate.

Source: RPA estimates.

ecologic areas appear to be already protected, there should not be substantial further reductions in land for environmental constraints. Another 1.6 million acres (24 percent of 1970 undeveloped land) is unsuited to primary development due to driving distance greater than 30 minutes from existing urban infrastructure. The remaining 2.3 million developable acres are nearly 10 times greater than the 242,000 acres required for base case and OCS-induced growth.

On the basis of the spatial analysis presented in Plates 7, 8, and 9, six major zones for primary development appear to exist in the Eastern South Carolina/Eastern Georgia region. Inland, the most likely zones lie in Orangeburg and Clarendon counties. Along the coast there are three possible zones which seem to be especially well qualified for primary development: zones centered on Charleston County, Beaufort/Jasper/Colleton Counties, and Chatham County. These three zones all have access to deep water and are located within relatively large unbroken tracts of undeveloped land.

Air Pollution

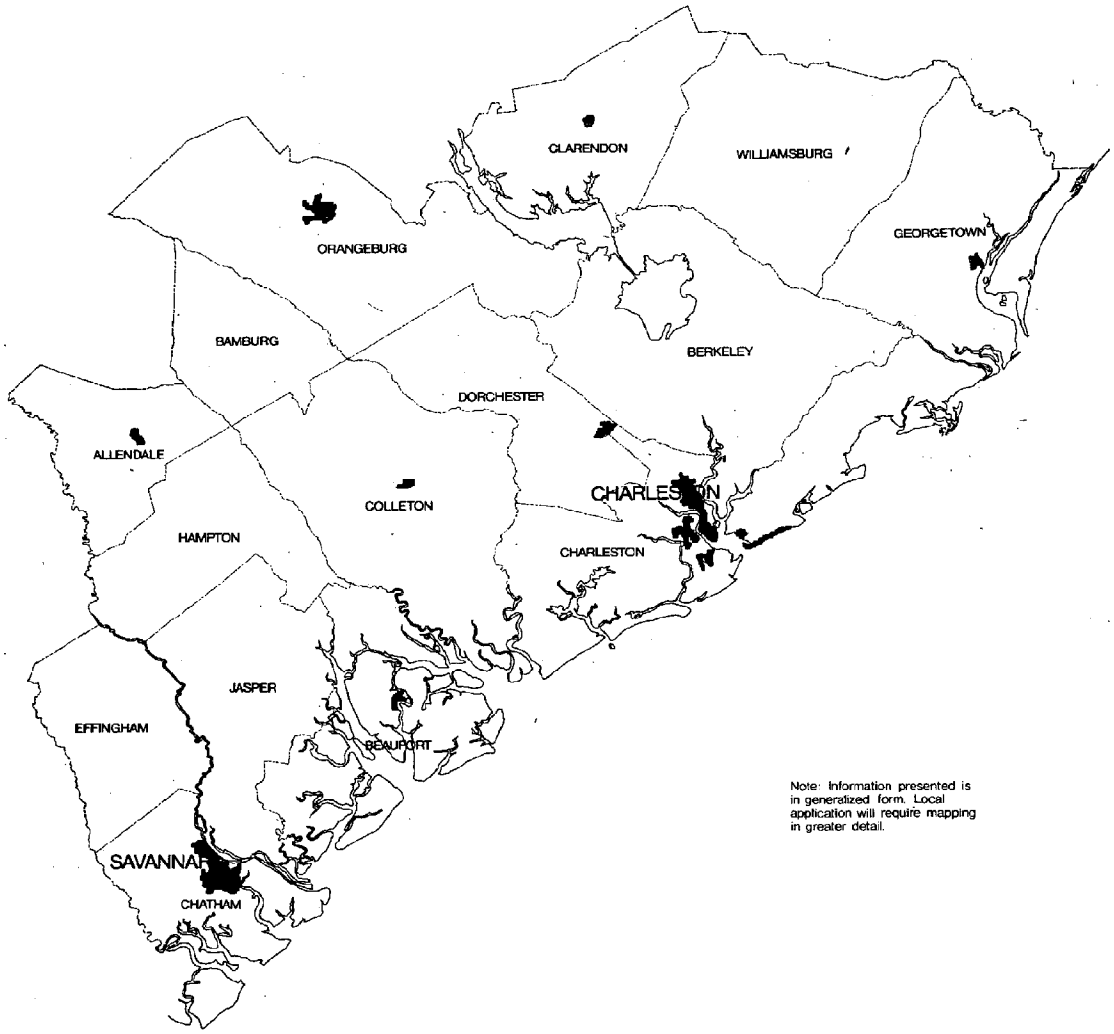
Air quality in the Charleston AQCR is relatively poor for particulates and sulphur oxides, but relatively good for nitrogen oxides, hydrocarbons, and carbon monoxide (Exhibit 5A-18). Both Berkeley and Dorchester Counties are close to the primary standard of 60 micrograms per cubic meter for particulates. The Charleston AQCR carries an air quality priority classification of I for particulates and sulphur oxides. The relatively high ambient particulate loadings (Exhibit 5A-19) are due mainly to the industrial process loss of the mineral products industry in the Charleston locality. Over 50 percent of the sulphur oxide loadings are the result of electric utility fossil fuel combustion. Nitrogen oxides, hydrocarbons, and carbon monoxide are less of a problem in the Charleston AQCR, having air quality priority classifications of III for all three pollutants.

Air quality is considerably better in the Eastern South Carolina/Eastern Georgia Region as a whole (Exhibit 5A-20). The region has an air priority classification of III for nitrogen oxides, hydrocarbons, and carbon monoxide. However, the industrialized centers of Augusta and Savannah are classified as I for particulates. As in the Charleston

POTENTIAL EFFECTS OF O.C.S. OIL AND GAS DEVELOPMENT

EASTERN S.C.
EASTERN GA.

PLATE 7



Note: Information presented is in generalized form. Local application will require mapping in greater detail.

UNDEVELOPED LAND

PRESENT CONDITIONS

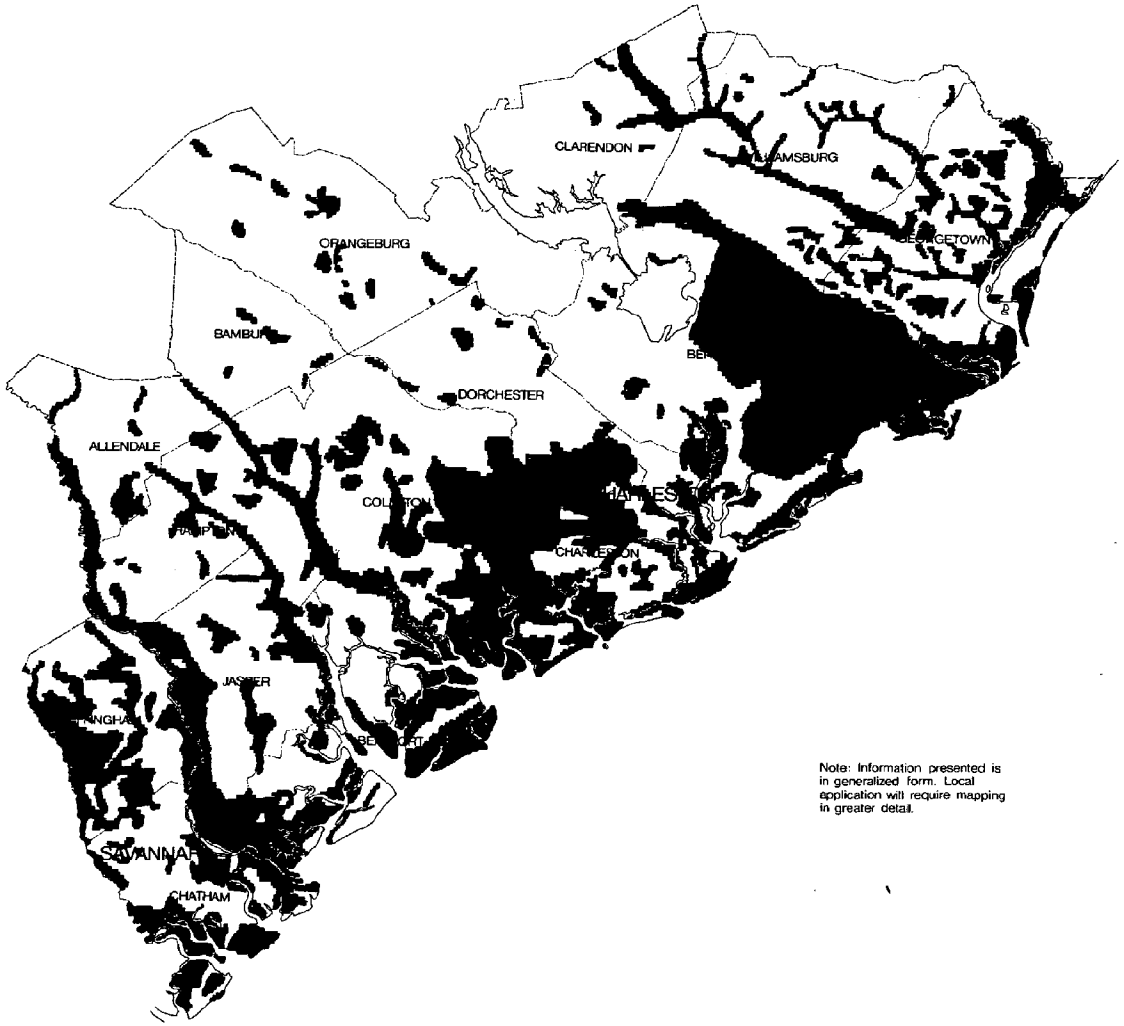
■ – DEVELOPED LAND
EXISTING LAND USES

□ – UNDEVELOPED LAND

RESOURCE PLANNING ASSOCIATES INC.

BASE MAP U.S.G.S. 1:250,000 DECEMBER 1973

miles



Note: Information presented is in generalized form. Local application will require mapping in greater detail.

POTENTIAL EFFECTS OF O.C.S. OIL AND GAS DEVELOPMENT

EASTERN S.C.
EASTERN GA.

PLATE 8

LAND USE IMPACT

LAND REQUIREMENTS TO SCALE
BASE CASE 2 HIGH IMPACT YEAR 2000

BASE CASE II (NO O.C.S.)		O.C.S. HIGH IMPACT		
PRIMARY	OTHER	PRIMARY	INDUCED	TOTAL
11,080	152,500	1565 1565 1565 1565 1285 OTHER 1925 9740	68,800	242,120 ACRES

SUITABLE LAND

FOR GENERAL DEVELOPMENT

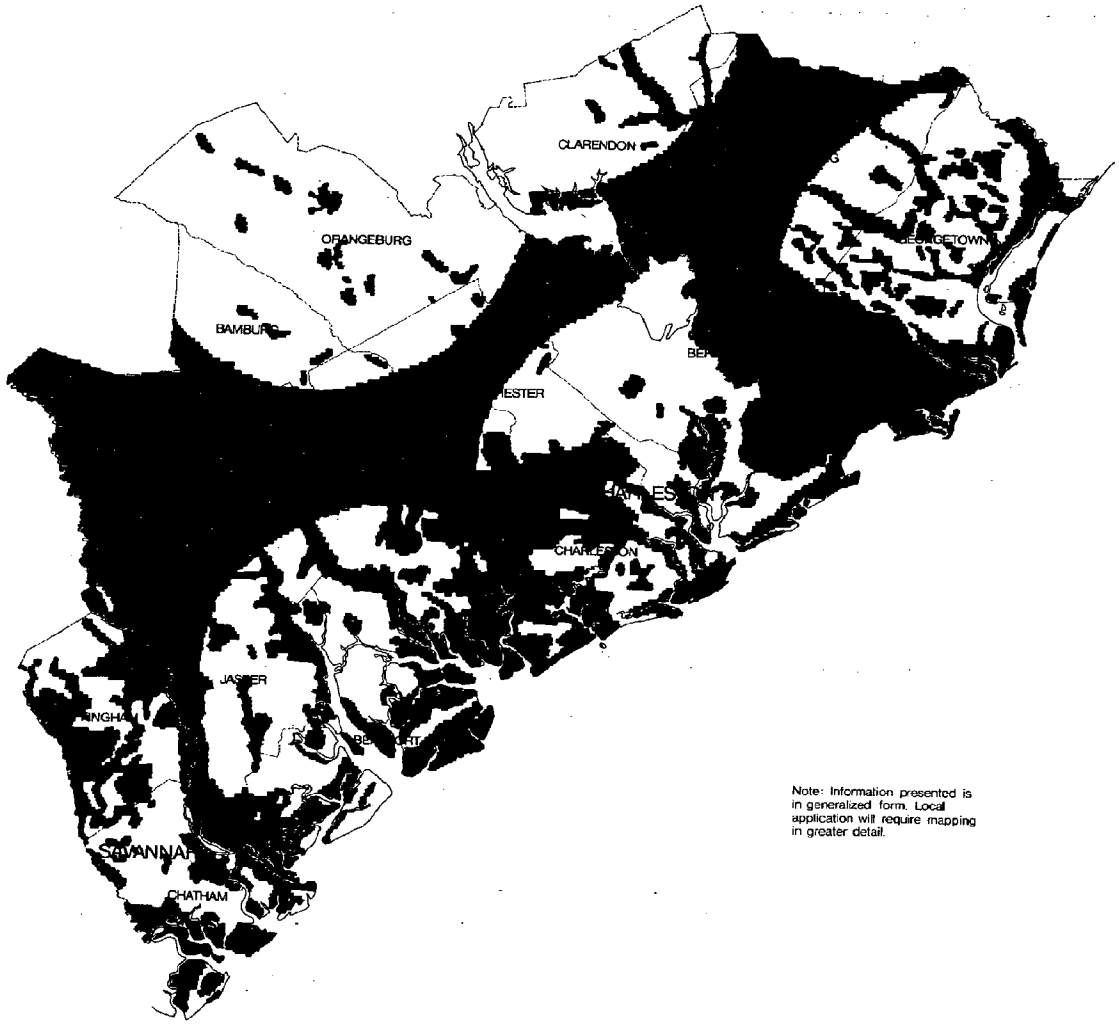
- UNSUITABLE LAND
  EXISTING AND PROJECTED LAND USES
  ENVIRONMENTAL CONSTRAINTS
- SUITABLE LAND
  SUBJECT TO AVAILABILITY AND LOCAL ZONING

RESOURCE PLANNING ASSOCIATES INC.

BASE MAP U.S.G.S. 1:250,000 DECEMBER 1973

8 0 5 10 15 20 30 miles

N



Note: Information presented is in generalized form. Local application will require mapping in greater detail.

POTENTIAL EFFECTS OF O.C.S. OIL AND GAS DEVELOPMENT

EASTERN S.C.
EASTERN GA.

PLATE 9

LAND USE IMPACT

LAND REQUIREMENTS TO SCALE
BASE CASE 2 HIGH IMPACT YEAR 2000

BASE CASE II (NO O.C.S.)		O.C.S. HIGH IMPACT		
PRIMARY	OTHER	PRIMARY	INDUCED	TOTAL
11,080	152,500	1565 1565 1565 1565 1285 OTHER 1925 9740	68,800	242,120 ACRES

SUITABLE LAND

FOR PRIMARY DEVELOPMENT

- UNSUITABLE LAND
  EXISTING AND PROJECTED LAND USES
  ENVIRONMENTAL CONSTRAINTS
  LOCATIONAL CONSTRAINTS
- SUITABLE LAND
  SUBJECT TO AVAILABILITY AND LOCAL ZONING

RESOURCE PLANNING ASSOCIATES INC.

BASE MAP U.S.G.S. 1:250,000 DECEMBER 1973

miles

N

EXHIBIT 5-18

AMBIENT AIR CONCENTRATION LEVELS

EASTERN SOUTH CAROLINA/GEORGIA

	Particulates ($\mu g/m^3$)	SO_x (ppm)
PRIMARY STANDARDS	60	.03
SOUTH CAROLINA		
Charleston Charleston	37	.011
Berkeley Charleston	45	.01
Dorchester Harleyville	52	-

Source: Environmental Protection Agency.

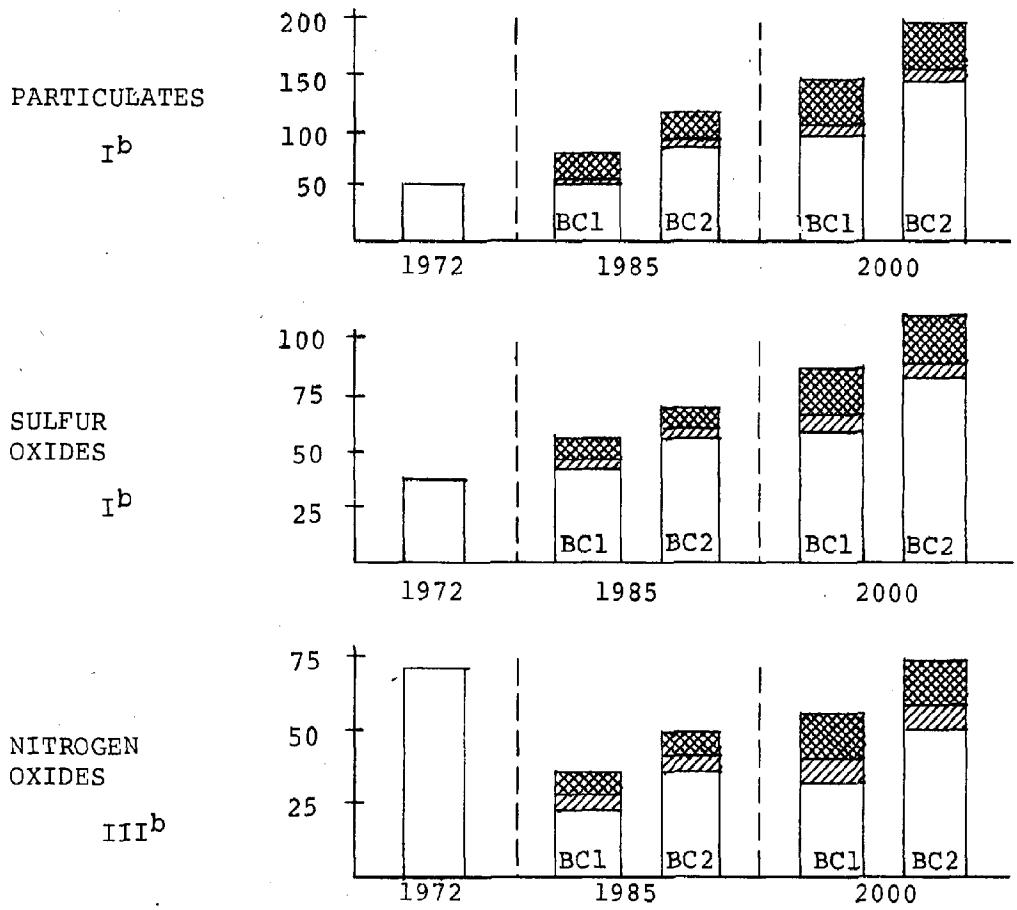
EXHIBIT 5A-19

SUMMARY OF IMPACTS - AIR POLLUTION LOADINGS[a]

(Thousand tons per year)

CHARLESTON

(Geographic Area)



[a]Refer to Appendix IX for a detailed discussion of the methodology for determination of each loading source and estimation of the control factors for each pollutant by geographic area.

[b]EPA Air Quality Priority Classification

BC 1: Base Case 1
BC 2: Base Case 2

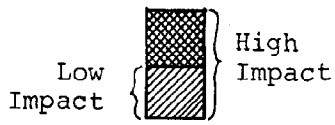


EXHIBIT 5A-19

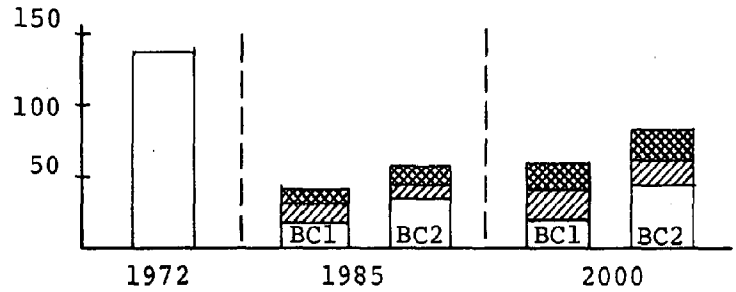
SUMMARY OF IMPACTS - AIR POLLUTION LOADINGS (CONTINUED)[a]

(Thousand tons per year)

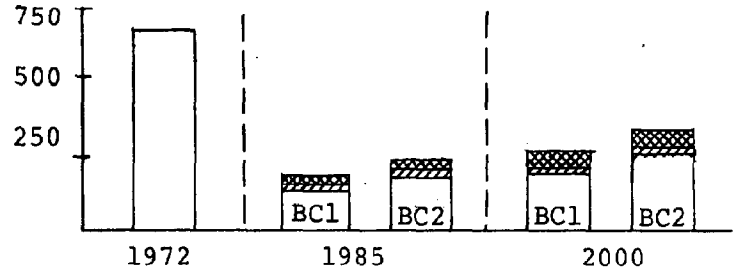
CHARLESTON

(Geographic Area)

HYDROCARBONS III[b]



CARBON MONOXIDE III[b]



---

[a] Refer to Appendix IX for a detailed discussion of the methodology for determination of each loading source and estimation of the control factors for each pollutant by geographic area.

[b] EPA Air Quality Priority Classification

BC 1: Base Case 1
BC 2: Base Case 2

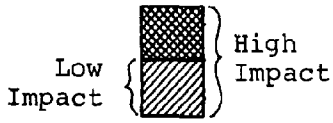


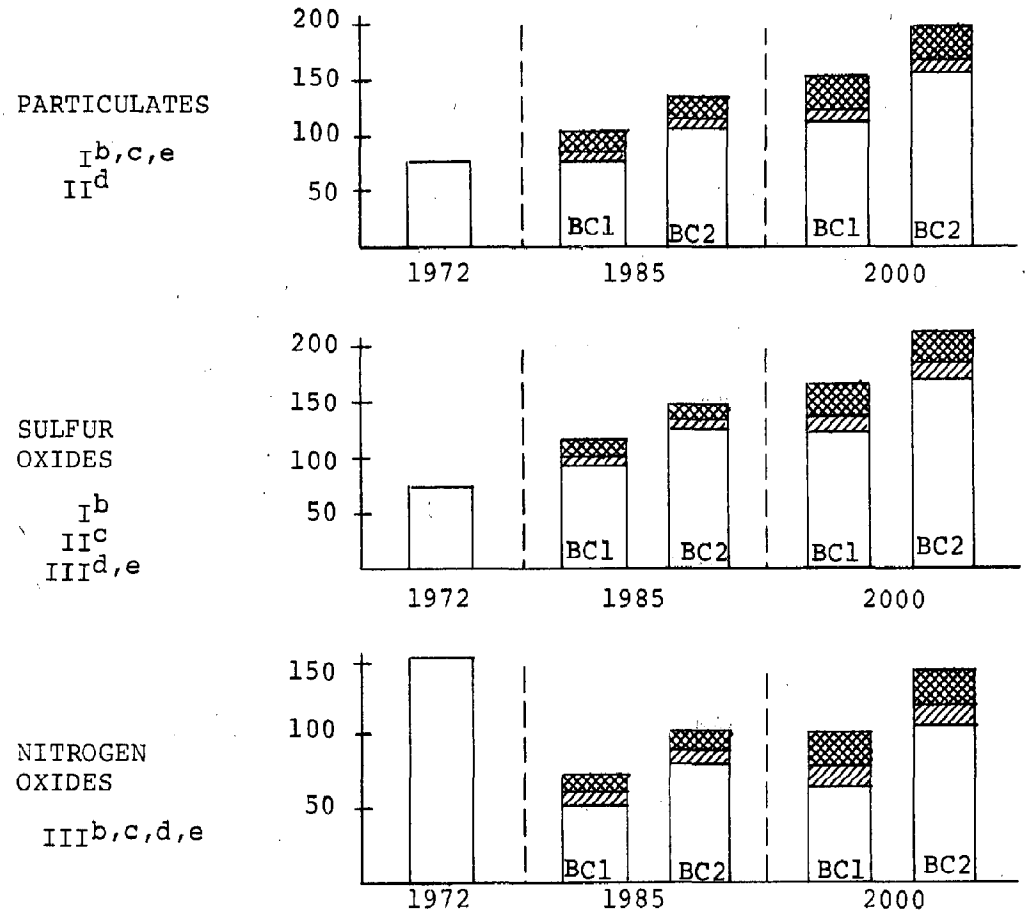
EXHIBIT 5A-20

SUMMARY OF IMPACTS - AIR POLLUTION LOADINGS [a]

(Thousand tons per year)

EASTERN S.C./EASTERN GA.

(Geographic Area)



[a]Refer to Appendix IX for a detailed discussion of the methodology for determination of each loading source and estimation of the control factors for each pollutant by geographic area.

BC 1: Base Case 1
BC 2: Base Case 2

EPA Air Quality Priority Classification for:
[b]Charleston Intrastate AQCR
[c]Augusta-Aiken Interstate AQCR
[d]Georgetown Intrastate AQCR
[e]Savannah-Beaufort Interstate AQCR

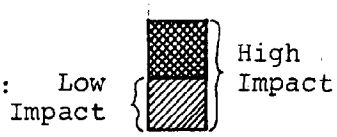


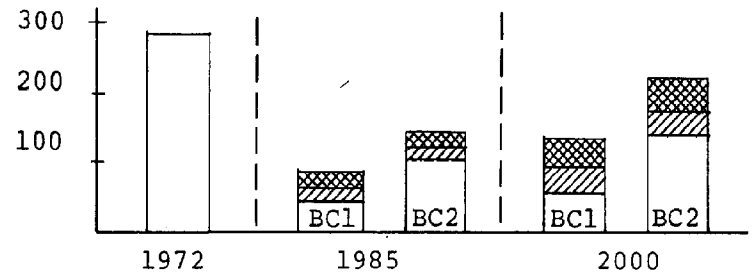
EXHIBIT 5A-20

SUMMARY OF IMPACTS - AIR POLLUTION LOADINGS (CONTINUED)[a]

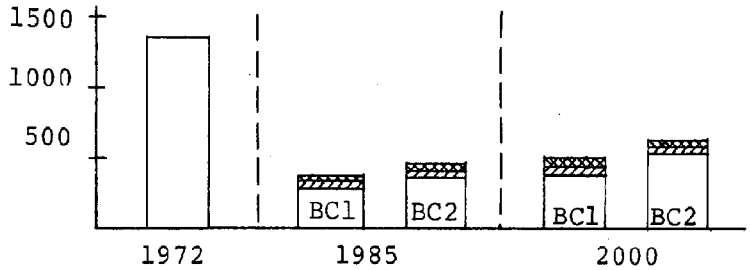
(Thousand tons per year)

EASTERN S.G./EASTERN GA.
(Geographic Area)

HYDROCARBONS
III[b,c,d,e]



CARBON MONOXIDE
III[b,c,d,e,]

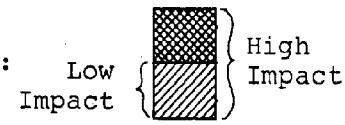


---

[a] Refer to Appendix IX for a detailed discussion of the methodology for determination of each loading source and estimation of the control factors for each pollutant by geographic area.

BC 1: Base Case 1
BC 2: Base Case 2

EPA Air Quality Priority Classification for:
[b] Charleston Intrastate AQCR
[c] Augusta-Aiken Interstate AQCR
[d] Georgetown Intrastate AQCR
[e] Savannah-Beaufort Interstate AQCR



locality, the mineral products industry and electric utilities are responsible for the majority of particulate air pollution.

Although three of the pollutant levels in the Charleston locality should decrease overall between now and 1985, the air pollution emission impacts should be relatively more significant than those in the New England and Mid-Atlantic demand areas. High OCS impacts over Base Case 2 have a wide range, from approximately 15 percent for carbon monoxide in 1985 to 50 percent for the hydrocarbons by the year 2000. Even though the impacts are significant for hydrocarbons and carbon monoxide, the total level of pollution loading will decrease from the 1972 levels due primarily to the emission controls required for mobile sources.

The most significant loading impacts in the Charleston locality are particulates and sulphur oxides. Charleston presently carries an air quality priority classification of I for particulates and sulphur oxides and the loading levels are predicted to increase almost three times under high OCS, Base Case 2 conditions for sulphur oxides by the year 2000. The primary sources of projected impact pollution loadings are induced fuel combustion and industrial process losses, as well as direct refinery and petrochemical process losses.

Because the Charleston locality constitutes a major portion of the total Eastern South Carolina/Eastern Georgia regional activity, the overall impacts are similar in nature to the locality, but somewhat less on a percentage basis. Once again, the potential impact of greatest concern appears to be particulates and sulphur oxides. Since the Georgetown Intrastate AQCR carries an air priority classification of II for particulates, it is expected that the increases in ambient air concentration of particulates in the rural areas should be less evident than in the more populated centers such as Charleston.

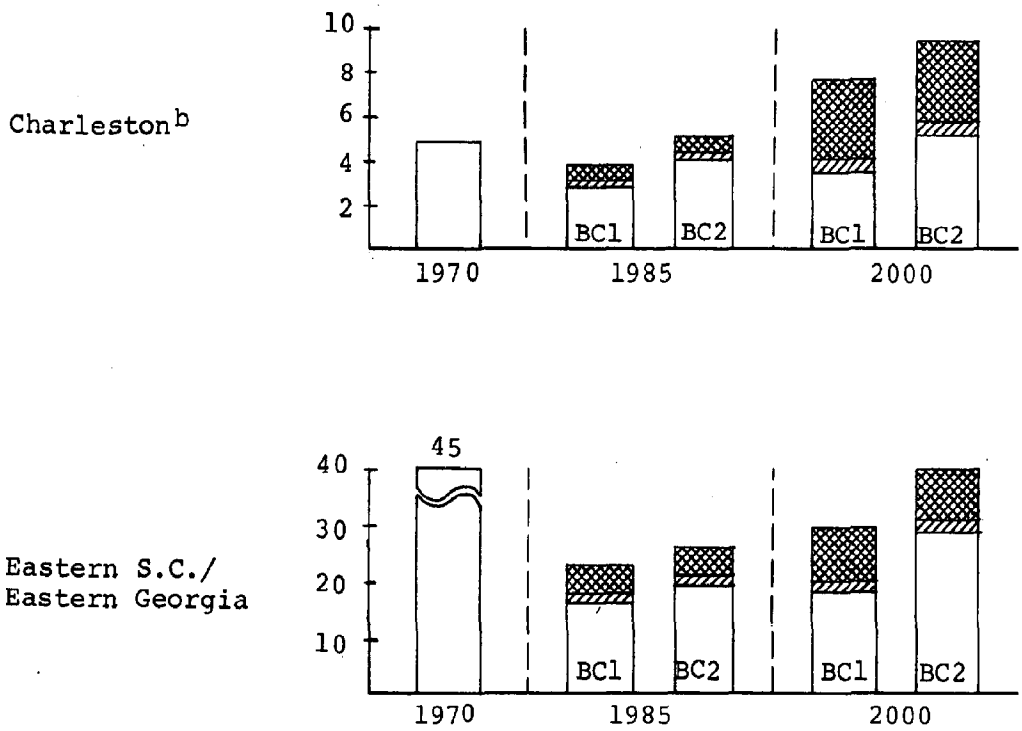
Water Pollution

Current BOD loadings for Charleston come mainly from municipal sewage treatment discharges (Exhibit 5A-21). Projected base case BOD loadings for 1985 and 2000 should decrease or remain approximately the same. However, under high OCS-induced development, these loadings could

EXHIBIT 5A-21

SUMMARY OF IMPACTS - BOD LOADING[a]
(Thousand tons per year)

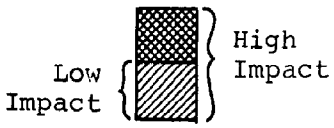
SOUTH ATLANTIC/CHARLESTON
(Geographic Area)



[a] Refer to Appendix IX for a detailed discussion of the methodology for determination of each loading source and estimation of the treatment factors for each region.

[b] Estimates may be low due to lack of data on the paper and allied products industry.

BC 1: Base Case 1
BC 2: Base Case 2



approximately double by the year 2000. The major contributors to the BOD under the high case would be petrochemicals and refining.

Over half of the BOD loadings in 1970 for the Eastern South Carolina/Eastern Georgia region come from the paper industry, while municipal sewage treatment discharges account for another 25 percent of the total loadings. The loading levels should be decreased by half in both base cases in 1985 and 2000 due to implementation of new treatment technologies. Under the high impact scenario the loadings should increase by as much as 35 percent in the year 2000, with over half of the additional loadings coming from refining and petrochemicals. However, the total loadings under the high impact case in the year 2000 are still projected to be less than the 1970 loadings.

SOURCES OF DATA

Socio-Economic

State of South Carolina
- Budget and Control Board
  - Division of Research & Statistic Services
- Employment Security Commission
- Department of Education
- Public Service Commission
- Division of Law Enforcement
- State Highway Department
- State Ports Authority

Berkeley-Charleston-Dorchester Regional Planning Commission
Charleston Chamber of Commerce
Southern Railroad Company
Seaboard Coastline Railroad Company

State of Georgia
- Bureau of State Planning and Community Affairs
- Department of Labor
  - Employment Security Agency

Land Use

Berkeley-Charleston-Dorchester Regional Planning Council, Preliminary Development Plan. June, 1973.

U.S. Department of Agriculture, Soil Conservation Service. Georgia Conservation Needs Inventory. April, 1970.

U.S. Department of Agriculture, Soil Conservation Service. South Carolina Conservation Needs Inventory. May, 1970.

Air & Water Pollution

TRW Systems Group. Emissions Inventory for the State of South Carolina. Springfield, Virginia. NTIS (PB 203 501) August, 1971.

SOURCES OF DATA (continued)

Wildlife and Vegetation

State of South Carolina

Department of Wildlife and Marine Resources.
State Ports Authority

U.S. Corps of Engineers, Environmental Research Branch. Environmental Reconnaissance Inventory of the Charleston District. January, 1974.

U.S. Department of Interior,Fish and Wildlife Service, Office of River Basin Studies. Wetlands of South Carolina. Appendix I. 1954.

U.S. Department of Interior, Fish and Wildlife Service, Office of River Basin Studies. Wetlands of Georgia. Appendix I. 1954.

B. NORTHEASTERN FLORIDA/SOUTHEASTERN GEORGIA

PROFILE OF CURRENT CONDITIONS

The five-county Jacksonville locality lies in Northeastern Florida, about 300 miles north of Miami and 200 miles southwest of Charleston, South Carolina (Exhibit 5B-1). The entire 3,218 square mile area consists of low-level coastal plain. Nassau, the northernmost county, is bordered on the north by Georgia and by Duval County on the south. Baker is the only county in the region with no coastline. Clay and St. John's Counties form the southern part of the locality.

The region is heavily forested with a bank of coastal salt marshes along the Georgia coastline and some areas of fresh water swamp alternating with general farmland further inland. Beaches along the coast around Jacksonville provide recreation for both residents and tourists. The region's major river is the St. Johns, which flows north, forming the border between Clay and St. Johns Counties, and then bisects Duval County before emptying into the Atlantic Ocean.

Jacksonville's climate is mild with short winters and warm summers. Average temperatures range from 55 degrees in December to 80 degrees in July. Rainfall is heavy, with an average of 51 inches per year.

Jacksonville is the only major urban development in the Northeastern Florida/Southeastern Georgia region. With 622,000 persons living within its five-county Standard Metropolitan Statistical Area (SMSA), it is the most heavily populated city in Florida. It also leads the state in area of developed land. In the 1960's Jacksonville expanded its transportation system and strengthened its industrial base. It is expected that the city's pace of growth will continue throughout the 1970's.

South of Jacksonville lies St. Augustine, a smaller urban center, but one that is also growing. Suburban growth has been taking place outside the heavily settled Duval County, especially in Clay County, where the population increased 64 percent between 1960 and 1970. In spite of this growth, the region remains for the most part undeveloped.

Although Jacksonville's mild climate attracts many retired senior citizens, the city's population is predominately

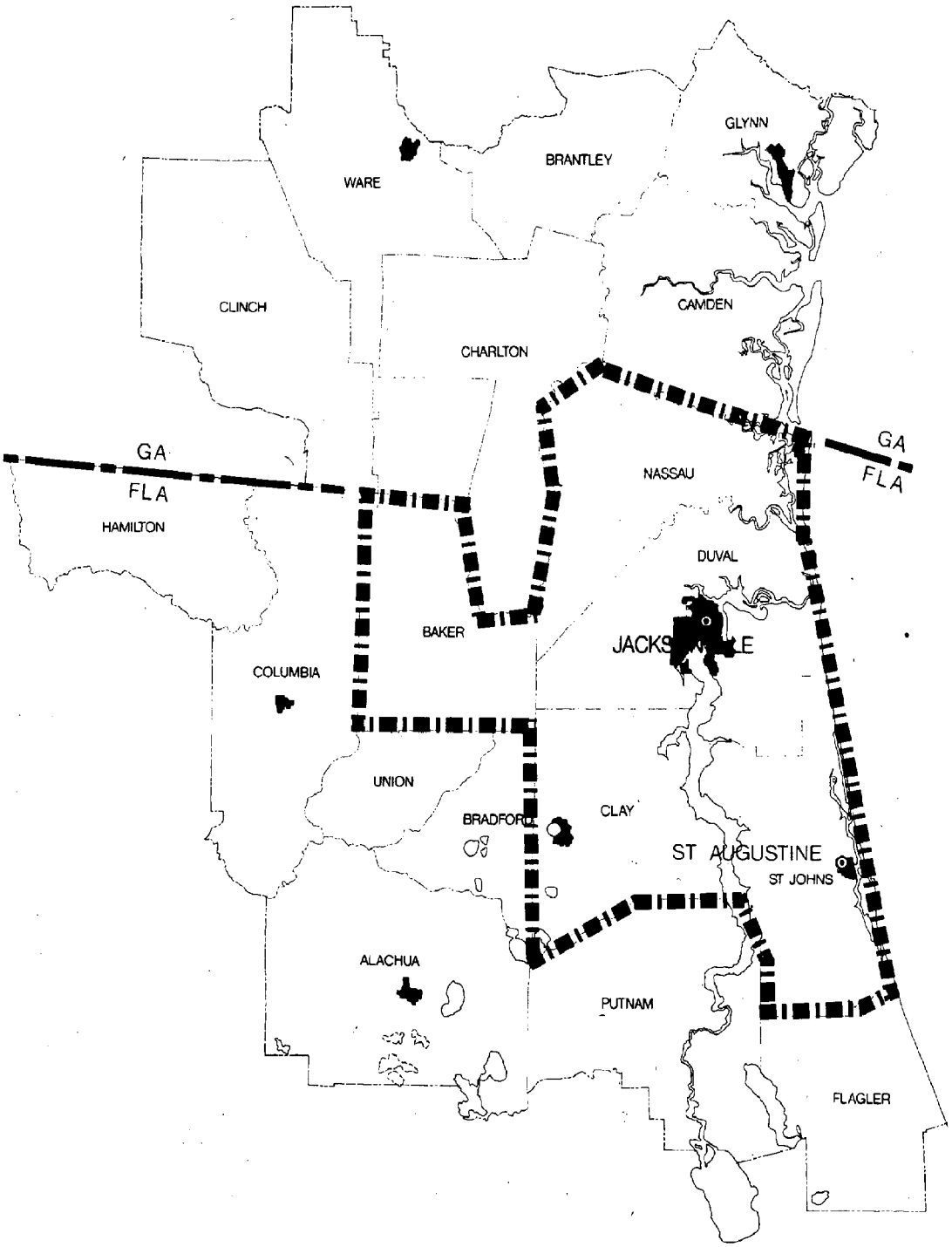


EXHIBIT 5B-1
NORTHEASTERN FLORIDA/SOUTHEASTERN GEORGIA REGION

N

RESOURCE PLANNING
ASSOCIATES INC.

young. In 1970 the median age was 26.0 years for Jacksonville; for the State of Florida, it was 32.3 years.

Jacksonville's civilian work force of 250,000 represents 40.2 percent of the population, a figure close to the national average. Unemployment in 1970 was a low 2.4 percent, and labor is in high supply in the rural areas surrounding the central city. However with manufacturing accounting for only 12 percent of total employment and the service sector accounting for 72 percent, 1970 per capita income reached only $3,689.

Employment in the manufacturing sector is equally spread among the following industries: food processing, tobacco, paper products, and chemicals. In the service sector, growth has centered mainly on finance and insurance. The city had 22,000, or about 11 percent of the work force, employed in these areas in April 1973. Jacksonville is also the administrative center for the region with 35,000 employees (or 17.6 percent of the work force) in state, local, and federal government positions, including the various naval installations. Given Jacksonville's large supply of office space, pleasant climatic conditions, and overall modernity of facilities, a continued increase in the number employed in finance and government is projected.

Jacksonville's location, port facilities, and transportation system make it the distribution center for the region. Four railroad systems, eighteen major freight carriers, and seven major airlines serve the city. Economically, in fact, Jacksonville dominates the region, providing 68 percent of the employment in the Northeast Florida/Southeast Georgia area. This region has a total population of 936,000. Average per capita income was $3,358 in 1970.

Within the Jacksonville SMSA, approximately 11 percent of the total land area is classified as developed. Taking the region as a whole, developed land comprises only 4 percent. Of the developed land, about 40 percent within the locality and 31 percent within the region is residential.

Jacksonville's air quality is rated as Class I for particulates and hydrocarbons, Class II for sulphur oxides, and Class III for nitrogen oxides and carbon monoxide. The emissions from several pulp mills in Duval County account for the high particulate loadings.

JACKSONVILLE AREA, FLORIDA

WILDLIFE AND VEGETATION PROTECTED AREAS

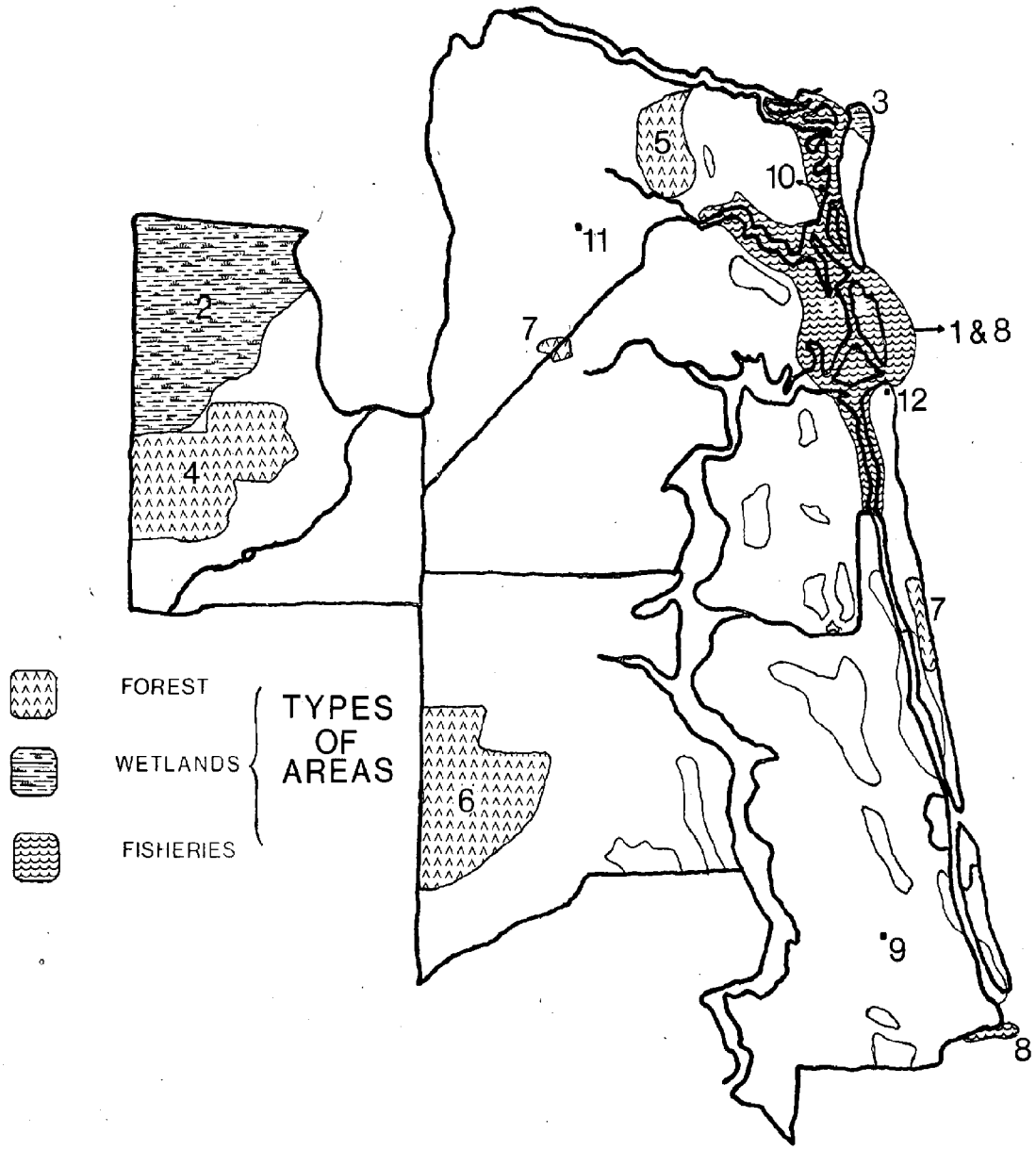


EXHIBIT 5B-2

EXHIBIT 5B-2 (cont.)

KEY JACKSONVILLE[a]

1. Florida Coastal Coordinating Council's selected freshwater (57,600 acres) and coastal salt marshes (64,600 acres)
2. Okefenokee Swamp and National Wildlife Refuge
3. Fort Clinch State Park,Amelia Island
4. Osceola National Forest
5. Nassau Game Management Area, 95,000 acres
6. Camp Blanding Game Management Area, 70,000 acres
7. Florida Coastal Coordinating Council's Wildlife Management areas (Cary State Forest and Guano Lake area)
8. Florida Coastal Coordinating Council's aquatic preserve areas
9. Welaka National Fish Hatchery
10. Sawpit Creek Sanctuary, 60 acres
11. Froitzheim Wilderness Sanctuary, 50 acres
12. Rollins Bird Sanctuary, 133 acres

[a] See Appendix X for a detailed description of the wildlife and vegetation of the local area as well as the region.

Note: Any outlined area which does not have a number or a symbol is a Florida Coastal Coordinating Council selected wetland.

The five county locality contains some 725,000 acres of wetlands; however, not all of them are of the type which is important in terms of either wildlife habitat or of estuarine activity. The Florida Coastal Coordinating Council has designated selected areas of coastal and fresh water marshes and water areas as areas to be preserved or conserved due to their ecological importance (Exhibit 5B-2).

Inland in Baker County lies the lower tip of the huge Okefenokee Swamp and National Wildlife Refuge as well as over half of the Osceola National Forest. Both of these areas support populations of such species as the American alligator and various other bog and swamp dwellers.

The Northeast Florida/Southeast Georgia region as a whole contains about 2 million acres of wetlands, most of them being wooded swamps. The Gainesville vicinity has several Florida Audubon Sanctuaries around its various lakes and ponds and the coastal region of Glyna County, Georgia, contains many acres of wildlife management land.

DEVELOPMENT ASSUMPTIONS

This section describes the base case and OCS production development assumed for the Northern Florida/Southeastern Georgia region for the oil refining, gas processing, petrochemicals, and construction sectors.[1]

Oil Refining

No development in the locality or region is assumed under Base Case 1. Even under Base Case 2 conditions, where a deepwater terminal is assumed for the South-Atlantic, the Jacksonville locality is assumed to account for only 180,000 of the 1.35 million barrels per day produced in the South Atlantic (Exhibit 5B-3). By the year 2000, the Jacksonville locality is assumed to produce 270,000, and the remaining Northern Florida/Southeastern Georgia region another 270,000 of the nearly 2.2 million barrels per day produced in the South Atlantic. The majority of base case production is assumed to occur in other South Atlantic cities closer to demand centers (e.g., in Georgia, South Carolina, and Virginia).

---

[1] The development of the offshore oil and gas recovery industry, which is treated similarly for each East Coast demand area, is described in Chapter 2.

EXHIBIT 5B-3

PROJECTED JACKSONVILLE/SOUTH ATLANTIC REFINERY DEVELOPMENT [a,b]

(million barrels/day)

	Base Case 1		Base Case 2		Low OCS		High OCS	
	1985	2000	1985	2000	1985	2000	1985	2000
Jacksonville, Fla. Locality	0	0	.18	.27	.15	.25	.25	.50
Northern Fla./ S.E. Ga. Region (not incl. local)	0	0		.27	0	0	0	.25
Other South Atlantic	.18	.18	1.17	1.62	.10	.25	.50	.75
Total	.18	.18	1.35	2.16	.25	.50	.75	1.50

[a] Refinery capacity is 10 percent larger than production, based on the assumption that refineries will operate at 90 percent capacity.

[b] Base case production is total, while low and high OCS production is incremental above base case.

Source: RPA estimates.

Under high OCS conditions, only one-third of the required South Atlantic refinery production is assumed to take place in the Jacksonville locality in both 1985 (250,000 barrels per day) and the year 2000 (500,000 barrels per day), with another 250,000 barrels per day being produced elsewhere in the region by the year 2000. If low OCS production occurs, only one refinery is assumed for the Jacksonville locality, producing 150,000 barrels per day in 1985 and expanding to 250,000 barrels per day in the year 2000. Like the base case, OCS refining production is assumed to be dispersed to other South Atlantic demand centers.

Gas Processing

The gas processing development assumptions for the Jacksonville/South Atlantic case are identical to those previously presented for Charleston, South Carolina. For completeness, Exhibit 5B-4 presents the projected gas processing development from offshore production.

EXHIBIT 5B-4

PROJECTED JACKSONVILLE/SOUTH ATLANTIC GAS PROCESSING DEVELOPMENT FROM OFFSHORE PRODUCTION

(billion cu. ft. per day)

	Low OCS		High OCS	
	1985	2000	1985	2000
Jacksonville, Fla. local	.3	1.8	.9	1.8
Northern Fla./Southeastern Georgia Region (not incl. local)	0	0	0	1.8
Total	.3	1.8	.9	3.6

Source: RPA estimates.

Petrochemicals

No petrochemical development is assumed in the South Atlantic under Base Case 1. Under Base Case 2 (see Exhibit 5B-5), extensive development is assumed in the South Atlantic due to the availability of refinery feedstocks in an area that should account for an increasing proportion of intermediate petrochemicals manufacturing facilities. However, none of this activity is assumed to occur in the Jacksonville locality or the Northeastern Florida/Southeastern Georgia region in 1985, and of the 17 billion pound per year complexes assumed for the South Atlantic in the year 2000, only three are assumed in the locality and another two elsewhere in the region.

Only under high OCS production conditions in the year 2000 is significant petrochemical manufacture assumed for the Jacksonville locality. Four of the 11 complexes projected for the South Atlantic are assumed to be developed in the local area, with another two elsewhere in the region. There is no incremental petrochemical development projected in the South Atlantic under low OCS conditions.

Construction

As previously mentioned, the South Atlantic demand area is expected to have the highest industrial growth impact from OCS development (especially in the petrochemical sector) of any of the demand area analyzed. However, a significant portion of the construction required to support this growth should be completed prior to 1985. Under high OCS conditions in 1985, the construction impact should be nearly $300 million in the Jacksonville locality and over $430 million in the Northeast Florida/Southeast Georgia Region (Exhibit 5B -6). This impact represents about a 30 percent increase over base case conditions, and should almost equal the rest of the combined primary industry output for the region as a whole. By the year 2000, with no heavy construction projected, total construction (all of it induced) should drop to $108 million for the locality and $174 million for the region as a whole.

Low OCS impacts should be less than 20 percent of the high impacts for the Jacksonville locality and about one-eighth of the high impacts for the region as a whole. Appendix V discusses construction assumptions in greater detail.

EXHIBIT 5B-5

PROJECTED JACKSONVILLE/SOUTH ATLANTIC PETROCHEMICAL PRODUCTION[a]

(Number of billion lb./yr. olefins complexes)

	Base Case 2		Low OCS		High OCS	
	1985	2000	1985	2000	1985	2000
Jacksonville, Florida locality	0	2.7	0	0	0	4.2
Northeastern Fla./ Southeast Georgia region (not incl. local)	0	1.8	0	0	0	1.6
Other South Atlantic	6.2	12.1	0	0	1.5	4.8
Total	6.2	16.6	0	0	1.5	10.6

[a]Base Case 2 production is total, while low and high OCS production is incremental above Base Case 2.

Source: RPA estimates.

EXHIBIT 5B-6

VALUE OF CONSTRUCTION OUTPUT[a]
($ million)

SOUTH ATLANTIC/JACKSONVILLE

Geographic Area	1970 Actual	1985			2000		
		Base Case[b]	Low OCS	High OCS	Base Case[b]	Low OCS	High OCS
JACKSONVILLE							
Refinery			29	92		0	0
Gas Processing			0	7		0	0
Petrochemical			11	118		0	0
Induced[c]			10	54		20	108
Total Local	416	830 [d]	50	271	1139 [d]	20	108
N.E. FLORIDA, S.E. GEORGIA							
Refinery			29	164		0	0
Gas Processing			0	20		0	0
Petrochemical			11	163		0	0
Induced[c]			10	87		20	174
Total Region	564	830 [e]	50	434	1381[e]	20	174

[a] Base Case total and OCS incremental. Appendix V describes the methods used in determining these values

[b] Base Case 1 for East Coast

[c] Other industrial, commercial, and residential construction activity induced by the direct industry activities

[d] Base Case 2: 1985 = 954
2000 = 1431

[e] Base Case 2: 1985 = 1139
2000 = 1504

Source: RPA estimates.

IMPACTS

This section discusses the impact that could occur in the 5-county Jacksonville locality and the Northeastern Florida/Southeastern Georgia region from offshore oil and gas development. The economic, social, land use, air and water pollution impacts are discussed in the following pages.

Economic

As was the case in Charleston, the economic growth assumptions for the Jacksonville SMSA differ substantially as a function of the specific base case assumptions (Exhibit 5B-7). However, even under Base Case 1, the 214,000 new jobs that would exist by the year 2000 (an increase of 88 percent over the 1970 level) represent both the biggest absolute and percentage increase projected for any East Coast demand area. Under Base Case 2 assumptions, employment in the year 2000 is estimated to reach 504,000 -- a 107 percent increase over 1970.

Two factors account for the differences between Base Case 1 and 2 employment estimates for the year 2000. First, an increase in refining, petrochemical, and construction activity within the SMSA directly accounts for 6,000 more jobs and induces a substantially greater activity in other sectors. Second, much of the activity induced by other primary development in the region should occur in Jacksonville since, as was the case in Charleston, it is the only metropolitan area in the region.

Since the Jacksonville locality represents such a large fraction of the region (66 percent of the 1970 population), the variations between Base Case 1 and 2 assumptions affect the region in much the same way as they do in the locality (Exhibit 5B-8). In fact, the projections show that under either Base Case, approximately 88 percent of the total 2000 regional employment would be located in the local SMSA. The corresponding figure for 1970 is only 68 percent.

Against this background, the following sections present the anticipated primary and aggregate impacts.

Primary Impacts

As would be true for both the Charleston, S.C., and

EXHIBIT 5B-7

SUMMARY OF BASE CASE ECONOMIC CONDITIONS

JACKSONVILLE

A. EMPLOYMENT (thousands)

Sector	Actual	Base Case 1		Base Case 2	
	1970	1985	2000	1985	2000
Construction	13.0	22.0	31.0	25.8	32.5
Ref., Gas, Petrochem.	0	0	0	.5	4.4
Other Manufacturing	29.0	53.0	59.0	59.7	70.5
Agriculture	4.0	2.0	4.0	2.1	4.1
Utilities	22.0	36.0	47.0	37.9	50.9
Services	176.0	265.0	317.0	279.0	341.7
TOTAL	244.0	378.0	458.0	405.0	504.1

B. VALUE OF OUTPUT ($ million)[a]

Sector	Actual	Base Case 1		Base Case 2	
	1970	1985	2000	1985	2000
Construction	416	830	1381	954	1431
Ref., Gas, Petrochem.	0	0	0	330	1196
Other Manufacturing	1000	2504	3795	2819	4534
Agriculture	56	42	128	44	131
Utilities	648	1382	2338	1455	2533
Services	3051	5745	8591	6049	9261
TOTAL	5171	10503	16233	11651	19086

Codes - * = negligible
: = infinite percentage since base case is zero

[a]All dollar figures are 1970 constant dollars.

Source: RPA estimates

EXHIBIT 5B-8

SUMMARY OF BASE CASE ECONOMIC CONDITIONS

N.E. FLORIDA/S.E. GEORGIA

A. EMPLOYMENT (thousands)

Sector	Actual	Base Case 1		Base Case 2	
	1970	1985	2000	1985	2000
Construction	17.6	22.0	31.0	31.4	34.7
Ref., Gas, Petrochem.	0	0	0	.5	7.6
Other Manufacturing	50.0	63.0	70.0	72.6	86.4
Agriculture	14.0	10.0	9.0	10.3	9.4
Utilities	26.6	36.0	47.0	38.8	52.6
Services	250.7	327.0	370.0	347.6	406.2
TOTAL	358.9	458.0	527.0	501.2	596.9

B. VALUE OF OUTPUT ($ million)[a]

Sector	Actual	Base Case 1		Base Case 2	
	1970	1985	2000	1985	2000
Construction	564	830	1381	1139	1504
Ref., Gas, Petrochem.	0	0	0	330	2159
Other Manufacturing	1798	2976	4502	3428	5556
Agriculture	195	211	288	217	300
Utilities	783	1382	2338	1487	2616
Services	4347	7089	10027	7537	11009
TOTAL	7687	12488	18536	14138	23144

Codes - * = negligible
: = infinite percentage since base case is zero

[a]All dollar figures are 1970 constant dollars.

Source: RPA estimates

Bristol County, Mass., localities, the biggest primary employment impact in 1985 would occur in the construction sector. Here over 8,000 new jobs would be created within the Jacksonville locality and over 13,000 in the Northeast Florida/Southeast Georgia region (Exhibit 5B-9). By the year 2000, construction employment is expected to fall off to just over 3,000 in the locality and 5,000 in the region. However, the petrochemical industry would contribute between 6,000 and 8,000 new jobs in both the locality and the region. This would result in small increases in total primary employment in both the locality and region between 1985 and 2000.

Again, as in Charleston, the absence of any petrochemical activity in either the locality or the region would result in substantially smaller total primary employment figures under low impact assumptions. In fact, all new primary jobs would occur in the local areas, comprising only 2,000 in 1985 and a little over 1,000 in the year 2000, when construction is expected to fall off.

Aggregate Impacts

In the Jacksonville SMSA, under high impact conditions, 37,000 new jobs are projected in 1985 and 59,000 in the year 2000, 9 to 13 percent above base case (Exhibit 5B-10). The comparable figures for the low impact case are 10,000 and 9,000 respectively, 2 to 3 percent above base case (Exhibit 5B-11). These employment impacts are approximately 20,000 jobs lower than for the Charleston locality under its high impact case and 4,000 lower under its low case. On a percentage basis, the impacts are relatively small and comparable with those in Bristol County, Mass.

The distribution of new jobs among sectors is similar to the pattern in other areas, with services projected to lead in absolute numbers and construction in percentages. Unlike the Charleston locality, the projected 37 percent increase in construction employment in Jacksonville does not seem large enough to suggest a possible labor shortage. In fact, one could expect that skilled workers from other parts of Florida could fill any short-term needs.

An unusual situation exists in the Northeast Florida/Southeast Georgia region where the impacts from high OCS conditions are actually larger on a percentage basis than in the Jacksonville local area (Exhibit 5B-12). The 54,000 new jobs in 1985 and the 85,000 in the year 2000 represent

EXHIBIT 5B-9

PRIMARY ECONOMIC IMPACTS

SOUTH ATLANTIC/JACKSONVILLE

A. EMPLOYMENT (thousands) HIGH IMPACT

	1985			2000		
	Local	Region[a]	Area[b]	Local	Region[a]	Area[b]
Oil and Gas Rec.	0	0	7.5	0	0	4.1
Gas Processing	.1	.1	0	.1	.2	0
Refineries	.8	.8	1.5	1.1	1.7	1.7
Petrochemical	0*	0	2.7	6.0	8.3	6.8
Construction	8.2	13.2	3.6	3.3	5.3	1.4

B. VALUE OF OUTPUT (millions 1970 dollars) HIGH IMPACT

	1985			2000		
	Local	Region[a]	Area[b]	Local	Region[a]	Area[b]
Oil and Gas Rec.	0	0	361	0	0	156
Gas Processing	24	24	0	48	95	0
Refineries	462	462	924	924	1386	1386
Petrochemical	0	0	390	1092	1508	1248
Construction	271	435	117	108	174	46

Code: * = negligible

[a] Region includes Local

[b] Area is "Demand Area" exclusive of the Region

Source: RPA estimates

EXHIBIT 5B-9 (cont.)

PRIMARY ECONOMIC IMPACTS

SOUTH ATLANTIC/JACKSONVILLE

C. EMPLOYMENT (thousands) LOW IMPACT

	1985			2000		
	Local	Region[a]	Area[b]	Local	Region[a]	Area[b]
Oil and Gas Rec.	0	0	3.3	0	0	1.5
Gas Processing	*	*	0	.1	.1	0
Refineries	.5	.5	.3	.6	.6	.6
Petrochemical	0	0	0	0	0	0
Construction	1.5	1.5	0	.6	.6	0

D. VALUE OF OUTPUT (millions 1970 dollars) LOW IMPACT

	1985			2000		
	Local	Region[a]	Area[b]	Local	Region[a]	Area[b]
Oil and Gas Rec.	0	0	161	0	0	58
Gas Processing	8	8	0	48	48	0
Refineries	281	281	181	462	462	462
Petrochemical	0	0	0	0	0	0
Construction	50	50	0	20	20	0

Code: * = negligible

[a] Region includes Local

[b] Area is "Demand Area" exclusive of the Region

Source: RPA estimates

EXHIBIT 5B-10

AGGREGATE ECONOMIC IMPACTS

JACKSONVILLE

HIGH IMPACT

A. EMPLOYMENT (thousands)

Sector	1985	Percent Over B.C. 1	Percent Over B.C. 2	2000	Percent Over B.C. 1	Percent Over B.C. 2
Construction	8.2	37	32	3.3	11	10
Ref. Gas, Petrochem.	.9	:	158	7.2	:	162
Other Manufacturing	7.0	13	12	12.9	22	18
Agriculture	.1	3	3	.1	2	2
Utilities	2.0	5	5	4.5	9	9
Services	18.8	7	7	30.7	10	9
TOTAL	37.0	10	9	58.7	13	12

B. VALUE OF OUTPUT ($ million)[a]

Sector	1985	Percent Over B.C. 1	Percent Over B.C. 2	2000	Percent Over B.C. 1	Percent Over B.C. 2
Construction	271	33	28	108	8	8
Ref., Gas, Petrochem.	486	:	147	2064	:	172
Other Manufacturing	331	13	12	831	22	18
Agriculture	1	3	3	3	2	2
Utilities	75	5	5	222	9	9
Services	408	7	7	833	10	9
TOTAL	1572	15	14	4061	25	21

Codes - * = negligible
: = infinite percentage since base case is zero

[a]All dollar figures are 1970 constant dollars.

Source: RPA estimates

EXHIBIT 5B-11

AGGREGATE ECONOMIC IMPACTS

JACKSONVILLE
LOW IMPACT

A. EMPLOYMENT (thousands)

Sector	1985	Percent Over B.C. 1	Percent Over B.C. 2	2000	Percent Over B.C. 1	Percent Over B.C. 2
Construction	1.5	7	6	.6	2	2
Ref., Gas, Petrochem.	.5	:	91	.6	:	15
Other Manufacturing	1.7	3	3	1.5	3	2
Agriculture	*	1	1	*	*	*
Utilities	.6	2	2	.7	1	1
Services	5.5	2	2	5.1	2	1
TOTAL	9.8	3	2	8.5	2	2

B. VALUE OF OUTPUT ($ million)[a]

Sector	1985	Percent Over B.C. 1	Percent Over B.C. 2	2000	Percent Over B.C. 1	Percent Over B.C. 2
Construction	50	6	5	20	1	1
Ref.,Gas, Petrochem.	289	:	88	510	:	43
Other Manufacturing	79	3	3	97	3	2
Agriculture	*	1	1	1	*	*
Utilities	23	2	2	33	1	1
Services	118	2	2	138	2	1
TOTAL	559	5	5	799	5	4

Codes - * = negligible
: = infinite percentage since base case is zero

[a]All dollar figures are 1970 constant dollars.

Source: RPA estimates

EXHIBIT 5B-12

AGGREGATE ECONOMIC IMPACTS

N.E. FLORIDA/S.E. GEORGIA

HIGH IMPACT

A. EMPLOYMENT (thousands)

Sector	1985	Percent Over B.C. 1	Percent Over B.C. 2	2000	Percent Over B.C. 1	Percent Over B.C. 2
Construction	13.2	60	42	5.3	17	15
Ref. Gas, Petrochem.	.9	:	158	10.1	:	133
Other Manufacturing	9.8	16	14	18.1	26	21
Agriculture	.3	3	3	.4	5	5
Utilities	2.7	8	7	6.3	13	12
Services	27.0	8	8	44.4	12	11
TOTAL	53.9	12	11	84.6	16	14

B. VALUE OF OUTPUT ($ million)[a]

Sector	1985	Percent Over B.C. 1	Percent Over B.C. 2	2000	Percent Over B.C. 1	Percent Over B.C. 2
Construction	435	52	38	174	13	12
Ref., Gas, Petrochem.	486	:	147	2989	:	138
Other Manufacturing	464	16	14	1166	26	21
Agriculture	6	3	3	14	5	5
Utilities	105	8	7	311	13	12
Services	586	8	8	1204	12	11
TOTAL	2082	17	15	5858	32	25

Codes - * = negligible
: = infinite percentage since base case is zero

[a]All dollar figures are 1970 constant dollars.

Source: RPA estimates

EXHIBIT 5B-13

AGGREGATE ECONOMIC IMPACTS

N.E. FLORIDA/S.E. GEORGIA

LOW IMPACT

A. EMPLOYMENT (thousands)

Sector	1985	Percent Over B.C. 1	Percent Over B.C. 2	2000	Percent Over B.C. 1	Percent Over B.C. 2
Construction	1.5	7	5	.6	2	2
Ref., Gas, Petrochem.	.5	:	91	.7	:	9
Other Manufacturing	2.3	4	3	2.1	3	2
Agriculture	.1	1	1	.1	1	1
Utilities	.8	2	2	.9	2	2
Services	7.6	2	2	7.1	2	2
TOTAL	12.8	3	3	11.4	2	2

B. VALUE OF OUTPUT ($ million)[a]

Sector	1985	Percent Over B.C. 1	Percent Over B.C. 2	2000	Percent Over B.C. 1	Percent Over B.C. 2
Construction	50	6	4	20	1	1
Ref.,Gas, Petrochem.	289	:	88	510	:	24
Other Manufacturing	107	4	3	133	3	2
Agriculture	2	1	1	2	1	1
Utilities	31	2	2	44	2	2
Services	165	2	2	194	2	2
TOTAL	643	5	5	903	5	4

Codes - * = negligible
: = infinite percentage since base case is zero

[a]All dollar figures are 1970 constant dollars.

Source: RPA estimates

between an 11 and 16 percent increase over base case conditions, versus 9 and 13 percent, respectively, for the locality. This differential stems entirely from the construction sector which shows more than a 60 percent greater employment impact in the region than in the locality. These workers would be engaged in the construction of refinery, gas processing, and petrochemical plants projected between the years 1985 and 2000.

The low impact conditions, on the other hand, do not differ substantially between the region and the locality (Exhibit 5B-13).

Social Infrastructure

The Jacksonville locality has a well developed base of commercial industry and should experience a healthy population growth in the future. Under Base Case 1 conditions, its population is expected to increase from 662,000 in 1970 to 915,000 in 1985. After 1985 its growth is expected to taper off, so that by the year 2000 1.07 million should reside in the local area. Base Case 2 growth would add 5 percent to Base Case 1, and OCS impacts would increase this growth by another 9 percent in 1985. In the year 2000 Base Case 2 would be 10 percent over Base Case 1, and an OCS high impact would add another 10 percent. Low OCS population impacts are about one-third of high in 1985, and one-sixth by the year 2000 (Exhibit 5B-14).

Jacksonville's officials appear to have successfully coped with the strains that arise from rapid population increases and the concommitant expansion of public services. Many of the facilities and services necessary for future growth appear to be in place. Thus, it seems reasonable that OCS development should not place an excessive strain on the existing social structure.

In other localities and regions of this study, OCS development is expected to require new schools, hospitals, electrical power plants, public water supplies, and other facilities. Instead of new construction, Jacksonville's needs would probably center either on the expansion of existing structures or on enlarging, by 10 percent, the facilities originally planned under its normal projections for growth.

Demand for electrical generation capacity from high

EXHIBIT 5B-14

JACKSONVILLE
(Geog. Area)

SOCIAL INFRASTRUCTURE IMPACT

	1970	1985		Incr.		2000		Incr.	
		Base Case 1	Base Case 2	High Impact	Low Impact	Base Case 1	Base Case 2	High Impact	Low Impact
POPULATION (000)	622	915	965	82.3	23.7	1069	1150	111.2	17.5
Percent Change %[a]				9/8.5	3/2.5			10.4/9.7	1.6/1.5
PHYSICAL SYSTEMS									
Water Demand Mil. gallons/day	93.3	156	164	14	4	203	218	21	3
Elec. Demand (% of Capacity)	NA	NA	NA	245	99	NA	NA	1030	142
Structures Residential (000)	187	274	289	25	7	321	345	33	5
Commercial (millions of sq. ft.)	15.6	22.9	24.1	2.0	.6	26.7	28.8	2.8	.5
SOCIAL SYSTEMS									
Schools - Enrollees (000)	168	247	260	23	7	289	310	30	4
Hospitals - Beds	2303	3385	3570	303	89	3955	4255	411	67
Police - Manpower	908	1336	1409	120	35	1561	1679	162	26
Solid Waste - Tons/Day	1866	2745	2894	247	71	3207	3450	334	53
Sewage - Mil.gal/day	74.6	110	116	10	3	128	138	13	2
Gov't. OH - ($000,000)	47.6	70.2	74.1	6.3	1.8	82.1	88.3	8.5	1.4
BUSINESS & GOVERNMENT INSTIT.									
Business Services - Employee (000)	127.4	186.7	196.7	16.7	4.8	218.1	234.6	22.7	3.6
Government - Employee (000)	20.4	29.9	31.5	2.7	.8	34.9	37.6	3.6	.6

[a] The percentage changes are indicated as follows:

Impact Case over Base Case 1/ Impact Case over Base Case 2

Source: RPA estimates.

OCS impacts in 1985 would be 245 Megawatts or the equivalent of one-fourth of an average 1000 Megawatt plant. By the year 2000, high OCS impacts would require the equivalent of one full new power plant, which should cost approximately $220 million (in 1973 dollars).

Twenty-three thousand new students would be added to the school population under high impact by 1983, but this number would be added to an already large base of school age children. Somewhat larger, rather than new, schools would probably be required.

In health services, the need for additional hospital beds translates into one medium-sized hospital containing 300 beds in 1985 under high impacts. In all probability the needed bed requirement could be met by expansion of existing hospitals.

Additional government overhead should not be a concern in the Jacksonville locality. There will be a need for more funds for planning and personnel, but these should not be required to implement new activities. The government overhead increment from OCS should involve a slight addition of manpower and funds to an already existing set of agencies.

Land Use

There appears to be adequate land available regionally and locally for base case and OCS-induced development. Inland locations, especially outside the Jacksonville locality, seem to be most attractive for primary industry development.

In the Jacksonville locality, Base Case 2 development is expected to reduce the percentage of undeveloped land from 89.1 percent in 1970 to 81 percent by the year 2000 (Exhibit 5B-15). OCS-related development, under high assumption levels, would drop undeveloped land another 1.5 percentage points. The most intensive land use would require 196,500 acres to meet the needs of both Base Case 2 development and OCS high production.

Percentage-wise, the region as a whole is less developed than the locality. Thus, the land use impact would be less severe. For instance, as shown in Exhibit 5B-16, from a current level of 94.9 percent, undeveloped land would

EXHIBIT 5B-15

LAND USE SUMMARY

LOCALITY : JACKSONVILLE

Summary in Thousands of acres		1970	Year 1985				Year 2000			
		Actual Development	Base Case 1 Development	Base Case 2 Development	OCS Low* Development	OCS High* Development	Base Case 1 Development	Base Case 2 Development	OCS Low* Development	OCS High* Development
Land Use Classification	DEVELOPED LAND	225.4	321.9	338.1	7.8 (1) 8.1 (2)	25.4 (1) 24.7 (2)	365.9	389.3	5.6 (1) 5.5 (2)	33.3 (1) 32.6 (2)
	. residential	90.0	124.1	128.5	2.0 (1) 2.3 (2)	7.1 (1) 6.5 (2)	136.7	141.2	.8 (1) .8 (2)	6.0 (1) 5.6 (2)
	. commercial industrial	21.2	29.3	31.9	1.4 (1) 1.4 (2)	3.2 (1) 3.1 (2)	32.4	36.4	1.5 (1) 1.4 (2)	6.9 (1) 6.6 (2)
	. other	114.2	168.5	177.7	4.4	15.1	196.8	211.7	3.3	20.4
	UNDEVELOPED LAND	1,838.2	1,741.7	1,725.5	1,733.9 (1) 1,717.4 (2)	1,716.3 (1) 1,700.8 (2)	1,697.7	1,674.3	1,692.1 (1) 1,668.8 (2)	1,664.4 (1) 1,641.7 (2)
	TOTAL ACREAGE	2,063.6								

* incremental acreage only. If two figures, number in parentheses refers to base case.

Summary in Percent		1970	Year 1985**				Year 2000**			
		Actual Development	Base Case 1 Development	Base Case 2 Development	OCS Low Above B.C.2	OCS High Above B.C.2	Base Case 1 Development	Base Case 2 Development	OCS Low Above B.C.2	OCS High Above B.C.2
Land Use Classification	DEVELOPED LAND	10.9	15.6	16.4	16.8	17.6	17.7	18.9	19.1	20.4
	. residential	4.4	6.0	6.2	6.3	6.5	6.6	6.8	6.9	7.1
	. commercial industrial	1.0	1.4	1.5	1.6	1.7	1.6	1.8	1.8	2.1
	. other	5.5	8.2	8.6	8.8	9.3	9.5	10.3	10.4	11.2
	UNDEVELOPED LAND	89.1	84.4	83.6	83.2	82.4	82.3	81.1	80.9	79.6

** Impacts of OCS developments indicated only above Base Case 2.

Source: RPA estimates.

EXHIBIT 5B-16

LAND USE SUMMARY

REGION : NE FLORIDA/SE GEORGIA

Summary in Thousands of acres		1970	Year 1985				Year 2000			
		Actual Development	Base Case 1 Development	Base Case 2 Development	OCS Low* Development	OCS High* Development	Base Case 1 Development	Base Case 2 Development	OCS Low* Development	OCS High* Development
Land Use Classification	DEVELOPED LAND	371.0	433.5	465.9	11.5 (1) 11.9 (2)	43.2 (1) 39.9 (2)	465.9	519.0	10.7 (1) 8.5 (2)	64.9 (1) 59.3 (2)
	. residential	138.2	168.4	174.9	2.2 (1) 2.8 (2)	9.4 (1) 7.1 (2)	177.9	187.5	3.1 (1) 1.2 (2)	11.5 (1) 8.1 (2)
	. commercial industrial	46.8	52.6	57.2	1.9 (1) 1.7 (2)	4.8 (1) 3.8 (2)	54.1	64.5	1.8 (1) 1.5 (2)	12.3 (1) 10.1 (2)
	. other	186.0	212.5	233.8	7.4	29.0	233.9	267.0	5.8	41.1
	UNDEVELOPED LAND	6,837.0	6,774.5	6,742.1	6,763.0 (1) 6,730.2 (2)	6,731.3 (1) 6,702.2 (2)	6,742.1	6,689.0	6,731.4 (1) 6,671.4 (2)	6,624.1 (1) 6,629.7 (2)
	TOTAL ACREAGE	7,208.0								

* incremental acreage only. If two figures, number in parentheses refers to base case.

Summary in Percent		1970	Year 1985**				Year 2000**			
		Actual Development	Base Case 1 Development	Base Case 2 Development	OCS Low Above B.C.2	OCS High Above B.C.2	Base Case 1 Development	Base Case 2 Development	OCS Low Above B.C.2	OCS High Above B.C.2
Land Use Classification	DEVELOPED LAND	5.1	6.0	6.5	6.6	7.0	6.5	7.2	7.4	8.0
	. residential	1.9	2.3	2.4	2.5	2.5	2.5	2.6	2.6	2.7
	. commercial industrial	.6	.7	.8	.8	.8	.8	.9	1.0	1.0
	. other	2.6	2.9	3.2	3.3	3.6	3.2	3.7	3.8	4.3
	UNDEVELOPED LAND	94.9	94.0	93.5	93.4	93.0	93.5	92.8	92.6	92.0

** Impacts of OCS developments indicated only above Base Case 2.

Source: RPA estimates.

EXHIBIT 5B-17

UNDEVELOPED LAND CAPABILITIES

Region: N.E. FLA./S.E. GA.

	Thousands of Acres		Percent
. TOTAL UNDEVELOPED LAND[a]		6,837.0	100
. UNAVAILABLE LAND DUE TO ENVIRONMENTAL CONSTRAINTS		3,636.7	53.2
. existing and projected uses	567.5		
. coastal zoning and improvements	919.9[h]		
. excessive slope (> 15%)	0		
. wetlands	2,149.3		
. water resources	~~YES~~ - NO[i]		
. UNSUITABLE LAND DUE TO LOCATIONAL CONSTRAINTS[b]		1,377.3	20.1
. excessive slope (> 5%)	0		
. distance (> 30 minutes)	1,377.3		
. water requirements	YES - ~~NO~~[j]		
. TOTAL REMAINING DEVELOPABLE LAND[c]		1,823.0	26.7
. TOTAL LAND USE REQUIREMENTS[d]		207.3	
. total direct land use[e]	13.2		
. total induced land use[f]	194.1		
residential	57.4		
commercial/industrial[g]	14.6		
other developed land	122.1		

[a]Refer to land use summary exhibits for each region. Total undeveloped land figure corresponds to 1970 data.
[b]Where overlap with land unavailable due to environmental constraints, only incremental value is considered.
[c]Land suited for primary industrial activities, e.g., refineries, petrochemical complexes, etc., but competing with other uses, e.g., residential, commercial, light industrial, agricultural, etc. ("general development").
[d]Total Land Use Requirements corresponds to worst possible case by year 2000 (in general, base case 2 combined with high level OCS development).
[e]Refer to Exhibit VIII-5, Total Direct Land Use. Corresponds to maximum primary development.
[f]Refer to land use summary exhibits for each region. Corresponds to worst possible case by year 2000.
[g]Excluding primary industrial land.
[h]Florida coastal zoning only.
[i]"No" indicates that water resource impoundment areas have not been included in the above acreages.
[j]"No" indicates that water supply from conventional sources is likely to be inadequate.

Source: RPA estimates.

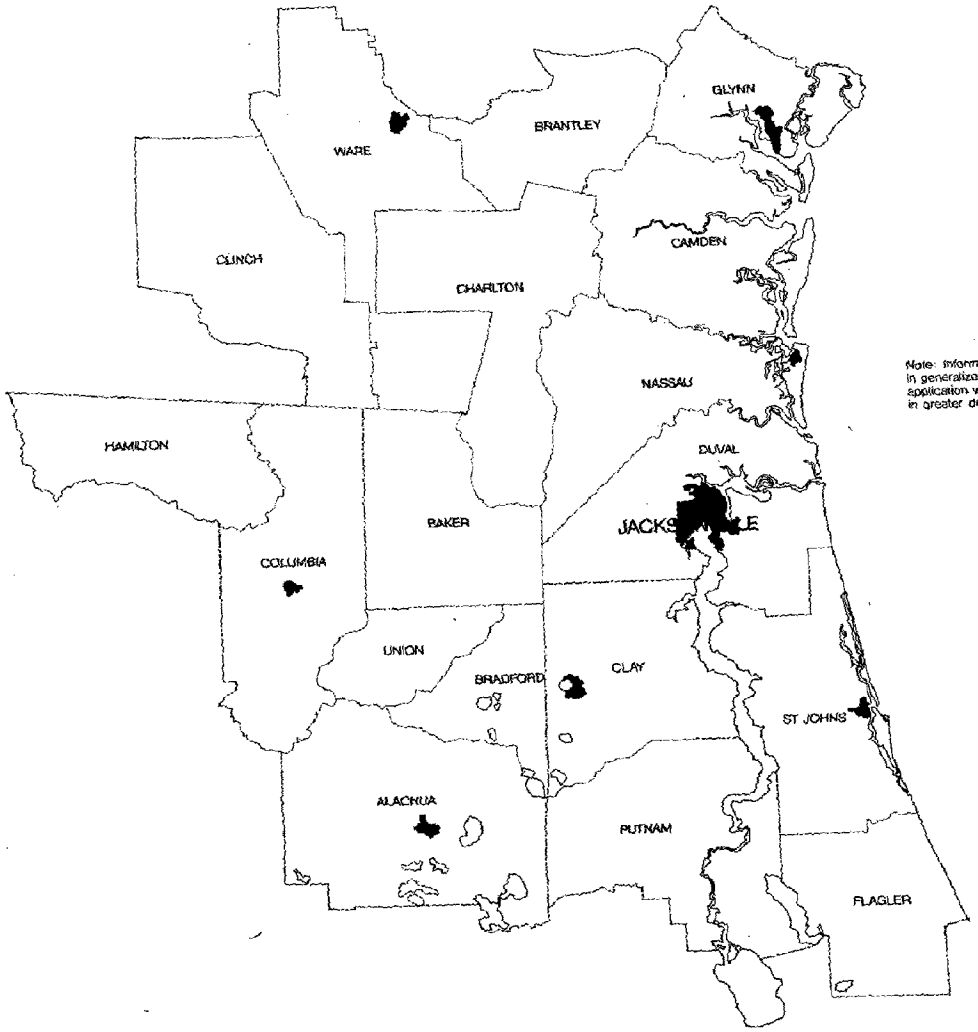
drop to 92 percent for the worst possible case. This corresponds to the development of a total of 207,300 acres in the region, only 11,000 acres more than for the locality.

Although 6.8 million acres of the Northeast Florida and Southeast Georgia region are undeveloped a good deal of the land is not actually available for development (Exhibit 5B-17). Land unavailable due to environmental constraints is estimated at 3.6 million acres. The Okefenokee Swamp and Osceola National Forest, covering more than 500,000 acres, are two large protected areas. In Alachua, Bradford, and Union Counties, numerous small swamps are vital to the ecological equilibrium of the entire area, and, therefore, are unavailable for development. Furthermore, the Florida coastal zoning plan precludes development for the entire coast from Flagler to Nassau County. Locational constraints reduce available land another 1.4 million acres. Overall, however, the 1.8 million remaining developable acres is almost 9 times as great as the 207,000 acres required for Base Case 2 and High OCS development.

As shown spatially in Plates 10, 11, and 12, there appear to exist many alternative zones for primary industry location in inland Florida. In the locality itself, possible sites could be chosen on the St. John's River. However, competing uses for this land may preclude primary development in some of this area.

Air Quality

Air quality in the Jacksonville AQCR is very uneven. Exhibit 5B-18 indicates that several areas around Jacksonville are at or near the primary standards of 75 micrograms per cubic meter for particulates. This high concentration results in an air quality priority classification of I for particulates in the Jacksonville area. The major sources of particulate loadings are industrial fuel combustion emissions and process losses from the mineral and wood products industries. Ambient air concentrations of sulphur oxides are below the federal standards of 103 parts per million, resulting in an air quality priority classification of II for sulphur oxides in the Jacksonville area. The major source of sulphur loadings is electric utility fossil fuel combustion. Hydrocarbons are also classified as Priority I by the EPA, with most emissions



Note: Information presented is in generalized form. Local application will require mapping in greater detail.

POTENTIAL EFFECTS OF O.C.S. OIL AND GAS DEVELOPMENT

NE FLORIDA SE GEORGIA

PLATE 10

UNDEVELOPED LAND

PRESENT CONDITIONS

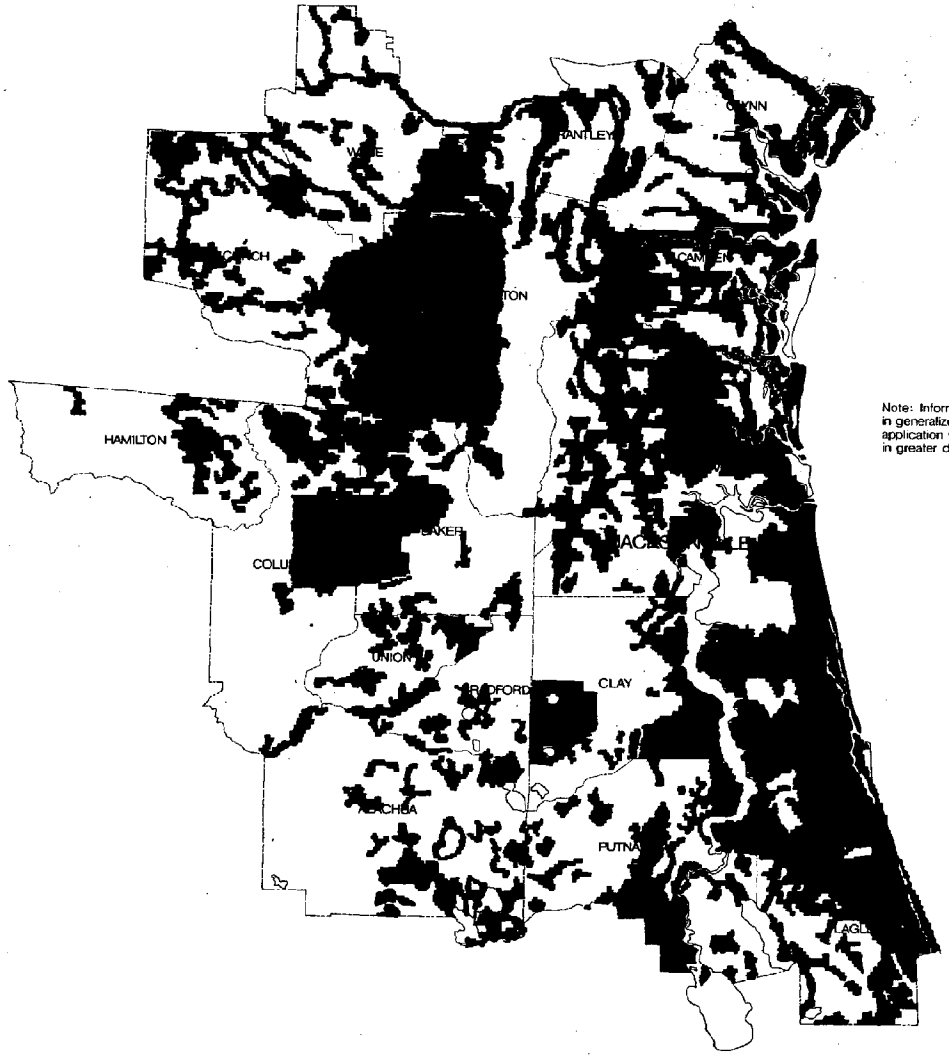
- DEVELOPED LAND
  EXISTING LAND USES
- UNDEVELOPED LAND

RESOURCE PLANNING ASSOCIATES INC.

BASE MAP U.S.G.S. 1:250,000 DECEMBER 1973

miles

N



Note: Information presented is in generalized form. Local application will require mapping in greater detail.

POTENTIAL EFFECTS OF O.C.S. OIL AND GAS DEVELOPMENT

NE FLORIDA
SE GEORGIA

PLATE 11

LAND USE IMPACT

LAND REQUIREMENTS TO SCALE
BASE CASE 2 HIGH IMPACT YEAR 2000

BASE CASE II (NO OCS)		OCS HIGH IMPACT		
PRIMARY	OTHER	PRIMARY	INDUCED	TOTAL

5935

142,100

1565
1565
1565
1005
OTHER 1530

7230

52,100

207,365 ACRES

SUITABLE LAND

FOR GENERAL DEVELOPMENT

■ – UNSUITABLE LAND
EXISTING AND PROJECTED LAND USES
ENVIRONMENTAL CONSTRAINTS

□ – SUITABLE LAND
SUBJECT TO AVAILABILITY AND LOCAL ZONING

RESOURCE PLANNING ASSOCIATES INC.

BASE MAP U.S.G.S. 1:250,000 DECEMBER 1973

miles

N

Note: Information presented is in generalized form. Local application will require mapping in greater detail.

POTENTIAL EFFECTS OF O.C.S. OIL AND GAS DEVELOPMENT

NE FLORIDA
SE GEORGIA

PLATE 12

LAND USE IMPACT

LAND REQUIREMENTS TO SCALE
BASE CASE 2 HIGH IMPACT YEAR 2000

BASE CASE II (NO O.C.S)		O.C.S. HIGH IMPACT		
PRIMARY	OTHER	PRIMARY	INDUCED	TOTAL

5935

142,100

1565
1565
1565
1005
OTHER 1530

7230

52,100

207,365 ACRES

SUITABLE LAND

FOR PRIMARY DEVELOPMENT

- UNSUITABLE LAND
  EXISTING AND PROJECTED LAND USES
  ENVIRONMENTAL CONSTRAINTS
  LOCATIONAL CONSTRAINTS
- SUITABLE LAND
  SUBJECT TO AVAILABILITY AND LOCAL ZONING

RESOURCE PLANNING ASSOCIATES INC.

BASE MAP U.S.G.S. 1:250,000 DECEMBER 1973

miles

EXHIBIT 5B-18

AMBIENT AIR CONCENTRATION LEVELS

NORTHEAST FLORIDA/GEORGIA

	Particulates Micro-grams Per Cubic Meter	SO_x Parts Per Million	NO_x Parts Per Million
PRIMARY STANDARDS	75	.03	.05
FLORIDA			
Duval			
Jacksonville			
1	58	.011	.023
2	71	.007	.018
3	44	.004	.010
4	59	.004	.019
5	65	.002	.018
6	45	.006	.014
7	61	.008	.014
Alachua			
Gainsville	70	-	-
GEORGIA			
Glynn			
Brunswick	67	.005	-

Source: Environmental Protection Agency.

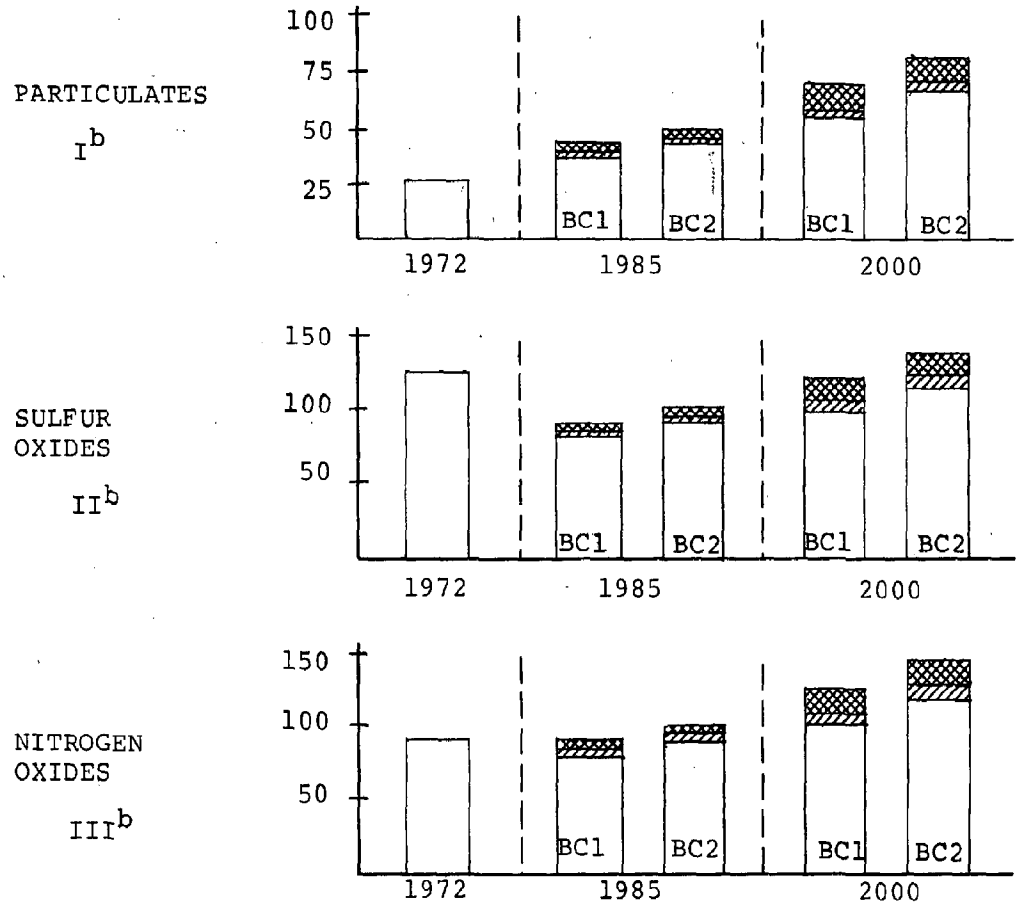
EXHIBIT 5B-19

SUMMARY OF IMPACTS - AIR POLLUTION LOADINGS [a]

(Thousand tons per year)

JACKSONVILLE

(Geographic Area)



[a] Refer to Appendix IX for a detailed discussion of the methodology for determination of each loading source and estimation of the control factors for each pollutant by geographic area.

[b] EPA Air Quality Priority Classification.

BC 1: Base Case 1
BC 2: Base Case 2

Low Impact — High Impact

EXHIBIT 5B-19

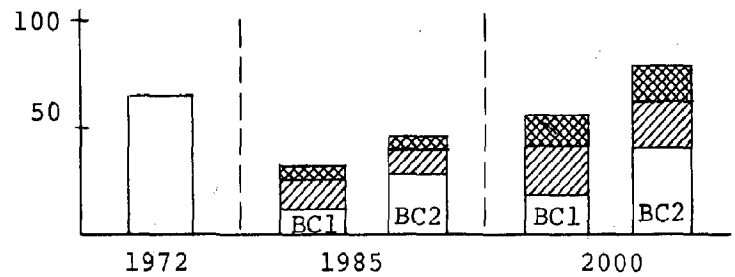
SUMMARY OF IMPACTS - AIR POLLUTION LOADINGS (CONTINUED) [a]

(Thousand tons per year)

JACKSONVILLE
(Geographic Area)

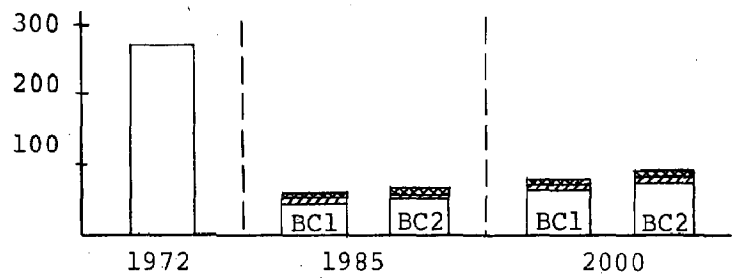
HYDROCARBONS

I[b]



CARBON MONOXIDE

III[b]



[a] Refer to Appendix IX for a detailed discussion of the methodology for determination of each loading source and estimation of the control factors for each pollutant by geographic area.

[b] EPA Air Quality Priority Classification.

BC 1: Base Case 1
BC 2: Base Case 2

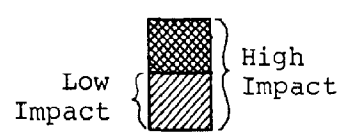


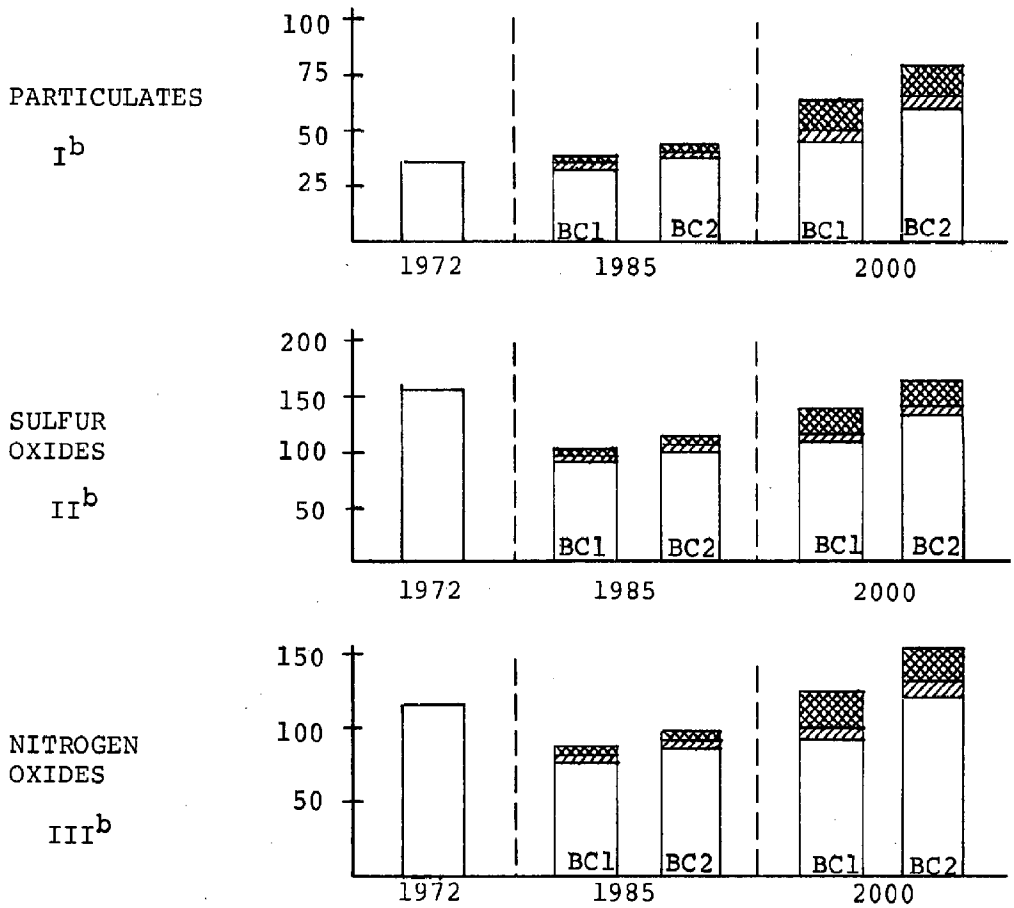
EXHIBIT 5B-20

SUMMARY OF IMPACTS - AIR POLLUTION LOADINGS[a]

(Thousand tons per year)

NE FLORIDA/SE GEORGIA

(Geographic Area)



[a]Refer to Appendix IX for a detailed discussion of the methodology for determination of each loading source and estimation of the control factors for each pollutant by geographic area.

[b]EPA Air Quality Priority Classification.

BC 1: Base Case 1
BC 2: Base Case 2

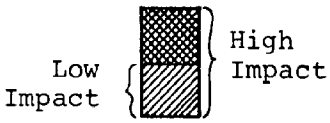


EXHIBIT 5B-20

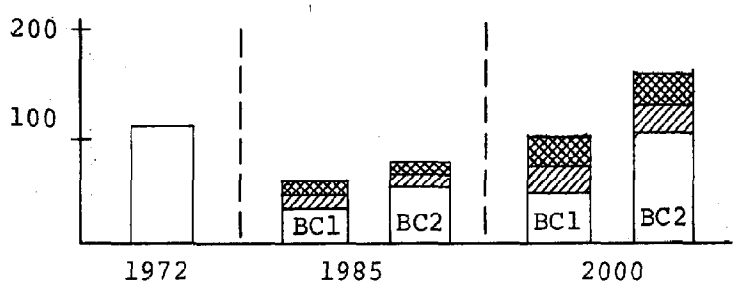
SUMMARY OF IMPACTS - AIR POLLUTION LOADINGS (CONTINUED)[a]

(Thousand tons per year)

N.E. FLORIDA/S.E. GEORGIA
(Geographic Area)

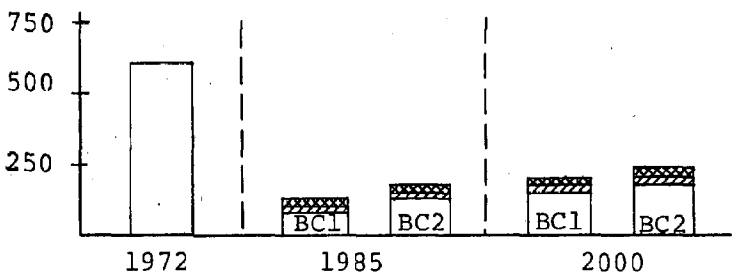
HYDROCARBONS

I[b]



CARBON MONOXIDE

III[b]

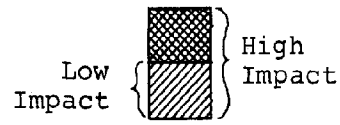


---

[a] Refer to Appendix IX for a detailed discussion of the methodology for determination of each loading source and estimation of the control factors for each pollutant by geographic area.

[b] EPA Air Quality Priority Classification.

BC 1: Base Case 1
BC 2: Base Case 2



attributed to mobile transportation sources. Carbon monoxide and nitrogen oxides are not major problems and result in priority classifications of III.

Air quality in the Northeast Florida/Southeast Georgia region is very similar to that in the Jacksonville locality, with the region assigned an air quality priority classification of I for particulates, II for sulphur oxides, and III for nitrogen oxides and carbon monoxide.

The nature of the air pollution impact loadings in the Jacksonville locality is similar to that of Charleston, but the magnitude is somewhat less. All of the pollutant impact loadings should increase base case loadings between 15 and 30 percent except for hydrocarbons, which are 60 percent over Base Case 1 conditions for the year 2000 (Exhibit 5B-19). Once again, carbon monoxide loadings decrease from the 1972 level in all cases due to emission controls on mobile sources. It is important to note that hydrocarbon loadings in aggregate are expected to decrease from 1972 levels in all cases, except Base Case 2 high conditions for the year 2000.

Aggregate particulate and nitrogen oxide pollution loadings are expected to increase significantly due to the increased level of fossil fuel combustion. With the current concentrations of particulates and the increased pollutant emissions expected under Base Case 2, high OCS conditions, particulate and sulphur oxide concentrations could increase substantially at specific sites in the Jacksonville locality.

The Northeast Florida/Southeastern Georgia region should have an impact virtually the same as the Jacksonville locality, except that the hydrocarbon and carbon monoxide loading impacts should be moderated somewhat by the year 2000 (Exhibit 5B-20).

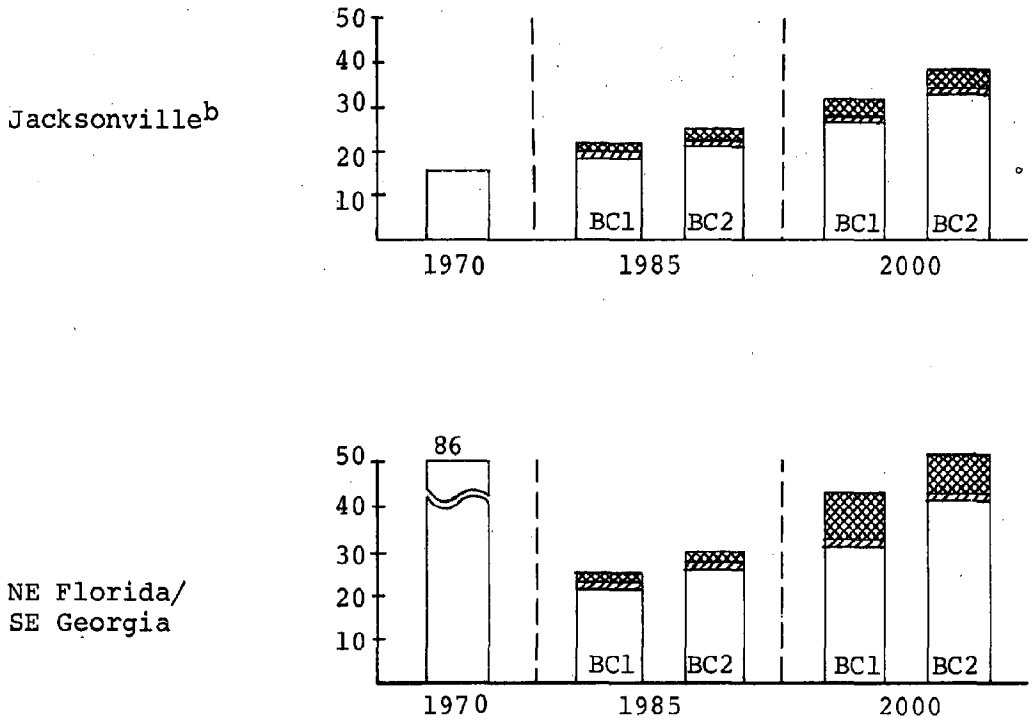
Water Pollution

The 1970 BOD loadings in the Jacksonville locality resemble the Charleston locality to a large degree, with approximately 60 percent of the total loadings attributable to the paper industry and 30 percent to municipal sewage treatment (Exhibit 5B-21). BOD loadings are projected

EXHIBIT 5B-21

SUMMARY OF IMPACTS - BOD LOADING[a]
(Thousand tons per year)

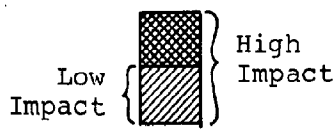
SOUTH ATLANTIC/JACKSONVILLE
(Geographic Area)



[a]Refer to Appendix IX for a detailed discussion of the methodology for determination of each loading source and estimation of the treatment factors for each region.

[b]Estimates may be low due to lack of information on the paper and allied product industry.

BC 1: Base Case 1
BC 2: Base Case 2



to increase in the locality over current levels by as much as 100 percent under Base Case 2 conditions in the year 2000. Impacts in the Jacksonville locality should be somewhat smaller than those in Charleston, with increases of approximately 25 percent over the Base Case 2 condition in the year 2000. Approximately 40 percent of the impact loadings should come from petrochemicals and refineries.

The BOD effluents in the Northeast Florida/Southeast Georgia region are much the same as those in the locality, with paper and allied products accounting for approximately 85 percent of the total BOD loadings and municipal discharges approximately 10 percent of the total. Once again, the regional loadings should be decreased to less than half of the 1970 loadings under all base case conditions. Impact loadings in the year 2000, high condition, however, could represent a 28 percent increase over the Base Case 2 condition.

SOURCES OF DATA

Socio-Economic

State of Florida

Bureau of Economic and Business Research
Department of Commerce
Bureau of Research and Statistics
Department of Education
Public Service Commission
Department of Law Enforcement
Department of Transportation

Jacksonville Port Authority
Health Planning Council of the Jacksonville Area, Inc.
Jacksonville Chamber of Commerce

State of Georgia

Bureau of State Planning and Community Affairs
Department of Labor
Employment Security Agency

Land Use

Florida Coastal Coordinating Council. Florida Coastal Zone Management Atlas: A Preliminary Survey and Analysis. December, 1972.

Florida Coastal Coordinating Council. Recommendations for Development Activities on Florida's Coastal Zone. April, 1973.

Florida Coastal Coordinating Council. Statistics Inventory of Key Biophysical Elements in Florida's Coastal Zone. May, 1973.

Florida Department of Agriculture and Consumer Service. Florida Conservation Needs Inventory. 1967.

Air & Water Pollution

Bio-Environmental Services Division. Emission Inventory of Air Pollutants in the City of Jacksonville, Fla. 1970.

SOURCES OF DATA (continued)

Wildlife and Vegetation

State of Florida

Department of Natural Resources
Division of Recreation and Parks
Division of Game and Fresh Water Fish

Florida Audubon Society
Environmental Information Center of the Florida Conservation Foundation, Inc.
Amelia Island Company

Florida Coastal Coordinating Council. Florida Coastal Zone Management Atlas: A Preliminary Survey and Analysis. December, 1972.

U.S. Department of Interior, Bureau of Land Management. Osceola National Forest EIS. 1973.

U.S. Department of Interior, Fish and Wildlife Services, Office of River Basin Studies. Wetlands of Florida, Appendix 1. 1954.

U.S. Department of Interior, Fish and Wildlife Services, Office of River Basin Studies. Wetlands of Georgia. Appendix I. 1954.

State of Georgia

Department of Natural Resources
Parks and Historic Sites Division

6. WEST COAST INTRODUCTION

The West Coast volume of this study considers the potential impact from the development of oil and gas reserves in the Gulf of Alaska. The West Coast, defined to include the Pacific states of Washington, Oregon and California, as well as Alaska, has received about 90 percent of its oil supplies from Petroleum Administrative for Defense (PAD) District V and the remainder from imports.

The overall configuration of production and processing developed in this study is inherently different for the Gulf of Alaska than for the Atlantic Coast OCS:

- Because of the very small market for refined products in Alaska, it was assumed that the oil would be transshipped from several processing areas along the coast of Alaska to other West Coast refining centers.

- Again, because of the virtually non-existent petrochemical market in Alaska as well as the need for refinery heavy liquids feedstock, it was assumed that development would take place in locations other than Alaska.

- However, because the gas must be desulphurized and dehydrated prior to pipelining or LNG liquefaction, Gulf of Alaska gas was assumed to be processed at its points of receipt on the Alaskan coast, after which it would most likely be liquefied and sent by LNG tanker to other West Coast sites.

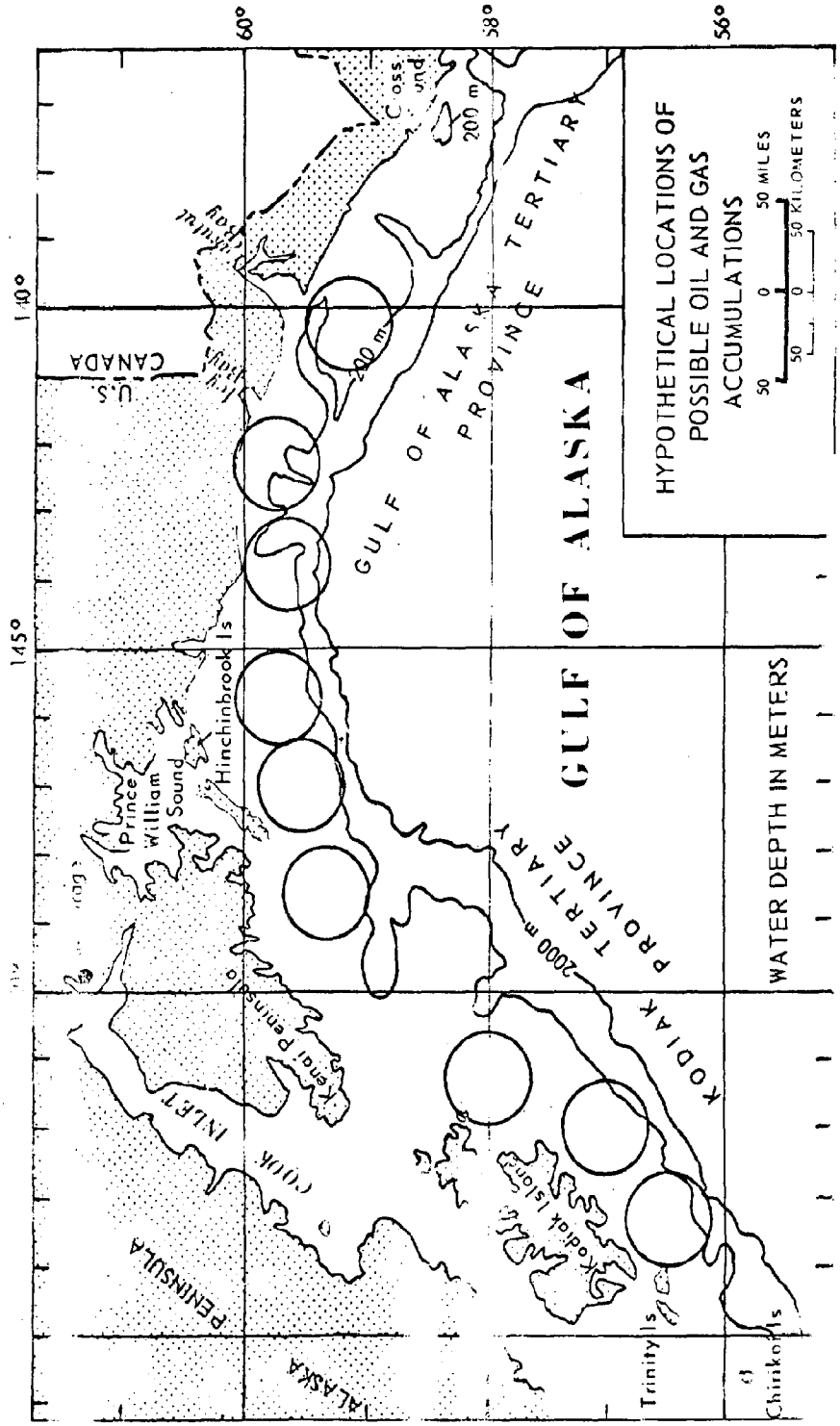
The remainder of this introductory chapter discusses: (1) sites chosen in Alaska and on the West Coast; (2) base case development; and (3) the assumed Gulf of Alaska oil and gas production levels.

SITES OF ANALYSIS

A number of Alaskan sites were considered as possible on-shore receiving and transshipment sites, depending upon the particular location where offshore oil and gas are discovered. Exhibit 6-1 shows hypothetical locations of

EXHIBIT 6-1

HYPOTHETICAL GULF OF ALASKA
OIL AND GAS LOCATIONS



Alaskan offshore oil and gas, based on projections by the United States Geological Survey (USGS).

A number of West Coast sites were similarly considered as potential refining expansion centers for the oil transshipped from Alaska. Six Alaskan receiving and transshipment sites and five West Coast refining sites were tentatively identified, as shown in Exhibit 6-2.

From the total list of potential sites, two Alaskan staging areas and two West Coast refining sites were chosen for the analytic purposes of this study, based on the following criteria:

- At least one site in each major demand area
- Proximity to hypothetical locations of offshore reserves and onshore markets
- A mix of developed and undeveloped localities
- Proximity to deepwater loading and unloading areas
- Reasonable availability of data

Based on the above criteria the following sites were selected for analysis:

Region	Locality
State of Alaska	City of Valdez, Alaska[a] City of Cordova, Alaska
Puget Sound Area	Skagit/Whatcom Counties, Washington
San Francisco Bay Area	Solano/Contra Costa Counties, California

The regions indicated above (including the localities) were chosen as areas where the majority of the direct socioeconomic and environmental impacts would be felt, and for which data was readily available. The localities were chosen as the one or two counties (except for Valdez and Cordova)

---

[a] In addition to analyzing Valdez and Cordova background profiles were constructed for the Yakutat and Seward areas (see Chapter 7).

EXHIBIT 6-2

POSSIBLE ALASKAN AND WEST COAST IMPACT SITES

Receiving and Trans-shipment Sites

ALASKA	Yakutat Bay *Cordova *Valdez Anchorage Seward Kodiak Island

Refining Sites

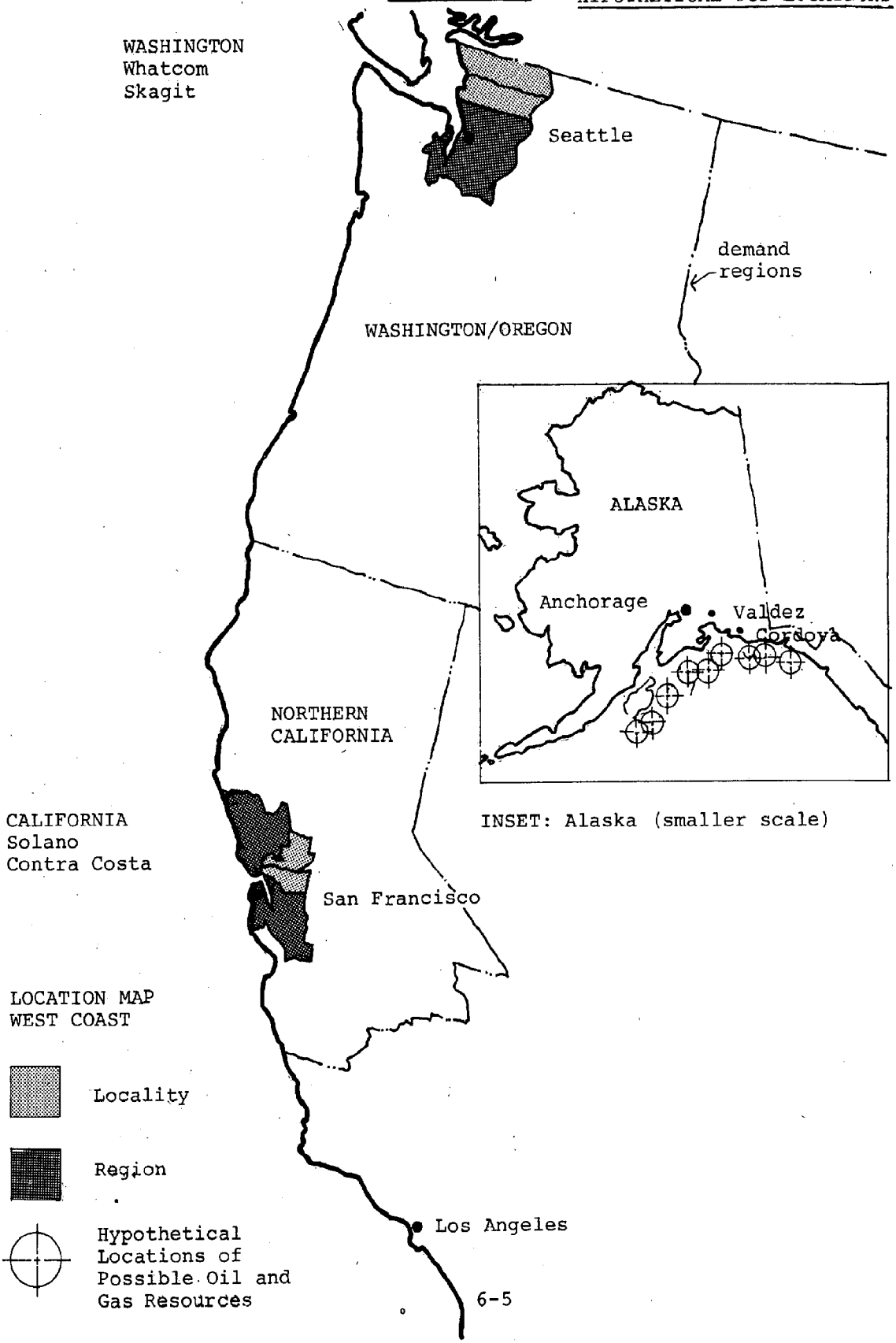
WEST COAST	*Puget Sound, Washington Columbia River Inlet, Oregon *San Francisco Bay area, California Monterey Bay, California Los Angeles, Long Beach, California

* Sites chosen for analysis.

Source: Dornbusch & Co. and RPA

EXHIBIT 6-3

WEST COAST SAMPLE SITES & HYPOTHETICAL OCS LOCATIONS



where either oil and gas might be brought ashore or where refining and petrochemical manufacturing facilities would locate, and for which data was readily available.

These sites represent a number of different sample conditions that should enable the CEQ to properly examine the potential impact on any site that may subsequently come under consideration. Since this study was not designed to recommend the best sites for onshore receipt or processing of oil and gas, it is important to emphasize that the sites were chosen as analytical samples only. Exhibit 6-3 lays out the precise boundaries of the sample localities and regions along with the hypothetical offshore resource locations.

BASE CASE DEVELOPMENT

Base case development assumptions for the West Coast have been made for the refining, gas processing, and petrochemical industries.

Refining

Refinery development on the West Coast relies on several different sources of crude oil supply. Although California is now supplying the major portion of the PAD V crude supply, the amount from this source is expected to decline steadily, with no new offshore California production assumed. By the year 2000, the Alaska North Slope is expected to supply two of the three million barrels per day PAD V supply. It is assumed that any North Slope production in excess of 2 million barrels per day would be diverted to the midwestern U.S.

Exhibit 6-4 gives the assumed sources of supply and the required expansion in refining capacity necessary to process the one produced. Current PAD V refineries are assumed to be able to expand 100 percent in capacity. Given these crude oil supply projections, PAD V would import about 22 percent of its refinery product needs in 1985 and about 43 percent in the year 2000, as summarized in Exhibit 6-5. Because of the significant increase in North Slope oil supply by 1985, all of the 65 percent refinery capacity increase must take place by then.

In developing the base case refining assumptions for the West Coast regions, it was assumed that all Canadian

EXHIBIT 6-4

PAD V CRUDE OIL SUPPLY AND REQUIRED REFINING CAPACITY ASSUMPTIONS
(Million barrels per day)

Source of Supply	1970	1985	2000
California[a]	1.0	.6	.4
Alaska North Slope	0	2.0	2.0
Alaska Cook Inlet	.2	.2	.3
Canadian Imports	.2	.3	.3
Other	.4	0	0
TOTAL CRUDE RUNS	1.8	3.1	3.0
Refining Capacity			
Required at 90 percent capacity	2.0	3.4	3.3
Existing in 1973	2.2	2.2	2.2
Expansion of existing capacity	0	1.1	1.0
New refineries[b] (Puget Sound)	0	.1	.1

[a]No California offshore oil production is assumed.

[b]Even though PAD V expansion in total does not exceed 100 percent of 1973 capacity, the Puget Sound area does.

Source: Dornbusch and Co. estimates.

EXHIBIT 6-5

PAD V BASE CASE ASSUMPTIONS
(Million barrels per day)

	1970	1985	2000
Product demand	1.9[a]	4.0[b]	5.3[b]
Imported products	.1[a]	.9	2.3
Crude runs	1.8	3.1	3.0
Required refinery capacity[c]	2.0	3.4	3.3

[a]Army Corps of Engineers, West Coast Deepwater Port Facilities Study, June 1973.

[b]Based on industry estimates of PAD V demand prorated to total U.S. demand as forecast in the U.S. Dept. of Interior report, Energy Through the Year 2000. These are higher than direct estimates of PAD V demand recently developed by Interior, which are 3.2 and 4.6 million barrels per day in 1985 and the year 2000, respectively.

[c]Based on 90 percent capacity.

Source: Dornbusch and Co. estimates.

imports would supply the Washington/Oregon area, while California crude oil would be split between southern and northern California in accordance with the current supply percentages. Further, it was assumed that all other oil flowing into PAD V would be allocated in accordance with its current demand distribution, which is 18 percent for Washington/Oregon, 29 percent for northern California, and 53 percent for other PAD V areas.

The synthesis of these assumptions results in a situation in which demand for petroleum products substantially exceeds supply in both 1985 and 2000 (see Exhibit 6-5). These assumptions are critical in that the forecasted San Francisco and Puget Sound impacts are directly proportional to this difference between supply and demand. Gulf of Alaska crude oil should impact these regions only to the extent that it narrows the gap between demand and other crude oil supplies.

The impact on San Francisco and Puget Sound is also reduced to the extent that Gulf of Alaska oil replaces North Shore crude or imports of foreign crude oil. If refinery capacity is constructed to process North Slope or foreign crude, the full impacts of its construction and operation would be present. If Gulf of Alaska crude should then supplant this crude, there would be no incremental impact. For this reason, the West Coast assumptions are that if any foreign oil (other than Canadian) is imported, it is refined <u>at its source</u>, not on the West Coast. This is a "worst" case assumption to show the maximum impacts that could be expected.[1]

There is assumed to be no substantial shipment of petroleum products between the major West Coast areas (Los Angeles, San Francisco, and Puget Sound) in the years 1985 and 2000. This is essentially the case now, with only relatively minor shipments occurring.

The West Coast currently has the deepest ports in the United States. Los Angeles--Long Beach Harbor, for example--can accommodate 130,000 dwt. tankers. This study assumes that the construction of deeper water facilities on the West Coast will not affect the volume of crude and

---

[1]There will be impacts in the Puget Sound and San Francisco regions attributable to some source of crude, whether it be Gulf of Alaska, additional North Slope, or foreign oil. To be conservative, impacts proportional to the gap between West Coast demand and other crude supplies have been attributed to Gulf of Alaska crude.

product imports, (with the exception of Canadian crude piped to Washington) and that any Alaskan and foreign imports will be shipped by tanker.

Exhibit 6-6 shows the crude oil supply and refining capacity assumption for each region.

EXHIBIT 6-6

PAD V REGIONAL CRUDE OIL SUPPLY AND REFINING BASE CASE PROJECTIONS
(Million barrels per day)

	Washington/ Oregon		Northern California		Other PAD V	
	1985	2000	1985	2000	1985	2000
Crude Oil Supply	.70	.71	.82	.82	1.58	1.48
Refining Capacity (90 percent utilization)	.78	.79	.91	.91	1.71	1.61

Source: Dornbusch and Co. estimates based on the assumed distributions of PAD V crude petroleum supplies projected in Exhibit 6-5.

Gas Processing

Gas processing development (other than Gulf of Alaska production) should be significant in Alaska, where Prudhoe Bay and other areas (e.g., Kenai Peninsula) should approximate 4 billion cubic feet per day in 1985, and 10 billion cubic feet per day in the year 2000. Most likely, this gas will be liquefied and shipped to the West Coast in LNG tankers, and each West Coast region will develop LNG offloading facilities. It was assumed that no LNG receiving facility will be developed in the West Coast localities being analyzed, and that this LNG activity should have a relatively small impact compared to the total regional activity.

Petrochemicals

Petrochemical development in the West Coast regions should be affected by such factors as profitability and availability of feedstock, which in the future will likely be refinery heavy liquids, either naphtha or gas oil. Therefore, petrochemical development should follow roughly the pattern of refinery development, although some petrochemical plants will be fed by natural gas liquids of imported refinery heavy liquids.

For the two West Coast regions of analysis, petrochemical development under base case conditions is expected to be less significant than for the U.S. overall because of a smaller, more limited market, and because the refinery activity should barely be enough (about 500,000 barrels per day) to support significant petrochemical production. For the two regions together, about two petrochemical complexes should be developed by 1985 and approximately three by the year 2000.[1]

ASSUMED OFFSHORE PRODUCTION LEVELS

There is considerable uncertainty regarding the level of oil and gas resources in the Gulf of Alaska Outer Continental Shelf. Therefore, based on resource estimates by the USGS, this study has used two potential offshore production levels, which are presented in Exhibit 6-7.

EXHIBIT 6-7

OFFSHORE PRODUCTION ESTIMATES
GULF OF ALASKA

Type of Resource	OCS Level	1985	2000
Oil (million barrels/day)	Low	.25	1.00
	High	.75	2.00
Gas (billion cu. ft./day)	Low	.30	2.40
	High	.90	7.20

Source: RPA/CEQ estimates based on USGS projections of resource availability.

[1] Petrochemical activity is often expressed in terms of complexes, each of which can be considered to support a billion pounds per year of olefin production, along with associated derivative plants. Appendix IV covers in detail the petrochemical development assumptions for each region.

For comparison purposes, Prudhoe Bay production is expected to approximate 2 million barrels per day of oil and 3 to 6 billion cubic feet per day of gas in 1985. Appendix I discusses the offshore oil and gas production assumptions in greater detail.

7. ALASKA

The Gulf of Alaska spans an enormous area of Alaska's southern coast. Because the potential for oil and gas production exists throughout the Gulf, it is difficult to eliminate any Gulf areas as possible sites for development.

Depending upon the location and size of any resource discoveries, several sites could be likely candidates for a staging area and transshipment facility. Valdez, Seward, Cordova, Katalla, Kodiak, and Yakutat are all possibilities. It is also possible for the development to locate at a virgin site. There is no reliable means for predicting the location or locations of development before exploration occurs.

Transshipment points could actually locate at several places, if the production areas are widely separated. It is assumed that three areas will be developed as staging areas and transshipment sites.

Two relatively similar sites located on the Gulf were chosen as sample sites for full analysis--Cordova and Valdez. The selection of Valdez was made because it will be the southern terminus of the Trans-Alaska Pipeline. Thus, a base of gas and oil industry operations is expected to exist. Cordova, on the other hand, will realize a lower level of development from the pipeline and is therefore more typical of other small Alaskan Gulf communities. Further, its central location on the Gulf as well as its larger airport would seem to make it a more likely candidate for a staging area.

Still, it is important to keep in mind that other communities along the Gulf Coast are also possible candidates for development, either in addition to, or instead of Valdez or Cordova. These other communities include Yakutat, Katalla, Seward, and Kodiak. For this reason background profiles and limited impact analyses of two other representative Gulf towns were prepared. These profiles describe the communities and their facilities, indicate how these communities are similar or dissimilar to Valdez or Cordova, and discuss what implications these similarities and dissimilarities may have regarding the transferability of the impact analysis. Specifically, Yakutat and Seward were selected for these profiles because these two are representative of the range of population sizes and development characteristics of Gulf coast communities.

The Alaska region analyzed was the state itself. This boundary was chosen because there is no smaller area in which a majority of the impacts would occur and for which data is aggregated.

Most of the impacts projected for the region (outside the staging areas) should in fact occur in Anchorage. The Anchorage area dominates the state, with 40 percent of the state's population and a similar proportion of the state's employment. Anchorage is situated on Cook Inlet, near the Gulf of Alaska. It is apparent that much of the supplier and induced activity resulting from the Gulf of Alaska oil and gas industry should occur there.

The remainder of this chapter is organized into four sections. The first provides a description of current socio-economic and environmental conditions in the city of Cordova, the city of Valdez and the Alaskan region. The second section lists the assumptions for future development for OCS oil and gas recovery, gas processing and construction - the three primary industries most likely to develop in Alaska. The third section discusses the specific socio-economic and environmental impacts that the assumed development is likely to produce. The final section provides profiles and impact analyses for the two other Gulf of Alaska candidate sites.

PROFILE OF CURRENT CONDITIONS

The two Alaskan local areas being analyzed are both small and relatively isolated sites. Cordova, the larger of the two, had a 1970 population of approximately 1600.[1] Valdez had only 1000 residents in the same year. Both cities are located on Prince William Sound in the Gulf of Alaska--Cordova 145 miles east-southeast of Anchorage and Valdez approximately half way between Cordova and Anchorage.

Both cities are connected with each other and with Juneau and Anchorage by air and with Anchorage by sea. In fact, Valdez is the northernmost ice-free seaport in

---

[1] This figure represents the population that can be considered as permanent. In the summer months an additional 5000 men migrate to Cordova to staff the fishing fleet as well as the fish processing plants.

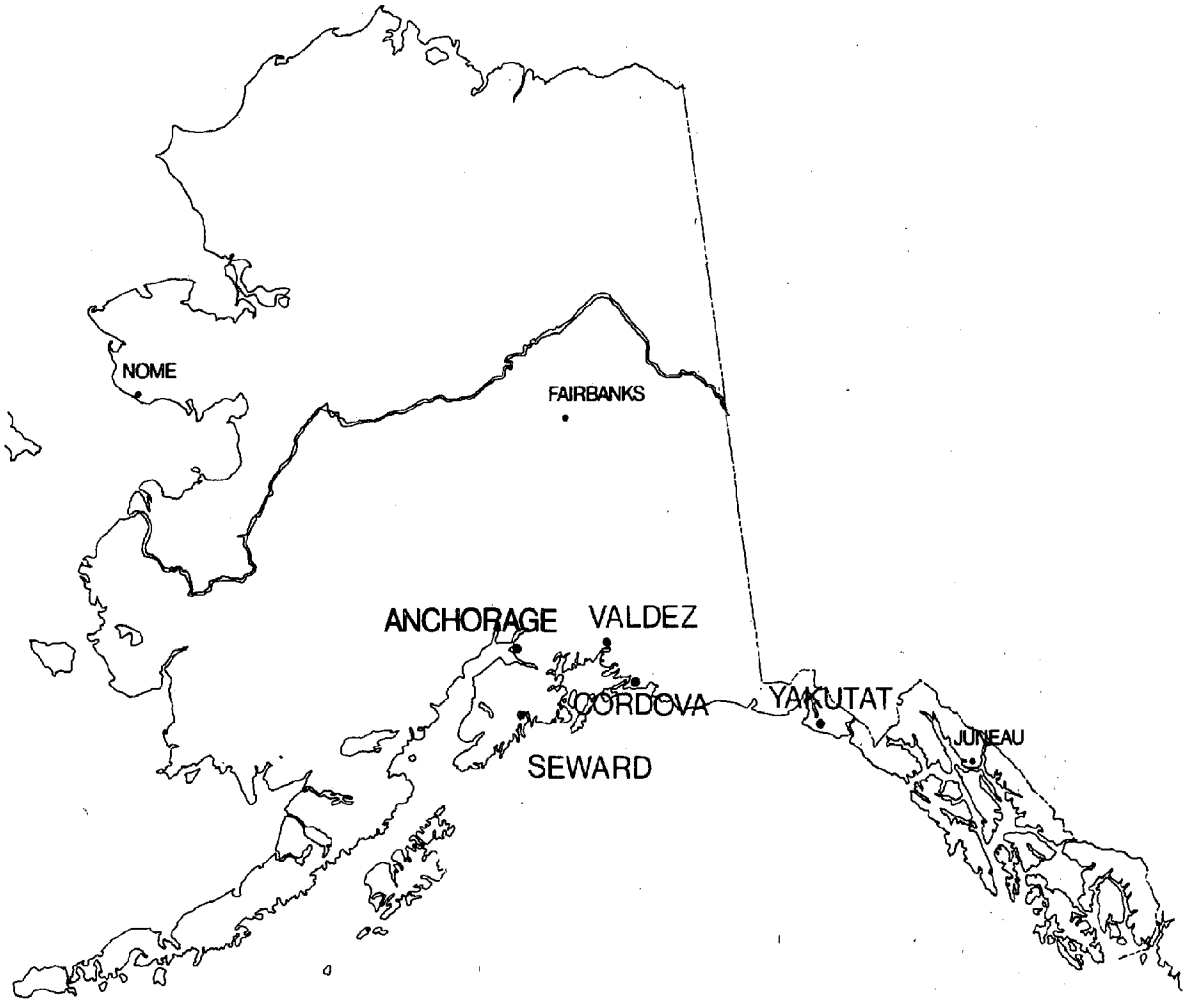


EXHIBIT 7-1
ALASKA REGION

RESOURCE PLANNING ASSOCIATES INC.

Alaska. Valdez is also connected with both Anchorage and the Alaskan interior by the Richardson Highway. A road linking Cordova with Chitina and the Alcan Highway is only 17 miles short of completion. Cordova's airport contains a 7500 foot runway capable of handling jet aircraft under instrument landing conditions. This is contrasted with Valdez's airport where a 5000 foot runway limits the type of aircraft that can be handled.

Climatic conditions in both areas are tempered somewhat by their proximity to the Pacific Ocean, but nevertheless can be extremely harsh in the winter. For example, in Valdez, temperatures ranging to 28 below zero have been recorded and wind gusts have been measured to 115 miles per hour.

The entire Cordova-Valdez region is earthquake prone and new construction must take this into consideration. In 1964, a quake measuring 8.4 on the Richter scale was recorded with an epicenter in the Prince William Sound. This severe quake together with ensuing waves completely destroyed Valdez. When the land subsided, the entire city was moved four miles from its old location. Cordova, on the other hand, suffered substantially less.

Since both Cordova and Valdez are so small, population trends are meaningful only in that both seem to be on an expansionary path.[1] For example, the Cordova population in 1973 had reached 2200, up from about 1400 in 1960 and 1600 in 1970. Similarly, Valdez showed a substantial relative growth of almost 500 people between 1960 and 1970.

Employment in Cordova is dominated by the fishing industry. In fact, the only major employment outside of the government sector was in the fish processing industry. The substantial increase in population between 1970 and 1973 is accounted for by noting that the fish industry partially switched to year round operations during that period. In Valdez, service sector jobs, primarily with the government, constitute 85 percent of the employment. The remaining 15 percent is spread among forestry-fishing, construction, manufacturing and utilities.

---

[1] Interestingly, Cordova's population was over 16,000 in the 1930's when the city was connected to a major mining area by rail.

The Alaskan region as a whole is dominated by the Anchorage area. Of the state's 305,000 residents in 1970, over one-third lived in Anchorage. Similarly, 41,000 of the state's 105,000 employed persons worked in or around Anchorage. Not surprisingly, the manufacturing sector in the state accounted for only 8 percent of the work force. Alaska is a large importer of finished goods.

Alaska's land is the most untouched in the nation and much of the undeveloped areas have been designated as National Forests. For example, Cordova is encompassed by the Chugach National Forest and Valdez is situated on the northeastern edge of the same area.

Air quality has deteriorated in only a few local areas in Alaska--primarily Fairbanks and Anchorage, and only on occasion. Neither Valdez or Cordova has experienced any significant air quality deterioration to date.

Water pollution, however, is a more serious problem in some local areas. For example, Valdez currently has no sewage treatment plant and untreated sewage flows into its port. Cordova is in the process of having a $3 million secondary treatment plant constructed.

Wildlife abounds in Alaska. Birdlife in the Prince William Sound periphery has been characterized by one observer as one of the "greatest remaining concentrations on the face of the earth."[1] During the first week of May of each year, millions of shorebirds, possibly including the entire Alaska population of some species, must pass through this area. Waterfowl are also numerous in the Sound, with some species present during the entire year.

Larger mammals inhabiting the Sound area include black, brown, and grizzly bears, moose, dall sheep, mountain goats, Sitka blacktail deer, and sea otters.

National Wildlife Refuges and Ranges throughout protect the birds and other wildlife in the state. Eighteen such areas, encompassing over 20 million acres, have been created to date.

Prince William Sound also supports a valuable commercial fishery. Species recently harvested include salmon - pink, chum, and sockeye - and crabs - dungeness and king - as well as halibut, herring, and razor clams.

---

[1] Trans-Alaska Pipeline Environmental Impact Statement, Department of Interior (quote from L.W. Sowl).

DEVELOPMENT ASSUMPTIONS

This section describes both the base case development and the development with OCS production that could occur in Alaska in support of offshore oil and gas recovery, gas processing, and construction. As explained in Chapter 6, no refinery or petrochemical development from offshore production is assumed for Alaska.

Offshore Oil and Gas Recovery

Several activities related to the development, operations and support of offshore oil and gas production should have impacts in Alaska. The timing of these is shown for high and low recovery cases in Exhibits 7-2 and 7-3.

First, there is exploration drilling. Assuming, for purposes of analysis, that lease sales start in 1976, exploratory drilling would commence in 1977 and reach a peak level in the mid 1980's when 8 drilling platforms, capable of drilling a total of 32 exploratory wells per year, would be in operation in the high impact case. Half this number of wells constitutes the low impact level of operations.

Second, oil discoveries would be followed by the erection and development of production platforms. In the high impact case 60 platforms, supporting 1200 wells, would be developed to reach maximum oil and gas production levels of 2 million barrels per day and 7.2 billion cubic feet per day respectively. The duration of the production platform development phase is expected to be about 17 years, starting in 1980, with each platform requiring approximately 3 years to develop.

The third activity having an impact in the region would be the operation and support of production platforms after their development is complete. With about 90 support personnel currently needed to operate such a platform, the 60 platforms (in the high impact case) would constitute significant activity in the locality and region.

Two other activities that are significant to offshore oil and gas production but which should not have a major impact in the region are platform fabrication and transportation facility development. The platform fabrication

EXHIBIT 7-2

OFFSHORE DEVELOPMENT TIMETABLE
GULF OF ALASKA-HIGH RECOVERY
(Each Drilling Area)

Exploration		Platform Development					
Year	Rigs/ Wells	Install	In place[a]	Oil Wells Drilled	Total Oil Wells Producing	Oil Produced[b] 10^3 b/d	Gas Produced 10^6 ft^3/d
1976							
77	1/4						
78	2/8						
79	3/12						
80	4/16	1	1	8	8	17	
81	6/24	2	3	24	32	67	
82	8/32	4	7	56	88	183	
83	8/32	4	11	80	168	350	
84	8/32	4	15	96	264	550	
85	8/32	4	19	96	360	750	900
86	8/32	4	23	80	440		
87	8/32	4	27	64	504		
88	8/32	4	31	48	552		
89	6/24	4	35	48	600		
90	4/16	4	39	48	648		
91	2/8	4	43	48	696		
92		4	47	48	744		
93		4	51	48	792		
94		4	55	48	840		
95		4	49	48	888		
96		1	60	40	928		
97				24	952		
98				8	960	2000	7200
99							
2000			60		960[a]	2000	7200

[a] After 1985, 20 platforms and 240 wells that produce only gas will be installed resulting in a total of 1,200 wells in the year 2000.

[b] Oil production will, of course, build up to its maximum, level off for a period, and then decline slowly as the deposits are exhausted.

Source: RPA estimates.

EXHIBIT 7-3

OFFSHORE DEVELOPMENT TIMETABLE
GULF OF ALASKA-LOW RECOVERY
(Each Drilling Area)

Exploration		Platform Development					
Year	Rigs/ Wells	Install	In place[a]	Oil Wells Drilled	Total Oil Wells Producing	Oil Produced[b] 10^3 b/d	Gas Produced 10^6 ft^3/d
1976							
77	1/4						
78	2/8						
79	3/12						
80	4/16						
81	4/16	1	1	8	8	17	
82	4/16	1	2	16	24	50	
83	4/16	1	3	24	48	100	
84	4/16	2	5	32	80	167	
85	4/16	2	7	40	120	250	300
86	2/8	2	9	48	168		
87		2	11	48	216		
88		2	13	48	264		
89		2	15	48	312		
90		2	17	48	360		
91		2	19	48	408		
92		2	21	40	448		
93		2	23	24	472		
94		2	25	8	480	1000	2400
95							
96							
97							
98							
99							
2000			25		480[a]	1000	2400

[a] After 1985, 5 platforms and 60 wells that produce only gas will be installed, resulting in a total of 540 wells in the year 2000.

[b] Oil production will, of course, build up to its maximum, level off for a period, and then decline slowly as the deposits are exhausted.

Source: RPA estimates.

would probably take place outside of Alaska. It is possible that a West Coast shipyard could construct some of these platforms if the number required became significant, but it is assumed that this shipyard would not be located in any of the regions being analyzed.

Transportation facilities development includes construction of barges or pipelines to bring the oil and gas ashore. Since barges should be used for only a short period, if at all, prior to pipeline completion (during the first few years of offshore development), and since pipeline construction is an extremely specialized activity of short duration that will not necessarily have an economic base in any of the regions of analysis, no regional impact has been assumed in the economic model.[1]

Gas Processing

A substantial amount of Alaskan gas processing (over 10 billion cubic feet per day by 2000) was assumed for base case development (without offshore production). Most of this should occur as a result of North Slope production, but a significant portion should also occur in Southern Alaska, mainly on the Kenai Peninsula. None of this base case development is assumed to take place in the Valdez or Cordova[2] locality.

Development with offshore production is assumed to take place either in Valdez or Cordova (about one third of the total) and in other areas along the Alaskan coast. Exhibit 7-4 summarizes development expected under the offshore gas production cases. Appendix III discusses the gas processing development assumptions in greater detail.

---

[1] However, transportation activity also includes the construction and operation of oil and LNG transshipment facilities. The construction phase is likely to be short, with regional construction costs of approximately $75 to $100 million before 1985. Operating the facilities should require few personnel with a payroll of $2 million to $4 million by the year 2000.

[2] However, it should be noted that consideration is being given to locating the gas liquification and transshipment facilities for processing North Slope gas in Cordova. A major factor in the decision will be the level of tanker congestion expected to occur in the Port of Valdez.

EXHIBIT 7-4

ASSUMED ALASKAN GAS PROCESSING DEVELOPMENT
(Million cubic feet per day)

Area	Low Case 1985	Low Case 2000	High Case 1985	High Case 2000
Locality	300	750	450	2250
Region	-	1650	450	4950
Total	300	2400	900	7200

Source: RPA and Dornbusch & Co. estimates.

Construction

Since no refining or petrochemical production is assumed to occur in Alaska, the OCS-induced construction output in 1985 is relatively low -- less than $20 million in Cordova and Valdez, and about $50 million for Alaska in total. Gas processing comprises 80 percent of this activity. Exhibit 7-5 summarizes the OCS construction assumptions for Alaska. Appendix V discusses the method of making these assumptions.

IMPACTS

The following sections discuss the impacts which are expected to result from OCS related development. The economic, social infrastructure, and land use impacts are discussed in turn. No analysis of air and water pollution was done for Alaska.

Economic

Considerable growth in employment and output is projected for both the City of Valdez, the City of Cordova, and the State of Alaska under baseline conditions. In Valdez and Alaska as a whole, this growth should take place as a result of the construction and operation of the Trans-Alaska pipeline. In Cordova several major factors are expected to influence the employment and population

EXHIBIT 7-5

VALUE OF CONSTRUCTION OUTPUT[a]
($ million)

ALASKA

Geographic Area	1970 Actual	1985 Base Case[b]	1985 Low OCS	1985 High OCS	2000 Base Case[b]	2000 Low OCS	2000 High OCS
CORDOVA/ VALDEZ							
Refinery			0	0		0	0
Gas Processing			3	13		0	0
Petrochemical			0	0		0	0
Induced[c]			0.8	3		1.5	6
Total Local	1	16	3.8	16	49	1.5	6
ALASKA							
Refinery			0	0		0	0
Gas Processing			14	44		0	0
Petrochemical			0	0		0	0
Induced[c]			4	11		7	21
Total Region	466	555	18	55	927	7	21

[a] Base Case total and OCS incremental. Appendix V describes the methods used in determining these values

[b] Base Case 1 for West Coast

[c] Other industrial, commercial, and residential construction activity induced by the direct industry activities

Source: RPA estimates.

within the city.

Perhaps the most important will be the completion of the highway connecting Cordova with the mining district at Chitina and the Alcan Highway to the interior. This road is currently 17 miles short of completion and has been held up by an environmental suit which is expected to be settled shortly. When construction resumes, approximately two years of work will be needed. This road will allow Cordova to become a major supply center for the mining area.

Cordova is also expected to become a major resort area following completion of the second chair lift for skiing in the state. Since Cordova is only a short flight from Anchorage, a great deal of tourist travel can be projected. Further, there is a significant possibility that a major contract with the Japanese for lumber shipments will be negotiated. This would require the construction and staffing of a mill together with the new employment associated with the logging industry. Other expected developments include the establishment of a sizeable Coast Guard Station in the city and a major boost in activity at the airport in connection with the Trans-Alaska pipeline. This latter would occur because Cordova's airport is the closest to Valdez capable of handling jet aircraft on instrument approaches.

Permanent employment in Cordova in 1970 was 475, of which the manufacturing sector had the largest share, with an average of 195 jobs.[1] (Exhibit 7-6). Nearly all of these jobs were in the fish processing industry. During and prior to 1970, the industry operated mainly in the summer when a large influx of transient workers manned the fishing fleet. This situation has now changed substantially with the industry operating year round, albeit at lower levels in the winter. This accounts for a substantial increase in employment and population in Cordova--partially represented by the 200 workers shown under agriculture in the exhibit.

Because of this change as well as the factors mentioned above, base case total employment is projected to increase from 475 to 1190 in 1985 and 1740 in 2000. The mix of jobs will not change substantially, however, with services accounting for about 40 percent in both years.

---

[1] "Look North to Cordova Alaska," Alaska Department of Employment, 1969.

EXHIBIT 7-6

SUMMARY OF BASE CASE ECONOMIC CONDITIONS

CORDOVA

A. EMPLOYMENT (actual number)

Sector	Actual	Base Case 1		Base Case 2	
	1970	1985	2000	1985	2000
Construction	30	60	90		
Ref., Gas, Petrochem.	0	0	0		
Other Manufacturing	195	400	500		
Agriculture [b]	0	200	200		
Utilities	65	180	250		
Services	185	350	700		
TOTAL	475	1190	1740		

B. VALUE OF OUTPUT ($ million)[a]

Sector	Actual	Base Case 1		Base Case 2	
	1970	1985	2000	1985	2000
Construction	1	3	6		
Ref., Gas, Petrochem.	0	0	0		
Other Manufacturing	5	26	40		
Agriculture [b]	0	10	10		
Utilities	3	8	15		
Services	4	10	26		
TOTAL	13	57	97		

Codes - * = negligible
: = infinite percentage since base case is zero

[a]All dollar figures are 1970 constant dollars

[b]This sector includes fishing activity which is difficult to reflect accurately because of its seasonal nature.

Source: RPA estimates.

EXHIBIT 7-7

SUMMARY OF BASE CASE ECONOMIC CONDITIONS

VALDEZ

A. EMPLOYMENT (actual number)

Sector	Actual	Base Case 1		Base Case 2	
	1970	1985	2000	1985	2000
Construction	20	280	750		
Ref., Gas, Petrochem.	0	0	0		
Other Manufacturing	5	280	1000		
Agriculture [b]	5	80	100		
Utilities	20	720	1850		
Services	275	1470	3500		
TOTAL	325	2830	7200		

B. VALUE OF OUTPUT ($ million)[a]

Sector	Actual	Base Case 1		Base Case 2	
	1970	1985	2000	1985	2000
Construction	1	16	49		
Ref., Gas, Petrochem.	0	0	0		
Other Manufacturing	*	18	79		
Agriculture [b]	*	2	4		
Utilities	1	34	112		
Services	8	45	134		
TOTAL	10	115	378		

Codes - * = negligible
: = infinite percentage since base case is zero

[a]All dollar figures are 1970 constant dollars.
[b]This sector includes fishing activity which is difficult to reflect accurately because of its seasonal nature.
Source: RPAestimates.

EXHIBIT 7-8

SUMMARY OF BASE CASE ECONOMIC CONDITIONS

ALASKA

A. EMPLOYMENT (actual number)

Sector	Actual	Base Case 1		Base Case 2	
	1970	1985	2000	1985	2000
Construction	7100	10000	14000		
Ref., Gas, Petrochem.	0	4200	600		
Other Manufacturing	8100	10800	24600		
Agriculture [b]	13500	11000	9000		
Utilities	9700	15000	24000		
Services	66600	134000	224000		
TOTAL	105000	185000	296,200		

B. VALUE OF OUTPUT ($ million)[a]

Sector	Actual	Base Case 1		Base Case 2	
	1970	1985	2000	1985	2000
Construction	466	555	927		
Ref., Gas, Petrochem.	0	80	1998		
Other Manufacturing	322	873	146		
Agriculture [b]	109	284	353		
Utilities	148	700	1459		
Services	2502	4067	9227		
TOTAL	3547	6559	14110		

Codes - * = negligible
: = infinite percentage since base case is zero

[a]All dollar figures are 1970 constant dollars.
[b]This sector includes fishing activity which is difficult to reflect accurately because of its seasonal nature.
Source: RPA estimates.

Even greater baseline employment gains are forecast for Valdez which showed only 325 jobs in 1970. (Exhibit 7-7). Employment in all Valdez sectors is projected to grow to 2,825 jobs by 1985. Services should still represent the greatest proportion, with 1,470, or 52 percent of total jobs. Manufacturing employment shows the greatest increase, from 5 jobs in 1970 to 280 jobs in 1985, when this sector should represent 10 percent of the total. Construction jobs are also expected to equal 280 by 1985. The utilities sector shows a large increase from 20 jobs in 1970 to 720 in 1985, when it should equal 25 percent of total employment. By 1985, total output is projected to reach $115 million.

By the year 2000 total Valdez employment is expected to reach 7,200 jobs. Services will still be the predominant sector, with 3,500 jobs, but it will represent a slightly lesser portion of total employment. Manufacturing shows the greatest absolute and proportionate increase, from 280 to 1000 jobs in the year 2000. The utilities sector will grow from 720 to 1,850 jobs, and construction is forecasted to reach 750 jobs. Total output is forecast at $378 million in the year 2000.

Under baseline conditions, considerable growth is also projected to 1985 and 2000 for the State of Alaska as a whole. Total employment should grow, from 105,000 jobs in 1970 to 185,000 in 1985 and 298,000 in the year 2000 (Exhibit 7-8). Most sectors retain approximately their current proportion of total employment throughout the thirty year growth period. In 1970, the services sector accounted for 64 percent of total jobs, and this proportion should increase to 75 percent by the year 2000. A small quantity of petroleum industry employment is anticipated, representing 2.3 percent of total jobs in 1985, and dropping to 0.2 percent of the total in the year 2000.

Forecast increases in total statewide output are sizeable: from $3.5 billion in 1970 to $6.6 billion in 1985. By the year 2000, output is projected to reach $14.1 billion, representing an additional annual 5.25 percent over the 1985 figure. Against this background, the primary and aggregate impacts expected from OCS development are discussed.

Primary Impacts

The major primary economic impacts in the locality and region should come from the oil and gas recovery and construction sectors (Exhibit 7-9). Oil and gas recovery should generate a significant number of jobs -- about 3,600 in both 1985 and 2000. However, it is extremely difficult to estimate the number of these jobs which would take place in the locality or region.[1] This is especially true for Alaska, since many of the men employed in this sector are expected to commute from the lower 48 states, at least for a significant portion of their time.

The second largest primary employment sector should be construction. In 1985, about 400 new construction jobs are forecast for Valdez and Cordova, and 1,300 for the region. These jobs should drop to 120 in each city and 450 for Alaska as a whole in the year 2000. Direct output from construction activity in Valdez and Cordova is expected to be $16 million in 1985, and drop to $6 million in the year 2000. For the region it is expected to be $54 million in 1985 and $22 million for the year 2000.

Under high production conditions, gas processing will contribute 50 new jobs to the local areas in 1985, and 130 jobs by the year 2000. Statewide, gas processing should account for 3 to 5 times this number of jobs. Output from gas processing should be $9 million in 1985, and $45 million in the year 2000. In the region, gas processing output should be twice that from the local areas in 1985 and about 3 times as great in 2000.

---

[1] For the oil and gas recovery sector all employment and output projections are shown totalled in the "area" column of Exhibit 7-9. In brief, the reason for this is simply that a large fraction of the actual employment is expected to occur offshore on the Continental Shelf. Rather than assign this employment to the locality or region it was assigned to the "area." However, when predicting impacts from population- or supplier-induced employment, estimates of the consumer expenditures of the sector's employees as well as the direct expenditures from the oil and gas recovery sector were made for the local and regional areas.

EXHIBIT 7-9

PRIMARY ECONOMIC IMPACTS

ALASKA

A. EMPLOYMENT (actual number) HIGH IMPACT

	1985			2000		
	Local	Region[a]	Area[b]	Local	Region[a]	Area[b]
Oil and Gas Rec.	0	0	3630	0	0	3600
Gas Processing	50	90	0	130	410	0
Refineries	0	0	0	0	0	0
Petrochemical	0	0	0	0	0	0
Construction	390	1310	0	120	450	0

B. VALUE OF OUTPUT (millions 1970 dollars) HIGH IMPACT

	1985			2000		
	Local	Region[a]	Area[b]	Local	Region[a]	Area[b]
Oil and Gas Rec.	0	0	345	0	0	240
Gas Processing	9	18	0	45	144	0
Refineries	0	0	0	0	0	0
Petrochemical	0	0	0	0	0	0
Construction	16	54	0	6	22	0

Code: * = negligible

[a] Region includes Local

[b] Area is "Demand Area" exclusive of the Region

Source: RPA estimates

EXHIBIT 7-9 (cont.)

PRIMARY ECONOMIC IMPACTS

ALASKA

C. EMPLOYMENT (actual number) LOW IMPACT

	1985			2000		
	Local	Region[a]	Area[b]	Local	Region[a]	Area[b]
Oil and Gas Rec.	0	0	1460	0	0	1500
Gas Processing	30	30	0	40	140	0
Refineries	0	0	0	0	0	0
Petrochemical	0	0	0	0	0	0
Construction	100	440	0	40	140	0

D. VALUE OF OUTPUT (millions 1970 dollars) LOW IMPACT

	1985			2000		
	Local	Region[a]	Area[b]	Local	Region[a]	Area[b]
Oil and Gas Rec.	0	0	152	0	0	100
Gas Processing	6	6	0	15	48	0
Refineries	0	0	0	0	0	0
Petrochemical	0	0	0	0	0	0
Construction	4	18	0	2	7	0

Code: * = negligible

[a] Region includes Local

[b] Area is "Demand Area" exclusive of the Region

Source: RPA estimates

Low employment and output impacts should be roughly one third as great as high impacts in all three primary industries in either locality and the region.

Aggregate Impacts

The aggregate 1985 employment increase that would occur in either Cordova or Valdez under high impact conditions is 1050 jobs, of which 440 or 42 percent occur in the primary industries (Exhibits 7-10 and 7-12). Of the remaining 600 jobs, over 500 are in the services sector. Other manufacturing and utilities would together account for less than 10 percent of the new jobs. Basically the projections indicate that either city would remain completely dependent on the outside world for all manufactured products.

The percentage increase in employment in either city over base case conditions would be substantial in 1985, but in Cordova the total number of new jobs would nearly double. The two sectors accounting for this increase are construction--up 650 percent--and services--up over 150 percent.

The increase in output follows a similar pattern--with a gross gain of $40 million in 1985. The primary industries would account for $25 million or 55 percent of this figure. The service sector accounts for $17 million or 37 percent of the total, while other manufacturing and utilities account for 8 percent. Since the two primary industries include a labor-intensive gas processing industry, induced output is roughly proportional to induced employment.

Past the peak of construction activity in the year 2000, the high impact employment drops to 840 jobs, of which only 250 are in the primary sectors. The service sector is dominant, with over 500, or 63 percent of total jobs, while other manufacturing and utilities supply only 6 percent. Of course, the percentage increases would also have fallen to a relatively meagre 12 percent in Valdez but a still impressive 50 percent in Cordova.

Under the low production case assumptions, aggregate impacts to either Cordova or Valdez would be roughly one-third of expected high impact levels in both 1985 and 2000 (Exhibit 7-11 and 7-13).

EXHIBIT 7-10

AGGREGATE ECONOMIC IMPACTS

CORDOVA

HIGH IMPACT

A. EMPLOYMENT (actual number)

Sector	1985	Percent Over B.C. 1	Percent Over B.C. 2	2000	Percent Over B.C. 1	Percent Over B.C. 2
Construction	390	650		120	133	
Ref. Gas, Petrochem.	50	:		130	:	
Other Manufacturing	40	10		30	6	
Agriculture	*	:		30	15	
Utilities	30	17		0	:	
Services	540	154		530	76	
TOTAL	1050	88		840	48	

B. VALUE OF OUTPUT ($ million)[a]

Sector	1985	Percent Over B.C. 1	Percent Over B.C. 2	2000	Percent Over B.C. 1	Percent Over B.C. 2
Construction	16	533		6	100	
Ref., Gas, Petrochem.	9	:		45	:	
Other Manufacturing	3	12		3	8	
Agriculture	*	:		*	:	
Utilities	1	13		2	13	
Services	17	170		20	77	
TOTAL	46	81		76	78	

Codes - * = negligible
: = infinite percentage since base case is zero

[a]All dollar figures are 1970 constant dollars.

Source: RPA estimates

EXHIBIT 7-11

AGGREGATE ECONOMIC IMPACTS

CORDOVA

LOW IMPACT

A. EMPLOYMENT (actual number)

Sector	1985	Percent Over B.C. 1	Percent Over B.C. 2	2000	Percent Over B.C. 1	Percent Over B.C. 2
Construction	100	166		40	44	
Ref., Gas, Petrochem.	30	:		40	0	
Other Manufacturing	10	3		10	2	
Agriculture	10	5		10	5	
Utilities	10	5		10	4	
Services	200	57		190	27	
TOTAL	360	30		300	17	

B. VALUE OF OUTPUT ($ million)[a]

Sector	1985	Percent Over B.C. 1	Percent Over B.C. 2	2000	Percent Over B.C. 1	Percent Over B.C. 2
Construction	4	133		2	33	
Ref.,Gas, Petrochem.	6	:		15	:	
Other Manufacturing	1	4		1	3	
Agriculture	*	:		*	:	
Utilities	1	13		1	7	
Services	6	60		7	27	
TOTAL	18	32		26	27	

Codes - * = negligible
: = infinite percentage since base case is zero

[a]All dollar figures are 1970 constant dollars.

Source: RPA estimates

EXHIBIT 7-12

AGGREGATE ECONOMIC IMPACTS

VALDEZ

HIGH IMPACT

A. EMPLOYMENT (actual number)

Sector	1985	Percent Over B.C. 1	Percent Over B.C. 2	2000	Percent Over B.C. 1	Percent Over B.C. 2
Construction	390	139		120	16	
Ref. Gas, Petrochem.	50	:		130	:	
Other Manufacturing	40	14		30	3	
Agriculture	*	2		30	2	
Utilities	30	4		0	2	
Services	540	37		530	15	
TOTAL	1050	37		840	12	

B. VALUE OF OUTPUT ($ million)[a]

Sector	1985	Percent Over B.C. 1	Percent Over B.C. 2	2000	Percent Over B.C. 1	Percent Over B.C. 2
Construction	16	101		6	12	
Ref., Gas, Petrochem.	9	:		45	:	
Other Manufacturing	3	14		3	3	
Agriculture	*	2		*	2	
Utilities	1	4		2	2	
Services	17	37		20	15	
TOTAL	46	40		76	20	

Codes - * = negligible
: = infinite percentage since base case is zero

[a]All dollar figures are 1970 constant dollars.

Source: RPA estimates

EXHIBIT 7-13

AGGREGATE ECONOMIC IMPACTS

VALDEZ

LOW IMPACT

A. EMPLOYMENT (actual number)

Sector	1985	Percent Over B.C. 1	Percent Over B.C. 2	2000	Percent Over B.C. 1	Percent Over B.C. 2
Construction	100	35		40	5	
Ref., Gas, Petrochem.	30	0		40	0	
Other Manufacturing	10	5		10	1	
Agriculture	10	1		10	1	
Utilities	10	2		10	1	
Services	200	14		190	6	
TOTAL	360	13		300	4	

B. VALUE OF OUTPUT ($ million)[a]

Sector	1985	Percent Over B.C. 1	Percent Over B.C. 2	2000	Percent Over B.C. 1	Percent Over B.C. 2
Construction	4	25		2	4	
Ref.,Gas, Petrochem.	6	:		15	:	
Other Manufacturing	1	5		1	1	
Agriculture	*	1		*	1	
Utilities	1	2		1	1	
Services	6	14		7	6	
TOTAL	18	16		26	7	

Codes - * = negligible
: = infinite percentage since base case is zero

[a]All dollar figures are 1970 constant dollars.

Source: RPA estimates

EXHIBIT 7-14

AGGREGATE ECONOMIC IMPACTS

ALASKA

HIGH IMPACT

A. EMPLOYMENT (actual number)

Sector	1985	Percent Over B.C. 1	Percent Over B.C. 2	2000	Percent Over B.C. 1	Percent Over B.C. 2
Construction	1310	13		450	3	
Ref. Gas, Petrochem.	90	2		410	69	
Other Manufacturing	220	2		190	1	
Agriculture	40	*		30	*	
Utilities	240	2		340	1	
Services	2500	2		2240	1	
TOTAL	4400	2		3660	1	

B. VALUE OF OUTPUT ($ million)[a]

Sector	1985	Percent Over B.C. 1	Percent Over B.C. 2	2000	Percent Over B.C. 1	Percent Over B.C. 2
Construction	54	10		22	2	
Ref., Gas, Petrochem.	18	23		144	7	
Other Manufacturing	14	2		15	10	
Agriculture	1	*		1	*	
Utilities	11	2		20	1	
Services	77	2		91	1	
TOTAL	175	3		293	2	

Codes - * = negligible
: = infinite percentage since base case is zero

[a]All dollar figures are 1970 constant dollars.

Source: RPA estimates

EXHIBIT 7-15

AGGREGATE ECONOMIC IMPACTS

ALASKA

LOW IMPACT

A. EMPLOYMENT (actual number)

Sector	1985	Percent Over B.C. 1	Percent Over B.C. 2	2000	Percent Over B.C. 1	Percent Over B.C. 2
Construction	440	4		140	1	
Ref., Gas, Petrochem.	30	1		140	23	
Other Manufacturing	80	1		70	*	
Agriculture	20	*		10	*	
Utilities	80	1		110	*	
Services	960	1		820	*	
TOTAL	1610	1		1290		

B. VALUE OF OUTPUT ($ million)[a]

Sector	1985	Percent Over B.C. 1	Percent Over B.C. 2	2000	Percent Over B.C. 1	Percent Over B.C. 2
Construction	18	3		7	1	
Ref.,Gas, Petrochem.	6	8		48	2	
Other Manufacturing	5	1		5	4	
Agriculture	*	*		*	*	
Utilities	4	1		7	*	
Services	29	1		33	*	
TOTAL	62	1		100	1	

Codes - * = negligible
: = infinite percentage since base case is zero

[a]All dollar figures are 1970 constant dollars.

Source: RPA estimates

Incremental regional employment should exceed baseline employment by 2.4 percent, with 4,400 jobs, the biggest shares provided by primary activities and services (Exhibit 7-14). Services account for 2,500 jobs, or 57 percent; construction activity provides 1,300, or 30 percent; and petroleum related industries account for 100 jobs, or 2 percent. Other manufacturing industries and the utilities sector should provide 200 jobs, or 5 percent, apiece.

Regional output is increased proportionally to employment, with the total increment, $175 million, representing a 3 percent increase over 1985 baseline forecasts. The services sector produces the greatest share of output, or 44 percent; construction accounts for 31 percent; petroleum industries and other manufacturing produce 10 percent and 8 percent, respectively.

By the year 2000 it is expected that there will be 3,700 new jobs in the Alaska region under the high impact case, an increase of only 1.2 percent over baseline employment forecasts. The services sector is the dominant employer, with 2,200 jobs, or 59 percent of the total increment. Primary industries offer another 24 percent, and the remaining 16 percent is shared by other manufacturing and utilities.

Total output is increased by $293 million, or 2 percent more than baseline forecasts. The petroleum industries realize nearly 50 percent of this output increment, and the services sector realizes another 31 percent.

Regional impacts under the assumption of low oil and gas production are roughly one-third those in the high production case for both output and employment in both forecast years (Exhibit 7-15).

Social Infrastructure

As was the case with employment, the potential impacts on the Cordova or Valdez social infrastructure, should either or both be chosen as staging areas for OCS developments, would be substantially different. The demand for services in Cordova, which is not expected to be directly affected by the Trans-Alaska pipeline, would approximately double under high impact versus base case conditions. Keeping in mind that the base case itself represents

---

[1] It should be noted here that the estimates of infrastructure impacts are based solely on population increase ratios and therefore may, in the case of such a small base case population, be exaggerated.

EXHIBIT 7-16

CORDOVA
(Geog. Area)

SOCIAL INFRASTRUCTURE IMPACT

	1970	1985		Incr.		2000		Incr.	
		Base Case 1	Base Case 2	High Impact	Low Impact	Base Case 1	Base Case 2	High Impact	Low Impact
POPULATION (000)	1.6	3.8		4.2	1.9	5.6		3.4	2.3
Percent Change %				111	50			61	41
PHYSICAL SYSTEMS									
Water Demand[a] Mil. gallons/day	1.5	1.8		.7	.3	2.0		.6	.2
Elec. Demand (MW of Capacity)	5.6	8.6		4.8	1.9	8.6		6.4	2.3
Structures Residential (000)	.5	1.1		1.2	.5	1.7		1.0	.7
Commercial (millions of sq. ft.)	NA	.1		.1	.03	.1		.1	.02
SOCIAL SYSTEMS									
Schools - Enrollees (000)	.5	1.1		.9	.4	1.7		.8	.3
Hospitals - Beds	15	15		15	6	15		12	5
Police - Manpower	6	6		4	2	6		3	2
Solid Waste - Tons/Day	5	11		13	6	17		10	7
Sewage - Mil.gal/day	.2	.4		.5	.2	.7		.4	.2
Gov't. OH - ($000,000)	NA	NA		NA	NA	NA		NA	NA
BUSINESS & GOVERNMENT INSTIT.									
Business Services - Employee (000)	NA	NA		NA	NA	NA		NA	NA
Government - Employees (Actual no.)	30	82		91	41	139		73	50

[a] Water Usage figures include requirements of Cordova's fish processing industry

Source: RPA estimates

EXHIBIT 7-17

VALDEZ
(Geog. Area)

SOCIAL INFRASTRUCTURE IMPACT

	1970	1985		Incr.		2000		Incr.	
		Base Case 1	Base Case 2	High Impact	Low Impact	Base Case 1	Base Case 2	High Impact	Low Impact
POPULATION (000)	1.1	9.6		4.2	1.9	25.8		3.4	2.3
Percent Change %				44	20			13	9
PHYSICAL SYSTEMS									
Water Demand Mil. gallons/day	.4	1.7		.7	.3	4.9		.6	.2
Elec. Demand (MW of Capacity)				4.76	1.87			6.38	2.29
Structures Residential (000)	.3	2.9		1.2	.5	7.7		1.0	.7
Commercial (millions of sq. ft.)	.1	.2		.1	.03	.4		.1	.02
SOCIAL SYSTEMS									
Schools - Enrollees (000)	.3	2.3		.9	4	6.2		.8	.3
Hospitals - Beds	0	34		15	6	91		12	5
Police - Manpower	3	18		8	3	42		6	3
Solid Waste - Tons/Day	3.2	29		13	6	77		10	7
Sewage - Mil.gal/day	.1	1.1		.5	.2	3.1		.4	.2
Gov't. OH - ($000,000)	.1	.7		.3	.1	1.8		.2	.1
BUSINESS & GOVERNMENT INSTIT.									
Business Services - Employee (000)	NA	NA		NA	NA	NA		NA	NA
Government - Employees (Actual no.)	23	224		91	41	585		73	50

Source: RPA estimates

significant growth, the conclusion that OCS development would lead to severe dislocations is inescapable.

The most obvious impact would be felt directly in the population base (Exhibit 7-16). The 1970 permanent[1] population of 1,600 which is projected to grow to 3,800 people by 1985, would have to absorb an additional 4,200 people under high impact assumptions. This represents an increase of 111 percent over 1985 base case, and 500 percent over the 1970 level. By the year 2000, the base case projections show somewhat less than 6,000 people which would be increased by 3,400 under OCS high impact. Of course, low impact assumptions would lead to substantially less growth--an additional 2,000 people in 1985 and 2000. This would represent about 50 percent of the base case projections.

The increased population base would then immediately require the services of those physical and social systems listed on Exhibit 7-16. For example, the Cordova electric utility, which is expected to have a capacity of 8.5 MW in 1985, would be unable to support the increased demand for electricity. This could be an especially critical problem for a city like Cordova, which has no ability to draw on outside supplies, as would be available to an area in the lower 48 states. Thus, if increased electrical generation capacity is to be required in the future, it is essential that the need be recognized early enough that planning and construction is possible.

---

1 As mentioned earlier, the city of Cordova experiences a major influx of transient workers in the summer months. The actual number has been estimated to be about 5,000 men. These individuals are employed in either fishing or fish processing for the peak summer period. Their demands on Cordova for services are substantial, although rather different from those required by the permanent residents. For example, they would not impact the school system or require permanent housing. However, their needs for housing, food, entertainment and so on must be viewed as a critical requirement to a city which essentially exists because of the fishing industry. Since OCS development would also generate a variable, but potentially large, number of non-permanent visitors, the possibility of shortages in the supply of services to transients is very real.

Similarly, the demand for permanent residential structures would more than double when comparing the high impact scenario with the base case in 1985. Again, timing construction would be the biggest problem. In an absolute sense, the 1200 new residential structures that would be required under high impact assumptions does not seem to be an unmanageable figure. Yet in an isolated area like Cordova, with no supply base of construction workers, supplies and so on, it would be a considerable undertaking--especially since it would have to be managed in conjunction with the other activities being undertaken.

The third physical system examined was the demand for water which should sustain only a small impact from OCS development. Water usage in Cordova is already extremely high owing to the demand from the fish processing industry and the water resources in the area are expected to be adequate to satisfy future growth.

The projected impacts from OCS development on the six social systems examined, although significant, would be less difficult to handle than those mentioned above. This is so primarily because the systems do not generally require major construction efforts to expand. The one exception, of course, would be sewage treatment--where large investments can be required. In Cordova, however, a new sewage treatment plant is about to be constructed at an investment cost of $3 million. Its design capacity will be 1.5 million gallons per day, which should be adequate to handle Cordova's base case growth as well as the growth from high impact OCS.

The potential OCS induced expansion in the school, hospital, police and solid waste systems is relatively large when compared to base case figures, but small enough in an absolute sense that it should be manageable. Of course, planning would be necessary to insure space in the schools, and perhaps an addition to the hospital. More critical in these areas would be the problem of insuring an adequate supply of personnel to operate the systems.

In summary, the problems that Cordova would likely experience within its social infrastructure in conjunction with high impact OCS development would relate primarily to difficulties associated with constructing capital intensive facilities requiring a long lead planning period in an isolated area where temporary solutions do

not readily exist. The city cannot draw upon resources from surrounding communities and must therefore be able to exist independently at all times. This implies that if a sudden spurt in the demand for services is to be handled, the planning and facilities construction must precede the arrival of those individuals who require the services.

In Valdez, on the other hand, the impact from either high or low impact OCS development would not be as significant in a relative sense. Largely as a result of the construction and operation of the Trans-Alaska pipeline, for which Valdez will serve as the southern terminus and transshipment point, baseline forecasts predict a sizeable expansion in the near future. All of the social infrastructure effects analyzed are predicated upon increases in the local population base, and the large baseline forecasts already strain the capacity of community facilities to serve their needs. Still, if the impacts associated with the pipeline can be handled, it would seem that the additional strain from OCS development would be much less than would occur in Cordova.

Baseline population is expected to reach 9,600 persons by 1985, a 770 percent increase from 1970, and to total 25,800 persons in the year 2000 (Exhibit 7-17). Under high impact assumptions, 1985 population should reach a total of 13,800 persons, a 44 percent increase over the baseline projection. High production is also expected to attract an additional 3,400 residents in the year 2000, for a total forecast of 29,200 persons. The low production case assumptions yield roughly one-third the population increment expected under high impact assumptions.

A fundamental limitation to adequate growth in infrastructure is the city's small revenue base. State revenue sharing is expected to be a prerequisite to Valdez's providing minimum services to accommodate even baseline expansion.[1] Government overhead expenses are expected to rise from $100,000 in 1970 to $700,000 in 1985, under baseline conditions. High production impacts will raise overhead an additional $300,000 in 1985, a 44 percent increase over baseline needs. Affected services include the sewer and solid

---

1 "Impact of Alyeska - Trans Alaska Pipeline on Valdez," 1973, p. 1.

waste disposal systems, the small boat harbor, the school system, and police and fire protection, as well as the city administration.

Although the existing sewer system is considered adequate to serve the present town site and all developed residential parcels are receiving service, installation of a new system will be required to accommodate expanded settlement. Moreover, the present sewage treatment plan is wholly inadequate to treat the sizeable additional loads forecast. High impact demand alone is five times the load presently treated, and baseline demand plus the high impact increment would increase the load roughly fifteen times.

Although present water supply and storage facilities should be adequate to serve the baseline and impact populations forecast, water mains need to be insulated or reburied deeper. Actual present water consumption is extremely wasteful, since most residents leave water running continually during the winter months to avoid pipes' freezing.

The school system will have to be greatly expanded to accommodate the children of new residents attracted by both pipeline and Gulf oil developments. The present system is heavily subsidized from state funds to support the State school for the mentally retarded. As the proportion of non-State supported students increases, Valdez will have to assume a greater burden of expenses. It is estimated that over $2 million will be required to provide school facilities necessary to accommodate long-term baseline enrollment forecasts. Attracting adequate teachers may be even more difficult. High impact assumptions predict an additional 900 students in 1985.

Both police and fire department manpower needs will rise under Gulf oil developments. Because workers may be temporary (rather than permanent) residents in Valdez during construction activity peaks, and given the nature of work shifts on construction crews, the frequency and types of crime which result could be totally unfamiliar to a small city like Valdez. Present police manpower is expected to increase six times to 18 officers by 1985, under baseline conditions, and high impact conditions presume the need for an additional eight officers. Present police quarters in the City Hall are inadequate to house

these increases in manpower and support services, or to provide adequate jail facilities for criminal offenders. A separate police department wing of the present City Hall has been suggested at an estimated cost of $150,000. Additional firehouse quarters and equipment will also be necessary to provide the protection an expanded townsite will require.

Valdez is currently underendowed with health facilities and staff. Although the Alaskan State Mental Hospital is located in Valdez, only 15 of its beds are available for local use; one doctor is in residence, and a dentist visits Valdez periodically. The need for hospital beds will double under baseline conditions by 1985, and triple under high impact Gulf oil development assumptions. Valdez will have to attract medical personnel to accommodate forecast population increments.

Most commercial and residential structures in Valdez are new, owing to relocation and reconstruction of the townsite after the 1946 earthquake. However, projected demand for new structures is considerable. Present commercial and retail floor space totals 100,000 square feet, and demand for floor space is projected to double by 1985, and again by the year 2000. High impact assumptions predict a 50 percent increase in demand for commercial space over baseline forecasts in 1985, and a 25 percent increase over baseline in 2000. These space requirements could easily expand the boundaries of the present and planned Valdez city center during peak activity.

Demand for residential units is expected to increase almost ten times to 2,900 units by 1985 under baseline conditions, and to almost triple again to 7,700 units by the year 2000. High impact assumptions would add another 41 percent to this incremental demand in 1985, and an additional 13 percent over baseline in 2000.

It will be extremely difficult for the City of Valdez to provide needed services to such an expanded residential population. Less than one-third of present residential lots are still undeveloped, and one-third of these have no hook-ups to water, sewer, and electricity systems. Road access is likewise limited to these lots, and future subdivisions will require road development on the part of the private sector developing these lots.

Since, as in many small Alaskan towns, private or commercial financing is practically non-existent in Valdez, private citizens will be at a disadvantage in developing their own housing. Not only do they face the added costs of access road development, but materials and shipment costs in Alaska are extremely high and the building season is very short. State-guaranteed development loans have been suggested as a possible solution. If large-scale private developers are to be enlisted to provide needed single- or multi-family units, then Valdez citizens must consider the ramifications such development has for their life style. Moreover, population density in Valdez is already high for such a small community, and rapid, large-scale development of single-family tracts or multi-family apartment buildings could easily create crowding.

There are seven trailer parks in Valdez, providing enough space for development of just under 300 units, of which only about 75 would necessarily be mobile homes. Three of these parks occupy land close to the city center, and this land is likely to be required for commercial expansion.

While trailer parks afford a comparatively inexpensive and rapid solution to the problem of sudden high demand for residential units, they are not necessarily a good solution. Not only do they not expand the local tax base to the same extent that permanent houses do, but they create a semi-transient atmosphere. If, as in the case of Valdez' three "downtown" parks, the land might be better occupied by other uses or structures, much of the cost of numerous water, sewage, and electrical hook-ups will be lost when the trailers are removed.

While it is apparent that the citizens of Valdez look forward to rapid oil and gas industry expansion in order to promote expanded services and facilities, projected expansion under baseline and high impact assumptions should far exceed the City's capacity to accommodate the population influx. It will be difficult for Valdez to realize its expectations of benefits from the

expansion boom unless some of the following conditions occur: (1) State or Federal revenue sharing funds are received from pipeline and Gulf production activities, (2) the petroleum industry provides extensive housing development and road access and shares certain services, like health care and fire protection, and (3) developing industry stimulates the Valdez economy through support of local trade establishments.

Land Use

As was the case in both the economic and social impact sections, the land use analysis reveals a striking contrast between the cities of Cordova and Valdez. In Cordova, the development requirements associated with high impact OCS activity could probably not be met within the city's existing boundaries or even on land currently available for expansion. In contrast, in Valdez over 99.7 percent of the land area is presently unused and could accommodate development requirements.

Needless to say, the idea of a city with a population of 2000 not having land for expansion is rather peculiar. The problem lies in the fact that the city boundaries contain less than 500 acres -- a miniscule city by any standards. Further, the city is completely encapsulated by National Forest lands, which under existing law cannot be used for development. Thus when it is seen that land requirements in the year 2000 for high impact plus base case growth could exceed 700 acres (Exhibit 7-18), it is obvious that the growth could not be accommodated.

If Cordova is to be developed, then, a portion of the National Forest must be made available for commercial and residential use. In fact, there is a very strong liklihood that this will occur, whether or not OCS development impacts the area. A group of Alaskan natives, currently residing in Cordova, have laid claim to significant amounts of land. Although these claims have yet to be resolved, the current expectation is that the natives will be deeded ownership to three 36 square mile tracts immediately surrounding Cordova. This land will be immediately available for development and obviously would be adequate to accommodate all future growth in the region. It is interesting to note that the native group holding the land could enjoy a substantial economic windfall if Cordova is chosen as an OCS staging area. They would

EXHIBIT 7-18

CORDOVA, ALASKA

Land Use Summary
(Acres)

Land Use	1963	Base Case[a] 1985	High OCS[a] 2000
Residential	24	80	190
Commercial & Industrial	9	25	160[b]
Other Developed	49	165	390
Total Developed	82	270	740
Remaining Undeveloped	209	21	-
TOTAL LAND	291	291	291

[a]Straight-line projections based on population and employment forecasts.

[b]Includes 100 acres for primary industry.

Source: Cordova 1980 General Plan, Alaska State Housing Authority, June 1963, and RPA estimates.

control the only land on which development could occur and this kind of monopoly power generally implies significant financial benefits.

In Valdez, where a city plan has been prepared[1], development through 1991 is expected to occur within an area of 46,600 acres--or slightly more than 26 percent of the total undeveloped land (Exhibit 7-19).

The basic "urban area" of 16,800 acres constitutes the principal locus of planned development. Comparing the 14,700 acres required for base case and high OCS conditions for the year 2000 with the city's plans, the urban area alone could not satisfy OCS land requirements (see Exhibits 7-19 and 7-20). However,the industrial land needed could be obtained from the 6,400 acres set aside by the city (again, Exhibit 7-19). Similarly, additional developed land could be provided from the 15,700 acre "recreation" category, and the 7,700 acres designated for "urban expansion". Thus, the total 46,600 acres which Valdez has set aside should be sufficient to accommodate the 14,700 gross acreage requirements of OCS.

ALASKA COMMUNITY PROFILES

The cities of Valdez and Cordova are in many ways representative of the several small communities along the Gulf of Alaska where the oil and gas industries might locate their staging and gas processing activities. Since the assumption that such activities will take place at Valdez and Cordova is, at best, uncertain, data are presented here from several other places along the Gulf. This allows the assessment of differing conditions in those areas not entirely represented by Valdez and Cordova. The other potential sites, Yakutat and Seward, are described in the following pages.

---

1 The analysis for Valdez relied heavily on the Comprehensive Development Plan prepared for the city by Bomkoff, Collie and Klotz, Consulting Engineers and Planners, in 1971. It was assumed that if this development could accommodate high OCS development conditions over base case in the year 2000, the land use impact of other cases would have been considered.

EXHIBIT 7-19

VALDEZ , ALASKA
PLANNED LAND USE 1991

Category	Acreage	Percent
Urban Area	16,800	9.5
Urban Expansion	7,700	4.4
Recreation	15,700	8.8
Industry	6,400	3.6
Subtotal	46,600	26.3
Open Space	94,160	54.0
Water	34,600	19.7
Total	175,360	100.0

Source: Comprehensive Development Plan, Valdez, Alaska, 1971.

EXHIBIT 7-20

LAND USE SUMMARY
VALDEZ CITY, ALASKA

Land Use Projections	Existing 1970	High OCS[a] 2000
Residential	67	1,800
Commercial and Industrial	167	4,200[b]
Other Developed	327	8,700
Total Developed	561	14,700
Total Land	175,360	175,360

[a]Straight-line projections based on population and employment forecasts.

[b]Includes 100 acres for primary industry.

Source: Valdez, Alaska, Comprehensive Development Plan Bomhoff, Collie & Klotz, Consulting Engineers and Planners, 1971, and RPA estimates.

Yakutat[1] and Seward[2] were selected for closer examination to give a more representative picture of the range of population and development characteristics of communities along the Gulf Coast.

The first, Yakutat, is a tiny community with about 250 people in all. The second, Seward, with a population of over 1800, is approximately eight times larger than Yakutat and is nearly twice as large as Valdez. As in Cordova and Valdez, the populations in Yakutat and Seward will undoubtedly increase over time. The Alaska State Housing Authority (ASHA) forecasts a 66% increase in Yakutat -- to 410 -- by 1990. Seward's already sizeable population is expected to nearly double -- to 3300 -- by 1985.

Both cities are situated on natural deepwater harbors, Yakutat on Monti Bay and Seward on Resurrection Bay. Yakutat is the largest community to be found along the unsettled region between the Sitka-Juneau area to the southeast and the central Gulf area of Valdez-Cordova. Daily flight service connects Yakutat to other points in Alaska, specifically Juneau, Cordova and Anchorage, and air travel is, in fact, the only means of transport in and out of the city. There are no regular highways linking Yakutat with either the Canadian or Alcan systems and there are few local access roads. Seward lies about 128 miles south of Anchorage. It is the southern terminus of the Alaskan railroad with links northward to Anchorage and Fairbanks. In addition, road, ferry and air services connect it with other points in the state.

Like the other communities on the Gulf Coast, Yakutat and Seward lie in a zone of severe earthquake activity.

---

[1] The information reported in the Yakutat Community Profile is derived from two sources: Yakutat, Alaska Comprehensive Development Plan, September 1971, and Yakutat: Reconnaissance Report and Initial Housing Element, April 1970. Both reports were prepared by the Alaska State Housing Authority.

[2] Information reported for Seward is derived from three principal sources: City of Seward Comprehensive Plan, 1967, ASHA; Kenai Peninsula Borough, Comprehensive Planning Program - Survey & Analysis, March 1968, ASHA; and "Seward, Alaska: A Community Profile," State of Alaska Department of Economic Development, 1973.

In the quake of March, 1964, Yakutat escaped serious damage. Seward, however, like Valdez, sustained heavy losses during both the tremor and the subsequent waves and landslides. Its transportation system was completely destroyed and the city assessed damages to its port and highway at over $15 million.[1] The period of inactivity for two years afterward saw the rise of new transportation routes along the Gulf, and the development of competing ports which may hamper Seward's rise to its former pre-eminence. Seward's shoreline is considered susceptible to further sliding and erosion and is, therefore, unsuitable for industrial, commercial or residential development.

Yakutat: A Depressed Community

Unlike the relatively prospering cities of Cordova and Valdez, the Yakutat community is economically depressed. As in Cordova, the fishing and processing industries dominate the employment picture. Logging also provides further employment but workers here have traditionally come from Washington and Oregon rather than the locality. Government agencies -- the Federal Aviation Administration, the U.S. Coast Guard, the U.S. Weather Bureau, as well as several state and local agencies -- and the airport are the leading sources of year-round jobs. (Fishing provides only seasonal employment.) In 1970 the median family income was $3,000.

Yakutat's financial resources may be characterized as seriously inadequate for providing basic services to its populace. Total revenue amounted to $50,014 for the fiscal year ending in June, 1970.[2] At present, the city relies on state and federal monies as well as publicly-owned assets to provide services. The fact that the Standard Oil Terminal, several businesses and the residences of approximately sixty people lie outside Yakutat's boundaries account, in part, for the city's financial plight. Thus, annexation of these areas is seen as a prerequisite to providing public services here, should expansion take place.

---

[1] Kenai Peninsula Borough, Comprehensive Planning Program - Survey & Analysis, March 1968, Alaska State Housing Authority, p. 34.

[2] All City financial information is quoted from the Yakutat Comprehensive Development Plan, pp. 71-76.

Several possible avenues exist for broadening Yakutat's economic base -- expanding existing fisheries to include species other than salmon, developing hunting and tanning industries and promoting tourism. More specific plans include a federally-funded cold-storage plant and timber sales to the U.S. Plywood-Champion Company.

A principal problem in Yakutat is the separation of the village proper and the airport community. Since visitors tend to stay within the airport's environs, the city receives little in the way of revenues from them. Integrating the two communities will serve to bring greater prosperity to Yakutat, as will implementing the possibilities mentioned above. Development from OCS-related activities would provide even more dramatic economic expansion.

Meanwhile, Yakutat's community services remain limited. The city's water system is already operating close to capacity; there is no sewage system and fire protection equipment would prove inadequate should a large conflagration occur. The Yakutat Electric Company has sufficient capacity to serve the entire area, but its only large consumer is the FAA. Thus, per-unit costs are high -- three times those in Anchorage -- and the company is seeking to lower rates by recruiting other large consumers. Yakutat has no local newspaper or radio station; only fifteen of the 52 village homes have telephones.[1] The police in Yakutat consists of a single local officer and a State Trooper who visits the area twice monthly. Fortunately, crime at present is limited, but increased development will undoubtedly call for a larger police force. Schools and health care services are limited. Seventy-three percent of existing housing is considered substandard. The lack of highways for transporting building materials, low resident incomes and credit and land shortages all combine to exacerbate the problem of inadequate housing. Yakutat's existing boat float lies in an area of protected waters and can accommodate 35 small craft. It can be expanded to a 50-boat capacity.

Impact of OCS Development

Compared to Valdez and Cordova, Yakutat is ill-equipped to provide the labor force and support services required for oil staging and processing operations. The present

---

[1] Ibid., p. 108; figures from 1970 Census data.

small population would be overwhelmed by the magnitude of OCS-related activities which would attract several thousand new residents. Present city revenues can barely meet the needs of the current population. The impact of OCS staging and processing operations on population growth and employment is shown in Exhibit 7-21. The same quantitative impacts are assumed here as for Valdez or Cordova.

Still, the population looks forward to the entrance of new industries which will not, as in the past, exploit its resources while excluding them from the resulting benefits. Thus, Yakutat seeks to insure that future industrial development expands the now inadequate tax base and that it will offer a significant degree of year-round employment to the local labor force. The city also seeks to conserve its rich natural resources and to protect its fisheries from any adverse consequences of increased logging or oil extraction.

In order to expand the tax base, Yakutat seeks the transfer of all state-selected lands to city ownership. Retaining the extensive land and water rights could assure it the revenues from the leases of these lands to oil companies.

But even with additional tax income, Yakutat will still be hard pressed to provide basic services to an expanded population. The oil industry, should it come to Yakutat, should anticipate providing certain services -- access roads and sewage treatment, for example.

Seward: A Prospering Community

Seward seems much like Valdez in that its capacity to serve the basic needs of an expanded population and poses fewer problems than in either Cordova or Yakutat, for already it is a relatively thriving community. The city counts a significant number of service industry, trade and transportation jobs. Government is a principal employer, as well, with half of its workers in the military. According to the city's Comprehensive Plan of 1967, employment as well as population is expected to double by 1985 as a result of natural development, with several significant shifts. Increased employment is expected in mining -- from its present nonexistence to 6.3 percent of total employment -- and manufacturing from 7.4 to

EXHIBIT 7-21

ALASKAN ECONOMIC SUMMARY

BASE CASE

	Population			Employment		
	1970	1985	2000	1970	1985	2000
Seward	1800[1]	3300[3]	4,800[4]	800[1]	1160[1]	2200[4]
Yakutat	250[2]	400[4]	620[4]	100	160[4]	260[4]

OCS HIGH IMPACT[4]

	Population				Employment			
	1985		2000		1985		2000	
	Actual Number	% Over B.Case	Actual Number	% Over B.Case	Actual Number	% Over B.Case	Actual Number	% Over B.Case
Seward	7,500	127	8,200	71	2,210	91	3,040	38
Yakutat	4,600	1,050	4,000	545	1,210	656	1,100	323

OCS LOW IMPACT[4]

	Population				Employment			
	1985		2000		1985		2000	
	Actual Number	% Over B.Case	Actual Number	% Over B.Case	Actual Number	% Over B.Case	Actual Number	% Over B.Case
Seward	5,200	58	7,100	48	1,520	31	2,500	14
Yakutat	2,300	475	2,920	371	520	225	560	115

Sources:
1. City of Seward Comprehensive Plan, 1967, Alaskan State Housing Authority
2. U.S. Dept. of Commerce, Bureau of the Census, 1970 Census of Population
3. RPA Estimates, based on Alaska State Housing Authority Forecasts
4. RPA Estimates

15.8 percent. Transportation is anticipated to remain at the same proportionate level and jobs in the services, trade and government are expected to decline within this period. Government, in particular, shows the greatest decrease, from 39.1 to 27 percent of total employment.[1]

EXHIBIT 7-22

ESTIMATED SEWARD AREA EMPLOYMENT, 1973

Agriculture*	0
Construction	17
Finance	10
Government	315
Mining	0
Manufacturing/Processing	106
Service	120
Trade	122
Transportation/ Communications	179
TOTAL	869

*-This sector includes fishing activity of a seasonal nature which, due to the timing of the survey, is not reflected here.

Source: "Seward, Alaska: A Community Profile," State of Alaska Department of Economic Development, 1973.

Seward has proposed the establishment of an export lumber industry, and its railroad, road and port transportation links will contribute to this end. The city has also proposed the exploitation of the Gulf's bottom fish resources and the expansion of existing fisheries. It also looks to the mining and petroleum industries to take advantage of Seward's location. Recreation and tourism will provide further sources of economic activity. Still, the future of Seward's transportation industry remains uncertain. Competition with the ports of Anchorage and Whittier may preclude its rise to major port status. Its airport can accommodate large propeller aircraft, but rapid economic expansion in the community would call

[1] City of Seward Comprehensive Plan, pp. 112-113.

for expansion of airport facilities, as well.

Overall, however, Seward's planners look with optimism upon its locational advantages and the availability of land for industry and residences. As the Comprehensive Plan states, "the community is well-prepared to accommodate a more rapid rate of development. With fortuitous public and private decisions relative to location, the population of Seward could exceed 4,000 by 1975."[1] This statement appears accurate; however, some specific services could be strained beyond their present capacities.

Nonetheless, Seward, quite unlike Yakutat, appears to have a well-endowed system of basic community facilities. Its sewer and water systems have undergone recent rehabilitation, and existing water supplies are estimated at four times the record 1965 demand. Sewage treatment does not exist at present, and this situation poses a potential environmental hazard to expansion. Solid waste facilities are limited to a private individual who collects and disposes of Seward's refuse and a sanitary landfill. Fire protection services were judged adequate for a growing population under the 1967 projections, as were schools and hospitals. Like Yakutat, crime in Seward is low, and it is difficult to estimate the capability of the present police force to cope with both the greater and unfamiliar problems resulting from expansion. Planners, using economic and population forecasts, predict that an additional 350 to 400 new housing units will be needed by 1985. Currently, there are 745 units in 620 structures, and almost half of these are in poor condition.[2] The city supplies electricity which it purchases from the Chugach Electric Association. Telephone service is provided by the General Telephone Company of Alaska and the ASHA believes the system adequate for the foreseeable needs of both Seward and the planning area. The Seward Municipal Boat Harbor built in 1964 contains 341 boat slips, an open-faced 620-foot dock to accommodate boats up to 620 feet, a dry-dock grid and a four-land loading ramp for small craft. An Economic Development Administration loan and grant tax was recently approved, and this will provide funds for immediate expansion of the new harbor.

---

[1] Ibid., p. 115.

[2] "Seward, Alaska: A Community Profile,", op. cit.

In sum, it appears that Seward's capacity to serve basic population needs will be greater than either Yakutat's or Cordova's. Seward's present population is the largest of the four Gulf communities considered here, and many of its services will be able to accommodate expansion. It must be emphasized, however, that rapid growth will require a faster delivery of services than local planners anticipated in 1967. Despite their confidence in the city's ability to accommodate growth, certain facilities -- housing, sewage treatment and solid waste disposal -- seem less than adequate at the present time. (For a display of employment impacts predicted for Seward see Exhibit 7-21.)

SOURCES OF DATA

Alaska Legislative Council, Legislative Affairs Agency. Parks and Recreation Study. 1969.

Alaska, State of, Department of Economic Development, Division of Economic Enterprise. Alaska Statistical Review 1972. December, 1972.

Alaska, State of, Department of Economic Development, Division of Economic Enterprise. "Seward, Alaska: A Community Profile." July, 1973.

Alaska, State of, Department of Economic Development, Division of Economic Enterprise. "Valdez, Alaska: A Community Profile." July, 1973.

Alaska, State of, Department of Economic Development, Industrial Development Division. "Look North to Cordova, Alaska." Standard Industrial Survey. 1971

Alaska, State of, Department of Economic Development, Industrial Development Division. "Look North to Seward, Alaska." Standard Industrial Survey." 1971.

Alaska, State of, Department of Labor, Employment Security Division, Research and Analysis Section. Alaska Economic Trends. June, 1973.

Alaska, State of, Department of Labor, Employment Security Division, Research and Analysis Section. Alaska Workforce Estimates by Industry and Area, 1972. July, 1973.

Alaska, State of, Department of Labor, Employment Security Division, Research and Analysis Section. "Impact Model of Sub-Regional Alaskan Employment." Economic Analysis, Vol. 1, No. 10, May 26, 1972.

Alaska, State of, Department of Labor, Office of Research and Analysis. "Regional Population and Employment Estimates, 1961-1980." Alaska's Manpower Outlook - 1970's, No. 7, May 28, 1970.

SOURCES OF DATA (continued)

Alaska, State of, Department of Natural Resources. Alaska Outdoor Recreation Plan. Vol. Four, Appendices.

Alaska, State of, Department of Natural Resources. Alaska Outdoor Recreation Plan. Vol. Two, Outdoor Recreation in Alaska.

Alaska, State of, Department of Natural Resources. Alaska Outdoor Recreation Plan. Vol. Three, Plan of Action for Implementation.

Alaska, State of , Department of Natural Resources, Division of Lands. Alaska Division of Lands, 1972 Annual Report.

Alaska, State of, Department of Revenue, Research & Analysis Section. Revenue News: An Annual Supplement. 1972.

Alaska, State of, Division of Aviation. Valdez, Alaska - Environmental Impact Statement. Draft, June 1973.

Alaska State Housing Authority. Cordova, 1980 General Plan. June 1963.

Alaska State Housing Authority. Kenai Peninsula Borough, Comprehensive Planning Program - Recommendations. Fall 1970.

Alaska State Housing Authority. Seward Comprehensive Plan. March 1968.

Alaska State Housing Authority. Yakutat, Alaska Comprehensive Development Plan. September 1971.

Alaska State Housing Authority. Yakutat Reconnaissance Report and Initial Housing Element. April 1970.

Alaska State Housing Authority, Department of Planning and Technical Services. Alaska Statewide Housing Study. Vol. I, Housing Conditions and Needs. December 1971.

Alaska State Housing Authority, Department of Planning and Technical Services. Community Impacts of the Trans-Alaska Pipeline. April 1971.

SOURCES OF DATA (continued)

Alyeska Pipeline Service Company, Inc. A Study of the Economic and Sociological Impact of Construction and Initial Operation of the Trans Alaska Pipeline, Vol. II, by Mathematical Sciences Northwest, Inc.

Anchorage, City of, Municipal Light and Power Department. Letter providing power consumption data, 1970, and peak demand estimates for 1985 and 2000 for the Anchorage Area by request. November 6, 1973.

Chugach Electric Association, Inc. Letter providing power consumption data, 1970, and peak demand estimates for 1985 and 2000 for the Anchorage Area by request. November 6, 1973.

Copper Valley Electric Association, Inc. Consumer Sales and Revenue Data Report for Valdez, Alaska, year ending December 31, 1970, and KWH estimates for 1982, by request. October 3, 1973.

Executive Office of the President, Council on Environmental Quality. Hearings Concerning Gulf of Alaska Petroleum Exploration and Development, held in Anchorage, Alaska September 26-27, 1973."

Federal Field Committee for Development Planning of Alaska. Economic Outlook for Alaska. 1971.

Graham, John, and Company. Central Business District Plan, Anchorage, Alaska, June 1972.

Graham, John, and Company, and The Greater Anchorage Area Borough Planning Department. Central Business District Plan, Anchorage, Alaska. May 1973.

Greater Anchorage Area Borough. "Anticipated Impact of the Trans-Alaska Pipeline on Public Services and Housing in the Greater Anchorage Area." October 9, 1973.

Greater Anchorage Area Borough. Economic Base Study, Greater Anchorage Area Borough, by Larry Smith & Company, Inc. May 1972.

Greater Anchorage Area Borough, Office of Budget. "Greater Anchorage Area Borough Annual Budget, Fiscal Year 1973-74."

SOURCES OF DATA (continued)

Greater Anchorage Area Borough Planning Commission. Parks, Recreation and Open Space: Standards, Policies and Guidelines for Development for the Greater Anchorage Area. September 1972.

Greater Anchorage Area Borough Planning Department. Population Projections: 1970-1990. May 1972.

Greater Anchorage Area Borough Planning Department. Preliminary Comprehensive Development Plan. Vol. I, Inventory and Analysis. February 1973.

Greater Anchorage Area Borough Planning Department. Preliminary Housing Plan. December 1972.

Harrison, Gordon Scott, ed. Alaska Public Policy: Current Problems and Issues. College, Alaska: University of Alaska, Institute of Social, Economic and Government Research, 1971.

Hession, Jack. "Showdown in Alaska." Sierra Club Bulletin, February 1972.

Lehfeldt, Herbert. "Impact of Alyeska-Trans Alaska Pipeline on Valdez." Valdez, Alaska: Office of City Manager, 1973.

Rogers, George W. Alaska Regional Population and Employment. ISEG Report No. 15. College, Alaska: University of Alaska, Institute of Social, Economic and Government Research, Decmeber 1967.

Rand McNally. "Alaska," map.

Selkregg, Lidia L., ed. Environmental Atlas of the Greater Anchorage Area Borough, Alaska. Anchorage, Alaska: University of Alaska, Arctic Environmental Information and Data Center, Resource and Science Services, December, 1972.

U. S. Department of Commerce, Social and Economic Statistics Administration, Bureau of the Census. County Business Patterns, 1972: Alaska.

U. S. Department of Commerce, Social and Economic Statistics Administration, Bureau of the Census. "Summary Profile of the 1970 Census for the Anchorage Standard Metropolitan Statistical Area." Reprint ed., Anchorage, Alaska: Greater Anchorage Area Borough Planning Department, March 1973.

SOURCES OF DATA (continued)

U. S. Department of the Interior, Geological Survey. "Alaska Prince William Sound Region: Valdez and Vicinity." Map, 1916.

U. S. Department of the Interior, Geological Survey. Tectonics of the March 27, 1964 Alaska Earthquake, by George Plafker. Geological survey Professional Paper 543-I. The Alaska Earthquake, March 27, 1964 Series, Regional Effects. Washington, D.C.: U. S. Government Printing Office, 1969.

U. S. Department of the Interior, Special Interagency Task Force for the Federal Task Force on Alaskan Oil Development. Final Environmental Impact Statement: Proposed Trans-Alaska Pipeline. Vol. 3, Environmental Setting Between Port Valdez, Alaska, and West Coast Ports. 1972.

U. S. Department of the Interior, Office of the Secretary. Alaska Pipeline Report, by Arlon R. Tussing et.al.

Valdez, City of. Valdez, Alaska: A Comprehensive Development Plan, by Bomhoff, Collie & Klotz. March 1971.

Valdez, City of. Valdez, Alaska: A Comprehensive Development Plan, Summary Report. July 1971.

Valdez, City of. "Valdez City Budget, 1972-1973."

8. PUGET SOUND

As one of the three major refinery areas on the West Coast, Puget Sound is a likely candidate for onshore secondary impacts associated with Alaskan OCS development.

The local study area in the Puget Sound region comprises Whatcom and Skagit counties, the northernmost counties on the eastern shore of the Sound. These counties represent the most significant present refinery development in Washington and are the sites where future development is most likely to occur. There are presently two refineries in Anacortes, in Skagit County, and two near Ferndale, in Whatcom County.

Both counties offer economic advantages for future development. Both have ample access to the deep waters of Puget Sound, making dredging to accommodate large tankers unnecessary. Fully developed transportation networks serve the two counties. A product pipeline to Seattle and Portland transverses both counties. A railroad system serves both Anacortes and Ferndale. Interstate 5, connecting Vancouver, B.C., with Seattle, Portland, and California, passes near the present refinery sites.

The regional study area comprises the Tacoma-Seattle-Everett metropolitan area as well as the two local counties. This additional area includes Pierce, King, Kitsap, and Snohomish counties and coincides with the jurisdictional area of the Puget Sound Intergovernmental Conference.

The remainder of this chapter is organized into three sections. The first section provides a description of current socio-economic and environmental conditions in Skagit and Whatcom counties and in the Puget Sound region. The second part describes the assumed future development by primary industry in the local and regional areas. The third section estimates and discusses the specific economic, social infrastructure, land use, and pollution impacts that would result from the assumed development.

PROFILE OF CURRENT CONDITIONS

Whatcom and Skagit Counties are in northwestern Washington, between the Seattle and Vancouver metropolitan areas (Exhibit 8-1). Mt. Vernon, the county seat of Skagit

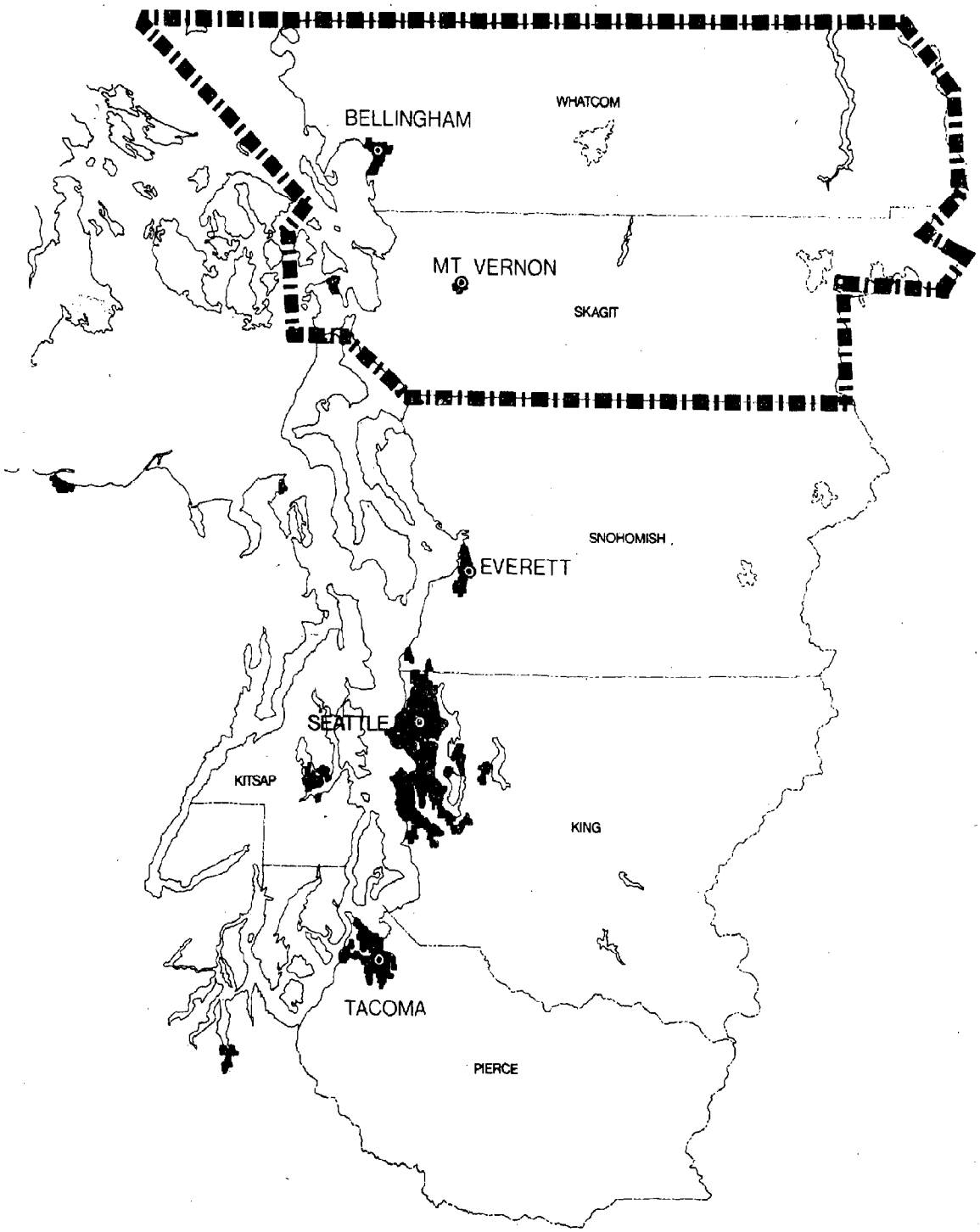


EXHIBIT 8-1
PUGET SOUND REGION

RESOURCE PLANNING
ASSOCIATES INC.

County, lies within a 75-mile radius of the cities of Seattle, Everett, and Vancouver in British Columbia. Bellingham, the county seat of Whatcom County and largest city of the region, lies about 25 miles north of Mt. Vernon.

Puget Sound is the western boundary of both Whatcom and Skagit Counties. Both have approximately 230 miles of irregular shorelines, islands as well as mainland. The major bays along the shore include Drayton Harbor, Birch Bay, Lummi Bay, Bellingham Bay, and Samish, Padilla, and Skagit Bays. Forks of the Nooksack River empty into Bellingham and Lummi Bays, while the Skagit River empties into Skagit Bay.

Several geologic faults are located along the eastern three-quarters of this region. Some earthquake activity has occurred, one as recently as 1965 near Bellingham. The quake was classified as having a Modified Mercalli Intensity of VIII.[1]

Development has been limited to the western coastal part of the counties where the Pacific inlet north of Puget Sound is the principal focus of commercial and industrial activity. The city of Ferndale, near Bellingham, supports refinery activity, while Bellingham provides a port for ocean-going commerce as well as a center for industrial development and bulkhead construction. Anacortes, the largest city in Skagit County, has development along its waterfront, and federal navigation projects provide for a commercial waterway and a harbor for small craft. Small rural communities are scattered between the coast and the border of the Mount Baker National Forest farther inland. While almost half of the region's population currently resides in unincorporated areas, the trend is toward a lower proportion of rural dwellers.

The population of Skagit and Whatcom Counties increased by over 12,500 between 1960 and 1970. This represents an

---

[1]This scale translates to mean slight damage in specially-designed structures, considerable in ordinary, substantial buildings with partial collapse; great in poorly-built structures. From Jerry L. Coffman and Carl A. von Hake, United States Earthquakes 1970, National Oceanic and Atmosphere Administration, U.S. Department of Commerce, Silver Spring, Maryland, 1972.

average annual growth rate of 1 percent. For the same time period, employment has grown 2 percent with 9,100 people added to the work force annually. Unemployment has shown a similar pattern, growing at an annual average of about 2 percent.

Major transportation corridors include Interstate 5, the new North Cascades Highway, and the ferry system connecting Anacortes with the San Juan Islands and Vancouver Island. All of these contribute to the accessibility of important areas within the region.

Whatcom and Skagit Counties can be classified as semi-rural with agriculture and service as the principal employment sectors. About 39 percent (the national average) of the region's total population of 134,000 constitutes the work force.

Within the locality, the manufacturing sector accounts for 17 percent of all jobs, agriculture accounts for 13 percent, and services account for 58 percent. Average per capita income for the locality is $3,969, and median family income amounts to $9,400. However, nearly 9 percent of Puget Sound's families have incomes below the official poverty level.

The northwestern Washington region, covering 3,861 square miles, has a total population of 2.1 million. Manufacturing accounts for 24 percent of all jobs, and the average per capita income in 1970 was $4,070.

That only 2.5 percent of the total land area is developed is evidence of the rural nature of the local area. Within the entire region, only 7 percent of the land is developed. Of this land, 49 percent within Whatcom and Skagit Counties and 51 percent within the region as a whole is residential.

Air quality in the region is currently satisfactory. The control rating for particulates is Class II, while all other major pollutants are presently rated Class III.

At the present time several of the estuarine zones in Puget Sound have been ruined or are in jeopardy due to industrial and commercial development that has degraded the quality of the water either through the dumping of effluents or dredge and fill operations. The Skagit and Nooksack Rivers have good water quality, and the maintenance and improvement of this quality as well as that of the

adjacent bay is essential to the continued estuarine production of the area.

Within Skagit and Whatcom Counties there are only approximately 28,000 acres of wetlands (Exhibit 8-2). However, the great majority of these coastal salt flats and marshes are of significant value for the waterfowl of the Pacific Flyway as well as the estuarine activities of the various river deltas. Parts of Padilla and Skagit Bay are classified as areas of statewide significance under the Shoreline Management Act. The Skagit flats area is of prime importance as it provides food and a wintering place for some 30,000 snow geese and numerous other rare or endangered species of waterfowl. The Skagit and the Nooksack Rivers both provide spawning grounds for large numbers of anadromous fish, most notable the chinook and coho salmon and the steelhead trout.

Most of the inland area of the locality and the region is mountainous terrain and heavily forested. Within the two-county area, the Cascade Mountain range covers over a million acres of the Mount Baker National Forest, the North Cascades National Park, the Pasayten and Glacier Peak Wilderness Areas, and the Ross Lake National Recreation Area. Farther south in the region lie the Snoqualrie and Wenatchee National Forests as well as Mt. Rainier National Park. All of these areas support large populations of such game species as black-tailed deer, elk, black bears, as well as numerous other small, fur-bearing mammals.

DEVELOPMENT ASSUMPTIONS

This section describes both the base case and OCS-induced development that could occur in the Puget Sound region for oil refining, gas processing, petrochemicals, and construction.

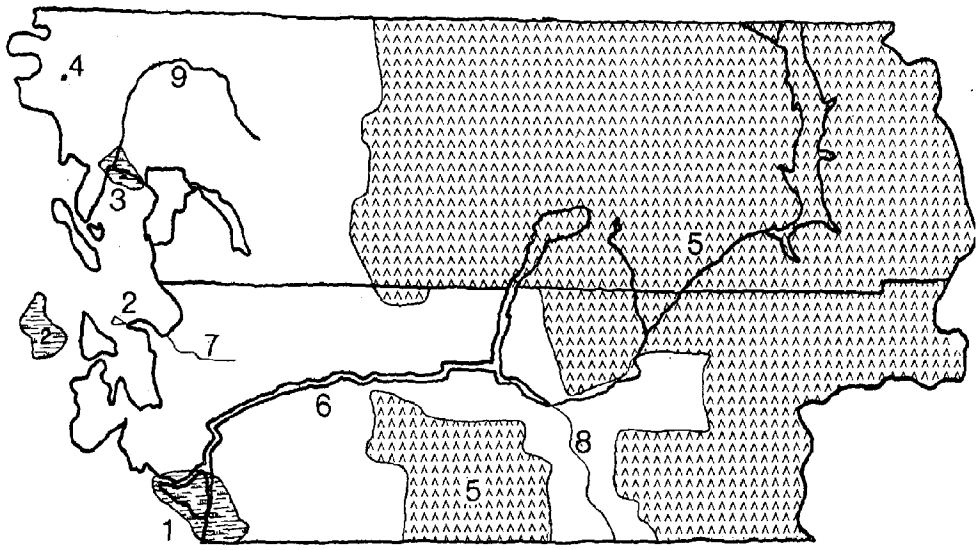
Oil Refining

In the Puget Sound region, refining capacity is expected to more than double from current levels to 780,000 barrels per day in 1985, and then remain at the capacity through the year 2000. This leveling of activity reflects the amount of crude oil supplies assumed available to the area. All of this development is expected to take place in the Skagit/Whatcom locality. Offshore Gulf of Alaska production would cause very little further expansion in

EXHIBIT 8-2

SKAGIT AND WHATCOM, WASHINGTON

WILDLIFE AND VEGETATION
PROTECTED AREAS



TYPES OF AREAS

- FOREST
- WETLANDS
- FISHERIES

EXHIBIT 8-2 (cont.)

KEY	SKAGIT/WHATCOM[a] COUNTIES
1. Skagit Flats Wildlife Recreation Area, 12,761 acres	
2. Samish and Cypress Islands	
3. Nooksack River Delta	
4. Lake Terrell Wildlife Recreation Area	
5. Mount Baker National Forest, North Cascades National Park, Ross Lake National Recreation Area, and Pasayten and Glacier Peak Wildernesses	
6. Skagit River	
7. Samish River	
8. Sauk River	
9. Nooksack River	

a See Appendix X for a detailed description of the wildlife and vegetation of the local area as well as the region.

1985 (20,000 barrels per day under either high or low OCS conditions), and between 190,000 (OCS low) and 270,000 (OCS high) barrels per day expansion between the years 1985 and 2000 (Exhibit 8-3). Appendix II discusses in greater detail the assumptions for refinery development.

EXHIBIT 8-3

PROJECTED PUGET SOUND REFINERY DEVELOPMENT
SKAGIT/WHATCOM LOCALITY

(Million barrels per day)

	Base Case	Low OCS		High OCS	
	1985 and 2000	1985	2000	1985	2000
Production	.70	.02	.17	.02	.24
Required Capacity[a]	.78	.02	.10	.02	.27

[a]Assumes 90 percent capacity utilization.

Source: Dornbusch & Co. and RPA estimates.

Gas Processing

No gas processing development for Gulf of Alaska gas production is assumed to occur in the Puget Sound region. The processing is expected to take place at the onshore receiving points in Alaska.

Petrochemicals

Some basic organic chemical manufacturing is expected to occur in Puget Sound under base case development, but to a lesser extent than in other areas of the country. Because it is tied mainly to the availability of refinery heavy liquids feedstocks, this development will probably occur in the Skagit Whatcom County locality, where all of the refinery expansion should occur.

Given offshore production, the petrochemical development (high impact case) could double by the year 2000, as shown in Exhibit 8-4. Appendix IV discusses in greater detail the development assumption for petrochemicals.

EXHIBIT 8-4

PROJECTED SKAGIT/WHATCOM PETROCHEMICAL DEVELOPMENT

(Number of billion lb./yr. olefins complexes)

Year	Base Case	Low Case	High Case	Total
1985	1.1	0	0	1.1
2000	2.6	0	3.0	5.6

Source: Dornbusch & Co. and RPA estimates.

Construction

Given the Gulf of Alaska OCS development scenario previously described, the peak of construction expenditures in the Skagit/Whatcom locality is expected to occur in the 1980s (Exhibit 8-5).[1] The value of 1985 construction output for the high OCS case would be over $200 million and accounts for almost 90 percent of the primary economic output resulting from OCS production.

The main contributor to the construction activity is the $117 million of refinery construction for capacity that is expected to come on stream right after 1985. The total 1985 high OCS construction would more than double the level of construction projected for the base case. Under low OCS conditions, impact construction would still be $117 million, 75 percent over base case.

By the year 2000 impact construction is expected to fall off to $86 million annually under high OCS conditions, 35 percent over base case. None of this construction is assumed to be for primary activities. Appendix V discusses the method of making these assumptions.

---

[1] All impact construction is expected to take place in the locality.

EXHIBIT 8-5

VALUE OF CONSTRUCTION OUTPUT[a]
($ million)

WASHINGTON/OREGON

Geographic Area	1970 Actual	1985 Base Case[b]	1985 Low OCS	1985 High OCS	2000 Base Case[b]	2000 Low OCS	2000 High OCS
SKAGIT/WHATCOM COUNTIES							
Refinery			94	117		0	0
Gas Processing			0	0		0	0
Petrochemical			0	54		0	0
Induced[c]			23	43		47	86
Total Local	98	165	117	214	244	47	86
PUGET SOUND REGION							
Refinery			94	117		0	0
Gas Processing			0	0		0	0
Petrochemical			0	54		0	0
Induced[c]			23	43		47	86
Total Region	1170	1858	117	214	2728	47	86

[a] Base Case total and OCS incremental. Appendix V describes the methods used in determining these values

[b] Base Case 1 for West Coast

[c] Other industrial, commercial, and residential construction activity induced by the direct industry activities

Source: RPA estimates.

IMPACTS

This section discusses the impacts that could occur in Skagit and Whatcom Counties and the Puget Sound region from offshore oil and gas production in the Gulf of Alaska. The economic, social infrastructure, land use, and air and water pollution impacts are presented in the following pages.

Economic

Projections for the Whatcom/Skagit local area indicate that between 1970 and 1985 employment should increase by only 14,000 or one and a half percent per year; between 1985 and 2000 the rate is expected to be somewhat higher, one and three-quarters percent per year (Exhibit 8-6). Services are expected to continue to dominate the employment category with 28,000 of the 33,000 total new jobs projected between 1970 and 2000.

Employment in the Puget Sound region is expected to grow at an average rate of one and three-quarters percent per year between 1970 and 1985 (Exhibit 8-7). This is slightly higher than the rate for the locality. Similarly, the employment growth rate of two percent between 1985 and 2000 will be higher for the region than for the locality.

The service sector in the region should continue to dominate both in employment and in value of production. Agriculture is expected to decline in terms of the number of jobs provided, even though agricultural production should increase overall. Since all of the refining takes place in Whatcom and Skagit Counties, total activity in the refining category remains the same for both the region and the locality.

Against this background, the following sections describe the primary and aggregate economic impacts expected from OCS production.

Primary Impacts

Direct employment and output effects for the Puget Sound and Whatcom/Skagit areas are reported in Exhibit 8-8. The exhibit shows these impacts to occur exclusively within the locality. Under high OCS conditions, construction should provide an added 6,500 jobs by 1985, decreasing to 2,200 jobs by the year 2000. Petrochemical employment in the year 2000 could grow by as many as 4,000 in the high case, or by as few as 900 in the low case. Finally, additional refinery employment should equal 100 jobs in 1985, possibly reaching 600 jobs by the year 2000.

EXHIBIT 8-6

SUMMARY OF BASE CASE ECONOMIC CONDITIONS

SKAGIT/WHATCOM COUNTIES

A. EMPLOYMENT (thousands)

Sector	Actual	Base Case 1		Base Case 2	
	1970	1985	2000	1985	2000
Construction	3.0	4.0	5.0		
Ref., Gas, Petrochem.	9.0	3.7	4.8		
Other Manufacturing		7.3	8.2		
Agriculture	7.0	6.0	6.0		
Utilities	2.0	3.0	3.0		
Services	30.0	42.0	58.0		
TOTAL	52.0	66.0	85.0		

B. VALUE OF OUTPUT ($ million)[a]

Sector	Actual	Base Case 1		Base Case 2	
	1970	1985	2000	1985	2000
Construction	98	165	244		
Ref., Gas, Petrochem.	389	1521	1885		
Other Manufacturing		382	636		
Agriculture	124	157	237		
Utilities	74	126	152		
Services	542	922	1588		
TOTAL	1227	3273	4742		

Codes - * = negligible
: = infinite percentage since base case is zero

[a]All dollar figures are 1970 constant dollars.

Source: RPA estimates

EXHIBIT 8-7

SUMMARY OF BASE CASE ECONOMIC CONDITIONS

PUGET SOUND, WASH.

A. EMPLOYMENT (thousands)

Sector	Actual	Base Case 1		Base Case 2	
	1970	1985	2000	1985	2000
Construction	33.0	45.0	56.0		
Ref., Gas, Petrochem.	} 186.0	3.7	4.8		
Other Manufacturing		225.3	303.2		
Agriculture	17.0	12.0	10.0		
Utilities	49.0	57.0	66.0		
Services	503.0	676.0	940.0		
TOTAL	788.0	1019.0	1380.0		

B. VALUE OF OUTPUT ($ million)[a]

Sector	Actual	Base Case 1		Base Case 2	
	1970	1985	2000	1985	2000
Construction	1170	1858	2728		
Ref., Gas, Petrochem.	} 7880	1521	1885		
Other Manufacturing		11752	22448		
Agriculture	299	313	395		
Utilities	1578	2397	3323		
Services	9612	14839	25729		
TOTAL	20539	32680	56508		

Codes - * = negligible
: = infinite percentage since base case is zero

[a]All dollar figures are 1970 constant dollars.

Source: RPA estimates

EXHIBIT 8-8

PRIMARY ECONOMIC IMPACTS

NORTHWEST WASHINGTON

A. EMPLOYMENT (thousands) HIGH IMPACT

	1985			2000		
	Local	Region[a]	Area[b]	Local	Region[a]	Area[b]
Oil and Gas Rec.	0	0	0	0	0	0
Gas Processing	0	0	0	0	0	0
Refineries	.1	.1	0	.6	.6	0
Petrochemical	0	0	0	4.0	4.0	0
Construction	6.5	6.5	0	2.2	2.2	0

B. VALUE OF OUTPUT (millions 1970 dollars) HIGH IMPACT

	1985			2000		
	Local	Region[a]	Area[b]	Local	Region[a]	Area[b]
Oil and Gas Rec.	0	0	0	0	0	0
Gas Processing	0	0	0	0	0	0
Refineries	33	33	0	479	479	0
Petrochemical	0	0	0	728	728	0
Construction	214	214	0	86	86	0

Code: * = negligible

[a] Region includes Local

[b] Area is "Demand Area" exclusive of the Region

Source: RPA estimates

EXHIBIT 8-8 (cont.)

PRIMARY ECONOMIC IMPACTS

NORTHWEST WASHINGTON

C. EMPLOYMENT (thousands) LOW IMPACT

	1985			2000		
	Local	Region[a]	Area[b]	Local	Region[a]	Area[b]
Oil and Gas Rec.	0	0	0	0	0	0
Gas Processing	0	0	0	0	0	0
Refineries	.1	.1	0	.4	.4	0
Petrochemical	0	0	0	.9	.9	0
Construction	3.6	3.6	0	1.2	1.2	0

D. VALUE OF OUTPUT (millions 1970 dollars) LOW IMPACT

	1985			2000		
	Local	Region[a]	Area[b]	Local	Region[a]	Area[b]
Oil and Gas Rec.	0	0	0	0	0	0
Gas Processing	0	0	0	0	0	0
Refineries	33	33	0	346	346	0
Petrochemical	0	0	0	156	156	0
Construction	117	117	0	47	47	0

Code: * = negligible

[a] Region includes Local

[b] Area is "Demand Area" exclusive of the Region

Source: RPA estimates

Aggregate Impacts

Employment impacts in the Whatcom/Skagit locality are almost 20 percent over base case projections (Exhibit 8-9). Low employment effects are estimated at about half this amount (Exhibit 8-10). These estimates are based not only on increased construction and refinery jobs, but also on activities serving these industries and their employees. In 1985 construction dominates in terms of added numbers of jobs and increased value of output. By the year 2000, however, refinery and petrochemicals lead in terms of induced value of production, while services provide the largest additional number of jobs.

Economic impacts associated with expansion of the oil industry in the Whatcom/Skagit locality differ dramatically from impacts in other localities under study in that the 2000 estimates depict substantially greater influence than the 1985 estimates. This occurs because only a small amount of Gulf of Alaska oil is needed to satisfy demand in 1985, whereas a substantial quantity will be required by the year 2000. Additionally, petrochemical development does not take place until after 1985.

Estimated secondary production and employment resulting from expanded refinery and petrochemical activities are relatively low for the locality. This is chiefly because much of the supplier activity associated with primary development is expected to take place in the remainder of the region, especially in the Seattle SMSA.

For the Puget Sound region as a whole, there should be a relatively small impact. High OCS conditions should result in only 2 percent more jobs in both 1985 and 2000 (Exhibit 8-11). Low OCS conditions should result in half this impact (Exhibit 8-12).

Social Infrastructure

Social infrastructure requirements depend upon population impacts. Between 1970 and 1985 under high impact conditions, population is expected to increase by 15 percent over present predictions, more than doubling the present average annual rate of growth from 3/4 percent to 1 3/4 percent. Similarly, the growth rate between 1985 and 2000 could increase from its expected 1.5 percent under base case conditions, to about 2.5 percent. This implies that public physical and social systems should experience

EXHIBIT 8-9

AGGREGATE ECONOMIC IMPACTS

SKAGIT/WHATCOM COUNTIES

HIGH IMPACT

A. EMPLOYMENT (thousands)

Sector	1985	Percent Over B.C. 1	Percent Over B.C. 2	2000	Percent Over B.C. 1	Percent Over B.C. 2
Construction	6.5	162		2.2	45	
Ref. Gas, Petrochem.	.1	1		4.6	95	
Other Manufacturing	.9	12		2.0	24	
Agriculture	*	*		*	*	
Utilities	.2	7		.8	26	
Services	3.3	8		6.9	12	
TOTAL	11.0	17		16.5	19	

B. VALUE OF OUTPUT ($ million)[a]

Sector	1985	Percent Over B.C. 1	Percent Over B.C. 2	2000	Percent Over B.C. 1	Percent Over B.C. 2
Construction	214	130		86	35	
Ref., Gas, Petrochem.	33	2		1207	64	
Other Manufacturing	52	14		156	25	
Agriculture	*	*		1	*	
Utilities	9	7		40	26	
Services	73	8		190	12	
TOTAL	381	12		1680	35	

Codes - * = negligible
: = infinite percentage since base case is zero

[a]All dollar figures are 1970 constant dollars.

Source: RPA estimates

EXHIBIT 8-10

AGGREGATE ECONOMIC IMPACTS

SKAGIT/WHATCOM COUNTIES

LOW IMPACT

A. EMPLOYMENT (thousands)

Sector	1985	Percent Over B.C. 1	Percent Over B.C. 2	2000	Percent Over B.C. 1	Percent Over B.C. 2
Construction	3.6	89		1.2	24	
Ref., Gas, Petrochem.	.1	1		1.3	26	
Other Manufacturing	.5	7		.7	9	
Agriculture	*	*		*	*	
Utilities	.1	4		.3	10	
Services	1.9	5		2.8	5	
TOTAL	6.3	9		6.4	7	

B. VALUE OF OUTPUT ($ million)[a]

Sector	1985	Percent Over B.C. 1	Percent Over B.C. 2	2000	Percent Over B.C. 1	Percent Over B.C. 2
Construction	117	71		47	19	
Ref.,Gas, Petrochem.	33	2		502	27	
Other Manufacturing	29	3		56	3	
Agriculture	*	*		*	*	
Utilities	5	4		15	10	
Services	42	5		78	5	
TOTAL	226	11		698	22	

Codes - * = negligible
: = infinite percentage since base case is zero

[a]All dollar figures are 1970 constant dollars.

Source: RPA estimates

EXHIBIT 8-11

AGGREGATE ECONOMIC IMPACTS

PUGET SOUND, WASH.

HIGH IMPACT

A. EMPLOYMENT (thousands)

Sector	1985	Percent Over B.C. 1	Percent Over B.C. 2	2000	Percent Over B.C. 1	Percent Over B.C. 2
Construction	6.5	14		2.2	4	
Ref. Gas, Petrochem.	.1	1		4.6	95	
Other Manufacturing	2.3	1		5.4	2	
Agriculture	.1	*		.1	1	
Utilities	.6	1		2.2	3	
Services	7.7	1		17.7	2	
TOTAL	17.3	2		32.2	2	

B. VALUE OF OUTPUT ($ million)[a]

Sector	1985	Percent Over B.C. 1	Percent Over B.C. 2	2000	Percent Over B.C. 1	Percent Over B.C. 2
Construction	214	12		86	3	
Ref., Gas, Petrochem.	33	2		1207	64	
Other Manufacturing	136	1		427	2	
Agriculture	1	*		4	1	
Utilities	24	1		109	3	
Services	169	1		483	2	
TOTAL	577	2		2316	4	

Codes - * = negligible
: = infinite percentage since base case is zero

[a]All dollar figures are 1970 constant dollars.

Source: RPA estimates

EXHIBIT 8-12

AGGREGATE ECONOMIC IMPACTS

PUGET SOUND, WASHINGTON

LOW IMPACT

A. EMPLOYMENT (thousands)

Sector	1985	Percent Over B.C. 1	Percent Over B.C. 2	2000	Percent Over B.C. 1	Percent Over B.C. 2
Construction	3.6	8		1.2	2	
Ref., Gas, Petrochem.	.1	1		1.3	26	
Other Manufacturing	1.3	1		2.0	1	
Agriculture	*	*		*	*	
Utilities	.3	1		.8	1	
Services	4.4	1		7.3	1	
TOTAL	9.7	1		12.6	1	

B. VALUE OF OUTPUT ($ million)[a]

Sector	1985	Percent Over B.C. 1	Percent Over B.C. 2	2000	Percent Over B.C. 1	Percent Over B.C. 2
Construction	117	6		47	2	
Ref.,Gas, Petrochem.	33	2		502	27	
Other Manufacturing	77	1		155	1	
Agriculture	1	*		2	*	
Utilities	14	1		42	1	
Services	97	1		199	1	
TOTAL	339	1		947	2	

Codes - * = negligible
: = infinite percentage since base case is zero

[a]All dollar figures are 1970 constant dollars.

Source: RPA estimates

aggregate base case and OCS impacts of the same order of magnitude.

Exhibit 8-13 reports the estimated social and infrastructure impacts. Each category indicates about a 15 percent increase over the base case estimates for the high impact situation, and about half this amount for the low impact case. Overall, growth should be 1 to 2.5 percent per year, including base case development. This growth should be manageable for the overall two county area. However, if this growth is concentrated in a few small communities, Anacortes and Ferndale, there will undoubtedly be a severe strain on the communities involved.

Residential and commercial water demands could increase by as much as 16 percent over the base case estimates in 1985 and 2000, but there are no apparent constraints on the basins' ability to meet these requirements. Similarly, residential and commercial impacts of this size should also be of little consequence to the building industry. Providing additional schools, hospitals, police, solid waste and sewage facilities, and government administration as a result of OCS production appears well within the capabilities of existing communities.

Increases in industrial water demand should also not constrain the area's ability to provide sufficient supplies. Present planning estimates indicate an excess capacity of almost 25 percent over projected total water demands (assuming no OCS development) by 1985. This figure increases to almost 75 percent by the year 2000.

The county road system within the Whatcom-Skagit area should also prove adequate. Based on a scatter diagram of population versus miles of county road (only those 10 counties within or adjacent to the Puget Sound area which had populations less than 120,000 were included), transportation needs were estimated at about five miles of roadway for each additional 1000 people. This means that an additional 110 miles(about 6 percent) of county roads could be required by 1985 as a consequence of Gulf of Alaska oil production. By the year 2000, county road needs could reach 155 miles (about 8 percent) over present estimates.

Community planners appear confident in their ability to deal with expected demands on the local physical and social systems. Except for possible environmental issues

EXHIBIT 8-13

SKAGIT/WHATCOM COUNTIES
(Geog. Area)

SOCIAL INFRASTRUCTURE IMPACT

	1970	1985		Incr.		2000		Incr.	
		Base Case 1	Base Case 2	High Impact	Low Impact	Base Case 1	Base Case 2	High Impact	Low Impact
POPULATION (000)	134	150		22	12	188		31	12
Percent Change %				15	8			16	6
PHYSICAL SYSTEMS									
Water Demand Mil. gallons/day	19	25		4	2	36		6	2
Elec. Demand (MW of Capacity)	NA	NA		41	26	NA		531	178
Structures Residential (000)	49	54		8	4	68		11	4
Commercial (millions of sq. ft.)	3.6	3.9		.6	.3	5.2		.9	.3
SOCIAL SYSTEMS									
Schools - Enrollees (000)	32	35		6	3	45		7	3
Hospitals - Beds	453	507		74	41	635		105	41
Police - Manpower	201	270		40	22	338		56	22
Solid Waste - Tons/Day	402	450		66	36	564		93	36
Sewage - Mil.gal/day	16	18		3	1	23		4	1
Gov't. OH - ($000,000)	NA	12		2	1	15		2	1
BUSINESS & GOVERNMENT INSTIT.									
Business Services - Employee (000)	NA	NA		NA	NA	NA		NA	NA
Government - Employee (000)	4	4.6		.6	.3	5.5		.9	.3

Source : RPA estimates

such as air and water pollution, the Whatcom County Director of Planning feels that "with respect to the local infrastructure, there are no constraining problems, other than the energy crunch."

Land Use

Even though the land requirements for the locality and the region are the smallest of any of the sample sites except Alaska, it should still be extremely difficult to find adequate land for base case and OCS-induced development. The 210,000 acres required for this growth represent over 70 percent of the undeveloped land suitable for general development.[1] The mountainous terrain of the region accounts for this finding, and suggests the potential difficulty of coordinating sites for primary development.

Currently, less than 3 percent of the total Skagit/Whatcom locality is developed compared to more than 21 percent, for example, in the Cumberland and Cape May locality (Exhibit 8-14). Base case development by the year 2000 is projected to reduce the percentage of undeveloped land by less than 1 percent, with high OCS requiring another one half percent.

Although the City of Seattle in King County makes the Puget Sound region as a whole somewhat more developed than Skagit and Whatcom Counties, undeveloped land is still a relatively high 93 percent (Exhibit 8-15). Base case and high OCS development should reduce this undeveloped land to 90 percent by the year 2000.

However, for both the locality and the region these high levels of undeveloped land are misleading, because most of it is mountainous and, hence, undevelopable.

---

[1] General development includes residential, commercial, industrial uses (e.g., refineries, petrochemical complexes). Land suited for primary development is also suited for general development.

EXHIBIT 8-14

LAND USE SUMMARY

LOCALITY : SKAGIT/WHATCOM COUNTIES

Summary in Thousands of acres		1970	Year 1985				Year 2000			
		Actual Development	Base Case 1 Development	Base Case 2 Development	OCS Low* Development	OCS High* Development	Base Case 1 Development	Base Case 2 Development	OCS Low* Development	OCS High* Development
Land Use Classification	DEVELOPED LAND	61.0	69.0		4.6	8.1	82.9		5.3	13.2
	. residential	30.0	32.9		1.9	3.2	37.9		1.3	3.7
	. commercial industrial	3.0	4.8		.2	.3	5.7		1.5	3.0
	. other	28.0	31.3		2.5	4.6	39.3		2.5	6.5
	UNDEVELOPED LAND	2,410.0	2,402.0		2,397.5	2,394.0	2,388.1		2,382.8	2,374.9
	TOTAL ACREAGE	2,471.0								

* incremental acreage only. If two figures, number in parentheses refers to base case.

Summary in Percent		1970	Year 1985**				Year 2000**			
		Actual Development	Base Case 1 Development	Base Case 2 Development	OCS Low Above B.C.1	OCS High Above B.C.1	Base Case 1 Development	Base Case 2 Development	OCS Low Above B.C.1	OCS High Above B.C1
Land Use Classification	DEVELOPED LAND	2.5	2.8		3.0	3.1	3.4		3.6	3.9
	. residential	1.2	1.3		1.4	1.5	1.5		1.6	1.7
	. commercial industrial	.1	.2		.2	.2	.2		.3	.4
	. other	1.1	1.3		1.4	1.5	1.6		1.7	1.9
	UNDEVELOPED LAND	97.5	97.2		97.0	96.9	96.6		96.4	96.1

** Impacts of OCS developments indicated only above Base Case 1.

Source: RPA estimates.

EXHIBIT 8-15

LAND USE SUMMARY

REGION : PUGET SOUND, WASH.

Summary in Thousands of acres		1970	Year 1985				Year 2000			
		Actual Development	Base Case 1 Development	Base Case 2 Development	OCS Low* Development	OCS High* Development	Base Case 1 Development	Base Case 2 Development	OCS Low* Development	OCS High* Development
Land Use Classification	DEVELOPED LAND	455.0	518.3		6.0	10.8	645.3		7.3	18.5
	. residential	231.0	258.1		2.4	4.3	308.1		1.9	5.5
	. commercial industrial	41.0	50.5		.3	.5	60.2		1.6	3.3
	. other	183.0	209.7		3.3	6.0	277.0		3.8	9.7
	UNDEVELOPED LAND	6,046.8	5,983.5		5,977.5	5,972.7	5,856.5		5,849.2	5,838.0
	TOTAL ACREAGE	6,501.8								

* incremental acreage only. If two figures, number in parentheses refers to base case.

Summary in Percent		1970	Year 1985**				Year 2000*			
		Actual Development	Base Case 1 Development	Base Case 2 Development	OCS Low Above B.C.1	OCS High Above B.C.1	Base Case 1 Development	Base Case 2 Development	OCS Low Above B.C.1	OCS High Above B.C.1
Land Use Classification	DEVELOPED LAND	7.0	8.0		8.1	8.1	9.9		10.0	10.2
	. residential	3.6	4.0		4.0	4.0	4.7		4.8	4.8
	. commercial industrial	.6	.8		.8	.8	.9		1.0	1.0
	. other	2.8	3.2		3.3	3.3	4.3		4.3	4.4
	UNDEVELOPED LAND	93.0	92.0		91.9	91.9	90.1		90.0	89.8

** Impacts of OCS developments indicated only above Base Case 1.

Source: RPA estimates.

EXHIBIT 8-16

UNDEVELOPED LAND CAPABILITIES

Region: PUGET SOUND

	Thousands of Acres		Percent
. TOTAL UNDEVELOPED LAND[a]		6,046.8	100
. UNAVAILABLE LAND DUE TO ENVIRONMENTAL CONSTRAINTS . existing and projected uses . coastal zoning and improvements . excessive slope (> 15%) . wetlands . water resources	YES - ~~NO~~[h]	5,705.8	95.1
. UNSUITABLE LAND DUE TO LOCATIONAL CONSTRAINTS[b] . excessive slope (> 5%) . distance (> 30 minutes) . water requirements	YES - ~~NO~~[i]		
. TOTAL REMAINING DEVELOPABLE LAND[c]		296.0	4.9
. TOTAL LAND USE REQUIREMENTS[d]		208.8	
. total direct land use[e]	4.3		
. total induced land use[f]	204.5		
residential	82.6		
commercial/industrial[g]	18.2		
other developed land	103.7		

[a]Refer to land use summary exhibits for each region. Total undeveloped land figure corresponds to 1970 data.
[b]Where overlap with land unavailable due to environmental constraints, only incremental value is considered.
[c]Land suited for primary industrial activities, e.g., refineries, petrochemical complexes, etc., but competing with other uses, e.g., residential, commercial, light industrial, agricultural, etc. ("general development").
[d]Total Land Use Requirements corresponds to worst possible case by year 2000 (in general, base case 2 combined with high level OCS development).
[e]Refer to Exhibit VIII-5, Total Direct Land Use. Corresponds to maximum primary development.
[f]Refer to land use summary exhibits for each region. Corresponds to worst possible case by year 2000.
[g]Excluding primary industrial land.
[h]"No" indicates that water resource impoundment areas have not been included in the above acreages.
[i]"No" indicates that water supply from conventional sources is likely to be inadequate.

Source: RPA estimates.

Environmental and locational[1] constraints imposed by the mountains and croplands eliminate more than 95 percent of the currently undeveloped land in the region (Exhibit 8-16).[2] As a result, less than 300,000 acres appears to be available for development in the Puget Sound region.

The spatial analysis presented in Plates 13, 14 and 15 indicates that it may be difficult for industry to find suitable land for both base case and high OCS development.[3] The total of 35,000 acres required for development must be secured in appropriately-sized tracts of land before the small amount of suitable land is consumed by competing uses or cut up into inadequate parcels.

The chief mitigating factor to this land scarcity is the possibility of acquiring croplands before they are legally frozen. Such action is clearly contrary to the expressed desire of the Puget Sound Plan to conserve dwindling cropland supplies, although croplands have been acquired previously in Northern Pierce and Southern King Counties for industrial purposes.

---

[1]For more detailed information on these constraints, refer to Appendix VIII - Land Use Methodology and Appendix X - Wildlife and Vegetation.

[2]The basis for lands shown as unsuitable within the Puget Sound Region is the Comprehensive Study of Water Related Resources for Puget Sound and Adjacent Waters performed by the Puget Sound Task Force - Pacific Northwest River Basins Commission, March 1970, for the State of Washington. The study and plan, although not legally binding, was adopted for the spatial analysis because the plan's methodology was very similar to that used in this study, and the plan itself was comprehensive, detailed, and expressive of local desires.

As in the case of the San Francisco Area, the decision to show the majority of land within the region as unsuitable is neither arbitrary nor environmentally biased, but is a simple expression of the land capabilities of an unusually mountainous region.

[3]The spatial analysis was conducted, for each of the seven regions examined by this report, on a regional basis only.

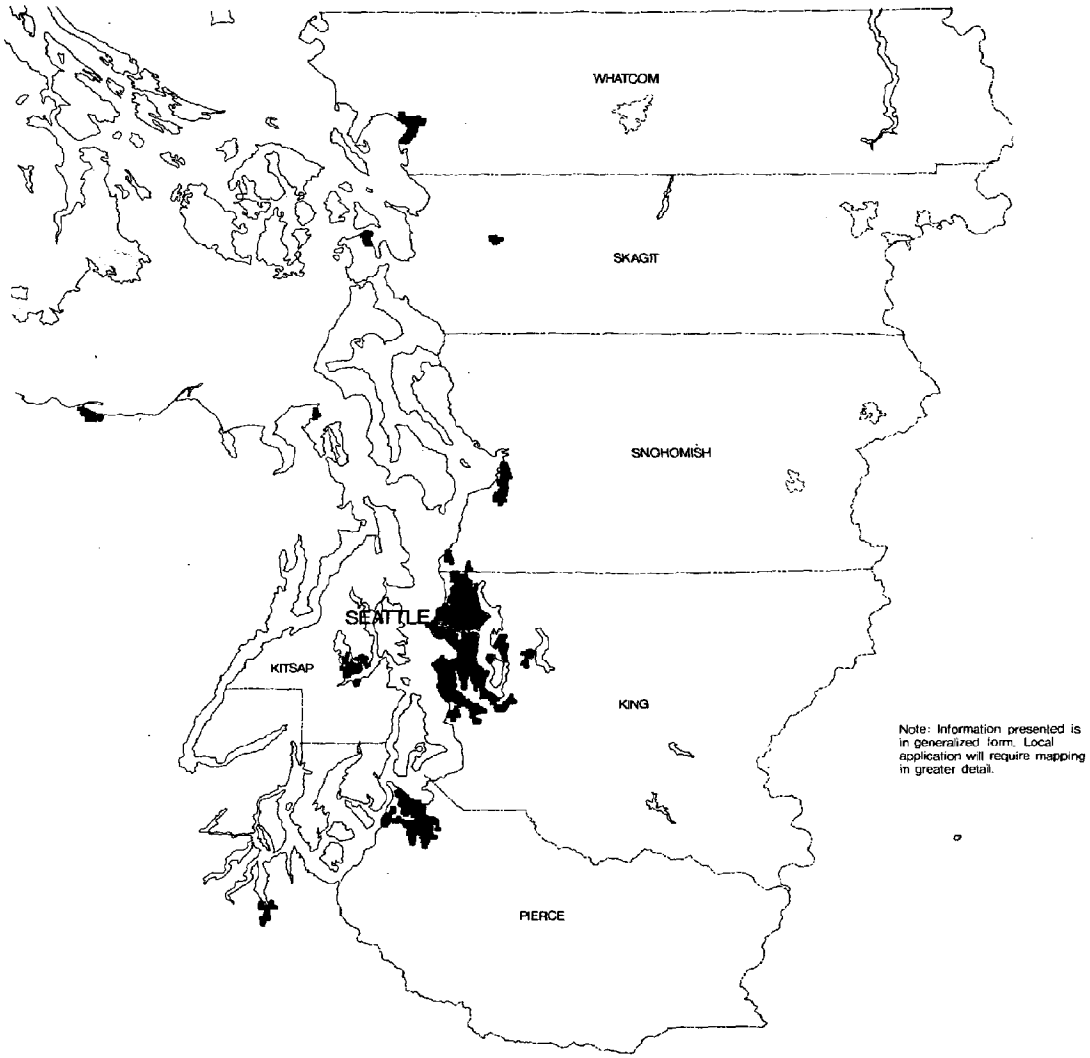
According to the Puget Sound Plan, possible zones of location for the petroleum and petrochemical industry, both suitable and favorably zoned, exist in very small tracts in Whatcom County and Skagit County (Anacortes Peninsula) in a larger zone in Kitsap County, and, probably the best zone, in Northern Pierce and Southern King Counties near Tacoma.

Air Pollution

Air quality in the Northern Washington AQCR is currently in compliance with primary standards, (Exhibit 8-17). Particulate concentrations are quite low with the exception of Whatcom County. Sulphur oxide concentrations are well within the primary air quality standards of 80 micrograms per cubic meter. These low ambient concentrations result in air quality priority classifications of III for all pollutants with the exception of particulates, which are classified as II. The major emissions sources in the two county area are industrial process losses in the primary metal, mineral product and petroleum industries.

Air quality in the Puget Sound Intrastate AQCR is significantly worse than the Northern Washington Intrastate AQCR, and is assigned an air quality priority classification of I by the EPA for all pollutants under consideration. Once again, the main sources of pollution in this area are industrial process losses in the mineral products, primary metals and petroleum industries.

The air pollution loading impacts for the Skagit/Whatcom County locality and for the Puget Sound region overall are virtually identical for all of the pollutants, about 10 to 15 percent over base case development in the locality and about 2 percent for the region overall (Exhibits 8-18 and 8-19). The only pollutant that appears to pose possible concentration problems in the future is particulates, where the current air quality priority classification is II, and the total loadings are expected to increase by the year 2000 due mainly to primary metal industry process losses. The sulphur oxide loadings are expected to decrease in aggregate by the year 2000 while nitrogen oxides, hydrocarbons and carbon monoxide should increase moderately. Increased hydrocarbon and nitrogen oxide emissions are attributable to new primary industries and carbon monoxide loadings to the primary metal



Note: Information presented is in generalized form. Local application will require mapping in greater detail.

POTENTIAL EFFECTS OF O.C.S. OIL AND GAS DEVELOPMENT

PUGET SOUND, WASH.

PLATE 13

UNDEVELOPED LAND

PRESENT CONDITIONS

■ – DEVELOPED LAND
EXISTING LAND USES

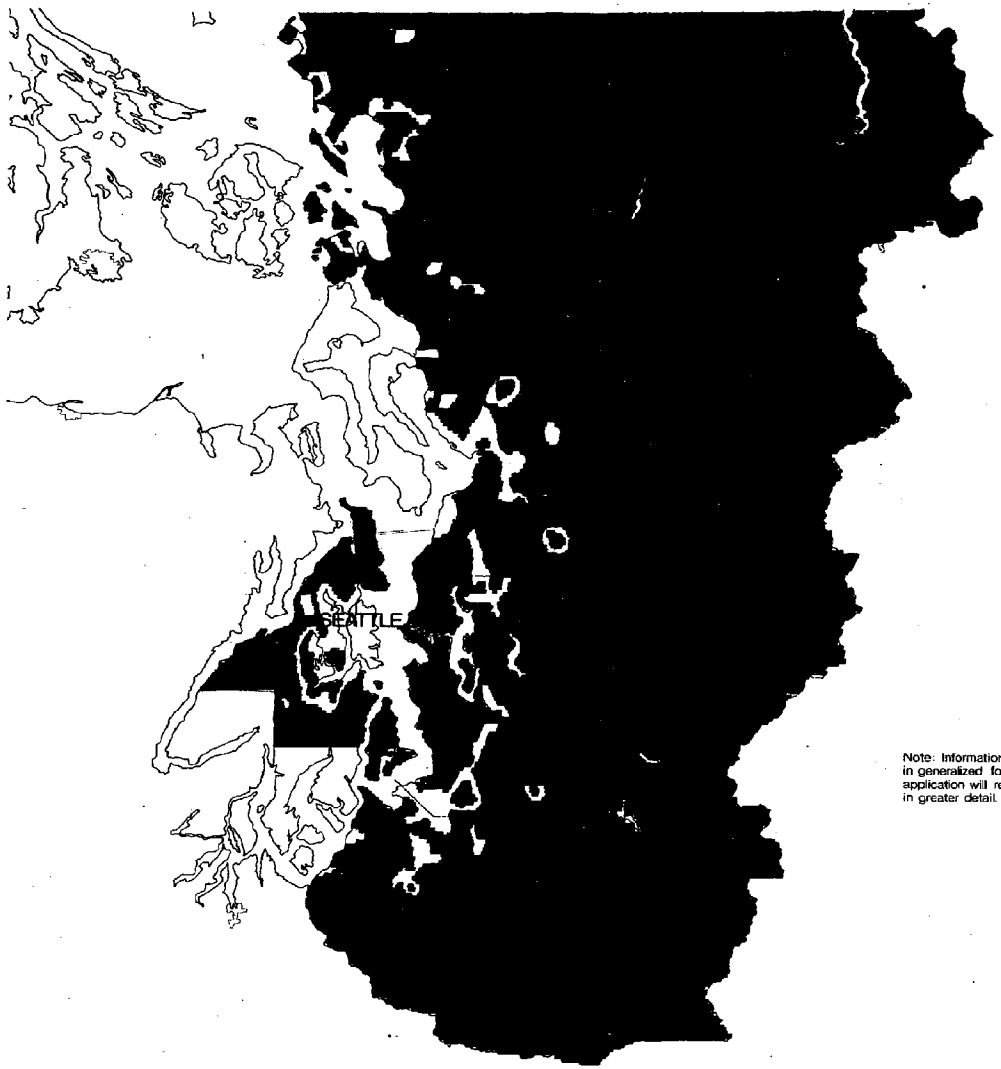
□ – UNDEVELOPED LAND

RESOURCE PLANNING ASSOCIATES INC.

BASE MAP U.S.G.S. 1:250,000 DECEMBER 1973

miles

N



Note: Information presented is in generalized form. Local application will require mapping in greater detail.

POTENTIAL EFFECTS OF O.C.S. OIL AND GAS DEVELOPMENT

PUGET SOUND, WASH.

PLATE 14/15

LAND USE IMPACT

LAND REQUIREMENTS TO SCALE
BASE CASE 2 HIGH IMPACT YEAR 2000

BASE CASE II (NO O.C.S.)		O.C.S. HIGH IMPACT		
PRIMARY	OTHER	PRIMARY	INDUCED	TOTAL
1675	188,600	1565	15,800	208,675 ACRES
		OTHER 1035		
		2600		

SUITABLE LAND

FOR GENERAL/PRIMARY DEVELOPMENT

- UNSUITABLE LAND
  EXISTING AND PROJECTED LAND USES
  ENVIRONMENTAL CONSTRAINTS
- SUITABLE LAND
  SUBJECT TO AVAILABILITY AND LOCAL ZONING

RESOURCE PLANNING ASSOCIATES INC.

BASE MAP U.S.G.S. 1:250,000 DECEMBER 1973

5 0 5 10 15 20 30 miles

N

EXHIBIT 8-17

AMBIENT AIR CONCENTRATION LEVELS

PUGET SOUND

	Particulates Micrograms per cubic meter	SO_x (mg/m^3) Annual Average
PRIMARY STANDARDS	75	80
WASHINGTON		
Skagit Mount Vernon	60	.01
Whatcom Bellingham	69	-
Kitsap Bremerton	48	-
Snohomish Everett	63	.01
King Seattle	58	31
Pierce Tacoma	49	14

Source: Environmental Protection Agency

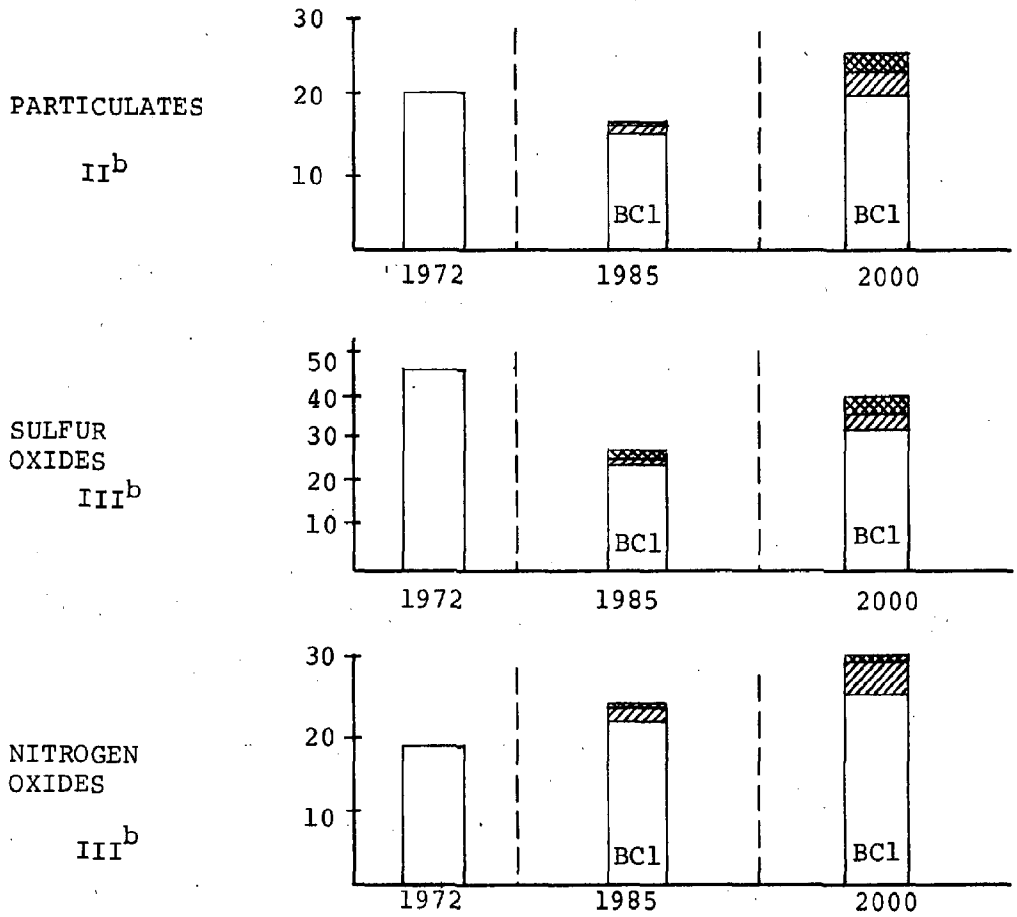
EXHIBIT 8-18

SUMMARY OF IMPACTS - AIR POLLUTION LOADINGS[a]

(Thousand tons per year)

SKAGIT/WHATCOM COUNTIES

(Geographic Area)



[a]Refer to Appendix IX for a detailed discussion of the methodology for determination of each loading source and estimation of the control factors for each pollutant by geographic area.

[b]EPA Air Quality Priority Classification.

BC 1: Base Case 1

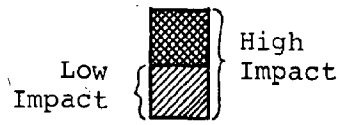


EXHIBIT 8-18

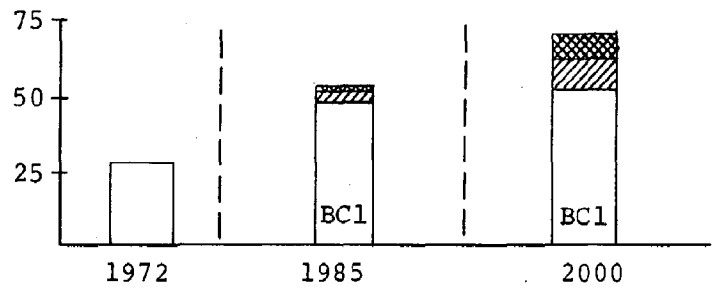
SUMMARY OF IMPACTS - AIR POLLUTION LOADINGS (CONTINUED)[a]

(Thousand tons per year)

SKAGIT/WHATCOM COUNTIES
(Geographic Area)

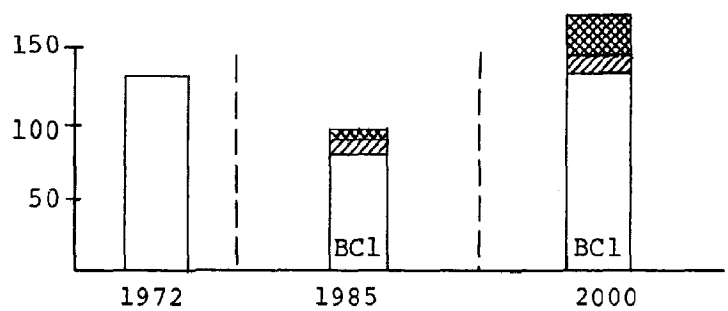
HYDROCARBONS

III[b]



CARBON MONOXIDE

III[b]



---

[a] Refer to Appendix IX for a detailed discussion of the methodology for determination of each loading source and estimation of the control factors for each pollutant by geographic area.

[b] EPA Air Quality Priority Classification.

BC 1: Base Case 1

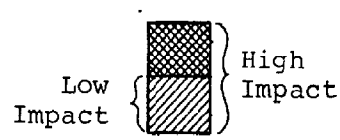


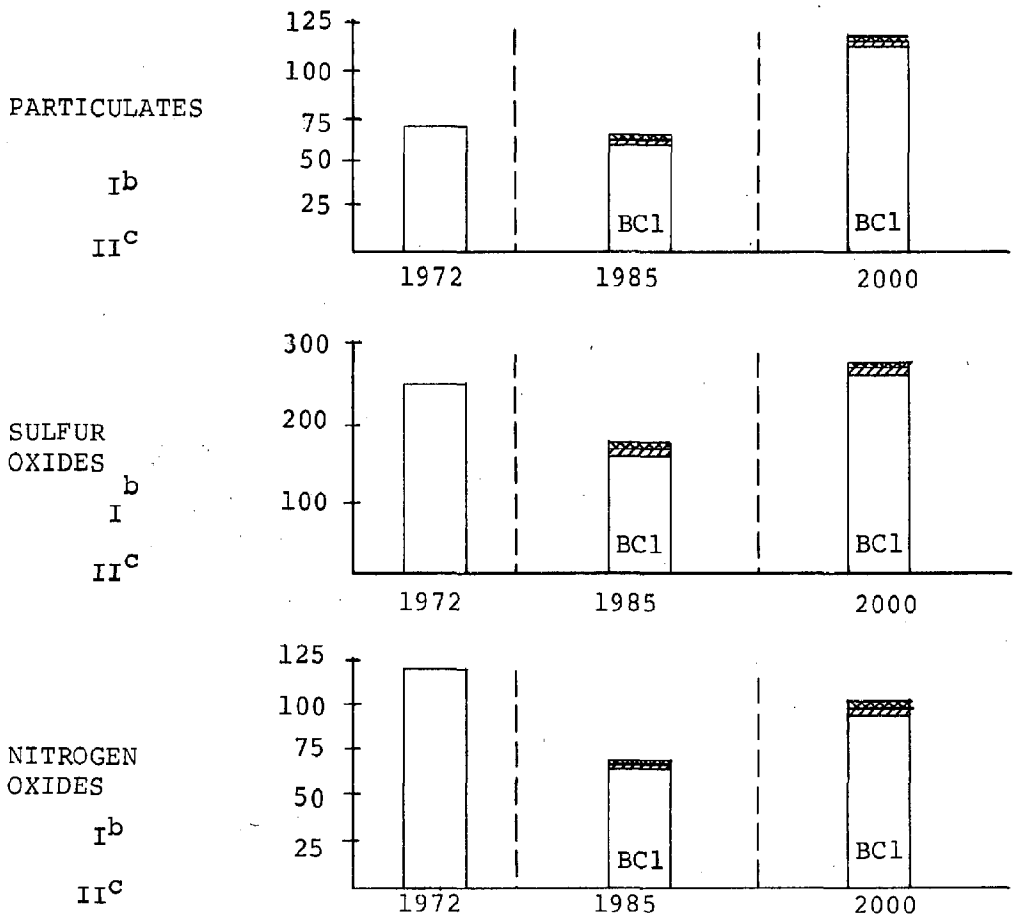
EXHIBIT 8-19

SUMMARY OF IMPACTS - AIR POLLUTION LOADINGS[a]

(Thousand tons per year)

PUGET SOUND

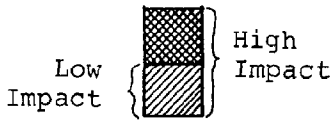
(Geographic Area)



[a]Refer to Appendix IX for a detailed discussion of the methodology for determination of each loading source and estimation of the control factors for each pollutant by geographic area.

BC 1: Base Case 1

EPA Air Quality Priority Classification for:



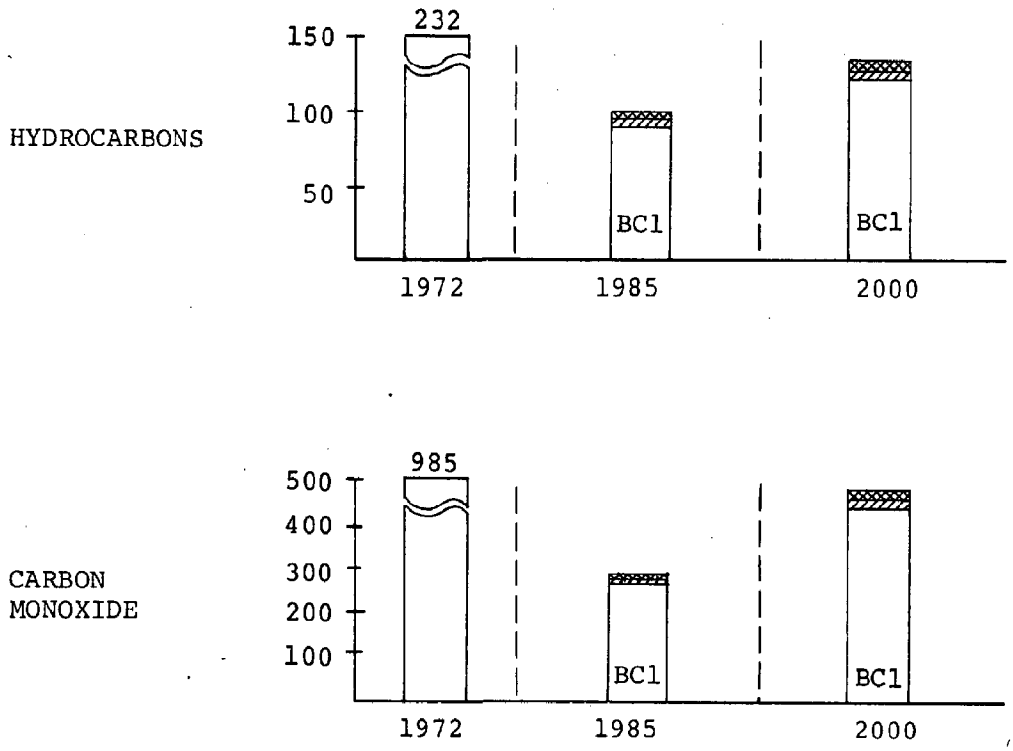
[b]Puget Sound Intrastate AQCR.
[c]Northern Washington Intrastate AQCR.

EXHIBIT 8-19

SUMMARY OF IMPACTS - AIR POLLUTION LOADINGS (CONTINUED)[a]

(Thousand tons per year)

PUGET SOUND
(Geographic Area)



[a]Refer to Appendix IX for a detailed discussion of the methodology for determination of each loading source and estimation of the control factors for each pollutant by geographic area.

BC 1: Base Case 1

EPA Air Quality Priority Classification for:

Low Impact — High Impact

[b]Puget Sound Intrastate AQCR.
[c]Northern Washington Intrastate AQCR.

industry.

Although the impact loadings from offshore production are very slight for the region overall, the base case loadings expected could produce unacceptable air concentration levels for particulates and sulphur oxides at certain sites within the region. Due to the varying terrain and isolated population centers, however, a specific dispersion analysis must be carried out for the Washington area to identify specific locations where pollutant concentrations could exceed standards. Although the area is classified priority I for hydrocarbons and carbon monoxide as well, expected applications of future control on mobile sources should reduce the pollution loadings significantly from 1972 to 2000.

Water Pollution

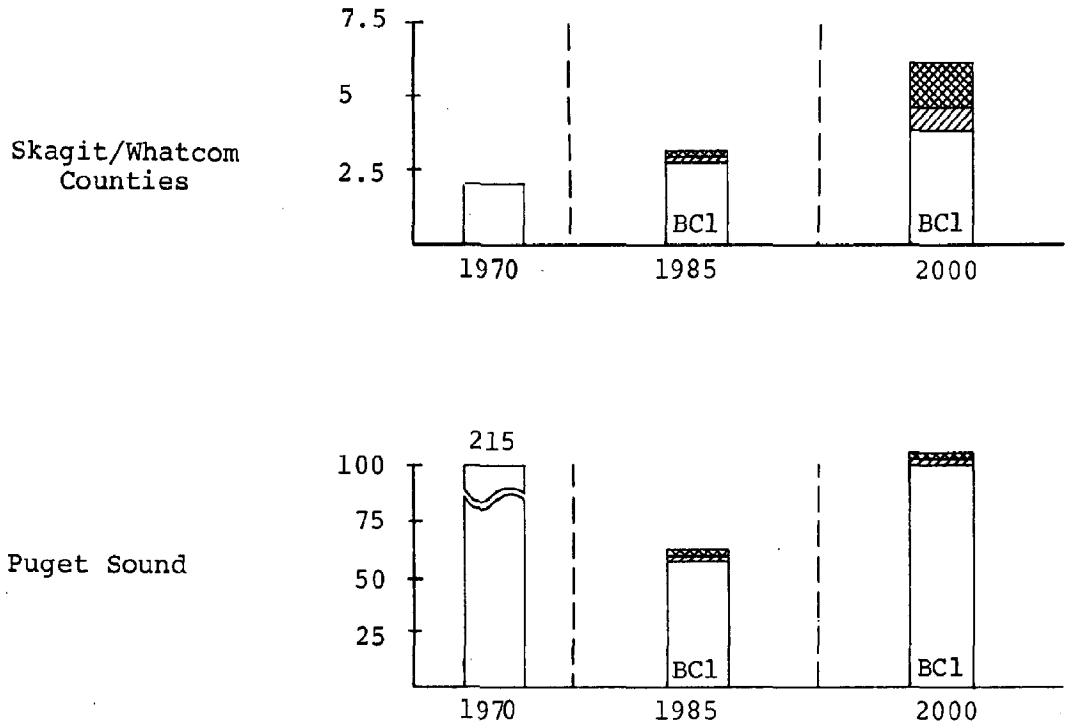
Municipal discharges account for approximately 65 percent of the total 1970 BOD loadings in the Skagit/Whatcom County locality (Exhibit 8-20). Base case loadings are projected to increase over the 1970 level in both 1985 and 2000. The impacts from high OCS production should be small in 1985, increasing BOD loadings by approximately 6 percent. However, in the year 2000, loadings from the high production case could represent a 50 percent increase over base case (although less than 5,000 tons per year). The bulk of these loadings are projected from new refinery and petrochemical activity.

In the Puget Sound region, paper and allied products account for approximately 80 percent of the total loadings. Under all cases the BOD discharges should decrease by at least 50 percent in the years 1985 and 2000 as a result of new control technology in the paper industry. Even with high OCS oil and gas production, the BOD loadings should only increase base case loadings by approximately 4 percent.

EXHIBIT 8-20

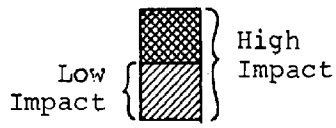
SUMMARY OF IMPACTS - BOD LOADING[a]
(Thousand tons per year)

WASHINGTON/OREGON
(Geographic Area)



[a]Refer to Appendix IX for a detailed discussion of the methodology for determination of each loading source and estimation of the treatment factors for each regior

BC 1: Base Case 1



SOURCES OF DATA

Socio-Economic

Borland, Stewart, and Oliver, Martha. Port Expansion in the Puget Sound Region, 1970-2000. Seattle, Washington: University of Washington, Division of Marine Resources, October 1972.

Beyers, Willign B., et al. Input-Output Tables for the Washington Economy, 1967. Seattle, Washington: University of Washington, Graduate School of Business Administration, December 1970.

Horner, Gerald; Weeks, Eldon; and Hungate, Eleanor. The Skagit Trade Area ofWashington State: A Survey of Selected Regional Characteristics. Washington State University, College of Agriculture, Washington Agricultural Experiment Station, October 1969.

Pacific Northwest River Basins Commission, Puget Sound Task Force, Land Usage and Development Technical Committee. Puget Sound andAdjacent Waters. Appendix V Water-Related Land Resources, 1970.

Pacific Northwest River Basins Commission, Puget Sound Task Force, Municipal and Industrial Water Supply and Water Quality Control Technical Committee, Puget Sound and Adjacent Waters. Appendix VI, Municipal and Industrial Water Supply. March 1970.

Pacific Northwest River Basins Commission, Puget Sound Task Force, Power Technical Committee. Puget Sound and Adjacent Waters, Appendix IX, Power. March 1970.

Pacific Northwest River Basins Commission , Puget Sound Task Force, Recreation Technical Committee. Puget Sound and Adjacent Waters. Appendix X, Recreation. 1970.

Puget Sound Governmental Conference. "Central Puget Sound Regional Housing Analysis." August 1972.

Puget Sound Governmental Conference. "Central Puget Sound Region Economic Base Study Summary." January 11, 1973.

SOURCES OF DATA (continued)

Puget Sound Governmental Conference. Population and Employment Forecasts and Distribution for the Central Puget Sound Region, 1975-1990, by Donald R. Pethick. Special Report Series No. 1. May 1969.

Puget Sound Governmental Conference. Population and Employment Forecasts and Distributions for the Central Puget Sound Region, 1975-1990 (1972 Revision). July 31, 1972.

Rasmussen, Norman. "Washington State Earthquakes, 1940 Through 1965." Bulletin of the Seismological Society of America, Vol. 57, No. 3, July .967, pp. 463-476.

Salo, Dr. Ernest. "The Effects of Pollution on the Estuaries of the Northwest Pacific Coast." WSG-TA 70-12. Seattle: University of Washington, Division of Marine Resources.

U.S. Army Corps of Engineers, North Pacific Division. National Shoreline Study, Inventory Report, Columbia-North Pacific Region, Washington and Oregon. August 1971.

U.S. Department of Housing and Urban Development. Land Use and Water-Related Factors, 1970-2000: Seattle-Everett SMSA and Tacoma SMSA, by Puget Sound Governmental Conference. August 1973.

U.S. Department of the Interior, Geological Survey. Geological Map of Washington. by A.E. Weissenborn. 1969.

Urban Land Institute. Skagit County: A Strategy for Environmental Protection and Economic Development. November 1972.

Washington, State of , Department of Commerce and Economic Development. Skagit County Industrial Site Survey. by Latourell Associates and Bert McNae, Inc. October 1972.

Washington, State of, Department of Commerce and Economic Development. "Total Personal Income in SMSA's and Non-SMSA Counties in Selected Years, 1950-1972." August 2, 1973. (Special Computer Run).

Washington, Stae of, Department of Commerce and Economic Development, Business & Economic Research Division. "Survey of Current and Future Housing Demands for the North Puget Sound Area," By David M. Desmarteau. November 1969.

SOURCES OF DATA (continued)

Washington, State of, Department of Commerce and Economic Development, Economic Analysis Division. "Preliminary Economic Forecasts, State of Washington." August 1973.

Washington, State of, Department of Commerce and Economic Development, and Skagit County Development Association. Preliminary Demand Forecast for the North Cascades Recreational Area, by Northwest American. July 1972.

Washington, State of, Department of Commerce and Economic Development, and Skagit County Development Association. A Tourist and Recreation Strategy for Skagit County with Recommendations for Implementation, by Northwest American. October 1972.

Washington, State of, Department of Employment Security, Economic Analysis Division. "Labor Force and Employment in Washington State."

Washington, State of, Department of Employment Security, Research and Statistics Division. Employment and and Payrolls in Washington State by County and by Industry. July 14, 1973, and July 16, 1973.

Washington, State of, Department of Commerce and Economic Development. "Long Range Washington State Employment and Personal Income Forecasts." August 31, 1973.

Washington, Atate of, Department of Highways. Draft Environmental Statement: SR 90, Jct. SR5 to West Shore Mercer Island. August 1972.

Washington, State of, Department of Natural Resources. "Washington's Major Public Lands." Map, 1973.

Washington, State of, Office of Program Planning and Fiscal Management. "Interim Population Projections to Year 2000 by County." October 1972.

Washington, State of, Office of Program Planning and Fiscal Management. Pocket Data Book, 1972. January 1973.

Washington, State of, Office of Program Planning and Fiscal Management, Population Studies Division. State of Washington Population Trends. June 1973.

SOURCES OF DATA (continued)

Washington, State of, Office of the State Treasurer. Forty Second Biennial Report of the State Treasurer. 1973.

Washington, State Parks and Recreation Commission. The North Cascades Highway: Its Impact on Community Economics, by Community Development Services, Inc. November 1972.

Whatcom County Regional Planning Council, Whatcom County Economic Development Committee. 1966 Overall Economic Development Program, Whatcom County, State of Washington. April 1966.

Land Use

Division of Marine Resources, University of Washington, Washington Sea Grant Program, Port Expansion in the Puget Sound Region 1970-2000. Steward Borland and Martha Oliver, October 1972.

Interagency Committee for Outdoor Recreation, Washington Statewide Comprehensive Outdoor Recreation and Open Space Plan, Fourth Edition, May, 1973, Volume II.

1966 Overall Economic Development Program, Whatcom County.

Puget Sound Governmental Conference and State of Washington, Puget Sound Regional Transportation Study: Summary Report, 1967.

Puget Sound Governmental Conference and Puget Sound Regional Planning Council, Summary Report: Project Open Space, by Merwin W. Parker, June 1966.

Puget Sound Governmental Conference, Seattle, August 1973, "Land Use and Water Related Factors 1970-2000, Seattle-Everett SMSA, Tacoma SMSA.

Puget Sound Task Force - Pacific Northwest River Basins Commission, Comprehensive Study of Water and Related Land Resources, Puget Sound and Adjacent Waters, Appendix V, March 1970.

SOURCES OF DATA (continued)

Urban Land Institute, Skagit County, A Strategy for Environmental Protection and Economic Development, Washington, D.C.

U.S. Army Corps of Engineers, Inventory Report Columbia-North Pacific Region, Washington and Oregon August 1971.

Washington, State of, Department of Natural Resources, Division of Surveys and Marine Land Management. "The Land Use Allocation Plan." February 14, 1973.

Washington, State of, Interagency Committee for Outdoor Recreation. To Have and To Hold: Washington's Outdoor Recreation Heritage. January 1970.

Washington, State of, Interagency Committee for Outdoor Recreation. Washington Statewide Comprehensive Outdoor Recreation and Open Space Plan, Vols. I and II. May 1973.

Washington, State of, Office of Program Planning and Fiscal Management. State Lands Inventory:Ownership, Control and Use Summary, 1970.

Whatcom County Planning Commission: Comprehensive Plan for Whatcom County, Washington: Land Use and Circulation Elements. 1970.

Air and Water Pollution

Mason, David V., et al. Seattle-Tacoma Air Pollutant Emission Inventory. Springfield, Virginia: NTIS (PB 206 245) December 1968.

Wildlife and Vegetation

Battelle Pacific Northwest Laboratories. Environmental Assessment: West Coast Deepwater Port Study. Battelle June 1973.

DeLacy, Allan C., et al. Checklist of Puget Sound Fishes. Washington Sea Grant Program. Seattle, Washington: University of Washington, Division of Marine Resources, July, 1972.

SOURCES OF DATA (continued)

Lyman, Leslie. Estuaries... A Resource Worth Saving. State of Washington, Department of Game, December 1972.

Puget Sound Task Force. Comprehensive Study of Water Related Land Resources, Puget Sound and Related Water Pacific Northwest River Basins Commission March 1970.

State of Washington: Department of Game
Department of Natural Resources

U.S. Corps of Engineers. West Coast Deepwater Port Facilities Study. Appendix E. U.S. Corps of Engineers, June 1973.

U.S. Department of Interior, Fish and Wildlife Service. Inventory of Permanent Water Areas for the State of Washington. Multilithe U.S. Department of Interior. February 1955.

U.S. Department of Interior, Fish and Wildlife Service, Inventory of Wetlands for the State of Washington Multilithe U.S. DOI April 1954.

Washington, State of, Department of Game, Environmental Management Division. "Wildlife Recreation Areas, Public Use and Production, 1970."

9. SAN FRANCISCO BAY AREA

Like Puget Sound, the San Francisco Bay area is a major refining center and a possible candidate for primary industry expansion associated with Gulf of Alaska OCS development. California crude oil production has recently been declining, and San Francisco is expected to be progressively relying on foreign sources of petroleum. The local study area in the San Francisco region consists of Contra Costa and Solano counties. Of the six refineries currently in the Bay Area, five are in Contra Costa County, while the sixth and newest is in Solano County.

This two-county area is in the eastern part of the Bay Area, straddling the primary fresh water sources of the Bay, the Sacramento and San Joaquin rivers. All of the refineries are located on this arm of the Bay, from the Standard Oil of California refinery on the open Bay in Richmond, upstream to San Pablo Bay, the Carguinez Straits, and Suisun Bay.

The two-county area has a well-developed transportation system. The area is well-endowed with freeways and has access to railroads and ports. There is a petroleum product pipeline network connecting the present refineries with Reno, Sacramento, Travis AFB, and the San Francisco airport.

The San Francisco regional study area comprises the nine-county Bay Area. Besides the two local counties, the area includes San Francisco, San Mateo, Santa Clara, Alameda, Napa, Sonoma, and Marin counties. This nine-county area coincides with the jurisdictional area of ABAG, the Association of Bay Area Governments.

The remainder of this chapter is organized into three sections. The first describes current socio-economic and environmental conditions in Contra Costa and Solano Counties and the San Francisco Bay region. The second discusses the assumed future development by primary industry in the local and regional areas. The third estimates and discusses the specific economic, social infrastructure, land use, and pollution impacts that would result from the assumed development.

PROFILE OF CURRENT CONDITIONS

San Francisco Bay is one of the nation's largest natural bays, with an area of 450 square miles (Exhibit 9-1).

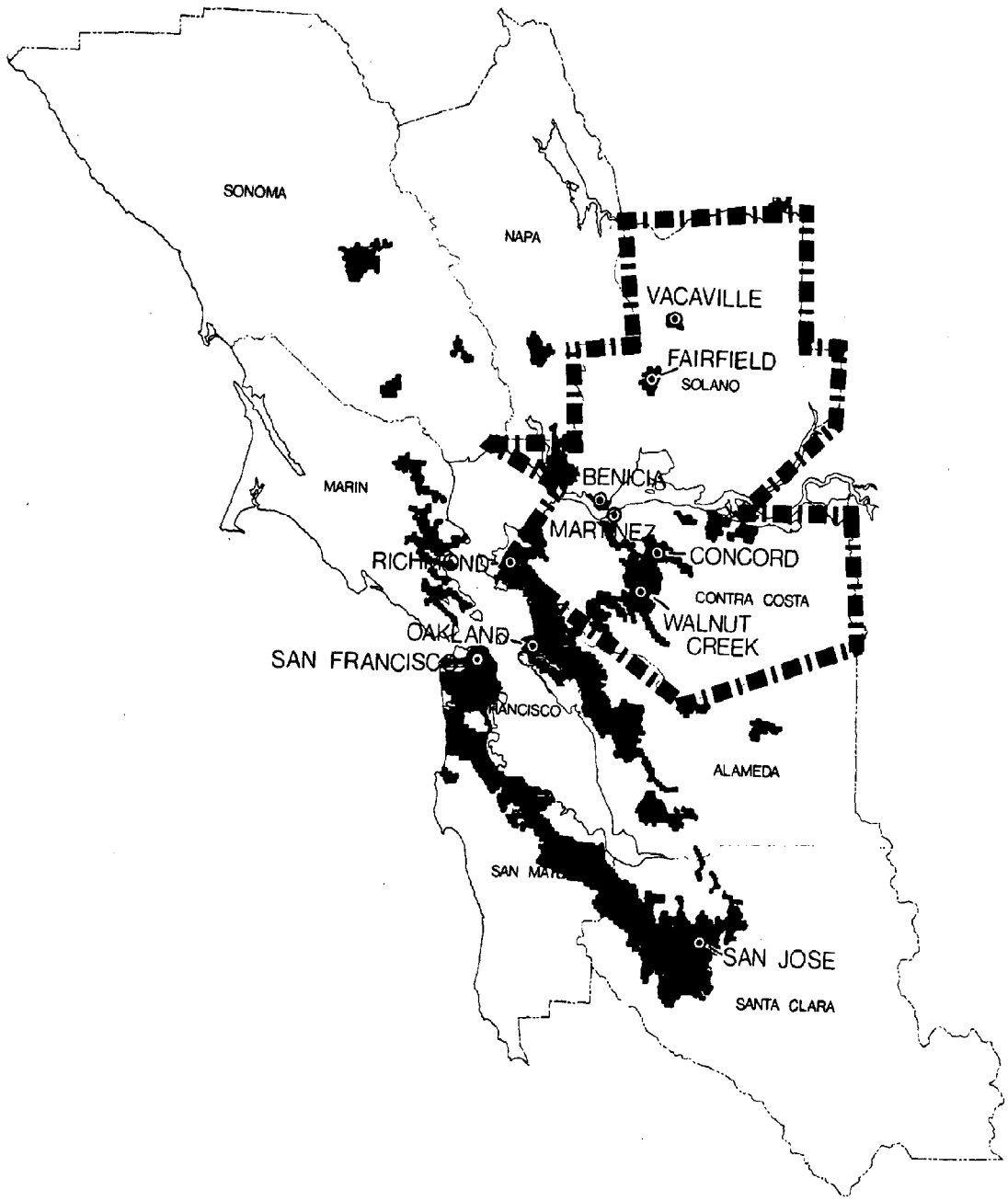


EXHIBIT 9-1
SAN FRANCISCO BAY REGION

RESOURCE PLANNING
ASSOCIATES INC.

On its eastern portion lie Solano and Contra Costa counties, which are separated by the Sacramento and San Joaquin Rivers. Suisun Bay, where the two rivers meet, lies at the center of the two-county area and is the site of much of the remaining marshland in the San Francisco Bay Area.

The topography of the Bay Area ranges from flatlands in several valleys to 3800-foot Mt. Diablo in Contra Costa County. Generally, the Bay is surrounded by mountains, with a coastal range running north and south parallel to the Diablo Range on the east flank of the Bay. Solano County contains the full range of Bay Area topography, from the broad flatlands of the Sacramento Valley to the slopes of the Vaca Mountains. The terrain of Contra Costa County is primarily steep, flattening out only around Concord and in areas adjacent to the Bay.

The climate of the Bay Area is moderate, with a variety of conditions prevailing. Temperature is a function of proximity to the Pacific Ocean and the Bay. The farther the land is from the moderating influence of these waters, the more extreme are the highs and lows. Mean temperature ranges from about 45°F in January to 75°F in July. Rainfall is heaviest in the coastal range, with 40 inches per year, and decreases in the valleys and toward the east. Solano and Contra Costa counties experience between 15 to 25 inches of rainfall per year.

With the San Andreas Fault system underlying the length of the area, earthquakes present a constant threat and small tremors are, in fact, common. The largest recorded quake in the area was the famous San Francisco earthquake of 1906, which measured 8.3 on the Richter scale.

San Francisco is the area's largest city, with a population of 715,674 in 1970. Other large urban centers include Oakland and San Jose. In all, nine counties of the region reported a combined population of 4,628,200 in 1970. This makes the Bay Area one of the largest metropolitan areas in the United States. Population has increased 27 percent between 1961 and 1971, and continued growth is expected.

In Solano and Contra Costa, lands adjacent to the Bay have undergone most of the urban development. Richmond, Martinez, and Benecia, situated on the Bay, are major industrial sites. Inland are the cities of Concord, Walnut Creek, Vacaville, and Fairfield. The locality provides

homes for 16 percent of the regional population, but it is the workplace for only 10.3 percent. This difference primarily stems from the fact that many residents of the two counties commute to work in the San Francisco-Oakland downtown areas.

In the two counties, agriculture plays a greater role in total employment than the Bay Area as a whole, with 16 percent of the area's farmers located here. The petroleum industry is also concentrated within the two counties and provides over 30 percent of the local area's employment. The entire Bay area, including Solano and Contra Costa, is heavily service-oriented; 71 percent of the work force falls into this category. Manufacturing accounts for 18 percent of the total regional employment and 17 percent of employment in the two-county local area.

Per capita income of Solano and Contra Costa residents in 1970 was $3,825. In the Bay Area as a whole, the 1970 per capita income was $4,651.

Within Solano and Contra Costa, 11 percent of the total land area is classified as developed. For the nine-county region, the figure is 10 percent. Of this land, 48 percent of the two-county local area and 51 percent of the region is residential.

Air quality information for the two counties alone is not available. The Bay Area Air Quality Control Region is currently rated Class II for particulates and sulphur oxides and Class I for other pollutants. Particularly during the summer, temperature inversions, photochemical oxidants and stagnant air conditions create severe smog conditions.

Agricultural runoff and municipal and industrial discharges into San Francisco Bay are the chief contributions to the poor quality of the water.

The Bay area has approximately 50 square miles of marshland, 78 square miles of tidal flats, and 400 miles of open water, all of which comprise a rich zone of estuarine activity for waterfowl, anadromous fish, shellfish, and pelagic organisms (Exhibit 9-2). In recognition of the importance of this area in terms of wildlife, two national wildlife refuges have recently been established in San Francisco and San Pablo Bays, protecting over 34,000 acres.

The counties of Solano and Contra Costa border the Sacramento-San Joaquin delta and its rich tidal flats. In

SOLANO AND CONTRA COSTA, CALIF.

WILDLIFE AND VEGETATION
PROTECTED AREAS

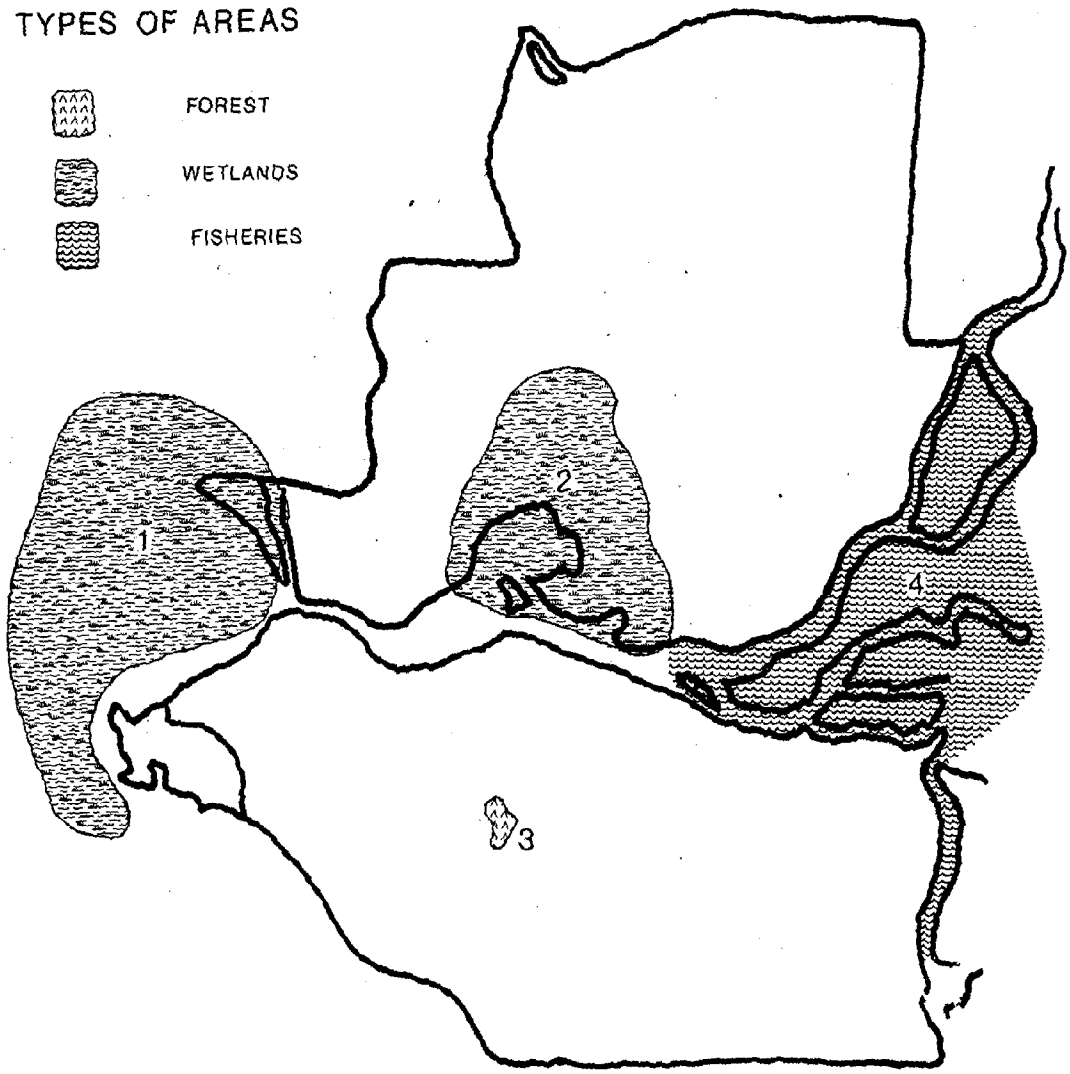


EXHIBIT 9-2

EXHIBIT 9-2 (cont.)

KEY	SOLANO/CONTRA COSTA[a] COUNTIES
1. San Pablo Bay National Wildlife Refuge	
2. Suisun Marsh and Grizzly Island Wildlife Management Area	
3. Mt. Diablo Game Refuge	
4. Sacramento River	

[a] See Appendix X for a detailed description of the wildlife and vegetation of the local area as well as the region.

Solano County the 54,000 acre Suisun Marsh not only represents one of California's few remaining natural wetlands and a refuge in times of drought, but also the major feeding and wintering ground for hundreds of thousands of the ducks and geese of the Pacific Flyway.

Major recreation areas within the Bay Area include Point Reyes National Seashore, Golden Gate National Recreation Area, East Bay Regional Park District, the Golden Gate Park, and Lake Berryessa.

DEVELOPMENT ASSUMPTIONS

This section describes both the base case and OCS-induced development that could occur in the San Francisco Bay region for each of the sectors directly analyzed: oil refining, gas processing, petrochemicals, and construction.

Oil Refining

Under base case development, all of which is expected to take place in Solano and Contra Costa Counties, refining capacity is expected to reach over 900,000 barrels per day in 1985, and remain at that level through the year 2000 (Exhibit 9-3). The leveling of activity reflects the amount of crude oil supplies assumed available to the area.

Offshore production could result in additional capacity from 310,000 (low OCS) to 630,000 (high OCS) barrels per day by the year 2000. Appendix II discusses in greater detail the refinery development assumptions.

EXHIBIT 9-3

PROJECTED SOLANO/CONTRA COSTA COUNTY REFINERY DEVELOPMENT

(Capacity in million barrels per day)

Year	Base Case	Low OCS	High OCS
1985	.91	.08	.23
2000	.91	.31	.63

Source: Dornbusch & Co. and RPA estimates.

Gas Processing

No gas processing development for Gulf of Alaska gas production is assumed to occur in the San Francisco Bay region. The processing is expected to take place at the onshore receiving points in Alaska.

Petrochemicals

With environmental and feedstock constraints limiting growth possibilities, only a slight amount of petrochemical development (all in Solano and Contra Costa Counties) is expected under base case conditions (less than one full complex, as shown in Exhibit 9-4).

Under high Gulf of Alaska production conditions, a more significant level of development should occur locally by the year 2000. An additional 3 complexes have been projected for the Solano/Contra Costa County area.

Appendix IV discusses in detail the development assumptions for petrochemicals.

EXHIBIT 9-4

PROJECTED SOLANO/CONTRA COSTA PETROCHEMICAL DEVELOPMENT FROM GULF OF ALASKA PRODUCTION

(Number of 1 billion lb./yr. olefin complexes)

Year	Base Case	Low OCS	High OCS	Total
1985	.7	0	.5	1.2
2000	.8	0	2.9	3.7

Source: Dornbusch & Co. and RPA estimates.

Construction

The level of construction activity in the San Francisco Bay Region would be similar to that of Puget Sound (Exhibit 9-5).[1] A peak would occur in the 1980s and the 1985 high

[1] All impact construction is expected to take place in the Solano/Contra Costa County locality.

EXHIBIT 9-5

VALUE OF CONSTRUCTION OUTPUT[a]
($ million)

NORTHERN CALIFORNIA

Geographic Area	1970 Actual	1985			2000		
		Base Case[b]	Low OCS	High OCS	Base Case[b]	Low OCS	High OCS
SOLANO/CONTRA COSTA COUNTIES							
Refinery			95	106		0	0
Gas Processing			0	0		0	0
Petrochemical			16	49		0	0
Induced[c]			28	39		56	78
Total Local	451	784	139	194	1266	56	78
SAN FRANCISCO BAY							
Refinery			95	106		0	0
Gas Processing			0	0		0	0
Petrochemical			16	49		0	0
Induced[c]			28	39		56	78
Total Region	3567	6027	139	194	9206	56	78

[a] Base Case total and OCS incremental. Appendix V describes the methods used in determining these values

[b] Base Case 1 for West Coast

[c] Other industrial, commercial, and residential construction activity induced by the direct industry activities

Source: RPA estimates.

OCS construction activity should be about $200 million, while low OCS conditions would result in about $140 million. The total 1985 high impact construction activity would be about one fourth of the base case activity for the Solano/Contra Costa County locality, and would result in 30 percent of the total primary economic output induced by OCS production. Refinery construction makes up the majority of total 1985 construction activity.

High impact construction in the locality should drop off to $78 million in the year 2000, all of which is expected to be induced industrial, commercial and residential. Appendix V discusses the method of making these assumptions.

IMPACTS

This section discusses the impacts that could occur in Solano and Contra Costa Counties and the San Francisco Bay Area from offshore Gulf of Alaska production. The economic, social, land use, and environmental impacts are presented in the following sub-sections.

Economic

Under base case conditions, Solano/Contra Costa County employment is expected to grow from 204,000 in 1970 to 281,000 in 1985, reaching 408,000 in the year 2000 (Exhibit 9-6). This growth represents a 2.2 percent per year rise between 1970 and 1985, accelerating to 2.5 percent per year between 1985 and 2000.

The 1970 employment was composed of 68 percent service, 17 percent manufacturing, 7 percent construction, 5 percent utility, and 3 percent agricultural. These proportions alter only slightly between 1970 and 2000, with agricultural and manufacturing employment losing importance and service employment gaining to 71 percent of the total.

In the San Francisco region, the employment pattern was similar to the smaller two-county area (Exhibit 9-7). Regional employment in 1970 was composed of 67 percent services, 18 percent manufacturing, 8 percent utilities, 5 percent construction, and 2 percent agriculture. This distribution changes slightly by 2000, with agricultural,

EXHIBIT 9-6

SUMMARY OF BASE CASE ECONOMIC CONDITIONS

SOLANO/CONTRA COSTA COUNTIES

A. EMPLOYMENT (thousands)

Sector	Actual	Base Case 1		Base Case 2	
	1970	1985	2000	1985	2000
Construction	13.0	19.0	26.0		
Ref., Gas, Petrochem.	35.0	3.5	2.8		
Other Manufacturing		41.5	60.2		
Agriculture	6.0	6.0	6.0		
Utilities	11.0	15.0	23.0		
Services	139.0	196.0	290.0		
TOTAL	204.0	281.0	408.0		

B. VALUE OF OUTPUT ($ million)[a]

Sector	Actual	Base Case 1		Base Case 2	
	1970	1985	2000	1985	2000
Construction	451	784	1266		
Ref., Gas, Petrochem.	1425	1657	1684		
Other Manufacturing		844	3093		
Agriculture	118	174	276		
Utilities	307	640	1278		
Services	2612	4621	8488		
TOTAL	4913	8720	16085		

Codes - * = negligible
: = infinite percentage since base case is zero

[a]All dollar figures are 1970 constant dollars.

Source: RPA estimates

EXHIBIT 9-7

SUMMARY OF BASE CASE ECONOMIC CONDITIONS

SAN FRANCISCO BAY

A. EMPLOYMENT (thousands)

Sector	Actual	Base Case 1		Base Case 2	
	1970	1985	2000	1985	2000
Construction	101	146.0	189.0		
Ref., Gas, Petrochem.	358	3.5	2.8		
Other Manufacturing		433.5	549.2		
Agriculture	38	33.0	29.0		
Utilities	151	169.0	211.0		
Services	1326	1693.0	2249.0		
TOTAL	1974	2478.0	3230.0		

B. VALUE OF OUTPUT ($ million)[a]

Sector	Actual	Base Case 1		Base Case 2	
	1970	1985	2000	1985	2000
Construction	3567	6027	9206		
Ref., Gas, Petrochem.	14554	1657	1684		
Other Manufacturing		22631	40392		
Agriculture	750	975	1290		
Utilities	5001	7212	11725		
Services	24951	39916	65824		
TOTAL	48823	78418	130120		

Codes - * = negligible
: = infinite percentage since base case is zero

[a]All dollar figures are 1970 constant dollars.

Source: RPA estimates

manufacturing, and utility employment decreasing in importance while construction and service employment become increasingly important.

Primary Impacts

If Gulf of Alaska oil and gas discoveries reach the high level assumed in the development scenario, a substantial number of persons would be employed in the Solano-Contra Costa locality (Exhibit 9-8). In 1985, an estimated 7,200 employees would be added to the refining, petrochemical, and construction industries in this area. The dominant portion is the 5,900 jobs in the construction industry. Refineries should employ an additional 600 persons, while petrochemical employment is expected to add 700.

Construction employment is far less important by the year 2000, contributing 1,800 of the expected 6,800 increase in jobs in these sectors (26 percent). Incremental refinery employment, on the other hand, doubles from 600 in 1985 to 1,300 in the year 2000 (19 percent). The rise in incremental petrochemical employment is expected to be even greater, from 700 in 1985 to 3,700 in the year 2000. The 2000 petrochemical employment represents 54 percent of the total increment.

The 7,200 new jobs in construction, refining, and petrochemicals in 1985 represent a 2.5 percent increase in local employment and a 0.3 percent increase in Bay Area employment. In the year 2000, these increases diminish slightly.

In contrast with the employment impacts, where the construction industry dominates, the largest contributor to the incremental value of output is refining. In 1985, the construction industry output is expected to be $194 million, or 29 percent of the incremental impact. This 29 percent contrasts sharply with construction's 82 percent share of the increased jobs, indicating that the construction industry is far more labor intensive than either refining or petrochemicals.

Incremental refining and petrochemical output is expected to be $380 million and $104 million, respectively, in 1985, representing 56 percent and 15 percent of the total increment. The value of construction output declines further by the year 2000, to $78 million, while refining grows to $1,040 million (58 percent of the total),

EXHIBIT 9-8

PRIMARY ECONOMIC IMPACTS

NORTHERN CALIFORNIA

A. EMPLOYMENT (thousands) HIGH IMPACT

	1985			2000		
	Local	Region[a]	Area[b]	Local	Region[a]	Area[b]
Oil and Gas Rec.	0	0	0	0	0	0
Gas Processing	0	0	0	0	0	0
Refineries	0.6	0.6	0	1.3	1.3	0
Petrochemical	0.7	0.7	0	3.7	3.7	0
Construction	5.9	5.9	0	1.8	1.8	0

B. VALUE OF OUTPUT (millions 1970 dollars) HIGH IMPACT

	1985			2000		
	Local	Region[a]	Area[b]	Local	Region[a]	Area[b]
Oil and Gas Rec.	0	0	0	0	0	0
Gas Processing	0	0	0	0	0	0
Refineries	380	380	0	1040	1040	0
Petrochemical	104	104	0	676	676	0
Construction	194	194	0	78	78	0

Code: * = negligible

[a] Region includes Local

[b] Area is "Demand Area" exclusive of the Region

Source: RPA estimates

EXHIBIT 9-8 (cont.)

PRIMARY ECONOMIC IMPACTS

NORTHERN CALIFORNIA

C. EMPLOYMENT (thousands) LOW IMPACT

	1985			2000		
	Local	Region[a]	Area[b]	Local	Region[a]	Area[b]
Oil and Gas Rec.	0	0	0	0	0	0
Gas Processing	0	0	0	0	0	0
Refineries	0.2	0.2	0	0.6	0.6	0
Petrochemical	0	0	0	0.9	0.9	0
Construction	4.2	4.2	0	1.3	1.3	0

D. VALUE OF OUTPUT (millions 1970 dollars) LOW IMPACT

	1985			2000		
	Local	Region[a]	Area[b]	Local	Region[a]	Area[b]
Oil and Gas Rec.	0	0	0	0	0	0
Gas Processing	0	0	0	0	0	0
Refineries	131	131	0	511	511	0
Petrochemical	0	0	0	156	156	0
Construction	140	140	0	56	56	0

Code: * = negligible

[a] Region includes Local

[b] Area is "Demand Area" exclusive of the Region

Source: RPA estimates

and petrochemicals sharply increases to $676 million (38 percent).

The economic impacts anticipated under the assumption of low oil and gas production are generally about one-half of those anticipated under the high production assumptions. Employment impacts expected in 1985 are 61 percent of the high impact case, while those expected in 2000 are 41 percent of the high impact case. The major difference between the impacts expected under high and low production conditions is that there is no petrochemical activity in 1985 in the low production case. Because of a size constraint on petrochemical complexes, none is assumed to locate in the San Francisco area until refinery capacity reaches a minimum level, which is not until after 1985.

Because the refinery, petrochemical, and construction activities associated with Gulf of Alaska oil and gas production are assumed to occur in the two-county local area, there should be no additional primary impact in the San Francisco region.

Aggregate Impacts

The aggregate 1985 employment increase expected in the Solano-Contra Costa locality under the high impact scenario is 16,400 jobs, of which 7,200 occur in the primary industries (Exhibit 9-9). The 9,200 jobs in non-primary industries are distributed 2,200 to manufacturing, 700 to utilities, and 6,300 to services. The increase in local 1985 employment by 16,400 represents an increase of 6 percent over the expected local employment of 281,000.

Total output is estimated at $975 million in 1985, $678 million of which is attributable to the three primary industries. The ratio of total output to primary output is much lower than that of total employment to primary employment: 1.4 as opposed to 2.3. This is because the primary industries of refining and petrochemicals are much more capital intensive than the average secondary industry.

In the year 2000, increased Solano-Contra Costa employment in the high impact case is estimated to be

EXHIBIT 9-9

AGGREGATE ECONOMIC IMPACTS

SOLANO/CONTRA COSTA COUNTIES

HIGH IMPACT

A. EMPLOYMENT (thousands)

Sector	1985	Percent Over B.C. 1	Percent Over B.C. 2	2000	Percent Over B.C. 1	Percent Over B.C. 2
Construction	5.9	31		1.8	7	
Ref. Gas, Petrochem.	1.3	38		4.9	176	
Other Manufacturing	2.2	5		3.5	6	
Agriculture	*	*		*	*	
Utilities	0.7	4		1.3	6	
Services	6.3	3		10.5	4	
TOTAL	16.4	6		22.0	5	

B. VALUE OF OUTPUT ($ million)[a]

Sector	1985	Percent Over B.C. 1	Percent Over B.C. 2	2000	Percent Over B.C. 1	Percent Over B.C. 2
Construction	194	25		78	6	
Ref., Gas, Petrochem.	484	29		1716	102	
Other Manufacturing	120	14		264	9	
Agriculture	*	*		1	*	
Utilities	28	4		73	6	
Services	149	3		308	4	
TOTAL	975	11		2440	15	

Codes - * = negligible
: = infinite percentage since base case is zero

[a]All dollar figures are 1970 constant dollars.

Source: RPA estimates

EXHIBIT 9-10
AGGREGATE ECONOMIC IMPACTS

SOLANO/CONTRA COSTA COUNTIES
LOW IMPACT

A. EMPLOYMENT (thousands)

Sector	1985	Percent Over B.C. 1	Percent Over B.C. 2	2000	Percent Over B.C. 1	Percent Over B.C. 2
Construction	4.2	22		1.3	5	
Ref., Gas, Petrochem.	0.2	6		1.5	52	
Other Manufacturing	1.0	2		1.3	2	
Agriculture	*	*		*	*	
Utilities	0.3	2		0.5	2	
Services	3.1	2		4.3	1	
TOTAL	8.8	3		8.9	2	

B. VALUE OF OUTPUT ($ million)[a]

Sector	1985	Percent Over B.C. 1	Percent Over B.C. 2	2000	Percent Over B.C. 1	Percent Over B.C. 2
Construction	140	18		56	4	
Ref.,Gas, Petrochem.	131	8		667	40	
Other Manufacturing	57	7		99	3	
Agriculture	*	*		*	*	
Utilities	12	2		28	2	
Services	72	2		126	1	
TOTAL	412	5		976	6	

Codes - * = negligible
: = infinite percentage since base case is zero

[a]All dollar figures are 1970 constant dollars.

Source: RPA estimates

EXHIBIT 9-11

AGGREGATE ECONOMIC IMPACTS

SAN FRANCISCO BAY

HIGH IMPACT

A. EMPLOYMENT (thousands)

Sector	1985	Percent Over B.C. 1	Percent Over B.C. 2	2000	Percent Over B.C. 1	Percent Over B.C. 2
Construction	5.9	4		1.8	1	
Ref. Gas, Petrochem.	1.3	38		4.9	176	
Other Manufacturing	4.9	1		7.9	1	
Agriculture	0.1	*		0.2	1	
Utilities	1.5	1		3.0	1	
Services	14.6	1		24.9	1	
TOTAL	28.3	1		42.7	1	

B. VALUE OF OUTPUT ($ million) [a]

Sector	1985	Percent Over B.C. 1	Percent Over B.C. 2	2000	Percent Over B.C. 1	Percent Over B.C. 2
Construction	194	3		7	1	
Ref., Gas, Petrochem.	484	29		78	102	
Other Manufacturing	269	1		1716	1	
Agriculture	3	*		597	1	
Utilities	64	1		165	1	
Services	345	1		728	1	
TOTAL	1359	1		3291	3	

Codes - * = negligible
: = infinite percentage since base case is zero

[a]All dollar figures are 1970 constant dollars.

Source: RPA estimates

EXHIBIT 9-12

AGGREGATE ECONOMIC IMPACTS

SAN FRANCISCO BAY

LOW IMPACT

A. EMPLOYMENT (thousands)

Sector	1985	Percent Over B.C. 1	Percent Over B.C. 2	2000	Percent Over B.C. 1	Percent Over B.C. 2
Construction	4.2	3		1.3	1	
Ref., Gas, Petrochem.	0.2	6		1.5	52	
Other Manufacturing	2.3	1		3.0	1	
Agriculture	*	*		*	*	
Utilities	0.6	*		1.1	1	
Services	7.0	*		10.1	*	
TOTAL	14.3	1		17.0	1	

B. VALUE OF OUTPUT ($ million)[a]

Sector	1985	Percent Over B.C. 1	Percent Over B.C. 2	2000	Percent Over B.C. 1	Percent Over B.C. 2
Construction	140	2		56	1	
Ref.,Gas, Petrochem.	131	8		667	40	
Other Manufacturing	128	1		225	1	
Agriculture	1	*		3	*	
Utilities	27	*		64	1	
Services	165	*		296	*	
TOTAL	592	1		1311	1	

Codes - * = negligible
: = infinite percentage since base case is zero

[a]All dollar figures are 1970 constant dollars.

Source: RPA estimates

22,000, of which 6,700 is in the primary industries. The remaining 15,300 is distributed 3,500 to manufacturing, 1,300 to utilities, 10,500 to services. These 20,000 employees represent a 5.4 percent increase over the 408,000 employees forecast under base conditions.

Under low oil and gas production assumptions, the impacts on Solano and Contra Costa Counties are approximately 40 to 50 percent of those expected under high production conditions (Exhibit 9-10). Local employment increases would be 8,800 in 1985 and 8,900 in the year 2000.

The impacts to the San Francisco Bay Region are significantly larger in absolute terms than are those to the local area (Exhibit 9-11). Much of the demand for goods and services generated by the increase in primary industries in the local area should be satisfied by firms located elsewhere in the region. In the high impact case, 1985 regional employment is expected to increase by 28,300 jobs over the base case total of 2.5 million, an increase of only 1.1 percent. The increases in employment would be concentrated in services (14,600), construction (5,900), and manufacturing (4,900).

In the year 2000, the increase in regional employment is anticipated to be 42,700, 1.3 percent above the base case estimate of 3.2 million. The service sector will provide the bulk (59 percent) of the increase in jobs, supplying 24,900 of the 42,500.

The low production scenario results in approximately 40 to 50 percent of the impacts induced by high production (Exhibit 9-12). Employment increases in 1985, for example, are 14,300 compared with a high impact of 28,300.

Social Infrastructure

Gulf of Alaska oil and gas production should increase the demand for social services and infrastructure systems by attracting new population into the Solano/Contra Costa locality. The new population expected in the high production scenario is 34,000 persons in 1985 and 42,000 in the year 2000 (Exhibit 9-13). These increments represent a 3.2 percent increase over 1985 base case population of 1.1 million and a 2.7 percent increase over the 2000 base case population of 1.5 million.

EXHIBIT 9-13

SOLANO/CONTRA COSTA COUNTIES

(Geog. Area)

SOCIAL INFRASTRUCTURE IMPACT

	1970	1985		Incr.		2000		Incr.	
		Base Case 1	Base Case 2	High Impact	Low Impact	Base Case 1	Base Case 2	High Impact	Low Impact
POPULATION (000)	728	1077		34	18	1530		42	17
Percent Change %				3	2			3	1
PHYSICAL SYSTEMS									
Water Demand Mil. gallons/day	125	183		6	3	291		8	3
Elec. Demand (MW of Capacity)	NA	NA		193	59	NA		663	228
Structures Residential (000)	226	334		11	6	474		13	5
Commercial (millions of sq. ft.)	16	26.9		.9	.5	40.2		1.1	.4
SOCIAL SYSTEMS									
Schools - Enrollees (000)	209	301		10	5	428		11	4
Hospitals - Beds	2190	3134		99	52	4452		122	49
Police - Manpower	1336	1936		61	32	2754		76	31
Solid Waste - Tons/Day	2184	3231		102	54	4590		126	51
Sewage - Mil.gal/day	87	129		4	2	184		5	2
Gov't. OH - ($000,000)	NA	139		4	2	197		5	2
BUSINESS & GOVERNMENT INSTIT.									
Business Services - Employee (000)	NA	NA		NA	NA	NA		NA	NA
Government - Employee (000)	25.1	37.3		1.2	.6	52.4		1.4	.6

Source : RPA estimates

The impact which this new population would have on the demand for social services in the Solano-Contra Costa area is not expected to be significant to the two-county area, since the increase is only 3 percent. The entire increase barely exceeds the average annual rate of increase expected under base case conditions (2.5 percent).

While the impact on the two-county area should be minimal, to the extent that the growth is concentrated in a few small communities, there could be significant impacts in those communities. No attempt was made in this study to predict the exact location within the two-county area of either the primary activities or development induced by those activities.

In general, the population impacts to the Solano-Contra Costa locality are so small as to present no difficulty in meeting increased demand for social services. Only those infrastructure elements which will be pressed by base case growth will have problems in meeting the demand generated in the impact scenarios. Few, if any, social and infrastructure elements appear to face substantial difficulties in expanding to meet the expected growth in demand.

One of the few instances where growth could confront difficulties is the water supply. Most of the potential fresh water supplies in the Bay Area have already been tapped and much of the present demand is satisfied by imported sources. Any increase in population, including the impact projected in this analysis, will also be served by water imported from outside the region. This fact implies that meeting the incremental demand for water will become more and more costly, but there are no apparent constraints on the possibility of providing for future needs.[1]

There are several sewage treatment facilities in the Solano-Contra Costa locality which are capable of only primary treatment. Development induced by Gulf of Alaska oil and gas production should cause the water quality to deteriorate and increase the urgency of building secondary treatment facilities, as would growth under base case conditions.

There appear to be no other serious constraints in meeting either the base case or impact case demands. Schools, police services, residential and commercial development, and health care should all be able to expand to service the new population associated with development.

---

[1] S. E. Rantz, A Summary View of Water Supply and Demand in the San Francisco Bay Region, 1972.

Land Use

In the San Francisco Bay region it should be extremely difficult to find suitable land for base case growth and, to a lesser extent, for OCS-induced growth. The major reason for this difficulty is that only limited acreage is actually available and suitable for major primary development.[1] Unless significant rezoning is done, it appears as if the amount of base case and OCS-induced development will have to be reduced in the San Francisco Bay region.

It is important to realize that base case growth rather than OCS-induced growth is expected to require significant acres of developable land. In Solano and Contra Costa Counties, base case development is expected to reduce the percentage of undeveloped land from 88.9 percent to about 80.4 percent by the year 2000 (Exhibit 9-14). The land requirements induced by offshore high production should reduce these percentages by only two-tenths of one percentage point. OCS high requirements correspond to an incremental need of only 7,800 acres above base case development.

Although the San Francisco Bay region as a whole is somewhat less developed percentage-wise than Solano and Contra Costa Counties, the land use impact would be similar (Exhibit 9-15). Undeveloped land should drop from about 89.7 percent to 85 percent by the year 2000. As in the Northeast Florida and Southeast Georgia region, all of the direct development and much of the indirect and induced development is expected to take place in the locality. Thus, the aggregate impact on the region from offshore oil and gas production should be insignificant.

As indicated in Exhibit 9-16, environmental and locational constraints eliminate 89 percent of the actual undeveloped land, thus leaving only 11 percent for primary industrial and other purposes. These figures indicate the extreme scarcity of land in the San Francisco Bay region.

---

[1] Primary development includes specialized and heavy industrial uses (e.g., refineries, petrochemical complexes). Land suited for primary development is also suited for general development which includes residential, commercial, industrial, and agricultural uses.

EXHIBIT 9-14

LAND USE SUMMARY

LOCALITY : SOLANO/CONTRA COSTA COUNTIES

Summary in Thousands of acres		1970	Year 1985				Year 2000			
		Actual Development	Base Case 1 Development	Base Case 2 Development	OCS Low* Development	OCS High* Development	Base Case 1 Development	Base Case 2 Development	OCS Low* Development	OCS High* Development
Land Use Classification	DEVELOPED LAND	111.5	152.9		2.4	5.2	196.1		2.3	7.8
	. residential	53.8	74.4		.7	1.5	93.2		.6	1.6
	. commercial industrial	34.0	43.5		1.1	2.6	53.2		1.1	4.8
	. other	23.7	35.0		.6	1.1	49.7		.6	1.4
	UNDEVELOPED LAND	890.5	849.1		846.7	843.9	805.9		803.6	798.1
	TOTAL ACREAGE	1,002.0								

* incremental acreage only. If two figures, number in parentheses refers to base case.

Summary in Percent		1970	Year 1985**				Year 2000**			
		Actual Development	Base Case 1 Development	Base Case 2 Development	OCS Low Above B.C.1	OCS High Above B.C.1	Base Case 1 Development	Base Case 2 Development	OCS Low Above B.C.1	OCS High Above B.C.1
Land Use Classification	DEVELOPED LAND	11.1	15.3		15.5	15.8	19.6		19.8	20.3
	. residential	5.4	7.4		7.5	7.6	9.3		9.4	9.5
	. commercial industrial	3.4	4.3		4.5	4.6	5.3		5.4	5.8
	. other	2.4	3.5		3.6	3.6	5.0		5.0	5.1
	UNDEVELOPED LAND	88.9	84.7		84.5	84.2	80.4		80.2	79.7

** Impacts of OCS developments indicated only above Base Case 1.

Source: RPA estimates.

EXHIBIT 9-15

LAND USE SUMMARY

REGION : SAN FRANCISCO BAY

Summary in Thousands of acres		1970	Year 1985				Year 2000			
		Actual Development	Base Case 1 Development	Base Case 2 Development	OCS Low* Development	OCS High* Development	Base Case 1 Development	Base Case 2 Development	OCS Low* Development	OCS High* Development
Land Use Classification	DEVELOPED LAND	468.1	587.4		3.2	7.3	698.6		3.2	10.9
	. residential	240.2	301.2		1.1	2.4	350.0		.8	2.6
	. commercial industrial	115.8	139.1		1.2	3.0	162.4		1.3	5.7
	. other	112.1	147.1		.9	1.9	186.2		1.1	2.6
	UNDEVELOPED LAND	4,077.1	3,957.8		3,954.6	3,950.5	3,846.6		3,843.4	3,835.7
	TOTAL ACREAGE	4,545.2								

* incremental acreage only. If two figures, number in parentheses refers to base case.

Summary in Percent		1970	Year 1985**				Year 2000**			
		Actual Development	Base Case 1 Development	Base Case 2 Development	OCS Low Above B.C.1	OCS High Above B.C.1	Base Case 1 Development	Base Case 2 Development	OCS Low Above B.C.1	OCS High Above B.C.1
Land Use Classification	DEVELOPED LAND	10.3	12.9		13.0	13.1	15.4		15.4	15.6
	. residential	5.2	6.6		6.7	6.7	7.7		7.7	7.8
	. commercial industrial	2.5	3.0		3.1	3.1	3.6		3.6	3.7
	. other	2.5	3.2		3.3	3.3	4.1		4.1	4.2
	UNDEVELOPED LAND	89.7	87.1		87.0	86.9	84.6		84.6	84.4

** Impacts of OCS developments indicated only above Base Case 1.

Source: RPA estimates.

EXHIBIT 9-16

UNDEVELOPED LAND CAPABILITIES

Region: SAN FRANCISCO BAY

	Thousands of Acres		Percent
. TOTAL UNDEVELOPED LAND[a]		4,077.1	100
. UNAVAILABLE LAND DUE TO ENVIRONMENTAL CONSTRAINTS			
. existing and projected uses			
. coastal zoning and improvements			
. excessive slope (> 15%)		3,434.3	84.2
. wetlands			
. water resources	YES - ~~NO~~[h]		
. UNSUITABLE LAND DUE TO LOCATIONAL CONSTRAINTS[b]		184.3	4.5
. excessive slope (> 5%)	184.3		
. distance (> 30 minutes)	0		
. water requirements	~~YES~~ - NO[i]		
. TOTAL REMAINING DEVELOPABLE LAND[c]		458.5	11.2
. TOTAL LAND USE REQUIREMENTS[d]		241.4	
. total direct land use[e]	4.3		
. total induced land use[f]	237.1		
residential	112.4		
commercial/industrial[g]	48.0		
other developed land	76.7		

[a]Refer to land use summary exhibits for each region. Total undeveloped land figure corresponds to 1970 data.
[b]Where overlap with land unavailable due to environmental constraints, only incremental value is considered.
[c]Land suited for primary industrial activities, e.g., refineries, petrochemical complexes, etc., but competing with other uses, e.g., residential, commercial, light industrial, agricultural, etc. ("general development").
[d]Total Land Use Requirements corresponds to worst possible case by year 2000 (in general, base case 2 combined with high level OCS development).
[e]Refer to Exhibit VIII-5, Total Direct Land Use. Corresponds to maximum primary development.
[f]Refer to land use summary exhibits for each region. Corresponds to worst possible case by year 2000.
[g]Excluding primary industrial land.
[h]"No" indicates that water resource impoundment areas have not been included in the above acreages.
[i]"No" indicates that water supply from conventional sources is likely to be inadequate.

Source: RPA estimates.

Plates 16, 17, and 18 present the spatial distributions of land suitable for general and primary development. Land shown on Plate 17 as suitable, is that termed "available for controlled development" in the ABAG Regional Plan.[1] This land, while physically suited to primary development, is actually zoned residential, and may well soon revert to permanent open space. Thus Plate 17 represents a search for possible locations for base case and OCS-related activity, in the absence of any other reasonable alternative. The difference between land shown as suitable on Plates 17 and 18 is that 5 percent subtracted due to the slope constraint.

Much of the land which Plate 18 shows to be suitable for primary development may not actually be available, for the following reasons. First, the southern half of the San Francisco Bay can be eliminated for any major industrial development since microclimatic considerations (two frequently stagnating air basins) tend to concentrate pollution in this area. It is expected that the San Francisco Bay Planning Authority will impose very stringent requirements for future land development in this area.

Second, only the few small areas shown as suitable (those touching the San Francisco Bay and the San Pedro Bay) are zoned for industrial - and most of this area, since

---

[1] Land shown on Plate 17 as unsuitable is in accordance with the legally binding Regional Plan 1970-1990 promulgated by the Association of Bay Area Governments (ABAG) on June 30, 1970.

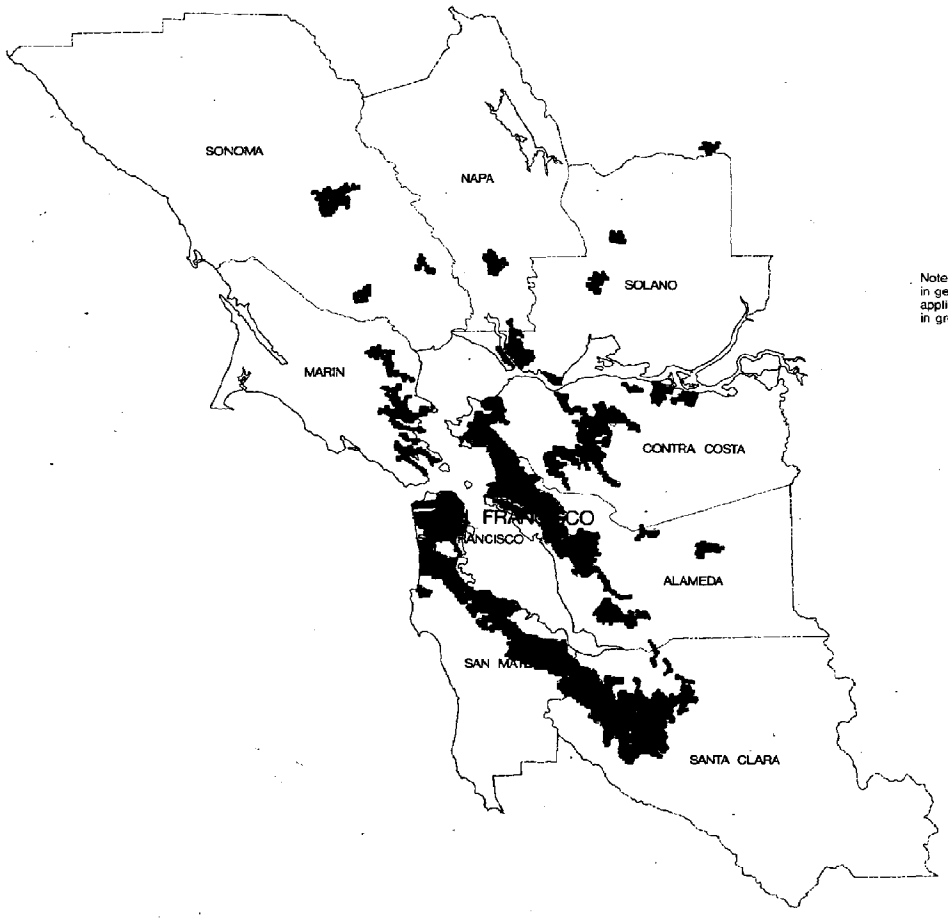
Statements in the text on the current status of the plan reflect opinions expressed in detailed discussions with ABAG officials.

Finally, it should be emphasized that the areas eliminated from development by the ABAG (shown on Plate 17) are neither arbitrary nor do they reflect a particular environmental bias. The majority of land within the study region is mountainous and/or hilly, and completely unsuited to any form of industrial, commercial or high-density residential development.

POTENTIAL EFFECTS OF O.C.S. OIL AND GAS DEVELOPMENT

SAN FRANCISCO BAY

PLATE 16



Note: Information presented is in generalized form. Local application will require mapping in greater detail.

UNDEVELOPED LAND

PRESENT CONDITIONS

■ – DEVELOPED LAND
EXISTING LAND USES

□ – UNDEVELOPED LAND

RESOURCE PLANNING ASSOCIATES INC.

BASE MAP U.S.G.S. 1:250,000 DECEMBER 1973

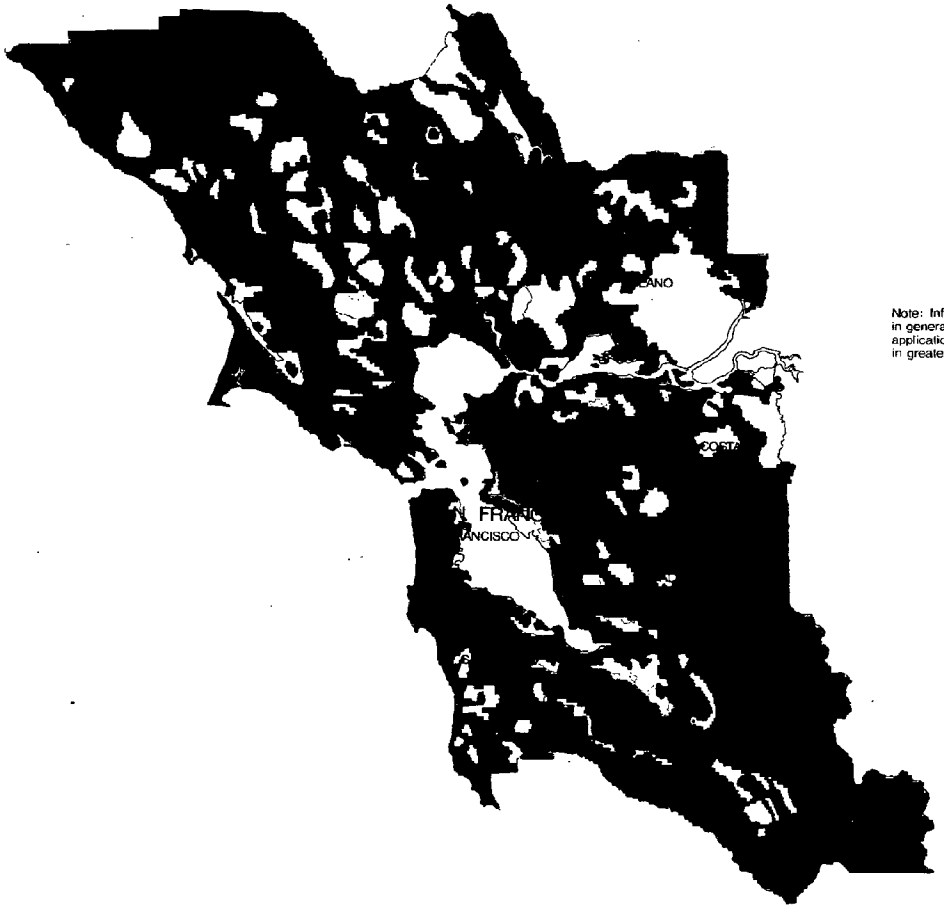
5 0 5 10 15 20 30 miles

N

POTENTIAL EFFECTS OF O.C.S. OIL AND GAS DEVELOPMENT

SAN FRANCISCO BAY

PLATE 17



Note: Information presented is in generalized form. Local application will require mapping in greater detail.

LAND USE IMPACT

LAND REQUIREMENTS TO SCALE
BASE CASE 2 HIGH IMPACT YEAR 2000

BASE CASE II (NO O.C.S.)		OCS HIGH IMPACT		
PRIMARY	OTHER	PRIMARY	INDUCED	TOTAL
510	230,000	1565 / 1565	7100	241,390 ACRES
		OTHER 320		
		3780		

SUITABLE LAND

FOR GENERAL DEVELOPMENT

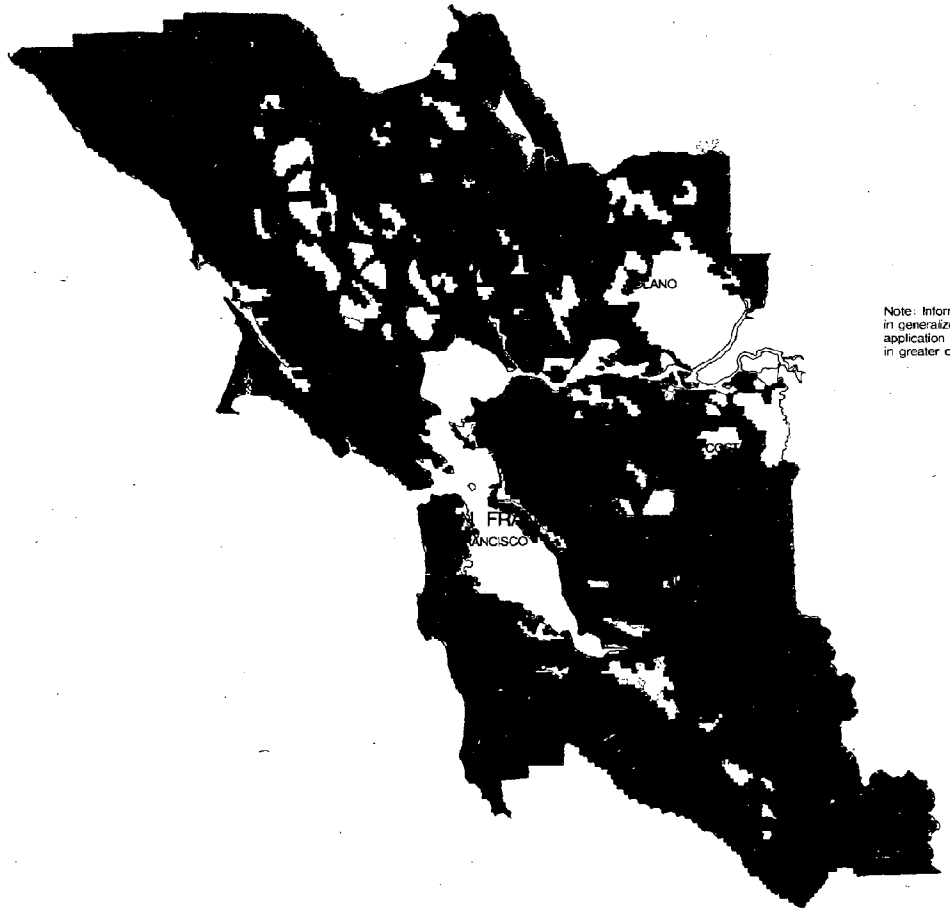
- UNSUITABLE LAND
  EXISTING AND PROJECTED LAND USES
  ENVIRONMENTAL CONSTRAINTS
- SUITABLE LAND
  SUBJECT TO AVAILABILITY AND LOCAL ZONING

RESOURCE PLANNING ASSOCIATES INC.

BASE MAP U.S.G.S. 1:250,000 DECEMBER 1973

miles

N



Note: Information presented is in generalized form. Local application will require mapping in greater detail.

POTENTIAL EFFECTS OF O.C.S. OIL AND GAS DEVELOPMENT

SAN FRANCISCO BAY

PLATE 18

LAND USE IMPACT

LAND REQUIREMENTS TO SCALE
BASE CASE 2 HIGH IMPACT YEAR 2000

BASE CASE II (NO O.C.S.)		O.C.S. HIGH IMPACT		
PRIMARY	OTHER	PRIMARY	INDUCED	TOTAL
510	230,000	1565	7100	241,390 ACRES
		1565		
		OTHER 320		
		3780		

SUITABLE LAND

FOR PRIMARY DEVELOPMENT

- UNSUITABLE LAND
  - EXISTING AND PROJECTED LAND USES
  - ENVIRONMENTAL CONSTRAINTS
  - LOCATIONAL CONSTRAINTS
- SUITABLE LAND
  - SUBJECT TO AVAILABILITY AND LOCAL ZONING

RESOURCE PLANNING ASSOCIATES INC.

BASE MAP U.S.G.S. 1:250,000 DECEMBER 1973

5 0 5 10 15 20 30 miles

N

promulgation of the plan, is already used up or available only in small tracts.[1]

Third, the Contra Costa and Solano locality which borders the San Joaquin-Sacramento estuary is vital to the ecological equilibrium of the entire bay. Thus, it seems probable that conservation groups would protest any major industrial development.

To summarize, lands zoned for industrial use, touching the two bays, are no longer available due to microclimatic conditions, prior use, or inadequate trace size, and lands in Solano County and Contra Costa are unavailable due to both adverse zoning and extremely sensitive ecological conditions. Reversal of this zoning may be extremely difficult. As a result, it should be extremely difficult to locate base case, and to a lesser extent, OCS-induced development in the Bay region.

Air Pollution

Air quality priority classifications were not available for Solano/Contra Costa Counties separately since they are included in the San Francisco Bay AQCR. However, ambient air concentrations in both counties are within the California primary standards with the exception of sulphur oxides at Richmond, in Contra Costa County (Exhibit 9-17).

The San Francisco AQCR is assigned air priority classifications of II for both particulates and sulphur oxides and I for nitrogen oxides, hydrocarbons, and carbon monoxide. Sources of particulate emissions are almost evenly divided between fossil fuel combustion, industrial process losses, solid waste disposal and transportation. Sources of sulphur oxides are principally fossil fuel combustion and industrial process loss from chemical manufacturing. Transportation is by far the major contributor of nitrogen oxides, hydrocarbons, and carbon

---

[1] The remainder of the area shown as suitable is actually zoned for residential, and if not used as such, will revert to permanent open land status. The proximity of the Suisun marshland west of Solano will undoubtedly support the zoning change of suitable land in Solano County to permanent open space.

EXHIBIT 9-17

AMBIENT AIR CONCENTRATION LEVELS

SAN FRANCISCO BAY

	Particulates (mg/m^3) Geometric Mean	SO_x (ppm) Max 24-hr Aver.	NO_x (ppm) Max Hourly Aver.	CO (ppm) Max. 12-hr Aver.
PRIMARY STANDARDS	60	.04	.25	40
CALIFORNIA				
San Francisco				
San Francisco	47	.033	.27*	11
Marin				
San Rafael	46	.012	.12	8
Contra Costa				
Richmond	44	.043*	.19	13
Pittsburg	41	.031	.15	6
Walnut Creek	-	-	-	-
Alameda				
Oakland	-	-	.25	11
San Leandro	-	-	-	-
Fremont	58	.007	-	9
Livermore	70*	.006	.19	8
Santa Clara				
San Jose	77*	.006	.24	14
San Mateo				
Redwood City	32	.012	.20	7
Burlingame	59	.015	-	10
Sonoma				
Petaluma	-	-	-	-
Napa				
Napa	-	-	-	9
Solano				
Vallejo	-	-	-	13
Fairfield	-	-	-	-

* Exceeds the primary standard

Source: Environmental Protection Agency

monoxide.

The air pollution loading impacts for particulates, sulphur oxides and nitrogen oxides of high OCS production should be significant in the Solano/Contra Costa locality, where the impacts are expected to range from 25 to 40 percent of the base case loading levels in the year 2000 (Exhibit 9-18). The high level of base case pollutants in 2000 accentuates these impacts. The bulk of these loadings can be attributed to the increased fossil fuel combustion in the two county area. Hydrocarbons and carbon monoxide loadings should be small in 1985 compared with the base case loadings, but increase to as much as 20 percent of the total loadings by the year 2000 with 90 percent of the impact loadings from the primary industries.

The air pollution loadings impact for the San Francisco Bay region will be somewhat different than for the two county Solano/Contra Costa locality (Exhibit 9-19). Particulates and sulphur oxides are large contributors to the pollution levels, with impact loadings responsible for as much as 10 percent of sulphur oxide emissions in the year 2000. The bulk of these emissions are expected to come from fossil fuel burning by induced industry. Hydrocarbons and carbon monoxide should decrease substantially in the Bay region, even under the high impact cases in the year 2000.

The precise effect of these varying pollutant loadings on ambient concentrations in the San Francisco Bay region is exceedingly difficult to predict due to the mountainous terrain and changing weather conditions. It would be necessary to conduct a dispersion analysis of the point source emitters in the area to analyze the changes in ambient concentrations resulting from the projected loadings.

Water Pollution

BOD water pollution in the Solano/Contra Costa Counties locality in 1970 was due principally to paper and allied products, which accounted for up to 70 percent of the estimated total loadings with municipal discharges accounting for another 20 percent (Exhibit 9-20). OCS impacts are expected to be negligible under both high and low conditions, with high Alaska oil production accounting for only a 12 percent increase over base case conditions

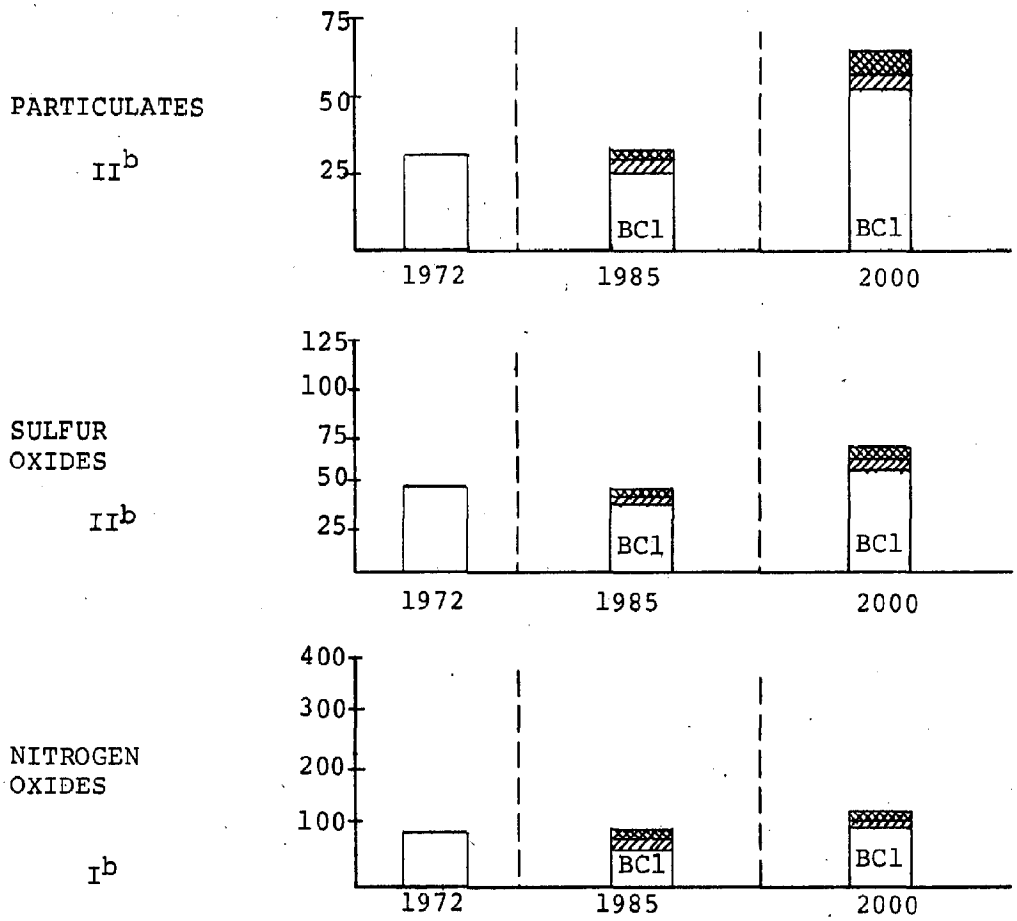
EXHIBIT 9-18

SUMMARY OF IMPACTS - AIR POLLUTION LOADINGS[a]

(Thousand tons per year)

SOLANO/CONTRA COSTA COUNTIES

(Geographic Area)



[a] Refer to Appendix IX for a detailed discussion of the methodology for determination of each loading source and estimation of the control factors for each pollutant by geographic area.

[b] EPA Air Quality Priority Classification.

BC 1: Base Case 1

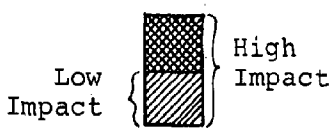


EXHIBIT 9-18

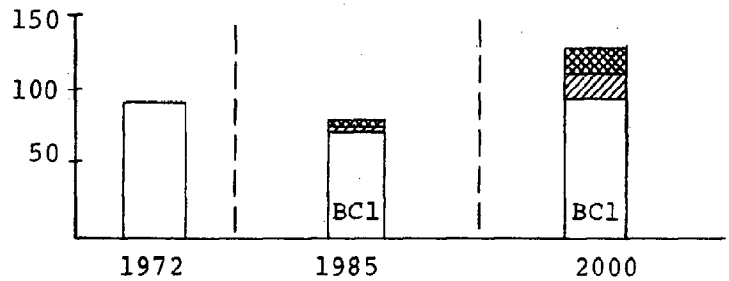
SUMMARY OF IMPACTS - AIR POLLUTION LOADINGS (CONTINUED)[a]

(Thousand tons per year)

SOLANO/CONTRA COSTA COUNTIES
(Geographic Area)

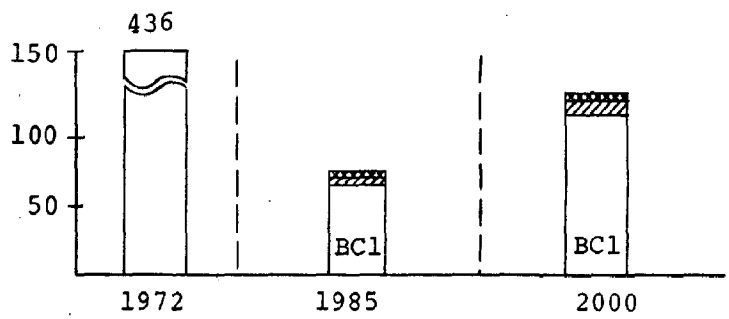
HYDROCARBONS

I[b]



CARBON MONOXIDE

I[b]



[a]Refer to Appendix IX for a detailed discussion of the methodology for determination of each loading source and estimation of the control factors for each pollutant by geographic area.

[b]EPA Air Quality Priority Classification.

BC 1: Base Case 1

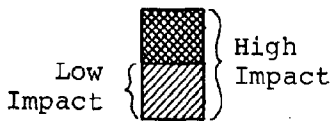


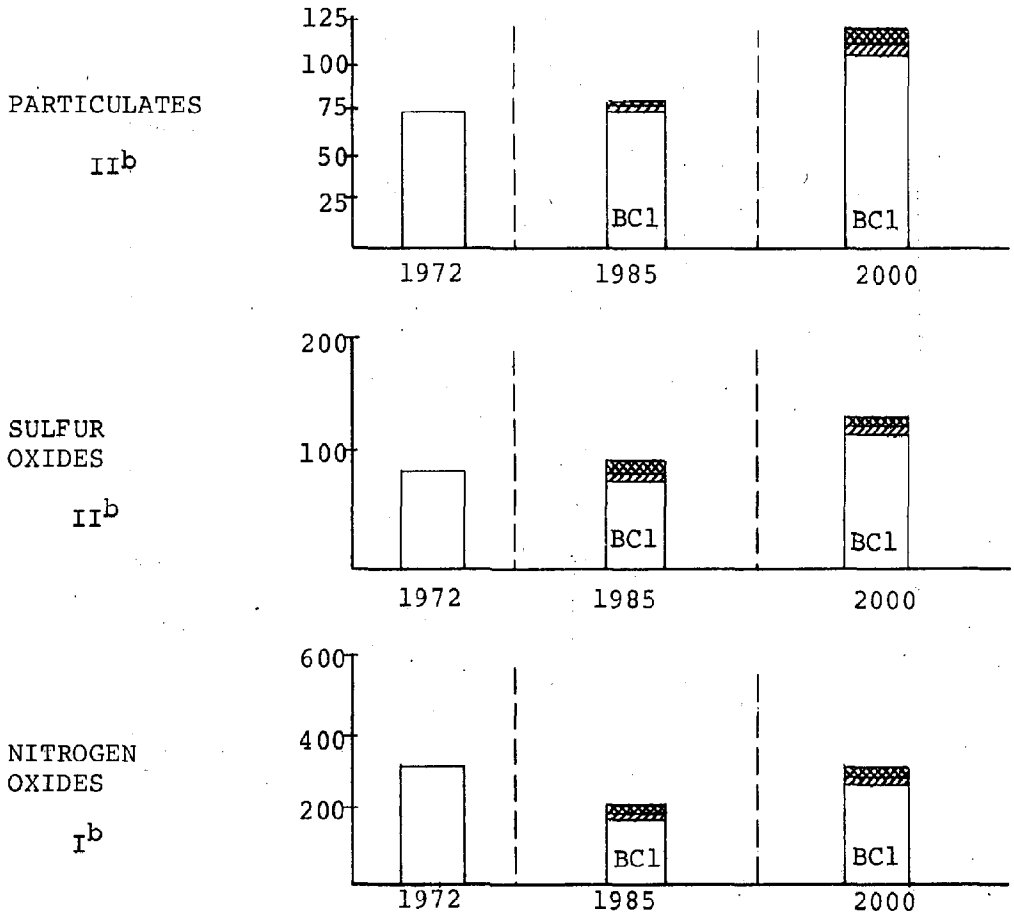
EXHIBIT 9-19

SUMMARY OF IMPACTS - AIR POLLUTION LOADINGS[a]

(Thousand tons per year)

SAN FRANCISCO BAY

(Geographic Area)



[a]Refer to Appendix IX for a detailed discussion of the methodology for determination of each loading source and estimation of the control factors for each pollutant by geographic area.

[b]EPA Air Quality Priority Classification.

BC 1: Base Case 1

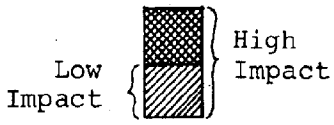


EXHIBIT 9-19

SUMMARY OF IMPACTS - AIR POLLUTION LOADINGS (CONTINUED)[a]

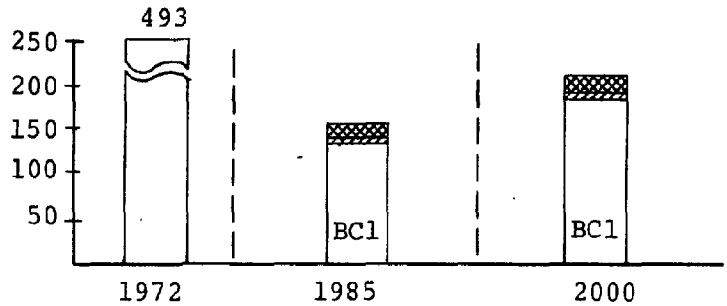
(Thousand tons per year)

SAN FRANCISCO BAY

(Geographic Area)

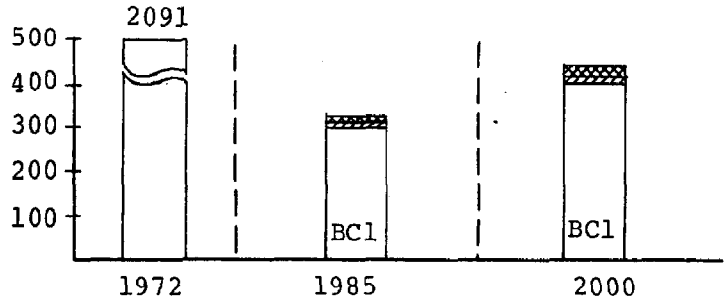
HYDROCARBONS

I[b]



CARBON MONOXIDE

I[b]



[a] Refer to Appendix IX for a detailed discussion of the methodology for determination of each loading source and estimation of the control factors for each pollutant by geographic area.

[b] EPA Air Quality Priority Classification.

BC 1: Base Case 1

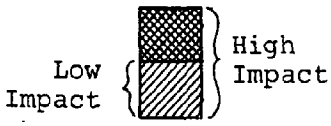


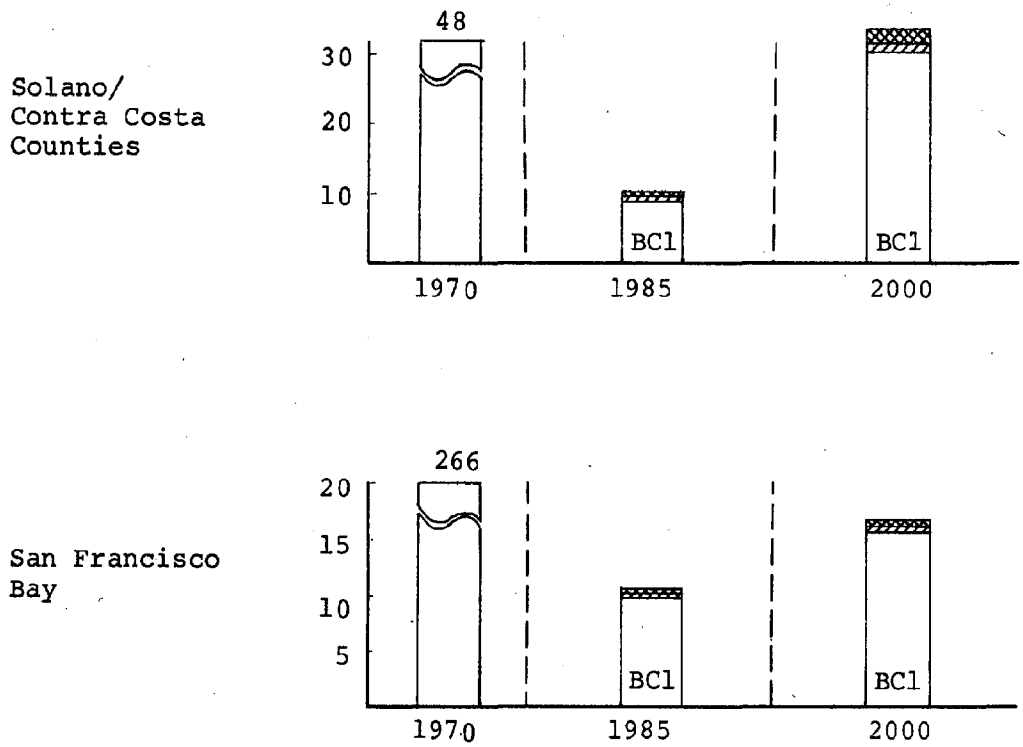
EXHIBIT 9-20

SUMMARY OF IMPACTS - BOD LOADING[a]

(Thousand tons per year)

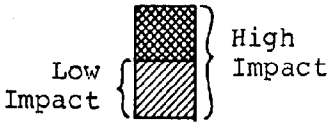
NORTHERN CALIFORNIA

(Geographic Area)



[a]Refer to Appendix IX for a detailed discussion of the methodology for determination of each loading source and estimation of the treatment factors for each region.

BC 1: Base Case 1



in the year 2000. Once again, new control technology is expected to reduce the level of effluents by approximately 60 percent by 2000.

The source of BOD loadings in the San Francisco Bay region is much like that of the Solano/Contra Costa locality, with paper and allied products accounting for approximately 60 percent of the total loadings. Effluents are expected to decrease dramatically by the year 1985 and 2000, with impacts from the high production level only accounting for a 3 percent increase over base case conditions.

SOURCES OF DATA

Socio-Economic

Association of Bay Area Governments. County Employment Projections for San Francisco Bay Region, 1970-2000.

Association of Bay Area Governments. Population, Employment and Land Use Projections, San Francisco Bay Region 1970-2000, by Basin, Sub-Basin, County and Hydrographic Subunit for the Comprehensive Water Quality Management Plan: San Francisco By Basin - Basin 2. February, 1973.

Bay Area Transportation Study Commission. Bay Area Transportation Report. May, 1969.

Benecia Chamber of Commerce. "Community Profile for Benecia." Benecia, California. June, 1971.

California, State of, Division of Mines and Geology. Preliminary Earthquake Epicenter Map of California, 1934-1971, by Wesley G. Bruer. 1972.

California, State of, Office of the Controller. Annual Report of Financial Transactions Concerning Counties of California, Fiscal Year 1970-71.

California, State of, Public Utilities Commission, Utilities Division, Electric Branch. "Report on Ten-Year Forecasts of Electric Utilities' Loads and Resources." October 5, 1973.

California, State of, The Resources Agency, Department of Conservation, Division of Oil and Gas. Energy in California. January, 1973.

California, State of, The Resources Agency, Department of Water Resources Central District. "Monthly Variation in Per Capita Water Use; Secular Trend: Memorandum Report." July, 1969.

California, State of, Water Resources Control Board. "Clean Water for San Francisco Bay: A Report to the California Legislature." April, 1971.

California, University of, Institute of Urban and Regional Development, Center for Real Estate and Urban Economics. Jobs, People and Land: Bay Area Simulation Study (BASS). Berkeley, California. 1968.

Contra Costa County Superintendent of Schools Office. Letter providing enrollment, staffing and facilities data for Contra Costa County Schools 1970-71, plus "Profiles of

SOURCES OF DATA (continued)

Contra Costa County School Districts, 1970-71," from the California School Testing Program, State Department of Education, by request. November 7, 1973.

Corwin, Ruth, ed. "National Parks and Urban America: Results of a Public Forum on the Golden Gate National Recreation Area, San Francisco and Marin Counties, California." Berkeley: University of California, University Extension, Continuing Education in City, Regional and Environmental Planning, May 12-17, 1973.

Pacific Gas and Electric Company. 1971 Annual Report.

Richmond Chamber of Commerce. "Community Economic Profile for Richmond." March, 1971.

Richmond City Planning Department. Richmond General Plan: A Guide to Community Development. June, 1966.

San Francisco Bay Conservation and Development Commission. Public Facilities and Utilities in and Around San Francisco Bay, by Clifford W. Graves. June, 1967.

San Francisco Bay Conservation and Development Commission. Economic and Population Growth in the San Francisco Bay Area, by Clifford W. Graves. February, 1967.

San Francisco Bay Conservation and Development Commission. "Ports." 1968.

Shell Oil Company. Martinez Refinery.

Solano County Industrial Development Agency. Solano County Directory of Manufacturers and Other Major Employers. 1972-1973.

Southern California Edison Company, Land Use & System Forecasting Section, System Planning. System Forecasts, 1972-1995. February, 1972

Standard Oil Company of California, Western Operations, Inc. Environmental Report: Richmond Low Sulfur Fuel Oil Project.

Standard Research Institute. Meeting California's Energy Requirements, 1975-2000. Menlo Park, California: May 1973.

SOURCES OF DATA (continued)

Standard Oil Company of California, Western Operations, Inc. Draft Environmental Impact Statement: Modernization of Richmond Long Wharf, Contra Costa County. February, 1973.

Standard Oil Company of California, Western Operations, Inc. Draft Environmental Impact Statement: Modernization of Richmond Long Wharf, Contra Costa County. Appendices. February, 1973.

Steinbrugge, Karl V. Earthquake Hazard in the San Francisco Bay Area: A Continuing Problem in Public Policy. Berkeley: University of California, Institute of Governmental Studies, 1968.

U. S. Army Corps of Engineers, North Pacific and South Pacific Divisions. West Coast Deepwater Port Facilities Study, 8 vols. June, 1973.

U. S. Army Corps of Engineers, San Francisco District, San Francisco Bay-Delta Region Industrial Water Quality Study, by E. M. Lofting. November, 1972.

U. S. Department of Commerce, Bureau of the Census. 1970 General Social and Economic Characteristics: California. Washington, D.C.: U.S. Government Printing Office, 1972.

U. S. Department of Commerce, Social and Economic Statistics Administration, Bureau of the Census. County Business Patterns, 1972: California.

U. S. Department of the Interior, Geological Survey, and U.S. Department of Housing and Urban Development. Preliminary Geologic Map of Solano County and Parts of Napa, Contra Costa, Marin and Yolo Counties, California, by J.D. Sims et. al. 1973

U. S. Department of the Interior, Geological Survey. A Review of Wastewater Problems and Wastewater-Management Planning in the San Francisco Bay Region, California, by W. G. Hines, 1973.

U. S. Department of the Interior, Geological Survey, and California State Division of Mines and Geology. Geologic Map of California. 1966.

U. S. Department of the Interior, Geological Survey, and U. S. Department of Housing and Urban Development.

"Active Faults and Preliminary Earthquake Epicenters (1969-1970) in the Southern Part of the San Francisco Bay Region," by R.D. Brown, Jr. and W.H.K. Lee. San Francisco Bay Region Environment and Resources Planning Study. Map, 1971.

U. S. Department of the Interior, Geological Survey and U.S. Department of Housing and Urban Development. "Faults That Are Historically Active or That Show Evidence of Geologically Young Surface Displacement, San Francisco Bay Region," by R.D. Brown, Jr. San Francisco Bay Region Environment and Resources Planning Study. Map, 1970.

U. S. Department of the Interior, Geological Survey, and U. S. Department of Housing and Urban Development. Map Showing Evidence for Recent Fault Activity in the Vicinity of Antioch, Contra Costa County, California, by D. B. Burke and E.J. Helley. 1973.

U. S. Department of the Interior, Geological Survey, and U. S. Department of Housing and Urban Development. Map Showing Recent Tectonic Movement on the Concord Fault, Contra Costa and Solano Counties, California, by Robert V.Sharp. 1973.

U. S. Deparment of the Interior, Geological Survey, and U. S. Department of Housing and Urban Development. "Solid-Waste Disposal in the San Francisco Bay Region, California," by Joseph Goss. San Francisco Bay Region Environment and Resources Planning Study. Basic Data Contribution no. 49. 1972

U. S. Department of the Interior, Geological Survey, and U. S. Department of Housing and Urban Development. A Summary View of Water Supply and Demand in the San Francisco Bay Region, California, by S. E. Rantz. San Francisco Bay Region Environment and Resources Planning Study. Basic Data Contribution No. 47. 1972.

SOURCES OF DATA (continued)

Land Use

Association of Bay Area Governments. Ocean Coastline Study, 1970.

Association of Bay Area Governments. Regional Ocean Coastline Plan for the San Francisco Area, Draft of Final Report, by Sedway/Cooke. Berkeley, California: Association of Bay Area Governments, June, 1973.

California, State of, The Resources Agency, Department of Navigation and Ocean Development. Approaches Towards a Land Use Allocation System for California's Coastal Zone, by Gruen, Gruen & Associates and Sedway/Cooke. October 22, 1971.

California, State of, The Resource Agency, Department of Parks and Recreation. California Coastline Preservation and Recreation Plan. August, 1971.

City of Richmond, California. Richmond General Plan, A Guide to Community Development, March 1966.

Contra Costa County Planning Department. Open Space - Conservation Plan. March, 1973.

Contra Costa County Planning Department. "Transit Inventory." Land Use and Transportation Study. April, 1972.

Hahn, Wise and Associates, Inc.; Zion, William R.; and Little, Arthur D., Inc. Land Use and Circulation Plan for the Eastern Portion of Contra Costa County. San Carlos, California: Hahn, Wise and Associates, Inc., May 1965.

Population, Employment and Land Use Projections - San Francisco Bay Region, 1970-2000 by Basin, Sub-Basin, County, and Hydrographic Subunit, February, 1973.

Regional Plan 1970, 1990, San Francisco Bay Region, July 1970.

Regional Open Space Plan Phase II, San Francisco Bay Region, April 1972.

Solano County. Solano County Facts File, April 1973.

Air & Water Pollution

Bay Area Air Pollution Control District. Air Pollution and the San Francisco Bay Area. September, 1972. (Xerox)

SOURCES OF DATA (continued)

Air & Water (cont')

Bay Area Air Pollution Control District. Comparison of Air Quality Data, 1969-1972. 1972. (Xerox).

Wildlife and Vegetation

Battelle Pacific Northwest Laboratories. Environmental Assessment: West Coast Deepwater Port Study. June, 1973.

The Nature Conservancy, Western Regional Office. Information on Lands owned in San Francisco Bay Area, by request. September,1973.

The State of California
The Resources Agency
Department of Parks and Recreation
Department of Fish & Game

The State of California, The Resources Agency, The Department of Fish and Game. Ecological Studies of the Sacramento-San Joaquin Estuary. June, 1972.

San Francisco Bay Conservation and Development Commission. Preliminary Fish and Wildlife Plan for San Francisco Bay-Estuary, by Glenn Delisle. October, 1966.

U. S. Corps of Engineers. West Coast Deepwater Port Facilities Study. Appendix 3, June 1973.

U. S. Department of Interior, Fish and Wildlife Service. Wetlands Inventory, California. July, 1954.

U. S. Department of Interior, Fish and Wildlife Service. Inventory of Permanent Water of Importance to Waterfowl, California. September, 1955.

APPENDIX I

OCS OIL AND GAS RECOVERY

This appendix describes the assumptions used to develop quantifiable measures of the onshore economic impacts associated with the search for and subsequent exploitation of Outer Continental Shelf (OCS) oil and gas deposits. No description of offshore technology will be presented, except where total cost and manpower estimates are concerned.

The first section of the appendix provides an introduction to the industry, while remaining sections discuss in greater detail the major industry activities.

INTRODUCTION

This section begins with a brief background of the industry. The remaining sections define the activities comprising the offshore oil and gas recovery industry, explain the general methodology used in formulating projections for the industry, and lay out the timetables used in industry development.

Background

Certain limitations of the data should first be made clear. The study team was unable to find a systematic industry description among the published literature of the industry. In addition, existing data in technical publications rarely contained employment information and generally applied only to conditions in the Gulf of Mexico. Further, since cost estimates depend on the size of a particular discovery and the conditions under which production will occur, it is difficult to estimate the economic variables required to analyze onshore impacts.

Despite these limitations, the economic analysis provided in this appendix attempts to be comprehensive. First, it provides a format for understanding what types of economic impacts might occur. Second, while the estimates developed are less precise than those for other primary industries, they do provide a starting point for continued research and discussion. Third, the total level of onshore

economic impacts, including refining, petrochemical and construction operations, are relatively insensitive to changes in exploration and development, since these constitute but a small fraction of the total.

Finally, it is important to remember that onshore effects associated with offshore oil and gas recovery would be concentrated in the vicinity of the port facilities used to service the offshore equipment. At the present time, each of the regions examined in the study has a port facility within its boundaries. However, there is no reason to assume that anyone of those port facilities servicing offshore activities exist near concentrated refinery and petrochemical activity. Nevertheless, this study makes the assumption that all activities would exist in the same region in order to examine maximum impact conditions.

Industry Definition

The activities relating to the location and production of oil and gas deposits are generally not viewed as an industry. Thus, it is necessary to define those to be included and analyzed. Essentially there are five activities:

- Exploration: This involves activity associated with an attempt to locate oil and gas deposits. In the main, exploration relates to the drilling of wells on the OCS from a movable platform such as a semi-submersible rig.

- Platform Development: Once an oil and/or gas field has been located and examined for exploitation, a non-moveable platform is set in place on the ocean bottom. From this platform, production wells are drilled. All platform and onshore activities relating to the installation and development of these production wells are included in this sub-sector.

- Oil & Gas Production: Following the installation and development of production wells, the crew must monitor and maintain the platform and its related equipment. Establishing the platform might require three years to complete; however, for actual oil and gas production the platform may have a life span of from 20 to 30 years. During this time a smaller crew than that for development is required.

- Platform Fabrication: This means the actual construction of a production platform and the subsequent towing of this platform to its ocean site and fixing it in place.

- Transportation: This involves moving the oil and gas from the platform to the shore. For large fields the installation of one or more pipelines is required.

Methodology

As discussed above, the oil and gas recovery industry was defined in terms of five essentially independent sub-sectors. Each of these sub-sectors was then analyzed in the context of developing first the Atlantic coast and then the Gulf of Alaska. The assumption implicit in this approach was that the onshore procedures would be repeated in the New England, Mid- and South Atlantic regions if lease sales were to occur in all these areas at the same time.

After this analysis of the five sub-sectors, data from the exploration, platform development and production operations were aggregated as a direct activity in the economic model. Data from the two construction activities, platform fabrication and transportation, were not included as part of the oil and gas recovery impact for reasons discussed later.

Following the initial development of assumptions and data, interviews and discussions were held with American Petroleum Institute representatives and experts from several major oil producing, platform construction and petroleum service firms. In addition, the MAFLA study[1] containing generalized data relating to activities on the Louisiana Gulf Coast provided a basic approach to the analysis.

---

[1] "Environmental Statement MAFLA (Mississippi, Alabama, Florida, Louisiana) Oil Transportation and Processing" (1973) which was submitted to the Bureau of Land Management (BLM) as supplemental data for the BLM's MAFLA Environmental Impact Statement.

Timetables for Development

Exhibits I-1 to I-4 present the timetables projected for OCS development. The first two detail the low and high recovery assumptions for the Atlantic Coast and the last two for the Gulf of Alaska.

These timetables were developed to meet the requirements of the oil and gas production estimates in 1985 and 2000 as provided by the Council on Environmental Quality after consultations with the Department of the Interior and representatives from the oil industry. The estimates here represent the range within which the level of recoverable oil and gas in 1985 and 2000 is expected to fall.[1]

A brief glance at the tables shows that the total oil and gas recovery industry would, in fact, reach a peak level in 1985, that it would decline sometime thereafter, and that it would level off in the mid-1990's. The reasons for this will be highlighted in subsequent sections.

EXPLORATION

In the following sections, exploration activities are defined, the assumptions used to develop exploration impacts discussed, and their implications analyzed.

Definition

Exploration activity for the recovery of oil and gas from the OCS centers around the drilling of test wells in locations which geologists have pinpointed as the most probable sources of deposits. For the purposes of this

---

[1]It should be pointed out that some members of the oil industry feel that the production range has been set too high. They agree that the numbers assume an immediate, and hence unrealistic commitment from the country to produce oil and gas from the OCS. To name several of the difficulties, a complete schedule of lease sales would have to be announced in the near future; sufficient acreage would have to be made available; environmental groups opposed to the venture would have to be placated; shortages of essential equipment such as fuel pipes and well casings would have to be overcome.

EXHIBIT I-1

OFFSHORE DEVELOPMENT TIMETABLE

ATLANTIC OCS-HIGH RECOVERY

(Each Drilling Area)

Exploration		Platform Development					
Year	Rigs/ Wells	Install	In place[a]	Oil Wells Drilled	Total Oil Wells Producing	Oil Produced[b] 10^3 b/d	Gas Produced 10^6 ft^3/d
1976							
77	3/12						
78	3/12						
79	6/24						
80	8/32	2	2	16	16	17	
81	10/40	4	6	48	64	67	
82	10/40	8	14	112	176	183	
83	10/40	8	22	160	336	350	
84	10/40	8	30	192	528	550	
85	10/40	8	38	192	720	750	900
86	10/40	6	44	176	896		
87	10/40	6	50	160	1056		
88	10/40	6	56	144	1200		
89	10/40	4	60	128	1328		
90	10/40	4	64	80	1408		
91	10/40	4	68	32	1440	1500	3600
92							
93							
94							
95							
96							
97							
98							
99							
2000			68		1440[a]	1500	3600

[a]After 1985, 8 platforms and 96 wells that produce only gas will be installed, resulting in a total of 1536 wells in the year 2000.

[b] Oil production will, of course, build up to its maximum, level off for a period, and then decline slowly as the deposits are exhausted.

Source: RPA estimates.

EXHIBIT I-2

OFFSHORE DEVELOPMENT TIMETABLE
ATLANTIC OCS-LOW RECOVERY
(Each Drilling Area)

Exploration		Platform Development					
Year	Rigs/ Wells	Install	In place[a]	Oil Wells Drilled	Total Oil Wells Producing	Oil Produced[b] 10^3 b/d	Gas Produced 10^6 ft^3/d
1976							
77	3/12						
78	3/12						
79	5/20						
80	5/20						
81	5/20	1	1	8	8	8	
82	5/20	2	3	24	32	33	
83	5/20	3	6	48	80	83	
84	5/20	4	10	72	152	158	
85	5/20	4	14	88	240	250	300
86	5/20	3	17	88	328		
87	5/20	2	19	72	400		
88	5/20	2	21	48	448		
89	5/20	2	23	24	472		
90		2	25	8	480	500	1800
91							
92							
93							
94							
95							
96							
97							
98							
99							
2000			25		480 [a]	500	1800

[a]After 1985, 5 platforms and 60 wells that produce only gas will be installed, resulting in a total of 540 wells in the year 2000.

[b] Oil production will, of course, build up to its maximum, level off for a period, and then decline slowly as the deposits are exhausted.

Source: RPA estimates.

EXHIBIT I-3

OFFSHORE DEVELOPMENT TIMETABLE
GULF OF ALASKA-HIGH RECOVERY
(Each Drilling Area)

Exploration		Platform Development					
Year	Rigs/ Wells	Install	In place[a]	Oil Wells Drilled	Total Oil Wells Producing	Oil Produced[b] 10^3 b/d	Gas Produced 10^6 ft^3/d
1976							
77	1/4						
78	2/8						
79	3/12						
80	4/16	1	1	8	8	17	
81	6/24	2	3	24	32	67	
82	8/32	4	7	56	88	183	
83	8/32	4	11	80	168	350	
84	8/32	4	15	96	264	550	
85	8/32	4	19	96	360	750	900
86	8/32	4	23	80	440		
87	8/32	4	27	64	504		
88	8/32	4	31	48	552		
89	6/24	4	35	48	600		
90	4/16	4	39	48	648		
91	2/8	4	43	48	696		
92		4	47	48	744		
93		4	51	48	792		
94		4	55	48	840		
95		4	49	48	888		
96		1	60	40	928		
97				24	952		
98				8	960	2000	7200
99							
2000			60		960[a]	2000	7200

[a]After 1985, 20 platforms and 240 wells that produce only gas will be installed, resulting in a total of 1200 wells in the year 2000.

[b] Oil production will, of course, build up to its maximum, level off for a period, and then decline slowly as the deposits are exhausted.

Source: RPA estimates.

EXHIBIT I-4

OFFSHORE DEVELOPMENT TIMETABLE
GULF OF ALASKA-LOW RECOVERY
(Each Drilling Area)

Exploration		Platform Development					
Year	Rigs/ Wells	Install	In place[a]	Oil Wells Drilled	Total Oil Wells Producing	Oil Produced[b] 10^3 b/d	Gas Produced 10^6 ft^3/d
1976							
77	1/4						
78	2/8						
79	3/12						
80	4/16						
81	4/16	1	1	8	8	17	
82	4/16	1	2	16	24	50	
83	4/16	1	3	24	48	100	
84	4/16	2	5	32	80	167	
85	4/16	2	7	40	120	250	300
86	2/8	2	9	48	168		
87		2	11	48	216		
88		2	13	48	264		
89		2	15	48	312		
90		2	17	48	360		
91		2	19	48	408		
92		2	21	40	448		
93		2	23	24	472		
94		2	25	8	480	1000	2400
95							
96							
97							
98							
99							
2000			25		480[a]	1000	2400

[a]After 1985, 5 platforms and 60 wells that produce only gas will be installed, resulting in a total of 540 wells in the year 2000.

[b] Oil production will, of course, build up to its maximum, level off for a period, and then decline slowly as the deposits are exhausted.

Source: RPA estimates.

study, exploration activity is defined specifically to include only those activities related directly to this exploratory drilling. Admittedly, this definition is not a comprehensive one. Before exploration could begin, many people would be working to decide where and at what pace it would occur. In some ways, then, all of these might be considered members of the oil exploration industry.

Despite this fact, these employees would have little economic affect on those onshore areas under examination here. Most would be located at the headquarters of their company and would reside in the locality or region for a short time only.[1]

Even some activities which would occur in the offshore area directly would have only a slight effect on any local area. For example, as many as eight or ten seismic exploration vessels might be active in the offshore area at any one time. These vessels typically carry a crew of 30 persons and could be expected to dock occasionally in one of the local or regional impact areas. It seems reasonable to assume that the crews would take up residence in the particular area. However, even if they should do so, one could argue that their action should not be treated as a direct onshore impact, since it would not relate to any local oil processing or development activity.

The impact to be measured, then, concerns employment, which would be directly related to exploratory drilling or to onshore activities required to support the exploration process. The types of jobs would include the following: rig crew, dockside support, geologists and engineers assigned to the drilling rig, helicopter pilots, supply boat personnel, dock workers, and specialized labor (for example, contract welders).

Assumptions

The following are assumptions which have been made for exploration activity:

---

[1]If production were to occur on the Atlantic OCS, one or more oil companies might establish regional offices somewhere on the east coast, but not necessarily in immediate proximity to the refining-petrochemical centers.

- Initial lease sales and a future schedule of lease sales would be established in 1976. From a practical viewpoint, this would be the earliest date that lease sales for either the Atlantic OCS or the Gulf of Alaska would probably occur.[1]

- Actual explorations would begin in 1977 in each area. For the first two years, three rigs would be available for wildcat drilling in the Atlantic and one in the Gulf of Alaska. Between 1979 and 1981, the number of rigs active in each area would increase as a function of the success ratio in the first two to three years. By 1985, eight to ten rigs would be active under a high success ratio or four to five under low success conditions.

- One exploratory, semi-submersible drilling rig could, on the average, drill four wells per year. Admittedly, the number of wells per rig could vary as a function of water depth, storm conditions, well depth, or distance between wells. The number chosen is intended to represent an average, but it is not essential to the analysis, since employment estimates are a function of the number of rigs.

- Total expenditures per exploratory well would average $2.5 million, or $30,000 per day, for Atlantic OCS exploration, and $5 million, or $60,000 per day, for Alaskan Gulf activities. The difference is due to the greater cost of semi-submersible rigs for use in Arctic waters.

- On the average, each exploratory rig in service in the Atlantic would require 175 workers.[2] Approximately 50 to 70 of these would be stationed on the rig at any one time and would work a 7-day-on/7-day-off rotation. The remaining workers would function in onshore transportation support operations. In the Gulf of Alaska, only 150 workers would be required since the rotation for rig crews in Alaska would probably be one of 14-days-on/7-days-off.

---

[1]The current energy crisis might lead to a speed-up in the normal operating procedures of the Federal Government.

[2]Employment and wage figures represent technological conditions in 1970.

- The average salary of the workers on this operation would be $13,000 in the Atlantic and $20,000 for the Gulf of Alaska. The advanced level of skills required, the work schedule and the rigorous conditions aboard a drilling rig account for these high wages.

- Average salaries, as expressed in constant 1970 dollars, would increase at 1 percent per year, as illustrated below:

	Atlantic Coast	Gulf of Alaska
1970	$13,000	$20,000
1985	$15,000	$24,000

- Since all figures are being expressed in constant 1970 dollars, the total expenditures per well would remain unchanged between 1970 and 2000. If the total wage bill were also to remain unchanged, while average salaries were to increase, the average employment per drilling rig would decline as follows:

Year	Average Employment/Rig	
	Atlantic	Alaska
1970	175	150
1985	155	125

- Approximately 20 percent of the total expenditures for exploratory drilling would be for goods and services produced within the region. The onshore activities associated with all phases of oil and gas recovery would occur at or near a port facility and new supplier activity would cluster in the same area.

The products expected to be supplied from localities would be those that do not require technical sophistication to produce, for example, cement, fuel and simple metal products. The expensive and complex equipment required for drilling (for example, drill bits and monitoring equipment) would probably be shipped into these regions from locations where production currently exists, that is, from the Gulf area.

Impact Implications

As was indicated by Exhibits I-1 through I-4, the exploration activity on the Atlantic OCS and the Gulf of Alaska would be concluded sometime in the 1990's. Therefore, onshore impacts associated with this phase of OCS oil and gas recovery will be measured only for 1985. These impacts are summarized in Exhibit I-5.

EXHIBIT I-5

EXPLORATION ECONOMIC SUMMARY: 1985

	ATLANTIC OCS (Each Region)		GULF OF ALASKA	
	High Success	Low Success	High Success	Low Success
1. Total expenditures ($ million 1970 constant)	100	50	160	80
2. Employment	1550	775	1000	500
3. Total associated earnings ($ million 1970 constant)	23	12	24	12

SOURCE: RPA Estimates.

PLATFORM DEVELOPMENT

Similarly, in the following section, platform development activities are defined, key assumptions are discussed, and the implications of platform development impacts are analyzed.

Definition

Once economically recoverable oil and gas deposits have been identified, the deposits must be exploited by setting a production platform in place and drilling production wells. Within the context of this study, the platform development activity includes only those tasks directly associated with the drilling of production wells.

In many respects platform development shares some similarities with exploration. Both employ workers with essentially the same skills and both require the same type of equipment. The one major difference lies in the stationary character of the platform from which production wells are drilled. This is not true for exploration, where the platform is only temporary. Thus, long-range weather conditions become less important than for a stationary platform. In addition, the time required to deactivate, move, and reactivate the exploration rig is saved.

Assumptions

The key assumptions for platform development are as follows:

- Each oil production platform would support 24 wells. In the Atlantic OCS, each platform is assumed to produce 25,000 barrels of oil per day. Platforms in the Gulf of Alaska are assumed to produce 50,000 barrels per day. It is not uncommon for one or two wells on a platform to be out of operation at any one time. Also, the oil and gas production from a platform will vary over its life, being higher at the beginning and declining with time. In this analysis, however, the simplifying assumption of constant production over time (at least through 1985) has been made. The estimate for the Gulf of Alaska production rate is higher because development and operating costs per well are substantially greater there than on the Atlantic OCS. Thus, it is more economically feasible to locate platforms only where large production volumes are expected. Both production assumptions are high in comparison with existing Gulf of Mexico platforms but low in comparison with expected production from North Sea platforms. It should be noted that it is extremely difficult to predict production outputs prior to

exploratory drilling. For example, industry experts differ widely on well production estimates. Some have suggested that the analysis should have used numbers as low as 12,000 barrels per day, while others have suggested estimates as high as 75,000 barrels per day for Atlantic OCS platforms.

- The initial platforms would be installed and the first wells drilled in 1980 under maximum success, or in 1981 under minimum success. In the Gulf of Alaska, two to four platforms would be set in place each year and production drilling would be begun. In each Atlantic coast OCS area, four to eight platforms per year would be set in place between 1982 and 1985.

- Well development, including production equipment, is estimated to cost $1 million for each Atlantic coast OCS well and $1.3 million for each production well drilled in the Gulf of Alaska.

- Three years would be required to complete the drilling of 24 production wells on each platform. This implies that eight wells[1] can be drilled from a platform in a single year. This is a significant increase over the four exploratory wells that can be drilled by a mobile drilling rig.

- As in exploration, each production platform being developed would require the employment of 175 persons in the Atlantic OCS and 150 in the Gulf of Alaska. (Again, 1970 technology is used as a base.) Approximately 50 to 70 of them would be stationed on the rig at any one time. They would be working a 7-day-on/7-day-off rotation in the Atlantic and a 14-day-on/7-day-off rotation in Alaska. The balance of the employees would engage in onshore and transportation support operations.

- The average salary of the platform development workers would be $13,000 in 1970 on the Atlantic coast

---

[1]Again, some oil industry sources believe that eight wells is too high an estimate, and consider six wells per year more realistic, given the harsh weather conditions of the Atlantic and Gulf of Alaska. Still, one can point out that technological progress might reduce drilling time in the future.

and $20,000 in the Gulf of Alaska.

- Average salaries, as expressed in constant 1970 dollars, are estimated to increase at 1 percent per year, implying the following average future wages:

	ATLANTIC COAST	GULF OF ALASKA
1970	$13,000	$20,000
1985	$15,000	$24,000

- The average employment required to develop a production platform is estimated to decline as follows:

	AVERAGE EMPLOYMENT PER PLATFORM ATLANTIC	ALASKA
1970	175	150
1985	155	125

- The percentage of locally purchased goods and services would correspond to the exploration case -- 20 percent of total expenditures within the region and 5 percent within the local area.

- The gas-oil ratio associated with oil producing platforms would be 1200. As with most assumptions about actual offshore conditions, this one is, admittedly, arbitrary. It simply is intended to represent a reasonable guess as to what might exist.

- In those cases where platforms must be installed for gas production only, each platform would produce 240 million cubic feet per day. For example, 12 wells would each produce 20 million cubic feet per day.

Impact Implications

From Exhibits I-1 to I-4, it is evident that platform development activity is concentrated in the decade between 1980 and 1990. There is one primary reason for this, and that is that the achievement of a production level of

750,000 barrels of oil per day by 1985 requires that 720 wells of 1,000 barrels per day, or 360 wells of 2,000 barrels per day be in operation by that year.

Similarly, because approximately three years are required to drill the 24 wells that a platform can support, the schedule shows that 38 platforms of 25,000 barrels per day, or 19 platforms of 50,000 barrels per day will have been set in place by 1985. This means that 1984 and 1985 are peak years for production well drilling, with 200,000 barrels per day achieved in each year.

The employment and expenditure impacts for the year 1985 are shown in Exhibit I-6.

EXHIBIT I-6

PLATFORM DEVELOPMENT ECONOMIC SUMMARY: 1985

	ATLANTIC OCS (Each Region)		GULF OF ALASKA	
	High Success	Low Success	High Success	Low Success
1. Total expenditures ($ million 1970 constant)	192	88	125	52
2. Employment	3720	1705	1500	625
3. Total Associated Earnings ($ million 1970 constant)	56	26	36	15

SOURCE: RPA Estimates.

OIL AND GAS PRODUCTION

In this section, oil and gas production activities are defined, key assumptions are discussed, and the implications of production impacts are summarized.

Definition

The third activity involved in the recovery of oil and gas deposits is the operation and support of the production platform once all the wells have been completed. In general, the same type of personnel are required for exploration and development. However, few people are utilized on the platform at any one time.

Perhaps the most important position on the production platform belongs to the monitor who controls the equipment which continually records the characteristics of each well. In addition, electricians and mechanics must service the specialized equipment; general maintenance staff must perform tasks such as painting, and special crews must periodically rebore the wells. In the production activity, ground and transportation support services make up a larger percentage of the total work force than in exploration or platform development.

Assumptions

The five major oil and gas production assumptions are as follows:

- On the average, each production platform would require the employment of 90 persons (using 1970 technology).

- Their average salary would be $10,000 in 1970, and is estimated to increase at the rate of 1.4 percent per year to $12,000 in 1985 and $15,000 in 2000. In Alaska, the corresponding figures would be $16,000, $19,000, and $23,000.

- Given a constant earnings-to-expenditures ratio, the level of employment would decline as follows:

YEAR	AVERAGE EMPLOYMENT PER PLATFORM
1970	90
1985	75
2000	60

- Total expenditures per year per platform would be $2.3 million for the Atlantic OCS and $4 million for the Gulf of Alaska.

- The percentage of regionally purchased goods and services is estimated at 30 percent of total expenditures. Many of these would be produced in the vicinity of the port.

Impact Implications

Of all the operations involved in OCS recovery, oil and gas production is the only activity that would require employment in 1985 and 2000. The impacts of this situation are summarized in Exhibit I-7.

EXHIBIT I-7

OIL AND GAS PRODUCTION ECONOMIC SUMMARY: 1985 & 2000

1985[a]

	ATLANTIC OCS (Each Region)		GULF OF ALASKA	
	High Success	Low Success	High Success	Low Success
1. Total expenditures ($ million 1970 constant)	69	23	60	20
2. Employment	2250	750	1125	375
3. Total Associated Earnings ($ million 1970 constant)	27	9	21	7

[a] The assumption implicit in the 1985 numbers is that a platform's manpower requirements are proportional to its output. For example, a platform with eight producing wells requires 25 service personnel, or one-third of its eventual requirements.

Exhibit I-7 Continued

Oil and Gas Production Economic Summary: 1985 & 2000

	2000			
	ATLANTIC OCS (Each Region)		GULF OF ALASKA	
	High Success	Low Success	High Success	Low Success
1. Total expenditures ($ million 1970 constant)	156	58	240	100
2. Employment	4080	1500	3600	1500
3. Total Associated Earnings ($ million 1970 constant)	61	23	83	35

SOURCE: RPA estimates.

PLATFORM FABRICATION

The primary construction activity of the oil and gas recovery industry is the fabrication of the large production platforms to be fixed in the ocean. Since water depth, storm conditions, the number of wells, rate of output, offshore processing facilities, and other factors vary, each platform is individually designed in order to insure its "fit" into its particular niche in the ocean environment.

The platforms are put together onshore. They are then towed to their intended destinations and set in place by flooding the compartments in their support legs. Like onshore buildings, their cost can vary widely, from $1 million to $100 million.

Four key assumptions were made for platform fabrication:

1. Each platform would be designed to support 24 wells.

2. Platforms without any facilities, intended for east coast OCS installation, would cost $25 million. Platforms for the Gulf of Alaska would cost $30 million.

3. Each $1 million worth of fabrication would require approximately 40 man-years of labor.

4. The average 1970 salary would be $12,500.

Because oil and gas production platforms are built in specialized locations and then towed to their ocean site, there is no reasonable way to predict whether fabrication yards would be located in one or more of the regions analyzed in this study.

Discussions with individuals from two of the three U.S. corporations currently fabricating platforms indicate that rig fabrication would probably not be undertaken on the east coast for the first five to ten years of development. They point out that existing shipyards are not equipped to build platforms and that the increased cost associated with this activity in a shipyard would far outweigh the transportation costs of towing the platform from a yard in one of the Gulf states. Such long distance transportation is, indeed, possible; structures built in Louisiana have been installed off the coasts of Africa and in the Middle East.

Thus, if platform fabrication is to be undertaken on the east coast, it would probably occur in yards that had been designed from scratch for this purpose. For this reason, no assumptions regarding the location of a platform fabricating yard have been made.

Because of the proximity of both the west coast and Japan to the Gulf of Alaska, it is likely that platform construction would occur at existing facilities in either or both locations. However, it is extremely difficult to predict exactly where platforms would be constructed. For analytic purposes, no platforms have been assumed to be constructed in the sample regions or localities.

TRANSPORTATION

The second construction activity associated with offshore oil and gas recovery is transportation facilities and equipment. Two potential means of transportation of oil to shore currently exist: barge and pipeline. In the early stages of offshore development, barges are sometimes used for oil shipment before volumes become large enough to justify pipeline construction. It is not anticipated that barging would be a significant phase in Atlantic OCS or Alaskan Gulf development because of distance and unfavorable weather conditions.

Therefore, a large network of pipelines will assuredly be constructed to connect the offshore oil platforms with onshore refineries or transshipment facilities. This would collect the oil and gas from a few central points for shipment to shore. It is estimated that there would be only one or two pipeline routes leading from each of the Atlantic offshore areas, and perhaps three routes leading from the Alaska OCS.

The actual installation of an offshore pipeline is done from a barge from which the pipe is lowered to the ocean floor. This barge remains at the farthest point of the pipeline and is supplied with materials and relief crews from shore.

Since pipeline construction is a specialized activity and would be completed more quickly than platform development, no significant onshore economic impact is anticipated in 1985. It is assumed that pipeline construction would occur simultaneously with drilling and production operations. It is not expected that pipeline construction crews would take up permanent residence in the particular region since they continually move from job to job.[1]

---

[1]In order to transport the high impact production levels, one industry source estimated that four 36-inch pipelines would be required. A reasonable estimate for laying a 36-inch line in the Atlantic waters would be $500,000 in 1970 dollars. If the distance to be covered was 100 miles, an investment of $200 million 1970 dollars would be required. The same source estimated that this level of pipeline construction might require 750 workers for three or four years.

In Alaska, the oil and gas would first be shipped to shore via pipeline, then trans-shipped by tanker to the west coast of the U.S. Present estimates call for tankers of the 80,000 to 200,000 dwt. range, at a cost of $20 million to $50 million each (in 1970 dollars).

Federal law requires that ships transporting goods between two U.S. ports be built in the United States. Since many shipyards are capable of constructing a tanker of this size, it is impossible to predict which construction site would be selected. To give a current example, a Los Angeles oil company is having several tankers built in Baltimore to carry North Slope oil from Alaska to its refinery near Seattle.

SUMMARY

Exhibit I-8 summarizes the total expenditures, employment, and the earnings forecast for high and low levels of oil and gas output in the years 1985 and 2000.

EXHIBIT I-8

RECOVERY OF OCS OIL AND GAS - SUMMARY

1985

	ATLANTIC OCS (Each Region)		GULF OF ALASKA	
	High Success	Low Success	High Success	Low Success
1. Total Expenditures ($ million 1970 constant)	361	161	345	152
2. Employment	7520	3230	3625	1500
3. Total associated earnings ($ million 1970 constant)	110	47	81	34

EXHIBIT I-8 Continued

Recovery of OCS Oil and Gas - Summary

2000

	ATLANTIC OCS (Each Region)		GULF OF ALASKA	
	High Success	Low Success	High Success	Low Success
1. Total expenditures ($ million 1970 constant)	156	58	240	100
2. Employment	4080	1500	3600	1500
3. Total associated earnings ($ million 1970 constant)	61	23	83	35

SOURCE: RPA Estimates.

Although the expenditure, employment, and earning levels under "high success" are more than twice those under "low success", a more important comparison can be made between the figures in 1985 and 2000 for the Atlantic coast regions. The figures show that if 1985 output levels were reached, the buildup in expenditures and employment would not be sustained. In fact, employment and expenditures for the year 2000 would be only about half of the 1985 levels.

The reason for this sharp decline in expenditures and employment can be explained by the obvious outphasing of exploration and platform development activities. If all three regions were developed simultaneously at the maximum success levels, over 10,000 workers on the east coast would be displaced[1] between 1985 and the early 1990's. However,

[1]That is, they would be unable to work in the same occupation in the same area. Of course, the possibility exists that they might find work in a different occupation within the same locality.

it does not seem reasonable to suggest that all three areas would be developed at the same rate. A more feasible possibility might show buildups in one area coinciding with reductions in another. This would allow for a smooth transfer of specialized workers between regions.

SOURCES OF DATA

American Petroleum Institute

American Petroleum Institute. The Economic Impact of the Louisiana Offshore Oil Industry on the State of Louisiana. Unpublished study prepared for API.

Chevron Oil Co.

Dresser Industries, Inc.

Halliburton

J. Ray McDermott & Co.

Kash, Don E. Energy Under the Oceans. Norman, Oklahoma: University of Oklahoma Press. 1973.

National Ocean Industries Association.

Offshore. Various Issues.

Oil & Gas Journal. Various Issues.

Shell Oil Co.

Shell Oil and Chevron Oil Companies. "Mississippi, Alabama, and Florida, Bureau of Land Management's Environmental Impact Statement." An unpublished supplemental data statement.

Shipbuilder's Council.

World Oil. Various Issues.

APPENDIX II

OIL REFINING INDUSTRY

To assess the potential onshore impact, should oil and gas resources be developed in the Atlantic and Gulf of Alaska Outer Continental Shelves (OCS), five potential industrial development activities were analyzed.[1] This appendix discusses the refinery development assumptions for each region, both for the baseline situation without OCS production and for the different OCS production cases. In three sections, this appendix:

- Discusses in brief the nature of the refining industry and future trends;
- Describes a model refinery which would be representative of future development;
- Projects future base case and OCS refining development for each region of analysis.

INDUSTRY DESCRIPTION

The U.S. petroleum refining industry is a large industry that should continue its trend towards larger economies of scale and should more than double by the year 2000.

In 1970 the petroleum refining industry had shipments of about $23 billion, employed over 100,000 persons, and had a value-added of $4.6 billion. Its imports exceeded exports substantially, resulting in a $2.3 billion foreign trade deficit.[2]

---

[1] The five activities are oil and gas recovery, refining, gas processing, petrochemicals, and construction.

[2] Source: U.S. Department of Commerce, 1970 Census of Manufactures.

During the 1960's, the size of new major grass roots refineries roughly doubled, resulting in substantially increased economies of scale, and it is likely that this trend will continue. Even now, there are several refineries on the Gulf Coast with output exceeding 300,000 barrels per day, and one of them, the Exxon Baytown refinery, is currently being expanded to a capacity of over 600,000 barrels per day. In the future, the size of the market should justify large refineries on the East Coast. On the West Coast it is expected that current refineries would be expanded to capacities of 150,000 to 250,000 barrels per day to handle increased demand.

In the regions of analysis, two general types of refineries could develop to support both the deepwater port base case[1] and the OCS development. The first and technically simpler type is a fuel-oil refinery producing low-sulphur fuels and naphtha for petrochemical feedstocks, power plants, and SNG plants. The second and more complex type is the high-gasoline refinery producing gasoline, distillates, and other light fuels.

The fuel-oil refinery would be expected to locate near a source of water transportation because almost half of its products cannot be transported by pipeline. In contrast, over 80 percent of the high-gasoline refinery products would likely be pipable and these facilities could locate inland as well, near existing pipeline systems. However, it seems reasonable that economic considerations would in many cases dictate attaching fuel-oil refineries to the more complex high-gasoline refineries.

Regarding overall industry growth, despite projected limitations in world petroleum supplies, U.S. refinery growth is expected to more than double by the year 2000. Exhibit II-1 summarizes the demand and supply projections used in this study.[2]

Since the Interior study was published in December 1972, representatives of industry and government have expressed concern that projected limitations in supply will fail to satisfy expected demand. It is possible that

---

[1] Base Case 2 for East Coast.

[2] As given in the Department of Interior report, Energy Through the Year 2000, December 1972.

EXHIBIT II-1

U.S. PETROLEUM DEMAND/SUPPLY PROJECTIONS

(Million Barrels/Day)

	1971	1985	2000
Total U.S. Refinery Products Demand	15.1	25.0	35.5
Supply			
48 State Production	11.3	9.2	6.0
Alaskan North Slope	--	2.0	3.5
Supplemental Supplies[a]	3.8	13.8	26.0

[a] Imports and synthetic liquids (e.g., coal liquefaction, shale oil).

Source: U.S. Department of the Interior, Energy Through the Year 2000, December 1972.

governmental policy could accelerate the development of alternative energy soruces, particularly nuclear power. However, a significant unsatisfied demand for refinery products is likely to remain. Thus, offshore oil production could potentially fill a critical supply gap. Potential production estimates for the OCS areas under study are detailed in Exhibit II-2.

EXHIBIT II-2

OFFSHORE OIL PRODUCTION ESTIMATES

(Million barrels per day)

Area	1985	2000
Atlantic Coast - low (each region[a])	0.25	0.50
Atlantic Coast - high (each region[a])	0.75	1.50
Gulf of Alaska - low	0.25	1.00
Gulf of Alaska - high	0.75	2.00

[a]The three producing areas are the Georges Bank, Baltimore Canyon, and the Georgia Embayment.

Source: RPA and Council on Environmental Quality projections based on USGS estimates.

Because of the uncertainty of the amount of oil and potential production levels, both low and high estimates were analyzed for these areas. To place these estimates in perspective it is helpful to compare them with the production from the Alaskan North Slope, which is expected to approximately 2 million barrels per day by 1985 and 3.5 million barrels per day by 2000.

MODEL REFINERY

To reflect the diversity of refined products that would be produced by future refineries, a complex, integrated refinery with the following overall product mix was chosen.

Inputs	(Percent)	Outputs	(Percent)
Crude	100	Gasoline	40
Liquid gases	3	Intermediates	30
	103	Residuals	15
		Other	18
			103

Source: RPA estimates.

This product mix does not necessarily represent the mix of any one refinery, but rather represents the overall product mix that would exist over the next 15 to 30 years.

New refineries would be established with an initial capacity of 100 to 300 thousand barrels per day and would expand to over 300,000 barrels per day within ten years. It is also expected that the average long-term throughput of future refineries would be 90 percent of rated capacity.

A storage capacity of 5 to 10 days is assumed for a refinery supplied by offshore production and 10 to 15 days for imported (tanker fed) crude.[1] In addition to these requirements, the model refinery would have a sizeable tank farm for its various gasoline, fuel oil, and petrochemical feedstock products.

---

[1] Some of this storage capacity could be at the receiving terminal. Additional storage for oil imports may be needed to provide for interrupted shipments, transit delays, terminal downtime due to bad weather, etc. These storage requirements would be in addition to the 10 to 15 days storage mentioned.

The remainder of this section discusses the economic characteristics, resource requirements, and pollution levels of the model refinery.

Economic Characteristics

Sales Value. The sales value of the refinery output has been estimated at $5 per barrel in constant 1970 dollars, thus yielding annual sales of $330 million for a 200,000 barrel per day refinery.[1]

Employment. 1970 employment of the model refinery has been set at 850 persons. Thereafter, the study assumes annual productivity increases of 3 percent to 1985 and of 2 percent in the years following. As a result, the number of employees for the model refinery would decrease to 540 in 1985 and 400 in the year 2000. Assuming that two-thirds of this productivity increase would be passed on in the form of increased employee compensation, the average wage of refinery employees would increase by 34 percent in 1985 and by an additional 30 percent in 2000. Exhibit II-3 shows projected refinery wage levels by region.

Investment Costs. The investment cost (expressed in 1970 dollars) for the model refinery would vary by region from a low of $250 million in the South Atlantic to a high of almost $400 million in the San Francisco area. Approximately 40 percent of this cost would represent capital equipment expenditures; the remainder would be spent for design and construction. Exhibit II-4 details the refinery investment cost factors used for new refinery construction and expansion of existing refineries.

Resource Requirements

The resource requirements of the model refinery are significant, particularly the requirements for land.

---

[1] The price of crude oil is currently rising extremely rapidly. The price of crude (in uninflated 1970 dollars) in 1985 and 2000 is subject to great speculation, but there are arguments that it could be either lower or higher than $5 in 2000.

EXHIBIT II-3

ESTIMATED EMPLOYEE COMPENSATION

REPRESENTATIVE REFINERY

Geographic Area	Relative[a] Wage Index	Direct Annual Compensation 1970	1985[b]	2000[b]
New England	3.59	11550	15550	20000
Mid Atlantic	3.86	12450	16750	21600
South Atlantic	3.26	10500	14150	18200
Puget Sound	4.23	13600	18300	23600
San Francisco Bay Area	3.98	12800	17250	22200

[a]Chemical Week, October 17, 1973 (figures deflated to 1970 dollars).

[b]Increased at 2 percent annually to 1985 and at 1.7 percent annually from 1985 to 2000.

Source: RPA Estimates.

EXHIBIT II-4

ESTIMATED INVESTMENT COST FACTORS

REPRESENTATIVE REFINERY[a]

Geographic Area	Construction Cost Index[b]	Investment Cost per Barrel per Day of Capacity (Constant 1970 Dollars) 1970 New	1970 Expansion	1985 New	1985 Expansion[c]	2000 New	2000 Expansion[c]
New England	1434	1927	1217	1975	1247	2002	1264
Mid-Atlantic	1414	1900	1200	1948	1230	1975	1247
South Atlantic	1101	1480	934	1517	957	1538	970
Puget Sound	1408	1892	1195	1939	1225	1966	1245
San Francisco Bay	1598	2147	1356	2201	1390	2231	1409

[a] For new refineries averaging 150,000 B/D capacity and expansions averaging 150,000 B/D.

[b] Engineering News Record, Construction Cost Index, December 1970.

[c] Factors increased in 1985 and 2000 to account for capital investments for productivity improvements.

Source: RPA estimates.

Discussions with industry personnel, a review of other impact studies, and an examination of current refinery land use all point to the need for a minimum of 1200 to 1400 acres for a 200,000 barrel per day refinery. This includes enough land for expansion to 400,000 barrels per day. This estimated acreage is based on the following factors:

Nature of Refinery	Acres per 1000 barrels/day
Base Case Refineries (Tanker-fed, 15-day storage)	7
OCS-supplied Refineries (10-day storage)	6

Source: RPA estimates.

There would likely be additional land requirements for oil import security (foreign crude cutoff, transit delays, etc.). Over 400 additional acres would be required in a region for 30 days storage of every million barrels per day imported.[1]

It is believed that water requirements for future refineries will decrease significantly from those of today. Assuming a shift toward air cooling and closed water systems, an estimated 4 million gallons per day of makeup water will be required for each 100,000 barrels per day capacity in 1985. It is estimated that these requirements will decline to 3 million gallons per day by 2000.

Electric power requirements for 100,000 barrels per day of capacity are currently estimated at 630,000 KWH per day, or 210 million KWH per year, a requirement that is not expected to change in the future.

---

[1] Source: Arthur D. Little, Inc., Potential Onshore Effects of Deepwater Oil Terminal-Related Industrial Development, October 1973. Since OCS oil would not require this additional storage, the issue of national security oil storage requirements was not addressed in detail. Assuming that at least 30 days security storage would be required, land requirements corresponding to that storage were assumed in the base case analysis. (See Appendix VIII.)

Pollution Levels

Most air and water pollution loadings from the model refinery are not expected to present any major problems in 1985 and 2000 because of expected improvements in effluent control and treatment. However, hydrocarbon emissions will likely pose an important control problem. Exhibit II-5 shows the pollution levels assumed for a 200,000 barrel per day integrated refinery. Appendix IX discusses the methodology for estimating the future pollutant loadings by source.

EXHIBIT II-5

ESTIMATED FUTURE POLLUTION LEVELS MODEL REFINERY

(Tons per year for 200,000 barrels per day production)

Pollutant	Level	
Air Emissions:		
Particulates	1591	
SO_x	3739	
NO_x	4362	
Hydrocarbons	11408	
Carbon Monoxide	330	
Water Effluents:	BA[a]	BP[b]
BOD	46	548
COD	365	2281
Suspended Solids	46	548
Ammonia	9	180
Phenal	0	18
Sulfide	0	9

[a] Best available control technology

[b] Best practical control technology

Source: RADIAN Corporation Technical Notes on refinery pollutants. Complex, integrated refinery using sour crude (1.8 percent sulfur).

PROJECTED REGIONAL REFINERY DEVELOPMENT

Analysis of regional refinery development was carried out separately for the East and West Coast, as described in the following sections.

East Coast

Because of the uncertainty regarding future refinery development on the East Coast (PAD I[1]), two base cases (i.e., development without offshore production) have been chosen for consideration. Base Case 1 corresponds roughly to that developed by the Department of the Interior for deep water port studies. Essentially, the Department's case assumes limited additions to existing East Coast refineries, rather than the establishment of new refineries, and looks either to the Gulf Coast or to imported refinery products to supply future demands. Specifically, it assumes that existing and announced capacity by 1975 = 1.5 million barrels per day - will be expanded 60 percent by 1985 and a total of 100 percent by 2000. Exhibit II-6 summarizes these assumptions.

EXHIBIT II-6

BASE CASE 1 REFINERY DEVELOPMENT ASSUMPTIONS

(Million Barrels per Day)

	1975	1985	2000
Existing Capacity	1.5	1.5	1.5
Expansion	--	.9	1.5
Total Capacity	1.5	2.4	3.0
Throughput (90 percent)	1.35	2.2	2.7
PAD I Demand	4.5	9.9	13.1

Source: RPA estimates

---

[1] Petroleum Administration for Defense District I

Because virtually no refining capacity exists outside of the Mid-Atlantic, Base Case 1 shows no refinery development in New England and only 100,000 barrels per day in the South Atlantic.

Base Case 2 represents the development of deepwater port terminals in each Atlantic Coast region, and assumes 50 percent self-sufficiency for PAD I in 1985 and 2000. This requires: (1) a 100 percent expansion of existing refineries (as in Base Case 1), and (2) development of 4.3 million barrels per day of new grass roots refinery capacity after 1975. Exhibit II-7 summarizes the assumptions for Base Case 2 refinery development.

EXHIBIT II-7

BASE CASE 2 REFINERY DEVELOPMENT ASSUMPTIONS

(Million Barrels per Day)

	1975	1985	2000
Existing capacity	1.5	1.5	1.5
Expansion	-	0.9	1.5
New refineries (initial capacity plus expansions)	-	3.1	4.3
Total capacity	1.5	5.5	7.3
Throughput (90 percent)	1.35	5.0	6.6
PAD I Demand	4.5	9.9	13.1

Source: RPA estimates

This base case would yield almost a five-fold increase in refining capacity by 2000, including significant development in the presently unexploited New England and South Atlantic areas. Exhibit II-8 summarizes the regional development.

EXHIBIT II-8

BASE CASE 2 REGIONAL DEVELOPMENT ASSUMPTIONS[a]

(Million Barrels per day)

Region	1975 Production	1985 Production	2000 Production	2000 Demand	2000 Percent Production/ Demand
New England	-	0.5	0.7	2.4	30
Mid Atlantic	1.25	3.1	3.7	5.5	67
S. Atlantic	0.10	1.4	2.2	5.2	41
Total	1.35	5.0	6.6	13.1	50 (average)

[a]Production throughput assumed to be 90 percent of capacity.

Source: RPA estimates.

Different environmental, economic and technological forces will affect refinery development differently in the various regions. In New England, for example, environmental groups may voice strong opposition to new development and expansion. In the Mid-Atlantic a large market and a network of already established refineries should facilitate additional industry expansion. In the South Atlantic, available land, economic need, and generally positive acceptance of new industry should stimulate almost as much new development as in the Mid-Atlantic region.

The OCS production impact analyses assume that the refining capacity needed to support offshore production would be additive to the requirements for the base case development. However, this may not actually be the case, since some imported crude might be replaced by the OCS production. Despite this possibility, the number of base case/impact case combinations is sufficient to include the absolute level of refinery production that could occur under a variety of situations. Importantly, these combinations allow for an assessment of the maximum possible impact from the OCS production levels analyzed.

The impact cases (see Exhibit II-2) result in different situations of new refinery development and expansion of previously built refineries, depending upon the base case/impact case combination. Exhibits II-9A through II-9X (at

the back of the appendix) detail these situations for each case analyzed for the East Coast. For the Base Case 2-high OCS scenario. New England and the Mid-Atlantic regions approach refining production close to self-sufficiency in the year 2000, as Exhibit II-10 illustrates.

EXHIBIT II-10

MAXIMUM REFINING DEVELOPMENT SITUATION - EAST COAST

BASE CASE 2 AND HIGH OCS PRODUCTION

(Million barrels per day)

Region	1985 Production[a]	Demand	2000 Production[a]	Demand
New England	1.2	1.8	2.2	2.4
Mid-Atlantic	3.9	4.2	5.2	5.5
South Atlantic	2.1	4.0	3.6	5.2

[a] 90 percent of capacity
Source: RPA estimates

West Coast

The West Coast (PAD V) analysis uses only one base case. In this situation, PAD V would import about 22 percent of its refinery product needs in 1985 and about 43 percent in 2000. This would require a 65 percent increase in refining capacity from 1970 to 2000. Exhibit II-11 summarizes the PAD V base case assumptions.

The 1985 and 2000 demand estimates exceed the Department of Interior's by 1 to 1.5 million barrels per day. This study used these higher figures because lower estimates would result in little additional refinery capacity should Gulf of Alaska OCS development occur. Hence, there would be little induced OCS impact except in Alaska. It is essential that this study not underestimate what the impact could be, given the assumed OCS production levels.

For economic reasons, it is assumed that PAD V would attempt to reach 100 percent self-sufficiency but that it would not become a net exporter of refined products. Therefore, the imports projected represent the maximum additional amount of refining capacity needed, of which part or all could be supplied by OCS production. These projections

EXHIBIT II-11

PAD V BASE CASE ASSUMPTIONS

(Million barrels per day)

	1970	1985	2000
Product demand	1.9[a]	4.0[b]	5.3[b]
Imported Products	0.1[b]	0.9	2.3
Crude Runs	1.8	3.1	3.0
Required refinery capacity[c]	2.0	3.4	3.3

[a] Army Corps of Engineers, West Coast Deepwater Port Facilities Study, June 1973.

[b] Based on industry estimates of PAD V demand prorated to total demand per Energy Through the Year 2000.

[c] Based on operation at 90 percent capacity.

Source: Dornbusch and Company estimates.

resulted from analyzing the potential supplies of crude oil to PAD V. From this analysis six basis assumptions were made.

First, it was assumed that oil supplied from California would decrease from 1 million barrels per day in 1970 to 400,000 in the year 2000.[1]

Second, it was assumed that that the Alaskan North Slope would provide 2 million barrels per day in both 1985 and 2000. Although more than this amount is expected from the North Slope by 2000, it is assumed that any amount exceeding this level would be shipped or piped to other areas of the country.[2] Third, it was assumed that the Alaska Cook Inlet would increase its oil supply to PAD V only slightly, from 200,000 barrels per day in 1970 to 300,000 barrels per day in 2000.[3]

Fourth, it was assumed that crude oil imports from Canada would increase only slightly from 200,000 barrels per day in 1970 to 300,000 barrels per day in 2000.[4] This limited increase reflects a higher priority demand for Canadian oil in other parts of the U.S. and the world.

Fifth, it was assumed that crude oil imports from other foreign sources would decrease from 300,000 barrels per day in 1970 to none in the future. This assumption is somewhat speculative, but allows examination of the most significant impact case. Finally it was assumed that inter-PAD shipments would be negligible.

---

[1] California Resources Agency Report, Energy in California, 1972 and Stanford Research Institute Report, Meeting California Energy Requirements - 1975 to 2000.

[2] To the extent that additional North Slope oil goes to PAD V, the Gulf of Alaska OCS impact would be lower. If total Alaskan oil supplies from all sources exceed PAD V demand, it is assumed that additional pipeline construction or tanker shipments to other parts of the U.S. would occur.

[3] U.S. Army Corps of Engineers, West Coast Deepwater Port Facilities Study, June 1973.

[4] Testimony of Mr. S. H. Clark at CEQ Hearings, Anchorage, Alaska, September 26, 1973.

Taken together, these assumptions indicate a need for a 65 percent increase in refinery capacity. It is expected that expansion of existing refineries can provide for this increase[1], which would be completely developed by 1985 to support the large increase in Alaskan North Slope oil supply. Exhibit II-12 summarizes these assumptions.

In analyzing the base case for two West Coast demand areas, Washington/Oregon and Northern California, it was assumed that the former would receive all Canadian imports and that other PAD V areas would share supplies of California crude according to the percentage now in use. It was further assumed that all other oil flowing into PAD V would be allocated according to the current demand distribution for PAD V.[2] Exhibit II-13 details the assumption of crude oil supplies for each of the West Coast regions under analysis. Exhibit II-14 shows the estimated required refining capacity and the associated amount of refinery expansion necessary to handle the assumed base case crude oil supplies for each region.

For the analysis of the OCS production impact cases, it was assumed that the necessary refinery capacity would be additive to the requirements for the base case development. However, this may not be the case, since OCS production could replace some imported crude oil. But making this assumption facilitates an analysis of the maximum possible impact from offshore production. (This assumption is discussed in more detail in Chapters 1 and 6 of the report).

---

[1] Current refineries can be expanded approximately 100 percent.

[2] The current demand breakdown is 18 percent for Washington/Oregon, 29 percent for Northern California, and 53 percent for other PAD V areas. This breakdown is not expected to change appreciably in the future. according to the Army Corps of Engineers report, West Coast Deepwater Port Facility Study, June 1973.

EXHIBIT II-12

PAD V CRUDE OIL SUPPLY AND REQUIRED REFINING CAPACITY ASSUMPTIONS

(Million barrels per day)

Source of Supply	1970	1985	2000
1. California[a]	1.0	0.6	0.4
2. Alaska North Slope	-	2.0	2.0
3. Alaska Cook Inlet	0.2	0.2	0.3
4. Canadian Imports	0.2	0.3	0.3
5. Other Imports	0.3	-	-
6. Inter PAD	0.1	-	-
TOTAL	1.8	3.1	3.0
Refining Capacity			
Required at 90 percent	2.0	3.4	3.3
Existing in 1973	2.2	2.2	2.2
Expansion of Existing Capacity	-	1.1	1.0
New Refineries[b] (Puget Sound)	-	0.1	0.1

[a] No new California offshore oil development is assumed.

[b] Even though PAD V expansion in total does not exceed 100 percent of 1973 capacity, the Puget Sound area does.

Source: Dornbusch and Company estimates.

EXHIBIT II-13

ASSUMED CRUDE OIL SUPPLIES - WEST COAST BASE CASE

(Million Barrels per day)

	Washington/Oregon[a]			Northern California[b]		
Source of Supply	1970	1985	2000	1970	1985	2000
1. California	-	-	-	.29	.15	.10
2. Alaska North Slope	-	.36	.36	-	.58	.58
3. Alaska Cook Inlet	.03	.04	.05	.09	.09	.13
4. Canadian Imports	.20	.30	.30	-	-	-
5. Other Imports	.04	-	-	.08	-	-
6. Inter-PAD	-	-	-	.02	-	-
TOTAL	.27	.70	.71	.48	.82	.81

[a] Served by Puget Sound refining capacity

[b] Served by the San Francisco refining capacity

Source: Dornbusch and Company estimates

EXHIBIT II-14

WEST COAST BASE CASE REGIONAL REFINING DEVELOPMENT ASSUMPTIONS

(Million barrels per day)

Puget Sound Area (Washington/Oregon)

	1970	1985	2000
Product Demand	.34	.72	.96
Imported Products	.07	.02	.25
Crude Runs	.27	.70	.71
Required Refining Capacity (Crude runs/90 percent)	.30	.78	.79
Existing 1973 Capacity	.34	.34	.34
Expansion of 1973 Capacity	-	.44	.45
New Refineries	-	.10	.11

San Francisco Area (Northern California)

	1970	1985	2000
Product Demand	.55	1.15	1.53
Imported Products	.07	.33	.72
Crude Runs	.48	.82	.81
Required refining Capacity (Crude runs/90 percent)	.53	.91	.90
Existing 1973 Capacity	.57	.57	.57
Expansion of 1973 refineries	-	.34	.34[a]
New refineries	-	-	-

[a] Slight excess capacity available.

Source: Dornbusch and Company estimates.

In the high Gulf of Alaska OCS production case (see Exhibit II-2), OCS oil could provide as much as 40 percent of PAD V oil supplies, allowing the district to be essentially self-sufficient, as shown in Exhibit II-15.

EXHIBIT II-15

PROJECTED PAD V REFINING IMPACTS

FROM OFFSHORE GULF OF ALASKA PRODUCTION

	1970	1985	2000
Demand (mil b/d)	1.9	4.0	5.3
Crude Runs (mil b/d)			
Base Case	1.8	3.1	3.0
Percent Self-sufficient	95%	78%	57%
Low Impact Case	-	.25	1.0
Cumulative percent Self-sufficient	95%	84%	75%
High Impact Case	-	.75	2.0
Cumulative percent Self-sufficient	95%	96%	94%

Source: Dornbusch and Company estimates

In the low impact case, expansion of existing refineries would be sufficient for the Gulf of Alaska production. However, the high impact case would require additional refineries supplying over 1 million barrels per day by 2000, as shown in Exhibit II-16.

EXHIBIT II-16

REQUIRED PAD V REFINERY CAPACITY

FOR OFFSHORE IMPACT CASES

(Million barrels per day)

	Low Case		High Case	
	1985	2000	1985	2000
Required refining capacity (Crude runs/90 percent)	3.7	4.4	4.3	5.6
Existing 1973 capacity	2.2	2.2	2.2	2.2
Expansion of 1973 refineries	1.4	1.8	2.0	2.2
New refineries	.1[a]	.4[a]	.1[a]	1.2

[a] Even though PAD V expansion in total does not exceed 100 percent of 1973 capacity, the Puget Sound and San Francisco areas do.

Source: Dornbusch and Company estimates.

Within PAD V Gulf of Alaska oil was allocated according to each region's demand percentage share, except in Puget Sound, where 100 percent self-sufficiency would be achieved in some cases. In both Puget Sound and San Francisco, the high OCS production case would require more new refinery construction proportionally than for the rest of PAD V. Exhibits II-17 and II-18 show the refinery development impacts from the Gulf of Alaska OCS production for these regions. In addition, Exhibits II-9Y through II-9DD detail the development of new refinery construction for each case.

EXHIBIT II-17

PUGET SOUND REGION

PROJECTED REFINERY IMPACT FROM
OFFSHORE GULF OF ALASKA OIL PRODUCTION

	1970	1985	2000
Demand (Million B/D)	.34	.72	.96
Crude Runs (Million B/D			
Base Case	.27	.70	.71
% Self-Sufficient	79%	97%	74%
Low Impact Case	-	.02	.18
Cum. % Self-sufficient	79%	100%	93%
High Impact Case	-	.02	.25
Cum. % Self-sufficient	79%	100%	100%

REQUIRED REFINING CAPACITY
(Million barrels per day)

	Low Case		High Case	
	1985	2000	1985	2000
Required Refinery Capacity	.80	.99	.80	1.07
Existing 1973	.34	.34	.34	.34
Expansion of 1973 Refineries	.34	.34	.34	.34
New Refineries	.12	.31	.12	.39

Source: Dornbusch and Company estimates

EXHIBIT II-18

SAN FRANCISCO BAY REGION

PROJECTED REFINERY IMPACT FROM
OFFSHORE GULF OF ALASKA OIL PRODUCTION

	1970	1985	2000
Demand (Million B/D)	.55	1.15	1.53
Crude Runs (Million B/D)			
Base Case	.48	.82	.81
% Self-sufficient	87%	71%	53%
Low Impact Case	-	.07	.29
Cum. % Self-sufficient	87%	77%	73%
High Impact Case	-	.21	.58
Cum. % Self-sufficient	87%	90	91%

REQUIRED REFINING CAPACITY
(Million barrels per day)

	Low Case		High Case	
	1985	2000	1985	2000
Required Refinery Capacity (Crude Runs/90 percent)	.99	1.22	1.14	1.54
Existing 1973	.57	.57	.57	.57
Expansion of 1973 refineries	.42	.57	.57	.57
New Refineries	-	.08	-	.40

Source: Dornbusch and Company estimates

EXHIBIT II - 9A

REFINERY CAPACITY DEVELOPMENT ASSUMPTIONS

(Million Barrels/Day)

New England
(Demand Area)

BASE CASE: 1 OCS PRODUCTION: NONE

	Bristol County	Rest of Eastern Mass./R.I.	Rest of Demand Area	Total Demand Area
Existing and Planned to 1975				
1975-1985 Refinery Expansions				
New Refineries				
Cumulative-Total				
-OCS Induced				
1985-2000 Refinery Expansions				
New Refineries				
Cumulative-Total				
-OCS Induced				

NO DEVELOPMENT

EXHIBIT II - 9B

REFINERY CAPACITY DEVELOPMENT ASSUMPTIONS

(Million Barrels/Day)

New England

(Demand Area)

BASE CASE: 2 OCS PRODUCTION: NONE

	Bristol County	Rest of Eastern Mass./R.I.	Rest of Demand Area	Total Demand Area
Existing and Planned to 1975	0	0	0	0
1975-1985 Refinery Expansions	0	0	0	0
New Refineries	0	0.30	0.20	0.50
Cumulative-Total	0	0.30	0.20	0.50
-OCS Induced	0	0	0	0
1985-2000 Refinery Expansions	0	0.20	0.10	0.30
New Refineries	0	0	0	0
Cumulative-Total		0.50	0.30	0.80
-OCS Induced	0	0	0	0

EXHIBIT II - 9C

REFINERY CAPACITY DEVELOPMENT ASSUMPTIONS

(Million Barrels/Day)

New England

(Demand Area)

BASE CASE: 1 OCS PRODUCTION: LOW

	Bristol County	Rest of Eastern Mass./R.I.	Rest of Demand Area	Total Demand Area
Existing and Planned to 1975	0	0	0	0
1975-1985 Refinery Expansions	0	0	0	0
New Refineries	0.17	0.11	0	0.28
Cumulative-Total	0.17	0.11	0	0.28
-OCS Induced	0.17	0.11	0	0.28
1985-2000 Refinery Expansions	0.11	0.17	0	0.28
New Refineries	0	0	0	0
Cumulative-Total	0.28	0.28	0	0.56
-OCS Induced	0.28	0.28	0	0.56

EXHIBIT II - 9D

REFINERY CAPACITY DEVELOPMENT ASSUMPTIONS

(Million Barrels/Day)

New England

(Demand Area)

BASE CASE: 1 OCS PRODUCTION: HIGH

	Bristol County	Rest of Eastern Mass./R.I.	Rest of Demand Area	Total Demand Area
Existing and Planned to 1975	0	0	0	0
1975-1985 Refinery Expansions	0	0	0	0
New Refineries	0.28	0.28	0.28	0.84
Cumulative-Total	0.28	0.28	0.28	0.84
-OCS Induced	0.28	0.28	0.28	0.84
1985-2000 Refinery Expansions	0	0	0	0
New Refineries	0.28	0.28	0.28	0.84
Cumulative-Total	0.56	0.56	0.56	1.68
-OCS Induced	0.56	0.56	0.56	1.68

EXHIBIT II - 9E

REFINERY CAPACITY DEVELOPMENT ASSUMPTIONS

(Million Barrels/Day)

New England

(Demand Area)

BASE CASE: 2 OCS PRODUCTION: LOW

	Bristol County	Rest of Eastern Mass./R.I.	Rest of Demand Area	Total Demand Area
Existing and Planned to 1975	0	0	0	0
1975-1985 Refinery Expansions	0	0	0	0
New Refineries	0.17	0.41	0.20	0.78
Cumulative-Total	0.17	0.41	0.20	0.78
-OCS Induced	0.17	0.11	0	0.28
1985-2000 Refinery Expansions	0.11	0.37	0.10	0.58
New Refineries	0	0	0	0
Cumulative-Total	0.28	0.78	0.30	1.36
-OCS Induced	0.28	0.28	0	0.56

EXHIBIT II - 9F

REFINERY CAPACITY DEVELOPMENT ASSUMPTIONS

(Million Barrels/Day)

New England
(Demand Area)

BASE CASE: 2 OCS PRODUCTION: HIGH

	Bristol County	Rest of Eastern Mass./R.I.	Rest of Demand Area	Total Demand Area
Existing and Planned to 1975	0	0	0	0
1975-1985 Refinery Expansions	0	0	0	0
New Refineries	0.28	0.58	0.48	1.34
Cumulative-Total	0.28	0.58	0.48	1.34
-OCS Induced	0.28	0.28	0.28	0.84
1985-2000 Refinery Expansions	0	0.20	0.10	0.30
New Refineries	0.28	0.28	0.28	0.84
Cumulative-Total	0.56	1.06	0.86	2.48
-OCS Induced	0.28	0.28	0.56	1.68

EXHIBIT II-9G

REFINERY CAPACITY DEVELOPMENT ASSUMPTIONS

(Million Barrels/Day)

Mid-Atlantic

(Demand Area)

BASE CASE: 1 OCS PRODUCTION: NONE

	Cumberland Cape May Counties	Rest of Delaware River Region	Rest of Demand Area	Total Demand Area
Existing and Planned to 1975	0	1.40	0	1.40
1975-1985 Refinery Expansions	0	0.80	0	0.80
New Refineries	0	0	0	0
Cumulative-Total	0	2.20	0	2.20
-OCS Induced	0	0	0	0
1985-2000 Refinery Expansions	0	0.60	0	0.60
New Refineries	0	0	0	0
Cumulative-Total	0	2.80	0	2.80
-OCS Induced	0	0	0	0

EXHIBIT II- 9H

REFINERY CAPACITY DEVELOPMENT ASSUMPTIONS

(Million Barrels/Day)

Mid-Atlantic

(Demand Area)

BASE CASE: 2 OCS PRODUCTION: NONE

	Cumberland Cape May Counties	Rest of Delaware River Region	Rest of Demand Area	Total Demand Area
Existing and Planned to 1975	0	1.40	0	1.40
1975-1985 Refinery Expansions	0	0.80	0	0.80
New Refineries	0.80	0.30	0.20	1.30
Cumulative-Total	0.80	2.50	0.20	3.50
-OCS Induced	0	0	0	0
1985-2000 Refinery Expansions	0.40	0.10	0.10	0.60
New Refineries	0	0	0	0
Cumulative-Total	1.20	2.60	0.30	4.10
-OCS Induced	0	0	0	0

EXHIBIT II-9I

REFINERY CAPACITY DEVELOPMENT ASSUMPTIONS

(Million Barrels/Day)

Mid-Atlantic

(Demand Area)

BASE CASE : 1 OCS PRODUCTION : LOW

	Cumberland Cape May Counties	Rest of Delaware River Region	Rest of Demand Area	Total Demand Area
Existing and Planned to 1975	0	1.40	0	1.40
1975-1985 Refinery Expansions	0	0.80	0	0.80
New Refineries	0.28	0	0	0.28
Cumulative-Total	0.28	2.20	0	2.48
-OCS Induced	0.28	0	0	0.28
1985-2000 Refinery Expansions	0	0.60	0	0.60
New Refineries	0	0.28	0	0.28
Cumulative-Total	0.28	3.08	0	3.36
-OCS Induced	0.28	0.28	0	0.56

EXHIBIT II-9J

REFINERY CAPACITY DEVELOPMENT ASSUMPTIONS

(Million Barrels/Day)

Mid-Atlantic

(Demand Area)

BASE CASE: 1 OCS PRODUCTION: HIGH

	Cumberland Cape May County	Rest of Delaware River Region	Rest of Demand Area	Total Demand Area
Existing and Planned to 1975	0	1.40	0	1.40
1975-1985 Refinery Expansions	0	0.92	0	0.92
New Refineries	0.39	0.33	0	0.72
Cumulative-Total	0.39	2.65	0	3.04
-OCS Induced	0.39	0.45	0	0.84
1985-2000 Refinery Expansions	0.18	0.60	0	0.78
New Refineries	0	0.44	0.22	0.66
Cumulative-Total	0.57	3.69	0.22	4.48
-OCS Induced	0.57	0.89	0.22	1.68

EXHIBIT II-9K

REFINERY CAPACITY DEVELOPMENT ASSUMPTIONS

(Million Barrels/Day)

Mid-Atlantic

(Demand Area)

BASE CASE: 2 OCS PRODUCTION: LOW

	Cumberland Cape May County	Rest of Delaware River Region	Rest of Demand Area	Total Demand Area
Existing and Planned to 1975	0	1.40	0	1.40
1975-1985 Refinery Expansions	0	0.80	0	0.80
New Refineries	1.08	0.30	0.20	1.58
Cumulative-Total	1.08	2.50	0.20	3.78
-OCS Induced	0.28	0	0	0.28
1985-2000 Refinery Expansions	0.40	0.10	0.10	0.60
New Refineries	0	0.28	0	0.28
Cumulative-Total	1.48	2.88	0.30	4.66
-OCS Induced	0.28	0.28	0	0.56

EXHIBIT II-9L

REFINERY CAPACITY DEVELOPMENT ASSUMPTIONS

(Million Barrels/Day)

Mid-Atlantic

(Demand Area)

BASE CASE 2 OCS PRODUCTION : HIGH

	Cumberland Cape May County	Rest of Delaware River Region	Rest of Demand Area	Total Demand Area
Existing and Planned to 1975	0	1.40	0	1.40
1975-1985 Refinery Expansions	0	0.92	0	0.92
New Refineries	1.19	0.63	0.20	2.02
Cumulative-Total	1.19	2.95	0.20	4.34
-OCS Induced	0.39	0.45	0	0.84
1985-2000 Refinery Expansions	0.28	0.10	0.10	0.48
New Refineries	0.30	0.44	0.22	0.96
Cumulative-Total	1.77	3.49	0.52	5.78
-OCS Induced	0.57	0.89	0.22	1.68

EXHIBIT II - 9M

REFINERY CAPACITY DEVELOPMENT ASSUMPTIONS

(Million Barrels/Day)

South Atlantic #1

(Demand Area)

BASE CASE: 1 OCS PRODUCTION: NONE

	Charleston	Rest of Eastern S.C./ Eastern GA.	Rest of Demand Area	Total Demand Area
Existing and Planned to 1975	0	0	0.10	0.10
1975-1985 Refinery Expansions	0	0	0.10	0.10
New Refineries	0	0	0	0
Cumulative-Total	0	0	0.20	0.20
-OCS Induced	0	0	0	0
1985-2000 Refinery Expansions	0	0	0	0
New Refineries	0	0	0	0
Cumulative-Total	0	0	0.20	0.20
-OCS Induced	0	0	0	0

EXHIBIT II - 9N

REFINERY CAPACITY DEVELOPMENT ASSUMPTIONS

(Million Barrels/Day)

South Atlantic #1
(Demand Area)

BASE CASE : 2 OCS PRODUCTION : NONE

	Charleston	Rest of Eastern S.C. Eastern Ga.	Rest of Demand Area	Total Demand Area
Existing and Planned to 1975	0	0	0.10	0.10
1975-1985 Refinery Expansions	0	0	0.10	0.10
New Refineries	0.20	0.60	0.50	1.30
Cumulative-Total	0.20	0.60	0.70	1.50
-OCS Induced	0	0	0	0
1985-2000 Refinery Expansions	0.10	0	0.20	0.30
New Refineries	0	0.30	0.30	0.60
Cumulative-Total	0.30	0.90	1.20	2.40
-OCS Induced	0	0	0	0

EXHIBIT II - 90

REFINERY CAPACITY DEVELOPMENT ASSUMPTIONS

(Million Barrels/Day)

South Atlantic #1

(Demand Area)

BASE CASE: 1 OCS PRODUCTION: LOW

	Charleston	Rest of Eastern S.C./ Eastern Ga.	Rest of Demand Area	Total Demand Area
Existing and Planned to 1975	0	0	0.10	0.10
1975-1985 Refinery Expansions	0	0	0.10	0.10
New Refineries	0.17	0.11	0	0.28
Cumulative-Total	0.17	0.11	0.20	0.48
-OCS Induced	0.17	0.11	0	0.28
1985-2000 Refinery Expansions	0	0	0	0
New Refineries	0.11	0.17	0	0.28
Cumulative-Total	0.28	0.28	0.20	0.76
-OCS Induced	0.28	0.28	0	0.56

EXHIBIT II - 9P

REFINERY CAPACITY DEVELOPMENT ASSUMPTIONS

(Million Barrels/Day)

South Atlantic #1

(Demand Area)

BASE CASE : 1 OCS PRODUCTION: HIGH

	Charleston	Rest of Eastern S.C/ Eastern Ga.	Rest of Demand Area	Total Demand Area
Existing and Planned to 1975	0	0	0.10	0.10
1975-1985 Refinery Expansions	0	0	0.10	0.10
New Refineries	0.28	0.28	0.28	0.84
Cumulative-Total	0.28	0.28	0.48	1.04
-OCS Induced	0.28	0.28	0.28	0.84
1985-2000 Refinery Expansions	0	0	0	0
New Refineries	0.28	0.28	0.28	0.84
Cumulative-Total	0.56	0.56	0.76	1.88
-OCS Induced	0.56	0.56	0.56	1.68

EXHIBIT II - 9Q

REFINERY CAPACITY DEVELOPMENT ASSUMPTIONS

(Million Barrels/Day)

South Atlantic #1

(Demand Area)

BASE CASE : 2 OCS PRODUCTION : LOW

	Charleston	Rest of Eastern S.C. Eastern Ga.	Rest of Demand Area	Total Demand Area
Existing and Planned to 1975	0	0	0.10	0.10
1975-1985 Refinery Expansions	0	0	0.10	0.10
New Refineries	0.37	0.71	0.50	1.58
Cumulative-Total	0.37	0.71	0.70	1.78
-OCS Induced	0.17	0.11	0	0.28
1985-2000 Refinery Expansions	0.21	0.17	0.20	0.58
New Refineries	0	0.30	0.30	0.60
Cumulative-Total	0.58	1.18	1.20	2.96
-OCS Induced	0.28	0.28	0	0.56

EXHIBIT II - 9R

REFINERY CAPACITY DEVELOPMENT ASSUMPTIONS

(Million Barrels/Day)

South Atlantic #1

(Demand Area)

BASE CASE: 2 OCS PRODUCTION: HIGH

	Charleston	Rest of Eastern S.C. Eastern Ga.	Rest of Demand Area	Total Demand Area
Existing and Planned to 1975	0	0	0.10	0.10
1975-1985 Refinery Expansions	0	0	0.10	0.10
New Refineries	0.48	0.88	0.78	2.14
Cumulative-Total	0.48	0.88	0.98	2.34
-OCS Induced	0.28	0.28	0.28	0.84
1985-2000 Refinery Expansions	0.10	0	0.20	0.30
New Refineries	0.28	0.58	0.58	1.44
Cumulative-Total	0.86	1.46	1.76	4.08
-OCS Induced	0.56	0.56	0.56	1.68

EXHIBIT II-9S

REFINERY CAPACITY DEVELOPMENT ASSUMPTIONS

(Million Barrels/Day)

South Atlantic #2

(Demand Area)

BASE CASE: 1 OCS PRODUCTION: NONE

	Jacksonville	Rest of NE Florida/ SE Georgia	Rest of Demand Area	Total Demand Area
Existing and Planned to 1975	0	0	0.10	0.10
1975-1985 Refinery Expansions	0	0	0.10	0.10
New Refineries	0	0	0	0
Cumulative-Total	0	0	0.20	0.20
-OCS Induced	0	0	0	0
1985-2000 Refinery Expansions	0	0	0	0
New Refineries	0	0	0	0
Cumulative-Total	0	0	0.20	0.20
-OCS Induced	0	0	0	0

EXHIBIT II-9T

REFINERY CAPACITY DEVELOPMENT ASSUMPTIONS

(Million Barrels/Day)

South Atlantic #2

(Demand Area)

BASE CASE: 2 OCS PRODUCTION: NONE

	Jacksonville	Rest of NE Florida/ SE Georgia	Rest of Demand Area	Total Demand Area
Existing and Planned to 1975	0	0	0.10	0.10
1975-1985 Refinery Expansions	0	0	0.10	0.10
New Refineries	0.20	0	1.10	1.30
Cumulative-Total	0.20	0	1.30	1.50
-OCS Induced	0	0	0	0
1985-2000 Refinery Expansions	0.10	0	0.20	0.30
New Refineries	0	0.30	0.30	0.60
Cumulative-Total	0.30	0.30	1.80	2.40
-OCS Induced	0	0	0	0

EXHIBIT II-9U

REFINERY CAPACITY DEVELOPMENT ASSUMPTIONS

(Million Barrels/Day)

South Atlantic #2

(Demand Area)

BASE CASE: 1 OCS PRODUCTION: LOW

	Jacksonville	Rest of NE Florida/ SE Georgia	Rest of Demand Area	Total Demand Area
Existing and Planned to 1975	0	0	0.10	0.10
1975-1985 Refinery Expansions	0	0	0.10	0.10
New Refineries	0.17	0	0.11	0.28
Cumulative-Total	0.17	0	0.31	0.48
-OCS Induced	0.17	0	0.11	0.28
1985-2000 Refinery Expansions	0.11	0	0.17	0.28
New Refineries	0	0	0	0
Cumulative-Total	0.28	0	0.48	0.76
-OCS Induced	0.28	0	0.28	0.56

EXHIBIT II-9V

REFINERY CAPACITY DEVELOPMENT ASSUMPTIONS

(Million Barrels/Day)

South Atlantic #2

(Demand Area)

BASE CASE: 1 OCS PRODUCTION: HIGH

	Jacksonville	Rest of NE Florida/ SE Georgia	Rest of Demand Area	Total Demand Area
Existing and Planned to 1975	0	0	0.10	0.10
1975-1985 Refinery Expansions	0	0	0.10	0.10
New Refineries	0.28	0	0.56	0.84
Cumulative-Total	0.28	0	0.76	1.04
-OCS Induced	0.28	0	0.56	0.84
1985-2000 Refinery Expansions	0	0	0	0
New Refineries	0.28	0.28	0.28	0.84
Cumulative-Total	0.56	0.28	1.04	1.88
-OCS Induced	0.56	0.28	0.84	1.68

EXHIBIT II-9W

REFINERY CAPACITY DEVELOPMENT ASSUMPTIONS

(Million Barrels/Day)

South Atlantic #2

(Demand Area)

BASE CASE : 2 OCS PRODUCTION : LOW

	Jacksonville	Rest of NE Florida/ SE Georgia	Rest of Demand Area	Total Demand Area
Existing and Planned to 1975	0	0	0.10	0.10
1975-1985 Refinery Expansions	0	0	0.10	0.10
New Refineries	0.37	0.30	0.91	1.58
Cumulative-Total	0.37	0.30	1.11	1.78
-OCS Induced	0.17	0	0.11	0.28
1985-2000 Refinery Expansions	0.21	0	0.37	0.58
New Refineries	0	0	0.60	0.60
Cumulative-Total	0.58	0.30	2.08	2.96
-OCS Induced	0.28	0	0.28	0.56

EXHIBIT II-9X

REFINERY CAPACITY DEVELOPMENT ASSUMPTIONS

(Million Barrels/Day)

South Atlantic #2

(Demand Area)

BASE CASE: 2 OCS PRODUCTION: HIGH

	Jacksonville	Rest of NE Florida/ SE Georgia	Rest of Demand Area	Total Demand Area
Existing and Planned to 1975	0	0	0.10	0.10
1975-1985 Refinery Expansions	0	0	0.10	0.10
New Refineries	0.48	0.30	1.36	2.14
Cumulative-Total	0.48	0.30	1.56	2.34
-OCS Induced	0.28	0	0.56	0.84
1985-2000 Refinery Expansions	0.10	0	0.20	0.30
New Refineries	0.28	0.28	0.88	1.44
Cumulative-Total	0.86	0.58	2.64	4.08
-OCS Induced	0.56	0.28	0.84	1.68

EXHIBIT II- 9Y

REFINERY CAPACITY DEVELOPMENT ASSUMPTIONS

(Million Barrels/Day)

Washington/Oregon

(Demand Area)

BASE CASE: 1 OCS PRODUCTION: NONE

	Skagit/ Whatcom Counties	Rest of Puget Sound, Washington	Rest of Demand Area	Total Demand Area
Existing and Planned to 1975	0.34	0	0	0.34
1975-1985 Refinery Expansions	0.34	0	0	0.34
New Refineries	0.10	0	0	0.10
Cumulative-Total	0.78	0	0	0.78
-OCS Induced	0	0	0	0
1985-2000 Refinery Expansions	0	0	0	0
New Refineries	0	0	0	0
Cumulative-Total	0.78	0	0	0.78
-OCS Induced	0	0	0	0

EXHIBIT II-9Z

REFINERY CAPACITY DEVELOPMENT ASSUMPTIONS

(Million Barrels/Day)

Washington/Oregon

(Demand Area)

BASE CASE: 1 OCS PRODUCTION: LOW

	Skagit/ Whatcom Counties	Rest of Puget Sound, Washington	Rest of Demand Area	Total Demand Area
Existing and Planned to 1975	0.34	0	0	0.34
1975-1985 Refinery Expansions	0.36	0	0	0.36
New Refineries	0.10	0	0	0.10
Cumulative-Total	0.80	0	0	0.80
-OCS Induced	0.02	0	0	0.02
1985-2000 Refinery Expansions	0	0	0	0
New Refineries	0.19	0	0	0.19
Cumulative-Total	0.99	0	0	0.99
-OCS Induced	0.21	0	0	0.21

EXHIBIT II-9AA

REFINERY CAPACITY DEVELOPMENT ASSUMPTIONS

(Million Barrels/Day)

Washington/Oregon

(Demand Area)

BASE CASE: 1 OCS PRODUCTION: HIGH

	Skagit/ Whatcom Counties	Rest of Puget Sound, Washington	Rest of Demand Area	Total Demand Area
Existing and Planned to 1975	0.34	0	0	0.34
1975-1985 Refinery Expansions	0.36	0	0	0.36
New Refineries	0.10	0	0	0.10
Cumulative-Total	0.80	0	0	0.80
-OCS Induced	0.02	0	0	0.02
1985-2000 Refinery Expansions	0	0	0	0
New Refineries	0.27	0	0	0.27
Cumulative-Total	1.07	0	0	1.07
-OCS Induced	0.29	0	0	0.29

EXHIBIT II - 9BB

REFINERY CAPACITY DEVELOPMENT ASSUMPTIONS

(Million Barrels/Day)

Northern California

(Demand Area)

BASE CASE: 1 OCS PRODUCTION: NONE

	Solano/ Contra Costa Counties	Rest of San Francisco Bay	Rest of Demand Area	Total Demand Area
Existing and Planned to 1975	0.57	0	0	0.57
1975-1985 Refinery Expansions	0.34	0	0	0.34
New Refineries	0	0	0	0
Cumulative-Total	0.91	0	0	0.91
-OCS Induced	0	0	0	0
1985-2000 Refinery Expansions	0	0	0	0
New Refineries	0	0	0	0
Cumulative-Total	0.91	0	0	0.91
-OCS Induced	0	0	0	0

EXHIBIT II - 9CC

REFINERY CAPACITY DEVELOPMENT ASSUMPTIONS

(Million Barrels/Day)

Northern California
(Demand Area)

BASE CASE: 1 OCS PRODUCTION: LOW

	Solano/ Contra Costa Counties	Rest of San Francisco Bay	Rest of Demand Area	Total Demand Area
Existing and Planned to 1975	0.57	0	0	0.57
1975-1985 Refinery Expansions	0.42	0	0	0.42
New Refineries	0	0	0	0
Cumulative-Total	0.99	0	0	0.99
-OCS Induced	0.08	0	0	0.08
1985-2000 Refinery Expansions	0.10	0	0	0.10
New Refineries	0.13	0	0	0.13
Cumulative-Total	1.22	0	0	1.22
-OCS Induced	0.31	0	0	0.31

EXHIBIT II - 9DD

REFINERY CAPACITY DEVELOPMENT ASSUMPTIONS

(Million Barrels/Day)

Northern California

(Demand Area)

BASE CASE: 1 OCS PRODUCTION: HIGH

	Solano/ Contra Costa Counties	Rest of San Francisco Bay	Rest of Demand Area	Total Demand Area
Existing and Planned to 1975	0.57	0	0	0.57
1975-1985 Refinery Expansions	0.47	0	0	0.47
New Refineries	0.10	0	0	0.10
Cumulative-Total	1.14	0	0	1.14
-OCS Induced	0.23	0	0	0.23
1985-2000 Refinery Expansions	0	0	0	0
New Refineries	0.40	0	0	0.40
Cumulative-Total	1.54	0	0	1.54
-OCS Induced	0.63	0	0	0.63

SOURCES OF DATA

American Petroleum Institute

Arthur D. Little, Inc. Potential Onshore Effects of Deep Water Terminal-Related Industrial Development. October 1973.

California Resources Agency. Energy in California. 1972

Clark, S. H. Testimony at CEQ Hearings, Anchorage, Alaska, September 26, 1973.

Engineering News Record. "Construction Cost Index." December 1970.

Exxon Corporation.

Gulf Oil Company.

National Ocean Industries Association.

Oil and Gas Journal. Various issues.

Phillips Petroleum Company, E. K. Grigsby, E. W. Mills, D. C. Collins. "Future Capital Requirements for Refined Petroleum Products." Paper presented at the National Petroleum Refiners Association Annual Meeting, April 1, 1973.

Radian Corporation. Technical Notes on Refinery Pollutants. 1973.

Roy F. Weston, Inc. "A New Petroleum Oil Refinery - The Environmental Impact." Paper presented at the 74th National Meeting of the American Institute of Engineers, March 11-15, 1973.

Shell Oil Company.

Stanford Research Institute. Meeting California's Energy Requirements: 1975-2000. 1973.

Sun Oil Company

Texaco Co.

SOURCES OF DATA (CONTINUED)

U.S. Department of Commerce. Bureau of the Census. Census of Manufacturers 1970. Washington, D.C.: U.S. Government Printing Office, 1971.

U.S. Department of Defense, Army Corps of Engineers. West Coast Deep Water Port Facility Study.

U.S. Department of the Interior, Geological Survey.

U.S. Department of the Interior. Energy Through the Year 2000. Washington, D.C.: U.S. Government Printing Office, December 1972.

U.S. Department of Labor, Bureau of Labor Statistics. Industry Wage Survey, Petroleum Refining. Washington, D.C.: U.S. Government Printing Office, 1972.

APPENDIX III

GAS PROCESSING INDUSTRY

To assess the onshore impact of developing oil and gas resources in the Atlantic and Gulf of Alaska Outer Continental Shelves (OCS), five potential industrial development activities[1] were analyzed in depth. This appendix discusses the development assumptions for the gas processing industry for each region of analysis, both for a baseline situation (without offshore production) and for high and low OCS production cases. The sections of this appendix cover:

- Trends in the gas processing industry and projected growth in gas consumption.
- The model for a gas processing plant used in the analysis as representative of future plants.
- Projections of regional gas processing development.

INDUSTRY DESCRIPTION

During the last 25 years, the production of natural gas and natural gas liquids (NGL) has increased rapidly in the continental United States. In the 1960's natural gas and NGL output increased approximately 70 percent to a 1970 output of approximately 22 trillion cubic feet of natural gas and 600 million barrels of NGL.[2] However, discovery of new reserves has declined since 1970 and, consequently, gas processing plant production and capacity utilization has declined, with an associated decrease in pipeline activity.

At the same time, pressures have been mounting for the use of natural gas and NGL as alternatives to oil or coal. Natural gas liquids in particular have emerged as extremely desirable products in an energy-deficient economy.

---

[1] The five development activities are offshore oil and gas recovery, oil refining, gas processing, petrochemicals and construction.

[2] Source: "U.S. Energy Outlook," National Petroleum Council, initial appraisal assumptions, 1972.

With decreasing exploration activity and proven reserves, it is not surprising that the growth of domestic natural gas and NGL production is expected to level out or even decrease over the next three decades. This should occur even with significant Alaskan production. On the other hand, substantial increases in synthetic gas production and imports are expected. Overall, the growth in gas supplies is forecasted at less than 2 percent annually through the year 2000, as shown in Exhibit III-1.

EXHIBIT III-1

U.S. GAS DEMAND/SUPPLY PROJECTIONS

(Billion Cubic Feet/Day)

	1971	1985	2000
Consumption:	60.5	80.8	105.4
Supply:			
Domestic Natural Gas	58.0	59.7	60.7
Synthetic Gas	0	5.5	15.1
Pipeline Imports	2.5	11.2	20.3
LNG Imports	0	4.4	9.3
TOTAL	60.5	80.8	105.4

Source: U.S. Dept. of Interior, Energy Through the Year 2000, 1972, p. 32 (converted to billion cubic feet per day).

These projections suggest that domestic natural gas production will grow only slightly through the year 2000.[1] The domestic NGL production trend should be tied fairly closely to that of natural gas production. Both the future level of exploration activity and the discovery of new reserves will determine these growth rates in the future.

[1] Industry experts and members of the Federal Power Commission have projected even lower levels of supply and consumption than shown in Exhibit III-1.

OCS production estimates have been developed for the Atlantic Coast and Gulf of Alaska areas as shown in Exhibit III-2.

EXHIBIT III-2

OFFSHORE GAS PRODUCTION ESTIMATES

(Billion Cubic Feet/Day)

Area		1985	2000
Atlantic Coast[1]	(low)	0.3	1.8
	(high)	0.9	3.6
Gulf of Alaska	(low)	0.3	2.4
	(high)	0.9	7.2

Source: RPA estimates based on Potential Gas Committee of Mineral Resources Institute, Colorado School of Mines Foundation, and U.S. Geological Survey (USGS) projections of resource availability, as well as comparison of Atlantic Coast and Gulf of Alaska reserves and production lifetime with other major supply fields.

For comparison purposes, Gulf of Mexico gas production is currently between 5 and 10 billion cubic feet per day. Projected Alaskan North Slope production projections range between 3 and 6 billion cubic feet per day by 1985 and between 7 and 12 billion cubic feet per day by 2000. Discussions with government and industry personnel suggest that the Atlantic Coast (total) and Gulf of Alaska each could approximate these two production areas by the year 2000.

Although the amount of gas resources off the Atlantic Coast and Gulf of Alaska is highly speculative, within the next 30 years proven reserves should reach approximately 50 trillion cubic feet for each area, with the Atlantic

---

[1]For each of the three potential producing areas (Georges Bank, Baltimore canyon and Georgia Embayment).

Coast somewhat higher than the Gulf of Alaska.[1] Aggregate reserves and daily production estimates for the two areas, based on reserve lifetimes of 15 and 20 years, are presented in Exhibit III-3.

EXHIBIT III-3

PROJECTED GAS RESERVES AND PRODUCTION LEVELS

Offshore Area	Reserves (Trillion Cubic Feet)	Production (Billion cfd) 15-year life	20-year life
Atlantic Coast	40-80	7.3-14.6	5.5-11.0
Gulf of Alaska	25-55	4.8-10.5	3.6-7.9

Source: RPA estimates based on Potential Gas Committee and USGS resource analysis.

The high end of the daily production range should be between 10 and 15 billion cubic feet per day on the Atlantic Coast by the year 2000. Thus, 10.8 billion cubic feet per day,[2] (or 3.6 billion for each of the three Atlantic Coast regions) has been estimated as the Atlantic Coast high. The potential Gulf of Alaska resources appear to be about two-thirds of the total Atlantic reserves (all three producing areas combined). Thus, 7.2 billion cubic feet per day is used as the Gulf of Alaska high estimate, as shown in Exhibit III-2.

REPRESENTATIVE PLANT

To estimate the onshore economic and environmental impacts, it was necessary to define a gas processing plant that would be representative of future plants, should offshore gas production occur. It was also necessary to

---

[1]The Potential Gas Committee estimates the total Atlantic OCS gas resources at 35 trillion cubic feet (31 trillion cubic feet of which are under water at less than 200 meters). The USGS estimates run to somewhat over 200 trillion cubic feet.

[2]As indicated in Exhibit III-2.

define the type of gas to be processed in this model plant. Thus, the study assumes that the gas would have the characteristics shown in Exhibit III-4.

EXHIBIT III-4

ASSUMED OCS GAS CHARACTERISTICS

Factor	Content
Hydrogen sulphide and other sulphur compounds	2 percent
Carbon dioxide	2 percent
Water	10-20 lbs/million cu. ft.
Liquid condensates	20 barrels/million cu. ft.
Extractable liquids (ethane and heavier)	0.8 gallons/thousand cu. ft.
Nitrogen and other inerts	(below required treatment levels)

The gas is assumed to contain 90 percent methane, as well as ethane, propane, butane, and assorted natural liquid condensates. Separation of liquid condensates and some dehydration is assumed to occur on the offshore platform prior to pipelining ashore.

All required processing was assumed to be done at the onshore receiving site. For the East Coast, this is desirable since there are local markets needing the gas. Alaskan gas must be processed locally because both pipelining and liquefaction (for shipping) require desulphurization and dehydration. Thus, LNG plants and shipping facilities would likely be developed in Alaska. On the West Coast, LNG offloading facilities would be developed (with or without OCS production), but no further gas processing would be required.

The balance of this section describes the physical and economic characteristics, resource requirements, and pollution levels of the model gas processing plant.

Physical Characteristics

Based on the type of gas used, the following gas processing activities would be required:

Processing

- Hydrogen sulphide removal, conversion to elemental sulphur, and tail gas clean-up;
- Dehydration (gas dehydrated to 10 - 20 pounds per million cubic feet on offshore platform);
- Liquid extraction of 0.6 gallons per thousand cubic feet;
- Separation of extracted liquids and liquid condensates into liquid petroleum gases and natural gasoline;
- Removal of heavier sulphur compounds by individual stream;

Storage and Distribution

- Storage of five to ten days' capacity for the liquid petroleum gases (gas distributors would have additional storage capacity);
- Storage of recovered sulphur;
- Two pipeline connections to distribution network.

The model plant is assumed to have a 500 million cubic feet (mmcf) per day processing capacity. In the first few years of offshore gas production, the plant likely would not be this large. However, by the year 2000, the projected high levels of gas production should result in plants with over one billion cubic feet per day capacities. It is further assumed that over the long term, the plants would operate at 90 percent of capacity, giving an average through-put of 450 million cubic feet per day for the model plant.

Economic Characteristics

The sales value, employment, employee earnings, and construction costs for a model plant were estimated, as discussed in the following paragraphs.

Sales Value. The sales value of a model plant was determined for extracted gas liquids (excluding natural condensates) since most of the investment and processing costs are relevant only to this product. The usual industry practice is that the producer sells the reserves to a distribution company but retains the right to process the gas for recovery of the liquids.

For the East and West Coast regions, extracted gas liquids were valued in constant 1970 dollars at $5.00 per barrel (about three times the 1970 value of liquified petroleum gas and ethane in the Gulf of Mexico states). This price represents the approximate local market value, based on total market demand and transportation costs from the Gulf to gas-deficient areas of the country.[1] The annual sales value for recovered gas liquids would therefore be $11.8 million for a 500 mmcf/day.[2] For Alaska, the sales value was estimated at $9 million due to additional transportation costs to the market.

Employment. The estimated 1970 employment for a representative plant is 55 persons.[3] Future productivity increases were assumed to be one percent through 1985 and four percent from 1985 to 2000. These figures draw on the assumption that in the early years of offshore production, the amount of gas processed would not justify construction of plants with capacities larger than 500 million cubic feet per day; but by the year 2000, the high levels of gas availability should allow plants of between one and two billion cubic feet per day to operate with greater economies of scale. The number of employees for the model plant based on these productivity increases was assumed to be 47 in 1985 and 26 in the year 2000.

---

[1] Bureau of Mines, Minerals Yearbook Preprint, 1971, p. 11.

[2] Calculation for value of extracted liquids:
14.3 bbl per mmcf x 500 mmcf/day x 330 stream days/year x $5.00/bbl = $11.8 million.

[3] Industry sources.

Earnings. The average 1970 compensation of gas processing plant employees in the Gulf of Mexico was approximately $10,000.[1] Assuming that two-thirds of the 1 percent productivity increase to 1985 and that one-third of the 4 percent increase to the year 2000 is passed on as employee compensation, the average compensation will increase 11 percent by 1985 and 34 percent by 2000. Exhibit III-5 projects employee compensation by geographic area.

EXHIBIT III-5

AVERAGE COMPENSATION

OF GAS PROCESSING PLANT EMPLOYEES

Geographic Area	Wage Index[a]	Direct Annual Compensation (1970 constant dollars)		
		1970	1985[b]	2000[b]
New England	3.23	11,950	13,250	16,100
Mid-Atlantic	3.40	12,600	13,950	16,950
South Atlantic	2.70	10,000	11,100	13,450
Alaska	4.66	17,250	19,150	23,250

[a]Statistical Abstract of the U.S., 1971, all manufacturing index, Department of Commerce, p. 227.

[b]Wages increase by 0.7 percent annual to 1985 and by 1.3 percent from 1985 to 2000.

Source: RPA Estimates.

Investment Requirements. The investment requirements for the model gas processing plant would be about 10 percent of those for a refinery or petrochemical complex. Based on industry publications and discussions with the gas processing industry representatives and their contractors, the construction cost per plant (1970 dollars) was estimated to be about $30 million for the East Coast and

[1]Industry sources.

$50 million for Alaska. Exhibit III-6 projects construction costs for 1985 and 2000 for each region of gas processing development.

EXHIBIT III-6

ESTIMATED INVESTMENT COSTS OF

REPRESENTATIVE GAS PROCESSING PLANT

Geographic Area	Construction Cost Index[a]	Estimated Investment Costs (Millions of 1970 Dollars)		
		1970	1985[b]	2000[b]
New England	1434	35.2	35.4	36.5
Mid Atlantic	1414	34.6	34.8	36.0
South Atlantic	1101	27.0	27.2	28.0
Alaska	2075	50.9	51.3	52.8

[a] Engineering News Record, Construction Cost Index, December, 1970. Alaskan index "patched" to this index using Robert Means, Building Construction Cost Data, 1971.

[b] Costs raised slightly (in 1970 dollars) to account for capital investments for productivity improvements.

Source: RPA Estimates.

Resource Requirements

As with the investment requirements, the land, water, and electrical resource requirements would not be nearly as high for the model gas plant as for a refinery or petrochemical complex.

The model plant would require approximately 20 acres, about half for direct plant use and the remaining half for expansion and other buffer purposes. These minimum land requirements are not expected to vary by region.

The future water and electrical requirements are estimated at 15,000 gallons of makeup water per day and approximately 1800 kilowatt hours per day of electrical energy.[1]

Pollution Levels

Water pollution loadings from the model plant would be insignificant. Air pollution loadings would be emitted from three sources: natural gas liquids extraction equipment, hydrogen sulfide removal equipment, and trucks loading liquid petroleum gases. Exhibit III-7 details the pollution levels assumed for a 500 mmcf/day gas processing plant.

EXHIBIT III-7

ESTIMATED POLLUTION LEVELS

REPRESENTATIVE GAS PROCESSING PLANT

(Tons per year)

Pollutant	Loading
Air	
Particulates	95
Oxides of sulfur	89
Oxides of nitrogen	1540
Hydrocarbons	238
Carbon monoxide	725
Water	
Biological oxygen demand	insignificant
Total dissolved solids	insignificant
Total suspended solids	insignificant

Source: Environmental Impacts, Efficiency, and Cost of Energy Supply and End Use, Hittman Associates, Inc., September, 1973, Table 25.

[1] Industry sources.

PROJECTED REGIONAL DEVELOPMENT

Future gas processing development on the East Coast and in Alaska is not expected to be limited by environmental factors, labor availability, or other factors that typically constrain oil refining or petrochemical development today. Two reasons account for this: (1) the preference for gas fuels over oil; and (2) the smaller resource requirements and the smaller physical scale of a gas processing operation.

Gas processing development under baseline conditions (i.e., without offshore gas production) is expected to have limited impact on the local and regional economies except in Alaska, where gas production in 1985 is projected at 4 billion cubic feet per day, and in 2000 at 10 billion cubic feet per day.[1] In the lower 48 states, LNG imports should increase in each region, but no processing of this gas is assumed since the gas would be de-sulphurized, dehydrated, and have liquids extracted before liquefaction.

Synthetic natural gas (SNG) development would likely also occur in the regions of analysis. It is assumed SNG production will not occur in the local areas studied. Some SNG production could develop in the regions of analysis by 1985, but by 2000 much of the SNG production would be tied to coal, a trend that will move this development out of these regions. It is assumed, then, that SNG production will not be significant when compared to the total industrial impact under study.

With regard to gas processing caused by OCS development, on the East Coast the greatest impact should occur in the locality of analysis. Only in the high development impact case for the year 2000 should gas processing develop outside these localities. For the higher Alaskan OCS production, about one-third of the processing would occur in the locality and two-thirds in the region.[2]

---

[1]The majority of this production should be from the Alaskan North Slope and the Kenai Peninsula and would be piped or shipped via LNG tanker (latter method most likely) to the U.S.

[2]After processing, the natural gas would be liquefied and shipped to the U.S.

Exhibits III-8, 9, and 10 detail the projected gas processing activity in number of model plants for the base case and OCS impact cases. An estimate of projected regional gas consumption for 1985 and 2000 indicates that each East Coast region would use all of its OCS gas production except the high production case for New England in the year 2000. Exhibit III-11 shows projected gas consumption levels by region.

EXHIBIT III-8

REGIONAL GAS PROCESSING PROJECTIONS

BASE CASES[a,b]

GEOGRAPHIC AREA	1970				1985				2000			
	Locality		Region		Locality		Region		Locality		Region	
	Gas Processed	Number of Plants	Gas Processed	Number of Plants	Gas Processed	Number of Plants	Gas Processed	Number of Plants	Gas Processed	Number of Plants	Gas Processed	Number of Plants
New England	0	0	0	0	0	0	0	0	0	0	0	0
Mid Atlantic	0	0	0	0	0	0	0	0	0	0	0	0
South Atlantic	0	0	0	0	0	0	0	0	0	0	0	0
Alaska[c]	0	0	40	0.1	0	0	4000	8.9	0	0	10000	22.2

[a] Base cases 1 and 2 (East Coast) identical; only one base case for Alaska.

[b] Gas processed is measured in millions of cu. ft. per day; number of plants is based on 500 million cu. ft./day plants at 90 percent capacity.

[c] No processing of Alaskan gas occurs on the West Coast.

Source: RPA estimates.

EXHIBIT III-9

REGIONAL GAS PROCESSING PROJECTIONS

OFFSHORE LOW PRODUCTION[a]

GEOGRAPHIC AREA	1970				1985				2000			
	Locality		Region		Locality		Region		Locality		Region	
	Gas Processed	Number of Plants	Gas Processed	Number of Plants	Gas Processed	Number of Plants	Gas Processed	Number of Plants	Gas Processed	Number of Plants	Gas Processed	Number of Plants
New England	0	0	0	0	300	0.7	0	0	1800	4	0	0
Mid Atlantic	0	0	0	0	300	0.7	0	0	1800	4	0	0
South Atlantic	0	0	0	0	300	0.7	0	0	1800	4	0	0
Alaska[b]	0	0	0	0	300	0.7	0	0	770	1.7	1630	3.6

[a] Gas processed in millions of cubic feet per day; number of plants based on 500 million cu. ft./day plants at 90 percent capacity.

[b] No processing of Alaskan gas occurs on the West Coast.

Source: RPA estimates.

EXHIBIT III-10

REGIONAL GAS PROCESSING PROJECTIONS

OFFSHORE HIGH PRODUCTION[a]

GEOGRAPHIC AREA	1970				1985				2000			
	Locality		Region		Locality		Region		Locality		Region	
	Gas Processed	Number of Plants	Gas Processed	Number of Plants	Gas Processed	Number of Plants	Gas Processed	Number of Plants	Gas Processed	Number of Plants	Gas Processed	Number of Plants
New England	0	0	0	0	900	2	0	0	1800	4	1800	4
Mid Atlantic	0	0	0	0	900	2	0	0	1800	4	1800	4
South Atlantic	0	0	0	0	900	2	0	0	1800	4	1800	4
Alaska[b]	0	0	0	0	450	1	450	1	2250	5	4950	11

[a] Gas processed in millions of cubic feet per day; number of plants based on 500 million cu. ft./day plants at 90 percent capacity.

[b] No processing of Alaskan gas occurs on the West Coast.

Source: RPA estimates.

EXHIBIT III-11

REGIONAL CONSUMPTION PROJECTIONS

(billion cubic feet per day)

Geographic Area	Consumption in Year: 1971	1985	2000	Year 2000 High OCS Production
New England	0.7	1.0	1.7	3.6
Mid Atlantic	5.1	7.1	9.9	3.6
South Atlantic	4.1	6.5	11.1	3.6
Washington/Oregon	0.7	1.0	1.5	0.0
California	5.9	8.0	12.5	0.0
Alaska	(nil)	(nil)	(nil)	7.2
Other U.S.	44.0	57.2	68.7	(n.a.)
TOTAL U.S.	60.5	80.8	105.4	(n.a.)

Source: "Confidential" industrial regional forecasts, prorated to total estimates from the Department of Interior publication, Energy Through the Year 2000, and RPA estimates.

SOURCES OF DATA

American Gas Association. A Comprehensive Summary, Gas Supply in the National Energy Situation. 1972.

American Gas Association, Department of Statistics. Gas Facts. 1971.

American Gas Association, Department of Statistics. Gas Utility Industry Projections to 1990. June 1973.

American Gas Association. Quarterly Reports of Gas Industry Operations.

American Gas Association. Release 22-73. March 19, 1973.

American Gas Association. Production of Pipeline Gas from Crude Oil Feedstocks. August, 1972.

Arthur D. Little. "A Current Review of SNG Process Technology." Paper presented at Gas Conditioning Conference, Norman, Oklahoma, March 16, 1973.

Arthur D. Little. "Substitute Natural Gas from Light Hydrocarbons." Paper presented to the New England Gas Association, June 21, 1973.

Colorado School of Mines Foundation, Mineral Resources Institute, Potential Gas Committee. Potential Supply of Natural Gas in the United States. October 1971.

Engineering News Record. "Construction Cost Index." December, 1970.

Federal Power Commission.

Hittman Associates, Inc. Environmental Impacts, Efficiency, and Cost of Energy Supply and End Use. September 1973.

Robert Means. Building Construction Cost Data. Robert Means, 1971.

National Association of Gas Processors.

National Petroleum Council. U.S. Energy Outlook. 1972.

Oil & Gas Journal. Various Issues.

SOURCES OF DATA (CONTINUED)

Pacific Lighting Corporation.

Texaco, Inc.

U.S. Department of Commerce, Bureau of the Census. Statistical Abstract of the United States. Washington, D.C.: U.S. Government Printing Office, 1971.

U.S. Department of the Interior. Energy through the Year 2000. Washington, D.C. U.S. Government Printing Office, December 1972.

U.S. Department of the Interior, Bureau of Mines, Mineral Industries Surveys. Natural Gas Production and Consumption: 1972. Washington, D.C.: U.S. Government Printing Office, 1972.

U.S. Department of the Interior, Bureau of Mines. Minerals Yearbook Preprints on Natural Gas and Natural Gas Liquids. Washington, D.C.: U.S. Government Printing Office, 1972.

U.S. Department of the Interior, Geological Survey.

APPENDIX IV

PETROCHEMICAL INDUSTRY

To assess the onshore impact of developing oil and gas resources in the Atlantic and Gulf of Alaska Outer Continental Shelves (OCS), five potential industrial development activities[1] were analyzed in depth. This appendix discusses the petrochemical industry development assumptions for each region of analysis, both for a baseline situation without OCS production, and for the different offshore production cases. In three major sections, this appendix:

- Discusses in brief the nature of the petrochemical industry and future trends;
- Describes the complex of plants used to represent future petrochemical development;
- Projects regional petrochemical development in terms of these representative complexes.

INDUSTRY DESCRIPTION

The U.S. petrochemical industry is a very large and complex industry whose rate of growth should decrease sharply in the future from its historic growth of over 10 percent.

Petrochemicals are chemicals derived from refined petroleum products (e.g., naphtha) and natural gas liquids. The chemicals directly produced from these raw feedstocks are classified into two main categories - olefins and aromatics. These basic petrochemicals are further processed through several intermediate stages into a wide range of chemical derivatives (e.g., dyes, resins, and fibers), from which many end products are made, including paints, textiles, rubbers, plastic products, and many others.

---

[1] The five activities are offshore oil and gas recovery, oil refining, gas processing, petrochemicals, and construction.

In 1970, petrochemical industry shipments totalled almost $20 billion, about one-third of total chemical industry sales. Its employment exceeded 300,000 and its value added approximated $10 billion, more than twice that of the petroleum refining industry. Primary organic petrochemicals - those whose manufacturing operations tend to locate close to feedstock sources - had a sales value of $7.4 billion.[1]

The petrochemical industry currently has a positive trade balance of over $1 billion, although since 1970 it has declined somewhat.[2] In the future, the U.S. export mix is expected to shift away from primary organic chemicals to more sophisticated derivatives as the strength of foreign competition increases in the basic chemicals.

With its historic annual growth rate of over 10 percent, during the 1950s and 1960s the average size of petrochemical plants increased dramatically. This trend had two important results: (1) it allowed prices to remain constant or grow slowly, thus stimulating further demand, and (2) it facilitated in the 1960s the creation of "chemical complexes", in which an integrated group of chemical plants, often associated with a refinery, was formed to optimize the complex economics of the group. A substantial portion of future industry development is likely to occur in the form of these complexes, particularly because future development should be much more dependent on refinery heavy liquid feedstock than in the past.

Perhaps the most important trend likely to affect future petrochemical industry development is the expected shift in feedstocks from natural gas liquids (NGL) toward refinery heavy liquids (eg. naptha or gas oil). The increasing priority of NGL for fuel uses and, most importantly, the expected limitation in NGL supplies should cause this shift. Unless significant new natural gas discoveries are made, the absolute amount of NGL used for petrochemical feedstock in the year 2000 could be the same or less than current usage. Currently, however, there are strong pressures on the Federal government to enact policies (e.g. deregulation of gas prices at the wellhead) that would stimulate new exploration and the associated discovery of new gas reserves. In any event, future NGL supplies should be limited, and the two main feedstocks for new petrochemical development should be the refinery

---

[1] U.S. Department of Commerce

[2] U.S. Department of Commerce

heavy liquids, naphtha and gas oil. These will likely be both domestically produced and imported.

The amount of future feedstock required depends on projected industry growth. The annual growth rate is likely to decrease from its historical 10 to 12 percent by the year 2000[1] for several reasons.

First, and most significantly, there should be constraints on feedstock supply. Foreign oil supply limitations during a period of rising U.S. dependence on imports is already constraining industry growth. Concern over feedstock limitations has resulted in the industry forming a petrochemical energy group (PEG) to analyze this problem and conduct governmental liaison to articulate the industry's needs vis-a-vis the fuel allocation programs being developed. In a report recently completed for PEG, Arthur D. Little analyzed a potential 15 percent cutback in primary organic chemical production. In any event there is likely to be some feedstock limitations which immediately drop the industry growth rate.

The second reason for projecting a decreasing growth rate is the likely rise in costs of energy and primary organic chemicals that would force up the end product prices, a trend that would tend to slow demand growth and allow at least some product substitution (e.g., natural fibers for synthetic fibers).

Third, even if feedstock and energy availability and costs were no problem, there will likely be construction industry capacity limitations and total capital funding constraints limiting the total heavy industry growth, including the chemical industry, in the last quarter of this decade.

Depending on the growth rate, the petrochemical industry could grow five to ten times its 1970 size by the year 2000. Assuming that 80 to 90 percent of new petrochemical development would be supplied by refinery heavy liquids, 10 to 26 percent of new refinery output would be required

---

[1] Predictions by governmental and industry sources of the industry growth rate by 2000 vary from 4 to 7 percent.

for petrochemical feedstocks, as shown in Exhibit IV-1. The high estimate of the gross feedstock requirements would be at or near the technical upper limit of refinery heavy liquids production. There would also be an economic limit from competing fuel uses. This study assumed that the percentage of new domestic refinery output used for new petrochemical feedstock would be 9-10 percent in 1985 and 12-13 percent in 2000.[1] Any additional feedstock requirements are assumed to be imported or come from new NGL supplies.

In assessing future petrochemical growth in the regions of analysis, it is useful to think about the development in terms of the complexes discussed earlier. The next section of this appendix describes the characteristics of these complexes as used for the impact analysis.

---

[1] It is assumed that, in essence, existing refineries would continue to supply the same amount of (current) feedstock in the future, perhaps a somewhat conservative assumption.

EXHIBIT IV-1

ESTIMATED NEW REFINERY OUTPUT FOR PETROCHEMICAL FEEDSTOCKS
(Thousand barrels per day)

Projections	1970	1985 Low[a]	1985 High[b]	2000 Low[a]	2000 High[b]
Total Domestic Refinery Runs[c]	10900	21000	21000	33000	33000
New Refinery Runs	-	10100	10100	22100	22100
Total Feedstock	750[d]	1710	2610	3240	7540
New Feedstock from Refinery Heavy Liquids[e]	-	820	1580	2120	5770
New Feedstock as Percent of New Refinery Runs[f]					
-Net	-	8%	16%	10%	26%
-Gross[g]	-	12%	23%	14%	38%

	Petrochemical Industry Growth Rate		
	1970s	1980s	1990s
[a]Low estimate	6%	5%	4%
[b]High estimate	9%	8%	7%

[c]Arthur D. Little report, Potential Onshore Effects of Deepwater Oil Terminal-Related Industrial Development, October, 1973.

[d]R.G. Dodge, Shell Oil Company, "The U.S. and its World Position in Hydrocarbon Raw Materials", February, 1973. (Converted to thousand barrels per day.)

[e]85% of future feedstock increases.

[f]Low severity process with 31 percent refinery returns assumed.

[g]Technical limit for gross refinery heavy liquids feedstock production somewhat over 30 percent of total output.

Source: RPA.

REPRESENTATIVE COMPLEX

To analyze the potential OCS impact, a petrochemical complex of plants supporting 1 billion pounds of olefins production per year was used as representative of future petrochemical development that would occur in the regions of analysis, where currently there is a minor amount of petrochemical manufacturing. These complexes would be tied largely to refinery development, and include plants producing those primary organic chemicals and key derivatives that are typically manufactured close to feedstock sources for economic reasons. The particular complex of plants assumed for analytical purposes is described in Exhibit IV-2. It produces all of the main olefins and aromatics, as well as key derivatives of ethylene, propylene, and benzene that would typically be produced near the feedstock source.[1] It is intended to represent those plants that would not locate in a region, were the feedstock not available. It would thus represent a true incremental impact, should OCS oil and gas be developed.

In determining the types of plants to include in this "impact complex", a judgement had to be made whether the "industry bandwagon" effect, which historically has drawn many downstream chemical plants into the petrochemical-intensive Gulf Coast area, would occur in the regions analyzed in this study. The determination was made that this would not occur, since even by 2,000 under high OCS production, the Gulf Coast is expected to retain the lion's share of total U.S. primary organic chemical production, and each of the regions analyzed a relatively small share.

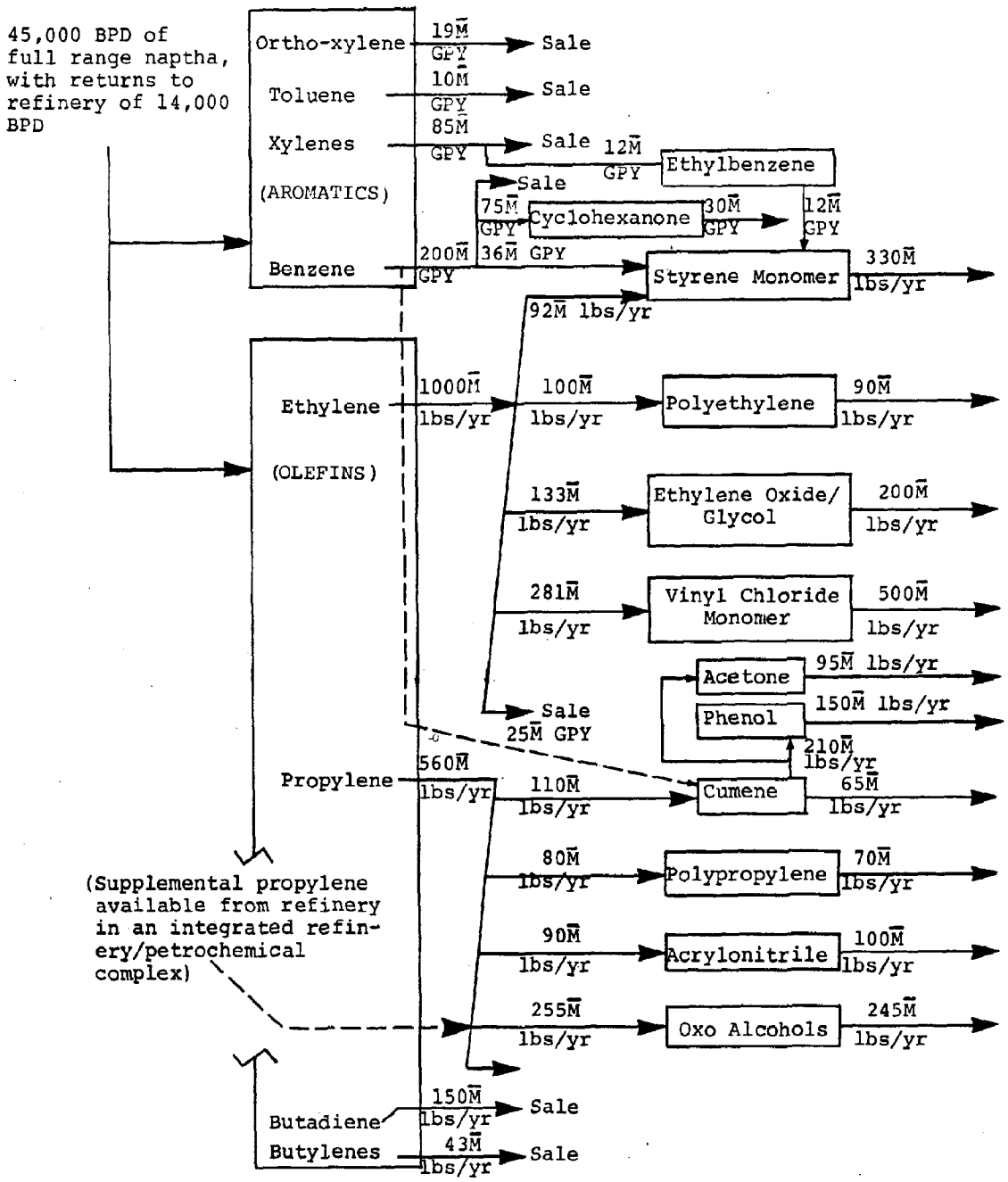
The representative complex is balanced for a future product mix using a full range naptha feedstock. The projected product mix was based on expected overall olefins and aromatics growth rates. Because olefin growth rates should be higher than aromatics, olefins production is overweighted in terms of current industry production. For example, a para-xylene plant is not included whereas an oxoalcohol plant is included because in many cases the complex will be refinery-tied.

Naptha is the most representative feedstock for analytic purposes of this study. For the lighter ethane feedstock complexes (perhaps ten to fifteen percent of future complexes), this assumption probably overstates development activity, since essentially only ethylene and its derivatives would be involved. For the heavier gas oil feedstock complexes,

[1] Although the type and amount of derivatives produced will change over time as new products are developed, the products in the complex are considered representative for the economic and environmental impact analysis.

EXHIBIT IV-2

REPRESENTATIVE PETROCHEMICAL COMPLEX[a]



[a] Relatively low severity process/high return process with a gross feedstock to ethylene ratio of 4.5.

this assumption may understate development activity since some additional olefins and aromatics derivatives production could occur that is not included in the representative complex. But overall, the development can best be approximated by the assumed complex.

In the balance of this section the economic, resource, and pollution characteristics of this representative complex are described.

Economic Characteristics

The sales value of the representative complex approximates $260 million for the assumed product mix, based on average 1970 U.S. prices. Exhibit IV-3 shows the output, prices, and sales value for each product in the complex.

The employment requirements for the assumed complex are estimated to be substantially lower than for current primary organic chemical production plants. Whereas a ratio of 14 workers per $1 million sales is currently typical overall, for the assumed petrochemical development in the regions of analysis a current ratio of 10 employees per $1 million sales is assumed . The main reason for the lower employment requirements is that the assumed development in the regions analyzed in this study has a greater proportion of integrated refinery/petrochemical complexes with lower employment ratios, and a correspondingly smaller proportion of small scale plants with higher employment ratios.

The assumed employment ratio includes both hourly and salaried personnel, and some base plant facilities (eg., offices, laboratory), and it results in 2,600 employees (at 1970 productivity levels) for the representative complex.

The number of employees is expected to decrease with future increases in productivity. Although the petrochemical industry has exhibited approximately a 5 percent annual productivity increase historically, it appears that the most significant gains from economies of scale have already been achieved. Therefore productivity increases through 1985 have been estimated at 2.5 percent annually, and after 1985 at 1.5 percent annually. These productivity increases would reduce the number of employees for a complex from 2,600 in 1970 to 1,780 in 1985, and 1,420 in the year 2000. Assuming that two-thirds of these productivity increases are passed on to the employees as increased compensation, employee

EXHIBIT IV-3

SALES VALUE OF REPRESENTATIVE COMPLEX

Product	Annual Output (Millions)	Average 1970 Price per unit[a]	1970 Sales Value ($ Millions)
1. Ortho-xylene	20 gal.	23¢	$4.6
2. Toluene	10 gal.	18¢	1.8
3. Xylenes	85 gal.	17¢	14.4
4. Benzene	200 gal.	18¢	36.0
5. Cyclohexane	30 gal.	25¢	7.5
6. Ethyl benzene	12 gal.	27¢	3.2
7. Styrene	380 lbs.	6¢	22.8
8. Ethylene	1000 lbs.	3¢	30.0
9. Polyethylene	90 lbs.	13¢	11.7
10. Ethylene Glycol	200 lbs.	7¢	14.0
11. Vinyl Chloride Monomer	500 lbs.	4¢	20.0
12. Propylene	560 lbs.	2.5¢	14.0
13. Cumene	275 lbs.	4¢	11.0
14. Phenol	150 lbs.	7¢	10.5
15. Polypropylene	70 lbs.	20¢	14.0
16. Acrylonitrile	100 lbs.	11¢	11.0
17. Oxo Alcohols	245 lbs.	8¢	19.6
18. Butadiene	150 lbs.	8¢	12.0
19. Butylenes	40 lbs.	4¢	1.6
TOTAL			$260 (rounded)

[a] Synthetic Organic Chemicals, U.S. Tariff Commission, 1970. Internal transfers valued at open market value.

Source: RPA estimates.

earnings will increase by about 30 percent from 1970 to 1985, and by an additional 20 percent by the year 2000. Exhibit IV-4 gives the projected annual compensation for petrochemical employees in each of the regions of analysis.

EXHIBIT IV-4

ESTIMATED AVERAGE COMPENSATION OF PETROCHEMICAL COMPLEX EMPLOYEES

Region	Chemical Industry Relative Wage Index[a]	Direct Annual Compensation[b] (1970 Dollars) 1970	1985	2000
N. Atlantic	3.59	10,700	13,800	16,000
Mid Atlantic	3.86	11,500	14,800	17,200
S. Atlantic	3.26	9,700	12,500	14,500
Puget Sound	4.23	12,600	16,200	18,850
San Francisco Bay Area	3.98	11,850	15,250	17,700

a -"Chemical Week",October 17, 1973, deflated to 1970.
b - 1.7 percent annual increase to 1985, 1.0 percent thereafter.

Source: RPA estimates.

The investment cost of a complex is estimated to range from 230 to 250 million dollars in the South Atlantic area to 330 to 360 million in the San Francisco area, based on assumed sales ratios that vary significantly by region. In the late sixties, the overall U.S. investment to sales ratio for petrochemical plant consturction increased to above 1.0 as investment costs rose while prices remained roughly constant. Investment to sales ratios should rise in the future as additional productivity-related capital investments are made.

Exhibit IV-5 shows the estimated future investment to sales ratios by region. The 1985 and 2000 ratios were calculated by adding to the 1970 investment cost one quarter of the present value of wage savings over a twenty-year period, the assumption

EXHIBIT IV-5

ESTIMATED FUTURE INVESTMENT COSTS

REPRESENTATIVE PETROCHEMICAL COMPLEX

Region	Sales Value of Complex (Millions of 1970 dollars)	Construction Cost Index a	Investment/ Sales Ratio[b]			Future Required Investment (Millions of 1970 dollars)	
			1970	1985	2000	1985	2000
U.S. Overall	260	1445	1.05	1.16	1.24	301	322
Gulf of Mexico	260	1150	.85	.94	1.00	244	260
N. Atlantic	260	1434	1.04	1.15	1.23	299	320
Mid Atlantic	260	1414	1.03	1.14	1.22	296	317
S. Atlantic	260	1101	.80	.88	.94	229	244
Puget Sound	260	1408	1.02	1.13	1.20	294	312
San Francisco Bay Area	260	1598	1.16	1.28	1.37	333	356

a - "Engineering News Record", Construction Cost Index, December 1970.

b - 1985 and 2000 ratios increased to reflect additional productivity-related investments.

Source: RPA Estimates

being that capital investments that increase productivity will not be instituted unless they can show a clear, attractive return. The investment to sales ratios are higher in New England, the Mid-Atlantic, and San Francisco because of the likelihood of more separate sites due to a greater emphasis on dispersion (Mid-Atlantic) and preservation of the coastline (New England and San Francisco).

Resource Requirements

The resource requirements of the representative complex are significant for land, water, and electrical demand.

Based on talks with industry representatives and contractors, it is estimated that a minimum of 300 acres are currently required for this type of complex. It is likely that the land requirements will rise somewhat in the future because of increased environmental pressures for aesthetics, noise abatement, safety, etc., forcing more green belt land. Although the trend towards integrated refineries and petrochemical complexes will tend to decrease the net land requirements, this should not offset other pressures for more land. It is assumed that land requirements in the more crowded Mid-Atlantic and San Francisco areas will stay the same as more land-efficient installations are used there. The future land requirements by region are assumed as follows:

REGION	ACRES REQUIRED
New England	330
Mid-Atlantic	300
South Atlantic	350
Puget Sound	350
San Francisco Bay Area	300

The water makeup requirements should decrease as industry becomes more efficient in using water, but should still be significant. Current water requirements for the representative complex approximate 24 million gallons per day (see Exhibit IV-6). Engineering contractors and industry sources indicate that a 50 percent reduction in water makeup requirements should be achieved by 1985 and an additional 20 percent reduction should occur by 2000.

EXHIBIT IV-6

ESTIMATED WATER REQUIREMENTS
REPRESENTATIVE PETROCHEMICAL COMPLEX[a]

Plant	Annual Output (Million lbs)	Current Makeup Makeup Requirements (Million GPD)
Orthoxylene	139	0.4
Toluene, Xylenes, Benzene	2150	1.8
Styrene	380	3.0
Ethylbenzene	87	0.5
Ethylene, Propylene	1560	6.0
Butadiene, Butylene	194	0.5
Cumene, Phenol, Acetone	520	0.8
Polyethylene	90	0.3
Ethylene Glycol	200	1.6
Vinyl Chloride Monomer	500	4.0
Polypropylene	70	0.2
Oxo Alcohols	245	1.3
Acrylonitrile	100	1.9
Cyclohexanone	237	1.6
Total	6472	24 (approx.)

[a]Obtained through discussions with engineering contractors and industry sources.

Source: RPA

Electrical energy is the third significant resource requirement for the complex. Purchased electrical energy requirements are estimated at 600 million kilowatt hours per year. To the extent that the power requirements in any locality or region pose a constraint, more power can be produced internally. In this case, more fuel would be consumed, and a somewhat greater plant investment would be required.

Pollution Levels

The estimated future air and water pollution loadings from the plants making up a petrochemical complex are expected to be substantially lower than for existing plants because of expected improvements in effluent control and treatment.

To determine air pollution loadings for the representative complex, particulates and hydrocarbon emissions data were obtained through discussions with chemical industry sources having similar plants, and expected future control factors were applied. The particulate and hydrocarbon loadings for a complex should be approximately one-quarter of those for a 200,000 barrel per day refinery, and are not expected to pose any significant problem. The basic olefins production plant is expected to produce the vast majority of the air pollution loadings of the complex.

The water pollution loadings are relatively more important than for the air pollutants, but due to expected reductions from future water treatment applications, the loadings should not present any significant problem in general. However, each body of water near which a petrochemical plant is located must be specifically analyzed to determine its capability to handle the plant discharges.

Exhibit IV-7 gives the estimated future air and water pollution loadings for the representative complex. Appendix IX discusses the methodology used in projecting the total air and water pollution loadings by region.

PROJECTED REGIONAL DEVELOPMENT

Future petrochemical development in the regions of analysis will be affected by a number of factors, such as profitability, availability of feedstock, investment costs,

EXHIBIT IV-7

ESTIMATED FUTURE AIR AND WATER POLLUTION LOADINGS
REPRESENTATIVE PETROCHEMICAL COMPLEX
(Tons per year)

Plant	Annual production (million lbs)	Air[a]		Water[b] (Best available technology)		
		Particulates	Hydrocarbons	BOD	COD	Suspended Solids
Orthoxylene, Toluene, Xylenes, Benzene	2289	nil	110	23	228	0-1
Styrene, Ethylbenzene	467	nil	467	18	875	5
Ethylene, Propylene, Butadiene, Butylene	1754	345	1754	43	442	20
Cumene, Phenol	425	2	102	12	517	4
Acetone	95	nil	nil	n.a.	n.a.	n.a.
Polyethylene	90	36	112	3	19	2
Ethylene Glycol	200	nil	80	3	98	0-1
Vinyl Chloride	500	nil	nil	12	110	10
Polypropylene	70	nil	nil	5	31	3
Acrylonitrile	100	nil	nil	3	25	15
Oxo Alcohols	245	nil	nil	21	1071	6
Cyclohexanone	237	nil	nil	11	111	0-1
Total	6472	383	2625	155	3527	68
				711[c]	6972[c]	374[c]

[a]Industry sources and RPA estimates

[b]Sources: -Roy F. Weston Inc., "Development Document for Effluent Limitations Guidelines and Standards of Performance for the Organic Chemicals Industry," June 1973.
-"EPA Proposed Effluent Guidelines", September 1973.
-RPA estimates.

[c]Best practical technology.

available labor skills and likely political/environmental resistance. Exhibit IV-8 shows the relative ranking of each of the regions vis-a-vis the key locational factors, and compares these regions against the Gulf of Mexico and the Midwest, the two geographic areas with the largest expected future petrochemical development.

As described earlier, future organic chemical production should be tied primarily to new refinery development, and to a limited degree to imported feedstocks and new NGL supplies.

On the East Coast, development in New England should be minor; only in the OCS high production case should there be any development at all. The reason for this is the relatively low level of expected refinery activity and the higher priority alternative fuel uses of that refinery output. Development in the Mid-Atlantic under base case and OCS development should approximate the overall U.S. refinery output percentage for petrochemical feedstock use. This development should occur despite potential industrial congestion and some political/environmental resistance because of the high market demand and attractive economics of petrochemical production in the Mid-Atlantic.

In the South Atlantic, substantial development should occur under Base Case 2 and OCS development, exceeding that of the Mid-Atlantic. The likely profitability, greater availability of feedstock, land availability, and more receptive political/environmental climate should allow more significant development in this area. (See Exhibit IV-8.)

On the West Coast, petrochemical development should occur on a limited basis due to lower feedstock availability, limited market demand in the Northwest, higher investment costs, and potential political/environmental resistance. This should be more the case for San Francisco than for Puget Sound. In fact, under high OCS development, the latter area could become a net exporter of petrochemical products to other western regions by the year 2000.

Exhibit IV-9 summarizes the rationale behind the regional development assumptions. The number of petrochemical complexes projected for each area varies according to the base case and the impact case. Exhibits IV-10A

EXHIBIT IV-8

RELATIVE RANKING OF REGIONS BY LOCATION FACTOR FOR FUTURE PRIMARY ORGANIC CHEMICAL DEVELOPMENT[a]

Locational Factor	Gulf of Mexico	Mid-west	North Atlantic	Mid-Atlantic	South Atlantic	Puget Sound	San Francisco Bay Area
1. Profitability	-	0	+	+	+	0	0
2. Feedstock availability (domestic and imported)[b]	+	0	-	0	+	0	0
3. Investment cost	+	0	0	0	+	0	-
4. Local market demand	-	+	0	+	0	-	0
5. Political/environmental resistance	+	0	-	-	+	0	-
6. Land availability	+	0	0	-	+	+	0
7. Skilled labor availability[c]	0	0	+	+	-	0	+
8. Local intra-industry technical support	+	0	-	0	-	-	-
9. Export demand location advantage[d]	+	-	0	-	+	0	-

[a]A "+" means that a region, for the factor indicated, has a relative advantage over most other regions for potential primary organic chemical production. A "-" means a disadvantage, and a "0" means no relative advantage or disadvantage.

[b]Takes into account competing demands for refinery products (e.g., fuel demand).

[c]Takes into account both the total demand and total availability of skilled labor.

[d]Takes into account local demand versus likely capacity; i.e., whether export demand opportunity can be capitalized on.

Source: RPA estimates.

EXHIBIT IV-9

PETROCHEMICAL INDUSTRY DEVELOPMENT RATIONALE

Demand Area	Base Case 1	Base Case 2	OCS Low	OCS High
North Atlantic	No development; no available feedstock.	No development; insufficient feedstock available vis-a-vis fuel demand.	No development, rationale same as Base Case 2.	Development below overall U.S. refinery output feedstock percent, particularly in 1985, because of alternative fuel demand.
Mid-Atlantic	Development at lower than overall U.S. refinery feedstock percent because of alternative fuel demand and environmental/political resistance.	Development at about overall refinery feedstock percent plus use of imported feedstock to serve large market. If refineries accepted, political/environmental resistance to petrochemical development considered reduced.	No development in 1985 due to insufficient incremental refinery volume. Development by 2000 in region at overall refinery feedstock percent.	Development at overall refinery feedstock percent plus use of NGL for one complex by 2000. Rationale same as Base Case 2.
South Atlantic (same rationale for both regions analyzed)	No development; no available feedstock.	Development significantly above overall refinery feedstock percent, plus several complexes by 2000 using imported feedstock and NGL, due to lower fuel demand, more available land, lower political resistance, lower investment cost, and existing intermediate fiber market.	No development; insufficient feedstock available in new refinery locations.	Development above refinery feedstock percent plus use of NGL for one complex by 2000. Rationale same as Base Case 2.

EXHIBIT IV-9 (continued)

PETROCHEMICAL INDUSTRY DEVELOPMENT RATIONALE

Demand Area	Base Case	OCS Low	OCS High
Washington/Oregon	Development lower than overall U.S. refinery feedstock percent due to limited local market. By 2000, some additional development probable to support Northern California market.	No development; insufficient incremental refinery volume.	Most development after 1985, but lower than overall refinery feedstock percent. Rationale same as Base Case. Development of 2 NGL-based complexes by 2000.
Northern California	Development lower than overall refinery feedstock percent due to limited feedstock availability, high investment costs and high political/environmental resistance. Part of market demand likely to be served by Puget Sound production by year 2000.	Development lower than overall refinery feedstock percent. Rationale same as Base Case.	Development lower than overall refinery feedstock percent, but increasing by 2000 on basis that if refinery expansion accepted, political/environmental resistance to petrochemical development would be lower. Also, one NGL-based complex developed by 2000.

to 10D express quantitatively the projected development in each locality and region of analysis, taking into account both domestic refinery output as well as imported feedstocks and NGL supplies.

EXHIBIT IV-10A

PROJECTED REGIONAL PETROCHEMICAL DEVELOPMENT

BASE CASE 1

Geographic Area	1970 Number of Complexes	1985					2000				
		Domestic Refineries			Number of Complexes Using Other Feedstock Sources	Total Number of Complexes Projected	Domestic Refineries			Number of Complexes Using Other Feedstock Sources	Total Number of Complexes Projected
		New runs (mil B/D)	Available Feedstock %	Available Feedstock Amount (000 B/D)			New runs (mil B/D)	Available Feedstock %	Available Feedstock Amount (000 B/D)		
New England											
Bristol County	0	0	0	0	0	0	0	0	0	0	0
Eastern Mass./R.I.[a]	0	0	0	0	0	0	0	0	0	0	0
Rest of Demand Area	0	0	0	0	0	0	0	0	0	0	0
Mid-Atlantic											
Cumberland/Cape May	0	0	0	0	0	0	0	0	0	0	0
Delaware River Region[a]	.50	.72	6	43	0	1.9	1.26	9	113	0	4.1
Rest of Demand Area	0	0	0	0	0	0	0	0	0	0	0
South Atlantic											
Charleston	0	0	0	0	0	0	0	0	0	0	0
Eastern S.C./E. Ga.[a]	0	0	0	0	0	0	0	0	0	0	0
Rest of Demand Area[b]	0	.09	0	0	0	0	.09	0	0	0	0
South Atlantic											
Jacksonville	0	0	0	0	0	0	0	0	0	0	0
NE Florida/SE Ga.[a]	0	0	0	0	0	0	0	0	0	0	0
Rest of Demand Area[b]	0	.09	0	0	0	0	.09	0	0	0	0
Washington/Oregon											
Skagit/Whatcom	0	.40	7	28	0	.9	.40	10	40	1	2.3
Puget Sound, Wash.[a]	0	0	0	0	0	0	0	0	0	0	0
Rest of Demand Area	0	0	0	0	0	0	0	0	0	0	0
Northern California											
Solano/Contra Costa	0	.31	6	19	0	.6	.31	7	22	0	.7
San Francisco Bay[a]	0	0	0	0	0	0	0	0	0	0	0
Rest of Demand Area	0	0	0	0	0	0	0	0	0	0	0

[a] Region excludes Locality

[b] Activity from Mississippi, Alabama, and Florida panhandle offshore production excluded

EXHIBIT IV-10B

PROJECTED REGIONAL PETROCHEMICAL DEVELOPMENT

BASE CASE 2

(Not applicable to West Coast)

Geographic Area	1970 Number of Complexes	1985					2000				
		Domestic Refineries			Number of Complexes Using Other Feedstock Sources	Total Number of Complexes Projected	Domestic Refineries			Number of Complexes Using Other Feedstock Sources	Total Number of Complexes Projected
		New runs (mil B/D)	Available Feedstock %	Available Feedstock Amount (000 B/D)			Cumul. New runs (mil B/D)	Available Feedstock %	Available Feedstock Amount (000 B/D)		
New England											
Bristol County	0	0	0	0	0	0	0	0	0	0	0
Eastern Mass./R.I.[a]	0	.27	0	0	0	0	.45	0	0	0	0
Rest of Demand Area	0	.18	0	0	0	0	.27	0	0	0	0
Mid-Atlantic											
Cumberland/Cape May	0	.72	9	65	1	3.1	1.08	12	130	2	6.2
Delaware River Region[a]	.5	.99	11	109	1	5.0	1.08	13	140	2	7.0
Rest of Demand Area[b]	0	.18	0	0	0	0	.27	0	0	0	0
South Atlantic											
Charleston	0	.18	0	0	0	0	.27	0	0	0	0
Eastern S.C./E. Ga.[a]	0	.54	15	81	1	3.6	.81	20	162	2	7.2
Rest of Demand Area[b]	0	.54	9	49	1	2.6	.99	20	198	3	9.4
South Atlantic											
Jacksonville	0	.18	0	0	0	0	.27	20	54	1	2.7
NE Florida/SE Ga.[a]	0	0	0	0	0	0	.27	20	54	0	1.8
Rest of Demand Area	0	1.08	12	130	2	6.2	1.53	16	252	4	12.1

[a] Region excludes Locality

[b] Activity from Mississippi, Alabama, and Florida panhandle offshore production excluded

EXHIBIT IV-10C

PROJECTED REGIONAL PETROCHEMICAL DEVELOPMENT

LOW OCS PRODUCTION

Geographic Area	1970 Number of Complexes	1985					2000				
		Domestic Refineries			Number of Complexes Using Other Feedstock Sources	Total Number of Complexes Projected	Domestic Refineries			Number of Complexes Using Other Feedstock Sources	Total Number of Complexes Projected
		New runs (mil B/D)	Available Feedstock %	Available Feedstock Amount (000 B/D)			New runs (mil B/D)	Available Feedstock %	Available Feedstock Amount (000 B/D)		
New England	n.a.										
Bristol County		.15	0	0	0	0	.25	0	0	0	0
Eastern Mass./R.I.[a]		.10	0	0	0	0	.25	0	0	0	0
Rest of Demand Area		0	0	0	0	0	0	0	0	0	0
Mid-Atlantic	n.a.										
Cumberland/Cape May		.25	0	0	0	0	.25	0	0	0	0
Delaware River Region[a]		0	0	0	0	0	.25	12	30	0	1.0
Rest of Demand Area		0	0	0	0	0	0	0	0	0	0
South Atlantic	n.a.										
Charleston		.15	0	0	0	0	.25	0	0	0	0
Eastern S.C./E. Ga.[a]		.10	0	0	0	0	.25	0	0	0	0
Rest of Demand Area[b]		0	0	0	0	0	0	0	0	0	0
South Atlantic	n.a.										
Jacksonville		.15	0	0	0	0	.25	0	0	0	0
NE Florida/SE Ga.[a]		0	0	0	0	0	0	0	0	0	0
Rest of Demand Area[b]		.10	0	0	0	0	.25	0	0	0	0
Washington/Oregon	n.a.										
Skagit/Whatcom		.02	0	0	0	0	.19	10	19	0	.6
Puget Sound, Wash.[a]		0	0	0	0	0	0	0	0	0	0
Rest of Demand Area		0	0	0	0	0	0	0	0	0	0
Northern California	n.a.										
Solano/Contra Costa		.07	0	0	0	0	.28	7	20	0	.6
San Francisco Bay[a]		0	0	0	0	0	0	0	0	0	0
Rest of Demand Area		0	0	0	0	0	0	0	0	0	0

[a] Region excludes Locality [b] Activity from Mississippi, Alabama and Florida panhandle offshore production excluded.

EXHIBIT IV-10D

PROJECTED REGIONAL PETROCHEMICAL DEVELOPMENT

HIGH OCS PRODUCTION

Geographic Area	1970 Number of Complexes	1985					2000				
		Domestic Refineries			Number of Complexes Using Other Feedstock Sources	Total Number of Complexes Projected	Domestic Refineries			Number of Complexes Using Other Feedstock Sources	Total Number of Complexes Projected
		New runs (mil B/D)	Available Feedstock %	Available Feedstock Amount (000 B/D)			New runs (mil B/D)	Available Feedstock %	Available Feedstock Amount (000 B/D)		
New England	n.a.										
Bristol County		.25	0	0	0	0	.50	5	25	0	.8
Eastern Mass./R.I.[a]		.25	6	15	0	.5	.50	10	50	0	1.6
Rest of Demand Area		.25	0	0	0	0	.50	8	40	0	1.3
Mid-Atlantic	n.a.										
Cumberland/Cape May		.35	9	32	0	1.0	.50	12	60	0	1.9
Delaware River Region[a]		.40	9	36	0	1.2	.80	12	96	1.0	4.1
Rest of Demand Area		0	0	0	0	0	.20	0	0	0	0
South Atlantic	n.a.										
Charleston		.25	15	38	0	1.2	.50	20	100	1	4.2
Eastern S.C./E. Ga.[a]		.25	15	38	0	1.2	.50	20	100	0	3.2
Rest of Demand Area[b]		.25	9	22	0	.7	.50	20	100	0	3.2
South Atlantic	n.a.										
Jacksonville		.25	0	0	0	0	.50	20	100	1	4.2
NE Florida/SE Ga.[a]		0	0	0	0	0	.25	20	50	0	1.6
Rest of Demand Area[b]		.50	9	45	0	1.5	.75	20	150	0	4.8
Washington/Oregon	n.a.										
Skagit/Whatcom		.02	0	0	0	0	.26	10	26	2	2.8
Puget Sound, Wash.[a]		0	0	0	0	0	0	0	0	0	0
Rest of Demand Area		0	0	0	0	0	0	0	0	0	0
Northern California	n.a.										
Solano/Contra Costa		.21	6	13	0	.4	.57	9	51	1	2.6
San Francisco Bay[a]		0	0	0	0	0	0	0	0	0	0
Rest of Demand Area		0	0	0	0	0	0	0	0	0	0

[a] Region excludes Locality

[b] Activity from Mississippi, Alabama and Florida panhandle offshore production excluded.

SOURCES OF DATA

Chemical Engineering. "Pollution Control at Carbide Ponce." June 18, 1973.

Chemical Marketing Research Association. Changing World Chemical Industry...Its Outlook and Problems to 1985. February 6-9, 1973.

Chemical Week. "Plant Sites, 1974." October 17, 1973.

Engineering News Record. "Construction Cost Index." December, 1970.

EPA Proposed Effluent Guidelines: Petrochemicals. September, 1973.

Exxon Chemical Company.

Manufacturing Chemists Association. Chemicals Statistical Handbook, 7th Edition.

Roy F. Weston, Inc. Development Document for Effluent Limitations Guidelines and Standards of Performance for the Organic Chemicals Industry. June 1973.

Shell Chemical Company.

Stone & Webster.

Union Carbide Corporation.

U.S. Department of Commerce, Bureau of Competitive Assessment.

U.S. Department of Labor, Bureau of Labor Statistics. Industry Wage Survey, Industrial Chemicals, June, 1971. Washington, D.C.: U.S. Government Printing Office, 1973.

U.S. Department of the Interior, Office of Oil & Gas.

U.S. Tariff Commission. Synthetic Organic Chemicals. Washington, D.C.: U.S. Government Printing Office, 1970.

APPENDIX V

CONSTRUCTION

To assess the onshore impacts that could occur if oil and gas resources were developed in the Atlantic and Gulf of Alaska Outer Continental Shelves (OCS), the incremental economic activity expected to occur in five of the most important industrial sectors was analyzed. The first four of these have been discussed in the preceding appendixes. This appendix discusses the fifth -- construction.

The appendix is organized into two sections. The first describes the primary construction associated with refining, gas processing, and petrochemical development, and the second describes the approach used to estimate the induced construction--i.e., that construction attributable to other industrial, commercial, and residential activity caused by the primary industries.

PRIMARY CONSTRUCTION

The nature of the primary construction activity is very different from the refining, gas processing, and petrochemical operations in that it experiences its peak activity during periods of heavy new plant building, and then dies off.

Several reasonable scenarios of construction activity can be developed in support of the primary industry capacities projected for 1985 and 2000. For all scenarios, however, the construction activity is not likely to be significant before 1980. A peak of activity will probably occur in the 1980's, when refining, gas processing, and petrochemical production would be increasing rapidly as more offshore reserves are discovered.

Although there will undoubtedly be some construction activity in the year 2000, it should be significantly lower than the 1980's peak and is included in the baseline projections. The intent of the study was to show what a typical peak construction year impact might be; 1985 would likely be at or near this peak.

The 1985 construction level has been estimated by assuming that all refineries and gas processing plants built between 1985 and 2000 will follow the offshore oil and gas production scenario, reaching full onstream capacity by about 1990 on the East Coast, and about 1995 in the Gulf of Alaska. Petrochemical production might lag refinery production somewhat, but for analytical purposes, plant construction timing has been assumed to coincide with refinery construction timing. The construction impact of the oil and gas recovery sector is assumed to be small because initial construction of offshore pipelines is assumed to be essentially complete by 1985 and platform fabrication is expected to have little, if any, impact on the East and West Coasts. (See Appendix I.)

It can be argued that the attainment of the maximum oil and gas production levels could be pushed further out in time, thereby decreasing the construction activity peak and extending its duration. It appears, however, that strong pressures should exist in the 1980's for increased U.S. domestic energy production (and associated refinery capacity). Therefore, a relatively high construction peak seems realistic. For the same reason, Base Case 2 construction activity was estimated to follow the same timing as OCS-induced construction.

In assessing the primary construction economic impact it was assumed that plant investment costs are divided 45 percent for labor and 55 percent for building materials and equipment. It was also assumed that the average construction employee wage levels (in 1970 dollars) would be as follows:

Geographic Area	1985	2000
Lower 48 states	15,000	17,500
Alaska	18,700	22,300

It should be noted that only a portion of a plant's total investment cost can be considered as construction. A large part of the investment (about 40 percent in the case of refineries, petrochemical, and gas plants) is spent for capital equipment and other off-site costs. This

portion of the investment must be examined separately, since the impacts from these expenditures on a local or regional area should be much smaller than the construction impacts, perhaps even zero.

The following steps were carried out in estimating the 1985 construction activity in each region:

- Determine the post-1985 development in the primary industries (refinery, gas processing, and petrochemicals).

- Develop the scenario of construction activity needed to support the timing of the assumed base case and OCS onstream industrial capacities.

- Break down the amount of construction by year using the following durations of construction for the various size investments:

Size of Investment[a]	Field Construction Duration[b]
$ 25 million	17 months
$100 million	24 months
$300 million	29 months

a The investment requirements per region for gas processing, refinery, and petrochemical plants are discussed in Appendixes II, III, and IV.

b From a modified Mattozzi curve used in discussions with engineering consulting firms.

- Calculate the total amount of construction for 1985.

Exhibits V-I to V-3 present the estimated primary new plant investment caused by OCS development for each region in 1985.

INDUCED CONSTRUCTION

In addition to the heavy construction directly associated with the construction of refineries, petrochemical

EXHIBIT V-1

ESTIMATED 1985 PRIMARY INVESTMENT ACTIVITY [a]

BASE CASE 2 INCREMENTAL

(Millions of 1970 Dollars)

Geographical Area	Sector			
	Refining	Gas	Petrochem.	Total
New England				
Bristol County	0	0	0	0
Eastern Mass./R.I.	63	0	0	63
Mid-Atlantic				
Cumberland/Cape May	124	0	188	312
Delaware River Region	23[b]	0	164[b]	187[b]
South Atlantic/Charleston				
Charleston	48	0	0	48
Eastern S.C./E. Georgia	201	0	168	369
South Atlantic/Jacksonville				
Jacksonville	48	0	117	165
N.E. Florida/S.E. Ga.	201	0	211	412

[a]Regional figures include the locality construction.

[b]Regional figure lower than locality figure in Mid-Atlantic because the construction in the region outside of the locality is actually less in Base Case 2 than in Base Case 1 (i.e., more PAD I dispersion).

Source: RPA estimates.

EXHIBIT V-2

ESTIMATED 1985 PRIMARY INVESTMENT ACTIVITY[a]

LOW OCS PRODUCTION

(Millions of 1970 Dollars)

Geographical Area	Sector			
	Refining	Gas	Petrochem.	Total
New England				
Bristol County	63	24	0	87
Eastern Mass./R.I.	63	24	0	87
Mid-Atlantic				
Cumberland/Cape May	0	23	0	23
Delaware River Region	196	23	61	280
South Atlantic/Charleston				
Charleston	48	0	18	66
Eastern S.C./E. Georgia	48	0	18	66
South Atlantic/Jacksonville				
Jacksonville	48	0	18	66
N.E. Florida/S.E. Ga.	48	0	18	66
Alaska				
Valdez	0	5	0	5
Alaska	0	24	0	24
Washington/Oregon				
Skagit/Whatcom	156	0	0	156
Puget Sound	156	0	0	156
Northern California				
Solano/Contra Costa	159	0	27	186
San Francisco Bay	159	0	27	186

[a] Regional figures include the locality construction.

Source: RPA estimates.

EXHIBIT V-3

ESTIMATED 1985 PRIMARY INVESTMENT ACTIVITY [a]

HIGH OCS PRODUCTION

(Millions of 1970 Dollars)

Geographical Area	Sector			
	Refining	Gas	Petrochem.	Total
New England				
Bristol County	199	14	49	262
Eastern Mass./R.I.	357	43	116	516
Mid-Atlantic				
Cumberland/Cape May	89	14	55	158
Delaware River Region	163	42	237	442
South Atlantic/Charleston				
Charleston	153	11	140	304
Eastern S.C./E. Georgia	274	33	234	541
South Atlantic/Jacksonville				
Jacksonville	153	11	197	361
N.E. Florida/S.E. Ga.	274	33	272	579
Alaska				
Valdez	0	21	0	21
Alaska	0	73	0	73
Washington/Oregon				
Skagit/Whatcom	195	0	90	285
Puget Sound	195	0	90	285
Northern California				
Solano/Contra Costa	177	0	82	259
San Francisco Bay	177	0	82	259

[a] Regional figures include the locality construction.
Source: RPA estimates.

complexes, and gas processing plants in each locality and region, there is expected to be other industrial, commercial and residential construction as a result of the economic activity caused by OCS. For example, the construction industry will be required to supply:

- Facilities for new industrial firms drawn to the area,
- Transportation facilities--especially expanded road networks,
- Public service facilities--including schools, hospitals hospitals and recreational facilities,
- New homes.

These induced construction requirements would occur over a 10-20 year time period--in many cases closely paralleling the growth in economic activity that will occur without OCS development. As a result, it is difficult to estimate accurately the level of new construction induced by OCS activity in any one year. However, since this employment sector is very labor intensive relative to others, and will thus lead to significant population and infrastructure impacts, it is most important to include some estimate of the activity level.

For the purpose of the report, it was decided to estimate induced construction as a simple function of direct heavy construction. In this context, it is important to keep in mind that the induced construction is <u>in addition</u> to the construction activity included in the base case projection.

The specific estimating functions used were:[1]

- 1985 Induced Construction = .25 x 1985 Incremental Primary Construction
- 2000 Induced Construction = .50 x 1985 Incremental Primary Construction[2]

---

1 The construction multipliers were based on an analysis of two regional input-output models as well as an examination of forecast construction in other areas where significant heavy construction investments are being made.

2 There should be a lag in some of the induced construction (eg., new schools, hospitals) caused by primary construction in 1985 and other years.

Total construction in any locality or region would thus equal base case construction plus OCS-related construction, where OCS-related construction equals new primary construction plus induced construction. Exhibits V-4 to V-6 present the estimates of total OCS-related construction that were used in the economic analysis.[3]

---

3 Described in Appendix VI

EXHIBIT V-4

ESTIMATED PRIMARY AND INDUCED CONSTRUCTION ACTIVITY

BASE CASE 2 INCREMENTAL

(Millions of 1970 Dollars)

Geographical Area	1985			2000		
	Local	Region[a]	Area[b]	Local	Region[a]	Area[b]
New England	0	47.3	0	0	18.9	0
Mid-Atlantic	234.0	140.3	0	93.6	56.1	0
South Atlantic/ Charleston	36.0	276.8	374.1	14.4	110.7	149.6
South Atlantic/ Jacksonville	123.8	309.0	332.5	49.5	123.6	133.0

a Region includes Local.

b Area is "Demand Area" exclusive of the Region.

Source: RPA estimates.

EXHIBIT V-5

ESTIMATED PRIMARY AND INDUCED CONSTRUCTION ACTIVITY

LOW OCS PRODUCTION

(Millions of 1970 Dollars)

Geographical Area	1985			2000		
	Local	Region[a]	Area[b]	Local	Region[a]	Area[b]
New England	65.3	65.3	0	26.1	26.1	0
Mid-Atlantic	17.3	210.0	0	6.9	84.0	0
South Atlantic/ Charleston	49.5	49.5	0	19.8	19.8	0
South Atlantic/ Jacksonville	49.5	49.5	0	19.8	19.8	0
Alaska	3.8	18.0	0	1.5	7.2	0
Washington/Oregon	117.0	117.0	0	46.8	46.8	0
Northern California	139.5	139.5	0	55.8	55.8	0

a Region includes Local.

b Area is "Demand Area" exclusive of the Region.

Source: RPA estimates.

EXHIBIT V- 6

ESTIMATED PRIMARY AND INDUCED CONSTRUCTION ACTIVITY

HIGH OCS PRODUCTION

(Millions of 1970 Dollars)

Geographical Area	1985			2000		
	Local	Region[a]	Area[b]	Local	Region[a]	Area[b]
New England	196.5	387.0	60.0	78.6	154.8	24
Mid-Atlantic	118.5	331.5	0	47.4	132.6	0
South Atlantic/ Charleston	228.0	405.8	87.8	91.2	162.3	35.1
South Atlantic/ Jacksonville	270.8	434.3	115.8	108.3	173.7	46.3
Alaska	15.8	54.8	0	6.3	21.9	0
Washington/Oregon	213.8	213.8	0	85.5	85.5	0
Northern California	194.3	194.3	0	77.7	77.7	0

a Region includes Local.

b Area is "Demand Area" exclusive of the Region.

Source: RPA estimates.

SOURCES OF DATA

Badger Corporation.

Engineering News Record. "Construction Cost Index." December, 1970.

Robert Means. Building Construction Cost Data. Robert Means, 1971.

APPENDIX VI

ECONOMIC METHODOLOGY

The establishment of a new industrial activity or other new business development within a geographic area will effect changes in the local economy, specifically in output, employment, and earnings.

This appendix presents the approach used to estimate the economic impact of future OCS oil and gas recovery operations in selected areas. As previously discussed, this approach has been applied to seven sample areas. Each has been broken down into a local impact area consisting of one to five counties, and a regional impact area, generally the geographic site most likely to experience the majority of direct economic and environmental impacts.

The first step in conducting an impact analysis is to develop a "base case," that is, a standard comparison against which incremental activity levels are measured. Steps in the economic methodology may be summarized as follows:

- Develop base case data by forecasting economic characteristics of an area without OCS development,

- Calculate gross income and product account data from expected development of output, employment, and earnings,

- Determine the economic impact by calculating the difference between the first two steps.

Other general methodologies are available for estimating the regional impact of specific economic developments. For example, a net regional income approach to larger areas has currently gained favor in some academic circles. [1] However, in an environmental or social/

---

[1] See Offshore Oil Task Group, The Georges Bank Petroleum Study, M.I.T., 1973, Vol. I, pp. 4-18.

infrastructure analysis, gross income and product account data must also be supplied. Therefore, we have used the gross impact method which is more suitable to geographic areas as small as those under examination in this study.

BASELINE PROJECTIONS

Baseline projections of economic growth were devised to demonstrate the expected level of demographic growth and economic activity in the regions and localities without any oil recovery from the Atlantic or Gulf of Alaska.

In general, this study assumes that inequalities in economic conditions between regions and localities will become less, rather than more, marked over time. To be more specific, it assumes that factors such as work force participation and rate of unemployment will move toward a norm which reflects the national average.

Unless otherwise indicated, the study relies on published projections of growth in each area. When no projection was available or when evident inconsistencies occurred, independent data were developed.

Two types of baseline data are included: (1) aggregate local and regional projections of population and personal income; and (2) detailed estimates by industrial sector of employment, earnings, and output.

Aggregate Area Projections

Population[1]

Predictions of population levels and density over extended periods of time have historically been subject to frequent revision because of unexpected changes in fertility rates. However, those predictions which assume a completed count fertility rate moving toward 2.11 children per woman are currently considered to be the most accurate available.

---

[1] Based on "Preliminary Projections of the Population of States: 1975 to 1990" as contained in the government pamphlet Population Estimates and Projections, Series P-25, No. 477, Bureau of the Census, U.S. Department of Commerce, March, 1972.

In compiling national forecasts of population, the Census Bureau has used several alternative methods of predicting the distribution of population among the states. Each of these assumes a different pattern of population movement. This study used the Bureau's Series IE which assumes the continuation of 1960-1970 gross migration trends between the states, as well as state and local forecasts of population consistent with the assumption of the low birth rate.

Forecasts of population density -- the number of inhabitants per square mile in each region and locality -- were obtained by dividing the forecast population for the years 1985 and 2000 by the 1970 land area. The study made no attempt to predict changes based on redrawing of boundaries, land reclamation, land erosion, or other such factors.

Income

The study projected total income by multiplying projected total earnings (discussed later in this appendix) for a given area by a constant income/earnings ratio for all areas. The ratio, 1.3, was reached by dividing 1970 total personal income (as derived from the Survey of Current Business and Bureau of Economic Analysis data) by an estimate of 1970 earnings. When this calculation was carried out for each of the states in the selected areas, the results ranged from ratios of 1.27 to 1.33. Thus, a constant ratio of 1.3 seemed appropriate for forecasting purposes. This differential of approximately 30 percent between earnings and income stems from the inclusion in income of items such as interest, transfer payments, dividends, and proprietor's income. Forecasts of per capita income were then derived by dividing the forecast total income in each area by the forecast total population.

Projections for the Industrial Sector

Exhibit VI-1 defines the sectors of industry examined here.

EXHIBIT VI-1

INDUSTRIAL SECTOR DEFINITIONS

Sector	1967 Standard Industrial Classification Codes
Agriculture[a]	1-9
Construction	15-17
Manufacturing	19-39
Public Utilities[b]	40-49
Services[c]	All Other

[a] Includes forestries and fisheries.

[b] Includes public utilities, transportation and communication.

[c] Includes wholesale and retail trade; finance; insurance; real estate; general service industries, and mining.

Source: Standard Industrial Classification Manual, Statistical Policy Division, Executive Office of the President, Office of Management and Budget, 1972.

Projections for these sectors were made for the three specific categories: employment; earnings; and output.

Employment

To develop projections for employment, it was necessary to estimate the size of the civilian labor force, unemployment rates, and proportions of employment for both local and regional sectors. Local and regional projections were utilized wherever possible.

In this study the civilian labor force is meant to include all persons over sixteen who are either employed or unemployed, excluding those in the Armed Forces and those over sixteen who are in school, keeping house, or not actively seeking work.[1]

The study used data from the various state employment security agencies to determine the historical participation rate in the labor force for each region and locality. In projecting the future national labor force, it was assumed that the national participation rate would continue to grow after 1990, but at a slower rate than previously.[2] Thus, the study predicated a national norm participation rate of 44.5 percent for the year 2000. Drawing from this, participation rates for local and regional work forces were estimated by assuming a growth rate which would bring them close to the national norm by the year 2000.

The following exhibit details these assumptions for two East Coast areas: Massachusetts, which has a traditionally high participation rate and Charleston, South Carolina, which has a lower rate.

---

1 Definition is that used by the U.S. Bureau of Labor Statistics.

2 Projections of the future national labor force through the year 1990 are based on predictions derived from the Bureau of the Census Series P-25 publications and data from the Bureau of Labor, published as Table E-2 in the Manpower Report to the President, 1973. The study's estimated size of the civilian labor force for 1985 -- 105 million -- does not correspond with that given in the Manpower Report to the President -- 108 million -- because it excludes military personnel.

EXHIBIT VI-2

PARTICIPATION RATE IN LABOR FORCE

(Percent of Total Population)

	1960[a]	1970[a]	1985[b]	2000[b]
U.S.	38.8	40.7	44.5	45.5
Mass.	44.0	46.0	46.5	47.0
Charleston	32.7	35.4	38.5	43.3

[a] U.S. Bureau of Labor Statistics, Employment and Earnings, April, 1973.

[b] RPA Forecasts.

In order to predict the total number of employed persons[1] in each area, it was necessary to estimate what percentage of the work force would be unemployed. Total employment was thus projected at 95 percent of the projected civilian work force in each region or locality.

Sector Employment Proportions

To develop an employment profile of each impact area, historical information on employment in each of the five sectors of industry was obtained by state and, where available, by county, from the employment security agencies. Where detailed historical breakdowns of employment were not available for individual counties (e.g., in Massachusetts and New York State,) the study estimated employment

[1] Our definition of an "employed person" includes everyone in employment in the agricultural and non-agricultural sectors, whether wage and salary earners, self-employed, unpaid family workers, or domestics.

by industrial sector, with data from the particular state as well as from the Bureau of the Census.[1] The small proportion of self-employed workers who could not be classified by industry were assigned to the service industries, to which most of them, in fact, belong.

Since the study had already calculated forecasts of total numbers of employed persons from the data on population, participation rate, work force, and unemployment in each area, it was necessary to predict employment by sector in order to determine the proportion of the total employment in each sector.[2]

The most important factor implicit in these sector forecasts is the move toward a "service"economy -- that is, one with a large proportion of workers in the service sector. Exhibit VI-3 shows the percentage of non-agricultural employment by industrial sector for 1970 and forecasts percentages for 1985 and 2000.

Forecasts of agricultural employment were based on the ratios implicit in the Manpower Report to the President, 1973. Industry experts believe that agriculture employment cannot continue to fall at the historical rate and still support the farm activity required by future demand for agricultural products. It was, therefore, concluded that the rate of decline in agricultural employment would level off between the years 1985 and 2000.

Following these national forecasts of employment by industrial sector, area economic profiles became the basis of a model for local development. Here two major assumptions were made: (1) that in time, the distribution of

---

[1] Bureau of the Census, U.S. Dept. of Commerce, County Business Patterns, 1970.

[2] National proportions for 1985 were projected by (1) the forecasts devised by the Bureau of Labor Statistics and published as Table E-10 in the Manpower Report to the President, 1973, (2) forecasts developed by McGraw Hill, Inc., in their publication, The American Economy, Prospects for Growth to 1985, and, (3) RPA estimates.

EXHIBIT VI-3

PROPORTION OF U.S. NON-AGRICULTURAL EMPLOYMENT IN EACH INDUSTRY SECTOR

Sector	Percents		
	1970[a]	1985[b]	2000[b]
Contract construction	4.7	5.5	5.5
Manufacture	27.4	25.0	25.0
Public Utilities	6.3	5.0	4.5
Services and Other	61.6	64.5	65.0
TOTAL	100.0	100.0	100.0

[a] Bureau of Labor Statistics, Employment and Earnings, August, 1971.

[b] RPA forecasts inferred from trends in the projection period, 1970-1985, which were assumed to continue.

employment by sector in any given area would grow more like the national pattern; and (2) that all areas would follow the national tendency towards a "service" economy, that is, one in which a large percentage of employment occurs in service sectors.

The methodology was somewhat altered for the West Coast areas where regional and state agencies, specifically the Association of Bay Area Governments -- the Washington State Employment Security Department, and the Alaska Department of Labor -- publish their own forecasts by sector. In general, these sector forecasts were used.

Earnings

To forecast earnings by industry sector for the years 1985 and 2000, the historical growth of earnings by industry sector and region was analyzed. The U.S. Department of Commerce[1] provided detailed information on this subject both for the nation and for each state and this information, together with sector employment data, was used to project a ratio of earnings per worker by industry sector. Forecasts of future earnings were based on this ratio.

An examination of historical trends in productivity growth by industrial sector and the effects of this growth upon earnings was used to determine a per annum growth rate in earnings for each sector in each region in making forecasts for 1985 and 2000. The growth rate for each sector is as follows:

	Percent Per Annum
Agriculture	2.8
Construction	1.1
Manufacturing	2.1
Public Utilities	1.8
Services	1.4

[1] Specifically, Commerce's Regional Economics Information Division of the Social and Economic Statistics Administration (REIDSESA).

Forecasts of aggregate annual earnings by sector were determined by multiplying forecasts of employment by earnings per worker.

Output

In this study, the measure of output by sector is the total value of sales of businesses operating therein. The total 1970 business receipts for each sector, as derived from official tables[1], were divided by 1970 sector earnings to obtain an earnings/output ratio. This ratio was then applied to earnings for the years 1985 and 2000 to predict future output in 1970 dollars.

IMPACT ANALYSIS

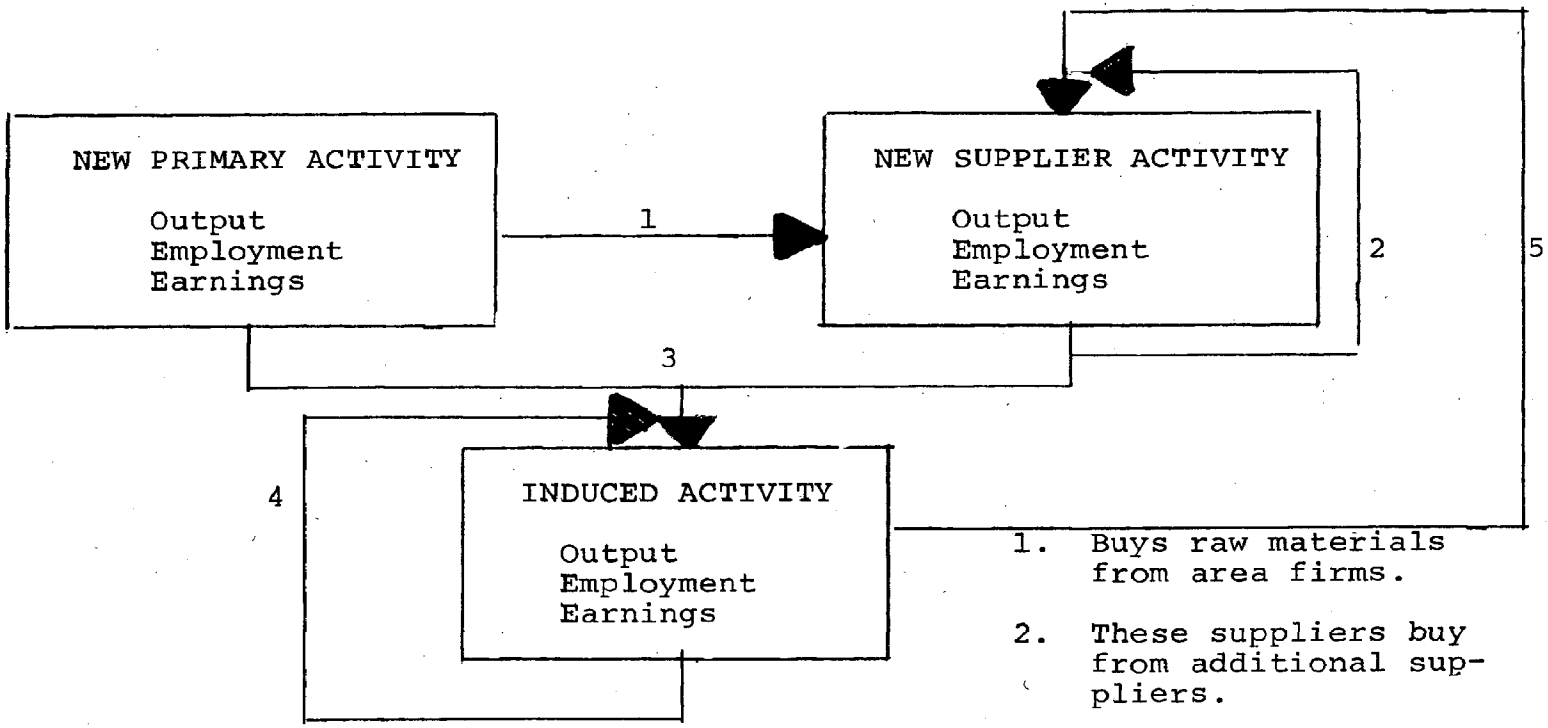
The establishment of a new business activity area will alter an area's level of output, employment, and earnings. (This development is termed "primary activity.") If the new firm purchases any input requirements from firms located in the area, total output, employment, and earnings, will increase. Similarly, the new firm may attract other new suppliers into the area. (This is termed "supplier activity.") Then, too, part of the earnings generated from employment in both the new and the supplier industries will be spent within the area. This increase in consumer spending will, in turn, generate additional output, employment, and earnings within the area. (This is termed "induced activity.") Exhibit VI-4 illustrates this "activity" process.

---

[1] Data on receipts for all business activities in 1970 were obtained from the Internal Revenue Service Publications, Business Income Tax Returns, 1970 (Table 1, "Proprietorships, Receipts, Selected Deductions and Net Profit by Industry," and Table 4, "Partnerships, Total Receipts, Selected Deductions and Net Profit by Industry"); from the Internal Revenue Service Publication, Corporation Income Tax Returns, 1970 (Table 1, "Selected Income Statement Items, Total Assets and Inventories by Major Industry"), and from input/output models for the San Francisco (Lofting, et al.) and Puget Sound (Beyers, et al.) areas.

EXHIBIT VI-4

DIAGRAM OF IMPACT ANALYSIS



1. Buys raw materials from area firms.

2. These suppliers buy from additional suppliers.

3,4. New employees spend some of their earnings here.

5. Consumer-oriented firms purchase some supplies from local firms.

Direct Impacts

Five basic activity sectors have been developed for direct analysis. The five, each of which is separately discussed in Appendices I to V, are: (1) Oil and Gas Recovery; (2) Petroleum Refining; (3) Gas Processing; (4) Petrochemical Manufacture; and (5) Induced Construction.

For each sector, the total output, employment, and earnings within each geographical impact area have been predicted for the years 1985 and 2000. The economic activity in each of these sectors would provide the stimulus for the incremental supplier and induced activities.

Supplier and Consumer Induced Impacts

A variety of factors are involved in analyzing the impacts resulting from suppliers to the direct industries and consumer induced impacts from both. These are described individually below.

Output (Sales)

The transition between direct- and supplier-induced impacts for industry outputs was determined by applying a series of input-output multipliers to the incremental direct economic activity.[1] These multipliers were developed for four economic sectors -- agriculture; manufacturing; utilities; and services -- and include all the categories used by the Commerce Department to classify U.S. economic activity. Each multiplier was adjusted to account for the special characteristics of each area under study as well as to reflect the types of activity that might be expected to develop in conjunction with the direct sectors.

---

[1] The multipliers are based upon the 1963 input-output tables published by the U.S. Department of Commerce. In addition, Arthur D. Little, Inc. provided a computerized calculating algorithm and assistance in developing the multipliers.

Employment and Earnings

Incremental earnings in the five economic sectors were calculated by multiplying the forecast output by a constant earnings/output ratio. It was then possible to estimate employment, since forecast earnings per employee in each sector were available from base case estimates.

Incremental supplier and induced economic activity for 1985 and 2000 was summarized in the following format:

Sectors	Output	Employment	Earnings
Agriculture	X	X	X
Manufacturing	X	X	X
Utilities & Transportation	X	X	X
Services	X	X	X
TOTAL	X	X	X

Given the total estimates of new output, employment, and earnings obtained by adding the direct, supplier, and induced increments, it is possible to calculate the additional impacts on other aggregate economic variables such as population and personal income. For example, incremental population can be derived by multiplying the impact employment estimates by a forecast population employment ratio, after estimating where the new employees will most likely reside.

Incremental personal income can also be calculated by factoring the earnings of new residents by a standardized income/earnings ratio. Total area earnings can be reached by adding the incremental figure to the base case. Finally, new per capita income can be obtained by dividing total income in the area by base case population plus incremental population.

Impact on Three Industries of Interest

Within the framework of the economic impact, the study team examined the possibility of analyzing the effects of on-shore OCS development on three specific industries: fishing, tourism, and agriculture. However, after reviewing other impact statements, testimony from the OCS Hearings, and a preliminary analysis the decision was reached not to conduct an intensive economic analysis of these industries, based on three considerations.

First, it was felt that a meaningful analysis would require an effort of magnitude outside the scope of the current study.

Second, further testimony from the OCS Hearings made it clear that concern from individual communities and environmental groups centered primarily on the risk of oil spills contaminating water and/or beach areas, endangering wild life, and jeopardizing recreation. Oil spills, then, constitute a direct impact concern that is being treated in a separate study.

Finally, the economic structure of these industries is inextricably bound to environmental issues. Agricultural output is a function of land use zoning. Tourism is commonly viewed in association with recreational facilities, and as such, is a function of visual, land use, air, and water quality considerations. Fishing is dependent on the quality of the water. Thus, it can be argued that any onshore impacts that might adversely affect the three special industries can be minimized or eliminated by zoning controls and pollution discharge regulations.

Some general observations of probable economic impacts as they relate to each specific industry are presented below.

Agriculture

Essentially, this study assumes that growth in non-agricultural industries will drive up the price for land and labor in the agricultural sector. As a result, the percentage of a region's active farmland will decline over time, perhaps even to zero.

During this process the current land owners will reap

large profits as their low-valued farms become high-value commercial or residential properties. In addition, considerable demand for labor will be generated. Thus, agricultural workers will move into other sectors. Needless to say, an individual wishing to remain employed within agriculture can presumably sell his land at a high price, purchase land of low value elsewhere and pocket the difference as profit.

Tourism

The types of business generally thought of as being in this category would include hotels and motels, restaurants and specialized recreational firms. Of the three groups, the first two would probably benefit directly by an economic expansion within the geographic area. Little can be said of the third group, however, without defining precisely what activity is currently located at specific sites and how these sites would be impacted by the OCS-induced expansion. This type of analysis, of course, is extremely difficult when only sample impact sites are being analyzed.

Fishing

New economic activity, whether onshore or offshore, should adversely affect fishing if water pollution significantly reduces the fish population. The risk of water pollution occurring in rivers and/or wetlands is discussed in Appendix IX.

It might, however, be argued that the fishing industry will decline in response to a demand for labor in other areas. This shift could well occur since fishing is a relatively low paying occupation compared to manufacturing or construction.

SOURCES OF DATA

Grubb, Herbert W. The Structure of the Texas Economy, Input-Output Analysis. Austin, Texas: State of Texas, Office of Information Services, March 1973.

McGraw-Hill Publications Economics Department. The American Economy -- Prospects for Growth to 1985. New York: McGraw-Hill, 1972.

Mlotok, Paul. A Study of the Economic Implications of the Refinery Proposed for Tiverton, Rhode Island. Kingston, R.I.: University of Rhode Island, Department of Resource Economics, December 1970.

U.S. Department of Commerce, Bureau of the Census. Current Population Reports. (Series P25 #493, 477, Series P26 #24) Washington, D.C.: U.S. Government Printing Office, 1972.

U.S. Department of Commerce, Bureau of the Census. County Business Patterns, 1970. (Massachusetts and New York sections only) Washington, D.C.: U.S. Government Printing Office, 1971.

U.S. Department of Commerce, Bureau of Economic Affairs, Regional Economics Information System. Industrial Sources of Current Income Received by Persons for Participation -- Current Production 1948-1971. Washington, D.C.: U.S. Government Printing Office, 1972.

U.S. Department of Commerce, Bureau of Economic Analysis. Survey of Current Business. Washington, D.C.: U.S. Government Printing Office, monthly.

U.S. Department of Commerce, Bureau of Economic Analysis. Personal Income - Major Sources by States, 1970. Washington, D.C.: U.S. Government Printing Office, 1971.

U.S. Department of Commerce, Office of Business Economics. Input-Output Structure of the United States Economy:1963. Washington, D.C.: U.S. Government Printing Office, 1969.

U.S. Department of Labor, Bureau of Labor Statistics. Employment and Earnings. Washington, D.C.: U.S. Government Printing Office, monthly.

SOURCES OF DATA (CONTINUED)

U.S. Department of Labor, Bureau of Labor Statistics. Indices of Output Per Man-Hour - Selected Industries. Washington, D.C.: U.S. Government Printing Office, 1972.

U.S. Department of Labor, Bureau of Labor Statistics. Manpower Report to the President. Washington, D.C.: U.S. Government Printing Office, 1973.

U.S. Department of the Treasury, Internal Revenue Service. Business Income Tax Returns, 1970. Washington, D.C.: U.S. Government Printing Office, 1971.

U.S. Department of the Treasury, Internal Revenue Service. Corporation Income Tax Returns, 1970. Washington, D.C.: U.S. Government Printing Office, 1971.

APPENDIX VII

SOCIAL INFRASTRUCTURE METHODOLOGY

This appendix describes the methodology used to identify the level of impact of OCS development on the social infrastructure of the localities studied. The following topics are covered:

- Definition of the components examined
- General nature of OCS social infrastructure impact
- Prediction methodology and data sources

It should be noted that while quantitative data is referred to and used extensively in the main report (Volumes I and II), the numbers should be viewed as tools for analysis and a means of assessing the magnitude of impact rather than as predictions of the exact level of impact.

SOCIAL INFRASTRUCTURE COMPONENTS

The major social infrastructure components are defined as follows:

- Physical Systems. The essential structural resources needed to supply and maintain a given community. These include the water supply system, the energy supply system, residential and commercial buildings and the various sectors of the transportation system.

- Service Systems. The essential services that support and maintain a given community. These include education, law enforcement, health care, sewage handling, solid waste management, and governmental planning and organization.

- Business and Government Institutions. The organizations that provide the basic structures and services essential to a given community. These include commercial establishments, industrial concerns, and governmental units.

- The Power Structure. The major advocates of action or inaction in a given community who have the resources to make their position or policy a reality. Members would include general civic groups such as the Chamber of Commerce, environmental groups such as the Sierra Club, government officials who develop and implement programs. and political figures who formulate public policy.

Within the physical and service system categories, additional areas of impact might be considered. However, the areas mentioned above, are, in general, the most basic and require the most resource investment, and also the most advanced planning. Further, they are representative of all other infrastructure impacts in terms of rate of growth and its impact.

GENERAL NATURE OF OCS SOCIAL INFRASTRUCTURE IMPACTS

Although there are many ways in which the onshore developments and OCS-induced growth can affect the infrastructure of a local area, the main impact is that of increased population. It is the rapid growth of the local population base that places the greatest strain on the infrastructure. The new residents increase the demand for water, sewers, electrical energy, schools, hospitals, and so on. Industrial growth also places demand on the infrastructure but industry is often self-contained and self-sufficient due to the nature and magnitude of their needs.

PREDICTION METHODOLOGY AND DATA SOURCES

In analyzing the impact of the aforementioned components of the social infrastructure, OCS-induced effects on separate elements within each major category were studied. For example, the impact on physical systems covers electrical demand as well as commercial office space and water supply. The methods for predicting 1985 and 2000 base case conditions as well as assessing the impacts and the sources for the 1970 figures are described below. It should be noted here that the use of a methodolgy based entirely on population increases and current ratios does have limitations particularly in the case of Alaska where the base case population and its characteristics may be an inadequate predition base.

Physical Systems

- Dwelling Units. To calculate the average number of persons per residential unit (i.e., apartments, houses, or their equivalents where individuals or families reside) in

each area studied the 1970 population was divided by the number of residential units (obtained from the US Census, Series HC, 1970). In predicting the demands for housing for the 1985 and 2000 base cases and OCS impact cases, this same number of persons per unit was used as a factor. The OCS impact is considered to be an additional demand for housing created by the induced population growth.

- Commercial Office Space. Requirements for office space for each area were estimated by calculating the number of office workers relative to the amount of space they require. A Bureau of Labor Statistics industry-occupation matrix was used to compute a ratio of office workers to total employment. This ratio multiplied by the projected total employment gave the office employment for 1985 and 2000. Office space requirements were estimated by multiplying the number of office workers by 150-the assumed average number of square feet per worker. [1]

- Public Water Supply. This system carries water for residential, commercial, and light industrial uses. Because regional demand for water varies due to factors such as sprinkling of lawns or leaving taps open to avoid freezing the pipes and because information on local uses was not readily available,an average figure of gallons per day per person was used to calculate future demands for water (170 in 1985 and 190 in 2000). The figures presented in the exhibits include only the muncipal and commercial demand for water which is often less that 20% of the total demand. This figure does, however, reflect the majority of the demand for clean, drinkable water usually supplied from reservoirs and ground water sources such as wells as opposed to industrial demand for cooling water which can be fresh or saline water and usually comes from surface water such as rivers or directly from the ocean. Lack of availability of rivers with sufficient flow to handle the cooling water demand of a refinery or petrochemical complex can obviously create problems in siting. Several factors make it difficult to predict industrial water demand and supply: 1) lack of adequate data on present supplies and uses, 2) possible switch to "closed" cooling systems which would affect the demand for cooling water, and 3) difficulty in predicting the effect on aquifer recharge rates of the development of previously open land.

---

[1] Building Planner and Managers Association, 1971 Annual Report.

In terms of public supply of drinking water the use of water for industrial purposes as well as predicted population increase would have an obvious effect and that fact should be taken into account when site location decisions are being made. For each area a discussion is included which points out any present or potential problems of water supply.

- Electrical Generating Capacity. The residential and commercial demand for electricity is expressed in terms of generating capacity to enable a comparison with present capacity serving the area. Whenever possible actual local usage figures for 1970 were obtained and a percapita consumption rate derived. When local data was not available, regional data was used and demand prorated to the local area on the basis of population. The percapita consumption rate was increased by 1.9% per year through 2000 based on Department of Interior projections. There are many factors which affect the per capita consumption rate in an area, such as degree of urbanization, climate, etc., however, the use of a rate which is comparable for different regions and types of areas (rural or urban) gives an average demand figure and allows for impact analysis. Industrial demand for electrical power is not covered here due to various constraints. It is impossible to predict the actual source of electrical power, that is, whether it is coming from a local power grid or from outside the area; firms vary widely on the amount of generation they handle themselves; and alternative pollution control requirements will have different impacts on the demand for power.

- Transportation. In the case of transportation systems it was determined that the impact analysis would be of a qualitative rather than a quantitative nature due to the time and data constraints as well as the complicated nature of transportation analysis. Any prediction of the demand for a particular mode of transportation involves an allocation between the various modes as well as between the region and the local area.

For each local area there is a discussion of the present transportation systems including airports, water-ports, high ways, and railroads and the demand for these systems. This data was obtained from Federal Aviation Administration and U.S. Corps of Engineers statistics as well as from state transportation departments.

Service Systems

For all of the services which are provided in a local area the assumption was made that the supply of each service would be equivalent to the demand for that service.

- Education. The need for educational facilities, materials, teachers, etc. depends, of course, on the number of school-age children. Wherever possible, State enrollment statistics were obtained to determine the number of enrollees in public and private school systems from nursery school through high school. The assumption was made that the ratio of school-age children to the total population would remain constant over time and the 1985 and 2000 predictions were made on that basis. College level educational needs were omitted because it was felt that higher education was not necessarily the responsibility of the local community.

- Law Enforcement. Citizen demand for safety and protection is normally translated into increase in the police force. Since manpower is generally the first consideration in terms of law enforcement, the demand for this service was predicted on the basis of the number of sworn personnel needed per 1,000 population. This ratio was obtained from the Uniform Crime Report for each area.

- Health Care. Although there are many components to an adequate health care system, the one which requires the most advanced planning and resource investment is the availability of hospital beds. For this reason, the number of beds in general medical and surgical hospitals required per 1,000 population was used as the determining factor for predictions and impact analysis. The information on the present availability of beds was obtained from the American Health Association Guide for 1972.

- Solid Waste. Impacts of OCS development on solid waste generation were analyzed as municipal and special industrial wastes. The municipal category includes residential, commercial, and some industrial wastes and is mainly associated with baseline and OCS-induced growth of population and service activities. Sources of industrial wastes requiring special handling include some primary OCS activities and other heavy industry in each geographic area.

Current municipal solid waste generation was estimated at six pounds per capita daily for all study areas, based upon state, regional, and local sources.[1] A lack of reliable quantitative records precluded more precise individual estimates, but the six-pound factor is representative.

It was assumed that the basic generation rate would remain unchanged in the future.[2] Although rising personal consumption and greater use of disposable packaging materials will increase waste generation, opposing forces are likely to balance this trend. Spurred by technological advances and, most importantly, by new regulations on packaging materials,[3] more widespread recycling and reuse of materials will tend to lower waste generation rates. Therefore, a "levelling-off" trend is assumed. Furthermore, because the primary OCS industrial solid waste contribution to the municipal solid waste stream should be relatively small (about 1-3 percent of the total stream), it was not considered significant enough to analyze directly.

Primary OCS and other industries generate wastes requiring special handling, unfortunately, and detailed information on their quantities and nature is limited. The basic research necessary to determine the nature and levels of various special wastes was beyond the scope of this study[4], and therefore no analysis has been carried out. However, the limited data available does indicate that special wastes would be significant. For example, it is estimated that a 100,000 barrel per day refinery produces approximately 15 tons per day[5] of solid wastes requiring special handling.

---

1 Most estimates ranged between five and six pounds per capita.

2 This view is supported by the Environmental Protection Agency.

3 For example, Oregon enacted a law in 1971 requiring a deposit on all beverage containers and banning pull-tab openers on beverage cans.

4 EPA is currently carrying out several studies on hazardous wastes.

5 Source: A New Petroleum Refinery - The Environmental Impact, Roy F. Weston, Inc., March, 1973.

- Sewage. The demand for sewage systems and treatment plants is expressed in terms of millions of gallons per day running through the system. Since local data on the rate of waste generation was not readily available, a hypothetical average of 120 gallons per day per person was used to predict 1985 and 2000 rates for all of the localities studied.

- Local Government Overhead. To get some perspective on the amount of organizational and planning activity within the local areas, an overhead budget was derived from figures out of the 1967 Census of Governments. Direct expenditures for education, police, hospitals, highways, and public welfare were subtracted from a total budgetary figure giving a total which, although not strictly overhead, projects an idea of the level of planning and administration. A dollars per capita factor was used in predicting future spending, assuming a constant ratio through the years. This ratio indicates how much the community is willing to spend on overhead-type expenditures.

Business and Government Institutions

In studying this category, two types of institutional developments were examined. First, the number of employees needed to operate the wholesale, retail, and service outlets were projected. In each local area the percentage of these employees relative to the total labor force was calculated, and this factor was used to project the increase of such employees as the population and labor base increase.. Second, the growth of government institutions was projected by the ratio of government employees per 1,000 population in each area. The growth of government personnel was then expressed in terms of skills and service needed to support the new population in the area.

The Power Structure

The position of community leaders on the issues raised by OCS induced growth will guide the manner in which the local area develops and will directly affect the quality of life there. Some community leaders will maintain current quality of life styles by resisting OCS opportunities for growth altogether. Others will support the development without any question or reservation. Another group will offer general support for development

with stringent requirements for environmental protection and carefully planned community development. In each local area, these interests must hammer out their competing values. Ultimately, the outcome of these discussions will determine what the community will do to prepare for growth and how well the community will adjust to the challenges of growth.

The Council on Environmental Quality held a series of public hearings on the subject of OCS development in various cities on the East coast and in Alaska. These hearings were held in order to give people an opportunity to state their views, express their concerns and to ask questions about this issue. The Council is publishing a summary of these hearings which will provide an insight into the position of community leaders in many of the localities studied as well as other possible sites.

SOURCES OF DATA

American Automobile Association. Map Series, 1973.

American Hospital Association. The AHA Guide to the Health Care Field. Washington, D.C: American Hospital Association, 1972.

1971 Annual Report. Building Owners and Managers Association. 1972.

Francis, John, and Swan, Norman. Scotland in Turmoil. Edinburgh, Scotland: The Saint Andrew Press, 1973.

Handy Railroad Atlas of the United States. New York: Rand McNally and Co., 1971.

U.S. Department of Commerce, Bureau of the Census. County Business Patterns. Washington, D.C.: U.S. Government Printing Office, 1971.

U.S. Department of Commerce, Bureau of the Census. 1967 Census of Business. Washington, D.C.: U.S. Government Printing Office, 1969.

U.S. Department of Commerce, Bureau of the Census. 1967 Census of Governments. Washington, D.C.: U.S. Government Printing Office, 1969.

U.S. Department of Commerce, Bureau of the Census. 1970 Census of Population and Housing. Washington, D.C.: U.S. Government Printing Office, 1972.

U.S. Department of Defense, Army Corps of Engineers. Waterborne Commerce of the United States, 1971. Washington, D.C.: Government Printing Office, 1972.

U.S. Department of Labor, Bureau of Labor Statistics. Occupational Employment Statistics, 1960-1970. Washington, D.C.: U.S. Government Printing Office, 1972 (Bulletin 1738).

U.S. Department of Trasnportation, Federal Aviation Administration. FAA Air Traffic Activity, 1970. Washington, D.C.: U.S. Government Printing Office, 1971.

APPENDIX VIII

LAND USE METHODOLOGY

The establishment of new industrial activity and other induced business development within a geographic area will effect changes in the land use pattern. This appendix presents the approach used to estimate the additional acreage needed by each category of user and, concomitantly, the undeveloped land remaining after different development scenarios.

This approach has been applied only to six planning areas. Alaska's land use impacts have required a different methodology, one better adapted to the nature of this region (Exhibit VIII-1). The land use impact analysis was conducted at two levels: 1) the local impact area ("locality"), and 2) the regional impact area ("region"), which includes the locality.[1] Exhibit VIII-2 presents a flow diagram summary of the land use methodology used in this study. The diagram indicates three basic activities: 1) 1970 land use inventory; 2) 1985 and 2000 land use estimates for each scenario, and 3) definition of actual undeveloped land capabilities.

LAND USE INVENTORY

This task involved two basic steps: 1) the classification of land uses and 2) the gathering and preparation of current land use data.

Classification of Land Uses

There exists no unique classification system and from one area to another it may differ widely. Therefore, the classification system must be flexible enough to accommodate wide variations in land-use definitions and, at the same time, be easily usable for making projections of

---

[1] Therefore the impacts on the region outside the locality are in fact the difference between the regional and local impacts.

EXHIBIT VIII-1

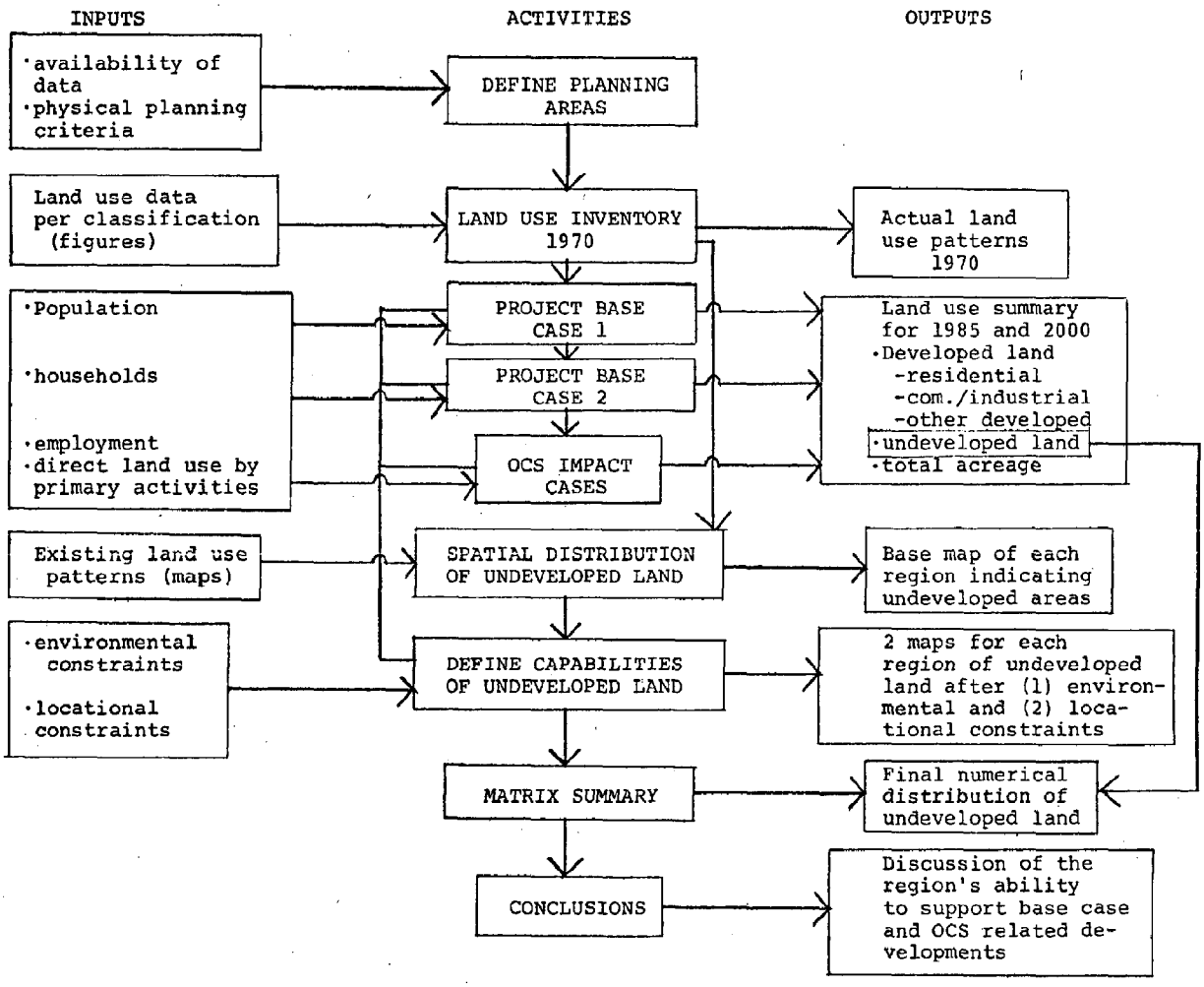
PLANNING AREAS

GEOGRAPHIC AREAS	LOCALITY	REGION
NEW ENGLAND	·Bristol, Mass.	·Rhode Island ·Eastern Massachusetts (9 counties)
MID ATLANTIC	·Cumberland, N.J. .Cape May, N.J.	·Southern New York (Richmond county) ·New Jersey (12 counties) ·Pennsylvania (5 counties) ·Delaware (New Castle county)
SOUTH ATLANTIC (1)	·Charleston, S.C. .Berkeley, S.C. ·Dorchester, S.C.	·Eastern South Carolina (13 counties) ·Eastern Georgia (2 counties)
SOUTH ATLANTIC (2)	.Duval, Fla. .Nassau, Fla. ·St. Johns, Fla. .Baker, Fla. .Clay, Fla.	·Northeastern Florida (12 counties) ·Southeastern Georgia (6 counties)
SAN FRANCISCO BAY AREA	.Solano, Cal. .Contra Costa, Cal.	·California (9 counties Bay Area)
PUGET SOUND	·Whatom, Wa. ·Skagit, Wa.	·Northwestern Washington (6 counties)
ALASKA	·Valdez (city), Ala.	·Alaska

Source: RPA

EXHIBIT VIII-2

LAND USE IMPACTS
SUMMARY OF METHODOLOGY



Source: RPA

future needs. The following system was adopted:

a. Developed Land (1 + 2 + 3)

   1. Residential
   2. Commercial/Industrial
   3. Other Developed Land

b. Undeveloped Land (c-a)

c. Total Land

Detailed definitions of these categories are as follows:

Developed land was defined as all land currently being used.[1]

- Residential land includes single family houses and mobile homes, multi-family houses and apartments as well as boarding houses and dormitories.

- The commercial and industrial category includes retail and wholesale establishments, warehouses, office buildings and other services, and light and heavy manufacturing.

- The last category, other developed land, comprises public and quasi public institutional buildings (e.g., schools, churches, hospitals), transportation (e.g., railroads, streets, airports, highways) and public open spaces (e.g., urban parks and recreational areas).[2]

---

[1] Land zoned as developable land but unused was not included in this category.

[2] Definitions of "public open space" varied in the study regions. Where possible, data was adjusted to include only open space uses directly associated with the local area, e.g., municipal park and recreational facilities. Larger extensive areas such as national and state parks were considered separately in the analysis of vacant land capabilities.

The residual category of undeveloped land includes all vacant and unused land, forests and agricultural land, as well as wetlands or other unsuitable[1] land (e.g., floodplains).

Current Land Use Data Gathering And Preparation

The sources of data used for each planning area are listed at the end of this appendix. These data were evaluated and updated to reflect the most accurate "current conditions" case possible. The year 1970 was chosen as the reference date and all other data were adjusted to 1970 to be consistent.

Several problems were encountered during the data gathering phase: (1) most of the data were old, which, in turn, lowers the validity of the 1970 base line figures; (2) the existing data are imprecise in most cases, and based on estimates rather than empirical analysis (e.g., photogrammetric mapping); and (3) inventory categories were as numerous as the agencies gathering data.[2]

It must be noted here that the purpose of this study was not to prepare precise land-use distributions but rather to evaluate the relative magnitude of two base case developments and two OCS developments on existing land-use characteristics.

YEAR 1985 AND 2000 PROJECTIONS

Three sets of projections had to be made under base case 1 and 2 and high and low OCS impact cases: (1) residential acreage, (2) commercial and industrial acreage and (3) other developed acreage. Undeveloped land was deducted by subtraction (total land minus estimated developed land).

---

[1] By unsuitable is meant environmentally fragile and generally not suited for development.

[2] To illustrate these extremes, land use in Bristol County was reported in 100 categories, including 22 urban and 15 intensive recreation types, while for part of Georgia, only a gross aggregate of "urban built-up areas," with no further breakdown, was available.

Residential Acreage Projections

A function Y of acreage per household versus population density was developed for each locality and region.[1] The economic model described in Appendix VI provided population projections for each planning area under each base and impact case. Population projections were translated into density (inhabitants per acre) which in turn, using the function, were translated into residential acreage per household. These projections were used to compute residential acreage needed in year 1985 and 2000 on the basis of the estimated number of households.[2]

The function Y was derived as follows. It was first assumed that current total residential land would be the lower boundary of 1985 acreage projections and that current residential acreage per household multiplied by the estimated future number of household would be the upper boundary. An example of this type of calculation for Bristol County, Massachusetts, follows:

	Actual 1970	Projections 1985	2000
Upper Boundary	-	46,600	50,100
Actual or estimated	41,400	-[3]	-[4]
Lower Boundary	-	41,400	45,600
Acres/household	.293	-[3]	-[4]
No. Households (from economic model)	141,549	159,296	175,226

Where 1985 upper boundary is equal to:
46,600 acres = .29 acres/household x 159,296 households.

---

[1] A total of 12 functions, each one representative of the specific characteristics of each of 6 regions and localities, were developed.

[2] Number of households was defined as the estimated population (from the economic model) divided by the 1970 population figure per household for a given area.

[3] The 1985 residential acreage estimate for Bristol County was 45,600 corresponding to .286 acres per household.

[4] Year 2000 projections were 48,300 residential acres with .276 acres per household.

The estimated 1985 residential acreage would therefore fall between these two boundaries.[1] Several distributions were analyzed for each planning area and then translated by regression into a function of the type

$Y = k_1 e^{-an} + k_2 e^{-bn} + C$, where Y is the residential acres per household and n is the density per acres for the given area.[2] Exhibit VIII-3 presents the graph of one such function, which was used to project total residential land acreage over time as density increases in the Cumberland and Cape May locality.

Density increases were related to the estimated total impacted population (including primary, supplier and induced). It was felt that any further differentiation among "resident" (e.g., those living in the area before OCS developments, those connected with primary activities, those resulting from secondary activities) in terms of specific acres per household would, at best, be purely arbitrary. Such a differentiation would require an in-depth understanding of such factors as household location decision making, land value and speculation in each planning area. This level of analysis was thought to be beyond the scope of the present study, especially given the precision of the economic model.[3]

---

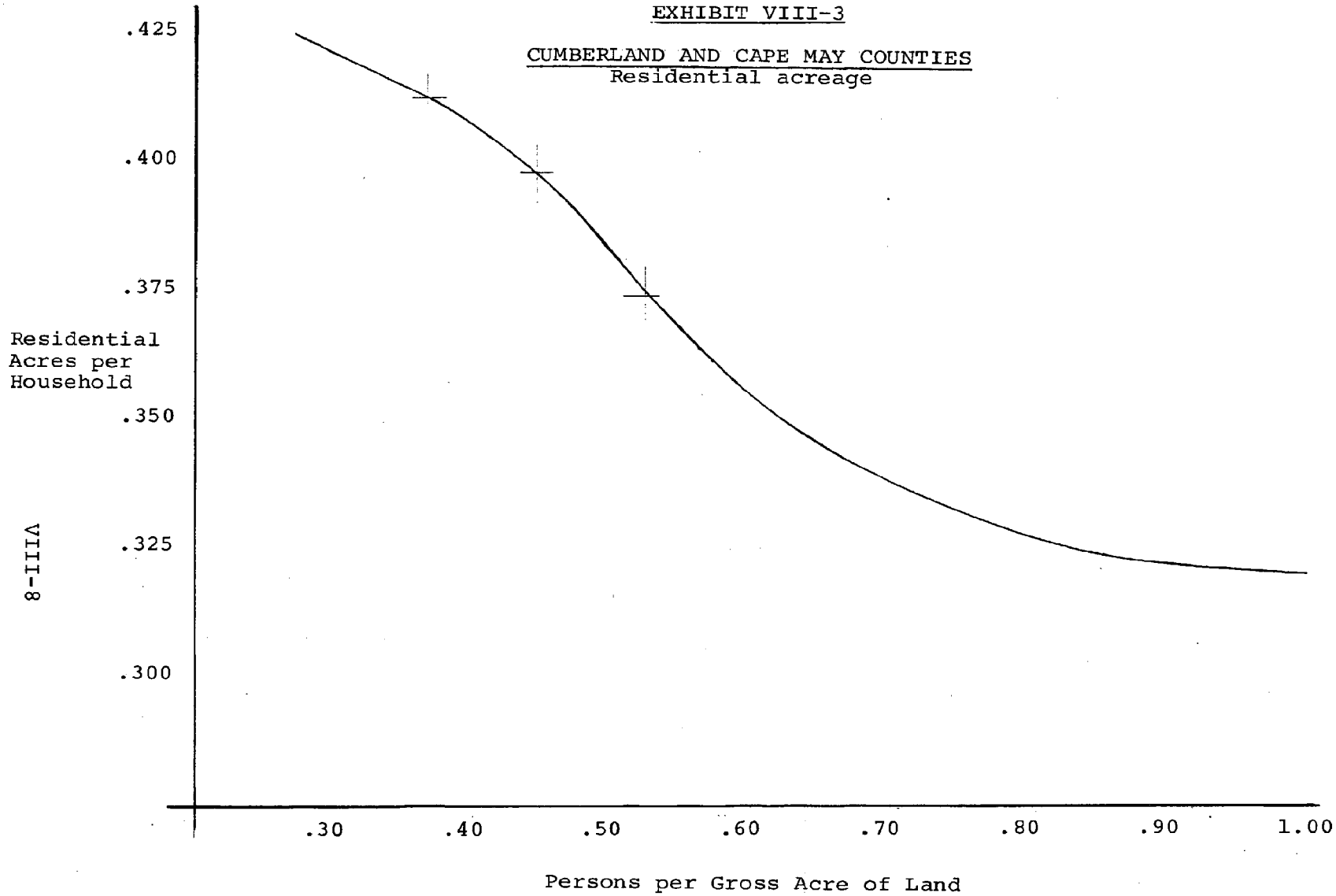
[1] The same approach was used to generate the year 2000 figure.

[2] A curve fitting program was used to perform the regression analysis and give to the researchers an idea of the shape of the function. Because of time constraints, graphs rather than precise mathematical functions were used to project residential land uses.

[3] From a sensitivity point of view a variation of 25 percent in the acres per household figures of household connected with industrial activities, e.g., refineries, petrochemical complexes, etc., would only result in a one percent variation in the overall residential acreage figure (based on Bristol County data, base case 1 with high OCS development for 1985).

EXHIBIT VIII-3

CUMBERLAND AND CAPE MAY COUNTIES
Residential acreage



Commercial and Industrial Acreage Projections

At this stage a differentiation was made between land used for primary activities[1] and other commercial and industrial activities.

Land Usage of Primary Industries

Industrial land used due to primary activities was assessed for years 1985 and 2000 by direct computation. Land requirement ratios were developed for each primary activity as a function of the required production capacity, storage capacity, and expansion (including greenbelt) needs.[2] Exhibit VIII-4 lists these ratios. Using data generated by the economic model, these ratios were multiplied by the number of plants in each primary activity and in each planning area. For instance, in the Cumberland County and Cape May locality, 4 refineries (200,000 barrels per day each) are projected by 1985 (base case 2, no OCS development), thus requiring 5600 acres of land.[3] Exhibit VIII-5 summarizes on a regional basis the direct land uses associated with primary industries.

Other Commercial and Industrial Acreage

Employment projections, irrespective of residency, were used to forecast commercial and industrial land uses following a methodology similar to the one used for residential acreage projections. Employment rather than households or population was used because it is a better indication of industrial and commercial activity and land use than population or number of household. Employment data were provided by the economic model.

---

[1] Primary activities are defined as deepwater ports and induced refinery and petrochemical activities for base case 2, and gas recovery, gas processing, petrochemicals, and refineries for the high and low impact cases.

[2] These ratios are based on discussions with industry personnel, review of other impact studies and examination of current land requirements of production complexes. Refer to appendixes discussing each activity for more details.

[3] Refer to Exhibit II-4H, appendix II.

EXHIBIT VIII-4

DIRECT LAND USE RATIOS FOR PRIMARY ACTIVITIES[1]

1. Petroleum Refining[2]	
. Base case refineries (tanker fed, 15-day storage)	7 acres per 1000 barrel/day
. Offshore-supplied refineries (10-day storage)	6 acres per 1000 barrels/day
2. Petrochemicals[3]	
Geographic Region:	
New England	330 acres per complex
Mid-Atlantic	300 acres per complex
South Atlantic	350 acres per complex
Puget Sound	350 acres per complex
San Francisco Bay Area	300 acres per complex
3. Gas Processing[4]	20 acres per plant

---

[1]Including direct plant use, expansion and other buffer requirements.
[2]*Supra*, Appendix II
[3]*Supra*, Appendix IV
[4]*Supra*, Appendix III

Source: RPA estimates.

EXHIBIT VIII-5

TOTAL DIRECT LAND USE ACRES

PRIMARY INDUSTRIES[a]

LOCATION	1985				2000[b]			
	BASE CASE 1	BASE CASE 2	OCS LOW	OCS HIGH	BASE CASE 1	BASE CASE 2	OCS LOW	OCS HIGH
NEW ENGLAND								
Local	0	0	1040	1720	0	0	1100	3700
Region	0	2275	1020	1855	0	2400	1020	3970
MID ATLANTIC								
Local	0	6875	1700	2680	0	7975	1760	2990
Region	570	4675	0	2430	1230	5360	1980	5930
S. ATLANTIC/CHARLESTON								
Local	0	1485	1040	1720	0	1530	1100	4910
Region	0	5935	1020	2100	0	9550	1020	4560
S. ATLANTIC/JACKSONVILLE								
Local	0	1485	1040	1720	0	2475	1100	4910
Region	0	475	0	0	0	3460	0	2320
ALASKA								
Local	0		20	20	0		40	100
Region	180		0	20	460		80	220
PUGET SOUND								
Local	1185		0	0	1675		1350	2600
Region	0		0	0	0		0	0
SAN FRANCISCO BAY								
Local	480		0	720	510		960	3780
Region	0		0	0	0		0	0

[a] Includes refining, petrochemicals, gas processing, and crude oil storage.
[b] Includes 1985.

Source: RPA

Other Developed Land Projections

These projections are probably the least accurate, for it was difficult to establish a good correlation between any factor and "other developed land." One obvious reason is that public policy, political considerations and many other intangible elements greatly affect the land set aside by communities for recreational and other public or quasi-public purposes. Therefore, a straight line projection using the 1970 ratio of "other land per capita" was made. Such a straight line projection is also more conservative in terms of the residual undeveloped land than assuming a decline of developed land on a per capita basis.[1]

Year 1985 and 2000 Land Use Summaries

All land use forecasts are presented in a format which facilitates the evaluation of the overall land use impacts associated with each base case and OCS development. Acreages as well as percentages are used to show variations in land-uses on a local and regional basis. Exhibit VIII-6 is a sample output of the format of these summaries.

UNDEVELOPED LAND CAPABILITIES

In the preceding land use sections, numerical projections were derived for developed and undeveloped land in each region under the various base cases and OCS impacts. Using these figures, it might be inferred statistically that if "undeveloped land" in any region far exceeded combined land requirements for normal growth and OCS activity, there would be no problem in accommodating these uses. Such a conclusion could be very misleading, since "undeveloped land" is not necessarily synonomous with "available land." Frequently, large portions of "undeveloped land" are either not available, or unsuitable for further development. For example, a dramatic reversal occurred in one region[2] where an apparent need for 3.5 percent of "undeveloped land" actually constituted 70.5 percent of all undeveloped land actually available for future development.

---

[1] No facts could be found that suggest that this ratio will decline. On the contrary, it appears that in the last few years more and more communities (due to public pressure) are increasing their inventory of public open space.

[2] Puget Sound, Wash., region, under Base Case 2, year 2000 OCS high conditions.

EXHIBIT VIII-6

LAND USE SUMMARY

Summary in Acres		1970	Year 1985				Year 2000			
		Actual Development	Base Case 1 Development	Base Case 2 Development	OCS Low* Development	OCS High* Development	Base Case 1 Development	Base Case 2 Development	OCS Low* Development	OCS High* Development
Land Use Classification	DEVELOPED LAND									
	. residential									
	. commercial industrial									
	. other									
	UNDEVELOPED LAND									
	TOTAL ACREAGE									

* incremental acreage only. If two figures, number in parentheses refers to base case.

Summary in Percent		1970	Year 1985*				Year 2000*			
		Actual Development	Base Case 1 Development	Base Case 2 Development	OCS Low Above B.C.2	OCS High Above B.C.2	Base Case 1 Development	Base Case 2 Development	OCS Low Above B.C.2	OCS High Above B.C.2
Land Use Classification	DEVELOPED LAND									
	. residential									
	. commercial industrial									
	. other									
	UNDEVELOPED LAND									

* Impacts of OCS developments indicated only above Base Case 2.

Source: RPA estimates.

The purpose of this section is to determine for each region the portion of "undeveloped land" actually suitable for development in its geographical and spatial context.

In order to define the capabilities of "undeveloped land" to accept normal and OCS related development, five steps were followed: 1) data gathering and preparation, 2) base map preparation; 3) definition of existing uses and environmental constraints; 4) definition of locational constraints; and 5) definition of undeveloped land capabilities. The spatial analysis was performed on a regional basis only, and land requirements are presented for the high impact case in 2000 to illustrate the maximum impact for each region.[1]

Data Gathering and Preparation

In preparing for a spatial analysis of the land-use data and projections, extreme difficulty was encountered in assembling comprehensive land-use and resource inventories and development plans for the study regions.

Existing comprehensive data varied widely from region to region and was often fragmented, too general, too disagregated, or too old to be reliable. As a result of recent nationwide legislation and activity, data bases should soon be available in many of the study regions. For this reason it is recommended that precise regional zoning and site selection not be attempted until this new information is incorporated into the regional maps.

In the New England region very little comprehensive spatial data could be found for existing land-use inventories and water resource systems. Additionally, in Massachusetts, no information was available on proposed areas of impoundment and coastal zoning.[2]

---

[1] If "worst-case" requirements generated by Base Case 2, OCS high, year 2000 conditions can be accommodated it can be assumed that lesser cases will also be feasible.

[2] Although land use and resource inventory mapping in New England is in progress, results are not yet available. The two principal studies are the Southeastern New England Study of Water and Related Land Resources by the New England River Basin Commission and a land use inventory of Massachusetts and Rhode Island by the Metropolitan Area Planning Commission.

Similar situations were found to exist in data availability for other Mid-Atlantic and South Atlantic regions, where inventory and planning efforts have been set in motion but results are as yet unavailable.

In marked contrast, the West Coast regions were able to furnish accurate and comprehensive data for most of the desired variables, and had precise regional plans which greatly facilitated analysis.[1]

In the preparation of the regional maps, the best available information was used and incomplete or omitted variables have been noted in the exhibit entitled "Undeveloped Land Capabilities," Exhibit VIII-8.

While this lack of detailed information may have affected the precision of the land use maps, it should not have lessened their accuracy since the intent of this analysis is to depict spatially the distribution, magnitude and characteristics of the acreages under discussion, not to select specific sites. As data become available, refined versions of these maps will make possible, for the appropriate policy-making officials, the in-depth studies necessary for precise regional zoning and subsequent site selection.

For the two West Coast regions detailed information was available and conclusions were brought to a higher level of detail.

Base Map Preparation

Base maps were first constructed showing the location of developed and undeveloped lands. These base maps show as "developed" only lands of relatively intensive use and omit suburban uses, small urban centers and other small privately or publicly held parcels.

---

[1] Information supplied by the Association of Bay Area Governments including the San Francisco Bay Regional Plan 1970 and the Comprehensive Study of Water and Related Land Resources, Puget Sound and Adjacent Waters published by the Puget Sound Task Force-Pacific Northwest River Basins Commission were used as a basis for analysis in the San Francisco Bay and Puget Sound, Wash. regions respectively.

Existing Uses and Environmental Constraints

Existing uses and environmental constraints include the following categories:

Land Unavailable Due to Existing or Planned Land Use

All significant[1] national, state and local parks, reserves, wildlife refuges, government, utility and institutionally owned lands were considered unavailable. Where known, planned recreation and conservation areas including outstanding beauty spots were shown as unavailable.

Land Unsuitable Due to Zoning

Areas of impoundment or adverse industrial zoning were considered unavailable.

Land Unsuitable Due to Slope-General Development

Fifteen percent was used as the cut-off for excessive slope.[2] Slopes greater than 15 percent are subject to erosion, present construction difficulties, and are not well-suited for road systems. Inclines of this magnitude usually occur in mountainous areas or along riparian borders. In the latter case, they would not be wide enough to appear on the small scale regional maps.[3]

Land Unsuitable Due to Ecological Constraints

All wetlands were considered unsuitable because of their unique wild-life supporting capacity and extreme

---

[1] Single tracts smaller than one square mile were generally omitted. As noted on the plates, local application will require mapping in greater detail.

[2] See The Plan and Program for the Brandywine, Institute of Economic Studies, University of Pennsylvania, 1968, pp. III-B 15.

[3] Slopes greater than 5 percent are later removed under "locational constraints" for reasons relating to primary development.

ecological vulnerability.[1] Principal elements of water resources systems, rivers and lakes, riparian borders to 300 feet, selected watersheds, aquifers, aquifer recharge areas and floodplains were also considered unsuitable for development.[2]

Available water resource elements were projected upon the base maps by the use of overlays. The result of this screening shows undeveloped land available for general development (residential; commercial; primary, induced and other industrial developments; agricultural; etc.)

Of all the variables considered, water resource data represented on a spatial basis were the least obtainable, varying greatly in completion and accuracy. Hydrological data when available were either too general or too disaggregated to be of use. It was far beyond the scope of this study to aggregate existing data or prepare regional inventories of resources, and it was therefore impossible to give hydrological factors emphasis equal to their importance.

Definition of Locational Constraints

Locational constraints are described in the following two sections:

Description of Existing Locational Patterns

Historically, refineries in the U.S. have located in the general area of crude oil production, concentrating

---

[1]It is likely that a smaller premium will be placed upon wetlands in regions where they are in great abundance than in drier regions. Planned management of these wetlands under state and national control is possible; without such control, it is prudent to consider all such development as unsuitable.

[2]As in the case of wetlands, this is a conservative approach, reserving the possibility of actually locating on the flood plain or within other water resource areas for site selection on a local basis. Land removed on this basis is overstated because there are complementary land uses possible for these areas, such as farming and recreation. By excluding the entire water resources systems, the availability of alternative areas not subject to environmental constraints can be tested.

also in the coastal regions accessible to tanker transportation, large inland population centers, and pipelines. With scattered exceptions, they are clustered in large groupings within the Gulf Coast/Southwest region, and in four smaller areas in the Mid Atlantic, Great Lakes, Northwest and Southern California regions.

Organically based petrochemical plants have located in a more compact pattern, favoring sites close to the source of feedstock, which in the past has been mainly natural gas liquids. The majority of organic petrochemical plants today can therefore be found in the Gulf Coast region, adjacent to the largest natural gas fields. As the percentage of natural gas liquids available for chemical users diminishes relative to total feedstock availability, the industry's new construction will probably shift toward heavy liquid feedstocks and organic chemical plants will then increasingly locate near refineries.

Unlike refineries and petrochemical complexes which are large land users, gas processing takes place in relatively small-sized plants located in close proximity to natural gas sources.

Criteria for Location within Region

In looking for sites within regions--as opposed to choosing between regions--refineries have two major locational constraints: availability of land and availability of adequate supplies of cooling water. A third criterion, proximity to work force and social infrastructure, while of significance, is generally satisfied within the six relatively densely populated coastal regions.

Approximately one half of the petrochemical plants under discussion must, for efficient production, be located adjacent to or within three to four miles of the refinery. The remaining half still have to be within the general area, 30 miles being considered the maximum feasible distance from the primary chemical plants.

Petrochemical plants occupy sizeable quantities of land and need even larger volumes of water than refineries for cooling purposes. They must also have access to economical means of shipping bulky products to the market. Although the selection of coastal regions ensures the general availability of ocean transport, a deep inland location

(where shipment by road, rail or pipeline is infeasible or unavailable) may cause excessive transportation costs.[1]

For the integrated refinery/petrochemical complex the combined locational constraints within the seven coastal regions are principally the availability of suitable land, adequate supplies of fresh water and economical market transportation. Because of their relatively small size, the locational constraints for gas processing plants are not as severe, the main criterion being proximity to natural gas sources.

Land Unsuitable Due to Slope - Primary Development

For the locational map a slope outline was constructed eliminating as unsuitable areas of slope exceeding 5 percent.[2] These are slopes which are excessive for the purpose of industrial plant layout and construction as opposed to slopes previously removed as unsuitable for general development.

Land Unsuitable Due to Inadequate Water Supply

Refineries and petrochemical complexes actually consume very little water. Most of the withdrawals are for cooling water purposes, and aside from considerations of heat and other pollution, can be returned to the natural system almost intact.

It is difficult to assess cooling water availability in any region absolutely since demand (withdrawals) and supply are not fixed.

First, potential water supply for any region from Conventional Sources--basically different forms of surface

---

[1]Such bulky products are at present usually transported by water using either barges or ocean-going vessels.

[2]One variable not considered explicitly (although often subsumed by other categories of unusable land such as wetlands and tidal marshes) is soil bearing capacity. Inclusion of this variable is necessary for precise regional zoning and specific site selection.

water--is not known. Groundwater is, generally speaking, an inadequate source of cooling water in these large volumes. (The concern of this study with respect to ground water was to avoid disturbing ground water systems which should be reserved for municipal drinking supply and private withdrawals, rather than to search for adequate ground water supplies for primary industry.)

Secondly, virtually any reasonably sized water supply can be developed in coastal regions at some cost, using new technology. Salt water cooling, water desalting plants and intra-basin transfer are now technically feasible and may become economically viable in the near future.

Finally, demand for withdrawals as projected, while assuming substantial reductions due to in-plant recycling of cooling water, can be further reduced sizeably if it is found cheaper to diminish withdrawals than to develop new supplies.

Because of data unavailability and the difficulty in estimating a unique supply and demand for cooling water, it was impossible to construct overlays showing regions of adequate water supply for primary purposes. Consequently, the constraint associated with cooling water needs was not used in the selection of "suitable zones for primary development" and areas suggested by the locational maps will still be subject to a site specific verification of the availability of water.

Conclusions for the likely availability of cooling water in each region presented in the exhibit entitled "Undeveloped Land Capabilities" were based upon findings of The Nation's Water Resources,[1] and assumed conventional water supply practices.

Exhibit VIII-7 gives values for the constraints which would aply to the representative plant complexes used in

---

[1]The Water Resources Council, Washington, D.C. (1968).

this study.[1] The locational constraints listed in the exhibit were superimposed over the base map and the first set of overlays to identify possible zones of suitable location.

Since it is clearly not within the scope of intent of this study to perform detailed land-use planning, the spatial depiction of data for areas without comprehensive regional plans is not pursued beyond this level.

It should be noted that while on one hand "unsuitable land" is generally overstated because of the possibility of complementary uses--farming on floodplains, regulated low density residential or forested slopes--on the other hand, acreage unavailable due to water resource protection could not be estimated and may balance if not exceed this amount.

Definition of Undeveloped Land Capabilities

When using the maps and matrixes it must be borne in mind that these are single purpose exhibits relating principally to the petroleum industry. Nevertheless, lands shown to be both available and suitable for primary industrial activities will be competing with the normal and induced growth components of residential, commercial, other industrial and agriculture. To aid in the allocation of these land uses, graphical scales have been drawn on the maps showing projections of normal growth, induced growth and primary industry land requirements. Land remaining after the allocation of primary activity, induced acting, and normal growth (Base Case 2) represents the minimum available to agriculture or left vacant for future uses.

---

[1] Petrochemical plants related to the representative refinery complex can be separated into two components, those directly tied to the refinery, and those which can locate in the near vicinity. Exhibit VIII-7 shows two figures for aggregated land consumption, that of the immediate complex refinery and inseparable components of petrochemical uses (and that of the total petroleum complex including petrochemical outriders). This establishes, for land-use purposes a high and low acreage figure for the representative petroleum complex in the event that land is too scarce or local impact too great.

EXHIBIT VIII-7

LOCATIONAL CONSTRAINTS

	Land (ac)	Slope	Distance
Refinery	1400	5%	30 minutes from housing and social infrastructure[a]
Inseparable Petrochemical	165	5%	
Separable Petrochemical	165	5%	
Gas Processing Plant	20	5%	

[a]For the highly urbanized regions (Eastern Mass./R.I., Delaware River Region, San Francisco Bay), population centers of 15,000 and over were used as adequate sources of housing and social infrastructure. For the less urbanized areas, 10,000 and over were used.

Source: RPA

EXHIBIT VIII-8

UNDEVELOPED LAND CAPABILITIES

Region:

	Thousands of Acres		Percent
. TOTAL UNDEVELOPED LAND[a]		_____	100
. UNAVAILABLE LAND DUE TO ENVIRONMENTAL CONSTRAINTS		_____	_____
. existing and projected uses	_____		
. coastal zoning and improvements	_____		
. excessive slope (> 15%)	_____		
. wetlands	_____		
. water resources	YES - NO		
. UNSUITABLE LAND DUE TO LOCATIONAL CONSTRAINTS[b]		_____	_____
. excessive slope (> 5%)	_____		
. distance (> 30 minutes)	_____		
. water requirements	YES - NO		
. TOTAL REMAINING DEVELOPABLE LAND[c]		_____	_____
. TOTAL LAND USE REQUIREMENTS[d]		_____	_____
. total direct land use[e]	_____		
. total induced land use[f]	_____		
residential	_____		
commercial/industrial[g]	_____		
other developed land	_____		

[a]Refer to land use summary exhibits for each region. Total undeveloped land figure corresponds to 1970 data.
[b]Where overlap with land unavailable due to environmental constraints, only incremental value is considered.
[c]Land suited for primary industrial activities, e.g., refineries, petrochemical complexes, etc., but competing with other uses, e.g., residential, commercial, light industrial, agricultural, etc. ("general development").
[d]Total Land Use Requirements corresponds to worst possible case by year 2000 (in general, base case 2 combined with high level OCS development).
[e]Refer to Exhibit VIII-5, Total Direct Land Use. Corresponds to maximum primary development.
[f]Refer to land use summary exhibits for each region. Corresponds to worst possible case by year 2000.
[g]Excluding primary industrial land.

Source: RPA estimates.

The percentage of open land removed by existing uses, environmental factors and locational constraints can be considered an indicator of the likelihood of finding a suitable location. For instance, if existing use, environmental factors and locational constraints remove 95 percent of the land in a region from consideration, 5 percent of the region appear to be open for primary industry. In fact, the margin of error resulting from varying and imprecise data bases is large enough that there could easily be no land available for primary activity.

Even in regions where good data is available the omission of suburban development, small urban centers and diverse small land holdings may make land assembly or an appropriate location with respect to local zoning ordinances in this remaining 5 percent impossible. Conversely, if hundreds of thousands of acres within a region are environmentally suited and a very small percent of the area is eliminated due to locational constraints, chances of finding actual sites are very high.

The graphical representation of acreages in the title blocks are drawn at the same scale as the maps, and represent, for year 2000, Base Case 2, High Impact, and the four following items:

1) Under "Base Case 2 (No OCS), Primary" is the portion of normal growth which will be devoted to primary industry by the year 2000 even if there is no OCS development.

2) Under "Base Case 2 (No OCS), Other" is all expected normal growth for the region until the year 2000, excluding the above "direct" acreage.[1]

3) Under "OCS High, Primary" is the acreage projected for the accommodation of OCS high primary activity-the actual land to be occupied by refineries, petrochemical plants and gas processing plants.

4) Under "OCS High, Induced" is the incremental amount of land which will be consumed by induced activity resulting from OCS high activity.

---

[1]One and two together comprise total expected normal growth for the region if OCS development does not occur.

Referring to Exhibit VIII-7, the blocks of 1565 acres represent single tracts of land which must be acquired or assembled to accommodate a 200,000 b/d refinery (1400 acres) and the 165 acre portion of a 330 acre "representative" petrochemical plant which must be located contiguous to the refinery. Tracts of 1400 acres represent refineries without petrochemical additions and the smaller areas are remaining portions of refining and petrochemical capacities.

The 165 acres of the petrochemical plants not directly connected to the refinery, together with gas processing plants and very small remainders of either refining or petrochemical plant capacities are shown together under "other" in the OCS high, direct column.

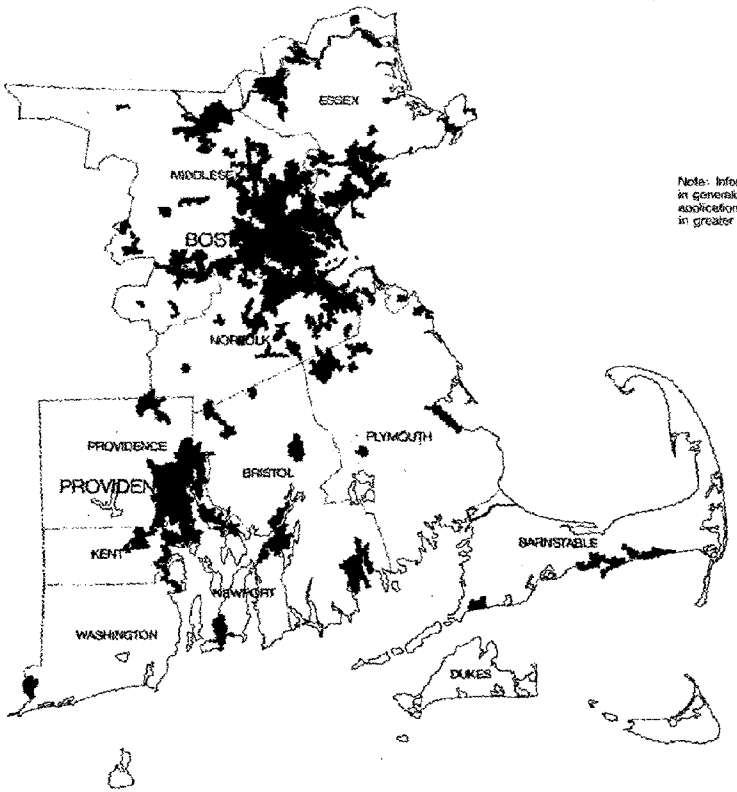
These can be located in diverse small tracts in the general vicinity (30 miles radius) of the refinery.

For an example of the land use map presentation see Plates 1, 2 and 3 which follow.

POTENTIAL EFFECTS OF O.C.S. OIL AND GAS DEVELOPMENT

EASTERN MASS./R.I.

PLATE 1



Note: Information presented is in generalized form. Local application will require mapping in greater detail.

UNDEVELOPED LAND

PRESENT CONDITIONS

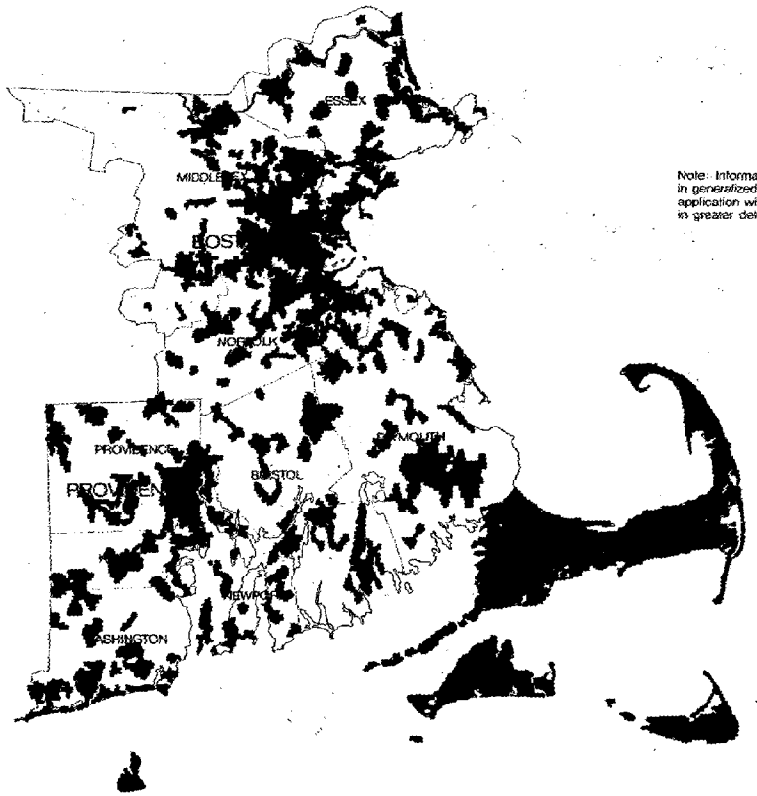
- DEVELOPED LAND
  EXISTING LAND USES
- UNDEVELOPED LAND

RESOURCE PLANNING ASSOCIATES INC.

BASE MAP U.S.G.S. 1:250,000 DECEMBER 1973

miles

N



Note: Information presented is in generalized form. Local application will require mapping in greater detail.

POTENTIAL EFFECTS OF O.C.S. OIL AND GAS DEVELOPMENT

EASTERN MASS./R.I.

PLATE 2

LAND USE IMPACT

LAND REQUIREMENTS TO SCALE
BASE CASE 2 HIGH IMPACT YEAR 2000

BASE CASE II (NO OCS)		OCS HIGH IMPACT		
PRIMARY	OTHER	PRIMARY	INDUCED	TOTAL
2400	162,000	1565 1565 1400 1400 1120 OTHER 620 7670	18,800	190,870 ACRES

SUITABLE LAND

FOR GENERAL DEVELOPMENT

- UNSUITABLE LAND
  EXISTING AND PROJECTED LAND USES
  ENVIRONMENTAL CONSTRAINTS
- SUITABLE LAND
  SUBJECT TO AVAILABILITY AND LOCAL ZONING

RESOURCE PLANNING ASSOCIATES INC.

BASE MAP U.S.G.S. 1:250,000 DECEMBER 1973

miles

N

Note: Information presented is in generalized form. Local application will require mapping in greater detail.

POTENTIAL EFFECTS OF O.C.S. OIL AND GAS DEVELOPMENT

EASTERN MASS./R.I.

PLATE 3

LAND USE IMPACT

LAND REQUIREMENTS TO SCALE
BASE CASE 2 HIGH IMPACT YEAR 2000

BASE CASE II (NO O.C.S.)		O.C.S. HIGH IMPACT		
PRIMARY	OTHER	PRIMARY	INDUCED	TOTAL
2400	162,000	1565 1565 1400 1400 1120 OTHER 620	18,800	190,870 ACRES 7670

SUITABLE LAND

FOR PRIMARY DEVELOPMENT

- UNSUITABLE LAND
  EXISTING AND PROJECTED LAND USES
  ENVIRONMENTAL CONSTRAINTS
  LOCATIONAL CONSTRAINTS
- SUITABLE LAND
  SUBJECT TO AVAILABILITY AND LOCAL ZONING

RESOURCE PLANNING ASSOCIATES INC.

BASE MAP U.S.G.S. 1:250,000 DECEMBER 1973

miles

N

SOURCES OF DATA

American Automobile Association. Map Series, 1973.

McHarg, Ian. Design with Nature. New York: Doubleday & Sons, 1969.

North Atlantic Regional Water Resources Study. North Atlantic Regional Water Resources Coordinating Committee. 1972.

Steinitz, Murray and Sinton, Way. A Comparative Evaluation of Resource Analysis Methods. Cambridge, Massachusetts: Harvard University, Graduate School of Design, Department of Landscape Architecture, 1969.

The Plan and Program for the Brandywine. Institute for Environmental Studies. Philadelphia: University of Pa. Press, 1968.

United States Department of the Interior, Geological Survey. National Topographic Maps, 1:250,000 scale series.

Water Resources Council. The Nation's Water Resources. Washington, D.C.: U.S. Government Printing Office, 1968.

APPENDIX IX

AIR AND WATER POLLUTION METHODOLOGY

This appendix discusses the methodology used in estimating the pollution impacts of both base case development and offshore production. The appendix is divided into two sections:

--Air Pollution
--Water Pollution

AIR POLLUTION

For each locality and region under study, two types of analysis were performed. First, 1970 ambient air concentrations were compiled for particulates and oxides of sulphur. Second, 1972 loadings for five pollutants from major point and area sources were estimated and projected to 1985 and 2000 under existing and anticipated control levels needed to meet air quality standards. Trends in industrial practices were also considered where regulations did not apply.

Ambient Concentrations

Ambient air concentrations for particulates and sulphur oxides in 1970 were reported for each county in the study areas utilizing the National Air Sampling Network Data. A complete tabulation of this data is presented in the body of the text which discusses individual study areas. Existing concentrations were also compared with state air priority classifications which were used to estimate the effects of future emissions on air quality.

Pollution Emissions

Pollution emissions were estimated for 1972 and projected to 1985 and 2000 for particulates, sulphur oxides, hydrocarbons, carbon monoxide, and nitrogen oxides for major point and area source polluters within the geographic areas under consideration. The projections were based on both existing control levels and anticipated control levels which would be needed to meet EPA standards. Control factors estimated for each source in each study area are tabulated and explained in Annex B.

Existing emissions from both stationary and mobile sources

in each of the twelve study areas are also reported in Annex B along with projected loadings. Loadings were projected for both direct industries and indirect activities on the basis of activity levels generated by the economic model.

1. Direct Industries

Source assumptions, control assumptions and emmissions were estimated for refineries, gas processing plants and petrochemical plants as follows:

a. Oil Refineries

For analytical purposes, a standard plant size of 200,000 bbl/day is considered for all applications. A detailed description of this "analytic" refinery is given in Appendix II. Source assumptions for refinery pollutants are shown in Exhibit IX-1.

EXHIBIT IX-1

REFINERY EMISSION SOURCES

Source	Emissions (tons/day)				
	Part	SO_x	HC	NO_x	CO
Heaters					
Atm. Distillation	1.22	2.49	0.16	2.12	0.21
Vac. Distillation	0.31	0.63	0.04	0.54	0.05
Naptha HDS	0.10	0.21	0.01	0.18	0.02
Distillate HDS	0.14	0.28	0.02	0.24	0.02
Gas Oil HDS	0.25	0.52	0.03	0.44	0.04
Residual HDS	0.20	0.40	0.03	0.34	0.03
Isomerization	0.09	0.19	0.01	0.16	0.02
Catalytic Cracker	0.70	0.43	0.09	1.22	0.12
Reformer	0.78	1.60	0.10	1.36	0.14
Hydrogen Plant	0.37	0.86	0.06	1.47	0.07
Alkylation	0.20	0.40	0.03	0.34	0.03
CO Boiler	0.38	2.31	0.19	4.72	0.21
Sulphur Tail Gas	--	1.01	--	--	--
Sludge Incineration	0.08	0.00	0.01	0.09	0.04
Petroleum Storage	--	--	4.05	--	--
Miscellaneous	--	--	29.74	--	--
Total tons/day	4.82	11.30	34.57	13.22	1.00
[a]Total tons/year	1591	3739	11408	4363	330

[a]Assumed 90 percent efficiency

Source: Radian Corporation Technical Notes on Refineries

The refinery pollution levels were applied to the projected number of plants in each study area under all impact conditions to obtain the projected pollution loadings from refineries.

b. Gas Processing Facilities

Pollution loadings from the gas processing industry are made up of particulates, sulphur oxides, and hydrocarbons as shown in Exhibit IX-2. A standard plant size of 450 million cubic feet per day, as described in Appendix III, was used in determining these loadings.

EXHIBIT IX-2

LOADINGS FOR GAS PROCESSING PLANTS

Pollutants	Loadings (tons/year)
Particulates	94
SO_X	91
HC	232

Source: Hittman Associates Report to CEQ, 1973

c. Petrochemical Plants

Petrochemical loadings presented in Exhibit IX-3 include particulates and hydrocarbons.

Data for sulphur oxides, nitrogen oxides and carbon monoxide was not available for the petrochemical complex under study. However, it is expected that these pollutants will not represent as great a pollution problem as hydrocarbons and particulates. A standard petrochemical complex (see Appendix IV) is assumed to produce a total of nearly 6.5 billion pounts of organic chemical products each year.

The projected loadings are applied to the number of complexes expected to locate in each of the study areas to determine the total loadings from petrochemical complexes.

EXHIBIT IX-3

LOADINGS FOR ORGANIC CHEMICALS

RESULTING FROM PETROCHEMICAL COMPLEX

Compound	Annual Production Million Pounds	Particulates Tons Per Year	Hydrocarbons Tons Per Year
Orthoxylene Toluene Xylenes Benzene	2,289	0	110
Styrene Ethylbenzene	467	0	467
Ethylene Propylene Butadiene Butylene	1,754	345	1,754
Cumene Phenol	425	2	102
Polyethylene	90	36	112
Ethylene Glycol	200	0	80
Vinyl Chloride	500	-	-
Polypropylene	70	-	-
Acrylonitrile	100	-	-
Oxo Alcohols	245	-	-
Cyclohexanone	237	0	0
Acetone	95	0	0
TOTAL	6,472	383	2,625

Source: RPA estimates based on discussions with industrial representatives.

2. Indirect Activities

In addition to the direct industrial activities, emissions were estimated for supplier and induced activities for the following emission source classifications:

- Indirect manufacturing.
- Commercial and residential
- Electric utilities
- Transportation
- Refuse disposal and miscellaneous

a. Indirect Manufacturing

Process pollution emissions from the manufacturing sector were disaggregated by major industrial polluters, while industrial loadings attributable to fuel combustion were disaggregated by fuel type. Projected loadings were based on existing emission rates and estimated changes in sales levels for each industrial classification and region. A control factor for each emission and source was then estimated on the basis of current technology and projected industry trends. These factors along with projected emissions are tabulated and explained in detail in Annex B.

b. Commercial and Residential

Commercial and residential loadings result from the burning of fuel oil and are less severe in those areas serviced by natural gas. Emission projections in the commercial sector were based on sales forecasts for 1985 and 2000. Pollution resulting from residential sources was based on projected changes in population for each individual region.

c. Electric Utilities

Pollution from electric utilities was assumed to remain constant from 1972 thru 2000 primarily for these reasons:

-- it is difficult to determine if the electric

generating facilities needed to supply increased demand caused by different OCS scenarios will locate in the region under study.

-- energy sources needed to supply utilities are expected to be composed of fossil fuel, nuclear fission and possibly nuclear fusion by 2000.

-- additional high sulfur fossil fuel burning utilities in the study areas would balance pollution control efforts.

d. Transportation

Uncontrolled transportation emissions are projected on the basis of population increases. Controls based on mobile source emission standards are applied to the uncontrolled loadings resulting in a 90 percent decrease in nitrogen oxide, hydrocarbon and carbon monoxide loadings by 1985 and 2000.

However, no control was projected for particulates or sulfur oxides since they originate principally from diesel powered mobile sources and are not expected to be controlled in the near future.

e. Refuse Disposal and Miscellaneous

Solid waste disposal by incineration is expected to decrease by approximately 85 percent in 1985 and 2000, effectively decreasing pollution levels by the same amount. Miscellaneous sources of pollution are not expected to be tightly controlled in the future, except in isolated instances detailed in Annex B.

WATER POLLUTION

Changes in water pollution in each study area were assessed by projecting BOD effluents from existing industries and municipalities and comparing these to estimated 1970 effluents. Although the limitations of using BOD as an indicator of water quality where petroleum and petrochemical pollution are concerned, this is the only indicator for which base case data exists and quantitative impact analysis is possible. In the Mid-Atlantic a river quality model was utilized to indicate the relative impact on water quality in the Delaware River from the direct industrial activity.

BOD Loadings

Total 1970 biochemical oxygen demand (BOD) discharges in each study area were estimated using The Economics of Clean Water (1972). Raw waste loads were calculated for industrial and municipal discharges in each of the study areas and are presented in Annex B. Treatment efficiencies of 70 percent for municipal discharges and 20 percent for industrial discharges were used to determine the estimated 1970 treated discharges.

Total biochemical oxygen demand discharges in the year 1985 and 2000 were projected in each study area for (1) direct industries on the basis of currently suggested EPA discharge guidelines and (2) indirect industries and municipalities on the basis of current discharge rates and recently recommended effluent guidelines.

1. Direct Industries

   The loadings for refineries and petrochemical complexes were based on currently suggested EPA guidelines. A detailed description of each plant is included in Appendices II and IV. Exhibit IX-4 indicates the expected loadings for each refinery and standard petrochemical complex utilizing both advance treatment techniques and what is presently considered best practical treatment.

2. Indirect Industries and Municipalities

   Loadings for supplier and induced industries were projected on the basis of regional tons of BOD/($MM value added). As indicated in Exhibit IX-5, BOD/$MM value added) varies dramatically by industry due to different water requirements in the production processes. A smaller variation is noticeable within the industrial classifications due to the intra-SIC industrial mix in the different regions.

EXHIBIT IX-4

WATER POLLUTION LOADINGS FOR REFINERIES AND PETROCHEMICALS

	BOD		COD		Suspended Solids		Phenol		Sulfide		Amonia	
	BA	BP	BA	BP	BA	BP	BA	BP	BA	BP	BA	BP
Refinery[a]	46	548	365	2281	46	548	0	18	0	9	9	180
Petrochemical[b]	155	711	3527	6972	68	374	-	-	-	-	-	-

BA = Best Available (Advanced Treatment)

BP = Best Practical (Secondary Treatment)

a - 365 Tons per year used for refinery BOD, based on 1972 guidelines.

b - 474 Tons per year used for petrochemicals, to approximate what EPA guidelines might suggest in light of refinery guidelines.

Source: RPA estimates based on industry sources and Roy Weston report, and Radian Corporation Technical Reports on Refinery Effluents.

EXHIBIT IX-5

TONS BOD PER MILLION DOLLARS VALUE ADDED

Region / Industries	Eastern Mass./R.I.	Delaware River	Eastern S.C./ Eastern Ga.	NE Fla./ SE Georgia	S.F. Bay	Puget Sound
Food and Kindred Products	2.66	2.33	5.18	5.18	2.96	5.41
Textile Mill Products	15.83	4.99	24.38	24.38	2.03	-
Paper and Allied Products	239.63	54.08	514.35	514.35	607.85	524.70
Chemicals	5.20	4.68	9.24	9.24	1.91	11.81
Primary Metals	.75	5.35	2.54	2.54	.25	3.11
Other Manufacturing	1.67	.64	.69	.69	5.69	2.38

Source: EPA, Economics of Clean Water, 1972, and RPA.

The BOD/($MM value added) ratios were applied to projected value added in each study area to determine the total raw BOD from sources under each of the base and impact cases. Control factors for the major SIC code industries shown in Exhibit IX-6 were applied to the raw waste loadings yielding projected wastes that would be discharged in each study area.

EXHIBIT IX-6

BOD REDUCTION AFTER TREATMENT

Industry	SIC CODE	Percent Reduction after Secondary Treatment
Food & Kindred Products	20	65.5
Textile Mill Products	22	91.8
Paper & Allied Products	26	91.1
Chemicals	28	91.0
Primary Metals	33	65.4

Source: EPA Contract #68-01-1535, RPA estimates.

Raw municipal sewage was projected solely on the basis of population and was calculated by multiplying projected population by the estimated raw sewage of 0.2 lb./day generated by an individual. It was estimated that this waste will be reduced by 85 percent with secondary treatment by 1985.

Industrial and municipal loads were added to determine the total BOD at each site for the base cases.

River Quality

The projected loadings from refineries and petrochemical complexes were applied to the Delaware River to determine effects on the dissolved oxygen levels.

The model calculated dissolved oxygen (DO) levels of the rivers as a function of flow, velocity, and discharge rates. It utilized existing DO levels and discharges along with predicted discharge levels for direct industries to indicate the relative change in the DO levels that may be expected with increased BOD discharges from the direct industries. The treatment alternatives used as the basis of projecting the loadings from refineries and petrochemical facilities were EPA guidelines for refineries and estimated equivalent EPA guideline technology for petrochemical plants.

SOURCES OF DATA

Arthur D. Little, Inc. Potential Onshore Effects of Deepwater Terminal - Related Industrial Development. Report to the Council on Environmental Quality. Cambridge, Massachusetts: Arthur D. Little, Inc., 1973.

Associated Water and Air Resources Engineers Inc. Estimating Water Pollution Control Costs for Selected Industries in the United States, 1973 - 1977. xerox, June, 1973.

Camp, Dresser & McKee. Report on the Development of a Mathematical Model for Minimizing Construction Costs in Water Pollution Control. Boston, Massachusetts: Camp, Dresser & McKee, 1969.

General Technologies Corporation. Development Document for Effluent Limitation Guidelines and Standards of Performance. xerox, June, 1973.

National Emissions Standards Study. Report to the Congress of the United States by the Secretary of Health, Education and Welfare in compliance with Public Law 90-148, Clean Air Act as Amended. March, 1970.

Radian Corporation. Technical Notes on Air Emission, Water Effluents and Solid Wastes from Oil Refineries. 1973.

Roy F. Weston, Inc. A New Petroleum Refinery - Environmental Impact. xerox, March 1973.

Roy F. Weston, Inc. Development Document for Effluent Limitation Guidelines and Standards of Performance for the Petroleum Refining Industry. xerox, June 1973.

Roy F. Weston, Inc. Development Document for Effluent Guidelines and Standards of Performance, Organic Chemicals Industry. xerox, June 1973.

U.S. Department of Commerce, Bureau of the Census. County Business Patterns, 1970. Washington, D.C.: U.S. Government Printing Office, 1971.

U.S. Department of Commerce, Environmental Science Service Administration, Environmental Data Service. Climatic Atlas of the United States. Washington, D.C.: U.S. Government Printing Office, June 1968.

SOURCES OF DATA (CONTINUED)

U.S. Environmental Protection Agency. Compilation of Air Pollution Emission Factors. Springfield, Virginia: National Technical Information Service (# AP 42), 1973.

U.S. Environmental Protection Agency. The Economics of Clean Water. (Volumes I - III) Washington, D.C.: U.S. Government Printing Office, 1972.

U.S. Environmental Protection Agency, National Emissions Data System. Emission Reports. Computer Print-outs, 1972.

U.S. Environmental Protection Agency, Office of the Assistant Commissioner for Regional Activities. Federal Air Quality Control Regions. Washington, D.C: U.S. Government Printing Office, 1972.

U.S. Department of the Interior, Geological Survey. Water Resources Data, 1971 Series. Washington, D.C.: U.S. Government Printing Office, 1971.

APPENDIX X

WILDLIFE AND VEGETATION

Although the study to assess the potential impact of OCS development was not intended to be site specific for the industrial, commercial and residential development projected, it was important to identify the types of areas that should be analyzed for ecological impact whenever any specific development would occur. To provide a framework for making such ecological impact analyses, this appendix:

- Describes the types of areas of ecological significance for wildlife vegetation
- Discusses the nature of the ecological impact that could occur from residential, commercial and industrial development
- Provides an inventory of significant areas in the sample localities and regions analyzed.

TYPES OF AREAS

The purpose of the wildlife and vegetation inventory was to pinpoint areas of significance as habitat for wildlife and vegetation which might be affected by onshore development induced by OCS oil and gas recovery. Certain categories of refuges and habitats were chosen as being of national, regional or local significance. In the following paragraphs each category is discussed and the main sources of data detailed.

National Wildlife Refuges

The purpose of the more than 330 refuges established in the United States is to protect and preserve numerous species of waterfowl as well as various endangered species. Within the refuges habitat is preserved for species whose habitat is becoming scarce due to human development, and various management and research techniques are employed to increase and study thousands of species. Most of the refuges found in the regions analyzed are coastal areas (usually wetlands) where migratory waterfowl rest, winter, or feed. All of the information on the various national refuges was provided by the U.S. Department of Interior Fish and Wildlife Service's Bureau of Sport

Fisheries and Wildlife which administers the refuge system.

National and State Forests

Both the National Forest Service and the various state forestry departments maintain large areas of forest land which provides habitat for wildlife and supports typical forest ecosystems. Many of these forests are also used as game management areas for recreational and conservation purposes. The National Forest Service and state forestry departments provided the data on acreages and habitat types for all of the forests inventoried.

State Wildlife Management Areas

Most states' fish and game departments maintain areas (owned either by the state or private organizations) which are managed as game preserves or hunting grounds. Through habitat maintenance and improvement these state areas are preserved as high quality wildlife habitat and the use of them by hunters is controlled.

Endangered Species Habitat

There are certain areas which are known to support populations of endangered or threatened species (i.e., those that are for whatever reason threatened with extinction). Most of these areas are within national wildlife refuges or lands owned by various conservations organizations. Information on the threatened species present in the study regions was obtained primarily from the 1973 edition of Threatened Wildlife of the United States, published by the U.S. Department of Interior, as well as from refuge manuals and conservation organizations.

Audubon Society Sanctuaries

The National Audubon Society, the various state Audubon Societies and numerous other conservation organizations own and maintain sanctuaries for wildlife, particularly birds. Due to the fact that the majority of the areas owned by such organizations are quite small in terms of acreage and information of their locations was not readily available, all areas of this type were not inventoried. Where information is listed in the inventories, it was provided by the various organizations and should serve to indicate not only that specific sanctuaries are present, but the level of activity and interest which such organizations have exhibited in

terms of particular parts of the country.

Fishery Resources

Under the general category of fishery resources two things were inventoried: the presence of anadromous fish runs in rivers and streams of the regions and state and federal fish hatchery operations. These categories were chosen as being those which would have the highest likelihood of being impacted by onshore OCS-associated development.

Wetlands

The word "wetlands" is used to mean many different things. In this report the term is used to mean "lowlands covered with shallow and sometimes temporary or intermittent waters. They are referred to as marshes, swamps, bogs, wet meadows, etc." This definition is quoted from the Fish and Wildlife Service Circular 39 entitled, The Wetlands of the United States. This document and the supporting state reports are the sources of all of the data on wetland types, acreages, and values presented in the following inventories.

Although this inventory was undertaken in 1954, it is still the most comprehensive information of its kind available. The inventory placed an emphasis on the significance of wetlands as waterfowl habitat; however, wetlands, in general have numerous other values such as storage for ground water, the production of timber and various other crops, and habitat as numerous other wildlife and agnotic species. The coastal wetlands in particular, even those of low or negligible value to waterfowl, play an important role as part of the estuarine system, in the accumulation and release of basic nutrients essential to the maintenance of marine life.

In order to avoid unnecessary repetition of the descriptions of the 20 wetland types, a list is presented here and any future reference to wetland types relate to these types, classified in Circular 39.

Type 1 - Seasonally flooded basins or flats

The soil is covered with water, or is waterlogged, during variable seasonal periods but usually is well drained during much of the growing season. This type is found both in upland depressions and in overflow bottom lands. Along river courses, flooding occurs in late fall, winter, or spring. In the uplands, basins

or flats may be filled with water during periods of heavy rain or melting snow.

Vegetation varies greatly according to the season and the duration of flooding. It includes bottom-land hardwoods as well as some herbaceous growths. Where the water has receded early in the growing season, smartweeds wild millet, fall panicum, tealgrass, chufa, redroot cyperus, and weeds (such as marsh elder, ragweed, and cockleburs) are likely to occur. Shallow basins that are submerged only very temporarily usually develop little or no wetland vegetation.

Type 2 - Inland fresh meadows

The soil usually is without standing water during most of the growing season but is waterlogged within at least a few inches of its surface. Vegetation includes grasses, sedges, rushes, and various broad-leaved plants. In the North, representative plants are carex, rushes, redtop, reedgrasses, mannagrasses, prairie cordgrass, and mints. In Florida, cordgrasses and various species of paspalums and beakrushes are common. Meadows may fill shallow lake basins, sloughs, or farmland sags, or these meadows may border shallow marshes on the landward side. Wild hay oftentimes is cut from such areas.

Fresh meadows are used somewhat in the North by nesting waterfowl, but in most of the country their value is mainly as supplemental feeding areas. If shallow water can be impounded on them, their value can be increased considerably.

Type 3 - Inland Shallow fresh marshes

The soil is usually waterlogged during the growing season; often it is covered with as much as 6 inches or more of water. Vegetation includes grasses, bulrushes, spikerushes, and various other marsh plants such as cattails, arrowheads, pickerelweed, and smartweeds. Common representatives in the North are reed, whitetop, rice cutgrass, carex, and giant burreed. In the Southeast, maidencane, sawgrass, arrowhead, and pickerelweed are characteristic. These marshes may nearly fill shallow lake basins or sloughs, or they may border deep marshes on the landward side. They are also common as seep areas on irrigated lands.

Marshes of this type are used extensively as nesting and feeding habitat in the pothole country of the North Central States and elsewhere. In combination with deep fresh marshes (Type 4), they constitute the principal production areas for waterfowl. Florida and Georgia are the only states where the majority of the shallow fresh marshes are considered to be of lesser importance to waterfowl. Florida alone contains more than 2 million acres of this type.

Type 4 - Inland deep fresh marshes

The soil is covered with 6 inches to 3 feet or more of water during the growing season. Vegetation includes cattails, reeds, bulrushes, spikerushes, and wildrice. In open areas, pondweeds, naiads, coontail, watermilfoils, waterweeds, duckweeds, waterlilies, or spatterdocks may occur. Water-hyacinth and water-primroses form surface mats in some localities in the Southeast. These deep marshes may almost completely fill shallow lake basins, potholes, limestone sinks, and sloughs, or they may border open water in such depressions.

Deep fresh marshes constitute the best breeding habitat in the country, and they are also important feeding places. In the Western States they are heavily used by migrating birds, especially diving ducks. Florida and Texas are the only States in which the vast majority of these marshes are not rated as being of primary importance to waterfowl.

Type 5 - Inland open fresh water

Shallow ponds and reservoirs are included in this type. Water is usually less than 10 feet deep and is fringed by a border of emergent vegetation. Vegetation (mainly at water depths of less than 6 feet) includes pondweeds, naiads, wildcelery, coontail, watermilfoils, muskgrasses, waterlilies, spatterdocks, and (in the South) water-hyacinth.

In the pothole country of the North Central States, Type 5 areas are used extensively as brood areas when, in midsummer and late summer, the less permanent marshes begin to dry out. The borders of such areas are used for nesting throughout the Northern States.

Where vegetation is plentiful, they are used in all sections of the country as feeding and resting areas by ducks, geese, and coots, especially during the migration period.

Type 6 - Shrub swamps

The soil is usually waterlogged during the growing season, and is often covered with as much as 6 inches of water. Vegetation includes alders, willows, buttonbush, dogwoods, and swamp-privet. Shrub swamps occur mostly along sluggish streams and occasionally on flood plains. They are used to a limited extent for nesting and feeding in the North and for roosting and feeding in some of the Mississippi Alluvial Valley States. Elsewhere, shrub swamps are little used except in a few special situations.

Type 7 - Wooded swamps

The soil is waterlogged at least to within a few inches of its surface during the growing season, and is often covered with as much as 1 foot of water. Wooded swamps occur mostly along sluggish streams, on flood plains, on flat uplands, and in very shallow lake basins. In the North, trees include tamarack, arborvitae, black spruce, balsam, red maple, and black ash. In the South, water oak, overcup oak, tupelo gum, swamp black gum, and cypress are dominant. In the Northwest, western hemlock, red alder, and willows are common. Northern evergreen swamps usually have a thick ground covering of mosses. Deciduous swamps frequently support beds of duckweeds, smartweeds, and other herbs.

Wooded swamps often occur in association with shrub swamps, and waterfowl often use the two types interchangeably. In the Southeast, Type 7 swamps become particularly important in years when lack of sufficient fall and early winter rains leave overflow areas dry. At such times, wooded swamps represent the only shallow water available over wide areas. This type is particularly useful to the wood duck throughout the range of this species.

Type 8 - Bogs

These are often called pocosins, bays, and savannahs

in the South. The soil is usually waterlogged and supports a spongy covering of mosses. Bogs occur mostly in shallow lake basins, on flat uplands, and along sluggish streams. Vegetation is woody or herbaceous, or both. Typical plants are heath shrubs, sphagnum moss, and sedges. In the North, leather-leaf, Labrador-tea, cranberries, carex, and cottongrass are often present. In the South, cyrilla, persea, gordonia, sweetbay, pond pine, Virginia chainfern, and pitcher-plants are common. Scattered, often stunted, black spruce and tamarack may occur in northern bogs.

Bogs have the lowest waterfowl rating, country-wide, of all the 20 types. In northern New England, however, they assume considerable significance. In Maine alone, 25,500 acres are classed as being of primary importance to waterfowl.

Type 9 - Inland Saline flats

The soil is without standing water except after periods of heavy precipitation, but it is waterlogged to within at least a few inches of the surface during the growing season. Vegetation (often sparse or patchy) consists of salt-tolerant plants such as sea-blite, saltgrass, Nevada bulrush, saltbush, and burro-weed. Type 9 wetlands occur in undrained sumps in many parts of the arid West. Sometimes they cover extensive areas.

Saline flats, under natural conditions, are used very little during most seasons, but ducks and geese feed extensively in flats that become flooded in the fall and winter.

Type 10 - Inland saline marshes

The soil is usually waterlogged during the growing season and is often covered with as much as 2 or 3 feet of water. This type occurs mostly in shallow lake basins. Vegetation is mainly alkali or hardstem bulrushes, often with wigeongrass or sago pondweed in openings.

Saline marshes are used heavily by nesting and feeding ducks and geese. They are extremely valuable to waterfowl in both the Pacific and Central Flyways.

Throughout the range of this type, 98 percent of the saline marshes are considered to be of primary importance to waterfowl.

Type 11 - Inland open saline water

These more permanent areas of shallow, saline water are often closely associated with Types 9 and 10. Depth of water is variable. Vegetation (mainly at water depths of less than 6 feet) includes sago pondweed, wigeongrass, and muskgrasses.

Type 11 is used very extensively by feeding ducks and geese wherever vegetation is plentiful. In the Pacific Flyway, where 93 percent of this type is located, it is of major importance during migration seasons. Throughout its range, 87 percent of these areas are considered to be of primary importance to waterfowl.

Type 12 - Coastal shallow fresh marshes

The soil is always waterlogged during the growing season. It may be covered at high tide with as much as 6 inches of water. These marshes are on the landward side of deep marshes along tidal rivers, sounds, and deltas. Vegetation consists of grasses (reed, big cordgrass, maidencane), sedges (carex, spikerushes, threesquares, sawgrass), and various other marsh plants such as cattails, arrowheads, smartweeds, and arrow-arum.

Nationwide, these shallow fresh marshes rate the highest of the nine coastal types in their importance to waterfowl. They are used moderately for nesting in the North Atlantic and Pacific Coast states, and they constitute the most used wetland type along the Gulf Coast during the winter season.

Type 13 - Coastal deep fresh marshes

The soil is covered at average high tide with 6 inches to 3 feet of water during the growing season. These marshes occur along tidal rivers and bays, mainly on the Atlantic and Gulf Coasts. Vegetation is mainly cattails, wildrice, pickerelweed, giant cutgrass, and spatterdocks, often with pondweeds and other submerged growths in marsh openings. In

the Gulf region, water-hyacinth, alligatorweed, and waterlettuce may produce surface mats.

More than 85 percent of the total of this type is found in Louisiana, where 422,000 acres are of primary importance to waterfowl and 984,000 acres are of lesser importance. This type, where suitable vegetation dominates, is used much in fall and winter by feeding waterfowl.

Type 14 - Coastal open fresh water

Included in this type are shallow portions of open water along fresh tidal rivers and sounds that are considered vulnerable to reclamation for agricultural or industrial uses. Vegetation is scarce, or absent, in stained or turbid waters. At depths of less than 6 feet, pondweeds, naiads, wildcelery, coontail, waterweeds, watermilfoils, and muskgrasses are common. In some localities of the Gulf region, water-hyacinth forms mats on the surface.

Nearly four-fifths of the acreage is on the Louisiana and Texas coasts, where 92,600 acres are of primary importance to waterfowl and 54,200 acres are of lesser importance. This type, although not abundant along the North Atlantic coast, is particularly valuable wherever present. It is also used heavily in the San Francisco Bay region.

Type 15 - Coastal salt flats

The soil is usually waterlogged during the growing season. Sites vary from those submerged only by occasional wind tides to those covered fairly regularly with a few inches of water at high tide. These areas are on the landward side of, or as islands or basins within, salt meadows and salt marshes. Vegetation is often sparse or patchy and consists mainly of glasswords, seablite, saltgrass, and, in the South, saltflat grass and saltwort.

Many salt flats were too small and too intermixed with other coastal saline types to be included as a separate type in the inventory. This is particularly true in the North Atlantic States where all salt flats necessarily were bypassed. Salt flats do not assume much importance, except in the Puget Sound and

San Francisco Bay areas where they are used for feeding. They are abundant on the Texas coast (351,000 acres), where 14 percent are of primary importance to waterfowl.

Type 16 - Coastal salt meadows

The soil is always waterlogged during the growing season, but is rarely covered with tidewater. These meadows are on the landward side of salt marshes or bordering open water. Vegetation on the Atlantic and Gulf coasts includes mainly saltmeadow cordgrass, saltgrass, blackrush, and, in fresher parts, Olney threesquare and saltmarsh fleabanes. On the Pacific Coast, carex, hairgrass, and jaumea often are present.

Salt meadows are used as feeding areas in both the production and wintering zones. The presence of shallow potholes greatly increases the value of these meadows.

Type 17 - Irregularly flooded salt marshes

The soil is covered by wind tides at irregular intervals during the growing season. These marshes are along the shores of nearly enclosed bays, sounds, and rivers on the Atlantic coast from Maryland southward, including the Gulf coast. Vegetation is dominantly needlerush. Pure stands of needlerush make poor waterfowl marshes, but where wigeongrass occurs in ponds or channels within the marsh, adjoining growths of needlerush provide protective cover to feeding ducks. Because of this interspersion of Type 17 with open water, these irregularly flooded salt marshes usually rate fairly high in value.

Type 18 - Regularly flooded salt marshes

The soil is covered at average high tide with 6 inches or more of water during the growing season. These marshes are along the open ocean in eastern Virginia, southern South Carolina, Georgia, and eastern Louisiana. Elsewhere, the type is found mostly along sounds. Vegetation on the Atlantic and Gulf coasts is mainly salt marsh cordgrass. On the Pacific coast, alkali bulrush, glassworts, and arrowgrass dominate. Permanent, open water in these marshes may support

wigeongrass, eelgrass, or sago pondweed.

This type is used very much by feeding ducks and geese, particularly along the Pacific and North Atlantic coasts where food-abundant ponds are present.

Type 19 - Sounds and bays

This type includes those portions of salt-water sounds and bays that are considered shallow enough to be diked and filled. On the Pacific and North Atlantic coasts, all water landward from the average low-tide line was included. In Texas, because of the small range between tide extremes, water less than 3 feet deep was arbitrarily classified in this type. Vegetation includes eelgrass, wigeongrass, sago pondweed, muskgrasses, and, in the Southeast, shoalgrass, manateegrass, and turtlegrass.

Sounds and bays are of particular value to wintering waterfowl in the San Francisco Bay area of California, on the Texas coast, and along the New England coast.

Type 20 - Mangrove swamps

The soil is covered at average high tide with 6 inches to 3 feet of water during the year-round growing season. This type is found only along the coast of the southern half of Florida; it is best developed on the western coast of that State from Cape Sable to Everglades City. Tree growth consists of much red mangrove and some black mangrove. Scattered areas of black mangrove in Louisiana were included with regularly flooded salt marshes.

The value of mangrove swamps for waterfowl is dependent on other wetland types associated with them. Except in localized situations where duck food is common, these swamps are sparsely used.

NATURE OF POTENTIAL IMPACTS

The impacts that OCS development could have upon wildlife and vegetation depends largely upon three factors: (1) the degree to which undeveloped land will be developed, (2) the attitude of the local population

towards conservation in general, and (3) the degree to which there are laws and formal systems which protect vegetation and wildlife habitation in the various states, counties and municipalities involved. The following paragraphs discuss the nature of the potential impacts that could occur if the development of the regions and localities of analysis is not properly planned with the significant areas in mind.

The most vulnerable of habitats is the estuarine wetlands due to its adaptability to many uses such as landfill sites for dredge and fill operations, solid waste disposal sites, agricultural land and (once transformed into dryland) for industrial or residential development. All of these uses destroy the valuable ecosystem of the coastal wetland; therefore wherever less land is available for these uses there is increased pressure to use wetlands and tidelands.

Inland, forest, old fields, and woodland as well as wetland habitat can be destroyed or devalued by the encroachments of population growth. Increases in population create demands for more highways, houses, shopping centers, etc., which in turn increase the vulnerability of wildlife habitat due to pressures for land.

In an area which is relatively undeveloped such as Cumberland-Cape May Counties, New Jersey, the large population increases predicted with OCS development could adversely affect some of the valuable coastal wetlands and the protective estuarine zone. There is an opportunity, however, with good planning and effective protective measures, to regulate the nature of development. In an area such as Solano/Contra Costa Counties, California, which is already relatively developed, even the small population increase and related development expected to occur with OCS development could drastically increase the pressure to use wildlife habitat for other purposes.

In each of the localities and regions the actual impact will be determined by the way development is handled. For instance, highways have been in the past one of the major causes of loss of wetlands. In Delaware, however, "a rebuilt road was equipped with adequate tide gates to allow manipulation of the water level which resulted in a general improvement of the adjacent marsh and the

area is now considered the most valuable in the state."[1] Wildlife management practices also can help prevent or mitigate deletorious impacts on habitats. If available, management practices are employed and if controls are applied to the form development takes, the impacts can be lessened.[2]

INVENTORY OF SIGNIFICANT AREAS

To provide a feel for the wildlife and vegetation resources of the sample localities and regions analyzed in this study, an inventory was made of each of the types of areas of significance discussed above. The descriptions and lists provided in the following pages should serve to point out areas where ecological studies should probably be undertaken at the time of lease sales and actual plant location decisions.

For each of the seven sample sites there is a detailed description of the locality along with a map showing the major areas discussed and a listing of areas of significance within the regions. The order in which the sites appear follows that of the chapters in Volumes II and III.

---

[1] The Wetlands of New Jersey, U.S. Department of Interior. (untitled publication).

[2] The National Estuarine Pollution Study contains more detailed descriptions of use conflicts in the estuarine zone and possible impacts on its viability as a productive eco-system.

THE WILDLIFE AND VEGETATION OF BRISTOL COUNTY, MASSACHUSETTS

Wetlands

Within Bristol County there are some 32,770 acres of wetlands, the majority of which is wooded swamp (BSFW Type 7), as indicated in the 1954 Wetlands of Massachusetts Report by the Bureau of Sport Fisheries and Wildlife. Although 90 percent of the wooded swamp area is rated as low or negligible value for waterfowl, these areas are important to other wildlife, particularly fur bearers such as raccoons, and deer and woodcock.

According to the Supplementary Report of June, 1965, on the Coastal Wetlands of Massachusetts, there were in 1964, 2,623 acres of Wetland Types 12, 13, 16-18 (as defined in Fish and Wildlife Circular 39). A previous study indicated that although there were at the time no immediate plans which would affect the value of these wetlands, it seemed quite possible that in the near future these lands would be jeopardized by housing developments, waste disposal and various forms of dredging and filling operations. In 1963, a "dredge and fill" act was passed which regulated such activities within the coastal zone.

Within the 2,623 acres of coastal wetlands there are several areas which are worthy of note:

[1]* The Fairhaven Wildlife Sanctuary is a 20 acre wood-rimmed salt marsh owned by the Massachusetts Audubon Society. The marsh provides habitat for migratory waterfowl as well as for estuarine life.

[2] Horseneck Beach State Park is a spur of land below Westport covering 600 acres. The area has natural sand beaches and dunes as well as inland marshes providing both dune and marsh habitat.

[3] Demarest Lloyd Memorial State Park is located south of Dartmouth along the coast. Offshore from the park is a mud flat area which serves as feeding grounds for migratory waterfowl.

Inland in Bristol County, there are 29,760 acres of wetlands including types 2,3,4,5,6,7,8 (as defined in the BSFW's Circular 39).

---

*Bracketed numbers refer to references on the map of the local area

BRISTOL COUNTY, MASS.

WILDLIFE AND VEGETATION
PROTECTED AREAS

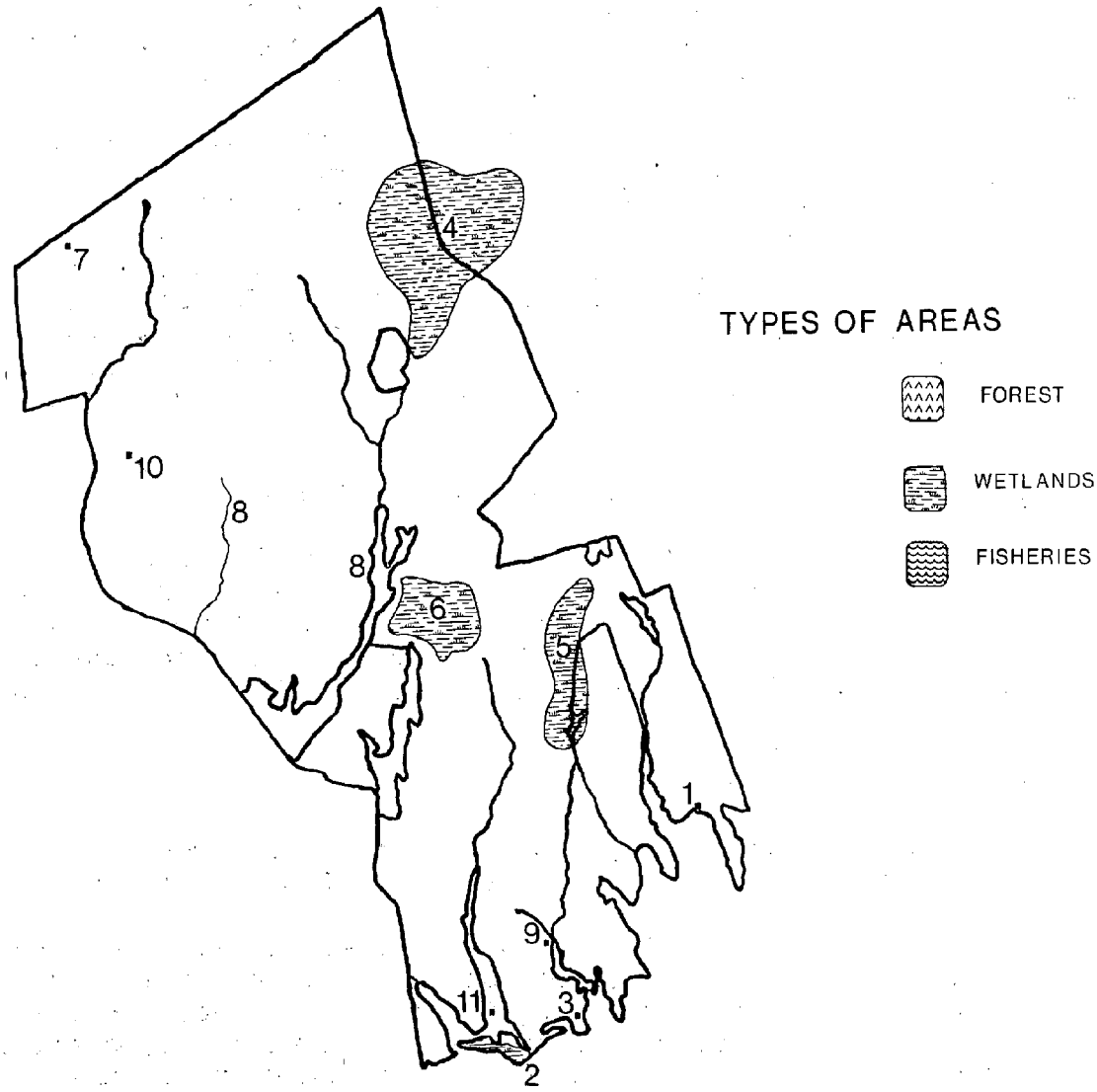


EXHIBIT 3-2

[4] Hockomook Swamp is unique in being the largest swamp in the Northeastern part of the U.S., covering over 6,000 acres within Taunton township. The vegetation within and surrounding the swamp is predominantly white cedar and the diversity of plants and wildlife (including numerous species of reptiles) which inhabit this area are usually productive. The ecology of the swamp is at present being threatened by proposed filling and development. The area is jointly owned by a private individual, a private organization and the local government.

[5] The Acushnet Cedar Swamp covering 1600 acres north of Acushnet is one of the wildest and most impenetrable swamps in Massachusetts. The lush vegetation including white cedar, white and pitch pine, mountain laurel, holly, etc. represents a standard forest-plant association and serves as habitat for innumerable fish, birds and animals. The area is owned by the Commonwealth of Massachusetts; however, the water balance within the swamp is fragile and could be disrupted by changes outside of the swamp itself.

State Forests and Wildlife Management Areas

Within Bristol County there is one state forest, the [6] Freetown Fall River Forest, within which there is a Wildlife Management Area used primarily for game species such as pheasant, deer, hare, etc. The forest covers hundreds of acres and contains predominantly Eastern White Pine trees.

Fish

In terms of fishery resources within the county, the following four types of areas are of significance:

[7] In North Attleboro on the upper Bungay River, the U.S. Department of Interior, Division of Wildlife Services runs a National Fish Hatchery. The six species produced in the hatchery (brook trout, rainbow trout, brown trout, small and large mouth bass, and bluegill) are stocked in suitable rivers in Connecticut, Massachusetts and Rhode Island.

The following rivers and streams are stocked with trout by the Massachusetts Division of Fisheries and Game:

River	Town
Acushnet River	Acushnet
Bungay River	Attleboro and No. Attleboro

River	Town
Copicut River, Shingle Island River	Dartmouth
Segregansett River	Dighton and Taunton
Rattlesnake River	Freetown
Wading River, Canoe River	Mansfield
Palmer River, Rocky Run River	Rehoboth
Coles River, Lewin Brook	Swansea
Cotley River	Taunton
East Branch Westport River Bread and Cheese Brook	Westport

The ponds and reservoirs listed below are considered "good fishing" for the species listed:

Pond	Town	Species
Sassaguin Pond	New Bedford	largemouth bass, chain pickerel, yellow perch, hornpout
Winneconnett Pond	Norton	largemouth bass, chain pickerel, white perch, yellow perch, hornpout
Sabbatin Lake	Taunton	largemouth bass, chain pickerel, hornpout
Manchester Pond	Attleboro	smallmouth bass, white perch, hornpout

[8] There are three rivers in Bristol County which support anadromous fish, mainly shad. In 1971 fertile shad eggs were planted into the Taunton River in an effort to restore a once existing shad run. Both the Palmer and North Rivers support runs of reasonable size and the number caught by anglers was a total of 365 in 1971.

Birds

Although Bristol County is on the periphery of the Atlantic Flyway's main route for migratory waterfowl, certain areas nonetheless provide suitable stop-over points for a wide variety of species.

On the South neck of the Slocum River just northeast of Dartmouth there is an area of moorland and saltmarsh called Barney's Joy Point.

[9] This 156 acre, privately held tract, provides a stopover for migratory birds, partly because it is the only headland not built on west of Buzzards Bay.

Also located in Bristol County is the Caratunk Wildlife Refuge [10] in Seekonk, owned by the Caratunk Wildlife Refuge Trust and managed by the Audubon Society of Rhode Island. This refuge covers 159 acres and includes woodland, old fields, and pond habitat for birds as well as other wildlife.

The only rare or endangered species found to be present in Bristol County is the osprey. On a two and three quarters acre island covered with oak trees and poison ivy, there have been for several years now a number of osprey nests. This small island located in the east branch of the Westport River [11] is owned by the Massachusetts Audubon Society.

AREAS OF SIGNIFICANCE FOR WILDLIFE AND VEGETATION WITHIN THE EASTERN MASS./RHODE ISLAND REGION

National Wildlife Refuges

Massachusetts	County	Acres	Species
Great Meadows	Essex	2,675	wood duck, black ducks, mallards, teal, song birds
Monomoy	Barnstable	2,698	black ducks, eiders, scoters, shore birds, rare migrants
Nantucket	Nantucket	40	sea ducks, Canada geese, black ducks, terns
Parker River (Plum Island)	Essex	4,650	black ducks, greater scaups, Canada geese, shore birds, peregrine falcons
Thatcher Island	Essex	50	gulls, terns, Leach's petrels, etc.
Rhode Island			
Ninigret	Washington	27.5	waterfowl, shore birds
Block Island	Washington	30	waterfowl, shore birds, song birds
Sachuest Point	Newport	75	shore birds, ducks, geese
Truston Pond	Washington	50	water birds, other wildlife

Massachusetts Audubon Society

Name	County	Acres	Habitat Type
Sanctuaries			
Ashumet	Barnstable	45	freshwater pond, woodland
Broadmoor/Little Pond	Middlesex	511	farmland,woodland, freshwater pond
Drumlin Farm	Middlesex	220	farmland,woodland
Felix Neck	Dukes	250	salt marsh,upland wooded
Ipswich River	Essex	2,400	freshwater marsh, woodland
Moose Hill	Norfolk	227	woodland
Stony Brook	Norfolk	103	freshwater, woodland
Wellfleet Bay	Barnstable	696	salt marsh, Cape Cod upland
Open Spaces			
Eastern Point	Essex	26	rocky shore, salt marsh,freshwater wetlands and woodland
Highland Farm	Suffolk	44	old field, woodland
Marblehead Neck	Essex	15	woodland, small freshwater pond
Waseeka	Middlesex	140	30 acres pond, 20 acres freshwater marsh,woodland

Other Areas Owned for Conservation

Name	County	Acres
Falmouth Salt Pond	Barnstable	around 100
Tern Island	Barnstable	10

Name	County	Acres
The Mud Hole	Barnstable	24
Rendezvous Lane	Barnstable	14
Poponesset Sand Spit	Barnstable	50
Pepper Lot	Barnstable	2
Tick Thicket	Barnstable	7
Maraspin Point	Barnstable	10
Malachi Brook	Plymouth	152
Outermost House	Barnstable	50
Patton's Cove	Plymouth	6
Heron Point	Plymouth	55
Great Neck	Plymouth	35
Gleason Property	Plymouth	56
Straits Mouth Island	Essex	33
Lynnfield Marsh	Essex	50
Norman's Low	Essex	25
Hemlock Pond	Suffolk	15

Conservation Restrictions

County	Acres
Barnstable	32
Bristol	156
Barnstable	19
Suffolk	30

Rhode Island Audubon Society

Wildlife Refuge Areas	Acres	Habitat Types
George B. Parker Woodland Coventry/Foster R.I. (stand of mature chestnut oak, one of last in R.I.)	450	woodland
David Memorial Wildlife Refuse North Kingston, R.I.	96	woodland & fresh water wetland
Emilie Ruecker Wildlife Refuse Tiverton, R.I. (egrets, herons, shore birds,etc.)	30	old fields, fresh water wetland, salt marsh & woodland
Norman Bird Sanctuary Middletown, R.I.	350	salt marsh, woodland, fresh water wetland, farmland
Kimball Wildlife Refuge Charlestown	30	woodland
Moonstone Waterfowl Refuge South Kingston	115	ocean front, salt marsh, fresh water wetland, farmland

Open Space Areas	Acres	Habitat Types
Fayette E. Bartlett Woodland Burrillville, R.I.	70	woodland
Margaret Robinson Knight Wildlife Refuge, Cranston, R.I.	52	woodland
Hundred Acre Cove Barrington, R.I.	43	salt marsh
John Francis Brown Ravine Warwick, R.I.	6	woodland
Occupessatuxet Cove Warwick, R.I.	3	salt marsh

Open Space Areas	Acres	Habitat Types
Usher Cove Bristol, R.I.	3	salt marsh
Gould Island Rookery Portsmouth, R.I. (last extensive heron rookery in Southeastern New England & northernmost nesting location for the cattle egret)	5	wooded island
Cocumscussoc Brook Reserve North Kingston, R.I.	16	woodland
Eldred Wildlife Refuge South Kingston, R.I.	48	freshwater wetland, woodland
Fox Hill Pond Jamestown, R.I.	45	salt marsh
Sheffield Cove Jamestown, R.I.	5	salt marsh
Marsh Meadows Wildlife Preserve Jamestown, R.I.	21	salt marsh
Racquet Road Thicket Jamestown, R.I.	19	woodland
The Dumpling Jamestown, R.I.	0.5	rocky island
Grey Craig Overlook Middletown, R.I.	29	rock ledge, woodland
Third Beach Road Lots Middletown, R.I.	18	farmland
Spectacle Island, Briggs Marsh Little Compton, R.I.	4	salt marsh, ooded island
Indian Run Woods South Kingstown, R.I.	50	woodland
Ocean Drive Marsh Newport, R.I.	9	salt marsh
Beech Grove South Kingstown, R.I.	7	woodland

Open Space Areas	Acres	Habitat Types
Wesquage Pond Narragansett, R.I.	30	salt marsh, fresh-water wetland
Matunuck Hills Woods South Kingstown, R.I.	35	woodland
Pettaquamscutt River Wildlife Habitat Narragansett, R.I.	10	salt marsh
Ram Island South Kingstown, R.I.	14	salt marsh, wooded island
Lonesome Swamp Cumberland, R.I.	0.5	freshwater wetland, woodland

State Wildlife Management Areas (WMA) and State Forests

Massachusetts		County
Myles Standish State Forest		Plymouth
Shawme Crowell State Forest		Barnstable
Roland C. Nickerson State Forest		Barnstable
Martha's Vineyard State Forest		Barnstable
Nantucket State Forest		Nantucket
Fort Gilbert State Forest		Norfolk
Whitehall State Forest		Middlesex
Lowell Dracut State Forest		Middlesex
Willard Brook State Forest		Middlesex
Harold Parker State Forest		Essex
Willowdale State Forest		Essex
Crane Pond	WMA	Essex
Harold Park	WMA	Essex
Mill Creek	WMA	Essex
Northeast	WMA	Essex
Pantry Brook	WMA	Middlesex
Crane	WMA	Barnstable
Myles Standish	WMA	Barnstable
Otis A.F.B.	WMA	Barnstalbe
Rocky Gutter	WMA	Plymouth
West Meadows	WMA	Plymouth

State Wildlife Management Areas (WMA) and State Forests

Rhode Island

George Washington Mem. State Forest	Providence
Dawley Memorial State Forest	Washington

Rhode Island State Wildlife Management Areas

Name	Acres	Game Species
Arcadia WMA	7,523	pheasant, dove, cottontail rabbit, deer, ruffed grouse, quail, hare, squirrel, raccoon, fox
Black Hut WMA	1,263	pheasant, dove, cottontail rabbit, deer, ruffed grouse, quail, hare, squirrel, raccoon, fox
Buck Hill WMA	1,291	cottontail, rabbit, deer, ruffed grouse, hare, squirrel, raccoon, fox
	825	pheasant, dove, cottontail rabbit, deer, ruffed grouse, quail, hare, squirrel, raccoon, fox
Carolina	1,523	pheasant, dove, cottontail rabbit, deer, ruffed grouse, quail, hare, squirrel, raccoon, fox, waterfowl
Duffee Hill	845	pheasant, dove, cottontail rabbit, deer, ruffed grouse, hare, squirrel, raccoon, fox
George Washington	3,041	cottontail rabbit, deer, ruffed grouse, hare, squirrel, raccoon, fox
Great Swamp	2,748	pheasant, dove, cottontail rabbit, deer, ruffed grouse, quail, hare, squirrel, raccoon, fox, waterfowl

Rhode Island State Wildlife Management Areas (cont')

Name	Acres	Game Species
Indian Cedar	921	pheasant, dove, cottontail rabbit, deer, ruffed grouse, quail, hare, squirrel, raccoon, fox
Newton Swamp	111	waterfowl
Sapowet	180	pheasant, dove, cottontail rabbit, quail, waterfowl, fox
Wickaboxet	405	pheasant, dove, cottontail rabbit, deer, ruffed grouse, quail, hare, squirrel, raccoon, fox
Woody Hill	723	dove, cottontail rabbit, deer, ruffed grouse, quail, hare, squirrel, raccoon, fox

Rare and Endangered Species Found in the Region

Species	Habitat
Ipswich Sparrow	the dunes of coast
Atlantic Salmon	north of Cape Cod
Atlantic Sturgeon	coastal rivers
Black meadow vole	Muskegat Island off Nantucket
Block Island meadow vole	Block Island, R. I.
Osprey	several spots in R. I.

The following is a breakdown of waterfowl-significant wetlands in the region.

Massachusetts

County	Acres	Value	Prime Types
Barnstable	25,755	8,805 high value	#6, 12, 13, 16, 18, 19
Bristol	32,770	6,000 or so high and moderate value	#18 and 19 Mud flats, etc. Salt Marsh

County	Acres	Value	Prime Types
Dukes	520	370 high value	#16 main, but all of them present
Essex	39,760	17,000 or so high and moderate value	All types #16, 17, 18, 19
Middlesex	28,840	13,785 low value	Inland types, #16, 17
Nantucket	1,350	all high and moderate values	All types
Norfolk	19,610	9,000 or so low value	All types inland fresh #7
Plymouth	45,385	1/2 high and moderate value	All types but 25,000 #7
Suffolk	220	all high value	#19 only Sounds and Bays

Rhode Island

County	Acres	Value	Prime Types
Providence	4,000	only 40 mod. value	7
Kent	2,400	only 50 mod.	7, 3
Newport	3,240	730 high and mod. value	7
Bristol	915	395 mod. value	16, 18, 7
Washington	14,725	approx. 2,500 high and mod. value	7 and 5 (high value)

The following State Fish Hatcheries are operated on rivers in the region:

Massachusetts	County	Species Propagated
Harold Park Pond System	Essex	bass
Sandwich State Fish Hatchery	Barnstable	brook trout, brown trout, rainbow trout

Rhode Island	Town	
Goose Neck Spring Hatchery	Lafayette, R.I.	brook trout, brown trout, rainbow trout
Perryville Hatchery	Perryville	salmon

WILDLIFE AND VEGETATION OF CAPE MAY AND CUMBERLAND COUNTIES, NEW JERSEY

Wetlands

Cape May and Cumberland Counties contain over 100,000 acres of wetlands, 99 percent of which are rated high and moderate value for waterfowl according to the 1954 Wetlands of New Jersey report by the Bureau of Sport Fisheries and Wildlife. The major type of wetland of significance within this area is coastal salt meadow (BSFW Type 16). According to the Supplementary Report of June, 1965, on the Coastal Wetlands of New Jersey, the state as a whole had 232,651 acres of coastal wetlands of types 12, 13, 14, 16, 18, 19 (as defined in Fish and Wildlife Circular 39). Of the 232,651 acres in the state in 1965, 33 percent were considered to be safe from destruction, an increase of 23 percent from a previous survey in 1959. This decreasing vulnerability is attributable, by and large, to the efforts of the state in its wetlands acquisition program as well as the actions of various private organizations. These wetlands are important, in terms of migratory birds and waterfowl habitat, being in the middle of the Atlantic Flyway. In fact, at one count back in 1947, there were a total of 111 species spotted within a 7 1/2 mile radius in Cape May County. The following is a list of New Jersey Division of Fish and Game Wildlife Management areas located in wetlands areas.

Name	County	Acres	Game Found There
*[1] Dix	Cumberland	1,579	pheasant, rabbit, quail, grouse, waterfowl, raccoon, fox
[2] Fortescue	Cumberland	885	waterfowl, raccoon
[3] Egg Island (This area is considered prime habitat due to the presence of open water within the meadows)	Cumberland	6,506	waterfowl, raccoon

*Bracketed numbers refer to reference on the map of the local area

CAPE MAY AND CUMBERLAND COUNTIES
NEW JERSEY

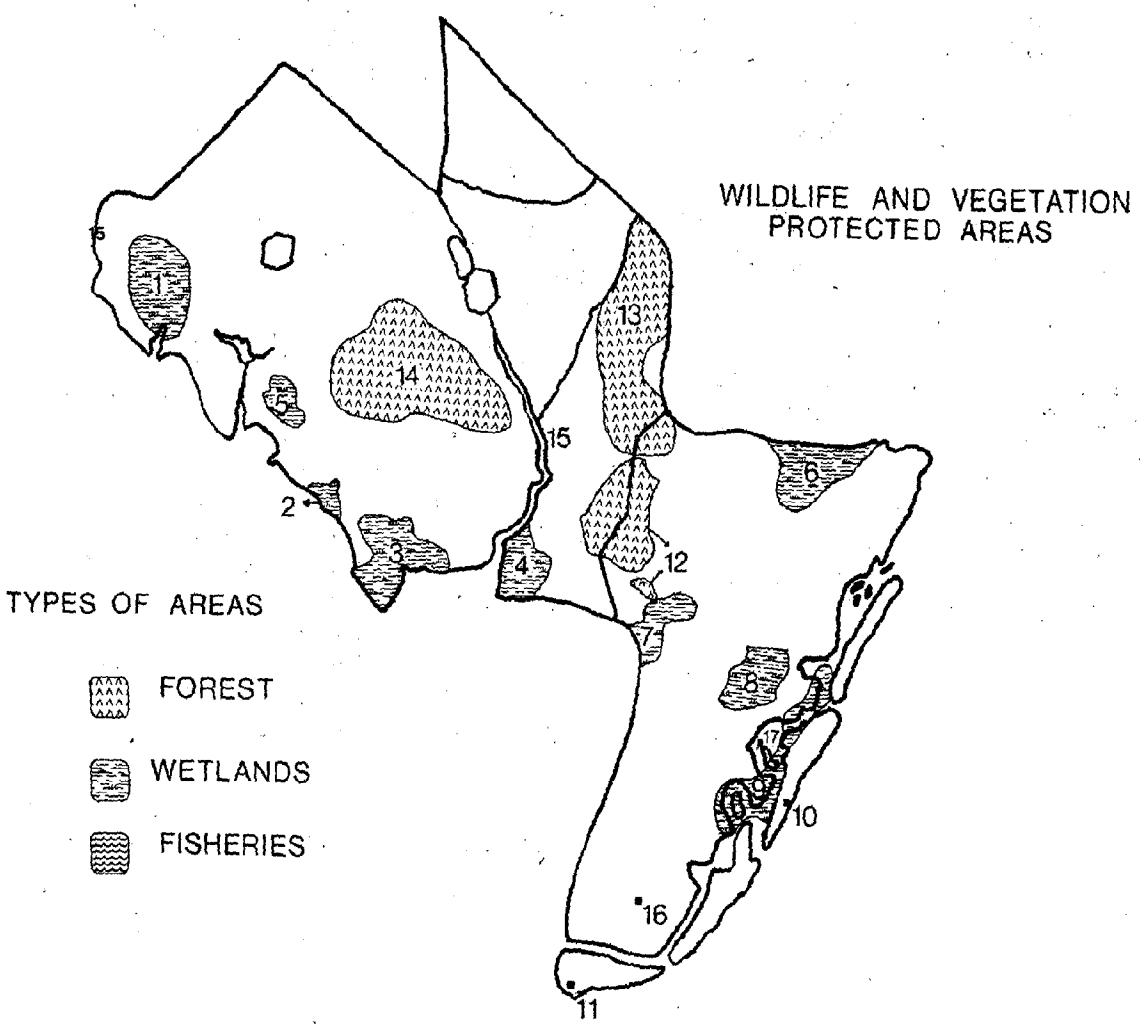


EXHIBIT 4-2

Name	County	Acres	Game Found There
[4] Heisler-ville	Cumberland	3,124	pheasant,rabbit,quail, grouse,waterfowl, raccoon,fox,woodcock, squirrel
[5] Nantuxent	Cumberland	962	pheasant,rabbit,quail, grouse,squirrel, waterfowl,raccoon, fox,woodcock
[6] Tuckahoe	Cape May	2,800	pheasant,rabbit,quail, grouse,squirrel,water-fowl,raccoon,fox, woodcock
[7] Dennis Creek	Cape May	1,320	rabbit,quail,water-fowl,raccoon,fox, woodcock
[8] Beaver Swamp	Cape May	1,320	rabbit,quail,squirrel, waterfowl,raccoon,fox, woodcock

The [9] World Wildlife Fund, although it owns land all over the world, only has a few holdings in the U.S. and one of the largest of these is a 5,000 acre trace of salt meadows and marsh wetlands in Cape May County (Stone Harbor, Wildwood, and Avalon Townships) maintained primarily for the migratory waterfowl of the Atlantic Flyway.

Several other areas, maintained as sanctuaries, are associated with wetlands and serve as migratory bird stopover points, breeding and wintering spots.

[10] Stone Harbor, Cape May County, has a 22 acre sanctuary in the south end of town which attracts a wide variety of species of migratory birds and waterfowl.

The following species stop over in the area: African cattle egret, Louisiana heron, glossy ibis, night heron. Bufflehead, loons, scotter, brant, scaup, greges, snow geese, eider duck, and gannets are known to winter in the sanctuary.

[11] The entire town of Cape May Point is lawfully a

sanctuary and serves as a stop-over point in the southern end of New Jersey for migratory birds.

State Forests and Wildlife Management Areas

[12] The Belleplain State Forest which covers 6,792 acres in both Cumberland and Cape May Counties contains stands of young pine, oak and southern white cedar. Holly and laurel also abound within the forest, but the Atlantic white cedar dominates the area, particularly along the swamps surrounding the streams. The wildlife within the forest include numerous deer, fox, rabbits, raccoons, opossums, red, gray and flying squirrels as well as furbearers such as muskrat and beaver. There are few waterfowl; however, quail and grouse are present in abundance.

The State Division of Fish and Game manages several other fish and wildlife areas within Cape May and Cumberland counties including:

[13] Peaslee	Cumberland	9,538	deer,rabbit,quail, grouse,squirrel, fox,raccoons
[14] Millville	Cumberland	11,796	deer,pheasant, rabbit,quail, grouse,squirrel, raccoon,fox, woodcock

Fish

The Maurice and the Cohancy Rivers [15] in Cumberland County support runs of anadromous fish, particularly American shad, striped bass, river herring, and sturgeon. These same rivers also contain various fresh water species of trout and bass.

Plants

The New Jersey Audubon Society owns a 10 acre area [16] in the town of Erma in Cape May County which is called the Bennett Bog Wildlife Sanctuary. This sanctuary contains several bogs and the intervening woodlands. The plants of the area include many species of the Pine Barrens affinity as

well as four species which are found only in this area in New Jersey: the snowy orchis, the wrinkled gama-grass, Small's yellow-eyed-grass, and a panic grass type. Since three of these four species reach their northern limit at Bennett Bog, the area around it can be considered important in terms of the extension of various species in the northerly or southerly direction. In the woodlands between the bogs lives the Pine Barrens tree frog, an endangered species.

Birds

The New Jersey Audubon Society also owns a 6 acre island [17] in Great Sound, Middle Township, Cape May County named The Beecher Bowdish Wildlife Sanctuary which provides breeding habitat for salt marsh wildlife.

AREAS OF SIGNIFICANCE FOR WILDLIFE AND VEGETATION IN THE DELAWARE RIVER REGION

National Wildlife Refuges

Kilcohook	Salem County, N.J.	5 acres for pheasants (soon to be 4,000 acres for migratory waterfowl)

State Forests

New Jersey	County	Acres
Wharton State Forest	Burlington	94,756
Lebanon	Burlington	22,216
Penn State Forest	Burlington	2,958
Green Bank State Forest	Burlington	1,833
Bass River State Forest	Burlington	9,270
Delaware		
Blackbird State Forest	New Castle	11,650
Pennsylvania		
Ridgley Creek	Delaware	
Lyndell	Chester	
French Creek	Chester	
Valley Forge	Montgomery	
Tyler	Bucks	
Ralph Stover	Bucks	

State Wildlife Management Areas

New Jersey		
Mad Horse Creek	Salem	
Glassboro	Gloucester	2,337
Winslow	Gloucester	1,882
Medford	Burlington	214
Assunpink Creek	Monmouth	359
Turkey Swamp	Monmouth	1,500
Pasadena	Burlington	
Parvin State Park Wildlife Sanctuary	Salem	1,125

Delaware (New Castle County)	Acres	Species
Becks Pond		pheasant, small game, white-tailed deer and waterfowl
Canal Wildlife Area	5,179	
Augustine Wildlife Area	1,495	
Apponquinimink Wildlife Area	34	

Pennsylvania	County
Schwenksville Game Area	Montgomery
Elverson Game Area	Chester
Sellersville Game Area	Bucks
Perkasie Game Area	Bucks
Ralph Stover Forest Game Area	Bucks
Lipper Black Eddy Game Area	Bucks

The following is a breakdown of the waterfowl-significant wetlands in area:

New Jersey

County	Acres	Value	Prime Types
Burlington	10,120	all high value	mainly #12 and 16
Camden	1,750	all high value	#12, 13, 19
Cape May	52,780	95 percent high and moderate value	mainly #16
Essex	2,740	all low value	mainly #7
Gloucester	4,220	all high value	#12,13,19
Hudson	5,900	all low value	#12
Mercer	610	all high value	#7,12,etc.
Middlesex	1,390	all low value	#12,16,18
Monmouth	5,210	mosly low value	#7,12,etc.
Salem	29,350	95 percent high value	mainly #12

Pennsylvania

County	Acres	Value	Prime Types
Bucks	NA	NA	NA
Chester	350	all medium value	#2,3,6,and 7

Pennsylvania (cont')

County	Acres	Value	Prime Types
Delaware	1,160	1,100 acres low value	#12
Montgomery	NA	NA	NA
Philadelphia	370	300 acres low value	#12

Delaware

County	Acres	Value	Prime Types
New Castle	27,602	18,000 high and moderate value	#13 and 18

The following state parks in Delaware provide habitat for unusual flora:

Brandywine Creek State Park	273 acres
Lums Pond State Park	1,055 acres

New Jersey Audubon Society Wildlife Sanctuaries (outside of local area)

Montclair Hawk Lookout Sanctuary, Upper Montclair, Essex County

Delaware Wild Lands, Inc. owns the following salt marshes in New Castle County, Delaware totalling over 3,000 acres:

Port Penn
Bayview
Taylor's Bridge

Both the Port Penn and Bayview Marshes have been sold to Delaware Department of Natural Resources and Environmental Control and are included in the Canal and Augustine State Wildlife Management areas respectively.

Wetlands

In 1954 there were over 800,000 acres of wetlands in the three county area. According to the State of South Carolina Wetlands Report of the Bureau of Sport Fisheries of Wildlife, only 4 percent of these areas are of high or moderate value for waterfowl since they are mainly regularly flooded salt marshes (Charleston County) and wooded swamps. It should be noted, however, that the coastal salt marshes are an important part of the estuarine zone and support large populations of shorebirds. The wooded swamp areas provide important habitat for raccoons, grouse, woodcock, hares, deer and the wild turkey which is so plentiful in this region.

There are within the 30,000 odd acres of prime wetlands area two national wildlife refuges.

[1]*Cape Romain National Wildlife Refuge contains about 34,700 acres of woodland, marsh and water within Charleston County. In this area is a 5,000 acre island, Bulls Island, the only wooded area in the refuge covered with live oaks, magnolia, pines and palmettos.[1]

Over 200 species of birds have been recorded in the refuge, over half of which are known to nest there. About 30 species that are considered rare or endangered are also present in the refuge at one time or another. Other wildlife found in the refuge include whitetail deer, wild turkeys, raccoons, black fox squirrels. In the warm sands of several islands the giant loggerhead sea turtles deposit their eggs and this is one of the few undisturbed nesting areas left to this reptile.

[2] Santee National Wildlife Refuge in total covers 74,352 acres, of which 70,940 acres are marsh and water. In Berkeley County on Lake Moultrie the sub-division covers some 29,500 acres. Santee is the southern terminus for most Canada Geese and up to 10,000 of them winter on the refuge along with many species of duck in numbers over 100,000. Over 200 species, of which only about a quarter nest there, have been reported on the refuge. Other wildlife present

---

*Bracketed numbers refer to areas noted on the map of the area.

[1] For further information on this area see the Environmental Impact Statement #21799 (2/4/72) NTIS #PB 206 382-D

CHARLESTON, S.C. AREA

WILDLIFE AND VEGETATION
PROTECTED AREAS

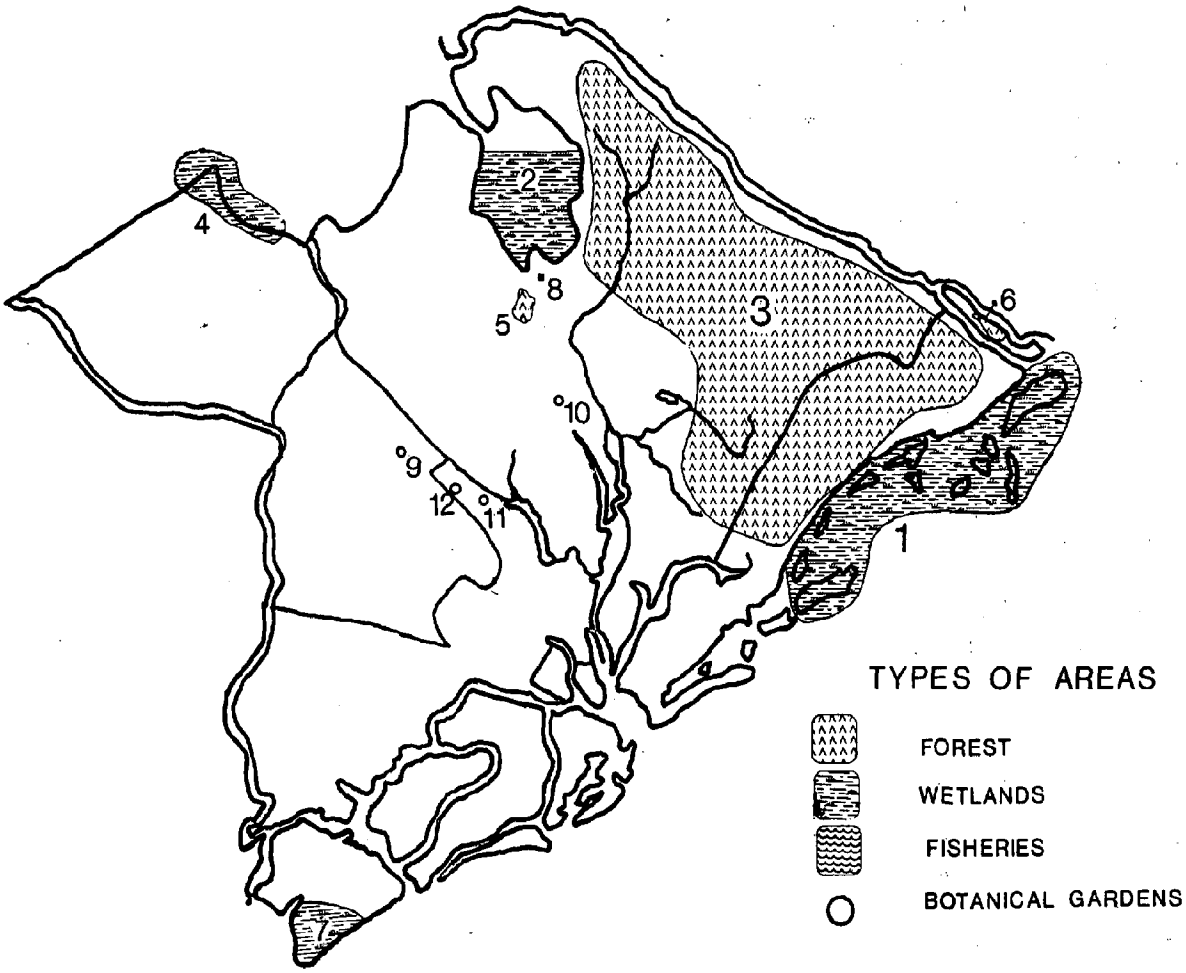


EXHIBIT 5A-2

in the refuge include furbearers such as raccoons, mink, otter, and muskrats and fox, as well as bobcats and deer. In the waters of Lake Moultrie are various types of bass, including the land-locked striped bass, bream, rock fish and crappie.

Also located within these prime wetlands is a large conservation area.

[3] Four Hole Swamp Natural Area is a 3,415 acres tract owned by the National Audubon Society and the Nature Conservancy. This large blackwater cypress swamp contains one of the last and largest (1,783 acres) stands of virgin bald cypress in the U.S. This swamp with its exotic vegetation provides excellent breeding grounds and habitat for otter, mink, oppossum, raccoon, bobcat, deer, black bear, and the endangered American alligator. Also present in the swamp are herons, Mississippi and swallow-tailed kites, and the rare Bachman's warbler.

Forests and State Wildlife Management Areas

[4] The Francis Marion National Forest, covering 249,000 acres of Berkeley County and Charleston County is rich in vegetation and wildlife of enormous variety. Pine trees are the most abundant form of vegetation; however, cypress, gums and live oaks also abound. Since a great deal of the area within the forst boundaries is swamps, and creeks and small ponds, many species of waterfowl and migratory birds winter there, around the areas of open water, as they do at Santee and Cape Romain. Other wildlife include the endangered American alligator, white-tail deer, rabbits, raccoons, and eastern wild turkey in great number. Bass and bream abound in the streams and creeks flowing through the forest.

All of the area in and around the national forest is managed by the South Carolina Wildlife Resources Department as a hunt unit. Two other game management units are located in the three county area. The Hartley GMA [5] in Berkeley County near Moncks Corner is 1,218 acres. The Santee-Delta GMA [6] of 1,501 acres is just between the National forest and the Cape Romain Wildlife Refuge and provides waterfowl habitat as does the Edisto Beach State Park area [7] with its inland salt marsh.

Fish

[8] In Moncks Corner, Berkeley County, below the Pinopolis Dam, the state runs a hatchery which propogates the striped bass and the hybrid (a cross between bass female and white bass male). The hybrids are now being stocked in several lakes and reservoirs.

Land-locked striped bass are numerous in the Charleston area. The hydroelectric plant reservoir lakes of Moultrie [2] and Marion support an important fishery for striped bass and several of the rivers, such as the Cooper and the Wando support runs of sturgeon, striped bass and river herrings.

Flora

The Charleston area has several important gardens in the environs which contain numerous species of exotic flowers and plants.

[9] Middletown Gardens is America's oldest landscaped garden with several camellias which were planted there in 1787 still thriving and alligators in the sculptured pools.

[10] Cypress Gardens is famous for its lush azalea bushes deep within a forest of spanish-moss covered live oaks and lagoons surrounded by ancient cypress trees.

[11] Magnolia Gardens contains great bushes of camellias and azaleas under giant live oaks draped with moss and lavendar wisteria.

[12] Mateeba Gardens

AREAS OF SIGNIFICANCE TO WILDLIFE AND VEGETATION IN THE EASTERN S.C./EASTERN GA. REGION

National Wildlife Refuges

State	County	Name	Acres	Species
S.C.	Clarendon	Santee	44,453	geese,duck,bald eagles,herons, otters,alligators
Ga.	Chatham	Tybee	100	shore birds
Ga.	Chatham	Wassaw	10,242	waterfowl,wading birds,shore birds
Ga.	Chatham	Savannah	5,555	waterfowl,herons, white ibises,bald eagles,deer,otters, alligators

State Game Management Areas

The following are the State Game or Wildlife Management Areas in the region:

South Carolina

Name	County	Acres
Baker	Hampton	400
Belmont	Hampton	6,000
Bear Island	Colleton	7,500
Cypress Creek	Hampton/Jasper	5,930
Santee-Cooper	Clarendon	1,275
Kilsock	Georgetown	8,275
Walker Farm-Gapway Bay	Georgetown	14,675
Pee Dee	Georgetown	1,275
Palachucola	Hampton	7,216

The game species present in these areas include wild turkey, quail, deer, raccoons, rabbits, opossums, squirrel, foxes, bobcats, migratory birds and waterfowl. The following birds of prey are present in some of these game areas, but are protected by law: two species of vultures; many hawks

(including osprey), falcons, harriers, bald eagles, and owls.

Botanical Gardens

State	County	Name
S. C.	Georgetown	Belle Isle Gardens Brookgreen Gardens
S. C.	Orangeburg	Edisto Gardens

Fish Hatcheries

The U.S. Department of Interior, Bureau of Sport Fisheries and Wildlife operates a warm-water species hatchery in Orangeburg, Orangeburg County on the north fork of the Edisto River. The following species are propagated there: striped bass, channel catfish, largemouth bass, bluegill, red-ear and red-breasted sunfish.

Wetlands

The following is a breakdown of the wetland acreages and types found in the region and their relative importance as waterfowl habitats. It should be noted that the prime types 7 and 18, although not particularly important for waterfowl, have significance in terms of estuarine zone activities as well as for habitat for other wildlife.

South Carolina

County	Acres	Value	Prime Types
Allendale	69,100	1/4 mod. value	1 and 7
Bamberg	78,600	all low and neg. value	all 1 and 7
Beaufort	243,100	less than 2% high and mod.	18 and 7
Clarendon	84,300	10% mod. and high value	1 and 7
Colleton	220,350	10% mod. and high value	7 and 18
Georgetown	243,350	10% mod. and high value	7, 17 and 18

South Carolina (cont.)

County	Acres	Value	Prime Types
Hampton	124,100	12% mod. value	7
Jasper	188,350	27% mod. and high value	7
Orangeburg	180,350	almost all low and neg. value	7
Williamsburg	140,330	all low and neg. value	7

Georgia

Effingham	161,000	20% mod. and high value	7
Chatham	174,600	10% high and mod. value	18 and 7

Endangered Species

The following are known to be present in the region:

Species	Habitat
Bachman's warbler	Francis Marion Forest and elsewhere
Eastern brown pelican	in the general region
American alligator	in the general region
Southern bald eagle	in the general region
Eskimo curlew	in the general region
American ivory-billed woodpecker	in the general region

THE WILDLIFE AND VEGETATION OF THE JACKSONVILLE, FLORIDA FIVE COUNTY AREA

Wetlands

In the five county area in and surrounding Jacksonville there are some 725,000 acres of wetlands. According to the 1954 study by the Bureau of Sport Fisheries and Wildlife only 2 percent or about 13,600 of these acres are of importance to waterfowl. The majority of the prime waterfowl habitat in the area is located in Clay County in the St. John's River drainage. The prime types of wetlands include wooded swamps and regularly and irregularly flooded salt marshes which although they are not significant in terms of waterfowl, are important as a habitat for other wildlife as part of the estuarine zone activities in the coastal region. Within the coastal zone the Florida Coastal Coordinating Council has designated selected fresh water and coastal marshes [1]*as being important for the propagation of marine life, habitat for waterfowl and wading birds or as generally important to the ecology of the area. The Coastal Zone Atlas shows the five county area as having 64,600 acres of selected coastal marshes and 57,600 acres of selected freshwater swamps and marshes.

The Okefenokee Swamp and National Wildlife Refuge [2] which covers some 400,000 acres of southern Georgia and the upper portion of Baker County, is a vast peat bog with a tangled forest of cypress, bay and gum trees hung with Spanish moss which represents one of the oldest and most primitive swamps in America. Within the refuge live numerous reptiles and amphibians including the American alligator, 13 species of turtles, 44 varieties of lizards and snakes, and 34 kinds of frogs, toads and salamanders.

Furbearers such as muskrat, beaver, raccoons as well as opossums, weasels, moles, fox, skunk, otter, bobcat, puma, squirrel, rabbit and armadillo make up the mammal population of the area living mainly on the islands within the swamp.

Present in the refuge are some 200 species of birds, primarily waterfowl, including numerous heron, egrets, ducks and geese, vulture and hawks, woodpeckers, warblers, and sparrows and several species which are considered rare or endangered.

* Bracketed numbers refer to reference on the map of the local area

JACKSONVILLE AREA, FLORIDA

WILDLIFE AND VEGETATION
PROTECTED AREAS

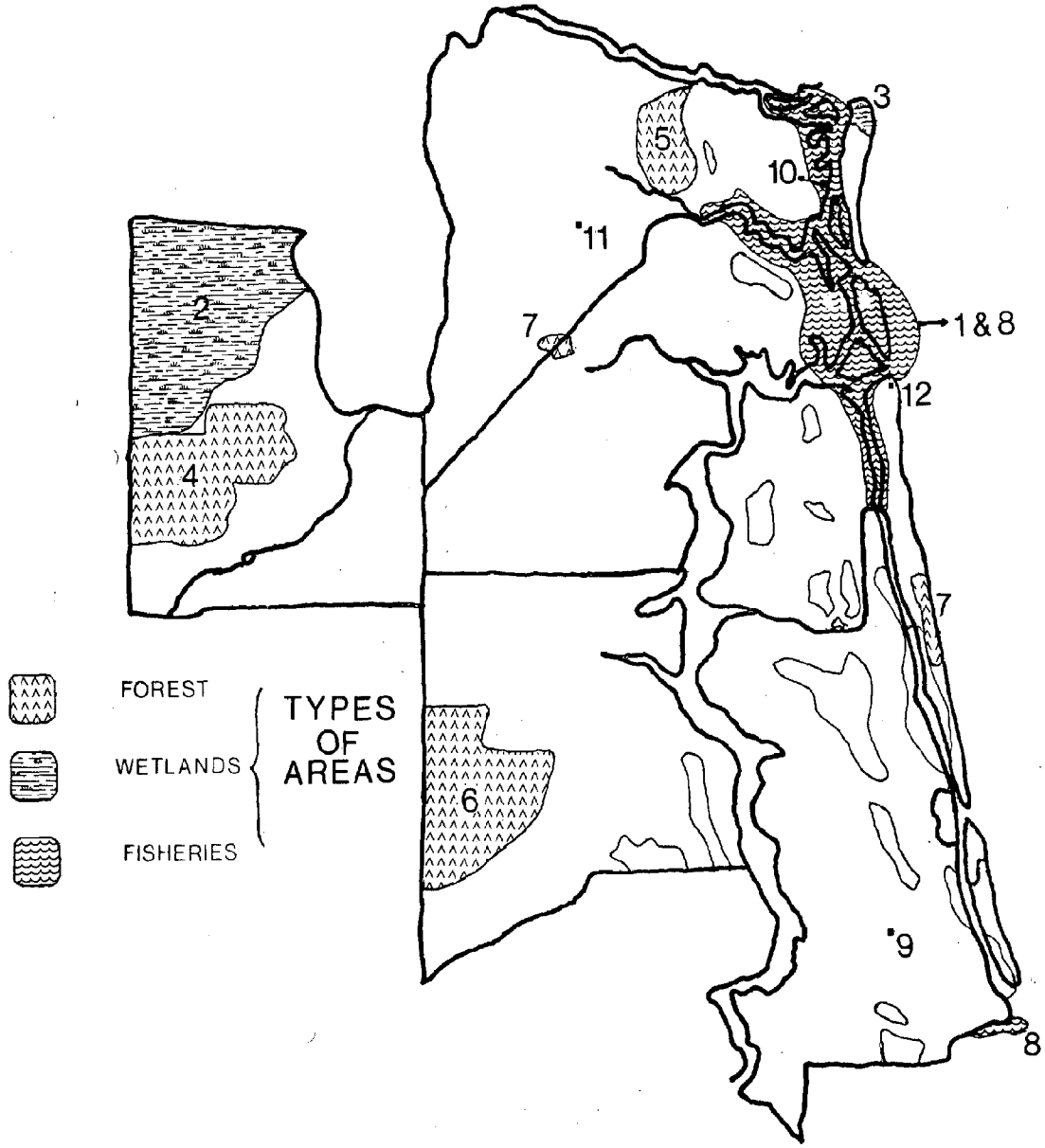


EXHIBIT 5B-2

It should be noted here that although the bulk of the Okefenokee area is outside of the Baker County area, the ecology of the Baker portion as well as that of the nearby Pinhook Swamp is similar to that described above.

[2] Fort Clinch State Park on Amelia Island in Nassau County contains some area of salt marsh and live oak forest. This island is of interest not only because it supports a variety of habitats, but also because, being isolated from other land by deep water and located in the extreme northeastern part of Florida, it is, according to James N. Layre of the Archbold Biological Station, Lake Placid, Florida, "a potential area of extension of species of northern affinities into the state" as well as for more northerly expension of primarily southern species. The following species have been reported in the vicinity of the park:

Mammals

opossum	skunk
Eastern mole	rice rat
star nose mole	cotton mouse
pipistrel bat	golden mouse
nine-banded armadillo	cotton rat
marsh rabbit	black rat
gray squirrel	raccoon
flying squirrel	otter
Florida panther (possibly)	

There is suitable habitat for the following reptiles and amphibians in the vicinity of the state park:

endangered American alligator	gopher tortoise
snapping turtle	Atlantic loggerhead turtle
Eastern mud turtle	six-lined racerunner
Florida box turtle	island glass lizard (rare)
yellow-bellied turtle	snakes
Florida coater	salamanders
chicken turtle	toads and frogs

The live oak hammonds in the park are habitat for numerous owls, warblers, hawks and woodpeckers; shorebirds of many types roam the beach; and over 70 species of wildlife are known to utilize the tidal wetlands and salt marsh.

---

1 All of the information concerning Amelia Island presented here was obtained from studies done for the Amelia Island Company and provided to RPA upon request.

Forests and Wildlife Management Areas

[4] Osceola National Forest is located in Baker and Columbia counties, divided between the two about 60 percent and 40 percent respectively. The vegetation of the forest is comprised of three distinctive associations:

A. Pine Flatwoods (70% of National Forest).
longleaf pine phase (68% of flatwoods) and slash pine phase (32% of flatwoods) with understory species such as saw palmetto, smilax, and wire grass, gallberry, etc.

B. Cypress Swamps (18% of forest).
pond cypress phase (60% of cypress swamp) and baldcypress - blackgum phase (40% of cypress swamp) with understory species such as ferns, fetterbush, holly, bays, etc. and sedges and rushes as ground cover.

C. Creek Swamps (12% of forest).
a variety of overstory vegetation including red maple, black gum, sweet bay and gum, slash pine and cypress and an understory of scrubs such as alder, button bush and green briar.

The forest is excellent habitat for turkey, black bear, gray squirrel and white-tailed deer, and certain concentrations of wood ducks. Among the species found within the forest, the following are threatened:

American alligator	Southern bald eagle
Florida panther	Arctic peregrine falcon
red-cockaded woodpecker	Florida manatee
Florida sandhill crane	Suwannee bass

The areas within the forest considered the most critical and ecologically sensitive are the swamps and bay areas which fed into the Okefenokee system and which provide escape cover for black bear, panther, and alligators.

The national forest is cooperatively managed as a game area by the Forest Service and the Florida Department of Fish and Game. The state operates several other areas as game management units:

---

1 All of the information concerning the Osceola National Forest are obtained from a pre-draft environmental impact statement being written by the Bureau of Land Management, U.S. Department of Interior

Name	County	Acres	Game Species
[5] Nassau	Nassau	95,000	deer, turkey, quail, squirrel
[6] Camp Blanding	Clay	70,000	deer, turkey, quail, squirrel

The Florida Coastal Zone Atlas indicates two areas covering some 46,980 acres of Nassau County and 7,300 acres in St. John's County as being designated wildlife management areas [7].

The state of Florida maintains a state forest, Cary State Forest, in the northwest corner of Duval County [7].

Fish

According to the Florida Coastal Zone Atlas there are several areas which should be considered as aquatic preserves, that is, bodies of water and adjacent land which are important to estuarine activities of marine species and for the propagation of various wildlife species. The following areas of water and salt marsh area support estuarine zone activities of shellfish and marine fisheries, and runs of anadromous fish: shad, striped bass, river herring and Atlantic sturgeon.

[8] Nassau River - Amelia River - Lofton Creek Intertidal area.

[9] South of Nassau River to St. John's River - Intertidal Area.

[10] Pelicer Creek Area, Southern end of St. John's Coast.

[11] The U.S. Department of Interior, Bureau of Sport Fisheries and Wildlife operates a warm-water species hatchery in Welaka, St. John's County. The following species are propagated there: striped bass, channel catfish, largemouth bass, bluegill and red-ear sunfish.

Birds[1]

The Florida Audubon Society owns two sanctuaries in the Jacksonville area:

[12] The Sawpit Creek Sanctuary is 60 acres with both fresh and salt water, sandy flats, islands and woodlands where shorebirds, waterfowl and long-legged waders as well as small woodland species abound.

[13] Froitzheim Wilderness Sanctuary covers 50 acres including woodland, open pasture and creek and cypress swamp habitat.

The State of Florida [14] Division of Fish and Game owns a sanctuary, Rollins Sanctuary, 133 acres, at the mouth of the St. John's River in Duval County where numerour shorebirds and waterfowl breed and winter.

---

[1] Although no information was available there is a National Wildlife Refuge called the St. John's which is discussed in Environmental Impact Statement 10071 (8/14/70).

AREAS OF SIGNIFICANCE TO WILDLIFE AND VEGETATION IN THE N.E. FLORIDA/S.E. GEORGIA REGION

Wetlands

The following is a breakdown of the wetlands acreages and types for the N.E. Florida/S.E. Georgia Region and an indication of the relative value of these areas in terms of waterfowl habitat. It should be noted that wooded swamps, the predominant type in the region, although not of high value to waterfowl, have value for other wildlife such as deer, alligators, etc.

County	Acres	Value	Prime Types
Florida			
Columbia	167,000	all low and neg.	1 and 7
Union	50,400	all low and neg.	7
Aluchua	122,900	40% high & mod.	2P and 5 and 7
Bradford	40,800	all low and neg.	7
Putnam	75,700	5% high and mod.	1, 7 and 4
Hamilton	66,100	all low and neg.	7 and 1
Flagler	283,500	2% mod.	1P, 7 and 18
Georgia			
Brantley	107,400	18% mod.	7
Camden	217,200	12% high and mod.	7, 13 and 18
Charlton	285,000	6% high and mod.	7 and 4
Clinch	181,350	almost all low and neg.	7
Glynn	153,900	7% high and mod.	18 and 7
Ware	321,450	3% high and mod.	7

Forests and State Wildlife or Game Management Areas

Florida

	County	Acres
Ocala National Forest	Putnam County	
Lake Butler Wildlife Management Area	Alachua County	100,000 acres
Aucilla Wildlife Management Area	Alachua County	165,000 acres

Georgia

	County
Waycross State Forest	Ware County
Suwannooche Wildlife Management Area	Clinch County
Arabia Bay Wildlife Management Area	Clinch County
Brunswick Wildlife Management Area	
Harrington	Brantley and Glynn Counties
Sansaville Tract	Glynn County
Atkinson Tract	Glynn County
Lampa Poshia Tract	Camden County
Attamaha Waterfowl Area	Glynn County

Birds

Florida Audobon Society Sanctuaries, Alachua County around Gainesville

Name of Sanctuary	Species
Bivan's Arm	ibis, heron, gallinules, rails
Lake Alice	ibis, heron, gallinules, rails, alligators
Tuscawailla Lake	
Micanopy Cypress	wood ibis, barred owl, pileated woodpecker, prothonotary warbler

Name of Sanctuary	Species
Orange Lake Wildlife Sanctuary	white ibis, snowy, common, and cattle egrets, purple and Florida gallinules, glossy ibis, cormorants, anhingas, Louisiana, little blue and black crowned night herons, and least bitterns (nesting area)
Colclough Pond Wildlife Sanctuary	Anhingas, etc.

Botanical Gardens

Florida

Name	County	Acres
Washington Oaks Gardens	Flagler	340
Ravine Gardens	Putnam	182

Endangered Species

The following species are listed as inhabiting the general region:

Species	Habitat
Florida manatee	New River, Osceola Forest
dusky seaside sparrow	East side of upper St. John's
Florida sandhill crane	Okefenokee Swamp, Osceola Forest
American alligator	Osceola Forest, Okefenokee Swamp, Bivan's Arm Audobon Sanctuary
Suwanee bass	Ichtucknee Springs, Columbia County, Fla., Osceola Forest

WILDLIFE AND VEGETATION OF THE VALDEZ ARM AREA, ALASKA

It should be noted at the outset that quite extensive information on the wildlife and vegetation of the Valdez area and Alaska as a whole has been gathered and is incorporated in the Department of Interior's Trans-Alaska Pipeline Environmental Impact Statement. The discussion below is presented to familiarize those to whom that document is not available with the Valdez area and Alaska in general and to give some idea of the importance of this area, on a national and international level, in terms of wildlife and vegetation. Another fine source of information about Alaskan wildlife and vegetation is the book entitled, "Alaska and its Wildlife," written by a British Petroleum Company ecologist, Bryan L. Sage.

Wetlands

In the vicinity of Valdez there is one area which can be classified as wetlands:

[1] The Lowe-Robe Lake Area, south of Valdez, is the nesting place of numerous waterfowl which migrate from all over the world. This area does not, however, support any significant populations, in size or in rarity, comparable to certain other spots in Alaska.

Forests and Other Wildlife Areas

Most of the peninsula below Valdez is part of a national forest.

[2] The entire Chugach National Forest covers an area of over 4 million acres, much of which is alpine area while the rest supports furs and spruces in abundance. The land on either side of the Valdez arm is part of the forest system. In the vicinity there is a wealth of wild flowers in the alpine areas including yellow mountain heather, saxifrage, rock jasmine and many other species. The game of the forest as well as the area closer to the town of Valdez includes moose, black, brown and grizzly bear, mountain goat, and one of the major populations of sitka blacktail deer in Alaska. The bald eagle is by no means an uncommon sight in this area.

Fish

In the rivers and streams of the area various species of anadromous fish thrive. The species present include king salmon, red salmon, pink salmon, silver salmon, cutthroat trout, and Dolly Varden. [1] Robe Lake also supports scores of Lake and Rainbow trout.

AREAS OF SIGNIFICANCE FOR WILDLIFE AND VEGETATION IN ALASKA

National Forests and Parks

Chugach National Forest

Tongass National Forest

Mt. McKinley National Park

National Wildlife Refuges (excluding Island areas)

Name	Acres	Species
Arctic National Wildlife Range	8,894,624	barren ground caribou, polar and grizzly bears, Dall's sheep, gray wolf, Arctic foxes, waterfowl, and shore birds
Cape Newenham	265,000	black brant, emperor goose, waterfowl, shore birds, murres, puffins, kittiwakes, grizzly bears, salmon
Chamisso	641	kittiwakes, murres, puffins
Clarence Rhode National Wildlife Range	2,887,026	black brant, emperor geese, whistling swans, sandhill (little brown) cranes, other waterfowl, salmon
Hazen Bay	6,800	Steller's eiders, cackling Canada geese, pintails, black brant, emperor geese
Izembek National Wildlife Range	320,802	black brant, emperor geese, other waterfowl, shore birds, ptarmigans, big brown bear, salmon
Kenai National Moose Range	1,730,000	Kenai moose, big brown bears, salmon, Dall's sheep, mountain goats, trumpeter swans, ptarmigans
Tuxedni	6,439	eiders, kittiwakes, gulls

The important fish resources in the state include:

sheefish	king salmon
red salmon	pink salmon
silver salmon	cutthroat trout
Dolly Varden	lake trout
Arctic char	northern pike
grayling	rainbow trout

The State operates four fish hatcheries:

Name	Location	Species Propagated
Deer Mountain Hatchery	Ketchikan	coho, sockeye and chinook salmon; steelhead trout
Fire Lake Hatchery	Chugiak	rainbow, cutthroat, and steelhead trout; coho and chinook salmon; grayling and sheefish
Kodiak Conservation Club Hatchery	Kodiak	rainbow and steelhead trout; coho salmon
Kitoi Bay Research Hatchery	Kodiak	sockeye and coho salmon

THE WILDLIFE AND VEGETATION OF SKAGIT AND WHATCOM COUNTIES, WASHINGTON

Wetlands

Within Skagit and Whatcom Counties there are only approximately 27,600 acres of wetlands; however, the great majority of these coastal salt flats and marshes are of significant value for the waterfowl of the Pacific Flyway and are associated with almost 100,000 acres of crop land which are foraged by geese and other waterfowl.

Twenty-six species of duck; snow, white-fronted and Canada geese; black brant, and whistling swan either nest or winter on the Skagit [1] Flats. The Washington Game Department manages 12,761 acres of this area as a Wildlife Recreation area. Besides the abundant waterfowl (20,000 - 35,000 snow geese winter there annually) nearly 200 other species of birds and mammals have been identified there including black-tail deer, pheasant, mink, river otters, and doves. Large numbers of the endangered bald eagles also nest and feed on the flats and rocky meadows. Nearby DeBay Slough, the former channel of the Skagit, is a resting and feeding area for the endangered trumpeter swan.

Several islands [2] just off the coast of Skagit and Whatcom Counties are important breeding areas for waterfowl species. On Samish Island surrounded by estuarine tidal flats there are approximately 125 nesting pair of great blue herons. Cypress Island, a 9 mile square island with swamps, fresh water marshes, and a lake in the center, is the home of a very large breeding population of longbilled marsh wrens and wood duck as well as numerous other species. The juniper and western red cedar provide excellent habitat for the cavity nesting wood duck.

Although the area around the Nooksack River delta [3] is increasingly being surrounded by industrial development, the mud flat and intertidal area of the delta is still an excellent feeding and resting ground for waterfowl, including the rare whistling swan.

Forests

[5] Mount Baker National Forest which covers some 525,000 acres in Skagit and Whatcom Counties, includes the North Cascades National Park, Ross Lake National Recreation Area and part of the Pasayten Wilderness as well as half of

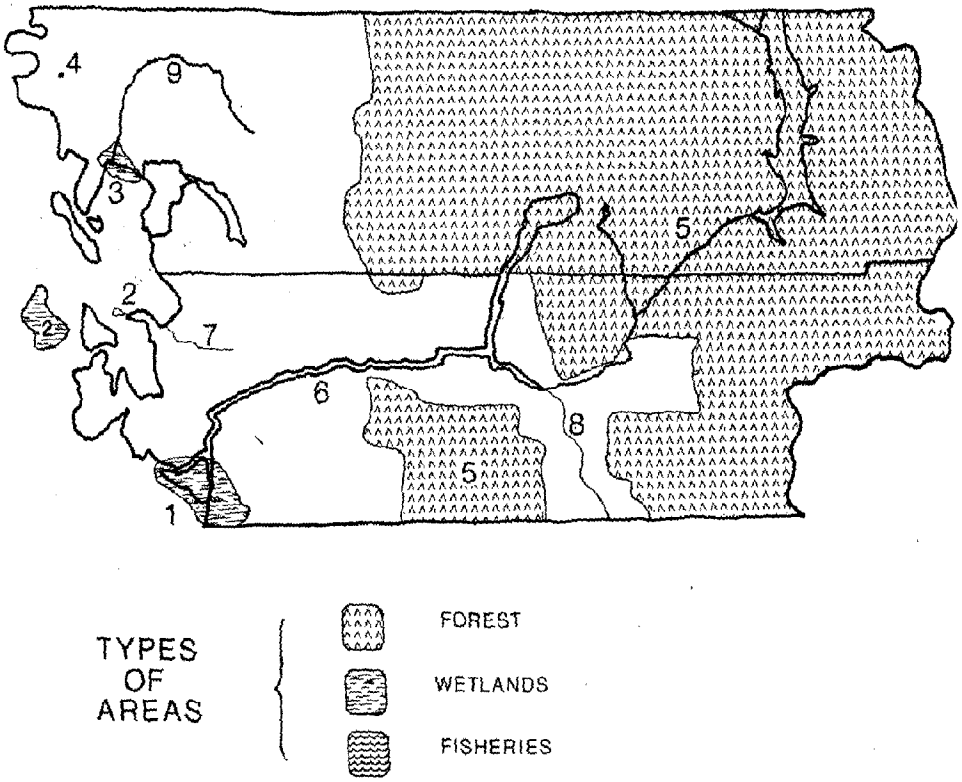
---

*Bracketed numbers refer to references on the map of the local area.

EXHIBIT 8-2

SKAGIT AND WHATCOM, WASHINGTON

WILDLIFE AND VEGETATION
PROTECTED AREAS



the Glacier Peak Wilderness. The natural vegetation of the forest includes Douglas fir, western red cedar, western hemlock, sitka spruce and Pacific silver fir in the deep valleys and higher up isolated patches of mountain hemlock and alpine fir separate meadows of vine maple, huckleberry, blueberry and mountain ash.

The wildlife of the area includes anadromous and fresh water species of fish in the lakes, streams and rivers as well as large concentrations of black bears, black-tailed deer, elk, and other game species and fur-bearers. The elk range is primarily in the area between the middle and southern forks of the Nooksack River with higher concentration by the end of southern fork. Deer cover most of the forest but are most plentiful near Baker and Ross Lakes and along the Skagit, Sauk and Nooksack Rivers and their tributaries. The Baker Lake area also attracts wintering waterfowl of various species.

The following mammals classified as "rare" in the State of Washington are known to be present in the Cascade Mountain area: moose, grizzly bear, cougar, Cascade red fox, wolverine, fisher and western gray squirrel.

Fish

As can be seen from the following table, the Skagit and Nooksack Rivers provide prime habitat for numerous species of fish. The Skagit has the best habitats partly due to its configurations and size and partly because of its high water quality.

Nooksack-Sumas Basin Density	Species	Skagit-Samish Basin Density
M	coho salmon	H
M	chinook salmon	H
H	pink salmon	H
M	chum salmon	M
M	steelhead trout	H
L	searun Dolly Varden	H
L	searun cutthroat trout	H
M	rainbow trout	H
M	cutthroat trout	H
M	brook trout	M
L	Dolly Varden	H

Nooksack-Sumas Basin Density	Species	Skagit-Samish Basin Density
M	kohanee	H
H	whitefish	H
M	largemouth bass	H
H	perch	H
M	crappie	M
M	pumpkinseed	M
H	bullhead	H
H	sculpin	H
H	stickleback	H
H	dace	H
H	lamprey	H

H = High concentrations of the species
M = Medium concentrations of the species
L = Low concentrations of the species

The following rivers and tributaries in the Nooksack-Sumas and Skagit-Samish basins have significant runs of winter run steelhead trout:

	1971-72 Winter Run
[6] Skagit River	22,796
[7] Samish River	5,409
[8] Sauk River	1,666
[9] Nooksack River	1,480

Within Skagit and Whatcom Counties there are seven state hatcheries or preserves:

Name	Species
Baker Lake Spawning Beach[1]	sockeye salmon
Nooksack State Salmon Hatchery	coho and chinook salmon

[1] Further information on this area can be found in the Baker Lake Watershed Environment Impact Statement 30354 (8/13/73) NTIS and EIS 73 #1327F

Name	Species
Samish State Salmon Hatchery	chum, coho and chinook salmon
Skagit State Salmon Hatchery	coho and chinook salmon
Bellingham Hatcheries	trout
Barnaby Slough Rearing Pond	winter-run steelhead trout
Lake Whatcom Eyeing Station	trout

Plants

There are two areas in the northwest region which are of botanical importance:

[2] Cypress Island, already mentioned as a haven for waterfowl, is abundant with unique flora, juniper trees, and western red cedar.

[6] Along the south side of the Skagit River there are cottonwood forests with morel and chanterelles mushrooms in abundance.

AREAS OF SIGNIFICANCE TO WILDLIFE AND VEGETATION IN PUGET SOUND

National Forests

There are three national forests in this region; the Mt. Baker, Snoqualmie, and Wenatchee National Forests [1], all of which support numerous wildlife species such as elk, deer, pheasant, etc.

Wildlife Recreation Areas

Besides the Skagit Flats and Lake Terrell Wildlife Recreation areas there are several other owned and managed by the Washington Game Department.

On Nisqually Delta there is a 665 acres area where marsh tidelands and mud flats host waterfowl, black-tail deer and many species of fur-bearing animals as well as well as the common local bird species.

Stillwater Wildlife Recreation area is located along two miles of the Snoqualmie River in which steelhead and searun cutthroat trout abound. Living among the open grasslands and the heavy brush areas are pheasant, rabbit, snipe, mink, black-tail deer and occasional bears.

Fish Resources

The major rivers and creeks with high densities of winterrun steelhead trout and other anadromous and fresh-water species are as follows:

River Basin	Species
Stillaquamish	coho and pink salmon, cutthroat and steelhead trout and whitefish

---

[1] For further information on these ares, see Alpine Lakes, Snoqualmie and Wenatchee National Forest Environmental Impact Statement #31265 (7/30/73) NTIS #EIS 73 1265D

River Basin	Species
Snohomisa	coho, chinook and pink salmon; steelhead, cutthroat, and rainbow trout; largemouth bass, perch, crappie, bluegill, bullhead
Cedar - Green	coho, chinook, and sockeye salmon; steelhead and rainbow trout; kokanee, largemouth bass, perch, crappie, bluegill, pumpkinseed, bullhead
Puyallup	coho salmon, steelhead trout, largemouth bass, perch, crappie, bluegill, bullhead, pumpkinseed
Nisqually-Deschutes	chinook and sockeye salmon, rainbow and cutthroat trout, coho salmon, steelhead trout, largemouth bass, perch, crappie, bluegill, bullhead, pumpkinseed

There are numerous state fish hatcheries and rearing ponds located in the Puget Sound area.

Name	Species Propagated
Green River State Salmon Hatchery	chinook and coho salmon
Issaquah State Salmon Hatchery	chinook, coho and sockeye salmon
Minter Creek Salmon Hatchery	chinook, coho, chum and pink salmon
Puyallup Salmon Hatchery	chinook and coho salmon
Skykomish State Salmon Hatchery	chinook, coho and pink salmon
Arlington Trout Hatchery	trout
Seward Park Trout Hatchery	trout

Tokul Creek Trout Hatchery	trout and steelhead trout
Green River Rearing Pond	winter-run steelhead trout
Tokul Creek Rearing Pond	winter-run steelhead trout

Wetlands

The following is a breakdown of the wetlands of the Puget Sound region with acreages, prime types, and level of value to waterfowl indicated:

County	Acres	Value	Prime Types
King	2,700 (with 15,200 acres of associated crop and pastureland)	75% high	7
Pierce	1,320 (with 1,200 acres of associates pasture and cropland)	all high and moderate	all 15 & 19
Snohomish	16,290 (with 40,310 acres of associated pasture and cropland)	Mostly high and moderate	18,19
Kitsap	NA	NA	NA

THE WILDLIFE AND VEGETATION OF CONTRA COSTA AND SOLANO COUNTIES, CALIFORNIA

Wetlands

Within Contra Costa and Solano Counties there are some 67,000 acres of wetlands, the majority of which are regularly flooded salt marshes (Type 18) located in Solano County. All but a few thousand of those areas are of high or moderate value to waterfowl since the area in general is the winter habitat of almost half of the ducks and geese of the Pacific Flyway. Several important specific areas of wetlands can be discussed in terms of their wildlife habitats.

[1] The San Pablo Bay National Wildlife Refuge covers nearly 12,000 acreas in Solano and adjacent counties and is the principal wintering area for canvasback ducks of the Pacific Flyway as well as providing habitat for the endangered California clapper rail and the salt marsh harvest mouse. Extensive areas of tidal flats, pickleweed and hord grass and the open waters of the Bay comprise the majority of the established refuge.

[2] Located within the 54,500 acre Suisun Marsh of Solano County is the Grizzly Island Wildlife Area managed by the California Department of Fish and Game. The wildlife management area itself is 10,487 acres divided between Joice and Grizzly Islands. Living or wintering in the area are a total of 168 bird species, including the uncommon white-tailed kite and great blue herons, as well as 21 identified species of mammals, including the river otter, beaver, mink, muskrat, striped skunk, raccoon, Suisun shrew and the endangered salt marsh harvest mouse. The Suisun Marsh is of increasing importance because it represents a part of California's remaining natural wetlands and because it is a permanent marsh available to wildlife during drought conditions.

Forests and State Game Refuges

There are no national or state designated forest reserves within Solano and Contra Costa Counties. However, there is one State Game Refuge located at Mt. Diablo [3] where various game species thrive.

---

*Bracketed numbers refer to references on the map of the local area.

SOLANO AND CONTRA COSTA, CALIF.

WILDLIFE AND VEGETATION
PROTECTED AREAS

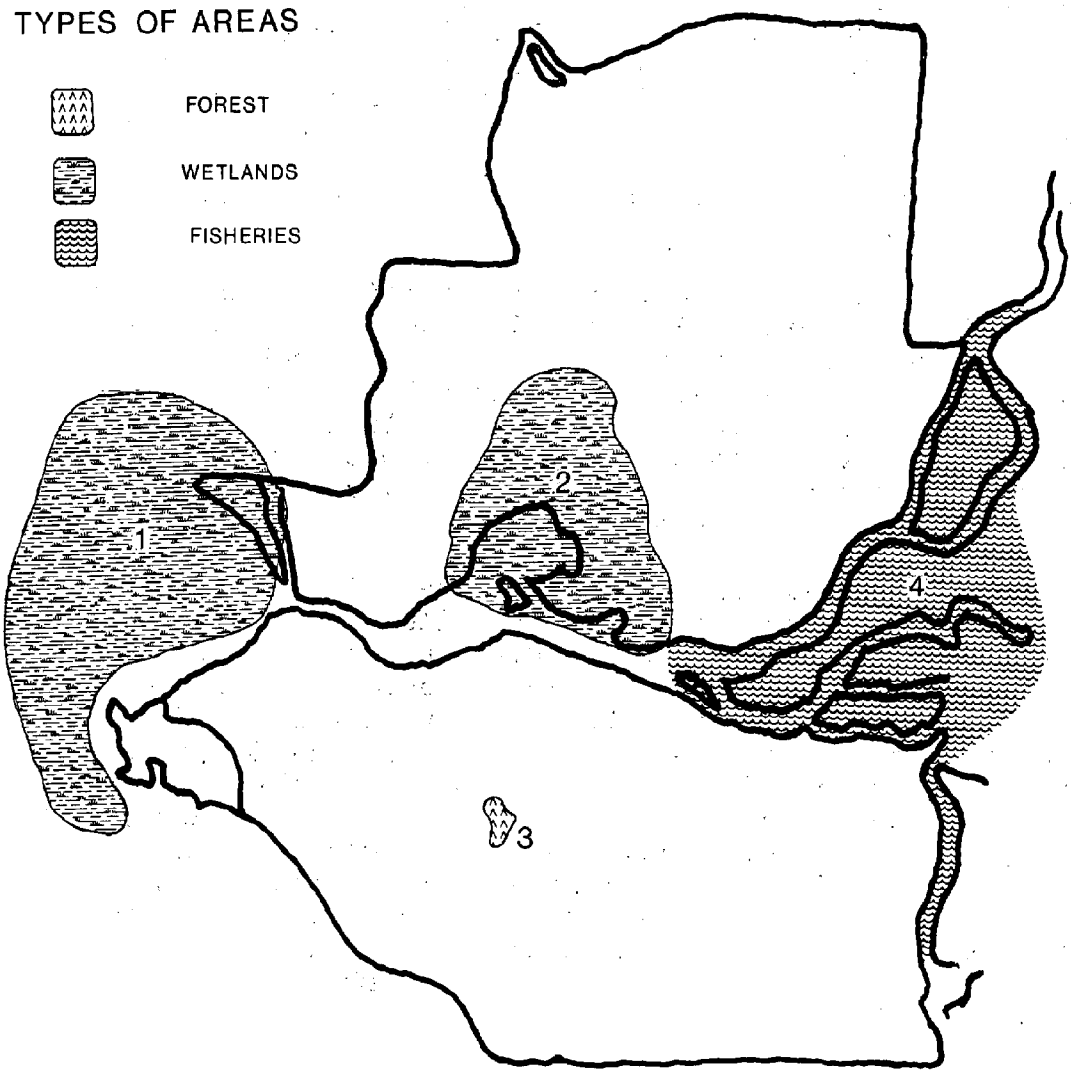


EXHIBIT 9-2

Fish

The San Francisco Bay Area is important as an area where anadromous fish live and spawn. The species present in the Bay include striped bass, Pacific salmon, sturgeon, steelhead trout and shad. The migration of many of these species is through the Bay into the lower Sacramento River [4] and the delta where they spawn.

AREAS OF SIGNIFICANCE TO WILDLIFE AND VEGETATION IN THE NINE COUNTY SAN FRANCISCO BAY REGION

Wetlands

The Bay has approximately 50 square miles of marshland, 78 square miles of tidal flats and 400 miles of open water. These areas are important to the estuarine activities that take place in the Bay area. The rivers and streams running into the Bay are spawning grounds for various species of anadromous fish. The following is the breakdown of wetlands acreage and types for the nine county area around San Francisco Bay and an indication of the relative value of these areas to waterfowl.

County	Acres	Value	Prime Types
Alameda	28,747	All high & mod.	15,18,19
Marin	12,077	Half high & mod.	18,19
Nepa	4,982	All high & mod.	18,19
San Mateo	13,982	All mod.	15,18,19
San Clara	11,400	All mod.	15,18,19
Sonoma	9,103	Almost all mod.	18,19

The major types of wetlands include the waters of the bay, salt flats and regularly flooded salt marshes and the preponderance of areas of high value is attributable to the fact that the Bay Area is one of the major wintering spots for the ducks and geese of the Pacific Flyway. These wetlands areas also support several endangered species of wildlife.

Endangered Species of Wildlife Present in the Region

Species	Habitat
salt marsh harvest mouse	salt marshes of San Francisco Bay, San Pablo Bay, Suisun Bay, Grizzly Island, and Dumbarton, etc. in South Bay Area.
California least tern	San Francisco Bay Area
California clapper rail	pickleweed salt marshes from Tomales Bay and S.F. south
San Francisco garter snake	San Francisco area.

National Wildlife Refuges and State Wildlife Areas

Besides the San Pablo Bay Refuge there is another national Wildlife Refuge in the Bay area named the San Francisco Bay National Wildlife Refuge. Encompassing some 21,662 acres, the refuge will be divided into 4 units, Greco Island in San Mateo County, Fremont and Mowry Sloughs in Alameda County, and Alviso in Santa Clara. Species protected will include the harbor seal, California least tern and clapper rail, the salt marsh harvest mouse, and various species of waterfowl and shore birds.

In San Mateo County lies the San Francisco state fish and game refuge.

National Audubon Sanctuaries

The National Audubon owns and operates three sanctuaries in the area: the Richardson Bay-Tiburon area and Canyon Ranch Sanctuary in Marin County and the Redwood City Sanctuaries in San Mateo County. These areas are maintained primarily for wintering and migrating waterfowl and various shore birds.

SOURCES OF DATA

Conservation Directory, 1973. National Wildlife Federation. Washington, D.C.: 1973.

National Audubon Society

The National Estuarine Pollution Study. Report of the Secretary of the Interior to the United States Congress, March 1970.

U.S. Department of Agriculture, Forest Service.

U.S. Department of the Interior, Fish and Wildlife Service. Wetlands of the United States. (Circular 39) Washington, D.C.: U.S. Government Printing Office, 1956.

U.S. Department of the Interior, Fish and Wildlife Service. Threatened Wildlife of the United States. Washington, D.C.: U.S. Government Printing Office, 1973.

U.S. Department of the Interior, Fish and Wildlife Service. Anadromous Fish Resources: Their Conservation, Development, and Enhancement. Washington, D.C.: U.S. Government Printing Office, March 1970.

U.S. Department of the Interior, Fish and Wildlife Service. Waterfowl Status Report 1972. Washington, D.C.: U.S. Government Printing Office, 1973.

U.S. Department of the Interior, Fish and Wildlife Service. Migratory Game Bird Briefing Book. Washington, D.C.: U.S. Government Printing Office, January 1971.

U.S. Department of the Interior, Bureau of Land Management. Final Environmental Statement for a Proposed 1973 OCS Oil and Gas General Lease Sale - Offshore Mississippi, Louisiana, Florida. Washington, D.C.: U.S. Government Printing Office, 1973. (Volumes I - V)

COASTAL ZONE
INFORMATION CENTER

NOAA COASTAL SERVICES CENTER LIBRARY
3 6668 00002 5603