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REGIONAL ASSESSMENT PROGRAM

**Regional Issue Identification
and Assessment (RIIA):**

**Volume I An Analysis of the TRENDLONG
MID-MID Scenario
for Federal Region 10**

July 1979

Prepared for Regional
Assessments Division,
Office of Technology Impacts
of U.S. Department of Energy
under Contract EY-76-C-06-1830

DOE Project Monitor: Arthur M. Katz

Pacific Northwest Laboratory
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REGIONAL ISSUE IDENTIFICATION AND ASSESSMENT
(RIIA)

VOLUME I: AN ANALYSIS OF THE TRENDLONG MID-MID
SCENARIO FOR FEDERAL REGION 10

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FOREWORD

The Office of Technology Impacts (OTI) within the Department of Energy was established to provide input for making national energy policy evaluations. The Regional Assessment Division (RAD) within OTI is responsible for reviewing national policy alternatives in terms of their potential impact on each of the ten Federal Regions. RAD has conducted this Regional Issue Identification and Assessment (RIIA) as an analysis of a national policy proposal (the National Energy Plan as described by President Carter on April 29, 1977). This summary report addresses the environmental, human health and safety, socioeconomic and institutional impacts of future energy development for Federal Region 10, which includes the states of Alaska, Idaho, Oregon, and Washington.

This document describes the existing environmental and the current energy, environmental, socioeconomic and institutional issues in Region 10. These topics are discussed on the regional and state levels and include an assessment of the impacts on the Region of the TRENDLONG MID-MID Scenario, a national energy alternative. The conclusions and key findings describe the issues and impacts that will probably occur if this particular scenario is implemented.

When the reader is interested in an individual state, it is recommended that he review the section dealing with the Region as a whole, as well as the section dealing with the particular state in order to gain a complete, integrated perspective of the issues.

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SUMMARY

KEY FINDINGS

- The reduction in electric generating capacity of 568 MWe specified by the scenario for Alaska will not be realized because of institutional constraints and economic impacts.
- Development of 1000 MWe of geothermal generating capacity in Region 10 called for by the scenario will not be met by 1990. Besides technical feasibility and economic constraints, procedures in Oregon and Washington for securing leases and siting permits have not been fully developed.
- The location and impacts associated with construction and operation of oil and gas transshipment facilities such as the proposed pipeline to transport natural gas from fields in northern Alaska to the lower 48 states and the pipeline to transport Alaskan oil through Washington State to refineries in the Midwest are likely to be important issues in the Region.
- The addition of 7,951 MWe to the currently existing hydroelectric generating capacity of 29,990 MWe by 1990 will intensify competition among multiple uses of limited water resources of the Columbia and Snake River systems which drain Idaho, Oregon, and Washington. Irrigation, recreation, transportation, maintenance of wildlife habitats and anadromous fisheries conflict and compete with hydroelectric power generation.
- Public opposition to further development of nuclear power currently exists and seems to be intensifying in light of recent events. Opposition results from failure, in the public view, of the Federal Government and the nuclear industry to prove the safety of nuclear power and to find an acceptable method of storing nuclear waste. The scenario-specified addition of 4,816 MWe of nuclear generating capacity to the Region's current nuclear capacity of 2,016 MWe may be jeopardized by this opposition; specifically the 1,174 MWe addition to Oregon's nuclear capacity may not be realized.

GENERAL CONCLUSIONS

The major issues in the Region that will impede implementation of portions of the scenario are primarily institutional in nature rather than environmental. Socioeconomic impacts may be high because the energy facilities projected by the scenario will occur primarily in rural areas. However, the Region is somewhat accustomed to rapid growth, and socioeconomic impacts should be amenable to mitigation.

The scenario specifies an unrealistic electric generating capacity for Alaska in 1990 of less than half the existing capacity, and calls for no gas-fired generating capacity in Alaska by 1985. Currently, approximately 50% of the total electric generation capacity in the state is of this type. Elimination of this capacity would have a high impact in terms of unemployment, loss of personal income, and economic depression (refer to Sections 3.2.2 and 5.1.7).

The pumped storage portion of the scenario for Oregon may not be realized by 1990. Lead times are sufficiently long that should planning begin immediately, even modest political opposition could delay completion of a facility within the time frame of the scenario (refer to Section 5.3.8).

The increased coal-fired power generation specified by the scenario is assumed to occur through expansion of existing power plants and surface coal mines, and completion of one plant presently under construction. Since no additional sites are to be developed, significant ecological impacts are not expected (refer to Sections 5.1.3, 5.3.3, and 5.4.3).

According to the scenario, a 150 MWe coal-fired generation facility is to become operational at Healy, Alaska, by 1985. The site also contains the state's only existing coal mine. The coal facilities with 54 MWe capacity currently supply electricity to Fairbanks. The proposed new facility was reduced to 105 MWe and, early in 1979, plans for the facility were cancelled by the utility because of inflationary cost escalation and air quality requirements. If the scenario is to be implemented, this decision will have to be reviewed. The proposed site is located only 10 miles from Mt. McKinley National Park, a Class I area. Operation of the coal plant expansion may cause air quality standards for Mt. McKinley National Park to be violated (refer to Section 5.1.1).

The use of coal as a fuel for electric generation will necessitate the disposal of approximately 46,500 tons of ash per month. Increased industrial use of coal will also necessitate the development of adequate disposal sites. Potential adverse impacts for ash disposal, such as leaching of toxic materials, contamination of groundwater, or blowing dust, will be minimized by careful selection of the disposal site and proper treatment of the ash (refer to Section 4.2.5).

The coal-fired facility currently under construction and specified by the scenario uses a man-made reservoir for water supply. Therefore, no significant water availability or water quality impacts on existing river systems will result from facility construction and operation (refer to Section 5.3.2).

Increased air concentrations of sulfur dioxide are associated with the coal-fired generating plants. Several species of native vegetation and several important crops are sensitive to SO_2 . Such crops cover more than 30% of some counties in north-central Oregon and south-central Washington. Estimates of probable atmosphere SO_2 levels associated with the plant under construction in north-central Oregon suggest that significant ecological impacts are unlikely (refer to Sections 5.3.3 and 5.4.3).

Significant opposition to the siting of nuclear power plants exists in some areas within the Region. In part, this opposition results from the failure of the Federal Government, in the view of the public, to prove the safety of plant operation and to find an acceptable nuclear waste disposal method. In addition, the Federal Government has not clearly defined the role that nuclear power will play in the Nation's energy supply. If Federal policy relating to the use of nuclear power is not clearly defined and supported by the Federal Government, the growth of nuclear power as specified by the scenario will be jeopardized (refer to Section 4.1.4).

Given the economic uncertainties, the time required in securing geothermal permits, and the current state of development of the technology required to generate electricity from the low to medium-temperature geothermal resources predominant in the Region, the scenario-specified figure of 1000 MWe of geothermal capacity in the Region by 1990 will not be met. In addition to problems of technical and economic feasibility, geothermal power generation in the Region must contend with slow responses to applications for geothermal leases. However, some procedures are established and several utilities are actively pursuing the development of geothermal resources, at least to the stage of securing leases on private property (refer to Sections 5.2.8, 5.3.8, and 5.4.8).

Table 1 summarizes the impacts of implementation of the TRENDLONG MID-MID Scenario on Region 10, while the following sections identify specific impacts associated with portions of the scenario.

COAL

Industrial Use

As part of the National Energy Policy, existing industry is being encouraged to switch from oil, natural gas, and electricity to coal as their primary fuel source. New industry will also be encouraged to use coal as its

TABLE 1. Impacts of the TRENDLONG MID-MID Scenario in Region 10

Federal Region 10	Regional Dimensions*			Comment or Cause of Constraint or Impact
	Local	Subregional	Regional	
** Likelihood of scenario-projected regional energy use or development producing significant impacts	H ^{1,2}	H ^{1,5}	H ^{2,3,4}	1) Approximately half of Alaska's total generation capacity is to be eliminated by 1985. This reduction is to be accomplished by eliminating all direct gas-fired capacity in the state.
** Likelihood of not attaining projected energy mix because of adverse impacts	H ¹	H ⁵	H ^{1,4,6}	2) Socioeconomic impacts will occur because energy facility additions projected by the scenario will occur in rural areas.
** Likelihood that specific technologies or resources will not attain projected level of use				3) The scenario does not specify development of oil and gas transshipment facilities. The location and impacts associated with construction of such facilities are likely to be regarded as important issues.
Utility:				4) Further development of hydroelectric generating facilities in the Columbia River system will intensify competition for a limited resource. Conflicting and competing uses include power generation, irrigation, recreation, transportation, maintenance of wildlife habitat, and the anadromous fishery.
• Hydro	LH ²	L	H ⁴	5) Opposition to further development of nuclear power currently exists and seems to be intensifying in light of recent events. The impact of this opposition may be felt most strongly in Oregon, where completion of a nuclear plant included in the scenario will likely be delayed past 1990.
• Nuclear	L	H ⁵	L	
• Oil	H ³	H ³	H ³	6) Institutional and technological considerations will prevent attainment of the scenario-specified goal of having 1000 MWe of geothermal power on-line in the region by 1990.
• Coal	L	L	L	
• Geothermal	H ^{5,6}	H ⁶	H ⁶	7) Industrial development could be restricted in some areas due to projected air quality violations. Federal policy encouraging coal use may exacerbate this problem.
General:				
• Utility	H ^{1,6}	H ^{1,6}	H ^{1,6}	
• Industry	H ⁷	H ⁷	H ⁷	
*Definitions: Local: Local site specific impacts Subregional: AQCR (Air), ASR (Water), County, State, Regional: Affects Federal region as a whole				
** Likelihood of falling short of projected goals: High - Large degree of certainty that conflict will arise in several facilities with no or little opportunity for cost effective mitigation. Medium - Specified concern could occur at few facilities, but potential cost effective mitigation strategies available. Low - Conflicts unlikely to occur.				

primary fuel source. The result is an increased demand for coal in the Region, about half of which will be used by industry. Industrial development is expected to increase in the Puget Sound-Willamette Lowlands; in the metropolitan and industrial area of Spokane, Washington; the mining area of Kellogg, Idaho, and the agricultural area of Pocatello, Idaho. Air quality is projected to exceed standards in these areas, which could restrict industrial development unless pollution offsets, or advanced pollution control techniques are used. Some of the anticipated impacts from industrial use of coal are:

- Increased reliance on coal as an energy source for industry will impact air quality in Region 10, and result in continued nonattainment of eight air quality control regions in the Region (refer to Sections 5.1.1, 5.2.1, 5.3.1, and 5.4.1).
- The scenario projects development which will cause violation of water quality in ASA 1705 (western Oregon). Industrial facilities sited by the scenario in this area will contribute to existing water quality violations (Section 5.3.2).
- Based on lead lab projections, total deaths from the effects of air pollution due to fossil fuel combustion are expected to increase between 1975 and 1990, but will still be lower than any other region in the country (refer to Sections 5.1.6, 5.2.6, 5.3.6, and 5.4.6).

Coal Mining

The scenario specifies coal production of 156 trillion Btu/year in 1990. Of this production, 88% will be met by surface mining in western Washington with the rest coming from coal fields in Alaska. Impacts that are identified for coal mining are:

- Approximately 7000 acres will be disturbed by surface mining by 1990. In comparison, development of subsurface mines will impact only 45 acres of surface land (refer to Section 5.4.4).

OIL

The scenario specifies that the Region will produce 4,9/8 trillion Btu/year of crude oil. Alaska is the only state with proven recoverable reserves of crude oil and almost all of this will be exported from the state. The scenario does not, however, specify how the crude oil will be transported. Crude oil currently moves from Alaska's North Slope by oil pipeline south to Valdez, Alaska's northernmost year-round, ice-free port, and is shipped by tanker to oil terminal facilities along the West Coast. Additional oil pipelines are being considered to move crude oil from the West Coast to other areas of the lower 48 states. Concern exists over the possibility of oil spills and related ecological damage. Impacts related to oil production and transportation include:

- Construction of pipeline corridors, and related facilities will have a direct impact upon current use of the land. The nature and scope of the impact varies with the land uses involved. Pipeline corridors generally result in alteration of habitat in the right of way. Since the routes and capacities of energy transmission systems are not included in the scenario, the extent of the impacts on land use and ecology can not be specified (refer to Section 4.2.3 and 4.2.4).
- Oil transshipment facilities, tanker traffic, and off-shore petroleum extraction create potentials for large oil spills and generate chronic low-level oil pollution, which may be equally damaging. Environmental pressures in marine areas may also increase because of expansion of both the commercial fishing industry and Outer Continental Shelf (OCS) activity (refer to Section 5.1.3).

NATURAL GAS

The scenario specifies 1,450 trillion Btu of natural gas production in 1990. All of this production will come from Alaska. Although there are no transport facilities to the lower 48 states currently in place, a natural gas pipeline from Alaska through Canada is currently in the planning stage. Impacts associated with the natural gas pipeline are:

- If a natural gas pipeline is built to transport gas from the North Slope fields, air quality impacts may occur from construction, operation, and decommissioning of the system (refer to Section 5.1.1).
- Construction of a natural gas pipeline could cause water quality impacts through both erosion of disturbed areas and through accidental discharges of pollutants (refer to Section 5.1.2).
- The pipeline will require substantial land for construction and right-of-way. Because of the uncertain ownership and management status of the lands through which the pipeline may pass, specific conflicts with other current and potential land uses cannot be identified at this time (refer to Section 5.1.4).
- Similar to the impact of the Trans-Alaska pipeline system, the socioeconomic impact of the gas pipeline would be important in terms of changes in lifestyle and economic changes that would occur. Previous studies indicate that regardless of the actual route chosen for the gas pipeline, the bulk of the impacts will occur in Anchorage, even though the routes do not pass through the city. Another factor potentially contributing to the socioeconomic effects of the gas pipeline is the timing of the construction relative to other planned developments in the state. The longer the delay in starting the project, higher ultimate costs and greater competition for scarce human and financial resources can be expected (refer to Section 5.1.7).

ELECTRIC SECTOR

The impacts associated with the expansion of the Region's electric generating capacity are discussed by generating technology in the following sections.

Hydroelectric Generation

Hydroelectric generation accounts for almost 80% of the electric generating capacity in Region 10. Washington produces almost 60% of this hydroelectricity, followed by Oregon, which contributes about 33% while Idaho produces about 7%. Most of Washington's hydroelectric potential has already been developed, but several small-capacity sites and potential pumped-storage sites have been identified. Idaho and Oregon have somewhat more undeveloped potential. Aside from site-specific environmental impacts, concern for the future of the Columbia River system anadromous fisheries may affect further hydroelectric development in Idaho, Oregon, and Washington. Alaska currently produces about 0.5% of the hydroelectricity in the Region and has great potential for development, particularly in the south-central and southeast subregions. However, seismic activity in these subregions may restrict such development. Expansions of existing facilities currently under construction or currently planned will meet most of the scenario-specified capacity by 1990. The major impacts associated with increased hydroelectric generation in the Region are:

- Increased use of the Columbia and Snake Rivers for hydroelectric generation will lead to water availability conflicts between fisheries, agriculture, recreation, and power generation. Because of this competition, the availability of water to meet scenario requirements for hydroelectric power is uncertain (refer to Section 4.2.2).
- Over the last several decades, self-maintaining runs of anadromous fish in the Columbia and Snake Rivers have declined drastically because of the construction of dams on these rivers. Although steps are now being taken to reduce fish loss due to dam operation and to develop improved fish passage facilities, it remains uncertain as to whether self-maintained populations can be sustained. Further hydroelectric use of these rivers will exacerbate the problem (refer to Section 4.2.3).
- Development of thermal electric generating facilities will result in a shift of use of hydroelectric facilities from base load to peak load operation. This will result in fluctuating water levels which can adversely impact aquatic ecosystems and riparian wildlife. These impacts result from, or are associated with, increased periodicity and amplitude of water level fluctuations (refer to Section 4.2.3).

Coal-Fired Generation

About 5% of the electricity currently generated in the Region is produced by two mine-mouth coal-fired plants. Another plant using coal from Wyoming is under construction. Air quality standards, particularly near Class I areas, are the major obstacle to further development of coal-fired electric generation in the Region. No significant environmental or social impacts associated with coal-fired electric generation as specified by the scenario were identified (refer to Section 4.2.3).

Nuclear Generation

Almost 7% of the electricity currently generated in the Region is from nuclear plants. There are five units currently under construction in Washington, with two more proposed in that state and two proposed in Oregon. According to the scenario, nuclear power will provide about 16% of the Region's electricity by 1985. Completion of the plants currently under construction and construction of the proposed plants will exceed the scenario-specified nuclear capacity for 1990. Washington, especially the south-central section of the state where defense-related nuclear facilities have been in operation for over 35 years, appears to be more accepting of nuclear power than the other states in the Region. Public opposition has been mounting in recent years, particularly in Oregon where recent events may have intensified opposition and actually jeopardized the construction of that state's two proposed nuclear plants. Impacts associated with nuclear power are highlighted below:

- As nuclear plants are added to the regional electric system, the hydroelectric plants will be used more and more to produce peaking power. The use of hydroelectric facilities for load following and peaking power will increase the rate of bank erosion and thus effect water quality on the Columbia and Snake Rivers (refer to Section 4.2.2).
- New nuclear plants are planned for Washington and Oregon. Although this implies increased employment within the region and expanded energy resources, the potential negative impacts have resulted in widespread public debate and resultant project delays. The people who bear most of the social costs of these developments often receive a much smaller portion of the economic benefits from them (refer to Section 4.2.7).

Natural Gas Generation

Natural gas-fired electric generating facilities in the Region are located primarily in Alaska. The impacts associated with this technology are presented below.

- The scenario calls for no gas-fired generating capacity for 1985 and 1990. Currently, approximately 50% of the total generation in Alaska is of this type. This elimination of capacity would have a high impact, in terms of its effect on personal income, levels of unemployment, and the health of the economy that is dependent on existing, if not growing, energy production (refer to Section 5.1.7).

Geothermal Generation

Although geothermal energy is currently utilized for space heating and industrial process heat, no electricity is generated by facilities utilizing geothermal resources. The Region contains some of the most promising low to medium-temperature geothermal resources found in the Nation. A 5 MWe pilot plant at Raft River, Idaho, should be operational by the early 1980's, and if successful, will stimulate further development. The major impacts associated with geothermal development are discussed below:

- Water quality impacts may result from any geothermal development carried out in the state. Geothermal waters are not normally sources of organic constituents. The pollutants of greatest concern, however, are heavy metals. Geothermal waters may contain measurable amounts of several metals. Some geothermal waters, particularly those with high salinity, contain metals in concentrations hazardous to humans, animals, and/or plant life. Waste heat in spent geothermal waters, if allowed to enter surface waters, is potentially dangerous to aquatic life. Sensitivity of most desirable aquatic organisms to temperature change is amplified because the optimum growth temperature is within only a few degrees of the destructive temperature. Land subsidence and the potential for altering existing aquifers need to be studied (refer to Sections 5.2.2, 5.3.2, and 5.4.2).
- The geothermal developments in Idaho, Oregon, and Washington are likely to occur in relatively remote, undeveloped areas. Because of the small land areas involved, and because geothermal facilities have not yet been sited except in Idaho, no specific ecological impacts can be identified (refer to Sections 4.2.3, 5.2.3, 5.3.4, and 5.4.8).
- Proposed geothermal development may cause some socioeconomic impacts because of their isolated locations. These locations may require the developer to establish and support temporary construction work camps, removed from existing communities (refer to Sections 4.2.7, 5.2.7, 5.3.7, and 5.4.7).

Transmission

Expansion of electric generating facilities invariably requires expansion of transmission facilities. Expansion of the extensive high voltage grid in

Idaho, Oregon, and Washington may require clearing little additional land for transmission corridors because expansion of generating facilities will occur primarily at existing facilities. Increased transmission capacity can be accomplished by modifying existing lines. Construction of transmission corridors in undeveloped areas of Alaska can be expected to have substantial impact. Major impacts associated with transmission corridors are listed below:

- Construction of new transmission corridors and related facilities have a direct impact upon the current use of land. The nature and scope of impact vary with the land uses involved. Since routes and capacity of energy transmission systems are not specified by the scenario, the extent of the impacts on land use cannot be specified (refer to Section 4.2.4).
- Loss of life has resulted when people have touched powerlines with irrigation pipes. Marginal expansion of the Region 10 transmission corridor system should not exacerbate this problem (refer to Section 4.2.6).

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1.0 INTRODUCTION

1.1 RIIA STUDY DESCRIPTION

The Regional Issue Identification and Assessment (RIIA) is an evaluation of the regional environmental impacts of future energy development. The study was conducted for the Regional Assessments Division, Office of Technology Impacts, Office of the Assistant Secretary for Environment, Department of Energy. The impacts described are based on a national energy projection (scenario) that assumes medium energy demand and fuel supply through 1990 but does not incorporate the policies of the National Energy Act (NEA). The scenario, known as the Projection Series C or the TRENDLONG MID-MID Scenario, is one of six possible energy futures produced by the Energy Information Administration (EIA) of the Department of Energy for the Department's 1977 Annual Report to Congress. It was chosen as representative of the official DOE national energy projections when this project was initiated, prior to the passage of the National Energy Act. Since the RIIA program is part of an ongoing review of the regional impact of energy policies, the next phase will examine the National Energy Act (NEA) and initiatives suggested by the President's second National Energy Plan. However, since coal utilization increases under the NEA, in general, impacts identified in the TRENDLONG MID-MID (SERIES C) Scenario should provide a framework for the discussion of impacts by NEA.

The environmental impacts discussed in this volume are for the Northwest states of Alaska, Idaho, Oregon, and Washington (Federal Region 10). There are nine companion volumes, one for each of the other Federal Regions in the nation (shown in Figure 1.1). Figure 1.1 shows the location of the ten Federal Regions and identifies the national laboratories responsible for each of the companion volumes. This set of reports represents a comprehensive, consistent portrayal of the regional environmental impacts and implications of the future national energy development reflected in the scenario. A detailed description of the methodologies used at each level of this study and a summary

FIGURE 1.1. Federal Regions and National Laboratory Responsibilities

of the data developed in the RIIA process for each state are available in Volume II of this report. For Region 10 there is a third volume entitled Institutional Barriers to Developing Power Generation Facilities in the Pacific Northwest.

1.2 RIIA METHODOLOGY AND ASSUMPTIONS

1.2.1 Overall Program Methodology

In developing the national energy scenarios, the Energy Information Administration balances projections of supply and demand at the Federal Region level. The RIIA studies used the predicted fuel mixes by Federal Regions derived from the TRENDLONG MID-MID (SERIES C) Scenario as a starting point for its analyses. County level patterns for utility, industry and mining activities for 1985 and 1990 were then developed from these Federal Region totals. Energy sources addressed were coal, nuclear, oil, oil shale, gas, geothermal, hydroelectric and solar.

Six of the national laboratories, Argonne (ANL), Brookhaven (BNL), Lawrence Berkeley (LBL), Los Alamos (LASL), Oak Ridge (ORNL), and Pacific Northwest (PNL), assumed various lead lab assignments. These lead labs analyzed at the county level, the impact on the air, water, and land resources of the country and on the socioeconomic and health and safety aspects of the nation's welfare. When these tasks were complete, the national laboratories focused on an assessment of the products of all of the lead lab analyses from the particular perspective of the states and regions for which they were responsible.

1.2.2 Assumptions

The major control technology assumptions used in the lead lab analyses are given in Table 1.1. In addition to these assumptions, other assumptions about regional energy resources were made where energy production and distribution differed significantly from national patterns.

The assumptions in the areas of hydroelectric generation, pumped storage, and geothermal resource development for Region 10 are discussed below.

	UTILITY	INDUSTRY	MINING																					
AIR	EMISSIONS AND LOCAL AIR QUALITY <u>COAL</u> - EXISTING PLANTS - UNCONTROLLED EMISSIONS BASED ON FPC COAL CHARACTERISTICS FOR ASH, HEAT AND SULFUR (1976) - PLANTS WITH STARTUP DATES PRIOR TO 1982 - SIPs OR NSPS REQUIREMENTS - PLANTS WITH STARTUP DATES AFTER 1982 - BACT, 85% AND 90% CONTROL OR REMOVAL OF SO₂ CONSIDERED <u>OIL</u> - SIPs REQUIREMENTS <u>GAS AND METALLURGICAL COAL</u> - UNCONTROLLED	EMISSIONS AND LOCAL AIR QUALITY SO₂ PARTICULATES <u>COAL</u> - NEW LARGE SOURCES (250 X 10⁶ BTU/HRI) BACT, 80% REMOVAL - NEW SMALL SOURCES (100-250 X 10⁶ BTU/HRI) 15 LB/10⁶ BTU - NEW NON-MFB PLANTS (100 X 10⁶ BTU/HRI) SIP, WITH PHYSICAL CLEANING - EXISTING LARGE SOURCES (250 X 10⁶ BTU) SIP, FOR MFB - EXISTING SMALL SOURCES (100-250 X 10⁶ BTU/HRI) SIP, FOR MFB - EXISTING NON-MFB PLANTS (100 X 10⁶ BTU/HRI) SIP, USING LOCALLY AVAILABLE COAL <u>OIL AND GAS</u> - SIP, LIMITATIONS ON SULFUR CONTENT OF FUEL, AS A WEIGHT FRACTION - EMISSIONS FACTORS IN USEPA "COMPILED OF AIR POLLUTANT FACTORS"	NO ASSUMPTIONS MADE - AIR POLLUTANTS FROM MINING ACTIVITIES NOT CONSIDERED																					
WATER QUALITY	BPCT, EFFECTIVE JULY 1977 BACTEA, EFFECTIVE JULY 1984 NSPS, EFFECTIVE JULY 1977 UTILITY GENERATING LOAD FACTOR - 55%	BPCT, EFFECTIVE JULY 1977 BACTEA, EFFECTIVE JULY 1984 NSPS, EFFECTIVE JULY 1977	MINE DRAINAGE "COAL SUPPLY REGION" (CSR) DRAINAGE DATABASE - COMPLIANCE WITH EFFLUENT LIMITATIONS ASSUMED COAL WASHING ASSUME 50% OF COAL IS CLEANED, 95% OF THAT BY WET METHODS. ALL FACILITIES HAVE ZERO DISCHARGE IN CSR. 7 - 10, 50% OF FACILITIES HAVE ZERO DISCHARGE IN CSR. 1 - 6, CSR 11 AND CSR 12 40% OF FACILITIES IN THOSE CSR PRODUCE 2,150 LITERS/METRIC TON OF COAL WASHED COAL REFUSE FILL 40% OF ANNUAL PRECIPITATION IN EACH CSR RESULTS IN EFFLUENT RUNOFF. 708 X 10⁶ HECTARES/METRIC TON OF COAL CLEANED ARE EXPOSED TO RAIN FOR ONE YEAR. RECLAMATION SEDIMENTATION CAN ACHIEVE 80% CONTROL EFFICIENCY. OTHER RUNOFF RATES ARE FROM EPA NATIONAL ASSESSMENT OF NON-POINT SOURCE POLLUTION.																					
WATER AVAILABILITY	COOLING OPTION: <table><thead><tr><th></th><th>NUCLEAR (1000 MW)</th><th>FOSSIL (1000 MW)</th></tr><tr><th></th><th>WITH-CONSUMPTION</th><th>WITH-CONSUMPTION</th></tr><tr><th></th><th>DRAWAL (MGD)</th><th>DRAWAL (MGD)</th></tr></thead><tbody><tr><td>ONCE THROUGH</td><td>1400</td><td>830</td></tr><tr><td>POND OR CANAL</td><td>42</td><td>25</td></tr><tr><td>WET COOLING TOWER</td><td>28</td><td>17</td></tr><tr><td>DRY COOLING TOWER</td><td>0.3</td><td>0</td></tr></tbody></table>		NUCLEAR (1000 MW)	FOSSIL (1000 MW)		WITH-CONSUMPTION	WITH-CONSUMPTION		DRAWAL (MGD)	DRAWAL (MGD)	ONCE THROUGH	1400	830	POND OR CANAL	42	25	WET COOLING TOWER	28	17	DRY COOLING TOWER	0.3	0	DATA BASE. WATER CONSUMPTION DATA DEVELOPED FOR THE WATER RESOURCES COUNCIL.	WATER REQUIREMENTS FOR COAL EXTRACTION AND WASHING, DUST CONTROL AND REVEGETATION ARE ASSUMED TO BE NEGLIGIBLE
	NUCLEAR (1000 MW)	FOSSIL (1000 MW)																						
	WITH-CONSUMPTION	WITH-CONSUMPTION																						
	DRAWAL (MGD)	DRAWAL (MGD)																						
ONCE THROUGH	1400	830																						
POND OR CANAL	42	25																						
WET COOLING TOWER	28	17																						
DRY COOLING TOWER	0.3	0																						
SOLID WASTE	- COAL CHARACTERISTICS IN 1985 AND 1990 ARE THE SAME AS IN 1976. DATA FROM FPC TAPES. - USE OF ELECTROSTATIC PRECIPITATORS AND FLUE GAS DESULFURIZATION WITH LIME/LIMESTONE SLURRIES ASSUMED FOR 1985 AND 1990.	NSPS AND SIP REQUIREMENTS USED TO DETERMINE ASH AND FGD SLUDGE PRODUCTION AND LAND REQUIREMENTS.	- CONVERSION FACTORS FOR COAL MINING RANGED FROM 0.0018 ACRES/1000 TONS (COAL MINED) IN DEEP MINING IN EASTERN KENTUCKY TO 0.235 ACRES/1000 TONS IN STRIP MINING IN ARKANSAS - PAST BUREAU OF MINES DATA AND MINRES PROGRAM WERE USED TO DETERMINE MINING RESIDUALS.																					

ABBREVIATIONS:

BACTEA	BEST AVAILABLE CONTROL TECHNOLOGY ECONOMICALLY ACHIEVABLE
BEA	BUREAU OF ECONOMIC ACTIVITY AREA
BPCT	BEST PRACTICABLE CONTROL TECHNOLOGY
BTU	BRITISH THERMAL UNIT
FGD	FLUE GAS DESULFURIZATION
FPC	FEDERAL POWER COMMISSION
MFB	MAJOR FUEL BURNING INSTALLATIONS
MGD	MILLION GALLONS PER DAY
MW	MEGAWATTS
NSPS	NEW SOURCE PERFORMANCE STANDARDS
SIP	STATE IMPLEMENTATION PLANS

TABLE 1.1. Control Technology Assumptions

1.2.2.1 Hydroelectric Generation

A major part of the hydroelectric generation capacity to be added in the Northwest will be provided by adding generators to existing facilities. As thermal base generation capacity is increased, the Region's hydroelectric capacity will be used more and more to meet peak load demand.

1.2.2.2 Hydro Pumped Storage

A large number of candidate pumped storage sites exist in Idaho, Oregon, and Washington. However, the assumption is made that pumped storage will develop slowly in the Northwest because additional peaking power can be produced at less cost and without the energy loss inherent in pumped storage by additions at existing hydroelectric plants.

Pumped storage can be classified as either on-stream or off-stream. In an on-stream project, reversible units are included in a conventional hydroelectric installation and some of the stream flow is pumped back into the project's reservoir to provide greater capacity during peak-load periods. In an off-stream project, water is pumped from a lower reservoir located in a stream to an off-stream reservoir for release during peak-load periods. It is assumed that additions to pumped storage capacity in the Northwest will be met by off-stream facilities.

1.2.2.3 Geothermal

A majority of the geothermal resources in the region are hot water rather than steam, and will require a vapor-turbine cycle facility. This type of facility requires hot water to be pumped to the surface and kept above saturation pressure. The water gives up its heat through a heat exchanger to a volatile liquid, such as isobutane or freon. The secondary loop then drives a turbine which in turn drives electric generators. The working fluid is cooled and recycled. Primary loop well water can be disposed of by reinjection into a nearby well, carrying most dissolved gases and solids with it. Non-condensable gases are vented.

Geothermal plants can be designed to require very little outside water. Thus, water availability is not considered a major constraint in the development of Northwest geothermal resources.

1.2.3 Criteria for Ranking of Impacts

For each region and for each state within the region, a summary matrix has been developed displaying the severity of specific environmental, health and safety, and socioeconomic impacts of energy technologies specified by the scenario. Severity is rated as high, medium or low according to criteria described in Table 1.2.

TABLE 1.2. Definition of Criteria for Rating of Impacts

IMPACT CATEGORY	HIGH IMPACT	MEDIUM IMPACT	LOW IMPACT
AIR QUALITY	MAJOR FACILITIES IN PROPOSED SITING SCENARIO COULD BE CONSTRAINED BY ONE OR ALL OF THE FOLLOWING ISSUES. A) PERSISTENT AND CONTINUED VIOLATIONS OF PRIMARY NATIONAL AMBIENT AIR QUALITY STANDARDS. B) INABILITY TO ATTAIN ACCEPTABLE PSD INCREMENT LIMITATIONS. C) LIMITED PROBABILITY THAT IMPROVED EMISSION CONTROL EFFICIENCIES OR OFFSETS WOULD RESULT IN NAAQS ATTAINMENT.	SOME MAJOR FACILITIES IN PROPOSED SITING SCENARIO COULD BE CONSTRAINED BY HIGH IMPACT ISSUES. VIOLATIONS OCCUR BUT ARE AMENABLE TO EXTENSIVE CONTROL TECHNOLOGY, FUEL (COAL AND OIL) PURCHASING POLICY, AND/OR OFFSET.	AIR QUALITY AND EMISSION LEVEL ARE WITHIN ACCEPTABLE STANDARDS. NO MAJOR ADJUSTMENTS TO SITING OF PLANTS BECAUSE OF AIR QUALITY ISSUES.
VISIBILITY	THERE IS A SIGNIFICANT DECREASE IN CALCULATED VISUAL RANGE IN CLASS I AREAS.	THERE IS A MODERATE DECREASE IN VISUAL RANGE BUT THE REDUCTION IS AMENABLE TO MITIGATION MEASURES.	NO DECREASE IN VISUAL RANGE OR NEW SITING IMPACTS AMENABLE TO MITIGATION MEASURES. NO MAJOR ADJUSTMENT IN SITING.
WATER QUALITY	SIGNIFICANT ECONOMIC BURDEN TO MEET WPCA REQUIREMENTS.	TREATED EFFLUENTS MEET EFFLUENT STANDARDS BUT OCCASIONAL LOCALIZED STREAM STANDARD VIOLATIONS WILL OCCUR IN RECEIVING WATER BODY.	RECEIVING BODY CAPABLE OF HANDLING ALL PROJECTED EFFLUENT ADDITIONS. FEW OR NO VIOLATIONS OF STREAM STANDARDS ANTICIPATED.
WATER AVAILABILITY	NO WATER AVAILABLE WITHOUT MAJOR SHIFTS IN CURRENT WATER USES, E. G., EITHER ENERGY DEVELOPMENT OF AGRICULTURE, EVEN WITH LOW-FLOW AUGMENTATION, OR WATER AVAILABLE THROUGH MAJOR STRUCTURAL AND NON-STRUCTURAL ALTERNATIVES, E. G., STRUCTURAL-CONSTRUCTION OF DAMS AND RESERVOIRS. GROUND WATER MINING WITH NO RECHARGE POTENTIAL.	WATER AVAILABLE AT MODERATE ECONOMIC COST TO THE REGION. GROUND WATER MINING WITH RECHARGE POTENTIAL AVAILABLE OR POSSIBLE.	NO CONFLICTS EXCEPT FOR RECREATIONAL USES. GROUND WATER WITHDRAWAL WHERE ANNUAL RECHARGING OCCURS.
SOLID WASTE	SEVERE POTENTIAL CONTAMINATION PROBLEMS LIKELY TO REQUIRE COMPLETE CONTAINMENT OF WASTES.	MINIMAL ENVIRONMENTAL IMPACTS WITH PROPER CONTROL TECHNOLOGY. INDICATION THAT MANY AREAS MAY EXPERIENCE PROBLEMS AND IN SOME OF THESE AREAS SUITABLE OPTIONS MAY NOT BE AVAILABLE.	MINIMAL ENVIRONMENTAL IMPACTS WITH PROPER CONTROL TECHNOLOGIES. SOME POTENTIAL PROBLEMS BUT GENERALLY AMENABLE TO CURRENT TECHNOLOGY OPTIONS AT ADDITIONAL COST.
ECOLOGY	CRITICAL NATURAL HABITATS WILL BE DISTURBED.	CRITICAL NATURAL HABITAT OR LARGE ACRES OF CROPLAND MAY BE DISTURBED.	LOCALIZED IMPACTS WHICH MAY BE READILY MITIGATED BY STRUCTURAL OR SITING ALTERNATIVES.
LAND USE	CONFLICT WITH HIGH VALUE LAND USE, SUCH AS LOSS OF HABITAT, PARKLAND, SEISMIC RISKS, SCENIC RESOURCES, INDIAN LANDS, AGRICULTURAL LAND.	SIMILAR CONFLICTS, WITH ALTERNATIVE SITES OR MITIGATION MEASURES COSTLY BUT AVAILABLE.	FEW CONFLICTS; OR A RANGE OF ALTERNATIVES AVAILABLE.
PUBLIC HEALTH	SIGNIFICANT INCREASES IN MORBIDITY AND MORTALITY RATE DUE TO EXPOSURE TO ENERGY RELATED POLLUTANTS.	MODERATE INCREASES IN MORBIDITY AND MORTALITY RATE DUE TO EXPOSURE TO ENERGY RELATED POLLUTANTS.	NO SIGNIFICANT IMPACT. ALL IMPACTS SUBJECT TO MITIGATION.
OCCUPATIONAL HEALTH AND SAFETY	SIGNIFICANT INCREASES IN OCCUPATIONALLY RELATED DEATHS, INJURIES, AND DISEASE DUE TO INCREASED ENERGY DEVELOPMENT.	POTENTIAL SIGNIFICANT INCREASES IN RESPIRATORY AND OTHER DISEASES BUT IMPROVEMENTS IN OSHA, NRC AND EPA REGULATIONS AND WORK-PLACE CONDITIONS EXPECTED TO ALLEVIATE MUCH OF THE PROBLEM.	NO SIGNIFICANT INCREASES IN OCCUPATIONALLY RELATED DEATHS, INJURIES, AND DISEASE DUE TO INCREASED ENERGY DEVELOPMENT.
LOCAL SOCIOLOGICAL FACTORS	IMPLEMENTATION DELAYED OR POSSIBLY BLOCKED DUE TO POTENTIALLY SEVERE CHANGES IN A COMMUNITY'S QUALITY OF LIFE; HEAVY DEMANDS PLACED ON PHYSICAL INFRASTRUCTURE INCLUDING SERVICES, FACILITIES, HOUSING; CONFLICT IN VALUES AND LIFESTYLE BETWEEN IMMIGRANTS AND LONG-TIME RESIDENTS; IMMIGRANTS REPRESENT A STATISTICALLY SIGNIFICANT PORTION OF THE BASELINE POPULATION; EXTENDED NEGOTIATIONS LIKELY BETWEEN DEVELOPER AND AFFECTED COMMUNITIES; AFFECTED COMMUNITIES WILL HAVE GREAT DIFFICULTY ABSORBING HIGH SOCIAL AND ECONOMIC COSTS OF PROJECT WITHOUT OUTSIDE ASSISTANCE.	POTENTIAL DELAYS DUE TO COMMUNITY AND LOCAL GOVERNMENT RESISTANCE TO FACILITY; POTENTIAL INCREASED COSTS TO LOCAL GOVERNMENT; SOME COMMUNITY FEARS FOR CHANGES IN THE QUALITY OF LIFE ACCOMPANYING INFLUX OF POPULATION; MITIGATION STRATEGIES AVAILABLE, BUT USUALLY COSTLY; MODERATE CAPACITY OF AFFECTED COMMUNITIES TO ABSORB THESE IMPACTS.	MINOR CHANGES IN LOCAL GOVERNMENT'S INFRASTRUCTURE; FEW IMMIGRANTS OR FEW CULTURAL AND LIFESTYLE CLASHES EXPECTED; MITIGATION COSTS EASILY ABSORBED BY AFFECTED COMMUNITIES.
LOCAL ECONOMICS	IMPLEMENTATION BLOCKED DUE TO UNACCEPTABLE ECONOMIC DEMANDS ON LOCAL INFRASTRUCTURE.	POTENTIAL DELAYS DUE TO LACK OF SKILLED PERSONNEL, FINANCIAL IMPACTS ON LOCAL GOVERNMENT.	INFRASTRUCTURE IMPACTS MINOR. ADAPTABILITY OF COMMUNITY GOVERNMENT HIGH.
REGIONAL ECONOMICS	CAUSES ADVERSE CAPITAL OR EMPLOYMENT IMPACTS ON REGION. DECREASES COMPETITIVE POSITION COMPARED TO OTHER REGIONS.	POTENTIAL EMPLOYMENT, CAPITAL OR COMPETITIVE IMPACTS, BUT MITIGATION STRATEGY POSSIBLE.	NO SIGNIFICANT IMPACTS.
INSTITUTIONAL AND LEGISLATIVE	PROHIBITION OF IMPLEMENTATION BASED ON AVAILABLE STRONG LEGAL CONSTRAINTS. ANTICIPATED LEGISLATIVE PROHIBITION. ABSENCE OF EFFECTIVE ORGANIZATIONAL RESPONSIBILITIES, STATUTES, ETC.	DELAY POSSIBLE DUE TO LEGAL OR POLITICAL CONSTRAINTS. LOW TO MODERATE PUBLIC OR PRIVATE INTEREST IN ENFORCEMENT.	NO SIGNIFICANT OPPOSITION, LEGAL CONSTRAINTS, OR ORGANIZATIONAL PROBLEMS.

2.0 REGIONAL OVERVIEW

Region 10 is a large, non-contiguous area covering more than one-quarter of the total area of the United States and includes the states of Alaska, Idaho, Oregon, and Washington. Alaska is far larger than the other three states combined, comprising about 80% of the Region's 835,000 square miles. Figure 2.1 shows environmentally similar subregions of the states of Federal Region 10.

2.1 PHYSICAL AND SOCIAL CHARACTERISTICS

The climate of Region 10 is primarily influenced by the southerly and easterly drift of storms that develop over the North Pacific Ocean. Considerable moisture is gathered in cloud masses over the North Pacific and Gulf of Alaska. Much of this moisture is deposited west of the Cascade Range in Oregon and Washington, and along the coast of south-central and southeastern Alaska. Airflows over the Region are generally in a west-to-east direction. They are complex and vary seasonally. Combined with local topography, they influence local moisture gradients to cause a diverse range of microclimates, which in turn influence vegetation and wildlife distributions. In general, the climate west of the Cascade Range in Oregon and Washington is characterized by mild, wet winters and moderate summers, while east of the Cascades and in Idaho semi-arid conditions prevail with extreme seasonal and daily temperature variations. Alaska follows the same general pattern of wet moderate climates on the southeastern, south-central and southwestern coasts. The inland subregions are characterized by greater climatic extremes.

Alaska is a vast area possessing tremendous natural and energy resources, much of it largely unexplored. The Arctic region of the state consists mainly of treeless tundra underlain with permafrost and contains three major offshore and three major onshore oil fields. Development of these fields is the primary cause of Alaska's rapid population and economic growth. The state's extensive coastal and inland waters support rich commercial and sport fisheries, particularly in the southwest and south-central regions of the state and along the Aleutian Island chain. The mountainous southeast region consists of extensive

FIGURE 2.1. Region 10: Environmentally similar Subregions, Major Rivers and Population Centers

island systems, bays, and fiords, and is heavily forested. Alaska's population (365,000 in 1975) is concentrated in the central and south-central regions, in and around the commercial and metropolitan centers of Fairbanks, Anchorage, and Valdez, however, much of Alaska's large native population lives by subsistence hunting and fishing in remote villages. A major issue in the state and in the Region is the impact that exploitation of the state's vast natural resources will have on its largely unspoiled natural environment and on the social environment of the people.

The lower 48 states of Idaho, Oregon, and Washington contain over 95% of the population of Region 10 (just under 7 million in 1975), and most of the industry and agriculture. The Coastal and Cascade Mountains of Oregon and Washington are heavily forested and supply a major share of the nation's demand for forest products as well as offer outstanding recreational opportunities. Inland, the Columbia and Snake River Plateaus of Oregon, Washington and southern Idaho contain much rangeland, and support extensive dry land and irrigated agriculture. The northern Rocky Mountains of north and central Idaho also support a strong forest products industry, although inland forests are not as productive as those nearer the Pacific Ocean. The bulk of the population of Region 10 live and work in the population centers of the Puget Sound-Willamette Lowlands (Seattle and Tacoma, Washington and Portland and Eugene, Oregon). Most of Idaho's population, industry, and agriculture is concentrated along the Snake River in the southeast corner of the state and around the state capital of Boise.

Three states in Region 10 grew at an annual rate well above the national average between 1970 and 1976. Alaska grew the fastest at a rate of 3.9%, Idaho followed at 2.5%, and Oregon grew 1.9% annually. Washington grew at the national rate of 0.9% annually. Population density in the Region approaches the national average of 60.7 persons per square mile in Washington where the value is 54.3. Oregon has 24.2 persons per square mile, Idaho 10.1, and Alaska ranks as the least densely populated state in the country with only 0.7 persons per square mile.

The average annual per capita income exceeds the national average in Alaska and Washington: the Alaskan average was \$10,178 in 1976 or 158% of the national average and \$6,772 or 105.1% in Washington. Oregon's per capita income was \$6,331 (98.3% of the average) in 1976 while Idaho residents earned \$5,726 per capita, or 88.9% of the average. The economy of the Region is heavily dependent on natural resource-based industries such as forest products, mining, agriculture, fishing, and fossil fuel extraction (in Alaska). The aluminum, aerospace, tourism, trade, and shipping industries are also important components of the Region's economy.

2.2 ENERGY

The Region is in a critical stage of energy assessment involving interrelated socio-economic and environmental impacts caused by reallocation of hydropower, increasing imports of energy sources, and major new energy developments. The disparity of energy resources among states in the Region further complicates decision-making. Physical distance between Alaska and the lower states in the Northwest has hindered energy transfers. Each area has specific environmental, social, and economic factors that must be considered separately in energy planning. Major shifts in the Region's energy use pattern are expected as the base load generation of electricity changes from hydroelectric to thermal.

Electric power has been an inexpensive source of energy in the states of Idaho, Oregon, and Washington, with hydroelectric generation supplying most electrical needs. However, forecasted load growth and the limited number of potential new hydroelectric sites will result in a heavier reliance upon thermal generation in the future. The transition from hydroelectric to thermal power generation will cause significant changes in the Northwest. The future path of electric power supply will be largely determined by demand, basic energy prices, governmental policy, public acceptance, and the environmental consequences of thermal power generation.

2.2.1 Reserves

Federal Region 10 contains extensive reserves of oil, natural gas, and coal. A comparison of regional and national energy reserves is given in Figure 2.2. The location of the Region's coal, oil, natural gas, and uranium fields are shown in Figure 2.3. Alaska contains all major regional reserves of oil and natural gas and most of the coal. Washington contains some coal and most of the Region's known uranium reserves. Alaska is thought to contain significant uranium resources, but exploration has not been extensive to date. All four states have one important energy resource, hydropower. Alaska has the largest share of untapped hydroelectric potential. Idaho, Oregon, and Washington have developed most of the sites having substantial hydroelectric potential (PNL 1977).

Data Source: PNL 1977

FIGURE 2.2. U.S. and Regional Energy Reserves in Quadrillion Btu

Data Source: PNL 1977

FIGURE 2.3. Regional Coal, Oil, Natural Gas, and Uranium Fields

The Region also contains less-conventional energy sources: geothermal, wind, solar, and biomass. These sources have a large energy potential; however, to date they have not been significantly utilized.

Geothermal energy is available in each of the states. It is being used for heating in Klamath Falls, Oregon and Boise, Idaho. In addition, there is a pilot electric generation project in Idaho. Wind power has a high potential for all of the Northwest. Areas with a lower solar radiation incidence along the coastline have the highest potential for wind power generation. Solar energy potential also is high in the Region. Commercial and residential buildings are beginning to find this source feasible for passive radiation and hot-water heating.

The Region's forest products industry harvests large quantities of timber. Residuals from logging and milling operations along with agricultural biomass have potential for energy production.

2.2.2 Production

Production of adequate energy for the consumer has always been a challenge. The Northwest is rich in certain energy forms and scarce in others. Thus, with growing demand the production of energy has had to be supplemented by new sources or imports to the Region.

2.2.1.1 Natural Gas

Alaska is the only state in the Region to produce natural gas. The primary producing fields are in the Cook Inlet area, although other large gas fields have been found on the North Slope. The Alaska Public Service Corporation and the Kenai Utility Service Corporation provide natural gas pipeline services within the state. Natural gas production reached approximately 165 trillion Btu in 1975, with over half of this total exported to Japan. On the other hand, Idaho, Oregon, and Washington import natural gas. Imports come principally from British Columbia and Alberta, Canada; and the American Rocky Mountain and southwest states. The three-state area is served by pipelines operated by the Northwest Pipeline Corporation. The corporation's main pipeline can carry as much as 1.45 billion cubic feet per day (PNL 1977).

2.2.2.2 Petroleum

The regional trend in petroleum production (all from Alaska) rose to nearly 84 million barrels per year in 1970, then dropped to less than 70 million barrels per year by 1975. With the addition of the Trans-Alaska Oil Pipeline, production in 1978 was about 600 million barrels per year.

Alaska, Oregon, and Washington contain the Region's ten refineries for converting crude oil into finished petroleum products (gasoline, residual and distillate oil, and asphalt). Total current capacity of these facilities is 449,000 barrels per day (PNL 1977).

2.2.2.3 Coal

Of the 4.7 million tons of coal consumed in Idaho, Oregon, and Washington during 1975, 3.7 million tons were mined near Centralia, Washington for use in a coal-fired power plant. Alaskan fields produced the bulk of the remainder for use primarily in electric generating plants.

2.2.2.4 Electric Generation

In 1975 the Region had a generating capacity of more than 25,500 MWe. Hydroelectric facilities accounted for more than 81% (20,800 MWe) of that capacity, with the rest available from coal, wood and nuclear-fueled steam plants, gas turbines, and internal combustion generators.

Washington accounts for more than 66% of the Region's total electric production. Oregon produces nearly 25%, while Idaho produces just over 7% and Alaska produces less than 2%. Most of Alaska's electricity comes from fossil fuel-fired plants, while hydropower is the leading source in the other states.

In addition to the generation facilities, there are a number of high-voltage lines used to move electricity within the Region because generating facilities are usually located far from load centers. The Bonneville Power Administration transmits most of the electricity generated in Oregon and Washington, while investor-owned utilities transmit most of Idaho's electricity (Figure 2.4). The Alaska Power Administration, a Federal agency overseeing transmission and wholesale marketing of power from Alaska's Federal dams, has transmission systems serving Anchorage and Juneau (PNL 1977).

Data Source: PNL 1977

FIGURE 2.4. Major Transmission Lines

2.2.2.5 Geothermal

At present there are 692,656 acres of known geothermal resource sites in the Northwest region, or 11.4% of the total national figure. Idaho, Oregon, and Washington have some of the nation's most promising low temperature (90°C-150°C) geothermal resources (see Figure 2.5). Alaska has both low and high temperature sites; however, development of any of the Alaska sites is not expected until after 1990.

2.2.3 Imports and Exports

With the exception of electricity, Idaho, Oregon, and Washington depend heavily upon imported energy sources. In 1975, for example, net imports accounted for two-thirds of the energy consumed in the Region. Petroleum, natural gas, and coal are imported.

2.2.3.1 Natural Gas

Alaska, again, is the only state in this Region capable of meeting its own natural gas requirements. Alaska exported about 90 million cubic feet (MMCF) of liquefied natural gas from its Kenai gas fields to Japan in 1978. Alaska's natural gas exports are continuing and will be expanded with construction of a natural gas pipeline connecting the Prudhoe Bay gas fields to the "lower 48" states.

Idaho, Oregon, and Washington, however, have no natural gas supplies and must import all they use. One interstate natural gas company, Northwest Pipeline Corporation, supplies all of those states' natural gas from fields in Canada and the American Rocky Mountain and Southwestern states (PNL 1977).

2.2.3.2 Petroleum

Of the four states in this Region, only Alaska produces crude oil; Washington and Oregon refineries must import crude oil supplies, while Idaho must import all finished petroleum products, since it has no refineries.

Washington and Oregon refineries supply many of the Region's finished petroleum products, although a significant portion is imported from foreign sources and by pipeline from refining centers in Montana and Utah.

Data Source: PNL 1977

FIGURE 2.5. Geothermal Resources for Region 10

2.2.3.3 Coal

Alaska and Washington are the coal-producing states in the Region; some of the Region's coal demand in 1975 was met by Utah (641,000 tons), Wyoming (370,000 tons), and the Southwest (5,000 tons).

2.3 INSTITUTIONS

Various levels of government (Federal, state and local) are involved in shaping energy policy. (The county names and state capitals for Region 10 are shown in Figure 2.6). Governmental agencies are involved in mining, transport and ultimate use of energy resources. Their direct participation in resource use decisions may result from: 1) outright ownership of the mineral resources or rights-of-way, 2) economic, environmental, health or safety considerations, or 3) directly related energy projects and programs.

Until recently, states in the Region have not been active in shaping energy policy. In general, planning and implementation of energy facilities and distribution systems was initiated and carried out by the private sector or by Federal agencies. The state's primary role in energy planning was limited to the regulatory power held by the various state public utility commissions. The commissioners represented the states position on utility rates and other aspects of private utility operation; they did not have a significant role in energy planning or implementation.

In recent years the Region has been faced with several energy crises that have moved state governments toward more active roles in energy planning. The oil embargo by the OPEC nations in the fall and winter of 1973 was preceded in late 1972 through the fall of 1973 by below-average waterflow in Northwest rivers and streams which resulted in a shortage of water for hydroelectric power generation.

As a result of these energy crises, the state legislatures created state energy offices to assist the governors on energy matters and on setting up state conservation programs. However, these state energy offices are likely to differ widely in the scope and degree of their planning activities.

FIGURE 2.6. Region 10 Counties and Election Districts by Names

FIGURE 2.6. (contd)

Besides the state energy offices and public utility commissions, state agencies have jurisdiction regarding economic development, program planning, ecology, and other areas that vary in scope, title, and authority from state to state. With this authority the states have substantial capability to influence energy planning. For example, effluent limitations can have an important impact on project locations, design, and cost (PNL 1977). A listing of the state agencies responsible for each state's conservation program, siting of energy facilities, and utility regulation is provided in Table 2.1.

TABLE 2.1. State Agencies Responsible for Energy Conservation, Facility Siting and Utility Regulation Programs^(a)

<u>State</u>	<u>Conservation</u>	<u>Energy Facility Siting</u>	<u>Public Utility Regulation</u>
Alaska	Alaska Divison of Energy and Power Development	Alaska Coastal Zone Man- agement Council Alaska Department of Natural Resources Alaska Power Authority Alaska Department of Fish and Game	Alaska Public Utilities Commission
Idaho	Idaho State Office of Energy	Idaho Public Utilities Commission	Idaho Public Utilities Commission
Oregon	Oregon Department of Energy	Oregon Department of Energy	Oregon Public Utility Commissioner
Washington	Washington State Energy Office	Washington Energy Facil- ity Site Evaluation Council	Washington Utilities and Transportation Commission

^(a) Data Source: Pacific Northwest Laboratory (1978a).

3.0 THE TRENDLONG MID-MID SCENARIO

3.1 THE NATIONAL SCENARIO

The TRENDLONG MID-MID Scenario represents a mid-range (1985 to 1990) projection of energy development based on the assumption of medium supply, medium demand, and constant world oil prices. It projects future energy supply and demand on the basis of the continuation of policies prior to the implementation of the National Energy Act (NEA). These are the basic assumptions of the scenario:

- slight increase of domestic oil production from Alaskan oil field and outer continental shelf development
- continued decline of natural gas production in the lower 48 states
- dramatic increase in coal production, particularly in the western states because of an increasing demand coupled with rising domestic oil and gas prices
- decrease in the growth of electricity sales from the historic 7% to 4.8% per year, representing saturation of air conditioning and major appliances that penetrated the market during the 1960s (the projected growth is consistent with 5% growth from 1970 to 1976 and 4.2% from 1976 to 1977)
- shift in the industrial sector from gas to oil, and, to a lesser extent, to electricity indicated by fuel shares in the industrial sector.

Table 3.1 shows the national TRENDLONG MID-MID Scenario projections for energy supply and consumption for 1985 and 1990. Total energy flow is projected to increase from 72.6 quadrillion Btu (Quads) in 1975 to 96.9 Quads in 1990. The total electricity distribution in 1975 was 2,036 billion kilowatt hours. The scenario projects that it will reach 3,045 billion kilowatt hours in 1985 and 3,692 billion kilowatt hours in 1990. Figures 3.1 to 3.3 show national employment, population, and energy growth patterns, respectively, from 1975 to 1985.

3.2 THE REGIONAL SCENARIO

The national scenario was disaggregated to the county and regional level. Fuel use by industrial and electric utility facilities was allocated

TABLE 3.1. National 1975, 1985 and 1990 Energy Supply/Consumption Balance (Quadrillion Btu Per Year)

<u>Projection Series(a)</u>	<u>1975</u>	<u>1985</u>	<u>1990</u>
<u>DOMESTIC PRODUCTION</u>			
Crude Oil	17.9	19.0	18.0
LNG and Butane	2.6	2.0	1.8
Shale Oil	0.0	.1	.3
Natural Gas	19.0	17.2	16.7
Coal	14.6	23.1	27.5
Nuclear	1.8	6.2	10.3
Hydro and Geothermal	3.2	4.2	5.0
TOTAL DOMESTIC PRODUCTION	59.1	71.8	79.6
<u>IMPORTS</u>			
Crude Oil	8.7	16.5	20.9
Petroleum Products	3.8	6.7	7.8
Natural Gas	1.0	1.9	2.6
TOTAL IMPORTS	13.5	25.1	31.3
TOTAL SUPPLY	72.6	96.9	110.9
<u>DOMESTIC CONSUMPTION</u>			
Oil	32.8	43.9	48.5
Natural Gas	20.0	19.1	19.3
Coal	12.8	21.2	25.4
Nuclear	1.8	6.2	10.3
Hydro and Geothermal	3.2	4.2	5.0
TOTAL DOMESTIC CONSUMPTION	70.6	94.6	108.5
<u>EXPORTS</u>			
Coal	1.8	1.9	2.1
Refinery Loss	.2	.4	.3
TOTAL CONSUMPTION AND EXPORT	72.6	96.9	110.9
<u>DOMESTIC CONSUMPTION BY SECTOR</u>			
Residential	14.7	19.0	21.2
Commercial	11.3	13.5	15.0
Industrial	26.0	40.7	49.0
Transportation	18.6	21.4	23.3
TOTAL DOMESTIC CONSUMPTION	70.6	94.6	108.5

(a) For the EIA TRENDLONG MID-MID Scenario.

AVERAGE ANNUAL PERCENTAGE GROWTH RATES

VERY LOW: < -0.008
 LOW: $-0.008 - 1.22$
 AVG: $1.23 - 3.45$
 HIGH: $3.46 - 4.42$
 VERY HIGH: > 4.42

FIGURE 3.1. Employment Growth 1975 to 1985 from P.I.E.S. MID-MID Scenario

Source: Oak Ridge National Laboratory, RIIA output.

AVERAGE ANNUAL PERCENTAGE GROWTH RATES

VERY LOW: < -0.009
 LOW: $-0.009 - .001$
 AVG: $.002 - 1.97$
 HIGH: $1.98 - 2.80$
 VERY HIGH: > 2.80

FIGURE 3.2. Population Growth 1975 to 1985 from P.I.E.S. MID-MID Scenario

Source: Oak Ridge National Laboratory, RIIA output

AVERAGE ANNUAL PERCENTAGE GROWTH RATES

FIGURE 3.3. Energy Growth 1975 to 1985 from MID-MID Scenario

Source: Oak Ridge National Laboratory, RIIA output

on a county-by-county basis. Other end-use energy consumption was disaggregated to the Bureau of Economic Activity (BEA) regional level. County level power plant siting patterns are based on Federal Energy Regulatory Commission (FERC) files of existing and announced utility plans for new generation facilities. However, the FERC sites do not include siting information for unconventional energy sources. Unconventional energy facilities are sited on the basis of resource availability.

3.2.1 Region 10 Energy Supply and Consumption

According to the scenario, Federal Region 10 crude oil and natural gas production will increase dramatically from 569 trillion Btu in 1975 to 5185 trillion Btu in 1985 and 6429 trillion Btu in 1990. The electric utility generation mix for Idaho, Oregon, and Washington during the 15-year period shifts from a hydroelectric generation base to a mixture of hydroelectric and thermal generation. Generation capacity is added in nuclear, geothermal, and coal technologies. The contribution that each technology currently makes to the Region's generating capacity, and the contribution from each technology called for by the scenario in 1990 is presented in Figure 3.4. As given here, the capacity of a generating facility represents its maximum instantaneous power output.

FIGURE 3.4. Regional Electric Generating Capacity by Technology

The facilities that comprise Region 10's 1990 scenario are identified by technology and by location in Figure 3.5. Hydroelectric generating facilities

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FIGURE 3.5. (contd)

are located throughout Idaho, Oregon, and Washington. Geothermal facilities are sited in the central portion of Oregon and Washington, and in southeastern Idaho. Nuclear facilities are located along the Columbia River and in western Washington.

Region-wide, electric generation by nuclear, geothermal, and coal plants increases from 16 million megawatt hours (MWh) in 1975 to 56.6 million MWh in 1990. Hydroelectric power continues to play a dominant role in the region's electric generation, increasing from 140 million MWh in 1975 to 185 billion MWh in 1990. The scenario specified energy consumption for Federal Region 10 is summarized by end use and fuel source in Table 3.2.

TABLE 3.2. TRENDLONG MID-MID Scenario Energy Consumption,
Federal Region 10 (trillion Btu per year)

<u>Sector/Fuel</u>	<u>1975</u>	<u>1985</u>	<u>1990</u>
Residential	287	426	451
Commercial	292	333	345
Industrial	546	791	878
Transportation	725	832	910
Total	1850	2382	2584
Electricity ^(a)	360	627	750
Oil	1034	1418	1689
Natural Gas	427	253	30
Coal	29	84	115
Total	1850	2382	2584

(a) Does not include utility fuel consumption.

3.2.2 Scenario Critique

The TRENDLONG MID-MID Scenario (the midpoint in a hypothetical set of total energy supply demand levels) is only one of a series of energy scenarios used for policy analysis at the National level. Although production, supply, and demand values specified by the scenario may be appropriate at the national level, the disaggregated Region 10 scenario contains some values which are inconsistent with current Regional plans.

Table 3.3 provides an estimate of the current level of electric generation capacity within Region 10 by technology and by state, and provides scenario-specified capacities for 1985 and 1990. On a regional basis, two major discrepancies appear. First, although Region 10 currently has no plans for developing geothermal power as a significant source of electricity by 1990, the scenario specifies a total of 1000 MWe (Table 3.3). Even on the assumption that suitable geothermal resources were tapped within the year and that appropriate technology was available, institutional factors and construction time will prevent scenario goals from being reached by 1990. In both Oregon and Washington, the procedures for obtaining permits and leases necessary for development of large-scale geothermal generating facilities have yet to be fully developed. Second, the scenario specifies that the natural gas supply to Idaho, Oregon, and Washington from the eastern Rocky Mountain area be reduced by about 93% by 1985, and that the Region's gas supply from Canada be cut off by 1990. Over the 15-year period covered by the scenario, regional natural gas supplies would be reduced by 99%. In contrast to this, the Northwest Energy Policy Project (NEPP 1978) suggests that natural gas consumption will remain relatively constant through 1990 in these three states.

At the state level, the scenario for Alaska is especially inconsistent with current plans. The scenario specifies 557 MWe of electrical generating capacity in the state by 1990. However, this is only 50% of the generating capacity currently in operation (Table 3.3). More specifically, the scenario calls for all current gas-fired and hydroelectric generation capacity to be phased out by 1990. These technologies currently provide 45% and 12%, respectively, of all the electric generating capacity in Alaska.

TABLE 3.3. Current Capacity and TRENDLONG MID-MID Scenario for Electric Power Generation in Region 10 (capacity in megawatts)

State	Year	Gas Peaking	Oil Peaking	Nuclear	Combined Cycle	Coal Steam	Gas Steam	Oil Steam	Hydro	Geothermal	Total
<u>Alaska^(a)</u>											
Current capacity	1978	510	416		0	54	14	0	131		1,125
Scenario	1985	0	392		0	150	0	15	0		557
	1990	0	392		0	150	0	15	0		557
<u>Idaho</u>											
Current capacity	1978	50	5						1,631	0	1,686
Scenario	1985	50	0						2,182	0	2,232
	1990	0	50						2,182	200	2,432
<u>Oregon</u>											
Current capacity	1978		392	1,216	585	0	36	85	7,445	0	9,759
Scenario	1985		718	1,130	100	500	15	175	8,654	0	11,292
	1990		718	2,390	100	500	15	175	8,809	400	13,102
<u>Washington</u>											
Current capacity	1978		130	800	0	1,330		208	13,791	0	16,559
Scenario	1985		263	5,702	510	1,200		0	19,335	0	27,330
	1990		261	6,942	510	1,200		0	19,655	400	29,268
<u>Total Region</u>											
Current capacity	1978	626	730	2,016	585	1,384	50	293	22,990	0	29,129
Scenario	1985	50	1,373	6,832	610	1,850	15	190	30,191	0	41,411
	1990	0	1,421		610	1,859	15	190	30,941	1,000	46,359

(a) Presented here for reference only

The principal inconsistency between the energy system currently planned in Idaho and the scenario is the amount of geothermal generation that will be operational in 1990. If the Raft River geothermal area in southeast Idaho proves to have its currently estimated potential, and if appropriate technology can be developed, the Raft River could contribute up to 50 MWe to the state's electric generating capacity by 1990. The Raft River site, however, is the only geothermal site being developed in Idaho for electric generation. Thus, development of geothermal resources in Idaho will not proceed at the pace called for by the scenario.

Although Oregon and Washington have geothermal resources at a number of sites (Figure 2.5), none have been investigated for their electric generating potential to the same extent as the Raft River fields. An additional constraint in the development of geothermal resources for electric generation, in contrast to Idaho, is the lack of established procedures to obtain leases and permits. Considering that geothermal resources have not been thoroughly investigated, and that site approvals and permits are needed, large scale additions of geothermal capacity will not be available to either state by 1990. This is at variance with the scenario which specifies 400 MWe of geothermal capacity for each state.

Because of the variances described above, the TRENDLONG MID-MID Scenario will not be realized by Region 10.

4.0 REGIONAL ASSESSMENT

4.1 NATIONAL ISSUES WITH REGIONAL IMPACT

A number of issues cannot be limited to state or even regional boundaries. They are effectively the product of national or multi-regional developments. Issues included in this category are long-range transport of pollutants, national socioeconomic impacts, inland and coastal water resources, opposition to nuclear power, and Federal environmental legislation constraints on energy development.

4.1.1 Long Range Transport/Visibility

Region 10 is not downwind of any major industrial areas outside of the Region; therefore, it is not a recipient of pollutants resulting from long range transport. In general, air pollutants in the Region are confined to the western valleys and air basins in which they originate. Therefore, the Region is not presently a significant emitter of pollutants that are transported eastward into other regions.

Region 10 contains a large number of federally mandated Class I areas (see Figure 4.1). The intent in classifying these areas as Class I is to preserve their pristine state. Class I areas include all national parks greater than 6000 acres and all wilderness areas over 5000 acres. Indian lands may also be classified as Class I areas under certain provisions of the Clean Air Act. New industrial sources sited in non-attainment areas must obtain offsetting reductions in emissions from existing sources. Because only low concentrations of air pollutants can be tolerated in Class I areas, long range transport of pollutants from sources outside and inside the Region were evaluated. The long range transport of pollutants can affect industrial siting in those areas where long range transport of pollutants may impact Class I areas.

Another effect of long range transport of air pollutants is the impact on visibility. Although EPA regulations will not be promulgated until August 1979, a safe assumption is that any significant decrease in visibility will not

FIGURE 4.1. Location of Mandatory Class I Areas

be permitted in Class I areas. In Region 10, a visibility decrease of up to 13% is projected for Class I areas in the Cascade Mountains of Washington and Northern Oregon by 1990. Because Region 10 is not a recipient of pollutants, the decrease in visibility results from industrial activities in the Puget Sound-Willamette Lowlands. As increasing sectors of the forest products industry come under compliance with air quality standards, other Class I areas in southern and eastern Oregon and in Idaho will experience increased visibility.

4.1.2 National Socioeconomic Effects

Implementation of the TRENDLONG MID-MID Scenario will require massive amounts of capital and commitment of a large labor force of skilled construction and operating personnel. The massive capital required to implement this scenario will be in direct competition with other national demands for the financial resources of the nation. The same is true for the skilled construction and operating personnel required to implement the national scenario. At the regional level, capital and manpower requirements may be constrained because of other national needs and because of competition from energy development programs in other regions. The discussion which follows identifies the requirements of capital and labor force associated with the implementation of the Region 10 scenario. The discussion is separated into direct and indirect capital and manpower requirements.

4.1.2.1 Direct Capital and Manpower Requirements

The direct regional capital and manpower requirements of the TRENDLONG MID-MID Scenario are shown in Table 4.1. These impacts are based on estimates of capital and manpower requirements for the construction and operation of energy facilities in the states of Alaska, Idaho, Oregon, and Washington. Estimates are presented for 1975 and as annual averages for the time periods 1976-80, 1981-85, and 1986-90.

Annual investment in energy facilities will average about \$2.4 billion over the 1976-80 period or about 26% less than the estimated 1975 level.

TABLE 4.1. Direct Capital and Manpower Requirements of the
the TRENDLONG MID-MID Scenario for Region 10

	<u>Baseline</u>	<u>Annual Averages</u>		
	<u>1975</u>	<u>1976-80</u>	<u>1981-85</u>	<u>1986-90</u>
Capital Costs of Regional Energy Facilities (millions of 1977\$)	3,219	2,369	3,935	2,588
(% Change from Previous Period)		-26.4	66.1	-18.4
Operating Costs of Regional Energy Facilities (millions of 1977\$)	523	589	734	927
(% Change from Previous Period)		12.6	24.6	26.3
Manpower Requirements for Constructing Energy Facilities (Man-Years)	17,407	13,925	21,353	15,763
(% Change from Previous Period)		-20.0	53.3	-26.2
Manpower Requirements for Operating Energy Facilities (Man-Years)	9,394	10,707	13,688	17,789
(% Change from Previous Period)		14.4	27.8	30.0
Total Manpower Requirements for Energy Facilities (Man-Years)	26,801	24,632	35,041	33,552
(% Change from Previous Period)		-8.1	42.3	-4.2

Average annual investment is expected to increase to about \$3.9 billion during the 1981-85 time period which is a 66% increase over the previous period. From 1986-90, average annual investment in energy facilities is expected to decline about 18.4%, to about \$2.6 billion per year. Major changes in the pattern of capital investments include a \$1 billion decline in annual investment for oil facilities from 1975 through the 1976-80 period because of the completion of the Alaskan oil pipeline. The increase in investments occurring

in the period 1981-85 is due largely to the projected construction of facilities to transport natural gas from Alaska. Average annual investment in natural gas facilities is expected to increase from \$0.1 billion during 1976-80 time period to \$1.1 billion during the next five year period followed by a decline to \$0.2 billion during the 1986-90 period. In addition, regional investment in nuclear reactors is expected to increase by an annual average of \$500 million between the 1976-80 and 1981-85 periods.

In contrast to the fluctuations exhibited in the level of capital investments, the operating costs of regional energy facilities are expected to climb at a fairly rapid rate over the time frame of this scenario. The annual operating costs of regional energy facilities are expected to average \$589 million from 1976-80 representing a modest increase of 12.6% over 1975 levels. Subsequently, average annual operating costs are expected to climb dramatically, rising from \$734 million per year during the 1981-85 period to \$927 million per year for the 1986-90 period. These figures represent increases of 25% and 26% respectively in average annual operating costs during these periods.

Total manpower requirements for the construction and operation of energy facilities are expected to exhibit temporal patterns that correspond closely to the levels of investment in and operating costs of regional energy facilities. Total energy related average annual manpower requirements are expected to decline by 8.1% from 1975 levels during the period 1976-80. This is due to the expected large decline in construction employment which outweighs the more moderate increases in operating employment during this period. However, both construction and operating employment increase substantially during 1981-85, causing total annual average energy related employment to increase by about 10,000 man-years. From 1986 to 1990, construction employment again declines, substantially offsetting increases in operating employment. This results in a slight decline in average employment of about 1,500 man-years from the previous period.

Construction related employment changes follow the pattern of investment in energy facilities. Construction of the Alaskan natural gas pipeline will result in a dramatic increase in employment during the 1981-85 period. The level of employment in construction of nuclear reactors is expected to increase

substantially during the 1981-85 period and increase slowly thereafter. Employment in construction of hydroelectric facilities declines through 1990. The construction of gas and nuclear facilities can be expected to cause local shortages in some skills and result in some labor and related population dislocations within the Region.

Operations employment increases follow the peak in construction investment. Natural gas and nuclear industry employment increases during the period 1986-90.

4.1.2.2 Indirect Capital and Manpower Requirements

In general, the indirect capital and manpower requirements of energy facility construction, which are shown in Table 4.2, are small compared to the total employment and income of the Region. Compared to 1972 regional employment and income levels, the 1986-90 period indirect impacts, which are the largest for all the time periods considered, amount to an increase of less than 2%.

While manpower requirements may seem insignificant at the regional level, impacts may be quite large at the local level. For example, the Alaska natural gas pipeline and several nuclear power plants will be sited in rural areas and will require a relatively large labor force.

4.1.3 Inland and Coastal Water Resources

The principal inland water resources of the Region, the Columbia and Snake River systems, have long played an important role. The huge runs of salmon and steelhead served as an important source of food and as transportation routes for the Native Americans and early settlers. Currently, the rivers provide hydroelectricity, fish and wildlife habitat, recreational opportunities, transportation routes, and water for irrigation, industrial and municipal uses. All of the desired uses of water cannot be completely and simultaneously met throughout the river system as conflicts have arisen between power production, irrigation and maintenance of flows necessary to maintain anadromous fish runs and water quality. In addition, because nearly one-fourth of the water of the Columbia River originates in Canada, water resources management is of major importance to the Region's as well as the nation's relationship with its northern neighbor.

TABLE 4.2. Indirect Socioeconomic Impacts of the Trendlong
Mid-Mid Scenario for Region 10

	Regional Total	Indirect Impacts Annual Averages		
	1972	1976-80	1981-85	1986-90
Regional Total Gross Output (millions of 1977\$)	96,023.2	1471.1	1727.9	1867.8
% Increase Over Previous Period	-	-	17.5%	8.1%
% of 1972 Baseline	-	1.5%	1.8%	1.9%
Construction Related Gross Output (millions of 1977\$)	19,576.9			
% of 1972 Construction Related Gross Output		7.5%	8.8%	9.5%
Regional Total Value Added (millions of 1977\$)	50,044.9	681.5	802.2	868.8
% Increase Over Previous Period	-	-	17.7%	8.3%
% of 1972 Related Value Added	-	1.4%	1.6%	1.7%
Construction Related Value Added (millions of 1977\$)	7,754.1			
% of 1972 Construction Related Value Added		8.8%	10.3%	11.2%
Regional Total Employment (thousands of man-years)	2,517.1	32.0	37.8	41.0
% Increase Over Previous Period	-	-	18.1%	8.5%
% of 1972 Baseline Total		1.3%	1.5%	1.6%
Construction Related Employment (thousands of man-years)	353.4			
% of 1972 Construction Related Employment		9.1%	10.7%	11.6%

Alaska, Oregon, and Washington have over 7000 miles of coastline, or about 57% of the U.S. total. The shoreline, tidal marshes, estuaries, and continental shelf are valuable resources. Estuaries and tidal marshes are extremely productive biologically, serving as spawning and nursery grounds for several species of migratory ocean fish and habitat for shellfish as well as wildlife and water birds. These areas also provide food and shelter for migratory waterfowl using the coastal portion of the Pacific flyway. The Region's estuaries and shoreline are important to the Regional economy yet are fragile and have been much abused in the past. Protection of these valuable areas is of growing concern.

One of the main concerns associated with ocean transport of crude oil in the Northwest is the impact that oil spills might have on the aesthetic, recreational, and fishery resources of the Region's extensive shoreline and coastal waters. This is of particular concern in the relatively closed waters of Puget Sound and the adjacent Straits of Georgia in British Columbia. In 1977, the Canadian crude oil pipeline serving the Puget Sound refineries was shut down. This has increased tanker traffic on Puget Sound. Because of the anticipated reduction in imports of Canadian crude to Midwest refineries, several alternatives have been proposed for the transport of crude oil from Alaska to refineries in the Midwest. A pipeline from Puget Sound to service these refineries has been proposed.

Siting of energy facilities and related impacts in the coastal environment are of interest to residents of Alaska, Oregon, and Washington. Oregon and Washington have approved Coastal Zone Management (CZM) programs developed with Federal assistance through Section 306 grants of the Coastal Zone Management Act (CZMA). Alaska expects program approval in July 1979. The CZMA requires that these state programs provide "adequate consideration of national interest" (Sec. 306 (6)(8)) including siting of energy facilities. In return the state may require that Federal action, including siting of energy facilities, in the coastal zone be consistent with the approved state program. One area of concern that surfaced during the CZM program development and approval is the need to provide criteria and standards by which regional and state interests and benefits may be weighted in consideration of national

interests. Examples where this consideration is important are the development of Alaska's Outer Continental Shelf and the proposed transshipment port in the State of Washington. Concerns regarding the risk of oil transport in Puget Sound have resulted in amendments to the Marine Mammal Act and Coast Guard regulations limiting the size of oil tankers allowed into inner Puget Sound to 125,000 deadweight tons (dwt).

4.1.4 Nuclear Power

Opposition to nuclear power plants exists in some areas within the Region. In part, this opposition results from the failure of the Federal Government and the utilities, in the view of the public, to prove the safety of plant operation and to find an acceptable nuclear waste disposal method and a real need for additional power. In addition, the Federal Government has not clearly defined the role that nuclear power will play in national energy supply. If Federal policy relating to the use of nuclear power is not clearly defined and supported by the Federal Government, the role of nuclear power in meeting the Region's future energy requirements may be seriously questioned.

4.1.5 Federal Environmental Legislation

A conflict exists between maintaining and meeting the high environmental standards specified by Federal legislation and implementing Federal policy calling for expanded domestic energy production. A multitude of Federal environmental regulations directly affecting energy development have been promulgated in recent years. These regulations relate to the planning and construction stage and to the daily operation of energy generating facilities. Major pieces of legislation are 1) the National Environmental Policy Act, 2) the 1972 Amendments to the Federal Water Pollution Control Act, 3) the 1977 Amendments to the Clean Air Act, 4) the Safe Drinking Water Act, 5) the Toxic Substances Control Act, 6) the Resource Conservation and Recovery Act, and 7) the Rivers and Harbor Act. These pieces of Federal legislation, either alone or together, place constraints on regional energy development through their influence on the type, size, and location of energy facilities that require large amounts of water or degrade the quality of the environment. In addition, the Federal Government has enacted laws that are specifically directed toward preserving and protecting the natural environment and that

preclude siting of energy facilities in areas designated as wildlife refuges, wilderness areas, and areas that contain certain protected species of vegetation, fish, and wildlife. For example, the Clean Air Act Amendments of 1977 specify that air quality in Class I areas may not be degraded by development of industrial facilities in the immediate region.

4.2 REGION-WIDE ISSUES

Many issues are unique to Region 10 but not limited to a single state. Therefore, issues common to more than one state but not to the entire nation are dealt with in this section. Discussions of regional issues in the areas of air, water, ecology, land use, solid waste, health and safety, socio-economics, and institutions are presented.

4.2.1 Air

4.2.1.1 Description

Under the Clean Air Act Amendments of 1977, each state must designate all regions in the state into one of three classes:

- Class I, which allows little or no industrial growth, as only very limited air quality deterioration may occur
- Class II, which allows moderate, well-controlled industrial growth
- Class III, which allows concentrated industrial growth, as long as air quality is not degraded beyond the secondary national Ambient Air Quality Standards.

Mandatory Class I areas in Region 10 are shown in Figure 4.1. All other areas are classified as Class II. Recently, EPA classified all portions of each state as attainment or nonattainment areas. Attainment means that all national ambient air quality standards, both short- and long-term, are being met. Nonattainment areas have concentrations of one or more criteria pollutants that exceed existing standards. To protect the air quality of areas currently classified as attainment areas, the Clean Air Act Amendments specify that the air quality in these areas cannot exceed specified incremental degradation. These Prevention of Significant Deterioration (PSD) regulations

have been established for SO₂ and TSP (Table 4.3), with regulations covering nitrogen oxides, hydrocarbons, carbon monoxide, and oxidants emissions forthcoming.

TABLE 4.3. Allowable Air Quality Increments Specified in Clean Air Act Amendments of 1977

<u>Pollutant</u>	<u>Averaging Time</u>	<u>Allowable Increments g/m³</u>		
		<u>Class I</u>	<u>Class II</u>	<u>Class III</u>
SO ₂	Annual	2	20	40
	24-hr maximum	8	91	182
	3-hr maximum	25	512	700
TSP	Annual	5	19	37
	24-hr maximum	10	37	75

Siting of industrial and energy facilities could be restricted by the location of Class I areas, nonattainment areas, and PSD regulations for attainment areas. Siting of facilities in Class I or attainment areas require pollutant emissions to meet the PSD regulations for such areas. In nonattainment areas, emission offsets will be required before additional industrial development can occur.

In addition to ambient air quality standards, each state has developed a set of health standards under their state implementation plans (SIPs). The primary health standards for air quality are set at levels comparable to the national ambient air quality standards. As air concentrations of pollutants increase above the primary levels, the alert levels are reached. Pollutant concentrations at or above these alert levels present a significantly higher health hazard.

Air quality violations occur in every state in Region 10. Standards for four of the major pollutants (carbon monoxide, oxidants, particulates, and sulfur dioxide) were exceeded in Washington for a three-year period ending in 1976. Idaho and Oregon exceeded standards for three of the major pollutants

(carbon monoxide, particulates, and sulfur dioxide in Idaho; and carbon monoxide, oxidants, and particulates in Oregon). Alaska exceeded standards for two pollutants (carbon monoxide and particulates) (EPA 1978a,b,c,d).

Region 10 has relatively few heavily populated urban centers. Only 6.5 million residents live in the four states. Where there are major urban centers, air pollution problems exist. Violations in fourteen Region 10 communities accounted for 79% of all violation-days and 74% of all alert level violation-days in the region.

Much of the air pollution in Region 10 can be attributed directly to automobile exhaust. Carbon monoxide and/or photochemical oxidants in urban areas caused 80% of the violations in Oregon, 65% in Washington, 23% in Idaho, and 50% in Alaska. In turn, 80 to 90% of these pollutants can be traced directly to automobile exhausts. Because over half of the Region's population lives in or near cities, automobile exhaust must be viewed as a significant problem in the Region. The Environmental Protection Agency (EPA) is working closely with the States of Alaska, Idaho, Oregon, and Washington to reduce both emissions from vehicles and the number of vehicle miles traveled in urban centers having high carbon monoxide pollution levels (EPA 1978a,b,c,d).

The suspended particulate problem is widespread and results from both industrial and non-industrial sources. Controls for suspended particulates have been installed on many industrial plants, and other plants are scheduled to reduce emissions in the near future. The principle non-industrial source of particulates is fugitive dust. Sources of fugitive dust include grass field burning in western Oregon and eastern Washington, wind-blown dust and dust from dirt roads. Fugitive dust is a common problem in the sparsely vegetated and dryland farming areas of the Columbia and Snake River Plateaus. Alaska also has fugitive dust problems resulting from wind erosion of mud flats exposed during low tides. Fugitive dust accounts for a significant portion of the TSP standard violations in certain areas of the region.

In communities such as Tacoma, Washington and Kellogg, Idaho, air pollution is largely attributable to the metals industry. Heavy metals, sulfur

dioxide, and particulate emissions from smelters and other industries have long caused problems in these areas. Control systems are currently being installed as required by law (EPA 1978a,b,c,d).

4.2.1.2 Background Issues

- There are several coal-fired generating plants in the Region. There is a 1330 MWe plant in western Washington, and two small plants in central Alaska. In contrast to other regions, coal-fired generation in the Northwest is very small. Therefore, effluents to the atmosphere from coal-fired generation are of little consequence on a Region-wide basis.

4.2.1.3 Scenario - Induced Changes

- Most of the electric generation capacity called for by the 1990 scenario will be met by hydroelectric and nuclear generating facilities, which are not major sources of air pollutants. Federal policy calls for increased reliance on coal. The impact of a national coal conversion policy which encourages industry and utilities to use coal as a major fuel could significantly impact air quality in the Northwest. Idaho, Oregon, and Washington contain 5.7 million acres of mandatory Class I areas in 24 national parks and wilderness areas (see Figure 4.1). Utility and industry may be restricted in the vicinity of these Class I areas, particularly when coal is used as the primary fuel.
- The proximity of the Healy plant to Mt. McKinley National Park may preclude expansion of that coal-fired power plant as specified by the scenario. Siting of additional energy and industrial facilities in Alaska is uncertain because the status of Alaska lands is as yet unsettled. Large areas may ultimately be classified as national parks and wilderness areas and, thus, become mandatory Class I areas.
- Transmission corridors through forested and wooded areas results in an accumulation of slash that must be disposed of. The typical means of disposal is by open burning, which results in the emission of combustion by-products into the air. These emissions disperse quite rapidly to ambient levels and are limited to the duration of the particular right-of-way clearing program. All burning is undertaken in accordance with local, state, and Federal air pollution regulations. Because burning usually takes place in relatively remote areas, air quality impacts are localized and temporary.

4.2.2 Water

4.2.2.1 Description

Under the Federal Water Pollution Control Act, the states established water quality standards to protect the public water supply and the quality of water for wildlife, recreation, navigation, agriculture, industry, and the propagation of fish and shellfish. The water quality standards in the states of Region 10 include parameters such as temperature, dissolved oxygen, bacteria, and turbidity in river water.

In order to provide a means of reliably measuring and comparing water quality in the Northwest, a standardized set of parameters and associated criteria has been selected. These criteria, termed "Federal water quality goals" in the following discussion, are a synthesis of the state standards, national criteria, information in the technical literature, and professional judgment (EPA 1978a,b,c,d).

Generally, the water quality in the Region meets Federal water quality goals. Over 85% of the water quality monitoring stations in Idaho, Oregon, and Washington report water quality above the Federal water quality goals. Of the 33 principal river basins in Region 10, portions of only nine of these rivers do not meet Federal water quality goals. Of the nine rivers which do not meet Federal water quality goals, only the Spokane and Willamette Basins are not in attainment because of industrial activities (refer to Figure 2.1 for the location of the Region's major river systems). In the Spokane Basin, water quality is affected by intense mining and smelting in the Kellogg, Idaho area and municipal discharge by the city of Spokane, Washington (EPA 1978b,c,d). Water quality in the Willamette River Basin is affected by municipal and industrial discharges in the Tualatin River, a tributary to the lower Willamette River. Major coastal and Puget Sound Rivers as well as the Upper Columbia, Clark Fork/Pend Oreille, and Kootenai river basins generally have relatively good water quality (EPA 1978).

The vast majority of fresh water in Alaska is considered to be of good quality, although some streams in Alaska have localized water quality deterioration near major population centers and in the more remote areas where placer mining activities are occurring (EPA 1978a). Water quality data for most areas is non-existent.

The U.S. Water Resource Council has divided the nation's drainage areas into aggregated subareas (ASA), which are a basic unit for which water policy and management decisions are made. Federal Region 10 contains all or portions of ten ASAs. These ASAs are presented in Figure 4.2.

4.2.2.2 Background Issues

- Hydroelectric development in Region 10 has changed water conditions in rivers that were once free-flowing, often with adverse effects on river biota. Although minimum flows are typically established by government agencies, downstream water temperatures may show wide fluctuations when deep, cool waters are withdrawn from reservoirs for power generation, and when low river flows during off-peak demand periods allow for increased solar warming. Low dissolved oxygen concentrations result from withdrawal of oxygen-depleted, deep waters of eutrophic reservoirs. Gas supersaturation occurs when large volumes of water are released over spillways and plunge into deep pools downstream of the dam, resulting in higher concentrations of dissolved gases, particularly nitrogen. Fish swimming in deep waters supersaturated with nitrogen are killed by gas bubbles that form in their tissues as they later approach the surface.
- Because the Columbia River system encompasses most of Idaho, Oregon, and Washington, interstate water relationships among the three states focus on the management of that system. With expanding populations and economies placing greater demands on the water resources of the Columbia and Snake River systems, interstate management problems are increasing in significance and becoming more difficult to resolve.

4.2.2.3 Scenario - Induced Changes

- Increases in hydroelectric generation through the use of additional turbines may actually enhance water quality, especially in the case of nitrogen supersaturation. Added generating units will increase the capacity of a facility to pass water through the turbines rather than over spillways.

FIGURE 4.2. Water Management Aggregated Subareas (ASA) for Region 10
Source: PNL-RAP-28

- Increases in hydroelectric generation may exacerbate water quality problems of temperature fluctuations and dissolved oxygen concentrations.
- Less than 2000 MWe of the Region's 45,000 MWe of generating capacity in 1990 is to be met by coal-fired generation. Some of the coal-fired generation specified by the scenario will use coal surface-mined within the Region. The principal pollutants associated with surface mining are suspended and dissolved solids produced by runoff from piles of overburden. In addition, leaching from coal storage sites at the generating plant produces acid runoff.
- The construction of new transmission facilities, and the operation and maintenance of the existing transmission system will result in minor water quality impacts within the region. The presence of cleared rights-of-way affects the amount, quality, and timing of water entering local streams.

4.2.3 Ecology

4.2.3.1 Description

Region 10 encompasses an enormous variety of climate and habitat types, from arctic tundra to sagebrush and grassland. The diversity in biota found in the Region reflects this variation. However, many introduced plant species now exist interspersed with native vegetation. As a result of these introductions, a highly diverse mosaic of plant communities exists.

Historic and current land use practices of forestry, farming, grazing, fire control, and settlement have modified original ecosystems extensively in many areas. Original distributions of the Region's climax vegetation still conform to original patterns, but is now fragmented into isolated pockets associated with man's land use. The primary areas where original vegetation still remains undisturbed in Idaho, Oregon and Washington are national, state and county parks, urban parks, roadless areas of National Forests, wilderness areas, experimental forest preserves, and wildlife refuges.

Fish and wildlife populations in Alaska are largely at population levels determined by the natural environment. For Idaho, Oregon and Washington, populations are strongly influenced by the activities of man. Examples of such habitat alterations in the Region are the clearcutting of large blocks of timber in coniferous forest ecosystems, and development of agricultural

lands. Populations usually decline as the habitat is destroyed, but the habitat may be altered in such a way as to favor some wildlife species. For example, the creation of open areas containing more browse species through timber harvest may increase deer populations.

Salmon are anadromous fish, spending their adult lives in the ocean and returning to freshwater streams to spawn. The fish are very selective about the locations at which they spawn, returning only to the area where they were hatched. If the waterway to the spawning grounds is blocked, propagation from that area is lost. Historically, dam construction has resulted in diminished anadromous fish populations and, in some cases, has blocked passage of anadromous fish to historical spawning grounds (Figure 4.3). Channeling, dredging, logging, and mining in the Northwest have also destroyed some natural spawning and rearing areas by changing streambed characteristics and altering flows (DOE-RAP-28 1978).

The Region's terrestrial ecosystems are joined with the marine ecosystem at the land-water interface along the coast and in Puget Sound. This interface includes thousands of miles of coastline, bays, mudflats, sand dunes, and estuaries which support a diverse biota including several commercially valuable species. Estuarine ecosystems are extremely productive biologically but are fragile and highly susceptible to pollution. In the past, estuaries have been used as garbage dumps and have been dredged or filled, all to the detriment of the natural ecosystem.

Many areas in Region 10 are covered by SO₂-sensitive crops that could be damaged by high sulfur emissions from coal-fired facilities. The SO₂-sensitive crops include berries, hay, Irish and sweet potatoes, non-citrus fruit orchards, grains such as barley, wheat and oats, soybeans, and vegetables.

4.2.3.2 Background Issues

- Over the last several decades self-maintaining runs of anadromous fish, particularly on the Columbia and Snake Rivers, have declined drastically largely because of the extensive development of hydroelectric dams on the Columbia and Snake Rivers. Although steps are now being taken to reduce

FIGURE 4.3. Anadromous Fish Spawning Grounds Cutoff by Dams
Source: Chaney, 1978

fish loss resulting from dam operation it remains uncertain as to whether self maintained populations can be sustained. Further hydroelectric development will probably exacerbate the problem.

- The release of water over dam spillways increases the total dissolved gas content of the water downstream, which can have an adverse effect upon aquatic life. The installation of spillway deflectors at the dams permits some water to be spilled without serious fish mortality from nitrogen supersaturation.
- Although turbines at some Northwest dams are screened to prevent the entrance of fish, small organisms such as juvenile fish may pass through. These organisms can be killed by impact against the turbines. Both the magnitude and timing of water releases have been coordinated with fisheries agencies to reduce injury to the fish.
- Construction and operation of hydroelectric dams and its associated reservoir has destroyed original riparian (shoreline) habitat. This habitat serves as an important feeding and nesting area for many wildlife species. Recently, efforts have been made to enhance habitat around some reservoirs.

4.2.3.3 Scenario - Induced Changes

- Additional energy facilities specified by the 1990 scenario will have only minimal impact on the Region's terrestrial ecology.
- Hydropeaking can cause a number of impacts on riparian wildlife. These impacts result from, or are associated with, increased periodicity and amplitude of water level fluctuations. Adverse impacts on waterfowl can occur, but the severity has not been determined. For example, land bridges formed to river islands during low water periods may result in increased predation on waterfowl nests.
- New hydroelectric generators will further threaten the already declining salmon populations in the Columbia and Snake Rivers. The forecasted hydroelectric expansion could further threaten fish populations in the following ways:
  - a) Direct kills by fish passing through turbines,
  - b) Destruction of spawning areas by increased variability in river flows associated with peak power generation,
  - c) Increased fish deaths during downstream migration because of increased transit time required to negotiate still-water reservoir pools. (There is a "time window" within which fish must reach salt water to permit successful physiological adaptation.)
- The construction of a coal-fired plant in the region will result in increased SO₂ and other pollutant concentrations. Current estimates indicate that pollution levels associated with the scenario are unlikely to be high enough to cause significant vegetation damage in the Region. However, extensive acreages of SO₂-sensitive vegetation, especially crops, do occur in the proximity of the projected coal-fired power plants.
- The scenario projects new geothermal development in Idaho, Oregon and Washington. These developments are likely to occur in relatively remote, undeveloped areas. Because of the small land areas involved and because geothermal facilities have not been sited, no specific ecological impacts can be identified.
- Transmission corridors and pipelines generally result in alteration of habitat in the right of way. Because the probable route for transmission corridors and pipelines have not been identified in the scenario, specific ecological impacts have not been identified.

4.2.4 Land Use

4.2.4.1 Description

Land productivity, climate, topography, and the resulting vegetative cover determine the use of much of the Region's land. In Idaho, Oregon, and Washington, coniferous forests are predominant in mountainous areas and sagebrush and grass are the natural cover of much of the semi-arid plateaus. Cropland is a major use of valley bottom lands; plateaus are used extensively for dry cropland, irrigated cropland, and rangeland. In Alaska, much of the land is covered by forests and tundra.

A major economic activity of the region is the forest products industry. Principal commercial species are Douglas fir and western hemlock. Commercial forests, which supply the raw material for the Region's forest products industry, produce about one-half of the national timber volume. Also, the Region is the leading plywood supplier, accounting for more than 50% of the national production. Woodpulp production amounts to about 20% of the nation's total. In addition, forest lands are important as fish and wildlife habitat and for outdoor recreation activities. Forested lands also contribute to the regional quality of life because of their outstanding natural and scenic areas, lakes, and waterways.

Agriculture ranks second to forest products in regional economic importance. If food processing, which is directly related to the Region's farm output is included, the agribusiness sector exceeds the forestry sector in cash receipts. Most of the cropland in the Region is located in Idaho, Oregon, and Washington. Farming west of the Cascades is concentrated in fertile river valleys. About one-fourth of the regional farm products come from this area. A variety of crops are produced in Oregon's Willamette and Hood River Valleys, and in fertile river valleys draining into Puget Sound in Washington. Major crops from the valleys are dairy products, berries, grass seed, vegetables, pears, cherries, apples and nuts.

East of the Cascades, the land which produces the remaining 75% of the regional farm output is far different in character. The low rainfall areas of

eastern Washington and north central Idaho produce large amounts of wheat. The area is also the Region's major producer of barley, dry peas, and lentils. Other crops include apples, potatoes, sugar beets, and hops.

The Region has an estimated 58.7 million acres of nonforested rangeland. These lands are concentrated in the more arid parts of southern Idaho and southeastern Oregon, with lesser amounts in central Washington and northeastern Oregon. The majority of this land is covered with sagebrush and other arid-climate vegetation.

4.2.4.2 Background Issues

- Forested areas in Idaho, Oregon, and Washington, and southeastern Alaska, are intensively managed for the purpose of timber production. Because some of these lands are highly valued for other uses, such as recreation and wilderness experiences, conflicts arise between potential users.
- The uncertain status of Alaskan lands has impeded development of comprehensive land use plans.

4.2.4.3 Scenario - Induced Changes

- The areas in arid parts of the Region particularly desirable for energy development are near water courses. Use of the land for energy facilities will compete with agricultural, urban, and industrial use of the land.
- The scenario includes the construction of several coal and nuclear power plants, all of which have been sited or are under construction. These sites include:
  - A 1,089 acre site for nuclear plants in south central Washington
  - A 2,170 acre site for nuclear plants in south western Washington
  - A 9,189 acre site for a nuclear plant in north central Oregon
  - A 2,170 acre site for a coal-fired plant in north central Oregon
  - There are also five geothermal facilities specified for development by the scenario in the Region. Land requirements for the facilities are presently unknown.
- Additional impacts on land use from hydroelectric expansion would be small because the additional units would be added to existing sites and land that is already committed to hydroelectric development. However, increased use of a given hydroelectric facility for peaking purposes

would alter future land use along the shoreline upstream and downstream of the dam, as well as instream uses, because of sudden fluctuations in the river level. These would also result in increased bank erosion. These changes in the land could result in a conflict with other land uses such as recreation and location of intake structures.

- Construction of new transmission or pipeline corridors, and related facilities have a direct impact upon the current use of the land. The nature and scope of the impact vary with the land uses involved. Since the routes and capacities of energy transmission systems are not included in scenario information, the extent of the impacts on land use cannot be specified.

4.2.5 Solid Waste

4.2.5.1 Description

The major solid waste problem confronting Region 10 associated with energy production is the handling and storage of nuclear waste (Sections 5.4.5.1-5.4.5.2). Since most of the energy generated in the region is hydroelectric, other sources of energy-related solid waste are minimal.

4.2.5.2 Background Issues

- The largest radioactive waste disposal site in the Region is located on the Hanford Reservation in central Washington, where radioactive waste from defense programs is stored. The existing high-level storage tanks and low-level waste burial grounds that are on the Reservation will preclude use of that land until either the wastes have decayed to what are considered "safe" levels or until the wastes are removed from the Reservation and the storage sites decommissioned. In addition, some sections of the Columbia Plateau (on which the reservation is located) are under consideration for permanent isolation of both commercial and defense wastes. The presence of a repository will preclude use of land in close proximity during the period of operation and for at least the short-term following closure.

4.2.5.3 Scenario - Induced Changes

- Waste generated from the nuclear-powered electrical generating plants called for in the scenario will be stored at the plant site pending a decision on the final disposal of such waste. Thus, in the short term, no facilities other than those currently planned at the nuclear plant sites will need to be constructed.

- The use of coal as a fuel for electric generation will necessitate the disposal of approximately 46,580 tons of ash per month. Potential adverse impacts from ash disposal - such as leaching of toxic materials, contamination of groundwater, or blowing dust - can be minimized by careful selection of the disposal site and proper treatment of the ash.

4.2.6 Health and Safety

4.2.6.1 Description

Increasing energy demands generally lead to occupational and public health impacts from fuel extraction and subsequent use. Accidental injury always accompanies major development, such as coal mining, pipeline construction, and OCS activities.

Determining the impact of airborne pollutants on the health of the general population is not simple. For some pollutants, qualitative statements concerning the possible physiological effects can be based on animal experimentation or human epidemiological studies. Quantitative measurement of the magnitude of effects or dose-response relationships are more difficult and are subject to considerable uncertainty. Airborne pollutants generally exhibit three types of health impacts: irritation, direct toxicity, and carcinogenesis (DOE-RAP-21 1978). The level of health impacts depend on the type of health impact, its severity, and the susceptibility of the exposed individual.

4.2.6.2 Background Issues

- Because hydroelectric generation facilities release virtually no pollutants, public health and safety impacts of energy production are currently quite low. Estimates of health risk associated with fossil fuel combustion by utilities and industries indicate that Region 10 has the lowest health and safety risk in the country in this category.
- Risk is low from effluents released by the Region's two operating nuclear plants and related nuclear fuel and waste handling. Estimates indicate that doses of radiation to individuals in the vicinity of these sites amounts to less than the normal 10 to 15% annual fluctuations in natural background radiation levels.

4.2.6.3 Scenario - Induced Changes

- Based on lead lab projections, total deaths from the effects of air pollution because of fossil fuel combustion are expected to increase between 1975 and 1990, but will still be lower than any other Region in the country.

- Coal mining in Region 10 is expected to be almost entirely surface mining. Occupational deaths and injuries associated with surface mining of coal are expected to increase only slightly by 1990.
- Radiation-induced cancer deaths associated with uranium mining and milling, nuclear fuel fabrication and waste management are expected to increase by no more than one death per year by 1990.
- Loss of life has resulted when people have touched powerlines with irrigation pipes. Expansion of the Region 10 transmission system should not exacerbate this problem.

4.2.7 Socioeconomic

4.2.7.1 Description

Energy development in the Northwest produces socioeconomic effects at the national, regional, state, and local levels which need to be anticipated by both government officials and citizens. Identification of effects, however, can be difficult when social and economic change is being induced by other forces in addition to energy development. Typically, socioeconomic impacts are most intensely exerted at the local level where people are least prepared to absorb and manage rapid social change.

At the local level (county and below), socioeconomic issues arise from the interaction between construction and operation of energy facilities and the capacity of the local area to absorb the construction work force. At the state and regional level these impacts are more diffuse. States and Regions are faced with problems of the equitable distribution of the social and economic costs and benefits of energy development.

A unique aspect of Region 10 is the distinctive character of Alaska compared with the other three states. The values of Alaska's Native groups are quite different from those of other segments of the region's population. These values include preservation of traditional cultural systems and lands, and are often in conflict with the values of other segments of society.

In the Northwest, new energy development and proposed facility expansions are planned for areas with low population density. These are areas where local economies and services will be especially sensitive to the social

changes caused by the development of energy facilities. Since socioeconomic effects are generated as the combined function of facility characteristics (size, time schedule, skill requirements) and the nature of the host community (size, complexity, access to resources, experience with change), local effects are unique to each area.

Local communities in many portions of Idaho, Oregon, and Washington have hosted major hydroelectric and nuclear developments in the past. Populations in the localities near those facilities are generally favorably disposed to additional expansions. However, region-wide there is a strong sentiment in favor of the conservation of energy and renewable resources.

4.2.7.2 Background Issues

- The construction of new generating facilities or the expansion of existing facilities typically results in the rapid influx of migrants into and around construction sites which are located in rural areas. The newcomers place a strain on the communities' existing capacity to supply adequate services. With an increase in the size of the local population, the complexity of social and political organization is likely to increase. Land values usually rise drastically. Small rural communities are typically unable to increase revenues soon enough to meet the new demands placed upon them.
- Often the new population moving into a community adheres to values and a world view that differ from those of the local people. Strong resistance can arise in the face of development when these changes are not addressed. In Alaska and other Northwest areas there may be a substantial social and economic disparity between the newcomers and the oldtimers. This can be especially serious if the influx of new people is large and the supporting community is small. There may be animosity generated between community groups who want to incorporate lifestyle changes introduced by the newcomers and those who wish to maintain traditional community lifestyles.
- State and regional planners cannot simply assume that the public will accept energy facility expansions without seriously questioning their costs and benefits for everyone in the Region.

4.2.7.3 Scenario - Induced Changes

- New nuclear plants are planned for Washington and Oregon. Although this implies increased employment within the region and expanded energy

resources, the potential negative impacts have resulted in widespread public debate and this has caused project delays and escalating construction costs. The people who bear most of the social costs of these developments often receive a much smaller portion of the development's economic benefits.

- Because the construction and operation of new energy facilities requires a large work force, and because these facilities are usually sited away from densely populated urban areas, large numbers of workers and their families will migrate to and reside near the site. The influx of construction workers increases secondary employment in the local area. The net result is that sometimes four or more people come into the area with each migrant construction worker. Future energy expansion in areas where plants are already under construction if phased correctly, could limit the impacts associated with them..
- Hydroelectric developments are widespread throughout the region. The location of dams is dependent on the unique geographical characteristics of the region. However, dams tend to be in predominantly rural areas that are least able to absorb the increased populations and changes associated with these developments.
- Proposed geothermal development may cause some socioeconomic impacts because they are located in very rural, isolated areas. These isolated areas may require the developer to establish and support temporary construction work camps, removed from existing communities.

4.2.8 Institutional

4.2.8.1 Description

Power generation in the states of Idaho, Oregon, and Washington is a regional undertaking. The Columbia River Basin drains major portions of all three states. The Federal Columbia River Power System (the dams and generating facilities of the Army Corps of Engineers and the Bureau of Reclamation, and the transmission facilities and marketing authority of the Bonneville Power Administration) accounts for nearly half of the power produced and transmitted in the three-state area (Comptroller General 1978).

The unique institutional arrangements for power generation in the Northwest date from the construction of the Grand Coulee and Bonneville Dams by the Bureau of Reclamation and the Army Corps of Engineers in the 1930s. At that time, the Bonneville Project Act created the Bonneville Power Administration (BPA) to market the Federally-generated power at wholesale and provide the

necessary transmission services (16 U.S.C. 832-832d). To encourage the formation of publicly-owned utilities, the Act gave public agencies first claim to BPA's hydropower in the form of the "preference clause." As a consequence, publicly owned utilities have prospered, especially in Washington.(*). Indeed, many have relied exclusively on BPA for power, as have direct industrial users (chiefly aluminum plants that were built before and during World War II). In addition, investor-owned and publicly owned utilities have supplemented self-generated power with that purchased from BPA. BPA's role broadened further when it was authorized by Congress to transmit non-Federally generated, as well as Federally generated power. This action made possible a truly regional system in which a given facility might buy Federal and non-Federal power, and sell self-generated power, Federal power, and power supplied by other utilities, all through Bonneville's high-voltage transmission lines (Comptroller General 1978).

Despite this high level of integration, the system is fragmented in important ways. Each state has autonomous institutions for siting and regulating power generation and transmission within the state's borders. In Washington, the Energy Facility Site Evaluation Council must approve all non-Federal thermal power plants and power transmission facilities (RCW Ch. 80.50); the Washington Utilities and Transportation Commission regulates the rates of investor-owned utilities (RCW Chs. 80.01 to 80.04). In Idaho, the Public Utilities Commission issues certificates of convenience and necessity for the generating and transmission facilities of investor-owned utilities and regulates their rates (IC 61-101 to 61-714). In Oregon, the Energy Facilities Siting Council must approve all non-Federal power plants and power transmission facilities (ORS 469.300 to 469.580); the Public Utility Commission

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(*) The varying success of publicly-owned facilities in Idaho, Oregon, and Washington probably stems from differing state laws. Idaho law does not authorize the formation of PUDs at all; publicly-owned utilities are confined to municipalities and rural electric cooperatives (Comptroller General 1978). Oregon law requires one election to establish a PUD and a second election to fund it (ORS Ch. 261). In Washington, voters can establish and fund a public utility district (PUD) in a single election (RCW Tit. 54).

regulates the rates of investor-owned utilities (ORS 756.040). Each state contains a different mix of public versus private utility ownership, and residential/rural versus commercial/industrial end-use. The large number of regional power organizations and agreements, with their overlapping memberships and missions, complicates regional decisionmaking.

Regional power organizations and agreements include: Northwest Power Pool, Pacific Northwest Coordination Agreement, Western Systems Coordinating Council, Mid-Columbia Hourly Coordination Agreements (investor-owned and publicly owned utilities, and Federal agencies); Pacific Northwest Utilities Conference Committee (investor-owned and publicly owned utilities); Columbia River Water Management Group (Federal agencies); and Intercompany Pool (investor-owned utilities).

4.2.8.2 Background Issues

Until recently, the advantages of physical integration, coupled with the availability of inexpensive hydropower from the Federal system, have overshadowed the potential difficulties posed by institutional fragmentation. To date there has been enough inexpensive Federally-supplied hydropower to satisfy the needs of investor-owned and publicly owned utilities, and direct industrial users alike (at extraordinarily reasonable rates compared to those paid by customers in other parts of the United States). However, by the 1960s, few environmentally and economically acceptable dam sites with large power potential remained. In 1973, BPA stopped selling investor-owned utilities firm (guaranteed) wholesale power (Institute of Environmental Studies, n.d.). In 1976, Bonneville put the region's publicly owned utilities on notice that after 1983 they would no longer be able to satisfy projected needs from available BPA power (Institute of Environmental Studies, n.d.). At the same time, BPA announced that the direct service industries' contracts for power would not be renewed when they expired in the 1980s (Institute of Environmental Studies, n.d.).

Bonneville's wholesale customers have responded in differing ways to the prospect of insufficient supplies. Both investor-owned and publicly owned utilities have begun to build their own generation facilities, largely thermal.

For the investor-owned utilities, this step has meant obtaining capital from the private market and passing the costs along to retail customers. The publicly owned utilities have adopted a more complicated course. Either separately or jointly, through the mechanisms of the Washington Public Power Supply System (WPPSS, comprised of publicly owned utilities in Washington), they are building thermal power plants and have arranged to sell the output to BPA. This power will then be blended with federally generated hydropower and the combination sold to Bonneville's customers at rates that average the two power sources. This procedure is known as net billing. The direct service industries have responded primarily by engaging in public relations and lobbying efforts aimed at changing Federal law to secure their continued access to low-cost Federal hydropower. All three sets of Bonneville's customers face the same problem, the inability of Federal hydropower to meet regional power demands. As a consequence, institutional issues have arisen. Three are of central importance: 1) allocation of existing, cheap hydropower; 2) selection of alternative sources to serve future needs, and 3) financing new power generation facilities.

The first issue concerns allocation of the finite supply of Federal hydropower; that is, who is to receive the power and at what rates. Under current arrangements, all generation could easily go to publicly owned utilities, which are preference customers under the Bonneville Project Act. Although obviously satisfactory to the publicly owned utilities, this result is plainly unacceptable to the investor-owned utilities and the direct service industries.

The second issue is how to make up the shortfall between existing hydro and thermal power generating capacity, and projected demands for the 1990s. The basic options are conservation; reliance on "soft path" technologies such as solar, biomass, and wind; and construction of new thermal power plants, or a combination. Few doubt that conservation and renewable resource technologies can make a contribution. Disagreement centers on the necessity of adding more thermal power plants beyond those already under construction or planned.

The third issue is how to finance new thermal power. One mechanism is "net billing." Under net billing, BPA promises to buy a utility's share of the electricity that is generated by a thermal power plant in whose construction the utility participates. BPA then blends this more expensive thermal power with its cheaper hydropower and sells the combination to all its customers, including the utility from which it bought the thermal power at an averaged rate. By acting as guarantor, BPA eases the utility's access to investors who may be reluctant to invest in otherwise risky power plant construction ventures.

Numerous groups have proposed policies for dealing with the three substantive issues and with the procedural question of where decisionmaking authority should reside. Some, but not all, would involve Federal legislation to replace current arrangements under the Bonneville Project Act. Descriptions of four of these proposals follow.

The Weaver Bill. Congressman Jim Weaver of Oregon introduced his proposal for dealing with these issues in March 1977 (H.R. 5862, 95th Cong., 1st Sess. 1977). This legislation would replace BPA with a Federally-chartered Columbia Basin Energy Corporation (CBEC). The Weaver Bill would address the allocation question by eliminating the Preference Clause. The CBEC would purchase the power generated by cooperating investor-owned and publicly owned utilities, meld it with Federally generated power, and resell the power to the utilities and direct service industrial customers through three rate pools (H.R. 5862, Sections 19-20). The bill would address the question of meeting future load growth by relying heavily on conservation. The corporation could construct new generating facilities or agree to purchase power from new facilities only after determining that the technology chosen would constitute the most economical means of balancing energy supply and demand (H.R. 5862, Section 6). The Weaver Bill would address the question of financing new thermal power facilities, if necessary, by authorizing CBEC to construct the facilities itself (H.R. 5862, Section 7).

The PNUCC Bill. The Pacific Northwest Utilities Conference Committee, a group of investor-owned and publicly owned utilities, drafted legislation introduced in Congress in September of 1977 (H.R. 9020, 95th Cong., 1st Sess. 1977). This legislation would rely heavily on an expanded role for BPA, which would acquire new powers. It would also establish the Pacific Northwest Planning and Conservation Organization (PNEPCO), a Washington corporation, to prepare load and resource forecasts, promote power conservation, study alternative energy sources, review utilities' long-range planning, provide oversight services specified in BPA power purchase contracts, and participate in plant siting studies (H.R. 9020, Sections 2,17).

The PNUCC proposal would address the allocation issue by modifying the Preference Clause to allow investor-owned utilities and direct industrial users to share in cheap hydropower through three rate pools.

The PNUCC proposal addresses the question of meeting new load growth by encouraging conservation, although to a lesser extent than the Weaver Bill. PNEPCO and BPA would manage a program of conservation standards to be adopted by the states; or if they failed to do so, by BPA.

The PNUCC Bill would address the issue of financing new power plants by giving BPA the authority to buy the output of any new thermal power plant, whether constructed by an investor-owned or publicly owned utility (H.R. 9020, Sess. 5).

The Jackson Bill. Partly in response to opposition to the PNUCC proposal by some publicly owned utilities, Senator Henry Jackson, chairman of the Senate Energy Committee, introduced his Northwest regional power bill in August 1978 (S. 3418, 95th Cong., 2nd Sess. 1978). (The identical bill has been reintroduced as S. 885, 96th Cong., 1st Sess. 1979.) The Jackson Bill would also expand BPA's role in regional power supply and planning.

The Jackson Bill would address the allocation issue by allocating the Federal power, now received by direct service industries, to the residential customers of the investor-owned utilities. This policy would be phased in gradually over a five-year period. Essentially, BPA would sell a pool of power at averaged rates to meet the general requirements (residential and

existing industrial) of publicly owned utilities and the residential requirements of investor-owned utilities. Direct service industries would purchase from Bonneville at rates comparable to those charged industrial customers by utilities.

The Jackson Bill would address the question of meeting load growth by emphasizing conservation and renewable resource power generation. BPA would be required to meet power obligations through feasible, cost effective conservation measures such as financing residential construction, increased system efficiency, and waste energy recovery. If BPA finds conservation measures insufficient to meet power obligations, it would be authorized to acquire additional resources, giving priority to renewable resources, or to construct non-hydroelectric generating facilities using renewable resources.

The Jackson Bill would address the issue of financing new thermal generating capacity by restoring and expanding a form of net billing to include investor-owned and publicly owned utilities alike (S. 3418, Section 5).

WPPSS Proposal. As a back-up approach in the event no Federal power bill is approved, the Washington Public Power Supply System (WPPSS) has recently proposed a more limited regional electricity generation plan. Publicly owned utilities would create a power pool and assign to it their allocation of Federal hydropower, and any other power to which they have rights, such as that generated by their own thermal power plants or power plants in which they have a share (such as WPPSS nuclear plants 1 through 5) to the extent these shares are not assigned to BPA. The power pool would then sell the electricity back to the utilities and to industrial users at an averaged rate.

Other Proposals. Various groups have made other, less comprehensive proposals. Portland Utilities Commissioner Invancie has proposed changing the Preference Clause to favor end-use allocation of Federal hydropower to residential customers. Through 1977 legislation, the Oregon Legislature has attempted to qualify the entire state of Oregon as a BPA preference customer, to be known as the Oregon Domestic and Rural Power Authority (DRPA). This "paper utility" would channel Federal hydropower to existing Oregon investor-owned and publicly owned utilities (Or. Laws, Ch. 888 1977).

The implementation of DRPA was to commence March 1, 1979; if the U.S. Congress had failed to enact a regional power bill satisfactory to the Oregon governor. A bill to delay implementation of DRPA for one year has been introduced in the Oregon Legislature. Finally, as indicated above, a Natural Resources Defense Council (NRDC) study has proposed an "alternative scenario" for meeting the region's electrical needs without constructing any additional nuclear or coal-fired power plants in the next twenty years beyond those already approved or under construction; that is, primarily through conservation (Beers and Lash 1977). The NRDC proposal addresses the allocation issue by assuming BPA would continue to supply power to direct service industries only so long as their plants are less than 35 years old. In other words, publicly owned utilities would gradually consume all Federal hydropower (Beers and Lash 1977). Additional information describing the Region's institutional framework as it relates to energy issues is presented in Volume III entitled, Institutional Barriers to Developing Power Generation Facilities in the Pacific Northwest.

4.2.8.3 Scenario - Induced Changes

- No regional institutional impacts were identified resulting from the TRENDLONG MID-MID scenario. State-level impacts can, however, occur and these are discussed in Chapter 5.

5.0 STATE ISSUES

This section discusses the impacts of the scenario on each of the individual states in Region 10. This discussion is parallel to that presented in Section 4.2 for the Region as a whole. For each of the states an overview of energy resources, energy supplies, the environment and background issues that may constrain energy development are discussed. Finally each section focuses on particular issues that will arise from implementation of the scenario. While certain energy technologies such as transmission lines and pipelines will cause impacts in the individual states, these technologies are discussed in Section 4.2 as Regional issues because the impacts from these technologies have not yet been disaggregated to the state level. Other information about each state's climate, geography and demography is found in Section 2, Regional Overview. The information is based on physiographic subareas within Region 10.

5.1 ALASKA

Alaska leads the Region in energy reserves by a large margin. It contains all of the Region's reserves of oil and natural gas and most of the coal. The size of Alaska's 1975 fossil fuel reserves in comparison to those of the rest of the Region and the U.S. is presented in Table 5.1. A comparison of Regional reserves to the U.S. total in quadrillion Btu is given in Figure 2.1. Location of Alaskan fossil fuel reserves is presented in Figure 2.3.

Alaska's fossil fuel reserves are being tapped. Annual oil extraction is about 600 million barrels per year, gas extraction is about 200 million cubic feet per year, and coal extraction is about 1 million tons per year. Almost all of the crude oil and nearly half of the natural gas is exported.

With the availability of these fossil fuel resources, Alaska's per capita consumption of electricity is below the rest of the Region. Alaskans consumed only about 2% of the Region's 141 million MWh of electricity generated in 1975. Alaska's electrical generation capacity is heavily oriented toward the use of the fossil fuels. In contrast to the other three states in the Region where hydroelectric power facilities constitutes about 90% of the installed generating capacity, fossil fuel-fired generating facilities make up nearly 90% of Alaska's installed capacity.

TABLE 5.1. Alaska Fossil Fuel Reserves Compared to the Rest of the Region and U.S.

	Crude Oil (Billion Barrels)	Natural Gas (Trillion Cubic Feet)	Coal (Billion Tons)
Alaska	10.1	31.9	5.8
Idaho	0	0	0
Oregon	0	0	0
Washington	0	0	1.0
Rest of U.S.	24	205	210

Source: PNL-RAP-28

The North Slope contains large amounts of natural gas. The 200 square mile Prudhoe Bay field contains an estimated 22.5 trillion cubic feet of proven natural gas reserves. A pipeline to transport gas to the lower 48 has received Federal approval, but construction of the pipeline is not expected to be completed before the mid-1980s. The State of Alaska is considering providing financial support for construction to allow the venture to proceed.

Alaska is the largest state in the nation, most of it yet unspoiled by the activities of man. The State's large reserves of fossil fuel, minerals, extensive forests, productive coastal waters, and abundant wildlife have promoted very rapid population and economic growth. In turn, this has created problems of environmental degradation in fragile ecosystems and social and political conflict between native and immigrant populations. Alaska's northern latitude, harsh climate, unique topography and ecology combine to create special problems of waste disposal, air pollution around population centers, land use, and resource development. The uncertain status of land ownership in Alaska and Federal regulations viewed by many Alaskans as unnecessary interference, will continue to cause uncertainty in energy and resource development.

The scenario for Alaska specifies an overall reduction in electric generation capacity by 1990. According to the scenario, all natural gas-fired generation (currently the largest contributor to existing capacity) and all hydroelectric generation will be phased out by 1990, while 100 megawatts of coal capacity and 15 MWe of oil steam capacity are to be added. Locations of Alaska's energy facilities is shown in Figure 3.5.

The scenario for Alaska is clearly unrealistic, and its implementation will undoubtedly be resisted. Phasing out of all existing hydroelectric and gas direct drive facilities will result in severe socioeconomic and institutional impacts. In fact, any attempt to reduce Alaska's generating capacity from 1125 MWe to 557 MWe will undoubtedly fail since no institution has the combination of legal authority, political power, or justifiable reason to accomplish the change. The expansion of the coal-fired facility near Mt. McKinley could be impeded due to air quality impacts in this mandatory Class I area. Although the exact route of a natural gas pipeline to the lower 48

states is not specified in the scenario, various water quality, ecological, socioeconomic, and land use impacts could occur depending on the route chosen. Industrial sitings could be restricted in some areas where national ambient air quality standards or PSD Class I or Class II increment standards will not be met. A rating of the environmental impacts for each of the energy technologies is presented in Table 5.2 in Section 5.5.

5.1.1 Air

- Figure 5.1 shows the two scenario projected nonattainment Air Quality Control Regions for Alaska in 1990.

- Construction and operation of a coal-fired plant expansion in central Alaska would cause air quality impacts in Mount McKinley National Park, a mandatory Class I area.

FIGURE 5.1. Alaska: Projected Nonattainment Air Quality Control Regions in 1990

5.1.1.1 Description

Generally air quality throughout Alaska is very good. Most of the state does not contain non-natural air pollution sources (ADEC 1977a). About 165 air pollution sources currently operate under air quality control permits issued by the state. Five of these sources require variances from regulations and are on schedules to attain compliance within the next five years. These include a pulp mill, three sawmills, and a urea-ammonia plant (ADEC 1979a).

During the three-year period ending in 1976, eight of Alaska's 18 election districts recorded concentrations of pollutants that exceeded primary air quality standards. Figure 5.2 shows pollutant and number of days that standards were exceeded for each of the eight election districts. The primary air

FIGURE 5.2. Alaska: Election Districts Not Currently Meeting Ambient Air Quality Standards

Source: EPA 1978

quality problem in the state is the high wintertime levels of carbon monoxide (CO) occurring in Fairbanks and Anchorage. Both of these cities have been designated CO nonattainment areas (ADEC 1977a). Carbon monoxide is generated almost exclusively by automobiles, and is trapped by cold-weather temperature inversions. The CO standard was exceeded in Fairbanks approximately one day in every four and in Anchorage one day in 14. Transportation control plans have been prepared for both cities; the Fairbanks plan has been adopted and the Anchorage plan is awaiting final action (Fairbanks North Star Borough 1979, Municipal Planning Department 1979).

The Valdez district has also been evaluated as a nonattainment area for sulfur dioxide (SO_2) (ADEC 1977a). This pollutant is generated by activities at the shipping terminal of the Trans-Alaska pipeline and associated with tanker traffic (Ester et al. 1976). Projections of possible violations prior to startup of terminal operations led to a recommendation by the state to declare the area in nonattainment status (Ester et al. 1976, ADEC 1978a). Recent data indicate that emissions of sulfur oxides (SO_x) from tankers are lower than anticipated (ADEC 1979b). The associated oil companies are currently conducting further studies of tanker emissions. The current position of the state is that Valdez should be considered in attainment if tanker emission data are confirmed to be at acceptable levels (ADEC 1977a). Another potential air quality impact is the currently proposed construction in the area of a large petroleum refinery. This facility would increase the present level of emissions.

Alaska also has a suspended particulate matter problem. High particulate levels are caused by windblown dust and dust entrained by motor vehicles on unsurfaced roads (ADEC 1977a, ADEC 1975a).

There are four mandatory Class I areas in Alaska. A discussion of air quality standards applied to Class I areas is given in Section 4.1.1 and the areas are identified in Figure 4.1. Visibility in Alaska's four Class I areas was not calculated due to incomplete data. However, visibility in Class I areas is not anticipated to decrease under the scenario.

5.1.1.2 Background Issues

- Control of the CO problem in Fairbanks and Anchorage is the most difficult problem facing the state. Automobile emissions cannot be completely controlled, so strategies for reducing CO levels must consider ways of altering transportation patterns (ADEC 1977a). Both cities are expected to be in compliance by 1987 (ADEC 1979a).
- A proposed regulation of the EPA requires removal of 85% of the sulfur from the emissions of coal-fired power plants (EPA 1978a). Alaskan coals are known to be of very low sulfur content; coal currently produced in the state contains less than 0.25% sulfur. Removal of 85% of this quantity is amenable only to expensive control technology, and is regarded by the state as unnecessary (ADEC 1978b).
- A second proposed regulation requires water injection to control NO_x emissions for new gas turbines (EPA 1977). Because of water availability problems in northern Alaska, the area's good air quality, and the limited anticipated development of this generating technology, this regulation is considered by the state as unnecessary (ADEC 1977b).
- Continued development of energy-related facilities may pose air quality problems. Since most areas of this state are currently very clean, rules that prevent significant deterioration could restrict industrial development at certain locations such as the Kenai Peninsula and Valdez.

5.1.1.3 Scenario - Induced Changes

- Lead lab analysis indicates that there will be two nonattainment air quality control regions for Alaska in 1990. Nonattainment will result from operation of oil shipment facilities and other industrial facilities projected for those areas by the TRENDLONG MID-MID scenario.
- According to the scenario, a 150 MWe coal-fired generation facility is to become operational near Mt. McKinley National Park by 1985. The site also contains the state's only existing coal mine, as well as a 25 MWe facility that supplies electricity to Fairbanks. The capacity of the proposed new facility was reduced to 105 MWe and, early in 1979, plans for the facility were cancelled by the utility because of inflationary cost escalation and excessive emissions requirements (Anchorage Daily News, December 27, 1978). The site is located only 10 miles from Mt. McKinley National Park, a Class I area. Construction and operation of the coal plant expansion may cause air quality standards for Mt. McKinley National Park to be violated.
- Should a natural gas pipeline be built to transport gas from the North Slope fields, air quality impacts may occur from construction, operation, and decommissioning of the system.

5.1.2. Water

- Construction of the Trans-Alaska natural gas pipeline could adversely affect water quality, through both erosion of disturbed areas and through accidental discharges of pollutants. The magnitude of this impact is not known.

- Scenario projected water quality violations for ASA 1901 in 1990 are shown in Figure 5.3. The water quality violations are not associated with energy facility development.

FIGURE 5.3. Alaska: Scenario Projected Water Quality Violations for Aggregated Subareas (ASA) in 1990

5.1.2.1. Description

Alaska has extensive water resources, estimated to be roughly one-third of the nation's freshwater supply. On a statewide basis, supplies of water substantially exceed demand and will continue to do so for the foreseeable

future. However, because of Alaska's unique combination of geology and climate, these water resources are not always readily available (U.S. Water Resources Council 1978).

Available data indicate that the majority of rivers in Alaska are relatively unpolluted (EPA 1978a). The lower portion of the Chena River which is a tributary to the Lower Yukon River (Figure 2.1), is in an unknown status, even though in the past it has had water quality problems from its confluence with the Little Chena River to its mouth. This river flows through the metropolitan area of Fairbanks and has been adversely affected by inadequately treated domestic sewage and urban runoff (EPA 1978a). Most of the remaining rivers can be assumed to meet Federal goals because they are located in remote, sparsely populated areas of the state.

Some violations of Federal water quality goals are expected to occur. High concentrations of heavy metals currently exist in the Susitna River. In the future, dissolved oxygen, organic toxicity, and inorganic toxicity problems can be anticipated in streams near urban centers where waste discharge and urban runoff programs have not been fully implemented. High suspended solids and turbidity are now present, but unmeasured, in streams where placer mining occurs (EPA 1978a).

5.1.2.2. Background Issues

- Several hydro projects are being considered in Alaska. Impacts could be associated with projects such as the 1500-MWe complex proposed for the Susitna River. The considerable seismic activity characteristic of much of Alaska represents a continual danger of dam collapse, with the resulting damage caused by flooding (Alaska Division of Energy and Power Development 1977).
- Oil terminal facilities, tanker traffic, and off-shore petroleum production create potentials for large oil spills (CEQ 1977) and generate chronic low-level oil pollution, which may be equally damaging. In 1976, the State legislature enacted legislation that includes a comprehensive oil spill prevention program. Most of the legislation, however, has been struck down in court or is still under litigation. Environmental pressures in marine areas may also increase because of expansion of both the commercial fishing industry and Outer Continental Shelf (OCS) development (EPA 1978a).

- Alaska's wastewater treatment program for municipal and industrial discharges is well advanced, but not yet complete. Continued emphasis on this program will be necessary to maintain water quality. Untreated domestic sewage discharges have been reduced in areas such as the Chena River near Fairbanks; however, many other interior and coastal communities still have inadequate sewage treatment facilities. Most seafood processors and pulp mills are presently increasing their treatment levels. As additional industrial treatment needs are met, water quality in localized problem areas should improve (EPA 1978a).

5.1.2.3. Scenario - Induced Changes

- Construction of a Trans-Alaska natural gas pipeline could cause water quality impacts through both erosion of disturbed areas and through accidental discharges of pollutants. Construction of the Trans-Alaska oil pipeline was accompanied by over 16,000 oil spills, 50 of which were more than 1000 gallons (ADEC 1974-7).

5.1.3. Ecology

- The natural gas pipeline may affect the ecology of Alaska to some extent, but specific impacts cannot be identified at this time.

5.1.3.1 Description

Alaska has an extremely diverse assemblage of habitat types and ecological regions that make generalizations about the ecology of the state difficult. For this reason, it is vital that site-specific factors be taken into account when considering the placement of energy-related facilities.

Almost one-half of Alaska is covered with tundra. The percentage of the state covered by each of the three major types of tundra are: alpine, 23%; moist, 17%; and wet, 9%. Forest covers 37% of the state: Common trees are white, black, and Sitka spruce, Douglas fir, western hemlock, white birch, quaking aspen, balsam poplar, and black cottonwood (Joint Federal State Land Use Planning Commission 1973).

Many types of ecological systems are unique to Alaska, due in large part to the state's severe northern climate. Interest has been expressed in preserving some of the outstanding wildlands through the Alaska National Interest Lands Settlement. Fish and wildlife resources in Alaska are an important part of the state's economy and lifestyle of the people. Commercial fisheries are a major contributor to the economy, and commercial and recreational hunting are also important. Especially important to traditional lifestyles in Alaska

is the subsistence use of fish and wildlife resources. Subsistence use of wildlife resources has been identified as a priority management objective.

Many native species are sensitive to development activities. The growing population is placing increasing pressure on fish and wildlife resources taken for subsistence, recreational, and commercial purposes. Examples of animals subject to such pressures are the caribou, moose, dall sheep, brown bear, grizzly bear, wolf, bald eagle, waterfowl, Arctic char, and Pacific salmon.

5.1.3.2 Background Issues

- Large populations of Canada geese and other migratory birds nest in Alaska during the summer months, and migrate south for the winter. Future developments in these nesting areas may disrupt and reduce populations.
- Caribou in Alaska migrate long distances from winter to summer habitats, and depend on the availability of vast forage ranges. Three major caribou herds exist in Arctic Alaska; their migratory routes and forage areas vary with time. Widespread petroleum development on the North Slope may threaten to disrupt populations and force them into unusual migratory patterns and ranges.
- Logging and mining in Alaska have destroyed some natural anadromous fish spawning and rearing areas by changing streambed characteristics and altering flows (DOE-RAP-28 1978). Placer mining and gravel extraction are also major activities with potential for introducing sediment into streams.
- The Outer Continental Shelf (OCS) of Alaska is believed to contain major undiscovered reserves of oil and natural gas. Areas of potential exploration are remote and subject to severe environmental conditions. These areas also have abundant marine life that might be damaged (Energy Northwest 1977). In 1977, the Secretary of the Interior revised the OCS leasing schedule, partly to set higher standards for environmental protection (CEQ 1977). Oil spills and chronic low-level oil pollution may threaten marine resources. Offshore petroleum extraction and onshore construction of seaport facilities could interfere with commercial fishing activities. Perhaps the most significant issue is the effect on marine mammals of proposed OCS activity in the Beaufort Sea. The native communities are opposing development where subsistence resources are felt to be threatened (North Slope Borough 1978, ACI 1978).

5.1.3.3 Scenario - Induced Changes

- The scenario specifies that a natural gas pipeline from Alaska to the lower 48 states will be constructed by 1985, but the exact route has not been chosen. Since the ecological effects of the proposed pipeline will be route-specific, no specific impacts can be identified at this time.

5.1.4 Land Use

- The scenario specifies expansion of the coal-fired facility near Fairbanks. This will require commitment of an additional 105 acres of land for the facility and its associated surface coal mine (Figure 5.4).
- Requirements of land for the natural gas pipeline may conflict with current land uses, but specific problems cannot be identified.

FIGURE 5.4. Alaska: Scenario Projected Land Use Requirements by Election District for Thermal Power Plants in 1990

5.1.4.1 Description

Until 1959 when Alaska became the 49th state, about 99% of Alaska was federally owned. To give the new state a resource base, Congress provided in the 1958 Statehood Act that 102.5 million acres of land could be selected by the state within 25 years. As of 1977, nearly 72 million acres had been selected (Alaska Division of Energy and Power Development 1977). Land claims of Alaska Natives resulted in a Federal Department of the Interior land

"freeze" in 1968. In 1971, the Alaska Native Claims Settlement Act (ANCSA) was passed. Under ANCSA, Congress granted native corporations \$962 million and the opportunity to select 44 million acres of land. In early 1979, the native corporations had overselected their entitlement by about 36 million acres and had received management title from the Federal Government for approximately 5 million acres.

Under provisions of Sections 17(d)(1) and 17(d)(2) of ANCSA, the Secretary of the Interior in the early 1970s withdrew millions of acres of public land from the operation of most public land laws, including state land selection. These National Interest Lands were subsequently studied to determine the most appropriate land use classifications for Congress to assign. However, Congressional action was delayed longer than anticipated. On December 17, 1978, Section (d)(2) expired, leaving some 60 million acres withdrawn under that section still protected under the less restrictive (d)(1) classification. Some of the (d)(1) lands were left open for exploration of metalliferous minerals and selection under the Alaskan Statehood Act.

On November 16, 1978, as the unsettled land issue neared the (d)(2) expiration date, Interior Secretary Andrus temporarily withdrew some 99 million acres under Section 204(e) of the Federal Land Policy and Management Act of 1976 (FLPMA). The Department of Agriculture used Section (b)(1) of the same Act to withdraw 11.2 million acres. Soon thereafter on December 1, President Carter designated 56 million acres as national monuments under the Antiquities Act. He also directed Interior Secretary Andrus to proceed with steps to set aside 39 million acres as national wildlife refuges under FLPMA Section 204(c).

Under the Antiquities Act, approximately 40 million acres were set aside as national parks, 14 million acres as national wildlife refuges, and 4 million acres as national forest wilderness areas. Unless overturned by Congress, national monument designation is permanent.

The enacted Section 204(3) of FLPMA allows a withdrawal period of three years while Section 204(b)(1) withdrawals are for two years. The proposed withdrawals under Section 204(c) of FLPMA would be for a twenty-year period. The Secretary of the Interior is unlikely to take final action on the proposal until after Congress has had an opportunity to resolve the land issue later this year.

The Antiquities Act withdrawals were made from land previously withdrawn under Sections 204(b)(1) and 204(e) of FLPMA. The proposed Section 204(c) withdrawals were also already protected by the FLPMA withdrawals of November, 1978.

The State is pursuing litigation in the U.S. District Court to overturn the Antiquities Act withdrawals. It charges that the President exceeded his authority granted under the Act and also that Native and state selections should be granted prior to Federal Government withdrawals.

All of the sections of FLPMA and the Antiquities Act under which land withdrawals have been enacted or proposed prohibit mineral entry and mineral leasing. This precludes new coal, uranium, gas and oil activity. However, valid existing claims can be developed if the environmental standards set forth in the respective withdrawal sections are met.

The Federal administration has assigned top priority to resolving the issue of Alaska's National Interest Lands. The President and Secretary of the Interior viewed the withdrawals as the only way to insure protection of these lands after Congress was unable to resolve the land use issue before the expiration of (d)(2).

5.1.4.2 Background Issues

- Debate over Federal land classifications and the resultant prolonged land conveyance process will retard land selections and resource development. Investors may be unwilling to invest in projects until the land status question is resolved.
- The subsurface rights to all Native lands are owned by Native regional corporations under the terms of ANCSA. In general, the village corporations selected lands that were traditional sites of village subsistence hunting, fishing, and gathering. Some villages may be reluctant to encourage the development of the subsurface resources. However, development of the subsurface resources is generally expected to be approved by the village corporations where such development can be accomplished without serious disruption of traditional lifestyles.

5.1.4.3. Scenario - Induced Changes

- Scenario-specified development of Alaskan gas reserves require that a pipeline be built for gas transport. Such a pipeline would require substantial land for construction and right-of-way. Because of the

uncertain ownership and management status of the lands through which the pipeline may pass, specific conflicts with other land uses cannot be identified at this time.

5.1.5. Solid Waste

- No scenario-induced impacts for solid waste disposal are identified.

5.1.5.1. Description

Alaska has most of the solid waste management problems found in the other states except that no large quantities of industrial and agricultural wastes are currently generated. In addition, Alaska has many other problems that few other states have experienced. These problems are climatic (arctic deserts, permafrost, coastal rainforests), geophysical (vast regions of unsuitable soils, mountainous terrain), and demographic (lack of surface transportation and dozens of isolated villages) (EPA 1978a). For example, no planning of solid waste handling was done during construction of the Trans-Alaska oil pipeline, leaving huge quantities of material to be disposed of when the project ended.

The status of solid waste management in Alaska is difficult to describe. One method of measuring the status and progress is to determine the number of people served by approved, state-permitted disposal facilities. Approximately 67% of Alaska's population was served by sites managed in accordance with permits issued by the state at the end of 1976. This was about 24% more than in 1974 (EPA 1978a).

5.1.5.2. Background Issues

- Most municipal waste disposal is accomplished in open dumps, which have problems including poor site selection, poor soils, permafrost, excessive rainfall, and poor management. However, much upgrading of disposal practices has been accomplished in recent years. Site selection is one critical factor, since a proper landfill competes with other uses that typically have higher priority.
- Because of the great physical difficulties confronting solid waste disposal in Alaska, alternative methods of disposal are being investigated. Utilization of municipal and mill wood wastes as fuel is being investigated, material recycling is being accomplished on a small scale, and waste oil recovery is being evaluated. Especially needed are suitable waste disposal solutions for remote villages (ADEC 1975b).

- Planning for disposal of wastes generated by large-scale development activities is important for solving solid waste problems. Disposal in northern Alaska has been an extremely difficult matter. Proper planning will allow systematic handling and return of waste materials, and prevent the accumulation of waste at undesirable locations.

5.1.5.3. Scenario - Induced Changes

No scenario-induced solid waste impacts were identified for Alaska.

5.1.6. Health and Safety

- No scenario-related health and safety impacts were identified by the lead lab analysis.

5.1.6.1. Description

Both Fairbanks and Anchorage have been designated CO nonattainment areas (Figure 5.2) primarily because of wintertime temperature inversions which prevent dispersion of this automobile-generated pollutant. Levels two to three times the primary standard have been recorded in these cities (ADEC 1977). Determining the impact of high levels of airborne pollutants on the health of the general population is subject to many variables and uncertainties.

Accidental injury always accompanies major development such as petroleum extraction, coal mining, pipeline construction, and OCS activities.

5.1.6.2. Background Issues

- Much of Alaska's population lies beyond the reach of community water supplies and sewage treatment systems. Adequate individual water and sewage systems may be very difficult to establish. A serious health hazard may occur where septic tanks affect water supply. Many villages still melt ice for water supply and use "honey buckets" for sewage disposal.
- In more densely populated areas of the state, such as Anchorage, Fairbanks, and Juneau, air pollution concentrations often exceed alert levels. Alert level violations represent significantly higher health risk than violations of the primary standard (EPA 1978a).
- Many villages in Alaska are accessible only by air; emergency health care may be contingent upon this form of transportation.

5.1.6.3. Scenario - Induced Changes

- Extraction of Alaskan natural gas reserves requires that a pipeline be constructed for gas transport. Such a pipeline would require substantial construction activity. The pipeline is still in the planning stages; therefore, health and safety impacts were not included in the scenario analysis.

5.1.7. Socioeconomic

- Reductions in gas-fired and hydroelectric capacity called for by the scenario would have large socioeconomic impacts, especially when alternative means to meet demands are not provided.
- The socioeconomic impact of the construction of the Trans-Alaska natural gas pipeline will be significant.

5.1.7.1. Description

Alaska's population, though small relative to other states (408,000 in 1976), has grown at a rapid rate, increasing by 34% from 1969 to 1970 and by 35% from 1970 to 1977. However, with completion of the oil pipeline, population fell to an estimated 403,000 by October 1978. Forecasted growth indicates an increase to 411,000 by 1980. About 50% of the population is presently living in the metropolitan area of Anchorage. About 40% of Alaska's population growth between 1970 and 1975 can be attributed to net immigration, primarily persons in the labor force between the ages of 20 and 30. Persons over age 40 have tended to outmigrate, resulting in a relatively young population. The balance of Alaska's growth is due to the excess of births over deaths, again influenced by the large portion of couples of childbearing age. Alaskan Natives represent about one-fifth of the total population, and they tend to reside in the smaller towns and villages. An estimated 4% of the Anchorage metropolitan area is Native, representing approximately 32% of the total Native population in 1977. Projections of Alaska's population size into the future under a variety of plausible assumptions suggest that the state's population will concentrate in the Anchorage and Fairbanks area.

Alaska's economy grew quite rapidly between 1965 and 1975. Per capita income in the state grew from \$3,435 to \$5,587 (in 1967 dollars) throughout this period. The value of real output produced by the Alaskan economy grew at a substantially faster rate than that of the U.S. as a whole; a 9.9% rate of average annual growth in 1972 dollars (1965-1975) for the State of Alaska as compared to a 2.6% rate of growth for the U.S. gross national product. The agricultural, forestry, and fisheries industries grew substantially in this same period, as did the construction industry. Government, trade, and the services also account for much of the employment in the state. The average yearly personal income in the state in 1977 was \$10,586, the highest average income for any state in the U.S.

5.1.7.2 Background Issues

- The Alaskan economy has recently experienced extremely rapid growth, spurred in part by the Trans-Alaska Oil Pipeline and other energy development activities. This growth has stimulated a rapid influx of outside influences, which offer lifestyle options that were previously unavailable to the Alaskan Natives. Many Native villages have a lifestyle based on subsistence hunting and fishing with little outside interference. Development near Native villages tends to affect, for better or worse, this lifestyle (Alaska Division of Energy and Power Development, 1977). The negative aspects of very rapid growth and sociocultural change have, in some cases, led to the opinion that outside development is something to be avoided. Also, during the construction of the oil pipeline, Natives and residents were not hired on a priority basis, partly because of lack of needed skills. This has caused some resentment.
- Population growth rates in parts of Alaska have been very rapid in recent years, and have caused social and economic disruption at the community level. These growth rates are due to people migrating to Alaska in search of employment opportunities and high wages. A serious economic problem is caused by immigration in excess of employment opportunity. This "excess migration" contributes to the state's high level of unemployment.
- Many villagers expressed skepticism about the merits of the development of the Beluga coal field. The presence of outsiders who have a different cultural lifestyle is viewed with suspicion and concern. Some villagers felt that outside influences have contributed to increases in alcoholism and drug abuse in Native villages (PNL 1979).
- Alaska's skewed population distribution and dispersed population centers will have important socioeconomic consequences. Anchorage is a "young" city and its lifestyle is significantly different from the small villages of the coast and interior. Future concentration of population in one or two major metropolitan areas suggests that persons with conflicting lifestyles will be able to coexist in relative isolation from one another for many years to come (Seiver 1976).
- A survey of residents of the Fairbanks area in 1976 indicates the kinds of social and economic disruptions that can be attributed to energy development (Kruse 1976). Residents of Fairbanks felt that the oil pipeline led to increased inflation, overcrowding, and a deterioration of the natural environment. Residents of Fairbanks believed that they had to bear the social and economic costs of the pipeline disproportionately to the benefit it provided. Many perceived that they had to sacrifice values important to their family, especially being together as often as they wanted. Over the longer term, traditional Alaskan concern for the attainment of a self-reliant lifestyle seems to be giving way to a desire

for high income and an exciting job experience. Conflict between economic gain and deterioration in quality of community life in Alaska is an issue that will accompany energy development in the foreseeable future.

- Some evidence suggests that a significant portion of the wages earned on the oil pipeline project were not spent in the State of Alaska (The Alaska Economic Information and Reporting System 1977). Also, failure to reinvest capital in the local economy has serious implications for the social and economic health of the state. This issue is equally pertinent to future energy developments in Alaska.
- Alaska's growth is being driven primarily by revenues from energy production. Determining how these revenues are used will be an important factor influencing whether future growth is relatively uniform, thereby minimizing social and economic disruptions.

5.1.7.3 Scenario - Induced Changes

- The scenario calls for no gas-fired generating capacity for 1985 and 1990. Currently, approximately 50% of the total generation in Alaska is of this type. This elimination of capacity would have a high impact, in terms of its effect on personal income, levels of unemployment, and the health of the economy that is dependent on existing, if not growing, energy production.
- The 1985 scenario indicates a reduction in total capacity for all technological alternatives to about one-half of current capacity. Without alternative means by which to increase capacity, local socioeconomic impacts would be very high, and economic consequences for the region could be severe.
- Similar to the impact of the Trans-Alaska pipeline system, the socioeconomic impact of the gas pipeline would be important in terms of changes in lifestyle and economic changes that would occur. Analyses performed under the Man-in-the-Arctic Program (MAP) indicates that regardless of the actual route chosen for the gas pipeline, the bulk of the impacts will occur in Anchorage, even though the routes do not pass through the city. This is the case because Anchorage is of such critical importance as a commercial center in Alaska (Kresge 1976). Another factor potentially contributing to the socioeconomic effects of the gas pipeline is the timing of the construction relative to other planned developments in the state. The longer the delay in starting the project, the greater the economic instability due to higher costs and the greater competition for scarce human and financial resources (The Alaska Economic Information and Reporting System 1977).

5.1.8 Institutional

- Any attempt to reduce Alaska's generating capacity from 1125 MWe to 557 MWe, as specified in the scenario will undoubtedly fail. No institution has the requisite combination of legal authority, political power, or justifiable reason to accomplish such a reduction.

5.1.8.1 Description

Energy development in Alaska is affected by three sets of institutions: the Federal Government, the State Government and the Alaska Native corporations.

The key importance of the Federal Government stems mainly from ultimate Federal ownership (when state selections are completed) of about 60% of Alaska's uplands, an artifact of Alaska's prestatehood days (Alaska Division of Energy and Power Development 1977). The availability of Alaska's federally held lands for the extraction and transportation of energy resources depends on its legal status. Resource preservation lands (the National Parks Systems administered by the National Park Service of the Department of the Interior; the National Wilderness Preservation System administered by the U.S. Forest Service in the Department of Agriculture; the National Park Service for the U.S. Fish and Wildlife Service of the Department of the Interior; and the National Wildlife Refuge System administered by the U.S. Wildlife Service) are essentially closed to energy development. Multiple resources sse lands (the National Forest System administered by the U.S. Forest Service; National Resource Lands administered by the Bureau of Land Management (BLM) of the Department of the Interior) are generally open to energy development, subject to the land use planning and leasing policies of the Forest Service and BLM. Other Federal lands, such as the National Petroleum Reserve of Alaska administered by the Department of Energy, represent major energy resources not now available for development.

The Federal government also has important responsibilities in connection with the proposed Alaskan Natural Gas Pipeline. The President has already chosen the route, pursuant to the Alaska Natural Gas Act of 1976 (15 USC 791-7190). The Federal Energy Regulatory Commission will be involved in setting end use and well head process for the gas.

Finally, pursuant to the Outer Continental Shelf Land Act, 43 U.S.C. 1331-1443, BLM is responsible for granting pipeline rights-of-way and issuing oil and gas leases.

The State Government of Alaska plays a variety of important roles in energy development. Under the Statehood Act of 1958, the State is entitled to select approximately 28% of Alaska's uplands, a process that must be completed by 1984 (Alaska Division of Energy and Power Development 1977). Thus, the State itself is a land owner second only in importance to the Federal Government.

Major state institutions which influence energy development in Alaska include the Department of Environmental Conservation, which coordinates state environmental policies and sets pollution standards as well as standards for oil and gas pipeline construction and operation (AS Chapter 44.46); the Department of Transportation and Public Facilities, which regulates tanker vessel traffic in coastal and inside coastal waters to prevent oil spills (AS 30.20.010); the Alaska Division of Energy and Power Development, which develops power, energy conservation, and energy resources (Alaska Administrative Order 21); the Alaska Public Utilities Commission, which regulates rates and issues certificates of public convenience and necessity for publicly owned, investor-owned, and cooperative electric utilities (AS 42.04.010-42.05.721); Alaska Power Authority, which constructs, acquires, finances, and operates hydroelectric and fossil fuel generating facilities (AS 44.56); the Department of Natural Resources, which administers state mining laws, leases state lands for the exploration and extraction of minerals, regulates oil, and gas drilling (AS Titles 27, 38, and 31); and the Alaska Pipeline Commission within the Department of Commerce and Economic Development, which regulates pipeline facilities and pipelines carriers (AS 42.04.010-42.06.640).

Yet a third important set of institutions are the twelve Alaska Native regional corporations established pursuant to the Alaska Native Claims Settlement Act of 1971 (ANCSA) (43 U.S.C. 1601-1628). Under the Act, Alaska is divided into twelve regions. The Native Alaskans residing in each region have

become the shareholders of a corresponding for-profit corporation whose assets will include about 10% of Alaska's uplands as well as approximately \$1 million in Alaskan Native funds.

5.1.8.2 Background Issues

- The major issue is the uncertain status of federally held lands. Section 17(d)(2) of ANCSA, 43 U.S.C. 1616, directs the Secretary of the Interior to withdraw from appropriation up to 80 million acres of land in Alaska for possible designation by Congress as additions to resource preservation lands, largely closing them to Federal development. Because Congress had not acted by December 18, 1978, when the withdrawals would have terminated pursuant to ANCSA, the Carter Administration temporarily withdrew 149 million acres under the Federal Land Policy and Management Act of 1976 43 U.S.C. 1701-1782, and designated about 56 million acres as national parks, wildlife refuges, and forest wilderness lands under the Antiquities Act (16 USC 431). Three Alaska land bills are presently before Congress. The most restrictive bill, sponsored by Representatives Morris Udall and John Anderson, has the support of the Administration, as President Carter has threatened to veto less restrictive alternatives. Under the Udall-Anderson Bill, substantial portions of Federal land would be precluded from energy development. Obviously, the stakes are high. The Administration/Udall/Anderson position has aroused the opposition of logging and mining companies, Native corporations, and some Federal and state agencies. At the same time, support for tight restrictions by environmental groups and other Federal and state agencies is equally intense. The outcome is uncertain but critical; it is likely to determine the course of energy development in Alaska for years to come.
- A second issue affects energy development on native corporation lands. Because the corporations are for-profit, their management has a duty to shareholders to manage the firm's assets profitably; most likely, through the development of energy resources on corporation lands. A variety of institutional impediments are slowing such development, however. First, because of disagreements with the Federal Government over easements and transportation corridors, much of the land has not actually been conveyed to the corporations. Lacking title, they can not have rights to development of mineral resources. Second, Section 7(e) of ANCSA 43 U.S.C. 1606, requires that 70% of the resources generated by mineral resources on a given corporation's land be split pro rata among all twelve native corporations; thus reducing the benefits to the corporation and energy development. Third, each corporation's constituent villages have a veto over development on their local lands.
- A third issue stems from development of Outer Continental Shelf (OCS) oil and gas reserves. Alaska's Continental Shelf represents 65-70% of the U.S. total reserves. Current estimates place crude oil potential at

between 15 and 50 billion barrels, and natural gas potential at between 71 and 295 trillion cubic feet (Alaska Division of Energy Development 1977). Areas of high potential include the Northern Gulf of Alaska, Lower Cook Inlet, and Western Gulf OCS areas on the south, the Bristol Bay area north of the Aleutian Chain, and areas around the Seward Peninsula and the Beaufort Sea of the North Slope. At present, there is uncertainty concerning jurisdiction over certain parts of those areas. In principle, the state owns the tide lands plus the three nautical mile coastal strip of the Continental Shelf; the Federal Government owns the submerged lands seaward of the State's lands to the 200 meter depth. But no agreements have been reached as to the exact boundaries. Until such an agreement is reached, development is unlikely to proceed.

- A fourth issue concerns financing of the Alaska Highway Pipeline Project, whose route was selected by President Carter and Prime Minister Trudeau September 8, 1977 and approved by Congress on November 8, 1978. Current estimates place the project's cost at \$10-15 billion, making it the most expensive private undertaking in history. Both the President and the project sponsors have maintained that the pipeline can be financed privately without Government assistance. However, depending on the end-use and wellhead prices for the gas established by the Federal Energy Regulatory Commission pursuant to the Natural Gas Policy Act of 1978, P.L. 93-621, and other statutory authority, additional Federal guarantees may be necessary to attract the requisite investment.

5.1.8.3 Scenario - Induced Changes

- Implementation of the TRENDLONG MID-MID Scenario which cuts electric generating capacity in Alaska to half of current capacity will produce institutional impacts.

5.2 IDAHO

Idaho does not have significant fossil fuel reserves. Nearly all (97%) of the state's electric generation capacity is hydroelectric. The state produced 7% of the 141 million MWH of electric energy produced in the Region in 1975. Hydroelectric generation will continue to dominate Idaho's electric generation in the foreseeable future. Expansion of Brownlee Dam (Figure 3.5) is currently under way. Expansion of the Dworshak, Hells Canyon, Bliss, Lower Salmon, and Oxbow projects are under consideration. In addition, a number of hydroelectric sites with smaller potential have been identified.

Several technologies for thermal power generation are under investigation. Several years ago, Idaho Power Company proposed construction of two 500 MWe coal-fired generating plants near Orchard, Idaho in Ada County. Idaho's Public Utility Commission rejected the proposed site primarily because of anticipated air quality problems. Other sites for at least one of the coal-fired plants are under consideration. In addition, the Raft River geothermal resource area in Cassia County is the site of two 5 MWe pilot electric generating plants. This reservoir has the potential to contribute up to 50 MWe to the state's power supply by 1990.

Idaho is undergoing rapid population and economic growth as the state's abundant forest and mineral resources, agricultural lands, and recreational opportunities continue to be developed. As in many fast growing areas, Idaho faces problems of unplanned residential expansion onto valuable agricultural lands, air pollution in urban centers from automobile exhaust, destruction of natural habitats, and social conflicts among groups having different values. Ever increasing and often competing demands for limited water resources may exacerbate existing water quality and availability problems, especially in southern Idaho. Demands for energy will increase, and since the investor-owned utilities serving most of the state do not have access to low-cost hydroelectric power generated by Federal water projects, Idaho is pursuing its own program of hydroelectric and other energy development to meet expanding demands.

The scenario specifies that 2,432 MWe of electric generation capacity will be operational in Idaho by 1990. System additions will be made to conventional hydroelectric and geothermal technologies. The scenario specifies that 50 MWe of natural gas capacity will be dropped and 50 MWe of oil capacity will be added. Location of Idaho's energy facilities is shown in Figure 3.5

No major issues have been identified for Idaho that would restrict development of the facilities projected under the scenario. Almost all of the scenario specified geothermal and hydroelectric capacity additions can be made at existing facilities, resulting in limited impacts on air quality, water quality, ecology, and land use. The switch from natural gas-fired to oil-fired generation will also result in minimal impacts on air quality, water quality, ecology, and land use. Because of the remote locations of these facilities, localized socioeconomic impacts will be experienced but will not impede development of the facilities.

Industrial facility expansion projected by the scenario will be restricted in areas where the National Ambient Air Quality Standards and PSD Class I or Class II increment standards are not met. A rating of environmental impacts for each of the energy technologies is presented in Table 5.3.

5.2.1 Air

- Additional industrial facilities sited by the scenario will cause two air quality control regions to remain in nonattainment in 1990 (Figure 5.5).
- Visibility in mandatory Class I areas in Idaho will increase. Figure 5.6 shows the projected visual range for Class I areas in 1990.

FIGURE 5.5. Idaho: Scenario Projected Nonattainment Air Quality Control Regions in 1990

5.2.1.1 Description

The overall air quality of the state of Idaho has been improving in recent years (EPA 1978). Particulate matter (TSP) violations are the leading cause of air quality violations, with carbon monoxide (CO) and sulfur dioxide (SO₂) standards violations occurring in the more populated or industrialized counties. Most of Idaho's counties either do not conduct air quality monitoring or monitoring to date is insufficient to draw valid conclusions.

FIGURE 5.6. Idaho: Scenario Projected Visual Range for Mandatory Class I Areas in 1990, miles

FIGURE 5.7. Idaho: Counties Not Currently Meeting Ambient Air Quality Standards

Source: EPA 1978b

During the three year period ending in 1976, 11 of Idaho's 44 counties (a map of counties is given in Section 2.2) did not meet one or more air quality standards (see Figure 5.7). All of those counties in violation of air quality standards exceeded the standard for total suspended particulates (TSP). The SO₂ standard was exceeded in Shoshone County on 30% of the days in 1976, reflecting the intense mining and smelting activities in that county. Bannock County exceeded the SO₂ standard on 10% of the days, probably because of the agricultural chemical industry located there. Ada County, where the state's capital and largest city is located, was the only county monitored for CO and the standard was exceeded on about one-third of all days in 1976 (EPA 1978b).

About one-third of all instances of air quality violations in Idaho involved concentrations of pollutants at or above the "alert" level. Alert level violations represent significantly higher health risk than violations of the primary standard. Almost 80% of the more serious conditions occurred in Ada, Bannock, Caribou, Shoshone, and Twin Falls Counties where approximately one-third of Idaho's population and most of its industry is located (EPA 1978b).

There are five mandatory Class I areas in Idaho. A discussion of air quality standards applied to Class I areas is given in Section 4.4.4 and the areas are identified in Figure 4.1.

5.2.1.2 Background Issues

- Fugitive dust is responsible for a large share of Idaho's particulate standards violations. While control of point sources of particulates is relatively easy and inexpensive, control of nonpoint sources (fugitive dust) is usually not amenable to simple solutions.
- Areas presently not meeting the Federal SO₂ air quality standard can be traced to two point sources; the smelting and mining complex at Kellogg in Shoshone County and the agricultural chemical facilities at Pocatello in Bannock County. Application of currently available technology can (and already has) reduced the severity, frequency, and duration of violations, but localized climatic conditions may make total control of SO₂ violations difficult, especially in the Kellogg area.

- As in other urban areas of the nation, transportation is the major source of CO in Boise (Ada County). The private automobile undoubtedly is responsible for most of this localized problem. As new automobiles with better emission controls and implementation of local programs to reduce travel in the city center and commuter corridors are phased in, a gradual reduction in CO and NO_x levels should occur (EPA 1978b).

5.2.1.3 Scenario - Induced Changes

- Siting in nonattainment areas is the major standard applicable to new industrial and energy facility sitings in Idaho. Constraints are anticipated for sitings in Bannock, Caribou, Nez Perce, Shoshone, and Twin Falls Counties.
- As with any major construction project, construction of geothermal or hydroelectric facilities may create short-term problems of fugitive dust and/or exhaust emissions for construction equipment.
- Siting of industrial plants near Class I areas will be restricted.
- The scenario specifies 200 MWe geothermal generating capacity in Idaho by 1990. Local air quality impacts in Cassia County will result from the construction and operation of such facilities. Most of the noncondensable gases or vapors that have been found in geothermal fluids are relatively innocuous and are normal components of the atmosphere. Some, however, normally are not significant atmospheric components. Of these, hydrogen sulfide is currently of the most concern. Other emissions likely to be regulated in the future include ammonia, mercury, arsenic, and radon. Boron, in the form of boric acid, may also be emitted in cooling tower drift.

5.2.2 Water

- Competition for the limited water resources in southern Idaho could restrict energy facility siting in that area.
- Expansion of hydroelectric sites in the northern part of the state will alter stream flow characteristics and cause water quality impacts.

5.2.2.1 Description

Except for a few localized areas, the state of Idaho faces few water quality problems. The northern portion of the state contains numerous mountain streams and rivers, and several large, clear lakes. The south is served by only one major river system, the Snake and its tributaries. In addition, the Snake River Plains aquifer underlies an area of about 9500 square miles

and is an important source of municipal and industrial, as well as irrigation water. A total of about 13.5 million acre feet of storage space in major existing reservoirs and about 2 million in smaller impoundments has been developed for irrigation, power generation, and compatible multiple uses (Pacific Northwest River Basins Commission 1979). Most of that storage capacity is in the Snake River Basin.

The most common forms of pollution in Idaho rivers and reservoirs are excessive dissolved and suspended solids, turbidity, and nutrients (Figure 5.8) (EPA 1978b). Agricultural irrigation combined with naturally high salt concentrations contribute excessive dissolved mineral salts to the Bear River system in the southeastern corner of Idaho. Excessive salt concentrations are also found in the Middle and Upper Snake River from ground water inflow and agricultural irrigation runoff.

Inorganic toxicity resulting from high concentrations of heavy metals from smelting and mining operations occur in the Coeur d'Alene River/Pend Oreille River system in the Northern Idaho Panhandle, in the Boise River tributary of the Snake River in the south from industrial activities, and in Henry's Fork, a tributary of the Snake River from unknown natural sources (EPA 1978b). Organic toxicity data for Idaho rivers, reservoirs and streams is lacking although agriculture and forestry make extensive use of herbicides and pesticides throughout the state (EPA 1978b).

5.2.2.2 Background Issues

- Perhaps the biggest issue involving water resources in Idaho is the ever increasing, often conflicting and competing demands made on the limited water resources of southern Idaho by agriculture and other uses such as fish and energy production.
- Idaho's objective of reducing its dependence on outside sources of electric energy, primarily by increasing its hydroelectric generation capacity, faces several constraints including: 1) water quality limitations based on Public Law 92-500, affecting water use for thermal plants, 2) stream and area classifications such as Wild and Scenic Rivers and National Recreation Areas which prohibit hydroelectric projects, 3) priority of the use of water in upstream areas for irrigation over power generation at the Hell's Canyon, Brownlee and Oxbow power projects on the

FIGURE 5.8. Idaho: Scenario Projected Water Quality Violations for Aggregated Subareas (ASA) by Pollutant Type in 1990

SNAKE RIVER, and 4) Federal Energy Regulatory Commission stipulations regarding minimum outflows at Hell's Canyon Dam (Pacific Northwest River Basins Commission 1979). Location of these facilities is shown in Figure 3.5.

- Maintenance of adequate instream flows required for fish and wildlife habitat, recreation, and other uses. Anadromous fish have particular needs for upstream and downstream migration, spawning, and rearing. Additional research is needed to establish and confirm minimum flow requirements and the suitability of present fish passage methods in order to maximize the benefits of multiple uses of limited water resources (Pacific Northwest River Basins Commission 1979).
- There are problems of finding adequate and acceptable sources of water for irrigation use. Competing nonconsumptive instream flow uses will continue to increase (Pacific Northwest River Basins Commission 1979).
- Because Idaho's border with Oregon and Washington is within the Columbia and Snake River systems, the interstate water relationships between the three states focus on the issue of how that system is managed. With expanding populations and economies placing greater demands on the water resources of the Columbia River system, interstate problems are increasing in significance and becoming more difficult to resolve (Pacific Northwest River Basins Commission 1979).

5.2.2.3 Scenario - Induced Changes

- The high demands placed on the limited water resources of southern Idaho may ultimately determine the course of energy development in that state. It is unlikely that any energy-related developments projected by the scenario will be allowed if they result in diminished quality or quantity of water resources already in short supply.
- Water quality impacts may result from any geothermal development carried out in the state. Geothermal waters are not normally sources of organic constituents. The pollutants of greatest concern, however, are heavy metals. Geothermal waters may contain measurable amounts of several metals. Some geothermal waters, particularly those with high salinity, contain metals in concentrations hazardous to humans, animals, and/or plant life. Waste heat in spent geothermal waters, if allowed to enter surface waters, is potentially dangerous to aquatic life. Sensitivity of most desirable aquatic organisms to temperature change is amplified because the optimum growth temperature often is within only a few degrees of the destructive temperature. Land subsidence and the potential for altering existing aquifers need to be studied.

5.2.3 Ecology

- Expansion of generation capacity at existing hydroelectric plants will further impact anadromous fish populations.
- Construction of new hydroelectric facilities will inundate riparian habitats and impede free-flowing streams.

5.2.3.1 Description

The state of Idaho contains a diverse assemblage of habitats and ecosystems, ranging from alpine meadows and dense coniferous forests in the mountainous north to sparsely vegetated arid plateaus of the south. Elevation ranges from 730 feet to 122,600 feet. Precipitation also shows wide variation, amounting to as little as seven inches in the south central plateaus to over 70 inches in the northern mountains. Recorded temperature extremes are -60 F and 118 F (Pacific Northwest River Basins Commission 1979).

Basically, the state consists of two distinct physiographic provinces; the northern Rocky Mountains and the Snake River Plateau. The northern Rocky Mountains area includes the rugged, mountainous Idaho Panhandle and central Idaho. The Snake River Plateau of southern Idaho is an extensive volcanic plateau ringed by mountains and consists of two subareas at different elevations and having different characteristics.

5.2.3.2 Background Issues

- Interspersion of native plant communities with areas modified by man has induced ecological stress on native plant, fish and wildlife populations. Further changes in land use and extensive development of agriculture will undoubtedly increase the stresses and reduce the amount of habitat available.
- In many areas, forest ecosystems are intensively managed for maximum timber production to the detriment of some components of the natural ecosystem.
- Continued discharges of SO₂ from smelters near Kellogg in Shoshone County have denuded the surrounding hillsides. The situation is improving (EPA 1978b), but the long-term, widespread effects of SO₂ on the surrounding area is largely undetermined.

- Expanding agriculture, especially irrigated agriculture, may have widespread effects on ground and surface water quality and aquatic ecosystems. Increased nutrients may cause increased eutrophication of receiving bodies of water.

5.2.3.3 Scenario - Induced Changes

- The scenario envisions expanded hydroelectric generating capacity for Idaho. This additional capacity is principally accommodated at existing dams. Construction and operation of these facilities will further impact anadromous fish populations. In addition, construction of new facilities will inundate riparian habitat and impede the free-flowing character of rivers and streams.

5.2.4 Land Use

- The major scenario-induced impact on land use will be due to construction of hydroelectric projects, which will cover some river canyons and bottom land.

5.2.4.1 Description

Land use capability is largely determined by the following physical factors: 1) character and kind of soil, 2) associated land features, and 3) climate. Most of the economy of Idaho is based upon use of the state's natural resources, primarily forestry, mining, agriculture, and recreation/tourism. Timber production and associated milling activities, as well as mining in the Kellogg-Coeur d'Alene area of Shoshone and Kootenai Counties, make up the major share of the economy of the northern Idaho Panhandle. Livestock production and associated hay farming is important in the broad valleys separating rugged mountain ranges in east central Idaho. The Snake River plateau supports an economy based mainly on agriculture. This area is extensively irrigated and produces row crops such as potatoes, beets, beans, corn, as well as wheat and hay. Livestock production includes sheep and beef cattle. Much of the land in southern Idaho is rangeland used for livestock grazing.

The mountains of northern Idaho support extensive forests of mixed species of true firs, Douglas fir, western larch, western red cedar, and white and ponderosa pine. The river basins of the Idaho Panhandle and lower Snake contain some 20.8 million acres of forest covering about 80% of the land in these areas (Pacific Northwest River Basins Commission 1979). Forests cover

41% of Idaho's total land area, make up about 4.4% of the Nations total forest area, and produce about 2.5% of the total timber cut (Pacific Northwest River Basins Commission 1979). The major portion of these forests are managed by the U.S. Forest Service as part of the National Forest System under multiple use concepts. Private harvest of national forests is managed and regulated to provide sustained yield. Much of this forested land is grass-covered, especially in east central Idaho, providing a significant amount of forest range for livestock.

Rangeland covers about 22.2 million acres of Idaho, making up about 43.7% of the total land area (Pacific Northwest River Basins Commission 1979). Bunch grass and other perennial grasses, and various perennial forbs and shrubs are typical of Idaho's rangeland. Open grasslands are characteristic of higher elevations and provide good summer range for cattle and sheep, as well as wildlife such as deer and elk. Rangelands at intermediate elevation, are often interspersed with timbered areas, especially in northern Idaho. Lower elevation rangeland contains more sagebrush and shrubs and covers a large portion of southern Idaho.

On all rangeland there are areas where the original desirable vegetation has been replaced by undesirable vegetation as a result of overgrazing, natural or man-caused fires, drought and other abusive uses. Noxious and poisonous plants are common in certain localities, greatly diminishing the value and amount of rangeland for livestock grazing and wildlife (BPA 1976). A fundamental problem facing the Bureau of Land Management, which manages most of the state's rangeland, is how to maintain and improve the quality of rangeland vegetation while providing for grazing by livestock (Pacific Northwest River Basins Commission 1979).

There are about 6.0 million acres of cropland in the state of Idaho, comprising about 11.7% of its total area. Of that 6.0 million acres, almost 60% of it is irrigated, primarily on the Snake River Plateau (Pacific Northwest River Basins Commission 1979). Irrigated land has a seasonal ground cover each year, while dry cropland used to grow wheat and barley is usually cropped every other year because of the scarcity of moisture (Pacific Northwest River Basins Commission 1979).

Only about 3.5% or 1.8 million acres of Idaho is devoted to uses other than those discussed. Such uses (or nonuses) include urban and industrial areas, roads and railroads, airports, bare rock and sand, and bodies of water.

5.2.4.2 Background Issues

- There is currently a heated debate over the outcome and implementation of the Roadless Area Review and Evaluation (RARE II) study conducted by the U.S. Forest Service. The study seeks to identify those areas best suited for inclusion into the Federal wilderness system and those best suited for other uses such as multiple use National Forests. A large portion of the RARE II lands under study in the Northwest are located in Idaho. Mining and timber industries contend that more lands should be opened for resource development or else the state's economy will suffer considerably. Preservationists argue that many of these lands are irreplaceable and should be closed to development for the enjoyment of future generations as wilderness.
- Urban land management problems include the effects of unplanned expansion of urban residential development into agricultural and flood hazard areas. Expansion onto agricultural land preempts valuable agricultural production.
- Mining area problems include loss or severe alteration of the land resource base by strip mining and waste disposal, and associated environmental degradation. There exists a need to restore areas damaged by past mining activities, particularly in the South Fork Coeur d'Alene district in Kootenay County and phosphate mines of southeastern Idaho near Pocatello in Bannock County (Pacific Northwest River Basins Commission 1979).

5.2.4.3 Scenario - Induced Changes

- Most of the hydroelectric generating capacity specified by the scenario can be met by expansion at existing facilities. If new facilities are needed, these will cover some river canyons and bottomland. Impacts will primarily be felt locally.
- Energy development may bring population and industrial growth and associated problems of further development.

5.2.5 Solid Waste

- No scenario induced impacts in the area of solid waste were identified.

5.2.5.1 Description

In 1976, 570,000 people, or about 60% of Idaho's population, was served by solid waste collection and disposal facilities approved by the state. This represents a 33% increase in five years. Some mining operations in Idaho produce large amounts of tailings which require proper management to prevent adverse environmental impacts. The forest products industries generate large amounts of solid waste. This waste could be utilized as a resource by using it in combustion boilers to produce industrial steam or electricity. Idaho has a state-licensed hazardous waste disposal facility which uses abandoned missile silos. It is one of two hazardous waste disposal sites in the region. Resource recovery is also being implemented in the state, especially in Nez Perce County where development of a solid waste recycling program is underway (EPA 1978b).

5.2.5.2 Background Issues

- Mine and smelter tailings near Kellogg in Shoshone County have contributed high concentrations of heavy metals to the Coeur d'Alene-Spokane River systems, adversely affecting the aquatic ecosystem (see Figure 5.8). Methods of disposal that prevent leaching of heavy metals or prevent their entry into local water courses must be further developed.

5.2.5.3 Scenario - Induced Changes

- No major scenario-induced changes are foreseen in the area of solid waste disposal. However, expanded energy supplies may promote industrial and population growth, which will generate increased volumes of solid waste.

5.2.6 Health and Safety

- No scenario-induced impacts in the area of health and safety were identified.

5.2.6.1 Description

Ninety-seven percent of Idaho's electric generating capacity is met by hydroelectric power. Health effects specifically associated with operation of the hydroelectric system have not been identified, but are considered to be negligible.

5.2.6.2 Background Issues

- Because no health and safety effects are identified relative to energy production in Idaho, no background issues have been identified.

5.2.6.3 Scenario - Induced Changes

- Since Idaho is expected to meet its energy demands by increased hydro-electric generating capacity and some geothermal development, few impacts on human health and safety are expected, other than possible increased incidence of occupational injuries associated with construction of these projects.

5.2.7 Socioeconomic

- The expansion of hydroelectric facilities in Idaho may cause local socioeconomic impacts, especially in rural communities that have little experience dealing with social and economic change.

5.2.7.1 Description

Idaho's population is predominantly rural, with 83.2% of its 857,000 residents in 1977 living in non-metropolitan area. Idaho's urban centers are located in its southeast and southwest sections. In 1977 there were 10.4 persons per square mile, placing Idaho 41st nationally in terms of population density. Population growth rates in the state jumped from 6.9% between 1960-1970, to 20.3% between 1970-1977, making it the sixth most rapidly growing state in the nation.

Although the state economy is based primarily on natural resource-dependent industries, employment is becoming increasingly concentrated in non-resource based industries, especially in the population centers of the state (Pacific Northwest River Basin Commission 1977). Unemployment rates are substantially below the national average, but may reach 15% or more in the Panhandle in winter reflecting the seasonal nature of the forest products industry (Pacific Northwest River Basin Commission 1977). Personal income in Idaho is largely dependent on the status of forestry, mining and agricultural sectors, and amounts to about 91% of the national average. Personal income is on the increase in Idaho because of continued economic growth and increased

economic stability in the Snake River Basin (Pacific Northwest River Basin Commission 1977). In 1977, the mean yearly personal income was \$5,980 as compared to a national average of \$7,019.

5.2.7.2 Background Issues

- Since Idaho is one of the more rapidly growing states in the country, with most of this growth occurring in nonmetropolitan portions of the state, residents are experiencing rapid social change. It is expected that conflicts may arise between newcomers and long-time residents who may not share common values with respect to further development.
- Idaho is, in some respects, one of the last frontier states, isolated in terms of its geography and predominantly rural in terms of settlement patterns. State government has recently focused on the conservation of limited resources, with a goal of a 5% reduction in projected energy use in the state by 1980 in conformity with national guidelines (Draft Idaho Energy Conservation Plan 1977). Within this context, there is likely to be conflict between pressures for economic growth and environmental preservation.

5.2.7.3 Scenario - Induced Changes

- Three hydro sites may cause some social and economic impacts in surrounding communities. The first is in Owyhee County. The existing dam will be raised and another dam will be constructed to regulate river flow. Assuming a moderate work force requirement, the small number and size of communities adjacent to the site suggest that even moderate immigration could strain nearby towns' facilities and services.
- The second hydroelectric site in Idaho that might have potential social and economic impacts is the project near the border of Elmore and Gooding Counties. It includes a new dam on the Snake River with three generating units, located near several small, unincorporated towns. This is an earthen dam which could generate some public concern for its safety. A recent draft environmental impact statement for a rock dam site in Washington State found public concern very high for a possible collapse of that dam. It can be assumed that in Idaho, where an earthen dam has recently collapsed, such concerns would also exist. The dam site is located within commuting distance of several large cities and is close to Interstate 80, which should facilitate commuting to the site.
- A third proposal for additional dams in Idaho which might generate social impacts is the planned series of new dams on the North and South Forks of the Payette River. While the exact locations of the dams is not known, it is possible to identify the area where they might be located. Few towns exist there, and most are unincorporated. The area is quite mountainous and rural. Boise, within a sixty mile range, is on the other

side of a mountain pass from the sites, making such long distance commuting difficult. Although socioeconomic impacts depend in part on the work force requirement, this situation is likely to produce a moderate level of impact.

- The other energy facility sites in Idaho identified in the scenario will likely produce some social impacts. Most are small additions to existing facilities, and it has been assumed that such additions require a smaller work force than a new construction project. Thus, there would be less social disruption and change.

5.2.8 Institutional

- No major institutional impacts are identified for Idaho.

5.2.8.1 Description

Virtually all of Idaho's electricity is generated by hydroelectric means. In contrast to Washington, Idaho is served primarily by regulated, investor-owned utilities. These privately owned utilities service about 86% of the state. The remainder is served by municipal utilities or rural electric cooperatives (U.S. Department of Energy 1976). However, Idaho's investor-owned utilities do not build and operate all the generating capacity upon which they rely for power. In some instances, they purchase power from facilities built in whole or in part by the Idaho Board of Water Resources. In still other cases, they rely on power marketed by BPA from facilities built and operated by the Army Corps of Engineers or the Bureau of Reclamation. Thus, different institutions are involved depending on who built the facilities.

Construction of a privately owned hydroelectric generating facility in Idaho requires the approval of several state agencies. The central role is played by the Idaho Public Utilities Commission, from which the utility must obtain a certificate of convenience and necessity before construction can begin (I.C. 61-503). The utility must also obtain a separate water permit from the Department of Water Resources, the state office charged with adopting a comprehensive program for the conservation, development, and use of all unappropriated water resources (I.C. 42-1759). The utility must see that its proposed facility complies with local land use requirements. A

proposed thermal or geothermal facility would also have to obtain an air quality permit from the Division of the Environment of the Department of Public Health.

In addition, the Board of Water Resources in the Department of Water Resources can build hydroelectric facilities itself, although it must market the power to investor-owned utilities or rural cooperatives.

And, of course, the U.S. Army Corps of Engineers and the Bureau of Reclamation can build dams and generating facilities whose power is marketed through the Bonneville Power Administration.

5.2.8.2 Background Issues

- Because of the existing preference clause in the Bonneville Project Act, most or all of the power generated from new Federal facilities would go to publicly owned utilities unless new Federal legislation reallocates BPA's hydropower. Since most power in Idaho is retailed by investor-owned utilities, this would mean exporting most of the power out of Idaho. Therefore, additional Federal hydroelectric projects are not apt to be very popular in the state.
- One current project in Idaho is motivated primarily by the desire to assure Idaho consumers continued access to relatively inexpensive hydropower. This is the proposal of the Idaho Board of Water Resources to add two new generating units to the Palisades Dam in southeast Idaho. This dam has been constructed and operated by the U.S. Bureau of Reclamation. The Board is proposing that the State finance the construction of the new units, and that the Bureau oversee construction, and when completed assume responsibility for their operation. The Board would then serve as marketing agent for the power generated. The Board's proposal would provide Idaho customers continued access to low-cost hydroelectric power by financing the construction and marketing of power from two new generating units in a Federal dam.
- Like other northwestern states, Idaho's geothermal resources are primarily moderate temperature hot water. Although this sort of resource has obvious application as a direct heat source, technology for generating electric power from moderate temperature hot water resources has not yet been perfected. However, the R&D for this technology is being performed by DOE at Raft River, Idaho, at the urging of a local rural electric cooperative and with the participation of other regional utilities. This situation has several favorable implications. First, the two pilot plants themselves could make a small contribution--10 MWe--to Idaho's electrical generating capacity. Second, if the useable reservoir at Raft River proves to have the currently estimated potential of 50 MWe electric, and if certain institutional barriers can be overcome, Raft

River could contribute perhaps 50 MWe electric to the state's power supplies by 1990. Third, the physical proximity of the technology and the present early involvement of local utilities, federal agencies, and state regulators could ease the transfer of the new technology to developers and users of the resources in other areas of Idaho over the next decade or so.

5.2.8.3 Scenario - Induced Changes

- As in other states, realization of the geothermal portion of the scenario faces severe technical and economic problems. However, Idaho is where the necessary moderate temperature power generation technology is being developed. The U.S. Department of Energy, the Idaho Water Resources Board, and various state utilities are participating. Therefore, if the technology proves commercially feasible, the institutional climate appears relatively favorable for future development.

5.3 OREGON

Oregon's base load electric generating capacity is largely based on hydroelectric power, a renewable resource. The state is actively evaluating the potential for using other renewable resources, such as geothermal, biomass, and wind, for the production of electrical power. Geothermal energy is currently being used directly for space heating in the Klamath Falls area and is under consideration as a source of heat to meet process steam needs for food processing at a site in eastern Oregon. Biomass is also being used for energy production. A Weyerhaeuser Company plant in Springfield, Oregon, is generating electricity from biomass. In addition to the use of renewable resources, Oregon is also adding thermal power capacity. A nuclear plant is presently in operation and a coal plant using coal imported from Wyoming is being constructed. Development and continued interest in Oregon's renewable resources reflect the state's desire to maintain a high environmental quality.

Oregon appears to be one of the most environmentally conscious states in the nation. The state enjoys a generally clean environment and great opportunities for outdoor recreation. Air quality problems are restricted to urban areas, agricultural areas where grass seed fields are occasionally burned, and areas where forest product mills burn their wastes. Electric generating projects utilizing forest products and municipal solid wastes are under construction or in planning. Water quality is generally good except in some rivers in the southwestern portion of the state where dams combined with land use practices such as logging and agriculture have caused problems of high temperatures during low flows, turbidity, and eutrophication. Agricultural runoff has caused the eutrophication of small lakes and streams in some areas. Since Oregon's electrical energy needs are expected to be met primarily by hydroelectric generation, further water quality impacts can be expected. In an attempt to gain access to low-cost Federal hydropower, the Oregon Legislature has created the domestic and rural Power Authority to qualify the entire state as a "preference" customer. Substantial public opposition to nuclear power exists in Oregon where conservation and "soft path" technologies enjoy more widespread acceptance.

The Oregon scenario specifies a 1990 level of electric generation capacity of 13,102 MWe. The generating capacity by technology is given in Table 3.3. The scenario specifies additions to generation capacity in conventional hydroelectric, pumped storage, nuclear, coal, oil direct drive, oil steam, and geothermal technologies. Combined cycle capacity is reduced from 585 MWe to 100 MWe over the period. The location of Oregon energy facilities are shown in Figure 3.5.

Issues have been identified for Oregon that could impede development of additional generating capacity projected by the scenario. This will apply to geothermal, nuclear, and hydroelectric facility development in Oregon. Additions to existing hydroelectric facilities could further reduce the already depleted anadromous fish runs, thus jeopardizing a valuable Regional resource. Also, further use of the Columbia River for hydroelectric production will lead to water availability conflicts between fishery, agriculture, and hydroelectric power requirements. Geothermal and nuclear development will be impeded because of unresolved institutional and environmental issues. Because all of the facilities will be located in rural areas, socioeconomic impacts can be anticipated. Such impacts, however, are not expected to prevent construction of the facilities. Industrial facility sitings will be restricted in all non-attainment areas and in all areas where PSD increments will be exceeded.

5.3.1 Air

- Additional industrial facilities sited by the scenario will cause one Air Quality Control Region to remain in non-attainment status in 1990 (Figure 5.9).

- Under the scenario, three counties will exceed PSD Class I increment standards in 1990 (Figure 5.10).

- A visibility decrease of up to 13% is projected for Class I areas in northwestern Oregon. Other Class I areas in southern and eastern Oregon are projected to have increased visibility (Figure 5.11).

FIGURE 5.9. Oregon: Scenario Projected Nonattainment Air Quality Control Regions in 1990

FIGURE 5.10. Oregon: Scenario Projected PSD Increment (TSP or SO_2) Exceeded in 1990

FIGURE 5.11. Oregon: Scenario Projected Visual Range for Mandatory Class I Areas in 1990, Miles

5.3.1.1 Description

Nine of Oregon's 36 counties (location of Oregon counties by name is shown in Figure 2.6) experienced recorded concentrations of pollutants that exceeded the allowable maximum specified by primary air quality standards during the three-year period ending in 1976 (see Figure 5.12). Particulate matter (TSP) resulting mainly from fugitive dust is the most widespread cause of an exceeded standard. (Sources of fugitive dust are discussed in Section 4.2.11.) Concentrations above the primary particulate standard occurred in all of the nine counties (except Marion County), in which air quality standards are not met. The carbon monoxide standard (CO) was exceeded in Marion, Lane, Jackson, and Multnomah Counties. The standard is exceeded 15% of the days in a year in Multnomah County, and 5% of the days in Jackson County. The oxidant standard (O_3) is exceeded in Marion, Lane, Jackson, Multnomah, and Clackamas Counties. Violations occur in Jackson County on about 8% of the days in a year and in Clackamas County on about 3% of the days (EPA 1978c).

Overall, Oregon's air quality improved between 1974 and 1976. Where trends could be established, all but one county is either improving or

FIGURE 5.12. Oregon: Counties Not Currently Meeting Ambient Air Quality Standards

Source: EPA 1978c

remaining the same. Benton County faces rising levels of sulfur dioxide; while there is presently no evidence that the primary standard is being exceeded, this may become a problem in the future (EPA 1978c).

There are eleven Class I areas in Oregon. A discussion of air quality standards applied to Class I areas is given in Section 4.1.1 and the areas are identified in Figure 4.1. Calculated visual range for Class I areas in Oregon are shown in Figure 5.11.

5.3.1.2 Background Issues

- While point sources of particulates can be controlled with reliable, relatively inexpensive technology, fugitive dust is responsible for a large share of Oregon's particulate problem (sources of fugitive dust

are discussed in Section 4.2.1.) Thus, even though further control of point sources will reduce the frequency and severity of violations, air quality violations will continue until area and fugitive dust sources are also controlled (EPA 1978c).

- Transportation is responsible for almost all the carbon monoxide emissions in Oregon urban areas. Recently, carbon monoxide emissions have decreased partly because of Federal emission standards on motor vehicles and partly because of less burning of solid waste. A reduction of over 14% in 1976 is credited to the Portland Inspection and Maintenance Program (EPA 1978c).
- The private automobile is responsible for more than 90% of the carbon monoxide concentration in those counties where the standard is not met.
- Transportation related sources, solvent evaporation, and gasoline evaporation account for almost one-half of the emitted hydrocarbons in the state.

5.3.1.3 Scenario - Induced Changes

- Additional industrial facilities cited by the scenario will cause one Air Quality Control Region to remain in nonattainment status in 1990 (Figure 5.9). This means that the projected industrial development can not occur unless "offsets" can be obtained.
- Under the scenario three counties (Klamath, Lane, Marion) will exceed PSD Class I increment standards in 1990 (Figure 5.10). The PSD Class I increments are given in Table 4.4. This means that the projected industrial development can not occur unless proper pollution control technology is applied and emission levels remain below the PSD increment levels.
- A visibility decrease up to 13% is projected for Class I areas in northwestern Oregon. Other Class I areas in southern and eastern Oregon are projected to have increase visibility (Figure 5.11). The decreased visibility in northwestern Oregon results from the industrial activity in the Air Quality Control Region to the west. Visibility is projected to increase in southern and eastern Oregon; this will occur as a result of the timber industry coming under compliance in the 1980's.
- The scenario specifies 1200 MWe of expansion in hydroelectric capacity to be provided by increasing the number of turbines at existing hydroelectric facilities. Location of Oregon energy facilities is shown in Figure 3.5. The Brownlee and Bonneville expansions are currently underway. Other facilities under consideration for expansion include John Day, McNary, Oxbow, and Prospect No. 2. One new pumped storage facility of 150 MWe capacity will need to be developed. In addition to these

hydro facilities, one nuclear, one coal, four (50 MWe) geothermal plants in Deschutes County, and four (50 MWe) geothermal plants in Lake County are to be constructed during the period. Addition of this hydroelectric and thermal generating capacity may produce localized short-term air quality impacts from fugitive dust during construction, depending on dust control practices.

- The scenario specifies 400 MWe geothermal generating capacity in Oregon by 1990. Local air quality impacts in Deschutes and Lake Counties will result from the construction and operation of such facilities. Most of the noncondensable gases or vapors that have been found in geothermal fluids are relatively innocuous and are normal components of the atmosphere. Some, however, normally are not significant atmospheric components. Of these, hydrogen sulfide is currently of the most concern. Other emissions likely to be regulated in the future include ammonia, mercury, arsenic, and radon. Boron, in the form of boric acid, may also be emitted in cooling tower drift.

5.3.2 Water

- Industrial facilities sited by the scenario in ASA 1705 area will contribute to existing water quality violations (Figure 5.13).

FIGURE 5.13. Oregon: Scenario Projected Water Quality Violations for Aggregated Subareas (ASA) by Pollutant Type in 1990

FIGURE 5.14: Oregon: Current Water Quality Violations for Aggregated Subareas (ASA) by Pollutant Type

5.3.2.1 Description

Of the 19 rivers in Oregon, eight are partly polluted and some or all of the reaches of another seven only provisionally meet Federal water quality goals. The lower reaches of two tributaries of the Snake River in eastern Oregon, the Malheur and the Owyhee, do not meet Federal goals for water quality and are unsuitable for propagation of salmonid fish and for unrestricted recreational use (EPA 1978c). Portions of five streams (mainstream Middle Snake; Klamath in Klamath County; Bear Creek, tributary to the Rogue River; Umatilla, tributary to the Columbia River; and Tualatin, tributary to the Willamette River) have poor water quality. Other rivers, mostly located in sparsely populated areas where the predominant land use is forestry, have good water quality.

Water quality problems in the Oregon rivers include high solids concentrations, heavy metals, organic matter contributing to low dissolved oxygen concentrations, and nutrient concentrations capable of causing nuisance growths of algae. Baseline concentrations for pollutants that exceed standards are shown in Figure 5.14. These types of contamination are common to many of the rivers in the eastern, agriculturally-oriented portion of the state, as well as in the more populated areas of the Willamette River system. High temperatures mainly occur in waters of the state where intensive land use for irrigation and low summer flows are prevalent.

It appears that little significant change in water quality can be anticipated in the next three to five years (EPA 1978c). With a few exceptions, the major water quality problems of Oregon do not stem from municipal and industrial waste discharges, which in the past were the primary targets of pollution abatement programs. Water pollution in rivers and lakes in the state results from intense land and water use, reservoir conditions, and natural runoff. Waste treatment is already well advanced in Oregon; however, some water quality problems still exist, especially in the more densely populated western portion of the state where waste treatment is inadequate. Further improvement in Oregon's waste treatment program is needed to achieve water quality standards in these areas, as well as the coastal areas where

shellfish harvesting is jeopardized by bacteriological contamination.

Measures to reduce water quality impacts from runoff, stream regulation, and improper land management largely remain to be defined, although programs are presently underway to determine the magnitude and extent of these impacts.

In eastern Oregon, a major source of phosphorus appears to be from agriculture and natural occurrences. Runoff in this area contributes most of the phosphorus in the mainstream Snake River and its tributaries (EPA 1978c).

Direct industrial and municipal waste discharges do not contribute significantly to suspended solids in Oregon streams (EPA 1978c). Erosion resulting from land management practices in agriculture and forestry are the main source of suspended solids (PNL 1978). In the Willamette River, and to a lesser degree in the Santiam and Tualatin Rivers, suspended solids are due to industrial and municipal waste discharge (EPA 1978c). Most organic matter in these rivers results from runoff associated with urban and rural lands, and other nonpoint sources (EPA 1978c). However, during low flows municipal and industrial discharges account for much of the observable biochemical oxygen demand (BOD).

Coos Bay in Coos County, Tillamook Bay in Tillamook County, and Yaquina Bay in Lincoln County comprise the most important shellfish growing waters in the state. Most of these waters are closed or conditionally approved for the commercial harvest of shellfish. Restrictions on shellfish harvesting result primarily from high bacterial levels caused by municipal sewage treatment plant discharges or seasonal increases in freshwater runoff from agricultural and logging areas (EPA 1978).

5.3.2.2 Background Issues

- Development of an extensive system of hydroelectric and water storage facilities in Oregon has changed the water temperature profile for some waterways.
- Because Oregon's border with Idaho and Washington is within the Columbia and Snake River systems, interstate water relationships between the three states focus on the issue of how that system is managed. With expanding populations and economies placing greater demands on the water resources

of the Columbia and Snake River systems, interstate problems are increasing in significance and becoming more difficult to resolve (Pacific Northwest River Basins Commission 1978).

5.3.2.3 Scenario - Induced Impacts

- The nuclear and coal-fired facility additions specified by the scenario use man-made reservoirs for water supply; therefore, no significant water availability or water quality impacts on existing river systems will result from facility construction and operation. As thermal plants are added to the regional electric system, the hydroelectric plants will be used more and more to produce peaking power. The use of hydroelectric facilities for load following and peaking power will increase the rate of bank erosion and thus effect water quality on the Columbia and Snake Rivers because of increased frequency and amplitude of water level fluctuations.
- Water quality impacts may result from any geothermal development carried out in the state. Geothermal waters are not normally sources of organic constituents. The pollutants of greatest concern, however, are heavy metals. Geothermal waters may contain measurable amounts of several metals. Some geothermal waters, particularly those with high salinity, contain metals in concentrations hazardous to humans, animals, and/or plant life. Waste heat in spent geothermal waters, if allowed to enter surface waters, is potentially dangerous to aquatic life. Sensitivity of most desirable aquatic organisms to temperature change is amplified because the optimum growth temperature is within only a few degrees of the destructive temperature. Land subsidence and the potential for altering existing aquifers also need to be studied.
- Any further use of the Columbia River for hydroelectric production will lead to water availability conflicts between fisheries, agriculture, and hydropower requirements. Because of this competition, the availability of water to meet the scenario requirements for hydroelectric power is uncertain.

5.3.3 Ecology

- The scenario envisions expanding hydroelectric generating capacity in Oregon. Construction and operation of hydroelectric facilities will impact anadromous and resident fish and wildlife by altering stream flows.
- Extensive areas of SO₂ sensitive crops lie downwind of a coal-fired plant located in Morrow County.
- Continually fluctuating water levels associated with pumped storage and use of hydroelectric capacity for peaking could adversely affect aquatic ecosystems and wildlife habitat.

FIGURE 5.15. Oregon: Percent of County Covered by SO₂ Sensitive Crops

5.3.3.1 Description

Oregon consists of three broad geographical areas lying roughly parallel to each other in a north-south direction: 1) the low, wet, coastal zone on the western slopes of the Coast Range, 2) the drier system of interior valleys between the Coast and Cascade Ranges, and 3) the high, arid area east of the Cascades characterized by wide daily and seasonal temperature variations. Of both state and regional importance is the Snake River running along much of Oregon's eastern border and the Columbia River along most of the state's northern border (Pacific Northwest River Basins Commission 1979). These rivers are shown in Figure 2.1.

Oregon has highly valued fish and wildlife resources. It shares the anadromous fishery of the Columbia River with Washington and Idaho. Anadromous fish such as salmon and steelhead trout also use the streams and rivers entering the Pacific along the coastal slope. Oregon tributaries which feed the Columbia and the Snake River downstream of Hell's Canyon Dam support the spawning activity of a significant portion of the Columbia River system anadromous fishery (Pacific Northwest River Basins Commission 1979). The Columbia and some of the coastal streams support growing runs of shad and white sturgeon, and the south coastal streams support striped bass.

A wide variety of wildlife exists in Oregon. The western forests support large mammals such as elk, black bear, white-tail and black-tail deer; smaller mammals including fur-bearers such as beaver; and predatory birds such as eagles, falcons, hawks, and owls. The high arid plateau supports many rodent species, mule deer, pronghorn antelope, many insect species, and birds of prey. Resident gamefish include catfish, bass, crappie, and bluegill in the lower warmer reaches of the Willamette, Rogue and Umpqua Rivers to rainbow, cutthroat, brown, and brook trout in the colder streams and lakes. Kokanee salmon are found in many lakes and reservoirs and whitefish in many upper tributary reaches (Pacific Northwest River Basins Commission 1979). Coastal waters support many different species of fish including lingcod, red snapper, kelp greenling, rock bass, flounder, and perch. Crabbing is common along the coast and several species of clams are harvested in bays, estuaries, and along open beaches. Oysters are raised commercially. Wintering waterfowl are also found in Oregon, along with several species of upland game birds.

Demand of these fish and wildlife resources is steadily increasing as commercial and recreational fishing and hunting increase. These pressures are compounded by problems of loss of habitat or deterioration of habitat quality already facing fish and wildlife (Pacific Northwest River Basins Commission 1979). A specific problem for coastal-stream anadromous fish is seasonal low-flows and high water temperatures.

5.3.3.2 Background Issues

- Loss of spawning and rearing areas of anadromous fish has occurred because of the construction of dams on tributaries of the Willamette, Deschutes, and Middle Snake Rivers which blocked passage to previously accessible spawning areas (Figure 4.3). Fish passage does occur around many dams but mortality rates can be high. Juvenile losses from all causes have been estimated at 15 to 20% at each mainstem dam as they migrate downstream. Additional fishing pressure from an increasing number of commercial and sport fishermen also contributes to depletion of anadromous fish populations.

5.3.3.3 Scenario - Induced Changes

- The scenario envisions expanding hydroelectric generating capacity in Oregon. Construction and operation of the hydroelectric system will negatively impact anadromous and resident fish and wildlife by altering stream flows and downstream temperature regimes, and by increasing turbine mortality.
- Increased atmospheric concentrations of sulfur dioxide are associated with the coal-fired generating plant in Morrow County projected by the scenario. Several species of native vegetation, particularly various species of grasses such as fescue, bluegrass, and bunchgrass as well as trees such as mountain hemlock and red alder, are sensitive to this pollutant. Douglas fir and sagebrush are somewhat more resistant. Several important crops are also sensitive to SO₂, including hay, fruit, wheat, and other grains. Such crops cover more than 30% of some counties in north central Oregon. Estimates of probable atmospheric SO₂ levels associated with the coal-fired power plant suggest that significant ecological impacts are unlikely.
- Development of thermal electric facilities will result in a shift of hydroelectric generation capacity from base load generation to peak load generation. This will result in fluctuating water levels, which can adversely impact aquatic ecosystems (Section 4.2.3).

5.3.4 Land Use

- Construction of a nuclear power plant in Gilliam County will require 9200 acres, 378 of which will be occupied by buildings. The coal-fired plant in Morrow County will require 2200 acres, 350 of which will be used for buildings. The majority of land in both cases will be covered by man-made cooling reservoirs (Figure 5.16).

FIGURE 5.16. Oregon: Projected Land Use by County for Thermal Power Plants in 1990

5.3.4.1 Description

Almost half of the land area of the state is classified as forest. Almost 90% of that forest is classified as suitable for commercial production. Douglas fir is the dominant species in almost half of Oregon's 27 million acres of forest land. Western Oregon, with 20% of the Region's commercial forest acreage, provides about 44% of the Region's timber harvest; eastern Oregon, with 13% of the Region's commercial forest acreage, provides about 6% of the Region's timber harvest (Pacific Northwest River Basins Commission 1979).

Rangeland occupies the second largest area of land in Oregon, totalling about 22.7 million acres. About 58% of this is Federally owned. About 6.5 million acres, or 29% of the total range, is grassland. Another 5.3 million acres of land is cropland, of which about 1.7 million acres is irrigated. Land classified as "other" totals about 2.3 million acres, and is increasing because of development activities. Included are urban and industrial areas, barren areas, small bodies of water, roads, and farms.

The state's vast timberlands support a diversified forest products industry of lumber, plywood, pulp and paper products, and numerous specialty products. Oregon has been the leading softwood timber producer in the United States for the past several years, largely because of a high production rate on private lands in western Oregon. The forests also supply a growing export market in logs, lumber, plywood, and wood chips. In addition to support of the forest products industry, forest lands and waters are important as fish and wildlife habitats. They provide a variety of outdoor recreation activities, and comprise major watersheds (Pacific Northwest River Basins Commission 1979).

Much of Oregon's rangeland was overgrazed in the past. This has resulted in the loss of vegetative cover, wind and water erosion, and a major decline in natural range forage productivity. In some areas, intensive rangeland development programs have improved both the vegetative and erosion conditions, but other areas still lack adequate protection or adequate rehabilitation measures (Pacific Northwest River Basins Commission 1979).

Other land areas in Oregon (urban, industrial, roads, etc.) consist of about 2.4 million acres, or 4% of Oregon's land area, and is projected to increase to about 2.9 million acres, or 5% of the land area by the year 2000. Most of that increase is expected to be in the Willamette Valley through urbanization and industrial development that will replace present cropland. A probable consequence is the conversion of some forest and rangeland to agricultural uses to compensate for the lost cropland (Pacific Northwest River Basins Commission 1979).

5.3.4.2 Background Issues

- Hydroelectric projects have inundated large areas. These projects are often in sparsely populated or forested areas. The impact of this land conversion generally has been accepted.
- An estimated 2 million acres of cropland in Oregon presently have an erosion problem. Nearly all croplands have erosion potential.

5.3.4.3 Scenario - Induced Changes

- The nuclear site in Gilliam County includes a man-made cooling reservoir which encompasses 9200 acres. The coal-fired site in Morrow County will cover about 2200 acres, most of it devoted to a man-made cooling reservoir. In both counties, rangeland is the predominant land use. The reservoirs are designed as multiple use reservoirs and will be a source of water for livestock and irrigated agriculture.
- Expansion of hydroelectric power may inundate land areas now used for other purposes. For example, a pumped storage facility is projected by the scenario for Oregon. This facility has not been sited; therefore, specific land use impacts cannot be anticipated.

5.3.5 Solid Waste

- The quantity of solid waste generated by the coal and nuclear facilities specified by the scenario will be small. Short-term storage of the nuclear waste and long-term disposal of the coal and will be handled onsite (Figure 5.17).

FIGURE 5.17. Oregon: Solid Waste Residuals from Coal-Fired Energy Facilities

5.3.5.1 Description

About 78% of Oregon's population was served by state-approved solid waste disposal sites in 1976 (EPA 1978c). One of two state-licensed hazardous waste disposal sites in the Northwest is located in Oregon. It is located near Arlington in Gilliam County.

In 1974, the Eugene Water and Electric Board conducted a feasibility analysis of burning municipal wastes in a steam electric generating plant. They concluded that, with power revenues generated at the plant helping to defray part of the costs, this method of solid waste disposal was economically competitive with other environmentally acceptable methods. Resource recovery projects are in the planning or construction stage throughout the state.

5.3.5.2 Background Issues

- Nuclear waste generated at the Trojan nuclear power plants is presently stored onsite pending long-term disposal. Oregon has passed a law (ORS 469.525) stating that a site for long-term disposal of nuclear waste can not be located in that State.

- Oregon's concern for the quality of its natural environment is reflected in legislation banning "pop-top" and nonreturnable beverage containers.

5.3.5.3 Scenario - Induced Changes

- The coal-fired generating plant under construction in Morrow County will produce about 84,000 tons of ash annually, requiring about 10 acres of land per year for disposal (Pacific Northwest Generating Company 1976). This is not expected to present any serious problems of waste management as land is presently available and is specified as a disposal site.
- The proposed nuclear plant in Gilliam County is expected to produce about 429 tons of waste annually, some of it high-level radioactive waste. Since only one plant is expected to be operational by 1990, the amount of solid waste actually generated within the scenario time frame will be less. Pending a decision on the ultimate disposal of radioactive wastes, the waste generated at this plant will be stored on-site.

5.3.6 Health and Safety

- No serious health and safety impacts are identified for Oregon.

5.3.6.1 Description

A health and safety concern related to energy development in Oregon is the handling and disposal of radioactive waste. Oregon has no long-term repository for storage of radioactive waste; therefore, Oregon presently sends some low-level radioactive wastes for storage to the Hanford Reservation operated by DOE near Richland, Washington.

Nine Oregon counties have experienced some air quality problems. These counties and the air pollutants are identified in Section 5.3.1.1. The air concentrations of some pollutants have at times exceeded alert levels for CO, O₃, and total suspended particulates (TSP).

5.3.6.2 Background Issues

- Oregon experiences some air quality problems, which at times exceed the alert level (Figure 5.12). At alert levels, there is some health risk.

5.3.6.3 Scenario -Induced Impacts

- No major health and safety impacts caused by implementation of the scenario are identified for Oregon.

- The annual radiation dose to the population surrounding the Gilliam County nuclear plant will be less than the normal fluctuation in naturally occurring background radiation, barring any uncontrolled releases.
- Health effects associated with air pollution and fuel transportation from the Morrow County coal-fired plant are expected to be minimal. Lead lab information predicts a rate of 2.8 - 45 deaths per million person-years.

5.3.7 Socioeconomic

- Construction of energy facilities in rural or partially isolated areas in Oregon will cause moderate to high socioeconomic impacts.

5.3.7.1 Description

Oregon's population is concentrated west of the Cascades with more than 70% in the Willamette Basin. The state population nearly doubled from 1940 to 1970. The 1970 population of about 2.1 million increased by more than 2.3 million by July 1976. Most of the future growth is expected to be in the areas that are presently heavily populated (Pacific Northwest River Basins Commission 1978). Currently 59.9% of the population lives in metropolitan areas, while 40% lives in non-metropolitan areas. The rate of population growth between 1970 and 1977 was 13.6% for the state. Sixty-seven percent of this population change was due to net immigration.

In 1977, the average yearly personal income in the state was \$7,007, placing Oregon 20th among states. The U.S. average for the same year was \$7,019. The most recent figures for state poverty levels indicate that in 1975 8.9% of the state's population (or 6.7% of the households in the state) were classified as poverty level, compared to national averages of 11.4% and 9.0% respectively. Historically the lumber industry has accounted for much of the employment in the state, although this trend has been changing in recent years (Oregon DOE 1978). Other major industrial employers include food processing and paper. Trade and government services also account for much employment in the state.

5.3.7.2 Background Issues

- Agricultural areas in central Oregon and the Willamette Valley are expected to experience rapid growth in the near future, regardless of the development of proposed energy facilities. Wilderness preservation and reduced immigration from other states enjoy considerable support in Oregon. Public attitudes about the availability of energy and the economic and social costs associated with energy and industrial development will continue to raise important socioeconomic issues.
- Energy conservation is an issue that has widespread social and economic implications. Some groups feel strongly that conservation is a viable alternative to continued expansion of energy facilities. While there is a potential for conflict among supporters of conservation and people who are in favor of industrial expansion requiring increased energy use, the government must decide how strong a role to play in determining the balance between increased energy use and conservation. This represents an important socioeconomic issue that must be resolved.

5.3.7.3 Scenario - Induced Changes

- There are several energy facility sites in Oregon that will cause moderate or high levels of socioeconomic impacts. These sites are characterized as rural, partially isolated areas. These impacts are not anticipated to impede construction of the facilities.
- Geothermal facilities are likely to be sited in two areas: Lake County (near the Crump Geyser), and Deschutes County (near Bend, Oregon). Both are in eastern Oregon. In Deschutes County, a geothermal development could presumably draw from Bend (1970 population 13,710) for construction and operating workers. Other than Bend, there are few small towns in the area. These local communities will have some difficulty supporting even a limited construction and operations work force. The territory is quite mountainous and long-distance commuting, such as from western Oregon, is not very feasible. The largest town within a sixty mile radius of the Lake County (Crump Geyser) site is Lakeview (population 2705). Thus, there may be significant problems accommodating any immigration of population associated with the geothermal development since the county has an extra low assimilative capacity. Because of the rural, isolated nature of both sites, moderate levels of socioeconomic impacts can be expected.
- The McNary Dam is an existing dam in Umatilla County, and while the expansion is of an existing facility, it is a large construction project that could potentially generate social impacts. The uncertainty of the available labor force in the local area (thus the possibility for a

large, temporary population increase) and the potential problems of an equitable distribution of impacts among several jurisdictions led to the assessment that a moderate impact would be incurred at this site.

- A second hydroelectric site, which is also identified as incurring a medium impact, is the Bonneville Dam in Multnomah County. Although this is an addition to an existing facility near a heavily populated area of Oregon, there may be social impacts because of the size of the project. Such a construction project could cause a local boom with a population influx, accompanying rising prices, and increased demand for local services and facilities.
- A new hydroelectric facility is also indicated in Polk County, providing 1997 MWe of power by 1985. If such a facility were to be built, the size of the project is such that almost certainly there would be some social and economic impacts in terms of increased prices, congestion, and a strain placed on housing and public facilities.
- An addition to John Day Dam in Sherman County will add a construction work force to a relatively rural county. This could put some strain on the existing small town services and facilities, and cause a shortage of housing.
- The proposed nuclear facility in Oregon would probably generate a high level of socioeconomic impact. The facility, Pebble Springs, is proposed to be built at Arlington (pop. 376) in Gilliam County. A large construction force peaking at 1100 to 1200 is expected for the plant. Even if only 20% of the work force lives in the area, service and facility problems can be expected. Gilliam County is identified as having a very low assimilative capacity.
- Boardman, Oregon, in Morrow County near the Washington border, is the site of a coal-steam project that will generate moderate impacts. The construction force is expected to peak at 914 in 1978. Although some of the construction force will presumably commute long-distance from the Tri-Cities and Pendleton, the problem remains of having one county absorb most of the impact and another county (or state) most of the benefit.

5.3.8. Institutional

- Institutional changes may occur as a result of implementation of the nuclear portion of the scenario, since political opposition to construction of the Pebble Springs plant is significant. Other impacts will result as lead times will have to be shortened in order to meet scenario deadlines.

5.3.8.1 Description

Institutional roles in Oregon's energy development are shared by private, federal, and state institutions. The major private role is played by the state's investor-owned utilities, which supply some 63% of the electrical load (DOE 1978). Oregon's investor-owned and publicly owned utilities alike rely heavily on hydroelectric power. Utilities purchase the bulk of their hydroelectric power at wholesale prices from BPA supplies, which are generated at Federal projects on the Columbia River and its tributaries in Washington and Idaho as well as Oregon. Because the Bonneville Project Act, 16 U.S.C. 832-832D, gives public agencies preferential access to Federal hydropower, Oregon's investor-owned utilities face difficulties in supplying their customers because Bonneville's supplies are not keeping pace with demand. As a consequence, the Oregon legislature in 1977 enacted legislation attempting to qualify the entire state of Oregon as a BPA preference customer to be known as the Oregon Domestic and Rural Power Authority (DRPA). DRPA would channel Federal hydroelectric power to existing Oregon investor-owned and publicly owned utilities. By the terms of the legislation, DRPA powers were to commence March 1, 1979, if the U.S. Congress had failed to enact a Regional power bill satisfactory to the Oregon governor (1977 OR Laws Ch. 888). Although Governor Atiyeh has instructed the Public Utilities Commission to begin hearings to set up DRPA, he has also indicated he wishes to await the outcome of Regional energy legislation in Congress. To this end, a bill to delay implementation of DRPA for one year has been introduced in the Oregon legislature. Oregon's utilities are also proceeding with the planning and construction of their own nuclear, hydroelectric power generating facilities.

Development of non-Federal power generation facilities is subject to the jurisdiction of the Oregon Energy Facilities Siting Council (EFSC) (ORS, 469.300-469.570). Developers of power generating facilities with a nominal capacity of more than 25,000 KWe must obtain a site certificate from EFSC. The council consists of seven public members appointed by the governor. It receives notification of intent to file an application, receives applications for site certification, sends copies to specified state agencies and affected

cities and counties, studies the site application independently or with outside assistance, holds public hearings, and approves, conditionally approves, or rejects the site application.

Approval or rejection is subject to judicial review by the Oregon Supreme Court. Once the certificate of approval becomes final, it binds the state and all its political subdivisions to the approval of the site and construction and operation of the facility. Affected state agencies and political subdivisions must issue the appropriate permits, licenses, and certificates necessary for construction and operation of an approved facility (ORS 469.400). These include necessary permits (when applicable) issued by the Department of Geology and Mineral Industries, the Division of State Lands, the Department of Transportation, the Department of Environmental Quality, the Department of Fish and Wildlife, and the Oregon Department of Natural Resources.

Several state agencies also have a general impact on the construction and operation of energy facilities. The Oregon Department of Energy, created in 1975, engages in research projects related to energy, collects data on energy, informs the public, and annually provides a preliminary and final forecast of energy supply and demand that defines the state's need for power (ORS 469.030). EFSC takes need for power into account in passing on applications for site certification. The Oregon Public Utility Commission regulates the rates of investor owned utilities (ORS 756.036). Finally, EFSC has ongoing regulatory responsibility with respect to the operation of nuclear power plants and the transportation of nuclear materials (ORS 469.530).

5.3.8.2 Background Issues

- State leaders differ as to what new regional power arrangements should be adopted to enable Oregon utilities to gain some access to Federal hydro power and to finance new generation facilities. Until Oregon's investor-owned utilities have access to Federal hydro power through the Bonneville Power Administration or some other regional entity, long-term power planning in the state will be difficult.
- In November 1978, Oregon voters approved Ballot Measure 9, which prohibits utilities from directly including charges for construction work in progress (CWIP) in their rate base. This measure is likely to make the financing of thermal power plants more difficult.

5.3.8.3 Scenario - Induced Changes

- In order for the scenario to be implemented, one of the two units of the planned Pebble Springs nuclear plants would have to be completed by 1990. Although completion is currently planned for 1989, institutional constraints and political opposition are likely to delay completion beyond 1990. Political opposition to nuclear power in the state is significant, and opponents have some levers to delay or possibly halt the Pebble Springs power plant. State site certification hearings have been reopened to consider the implications of the accident at Three Mile Island. Although EFSC was previously expected to approve site certification, the outcome may change or be delayed in these circumstances.

5.4 WASHINGTON

Washington is the most populated state in the Region and the most extensively developed, yet it still enjoys a high quality environment. Its air quality is generally good except in urban areas when temperature inversions occur and in the semi-arid, agricultural portions of the state east of the Cascade Range where dust problems occur. Existing water quality is good and pollution abatement programs are well developed. Conflicts between competing uses of Columbia River water will become more severe in the future, especially when destruction of the Region's important anadromous fishery is considered. The state produces more hydroelectricity than any other in the Region and is served primarily by public utilities with low-cost power from Federal projects.

Eighty-five percent of Washington's electrical generating capacity is provided by hydroelectric facilities. This resource base is being complemented by the addition of thermal steam generating capacity. A dual purpose Department of Energy nuclear plant began producing electrical power in 1966. Present contracts call for power from this facility to be available through 1983. High public acceptance of nuclear power in south-central Washington has encouraged nuclear power development in that part of the state. Three nuclear power plants are currently under construction. Two additional nuclear plants are under construction in west-central Washington. These plants represent the bulk of a thermal generating base currently being developed.

The 1990 scenario for Washington specifies 29,268 MWe of electric generation capacity. Additions are made in the conventional, hydroelectric pumped storage, nuclear, oil, and geothermal technologies. Coal-fueled generation capacity is reduced from 1330 to 1200 MWe during the 1975-1990 period. Overall environmental impacts of the 1990 scenario for Washington are presented in Section 5.5, and are described in the following subsections.

Issues have been identified for Washington that could impede development of additional hydroelectric and geothermal generating capacity projected by the scenario. Additions to existing hydroelectric facilities could further

reduce the already depleted anadromous fish runs, thus jeopardizing that part of the Regional economy. Also, further use of the Columbia River for hydroelectric production will lead to water availability conflicts between fishery, agriculture, and hydroelectric power requirements. Geothermal facilities will be impeded primarily by the lack of established procedures in obtaining permits and leases.

5.4.1 Air

- Additional industrial facilities sited by the scenario will cause three Air Quality Control Regions to remain in nonattainment status in 1990 (Figure 5.18).
- Under the scenario, four counties will exceed PSD Class I increment standards in 1990 and two counties will exceed Class II increment standards in 1990 (Figure 5.19).
- A visibility decrease of up to 13% is projected for Class I areas in western Washington (Figure 5.20).

FIGURE 5.18. Washington: Scenario Projected Nonattainment Air Quality Control Regions in 1990.

FIGURE 5.19. Washington: Scenario Projected PSD Increments (TSP or SO₂) Exceeded in 1990

FIGURE 5.20. Washington: Scenario Projected Visual Range for Mandatory Class I Areas in 1990, Miles

FIGURE 5.21. Washington: Counties Not Currently Meeting Ambient Air Quality Standards
Source: EPA 1978d

5.4.1.1 Description

During the three-year period ending in 1976, data from monitoring stations showed that 17 of Washington's counties, as shown in Figure 5.21, had concentrations of pollutants that exceeded the primary air quality standard (EPA 1978d). Particulate matter (TSP) violations were the most widespread due in large part to fugitive dust (sources of fugitive dust are discussed in Section 4.2.1). The sulfur dioxide (SO_2) standard was exceeded in Clallam and Pierce Counties. Spokane and King Counties recorded carbon monoxide (CO) violations 28% and 24% of the time, respectively. Pierce, Yakima, and Clark Counties also recorded CO violations. Oxidant (O_3) violations occurred in King, Pierce, Clark, and Spokane Counties (EPA 1978d).

In approximately 17% of all instances in which air quality standards were exceeded in Washington, the concentrations were at or above the alert level. Almost half of the violations at the alert level occurred in the more populated or industrialized counties of King, Pierce, and Spokane, where about 60% of the state's population resides (EPA 1978d).

Overall, Washington's air quality improved between 1974 and 1976. Where trends could be established, 11 counties showed deteriorating air quality while 30 counties' air quality either improved or remained the same (EPA 1978d). There are eight mandatory Class I areas in Washington. A discussion of air quality standards applied to Class I areas is given in Section 4.1.1, and the areas are identified in Figure 4.1. Calculated visual range for Class I areas in Washington are shown in Figure 5.20.

5.4.1.2 Background Issues

- Sixty-six percent of all the sulfur dioxide emitted in Washington originates in Pierce County. Most of this comes from smelting and refining operations in Tacoma (EPA 1978d).
- Sixty-five percent of the standards violations in Washington are due to carbon monoxide and/or photochemical oxidants in urban areas. The private automobile is responsible for more than 90% of the carbon monoxide emissions in those counties where the standard is not met (EPA 1978d).

5.4.1.3 Scenario - Induced Impacts

- Additional industrial facilities sited by the scenario will cause the Air Quality Control Regions to remain in nonattainment status in 1990 (Figure 5.18). This means that the projected industrial development can not occur unless offsets can be obtained.
- Under the scenario, four counties (Clallam, Skagit, Snohomish, and Whatcom) will exceed PSD Class I increment standards in 1990 and two counties (Clark and Cowlitz) will exceed PSD Class II increment standards in 1990. The allowable PSD increment levels are given in Table 4.4. This means that the projected industrial development can not occur unless proper pollution control technology is applied and emission levels remain below the PSD Class I or Class II increment levels.
- A visibility decrease of up to 13% is projected for Class I areas in western Washington. This decrease in visibility results from the industrial activity in the Air Quality Control Regions to the west of these areas.
- According to the scenario, electrical generating capacity increases are to come primarily from three sources: nuclear, hydroelectric, and geothermal. Air pollution impacts of the first two generation sources are mainly confined to the construction stage; for geothermal power, odors and air pollution may occur during both construction and operation phases.
- The nuclear component of the scenario for Washington consists of five nuclear power plants, all of which are currently under construction. Aside from air quality impacts of fugitive dust during construction, the major air quality impact is the release of small amounts of radioactive gases to the atmosphere.
- The scenario envisions the addition of 5564 MWe of hydroelectric generation capacity by 1985. The air quality impacts of hydroelectric generation are minimal, although fugitive dust may have a local impact during construction.
- The scenario specifies 400 MWe of geothermal generating capacity in Washington by 1990. Local air quality impacts will result in Lewis and Whatcom Counties from the construction and operation of such facilities. Most of the noncondensable gases or vapors that have been found in geothermal fluids are relatively innocuous and are normal components of the atmosphere. Some, however, normally are not significant atmospheric components. Of these, hydrogen sulfide is currently of most concern.

Other emissions likely to be regulated in the future include ammonia, mercury, arsenic, and radon. Boron, in the form of boric acid, may also be emitted in cooling tower drift.

- One hundred thirty-one MWe of oil peaking capacity and 510 MWe of combined cycle capacity are also forecast. If these facilities are built, there will be minimal releases of combustion products, which are not expected to impact local air quality.

5.4.2. Water

• Any further use of the Columbia River for hydroelectric generation will lead to water availability conflicts between fishery, agriculture and hydropower requirements.

• Two aggregated subareas (ASA 1705 and ASA 1706) will show increases in pollutant concentrations in 1990. These increases, however, are small (less than 2%), (Figure 5.22).

FIGURE 5.22. Washington: Scenario Projected Water Quality Violations for Aggregated Subareas (ASA) by Pollutant Type in 1990

5.4.2.1 Description

With some exceptions, water quality in the rivers, streams, and lakes in Washington meets the goals of the Federal Water Pollution Control Act. Washington's water quality monitoring program is one of the most complete in the region, and the status of most of the principal rivers in the state is known.

Water quality tends to improve progressively from east to west (EPA 1978d). Portions of five streams east of the Cascade Mountains do not meet Federal water quality goals for propagation of native fish and unrestricted recreational use. Of the 22 streams evaluated, 15 meet Federal goals while 8 provisionally meet such goals. Eleven of these streams are located west of the Cascades and discharge directly into Puget Sound or the Pacific Ocean.

Generally, rivers on the east side of the Cascades show higher concentrations of phosphorus and solids as well as higher temperatures than those on the west side (EPA 1978d). This results, in part, from intensive land use and agriculture. Five of the rivers studied not meeting water quality goals (Crab Creek, the Spokane, Walla Walla, Palouse, and Touchet Rivers) lie mainly in agricultural areas east of the Cascades. During heavy runoff periods, problems occur from soil erosion. Low summer flows and runoff from agricultural lands during the irrigation season largely account for increased temperature and nutrients and dissolved and suspended solids. The Spokane River, which flows into Washington from Idaho, contains excessive concentrations of heavy metals, bacteria, and nutrients. Sources in Idaho account for the heavy metals and part of the phosphorus; however, the major portions of nutrients and bacteria originate from the City of Spokane.

Of 19 lakes and reservoirs in Washington, at least 10 square miles surface area, one is eutrophic (high nutrient concentrations and algal productivity) and another nine are mesoeutrophic (tending toward eutrophy). These waters are all located in the eastern part of the state in either agricultural areas, or are part of the Columbia and Snake River reservoir systems. These lakes and reservoirs are sinks for natural and man-made

nutrients (EPA 1978). Nine other lakes are either oligotrophic (relatively pristine) or mesotrophic (moderate algal productivity). The two oligotrophic lakes are located at relatively high altitudes, where population is sparse and land use activity is minimal. The remaining lakes and reservoirs, classified as mesotrophic, experience moderate algal productivity.

Its vast coastal and estuarine waters make Washington one of the most active commercial and recreational areas in the country. Over the last five years, there have been significant improvements in the marine water quality of Washington as a result of waste treatment programs (EPA 1978).

During years of high runoff, much water must be spilled over dam spillways rather than passed through the generating turbines. When large volumes of water carrying along atmospheric gases plunge into deep pools behind the dams, gas supersaturation occurs when these gases dissolve at depth under pressure. Fish swimming in deep waters supersaturated with atmospheric gases, primarily nitrogen are killed by bubble formation in their tissues when they later approach the surface. In the past, nitrogen levels between mainstream Columbia River dams have reached well above critical levels for both adult and juvenile salmon and steelhead. Modifications to spillways and flow manipulations have greatly reduced the nitrogen supersaturation problem in recent years.

The drinking water coming into most homes in Washington is generally considered safe. Approximately 40% of the state's 2500 community water systems are monitoring bacteria and turbidity levels, as required by the Safe Drinking Water Act of 1974 (EPA 1978).

5.4.2.2 Background Issues

- ◆ In the western portion of the state, the water quality effects of increased population, the need for additional treatment of municipal and industrial waste discharges, the presence of toxic substances, and increased potential for oil spills occurring in Puget Sound are all areas of concern.
- ◆ All aggregated subareas in Washington currently exhibit concentrations of at least one heavy metal in violation of standards (Figure 5.23). In all cases the concentrations have been identified by the lead lab as being due to background sources.

FIGURE 5.23. Washington: Current Water Quality Violations for Aggregated Subareas (ASA) by Pollutant Type

- Significant areas of land in Washington (15.5 million acres, or 35% of the state's land area) are owned by the Federal government. Under the reserved water principle, Federal reservations may reserve water for facilities developed within the reservation boundaries. The amount of water reserved is not specified, thus presenting an obstacle to sound planning for water and related resources (Pacific Northwest River Basins Commission 1978).
- There are 22 Indian reservations totaling 2.89 million acres (6.5% of the state's total land area) for which the U.S. Supreme Court holds that an unspecified amount of water is reserved to carry out the purposes for which each reservation was created. The lack of quantification of Indian water rights in Washington, which involves primarily the Colville, Spokane, and Yakima reservations, also creates an obstacle to sound water planning.
- Because Washington's entire border with Idaho and Oregon is within the Columbia River system, interstate water relationships among the three states focus on the issue of how that system is managed. With expanding populations and economies placing greater demands on the water resources of the Columbia River system, interstate problems are increasing in significance and becoming more difficult to resolve.
- Because nearly one-fourth of the surface water available in Washington originates in Canada, water management is of major significance in the state's relationship with its northern neighbor.

5.4.2.3 Scenario - Induced Impacts

- Any further use of Columbia River water for hydroelectric production will lead to water availability conflicts between fisheries, agriculture, and hydropower requirements. Because of this competition, the availability of water to meet the scenario requirements for hydroelectric power is uncertain.
- Water quality impacts may result from any geothermal development carried out in the state. Geothermal waters are not normally sources of organic constituents. The pollutants of greatest concern, however, are heavy metals. Geothermal waters may contain measurable amounts of several metals. Some geothermal waters, particularly those with high salinity, contain metals in concentrations hazardous to humans, animals, and/or plant life. Waste heat in spent geothermal waters, if allowed to enter surface waters, is potentially dangerous to aquatic life. Sensitivity of most desirable aquatic organisms to temperature change is amplified because the optimum growth temperature is within only a few degrees of the destructive temperature. Land subsidence and the potential for altering existing aquifers needs to be studied.

- As thermal plants are added to the regional electric system, the hydroelectric plants will be used more and more to produce peaking power. The use of hydroelectric facilities for load following and peaking power will increase the rate of bank erosion and thus affect water quality on the Columbia and Snake Rivers.

5.4.3 Ecology

- The scenario envisions expanding hydroelectric generating capacity in Washington. Construction and operation of hydroelectric facilities will further impact anadromous and resident fish and wildlife by altering stream flows, particularly on the Columbia River.
- Extensive areas of SO₂ sensitive crops and vegetation lie downwind of a scenario-identified coal-fired plant located in north-central Oregon (Figure 5.24).
- Continually fluctuating water levels associated with pumped storage and use of hydroelectric capacity for peaking could adversely affect aquatic ecosystems and wildlife habitat.

FIGURE 5.24. Washington: Percent of County Covered by SO₂ Sensitive Crops

5.4.3.1 Description

The Cascade Mountains divide the state into two distinct physiographic regions. The area west of the mountains has a temperate maritime climate with dry, moderately warm summers and wet, mild winters. The eastern section has an arid to semi-arid climate with much greater extremes in temperature during summer and winter than western Washington.

The coastal area of Washington lies in the humid coniferous forest zone (Pacific Northwest River Basins Commission 1978). Variations in species composition occur according to precipitation and elevation differences. Shrubs and Sitka spruce near the shoreline merges into forests of Douglas fir and western hemlock, with fir and cedar also present. Subalpine forests occur in the Olympic mountains.

Vegetation in the Puget Sound-Willamette lowlands has been modified extensively by human activity. Cities, farmlands, and other developments dominate the landscape and, even where natural vegetation remains, it has been largely altered by clearing, logging and grazing activities. Eastward to the Cascades there are stands of Douglas fir, western hemlock, western white pine, Engelmann spruce, and silver fir.

Vegetation consists of shrub-steppe species throughout the Columbia Plateau, with the exception of areas that have been farmed. Sagebrush and wheatgrass are common plants. In the eastern part of the state, extensive ponderosa and lodgepole pine forests are found.

Two areas of the state have an unusually large number of rare and potentially endangered plant species: one, the Wenatchee Mountain Range, where distinctive climatic and soil conditions provide a refuge for several endemic species; the other, the Columbia River Gorge, which forms a unique lowland "bridge" between the flora of the east and west sides of the Cascade Range. The unusual soil, moisture and wind conditions in the Gorge have allowed species and varieties found nowhere else in the world to evolve and survive (Pacific Northwest River Basins Commission 1978).

The many different landforms and water resource areas of the state provide habitat for a great variety of fish and wildlife species which contribute to the environmental quality and support some segments of the economy.

Anadromous fish use nearly all rivers and streams emptying into the Pacific Ocean and Puget Sound. These waters are inhabited by adults and/or juveniles of one or more anadromous fish species during certain times of the year. Resident fish inhabit all state waters with the distribution of each species determined by habitat conditions. Rainbow trout are the most widely

distributed and the most abundant. Most low-elevation water bodies support warmwater game fish including catfish, bass, sunfish, perch, and walleye. Many marine fish inhabit coastal waters including tuna, herring, halibut, and lingcod. Important shellfish include shrimp, crab, clams, and oysters (Pacific Northwest Rivers Basins Commission 1978).

The state has very significant wildlife resources. Many species have large populations, their numbers being defined primarily by the availability of suitable habitat. Water supply is not generally the limiting factor in habitat availability except in the arid areas of eastern Washington.

Among big game animals within the state, deer, elk, and black bear are the most numerous, and present on both sides of the Cascades. Extensive logging in western Washington has had both positive and negative effects on the habitat for these species (Pacific Northwest River Basins Commission 1978).

Washington state is the route of a major flyway for migratory birds, extending in a northeast-southwest direction across the state above the Columbia Basin area and along the Pacific Ocean and Puget Sound. The wildfowl flyway probably has shifted westward as a result of changes in the availability of food, shelter, and water (Pacific Northwest River Basin Commission 1978).

5.4.3.2 Background Issues

- Dams constructed on the Columbia and Snake Rivers have impounded most of the free-flowing sections of these rivers, resulting in diminished anadromous fish populations. Construction of dams has blocked passage to previously accessible spawning and rearing grounds (Figure 4.3). Additional fishing pressure from an increasing number of commercial and sport fishermen also contributes to depletion of anadromous fish populations. Fish passage does occur around many dams but mortality rates can be high. Generally, the higher the river flow, the poorer the passage conditions. Juvenile losses from all causes have been estimated at 15 to 20% at each mainstream dam as they come downstream.

5.4.3.3 Scenario - Induced Impacts

- The impacts of increased hydro development in Washington are considered to be high. In the Northwest, the most serious water related impact is to anadromous fish, which are impeded by the dam in both upstream and downstream movement. It has been stated (NEPP 1977) that, "If new hydroelectric dams that would adversely affect anadromous fish are developed, upriver races of fish probably would be lost."

- Development of thermal electric facilities for production of base load power will result in a shift of use of hydroelectric facilities to produce peak power. This will result in fluctuating water levels which can adversely impact aquatic ecosystems.
- Impacts may occur from development of pumped storage sites, oil direct drive, and combined cycle facilities. Additional power generation from pumped storage in the near term will occur as expansions to existing sites. Oil direct drive and combined cycle facilities will be developed as additions to or modifications of existing facilities. The ecological impacts of these facilities is not expected to be significant.
- Increased concentration of sulfur dioxide in south-central Washington is associated with the coal-fired generating plant in north-central Oregon currently under construction. Several species of native vegetation, particularly various species of grasses such as fescue, bluegrass, and bunchgrass, as well as trees such as mountain hemlock and red alder, are sensitive to this pollutant. Douglas fir and sagebrush are somewhat more resistant. Several important crops are also sensitive to SO_2 , including hay, fruit, wheat, and other grains. Such crops cover more than 30% of some counties in south-central Washington.

5.4.4 Land Use

• Figure 5.24 shows projected land use. Up to 7000 acres of land will be disturbed by surface mining of coal in Washington.

• 2600 acres of land will be required for the five nuclear power plant sites in Washington.

FIGURE 5.25. Washington: Projected Land Use Requirements by County for Mining and Thermal Power Plants in 1990

5.4.4.1 Description

Forestry, farming, and rangeland are the three economic activities that most land is devoted to in Washington. Of the total state area, 54% is predominantly forest land, 20% rangeland, 19% cropland, and the remaining 7% include barren land, urban, industrial and commercial developments, farmsteads, roads, railroads, airports, and bodies of water.

The state's vast timberlands support a diversified forest products industry of lumber, plywood, pulp and paper products, and numerous specialty products. They also supply a growing export market in logs, lumber, plywood, and wood chips. In addition to support of the forest products industry, forest lands and waters are important as fish and wildlife habitats, offer a variety of outdoor recreation activities, and comprise major watersheds (Pacific Northwest River Basin Commission 1978).

Croplands and rangeland produce a wide range of agricultural products. Wheat farming accounts for a large percentage of agricultural land primarily in eastern Washington; milk and beef cattle production are also major land users. Fertile river valleys and lowlands are farmed in western Washington.

In northeastern Washington exploration for uranium has been intense during the past few years. The energy-producing material is being mined on the Spokane Indian Reservation, and a second large mine was due to start production in 1978 (Pacific Northwest River Basins Commission 1978).

Coal is found in Washington, with about half the reserves being located in Lewis and Thurston Counties. The total amount of demonstrated coal reserves available is 1954 million tons; almost all of this coal is expected to be surface mined.

5.4.2.2 Background Issues

- Debates on the Roadless Area Review and Evaluation (RARE II) study continue, and are representative of the differences of opinion that exist on the issue of how much land should be set aside as wilderness in the state.
- Washington does not have comprehensive land use legislation, though a concern about residential and commercial development encroaching on valuable agricultural, forest, and range lands has caused several bills to be considered by the legislature (DOE-RAP-21 1978).

5.4.4.3 Scenario - Induced Changes

- Land use impacts are expected from surface mining of the state's coal reserves. The scenario projects that approximately 7000 acres will be disturbed by surface mines by 1990. In comparison, development of subsurface mines will affect only 45 acres of surface land. Sixty to seventy percent of the land area in the counties where coal development is projected to occur is occupied by commercial forest.
- Increases in other energy technologies may also affect present land uses. Expansion of hydropower and pumped storage, for example, may inundate land area now used for other purposes. Raising the existing Ross Dam on the Skagit River to increase the hydroelectric generating capacity is constrained by the fact that the additional land flooded would include acreage in Canada (an increase of 125 feet in height would flood 5000 acres in Canada) (Pacific Northwest River Basins Commission 1978).
- Construction of five nuclear plants in Washington will require commitment of 3,600 acres of land. Land use conflicts are not likely to result from this nuclear power plant development because all plants have been sited and are under construction.

5.4.5 Solid Waste

- Nuclear reactors will be the major source of energy-related solid waste, some of which will be highly radioactive.
- Solid waste generated from coal combustion in Washington is expected to amount to 400,000 tons in 1990 (Figure 5.26).

FIGURE 5.26. Washington: Solid Waste Residuals From Coal-Fired Energy Facilities

5.4.5.1 Description

In 1976, some 1.1 million people or 32% of Washington's population was being served by state-approved solid waste disposal sites. This is an increase of 100% in the past five years (EPA 1978d).

The recovery of energy and other resources from waste is being considered and developed as problems and costs of other acceptable disposal systems have increased. One of the largest such projects is in Seattle, where a "fuel from refuse" facility is planned.

The most controversial aspect of solid waste disposal in Washington is the disposal of waste generated by the nuclear power industry. Wastes generated by the U.S. defense program are stored at the Hanford Reservation in the south-central Washington. These wastes are grouped as "high-level" or

intensely radioactive materials and those of "low-level" or weak radioactivity (National Academy of Sciences 1978). Research is being conducted at the Hanford Reservation to determine safe methods for long term disposal of nuclear wastes.

5.4.5.2 Background Issues

- Leaks from 20 high-level waste tanks have been detected through 1976, releasing a total of about 1700 cubic meters (450,000 gallons of high-level waste to the ground. In addition to the 20 confirmed leaking tanks, another 14 have been removed from service because their integrity was suspect. Although none of these leaks has posed a serious hazard (National Academy of Sciences 1978), a more secure method of disposal of Hanford wastes is being sought, possibly by deep geologic isolation.

5.4.5.3 Scenario - Induced Changes

- The only major scenario-induced change with respect to solid waste will be disposal of radioactive wastes generated by nuclear power plants. In addition, the Hanford reservation operated by DOE in south-central Washington may receive wastes from reactors throughout the region as well as the nation.
- Operation of the coal-fired plant in southwest Washington is expected to generate 400,000 tons of solid waste in the year 1990.

5.4.6 Health and Safety

- No serious health and safety impacts are expected in Washington.

5.4.6.1 Description

A major area of concern in the health and safety aspects of energy development in Washington is the handling and disposal of radioactive waste. The radioactive constituents of wastes offer two kinds of potential radiation hazard: whole-body exposure from gamma-rays, and localized irradiation of specific body tissues from beta- and alpha-emitting ingested radionuclides.

As a basis for comparing hazards: (a) the measured natural background radiation of the Hanford area from cosmic rays and radioactive elements in rocks and soil ranges from 75 to 92 millirems per year (mrem/yr) for an individual; (b) natural radioactive materials within the body, acquired from ingestion and inhalation, add another 25 mrem/yr; and (c) the average exposure

from medical and dental procedures to an individual in the United States is about 70 mrem/yr (National Academy of Sciences 1978).

The external radiation hazard from wastes stored in Washington is very small, to either operating personnel or the public, because the wastes are shielded and confined. The added average per capita annual dose rate for the population within 80 kilometers (50 miles) of the area is 0.1 mrem; for a person standing for an entire year directly over a tank containing high-level waste, the radiation dose would be about 350 mrem, less than five times the dose from natural background radiation. The dose rates at ground level above cribs into which low-level wastes have been percolated are much less, averaging 7×10^{-6} mrem per year (National Academy of Sciences 1978).

A series of statistical studies have been and are being made to investigate the health of workers at nuclear facilities, including Hanford, as related to external radiation levels and other factors. The AEC/ERDA Health and Mortality study, begun in 1964, has reported the year and cause of death and radiation exposure history for the work force at the area since 1944. The first analysis of this data suggested a radiation-induced effect for certain malignant diseases. Two subsequent studies, however, have found no convincing evidence of an excess of cancer among exposed Hanford workers. Studies are still continuing, and other data from other disposal sites and other statistical analyses of the data will be required to resolve these different interpretations of the same body of data (National Academy of Sciences 1978).

5.4.6.2 Background Issues

- The external radiation hazard from wastes stored in Washington is very small to either operating personnel or the public, because the wastes are shielded or confined.

5.4.6.3 Scenario - Induced Changes

- The only major coal mine operating in Washington is a surface mine supplying a coal-fired generating plant in Lewis and Thurston counties. Lead lab information suggests there will be 0.15-0.51 deaths and 8.1-30 injuries associated with surface coal mining in the year 1990. Underground mining is expected to cause 0.16-0.60 deaths and 18-68 injuries for the same year. Up to 5 cases of chronic respiratory disease and 0-0.4 deaths are also expected to occur among coal workers in 1990.

Since underground mining is not expected to be of great importance in coal extraction in the state (DOE-RAP-21 1978) and lead-lab projections are based on national statistics, the predictions of death and injury and occupational hazards in coal miners are probably not realistic for the state of Washington.

- In 1990, lead lab information predicts nuclear fuel fabrication will cause 1.1 radiation-induced cancer deaths among workers; .0014 such deaths in Washington State's general public, and 0.000004 to 0.0022 such deaths in the public as the result of an accident.
- Nuclear waste management is expected to cause .081 occupationally induced cancer deaths in 1990.
- Lead-lab information predicts a death rate of 3.8 to 61 per 10^6 person-year, or 15-230 total deaths in the state due to utility and industrial use of coal as fuel in 1990.

5.4.7 Socioeconomic

• Socioeconomic impacts are projected whenever large construction projects occur in conjunction with areas of low assimilative capacity. Impacts may occur in previously undeveloped areas in realizing the geothermal portion of the scenario.

5.4.7.1 Description

Washington State has a population of 3.7 million (1977 estimates), representing an increase of approximately 28% since 1960. Much of this population growth has been concentrated in urban areas where 71.4% of the state's population lives. The average density of 54.9 persons per square mile ranks this state 22nd in the nation for population concentration. However, the western third of the state is much more densely populated; the 18 counties west of the Cascade Mountain Range contain 74.8% of the state's population and have a density of 116.0 persons per square mile, more than twice the state average. Washington's rate of growth has declined from 1.8% per year in the 1960's to 1.0% per year in the 1970's, compared to rates for the U.S. of 1.3% and 0.9%.

Aerospace, forest products, and machinery industries dominate the manufacturing sector of the state's economy. Agriculture and other resource industries are also important; and because of the geographic location of the state, military/defense activities are also an important sector in the state economy.

From 1967 to 1976, the employment of the working age population increased 4.8%, from 69.8 to 74.6%. Average weekly earnings for the state exceeded national averages by \$41 in 1977, with a state average wage of \$268.00 per week. Personal income from all sources was \$7,528 in 1977, ranking 13th nationally. The most recent figures for state poverty levels indicate that, in 1975, 8.5% of the state's population (or 6.6% of the households in the state) were classified as below the poverty level compared to national averages of 11.4% and 9.0%, respectively.

5.4.7.2 Background Issues

- The proposed hydroelectric facilities are primarily additions to existing dams. If the site is in a rural, sparsely populated area, even a moderately sized construction force can cause social and economic impacts in the form of changing community character and strains put on existing facilities and services. The problem is compounded if, when the construction force leaves, overcapacity exists in community services.
- Some Washington residents place a high value on the conservation of scarce and costly energy resources. Policies which advocate extensive energy development without concern for conservation will encounter opposition from a significant portion of the state's energy consumers.
- Most citizens of Washington desire moderate economic growth in their state with more balance between urban and rural areas. Since energy policy tends to concentrate rapid development in predominately rural areas, with most of the economic benefits accruing to urban areas, the desired balance is rarely achieved. Public concerns of this type may affect energy development.
- Public concern for preservation of the natural environment is often in conflict with the need to expand energy production. Raising hydroelectric dams threatens vast expanses of forest lands and alters the natural ecology of river systems. Issues in ecology, land use, and water quality easily become social and economic issues and matters of intense public debate, the outcome of which can have a major bearing on a state's energy future.
- Washington relies primarily on hydroelectric energy and, relative to the national average, pays substantially less for this energy. It will be difficult to expand hydro facilities much further, and, as the state begins to rely more heavily on alternative sources such as nuclear, the costs to the consumer will rise dramatically in the coming years. Public attention will focus more intensely on energy policy as the number of energy consumers continues to rise in the face of uncertain supplies and increasing prices.

- Washington state presently hosts a major nuclear waste disposal site and may in the future absorb the waste products of other states' nuclear energy projects. While populations living near these facilities tend to value the economic benefits associated with nuclear energy, other residents in the state object to their state becoming the country's nuclear dumping ground. Both local and national concern with this issue could affect the course of nuclear energy development in this state.

5.4.7.3 Scenario - Induced Changes

- One of the nuclear sites is in Benton County, where construction of three plants is ongoing. The lead lab has projected that the primary work force will peak at 7153 in 1984, implying a total job-induced population immigration of 35,799. This represents 48.6% of the total county population. Such a population increase, if it occurred, would put a tremendous strain on local government services in the Tri-Cities area during the construction period. This implies a high level of impact on social services, although a segment of the area's population views the increased employment opportunities as beneficial. A sudden decline from the large construction work force to a permanent operating work force of 500 people could produce severe social adjustment problems.
- The other nuclear site is in Grays Harbor County in the south-western corner of the state. The lead lab has projected a peak labor force of 2186 in 1987. This implies a peak construction-related increase in population of 3766, which represents 5.8% of the baseline population. This is viewed as causing moderate impact, and impact payments between the utility and some of the local governments have already been negotiated.
- One of the proposed geothermal facilities would be located in the eastern third of Lewis County. This is a mountainous, very sparsely populated area of the state. Presumably, the labor force for a geothermal facility would be moderate in size; however, given the location, much of the work force might immigrate to the area. This could put a strain on the few existing towns. Prices might be inflated, housing could be hard to find, and services and facilities could be strained. The other proposed geothermal site in Washington is in the Mt. Baker area in Whatcom County, where a situation similar to Lewis County exists. Possibly, much of the work force might have to live near the site in presently unincorporated towns, putting a strain on county services and facilities. However, if a work camp is created and supported by the builder/contractors, social impacts on surrounding communities may be low.
- There are three hydro sites in Washington that might have moderate social impacts associated with their development. The first is a rock-fill dam

in Skagit County. While the work force is expected to be small, a recent draft environmental impact statement on the dam indicated that the following socioeconomic impacts would be significant: widespread local public concern that the rockfill dam would be unsafe and pose a threat to the lives and property of downstream residents, land use and development in the Skagit River valley would be intensified by the construction labor force, and construction of the dam along with a proposed nuclear project not currently identified by the scenario would create a housing shortage in the Skagit River valley.

- The raising of a dam in Whatcom County north of the Copper Creek site may also cause moderate social impacts. There are only a few very small towns in the vicinity. The site is isolated enough to preclude commuting, except possibly from a small town an hour or so in driving time to the west. Thus even a small work force moving temporarily into the area (particularly with additional household members) could put a significant strain on the few communities there.
- The third hydro site in Washington that may cause moderate impacts is the Grand Coulee Dam in Grant County. There are plans to add 2400 megawatts to the existing dam, which would entail a large construction effort in a very rural, sparsely populated area of the state. There are only small towns in the area, and substantial immigration, even on a temporary basis, could prove a hardship for some of the small towns that have part-time governments, services, facilities geared to a rural lifestyle unlike that of the more urban construction worker.
- The combined cycle site in Lewis County also may generate moderate impacts. While surrounding towns can likely supply the requisite labor force, a new plant generating 510 megawatts will certainly have an economic effect on the area, both during construction and into the operation phase. Certain strains may be placed on the local economy if demand exceeds the capacity of facilities and services during a boom construction period. Changes in community life style may also occur if there is much immigration of the construction force and secondary population.
- A proposed new hydro facility in Clark County may also generate moderate impacts. This facility has not been identified by any Northwest official or utility representative. However, if such a facility were to be constructed, it would likely, because of its size, generate some social and economic impacts. The labor force would probably be drawn from the Vancouver-Portland area, and some changes might be expected in the local area's economy during the temporary construction phase. Overcrowding may cause changes in the style of life in the communities adjacent to the dam site.

- An addition of 446 MWe to a hydro facility in Benton County has also been proposed in the scenario. If a hydro facility in Benton County were to be expanded it is possible that significant social impacts could result. This would be primarily because there is a boom already occurring in the county caused by the development of other energy facilities, particularly the nuclear plants. Another large construction project would further exacerbate the boom problems of spiraling prices and overloading of services and facilities in the county.

5.4.8. Institutional

- Political and legal opposition to High Ross Dam and Copper Creek could stop or slow construction.

5.4.8.1 Description

In comparison to other northwestern states, federal and state institutions in Washington play a larger role in power development than private institutions. This is because in Washington investor-owned utilities supply only 23% of the electrical power to end-users. Fully 77% of the market is occupied by publicly owned utilities, primarily public utility districts and large municipal-owned utilities such as Seattle City Light and Tacoma City Light (U.S. Department of Energy 1978). The Bonneville Power Administration supplies most of the public utilities' needs and a significant fraction of the investor-owned utilities' needs with hydroelectric power generated by the Federal Columbia River Power System.

Because federal hydroelectric power is not expanding fast enough to meet anticipated demand in the 1980s, both investor-owned and publicly owned utilities in Washington have begun constructing their own new power plants, mostly thermal. The state's publicly owned utilities are building five nuclear power plants through the Washington Public Power Supply System (WPPSS). WPPSS was established in 1957 as a municipal corporation and joint operating agency of the State of Washington. Its members consist of 19 public utility districts and 3 municipal utilities in the state (WPPSS Quarterly Report, September 30, 1978). Essentially, WPPSS is a vehicle for the joint construction and operation of thermal power plants by its member utilities, which are thereby able to aggregate their capability to issue low-interest municipal bonds.

In constructing new generating facilities, both publicly owned utilities (whether through WPPSS or independently) and investor-owned utilities are subject to extensive state regulation. The state licensing process centers on the Energy Facility Site Evaluation Council (EFSEC) created by RCW Chapter 80.50, which must approve all thermal (but not hydroelectric or geothermal) power plants. Represented on the council are the state agencies and political subdivisions whose approval would otherwise have to be individually obtained for siting of the facility. Instead of approving the facility separately, however, the Council's members review the application for compliance with relevant state laws, hold hearings, and collectively pass on the application. If the Council's decision is favorable, it recommends certification (subject to any conditions) by the Governor, with whom the final decision rests. Among other things, EFSEC is responsible for ensuring the equivalent of compliance with the Washington State Environmental Policy Act, (RCW Chapter 43.21C), through environmental analysis by an independent consultant (RCS 80.50.071). EFSEC's authority supersedes the authority of all state agencies and political subdivisions that might otherwise impose requirements on the construction of the facility. Agencies represented on the Council who also play significant state energy roles in their own right, include the Department of Ecology (administers state air pollution, water pollution, and many SEPA regulations) and the Department of Natural Resources (manages state-owned lands). Other state agencies involved in state energy policy are the State Energy Office, which essentially provides information and advice, and the Washington Utilities and Transportation Commission, which regulates rates of investor-owned utilities.

5.4.8.2 Background Issues

- WPPSS has recently come under criticism for its management of the construction of the five nuclear plants. A recent study of three of the WPPSS projects, performed for BPA by Theodore Barry and Associates, attributes cost escalations of roughly 275% in part to inadequacies in the management of WPPSS. In addition, the study concludes that WPPSS lacks effective checks and balances from either external or internal sources. The Barry report recommends a strengthened role for BPA in overseeing construction of the WPPSS facilities. Senator Ted Bottinger, Chairman of the Senate Energy and Utility Committee in the Washington

Legislature, has proposed creation of a joint legislative committee to monitor the projects on a continuing basis. A similar measure has also been proposed in the state's House of Representatives. As a result of this cost escalation, BPA, which through "net billing" is purchasing all of the output of two of the plants and 70% of the output of the third on long-term contract, has announced a wholesale rate increase of 40% for November, 1979. Additional projected increases are 28% in 1981, 24% in 1983, and 15% in 1985. This situation has led to concern about future federal underwriting of thermal power plant construction, since the cost increases from the WPPSS facilities will be borne by all consumers whose utilities purchase wholesale power from BPA. Some believe restoration of this practice for the construction of thermal generating facilities by publicly-owned utilities, and its extension to investor-owned utilities as well, could result in unacceptably high power rates because of inadequate incentives for the builders of net-billed plants to hold down costs.

- Presently, it is unclear whether EFSEC's authority overrides city, county, or regional zoning codes. By statute, EFSEC is required to hold hearings on compliance of a proposed facility with land use plans rezoning ordinances. However, a recent Attorney General's opinion states that the Council may go ahead and approve sites even after determining that their use is inconsistent with local land use laws. This issue is now being litigated and will be resolved either by the Washington Supreme Court or by legislation. State legislators have recently introduced several bills that would require compliance with local zoning as of the date of application to EFSEC.
- Considerable uncertainty surrounds the status of the Washington State Energy Office. The office has been critized by a GAO audit, a state audit, the state legislature, and the Governor as suffering from weak management and unclear objectives. New legislation may reconstitute the office, perhaps by transferring its functions to the State Utilities and Transportation Commission. Although the office does not have a major role in energy development, it does administer federal funds, such as those provided for conservation. Until the status of the office is clarified, these functions are apt to remain unperformed.

5.4.8.3 Scenario Induced Changes

- The nuclear facilities included in the scenario are under construction. State siting permits and NRC construction permits have been granted. Political opponents of nuclear power in the state such as the Crabshell Alliance have few legal levers left. Although cost escalation and charges of poor management may lead the Washington Legislature to restructure the Washington Public Power Supply System, builder of the facilities, such a move is unlikely to delay completion of the facilities beyond 1990. New NRC regulatory requirements imposed in the wake of Three Mile Island could also slow completion, but probably not beyond 1990.

- Most of the additions to Washington's hydroelectric capacity are also sufficiently well advanced that they are likely to be in place by 1990. However, some 20% of the hydroelectric capacity is still in the very early planning stages. Of these, some federal projects may not receive necessary Congressional approval. Two projects of Seattle City Light, the raising of High Ross Dam and the construction of a dam on Copper Creek, also face political and legal opposition that could stop or slow them.
- Technical and economic considerations tend to foreclose the development of significant geothermal electrical generating capacity in Washington by 1990. Institutional considerations only enhance the difficulties: the state has not developed statutory norms for leasing geothermal resources on state lands, the state has not developed procedures for the required drilling permits on private or state lands, and federal procedures for leasing federal land are slow.

5.5 ENVIRONMENTAL OVERVIEW OF THE TRENDLONG MID-MID SCENARIO FOR ALASKA, IDAHO, OREGON AND WASHINGTON

Tables 5.2 through 5.5 present the level of environmental impact in Alaska, Idaho, Oregon, and Washington for each of the environmental technologies specified in the Region 10 scenario. Definitions of low, medium and high impact is given in Table 1.2. In addition to these three definitions, two more have been used. No impact (-) indicates that once the technology is in place, there is no impact in the state. An asterisk (*) indicates that insufficient data is available to assess impacts. Blanks indicate the energy technology was not specified by the scenario.

The reader is directed to Chapter 5 for a detailed description of scenario related impacts.

TABLE 5.2. Environmental Impacts of the State Level Mid-Mid Scenario Energy Technologies in Alaska

Energy Source	Air Quality	Water		Ecology	Land		Solid Waste	Health/Safety Occupational and Others	Social and Economic	
		Quality	Availability		Land Use				Regional/Local Economic and Sociologic Factors	Institutional and Legislative
Extraction										
Coal	L	L	-	M	M	-	-	-	L	L
Oil	L	L	-	L	L	-	-	-	L	L
Gas	L	L	-	L	-	-	-	-	L	L
Geothermal										
Transport of Energy										
Oil tankers	-	L	-	-	L	-	-	-	L	L
Pipelines	M	M	L	M	M	-	-	-	H	M
Transmission lines	-	L	-	M	M	-	-	-	L	L
Conversion										
Refineries										
Electric Generation										
Hydro										
Conventional	-	-	-	-	-	-	-	-	H	H
Hydro Pumped Storage										
Coal	M	L	L	L	L	L	L	L	L	L
Nuclear										
Gas Direct Drive	-	-	-	-	-	-	-	-	H	H
Gas Steam										
Oil Direct Drive	L	-	-	-	-	-	-	-	L	L
Oil Steam	L	L	L	L	L	-	-	-	L	L
Combined Cycle										
Geothermal										

High (H), Medium (M), Low (L)

(-) No Impact^(a)

(*) Data is not sufficient to assess impacts.

(a) No impact indicates that once the technology is in place, there is no impact in the state. A blank indicates the energy technology was not specified by the scenario.

TABLE 5.3. Environmental Impacts of the State Level Mid-Mid Scenario Energy Technologies in Idaho

Energy Source	Air Quality	Water		Ecology	Land		Solid Waste	Health/Safety Occupational and Others	Social and Economic	
		Quality	Availability		Land Use				Regional/Local Economic and Sociologic Factors	Institutional and Legislative
Extraction										
Coal										
Oil										
Gas										
Geothermal	*	*	*	L	L		-	-	L	M
Transport of Energy										
Oil tankers										
Pipelines	-	L	-	L	L		-	-	M	M
Transmission lines	-	L	-	M	M		-	-	-	-
Conversion										
Refineries										
Electric Generation										
Hydro										
Conventional	L	L	L	H	L		-	-	M	L
Hydro Pumped Storage										
Coal										
Nuclear										
Gas Direct Drive										
Gas Steam										
Oil Direct Drive	L	-	-	-	-		-	-	L	L
Oil Steam										
Combined Cycle										
Geothermal	*	*	*	L	L		-	-	L	M

High (H), Medium (M), Low (L)

(-) No Impact^(a)

(*) Data is not sufficient to assess impacts.

(a) No impact indicates that once the technology is in place, there is no impact in the state. A blank indicates the energy technology was not specified by the scenario.

TABLE 5.4. Environmental Impacts of the State Level Mid-Mid Scenario Energy Technologies in Oregon

Energy Source	Air Quality	Water		Ecology	Land		Health/Safety Occupational and Others	Social and Economic	
		Quality	Availability		Land Use	Solid Waste		Regional/Local Economic and Sociologic. Factors	Institutional and Legislative
Extraction									
Coal									
Oil									
Gas									
Geothermal	*	*	*	L	L	-	-	L	M
Transport of Energy									
Oil tankers									
Pipelines									
Transmission lines	-	L	-	M	M	-	-	-	-
Conversion									
Refineries									
Electric Generation									
Hydro									
Conventional	L	L	M	L	L	-	-	M-H	H
Hydro Pumped Storage	L	L	L	L	L	-	-	L	H
Coal	L	L	L	L	L	L	L	M	M
Nuclear	L	L	L	L	L	L	L	H	H
Gas Direct Drive									
Gas Steam									
Oil Direct Drive	-	-	-	-	-	-	-	L	L
Oil Steam	L	-	-	L	L	-	-	L	H
Combined Cycle	L	-	-	L	L	-	-	-	-
Geothermal	*	*	*	L	L	-	-	M	M

High (H), Medium (M), Low (L)

(-) No Impact^(a)

(*) Data is not sufficient to assess impacts.

(a) No impact indicates that once the technology is in place, there is no impact in the state. A blank indicates the energy technology was not specified by the scenario.

Table 5.5. Environmental Impacts of the State Level Mid-Mid Scenario Energy Technologies in Washington

Energy Source	Air Quality	Water		Ecology	Land		Solid Waste	Health/Safety Occupational and Others	Social and Economic	
		Quality	Availability		Land Use				Regional/Local Economic and Sociologic Factors	Institutional and Legislative
Extraction										
Coal	L	L	-	L	L		L	-	L	-
Oil										
Gas										
Geothermal	*	*	*	L	L		-	-	L	M
Transport of Energy										
Oil tankers	-	L	-	*	-		-	-	-	-
Pipelines	-	L	-	L	L		-	-	M	M
Transmission lines	-	L	-	M	M		-	-	-	-
Conversion										
Refineries	L	L	L	L	L		-	-	-	-
Electric Generation										
Hydro										
Conventional	L	L	M	M	L		-	-	M	L
Hydro Pumped Storage	L	L	L	L	L		-	-	L	-
Coal	L	L	L	M	M		L	L	-	-
Nuclear	L	L	L	L	L		L	L	H	M
Gas Direct Drive										
Gas Steam										
Oil Direct Drive	L	-	-	L	L		-	-	L	L
Oil Steam	L	-	-	L	L		-	-	L	H
Combined Cycle	L	-	-	L	L		-	-	-	-
Geothermal	*	*	*	L	L		-	-	M	H

High (H), Medium (M), Low (L)

(-) No Impact^(a)

(*) Data is not sufficient to assess impacts.

(a) No impact indicates that once the technology is in place, there is no impact in the state. A blank indicates the energy technology was not specified by the scenario.

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