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Draft Environmental Impact Statement

BONNEVILLE POWER
ADMINISTRATION

DIRECT SERVICE INDUSTRY OPTIONS

U.S. Department of Energy

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Appendices

APPENDICES TO THE DRAFT ENVIRONMENTAL IMPACT STATEMENT

on

THE DIRECT SERVICE INDUSTRY OPTIONS

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Revised - Table 4.12
Atmospheric Emissions (ton/yr)

Plant	Plant Capacity TAP/day[a]	Particulates	Fluorides[b]	Hydrocarbons	SOx[c]	CO
Vancouver[d]	338	678	185	30	1,276	7,023
Longview	575	1,575	263	No data	No data	No data
Troutdale[e]	356	877	162	No data	2,799	12,822
The Dalles	250	435	102	No data	503	15,926
Goldendale	482	595	161	No data	633	No data
Wenatchee[f]	630	1,368	495	401	2,737	No data
Tacoma	218	600	158	36	1,941	11,336
Ferndale	798	620	117	9	5,082	37,205
Mead	636	1,544	685	No data	404	24,132
Columbia Falls	437	837	456	625	1,850	No data

(a) TAP/day = tons aluminum produced per day.
(b) Includes particulate and gaseous fluorides.
(c) Washington regulates based on sulfur content in coke - limits to 60 lbs SO_2/TAP; Oregon limits emissions on an individual basis for each plant; Montana does not have an SO_2 atmospheric emission limit for aluminum smelters.
(d) Blessinger, J. A. 1985; letter and material submitted 7/3/85, from Environmental Superintendent of Alcoa at Vancouver; Willenberg, J. 1985; letter dated 6/19/85 transmitting air emission data for Alcoa Vancouver plant.
(e) Production numbers for Troutdale are considered proprietary; see Table 4.13 for effluent information.
(f) New air pollution control equipment was operational in May 1985 and is expected to significantly reduce the reported emissions.

of particulate alumina are from ship unloading and about 7 ton/yr of particulate matter are released from alumina conveying, storage, and handling.

Upgraded equipment for control of air emissions was installed and first operated in 1974. Alcoa A-398 dry scrubbers are used to capture particulates and to capture and recycle fluoride emitted from the smelting process. Alcoa 446 dry scrubbers are used to collect combustion products from anode baking furnaces. In addition, nuisance dust collectors (baghouses) are used to control emissions from material handling systems where dust is generated.[a]

The potroom dry scrubbing equipment (secondary system) has a rated efficiency above 99% for particulates and fluoride from the reduction plant. Control equipment on the anode baking furnaces has efficiencies above 95% for hydrocarbon removal and about 95% for total carbon removal. Other baghouses in the plant have efficiencies above 98% for particulates; the electrostatic precipitator is rated at 95% efficiency.[b]

Longview. Atmospheric emissions are regulated by the Washington State Air Pollution Control Board relative to the amount of aluminum produced. The fluoride pollution control system must be designed to collect 85% of the emissions and remove 95% of the collected material. Currently, total fluoride emissions range from approximately 2.0 to 2.5 lbs/ton. Particulate emissions rarely exceed 15 lb/ton.

Troutdale. Atmospheric emissions are regulated by an Air Contaminant Discharge Permit (ACDP) from the Oregon Department of Environmental Quality. The permitted releases are related to aluminum production and are listed in Table 4.13.

Revised - Table 4.13
Air Pollutant Emissions from Troutdale

Component	Permitted	Actual (1981)
Fluorides	3.5 lb/ton Al	2.6 lb/ton Al
SO_2	2868 ton/yr[a]	3432.8 ton/yr
Particulates	15.6 lb/ton Al	12.0 lb/ton Al

(a) Annual permitted value.

The Dalles. Average release for July 1982 through June 1983 included 6.2 lb/TAP total particulates, 0.5 lb/TAP particulate F^-, 0.2 lb/TAP gaseous F(HF), and 8.2 lb/TAP SO_2.

(a) Letter and material from J. A. Blessinger submitted July 3, 1985, from Environmental Superintendent of Alcoa Vancouver plant.
(b) Aluminum Company of America (Alcoa). 1976. Environmental Assessment of Alcoa Vancouver operations. Vancouver, Washington.

APPENDIX A

AN ENVIRONMENTAL AND SOCIOECONOMIC ANALYSIS OF NORTHWESTERN ALUMINUM SMELTERS

APPENDIX A

AN ENVIRONMENTAL AND SOCIOECONOMIC ANALYSIS OF NORTHWESTERN ALUMINUM SMELTERS

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SUMMARY

This report was prepared by Pacific Northwest Laboratory (PNL) for the Bonneville Power Administration (BPA). It was undertaken to provide BPA with information and analysis on the socioeconomic and environmental consequences of the operation of Pacific Northwest aluminum smelters. BPA is considering options for relieving certain problems related to its aluminum smelter customers. The Northwest aluminum smelters are experiencing financial problems because of the current low worldwide price for aluminum and the relatively high rates for electricity.

In this report, the affected environment (socioeconomic and physical environment) surrounding the ten Pacific Northwest aluminum smelters and the impacts of plant operation are discussed. The impacts are described by comparing current conditions for two levels of plant operation: full capacity and complete shutdown. The data for this analysis consist of information obtained from visits with the aluminum companies and community officials, from state agencies, and from other secondary sources.

The major findings are listed below:

1. The economic and social impacts of the shutdown of a major industrial facility are widespread and complex. Our analysis indicates that in addition to the job losses directly associated with the shutdown of an aluminum smelter, from 2.5 to 3.1 additional, indirect jobs are lost. The impacts of shutdown would be more severe in the smaller, less diversified, more isolated communities than in urban areas where the size and diversity of the economy and the government social systems tend to disperse such impacts. For this reason, Wenatchee, Columbia Falls, Goldendale, The Dalles, and, possibly to a slightly lesser extent, Ferndale and Longview-Kelso are particularly vulnerable.

2. In addition to the secondary employment impacts of plant closures, the immediate employment impacts are likely to cause reduced demand for housing and a subsequent depression of housing prices, reduced tax revenue for local governments and school districts, and increased out-migration. Again, these impacts are expected to be more severe for the smaller communities than for larger, more dispersed areas.

3. Alternatively, return to full operation would present relatively few adverse social or economic impacts. In most cases, the plants are presently operated at reduced capacity with recent lay-offs resulting in an existing supply of labor that could be used to bring the plant up to full capacity. Also, since these plants have been present in the communities for many years, most of the potential social and community impacts of plant operation have been adequately addressed by the local governments.

4. Aluminum smelting produces gaseous and particulate airborne contaminants including fluorides, volatile organic compounds, sulfur dioxide, and carbon monoxide. Atmospheric emissions of these materials are partially controlled by scrubber systems. Aquatic effluents result primarily from air-pollution control (wet scrubbers) and from plant process water (cooling), and include fluorides, total suspended solids, cyanides, oil and grease, and organic compounds.

5. Atmospheric emission rates are regulated by the states. Ambient concentrations of airborne fluorides are generally below levels reported to cause injury to plants, and reported fluoride levels are below those expected to cause symptoms in cattle.

6. Aquatic effluents are regulated by state-issued National Pollutant Discharge Elimination System (NPDES) permits. As a result, concentrations of toxic materials in waters receiving the effluents are below levels reported to cause acute toxicity in aquatic organisms. Fluorides in Columbia River water have been suggested as a contributing factor to delays in adult salmon migration at John Day Dam, however, conclusive evidence of their effect is not available.

7. Significant quantities of solid wastes are produced in conjunction with smelter operations. Open storage of spent potliners has resulted in cyanide-contaminated leachate at at least two sites. This leachate is a potential threat to groundwater beneath the sites. Changes in waste-handling are being implemented; these changes include dry (indoor) storage, reprocessing, shipping to approved offsite disposal facilities, and leachate collection and treatment to mitigate or prevent further contamination. Similar changes in handling wet-scrubber sludge are being implemented at one site where polynuclear aromatic hydrocarbons threaten surface water.

Chapter 1

INTRODUCTION

The Bonneville Power Administration (BPA) is considering options for relieving certain problems related to its direct service industry (DSI) customers. The DSIs most affected are aluminum smelters. These Northwest smelters are experiencing financial problems because of the current low worldwide price for aluminum and the relatively high rates for electricity.

The financial health of the Northwest aluminum industry is important to BPA because an unstable industry creates uncertainty in BPA's revenues and in its ability to repay its U.S. Treasury obligations on schedule. Also, since BPA's costs are relatively fixed, loss of revenue from its aluminum customers may mean rate increases for other BPA customers. Finally, the fluctuations and uncertainty in the aluminum industry create uncertainty about future BPA resource needs and poses problems in planning and operating existing resources.

BPA recently completed an analysis of possible relief measures (The DSI Options Study). The five BPA measures evaluated in the DSI options study were:

1. no action: continue present rate structure and delivery system
2. tie electricity rates to an index of aluminum prices
3. increase interruptibility of DSI power delivery
4. finance DSI energy conservation measures
5. increase access of DSIs to other (non-BPA) sources of power.

The DSI Option Study recommended that BPA attempt to link a variable rate for electricity to an index of aluminum prices and to help the aluminum smelters invest in modernization and conservation. However, before it could choose and implement an option, BPA needed to complete additional analyses of the action's socioeconomic and environmental impacts. BPA contracted with Pacific Northwest Laboratory (PNL) to perform part of these socioeconomic and environmental analyses.

1.1 OBJECTIVES

The major objective of this study is to produce a socioeconomic and environmental analysis of the operations of Northwest aluminum smelters. The analysis will be used by BPA to help determine whether the options differ significantly in socioeconomic and environmental impacts.

Also, BPA may need to prepare an environmental impact statement (EIS) or an environmental assessment. While this report is not intended to provide specific material for an EIS, some of the material may serve as back-up or

support for such an assessment. We believe it will help BPA determine whether any of the policies it is considering enacting have important socioeconomic or environmental consequences.

1.2 SCOPE AND ORGANIZATION

In this report the socioeconomic and physical environment surrounding the ten Northwest aluminum smelters and the impacts of plant operations are discussed. Not all data and information could be compiled and included in this report because of the project's time schedule. The description and analysis rely on existing data and site visits.

BPA and PNL have agreed that it would be nearly impossible to specifically address the impacts of each option evaluated in the option study on each aluminum smelter's level of operation. This would require forecasting company responses to each of the BPA options. Instead, BPA has requested that PNL evaluate the results of two levels of plant operation, full capacity (100% operation) and shutdown (0% operation) by comparing the operations at this level with the present level of operations. This analysis was completed in late summer 1985. Subsequently several of the plants further reduced capacity and employment, demonstrating the continuing decline of Northwest aluminum smelters.

The report is divided into three additional chapters. Chapters 2 and 3 are socioeconomic and environmental chapters, respectively, describing the environment surrounding the aluminum smelters. We have included the tables for Chapter 2 as Appendix A-A in a separate volume. The employment information contained in Chapter 2 was correct when the information was collected (late summer 1985). However, a number of plants have reduced employment since our data were collected.

Chapter 4 contains the discussion of socioeconomic and environmental impacts if the ten Northwest aluminum smelters were operated at full capacity and if they were shut down. The discussion also includes background information on the mechanisms that result in socioeconomic impacts and a discussion of aluminum plant effluents and damage pathways. We have also provided information on the model (the Metropolitan and State Economic Regions Model) used to estimate employment, demographic, and fiscal impacts, along with the complete outputs of this model as Appendices A-B, A-C and A-D.

Chapter 2

THE AFFECTED SOCIOECONOMIC ENVIRONMENT

The description of the affected socioeconomic environment focuses upon the counties in which the aluminum smelters are located, with special attention to the communities located closest to the plants. In the description of the affected environment, each county is described separately, although it is recognized that the plants have socioeconomic effects that extend across county and, in some cases, state boundaries. In the impact discussion (Chapter 4), these interrelationships are addressed by analyzing as a set the plants located in proximity to one another. This report generally presents information available from secondary sources, although site visits were conducted at each location to obtain more current, site-specific information. Most of the supporting data for this chapter are included in tables in Appendix A-A. The location of each of the aluminum smelters is shown in Figure 3.1 in Chapter 3.

2.1 INTRODUCTION

A "screening" process similar to that described in Branch, et al. (1984) was followed to identify the socioeconomic variables likely to be affected by shutdown or full operation of the aluminum smelters.

Particular attention was given to identifying county and community characteristics that would be affected by the loss of jobs, income, population, tax revenues and other resources, and loss or change in the organizations affecting the community. The framework of this analysis is presented in more detail in Chapter 4.

2.1.1 Organization of the Chapter

The ten aluminum smelter sites are first grouped into geographic areas: 1) lower Columbia, 2) mid-Columbia, 3) upper Columbia, 4) Puget Sound, 5) Northeastern Washington, and 6) Western Montana. Within each of these geographic areas, the pertinent socioeconomic characteristics--economy, demography, housing, land use, public sector, and social organization--of each county and selected communities are then described. This organization allows relatively easy comparison across counties and communities and provides the most efficient basis for addressing the socioeconomic impacts of plant closure or full operation.

2.1.2 Time Frame Covered

To provide a basis for analyzing impacts of modifying plant operations, the description of the affected environment includes both historical and current information. In general, economic, demographic, and housing data have been compiled for 1970, 1980, and the most recent year available. Information on land use, public services, and social organization generally covers a shorter time period; current conditions are characterized and significant historical changes are identified.

2.1.3 Study Area Definition

The study area for this analysis has been defined separately for each smelter, primarily on the basis of economic patterns and jurisdictional boundaries. Lacking information about purchasing patterns of the DSIs and residential and shopping patterns of the aluminum workers, we have defined the study areas in terms of counties and communities near the plant, with an effort to include all counties that would incur substantive socioeconomic impacts from either plant closure or continued operation. In several instances (for example, the lower Columbia and mid-Columbia areas), plant location and economic relationships indicate that the effects of some DSIs extend substantially across county and state boundaries.

2.2 SOCIOECONOMIC DESCRIPTIONS OF THE SITES

The economy, demography, housing, land use, public sector, and social organization of the communities and counties surrounding the ten Northwest aluminum smelters are described below.

2.2.1 The Lower Columbia Area

These are three plants along the lower Columbia River. Reynolds Metal Company has two plants: one in Longview, Washington, and another at Troutdale, Oregon. The Alcoa Company has a reduction plant near Vancouver, Washington.

2.2.1.1 Plant Characteristics

Reynolds Metals Company - Longview Plant. The location of the plant in Cowlitz County is shown in Figures 3.1 and 3.2 in Chapter 3. The Reynolds aluminum reduction plant is located in an area of Cowlitz County that is zoned for heavy industrial use, and is near major Weyerhaueser and Longview Fibre facilities. The plant site is bordered on the south by the Columbia River. The plant was established in 1941. In 1968, the original three production lines were expanded to six, and the work force was increased by 500-600 workers. Reynolds also operates a cable plant adjacent to the reduction facility, transporting the necessary material in molten form from the reduction plant. Although the cable plant workers are not included in the work force figures for the reduction plant, area residents often refer to both facilities when discussing the role of the company in the community, and it is likely that employment at the cable plant (currently about 200 workers) is tied to the continued operation of the reduction facility.

The reduction plant has an average full production work force of about 1,000 workers consisting of about 200 maintenance, 200 salaried, and 600 hourly production workers. In July 1985 the plant curtailed production from six to five potlines. According to Louis Bacon, executive director at the Longview Chamber of Commerce, managers at the plant live primarily in Longview, while other plant workers are distributed throughout the county. A curtailment of the reduction operations occurred in 1981-1982 when the plant operated at about two-thirds capacity. Three potlines were restarted in 1983, one each in April, June, and August. After recalling all former workers who wished to return to

the plant, about 115 new employees were hired, indicating that about 10% of those laid off had either left the area or found other jobs during the interim. According to Douglas Nielson, Reynolds personnel manager, there were about 1,100 applicants for the 115 openings.

The wage scale in 1985 for the production workers, all of whom are unionized, is from $11.70 to $15.00 per hour. The average is about $13.25 to $13.50 for skilled workers. The 1984 payroll was $31,247,000 for the reduction plant and $6,825,000 for the cable plant. In 1984, fringe benefits for reduction and cable plant workers totaled $9,487,000 and $2,198,000, respectively. Excluding power, the reduction plant made $11,546,000 in purchases in the Northwest region in 1984; purchases by the cable plant totaled $17,528,000. Taxes paid by the reduction and cable plants in 1984 totaled $2,527,000 and $827,000, respectively. According to Douglas Nielsen of Reynolds, approximately 80% of the reduction plant production is shipped out of the region to fabrication facilities.

Aluminum Corporation of America (Alcoa) - Vancouver Plant. The location of the Alcoa Vancouver smelter is shown in Figures 3.1 and 3.2 in Chapter 3. The plant was established in 1940, and presently consists of both a reduction and a fabrication facility. The highest total employment at the smelter since 1980 occurred in March of 1981 when the work force reached 1,280 workers. The work force was reduced in May, July, October, and December of 1981, and in January and December of 1982. At the end of May 1985, when the plant was considered to be at 60% production, employment at the Vancouver smelter stood at 798 workers, of whom 634 were hourly and 164 were salaried. About 75% of the hourly employees at the plant in May 1985 had 10 or more years of seniority with Alcoa.

According to John Vasquez of Alcoa, the average wage for noncraft production workers at the Vancouver plant in 1985 was $12.75; average wages for craft workers were somewhat higher. In 1984, the plant paid $28.17 million in wages and salaries, $2.51 million in state and local taxes (down from $3.14 million in 1983), and $18.21 million to suppliers in the Northwest region.

Reynolds Metals Company - Troutdale Plant. The location of the Reynold's Aluminum reduction plant near Troutdale, Oregon, is shown in Figures 3.1 and 3.2 in Chapter 3. The plant, originally built by Alcoa, was purchased by Reynolds Metal Company after World War II. The smelter currently has five production ("pot") lines, and, when running at full production, employs approximately 920 workers. The plant operated at full production in early 1981 but curtailed production by two potlines in October. In 1982, operations were further reduced to only one potline until mid-1983 when the level was increased to three. The remaining two lines were put back into production in the fall of 1983, and the plant ran at full production from November 1983 to July of 1984. From July 1984 to July 1985, the plant ran three potlines, operating at about 60% capacity with 615 workers on active status at the plant. In July 1985 Troutdale curtailed production in one potline leaving only two of the five potlines in operation.

Currently, 52% of the work force on active status at the Reynold's Troutdale plant are age 40 or over (compared to 44% age 30 or younger among those laid

off). About 85% of plant personnel are unionized; the other 15% are nonunion and salaried. According to Reynolds official Richard Reedy, the average wage at the plant in 1985 was about $12.50 per hour. Although precise information is not available on where workers live, it was estimated that between 60% and 70% of the plant employees lived in the eastern portion of Multnomah County and that approximately 25% of the workers and their families lived in Troutdale.

During the most recent full-production month, the total payroll, including wage and salaried workers, was $2.23 million. In the spring of 1985 the plant was operating at 60% production and the monthly payroll was $1.62 million. In 1984, Reynolds paid $2.98 million in payroll taxes and $550,000 in property taxes; no state corporate income taxes were paid because Reynolds did not make a profit. In 1984, the total dollar volume of purchases from suppliers in the Pacific Northwest was estimated by a Reynolds official to be about $13.7 million.

2.2.1.2 Cowlitz County and the Communities of Longview and Kelso

Economic Characteristics. The economy of Cowlitz County is not highly diversified. However, its location near Interstate-5, and its ready access to both the Burlington Northern and Union Pacific Railways and to several deep water ports on the Columbia River place it in a favorable position in the transportation system of the Northwest. Traditionally, the economy of the area has been heavily dependent upon the wood products industry. Port and metals production and fabrication activities increased in importance during and after WWII.

Between 1970 and 1980 the economy of the county expanded. Total employment (by place of work) increased from 23,360 to 35,855 over this period. However, difficulties in the wood products industry since the mid-1970s, uncertainty in the metals production sector, and the Mt. St. Helens eruption have adversely affected the county's economy. The civilian labor force in Cowlitz County declined between 1980 and 1984, falling from 34,580 in 1980 to 32,700 in 1984. Total average employment in the county also declined over this period, from 30,860 in 1980 to 28,460 in 1984. Reflecting this contraction in economic activity, unemployment increased from 10.8% in 1980 to 13.0% in 1984. Retail sales, labor and proprietors' income, and total personal income show a pattern of growth between 1970 and 1977 followed by significant decline between 1977 and 1982 (the most recent year for which data are available). Between 1975 and 1982, per capita income in Cowlitz County declined as a percentage of state levels, falling from a peak of 98.3% in 1975 to 91.9% in 1982.

Demographic Characteristics. The population of Cowlitz County increased from 68,616 persons in 1970 to 79,548 in 1980. It then declined between 1980 and 1983, falling to 79,300, then increased to 79,900 in 1984. During the 1980-1984 period, the components of population change (net increase of 352 persons) included 5,111 births, 2,456 deaths, and an out-migration of 2,303 persons (Washington State Office of Financial Management 1984, Table 9). Between 1980 and 1984, the proportion of the population residing in the unincorporated areas of the county increased from 39.8% to 41.9%.

The population of the county was over 95% white in 1970, 1980, and 1983, although the proportion of nonwhites has increased slightly over this period. Native Americans and Asians constitute the largest nonwhite components of the population, though neither group comprises even 2% of the total population.

The population of both Kelso and Longview declined between 1980 and 1984. In 1984, the population of Kelso was 10,840 persons, down from 11,129 in 1980 and only slightly above the 1970 population of 10,296. Longview, which is the economic center of the county, declined by 1,232 persons (4.0%) between 1980 and 1984, falling from 31,052 persons in 1980 to 29,820 in 1984.

Housing Characteristics. Total housing stock in Cowlitz County in 1984 was 32,742 units, of which 61.6% were single family units, 18.2% were multiple family units, and 6.9% were mobile homes. According to the decennial census data, the proportion of the county's year-round housing that was single family units declined from 78.6% in 1970 to 71.6% in 1980. Overall, a slightly higher proportion of occupied units in Cowlitz County than in the state were owner-occupied (66.5% compared to 65.6%).

In 1984, the total housing stock in Kelso and Longview was 4,811 and 13,190 units, respectively. Census housing data indicate a somewhat older, lower value stock of housing in Kelso than in either Longview or the county (31.7% constructed prior to 1940 compared with 20.5% in Longview and 21.8% in the county).

Throughout the county, reduced population and difficult economic conditions have lessened demand for housing. According to Hal Palmer, president of the local board of realtors, in June 1985 approximately 1,000 units were on the market in Longview and Kelso with an average length of time-to-sale of approximately 6 months. According to these figures, there has been a substantial softening of the housing market since 1980.

Land Use Characteristics. The Reynolds plant is located in an industrial park on unincorporated land contiguous to the southwest section of the city of Longview within easy commuting distance from the cities of Longview, Kelso, Rainier (Oregon), and much of Cowlitz County. There is considerable room in the industrial park for additional facilities. The plant is within the jurisdictional boundaries of Cowlitz County, the Port of Longview, and the Longview School District. Under the auspices of the Governmental Conference of Cowlitz and Wahkiakum Counties, development assistance has been sought and received from the Economic Development Administration to provide the services to the industrial land that would make it attractive to new industry. According to John Thompson, executive director of the Cowlitz County Economic Development Corporation, industrial land is relatively inexpensive in the area, and application has been made for foreign trade zone status to increase the attractiveness of the area to firms that use foreign parts in their products. Because of its long-time presence in the county, the plant is incorporated in existing and future land use plans within the industrially zoned areas.

Public Sector Characteristics. Cowlitz County is governed by a county commission headed by three elected commissioners. The major sources of county

revenue include property taxes (54%), sales taxes (7%), and intergovernmental transfers (18%). Most of the remaining revenue is obtained from various user fees.

The city of Longview is headed by a seven-member city council, elected at large and serving part-time. The city manager is responsible for day-to-day management of the city. The city has a $35 million budget, which is considered adequate to maintain current services. The structure of the government in Kelso is nearly identical to that of Longview. However, Kelso has experienced difficulty maintaining service levels and has recently been operating at a deficit. The city governments depend upon a mix of property tax, business and occupation tax, sales tax, user fees, and intergovernmental transfers to supply operating funds.

The Longview School District has an enrollment of about 7,000 students and an operating budget of $23.3 million. The primary source of revenue for the district is the property tax. According to Grant Hendrickson, school superintendent, support for the school system has historically been strong; voters recently passed a special $3 million levy.

Social Organization and Well-Being Characteristics. The recent decline in economic activity and loss of population have already affected social conditions in the area. Cowlitz County and its major communities remain fairly homogeneous in terms of ethnicity and culture, although the recent influx of Southeast Asians has increased cultural diversity in the area.

Governmental structure in the area is moderately complex, influenced to a considerable degree by cooperation rather than competition between the various jurisdictional units. Members of the major firms, the professions, and the retail sector are active in the local political arena. Local government in both communities, but particularly in Longview, has been quite active. Standard indicators of social well-being (e.g., crime, divorce, infant mortality, unemployment rates) do not indicate unusual levels of social problems in the county.

2.2.1.3 Clark County and the Community of Vancouver

Economic Characteristics. Clark County in Washington is one of four counties included in the Portland Metropolitan Statistical Area (MSA). Vancouver, the county seat, is the largest incorporated entity in the county. Camas and Washougal are located side-by-side on the Columbia River about 15 miles east of Vancouver and represent the eastern boundary of the rapidly urbanizing area around the city of Vancouver. Clark County serves as a labor source for Portland and the surrounding area in Oregon. In 1980, for example, an estimated 22,000 workers from Clark County commuted to Oregon for work, compared to only 5,100 workers commuting into Clark County from Oregon (Ness 1984).

Total average employment in Clark County fell from 85,980 in 1980 to 80,710 in 1981, then rose to 83,960 in 1982, 84,900 in 1983, and 86,230 in 1984. Unemployment over this period was 7.1% of the civilian labor force in 1980, 8.5% in

1981, 11.8% in 1982, 9.6% in 1983, and 8.4% in 1984. Throughout this period, the unemployment rate in Clark County was below that of Washington State (Washington State Employment Security Department 1981-1985).

Total labor and proprietor income in Clark County (constant 1970 dollars) rose from $305 million in 1970 to $864.1 million in 1980, but fell to $827.3 million in 1982. In 1980 and 1982, labor and proprietor income from manufacture of durable goods accounted for $67.6 and $61.5 million, respectively (Bureau of Economic Analysis 1982 and 1984b).

The largest business and industrial employers in Clark County include Tektronix, which employs about 2,000 workers; Crown Zellerbach, which has a work force of approximately 1,800; and Alcoa, which until recently employed about 900 workers. Approximately 15 other firms in Clark County employed 300 or more workers in 1985. Manufacturing, retail trade, services, and government constitute the largest sectors of the Clark County economy in terms of employment by place of work. Between 1972 and 1982, Vancouver's percentage of county retail sales and total number of retail establishments has declined. By 1982, 26.6% (371) of the county's 1,395 retail establishments were located in Vancouver (down from 50.3% in 1972); Vancouver's share of total retail sales in the county was 34.1%, down from 56.2% in 1972 (Bureau of the Census 1976, 1980, and 1984, and Bureau of Economic Analysis 1984b).

Demographic Characteristics. Clark County experienced significant growth during the 1970s; county population increased from 128,454 in 1970 to 192,227 in 1980. In 1983 the population of Clark County was estimated to be about 200,000, making Clark the fastest growing of the four counties in the Portland MSA. The city of Vancouver has not grown as rapidly as the county. In 1970, the population of Vancouver was 42,493; in 1980 it was 42,834; and in 1983, it was estimated to be 42,600. Although the percentage of nonwhites in the population of both Clark County and Vancouver has increased since 1970, in 1983 whites still constituted 95% of the total population in the county. The population in Vancouver in 1980 was significantly older than in the county or the state. In 1980, 34% of the Clark County and 27% of the Vancouver population was under 20 years of age (compared to 30% and 31% in Washington and the U.S.), while 9% of the county population and 16% of the city population were 65 years of age or older compared to 10% in Washington and 11% in the U.S. (Bureau of the Census 1982d and Washington State Office of Financial Management 1984).

Housing Characteristics. Total housing stock in Clark County increased from 42,800 units in 1970 to 72,806 units in 1980 and to 78,494 units in 1984. In Vancouver, housing stock increased from 19,894 units in 1980 to 20,503 units in 1984. Much of this growth occurred in the county along the northern edge of Vancouver.

In 1980, 75.6% and 58.7% of the year-round housing units in Clark County and Vancouver, respectively, were single family dwellings. In Vancouver, 40.% were multiple family units and 1.3% were mobile homes. In Clark County, 20.2% were multiple family units and 5.5% were mobile homes. A higher proportion of Clark

County housing was owner-occupied in 1980 (67.4%) than in either Vancouver (47.5%) or the state of Washington (65.6%) (Bureau of the Census 1977, 1983b, and Washington State Office of Financial Management 1984).

In May 1985, the average sale price of homes listed with the Clark County Multiple Listing Service was $60,700. This is the same as the median value of a single family dwelling in 1980, according to U.S. Census figures. In late May of 1985 there were about 1,600 single family dwellings in the multiple listings for Clark County and the average time-to-sale was about 120 days. According to Rick Haddock, a local realtor, the rental market in the county in May 1985 was considered very strong, with rental rates generally rising.

Land Use Characteristics. The Alcoa Vancouver plant is located in an unincorporated area two or three miles west and downriver from the Vancouver city limits near the Port of Vancouver. The smelter is located in an area between the Columbia River and Vancouver Lake that is zoned for heavy industry and is primarily open and undeveloped. The plant site is considered prime industrial land. Plans are currently under way to site an additional industrial development (Habitek) near Vancouver Lake. A recent reclamation project has increased the recreational value of Vancouver Lake, and considerable planning has taken place to ensure that the new industrial development will be compatible with the recreational use of the area.

Clark County has a comprehensive development plan that is generally considered to be fairly strict, well-implemented, and enforced. The county and the city appear committed to maintaining a balance between development and "livability" or attractiveness of the community (The Columbian, January 27-29, 1985).

Public Sector Characteristics. Clark County is governed by a three-person county commission, with no county administrator. Revenues to the county for 1984 amounted to $21.4 million and actual expenditures were $18.9 million. The major sources of county revenues were property taxes ($7.6 million) and retail sales and use taxes ($3.6 million). The rapid growth of the unincorporated areas of the county has increased demand for county services.

The city of Vancouver has a council/city manager form of government. The city budget for 1985 was $44.45 million. The city was adversely affected by the 1981-1982 economic downturn, to which it responded by reducing expenditures in selected programs. By 1985, the financial and administrative status of the city was considered to be stable, with some reserves built up to counter unexpected revenue shortfalls (City of Vancouver 1985).

The Alcoa plant is located in the Vancouver School District, which served 15,072 students in 1984-1985. Although enrollments have been declining somewhat since 1980, it is believed that they have now stabilized.

Social Organization and Well-Being Characteristics. As a result of the rapid urbanization of Clark County, social conditions and residents' perceptions of the area and their community have undergone considerable change in the last several years. Urbanization and the relatively severe effect of the 1980-1981 recession on the county have increased poverty and other social problems in the

area. Although standard social indicator data through 1983 (infant mortality, FBI crime statistics, divorce) do not indicate a substantial increase in the rates at which problem behaviors are occurring in Clark County, local officials indicate the number of Clark County families receiving food stamps increased by 52% between 1980 and 1984, despite the tightening of eligibility requirements over this period. In January 1984, 7,045 families (18,647 individuals) received food stamps, and it was estimated that in January 1985, more than 20,000 county residents (about 10% of the population) were receiving food stamps (The Columbian January 29, 1985). These figures indicate vulnerability to further economic decline.

2.2.1.4 Multnomah County and the Communities of Troutdale and Gresham

Economic Characteristics. Multnomah County, Oregon, is one of four counties that comprise the Portland Metropolitan Statistical Area (MSA). The city of Portland lies mainly in Multnomah County, and represents about 65% of the total county population. The eastern portion of Multnomah County, where the Reynolds Troutdale plant is located, has been primarily a residential area for persons working in Portland. It is estimated that about 74% of the workers living in the eastern portion of the county commute to jobs in other areas, principally Portland (Gresham Area Chamber of Commerce 1985). East Multnomah County (a specific set of census tracts with a total 1980 population of 197,589) includes the incorporated towns of Gresham, Troutdale, Wood Village, and Fairview. The far eastern portion of this area remains rural in character.

In 1980, the total average employment and the civilian labor force in the Portland MSA was 595,600 and 635,500, respectively, giving an unemployment rate of 6.3%. In 1984, the total average employment in the MSA was 556,400 and the civilian labor force was 614,800, slightly above 1983 levels. In 1984, the unemployment rate in the Portland MSA was 7.9% (Oregon Employment Division 1981-1985).

Total employment by place of work in Multnomah County increased during the 1970s, from 313,178 in 1970 to 384,969 in 1980. Between 1980 and 1982, however, county employment by place of work declined by 28,212 jobs, a drop of 7.4%. For the county as a whole, manufacturing, retail trade, services, and government have been the major employment sectors, although between 1970 and 1982, manufacturing has declined from 17.1 to 13.4% of total wage employment. Retail sales for 1982 in Multnomah County fell to 89.5% of the 1972 level (in constant 1972 dollars), although the number of retail establishments had increased. In 1982, per capita income in Multnomah was 89.6% of the average state level, down from 92.5% in 1980 and 90.3% in 1975 (Bureau of Economic Analysis 1984a). In 1984, per capita income in the county was $12,649 (1984 dollars) (Gresham Area Chamber of Commerce 1985).

Although Multnomah County as a whole is dominated by the urban economy of the Portland area, Troutdale and Gresham are less urbanized. Troutdale's early history was based on its role as a rail depot and its position as the gateway to the Columbia Gorge area. Gresham developed primarily as an agricultural community, with berry farms, canneries, and nurseries the principal economic

activities until the early 1970s. Extensive subdivision development has curtailed much of the agricultural activity, and the Gresham area has become primarily residential, with commercial activity limited mainly to retail sales and services.

The three largest manufacturing employers in East Multnomah County in recent years were Boeing (aircraft frame structures), with about 1,600 employees; Reynolds Metal Company, with about 900 employees; and Cascade Corporation, with about 420 employees. Other employers of over 200 workers included Viking Industries, Opti-Craft, and Western Skyways (Gresham Area Chamber of Commerce 1985).

Demographic Characteristics. Between 1970 and 1980, the population of Multnomah County and the Portland MSA increased by 1.1% and 2.4%, respectively. In 1980, the population of Portland was 562,640 persons, 54.8% of the 1,026,144 people in the Portland MSA. In 1980, the populations of Troutdale and Gresham were 5,908 and 33,005 persons, respectively. In 1980, the population of Multnomah County was somewhat older than that of the Portland MSA or the state of Oregon, with 27% of the total population under 20 years of age and 13% age 65 or older. The population of the city of Troutdale was substantially younger than the county, with 38% of the population under age 20 and only 3% age 65 or older. The population of the area is predominately white, although in 1980, over 10% of the population of Multnomah County was nonwhite--primarily blacks (5.3%), Asians (2.4%) and Native American (0.9%). Persons of Spanish origin constituted 2.0% of the county population in 1980 (Bureau of the Census 1982b).

Housing Characteristics. In 1980, the total housing stock in Multnomah County, Troutdale, and Gresham was 245,135, 1,976, and 12,375 units, respectively. In Troutdale, 93.6% of year-round units were single family dwellings and 73.8% were owner-occupied. In Gresham and Multnomah County, 81.1% and 76.7% of year-round units were single family dwellings; 64.6% were owner-occupied in Gresham compared to 56.7% in Multnomah County. The housing in Gresham and Troutdale is considerably newer than that in the county as a whole. In 1980, 68.3% of housing units in Gresham and 82.9% of housing units in Troutdale were less than 10 years old, compared to about 18% in Multnomah County. Only 6.3% and 4.9% of the occupied units in Troutdale and Gresham, respectively, were pre-1940 construction, compared to 34.9% in Multnomah County as a whole (Bureau of the Census 1977, 1983b). Pamela Christian, city administrator for Troutdale, stated that the market value of homes had been dropping in Troutdale for the last five years. It is likely that a similar drop has occurred in the rest of the east Multnomah County area.

Land Use Characteristics. The Reynolds Troutdale plant is located adjacent to the Portland-Troutdale airport in an area zoned mainly for industrial use. Land near the plant is still primarily undeveloped.

In 1985, there were an estimated 3,480 acres in East Multnomah County designated for industrial development in the comprehensive plans of East Multnomah communities, with 720 acres readily developable (Gresham Area Chamber of Commerce 1985). In 1979, METRO (the Metropolitan Service District), which

serves the urbanized portions of the three Portland area counties, including Multnomah, obtained state approval for an Urban Growth Boundary. The boundary is designed to define areas for urban growth and development to the year 2000 and to preserve rural and farm lands. METRO reviews the comprehensive plans of the cities in the counties it serves to assure compliance with state land use laws.

In preparing its long-term growth strategy and participating in the Columbia Corridor Development Program, the city of Troutdale has designated some sites for industrial growth. The area adjacent to Troutdale that extends along the Columbia River between the Sandy River and the Willamette River constitutes the area included in the Columbia Corridor Development Program. It includes 6,500 acres of vacant industrial land and an additional 2,000 acres of underdeveloped property that is zoned for industrial development. The Troutdale plant is incorporated in the existing land use plans and is therefore considered to be compatible with current and future zoning, land use and comprehensive plans.

Public Sector. Multnomah County operates under a home rule charter and has a County Executive and a five-member County Board of Commissioners, elected from districts for two-year terms. Most of the county is unincorporated and therefore falls under the jurisdiction of the county and other special purpose districts. The METRO is an elected tri-county area council of governments that governs transportation, solid waste disposal, drainage and flood plains, urban growth, and city and county comprehensive plans.

The Port of Portland operates marine terminals and airports and provides economic assistance to the tri-county area. Local governmental units derive most of their operating funds from taxes on land, buildings, tangible personal property, and license fees. Multnomah County's annual budget was $174.34 million in 1983-1984 and rose to $248.96 million in 1984-1985. Taxable value of real property in Multnomah County was $18,164.76 million in 1984-1985, and property taxes, after offsets, were $56.85 million.

Gresham has a council/manager form of government, with an elected mayor and an elected six-person council, all serving four-year terms. Gresham provides a full range of municipal services. In 1983-1984, the city employed 180 persons. In 1983-1984 and 1984-1985, the Gresham city budget was $28.74 and $49.38 million, respectively. The city received, after offsets, $5.26 million in property taxes in 1984-1985. The taxable value of real property in Gresham in 1984-1985 was $1,175.15 million.

Troutdale has a council/administrator form of government, with an elected mayor who serves two years on a volunteer basis. The city council has six members who serve four-year terms. In 1978-1979, Troutdale set its tax base at $350,000 and has increased it by the state-permitted level of 6% each year since then. Troutdale is a self-sustaining city--it provides all of its own services instead of contracting with other jurisdictions. In 1983-1984, Troutdale's annual budget was $2.86 million; in 1984-1985, it increased to

$4.22 million. In 1984-1985, the city received $499,440 in property taxes, after offsets, on real property with a taxable value of $163.10 million (Gresham Area Chamber of Commerce 1985).

The Reynolds Troutdale plant is located in Reynolds School District #7. In 1984, enrollment in the Reynolds District (K-12) was 6,403 students, down from a high of 6,661 students in 1980. The Reynolds School District failed to pass a $2.24 million levy in May 1985. Should the modified proposal ($2.18 million) also fail, the district will have to curtail expenditures (Reynolds School District 1985).

Social Organization and Well-Being Characteristics. The rapid urbanization of East Multnomah County in the late 1970s, accompanied by the slump in economic and construction activities that began in the early 1980s, has caused residents and officials of this area to address issues concerning the balance between growth and maintenance of the lifestyle that initially attracted many of them to the area. The area has remained relatively homogeneous both socially and economically; economic diversity is limited despite the presence of Reynolds Metals and Boeing. The recent, rapid suburban development has created an influx of new residents that is more oriented toward the metropolitan area than toward a rural, residential and community orientation. Although the individual communities in the East Multnomah area continue to guard their individuality and identity, signs of increased intergovernmental cooperation, exemplified by the Metropolitan Service District, are becoming evident. Standard measures of social indicators do not reveal unusual levels of social problems or disorganization.

2.2.2 The Mid-Columbia Area

The mid-Columbia area includes two aluminum smelters, the Commonwealth Aluminum Company site near Goldendale, Washington, and the Martin Marietta site (now closed) near The Dalles, Oregon. Figures 3.1 and 3.8 show the locations of these plants.

2.2.2.1 Plant Characteristics

Commonwealth Aluminum - Goldendale Plant. The Commonwealth aluminum reduction plant is located about 20 miles southeast of Goldendale near the Columbia River, within an extensive silvicultural/agricultural area. The plant is situated on an isolated parcel zoned for heavy industrial use. The plant was established in 1970 and began operations in 1971 under the ownership of Martin Marietta. In 1978, Martin Marietta built an additional potline, increasing the facility's capacity to 526 cells and employment to 1000 workers. Employment remained near this level until last year when the company sold its operations to Commonwealth Aluminum, a wholly owned subsidiary of Comalco, Ltd., Australia's largest aluminum producer.

The peak employment for the Goldendale plant was 858 workers in 1982. The employment level since that time has tapered off steadily, with fluctuations occurring as The Dalles' operations were phased out and the Goldendale work force was shifted and displaced. The largest recent curtailment of operations

occurred in March 1985 when a potline was shut down, affecting 205 workers.[a] The present employment level at the Goldendale facility is about 650 workers. Results from a worker survey conducted for this study (364 workers responded) indicate that over three-fourths of the employees reside in either Goldendale (44%) or The Dalles (33.8%), with the remainder commuting from other centers in Washington (Dallesport, 3.8%; Centerville, 3.0%; Wishram, 2.8%; Lyle, 1.6%; and Wapato, Roosevelt, White Salmon, Maryhill, Grandview, and Glenwood, 3.8%) and Oregon (Rufus, 2.2%; Dufur, 1.6%; and Mosier, Wasco, Moro, and Hood River, 2.8%).

Through the first six months of 1985 the payroll for the Commonwealth reduction plant was $14,240,500. Commonwealth estimates that, excluding power, the company will make $10,641,000 in purchases in the Northwest in 1985. Of this estimate, 13% of the plant's purchases will be made locally in Klickitat and Wasco counties. Taxes paid by the reduction plant for 1985 totaled $3,084,300, with over a third earmarked for the state school fund and the remainder allocated to the road district (18%), the Goldendale school district (17%), Klickitat County government (14%), fire district (8%), county hospital (5%), and library district (4%).

Martin Marietta Aluminum - The Dalles Plant. Martin Marietta Aluminum, a wholly owned subsidiary of Martin Marietta Corporation, became involved in the Pacific Northwest aluminum industry with the purchase of an aluminum reduction plant from Harvey Aluminum in The Dalles in 1956. The reduction facility is located on an unincorporated tract just beyond the city limits to the west of The Dalles. The Martin Marietta plant was closed in 1985 after attempts to sell it were unsuccessful; the plant has remained shut down since then.

2.2.2.2 Klickitat County and the Community of Goldendale

The description of the affected environment for the Commonwealth reduction plant focuses on Klickitat County and the community of Goldendale, which is the largest city in proximity to the Commonwealth facility.

Economic Characteristics. The economy of Klickitat County is highly dependent on agriculture and silviculture. In the early 1970s, the county's economic base added a third export industry with the aluminum reduction plant. A decade earlier, the county experienced a substantial in-migration when the John Day Dam was constructed on the Columbia River nearby. After the dam was completed, some of these workers found employment on the potlines at the aluminum reduction plant. Today, the nature of the county's economic base makes it susceptible to wide fluctuations in the national business cycle.

Location quotients, a common measure of the economic structure of a local area, were calculated for Klickitat County. Using employment data for 1982, the economic base for the county was determined to be agriculture, durable manufacturing, and government. All of these sectors had 1982 location quotients of

(a) As of October 5, 1985, Commonwealth reduced its operating capacity to 60%; 120 employees will be laid off.

over 1.00, indicating that the county specializes in providing goods and services related to these sectors (and hence exports a portion). Over a third of the total employment (by place of work) in Klickitat County is engaged in durable manufacturing. This sector has experienced a 60% increase in employment since 1970, when the aluminum reduction plant started production.

Recent statistics, however, indicate that the county has been adversely affected by the slump in the wood products industry and uncertainty in the metals production sector. The civilian labor force in Klickitat County declined slightly between 1970 and 1982, falling from 7,350 in 1980 to 7,260 in 1980. The unemployment rate in the county (1984 rate was 15.6%) has remained one of the state's highest over the last five years. Total personal income shows a pattern of growth (in real terms) between 1970 and 1980 followed by significant decline between 1980 and 1982 (the latest year for which data are available). Although labor and proprietors' income has nearly doubled in real terms between 1970 and 1982, personal income derived from durable goods manufacturing further underscores the county's economic dependence on this sector. Over a third of the county's 1982 total labor and proprietor income is derived from this sector. Since 1975, per capita income in Klickitat County has declined as a percentage of the state's average, falling from a peak of 88.2% in 1975 to 82% in 1982 (the latest year for which data are available). Retail sales in the county have also declined in real terms since 1972, in spite of the growth in the number of retail establishments. Another measure of retail sales, trade area capture (an estimate of the number of consumers for whom purchases are made within a county or community) indicates that many consumers in Klickitat County are traveling elsewhere (presumably to Oregon where there is no sales tax and selection is greater) to purchase retail goods and services.

Demographic Characteristics. The population of Klickitat County increased from 12,138 persons in 1970 to 15,822 persons in 1980, an annual growth rate of over three percent. This is in contrast to the 1960s when the county's population declined nearly 10%. The county's population was estimated to continue to grow, albeit modestly, during the 1980s. The county's population was nearly 95% white in 1970, 1980, and 1983, although the proportion of nonwhites has slightly increased over this period. Native Americans and Asians constitute the largest nonwhite components of the population, even though neither group comprises even three percent of the total population.

The incorporated communities in Klickitat County include Bingen, Goldendale, and White Salmon. Goldendale, the county seat, is the largest incorporated city in the county with a 1983 population of 3,690 persons. The city's population grew by 37.4% during the 1970s and has continued to grow since 1980.

Housing Characteristics. Total housing stock in 1984 for Klickitat County was 7,172 units, of which 66.3% were single family dwellings, 20.3% were mobile homes, and 13.4% were multiple family dwellings. Between 1980 and 1984 the housing stock increased by 10.4% in Klickitat County. According to the most recent census data, a slightly higher proportion of dwellings in Klickitat County were owner-occupied and were older stock than statewide.

In 1984, the total housing stock in Goldendale was 1,517 units, an increase of 8.4% since 1980. Of this total, 69.2% of the housing units were single family dwellings, 17.7% were multiple family units, and 13.1% were mobile homes. The median value of single family dwellings in Goldendale ($38,800 in current dollars) was slightly under the median value countywide.

The recent layoffs and reductions at the Commonwealth plant have reduced local demand for housing. In June 1985, it was estimated there were between 40-50 houses for sale in Goldendale alone, with the average time-to-sale for most houses approximately one year.

In addition, the number of housing foreclosures in the county has increased markedly. These figures coupled with interviews with local housing experts indicate that there has been a substantial softening of the housing market since 1980.

Land Use Characteristics. Although the Commonwealth plant is not within the incorporated boundaries of Goldendale, the facility lies within the jurisdictional lines of Klickitat County, the Goldendale School District, and the Port District. Given the plant's isolated location and distance from Goldendale, the city has no plans to annex the plant property.

Both the city of Goldendale and Klickitat County have enacted comprehensive land use plans. The city is revising its original comprehensive land use plan, largely unamended since 1959, to address issues such as economic diversification and annexation of some contiguous tracts. There are no conflicts between the land use plans of the city and the county.

Public Sector Characteristics. Klickitat County is governed by a county commission headed by three elected commissioners who serve four-year terms. According to Steve Anderson, Klickitat County planning director, the total budget for 1985 was $12 million, with major expenditures (both capital and operating) allocated to county roads, the county jail, and the Sheriff's department. The major sources of revenue for the county include: property taxes, county sales tax, motor vehicle fuel tax, intergovernmental transfers, equipment rental and inventory sales, and various user fees.

Goldendale has a council/mayor form of government, with an elected mayor and a seven-member council. The city has a 1985 budget of $8.1 million, which is considered adequate to maintain the quality of current services. The city government depends upon a mix of property tax, business and occupation tax, sales tax, user fees, and intergovernmental transfers to finance its expenditures.

The Goldendale School District has a 1985 enrollment of 1,290 students. It employs 71 teachers and administrators along with 43 support staff and has an operating budget of $4 million. According to Mary Ellen Schull, business manager for the Goldendale School District, the primary source of revenue for the district has been the property tax, supplemented with state education payments of $2,055/student.

Social Organization and Well-Being Characteristics. Klickitat County and its major community of Goldendale are fairly homogeneous in terms of ethnicity and culture. The area does not appear to be complex in economic and political structure, with the underlying dynamic of local activities being one of cooperation instead of competition. Employees of the major firms (notably the aluminum reduction plant), the professions, and the business community are active in the area's various volunteer associations. Outside of the high rate of unemployment, other standard statistical indicators of social well-being (e.g., crime, divorce, infant mortality) do not show unusual levels of social problems and disorganization.

2.2.2.3 Wasco County and the Community of The Dalles

Wasco County is situated in north central Oregon. The county is bounded by the Columbia River to the north, the counties of Hood River, Clackamas, and Marion to the west, Jefferson County to the south, and Wheeler and Sherman Counties to the east. Approximately half of the state's largest Indian reservation, Warm Springs, lies within the southwestern part of Wasco County. The description of the affected environment for the Martin Marietta plant focuses on Wasco County and the community of The Dalles, where the Martin Marietta aluminum reduction facility is located.

Economic Characteristics. Economic growth in Wasco County has been fostered by resource development in agriculture, fisheries, and forestry. Processing industries (i.e., fruit packing and canning, fish processing, wheat milling, and wood preserving) have helped to diversify the local economy. Historically, the economic importance of The Dalles has been as a governmental and trading center. In recent times, the local economy has been stimulated by the construction of major federal projects and large-scale manufacturing plants. The city continues to be an important service and retailing center for the region and serves as the governmental center for the county. Its economy is still resource-dependent, even though the fish packing plant and the wheat milling company have since ceased operations. Fruit packing and wood preserving are still major industries in the area.

According to the State of Oregon's Employment Division, the Wasco-Sherman Labor Area had an 1984 average of 12,470 persons in its labor force. Of this labor force total, 12.3% was unemployed, compared to the state's average unemployment rate of 9.4%. Unlike the state, employment in Wasco-Sherman Counties has not returned to its level prior to the 1980-1982 recession. Although state employment grew over 21% between 1970 and 1982, total employment in the county actually declined by nearly 5% between 1980 and 1982. Most of the broad industrial sectors experienced an employment loss during this period, especially durable manufacturing.

Wage and salary employment in Wasco County is dominated by government (21.3%), services (20.7%), retail trade (18.5%), and manufacturing (15.3%). In terms of employment, the county's economic structure is changing from a goods-producing economy to a service-related one. Between 1970 and 1982 employment in the services sector grew by nearly 75% while employment in the wholesale and retail trades grew by 37%. Location quotients, a common measure of the economic

structure of a local area, were calculated for Wasco County; the economic base for the county was determined to be agriculture, retail trade, services, and government. All of these sectors had 1982 employment location quotients of over 1.00, indicating that the county specializes in providing goods and services (and hence exports a portion).

Total personal income in Wasco County grew by 33.6% over the twelve-year period 1970-1982. This growth is largely attributable to the substantial increase in property income and transfer payments. Per capita real income grew over 20% during this period, from $3,608 in 1970 to $4,339 in 1982. This real income growth in the county was nearly twice that of the state's. For 1982, major sources of personal income in the county were durable manufacturing (12.4%), services (10.2%), state and local government (8.4%), and retail trade (7.6%).

During the ten-year period 1972-1982, retail sales declined by 6% in real terms. The Dalles is the area's major retailing center, accounting for 95% of the county's total retail sales. Trade area capture, a measure that describes the number of customers retailers draw into the locale to purchase a given set of retail goods and services, has grown over 15% in The Dalles between 1972 and 1982. The aggregate trade area capture estimate for The Dalles indicates the city's dominance as a retailing center, drawing more than 2.4 times its resident population.

Since the loss of the area's major employer--the Martin Marietta aluminum reduction plant--the city has become more active in promoting economic development. For instance, the city recently passed a $4.5 million bond issue to develop 114 acres along the river for industrial use. The parcel will allow the city to broaden the economic scope of its port facility.

Demographic Characteristics. The population of Wasco County increased from 20,133 in 1970 to 21,732 in 1980, a modest growth rate of 7.9% compared to overall growth for the state of 25.9%. The proportion of minorities in the county is similar to that of the state; about 95% of the population is white. Compared to the state, Wasco County has a high percentage of Native Americans (2.8%) which can be attributed to the presence of the Warm Springs Indian Reservation within the county.

The Dalles is the largest incorporated city in the county with a 1980 population of 10,820 persons. The city, which accounts for nearly half of the county's 1980 population, grew by only 3.8% during the previous decade from a 1970 population of 10,423 persons (Bureau of the Census 1973 and 1982b).

Housing Characteristics. Total housing stock in Wasco County in 1980 was 8,925 units, of which 70.3% were single family dwellings and 68.4% were owner-occupied. In 1980, there were 4,681 housing units in The Dalles. Three-fourths of these units were single family dwellings and nearly two-thirds were owner-occupied. Nearly 40% of the housing stock in The Dalles was constructed before 1940, making its age nearly twice that of the state average.

Growth in the housing market in Wasco County was moderate during the 1970s, as compared to the substantial surge in building during the previous decade. The

residential growth during the 1960s was attributable to a series of major construction projects, including the John Day Dam and The Dalles Dam, Celilo Converter Station, the Interstate 84 highway, and the aluminum reduction plant in nearby Goldendale, Washington.

According to the Census of Housing, the median value of single family dwellings in The Dalles for 1980 was $49,600 (Bureau of the Census 1982a). Court Assessor Herb Crook, Jr., estimated that the assessed value of houses in The Dalles in 1985 had declined an average of 15%; the decline is partly attributable to the recent closure of the Martin Marietta plant. Other figures, provided by local realtor Elt Fadness, indicate a recent slump in the local housing market; these figures include the high number of houses on the market (325 listings in June 1985) and repossessions (35 homes as of June 1985).

Land Use Characteristics. The Martin Marietta aluminum reduction plant is located between Interstate 84 and the Columbia River in an unincorporated area west of and contiguous to The Dalles city limits. The east-west line of the Union Pacific railroad system runs along the southern edge of the property. The area where the smelter is located is predominantly zoned for heavy industry and is generally open and undeveloped. The city recently passed a $4.5 million bond issue to develop 114 acres of Port-owned land adjacent to the Martin Marietta plant for industrial uses. This land parcel would be part of the Port of The Dalles expansion plan. Aside from the prime industrial land located in the vicinity of the Martin Marietta plant, a large area east of the city's central business district is zoned for heavy industrial use. In all, 351 acres have been designated for industrial uses within the city's urban growth boundary.

The city of The Dalles last adopted a comprehensive land use plan in early 1983. Recommendations pursuant to the plan were adopted to encourage land intensive commercial enterprises to relocate near the shopping center on the west side of the city; to encourage commercial expansion in the north portion of the downtown core area; and to encourage industrial development of the 114-acre parcel of Port-owned land.

Public Sector Characteristics. Wasco County is governed by a county commission headed by three elected commissioners. The 1985 fiscal year budget for Wasco County was $11.5 million. Major sources of county revenue include property taxes, intergovernmental transfers, and various user fees. According to Herb Crook, county assessor, Wasco County was recently successful in passing a one year special operating levy for the 1986 fiscal year authorizing the county to levy outside its constitutional limits for financing operations. The levy of $978,400 was necessary to fund the operations of the county in addition to its present tax base of $1.5 million, which has been inadequate to meet the operational needs of the county for some years.

The city of The Dalles has a council/city manager form of government, with an elected mayor and six-member council. The city had a budget of $9.6 million with 90 employees during the 1985 fiscal year. Although The Dalles has not needed to pass a special bond issue for supplemental operating revenues during

the last two years, the city was recently successful in passing a one-year operating levy of $199,700 outside its tax base to provide city services in fiscal year 1986, according to Herb Crook, county assessor.

There are two school districts within the city of The Dalles, #9 and #12. The western portion of The Dalles, including the Martin Marietta plant property, lies within the boundaries of the Chenowith School District (#9). The average enrollment for this school district in 1985 was 889 students. According to School Superintendent Frank Dummer, the school district has been forced to lay off staff because a property tax appeal by Martin Marietta has substantially reduced the school budget. The Chenowith School District had one of the highest tax rates ($22.20 per $1,000 of assessed value) in the state of Oregon during fiscal year 1982. During the late 1960s and 1970s, the Martin Marietta property represented over half of the school district's tax base. Currently, that same property represents only 6% of the district's tax base.

Social Organization and Well-Being Characteristics. The recent closure of the Martin Marietta plant and subsequent decline in economic activity and loss of population have affected the social conditions in the area. The other notable event in the recent history of the area has been the arrival of the Rajneesh community in the southeastern edge of the county. Historically, Wasco County was quite ethnically and culturally homogeneous. The arrival of the Rajneesh in 1984 and the establishment of that community in what used to be called Antelope has generated considerable conflict and concern among long-time county residents. Local officials expressed concern over the potential negative effect that the Rajneesh activities might have on business and industrial recruitment for the county.

The underlying dynamic of local activities appears to be influenced to a considerable degree by cooperation, especially after the recent closure of the Martin Marietta aluminum reduction plant. Members of the business community and the professions are active in the community of The Dalles. The area supports a large number of active volunteer associations. Other than the high rate of unemployment, available statistical indicators of social well-being (e.g., crime, divorce, and infant mortality) do not show unusual levels of social disorganization and problems.

2.2.3 The Upper Columbia

The only aluminum smelter located on the Upper Columbia is the Aluminum Company of America's (Alcoa) plant near Wenatchee. The location of the plant in relation to the rest of the Northwest aluminum smelters is shown in Figure 3.1 of Chapter 3.

2.2.3.1 Plant Characteristics

The location of the Wenatchee Plant on the Columbia River southeast of Wenatchee is shown in Figure 3.12 in Chapter 3. The Alcoa plant near Wenatchee went into production in 1952. It consists solely of smelting works and has a production capacity of 205 metric tons of ingots per year. There are five potlines, all of which were operating in June 1985. In contrast to other aluminum

smelters in the Northwest, the Alcoa Wenatchee plant receives a sizeable portion of its power from non-BPA sources. Two potlines run on power from the Colockum Transmission Company, a wholly owned subsidiary of Alcoa, and the remaining three potlines operate on BPA power. The primary market for the plant's production includes other Alcoa facilities, outside traders, and exports, the latter of which has ranged from between 20% to 40% of total sales. Employment at the plant peaked in the late 1960s and early 1970s when the fifth potline was added, reaching a level of 1,200 to 1,400 employees. Since then employment has fluctuated. Between 1980 and 1982, two production cutbacks occurred because of interruptions of electrical power supplies. In September 1981 one potline was shut down, another in December 1981. These remained out of production until March and April of 1983. As a result of this production cutback in 1981, approximately 100 to 150 workers were laid off. According to Phil Bussey, Alcoa public relations manager, attempts to streamline the production process to reduce costs have also lowered the number of workers needed to operate the plant. Since 1984 plant employment has been stable at approximately 950 to 1,000.

2.2.3.2 Chelan County and the Community of Wenatchee

Economic Characteristics. The primarily agricultural economy of Wenatchee and its environs was altered when Alcoa built an aluminum smelter near the community after World War II. Substantial in-migration followed and retail and service industries grew. The orchards and the aluminum smelter became the economic base, with a general network of supporting enterprises heavily dependent on one or the other of the two primary industries. The town of East Wenatchee, in Douglas County, lies just across the Columbia River from Wenatchee and is a social and economic extension of Wenatchee.

Nonfarm proprietors in Chelan County have gradually increased to outnumber farm proprietors. Fairly even in numbers in 1970, by 1980 there were 1,868 farm and 2,057 nonfarm proprietors. Although Alcoa's proportion of total employment within the nonfarming sector decreased between 1970 and 1982, aluminum production, along with related enterprises, is an important employer and source of income. According to Alcoa plant representatives, average income of an Alcoa plant worker is $30,000 to $35,000 per year plus benefits, making those jobs particularly important to the economy of the region.

The resident civilian labor force in Chelan and Douglas Counties stood at 37,040 in 1980, dropped to 34,690 in 1981, and then gradually increased, to 38,100 in 1984. Unemployment in the two-county area has consistently been higher than state levels since 1980. Peak unemployment of 16.1% in 1982 corresponded to the shutdown of two Alcoa potlines. For the five years from 1980 and 1984 the lowest unemployment figure was 11.3% in 1980, and in 1984 it was 12.7%.

Other indicators of economic health show a general condition of economic growth during the 1970s, although this upward trend drops and, in some cases, reverses between 1980 and 1982 (most recent figures available). This pattern is found

for Wenatchee and for Chelan County in general with respect to amount of retail sales and total personal income. Retail sales in Douglas County did not show the same decline, although total personal income did.

Local officials indicate a general improvement in retail trade and services in the area when the Alcoa plant returned to full operation in 1984. The need to diversify has become apparent. The orchard industry faces challenges from both domestic and foreign competition as well as from the ever-present hazard of crop-damaging weather conditions. Heber Kennedy, local official, stated that there are plans to attract more tourists and light manufacturing industries in an attempt to offset downturns in either or both the orchard and aluminum industries.

Demographic Characteristics. Chelan County as a whole grew from a population of 41,355 in 1970 to 46,500 in 1983, but Wenatchee itself had a net increase of only 238 between 1970 and 1983. The city actually experienced a net loss of 107 between 1980 and 1983.

The proportion of minorities in Chelan County and in Wenatchee has remained considerably lower than for the state as a whole. County and city figures for the period 1970 to 1983 indicate the population to be over 96% white. The largest minority population in both the county and the city is Hispanic. The number of Hispanics grew during the 1970s from less than 400 to a 1983 level of 1,670 for the county as a whole, with 381 (23%) of the total group living in Wenatchee in 1983.

While the proportion of persons in the school age categories declined between 1970 and 1980, the percent of those age 65 and over increased in Chelan County and in Wenatchee. The percent of the Wenatchee population that is elderly (18%) greatly exceeds that of the state as a whole (10%).

Housing Characteristics. Chelan County has a total housing stock of about 23,636 (1984); of this, about 7,832 (33%) is in Wenatchee. The increase in housing stock between 1980 and 1984 was greater for the county than for Wenatchee (6% versus 2%). In 1980, housing units in Wenatchee were somewhat less likely to be owner-occupied than for the county or the state as a whole (56% versus 65% and 66%, respectively), and Wenatchee housing was somewhat more likely to be single-family than for the state as a whole (73% versus 69%). About 30% of the housing in Wenatchee was built before 1940.

Median housing values in 1980 were lower in this region ($48,500 for the county, and $45,100 for Wenatchee) than the statewide average ($60,700). According to Heber Kennedy, the current housing market is tight because of recently lowered interest rates.

Land Use Characteristics. Most of Chelan County is located in Wenatchee National Forest, and much of the land is characterized by mountainous, timbered terrain. According to Jim Lynch and Heber Kennedy, local officials, residents value the pastoral character of the area and wish to preserve it. As a result,

there is little space available or zoned for heavy industrial manufacturing. Current planning emphasizes tourism, retail, and perhaps light manufacturing developments.

The Alcoa plant and a related metals industry, KBI, lie in an industrial zone in the unincorporated town of Malaga. Converting an aluminum smelter to another use is difficult. However, it is likely that at least two potlines will continue to operate on non-BPA power under foreseeable circumstances.

Public Sector Characteristics. The city government of Wenatchee consists of a mayor and three commissioners. According to Mayor Jim Lynch, Wenatchee's fiscal condition is considered to be stable at the present time. In the past few years, through a policy of fiscal conservatism, the city has decreased its budget by $3 to $4 million to $13 million. The accumulated reserve has been a vital source of fiscal stability. The present size of the of municipal government is between 160 and 210 full-time equivalent employees. In past periods of economic downturn, the city government has not been forced to cut back its employment to any great degree, with normal attrition and retirement accomplishing the necessary reductions.

The public schools in the Wenatchee area have experienced a somewhat declining enrollment in the last eight years, similar to that for other districts in the state and in the nation. Bond issue measures on the ballot were defeated in 1976, 1978, 1984, and 1985, leading to problems with operational and maintenance funds, and with planning for capital expenditures. Wenatchee Valley College, a community college located in Wenatchee, is funded predominantly from state sources.

Significant staff reductions also have resulted from these budget problems. Some recent special levies have passed by substantial margins, but teacher and administrator salaries in the district continue to be below average. Alcoa is a substantial contributor to the school district through tax revenues. Furthermore, Alcoa makes a variety of educational and cultural contributions, including sponsorship of special events for the community, and a scholarship program for the continuing education of public school teachers and for sending local students to college.

Social Organization and Well-Being Characteristics. Most of the population in Wenatchee and East Wenatchee are of Western European descent, and the residents of the area generally have a strong affiliation with their community. According to the mayor, Jim Lynch, Alcoa is viewed as an important contributor to the lifestyle of the community through its sponsorship of cultural and civic activities. The town is characterized by the mayor as having a relatively high level of participation in voluntary/civic organizations. The small Hispanic minority in the community is generally associated with orchard work and is not well-integrated into the social or economic life of the community. At the present time there are approximately 5,000 recipients of social and welfare benefits served by the Department of Social and Health Services office. The majority of these recipients are elderly, disabled, or members of minority groups.

2.2.4 The Puget Sound Area

The Puget Sound area contains two aluminum smelters, the Kaiser Company plant in Tacoma, Washington, and the Intalco plant near Ferndale and Bellingham, Washington (see Figure 3.15 in Chapter 3).

2.2.4.1 Plant Characteristics

Kaiser Aluminum Company - Tacoma Plant. The location of the Kaiser smelter is shown in Figure 3.16 in Chapter 3. The plant was built in 1942 by the federal government as part of the war effort and was purchased by Kaiser in 1947. Kaiser has expanded the facility, almost doubling production capacity to 81,000 tons per year. However, shortly after the modernization, the plant was shut down for economic reasons, and remained closed for six years. The plant has three production potlines, with 400 cells. Kaiser obtains its alumina from Australia.

The plant reached its peak work force level in 1981, when 475-500 workers were employed. Average annual employment at the plant declined from 475 workers in 1982 to 387 in 1983 and then increased to 398 in 1984. In summer 1985, Kaiser announced that it was curtailing operations at the Tacoma facility and reducing production by 20% (to 61,000 tons) by closing one potline. This curtailment resulted in the layoff of 75 workers, and reduced the work force at the Tacoma facility to 323 workers.

According to Susan Stones, a plant official, the 1981 payroll for the Kaiser Tacoma facility was $18.8 million. This increased to $20.0 million in 1982, then declined to $19.54 million in 1983 and $19.51 in 1984. Local purchases by the plant, including freight and electricity (from both the local utility and BPA), increased from $21.82 million in 1981 to $37 million in 1982, $45.63 million in 1983, and $47.48 million in 1984. In 1981 and 1982, Kaiser made capital investments in the Tacoma facility (including environmental upgrading expenditures) of $16.95 million and $3 million, respectively. In 1983 and 1984, capital investment and environmental upgrading expenditures declined to $1.17 million and $1.60 million, respectively. Total state and local taxes paid by Kaiser on the Tacoma facility were $1.5 million in 1981, $1.42 million in 1982, $1.70 million in 1983, and $1.84 million in 1984.

Intalco Aluminum Corporation - Ferndale Plant. The Intalco aluminum plant in Ferndale, Washington, was built in 1966 as a shared venture among three firms from the United States and France. Intalco is now a wholly owned subsidiary of Alumax, and the Ferndale plant is considered to be one of the most efficient, as well as the largest, aluminum reduction facility in the United States (Community Profile, December 1983). The plant produces about 280,000 tons of aluminum annually. The location of the plant in Whatcom County is shown in Figures 3.15 and 3.18 of Chapter 3.

In spring 1985, 1,242 workers were employed at the Intalco plant, approximately the same number employed at the plant (average 1,250 workers) over the preceding five years. According to a survey of plant workers conducted for a transportation study in Whatcom County, about 38% of the Intalco employees live in

the city of Bellingham, 32% in Ferndale, 9% in Lynden, 7% in Blaine, 5% in Custer, 5% in Everson, 1% in Sedro Woolley (Skagit County) and 3% in other areas. In 1985, approximately 92% of the Intalco workers were white, 4% were Hispanic, 2% were Native American (principally Lummi), and less than 2% were Southeast Asian (and other). Ninety-nine percent of the approximately 1000 production workers were male, while about 33% of the nonproduction workers were male. The average age of the Intalco workers was about 40 years, with most workers clustered within a fairly narrow age range. The plant has no history of major fluctuations in work force due to variations in production levels.

According to James Frederick of Intalco, average annual pay per employee at the Intalco plant in 1985 was $30,542. Total annual payroll from the plant in 1985 was estimated to be about $38 million. About $47 million in purchases were made annually by the plant in the Pacific Northwest, excluding the $95 million paid for electricity. Approximately 45% ($21 million) of the purchases were made in Whatcom County. In addition, the plant pays approximately $11.4 million annually in freight costs, $5 million for natural gas purchases, and $4.9 million in state and local taxes.

2.2.4.2 Pierce County and the Community of Tacoma

Economic Characteristics. Throughout the area's history, Pierce County and Tacoma have been influenced by the wood and paper products industry, shipping and shipbuilding, primary metals and chemical manufacturing, and the military. The major nongovernmental employers in the county in 1985 included Weyerhaeuser, whose headquarters are located near Tacoma, 2,355 employees; Multicare Medical Center, 2,200 employees; Safeway Stores, Inc., 1,900 employees; Tacoma Shipbuilding Co., 1,600 employees; St. Joseph's and Good Samaritan Hospitals, together employing 2,665; and Puget Sound National Bank, 1,350 employees. In addition, in 1985 the federal government and military accounted for over 31,000 jobs and an estimated 5,590 workers commuted outside the county to jobs with the Boeing Company. (Tacoma-Pierce County Chamber of Commerce 1985).

According to State Employment Security figures, total average employment in Pierce County increased from 164,400 workers in 1980 to 172,810 in 1984, although employment fell below 1980 levels in 1981 and 1982. Unemployment in the county was 7.9% in 1980; 9.2% in 1981; 12.5% in 1982 (as the labor force increased faster than employment); 12.1% in 1983; and 10.4% in 1984 (Washington State Employment Security Department 1985).

Although total employment by place of work in Pierce County grew by 8.1% between 1970 and 1982, wage and salary employment declined from 169,690 workers in 1970 to 156,822 in 1975 and again in 1977 to 164,305 before rising to 179,585 in 1982. Between 1975 and 1982, employment in manufacturing increased by 1,442 jobs, 1,360 of which were in the durable manufacturing sector. During this same period, employment in the retail sector increased from 21,585 to 26,048 and employment in the government sector increased from 65,117 to 68,913. During this same period, the number of retail establishments in Tacoma declined (from 1,467 to 1,436), although total retail sales increased slightly

(from $439.5 million to $453.3 million 1972 dollars). Total personal income in Pierce County has declined from 100.7% of the state average in 1970 to 90.8% in 1975, 89.8% in 1980, and 89.3% in 1982 (Bureau of Economic Analysis 1984b,c).

Tacoma and Pierce County are currently facing the loss of significant numbers of jobs, payroll, and tax revenues as a result of the closing of the American Smelting and Refining Company (ASARCO) smelter, reductions in work force (and possible shutdown) at Tacoma Shipbuilding, as well as the overall reduction in the timber and fishing industries. A task force has been formed (comprised of representatives from industry; county, city, and state governments; and voluntary organization) to address the problems created for the community and the workers displaced by the ASARCO shutdown. Mayor Doug Sutherland and other community officials indicated that it would be increasingly difficult to place additional unemployed blue collar workers in the future, as appropriate positions are becoming saturated.

Demographic Characteristics. The 1984 estimated population of Pierce County was 514,600; 159,400, or 31.0% of the total county population, resided in the city of Tacoma. Between 1980 and 1984, the proportion of the county population living in incorporated areas decreased slightly (from 43.9% to 42.1%). Between 1980 and 1984, Pierce County experienced a growth in population of 28,933 persons. During this same period, the population of Tacoma grew by 4,819 persons, an increase of 3.1% over the 1970 population of 154,581 persons (Washington State Office of Financial Management 1984).

Housing Characteristics. From 1980 to 1984, the number of housing units in Pierce County increased by 6.9% from 187,432 to 200,413. The housing mix in Pierce County in 1980 was similar to that in the state, with a slightly higher proportion of single family and multiple family units and a slightly lower proportion of mobile homes. In 1984, there were an estimated 70,706 housing units in the city of Tacoma, an increase of 2,947 over 1980 levels. The housing stock in Tacoma in 1980 showed a greater proportion of multiple family units (30.9% of year-round stock) than in the county or the state, a lower proportion of mobile homes (0.2% of year-round stock), and a higher proportion of homes constructed prior to 1940 (36.2% of occupied units). In 1980, 63.4% of occupied units in Pierce County were owner-occupied, a higher proportion than in Tacoma (58.7% of occupied units). According to Lyn Eddinger of the Board of Realtors, the real estate market (both residential and commercial) was strong, though varying by neighborhood, with much of the growth occurring in the county, particularly in the area between Tacoma and Puyallup.

Land Use Characteristics. The Kaiser Tacoma plant was established in 1943; city and county land use and zoning plans developed since then have taken into account Kaiser's pre-existing use of the land. The Port of Tacoma has land use planning responsibility for much of the Port industrial area on the waterways of Commencement Bay where the Kaiser plant is located. This area is about eight square miles; industrial use (both heavy and light) predominates. Commercial land uses are scattered throughout the area, with the heaviest concentration along Highway-99 and Interstate-5. The limited residential use of land in this area, including both single and multiple family dwellings, is also concentrated along Highway 99 and in the small city of Fife, straddling I-5 and

extending south. There is no recreational land within the Port industrial area. According to William Bailey, city planner, and William Kittrell, real estate director for the Port, the Kaiser site would remain zoned heavy industrial, with the level of plant operation having no significant effect on land use patterns in the area.

Public Sector Characteristics. In addition to the county, school district, and municipal governments, Pierce County and Tacoma are served by the Port of Tacoma, and the Puget Sound Council of Governments. Pierce County passed a home rule charter in 1980 that established an executive-council form of government. The legislative body of Pierce County is the County Council, composed of seven members each elected from one of the county's seven districts. The total annual budget for Pierce County increased from $140.5 million in 1980 to $145.9 million in 1985. Total assessed valuation in Pierce County increased from $6.1 billion in 1980 to $13.3 billion in 1985. Property, sales, and road taxes contributed the largest portion of tax revenues, (estimated at $16.4, $11.4, and $3.2 million, respectively, in the 1985 budget), with delinquent tax penalties, state and federal grants/revenue sharing/intergovernmental transfers, court fees and fines, and investment interest the other largest contributors. In 1985, property taxes were expected to contribute 40.4% of total county general fund revenues, with sales taxes accounting for an additional 20.2% (Pierce County 1984).

Tacoma has a council-manager form of government and operates according to a city charter adopted in 1952. The city manager, the chief executive of the city, is appointed for an indefinite term by the city council. The total annual budget for the city of Tacoma increased from $287.9 million in 1983 to an estimated $397.7 in 1985. The total general fund expenditures for these years was $62.8 million and $74.7 million (estimated). In the 1985 general fund budget, retail sales tax revenues account for $16.4 million (21.9%) of total expected revenues, business taxes for 24.3%, utility taxes for 17.4%, and property taxes for 12.8%. Personal services accounted for $39.2 million (52.4%) of the estimated $74.7 million expenditures for 1985. Contributions to other funds (22.7%) and supplies and services (15.0%) accounted for the next largest expenditures (City of Tacoma n.d.; City of Tacoma 1983).

The Kaiser facility is located within the Port of Tacoma's Commencement Bay Terminal Industrial Development District; use of the Port facilities is essential to Kaiser operations. According to local and Port officials, for the past 10 years the Kaiser Aluminum has imported an average of 500,000 short tons of materials through the Port, generating about 25,000 hours of work for longshoremen and other Port-related workers. The Kaiser group pays an estimated $1 million in Port costs per year.

Social Organization and Well-Being Characteristics. Tacoma has undergone a regeneration during the 1980s after suffering employment and population decline during the 1970s. The most visible signs of this revitalization are the Tacoma Dome, a $44 million facility, and the downtown rehabilitation and growth programs. Construction of the new Tacoma Center, including the 328-room Sheraton Tacoma Hotel (the first new downtown hotel built in Tacoma in 60 years) and the

highway connecting Interstate-5 and downtown are considered a reflection of the new, optimistic outlook of the city and a continuation of the improvements that contributed to Tacoma's selection as an All-American city in 1984.

The new outlook is associated with a transition of industrial activity from the oldline mills and smelters to the service sector, especially support services for maritime activities. Community officials and developers believe this emphasis on, and the recent success of, the service sector in Tacoma has softened the impact of decline in the heavy industrial sector over the last several years and has resulted in a decline in the relative importance of blue collar employment in the community.

The persistently high unemployment levels, at least through 1982, and the uncertainty in the heavy industrial sector of the economy indicate that the recent prosperity has not been equally distributed to all county residents, and suggest that blue collar workers and their families may have continuing difficulty in the area. Nevertheless, in aggregate, the county's turnaround and recent growth trends are generally considered to be positive indications of increased ability of community resources to respond to social problems and individual needs.

2.2.4.3 Whatcom County and the Communities of Ferndale and Bellingham

Economic Characteristics. Historically, the economy of Whatcom County has been based on mining (coal in Bellingham), fishing, agriculture, and forestry. During the 1960s, this historical pattern was altered with the dramatic expansion of the local state college into a regional university with 10,000 students (Western Washington University), and the development of the Cherry Point industrial area with three primary employers: Intalco, Mobil Oil, and ARCO. In addition, the growth of the lower mainland area of British Columbia increased the market potential for the retail and service sectors of the Whatcom County economy. According to Bureau of Economic Analysis data, total employment by place of work increased by 12,638 between 1970 and 1980, from 32,359 to 44,997, an increase of 39.1%. Much of this increase occurred in the retail trade and services sectors, although the manufacturing and state and local government sectors also showed considerable growth (Bureau of Economic Analysis 1984b).

The economy of Whatcom County was adversely affected by the national recession of 1981-1982. Total employment by place of work (Bureau of Economic Analysis 1984b) declined between 1980 and 1982. According to state employment security data, the total civilian labor force in Whatcom County declined from 48,980 in 1980 to 47,060 in 1981, while total average employment dropped from 44,000 to 41,810 and the unemployment rate increased from 10.2% to 11.2%. Although the downward trend in employment reversed in 1982 when the civilian labor force increased to 48,839 and total average employment increased to 42,470, the unemployment rate continued to rise, reaching an average 13.0% in 1982. By 1984, continued employment growth had reduced the unemployment rate slightly, to 11.0%, although the county level was still above the state average of 9.5%

(Washington State Employment Security Department 1981-1985). In 1982, per capita income in Whatcom County was 84.5% of the state average, down from 85.0% in 1980 and 91.5% in 1970 (Bureau of Economic Analysis 1984b,c).

In 1983, eight private sector employers with more than 200 employees were located in the county: Intalco, Georgia-Pacific, ARCO, Mobil, Bellingham Cold Storage, Puget Sound Power and Light, Mt. Baker Plywood, and Chris Craft. Intalco is the largest employer in the county accounting for about 3% of the total jobs in the county in 1982 and nearly 6% of all wages paid in the county.

Demographic Characteristics. During the 1970s, the population of Whatcom County grew faster than the state of Washington (30.2% increase compared to 21%). In 1980, the population of Whatcom County was 106,701 persons. In 1983, the population of the county had risen to 112,100, with 68% of the increase resulting from migration (compared to 50% in the state as a whole). In 1980, the population of Bellingham and Ferndale was 45,794 and 3,855, respectively. The total percentage of the population composed of nonwhites is lower in Whatcom County than in the state as a whole. The major minority group in Whatcom County is Native American (3.3%), followed by Spanish (2%) and Asian (1.1%). During the 1970s and 1980s population grew faster in the unincorporated areas of the county than in the cities (Bureau of the Census 1983a and 1982d; Washington State Office of Financial Management 1984).

Housing Characteristics. In 1984, total housing stock in Whatcom County was 50,390 units, of which 70.1% were single family units, 21.1% were multiple family units, and 8.9% were mobile homes. In 1980, total housing stock in the county had been 47,479 units. In 1984, the total housing stock in Bellingham and Ferndale was 20,238 and 1,835 units, respectively, 62.3% and 66.0% of which were single family units (Bureau of the Census 1982a; Washington State Office of Financial Management 1983b, 1984). According to Whatcom County Real Estate data, the average price of houses sold has decreased since 1980, reversing a trend of increasing sale prices that prevailed throughout the 1970s (Whatcom County Real Estate Research Report 1980-1984).

Land Use Characteristics. The Cherry Point industrial area (approximately 6,000 acres) is designated heavy impact industrial. Local government officials and economic development professionals agree that this zoning is appropriate and that it will remain in effect. The state recently refused Chicago Bridge and Iron and Kiewit Construction Company permits for new industrial projects in the Cherry Point area on the grounds that they did not conform to the requirements of the Washington State Shoreline Management Act of 1971 and would cause unacceptable environmental impacts on the area. The Cherry Point-Ferndale area is one of ten subareas into which Whatcom County was divided by the Planning Commission. A comprehensive plan for the county was adopted in 1970, and for the Cherry Point Subarea in 1981. The subarea encompasses approximately 63 square miles, excluding the city of Ferndale; it contains land in a number of zoning districts, ranging from the 6,000 acres of heavy impact industrial to large rural and agricultural zones, and includes light impact industrial and urban residential areas.

Public Sector Characteristics. Whatcom County passed a home rule charter in 1978, replacing the commissioner form of government with a full-time, nonpartisan, elected county executive and a seven-member, part-time county council. Because of restricted revenue sources, the number of county employees has been reduced from about 700 in 1979 to 475 in 1985. In 1985, the assessed value of the Intalco plant was about $116 million, roughly 2.7% of the county total. In 1985, Intalco paid about $1.45 million in property taxes to the county.

The city of Bellingham has an elected mayor and seven elected council members. Ferndale has a city manager, an elected mayor, and a six-member city council. In 1985, the total general fund revenues for Bellingham were $16.6 million. Major sources of funds included local sales taxes ($2.1 million), business and franchise taxes ($2.4 million), and property taxes ($2.4 million).

According to Dr. Dennis Peterson, Ferndale school superintendent, the Ferndale school district includes Cherry Point and the Intalco plant, which constitutes over 16% of the district's tax base. During the past seven years, the district added $12 million of capital facilities and property in anticipation of stable or growing enrollment.

According to Don Fleming of the Port of Bellingham, the Port is governed by an elected three-member board. In 1984, 180,000 of the 500,000 tons of material handled at the main terminal shipping facility in Bellingham were Intalco aluminum, with about 68% of the total 30,000 work hours at the terminal devoted to aluminum handling.

Social Organization and Well-Being Characteristics. Although Whatcom county is not highly diversified economically or ethnically, the presence of a substantial number of Native Americans, primarily the Lummi whose reservation borders the Cherry Point industrial area, and the large number of Western Washington University students, increase the complexity of the county's social organization. In addition, Whatcom County's role as a second home and recreational area, and increasingly as a retail trade source for residents of Vancouver and Victoria, British Columbia, and Seattle, Washington, have influenced the orientation and priorities of Whatcom County residents. Noted for its natural beauty, as well as for the economic potential of its natural resources, the area has attracted a substantial number of residents by its amenity values, and has acquired a reputation for the strong environmentalist orientation of a significant group of residents.

Despite the economic difficulties experienced during the early 1980s, a survey conducted by Western Washington University in spring of 1980 indicated that 80% of Whatcom County residents were very satisfied with the quality of life in their community. In this survey, public services were rated as good or excellent, and public officials were considered responsive. Only 20% of respondents to this survey favored population growth in the county, while 43% favored industrial growth and 77% favored retaining the existing industries in the county. (Parametrix 1981.)

2.2.5 The Northeastern Washington Area

Kaiser operates the Mead Plant near Spokane, Washington, the only aluminum smelter in northeastern Washington. The location of the Kaiser-Mead plant is shown in Figure 3.20 of Chapter 3.

2.2.5.1 Plant Characteristics

During World War II the Kaiser Mead plant was owned and operated by Alcoa; the federal government purchased the plant in 1946. The Kaiser purchase of the Mead plant constituted the beginning of Kaiser Aluminum. The Mead plant contains eight potlines, four of which are currently (June 1985) in operation. The plant's peak production period occurred in 1981, with 220,000 tons/yr. Its lowest production was in 1982, when six lines were closed. Since 1983 the number of lines in production has fluctuated.

Peak employment of approximately 1,850 occurred in 1981, in conjunction with the peak production period. Average annual employment in recent years has been 721 for 1983, 991 for 1984, and approximately 650 at mid-year 1985.

2.2.5.2 Spokane County and the Community of Spokane

Economic Characteristics. The Spokane metropolitan area functions as the retail and financial hub for Eastern Washington, Northeastern Oregon, Northern Idaho, and portions of Western Montana and Southeastern British Columbia, often referred to as "the Inland Empire." Employment opportunities are fairly diverse, with services accounting for 28% of wage employment, manufacturing for 11%, agriculture and mining for 9%, and the public sector 19%, for example.

Although Spokane grew economically at a fairly steady rate in the 1960s and early 1970s, growth has slowed substantially. Some of the apparent decline for the city of Spokane is due to an increased development outside the city limits, although the picture for the county as a whole is also one of an economic slowdown, in particular in the early 1980s. Total retail sales for Spokane were lower in 1982 than in 1972; there was a similar but less extreme decline in overall retail sales for Spokane County. Total personal income for Spokane County showed a net increase of 29% between 1970 and 1982, although its general upward trend was interrupted between 1980 and 1982 (most recent data).

Changes in employment by type of workplace indicate a general decline in virtually all major categories of private enterprise between 1980 and 1982, a reversal of the trend from 1970 to 1980. The major exception is found in the services industry, which has maintained its growth trend. Public sector (government) employment also showed continual growth although, when it is broken down into civilian and military categories, it is evident that the growth was due to an influx of military personnel after 1980, while nonmilitary governmental employment decreased. Although more recent figures are not available for retail sales and employment by category, the downward trend may have been reversed by a steady increase in the size of the resident civilian labor force

beginning in 1982. Between 1980 and 1984, unemployment levels for the resident labor force in Spokane County peaked in 1982 at 12.5% and then dropped gradually to 8.7% in 1984, which was below the state average of 9.5%.

Although Kaiser currently is operating at about half capacity, with approximately 650 employees at the Mead smelter and 900 at the Trentwood rolling mill, it generally is considered to be one of Spokane's major manufacturing employers along with Key Tronic, Hewlett Packard, and ISC. According to Jed Daniel, Kaiser Mead plant manager, the Trentwood facility, which uses most of the molten metal produced at Mead, has recently made substantial capital improvements and is considered to be the most modern rolling mill in the country.

Demographic Characteristics. The 1983 population for Spokane County was estimated to be 348,000, with 170,200, or almost 50%, of the county's population residing in Spokane. The population remained fairly stable in the city of Spokane between 1970 and 1983 while the county population increased by 21% over the same period (Spokane Area Development Council 1984). This growth has taken place mainly in the unincorporated areas of the county, with the highest growth rates in the areas north of Spokane and directly east.

Both the city and county have higher percentages of white population than does the state as a whole (94% and 95% respectively, versus 91.5%). The two largest minority groups are blacks and Hispanics, although neither constituted even 2% of the city or county population in 1980.

On the average the age of the city residents is somewhat higher than for the county as a whole. In both Spokane and Spokane County between 1970 and 1980 the proportion of persons under age 20 declined; there was little change in the proportion of age 65 and over.

Housing Characteristics. As of 1984 there were 143,165 housing units in Spokane County, 77,891 of which were in Spokane itself. In 1980 the percentage of single family units in Spokane equaled the state average (69%), while a higher percentage (76%) of the housing in the county as a whole was single-family. Owner-occupancy of housing also is somewhat higher for the county than in the city, 67% compared to 61.5% in 1980.

Housing values in the area are considerably below the state average (about $42,000 versus $60,700). The median value of a single family dwelling was somewhat higher in the county than in the city, which probably reflects the generally more recent development outside the city. In Spokane almost 38% of the housing was built prior to 1940, while this figure for the county as a whole is 26.5% (Bureau of the Census 1983b).

Home values in general have declined since 1980. According to Dale Strom, housing specialist for the City of Spokane, out of approximately 18,000 homes put up for sale each year, only 6,000 actually sell. The vacancy rate for apartments is just under 5%, but about 800 units that currently are under construction with a federal subsidy may increase that rate.

Land Use Characteristics. The Mead plant is situated in an industrial zone about three miles from the north edge of Spokane. It is the largest of the industries in that area. It is served by rail and is close to state and interstate highways. This industrial area is near a large residential zone. There are no areas zoned for recreational use in the immediate vicinity of this industrial zone.

Other industrial areas include the valley region along the Spokane River to the east of the downtown section. Hewlett Packard and the Trentwood mill are located in this zone. The most recent industrial development has been undertaken in the West Plains area near the airport, where an industrial park is being built on what was once a military air field. Water and sewer service were extended to this area to facilitate industrial development.

Public Sector Characteristics. Spokane County is governed by a three-member county commission. The county government is organized into departments, with department heads reporting to the commissioners. Fiscal resources have been relatively stable over the last few years.

In the city of Spokane, six elected council members and a mayor form the policy-making and legislative body. A city manager handles the day-to-day operations of the city, using department heads of his selection for community services, administrative services, planning and community development, and engineering.

The 1985 municipal budget anticipates revenues and expenditures of about $68.4 million. The three main sources of revenues are retail sales taxes (21.6%), utility taxes (19.8%), and property taxes (16.3%), with cash reserves and federal and state shared revenues comprising 20.5% of the city's revenues. Financial stability has been achieved through efforts in the past few years to cut services and increase automation.

Although the plant is located in the Mead School District, the majority of the children of Kaiser Mead employees attend school in Spokane School District #81. District #81 is a municipal corporation organized to provide school services. It is run by an independently elected board of directors whose fiscal responsibility includes budget authority and the power to set educational fees, levy property taxes, and issue school bonds. District #81 is the second largest school district in the state with a total kindergarden through twelfth grade (K-12) enrollment in 1983 of 27,368 students. In recent years enrollment has been declining, consistent with state and national enrollment trends. Kaiser's other tax contributions to the district (i.e., from the Trentwood rolling mill) do not represent a particularly large percent of its overall revenue, but Kaiser is recognized for other kinds of support. These include supporting levy drives, sponsoring an annual awards luncheon to recognize outstanding teachers from the area, and helping implement a health benefits management program that resulted in substantial savings to the district.

Social Organization and Well-Being Characteristics. Although Spokane has maintained its position as a trade center for a fairly large region, its economy has long since moved away from agricultural and other extractive industries as

an important base. Its main growth areas have been banking, health services and research, utilities, education, and government, making it generally a white collar town. Although Kaiser and other manufactures have an important place in the economy, the emphasis for the future appears to be on light industry and research and development. Until about seven years ago city politics had been controlled by a strong, cohesive and conservative business community. However, the rapid growth of the unincorporated portion of the county, the diversification of activities, and the increase in enterprises receiving guidance from headquarters outside the community has fractionalized this power group and leadership is now more widely distributed. The general slow local economy, bordering on stagnation, is cause for concern in the community and more emphasis is being placed on counteracting the potentially negative economic events faced both by government and by the business community.

There is little diversity in Spokane's racial or ethnic composition, although the city has distinct socioeconomic and cultural neighborhoods. The community leaders are proud of what the city represents to its residents and promote its high quality and well-educated work force, low utility rates, competitive land prices, low housing costs, good quality public education, and the general quality of life related to the natural features of the area. There appears to be a wide variety of interest and civic groups active in the community. Kaiser employees show a high level of social consciousness, participating in these organizations and supporting local causes such as United Way.

About 13% of the population in the statistical metropolitan area (Spokane County) received some form of public assistance in 1984. The majority of these received food stamps, with about half as many receiving Aid to Families with Dependent Children (Spokane Area Development Council 1984). Although Spokane has a relatively high rate of larceny-theft, it ranks low with respect to violent crimes (Spokane Area Development Council 1984).

2.2.6 The Western Montana Area

The socioeconomic profile of Flathead County and the communities surrounding the aluminum plant near Columbia Falls, Montana, is presented in this chapter. Figure 3.1 in Chapter 3 shows the location of this plant in relationship to other northwest aluminum smelters. Figure 3.22 shows the plant and its surrounding area.

2.2.6.1 Plant Characteristics

The Columbia Falls plant was initially operated by the Anaconda Aluminum Company and, until recently, by the Atlantic Richfield Company (ARCO). In September 1985 the plant was purchased by its employees and renamed the Columbia Falls Aluminum Company (CFAC). In 1977-80 the plant was upgraded by the installation of a new process for smelting that has enhanced its competitiveness in aluminum production and has reduced energy consumption. The Columbia Falls plant currently (October 1985) operates at full capacity and employs 1,006 fulltime workers.

2.2.6.2 Flathead County and the Communities of Columbia Falls and Kalispell

Flathead County, Montana, is located in the northwestern portion of the state. Kalispell, the largest city in the county, is the county seat. The next two largest incorporated areas are Columbia Falls and Whitefish. A major indicator of economic conditions in the area is nonfarm labor income, which consists of wages and salaries, proprietors income, and certain monetary fringe benefits of all persons except those working on farms and ranches. The nonfarm labor income data for Flathead County indicate the cyclical nature of the local economy. From 1970 to 1973, nonfarm labor income grew at an annual rate of 5.6%, with a flat period during 1974 and 1975 corresponding to the nationwide recession that occurred at that time. Between 1975 and 1979 the economy experienced a recovery that yielded an annual growth rate of 9.5%. Data for the ensuing years mirror those prevalent in other areas of the country, showing an economic downturn in the early 1980s. For example, between 1977 and 1982 retail sales declined in Columbia Falls and in the county as a whole, as did total personal income. Unemployment peaked in 1982, at 12.9%, but then fell gradually to 7.9% in 1984 (latest figure).

Basic or export industries are the other major determinant of growth in Flathead County. These industries depend heavily on markets outside the region or are otherwise influenced by factors originating beyond the region's borders. The major examples of county industry include agriculture, mining, railroads, wood products, tourism, and the federal government. These industries in Flathead County increased significantly between 1970 and 1980. In 1972 dollars, total labor income in the export industries rose from $51.1 million in 1970 to $56 million in 1975, and to $67.2 million in 1980 (Polzin 1981).

The Anaconda Aluminum Company (later acquired by ARCO) was the largest single contributor to economic growth in Flathead County in the late 1970s. The growth in this industry was due to modifications at the smelter that were primarily designed to bring it into compliance with emission standards and also to reduce its use of electricity. Labor income in primary metals refining more than doubled during the late 1970s, from $11.0 million in 1975 to $22.1 million in 1980 (all 1972 dollars). The roughly $11-million increase in this category is accounted for primarily by the growth in the basic industries category between 1975 and 1980.

The wood products industry also has been considered a mainstay of the local economy, although it showed no growth during the 1970s and 1980s. In addition to major fire destruction of large tracts, it has suffered the same problems as the rest of the timber industry throughout the Northwest during the 1980s. While the nature of activities have shifted somewhat, in general, there has been little net growth in the wood products industry in Flathead County in at least fifteen years.

Demographic Characteristics. Flathead County experienced a 31.7% increase in population between 1970 and 1980, from 39,460 to 51,966. County population in 1985 is estimated to be in excess of 60,000, making it one of the fastest growing areas in the state (Bureau of the Census 1973 and 1982c).

Kalispell is the largest city in the county, with an estimated 1984 population of 10,695. The other two major population centers are Columbia Falls (3,112) and Whitefish (3,703). Most of the people in Flathead County live outside of incorporated cities. Taken together, the population of the three largest cities in the county account for only one-third of the county's total population (Polzin 1981).

Housing Characteristics. Roughly 70% of all housing in the area, whether county or community, is single family, which corresponds to the statewide pattern. The median value of a single family dwelling in Columbia Falls and Kalispell in 1980 was about $43,000, which was somewhat lower than the median value for the county ($48,000) or for the state ($46,500). About 23% of the housing in the county was built prior to 1940, compared to 30% for the state. Columbia Falls reflects the recent growth in the area, with only about 18% of its housing stock was built prior to World War II. In Kalispell, 40% of the housing stock was built prior to 1940.

Housing supply in the area exceeds demand by a substantial margin. Most of the excess supply is attributed to the long trend of work force reductions in the forest products industry. Some unemployed workers have left the immediate area and others have bought less expensive homes, creating the higher vacancy rates for moderate to middle level homes. According to Judith Biardi, bank manager, real estate listings and the time-to-sale period have increased since 1982.

Land Use Characteristics. The CFAC plant is situated on the outskirts of Columbia Falls in an area that is used primarily for agriculture. The plant is served by rail lines and has ready access to Highway 2 and the interstate system to the south. As is the case with other aluminum smelters, land use alternatives for the physical plant itself and the land on which it is located are limited. The abundance of land available for industrial development and the low demand for such land means that the pressure for alternative uses is very low.

Public Sector Characteristics. Columbia Falls has a mayor-city council form of government. The mayor position is paid, part-time; the council positions are elective and voluntary. Budget pressures have recently increased because the severe cutbacks in the forest products industry have had an impact on city revenues. As a result, not only have there been few increases in city services, but much preventative maintenance has been postponed, according to Colleen Allison, mayor of Columbia Falls.

In 1984-85, local public services were supported by seventeen countywide bond levy funds to which ARCO contributed in the form of taxes. In the same period of 1984-85, ARCO directly paid $2,685,336 in taxes, of which $959,236 were paid to Flathead County. No information is currently available on whether CFAC taxes will be similar to ARCO's.

The region around the CFAC smelter is served by school districts #6 (Montana's largest school district), #5, Evergreen School District #50, Bigfork Public Schools, Whitefish Public Schools, and Flathead Valley Community College. All of the schools in the county receive approximately 53% of their total budgets

through county tax revenues; over 11% of this amount was paid by ARCO. County-wide enrollment has dropped to 1,973; during the peak year 1974-75, there were 3,478 students in grades K-12.

Social Organization and Well-Being Characteristics. Flathead County is an amalgam of rural, suburban, and urban areas, although the preponderance of the population lives outside the boundaries of incorporated cities. For the most part, residents see themselves as epitomizing small town and country values and attitudes, a perception that has been maintained in the face of population growth and increased commercial activity. As a whole, residents seem strongly attached to the area, both because of its pristine environment and natural beauty and because of their sense of community and belonging. The communities in the area generally are homogeneous, although there is a large Native American population in the area. Crime rates apparently have remained relatively low across good and bad economic times.

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Chapter 3

THE AFFECTED PHYSICAL ENVIRONMENT

In the Pacific Northwest aluminum is produced in ten separate primary reduction plants owned and operated by seven different companies. Seven of these plants are located throughout Washington, two are located in northern Oregon, and one plant is located in western Montana (Figure 3.1).

Some of the aluminum plant sites are described individually; others are described collectively because individual plant site characteristics are similar enough to apply to more than one plant. The following information describing the physical affected environment is organized by regions for ease of comprehension. This information was extracted primarily from information developed by the aluminum companies for BPA's use in preparing an EIS, from contacts with the individual aluminum companies and cognizant state agencies, and from selected references.

3.1 LOWER COLUMBIA

Two companies have aluminum reduction plants along the reaches of the lower Columbia River. Reynolds Metals Company has a plant in Longview, Washington, and another plant in the Portland area at Troutdale, Oregon. The Alcoa Company has a reduction plant in Vancouver, Washington. The environmental conditions in the vicinity of these plants are similar in many respects. For this reason, the affected environments of these sites are described generally as that of the lower Columbia. Features unique to each site are pointed out.

3.1.1 Site Location and Layout

A range of urban and nonurban areas is found in the lower Columbia River area. While much of the surrounding land is agricultural or forested land, the three sites are located within urban areas.

The Troutdale, Longview and Vancouver primary aluminum plants are included in the Portland-Vancouver geographical area (Figure 3.2). Five counties, three in Oregon and two in Washington, form the area. The Oregon counties are Multnomah, Clackamas and Washington; the two Washington counties are Clark and Cowlitz.

The Reynolds plant in Longview is located west of the city in an industrialized area of about 3750 acres. The plant facilities consist of the dock on the Columbia River, the rectifier where electric power is converted to DC power for the reduction cells, the carbon plant where anode paste is produced, the potrooms where alumina is reduced to aluminum, the cast house where the aluminum is cast into ingots or billets, and the cryolyte plant where materials are reclaimed. A plot plan of the site is presented in Figure 3.3.

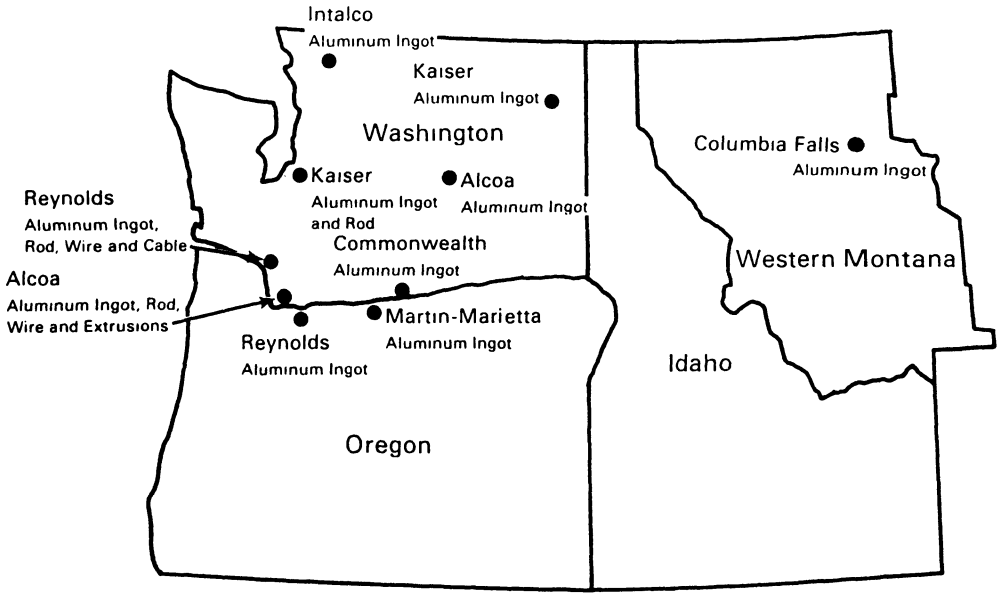

Figure 3.1
Pacific Northwest Aluminum Reduction Facilities

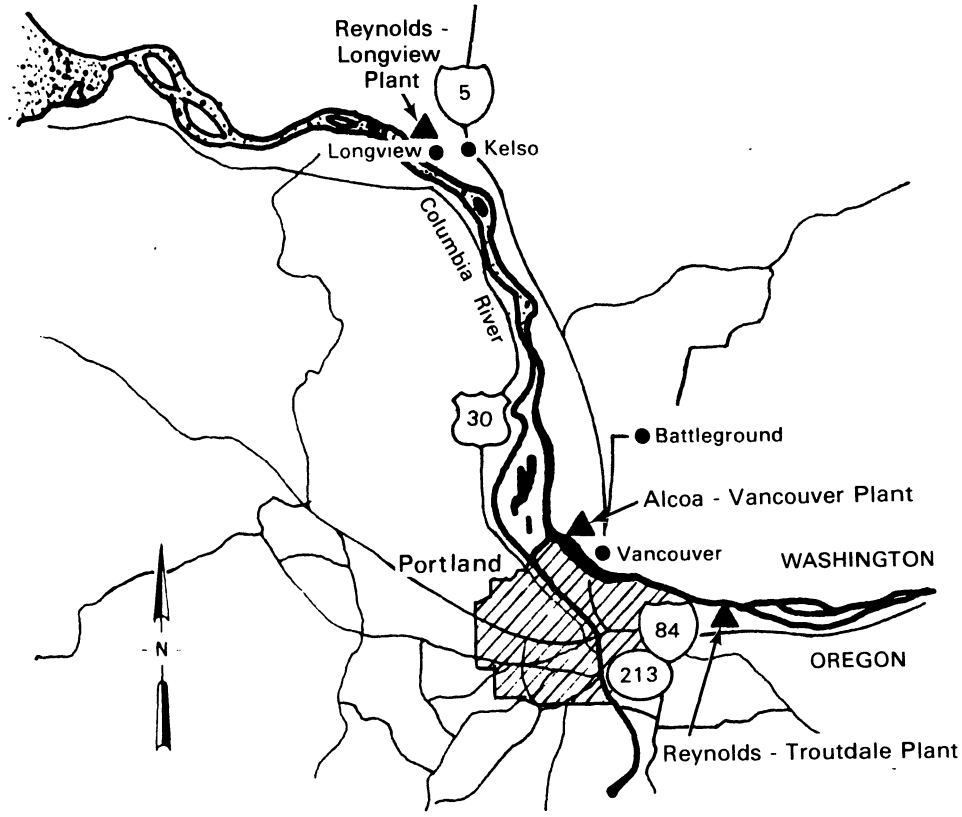

Figure 3.2
Lower Columbia River Aluminum Reduction Facilities

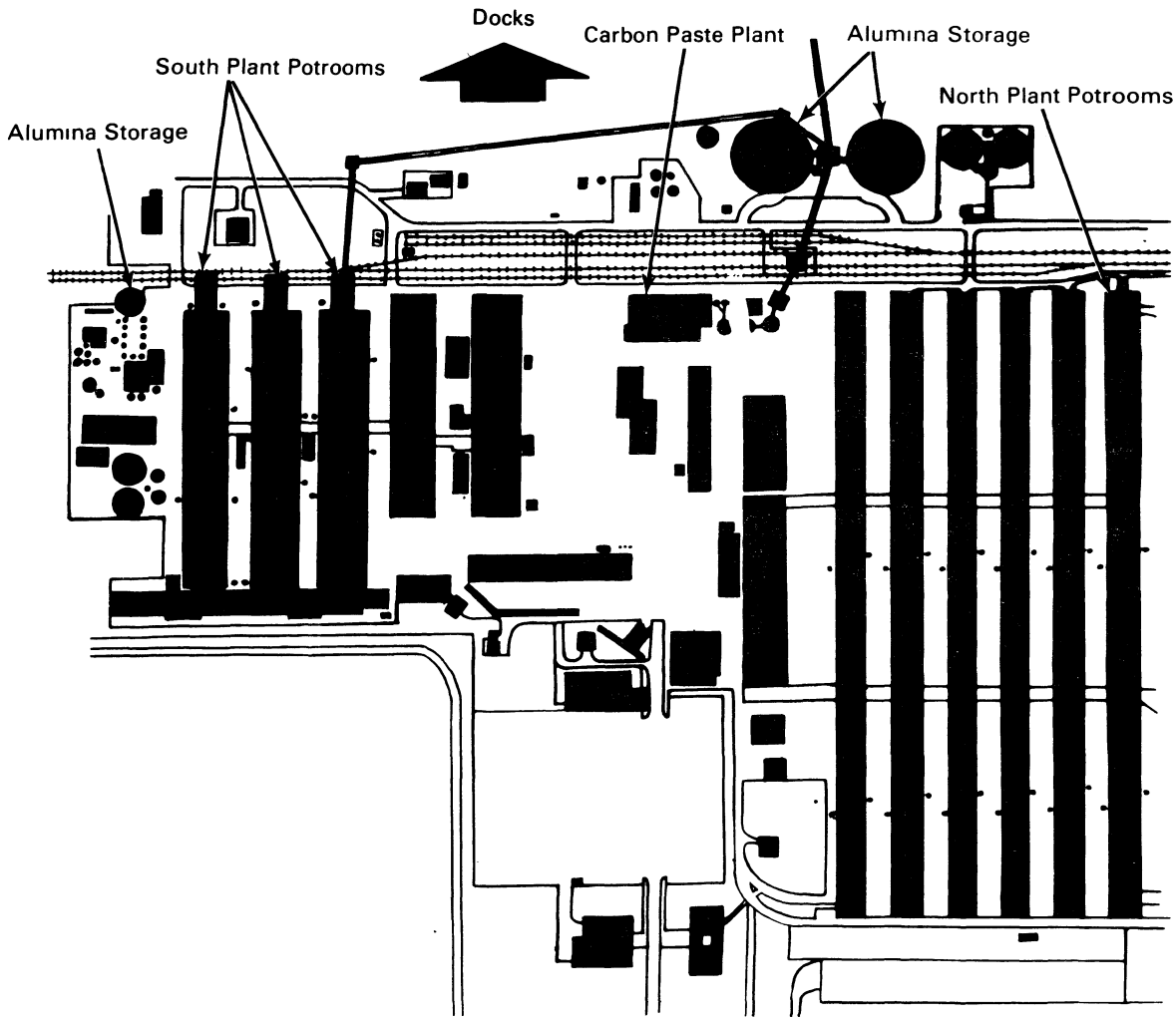

Figure 3.3
Site Plot Plan: Reynolds at Longview

The Reynolds plant at Troutdale is located on about 80 acres in east Multnomah County. The plant site and adjoining property, owned by Reynolds Metals Company, are bounded on the north by the Columbia River and the Sandy Drainage Dike, on the east by the Sandy River, on the south by the Troutdale Airport, Interstate 84N and Sandy Boulevard, and on the west by the boundary of the former Fairview Farms property. The site layout is presented in Figure 3.4.

The Alcoa aluminum plant at Vancouver (Figure 3.5) lies west of the city of Vancouver in Clark County. The plant site occupies 124 fenced acres of an 1816-acre site owned and controlled by Alcoa. The plant site lies between a large, shallow lake (Vancouver Lake) to the north and the north shore of the Columbia River at river mile (RM) 103, where a 40-ft-deep channel is used to berth deep-draft ships that import ore. The Willamette River empties into the Columbia on the south shore about one mile below the plant (Tabor 1976a). Hayden Island lies in the river just upstream of the plant, while Sauvie Island

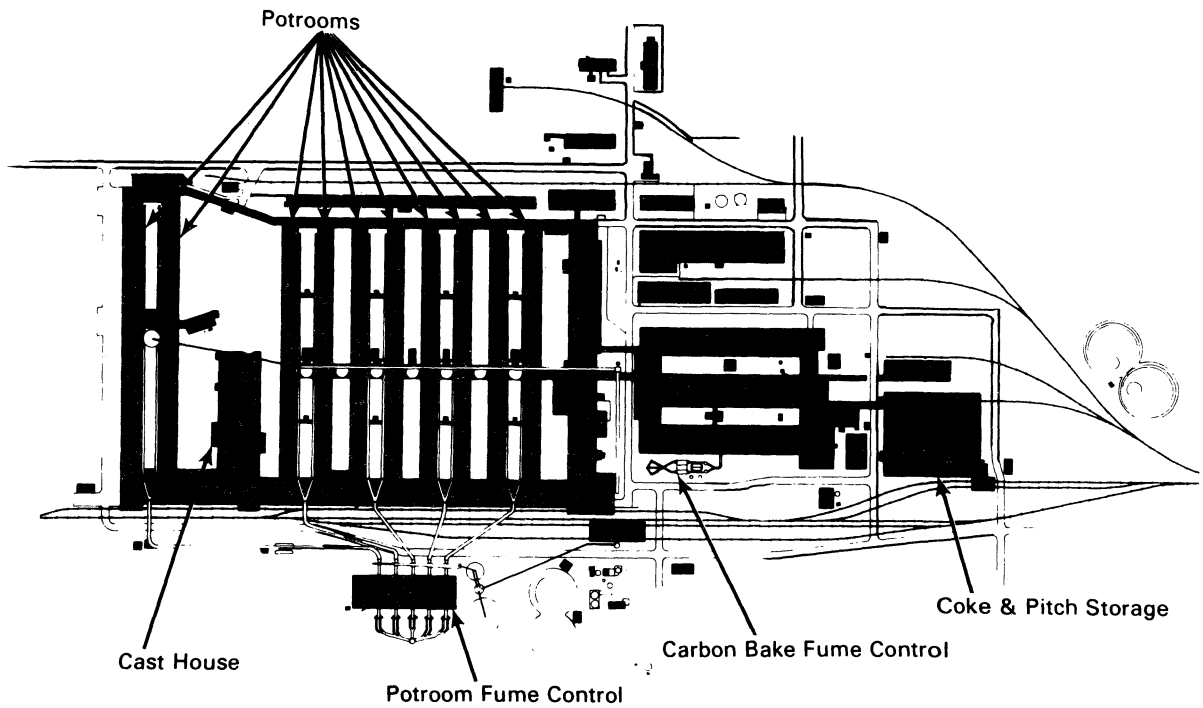

Figure 3.4
Site Plot Plan: Reynolds at Troutdale

is two miles downstream. The city of Portland, Oregon, lies about four miles south. The site layout is presented in Figure 3.6.

3.1.2 Geography

The aluminum plants of the lower Columbia are located in the physiographic region known as the Puget Trough. The Puget Trough is the southern end of a structural and topographic depression that extends from the Willamette Valley in Oregon northward for about 1500 mi into Washington and along the coast of British Columbia. At the south, the trough forms a lowland 200 mi long and barely 25 mi wide between the Oregon Coast Range and the Cascade Mountains.

The valley floors of the Columbia and Willamette Rivers, the area's major surface-water drainages, are nearly flat to gently rolling, terraced surfaces. The surrounding area, lying at the confluence of these rivers, is near sea level, rising to nearly 400 ft on the higher terraces and to 1000 ft or more in the hilly regions. A number of small buttes of volcanic origin protrude above the plain to the east of the Willamette River, including Rocky Butte (612 ft), Kelly Butte (593 ft) and Mt. Tabor (about 645 ft). Mt. Scott, just south of the Portland city limits, reaches about 1100 ft above sea level.

The plant facilities lie on Recent and Pleistocene sedimentary deposits of the Columbia or Willamette rivers. The sediments consist of silt, sand and gravel, in varying proportions, and are heterogeneously deposited. Sediments below the

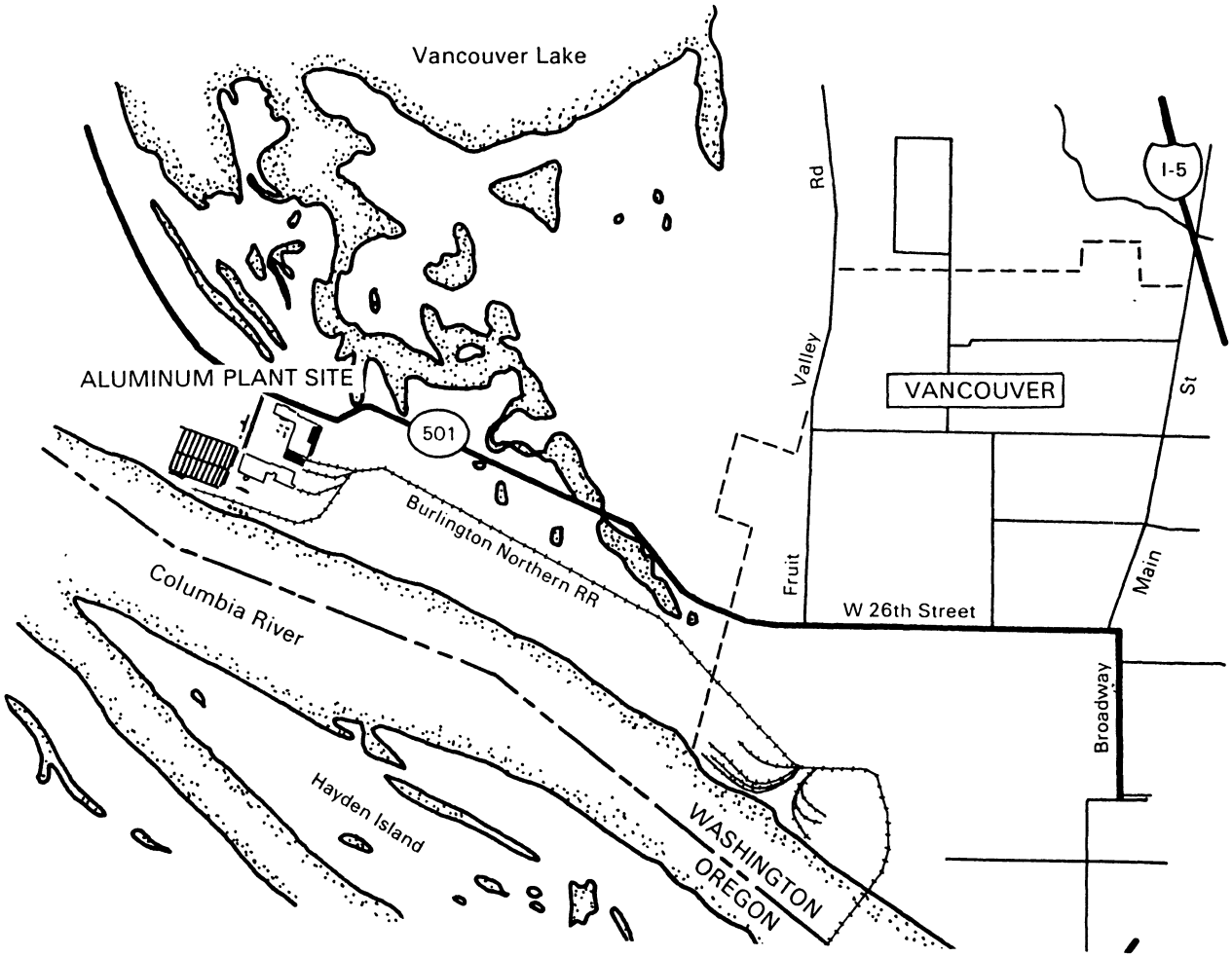

Figure 3.5
Alcoa Aluminum Plant at Vancouver

Alcoa Vancouver plant, which may be typical of the general area, consist of six successive layers of these materials (Noble and Sebren 1983).

3.1.3 Hydrology

The major water body in the Portland-Vancouver area is the Columbia River. Therefore, a general description of the Columbia drainage system and its characteristics is presented here. The surface-water hydrology of the Pacific Northwest is dominated by the Columbia, Snake and Willamette rivers. The Columbia River originates some 2652 ft above sea level in Columbia Lake, British Columbia, Canada. The Columbia River has been extensively developed to provide hydroelectric power, irrigation water, flood control, navigation, recreation and other societal benefits (PNRBC 1979). The river also supports valuable runs of anadromous fish.

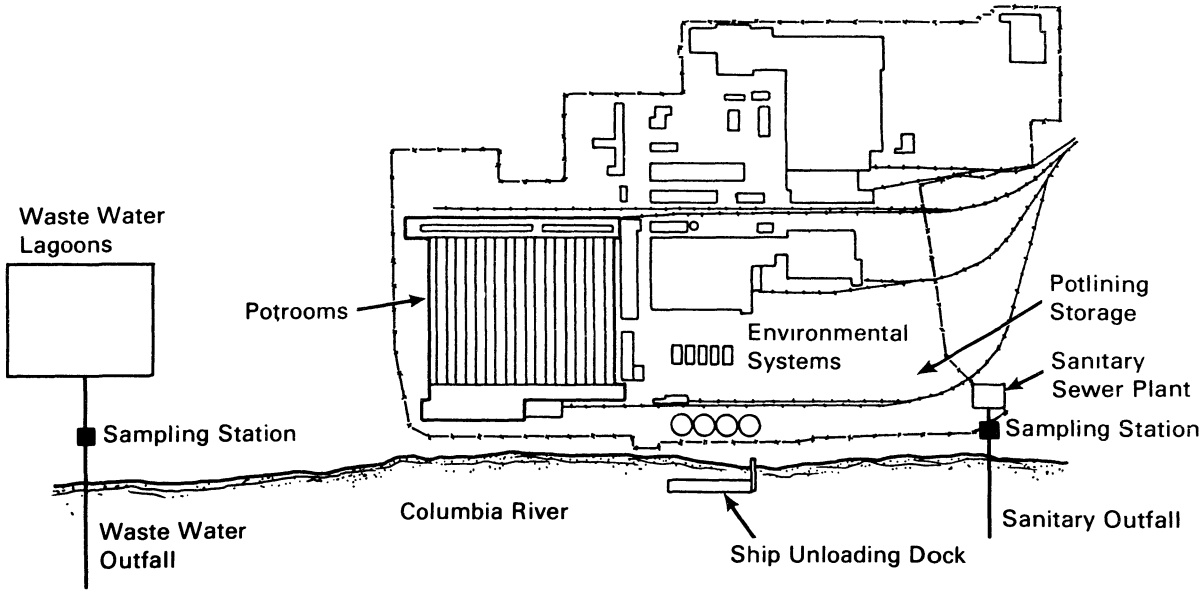

Figure 3.6
Site Plot Plan: Alcoa at Vancouver

The main tributaries that enter the Columbia River in Washington are the Spokane, Okanogan, Wenatchee, Yakima, Snake, Cowlitz, and Lewis rivers. In Oregon, the main tributaries of the Columbia River are the Umatilla, John Day, Deschutes, and Willamette rivers.

Drainage Area. The combined drainage area for the Columbia River and its tributaries is about 259,000 sq mi (15% or 38,850 sq mi lies in Canada). Much of the drainage area lies east of the Cascade Mountains in an area called the Columbia Plateau, which is built of nearly horizontal sheets of basalt rock. On the east and north, the Columbia Plateau is bounded by the Rocky Mountains. The south boundary is the Great Basin. The watershed is generally rugged, with elevations ranging up to 14,000 ft above sea level on Mt. Rainier. The river course drops from 2600 ft elevation at its origin to below sea level (as measured at river bottom) below Bonneville Dam. The river has cut a deep gorge through the Cascade Mountains to reach the Pacific Ocean (Neal 1972).

Navigation. The Columbia River now serves as an important commercial route, land as well as water, between the Pacific Coast and the interior Columbia Plateau. Ocean vessels travel up the Columbia to Vancouver, Washington, and to Portland, Oregon, via the Willamette River. Columbia River barge traffic passes through locks at Bonneville Dam, upstream through locks at other dams as far as Pasco, Washington, and up the Snake River as far as Clarkston, Washington. Highways follow the mainstem and tributaries throughout the interior.

River Flow. Flow volumes in the Columbia River historically have varied widely. Extreme low flow at the river's outlet has been estimated at 65,000 cubic feet/second (cfs) while the maximum discharge during flood in June 1894

was estimated at 1,200,000 cfs. Extensive dam construction on the Columbia River system has greatly moderated flow extremes, but seasonal flow characteristics are largely retained. Maximum flows usually occur during May, June and July because of snowmelt in high headwater streams. Minimum flows usually occur during the winter from September through March. Maximum seasonal flows are now about 600,000 cfs or less, and minimum seasonal flows are now about 150,000 cfs.

The width of the Columbia River is greatest near its outlet. It is about 9 mi wide 20 mi upstream, but decreases to 1 mi wide 52 mi upstream. Tidal fluctuations in water level occur as far upstream as Bonneville Dam (140 river miles from the mouth) during low river flow.

Water Quality. Despite its extensive drainage area, the lower Columbia River remains relatively free of pollution and meets high water-quality standards (WDOE 1977). The large discharge volumes of the river provide great dilution capacity. Further, industrial and municipal releases to the river must have federal National Pollutant Discharge Elimination System (NPDES) discharge permits that limit waste concentrations to levels considered safe by the EPA.

Recent water-quality data obtained by the U.S. Geological Survey from the Columbia River at Warrendale, Oregon (2.3 mi below Bonneville Dam), are listed in Table 3.1. The minimum water temperature at the site was 3.5°C in February, and the maximum water temperature was 21.0°C in August.

3.1.4 Meteorology

The populated region along the lower Columbia River from Portland-Vancouver to Longview-Kelso (site areas) is considered one air shed, having similar meteorological characteristics, air mass movements, and terrain. Portland-Vancouver and the Willamette Valley have one of the highest meteorological potentials for air pollution in the United States. Approximately 84% of the days during the year have shallow morning inversions lasting about six hours.[a]

The Columbia River valley between Longview, Washington, and Portland, Oregon, is oriented in a generally north/south direction. The coastal range forms the western edge of the valley. The winter season is marked by relatively mild temperatures, cloudy skies and rain, with southeasterly surface winds predominating. Summer produces pleasantly mild temperatures, northwesterly winds, and very little precipitation. Fall and spring are transitional in nature. Fog occurs most frequently in fall and early winter. At all times, incursions of marine air from the Pacific Ocean are a frequent, moderating influence (NCDC 1984).

Maritime polar air masses dominate the weather of the lower Columbia. Frontal systems move onto the coast with prevailing southwesterly winds. The coastal range of mountains, rising to 1500-2700 ft, provides limited shielding from the

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(a) Bonneville Power Administration (BPA). n.d. Portland Area Plants--Description of the Environment. Portland, Oregon.

Table 3.1
Water Quality Analyses from the Lower Columbia River at Warrendale, Oregon, for Water Year October 1982 to September 1983 (Hubbard et al. 1984)[a]

Item	Mean[b]
Discharge (cfs)	187,500
Specific conductance (μmhos)	162
pH (standard units)	8.0-8.3
Oxygen, dissolved (mg/L)	10.7
Hardness (mg/L as $CaCO_3$)	68
Phosphorus, total (mg/L as P)	0.06
Fluoride, dissolved (mg/L as F)	0.18
Silica, dissolved (mg/L as SiO_2)	11.3
Turbidity (NTU)[c]	5.5
Dissolved Trace Elements (μg/L)	
aluminum (Al)	42.5
arsenic (As)	1.5
barium (Ba)	29.3
beryllium (Be)	<1
cadmium (Cd)	<1
chromium (Cr)	<1
cobalt (Co)	<3
copper (Cu)	4.6
iron (Fe)	41.5
lead (Pb)	2.9
lithium (Li)	10.0
manganese (Mn)	4.5
mercury (Hg)	<0.1
molybdenum (Mo)	<10
nickel (Ni)	<1
selenium (Se)	<1
silver (Ag)	<1
strontium (Sr)	98.0
vanadium (V)	<6
zinc (Zn)	26.0

(a) Source: U.S. Geological Survey 1984.
(b) Data are the mean of four samples.
(c) Nephelometric Turbidity Units.

more intense winter storms. Formation of continental high pressure from east of the Cascade Mountains produces a strong westerly flow through the Columbia Gorge into the Portland area. In winter, this brings the coldest weather with the extremes of low temperature registered in the cold air mass. Freezing rain and ice glaze are sometimes transitional effects.

The meteorological data given below were collected at Portland, Oregon (NCDC 1984), and are considered to represent general conditions in the lower Columbia River study area.

Air Temperature. The data cover 30 years of record, 1955 to 1984. The average annual air temperature is about 53°F (12°C). The annual temperature range is moderate. Average maxima and minima air temperatures are about 62°F (16°C) and 44°F (7°C), respectively. The highest monthly average temperature occurs in July and is about 66°F (19°C), while the lowest occurs in January and is about 33°F (0.6°C). The highest monthly average temperature ever recorded was about 73°F (23°C) in August 1967, while the lowest monthly average ever recorded was about 31°F (-0.4°C) in January 1957.

Precipitation. The data cover 30 years of record, 1955 to 1984. The average annual precipitation is about 38 in. The maximum annual precipitation is about 51 in. in 1968, and the minimum is about 27 in. in 1976. The area has a very definite winter rainfall climate. About 88% of the precipitation occurs from October through May, 9% in June and September, while only 3% comes in July and August. Precipitation is mostly rain.

Snowfall. Snowfall may occur from November through March, but, on the average, measurable snow occurs only five days each year. The annual average snowfall is about 7 in. Seasonal average snowfalls for December, January and February are about 1.4, 3.9, and 0.6 in., respectively. Snowfalls are seldom more than 2 in. and generally linger only a few days.

Wind. Winds usually blow northwesterly during the spring and summer, and southeasterly in fall and winter. Figure 3.7 shows data for the year 1974 taken at the Vancouver military reservation. Monthly mean wind velocities range from 6.5 to 10.0 mph. Surface winds seldom exceed gale force, and winds have exceeded 75 mph only twice in the period of record.

Air Quality. Air quality data for 1984 reported by the Oregon Department of Environmental Quality (DEQ) from sampling stations in the Portland area are shown in Table 3.2. This area is part of a large industrial and residential air shed.

3.1.5 Ecology

Ecological characteristics of the Lower Columbia are described in two sections: terrestrial and aquatic.

3.1.5.1 Terrestrial

Climatic changes occurring from the coastal zone to the inland zone cause changes in natural as well as cultivated vegetation. The Coast Range and Cascade Mountains support extensive coniferous forests, and the many fertile valleys provide productive farmland for cultivated agriculture. West of the Cascades, much of the land is devoted to fruit and vegetable farming and to dairying, but more and more farmland is being used for highways and urban development.

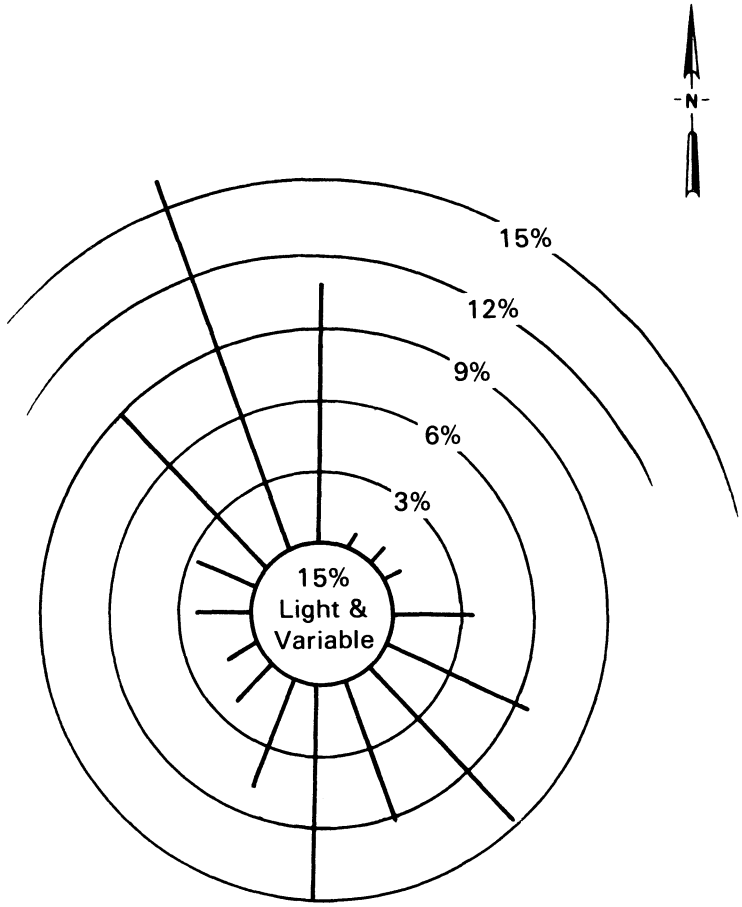

Figure 3.7
Wind Rose for 1974 Taken at the Vancouver Military Reservation
(% of time wind blows from the indicated direction)

The three sites in the lower Columbia area have similar soils, climate and topography. Consequently, the terrestrial plant and animal communities at the three sites are similar. Agricultural practices are similar throughout the Puget Trough, which results in generally similar plant and animal communities in area farmlands.

Cities, farmland and other human developments dot the landscape in the lower Columbia. The natural vegetation of the lower Columbia River area around Portland and Vancouver consists largely of forests dominated by pine, maple, oak and Douglas fir. The remaining natural vegetation includes grasslands, oak woodlands, coniferous forests, and various riparian communities. Where the forests remain, vegetation includes meadow grasses; hardwood trees represented by cottonwood, alder, maple and willow; and softwood trees represented by Douglas fir, grand fir, western hemlock and western red cedar. Woodland and meadow communities occur on the upland portions.

Upland areas on the Washington side of the Columbia River support a coniferous forest composed mainly of Douglas fir, grand fir, and bigleaf maple. Western

Table 3.2
Annual Air Quality Data, Portland Area (1984)[a]

	Arithmetic Mean ($\mu g/m^3$)	Geometric Mean ($\mu g/m^3$)	Federal Primary Standard ($\mu g/m^3$)	Oregon Standard ($\mu g/m^3$)
Total hydrocarbons	1323	1295	No standard	160[b]
CO	1550	No data	10,000[c]	10,000[c]
NO_2	31.9	27.0	100	100
NO	27.8	10.9	No standard	No standard
Ozone	27.7	14.6	235	235
SO_2	18.6	12.8	80[d]	60
Suspended particulate[e]	No data	59.0	75[f]	60[f]

(a) Oregon State Department of Ecology. 1985. Oregon Air Quality Annual Report, 1984. Portland, Oregon.
(b) Maximum 3-h average.
(c) Maximum 8-h average--no federal or state standard based on annual average exposures.
(d) Maximum annual average.
(e) 19679-1974.
(f) Annual geometric mean.

red cedar, while not numerous, occurs in these forests. The shrubs that generally comprise the understory consist of vine maple, hazel, oceanspray and baldhip roses. The upland has been subject to farming and logging for many years.

Riparian vegetation on the lower Columbia River occurs on poorly drained sites that are often subject to annual flooding. Typical species include Oregon ash, black cottonwood, bigleaf maple and red alder. Various species of willows occur as understory. Wappato, an aquatic plant once important to the diet of Indians, was once abundant and widespread in this area but is now uncommon. Riparian species have limited value as pulpwood, firewood and furniture wood; their greatest value is ecological in protecting stream banks during floods. Riparian vegetation is also important as wildlife habitat, particularly where forest cover has been removed for development. The Columbian white-tailed deer is an endangered species occurring in riparian areas along the lower Columbia River (USFWS 1984). Other wildife habitats are discussed below.

Agricultural. Characterized by short vegetation and often shrubby fence rows, this habitat is used by deer, geese, and many species of birds and small mammals.

Riparian. Vegetation along waterways and around lakes is heavily used by waterfowl, shorebirds and many species of songbirds. Mammals using riparian

areas include beaver, mink, opossum, racoon, nutria, muskrat and river otter. Riparian areas are also used by deer, rabbits, small rodents, quail, grouse, pheasants, ducks and songbirds.

Woodland. These upland areas are frequented by large and small mammals such as blacktail deer, elk, bobcats, rabbits and small rodents. Woodlands also provide feeding and nesting habitat for grouse, songbirds and numerous birds of prey.

Shoreline and Sandbars. Exposed areas of river deposits along and in the Columbia are important feeding and nesting areas for many species of aquatic birds (gulls, ducks, geese, owls, loons, grebes, and other shorebirds).

3.1.5.2 Aquatic

Salt water from the Pacific Ocean penetrates upriver past the aluminum plants on the lower Columbia River, and the tidal effect is apparent as far upriver as Bonneville Dam. Flow characteristics in the lower Columbia River generally follow the historical seasonal pattern of high flows (from snowmelt and runoff) in the spring and low flows during fall and winter (Neal 1972; PNRBC 1979). In general, water quality in the lower Columbia River remains high (see Chapter 3.1.3).

Fish populations in the lower Columbia River can be divided into anadromous and resident fish. Resident group fish include native and introduced species.

Anadromous. Anadromous fish grow and mature in the ocean and return to spawn in various tributaries throughout much of the Columbia River system. Anadromous fish are represented by sea-run salmonids, which include chinook salmon, coho salmon, sockeye salmon, and steelhead (Schwiebert 1977; Stober et al. 1979; ODFW and WDF 1983). Smelt and shad are also anadromous. Anadromous fish are important to commercial and sport fisheries and to Native American tribes. Populations of anadromous salmonids are supported by artificial-rearing programs conducted at state and federal hatcheries and all are subject to extensive enhancement practices (NWPPC 1984).

Resident. Resident fish spawn in fresh water and spend most of their life in the river. Some resident fish move from the lower Columbia into tributaries and return later, but little movement by resident fish occurs upriver over Bonneville Dam. White sturgeon is a resident species that may enter the sea.

Native. Native fish represent the natural fish fauna of the Columbia River ecosystem. Some native fish, like steelhead, cutthroat and rainbow trout, whitefish, and white sturgeon, are of considerable commercial or sport value. Most native fish have limited commercial or sport value, but considerable ecological value. Native fish include various species of suckers, squawfish, chubs, minnows, dace and sculpins (Wydowski and Whitney 1979).

Introduced. Introduced fish were initially stocked from eastern areas of North America, adapted to the Columbia River ecosystem and became part of the local fish fauna. The carp is an introduced species of limited value. However, many

introduced species have become important for sport fishing, including largemouth and smallmouth bass, walleye, channel catfish and other bullheads, crappie and bluegill.

The commercial fishery in the lower Columbia River focuses on chinook salmon, coho salmon, steelhead, white sturgeon, smelt and shad. Commercial fishing occurs from the river outlet upstream to Bonneville Dam and is regulated jointly by the states of Washington and Oregon (ODFW and WDF 1983).

Native American subsistence and ceremonial fishing takes place above Bonneville Dam. Populations of salmonids in the Columbia River have been reduced since the turn of the century, primarily a result of overfishing (Chapman et al. 1982) and inundation of upriver spawning areas (Fulton 1968). Adult salmon migrating upstream and juvenile salmon emigrating downstream are routinely monitored at dams to index population levels.

3.2 MID-COLUMBIA

Two plant sites are located in the mid-Columbia region (see Figure 3.1). The Commonwealth plant is located on the Columbia River about 17 mi south of the town of Goldendale and is referred to as the Goldendale site. The Dalles plant, owned by Martin Marietta, is located on the western edge of the town of The Dalles, about 25 mi downstream from the Goldendale site.

3.2.1 Commonwealth at Goldendale

3.2.1.1 Site Location and Layout

The Goldendale plant is located in the extreme southern portion of the state of Washington in Klickitat County. Klickitat County lies on the western end of the south slope of the Horse Heaven Hills and the southeast slope of Mount Adams. There are few inhabitants in the area of the plant (Figure 3.8).

The plant buildings encompass an area of about 19 acres and are located on approximately 5275 acres owned by Commonwealth. The plant also leases about 105 acres of land in the vicinity from the Corps of Engineers and 480 acres from the state of Washington. A plot plan of the site, showing the placement of the major buildings, their type, and waste disposal facilities, is shown in Figure 3.9. The location of the primary air quality control units is indicated. Secondary air quality control is handled by a system that is installed in roof-tunnel monitors that run the length of each cell-room building.

3.2.1.2 Geography

The Goldendale plant lies between Washington Highway 14 and the Columbia River adjacent to the back bay of the John Day Dam. Vast basalt cliffs rise steeply to the west and north to about 1000 ft. The terrain is dominated by basalt outcroppings entrapping small pockets of soil where natural species of vegetation have colonized.

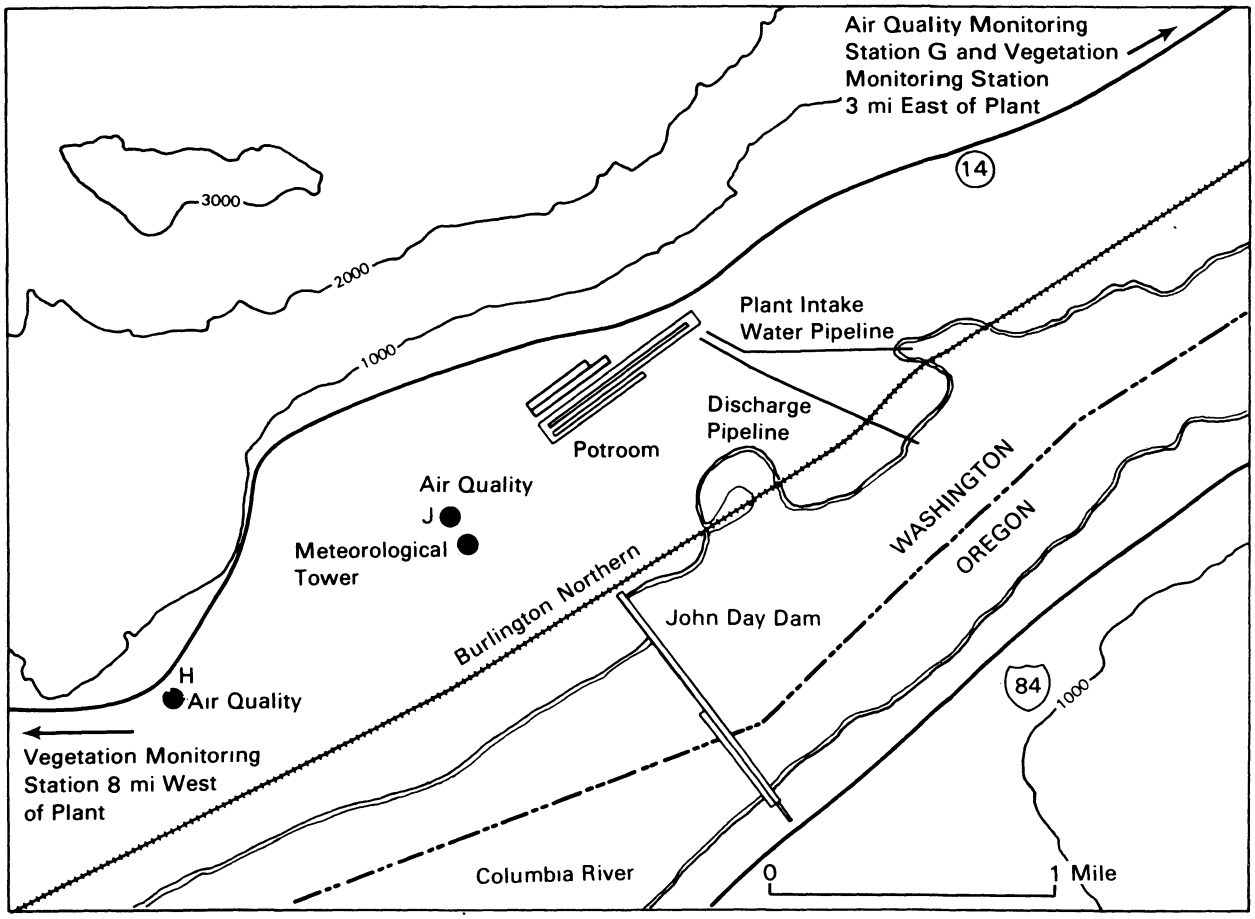

Figure 3.8
Commonwealth Aluminum Plant: Goldendale

3.2.1.3 Hydrology

Because of basalt cliffs and bedrock under shallow soils on both sides of the Columbia River near the Goldendale plant, most precipitation in the form of rain or snow is either lost to the atmosphere by evapotranspiration or soon reaches the river.

The surface-water hydrology of the Columbia River is described in Chapter 3.1.3. Flows near the Goldendale plant are moderated by temporary impoundment of river water in Lake Umatilla between John Day Dam (RM 215.5), just below the plant site, and McNary Dam (RM 292) further upriver. The John Day Dam was constructed in 1968. Lake Celilo, an impoundment formed behind The Dalles Dam, lies below John Day Dam. Lake Umatilla is a "river-run" impoundment with 2,530,000 acre ft of storage capacity (WDOE 1981).

On the Oregon side of the Columbia River near the site, the Deschutes River enters Lake Umatilla at RM 204, about 12 mi below the Goldendale plant, and the John Day River enters at RM 218, about three miles above. On the Washington

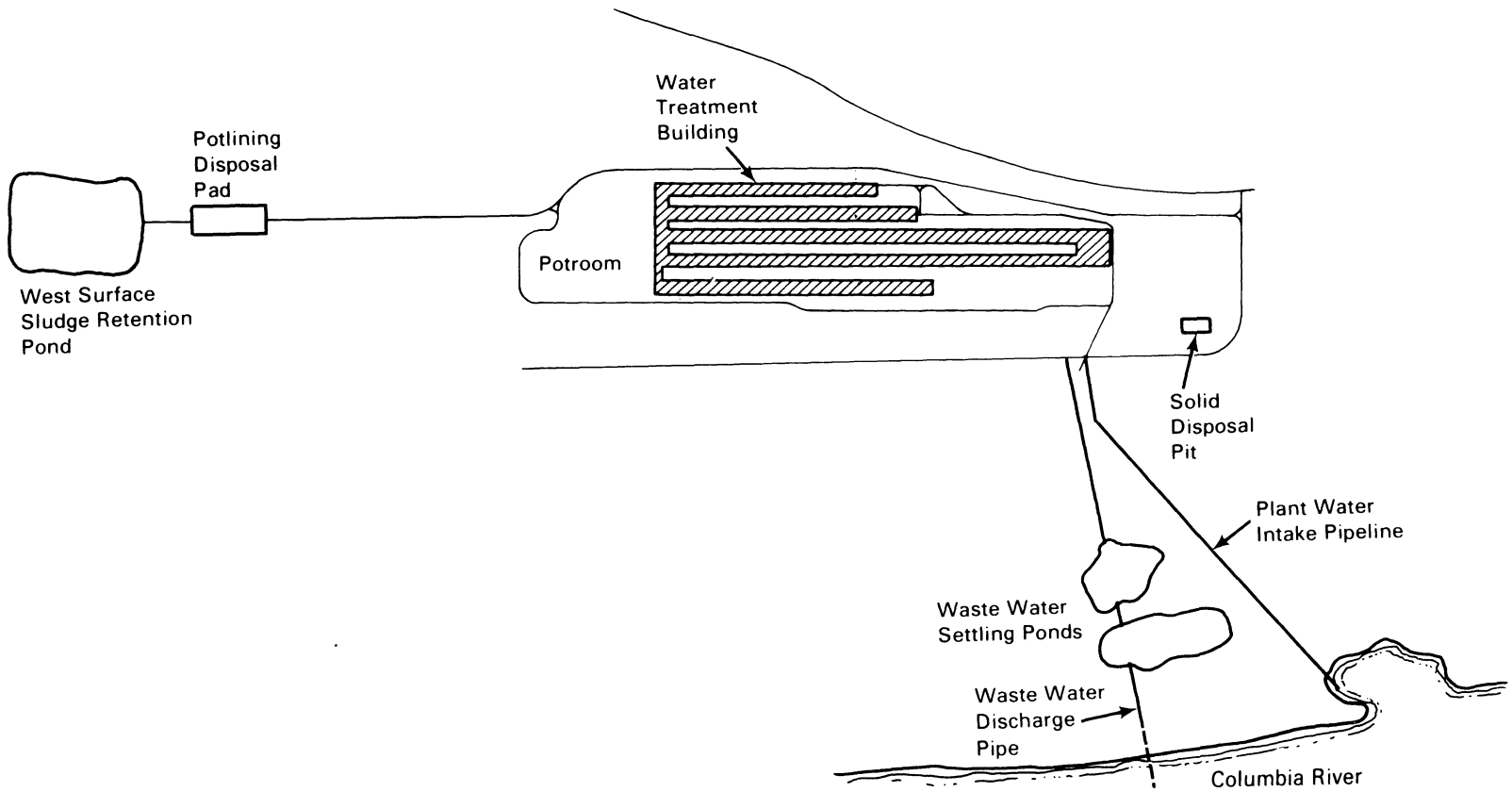

Figure 3.9
Site Plot Plan: Commonwealth at Goldendale

side, Rock Creek enters at RM 229, about 13 mi above the plant. A few smaller streams with limited or ephemeral flow also enter Lake Umatilla.

The Columbia River east of the Columbia Gorge is relatively free of point-source pollution, corresponding to its Class A designation for water quality standards. Discharge volumes at this point in the mainstem are relatively great. Columbia River flows at The Dalles, Oregon, during Water Year October 1982 to September 1983 averaged 216,600 cfs, with a maximum of 426,009 cfs and a minimum of 85,000 cfs (Hubbard et al. 1984).

Water levels fluctuate daily in Lake Umatilla and Lake Celilo from power plant and lock operations at the John Day and The Dalles dams. The area also has many diversions for irrigation.

3.2.1.4 Meteorology

A 10-m-high meteorological tower has been installed and has been fully operational since April 1984.[a] The tower is located 0.6 km southwest of the Goldendale plant site (Figure 3.8). Raw meteorological data are included in Campbell et al.[a] Among the many parameters measured were, mean vector wind direction, mean scalar wind direction, wind speed and vector magnitude. Reduction and summarization of raw data are not available.

Climatological data have been recorded from stations at Dallesport (1941-1965) and John Day Dam (1958-1965) by the National Weather Service (Donaldson 1979). Generally, winds in the southern portion of Klickitat County are influenced by the Columbia Gorge (Lynott 1966). Drainage winds generally blow east-west along the Columbia River. Stronger easterly winds occur with an outbreak of polar air over eastern Washington or with the approach of a deep low-pressure system near the Pacific coast. Major storm may produce winds in excess of 50 mph with stronger gusts, but these storms are not common.

3.2.1.5 Ecology

Terrestrial Ecology. The Goldendale plant lies within the shrub-steppe province of southcentral Washington (Franklin and Dyrness 1973). Climatically, the area is typified as semiarid with low precipitation, warm-to-hot dry summers, and relatively cold winters. The climax plant community surrounding the Goldendale site is a wheatgrass/bluegrass association. There is generally an absence of big sagebrush with gray rabbitbrush being the predominant shrub. Wheatgrass is noticeably absent in areas subjected to heavy grazing, and cheatgrass becomes more abundant as the wheatgrass decreases.

Near the Goldendale plant (RM 216), tall and vertical rock cliffs extend to very near the top of the gorge. Talus slopes are common under the cliffs. Hackberry, ceanothus, common chokecherry, and juniper occur near margins of the

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(a) Campbell, S., R. Browner, R. Lanza, N. Pfeffer, and K. Zankel. 1985. PSD Permit Revision Application for the Goldendale Aluminum Plant. Martin Marietta Environmental Systems, Columbia, Maryland.

talus. The steep slopes under the cliffs that have a soil layer support Sandberg's bluegrass, cheatgrass, and smaller amounts of needlegrass and bluebunch wheatgrass. The gentle slope between the river's edge and the steep slope supports willow, tree-of-heaven, locust, and white poplar. Gray rabbitbrush with a cheatgrass understory covers most of the gentle slope. Soil is moderately deep at the bottom of the cliff, but becomes gradually shallower and rocky towards the top of the canyon (Tabor 1976a).

Blacktailed deer, mule deer, and possibly intergrades between these two species occur at the eastern end of the Columbia River Gorge. The only other big game animal present, though rarely, is the cougar.

Terrestrial furbearers are common at the eastern end of the Columbia River Gorge. Racoon occur in most vegetative types, but prefer riparian habitats and are the only furbearer that utilizes rock rip-rap along the shoreline. Striped skunks, coyotes, bobcats, and porcupines are widely distributed in the area. Spotted skunks and badgers occur in rabbitbrush, rock cliff/grassland, and grassland habits. Aquatic furbearers including beaver, otter, mink and muskrats are present, but populations are low because of unsuitable, rocky riparian habitat. Aquatic furbearers most often occur near tributaries and shoreline marshes (Tabor 1976a).

Game birds at the eastern end of the Columbia River Gorge include ring-necked pheasant, California quail, chukar, mourning dove, and snipe. The chukar is the most abundant of these birds, and is associated with rocky canyon walls. The other species are in low-to-moderate abundance, and occur primarily in riparian habitats.

About 27 species of waterfowl are known to occur in the upper end of Lake Bonneville, Lake Celilo, and the lower end of Lake Umatilla. The largest numbers occur during the winter but there are also substantial breeding numbers during spring and summer. These reservoirs also serve as a staging area for migrating waterfowl. Canada geese and mallards are the most numerous wintering and breeding species. Particularly during winter, geese use open waters of Lakes Celilo and Umatilla for resting between feeding flights to inland grainfields. The Umatilla National Wildlife Refuge (NWR) is located on the upper and middle reaches of Lake Umatilla. Water level fluctuations combined with a limited nontidal marsh along the reservoir shoreline appear to limit waterfowl nesting in most of the area, but nesting is heavy in the Umatilla NWR (Tabor 1976a).

Aquatic. The classification of fish populations into anadromous, resident, native and introduced (see Section 3.1.5.2) is applicable here.

Anadromous salmonids passing The Dalles and John Day dams are the same species occurring in the lower Columbia River, but numbers of adult return migrants are reduced by fish that divert to tributaries bordering Lake Bonneville and Lake Celilo. Important salmonid spawning tributaries at the eastern end of the Columbia Gorge include the Klickitat, Deschutes and John Day Rivers. The commercial fishery for salmonids above Bonneville Dam is now open only for Native

American tribes (ODFW and WDF 1983). Species in the catch are chinook, coho and sockeye salmon, and steelhead.

Counts of adult salmonids over the John Day Dam for the last five years are given in Table 3.3.

Table 3.3
Counts of Adult Salmonids Migrating Upstream
at John Day Dam, 1980 to 1984
(ACOE 1984)

	Species				
Year	Chinook	Coho	Sockeye	Steelhead	Total
1980	100,664	1,924	50,675	78,199	231,462
1981	114,359	2,562	46,146	95,172	258,239
1982	144,082	4,063	37,970	108,603	294,718
1983	139,706	1,640	89,810	154,697	385,853
1984	188,770	2,065	109,815	199,833	500,483

The timing of the upriver salmonid migration through the eastern Columbia River Gorge varies with species and run. Generally, adult fish return from early spring, through the summer until early fall. Juvenile salmonids migrate seaward from upriver spawning areas and hatcheries during spring and summer.

Important sport fisheries exist in the area for smallmouth bass and walleye.

3.2.2 Martin Marietta at The Dalles

3.2.2.1 Site Location and Layout

The Martin Marietta plant is located about three miles west of the center of the city of The Dalles, Oregon. The plant is located between the Columbia River to the northeast and Interstate 84 to the southwest.

The plant buildings encompass a total area of about 17.5 acres and are located on about 430 acres of land. A site plot plan is shown in Figure 3.10, which details the placement of buildings, their type, and related facilities. The location of the primary air quality control units is also shown. The secondary air quality control system is installed in roof-tunnel monitors that run the length of each cell-room building. Plant access points are also shown on the plot plan.

3.2.2.2 Geography

The Martin Marietta plant was built on a relatively rugged, basalt-dominated bench that rests on the southwestern shore of the Columbia River. The Oregon Cascade foothills and Interstate 84 border the site. Elevations increase rapidly toward the south and west.

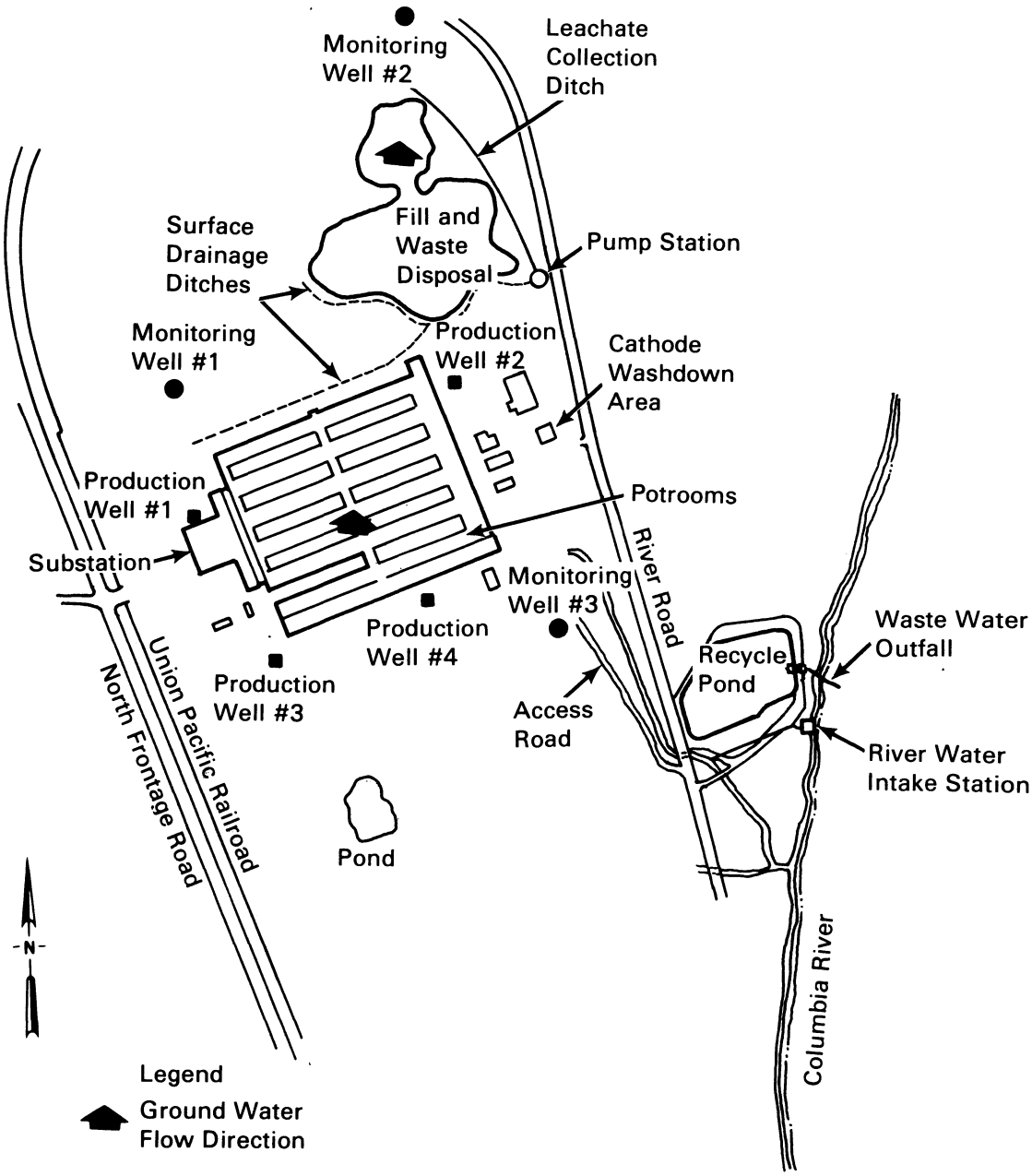

Figure 3.10
Site Plot Plan: Martin Marietta at The Dalles

3.2.2.3 Hydrology

Because of basalt cliffs and bedrock under shallow soil on both sides of the Columbia River near The Dalles plant, most precipitation in the form of rain or snow is lost to the atmosphere by evapotranspiration or soon enters the river. The general flow of groundwater beneath The Dalles site is north, parallel to the Columbia River (Figure 3.10).

The surface-water hydrology of the Columbia River is described in Chapter 3.1.3. Flows near The Dalles plant are moderated by temporary impoundment of river water in Lake Bonneville behind Bonneville Dam (RM 146). Lake Bonneville has a storage capacity of 537,000 acre ft and extends upriver to The Dalles Dam (RM 192), 4 mi above the plant site.

On the Washington side of the Columbia River near the site, the Klickitat River enters Lake Bonneville at RM 180. A few smaller streams enter Lake Bonneville on both the Oregon and Washington shores.

3.2.2.4 Meteorology

Site specific meteorological information for the Martin Marietta The Dalles plant is not available. A wind rose for North Dalles is shown in Figure 3.11 (Donaldson 1979). The predominant wind direction is from the northwest about 25% of the time with a wind speed of about 16 to 31 mph. Winds of similar magnitudes come from the west about 18% of the time. Climatological data presented for the mid-Columbia region in Chapter 3.2.1.4 applies to this site area.

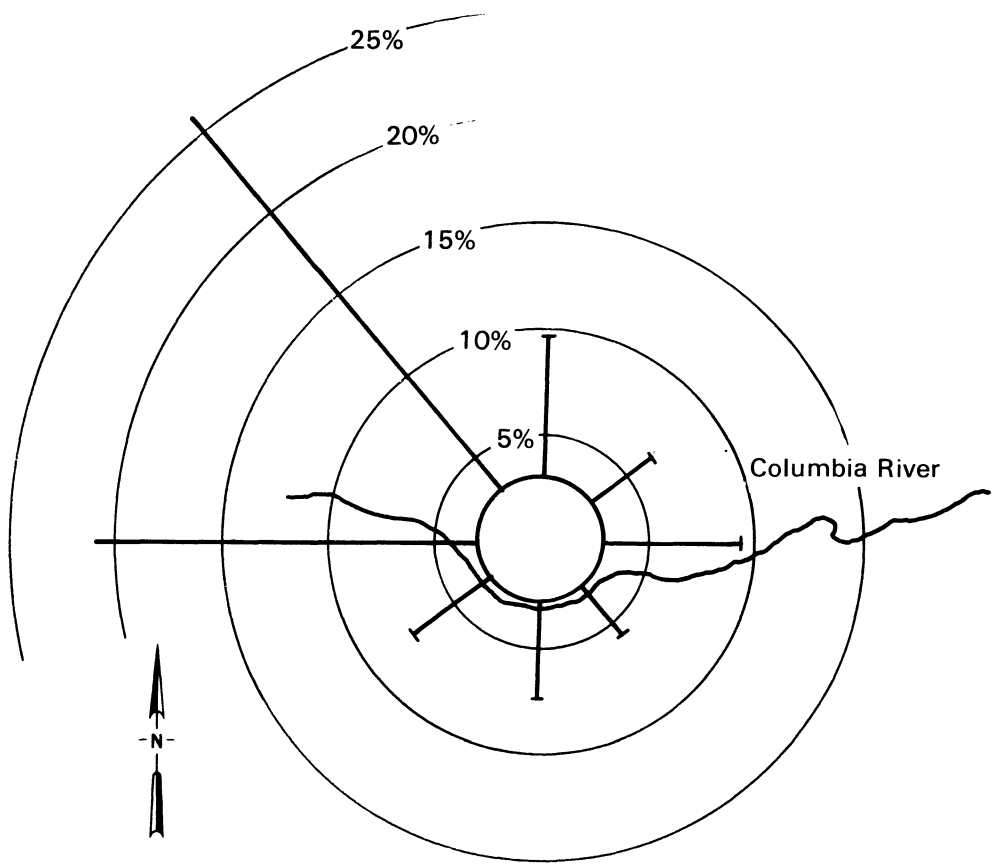

Figure 3.11
Wind Rose for North Dalles
(% of time wind blows from the indicated direction)

At Dallesport, the average maximum annual air temperature is 64°F (17.8°C), the average minimum is 42°F (5.6°C), and the average mean is 53°F (11.7°C). At John Day Dam, the average maximum annual air temperature is 64°F (17.8°C), the average minimum is 45°F (7.2°C), and the average mean is 55°F (12.8°C). Peak air temperatures occur in June, July and August, and low air temperatures occur in December, January and February (Donaldson 1979).

The annual average precipitation at Dallesport is 13.70 in. At John Day Dam annual precipitation averages 10.59 in., reflecting the slightly dry conditions inland further up the Columbia River. The annual average snowfall is 20.2 in. at Dallesport, with about half of this falling in January (Donaldson 1979).

3.2.2.5 Ecology

The Dalles plant is located at the eastern end of the Columbia River Gorge, which is the transition area from the marine-type climate of western Oregon and Washington to a continental-type climate of the east. The major terrestrial ecological characteristics are discussed. The aquatic ecology is very similar to the Goldendale site presented in Chapter 3.2.1.5. No endangered or threatened plant species specific to the general area have been identified (USFWS 1984).

At the eastern end of the Columbia River Gorge near The Dalles, the Douglas fir forests that dominate the lower elevations are replaced by a narrow zone of Ponderosa pine with an association of Oregon white oak. East of the city of The Dalles is the sagebrush-dominated shrub-steppe zone of eastern Washington and Oregon, where climax communities are dominated by sagebrush/bunchgrass associations. Vegetation in the riparian zone near the Columbia River is influenced by basalt rock cuts, numerous rip-rap fills and water-level fluctuations in river-run impoundments.

Near The Dalles plant (RM 188), steep rock cliffs form a high canyon wall, and the plain between the river and the cliffs is narrow. In many areas, Interstate 84N occupies the entire plain. Soils are shallow and sandy-textured. Ponderosa pine replaces Douglas fir and western hemlock forest communities to the west. Oregon white oak is dominant on xeric sites and forms associations with Ponderosa pine on slopes near the river. Snowberry, vine maple, bitterbrush, and tall Oregon grape are major shrubs in the Ponderosa pine communities. Idaho fescue, bluebunch wheatgrass, and cheatgrass are dominant grass species. Poison oak may form dense stands under Oregon white oak canopies. Snowberry, oceanspray, and Oregon grape add to the shrub diversity. On moist sites near the river, Pacific willow, Columbia River willow, and peach-leaf willow form dense stands. Reed canarygrass dominates the understory (Tabor 1976a).

Although close together geographically, the vegetation of the two mid-Columbia sites is dissimilar. The physical environment and resulting terrestrial communities are remarkably different between the south-facing slopes above the Commonwealth plant and the north-facing slopes above the Martin-Marietta plant. The result is an ecologically unique area where a number of species

from the Eastern U.S. reach their westernmost distribution and a number of Pacific Northwest species reach their easternmost distribution.

3.3 UPPER COLUMBIA

One aluminum reduction plant is sited in the upper Columbia River region. The Alcoa Company owns and operates a facility near Wenatchee, in Chelan County, Washington (Figure 3.12).

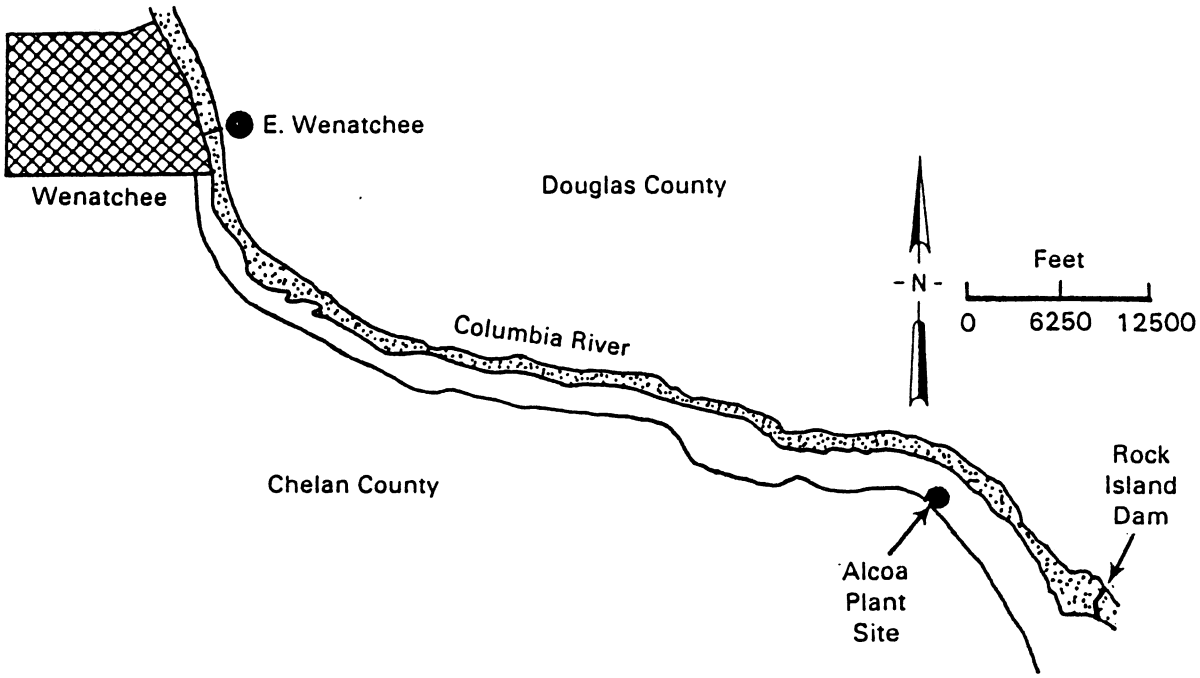

Figure 3.12
Alcoa Wenatchee Plant Area

3.3.1 Site Location and Layout

The Alcoa Wenatchee plant is located on the upper Columbia River at RM 455.

The cities of Wenatchee (Chelan County) and East Wenatchee (Douglas County) are about 10.5 mi upriver northwest of the plant (Figure 3.12). The community of Rock Island is about 2 mi upriver. Rock Island Dam is about 1 mi downriver. The nearest town to the southeast of the plant is Quincy, about 25 mi away.

The Alcoa plant contains 94 fenced acres situated upon a 360-acre tract of land controlled by Alcoa.

The plant is served by a spur line of Burlington Northern Railroad and a county road leading 11 mi to U.S. Highways 2 and 97. There is no commercial navigation on the Columbia River as far upstream as Wenatchee. Feed material for the plant and finished product are shipped primarily by rail.

A site plot plan (Figure 3.13) shows the layout of the plant facilities with respect to waterways, railroads and port facilities.

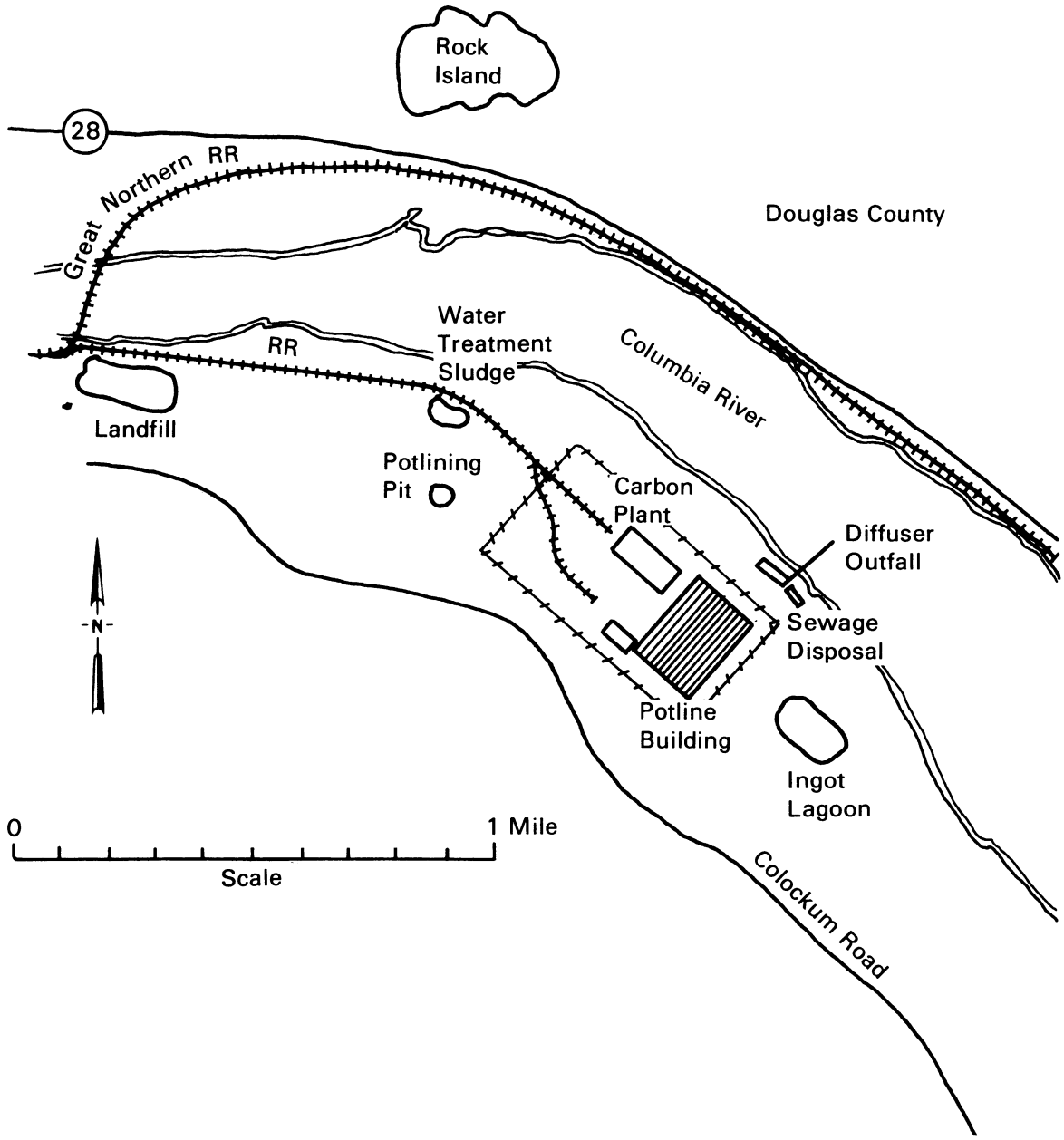

Figure 3.13
Site Plot Plan: Alcoa at Wenatchee

About 10 million gallons of process water are drawn daily from the Columbia River. Potable water is obtained from wells on the plant site. The plant has a secondary sewage treatment facility onsite.

3.3.2 Geography

The site lies on a narrow bench along the southwest shore of the Columbia River. At this point, the Columbia River is impounded as a "river-run" reservoir behind Rock Island Dam. The ordinary high-water level of the Rock Island Pool is 607 ft, and the river flows from northwest to southeast. The valley penetrated by the river is narrow, and steep bluffs rise on both sides to over 2000 ft.

Soils at the Wenatchee plant site and on the principal bench are primarily Aeneas fine sandy loam or Malaga sandy loam. The moderately permeable topsoil limits the application of irrigation water. To prevent surface runoff, the recommended application rate is less than 0.5 in. per hour. Most surface drainage returns to the Columbia River.

Most land in the area is zoned for general agriculture. Limitations on developing lands adjacent to the Columbia River are imposed by the Washington State Shorelines Management Act. A number of small residential areas have appeared north of the plant site toward Wenatchee and East Wenatchee, and down the Columbia River toward Quincy.

3.3.3 Hydrology

The Columbia River flows by the Wenatchee plant. Flows are moderated by temporary impoundment of river water between Rock Island Dam, sited one mile below the plant site (RM 453), and Rocky Reach Dam upstream above the city of Wenatchee (RM 474). Rock Island Dam was constructed in 1933. The resulting impoundment, Rock Island Pool, has a storage capacity of 130,000 acre ft (WDOE 1981). The impoundment is "river-run," and most of the water that enters the impoundment each day soon passes on downstream.

The entire mid-Columbia River is classified as "A" or "Excellent" by the state (Chapter 173-201 of the Washington Annotated Code, WDOE 1977). This classification requires that river water quality meet or exceed the requirements for all or substantially all societal uses, including those for domestic, industrial and agricultural water supplies.

The Wenatchee River enters the Rock Island Pool above the city of Wenatchee. A few smaller streams with limited or ephemeral flow drain from bluffs along the Columbia River and also enter the Rock Island Pool. In addition, there is some subsurface drainage seasonally to the pool from snowmelt during winter and irrigation during spring, summer, and fall.

Two small reservoirs, Meadow Lake and Cortez Lake, are 4.5 mi to the west, between the plant site and Wenatchee.

River flows at Rock Island Dam are variable and reflect releases of water further upriver at Grand Coulee Dam (RM 597). Lake Roosevelt, behind Grand Coulee Dam, has a storage capacity of 5.2 million acre ft, whereas the Rock Island Pool has a capacity of only 130,000 acre ft (PNRBC 1979). Releases of water at Grand Coulee trigger downstream flows through the entire reservoir system below

the dam. Flows at Rock Island Dam average about 110,000 cfs. Peak flow usually occurs from April to June and low flow in August (WSU 1982). River discharge patterns today show a small range between high and low flow as regulation for maximizing hydro power increases.

Because of releases at Grand Coulee Dam and the "flow-through" feature of downriver impoundments, water quality is generally similar throughout the mid-Columbia River system.

Alteration of water quality in the mid-Columbia River is probably within safe limits today, and water temperatures at Rock Island Dam are now probably lower than they were in the 1930s (Gould and Wedemeyer 1981). This is due, in part, to retention and release of seasonally cooler water from Lake Roosevelt behind Grand Coulee Dam (Jaske and Goebel 1967). Large amounts of river water are withdrawn and used in the Columbia Basin Irrigation Project, which now irrigates about 530,000 acres, or about half of the project's full estimated potential.

3.3.4 Meteorology

Wind data are taken at BPA's Columbia substation located at Rock Island Dam. Climatological data are for the city of Wenatchee, and were obtained from "Climatological Data for State of Washington," published by the U.S. Weather Bureau.[a]

Data compiled through 1976 show that winds blow 75 to 90% of the time near the plant site. About 45% of the time the winds blow from the north and about 15% from the northwest. Wind velocities are usually between 7 and 9 mph.

A wind rose for the Wenatchee area in 1984 is given in Figure 3.14. The prevailing wind direction was east by southeast, the average wind speed was 3.10 meters per second (m/s), and there were 1010 hours of calm winds (blowing less than 1 m/s) about 12% of the time during the year.

Up to 1974, there were no data on the air pollutants carbon monoxide, sulfur oxides, photochemical oxidants, hydrocarbons or nitrogen oxides in the vicinity of the Alcoa Wenatchee plant. However, data on particulates in ambient air were taken at three sites: two located 10.5 mi upriver from the plant at the cities of Wenatchee and East Wenatchee, and one located 2 mi downriver at Rock Island Dam.[a]

In 1974, the only existing point sources of air emission near the site were the Alcoa Wenatchee plant and the Hanna Mining Corporation's ferrosilicon plant at Rock Island. Hanna Mining Corporation reduced the levels of particulates released to ambient air before 1976 by installing environmental control equipment. The remaining emissions consisted primarily of silica and carbon.

(a) Aluminum Company of America (Alcoa). 1976. Environmental assessment of Alcoa aluminum plant at Wenatchee. Wenatchee, Washington.

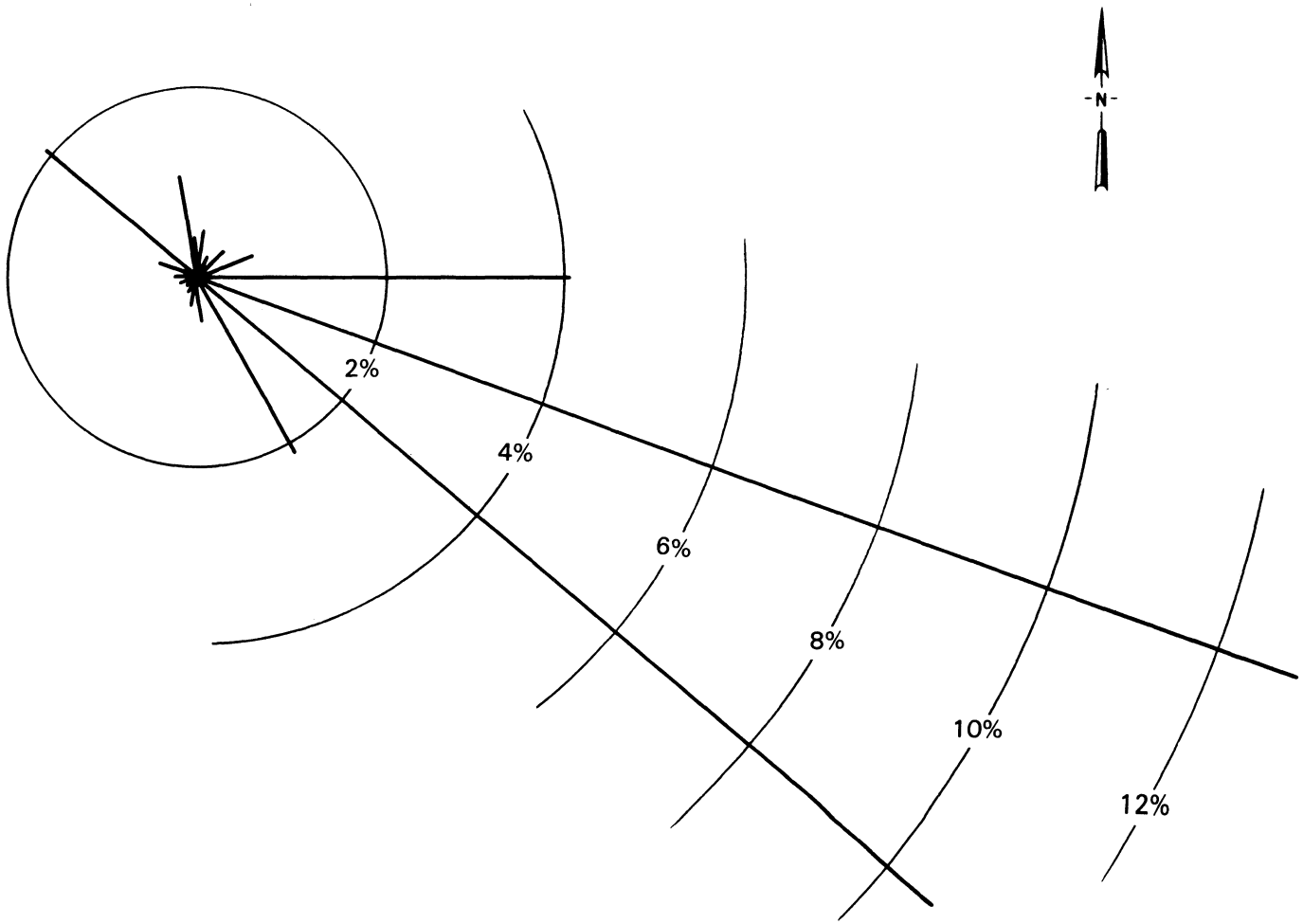

Figure 3.14
Wind Rose for the Wenatchee Area--1984
(% of time wind blows from the indicated direction)

The most significant source of suspended particulates near the Wenatchee plant site is wind-blown dust and dirt. Dust storms are common on the relatively high, flat area to the north and east. Wind data show that about 85% of the time the prevailing wind blows from the northwest quadrant. Suspended particulates are essentially the same 10.5 mi northwest at Wenatchee as they are 2 mi southeast at Rock Island.[a]

Annual average temperature over 39 years of record (1935 to 1974) is about 50°F; average maxima and minima are about 79°F and 22°F, respectively. Absolute monthly maximum and minimum air temperatures are 110°F and -29°F, respectively. The highest monthly average temperature is about 78°F (25°C) occurring in July, and the lowest monthly average is about 10°F (-12°C) occurring in January.[a]

Annual average precipitation over 40 years of record (1934 to 1974) is about 9 in.; maximum and minimum values have been almost 18 in. and 4 in., respectively. Most of the precipitation falls from December through January, the least in July and August.[a]

Annual average snowfall over 32 years of record (1942 to 1974) is almost 35 in.; maximum and minimum values have been 57 in. and 11 in., respectively. Most snow falls from November through March.[a]

3.3.5 Ecology

The major ecological characteristics of the Wenatchee plant site are described in two sections: terrestrial and aquatic. No endangered or threatened plant or animal species specific to the area have been identified. However, the site is within the nesting range of the American peregrine falcon, an endangered species (USFWS 1984).

3.3.5.1 Terrestrial

The site is characterized as in the "Upper Sonoran Zone," one of the seven major life zones occurring in Washington State. This zone includes the lowlands of the Columbia Basin that are extremely arid and support a shrub-steppe vegetation with various grasses and herbs growing among the shrubs (Highsmith and Kimerling 1979). Winters are mild and summers are long and hot, but there is little natural vegetation because of limited moisture. Most of the area is too dry for dryland farming, but the soils produce crops when fertilized and irrigated. This area is rapidly being modified for irrigated agriculture as the Columbia Basin Irrigation Project is expanded.

Generally, there are no naturally growing trees at lower elevations in the area. Further, ornamental vegetation, forage for wild browsing animals, and brush for wildlife shelters are limited. Native species of forage and brush grow primarily in crevices running downslope from higher elevations, which

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(a) Aluminum Company of America (Alcoa). 1976. Environmental assessment of Alcoa aluminum plant at Wenatchee. Wenatchee, Washington.

funnel runoff during periods of snowmelt and rainfall, or near the margins of permanent water such as the Columbia River.

Today, natural vegetation of the shrub-steppe region around the plant site exists primarily in areas unsuited for agriculture. However, some apparently natural plant associations have been modified by livestock grazing. Specifically, the natural vegetation around the plant site consists largely of big sagebrush, with an undercover of various grasses dominated by bluebunch wheatgrass. During the rainy season, the soil not covered by vascular plants supports a thin and fragile crust of mainly lichens, tiny acrocarpus mosses, and occasionally, liverworts (Daubenmire 1970). Soils cleared of natural vegetation often revert initially to dense stands of cheatgrass.

Because of better soil and irrigation, farms at lower elevations along this stretch of the Columbia River support a variety of crops. Fruit orchards (cherries, apples, apricots, pears), alfalfa fields and wheat fields are common on terraced areas. Because suitable land along the margin of the Columbia River is limited, most farms near the plant site are relatively small in acreage. Coniferous forests grow at higher elevations along the Colockum Ridge about 2 mi west and southwest of the plant site.

Native mammals characteristic of the big sagebrush/wheatgrass-cheatgrass association include coyote, badger, rabbits (blacktailed jackrabbit, white-tailed jackrabbit, cottontail and pigmy rabbit), chipmunk (where rock rubble is nearby), and various species of mice (Daubenmire 1970).

Along the Columbia River above Rock Island Dam (Rock Island Pool), riparian habitat occurs along 60% of the reservoir shoreline and along 75% of the island shoreline (Tabor 1976b). The reservoir, the oldest on the mid-Columbia River, has a good diversity of established riparian plants, including several stands of willows and cottonwood growing in the silt deposits. Grasses grow along the river in the low-high water zone or close to it. The few islands in the Rock Island Pool are mostly the result of railroad grade cuts along the older, now-flooded right-of-way; these islands generally have steep rock banks and a dense scrub cover.

Canada geese nest along the Rock Island Pool, most often on Rock Island just above the dam (Tabor 1976b); except for a few mallards, other nesting waterfowl are uncommon. However, many waterfowl use the Rock Island Pool during the winter. The Canada geese and mallards are most abundant, but numerous other species have been identified on the impoundment, including loons, grebes, great blue heron, whistling swan, pintail, green-winged teal, wigeon, redhead canvasback, scaup, goldeneyes, bufflehead, mergansers, coot, and white pelican (Tabor 1976b). California, ring-billed and herring gulls occur along the upper Columbia River most of the year and are common during late fall and winter. Upland gamebirds present along the margin of the Rock Island Pool include ringneck pheasant, California quail, chukar and mourning dove (Tabor 1976b).

Larger mammals and fur bearers occurring along the Rock Island Pool include mink, muskrat, racoon, coyote, badger, skunk, porcupine, mule deer and bobcat (uncommon) (Tabor 1976b).

Raptors (birds of prey) reported along the Rock Island Pool include red-tailed hawk, Cooper's hawk, bald eagle, osprey and American kestrel (Tabor 1976b), but other species of raptors are likely present during some seasons. The bald eagle and osprey depend on fish in the reservoir for their food supply.

Numerous species of small mammals, nongame birds, reptiles and amphibians are associated with riparian areas along the Rocky Reach Pool (Tabor 1976b). None of these are listed as endangered or threatened species (USFWS 1984).

3.3.5.2 Aquatic

Species of fish that occur between Rock Island and Rocky Reach dams are generally those common to the impounded Columbia River. They include anadromous fish such as salmonids (salmon and steelhead) that pass through the Rock Island Pool during annual upstream and downstream migrations, and resident fish that stay there the year round. The resident fish include native species, representing original fauna of the Columbia River ecosystem, and introduced species that became abundant after introduction by man.

Anadromous salmonids are economically valuable to the sport, commercial and Native American fisheries of the lower Columbia River. At the present time, most runs to the Columbia River reflect reduced population levels. Only runs of chinook salmon, sockeye salmon, a few coho salmon and steelhead penetrate upstream past Priest Rapids Dam (RM 397) to the Rock Island Pool and above. State and federal hatcheries are operated above the city of Wenatchee to maintain upriver runs (Kaczynski and Moos 1979; Mullan 1982, 1984a, 1984b).

Management practices strongly affect the status of salmonid runs to this stretch of the Columbia River today (Becker 1985). Nearly all adult fall chinook salmon migrating upriver to spawn are now trapped downstream at Priest Rapids Dam for hatchery-rearing programs. Spring chinook salmon are reared and released at three federal hatcheries (Leavenworth, Entiat, and Methow) above the Rock Island Pool, but some spawn naturally in the Wenatchee, Entiat and Methow rivers. Runs of summer chinook salmon are limited, but some fish still spawn in tributaries above Rock Island. Upriver runs of coho salmon are depressed, and introduction of hatchery fish was curtailed in 1976. Runs of red salmon are maintained entirely by natural spawning above Rock Island Dam in Lakes Wenatchee and Osoyoos (Mullan 1984b), and the population has recently increased. Steelhead are produced in hatcheries and spawn naturally in upriver tributary streams.

Counts of adult salmonids over Rock Island Dam for the last five years are given in Table 3.4.

Juvenile salmonids emigrate downstream through the Rock Island Pool annually during spring and summer, with the majority passing in April and May. Population levels vary from year to year with success of natural spawning and releases from the Leavenworth, Entiat, Methow (federal), Rocky Reach and Wells Dam (state) hatcheries. The out-migration path is primarily through the upper layers of Rock Island Pool.

Table 3.4
Counts of Adult Salmonids Migrating Upstream at Rock Island Dam, 1980 to 1984. (Data Supplied by Grant County Public Utility District No. 2.)

Year	Species				Total
	Chinook	Coho	Sockeye	Steelhead	
1980	26,996	783	52,657	7,017	87,453
1981	20,710	826	47,139	7,512	76,187
1982	23,940	1,915	41,111	9,879	76,845
1983	23,608	260	86,424	29,666	139,958
1984	37,041	2,179	109,074	25,096	173,390

Most native species of fish in the Columbia River above and below Rock Island Dam are of limited sport or commercial value. The native fish include suckers, squawfish, peamouth, chiselmouth, chubs, minnows, dace and sculpins (Ericksen et al. 1977; Stober et al. 1979). However, cutthroat trout, rainbow trout, and mountain whitefish are native fish sought by sport fishermen.

Several introduced species are sport fish in this region of the Columbia River. The list includes largemouth and smallmouth bass, yellow perch, walleye, channel catfish, bullheads, crappie and bluegill.

3.4 PUGET SOUND AREA

Two primary aluminum plants are located in the Puget Sound area of Washington State. The Kaiser Tacoma works, which was constructed during the early 1940s, is located on the southern portion of Puget Sound in Pierce County. The Intalco aluminum plant, built in 1967, is located north of the Sound in Whatcom County. Figure 3.15 shows the location of the plants with respect to Puget Sound.

3.4.1 Kaiser Aluminum at Tacoma

3.4.1.1 Site Location and Layout

The Kaiser Tacoma works is located on an 88-acre site in an industrial area within the limits of the city of Tacoma. Figure 3.16 shows the surrounding area. Nearby industry includes port-oriented loading and unloading facilities as well as chemicals, building materials and lumber.

The site plot plan, Figure 3.17, shows the layout of the plant facilities with respect to waterways and port facilities. Two domes for storing alumina are owned by the Port of Tacoma but are located about 3 mi from the Kaiser plant.

3.4.1.2 Geography

The plant is located on reclaimed tidal flats along Commencement Bay at the end of the Puyallup River Valley. The reclaimed land is fill dredged from the

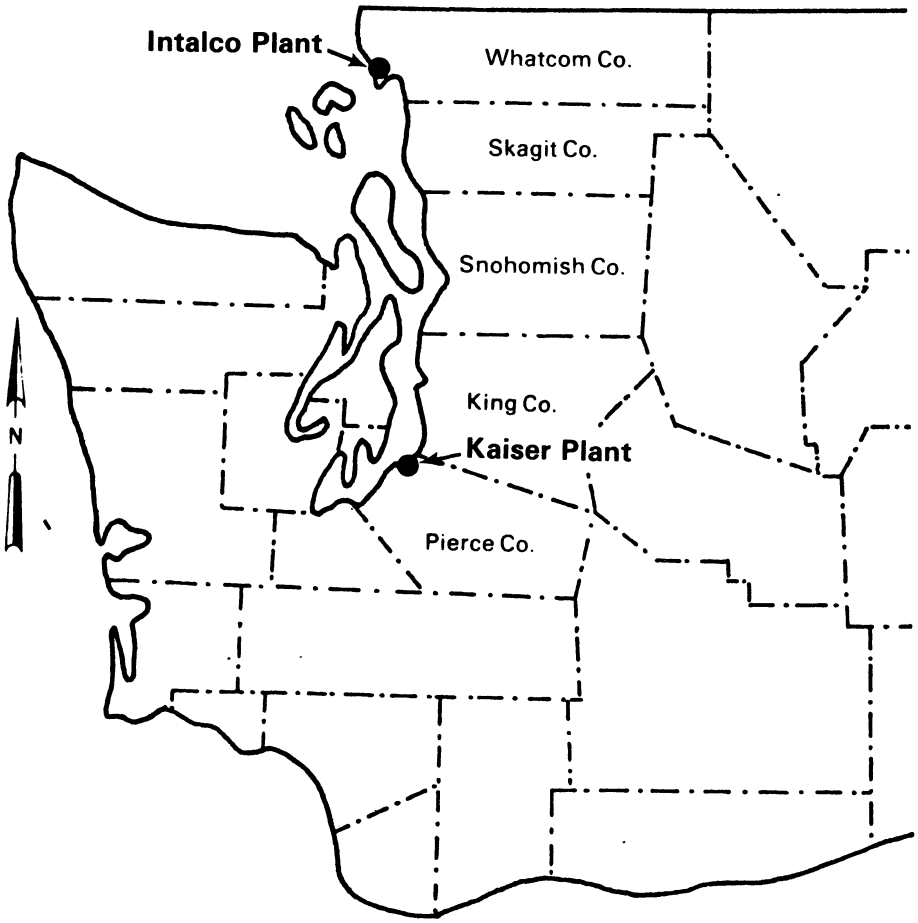

Figure 3.15
Location of the Kaiser (Tacoma) and Intalco (Ferndale) Facilities

Sound and has no natural features. The plant is located between two ship channels: the Hylebos Waterway to the north and the Blair Waterway to the south. The Puyallup River, with headwaters on Mt. Rainier, runs in a southeast to northwest direction as it joins Puget Sound. The valley floor, which is at or near sea level, is approximately two miles wide. To the north and northeast and to the south and southwest are elevations which rise up to 500 ft above the valley floor.

3.4.1.3 Hydrology

Plant water is obtained from two deep wells on plant property. The wells, which are screened at depths in the range of 600 to 700 and 900 ft, provide yearly average flows of 900 and 300 gallons per minute (gpm), respectively (Dames and Moore 1985). Near-surface groundwater is brackish, contaminated from numerous industrial activities in the area, and is not used as a water source. Plant supply is adequate for present and anticipated water requirements. No pretreatment is required for plant use.

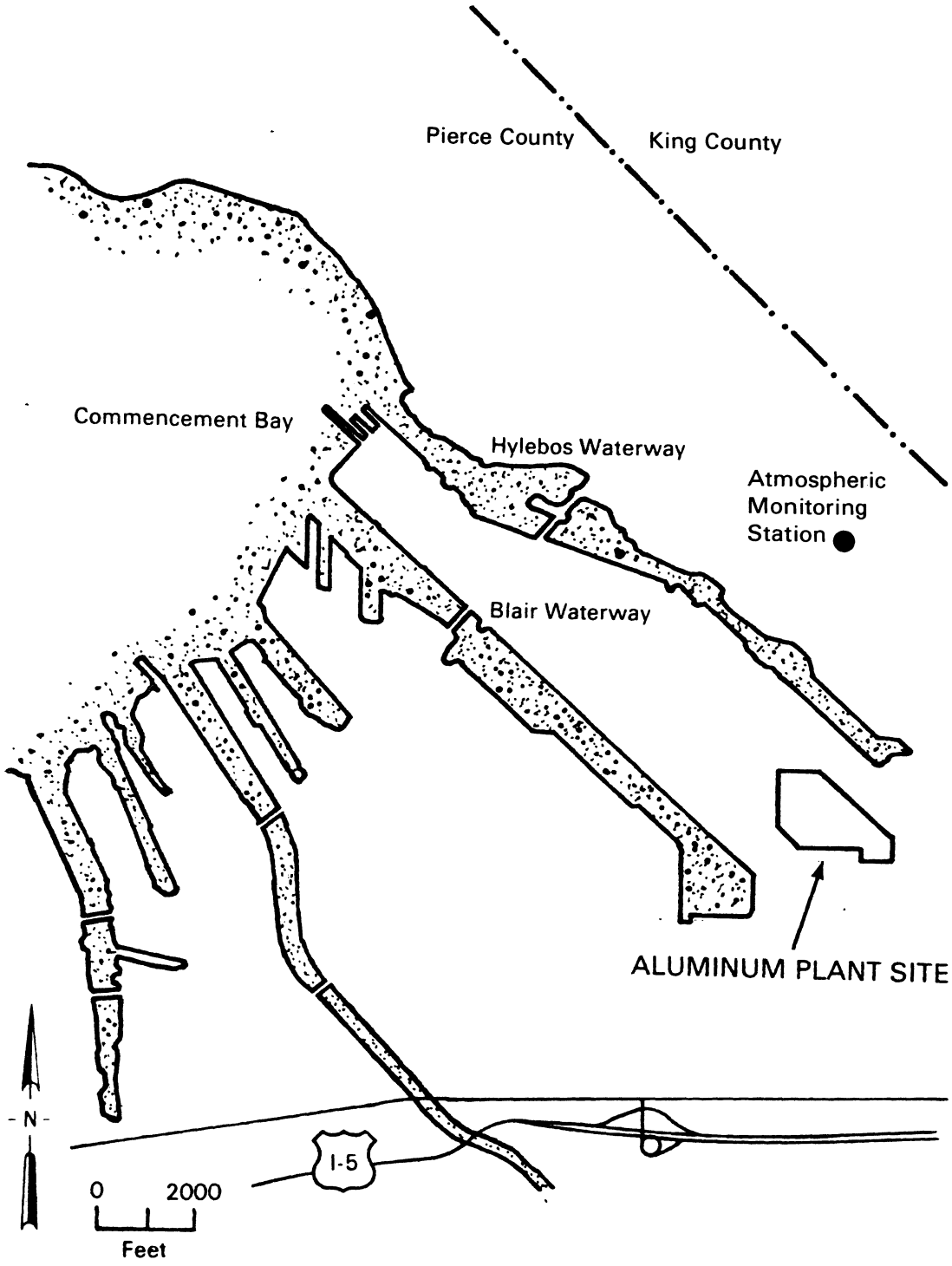

Figure 3.16
Kaiser Aluminum Tacoma Plant and Vicinity

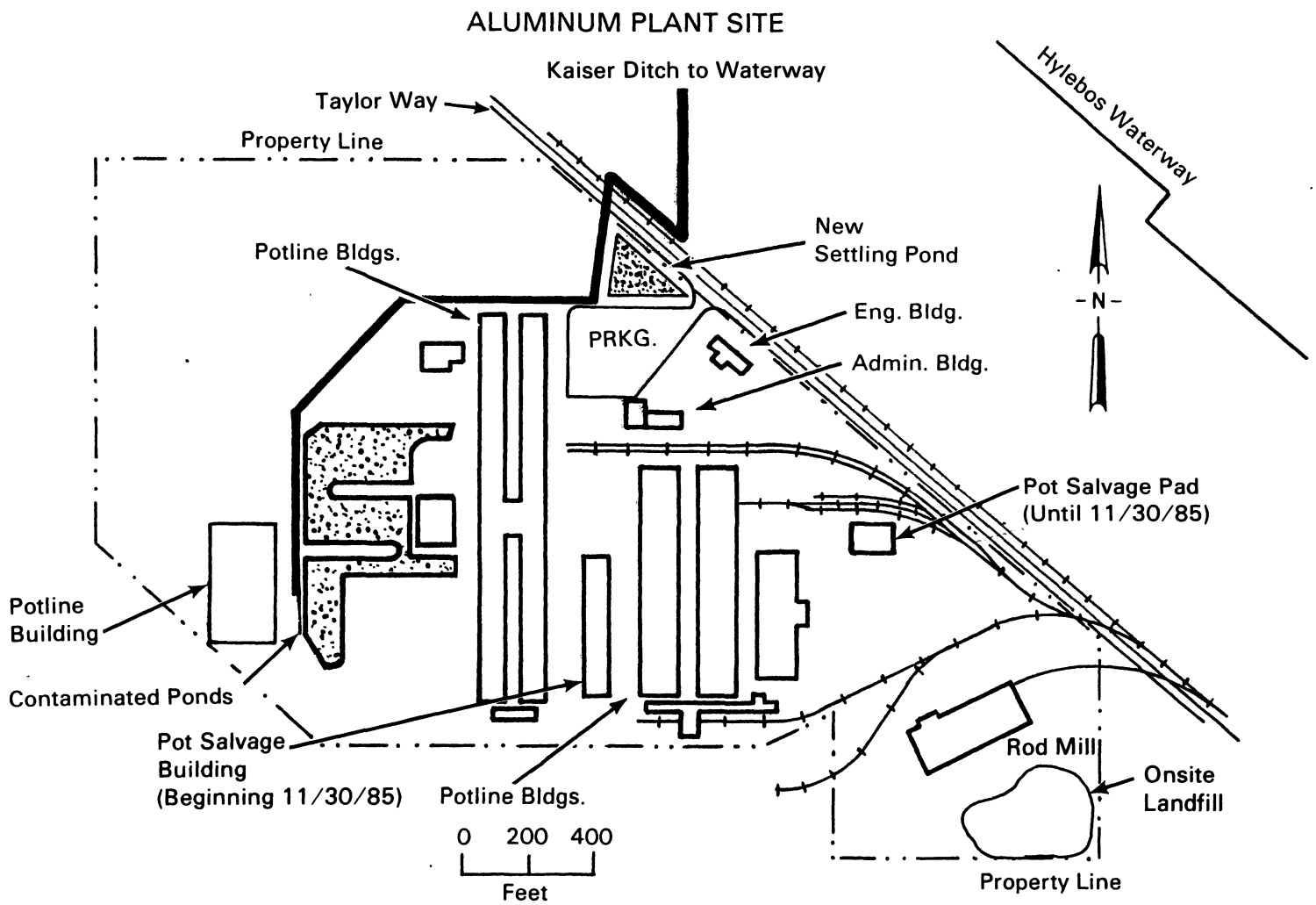

Figure 3.17
Site Plot Plan: Kaiser at Tacoma

The nearest surface water is the Hylebos Waterway, a tidal basin, into which the plant discharges waste waters via the Kaiser ditch under an NPDES permit. Current treatment of cyanide-bearing waste waters does not meet requirements of the new NPDES permit. A WDOE regulatory order requires compliance by January 1, 1986. For this reason, Kaiser is converting to "dry digging" which requires no water to remove potliners. Sanitary wastes are discharged untreated into the local sanitary sewer system.

3.4.1.4 Meteorology

Meteorological data were compiled from both Kaiser's onsite and backup monitoring stations (no longer operating). An annual summary of wind direction and velocity for 1981 from the onsite station shows the predominant wind directions are south-southeast, south and southeast at the plant site.[a] Local terrain effects are evident during low-velocity periods, channeling down the tidal flats and over Commencement Bay.

A large area in Tacoma's industrial tide flat area exceeds the federal primary standards for total suspended particulates (TSP) and is designated as a non-attainment area (NAA). The plant is outside a small corridor of downtown Tacoma that exceeds the federal and state eight-hours ambient air standard for CO (10 mg/m3).[a]

3.4.1.5 Ecology

Terrestrial. In the near vicinity of the plant site, natural conditions have been highly disturbed by dredge-filling of the mud flats and by farming and residential development. Rushes, sedges and other wetland species have invaded the undisturbed fill and dikes used to retain the fill. Mixed conifers and hardwoods occur on the steep slopes east and northeast of the plant site and on the rough terrain of the elevations. No sensitive species occur in the vicinity of the plant site (Kaiser 1976). There is a limited amount of agriculture within five miles of the plant.

A small flock of migratory geese returns each year to the retention basin through which plant waste waters flow. There is probably little other wildlife residing in this highly industrialized area.

Marine. The Commencement Bay Superfund site includes several waterways and shoreline. The Hylebos Waterway in the vicinity of Kaiser Aluminum has been designated a high priority area based on sediment chemistry and toxicity, bioaccumulation, and benthic community structure (Tetra Tech 1985).

(a) Kaiser Aluminum and Chemical Corporation. 1984. Hazardous Waste Management Plan. Tacoma, Washington.

3.4.2 Intalco Aluminum at Ferndale

3.4.2.1 Site Location and Layout

The Intalco plant site is located 13 mi northwest of Bellingham, the largest city in Whatcom County, and about 7 mi west of Ferndale. Whatcom County is the most northwestern county in Washington State. It is bordered on the north by Canada and on the west by the Strait of Georgia (Pacific Ocean) (Figure 3.18).

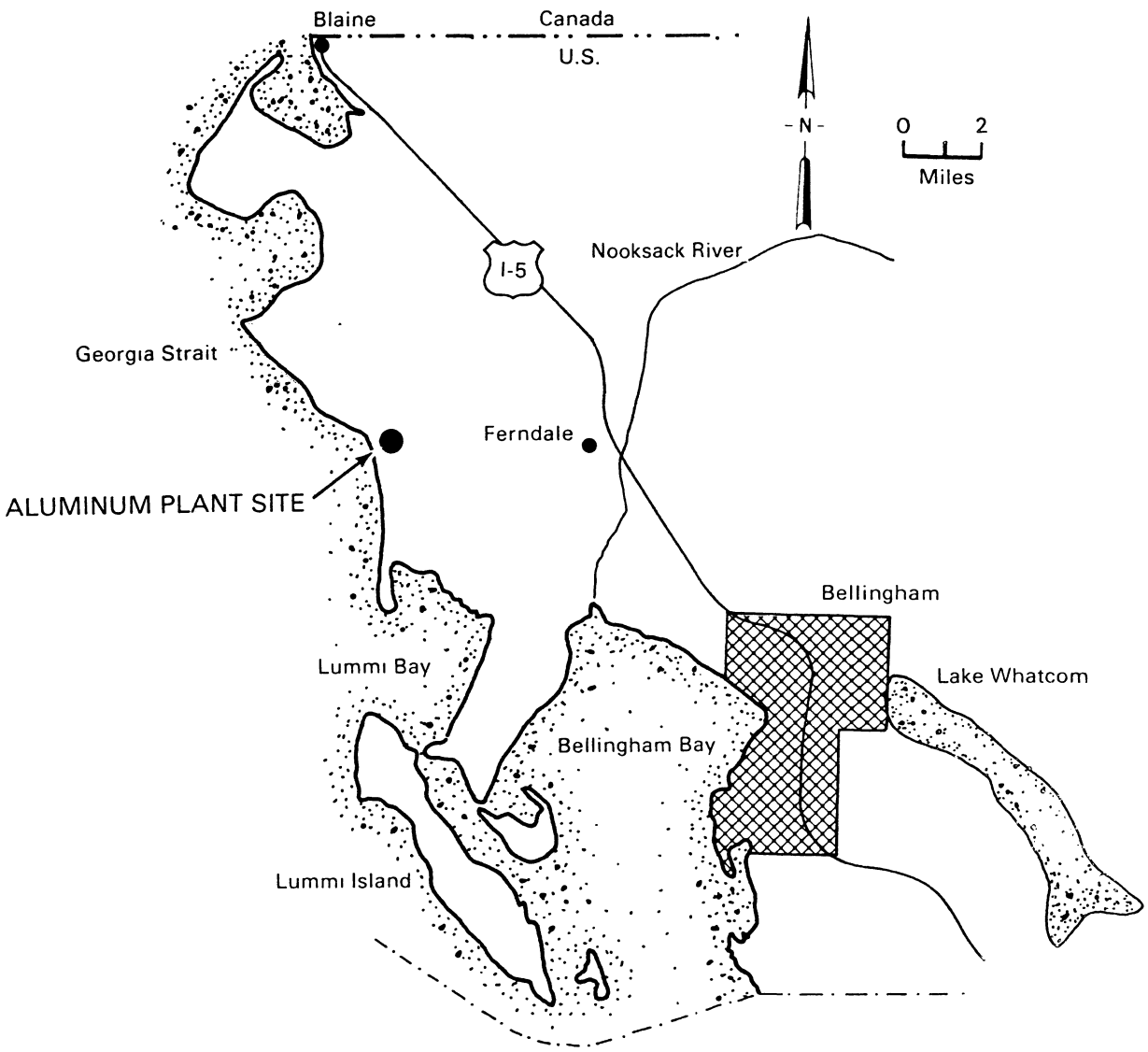

Figure 3.18
Intalco Aluminum Plant and Vicinity

The Intalco plant is located in the Cherry Point industrial area, which is zoned for heavy impact industrial. The 1300-acre plant site is bounded by an Atlantic Richfield refinery to the north and by a Mobil refinery to the

south. The 330-acre, fenced area contains the major buildings except the alumina storage silos; Figure 3.19 shows the site plot plan.

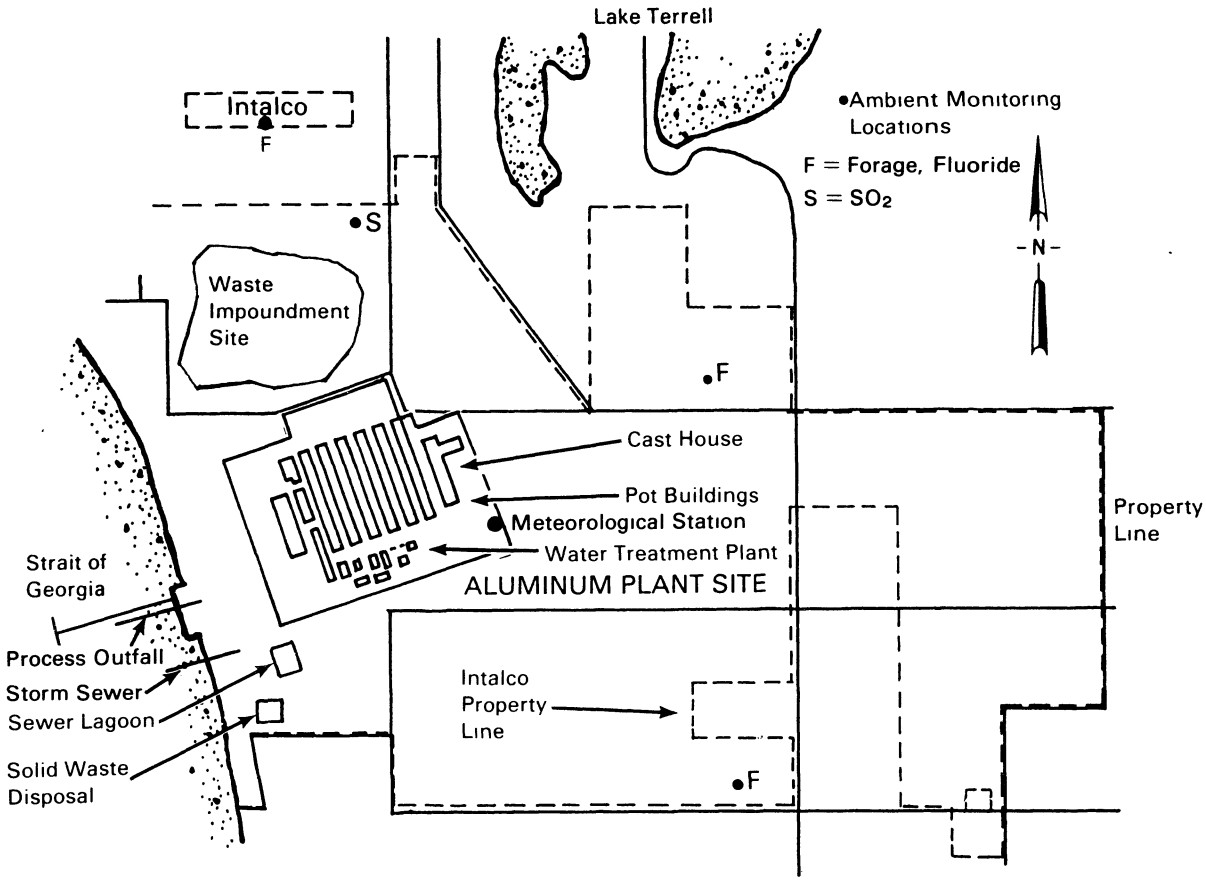

Figure 3.19
Site Plot Plan: Intalco at Ferndale

3.4.2.2 Geography

Whatcom County has a saltwater coastline roughly 100 mi long. In sharp contrast to the lowlands in the western section of the county, the Cascade Mountain Range looms up in the eastern section of the county. Mount Baker, about 50 mi away, rises to an elevation of 10,750 ft above sea level.

Whatcom County's coast has a direct western exposure to the Georgia Strait and runs northwest to southeast. The shoreline is sea cliff with a narrow beach. The Intalco pier is located on tidelands leased from the state. The area on top of the bank, where the plant buildings are located, has a gentle slope to the east. The plant is southwest of Lake Terrell, a small lake covering approximately 440 acres. The Nooksack River is located 7 miles east, bordering the town of Ferndale.

3.4.2.3 Hydrology

The Intalco plant site is supplied with water from the Nooksack River. The pumping and pretreatment plant is owned by Whatcom County P.U.D. #1. The town of Ferndale draws water from the same source. Prior to installation of the water treatment plant for the city (1975), the town water supply was dependent upon local wells. Other residents outside the city service area still depend on wells for their potable water supply (Intalco Aluminum 1976). There is one regionally extensive aquifer beneath the upland adjacent to the Intalco site. This aquifer occurs near sea level (about 210 ft deep at the site). It is the only aquifer capable of supplying domestic or industrial supplies. All domestic wells in the vicinity of the plant obtain water from this aquifer. Limited discontinuous "perched" aquifers are restricted in area and have seasonal water-yield potential.[a]

Intalco has a sewer treatment lagoon located just southwest of the plant buildings (Figure 3.19). Sanitary wastes are oxidized by an aeration system. The effluent is chlorinated and discharged into the process outfall system. Treated storm water and process effluents flow directly into the Georgia Straits. No other body of water is affected by any outfall water.

3.4.2.4 Meteorology

Meteorological conditions are very similar for the entire western portion of Whatcom County, and ambient air quality is generally excellent. Wind rose data (taken at the plant site) indicate that the dominant wind direction appears to be from the south-southeast (Intalco Aluminum 1976). A weather station on the plant site (see Figure 3.19) collects 15-minute averages of wind speed and direction at two tower levels, plus temperature, dew point and rainfall.[b]

3.4.2.5 Ecology

The major ecological characteristics of the Ferndale plant site are described in two sections: terrestrial and marine (Intalco Aluminum 1976). No endangered fish or wildlife have been identified at the site.

Terrestrial. The nonindustrial area around the plant site has few trees, since it was at one time or another cleared for farming. This is true of a good deal of the land between Cherry Point and Ferndale. Intalco property has some forested areas, and there are some other similar isolated sections scattered

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(a) Shannon & Wilson, Inc. 1983. Waste Site Impoundment Area Groundwater Investigation, Phase 3 Report. Prepared for Intalco Aluminum Corporation, Ferndale, Washington, by Shannon & Wilson, Inc., Geotechnical Consultants, Seattle, Washington.

(b) Intalco Aluminum Corporation. 1985. Technical Memo: Environmental Data Related to Aluminum Smelter Operations. TM-44-85, Intalco Aluminum, Ferndale, Washington.

throughout the region, especially on the industrial and development property to the north. The Lake Terrell Wildlife Recreation Area maintains a relatively large area of forested land.

The predominant tree species in the area include such conifers as Douglas fir, western red cedar and western hemlock. The primary deciduous varieties are maple, alder, birch and cottonwood. The groundstory is mainly ferns and mosses in the second-growth forest area with reed-canary grass, orchard grass, wild fescue grass and similar species growing elsewhere. The understory consists mainly of salal, Oregon grape, spirea, and berry bushes.

Refuges in the vicinity of Intalco include Lake Terrell Wildlife Recreation Area and Lake Tennant Wildlife Recreation Area. This section of the country is part of the Pacific Flyway. Lake Terrell is one of the first stopping points for waterfowl on their southern migration coming out of the Fraser River delta in Canada. Nesting areas include Lake Terrell, Lake Tennant, and the Nooksack River delta. Game birds in the area include quail, ring-neck pheasant, partridge and grouse.

Terrestrial animals seen in the area are the blacktail deer, black bear, raccoon, skunk, opossum, beaver, red and gray fox, river otter, mink, weasel, muskrat, bobcat, coyote and cougar.

Marine. Data compiled by the Washington State Department of Fisheries show the following marine fish are common in the Georgia Straits (which is adjacent to the plant site): flounder, salmon, dogfish, ling cod, Pacific hake, sole, cod, ratfish, skates, sablefish, herring and walleye pollock. The more stable rocks in the shallow waters provide attachment for barnacles and mussels. Clams and crabs are also seen near the shore.

3.5 NORTHEASTERN WASHINGTON

Kaiser owns and operates one primary aluminum production plant in the Spokane area.

3.5.1 Site Location and Layout

The Kaiser reduction plant is located in the vicinity of the unincorporated town of Mead, on the northern edge of the city of Spokane on the Spokane River Valley floor (Figure 3.20), at an elevation of approximately 2000 ft. The Kaiser plant occupies 37 fenced acres on a total site of 1135 acres. The unfenced portion of the site is used as a buffer zone. Feed material is delivered to the site by a spur of the Burlington Northern railroad. A site plot plan (Figure 3.21) shows a schematic of several Kaiser plant facilities, as well as some facilities that are environmentally important.

3.5.2 Geography

Spokane County is split by the Spokane River, which flows west from its source in Lake Coeur d'Alene, across the county and through the city of Spokane, flowing northwest until it empties into the Columbia River. The floor of the

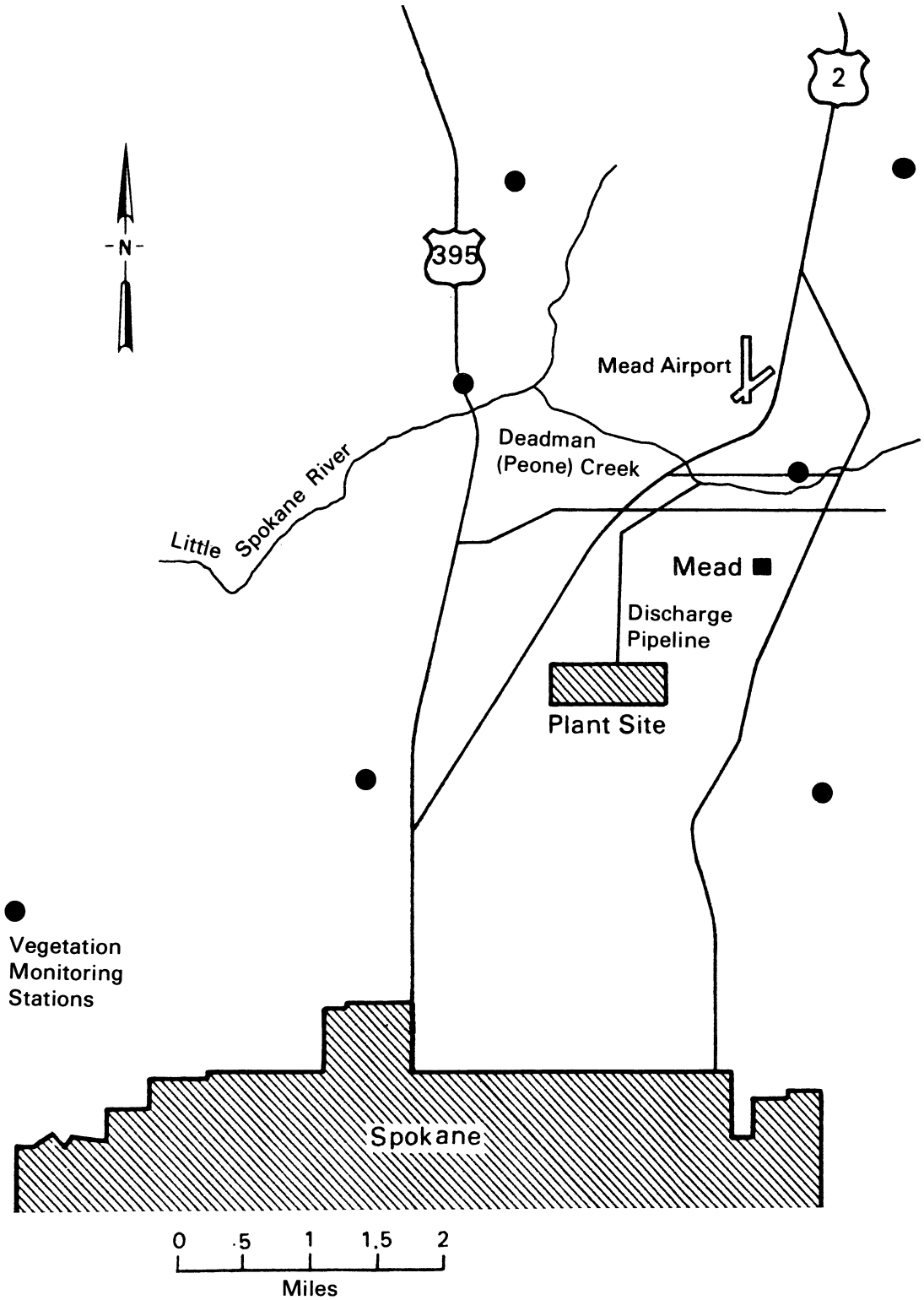

Figure 3.20
Kaiser (Mead) Plant and Vicinity

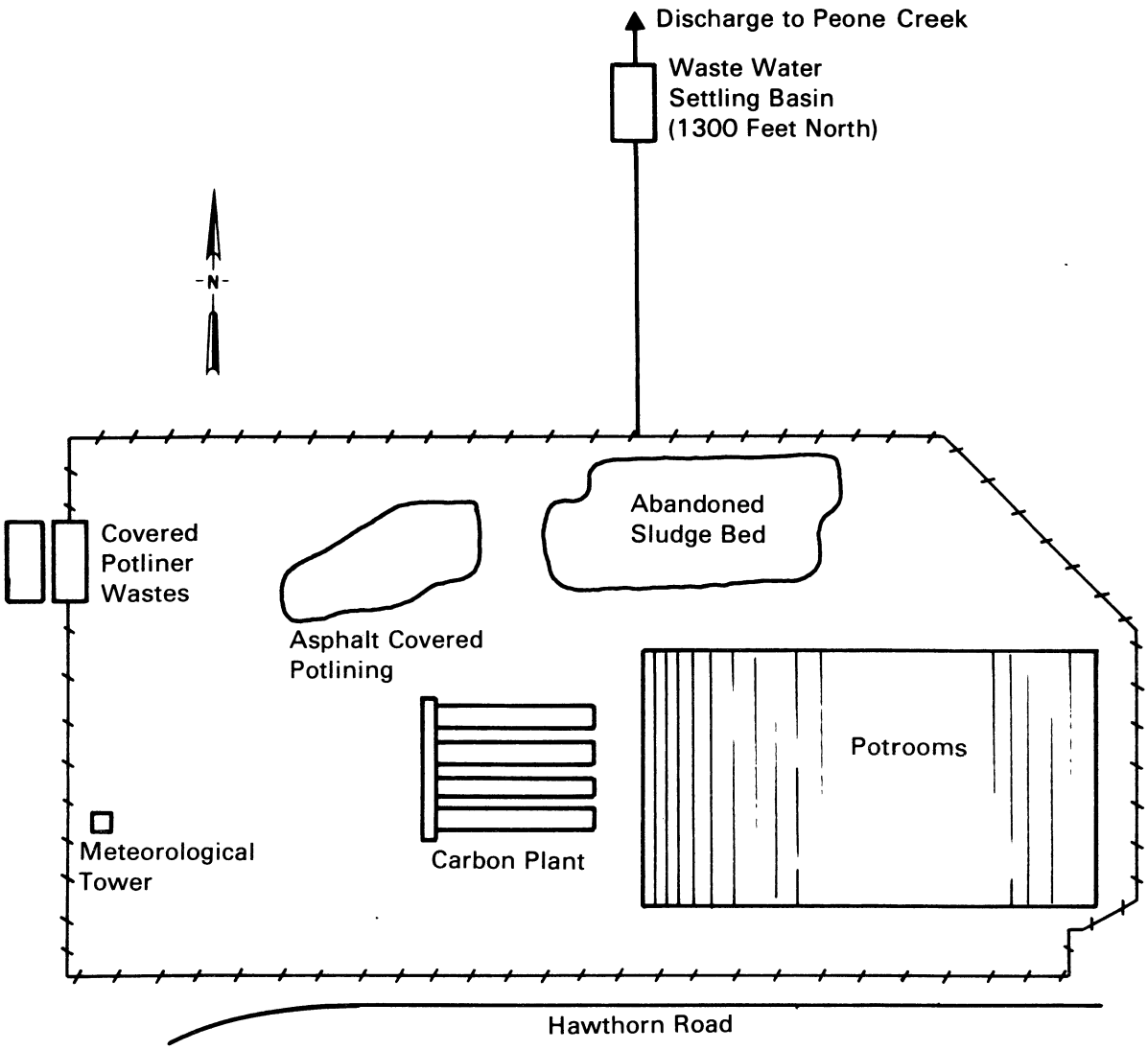

Figure 3.21
Site Plot Plan: Kaiser at Mead

Spokane River Valley is characterized mainly by black volcanic rock, basalt, and the valley itself is a part of the vast, channeled scablands of eastern Washington.

The county is generally composed of and bordered by plateaus, rolling hills, plains and mountains. Emanating from the city of Spokane to the north are plateaus rising in elevation to the foothills of Mt. Spokane. To the east, the valley widens into Rathdrum Prairie bounded by the Selkirk Mountains. To the west, there are more plateaus with a gradual downward sloping to the Columbia River. To the south and out of the valley, there are more plateaus and rolling flatlands. There are 76 lakes within a 50-mi radius of the city of Spokane.

3.5.3 Hydrology

Peone Creek, also known as Deadman Creek, is located north of the plant site. Both domestic and industrial waste water from the plant are discharged to Peone Creek after treatment to ensure that it meets discharge standards. Only limited data have been found on the flow rate or water quality of Peone Creek or the water quality of the Little Spokane River into which it discharges.[a]

3.5.4 Meteorology

Wind speed and direction data are measured at a meteorological station located on the plant site (Figure 3.21). The predominant wind is from the southwest in the winter and the northwest in the summer with an average speed of 2 to 5 mph.

3.5.5 Ecology

Native stands of forest trees are diverse in location and species distribution due to the diversity of habitats. In the near vicinity of the plant, a combination of land development and soil conditions accounts for the scattered and poorly developed stands of ponderosa pine and lesser numbers of other coniferous species. At greater distances, land-use patterns are responsible for forest tree distribution; for the most part, trees occur on lands not presently suitable for development for agricultural, residential, commercial or industrial use. In the near vicinity of the plant, natural vegetation has been disturbed by man's activities. Scattered trees and small stands of native trees occur only in areas presently undeveloped and are relatively poor due to soil conditions. Mixed grasses, forbes and shrubby perennials make up the ground cover. Ornamentals are cultivated on the plant site and around various industrial buildings on adjacent sites as well as in residential areas.

The only information on aquatic ecosystems in the area is contained in a report by Hartung and Meier[a] who conducted an ecological survey of the Little Spokane River, which receives Peone Creek and subsurface inputs of leached cyanide wastes from the plant. They present information on fish and invertebrate populations. The more abundant fish species include rainbow trout, whitefish, carp, chiselmouth, redside shiner, northern squawfish, sucker, yellow perch and mottled sculpin. No information is available concerning threatened or endangered species, although it is highly unlikely that any occur on the plant site.

3.6 WESTERN MONTANA

The Columbia Falls Aluminum Company (CFAC) owns and operates a primary aluminum reduction plant near Columbia Falls, Montana.

(a) Hartung, R. and P. G. Meier. 1980. Ecological Survey of the Little Spokane River in Relation to Cyanide Inputs. Unpublished research report for Kaiser Aluminum Company, Spokane, Washington.

3.6.1 Site Location and Layout

The CFAC plant lies just east of the town of Columbia Falls on a site 1000 ft north of the main stream of the Flathead River and west of Teakettle Mountain in the Whitefish Mountain Range. The site is shown in Figure 3.22 with respect to waterways and major highways. The plant site is located 8 mi southwest of Glacier National Park. In essence, the plant lies on the geographic site named by the Indians, the flat head of the valley just west of the Continental Divide. The site consists of 184 acres within a total plant site of 543 acres. The plant is in Flathead County, which is bordered on the south by the Flathead River, on the west by Lincoln County, and on the north by Canada. The site plot plan (Figure 3.23) shows the layout of the major plant facilities and associated waste disposal areas.

3.6.2 Geography

The CFAC plant lies at the head of a broad mountain valley, at about 3000 ft elevation, with mountains to the east, forest land to the north and northwest, and agricultural land west and south. The valley is traversed by highways and rivers. To the east of the CFAC site are the approach foothills and mountains reaching the Continental Divide. The Flathead River at the site flows through Bad Rock Canyon, a pioneer approach to Marias Pass. The main stem of the Flathead River starts about a mile east of the site where the South Fork of the Flathead River joins the river. The other two segments, the North Fork and the Middle Fork, merge about 7 mi upstream. The Flathead River is included in the National Wild and Scenic Rivers System. Further up the canyon is the western entry to Glacier National Park at West Glacier, some 15 road mi from Columbia Falls. To the north is the approach to the North Fork of the Flathead River with the road following the river valley to the border station crossing at Trail Creek. This is one of the main timber harvest areas in Flathead County. To the west is the community of Columbia Falls and two highways leading to the neighboring community of Whitefish. To the south are two major highways which meet in Kalispell, the county seat.

3.6.3 Hydrology

The drainage area of Flathead Lake at Polson encompasses approximately 7010 sq mi in Montana and Canada. The North Fork of the Flathead River at the international border has a drainage area of about 450 sq mi in Canada, with an additional 175 sq mi of drainage in Canada that flows into tributaries that enter the North Fork below the border. Of approximately 6375 sq mi of the drainage in Montana, 4440 are in Flathead County and 850 are in Lake County. Powell, Missoula, Lincoln, and Lewis and Clark Counties contain about 425, 410, 90 and 65 sq mi of the Flathead drainage, respectively. All of Glacier Park west of the divide, or 875 sq mi, and most of the Flathead National Forest's 3680 sq mi are located in the drainage. The major rivers include the South, North and Middle Forks of the Flathead River, which join to form the Flathead River at Columbia Falls, Montana. The Whitefish and Stillwater Rivers merge and empty into the Flathead River below Kalispell. Some physical-chemical data on the Flathead River are presented in Table 3.5.

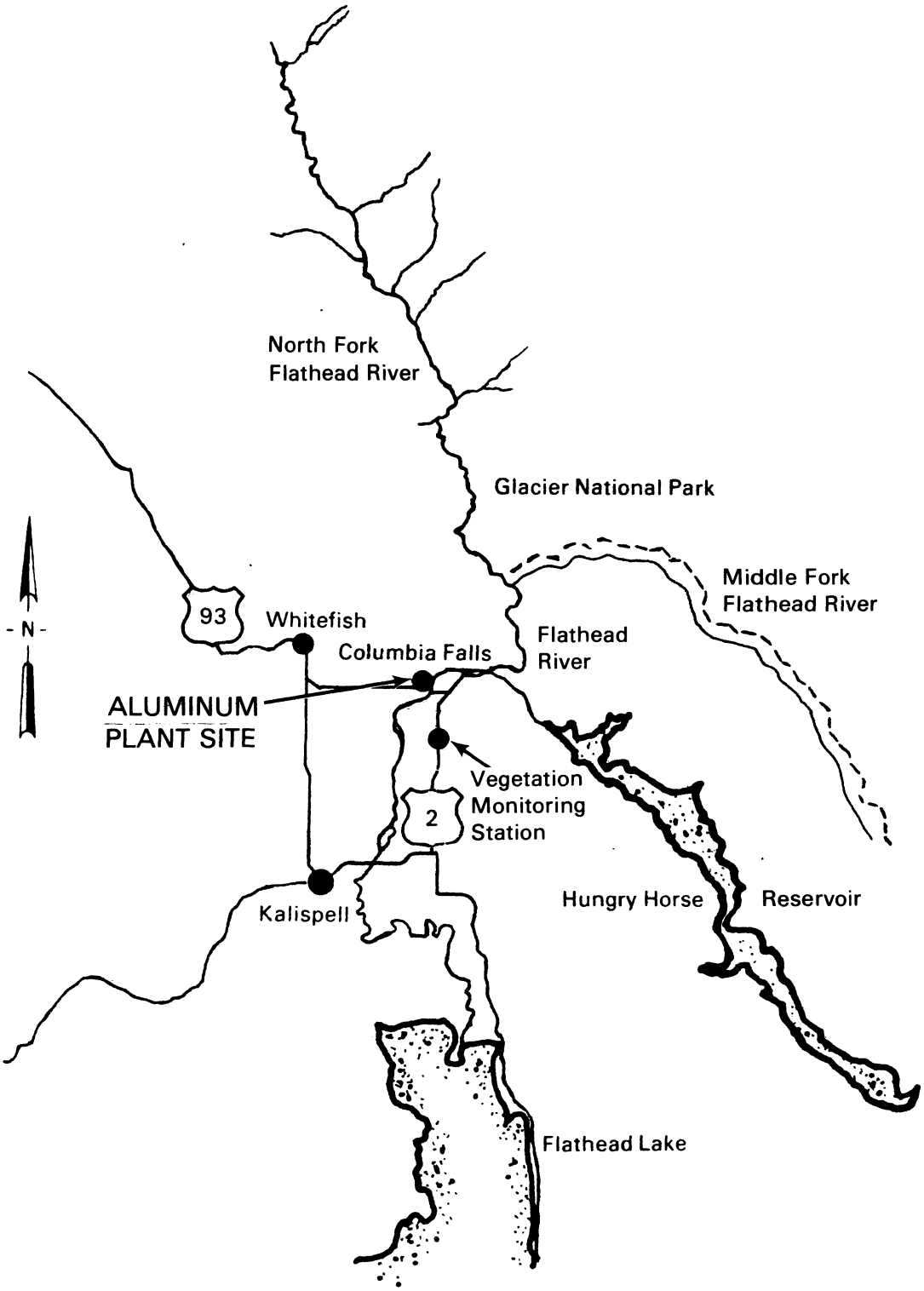

Figure 3.22
Columbia Falls Aluminum Company Plant and Vicinity

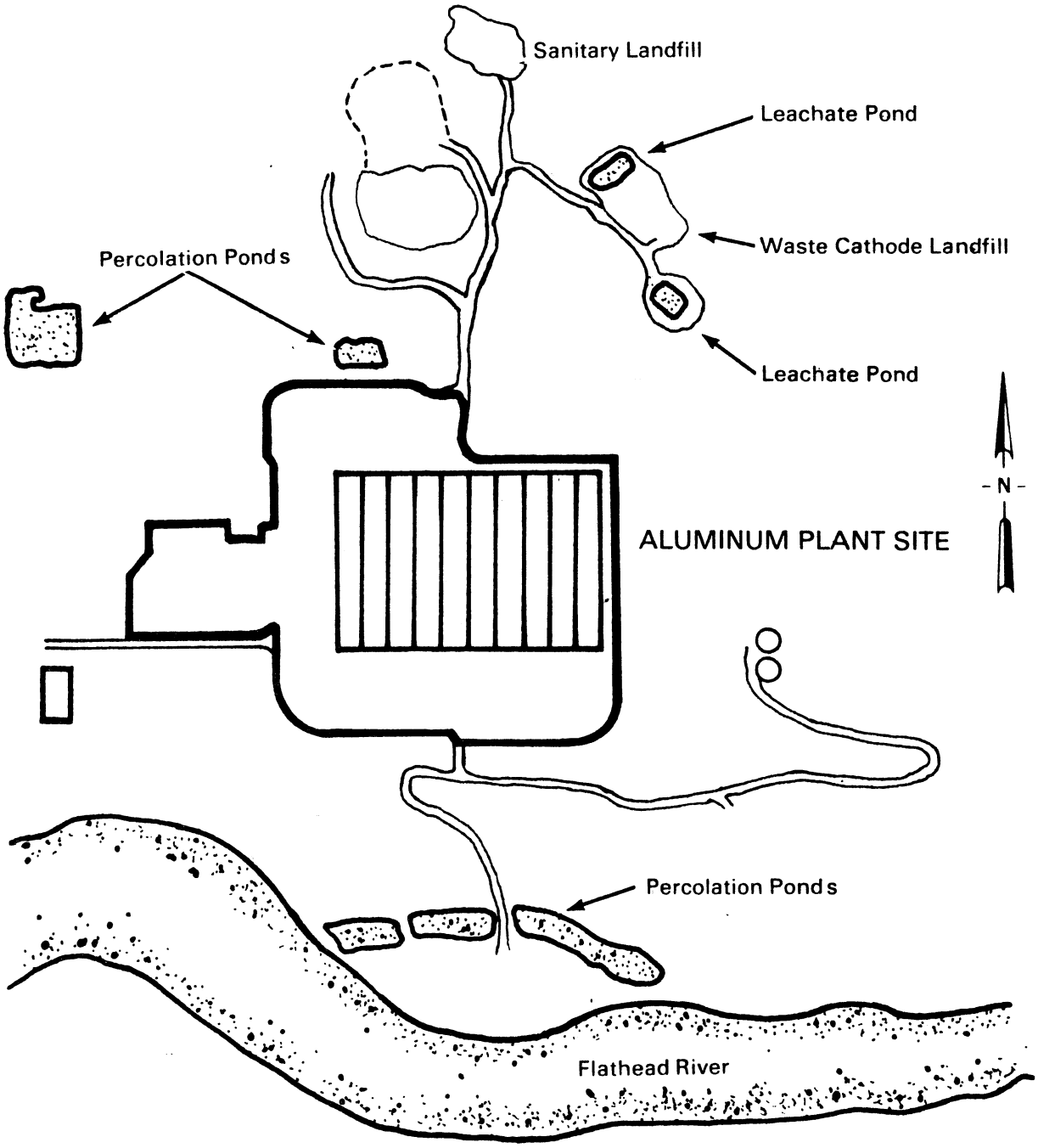

Figure 3.23
Site Plot Plan: Columbia Falls Aluminum Company at Columbia Falls

Table 3.5
Physical-Chemical Characteristics of the Flathead River

Component	Characteristics
Mean annual discharge[a]	8,490 $m^3 \times 10^6$
Total phosphorus	22.7 µg P/L
Dissolved inorganic phosphorus	1.35 µg P/L
Nitrate	61.3 µg N/L
Total Kjedahl nitrogen	83.1 µg N/L
Calcium	22.7 mg Ca/L
Magnesium	5.69 mg Mg/L

(a) At Columbia Falls; all chemical data at mouth of Flathead River.

3.6.4 Meteorology

The local air shed encompasses the northern portion of the Flathead Valley in northwest Montana. The valley is bordered on the east by high mountains (the Continental Divide is approximately 40 mi east of the plant site) and on the west and north by lower mountains. The prevailing wind at Columbia Falls is from the south, influenced mainly by the thermal effects of Flathead Lake.

During winter storm periods, wind gusts up to 45 mph have been measured at the weather service station located at Glacier International Airport, about 9 mi southwest of the CFAC site. Such gusts are infrequent. Major weather influences in the valley are from air masses moving in from the Pacific Ocean. Arctic air masses sometime spill across the Continental Divide but generally move down the east side of the Divide.

Average annual precipitation is about 15 in. with an average annual snowfall of about 49 in. July and August are the only months in which snowfall has not been observed. Average monthly precipitation ranges from 0.80 in. in April to about 2 in. in June.

3.6.5 Ecology

No threatened or endangered species are known to occur on or near the site.

Terrestrial. Flathead area forests are predominantly coniferous, evergreen, with about 2% deciduous. Major species in order are: lodgepole pine, Douglas fir, western larch, Englemann spruce, and sub-alpine fir. About 5% of the area is in white, ponderosa, and white bark pine. Cedar, juniper and hemlock are present. Deciduous species are cottonwood, alder and birch. Wildlife forage brush is common in big game areas.

Dominant large wildlife species include deer, elk, bear, moose, mountain lion, bighorn sheep and Rocky Mountain goat. Smaller species include beaver, coyote,

marten, weasel, muskrat, wolverine and squirrels. Predominant bird species found in the area are ducks, geese, grouse, pheasant, turkeys, hawks, osprey and eagles.

Aquatic. The Flathead River and its three main tributaries flow over extensive alluvial deposits with a substrate made up largely of boulders and large rubble (Hauer and Stanford 1982a). Low order streams have a forest canopy of Douglas fir and western larch whereas the larger river reaches are largely unshaded (Hauer and Stanford 1982b). Periphyton is abundant except during scouring in spring, and a fairly typical invertebrate fauna is present. Predominant species of fish found in the Flathead River in the vicinity of the site include native cutthroat trout, Dolly Varden trout, kokanee salmon, mountain and lake whitefish, and eastern brook trout.

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Chapter 4

IMPACTS OF PLANT OPERATION

This chapter discusses the socioeconomic and environmental impacts associated with aluminum smelter operation. With one exception, impacts are discussed for two levels of plant operation, full capacity or 100% operation and shutdown or 0% operation. Because of non-BPA power supplies, the scenarios examined for the Wenatchee plant also included 40% capacity production. The impact chapter is divided into four sections. The first two, sections 4.1 and 4.2, are overviews of the socioeconomic and environmental impacts, respectively. These sections describe the relevant impacts and link aluminum smelter operation (or shutdown) to the impacts. The plant and community level impacts for each aluminum smelter are described in Section 4.3. Finally, the last section contains a discussion of socioeconomic implications of several smelter closures and the differences between temporary and permanent closures. The final section also contains a number of specific environmental topics usually covered in an environmental impact statement (EIS).

4.1 OVERVIEW OF SOCIOECONOMIC IMPACTS

This chapter discusses the types of socioeconomic impacts expected if operating levels are modified at the aluminum smelters in the Pacific Northwest and the principal mechanisms by which those impacts are anticipated to occur.

4.1.1 Economic

Items of major concern in economic impact analysis are changes in the number of regional jobs, in regional income, and in government financing requirements. Standard regional economic approaches identify three categories of employment changes: direct effects, indirect effects, and induced effects. Direct effects are the changes in employment at the impact site itself. Direct workers are those employed at the impact site. Indirect effects refer to changes in employment at firms that supply goods or services to the aluminum plant; e.g., plant closure would eliminate the need to transport aluminum ingot and would result in layoffs of transportation workers. Indirect workers are those employed by these suppliers. Induced effects refer to changes in employment resulting from changes in the purchases of direct and indirect workers, e.g., job losses due to closure or reduced operating levels at restaurants, supermarkets, and retail outlets that provide goods and services to direct and indirect workers. Job loss or gain has subsequent impacts on regional income primarily through reductions in wages paid to workers living in the region and on revenues of local governments through reductions in the tax base. However, changes in government revenues tend to be at least somewhat offset by population changes that affect the demand for government services.

To develop quantitative estimates of these various impacts, direct employment changes at aluminum plants for full capacity and plant closure cases were developed from current and full capacity estimates of plant employment.

Indirect employment changes were then estimated using the Washington State gross flows (input-output) table. (The estimation of these impacts is described in Appendix A-B.)

To estimate the overall employment effects, the estimated direct and indirect employment changes associated with the two levels of operation were introduced into the Metropolitan and State Economic Regions (MASTER) model. That is, employment for each industrial category in the model was increased (decreased) to reflect the impact of moving to full capacity (plant closure) from 1985 operating levels. The direct and indirect employment levels were assumed constant over the entire forecast period for each production level, i.e., the plant operates either at full employment from 1985 to 2001 or is closed for the entire period. The plant closure case assumes direct and indirect employment is zero from 1985 to 2001. This implies that the plants are essentially abandoned without maintenance, security, or dismantling. Results from the MASTER model scenarios then served as inputs to the Fiscal Impacts Model (FIM) which produces estimates of local government revenues and expenditures.

The MASTER model is an econometric, simultaneous equation, simulation model estimated from local county-level data on economic and demographic variables for the mid 1960s to the late 1970s. County, Metropolitan Statistical Area/ Rest of State Area (MSA/ROSA), and state-level data are contained in the data base. Variables include employment, wage and salary income, and wage rates for 12 standard industrial categories (SICs); personal income; commercial construction for 20 building types and residential construction for 5 building types; population; births; deaths; net-migration; and energy prices (natural gas, electricity, petroleum, coal).

MASTER regional economic activity forecasts can be produced for counties, MSA/ROSAs, and states in the continental U.S. For each geographical unit (region) the model forecasts such variables as: employment, wage rates, commercial construction, residential construction, and income.

MASTER was specifically designed to assess the regional economic impact caused by various national and regional changes. It is particularly well-suited to estimate the regional economic impact caused by adding capacity or shutting down a major employer in a region. The steps involved in using MASTER include selecting the region to be investigated (e.g., a group of counties or an MSA), developing a base case macroeconomic forecast, and, finally, specifying changes in model inputs to reflect the impacts of interest. The specific macroeconomic assumptions and greater detail on the MASTER model are given in Appendix A-C. Detailed results of MASTER simulations for each region are given in Appendix A-D.

The Fiscal Impacts Model (FIM) uses population projections of the MASTER model to project local government revenues and expenditures. The model is based on a detailed data base including historical local revenues and expenditures. It assumes that revenues and expenditures are directly proportional to population, with education expenditures proportional to school age population. Greater detail on FIM is given in Appendix A-C.

The significance of the impacts associated with modified production levels in the aluminum industry are dependent upon the context in which they occur. Should the national, regional, and local economies be growing when the aluminum facilities reduce employment and income in the region, the consequences of the loss of jobs, income, and tax revenue will be less difficult to handle than if those losses occur during a period of economic recession.

4.1.2 Demographic

Increases or decreases in employment in a region are likely to affect the demographics of the area. Closure of a plant and ripple effects of job loss in the local economy are likely to lead to increased out-migration as some unemployed workers relocate. Because decisions to migrate out of an area may depend not only on aluminum industry employment but on availability of other jobs as well, it is necessary to consider the full employment picture including direct, indirect, and induced employment impacts. Similarly, aluminum industry expansion would create other job opportunities as well. Equations relating migration decisions and population to local economic activity are incorporated in the MASTER model. Thus, estimated population changes are consistent with the complete economic picture as described by MASTER.

As with employment impacts, population impacts depend upon local, regional, and national conditions. In some communities where a high proportion of total jobs has been lost, workers and their families have remained longer than anticipated. The delay in out-migration has been attributed to several factors that apply to the aluminum industry in the Pacific Northwest: 1) many of the workers are older and, when faced with job loss and the need to relocate, choose instead to retire; 2) if many workers are trying to leave an area at the same time, they may not be able to sell their homes, and may hesitate, or be unable, to relocate; 3) if job loss in the aluminum industry accompanies a recession in the regional or national economy, unemployed workers may be unable to obtain jobs elsewhere and may decide that it is more prudent to remain where they are. If growth conditions prevail, at least some of the unemployed aluminum workers are likely to be able to find jobs locally, and the economic conditions that would retard out-migration of the remaining workers are not likely to occur.

4.1.3 Housing

Impacts on housing from changing production levels in the aluminum industry occur principally as the result of in- and out-migration of population. As indicated in Chapter 4.1.2, should significant numbers of workers become unemployed in an area that is not generating replacement jobs, the net impetus for out-migration has the potential to significantly increase the supply of housing on the market while reducing the demand. Housing availability would increase under these circumstances and housing prices would fall.

4.1.4 Land Use

Impacts on land use would result from plant shutdown that led to disassembly of the plant and conversion to another use or from changes in the residential

patterns due to job loss and out-migration. Information for assessing potential impacts on land use was gained primarily from plant officials and local land use planners. In most cases, the aluminum facilities are located in heavy industrial areas containing other industrial facilities. In these circumstances, it is not likely that the plant site would be converted to nonindustrial use, even if it were to be abandoned by the aluminum industry. Even where the plant is relatively isolated (for example, Goldendale), dismantling and clearing the site is costly enough that plant officials indicated the facilities were likely to remain intact for a considerable period after closure.

4.1.5 Public Services

Impacts on public services occur principally as changes in population and housing alter demand for services and as changes in revenue alter the ability of governmental units to provide service or require increased tax rates to maintain service levels. The aluminum industry generally pays substantial property taxes to the local governments in whose jurisdictions they are located. In addition, state income taxes and retail sales revenues from the plant and its workers can be an important source of revenue. As with the other socioeconomic components, the significance of the public sector impacts from changes in production levels at the aluminum smelters depends upon the overall economic and fiscal context in which they occur. Currently, many local governmental units are concerned about revenue sources as changes in federal programs and tight financial conditions at the state level are reducing intergovernmental transfers. In this assessment, the focus is on local jurisdictions rather than the state.

4.1.6 Social

In this assessment, the social consequences are addressed primarily as a summation of the preceding socioeconomic components, with an effort to determine what their collective impact on community social organization and individual well-being would be. Factors such as changes in community resources and their distribution, community diversity, outside linkages, levels of coordination and cooperation, and social problems are considered. The approach taken in the assessment is described more fully in Branch et al. (1984).

4.2 OVERVIEW OF ENVIRONMENTAL IMPACTS

This chapter provides an overview of the principal environmental consequences of the operation of an aluminum smeltor. Specifically, it covers effluents associated with full capacity; physical impacts associated with transmission lines and the transportation of raw materials; exposure pathways; and the environmental impacts of fluorides.

4.2.1 Effluents

In this chapter information on plant effluents is provided. The data presented represent that most recently available for plants operating at near capacity.

In most cases that was during 1983-1984; in some cases, it was earlier. The impacts of the effluents are discussed in Chapters 4.2.4, and 4.3.

4.2.1.1 Waste Water Discharges

The Northwest aluminum plants each use up to about 10 million gallons of water per day. The water is generally drawn either from onsite wells or from surface water sources. It is used primarily for cooling plant equipment (e.g., rectifiers, furnaces, casting machines, air compressors) and as a scrubber agent in air quality control equipment. When used for air quality control, it captures many of the contaminants in the effluent water that would otherwise leave the plant through the air ventilation system.

Waste water effluents include industrial waste, storm drainage, and sanitary wastes. In general, the effluents are discharged to surface water bodies under National Pollutant Discharge Elimination System (NPDES) permits. The principal industrial waste contaminant of concern is fluoride (Table 4.1). Other regulated contaminants and the range of discharge concentrations include cyanide (less than 0.03 mg/L), oil and grease (0.02-10 mg/L), and total suspended solids (2.8-13 mg/L). Temperature and pH are also regulated. For plants where test results are available, the undiluted effluent is either not toxic in 96-hour bioassay tests with trout, or may be made nontoxic by less than 1:1 dilution.

Table 4.1
Waste Water Effluent Volume, Fluoride Content and Receiving Waters for Northwest Aluminum Plants

Plant	Volume	Fluoride	Receiving Water
Vancouver	4.8 MGD	1.8 mg/L	Columbia River
Longview	9.1	12	Columbia River
Troutdale	1.6	26	Columbia River
The Dalles	2.5	16	Columbia River
Goldendale	8.9	9	Columbia River
Wenatchee	9.1	5.4	Columbia River
Tacoma	0.7	5.0	Hylebos Waterway
	1.0	<1.0	Blair Waterway
Ferndale	6.1	5.1	Straits of Georgia
Mead	3.4	23	Peone Creek (Spokane River)
Columbia Falls	4.7	1.8	Onsite ponds (no offsite discharge)

Sanitary wastes are generally treated onsite.

Vancouver. The Vancouver plant has two liquid waste outfalls, both near the Columbia River bank, as indicated on Figure 3.6. One outfall carries industrial waste water and discharges from two settling lagoons to the Columbia River. The second outfall discharges from a secondary sewage treatment

system. Both discharges are regulated by NPDES Permit WA 000029-9. Table 4.2 gives additional information on composition of liquid discharges from the plant.

Table 4.2
Composition of Liquid Discharges from the Alcoa Vancouver Plant, 1984

Components	Permitted (lb/day) 24-hr avg.	Permitted (lb/day) Maximum	Estimated Amounts (lb/day)
Discharge volume (MGD)	Not applicable	Not applicable	4.8
Aluminum	66	148	47
Benzo-a-pyrene	0.02	0.04	No data
Nickel	2.4	3.4	1.7
Zinc	0.8	1.5	1.0
Fluoride	100	200	68
Cyanide	0.15	0.4	0.10
Antimony	2	3	1.0
Chromium	0.8	1.5	0.2
Oil and grease	70	150	34
Total suspended solids (TSS)	930	1860	455
pH of effluent	6-9	6-9	7.4

Longview. The plant waste water is discharged into the Columbia River three miles below the Longview Bridge and is regulated by an NPDES permit issued by the Washington State Department of Ecology. Three outfalls are in use, one each for sanitary wastes, industrial and cooling waste water, and storm sewer. The actual and permitted discharges are listed in Table 4.3.

Table 4.3
Composition of Liquid Discharges from the Reynolds Longview Plant

Component	Permitted Limits: Sewer	Permitted Limits: Industrial and Cooling	Permitted Limits: Storm Sewer	Actual Avg. Monthly (7/83 to 6/84) Industrial and Cooling
Discharge volume (MGD)	<0.15	11	4	9.1
TSS	<30 mg/L	1800 lb/day	3 mg/L	977.7 lb/day
Fluorides	No data	1200 lb/day (<20 mg/L)	No data	12.0 mg/L
Cyanide	No data	5 lb/day (<0.06 mg/L)	No data	0.03 mg/L
Oil and grease	No data	200 lb/day	No data	120.6 lb/day
pH	6.5-8.5	6.5-9.0	6.5-9.0	8.2

Troutdale. Cooling waste water and treated sanitary waste water are pumped into a company lake where sedimentation takes place. A 36-in. pipe discharges from the lake into the Columbia River. The discharge is regulated by the Oregon Department of Environmental Quality under NPDES Permit 2835-J. The permitted and actual average discharges are listed in Table 4.4.

Table 4.4
Composition of Liquid Discharges from the Reynolds Troutdale Plant

Component	Permitted	Actual Average Monthly 7/83-6/84
Discharge volume (MGD)	Not applicable	1.6
Fluorides	710 lb/day	335 lb/day
TSS	1065 lb/day	145 lb/day
Oil and grease	<10 mg/L	1.7 mg/L
Cyanide	1 lb/day	0.1 lb/day
pH	6.0-9.0	7.9

An additional one-time grab sampling of waste water was collected in conjunction with the NPDES permit application and those analyses are indicated in Table 4.5.

The Dalles. The Dalles plant obtained water from the Columbia River for industrial use (16 MGD as a scrubber agent and for cooling) and from wells for drinking and washing (0.9 MGD). When it was operating, the plant discharged industrial waste through a recycle pond north of the plant and adjacent to the Columbia River. The waste water was discharged from the pond to the Columbia River through a submerged pipe. Sanitary wastes were sent to a secondary biological treatment plant. The effluent from this plant was chlorinated and mixed with the industrial waste water discharge prior to release into the Columbia River.

In 1981, the volume of discharge from various plant sources was 100-2400 gpm from foundry and rectifier cooling, 100-500 gpm from paste plant cooling, 0-1000 gpm from storm drainage, 100-600 gpm from roof scrubber operation (recycle bleed), and 20-40 gpm from the sewage plant.

The Dalles site is a proposed EPA superfund site because of the possibility that groundwater has been contaminated with cyanide and fluoride salts (Oregonian 1985). The NPDES discharge permit limits and actual effluents are listed in Table 4.6.

Goldendale. The plant uses Columbia River water as a scrubber agent in air quality control systems and for process purposes, primarily cooling. About 18,000 gal/day of well water is used for drinking and washing purposes.

About 8.9 MGD of cooling and scrubber water are discharged into the Columbia River through a three-port diffuser that is 1700 yards above John Day Dam; the diffuser is 300 ft from shore at a depth of 30 ft. Each of the ports has an 8-in. nozzle to improve diffusion characteristics of the discharge and to reduce the temperature change in the Columbia River to less than a measurable difference. Diffusion of the discharge plume depends on river flow and temperature in both the Columbia and John Day rivers, operation of John Day Dam, and wind conditions.

Table 4.5
Results of a Single Grab Sample of Liquid Discharge from the Reynolds Plant at Troutdale

Compound	Amount (mg/L)
Cd	0.003
Cyanide	0.044
Phenols	0.0056
BOD	1.5
COD	8.3
Oil/grease	8.1
Flourides	32
TOC	6.0
TSS	40
NH_4 as N	0.34
SO_4	266
Al	0.15
Fe	0.20
Mg	5.0
Mn	0.20
Acenaphthene	0.00041
Anthracene	0.00004
Benzo-Anthracene	0.00102
Benzo-a-Pyrene	0.00074
3,4 Benzo Fluoranthene	0.00103
Benzo (ghi) Perylene	0.00028
Benzo (k) Fluoranthene	0.00030
Chrysene	0.00124
DiBenzo (a,h) Anthracene	0.00070
Phenanthrene	0.00015
Pyrene	0.00032
An, As, Be, Cr, Cu, Pb, Hg, Ni, Se, Ag, Th, Zn	all below detection limits
pH	7.1-9.1

Table 4.6
Composition of Liquid Discharges from the Martin Marietta Plant at The Dalles (July 1982 through May 1983).

Component	Permitted Limit	Actual
Discharge volume (MGD)	Not applicable	2.5
TSS	750 lb/day	143 lb/day (7.2 mg/L)
Fluoride	500 lb/day	326 lb/day (16 mg/L)
Oil and grease	<10 mg/L	1.5 mg/L
pH	6.0 - 9.0	7.6 (7.4-7.8)
Temperature (monthly average)	No limits	58 - 74 °F

Prior to discharge, water from the secondary scrubber systems is treated to adjust pH, remove fluorides, reduce suspended solids, and remove oil and grease. Sanitary wastes are treated in a secondary treatment plant, chlorinated, and co-mingled with the main plant discharge.

Characteristics of the Commonwealth plant effluent stream are compared with Columbia River water in Table 4.7.

Table 4.7
Composition of Liquid Discharges from the Commonwealth Plant at Goldendale

Component	Value of Plant Discharge	Normal River Value
Discharge volume (MGD)	8.9	1.4×10^5
Temperature	45-80°F	33-72°F[a]
Fluoride	9 mg/L	0.2 mg/L
Oil and grease	1 to 2 mg/L	Negligible
pH	6.5-8.5	6.5-8.5

(a) Average of 8 stations adjacent to the plant.

Wenatchee. Cooling water has been applied to the soil since 1977, hence there is no impact on surface waters from heat dissipation. Plant waste water is discharged to the Columbia River in the Rock Island Pool, through a diffuser located on the river bottom about 500 ft from shore.[a] The discharge is controlled by NPDES Permit WA 0000068-0. The permitted and actual discharges are listed in Table 4.8. Available data indicate that the plant normally operates within conditions of the NPDES permit. Close, nearly continuous in-plant monitoring is conducted to assure compliance.

Tacoma. Kaiser Aluminum discharges waste water to the Hylebos Waterway under NPDES Permit WA-000093-1 (issued August 1, 1984). Actual plant discharge is about 1.7 MGD at 80° to 85°F. This is enough energy to raise the temperature of the last half-mile reach of the Hylebos Waterway by about 1°F. The waterway has a Class B (good) water use and criteria designation, which allows less restrictive temperature increases than Class AA and A waters.[b]

(a) J. A. Thompson. 1985. Letter and material submitted July 5, 1985, from Northwest Environmental and Industrial Hygiene Manager of Alcoa Wenatchee plant.

(b) According to WAC 173-201-045, the temperature of Class B marine water shall not exceed 19°C due to human activities. Temperature increases (t) may not exceed t=16/T, where T is the ambient water temperature, unless T is greater than 19°C, in which case the allowable increase is 0.3°C.

Table 4.8
Composition of Liquid Discharges from the Alcoa Plant at Wenatchee, May 1984 to May 1985

Component	Permitted Limits		Estimated Concentration[a]	
	24-hr avg.	Maximum	Average (lb/day)	Maximum
Discharge volume (MGD)	Not applicable	Not applicable	9.1	Not applicable
Fluoride	1020	2080	395	812
Oil and grease	260	520	1.1	13
TSS	1560	3120	206	1770
pH	6.0-9.0	No data	6.6-9.8	No data

(a) Based on analyses from continuous grab samples.

In addition, the effluent water contains fluoride, total suspended solids (TSS), oil and grease, and cyanide. Table 4.9 shows current NPDES permit conditions and actual discharges. The plant does not meet effluent limits that went into effect August 1, 1984. However, the plant is operating under a regulatory order to come into compliance by January 1, 1986. Treatment to achieve the stricter guidelines of 0.050 mg/L cyanide from the potlining management area must also be in operation by January 1, 1986.

Table 4.9
Composition of Liquid Discharges from the Kaiser Plant at Tacoma

Component	Permitted Daily Average	Permitted Daily Limits	Actual Daily Average[a]
Discharge volume (MGD)	Not applicable	<3	1.7
Fluoride	100 lb/day	200 lb/day	31 lb/day
TSS (average)	200 lb/day	400 lb/day	60 lb/day
Oil and grease (max.)	No data	10 mg/L	7.8 mg/L
Cyanide (max.)[b]	No data	0.05 mg/L	40 mg/L
pH	No data	6.1-9.0	No data

(a) Period 7/83 through 6/84.
(b) Cyanide discharge from the pot salvage area.

Ferndale. Water is withdrawn from the Nooksack River; the withdrawal rate is small compared with the minimum flow rate of the river (about 500 cfs). The plant discharges waste water to Georgia Straits through two outfalls. One outfall carries the process water and discharges about 6.1 MGD. The other outfall carries storm water with a total discharge of 0.4 MGD. The average temperature of the effluent process water is 64.4°F, with a maximum of 77°F. The average

temperature range registered at the outfall is 64-70°F (18-21°C). The receiving waters are Class AA marine waters, and the NPDES permit stipulates compliance with the regulation for that class of water.[a] The temperature is monitored and does comply with the permit at all times.

Process and storm water effluents are discharged under NPDES Permit WA 000295-0. The conditions of the present permit and actual discharges are given in Table 4.10. A revised permit, effective July 1, 1987, changes fluoride allowances to average daily and maximum discharges of 130 and 300 lb/day, respectively. TSS limits will be 650 and 1300 lb/day, and oil and grease limits will be 200 lb/day (not to exceed 15 mg/L). The new permit also regulates discharge of certain metals. The plant will have to reduce the current fluoride discharge to about one-third the present level to meet the revised permit levels. Intalco is presently working on secondary water treatment equipment required to meet the new EPA Effluent Guidelines.

Table 4.10
Composition of Liquid Discharge from the Intalco Plant at Ferndale

Component	Permitted Daily Average	Permitted Daily Limits	Actual Daily Average[a]
Discharge volume (MGD)	Not applicable	Not applicable	8.7 MGD
Fluorides	570 lb/day	1140 lb/day	359 lb/day
TSS	2200 lb/day	4400 lb/day	673 lb/day
Oil and grease	500 lb/day	10 mg/L[b]	123 lb/day
Cyanides	0.05 mg/L[c]	0.05 mg/L	<0.03 mg/L
pH	Not applicable	6.0-9.0	7.5

(a) Daily average for the calendar month.
(b) Not to be exceeded more than three times per month.
(c) Permitted daily average level of cyanides is also used as a daily limit.

A sewer treatment lagoon and aeration system for oxidation of sanitary wastes is located just southwest of the plant buildings. The effluent is chlorinated and discharged into the process water outfall system.

Mead. Waste water (3.4 MGD) is treated prior to discharge to Peone Creek (Figure 3.21), a tributary of the Little Spokane River. Actual discharge information for the Kaiser Mead plant is shown in Table 4.11. An NPDES permit regulates the discharge.

Peone Creek monitoring data are not available. However, the Little Spokane River has been measured both above and below the confluence of Peone (Deadman)

(a) For Class AA marine water, the temperature change, t (°C) across the dilution zone, cannot exceed t=8 (T-4), where T is the highest existing temperature in this water classification outside of any dilution zone. When natural conditions exceed 13°C, only 0.3°C increase is allowed.

Table 4.11
Composition of Liquid Discharges from the Kaiser Plant at Mead

Component	Permitted	Actual
Discharge volume (MGD)	7.0	3.4
Fluoride	150 lb/day	47 lb/day
TSS	120 lb/day	85 lb/day
Oil and grease	10 lb/day	2.7 lb/day
Cyanide	0.05 mg/L	0.006 mg/L
Temperature	82°F	59.4°F
pH	6.5-8.5	7.2-8.0

Creek.[a] Values for all properties measured were not significantly different between stations except for cyanide which was reported to be <1 μg/L above the Deadman Creek entrance and about 38 μg/L (0.038 mg/L) below.

Columbia Falls. Water is pumped from onsite wells, and waste water is discharged to onsite percolation ponds, with no offsite discharge. About 4.7 MGD, including 0.1 MGD sanitary waste effluent, is discharged to the percolation ponds.

4.2.1.2 Atmospheric Emissions

Atmospheric emissions are the principal source of environmental contaminants from aluminum plant operations. The major in-plant sources are gaseous and particulate releases from the potlines; these releases include fluorides, carbon monoxide, sulfur dioxide, and volatile organic carbon. The aluminum pots generally have collection systems that carry pollutants to an air pollution control device. Since these "primary systems" are not completely effective in capturing all emissions from the pots, some emissions pass through roof vents. Some plants have additional air quality control equipment to capture pollutants at the roof vents. In plants that use pre-baked anodes, the anode baking process is an additional source of sulfur dioxide, particulates, and volatile organic carbon. Emissions are partially controlled by use of wet and/or dry scrubbers in the plants. The emissions are regulated by state agencies responsible for air quality. Each plant is regulated differently based on a variety of considerations including site location, population density, other industrial activities, etc. Atmospheric emission data are summarized in Table 4.12.

Vancouver. In addition to the air pollutants listed in the table above, the Vancouver plant releases 2 ton/yr of nitrogen oxides (NOx).[b] About 10 ton/yr

(a) Hartung, R. and P. G. Meier. 1980. Ecological Survey of the Little Spokane River in Relation to Cyanide Inputs. Unpublished research for Kaiser Aluminum Co., Spokane, Washington.
(b) Letter dated June 19, 1985, from J. Willenberg, transmitting air emission data for Alcoa Vancouver plant. Washington Dept. of Ecology, Redmond, Washington.

Table 4.12
Atmospheric Emissions (ton/yr)

Plant	Plant Capacity TAP/day[a]	Particulates	Fluorides[b]	Hydrocarbons	SOx[c]	CO
Vancouver[d]	338	678	185	30	1,276	7,023
Longview	575	1,575	263	No data	No data	No data
Troutdale[e]	356	878	163	No data	4,700	No data
The Dalles	250	286	33	No data	370	No data
Goldendale	482	595	161	No data	633	No data
Wenatchee[f]	630	1,368	495	401	2,737	No data
Tacoma	218	600	158	36	1,941	11,336
Ferndale	798	620	117	9	5,082	37,205
Mead	636	1,544	685	No data	404	24,132
Columbia Falls	437	837	456	625	1,850	No data

(a) TAP/day = tons aluminum produced per day.
(b) Includes particulate and gaseous fluorides.
(c) Washington regulates based on sulfur content in coke - limits to 60 lbs SO_2/TAP; Oregon limits emissions to 4700 ton SO_2/yr; Montana does not have an SO_2 atmospheric emission limit for aluminum smelters.
(d) Blessinger, J. A. 1985; letter and material submitted 7/3/85, from Environmental Superintendent of Alcoa at Vancouver; Willenberg, J. 1985; letter dated 6/19/85 transmitting air emission data for Alcoa Vancouver plant.
(e) Production numbers for Troutdale are considered proprietary; see Table 4.13 for effluent information.
(f) New air pollution control equipment was operational in May 1985 and is expected to significantly reduce the reported emissions.

of particulate alumina are from ship unloading and about 7 ton/yr of particulate matter are released from alumina conveying, storage, and handling.

Upgraded equipment for control of air emissions was installed and first operated in 1974. Alcoa A-398 dry scrubbers are used to capture particulates and to capture and recycle fluoride emitted from the smelting process. Alcoa 446 dry scrubbers are used to collect combustion products from anode baking furnaces. In addition, nuisance dust collectors (baghouses) are used to control emissions from material handling systems where dust is generated.[a]

The potroom dry scrubbing equipment (secondary system) has a rated efficiency above 99% for particulates and fluoride from the reduction plant. Control equipment on the anode baking furnaces has efficiencies above 95% for hydrocarbon removal and about 95% for total carbon removal. Other baghouses in the plant have efficiencies above 98% for particulates; the electrostatic precipitator is rated at 95% efficiency.[b]

Longview. Atmospheric emissions are regulated by the Washington State Air Pollution Control Board relative to the amount of aluminum produced. The fluoride pollution control system must be designed to collect 85% of the emissions and remove 95% of the collected material. Currently, total fluoride emissions range from approximately 2.0 to 2.5 lbs/ton. Particulate emissions rarely exceed 15 lb/ton.

Troutdale. Atmospheric emissions are regulated by an Air Contaminant Discharge Permit (ACDP) from the Oregon Department of Environmental Quality. The permitted releases are related to aluminum production and are listed in Table 4.13.

Table 4.13
Air Pollutant Emissions from Troutdale

Component	Monthly Permitted (lb/ton Al)	Actual (1981) (lb/ton Al)
Fluorides	3.5	2.6
SO_2	4700 ton/yr[a]	56.0
Particulates	15.6	12.0

(a) Annual permitted value.

The Dalles. Average release for July 1982 through June 1983 included 6.6 lb/TAP total particulates, 0.5 lb/TAP particulate F^-, 0.2 lb/TAP gaseous F(HF), and 8 lb/TAP SO_2.

(a) Letter and material from J. A. Blessinger submitted July 3, 1985, from Environmental Superintendent of Alcoa Vancouver plant.
(b) Aluminum Company of America (Alcoa). 1976. Environmental Assessment of Alcoa Vancouver operations. Vancouver, Washington.

The Dalles. Average release for July 1982 through June 1983 included 6.6 lb/TAP total particulates, 0.5 lb/TAP particulate F^-, 0.2 lb/TAP gaseous F(HF), and 8 lb/TAP SO_2.

Goldendale. Atmospheric emissions are regulated by an EPA consent decree as a requirement to the Goldendale "prevention of significant deterioration" (PSD) permit application. The requirements include limitations on total suspended particulate emissions (less than 7.5 lb/TAP 12-month average) and fluoride (no more than 2.0 lb/TAP). SO_2 emissions as regulated by the state of Washington must not exceed 60 lb/TAP or 1,000 ppm in any exhaust gas. Federal EPA consent decree requirements for fluorides are being met at the Goldendale plant. In Table 4.14 measured Goldendale plant emissions are compared to EPA regulatory limits.

Table 4.14
Measured Goldendale Plant Emissions Compared with EPA Regulatory Limits (lb/TAP)[a]

Component	Current Consent Decree Federal EPA		Actual Emissions
	Monthly Avg.	12-mo. Avg.	(12 mo. avg.)
TSP	8.0	7.5	6.8
Fluorides	2.6	2.0	1.8

(a) Campbell, S., R. Brower, R. Lanza, N. Pfeffer, and K. Zankel. 1985. PSD Permit Application for the Goldendale Aluminum Plant. Martin Marietta Environmental Systems, Columbia, Maryland.

Wenatchee. The maximum throughput for the Wenatchee plant occurred during the 12-month period of 1984. Particulate and gaseous fluoride releases during this period were presented in Table 4.12. Particulate and HF emissions were greatly reduced after new dry scrubbing systems were installed early in 1985 to remove fluorides from potlines 1 to 3. For example, in April and May 1985, total particulates averaged 3,546 lb/day, the HF averaged 516 lb/day, and particulate F^- averaged 686 lb/day. This is a substantial reduction over previous emission levels.

Each potline has equipment for measuring and controlling atmospheric emissions. Release of pollutants at each potline is measured monthly. Most emissions issue from potline roof vents and treatment systems (particulates and SO_2); emissions from anode baking furnace stacks (particulates, SO_2, and CO) go to the 446 dry scrubber units.[a]

(a) Thompson, J. A. 1985. Letter and material submitted from Northwest Environmental and Industrial Hygiene Manager for Alcoa Wenatchee.

There are no data on fugitive emissions at the plant. The amounts of pollutants released to the air from miscellaneous sources are relatively low.

The primary source of atmospheric emissions is the potrooms. When the plant was built in 1952, there were four potlines with dry electrostatic precipitators followed by wet scrubbers. In 1967, potline 5 was constructed with a dry system. In May 1985, potlines 1 to 3 were retrofitted with dry systems.[a] The dry systems are over 99% efficient at removing gaseous and particulate fluoride. Therefore, data on the Emission Monitoring Report and the fluoride level in ambient air data for April and May 1985 are lower than data shown on previous reports. However, the recent data are typical of current and future operations at Alcoa Wenatchee.

Even though the new dry systems were operating, water still flowed to the wet scrubber towers until June 1985. Current water discharge (June and July 1985) is less than 50% of that in May 1985, and discharged pollutants are now reduced about 90%.[a]

Other emission control equipment is indicated in Annual Emission Inventory Reports to the Washington Department of Ecology and to the U.S. Environmental Protection Agency. These systems include numerous baghouses throughout the plant. All dust collectors operate at 99% efficiency.

Tacoma. In addition to the atmospheric releases tabulated in Table 4.12, the Tacoma plant emits 8 ton/yr nitrogen oxides to the atmosphere. Of the total fluoride released, about one-third is particulate, and two-thirds is gaseous.

Ferndale. The plant discharges 91 ton/yr nitrogen oxides, in addition to the emissions tabulated in Table 4.12. The total plant emission factor for fluorides is 3.8 lb/TAP, with 3.7 lb/TAP from the potlines only. About 73% of the fluoride emissions are in particulate form.

Mead. The plant was at maximum aluminum production in 1981, corresponding to a discharge of about 13.3 lbs/TAP of particulates per day. Particulate data for 1984 reveal about 13.0 lbs/TAP. Therefore we assume that the 1984 fluoride data available to us are representative of the maximum throughput year. Therefore about 3.0 lbs/TAP of particulate fluorides per day and about 2.9 lbs/TAP per day of HF are released to the environment. The average annual HF atmospheric discharge concentration is about 0.16 $\mu g/m^3$, which is well below the Washington State regulation of 0.5 $\mu g/m^3$.

Columbia Falls. The only present requirements concerning atmospheric emissions are for measurement of roof fluoride emissions and vegetation analysis for fluoride concentrations. During the first quarter of 1985, fluoride emissions were 2.1 lb/TAP. The 1984 average fluoride emissions were 32 lb/day. These values are similar to those reported in the quarterly summaries for 1983 and 1984. Montana eliminated standards for ambient air concentrations of fluorides

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(a) Thompson, J. A. 1985. Letter and material submitted from Northwest Environmental and Industrial Hygiene Manager for Alcoa Wenatchee.

from aluminum plants in 1980. Prior to this, the plant was operating well within the former standard of 1 μg HF/m^3, however, no recent data are available for the maximum throughput case considered here. (The standard for vegetation fluoride content remains in effect.)

4.2.1.3 Solid Waste

Solid wastes produced in the aluminum reduction plants include cardboard, paper, wood, and garbage; general plant refuse; spent potlining; firebrick and insulation; furnace dross; waste oil; and sludge and other waste associated with air clean-up systems and waste water control equipment. Trash and refuse are generally placed in an onsite landfill or shipped to a commercial or municipal landfill.

Spent potlining is classified by the state of Washington as a solid waste subject to fish bioassays and characterization to determine if it is a dangerous or hazardous waste. It contains sodium fluoride, aluminum oxide, and about one percent cyanide. Potlining waste is generally stored onsite for later reprocessing to reclaim cryolite or for shipping to a commercial hazardous waste disposal site. Concerns have been raised with regard to cyanide-containing leachate from spent potlining storage and the potential for groundwater contamination.

Table 4.15 lists the solid waste volume produced by the plants during recent maximum-capacity operations. Additional information is provided below for specific plants. The amount of potlining and brick and insulation waste produced varies from year to year.

Table 4.15
Solid Waste (in tons per year unless otherwise noted)

Plant	Trash and Refuse	Spent Potlining	Furnace Dross	Fire Brick and Insulation
Vancouver	10,300[a]	2,500	--[b]	500
Longview	12,343[a]	8,672	5,250	No data
Troutdale	1,440	7,315	2,150	2,210
The Dalles	No data	3,100	No data	2,200
Goldendale	6,800	4,800	--[b]	3,200
Wenatchee	8,960[a]	3,000	No data	11,200
Tacoma	2,400	5,000	375[b]	100
Ferndale	15,500	17,470	3,723	10,404
Mead	No data	4,000	--[c]	No data
Columbia Falls	20,000	6,800	2,250	1,000

(a) Cubic yard/year.
(b) Sold to metals reprocessor.
(c) Reprocessed.

Vancouver. Solid waste (5000 cu yd/yr cardboard, paper, wood, and garbage) is disposed of in a municipal landfill operated by the city of Vancouver. General plant refuse (4200 cu yd/yr) and waste alumina (1100 cu yd/yr) are disposed of in an onsite landfill. Recyclable materials (e.g., scrap aluminum, dross, saw chips, steel) are either reused in the plant or sold to scrapbuyers. Potliner waste from the plant is toxic to trout at 100 mg/L and contains elevated levels of several elements including fluoride (10.5 ppm) and zinc (1.1 ppm).[a] Cyanide from potliner waste has leached into the soil at two large, presently unused sites (Noble and Sebren 1983). Movement of leachate in the upper layers of soil is monitored by samples from onsite wells. The leachate has not contaminated plant water supplies or reached the Columbia River.

Longview. Trash is sent to a Cowlitz County solid waste disposal site. Dross is sent for reclamation. Waste oil (75,993 gal/yr) is sent for reprocessing. Potliner scrap is reprocessed in the plant to reclaim cryolite.

Troutdale. All spent potliners are stored indoors prior to shipment to a secure landfill in Arlington, Oregon. Solid wastes from the carbon plant and cast house are hauled to a special landfill. Wood, trash, and garbage are hauled to commercial landfills.

The Dalles. Spent potliners are stored for possible future reclamation. In addition, the plant produces brick and insulation waste and sludge from waste water treatment (3500 ton/yr). The sludge contains calcium fluoride, calcium sulfate, calcium carbonate, alumina and some carbon.

Goldendale. Spent potliners are stored on a 200-ft by 480-ft concrete pad (Figure 3.9) for possible future reclamation. Leachates from potliner storage are monitored and collected in a lined holding pond for evaporation. The plant also produces brick and insulation waste and sludge from waste water treatment (4200 ton/yr) containing calcium fluoride, calcium sulfate, calcium carbonate, alumina, and some carbon. Refuse and trash are shipped to the Klickitat County landfill. Wood is burned onsite. Furnace dross is transported offsite for recovery.

Wenatchee. The plant produced some 42,740 cu yd of solid waste in 1982. Included in that volume are 5600 cu yd of cardboard, paper, and wood; 560 cu yd of garbage; 2800 cu yd of general plant refuse; 11,200 cu yd of fire brick; 1400 cu yd of carbon blocks and dust; and 15,100 cu yd of potroom scrubber sludge. All of the above waste was disposed of onsite, primarily by burial. Spent potliners are stored onsite. Locations dedicated to waste disposal are indicated on the plot plan of the site (Figure 3.13). The potlining waste is temporarily considered by the state to be a "solid waste" rather than a "hazardous waste" because it is not toxic to trout at 1000 mg/L mixed well water.[b]

(a) Unpublished data from J. A. Blessinger, Environmental Superintendent of Alcoa Vancouver Plant.

(b) Information from J. A. Thompson, Northwest Environmental and Industrial Hygiene Manager, Alcoa Wenatchee plant.

Tacoma. Spent potliners are temporarily stored on a concrete slab with a drainage and sump system and batch treatment plant for leachate (Dames and Moore 1985). This area will be closed in the near future, and spent potliners will be stored temporarily indoors in an unused potline building. The potliner wastes are trucked as generated to the Chem-Security Systems hazardous waste facility near Arlington, Oregon.

Paper, wood scraps and plant rubbish are hauled under contract to the Tacoma city dump. Dirt, concrete, contaminated alumina and used refractory materials are deposited in a small onsite landfill in the southeast corner of the plant site.[a] Waste insulation materials containing asbestos are placed in drums and disposed of in the Tacoma city dump.

Between 1968 and 1974 60,000 cu yd of wet scrubber sludge was disposed of onsite. The sludge contains 5% polynuclear aromatic hydrocarbons attributed to the coal tar pitch used in the anode paste. An effluent ditch flowing through the site borders one of the abandoned sludge disposal areas. In the past, tidal effects have caused regular flooding of part of the sludge bed. Kaiser was ordered by the Washington State Department of Ecology to prevent further erosion of the sludge sites and to divert water from them.[a] This mitigative work was finished in November 1984 with the completion of a new settling pond (Figure 3.17). Kaiser is now under order from the state to evaluate the potential movement of sludge components in the groundwater and surface runoff from the abandoned sludge sites, and to recommend additional mitigative actions by September 1987.

Ferndale. Noncombustible solid waste including incinerator ash is disposed of in an onsite landfill. Contaminated solid wastes (about 35,000 ton/yr) are disposed in a second onsite dump. This is a 24-acre area in the northwest part of the plant site. A retention dike impounds surface water runoff from the potlining wastes. The runoff, which contains 0.8 mg/L cyanide and 3409 mg/L NaF and has a pH of 10.4, is routed to the process water treatment plant. Since the plant was built, some 385,000 tons of waste have been disposed of in the dump site. About half of this waste is spent potliners.

The plant generates some waste solvents from cutting oil and degreasing (components include mineral spirits and methyl ethyl ketone) which are designated as dangerous waste under state regulations. These wastes are collected and held in a 1500 gallon above ground storage tank for a period not exceeding 90 days. The wastes are then shipped offsite to a chemical reprocessor in Seattle.

Mead. Brick and rubble are placed in an open onsite dump. Sulfated lime (1000 ton/yr) and garbage are disposed of in offsite commercial landfills. Baghouse wastes (60 ton/yr) are transported to a commercial hazardous waste disposal site near Arlington, Oregon. Spent potlining is retained onsite. The EPA has proposed the Mead site as a superfund site because of the possibility

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(a) Kaiser Aluminum. 1984. Hazardous Waste Management Plan. Kaiser Aluminum & Chemical Corp., Tacoma, Washington 98421.

of cyanide leaching from a six-acre pile of spent potliners (Oregonian 1985). A study was conducted to determine impacts of the leachate seepage to the Little Spokane River; no differences in ecological characteristics could be attributed to cyanide leachate.[a] Potliner waste is presently stored in a closed building on an asphalt pad that is lined with plastic to collect leachates. Very little furnace dross is produced and the small amount is recycled.

Columbia Falls. Refuse is disposed of in commercial landfills. The plant produces 13,500 ton/yr calcium fluoride sludge, 6800 ton/yr potliner waste, and 765 ton/yr pot slabs (skulls left in cathode). The pot slabs are recycled.

4.2.2 Physical Impacts

4.2.2.1 Impacts of Transmission Lines

Most of the plants are located near the BPA grid. Transmission lines to serve these plants are generally very short and do not extend significantly beyond the plant boundaries. The Intalco plant, which has a ten-mile long transmission line from the grid to the plant, is an exception.

Transmission lines and their associated transmission towers may have some impact on wintering waterfowl and birds of prey. Waterfowl and other groups of birds have been observed to collide with towers and transmission lines (Avery et al. 1978; James and Haak 1979). Since the Columbia River and the Lake Terrell Wildlife Refuge Area near the Intalco plant are major wintering areas for waterfowl, some collisions with transmission lines could be expected. However, the short distance between the plants and the BPA grid minimizes this potential impact. Plant closure would not lead to reduction of adverse effects if towers and lines are left in place.

4.2.2.2 Impacts of Transportation

The aluminum plants require large amounts of raw materials, primarily alumina, petroleum coke, coal tar pitch, aluminum fluoride, and cryolite. They produce large amounts of aluminum ingot and other aluminum products as well as substantial quantities of solid wastes. Generally the raw materials are delivered to the plants by ship or rail. Those waste materials removed from the plants are hauled from the sites by truck. The products are normally shipped from the plants by rail or truck, although the Ferndale plant also sends products out by ship.

Alumina is delivered by ship to the plants with port facilities (Vancouver, Longview, Tacoma, and Ferndale). Alumina is delivered from port facilities to the other plants by rail. Other raw materials are delivered to all of the plants by railroad and truck.

(a) Hartung, R. and P. G. Meier. 1980. Ecological Survey of the Little Spokane River in Relation to Cyanide Impacts. Unpublished research report for Kaiser Aluminum Company, Spokane, Washington.

The plants are generally located adjacent to or near major railroad and highway systems. Therefore, possible environmental impacts of transportation to the plants are difficult to separate from impacts of the transportation systems in general. Plant closure would not significantly reduce the volume of traffic on these systems.

4.2.3 Exposure Pathways

Atmospheric emissions from these plants may be inhaled by humans or animals, or materials may be deposited on soil or vegetation and subsequently be taken up by forage or crop plants that are consumed by humans or animals. Aquatic discharges may enter freshwater or marine food chains, and materials may accumulate in edible tissues of fish or invertebrates and subsequently be transferred to humans or certain species of birds (e.g., great blue herons). Leachates from solid waste materials may reach groundwater and contaminate drinking water sources. Each of these potential exposure pathways has been considered with regard to potential hazard to environmental and human health.

Fluorides released to the atmosphere and water are of special interest to this assessment because they have been released to the environment by all aluminum reduction plants. Cyanides in leachate from potliner wastes, and polyaromatic hydrocarbons (PAH) from several potential plant sources are of concern but have only been reported sporadically by a few plants.

Atmospheric releases of fluorides include both particulate and gaseous fluorides. Primary concerns are related to contamination of plants and subsequent transfer to humans or animals. Plants may be exposed to fluorides, either by direct exposure to gaseous fluoride, by deposition of particulate fluoride on leaf surfaces, or by uptake through the roots of fluorides deposited to the soil (Chang 1975). In either case, fluorides move through the plant by transpiration and accumulate at the leaf tip and margins (Treshow 1971). A number of direct effects on plants (e.g., necrosis, tip burn) have been related to fluoride exposure, although sensitivity of plants varies widely, as described in Chapter 4.2.4.

Fluorides accumulated in forage or crop plants are transferred to animal (e.g., livestock, deer, elk) or humans who consume the plant materials. The effects of fluorides on animals and humans may include mottling of dental enamel, bone lesions, and intermittent lameness, as described in Chapter 4.2.4. Transfer to milk (through the grass/cow/milk food chain) is a potential pathway, and the amount transferred from fresh forage to milk may be calculated using a transfer coefficient of 7.0×10^{-3} (Napier et al. 1980). Thus, a dairy cow consuming 55 kg/day of forage containing 21 mg/kg F^- would produce milk with about 8 mg/kg F^-. Fluorides accumulate primarily in bones rather than in muscle of animals, hence, further transfer through the food chain by consumption of meat is not an important transfer pathway. Standards for ambient atmospheric concentration of gaseous fluorides are derived to protect sensitive plant species, and standards for fluoride concentration in forage vegetation are derived to protect cattle.

The bioconcentration factor for fluoride in fish, crustaceans, and mollusks is low (Napier et al. give a value of 4). Thus, the exposure route via consumption of aquatic organisms is not important.

Spent potliner waste contains cyanides. Leachates from outdoor storage of potliner waste may, in some circumstances, reach surface water, soil, or groundwater beneath the storage site. The amount of leachates formed in the potliner waste pile depends upon the exposure of the waste material to precipitation. Geographic location can have an effect upon the volume of leachate, i.e., under similar disposal practices, the lower Columbia and Puget Sound aluminum plants may expect four to five times the leachate volume as the plants sited east of the Cascade Mountains. This difference can be modified by the method of storage/disposal. For example, Kaiser Tacoma plans to store potliner wastes in an abandoned production building. Both groundwater and surface water sources could be an exposure pathway via drinking water to humans, domestic and wild animals, and fish.

Cyanide has not been reported to have any direct effect on recreational uses of water other than its effects on aquatic life. Cyanide exists in water in the free form (CN^- and HCN) which is extremely toxic; bound to organic or inorganic substances it is less toxic (Sittig 1980). Free and complex forms of cyanide can be converted from one to the other under conditions found in the aquatic environment. Cyanide has been shown to be lethal to some species of freshwater fish at concentrations as low as about 0.05 mg/L (Sittig 1980) and some adverse effects were observed in invertebrates and fishes at concentrations as low as 0.01 mg/L (EPA 1976; Sittig 1980). However, experience suggests that 0.2 mg/L is a safe criterion for most species of fish (Sittig 1980). Cyanide is unlikely to become a widespread environmental pollutant because of its low degree of persistence in the biosphere. It is not accumulated or stored in mammals and there is no evidence of bioaccumulation in food chains.

Cyanides are known to be degraded by the human liver to less toxic thiocyanate and, despite their high levels of acute toxicity, are not known to be chronically toxic to humans (Sittig 1980).

Volatile organic materials are released from the anode material during heating. In pre-bake plants the primary source of volatile organics would be the anode paste bake plant, while in plants using the Soderberg process, volatile organics would be primarily released from the potlines. The volatile organics are a complex mixture of compounds found in petroluem coke, including polynuclear aromatic hydrocarbons (PAHs). Some of the compounds are potentially carcinogenic (Gray and Cowser; 1982). They are of concern because of their potential to accumulate (particularly in fatty tissue) in organisms, to be metabolically transformed, and to be transferred through the food chain. The volume of coke used in the aluminum plants ranges from about 27,000 to 108,000 tons year (calculated from Table 4.31).

Hydrocarbon emissions to the atmosphere are controlled by scrubbers at some of the plants. The individual plant atmospheric emission rates range from about 10 to 600 tons of hydrocarbons per year (Table 4.12). Liquid effluent analysis at the Reynolds Troutdale plant indicated levels in the μg/L range for the

aromatic hydrocarbons tested (Table 4.5). Similar levels were reported in a single water sample taken from the settling pond at the Commonwealth Goldendale plant, although the compounds were not detected in river water adjacent to the plant (Damkaer 1983).

Little data are available on environmental levels of hydrocarbons near the plants. To recommend alternative actions for reducing the potential for impacts on adjacent waterways, the Kaiser Tacoma plant is currently evaluating methods of handling wet scrubber sludge that is contaminated with PAH.

The Tacoma plant deposited sludge containing 5% PAH in settling ponds between 1968 and 1974, which may have contributed to contamination of Commencement Bay, although this area is contaminated with other materials (PCBs, metals, various organic compounds) from many other industrial operations. A health advisory was issued by the Tacoma-Pierce County Health Department and the U.S. Environmental Protection Agency in 1982. Consumption of fish and shellfish from the contaminated areas of Commencement Bay is estimated to be 105,000 lb/yr (VERSAR 1985). The plant has completed work to prevent further erosion of the contaminated sludge and has been ordered by the state to evaluate the movement of components of sludge in the surface runoff and in the groundwater by September 1, 1987.[a]

There was evidence of increased levels of organic compounds in Columbia River sediments adjacent to the Commonwealth Goldendale plant when compared with sediments collected about two miles further upstream (Damkaer 1983). The source of these compounds is speculated to be the aluminum plant. While these compounds may enter the aquatic food chain from interstitial water through benthic organisms, they are subject to complex metabolic processes, and the state-of-the-art does not permit conclusive statements about ecosystem effects (Fickeisen and Vaughan 1984; Vaughan 1984).

4.2.4 Environmental Impacts of Fluorides

4.2.4.1 Effects on Plants

Plants vary in sensitivity to fluoride, and the effect of exposure is complicated by several factors, including time of year, meteorological conditions, age and phenology of the plant, and genotype (Treshow 1971) or presence of other pollutants (Mandl et al. 1975). Combined exposure to sulfur dioxide and gaseous fluoride has an additive effect on some citrus species and may induce greater than additive effects on grains (Reinert et al. 1975). Fluoride injury may go undetected, particularly if another stress is more obvious, and may lead to incorrect diagnosis (Gordon 1976). Fluoride stress has been found to favor insect infestation in forest trees (Carlson and Hammer 1974).

Literature on the mechanisms of fluoride injury to plants has been reviewed by Chang (1975). Fluorides can affect various metabolites, respiration and

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(a) Kaiser Aluminum. 1984. Hazardous Waste Management Plan. Kaiser Aluminum & Chemical Corp., Tacoma, Washington.

related biochemical reactions, and photosynthesis resulting in injury to plants. Effects were grouped into four major categories by Treshow (1971): 1) visible leaf chlorosis and necrosis and fruit abnormalities; 2) changes in growth or yield resulting from effects on metabolic activities, physiological processes, and cellular structure; 3) altered growth effects including changes in mass or dimension, changes in flowering or fruiting, or reduction in the number or quality of fruit; and 4) accumulation of fluoride in tissues. Table 4.16 is a summary, based on a survey of the literature, of vegetation injuries from fluorides.

In the past, some fluoride-related damage has been noted at specific sites included in this study. There was some visible damage to conifers near the Columbia Falls plant in the past, but fluoride emissions have been reduced sufficiently to prevent further damage. Injuries to trees in the Spokane area in the early 1950s were attributed to fluoride (NAS 1971). Damage to orchard trees in The Dalles area during the late 1960s and early 1970s was also attributed to fluorides (NAS 1971).

4.2.4.2 Effects on Insects

Air pollutants, in general, can have significant effects on insects. Pollinators are particularly susceptible because they accumulate contaminants while foraging on flowers. Severe mortalities of honeybees have been reported near smelters and coal-fired power plants (Steche 1975). Destruction of honeybees may occur slowly over their entire feeding season. A fluoride content of more than 1 μg per bee has been said to indicate fluoride pollution (Lillie 1970). However, in another study, normal bees contained 7 μg fluoride per bee while poisoned bees had 23 to 47 μg fluoride per bee. It has not been possible to relate these levels to a toxic ambient air concentration, but should the bees be susceptible to injury from fluoride, the result could be shifts in the types of plants pollinated, causing a change in the plant community (Groth III 1975).

Air pollutants may be passed up food chains and build up in predators or parasitic insects. As a result, populations of insects that normally control insect pests and pathogens are reduced and this, in turn, can result in outbreaks of the pests (Bromenshenk and Gordon 1978).

Samples of different insect species collected within one-half mile of the Columbia Falls aluminum reduction plant indicated varying levels of fluoride accumulation (Carlson and Dewey 1971).

4.2.4.3 Effects on Livestock and Wildlife

Much of the experimental work on fluoride effects on animals has focused on dairy or beef cattle. No direct effect has been demonstrated on lactogenesis, but prolonged excessive ingestion may decrease animal performance. The severe lameness and skeletal lesions that have been observed in animals fed a diet with over 50 ppm F^- from a young age may also influence the animals' ability to graze or consume dry feed and, thus, impact production (NAS 1974). However, the available evidence indicates that beef and dairy cattle first exposed to

Table 4.16
Fluoride Injury to Plant Species

Plant Type	Ambient F[a]	Tissue F[b]	Injury[c]	Reference
Douglas Fir	No data	12.0	B	Carlson & Dewey 1971
Lodgepole pine	No data	22.0	B	Carlson & Dewey 1971
White Pine	No data	45.0	B	Carlson & Dewey 1971
Ponderosa pine	No data	35.5	B	Carlson & Dewey 1971
Lily of the Valley	No data	25.5	B	Carlson & Dewey 1971
Ceanothus	No data	190.0	B	Carlson & Dewey 1971
Ribes sp.	No data	563.0	B	Carlson & Dewey 1971
Oregon grape	No data	9.0	B	Carlson & Dewey 1971
Larch	No data	16.3	B	Carlson & Dewey 1971
Sorghum sp.	0.004-0.007 for 8 days	No data	N/M	Chang 1975
Cammellia japonica	2 ppb	No data	B	Chang 1975
Bush beans	10-15 ppb for 5 days	No data	B	Chang 1975
Gladiolus		26-48 ppm	P	Chang 1975
Tomato	1.3-12.4 ppb for 24 h	No data	P/G	Chang 1975
Orange tree seedlings	2-3 ppb	No data	G	Chang 1975
Ponderosa pine	No data	24-104 ppm	B	NAS 1971
"Susceptible" spp.	0.003-0.004 for 1 day	20-150 ppm	N/M	NAS 1971
"Resistant" spp.	No data	4000 ppm	none	NAS 1971
Chinese apricot	0.0011 for 7 weeks	No data	N	NAS 1971
Sweet corn	0.0015 for 1 week	No data	N/M	NAS 1971
Apple	0.0018 for 2 weeks	No data	L	NAS 1971
Beans	0.0021 for 10 weeks	No data	R	NAS 1971
Gladiolus	0.005 for 1 day	No data	N	NAS 1971
Tomato	0.010 for 1 day	No data	L	NAS 1971

Table 4.16 (contd)

Plant Type	Ambient F[a]	Tissue F[b]	Injury[c]	Reference
"Sensitive" spp.	0.002-0.005 for 1 day	30-50 ppm	"adverse effects"	Treshow 1980
Peaches	(d)	No data	S	NAS 1971, Facteau and Rowe 1976
Cherry	No data	No data	T	Facteau et al. 1973
Apricot	No data	No data	T	Facteau and Rowe 1977
Tomato, cucumber	No data	No data	T	Sulzback and Pack 1972
Several vegetables[e]	No data	No data	R	Pack and Sulzback 1976

(a) Fluoride concentrations in mg/cubic meter unless otherwise indicated.
(b) Minimum tissue concentration (ppm F) at which injury occurred.
(c) Injury codes: B = foliar burn
N = leaf necrosis
M = leaf mottle
P = photosynthesis is inhibited
G = growth rate reduction; no visible symptoms
L = foliar lesions
R = reproduction decreased
S = soft suture
T = decreased pollen tube growth
(d) Weekly spray with 0.025% ammonium fluoride.
(e) Soybean, bell pepper, sweet corn, and cucumber more sensitive than pea, grain sorghum, and wheat.

elevated fluoride intake at 3-4 years of age can be fed as much as 50 ppm F^- in their diet without influencing performance. Table 4.17 lists observed effects in cattle.

Table 4.17
Relationship of Dietary Fluoride to Symptoms in Cattle

Symptom	Total Fluorine in Diet (ppm)			
	20-30	30-40	40-50	More than 50
Dental mottling	yes	yes	yes	yes
Enamel hypoplasia	no	no	yes	yes
Periosteal hyperostosis slight gross	no	yes	yes	yes
Periosteal hyperostosis moderate gross	no	no	yes	yes
Significant incidence of lameness	no	no	no	yes
Decreased milk production	no	no	no	yes
Skeletal F = to 5000 ppm at 5 yr	no	no	no	yes
Urine F of 25 ppm	no	no	yes	yes

In chickens, the data suggest that growing chicks can tolerate 300 ppm F^- in their diets and laying hens can tolerate 400 ppm. It is suggested that tolerance for turkeys is about 400 ppm (NAS 1974).

A study of black-tailed deer within 5 km of the Ferndale plant between 1971 and 1977 (Newman and Murphy 1979) demonstrated fluorosis symptoms. Concentrations of fluoride in bone of nine deer ranged from 638 to 5426 ppm and were 7 to 40 times the levels of controls. At that time the native vegetation showed levels of fluoride above 40 ppm. Sword fern, a major food for the deer, averaged over 300 ppm F^-. Pasture grass fluoride concentrations ranged from 10 to 230 ppm. Changes in plant emission controls have resulted in a reduction in levels of fluoride released, and levels in pasture grass averaged 21 ppm in 1984. A demonstration herd of beef cattle is kept on the Ferndale site. Concentrations of fluoride in forage samples taken on the site are at a level equivalent to the threshold of discernable dental mottling after several years of exposure (NAS 1971).

4.2.4.4 Effects on Humans

Experimental evidence has not shown any deleterious effect on human health from consumption of edible products from animals that have ingested high levels of fluoride. Only rarely has fluoride toxicosis occurred when livestock have consumed animal by-product feeds containing high levels of fluorides.

4.2.4.5 Effects on Aquatic Organisms

The response of fish to elevated fluoride concentrations is not uniform and is apparently correlated with other chemical constituents, particularly chlorides and calcium. Biological, chemical, and physical factors all influence the toxicity of fluorides in fish. Median tolerance limits (concentration lethal to half of test fish in 96 hr) for fluoride have been reported between 2.3 and 7.5 ppm for trout (Neuhold and Sigler 1960; Angelovic et al. 1961). However, healthy populations of trout exist in the Firehole River in Yellowstone National Park where natural fluoride concentrations reach 14 ppm. Concentrations of fluoride in natural water bodies are commonly 0.1 ppm and values over 1.0 ppm are not rare (Sigler and Neuhold 1972).

Fish eggs exposed to 1.5 ppm F^- were delayed 7 to 10 days in hatching compared to controls. (Ellis et al. 1948). Further work by Neuhold and Sigler (1960) indicated that there was a linear decrease in hatching time at levels of 100, 200, and 300 ppm F^-.

Delays in adult salmonid upstream migration at John Day Dam led to an investigation of fluoride effects on behavior. As a result, Damkaer and Dey (1985) concluded that 0.5 ppm was avoided by chinook and coho salmon while 0.2 ppm was not.

4.3 SOCIOECONOMIC AND ENVIRONMENTAL IMPACTS

The local and community level socioeconomic and environmental impacts of aluminum smelter operation at the Northwestern plants are discussed in this chapter.

Where appropriate, several plant sites are discussed together because of their proximity to one another. The first group of sites is in the lower Columbia area followed by mid-Columbia, the upper Columbia, lower Puget Sound, upper Puget Sound, Northeastern Washington, and, finally, Western Montana.

4.3.1 Lower Columbia Area

4.3.1.1 Regional and Local Socioeconomic Impacts: Clark, Multnomah, and Cowlitz Counties, and Vancouver, Troutdale, Longview, and Kelso Communities

For purposes of developing scenarios for analysis, two cases were considered: 1) plant shutdown, where all three aluminum smelters in the Portland area close; and 2) full capacity production, where all three plants in the Portland area operate at full capacity.

Economic. Because of the size of the Portland MSA in terms of population and economy in 1980 (population of 1.0 million and wage and salary employment of about 595,000 persons), the socioeconomic effects of changing operating levels at the two smelters located in the Portland area (Alcoa Vancouver and Reynolds Troutdale with total 1985 employment of approximately 2,000) will be somewhat diffused, and the actions of a single employer will be modulated. This is less true for the Longview/Cowlitz County area than for the counties and communities (including Clark and Multnomah Counties) which are part of the urbanized Portland area included in the Portland MSA.

Unlike some of the more isolated areas, where direct plant employment accounts for a sizable percentage of total wage and salary employment, employment at the smelters in the Portland area accounts for substantially less than 1% of all wage and salary jobs in the Portland MSA. In the case of Longview/Cowlitz County, total employment is approximately 26,000 and the Reynolds Longview plant contributes 1,015 to that figure. Expansion or closure of the plants will produce more dramatic community level effects in the smaller economies. Nevertheless, loss of jobs, income, and taxes from the closure of one or all of the three smelters would create important demands on individuals, families, and community services, especially in the smaller communities of Longview, Kelso in Cowlitz County, and Troutdale and Gresham in the Portland metropolitan area. This is particularly true if the closures correspond with a worsening of the already depressed economic conditions in the lower Columbia region, and closure of other local industries or reduction in labor force.

At full operations, the Alcoa and Reynolds smelters in the lower Columbia region would help the area maintain its durable manufacturing and heavy industrial sectors, which were generally adversely affected by the recent nationwide recession. This would contribute to the continuing diversity of the area's economy, and provide a range of occupations for area workers. There is some concern that well-paying blue collar jobs are diminishing throughout the region, making it difficult for blue collar families to maintain their lifestyle in the Pacific Northwest. Continued operation of the smelters would buttress this aspect of the economy in Portland, Vancouver, Longview, and the surrounding areas, and would contribute to the overall vitality of the region.

Shutdown of the Portland area smelters would create hardships for the smelter employees, who would have difficulty finding comparable employment within the region, and for their families. In addition, it would have adverse economic consequences for many firms and workers in the lower Columbia area as a result of reduced purchases by the companies and their workers.

Results from the MASTER model for the Portland area are shown in Table 4.18. Plant closure would result in a loss of 3,000 direct and an estimated 1856 indirect (from local companies supplying the aluminum plant) jobs in the Portland area, based on 1985 employment levels. The total employment impact (difference between full production and shutdown of all three plants) for the Portland area, assuming closure in 1985, is on the order of 8,900 to 9,200 workers. These relationships indicate an employment multiplier of 2.6--that is, one plant job translates into just over two and one-half jobs for the Portland area. The method used to derive the indirect and induced impacts is discussed in Chapter 4.1 and Appendices A-B and A-C. Although these impacts might be relatively dispersed, given the urban nature of the locale, the loss of approximately 3,000 well-paying direct aluminum industry jobs and an additional 6,000 to 7,000 indirect and induced jobs would be felt throughout the communities in this area. In communities where concentrations of smelter employees live (e.g., Longview), these adverse impacts would be more intense and could create localized impacts on businesses and housing.

Demographic. The demographic effects of changes in the production levels at the three smelters in the lower Columbia area depend heavily upon economic conditions in the region at that time. Experience at the ASARCO smelter in Tacoma indicates that many of the workers are likely to wish to remain in the community, or at least in the Pacific Northwest, and to resist moving. However, there are indications that the local economy may have few jobs available for workers with the types of skills attained in the aluminum industry, and that many of the workers will have difficulty finding local employment without retraining. Experience elsewhere indicates that it may be difficult for the unemployed workers to find jobs in a similar occupation or at an equivalent wage rate, and that many of the older workers will choose to take early retirement rather than move their residence or develop a new occupational skill.

The size of the population base in the Portland MSA (1 million in 1980) makes it unlikely that the overall population structure will be significantly affected by changes at the two smelters; demographic impacts could occur in the smaller communities with high concentrations of smelter workers should the smelters close and workers leave. The same would not be true of the Longview-Kelso area, where an already depressed economy and a high unemployment rate suggest that smelter workers would have considerable difficulty finding replacement jobs. Shutdown of the plant is likely to result in increased out-migration, primarily by blue collar and service sector employees and members of their households. However, the extent of this out-migration depends greatly upon the alternative economic opportunities in the area and the re-employment services offered by the state and federal governments.

As shown in Table 4.18, the out-migration associated with closure of the smelters is not expected to have significant long-term impact on the size of

Table 4.18
MASTER Forecast of Economic and Fiscal Impacts for Portland MSA (Washington and Oregon)

Impacts	1985	1986	1987	1988	1989	1990	1995	2000	2001
EMPLOYMENT (Thousands of People)	8.9	9.4	9.3	9.2	9.2	9.2	9.0	9.0	9.0
TOTAL PERSONAL INCOME (Millions of 1984 $)	266.1	296.5	296.3	295.4	295.1	294.7	298.4	304.0	306.9
POPULATION (Thousands of People)	0.0	10.1	10.7	10.7	10.7	10.7	10.8	11.0	11.1
TOTAL GOVERNMENT EXPENDITURE (Millions of 1984 $)	0.0	12.5	13.1	13.1	13.1	13.1	13.3	-1.8	28.8
TOTAL GOVERNMENT REVENUE (Millions of 1984 $)	0.0	8.0	8.5	8.5	8.4	8.5	8.6	8.6	8.8

population in the Portland area, though it could have local effects on the smaller communities of Troutdale, Longview, and Kelso. In 1987, after the major impacts on population would have occurred, the Portland area population would be less than 0.1% lower with complete plant closure than with all three plants operating at full capacity.

Housing. The effects on housing of changing production levels at the three Portland area smelters are also expected to be moderate and dispersed among the large housing stock and numerous communities and neighborhoods in the MSA. Changes in demand for housing resulting from modification of production levels at the Troutdale Reynolds plant and the Vancouver Alcoa plant would be significant only in combination with other economic changes in the area--either substantial growth or significant decline--though localized community or neighborhood effects might occur. The housing market in Longview/Kelso is more likely to be affected, in particular by a complete closure of the local Reynolds plant, since layoffs in the wood products industry and the eruption of Mt. St. Helens have already contributed to out-migration and excess housing stock.

Public Services. The smelters' contributions to the tax rolls of the counties, the municipalities, the school districts, and the states--both through direct payments and through taxes paid by other businesses and smelter workers--are substantial. Nevertheless, because of the large tax base and the diversity of service recipients in the Portland MSA, changes in production levels at the two smelters are not expected to cause significant structural or service-level effects in the public sectors of the area. Because of their location in a large urban area, two of the three smelters do not constitute the primary or sole source of demand or revenue for any major public service agency or sector. In the Longview/Kelso area, the plant represents a relatively greater proportion of the local revenues, making the communities more sensitive to changing production levels than is true for communities located in the urbanized area immediately surrounding Portland. Complete closure of any of the three plants would be felt by the school district in which it is located, although none of the districts would be debilitated by such loss. As with the economic, demographic, and housing impacts discussed above, changes in operating levels at the smelters would become increasingly important should they be part of widespread trends of growth or decline that place high cumulative impacts on the area.

Land Use. No significant impacts on land use, comprehensive development or land use plans, or zoning are anticipated from changes in operating levels at the smelters, although interest has been expressed in the potential of annexing land adjacent to one of the smelters. None of the three smelters is in such an isolated location that its closure would be likely to result in change of land use from the industrial category.

Social. Although altered production levels at the three smelters are not expected to have profound community-level effects on the resources, social organization, or well-being of the communities in the Portland MSA, largely because the effects will be dispersed within a highly complex and diverse setting, individuals and their families and friends will be affected. These

effects will be generally positive should additional jobs and opportunities become available through increased production, and generally negative should the plant shut down. The impacts would be expected to be greater for Longview/Kelso, which is at some distance from the Portland metropolitan area; the community is less diversified economically, and has recently had to absorb the impacts of cutbacks in the lumber industry and a variety of economic consequences of the Mt. St. Helens eruptions of 1980. The personal, family, and social impacts of unemployment have been well-documented in numerous studies. Adverse effects include reduced economic well-being, increased stress, lowered self-esteem, family conflict, involuntary relocation, dependence upon social services, and others. Given the availability of adequate resources, the skills are available in the Portland area to provide effective assistance to unemployed workers in the future if the institutional and political arrangements can be organized and coordinated. As with the other aspects of socioeconomic impact, the magnitude and importance of the social impacts associated with closure of the smelters are heavily dependent upon the broader economic and social climate of the area at the time, as this will determine the range of alternatives available to dislocated workers, affected business, and the community as a whole.

4.3.1.2 Physical Environmental Impacts

Vancouver. Atmospheric releases are distributed by the prevailing winds which are primarily up the Columbia River during the winter and down the river during the summer. Data reported to the Washington State Department of Ecology for HF in air at ambient monitoring stations indicate monthly maxima of 0.10 to 0.22 $\mu g/m^3$ for 1981-1985. The standard for ambient F^- concentration is 0.5 $\mu g/m^3$ during the growing season and is based on levels that will not cause injury to sensitive plant species. Thus, the ambient levels of HF are below those reported to cause injury to plants.

Monthly forage samples reported to the Washington Department of Ecology indicate monthly F^- maxima of 6 to 43 ppm for 1981-1985. The standard for F^- in forage is 40 ppm average for 12 consecutive months, 60 ppm for 2 months and 80 ppm for no more than one month. The reported values appear to be well within the standard which is based on safe dietary levels for cattle. Thus no impacts are expected to animals grazing on forage near the plant.

There is no environmental impact from intake of cooling water from onsite wells. Heat is dissipated largely to the atmosphere from two onsite lagoons through which the waste water passes prior to release to the Columbia River.

To monitor toxicity of the industrial waste effluent, bioassays are conducted periodically in 96-hour static tests with rainbow trout (*Salmo gairdneri*). Exposed fish usually survive concentrations of 100% industrial waste water and 65% waste water diluted with onsite well water. Concentrations of trace elements in exposure solutions are determined for fluoride (<0.8 mg/L) and CN^-, Ni, Zn, Cr, Al, Sb, Cl, and SO_4 (all at nonlethal concentrations). The pH usually ranges from 7.8 to 8.4. Treated (chlorinated) sanitary wastes and

lagooned industrial waste water are rapidly mixed and diluted in waters of the lower Columbia River. As a result, no adverse impact to fish, aquatic birds and aquatic mammals is expected.

Shallow groundwater under the plant is contaminated with cyanide from waste piles that are no longer used and are presently sealed (Noble and Sebren 1983). The highest concentrations of cyanide occur in the silt zone near the surface. The cyanide is apparently leaching very slowly to an underlying layer of fine sand. The sand layer lies over a major, regional gravel aquifer that supplies the plant wells. Cyanide found south of the waste piles may move slowly toward the Columbia River, while cyanide north of the piles may move toward plant pumping wells. Evidence indicates that chemical breakdown of cyanide is occurring in the soil and that contamination of the river or aquifer is unlikely.

Longview. Ambient concentrations of fluoride in air are monitored at three stations near the plant. Monthly average values at the highest of the stations were 0.67 $\mu g/m^3$ but did not exceed 0.5 $\mu g/m^3$ during the growing season. The standards allow concentrations for a 30-day average of 0.84 $\mu g/m^3$ and 0.5 $\mu g/m^3$ during the growing season. Samples of forage taken from the 16 stations within 12 miles of the plant from July 1983 through June 1984 indicate a range of fluoride concentrations from 5 to 69 ppm, with an average maximum value of 36 ppm.

There is no significant impact from the intake of water from onsite wells. The waste water discharges are in compliance with state and federal regulations. Static bioassay tests on the effluent water with rainbow trout indicate no significant toxicity in 96-hour static tests of 65% dilution. That is, in semi-annual tests during the past seven years, a mixture of 65% effluent in control water has always passed the State's 80% survival rate criterion. Treated sanitary effluent is chlorinated and discharged to the Columbia River where rapid dilution occurs. There is no apparent impact on water quality or uses of the Columbia River. This method of disposal is common among industrial units located along the lower Columbia River.

Troutdale. Ambient atmospheric fluoride levels are monitored at stations near the plant and are well below the allowable levels (Table 4.19). No adverse effects on plants would be expected from the reported levels of fluorides.

The concentrations of fluorides in vegetation were also monitored (Table 4.20) and are within the levels established to protect animals eating forage. Thus no impact would be expected on domestic or wild animals consuming forage grown near the plant.

A survey was conducted in September 1975 to estimate the mixing zone for effluents in the Columbia River. The NPDES permit allows a 150-foot mixing zone,

Table 4.19
Ambient Atmospheric Concentrations of Pollutants at Reynolds Troutdale Plant

Component	Allowable	Actual Avg. Monthly Values
HF	0.78	
0.7 mi E[a]		0.09
1.5 mi W		0.20
Particulate F	No data	
0.7 mi E		0.07
1.5 mi W		0.15
Suspended Particulates	No data	
0.7 mi E		27
1.5 mi W		33

(a) Monitoring locations are placed in the directions of the prevailing winds and measured from the point of release.

Table 4.20
Concentrations of Fluorides on Vegetation (ppm F^- on a Dry Weight Basis) in the Area of the Reynolds Troutdale Plant

Location from Point of Release Sample Designation	Monthly Avg. Values[a] ppm F^- (dry wt) (1981)
20E 1.0mi-225 deg.	17.1
5 0.8mi-135 deg.	24.8
18 1.3mi-200 deg.	10.0
20B 1.5mi-270 deg.	34.7
4 2.1mi-115 deg.	27.6
4C 2.3mi- 90 deg.	22.6

(a) Allowable limits are 40 ppm for any 12 consecutive months.

and the Oregon Water Quality Division concluded that this was adequate on the basis of the study.[a] Fluoride concentrations at different points in the river are listed in Table 4.21.

Toxicity tests were conducted on rainbow trout in 1980 (Cummins and Gangmark 1981). No mortality was observed after 96 hours at 100% concentration of effluent water.

(a) Letter, G. Bruce Sutherland, Water Quality Division, Oregon Department of Environmental Quality to William Nichols, Reynolds Co., June 4, 1976.

Table 4.21
Mixing Zone Survey in the Columbia River; Reynolds Metals Co., Troutdale Reduction Plant, 1975

Location	Distance from Discharge Offshore	Distance from Discharge Downstream	Fluorides (mg/L)
A	50	50	0.18
B	100	200	0.46
C	100	1000	0.32

4.3.2 Mid-Columbia Area

4.3.2.1 Regional and Local Socioeconomic Impacts: Klickitat and Wasco Counties and The Dalles and Goldendale Communities

This impact assessment is based on comparison of two scenarios. One assumes full capacity production at both the Martin Marietta plant in The Dalles and the Commonwealth plant in Goldendale. This scenario would require restart of The Dalles plant that is currently shut down. The second scenario assumes that both plants are shut down.

Economic. Klickitat and Wasco Counties and the cities of Goldendale and The Dalles have been hard hit in recent years as a result of simultaneous slumps in the primary industries of aluminum, agriculture, and lumber. These three industries form the economic foundation of this region. Much of the economic future of the area depends on the status of these basic industries, as well as the ability to diversify the economic base and reduce the existing and historic dependency on large-scale industrial undertakings.

Unlike other study communities, The Dalles and Goldendale have actually experienced the recent shutdown of a major smelting operation. The Martin Marietta plant in The Dalles closed in December 1984 following employment declines since 1980. The effects of this shutdown were somewhat attenuated by the phased reduction in work force, the liberal severance pay agreement between Martin Marietta and its workers, and the ability of many former workers at The Dalles smelter to obtain employment at the Goldendale plant. As of August 1985, up to 300 former Marietta employees were commuting to the Goldendale smelter from The Dalles. Without these replacement employment opportunities, the economic impact of the Martin Marietta plant shutdown would have been far greater for Wasco County and The Dalles than it has been. The severance pay agreement, along with public maintenance programs (unemployment compensation, food stamps, etc.) have substantially reduced the overall economic effect of the plant closure. Community leaders emphasize, however, that the moderating influence of these transfer payments will eventually lessen, resulting in renewed economic pressure on the service, retail, and governmental sectors.

Given its size and current depressed condition, it is unlikely that additional reductions in the work force at the aluminum plants could be absorbed into the local economy. Smelter jobs pay more than most other jobs in the area, both in the public and private sectors, and the skills could not be substituted in

other sectors of the economy. The present unemployment rate for Klickitat County is estimated to be over 19%. Given this existing high level of unemployment, any further layoffs resulting from partial or total plant closure would exacerbate an already problemmatic situation and would result in greater levels of unemployment.

Another main concern associated with a plant shutdown is the effect this would have on local retail sales. Businesses are currently experiencing a lower level of sales as a result of the layoffs to date, although they say that they are not losing customers. The retail sector in Goldendale is limited, but relatively stable, serving a wide market area. Its patterns of growth and decline are closely tied to the status of the aluminum industry, since the plant is such a large employer (the largest corporate employer in the area) and plant employees are among the highest paid in the area.

To operate the two mid-Columbia area plants at full capacity would entail employment of 750 additional workers from mid-1985 levels; complete closure of both plants would result in a direct loss of 930 jobs (from mid-1985 levels). The indirect employment associated with companies supplying the aluminum plants is estimated to be 575 jobs. As shown in Table 4.22, the total employment difference (including direct, indirect, and induced employment) between the full capacity and the complete closure scenarios (assuming closure in 1985) is on the order of 4200 to 4500 jobs. The ratio of total employment to direct employment, or the economic multiplier for the mid-Columbia area is thus 2.6--one smelter job resulting in a total employment change in the area of about 2.6 jobs. The method of deriving the indirect impacts is discussed in Chapter 4.1 and Appendixes A-B and A-C.

Within this context, expansion of the Commonwealth smelter to full production levels and the reopening of the Martin Marietta smelter would be viewed as a positive contribution to recovery of the area economy. The lumber and agricultural industries remain vitally important to the regional economy, however, since the Martin Marietta facility closed, the area has become increasingly dependent upon the economic condition of the Commonwealth plant, in terms of employment, local purchases, and tax payments.

Impacts from plant closure would be felt both in Goldendale and in The Dalles, where a significant proportion of the remaining plant workers are living.

Demography. An out-migration has already occurred as a result of The Dalles facility shutdown. Although the large majority of layoffs occurred among hourly employees who had worked at the plant for less than 7 years, many of these workers remain in the area. According to local accounts, most of those who left the area were managerial or executive level employees. In the spring of 1985, 200 workers were laid off at the Goldendale facility, but at the time of the field research (June 1985), no significant out-migration had occurred, a fact attributed to workers preferring to wait until the end of the school term and to the ability of workers to obtain alternative employment.

Table 4.22
MASTER Forecast of Economic and Fiscal Impacts for Wasco County, Oregon, and Klickitat County, Washington

Impacts	1985	1986	1987	1988	1989	1990	1995	2000	2001
EMPLOYMENT (Thousands of People)	4.2	4.3	4.3	4.3	4.3	4.3	4.3	4.5	4.5
TOTAL PERSONAL INCOME (Millions of 1984 $)	135.2	149.4	149.1	149.8	151.8	152.6	161.1	171.6	174.7
POPULATION (Thousands of People)	0.0	4.7	4.9	4.9	4.9	5.0	5.2	5.4	5.5
TOTAL GOVERNMENT EXPENDITURE (Millions of 1984 $)	0.0	9.4	9.7	9.7	9.7	9.9	10.4	10.8	11.0
TOTAL GOVERNMENT REVENUE (Millions of 1984 $)	0.0	5.9	6.1	6.1	6.2	6.2	6.3	8.8	8.9

Operation of both the Commonwealth and Martin Marietta plants at full operation would stabilize local population and attract in-migrants (or returnees) to the area. If the expansion occurred in the short term, it is anticipated that in-migration would be moderated by the availability of workers who have not yet left the area. Total, permanent plant closure would result in increased out-migration, since the limited absorptive capacity of the area economy would be exceeded. However, since the remaining aluminum industry work force in the area consists of those with long tenure, personal and financial ties to the area might limit, or slow, residential mobility. Loss of additional managerial and blue collar manufacturing workers would reduce the diversity of the area population, especially in the more rural Klickitat County.

MASTER forecasts, shown in Table 4.22 and Appendix A-B show population impacts (difference between full capacity at both plants and complete shutdown at both plants) ranging from 4.7 thousand persons in 1986 to 5.5 thousand in 2001. This means that with both plants closed, the population of the two-county area would be roughly 11% lower in 1987, when the major impacts of migration would have occurred, than with both plants operating at full capacity. This difference increases to about 13% in 2001.

Housing. As a result of the recent layoffs at the plant, the housing market in both Klickitat and Wasco counties is already extremely soft. Out of the total 650 people currently employed at the Goldendale plant, it is estimated that only 100 live in Goldendale itself. Approximately 250 live in The Dalles; the rest are scattered primarily throughout Klickitat County in the area surrounding Goldendale. The out-migration of plant workers from the shutdown of the Martin Marietta plant and the work force reduction at the Commonwealth plant has left a number of empty homes. The oversupply of available housing has had the dual effect of drastically reducing the sale value and prolonging the length of time homes stay on the market.

The Dalles has also felt the effects of reduced aluminum industry employment. Herb Crook, Jr., county assessor in Wasco County, estimates that the assessed value of homes in The Dalles has declined an average of 15% since 1984; this is partly attributable to the Martin Marietta shutdown. Shutdown of aluminum smelting in the area, particularly if followed by heightened out-migration, would further depress the housing market and make it difficult for departing workers to sell their homes.

If the Goldendale plant were to expand to full production and the Martin Marietta plant were to reopen, the housing market would improve, as indicated by the impact on the housing market in the 1970s during the construction and expansion of the Goldendale plant. This improvement would be particularly pronounced if the expansion were accompanied by significant reduction in the uncertainty concerning stability of employment at the aluminum smelters. If local efforts to attract additional new businesses and industries into the area are effective and correspond temporally with the recovery of the aluminum industry, the current excess housing supply could be eliminated relatively promptly. The existing buyers' market in housing is, in fact, one of the selling points used to attract outsiders into the area.

Public Services. The Commonwealth plant is a major contributor to most public service organizations in Klickitat County. It accounts for approximately 40% of the property tax revenue of Klickitat County, and provides large contributions to the Goldendale School District, the Fire District, and the Road District budgets.

The Goldendale plant does not pay taxes directly to the city of Goldendale. Given the relatively limited number of purchases made by the company in Klickitat County or Goldendale, and the limited (approximately 100) number of plant employees/households in Goldendale, impacts on city revenues from plant closure would be less severe than at the county or school district level. Principal revenue effects in Goldendale would be reduced retail sales tax revenues resulting from reduced spending. Nevertheless, closure of the Goldendale plant was expected to cause substantial staff reductions within the city government during the first few years following the shutdown. This is due, in part, to reductions in service fees as unemployed workers left the area.

Klickitat County would be particularly hard-pressed to recover from the loss of revenue generated by the Commonwealth plant. Because most of the county is unincorporated, the county government service area is large and its staff capacity is already strained. A plant shutdown would necessitate budgetary cutbacks and curtailment of service levels. In an attempt to mitigate the impacts of a shutdown as well as to improve the overall condition of county finances, Klickitat County has established an Economic Development Organization (to function independently of the Mid-Columbia Economic Development District, of which it is also a member) that will refine and help implement economic diversification strategy for the county.

The Goldendale School District relies on the plant not only for tax revenues, but for enrollment levels upon which state assistance is granted. Estimates provided by school district administrators indicate that shutdown of the Commonwealth plant would reduce student enrollment by up to 30%, assuming an out-migration rate of 60% during that period. This would translate into a revenue loss of $700,000 (current level is $4 million). Because of contractual obligations, the size of the staff could not be reduced immediately and this would create budgetary difficulties. With a smaller student population and the resulting reduction in state assistance, school administrators are concerned that certain special programs would have to be eliminated from the curriculum. Another negative impact on the schools would be loss of many actively involved and supportive parents, who contribute their time and energy to extracurricular and academic activities.

The Dalles is currently experiencing a budget squeeze resulting from a loss in property tax revenue caused by the Martin Marietta plant closure, increased tax delinquencies, population reduction, and general decline in property values in the county. For example, as a result of the loss in property tax revenues, the Chenowith School District in the western portion of The Dalles laid off four teachers for the 1985-1986 school year despite stability in school enrollment levels. At the same time, providers of public services are being pressured to increase local government spending because there is increased demand for welfare and social services, and local government is being pressured to recruit replacement industry.

Land Use. The Commonwealth plant occupies most of the land zoned for heavy industrial use in Klickitat County. If the plant were to close, it is not clear whether the plant would be physically removed, or if the area would be rezoned for nonindustrial uses. It is not likely that the site would be designated for any other nonagricultural or recreational purpose in the near future, given its distance from population centers and the current interest in developing lower areas of the Columbia River Gorge as a national park or national scenic area. This is one of the few sites in the study where strong pressure might be exerted to remove the plant and reclassify the land for nonindustrial use.

Although there has been no significant impact on land use, land use plans, or zoning as a result of the closure of the Martin Marietta plant, the city of The Dalles recently passed a $4.5 million bond issue to develop 114 acres of individual property adjacent to the Martin Marietta holdings in order to attract replacement industry.

Operation of the plants at full capacity would not affect land use, land use plans, or zoning in either Klickitat or Wasco County.

Social. Impacts on social structure and community organization will be highly significant in the event that both the Goldendale and The Dalles plants are shut down. The out-migration of the white collar and blue collar workers will most likely not be replaced by a parallel in-migration. Stress will be created by both population loss and any extended periods of unemployment sustained by former workers trying to remain in the area.

A large-scale out-migration would result in a substantial change in the social structure of the area, given the small population of Goldendale and Klickitat County and its relatively undiversified economic base. The loss of the plant managers and white collar workers and their families would be particularly noticeable in the community civic and social organizations where this group has played a particularly vital role. Evidence thus far points to problems of apathy and complacency among the rest of the community as a result of The Dalles plant closure.

Increased financial pressure emanating from a loss of revenues could divide the community and negatively affect relations between the public and private sectors. This is particularly true at the county government level, where losses will be quickly felt and where the large service area will be directly forced to cope with reduced services and higher service fees, and in some areas, increased demands for service. The inevitable cutbacks faced by all public sector institutions will bring on potentially divisive issues of resource distribution, which could further strain a social structure already undergoing an uneasy transition.

In addition to the adverse economic impacts caused by plant closure, the quality of life in the communities may be seriously impaired by drastic curtailment of employment opportunities in the area. There is evidence that individuals experiencing job loss tend to withdraw from community life. Stricken communities thus face reduced participation in social organizations such as churches,

and in civic and social groups. This withdrawal can dampen community vitality, weaken social cohesion, and create a generally dreary climate that encourages out-migration and exacerbates community economic problems. To date, The Dalles seems to have avoided severe effects of this type, but additional, substantial reductions in jobs and economy could strain the coping ability of the community beyond its capacity and severely affect its vitality and quality of life. (Gordus, Jarley and Ferman 1981.)

4.3.2.2 Physical Environmental Impacts

The Dalles. From July 1982 through June 1983, monthly average levels of HF were less than 0.22 $\mu g/m^3$ at four ambient sampling stations. The reported levels did not exceed standards established to protect sensitive plant species, and therefore no significant impact is expected on plants should the smelter restart and operate as it previously did.

The reported levels of fluoride in the discharge (16 mg/L) exceed the tolerance reported for trout (2.3 to 7.5 mg/L), however, dilution in the Columbia River would rapidly reduce the concentration to below the lethal level, and no major impact would be expected.

Goldendale. The meteorological and ambient air quality monitoring networks have been described by Campbell et al.;[a] compliance with all applicable ambient air quality standards is demonstrated also.

Detailed meterological sampling has been conducted for the Goldendale plant by Campbell et al.[a] Their report provides a thorough description and analysis of the ambient air quality and meterological monitoring plan required by EPA, Region X, for the 1982 PSD permit application for the expansion of the Goldendale plant. The following discussion quoted from Campbell et al. provides the results of the post-expansion monitoring:

> Particulates. Particulate levels (Tables... V-2) [Table 4.23] were well below the National Ambient Air Quality standards... following expansion.... The highest annual geometric mean was 21 $\mu g/m^3$ at Station G in 1983; this is well below the state standard of 60 $\mu g/m^3$. The highest 24-hr TSP level occurred on September 15, 1984, (see Table V.2) [4.23] when all samplers indicated levels of about 110 $\mu g/m^3$; this is below the secondary state and secondary federal standard of 150 $\mu g/m^3$. On that date, winds were from the southwest for the whole day and were fairly strong for much of the day. The fact that the samplers upwind and downwind of the plant measured the same TSP level indicates that little of the sampled dust came from the plant. Except for this day, during the 2 years after plant expansion all levels were less that 60% of the secondary standard. Particulate levels continued to be low during the first quarter of 1985....

(a) Campbell, S., R. Brower, R. Lanza, N. P. Feffer, and K. Zankel. 1985. PSD Permit Revision Application for the Goldendale Aluminum Plant. Martin Marietta Environmental Systems, Columbia, Maryland.

Table 4.23[a]
Summary of Ambient TSP Levels for 1984 in
the Vicinity of the Commonwealth Goldendale Plant

Averaging Time	Washington Standard ($\mu g/m^3$)	Station G TSP Concentration ($\mu g/m^3$)	Date	Station H TSP Concentration (μ/m^3)	Date	Station J TSP Concentration ($\mu g/m^3$)	Date
Highest 24-hr average	150[b]	109	09/15	110	09/15	107	09/15
2nd highest 24-hr average	150[b]	78	07/23	89	10/03	89	10/03
Annual geometric mean	60[c]	17	--	18	--	20[d]	--

(a) Table V-2 from Campbell et al. cited on p. 4.41.
(b) 120 $\mu g/m^3$ plus background, if background > 30 $\mu g/m^3$.
(c) 40 $\mu g/m^3$ plus background, if background > 20 $\mu g/m^3$.
(d) Based on 11 months of data.

Fluorides. In the request for modifications to the existing permit,... ground-level concentrations of HF were projected to be less than those allowed under Washington regulation. The ambient data demonstrates that when NSPS are met, standards are not contravened. Table... V-5 [4.24] show[s] the... ambient HF levels for the averages of periods specified in the Washington Ambient Air Quality Standards. [This table does] not include data from January 1983, when emissions were very high due to start-up of "D" room; from December 1983 and January 1984, when the pipes were frozen and the secondary control system was not operating; or during July 1984, when HF emissions from the plant were very high due to severe operating problems resulting from the presence of shot coke in the anodes and excessive anode burning....

Although Station J was established at the location that modeling projected to have the highest impact, 1984... data (Table... V-5...) [Table 4.24] show[s] that Station J has lower average HF levels than Station H for averaging periods of 7 days or longer. The maximum 24-hr impacts of Stations H and J appear comparable.

Fluoride analyses of forage samples collected during 1983 and 1984 indicate that the 12-month standard of 40 ppm was not exceeded, even though emissions were higher than NSPS during 1983. The highest single mean for any station, 11.3 ppm, occurred at Station G in July of 1983. The highest monthly level at any of the other stations was less than 17 ppm. Since Station G does not supply livestock feed, levels at all sites are well below forage fluoride standards of 60 ppm not to be exceeded for more than 2 consecutive months, 80 ppm not to be exceeded more than once in any two consecutive months, and 40 ppm not to be exceeded in cured forage for sale as livestock feed.

It appears from the monitoring data that when the expanded aluminum smelter is operating within NSPS, it is also in compliance with all of the State of Washington's ambient HF and fluoride forage standards."

Detailed air modeling results predict that the plant likely meets all applicable state and federal standards for ambient air quality and that ambient particulate concentrations are below the allowable prevention of significant deterioration (PSD) class increments. Particulate emissions will have a minimal effect on visibility, soils, and vegetation. The results imply that impacts on the elevated plateau, approximately 1.5 km to the northwest of the facility, are negligible.

The maximum surface concentration of effluent in the Columbia River is at the point the discharge reaches the surface, where it is diluted by a 60:1 ratio. Fluoride concentrations measured in the river indicate a dilution to 150:1 at 300 ft from the discharge point (Bryan M. Johnson and Associates, Inc. 1972).

Table 4.24[a]
Summary of Ambient HF Levels for 1984 in
the Vicinity of the Commonwealth Goldendale Plant

Averaging Time	Washington Standard ($\mu g/m^3$)	Station G HF Concentration ($\mu g/m^3$)	Date	Station H HF Concentration (μ/m^3)	Date	Station J HF Concentration ($\mu g/m^3$)	Date
24-hr highest	2.9	1.73	2/1-2/2	2.20	11/12-11/13	2.37	11/11-11/12
24-hr 2nd highest		1.56	5/18-5/19	2.19	12/19-12/20	1.75	8/8-8/9
7-day highest	1.7	0.70	10/2-10/8	1.18	10/1-10/7	0.704	10/1-10/7
7-day 2nd highest		0.55	3/3-3/9	1.02	2/9-2/15	0.703	11/7-11/13
30-day highest	0.84	0.42	8/6-9/4	0.65	1/31-2/29	0.30	8/7-9/5
30-day 2nd highest		0.40	10/1-10/30	0.62	9/24-10/21	0.28	10/22-11/20
Seasonal (3/1-10/31)	0.5	0.30	3/1-10/31	0.32	3/1-10/31	0.25	3/1-10/31

(a) Table V-5 from Campbell et al. cited on p. 4.41.

Most of the time the dilution ratio is 300:1 at 900 ft, however, exceptions occur during high winds. For example, on one occasion with 20 mi/hr downstream winds, the observed fluoride concentration 900 ft below the outfall was 0.42 mg/L, or 0.20 mg/L above the background level.

There has been concern that fluoride from plant operation may have delayed adult salmon migration at John Day Dam. However, Damkaer and Dey (1985) concluded that recent changes in plant operation resulting in reduced levels of fluoride in the plant effluent have reduced this concern. Because of the ecological uniqueness of the mid-Columbia area there has also been concern about the potential effects of air pollutants, such as fluorides, upon populations of plants or animals near the extreme limits of their ecological niche. Such populations are more readily affected by environmental perturbations than are populations near the center of a species distributional range. However, the continued operation of the Goldendale plant in compliance with air quality standards and the closing of The Dalles plant suggests that this currently is not a problem.

4.3.3 Upper Columbia Area

4.3.3.1 Regional and Local Socioeconomic Impacts: Chelan County and Wenatchee

In this analysis, the full-capacity scenario assumes that the Alcoa facility would increase employment by 50 over the 1985 level of 950 workers. The difference between the full capacity (high) and closure (low) scenario would thus be 1000 aluminum industry jobs. In addition to the full capacity and plant closure cases for the Alcoa facility, an additional case in which the plant operated at two-fifths capacity (medium) was also examined, since Alcoa has a low-cost non-BPA power supply that is sufficient to operate two of the plant's five potlines. In this alternative, plant employment was estimated to be 400 workers, 600 workers below the full-capacity scenario.

Economic. Historically the local and regional economies of Chelan (and Douglas) County have been based primarily upon the orchard industry. The establishment of the Alcoa smelter contributed to social and economic diversity and to the establishment of a strong middle income group in the area. Loss of 1000 highly paid jobs in the aluminum industry is likely to have substantial impact on both the employment in the region and on the local economies. MASTER forecasts that an estimated 588 indirect jobs (in industries supplying the smelter) are created in Chelan County by the plant at full production. In addition, approximately 980 other jobs (induced employment) are generated by the plant at full capacity. As shown in Table 4.25, the total difference in employment between the full capacity and shutdown cases is estimated to be between 2500 and 2700 jobs. In the medium scenario, (2/5 production) indirect and induced job losses were estimated to be 340 and 575 jobs, respectively, and total induced, direct, and indirect employment loss compared to the high scenario was estimated to be between 1500 and 1600 jobs. For the Chelan County area, the employment multiplier--the ratio of total employment to direct plant jobs--is estimated to be 2.6. This means that each smelter job lost translates into a total loss for Chelan County of 2.6 jobs.

Table 4.25
MASTER Forecast of Economic and Fiscal Impacts for Chelan County, Washington

Impacts	1985	1986	1987	1988	1989	1990	1995	2000	2001
EMPLOYMENT (Thousands of People)	2.6	2.6	2.7	2.7	2.7	2.7	2.7	2.6	2.5
TOTAL PERSONAL INCOME (Millions of 1984 $)	83.8	92.2	92.8	93.2	95.0	94.8	95.7	94.4	94.3
POPULATION (Thousands of People)	0.0	2.9	3.0	3.0	3.1	3.1	3.1	3.0	3.1
TOTAL GOVERNMENT EXPENDITURE (Millions of 1984 $)	0.0	9.4	9.7	9.7	9.7	9.9	10.0	9.9	9.9
TOTAL GOVERNMENT REVENUE (Millions of 1984 $)	0.0	5.2	5.3	5.4	5.3	5.5	5.5	5.5	5.5

It is unlikely that laid-off aluminum workers will be able to find comparable jobs in the region. Even if they were willing to take lower playing jobs, current conditions indicate that they would face considerable competition. The plant workers least likely to find an alternative local market for their skills are the long-time potline workers.

The tenuous economic situation that would be created by an Alcoa shutdown would make the region more sensitive to changes in the orchard industry. Although the orchard industry in the area is considered relatively stable, it is facing increasing national and international competition. Thus, closure of the Alcoa plant would place considerable stress on a local economy that may not be able to counter with growth in other sectors.

Chelan County and Wenatchee have experienced fluctuations in employment at the Alcoa plant in the past. However, given the importance of the aluminum industry to the area's economy, permanent shutdown would have substantial, long-term, adverse economic impacts on the area. Although community officials and concerned citizens have taken initial steps to diversify the area economy and to attract additional development, no comprehensive development plan has yet been completed.

A major difficulty for the community in its efforts to diversity is the limited resource base in Chelan County. A majority of the land is owned by the state and federal governments; there is very little land available for industrial use and there is a strong local sentiment for protecting the integrity of the natural environment.

An intergovernmental consortium including the Ports of Chelan and Douglas Counties, the joint Economic Development Commission (both counties), and the Chambers of Commerce for each county is currently collaborating to urge planning commissions to coordinate economic development activities and promote economic diversity in the region. Success in these efforts would help to offset the consequences should the aluminum smelter be closed permanently; continued operation of Alcoa at full production would help stabilize the economy of the area, although it might reduce local efforts toward diversification.

Demographic. The population of Wenatchee and Chelan County has remained relatively stable for several years. Continued operation of the Alcoa plant would contribute to this stability and serve as a basis upon which growth could occur if efforts to diversify the area were successful. Should the plant shut down, it is expected that many of the workers would try to stay in the area as long as possible. If the shutdown were temporary (from 6 to 12 months), outmigration would probably be limited, since recalls would begin before most workers had decided to leave.

Because the plant is a long-established part of the community, a high proportion of its work force are long-term employees with strong economic and social

ties to the area. In addition, the quality of life in the area is attractive to many of the current residents, creating a strong incentive to remain in the area if at all possible. Even if there are few employment opportunities in Wenatchee itself, the strong community ties of area residents indicate that unemployed workers may be willing to commute relatively long distances in order to remain in Wenatchee. Once the direct and induced economic effects of a permanent shutdown start to occur, however, laid-off employees and their families will be forced to think more seriously about leaving permanently.

The reduced wage and salary income that would result from plant shutdown and its effects on the retail community and the tax base will put considerable strain on public services such as education and public safety. This will lower the general quality of life in the area and may well contribute further to out-migration by both Alcoa workers and people whose businesses and life styles have been negatively affected by the shutdown. Forecasts by the MASTER model (shown in Table 4.25) indicate that in 1987, after the major impacts of migration would have occurred, the Chelan County population would be roughly 6% lower in the plant closure case than if the plant were operating at full capacity. In 2001, this difference would be reduced to 5%.

Housing. Reflecting recent population trends, the housing stock and housing market in Wenatchee have been relatively stable over the past several years. The strong relationship between Alcoa and the development of a middle income group in the area is reflected in the growth of the middle income neighborhoods during the 1950s and 1960s. Expansion of the plant to full capacity would not cause significant impact on the housing market. However, in the event of a permanent shutdown and an eventual out-migration of Alcoa employees and other affected workers and their families (up to 6% of the county population), the market would be substantially affected, as there would be few potential buyers for these homes. Should many of these out-migrants be faced with foreclosures, the lack of potential buyers could affect local lending institutions.

Public Services. Increasing plant operation from current to full capacity would have little impact on the fiscal condition of the city or county budget. However, the city of Wenatchee would be significantly affected by a permanent plant shutdown. Table 4.25 presents MASTER forecasts of total government revenues and the difference between the high and low scenarios. The loss of revenue through reduced retail sales taxes and an overall shrinkage of the tax base related to a reduction in individual income is likely to trigger a necessary reduction in public sector employment by about 10-15% (full-time equivalents). Those losing their jobs first would be the ones not covered by special mandated union contracts, such as the Public Works Union, International Firefighters, AFL-CIO, and the Police Guild. Reductions in work force can be expected to lower the quality of services and reduce their availability. In general, the present level of reserves would carry the city government through a 12-month period.

If the plant were shut down permanently, the loss of property tax revenue would be significant, putting an added strain on the rest of the taxing jurisdictions. City and county government, as well as the school district, would be significantly hurt by a loss of this revenue, and employment reductions under

these circumstances are likely. Since state assistance to public schools is based on enrollment levels, out-migration of a substantial portion of local families, such as that forecast by the MASTER model, would result in a reduction in this source of funding. This could lead to difficulties in the district's ability to maintain buildings and other school facilities, as well as reductions in the number and variety of educational programs and curriculum offerings.

The initial period of unemployment would be eased by unemployment benefits, including the Supplemental Unemployment Benefits provided by Alcoa. At present there are 740 people entitled to these benefits. Impacts of a permanent shutdown on social and health services would manifest themselves once unemployment benefits expired. Although many of the applicants for welfare payments may not immediately qualify for assistance from the state Department of Social and Health Services (DSHS) because of their assets (homes, RVs, boats, etc.), many others will. Besides increasing the numbers eligible for assistance, duration of assistance may be extended, placing a strain on the capacity of the DSHS to provide these services throughout the county. To provide these services effectively, local and state officials will have to coordinate their efforts.

Land Use. The likelihood that the Alcoa plant would be purchased in the event of a shutdown seems to be slight, given the expense associated with converting the plant to another type of manufacturing. The plant site is within an area zoned for heavy industry; according to the Wenatchee Urban Area Comprehensive Plan of 1972, that zoning will remain in effect for at least 20 years.

Social. Unemployment and competition for scarce jobs can result in various kinds of stresses upon individuals, families, and communities. Any increase in unemployment, such as occurs with partial shutdown, or a total but temporary shutdown, is likely to be followed by an increase in the level of uncertainty in the community. This contributes to various types of social disruption such as racial tensions, domestic violence, and alcohol abuse. Although the demand for public assistance would be lower under the partial and temporary shutdown cases, the degree of uncertainty and tension may be as high or higher than under the permanent shutdown condition.

A permanent shutdown of the Alcoa plant can be expected to affect the overall social well-being of the area. Besides the likely social consequences mentioned above, other elements of the local social organization such as church groups and the numerous civic organizations will also be affected. These organizations can play an important role in the early stages of an economic downturn by helping to mitigate the financial and personal difficulties experienced by laid-off workers, however, they cannot completely ameliorate the adverse effects of economic depression and unemployment.

4.3.3.2. Physical Environmental Impacts

Wenatchee. Atmospheric emissions from the plant are distributed by prevailing winds that are east by southeast at Wenatchee. This is essentially down the Columbia River, which has high bluffs on both sides in this area. Winds blow 75% to 95% of the time at the site.

Hydrogen fluoride (HF) is monitored daily at two ambient stations. One is located 4.5 mi southeast of the plant and the other is located 1 mi west of the plant. Concentrations in ambient air for 24 hr are determined in $\mu g/m^3$.[a] Ambient air concentrations of HF at the downwind station exceeded the state limit of 0.5 $\mu g/m^3$ during the growing season only once over the past 15 years. Maximum ambient concentrations of HF were evident in July 1984, when the monthly average was 1.19 $\mu g/m^3$. From March 1984 to October 1984, ambient concentrations of HF at the upwind station were consistently less than the state limit of 0.5 $\mu g/m^3$.

Because new dry systems for removing gaseous fluoride were installed in April and May 1985, ambient air concentrations of HF at both stations were consistently less than 0.4 $\mu g/m^3$. Concentrations downwind (SE) were somewhat less than those to the west, perhaps in part because of the greater distance to the downwind station. While there are not much data available after installation of the new systems, early monitoring indicates that ambient HF levels will not cause significant impacts to plant species.

Ambient fluoride content of forage is monitored monthly at four stations surrounding the plant. The stations are 2 mi west, 2.7 mi northwest, 0.7 mi north, and 0.5 mi southeast (in the direction of prevailing winds).[a] The average levels of F^- in forage from March 1984 to October 1984 were 11.7, 17.4, 8.1, and 36.7, at the respective stations. For April and May 1985, after installation of the new emission control systems, concentrations in forage were somewhat lower. Future data can be expected to show further decline. However, even before installation of the new systems, the levels of fluoride in forage from downwind stations were within state standards. No significant fluoride impact on animals consuming forage near the plant is anticipated.

Industrial waste water discharge at the Alcoa Wenatchee plant is monitored continuously for trace elements, including fluoride. In addition, 96-hour static bioassays with rainbow trout (*Salmo gairdneri*) are conducted periodically. Fish are exposed to 65% waste water, with dilutent and control water from plant wells. Concentrations of selected trace elements, including fluoride, in exposure solutions are determined by chemical analysis. Fish survival is typically 100%.

There appears to be no adverse impact from solid wastes stored on the plant site. No information is available on possible leachate from buried or landfill wastes. However, an average of only 9 in. of precipitation annually in this arid region suggests a much lower probability of a problem than may occur in an area of higher precipitation.

(a) J. A. Thompson. Letter and material submitted July 5, 1985, from National Environmental and Industrial Hygiene Manager of Alcoa Wenatchee Plant.

4.3.4 Lower Puget Sound

4.3.4.1 Regional and Local Socioeconomic Impacts: Pierce County and Tacoma

Economic. Because of the size of the Tacoma economy, with wage and salary employment of about 150,000, the effects of changing operating levels at the Kaiser smelter will be diffused. Unlike some other aluminum smelter communities where direct plant employment accounts for a sizable percentage of total wage and salary employment, employment at the Kaiser smelter in Tacoma accounts for substantially less than 1% of all wage and salary jobs in Pierce County. For this reason, expansion or closure of the Kaiser plant will produce less dramatic community-level effects than similar actions in smaller economies.

Results from the MASTER model for the Pierce County area are shown in Table 4.26. The Tacoma plant currently is operating at near capacity and the full-capacity scenario is based on only a 25 job increase in employment from current levels. Plant closure would mean a direct loss of 475 jobs, assuming the shutdown would occur in 1985, and an estimated indirect impact (loss of jobs at local companies supplying the aluminum plant) of an additional 294 jobs. The total employment impact (difference between full production and shutdown of the plant) for the Pierce County area, assuming closure in 1985, is approximately 1,200 to 1,300 jobs. This estimate indicates an employment multiplier of 2.5--that is, a job lost at the Kaiser plant in Tacoma translates into a total job loss for the Tacoma MSA of two and one-half jobs. The method for deriving the indirect and induced impacts is discussed in Chapter 4.1 and Appendices A-B and A-C.

At full operations, the Kaiser smelter in Tacoma would assist the community in maintaining its durable manufacturing and heavy industrial sectors, which have experienced decline in recent years. Full operations would contribute to the continuing diversity of the area's economy, and would provide a range of occupations for area workers.

Shutdown of the Kaiser Tacoma smelter would create hardships for its employees, who would have difficulty finding comparable employment within the region, and for their families. In addition, it would have adverse economic consequences for many firms and workers in Pierce County and Tacoma as a result of reduced purchases by the company and its workers. Although these impacts might be relatively dispersed, given the urban nature of the locale, they would follow after similar effects from closure of the ASARCO smelter and reductions in work force at Tacoma Boat. Loss of jobs may create important demands on individuals, families, and community services in Tacoma/Pierce County, just as they would in smaller communities.

Demographic. The demographic effects of changes in production levels at the Kaiser Tacoma plant depend heavily upon economic conditions in the area at that time. Experience at ASARCO indicates that many of the workers are likely to wish to remain in the community, or at least in the Pacific Northwest, and to

Table 4.26
MASTER Forecast of Economic and Fiscal Impacts for Tacoma, Washington, MSA

Impacts	1985	1986	1987	1988	1989	1990	1995	2000	2001
EMPLOYMENT (Thousands of People)	1.2	1.1	1.1	1.1	1.2	1.1	1.2	1.2	1.3
TOTAL PERSONAL INCOME (Millions of 1984 $)	35.5	39.8	39.8	39.9	40.3	40.6	43.7	49.6	-348.7
POPULATION (Thousands of People)	0.0	1.2	1.4	1.4	1.4	1.4	1.5	1.6	1.6
TOTAL GOVERNMENT EXPENDITURE (Millions of 1984 $)	0.0	2.7	2.8	2.8	2.9	2.9	3.1	3.4	3.5
TOTAL GOVERNMENT REVENUE (Millions of 1984 $)	0.0	2.4	2.5	2.5	2.5	2.5	2.6	3.0	3.1

resist moving. However, there are indications that the local economy may have been nearly saturated by efforts to find positions for previously unemployed workers, making it difficult to find further additional jobs of this type. Additionally, the size of the population base in Pierce County (463,810 in 1980) makes it unlikely that population structure will be significantly affected by changes at the Tacoma Plant.

Shutdown of the plant is likely to result in increased out-migration, primarily by blue collar and service sector employees and members of their households. However, the extent of this out-migration depends very heavily upon the alternative economic opportunities in the area. It is not anticipated that the out-migration associated with closure of the Kaiser plant would have significant long-term impact on the size of population in Pierce County or Tacoma. As shown in Table 4.26, the MASTER model indicates that after the major impacts of migration have occurred (by 1987), the Tacoma population is roughly 2% lower in the plant closure case than in the full-capacity case. By 2001, the population difference is 1%.

Housing. The effects on housing of changing production levels at the Kaiser plant are also expected to be moderate and dispersed among the large housing stock and numerous neighborhoods in Pierce County and Tacoma. Changes in demand for housing associated with changing production levels at the Kaiser plant would become significant only in combination with other economic changes in the community--either substantial growth or significant decline.

Public Services. Because of its location in a large urban area, the Kaiser smelter does not constitute the primary or sole source of demand or revenue for any major public service agency or sector. The public sector most directly affected by the Kaiser plant is the Port of Tacoma, which conducts approximately $1 million of business with Kaiser each year. Kaiser's contributions to the tax rolls of the county, the municipality, the school district, and the state--both through direct payments and through taxes paid by other businesses and Kaiser workers--are substantial. Nevertheless, because of the large tax base and the diversity of service recipients in Tacoma and Pierce County, changes in production levels at the Kaiser plant are not anticipated to cause significant structural or service-level effects in the public sectors of the area. As with the economic, demographic, and housing impacts discussed above, changes in operating levels at the Kaiser plant would become increasingly important should they be part of widespread trends of growth or decline that place high cumulative impacts on Pierce County and Tacoma.

Land Use. No significant impacts on land use or zoning are anticipated from changes in operating levels at the Kaiser plant. Since alternative use of the smelter structures is unlikely and the expense of dismantling is high, it is not clear when and if further use can be made of the site.

Social. Although altered levels of production at the Kaiser plant are not expected to have profound community-level effects on the resources, social organization, or well-being of the communities in Pierce County, largely because the effects will be dispersed within a highly complex and diverse setting, individuals and their families and friends will be affected. These

effects will be generally positive should additional jobs and opportunities become available through increased levels of production, and generally negative should the plant shut down. The personal, family, and social impacts of unemployment have been well-documented in numerous studies. Adverse effects include reduced economic well-being, increased stress, lowered self-esteem, family conflict, involuntary relocation, dependence upon social services, and others.

By their response to the ASARCO shutdown, Tacoma and Pierce County have demonstrated their intention and ability to assist workers and their families--and the community--with the dislocations associated with plant closures. Consequently, it is anticipated that, given the availability of adequate resources, the community is in a good position to provide effective assistance to unemployed workers in the future. As with the other aspects of socioeconomic impact, the magnitude and importance of the social impacts associated with a closure of the Kaiser plant are heavily dependent upon the broader economic and social climate of the area at the time because this determines the range of choices available to dislocated workers, affected businesses, and the community as a whole.

4.3.4.2. Physical Environmental Impacts

Tacoma. Ambient concentrations of HF are monitored daily at a station one mile northeast of the plant (which is the downwind direction from the release point), and 400 ft above the valley floor. A second station, which was upwind, was closed in 1982 because fluoride levels were consistently lower there. The 1984 average HF concentration at the operating station was 0.28 $\mu g/m^3$, with monthly averages ranging from 0.15 to 0.38 $\mu g/m^3$. Average ambient concentrations during the 1984 growing season ranged from 0.33 to 0.78 $\mu g/m^3$. Note that these values do not include particulate fluoride. Because of the urban setting of the plant, there is minor potential for a terrestrial foodchain exposure route. A small amount of agricultural land is located within 2 mi of the plant, generally to the southeast (the upwind direction). Forested areas are generally 3 mi from the plant with isolated stands within 1 mi.

Forage is also sampled from stations within 5 mi of the plant and analyzed for F^- content throughout the growing season. From July 1983 through September 1983 and April 1984 through June 1984, the fluoride levels in forage ranged from 4.2 ppm to 13.4 ppm F^-. These levels are well below the threshold of effects noted for domestic cattle (NAS 1971).

The volatile organic compounds are not monitored in the ambient environment. The components are coal tar pitch volatiles which include heavy aromatic hydrocarbons. These may deposit on surfaces near the plant and be transferred to runoff which flows into Hylebos Waterway.

Groundwater from deep aquifers (600-900 ft) supplies the plant. The quality of these aquifers is not affected by plant operations. Commencement Bay and its waterways provide a groundwater sink for shallow aquifers. It is likely that

domestic and commercial users have access to city water and, therefore, the exposure pathway from shallow aquifers that might be contaminated is assumed to be minor.

Marine organisms may be exposed to contaminants from the outfall of the plant, from surface runoff from the site, and from tidal interaction with wastes located at low elevation. The Tacoma waterways are being studied as a Superfund site as a result of numerous activities in the Tacoma industrial area. There have been concerns that contaminants in fish tissue from the Commencement Bay area might pose a public health problem. A health advisory was issued in 1982 based on a joint Tacoma-Pierce County Health Department and U.S. EPA analysis. Consumption of fish and shellfish from the contaminated areas is estimated to be 105,000 lb/yr (VERSAR 1985). Contaminants from many sources impact the Commencement Bay Superfund site and include PCBs, metals, and various other organic chemicals.

4.3.5 Upper Puget Sound

4.3.5.1 Regional and Local Socioeconomic Impacts: Whatcom County and Ferndale and Bellingham Communities

Economic. Future economic conditions in Whatcom County are highly dependent upon several exogenous factors that can be only poorly forecast: economic conditions in British Columbia and the exchange rate between the Canadian and American dollar; the success of the economic development activities of the county; and agricultural, forestry, and fishery markets and prices. Recent economic trends in Whatcom County (since 1980) have indicated erosion of the overall economic vitality of the area, although the Intalco Plant has maintained a generally stable level of operation and employment.

With the Intalco Plant at full operation, the community of Ferndale is likely to see consolidation of its economy over the near term after its rather rapid growth during the late 1970s. Even if further major development occurs, Ferndale is likely to remain primarily a residential community, since the majority of the economic activities would be located outside municipal boundaries. The presence of a deep water port increases the area's potential for diversification of its basic industries.

If community development efforts are successful, the economy of the county and of Bellingham will become increasingly diversified with the addition of a greater number of small-to-medium, basic-sector employers. Nevertheless, barring the introduction (or loss) of a major employer, or several medium-sized employers, the economies of Ferndale and Bellingham are likely to remain relatively unchanged, given the size and proximity of Vancouver, B.C., and Seattle, and the presence of major employers such as Georgia Pacific, Western Washington University, ARCO, Mobil, and Chris Craft.

Results from the MASTER model for the Whatcom County area are shown in Table 4.27. Since the Intalco Plant currently is operating at essentially full

Table 4.27
MASTER Forecast of Economic and Fiscal Impacts for Whatcom County, Washington

Impacts	1985	1986	1987	1988	1989	1990	1995	2000	2001
EMPLOYMENT (Thousands of People)	3.3	3.4	3.4	3.3	3.3	3.4	3.5	3.6	3.6
TOTAL PERSONAL INCOME (Millions of 1984 $)	102.6	110.7	110.5	109.6	110.1	110.9	116.1	122.0	123.6
POPULATION (Thousands of People)	0.0	2.08	2.16	2.08	1.95	1.95	1.78	1.51	1.46
TOTAL GOVERNMENT EXPENDITURE (Millions of 1984 $)	0.0	6.2	6.6	6.2	5.7	5.7	5.3	4.5	4.4
TOTAL GOVERNMENT REVENUE (Millions of 1984 $)	0.0	3.7	4.0	3.7	3.4	3.4	3.2	2.7	2.6

production, the full-capacity scenario represents a continuation of conditions existing over the past six years in terms of aluminum plant employment, adding only 25 jobs.

Shutdown of the Intalco Plant would have significant impacts on the economy of Whatcom County, Ferndale, and Bellingham. For analysis purposes, a closure of the plant occurring in 1985 was assumed. Results from the MASTER model for Whatcom County indicate that plant closure would result in a direct loss of 1250 jobs and an estimated 773 indirect (from local companies supplying the aluminum plant) jobs in Whatcom County. The total employment impact for Whatcom County (difference between full production and shutdown of the Intalco Plant) is on the order of 3,400 to 3,600 workers. This estimate indicates an employment multiplier of 2.7; i.e., one plant job translates into a little over two and one-half jobs for the Whatcom County area. The method for deriving the indirect and induced impacts is discussed in Chapter 4.1 and Appendix A-B.

Although some effects will be felt throughout the county, it is expected that the direct impacts from job loss will be concentrated in Bellingham and Ferndale. As an indication of the importance of Intalco workers to Ferndale, unemployed Intalco workers could constitute an estimated 8.8% of the 1983 population in Ferndale.

Assuming no replacement jobs are created, the loss of jobs at the Intalco plant itself would reduce total employment in Whatcom County by 2.8% and manufacturing employment by 16.7%. In addition, the discontinuance of almost $50 million in annual purchases of materials and supplies in the Northwest would result in further employment reductions in Whatcom County.

Although transfer payments of various types may moderate the impact of job loss for Intalco workers, indirect and induced economic effects can be expected to cause economic pressure on the service, retail, and governmental sectors after only a short time. Because Bellingham serves as a regional economic center, local indirect and induced economic impacts would be concentrated there.

Experiences at other heavy industrial sites (Buss and Redburn 1983; Root 1979) indicate that a relatively high proportion of plant workers might take early retirement rather than attempt to transfer to another industry and/or move outside the community. In addition, given the relatively long tenure and high wages of the aluminum industry work force, unemployment benefits, pensions, and union funds are likely to be higher than average, somewhat buffering the economic impact of employment loss. Nevertheless, these characteristics--older workers, high wage scales, long-term single industry employment--also tend to increase the difficulty of relocating the work force, thus increasing the duration of unemployment. Less mobile segments of the community currently employed at the Intalco Plant, for example the Lummi Indians who have strong cultural and land-based ties to the area, and other minority employees (about 8% of the current work force at Intalco is minority), could find it particularly difficult to obtain comparable employment should they lose their jobs at Intalco.

Given its small size and limited resource base, the community of Ferndale appears to have little ability to avoid or counteract the adverse economic impacts associated with a closure of the Intalco Plant. However, as with Bellingham and the county, participation in active, coordinated efforts to diversify and expand the economic base of the county as a whole offers some leverage on this problem.

Demographic. Whatcom County has potential for population growth as a result of employment, education, or amenity-induced in-migration. Proximity to Vancouver, B.C., and Seattle provides large population centers from which the county could attract commuters, second-home owners, retirees, and others seeking the amenities and lifestyle available in Whatcom County. Successful expansion of the economic base of the county, in accordance with economic development objectives, could attract new workers and their families to the area. On the other hand, continuation of recent economic trends could result in out-migration as job-seekers and their families leave the area.

With continued operation of the Intalco Plant, county and community population characteristics will depend largely upon other aspects of the local economy and region. Unless the economic development efforts are highly successful, however, major population change appears unlikely over the relatively near term. The county and Bellingham will continue to reflect the presence of the University, and Ferndale's population will become more similar to the rest of the county as the new workers associated with the developments at Cherry Point age. The MASTER model results (see Table 4.27) indicate that the Whatcom County population would be roughly 2% lower in the plant closure case compared to the full capacity case. By 2001, the population difference is just under 1%.

Termination of the Intalco operations could create substantial pressure for out-migration of unemployed workers. The timing and extent of this out-migration will be influenced by regional and national economic conditions, the availability of jobs in the aluminum industry elsewhere in the country, and residential decisions by those workers who choose to retire rather than seek alternative employment. Previous experience indicates that blue collar workers are more reluctant than white collar workers to initiate job searches outside their home community or region; there is also reluctance among persons with special ties to the area (such as the Lummi) or those whose alternative employment opportunities are limited (such as Hispanics and Southeast Asians). Given the high proportion of households in Whatcom County potentially affected by job and income loss, pressure for out-migration is expected to be high, especially in Ferndale. However, without countervailing economic growth, potential out-migrants may be unable to sell their homes, and out-migration might be reduced and/or delayed. Furthermore, federal programs for training and relocating workers in affected industries also may affect population change in the area. How such factors, in combination, will affect residential decision making and population change in Whatcom County and its communities is not clear, but they may make the actual outcome differ from that forecast by the MASTER model.

Housing. Impacts on housing are directly related to economic and demographic conditions in the area, and hence are subject to the uncertainties discussed in

the preceding section. In 1980, the vacancy rate in Whatcom County was 16.5%, almost twice that of Washington as a whole. Interviews with local officials and housing specialists indicate that the housing market in Whatcom County has become increasingly soft; selling prices have declined and time-to-sale has increased. No detailed information about local developers' plans for residential construction is available upon which to base estimates of near-term expansion in housing stock. If the decline in employment resulting from closure of the Intalco Plant is temporary, significant impact on the stock and market for housing is unlikely. MASTER model forecasts indicate population and per capita income, both of which are factors important to a stable housing market, will continue to grow under both full operation and shutdown conditions (except for the year immediately following plant shutdown).

Public Services. Public sector impacts of concern to officials in Whatcom County are those resulting from a decline in revenue sources without a concommitant decline in demand for services. Closing Intalco would result in sharp declines in property tax revenue and in retail sales tax revenue. Previous experience with plant closures in areas dependent upon retail sales tax for a substantial proportion of their revenues has shown that tax revenues frequently drop more quickly than demand for services--or more quickly than the system can respond, given existing contracts and commitments. In addition, the demand for some public services (such as mental health, public safety, social services, education, employment security) increases as a result of the personal hardships and stresses created by job uncertainty and layoffs. Unless replaced by new facilities, the loss of property taxes from a major facility such as the Intalco Plant can have pronounced impacts on particular taxing jurisdictions, especially school districts where such facilities may account for a large proportion of the tax base. In addition to the loss of property taxes, the Ferndale School District would also have to deal with the need to maintain underused buildings and facilities as a result of population loss following a shutdown of Intalco.

The existing infrastructure and public sector organization of Whatcom County, Bellingham, and Ferndale provide substantial capacity for response to changing economic and social conditions. Given the nature of the economic and demographic changes that might occur under the full operation and shutdown scenarios, the principal concern of public officials in Whatcom county will be to maintain service levels without increasing tax rates. If the county shows continued, moderate growth under both scenarios as indicated by the MASTER model, public sector impacts are expected to be isolated in particular service agencies and to require innovative management and assistance in specific areas rather than widespread reorganization or modification of services. Meeting the needs of individuals and families adversely affected by plant shutdown will require active coordination and cooperation between those who provide services in all local jurisdictions (and the state and federal agencies).

Land Use. No significant impacts on land use or comprehensive plans are anticipated from either continued operation or plant closure. Given the difficulty of making alternative use of the smelter structures and the expense of dismantling them, it is not clear when and if further use can be made of the site.

Social. Changes such as the termination of plant operations and the departure of a major employer have the potential to cause social impacts at the individual, family, organizational, and community level. A number of studies have been conducted that document the stress placed on individuals and families experiencing the economic and social dislocations associated with job loss (Buss and Redburn 1985; Hansen et al. 1981; McKensie and Sengenberger 1983). Public and private service agencies dealing with affected individuals and families also may experience stress. If the job loss is large relative to the economic base of the community, substantial changes in community resources, social organization, and well-being may result. Although some of these adverse impacts are inherent and unavoidable, many can be alleviated by effective assistance and intervention.

No significant adverse social impacts are anticipated from increasing operation of the Intalco plant to full capacity, in part because Intalco has been operating at a high level of employment for a number of years.

Even with new jobs expected in the county, many of those losing employment as a result of the shutdown may be unable to obtain replacement jobs within the community and will choose either to take early retirement or to seek employment elsewhere. Although all such workers and their families require attention, it is likely that members of minority groups such as the Lummi, Hispanics, and Southeast Asians may require special assistance during the transition period.

Distribution of employment, population, and resources among communities in Whatcom county will be affected by the location of the replacement jobs and economic activity. Ferndale, with its relatively small population and employment base, is particularly vulnerable to significant job loss and out-migration. Should the new jobs created in the county be outside the durable manufacturing sector, the current social structure of the communities in the county may be modified by out-migration of blue collar workers who are not replaced by in-migration. To some extent, this reflects changes occurring throughout the country, and requires long-term attention to the diversity of the communities and the re-incorporation of ex-blue collar workers.

Loss of jobs, population, and tax revenues may stress the cooperative relationships between social groups and governmental units in Whatcom County. Decisions concerning provision of assistance, curtailment of public services, tax rate increases, and readjustment of jurisdictional relationships have the potential to increase conflict and tension. Although mechanisms for intergovernmental coordination appear to be available in Whatcom County (e.g., the Whatcom County Council of Governments), special attention to issues of equity and conflict resolution may be required.

4.3.5.2. Physical Environmental Impacts

Ferndale. Ambient HF concentrations are monitored daily at three stations located 0.9 to 1.35 mi from the plant (see Figure 3.19). In 1984, the monthly average HF concentrations at the three locations were less than 0.10 $\mu g/m^3$, with a range of about 0.07 to 0.12 $\mu g/m^3$. These values are well within the state standard of 0.5 $\mu g/m^3$ during the growing season (March 1 through

October 31). They are well below the levels expected to cause foliar damage to Oregon grape or Douglas fir, which are the sensitive plant species found in the vicinity.

Pasture grass samples are taken from the same locations every two weeks during the growing season. The fluoride content of the 21 samples gathered in 1984 averaged 21 ppm F^-, and ranged from 5 to 48 ppm. These values are well below the state standards for F^- in forage which are 40 ppm average for 12 consecutive months, 60 ppm for 2 months, and 80 ppm for no more than 1 month. Concentrations of fluoride in forage samples taken on the plant site in 1984 are at the threshold of discernible dental mottling in cattle after several years exposure during the period of tooth formation (NAS 1971). The nearest agricultural land is about 1 mi east of the plant. A demonstration herd of beef cattle is kept on the site. Intalco ambient monitoring data indicate that fluoride concentrations should have no discernable effects on crops or animals.

A preliminary study from 1971 through 1977 of black-tailed deer (Newman and Murphy 1979) indicated that deer within 5 km of the plant showed symptoms of fluorosis. Fluoride concentrations in the bone of nine deer from within 5 km of the plant ranged from 638 to 5426 ppm. The fluoride levels in the bones of these deer were 7 to 40 times greater than that of the the controls. At that time, the average fluoride concentration in samples of native vegetation exceeded 40 ppm F^-. Sword fern had the highest fluoride levels, averaging over 300 ppm, and was a major source of fluoride for the browsing deer. Fluoride levels in pasture grass samples ranged from 10 to 230 ppm. Emissions have decreased since installation of pot hoods and dry scrubbers in 1972 and 1973. Current fluoride concentrations in pasture grass (21 ppm average) are a small fraction of the 1972 values. The decrease in fluoride emissions and ambient concentrations suggest that the impact on wildlife has been reduced since the study was published in 1979.

Routine bioassay procedures were used on oyster embryos in 1973 to study the effects of outfalls from the Ferndale industrial area on nearby waters of Georgia Straits. Relatively poor water quality was found only in a very limited area between the Intalco and Mobil discharge points. Bioassays of in-plant samples taken from Intalco waste discharges indicate the wastes were nontoxic at the lowest dilution tested (1:5). Intalco improved its waste water treatment in 1972 and 1973, which is reflected in the improvement of oyster embryo bioassays over similar studies conducted in 1971 and 1972.

Ambient SO_2 monitoring is done by a continuous instrument at 0.7 mi from the plant (see Figure 3.19). The annual average concentration measured was 0.004 $\mu g/m^3$, with a 1-hr maximum of 0.151 $\mu g/m^3$. This is well below the National Primary Ambient Air Quality Standards of 80 $\mu g/m^3$ (annual) and 365 $\mu g/m^3$ (24-hr) and the Washington State Air Quality Standards of 60 $\mu g/m^3$ (annual) and 120 $\mu g/m^3$ maximum 30-day average.

4.3.6 Northeastern Washington Area

4.3.6.1 Regional and Local Socioeconomic Impacts: Spokane County

The Kaiser Mead smelter is located in an unincorporated area of Spokane County. At full capacity, employment at the plant would increase by 450 jobs from the 1985 level of 650. The analysis discussed in this chapter focuses on comparison between the full capacity scenario (high) and plant shutdown (low). For this analysis, plant shutdown is assumed to occur in 1985.

Economic. Kaiser's Mead smelter has been operating at reduced levels since 1982. The 1985 work force was approximately 650 persons, down from a peak of 1850 in 1981. Consequently, return to full production levels would entail expansion of the work force by approximately 1200 aluminum workers, while complete shutdown would reduce employment by 650. Because of the reduced operation at Kaiser, the community and county of Spokane have already experienced economic impacts of greater magnitude than would result from the shutdown of the smelter. As discussed in the description of the affected environment, the reduction in work force at the Kaiser Mead smelter contributed to an overall economic downturn in Spokane County in 1983, when total employment fell to 147,679 workers.

Since 1982, the economy of the area has been recovering. The community has taken aggressive action to promote economic development, including successful efforts to attract high technology industries to the area and the construction of a large industrial park located west of the city in the vicinity of Spokane International Airport. Though not as large an economy as the Portland or Tacoma MSA, Spokane nevertheless represents an urban, diversified economy that which serves a large market area. Its susceptibility to impact from modifications in a single industry is therefore somewhat moderated by its diversity and size.

At full production levels, the Kaiser plant would add to the number of durable manufacturing jobs available in the community, would contribute substantially to expansion in wage and salary earnings, and would support expansion of local businesses that supply goods and services to the company and its employees. However, because the number of additional jobs associated with full production at the Kaiser plant is small relative to the overall economy (less than 1% of total employment), the overall effect on the area's economy would not be dramatic. Given the current concern in the area over maintenance of high-paying manufacturing jobs and the moderate pace of growth in the economy as a whole, expansion of employment would be considered positively by community officials and residents.

The MASTER model forecasts that the estimated indirect impact (loss of jobs at local companies supplying the aluminum plant) of plant closure would be 804 jobs in Spokane County. The estimated impact on induced employment (loss of jobs at local companies supplying the workers and their families) is estimated at 2570 jobs, giving a total employment multiplier for the aluminum industry in Spokane County of 3.1. This means that each job lost in the aluminum industry

results in a total reduction of employment in the county of 3.1 jobs. Total employment impact of plant closure (shown in Table 4.28) is thus on the order of 4500 to 6300 jobs compared to full capacity operation. The method for deriving the indirect impacts is discussed in Chapter 4.1 and Appendices A-B and A-C.

At the community level, these changes are moderate, and would not have a significant impact on the economic structure or organization of the community. Less uncertainty over the future of the aluminum industry and evidence that the aluminum-related jobs are secure would contribute to a positive, optimistic view of Spokane's future. It is not known how many of the previous Kaiser employees remain in the area and would return to work at the smelter, should jobs become available. Experience elsewhere in the region (Goldendale) has demonstrated high interest and competition for smelter jobs.

Demographic. It is difficult to anticipate the demographic effects of plant expansion or shutdown in the Spokane area, given the recent history of work force fluctuation in the area. Prospects of job substitution for unskilled laborers and craft workers are limited, and it is not certain whether unemployed workers would remain in the area, utilizing severance benefits and unemployment for a longer period; would accept lower paying employment in order to remain in the area; or would out-migrate promptly. To a large extent, these decisions are likely to be influenced by local and national economic conditions at the time workers and their families are required to make such relocation decisions. Experience at other manufacturing facilities indicates that a relatively high proportion of those eligible for early retirement will leave the work force and that many will remain in the local area. However, no accurate picture of the demographic movements of the previously laid-off workers is available. In general, those who have already been laid off had worked for less than five years at the plant. Of these people, unskilled laborers are believed to have remained and sought new jobs, whereas professionals or skilled technicians are thought to have left the area. The MASTER model forecasts impacts from reduction in population in 1987, after the major effects of migration have occurred, of approximately 1% of the full-capacity population level of the county. By 2001, these impacts are estimated to be just under 2%, as shown in Table 4.28.

Housing. Effects of a plant shutdown on the housing market will depend very much on the economic and demographic impacts. Estimates provided by the housing division of the city government indicate that, in the event of a 69% out-migration of unemployed workers from shutdown of the Kaiser smelter, an additional 1,300 homes would be up for sale. According to their estimates, this would greatly exacerbate an already glutted housing market in which currently only 1/3 of the homes for sale each year are actually sold. This figure, however, assumes both a sizable migration rate and almost exclusive home ownership on the part of Kaiser employees, neither of which can be relied upon. In the event of a shutdown, increasing numbers of mortgage foreclosures are also anticipated. An even greater impact would be felt in the rental market; the housing division estimates vacancy rates would increase by 28% (given the out-migration rate of 69% mentioned above) and the value of rental units would be severely depressed. Part of the current housing surplus could be

Table 4.28
MASTER Forecast of Economic and Fiscal Impacts for Spokane County, Washington

Impacts	1985	1986	1987	1988	1989	1990	1995	2000	2001
EMPLOYMENT (Thousands of People)	4.5	4.9	4.9	5.0	5.0	5.1	5.6	8.2	6.3
TOTAL PERSONAL INCOME (Millions of 1984 $)	133.9	154.6	157.8	159.1	161.9	164.7	183.2	208.3	211.6
POPULATION (Thousands of People)	0.5	5.4	5.8	5.9	6.0	6.1	7.1	8.1	8.3
TOTAL GOVERNMENT EXPENDITURE (Millions of 1984 $)	1.2	11.9	13.0	13.2	13.4	13.7	15.7	18.1	18.5
TOTAL GOVERNMENT REVENUE (Millions of 1984 $)	0.8	8.8	8.7	8.9	9.0	9.2	10.5	12.2	12.4

attributable to an out-migration of Kaiser employees, although the explanation provided by the housing division is simply that home owners are unable to accept the fact that housing values have declined since 1980. The overpriced homes stay on the market longer, however, many home owners have chosen to wait another year rather than to sell their homes at a loss.

Returning the Kaiser plant to full operation would result in slight improvement in the housing market, with increase in wage income and stabilization or slight growth of the population. As at other sites, the actual impacts depend significantly on other economic and social conditions in the area.

Public Services. The Kaiser plant in Mead is not located within any city; Mead is an unincorporated area in Spokane County. At the Spokane city level, the most pressing budgetary concern is the pending loss of federal revenue sharing, and although a plant shutdown would result in some shrinkage in the tax base, this loss would not be significant in itself. Table 4.28 shows MASTER estimates of impacts on state and local revenues. A plant shutdown would certainly exacerbate the budgetary constraints brought on by the loss of revenue-sharing funds. The effect would be staff reductions and a general decline in the quality of public services. The fact that half the population of Spokane County is concentrated in the city of Spokane puts an added strain on the city government. In the event the plant closed and a shrinkage in the tax base resulted, the city would appeal to the state for assistance, but the likelihood of obtaining such assistance is felt to be slight. Potentially offsetting conditions for the loss of governmental revenue include the success of current strategies aimed at developing the tourist industry and attracting new manufacturing and service industries into the area. This would help alleviate the strains on unemployment and would put more needed income and retail sales tax revenues into the city coffers.

Similar impacts would be felt by the public educational systems in the area. The plant is located in the Mead School District, which receives property taxes from the plant, but relatively few plant employees live in Mead. According to Spokane School District Superintendant Gerald Hester, most employees live in the northern suburbs of Spokane and their children attend schools in District #81. The primary impact that would be immediately felt would be a reduction in the tax base supporting the Mead School District, although it may not experience a parallel decline in enrollment. The programs offered by the schools would need to be reassessed. In assessing the priorities for curriculum offerings, greatest emphasis would be placed on maintaining the quality and quantity of courses considered to be fundamental to a "basic" education for all students. In addition, the district would have to ensure that programs required by state and federal law--primarily special educational programs for handicapped children--remain in place at sufficient levels to satisfy the requirements of law.

As noted above, closure of the Mead operation would have little direct impact on the number of students enrolled in the district's schools because the proportion of students with parents employed at Kaiser is small relative to the total student population in the Mead District. Closure of the aluminum facility and the associated out-migration would affect enrollment patterns in all area schools, though none is expected to be dramatically affected.

In terms of state welfare assistance, additional demand is expected in the event of a shutdown. Initially most Kaiser workers will not qualify for welfare; the possible exception is the foodstamp program, which comprises 25% of the state welfare budget, according to Bill Ross of the Department of Social Health Services office in Spokane. The loss of benefits associated with unemployment will place an added strain on welfare services, particularly in the case of older workers who elect to cash out on their retirement. As a result, the Department of Social and Health Services expects demand for medical assistance would be greatly heightened in the event of plant closure.

Land Use. There are no anticipated changes in the land use of plant property in the event of a shutdown. Industrially zoned land is generally on the increase in certain peripheral areas of the city, particularly southwest in the West Plains, which has just been provided with a new water and sewage system designed to accommodate industrial development. This area is the future site of a large-scale industrial park. Other manufacturing industries are situated to the north and to the east of the city in a valley very close to the Idaho border. Kaiser's Trentwood rolling mill is located here, and because of its proximity to the border, about 25% of the mill employees live in Idaho. Kaiser Mead lies north of the city in a smaller industrial zone. Although there are a few other manufacturing plants in this area, Kaiser Mead is by far the largest in the vicinity. Because of poor access and limited transportation and utility facilities, the land is suitable for little else.

Social. Because the Kaiser plant is already operating at half capacity, any social consequences of a total shutdown would merely be a magnification of what is already taking place. Strains on the social fabric will result in scenarios of both out-migration and nonmigration. Should laid-off workers remain in the area for an extended period of time, the ensuing unemployment will most likely place added strains on domestic relationships, possibly increasing the levels of child and spouse abuse and resulting in a higher divorce rate. This is most likely to occur among those whose job prospects are the least favorable. Even replacement jobs are not likely to prevent economic dislocations and stress. Unemployment could also increase the level of criminal activity in the city and county, particularly if high unemployment levels persist and economic hardships continue.

Although the loss of plant contributions to local associations and community activities will most likely be felt, Kaiser does not appear to be the sole or primary contributor to any particular group, with the possible exception of the United Way. Other large corporations act as a counterweight to Kaiser in this regard, therefore the dependency upon the aluminum plant for financial and personal contributions to local organizations is not as great in Spokane as it is in smaller and less diversified areas such as Wenatchee or Goldendale.

4.3.6.2 Physical Environmental Impacts

Mead. Alfalfa and pine needle samples are collected to monitor ambient fluoride concentrations (Figure 3.20). Most of the sample locations are downwind. A few additional sampling locations are located northeast of the plant outside the boundary of Figure 3.20. Concentrations in alfalfa range from 9.39

to 17.31 ppm F^-. The mean of 71 pine needle samples was 7.23 ppm F^-. The alfalfa samples are well within the standard for protection of cattle, and there are no known impacts on cattle.

A study of the Little Spokane River could attribute no impacts to cyanide leachate.[a] Bioassays with salmonids are performed twice a year to investigate toxic effects of the effluents. Results have been within standards acceptability.[b]

4.3.7 Western Montana Area

4.3.7.1 Regional and Local Socioeconomic Impacts: Flathead County and Columbia Falls

Economic. The CFAC smelter constitutes an important component of the Flathead County economy and is particularly important to the community of Columbia Falls. The generally remote nature of the area, whose economy is heavily influenced by its natural resources, makes the county and community vulnerable to impact from altered production levels at the CFAC smelter.

Shutdown of the CFAC smelter would have significant impact on the economy of Flathead County, Columbia Falls, and Kalispell. Because the area's economy is small, the opportunity for unemployed smelter workers to find other jobs locally is very limited, and there are no local employers that can provide jobs at comparable wages. Closure of the CFAC smelter would reduce manufacturing employment in Flathead County by nearly one-third, and would cut employment in the durable manufacturing sector by almost one-half. These figures indicate that closing the CFAC smelter will significantly affect the economic structure of the county, decreasing its diversity, and increasing its dependence on forest products and tourism.

Because the economy of Montana has been severely affected by reduced prices for agricultural and forest products and by reduced energy and mineral development (including closure of the Anaconda smelter and the Butte copper mine; decreased oil, gas, and coal exploration and development), displaced workers are likely to have difficulty finding employment within the state. The inability to relocate workers within the local economy will increase the economic impact of plant closure by increasing the proportion of unemployed workers who will leave the area. One mitigating factor may be the relatively older age structure generally found at aluminum smelters; this, combined with the relatively high amenity value of the area, may result in a high proportion of workers taking early retirement and remaining in the community. Nevertheless, the multiplier effect of plant closure will cause significant contraction of the local economy, creating difficult times for the smelter workers and many in the retail, service, and governmental sectors. The remote location of the county limits the potential for significant diversification or expansion.

(a) Hartung, R. and P. G. Meier. 1980. Ecological Survey of the Little Spokane River in Relation to Cyanide Impacts. Unpublished research report for Kaiser Aluminum Company, Spokane Washington.
(b) Richard Jeltsch, Staff Process Engineer, Kaiser Mead.

According to the MASTER model, full capacity production at the plant would result in employment of 1000. The estimated indirect impact (loss of jobs at local companies supplying the aluminum plant) of plant closure would be an additional 556 jobs in Flathead County. Total employment impacts (the difference between full operation and shutdown) is the sum of direct (1000), indirect (about 556) and induced (about 1190) jobs, or a total of between 2700 and 2900 jobs in the Flathead economy. These figures are shown in Table 4.29. In terms of the frequently used multiplier analysis, this implies a local employment multiplier of 2.8--with one job lost at the CFAC plant resulting in a loss of 2.8 jobs in the county.

Demographic. Flathead County has experienced a long period of population growth, both through natural increase (more births than deaths) and through in-migration. These trends are expected to continue, pending major modifications in the overall economic climate, and would be slightly enhanced by increased employment and/or decreased uncertainty at the CFAC plant.

Termination of CFAC operations would create significant pressure for out-migration by county residents, particularly those from the heavily impacted communities of Columbia Falls and Kalispell. Given the magnitude of the economic impact that is forecast to result from plant closure (net loss of jobs and wages in the county during the subsequent years), and forecasts of national reduction in durable manufacturing employment, it is not clear what decisions the unemployed smelter workers will make concerning relocation. There is general belief in the community that the patterns observed in Butte and Anaconda, Montana, following the closure of copper mining and smelting operations will occur in Flathead County should the smelter close, i.e., very depressed economic conditions, limited opportunity for local employment, high pressure for out-migration, but difficulty selling homes and finding satisfactory, permanent employment elsewhere. Under these conditions, there is the expectation that some workers will leave their families in the local area while they seek work elsewhere, and that the population impacts of plant closure will be manifested over an extended period of time. Uncertainty over the population characteristics of the area will heighten uncertainty in the local economy, housing market, and public sectors.

The MASTER model forecasts of population impact are shown in Table 4.29. In 1987, after the major impacts on migration would have occurred, Flathead County is projected to have a population roughly 4% lower in the plant closure case compared to the full capacity case. By 2001, the population difference would be just under 3%.

Housing. The impacts on housing that will occur as a result of changing production levels at the CFAC smelter are directly linked to the changes in the local economy and population. Perceptions and expectations of area residents and developers will also have an important influence on the local housing market. Although Flathead County has experienced relatively rapid growth during the last fifteen years, housing stock has kept pace with demand. Consequently, local ability to respond to the increased population and business activity associated with full production levels at the CFAC plant are not expected to cause housing or commercial building shortages.

Table 4.29
MASTER Forecast of Economic and Fiscal Impacts for Flathead County, Montana

Impacts	1985	1986	1987	1988	1989	1990	1995	2000	2001
EMPLOYMENT (Thousands of People)	2.7	2.8	2.7	2.7	2.7	2.7	2.8	2.9	2.9
TOTAL PERSONAL INCOME (Millions of 1984 $)	80.1	84.8	85.2	85.8	86.4	87.3	93.9	102.1	104.7
POPULATION (Thousands of People)	0.2	2.1	2.2	2.2	2.2	2.2	2.3	2.2	2.2
TOTAL GOVERNMENT EXPENDITURE (Millions of 1984 $)	0.4	4.5	4.6	4.6	4.6	4.7	5.0	4.7	4.7
TOTAL GOVERNMENT REVENUE (Millions of 1984 $)	0.3	3.3	3.3	3.3	3.3	3.4	3.6	3.4	3.4

Should the CFAC smelter close, the housing market in Kalispell, Columbia Falls, and the surrounding area is expected to be significantly depressed, creating difficulties for home owners who are pressed into residential relocation and for other sellers. Conversely, such depressed conditions provide significant opportunities for acquisition by local residents and in-migrants who are not economically affected by the closure. Forecasts of job and wage loss and population change following plant closure indicate that the impact on the local housing market is likely to be significant, with the potential that some out-migrants will be unable to sell their homes and will default on their mortgages. The inability of a relatively large number of unemployed workers to meet existing mortgage payments will put pressure on the banking community in the area, particularly small locally owned banks that still hold home mortgages outside of the secondary market. The proportion of renters among the CFAC work force is small, so the direct impact of their departure on the rental housing market will not be significant. However, there is likely to be a substantial impact if a large number of owner-occupied homes are put onto the rental market. The magnitude of this effect cannot be predicted at this time.

Public Services. Public sector officials are concerned about potential revenue loss associated with closure of the CFAC smelter and associated increased demand for services in the public sector. The impact of stabilizing plant operations at full production levels will be to reduce uncertainty about the future of the plant and its employees and to increase the ability of local governmental services to plan and operate.

Closure of the CFAC plant would result in a sharp decline in property taxes paid by the company. Table 4.29 shows forecast impacts of plant closure on total governmental revenues. The CFAC plant (including the rod mill) represents over 12% of the total taxable value in Flathead County and provides over 12% of total county taxes ($2.7 million in 1984). Loss of this revenue would create significant difficulties for the county, particularly when combined with the additional loss of taxes from unemployed workers and other affected businesses.[a] Flathead County and the school district would be most directly and severely affected by these tax reductions.

Because of its isolation and small population, Flathead County and its communities do not have the specialized infrastructure of more urban areas to call upon in responding to the changing economic and social conditions that would result from plant closure. Given the magnitude of the economic and demographic changes that might occur under the shutdown alternative, the principal concern of public officials in Flathead County, Columbia Falls, and Kalispell, as well as the other surrounding communities, will be to maintain acceptable service levels without further aggravating depressed economic conditions by raising taxes. Because local communities in Montana have only limited discretion in imposing taxes, their ability to respond may be further constrained. Given the forecasts of revenue loss, it is expected that the public sector in Flathead County will experience great difficulty meeting the needs of individuals and families adversely affected by plant shutdown.

(a) Allen Jacobsen. 1985. Memo entitled "Comments on BPA Public Meeting in Flathead County."

Land Use. No significant impacts on land use or comprehensive plans are anticipated from either continued operation or closure of the CFAC plant. Should the plant be closed and razed, the site might revert to agricultural or open country usage.

Social. No significant adverse social impacts are expected to result from maintaining operation of the CFAC plant at full production levels. The increase associated with this expansion will be small relative to existing levels.

Termination of plant operations and loss of a major corporate presence from a low-population county has the potential to cause significant change in the social organization of the community and to have adverse impacts on the social well-being of area residents. Job loss, income reduction, and residential dislocation can result in severe stress on individuals and families; significant economic and population decline can affect entire communities. Increased coordination and cooperation among officials in various jurisdictions will be needed to respond to the problems created by these conditions. Effective response has the potential to alleviate, though not eliminate, many of the adverse impacts associated with economic and social dislocation.

Columbia Falls has already demonstrated its ability to marshall community resources to respond to an impending crisis; the community organized a formal group to deal with the problems presented by ARCO's announcement that it would sell the smelter or close it if no buyer could be found. Because of the perceived importance of the facility to the economic well-being of the community, both governmental and nongovernmental resources were organized in a campaign to help ARCO find a suitable buyer. In addition to working within the community, Columbia Falls residents took the initiative in presenting their case to western state governors and to congressional delegations and federal officials. Funding for much of this activity came not from local governmental budgets but from the individuals involved. This degree of involvement and commitment indicates that the community is likely to respond actively to future problems emerging from altered operating levels at the CFAC plant.

4.3.7.2 Physical Environmental Impacts

Columbia Falls. There is no impact of waste discharge to offsite surface waters because the discharges are pumped to percolation ponds that intentionally do not contain aquatic life. There is no aqueous effluent discharge offsite. Monitoring of test wells on the property has not indicated hazardous concentrations of effluent materials in groundwater.

Vegetation samples collected at three sites south of the plant (Figure 3.22) during the grazing season in 1984 averaged 17 ppm F^-. In 1983, the average was 16 ppm F^-. These values are well within the state standard of 35 ppm. In 1975, the plant was violating gaseous fluoride standards at some monitoring sites, and damage to vegetation and wildlife was documented at several locations. These problems have been corrected with installation of new pollution control equipment, and the plant is presently operating well within current

state standards. There has been obvious damage to the conifers in the vicinity of the plant in years past, but fluoride emissions have been reduced sufficiently to prevent further damage.

4.4 CUMULATIVE AND GENERIC IMPACTS

The impacts considered so far are related to individual plant operations. Other impacts may result if plants are shut down only temporarily rather than permanently, or if a large number of plants close, resulting in cumulative impacts. Section 4.4.2, Physical Environment, also contains a discussion of several topics that are often required in an environmental impact statement and are covered here to complete the scope of this analysis.

4.4.1 Socioeconomic

The key economic and demographic impacts (difference between full production and plant shutdown) across all sites are summarized in Table 4.30.

Table 4.30
Demographic and Economic Impacts

Area	Multiplier (Employed)	Job Loss Total	Job Loss Induced	Population Loss Percent of Total 1985-1987	Population Loss Percent of Total 2001
Portland Area	2.6	8900-9200	3400	0.1	--
Wasco/Klickitat	2.6	4200-4500	1630	11	13
Tacoma SMA	2.5	1200-1300	480	2	1
Whatcom	2.7	3400-3600	1500	2	1
Spokane	3.1	4500-6300	2570	1	2
Flathead	2.8	2700-2900	1190	4	3
Chelan	2.6	2500-2700	575	6	5

As seen in this table, the economic multiplier, which relates jobs lost at an aluminum plant to total jobs lost in the area economy, ranges from a low of 2.5 for Tacoma (because of high leakage into the Seattle MSA) to a high of 3.1 in Spokane. The three plants located in the Portland area combine to cause a total employment impact of between 8900 and 9200 jobs, the largest of all the study area regions, but also the one with the largest population and employment base in which to absorb the change. The greatest population impacts are forecast for the Wasco-Klickitat bi-county area. In 1987, population impacts (difference between full production of both the currently closed Dalles plant and the Goldendale plant and complete shutdown of both plants) amount to about 11% of the area's total population.

4.4.1.1 Cumulative Economic Impacts

In the analysis performed for this study, plants located within the same general area and affecting the same local economies were analyzed together. Consequently, on a study area basis, the results presented in this analysis represent the cumulative impact of changing production levels at more than one

plant simultaneously. The cumulative impact upon the region, i.e., the difference of shutting all plants down or operating all plants at full capacity was not explicitly addressed in this analysis. This type of cumulative analysis would probably not significantly change the MASTER model outputs, although the large metropolitan areas like Tacoma and Portland would likely show slightly higher employment and income effects because of their roles as regional economic centers.

However, should the entire aluminum smelting industry in the Pacific Northwest disappear, the impacts on individual workers might be significantly greater than if only individual plants were to close. For example, field research indicated that many of the workers who were laid off from The Dalles plant were able to obtain employment at the Goldendale plant. Should the shutdown be regionwide, such intra-regional transfers of workers would not be possible, thus aggravating the personal problems faced by unemployed workers and increasing migration out of the region.

The impact on local economies of potential cost-of-power increases should the aluminum smelters disappear was not examined. In some communities, local officials expressed considerable concern about this impact.

4.4.1.2 Impacts of Temporary versus Permanent Shutdown

In the Pacific Northwest, the aluminum industry has a history of uneven operating levels. For example, the Tacoma smelter was shut down for six years in the late 1960s, and the plant in The Dalles is now out of production. Differences in socioeconomic impacts from temporary as compared to permanent shutdown of the smelters appear to depend primarily upon the perceptions of the workers and communities about the duration of the shutdown. In general, experience indicates that white collar workers are likely to leave the area rather quickly following plant shutdown, while blue collar workers are considerably slower to respond. As the length of shutdown increases, more and more workers can be expected to seek other jobs within the community or out-migrate to other areas.

One of the important factors affecting individual and community response to plant shutdown is the level of uncertainty about future plant operating levels. If information about the permanence of shutdown is not emphatically communicated, it is likely that many workers and community residents will continue to anticipate future recovery and will act as if the shutdown were temporary rather than permanent. As with all aspects of socioeconomic impact, these factors are influenced by the general socioeconomic context in which the shutdown occurs. If the smelter is important to the area's entire economy, as in The Dalles and Goldendale, plant shutdown is likely to affect the overall economic climate in the community. In these cases, perception that the shutdown is permanent rather than temporary is likely to result in greater and more immediate reductions in employment and income in other sectors, in increased reluctance of business to invest in the community, and in action by the local governments to protect revenue levels and/or reduce expenditures.

In conclusion, unless specifically prevented from doing so, communities and individuals are likely to respond to all shutdowns as if they are temporary, thus delaying appropriate and necessary response.

4.4.2 Physical Environment

4.4.2.1. Plant Closures

If operations at the Northwest aluminum plants were no longer economic, the plants could be temporarily shut down to await a more attractive economic environment, permanently closed and dismantled, or made available for an alternate use such as commercial, residential, or agricultural development. Different use of the plant sites in the future might require soil decontamination, depending upon the level of fluorides, cyanide, or other harmful materials in the soil Potliner and other wastes may have to be removed from the sites for disposal. The extent to which the site is restored will depend upon its future use.

4.4.2.2. Mitigation

All of the aluminum plants are required to comply with federal and state laws and regulations for protection of the environment. The plant effluents and ambient concentrations of toxicants are monitored and reported to state agencies.

Air pollution control equipment has been installed in the plants to comply with regulatory requirements. Facilities for storage of spent potliners have been improved at several of the plants to prevent cyanide-containing leachate from reaching soil or groundwater. For example, the Mead plant stores potliner wastes indoors, and the Tacoma plant will convert to indoor storage by January 1, 1986. Impacts to plants and animals near some of the plants were reported in earlier years, however, reductions in plant effluents appear to have mitigated all of those impacts.

4.4.2.3 Relationship Between Short-Term and Long-Term Productivity

The Northwest aluminum industry has operated for decades. The ten aluminum plants in the region were constructed between 1940 and 1970. The existing use of the environment has been and continues to be for operation of the aluminum smelters. This commitment effectively removed portions of the plant sites from contributing to the natural productivity of the region. Major facilities at most of the aluminum plant sites occupy a fraction of the dedicated sites; hence, the effect of land dedication on regional productivity is minimal. The surrounding environment is relatively unaffected by these facilities (see Chapter 4.2).

The Northwest aluminum plants contribute a major share of the national production of aluminum and provide substantial socioeconomic benefits to the region.

Future plans for the aluminum plant sites generally are for continued use as areas dedicated primarily to aluminum smelting operations, but economic and other factors have resulted in closure of one plant and may result in closure of others at some time in the future.

4.4.2.4 Relationship of Facilities to Land Use Plans

The continued operation of the Northwest aluminum plants does not conflict with present national, state, or local land use plans or policies. The Northwest aluminum plant sites are already dedicated to production of aluminum, consistent with governmental land use plans or policies. Actions being considered by BPA will not result in significant changes in land use and may encourage stability in current use. All land is, and will continue to be, managed in conformance with appropriate federal and state regulations to ensure the safety and well-being of the public.

4.4.2.5 Irreversible and Irretrievable Commitments of Resources

The Northwest aluminum plants were sited many years ago. The associated resource commitments due to plant construction have already been made. Some additional commitment of resources may be made as a consequence of plant modernization or increased plant production which could result from operation of the plant at full capacity.

Raw Materials. Several raw materials are consumed in the production of aluminum and are essentially irretrievable. Aluminum, however, is a highly recyclable material, and part of the aluminum produced will probably be recycled. A general range of consumption of raw materials is shown in Table 4.31.

Table 4.31
Raw Material Requirements for Aluminum Production (Shapiro and Assoc. 1984)

Material	Typical Value (lb/lb of Al produced)
Alumina (Al_2O_3)	1.9
Cryolite (Na_3AlF_6)	0.03 - 0.05
Aluminum fluoride (AlF_3)[a]	0.03 - 0.05
Fluorspar $(CaF_2)_2$[a]	0.003
Anode	
Petroleum coke	0.46 - 0.49
Pitch binder	0.12 - 0.17
Cathode (carbon)	0.02

(a) Either calcium fluoride or aluminum fluoride is added to the cryolite bath to reduce the bath melting point.

Energy. Electrical energy is used in large amounts to produce aluminum. Hydroelectric power is renewable through the global water cycle. Fossil fuel or nuclear-generated power is nonrenewable since the fuel is consumed. The aluminum plants also use fossil fuels directly, primarily natural gas, with some oil and propane. To some degree, these latter fuels can be substituted for each other, so specific quantities of each may vary with price and availability. Table 4.32 lists electric and fossil fuel energy requirements.

Table 4.32
Energy Use (fossil fuels include natural gas, propane, and oil)

Plant	Electrical Consumption (MWHr/yr)	Fossil Fuels Therms/yr
Vancouver	2.1×10^6	8.8×10^7
Longview	No data	1.1×10^6
Troutdale	No data	No data
The Dalles	1.6×10^6	2.4×10^6
Goldendale	1.9×10^6	2.3×10^6
Wenatchee	3.2×10^6	1.1×10^7
Tacoma	1.2×10^6	1.5×10^6
Ferndale	3.8×10^6	1.0×10^7
Mead	3.8×10^6	1.2×10^6
Columbia Falls	3.2×10^6	1.2×10^7

Land. One of the greatest resources utilized by the siting of aluminum plants is land and the disruption of the natural plant and animal communities that occupied it.

Construction Materials. One irretrievable commitment of resources is that of materials used in plant construction. Concrete, reinforcement steel, other structural materials, and labor are examples.

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Chapter 5

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APPENDICES TO APPENDIX A

AN ENVIRONMENTAL AND SOCIOECONOMIC ANALYSIS OF NORTHWESTERN ALUMINUM SMELTERS

Appendices A-A, A-B, A-C, and A-D

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FOREWORD

These Appendices contain detailed data and information prepared by Pacific Northwest Laboratory as part of a socioeconomic and environmental analysis of the impacts of Pacific Northwest aluminum smelters. The main report was published as a separate volume titled An Environmental and Socioeconomic Analysis of Northwest Aluminum Smelters.

Appendix A-A contains data and tables supporting the description of the affected socioeconomic environment, Chapter 2 of the main report. Appendix A-B contains a technical description of how the direct and indirect employment multipliers were calculated. Appendix A-C is a description of the regional economic model, The Metropolitan and State Economic Regions (MASTER) model, used in estimating the regional economic impacts. Appendix A-D contains detailed results of the MASTER runs.

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DATA AND TABLES SUPPORTING THE AFFECTED SOCIOECONOMIC ENVIRONMENT

Table A.1.1. Total Personal Income in Montana: 1970-1982.

(000 1970 $)	1970	1975	1980	1982	% Change 1970-82
Total Earnings	1888855	2196892	2258369	2073011	9.7
Soc. Security Adjustment	-82892	-118785	-146599	-153236	---
Residence Adjustment	-1737	-2352	-6380	-4784	---
Net Earnings	1804226	2075754	2105391	1914991	6.2
Dividends, Interest, Rent	384663	458418	659288	675831	75.7
Transfer Payments	253841	394822	450070	497332	95.9
Total Personal Income	2442730	2928995	3214749	3088154	26.4
Per Capita Income	3500	3910	4077	3839	9.7

Sources: Bureau of Economic Analysis, Local Area Personal Income, 1969-1974 Volume 4: Western States By Major Source for Counties and SMSAs, June 1976.
Bureau of Economic Analysis, Local Area Personal Income, 1975-80, Rocky Mountain Region and Western Region, June 1982.
Bureau of Economic Analysis, Local Area Personal Income, 1977-1982, Rocky Mountain Region and Far West Region, June 1984.

Table A.1.2. Personal Income by Major Sources for Montana: 1970-1982.

By Industrial Sector	1970 ($000)	1975 ($000)	1980 ($000)	1982 ($000)	% Change 1970-82
MONTANA					
Total Labor & Proprietor Income	1888855	2196892	3105808	3088154	63.5
Farm	323313	305769	117491	87404	-73.0
Nonfarm	1565542	1891123	2083103	1985608	26.8
Private	1177230	1419156	1633690	1538548	30.7
Agric. Ser., Forest. & Fish.	6862	9528	8903	9507	38.5
Mining	63538	81371	110415	116731	83.6
Contract Construction	123521	154489	171141	147421	18.5
Manufacturing	198664	212269	228448	186135	-6.3
Nondurable Goods	NA	74913	81480	79525	--.-
Durable Goods	NA	137356	146968	106610	--.-
Transport. & Public Utilities	166468	205893	255137	249208	49.7
Wholesale Trade**	305563	133723	151797	142702	--.-
Retail Trade	NA	254346	250479	237306	--.-
Fin., Insur. & Real Estate	68612	75790	103791	100589	46.6
Services	244002	291746	353579	348948	43.0
Government	388312	471967	449412	447059	15.2
Federal, Civilian	107948	136616	121486	113519	5.2
Federal, Military	57457	52447	35272	35308	-38.6
State & Local	222907	282905	292654	298233	33.6

Income in 1975, 1980, and 1982 are deflated to 1970 dollars according to the Consumer Price Index

(D)-Data withheld for reasons of disclosure (L)-Less than $10,000 in income

NA-Information not available

**-Income for both the wholesale and retail trade sectors are combined for 1970 only

Sources: Bureau of Economic Analysis, Local Area Personal Income, 1969-1974 Volume 4: Western States By Major Source for Counties and SMSAs, June, 1976.
Bureau of Economic Analysis, Local Area Personal Income, 1975-1980, Rocky Mountain Region and Western Region, June, 1982.
Bureau of Economic Analysis, Local Area Personal Income, 1977-1982, Rocky Mountain Region and Western Region, June, 1984.

Table A.1.3. Resident Labor Force and Employment in the Site Area States and Labor Market Areas: 1980.

State/Labor Area (County)	Civilian Labor Force	Total Ave. Employment	Total Ave. Unemployment	Percent of Labor Force
State of Montana	371000	348000	23000	6.1
Flathead County	23342	21407	1935	8.3
State of Oregon	1295000	1188000	107000	8.3
Portland SMSA*	635500	595600	39900	6.3
Wasco-Sherman	11510	10670	840	7.3
State of Washington	1908000	1765000	143000	7.5
Chelan-Douglas	37040	32870	4170	11.3
Clark	92560	85980	6580	7.1
Cowlitz	34580	30860	3720	10.8
Klickitat	7350	6280	1070	14.6
Tacoma SMSA (Pierce)	178600	164400	14200	7.9
Spokane SMSA (Spokane)	151400	139200	12200	8.1
Whatcom	48980	44000	4980	10.2

*Portland SMSA contains Clackimas, Multnomah, and Washington Counties in Oregon and Clark County in Washington.

Sources: State of Montana Job Service, Research & Analysis. Montana Labor and Industry Helena, Montana, 1981. State of Oregon Employment Division, Research & Statastics. Resident Oregon Labor Force and Unemployment by Area. Salem, Oregon, 1981. State of Washington Employment Security Department, Research and Analysis Branch. Resident Labor Force and Employment in Washington State and Labor Market Areas. Olympia, Washington, 1981.

Table A.1.4. Resident Labor Force and Employment in the Site Area States and Labor Market Areas: 1981.

State/Labor Area (County)	Civilian Labor Force	Total Ave. Employment	Total Ave. Unemployment	Percent of Labor Force
State of Montana	385000	358000	27000	6.9
Flathead County	24127	21695	2432	10.1
State of Oregon	1337000	1205000	132000	9.9
Portland SMSA*	659500	607100	52400	7.9
Wasco-Sherman	12050	10990	1060	8.8
State of Washington	1987000	1798000	189000	9.5
Chelan-Douglas	34690	30390	4300	12.4
Clark	88200	80710	7490	8.5
Cowlitz	33000	28680	4320	13.1
Klickitat	6560	5470	1090	16.6
Tacoma SMSA (Pierce)	173200	157200	16000	9.2
Spokane SMSA (Spokane)	146000	132200	13800	9.5
Whatcom	47060	41810	5250	11.2

*Portland SMSA contains Clackimas, Multnomah, and Washington Counties in Oregon and Clark County in Washington.

Sources: State of Montana Job Service, Research & Analysis. Montana Labor and Industry Helena, Montana, 1982. State of Oregon Employment Division, Research & Statastics. Resident Oregon Labor Force and Unemployment by Area. Salem, Oregon, 1982. State of Washington Employment Security Department, Research and Analysis Branch. Resident Labor Force and Employment in Washington State and Labor Market Areas. Olympia, Washington, 1982.

Table A.1.5. Resident Labor Force and Employment in the Site Area States and Labor Market Areas: 1982.

State/Labor Area (County)	Civilian Labor Force	Total Ave. Employment	Total Ave. Unemployment	Percent of Labor Force
State of Montana	394000	360000	34000	8.6
Flathead County	24635	21455	3180	12.9
State of Oregon	1324000	1171000	153000	11.5
Portland SMSA*	663200	596200	67000	10.1
Wasco-Sherman	12280	10720	1560	12.7
State of Washington	2024000	1779000	245000	12.1
Chelan-Douglas	37200	31210	5990	16.1
Clark	95210	83960	11250	11.8
Cowlitz	33910	27910	6000	17.7
Klickitat	7360	5740	1620	22.0
Tacoma SMSA (Pierce)	183600	160700	22900	12.5
Spokane SMSA (Spokane)	149800	131100	18700	12.5
Whatcom	48830	42470	6360	13.0

*Portland SMSA contains Clackimas, Multnomah, and Washington Counties in Oregon and Clark County in Washington.

Sources: State of Montana Job Service, Research & Analysis. Montana Labor and Industry Helena, Montana, 1983. State of Oregon Employment Division, Research & Statastics. Resident Oregon Labor Force and Unemployment by Area. Salem, Oregon, 1983. State of Washington Employment Security Department, Research and Analysis Branch. Resident Labor Force and Employment in Washington State and Labor Market Areas. Olympia, Washington, 1983.

Table A.1.6. **Resident Labor Force and Employment in the Site Area States and Labor Market Areas: 1983.**

State/Labor Area (County)	Civilian Labor Force	Total Ave. Employment	Total Ave. Unemployment	Percent of Labor Force
State of Montana	396000	361000	35000	8.8
Flathead County	26579	23793	2786	10.5
State of Oregon	1341000	1196000	145000	10.8
Portland SMSA*	615500	555400	67100	9.8
Wasco-Sherman	12460	10890	1570	12.6
State of Washington	2069000	1838000	231000	11.2
Chelan-Douglas	37670	32190	5480	14.5
Clark	93960	84900	9060	9.6
Cowlitz	33500	28560	4940	14.7
Klickitat	7090	5860	1230	17.3
Tacoma SMSA (Pierce)	190500	167500	23000	12.1
Spokane SMSA (Spokane)	153900	138600	15300	9.9
Whatcom	50400	44400	6000	11.9

*Portland SMSA contains Clackimas, Multnomah, Washington and Yamhill Counties in Oregon.

Sources: State of Montana Job Service, Research & Analysis. Montana Labor and Industry Helena, Montana, 1984. State of Oregon Employment Division, Research & Statastics. Resident Oregon Labor Force and Unemployment by Area. Salem, Oregon, 1984. State of Washington Employment Security Department, Research and Analysis Branch. Resident Labor Force and Employment in Washington State and Labor Market Areas. Olympia, Washington, 1984.

Table A.1.7. Resident Labor Force and Employment in the Site Area States and Labor Market Areas: 1984.

State/Labor Area (County)	Civilian Labor Force	Total Ave. Employment	Total Ave. Unemployment	Percent of Labor Force
State of Montana	406000	376000	30000	7.4
Flathead County	28413	26463	2250	7.9
State of Oregon	1335000	1210000	125000	9.4
Portland SMSA*	614800	556400	48400	7.9
Wasco-Sherman	12470	10940	1530	12.3
State of Washington	2053000	1859000	194000	9.5
Chelan-Douglas	38100	33250	4850	12.7
Clark	94130	86230	7900	8.4
Cowlitz	32700	28460	4240	13.0
Klickitat	7260	6130	1130	15.6
Tacoma SMSA (Pierce)	192980	172810	20170	10.4
Spokane SMSA (Spokane)	155910	142390	13520	8.7
Whatcom	52060	46320	5740	11.0

*Portland SMSA contains Clackimas, Multnomah, Washington and Yamhill Counties in Oregon.

Sources: State of Montana Job Service, Research & Analysis. Montana Labor and Industry Helena, Montana, 1985. State of Oregon Employment Division, Research & Statastics. Resident Oregon Labor Force and Unemployment by Area. Salem, Oregon, 1985. State of Washington Employment Security Department, Research and Analysis Branch. Resident Labor Force and Employment in Washington State and Labor Market Areas. Olympia, Washington, 1985.

Table A.1.8 Retail Sales in Montana: 1972-1982

	1972		1977		1982	
	Number	Sales	Number	Sales	Number	Sales
Montana, State						
All Establishments	8824	1613941	8880	1965808	9504	1714239
Bldg.Mat.,Hardware	516	137812	617	179380	438	115488
Gen. Merchandise	240	140636	217	169246	151	(D)
Food Stores	952	357938	890	413690	709	401637
Auto Dealers	577	340112	655	416770	459	316579
Gasoline Service	1190	150242	968	187892	522	167998
Apparel & Accesory	474	80616	552	94342	560	85212
Furniture & Furnishings	396	65012	603	84246	389	71267
Eating and Drinking	2111	153428	2083	189623	1925	178954
Drug Stores	222	56750	215	68652	200	58312
Miscellaneous Retail	2146	130849	2080	161967	1067	(D)

Sales in 1977 and 1982 are deflated to 1972 dollars according to the Consumer Price Index.

Sources: Bureau of the Census, 1976. 1972 Census of Retail Trade. Volume II Area Statistics, Part 2. Iowa-North Carolina. Table 6: 27-18--27-19.
Bureau of the Census, 1980. 1977 Census of Retail Trade. Volume II Geographical Area Statistics. Part 2. Iowa-North Carolina. Table 7: 27-22--27-23.
Bureau of the Census, 1984. 1982 Census of Retail Trade. Volume II Geographical Area Statistics. Part 2. Iowa-North Carolina. Table 8: Mont.-20--Mont. 21.

Table A.1.9. Trade Area Capture for Site Communities and Counties: 1972-1982

SITE COMMUNITY/COUNTY	TRADE AREA CAPTURE--TOTAL RETAIL SALES 1972	1977	1982	% Change 1972-1982
Flathead County, Montana	48804	51889	57541	17.9
Columbia Falls	3843	3907	4030	4.9
Multnomah County, Oregon	599903	546689	639672	6.6
Troutdale	NA	NA	2846	--.-
Wasco County, Oregon	24190	23330	27301	12.9
City of the Dalles	22969	22354	26457	15.2
Chelan County, Washington	52466	53723	55184	5.2
Wenatchee	35663	33363	38189	7.1
Douglas County, Washington	8091	14788	20916	158.5
Cowlitz County, Washington	75869	75819	89161	17.5
Longview	57747	56531	62939	9.0
Kelso	10315	10804	11830	14.7
Clark County, Washington	110883	152424	163886	47.8
Vancouver	62320	67649	55937	-10.2
Klickitat County, Washington	8234	8113	9626	16.9
Goldendale	NA	NA	4409	--.-
Pierce County, Washington	384507	441363	508486	32.2
Tacoma	209654	225065	250704	19.6
Spokane County, Washington	337625	379874	412618	22.2
Spokane (City)	240933	251249	267393	11.0
Whatcom County, Washington	97864	121515	136656	39.6
Ferndale	NA	NA	8106	--.-
Bellingham	70507	83953	96348	36.7

A community's/county's trade area capture is represented by the following formula:

$$TCij = \left[\frac{ASij}{(ASsj/Ps) \cdot (Yc/Ys)} \right]$$

where: TCij is the trade area capture of retail category j in community/county i
ASij is the annual retail sales category j in community/county i
ASsj is the annual retail sales category j in state s
Ps is the population for state s
Yc is the average per capita income for county c containing community i
Ys is the average per capita income for state s

Sources: Bureau of the Census, 1976. 1972 Census of Retail Trade. Volume II Area Statistics. Part 3, North Dakota-Wyoming. Table 6: 48-44--48-49.
Bureau of the Census, 1980. 1977 Census of Retail Trade. Volume II Geographical Area Statistics. Part 3, North Dakota-Wyoming. Table 7: 48-50--48-49.
Bureau of the Census, 1984. 1982 Census of Retail Trade. Volume II Geographical Area Statistics. Part 3, North Dakota- Wyoming. Table 8: Wash.44--Wash.47.
Chase, Robert A. and Glen C. Pulver. "The Impact of Shopping Center Development on Downtowns of Small Nonmetropolitan Communities". Journal of the Community Development Society, 14,2 (1983): 51-64.

Table A.1.10. Total Personal Income in Oregon: 1970-1982.

(000 1970 $)	1970	1975	1980	1982	% Change 1970-82
Total Earnings	6155696	7297097	8793113	7625001	23.9
Soc. Security Adjustment	-268059	-425705	-520372	-507562	---
Residence Adjustment	-66621	-94681	-185539	-167931	---
Net Earnings	5821016	6776712	8087202	6949507	19.4
Dividends, Interest, Rent	1136973	1358515	1828836	2217950	95.1
Transfer Payments	855936	1463734	1644473	1835122	114.7
Total Personal Income	7813925	9598960	11560511	11002579	40.8
Per Capita Income	3719	4129	4381	4116	10.7

Sources: Bureau of Economic Analysis, Local Area Personal Income, 1969-1974 Volume 4: Western States By Major Source for Counties and SMSAs, June 1976.
Bureau of Economic Analysis, Local Area Personal Income, 1975-80, Rocky Mountain Region and Western Region, June 1982.
Bureau of Economic Analysis, Local Area Personal Income, 1977-1982, Rocky Mountain Region and Far West Region, June 1984.

Table A.1.11. Personal Income by Major Sources for Oregon: 1970-1982.

By Industrial Sector	1970 ($000)	1975 ($000)	1980 ($000)	1982 ($000)	% Change 1970-82
OREGON					
Total Labor & Proprietor Income	6155696	7297097	11628852	1100279	78.7
Farm	207176	281464	310665	211486	2.1
Nonfarm	5948520	7015633	8432473	7413515	24.6
Private	4868444	5675777	7034483	6039771	24.1
Agric. Ser., Forest. & Fish.	30307	47262	64101	55450	82.9
Mining	13093	18728	22232	17646	34.4
Contract Construction	368071	454823	609355	355754	-3.3
Manufacturing	1563048	1753979	2147113	1801367	15.3
Nondurable Goods	NA	435209	489957	460470	--.-
Durable Goods	NA	1318770	1657156	1340896	--.-
Transport. & Public Utilities	507050	564849	692140	639669	26.1
Wholesale Trade**	1187449	549449	651845	570794	--.-
Retail Trade	NA	8077604	963693	838457	--.-
Fin., Insur. & Real Estate	296056	330586	495177	436125	47.3
Services	903370	1093138	138827	1324472	46.6
Government	1080076	1339856	1397990	1373744	27.2
Federal, Civilian	263775	289870	287347	292853	11.0
Federal, Military	52175	39829	32239	30652	-41.3
State & Local	764126	1019157	1078404	1050238	37.4

Income in 1975, 1980, and 1982 are deflated to 1970 dollars according to the Consumer Price Index

(D)-Data withheld for reasons of disclosure (L)-Less than $10,000 in income

NA-Information not available

**-Income for both the wholesale and retail trade sectors are combined for 1970 only

Sources: Bureau of Economic Analysis, Local Area Personal Income, 1969-1974 Volume 4: Western States By Major Source for Counties and SMSAs, June, 1976.
Bureau of Economic Analysis, Local Area Personal Income, 1975-1980, Rocky Mountain Region and Western Region, June, 1982.
Bureau of Economic Analysis, Local Area Personal Income, 1977-1982, Rocky Mountain Region and Western Region, June, 1984.

Table A.1.12. Employment By Place of Work in Oregon: 1970-1982.

	Employment By Type and Broad Industrial Sources				
	1970	1975	1977	1980	1982
Total Employment, Oregon	881238	1023479	1129253	1248038	1168384
Number of Proprietors	109504	120053	132913	155584	161325
Farm Proprietors	35788	34752	34577	40301	41390
Non-Farm Proprietors	73716	85301	98336	115283	119935
Total Wage Employment	771734	903426	996340	1092454	1007059
Farm	22063	26731	29743	26737	26524
Non-Farm	749671	876695	966597	1065717	980535
Private	584752	677912	765636	852848	778734
Ag. Services, For. & Other	4143	5935	7092	9694	9500
Mining	1362	1680	1779	2281	1836
Contract Construction	30310	35483	42697	46608	28772
Manufacturing	173300	183154	205878	214939	186055
Non-Durable Manufacturing	49506	49582	53738	55570	53018
Durable Manufacturing	123794	133572	152140	159369	133037
Transport. & Public Utilities	48896	50269	53862	60062	56291
Wholesale Trade	42689	52382	57977	67400	62475
Retail Trade	119793	146301	167623	188006	176030
Finance, Ins. & Real Estate	35383	43245	50117	60332	57498
Services	128876	159463	178611	203526	200801
Government	164919	198783	200961	212869	201801
Federal, Civilian	25411	26648	27765	30273	29252
Federal, Military	16567	16858	13651	13931	10343
State and Local	122941	155277	159545	168665	162206

(D)- Data withheld for reasons of disclosure

Source: Bureau of Economic Analysis, Regional Economic Information Service, Table 25, April, 1984.

Table A.1.13. Retail Sales in Oregon: 1972-1982

	1972 Sales		1977 Sales		1982 Sales	
	Number	(000 $)	Number	(000 $)	Number	(000 $)
All Establishments	22595	5190581	22788	6453466	26200	5475767
Bldg.Mat.,Hardware	1170	322932	1439	434082	941	238010
Gen. Merchandise	506	559063	481	867387	369	771462
Food Stores	2635	1206525	2729	1257638	2370	1152866
Auto Dealers	1552	1130106	1747	1438161	1221	960954
Gasoline Service	2828	391863	2185	452038	1492	479650
Apparel & Accesory	1103	215115	1382	269666	1354	254873
Furniture & Furnishings	1310	234935	1915	332061	1253	213672
Eating and Drinking	4298	438853	4578	607026	4581	573603
Drug Stores	497	171968	492	211914	465	161343
Miscellaneous Retail	6696	519221	5840	583493	3093	517061

Sales in 1977 and 1982 are deflated to 1972 dollars according to the Consumer Price Index.
(D)-Data withheld for reasons of disclosure

Sources: Bureau of the Census, 1976. 1972 Census of Retail Trade. Volume II Area Statistics. Part 3, North Dakota-Wyoming. Table 6: 38-34--38-37.
Bureau of the Census, 1980. 1977 Census of Retail Trade. Volume II Geographical Area Statistics. Part 3, North Dakota-Wyoming. Table 7: 38-38--38-41.
Bureau of the Census, 1984. 1982 Census of Retail Trade. Volume II Geographical Area Statistics. Part 3, North Dakota- Wyoming. Table 8: Oreg.-36--Oreg.-39.

Table A.1.14. Total Personal Income in Washington: 1970-1982.

(000 1970 $)	1970	1975	1980	1982	% Change 1970-82
Total Earnings	10753007	12084170	15039744	13848399	28.4
Soc. Security Adjustment	-433973	-733364	-844219	-883676	---
Residence Adjustment	119996	272985	277874	280606	---
Net Earnings	10439030	11623791	14473399	13245329	26.9
Dividends, Interest, Rent	1888927	2202187	3122676	3558549	88.4
Transfer Payments	1506483	2395498	2604932	2952803	96.5
Total Personal Income	13834440	16221476	20201006	197566814	42.8
Per Capita Income	4053	4482	4880	4613	13.8

Sources: Bureau of Economic Analysis, Local Area Personal Income, 1969-1974 Volume 4: Western States By Major Source for Counties and SMSAs, June 1976.
Bureau of Economic Analysis, Local Area Personal Income, 1975-80, Rocky Mountain Region and Western Region, June 1982.
Bureau of Economic Analysis, Local Area Personal Income, 1977-1982, Rocky Mountain Region and Far West Region, June 1984.

Table A.1.15. Personal Income by Major Sources for Washington: 1970-1982.

By Industrial Sector	1970 ($000)	1975 ($000)	1980 ($000)	1982 ($000)	% Change 1970-82
WASHINGTON					
Total Labor & Proprietor Income	10753007	12084170	19933058	19756680	83.7
Farm	339231	624898	401984	457296	34.8
Nonfarm	10413776	11459271	14357617	13391103	28.6
Private	7926537	8826356	11562763	10570228	33.3
Agric. Ser., Forest. & Fish.	59374	82261	144675	119625	101.3
Mining	18018	24456	36661	33200	84.4
Contract Construction	675031	767102	1136947	874369	29.5
Manufacturing	2518844	2667174	3433896	3245047	28.8
Nondurable Goods	NA	720807	849731	816903	--.-
Durable Goods	NA	1946366	2631288	2428143	--.-
Transport. & Public Utilities	768428	846515	1068511	1027799	33.8
Wholesale Trade**	1844398	840752	1002010	925975	--.-
Retail Trade	NA	1297622	1481508	1368089	--.-
Fin., Insur. & Real Estate	542642	520791	799954	758700	39.8
Services	1499810	1779684	2411476	2217425	47.8
Government	2487239	2632915	2794854	2820875	13.2
Federal, Civilian	582689	654364	654965	637260	9.4
Federal, Military	528689	383270	325292	430870	-18.5
State & Local	1373916	1595282	1814598	1752744	27.6

Income in 1975, 1980, and 1982 are deflated to 1970 dollars according to the Consumer Price Index

(D)-Data withheld for reasons of disclosure (L)-Less than $10,000 in income

NA-Information not available

**-Income for both the wholesale and retail trade sectors are combined for 1970 only

Sources: Bureau of Economic Analysis, Local Area Personal Income, 1969-1974 Volume 4: Western States By Major Source for Counties and SMSAs, June, 1976.
Bureau of Economic Analysis, Local Area Personal Income, 1975-1980, Rocky Mountain Region and Western Region, June, 1982.
Bureau of Economic Analysis, Local Area Personal Income, 1977-1982, Rocky Mountain Region and Western Region, June, 1984.

Table A.1.16. Employment By Place of Work in Washington: 1970-1982.

	Employment By Type and Broad Industrial Sources				
	1970	1975	1977	1980	1982
Total Employment, Washington	1411608	1539410	1689097	1950303	1925455
Number of Proprietors	139004	148646	165497	191290	198527
Farm Proprietors	42187	38040	39065	43508	44539
Non-Farm Proprietors	96817	110606	126432	147782	153988
Total Wage Employment	1272604	1390764	1523600	1759013	1726928
Farm	34992	43107	39124	45118	47841
Non-Farm	1237612	1347657	1484476	1713895	1679087
Private	884231	985277	1123111	1324488	1271742
Ag. Services, For. & Other	6812	8886	11132	15754	15984
Mining	1686	1982	2295	3155	2867
Contract Construction	54687	59530	77602	93794	73442
Manufacturing	240352	243741	262657	308540	287010
Non-Durable Manufacturing	74620	74908	82666	87524	84727
Durable Manufacturing	165732	168833	179991	221016	202283
Transport. & Public Utilities	71908	72763	78478	91255	88020
Wholesale Trade	64570	79293	88926	100407	97927
Retail Trade	179561	206176	239905	280791	279370
Finance, Ins. & Real Estate	60352	66398	77165	94942	92360
Services	204503	246508	284951	335850	334762
Government	353381	362380	361365	389407	407345
Federal, Civilian	58713	60834	61937	67803	65827
Federal, Military	87965	66441	67897	68011	94744
State and Local	206703	235105	231531	253593	246774

(D)- Data withheld for reasons of disclosure
(L)-Less than ten employees

Source: Bureau of Economic Analysis, Regional Economic Information Service, Table 25, April, 1984.

Table A.1.17. Retail Sales in Washington: 1972-1982.

	1972 Sales		1977 Sales		1982 Sales	
	Number	(000 $)	Number	(000 $)	Number	(000 $)
Washington, State						
All Establishments	31611	7494903	31872	9322073	37697	8671601
Bldg.Mat.,Hardware	1467	367046	1776	619919	1335	469399
Gen. Merchandise	654	1002835	586	1107054	480	940458
Food Stores	3591	1740239	3586	1998733	3299	2082685
Auto Dealers	2304	1440259	2640	1903647	1880	1388105
Gasoline Service	3945	575552	3005	653766	2144	732380
Apparel & Accesory	1566	337588	1815	421529	1909	421066
Furniture & Furnishings	2004	332053	2917	462123	1958	354322
Eating and Drinking	6063	673574	6296	935825	6543	967932
Drug Stores	867	302272	819	370041	842	345107
Miscellaneous Retail	9150	733485	8432	849435	4595	793333

Sales in 1977 and 1982 are deflated to 1972 dollars according to the Consumer Price Index.
(D)-Data withheld for reasons of disclosure

Sources: Bureau of the Census, 1976. 1972 Census of Retail Trade. Volume II Area Statistics. Part 3, North Dakota-Wyoming. Table 6: 48-44--48-49.
Bureau of the Census, 1980. 1977 Census of Retail Trade. Volume II Geographical Area Statistics. Part 3, North Dakota-Wyoming. Table 7: 48-50--48-53.
Bureau of the Census, 1984. 1982 Census of Retail Trade. Volume II Geographical Area Statistics. Part 3, North Dakota- Wyoming. Table 8: Wash.44--Wash.47.

Table A.1.18. Total Personal Income in Cowlitz County, Washington: 1970-1982.

(000 1970 $)	1970	1975	1980	1982	% Change 1970-82
Total Earnings	227413	277286	302031	247250	8.8
Soc. Security Adjustment	-9391	-17408	-17231	-16282	---
Residence Adjustment	-14171	-11492	-8522	-5069	---
Net Earnings	203851	248386	276278	225899	10.8
Dividends, Interest, Rent	29542	36022	48256	54117	83.4
Transfer Payments	26253	43560	51044	56742	116.4
Total Personal Income	259646	327967	375579	336768	29.6
Per Capita Income	3780	4405	4710	4238	12.1
As % of State	93.3	98.3	96.5	91.9	

Sources: Bureau of Economic Analysis, Local Area Personal Income, 1969-1974 Volume 4: Western States By Major Source for Counties and SMSAs, June 1976.
Bureau of Economic Analysis, Local Area Personal Income, 1975-80, Rocky Mountain Region and Western Region, June 1982.
Bureau of Economic Analysis, Local Area Personal Income, 1977-1982, Rocky Mountain Region and Far West Region, June 1984.

Table A.1.19. Personal Income by Major Sources for Cowlitz County, Washington: 1970-1982.

By Industrial Sector	1970 ($000)	1975 ($000)	1980 ($000)	1982 ($000)	% Change 1970-82
COWLITZ COUNTY					
Total Labor & Proprietor Income	227413	277286	368393	336757	48.1
Farm	2144	3867	3178	3660	70.7
Nonfarm	225269	273419	293218	243589	8.1
Private	119103	243221	260996	213226	79.0
Agric. Ser., Forest. & Fish.	(D)	1148	(D)	1377	--.-
Mining	(D)	219	(D)	32	--.-
Contract Construction	12813	30809	29186	11712	-8.6
Manufacturing	112918	129995	135616	116561	3.2
Nondurable Goods	NA	46441	52451	49223	--.-
Durable Goods	NA	83553	83165	67338	--.-
Transport. & Public Utilities	15266	15931	18139	16097	5.4
Wholesale Trade**	29260	7702	9488	8030	--.-
Retail Trade	NA	25882	25963	22487	--.-
Fin., Insur. & Real Estate	4650	4527	6934	6529	40.4
Services	23376	27009	33648	30401	30.1
Government	26166	30198	32221	30363	16.0
Federal, Civilian	2266	2131	1886	1603	-29.3
Federal, Military	1513	778	490	1251	-17.3
State & Local	22387	27289	29845	27509	22.9

Income in 1975, 1980, and 1982 are deflated to 1970 dollars according to the Consumer Price Index

(D)-Data withheld for reasons of disclosure (L)-Less than $10,000 in income

NA-Information not available

**-Income for both the wholesale and retail trade sectors are combined for 1970 only

Sources: Bureau of Economic Analysis, Local Area Personal Income, 1969-1974 Volume 4: Western States By Major Source for Counties and SMSAs, June, 1976.
Bureau of Economic Analysis, Local Area Personal Income, 1975-1980, Rocky Mountain Region and Western Region, June, 1982.
Bureau of Economic Analysis, Local Area Personal Income, 1977-1982, Rocky Mountain Region and Western Region, June, 1984.

Table A.1.20. Employment By Place of Work in Cowlitz County, Washington: 1970-1982.

	Employment By Type and Broad Industrial Sources				
	1970	1975	1977	1980	1982
Total Employment, Cowlitz County	28360	32494	33855	35292	32405
Number of Proprietors	2383	2597	2898	3381	3515
Farm Proprietors	473	423	434	483	495
Non-Farm Proprietors	1910	2174	2464	2898	3020
Total Wage Employment	25977	29709	30957	31911	28890
Farm	188	188	170	196	207
Non-Farm	25789	29709	30787	31715	28683
Private	21406	24999	26343	26880	23791
Ag. Services, For. & Other	104	209	256	(D)	391
Mining	14	17	12	(D)	(L)
Contract Construction	1031	2325	1611	2117	1065
Manufacturing	11075	11607	12211	10857	9513
Non-Durable Manufacturing	3932	3808	3836	4026	3851
Durable Manufacturing	7143	7799	8375	6831	5662
Transport. & Public Utilities	1443	1417	1402	1520	1468
Wholesale Trade	484	555	659	747	695
Retail Trade	3431	4044	4486	4960	4740
Finance, Ins. & Real Estate	570	717	881	1031	1006
Services	3254	4108	4825	5257	4905
Government	4383	4710	4444	4835	4892
Federal, Civilian	200	200	220	187	154
Federal, Military	384	381	320	337	758
State and Local	3799	4129	3904	4311	3980

(D)- Data withheld for reasons of disclosure
(L)-Less than ten employees

Source: Bureau of Economic Analysis, Regional Economic Information Service, Table 25, April, 1984.

Table A.1.21. Retail Sales in Cowlitz County, Washington: 1972-1982.

	1972 Sales		1977 Sales		1982 Sales	
	Number	(000 $)	Number	(000 $)	Number	(000 $)
Cowlitz County						
All Establishments	653	160697	649	190357	716	165891
Bldg.Mat.,Hardware	35	9964	36	(D)	27	7456
Gen. Merchandise	15	(D)	19	(D)	15	23083
Food Stores	83	36810	83	41321	81	46944
Auto Dealers	55	38741	67	46335	44	29238
Gasoline Service	87	11586	65	13332	40	15182
Apparel & Accesory	27	(D)	26	5379	22	3309
Furniture & Furnishings	31	6535	47	7825	32	4332
Eating and Drinking	115	13153	125	16602	137	17880
Drug Stores	15	9322	12	(D)	13	6063
Miscellaneous Retail	190	10246	169	11557	81	9796

Sales in 1977 and 1982 are deflated to 1972 dollars according to the Consumer Price Index.
(D)-Data withheld for reasons of disclosure

Sources: Bureau of the Census, 1976. 1972 Census of Retail Trade. Volume II Area Statistics. Part 3, North Dakota-Wyoming. Table 6: 48-44--48-49.
Bureau of the Census, 1980. 1977 Census of Retail Trade. Volume II Geographical Area Statistics. Part 3, North Dakota-Wyoming. Table 7: 48-50--48-53.
Bureau of the Census, 1984. 1982 Census of Retail Trade. Volume II Geographical Area Statistics. Part 3, North Dakota- Wyoming. Table 8: Wash.44--Wash.47.

Table A.1.22. Retail Sales in Longview, Washington: 1972-1982.

	1972 Sales		1977 Sales		1982 Sales	
	Number	(000 $)	Number	(000 $)	Number	(000 $)
Longview						
All Establishments	369	122314	373	141931	412	117103
Bldg.Mat.,Hardware	20	7310	22	8750	16	4990
Gen. Merchandise	10	19698	11	26607	12	22887
Food Stores	43	24959	41	24290	40	24874
Auto Dealers	38	31850	39	38626	35	25987
Gasoline Service	44	6116	32	(D)	20	8620
Apparel & Accesory	22	3698	21	(D)	19	3129
Furniture & Furnishings	19	4191	28	5258	26	3251
Eating and Drinking	57	8580	67	11214	72	11011
Drug Stores	10	8425	8	(D)	7	4158
Miscellaneous Retail	106	7487	104	8538	54	6828

Sales in 1977 and 1982 are deflated to 1972 dollars according to the Consumer Price Index.
(D)-Data withheld for reasons of disclosure

Sources: Bureau of the Census, 1976. 1972 Census of Retail Trade. Volume II Area Statistics. Part 3, North Dakota-Wyoming. Table 6: 48-44--48-49.
Bureau of the Census, 1980. 1977 Census of Retail Trade. Volume II Geographical Area Statistics. Part 3, North Dakota-Wyoming. Table 7: 48-50--48-53.
Bureau of the Census, 1984. 1982 Census of Retail Trade. Volume II Geographical Area Statistics. Part 3, North Dakota- Wyoming. Table 8: Wash.44--Wash.47.

Table A.1.23. Retail Sales in Kelso, Washington: 1972-1982.

	1972 Sales		1977 Sales		1982 Sales	
	Number	(000 $)	Number	(000 $)	Number	(000 $)
Kelso						
All Establishments	147	21849	142	27125	149	22011
Bldg.Mat.,Hardware	6	1694	7	3110	5	1461
Gen. Merchandise	1	(D)	3	(D)	1	(D)
Food Stores	21	8422	20	10411	21	9421
Auto Dealers	10	2718	17	3191	4	681
Gasoline Service	22	2298	15	2732	8	3075
Apparel & Accesory	3	(D)	3	(D)	2	(D)
Furniture & Furnishings	7	2252	13	2453	6	1081
Eating and Drinking	34	1882	28	(D)	37	3464
Drug Stores	2	(D)	1	(D)	3	(D)
Miscellaneous Retail	41	1682	35	1932	14	1228

Sales in 1977 and 1982 are deflated to 1972 dollars according to the Consumer Price Index.
(D)-Data withheld for reasons of disclosure

Sources: Bureau of the Census, 1976. 1972 Census of Retail Trade. Volume II Area Statistics. Part 3, North Dakota-Wyoming. Table 6: 48-44--48-49.
Bureau of the Census, 1980. 1977 Census of Retail Trade. Volume II Geographical Area Statistics. Part 3, North Dakota-Wyoming. Table 7: 48-50--48-53.
Bureau of the Census, 1984. 1982 Census of Retail Trade. Volume II Geographical Area Statistics. Part 3, North Dakota- Wyoming. Table 8: Wash.44--Wash.47.

Table A.1.24. Total Personal Income in Multnomah County, Oregon: 1970-1982.

(000 1970 $)	1970	1975	1980	1982	% Change 1970-82
Total Earnings	2499689	2728368	3081650	2705311	10.2
Soc. Security Adjustment	-109896	-166219	-186221	-183364	---
Residence Adjustment	-578161	-633751	-760009	-672241	---
Net Earnings	1811632	1928399	2135420	1849706	2.1
Dividends, Interest, Rent	357010	388801	468987	561653	57.4
Transfer Payments	274661	419529	430004	467758	70.3
Total Personal Income	2443303	2736729	3034410	2879117	17.8
Per Capita Income	4369	5000	5379	5088	16.5
As % of State	117.5	121.1	122.8	123.6	

Sources: Bureau of Economic Analysis, Local Area Personal Income, 1969-1974 Volume 4: Western States By Major Source for Counties and SMSAs, June 1976.
Bureau of Economic Analysis, Local Area Personal Income, 1975-80, Rocky Mountain Region and Western Region, June 1982.
Bureau of Economic Analysis, Local Area Personal Income, 1977-1982, Rocky Mountain Region and Far West Region, June 1984.

Table A.1.25. Personal Income by Major Sources for Multnomah County, Oregon: 1970-1982.

By Industrial Sector	1970 ($000)	1975 ($000)	1980 ($000)	1982 ($000)	% Change 1970-82
MULTNOMAH COUNTY					
Total Labor & Proprietor Income	2499689	2738368	3014986	2879117	15.2
Farm	9109	8351	11841	10278	12.8
Nonfarm	2490580	2720017	3027450	2695033	8.2
Private	2128034	2302860	2618420	2286794	4.9
Agric. Ser., Forest. & Fish.	(D)	4767	5606	4607	--.-
Mining	(D)	1246	4378	5739	--.-
Contract Construction	148279	150626	185241	120688	-18.6
Manufacturing	486395	525086	573153	469316	-3.5
Nondurable Goods	NA	168406	170080	154821	--.-
Durable Goods	NA	3566680	403073	314495	--.-
Transport. & Public Utilities	285432	297170	357892	338608	18.6
Wholesale Trade**	571891	323714	351076	292796	--.-
Retail Trade	NA	301816	300741	264295	--.-
Fin., Insur. & Real Estate	184809	201700	260653	237905	28.7
Services	446992	496737	579681	552841	23.7
Government	362546	417158	409030	408239	12.6
Federal, Civilian	129660	130332	125811	130398	0.5
Federal, Military	9792	14536	9927	8917	-8.9
State & Local	223094	272289	273291	268924	20.5

Income in 1975, 1980, and 1982 are deflated to 1970 dollars according to the Consumer Price Index

(D)-Data withheld for reasons of disclosure (L)-Less than $10,000 in income

NA-Information not available

**-Income for both the wholesale and retail trade sectors are combined for 1970 only

Sources: Bureau of Economic Analysis, Local Area Personal Income, 1969-1974 Volume 4: Western States By Major Source for Counties and SMSAs, June, 1976.
Bureau of Economic Analysis, Local Area Personal Income, 1975-1980, Rocky Mountain Region and Western Region, June, 1982.
Bureau of Economic Analysis, Local Area Personal Income, 1977-1982, Rocky Mountain Region and Western Region, June, 1984.

Table A.1.26. Employment By Place of Work in Multnomah County, Oregon: 1970-1982.

	Employment By Type and Broad Industrial Sources				
	1970	1975	1977	1980	1982
Total Employ., Multnomah County	313178	338463	354969	383649	355437
Number of Proprietors	20116	21463	23839	27466	28567
Farm Proprietors	751	627	724	727	747
Non-Farm Proprietors	19365	21132	23215	26739	27820
Total Wage Employment	293062	316704	331130	356183	326870
Farm	1049	1134	1263	1135	1126
Non-Farm	292013	312270	329867	355045	325744
Private	244401	260573	275223	298656	272811
Ag. Services, For. & Other	(D)	699	770	923	789
Mining	(D)	1217	245	358	433
Contract Construction	12109	11591	12819	13417	9284
Manufacturing	50251	50148	52079	52799	43872
Non-Durable Manufacturing	19182	17462	18096	17758	16503
Durable Manufacturing	31069	32686	33983	35041	27369
Transport. & Public Utilities	26325	25092	26006	29656	28331
Wholesale Trade	28677	29841	31509	34222	29903
Retail Trade	44523	50192	52591	56289	52598
Finance, Ins. & Real Estate	21843	24675	27088	31211	30014
Services	60096	68208	72116	79781	77587
Government	47612	54997	54644	56392	52933
Federal, Civilian	11792	11570	11689	12189	12030
Federal, Military	4033	4816	3536	3422	2452
State and Local	31787	38611	39416	40781	38451

(D)- Data withheld for reasons of disclosure

Source: Bureau of Economic Analysis, Regional Economic Information Service, Table 25, April, 1984.

Table A.1.27. Retail Sales in Multnomah County, Oregon: 1972-1982.

	1972 Sales		1977 Sales		1982 Sales	
	Number	(000 $)	Number	(000 $)	Number	(000 $)
Multnomah County						
All Establishments	5373	1614787	4991	1715280	5500	1445207
Bldg.Mat.,Hardware	166	48670	192	55938	125	36164
Gen. Merchandise	88	251753	91	310812	70	269786
Food Stores	569	374464	524	252767	440	228980
Auto Dealers	347	307813	362	351214	217	217650
Gasoline Service	591	97753	432	11302	312	120656
Apparel & Accesory	282	78382	316	75975	289	77692
Furniture & Furnishings	343	82055	439	117373	299	69916
Eating and Drinking	1165	153825	1240	202958	1178	175149
Drug Stores	110	29537	87	31973	80	20823
Miscellaneous Retail	1712	190535	1308	204967	757	196708

Sales in 1977 and 1982 are deflated to 1972 dollars according to the Consumer Price Index.
(D)-Data withheld for reasons of disclosure

Sources: Bureau of the Census, 1976. 1972 Census of Retail Trade. Volume II Area Statistics. Part 3, North Dakota-Wyoming. Table 6: 38-34--38-37.
Bureau of the Census, 1980. 1977 Census of Retail Trade. Volume II Geographical Area Statistics. Part 3, North Dakota-Wyoming. Table 7: 38-38--38-41.
Bureau of the Census, 1984. 1982 Census of Retail Trade. Volume II Geographical Area Statistics. Part 3, North Dakota- Wyoming. Table 8: Oreg.-36--Oreg.-39.

Table A.1.28. Retail Sales in Troutdale, Oregon: 1972-1982.

	1972 Sales		1977 Sales		1982 Sales	
	Number	(000 $)	Number	(000 $)	Number	(000 $)
All Establishments	NA	NA	NA	NA	46	6430
Bldg.Mat.,Hardware	NA	NA	NA	NA	0	---
Gen. Merchandise	NA	NA	NA	NA	0	---
Food Stores	NA	NA	NA	NA	2	(D)
Auto Dealers	NA	NA	NA	NA	0	---
Gasoline Service	NA	NA	NA	NA	7	4302
Apparel & Accesory	NA	NA	NA	NA	0	---
Furniture & Furnishings	NA	NA	NA	NA	0	---
Eating and Drinking	NA	NA	NA	NA	8	1415
Drug Stores	NA	NA	NA	NA	0	---
Miscellaneous Retail	NA	NA	NA	NA	3	(D)

Sales in 1977 and 1982 are deflated to 1972 dollars according to the Consumer Price Index.
(D)-Data withheld for reasons of disclosure
NA-Information not available
Sources: Bureau of the Census, 1976. 1972 Census of Retail Trade. Volume II Area Statistics. Part 3, North Dakota-Wyoming. Table 6: 38-34--38-37.
Bureau of the Census, 1980. 1977 Census of Retail Trade. Volume II Geographical Area Statistics. Part 3, North Dakota-Wyoming. Table 7: 38-38--38-41.
Bureau of the Census, 1984. 1982 Census of Retail Trade. Volume II Geographical Area Statistics. Part 3, North Dakota- Wyoming. Table 8: Oreg.-36--Oreg.-39.

Table A.1.29. Total Personal Income in Clark County, Washington: 1970-1982.

(000 1970 $)	1970	1975	1980	1982	% Change 1970-82
Total Earnings	305042	369387	453396	415290	36.2
Soc. Security Adjustment	-13510	-23733	-26294	-27075	---
Residence Adjustment	89194	121101	218786	188721	---
Net Earnings	380726	466754	645888	572914	50.4
Dividends, Interest, Rent	57366	76431	120429	136618	140.4
Transfer Payments	49520	91801	103405	117810	138.0
Total Personal Income	487612	634986	869722	827342	69.5
Per Capita Income	3792	4046	4514	4133	9.0
As % of State	93.6	90.3	92.5	89.6	

Sources: Bureau of Economic Analysis, Local Area Personal Income, 1969-1974 Volume 4: Western States By Major Source for Counties and SMSAs, June 1976.
Bureau of Economic Analysis, Local Area Personal Income, 1975-80, Rocky Mountain Region and Western Region, June 1982.
Bureau of Economic Analysis, Local Area Personal Income, 1977-1982, Rocky Mountain Region and Far West Region, June 1984.

Table A.1.30. Personal Income by Major Sources for Clark County, Washington: 1970-1982.

By Industrial Sector	1970 ($000)	1975 ($000)	1980 ($000)	1982 ($000)	% Change 1970-82
CLARK COUNTY					
Total Labor & Proprietor Income	305042	369387	864080	827342	171.2
Farm	6427	7471	6979	8920	38.8
Nonfarm	298615	361916	441395	406371	36.1
Private	225929	278124	350297	314918	39.4
Agric. Ser., Forest. & Fish.	(D)	1599	1842	1643	--.-
Mining	(D)	892	2053	2227	--.-
Contract Construction	18592	26207	38395	26241	41.1
Manufacturing	100778	112281	133804	124613	23.6
Nondurable Goods	NA	56703	66178	63153	--.-
Durable Goods	NA	55577	67626	61460	--.-
Transport. & Public Utilities	21803	27124	28325	29409	34.9
Wholesale Trade**	38136	13863	16562	14869	--.-
Retail Trade	NA	38476	48690	43788	--.-
Fin., Insur. & Real Estate	8989	9103	17447	14163	57.6
Services	35816	48578	63179	57965	61.8
Government	72686	83792	91098	91452	25.8
Federal, Civilian	25298	28118	27567	28287	11.8
Federal, Military	3436	2023	1282	3166	-7.9
State & Local	43952	53650	62249	59998	36.5

Income in 1975, 1980, and 1982 are deflated to 1970 dollars according to the Consumer Price Index

(D)-Data withheld for reasons of disclosure (L)-Less than $10,000 in income

NA-Information not available

**-Income for both the wholesale and retail trade sectors are combined for 1970 only

Sources: Bureau of Economic Analysis, Local Area Personal Income, 1969-1974 Volume 4: Western States By Major Source for Counties and SMSAs, June, 1976.
Bureau of Economic Analysis, Local Area Personal Income, 1975-1980, Rocky Mountain Region and Western Region, June, 1982.
Bureau of Economic Analysis, Local Area Personal Income, 1977-1982, Rocky Mountain Region and Western Region, June, 1984.

Table A.1.31. Employument By Place of Work in Clark County, Washington: 1970-1982.

	Employment By Type and Broad Industrial Sources				
	1970	1975	1977	1980	1982
Total Employment, Clark County	41482	49013	55754	62820	62713
Number of Proprietors	4824	5727	6589	7804	8101
Farm Proprietors	1746	1475	1515	1688	1728
Non-Farm Proprietors	3078	4252	5074	6116	6373
Total Wage Employment	36658	43286	49165	55016	54612
Farm	541	480	437	502	533
Non-Farm	36117	42806	48728	54514	54079
Private	26231	31717	37915	42577	40942
Ag. Services, For. & Other	103	160	(D)	272	309
Mining	52	62	(D)	154	200
Contract Construction	1615	2072	3017	3192	2439
Manufacturing	10708	10953	12146	12848	12568
Non-Durable Manufacturing	5891	5937	6417	6475	6342
Durable Manufacturing	4817	5016	5729	6373	6226
Transport. & Public Utilities	2073	2392	2615	2335	2540
Wholesale Trade	614	1166	1525	1671	1602
Retail Trade	4340	5807	7660	9749	9438
Finance, Ins. & Real Estate	1058	1334	1770	2368	2098
Services	5668	7767	8879	9988	9748
Government	9886	11089	10813	11937	13137
Federal, Civilian	2275	2439	2342	2549	2694
Federal, Military	792	860	733	824	1849
State and Local	6819	7790	7738	8564	8594

(D)- Data withheld for reasons of disclosure
(L)-Less than ten employees

Source: Bureau of Economic Analysis, Regional Economic Information Service, Table 25, April, 1984.

Table A.1.32. Retail Sales in Clark County, Washington: 1972-1982.

	1972 Sales		1977 Sales		1982 Sales	
	Number	(000 $)	Number	(000 $)	Number	(000 $)
Clark County						
All Establishments	1082	233159	1117	311504	1395	297290
Bldg.Mat.,Hardware	46	17006	61	19753	46	13283
Gen. Merchandise	17	(D)	13	(D)	13	13283
Food Stores	140	66206	151	(D)	163	77696
Auto Dealers	89	46833	83	61261	63	41508
Gasoline Service	116	16486	114	25418	74	23049
Apparel & Accesory	52	7691	74	13447	66	11804
Furniture & Furnishings	54	10869	101	12139	53	10096
Eating and Drinking	179	20720	215	33177	252	35165
Drug Stores	25	(D)	25	13172	23	12236
Miscellaneous Retail	364	(D)	280	18462	134	16638

Sales in 1977 and 1982 are deflated to 1972 dollars according to the Consumer Price Index.
(D)-Data withheld for reasons of disclosure

Sources: Bureau of the Census, 1976. 1972 Census of Retail Trade. Volume II Area Statistics. Part 3, North Dakota-Wyoming. Table 6: 48-44--48-49.
Bureau of the Census, 1980. 1977 Census of Retail Trade. Volume II Geographical Area Statistics. Part 3, North Dakota-Wyoming. Table 7: 48-50--48-53.
Bureau of the Census, 1984. 1982 Census of Retail Trade. Volume II Geographical Area Statistics. Part 3, North Dakota-Wyoming. Table 8: Wash.44--Wash.47.

Table A.1.33. Retail Sales in Vancouver, Washington: 1972-1982.

	1972 Sales		1977 Sales		1982 Sales	
	Number	(000 $)	Number	(000 $)	Number	(000 $)
Vancouver						
All Establishments	544	131044	509	138251	371	101470
Bldg.Mat.,Hardware	18	2233	16	(D)	12	5591
Gen. Merchandise	9	20040	6	(D)	3	(D)
Food Stores	71	29576	52	25169	44	20836
Auto Dealers	35	28320	36	32113	29	26698
Gasoline Service	51	7158	37	8649	23	7404
Apparel & Accesory	39	6211	57	12154	12	978
Furniture & Furnishings	30	7961	51	8641	19	4410
Eating and Drinking	78	11480	97	(D)	85	14242
Drug Stores	15	6455	9	5373	7	3536
Miscellaneous Retail	198	11610	148	11594	53	(D)

Sales in 1977 and 1982 are deflated to 1972 dollars according to the Consumer Price Index.
(D)-Data withheld for reasons of disclosure

Sources: Bureau of the Census, 1976. 1972 Census of Retail Trade. Volume II Area Statistics. Part 3, North Dakota-Wyoming. Table 6: 48-44--48-49.
Bureau of the Census, 1980. 1977 Census of Retail Trade. Volume II Geographical Area Statistics. Part 3, North Dakota-Wyoming. Table 7: 48-50--48-53.
Bureau of the Census, 1984. 1982 Census of Retail Trade. Volume II Geographical Area Statistics. Part 3, North Dakota-Wyoming. Table 8: Wash.44--Wash.47.

Table A.1.34. Total Personal Income in Klickitat County, Washington: 1970-1982.

(000 1970 $)	1970	1975	1980	1982	% Change 1970-82
Total Earnings	32027	40884	46815	42370	32.2
Soc. Security Adjustment	-1434	-2204	-2476	-2458	---
Residence Adjustment	-1123	-361	-986	-870	---
Net Earnings	29470	38318	43353	39042	32.2
Dividends, Interest, Rent	5999	6593	10406	11273	88.3
Transfer Payments	5313	8989	10580	12015	126.4
Total Personal Income	40782	53901	64339	62330	52.7
Per Capita Income	3356	3951	4057	3784	12.8
As % of State	82.8	88.2	83.1	82.0	

Sources: Bureau of Economic Analysis, Local Area Personal Income, 1969-1974 Volume 4: Western States By Major Source for Counties and SMSAs, June 1976.
Bureau of Economic Analysis, Local Area Personal Income, 1975-80, Rocky Mountain Region and Western Region, June 1982.
Bureau of Economic Analysis, Local Area Personal Income, 1977-1982, Rocky Mountain Region and Far West Region, June 1984.

Table A.1.35. Personal Income by Major Sources for Klickitat County, Washington: 1970-1982.

By Industrial Sector	1970 ($000)	1975 ($000)	1980 ($000)	1982 ($000)	% Change 1970-82
KLICKITAT COUNTY					
Total Labor & Proprietor Income	32027	40884	61426	62330	94.6
Farm	2472	7889	2716	4862	96.7
Nonfarm	29555	32995	41232	37508	26.9
Private	22596	25553	30031	29709	31.5
Agric. Ser., Forest. & Fish.	(D)	234	291	(D)	--.-
Mining	(D)	195	85	39	--.-
Contract Construction	5118	1893	3733	1313	-74.3
Manufacturing	9019	14526	19979	20879	131.5
Nondurable Goods	NA	263	194	343	--.-
Durable Goods	NA	14263	19785	20536	--.-
Transport. & Public Utilities	2609	2878	2357	1612	-38.2
Wholesale Trade**	2989	809	700	(D)	--.-
Retail Trade	NA	2680	2541	1903	--.-
Fin., Insur. & Real Estate	615	649	836	718	16.7
Services	(D)	1690	2509	2107	--.-
Government	6959	7442	8200	7799	12.1
Federal, Civilian	1135	1045	1356	1018	-10.3
Federal, Military	415	254	90	243	-41.4
State & Local	5409	6143	6755	6538	20.9

Income in 1975, 1980, and 1982 are deflated to 1970 dollars according to the Consumer Price Index

(D)-Data withheld for reasons of disclosure (L)-Less than $10,000 in income

NA-Information not available

**-Income for both the wholesale and retail trade sectors are combined for 1970 only

Sources: Bureau of Economic Analysis, Local Area Personal Income, 1969-1974 Volume 4: Western States By Major Source for Counties and SMSAs, June, 1976.
Bureau of Economic Analysis, Local Area Personal Income, 1975-1980, Rocky Mountain Region and Western Region, June, 1982.
Bureau of Economic Analysis, Local Area Personal Income, 1977-1982, Rocky Mountain Region and Western Region, June, 1984.

Table A.1.36. Employment By Place of Work in Klickitat County, Washington: 1970-1982.

	Employment By Type and Broad Industrial Sources				
	1970	1975	1977	1980	1982
Total Employment, Klickitat County	5294	5376	5675	6391	6250
Number of Proprietors	1172	1084	1127	1291	1332
Farm Proprietors	745	613	630	702	718
Non-Farm Proprietors	427	471	497	589	614
Total Wage Employment	4122	4292	4548	5100	4918
Farm	407	404	367	422	448
Non-Farm	3715	3888	4181	4678	4470
Private	2647	2686	2993	3240	3080
Ag. Services, For. & Other	(L)	11	18	34	(D)
Mining	11	13	(L)	(L)	(L)
Contract Construction	451	103	164	181	62
Manufacturing	1072	1360	1507	1613	1728
Non-Durable Manufacturing	53	41	44	35	82
Durable Manufacturing	1023	1319	1463	1578	1646
Transport. & Public Utilities	259	282	268	236	156
Wholesale Trade	31	73	73	81	(D)
Retail Trade	413	446	508	484	429
Finance, Ins. & Real Estate	80	89	97	127	103
Services	319	309	352	478	441
Government	1068	1202	1188	1438	1390
Federal, Civilian	111	117	146	181	135
Federal, Military	85	86	59	66	152
State and Local	872	999	983	1191	1103

(D)- Data withheld for reasons of disclosure
(L)-Less than ten employees

Source: Bureau of Economic Analysis, Regional Economic Information Service, Table 25, April, 1984.

Table A.1.37. Retail Sales in Klickitat County, Washington: 1972-1982.

	1972 Sales		1977 Sales		1982 Sales	
	Number	(000 $)	Number	(000 $)	Number	(000 $)
Klickitat County						
All Establishments	143	16501	141	16621	155	15980
Bldg.Mat.,Hardware	6	820	14	1784	8	1300
Gen. Merchandise	5	586	3	293	3	170
Food Stores	17	4360	19	3120	15	4556
Auto Dealers	15	3217	11	4899	9	2717
Gasoline Service	20	2186	15	2317	12	2536
Apparel & Accesory	5	604	6	696	5	326
Furniture & Furnishings	6	(D)	6	68	1	(D)
Eating and Drinking	28	1728	28	1614	24	1474
Drug Stores	4	636	4	(D)	5	670
Miscellaneous Retail	37	(D)	35	(D)	12	(D)

Sales in 1977 and 1982 are deflated to 1972 dollars according to the Consumer Price Index.
(D)-Data withheld for reasons of disclosure

Sources: Bureau of the Census, 1976. 1972 Census of Retail Trade. Volume II Area Statistics. Part 3, North Dakota-Wyoming. Table 6: 48-44--48-49.
Bureau of the Census, 1980. 1977 Census of Retail Trade. Volume II Geographical Area Statistics. Part 3, North Dakota-Wyoming. Table 7: 48-50--48-53.
Bureau of the Census, 1984. 1982 Census of Retail Trade. Volume II Geographical Area Statistics. Part 3, North Dakota- Wyoming. Table 8: Wash.44--Wash.47.

Table A.1.38. Retail Sales in Goldendale, Washington: 1972-1982.

	1972 Sales		1977 Sales		1982 Sales	
	Number	(000 $)	Number	(000 $)	Number	(000 $)
Goldendale						
All Establishments	NA	NA	NA	NA	50	7320
Bldg.Mat.,Hardware	NA	NA	NA	NA	3	(D)
Gen. Merchandise	NA	NA	NA	NA	1	(D)
Food Stores	NA	NA	NA	NA	5	(D)
Auto Dealers	NA	NA	NA	NA	5	(D)
Gasoline Service	NA	NA	NA	NA	2	(D)
Apparel & Accesory	NA	NA	NA	NA	3	(D)
Furniture & Furnishings	NA	NA	NA	NA	1	(D)
Eating and Drinking	NA	NA	NA	NA	6	501
Drug Stores	NA	NA	NA	NA	2	(D)
Miscellaneous Retail	NA	NA	NA	NA	5	(D)

Sales in 1977 and 1982 are deflated to 1972 dollars according to the Consumer Price Index.
(D)-Data withheld for reasons of disclosure
NA-Information not available

Sources: Bureau of the Census, 1976. 1972 Census of Retail Trade. Volume II Area Statistics. Part 3, North Dakota-Wyoming. Table 6: 48-44--48-49.
Bureau of the Census, 1980. 1977 Census of Retail Trade. Volume II Geographical Area Statistics. Part 3, North Dakota-Wyoming. Table 7: 48-50--48-53.
Bureau of the Census, 1984. 1982 Census of Retail Trade. Volume II Geographical Area Statistics. Part 3, North Dakota- Wyoming. Table 8: Wash.44--Wash.47.

Table A.1.39. Total Personal Income in Wasco County, Oregon: 1970-1982.

(000 1970 $)	1970	1975	1980	1982	% Change 1970-82
Total Earnings	52647	63301	69856	60512	15.0
Soc. Security Adjustment	-2268	-3313	-3856	-3747	---
Residence Adjustment	3345	-3248	3829	1632	---
Net Earnings	53724	63237	69829	58397	8.8
Dividends, Interest, Rent	10889	13835	17140	21331	95.4
Transfer Payments	8367	14136	15246	17742	110.7
Total Personal Income	72980	91208	102215	97470	33.6
Per Capita Income	3608	4488	4693	4339	20.3
As % of State	97.0	108.7	107.1	105.4	

Sources: Bureau of Economic Analysis, Local Area Personal Income, 1969-1974 Volume 4: Western States By Major Source for Counties and SMSAs, June 1976.
Bureau of Economic Analysis, Local Area Personal Income, 1975-80, Rocky Mountain Region and Western Region, June 1982.
Bureau of Economic Analysis, Local Area Personal Income, 1977-1982, Rocky Mountain Region and Far West Region, June 1984

Table A.1.40. Personal Income by Major Sources for Wasco County, Oregon: 1970-1982.

By Industrial Sector	1970 ($000)	1975 ($000)	1980 ($000)	1982 ($000)	% Change 1970-82
WASCO COUNTY					
Total Labor & Proprietor Income	52647	63301	104522	97470	85.1
Farm	5826	9632	9702	6047	3.8
Nonfarm	46821	53669	60981	54465	16.3
Private	35843	41085	48489	41907	16.9
Agric. Ser., Forest. & Fish.	(D)	455	(D)	(D)	--.-
Mining	(L)	139	(D)	(D)	--.-
Contract Construction	3303	3524	3885	2307	-30.2
Manufacturing	11051	11458	17126	14149	28.1
Nondurable Goods	NA	1530	1941	2070	--.-
Durable Goods	NA	9928	15184	12079	--.-
Transport. & Public Utilities	4184	4394	4312	3654	-12.7
Wholesale Trade**	8991	2437	2344	2174	--.-
Retail Trade	NA	8298	8516	7471	--.-
Fin., Insur. & Real Estate	1311	1270	1708	1462	11.5
Services	(D)	9110	9816	9997	--.-
Government	10978	12584	12492	12558	14.4
Federal, Civilian	3802	4032	4068	4283	12.7
Federal, Military	249	178	135	130	-47.8
State & Local	6927	8373	8289	8145	17.6

Income in 1975, 1980, and 1982 are deflated to 1970 dollars according to the Consumer Price Index

(D)-Data withheld for reasons of disclosure (L)-Less than $10,000 in income

NA-Information not available

**-Income for both the wholesale and retail trade sectors are combined for 1970 only

Sources: Bureau of Economic Analysis, Local Area Personal Income, 1969-1974 Volume 4: Western States By Major Source for Counties and SMSAs, June, 1976.
Bureau of Economic Analysis, Local Area Personal Income, 1975-1980, Rocky Mountain Region and Western Region, June, 1982.
Bureau of Economic Analysis, Local Area Personal Income, 1977-1982, Rocky Mountain Region and Western Region, June, 1984.

Table A.1.41. Employment By Place of Work in Wasco County, Oregon: 1970-1982

	Employment By Type and Broad Industrial Sources				
	1970	1975	1977	1980	1982
Total Employ., Wasco County	8223	9222	9474	10471	9990
Number of Proprietors	1404	1394	1456	1691	1749
Farm Proprietors	678	643	639	746	766
Non-Farm Proprietors	726	751	817	945	983
Total Wage Employment	6819	7828	8018	8780	8241
Farm	796	858	8018	8780	8241
Non-Farm	6023	6970	7063	7921	7389
Private	4325	5123	5311	6001	5631
Ag. Services, For. & Other	48	49	(D)	(D)	(D)
Mining	0	(L)	(D)	(D)	(D)
Contract Construction	238	237	224	263	198
Manufacturing	1202	1163	1201	1455	1261
Non-Durable Manufacturing	279	229	226	335	366
Durable Manufacturing	923	934	975	1120	895
Transport. & Public Utilities	420	398	363	368	313
Wholesale Trade	89	263	218	271	265
Retail Trade	1214	1368	1403	1607	1528
Finance, Ins. & Real Estate	134	176	198	214	207
Services	980	1461	1601	1685	1710
Government	1698	1847	1753	1920	1758
Federal, Civilian	338	381	373	411	419
Federal, Military	132	123	92	95	73
State and Local	1228	1343	1287	1414	1266

(D)- Data withheld for reasons of disclosure
(L)-Less than ten employees

Source: Bureau of Economic Analysis, Regional Economic Information Service, Table 25, Ap
1984.

Table A.1.42. Retail Sales in Wasco County, Oregon: 1972-1982.

	1972 Sales		1977 Sales		1982 Sales	
	Number	(000 $)	Number	(000 $)	Number	(000 $)
All Establishments	244	55919	235	61165	240	52566
Bldg.Mat.,Hardware	14	3030	16	4185	10	2943
Gen. Merchandise	7	3243	4	(D)	3	(D)
Food Stores	25	11126	26	10588	21	8843
Auto Dealers	17	15574	17	18174	14	11580
Gasoline Service	30	4110	28	4454	14	3530
Apparel & Accesory	13	1723	18	3849	16	2926
Furniture & Furnishings	20	2799	21	2844	16	1512
Eating and Drinking	50	5899	42	5579	40	5520
Drug Stores	7	3769	7	(D)	6	(D)
Miscellaneous Retail	61	4646	56	5248	31	4229

Sales in 1977 and 1982 are deflated to 1972 dollars according to the Consumer Price Index.
(D)-Data withheld for reasons of disclosure
Sources: Bureau of the Census, 1976. 1972 Census of Retail Trade. Volume II Area Statistics. Part 3, North Dakota-Wyoming. Table 6: 38-34--38-37.
Bureau of the Census, 1980. 1977 Census of Retail Trade. Volume II Geographical Area Statistics. Part 3, North Dakota-Wyoming. Table 7: 38-38--38-41.
Bureau of the Census, 1984. 1982 Census of Retail Trade. Volume II Geographical Area Statistics. Part 3, North Dakota- Wyoming. Table 8: Oreg.-36--Oreg.-39.

Table A.1.43. Retail Sales in the City of The Dalles, Oregon: 1972-1982.

	1972 Sales		1977 Sales		1982 Sales	
	Number	(000 $)	Number	(000 $)	Number	(000 $)
the Dalles						
All Establishments	205	53096	200	58605	207	50940
Bldg.Mat.,Hardware	11	(D)	12	3492	8	(D)
Gen. Merchandise	5	(D)	3	(D)	2	(D)
Food Stores	18	10540	17	9845	17	8322
Auto Dealers	15	(D)	17	18174	14	11580
Gasoline Service	24	3671	23	4170	12	(D)
Apparel & Accesory	13	1723	18	3849	16	2926
Furniture & Furnishings	20	2799	21	2844	16	1512
Eating and Drinking	36	5374	32	5088	32	5209
Drug Stores	6	(D)	6	(D)	5	(D)
Miscellaneous Retail	57	4567	51	(D)	30	(D)

Sales in 1977 and 1982 are deflated to 1972 dollars according to the Consumer Price Index.
(D)-Data withheld for reasons of disclosure

Sources: Bureau of the Census, 1976. 1972 Census of Retail Trade. Volume II Area Statistics. Part 3, North Dakota-Wyoming. Table 6: 38-34--38-37.
Bureau of the Census, 1980. 1977 Census of Retail Trade. Volume II Geographical Area Statistics. Part 3, North Dakota-Wyoming. Table 7: 38-38--38-41.
Bureau of the Census, 1984. 1982 Census of Retail Trade. Volume II Geographical Area Statistics. Part 3, North Dakota- Wyoming. Table 8: Oreg.-36--Oreg.-39.

Table A.1.44. Total Personal Income in Pierce County, Washington: 1970-1982.

(000 1970 $)	1970	1975	1980	1982	% Change 1970-82
Total Earnings	1299876	1239286	1364613	1307031	0.5
Soc. Security Adjustment	-41624	-75201	-79847	-84148	---
Residence Adjustment	65247	80555	222983	174060	---
Net Earnings	1323499	1244640	1507748	1396942	5.6
Dividends, Interest, Rent	170060	203261	285495	327633	92.6
Transfer Payments	186753	309464	341163	378413	102.1
Total Personal Income	1680312	1757365	2134406	2102989	25.2
Per Capita Income	4083	4068	4385	4121	0.9
As % of State	100.7	90.8	89.8	89.3	

Sources: Bureau of Economic Analysis, Local Area Personal Income, 1969-1974 Volume 4: Western States By Major Source for Counties and SMSAs, June 1976.
Bureau of Economic Analysis, Local Area Personal Income, 1975-80, Rocky Mountain Region and Western Region, June 1982.
Bureau of Economic Analysis, Local Area Personal Income, 1977-1982, Rocky Mountain Region and Far West Region, June 1984.

Table A.1.45. Personal Income by Major Sources for Pierce County, Washington: 1970-1982.

By Industrial Sector	1970 ($000)	1975 ($000)	1980 ($000)	1982 ($000)	% Change 1970-82
PIERCE COUNTY					
Total Labor & Proprietor Income	1299876	1239286	2116694	2102879	61.8
Farm	10084	10500	10011	11443	13.5
Nonfarm	1289792	1228786	1333762	1295588	0.4
Private	723853	772894	905705	843979	16.6
Agric. Ser., Forest. & Fish.	4098	4192	5396	4475	9.2
Mining	1158	1529	2044	1722	48.7
Contract Construction	67438	70294	86754	71497	6.0
Manufacturing	196311	217533	235974	232024	18.2
Nondurable Goods	NA	77705	82614	74199	--.-
Durable Goods	NA	139828	153361	157824	--.-
Transport. & Public Utilities	63045	61446	74393	70656	12.1
Wholesale Trade**	177072	66524	79374	74999	--.-
Retail Trade	NA	135385	138121	127927	--.-
Fin., Insur. & Real Estate	56889	42942	61162	52563	-7.6
Services	157842	173047	222487	208116	31.9
Government	565939	455892	428057	451609	-20.2
Federal, Civilian	94763	91994	87571	87668	-7.5
Federal, Military	334945	209357	164367	194631	-41.9
State & Local	136231	154542	176119	169310	24.3

Income in 1975, 1980, and 1982 are deflated to 1970 dollars according to the Consumer Price Index

(D)-Data withheld for reasons of disclosure (L)-Less than $10,000 in income

NA-Information not available

**-Income for both the wholesale and retail trade sectors are combined for 1970 only

Sources: Bureau of Economic Analysis, Local Area Personal Income, 1969-1974 Volume 4: Western States By Major Source for Counties and SMSAs, June, 1976.
Bureau of Economic Analysis, Local Area Personal Income, 1975-1980, Rocky Mountain Region and Western Region, June, 1982.
Bureau of Economic Analysis, Local Area Personal Income, 1977-1982, Rocky Mountain Region and Western Region, June, 1984.

Table A.1.46. Employment By Place of Work in Pierce County, Washington: 1970-1982.

	Employment By Type and Broad Industrial Sources				
	1970	1975	1977	1980	1982
Total Employment, Pierce County	180406	168536	177272	190815	195046
Number of Proprietors	10716	11714	12967	14862	15461
Farm Proprietors	1431	1199	1231	1372	1405
Non-Farm Proprietors	9285	10515	11736	13490	14056
Total Wage Employment	169690	156822	164305	175953	179585
Farm	1069	1179	1071	1235	1310
Non-Farm	168621	155643	163234	174718	178275
Private	83901	90526	99184	110377	109362
Ag. Services, For. & Other	543	608	705	848	825
Mining	103	116	128	135	116
Contract Construction	5561	5688	6726	7404	6247
Manufacturing	19653	20410	20486	21915	21852
Non-Durable Manufacturing	7975	7741	7952	8240	7823
Durable Manufacturing	11678	12669	12534	13675	14029
Transport. & Public Utilities	6372	5629	5956	6775	6640
Wholesale Trade	4830	5945	6885	7526	7618
Retail Trade	18871	21585	23191	25890	26048
Finance, Ins. & Real Estate	6382	5707	6269	7302	6982
Services	21586	24838	28838	32582	33034
Government	84720	65117	64050	64341	68913
Federal, Civilian	11656	9938	9413	9754	10187
Federal, Military	52292	31471	31338	29325	35180
State and Local	20772	23708	23299	25262	23546

(D)- Data withheld for reasons of disclosure
(L)-Less than ten employees

Source: Bureau of Economic Analysis, Regional Economic Information Service, Table 25, April, 1984.

Table A.1.47. Retail Sales in Pierce County, Washington: 1972-1982.

	1972 Sales		1977 Sales		1982 Sales	
	Number	(000 $)	Number	(000 $)	Number	(000 $)
Pierce County						
All Establishments	3212	805992	3180	992503	3771	919308
Bldg.Mat.,Hardware	153	32418	174	56337	126	59120
Gen. Merchandise	47	124522	42	139914	34	113088
Food Stores	318	162519	370	190259	326	198716
Auto Dealers	256	167208	303	226063	206	167365
Gasoline Service	398	63169	327	77116	242	88020
Apparel & Accesory	141	32455	144	(D)	158	36434
Furniture & Furnishings	220	41245	309	52725	200	37030
Eating and Drinking	626	74501	599	89945	616	94914
Drug Stores	76	26880	70	(D)	78	30730
Miscellaneous Retail	977	81075	842	87533	466	77592

Sales in 1977 and 1982 are deflated to 1972 dollars according to the Consumer Price Index.
(D)-Data withheld for reasons of disclosure

Sources: Bureau of the Census, 1976. 1972 Census of Retail Trade. Volume II Area Statistics. Part 3, North Dakota-Wyoming. Table 6: 48-44--48-49.
Bureau of the Census, 1980. 1977 Census of Retail Trade. Volume II Geographical Area Statistics. Part 3, North Dakota-Wyoming, Table 7: 48-50--48-53.
Bureau of the Census, 1984. 1982 Census of Retail Trade. Volume II Geographical Area Statistics. Part 3, North Dakota- Wyoming. Table 8: Wash.44--Wash.47.

Table A.1.48. Retail Sales in Tacoma, Washington: 1972-1982.

	1972 Sales		1977 Sales		1982 Sales	
	Number	(000 $)	Number	(000 $)	Number	(000 $)
Tacoma						
All Establishments	1467	439471	1313	506109	1436	453256
Bldg.Mat.,Hardware	44	7972	48	(D)	30	14424
Gen. Merchandise	19	(D)	17	(D)	15	88427
Food Stores	138	72964	127	70385	110	71362
Auto Dealers	107	96917	130	134165	96	92807
Gasoline Service	172	27380	129	31093	99	40836
Apparel & Accesory	87	22177	81	28725	84	23852
Furniture & Furnishings	102	22462	124	25897	89	20523
Eating and Drinking	337	40050	297	44402	294	464252
Drug Stores	39	14666	33	15622	38	13708
Miscellaneous Retail	422	(D)	327	39928	188	36113

Sales in 1977 and 1982 are deflated to 1972 dollars according to the Consumer Price Index.
(D)-Data withheld for reasons of disclosure

Sources: Bureau of the Census, 1976. 1972 Census of Retail Trade. Volume II Area Statistics. Part 3, North Dakota-Wyoming. Table 6: 48-44--48-49.
Bureau of the Census, 1980. 1977 Census of Retail Trade. Volume II Geographical Area Statistics. Part 3, North Dakota-Wyoming. Table 7: 48-50--48-53.
Bureau of the Census, 1984. 1982 Census of Retail Trade. Volume II Geographical Area Statistics. Part 3, North Dakota- Wyoming. Table 8: Wash.44--Wash.47.

Table A.1.49. Total Personal Income in Whatcom County, Washington: 1970-1982.

(000 1970 $)	1970	1975	1980	1982	% Change 1970-82
Total Earnings	231684	272905	319201	284786	22.8
Soc. Security Adjustment	-8941	-16312	-17194	-17381	---
Residence Adjustment	422	-1115	-1137	-4375	---
Net Earnings	233165	255478	300870	271781	16.7
Dividends, Interest, Rent	46604	52853	80054	89221	89.4
Transfer Payments	34609	58786	62672	68487	98.0
Total Personal Income	304378	367217	443596	429489	41.1
Per Capita Income	3710	3935	4148	3899	5.1
As % of State	91.5	87.8	85.0	84.5	

Sources: Bureau of Economic Analysis, Local Area Personal Income, 1969-1974 Volume 4: Western States By Major Source for Counties and SMSAs, June 1976.
Bureau of Economic Analysis, Local Area Personal Income, 1975-80, Rocky Mountain Region and Western Region, June 1982.
Bureau of Economic Analysis, Local Area Personal Income, 1977-1982, Rocky Mountain Region and Far West Region, June 1984.

Table A.1.50. Personal Income by Major Sources for Whatcom County, Washington: 1970-1982.

By Industrial Sector	1970 ($000)	1975 ($000)	1980 ($000)	1982 ($000)	% Change 1970-82
WHATCOM COUNTY					
Total Labor & Proprietor Income	231684	272905	433059	429489	85.4
Farm	19214	18986	14192	23159	20.5
Nonfarm	212470	253919	294920	261627	23.1
Private	171532	208981	247801	216858	26.4
Agric. Ser., Forest. & Fish.	(D)	4386	4903	3970	--.-
Mining	(D)	584	1118	819	--.-
Contract Construction	23924	22743	25373	18398	-23.1
Manufacturing	57461	71794	84118	78712	37.0
Nondurable Goods	NA	37064	44001	42030	--.-
Durable Goods	NA	34730	40117	36682	--.-
Transport. & Public Utilities	15790	19084	22427	16371	3.7
Wholesale Trade**	36463	9740	11644	10288	--.-
Retail Trade	NA	35494	38649	35214	--.-
Fin., Insur. & Real Estate	6063	7807	11033	9777	61.3
Services	28075	37350	48537	43309	54.3
Government	40938	44938	47119	44768	9.4
Federal, Civilian	6259	4065	4332	4133	-34.0
Federal, Military	3501	2470	626	1661	-52.6
State & Local	31178	38403	42161	38974	25.0

Income in 1975, 1980, and 1982 are deflated to 1970 dollars according to the Consumer Price Index

(D)-Data withheld for reasons of disclosure (L)-Less than $10,000 in income

NA-Information not available

**-Income for both the wholesale and retail trade sectors are combined for 1970 only

Sources: Bureau of Economic Analysis, Local Area Personal Income, 1969-1974 Volume 4: Western States By Major Source for Counties and SMSAs, June, 1976.
Bureau of Economic Analysis, Local Area Personal Income, 1975-1980, Rocky Mountain Region and Western Region, June, 1982.
Bureau of Economic Analysis, Local Area Personal Income, 1977-1982, Rocky Mountain Region and Western Region, June, 1984.

Table A.1.51. Employment By Place of Work in Whatcom County, Washington: 1970-1982.

	Employment By Type and Broad Industrial Sources				
	1970	1975	1977	1980	1982
Total Employment, Whatcom County	32359	37438	41473	44997	44122
Number of Proprietors	5315	5138	5637	6472	6702
Farm Proprietors	2373	1983	2036	2267	2323
Non-Farm Proprietors	2942	3155	3601	4203	4379
Total Wage Employment	27044	32300	35836	38525	37420
Farm	806	1036	940	1084	1151
Non-Farm	26238	31264	34896	37441	36269
Private	20314	24597	28482	30554	29085
Ag. Services, For. & Other	288	348	384	432	427
Mining	65	57	84	117	90
Contract Construction	1964	1844	2238	2070	1579
Manufacturing	5712	6395	6713	7230	6925
Non-Durable Manufacturing	2821	3365	3599	3807	3769
Durable Manufacturing	2891	3030	3114	3807	3769
Transport. & Public Utilities	1586	1795	1810	2060	1542
Wholesale Trade	698	1094	1469	1413	1314
Retail Trade	4834	5948	7232	7827	7881
Finance, Ins. & Real Estate	724	1098	1398	1535	1476
Services	4438	6018	7154	7870	7851
Government	5924	6667	6414	6887	7184
Federal, Civilian	349	364	347	464	405
Federal, Military	858	672	417	446	1030
State and Local	4717	5631	5650	5977	5749

(D)- Data withheld for reasons of disclosure
(L)-Less than ten employees

Source: Bureau of Economic Analysis, Regional Economic Information Service, Table 25, April, 1984.

Table A.1.52. Retail Sales in Whatcom County, Washington: 1972-1982.

	1972 Sales		1977 Sales		1982 Sales	
	Number	(000 $)	Number	(000 $)	Number	(000 $)
Whatcom County						
All Establishments	894	194411	947	264546	1112	233785
Bldg.Mat.,Hardware	50	16015	60	(D)	50	17881
Gen. Merchandise	25	(D)	25	35312	19	26805
Food Stores	102	44464	116	48669	97	55969
Auto Dealers	65	32361	69	54413	62	34694
Gasoline Service	123	15463	84	16050	62	18551
Apparel & Accesory	60	8790	60	10974	55	9267
Furniture & Furnishings	54	9020	82	13679	67	10578
Eating and Drinking	150	18307	187	29413	207	27725
Drug Stores	22	(D)	18	(D)	20	8319
Miscellaneous Retail	243	(D)	246	23178	133	18973

Sales in 1977 and 1982 are deflated to 1972 dollars according to the Consumer Price Index.
(D)-Data withheld for reasons of disclosure

Sources: Bureau of the Census, 1976. 1972 Census of Retail Trade. Volume II Area Statistics. Part 3, North Dakota-Wyoming. Table 6: 48-44--48-49.
Bureau of the Census, 1980. 1977 Census of Retail Trade. Volume II Geographical Area Statistics. Part 3, North Dakota-Wyoming. Table 7: 48-50--48-53.
Bureau of the Census, 1984. 1982 Census of Retail Trade. Volume II Geographical Area Statistics. Part 3, North Dakota- Wyoming. Table 8: Wash.44--Wash.47.

Table A.1.53. Retail Sales in Ferndale, Washington: 1972-1982.

	1972 Sales		1977 Sales		1982 Sales	
	Number	(000 $)	Number	(000 $)	Number	(000 $)
Ferndale						
All Establishments	NA	NA	NA	NA	74	13868
Bldg.Mat.,Hardware	NA	NA	NA	NA	4	723
Gen. Merchandise	NA	NA	NA	NA	1	(D)
Food Stores	NA	NA	NA	NA	5	(D)
Auto Dealers	NA	NA	NA	NA	3	(D)
Gasoline Service	NA	NA	NA	NA	3	1484
Apparel & Accesory	NA	NA	NA	NA	1	(D)
Furniture & Furnishings	NA	NA	NA	NA	1	(D)
Eating and Drinking	NA	NA	NA	NA	13	1312
Drug Stores	NA	NA	NA	NA	1	(D)
Miscellaneous Retail	NA	NA	NA	NA	3	(D)

Sales in 1977 and 1982 are deflated to 1972 dollars according to the Consumer Price Index.
(D)-Data withheld for reasons of disclosure
NA- Information not available
Sources: Bureau of the Census, 1976. 1972 Census of Retail Trade. Volume II Area Statistics. Part 3, North Dakota-Wyoming. Table 6: 48-44--48-49.
Bureau of the Census, 1980. 1977 Census of Retail Trade. Volume II Geographical Area Statistics. Part 3, North Dakota-Wyoming. Table 7: 48-50--48-53.
Bureau of the Census, 1984. 1982 Census of Retail Trade. Volume II Geographical Area Statistics. Part 3, North Dakota- Wyoming. Table 8: Wash.44--Wash.47.

Table A.1.54. Retail Sales in Bellingham, Washington: 1972-1982.

	1972 Sales		1977 Sales		1982 Sales	
	Number	(000 $)	Number	(000 $)	Number	(000 $)
Bellingham						
All Establishments	544	140065	578	182770	707	164827
Bldg.Mat.,Hardware	27	10785	28	14868	23	11467
Gen. Merchandise	14	24910	14	(D)	10	22838
Food Stores	54	31406	61	30073	46	38062
Auto Dealers	43	21368	44	30741	44	23546
Gasoline Service	73	9311	52	9338	38	12274
Apparel & Accesory	43	7119	43	9211	42	7046
Furniture & Furnishings	39	6316	51	9267	53	(D)
Eating and Drinking	93	13050	115	20448	136	18892
Drug Stores	14	4385	11	(D)	14	6929
Miscellaneous Retail	144	11415	159	18081	90	(D)

Sales in 1977 and 1982 are deflated to 1972 dollars according to the Consumer Price Index.
(D)-Data withheld for reasons of disclosure

Sources: Bureau of the Census, 1976. 1972 Census of Retail Trade. Volume II Area Statistics. Part 3, North Dakota-Wyoming. Table 6: 48-44--48-49.
Bureau of the Census, 1980. 1977 Census of Retail Trade. Volume II Geographical Area Statistics. Part 3, North Dakota-Wyoming. Table 7: 48-50--48-53.
Bureau of the Census, 1984. 1982 Census of Retail Trade. Volume II Geographical Area Statistics. Part 3, North Dakota- Wyoming. Table 8: Wash.44--Wash.47.

Table A.1.55. Total Personal Income in Chelan County, Washington: 1970-1982.

(000 1970 $)	1970	1975	1980	1982	% Change 1970-82
Total Earnings	133385	162806	177862	156833	17.5
Soc. Security Adjustment	-5531	-9097	-9016	-9188	---
Residence Adjustment	-14684	-19503	-22203	-19347	---
Net Earnings	113170	134206	146643	128298	13.3
Dividends, Interest, Rent	26025	28416	39619	45894	76.5
Transfer Payments	21970	33086	38150	40109	82.3
Total Personal Income	161165	195707	224412	214301	32.9
Per Capita Income	3893	4743	4969	4614	18.5
As % of State	96.0	105.8	101.8	100.0	

Sources: Bureau of Economic Analysis, Local Area Personal Income, 1969-1974 Volume 4: Western States By Major Source for Counties and SMSAs, June 1976.
Bureau of Economic Analysis, Local Area Personal Income, 1975-80, Rocky Mountain Region and Western Region, June 1982.
Bureau of Economic Analysis, Local Area Personal Income, 1977-1982, Rocky Mountain Region and Far West Region, June 1984.

Table A.1.56. Total Personal Income in Douglas County, Washington: 1970-1982.

(000 1970 $)	1970	1975	1980	1982	% Change 1970-82
Total Earnings	25797	48568	41687	36069	39.9
Soc. Security Adjustment	-1012	-1696	-1885	-1813	---
Residence Adjustment	15051	18676	21115	18909	---
Net Earnings	39836	65547	60917	53165	33.7
Dividends, Interest, Rent	7726	10642	15051	17271	123.4
Transfer Payments	5228	9514	11997	12450	138.0
Total Personal Income	52791	85703	87965	82886	57.0
Per Capita Income	3141	4395	3963	3625	15.4
As % of State	77.5	98.1	81.2	78.6	

Sources: Bureau of Economic Analysis, Local Area Personal Income, 1969-1974 Volume 4: Western States By Major Source for Counties and SMSAs, June 1976.
Bureau of Economic Analysis, Local Area Personal Income, 1975-80, Rocky Mountain Region and Western Region, June 1982.
Bureau of Economic Analysis, Local Area Personal Income, 1977-1982, Rocky Mountain Region and Far West Region, June 1984.

Table A.1.57. Personal Income by Major Sources for Chelan County, Washington: 1970-1982.

By Industrial Sector	1970 ($000)	1975 ($000)	1980 ($000)	1982 ($000)	% Change 1970-82
CHELAN COUNTY					
Total Labor & Proprietor Income	133385	162806	214150	214301	60.7
Farm	13485	23795	18753	20515	52.1
Nonfarm	119900	139010	150573	136318	13.7
Private	93925	110245	120974	108266	15.3
Agric. Ser., Forest. & Fish.	(D)	2254	4723	4360	--.-
Mining	(D)	227	(D)	(D)	--.-
Contract Construction	6867	9681	9863	6910	0.6
Manufacturing	23660	27246	29565	23922	1.1
Nondurable Goods	NA	7655	7999	7561	--.-
Durable Goods	NA	19591	21566	16361	--.-
Transport. & Public Utilities	3646	6498	7170	6910	89.5
Wholesale Trade**	30444	17675	(D)	(D)	--.-
Retail Trade	NA	18854	18190	16525	--.-
Fin., Insur. & Real Estate	4797	4816	7100	6072	26.6
Services	19793	22993	27232	25831	30.3
Government	25975	28765	29599	28053	8.0
Federal, Civilian	6590	6965	6303	5995	-9.0
Federal, Military	817	377	300	724	-11.4
State & Local	18568	21424	22997	21334	14.9

Income in 1975, 1980, and 1982 are deflated to 1970 dollars according to the Consumer Price Index

(D)-Data withheld for reasons of disclosure (L)-Less than $10,000 in income

NA-Information not available

**-Income for both the wholesale and retail trade sectors are combined for 1970 only

Sources: Bureau of Economic Analysis, Local Area Personal Income, 1969-1974 Volume 4: Western States By Major Source for Counties and SMSAs, June, 1976.
Bureau of Economic Analysis, Local Area Personal Income, 1975-1980, Rocky Mountain Region and Western Region, June, 1982.
Bureau of Economic Analysis, Local Area Personal Income, 1977-1982, Rocky Mountain Region and Western Region, June, 1984.

Table A.1.58. Personal Income by Major Sources for Douglas County, Washington: 1970-1982.

By Industrial Sector	1970 ($000)	1975 ($000)	1980 ($000)	1982 ($000)	% Change 1970-82
DOUGLAS COUNTY					
Total Labor & Proprietor Income	25797	48568	85244	82886	221.3
Farm	5627	23595	9184	10071	79.0
Nonfarm	20170	24973	29781	25998	28.9
Private	13970	17464	20992	17012	21.2
Agric. Ser., Forest. & Fish.	(D)	1749	1857	1829	--.-
Mining	(D)	141	(D)	(L)	--.-
Contract Construction	2772	4382	4475	2250	-18.8
Manufacturing	(D)	2019	2207	1684	--.-
Nondurable Goods	NA	95	41	66	--.-
Durable Goods	NA	1925	2166	1618	--.-
Transport. & Public Utilities	1360	1656	1321	1215	-10.7
Wholesale Trade**	2945	791	(D)	1562	--.-
Retail Trade	NA	3446	5009	4663	--.-
Fin., Insur. & Real Estate	631	367	724	645	2.2
Services	2854	2912	3545	3149	10.3
Government	6200	7508	8789	8985	44.9
Federal, Civilian	1249	1310	1437	1257	0.6
Federal, Military	285	133	124	350	22.8
State & Local	4666	6065	7228	7379	58.1

Income in 1975, 1980, and 1982 are deflated to 1970 dollars according to the Consumer Price Index

(D)-Data withheld for reasons of disclosure (L)-Less than $10,000 in income

NA-Information not available

**-Income for both the wholesale and retail trade sectors are combined for 1970 only

Sources: Bureau of Economic Analysis, Local Area Personal Income, 1969-1974 Volume 4: Western States By Major Source for Counties and SMSAs, June, 1976.
Bureau of Economic Analysis, Local Area Personal Income, 1975-1980, Rocky Mountain Region and Western Region, June, 1982.
Bureau of Economic Analysis, Local Area Personal Income, 1977-1982, Rocky Mountain Region and Western Region, June, 1984.

Table A.1.59. Employment By Place of Work in Chelan County, Washington: 1970-1982.

	Employment By Type and Broad Industrial Sources				
	1970	1975	1977	1980	1982
Total Employment, Chelan County	21762	24282	26474	27421	27354
Number of Proprietors	3113	3232	3391	3798	3925
Farm Proprietors	1591	1595	1638	1824	1868
Non-Farm Proprietors	1522	1637	1753	1974	2057
Total Wage Employment	18649	21050	23083	23628	23429
Farm	2295	2635	2392	2758	2925
Non-Farm	16354	18415	20691	20865	20504
Private	12547	14442	16808	16754	16400
Ag. Services, For. & Other	238	273	(D)	959	947
Mining	29	30	(D)	(D)	(D)
Contract Construction	559	713	1527	797	642
Manufacturing	2599	2813	2842	2705	2232
Non-Durable Manufacturing	955	1089	1098	1049	969
Durable Manufacturing	1644	1724	1744	1656	1263
Transport. & Public Utilities	702	660	655	768	738
Wholesale Trade	2137	2596	2899	(D)	(D)
Retail Trade	2745	3187	3582	3600	3658
Finance, Ins. & Real Estate	600	697	811	1005	906
Services	2938	3473	3967	4298	4401
Government	3807	3973	3883	4111	4104
Federal, Civilian	726	654	728	688	620
Federal, Military	218	205	185	191	439
State and Local	2863	3114	2970	3232	3045

(D)- Data withheld for reasons of disclosure
(L)-Less than ten employees

Source: Bureau of Economic Analysis, Regional Economic Information Service, Table 25, April, 1984.

Table A.1.60. Retail Sales in Chelan County, Washington: 1972-1982.

	1972 Sales		1977 Sales		1982 Sales	
	Number	(000 $)	Number	(000 $)	Number	(000 $)
Chelan County						
All Establishments	562	120677	556	140059	624	111724
Bldg.Mat.,Hardware	22	(D)	33	(D)	25	8426
Gen. Merchandise	19	15813	17	15821	12	10467
Food Stores	74	26756	68	29367	48	25230
Auto Dealers	42	21584	43	29739	39	20511
Gasoline Service	93	11966	50	10112	41	8970
Apparel & Accesory	39	5591	33	(D)	40	4272
Furniture & Furnishings	21	3541	37	4373	29	4048
Eating and Drinking	108	11631	110	12763	105	10854
Drug Stores	16	(D)	14	(D)	15	5456
Miscellaneous Retail	128	8801	151	10226	81	10122

Sales in 1977 and 1982 are deflated to 1972 dollars according to the Consumer Price Index.
(D)-Data withheld for reasons of disclosure

Sources: Bureau of the Census, 1976. 1972 Census of Retail Trade. Volume II Area Statistics. Part 3, North Dakota-Wyoming. Table 6: 48-44--48-49.
Bureau of the Census, 1980. 1977 Census of Retail Trade. Volume II Geographical Area Statistics. Part 3, North Dakota-Wyoming. Table 7: 48-50--48-53.
Bureau of the Census, 1984. 1982 Census of Retail Trade. Volume II Geographical Area Statistics. Part 3, North Dakota- Wyoming. Table 8: Wash.44--Wash.47.

Table A.1.61. Retail Sales in Wenatchee, Washington. 1972-1982.

	1972 Sales		1977 Sales		1982 Sales	
	Number	(000 $)	Number	(000 $)	Number	(000 $)
Wenatchee						
All Establishments	357	82028	313	86978	374	77316
Bldg.Mat.,Hardware	9	2770	17	7031	12	3536
Gen. Merchandise	12	12509	9	(D)	8	(D)
Food Stores	41	15322	33	16326	21	12654
Auto Dealers	26	15698	23	21270	29	17962
Gasoline Service	64	9036	21	4561	26	6014
Apparel & Accesory	31	4815	25	(D)	30	3755
Furniture & Furnishings	16	2544	32	3342	22	(D)
Eating and Drinking	57	7366	54	7699	61	7512
Drug Stores	9	5202	8	(D)	8	4499
Miscellaneous Retail	92	6766	91	7542	51	7435

Sales in 1977 and 1982 are deflated to 1972 dollars according to the Consumer Price Index.
(D)-Data withheld for reasons of disclosure

Sources: Bureau of the Census, 1976. 1972 Census of Retail Trade. Volume II Area Statistics. Part 3, North Dakota-Wyoming. Table 6: 48-44--48-49.
Bureau of the Census, 1980. 1977 Census of Retail Trade. Volume II Geographical Area Statistics. Part 3, North Dakota-Wyoming. Table 7: 48-50--48-53.
Bureau of the Census, 1984. 1982 Census of Retail Trade. Volume II Geographical Area Statistics. Part 3, North Dakota- Wyoming. Table 8: Wash.44--Wash.47.

Table A.1.62. Retail Sales in Douglas County, Washington: 1972-1982.

	1972 Sales		1977 Sales		1982 Sales	
	Number	(000 $)	Number	(000 $)	Number	(000 $)
Douglas County						
All Establishments	126	15966	132	32780	172	33284
Bldg.Mat.,Hardware	9	423	12	2386	8	2039
Gen. Merchandise	2	(D)	2	(D)	1	(D)
Food Stores	15	6808	17	10582	16	13016
Auto Dealers	10	2738	11	4034	5	2454
Gasoline Service	15	1412	12	(D)	7	1104
Apparel & Accesory	7	399	9	1497	9	2152
Furniture & Furnishings	4	(D)	9	1497	9	2152
Eating and Drinking	26	2117	22	2403	37	3557
Drug Stores	3	620	4	(D)	5	1881
Miscellaneous Retail	35	1070	34	1632	17	(D)

Sales in 1977 and 1982 are deflated to 1972 dollars according to the Consumer Price Index.
(D)-Data withheld for reasons of disclosure

Sources: Bureau of the Census, 1976. 1972 Census of Retail Trade. Volume II Area Statistics. Part 3, North Dakota-Wyoming. Table 6: 48-44--48-49.
Bureau of the Census, 1980. 1977 Census of Retail Trade. Volume II Geographical Area Statistics. Part 3, North Dakota-Wyoming. Table 7: 48-50--48-53.
Bureau of the Census, 1984. 1982 Census of Retail Trade. Volume II Geographical Area Statistics. Part 3, North Dakota-Wyoming. Table 8: Wash.44--Wash.47.

Table A.1.63. Total Personal Income in Spokane County, Washington: 1970-1982.

(000 1970 $)	1970	1975	1980	1982	% Change 1970-82
Total Earnings	810657	926499	1084107	955441	17.8
Soc. Security Adjustment	-33549	-57963	-62805	-65524	---
Residence Adjustment	-20716	-25110	-32344	-28734	---
Net Earnings	756392	843426	988958	864183	14.3
Dividends, Interest, Rent	180493	182074	237796	268036	48.9
Transfer Payments	130051	206000	225347	250288	92.3
Total Personal Income	1066936	1231500	1452101	1382507	29.0
Per Capita Income	3707	3957	4238	3958	6.8
As % of State	91.5	93.5	94.6	81.1	

Sources: Bureau of Economic Analysis, Local Area Personal Income, 1969-1974 Volume 4: Western States By Major Source for Counties and SMSAs, June 1976.
Bureau of Economic Analysis, Local Area Personal Income, 1975-80, Rocky Mountain Region and Western Region, June 1982.
Bureau of Economic Analysis, Local Area Personal Income, 1977-1982, Rocky Mountain Region and Far West Region, June 1984.

Table A.1.64. Personal Income by Major Sources for Spokane County, Washington: 1970-1982.

By Industrial Sector	1970 ($000)	1975 ($000)	1980 ($000)	1982 ($000)	% Change 1970-82
SPOKANE COUNTY					
Total Labor & Proprietor Income	810657	926499	1428883	1382507	70.5
Farm	15906	33911	17965	18935	19.0
Nonfarm	794751	892588	1043815	936505	17.8
Private	626567	705479	850078	747291	19.3
Agric. Ser., Forest. & Fish.	1643	1821	1757	1529	-6.9
Mining	1699	1209	2323	2295	35.1
Contract Construction	58195	68829	83105	53210	-8.6
Manufacturing	121337	134684	174705	157590	29.9
Nondurable Goods	NA	32840	36782	33453	--.-
Durable Goods	NA	101844	137923	124136	--.-
Transport. & Public Utilities	74241	80475	90042	82441	11.0
Wholesale Trade**	173567	89900	101273	89534	--.-
Retail Trade	NA	114612	126104	109960	--.-
Fin., Insur. & Real Estate	47621	47681	67650	61980	30.2
Services	148264	166252	203118	188752	27.3
Government	168184	187110	193737	189214	12.5
Federal, Civilian	36854	42257	40065	38934	5.6
Federal, Military	36779	34807	29084	33529	-8.8
State & Local	94551	110046	124588	116751	23.5

Income in 1975, 1980, and 1982 are deflated to 1970 dollars according to the Consumer Price Index

(D)-Data withheld for reasons of disclosure (L)-Less than $10,000 in income

NA-Information not available

**-Income for both the wholesale and retail trade sectors are combined for 1970 only

Sources: Bureau of Economic Analysis, Local Area Personal Income, 1969-1974 Volume 4: Western States By Major Source for Counties and SMSAs, June, 1976.
Bureau of Economic Analysis, Local Area Personal Income, 1975-1980, Rocky Mountain Region and Western Region, June, 1982.
Bureau of Economic Analysis, Local Area Personal Income, 1977-1982, Rocky Mountain Region and Western Region, June, 1984.

Table A.1.65. Employment By Place of Work in Spokane County, Washington: 1970-1982.

	Employment By Type and Broad Industrial Sources				
	1970	1975	1977	1980	1982
Total Employment, Spokane County	113320	125499	138372	152240	147679
Number of Proprietors	11009	11854	13118	14753	15325
Farm Proprietors	2548	2281	2341	2609	2671
Non-Farm Proprietors	8461	9573	10777	12144	12654
Total Wage Employment	102311	113645	125254	137487	132354
Farm	739	695	630	727	770
Non-Farm	101572	112950	124624	136760	131584
Private	78019	86520	98759	109211	103066
Ag. Services, For. & Other	157	208	261	295	282
Mining	158	173	252	313	304
Contract Construction	4875	5253	6667	7117	4843
Manufacturing	12649	13231	15800	16947	16207
Non-Durable Manufacturing	4174	3741	4115	4408	4082
Durable Manufacturing	8475	9490	11685	12539	12125
Transport. & Public Utilities	7344	7398	7419	8101	7488
Wholesale Trade	7300	8947	9713	10809	10009
Retail Trade	16883	19440	22231	25200	23681
Finance, Ins. & Real Estate	5474	6327	7658	8422	7969
Services	23179	25543	28758	32007	32283
Government	23553	26430	25865	27549	28518
Federal, Civilian	3712	4284	4100	4228	4159
Federal, Military	5788	5671	5051	5079	7398
State and Local	14053	16475	16714	18242	16961

(D)- Data withheld for reasons of disclosure
(L)-Less than ten employees

Source: Bureau of Economic Analysis, Regional Economic Information Service, Table 25, April, 1984.

Table A.1.66. Retail Sales in Spokane County, Washington: 1972-1982.

	1972 Sales		1977 Sales		1982 Sales	
	Number	(000 $)	Number	(000 $)	Number	(000 $)
Spokane County						
All Establishments	2554	699576	2541	837335	3030	716747
Bldg.Mat.,Hardware	104	36163	143	57870	93	32507
Gen. Merchandise	47	123628	42	119742	36	90658
Food Stores	265	139373	267	165919	251	168400
Auto Dealers	199	141120	239	178979	167	127873
Gasoline Service	321	46758	235	53412	172	55472
Apparel & Accesory	119	28171	142	(D)	147	33578
Furniture & Furnishings	174	38051	258	49253	169	31818
Eating and Drinking	471	53796	490	74369	516	74596
Drug Stores	66	(D)	67	(D)	65	26048
Miscellaneous Retail	788	(D)	658	69500	378	61441

Sales in 1977 and 1982 are deflated to 1972 dollars according to the Consumer Price Index.
(D)-Data withheld for reasons of disclosure

Sources: Bureau of the Census, 1976. 1972 Census of Retail Trade. Volume II Area Statistics. Part 3, North Dakota-Wyoming. Table 6: 48-44--48-49.
Bureau of the Census, 1980. 1977 Census of Retail Trade. Volume II Geographical Area Statistics. Part 3, North Dakota-Wyoming. Table 7: 48-50--48-53.
Bureau of the Census, 1984. 1982 Census of Retail Trade. Volume II Geographical Area Statistics. Part 3, North Dakota- Wyoming. Table 8: Wash.44--Wash.47.

Table A.1.67. Retail Sales in Spokane (City), Washington.: 1972-1982.

	1972		1977		1982	
		Sales		Sales		Sales
	Number	(000 $)	Number	(000 $)	Number	(000 $)
Spokane City						
All Establishments	1697	499225	1608	553815	1760	464482
Bldg.Mat.,Hardware	44	12366	63	21072	37	14418
Gen. Merchandise	30	12366	28	(D)	23	70110
Food Stores	177	91404	158	96728	148	105167
Auto Dealers	113	99580	139	114593	89	76486
Gasoline Service	197	28386	149	33109	105	31613
Apparel & Accesory	98	23092	105	29815	102	25901
Furniture & Furnishings	132	30481	163	32102	108	23027
Eating and Drinking	328	39023	332	51008	325	48648
Drug Stores	47	(D)	48	(D)	45	18336
Miscellaneous Retail	521	(D)	423	53639	262	43496

Sales in 1977 and 1982 are deflated to 1972 dollars according to the Consumer Price Index.
(D)-Data withheld for reasons of disclosure

Sources: Bureau of the Census, 1976. 1972 Census of Retail Trade. Volume II Area Statistics. Part 3, North Dakota-Wyoming. Table 6: 48-44--48-49.
Bureau of the Census, 1980. 1977 Census of Retail Trade. Volume II Geographical Area Statistics. Part 3, North Dakota-Wyoming. Table 7: 48-50--48-53.
Bureau of the Census, 1984. 1982 Census of Retail Trade. Volume II Geographical Area Statistics. Part 3, North Dakota- Wyoming. Table 8: Wash.44--Wash.47.

Table A.1.68. Total Personal Income in Flathead County, Montana: 1970-1982.

(000 1970 $)	1970	1975	1980	1982	% Change 1970-82
Total Earnings	91442	113125	139274	119480	30.6
Soc. Security Adjustment	-4708	-6975	-9368	-9109	---
Residence Adjustment	2042	771	-1153	732	---
Net Earnings	88776	106920	129225	109639	23.4
Dividends, Interest, Rent	20486	28719	44855	45658	122.8
Transfer Payments	16919	28765	32983	37098	119.5
Total Personal Income	126181	164405	207063	192395	52.5
Per Capita Income	3181	3658	3975	3678	15.6
As % of State	90.9	93.6	97.5	95.8	

Sources: Bureau of Economic Analysis, Local Area Personal Income, 1969-1974 Volume 4: Western States By Major Source for Counties and SMSAs, June 1976.
Bureau of Economic Analysis, Local Area Personal Income, 1975-80, Rocky Mountain Region and Western Region, June 1982.
Bureau of Economic Analysis, Local Area Personal Income, 1977-1982, Rocky Mountain Region and Far West Region, June 1984.

Table A.1.69. Personal Income by Major Sources for Flathead County, Montana: 1970-1982.

By Industrial Sector	1970 ($000)	1975 ($000)	1980 ($000)	1982 ($000)	% Change 1970-82
FLATHEAD COUNTY					
Total Labor & Proprietor Income	91442	113125	198734	192395	110.4
Farm	3020	3493	976	1151	-61.9
Nonfarm	88422	109632	134305	118329	33.8
Private	72855	89849	112906	96767	32.8
Agric. Ser., Forest. & Fish.	(D)	413	509	487	--.-
Mining	(D)	150	(L)	286	--.-
Contract Construction	4329	5788	8631	6121	41.4
Manufacturing	27447	33931	40111	28997	5.6
Nondurable Goods	----	1317	1497	1294	--.-
Durable Goods	----	32615	38614	27703	--.-
Transport. & Public Utilities	11507	12866	17049	15893	38.1
Wholesale Trade**	15426	4040	5277	5162	--.-
Retail Trade	NA	14840	16598	15218	--.-
Fin., Insur. & Real Estate	2762	3802	5019	5053	82.9
Services	10701	14019	19710	19549	82.7
Government	15567	19783	21399	21562	38.5
Federal, Civilian	5088	5809	6477	6620	30.1
Federal, Military	1318	947	504	445	-66.2
State & Local	9161	13026	14418	14497	58.2

Income in 1975, 1980, and 1982 are deflated to 1970 dollars according to the Consumer Price Index

(D)-Data withheld for reasons of disclosure (L)-Less than $10,000 in income

NA-Information not available

**-Income for both the wholesale and retail trade sectors are combined for 1970 only

Sources: Bureau of Economic Analysis, Local Area Personal Income, 1969-1974 Volume 4: Western States By Major Source for Counties and SMSAs, June, 1976.
Bureau of Economic Analysis, Local Area Personal Income, 1975-1980, Rocky Mountain Region and Western Region, June, 1982.
Bureau of Economic Analysis, Local Area Personal Income, 1977-1982, Rocky Mountain Region and Western Region, June, 1984.

Table A.1.70. Retail Sales in Flathead County, Montana: 1972-1982

	1972 Sales		1977 Sales		1982 Sales	
	Number	(000 $)	Number	(000 $)	Number	(000 $)
Flathead County, Montana						
All Establishments	548	98569	647	135539	720	117488
Bldg.Mat.,Hardware	37	9390	49	11334	31	8236
Gen. Merchandise	16	7732	9	(D)	6	3803
Food Stores	50	27424	56	32973	50	36014
Auto Dealers	52	19307	56	28160	41	19847
Gasoline Service	66	6473	58	8140	22	5930
Apparel & Accesory	25	3422	36	7483	35	5689
Furniture & Furnishings	28	4721	42	5920	32	4889
Eating and Drinking	131	9110	148	13841	134	12888
Drug Stores	12	1905	11	(D)	11	3954
Miscellaneous Retail	131	9085	182	15102	99	11526

Sales in 1977 and 1982 are deflated to 1972 dollars according to the Consumer Price Index.

Sources: Bureau of the Census, 1976. 1972 Census of Retail Trade. Volume II Area Statistics, Part 2. Iowa-North Carolina. Table 6: 27-18--27-19.
Bureau of the Census, 1980. 1977 Census of Retail Trade. Volume II Geographical Area Statistics. Part 2. Iowa-North Carolina. Table 7: 27-22--27-23.
Bureau of the Census, 1984. 1982 Census of Retail Trade. Volume II Geographical Area Statistics. Part 2. Iowa-North Carolina. Table 8: Mont.-20--Mont. 21.

Table A.1.71. Retail Sales in Columbia Falls, Montana: 1972-1982

	1972 Sales		1977 Sales		1982 Sales	
	Number	(000 $)	Number	(000 $)	Number	(000 $)
Columbia Falls, Montana						
All Establishments	61	7761	75	10205	68	8229
Bldg.Mat.,Hardware	3	377	7	766	1	(D)
Gen. Merchandise	1	(D)	0	---	0	---
Food Stores	9	3718	9	(D)	7	4738
Auto Dealers	5	190	4	413	1	(D)
Gasoline Service	9	561	9	537	1	(D)
Apparel & Accesory	2	(D)	2	(D)	3	(D)
Furniture & Furnishings	4	(D)	4	764	3	514
Eating and Drinking	13	967	21	1455	13	873
Drug Stores	2	(D)	2	(D)	2	(2)
Miscellaneous Retail	13	638	17	587	5	361

Sales in 1977 and 1982 are deflated to 1972 dollars according to the Consumer Price Index.
(D)-Data withheld for reasons of disclosure

Sources: Bureau of the Census, 1976. 1972 Census of Retail Trade. Volume II Area Statistics, Part 2. Iowa-North Carolina. Table 6: 27-18--27-19.
Bureau of the Census, 1980. 1977 Census of Retail Trade. Volume II Geographical Area Statistics. Part 2. Iowa-North Carolina. Table 7: 27-22--27-23.
Bureau of the Census, 1984. 1982 Census of Retail Trade. Volume II Geographical Area Statistics. Part 2. Iowa-North Carolina. Table 8: Mont.-20--Mont. 21.

TABLE A.2.1. Lower Columbia Region: Population Size and Annual Rates of Change: 1960 to 1984.

PLACE and PERIOD	1960	1960-70	1970	1970-75	1975	1975-80	1980	1980-84	1984
State of Washington	2,853,214	1.8%	3,409,169	0.5%	3,493,990	3.4%	4,132,156	1.2%	4,328,100
State of Oregon	1,768,687	1.7%	2,091,385	1.9%	2,299,000	2.7%	2,633,000	0.3%	2,660,000
Clark County, WA	93,809	3.1%	128,454	3.0%	149,000	5.1%	192,227	1.2%	201,700
Vancouver (city)	32,464	2.7%	42,493	1.8%	46,500	-1.6%	42,834	0.0%	42,850
Cowlitz County, WA	57,801	1.7%	68,616	0.6%	70,700	2.4%	79,548	0.1%	79,900
Kelso (city)	8,379	2.1%	10,296	0.2%	10,400	1.4%	11,129	-0.7%	10,840
Longview (city)	23,349	1.9%	28,373	0.5%	29,049	1.3%	31,052	-0.8%	30,100
Multnomah County, OR	522,813	0.6%	556,667	-0.3%	547,900	0.5%	562,640	0.0%	562,300
Gresham (city)	3,944	9.3%	10,030	15.1%	21,335	8.7%	33,005	2.4%	36,370
Troutdale (city)	522	11.6%	1,661	8.2%	2,500	17.2%	5,908	3.7%	6,850
Washington County, OR	92,237	5.4%	157,920	3.8%	190,900	5.1%	245,808	1.4%	260,200
Portland SMSA	708,859	1.7%	843,041	1.0%	887,800	2.4%	1,000,675	0.6%	1,024,200

Notes: The average annual rate of change (in percent) is computed as follows: Rate = 100 X (LN(P2)-LN(P1)) / Time in Years, Where P2 = Population at Time 2, P1 = Population at Time 1, and LN is the natural logarithm.
Although the components of the Portland SMSA changed in 1983, the SMSA as defined in the 1980 Census (Clark, Clackamas, Multnomah and Washington Counties) is used in this table.

Sources: U.S. Bureau of the Census, 1980, Number of Inhabitants, Oregon. U.S. Government Printing Office: Washington, D.C.
U.S. Bureau of the Census, 1980, Number of Inhabitants, Washington. U.S. Government Printing Office: Washington, D.C.
U.S. Bureau of the Census, 1970, Volume 1, Characteristics of the Population, Oregon. U.S. Government Printing Office: Washington, D.C.
U.S. Bureau of the Census, 1970, Volume 1, Characteristics of the Population, Washington. U.S. Government Printing Office: Washington, D.C.
State of Washington, Office of Fiscal Management, Population Trends, 1979.
State of Washington, Office of Fiscal Management, Population Trends, 1984.
Portland State University, Center for Population Research and Census, Population Estimates of Oregon Counties and Incorporated Cities.

Table A.2.2. Population Size by Race: 1970 to 1983

Place and Period	Population	White	Percent White	Black	Percent Black	American Indian	Percent Indian	Asian	Percent Asian	Spanish Origin
					RACE					
State of Washington										
1970										
1980	4,132,156	3,779,170	91.5	105,574	2.6	60,804	1.5	110,052	2.9	120,016
1983	4,285,100	3,883,824	90.6	117,916	2.8	65,109	1.5	136,399	3.2	127,094
Clark County										
1970	128,454	126,965	98.8	569	.4	398	.3	278	.2	1,010
1980	192,227	184,827	96.0	1,682	.8	1,521	.8	2,020	1.0	3,059
1983	200,000	190,719	95.0	2,098	1.0	1,921	1.0	3,323	1.6	3,327
Vancouver (city)										
1970	42,493	41,732	98.0	428	1.0	112	.2	117	.3	
1980	42,834	40,477	97.0	633	1.5	426	.1	535	1.2	733

NOTES: American Indian includes Aleut and Eskimo in 1980.
Asian includes Japanese, Chinese, Filipino, Korean, Asian Indian, Vietnamese in 1980.
Spanish Origin includes all persons of Spanish/Hispanic origin. Persons of Spanish origin may be of any race. In 1970 identified as persons of Spanish language. In 1980 identified as Spanish Origin.

Sources: Washington State Office of Financial Management, 1984. 1984 Population Trends for Washington State. Olympia, Washington: Division of Policy Analysis and Forecasting. Table 7: 16. U.S. Bureau of the Census, General Population Characteristics - Washington, 1980, Washington, D.C.

Table A.2.2. (cont.)

Place and Period	Population	White	Percent White	Black	Percent Black	American Indian	Percent Indian	Asian	Percent Asian	Spanish Origin
					RACE					
State of Washington										
1970										
1980	4,132,156	3,779,170	91.5	105,574	2.6	60,804	1.5	110,052	2.9	120,016
1983	4,285,100	3,883,824	90.6	117,916	2.8	65,109	1.5	136,399	3.2	127,094
Cowlitz County										
1970	68,616	67,819	98.8	109	.2	357	.5	157	.2	639
1980	79,548	76,964	96.8	191	.2	964	1.2	762	1.0	1,067
1983	79,300	76,653	96.7	210	.3	887	1.1	955	1.2	1,068
Longview (city)										
1970	28,373	27,941	98.5	99	.3	160	.6	104	.4	
1980	31,052	29,736	95.8	143	.5	362	1.2	515	1.7	438
Kelso (city)										
1970	10,296	10,207	99.1	2	.02	38	.4	17	.2	
1980	11,129	10,750	96.6	13	.1	190	1.7	68	.6	155

NOTES: American Indian includes Aleut and Eskimo in 1980.
Asian includes Japanese, Chinese, Filipino, Korean, Asian Indian, Vietnamese in 1980.
Spanish Origin includes all persons of Spanish/Hispanic origin. Persons of Spanish origin may be of any race. In 1970 identified as persons of Spanish language. In 1980 identified as Spanish Origin.

Sources: Washington State Office of Financial Management, 1984. 1984 Population Trends for Washington State. Olympia, Washington: Division of Policy Analysis and Forecasting. Table 7: 16. U.S. Bureau of the Census, General Population Characteristics - Washington, 1980, Washington, D.C.

Table A.2.3. Population Size by Race: 1970 to 1983

Place and Period	Population	White	Percent White	Black	Percent Black	American Indian	Percent Indian	Asian	Percent Asian	Spanish Origin
					RACE					
State of Oregon										
1970	2,091,385	2,032,079	97.2							
1980	2,633,105	2,490,610	94.6	37,060	1.4	27,314	1.0	32,656	1.2	65,847
Multnomah County										
1970	556,667	523,522	94.0	22,155	4.0	2,673	.5	6,513	1.2	5,419
1980	562,640	504,113	89.6	29,844	5.3	4,819	.9	13,571	2.4	11,239
Portland (SMSA)										
1970	1,009,129	970,857	96.0	23,284	2.3	4,011	.40	8,216	.81	11,674
1980	1,026,144	946,924	92.0	32,831	3.0	8,511	.8	22,720	2.2	20,486
Gresham (city)										
1970	10,030	9,740	97.0	9	.09	24	.24	70	.70	
1980	33,005	31,701	96.0	247	.7	194	.59	536	1.6	528
Troutdale (city)										
1970	Not Available									
1980	5,908	5,670	96.0	96	1.6	27	.5	80	1.4	91

NOTES: American Indian includes Aleut and Eskimo in 1980.
Asian includes Japanese, Chinese, Filipino, Korean, Asian Indian, Vietnamese in 1980.
Spanish Origin includes all persons of Spanish/Hispanic origin. Persons of Spanish origin may be of any race. In 1970 identified as persons of Spanish language. In 1980 identified as Spanish Origin.

Source: U.S. Bureau of the Census, General Population Characteristics - Oregon, 1980, Washington, D.C.

Table A.2.4. Population Size by Selected Age Categories: 1970 to 1983

Place and Age	1970 Number	1970 Percent	YEAR 1980 Number	YEAR 1980 Percent
State of Washington				
Total Population	3,409,109	100	4,132,156	100
Under 5	280,442	8	306,123	7
5 to 14	677,289	20	618,006	15
15 to 19	369,023	11	329,903	8
65 and over	322,061	9	431,562	10
Clark County				
Total Population	128,454	100	192,227	100
Under 5	11,628	9	16,325	8
5 to 14	27,173	21	33,564	17
15 to 19	11,830	9	17,038	9
65 and over	11,651	9	17,379	9
Vancouver (city)				
Total Population	42,493	100	42,834	100
Under 5	3,626	9	3,009	7
5 to 14	7,425	17	5,039	12
15 to 19	3,769	9	3,564	8
65 and over	5,137	12	6,707	16

Sources: Washington data: U.S. Bureau of the Census, General Population Characteristics-Washington, 1980 Census of Population, Tables 25, 26, 33, 39

Table A.2.5. Population Size by Selected Age Categories: 1970 to 1983

Place and Age	YEAR 1970 Number	Percent	1980 Number	Percent
State of Oregon				
Total Population	2,091,385	100	2,633,105	100
Under 5	164,060	8	198,046	8
5 to 14	405,629	19	391,832	15
15 to 19	203,362	10	225,868	9
65 and over	226,799	11	303,336	12
Portland SMSA (WA-ORE)				
Total Population	824,926	100	1,026,144	100
Under 5	65,912	8	75,464	7
5 to 14	150,167	18	144,607	14
15 to 19	74,604	9	81,676	8
65 and over	93,157	11	116,308	11
Multnomah County				
Total Population	556,667	100	562,640	100
Under 5	41,818	8	38,788	7
5 to 14	95,507	17	70,026	12
15 to 19	50,822	9	43,290	8
65 and over	70,515	13	75,049	13

Source: Oregon data: U.S. Bureau of the Census, General Population Characteristics-Oregon, 1980 Census of Population, Table 33, 39, 46

Table A.2.6. Population Size by Selected Age Categories: 1970 to 1983

Place and Age	YEAR 1970 Number	Percent	YEAR 1980 Number	Percent
State of Washington				
Total Population	3,409,109	100	4,132,156	100
Under 5	280,442	8	306,123	7
5 to 14	677,289	20	618,006	15
15 to 19	369,023	11	329,903	8
65 and over	322,061	9	431,562	10
Cowlitz County				
Total Population	68,616	100	79,548	100
Under 5	6,308	9	6,592	8
5 to 14	14,264	21	13,114	16
15 to 19	6,554	10	6,960	9
65 and over	5,995	9	8,611	11
Kelso (city)				
Total Population	10,296	100	11,129	100
Under 5	997	10	1,005	9
5 to 14	1,911	19	1,728	16
15 to 19	939	9	948	9
65 and over	1,210	12	1,269	11
Longview (city)				
Total Population	28,373	100	31,052	100
Under 5	2,637	9	2,497	8
5 to 14	5,480	19	4,705	15
15 to 19	2,641	9	2,563	8
65 and over	2,460	9	3,894	13

Sources: Washington data: U.S. Bureau of the Census, General Population Characteristics-Washington, 1980 Census of Population, Tables 25, 26, 33, 39

Table A.2.7. Population Size by Selected Age Categories: 1970 to 1983

Place and Age	1970 Number	1970 Percent	YEAR 1980 Number	1980 Percent
State of Oregon				
Total Population	2,091,385	100	2,633,105	100
Under 5	164,060	8	198,046	8
5 to 14	405,629	19	391,832	15
15 to 19	203,362	10	225,868	9
65 and over	226,799	11	303,336	12
Multnomah County				
Total Population	556,667	100	562,640	100
Under 5	41,818	8	38,788	7
5 to 14	95,507	17	70,026	12
15 to 19	50,822	9	43,290	8
65 and over	70,515	13	75,049	13
Troutdale (city)				
Total Population	Not Available		5,908	100
Under 5			658	11
5 to 14			1,168	20
15 to 19			408	7
65 and over			192	3
Gresham (city)				
Total Population	9,875	100	33,005	100
Under 5	850	9	2,877	9
5 to 14	2,189	22	5,581	17
15 to 19	923	9	2,781	8
65 and over	927	9	2,692	8

Source: Oregon data: U.S. Bureau of the Census, General Population Characteristics-Oregon, 1980 Census of Population, Table 33, 39, 46

TABLE A.2.8. Mid-Columbia Region: Population Size and Annual Rates of Change: 1960 to 1984.

PLACE and PERIOD	1960	1960-70	1970	1970-75	1975	1975-80	1980	1980-84	1984
State of Washington	2,853,214	1.8%	3,409,169	0.5%	3,493,990	3.4%	4,132,156	1.2%	4,328,100
State of Oregon	1,768,687	1.7%	2,091,385	1.9%	2,299,000	2.7%	2,633,000	0.3%	2,660,000
Klickitat County, WA	13,455	-1.0%	12,138	1.4%	13,000	3.9%	15,822	1.0%	16,500
Goldendale (city)	2,536	-0.2%	2,484	5.5%	3,275	0.8%	3,414	1.7%	3,660
Wasco County, OR	20,205	0.0%	20,133	0.1%	20,230	1.4%	21,732	0.9%	22,500
The Dalles (city)	10,493	-0.1%	10,423	0.7%	10,800	0.0%	10,820	0.3%	10,960

Notes: The average annual rate of change (in percent) is computed as follows: Rate = 100 X (LN(P2)-LN(P1)) / Time in Years, Where P2 = Population at Time 2, P1 = Population at Time 1, and LN is the natural logarithm.
Although the components of the Portland SMSA changed in 1983, the SMSA as defined in the 1980 Census (Clark, Clackamas, Multnomah and Washington Counties) is used in this table.

Sources: U.S. Bureau of the Census, 1980, Number of Inhabitants, Oregon. U.S. Government Printing Office: Washington, D.C.
U.S. Bureau of the Census, 1980, Number of Inhabitants, Washington. U.S. Government Printing Office: Washington, D.C.
U.S. Bureau of the Census, 1970, Volume 1, Characteristics of the Population, Oregon. U.S. Government Printing Office: Washington, D.C.
U.S. Bureau of the Census, 1970, Volume 1, Characteristics of the Population, Washington. U.S. Government Printing Office: Washington, D.C.
State of Washington, Office of Fiscal Management, Population Trends, 1979.
State of Washington, Office of Fiscal Management, Population Trends, 1984.

Table A.2.9. Population Size by Race: 1970 to 1983

Place and Period	Population	White	Percent White	Black	Percent Black	American Indian	Percent Indian	Asian	Percent Asian	Spanish Origin
					RACE					
State of Oregon										
1970	2,091,385	2,032,079	97.2	26,308	1.3	13,510	.6	13,290	.6	34,577
1980	2,633,105	2,490,610	94.6	37,060	1.4	27,314	1.0	32,656	1.2	65,847
Wasco County										
1970	20,133	19,505	97.0	73	.36	479	2.4	55	.27	400
1980	21,732	20,676	95.1	65	.3	617	2.8	205	.5	486
The Dalles (city)										
1970	10,473	10,276	99.0	54	.52	55	.53	12	.1	
1980	10,820	10,425	96.3	46	.4	142	1.3	57	.5	227

NOTES: American Indian includes Aleut and Eskimo in 1980.
Asian includes Japanese, Chinese, Filipino, Korean, Asian Indian, Vietnamese in 1980.
Spanish Origin includes all persons of Spanish/Hispanic origin. Persons of Spanish origin may be of any race. In 1970 identified as persons of Spanish language. In 1980 identified as Spanish Origin.

Sources: U.S. Bureau of the Census, General Population Characteristics - Oregon, 1970, Washington, D.C.
U.S. Bureau of the Census, General Population Characteristics - Washington, 1970, Washington, D.C.
U.S. Bureau of the Census, General Population Characteristics - Oregon, 1980, Washington, D.C.
U.S. Bureau of the Census, General Population Characteristics - Washington, 1980, Washington, D.C.

Table A.2.10. Population Size by Race: 1970 to 1983

Place and Period	Population	White	Percent White	Black	Percent Black	American Indian	Percent Indian	Asian	Percent Asian	Spanish Origin
					RACE					
State of Washington										
1970	3,409,169	3,251,055	95.3	71,308	2.1	33,386	1.0	40,998	1.2	70,734
1980	4,132,156	3,779,170	91.5	105,574	2.6	60,804	1.5	110,052	2.9	120,016
1983	4,285,100	3,883,824	90.6	117,916	2.8	65,109	1.5	136,399	3.2	127,094
Klickitat County										
1970	12,138	11,758	96.9	10	.1	279	2.3	56	.5	400
1980	15,822	14,969	94.6	19	.1	467	2.9	98	.6	474
1983	16,300	15,374	94.3	23	.1	470	2.9	129	.8	520
Goldendale (city)										
1970	2,484	2,422	97.5	4	.2	58	---	58	---	
1980	3,414	3,244	95.0	1	---	74	2.2	14	.4	102

NOTES: American Indian includes Aleut and Eskimo in 1980.
Asian includes Japanese, Chinese, Filipino, Korean, Asian Indian, Vietnamese in 1980.
Spanish Origin includes all persons of Spanish/Hispanic origin. Persons of Spanish origin may be of any race. In 1970 identified as persons of Spanish language. In 1980 identified as Spanish Origin.

Sources: Washington State Office of Financial Management, 1984. 1984 Population Trends for Washington State. Olympia, Washington: Division of Policy Analysis and Forecasting. Table 7: 16. U.S. Bureau of the Census, General Population Characteristics - Washington, 1980, Washington, D.C.

Table A.2.11. Population Size by Selected Age Categories: 1970 to 1983

Place and Age	YEAR 1970 Number	Percent	YEAR 1980 Number	Percent
State of Oregon				
Total Population	2,091,385	100	2,633,105	100
Under 5	164,060	8	198,046	8
5 to 14	405,629	19	391,832	15
15 to 19	203,362	10	225,868	9
65 and over	226,799	11	303,336	12
Wasco County				
Total Population	20,133	100	21,732	100
Under 5	1,455	7	1,700	8
5 to 14	4,041	20	3,427	16
15 to 19	1,881	9	1,763	8
65 and over	2,304	11	3,049	14
City of The Dalles				
Total Population	10,423	100	10,820	100
Under 5	688	7	823	8
5 to 14	1,907	18	1,533	14
15 to 19	881	8	820	8
65 and over	1,456	14	1,850	17

Source: Oregon data: U.S. Bureau of the Census, General Population Characteristics-Oregon, 1980 Census of Population, Table 33, 39, 46

Table A.2.12. Population Size by Selected Age Categories: 1970 to 1983

Place and Age	1970 Number	1970 Percent	YEAR 1980 Number	1980 Percent
State of Washington				
Total Population	3,409,109	100	4,132,156	100
Under 5	280,442	8	306,123	7
5 to 14	677,289	20	618,006	15
15 to 19	369,023	11	329,903	8
65 and over	322,061	9	431,562	10
Klickitat County				
Total Population	12,138	100	15,822	100
Under 5	943	8	1,311	8
5 to 14	2,586	21	2,672	17
15 to 19	1,174	10	1,346	9
65 and over	1,388	11	1,943	12
Goldendale (city)				
Total Population	Not Available		3,414	100
Under 5			321	9
5 to 14			589	17
15 to 19			243	7
65 and over			531	16

Sources: Washington data: U.S. Bureau of the Census, General Population Characteristics-Washington, 1980 Census of Population, Tables 25, 26, 33, 39

TABLE A.2.13. Upper Columbia Region: Population Size and Annual Rates of Change: 1960 to 1984.

PLACE and PERIOD	1960	1960-70	1970	1970-75	1975	1975-80	1980	1980-84	1984
State of Washington	2,853,214	1.8%	3,409,169	0.5%	3,493,990	3.4%	4,132,156	1.2%	4,328,100
Chelan County, WA	40,744	0.1%	41,355	-0.2%	40,900	1.9%	45,061	1.3%	47,500
Wenatchee (city)	16,726	0.1%	16,912	0.9%	17,730	-0.5%	17,257	0.1%	17,330
Douglas County, WA	14,890	1.2%	16,787	1.5%	18,100	4.0%	22,144	0.5%	22,600
Spokane County, WA	278,333	0.3%	287,487	0.7%	298,000	2.7%	341,835	0.5%	349,400
Spokane (city)	181,608	-0.6%	170,516	0.5%	174,500	-0.4%	171,300	0.0%	171,500

Notes: The average annual rate of change (in percent) is computed as follows: Rate = 100 X (LN(P2)-LN(P1)) / Time in Years, Where P2 = Population at Time 2, P1 = Population at Time 1, and LN is the natural logarithm.

Sources: U.S. Bureau of the Census, 1980, Number of Inhabitants, Washington. U.S. Government Printing Office: Washington, D.C.
U.S. Bureau of the Census, 1970, Volume 1, Characteristics of the Population, Washington. U.S. Government Printing Office: Washington, D.C.
State of Washington, Office of Fiscal Management, Population Trends, 1979.
State of Washington, Office of Fiscal Management, Population Trends, 1984.

Table A.2.14. Population Size by Race: 1970 to 1983

Place and Period	Population	White	Percent White	Black	Percent Black	American Indian	Percent Indian	Asian	Percent Asian	Spanish Origin
					RACE					
State of Washington										
1970										
1980	4,132,156	3,779,170	91.5	105,574	2.6	60,804	1.5	110,052	2.9	120,016
1983	4,285,100	3,883,824	90.6	117,916	2.8	65,109	1.5	136,399	3.2	127,094
Chelan County										
1970	41,355	40,844	98.8	42	.1	281	.7	50	.1	400
1980	45,061	43,701	96.9	47	.1	358	.8	156	.3	1,368
1983	46,500	44,731	96.2	39	.1	388	.8	279	.6	1,670
Wenatchee (city)										
1970	16,912	16,664	98.4	31	.2	137	.8	36	.2	
1980	17,257	16,714	96.9	34	.2	163	.9	105	.6	381

NOTES: American Indian includes Aleut and Eskimo in 1980.
Asian includes Japanese, Chinese, Filipino, Korean, Asian Indian, Vietnamese in 1980.
Spanish Origin includes all persons of Spanish/Hispanic origin. Persons of Spanish origin may be of any race. In 1970 identified as persons of Spanish language. In 1980 identified as Spanish Origin.

Sources: Washington State Office of Financial Management, 1984. 1984 Population Trends for Washington State. Olympia, Washington: Division of Policy Analysis and Forecasting. Table 7: 16. U.S. Bureau of the Census, General Population Characteristics - Washington, 1980, Washington, D.C.

Table A.2.15. Population Size by Selected Age Categories: 1970 to 1983

Place and Age	YEAR 1970 Number	Percent	YEAR 1980 Number	Percent
State of Washington				
Total Population	3,409,109	100	4,132,156	100
Under 5	280,442	8	306,123	7
5 to 14	677,289	20	618,006	15
15 to 19	369,023	11	329,903	8
65 and over	322,061	9	431,562	10
Chelan County				
Total Population	41,355	100	45,061	100
Under 5	2,862	7	3,132	7
5 to 14	7,845	19	6,140	14
15 to 19	4,203	10	3,830	8
65 and over	5,268	13	6,828	15
Wenatchee (city)				
Total Population	16,912	100	17,257	100
Under 5	1,219	7	1,150	7
5 to 14	3,061	18	2,128	12
15 to 19	1,781	11	1,488	9
65 and over	2,457	15	3,032	18

Sources: Washington data: U.S. Bureau of the Census, General Population Characteristics-Washington, 1980 Census of Population, Tables 25, 26, 33, 39

TABLE A.2.16. Puget Sound Region: Population Size and Annual Rates of Change: 1960 to 1984.

PLACE and PERIOD	1960	1960-70	1970	1970-75	1975	1975-80	1980	1980-84	1984
State of Washington	2,853,214	1.8%	3,409,169	0.5%	3,493,990	3.4%	4,132,156	1.2%	4,328,100
Pierce County, WA	321,590	2.5%	411,027	0.1%	413,500	3.2%	485,667	1.4%	514,600
Tacoma (city)	147,979	0.4%	154,581	0.2%	156,500	0.3%	158,501	0.1%	159,400
Whatcom County, WA	70,317	1.5%	81,950	1.0%	86,200	4.3%	106,701	1.6%	113,700
Bellingham (city)	34,688	1.3%	39,375	0.8%	41,000	2.2%	45,794	0.1%	46,010
Ferndale (city)	1,442	4.1%	2,164	6.7%	3,030	4.8%	3,855	3.5%	4,440

Notes: The average annual rate of change (in percent) is computed as follows: Rate = 100 X (LN(P2)-LN(P1)) / Time in Years, Where P2 = Population at Time 2, P1 = Population at Time 1, and LN is the natural logarithm.

Sources: U.S. Bureau of the Census, 1980, Number of Inhabitants, Washington. U.S. Government Printing Office: Washington, D.C.
U.S. Bureau of the Census, 1970, Volume 1, Characteristics of the Population, Washington. U.S. Government Printing Office: Washington, D.C.
State of Washington, Office of Fiscal Management, Population Trends, 1979.
State of Washington, Office of Fiscal Management, Population Trends, 1984.

Table A.2.17. Population Size by Race: 1970 to 1983

Place and Period	Population	White	Percent White	Black	Percent Black	American Indian	Percent Indian	Asian	Percent Asian	Spanish Origin
					RACE					
State of Washington										
1970										
1980	4,132,156	3,779,170	91.5	105,574	2.6	60,804	1.5	110,052	2.9	120,016
1983	4,285,100	3,883,824	90.6	117,916	2.8	65,109	1.5	136,399	3.2	127,094
Pierce County										
1970	411,027	382,429	93.0	18,501	4.5	3,343	.8	4,536	1.1	9,234
1980	485,643	425,951	87.7	29,827	6.1	5,919	1.2	12,926	2.7	12,892
1983	507,000	438,968	86.6	33,510	6.6	6,352	1.3	19,731	3.9	13,294
Tacoma (city)										
1970	154,581	140,301	90.8	10,436	6.8	1,703	1.1	1,449	.9	2,248
1980	158,501	133,471	84.2	14,507	9.2	2,895	1.8	4,346	2.7	3,869

NOTES: American Indian includes Aleut and Eskimo in 1980.
Asian includes Japanese, Chinese, Filipino, Korean, Asian Indian, Vietnamese in 1980.
Spanish Origin includes all persons of Spanish/Hispanic origin. Persons of Spanish origin may be of any race. In 1970 identified as persons of Spanish language. In 1980 identified as Spanish Origin.

Sources: Washington State Office of Financial Management, 1984. 1984 Population Trends for Washington State. Olympia, Washington: Division of Policy Analysis and Forecasting. Table 7: 16. U.S. Bureau of the Census, General Population Characteristics - Washington, 1980, Washington, D.C.

Table A.2.18. Population Size by Race: 1970 to 1983

Place and Period	Population	White	Percent White	Black	Percent Black	American Indian	Percent Indian	Asian	Percent Asian	Spanish Origin
					RACE					
State of Washington										
1970										
1980	4,132,156	3,779,170	91.5	105,574	2.6	60,804	1.5	110,052	2.9	120,016
1983	4,285,100	3,883,824	90.6	117,916	2.8	65,109	1.5	136,399	3.2	127,094
Whatcom County										
1970	81,950	79,257	96.7	201	.2	1,949	2.4	262	.3	956
1980	106,701	100,895	94.6	328	.3	3,252	3.0	847	.8	2,065
1983	112,100	105,360	94.0	407	.4	3,716	3.3	1,193	1.1	2,208
Bellingham (city)										
1970	39,375	38,461	97.7	135	.3	473	1.2	181	.5	
1980	45,794	43,628	95.3	217	.5	856	1.9	550	1.2	722
Ferndale (city)										
1970	2,164	2,109		0		NA		NA		NA
1980	3,855	3,546	92.0	5	.1	173	4.5	34	.9	135

NOTES: American Indian includes Aleut and Eskimo in 1980.
Asian includes Japanese, Chinese, Filipino, Korean, Asian Indian, Vietnamese in 1980.
Spanish Origin includes all persons of Spanish/Hispanic origin. Persons of Spanish origin may be of any race. In 1970 identified as persons of Spanish language. In 1980 identified as Spanish Origin.

Sources: Washington State Office of Financial Management, 1984. 1984 Population Trends for Washington State. Olympia, Washington: Division of Policy Analysis and Forecasting. Table 7: 16. U.S. Bureau of the Census, General Population Characteristics - Washington, 1980, Washington, D.C.

Table A.2.19. Population Size by Selected Age Categories: 1970 to 1983

Place and Age	YEAR 1970 Number	1970 Percent	YEAR 1980 Number	1980 Percent
State of Washington				
Total Population	3,409,109	100	4,132,156	100
Under 5	280,442	8	306,123	7
5 to 14	677,289	20	618,006	15
15 to 19	369,023	11	329,903	8
65 and over	322,061	9	431,562	10
Pierce County				
Total Population	411,027	100	485,643	100
Under 5	33,587	8	38,972	8
5 to 14	79,114	19	72,706	15
15 to 19	44,717	11	46,972	10
65 and over	33,909	8	45,530	9
Tacoma (city)				
Total Population	154,581	100	158,501	100
Under 5	12,879	8	12,152	8
5 to 14	29,412	19	22,351	14
15 to 19	14,113	9	13,857	9
65 and over	18,714	12	21,460	14

Sources: Washington data: U.S. Bureau of the Census, General Population Characteristics-Washington, 1980 Census of Population, Tables 25, 26, 33, 39

Table A.2.20. Population Size by Selected Age Categories: 1970 to 1983

Place and Age	YEAR 1970 Number	1970 Percent	YEAR 1980 Number	1980 Percent
State of Washington				
Total Population	3,409,109	100	4,132,156	100
Under 5	280,442	8	306,123	7
5 to 14	677,289	20	618,006	15
15 to 19	369,023	11	329,903	8
65 and over	322,061	9	431,562	10
Whatcom County				
Total Population	81,950	100	106,701	100
Under 5	6,403	8	7,751	7
5 to 14	14,795	18	15,430	14
15 to 19	9,140	11	10,019	9
65 and over	9,604	12	11,967	11
Bellingham (city)				
Total Population	39,375	100	45,794	100
Under 5	2,722	7	2,571	6
5 to 14	5,502	14	5,037	11
15 to 19	4,976	13	4,627	10
65 and over	5,343	14	6,122	13
Ferndale (city)				
Total Population	Not Available		3,855	100
Under 5			322	8
5 to 14			691	18
15 to 19			378	10
65 and over			390	10

Sources: Washington data: U.S. Bureau of the Census, General Population Characteristics-Washington, 1980 Census of Population, Tables 25, 26, 33, 39

Table A.2.21. Population Size by Race: 1970 to 1983

Place and Period	Population	White	Percent White	Black	Percent Black	American Indian	Percent Indian	Asian	Percent Asian	Spanish Origin
					RACE					
State of Washington										
1970										
1980	4,132,156	3,779,170	91.5	105,574	2.6	60,804	1.5	110,052	2.9	120,016
1983	4,285,100	3,883,824	90.6	117,916	2.8	65,109	1.5	136,399	3.2	127,094
Spokane County										
1970	287,487	280,174	97.5	2,989	1.0	1,988	.7	1,699	.6	2,894
1980	341,835	326,221	95.4	4,305	1.3	4,193	1.2	3,687	1.1	4,811
1983	348,000	330,863	95.1	4,800	1.4	4,174	1.2	5,660	1.6	4,803
Spokane (city)										
1970	170,516	165,339	97.0	2,161	1.3	1,419	.8	1,233	.7	1,824
1980	171,300	161,597	94.3	2,767	1.6	2,694	1.6	2,206	1.3	2,554

NOTES: American Indian includes Aleut and Eskimo in 1980.
Asian includes Japanese, Chinese, Filipino, Korean, Asian Indian, Vietnamese in 1980.
Spanish Origin includes all persons of Spanish/Hispanic origin. Persons of Spanish origin may be of any race. In 1970 identified as persons of Spanish language. In 1980 identified as Spanish Origin.

Sources: Washington State Office of Financial Management, 1984. 1984 Population Trends for Washington State. Olympia, Washington: Division of Policy Analysis and Forecasting. Table 7: 16. U.S. Bureau of the Census, General Population Characteristics - Washington, 1980, Washington, D.C.

Table A.2.22. Population Size by Selected Age Categories: 1970 to 1983

Place and Age	YEAR 1970 Number	1970 Percent	YEAR 1980 Number	1980 Percent
State of Washington				
Total Population	3,409,109	100	4,132,156	100
Under 5	280,442	8	306,123	7
5 to 14	677,289	20	618,006	15
15 to 19	369,023	11	329,903	8
65 and over	322,061	9	431,562	10
Spokane County				
Total Population	287,487	100	341,835	100
Under 5	22,860	8	26,032	8
5 to 14	56,259	19	52,094	15
15 to 19	28,879	10	31,195	9
65 and over	31,934	11	39,453	12
Spokane (city)				
Total Population	170,516	100	171,300	100
Under 5	13,005	8	12,373	7
5 to 14	30,337	18	21,999	13
15 to 19	16,547	10	14,159	8
65 and over	12,826	14	26,166	15

Sources: Washington data: U.S. Bureau of the Census, General Population Characteristics-Washington, 1980 Census of Population, Tables 25, 26, 33, 39

TABLE A.2.23. Western Montana Region: Population Size and Annual Rates of Change: 1960 to 1984.

PLACE and PERIOD	1960	1960-70	1970	1970-75	1975	1975-80	1980	1980-84	1984
State of Montana	674,767	0.3%	694,409	1.4%	746,244	1.1%	786,690	1.2%	824,000
Flathead County, MT	32,965	1.8%	39,460	2.5%	44,604	3.1%	51,966	0.9%	53,900
Kalispell (city)	10,151	0.4%	10,526	6.3%	14,457	-6.1%	10,648	0.1%	10,675
Columbia Falls (city)	2,132	2.2%	2,652	2.7%	3,034	0.5%	3,112	0.0%	3,112

Notes: The average annual rate of change (in percent) is computed as follows: Rate = 100 X (LN(P2)-LN(P1)) / Time in Years, Where P2 = Population at Time 2, P1 = Population at Time 1, and LN is the natural logarithm.

Population estimates for Kalispell and Columbia Falls were not available for 1984. Estimates for 1984 were derived from 1982 data, based on the ratio of city to county populations in 1982.

Sources: U.S. Bureau of the Census, 1980, Number of Inhabitants, Montana. U.S. Government Printing Office: Washington, D.C.

U.S. Bureau of the Census, 1970, Volume 1, Characteristics of the Population, Montana. U.S. Government Printing Office: Washington, D.C.

Personal communication with Paul Paulson, Bureau of Business Research, University of Montana, August 7, 1985.

Table A.2.24. Population Size by Race: 1970 to 1983

Place and Period	Population	White	Percent White	Black	Percent Black	American Indian	Percent Indian	Asian	Percent Asian	Spanish Origin
					RACE					
State of Montana										
1970	694,409	663,043	95	1,995	.29	27,130	3.91	1,099	.16	5,215
1980	786,690	740,148	94	1,786	.23	37,270	4.7	2,296	.29	9,974
Kalispell (city)										
1970	10,526	10,415	99	14	.13	68	.65	22	.21	400
1980	10,648	10,455	98	8	.08	103	.97	31	.29	77
Columbia Falls (city)										
1970	2,652	2,635	99	0	0	14	.53	0	0	400
1980	3,112	3,036	98	4	.13	59	1.90	8	.26	20
Flathead (city)										
1970	39,460	38,991	99	30	.08	327	.83	53	.13	416
1980	51,966	51,086	98	37	.07	552	1.06	129	.25	367

NOTES: American Indian includes Aleut and Eskimo in 1980.
Asian includes Japanese, Chinese, Filipino, Korean, Asian Indian, Vietnamese in 1980.
Spanish Origin includes all persons of Spanish/Hispanic origin. Persons of Spanish origin may be of any race. In 1970 identified as persons of Spanish language. In 1980 identified as Spanish Origin.

Sources: U.S. Bureau of the Census, General Population Characteristics - Montana, 1970
U.S. Bureau of the Census, General Social and Economic Characteristics - Montanta, 1970
U.S. Bureau of the Census, General Population Characteristics - Montana, 1980

Table A.2.25. Population Size by Selected Age Categories: 1970 to 1983

Place and Age	YEAR 1970 Number	Percent	YEAR 1980 Number	Percent
State of Montana				
Total Population	694,409		786,690	
Under 5	57,054	8	64,455	8
5 to 14	150,876	22	122,777	16
15 to 19	70,346	10	74,622	10
65 and over	65,520	9	84,559	11
Flathead County				
Total Population	39,460		51,966	
Under 5	3,324	8.4	4,285	8.2
5 to 14	8,982	22	8,451	16
15 to 19	3,923	9.9	4,592	8.8
65 and over	4,124	10.5	5,376	10
Kalispell (city)				
Total Population	10,526		10,648	
Under 5	748	7	762	7
5 to 14	2,032	19	1,471	14
15 to 19	1,025	9	872	8
65 and over	1,640	16	1,797	17
Columbia Falls				
Total Population	1,285		3,112	
Under 5	131	10	294	9.4
5 to 14	326	25	560	18
15 to 19	103	8	304	9.8
65 and over	78	6	256	8

Source: Montana data: U.S. Bureau of the Census, General Population Characteristics-Montana, 1970

Montana data: U.S. Bureau of the Census, General Population Characteristics-Montana, 1980

Table A.3.1
Housing Characteristics in Washington State and Cowlitz County

Housing Characteristics	Washington State 1970	Washington State 1980	Washington State 1984	Cowlitz County 1970	Cowlitz County 1980	Cowlitz County 1984
Total Units		1,689,450	1,813,321.		31,748.	32,742.
Percent Single Family			67.8			71.0
Percent Multiple Family			24.5			21.0
Percent Mobile Home			7.7			8.0
Year Round Units	1,204,902	1,650,411		23,352.	31,499.	
Percent Single Family	75.6	69.4		78.6	71.6	
Percent Multiple Family		24.6			21.4	
Percent Mobile Homes		6.0			7.0	
Total Occupied Units						
Percent Owner Occupied	66.8	65.6		68.7	66.5	
Percent pre-1940 Construction		21.3			21.8	
Median Value Single Family Units	$18,529.	$60,700.		$15,897.	$50,600.	
Median Monthly Gross Rental	115.	254.		105.	225.	
Vacancy Rate	8.1(b)	8.8(b)				
Owner Occupied		2.1			1.5	
Renter Occupied		7.3			10.1	
Persons Per Household	2.9(b)	2.6(b)	2.4		2.5	2.4

Sources: U.S. Bureau of the Census. County and City Data Book, 1977. Washington, D.C. (1970 Figures); U.S. Bureau of the Census. 1980 Census of Housing. Vol 1, Characteristics of Housing Units, Chapter A, General Housing Characteristics and Chapter B, Detailed Housing Characteristics, Parts 28 Montana, 39 Oregon, and 49 Washington. Washington, D.C. (1980 Figures); U.S. Bureau of the Census. County and City Data Book, 1983 . Washington, D.C. (1980 Figures); (b) Shapiro and Associates. 1984. Kiewit Marine Facility DEIS. Bellingham,Washington. Whatcom County Department of Public Works.

Table A.3.2
Housing Characteristics in Longview and Kelso, Cowlitz County Washington

Housing Characteristics	Longview 1970	Longview 1980	Longview 1984	Kelso 1980	Kelso 1984
Total Units		13,118	13,190	4,794	4,811
Percent Single Family			69.1		66.6
Percent Multiple Family			29.0		29.9
Percent Mobile Home			1.9		3.5
Year Round Units	9,956	13,103		4,783	
Percent Single Family	74.1	68.5		72.3	
Percent Multiple Family		28.7		23.3	
Percent Mobile Homes		2.9		4.4	
Total Occupied Units					
Percent Owner Occupied	64.2	58.7		55.9	
Percent pre-1940 Construction		20.5		31.7	
Median Value Single Family Units	$16,684.00	$51,600.00		$41,900.00	
Median Monthly Gross Rental	111.00	228.00		209.00	
Vacancy Rate					
Owner Occupied		1.6		1.7	
Renter Occupied		9.6		13.1	
Persons Per Household		2.4	2.3	2.3	2.2

Sources: U.S. Bureau of the Census. County and City Data Book, 1977. Washington, D.C. (1970 Figures); U.S. Bureau of the Census. 1980 Census of Housing. Vol 1, Characteristics of Housing Units, Chapter A, General Housing Characteristics and Chapter B, Detailed Housing Characteristics, Parts 28 Montana, 39 Oregon, and 49 Washington. Washington, D.C. (1980 Figures); U.S. Bureau of the Census. County and City Data Book, 1983 . Washington, D.C. (1980 Figures); (b) Shapiro and Associates. 1984. Kiewit Marine Facility DEIS. Bellingham,Washington. Whatcom County Department of Public Works.

Table A.3.3
Housing Characteristics in Washington State and Clark County

Housing Characteristics	Washington State 1970	Washington State 1980	Washington State 1984	Clark County 1970	Clark County 1980	Clark County 1984
Total Units		1,689,450	1,813,321		72,806.	78,494.
Percent Single Family			67.8			74.0
Percent Multiple Family			24.5			19.4
Percent Mobile Home			7.7			6.6
Year Round Units	1,204,902	1,650,411		42,816.	72,643.	
Percent Single Family	75.6	69.4		79.9	75.6	
Percent Multiple Family		24.6			20.2	
Percent Mobile Homes		6.0			5.5	
Total Occupied Units						
Percent Owner Occupied	66.8	65.6		69.7	67.4	
Percent pre-1940 Construction		21.3			12.5	
Median Value Single Family Units	$18,529.	$60,700.		$16,666.	$60,700.	
Median Monthly Gross Rental	115.	254.		115.	246.	
Vacancy Rate	8.1(b)	8.8(b)				
Owner Occupied		2.1			2.4	
Renter Occupied		7.3			6.9	
Persons Per Household	2.9(b)	2.6(b)			2.6	2.6

Sources: U.S. Bureau of the Census. County and City Data Book, 1977. Washington, D.C. (1970 Figures); U.S. Bureau of the Census. 1980 Census of Housing. Vol 1, Characteristics of Housing Units, Chapter A, General Housing Characteristics and Chapter B, Detailed Housing Characteristics, Parts 28 Montana, 39 Oregon, and 49 Washington. Washington, D.C. (1980 Figures); U.S. Bureau of the Census. County and City Data Book, 1983 . Washington, D.C. (1980 Figures); (b) Shapiro and Associates. 1984. Kiewit Marine Facility DEIS. Bellingham,Washington. Whatcom County Department of Public Works.

Table A.3.4
Housing Characteristics in Vancouver and Portland SMSA

Housing Characteristics	Vancouver 1970	Vancouver 1980	Vancouver 1984	Portland SMSA 1970	Portland SMSA 1980
Total Units		19,894	20,503		506,200
Percent Single Family			57.0		
Percent Multiple Family			41.8		
Percent Mobile Home			1.2		
Year Round Units	16,075	19,880		357,351	504,146
Percent Single Family	70.5	58.7		74.1	78.1
Percent Multiple Family		40.0			18.4
Percent Mobile Homes		1.3			3.5
Total Occupied Units					
Percent Owner Occupied	57.8	47.5		65.0	62.8
Percent pre-1940 Construction		17.4			
Median Value Single Family Units	$14,688.	$48,300.		$16,893	$62,300
Median Monthly Gross Rental	115.	226.		117	226
Vacancy Rate					
Owner Occupied		1.4		1.0	
Renter Occupied		6.3		7.4	
Persons Per Household		2.2	2.1		

Sources: U.S. Bureau of the Census. County and City Data Book, 1977. Washington, D.C. (1970 Figures); U.S. Bureau of the Census. 1980 Census of Housing. Vol 1, Characteristics of Housing Units, Chapter A, General Housing Characteristics and Chapter B, Detailed Housing Characteristics, Parts 28 Montana, 39 Oregon, and 49 Washington. Washington, D.C. (1980 Figures); U.S. Bureau of the Census. County and City Data Book, 1983 . Washington, D.C. (1980 Figures); (b) Shapiro and Associates. 1984. Kiewit Marine Facility DEIS. Bellingham,Washington. Whatcom County Department of Public Works.

Table A.3.5
Housing Characteristics in Oregon State and Multnomah County

Housing Characteristics	Oregon State 1970	Oregon State 1980	Multnomah County 1970	Multnomah County 1980	Troutdale 1980	Gresham 1980
Total Units		1,083,285		245,135	1,976	12,375
Percent Single Family						
Percent Multiple Family						
Percent Mobile Home						
Year Round Units	735,631	1,071,294	208,868	245,970	1,974	12,359
Percent Single Family	76.9	75.8	70.5	76.7	93.6	81.1
Percent Multiple Family		18.2		21.8	5.8	16.1
Percent Mobile Homes		6.0		1.5	0.6	2.8
Total Occupied Units						
Percent Owner Occupied	66.1	65.1	60.4	56.7	73.8	64.6
Percent pre-1940 Construction		20.6		34.9	6.3	4.9
Median Value Single Family Units	$15,563	$56,900	$15,270	$55,300	$68,200	$70,500
Median Monthly Gross Rental	109	212	112	214	300	268
Vacancy Rate						
Owner Occupied	1.1	2.0		1.9	7.1	3.9
Renter Occupied	7.3	7.4		5.6	11.1	6.3

Sources: U.S. Bureau of the Census. County and City Data Book, 1977. Washington, D.C. (1970 Figures); U.S. Bureau of the Census. 1980 Census of Housing. Vol 1, Characteristics of Housing Units, Chapter A, General Housing Characteristics and Chapter B, Detailed Housing Characteristics, Parts 28 Montana, 39 Oregon, and 49 Washington. Washington, D.C. (1980 Figures); U.S. Bureau of the Census. County and City Data Book, 1983 . Washington, D.C.

Table A.3.6
Housing Characteristics in Oregon State and Wasco County

Housing Characteristics	Oregon State 1970	Oregon State 1980	Wasco County 1970	Wasco County 1980
Total Units		1,083,285		9,889
Percent Single Family				
Percent Multiple Family				
Percent Mobile Home				
Year Round Units	735,631	1,071,294	7,127	8,925
Percent Single Family	76.9	75.8	77.3	70.3
Percent Multiple Family				15.0
Percent Mobile Homes		6.0		14.7
Total Occupied Units				
Percent Owner Occupied	66.1	65.1	67.3	68.4
Percent pre-1940 Construction		20.6		31.5
Median Value Single Family Units	$15,563	$56,900	$13,609	$47,100
Median Monthly Gross Rental	109	212	92	173
Vacancy Rate				
Owner Occupied	1.1	2.0		1.6
Renter Occupied	7.3	7.4		10.2

Sources: U.S. Bureau of the Census. County and City Data Book, 1977. Washington, D.C. (1970 Figures); U.S. Bureau of the Census. 1980 Census of Housing, Vol 1, Characteristics of Housing Units, Chapter A, General Housing Characteristics and Chapter B, Detailed Housing Characteristics, Parts 28 Montana, 39 Oregon, and 49 Washington. Washington, D.C. (1980 Figures); U.S. Bureau of the Census. County and City Data Book, 1983. Washington, D.C. (1980 Figures).

Table A.3.7
Housing Characteristics in Washington State and Klickitat County

Housing Characteristics	Washington State 1970	Washington State 1980	Washington State 1984	Klickitat County 1970	Klickitat County 1980	Klickitat County 1984
Total Units		1,689,450	1,813,321		6,498	7,172
Percent Single Family			67.8			66.3
Percent Multiple Family			24.5			13.4
Percent Mobile Home			7.7			20.3
Year Round Units	1,204,902	1,650,411		4,583.	6,364.	
Percent Single Family	75.6	69.4		86.2	70.0	
Percent Multiple Family		24.6			17.4	
Percent Mobile Homes		6.0			12.6	
Total Occupied Units						
Percent Owner Occupied	66.8	65.6		64.8	68.2	
Percent pre-1940 Construction		21.3			26.1	
Median Value Single Family Units	$18,529.	$60,700.		$11,659.	$39,500.	
Median Monthly Gross Rental	115.	254.		87.	192.	
Vacancy Rate	8.1(b)	8.8(b)				
Owner Occupied		2.1			1.1	
Renter Occupied		7.3			11.0	
Persons Per Household	2.9(b)	2.6(b)	2.4		2.4	2.3

Sources: U.S. Bureau of the Census. County and City Data Book, 1977. Washington, D.C. (1970 Figures); U.S. Bureau of the Census. 1980 Census of Housing. Vol 1, Characteristics of Housing Units, Chapter A, General Housing Characteristics and Chapter B, Detailed Housing Characteristics, Parts 28 Montana, 39 Oregon, and 49 Washington. Washington, D.C. (1980 Figures); U.S. Bureau of the Census. County and City Data Book, 1983. Washington, D.C. (1980 Figures); (b) Shapiro and Associates. 1984. Kiewit Marine Facility DEIS. Bellingham,Washington. Whatcom County Department of Public Works.

Table A.3.8
Housing Characteristics in Goldendale and The Dalles

Housing Characteristics	Goldendale 1970	Goldendale 1980	Goldendale 1984	The Dalles 1970	The Dalles 1980	The Dalles
Total Units		1,400	1,517	3,804	4,681	
Percent Single Family			69.2			
Percent Multiple Family			17.7			
Percent Mobile Home			13.1			
Year Round Units			1,399		3,787	4,634
Percent Single Family			71.6		74.3	75.0
Percent Multiple Family						20.3
Percent Mobile Homes						4.7
Total Occupied Units						
Percent Owner Occupied			64.8		64.4	64.6
Percent pre-1940 Construction			22.9			38.5
Median Value Single Family Units			$38,800.		$14,300	$49,600
Median Monthly Gross Rental			150.		77	177
Vacancy Rate						
Owner Occupied			1.1		1.8	2.0
Renter Occupied			10.2		11.3	10.1
Persons Per Household			2.6	2.4	--	--

Sources: U.S. Bureau of the Census. County and City Data Book, 1977. Washington, D.C. (1970 Figures); U.S. Bureau of the Census. 1980 Census of Housing, Vol 1, Characteristics of Housing Units, Chapter A, General Housing Characteristics and Chapter B, Detailed Housing Characteristics, Parts 28 Montana, 39 Oregon, and 49 Washington. Washington, D.C. (1980 Figures); U.S. Bureau of the Census. County and City Data Book, 1983. Washington, D.C. (1980 Figures); (b) Shapiro and Associates. 1984. Kiewit Marine Facility DEIS. Bellingham,Washington. Whatcom County Department of Public Works.

Table A.3.9
Housing Characteristics in Washington State and Chelan County

Housing Characteristics	Washington State 1970	Washington State 1980	Washington State 1984	Chelan County 1970	Chelan County 1980	Chelan County 1984
Total Units		1,689,450	1,813,321.		22,140.	23,636.
Percent Single Family			67.8			69.2
Percent Multiple Family			24.5			20.2
Percent Mobile Home			7.7			10.6
Year Round Units	1,204,902	1,650,411		16,737.	19514.	
Percent Single Family	75.6	69.4		80.8	73.4	
Percent Multiple Family		24.6			20.2	
Percent Mobile Homes		6.0			6.4	
Total Occupied Units						
Percent Owner Occupied	66.8	65.6		64.5	65.2	
Percent pre-1940 Construction		21.3			29.8	
Median Value Single Family Units	$18,529.	$60,700.		$15,774.	$48,500.	
Median Monthly Gross Rental	115.	254.		93.	212.	
Vacancy Rate	8.1(b)	8.8(b)				
Owner Occupied		2.1			1.7	
Renter Occupied		7.3			9.1	
Persons Per Household	2.9(b)	2.6(b)			2.0	2.0

Sources: U.S. Bureau of the Census. County and City Data Book, 1977. Washington, D.C. (1970 Figures); U.S. Bureau of the Census. 1980 Census of Housing, Vol 1, Characteristics of Housing Units, Chapter A, General Housing Characteristics and Chapter B, Detailed Housing Characteristics, Parts 28 Montana, 39 Oregon, and 49 Washington. Washington, D.C. (1980 Figures); U.S. Bureau of the Census. County and City Data Book, 1983. Washington, D.C. (1980 Figures); (b) Shapiro and Associates. 1984. Kiewit Marine Facility DEIS. Bellingham,Washington. Whatcom County Department of Public Works.

Table A.3.10
Housing Characteristics in Washington State and Pierce County

Housing Characteristics	Washington State 1970	Washington State 1980	Washington State 1984	Pierce County 1970	Pierce County 1980	Pierce County 1984
Total Units		1,689,450	1,813,321		187,432	200,413
Percent Single Family			67.8			68.3
Percent Multiple Family			24.5			25.3
Percent Mobile Home			7.7			6.5
Year Round Units	1,204,902	1,650,411		133,155	184,966	
Percent Single Family	75.6	69.4		75.5	68.8	
Percent Multiple Family		24.6			25.8	
Percent Mobile Homes		6.0			5.4	
Total Occupied Units						
Percent Owner Occupied	66.8	65.6		66.0	63.4	
Percent pre-1940 Construction		21.3			20.7	
Median Value Single Family Units	$18,529.	$60,700.		$17,518.	$55,200.	
Median Monthly Gross Rental	115.	254.		116.	239.	
Vacancy Rate	8.1(b)	8.8(b)				
Owner Occupied		2.1			2.0	
Renter Occupied		7.3			7.3	
Persons Per Household	2.9(b)	2.6(b)	2.4	3.0(c)	2.6	2.6

Sources: U.S. Bureau of the Census. County and City Data Book, 1977. Washington, D.C. (1970 Figures); U.S. Bureau of the Census. 1980 Census of Housing. Vol 1, Characteristics of Housing Units, Chapter A, General Housing Characteristics and Chapter B, Detailed Housing Characteristics, Parts 28 Montana, 39 Oregon, and 49 Washington. Washington, D.C. (1980 Figures); U.S. Bureau of the Census. County and City Data Book, 1983. Washington, D.C. (1980 Figures); (b) Shapiro and Associates. 1984. Kiewit Marine Facility DEIS. Bellingham,Washington. Whatcom County Department of Public Works; (c) Puget Sound Council of Governments. 1984. Population and Employment Forecasts. Seattle, Washington. (Tacoma Portion).

Table A.3.12
Housing Characteristics in Tacoma, Washington

Housing Characteristics	Tacoma 1970	Tacoma 1980	Tacoma 1984
Total Units		67,759	70,706.
Percent Single Family			68.2
Percent Multiple Family			31.8
Percent Mobile Home			0.0
Year Round Units	58,609	67,714.	
Percent Single Family	74.0	68.9	
Percent Multiple Family		30.9	
Percent Mobile Homes		0.2	
Total Occupied Units			
Percent Owner Occupied	65.0	58.7	
Percent pre-1940 Construction		36.2	
Median Value Single Family Units	$15,040.	$44,400.	
Median Monthly Gross Rental	101.	220.	
Vacancy Rate			
Owner Occupied		2.3	
Renter Occupied		7.6	
Persons Per Household	2.8	2.4	2.2

Sources: U.S. Bureau of the Census. County and City Data Book, 1977. Washington, D.C. (1970 Figures); U.S. Bureau of the Census. 1980 Census of Housing. Vol 1, Characteristics of Housing Units, Chapter A, General Housing Characteristics and Chapter B, Detailed Housing Characteristics, Parts 28 Montana, 39 Oregon, and 49 Washington. Washington, D.C. (1980 Figures); U.S. Bureau of the Census. County and City Data Book, 1983. Washington, D.C. (1980 Figures); (b) Shapiro and Associates. 1984. Kiewit Marine Facility DEIS. Bellingham,Washington. Whatcom County Department of Public Works.

Table A.3.13
Housing Characteristics in Washington State and Whatcom County

Housing Characteristics	Washington State 1970	Washington State 1980	Washington State 1984	Whatcom County 1970	Whatcom County 1980	Whatcom County 1984
Total Units		1,689,450	1,813,321	30,423	47,479	50,390
Percent Single Family			67.8			70.1
Percent Multiple Family			24.5			21.1
Percent Mobile Home			7.7			8.9
Year Round Units	1,204,902	1,650,411		29,867	43,668	
Percent Single Family	75.6	69.4		80.9	71.2	
Percent Multiple Family		24.6			22.1	
Percent Mobile Homes		6.0			6.7	
Total Occupied Units						
Percent Owner Occupied	66.8	65.6		69.2	65.2	
Percent pre-1940 Construction		21.3			27.4	
Median Value Single Family Units	18,529.0	60,700.0		17,287.0	58,100.0	
Median Monthly Gross Rental	115.0	254.0		112.0	246.0	
Vacancy Rate	8.1(b)	8.8(b)		10.5(b)	16.5(b)	
Owner Occupied					1.8	
Renter Occupied					7.7	
Persons Per Household	2.9(b)	2.6(b)	2.4	2.9(b)	2.6(b)	2.3

Sources: U.S. Bureau of the Census. County and City Data Book, 1977. Washington, D.C. (1970 Figures); U.S. Bureau of the Census. 1980 Census of Housing. Vol 1, Characteristics of Housing Units, Chapter A, General Housing Characteristics and Chapter B, Detailed Housing Characteristics, Parts 28 Montana, 39 Oregon, and 49 Washington. Washington, D.C. (1980 Figures); U.S. Bureau of the Census. County and City Data Book, 1983. Washington, D.C. (1980 Figures); (b) Shapiro and Associates. 1984. Kiewit Marine Facility DEIS. Bellingham,Washington. Whatcom County Department of Public Works.

Table A.3.14
Housing Characteristics in Bellingham and Ferndale, Whatcom County Washington

Housing Characteristics	Bellingham 1970	Bellingham 1980	Bellingham 1984	Ferndale 1970	Ferndale 1980	Ferndale 1984
Total Units		19,750	20,238		1,465	1,835.
Percent Single Family			62.3			66.0
Percent Multiple Family			35.2			28.0
Percent Mobile Home			2.4			6.0
Year Round Units	12,202	19,739			1,465	
Percent Single Family	62.6	63.0			73.9	
Percent Multiple Family		34.3				
Percent Mobile Homes		2.7				
Total Occupied Units						
Percent Owner Occupied	51.8	54.4			56.1	
Percent pre-1940 Construction		35.1			15.4	
Median Value Single Family Units	$16,346.	$55,100.			$41,900.	
Median Monthly Gross Rental	111.	245.			176.	
Vacancy Rate						
Owner Occupied		1.7			3.1	
Renter Occupied		7.7			8.1	
Persons Per Household		2.3	2.3		2.6	2.4

Sources: U.S. Bureau of the Census. County and City Data Book, 1977. Washington, D.C. (1970 Figures); U.S. Bureau of the Census. 1980 Census of Housing, Vol 1, Characteristics of Housing Units, Chapter A, General Housing Characteristics and Chapter B, Detailed Housing Characteristics, Parts 28 Montana, 39 Oregon, and 49 Washington. Washington, D.C. (1980 Figures); U.S. Bureau of the Census. County and City Data Book, 1983. Washington, D.C. (1980 Figures); (b) Shapiro and Associates. 1984. Kiewit Marine Facility DEIS. Bellingham,Washington. Whatcom County Department of Public Works.

Table A.3.15
Housing Characteristics in Washington State and Spokane County

Housing Characteristics	Washington State 1970	1980	1984	Spokane County 1970	1980	1984
Total Units		1,689,450	1,813,321.		137,673	143165.
Percent Single Family			67.8			70.2
Percent Multiple Family			24.5			23.6
Percent Mobile Home			7.7			6.2
Year Round Units	1,204,902	1,650,411		99,439	137,216.	
Percent Single Family	75.6	69.4		77.5	75.8	
Percent Multiple Family		24.6			19.1	
Percent Mobile Homes		6.0			5.1	
Total Occupied Units						
Percent Owner Occupied	66.8	65.6		69.2	67.0	
Percent pre-1940 Construction		21.3			26.5	
Median Value Single Family Units	$18,529.	$60,700.		$14,111.	$42,200.	
Median Monthly Gross Rental	115.	254.		92	186	
Vacancy Rate	8.1(b)	8.8(b)				
Owner Occupied		2.1			2.1	
Renter Occupied		7.3			8.3	
Persons Per Household	2.9(b)	2.6(b)	2.4		2.5	2.4

Sources: U.S. Bureau of the Census. County and City Data Book, 1977. Washington, D.C. (1970 Figures); U.S. Bureau of the Census. 1980 Census of Housing. Vol 1, Characteristics of Housing Units, Chapter A, General Housing Characteristics and Chapter B, Detailed Housing Characteristics, Parts 28 Montana, 39 Oregon, and 49 Washington. Washington, D.C. (1980 Figures); U.S. Bureau of the Census. County and City Data Book, 1983. Washington, D.C. (1980 Figures); (b) Shapiro and Associates. 1984. Kiewit Marine Facility DEIS. Bellingham,Washington. Whatcom County Department of Public Works.

Table A.3.16
Housing Characteristics in Spokane, Spokane Co. and Wenatchee, Chelan Co. Washington

Housing Characteristics	Spokane (city) 1970	1980	1984	Wenatchee 1970	1980	1984
Total Units		76,041	77,891		7,682	7,832.
Percent Single Family			68.6			65.6
Percent Multiple Family			29.9			30.9
Percent Mobile Home			1.5			3.5
Year Round Units	64,321	76,010.			7,677.	
Percent Single Family	75.6	69.2			73.2	
Percent Multiple Family		29.5			24.8	
Percent Mobile Homes		1.3			2.0	
Total Occupied Units						
Percent Owner Occupied	66.3	61.5			56.1	
Percent pre-1940 Construction		37.7			30.3	
Median Value Single Family Units	$12,809.	$41,300.			$45,100.	
Median Monthly Gross Rental	88.	216.			225.	
Vacancy Rate						
Owner Occupied		1.8			1.9	
Renter Occupied		8.4			10.6	
Persons Per Household		2.2	2.2		2.3	2.2

Sources: U.S. Bureau of the Census. County and City Data Book, 1977. Washington, D.C. (1970 Figures); U.S. Bureau of the Census. 1980 Census of Housing. Vol 1, Characteristics of Housing Units, Chapter A, General Housing Characteristics and Chapter B, Detailed Housing Characteristics, Parts 28 Montana, 39 Oregon, and 49 Washington. Washington, D.C. (1980 Figures); U.S. Bureau of the Census. County and City Data Book, 1983. Washington, D.C. (19830 Figures); (b) Shapiro and Associates. 1984. Kiewit Marine Facility DEIS. Bellingham,Washington. Whatcom County Department of Public Works.

Table A.3.17
Housing Characteristics in Montana and Flathead County

Housing Characteristics	Montana State 1980	Flathead County 1980	Columbia Falls 1980	Kalispell 1984
Total Units	328,465	22,485	1,171	4,772
Percent Single Family				
Percent Multiple Family				
Percent Mobile Home				
Year Round Units	315,015	20,707	1,170	4,762
Percent Single Family	70.4	70.1	72.4	73.0
Percent Multiple Family	17.8	13.7	23.1	24.9
Percent Mobile Homes	11.8	16.2	4.5	2.1
Total Occupied Units				
Percent Owner Occupied	68.6	74.0	67.4	62.8
Percent pre-1940 Construction	30.3	22.5	17.6	39.6
Median Value Single Family Units	$46,500	$48,000	$34,100.	$43,000.
Median Monthly Gross Rental	165	174	180	169
Vacancy Rate				
Owner Occupied	1.9	2.2	1.5	2.3
Renter Occupied	11.0	11.5	8.7	10.1
Persons Per Household				

Sources: U.S. Bureau of the Census. County and City Data Book, 1977. Washington, D.C. (1970 Figures); U.S. Bureau of the Census. 1980 Census of Housing. Vol 1, Characteristics of Housing Units, Chapter A, General Housing Characteristics and Chapter B, Detailed Housing Characteristics, Parts 28 Montana, 39 Oregon, and 49 Washington. Washington, D.C. (1980 Figures); U.S. Bureau of the Census. County and City Data Book, 1983. Washington, D.C. (1983 Figures); (b) Shapiro and Associates. 1984. Kiewit Marine Facility DEIS. Bellingham,Washington. Whatcom County Department of Public Works.

APPENDIX A-B

CALCULATION OF THE DIRECT PLUS INDIRECT EMPLOYMENT MULTIPLIER FOR THE STATE OF WASHINGTON

Appendix B

Calculation of the Direct plus Indirect Employment Multiplier for the State of Washington

Bourque and Conway (1976) provide a comprehensive table of Washington State inter-industry flows. As addenda, the table includes direct employment by industry and an employment multiplier. The direct employment estimate for industry can provide an estimate of the impact of an exogenous reduction in, for example, final demand for aluminum on employment in the aluminum industry. The employment multiplier concept included in the table includes this direct effect, the indirect effect based on reduced purchases by the aluminum industry, and the induced effect due to a reduction in income (personal consumption expenditures) in the state. For a variety of reasons the static nature of the input-output structure provides poor estimates of the induced employment effect. Thus, we employ the MASTER model to estimate the induced effects. A major advantage is that it provides information on the dynamics of adjustment.

However, as an input to MASTER, estimates of the direct plus indirect labor impacts are required. These are deducible from the gross flows matrix as follows:

Let n	=	number of industries (51 in the Washington State gross flows table)
Let Q(nxn)	=	matrix of gross inter-industry flows
K(nxn)	=	diagonal matrix of total gross output by industry; K(i,j) = output in industry i for i = j and 0 otherwise.

Define A(nxn) as the matrix of technical coefficients. A can be derived from Q and K as

$$A = Q \cdot K^{-1}$$

Let L(n) = vector of direct labor requirements per dollar of output by industry.

Define D(n) = vector of direct plus indirect labor requirements for a change in final demand in each industry. D is deducible from L and A as

$$D = L \cdot (I-A)^{-1}$$

where I is the identity matrix. (See, for example, Chiou-Shuang Yan, 1969, pp. 75-81).

The full D vector is given in Table B.1. For our purposes we require the employment multiplier for the aluminum industry (#32) disaggregated by its impact on each industry. Disaggregation by industry is obtained through element-by-element multiplication of the L vector and the column vector of $(I-A)^{-1}$ associated with the aluminum industry. This 51 element vector is given in Table B.2.

Table B.1. Direct plus Indirect Employment Multipliers for Washington State Wage and Salary Workers per Million (1972) dollar change in final demand.

Industry	Multiplier	Industry (cont)	Multiplier (cont
1	36.121	27	5.628
2	38.651	28	38.138
3	30.035	29	38.536
4	34.725	30	37.311
5	42.392	31	43.220
6	22.802	32	15.181
7	35.009	33	37.175
8	42.729	34	28.530
9	22.230	35	38.918
10	24.387	36	48.534
11	38.014	37	39.076
12	41.269	38	36.872
13	47.979	39	25.722
14	33.500	40	17.829
15	8.551	41	50.743
16	34.013	42	41.892
17	40.313	43	54.206
18	38.899	44	21.928
19	38.653	45	10.334
20	52.032	46	11.509
21	30.566	47	32.580
22	29.431	48	39.423
23	29.803	49	67.506
24	51.427	50	55.655
25	29.419	51	74.759
26	32.389		

Table B.2. Direct plus Indirect Employment Effects by Industry of a $1 Million Dollar (1972$) Change in Final Demand for Aluminum

Industry	Multiplier	Industry (cont)	Multiplier (cont)
1	.0106	27	.0009
2	.0024	28	.0014
3	.0021	29	.0021
4	.0015	30	.0041
5	.0045	31	1.0320
6	.0009	32	11.3150
7	.0019	33	1.3669
8	.0156	34	.4089
9	.0019	35	.01197
10	.0280	36	.0822
11	.0025	37	.4153
12	.0002	38	.2053
13	.0008	39	.0083
14	.0021	40	.0545
15	.0056	41	.0301
16	.0026	42	.0884
17	.0039	43	.0021
18	.0018	44	.0013
19	.0569	45	.0001
20	.0920	46	.0004
21	.0027	47	.0021
22	.0034	48	.1293
23	.0012	49	.0026
24	.0010	50	.0037
25	.0036	51	.0036
26	.0072		

The elements of the 51 element vector in Table B.2 are summed together as appropriate to create the 12 industrial sectors of the Master Model (Table B.3). For our purposes, we need to enter employment changes rather than dollar value of aluminum demand change. Thus, the multipliers in column 3 are divided by direct aluminum labor requirements per dollar of aluminum output. This produces a column of multipliers (column 4) which when multiplied by direct labor changes in the aluminum industry yield indirect employment effects by industry.

Table B.3. Direct plus Indirect Employment Multipliers by Industry, Summed to Conform to Master Categories

1	2	3	4
MASTER Industrial Category	Washington State I/O Categories	Multiplier 1[b] (Employment change per change in final demand for Aluminum)	Multiplier 2[c] (Employment change per direct employment Change in Aluminum Industry)
AGG	1-3	.0151	.00158
AFF	4,5,15	.0116	.00122
MINING	14	.0021	.00022
CONSTRUCTION	48	.1293	.01356
NONDURABLE MFG.	6-13,16-27	.2290	.02402
DURABLE MFG.	28-42	15.0264	1.57630
PUT & COM	43-47	.0060	.00063
WHOLESALE TRADE	49[a]	.00076	.00008
RETAIL TRADE	49[a]	.00184	.00019
FIRE	50	.0037	.00039
SERVICES	51	.0036	.00038

(a) The Washington State I/O Table combines retail and wholesale trade. The multipliers are assumed to be proportional to employment in wholesale and retail trade in the study regions for 1980. The total multiplier for trade is .0026. 1980 wholesale trade employment was 70745 and retail trade employment was 170,124.

(b) Equal to sum of multipliers from Table 2 for reported Washington State Industrial categories in Column 2.

(c) Equal to column 3 divided by the direct employment multiplier in the aluminum industry (8,200/860.2 = 9.5327)

APPENDIX A-C

ECONOMIC MODEL DOCUMENTATION AND MACROECONOMIC ASSUMPTIONS

APPENDIX C

ECONOMIC MODEL DOCUMENTATION AND MACROECONOMIC ASSUMPTIONS

C.1. METROPOLITAN AND STATE ECONOMIC REGIONS (MASTER) MODEL

The Metropolitan and State Economic Regions (MASTER) Model is a computer code designed for (1) forecasting economic activity in substate geographic areas, and (2) planning and policymaking in energy-related fields. MASTER forecasts economic activity in all 268 metropolitan statistical areas (MSAs) recognized by the Bureau of Census, plus 48 rest-of-state areas (ROSAs) that make up the remainder of the 48 contiguous states and the District of Columbia. It can also forecast activity at the county level. MASTER Version 1.0 (Adams, Moe and Scott, 1983) was used in the BPA/DSI study. Version 1.0 consists of four submodels, one for each U.S. Census Region (Northeast, North Central, West, South). Each submodel can be used to forecast annual economic activity in any MSA, ROSA, or county in the corresponding census region. Each submodel contains 53 stochastic equations linked together by more than 100 definitional or accounting identity equations. MASTER is an econometric model; the stochastic equations were estimated statistically using time-series/ cross-section, economic and demographic data for the years 1967-1976 for each MSA/ROSA in the corresponding census region. The endogenous or dependent variables forecasted by MASTER for any MSA/ROSA/County are shown in Table C.1.

The functional forms and variables used in the MASTER model equations were selected primarily according to their consistency with economic theory and how well the resulting equations could be applied to a wide range of local conditions. For example, the dependent variable in each employment equation is the annual percentage change in employment because this functional form could be readily adapted to both large and small regions. When a forecast is prepared, the starting value for each dependent variable is adjusted automatically in two rounds to incorporate area-specific differences between the behavior of the dependent

variable in an "average" MSA/ROSA/County in the census region and the actual benchmark value in the area for which the forecast is prepared.

The MASTER model can forecast for any county or aggregation of counties in the United States. This is accomplished by selecting appropriate start-up values for the model's dependent variables for the group of counties and calling the model. The model then treats the aggregation of counties as it would any MSA/ROSA and produces a forecast. This was done for this report.

A simple schematic diagram of MASTER is shown in Figure C.1. The MASTER forecast begins with exogenous (outside the model) forecasts of sector real (adjusted for inflation) wage rates, consumer price index, national unemployment rate, and the historical ratio of local to national wage rates. Local wage rates are calculated and fed to the employment equations, along with estimates of local real personal income, national real output by sector, and cost variables such as energy prices and interest rats. Local employment is thus determined by a mix of local and national conditions. Employment is, in turn, a key input into the model's estimate of real income (which includes wage and nonwage income by component) and population. Construction is determined by interest rates, local construction prices per square foot, and the level of employment by sector or population, as appropriate. Employment, income, construction, and population are all solved for simultaneously in each forecast year to ensure internal forecast consistency. The model is fully described in Adams, Moe and Scott, "The Metropolitan and State Economic Regions (MASTER) Model - Overview, May 1983. Pacific Northwest Laboratory.

C.1.1 Fiscal Impact Model

The Fiscal Impact Model (FIM) is a computer code that estimates per capita revenues, expenditures, and other fiscal items such as the amount of bonded debt for state and local government entities in any geographic region for which the MASTER

model provide population forecasts. Four levels of government are currently recognized: state, county, city, and independent school districts. FIM can be used to forecast each local jurisdiction separately, or consolidated fiscal estimates for all cities, county governments, or school districts may be provided. FIM forecasts 181 fiscal line items, corresponding to groups or categories of revenues (by source), expenditures (by function and type of expenditure), and balance sheet items recorded in the Census of Governments. For this study, only total expenditures and revenues were reported. Table C.2 lists the normal FIM outputs.

Figure C.2 shows a simple schematic diagram of FIM. Any forecast begins with a selection of the jurisdiction(s) that are to be reported in the forecast. MASTER model population forecasts must be available for the service area(s) represented by each local jurisdiction. For each jurisdiction, the model accesses the data base containing historical total dollar amounts for the fiscal items reported by the FIM model. These jurisdictions are aggregated as appropriate for the forecast (e.g., all cities within a given county might be combined), and divided by the appropriate historical population measure to obtain per capita values for the various fiscal items. For most items, this is total resident population; however, for a limited number of programs a definite age cohort user group may be identified, as in the case of primary and secondary education. In that case the user group is population aged 5-17 years. If the users have better information, they may override the default per capita values computed by FIM.

FIM next links the appropriate forecasted population totals to the per capita fiscal item totals. The model then calculates each fiscal item for each forecast year for each population forecast. The individual fiscal items are then aggregated as appropriate, the forecasts are compared to determine impacts.

C.1.2 Macroeconomic Assumptions for the Master Model

The MASTER model requires several macroeconomic assumptions as exogenous input to produce a scenario. Within the model, local economic activity is derived from these macroeconomic variables. The variables include 8 categories of industrial output, 3 interest rate measures, the national unemployment rate, national population, and the national consumer price index. The values assumed for these variables are given in Table C.3. As indicated in the text, the macroeconomic assumptions were assumed to be those used in the BPA's DSI OPTIONS STUDY (1985).

TABLE C.1. Outputs of the Fiscal Impact Model[a]

Revenue by Source:

- Property Tax
- Sales Taxes
- Miscellaneous Taxes
- Transfer Payments (Federal)
- Transfer Payments (State)
- Transfer Payments (Local)

Expenditures by Function:[b]

- Education
- Public Safety
- Public Assistance
- Parks and Recreation
- Administration
- Health
- Sanitation
- Utilities
- Transportation
- Libraries
- Natural Resources
- Miscellaneous

Debt:

- Issued
- Retired
- Full Faith and Credit
- Non-Guaranteed
- Short Term, Beginning of Year
- Short Term, End of Year
- Total Debt

(a) All results are reported in 1985 constant dollars. A discounted flow value is reported for each item for the period 1985-2030.

(b) All categories are reported by capital and non-capital.

TABLE C.2. MASTER Forecast Variables

Employment and Wage Rates (1972 dollars/year)

- Agricultural Production
- Agricultural Services, Forestry, Fisheries, etc.
- Mining
- Construction
- Durable Manufacturing
- Transportation, Communication, Public Utilities
- Retail Trade
- Wholesale Trade
- Finance, Insurance, Real Estate
- Services
- Government

Changes in Commercial Floorspace (square feet)

- Retail and Wholesale Trade
- Office
- Auto Repair and Garage
- Warehouse
- Education
- Health
- Religious
- Public
- Hotel/Motel
- Miscellaneous Commercial

Changes in Residential Units (square feet)

- Single Family Detached
- Single Family Detached
- Three-Four Units
- Five or More Units, Three or Less Floors
- Five or More Units, More than Three Floors

Demographics

- Births
- Deaths
- Net Migration
- Population

Income (1972 dollars)

- Labor and Proprietor Income
- Transfer Payments
- Dividend, Interest, Rent
- Social Insurance and Residence Adjustments
- Personal Income

MACROECONOMIC ASSUMPTIONS

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
	XGGAG	XGGMG	XGGMFD	XGGMFN	XGGWR	XGGFI	XGGSV	XGGCC	FRMCSAAA	FRMTB3MY	FRMCP3M	NRUT	NPT	CPI
1980	100.89	28.092	492.82	410.67	336.92	339.24	309.57	119.56	11.9380	11.4340	12.6570	7.1000	227.74	246.8
1981	114.54	28.513	506.82	413.51	346.24	350.76	323.24	115.07	14.1710	14.0250	15.3250	7.6000	230.47	272.4
1982	111.51	27.007	459.99	402.88	342.95	357.24	327.06	112.51	13.7870	10.6140	11.8920	9.7000	233.18	289.1
1983	98.87	26.440	492.01	418.52	399.17	384.52	355.03	134.74	12.0420	8.6108	8.8783	9.6000	235.42	298.4
1984	108.81	28.380	564.93	443.66	399.17	384.52	355.03	134.74	12.7130	9.5489	10.1420	7.5529	238.21	310.9
1985	110.10	28.328	590.45	450.52	414.19	397.55	369.12	143.11	11.8030	8.8752	9.0629	7.0374	240.72	321.7
1986	112.96	28.437	616.25	462.04	426.76	408.32	381.69	148.72	12.1530	9.9639	9.9603	7.0025	243.18	335.0
1987	114.51	28.430	633.06	471.24	435.01	418.82	392.76	147.52	12.1270	10.6290	9.7519	7.4277	245.52	354.7
1988	121.45	29.149	687.03	494.73	450.53	434.73	406.80	158.14	10.7590	8.0910	9.1088	6.7839	247.76	373.5
1989	123.74	29.047	705.14	504.00	459.62	446.51	417.04	157.24	11.0220	8.3369	9.3815	6.4222	249.92	393.8
1990	127.01	29.329	721.70	516.04	467.70	459.17	426.93	154.39	11.4260	9.2306	10.3730	6.3379	252.02	416.3
1991	123.94	28.293	701.13	510.98	467.74	467.69	433.67	148.04	11.5770	10.6980	11.9990	7.6041	254.06	438.2
1992	133.01	29.797	765.49	540.39	485.88	485.44	448.74	161.62	10.4300	7.4463	8.3940	6.7448	256.06	459.5
1993	135.88	30.131	793.73	553.04	496.46	500.21	460.64	164.81	10.6420	7.9523	8.9551	6.2833	258.07	483.3
1994	139.43	30.510	818.01	566.14	505.98	514.34	472.57	164.65	11.0320	8.9503	10.0620	6.0810	260.07	509.7
1995	144.37	31.295	850.68	580.09	516.32	528.37	484.17	167.23	10.8290	9.1114	10.2400	6.0091	262.02	537.9
1996	142.34	30.503	836.90	573.74	515.03	536.58	490.25	161.13	11.3590	9.4673	10.6350	6.7246	263.94	565.0
1997	149.67	32.030	902.66	596.34	534.72	555.06	506.30	177.03	10.9720	6.9627	1.8577	6.1801	265.82	589.9
1998	154.17	32.886	935.68	613.23	549.74	571.23	521.70	177.39	10.2390	7.1098	8.0208	6.0051	267.68	616.6
1999	158.44	33.585	962.02	627.70	563.94	587.52	538.04	176.81	9.6438	7.2302	8.1544	5.9293	269.52	643.7
2000	162.03	33.859	985.59	640.25	577.66	603.72	552.93	180.51	9.4174	7.4645	8.4141	5.8481	271.34	673.0
2001	160.66	33.437	972.25	634.64	575.75	613.82	560.27	178.46	9.6758	7.8718	8.8658	6.5436	273.14	701.7
2002	169.21	35.573	1047.00	662.68	599.06	635.73	579.69	196.58	9.4015	6.0880	6.8877	6.1749	274.92	732.3
2003	174.07	36.556	1079.20	678.73	613.83	652.53	595.51	192.71	9.0529	6.5789	7.4320	6.0794	276.68	764.6
2004	178.66	37.467	1110.40	694.44	629.45	670.12	612.33	193.74	8.8110	6.7330	7.6030	5.9039	278.43	801.2
2005	182.44	38.318	1142.30	707.67	643.01	687.62	627.37	199.30	8.7590	6.7981	7.6752	5.7787	280.15	840.9

COLUMNS 1-8: REAL GROSS OUTPUT (1972 $)
XGGAG: Agriculture, Forestry, Fisheries
XGGMG: Mining
XGGMFD: Durable Manufacturing
XGGMFN: Non-durable Manufacturing
XGGWR: Wholesale & Retail Trade
XGGFI: Finance, Insurance, Real Estate
XGGSV: Services
XGGCC: Contract Construction

FRMCSAAA: Moody's Corp. Bond Rate, AAA Rated
FRMTB3MY: Market Yield, 3 mo. Treasury Bills
FRMCP3M: Prime Commercial Paper Rate, 3 mo.
NRUT: National Unemployment Rate
NPT: National Population
CPI: Consumer Price Index (1967=100)

FIGURE C-1. Master Model: Simple Model Schematic

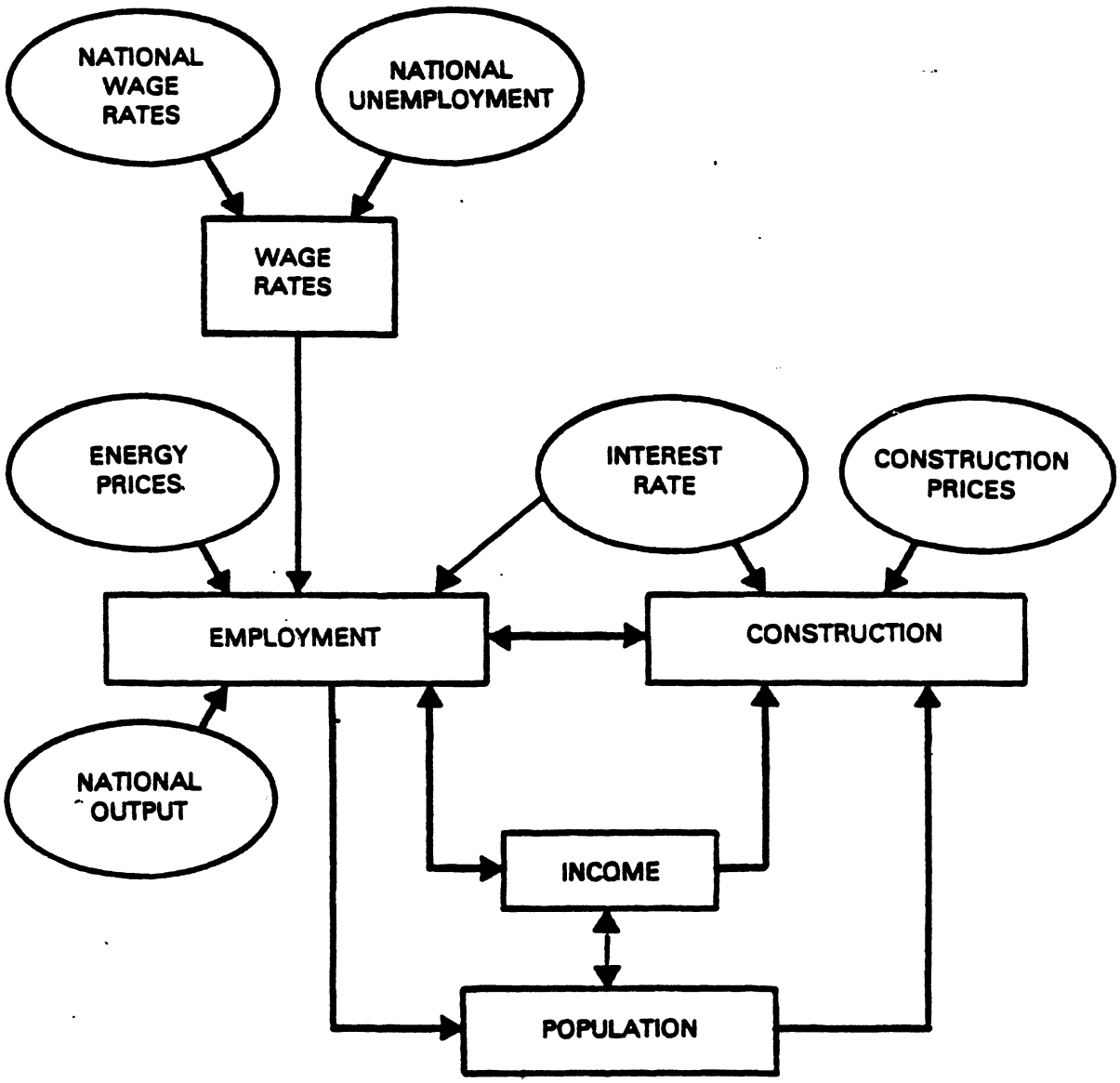
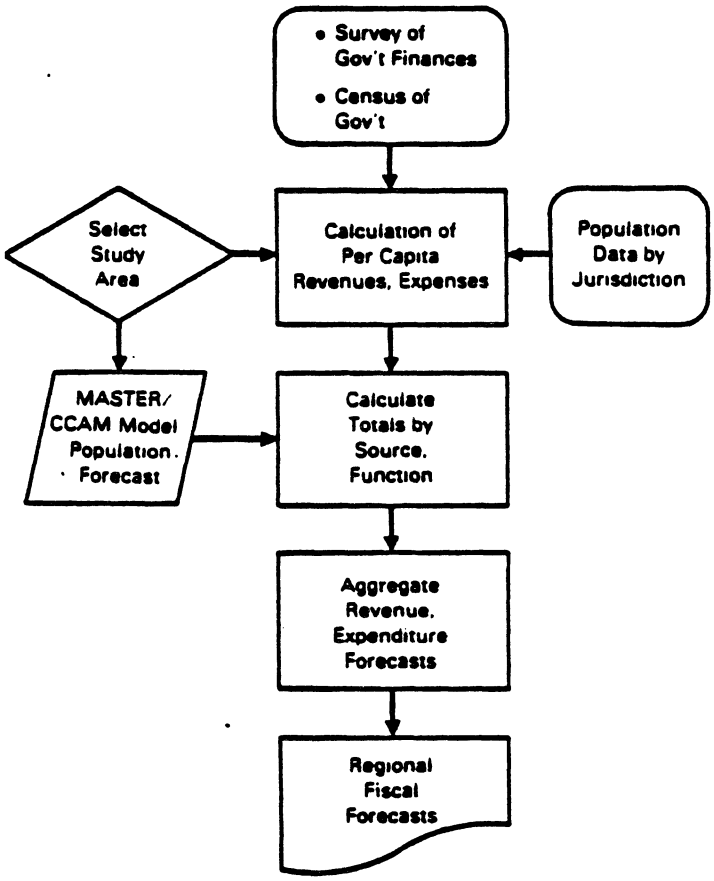


FIGURE C-2. Simple Schematic of FIM



APPENDIX A-D

DETAILED RESULTS OF MASTER MODEL RUNS

PORTLAND MSA:

CLACKAMAS, MULTNOMAH AND WASHINGTON COUNTIES, OREGON

AND

CLARK AND COWLITZ COUNTIES, WASHINGTON

(Renolds Plant Site, Troutdale; Alcoa Plant Site, Vancouver; and Reynolds Plant Site, Longview)

MASTER HIGH FORECAST FOR BPADSI REGION 1

	1980	1981	1982	1983	1984	1985	1986	1987
EMPLOYMENT:PERSONS								
AGRICULTURAL	4801	4788	4774	4764	4753	4747	4738	4731
AGRICULTURAL SERVICES	2337	2385	2475	2550	2592	2664	2733	2798
MINING	382	393	408	407	397	410	409	407
CONSTRUCTION	24688	24023	23491	23336	23142	22951	22723	22497
NONDURABLE MANUFACTURING	35151	34955	34640	34352	34207	34067	33867	33667
DURABLE MANUFACTURING	78596	78738	78649	77922	77389	78303	78105	78049
PUBLIC UTILITIES	32429	32524	32619	32715	32810	32907	33003	33099
WHOLESALE TRADE	43217	43342	43753	43979	44334	44969	45337	45456
RETAIL TRADE	99998	102831	105208	107594	110098	112521	115102	118098
FINANCE-INSURANCE-REAL ESTATE	37320	36818	36500	36588	36500	36261	36061	35854
SERVICES	113557	110103	109919	111248	111773	113109	113515	113121
GOVERNMENT	106433	109686	113037	116452	120052	123721	127501	131398
TOTAL	578910	580586	585475	591947	598051	606631	613094	619175
NEW COMMERCIAL CONSTRUCTION SQ.FT								
RETAIL-WHOLESALE	2087862	941566	306137	1347642	2806401	2266191	2931679	2560205
OFFICE BUILDINGS	1334339	221683	202652	1374731	2129418	928740	1686120	1068201
AUTO REPAIR	374491	1101546	1213918	79759	22547	59057	22547	22547
WAREHOUSES	1850421	1232674	822917	1202367	1857843	1712491	2083119	2010870
EDUCATION	658156	647948	586769	500601	461922	483946	485199	512003
HEALTH	177478	140076	57637	57637	57637	57637	57637	57637
PUBLIC	204401	48410	48410	235421	557094	289576	475792	328693
RELIGIOUS	177185	199043	213498	195310	167113	174148	162180	168122
HOTEL-MOTEL	82088	25910	25910	25910	25910	25910	25910	25910
MISCELLANEOUS	974574	893216	851413	892080	951731	932762	973344	968673
TOTAL	7920914	5452073	4329262	5911457	9037617	6930458	8903449	7722862
COMMERCIAL CONSTRUCTION SQ.FT ADDITIONS AND ALTERATIONS								
RETAIL-WHOLESALE	87612	143996	146604	69278	26722	105536	54983	99144
OFFICE BUILDINGS	86310	14097	14097	65781	122646	41365	92768	51705
AUTO REPAIR	8495	2483	0	0	0	0	0	0
WAREHOUSES	208119	200299	197141	207087	218521	214656	223079	222571
EDUCATION	57593	59272	59272	61002	62166	63573	64906	66391
HEALTH	132978	124877	121921	135109	149410	143121	148691	144474
PUBLIC	17287	10953	10010	18331	24407	17667	23702	20596
RELIGIOUS	72695	72190	71499	70546	70280	70052	70331	70681
HOTEL-MOTEL	15697	2202	2202	2202	11474	2202	9071	2202
MISCELLANEOUS	91528	86882	72406	58156	59287	70358	70560	76761
TOTAL	778314	717253	695153	687492	744912	728531	758092	754525
RESIDENTIAL CONSTRUCTION SQ.FT:								
APARTMENTS								
FIVE OR MORE UNITS								
1-3 STORIES	1644294	1118497	881263	1349954	1803991	2048506	2228122	2223268
4 OR MORE STORIES	363619	391370	449186	522387	580196	611480	623083	631885
THREE TO FOUR UNITS	793185	672496	620960	762417	894524	956778	998900	988479
SINGLE FAMILY DETACHED	14023765	13038911	13398436	14750141	15704486	16461322	16907022	17257733
DUPLEXES	521068	433301	383562	451193	513115	542641	564796	557654
TOTAL	17345931	15654574	15733407	17836091	19496313	20620727	21321924	21659020
WAGES: ANNUAL 000 1984 $								
AGRICULTURAL	27.087	27.210	27.571	27.808	27.772	27.886	28.029	28.186
AGRICULTURAL SERVICES	20.640	20.734	20.348	20.187	20.415	20.371	20.342	20.406
MINING	36.090	38.551	39.520	39.346	39.433	39.396	39.695	40.723
CONSTRUCTION	38.026	37.916	37.887	38.204	38.555	38.799	38.955	38.975
NONDURABLE MANUFACTURING	27.180	27.332	27.629	27.907	27.979	28.125	28.293	28.488
DURABLE MANUFACTURING	28.186	28.205	28.509	28.717	28.644	28.729	28.838	28.951
PUBLIC UTILITIES	33.480	33.795	34.148	34.362	34.355	34.431	34.585	34.876
WHOLESALE TRADE	30.889	31.346	31.630	31.971	32.271	32.492	32.741	33.090
RETAIL TRADE	14.690	14.300	14.175	14.199	14.132	14.111	14.058	13.923
FINANCE-INSURANCE-REAL ESTATE	28.247	29.938	30.500	30.703	31.046	31.134	31.468	32.398
SERVICES	20.774	21.129	21.250	21.346	21.483	21.543	21.646	21.869
GOVERNMENT	20.433	20.657	20.884	21.114	21.346	21.580	21.817	22.056
PERSONAL INCOME 000 1984 $								
WAGE BILL	13779231	13904675	14086225	14303442	14477536	14718531	14917941	15138975
PROPERTY INCOME	2625097	2779609	2925390	3064375	3218715	3381903	3557667	3760089
TRANSFER PAYMENTS	2359876	2398391	2441200	2491356	2545726	2600347	2661245	2718789
RESIDENCE ADJUSTMENT	-9076	-4117	-7184	-10791	-12275	-14342	-14308	-13195
SOCIAL INSURANCE ADJUSTMENT	816709	837133	852075	869581	888558	907623	928879	948964
PER CAPITA INCOME	13.494	13.536	13.692	13.832	13.934	14.090	14.197	14.358
TOTAL PERSONAL INCOME	17918418	18241425	18593555	18978800	19341143	19778817	20193665	20635693
DEMOGRAPHICS								
POPULATION	1327920	1347585	1357990	1372100	1388094	1403769	1422349	1438646
BIRTHS	20016	20314	20473	20696	20947	21189	21480	21733
DEATHS	12251	12435	12532	12664	12813	12960	13133	13286
MIGRATION	14371	11786	2464	6079	7860	7445	10233	7850

MASTER HIGH FORECAST FOR BPADSI REGION 1

	1988	1989	1990	1991	1992	1993	1994	1995
EMPLOYMENT:PERSONS								
AGRICULTURAL	4729	4728	4727	4721	4723	4727	4729	4732
AGRICULTURAL SERVICES	2858	2924	2990	3069	3137	3209	3282	3358
MINING	406	404	403	403	404	405	406	406
CONSTRUCTION	22383	22338	22229	21965	21936	22105	22153	22154
NONDURABLE MANUFACTURING	33530	33401	33271	33097	33006	32926	32841	32765
DURABLE MANUFACTURING	78297	78585	78760	78760	79186	79663	80012	80326
PUBLIC UTILITIES	33196	33293	33391	33488	33586	33685	33783	33882
WHOLESALE TRADE	45634	45765	45819	45879	45912	45846	45642	45369
RETAIL TRADE	121278	124617	128070	131375	134996	138839	142806	146926
FINANCE-INSURANCE-REAL ESTATE	35694	35538	35362	35105	34902	34701	34475	34242
SERVICES	114585	115921	116626	116449	118590	120410	121488	122493
GOVERNMENT	135413	139551	143816	148211	152740	157408	162218	167176
TOTAL	628005	637067	645464	652523	663119	673925	683837	693830
NEW COMMERCIAL CONSTRUCTION SQ.FT								
RETAIL-WHOLESALE	2598893	3521615	3037168	2656240	2680454	3520772	3135464	2778161
OFFICE BUILDINGS	1233151	1901691	1129808	1037412	1123131	1742626	1114965	1006645
AUTO REPAIR	22547	22547	22547	22547	22547	22547	22547	33279
WAREHOUSES	2104080	2625301	2573437	2502696	2512005	3037595	3034973	2988110
EDUCATION	524339	537653	583687	610951	623807	634343	674845	701734
HEALTH	57637	57637	57637	57637	57637	57637	60044	57637
PUBLIC	350680	651792	454888	348445	365795	698702	521701	410650
RELIGIOUS	169060	155399	164570	173883	178889	168924	177974	187891
HOTEL-MOTEL	25910	91810	52997	25910	25910	126348	120971	100694
MISCELLANEOUS	986993	1045292	1053992	1061141	1068537	1129115	1148332	1162433
TOTAL	8065131	10610738	9129934	8496864	8578713	11138610	10011816	9427234
COMMERCIAL CONSTRUCTION SQ.FT ADDITIONS AND ALTERATIONS								
RETAIL-WHOLESALE	88256	41537	101756	109835	103100	53687	109234	119576
OFFICE BUILDINGS	62627	110942	59526	52269	57125	101894	59865	51494
AUTO REPAIR	0	1961	3819	3669	3205	6699	8537	8339
WAREHOUSES	226699	237763	238740	240818	243837	255600	258560	261823
EDUCATION	68149	70012	71872	73611	75761	78058	80365	82759
HEALTH	144443	151924	146595	143112	142768	149870	145843	142813
PUBLIC	22483	28384	24427	26559	26077	31808	28830	29063
RELIGIOUS	71120	72030	73257	74379	75122	76485	78318	80800
HOTEL-MOTEL	3355	22837	21479	19140	17017	37425	39818	39384
MISCELLANEOUS	77684	80527	90975	92922	91979	94389	103910	106438
TOTAL	764817	817917	832445	834312	835992	885836	913280	921690
RESIDENTIAL CONSTRUCTION SQ.FT:								
APARTMENTS								
FIVE OR MORE UNITS								
1-3 STORIES	2126564	2039078	1899769	1534603	1345337	1539038	1537494	1371019
4 OR MORE STORIES	639501	624258	612895	596794	579528	588975	588478	581892
THREE TO FOUR UNITS	961575	931258	892575	801075	737655	793541	794388	749239
SINGLE FAMILY DETACHED	17235870	17248800	17021949	16065523	16342765	16870589	16937071	16724601
DUPLEXES	538333	526383	505842	447290	420337	459305	463585	438757
TOTAL	21501843	21369777	20933030	19445285	19425622	20251448	20321008	19865507
WAGES: ANNUAL 000 1984 $								
AGRICULTURAL	28.284	28.392	28.495	28.657	28.728	28.812	28.895	28.972
AGRICULTURAL SERVICES	20.568	20.711	20.851	20.846	21.034	21.207	21.378	21.546
MINING	41.520	42.402	43.399	44.292	45.002	45.846	46.791	47.758
CONSTRUCTION	39.094	39.168	39.183	39.121	39.214	39.252	39.247	39.220
NONDURABLE MANUFACTURING	28.670	28.852	29.016	29.183	29.341	29.502	29.654	29.796
DURABLE MANUFACTURING	29.010	29.081	29.146	29.276	29.318	29.373	29.427	29.476
PUBLIC UTILITIES	35.132	35.408	35.683	35.951	36.195	36.466	36.745	37.018
WHOLESALE TRADE	33.479	33.857	34.204	34.447	34.803	35.151	35.485	35.801
RETAIL TRADE	13.817	13.706	13.580	13.477	13.392	13.295	13.187	13.078
FINANCE-INSURANCE-REAL ESTATE	33.321	34.268	35.223	35.897	36.756	37.682	38.648	39.602
SERVICES	22.112	22.357	22.598	22.762	22.996	23.238	23.482	23.721
GOVERNMENT	22.299	22.544	22.791	23.041	23.294	23.550	23.809	24.070
PERSONAL INCOME 000 1984 $								
WAGE BILL	15429473	15727597	16003176	16228612	16559353	16900212	17215289	17527265
PROPERTY INCOME	3978306	4215206	4472405	4742803	5037774	5360393	5710817	6091680
TRANSFER PAYMENTS	2776597	2841500	2908183	2974689	3039473	3113535	3189552	3265009
RESIDENCE ADJUSTMENT	-12572	-10525	-8019	-6092	-4880	-2145	905	3740
SOCIAL INSURANCE ADJUSTMENT	969142	991795	1015070	1038283	1060896	1086746	1113279	1139616
PER CAPITA INCOME	14.576	14.779	14.973	15.143	15.407	15.652	15.889	16.145
TOTAL PERSONAL INCOME	21202664	21781982	22360675	22901729	23570825	24285248	25003284	25748078
DEMOGRAPHICS								
POPULATION	1454616	1473805	1493383	1512336	1529896	1551581	1573647	1594848
BIRTHS	21985	22291	22601	22901	23178	23526	23877	24216
DEATHS	13435	13614	13798	13975	14139	14342	14548	14747
MIGRATION	7420	10513	10775	10026	8521	12501	12737	11731

MASTER HIGH FORECAST FOR BPADSI REGION 1

	1996	1997	1998	1999	2000	2001
EMPLOYMENT:PERSONS						
AGRICULTURAL	4734	4741	4750	4760	4771	4782
AGRICULTURAL SERVICES	3444	3529	3621	3716	3815	3923
MINING	410	414	418	422	426	430
CONSTRUCTION	22152	22371	22694	22959	23217	23474
NONDURABLE MANUFACTURING	32691	32686	32710	32751	32816	32894
DURABLE MANUFACTURING	80218	80479	80866	81306	81836	82453
PUBLIC UTILITIES	33981	34080	34180	34280	34380	34481
WHOLESALE TRADE	45048	44878	44738	44616	44483	44405
RETAIL TRADE	151241	155851	160732	165808	171157	176625
FINANCE-INSURANCE-REAL ESTATE	34148	34115	34103	34106	34123	34117
SERVICES	123421	126422	129453	132531	135506	138349
GOVERNMENT	172285	177549	182975	188567	194329	200268
TOTAL	703774	717117	731241	745823	760861	776201
NEW COMMERCIAL CONSTRUCTION SQ.FT						
RETAIL-WHOLESALE	3022117	2628025	3139870	3777131	4104811	4045388
OFFICE BUILDINGS	1259452	934622	1350146	1530443	1497795	1352583
AUTO REPAIR	22547	114234	22547	22547	22547	22547
WAREHOUSES	3194070	3103361	3482782	3974526	4353521	4558034
EDUCATION	716651	738482	747581	772270	815721	867774
HEALTH	57637	57637	57637	57637	67488	90904
PUBLIC	531955	387391	598588	809299	888181	833474
RELIGIOUS	189807	200785	199917	196937	198032	204851
HOTEL-MOTEL	131059	100518	164148	250924	321138	363597
MISCELLANEOUS	1194265	1204409	1259733	1317398	1363769	1402298
TOTAL	10319560	9469466	11022950	12709113	13633004	13741450
COMMERCIAL CONSTRUCTION SQ.FT ADDITIONS AND ALTERATIONS						
RETAIL-WHOLESALE	97373	131487	93723	79495	87101	106503
OFFICE BUILDINGS	68980	46579	75779	90069	89673	80689
AUTO REPAIR	9331	9862	12348	15874	19241	22053
WAREHOUSES	268819	271504	282009	292485	301212	308858
EDUCATION	85174	87986	91009	94191	97574	101099
HEALTH	144611	141401	144933	148664	149777	148265
PUBLIC	32074	30712	34887	37878	39512	40220
RELIGIOUS	81606	83091	85310	88110	91040	94142
HOTEL-MOTEL	46196	43555	59355	75844	87401	95181
MISCELLANEOUS	107010	110451	111887	117783	126432	135103
TOTAL	941174	956629	991240	1040392	1088961	1132113
RESIDENTIAL CONSTRUCTION SQ.FT:						
APARTMENTS						
FIVE OR MORE UNITS						
1-3 STORIES	1217910	1393821	1746245	1803465	1701586	1554159
4 OR MORE STORIES	573865	577587	600183	598576	586356	571844
THREE TO FOUR UNITS	706281	739315	835494	845549	812215	767729
SINGLE FAMILY DETACHED	16623580	17804316	18746575	19082834	19076242	18978169
DUPLEXES	416767	451077	514400	527591	514109	493347
TOTAL	19538403	20966116	22442897	22858016	22690508	22365248
WAGES: ANNUAL 000 1984 $						
AGRICULTURAL	29.070	29.124	29.182	29.239	29.288	29.354
AGRICULTURAL SERVICES	21.636	21.791	21.930	22.060	22.203	22.290
MINING	48.584	49.191	49.848	50.471	51.141	51.745
CONSTRUCTION	39.163	39.194	39.190	39.180	39.155	39.104
NONDURABLE MANUFACTURING	29.923	30.037	30.145	30.245	30.339	30.426
DURABLE MANUFACTURING	29.550	29.583	29.622	29.660	29.691	29.741
PUBLIC UTILITIES	37.256	37.451	37.648	37.834	38.021	38.192
WHOLESALE TRADE	36.036	36.292	36.527	36.742	36.956	37.119
RETAIL TRADE	12.986	12.917	12.844	12.774	12.699	12.633
FINANCE-INSURANCE-REAL ESTATE	40.314	40.976	41.633	42.245	42.900	43.413
SERVICES	23.897	24.077	24.249	24.407	24.573	24.699
GOVERNMENT	24.335	24.602	24.872	25.145	25.421	25.700
PERSONAL INCOME 000 1984 $						
WAGE BILL	17820227	18202804	18604811	19015367	19439007	19862698
PROPERTY INCOME	6497269	6935797	7414127	7930850	8494776	9101104
TRANSFER PAYMENTS	3342143	3421627	3509854	3601757	3696656	3794624
RESIDENCE ADJUSTMENT	6179	8199	11058	13946	16987	19845
SOCIAL INSURANCE ADJUSTMENT	1166539	1194282	1225077	1257155	1290278	1324473
PER CAPITA INCOME	16.395	16.709	17.018	17.336	17.674	18.019
TOTAL PERSONAL INCOME	26499278	27374144	28314773	29304765	30357147	31453797
DEMOGRAPHICS						
POPULATION	1616281	1638256	1663777	1690353	1717628	1745605
BIRTHS	24559	24911	25321	25747	26185	26635
DEATHS	14947	15153	15392	15641	15896	16158
MIGRATION	11822	12216	15592	16470	16986	17500

MASTER LOW FORECAST FOR BPADSI REGION 1

	1980	1981	1982	1983	1984	1985	1986	1987
EMPLOYMENT:PERSONS								
AGRICULTURAL	4801	4788	4774	4764	4753	4724	4713	4706
AGRICULTURAL SERVICES	2337	2385	2475	2550	2592	2645	2713	2777
MINING	382	393	408	407	397	489	408	406
CONSTRUCTION	24688	24023	23491	23336	23142	22434	22072	21880
NONDURABLE MANUFACTURING	35151	34955	34640	34352	34287	33759	33535	33338
DURABLE MANUFACTURING	78596	78738	78649	77922	77389	71547	71234	71234
PUBLIC UTILITIES	32429	32524	32619	32715	32810	32904	33001	33097
WHOLESALE TRADE	43217	43342	43753	43979	44334	44824	45177	45299
RETAIL TRADE	99998	102831	105208	107594	110098	111857	114355	117344
FINANCE-INSURANCE-REAL ESTATE	37320	36818	36500	36588	36500	36046	35825	35623
SERVICES	113557	110103	109919	111248	111773	112787	113157	112768
GOVERNMENT	106433	109686	113037	116492	120052	123721	127501	131398
TOTAL	578910	580586	585475	591947	598051	597658	603713	609871
NEW COMMERCIAL CONSTRUCTION SQ.FT								
RETAIL-WHOLESALE	2087862	941566	306137	1347642	2806401	2266191	2893929	2530947
OFFICE BUILDINGS	1334339	221683	202652	1374731	2129418	928740	1649341	1053721
AUTO REPAIR	374491	1101546	1213918	79759	22547	59057	22547	22547
WAREHOUSES	1850421	1232674	822917	1202367	1857843	1712491	1889532	1837456
EDUCATION	658156	647948	586769	500601	461922	483946	485199	510212
HEALTH	177478	140076	57637	57637	57637	57637	57637	57637
PUBLIC	204401	48410	48410	235421	557094	289576	475792	343641
RELIGIOUS	177185	199043	213498	195310	167113	174148	162100	167835
HOTEL-MOTEL	82088	25910	25910	25910	25910	25910	25910	25910
MISCELLANEOUS	974574	893216	851413	892080	951731	932762	922573	933123
TOTAL	7920914	5452073	4329262	5911457	9037617	6930458	8584362	7482830
COMMERCIAL CONSTRUCTION SQ.FT								
ADDITIONS AND ALTERATIONS								
RETAIL-WHOLESALE	87612	143996	146604	69278	26722	105536	55427	98583
OFFICE BUILDINGS	86310	14097	14097	65781	122646	41365	89223	50730
AUTO REPAIR	8495	2483	0	0	0	0	0	0
WAREHOUSES	208119	200299	197141	207887	218521	214656	216795	218888
EDUCATION	57593	59272	59272	61002	62166	62718	63953	65439
HEALTH	132978	124877	121921	135109	149410	143121	148691	144473
PUBLIC	17287	10953	10810	18331	24407	17667	23702	20596
RELIGIOUS	72695	72190	71499	70546	70280	70052	68884	68519
HOTEL-MOTEL	15697	2202	2202	2202	11474	2202	2202	2202
MISCELLANEOUS	91528	86882	72406	58156	59287	70358	66660	74876
TOTAL	778314	717253	695153	687492	744912	727675	735539	744306
RESIDENTIAL CONSTRUCTION SQ.FT:								
APARTMENTS								
FIVE OR MORE UNITS								
1-3 STORIES	1644294	1118497	881263	1349954	1803991	2048506	1968311	2033279
4 OR MORE STORIES	363619	391370	449186	522387	580196	611480	657091	652816
THREE TO FOUR UNITS	793185	672496	620960	762417	894524	956778	938891	946485
SINGLE FAMILY DETACHED	14023765	13038911	13398436	14750141	15704486	16461322	16618834	17011286
DUPLEXES	521068	433301	383362	451193	513115	542641	511336	520336
TOTAL	17345931	15654574	15733407	17836091	19496313	20620727	20693663	21164114
WAGES: ANNUAL 000 1984 $								
AGRICULTURAL	27.087	27.210	27.571	27.808	27.772	27.886	28.029	28.186
AGRICULTURAL SERVICES	20.640	20.734	20.348	20.187	20.415	20.371	20.342	20.406
MINING	36.090	38.551	39.520	39.346	39.433	39.396	39.695	40.723
CONSTRUCTION	38.026	37.916	37.887	38.204	38.555	38.799	38.955	38.975
NONDURABLE MANUFACTURING	27.180	27.332	27.629	27.907	27.979	28.125	28.293	28.488
DURABLE MANUFACTURING	28.186	28.205	28.509	28.717	28.644	28.729	28.838	28.951
PUBLIC UTILITIES	33.480	33.795	34.148	34.362	34.355	34.431	34.585	34.876
WHOLESALE TRADE	30.889	31.346	31.630	31.971	32.271	32.492	32.741	33.098
RETAIL TRADE	14.690	14.300	14.175	14.199	14.132	14.111	14.058	13.923
FINANCE-INSURANCE-REAL ESTATE	28.247	29.938	30.500	30.703	31.046	31.134	31.468	32.396
SERVICES	20.774	21.129	21.250	21.346	21.483	21.543	21.646	21.869
GOVERNMENT	20.433	20.657	20.884	21.114	21.346	21.580	21.817	22.056
PERSONAL INCOME 000 1984 $								
WAGE BILL	13779231	13904675	14086225	14303442	14477536	14466827	14653529	14876119
PROPERTY INCOME	2625097	2779609	2925390	3064375	3218715	3367522	3542815	3743845
TRANSFER PAYMENTS	2339876	2398391	2441200	2491356	2545726	2600347	2642216	2698572
RESIDENCE ADJUSTMENT	-9076	-4117	-7184	-10791	-12275	-14331	-18319	-17180
SOCIAL INSURANCE ADJUSTMENT	816709	837133	852075	869581	888558	907623	922237	941906
PER CAPITA INCOME	13.494	13.536	13.692	13.832	13.934	13.900	14.090	14.256
TOTAL PERSONAL INCOME	17918418	18241425	18593555	18978800	19341143	19512742	19897203	20359446
DEMOGRAPHICS								
POPULATION	1327920	1347585	1357990	1372180	1388094	1403769	1412179	1427948
BIRTHS	20016	20314	20473	20696	20947	21189	21312	21564
DEATHS	12251	12435	12532	12664	12813	12960	13039	13186
MIGRATION	14371	11786	2464	6079	7860	7445	136	7391

MASTER LOW FORECAST FOR BPADSI REGION 1

	1988	1989	1990	1991	1992	1993	1994	1995
EMPLOYMENT:PERSONS								
AGRICULTURAL	4705	4705	4704	4699	4701	4705	4708	4711
AGRICULTURAL SERVICES	2838	2903	2969	3048	3116	3188	3262	3338
MINING	405	403	402	402	403	403	404	405
CONSTRUCTION	21800	21784	21698	21455	21443	21627	21688	21702
NONDURABLE MANUFACTURING	33205	33078	32951	32780	32690	32613	32529	32455
DURABLE MANUFACTURING	71497	71795	71989	72018	72439	72904	73252	73568
PUBLIC UTILITIES	33194	33291	33388	33486	33584	33682	33781	33880
WHOLESALE TRADE	45482	45616	45675	45737	45774	45712	45512	45243
RETAIL TRADE	120520	123854	127300	130599	134213	138047	142006	146116
FINANCE-INSURANCE-REAL ESTATE	35468	35316	35146	34893	34694	34497	34276	34046
SERVICES	114233	115570	116278	116104	118243	120062	121140	122146
GOVERNMENT	135413	139551	143816	148211	152740	157408	162218	167176
TOTAL	618761	627869	636316	643434	654042	664850	674777	684787
NEW COMMERCIAL CONSTRUCTION SQ.FT								
RETAIL-WHOLESALE	2569351	3500052	3021394	2644441	2590070	3506487	3123691	2768558
OFFICE BUILDINGS	1219920	1882846	1117812	1027035	1111857	1726217	1104440	997043
AUTO REPAIR	22547	22547	22547	22547	22547	22547	22547	32504
WAREHOUSES	1966051	2508959	2480500	2428368	2450674	2979694	2985352	2945812
EDUCATION	520270	532118	577229	603883	616316	626544	666795	693451
HEALTH	57637	57637	57637	57637	57637	57637	59862	57637
PUBLIC	355469	650118	452855	346469	363436	694151	518373	408059
RELIGIOUS	168369	154395	163329	172458	177318	167239	176193	186027
HOTEL-MOTEL	25910	90806	51297	25910	25910	125030	118833	98201
MISCELLANEOUS	965232	1031008	1043594	1052838	1061325	1122295	1141617	1155815
TOTAL	7870757	10430487	8988194	8381586	8477090	11027841	9917703	9343102
COMMERCIAL CONSTRUCTION SQ.FT ADDITIONS AND ALTERATIONS								
RETAIL-WHOLESALE	87669	41261	101097	109141	102466	53360	108583	118877
OFFICE BUILDINGS	61902	109940	58911	51696	56507	101016	59284	50963
AUTO REPAIR	0	1786	3639	3487	3018	6510	8344	8145
WAREHOUSES	224293	235723	236790	238897	241923	253664	256603	259861
EDUCATION	67200	69063	70924	72664	74812	77104	79409	81800
HEALTH	144443	151924	146595	143112	142768	149870	145843	142813
PUBLIC	22347	28237	24276	24403	25916	31642	28659	28886
RELIGIOUS	69263	70466	71925	73236	74138	75622	77540	79292
HOTEL-MOTEL	3371	22909	21536	19197	17063	37391	39705	39254
MISCELLANEOUS	76527	79511	89977	91930	90987	93303	102892	105418
TOTAL	757013	810820	825670	827764	829597	879483	906861	915309
RESIDENTIAL CONSTRUCTION SQ.FT:								
APARTMENTS								
FIVE OR MORE UNITS								
1-3 STORIES	1996739	1948788	1835394	1487601	1310118	1510325	1512835	1349376
4 OR MORE STORIES	650444	629186	614033	595625	576906	585634	584713	577824
THREE TO FOUR UNITS	934229	912874	879624	791503	730220	787111	788512	743776
SINGLE FAMILY DETACHED	17037408	17087512	16889450	15955795	16251185	16791793	16868013	16663546
DUPLEXES	514341	510927	495838	440847	416248	456467	461504	437236
TOTAL	21133161	21089207	20714339	19271372	19284678	20131330	20215577	19771758
WAGES: ANNUAL 000 1984 $								
AGRICULTURAL	28.284	28.392	28.495	28.657	28.728	28.812	28.895	28.972
AGRICULTURAL SERVICES	20.568	20.711	20.851	20.846	21.034	21.207	21.378	21.546
MINING	41.520	42.402	43.399	44.292	45.002	45.846	46.791	47.758
CONSTRUCTION	39.094	39.168	39.183	39.121	39.214	39.252	39.247	39.220
NONDURABLE MANUFACTURING	28.670	28.852	29.016	29.183	29.341	29.502	29.654	29.796
DURABLE MANUFACTURING	29.010	29.081	29.146	29.276	29.318	29.373	29.427	29.476
PUBLIC UTILITIES	35.132	35.408	35.683	35.951	36.195	36.466	36.745	37.018
WHOLESALE TRADE	33.479	33.857	34.204	34.447	34.803	35.151	35.485	35.801
RETAIL TRADE	13.817	13.706	13.580	13.477	13.392	13.295	13.187	13.076
FINANCE-INSURANCE-REAL ESTATE	33.321	34.268	35.223	35.897	36.756	37.682	38.648	39.602
SERVICES	22.112	22.357	22.598	22.762	22.996	23.238	23.482	23.721
GOVERNMENT	22.299	22.544	22.791	23.041	23.294	23.550	23.809	24.070
PERSONAL INCOME 000 1984 $								
WAGE BILL	15167964	15466971	15743632	15970053	16308849	16641436	16956612	17268831
PROPERTY INCOME	3961471	4197712	4454187	4723818	5017957	5339652	5689078	6068871
TRANSFER PAYMENTS	2756211	2820907	2887352	2953627	3018196	3091934	3167601	3242731
RESIDENCE ADJUSTMENT	-16349	-14189	-11414	-9321	-7960	-5088	-1902	1067
SOCIAL INSURANCE ADJUSTMENT	962026	984607	1007799	1030932	1053469	1079206	1105617	1131841
PER CAPITA INCOME	14.479	14.686	14.882	15.055	15.321	15.569	15.888	16.067
TOTAL PERSONAL INCOME	20907272	21486874	22065958	22607245	23275573	23988727	24705771	25449660
DEMOGRAPHICS								
POPULATION	1443936	1463125	1482686	1501628	1519187	1540817	1562817	1583966
BIRTHS	21817	22123	22433	22733	23010	23357	23708	24045
DEATHS	13335	13515	13698	13875	14039	14241	14447	14645
MIGRATION	7507	10581	10826	10084	8587	12514	12740	11748

MASTER LOW FORECAST FOR BPADSI REGION 1

	1996	1997	1998	1999	2000	2001
EMPLOYMENT:PERSONS						
AGRICULTURAL	4713	4721	4730	4740	4752	4763
AGRICULTURAL SERVICES	3423	3508	3600	3695	3794	3901
MINING	408	412	416	420	425	429
CONSTRUCTION	21713	21943	22273	22544	22809	23070
NONDURABLE MANUFACTURING	32383	32380	32405	32447	32513	32591
DURABLE MANUFACTURING	73502	73773	74157	74588	75101	75692
PUBLIC UTILITIES	33979	34078	34178	34278	34378	34479
WHOLESALE TRADE	44927	44761	44624	44507	44377	44302
RETAIL TRADE	150425	155028	159899	164964	170302	175757
FINANCE-INSURANCE-REAL ESTATE	33957	33927	33919	33923	33944	33940
SERVICES	123077	126074	129101	132175	135146	137985
GOVERNMENT	172285	177549	182975	188567	194329	200268
TOTAL	694792	708157	722279	736851	751870	767177
NEW COMMERCIAL CONSTRUCTION SQ.FT						
RETAIL-WHOLESALE	3011627	2619819	3129605	3764142	4090579	4031678
OFFICE BUILDINGS	1247740	925910	1338129	1517306	1485368	1341650
AUTO REPAIR	22547	113360	22547	22547	22547	22547
WAREHOUSES	3154761	3070535	3450275	3939834	4317464	4522265
EDUCATION	708144	729758	738653	763159	806396	858206
HEALTH	57637	57637	57637	57637	67483	90812
PUBLIC	528581	384908	594410	804102	882732	828508
RELIGIOUS	187868	198778	197848	194812	195849	202607
HOTEL-MOTEL	128453	98035	161659	248241	318281	360552
MISCELLANEOUS	1187706	1198110	1253440	1310888	1357062	1395395
TOTAL	10235064	9396849	10944203	12622668	13543762	13654220
COMMERCIAL CONSTRUCTION SQ.FT ADDITIONS AND ALTERATIONS						
RETAIL-WHOLESALE	96814	138746	93203	79062	86634	105943
OFFICE BUILDINGS	68343	46094	75126	89356	88994	80087
AUTO REPAIR	9137	9675	12160	15673	19035	21841
WAREHOUSES	266853	269562	280058	290503	299206	306828
EDUCATION	84216	87027	90845	93221	96596	100112
HEALTH	144611	141401	144933	148664	149777	148265
PUBLIC	31890	30522	34689	37677	39304	40005
RELIGIOUS	88956	82497	84771	87583	90514	93608
HOTEL-MOTEL	46062	43513	59306	75706	87193	94910
MISCELLANEOUS	105989	109445	110874	116751	125387	134045
TOTAL	934872	950481	985166	1034196	1082640	1125644
RESIDENTIAL CONSTRUCTION SQ.FT:						
APARTMENTS						
FIVE OR MORE UNITS						
1-3 STORIES	1198344	1380475	1732391	1788593	1685794	1537446
4 OR MORE STORIES	569590	572543	595310	593892	581808	567408
THREE TO FOUR UNITS	701087	735419	831318	841041	807442	762718
SINGLE FAMILY DETACHED	16568886	17759986	18705251	19043115	19037510	18939862
DUPLEXES	415628	451182	514343	527290	513605	492652
TOTAL	19453535	20899605	22378612	22793931	22626158	22300085
WAGES: ANNUAL 000 1984 $						
AGRICULTURAL	29.070	29.124	29.182	29.239	29.288	29.354
AGRICULTURAL SERVICES	21.636	21.791	21.930	22.060	22.203	22.290
MINING	48.584	49.191	49.848	50.471	51.141	51.745
CONSTRUCTION	39.163	39.194	39.190	39.180	39.155	39.104
NONDURABLE MANUFACTURING	29.923	30.037	30.145	30.245	30.339	30.426
DURABLE MANUFACTURING	29.558	29.583	29.622	29.660	29.691	29.741
PUBLIC UTILITIES	37.256	37.451	37.648	37.834	38.021	38.192
WHOLESALE TRADE	36.036	36.292	36.527	36.742	36.956	37.119
RETAIL TRADE	12.986	12.917	12.844	12.774	12.699	12.633
FINANCE-INSURANCE-REAL ESTATE	40.314	40.976	41.633	42.245	42.900	43.413
SERVICES	23.897	24.077	24.249	24.407	24.573	24.699
GOVERNMENT	24.335	24.602	24.872	25.145	25.421	25.700
PERSONAL INCOME 000 1984 $						
WAGE BILL	17563230	17946319	18348135	18758300	19181314	19603943
PROPERTY INCOME	6473449	6918906	7388030	7903452	8465948	9070722
TRANSFER PAYMENTS	3319541	3399099	3487008	3578532	3673026	3770559
RESIDENCE ADJUSTMENT	3623	5783	8737	11708	14832	17760
SOCIAL INSURANCE ADJUSTMENT	1158650	1186419	1217103	1249048	1282030	1316073
PER CAPITA INCOME	16.321	16.637	16.948	17.269	17.609	17.957
TOTAL PERSONAL INCOME	26201192	27075687	28014807	29002944	30053089	31146910
DEMOGRAPHICS						
POPULATION	1605351	1627469	1652947	1679453	1706649	1734534
BIRTHS	24388	24742	25152	25577	26813	26462
DEATHS	14845	15052	15290	15538	15793	16054
MIGRATION	11841	12428	15616	16468	16975	17478

WASCO COUNTY, OREGON

AND

KLICKITAT COUNTY, WASHINGTON

(Martin Marietta Plant Site, The Dalles and
Commonwealth Plant Site, Goldendale)

MASTER HIGH FORECAST FOR BPADSI REGION 2

	1980	1981	1982	1983	1984	1985	1986	1987
EMPLOYMENT:PERSONS								
AGRICULTURAL	1329	1347	1362	1376	1393	1450	1469	1485
AGRICULTURAL SERVICES	98	102	106	109	112	121	125	129
MINING	20	21	23	23	23	25	25	26
CONSTRUCTION	334	331	328	340	396	424	417	394
NONDURABLE MANUFACTURING	262	255	249	244	241	267	263	257
DURABLE MANUFACTURING	2496	2539	2559	2543	2556	4084	4132	4131
PUBLIC UTILITIES	634	625	616	607	599	591	583	575
WHOLESALE TRADE	388	392	401	411	422	445	455	457
RETAIL TRADE	1964	1982	1984	1981	1986	2073	2080	2084
FINANCE-INSURANCE-REAL ESTATE	321	317	315	316	316	328	327	324
SERVICES	2126	2047	2038	2059	2067	2134	2140	2122
GOVERNMENT	3378	3448	3519	3592	3667	3742	3820	3899
TOTAL	13350	13406	13501	13603	13778	15683	15836	15882
NEW COMMERCIAL CONSTRUCTION SQ.FT								
RETAIL-WHOLESALE	33825	14763	7430	25971	51247	41990	57106	49040
OFFICE BUILDINGS	15721	314965	172321	820	820	820	820	820
AUTO REPAIR	39881	354183	378408	295	295	295	295	295
WAREHOUSES	83045	177399	297680	362784	363888	397461	433733	440435
EDUCATION	3370	3370	3370	3370	3370	3370	3370	3370
HEALTH	832	832	832	832	832	832	832	832
PUBLIC	1225	1225	1225	1225	1225	1225	1225	1225
RELIGIOUS	252	18141	29010	7577	252	252	252	252
HOTEL-MOTEL	1450	1450	1450	1450	1450	1450	1450	1450
MISCELLANEOUS	9425	1947	1947	23790	63501	35286	63777	43671
TOTAL	189027	888277	893675	428116	486880	482982	562861	541390
COMMERCIAL CONSTRUCTION SQ.FT								
ADDITIONS AND ALTERATIONS								
RETAIL-WHOLESALE	560	560	560	8103	16911	1346	11489	3494
OFFICE BUILDINGS	0	0	0	0	0	0	0	0
AUTO REPAIR	0	0	0	0	0	0	0	0
WAREHOUSES	0	0	0	0	2003	0	1210	0
EDUCATION	1100	1100	1100	1100	1657	1100	1933	1100
HEALTH	2253	1345	1345	6820	17124	8986	13539	8891
PUBLIC	157	157	157	157	2838	157	790	157
RELIGIOUS	15	0	0	31	107	86	122	106
HOTEL-MOTEL	197	197	197	197	12461	197	10523	1195
MISCELLANEOUS	0	0	0	0	0	0	0	0
TOTAL	4283	3360	3360	16409	53102	11874	39606	14944
RESIDENTIAL CONSTRUCTION SQ.FT:								
APARTMENTS								
FIVE OR MORE UNITS								
1-3 STORIES	3415	3415	3415	317662	618536	766792	852716	786700
4 OR MORE STORIES	0	0	0	29583	64499	77777	79018	77852
THREE TO FOUR UNITS	835	835	835	47692	109156	128108	134804	100794
SINGLE FAMILY DETACHED	295028	31502	850736	2456941	3553473	4427449	4932553	5332046
DUPLEXES	130	130	130	31019	59276	69297	73791	56916
TOTAL	299408	35882	855116	2882897	4404940	5469423	6072882	6354309
WAGES: ANNUAL 000 1984 $								
AGRICULTURAL	36.234	35.682	35.733	35.888	35.691	35.698	35.684	35.560
AGRICULTURAL SERVICES	27.080	26.758	26.249	26.141	26.360	26.340	26.290	26.234
MINING	57.543	59.955	61.555	62.497	63.384	64.215	65.134	66.267
CONSTRUCTION	49.315	48.715	48.608	49.116	49.532	49.895	50.078	49.922
NONDURABLE MANUFACTURING	19.712	20.192	20.544	20.699	20.731	20.801	20.954	21.268
DURABLE MANUFACTURING	30.737	30.703	31.040	31.341	31.327	31.481	31.634	31.735
PUBLIC UTILITIES	30.454	30.896	31.267	31.427	31.400	31.442	31.585	31.922
WHOLESALE TRADE	24.708	24.992	24.927	24.786	24.712	24.545	24.494	24.720
RETAIL TRADE	15.282	14.902	14.806	14.871	14.835	14.848	14.820	14.694
FINANCE-INSURANCE-REAL ESTATE	27.841	28.810	29.400	29.600	29.951	30.041	30.384	31.341
SERVICES	17.710	18.209	18.361	18.415	18.543	18.579	18.682	18.957
GOVERNMENT	19.150	19.482	19.821	20.165	20.515	20.872	21.234	21.603
PERSONAL INCOME 000 1984 $								
WAGE BILL	320214	323491	328395	333570	340541	399656	405850	408984
PROPERTY INCOME	72541	77373	81965	86370	91417	99960	105858	112433
TRANSFER PAYMENTS	68305	69486	70423	71463	72536	73792	79063	80375
RESIDENCE ADJUSTMENT	23547	27432	28627	28166	28407	28323	29505	30984
SOCIAL INSURANCE ADJUSTMENT	16295	16577	16801	17049	17305	17604	18862	19175
PER CAPITA INCOME	13.154	13.420	13.691	13.901	14.194	15.965	15.496	15.708
TOTAL PERSONAL INCOME	468312	481204	492610	502520	515597	584127	601414	613602
DEMOGRAPHICS								
POPULATION	35603	35858	35981	36149	36326	36588	38811	39063
BIRTHS	544	548	551	554	557	562	599	602
DEATHS	360	362	363	365	367	370	392	395
MIGRATION	68	69	-65	-21	-13	70	2016	44

MASTER HIGH FORECAST FOR BPADSI REGION 2

	1988	1989	1990	1991	1992	1993	1994	1995
EMPLOYMENT:PERSONS								
AGRICULTURAL	1502	1522	1540	1558	1578	1600	1621	1642
AGRICULTURAL SERVICES	132	136	140	145	149	153	158	162
MINING	26	27	28	28	29	30	31	32
CONSTRUCTION	390	414	398	394	391	413	399	396
NONDURABLE MANUFACTURING	251	246	240	234	229	224	218	213
DURABLE MANUFACTURING	4144	4180	4192	4213	4241	4288	4315	4348
PUBLIC UTILITIES	566	559	551	543	535	528	520	513
WHOLESALE TRADE	459	460	459	459	458	456	451	446
RETAIL TRADE	2089	2100	2108	2115	2123	2137	2148	2161
FINANCE-INSURANCE-REAL ESTATE	323	321	319	317	315	313	311	309
SERVICES	2139	2156	2158	2147	2177	2202	2212	2220
GOVERNMENT	3980	4062	4146	4232	4320	4409	4500	4594
TOTAL	16003	16184	16280	16387	16546	16754	16884	17038
NEW COMMERCIAL CONSTRUCTION SQ.FT								
RETAIL-WHOLESALE	47769	61775	52646	45324	43698	57166	50381	44070
OFFICE BUILDINGS	820	820	820	820	820	820	820	820
AUTO REPAIR	295	295	295	295	295	295	295	295
WAREHOUSES	439755	404326	393268	392925	396097	369829	362167	364523
EDUCATION	3370	3370	3370	3370	3370	3370	3370	3370
HEALTH	832	832	832	832	832	832	832	832
PUBLIC	1225	1225	1225	1225	1225	1225	1225	1225
RELIGIOUS	252	252	252	252	252	252	252	252
HOTEL-MOTEL	1450	1450	1450	1450	1450	1450	1450	1450
MISCELLANEOUS	39930	66304	47347	34021	32519	59132	45980	35135
TOTAL	535700	540650	501506	480515	480559	494372	466773	451973
COMMERCIAL CONSTRUCTION SQ.FT ADDITIONS AND ALTERATIONS								
RETAIL-WHOLESALE	5912	14508	4043	3142	4757	13066	4355	3220
OFFICE BUILDINGS	0	0	0	0	0	0	0	0
AUTO REPAIR	0	0	0	0	0	0	0	0
WAREHOUSES	0	2986	0	0	0	3023	0	0
EDUCATION	1100	2076	1100	1100	1100	2310	1100	1100
HEALTH	8618	15885	10558	7087	6731	13733	9753	6760
PUBLIC	157	3129	157	157	157	2905	157	157
RELIGIOUS	101	143	123	101	91	132	116	97
HOTEL-MOTEL	197	11445	3813	197	197	10349	4483	197
MISCELLANEOUS	0	0	0	0	0	0	0	0
TOTAL	16086	50174	19795	11785	13035	45518	19964	11531
RESIDENTIAL CONSTRUCTION SQ.FT:								
APARTMENTS								
FIVE OR MORE UNITS								
1-3 STORIES	648083	446799	216278	3415	3415	3415	3415	3415
4 OR MORE STORIES	76156	63162	51256	30025	2012	15583	15292	2835
THREE TO FOUR UNITS	57213	835	835	835	835	835	835	835
SINGLE FAMILY DETACHED	5347814	5295653	5000963	3998265	4270988	4674607	4625792	4335720
DUPLEXES	32510	955	130	130	130	130	130	130
TOTAL	6161777	5807403	5269462	4032670	4277380	4694570	4645465	4342936
WAGES: ANNUAL 000 1984 $								
AGRICULTURAL	35.424	35.294	35.146	35.093	34.977	34.859	34.729	34.596
AGRICULTURAL SERVICES	26.316	26.376	26.422	26.350	26.493	26.604	26.700	26.791
MINING	67.218	68.141	69.040	69.878	70.573	71.271	71.955	72.603
CONSTRUCTION	49.910	49.823	49.639	49.412	49.369	49.231	49.017	48.768
NONDURABLE MANUFACTURING	21.538	21.828	22.125	22.402	22.652	22.930	23.221	23.509
DURABLE MANUFACTURING	31.791	31.849	31.887	31.997	32.024	32.052	32.067	32.073
PUBLIC UTILITIES	32.211	32.529	32.857	33.168	33.447	33.764	34.099	34.431
WHOLESALE TRADE	24.978	25.270	25.586	25.789	26.098	26.448	26.829	27.214
RETAIL TRADE	14.597	14.492	14.368	14.266	14.184	14.086	13.973	13.856
FINANCE-INSURANCE-REAL ESTATE	32.286	33.254	34.234	34.927	35.802	36.747	37.734	38.709
SERVICES	19.241	19.534	19.833	20.044	20.319	20.610	20.914	21.213
GOVERNMENT	21.978	22.360	22.748	23.143	23.545	23.954	24.370	24.793
PERSONAL INCOME 000 1984 $								
WAGE BILL	614320	422118	426642	432080	438695	447413	453211	459943
PROPERTY INCOME	119559	127446	135882	144919	154717	165594	177296	190136
TRANSFER PAYMENTS	81457	82734	84176	85438	86747	88208	89816	91254
RESIDENCE ADJUSTMENT	32119	33402	34890	36120	37163	38414	39835	41269
SOCIAL INSURANCE ADJUSTMENT	19433	19737	20082	20383	20695	21043	21427	21770
PER CAPITA INCOME	16.023	16.390	16.662	16.999	17.371	17.799	18.151	18.584
TOTAL PERSONAL INCOME	628022	645962	661509	678173	696627	718586	738731	760831
DEMOGRAPHICS								
POPULATION	39195	39413	39701	39895	40103	40373	40700	40940
BIRTHS	605	609	614	617	621	626	632	636
DEATHS	396	399	401	403	406	408	412	414
MIGRATION	-76	8	76	-20	-7	52	107	18

MASTER HIGH FORECAST FOR BPADSI REGION 2

	1996	1997	1998	1999	2000	2001
EMPLOYMENT:PERSONS						
AGRICULTURAL	1664	1687	1713	1737	1763	1790
AGRICULTURAL SERVICES	167	172	178	183	189	196
MINING	33	34	36	37	38	40
CONSTRUCTION	393	391	435	421	432	428
NONDURABLE MANUFACTURING	208	204	200	196	192	189
DURABLE MANUFACTURING	4358	4378	4431	4461	4508	4560
PUBLIC UTILITIES	506	499	492	485	478	472
WHOLESALE TRADE	440	437	434	431	428	426
RETAIL TRADE	2176	2191	2213	2231	2253	2274
FINANCE-INSURANCE-REAL ESTATE	308	307	307	307	307	307
SERVICES	2229	2275	2323	2369	2415	2458
GOVERNMENT	4689	4786	4865	4986	5089	5195
TOTAL	17173	17362	17647	17845	18094	18334
NEW COMMERCIAL CONSTRUCTION SQ.FT						
RETAIL-WHOLESALE	46997	40573	47212	55614	59056	57183
OFFICE BUILDINGS	820	820	820	820	820	820
AUTO REPAIR	295	295	295	295	295	295
WAREHOUSES	361928	374033	374626	363048	340188	321596
EDUCATION	3370	3370	3370	3370	3370	3370
HEALTH	832	832	832	832	832	832
PUBLIC	1225	1225	1225	1225	1225	1225
RELIGIOUS	252	252	252	252	252	252
HOTEL-MOTEL	1450	1450	1450	1450	1450	1450
MISCELLANEOUS	42213	31020	44678	60456	65838	62051
TOTAL	459382	453872	474761	487364	473327	449075
COMMERCIAL CONSTRUCTION SQ.FT ADDITIONS AND ALTERATIONS						
RETAIL-WHOLESALE	7012	2319	8183	10386	9509	7149
OFFICE BUILDINGS	0	0	0	0	0	0
AUTO REPAIR	0	0	0	0	0	0
WAREHOUSES	0	0	616	2947	3916	3504
EDUCATION	1100	1100	2692	2781	2882	2987
HEALTH	8532	5365	8848	12527	13622	12131
PUBLIC	157	157	345	2027	2250	1479
RELIGIOUS	103	80	97	127	146	148
HOTEL-MOTEL	2547	197	4027	10033	12473	11307
MISCELLANEOUS	0	0	0	0	0	0
TOTAL	19451	9219	24808	40827	44798	38704
RESIDENTIAL CONSTRUCTION SQ.FT:						
APARTMENTS						
FIVE OR MORE UNITS						
1-3 STORIES	3415	3415	3415	3415	3415	3415
4 OR MORE STORIES	0	0	22317	19605	5116	0
THREE TO FOUR UNITS	835	835	835	835	835	835
SINGLE FAMILY DETACHED	4159654	5257459	6029203	6195183	6022326	5765071
DUPLEXES	130	130	130	130	130	130
TOTAL	4164034	5261839	6055900	6219168	6031822	5769451
WAGES: ANNUAL 000 1984 $						
AGRICULTURAL	34.514	34.425	34.337	34.256	34.162	34.103
AGRICULTURAL SERVICES	26.829	26.962	27.070	27.173	27.277	27.338
MINING	73.189	73.670	74.139	74.575	74.995	75.390
CONSTRUCTION	48.531	48.432	48.282	48.133	47.951	47.763
NONDURABLE MANUFACTURING	23.757	23.957	24.152	24.354	24.552	24.730
DURABLE MANUFACTURING	32.113	32.125	32.136	32.148	32.146	32.169
PUBLIC UTILITIES	34.717	34.947	35.183	35.405	35.635	35.842
WHOLESALE TRADE	27.497	27.764	28.033	28.286	28.562	28.774
RETAIL TRADE	13.759	13.689	13.611	13.537	13.456	13.385
FINANCE-INSURANCE-REAL ESTATE	39.438	40.111	40.781	41.404	42.072	42.597
SERVICES	21.440	21.657	21.869	22.066	22.275	22.439
GOVERNMENT	25.224	25.662	26.107	26.561	27.022	27.491
PERSONAL INCOME 000 1984 $						
WAGE BILL	466133	473644	484947	492652	502418	511820
PROPERTY INCOME	203835	218613	235096	252610	271972	292841
TRANSFER PAYMENTS	92777	94281	95949	97899	99656	101582
RESIDENCE ADJUSTMENT	42468	43369	44352	45307	46319	47218
SOCIAL INSURANCE ADJUSTMENT	22134	22492	22890	23355	23775	24234
PER CAPITA INCOME	19.003	19.474	20.047	20.501	21.082	21.651
TOTAL PERSONAL INCOME	783079	807413	837454	865112	896591	929226
DEMOGRAPHICS						
POPULATION	41209	41460	41774	42199	42529	42919
BIRTHS	641	646	652	659	665	672
DEATHS	417	419	423	427	430	434
MIGRATION	45	25	85	193	95	152

MASTER LOW FORECAST FOR BPADSI REGION 2

	1980	1981	1982	1983	1984	1985	1986	1987
EMPLOYMENT:PERSONS								
AGRICULTURAL	1329	1347	1362	1376	1393	1344	1353	1371
AGRICULTURAL SERVICES	98	102	106	109	112	107	110	113
MINING	20	21	23	23	23	24	25	25
CONSTRUCTION	334	331	328	340	396	350	328	325
NONDURABLE MANUFACTURING	262	255	249	244	241	196	190	186
DURABLE MANUFACTURING	2496	2539	2559	2543	2556	590	580	585
PUBLIC UTILITIES	634	625	616	607	599	590	582	573
WHOLESALE TRADE	388	392	401	411	422	418	425	427
RETAIL TRADE	1964	1982	1984	1981	1986	1840	1826	1834
FINANCE-INSURANCE-REAL ESTATE	321	317	315	316	316	291	287	286
SERVICES	2126	2047	2038	2059	2067	2018	2013	1997
GOVERNMENT	3378	3448	3519	3592	3667	3742	3820	3899
TOTAL	13350	13406	13501	13603	13778	11510	11540	11622
NEW COMMERCIAL CONSTRUCTION SQ.FT								
RETAIL-WHOLESALE	33825	14763	7430	25971	51247	41990	44985	39994
OFFICE BUILDINGS	15721	314965	172321	820	820	820	820	820
AUTO REPAIR	39881	354183	378408	295	295	295	295	295
WAREHOUSES	83045	177399	297680	362784	363888	397461	335361	353233
EDUCATION	3370	3370	3370	3370	3370	3370	3370	3370
HEALTH	832	832	832	832	832	832	832	832
PUBLIC	1225	1225	1225	1225	1225	1225	1225	1225
RELIGIOUS	252	18141	29010	7577	252	252	252	252
HOTEL-MOTEL	1450	1450	1450	1450	1450	1450	1450	1450
MISCELLANEOUS	9425	1947	1947	23790	63501	35286	37876	25849
TOTAL	189027	888277	893675	428116	486880	482982	426467	427320
COMMERCIAL CONSTRUCTION SQ.FT ADDITIONS-AND ALTERATIONS								
RETAIL-WHOLESALE	560	560	560	8103	16911	1346	11632	3311
OFFICE BUILDINGS	0	0	0	0	0	0	0	0
AUTO REPAIR	0	0	0	0	0	0	0	0
WAREHOUSES	0	0	0	0	2083	0	0	0
EDUCATION	1100	1100	1100	1100	1657	1100	1453	1100
HEALTH	2253	1345	1345	6820	17124	8986	13539	8891
PUBLIC	157	157	157	157	2838	157	790	157
RELIGIOUS	15	0	0	31	107	86	103	79
HOTEL-MOTEL	197	197	197	197	12461	197	371	197
MISCELLANEOUS	0	0	0	0	0	0	0	0
TOTAL	4283	3360	3360	16409	53102	11874	27887	13735
RESIDENTIAL CONSTRUCTION SQ.FT:								
APARTMENTS								
FIVE OR MORE UNITS	3415	3415	3415	317662	618536	766792	731949	700353
1-3 STORIES	0	0	0	29583	64499	77777	94826	87324
4 OR MORE STORIES	835	835	835	47692	109156	128108	106538	81697
THREE TO FOUR UNITS	295028	31502	850736	2456941	3553473	4427449	4798595	5219671
SINGLE FAMILY DETACHED	130	130	130	31019	59276	69297	48941	39973
DUPLEXES								
TOTAL	299408	35882	855116	2882897	4404940	5469423	5780849	6129018
WAGES: ANNUAL 000 1984 $								
AGRICULTURAL	36.234	35.682	35.733	35.888	35.691	35.698	35.684	35.560
AGRICULTURAL SERVICES	27.080	26.758	26.249	26.141	26.360	26.340	26.290	26.234
MINING	57.543	59.955	61.555	62.497	63.384	64.215	65.134	66.267
CONSTRUCTION	49.315	48.715	48.608	49.116	49.532	49.895	50.078	49.922
NONDURABLE MANUFACTURING	19.712	20.192	20.544	20.699	20.731	20.801	20.954	21.268
DURABLE MANUFACTURING	30.737	30.703	31.040	31.341	31.327	31.481	31.634	31.735
PUBLIC UTILITIES	30.454	30.896	31.267	31.427	31.408	31.442	31.585	31.922
WHOLESALE TRADE	24.708	24.992	24.927	24.786	24.712	24.545	24.494	24.720
RETAIL TRADE	15.282	14.902	14.806	14.871	14.835	14.848	14.820	14.694
FINANCE-INSURANCE-REAL ESTATE	27.041	28.810	29.400	29.600	29.951	30.041	30.384	31.341
SERVICES	17.710	18.209	18.361	18.415	18.543	18.579	18.682	18.957
GOVERNMENT	19.150	19.482	19.821	20.165	20.515	20.872	21.234	21.603
PERSONAL INCOME 000 1984 $								
WAGE BILL	320214	323491	328395	333570	340541	272906	274830	278984
PROPERTY INCOME	72541	77373	81965	[illegible]370	91417	91497	96698	102829
TRANSFER PAYMENTS	68305	69486	70423	[illegible]463	72536	73792	69432	70302
RESIDENCE ADJUSTMENT	23547	27432	28627	28166	28407	28328	27640	29160
SOCIAL INSURANCE ADJUSTMENT	16295	16577	16801	17049	17305	17604	16564	16772
PER CAPITA INCOME	13.154	13.420	13.691	13.901	14.194	12.270	13.263	13.595
TOTAL PERSONAL INCOME	468312	481204	492610	502520	515597	448920	452037	464504
DEMOGRAPHICS								
POPULATION	35603	35858	35981	36149	36326	36588	34084	34167
BIRTHS	544	548	551	554	557	562	520	523
DEATHS	360	362	363	365	367	370	344	345
MIGRATION	68	69	-65	-21	-13	70	-2680	-95

MASTER LOW FORECAST FOR BPADSI REGION 2

	1988	1989	1990	1991	1992	1993	1994	1995
EMPLOYMENT:PERSONS								
AGRICULTURAL	1389	1409	1428	1447	1467	1489	1511	1533
AGRICULTURAL SERVICES	117	120	124	128	132	136	141	145
MINING	26	26	27	27	28	29	30	30
CONSTRUCTION	323	343	331	328	326	345	334	332
NONDURABLE MANUFACTURING	182	178	173	169	165	162	158	154
DURABLE MANUFACTURING	591	600	606	612	620	631	639	648
PUBLIC UTILITIES	565	558	550	542	534	527	520	512
WHOLESALE TRADE	430	432	431	432	432	430	426	421
RETAIL TRADE	1842	1853	1864	1872	1882	1896	1909	1924
FINANCE-INSURANCE-REAL ESTATE	284	283	282	230	279	277	276	274
SERVICES	2014	2030	2033	2023	2052	2076	2086	2095
GOVERNMENT	3980	4062	4146	4232	4320	4409	4500	4594
TOTAL	11743	11895	11996	12095	12240	12409	12529	12664
NEW COMMERCIAL CONSTRUCTION SQ.FT								
RETAIL-WHOLESALE	41347	55421	48069	42040	40882	53282	47257	41652
OFFICE BUILDINGS	820	820	820	820	820	820	820	820
AUTO REPAIR	295	295	295	295	295	295	295	295
WAREHOUSES	370504	345029	344366	353139	362209	337369	333209	339389
EDUCATION	3370	3370	3370	3370	3370	3370	3370	3370
HEALTH	832	832	832	832	832	832	832	832
PUBLIC	1225	1225	1225	1225	1225	1225	1225	1225
RELIGIOUS	252	252	252	252	252	252	252	252
HOTEL-MOTEL	1450	1450	1450	1450	1450	1450	1450	1450
MISCELLANEOUS	29047	58925	41601	29352	28289	55118	41879	31156
TOTAL	449143	467620	442281	432775	439626	454014	430590	420443
COMMERCIAL CONSTRUCTION SQ.FT ADDITIONS AND ALTERATIONS								
RETAIL-WHOLESALE	5726	14422	3842	2931	4567	12967	4163	3016
OFFICE BUILDINGS	0	0	0	0	0	0	0	0
AUTO REPAIR	0	0	0	0	0	0	0	0
WAREHOUSES	0	2262	0	0	0	2259	0	0
EDUCATION	1100	1588	1100	1100	1100	1802	1100	1100
HEALTH	8618	15885	10558	7087	6731	13733	9753	6760
PUBLIC	157	3127	157	157	157	2903	157	157
RELIGIOUS	78	124	106	86	78	121	106	87
HOTEL-MOTEL	197	11389	3639	197	197	10239	4245	197
MISCELLANEOUS	0	0	0	0	0	0	0	0
TOTAL	15876	48797	19402	11559	12832	44024	19524	11318
RESIDENTIAL CONSTRUCTION SQ.FT:								
APARTMENTS								
FIVE OR MORE UNITS								
1-3 STORIES	589181	405106	185179	3415	3415	3415	3415	3415
4 OR MORE STORIES	81083	65425	51981	29667	1026	14233	13801	1136
THREE TO FOUR UNITS	44821	835	835	835	835	835	835	835
SINGLE FAMILY DETACHED	5257436	5221402	4938435	3945980	4226365	4635750	4590679	4304441
DUPLEXES	21642	130	130	130	130	130	130	130
TOTAL	5994164	5692898	5176560	3980027	4231771	4654362	4608861	4309958
WAGES: ANNUAL 000 1984 $								
AGRICULTURAL	35.424	35.294	35.146	35.093	34.977	34.859	34.729	34.596
AGRICULTURAL SERVICES	26.316	26.376	26.422	26.350	26.493	26.604	26.700	26.791
MINING	67.218	68.141	69.040	69.878	70.573	71.271	71.955	72.603
CONSTRUCTION	49.910	49.823	49.639	49.412	49.369	49.231	49.017	48.768
NONDURABLE MANUFACTURING	21.538	21.828	22.125	22.402	22.652	22.930	23.221	23.509
DURABLE MANUFACTURING	31.791	31.849	31.887	31.997	32.024	32.052	32.067	32.073
PUBLIC UTILITIES	32.211	32.529	32.857	33.168	33.447	33.764	34.099	34.431
WHOLESALE TRADE	24.978	25.270	25.586	25.789	26.098	26.448	26.829	27.214
RETAIL TRADE	14.597	14.492	14.368	14.266	14.184	14.086	13.973	13.856
FINANCE-INSURANCE-REAL ESTATE	32.286	33.254	34.234	34.927	35.802	36.747	37.734	38.[illegible]
SERVICES	19.241	19.534	19.833	20.044	20.319	20.610	20.914	21.213
GOVERNMENT	21.978	22.360	22.748	23.143	23.545	23.954	24.370	24.793
PERSONAL INCOME 000 1984 $								
WAGE BILL	284050	290562	295046	299787	305753	312976	318370	324426
PROPERTY INCOME	109433	116706	124520	132866	141937	151969	162797	174670
TRANSFER PAYMENTS	71309	72424	73631	74735	75855	77104	78437	79670
RESIDENCE ADJUSTMENT	30392	31754	33312	34613	35715	37025	38499	39992
SOCIAL INSURANCE ADJUSTMENT	17012	17278	17566	17829	18096	18395	18712	19006
PER CAPITA INCOME	13.936	14.323	14.655	15.020	15.432	15.887	16.301	16.780
TOTAL PERSONAL INCOME	478172	494168	508942	524171	541164	560680	579390	599751
DEMOGRAPHICS								
POPULATION	34312	34501	34727	34897	35068	35291	35543	35743
BIRTHS	526	529	534	537	540	544	549	553
DEATHS	346	348	351	352	354	356	359	361
MIGRATION	-35	8	43	-15	-16	35	62	7

MASTER LOW FORECAST FOR BPADSI REGION 2

	1996	1997	1998	1999	2000	2001
EMPLOYMENT:PERSONS						
AGRICULTURAL	1556	1579	1606	1631	1658	1684
AGRICULTURAL SERVICES	150	155	160	165	171	177
MINING	31	32	34	35	36	37
CONSTRUCTION	331	330	366	354	364	361
NONDURABLE MANUFACTURING	151	148	145	142	139	136
DURABLE MANUFACTURING	654	662	673	682	693	705
PUBLIC UTILITIES	505	498	491	484	477	471
WHOLESALE TRADE	417	414	412	410	407	405
RETAIL TRADE	1940	1957	1979	1998	2021	2042
FINANCE-INSURANCE-REAL ESTATE	273	273	274	274	274	274
SERVICES	2104	2149	2195	2240	2283	2325
GOVERNMENT	4689	4786	4885	4986	5089	5195
TOTAL	12802	12983	13219	13401	13614	13814
NEW COMMERCIAL CONSTRUCTION SQ.FT						
RETAIL-WHOLESALE	44378	38625	44728	52383	55577	53904
OFFICE BUILDINGS	820	820	820	820	820	820
AUTO REPAIR	295	295	295	295	295	295
WAREHOUSES	338047	353270	353805	340018	316529	297775
EDUCATION	3370	3370	3370	3370	3370	3370
HEALTH	832	832	832	832	832	832
PUBLIC	1225	1225	1225	1225	1225	1225
RELIGIOUS	252	252	252	252	252	252
HOTEL-MOTEL	1450	1450	1450	1450	1450	1450
MISCELLANEOUS	38228	27121	40766	56203	61581	57634
TOTAL	428899	427261	447543	456849	441932	417557
COMMERCIAL CONSTRUCTION SQ.FT						
ADDITIONS AND ALTERATIONS						
RETAIL-WHOLESALE	6858	2109	8036	10266	9378	6995
OFFICE BUILDINGS	0	0	0	0	0	0
AUTO REPAIR	0	0	0	0	0	0
WAREHOUSES	0	0	0	1930	2800	2334
EDUCATION	1100	1100	2156	2238	2330	2425
HEALTH	8532	5365	8848	12527	13622	12131
PUBLIC	157	157	342	2024	2247	1476
RELIGIOUS	94	72	90	119	139	141
HOTEL-MOTEL	2416	197	3919	9745	12178	10953
MISCELLANEOUS	0	0	0	0	0	0
TOTAL	19151	9001	23391	38849	42695	36455
RESIDENTIAL CONSTRUCTION SQ.FT:						
APARTMENTS						
FIVE OR MORE UNITS						
1-3 STORIES	3415	3415	3415	3415	3415	3415
4 OR MORE STORIES	0	0	21515	18456	3621	0
THREE TO FOUR UNITS	835	835	835	835	835	835
SINGLE FAMILY DETACHED	4131097	5231690	6005287	6171398	5999621	5742568
DUPLEXES	130	130	130	130	130	130
TOTAL	4135477	5236070	6031182	6194234	6007621	5746948
WAGES: ANNUAL 000 1984 $						
AGRICULTURAL	34.514	34.425	34.337	34.256	34.162	34.103
AGRICULTURAL SERVICES	26.829	26.962	27.070	27.173	27.277	27.338
MINING	73.189	73.670	74.139	74.575	74.995	75.390
CONSTRUCTION	48.531	48.432	48.282	48.133	47.951	47.763
NONDURABLE MANUFACTURING	23.757	23.957	24.162	24.354	24.552	24.730
DURABLE MANUFACTURING	32.113	32.125	32.136	32.148	32.146	32.169
PUBLIC UTILITIES	34.717	34.947	35.183	35.405	35.635	35.842
WHOLESALE TRADE	27.497	27.764	28.033	28.286	28.562	28.774
RETAIL TRADE	13.759	13.689	13.611	13.537	13.456	13.385
FINANCE-INSURANCE-REAL ESTATE	39.438	40.111	40.781	41.404	42.072	42.597
SERVICES	21.440	21.657	21.869	22.066	22.275	22.439
GOVERNMENT	25.224	25.662	26.107	26.561	27.022	27.491
PERSONAL INCOME 000 1984 $						
WAGE BILL	330505	337684	347202	354330	362882	370980
PROPERTY INCOME	187413	201181	215456	232745	250721	270068
TRANSFER PAYMENTS	80961	82284	83743	85371	86885	88510
RESIDENCE ADJUSTMENT	41240	42187	43214	44199	45249	46178
SOCIAL INSURANCE ADJUSTMENT	19315	19630	19978	20367	20728	21115
PER CAPITA INCOME	17.263	17.789	18.394	18.921	19.553	20.177
TOTAL PERSONAL INCOME	620806	643706	670637	696278	725088	754540
DEMOGRAPHICS						
POPULATION	35961	36185	36460	36799	37079	37396
BIRTHS	557	561	567	573	578	584
DEATHS	363	365	368	372	375	378
MIGRATION	24	28	76	138	77	111

CHELAN COUNTY, WASHINGTON

(Alcoa Plant Site, Wenatchee)

MASTER HIGH FORECAST FOR BPADSI REGION 3

	1980	1981	1982	1983	1984	1985	1986	1987
EMPLOYMENT:PERSONS								
AGRICULTURAL	3762	3906	4050	4196	4353	4516	4682	4859
AGRICULTURAL SERVICES	417	427	443	455	463	475	487	498
MINING	37	38	40	41	41	43	43	44
CONSTRUCTION	1439	1433	1476	1518	1629	1641	1690	1742
NONDURABLE MANUFACTURING	994	995	995	997	1006	1014	1019	1020
DURABLE MANUFACTURING	2048	2074	2084	2062	2059	2145	2142	2145
PUBLIC UTILITIES	618	610	602	594	586	578	570	563
WHOLESALE TRADE	3226	3213	3299	3410	3523	3672	3788	3849
RETAIL TRADE	3783	3846	3884	3910	3949	3977	4008	4053
FINANCE-INSURANCE-REAL ESTATE	382	872	865	865	864	857	852	846
SERVICES	4161	4025	4016	4063	4082	4129	4139	4116
GOVERNMENT	4382	4468	4557	4647	4739	4832	4928	5025
TOTAL	25748	25908	26312	26760	27294	27881	28349	28763
NEW COMMERCIAL CONSTRUCTION SQ.FT								
RETAIL-WHOLESALE	62052	6425	6425	45962	112231	81504	112977	92328
OFFICE BUILDINGS	20189	295623	152760	815	815	815	815	815
AUTO REPAIR	49305	375979	400264	300	300	300	300	300
WAREHOUSES	143737	232051	343602	412552	421904	452022	453091	463284
EDUCATION	10197	10197	10197	10197	10197	10197	10197	10197
HEALTH	995	995	995	995	995	995	995	995
PUBLIC	3965	3965	3965	3965	3965	3965	3965	3965
RELIGIOUS	7401	28675	42040	22447	335	3613	335	335
HOTEL-MOTEL	3027	3027	3027	3027	3027	3027	3027	3027
MISCELLANEOUS	28431	3797	3797	32764	76130	50105	69341	53537
TOTAL	329300	960735	967073	533025	629901	606545	655044	628784
COMMERCIAL CONSTRUCTION SQ.FT ADDITIONS AND ALTERATIONS								
RETAIL-WHOLESALE	4155	1082	1082	10803	17945	5492	13697	7363
OFFICE BUILDINGS	515	515	515	515	515	515	515	515
AUTO REPAIR	0	0	0	0	0	0	0	0
WAREHOUSES	3667	1152	1152	1242	7578	1222	5594	2543
EDUCATION	1232	1232	1232	1232	2624	1232	2777	1232
HEALTH	28632	16064	10858	23005	36829	30221	35670	31351
PUBLIC	147	147	147	147	2647	147	584	147
RELIGIOUS	11844	11470	11164	10971	10845	10689	10589	10481
HOTEL-MOTEL	11688	1352	1352	6233	21518	9070	16923	10152
MISCELLANEOUS	562	562	562	562	562	562	562	562
TOTAL	62444	33579	28067	54712	101064	59151	86910	64346
RESIDENTIAL CONSTRUCTION SQ.FT:								
APARTMENTS								
FIVE OR MORE UNITS								
1-3 STORIES	10255	10255	10255	10255	10255	10255	10255	10255
4 OR MORE STORIES	1170	1170	1170	32206	67926	81690	89639	86173
THREE TO FOUR UNITS	1220	1220	1220	81629	163912	195953	199799	175330
SINGLE FAMILY DETACHED	234284	40082	822922	2401702	3474805	4331338	4769900	5171493
DUPLEXES	172	172	172	10315	25500	27204	16557	172
TOTAL	247101	52900	835740	2536106	3742398	4646441	5086150	5443423
WAGES: ANNUAL 000 1984 $								
AGRICULTURAL	29.274	29.561	30.135	30.631	30.806	31.131	31.447	31.699
AGRICULTURAL SERVICES	21.082	21.151	20.759	20.605	20.833	20.792	20.763	20.820
MINING	33.135	35.820	36.893	36.751	36.894	36.896	37.249	38.371
CONSTRUCTION	37.988	37.832	37.761	38.037	38.351	38.560	38.686	38.682
NONDURABLE MANUFACTURING	21.612	22.019	22.366	22.561	22.611	22.708	22.871	23.160
DURABLE MANUFACTURING	33.351	33.253	33.616	34.003	34.042	34.259	34.451	34.536
PUBLIC UTILITIES	28.078	28.652	29.065	29.210	29.191	29.230	29.386	29.775
WHOLESALE TRADE	20.742	21.705	22.118	22.343	22.635	22.797	23.064	23.604
RETAIL TRADE	14.429	14.028	13.886	13.887	13.802	13.762	13.695	13.553
FINANCE-INSURANCE-REAL ESTATE	25.726	27.530	28.109	28.268	28.595	28.655	28.983	29.952
SERVICES	19.078	19.471	19.571	19.607	19.707	19.723	19.798	20.029
GOVERNMENT	20.990	21.330	21.676	22.027	22.384	22.747	23.116	23.490
PERSONAL INCOME 000 1984 $								
WAGE BILL	597444	609780	626866	644075	663137	683108	700981	719574
PROPERTY INCOME	93609	96943	99897	102420	105405	108432	111651	115457
TRANSFER PAYMENTS	104611	106911	108273	110296	112465	114905	117527	119873
RESIDENCE ADJUSTMENT	-40560	-33772	-32159	-33623	-33661	-34324	-33965	-31400
SOCIAL INSURANCE ADJUSTMENT	28763	29395	29770	30326	30922	31593	32314	32959
PER CAPITA INCOME	15.643	15.974	16.412	16.688	17.022	17.325	17.584	17.951
TOTAL PERSONAL INCOME	726341	750467	773106	792842	816423	840528	863880	890545
DEMOGRAPHICS								
POPULATION	46433	46981	47107	47509	47962	48515	49128	49610
BIRTHS	613	622	624	630	637	645	653	660
DEATHS	486	492	493	497	502	508	514	520
MIGRATION	589	419	-6	270	318	416	474	341

MASTER HIGH FORECAST FOR BPADSI REGION 3

	1988	1989	1990	1991	1992	1993	1994	1995
EMPLOYMENT:PERSONS								
AGRICULTURAL	5045	5251	5447	5651	5867	6106	6333	6573
AGRICULTURAL SERVICES	508	521	531	544	555	568	578	589
MINING	44	45	45	46	47	48	49	50
CONSTRUCTION	1798	2017	2012	2072	2137	2387	2383	2455
NONDURABLE MANUFACTURING	1023	1030	1029	1030	1031	1036	1035	1034
DURABLE MANUFACTURING	2150	2180	2173	2169	2171	2195	2183	2175
PUBLIC UTILITIES	556	548	541	534	527	520	513	506
WHOLESALE TRADE	3921	3997	4054	4127	4198	4265	4305	4341
RETAIL TRADE	4098	4161	4204	4244	4288	4351	4392	4438
FINANCE-INSURANCE-REAL ESTATE	841	839	833	825	818	814	805	797
SERVICES	4159	4204	4214	4196	4259	4317	4336	4354
GOVERNMENT	5125	5226	5330	5435	5542	5652	5764	5878
TOTAL	29269	30020	30415	30875	31442	32261	32676	33190
NEW COMMERCIAL CONSTRUCTION SQ.FT								
RETAIL-WHOLESALE	90332	134014	109017	87439	83779	126910	107462	87193
OFFICE BUILDINGS	815	815	815	815	815	815	815	815
AUTO REPAIR	300	300	300	300	300	300	300	300
WAREHOUSES	472922	451251	448730	447991	452225	434984	432979	430762
EDUCATION	10197	10197	10197	10197	10197	10197	10197	10197
HEALTH	995	995	995	995	995	995	995	995
PUBLIC	3965	3965	3965	3965	3965	3965	3965	3965
RELIGIOUS	335	335	335	573	335	335	335	423
HOTEL-MOTEL	3027	3027	3027	3027	3027	3027	3027	3027
MISCELLANEOUS	53750	82283	65819	52331	50849	77902	66511	54698
TOTAL	636640	687182	643202	607633	606487	659431	626587	592377
COMMERCIAL CONSTRUCTION SQ.FT								
ADDITIONS AND ALTERATIONS								
RETAIL-WHOLESALE	9380	16146	7998	7424	8731	15145	8526	7795
OFFICE BUILDINGS	515	515	515	515	515	515	515	515
AUTO REPAIR	0	0	0	0	0	0	0	0
WAREHOUSES	3086	9146	5771	3850	4081	9712	7165	5357
EDUCATION	1232	3077	1232	1232	1232	3495	1232	1232
HEALTH	31281	38787	33416	29908	29559	36705	32653	29604
PUBLIC	147	2923	147	147	147	2687	147	147
RELIGIOUS	10399	10362	10299	10242	10200	10196	10165	10134
HOTEL-MOTEL	10110	22755	16297	10622	9746	21425	16872	11742
MISCELLANEOUS	562	562	562	562	562	562	562	562
TOTAL	66714	104274	76238	64503	64775	100442	77839	67090
RESIDENTIAL CONSTRUCTION SQ.FT:								
APARTMENTS								
FIVE OR MORE UNITS								
1-3 STORIES	10255	10255	10255	10255	10255	10255	10255	10255
4 OR MORE STORIES	82897	68906	55745	34852	6880	20317	19238	7611
THREE TO FOUR UNITS	138487	80703	21120	1220	1220	1220	1220	1220
SINGLE FAMILY DETACHED	5193832	5150191	4871072	3875280	4158185	4574451	4544820	4262420
DUPLEXES	172	172	172	172	172	172	172	172
TOTAL	5425643	5310228	4958364	3921780	4176712	4606416	4575706	4281678
WAGES: ANNUAL 000 1984 $								
AGRICULTURAL	31.898	32.069	32.215	32.422	32.538	32.643	32.725	32.789
AGRICULTURAL SERVICES	20.977	21.115	21.249	21.239	21.424	21.592	21.758	21.922
MINING	39.246	40.207	41.287	42.251	43.023	43.933	44.948	45.984
CONSTRUCTION	38.780	38.835	38.836	38.761	38.841	38.870	38.858	38.826
NONDURABLE MANUFACTURING	23.412	23.678	23.945	24.197	24.426	24.676	24.934	25.185
DURABLE MANUFACTURING	34.584	34.624	34.632	34.718	34.728	34.725	34.699	34.660
PUBLIC UTILITIES	30.105	30.467	30.846	31.201	31.517	31.877	32.260	32.642
WHOLESALE TRADE	24.142	24.688	25.236	25.647	26.143	26.664	27.196	27.718
RETAIL TRADE	13.439	13.323	13.196	13.090	13.002	12.904	12.798	12.691
FINANCE-INSURANCE-REAL ESTATE	30.902	31.881	32.877	33.552	34.465	35.424	36.429	37.424
SERVICES	20.275	20.530	20.790	20.967	21.212	21.472	21.743	22.010
GOVERNMENT	23.871	24.258	24.651	25.051	25.457	25.869	26.289	26.715
PERSONAL INCOME 000 1984 $								
WAGE BILL	740436	770050	787539	807166	830131	862477	881120	903292
PROPERTY INCOME	119475	124084	128642	133456	138596	144493	150339	156746
TRANSFER PAYMENTS	122109	124641	127905	130217	132753	135643	139322	141876
RESIDENCE ADJUSTMENT	-29420	-27134	-24361	-22149	-20275	-17956	-15225	-12521
SOCIAL INSURANCE ADJUSTMENT	33574	34270	35168	35803	36501	37295	38307	39009
PER CAPITA INCOME	18.369	18.935	19.166	19.562	19.990	20.568	20.782	21.224
TOTAL PERSONAL INCOME	919027	957371	984558	1012886	1044705	1087361	1117249	1150384
DEMOGRAPHICS								
POPULATION	50032	50562	51369	51778	52261	52867	53761	54202
BIRTHS	666	674	686	692	699	708	721	727
DEATHS	524	530	538	543	548	554	564	568
MIGRATION	280	385	660	259	332	452	737	282

MASTER HIGH FORECAST FOR BPADSI REGION 3

	1996	1997	1998	1999	2000	2001
EMPLOYMENT:PERSONS						
AGRICULTURAL	6819	7078	7348	7639	7942	8248
AGRICULTURAL SERVICES	602	614	627	641	656	671
MINING	51	52	54	55	57	58
CONSTRUCTION	2529	2607	2688	2902	3108	3233
NONDURABLE MANUFACTURING	1033	1034	1035	1039	1042	1044
DURABLE MANUFACTURING	2154	2137	2122	2121	2119	2109
PUBLIC UTILITIES	500	493	487	480	474	468
WHOLESALE TRADE	4384	4448	4514	4591	4664	4746
RETAIL TRADE	4485	4535	4587	4650	4715	4770
FINANCE-INSURANCE-REAL ESTATE	791	787	783	780	778	773
SERVICES	4369	4457	4544	4637	4724	4802
GOVERNMENT	5994	6113	6233	6357	6482	6611
TOTAL	33712	34356	35023	35894	36761	37534
NEW COMMERCIAL CONSTRUCTION SQ.FT						
RETAIL-WHOLESALE	96362	76195	98638	126151	139871	135134
OFFICE BUILDINGS	815	815	815	815	815	815
AUTO REPAIR	300	300	300	300	300	300
WAREHOUSES	429163	437493	441611	432309	418422	402918
EDUCATION	10197	10197	10197	10197	10197	10197
HEALTH	995	995	995	995	995	995
PUBLIC	3965	3965	3965	3965	3965	3965
RELIGIOUS	335	2000	335	335	335	335
HOTEL-MOTEL	3027	3027	3027	3027	3027	3027
MISCELLANEOUS	61596	50310	64196	79442	86576	83415
TOTAL	606755	585297	624131	657537	664504	641102
COMMERCIAL CONSTRUCTION SQ.FT ADDITIONS AND ALTERATIONS						
RETAIL-WHOLESALE	10707	7224	11653	13328	12680	11002
OFFICE BUILDINGS	515	515	515	515	515	515
AUTO REPAIR	0	0	0	0	0	0
WAREHOUSES	7154	4889	7790	10705	12111	11845
EDUCATION	1232	1232	1232	4185	4335	4475
HEALTH	31414	28183	31738	35494	36614	35093
PUBLIC	147	147	147	1792	2011	1231
RELIGIOUS	10121	10094	10094	10104	10112	10111
HOTEL-MOTEL	14444	9245	14712	21238	24710	23873
MISCELLANEOUS	562	562	562	562	562	562
TOTAL	76298	62092	78444	97924	103652	98707
RESIDENTIAL CONSTRUCTION SQ.FT:						
APARTMENTS						
FIVE OR MORE UNITS						
1-3 STORIES	10255	10255	10255	10255	10255	10255
4 OR MORE STORIES	1170	1170	24852	23369	8596	1170
THREE TO FOUR UNITS	1220	1220	1220	1220	1220	1220
SINGLE FAMILY DETACHED	4097526	5207784	5994358	6172657	6021569	5782883
DUPLEXES	172	172	172	172	172	172
TOTAL	4110344	5220601	6030888	6207674	6041813	5795700
WAGES: ANNUAL 000 1984 $						
AGRICULTURAL	32.882	32.946	33.003	33.055	33.088	33.143
AGRICULTURAL SERVICES	22.008	22.161	22.299	22.427	22.567	22.653
MINING	46.868	47.523	48.227	48.895	49.612	50.257
CONSTRUCTION	38.764	38.789	38.781	38.767	38.740	38.686
NONDURABLE MANUFACTURING	25.404	25.584	25.764	25.934	26.106	26.262
DURABLE MANUFACTURING	34.663	34.652	34.635	34.619	34.583	34.577
PUBLIC UTILITIES	32.970	33.231	33.500	33.755	34.019	34.256
WHOLESALE TRADE	28.123	28.505	28.877	29.224	29.583	29.872
RETAIL TRADE	12.601	12.533	12.460	12.392	12.319	12.255
FINANCE-INSURANCE-REAL ESTATE	38.169	38.850	39.531	40.165	40.847	41.382
SERVICES	22.210	22.404	22.594	22.770	22.957	23.102
GOVERNMENT	27.148	27.588	28.033	28.489	28.951	29.420
PERSONAL INCOME 000 1984 $						
WAGE BILL	925034	949979	975655	1008489	1041358	1070587
PROPERTY INCOME	163422	170468	178041	186349	195252	204453
TRANSFER PAYMENTS	144766	147732	151119	154637	158853	163136
RESIDENCE ADJUSTMENT	-10261	-8581	-6717	-4940	-2946	-1200
SOCIAL INSURANCE ADJUSTMENT	39804	40619	41550	42518	43677	44855
PER CAPITA INCOME	21.608	22.035	22.428	22.939	23.366	23.718
TOTAL PERSONAL INCOME	1183158	1218978	1256547	1302018	1348840	1392123
DEMOGRAPHICS						
POPULATION	54756	55321	56027	56760	57728	58694
BIRTHS	735	744	754	764	778	792
DEATHS	574	580	588	595	606	616
MIGRATION	393	402	539	565	795	791

MASTER 2/5 CAPACITY FORECAST FOR BPACSI REGION 3

	1980	1981	1982	1983	1984	1985	1986	1987
EMPLOYMENT:PERSONS								
AGRICULTURAL	3762	3906	4050	4195	4353	4440	4598	4774
AGRICULTURAL SERVICES	417	427	443	455	463	463	474	485
MINING	37	38	40	41	41	42	43	43
CONSTRUCTION	1439	1433	1476	1518	1629	1584	1627	1679
NONDURABLE MANUFACTURING	994	995	995	997	1006	970	971	973
DURABLE MANUFACTURING	2048	2074	2084	2082	2059	1042	1034	1038
PUBLIC UTILITIES	618	610	602	594	586	578	570	563
WHOLESALE TRADE	3226	3213	3299	3410	3523	3620	3730	3792
RETAIL TRADE	3783	3846	3884	3910	3949	3869	3891	3937
FINANCE-INSURANCE-REAL ESTATE	882	872	865	865	864	834	827	822
SERVICES	4161	4025	4016	4063	4082	4076	4082	4059
GOVERNMENT	4382	4468	4557	4647	4739	4832	4928	5025
TOTAL	25748	25908	26312	26760	27294	26351	26775	27190
NEW COMMERCIAL CONSTRUCTION SQ.FT								
RETAIL-WHOLESALE	62052	6425	6425	45962	112231	81504	105548	86739
OFFICE BUILDINGS	20189	295623	152760	815	815	815	815	815
AUTO REPAIR	49305	375979	400264	300	300	300	300	300
WAREHOUSES	143737	232051	343602	412552	421904	452022	416885	431233
EDUCATION	10197	10197	10197	10197	10197	10197	10197	10197
HEALTH	995	995	995	995	995	995	995	995
PUBLIC	3965	3965	3965	3965	3965	3965	3965	3965
RELIGIOUS	7401	28675	42040	22447	335	3613	335	335
HOTEL-MOTEL	3027	3027	3027	3027	3027	3027	3027	3027
MISCELLANEOUS	28431	3797	3797	32764	76130	50105	59807	46989
TOTAL	329300	960735	967073	533025	629901	606545	601875	584596
COMMERCIAL CONSTRUCTION SQ.FT								
ADDITIONS AND ALTERATIONS								
RETAIL-WHOLESALE	4155	1082	1082	10803	17945	5492	13784	7251
OFFICE BUILDINGS	515	515	515	515	515	515	515	515
AUTO REPAIR	0	0	0	0	0	0	0	0
WAREHOUSES	3667	1152	1152	1242	7578	1222	4419	1865
EDUCATION	1232	1232	1232	1232	2624	1232	2600	1232
HEALTH	28632	16064	10858	23005	36829	30221	35670	31351
PUBLIC	147	147	147	147	2647	147	584	147
RELIGIOUS	11844	11470	11164	10971	10845	10689	10580	10467
HOTEL-MOTEL	11688	1352	1352	6233	21518	9070	13186	7900
MISCELLANEOUS	562	562	562	562	562	562	562	562
TOTAL	62444	33579	28067	54712	101064	59151	81900	61291
RESIDENTIAL CONSTRUCTION SQ.FT:								
APARTMENTS								
FIVE OR MORE UNITS								
1-3 STORIES	10255	10255	10255	10255	10255	10255	10255	10255
4 OR MORE STORIES	1170	1170	1170	32206	67926	81690	95445	89632
THREE TO FOUR UNITS	1220	1220	1220	81629	163912	195953	189418	168351
SINGLE FAMILY DETACHED	234284	40082	822922	2401702	3474805	4331338	4720699	5130383
DUPLEXES	172	172	172	10315	25500	27204	7430	172
TOTAL	247101	52900	835740	2536106	3742398	4646441	5023246	5398794
WAGES: ANNUAL 000 1984 $								
AGRICULTURAL	29.274	29.561	30.135	30.631	30.806	31.131	31.447	31.699
AGRICULTURAL SERVICES	21.082	21.151	20.759	20.605	20.833	20.792	20.763	20.820
MINING	33.135	35.820	36.893	36.751	36.894	36.896	37.249	38.371
CONSTRUCTION	37.988	37.832	37.761	38.037	38.351	38.560	38.686	38.682
NONDURABLE MANUFACTURING	21.612	22.019	22.366	22.561	22.611	22.708	22.871	23.160
DURABLE MANUFACTURING	33.351	33.253	33.616	34.003	34.042	34.259	34.451	34.536
PUBLIC UTILITIES	28.078	28.652	29.065	29.210	29.191	29.230	29.386	29.775
WHOLESALE TRADE	20.742	21.705	22.118	22.343	22.635	22.797	23.064	23.604
RETAIL TRADE	14.429	14.028	13.886	13.887	13.802	13.762	13.695	13.553
FINANCE-INSURANCE-REAL ESTATE	25.726	27.530	28.109	28.268	28.595	28.655	28.983	29.952
SERVICES	19.078	19.471	19.571	19.607	19.707	19.723	19.798	20.029
GOVERNMENT	20.990	21.330	21.676	22.027	22.384	22.747	23.116	23.490
PERSONAL INCOME 000 1984 $								
WAGE BILL	597444	609780	626866	644075	663137	635077	651549	669979
PROPERTY INCOME	93609	96943	99897	102420	105405	106697	109842	113616
TRANSFER PAYMENTS	104611	106911	108273	110296	112465	114905	113395	115565
RESIDENCE ADJUSTMENT	-40560	-33772	-32159	-33623	-33661	-34322	-34647	-32064
SOCIAL INSURANCE ADJUSTMENT	28763	29395	29770	30326	30922	31593	31178	31775
PER CAPITA INCOME	15.643	15.974	16.412	16.688	17.022	16.299	17.067	17.465
TOTAL PERSONAL INCOME	726341	750467	773106	792842	816423	790764	808962	835321
DEMOGRAPHICS								
POPULATION	46433	46981	47107	47509	47962	48515	47401	47827
BIRTHS	613	622	624	630	637	645	628	636
DEATHS	486	492	493	497	502	508	496	501
MIGRATION	589	419	-6	270	318	416	-1246	291

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MASTER 2/5 CAPACITY FORECAST FOR BPADSI REGION 3

	1988	1989	1990	1991	1992	1993	1994	1995
EMPLOYMENT:PERSONS								
AGRICULTURAL	4959	5164	5359	5562	5777	6015	6242	6481
AGRICULTURAL SERVICES	495	508	518	531	542	555	566	577
MINING	44	44	45	46	47	47	48	49
CONSTRUCTION	1734	1946	1944	2003	2068	2312	2309	2381
NONDURABLE MANUFACTURING	976	982	983	983	985	990	989	988
DURABLE MANUFACTURING	1042	1059	1058	1058	1061	1075	1072	1070
PUBLIC UTILITIES	555	548	541	534	527	520	513	506
WHOLESALE TRADE	3865	3941	3999	4073	4145	4212	4253	4291
RETAIL TRADE	3983	4046	4091	4132	4177	4240	4283	4330
FINANCE-INSURANCE-REAL ESTATE	818	816	810	803	797	793	785	777
SERVICES	4102	4147	4158	4141	4204	4262	4282	4300
GOVERNMENT	5125	5226	5330	5435	5542	5652	5764	5878
TOTAL	27699	28429	28836	29302	29873	30675	31106	31631
NEW COMMERCIAL CONSTRUCTION SQ.FT								
RETAIL-WHOLESALE	86305	130043	106138	85414	82075	124568	105581	85806
OFFICE BUILDINGS	815	815	815	815	815	815	815	815
AUTO REPAIR	300	300	300	300	300	300	300	300
WAREHOUSES	447173	429290	430460	433478	440251	423809	423025	422713
EDUCATION	10197	10197	10197	10197	10197	10197	10197	10197
HEALTH	995	995	995	995	995	995	995	995
PUBLIC	3965	3965	3965	3965	3965	3965	3965	3965
RELIGIOUS	335	335	335	569	335	335	335	420
HOTEL-MOTEL	3027	3027	3027	3027	3027	3027	3027	3027
MISCELLANEOUS	49673	79546	63448	50667	49426	76597	65128	53481
TOTAL	602787	658513	619882	589429	591387	644608	613369	581720
COMMERCIAL CONSTRUCTION SQ.FT								
ADDITIONS AND ALTERATIONS								
RETAIL-WHOLESALE	9266	16092	7873	7292	8612	15083	8408	7668
OFFICE BUILDINGS	515	515	515	515	515	515	515	515
AUTO REPAIR	0	0	0	0	0	0	0	0
WAREHOUSES	2634	8757	5380	3481	3715	9345	6781	4991
EDUCATION	1232	2896	1232	1232	1232	3312	1232	1232
HEALTH	31281	38787	33416	29908	29559	36705	32653	29604
PUBLIC	147	2922	147	147	147	2686	147	147
RELIGIOUS	10388	10352	10290	10234	10193	10191	10160	10129
HOTEL-MOTEL	8964	22170	15935	10455	9664	21381	16792	11729
MISCELLANEOUS	562	562	562	562	562	562	562	562
TOTAL	64989	103054	75351	63827	64201	99780	77252	66579
RESIDENTIAL CONSTRUCTION SQ.FT:								
APARTMENTS								
FIVE OR MORE UNITS								
1-3 STORIES	10255	10255	10255	10255	10255	10255	10255	10255
4 OR MORE STORIES	84724	69726	56026	34673	6437	19726	18633	6870
THREE TO FOUR UNITS	133908	77600	18777	1220	1220	1220	1220	1220
SINGLE FAMILY DETACHED	5160532	5123014	4848002	3856467	4142567	4561236	4532839	4252433
DUPLEXES	172	172	172	172	172	172	172	172
TOTAL	5389591	5280768	4933233	3902788	4160652	4592609	4563119	4270951
WAGES: ANNUAL 000 1984 $								
AGRICULTURAL	31.890	32.069	32.215	32.422	32.538	32.643	32.725	32.789
AGRICULTURAL SERVICES	20.977	21.115	21.249	21.239	21.424	21.592	21.758	21.922
MINING	39.246	40.207	41.287	42.251	43.023	43.933	44.948	45.984
CONSTRUCTION	38.780	38.835	38.836	38.761	38.841	38.870	38.858	38.826
NONDURABLE MANUFACTURING	23.412	23.678	23.945	24.197	24.426	24.676	24.934	25.185
DURABLE MANUFACTURING	34.584	34.624	34.632	34.718	34.728	34.725	34.699	34.660
PUBLIC UTILITIES	30.105	30.467	30.846	31.201	31.517	31.877	32.260	32.642
WHOLESALE TRADE	24.142	24.688	25.236	25.647	26.143	26.664	27.196	27.718
RETAIL TRADE	13.439	13.323	13.196	13.090	13.002	12.904	12.798	12.691
FINANCE-INSURANCE-REAL ESTATE	30.902	31.881	32.877	33.562	34.465	35.424	36.429	37.424
SERVICES	20.275	20.530	20.790	20.967	21.212	21.472	21.743	22.010
GOVERNMENT	23.871	24.258	24.651	25.051	25.457	25.869	26.289	26.715
PERSONAL INCOME 000 1984 $								
WAGE BILL	690702	719435	737199	756863	779824	811466	830555	853026
PROPERTY INCOME	117606	122166	126695	131476	136582	142425	148236	154604
TRANSFER PAYMENTS	117748	120226	123373	125660	128156	130996	134565	137102
RESIDENCE ADJUSTMENT	-30052	-27735	-24938	-22696	-20795	-18451	-15701	-12969
SOCIAL INSURANCE ADJUSTMENT	32375	33056	33922	34550	35237	36017	36999	37696
PER CAPITA INCOME	17.901	18.475	18.737	19.148	19.594	20.182	20.427	20.888
TOTAL PERSONAL INCOME	863629	901037	928408	956753	988531	1030418	1060656	1094066
DEMOGRAPHICS								
POPULATION	48246	48771	49550	49966	50451	51056	51925	52378
BIRTHS	642	650	661	667	674	683	696	702
DEATHS	505	511	519	523	528	535	544	549
MIGRATION	282	386	636	272	348	456	717	299

MASTER 2/5 CAPACITY FORECAST FOR BPADSI REGION 3

	1996	1997	1998	1999	2000	2001
EMPLOYMENT:PERSONS						
AGRICULTURAL	6727	6987	7257	7547	7849	8155
AGRICULTURAL SERVICES	590	602	615	629	644	659
MINING	50	52	53	54	56	57
CONSTRUCTION	2455	2533	2614	2826	3028	3152
NONDURABLE MANUFACTURING	988	989	990	994	998	1000
DURABLE MANUFACTURING	1062	1057	1052	1053	1054	1051
PUBLIC UTILITIES	499	493	486	480	474	467
WHOLESALE TRADE	4335	4400	4468	4545	4620	4702
RETAIL TRADE	4380	4431	4484	4549	4614	4671
FINANCE-INSURANCE-REAL ESTATE	772	768	764	762	760	757
SERVICES	4317	4405	4492	4584	4671	4749
GOVERNMENT	5994	6113	6233	6357	6482	6611
TOTAL	32171	32829	33509	34383	35252	36033
NEW COMMERCIAL CONSTRUCTION SQ.FT						
RETAIL-WHOLESALE	94903	75169	97357	124443	138006	133391
OFFICE BUILDINGS	815	815	815	815	815	815
AUTO REPAIR	300	300	300	300	300	300
WAREHOUSES	422015	431821	436234	426854	412748	397325
EDUCATION	10197	10197	10197	10197	10197	10197
HEALTH	995	995	995	995	995	995
PUBLIC	3965	3965	3965	3965	3965	3965
RELIGIOUS	335	1996	335	335	335	335
HOTEL-MOTEL	3027	3027	3027	3027	3027	3027
MISCELLANEOUS	60456	49256	63174	78434	85507	82298
TOTAL	597009	577541	616400	649366	655895	632649
COMMERCIAL CONSTRUCTION SQ.FT						
ADDITIONS AND ALTERATIONS						
RETAIL-WHOLESALE	10608	7097	11565	13255	12603	10912
OFFICE BUILDINGS	515	515	515	515	515	515
AUTO REPAIR	0	0	0	0	0	0
WAREHOUSES	6792	4535	7439	10355	11755	11484
EDUCATION	1232	1232	1232	4008	4158	4298
HEALTH	31414	28183	31738	35494	36614	35093
PUBLIC	147	147	147	1791	2010	1230
RELIGIOUS	10117	10090	10091	10101	10109	10108
HOTEL-MOTEL	14458	9289	14764	21291	24735	23878
MISCELLANEOUS	562	562	562	562	562	562
TOTAL	75846	61651	78053	97373	103062	98081
RESIDENTIAL CONSTRUCTION SQ.FT:						
APARTMENTS						
FIVE OR MORE UNITS						
1-3 STORIES	10255	10255	10255	10255	10255	10255
4 OR MORE STORIES	1170	1170	24527	22802	7940	1170
THREE TO FOUR UNITS	1220	1220	1220	1220	1220	1220
SINGLE FAMILY DETACHED	4088968	5200589	5988119	6167142	6016291	5777737
DUPLEXES	172	172	172	172	172	172
TOTAL	4101786	5213407	6024294	6201592	6033878	5790554
WAGES: ANNUAL 000 1984 $						
AGRICULTURAL	32.882	32.946	33.003	33.055	33.088	33.143
AGRICULTURAL SERVICES	22.008	22.161	22.299	22.427	22.567	22.653
MINING	46.868	47.523	48.227	48.895	49.612	50.257
CONSTRUCTION	38.764	38.789	38.781	38.767	38.740	38.686
NONDURABLE MANUFACTURING	25.404	25.584	25.764	25.934	26.106	26.262
DURABLE MANUFACTURING	34.663	34.652	34.635	34.619	34.583	34.577
PUBLIC UTILITIES	32.970	33.231	33.500	33.755	34.019	34.256
WHOLESALE TRADE	28.123	28.505	28.877	29.224	29.583	29.872
RETAIL TRADE	12.601	12.533	12.460	12.392	12.319	12.255
FINANCE-INSURANCE-REAL ESTATE	38.169	38.850	39.531	40.165	40.847	41.332
SERVICES	22.210	22.404	22.594	22.770	22.957	23.102
GOVERNMENT	27.148	27.588	28.035	28.489	28.951	29.420
PERSONAL INCOME 000 1984 $						
WAGE BILL	875289	900647	926711	959570	992422	1021870
PROPERTY INCOME	161250	168266	175807	184072	192925	202080
TRANSFER PAYMENTS	139962	142921	146288	149784	153944	158167
RESIDENCE ADJUSTMENT	-10685	-8985	-7100	-5306	-3297	-1536
SOCIAL INSURANCE ADJUSTMENT	38483	39296	40222	41183	42327	43488
PER CAPITA INCOME	21.295	21.741	22.153	22.680	23.124	23.496
TOTAL PERSONAL INCOME	1127334	1163553	1201484	1246937	1293667	1337092
DEMOGRAPHICS						
POPULATION	52939	53520	54236	54979	55944	56906
BIRTHS	711	719	729	740	754	767
DEATHS	555	561	569	576	587	597
MIGRATION	405	423	555	580	798	792

MASTER LOW FORECAST FOR BPADSI REGION 3

	1980	1981	1982	1983	1984	1985	1986	1987
EMPLOYMENT:PERSONS								
AGRICULTURAL	3762	3906	4050	4196	4353	4385	4537	4712
AGRICULTURAL SERVICES	417	427	443	455	463	454	464	476
MINING	37	38	40	41	41	42	43	43
CONSTRUCTION	1439	1433	1476	1518	1629	1544	1583	1635
NONDURABLE MANUFACTURING	994	995	995	997	1006	939	938	940
DURABLE MANUFACTURING	2048	2074	2084	2062	2059	297	294	295
PUBLIC UTILITIES	618	610	602	594	586	577	570	562
WHOLESALE TRADE	3226	3213	3299	3410	3523	3582	3689	3751
RETAIL TRADE	3783	3846	3884	3910	3949	3792	3807	3853
FINANCE-INSURANCE-REAL ESTATE	882	872	865	865	864	818	809	805
SERVICES	4161	4025	4016	4063	4082	4038	4040	4018
GOVERNMENT	4382	4468	4557	4647	4739	4832	4928	5025
TOTAL	25748	25908	26312	26760	27294	25303	25704	26117
NEW COMMERCIAL CONSTRUCTION SQ.FT								
RETAIL-WHOLESALE	62052	6425	6425	45962	112231	81504	100195	82746
OFFICE BUILDINGS	20189	295623	152760	815	815	815	815	815
AUTO REPAIR	49305	375979	400264	300	300	300	300	300
WAREHOUSES	143737	232051	343602	412552	421904	452022	392134	409512
EDUCATION	10197	10197	10197	10197	10197	10197	10197	10197
HEALTH	995	995	995	995	995	995	995	995
PUBLIC	3965	3965	3965	3965	3965	3965	3965	3965
RELIGIOUS	7401	28675	42040	22447	335	3613	335	335
HOTEL-MOTEL	3027	3027	3027	3027	3027	3027	3027	3027
MISCELLANEOUS	28431	3797	3797	32764	76130	50105	53291	42563
TOTAL	329300	960735	967073	533025	629901	606545	565255	554456
COMMERCIAL CONSTRUCTION SQ.FT ADDITIONS AND ALTERATIONS								
RETAIL-WHOLESALE	4155	1082	1082	10803	17945	5492	13847	7170
OFFICE BUILDINGS	515	515	515	515	515	515	515	515
AUTO REPAIR	0	0	0	0	0	0	0	0
WAREHOUSES	3667	1152	1152	1242	7578	1222	3616	1408
EDUCATION	1232	1232	1232	1232	2624	1232	2480	1232
HEALTH	28632	16064	10858	23005	36829	30221	35670	31351
PUBLIC	147	147	147	147	2647	147	584	147
RELIGIOUS	11844	11470	11164	10971	10845	10689	10574	10458
HOTEL-MOTEL	11688	1352	1352	6233	21518	9070	10632	6381
MISCELLANEOUS	562	562	562	562	562	562	562	562
TOTAL	62444	33579	28067	54712	101064	59151	78480	59224
RESIDENTIAL CONSTRUCTION SQ.FT:								
APARTMENTS								
FIVE OR MORE UNITS								
1-3 STORIES	10255	10255	10255	10255	10255	10255	10255	10255
4 OR MORE STORIES	1170	1170	1170	32206	67926	81690	99426	91975
THREE TO FOUR UNITS	1220	1220	1220	81629	163912	195953	182299	163618
SINGLE FAMILY DETACHED	234284	40082	822922	2401702	3474805	4331338	4686961	5102447
DUPLEXES	172	172	172	10315	25500	27204	1171	172
TOTAL	247101	52900	835740	2536106	3742398	4646441	4980113	5368467
WAGES: ANNUAL 000 1984 $								
AGRICULTURAL	29.274	29.561	30.135	30.631	30.806	31.131	31.447	31.699
AGRICULTURAL SERVICES	21.082	21.151	20.759	20.605	20.833	20.792	20.763	20.820
MINING	33.135	35.820	36.893	36.751	36.894	36.896	37.249	38.371
CONSTRUCTION	37.988	37.832	37.761	38.037	38.351	38.560	38.686	38.682
NONDURABLE MANUFACTURING	21.612	22.019	22.366	22.561	22.611	22.708	22.871	23.160
DURABLE MANUFACTURING	33.351	33.253	33.616	34.003	34.042	34.259	34.451	34.536
PUBLIC UTILITIES	28.078	28.652	29.065	29.210	29.191	29.230	29.386	29.775
WHOLESALE TRADE	20.742	21.705	22.118	22.343	22.635	22.797	23.064	23.604
RETAIL TRADE	14.429	14.028	13.886	13.887	13.802	13.762	13.695	13.553
FINANCE-INSURANCE-REAL ESTATE	25.726	27.530	28.109	28.268	28.595	28.655	28.983	29.952
SERVICES	19.078	19.471	19.571	19.607	19.707	19.723	19.798	20.029
GOVERNMENT	20.990	21.330	21.676	22.027	22.384	22.747	23.116	23.490
PERSONAL INCOME 000 1984 $								
WAGE BILL	597444	609780	626866	644075	663137	602289	618067	636284
PROPERTY INCOME	93609	96943	99897	102420	105405	105465	108567	112315
TRANSFER PAYMENTS	104611	106911	108273	110296	112465	114905	110561	112632
RESIDENCE ADJUSTMENT	-40560	-33772	-32159	-33023	-33661	-34321	-35114	-32516
SOCIAL INSURANCE ADJUSTMENT	28763	29395	29770	30326	30922	31593	30399	30968
PER CAPITA INCOME	15.643	15.974	16.412	16.688	17.022	15.598	16.697	17.114
TOTAL PERSONAL INCOME	726341	750467	773106	792842	816423	756745	771682	797746
DEMOGRAPHICS								
POPULATION	46433	46981	47107	47509	47962	48515	46216	46613
BIRTHS	613	622	624	630	637	645	611	619
DEATHS	486	492	493	497	502	508	484	488
MIGRATION	589	419	-6	270	318	416	-2426	266

MASTER LOW FORECAST FOR BPADSI REGION 3

	1988	1989	1990	1991	1992	1993	1994	1995
EMPLOYMENT:PERSONS								
AGRICULTURAL	4897	5100	5296	5497	5712	5949	6175	6414
AGRICULTURAL SERVICES	486	498	509	522	532	546	556	568
MINING	44	44	45	46	46	47	48	49
CONSTRUCTION	1689	1896	1895	1955	2019	2258	2257	2329
NONDURABLE MANUFACTURING	943	949	950	950	952	957	956	956
DURABLE MANUFACTURING	297	302	303	303	304	309	308	308
PUBLIC UTILITIES	555	548	540	533	526	519	513	506
WHOLESALE TRADE	3824	3901	3959	4033	4106	4174	4216	4254
RETAIL TRADE	3900	3964	4009	4051	4096	4160	4203	4252
FINANCE-INSURANCE-REAL ESTATE	801	799	794	787	781	778	770	762
SERVICES	4062	4106	4118	4101	4165	4222	4242	4261
GOVERNMENT	5125	5226	5330	5435	5542	5652	5764	5878
TOTAL	26623	27335	27746	28215	28784	29571	30009	30538
NEW COMMERCIAL CONSTRUCTION SQ.FT								
RETAIL-WHOLESALE	83418	127177	104044	83926	80814	122836	104178	84759
OFFICE BUILDINGS	815	815	815	815	815	815	815	815
AUTO REPAIR	300	300	300	300	300	300	300	300
WAREHOUSES	429659	414253	417856	423366	431821	415872	415877	416844
EDUCATION	10197	10197	10197	10197	10197	10197	10197	10197
HEALTH	995	995	995	995	995	995	995	995
PUBLIC	3965	3965	3965	3965	3965	3965	3965	3965
RELIGIOUS	335	335	335	567	335	335	335	417
HOTEL-MOTEL	3027	3027	3027	3027	3027	3027	3027	3027
MISCELLANEOUS	46898	77658	62130	49485	48402	75648	64121	52585
TOTAL	579611	638723	603666	576645	580672	633990	603811	573905
COMMERCIAL CONSTRUCTION SQ.FT								
ADDITIONS AND ALTERATIONS								
RETAIL-WHOLESALE	9184	16054	7784	7197	8527	15038	8323	7577
OFFICE BUILDINGS	515	515	515	515	515	515	515	515
AUTO REPAIR	0	0	0	0	0	0	0	0
WAREHOUSES	2326	8489	5109	3224	3459	9088	6511	4732
EDUCATION	1232	2772	1232	1232	1232	3185	1232	1232
HEALTH	31281	38787	33416	29908	29559	36705	32653	29604
PUBLIC	147	2922	147	147	147	2685	147	147
RELIGIOUS	10380	10345	10284	10229	10189	10187	10156	10126
HOTEL-MOTEL	8183	21762	15673	10323	9589	21332	16717	11699
MISCELLANEOUS	562	562	562	562	562	562	562	562
TOTAL	63811	102208	74724	63339	63781	99297	76817	66196
RESIDENTIAL CONSTRUCTION SQ.FT:								
APARTMENTS								
FIVE OR MORE UNITS								
1-3 STORIES	10255	10255	10255	10255	10255	10255	10255	10255
4 OR MORE STORIES	85971	70300	56240	34577	6162	19349	18246	6390
THREE TO FOUR UNITS	130781	75456	17138	1220	1220	1220	1220	1220
SINGLE FAMILY DETACHED	5137804	5104348	4832048	3843339	4131564	4551825	4524221	4245148
DUPLEXES	172	172	172	172	172	172	172	172
TOTAL	5364984	5260532	4915853	3889564	4149373	4582821	4554115	4263185
WAGES: ANNUAL 000 1984 $								
AGRICULTURAL	31.890	32.069	32.215	32.422	32.538	32.643	32.725	32.789
AGRICULTURAL SERVICES	20.977	21.115	21.249	21.239	21.424	21.592	21.758	21.922
MINING	39.246	40.207	41.287	42.251	43.023	43.933	44.948	45.984
CONSTRUCTION	38.780	38.835	38.836	38.761	38.841	38.870	38.858	38.826
NONDURABLE MANUFACTURING	23.412	23.678	23.945	24.197	24.426	24.676	24.934	25.185
DURABLE MANUFACTURING	34.584	34.624	34.632	34.718	34.728	34.725	34.699	34.660
PUBLIC UTILITIES	30.105	30.447	30.846	31.201	31.517	31.877	32.260	32.642
WHOLESALE TRADE	24.142	24.688	25.236	25.647	26.143	26.664	27.196	27.718
RETAIL TRADE	13.439	13.323	13.196	13.090	13.002	12.904	12.798	12.691
FINANCE-INSURANCE-REAL ESTATE	30.902	31.881	32.877	33.582	34.465	35.424	36.429	37.424
SERVICES	20.275	20.530	20.790	20.967	21.212	21.472	21.743	22.010
GOVERNMENT	23.871	24.258	24.651	25.051	25.457	25.869	26.289	26.715
PERSONAL INCOME 000 1984 $								
WAGE BILL	656791	684805	702630	722204	745043	776075	795352	817908
PROPERTY INCOME	116251	120804	125308	130062	135140	140939	146722	153057
TRANSFER PAYMENTS	114771	117202	120260	122517	124977	127771	131252	133768
RESIDENCE ADJUSTMENT	-30483	-28147	-25335	-23072	-21155	-18795	-16032	-13282
SOCIAL INSURANCE ADJUSTMENT	31556	32225	33066	33686	34363	35131	36088	36780
PER CAPITA INCOME	17.561	18.140	18.423	18.844	19.302	19.897	20.163	20.638
TOTAL PERSONAL INCOME	825804	862439	889797	918025	949642	990860	1021207	1054671
DEMOGRAPHICS								
POPULATION	47026	47544	48299	48716	49200	49799	50647	51104
BIRTHS	625	633	644	650	657	666	678	685
DEATHS	492	498	506	510	515	522	531	535
MIGRATION	280	383	617	277	341	455	700	307

MASTER LOW FORECAST FOR BPADSI REGION 3

	1996	1997	1998	1999	2000	2001
EMPLOYMENT:PERSONS						
AGRICULTURAL	6660	6919	7189	7479	7780	8085
AGRICULTURAL SERVICES	581	593	606	621	635	650
MINING	50	51	53	54	55	57
CONSTRUCTION	2402	2480	2561	2771	2970	3092
NONDURABLE MANUFACTURING	956	957	959	963	966	969
DURABLE MANUFACTURING	306	305	304	305	306	305
PUBLIC UTILITIES	499	493	486	480	473	467
WHOLESALE TRADE	4299	4365	4433	4511	4586	4670
RETAIL TRADE	4302	4354	4409	4473	4539	4597
FINANCE-INSURANCE-REAL ESTATE	758	754	751	749	748	744
SERVICES	4278	4366	4453	4546	4632	4710
GOVERNMENT	5994	6113	6233	6357	6482	6611
TOTAL	31087	31752	32438	33309	34175	34959
NEW COMMERCIAL CONSTRUCTION SQ.FT						
RETAIL-WHOLESALE	93800	74379	96339	123144	136585	132057
OFFICE BUILDINGS	815	815	815	815	815	815
AUTO REPAIR	300	300	300	300	300	300
WAREHOUSES	416733	427531	432120	422660	408362	392986
EDUCATION	10197	10197	10197	10197	10197	10197
HEALTH	995	995	995	995	995	995
PUBLIC	3965	3965	3965	3965	3965	3965
RELIGIOUS	335	1994	335	335	335	335
HOTEL-MOTEL	3027	3027	3027	3027	3027	3027
MISCELLANEOUS	59609	48464	62403	77671	84694	81453
TOTAL	589777	571668	610496	643109	649276	626131
COMMERCIAL CONSTRUCTION SQ.FT						
ADDITIONS AND ALTERATIONS						
RETAIL-WHOLESALE	10535	7004	11500	13201	12546	10846
OFFICE BUILDINGS	515	515	515	515	515	515
AUTO REPAIR	0	0	0	0	0	0
WAREHOUSES	6536	4283	7188	10104	11498	11224
EDUCATION	1232	1232	1232	3882	4032	4171
HEALTH	31414	28183	31738	35494	36614	35093
PUBLIC	147	147	147	1790	2009	1229
RELIGIOUS	10114	10087	10058	10099	10107	10105
HOTEL-MOTEL	14448	9299	14779	21308	24731	23862
MISCELLANEOUS	562	562	562	562	562	562
TOTAL	75504	61313	77750	96956	102615	97609
RESIDENTIAL CONSTRUCTION SQ.FT:						
APARTMENTS						
FIVE OR MORE UNITS						
1-3 STORIES	10255	10255	10255	10255	10255	10255
4 OR MORE STORIES	1170	1170	24292	22424	7504	1170
THREE TO FOUR UNITS	1220	1220	1220	1220	1220	1220
SINGLE FAMILY DETACHED	4082630	5195156	5983319	6162825	6012103	5773634
DUPLEXES	172	172	172	172	172	172
TOTAL	4095448	5207974	6019259	6196897	6031255	5786452
WAGES: ANNUAL 000 1984 $						
AGRICULTURAL	32.882	32.946	33.003	33.055	33.088	33.143
AGRICULTURAL SERVICES	22.008	22.161	22.299	22.427	22.567	22.653
MINING	46.868	47.523	48.227	48.895	49.612	50.257
CONSTRUCTION	38.764	38.789	38.781	38.767	38.740	38.686
NONDURABLE MANUFACTURING	25.404	25.584	25.764	25.934	26.106	26.262
DURABLE MANUFACTURING	34.663	34.652	34.635	34.619	34.583	34.577
PUBLIC UTILITIES	32.970	33.231	33.500	33.755	34.019	34.256
WHOLESALE TRADE	28.123	28.505	28.877	29.224	29.583	29.872
RETAIL TRADE	12.601	12.533	12.460	12.392	12.319	12.255
FINANCE-INSURANCE-REAL ESTATE	38.169	38.850	39.531	40.165	40.847	41.382
SERVICES	22.210	22.404	22.594	22.770	22.957	23.102
GOVERNMENT	27.148	27.588	28.035	28.489	28.951	29.420
PERSONAL INCOME 000 1984 $						
WAGE BILL	840404	865926	892144	924882	957614	987114
PROPERTY INCOME	159677	166668	174180	182409	191221	200339
TRANSFER PAYMENTS	136596	139538	142881	146350	150458	154626
RESIDENCE ADJUSTMENT	-10983	-9269	-7371	-5564	-3545	-1776
SOCIAL INSURANCE ADJUSTMENT	37557	38366	39285	40239	41369	42515
PER CAPITA INCOME	21.061	21.520	21.946	22.485	22.942	23.328
TOTAL PERSONAL INCOME	1088138	1124497	1162543	1207838	1254379	1297787
DEMOGRAPHICS						
POPULATION	51665	52253	52972	53718	54677	55632
BIRTHS	693	702	712	723	737	750
DEATHS	541	548	555	563	573	583
MIGRATION	410	433	562	586	795	789

WHATCOM COUNTY, WASHINGTON

(Intalco Plant Site, Ferndale)

MASTER HIGH FORECAST FOR BPADSI REGION 4

	1980	1981	1982	1983	1984	1985	1986	1987
EMPLOYMENT:PERSONS								
AGRICULTURAL	1433	1480	1526	1573	1627	1678	1731	1785
AGRICULTURAL SERVICES	375	395	413	427	442	458	475	495
MINING	89	94	102	105	106	114	118	122
CONSTRUCTION	2024	1996	1966	1934	2264	2201	2198	2111
NONDURABLE MANUFACTURING	4124	4271	4395	4513	4686	4831	4981	5138
DURABLE MANUFACTURING	3583	3623	3643	3623	3678	3738	3748	3754
PUBLIC UTILITIES	2063	2122	2182	2243	2307	2372	2439	2508
WHOLESALE TRADE	1389	1421	1476	1533	1598	1672	1736	1783
RETAIL TRADE	8004	8212	8378	8538	8759	8918	9093	9286
FINANCE-INSURANCE-REAL ESTATE	1450	1434	1425	1430	1437	1429	1423	1416
SERVICES	7185	6988	7015	7144	7243	7376	7451	7466
GOVERNMENT	7670	7888	8113	8343	8581	8825	9076	9334
TOTAL	39391	39924	40634	41408	42738	43613	44470	45198
NEW COMMERCIAL CONSTRUCTION SQ.FT								
RETAIL-WHOLESALE	108108	31031	22400	81222	173828	135868	177938	151026
OFFICE BUILDINGS	68611	325127	182727	8542	8542	8542	8542	8542
AUTO REPAIR	55106	388826	418329	1300	1300	1300	1300	1300
WAREHOUSES	86562	143817	237819	316534	347934	384975	395887	403516
EDUCATION	15555	15555	15555	15555	15555	15555	15555	15555
HEALTH	3518	3518	3518	3518	3518	3518	3518	3518
PUBLIC	4567	4567	4567	4567	4567	4567	4567	4567
RELIGIOUS	10418	32167	45889	26633	1710	5962	1710	2320
HOTEL-MOTEL	2622	2622	2622	2622	2622	2622	2622	2622
MISCELLANEOUS	150918	110863	94224	140041	193050	175315	196353	182150
TOTAL	505986	1057292	1027651	600535	752628	738225	807993	775117
COMMERCIAL CONSTRUCTION SQ.FT ADDITIONS AND ALTERATIONS								
RETAIL-WHOLESALE	1914	277	277	8334	14527	3833	10960	5620
OFFICE BUILDINGS	435	435	435	435	435	435	435	435
AUTO REPAIR	0	0	0	0	0	0	0	0
WAREHOUSES	2359	832	832	832	7010	1066	5349	2418
EDUCATION	4090	10390	10390	4459	4644	10390	4924	5069
HEALTH	7805	1632	1632	9648	21138	13753	18607	14168
PUBLIC	644	620	620	620	5091	620	3837	620
RELIGIOUS	382	382	382	382	382	382	382	382
HOTEL-MOTEL	0	0	0	0	11872	0	5873	0
MISCELLANEOUS	1417	1417	1417	1417	1417	1417	1417	1417
TOTAL	19047	15987	15987	26128	66516	31897	50986	30156
RESIDENTIAL CONSTRUCTION SQ.FT:								
APARTMENTS								
FIVE OR MORE UNITS								
1-3 STORIES	38587	38587	38587	535552	974699	1214559	1301282	1288[illegible]
4 OR MORE STORIES	3545	3545	3545	23082	49760	58558	65597	61423
THREE TO FOUR UNITS	8805	8805	8805	65336	137034	162252	158620	130057
SINGLE FAMILY DETACHED	918296	271566	1143064	2789704	3934860	4846631	5314020	5742264
DUPLEXES	8500	8500	8500	52307	92641	118164	106781	95156
TOTAL	969733	331004	1202501	3465981	5188994	6392164	6946300	7317131
WAGES: ANNUAL 000 1984 $								
AGRICULTURAL	42.162	40.973	40.647	40.577	40.124	39.916	39.671	39.266
AGRICULTURAL SERVICES	41.285	40.356	39.814	40.025	40.385	40.555	40.562	40.304
MINING	38.402	40.998	42.159	42.226	42.507	42.667	43.123	44.232
CONSTRUCTION	35.880	35.822	35.772	36.018	36.324	36.517	36.641	36.674
NONDURABLE MANUFACTURING	30.599	30.703	31.065	31.486	31.655	31.909	32.149	32.341
DURABLE MANUFACTURING	30.168	30.110	30.408	30.657	30.603	30.714	30.835	30.921
PUBLIC UTILITIES	29.714	30.186	30.560	30.706	30.673	30.706	30.847	31.194
WHOLESALE TRADE	25.778	26.366	26.605	26.782	26.983	27.084	27.262	27.646
RETAIL TRADE	13.777	13.392	13.244	13.223	13.125	13.070	12.993	12.856
FINANCE-INSURANCE-REAL ESTATE	26.345	28.105	28.666	28.823	29.142	29.199	29.520	30.473
SERVICES	19.091	19.605	19.814	19.955	20.149	20.254	20.409	20.700
GOVERNMENT	19.439	19.733	20.032	20.335	20.643	20.956	21.273	21.596
PERSONAL INCOME 000 1984 $								
WAGE BILL	918062	936578	959636	984479	1024595	1050480	1077110	1101250
PROPERTY INCOME	197102	208759	219684	230009	242392	254436	267599	282564
TRANSFER PAYMENTS	193166	198656	203422	208644	215231	221970	227917	233925
RESIDENCE ADJUSTMENT	17609	21671	22689	21994	22372	22360	22684	24239
SOCIAL INSURANCE ADJUSTMENT	53691	55124	56446	57895	59723	61593	63243	64911
PER CAPITA INCOME	11.672	11.807	11.988	12.140	12.381	12.485	12.648	12.812
TOTAL PERSONAL INCOME	1272339	1310541	1348984	1387229	1444866	1487653	1532067	1577069
DEMOGRAPHICS								
POPULATION	109812	110995	112526	114267	116701	119158	121133	123089
BIRTHS	1579	1609	1632	1658	1694	1731	1761	1790
DEATHS	994	1012	1026	1043	1065	1088	1106	1124
MIGRATION	1412	1386	926	1125	1805	1813	1320	1290

MASTER HIGH FORECAST FOR BPADSI REGION 4

	1988	1989	1990	1991	1992	1993	1994	1995
EMPLOYMENT:PERSONS								
AGRICULTURAL	1842	1903	1965	2029	2096	2166	2239	2314
AGRICULTURAL SERVICES	514	535	557	581	604	628	654	682
MINING	126	130	135	140	146	152	158	165
CONSTRUCTION	2039	2025	2011	1992	1985	1980	1973	1968
NONDURABLE MANUFACTURING	5308	5491	5684	5879	6092	6316	6551	6801
DURABLE MANUFACTURING	3772	3799	3824	3845	3880	3916	3948	3978
PUBLIC UTILITIES	2579	2651	2726	2803	2883	2964	3048	3134
WHOLESALE TRADE	1834	1884	1931	1982	2033	2078	2117	2154
RETAIL TRADE	9489	9708	9936	10154	10390	10637	10892	11156
FINANCE-INSURANCE-REAL ESTATE	1410	1406	1401	1393	1387	1381	1374	1367
SERVICES	7605	7740	7836	7878	8076	8253	8383	8511
GOVERNMENT	9599	9872	10153	10441	10738	11044	11358	11681
TOTAL	46117	47145	48161	49119	50310	51516	52697	53910
NEW COMMERCIAL CONSTRUCTION SQ.FT								
RETAIL-WHOLESALE	151927	215493	182073	155893	152432	217018	190269	165528
OFFICE BUILDINGS	8542	8542	8542	8542	8542	8542	8542	8542
AUTO REPAIR	1300	1300	1300	1300	1300	1300	1300	1300
WAREHOUSES	413294	409264	408699	403423	412102	418646	413606	417968
EDUCATION	15555	15555	15555	15555	15555	15555	15555	15555
HEALTH	3518	3518	3518	3518	3518	3518	3518	3518
PUBLIC	4567	4567	4567	4567	4567	4567	4567	4567
RELIGIOUS	1710	1710	1710	2953	1710	1710	1710	2835
HOTEL-MOTEL	2622	2622	2622	2622	2622	2622	2622	2622
MISCELLANEOUS	182901	212653	196314	185552	185462	214562	203192	194491
TOTAL	785937	875226	816901	783926	787810	888041	844882	816920
COMMERCIAL CONSTRUCTION SQ.FT ADDITIONS AND ALTERATIONS								
RETAIL-WHOLESALE	7388	13075	6404	6040	7263	12443	7313	6869
OFFICE BUILDINGS	435	435	435	435	435	435	435	435
AUTO REPAIR	0	0	0	0	0	0	0	0
WAREHOUSES	3030	9288	5980	4471	4917	10872	8404	7697
EDUCATION	5232	5414	5602	5788	6002	6227	6459	6701
HEALTH	14088	21238	15993	12574	12228	19147	15216	12259
PUBLIC	620	5391	640	620	620	5177	1236	620
RELIGIOUS	382	382	382	382	382	382	382	382
HOTEL-MOTEL	0	11455	4112	0	0	11242	5919	1516
MISCELLANEOUS	1417	1417	1417	1417	1417	1417	1417	1417
TOTAL	32513	68097	40966	31727	33266	67343	46782	37284
RESIDENTIAL CONSTRUCTION SQ.FT:								
APARTMENTS								
FIVE OR MORE UNITS								
1-3 STORIES	1187545	1017977	813429	416341	240395	338856	258871	5660
4 OR MORE STORIES	58209	44099	31594	10011	3545	8673	3814	3565
THREE TO FOUR UNITS	90137	31040	8805	8805	8805	8805	8805	8805
SINGLE FAMILY DETACHED	5784288	5760235	5493350	4519209	4821828	5255120	5231081	4966218
DUPLEXES	74115	45543	13110	8500	8500	8500	8500	8500
TOTAL	7194295	6898893	6360288	4962866	5083073	5619953	5511071	5043728
WAGES: ANNUAL 000 1984 $								
AGRICULTURAL	38.886	38.524	38.151	37.899	37.687	37.315	37.816	36.724
AGRICULTURAL SERVICES	40.268	40.187	40.054	39.862	39.932	39.921	39.857	39.779
MINING	45.111	46.052	47.083	48.011	48.758	49.617	50.556	51.565
CONSTRUCTION	36.799	36.887	36.927	36.884	36.992	37.055	37.083	37.095
NONDURABLE MANUFACTURING	32.529	32.702	32.837	32.984	33.128	33.257	33.361	33.467
DURABLE MANUFACTURING	30.961	31.007	31.040	31.144	31.165	31.190	31.209	31.221
PUBLIC UTILITIES	31.491	31.818	32.158	32.480	32.768	33.096	33.444	33.790
WHOLESALE TRADE	28.053	28.467	28.876	29.167	29.560	29.969	30.384	30.768
RETAIL TRADE	12.744	12.633	12.513	12.413	12.329	12.240	12.144	12.048
FINANCE-INSURANCE-REAL ESTATE	31.411	32.378	33.360	34.054	34.929	35.877	36.871	37.856
SERVICES	21.003	21.305	21.603	21.817	22.095	22.381	22.671	22.952
GOVERNMENT	21.923	22.295	22.592	22.934	23.281	23.634	23.992	24.355
PERSONAL INCOME 000 1984 $								
WAGE BILL	1130496	1163599	1196415	1227594	1265747	1304839	1343624	1383611
PROPERTY INCOME	298651	316264	335429	355628	377556	401495	427552	455690
TRANSFER PAYMENTS	239776	246157	252912	259775	267024	274683	282420	290257
RESIDENCE ADJUSTMENT	25421	26818	28464	29855	31073	32536	34156	35806
SOCIAL INSURANCE ADJUSTMENT	66534	68305	70179	72083	74095	76220	78367	80542
PER CAPITA INCOME	13.032	13.268	13.497	13.712	13.971	14.233	14.502	14.787
TOTAL PERSONAL INCOME	1627889	1684534	1743041	1800769	1867306	1937332	2009385	2084822
DEMOGRAPHICS								
POPULATION	124912	126961	129146	131331	133653	136118	138560	140988
BIRTHS	1818	1849	1882	1916	1951	1988	2026	2063
DEATHS	1141	1160	1180	1200	1222	1245	1267	1290
MIGRATION	1146	1360	1484	1469	1593	1721	1683	1655

MASTER HIGH FORECAST FOR BPADSI REGION 4

	1996	1997	1998	1999	2000	2001
EMPLOYMENT:PERSONS						
AGRICULTURAL	2391	2472	2559	2646	2737	2831
AGRICULTURAL SERVICES	710	739	770	802	835	870
MINING	172	181	189	199	209	219
CONSTRUCTION	1961	1963	2144	2099	2069	2077
NONDURABLE MANUFACTURING	7059	7337	7648	7958	8288	8638
DURABLE MANUFACTURING	3989	4013	4062	4086	4115	4152
PUBLIC UTILITIES	3222	3313	3407	3503	3602	3704
WHOLESALE TRADE	2192	2238	2289	2340	2390	2446
RETAIL TRADE	11434	11728	12057	12371	12700	13039
FINANCE-INSURANCE-REAL ESTATE	1365	1365	1369	1369	1371	1372
SERVICES	8636	8908	9193	9476	9755	10030
GOVERNMENT	12013	12354	12706	13067	13439	13821
TOTAL	55145	56612	58395	59917	61512	63202
NEW COMMERCIAL CONSTRUCTION SQ.FT						
RETAIL-WHOLESALE	183021	155673	191936	238286	260857	256084
OFFICE BUILDINGS	8542	8542	8542	8542	8542	8542
AUTO REPAIR	1300	1300	1300	1300	1300	1300
WAREHOUSES	430124	440722	465210	488702	488555	482313
EDUCATION	15555	15555	15555	15555	15555	15555
HEALTH	3518	3518	3518	3518	3518	3518
PUBLIC	4567	4567	4567	4567	4567	4567
RELIGIOUS	1710	4426	1710	1710	1710	1710
HOTEL-MOTEL	2622	2622	2622	2622	2622	2622
MISCELLANEOUS	203481	194119	210594	230279	237496	235759
TOTAL	854441	831045	905555	995081	1024723	1011972
COMMERCIAL CONSTRUCTION SQ.FT ADDITIONS AND ALTERATIONS						
RETAIL-WHOLESALE	9260	6809	10250	11526	11194	10127
OFFICE BUILDINGS	435	435	435	435	435	435
AUTO REPAIR	0	0	0	0	0	0
WAREHOUSES	9233	7310	10655	14246	15782	15893
EDUCATION	6949	7226	7551	7854	8176	8519
HEALTH	14009	10882	14321	17951	19031	17558
PUBLIC	2230	620	2632	4328	4557	3787
RELIGIOUS	382	382	382	382	382	382
HOTEL-MOTEL	4592	0	5949	13723	16683	15947
MISCELLANEOUS	1417	1417	1417	1417	1417	1417
TOTAL	48507	35082	53594	71863	77658	74065
RESIDENTIAL CONSTRUCTION SQ.FT:						
APARTMENTS						
FIVE OR MORE UNITS						
1-3 STORIES	38587	126022	339264	268244	55450	38587
4 OR MORE STORIES	3545	3545	15892	8383	3545	3545
THREE TO FOUR UNITS	8805	8805	8805	8805	8805	8805
SINGLE FAMILY DETACHED	4814404	5944492	6758482	6954789	6810138	6581768
DUPLEXES	8500	8500	23500	8500	8500	8500
TOTAL	4873841	6091363	7145943	7248721	6886437	6641205
WAGES: ANNUAL 000 1984 $						
AGRICULTURAL	36.502	36.293	36.090	35.902	35.705	35.552
AGRICULTURAL SERVICES	39.787	39.802	39.847	39.894	39.915	39.919
MINING	52.321	52.934	53.584	54.208	54.851	55.448
CONSTRUCTION	37.066	37.116	37.136	37.148	37.151	37.123
NONDURABLE MANUFACTURING	33.532	33.620	33.694	33.760	33.812	33.864
DURABLE MANUFACTURING	31.263	31.275	31.289	31.303	31.307	31.334
PUBLIC UTILITIES	34.888	34.326	34.571	34.802	35.042	35.258
WHOLESALE TRADE	31.095	31.398	31.689	31.959	32.240	32.459
RETAIL TRADE	11.967	11.904	11.839	11.778	11.713	11.657
FINANCE-INSURANCE-REAL ESTATE	38.591	39.266	39.941	40.568	41.243	41.772
SERVICES	23.166	23.376	23.578	23.766	23.959	24.111
GOVERNMENT	24.724	25.098	25.478	25.864	26.256	26.654
PERSONAL INCOME 000 1984 $						
WAGE BILL	1423155	1469244	1525844	1573448	1623613	1676791
PROPERTY INCOME	486078	518567	554632	592672	634212	679801
TRANSFER PAYMENTS	298332	307208	317343	327341	337318	347793
RESIDENCE ADJUSTMENT	37195	38225	39632	40833	42087	43222
SOCIAL INSURANCE ADJUSTMENT	82782	85245	88058	90832	93601	96587
PER CAPITA INCOME	15.069	15.370	15.706	15.995	16.320	16.658
TOTAL PERSONAL INCOME	2161977	2248098	2349392	2443461	2543629	2650308
DEMOGRAPHICS						
POPULATION	143468	146266	149588	152766	155856	159097
BIRTHS	2101	2144	2194	2243	2290	2340
DEATHS	1313	1339	1369	1399	1427	1457
MIGRATION	1692	1993	2497	2333	2227	2358

MASTER LOW FORECAST FOR BPADSI REGION 4

	1980	1981	1982	1983	1984	1985	1986	1987
EMPLOYMENT:PERSONS								
AGRICULTURAL	1433	1480	1526	1573	1627	1643	1693	1747
AGRICULTURAL SERVICES	375	395	413	427	442	443	459	479
MINING	89	94	102	105	106	113	117	121
CONSTRUCTION	2024	1996	1966	1934	2264	1955	1898	1837
NONDURABLE MANUFACTURING	4124	4271	4395	4513	4686	4638	4770	4923
DURABLE MANUFACTURING	3583	3623	3643	3623	3678	1398	1395	1402
PUBLIC UTILITIES	2063	2122	2182	2243	2307	2371	2438	2507
WHOLESALE TRADE	1389	1421	1476	1533	1598	1645	1706	1753
RETAIL TRADE	8004	8212	8378	8538	8759	8639	8793	8987
FINANCE-INSURANCE-REAL ESTATE	1450	1434	1425	1430	1437	1384	1376	1376
SERVICES	7185	6988	7015	7144	7243	7266	7333	7358
GOVERNMENT	7670	7888	8113	8343	8581	8825	9076	933[illegible]
TOTAL	39391	39924	40634	41408	42730	40321	41056	4165[illegible]
NEW COMMERCIAL CONSTRUCTION SQ.FT								
RETAIL-WHOLESALE	108108	31031	22400	81222	173828	139868	163645	140594
OFFICE BUILDINGS	68611	325127	182727	8542	8542	8542	8542	8542
AUTO REPAIR	55106	388026	418329	1300	1300	1300	1300	1300
WAREHOUSES	86562	143817	237819	316534	347934	384975	321206	339270
EDUCATION	15555	15555	15555	15555	15555	15555	15555	15555
HEALTH	3518	3518	3518	3518	3518	3518	3518	3518
PUBLIC	4567	4567	4567	4567	4567	4567	4567	4567
RELIGIOUS	10418	32167	45889	26633	1710	5962	1710	2311
HOTEL-MOTEL	2622	2622	2622	2622	2622	2622	2622	2622
MISCELLANEOUS	150918	110863	94224	140841	193050	175315	176689	169138
TOTAL	505986	1057292	1027651	608535	752628	738225	699355	687369
COMMERCIAL CONSTRUCTION SQ.FT ADDITIONS AND ALTERATIONS								
RETAIL-WHOLESALE	1914	277	277	8334	14527	3833	11128	5481
OFFICE BUILDINGS	435	435	435	435	435	435	435	435
AUTO REPAIR	0	0	0	0	0	0	0	0
WAREHOUSES	2359	832	832	832	7010	1066	2925	1081
EDUCATION	4090	10390	10390	4459	4644	10390	4569	4714
HEALTH	7805	1632	1632	9648	21138	13753	18607	14186
PUBLIC	644	620	620	620	5091	620	3837	620
RELIGIOUS	382	382	382	382	382	382	382	382
HOTEL-MOTEL	0	0	0	0	11872	0	0	0
MISCELLANEOUS	1417	1417	1417	1417	1417	1417	1417	1417
TOTAL	19047	15987	15987	26128	66516	31897	42501	2823[illegible]
RESIDENTIAL CONSTRUCTION SQ.FT:								
APARTMENTS								
FIVE OR MORE UNITS								
1-3 STORIES	38587	38587	38587	535552	974699	1214559	1247868	1248885
4 OR MORE STORIES	3545	3545	3545	23082	49760	58558	72589	65878
THREE TO FOUR UNITS	8805	8805	8805	65336	137034	162252	146119	121134
SINGLE FAMILY DETACHED	910296	271566	1143064	2789704	3934860	4846631	5254772	5690303
DUPLEXES	8500	8500	8500	52307	92641	110164	95790	87243
TOTAL	969733	331804	1202501	3465981	5188994	6392164	6817138	7212564
WAGES: ANNUAL 000 1984 $								
AGRICULTURAL	42.162	40.973	40.647	40.577	40.124	39.916	39.671	39.266
AGRICULTURAL SERVICES	41.285	40.356	39.814	40.025	40.385	40.555	40.562	40.386
MINING	38.402	40.998	42.159	42.226	42.507	42.667	43.123	44.232
CONSTRUCTION	35.880	35.822	35.772	36.018	36.324	36.517	36.641	36.674
NONDURABLE MANUFACTURING	30.599	30.703	31.065	31.486	31.655	31.909	32.149	32.341
DURABLE MANUFACTURING	30.168	30.110	30.408	30.657	30.603	30.714	30.835	30.921
PUBLIC UTILITIES	29.714	30.186	30.560	30.706	30.673	30.706	30.847	31.194
WHOLESALE TRADE	25.778	26.366	26.605	26.782	26.983	27.084	27.262	27.646
RETAIL TRADE	13.777	13.392	13.244	13.223	13.125	13.070	12.993	12.856
FINANCE-INSURANCE-REAL ESTATE	26.345	28.105	28.666	28.823	29.142	29.199	29.520	30.473
SERVICES	19.091	19.605	19.814	19.955	20.149	20.254	20.409	20.700
GOVERNMENT	19.439	19.733	20.032	20.335	20.643	20.956	21.273	21.596
PERSONAL INCOME 000 1984 $								
WAGE BILL	918062	936578	959636	984479	1024595	953477	976104	1000862
PROPERTY INCOME	197102	208759	219684	230089	242392	248791	261557	276339
TRANSFER PAYMENTS	193166	198656	203422	208644	215231	221970	224003	229680
RESIDENCE ADJUSTMENT	17609	21671	22689	21994	22372	22363	21866	23409
SOCIAL INSURANCE ADJUSTMENT	53681	55124	56446	57895	59723	61593	62157	63733
PER CAPITA INCOME	11.672	11.807	11.988	12.140	12.381	11.623	11.939	12.135
TOTAL PERSONAL INCOME	1272339	1310541	1348984	1387229	1444866	1385089	1421372	1466557
DEMOGRAPHICS								
POPULATION	109012	110995	112526	114267	116701	119158	119052	120855
BIRTHS	1579	1609	1632	1658	1694	1731	1724	1752
DEATHS	994	1012	1026	1043	1065	1088	1087	1104
MIGRATION	1412	1386	926	1125	1805	1813	-743	1154

MASTER LOW FORECAST FOR BPADSI REGION 4

	1988	1989	1990	1991	1992	1993	1994	1995
EMPLOYMENT:PERSONS								
AGRICULTURAL	1805	1865	1928	1991	2058	2128	2200	2274
AGRICULTURAL SERVICES	498	519	541	564	587	611	637	664
MINING	125	129	134	139	145	150	156	163
CONSTRUCTION	1798	1792	1785	1773	1771	1771	1770	1769
NONDURABLE MANUFACTURING	5089	5266	5452	5640	5845	6061	6289	6529
DURABLE MANUFACTURING	1413	1427	1440	1451	1467	1484	1499	1514
PUBLIC UTILITIES	2578	2650	2725	2802	2882	2963	3047	3133
WHOLESALE TRADE	1804	1854	1901	1953	2003	2049	2089	2125
RETAIL TRADE	9193	9412	9639	9855	10089	10335	10589	10851
FINANCE-INSURANCE-REAL ESTATE	1366	1362	1358	1351	1346	1341	1334	1328
SERVICES	7490	7624	7721	7763	7959	8136	8265	8393
GOVERNMENT	9599	9872	10153	10441	10738	11044	11358	11681
TOTAL	42759	43775	44778	45724	46892	48073	49233	50426
NEW COMMERCIAL CONSTRUCTION SQ.FT								
RETAIL-WHOLESALE	144290	207977	176559	151734	148731	211917	186082	162128
OFFICE BUILDINGS	8542	8542	8542	8542	8542	8542	8542	8542
AUTO REPAIR	1300	1300	1300	1300	1300	1300	1300	1300
WAREHOUSES	362246	366654	366139	375097	387981	395445	393339	400297
EDUCATION	15555	15555	15555	15555	15555	15555	15555	15555
HEALTH	3518	3518	3518	3518	3518	3518	3518	3518
PUBLIC	4567	4567	4567	4567	4567	4567	4567	4567
RELIGIOUS	1710	1710	1710	2940	1710	1710	1710	2821
HOTEL-MOTEL	2622	2622	2622	2622	2622	2622	2622	2622
MISCELLANEOUS	174936	207528	192419	182268	182460	211684	200356	191682
TOTAL	719286	819974	772933	748144	756987	856861	817592	793031
COMMERCIAL CONSTRUCTION SQ.FT ADDITIONS AND ALTERATIONS								
RETAIL-WHOLESALE	7173	12973	6168	5792	7037	12326	7079	6619
OFFICE BUILDINGS	435	435	435	435	435	435	435	435
AUTO REPAIR	0	0	0	0	0	0	0	0
WAREHOUSES	2145	8546	5245	3730	4167	10112	7635	6322
EDUCATION	4880	5060	5246	5428	5639	5860	6089	6328
HEALTH	14008	21238	15993	12574	12228	19147	15216	12259
PUBLIC	620	5388	637	620	620	5175	1234	620
RELIGIOUS	382	382	382	382	382	382	382	382
HOTEL-MOTEL	0	11527	4105	0	0	11162	5795	1375
MISCELLANEOUS	1417	1417	1417	1417	1417	1417	1417	1417
TOTAL	31061	66968	39629	30379	31926	66017	45282	35758
RESIDENTIAL CONSTRUCTION SQ.FT:								
APARTMENTS								
FIVE OR MORE UNITS								
1-3 STORIES	1163961	1004838	804102	408651	235797	336137	257221	56743
4 OR MORE STORIES	60035	44419	31425	9659	3545	8192	3545	3545
THREE TO FOUR UNITS	85252	28507	8805	8805	8805	8805	8805	8805
SINGLE FAMILY DETACHED	5746772	5733391	5471427	4500156	4807251	5243867	5222243	4960414
DUPLEXES	69830	43466	11808	8500	8500	8500	8500	8500
TOTAL	7125851	6854621	6327567	4935772	5063897	5605501	5500314	5038007
WAGES: ANNUAL 000 1984 $								
AGRICULTURAL	38.886	38.524	38.151	37.899	37.607	37.315	37.016	36.724
AGRICULTURAL SERVICES	40.268	40.187	40.054	39.862	39.932	39.921	39.857	39.779
MINING	45.111	46.052	47.083	48.011	48.758	49.617	50.556	51.505
CONSTRUCTION	36.799	36.887	36.927	36.884	36.992	37.055	37.083	37.093
NONDURABLE MANUFACTURING	32.529	32.702	32.837	32.984	33.128	33.257	33.361	33.447
DURABLE MANUFACTURING	30.961	31.007	31.040	31.144	31.165	31.190	31.209	31.221
PUBLIC UTILITIES	31.491	31.818	32.158	32.480	32.768	33.096	33.444	33.790
WHOLESALE TRADE	28.853	28.467	28.876	29.167	29.560	29.969	30.384	30.788
RETAIL TRADE	12.744	12.633	12.513	12.413	12.329	12.240	12.144	12.048
FINANCE-INSURANCE-REAL ESTATE	31.411	32.378	33.360	34.054	34.929	35.877	36.871	37.856
SERVICES	21.003	21.305	21.603	21.817	22.095	22.381	22.671	22.952
GOVERNMENT	21.923	22.255	22.592	22.934	23.281	23.634	23.992	24.355
PERSONAL INCOME 000 1984 $								
WAGE BILL	1038942	1063488	1095780	1126340	1163658	1201890	1239936	1279031
PROPERTY INCOME	292264	309627	328514	348418	370035	393632	419319	447262
TRANSFER PAYMENTS	235788	242381	249107	255872	263188	270883	278650	286601
RESIDENCE ADJUSTMENT	24687	26166	27849	29262	30521	32022	33678	35371
SOCIAL INSURANCE ADJUSTMENT	65428	67257	69123	71000	73028	75166	77321	79527
PER CAPITA INCOME	12.368	12.594	12.831	13.056	13.318	13.583	13.856	14.142
TOTAL PERSONAL INCOME	1518254	1574405	1632127	1688891	1754365	1823261	1894262	1968737
DEMOGRAPHICS								
POPULATION	122835	125013	127203	129358	131729	134235	136710	139212
BIRTHS	1782	1816	1849	1882	1918	1956	1994	2032
DEATHS	1122	1142	1162	1182	1204	1227	1250	1273
MIGRATION	1318	1505	1504	1455	1657	1778	1731	1742

MASTER LOW FORECAST FOR BPADSI REGION 4

	1996	1997	1998	1999	2000	2001
EMPLOYMENT:PERSONS						
AGRICULTURAL	2351	2432	2519	2606	2697	2791
AGRICULTURAL SERVICES	692	720	752	783	816	851
MINING	170	178	187	196	206	216
CONSTRUCTION	1768	1774	1942	1905	1884	1895
NONDURABLE MANUFACTURING	6780	7049	7348	7648	7967	8305
DURABLE MANUFACTURING	1522	1534	1555	1568	1582	1599
PUBLIC UTILITIES	3221	3312	3406	3502	3601	3703
WHOLESALE TRADE	2163	2211	2262	2312	2363	2419
RETAIL TRADE	11128	11421	11746	12059	12387	12723
FINANCE-INSURANCE-REAL ESTATE	1327	1328	1332	1333	1335	1337
SERVICES	8519	8788	9071	9351	9628	9902
GOVERNMENT	12013	12354	12706	13067	13439	13821
TOTAL	51656	53104	54826	56331	57905	59561
NEW COMMERCIAL CONSTRUCTION SQ.FT						
RETAIL-WHOLESALE	179328	152800	188318	233574	255802	251304
OFFICE BUILDINGS	8542	8542	8542	8542	8542	8542
AUTO REPAIR	1300	1300	1300	1300	1300	1300
WAREHOUSES	413464	426419	450804	472375	472083	466332
EDUCATION	15555	15555	15555	15555	15555	15555
HEALTH	3518	3518	3518	3518	3518	3518
PUBLIC	4567	4567	4567	4567	4567	4567
RELIGIOUS	1718	4411	1718	1718	1718	1718
HOTEL-MOTEL	2622	2622	2622	2622	2622	2622
MISCELLANEOUS	208694	191415	207857	227218	234521	232815
TOTAL	831301	811150	884794	970974	1000221	988266
COMMERCIAL CONSTRUCTION SQ.FT ADDITIONS AND ALTERATIONS						
RETAIL-WHOLESALE	9059	6545	18065	11373	11025	9925
OFFICE BUILDINGS	435	435	435	435	435	435
AUTO REPAIR	0	0	0	0	0	0
WAREHOUSES	8453	6535	9869	13416	14963	15072
EDUCATION	6574	6848	7166	7465	7783	8121
HEALTH	14009	10882	14321	17951	19031	17558
PUBLIC	2228	620	2630	4326	4555	3784
RELIGIOUS	382	382	332	382	382	382
HOTEL-MOTEL	4449	0	5880	13501	16499	15778
MISCELLANEOUS	1417	1417	1417	1417	1417	1417
TOTAL	47007	33665	52166	70267	76092	72474
RESIDENTIAL CONSTRUCTION SQ.FT:						
APARTMENTS						
FIVE OR MORE UNITS						
1-3 STORIES	38587	127229	348155	268795	56908	38587
4 OR MORE STORIES	3545	3545	15516	7799	3545	3545
THREE TO FOUR UNITS	8805	8805	8805	8805	8805	8805
SINGLE FAMILY DETACHED	4811271	5943215	6757429	6953771	6810407	6582649
DUPLEXES	8500	8500	23653	8500	8500	8500
TOTAL	4870708	6091294	7145558	7247670	6888165	6642086
WAGES: ANNUAL 000 1984 $						
AGRICULTURAL	36.502	36.293	36.090	35.902	35.705	35.552
AGRICULTURAL SERVICES	39.707	39.802	39.847	39.894	39.915	39.919
MINING	52.321	52.934	53.584	54.280	54.851	55.440
CONSTRUCTION	37.066	37.116	37.136	37.148	37.151	37.123
NONDURABLE MANUFACTURING	33.532	33.620	33.694	33.760	33.812	33.864
DURABLE MANUFACTURING	31.263	31.275	31.289	31.303	31.307	31.334
PUBLIC UTILITIES	34.088	34.326	34.571	34.802	35.042	35.258
WHOLESALE TRADE	31.095	31.398	31.689	31.959	32.240	32.459
RETAIL TRADE	11.967	11.984	11.839	11.778	11.713	11.657
FINANCE-INSURANCE-REAL ESTATE	38.591	39.266	39.941	40.568	41.243	41.772
SERVICES	23.166	23.376	23.578	23.766	23.959	24.111
GOVERNMENT	24.724	25.098	25.478	25.864	26.256	26.654
PERSONAL INCOME 000 1984 $						
WAGE BILL	1318477	1363931	1418498	1465558	1513088	1567155
PROPERTY INCOME	477076	509168	544718	582303	623348	667579
TRANSFER PAYMENTS	294818	303802	313960	323970	334057	344618
RESIDENCE ADJUSTMENT	36808	37963	39292	40512	41792	42949
SOCIAL INSURANCE ADJUSTMENT	81805	84308	87119	89897	92696	95624
PER CAPITA INCOME	14.427	14.738	15.064	15.361	15.689	16.028
TOTAL PERSONAL INCOME	2045358	2138564	2229348	2322447	2421589	2526669
DEMOGRAPHICS						
POPULATION	141774	144645	147994	151193	154349	157641
BIRTHS	2072	2115	2166	2215	2264	2314
DEATHS	1297	1324	1355	1384	1414	1444
MIGRATION	1788	2079	2537	2368	2306	2421

TACOMA MSA:
PIERCE COUNTY, WASHINGTON

(Kaiser Plant Site, Tacoma)

MASTER HIGH FORECAST FOR BPADSI REGION 5

	1980	1981	1982	1983	1984	1985	1986	1987
EMPLOYMENT:PERSONS								
AGRICULTURAL	1597	1645	1696	1750	1807	1866	1926	1989
AGRICULTURAL SERVICES	797	820	860	896	922	958	994	1028
MINING	124	125	127	124	118	118	115	112
CONSTRUCTION	5408	5240	5111	5125	5243	5142	5083	4967
NONDURABLE MANUFACTURING	8009	7967	7901	7847	7832	7804	7771	7735
DURABLE MANUFACTURING	12865	12825	12780	12662	12606	12662	12640	12623
PUBLIC UTILITIES	5083	4980	4879	4781	4684	4589	4497	4406
WHOLESALE TRADE	7612	7835	8114	8367	8657	9004	9313	9580
RETAIL TRADE	24139	24366	24482	24605	24764	24859	24997	25201
FINANCE-INSURANCE-REAL ESTATE	6053	5779	5550	5396	5224	5038	4851	4675
SERVICES	28630	27449	27148	27251	27154	27241	27102	26748
GOVERNMENT	56770	55234	53739	52285	50870	49493	48154	46851
TOTAL	157080	154266	152387	151088	149881	148768	147444	145915
NEW COMMERCIAL CONSTRUCTION SQ.FT								
RETAIL-WHOLESALE	471349	228649	81400	321898	648884	533437	676559	595737
OFFICE BUILDINGS	174041	245915	112173	39615	39615	39615	39615	39615
AUTO REPAIR	106699	502380	545561	6707	6707	6707	6707	6707
WAREHOUSES	221368	100987	77423	236413	426752	426774	521137	515159
EDUCATION	72876	48188	37770	37770	37770	37770	37770	37776
HEALTH	19292	19292	19292	19292	19292	19292	19292	19292
PUBLIC	36721	12612	12612	12612	36989	12612	20174	12612
RELIGIOUS	89171	108768	120924	100448	70068	74949	60732	64518
HOTEL-MOTEL	845	845	845	845	845	845	845	845
MISCELLANEOUS	439817	378122	351916	395982	451901	432969	457188	445106
TOTAL	1631381	1637760	1359919	1171583	1737944	1584973	1840021	1737355
COMMERCIAL CONSTRUCTION SQ.FT								
ADDITIONS AND ALTERATIONS								
RETAIL-WHOLESALE	29123	32198	33323	30495	28687	32400	30143	32514
OFFICE BUILDINGS	31537	13370	8295	8295	11370	8295	10684	8946
AUTO REPAIR	0	0	0	0	0	0	0	0
WAREHOUSES	7823	1650	1650	4891	12775	7102	12015	9460
EDUCATION	16950	19757	19757	17532	17795	18070	18351	18649
HEALTH	32149	21357	17028	29240	42896	36526	41932	37753
PUBLIC	9953	2946	2495	8876	14297	6910	12190	8353
RELIGIOUS	11256	11307	11360	11578	11906	12048	12258	12369
HOTEL-MOTEL	0	0	0	0	9136	0	3315	0
MISCELLANEOUS	12298	7005	3857	3857	3857	3857	3857	3857
TOTAL	151090	109591	97766	114765	152721	125209	144746	131892
RESIDENTIAL CONSTRUCTION SQ.FT:								
APARTMENTS								
FIVE OR MORE UNITS								
1-3 STORIES	755876	394004	456985	1054204	1559830	1847696	1983678	2000622
4 OR MORE STORIES	154968	141303	144682	191612	235422	254663	266372	266172
THREE TO FOUR UNITS	40795	40795	40795	160626	271415	321703	337733	320799
SINGLE FAMILY DETACHED	3359004	2569667	3291521	4845336	5917787	6776555	7220965	7627304
DUPLEXES	187269	122283	128765	219231	289649	327241	339993	337733
TOTAL	4497912	3268052	4062748	6471008	8274105	9527858	10148741	10552638
WAGES: ANNUAL 000 1984 $								
AGRICULTURAL	26.447	26.761	27.271	27.638	27.724	27.950	28.198	28.447
AGRICULTURAL SERVICES	20.108	20.237	19.862	19.698	19.927	19.881	19.855	19.929
MINING	61.090	62.960	64.193	64.865	65.474	66.061	66.738	67.622
CONSTRUCTION	35.218	35.168	35.103	35.320	35.606	35.776	35.885	35.917
NONDURABLE MANUFACTURING	27.631	27.749	28.030	28.303	28.367	28.507	28.666	28.848
DURABLE MANUFACTURING	30.170	30.134	30.450	30.718	30.679	30.807	30.941	31.037
PUBLIC UTILITIES	31.205	31.644	32.036	32.234	32.233	32.305	32.469	32.809
WHOLESALE TRADE	31.343	31.753	32.010	32.335	32.618	32.823	33.056	33.384
RETAIL TRADE	15.084	14.663	14.524	14.543	14.468	14.441	14.381	14.233
FINANCE-INSURANCE-REAL ESTATE	27.793	29.479	30.022	30.197	30.519	30.586	30.905	31.832
SERVICES	19.926	20.302	20.414	20.482	20.602	20.642	20.732	20.960
GOVERNMENT	21.149	21.670	22.203	22.749	23.309	23.883	24.470	25.072
PERSONAL INCOME 000 1984 $								
WAGE BILL	3566136	3548519	3547097	3559099	3567987	3576503	3581477	3585137
PROPERTY INCOME	757021	810961	863563	915548	973665	1034786	1101756	1178301
TRANSFER PAYMENTS	934392	952304	967296	984748	1003906	1023658	1044022	1064269
RESIDENCE ADJUSTMENT	243036	235571	232977	234517	234786	235845	235820	233145
SOCIAL INSURANCE ADJUSTMENT	227061	231414	235057	239298	243953	248753	253702	258622
PER CAPITA INCOME	11.370	11.359	11.423	11.499	11.564	11.632	11.698	11.780
TOTAL PERSONAL INCOME	5273523	5315941	5375876	5454615	5536390	5622039	5709373	5802230
DEMOGRAPHICS								
POPULATION	463810	467997	470635	474359	478776	483338	488048	492563
BIRTHS	7879	7947	7991	8056	8134	8213	8295	8373
DEATHS	3792	3827	3849	3880	3916	3954	3993	4031
MIGRATION	806	68	-1505	-453	208	303	409	171

MASTER HIGH FORECAST FOR BPADSI REGION 5

	1988	1989	1990	1991	1992	1993	1994	1995
EMPLOYMENT:PERSONS								
AGRICULTURAL	2056	2126	2199	2273	2354	2439	2527	2619
AGRICULTURAL SERVICES	1062	1098	1136	1180	1221	1265	1310	1358
MINING	109	106	104	101	99	97	95	93
CONSTRUCTION	4882	4825	4703	4561	4545	4675	4634	4582
NONDURABLE MANUFACTURING	7712	7693	7675	7653	7651	7656	7660	7670
DURABLE MANUFACTURING	12653	12700	12738	12775	12884	13024	13145	13276
PUBLIC UTILITIES	4317	4229	4144	4060	3978	3898	3819	3742
WHOLESALE TRADE	9866	10151	10429	10718	11010	11289	11561	11782
RETAIL TRADE	25428	25678	25942	26178	26463	26792	27128	27486
FINANCE-INSURANCE-REAL ESTATE	4511	4354	4201	4047	3905	3770	3637	3509
SERVICES	26838	26894	26801	26518	26766	26939	26939	26926
GOVERNMENT	45583	44349	43149	41981	40845	39740	38664	37618
TOTAL	145019	144207	143222	142048	141723	141584	141100	140661
NEW COMMERCIAL CONSTRUCTION SQ.FT								
RETAIL-WHOLESALE	688731	796341	690285	687138	593858	783579	700990	624169
OFFICE BUILDINGS	39615	39615	39615	39615	39615	39615	39615	39615
AUTO REPAIR	6707	6707	6707	6707	6707	6707	6707	6707
WAREHOUSES	542364	651057	628971	612567	624012	742785	744871	742027
EDUCATION	37770	37770	37770	37770	37770	37770	37770	37776
HEALTH	19292	19292	19292	19292	19292	19292	19292	19292
PUBLIC	12612	43562	15973	12612	12612	41553	20666	12612
RELIGIOUS	63187	47080	53578	60082	62095	49031	54798	61155
HOTEL-MOTEL	845	845	845	845	845	845	845	845
MISCELLANEOUS	448547	482968	478777	462872	464921	508890	497275	493516
TOTAL	1771392	2125159	1963814	1859582	1861729	2222064	2122832	2037787
COMMERCIAL CONSTRUCTION SQ.FT								
ADDITIONS AND ALTERATIONS								
RETAIL-WHOLESALE	32136	29618	33176	33918	33754	38670	34468	35467
OFFICE BUILDINGS	8301	14125	13833	11381	9723	13692	14339	12133
AUTO REPAIR	0	0	0	0	0	0	0	0
WAREHOUSES	18694	17475	14782	13764	14665	21693	20368	19858
EDUCATION	19018	19422	19831	20236	20755	21339	21925	22551
HEALTH	37705	45045	39803	36381	36042	43009	39056	36082
PUBLIC	9414	14470	9693	8903	9450	14160	10194	9312
RELIGIOUS	12484	12705	12830	12934	13034	13273	13451	13683
HOTEL-MOTEL	0	10480	3017	0	0	12595	9195	5647
MISCELLANEOUS	3857	3857	3857	3857	3857	3857	5632	5232
TOTAL	133410	167196	150822	141375	141281	174288	168619	159884
RESIDENTIAL CONSTRUCTION SQ.FT:								
APARTMENTS								
FIVE OR MORE UNITS								
1-3 STORIES	1920105	1779157	1595691	1218764	1036957	1160515	1106517	915514
4 OR MORE STORIES	266054	252508	240862	220838	195016	207584	206945	196096
THREE TO FOUR UNITS	288230	237369	181735	79755	40795	64506	41997	40795
SINGLE FAMILY DETACHED	7651653	7629885	7366345	6392046	6687254	7140315	7141544	6889235
DUPLEXES	322349	300103	271654	210530	188353	214346	209751	182036
TOTAL	10448391	10199022	9656287	8113933	8148375	8787266	8706753	8223671
WAGES: ANNUAL 000 1984 $								
AGRICULTURAL	28.627	28.889	28.974	29.194	29.318	29.447	29.567	29.676
AGRICULTURAL SERVICES	20.098	20.248	20.396	20.396	20.588	20.766	20.943	21.118
MINING	68.355	69.076	69.789	70.461	71.006	71.566	72.124	72.659
CONSTRUCTION	36.041	36.129	36.175	36.136	36.245	36.314	36.351	36.372
NONDURABLE MANUFACTURING	29.017	29.188	29.339	29.495	29.644	29.794	29.936	30.067
DURABLE MANUFACTURING	31.087	31.142	31.182	31.291	31.318	31.349	31.370	31.384
PUBLIC UTILITIES	33.183	33.421	33.745	34.054	34.332	34.644	34.969	35.290
WHOLESALE TRADE	33.756	34.116	34.447	34.675	35.018	35.354	35.676	35.979
RETAIL TRADE	14.116	13.994	13.857	13.744	13.650	13.545	13.428	13.309
FINANCE-INSURANCE-REAL ESTATE	32.752	33.697	34.654	35.329	36.187	37.116	38.087	39.046
SERVICES	21.206	21.456	21.707	21.878	22.118	22.370	22.628	22.881
GOVERNMENT	25.689	26.321	26.969	27.633	28.313	29.009	29.723	30.454
PERSONAL INCOME 000 1984 $								
WAGE BILL	3603497	3623339	3636228	3640776	3669364	3703588	3725986	3747553
PROPERTY INCOME	1261507	1352668	1452424	1559093	1676672	1806903	1949197	2105536
TRANSFER PAYMENTS	1084403	1186507	1129271	1152051	1174798	1200214	1226649	1252722
RESIDENCE ADJUSTMENT	231017	228829	226194	223964	222067	219957	217477	214750
SOCIAL INSURANCE ADJUSTMENT	263514	268886	274418	279953	285481	291657	298081	304417
PER CAPITA INCOME	11.908	12.037	12.164	12.290	12.485	12.691	12.886	13.109
TOTAL PERSONAL INCOME	5916908	6042458	6169700	6295929	6457420	6639005	6821227	7016143
DEMOGRAPHICS								
POPULATION	496887	501971	507200	512283	517200	523132	529334	535206
BIRTHS	8449	8540	8633	8724	8812	8919	9032	9139
DEATHS	4066	4109	4152	4194	4235	4284	4335	4384
MIGRATION	-58	652	748	553	340	1296	1506	1117

MASTER HIGH FORECAST FOR BPADSI REGION 5

	1996	1997	1998	1999	2000	2001
EMPLOYMENT:PERSONS						
AGRICULTURAL	2715	2818	2927	3041	3161	3286
AGRICULTURAL SERVICES	1411	1467	1527	1590	1657	1730
MINING	92	90	89	88	87	86
CONSTRUCTION	4594	4816	5046	5145	5216	5286
NONDURABLE MANUFACTURING	7686	7723	7770	7822	7884	7953
DURABLE MANUFACTURING	13367	13541	13751	13975	14230	14525
PUBLIC UTILITIES	3666	3592	3519	3448	3379	3310
WHOLESALE TRADE	12020	12306	12609	12924	13245	13594
RETAIL TRADE	27883	28332	28821	29328	29874	30435
FINANCE-INSURANCE-REAL ESTATE	3402	3307	3217	3131	3050	2971
SERVICES	26907	27349	27792	28239	28658	29041
GOVERNMENT	36600	35610	34646	33708	32796	31909
TOTAL	140345	140952	141715	142442	143237	144136
NEW COMMERCIAL CONSTRUCTION SQ.FT						
RETAIL-WHOLESALE	671722	589082	692071	819440	882509	866885
OFFICE BUILDINGS	39615	39615	39615	39615	39615	39615
AUTO REPAIR	6707	6707	6707	6707	6707	6707
WAREHOUSES	800328	801970	917325	1050391	1147237	1203938
EDUCATION	37770	37770	37770	37770	37770	37770
HEALTH	19292	19292	19292	19292	19292	19292
PUBLIC	15138	12612	16320	34708	47136	47502
RELIGIOUS	59262	66227	61153	53657	49841	51346
HOTEL-MOTEL	845	845	345	845	17561	22752
MISCELLANEOUS	507983	504968	532708	561771	580145	589749
TOTAL	2158662	2079009	2323807	2624197	2827813	2885557
COMMERCIAL CONSTRUCTION SQ.FT ADDITIONS AND ALTERATIONS						
RETAIL-WHOLESALE	34114	36806	34164	33174	33886	35623
OFFICE BUILDINGS	11771	10304	10302	13318	16646	18568
AUTO REPAIR	0	0	0	0	0	0
WAREHOUSES	22955	22142	27228	32299	35619	37588
EDUCATION	23221	24032	24920	25861	26879	27976
HEALTH	37844	34697	38159	41814	42902	41428
PUBLIC	11142	8593	11497	13169	13374	12581
RELIGIOUS	13793	13938	14225	14583	14925	15251
HOTEL-MOTEL	9847	6445	15847	26041	31961	34068
MISCELLANEOUS	3857	5259	3857	6781	12473	18135
TOTAL	168545	162215	180199	206951	228667	241209
RESIDENTIAL CONSTRUCTION SQ.FT:						
APARTMENTS						
FIVE OR MORE UNITS						
1-3 STORIES	740154	889956	1161356	1141829	967242	754452
4 OR MORE STORIES	183522	183218	208887	208991	197840	181415
THREE TO FOUR UNITS	40795	40795	76562	41472	40795	40795
SINGLE FAMILY DETACHED	6750331	7888775	8727201	8955445	8841192	8638798
DUPLEXES	157615	188697	237519	237324	211920	180800
TOTAL	7872417	9191434	10411524	10584262	10258188	9796260
WAGES: ANNUAL 000 1984 $						
AGRICULTURAL	29.803	29.887	29.970	30.049	30.116	30.200
AGRICULTURAL SERVICES	21.212	21.369	21.511	21.643	21.789	21.878
MINING	73.142	73.529	73.913	74.271	74.621	74.951
CONSTRUCTION	36.353	36.407	36.434	36.452	36.463	36.443
NONDURABLE MANUFACTURING	30.186	30.293	30.393	30.486	30.573	30.654
DURABLE MANUFACTURING	31.429	31.444	31.460	31.477	31.481	31.509
PUBLIC UTILITIES	35.567	35.792	36.021	36.237	36.458	36.658
WHOLESALE TRADE	36.204	36.451	36.677	36.884	37.091	37.247
RETAIL TRADE	13.209	13.134	13.054	12.978	12.897	12.826
FINANCE-INSURANCE-REAL ESTATE	39.763	40.426	41.086	41.701	42.360	42.876
SERVICES	23.069	23.256	23.437	23.605	23.781	23.917
GOVERNMENT	31.204	31.971	32.758	33.564	34.390	35.236
PERSONAL INCOME 000 1984 $						
WAGE BILL	3768651	3814750	3863687	3909066	3955295	4002148
PROPERTY INCOME	2274925	2461467	2667248	2891778	3139535	3410067
TRANSFER PAYMENTS	1279453	1307078	1337814	1369653	1402888	1435429
RESIDENCE ADJUSTMENT	212553	211841	209550	208162	206522	205144
SOCIAL INSURANCE ADJUSTMENT	310913	317625	325095	332831	340713	348815
PER CAPITA INCOME	13.350	13.659	13.978	14.311	14.676	15.070
TOTAL PERSONAL INCOME	7224671	7476711	7753205	8045820	8362726	8703973
DEMOGRAPHICS						
POPULATION	541188	547371	554669	562219	569806	577551
BIRTHS	9248	9362	9498	9638	9779	9924
DEATHS	4433	4485	4545	4608	4671	4735
MIGRATION	1167	1306	2345	2520	2479	2556

MASTER LOW FORECAST FOR BPADSI REGION 5

	1980	1981	1982	1983	1984	1985	1986	1987
EMPLOYMENT:PERSONS								
AGRICULTURAL	1597	1645	1696	1750	1807	1862	1922	1984
AGRICULTURAL SERVICES	797	820	860	896	922	955	991	1025
MINING	124	125	127	124	118	118	115	112
CONSTRUCTION	5400	5240	5111	5125	5243	5086	5008	4900
NONDURABLE MANUFACTURING	8009	7967	7901	7847	7832	7768	7732	7696
DURABLE MANUFACTURING	12865	12825	12780	12662	12606	11773	11743	11729
PUBLIC UTILITIES	5083	4980	4879	4781	4684	4589	4496	4405
WHOLESALE TRADE	7612	7835	8114	8367	8657	8990	9298	9565
RETAIL TRADE	24139	24366	24482	24605	24764	24789	24919	25123
FINANCE-INSURANCE-REAL ESTATE	6053	5779	5550	5396	5224	5015	4835	4660
SERVICES	28630	27449	27148	27251	27154	27205	27062	26708
GOVERNMENT	56770	55234	53739	52285	50870	49493	48154	46851
TOTAL	157080	154266	152387	151088	149881	147645	146275	144759
NEW COMMERCIAL CONSTRUCTION SQ.FT								
RETAIL-WHOLESALE	471349	220649	81400	321898	648084	533437	672681	592726
OFFICE BUILDINGS	174041	245915	112173	39615	39615	39615	39615	39615
AUTO REPAIR	106699	502380	545561	6707	6707	6707	6707	6707
WAREHOUSES	221368	100987	77423	236413	426752	426774	495315	491852
EDUCATION	72876	48188	37770	37770	37770	37770	37770	37770
HEALTH	19292	19292	19292	19292	19292	19292	19292	19292
PUBLIC	36721	12612	12612	12612	36909	12612	20174	12612
RELIGIOUS	89171	108768	120926	100448	70068	74949	68732	64490
HOTEL-MOTEL	845	845	845	845	845	845	845	845
MISCELLANEOUS	439017	378122	351916	395982	451901	432969	450389	448317
TOTAL	1631381	1637760	1359919	1171583	1737944	1584973	1803522	1706235
COMMERCIAL CONSTRUCTION SQ.FT ADDITIONS AND ALTERATIONS								
RETAIL-WHOLESALE	29123	32198	33323	30495	28687	32408	30189	32456
OFFICE BUILDINGS	31537	13370	8295	8295	11370	8295	10445	8886
AUTO REPAIR	0	0	0	0	0	0	0	0
WAREHOUSES	7823	1650	1650	4891	12775	7102	11177	8962
EDUCATION	16950	19757	19757	17532	17795	17956	18223	18522
HEALTH	32149	21357	17028	29240	42896	36526	41932	37753
PUBLIC	9953	2946	2495	8876	14297	6910	12190	8353
RELIGIOUS	11256	11307	11360	11578	11906	12048	12193	12276
HOTEL-MOTEL	0	0	0	0	9136	0	651	0
MISCELLANEOUS	12298	7005	3857	3857	3857	3857	3857	3857
TOTAL	151090	109591	97766	114765	152721	125094	140858	131059
RESIDENTIAL CONSTRUCTION SQ.FT:								
APARTMENTS								
FIVE OR MORE UNITS								
1-3 STORIES	755876	394004	456985	1054204	1559830	1847696	1950884	1976677
4 OR MORE STORIES	154968	141303	144682	191612	235422	254663	270665	268869
THREE TO FOUR UNITS	40795	40795	40795	160626	271415	321703	330058	315490
SINGLE FAMILY DETACHED	3359004	2569667	3291521	4845336	5917787	6776555	7184589	7596230
DUPLEXES	187269	122283	128765	219231	289649	327241	333245	333036
TOTAL	4497912	3268052	4062748	6471008	8274105	9527858	10069440	10490267
WAGES: ANNUAL 000 1984 $								
AGRICULTURAL	26.447	26.761	27.271	27.638	27.724	27.950	28.198	28.447
AGRICULTURAL SERVICES	20.108	20.237	19.862	19.698	19.927	19.881	19.855	19.929
MINING	61.090	62.960	64.193	64.865	65.474	66.061	66.738	67.622
CONSTRUCTION	35.218	35.168	35.103	35.320	35.606	35.776	35.885	35.917
NONDURABLE MANUFACTURING	27.631	27.749	28.030	28.303	28.367	28.587	28.666	28.848
DURABLE MANUFACTURING	30.170	30.134	30.450	30.718	30.679	30.807	30.941	31.037
PUBLIC UTILITIES	31.205	31.644	32.036	32.234	32.233	32.305	32.469	32.809
WHOLESALE TRADE	31.343	31.753	32.010	32.335	32.618	32.823	33.056	33.384
RETAIL TRADE	15.084	14.663	14.524	14.543	14.468	14.441	14.381	14.233
FINANCE-INSURANCE-REAL ESTATE	27.793	29.479	30.022	30.197	30.519	30.586	30.905	31.832
SERVICES	19.926	20.302	20.414	20.482	20.602	20.642	20.732	20.966
GOVERNMENT	21.149	21.670	22.203	22.749	23.309	23.883	24.470	25.072
PERSONAL INCOME 000 1984 $								
WAGE BILL	3566136	3548519	3547097	3559099	3567987	3543250	3546764	3550726
PROPERTY INCOME	757021	810961	863563	915548	973665	1032547	1099253	1175625
TRANSFER PAYMENTS	934392	952304	967296	984748	1003906	1023658	1041290	1061369
RESIDENCE ADJUSTMENT	243036	235571	232977	234517	234786	235846	235316	232646
SOCIAL INSURANCE ADJUSTMENT	227061	231414	235057	239298	243953	248753	253038	257917
PER CAPITA INCOME	11.370	11.359	11.423	11.499	11.564	11.558	11.647	11.731
TOTAL PERSONAL INCOME	5273523	5315941	5375876	5454615	5536390	5586547	5669585	5762441
DEMOGRAPHICS								
POPULATION	463810	467997	470635	474359	478776	483338	486771	491221
BIRTHS	7879	7947	7991	8056	8134	8213	8271	8349
DEATHS	3792	3827	3849	3880	3916	3954	3983	4020
MIGRATION	806	68	-1505	-453	200	303	-855	120

MASTER LOW FORECAST FOR BPADSI REGION 5

	1988	1989	1990	1991	1992	1993	1994	1995
EMPLOYMENT:PERSONS								
AGRICULTURAL	2052	2122	2194	2268	2349	2434	2522	2613
AGRICULTURAL SERVICES	1059	1095	1132	1176	1217	1261	1306	1354
MINING	109	106	103	101	99	97	95	93
CONSTRUCTION	4820	4765	4645	4506	4492	4619	4579	4528
NONDURABLE MANUFACTURING	7673	7654	7636	7614	7611	7616	7620	7630
DURABLE MANUFACTURING	11759	11804	11840	11876	11978	12109	12223	12345
PUBLIC UTILITIES	4316	4229	4144	4060	3978	3898	3819	3742
WHOLESALE TRADE	9851	10136	10413	10702	10993	11272	11524	11765
RETAIL TRADE	25350	25600	25863	26099	26384	26711	27046	27404
FINANCE-INSURANCE-REAL ESTATE	4497	4340	4188	4035	3893	3758	3626	3498
SERVICES	26798	26854	26761	26478	26726	26899	26899	26885
GOVERNMENT	45583	44349	43149	41981	40845	39740	38664	37618
TOTAL	143866	143054	142069	140898	140566	140415	139922	139476
NEW COMMERCIAL CONSTRUCTION SQ.FT								
RETAIL-WHOLESALE	598527	794121	688643	605895	592763	782058	699706	623105
OFFICE BUILDINGS	39615	39615	39615	39615	39615	39615	39615	39615
AUTO REPAIR	6707	6707	6707	6707	6707	6707	6707	6707
WAREHOUSES	523802	635211	616066	601991	615068	734055	736941	734899
EDUCATION	37770	37770	37770	37770	37770	37770	37770	37770
HEALTH	19292	19292	19292	19292	19292	19292	19292	19292
PUBLIC	12612	43479	15903	12612	12612	41484	20605	12612
RELIGIOUS	63078	46958	53526	60023	62030	48961	54724	61075
HOTEL-MOTEL	845	845	845	845	845	845	845	845
MISCELLANEOUS	445412	488993	469283	461630	463814	499793	496129	492356
TOTAL	1747661	2104992	1947650	1846381	1850517	2210581	2112335	2028277
COMMERCIAL CONSTRUCTION SQ.FT ADDITIONS AND ALTERATIONS								
RETAIL-WHOLESALE	32075	29590	33108	33847	33688	38637	34400	35394
OFFICE BUILDINGS	8295	14065	13798	11349	9690	13643	14307	12105
AUTO REPAIR	0	0	0	0	0	0	0	0
WAREHOUSES	10170	17194	14509	13492	14392	21411	20066	19560
EDUCATION	18890	19292	19700	20105	20622	21203	21786	22411
HEALTH	37705	45045	39803	36381	36042	43089	39056	36082
PUBLIC	9411	14467	9691	8900	9447	14157	10191	9309
RELIGIOUS	12489	12642	12775	12886	12993	13236	13417	13570
RESIDENTIAL CONSTRUCTION SQ.FT:								
APARTMENTS								
FIVE OR MORE UNITS								
1-3 STORIES	1903690	1767508	1587098	1204214	1031829	1156034	1102290	911572
4 OR MORE STORIES	267440	253154	241063	220761	194757	207249	206582	195697
THREE TO FOUR UNITS	284771	234988	179993	78407	40795	64176	41421	40795
SINGLE FAMILY DETACHED	7626578	7609239	7349067	6377419	6674780	7129200	7131300	6879800
DUPLEXES	319315	298099	270297	209594	187704	213823	209275	181609
TOTAL	10401794	10162979	9627518	8090396	8129865	8770482	8690868	8209474
WAGES: ANNUAL 000 1984 $								
AGRICULTURAL	28.627	28.809	28.974	29.194	29.318	29.447	29.567	29.676
AGRICULTURAL SERVICES	20.098	20.248	20.396	20.396	20.588	20.766	20.943	21.118
MINING	68.355	69.076	69.789	70.461	71.006	71.566	72.124	72.659
CONSTRUCTION	36.041	36.129	36.175	36.136	36.245	36.314	36.351	36.372
NONDURABLE MANUFACTURING	29.017	29.188	29.339	29.495	29.644	29.794	29.936	30.067
DURABLE MANUFACTURING	31.087	31.142	31.182	31.291	31.318	31.349	31.370	31.384
PUBLIC UTILITIES	33.103	33.421	33.745	34.054	34.332	34.644	34.969	35.290
WHOLESALE TRADE	33.756	34.116	34.447	34.675	35.018	35.354	35.676	35.979
RETAIL TRADE	14.116	13.994	13.857	13.744	13.650	13.545	13.428	13.309
FINANCE-INSURANCE-REAL ESTATE	32.752	33.697	34.654	35.329	36.187	37.116	38.087	39.046
SERVICES	21.206	21.456	21.707	21.878	22.118	22.370	22.628	22.881
GOVERNMENT	25.689	26.321	26.969	27.633	28.313	29.089	29.723	30.454
PERSONAL INCOME 000 1984 $								
WAGE BILL	3569127	3588911	3601769	3606317	3634643	3668418	3690524	3711861
PROPERTY INCOME	1258631	1349568	1449073	1555475	1672748	1802622	1944529	2100448
TRANSFER PAYMENTS	1081474	1103529	1126233	1148952	1171645	1196978	1223314	1249297
RESIDENCE ADJUSTMENT	230542	228375	225761	223549	221668	219571	217103	214391
SOCIAL INSURANCE ADJUSTMENT	262803	268162	273679	279200	284715	290871	297271	303584
PER CAPITA INCOME	11.860	11.990	12.117	12.243	12.439	12.644	12.840	13.063
TOTAL PERSONAL INCOME	5876972	6002220	6129157	6255093	6415990	6596719	6778200	6972412
DEMOGRAPHICS								
POPULATION	495545	500620	505836	510905	515812	521721	527895	533743
BIRTHS	8425	8515	8608	8699	8786	8894	9006	9112
DEATHS	4055	4097	4141	4183	4223	4272	4323	4372
MIGRATION	-45	656	748	553	344	1288	1491	1108

MASTER LOW FORECAST FOR BPADSI REGION 5

	1996	1997	1998	1999	2000	2001
EMPLOYMENT:PERSONS						
AGRICULTURAL	2709	2812	2921	3035	3154	3280
AGRICULTURAL SERVICES	1407	1463	1522	1586	1652	1725
MINING	92	90	89	88	87	86
CONSTRUCTION	4542	4759	4987	5085	5156	5225
NONDURABLE MANUFACTURING	7645	7682	7729	7780	7841	7910
DURABLE MANUFACTURING	12431	12594	12790	13000	13237	13512
PUBLIC UTILITIES	3666	3592	3519	3448	3378	3310
WHOLESALE TRADE	12003	12289	12591	12906	13227	13575
RETAIL TRADE	27800	28248	28736	29242	29785	30345
FINANCE-INSURANCE-REAL ESTATE	3392	3296	3207	3122	3041	2961
SERVICES	26866	27307	27750	28195	28614	29006
GOVERNMENT	36600	35610	34646	33708	32796	31909
TOTAL	139154	139743	140487	141195	141969	142844
NEW COMMERCIAL CONSTRUCTION SQ.FT						
RETAIL-WHOLESALE	670565	588073	690883	817939	880860	865280
OFFICE BUILDINGS	39615	39615	39615	39615	39615	39615
AUTO REPAIR	6707	6707	6707	6707	6707	6707
WAREHOUSES	793443	795735	910634	1042995	1139316	1195743
EDUCATION	37770	37770	37770	37770	37770	37770
HEALTH	19292	19292	19292	19292	19292	19292
PUBLIC	15094	12612	16273	34638	47061	47433
RELIGIOUS	59180	66142	61064	53564	49744	51245
HOTEL-MOTEL	845	845	845	845	17121	22069
MISCELLANEOUS	506817	503788	531429	560489	578718	588249
TOTAL	2149329	2070580	2314514	2613776	2816205	2873405
COMMERCIAL CONSTRUCTION SQ.FT ADDITIONS AND ALTERATIONS						
RETAIL-WHOLESALE	34055	36727	34109	33129	33836	35562
OFFICE BUILDINGS	11737	18279	18267	13272	16611	18537
AUTO REPAIR	0	0	0	0	0	0
WAREHOUSES	22654	21835	26986	31965	35275	37231
EDUCATION	23079	23885	24770	25706	26720	27811
HEALTH	37844	34697	38159	41814	42982	41420
PUBLIC	11140	8591	11494	13166	13372	12578
RELIGIOUS	13762	13908	14196	14552	14893	15217
HOTEL-MOTEL	9745	6340	15707	25876	31780	33870
MISCELLANEOUS	3857	5127	3857	6556	12298	17948
TOTAL	167873	161389	179465	206036	227687	240176
RESIDENTIAL CONSTRUCTION SQ.FT:						
APARTMENTS						
FIVE OR MORE UNITS						
1-3 STORIES	736432	886406	1157558	1137022	963084	750115
4 OR MORE STORIES	183088	182749	208451	208570	196622	181082
THREE TO FOUR UNITS	40795	40795	76140	40795	40795	40795
SINGLE FAMILY DETACHED	6741564	7880560	8719016	8947232	8832939	8630425
DUPLEXES	157239	188357	237129	236896	211467	180317
TOTAL	7859118	9178867	10398294	10570515	10244907	9782654
WAGES: ANNUAL 000 1984 $						
AGRICULTURAL	29.803	29.887	29.970	30.049	30.116	30.200
AGRICULTURAL SERVICES	21.212	21.369	21.511	21.643	21.789	21.878
MINING	73.142	73.529	73.913	74.271	74.621	74.951
CONSTRUCTION	36.353	36.407	36.434	36.452	36.463	36.443
NONDURABLE MANUFACTURING	30.186	30.293	30.393	30.486	30.573	30.654
DURABLE MANUFACTURING	31.429	31.444	31.460	31.477	31.481	31.509
PUBLIC UTILITIES	35.567	35.792	36.021	36.237	36.458	36.658
WHOLESALE TRADE	36.204	36.451	36.677	36.884	37.091	37.247
RETAIL TRADE	13.209	13.134	13.054	12.978	12.897	12.826
FINANCE-INSURANCE-REAL ESTATE	39.763	40.426	41.086	41.701	42.360	42.876
SERVICES	23.069	23.256	23.437	23.605	23.781	23.917
GOVERNMENT	31.284	31.971	32.758	33.564	34.390	35.236
PERSONAL INCOME 000 1984 $						
WAGE BILL	3732741	3778252	3826583	3871372	3916958	3963038
PROPERTY INCOME	2269389	2455412	2660620	2884511	3131567	3401381
TRANSFER PAYMENTS	1275941	1303480	1334095	1365807	1398112	1431313
RESIDENCE ADJUSTMENT	212206	218703	209219	207838	206205	204832
SOCIAL INSURANCE ADJUSTMENT	310059	316751	324191	331897	339747	347816
PER CAPITA INCOME	13.304	13.613	13.932	14.265	14.631	15.025
TOTAL PERSONAL INCOME	7180218	7431097	7706326	7997631	8313895	8652670
DEMOGRAPHICS						
POPULATION	539782	545865	553126	560648	568198	575896
BIRTHS	9222	9335	9470	9609	9750	9894
DEATHS	4421	4472	4532	4595	4657	4721
MIGRATION	1159	1308	2324	2499	2458	2533

SPOKANE COUNTY, WASHINGTON

(Kaiser Plant Site, Mead)

MASTER HIGH FORECAST FOR BPADSI REGION 6

	1980	1981	1982	1983	1984	1985	1986	1987
EMPLOYMENT:PERSONS								
AGRICULTURAL	941	966	989	1013	1038	1065	1091	1118
AGRICULTURAL SERVICES	256	261	269	275	279	286	292	298
MINING	258	271	290	300	303	323	333	340
CONSTRUCTION	7237	7357	7476	7916	8438	8725	8951	9089
NONDURABLE MANUFACTURING	3864	3794	3717	3655	3612	3584	3528	3466
DURABLE MANUFACTURING	13001	13310	13558	13741	13992	15116	15390	15670
PUBLIC UTILITIES	7292	7272	7251	7230	7209	7189	7168	7148
WHOLESALE TRADE	11688	11987	12422	12856	13333	13924	14424	14822
RETAIL TRADE	24876	25498	25991	26516	27088	27657	28200	28817
FINANCE-INSURANCE-REAL ESTATE	8584	8520	8494	8571	8614	8627	8631	8627
SERVICES	28706	27374	26956	26966	26772	26795	26553	26090
GOVERNMENT	30668	31594	32548	33530	34543	35585	36660	37767
TOTAL	137372	138205	139961	142569	145221	148879	151222	153251
NEW COMMERCIAL CONSTRUCTION SQ.FT								
RETAIL-WHOLESALE	435761	147122	62770	304673	671931	526355	703214	603118
OFFICE BUILDINGS	302929	289006	147114	38030	38030	100789	38030	95291
AUTO REPAIR	164850	583988	634320	10870	10870	10870	10870	10870
WAREHOUSES	717268	656285	666774	797184	946016	952425	1045566	1035856
EDUCATION	115861	88324	40375	40375	40375	40375	40375	40375
HEALTH	33948	24982	24982	24982	24982	24982	24982	24982
PUBLIC	4577	4577	4577	4577	4577	4577	4577	4577
RELIGIOUS	18312	40970	55397	36585	7432	13239	4565	7591
HOTEL-MOTEL	16057	16057	16057	16057	16057	16057	16057	16057
MISCELLANEOUS	321748	276232	257353	302359	359041	341031	370309	355728
TOTAL	2131312	2127545	1909721	1575694	2119312	2030703	2258547	2194446
COMMERCIAL CONSTRUCTION SQ.FT ADDITIONS AND ALTERATIONS								
RETAIL-WHOLESALE	30454	36256	38237	32332	28485	36439	31591	36921
OFFICE BUILDINGS	18520	3855	3855	3855	5810	3855	4239	3855
AUTO REPAIR	4478	910	910	910	910	910	910	910
WAREHOUSES	10626	2153	1440	7156	15853	10572	16265	13473
EDUCATION	13403	7222	7222	14333	14696	7222	15500	15873
HEALTH	66111	56424	52653	65195	79044	72730	78185	74010
PUBLIC	9871	2930	2420	8995	14484	7168	12522	8761
RELIGIOUS	19944	20142	20302	20488	20729	20888	21111	21237
HOTEL-MOTEL	12227	1910	1910	5229	21352	9349	19348	11594
MISCELLANEOUS	33431	28391	13594	7685	7685	10400	7687	12458
TOTAL	219066	160193	142544	166177	209049	179533	207357	199093
RESIDENTIAL CONSTRUCTION SQ.FT:								
APARTMENTS								
FIVE OR MORE UNITS								
1-3 STORIES	105947	105947	105947	269132	498756	614655	645027	552771
4 OR MORE STORIES	98773	93574	103283	154669	200607	219949	230500	234272
THREE TO FOUR UNITS	22280	22280	22280	118517	216998	262842	279242	255161
SINGLE FAMILY DETACHED	3420394	2701932	3475083	5068896	6182035	7087689	7584671	7999043
DUPLEXES	228599	162434	167341	256710	327986	368634	385908	379929
TOTAL	3875993	3086168	3873935	5867923	7426383	8553769	9125348	9421176
WAGES: ANNUAL 000 1984 $								
AGRICULTURAL	95.200	88.887	85.696	84.112	81.802	80.092	78.154	75.519
AGRICULTURAL SERVICES	23.575	23.560	23.180	23.097	23.363	23.366	23.354	23.379
MINING	18.881	21.459	21.988	20.984	20.489	19.811	19.662	20.645
CONSTRUCTION	35.366	35.255	35.141	35.314	35.559	35.691	35.765	35.768
NONDURABLE MANUFACTURING	24.494	24.729	25.014	25.218	25.249	25.341	25.481	25.701
DURABLE MANUFACTURING	28.695	28.655	28.923	29.108	29.009	29.072	29.159	29.245
PUBLIC UTILITIES	31.719	32.135	32.523	32.730	32.732	32.808	32.974	33.306
WHOLESALE TRADE	28.252	28.788	29.058	29.323	29.581	29.747	29.966	30.338
RETAIL TRADE	14.024	13.664	13.545	13.559	13.489	13.462	13.408	13.285
FINANCE-INSURANCE-REAL ESTATE	26.564	28.265	28.784	28.907	29.195	29.225	29.521	30.453
SERVICES	19.802	19.462	19.619	19.709	19.858	19.920	20.036	20.300
GOVERNMENT	20.098	20.338	20.582	20.828	21.077	21.329	21.584	21.842
PERSONAL INCOME 000 1984 $								
WAGE BILL	3124391	3175709	3237222	3320236	3401667	3507330	3582189	3658614
PROPERTY INCOME	595234	615421	632636	647882	665435	684162	703139	725703
TRANSFER PAYMENTS	676399	694875	710406	728243	748310	769937	793207	813994
RESIDENCE ADJUSTMENT	-35701	-30008	-29802	-32140	-32599	-33431	-33002	-30878
SOCIAL INSURANCE ADJUSTMENT	190321	195520	199890	204909	210555	216640	223188	229037
PER CAPITA INCOME	11.477	11.529	11.631	11.747	11.839	11.976	12.018	12.113
TOTAL PERSONAL INCOME	4170002	4260477	4350572	4459312	4572257	4711357	4822345	4938397
DEMOGRAPHICS								
POPULATION	363339	369549	374050	379627	386206	393413	401271	407690
BIRTHS	5860	5960	6033	6125	6234	6352	6481	6585
DEATHS	3556	3618	3662	3718	3783	3854	3932	3996
MIGRATION	4760	3868	2130	3169	4128	4710	5308	3830

MASTER HIGH FORECAST FOR BPADSI REGION 6

	1988	1989	1990	1991	1992	1993	1994	1995
EMPLOYMENT:PERSONS								
AGRICULTURAL	1146	1175	1204	1233	1264	1298	1331	1364
AGRICULTURAL SERVICES	303	309	315	321	327	334	340	346
MINING	349	358	367	378	390	401	414	426
CONSTRUCTION	9235	9441	9510	9456	9713	10524	10728	10743
NONDURABLE MANUFACTURING	3410	3355	3297	3234	3183	3138	3085	3028
DURABLE MANUFACTURING	15997	16340	16641	16886	17255	17728	18068	18352
PUBLIC UTILITIES	7127	7107	7086	7066	7046	7025	7005	6985
WHOLESALE TRADE	15250	15671	16067	16481	16900	17303	17637	17939
RETAIL TRADE	29463	30140	30819	31441	32149	32957	33712	34455
FINANCE-INSURANCE-REAL ESTATE	8630	8634	8628	8598	8586	8589	8566	8532
SERVICES	24064	26004	25790	25384	25498	25554	25416	25249
GOVERNMENT	38907	40081	41291	42538	43822	45145	46508	47912
TOTAL	155881	158616	161816	163018	166134	169999	172810	175332
NEW COMMERCIAL CONSTRUCTION SQ.FT								
RETAIL-WHOLESALE	608079	856796	726739	622941	607569	858824	758064	657521
OFFICE BUILDINGS	66457	38030	135457	127981	97925	46410	144516	137540
AUTO REPAIR	10870	10870	10870	10870	10870	10870	10870	10870
WAREHOUSES	1055157	1136672	1113227	1091195	1084066	1174883	1182001	1163234
EDUCATION	40375	40375	40375	40375	40375	40375	40375	40375
HEALTH	24982	24982	24982	24982	24982	24982	24982	24982
PUBLIC	4577	12952	4577	4577	4577	18176	4577	4577
RELIGIOUS	5639	4565	6793	10093	9742	4565	6499	10026
HOTEL-MOTEL	16057	32009	16057	16057	16057	40205	16057	16057
MISCELLANEOUS	357775	390807	377413	367313	365526	399745	397697	389116
TOTAL	2189969	2548059	2456493	2316386	2262490	2619034	2585639	2454300
COMMERCIAL CONSTRUCTION SQ.FT ADDITIONS AND ALTERATIONS								
RETAIL-WHOLESALE	36198	30734	38498	40095	39683	33046	41120	43253
OFFICE BUILDINGS	3855	11393	4992	3855	3855	12180	7127	3962
AUTO REPAIR	910	910	910	910	910	1530	2749	1680
WAREHOUSES	14544	21499	18817	17662	18216	25155	24083	22979
EDUCATION	16296	16746	17173	17551	18049	18654	19165	19647
HEALTH	73970	81337	76082	72650	72311	79300	75335	72352
PUBLIC	9903	15039	10343	9636	10269	15068	11192	10407
RELIGIOUS	21339	21484	21592	21676	21727	21867	22039	22152
HOTEL-MOTEL	11194	24702	18547	13325	11449	25163	23325	18316
MISCELLANEOUS	11665	12225	20757	21046	18897	18505	26017	26230
TOTAL	199875	236069	227711	218405	215366	250468	252152	240976
RESIDENTIAL CONSTRUCTION SQ.FT:								
APARTMENTS								
FIVE OR MORE UNITS								
1-3 STORIES	389492	185954	105947	105947	105947	105947	105947	105947
4 OR MORE STORIES	237312	226115	216115	197988	174368	186788	184979	176436
THREE TO FOUR UNITS	217401	163047	105275	22280	22280	22588	22280	22280
SINGLE FAMILY DETACHED	8027691	8009565	7750792	6776375	7065978	7530156	7553806	7296607
DUPLEXES	361425	336887	306981	243870	219080	245991	244864	213801
TOTAL	9233321	8921568	8485111	7346460	7587653	8091471	8110277	7815071
WAGES: ANNUAL 000 1984 $								
AGRICULTURAL	73.226	71.010	68.801	66.943	65.232	63.512	61.792	60.139
AGRICULTURAL SERVICES	23.520	23.636	23.741	23.712	23.886	24.034	24.173	24.306
MINING	21.353	22.232	23.333	24.291	25.034	26.011	27.179	28.410
CONSTRUCTION	35.865	35.930	35.956	35.898	35.991	36.046	36.072	36.083
NONDURABLE MANUFACTURING	25.898	26.105	26.306	26.502	26.683	26.879	27.076	27.266
DURABLE MANUFACTURING	29.281	29.331	29.375	29.487	29.512	29.551	29.590	29.625
PUBLIC UTILITIES	33.593	33.904	34.219	34.520	34.792	35.096	35.411	35.722
WHOLESALE TRADE	30.742	31.142	31.524	31.795	32.173	32.555	32.933	33.295
RETAIL TRADE	13.186	13.085	12.972	12.879	12.802	12.716	12.621	12.525
FINANCE-INSURANCE-REAL ESTATE	31.372	32.323	33.291	33.973	34.837	35.776	36.763	37.741
SERVICES	20.577	20.858	21.139	21.337	21.600	21.875	22.157	22.433
GOVERNMENT	22.103	22.367	22.635	22.905	23.179	23.456	23.737	24.021
PERSONAL INCOME 000 1984 $								
WAGE BILL	3750174	3846106	3932176	4003350	4109854	4242678	4343204	4434058
PROPERTY INCOME	749667	775577	803231	831330	862150	896693	932447	970322
TRANSFER PAYMENTS	834489	856781	879777	902456	924648	950427	978090	1003754
RESIDENCE ADJUSTMENT	-29382	-27327	-24795	-22781	-21225	-18808	-15880	-13165
SOCIAL INSURANCE ADJUSTMENT	234803	241076	247546	253928	260172	267425	275209	282430
PER CAPITA INCOME	12.253	12.387	12.495	12.574	12.747	12.946	13.054	13.171
TOTAL PERSONAL INCOME	5070144	5210061	5342843	5460428	5615254	5803565	5962652	6112539
DEMOGRAPHICS								
POPULATION	413795	420622	427614	434273	440524	448301	456758	464079
BIRTHS	6686	6799	6915	7025	7128	7258	7400	7521
DEATHS	4057	4124	4194	4260	4322	4399	4483	4556
MIGRATION	3477	4152	4270	3893	3446	4918	5541	4356

MASTER HIGH FORECAST FOR BPADSI REGION 6

	1996	1997	1998	1999	2000	2001
EMPLOYMENT:PERSONS						
AGRICULTURAL	1397	1435	1473	1510	1548	1587
AGRICULTURAL SERVICES	352	360	367	375	382	390
MINING	442	459	477	496	516	536
CONSTRUCTION	10991	12139	12972	13394	13682	13900
NONDURABLE MANUFACTURING	2975	2938	2899	2856	2813	2769
DURABLE MANUFACTURING	18569	19011	19409	19732	20034	20333
PUBLIC UTILITIES	6965	6945	6925	6905	6885	6866
WHOLESALE TRADE	18242	18644	19049	19455	19852	20283
RETAIL TRADE	35251	36198	37144	38059	38990	39910
FINANCE-INSURANCE-REAL ESTATE	8536	8578	8611	8634	8653	8662
SERVICES	25079	25366	25628	25868	26064	26220
GOVERNMENT	49359	50849	52384	53966	55595	57273
TOTAL	178158	182924	187339	191251	195015	198729
NEW COMMERCIAL CONSTRUCTION SQ.FT						
RETAIL-WHOLESALE	719392	609290	754349	928696	1013924	990848
OFFICE BUILDINGS	96479	137128	88567	93852	129432	167771
AUTO REPAIR	10870	10870	10870	10870	10870	10870
WAREHOUSES	1185075	1163269	1263587	1355103	1395844	1393821
EDUCATION	40375	40375	40375	40375	40375	50323
HEALTH	24982	24982	24982	24982	24982	24982
PUBLIC	4577	4577	4577	17715	29420	27102
RELIGIOUS	6034	11435	5172	4565	4565	4565
HOTEL-MOTEL	16057	16057	16057	43801	70207	74751
MISCELLANEOUS	396595	388127	416845	440055	448630	447272
TOTAL	2500438	2406111	2625382	2960016	3168250	3192305
COMMERCIAL CONSTRUCTION SQ.FT ADDITIONS AND ALTERATIONS						
RETAIL-WHOLESALE	40344	45858	40183	38197	39680	43148
OFFICE BUILDINGS	6597	3855	7537	12749	15639	15824
AUTO REPAIR	1723	1384	2641	4530	6404	7628
WAREHOUSES	25286	23883	29104	33323	35373	35958
EDUCATION	20151	20868	21561	22205	22844	23480
HEALTH	74120	70962	74436	78104	79196	77708
PUBLIC	12339	9892	12899	14686	15013	14343
RELIGIOUS	22230	22286	22531	22768	22937	23063
HOTEL-MOTEL	20143	15049	25325	33566	36123	34651
MISCELLANEOUS	24309	25659	24231	26733	31808	36717
TOTAL	247242	239697	260448	286860	305017	312522
RESIDENTIAL CONSTRUCTION SQ.FT:						
APARTMENTS						
FIVE OR MORE UNITS						
1-3 STORIES	105947	105947	105947	105947	105947	105947
4 OR MORE STORIES	166769	163254	188104	189990	181188	168543
THREE TO FOUR UNITS	22280	22280	37585	22280	22280	22280
SINGLE FAMILY DETACHED	7144811	8317637	9178546	9409802	9284134	9066490
DUPLEXES	185664	222350	273564	271824	242542	207477
TOTAL	7625472	8831469	9783747	9999843	9836092	9570738
WAGES: ANNUAL 000 1984 $						
AGRICULTURAL	58.736	57.533	56.356	55.264	54.175	53.220
AGRICULTURAL SERVICES	24.374	24.521	24.648	24.767	24.893	24.968
MINING	29.437	30.156	30.971	31.751	32.626	33.402
CONSTRUCTION	36.055	36.101	36.120	36.132	36.138	36.112
NONDURABLE MANUFACTURING	27.432	27.573	27.711	27.842	27.971	28.089
DURABLE MANUFACTURING	29.686	29.709	29.737	29.765	29.787	29.829
PUBLIC UTILITIES	35.991	36.210	36.433	36.642	36.856	37.049
WHOLESALE TRADE	33.569	33.850	34.115	34.360	34.609	34.801
RETAIL TRADE	12.444	12.383	12.318	12.257	12.191	12.133
FINANCE-INSURANCE-REAL ESTATE	38.471	39.140	39.810	40.434	41.105	41.631
SERVICES	22.642	22.845	23.043	23.226	23.417	23.567
GOVERNMENT	24.308	24.598	24.893	25.190	25.491	25.796
PERSONAL INCOME 000 1984 $						
WAGE BILL	4530496	4686134	4829888	4956582	5079450	5198732
PROPERTY INCOME	1010143	1054263	1100798	1149045	1200507	1254370
TRANSFER PAYMENTS	1029227	1058991	1091233	1123271	1154689	1186376
RESIDENCE ADJUSTMENT	-10988	-8997	-6684	-4570	-2414	-538
SOCIAL INSURANCE ADJUSTMENT	289598	297973	307045	316059	324899	333815
PER CAPITA INCOME	13.307	13.528	13.701	13.845	13.996	14.142
TOTAL PERSONAL INCOME	6269280	6492419	6708191	6908269	7107333	7305125
DEMOGRAPHICS						
POPULATION	471122	479923	489613	498973	507826	516570
BIRTHS	7638	7783	7946	8102	8249	8395
DEATHS	4626	4714	4810	4903	4991	5078
MIGRATION	4031	5731	6555	6161	5595	5428

MASTER LOW FORECAST FOR BPADSI REGION 6

	1980	1981	1982	1983	1984	1985	1986	1987
EMPLOYMENT:PERSONS								
AGRICULTURAL	941	966	989	1013	1038	1054	1078	1105
AGRICULTURAL SERVICES	256	261	269	275	279	281	286	292
MINING	258	271	290	300	303	322	332	340
CONSTRUCTION	7237	7357	7476	7916	8438	8314	8391	8536
NONDURABLE MANUFACTURING	3864	3794	3717	3655	3612	3491	3430	3368
DURABLE MANUFACTURING	13001	13310	13558	13741	13992	11851	12009	12229
PUBLIC UTILITIES	7292	7272	7251	7230	7209	7188	7167	7146
WHOLESALE TRADE	11688	11987	12422	12856	13333	13832	14316	14710
RETAIL TRADE	24876	25498	25991	26516	27088	27310	27797	28404
FINANCE-INSURANCE-REAL ESTATE	8584	8520	8494	8571	8614	8519	8508	8503
SERVICES	28706	27374	26956	26966	26772	26631	26367	25986
GOVERNMENT	30668	31594	32548	33530	34543	35585	36660	37767
TOTAL	137372	138205	139961	142569	145221	144378	146341	148306
NEW COMMERCIAL CONSTRUCTION SQ.FT								
RETAIL-WHOLESALE	435761	147122	62770	304673	671931	526355	682671	586359
OFFICE BUILDINGS	302929	289006	147114	38030	38030	100789	38030	87233
AUTO REPAIR	164850	583988	634320	10870	10870	10870	10870	10870
WAREHOUSES	717268	656285	666774	797184	946016	952425	948187	944666
EDUCATION	115861	88324	40375	40375	40375	40375	40375	40375
HEALTH	33948	24982	24982	24982	24982	24982	24982	24982
PUBLIC	4577	4577	4577	4577	4577	4577	4577	4577
RELIGIOUS	18312	40970	55397	36585	7432	13239	4565	7549
HOTEL-MOTEL	16057	16057	16057	16057	16057	16057	16057	16057
MISCELLANEOUS	321748	276232	257353	302359	359041	341031	344669	336796
TOTAL	2131312	2127545	1909721	1575694	2119312	2030703	2114985	2059466
COMMERCIAL CONSTRUCTION SQ.FT ADDITIONS AND ALTERATIONS								
RETAIL-WHOLESALE	30454	36256	38237	32332	28485	36439	31833	36629
OFFICE BUILDINGS	18520	3855	3855	3855	5810	3855	3855	3855
AUTO REPAIR	4478	910	910	910	910	910	910	910
WAREHOUSES	10626	2153	1440	7156	15853	10572	13105	11487
EDUCATION	13403	7222	7222	14333	14696	7222	15003	15366
HEALTH	66111	56424	52653	65195	79044	72730	78185	74010
PUBLIC	9871	2930	2420	8995	14484	7168	12522	8759
RELIGIOUS	19944	20142	20302	20488	20729	20888	20903	20947
HOTEL-MOTEL	12227	1910	1910	5229	21352	9349	9299	5020
MISCELLANEOUS	33431	28391	13594	7685	7685	10400	7685	11782
TOTAL	219066	160193	142544	166177	209049	179533	193299	188767
RESIDENTIAL CONSTRUCTION SQ.FT:								
APARTMENTS								
FIVE OR MORE UNITS								
1-3 STORIES	105947	105947	105947	269132	498756	600843	512185	450572
4 OR MORE STORIES	98773	93574	103283	154669	208607	221757	247678	245497
THREE TO FOUR UNITS	22280	22280	22280	118517	216998	259609	248277	232467
SINGLE FAMILY DETACHED	3420394	2701932	3475083	5068896	6182035	7072368	7435421	7865698
DUPLEXES	228599	162434	167341	256710	327986	365792	358668	359648
TOTAL	3875993	3086168	3873935	5867923	7426383	8520369	8802229	9153898
WAGES: ANNUAL 000 1984 $								
AGRICULTURAL	95.200	88.887	85.696	84.112	81.882	80.092	78.154	75.519
AGRICULTURAL SERVICES	23.575	23.560	23.180	23.097	23.363	23.366	23.354	23.379
MINING	18.881	21.459	21.988	20.984	20.489	19.811	19.662	20.645
CONSTRUCTION	35.366	35.255	35.141	35.314	35.559	35.691	35.765	35.768
NONDURABLE MANUFACTURING	24.494	24.729	25.014	25.218	25.249	25.341	25.481	25.701
DURABLE MANUFACTURING	28.695	28.655	28.923	29.108	29.089	29.072	29.159	29.245
PUBLIC UTILITIES	31.719	32.135	32.523	32.730	32.732	32.808	32.974	33.306
WHOLESALE TRADE	28.252	28.788	29.058	29.323	29.581	29.747	29.966	30.338
RETAIL TRADE	14.024	13.664	13.545	13.559	13.489	13.462	13.408	13.285
FINANCE-INSURANCE-REAL ESTATE	26.564	28.265	28.784	28.907	29.195	29.225	29.521	30.453
SERVICES	19.002	19.462	19.619	19.709	19.858	19.920	20.036	20.300
GOVERNMENT	20.098	20.338	20.582	20.828	21.077	21.329	21.584	21.842
PERSONAL INCOME 000 1984 $								
WAGE BILL	3124391	3175709	3237222	3320236	3401667	3380436	3443849	3518151
PROPERTY INCOME	595234	615421	632636	647882	665435	678184	696573	718928
TRANSFER PAYMENTS	676399	694875	710406	728243	748310	768886	782641	802382
RESIDENCE ADJUSTMENT	-35701	-30008	-29802	-32140	-32599	-33647	-35110	-33044
SOCIAL INSURANCE ADJUSTMENT	190321	195520	199890	204909	210555	216344	220215	225770
PER CAPITA INCOME	11.477	11.529	11.631	11.747	11.839	11.651	11.789	11.896
TOTAL PERSONAL INCOME	4170002	4260477	4350572	4459312	4572257	4577514	4667738	4780648
DEMOGRAPHICS								
POPULATION	363339	369549	374058	379627	386206	392876	395926	401874
BIRTHS	5860	5960	6033	6125	6234	6343	6386	6486
DEATHS	3556	3618	3662	3718	3783	3849	3879	3938
MIGRATION	4760	3868	2138	3169	4128	4176	542	3401

MASTER LOW FORECAST FOR BPADSI REGION 6

	1988	1989	1990	1991	1992	1993	1994	1995
EMPLOYMENT:PERSONS								
AGRICULTURAL	1133	1162	1191	1219	1250	1284	1316	1349
AGRICULTURAL SERVICES	297	303	308	315	321	327	333	339
MINING	348	357	366	376	388	400	411	424
CONSTRUCTION	8713	8927	8993	8967	9214	9955	10138	10175
NONDURABLE MANUFACTURING	3314	3260	3203	3141	3091	3046	2993	2938
DURABLE MANUFACTURING	12493	12767	13005	13205	13496	13861	14128	14359
PUBLIC UTILITIES	7126	7105	7085	7065	7044	7024	7004	6984
WHOLESALE TRADE	15138	15556	15950	16363	16780	17179	17511	17812
RETAIL TRADE	29044	29714	30383	30999	31697	32486	33228	33964
FINANCE-INSURANCE-REAL ESTATE	8507	8511	8505	8476	8464	8464	8441	8408
SERVICES	25881	25820	25607	25204	25316	25367	25229	25064
GOVERNMENT	38907	40081	41291	42538	43822	45145	46508	47912
TOTAL	150901	153565	155889	157870	160884	164539	167241	169729
NEW COMMERCIAL CONSTRUCTION SQ.FT								
RETAIL-WHOLESALE	595296	843832	716858	615134	680644	849222	749266	650014
OFFICE BUILDINGS	59056	38030	128888	121713	91222	38030	137374	131079
AUTO REPAIR	10870	10870	10870	10870	10870	10870	10870	10870
WAREHOUSES	980288	1072242	1059753	1046239	1046940	1137297	1145076	1129589
EDUCATION	40375	40375	40375	40375	40375	40375	40375	40375
HEALTH	24982	24982	24982	24982	24982	24982	24982	24982
PUBLIC	4577	12530	4577	4577	4577	17687	4577	4577
RELIGIOUS	5544	4565	6723	9968	9573	4565	6417	9879
HOTEL-MOTEL	16057	31120	16057	16057	16057	38862	16057	16057
MISCELLANEOUS	345593	382524	370963	361766	360740	394906	392034	383554
TOTAL	2082640	2461072	2380048	2251683	2205981	2556797	2527030	2480978
COMMERCIAL CONSTRUCTION SQ.FT ADDITIONS AND ALTERATIONS								
RETAIL-WHOLESALE	35871	38580	38121	39691	39303	32856	40733	42813
OFFICE BUILDINGS	3855	18822	4613	3855	3855	11625	6700	3855
AUTO REPAIR	910	910	910	910	910	1380	2557	1514
WAREHOUSES	13196	20350	17687	16518	17094	23977	22779	21680
EDUCATION	15785	16226	16644	17017	17503	18084	18581	19058
HEALTH	73970	81337	76082	72650	72311	79300	75335	72352
PUBLIC	9886	15019	10323	9615	10247	15845	11168	10361
RELIGIOUS	21080	21260	21395	21499	21570	21723	21893	22008
HOTEL-MOTEL	7677	22840	17420	12545	10963	24649	22499	17574
MISCELLANEOUS	11069	11660	20175	20450	18314	17887	25324	25550
TOTAL	193299	231005	223368	214751	212070	246526	247569	236783
RESIDENTIAL CONSTRUCTION SQ.FT:								
APARTMENTS								
FIVE OR MORE UNITS								
1-3 STORIES	316314	132993	105947	105947	105947	105947	105947	105947
4 OR MORE STORIES	243574	229190	217348	198081	173533	185986	184252	175338
THREE TO FOUR UNITS	201908	152155	96959	22280	22280	22280	22280	22280
SINGLE FAMILY DETACHED	7916754	7917093	7671618	6787442	7086752	7473300	7497069	7244469
DUPLEXES	347858	327716	300442	239008	215627	242481	240367	210569
TOTAL	9026409	8759148	8392314	7272758	7524139	8029995	8049914	7758530
WAGES: ANNUAL 000 1984 $								
AGRICULTURAL	73.226	71.010	68.801	66.943	65.232	63.512	61.792	60.139
AGRICULTURAL SERVICES	23.520	23.636	23.741	23.712	23.886	24.034	24.173	24.306
MINING	21.353	22.232	23.333	24.291	25.034	26.011	27.179	28.410
CONSTRUCTION	35.865	35.930	35.956	35.898	35.991	36.046	36.072	36.083
NONDURABLE MANUFACTURING	25.898	26.105	26.306	26.502	26.683	26.879	27.076	27.266
DURABLE MANUFACTURING	29.281	29.331	29.375	29.487	29.512	29.551	29.590	29.625
PUBLIC UTILITIES	33.593	33.904	34.219	34.520	34.792	35.096	35.411	35.722
WHOLESALE TRADE	30.742	31.142	31.524	31.795	32.173	32.555	32.933	33.295
RETAIL TRADE	13.186	13.085	12.972	12.879	12.802	12.716	12.621	12.525
FINANCE-INSURANCE-REAL ESTATE	31.372	32.323	33.291	33.973	34.837	35.776	36.763	37.741
SERVICES	20.577	20.858	21.139	21.337	21.688	21.875	22.157	22.433
GOVERNMENT	22.103	22.367	22.635	22.905	23.179	23.456	23.737	24.021
PERSONAL INCOME 000 1984 $								
WAGE BILL	3608619	3702255	3785889	3856197	3959500	4085648	4182666	4272438
PROPERTY INCOME	742739	768432	795833	823737	854269	888362	923753	961352
TRANSFER PAYMENTS	822529	844534	867152	889434	911351	936457	963371	988514
RESIDENCE ADJUSTMENT	-31480	-29344	-26743	-24670	-23047	-20609	-17662	-14896
SOCIAL INSURANCE ADJUSTMENT	231438	237630	243994	250264	256431	263495	271067	278142
PER CAPITA INCOME	12.841	12.176	12.286	12.370	12.542	12.738	12.850	12.973
TOTAL PERSONAL INCOME	4910969	5048246	5178137	5294434	5445643	5626363	5781860	5929265
DEMOGRAPHICS								
POPULATION	407865	414610	421478	428007	434189	441711	449884	457033
BIRTHS	6585	6697	6811	6919	7020	7146	7283	7401
DEATHS	3998	4065	4133	4198	4259	4334	4415	4486
MIGRATION	3405	4113	4190	3808	3422	4709	5305	4233

MASTER LOW FORECAST FOR BPADSI REGION 6

	1996	1997	1998	1999	2000	2001
EMPLOYMENT:PERSONS						
AGRICULTURAL	1382	1419	1457	1494	1532	1570
AGRICULTURAL SERVICES	346	353	360	367	375	382
MINING	440	456	474	493	512	532
CONSTRUCTION	10416	11462	12240	12641	12917	13126
NONDURABLE MANUFACTURING	2886	2849	2810	2768	2726	2683
DURABLE MANUFACTURING	14535	14875	15187	15445	15688	15929
PUBLIC UTILITIES	6964	6944	6924	6904	6884	6865
WHOLESALE TRADE	18115	18513	18915	19320	19716	20145
RETAIL TRADE	34751	35677	36605	37508	38428	39337
FINANCE-INSURANCE-REAL ESTATE	8412	8450	8483	8505	8524	8533
SERVICES	24894	25175	25433	25670	25865	26019
GOVERNMENT	49359	50849	52384	53966	55595	57273
TOTAL	172501	177024	181273	185082	188762	192395
NEW COMMERCIAL CONSTRUCTION SQ.FT						
RETAIL-WHOLESALE	711589	602960	745750	917979	1002407	979868
OFFICE BUILDINGS	88830	131178	79781	84242	120264	159604
AUTO REPAIR	10870	10870	10870	10870	10870	10870
WAREHOUSES	1154256	1136116	1231891	1320393	1360721	1359974
EDUCATION	40375	40375	40375	40375	40375	49559
HEALTH	24982	24982	24982	24982	24982	24982
PUBLIC	4577	4577	4577	17248	28729	26381
RELIGIOUS	5834	11193	4896	4565	4565	4565
HOTEL-MOTEL	16057	16057	16057	41882	67654	72042
MISCELLANEOUS	391564	383231	418771	433725	442534	441406
TOTAL	2448935	2361540	2569951	2896181	3103102	3129251
COMMERCIAL CONSTRUCTION SQ.FT						
ADDITIONS AND ALTERATIONS						
RETAIL-WHOLESALE	39981	45374	39854	37910	39358	42751
OFFICE BUILDINGS	6171	3855	7022	12202	15122	15361
AUTO REPAIR	1582	1234	2429	4337	6226	7454
WAREHOUSES	24031	22617	27672	31860	33924	34512
EDUCATION	19554	20243	20916	21546	22175	22800
HEALTH	74120	70962	74436	78184	79196	77708
PUBLIC	12311	9863	12869	14653	14978	14306
RELIGIOUS	22096	22160	22394	22623	22791	22919
HOTEL-MOTEL	19647	14624	24454	32651	35356	34015
MISCELLANEOUS	23659	24999	23469	25963	31053	35964
TOTAL	243151	235931	255515	281849	300177	307790
RESIDENTIAL CONSTRUCTION SQ.FT:						
APARTMENTS						
FIVE OR MORE UNITS						
1-3 STORIES	105947	105947	105947	105947	105947	105947
4 OR MORE STORIES	165128	161808	186974	188726	179568	166605
THREE TO FOUR UNITS	22280	22280	34620	22280	22280	22280
SINGLE FAMILY DETACHED	7097832	8270140	9128497	9359916	9236244	9020678
DUPLEXES	183175	219492	270093	268390	239501	204802
TOTAL	7574363	8779667	9726132	9945260	9783540	9520312
WAGES: ANNUAL 000 1984 $						
AGRICULTURAL	58.736	57.533	56.356	55.264	54.175	53.220
AGRICULTURAL SERVICES	24.374	24.521	24.648	24.767	24.893	24.968
MINING	29.437	30.156	30.971	31.791	32.626	33.402
CONSTRUCTION	36.055	36.101	36.120	36.132	36.138	36.112
NONDURABLE MANUFACTURING	27.432	27.573	27.711	27.842	27.971	28.089
DURABLE MANUFACTURING	29.686	29.709	29.737	29.765	29.787	29.829
PUBLIC UTILITIES	35.991	36.210	36.433	36.642	36.856	37.049
WHOLESALE TRADE	33.569	33.850	34.115	34.360	34.609	34.801
RETAIL TRADE	12.444	12.383	12.318	12.257	12.191	12.133
FINANCE-INSURANCE-REAL ESTATE	38.471	39.140	39.810	40.434	41.105	41.631
SERVICES	22.642	22.845	23.043	23.226	23.417	23.567
GOVERNMENT	24.308	24.598	24.893	25.190	25.491	25.796
PERSONAL INCOME 000 1984 $						
WAGE BILL	4367087	4514931	4653401	4776869	4897143	5013899
PROPERTY INCOME	1000864	1044427	1090487	1138322	1189372	1242886
TRANSFER PAYMENTS	1013640	1042690	1074042	1105361	1136208	1167362
RESIDENCE ADJUSTMENT	-12657	-10652	-8337	-6283	-4010	-2097
SOCIAL INSURANCE ADJUSTMENT	285212	293386	302208	311020	319699	328465
PER CAPITA INCOME	13.112	13.328	13.584	13.652	13.806	13.956
TOTAL PERSONAL INCOME	6083642	6298010	6507386	6703329	6899013	7093584
DEMOGRAPHICS						
POPULATION	463987	472535	481988	491017	499698	508291
BIRTHS	7517	7658	7816	7968	8112	8255
DEATHS	4555	4648	4733	4824	4911	4996
MIGRATION	3993	5530	6283	5973	5479	5334

FLATHEAD COUNTY, MONTANA

(Columbia Falls Aluminum Company Plant Site, Columbia Falls)

MASTER HIGH FORECAST FOR BPADSI REGION 7

	1980	1981	1982	1983	1984	1985	1986	1987
EMPLOYMENT:PERSONS								
AGRICULTURAL	138	135	132	128	125	123	120	117
AGRICULTURAL SERVICES	41	43	44	45	46	47	48	49
MINING	21	21	22	22	21	22	22	22
CONSTRUCTION	794	782	762	733	707	700	682	670
NONDURABLE MANUFACTURING	311	308	309	312	316	325	329	330
DURABLE MANUFACTURING	4160	4224	4230	4155	4105	4313	4306	4324
PUBLIC UTILITIES	1246	1251	1257	1263	1268	1274	1280	1285
WHOLESALE TRADE	644	647	664	682	702	729	750	763
RETAIL TRADE	3488	3573	3631	3676	3728	3796	3855	3931
FINANCE-INSURANCE-REAL ESTATE	653	651	650	653	654	656	657	658
SERVICES	2845	2728	2705	2721	2715	2737	2730	2697
GOVERNMENT	3857	4011	4172	4338	4512	4692	4880	5075
TOTAL	18198	18376	18578	18731	18901	19416	19661	19923
NEW COMMERCIAL CONSTRUCTION SQ.FT								
RETAIL-WHOLESALE	26324	3750	3750	23526	60521	39676	57579	44532
OFFICE BUILDINGS	18108	304913	162040	740	740	740	740	740
AUTO REPAIR	42418	360981	386534	40	40	40	40	40
WAREHOUSES	128361	220524	337672	404097	407466	435914	439540	451366
EDUCATION	942	942	942	942	942	942	942	942
HEALTH	3880	3880	3880	3880	3880	3880	3880	3880
PUBLIC	260	260	260	260	260	260	260	260
RELIGIOUS	5267	25955	38889	18978	75	2276	75	75
HOTEL-MOTEL	462	462	462	462	462	462	462	462
MISCELLANEOUS	19519	3125	3125	29049	70466	42805	63078	47089
TOTAL	245542	924793	937555	481975	544853	526995	566596	549307
COMMERCIAL CONSTRUCTION SQ.FT								
ADDITIONS AND ALTERATIONS								
RETAIL-WHOLESALE	0	0	0	5684	13827	0	8902	1519
OFFICE BUILDINGS	200	200	200	200	200	200	200	200
AUTO REPAIR	0	0	0	0	0	0	0	0
WAREHOUSES	0	0	0	0	2587	0	722	0
EDUCATION	627	627	627	627	2148	627	2299	627
HEALTH	9172	1642	1642	10112	21865	14597	19513	15123
PUBLIC	492	492	492	492	4388	492	2326	492
RELIGIOUS	467	438	420	501	618	631	689	695
HOTEL-MOTEL	0	0	0	0	12084	0	6640	0
MISCELLANEOUS	0	0	0	0	0	0	0	0
TOTAL	10959	3401	3382	17637	57717	16548	41291	18657
RESIDENTIAL CONSTRUCTION SQ.FT:								
APARTMENTS								
FIVE OR MORE UNITS								
1-3 STORIES	5585	5585	5585	5585	5585	5585	5585	5585
4 OR MORE STORIES	0	0	0	32238	69105	83185	91028	88133
THREE TO FOUR UNITS	167	167	167	74145	151934	182053	185462	159845
SINGLE FAMILY DETACHED	224944	23837	819086	2403128	3479056	4341615	4787994	5190195
DUPLEXES	365	365	365	11532	26236	28076	17190	365
TOTAL	231062	29955	825204	2526627	3731915	4640514	5087259	5444123
WAGES: ANNUAL 000 1984 $								
AGRICULTURAL	46.572	44.828	44.150	43.844	43.138	42.711	42.242	41.588
AGRICULTURAL SERVICES	42.288	41.284	40.714	40.927	41.281	41.449	41.450	41.171
MINING	16.109	18.676	19.108	17.946	17.334	16.532	16.291	17.253
CONSTRUCTION	29.992	30.274	30.339	30.557	30.894	31.085	31.250	31.416
NONDURABLE MANUFACTURING	14.775	15.402	15.729	15.743	15.695	15.664	15.761	16.119
DURABLE MANUFACTURING	27.571	27.619	27.929	28.129	28.054	28.134	28.244	28.367
PUBLIC UTILITIES	30.946	31.380	31.760	31.940	31.926	31.984	32.137	32.473
WHOLESALE TRADE	23.341	24.166	24.538	24.785	25.073	25.244	25.501	25.987
RETAIL TRADE	13.105	12.784	12.670	12.668	12.592	12.555	12.499	12.389
FINANCE-INSURANCE-REAL ESTATE	26.931	28.708	29.302	29.504	29.857	29.947	30.292	31.293
SERVICES	17.394	17.854	17.961	17.964	18.050	18.044	18.112	18.367
GOVERNMENT	17.947	18.208	18.474	18.743	19.016	19.293	19.574	19.860
PERSONAL INCOME 000 1984 $								
WAGE BILL	387168	394315	401061	405359	409007	422150	428861	437471
PROPERTY INCOME	116622	125587	134257	142635	152015	162710	173832	186663
TRANSFER PAYMENTS	96651	99551	102058	104664	107221	110276	113727	116658
RESIDENCE ADJUSTMENT	20596	24759	26057	25621	25887	25879	26444	28043
SOCIAL INSURANCE ADJUSTMENT	23436	24139	24747	25379	25999	26748	27577	28288
PER CAPITA INCOME	11.140	11.335	11.503	11.581	11.685	11.925	12.833	12.267
TOTAL PERSONAL INCOME	597602	628073	638684	652900	668131	694275	715287	740548
DEMOGRAPHICS								
POPULATION	53643	54704	55523	56374	57177	58221	59445	60371
BIRTHS	831	848	861	875	888	904	924	939
DEATHS	502	512	520	528	536	546	557	566
MIGRATION	683	725	478	505	450	686	858	553

MASTER HIGH FORECAST FOR BPADSI REGION.7

	1988	1989	1990	1991	1992	1993	1994	1995
EMPLOYMENT:PERSONS								
AGRICULTURAL	115	113	110	108	106	104	102	100
AGRICULTURAL SERVICES	50	52	53	55	56	58	59	61
MINING	22	21	21	21	21	21	21	21
CONSTRUCTION	659	651	643	636	630	627	624	623
NONDURABLE MANUFACTURING	331	332	333	333	335	336	336	336
DURABLE MANUFACTURING	4348	4380	4415	4451	4498	4552	4611	4673
PUBLIC UTILITIES	1291	1297	1303	1309	1315	1321	1326	1332
WHOLESALE TRADE	778	792	805	820	834	847	857	867
RETAIL TRADE	4009	4092	4181	4267	4359	4457	4562	4672
FINANCE-INSURANCE-REAL ESTATE	660	662	664	665	667	669	671	673
SERVICES	2709	2717	2710	2686	2714	2733	2735	2736
GOVERNMENT	5278	5489	5709	5937	6175	6422	6679	6946
TOTAL	20251	20599	20948	21289	21710	22147	22584	23041
NEW COMMERCIAL CONSTRUCTION SQ.FT								
RETAIL-WHOLESALE	44399	71575	56482	44800	43155	70655	58963	48321
OFFICE BUILDINGS	740	740	740	740	740	740	740	740
AUTO REPAIR	40	40	40	40	40	40	40	40
WAREHOUSES	462054	438349	432450	439082	448212	431885	428099	436423
EDUCATION	942	942	942	942	942	942	942	942
HEALTH	3880	3880	3880	3880	3880	3880	3880	3880
PUBLIC	260	260	260	260	260	260	260	260
RELIGIOUS	75	75	75	75	75	75	75	75
HOTEL-MOTEL	462	462	462	462	462	462	462	462
MISCELLANEOUS	47239	75836	57969	46182	45602	73174	60656	51202
TOTAL	560093	592160	553301	536464	543370	582114	554118	542347
COMMERCIAL CONSTRUCTION SQ.FT ADDITIONS AND ALTERATIONS								
RETAIL-WHOLESALE	3774	11643	2156	1404	2937	10433	2682	1747
OFFICE BUILDINGS	200	200	200	200	200	200	200	200
AUTO REPAIR	0	0	0	0	0	0	0	0
WAREHOUSES	0	3685	0	0	0	4106	987	0
EDUCATION	627	2564	627	627	627	3016	627	627
HEALTH	14958	22199	16955	13536	13192	20114	16181	13224
PUBLIC	492	4668	492	492	492	4435	492	492
RELIGIOUS	712	774	771	763	766	818	813	803
HOTEL-MOTEL	0	11721	4242	0	0	10982	5514	1100
MISCELLANEOUS	0	0	0	0	0	0	0	0
TOTAL	20764	57454	25444	17024	18215	54104	27497	18194
RESIDENTIAL CONSTRUCTION SQ.FT:								
APARTMENTS								
FIVE OR MORE UNITS								
1-3 STORIES	5585	5585	5585	5585	5585	5585	5585	5585
4 OR MORE STORIES	84998	71277	59203	37655	9648	23255	23244	10788
THREE TO FOUR UNITS	122858	64886	3749	167	167	167	167	167
SINGLE FAMILY DETACHED	5214312	5170419	4883031	3891116	4173943	4588448	4549205	4271240
DUPLEXES	365	365	365	365	365	365	365	365
TOTAL	5428118	5312531	4951932	3934888	4189708	4617821	4578567	4288145
WAGES: ANNUAL 000 1984 $								
AGRICULTURAL	40.990	40.423	39.856	39.433	38.987	38.550	38.113	37.692
AGRICULTURAL SERVICES	41.120	41.825	40.877	40.673	40.736	40.715	40.639	40.549
MINING	17.933	18.799	19.908	20.868	21.609	22.601	23.800	25.071
CONSTRUCTION	31.649	31.852	32.024	32.092	32.293	32.466	32.617	32.751
NONDURABLE MANUFACTURING	16.415	16.748	17.112	17.441	17.731	18.072	18.444	18.821
DURABLE MANUFACTURING	28.434	28.515	28.592	28.732	28.782	28.847	28.912	28.974
PUBLIC UTILITIES	32.763	33.079	33.402	33.711	33.988	34.300	34.627	34.951
WHOLESALE TRADE	26.483	26.983	27.477	27.842	28.300	28.775	29.255	29.723
RETAIL TRADE	12.301	12.212	12.115	12.035	11.969	11.898	11.819	11.741
FINANCE-INSURANCE-REAL ESTATE	32.200	33.171	34.153	34.848	35.725	36.672	37.661	38.638
SERVICES	18.630	18.907	19.194	19.395	19.658	19.944	20.245	20.545
GOVERNMENT	20.149	20.443	20.741	21.043	21.350	21.661	21.976	22.297
PERSONAL INCOME 000 1984 $								
WAGE BILL	447394	458044	468910	479542	492081	505389	518991	533168
PROPERTY INCOME	200589	215891	232754	250911	270788	292771	317046	343814
TRANSFER PAYMENTS	119688	122930	126281	129707	133185	136922	140775	144712
RESIDENCE ADJUSTMENT	29331	30760	32381	33757	34926	36312	37858	39433
SOCIAL INSURANCE ADJUSTMENT	29022	29808	30621	31452	32295	33201	34135	35090
PER CAPITA INCOME	12.524	12.794	13.083	13.373	13.707	14.059	14.435	14.842
TOTAL PERSONAL INCOME	767980	797818	829704	862465	898685	938193	980534	1026837
DEMOGRAPHICS								
POPULATION	61323	62357	63419	64492	65562	66731	67926	69131
BIRTHS	954	971	989	1007	1025	1044	1064	1084
DEATHS	575	585	595	605	616	627	638	649
MIGRATION	573	648	669	671	661	751	769	770

MASTER HIGH FORECAST FOR BPADSI REGION 7

	1996	1997	1998	1999	2000	2001
EMPLOYMENT:PERSONS						
AGRICULTURAL	98	96	94	93	91	90
AGRICULTURAL SERVICES	63	65	66	68	70	73
MINING	21	21	21	21	21	21
CONSTRUCTION	621	621	623	626	631	637
NONDURABLE MANUFACTURING	337	338	340	342	344	346
DURABLE MANUFACTURING	4713	4763	4825	4895	4976	5069
PUBLIC UTILITIES	1338	1344	1351	1357	1363	1369
WHOLESALE TRADE	877	891	905	921	937	955
RETAIL TRADE	4789	4910	5040	5177	5322	5473
FINANCE-INSURANCE-REAL ESTATE	678	683	690	697	704	712
SERVICES	2737	2784	2831	2880	2925	2969
GOVERNMENT	7224	7513	7813	8126	8451	8789
TOTAL	23497	24031	24601	25202	25836	26503
NEW COMMERCIAL CONSTRUCTION SQ.FT						
RETAIL-WHOLESALE	55846	44159	59515	78718	88662	86942
OFFICE BUILDINGS	740	740	740	740	740	740
AUTO REPAIR	40	40	40	40	40	40
WAREHOUSES	441788	458456	463434	465861	455307	446254
EDUCATION	942	942	942	942	942	942
HEALTH	3880	3880	3880	3880	3880	3880
PUBLIC	260	260	260	260	260	260
RELIGIOUS	75	672	75	75	75	75
HOTEL-MOTEL	462	462	462	462	462	462
MISCELLANEOUS	59461	49404	64286	80775	88074	85924
TOTAL	563494	559016	598635	631754	638443	625519
COMMERCIAL CONSTRUCTION SQ.FT ADDITIONS AND ALTERATIONS						
RETAIL-WHOLESALE	5180	1123	6338	8301	7568	5591
OFFICE BUILDINGS	200	200	200	200	200	200
AUTO REPAIR	0	0	0	0	0	0
WAREHOUSES	1454	0	2417	5342	6755	6656
EDUCATION	627	627	627	3988	4199	4426
HEALTH	14974	11846	15286	18919	19999	18526
PUBLIC	1471	492	1860	3549	3770	2991
RELIGIOUS	819	804	830	868	896	908
HOTEL-MOTEL	4152	0	5347	12033	15321	14698
MISCELLANEOUS	0	0	0	0	0	0
TOTAL	28876	15094	32905	53198	58708	53996
RESIDENTIAL CONSTRUCTION SQ.FT:						
APARTMENTS						
FIVE OR MORE UNITS						
1-3 STORIES	5585	5585	5585	5585	5585	5585
4 OR MORE STORIES	0	0	25654	25380	12098	0
THREE TO FOUR UNITS	167	167	167	167	167	167
SINGLE FAMILY DETACHED	4106699	5216237	6000159	6176012	6016833	5773144
DUPLEXES	365	365	365	365	365	365
TOTAL	4112817	5222354	6031931	6207509	6035048	5779262
WAGES: ANNUAL 000 1984 $						
AGRICULTURAL	37.358	37.048	36.751	36.476	36.199	35.972
AGRICULTURAL SERVICES	40.468	40.560	40.599	40.642	40.657	40.657
MINING	26.126	26.860	27.697	28.500	29.406	30.208
CONSTRUCTION	32.828	32.957	33.062	33.155	33.244	33.292
NONDURABLE MANUFACTURING	19.140	19.388	19.650	19.897	20.160	20.394
DURABLE MANUFACTURING	29.058	29.099	29.146	29.191	29.231	29.289
PUBLIC UTILITIES	35.231	35.457	35.688	35.905	36.129	36.331
WHOLESALE TRADE	30.084	30.432	30.769	31.081	31.402	31.659
RETAIL TRADE	11.675	11.624	11.571	11.521	11.468	11.421
FINANCE-INSURANCE-REAL ESTATE	39.369	40.042	40.714	41.338	42.008	42.533
SERVICES	20.771	20.983	21.194	21.391	21.601	21.766
GOVERNMENT	22.622	22.951	23.286	23.625	23.969	24.319
PERSONAL INCOME 000 1984 $						
WAGE BILL	546937	562454	579052	596552	615160	634641
PROPERTY INCOME	372783	404351	439224	477493	519855	566217
TRANSFER PAYMENTS	148780	152931	157363	161978	166772	171841
RESIDENCE ADJUSTMENT	40758	41772	42873	43922	45053	46066
SOCIAL INSURANCE ADJUSTMENT	36077	37083	38158	39277	40439	41668
PER CAPITA INCOME	15.251	15.702	16.180	16.688	17.239	17.813
TOTAL PERSONAL INCOME	1073181	1124425	1180354	1240669	1306401	1377097
DEMOGRAPHICS						
POPULATION	70367	71610	72953	74345	75784	77310
BIRTHS	1105	1126	1149	1172	1197	1223
DEATHS	661	673	686	699	713	727
MIGRATION	792	790	879	919	954	1031

MASTER LOW FORECAST FOR BPADSI REGION 7

	1980	1981	1982	1983	1984	1985	1986	1987
EMPLOYMENT:PERSONS								
AGRICULTURAL	138	135	132	128	125	117	114	112
AGRICULTURAL SERVICES	41	43	44	45	46	43	44	45
MINING	21	21	22	22	21	22	22	21
CONSTRUCTION	794	782	762	733	707	567	549	543
NONDURABLE MANUFACTURING	311	308	309	312	316	282	285	286
DURABLE MANUFACTURING	4168	4224	4230	4155	4105	2105	2092	2110
PUBLIC UTILITIES	1246	1251	1257	1263	1268	1273	1279	1285
WHOLESALE TRADE	644	647	664	682	702	709	728	741
RETAIL TRADE	3488	3573	3631	3676	3728	3592	3641	3718
FINANCE-INSURANCE-REAL ESTATE	653	651	650	653	654	621	621	622
SERVICES	2845	2728	2705	2721	2715	2667	2656	2626
GOVERNMENT	3857	4011	4172	4338	4512	4692	4880	5075
TOTAL	18198	18376	18578	18731	18901	16691	16913	17185
NEW COMMERCIAL CONSTRUCTION SQ.FT								
RETAIL-WHOLESALE	26324	3750	3750	23526	60521	39676	47118	37116
OFFICE BUILDINGS	18108	384913	162040	740	740	740	740	740
AUTO REPAIR	42418	360981	386534	40	40	40	40	40
WAREHOUSES	128361	220524	337672	404097	407466	435914	381291	402411
EDUCATION	942	942	942	942	942	942	942	942
HEALTH	3880	3880	3880	3880	3880	3880	3880	3880
PUBLIC	260	260	260	260	260	260	260	260
RELIGIOUS	5267	25955	38889	18978	75	2276	75	75
HOTEL-MOTEL	462	462	462	462	462	462	462	462
MISCELLANEOUS	19519	3125	3125	29049	70466	42805	47741	37167
TOTAL	245542	924793	937555	481975	544853	526995	482550	483094
COMMERCIAL CONSTRUCTION SQ.FT								
ADDITIONS AND ALTERATIONS								
RETAIL-WHOLESALE	0	0	0	5684	13827	0	9025	1356
OFFICE BUILDINGS	200	200	200	200	200	200	200	200
AUTO REPAIR	0	0	0	0	0	0	0	0
WAREHOUSES	0	0	0	0	2587	0	0	0
EDUCATION	627	627	627	627	2148	627	2027	627
HEALTH	9172	1642	1642	10132	21865	14597	19513	15123
PUBLIC	492	492	492	492	4388	492	2326	492
RELIGIOUS	467	438	420	501	618	631	669	672
HOTEL-MOTEL	0	0	0	0	12084	0	629	0
MISCELLANEOUS	0	0	0	0	0	0	0	0
TOTAL	10959	3401	3382	17637	57717	16548	34389	18471
RESIDENTIAL CONSTRUCTION SQ.FT:								
APARTMENTS								
FIVE OR MORE UNITS								
1-3 STORIES	5585	5585	5585	5585	5585	5585	5585	5585
4 OR MORE STORIES	0	0	0	32238	69105	83898	97668	91998
THREE TO FOUR UNITS	167	167	167	74145	151934	188779	173491	151924
SINGLE FAMILY DETACHED	224944	23837	819086	2403128	3479056	4335577	4730279	5142631
DUPLEXES	365	365	365	11532	26236	26955	6660	365
TOTAL	231062	29955	825204	2526627	3731915	4632794	5013683	5392503
WAGES: ANNUAL 000 1984 $								
AGRICULTURAL	46.572	44.828	44.150	43.844	43.138	42.711	42.242	41.588
AGRICULTURAL SERVICES	42.288	41.284	40.714	40.927	41.281	41.449	41.450	41.171
MINING	16.109	18.676	19.108	17.946	17.334	16.532	16.291	17.253
CONSTRUCTION	29.992	30.274	30.339	30.557	30.894	31.085	31.250	31.416
NONDURABLE MANUFACTURING	14.775	15.402	15.729	15.743	15.695	15.664	15.761	16.119
DURABLE MANUFACTURING	27.571	27.619	27.929	28.129	28.054	28.134	28.244	28.367
PUBLIC UTILITIES	30.946	31.380	31.760	31.940	31.926	31.984	32.137	32.473
WHOLESALE TRADE	23.341	24.166	24.538	24.785	25.073	25.244	25.501	25.987
RETAIL TRADE	13.105	12.784	12.670	12.668	12.592	12.555	12.499	12.389
FINANCE-INSURANCE-REAL ESTATE	26.931	28.708	29.302	29.504	29.857	29.947	30.292	31.253
SERVICES	17.394	17.854	17.961	17.964	18.050	18.044	18.112	18.367
GOVERNMENT	17.947	18.208	18.474	18.743	19.016	19.293	19.574	19.860
PERSONAL INCOME 000 1984 $								
WAGE BILL	387168	394315	401061	405359	409007	349376	355377	363921
PROPERTY INCOME	116622	125587	134257	142635	152015	155823	166508	178937
TRANSFER PAYMENTS	96651	99551	102058	104664	107221	109863	109646	112454
RESIDENCE ADJUSTMENT	20596	24759	26057	25621	25887	25793	25603	27234
SOCIAL INSURANCE ADJUSTMENT	23436	24139	24747	25379	25999	26640	26587	27268
PER CAPITA INCOME	11.140	11.335	11.503	11.581	11.685	10.589	11.002	11.260
TOTAL PERSONAL INCOME	597602	620073	638684	652900	668131	614215	630547	635278
DEMOGRAPHICS								
POPULATION	53643	54704	55523	56374	57177	58003	57312	58195
BIRTHS	831	848	861	875	888	901	886	901
DEATHS	502	512	520	528	536	544	537	546
MIGRATION	683	725	478	505	450	469	-1039	527

MASTER LOW FORECAST FOR BPADSI REGION 7

	1988	1989	1990	1991	1992	1993	1994	1995
EMPLOYMENT:PERSONS								
AGRICULTURAL	110	107	105	103	101	99	98	96
AGRICULTURAL SERVICES	47	48	49	51	52	54	55	57
MINING	21	21	21	21	21	20	20	20
CONSTRUCTION	537	533	530	526	525	524	524	526
NONDURABLE MANUFACTURING	287	288	289	290	291	292	292	292
DURABLE MANUFACTURING	2133	2158	2185	2211	2244	2279	2317	2357
PUBLIC UTILITIES	1291	1296	1302	1308	1314	1320	1326	1332
WHOLESALE TRADE	756	771	784	799	814	827	838	847
RETAIL TRADE	3796	3880	3969	4055	4146	4244	4348	4457
FINANCE-INSURANCE-REAL ESTATE	625	627	630	632	634	636	639	641
SERVICES	2638	2647	2642	2619	2647	2667	2670	2672
GOVERNMENT	5278	5489	5709	5937	6175	6422	6679	6946
TOTAL	17520	17868	18216	18553	18964	19385	19806	20243
NEW COMMERCIAL CONSTRUCTION SQ.FT								
RETAIL-WHOLESALE	38994	66158	52557	41894	40604	67134	56089	45989
OFFICE BUILDINGS	740	740	740	740	740	740	740	740
AUTO REPAIR	40	40	40	40	40	40	40	40
WAREHOUSES	422664	404567	404879	416353	428677	413080	411315	421368
EDUCATION	942	942	942	942	942	942	942	942
HEALTH	3880	3880	3880	3880	3880	3880	3880	3880
PUBLIC	260	260	260	260	260	260	260	260
RELIGIOUS	75	75	75	75	75	75	75	75
HOTEL-MOTEL	462	462	462	462	462	462	462	462
MISCELLANEOUS	41076	71640	54773	43489	43125	70795	58269	48769
TOTAL	509134	548766	518609	508136	518806	557330	532873	522527
COMMERCIAL CONSTRUCTION SQ.FT ADDITIONS AND ALTERATIONS								
RETAIL-WHOLESALE	3620	11571	1986	1226	2775	10349	2516	1571
OFFICE BUILDINGS	200	200	200	200	200	200	200	200
AUTO REPAIR	0	0	0	0	0	0	0	0
WAREHOUSES	0	3270	0	0	0	3662	410	0
EDUCATION	627	2286	627	627	627	2724	627	627
HEALTH	14958	22199	16955	13536	13192	20114	16181	13224
PUBLIC	492	4666	492	492	492	4434	492	492
RELIGIOUS	692	757	756	750	754	807	802	793
HOTEL-MOTEL	0	11686	4171	0	0	10900	5372	915
MISCELLANEOUS	0	0	0	0	0	0	0	0
TOTAL	20590	56635	25187	16832	18040	53190	26601	17823
RESIDENTIAL CONSTRUCTION SQ.FT:								
APARTMENTS								
FIVE OR MORE UNITS								
1-3 STORIES	5585	5585	5585	5585	5585	5585	5585	5585
4 OR MORE STORIES	87022	72179	59431	37473	9219	22693	22614	10118
THREE TO FOUR UNITS	117641	61308	1146	167	167	167	167	167
SINGLE FAMILY DETACHED	5175727	5138764	4856652	3868800	4154740	4571498	4533854	4257063
DUPLEXES	365	365	365	365	365	365	365	365
TOTAL	5386341	5278201	4923178	3912391	4170077	4600308	4562585	4273299
WAGES: ANNUAL 000 1984 $								
AGRICULTURAL	40.990	40.423	39.856	39.433	38.987	38.558	38.113	37.692
AGRICULTURAL SERVICES	41.120	41.025	40.877	40.673	40.736	40.715	40.639	40.549
MINING	17.933	18.799	19.908	20.868	21.609	22.601	23.800	25.071
CONSTRUCTION	31.649	31.852	32.024	32.092	32.293	32.466	32.617	32.751
NONDURABLE MANUFACTURING	16.415	16.748	17.112	17.441	17.731	18.072	18.444	18.821
DURABLE MANUFACTURING	28.434	28.515	28.592	28.732	28.782	28.847	28.912	28.974
PUBLIC UTILITIES	32.763	33.079	33.402	33.711	33.988	34.300	34.627	34.951
WHOLESALE TRADE	26.483	26.983	27.477	27.842	28.380	28.775	29.255	29.723
RETAIL TRADE	12.301	12.212	12.115	12.035	11.969	11.898	11.819	11.741
FINANCE-INSURANCE-REAL ESTATE	32.200	33.171	34.153	34.848	35.725	36.672	37.661	38.638
SERVICES	18.630	18.907	19.194	19.395	19.658	19.944	20.245	20.545
GOVERNMENT	20.149	20.443	20.741	21.043	21.350	21.661	21.976	22.297
PERSONAL INCOME 000 1984 $								
WAGE BILL	373785	384201	394776	404944	417026	429700	442605	456018
PROPERTY INCOME	192448	207288	223635	241232	260516	281833	305366	331319
TRANSFER PAYMENTS	115430	118609	121884	125228	128616	132248	135983	139794
RESIDENCE ADJUSTMENT	28560	30026	31680	33086	34279	35690	37259	38857
SOCIAL INSURANCE ADJUSTMENT	27990	28761	29535	30365	31187	32068	32973	33898
PER CAPITA INCOME	11.536	11.824	12.129	12.433	12.782	13.148	13.537	13.957
TOTAL PERSONAL INCOME	682234	711363	742421	774125	809251	847403	888239	932090
DEMOGRAPHICS								
POPULATION	59141	60165	61211	62264	63313	64453	65614	66782
BIRTHS	917	934	951	968	986	1005	1024	1044
DEATHS	555	564	574	584	594	605	616	627
MIGRATION	584	655	669	669	657	740	752	751

MASTER LOW FORECAST FOR BPADSI REGION 7

	1996	1997	1998	1999	2000	2001
EMPLOYMENT:PERSONS						
AGRICULTURAL	94	92	91	89	88	86
AGRICULTURAL SERVICES	59	61	62	64	66	68
MINING	20	20	20	21	21	21
CONSTRUCTION	527	529	533	538	544	551
NONDURABLE MANUFACTURING	293	295	296	298	300	302
DURABLE MANUFACTURING	2386	2421	2461	2505	2555	2610
PUBLIC UTILITIES	1338	1344	1350	1356	1362	1368
WHOLESALE TRADE	858	872	887	903	919	937
RETAIL TRADE	4573	4694	4823	4958	5102	5251
FINANCE-INSURANCE-REAL ESTATE	646	652	659	666	674	681
SERVICES	2674	2721	2768	2816	2861	2905
GOVERNMENT	7224	7513	7813	8126	8451	8789
TOTAL	20692	21215	21765	22342	22944	23571
NEW COMMERCIAL CONSTRUCTION SQ.FT						
RETAIL-WHOLESALE	53281	42155	57013	75560	85210	83627
OFFICE BUILDINGS	740	740	740	740	740	740
AUTO REPAIR	40	40	40	40	40	40
WAREHOUSES	427096	445307	455172	451700	440428	431101
EDUCATION	942	942	942	942	942	942
HEALTH	3880	3880	3880	3880	3880	3880
PUBLIC	260	260	260	260	260	260
RELIGIOUS	75	665	75	75	75	75
HOTEL-MOTEL	462	462	462	462	462	462
MISCELLANEOUS	56961	46916	61805	78217	85417	83140
TOTAL	543738	541369	580390	611877	617455	604268
COMMERCIAL CONSTRUCTION SQ.FT ADDITIONS AND ALTERATIONS						
RETAIL-WHOLESALE	5039	937	6208	8192	7451	5451
OFFICE BUILDINGS	200	200	200	200	200	200
AUTO REPAIR	0	0	0	0	0	0
WAREHOUSES	977	0	1936	4715	6076	5947
EDUCATION	627	627	627	3666	3871	4090
HEALTH	14974	11846	15286	18919	19999	18526
PUBLIC	1469	492	1858	3547	3768	2990
RELIGIOUS	809	795	821	859	888	899
HOTEL-MOTEL	3936	0	5253	11865	15100	14427
MISCELLANEOUS	0	0	0	0	0	0
TOTAL	28032	14898	32189	51963	57352	52530
RESIDENTIAL CONSTRUCTION SQ.FT:						
APARTMENTS						
FIVE OR MORE UNITS						
1-3 STORIES	5585	5585	5585	5585	5585	5585
4 OR MORE STORIES	0	0	25144	24547	11051	0
THREE TO FOUR UNITS	167	167	167	167	167	167
SINGLE FAMILY DETACHED	4093343	5205952	5991878	6169445	6011821	5768337
DUPLEXES	365	365	365	365	365	365
TOTAL	4099460	5212069	6023140	6200189	6028990	5774454
WAGES: ANNUAL 000 1984 $						
AGRICULTURAL	37.358	37.048	36.751	36.476	36.199	35.972
AGRICULTURAL SERVICES	40.468	40.560	40.599	40.642	40.657	40.657
MINING	26.126	26.860	27.697	28.500	29.406	30.208
CONSTRUCTION	32.828	32.957	33.062	33.155	33.244	33.292
NONDURABLE MANUFACTURING	19.140	19.388	19.650	19.897	20.160	20.394
DURABLE MANUFACTURING	29.058	29.099	29.146	29.191	29.231	29.289
PUBLIC UTILITIES	35.231	35.457	35.688	35.905	36.129	36.331
WHOLESALE TRADE	30.084	30.432	30.769	31.081	31.402	31.659
RETAIL TRADE	11.675	11.624	11.571	11.521	11.468	11.421
FINANCE-INSURANCE-REAL ESTATE	39.369	40.042	40.714	41.338	42.008	42.533
SERVICES	20.771	20.983	21.194	21.391	21.601	21.766
GOVERNMENT	22.622	22.951	23.286	23.625	23.969	24.319
PERSONAL INCOME 000 1984 $						
WAGE BILL	469366	484408	500310	516973	534966	552776
PROPERTY INCOME	359476	390191	424106	461322	502505	547594
TRANSFER PAYMENTS	143728	147934	152390	157038	161882	166917
RESIDENCE ADJUSTMENT	40199	41249	42379	43457	44618	45658
SOCIAL INSURANCE ADJUSTMENT	34851	35871	36952	38079	39254	40474
PER CAPITA INCOME	14.386	14.839	15.319	15.826	16.372	16.944
TOTAL PERSONAL INCOME	977918	1027910	1082232	1140712	1204317	1272422
DEMOGRAPHICS						
POPULATION	67978	69271	70647	72078	73562	75095
BIRTHS	1064	1086	1109	1134	1159	1185
DEATHS	639	651	664	677	692	706
MIGRATION	770	858	931	975	1017	1054

APPENDIX B

DECISION ANALYSIS MODEL DOCUMENTATION

Appendix B

DECISION ANALYSIS MODEL DOCUMENTATION

The Decision Analysis Model (DAM) simulates the effects of different resource and rate decisions by forecasting loads including aluminum smelter load for each plant, acquiring resources, operating the electrical system, and calculating costs, ensuing rates, BPA finances, and net economic benefits.

In simulating the effect of resource and rate decisions the model explicitly handles risk by introducing randomness through several variables. Randomness enters through load forecasts, unscheduled resource termination, the amount of water available each year, aluminum price, and smelter production costs.

The Model Period is the entire period under consideration--currently the period through 2015. The Planning Period is an artifact of the model. It is the rolling 7-year period for which loads are forecast and resource decisions are made. The aluminum Direct Service Industries (DSI) sector has a rolling 10-year planning period for decisions regarding smelter capacity changes and modernization.

The DAM cycles through the model period on an annual basis. For each year of the model period, a rolling forecast is made (for the 7-year and 10-year planning periods), the system is operated, rates and costs calculated, and resources acquired to meet the load, if necessary. Each pass through the entire model period is one game. Each game utilizes a new random selection of values for those variables which are uncertain. Usually several games are run (50 or more) to ensure that a wide range of uncertainty is modeled, and the probability of different outcomes can be determined. Single games may also be run, or single values for the random variables can be entered, depending on how the model is to be used.

The model is capable of producing tables, histograms, expected values, and the variance of the principal variables. Outputs include net benefits, costs, rates, fund balances, resource scheduling, loads, and markets served. These are calculated in the modules discussed next.

The Load Forecasting Module forecasts loads to be served with resources acquired in the Resource Analysis Module. System expansion and operations to meet these loads are costed out and the rate effects calculated in the Finances and Rates Module. The Net Benefits Module estimates the net economic benefits of resource decisions.

B.1 LOAD FORECASTING MODULE

B.1.1 Overview

The Load Forecasting Module (LFM) forecasts loads using simple equations that include a starting load value, predetermined expected growth rates, price elasticities, and a randomness component. During each operating year simulated by the model, loads are forecast for a subsequent period of years

(the planning period) corresponding to the longest lead time required to bring a resource on line. The LFM also determines the realized load for the current operating year. The discussion distinguishes between forecast and realized loads.

Loads are calculated for seven rate-oriented customer classes. They are: IOU exchange loads, IOU nonexchange loads, public exchange loads, public nonexchange loads, DSI aluminum loads, DSI nonaluminum loads, and other BPA priority firm loads. The LFM uses identical methodology to forecast loads for each class. The following discussion applies to all load classes except the aluminum DSI loads which are forecast somewhat differently and are discussed separately.

The input values and parameters of the LFM are calibrated to be consistent with BPA's 1986 long-term load forecast. Load forecasting equations are actually used twice. The first use is to make a planning period forecast that includes inertia and projected rate effects, but no random disturbances. Rates for the operating year are then derived by costing out the resources used to meet the planning period forecast. During the next pass, loads for the operating year are determined based on the new rates and a random disturbance. This results in a realized load to be used later in the System Operation Activity of the Resource Analysis Module.

The inertial component of the forecast depends on a user-specified long-term expected growth rate and current growth rates. In the first year of the forecast, the long-term expected growth rate is applied to the base year load. These values are inputs to the model. Thereafter, the expected growth rate for the next time period varies directly with the growth rate of the current time period; in other words, loads increase generally along a path predicted by the long-term expected growth rate. Deviation occurs because the most recently experienced growth rates will act either to brake or accelerate the long-term growth rate.

Randomness is introduced through the growth rate, which for any time period is distributed normally. The mean of the distribution is the expected growth rate--the inertial component discussed above. Each model game selects a growth rate from the distribution according to the probabilities assigned to each possible value. Thus, the inertial component is adjusted by random deviations from its expected value. This explicitly introduces a form of uncertainty.

Price effects then act on the growth rate. Price elasticity information is applied to reflect how loads would respond to changes in relative prices. To be precise, it is the perceived price, not the actual price, that influences the loads. Discrepancies between perceived and actual prices occur because of a lag between actual price changes and recognition of those changes.

In short, loads proceed along a long-term expected growth path. Their rate of growth tends to increase (decrease) when the most recently experienced growth rates exceed (fall short of) the long-term rate. The resulting load is then subjected to a random adjustment. Finally, relatively higher or lower perceived price changes dampen or accelerate that growth rate.

B.1.2 The Mechanics

Forecasted loads for any given year are a function of the previous year's load, a long-term expected growth rate, the current growth rate, an uncertainty coefficient, the perceived price, the previous year's perceived price, a reference price, a lag coefficient, and a price elasticity variable.

(1) $L_t = L_t(L_{t-1}, G', G_t, U, P_t, P_{t-1}, P', C, E)$

where
- L_t = Forecast load for year t
- L_{t-1} = Forecast load for year t-1
- G' = Long-term expected growth rate
- G_t = Growth rate year t
- U = Uncertainty coefficient
- P_t = Perceived price in year t
- P_{t-1} = Perceived price year t-1
- P' = Reference price
- C = Lag coefficient
- E = Price elasticity of demand

Equation (1) is a functional description of the variables used in the load forecasting process. The equations that follow define the process.

The expected growth rate, $E(G_t)$, is calculated annually and may therefore be viewed as a 1-year forecast. The expected growth rate influences both forecast loads and realized loads. It is derived by:

(5) $E(G_t) = G' * (1 - U) + G_{t-1} * U$

where $E(G_t)$ = Expected growth rate in year t
and G_{t-1} = The previous year's (t-1) growth rate

The long-term expected growth rate is user-specified, and may be derived from the expected load growth rate of BPA's long-term forecast. The uncertainty coefficient (U) is also user-specified. As it increases, the variance of the long-term loads increases. It is typically set so that the histogram of year 2005 loads produced by the model is consistent with a probability distribution of loads obtained from another source--in this case, the 1985 load forecast. Note that the expected growth rate $E(G_t)$ converges more rapidly on the long-term expected growth rate (G') when U approaches zero.

The reference load--that is, the load forecast without price effects--is calculated by equation (4).

(4) $L_t' = L_{t-1}' * (1 + G_t)$

For load forecasts, G_t equals $E(G_t)$; no random disturbances occur. In determining realized or operating year loads the growth rate (G_t) is a random variable. It is distributed normally with a mean equal to the expected growth rate and a standard deviation, sigma, equal to the 1-year standard deviation in load growth. The value of sigma is user-specified; as it increases, the variability of G_t increases.

The reference loads are then adjusted for perceived price effects. The perceived price (P_t) is determined by the model. It represents the price that each class "sees" as the price it faces, not the actual price to be paid. It is determined by a weighted average of the actual price and the previous year's perceived price (P_{t-1}). The calculation is algebraically equivalent to (3).

(3) $P_t = P_{t-1} * (1-C) + P_{at} * C$

where P_{at} = Actual price (determined by the rates module)
C = A lag coefficient (C is between zero and one)

The lag coefficient influences how quickly price changes will be perceived and result in actual changes in loads. The user specifies the value of C; ideally, it should match historically observed lags. A value of one indicates an instantaneous response to actual price changes. Conversely, a value of zero indicates no response to actual price changes.

The reference load and price effects combine to produce actual loads.

(2) $L_t = L_t' * (P_t/P')^E$

where L_t' = Reference load for year t

Equation (2) shows that the reference load is adjusted by accounting for price effects. The price elasticity of demand (E) expresses the percent change in quantity demanded, given a one percent change in price. Used in an exponential equation such as (2), E is expressed as its actual estimated value, input by the user.

Since (E) is a negative value, note that when perceived prices exceed a reference price the effect is to diminish loads from the reference load. The reference price, like the price elasticity, is specified by the user. It should be consistent with the price(s) used to calculate the reference long-term growth rate.

The forecasted loads for each customer class are used in the Resource Analysis Module (RAM) to determine what resources must be acquired to meet load in the planning period.

B.1.3 DSI Loads

In the aluminum DSI sector loads are forecast for each smelter over a rolling ten-year planning period. The forecasts consist of a long-run capital investment decision that results in a projected capacity value for each smelter. The capacity determination is a two part procedure. In the first part total production costs are compared to the market price of aluminum. If the present value of costs is less than the present value of revenues over that period the smelter is assumed to remain in operation.

The market price of aluminum is an expected value forecast in which the expected current price is a function of past prices, the long run expected price, and a randomness component. As in the rest of the model, quarterly information is aggregated into annual values. In the case of the expected aluminum price, the previous two quarters' values are weighted by the long run expected aluminum price to produce the expected quarterly price. By adjusting the weights on these parameters, any desired distribution of prices may be obtained.

The production costs, which are compared to the expected aluminum price, are input from a set of production cost forecasts developed for BPA for each smelter. (Because of proprietary information, actual data on each smelter's costs are not available.)

If expected long run prices exceed the costs of production for a smelter it is assumed to remain in operation. The model next determines whether an investment in either of two levels of modernization would increase the profitability of operations over the long term. The specified levels of investment lower production costs, thereby increasing the level of profitability. A case is also available in which there is no investment in modernization and production costs remain the same. The model chooses either level of modernization, or no modernization, on the basis of which maximizes the level of profitability for each smelter. If the forecast production costs exceed the expected aluminum price over the 10-year planning period the smelter is closed. Regardless of the level of investment selected, the outcome is a capacity value for each smelter for the planning period. The model assumes that three-fourths of the capacity value is a firm load to be served. This firm load value feeds into the Resource Analysis Module with the load forecasts for the rate classes discussed previously. The 10-year forecast is repeated each operating year.

During the operating year the amount of firm load served depends on quarterly production decisions. The realized quarterly aluminum price is compared to the short run marginal cost of operation to determine the level of operation for each smelter. The realized quarterly aluminum price is the expected quarterly price, discussed above, adjusted randomly to account for market uncertainty. When that price exceeds the variable cost of operation, the smelter operates at full capacity. When it is less than the variable cost the plant operates at a minimum level of capacity, approximately equal to one potline. The plants never close in the short run, and they operate at either full or minimum capacity. The aggregated loads of all smelters become a firm load for the model to serve. (See the System Operation Activity portion of the Resource Analysis Module. Also, greater detail on the DSI portions of the model is available in The DSI Options Study, Final Report, Part 2 published by BPA in June 1985.)

B.2 RESOURCE ANALYSIS MODULE (RAM)

The Resource Analysis Module performs two major activities. First, it scans the future to determine whether resources must be acquired to meet loads. It then makes the necessary acquisitions. Second, it operates the generating

system. This activity consists of allocating available energy to the different markets, and calculating the ensuing revenues, costs, and loads served. All public loads, DSI loads, and other priority firm loads make up the BPA/Public sector, with IOU loads going to the IOU sector.

B.2.1 Acquisitions

The RAM acquires resources to meet the loads of two sectors: BPA/Public Utilities, and Investor Owned Utilities (IOUs). Load forecasts from the Load Forecasting Module (LFM) are aggregated into one of these two sectors.

Two sets of resource supply information are provided. The first, existing and committed resources, tells the model how much firm energy can be produced with the current system; that is, if no further actions are taken. Subtracting the available supply from forecast loads yields a forecast of the load-resource balance. The load-resource balance is calculated for both sectors. The RAM examines that balance for as far into the future as would be necessary to bring the longest lead-time resource on line to meet loads.

During any period, if the system is forecast to be surplus, the model will not acquire any new resource, (other than those that have already been committed.) If, however, the system is projected to be deficit, new resource acquisitions are scheduled. If the lead time required to bring those resources on line is such that a decision must be made in that planning year, the model permanently schedules the resource. Otherwise, the resource schedule may be revised in a later planning year.

B.2.2 Generating Resources

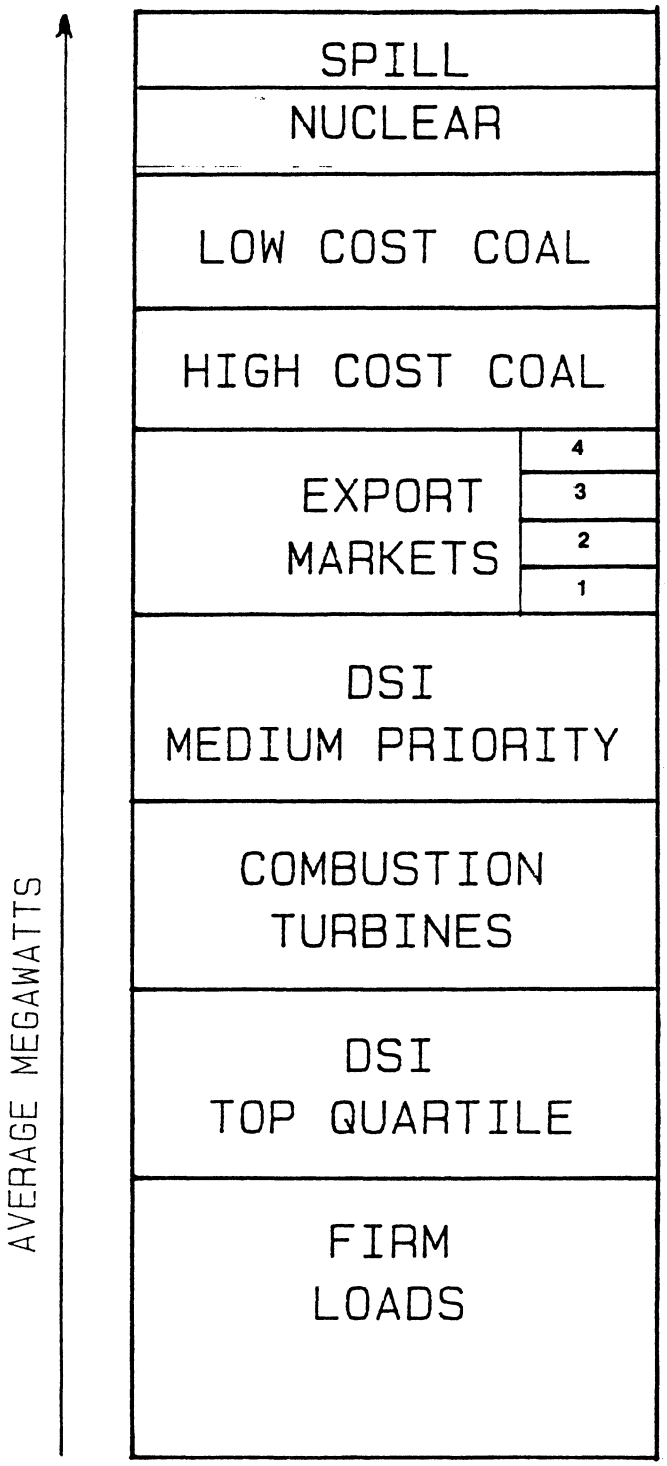
In each sector the model selects from a stack of resources available to be built to meet loads. The resources are arranged according to a priority specified by the user. Generally, the resources would be arranged so that the cheapest ones are acquired first, but other ordering criteria could be used; for example, to test alternative resource decisions. (See Figure B-1.)

How and when does the model acquire a resource? In scanning the projected load-resource balances for each year of the planning period, the RAM asks, "Is there a deficit that year?" If there is not, or if the deficit is less than a specified amount, the model simply looks at the next year and asks the same question. This process continues to the last year of the planning period, or until a deficit exists.

When there is a deficit the model begins to acquire resources from the stack in the order specified, providing only that the resource can be on line in time to meet the deficit. If it cannot, it looks at the next highest priority resource and its lead time. That year's deficit, and all subsequent deficits are reduced by the permanent and temporary acquisitions. The distinction between a permanent and a temporary acquisition is necessary for modeling purposes only. Essentially, the model first assumes all resources are temporary acquisitions as it selects the various resources for meeting projected firm deficits. It becomes a permanent acquisition in the model only

Figure B-1

RESOURCE MODULE



if the lead time for the resource is such that a build decision must be made in the current year so that the resource will be on line when needed. Otherwise, if the lead time is shorter than the length of time before the resource is needed, no permanent decision is made.

If such acquisitions are sufficient to erase the deficit, the model cycles to the next year of the forecast period and repeats the process. If a deficit remains, however, it returns to the stack to make further acquisitions. Once these determinations have been made, all the temporary acquisitions are deleted by returning them to the resource stack. The entire process is repeated for the next planning period.

The model continues to acquire resources in the order specified to meet all firm deficits.

Option resources are built in two stages. In the first stage the model does the preconstruction and incurs option hold-costs. This stage continues for a specified hold time, or until the model decides to construct the resource. If the hold time elapses and the resources have not been constructed, they are terminated. The second stage is the period required to actually construct the resource.

The acquisition activity can be affected by two sources of uncertainty. During each game, load forecasts change, partly because of randomness. (See LFM section.) The available resource supply is fixed, however. Consequently, the load-resource balance is also random.

The other component of uncertainty is the possibility that a resource will be unavailable when needed; that is, that it will be terminated involuntarily. The user specifies the probability of unscheduled termination. The two nuclear plants, for example, are assumed to have a 10 percent chance of being unavailable to the region. Thus, in approximately 10 percent of the games, the nuclear plants are not available, so a resource lower in priority must be acquired instead.

Note that the model is given no choice about the resources to acquire. If a deficit of a specified size exists, resources must be acquired to erase it. Not only that, they must be acquired in a predetermined order, subject only to the condition that the resource's lead time is sufficiently short. If there is no perceived deficit, the model will not acquire resources except for those that have a user-specified build date. During each set of games the resource stacks are identical. Differences in resources that are acquired between games occur only because of variations in future loads or because of the unscheduled termination of a resource.

When resources are scheduled the RAM keeps an account of the costs and other information. Two costs are peculiar to option resources: the one-time cost of the option and an annual option holding cost. (Option costs are allocated over all BPA loads in the Rates Module.) Other costs, applied to all permanently scheduled resources, are the capital cost and fixed annual operating cost. The variable operating costs are calculated and tallied in the Systems Operation Activity.

B.2.3 Costs and End-Effects Calculations

Because most resources still have a useful life at the end of the model period (2015), the model tracks costs incurred up to that period, as well as the benefits associated with the lifetime remaining for the resource.

The model first constructs the resource's fixed cost stream in real dollars. This results in a downward sloping real cost stream, with high real costs early in the resource's life, and lower real costs later on. The cost of the resource equals the present value of the costs incurred up to the end of the model period.

$$\text{COST} = \text{SUM} \quad C_t/(1.03)^t$$

over all t = from the first year a resource is on line to the end of model period

where COST = Present value of resource cost

C_t = Real cost in year t

Thus the model accounts for costs faced by ratepayers for the years that the resource produces output, up to the end of the model period.

At the end of the model period the resource may still be productive. The longer the useful life and the more costs that have already been paid, the greater the remaining benefits to the region.

Assume that resource A could be replaced by resource B at the same real levelized cost. The benefits that accrue from having resource A are the difference between the costs remaining to be paid (the present value of the remaining real cost stream) and the levelized costs of resource B that would otherwise have to be paid. Since payments initially exceed the real levelized cost, at any time during the resource's life the present value of <u>remaining</u> costs is less than the present value of real <u>levelized</u> costs remaining.

Therefore, the model subtracts the real cost stream from the levelized stream to compute the savings, or benefits, associated with the resource's remaining life.

$$\text{NET BENEFITS} = \text{SUM} \ (LC_t - C_t)/(1.03)^t$$

over all t where t = end of model period to end of resource life

and NET BENEFITS = Regional benefit of resource's remaining life (plant value)

LC = Real levelized cost of resource

The net benefits are simply the cost savings associated with having a plant with useful life remaining, and having already incurred costs in excess of the real levelized resource cost. These benefits are added to those computed in the Net Benefits Module discussed below.

B.2.4 Conservation Resources

Conservation resources are acquired by disaggregated sectors. They are the BPA/Public and IOU sectors, each divided into exchange and nonexchange segments. Aluminum smelter conservation is not a form of conservation that the model can select as a means of limiting future load growth. Aluminum smelter conservation occurs in the model when the model calculates that it is cost-effective for individual smelters.

The conservation resource logic is simple: conservation savings prior to 1992 are subtracted from loads; then, in 1992, the model must select one of three possible paths for conservation savings and remain on that path forever.

Conservation savings prior to 1992 are created either through currently planned programs or through the conservation strategies being tested. Loads during that period are reduced by currently planned programs. They are further reduced by the amount acquired under each strategy.

For 1992 and subsequent years, the model selects a conservation path from the three that are available. Savings prior to 1992 are those that result from each strategy and are therefore identical regardless of the path.

The path selection depends upon a simple decision rule. If the surplus exceeds 1500 MW (or any other specified amount) a low path is selected. If the surplus is less than 1500 MW, the medium path is selected. Finally, if the deficit exceeds a specified amount, the high path is selected. Whatever path is selected remains fixed for all subsequent years.

Since conservation is treated as a load reduction, it is acquired prior to all generation acquisitions. This is tantamount to making conservation the highest priority in the resource stack.

Conservation capital costs incurred by BPA are calculated similarly to generation capital costs. In addition, consumer costs (i.e. non-BPA costs) are also added in.

B.2.5 System Operation Activity

The second major activity of the RAM is operating the system. The module computes system operating costs, export sales revenues, and service to the firm, DSI, and Southwest markets.

During each operating year, for each game, the model selects the amount of available water and generates a realized load using the LFM with a random disturbance. Available water is also a random variable. Summing the energy produced by other resources and the energy represented by the water yields total energy available to serve the various markets--firm, DSI, export, etc. Those markets are assigned a priority for service such that firm loads are always served first and low cost thermal plants served--or displaced actually--last.

The model selects from 40 available historic water years. These are the same water years used in the Systems Analysis Model with hydrogeneration data specified quarterly for each year. The user can shape the energy by moving energy from one quarter to another, but any such transfers must then occur during every year of system operation. The current version of the model shifts 1000 MW from period three (April - June) to period one (October - December).

The model initially assumes that all available resources, including combustion turbines are in operation. It then determines the extent to which those resources can be displaced by hydropower. When energy from available hydro and thermal resources is more than enough to meet all firm loads during each quarter, residual energy becomes available to serve the remaining markets in order of their priority. (See Figure B-2.)

The accompanying figure shows one possible priority configuration. During each quarter of each year the different "markets" are stacked in order of their priority. Markets consist of firm loads, secondary sales markets, and displaceable resources. The highest priority markets are at the bottom of the stack. Markets further up the stack have successively lower priority. Generally, highest priority would be assigned to markets that BPA has a contractual obligation to serve. Next would be the markets with the highest incremental value of revenues or cost savings. If, for example, export market 4 revenues would be 25 mills/kwh, it would normally have a higher priority than displacing a thermal plant with operating costs of, say, 20 mills/kwh.

Because of coal contracts and other reasons, not all thermal plants can be displaced at any time. Consequently, some proportion of the plants must be operated. That proportion can be specified by the user, with the current model version using a value of 25 percent. This proportion is removed from the market stack since it is unavailable for displacement.

If after serving all markets surplus energy is still available, it is spilled. Therefore, in the best water years, the size of the intertie can serve as a significant constraint. The model can operate with different assumptions of intertie capacity.

For each operating year the model tallies the amount of energy serving each market. For sales markets, it calculates the resulting sales revenues, and for displacement markets the reductions in costs.

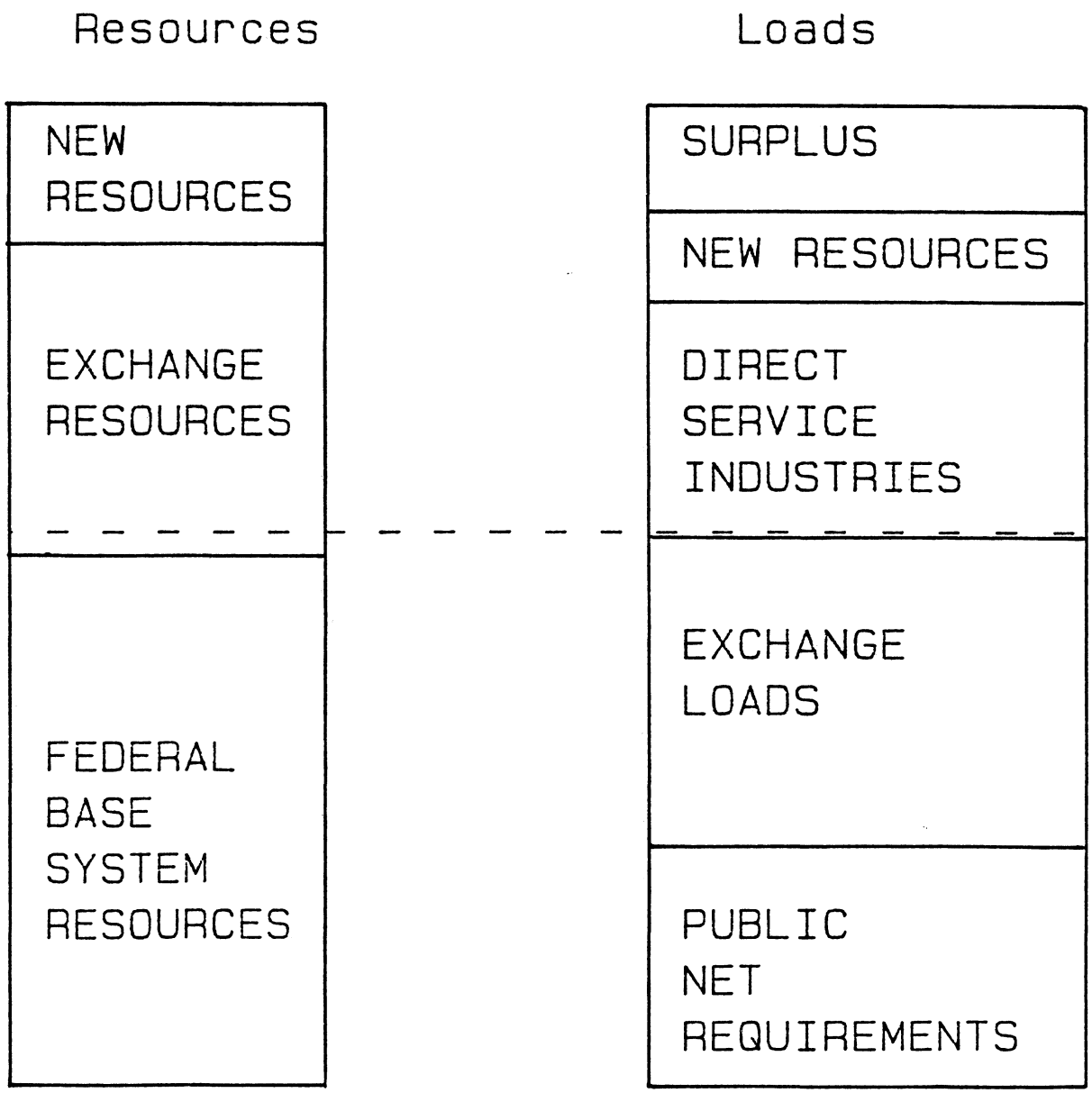
The four major groups of output from the RAM are: (1) amounts and costs of new resource acquisitions; (2) system operating costs; (3) loads served in each market; and (4) export revenues.

B.3 FINANCING AND RATES MODULE (FARM)

The Financing and Rates Module (FARM) calculates customers' rates and tracks BPA's financial outlook. The module simulates the methodologies BPA developed during its 1985 ratesetting process.

Figure B-2

RATES MODULE



A simplified picture of how rates are calculated is displayed in the accompanying figure. Rates generally are based on resource costs, with the priority firm (PF) rate the basis for calculating the other rates. Resources available to BPA appear on the left of the figure. The three resource pools are: (1) the Federal Base System (FBS) which includes the Federal hydroelectric system and the federal share of the region's nuclear plants; (2) the exchange resource pool resulting from the Residential and Small Farm Load Exchange Program; and (3) the new resource pool consisting of other generating resources acquired by BPA.

The loads served by BPA appear on the right of the figure. Priority firm loads, including public net requirements and exchange loads, are the first block. DSI loads are next, followed by new resource loads, and surplus loads. Priority firm customers are charged the Priority Firm (PF) rate, DSIs are charged the Industrial Firm Power (IP) rate, and the surplus firm and new resource customers are charged the New Resources Firm and Surplus Firm rates, summarized here as the NR rate.

The exchange costs are essentially the average system costs of all utilities participating in the exchange program.

(1) Average Exchange Cost = $(\text{SUM } T_i)/(\text{SUM } G_i)$

where T_i = Total system cost for utility i
G_i = Generation for utility i

Priority firm loads are served first by FBS resources, next by exchange resources, and then by new resources. The figure indicates that, because FBS resources are insufficient to meet PF loads, some portion of the exchange resources are required. Hence, the cost of that portion of exchange resources is added to FBS costs to find the total cost of meeting PF loads. When divided by total PF loads, that figure yields a preliminary estimate of the PF rate.

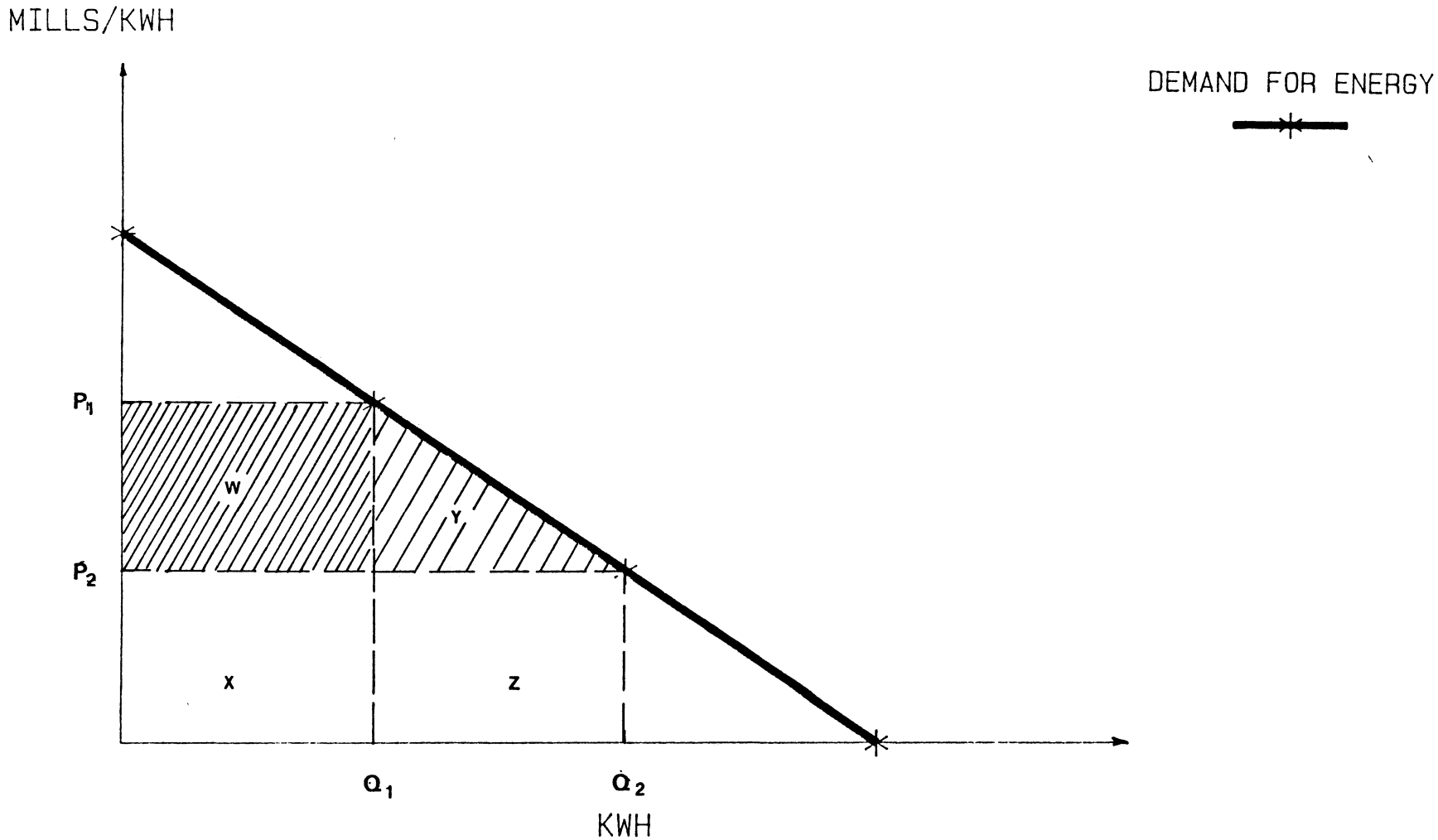
(2) $$PF_p = \frac{FBS + (P) * (ASC) * (LE)}{(LP + LE)}$$

where PF_p = Priority firm rate (preliminary)
FBS = Total costs of Federal Base System
P = Proportion of exchange resources required to serve PF loads
ASC = Cost of exchange resources
LE = Exchange loads
LP = Public Net Requirements loads

The average cost of all remaining resources becomes the basis for the NR rate and the cost of serving the DSIs. That average cost is computed by dividing the sum of the remaining exchange costs and the new resource costs by the sum of the remaining loads--DSI, surplus firm, and IOU net requirements loads.

Figure B-3

NET BENEFITS FOR GENERATING RESOURCE



(3) $$NR_p = \frac{(1 - P) * (ASC) * (LE) + NR\$}{L_{DSI} + L_{nr} + L_s}$$

where
- NR_p = Preliminary NR rate
- $(1-P)$ = Remaining proportion of exchange costs
- $NR\$$ = Total cost of new resources
- L_{DSI} = DSI loads
- L_{nr} = New resource loads
- L_s = Surplus firm loads

The IP rate charged to DSI customers is not set at NR_p (the cost of service to the DSIs) but equals the PF rate plus a margin as provided for in section 7(c)(2) of the Northwest Power Act, less a credit for BPA restriction rights on DSI loads. Since this rate differs from the preliminary NR rate, an over- or under-recovery of revenues would be generated relative to the new resource costs and the remaining exchange costs. The difference between allocated costs and expected revenues using the preliminary rates, is computed and added to all rates to produce the final PF, IP, and NR rates. This is done simply by subtracting a preliminary IP rate from the preliminary NR rate and multiplying the result by the ratio of DSI loads to total BPA loads.

(4) $$\text{Delta} = (\text{NR prelim} - \text{IP prelim})(L_{DSI}/L_{BPA})$$

(5) $$\text{PF} = \text{PF prelim} + \text{Delta}$$

(6) $$\text{IP} = \text{IP prelim} + \text{Delta}$$

(7) $$\text{NR} = \text{NR prelim} + \text{Delta}$$

(8) $$\text{SP} = \text{SP prelim} + \text{Delta}$$

The resulting rates estimated in equations (5) through (8) are based on critical water. The average water conditions prevailing over time, however, produce nonfirm revenues. Such revenues would result in a long run over-recovery of revenues. Therefore, the amount of nonfirm revenues that would accrue under average water conditions is allocated proportionally to the PF, IP, and NR rates, in proportion to their loads.

When modeling the variable rate, this module adjusts the rate charged aluminum smelters based on the aluminum price selected for each game and the formula for the variable rate being modeled. The plateau rate for a variable rate is that computed as the IP Standard rate by the model.

The model also accounts for costs unrelated to resources, as does the actual ratesetting process. Thus, costs for fish and wildlife programs, conservation programs, and administrative costs, for example, are summed. The total amount is then divided by total BPA load--the right side of the figure. The result is added to each rate.

Further, the IP rate is reduced to account for the value of reserves provided by BPA restriction rights on DSI loads. The resulting loss of revenue,

divided by total load, is added to other customer rates. Finally, the resulting IP rate is checked to ensure that it is at least as great as a specified floor rate that must be charged to DSIs.

The standard nonfirm rate (NF) is calculated by summing all resource costs (including exchange costs), program costs, and transmission costs, and dividing the result by total generated energy (including exchange energy). The NF rate that results is used in export market revenue calculations. The price actually charged for export power (both firm and nonfirm) is a simple average of the NF rate and the buyer's willingness-to-pay (WTP) whenever WTP is greater than the NF rate. If WTP is less than the NF rate, WTP is charged.

After setting the rates the model computes what actually happens with realized loads and randomly selected water conditions. It computes realized costs and revenues. Since most resource costs are fixed in the short run (1 year in this case) not much change occurs for costs. Realized revenues may be significantly different from projected revenues, however, if realized loads and water conditions are different from projected loads and water conditions.

Each year then, realized revenues and costs are calculated and compared. Over-recoveries accumulate in an interest bearing fund. Under-recoveries are met with drawdowns of the fund. If the fund is insufficient to meet a given under-recovery, the residual is put into the next year's rates, or the following 2 years' rates if the shortfall exceeds a specified size.

The FARM outputs are information on retail rates for all regional consumers and wholesale rates for BPA customer classes. These rates are the prices used in the LFM and RAM. Finally, from the wholesale rates determined above, retail rates by consuming sector are determined. The regional consuming sectors and the general cost components of each sector are:

1) IOU Exchange = PF rate plus adder for distribution costs

2) IOU Nonexchange = Average system cost (includes NR purchases but not exchange benefits) and distribution cost adder

3) Public Exchange = Same as (1)

4) Public Nonexchange = Average system cost (including PF purchases) and distribution cost adder.

B.4 NET BENEFITS MODULE

The Net Benefits Module (NBM) calculates the change in net benefits resulting from changes in quantity and price of power purchases. Net benefits are an appropriate measure for determining the economic efficiency of resource decisions. Changes are calculated for each customer class--public and private exchange, other priority firm, public and private nonexchange, and the DSIs. Calculations are performed for each year; they are then discounted, summed and expressed as the present value of net benefits for the model period.

Two additional calculations complete the net benefits estimates. First, changes in the financial fund balance at the model horizon (2015) are added to net benefits. This procedure, discussed in the finances and rates module, accounts for the under and over payments that occur because actual loads differ slightly from forecast loads. This calculation has little effect on the total net benefits estimate.

The second adjustment accounts for the value of the infrastructure in place at the end of the planning period . That value, called the end-effects value, is treated as a regional benefit; it is not credited to any of the customer classes. End-effects occur because many of the resources used to meet load during the model period are still productive at the end of the period. The value remaining is credited to the region and included in total net benefits. This calculation is discussed in the RAM section.

The change in net benefits for all sectors except the DSIs is the change in consumer surplus* that results. If the action results in a change in the price of energy to the customer, the change in net benefit is shown as the shaded area of the Net Benefits figures.

Thus the net benefit accruing to a customer class is the total net benefit of the previous period plus the change (positive or negative) in benefits occurring during the current period.

(1) $NB_t = NB_{t-1} + CNB_t$

Where NB_t = Net benefits in time t
NB_{t-1} = Net benefits in time t-1
CNB_t = Change in net benefits in time t

The change in net benefits has two components referred to as the bill effect and the service effect. The bill effect refers to the change in the customers power bill. The change can be either positive or negative. The service effect accounts for the change in value resulting from the change in energy availability. For price increases the service effect is always negative and for price decreases it is always positive.

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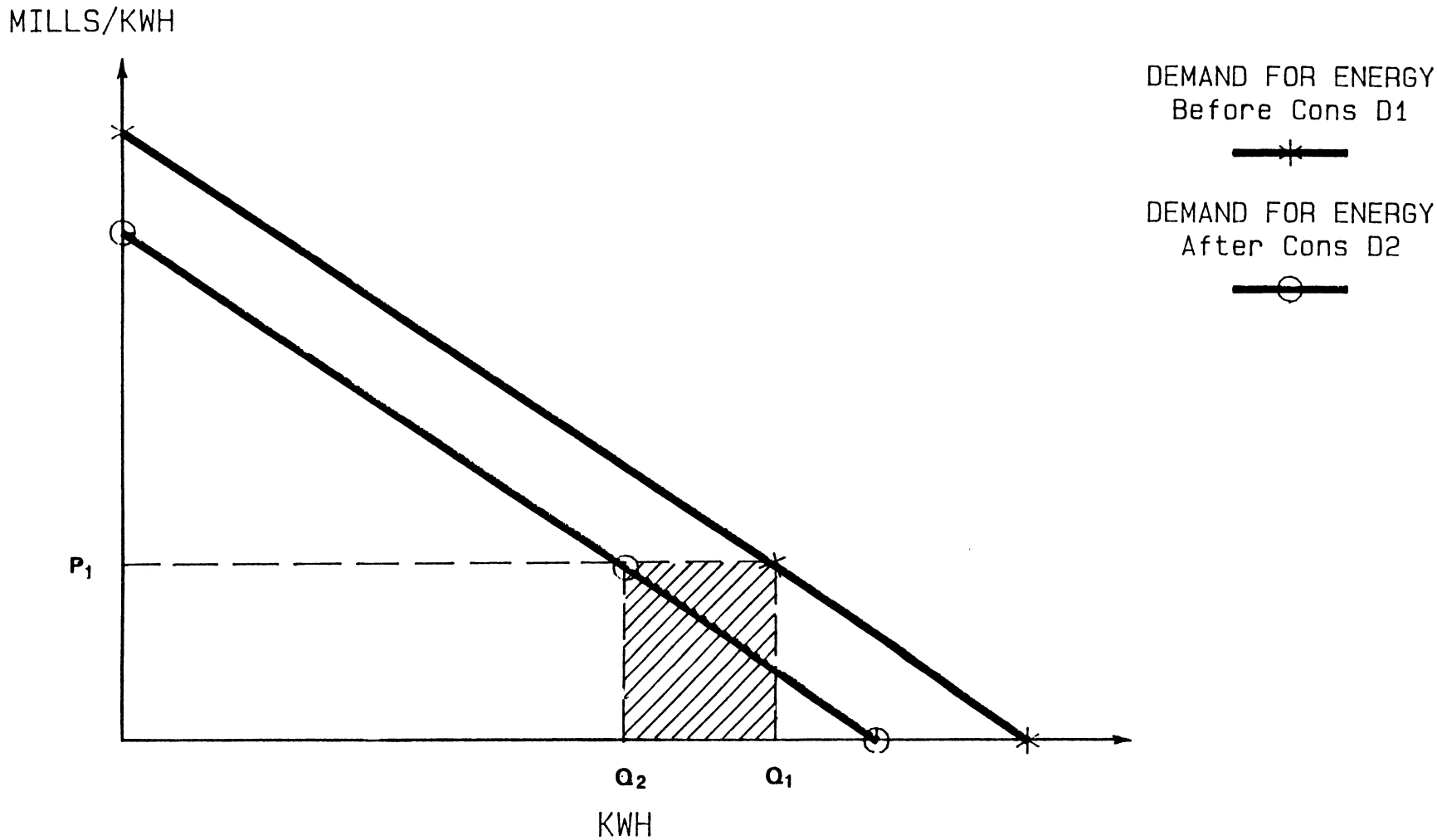
* The concept of Consumer Surplus as a benefit measure arises because of the downward sloping nature of the demand curve. The consumer pays a price equal to the value of the last unit purchased. But the same consumer would have paid more than that price for the previous units. The difference between what the consumer is willing to pay (indicated by the height of the demand curve for any quantity) and what the consumer must pay (indicated by the price) is the consumer surplus. In the figure the consumer would pay price P_1 for unit Q_1. If Q_2 units are purchased, a price P_2 is paid for all units. Thus for unit Q_1, the consumer would have been willing to pay P_1. Consumer surplus is always the area above the price line and below the demand curve.

Figure B-4

NET BENEFITS: CONSERVATION WITH NO PRICE CHANGE



(2) $CNB_t = B_t + S_t$

Where B_t = Bill effect

S_t = Service effect

The bill effect is calculated by:

(3) $B_t = (Q_1 * P_1) - (Q_2 * P_2)$

Where Q_1 = Reference load; i.e., the load that would have existed in the absence of the action whose benefits are being calculated.

Note that $(Q_1 * P_1)$ is equal to areas w plus area x in the first figure. Similarly, $(Q_2 * P_2)$ is equal to area x plus area z.

The service effect is calculated by:

(4) $S_t = (Q_2 - Q_1) * (P_2 + P_1)/2$

This calculation shows the value of the change in service $(Q_2 - Q_1)$ priced at an average of the new and old price. Note that for price <u>reductions</u>, quantity purchased increases. Therefore $Q_2 .>. Q_1$ so S_t would always be positive. Conversely, when prices are <u>increased</u> (say from P_2 to P_1) then S_t would be negative.

If the demand curve is assumed to be <u>linear</u>, equation (4) calculates the area y plus z, exactly. The demand curves in the model are non-linear. For a non-linear demand curve, equation (4) provides a close approximation to the areas of y and z. Since by (2) change in net benefits equal $(B_t + S_t)$, this means adding (3) and (4) should give the change in net benefits.

(5) $CNB_t = B_t + S_t = (Q_1 * P_1) - (Q_2 * P_2) + (Q_2 - Q_1)(P_2 + P_1)/2$

or in terms of areas in the first figure:

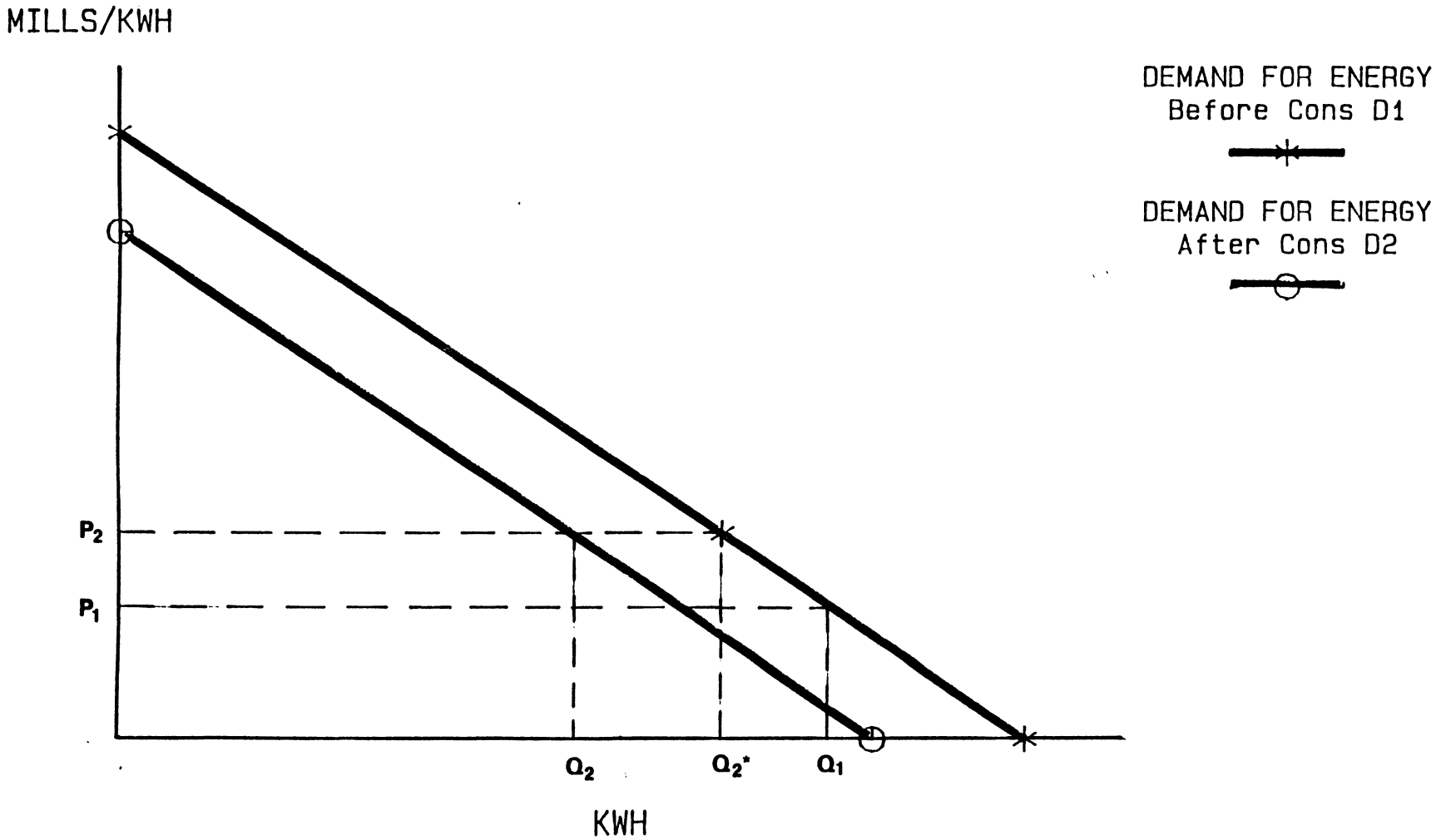
(6) CNB_t = (Area w + Area x) - (Area x + Area z) + (Area y + Area z)
= Area w + Area y.

This is exactly the area that represents the change in benefits resulting from the action.

The foregoing description applies to generation resources. Conservation has a slightly different effect. It reduces the amount of energy that a consumer must purchase to be at the same level of satisfaction as before the conservation. In economic terms, there are two demand curves; one for the actual electricity purchases, and one for the effective energy used.

Figure B-5

NET BENEFITS: CONSERVATION WITH A PRICE CHANGE



Consider the second figure. Two demand curves are shown: one for energy prior to conservation (that is, for effective energy) and another for energy after conservation. Essentially the difference between the two ($Q_1 - Q_2$) is the amount of conservation. Curve D_1 can be thought of as the demand for all energy, including conservation. Curve D_2 is a demand for electrical generation.

The second figure shows the effect of conservation when there is no price change. The consumer is clearly better off with the conservation. In terms of a service effect the consumer has lost nothing--the only difference is that some energy is supplied as conservation. If, for example, extra insulation enables a consumer to heat a room to the same temperature as before but with less generated electricity, then in terms of service the consumer has neither gained nor lost.

In terms of a bill effect, however, the consumer benefits by having a lower utility bill. The new bill is $P_1 * Q_2$ compared to the old bill of $P_1 * Q_1$. The consumer gains an amount indicated by the shaded area.

Note that equation (3) merely requires setting P_2 equal to P_1. Since Q_2 is less than Q_1 the bill effect is positive.

The service effect equation (4) also requires an adjustment. The amount of conservation is added to the actual load served. This ensures that the value of effective energy received (shown by D_1) is still counted as a benefit. The amount of conservation is $Q_1 - Q_2$. Adding this to actual loads in (4) gives:

$$(4)' \quad S_t = (Q_2 + (Q_1 - Q_2) - Q_1) * (P_2 + P_1)/2$$

Since the first term reduces to zero, the service effect is zero. Therefore, the total change in benefit is equal to the reduction in the power bill, the amount represented by the shaded area.

The benefit calculation with a price change is shown in the third figure. Here, prices increase from P_1 to P_2, and electricity purchases decrease from Q_1 to Q_2 as a result of both conservation and the price change. With one exception, the change in net benefits is calculated in the same fashion as with price changes associated with generation. The bill effect is estimated by subtracting the new bill, ($P_2 * Q_2$) from the reference bill ($P_1 * Q_1$). The service effect differs since the <u>effective</u> energy is now Q_2^*, not Q_2. Thus, the service effect calculates only the loss of service represented by ($Q_2^* - Q_1$) priced at an average of P_1 and P_2.

For conservation measures, the consumers' costs (that is, the costs not paid by BPA) are subtracted from net benefits. This is done for each sector.

Net benefits for the aluminum DSIs are calculated for each smelter based on cash flow analysis. Each year's profits are calculated by subtracting total production costs from revenues. This is analogous to the consumer surplus measure of net benefits used for the other sectors. In the case of the DSIs, however, the measure is a producer surplus, equal to the area bounded by a price line and a marginal cost curve. The amounts are calculated each year and discounted to a present value figure representing the net benefits to the DSIs.

B.5 EMPLOYMENT MODULE

The model calculates direct employment impacts for five sectors: (1) the aluminum industry; (2) BPA's other directly serviced industries; (3) each of five major manufacturing industries; (4) all other manufacturing industries as a group; and (5) the agricultural sector. Other direct employment impacts were assumed to be zero, because of either relatively small industry employment or relatively small shares of costs represented by electricity purchases.

Indirect and induced employment impacts are calculated based on the direct employment estimates. These secondary employment impacts occur as a result of changes in economic activity in industries supplying goods or services to the industries which incur initial direct impacts, and because of changes in income associated with those changes. These secondary changes in employment, unlike the direct changes, are not reported by sector but are aggregated over all industries.

All employment impacts are expressed as average changes in jobs over a thirty year period compared to the base case. This is done by adding up the changes estimated for each year of the study and dividing by 30.

A combination of employment elasticities and employment multipliers are used to calculate the employment changes. First, a reference employment projection for each of the five sectors is constructed. These references are based on and consistent with the assumptions and projections of BPA's 1985 long-term load forecast.

Reference electricity prices are constructed based on BPA's estimate of the prices expected to prevail in 1986 for each of the customer groups. For each case and option, electricity prices calculated in the rates module are subtracted each year from the reference price. The difference is multiplied by the industry-specific employment elasticities with the product multiplied by the reference employment for the year. This gives the direct change in employment for each sector. Then industry-specific employment multipliers are used to calculated the secondary employment effects.

The aluminum DSIs also use a reference employment level, but the direct employment changes are based not on elasticities with respect to electricity prices but on the operating level of the plants. Each operating level is associated with a specific level of employment based on labor coefficients developed as part of this process. This level is subtracted from the

reference level to yield the direct changes in employment. Then, as with the other sectors, the result is multiplied by industry-specific employment multipliers to yield the total change in employment.

The changes are summed over all sectors to produce the final estimated average change in employment associated with each option tested with the model. Considerably more detail on the estimation of parameters and their values is available in the DSI Option Study, Final Report, Part 2.

APPENDIX C

ESTIMATED ATMOSPHERIC EMISSIONS IN TONS PER YEAR BY PLANT

TABLE: 3

PLME: 1/9/86
EISVRCM1
(A80..0130)

ESTIMATED ATMOSPHERIC EMISSIONS IN TONS PER YEAR, BY PLANT 1/

(Reproduction of EIS, Table 4.12)

OPTION 0

PLANT NUMBER	PLANT NAME	(A) PLANT CAPACITY (a) (TAP(000)/YR)	(B) PARTICULATES	(C) FLUORIDES (b)	(D) HYDROCARBONS	(E) SOx (c)	(F) CO
Plant (1)	ALCOA (d) VANCOUVER	123.37	678.00	185.00	30.00	1,276.00	7,023.00
Plant (2)	ALCOA (f) WENATCHEE	229.95	1.368.00	495.00	401.00	2,737.00	NA
Plant (3)	COLUMBIA FALLS	159.51	837.00	456.00	625.00	1,850.00	NA
Plant (4)	INTALCO	291.27	620.00	117.00	9.00	5,082.00	37,205.00
Plant (5)	KAISER MEAD	232.14	1,544.00	685.00	NA	404.00	24,132.00
Plant (6)	KAISER TACOMA	79.57	600.00	158.00	36.00	1,941.00	11,336.00
Plant (7)	COMMONWEALTH	175.93	595.00	161.00	NA	633.00	NA
Plant (8)	MARTIN-MARIETTA	91.25	286.00	33.00	NA	370.00	NA
Plant (9)	REYNOLDS LONGVIEW	209.88	1,575.00	263.00	NA	NA	NA
Plant (10)	REYNOLDS (e) TROUTDALE	129.94	878.00	163.00	NA	4,700.00	NA
TOTAL:		1,722.80	8,981.00	2,716.00	1,101.00	18,993.00	79,696.00

Source: Decision Analysis Model (DAM): Table 4.

1/ Emission levels assume plants operate at full capacity for the entire year.

TABLE: 4

PLME: 1/9/86
EISVRCM1
(A140..D195)

NO ACTION: ESTIMATED ATMOSPHERIC EMISSIONS IN TONS PER YEAR. BY PLANT

1987-1991

OPTION 0

PLANT NUMBER	PLANT NAME	(A) PLANT PRODUCTION (TAP/YR)	(B) PARTICULATES	(C) FLUORIDES	(D) HYDROCARBONS	(E) SOx	(F) CO
Plant (1)	ALCOA VANCOUVER	57.00	313	85	14	590	3,245
Plant (2)	ALCOA WENATCHEE	94.00	559	202	164	1.119	0
Plant (3)	COLUMBIA FALLS	71.60	376	205	281	830	0
Plant (4)	INTALCO	232.20	494	93	7	4.051	29.660
Plant (5)	KAISER MEAD	113.60	756	335	0	198	11,809
Plant (6)	KAISER TACOMA	45.80	345	91	21	1,117	6.525
Plant (7)	COMMONWEALTH	101.40	343	93	0	365	0
Plant (8)	MARTIN-MARIETTA	59.20	186	21	0	240	0
Plant (9)	REYNOLDS LONGVIEW	130.40	979	163	0	0	0
Plant (10)	REYNOLDS TROUTDALE	35.60	241	45	0	1.288	0
TOTAL:		941	4,591	1,334	486	9,798	51,239

Source: Decision Analysis Model (DAM): Table 4.

TABLE: 5

PLME: 1/9/86
EISVRCM1
(A200..0260)

NO ACTION: ESTIMATED ATMOSPHERIC EMISSIONS IN TONS PER YEAR, BY PLANT

1992-1996

OPTION 0

PLANT NUMBER	PLANT NAME	(A) PLANT PRODUCTION (TAP/DAY)	(B) PARTICULATES	(C) FLUORIDES	(D) HYDROCARBONS	(E) SOx	(F) CO
Plant (1)	ALCOA VANCOUVER	59.80	329	90	15	619	3,404
Plant (2)	ALCOA WENATCHEE	99.00	589	213	173	1,178	0
Plant (3)	COLUMBIA FALLS	70.40	369	201	276	817	0
Plant (4)	INTALCO	231.80	493	93	7	4,044	29,609
Plant (5)	KAISER MEAD	119.20	793	352	0	207	12,391
Plant (6)	KAISER TACOMA	51.20	386	102	23	1,249	7,294
Plant (7)	COMMONWEALTH	108.00	365	99	0	389	0
Plant (8)	MARTIN-MARIETTA	60.80	191	22	0	247	0
Plant (9)	REYNOLDS LONGVIEW	147.40	1,106	185	0	0	0
Plant (10)	REYNOLDS TROUTDALE	37.60	254	47	0	1,360	0
TOTAL:		985	4,875	1,403	493	10,109	52,698

Source: Decision Analysis Model (DAM): Table 4.

TABLE: 6

PLME: 1/9/86
EISVRCM1
(A261..D310)

NO ACTION: ESTIMATED ATMOSPHERIC EMISSIONS IN TONS PER YEAR, BY PLANT

1997-2000

OPTION 0

PLANT NUMBER	PLANT NAME	(A) PLANT PRODUCTION (TAP/DAY)	(B) PARTICULATES	(C) FLUORIDES	(D) HYDROCARBONS	(E) SOx	(F) CO
Plant (1)	ALCOA VANCOUVER	59.50	327	89	14	615	3,387
Plant (2)	ALCOA WENATCHEE	100.75	599	217	176	1,199	0
Plant (3)	COLUMBIA FALLS	77.00	404	220	302	893	0
Plant 4,	INTALCO	232.75	495	93	7	4,061	29,730
Plant (5)	KAISER MEAD	116.50	775	344	0	203	12,111
Plant (6)	KAISER TACOMA	51.25	386	102	23	1,250	7,301
Plant (7)	COMMONWEALTH	111.00	375	102	0	399	0
Plant (8)	MARTIN-MARIETTA	60.50	190	22	0	245	0
Plant (9)	REYNOLDS LONGVIEW	146.00	1,096	183	0	0	0
Plant (10)	REYNOLDS TROUTDALE	38.75	262	49	0	1,402	0
TOTAL:		994	4,910	1,420	522	10,268	52,529

Source: Decision Analysis Model (DAM): Table 4.

APPENDIX D

ESTIMATED WATER POLLUTION DISCHARGES BY PLANT

TABLE: 3

PLME: 1/9/86
EISVRCM2
(A80..H130)

ESTIMATED WATER POLLUTION DISCHARGES IN TONS PER YEAR, BY PLANT 1/

(Reproduction of EIS, Table 4.1)

OPTION 0

PLANT NUMBER	PLANT NAME	(A) PLANT CAPACITY (a) (TAP(000)/YR)	(B) WATER DISCHARGE (million gal/yr)	(C) (b) FLUORIDES (tons/yr)	RECEIVING WATER
Plant (1)	ALCOA (d) VANCOUVER	123.37	1,752.00	13.16	COLUMBIA RIVER
Plant (2)	ALCOA (f) WENATCHEE	229.95	3,321.50	74.84	COLUMBIA RIVER
Plant (3)	COLUMBIA FALLS	159.51	1,715.50	12.89	ONSITE PONDS
Plant (4)	INTALCO	291.27	2,226.50	47.38	STRAITS OF GEORGIA
Plant (5)	KAISER MEAD	232.14	1,241.00	119.11	PEONE CREEK
Plant (6)	KAISER TACOMA	79.57	255.50	5.33	HYLEBOS WATERWAY
Plant (7)	COMMONWEALTH	175.93	3,248.50	122.00	COLUMBIA RIVER
Plant (8)	MARTIN-MARIETTA	91.25	912.50	60.92	COLUMBIA RIVER
Plant (9)	REYNOLDS LONGVIEW	209.88	3,321.50	166.32	COLUMBIA RIVER
Plant (10)	REYNOLDS (e) TROUTDALE	129.94	584.00	63.36	COLUMBIA RIVER
TOTAL:		1,722.80	18,578.50	685.31	

Source: Decision Analysis Model (DAM): Table 4.

1/ Pollution levels assume plants operate at full capacity for the entire year.

TABLE: 4

PLME: 1/9/86
EISVRCM2
(A140..H195)

NO ACTION: ESTIMATED WATER POLLUTION DISCHARGES IN TONS PER YEAR, BY PLANT

1987-1991

OPTION 0

PLANT NUMBER	PLANT NAME	(A) PLANT PRODUCTION (TAP/YR)	(B) WATER DISCHARGE (million gal/yr)	(C) FLUORIDES (tons/yr)	RECEIVING WATER
Plant (1)	ALCOA VANCOUVER	57.00	809	6	COLUMBIA RIVER
Plant (2)	ALCOA WENATCHEE	94.00	1,358	31	COLUMBIA RIVER
Plant (3)	COLUMBIA FALLS	71.60	770	6	ONSITE PONDS
Plant (4)	INTALCO	232.20	1,775	38	STRAITS OF GEORGIA
Plant (5)	KAISER MEAD	113.60	607	58	PEONE CREEK
Plant (6)	KAISER TACOMA	45.80	147	3	HYLEBOS WATERWAY
Plant (7)	COMMONWEALTH	101.40	1,872	70	COLUMBIA RIVER
Plant (8)	MARTIN-MARIETTA	59.20	592	40	COLUMBIA RIVER
Plant (9)	REYNOLDS LONGVIEW	130.40	2,064	103	COLUMBIA RIVER
Plant (10)	REYNOLDS TROUTDALE	35.60	160	17	COLUMBIA RIVER
TOTAL:		941	10,155	372	

Source: Decision Analysis Model (DAM): Table 4.

TABLE: 5

PLME: 1/9/86
EISVRCM2
(A200..H260)

NO ACTION: ESTIMATED WATER POLLUTION DISCHARGES IN TONS PER YEAR, BY PLANT

1992-1996

OPTION 0

PLANT NUMBER	PLANT NAME	(A) PLANT PRODUCTION (TAP/DAY)	(B) WATER DISCHARGE (million gal/yr)	(C) FLUORIDES (tons/yr)	RECEIVING WATER
Plant (1)	ALCOA VANCOUVER	59.80	849	6	COLUMBIA RIVER
Plant (2)	ALCOA WENATCHEE	99.00	1.430	32	COLUMBIA RIVER
Plant (3)	COLUMBIA FALLS	70.40	757	6	ONSITE PONDS
Plant (4)	INTALCO	231.80	1.772	38	STRAITS OF GEORGIA
Plant (5)	KAISER MEAD	119.20	637	61	PEONE CREEK
Plant (6)	KAISER TACOMA	51.20	164	3	HYLEBOS WATERWAY
Plant (7)	COMMONWEALTH	108.00	1.994	75	COLUMBIA RIVER
Plant (8)	MARTIN-MARIETTA	60.80	608	41	COLUMBIA RIVER
Plant (9)	REYNOLDS LONGVIEW	147.40	2.333	117	COLUMBIA RIVER
Plant (10)	REYNOLDS TROUTDALE	37.60	169	18	COLUMBIA RIVER
TOTAL:		985	10,714	397	

Source: Decision Analysis Model (DAM): Table 4.

TABLE: 6

PLME: 1/9/86
EISVRCM2
(A261..H310)

NO ACTION: ESTIMATED WATER POLLUTION DISCHARGES IN TONS PER YEAR, BY PLANT

1997-2000

OPTION 0

PLANT NUMBER	PLANT NAME	(A) PLANT PRODUCTION (TAP/DAY)	(B) WATER DISCHARGE (million gal/yr)	(C) FLUORIDES (tons/yr)	RECEIVING WATER
Plant (1)	ALCOA VANCOUVER	59.50	845	6	COLUMBIA RIVER
Plant (2)	ALCOA WENATCHEE	100.75	1,455	33	COLUMBIA RIVER
Plant (3)	COLUMBIA FALLS	77.00	828	6	ONSITE PONDS
Plant (4)	INTALCO	232.75	1,779	38	STRAITS OF GEORGIA
Plant (5)	KAISER MEAD	116.50	623	60	PEONE CREEK
Plant (6)	KAISER TACOMA	51.25	165	3	HYLEBOS WATERWAY
Plant (7)	COMMONWEALTH	111.00	2,050	77	COLUMBIA RIVER
Plant (8)	MARTIN-MARIETTA	60.50	605	40	COLUMBIA RIVER
Plant (9)	REYNOLDS LONGVIEW	146.00	2,311	116	COLUMBIA RIVER
Plant (10)	REYNOLDS TROUTDALE	38.75	174	19	COLUMBIA RIVER
TOTAL:		994	10,834	398	

Source: Decision Analysis Model (DAM): Table 4.

APPENDIX E

DIFFERENCES IN GENERATION IMPACTS AMONG OPTIONS

ENVIRONMENTAL IMPACTS OF DIFFERENCE BETWEEN RATE BASE AND VARIABLE RATE OPTIONS

Line No.	I. VARIABLE RATE	OPTION 1: REVENUE A Coal	B Nuclear	C CT	OPTION 2: BPA PROPOSAL D Coal	E Nuclear	F CT	OPTION 3: LOAD G Coal	H Nuclear	I CT
	Mine Site		1/			1/			1/	
1	Overburden Removed (tons)	2081.81	102965		930.06	11362		767.84	0	
2	Process Water Used (acre/ft)		14			2			0	
3	Solid Waste (tons)	17.83	3343		7.96	369		6.58	0	
	Air Pollutants (tons):									
4	Particulates	196.33	2.20		87.71	0.24		72.41	0.00	
5	SO2	7.88	0.32		3.52	0.04		2.91	0.00	
6	NOx	19.56	0.34		8.74	0.04		7.21	0.00	
7	Hydrocarbons	5.87	0.01		2.62	.00		2.16	0.00	
8	CO	9.14	.00		4.08	.00		3.37	0.00	
9	Other	3.30	0.13		1.47	0.01		1.22	0.00	
10	Water Pollutants (tons)		73.11			8.07			0.00	
11	Deaths		.00			.00			0.00	
12	Injuries	0.25	0.19		0.11	0.02		0.09	0.00	
	Process Site									
14	Process Water Used (acre/ft)		438.25			48.36			0.00	
15	Solid Waste (tons)		0.93			0.10			0.00	
	Air Pollutants (tons):									
16	Particulates		16.03			1.77			0.00	
17	SO2		61.72			6.81			0.00	
18	NOx		16.26			1.79			0.00	
19	Hydrocarbons		0.17			0.02			0.00	
20	CO		0.41			0.05			0.00	
21	Flouride		0.01			.00			0.00	
22	Water Pollutants (tons)		1.53			0.17			0.00	
	Generating Site									
23	Process Water Used (acre/ft)	366.56	247.63		163.76	27.32		135.20	0.00	
24	Solid Waste (tons)	38710.40	247.90		17294.00	27.35		14277.60	0.00	
	Air Pollutants (tons)									
25	Particulates	443.81	.00	3.13	198.28	.00	1.86	163.69	0.00	1.18
26	SO2	495.18			221.22			182.64		
27	NOx	700.40	0.13	90.41	312.91	0.01	53.76	258.33	0.00	34.21
28	Hydrocarbons	26.14	0.01	9.14	11.68	.00	5.44	9.64	0.00	3.46
29	CO	75.86	0.02	25.24	33.89	.00	15.00	27.98	0.00	9.55
30	CO2	254782			113825			93971		
31	Other	0.36	0.08	1.74	0.16	0.01	1.03	0.13	0.00	0.66
32	Water Pollutants (tons)		0.60			0.07			0.00	
33	Deaths	.00	.00		.00	.00		.00	0.00	
34	Injuries	0.14	0.05		0.06	0.01		0.05	0.00	
35	Average AMW difference 2/	27.5	10.36	2.64	12.29	1.14	1.57	10.14	0.00	1.00
36	Maximum AMW difference 3/	70	64	6	27	16	4	21	0	3
37	Minimum AMW difference 4/	-1	0	0	2	0	0	-3	0	-1

1/ To calculate: Environmental impact per one AMW generation, multiplied by average annual AMW difference between rate base and option (see line 35). Sources: Technological Characterizations: Environmental Information Handbook, 3/83; DAM.

2/ The average annual difference in AMW between rate base and each option (over period 1987 through 2000).

3/ The maximum annual difference in AMW between rate base and each option (1987-2000).

4/ The minimum annual difference in AMW between rate base and each option (1987-2000).

12/17/85 ENVIRONMENTAL IMPACTS OF DIFFERENCE BETWEEN RATE BASE AND COMBINATION RATE OPTIONS

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Line No.	III. Combination (Con/Mod-Variable)	OPTION 1: REVENUE A Coal	B Nuclear	C CT	OPTION 2: BPA PROPOSAL (5 mills) D Coal	E Nuclear	F CT	OPTION 3: BPA PROPOSAL (10 mills) G Coal	H Nuclear	I CT	OPTION 4: LOAD J Coal	K Nuclear	L CT
	Mine Site	1/			1/			1/			1/		
1	Overburden Removed (tons)	2157.52	137760		665.10	126398		2157.52	-148411		3060.54	-137050	
2	Process Water Used (acre/ft)		19			18			-21			-19	
3	Solid Waste (tons)	18.48	4473		5.70	4104		18.48	-4819		26.21	-4450	
	Air Pollutants (tons):												
4	Particulates	203.47	2.95		62.72	2.71		203.47	-3.18		288.64	-2.93	
5	SO2	8.17	0.43		2.52	0.39		8.17	-0.46		11.58	-0.42	
6	NOx	20.27	0.45		6.25	0.41		20.27	-0.48		28.76	-0.45	
7	Hydrocarbons	6.08	0.02		1.87	0.02		6.08	-0.02		8.63	-0.02	
8	CO	9.47	.00		2.92	.00		9.47	.00		13.43	.00	
9	Other	3.42	0.17		1.05	0.16		3.42	-0.19		4.85	-0.17	
10	Water Pollutants (tons)		97.82			89.75			-105.38			-97.31	
11	Deaths		.00			.00			.00			.00	
12	Injuries	0.26	0.25		0.08	0.23		0.26	-0.27		0.37	-0.25	
	Process Site												
14	Process Water Used (acre/ft)		536.35			537.99			-631.69			-583.33	
15	Solid Waste (tons)		1.24			1.14			-1.34			-1.24	
	Air Pollutants (tons):												
16	Particulates		21.45			19.68			-23.11			-21.34	
17	SO2		82.58			75.77			-88.96			-82.15	
18	NOx		21.76			19.96			-23.44			-21.65	
19	Hydrocarbons		0.22			0.21			-0.24			-0.22	
20	CO		0.55			0.50			-0.59			-0.54	
21	Flouride		0.01			0.01			-0.01			-0.01	
22	Water Pollutants (tons)		2.05			1.88			-2.21			-2.04	
	Generating Site												
23	Process Water Used (acre/ft)	379.89	331.31		117.11	303.99		379.89	-356.93		538.89	-329.60	
24	Solid Waste (tons)	40118.05	331.67		12367.22	304.31		40118.05	-357.31		56909.32	-329.96	
	Air Pollutants (tons)												
25	Particulates	459.95	.00	1.69	141.79	.00	-0.42	459.95	-0.01	0.68	652.46	.00	1.52
26	SO2	513.19			158.20			513.19			727.98		
27	NOx	725.87	0.17	48.87	223.77	0.16	-12.22	725.87	-0.19	19.55	1029.68	-0.17	43.98
28	Hydrocarbons	27.09	0.01	4.94	8.35	0.01	-1.24	27.09	-0.01	1.98	38.42	-0.01	4.45
29	CO	78.62	0.03	13.64	24.24	0.03	-3.41	78.62	-0.03	5.46	111.52	-0.03	12.28
30	CO2	264047			81398			264047			374562		
31	Other	0.38	0.11	0.94	0.12	0.10	-0.23	0.38	-0.12	0.38	0.54	-0.11	0.84
32	Water Pollutants (tons)		0.81			0.74			-0.87			-0.80	
33	Deaths	.00	.00		.00	.00		.00	.00		0.01	.00	
34	Injuries	0.15	0.07		0.05	0.06		0.15	-0.08		0.21	-0.07	
35	Average AMW difference 2/	28.50	13.86	1.43	8.79	12.71	-0.36	28.50	-14.93	0.57	40.43	-13.79	1.29
36	Maximum AMW difference 3/	59	48	5	19	33	1	48	16	8	90	16	7
37	Minimum AMW difference 4/	0	0	-1	-2	0	-3	-15	-65	-2	-5	-64	-2

1/ To calculate: Environmental impact per one AMW generation, multiplied by average annual AMW difference between rate base and option (see line 35). Sources: Technological Characteristics: Environmental Information Handbook, 6/81; DAM)

2/ The average annual difference in AMW between rate base and each option (over period 1987 through 2000).

3/ The maximum annual difference in AMW between rate base and each option (1987-2000).

4/ The minimum annual difference in AMW between rate base and each option (1987-2000).

12/18/85
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ENVIRONMENTAL IMPACTS OF DIFFERENCE BETWEEN RATE BASE AND CON/MOD RATE OPTIONS

II. Con/Mod

Line No.		OPTION 1: CON/MOD: 3 mills			OPTION 2: CON/MOD: 5 mills			OPTION 3:CON/MOD: 10 mills		
		A Coal	B Nuclear	C CT	D Coal	E Nuclear	F CT	G Coal	H Nuclear	I CT
	Mine Site	1/			1/			1/		
1	Overburden Removed (tons)	-5.41	80952		64.89	80952		1411.31	-148411	
2	Process Water Used (acre/ft)		11			11			-21	
3	Solid Waste (tons)	-0.05	2628		0.56	2628		12.09	-4819	
	Air Pollutants (tons):									
4	Particulates	-0.51	1.73		6.12	1.73		133.10	-3.18	
5	SO2	-0.02	0.25		0.25	0.25		5.34	-0.46	
6	NOx	-0.05	0.26		0.61	0.26		13.26	-0.48	
7	Hydrocarbons	-0.02	0.01		0.18	0.01		3.98	-0.02	
8	CO	-0.02	.00		0.28	.00		6.19	.00	
9	Other	-0.01	0.10		0.10	0.10		2.24	-0.19	
10	Water Pollutants (tons)		57.48			57.48			-105.38	
11	Deaths		.00			.00			.00	
12	Injuries	.00	0.15		0.01	0.15		0.17	-0.27	
	Process Site									
14	Process Water Used (acre/ft)		344.56			344.56			-631.69	
15	Solid Waste (tons)		0.73			0.73			-1.34	
	Air Pollutants (tons):									
16	Particulates		12.61			12.61			-23.11	
17	SO2		48.53			48.53			-88.96	
18	NOx		12.79			12.79			-23.44	
19	Hydrocarbons		0.13			0.13			-0.24	
20	CO		0.32			0.32			-0.59	
21	Flouride		0.01			0.01			-0.01	
22	Water Pollutants (tons)		1.21			1.21			-2.21	
	Generating Site									
23	Process Water Used (acre/ft)	-0.95	194.69		11.43	194.69		248.50	-356.93	
24	Solid Waste (tons)	-100.55	194.90		1206.56	194.90		26242.64	-357.31	
	Air Pollutants (tons)									
25	Particulates	-1.15	.00	-1.10	13.83	.00	-0.92918	300.87	-0.01	-0.17
26	SO2	-1.29			15.43			335.69		
27	NOx	-1.82	0.10	-31.76	21.83	0.10	-26.8775	474.82	-0.19	-4.89
28	Hydrocarbons	-0.07	0.01	-3.21	0.81	0.01	-2.71872	17.72	-0.01	-0.49
29	CO	-0.20	0.02	-8.87	2.36	0.02	-7.50231	51.43	-0.03	-1.36
30	CO2	-661.77			7941			172722		
31	Other	.00	0.07	-0.61	0.01	0.07	-0.51621	0.25	-0.12	-0.09
32	Water Pollutants (tons)		0.47			0.47			-0.87	
33	Deaths	.00	.00		.00	.00		.00	.00	
34	Injuries	.00	0.04		.00	0.04		0.10	-0.08	
35	Average AMW difference 2/	-0.07	8.14	-0.93	0.86	8.14	-0.79	18.64	-14.93	-0.14
36	Maximum AMW difference 3/	11	33	3	15	33	3	39	16	7
37	Minimum AMW difference 4/	-18	0	-6	-18	0	-4	-20	-63	-3

1/ To calculate: Environmental impact per one AMW generation, multiplied by average annual AMW difference between rate base and option (see line 35). Sources: Technological Characteristics: Environmental Information Handbook, 6/81; DAM)
2/ The average annual difference in AMW between rate base and each option (over period 1987 through 2000).
3/ The maximum annual difference in AMW between rate base and each option (1987-2000).
4/ The minimum annual difference in AMW between rate base and each option (1987-2000).

APPENDIX F

POWER RATES BY YEAR

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CASE 1: TRACY VAR RATE---FIS PROBABILISTIC RUN OPTION 0 INCENTIVE RATE BASE GAME = 50

TABLE 18
POWER RATES BY YEAR

(MILLS PER KWH)
(EXPECTED VALUES)

YEAR	PRIORITY FIRM	DSI STANDARD	NEW RESOURCE	FIRM SURPLUS	STANDARD NONFIRM	PUBLIC NON EXCHANGE	PRIVATE NON EXCHANGE
1986	20.6	21.3	25.9	25.9	22.1	29.1	42.2
1987	20.4	20.4	25.4	25.4	21.4	28.9	41.6
1988	18.0	19.6	21.0	21.0	19.5	26.5	39.8
1989	19.9	19.2	22.8	22.8	19.9	27.6	39.6
1990	20.6	18.9	23.8	23.8	20.3	28.1	39.9
1991	20.2	18.5	23.4	23.4	20.1	28.0	40.0
1992	19.3	17.9	23.5	23.5	19.6	27.6	40.5
1993	19.4	17.8	24.1	24.1	19.7	27.7	41.2
1994	18.5	17.0	24.6	24.6	19.3	27.3	41.4
1995	18.7	17.2	25.9	25.9	19.4	27.6	42.7
1996	18.7	17.2	27.4	27.4	19.4	27.7	43.8
1997	18.5	17.0	28.1	28.1	19.5	27.7	44.2
1998	18.6	17.0	28.9	28.9	19.6	27.8	44.7
1999	18.7	17.1	30.0	30.0	19.8	28.1	45.2
2000	18.9	17.2	30.8	30.8	20.1	28.3	45.9
2001	19.1	17.5	31.6	31.6	20.1	28.6	46.2
2002	18.9	17.2	31.5	31.5	20.0	28.6	46.5
2003	19.2	17.5	32.2	32.2	20.2	28.9	46.7
2004	19.1	17.4	32.5	32.5	20.3	28.9	46.8
2005	18.9	17.3	33.0	33.0	20.4	28.9	47.0
2006	19.2	17.4	34.1	34.1	20.6	29.1	47.5
2007	19.1	17.4	34.6	34.6	20.8	29.2	47.7
2008	19.4	17.7	35.9	35.9	21.0	29.5	48.1
2009	18.9	17.2	35.6	35.6	20.9	29.3	48.1
2010	18.8	17.2	36.5	36.5	21.1	29.4	48.4
2011	18.6	17.0	36.3	36.3	21.0	29.4	48.4
2012	19.0	17.3	37.6	37.6	21.3	29.7	48.9
2013	18.1	16.5	37.4	37.4	20.8	29.4	49.2
2014	18.4	16.8	38.2	38.2	21.0	29.6	49.3
2015	18.9	17.1	39.1	39.1	21.2	30.1	49.3

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CASE 1: TRACY VAR RATE---EIS PROBABILISTIC RUN OPTION 1 REVENUE GAME = 50

TABLE 12
POWER RATES BY YEAR

(MILLS PER KWH)
(EXPECTED VALUES)

YEAR	PRIORITY FIRM	DSI STANDARD	NEW RESOURCE	FIRM SURPLUS	STANDARD NONFIRM	PUBLIC NON EXCHANGE	PRIVATE NON EXCHANGE
1986	20.6	21.3	25.9	25.9	22.1	29.1	42.2
1987	20.4	20.4	25.4	25.4	21.4	28.9	41.6
1988	17.9	19.6	20.9	20.9	19.5	26.5	39.8
1989	19.3	19.2	22.2	22.2	19.9	27.2	39.6
1990	19.6	18.5	22.6	22.6	20.2	27.5	39.9
1991	18.3	17.9	21.9	21.9	20.0	27.1	40.0
1992	17.8	17.1	21.9	21.9	19.5	26.6	40.5
1993	18.0	16.8	22.5	22.5	19.7	26.7	41.1
1994	17.3	16.2	23.4	23.4	19.2	26.5	41.4
1995	17.5	16.2	24.9	24.9	19.4	26.7	42.6
1996	17.7	16.3	26.4	26.4	19.5	27.0	43.8
1997	17.8	16.3	27.5	27.5	19.6	27.1	44.3
1998	18.5	17.0	29.2	29.2	19.8	27.7	44.8
1999	18.7	17.2	30.3	30.3	20.0	28.0	45.4
2000	18.9	17.2	31.1	31.1	20.3	28.2	46.2
2001	19.2	17.5	32.0	32.0	20.4	28.6	46.5
2002	19.0	17.3	32.1	32.1	20.4	28.6	46.8
2003	19.4	17.7	33.0	33.0	20.6	29.0	47.1
2004	19.2	17.5	33.4	33.4	20.7	29.0	47.2
2005	19.2	17.5	34.0	34.0	20.8	29.0	47.3
2006	19.3	17.6	34.8	34.8	20.9	29.2	47.7
2007	19.3	17.6	35.1	35.1	21.0	29.3	47.8
2008	19.7	17.9	36.3	36.3	21.3	29.6	48.2
2009	19.1	17.4	35.8	35.8	21.2	29.4	48.2
2010	19.0	17.3	36.5	36.5	21.3	29.5	48.5
2011	18.7	17.0	36.3	36.3	21.0	29.4	48.4
2012	19.0	17.3	37.7	37.7	21.4	29.7	49.0
2013	18.1	16.5	37.4	37.4	20.8	29.4	49.2
2014	18.5	16.8	38.2	38.2	21.0	29.7	49.3
2015	18.7	17.1	38.7	38.7	21.1	30.0	49.2

TABLE 19
POWER RATES BY YEAR

(MILLS PER KWH)
(EXPECTED VALUES)

YEAR	PRIORITY FIRM	DSI STANDARD	NEW RESOURCE	FIRM SURPLUS	STANDARD NONFIRM	PUBLIC NON EXCHANGE	PRIVATE NON EXCHANGE
1986	20.6	21.3	25.9	25.9	22.1	29.1	42.2
1987	20.4	20.4	25.4	25.4	21.4	28.9	41.6
1988	18.0	19.6	21.0	21.0	19.5	26.5	39.8
1989	19.9	19.2	22.8	22.8	19.9	27.6	39.7
1990	20.5	18.8	23.5	23.5	20.3	28.0	39.9
1991	19.8	18.3	23.0	23.0	20.1	27.8	40.0
1992	19.0	17.6	23.2	23.2	19.6	27.4	40.5
1993	19.2	17.6	23.9	23.9	19.7	27.5	41.2
1994	18.3	16.8	24.4	24.4	19.3	27.2	41.4
1995	18.3	16.9	25.6	25.6	19.4	27.3	42.7
1996	18.3	16.8	26.9	26.9	19.4	27.4	43.8
1997	18.3	16.7	27.7	27.7	19.5	27.5	44.1
1998	18.5	17.0	28.8	28.8	19.6	27.8	44.6
1999	18.7	17.2	30.1	30.1	19.8	28.1	45.3
2000	18.9	17.3	31.0	31.0	20.2	28.3	46.0
2001	19.1	17.5	31.7	31.7	20.2	28.6	46.3
2002	18.9	17.3	31.8	31.8	20.1	28.6	46.6
2003	19.3	17.6	32.5	32.5	20.3	28.9	46.8
2004	19.2	17.5	32.9	32.9	20.5	29.0	46.9
2005	19.1	17.4	33.4	33.4	20.5	29.0	47.1
2006	19.2	17.5	34.3	34.3	20.7	29.1	47.5
2007	19.1	17.4	34.7	34.7	20.8	29.2	47.7
2008	19.5	17.8	36.2	36.2	21.2	29.5	48.1
2009	19.0	17.3	35.8	35.8	21.0	29.3	48.1
2010	18.9	17.2	36.6	36.6	21.2	29.4	48.4
2011	18.6	17.0	36.4	36.4	21.0	29.4	48.5
2012	19.0	17.3	37.8	37.8	21.4	29.7	49.0
2013	18.2	16.6	37.7	37.7	20.9	29.4	49.2
2014	18.5	16.9	38.4	38.4	21.1	29.7	49.3
2015	18.8	17.1	39.0	39.0	21.2	30.0	49.3

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CASE 1: TRACY VAR RATE---EIS PROBABILISTIC RUN OPTION 3 LOAD GAME = 50

TABLE 19
POWER RATES BY YEAR

(MILLS PER KWH)
(EXPECTED VALUES)

YEAR	PRIORITY FIRM	DSI STANDARD	NEW RESOURCE	FIRM SURPLUS	STANDARD NONFIRM	PUBLIC NON EXCHANGE	PRIVATE NON EXCHANGE
1986	20.6	21.7	25.9	25.9	22.1	29.1	42.2
1987	20.5	20.4	25.5	25.5	21.4	28.9	41.6
1988	18.1	19.6	21.0	21.0	19.5	26.6	39.8
1989	20.0	19.2	22.9	22.9	19.9	27.6	39.7
1990	20.7	19.0	23.8	23.8	20.3	28.2	39.9
1991	20.0	18.5	23.3	23.3	20.1	27.9	40.0
1992	19.1	17.7	23.4	23.4	19.6	27.5	40.5
1993	19.4	17.8	24.1	24.1	19.7	27.7	41.2
1994	18.4	16.9	24.7	24.7	19.3	27.3	41.4
1995	18.5	17.0	25.8	25.8	19.4	27.4	42.7
1996	18.5	17.0	27.3	27.3	19.4	27.6	43.8
1997	18.5	16.9	28.1	28.1	19.5	27.6	44.2
1998	18.6	17.0	28.8	28.8	19.5	27.8	44.6
1999	18.8	17.2	30.2	30.2	19.8	28.1	45.3
2000	18.9	17.3	30.9	30.9	20.1	28.3	46.0
2001	19.1	17.5	31.5	31.5	20.1	28.6	46.2
2002	18.9	17.2	31.3	31.3	20.0	28.5	46.5
2003	19.2	17.5	32.1	32.1	20.2	28.9	46.7
2004	19.1	17.4	32.7	32.7	20.3	28.9	46.9
2005	19.0	17.3	33.2	33.2	20.4	28.9	47.0
2006	19.1	17.4	34.1	34.1	20.7	29.1	47.5
2007	19.1	17.4	34.6	34.6	20.8	29.2	47.7
2008	19.4	17.7	35.8	35.8	21.1	29.5	48.1
2009	18.9	17.2	35.5	35.5	20.9	29.3	48.1
2010	18.8	17.2	36.3	36.3	21.1	29.4	48.4
2011	18.6	17.0	36.3	36.3	21.0	29.4	48.5
2012	19.0	17.3	37.6	37.6	21.3	29.7	48.9
2013	18.2	16.6	37.6	37.6	20.9	29.4	49.2
2014	18.4	16.8	38.4	38.4	21.0	29.7	49.3
2015	18.7	17.1	39.0	39.0	21.2	30.0	49.2

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CASE 1: TRACY CON/MOD-FIS PROBABILISTIC RUN OPTION 0 INCENTIVE RATE BASE GAME = 50

TABLE 18
POWER RATES BY YEAR

(MILLS PER KWH)
(EXPECTED VALUES)

YEAR	PRIORITY FIRM	DSI STANDARD	NEW RESOURCE	FIRM SURPLUS	STANDARD NONFIRM	PUBLIC NON EXCHANGE	PRIVATE NON EXCHANGE
1986	20.6	21.3	25.9	25.9	22.1	29.1	42.2
1987	20.4	20.4	25.4	25.4	21.4	28.9	41.6
1988	18.0	19.6	21.0	21.0	19.5	26.5	39.8
1989	19.9	19.2	22.8	22.8	19.9	27.6	39.6
1990	20.6	18.9	23.8	23.8	20.3	28.1	39.9
1991	20.2	18.5	23.4	23.4	20.1	28.0	40.0
1992	19.3	17.9	23.5	23.5	19.6	27.6	40.5
1993	19.4	17.8	24.1	24.1	19.7	27.7	41.2
1994	18.5	17.0	24.6	24.6	19.3	27.3	41.4
1995	18.7	17.2	25.9	25.9	19.4	27.6	42.7
1996	18.7	17.2	27.4	27.4	19.4	27.7	43.8
1997	18.5	17.0	28.1	28.1	19.5	27.7	44.2
1998	18.6	17.0	28.9	28.9	19.6	27.8	44.7
1999	18.7	17.1	30.0	30.0	19.8	28.1	45.2
2000	18.9	17.2	30.8	30.8	20.1	28.3	45.9
2001	19.1	17.5	31.6	31.6	20.1	28.6	46.2
2002	18.9	17.2	31.5	31.5	20.0	28.6	46.5
2003	19.2	17.5	32.2	32.2	20.2	28.9	46.7
2004	19.1	17.4	32.5	32.5	20.3	28.9	46.8
2005	18.9	17.3	33.0	33.0	20.4	28.9	47.0
2006	19.2	17.4	34.1	34.1	20.6	29.1	47.5
2007	19.1	17.4	34.6	34.6	20.8	29.2	47.7
2008	19.4	17.7	35.9	35.9	21.0	29.5	48.1
2009	18.9	17.2	35.6	35.6	20.9	29.3	48.1
2010	18.8	17.2	36.5	36.5	21.1	29.4	48.4
2011	18.6	17.0	36.3	36.3	21.0	29.4	48.4
2012	19.0	17.3	37.6	37.6	21.3	29.7	48.9
2013	18.1	16.5	37.4	37.4	20.8	29.4	49.2
2014	18.4	16.8	38.2	38.2	21.0	29.6	49.3
2015	18.8	17.1	39.1	39.1	21.2	30.1	49.3

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CASE 1: TRACY CON/MOD-FIS PROBABILISTIC RUN OPTION 1 CON/MOD GAME = 3 MILL

TABLE 18
POWER RATES BY YEAR

(MILLS PER KWH)
(EXPECTED VALUES)

YEAR	PRIORITY FIRM	DSI STANDARD	NEW RESOURCE	FIRM SURPLUS	STANDARD NONFIRM	PUBLIC NON EXCHANGE	PRIVATE NON EXCHANGE
1986	20.6	21.3	25.9	25.9	22.1	29.1	42.2
1987	20.4	20.4	25.4	25.4	21.4	28.9	41.6
1988	18.0	19.6	21.0	21.0	19.5	26.5	39.8
1989	19.9	19.2	22.7	22.7	19.9	27.6	39.6
1990	20.6	18.9	23.7	23.7	20.3	28.1	39.9
1991	20.3	18.6	23.6	23.6	20.2	28.0	40.0
1992	19.4	17.8	23.6	23.6	19.6	27.7	40.5
1993	19.4	17.9	24.2	24.2	19.8	27.7	41.2
1994	18.6	17.1	24.7	24.7	19.3	27.4	41.4
1995	18.8	17.3	25.9	25.9	19.4	27.6	42.7
1996	18.8	17.2	27.4	27.4	19.4	27.8	43.9
1997	18.7	17.1	28.2	28.2	19.5	27.8	44.2
1998	18.5	16.9	28.6	28.6	19.5	27.8	44.6
1999	18.7	17.1	29.7	29.7	19.7	28.0	45.1
2000	18.8	17.2	30.6	30.6	20.0	28.3	45.8
2001	19.1	17.4	31.3	31.3	20.0	28.6	46.2
2002	18.8	17.1	31.3	31.3	19.9	28.6	46.4
2003	19.1	17.5	31.9	31.9	20.1	28.8	46.7
2004	19.0	17.3	32.4	32.4	20.2	28.9	46.8
2005	18.9	17.2	32.7	32.7	20.3	28.8	46.9
2006	19.0	17.3	33.8	33.8	20.6	29.0	47.4
2007	19.1	17.4	34.3	34.3	20.7	29.1	47.7
2008	19.4	17.7	35.7	35.7	21.0	29.5	48.1
2009	18.9	17.2	35.3	35.3	20.9	29.3	48.1
2010	18.8	17.1	36.2	36.2	21.1	29.4	48.4
2011	18.5	16.9	36.1	36.1	21.0	29.3	48.4
2012	19.0	17.3	37.3	37.3	21.2	29.7	48.9
2013	18.2	16.6	37.4	37.4	20.8	29.4	49.2
2014	18.5	16.8	38.2	38.2	21.0	29.7	49.3
2015	18.8	17.1	38.9	38.9	21.2	30.1	49.3

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CASE 1: TRACY CON/MOD-FIS PROBABILISTIC RUN OPTION 2 CON/MOD GAME = 50
5 MILL

TABLE 19
POWER RATES BY YEAR

(MILLS PER KWH)
(EXPECTED VALUES)

YEAR	PRIORITY FIRM	DSI STANDARD	NEW RESOURCE	FIRM SURPLUS	STANDARD NONFIRM	PUBLIC NON EXCHANGE	PRIVATE NON EXCHANGE
1986	20.6	21.3	25.9	25.9	22.1	29.1	42.2
1987	20.4	20.4	25.4	25.4	21.4	28.9	41.6
1988	18.0	19.6	21.0	21.0	19.5	26.5	39.8
1989	19.9	19.2	22.7	22.7	19.9	27.6	39.6
1990	20.6	18.9	23.7	23.7	20.3	28.1	39.9
1991	20.3	18.6	23.6	23.6	20.2	29.0	40.0
1992	19.4	17.8	23.6	23.6	19.6	27.7	40.5
1993	19.5	17.9	24.2	24.2	19.8	27.7	41.2
1994	18.6	17.1	24.7	24.7	19.3	27.4	41.4
1995	18.8	17.3	25.9	25.9	19.4	27.6	42.7
1996	18.8	17.3	27.5	27.5	19.4	27.8	43.9
1997	18.7	17.1	28.2	28.2	19.5	27.8	44.2
1998	18.5	17.0	28.7	28.7	19.5	27.8	44.7
1999	18.7	17.1	29.8	29.8	19.7	28.0	45.1
2000	18.8	17.2	30.7	30.7	20.0	28.3	45.8
2001	19.1	17.5	31.4	31.4	20.0	28.6	46.2
2002	18.9	17.2	31.4	31.4	20.0	28.6	46.5
2003	19.2	17.5	31.9	31.9	20.2	28.9	46.7
2004	19.0	17.4	32.3	32.3	20.2	28.9	46.8
2005	18.9	17.2	32.8	32.8	20.3	28.9	46.9
2006	19.0	17.3	33.6	33.6	20.5	29.0	47.4
2007	19.0	17.3	34.2	34.2	20.7	29.1	47.7
2008	19.4	17.7	35.6	35.6	21.0	29.4	48.0
2009	18.9	17.2	35.2	35.2	20.8	29.3	48.0
2010	18.8	17.1	36.1	36.1	21.0	29.4	48.4
2011	18.5	16.9	36.0	36.0	20.9	29.3	48.4
2012	18.9	17.3	37.1	37.1	21.2	29.7	48.9
2013	18.2	16.6	37.1	37.1	20.8	29.4	49.1
2014	18.4	16.8	38.0	38.0	21.0	29.7	49.3
2015	18.8	17.1	38.6	38.6	21.1	30.0	49.3

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CASE 1: TRACY CON/MOD-FIS PROBABILISTIC RUN OPTION 3 CON/MOD GAME = 50
10 MILL

TABLE 19
POWER RATES BY YEAR

(MILLS PER KWH)
(EXPECTED VALUES)

YEAR	PRIORITY FIRM	DSI STANDARD	NEW RESOURCE	FIRM SURPLUS	STANDARD NONFIRM	PUBLIC NON EXCHANGE	PRIVATE NON EXCHANGE
1986	20.6	21.2	25.9	25.9	22.0	29.1	42.2
1987	20.4	20.4	25.4	25.4	21.3	28.9	41.6
1988	19.0	19.5	20.9	20.9	19.5	26.5	39.8
1989	19.8	19.1	22.7	22.7	19.9	27.5	39.6
1990	20.6	18.9	23.7	23.7	20.3	28.1	39.9
1991	20.3	18.6	23.6	23.6	20.1	28.0	40.0
1992	19.4	17.8	23.7	23.7	19.5	27.7	40.5
1993	19.5	17.9	24.3	24.3	19.7	27.8	41.2
1994	18.6	17.0	24.9	24.9	19.2	27.4	41.5
1995	18.9	17.4	26.2	26.2	19.3	27.7	42.7
1996	18.9	17.3	27.8	27.8	19.3	27.8	43.9
1997	18.9	17.2	28.6	28.6	19.3	27.9	44.3
1998	18.7	17.1	29.2	29.2	19.5	27.9	44.8
1999	18.7	17.1	30.3	30.3	19.7	28.1	45.3
2000	18.9	17.2	30.9	30.9	20.0	28.3	45.9
2001	19.1	17.5	31.6	31.6	20.0	28.6	46.2
2002	19.0	17.3	31.8	31.8	20.1	28.7	46.5
2003	19.3	17.6	32.4	32.4	20.2	28.9	46.7
2004	19.1	17.4	32.6	32.6	20.3	28.9	46.8
2005	19.1	17.4	33.2	33.2	20.4	29.0	46.9
2006	19.2	17.4	34.0	34.0	20.6	29.1	47.5
2007	19.2	17.4	34.5	34.5	20.8	29.2	47.7
2008	19.5	17.8	36.0	36.0	21.1	29.6	48.1
2009	19.0	17.3	35.6	35.6	20.9	29.4	48.1
2010	18.9	17.2	36.5	36.5	21.1	29.4	48.4
2011	18.6	16.9	36.4	36.4	21.0	29.4	48.4
2012	19.0	17.3	37.6	37.6	21.2	29.7	48.9
2013	18.2	16.6	37.5	37.5	20.8	29.5	49.1
2014	18.4	16.8	38.2	38.2	21.0	29.7	49.3
2015	18.7	17.0	38.8	38.8	21.1	30.0	49.2

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CASE 1: TRACY VAR RATE AND CON/MOD-EIS PROBABILISTIC RUN OPTION 0 INCENTIVE RATE BASE GAME = 50

TABLE 19
POWER RATES BY YEAR

(MILLS PER KWH)
(EXPECTED VALUES)

YEAR	PRIORITY FIRM	DSI STANDARD	NEW RESOURCE	FIRM SURPLUS	STANDARD NONFIRM	NON EXCHANGE	PUBLIC EXCHANGE	PRIVATE NON EXCHANGE
1986	20.6	21.3	25.9	25.9	22.1		29.1	42.2
1987	20.4	20.4	25.4	25.4	21.4		28.9	41.6
1988	18.0	19.6	21.0	21.0	19.5		26.5	39.8
1989	19.9	19.2	22.8	22.8	19.9		27.6	39.6
1990	20.6	18.9	23.8	23.8	20.3		28.1	39.9
1991	20.2	18.5	23.4	23.4	20.1		28.0	40.0
1992	19.3	17.8	23.5	23.5	19.6		27.6	40.5
1993	19.4	17.8	24.1	24.1	19.7		27.7	41.2
1994	18.5	17.0	24.6	24.6	19.3		27.3	41.4
1995	18.7	17.2	25.9	25.9	19.4		27.6	42.7
1996	18.7	17.2	27.4	27.4	19.4		27.7	43.8
1997	18.5	17.0	28.1	28.1	19.5		27.7	44.2
1998	18.6	17.0	28.9	28.9	19.6		27.8	44.7
1999	18.7	17.1	30.0	30.0	19.3		28.1	45.2
2000	18.9	17.2	30.8	30.8	20.1		28.3	45.9
2001	19.1	17.5	31.6	31.6	20.1		28.6	46.2
2002	18.9	17.2	31.5	31.5	20.0		28.6	46.5
2003	19.2	17.5	32.2	32.2	20.2		28.9	46.7
2004	19.1	17.4	32.5	32.5	20.3		28.9	46.8
2005	18.9	17.3	33.0	33.0	20.4		28.9	47.0
2006	19.2	17.4	34.1	34.1	20.6		29.1	47.5
2007	19.1	17.4	34.6	34.6	20.8		29.2	47.7
2008	19.4	17.7	35.9	35.9	21.0		29.5	48.1
2009	18.9	17.2	35.6	35.6	20.9		29.3	48.1
2010	18.8	17.2	36.5	36.5	21.1		29.4	48.4
2011	18.6	17.0	36.3	36.3	21.0		29.4	48.4
2012	19.0	17.3	37.6	37.6	21.3		29.7	48.9
2013	18.1	16.5	37.4	37.4	20.8		29.4	49.2
2014	18.4	16.8	38.2	38.2	21.0		29.6	49.3
2015	18.8	17.1	39.1	39.1	21.2		30.1	49.3

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CASE 1: TRACY VAR RATE AND CON/MOD-EIS PROBABILISTIC RUN OPTION 1 REVENUE 5 MILL CON/MOD SAME = 50

TABLE 13
POWER RATES BY YEAR

(MILLS PER KWH)
(EXPECTED VALUES)

YEAR	PRIORITY FIRM	DSI STANDARD	NEW RESOURCE	FIRM SURPLUS	STANDARD NONFIRM	PUBLIC NON EXCHANGE	PRIVATE NON EXCHANGE
1986	20.6	21.3	25.9	25.9	22.1	29.1	42.2
1987	20.4	20.4	25.4	25.4	21.4	28.9	41.6
1988	17.9	19.6	20.9	20.9	19.5	26.5	39.8
1989	19.3	19.1	22.1	22.1	19.9	27.2	39.6
1990	19.6	18.5	22.6	22.6	20.2	27.5	39.9
1991	19.0	18.0	22.1	22.1	20.1	27.2	40.0
1992	17.9	17.1	21.9	21.9	19.5	26.7	40.5
1993	18.1	16.9	22.6	22.6	19.7	26.8	41.1
1994	17.4	16.2	23.4	23.4	19.2	26.5	41.4
1995	17.5	16.2	24.3	24.8	19.4	26.7	42.6
1996	17.7	16.2	26.3	26.3	19.4	27.0	43.8
1997	17.8	16.3	27.6	27.6	19.6	27.2	44.3
1998	18.6	17.0	29.3	29.3	19.9	27.7	44.8
1999	18.7	17.1	30.2	30.2	20.0	28.0	45.4
2000	18.9	17.2	31.0	31.0	20.3	28.2	46.2
2001	19.1	17.4	31.6	31.6	20.3	28.5	46.4
2002	19.0	17.3	31.9	31.9	20.3	28.6	46.7
2003	19.4	17.7	33.1	33.1	20.6	29.0	47.1
2004	19.3	17.6	33.2	33.2	20.6	29.0	47.1
2005	19.2	17.5	33.8	33.8	20.7	29.0	47.2
2006	19.3	17.6	34.5	34.5	20.8	29.2	47.6
2007	19.3	17.5	34.8	34.8	21.0	29.3	47.8
2008	19.6	17.9	36.1	36.1	21.2	29.6	48.2
2009	19.1	17.4	35.7	35.7	21.0	29.4	48.1
2010	18.9	17.3	36.3	36.3	21.2	29.5	48.4
2011	19.7	17.0	36.2	36.2	21.0	29.4	48.4
2012	19.0	17.3	37.6	37.6	21.3	29.7	48.9
2013	18.2	16.6	37.3	37.3	20.8	29.4	49.1
2014	18.4	16.8	38.0	38.0	21.0	29.7	49.3
2015	19.8	17.1	38.6	38.6	21.1	30.0	49.2

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CASE 1: TRACY VAR RATE AND CON/MOD-FIS PROBABILISTIC RUN OPTION 2 PROPOSAL GAME = 50
5 MILL
CON/MOD

TABLE 18
POWER RATES BY YEAR

(MILLS PER KWH)
(EXPECTED VALUES)

YEAR	PRIORITY FIRM	OSI STANDARD	NEW RESOURCE	FIRM SURPLUS	STANDARD NONFIRM	PUBLIC NON EXCHANGE	PRIVATE NON EXCHANGE
1986	20.6	21.3	25.9	25.9	22.1	29.1	42.2
1987	20.4	20.4	25.4	25.4	21.4	28.9	41.6
1988	18.0	19.6	21.0	21.0	19.5	26.5	39.8
1989	19.8	19.2	22.7	22.7	19.9	27.5	39.6
1990	20.4	18.3	23.5	23.5	20.3	28.0	39.9
1991	19.9	18.4	23.2	23.2	20.2	27.8	40.0
1992	19.0	17.6	23.2	23.2	19.6	27.5	40.5
1993	19.2	17.7	23.9	23.9	19.8	27.6	41.2
1994	18.4	16.9	24.5	24.5	19.3	27.2	41.4
1995	18.4	16.9	25.5	25.5	19.4	27.4	42.6
1996	18.4	16.9	27.0	27.0	19.4	27.5	43.8
1997	18.4	16.8	27.9	27.9	19.5	27.6	44.2
1998	18.5	17.0	28.7	28.7	19.5	27.8	44.6
1999	18.7	17.2	29.9	29.9	19.8	28.1	45.3
2000	18.9	17.3	30.7	30.7	20.1	28.3	46.0
2001	19.1	17.4	31.3	31.3	20.1	28.6	46.2
2002	18.9	17.2	31.2	31.2	20.0	28.6	46.5
2003	19.2	17.5	32.1	32.1	20.2	28.9	46.8
2004	19.0	17.4	32.5	32.5	20.3	28.9	46.9
2005	19.0	17.3	33.0	33.0	20.3	28.9	47.0
2006	19.1	17.4	33.8	33.8	20.5	29.0	47.5
2007	19.1	17.4	34.2	34.2	20.7	29.1	47.7
2008	19.4	17.7	35.8	35.8	21.0	29.5	48.1
2009	19.0	17.3	35.4	35.4	20.9	29.3	48.2
2010	18.9	17.2	36.1	36.1	21.1	29.4	48.4
2011	18.6	17.0	36.1	36.1	20.9	29.4	48.4
2012	19.0	17.3	37.3	37.3	21.2	29.7	48.9
2013	18.2	16.6	37.5	37.5	20.8	29.5	49.1
2014	18.5	16.9	38.3	38.3	21.1	29.7	49.3
2015	18.8	17.1	38.8	38.8	21.2	30.1	49.3

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CASE 1: TRACY VAR RATE AND CON/MOD-EIS PROBABILISTIC RUN OPTION 3 PROPOSAL 10 MILL CON/MOD GAME = 50

TABLE 13
POWER RATES BY YEAR

(MILLS PER KWH)
(EXPECTED VALUES)

YEAR	PRIORITY FIRM	DSI STANDARD	NEW RESOURCE	FIRM SURPLUS	STANDARD NONFIRM	PUBLIC NON EXCHANGE	PRIVATE NON EXCHANGE
1986	20.6	21.2	25.9	25.9	22.0	29.1	42.2
1987	20.4	20.4	25.4	25.4	21.3	28.9	41.6
1988	19.0	19.5	20.9	20.9	19.5	26.5	39.8
1989	19.8	19.1	22.7	22.7	19.9	27.5	39.6
1990	20.4	18.7	23.5	23.5	20.3	28.0	39.9
1991	19.9	18.3	23.2	23.2	20.1	27.8	40.0
1992	19.1	17.6	23.3	23.3	19.5	27.5	40.5
1993	19.3	17.7	24.1	24.1	19.7	27.6	41.2
1994	18.4	16.8	24.7	24.7	19.2	27.3	41.4
1995	18.6	17.1	25.9	25.9	19.2	27.5	42.7
1996	18.4	16.9	27.2	27.2	19.3	27.5	43.9
1997	18.4	16.9	28.1	28.1	19.4	27.6	44.2
1998	18.7	17.1	29.1	29.1	19.5	27.9	44.7
1999	18.9	17.2	30.5	30.5	19.8	28.2	45.4
2000	18.8	17.2	30.8	30.8	20.0	28.3	46.0
2001	19.1	17.4	31.6	31.6	20.1	28.5	46.2
2002	18.9	17.2	31.7	31.7	20.1	28.6	46.5
2003	19.3	17.5	32.4	32.4	20.3	28.9	46.8
2004	19.1	17.4	32.8	32.8	20.3	28.9	46.9
2005	19.1	17.4	33.5	33.5	20.5	29.0	47.0
2006	19.2	17.5	34.4	34.4	20.7	29.1	47.5
2007	19.2	17.5	34.8	34.8	20.8	29.2	47.7
2008	19.5	17.8	36.1	36.1	21.1	29.6	48.2
2009	19.0	17.3	35.7	35.7	21.0	29.4	48.2
2010	18.9	17.2	36.7	36.7	21.2	29.5	48.5
2011	18.7	17.0	36.4	36.4	21.0	29.4	48.4
2012	19.0	17.3	37.7	37.7	21.3	29.7	48.9
2013	18.3	16.7	37.8	37.8	20.9	29.5	49.1
2014	18.5	16.8	38.5	38.5	21.1	29.7	49.3
2015	18.8	17.1	39.1	39.1	21.2	30.1	49.2

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CASE 1: TRACY VAR RATE AND CON/MOD-LIS PROBABILISTIC RUN OPTION 4 LOAD 20 MILL CONMOD GAME = 50

TABLE 12
POWER RATES BY YEAR

(MILLS PER KWH)
(EXPECTED VALUES)

YEAR	PRIORITY FIRM	DSI STANDARD	NEW RESOURCE	FIRM SURPLUS	STANDARD NONFIRM	PUBLIC NON EXCHANGE	PRIVATE NON EXCHANGE
1986	20.6	21.2	25.9	25.9	22.0	29.1	42.2
1987	20.5	20.4	25.5	25.5	21.3	26.9	41.6
1988	18.0	19.5	20.9	20.9	19.4	26.5	39.8
1989	19.9	19.1	22.7	22.7	19.9	27.5	39.6
1990	20.7	19.0	23.8	23.8	20.2	28.2	39.9
1991	20.4	18.7	23.7	23.7	20.1	28.1	40.0
1992	19.5	17.9	23.8	23.8	19.5	27.8	40.5
1993	19.7	18.1	24.7	24.7	19.7	27.9	41.2
1994	18.8	17.2	25.2	25.2	19.2	27.5	41.5
1995	18.9	17.4	26.2	26.2	19.2	27.7	42.7
1996	19.0	17.4	27.9	27.9	19.3	27.9	43.9
1997	19.0	17.3	28.7	28.7	19.4	28.0	44.3
1998	18.9	17.3	29.4	29.4	19.5	28.1	44.8
1999	18.9	17.3	30.4	30.4	19.8	28.2	45.3
2000	19.0	17.3	30.8	30.8	20.0	28.4	45.9
2001	19.2	17.5	31.6	31.6	20.0	28.6	46.2
2002	19.1	17.4	31.9	31.9	20.1	28.7	46.5
2003	19.4	17.6	32.6	32.6	20.3	29.0	46.8
2004	19.2	17.5	32.9	32.9	20.3	29.0	46.8
2005	19.1	17.4	33.3	33.3	20.4	29.0	47.0
2006	19.3	17.6	34.3	34.3	20.7	29.2	47.5
2007	19.2	17.4	34.7	34.7	20.8	29.2	47.7
2008	19.6	17.8	36.3	36.3	21.1	29.6	48.1
2009	19.1	17.4	36.0	36.0	21.0	29.4	48.2
2010	18.9	17.2	36.8	36.8	21.2	29.5	48.5
2011	18.7	17.0	36.7	36.7	21.0	29.4	48.5
2012	19.1	17.4	38.0	38.0	21.3	29.8	48.9
2013	18.4	16.7	38.0	38.0	20.9	29.6	49.2
2014	18.4	16.8	38.5	38.5	21.1	29.7	49.3
2015	18.9	17.2	39.0	39.0	21.2	30.1	49.2

APPENDIX G

EMPLOYMENT IMPACTS

Table: 1

PLME:12/30/85
EIS: EMPOVR
(A1..J35)

No Action: EMPLOYMENT IMPACTS

OPTION 0

1987-2000

Year	(A) Aluminum 2/	(B) 1/ Other Industry (A + 9100)	(C) 2/	(D) 1/ Other Industry (C + 725000)	(E) 2/ Indirect	(F) 1/ (E + 2994300)	(G) TOTAL EMPLOYMENT (B+D+F)
1987	(5,720)	3,380	941	725,941	2,478	2,996,778	3,726,099
1988	(4,570)	4,530	1,776	726,776	4,790	2,999,090	3,730,396
1989	(4,155)	4,945	1,589	726,589	4,226	2,998,526	3,730,060
1990	(4,456)	4,644	1,428	726,428	3,768	2,998,068	3,729,140
1991	(4,547)	4,553	1,451	726,451	3,834	2,998,134	3,729,138
1992	(4,522)	4,578	1,446	726,446	3,851	2,998,151	3,729,175
1993	(4,601)	4,499	1,317	726,317	3,516	2,997,816	3,728,632
1994	(4,451)	4,649	1,373	726,373	3,698	2,997,998	3,729,020
1995	(4,338)	4,762	1,094	726,094	2,965	2,997,265	3,728,121
1996	(4,551)	4,549	854	725,854	2,341	2,996,641	3,727,044
1997	(4,501)	4,599	793	725,793	2,186	2,996,486	3,726,878
1998	(4,353)	4,747	678	725,678	1,885	2,996,185	3,726,610
1999	(4,389)	4,711	531	725,531	1,492	2,995,792	3,726,034
2000	(4,756)	4,344	348	725,348	1,004	2,995,304	3,724,996

1/ Source for constants- Power Forecasting (PNIC; Peter West), 12/12/85.

2/ Source for variable data- Employment Impacts: Change in Employment (Person-Years), Table 10.
Computer Printout dated: 12/28/85.

Table: 1

PLME:12/30/85
EIS: EMPOVR
(A40..J60)

No Action: EMPLOYMENT IMPACTS

OPTION 0

1987-2000

Year	(A) Aluminum 2/	(B) 1/ Other Industry (A + 9100)	(C) 2/	(D) 1/ Other Industry (C + 725000)	(E) 2/ Indirect	(F) 1/ (E + 2994300)	(G) TOTAL EMPLOYMENT (B+D+F)
1987-1993	(4,653)	4,447	1,421	726,421	3,780	2,998,080	3,728,949
1994-2000	(4,477)	4,623	810	725,810	2,224	2,996,524	3,726,958

Table: 2

PLME:12/30/85
EIS: EMPOVR
(L1..U35)

EMPLOYMENT IMPACTS

OPTION 1 (REVENUE)

1987-2000

Year	(A) 2/ Aluminum	(B) 1/ Other Industry (A + 9100)	(C) 2/ Industry	(D) 1/ Other Industry (C + 725000)	(E) 2/ Industry Indirect	(F) 1/ (E + 2994300)	(G) TOTAL EMPLOYMENT (B+D+F)
1987	(5,718)	3,382	941	725,941	2,480	2,996,780	3,726,103
1988	(4,543)	4,557	1,786	726,786	4,820	2,999,120	3,730,463
1989	(4,119)	4,981	1,669	726,669	4,461	2,998,761	3,730,411
1990	(4,425)	4,675	1,574	726,574	4,196	2,998,496	3,729,745
1991	(4,501)	4,599	1,654	726,654	4,430	2,998,730	3,729,983
1992	(4,479)	4,621	1,684	726,684	4,550	2,998,850	3,730,155
1993	(4,533)	4,567	1,548	726,548	4,194	2,998,494	3,729,609
1994	(4,290)	4,810	1,570	726,570	4,277	2,998,577	3,729,957
1995	(4,235)	4,865	1,298	726,298	3,562	2,997,862	3,729,025
1996	(4,423)	4,677	1,037	726,037	2,876	2,997,176	3,727,890
1997	(4,409)	4,691	911	725,911	2,544	2,996,844	3,727,446
1998	(4,306)	4,794	680	725,680	1,902	2,996,202	3,726,676
1999	(4,324)	4,776	504	725,504	1,429	2,995,729	3,726,009
2000	(4,681)	4,419	303	725,303	897	2,995,197	3,724,919

1/ Source for constants- Power Forecasting (PNIC; Peter West), 12/12/85.

2/ Source for variable data- Employment Impacts: Change in Employment (Person-Years). Table 10.
Computer Printout dated: 12/28/85.

Table: 2

PLME:12/30/85
EIS: EMPOVR
(L40..U60)

EMPLOYMENT IMPACTS

OPTION 1 (REVENUE)

1987-2000

Year	(A) 2/ Aluminum	(B) 1/ Other Industry (A + 9100)	(C) 2/ Industry	(D) 1/ Other Industry (C + 725000)	(E) 2/ Industry Indirect	(F) 1/ (E + 2994300)	(G) TOTAL EMPLOYMENT (B+D+F)
1987-1993	(4,617)	4,483	1,551	726,551	4,162	2,998,462	3,729,496
1994-2000	(4,381)	4,719	900	725,900	2,498	2,996,798	3,727,417

Table: 3

PLME:12/30/85
EIS: EMPOVR
(W1..AF35)

EMPLOYMENT IMPACTS

OPTION 2 (BPA PROPOSAL)

1987-2000

Year	(A) Aluminum 2/	(B) 1/ Other Industry (A + 9100)	(C) 2/	(D) 1/ Other Industry (C + 725000)	(E) 2/ Indirect	(F) 1/ (E + 2994300)	(G) TOTAL EMPLOYMENT (B+D+F)
1987	(5,656)	3,444	937	725,937	2,465	2,996,765	3,726,146
1988	(4,505)	4,595	1,772	726,772	4,870	2,999,170	3,730,537
1989	(4,066)	5,034	1,593	726,593	4,239	2,998,539	3,730,166
1990	(4,395)	4,705	1,452	726,452	3,837	2,998,137	3,729,294
1991	(4,481)	4,619	1,503	726,503	3,988	2,998,288	3,729,410
1992	(4,469)	4,631	1,492	726,492	3,988	2,998,288	3,729,411
1993	(4,528)	4,572	1,353	726,353	3,620	2,997,920	3,728,845
1994	(4,441)	4,659	1,408	726,408	3,800	2,998,100	3,729,167
1995	(4,283)	4,817	1,157	726,157	3,148	2,997,448	3,728,422
1996	(4,409)	4,691	922	725,922	2,539	2,996,839	3,727,452
1997	(4,459)	4,641	848	725,848	2,345	2,996,645	3,727,134
1998	(4,330)	4,770	699	725,699	1,945	2,996,245	3,726,714
1999	(4,370)	4,730	511	725,511	1,441	2,995,741	3,725,982
2000	(4,741)	4,359	313	725,313	913	2,995,213	3,724,885

1/ Source for constants- Power Forecasting (PNIC; Peter West), 12/12/85.

2/ Source for variable data- Employment Impacts: Change in Employment (Person-Years), Table 10.
Computer Printout dated: 12/28/85.

Table: 3

PLME:12/30/85
EIS: EMPOVR
(W40..AF60)

EMPLOYMENT IMPACTS

OPTION 2 (BPA PROPOSAL)

1987-2000

Year	(A) Aluminum 2/	(B) 1/ Other Industry (A + 9100)	(C) 2/	(D) 1/ Other Industry (C + 725000)	(E) 2/ Indirect	(F) 1/ (E + 2994300)	(G) TOTAL EMPLOYMENT (B+D+F)
1987-1993	(4,586)	4,514	1,443	726,443	3,858	2,998,158	3,729,116
1994-2000	(4,433)	4,667	837	725,837	2,304	2,996,604	3,727,108

Table: 4

PLME:12/30/85
EIS: EMPOVR
(AH1..AQ35)

EMPLOYMENT IMPACTS

OPTION 3 (LOAD)

1987-2000

Year	(A) 2/ Aluminum	(B) 1/ Other Industry (A + 9100)	(C) 2/	(D) 1/ Other Industry (C + 725000)	(E) 2/ Indirect	(F) 1/ (E + 2994300)	(G) TOTAL EMPLOYMENT (B+D+F)
1987	(5,644)	3,456	931	725,931	2,450	2,996,750	3,726,137
1988	(4,469)	4,631	1,768	726,768	4,766	2,999,066	3,730,465
1989	(4,049)	5,051	1,581	726,581	4,203	2,998,503	3,730,135
1990	(4,379)	4,721	1,421	726,421	3,745	2,998,045	3,729,187
1991	(4,489)	4,611	1,471	726,471	3,894	2,998,194	3,729,276
1992	(4,463)	4,637	1,470	726,470	3,924	2,998,224	3,729,331
1993	(4,559)	4,541	1,315	726,315	3,509	2,997,809	3,728,665
1994	(4,452)	4,648	1,378	726,378	3,713	2,998,013	3,729,039
1995	(4,344)	4,756	1,125	726,125	3,056	2,997,356	3,728,237
1996	(4,415)	4,685	881	725,881	2,422	2,996,722	3,727,288
1997	(4,495)	4,605	807	725,807	2,228	2,996,528	3,726,940
1998	(4,360)	4,740	685	725,685	1,902	2,996,202	3,726,627
1999	(4,367)	4,733	496	725,496	1,397	2,995,697	3,725,926
2000	(4,747)	4,353	317	725,317	924	2,995,224	3,724,894

1/ Source for constants- Power Forecasting (PNIC; Peter West), 12/12/85.

2/ Source for variable data- Employment Impacts: Change in Employment (Person-Years), Table 10.
Computer Printout dated: 12/11/85.

Table: 4

PLME:12/30/85
EIS: EMPOVR
(AH40..AQ60)

EMPLOYMENT IMPACTS

OPTION 3 (LOAD)

1987-2000

Year	(A) 2/ Aluminum	(B) 1/ Other Industry (A + 9100)	(C) 2/	(D) 1/ Other Industry (C + 725000)	(E) 2/ Indirect	(F) 1/ (E + 2994300)	(G) TOTAL EMPLOYMENT (B+D+F)
1987-1993	(4,579)	4,521	1,422	726,422	3,784	2,998,084	3,729,028
1994-2000	(4,454)	4,646	813	725,813	2,235	2,996,535	3,726,993

Table: 1

PLME:12/30/85
EIS: EMPOCM
(A1..J35)

No Action: EMPLOYMENT IMPACTS

OPTION 0

1987-2000

Year	(A) 2/ Aluminum	(B) 1/ Other Industry (A + 9100)	(C) 2/	(D) 1/ Other Industry (C + 725000)	(E) 2/ Indirect	(F) 1/ (E + 2994300)	(G) TOTAL EMPLOYMENT (B+D+F)
1987	(5,720)	3,380	941	725,941	2,478	2,996,778	3,726,099
1988	(4,570)	4,530	1,776	726,776	4,790	2,999,090	3,730,396
1989	(4,155)	4,945	1,589	726,589	4,226	2,998,526	3,730,060
1990	(4,456)	4,644	1,428	726,428	3,768	2,998,068	3,729,140
1991	(4,547)	4,553	1,451	726,451	3,834	2,998,134	3,729,138
1992	(4,522)	4,578	1,446	726,446	3,851	2,998,151	3,729,175
1993	(4,601)	4,499	1,317	726,317	3,516	2,997,816	3,728,632
1994	(4,451)	4,649	1,373	726,373	3,698	2,997,998	3,729,020
1995	(4,338)	4,762	1,094	726,094	2,965	2,997,265	3,728,121
1996	(4,551)	4,549	854	725,854	2,341	2,996,641	3,727,044
1997	(4,501)	4,599	793	725,793	2,186	2,996,486	3,726,878
1998	(4,353)	4,747	678	725,678	1,885	2,996,185	3,726,610
1999	(4,389)	4,711	531	725,531	1,492	2,995,792	3,726,034
2000	(4,756)	4,344	348	725,348	1,004	2,995,304	3,724,996

1/ Source for constants- Power Forecasting (PNIC; Peter West), 12/12/85.

2/ Source for variable data- Employment Impacts: Change in Employment (Person-Years), Table 10. Computer Printout dated: 12/28/85.

Table: 1

PLME:12/30/85
EIS: EMPOCM
(A40..J60)

No Action: EMPLOYMENT IMPACTS

OPTION 0

1987-2000

Year	(A) 2/ Aluminum	(B) 1/ Other Industry (A + 9100)	(C) 2/	(D) 1/ Other Industry (C + 725000)	(E) 2/ Indirect	(F) 1/ (E + 2994300)	(G) TOTAL EMPLOYMENT (B+D+F)
1987-1993	(4,653)	4,447	1,421	726,421	3,780	2,998,080	3,728,949
1994-2000	(4,477)	4,623	810	725,810	2,224	2,996,524	3,726,958

Table: 2

PLME:12/30/85
EIS: EMPOCM
(L1..U35)

EMPLOYMENT IMPACTS

OPTION 1 (CON/MOD 3 MILL)

1987-2000

Year	(A) Aluminum 2/	(B) 1/ Other Industry (A + 9100)	(C) 2/	(D) 1/ (C + 725000)	(E) 2/ Indirect	(F) 1/ (E + 2994300)	(G) TOTAL EMPLOYMENT (B+D+F)
1987	(5,683)	3,417	940	725,940	2,476	2,996,776	3,726,133
1988	(4,557)	4,543	1,776	726,776	4,792	2,999,092	3,730,411
1989	(4,086)	5,014	1,596	726,596	4,245	2,998,545	3,730,155
1990	(4,447)	4,653	1,434	726,434	3,782	2,998,082	3,729,169
1991	(4,512)	4,588	1,438	726,438	3,798	2,998,098	3,729,124
1992	(4,450)	4,650	1,438	726,438	3,827	2,998,127	3,729,215
1993	(4,511)	4,589	1,305	726,305	3,480	2,997,780	3,728,674
1994	(4,408)	4,692	1,356	726,356	3,646	2,997,946	3,728,994
1995	(4,292)	4,808	1,084	726,084	2,933	2,997,233	3,728,125
1996	(4,449)	4,651	835	725,835	2,286	2,996,586	3,727,072
1997	(4,389)	4,711	765	725,765	2,107	2,996,407	3,726,883
1998	(4,253)	4,847	693	725,693	1,925	2,996,225	3,726,765
1999	(4,317)	4,783	544	725,544	1,525	2,995,825	3,726,152
2000	(4,701)	4,399	366	725,366	1,053	2,995,353	3,725,118

1/ Source for constants- Power Forecasting (PNIC; Peter West), 12/12/85.

2/ Source for variable data- Employment Impacts: Change in Employment (Person-Years), Table 10.
Computer Printout dated: 12/28/85.

Table: 2

PLME:12/30/85
EIS: EMPOCM
(L40..U60)

EMPLOYMENT IMPACTS

OPTION 1 (CON/MOD 3 MILL)

1987-2000

Year	(A) Aluminum 2/	(B) 1/ Other Industry (A + 9100)	(C) 2/	(D) 1/ (C + 725000)	(E) 2/ Indirect	(F) 1/ (E + 2994300)	(G) TOTAL EMPLOYMENT (B+D+F)
1987-1993	(4,607)	4,493	1,418	726,418	3,771	2,998,071	3,728,[illegible]
1994-2000	(4,401)	4,699	806	725,806	2,211	2,996,511	3,727,016

Table: 3

PLME:12/30/85
EIS: EMPOCM
(W1..AF35)

EMPLOYMENT IMPACTS

OPTION 2 (CON/MOD 5 MILL)

1987-2000

Year	(A) Aluminum 2/	(B) 1/ Other Industry (A + 9100)	(C) 2/	(D) 1/ Other Industry (C + 725000)	(E) 2/ Indirect	(F) 1/ (E + 2994300)	(G) TOTAL EMPLOYMENT (B+D+F)
1987	(5,699)	3,401	940	725,940	2,476	2,996,776	3,726,117
1988	(4,547)	4,553	1,777	726,777	4,794	2,999,094	3,730,424
1989	(4,061)	5,039	1,596	726,596	4,246	2,998,546	3,730,181
1990	(4,433)	4,667	1,433	726,433	3,780	2,998,080	3,729,180
1991	(4,524)	4,576	1,434	726,434	3,787	2,998,087	3,729,097
1992	(4,446)	4,654	1,438	726,438	3,828	2,998,128	3,729,220
1993	(4,502)	4,598	1,303	726,303	3,474	2,997,774	3,728,675
1994	(4,383)	4,717	1,355	726,355	3,645	2,997,945	3,729,017
1995	(4,273)	4,827	1,075	726,075	2,908	2,997,208	3,728,110
1996	(4,437)	4,663	829	725,829	2,269	2,996,569	3,727,061
1997	(4,345)	4,755	759	725,759	2,090	2,996,390	3,726,904
1998	(4,263)	4,837	681	725,681	1,892	2,996,192	3,726,710
1999	(4,333)	4,767	542	725,542	1,521	2,995,821	3,726,130
2000	(4,660)	4,440	356	725,356	1,026	2,995,326	3,725,122

1/ Source for constants- Power Forecasting (PNIC; Peter West), 12/12/85.

2/ Source for variable data- Employment Impacts: Change in Employment (Person-Years), Table 10.
Computer Printout dated: 12/28/85.

Table: 3

PLME:12/30/85
EIS: EMPOCM
(W40..AF60)

EMPLOYMENT IMPACTS

OPTION 2 (CON/MOD 5 MILL)

1987-2000

Year	(A) Aluminum 2/	(B) 1/ Other Industry (A + 9100)	(C) 2/	(D) 1/ Other Industry (C + 725000)	(E) 2/ Indirect	(F) 1/ (E + 2994300)	(G) TOTAL EMPLOYMENT (B+D+F)
1987-1993	(4.602)	4,498	1,417	726,417	3,769	2,998,069	3,728,985
1994-2000	(4,385)	4,715	800	725,800	2,193	2,996,493	3,727,008

Table: 4

PLME:12/30/85
EIS: EMPOCM
(AH1..AQ35)

EMPLOYMENT IMPACTS

OPTION 3 (CON/MOD 10 MILL)

1987-2000

Year	(A) 2/ Aluminum	(B) 1/ (A + 9100)	(C) 2/ Other Industry	(D) 1/ (C + 725000)	(E) 2/ Other Industry Indirect	(F) 1/ (E + 2994300)	(G) TOTAL EMPLOYMENT (B+D+F)
1987	(5,445)	3,655	942	725,942	2,482	2,996,782	3,726,379
1988	(4,426)	4,674	1,785	726,785	4,817	2,999,117	3,730,576
1989	(4,010)	5,090	1,603	726,603	4,267	2,998,567	3,730,260
1990	(4,237)	4,863	1,436	726,436	3,787	2,998,087	3,729,386
1991	(4,493)	4,607	1,438	726,438	3,797	2,998,097	3,729,142
1992	(4,393)	4,707	1,434	726,434	3,817	2,998,117	3,729,258
1993	(4,409)	4,691	1,300	726,300	3,466	2,997,766	3,728,757
1994	(4,184)	4,916	1,343	726,343	3,612	2,997,912	3,729,171
1995	(4,106)	4,994	1,058	726,058	2,860	2,997,160	3,728,212
1996	(4,217)	4,883	807	725,807	2,208	2,996,508	3,727,198
1997	(4,241)	4,859	728	725,728	2,001	2,996,301	3,726,888
1998	(4,145)	4,955	641	725,641	1,780	2,996,080	3,726,676
1999	(4,208)	4,892	513	725,513	1,444	2,995,744	3,726,149
2000	(4,551)	4,549	345	725,345	995	2,995,295	3,725,189

1/ Source for constants- Power Forecasting (PNIC; Peter West), 12/12/85.

2/ Source for variable data- Employment Impacts: Change in Employment (Person-Years), Table 10.
Computer Printout dated: 12/28/85.

Table: 4

PLME:12/30/85
EIS: EMPOCM
(AH40..AQ60)

EMPLOYMENT IMPACTS

OPTION 3 (CON/MOD 10 MILL)

1987-2000

Year	(A) 2/ Aluminum	(B) 1/ (A + 9100)	(C) 2/ Other Industry	(D) 1/ (C + 725000)	(E) 2/ Other Industry Indirect	(F) 1/ (E + 2994300)	(G) TOTAL EMPLOYMENT (B+D+F)
1987-1993	(4,488)	4,612	1,420	726,420	3,776	2,998,076	3,729,108
1994-2000	(4,236)	4,864	776	725,776	2,129	2,996,429	3,727,069

Table: 1

PLME:12/30/85
EIS: EMPOVR&CM
(A1..J35)

No Action: EMPLOYMENT IMPACTS

OPTION 0

1987-2000

Year	(A) Aluminum 2/	(B) 1/ Other Industry (A + 9100)	(C) 2/	(D) (C + 725000)	(E) 2/ Indirect	(F) 1/ (E + 2994300)	(G) TOTAL EMPLOYMENT (B+D+F)
1987	(5,720)	3,380	941	725,941	2,478	2,996,778	3,726,099
1988	(4,570)	4,530	1,776	726,776	4,790	2,999,090	3,730,396
1989	(4,155)	4,945	1,589	726,589	4,226	2,998,526	3,730,060
1990	(4,456)	4,644	1,428	726,428	3,768	2,998,068	3,729,140
1991	(4,547)	4,553	1,451	726,451	3,834	2,998,134	3,729,138
1992	(4,522)	4,578	1,446	726,446	3,851	2,998,151	3,729,175
1993	(4,601)	4,499	1,317	726,317	3,516	2,997,816	3,728,632
1994	(4,451)	4,649	1,373	726,373	3,698	2,997,998	3,729,020
1995	(4,338)	4,762	1,094	726,094	2,965	2,997,265	3,728,121
1996	(4,551)	4,549	854	725,854	2,341	2,996,641	3,727,044
1997	(4,501)	4,599	793	725,793	2,186	2,996,486	3,726,878
1998	(4,353)	4,747	678	725,678	1,885	2,996,185	3,726,610
1999	(4,389)	4,711	531	725,531	1,492	2,995,792	3,726,034
2000	(4,756)	4,344	348	725,348	1,004	2,995,304	3,724,996

1/ Source for constants- Power Forecasting (PNIC; Peter West), 12/12/85.

2/ Source for variable data- Employment Impacts: Change in Employment (Person-Years), Table 10.
Computer Printout dated: 12/28/85.

Table: 1

PLME:12/13/85
EIS: EMPOVR&CM
(A40..J60)

No Action: EMPLOYMENT IMPACTS

OPTION 0

1987-2000

Year	(A) Aluminum 2/	(B) 1/ Other Industry (A + 9100)	(C) 2/	(D) (C + 725000)	(E) 2/ Indirect	(F) 1/ (E + 2994300)	(G) TOTAL EMPLOYMENT (B+D+F)
1987-1993	(4,653)	4,447	1,421	726,421	3,780	2,998,080	3,728,949
1994-2000	(4,477)	4,623	810	725,810	2,224	2,996,524	3,726,958

Table: 2

PLME:12/30/85
EIS: EMPOVR&CM
(L1..U35)

EMPLOYMENT IMPACTS

OPTION 1 (REVENUE & 5 MILL)

1987-2000

Year	(A) 2/ Aluminum	(B) 1/ Other Industry (A + 9100)	(C) 2/ Industry	(D) 1/ (C + 725000)	(E) 2/ Other Industry Indirect	(F) 1/ (E + 2994300)	(G) TOTAL EMPLOYMENT (B+D+F)
1987	(5,710)	3,390	942	725,942	2,480	2,996,780	3,726,112
1988	(4,539)	4,561	1,787	726,787	4,825	2,999,125	3,730,473
1989	(4,066)	5,034	1,672	726,672	4,470	2,998,770	3,730,476
1990	(4,427)	4,673	1,575	726,575	4,197	2,998,497	3,729,745
1991	(4,532)	4,568	1,635	726,635	4,375	2,998,675	3,729,878
1992	(4,406)	4,694	1,675	726,675	4,524	2,998,824	3,730,193
1993	(4,469)	4,631	1,532	726,532	4,147	2,998,447	3,729,610
1994	(4,274)	4,826	1,566	726,566	4,263	2,998,563	3,729,955
1995	(4,199)	4,901	1,295	726,295	3,554	2,997,854	3,729,050
1996	(4,379)	4,721	1,036	726,036	2,873	2,997,173	3,727,930
1997	(4,286)	4,814	893	725,893	2,493	2,996,793	3,727,500
1998	(4,240)	4,860	668	725,668	1,869	2,996,169	3,726,697
1999	(4,310)	4,790	505	725,505	1,431	2,995,731	3,726,026
2000	(4,659)	4,441	306	725,306	905	2,995,205	3,724,952

1/ Source for constants- Power Forecasting (PNIC; Peter West), 12/12/85.

2/ Source for variable data- Employment Impacts: Change in Employment (Person-Years), Table 10.
Computer Printout dated: 12/28/85.

Table: 2

PLME:12/13/85
EIS: EMPOVR&CM
(L40..U60)

EMPLOYMENT IMPACTS

OPTION 1 (REVENUE & 5 MILL)

1987-2000

Year	(A) 2/ Aluminum	(B) 1/ Other Industry (A + 9100)	(C) 2/ Industry	(D) 1/ (C + 725000)	(E) 2/ Other Industry Indirect	(F) 1/ (E + 2994300)	(G) TOTAL EMPLOYMENT (B+D+F)
1987-1993	(4,593)	4,507	1,545	726,545	4,145	2,998,445	3,729,498
1994-2000	(4,335)	4,765	896	725,896	2,484	2,996,784	3,727,444

Table: 3

PLME:12/30/85
EIS: EMPOVR&CM
(W1..AF35)

EMPLOYMENT IMPACTS

OPTION 2 (BPA PROPOSAL & 5 MILL)

1987-2000

Year	(A) 2/ Aluminum	(B) 1/ Other Industry (A + 9100)	(C) 2/	(D) 1/ Other Industry (C + 725000)	(E) 2/ Indirect	(F) 1/ (E + 2994300)	(G) TOTAL EMPLOYMENT (B+D+F)
1987	(5,657)	3,443	937	725,937	2,466	2,996,766	3,726,146
1988	(4,515)	4,585	1,774	726,774	4,785	2,999,085	3,730,444
1989	(4,010)	5,090	1,598	726,598	4,251	2,998,551	3,730,239
1990	(4,398)	4,702	1,457	726,457	3,851	2,998,151	3,729,310
1991	(4,513)	4,587	1,486	726,486	3,940	2,998,240	3,729,313
1992	(4,428)	4,672	1,489	726,489	3,977	2,998,277	3,729,438
1993	(4,487)	4,613	1,339	726,339	3,580	2,997,880	3,728,832
1994	(4,362)	4,738	1,395	726,395	3,761	2,998,061	3,729,194
1995	(4,263)	4,837	1,147	726,147	3,119	2,997,419	3,728,403
1996	(4,373)	4,727	900	725,900	2,476	2,996,776	3,727,403
1997	(4,326)	4,774	816	725,816	2,254	2,996,554	3,727,144
1998	(4,271)	4,829	693	725,693	1,927	2,996,227	3,726,749
1999	(4,347)	4,753	515	725,515	1,451	2,995,751	3,726,019
2000	(4,678)	4,422	328	725,328	955	2,995,255	3,725,005

1/ Source for constants- Power Forecasting (PNIC; Peter West), 12/12/85.

2/ Source for variable data- Employment Impacts: Change in Employment (Person-Years), Table 10. Computer Printout dated: 12/28/85.

Table: 3

PLME:12/13/85
EIS: EMPOVR&CM
(W40..AF60)

EMPLOYMENT IMPACTS

OPTION 2 (BPA PROPOSAL & 5 MILL)

1987-2000

Year	(A) 2/ Aluminum	(B) 1/ Other Industry (A + 9100)	(C) 2/	(D) 1/ Other Industry (C + 725000)	(E) 2/ Indirect	(F) 1/ (E + 2994300)	(G) TOTAL EMPLOYMENT (B+D+F)
1987-1993	(4,573)	4,527	1,440	726,440	3,836	2,998,136	3,729,103
1994-2000	(4,374)	4,726	828	725,828	2,278	2,996,578	3,727,131

Table: 4

PLME:12/30/85
EIS: EMPOVR&CM
(AH1..AQ35)

EMPLOYMENT IMPACTS

OPTION 3 (BPA PROPOSAL & 10 MILL)

1987-2000

Year	(A) Aluminum 2/	(B) 1/ Other Industry (A + 9100)	(C) 2/	(D) 1/ Other Industry (C + 725000)	(E) 2/ Indirect	(F) 1/ (E + 2994300)	(G) TOTAL EMPLOYMENT (B+D+F)
1987	(5,385)	3,715	938	725,938	2,471	2,996,771	3,726,424
1988	(4,404)	4,696	1,783	726,783	4,810	2,999,110	3,730,589
1989	(3,948)	5,152	1,605	726,605	4,270	2,998,570	3,730,327
1990	(4,194)	4,906	1,458	726,458	3,852	2,998,152	3,729,516
1991	(4,480)	4,620	1,485	726,485	3,936	2,998,236	3,729,341
1992	(4,384)	4,716	1,478	726,478	3,946	2,998,246	3,729,440
1993	(4,400)	4,700	1,330	726,330	3,552	2,997,852	3,728,882
1994	(4,179)	4,921	1,383	726,383	3,730	2,998,030	3,729,334
1995	(4,054)	5,046	1,116	726,116	3,028	2,997,328	3,728,490
1996	(4,166)	4,934	890	725,890	2,451	2,996,751	3,727,575
1997	(4,232)	4,868	804	725,804	2,223	2,996,523	3,727,195
1998	(4,144)	4,956	650	725,650	1,808	2,996,108	3,726,714
1999	(4,207)	4,893	476	725,476	1,341	2,995,641	3,726,010
2000	(4,553)	4,547	330	725,330	961	2,995,261	3,725,138

1/ Source for constants- Power Forecasting (PNIC; Peter West), 12/12/85.

2/ Source for variable data- Employment Impacts: Change in Employment (Person-Years), Table 10.
Computer Printout dated: 12/28/85.

Table: 4

PLME:12/13/85
EIS: EMPOVR&CM
(AH40..AQ60)

EMPLOYMENT IMPACTS

OPTION 3 (BPA PROPOSAL & 10 MILL)

1987-2000

Year	(A) Aluminum 2/	(B) 1/ Other Industry (A + 9100)	(C) 2/	(D) 1/ Other Industry (C + 725000)	(E) 2/ Indirect	(F) 1/ (E + 2994300)	(G) TOTAL EMPLOYMENT (B+D+F)
1987-1993	(4,456)	4,644	1,440	726,440	3,834	2,998,134	3,729,217
1994-2000	(4,219)	4,881	807	725,807	2,220	2,996,520	3,727,208

Table: 5

PLME:12/30/85
EIS: EMPOVR&CM
(AW1..BF35)

EMPLOYMENT IMPACTS

OPTION 4 (LOAD & 20 MILL)

1987-2000

Year	(A) 2/ Aluminum	(B) 1/ Other Industry (A + 9100)	(C) 2/	(D) 1/ Other Industry (C + 725000)	(E) 2/ Indirect	(F) 1/ (E + 2994300)	(G) TOTAL EMPLOYMENT (B+D+F)
1987	(4,875)	4,225	933	725,933	2,454	2,996,754	3,726,912
1988	(4,115)	4,985	1,783	726,783	4,811	2,999,111	3,730,879
1989	(3,711)	5,389	1,597	726,597	4,248	2,998,548	3,730,534
1990	(3,946)	5,154	1,419	726,419	3,738	2,998,038	3,729,611
1991	(4,280)	4,820	1,422	726,422	3,751	2,998,051	3,729,293
1992	(4,183)	4,917	1,419	726,419	3,771	2,998,071	3,729,407
1993	(4,194)	4,906	1,263	726,263	3,358	2,997,658	3,728,827
1994	(3,947)	5,153	1,313	726,313	3,523	2,997,823	3,729,289
1995	(3,857)	5,243	1,069	726,069	2,891	2,997,191	3,728,503
1996	(3,917)	5,183	797	725,797	2,178	2,996,478	3,727,458
1997	(3,998)	5,102	711	725,711	1,950	2,996,250	3,727,063
1998	(3,957)	5,143	599	725,599	1,660	2,995,960	3,726,702
1999	(3,972)	5,128	476	725,476	1,334	2,995,634	3,726.238
2000	(4,377)	4,723	333	725,333	959	2,995,259	3,725,315

1/ Source for constants- Power Forecasting (PNIC; Peter West), 12/12/85.

2/ Source for variable data- Employment Impacts: Change in Employment (Person-Years), Table 10.
Computer Printout dated: 12/11/85.

Table: 5

PLME:12/13/85
EIS: EMPOVR&CM
(AW40..BF60)

EMPLOYMENT IMPACTS

OPTION 4 (BPA PROPOSAL & 20 MILL)

1987-2000

Year	(A) 2/ Aluminum	(B) 1/ Other Industry (A + 9100)	(C) 2/	(D) 1/ Other Industry (C + 725000)	(E) 2/ Indirect	(F) 1/ (E + 2994300)	(G) TOTAL EMPLOYMENT (B+D+F)
1987-1993	(4,186)	4,914	1,405	726,405	3,733	2,998,033	3,729,352
1994-2000	(4,004)	5,096	757	725,757	2,071	2,996,371	3,727,224

APPENDIX H

VARIABLE INDUSTRIAL POWER RATE DESIGN STUDY

Appendix H

VARIABLE INDUSTRIAL POWER RATE

DESIGN STUDY

BONNEVILLE POWER ADMINISTRATION

U.S. DEPARTMENT OF ENERGY

December 1985

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I. Introduction

A. Purpose

In this study, BPA is proposing a Variable Industrial Power (VI-86) rate option for aluminum smelter loads. This rate would provide a predetermined contractual tie between the price of BPA's power and the U.S. market price of aluminum. Establishing a tie between input price (electricity) and output price (aluminum) will enhance the ability of aluminum producers to operate over the entire business cycle. With this type of rate, when the price of aluminum decreases or increases, so will the price of power, within certain limits. Decreasing the price of power when aluminum prices are low reduces the operating costs at the smelters and should encourage higher production levels than if a fixed rate were in place. This in turn should reduce the cyclicality of smelter operations. Increasing the price of power when aluminum prices are high is intended to compensate BPA for the decrease in its revenues when the lower rates occur. Various proposals for and discussions of a variable rate for BPA's direct-service industrial (DSI) customers have occurred throughout the region over the past year. This study is the result of analyses conducted as well as public comment on a variable rate. This study describes the Variable rate proposed by BPA and the analyses conducted in support of the rate.

B. Organization of the Study

The remaining parts of Section I provide background information and definitions for the Study. In Section II the computer models used in the rate design are briefly described. Section III provides information on aluminum industry economics, including price forecasts and cost analysis. The design of the Variable rate itself is described in Section IV, including the rate adjustments. Section V describes the analyses prepared in support of the proposed Variable rate. The load, revenue and cash flow analyses are used both to design some of the Variable rate parameters and to check the impact of the rate on BPA's total revenues. Following these sections are supporting tables, Appendix H-A with a more detailed description of the computer models and Appendix H-B the proposed VI-86 rate schedule. A volume of Documentation for the Variable Industrial Power Rate Design Study is also available (VI-86-E-BPA-01A).

C. Background

In the Pacific Northwest, BPA serves 15 DSIs that produce pulp and paper, various chemicals, and metals, primarily aluminum. The aluminum companies account for about 90 percent of the electric power purchased by the DSIs. Of the 12 primary aluminum producers in the United States, seven have smelters in the Pacific Northwest. In recent years the price of aluminum has been very volatile with prolonged periods where the price has remained below the operating costs of most of the region's smelters. In response to the volatile price of aluminum the amount of power demanded by the DSIs has fluctuated dramatically. The changing demand for power has caused problems

for BPA and the Pacific Northwest region, increasing the uncertainty about BPA's future resource planning, financial strength, and rate stability. Changes in Northwest aluminum smelter operations also have contributed to the region's economic problems as a whole.

Recently, beginning in the fall of 1984, BPA has provided short-term discounts, called Incentive rates, to the DSIs when aluminum markets were depressed. As a result of these discounts, BPA's total revenues increased and aluminum smelter operations were higher than they would have been without the rate reduction. These short-term attempts have been only partially successful at addressing the problems associated with fluctuations in the DSI loads. The DSIs have indicated that predictable rates are necessary for long-term investment decisions.

The concept of a variable rate for the DSIs in the Pacific Northwest has been proposed in papers prepared by various groups within the region, including the DSIs, Springfield Utility Board, and Portland General Electric Company and in a report prepared by Resource Strategies, Inc. for BPA. This concept was also briefly mentioned in "Energy and the Primary Aluminum Industry," a report issued in November 1984 by the U.S. Department of Commerce. BPA undertook the DSI Options Study late in 1984 to analyze this concept in more detail, along with other proposed policy and service options relating to BPA's DSI customers.

D. Summary and Conclusions of the DSI Options Study

Shortly after the start of BPA's 1985 rate proceeding, the BPA Administrator announced that a separate process, the DSI Options Study (Study), would be undertaken to study various long-term DSI options. Within the Study five options were examined: (1) a variable DSI rate tied to the price of aluminum; (2) a reduction in current rates in return for increased power interruptibility rights in the future; (3) allowing the DSIs to purchase electricity from other suppliers who could provide more attractive rates; (4) financial support to encourage conservation/modernization investments in DSI plants; and (5) "no action", or pursuing a business-as-usual course. Based on the results of the Study and public comment, the Administrator concluded that two of the options should be pursued at this time: a power rate linked to the price of aluminum and limited financial support for conservation/modernization of DSI plants.

A number of factors influenced the Administrator's decision to pursue a variable rate. Probably the most significant factor was the perception that some of the problems facing the DSIs were not necessarily long term in duration. After a period of dramatic cost increases from 1979 to 1983, BPA has managed to stabilize costs. Over the long term, BPA's efforts to stabilize costs and rates should allow the PNW aluminum plants to be competitive in the world aluminum market as the power costs in competing regions increase more rapidly. The regional perception gained from the DSI Options Study was that BPA's actions to stabilize revenues from its aluminum customers should not be directed towards the long term but rather should be directed towards the "intermediate term" (5-10 years).

The advantages of a variable rate appeared to be the greatest in the intermediate term. When implementation of a variable rate was modeled in the DSI Options Study, the variable rate option principally affected aluminum companies' short-term operating decisions over the course of the business cycle, while having only a minor influence on long-term decisions to remain in operation or close plants. The model results suggested that the variable rate alone will not forestall plant closure.

The model results consistently showed that the variable rate provided benefits to BPA's non-DSI customers greater than those in the "no action" case. Although the model results showed negative benefits to the DSIs, comments received from the DSIs suggested that other considerations not specifically accounted for within the model made this option attractive to them. The primary advantage to the DSIs is the predictability offered by a variable rate. This rate predictability would enable the aluminum companies to maintain higher production levels, thereby reducing their average unit production costs by avoiding shutdown and startup expense. Further, the variable rate does not contain the same degree of uncertainty and time lag as the current incentive rate provisions. These factors will enhance the Northwest smelters' competitive position on the worldwide aluminum industry supply curve.

E. Current DSI Rates

Currently all DSIs, except for Hanna Nickel, purchase power under the Industrial Firm Power (IP) rate schedule. The IP rate schedule contains a Standard rate (which averages 22.8 mills per kilowatthour), a Premium rate, and an Incentive rate. The Incentive rate provisions allow BPA to offer temporary discounts to the DSIs when such discounts would increase BPA's total revenues based on the companies' commitments to purchase certain amounts of power from BPA. BPA's first two Incentive rate offers were made under the IP-83 rate schedule. The first offer was for the period September 1984 through February 1985, the second, for the period March 1985 through June 1985. A third Incentive rate offered by BPA was implemented in September 1985 and terminates June 30, 1986. The average rate projected for the current Incentive rate offer is 19.3 mills per kilowatthour.

F. Goals of the Proposed Variable Rate

BPA has identified the following goals for the proposed Variable rate. BPA's initial proposal attempts to balance these goals in the design of the Variable rate.

1. Discourage aluminum plant closures during the short-run; i.e., 1 to 3 years. The Variable rate is not intended to forestall closure of those plants that are not economic over the medium to long term at the IP Standard rate.

2. Encourage high aluminum plant operating rates and discourage swing operations during BPA's surplus power period.

3. Increase BPA's total revenues over the revenues anticipated if the IP Standard rate to the DSIs were to remain in effect. If possible, the average rate paid under the Variable rate option, over the ten-year time period the rate is in effect, should equal the IP Standard rate over the same time period.

G. Definitions

The Variable rate has the following parameters (see also Figure 1):

1. plateau: a range of aluminum prices over which the price of power remains constant. The plateau electricity charge equals the average IP Standard rate.

2. pivot points: the point on the plateau at which the electricity price changes in response to aluminum market prices.

3. lower pivot point: the point on the plateau at which a further decrease in the market price of aluminum results in a decrease in the electricity price.

4. upper pivot point: the point on the plateau at which a further increase in the market price of aluminum results in an increase in the electricity price.

5. slope: the rate of change in the power price to the DSIs as a function of the change in the market price of aluminum.

6. lower slope: the rate of change in the price of electricity due to a change in the market aluminum price below the lower pivot point.

7. upper slope: the rate of change in the price of electricity due to a change in the market aluminum price above the upper pivot point.

8. rate limits: the point at which the electricity price no longer changes in response to a change in aluminum prices from the pivot points. The rate limits establish the range of possible electricity prices under the Variable rate.

9. lower rate limit: the limit below which a change in aluminum prices below the lower pivot point will not result in a further change in the electricity price; the lowest electricity price possible under the Variable rate.

10. upper rate limit: the limit above which a change in aluminum prices above the upper pivot point will not result in a further change in the electricity price; the highest electricity price possible under the Variable rate.

II. Principles and Methodology: Analytical Models

A. Aluminum Smelter Model

In designing and analyzing the Variable rate, the Aluminum Smelter Model (ASM) was used to project regional smelter operating decisions. The ASM originally was developed during BPA's 1983 wholesale power rate proceeding and has undergone extensive development since then. The basic theory underlying the ASM is that in the short-run, when capacity cannot be expanded, a smelter will operate when the market price for aluminum ingot is greater than or equal to the sum of its variable operating costs.

In the ASM, the market price is the transaction price of aluminum ingot in U.S. markets. The variable costs are those costs of production that vary directly with the level of ingot production. The determination of the smelters' variable costs is discussed in section III.B. The variable costs, developed for each individual plant, are compared to the price of aluminum in the ASM. When a smelter is shown to cover its variable costs including restart costs, the smelter, unless already at full capacity, will incrementally increase its load above current levels by one potline per month up to the plant's full capacity. If a smelter is not covering variable costs, it will shut down one potline per month, to a minimum of one potline. (The ASM is discussed in greater detail in Appendix H-A. A complete copy of the ASM computer code is provided in the Documentation to the Variable Rate Study. VI-86-E-BPA-01A.)

B. Nonfirm Revenue Analysis Program

The Nonfirm Revenue Analysis Program (NFRAP) was used to estimate BPA revenues. The NFRAP estimates sales, revenues, adjustments to sales, and wheeling values for all revenue categories that vary in response to water conditions in the Pacific Northwest (PNW). The model focuses on Federal revenue levels and does not explicitly model non-Federal revenues. Federal revenue categories forecasted or adjusted by the NFRAP include: Nonfirm Energy, Industrial Firm Power (first quartile), Special Industrial (Hanna interruptible), Surplus Firm Power, Priority Firm, and incidental wheeling and coordination agreement revenues.

The NFRAP uses hydrological data for the region and the Federal system based on 40 years of historical water conditions. The average of 40 historical water years (average water) is used in all analyses for the Variable rate. The NFRAP also uses expected PNW thermal plant availability and costs to determine PNW resources available for displacement by nonfirm energy. For determining Pacific Southwest (PSW) markets the NFRAP uses projected Intertie capabilities and firm contractual arrangements using the Intertie. Projected surplus firm resources affect estimates of sales and the rate levels at which sales are made.

Given the water conditions of a particular month in a particular historical water year and surplus firm resources not sold at firm rates (open market), the NFRAP first calculates service to the interruptible industrial

loads. The NFRAP next compares the available regional resources to all PNW and PSW markets at the NF Standard and High Cost Displacement rates. If the markets exceed the resources, all PNW resources serve a portion of the NF Standard and High Cost Displacement markets, with non-Federal resources serving highest cost markets first. If the resources exceed the markets, the NFRAP apportions Federal and non-Federal sales over the Intertie, at the NF Standard and High Cost Displacement rates. Any remaining resources after these markets are satisfied serve low cost markets, mainly in the PNW. Remaining non-Federal resources serve these low cost markets first and if the low cost markets are completely served, non-Federal resources are spilled. If any low cost markets still remain unserved, Federal resources serve them at the Low Cost Displacement rate. If Federal resources remain after non-Federal and Federal resources have served all lower cost markets, the remaining resources are spilled. A more detailed discussion of the NFRAP is included in Appendix H-A.

C. Revenue Estimating Model

The Revenue Estimating Model (REVEST) compiles all the data required to estimate BPA's total sales and revenues. The REVEST uses monthly data on energy sales, peak demands, rates, and billing provisions to estimate revenues for a 12-month period. Generally, the REVEST applies rates to estimated sales and then summarizes the results in tables showing total BPA sales and total BPA revenues. A small portion of revenues appearing in the summary tables is put directly into the program, not calculated internally.

The REVEST uses data from several sources. Wholesale power rates are direct inputs in the program. The NFRAP provides sales (and some revenues) data and adjustments to sales for rate categories whose sales or revenues vary in response to water conditions occurring in the PNW. Files of loads and purchases under contracts are provided by the other BPA planning and forecasting models. Externally forecasted transmission and miscellaneous revenues are included in the summary revenue data.

D. Smelter Net Cash Flow Analysis

While the ASM discussed in section II.A. above, produces reasonable estimates of month-to-month smelter operating decisions given projected short-run variable costs and aluminum prices, it cannot directly address the question of whether specific smelters are economically viable over the mid- to long-term (i.e., whether the smelters should remain in operation at all or be closed permanently). This question can be answered only by examining the smelters' total costs over a period of time and comparing these costs to the revenues expected over that same period.

BPA examined the regional smelters' net cash flows (i.e., revenues less total outlays) over the period for which the Variable rate is proposed to be offered. This was accomplished by applying standard discounted net cash flow analysis to each plant using a simple model constructed for this purpose. The resulting discounted cash flows were used to evaluate the

impacts of the proposed Variable rate on the regional smelters with various aluminum price scenarios and to serve as a check on plant closure assumptions used in some scenarios. The calculations used to perform this analysis are described in more detail Appendix H-A.

III. Aluminum Industry Economics

A. Aluminum Price Forecasts

BPA performed sensitivity analyses of the Variable rate for a number of aluminum price projections. Two of these price forecasts were obtained from independent consultants: Resource Strategies, Inc. (RSI) and Chase Econometrics. Other price projections were developed by BPA based on various assumptions concerning the repetition of past price cycles that may occur in the future. These aluminum price forecasts are shown by quarter for the years 1986 through 1996 in Table 1. (See also Figure 3.)

1. Resource Strategies, Inc.

The RSI price forecast was obtained from the July 1985 and October 1985 editions of Aluminum Industry Analysis. RSI's forecast of aluminum prices is based on a proprietary dynamic model of the world aluminum industry that explicitly attempts to equilibrate supply and demand. RSI projects prices to improve slowly but steadily over the next few years, with any potential dramatic increases in price dampened by restart of idle facilities or the addition of new capacity. This price scenario assumes slow but stable macroeconomic growth of about 2.3 percent, without recession. Although nominal interest rates are projected to climb back to approximately 12 percent by 1990, inflation is projected to remain under 5 percent. Primary aluminum consumption is projected to grow by 1.8 percent per year beginning in 1985 and continuing through 1990. After 1990, consumption growth is expected to rise to about 3.4 percent per year, with prices increasing somewhat more substantially until the mid-1990s, when a presumed economic slowdown causes a severe price decline. The price of aluminum, in the RSI price forecast averages 63.2 cents per pound for the years 1986 through 1991 and 65.4 cents per pound for the years 1986 through 1996.

2. Chase Econometrics

The Chase Econometrics aluminum price forecast is also the product of a world aluminum industry model that equilibrates supply and demand. The Chase aluminum price forecast used by BPA is consistent with the scenario described in the midyear 1985 World Aluminum Outlook. This forecast expects aluminum prices to increase more rapidly in the near-term than the RSI forecast, but then to decline during a presumed recessionary downturn during 1988, recover strongly in 1990-91, and then grow moderately during the mid-1990s. World consumption of primary aluminum grows at 3.3 percent annually from 1985 to 1990, and at 2.8 percent annually from 1990 to 1995. Macroeconomic assumptions call for 2 to 4 percent growth in GNP, with recessions in 1988 and 1992. Nominal interest rates are projected to be in the 10 to 12 percent range and inflation at approximately 6 percent. The average price of aluminum for the years 1986 through 1991 is projected to be 67.6 cents per pound and for the years 1986 through 1996, 68.7 cents per pound.

3. BPA's Price Scenarios

BPA's price scenarios are based on a recurrence of past price cycles. Two basic price scenarios were developed: a medium cycle and a random low cycle. The medium cycle scenario assumes that the historical cycle from mid-1982 to mid-1984 repeats itself continuously over the forecast period. The projected 1986-1991 medium cycle average aluminum price is 64.5 cents per pound, and 61.6 cents per pound for the period 1986-1996. The random low cycle reduces the amplitude of the medium cycle such that the peak is at roughly 65 cents per pound, troughs are at 45 cents per pound, and the mean is at 55 cents per pound. A random element is then added that draws from a normal distribution with standard deviation equal to 2 cents per pound. The Random Low projects a 5-year average aluminum price of 53.9 cents per pound for the 1986-1991 period and 53.6 cents per pound for the 10-year period 1986-1996.

Table 1 and Figure 3 present all of the price forecasts used in this analysis. The forecasts obtained from RSI and Chase Econometrics were adjusted to 1985 dollars using an implicit price deflator for GNP. RSI's price forecast was further adjusted from a London Metals Exchange basis to a U.S. market basis using a 5 percent markup. Both forecasts were interpolated to monthly values from quarterly or annual values.

B. Aluminum Plant Economics

1. General Methodology

The basic categories of production costs used in the ASM are electric energy, labor, alumina, and "other". Published reports of smelter-specific production costs are practically non-existent because the costs are held as proprietary information by the aluminum companies. To a large extent, therefore, BPA has relied on special studies of aluminum industry economics made by independent consultants specializing in the aluminum industry. Two reports in particular were instrumental in the development of the cost parameters used in the Variable rate analysis. The first report was prepared for BPA by John Moberly Associates (Primary Aluminum Production Costs in the Pacific Northwest, July 1984.) The second report was prepared for BPA by Resource Strategies, Inc. (Alumina Costs and Supply Arrangements in the Pacific Northwest, May 1985). These reports, as well as BPA's own estimates and analyses, are the basis for all the production costs used in the ASM. These cost estimates also reflect extensive public review and input regarding the cost parameters that occurred during the technical review sessions held by BPA as part of the DSI Options Study.

a. Electric Energy Costs

The costs of electric energy are a function of both the price of electricity (mills per kilowatthour) and the efficiency of power use (kilowatthours per pound). In the ASM, the rate is either the IP Standard rate or the calculated Variable rate, depending on which scenario is being run. The IP Standard rate is equal to 22.8 mills per kilowatthour on an

annual average basis, but varies by month due to seasonal differentiation of both the demand and energy charges. The Variable rate can change monthly depending on the market aluminum price and the parameter settings of the rate structure itself.

Estimates of each smelter's energy efficiency were made by BPA during the 1985 wholesale power rate proceeding, and have not been changed for this study. These estimates are based on statistical analyses (linear regression) of energy use as a function of smelter production, using monthly data for each smelter. Generally, historical smelter production levels are taken from reports on pollution and output levels made by each smelter to state environmental quality offices. The exception to this procedure was for the Columbia Falls smelter, whose production levels are not reported directly to the Montana State Environmental Quality office. For this smelter, the power use efficiency was estimated using historical energy use divided by rated capacity.

b. Labor Costs

The cost of labor is a function of both a wage rate (dollars per labor hour) and a labor efficiency coefficient (labor hours per pound). Estimates of labor efficiency for all smelters are taken directly from the Moberly report. Wage rates are also taken from the Moberly report and are assumed equal for all smelters at $25 per hour, including all benefits. The exceptions are the two Kaiser facilities, which negotiated a $4 per hour wage reduction during 1985. Although this reduction is somewhat offset by the employees' receipt of company stock, BPA does not believe the value of this stock should be considered a cost that would influence short-term operating decisions by Kaiser management. Labor contract renegotiation has occurred at the Columbia Falls smelter since this analysis was conducted. As a result, future analysis will also incorporate wage reductions of approximately a $4 per hour for the Columbia Falls smelter. Alcoa and Reynolds also both face contract negotiations during 1986, and future analyses will reflect any changes in labor costs for these smelters as well.

c. Alumina Costs

Alumina cost estimates for each of the smelters are based on RSI's report on alumina supply arrangements in the PNW. This analysis concluded that the cost of alumina in the PNW varies substantially among smelters depending on company-specific supply arrangements. Alcoa, Kaiser, and Reynolds are each involved in equity ownership of several sources of alumina. Their total costs for alumina are therefore a function of their average system costs. Variable costs for these companies reflect avoidable costs at their marginal refineries. Comalco and Alumax appear to serve their PNW smelters with mid- to long-term contractual arrangements. Their variable costs reflect the difference between contractual costs and spot market prices. The Columbia Falls and The Dalles smelters are assumed to be supplied in the future with spot market alumina. The RSI report suggested this

explicitly for The Dalles, and given recent information on the sale of the Columbia Falls smelter, the same is assumed for it. Since spot alumina prices are directly related to metal prices, a simple linear regression model (Price of alumina = (Price of aluminum * 2.921)-12.588; r^2 = .809) is used to determine a spot price of alumina for any given market price of aluminum.

d. Other Costs

This category of costs includes a variety of operating expenses, including cryolite, fluoride, petroleum coke, pitch, natural gas, pot relining, corporate overhead, local taxes, insurance, regional transportation disadvantage, and restart costs. All but the restart costs are from the Moberly study. The restart cost is incurred only as cold potlines are brought back into production. The estimate of this cost (3.0 cents per pound) is the same as has been used in the past two BPA wholesale power rate proceedings.

2. Plant Specific Cost Estimates

Table 2 summarizes variable production cost estimates for each smelter. Short-run variable costs range from a low of 51.2 cents/pound at Intalco, column G, line 4; to a high of 61.2 cents/pound at Reynolds, Troutdale, column G, line 10. These are the costs used in the ASM to determine smelter loads throughout the forecast period.

There has been some technical debate about the variation of operating costs over the short-term, medium-term, and long-term. Little hard evidence exists on this subject. It is generally known, however, that fixed costs do exist for several production components (e.g., supplemental unemployment benefits for labor, take-or-pay alumina contracts, etc.). Table 3 presents estimates of how the variable portion of total costs may vary over time. The short-term variable costs, column B, are consistent with the values used in the ASM. Over a longer period (i.e., 1-3 years) it is assumed that all alumina and labor costs become variable, shown as medium-term variable costs, column C. If all smelters were to undergo a specified level of modernization and achieve labor wage concessions similar to those negotiated by Kaiser, the short-run variable costs would be reduced. Estimates of the short-run variable costs if wage concessions and conservation programs were undertaken by all smelters are provided in column D. The estimates of long-run variable costs, column E, assume that all costs are fully variable. These costs exclude any return on capital. For analysis of the Variable rate, only the short-term variable costs are used in the ASM.

IV. Rate Design

A. Eligibility

Because the proposed Variable rate is a function of the price of aluminum, this option is available only for aluminum smelter operations. Other aluminum operations (i.e., aluminum fabrication) and all non-aluminum DSI customers are ineligible to purchase power at the Variable rate. These customers will continue to purchase power at the IP-85 rate and its successor rate schedules.

B. Term of the Rate

The proposed Variable rate is available, on a voluntary basis, for those aluminum smelters that elect to purchase power under this rate schedule. While BPA anticipates that the Variable rate may be effective July 1, 1986, it is possible that the Federal Energy Regulatory Commission (FERC) will not grant interim approval until a later date. Currently, the aluminum smelters are purchasing power at the IP-85 Incentive rate offered in September 1985. The Incentive rate offer will expire June 30, 1986. BPA does not propose to offer the Variable rate prior to termination of the current Incentive rate. This rate schedule is available for 10 years from its anticipated effective date, July 1, 1986.

C. Implementation

Before the rate becomes effective, BPA will request that each regional smelter select either the VI-86 rate schedule or the IP-85 rate schedule and its successors. BPA proposes that this offer will be made only once. After the choice is made, a smelter will not be allowed to switch between rate schedules for 10 years from the effective date of the Variable rate.

Most of the analyses conducted by BPA in support of the proposed Variable rate assume that all of the regional smelters elect to purchase under this rate. BPA expects that most, if not all, of the smelters will participate. Actual implementation of the Variable rate may not necessarily require participation of all regional smelters. The Administrator retains the discretion to determine whether the level of participation does not warrant actual implementation of a Variable rate once offered. BPA expects that after the VI-86 rate schedule is implemented, future IP-85 Incentive rate offers will not be made and future IP rate schedules will not retain the Incentive rate provision. In the event that the Administrator finds that the participation level is not sufficient to implement a Variable rate, a record of decision will be published and the Variable rate offer rescinded.

D. Rate Plateau - Calculation of the VI-86 Rate

The proposed Variable rate schedule contains demand and energy charges. The demand charge is time differentiated on a daily basis. There is no demand charge for deliveries during offpeak hours. The demand and plateau

energy charges are based on the average IP-85 Standard rate of 22.8 mills per kilowatthour assuming a 98.5 percent load factor. The IP-85 Standard rate was determined in BPA's 1985 general rate proceeding and approved on an interim basis by the Federal Energy Regulatory Commission Order issued June 28, 1985 (Docket No. EF85-2011-000). The plateau energy charge calculation includes a credit for the value of reserves provided by BPA's right to restrict the DSI loads and an adder for firm service to the first quartile of the DSIs' load. The plateau energy charge is reduced 0.5 mills per kilowatthour for all energy purchased when the purchaser requests service with other than Surplus Firm Energy Load Carrying Capability (FELCC). The demand charge does not vary with changes in aluminum price. For simplicity, all the rate levels discussed hereafter are average electricity prices, combining the demand and energy charges and including the value of reserves credit and the discount for first quartile service. The plateau energy charge initially remains unchanged when aluminum prices are between 61.0 cents per pound and 72.0 cents per pound.

The demand and energy charges are calculated so that the Variable rate on average net of the discount for First Quartile service, equals the IP Standard rate on average. The Variable rate demand charge is equal to the IP demand charges prior to the value of reserves credit. The seasonality of the IP Standard rate demand charge is removed by summing the monthly demand charges over the year and dividing by 12. To calculate the energy charge, the uniform demand charges are first converted to mills per kilowatthour by dividing a .985 load factor and 8,706 hours. The demand in mills per kilowatthour is then subtracted from the average IP Standard rate gross of the value of reserves credit which is equal to the DSI floor rate (24.7 mills per kilowatthour). The resulting energy charge is then adjusted for the total value of reserves credit and the discount for First Quartile service. The discount for First Quartile service is based on the character of service adjustment determined in BPA's Section 7(c)(2) Industrial Margin Study prepared in the 1985 wholesale rate proceedings. These calculations are shown in Table 4.

E. Lower Rate Components

The lower pivot point, the lower slope, and the lower rate limit constitute the lower rate components. The lower rate components define the parameters for electricity price reductions from the plateau.

The lower rate components are designed so that when the market price of aluminum falls below the short-run variable production costs at the region's highest-cost smelter, the price of electricity decreases. In the short run, a smelter is assumed to operate when the market price of aluminum is equal to or greater than the short-run variable cost of producing aluminum. When the price of aluminum falls below short-run variable cost, a smelter may reduce production to reduce costs. BPA has estimated the current short-run variable cost at the highest cost smelter to be approximately 61 cents per pound (see Table 2, column G, line 10). This estimation is based on the costs that a smelter can avoid, in the short-run, if production is reduced or suspended. Short-run variable costs include all electricity costs

and a portion of alumina, labor, and other costs (i.e., transportation and other raw materials). Another reason for setting the lower pivot point at 61 cents is that the regions higher cost smelters, other than the highest cost smelter, can cover or almost cover medium term variable costs at that aluminum price. Furthermore, the forecast of aluminum prices over the term of the Variable rate falls near the middle of the plateau. This in turn helps ensure that the forecasted revenue over the Variable rate period will approximate the IP Standard rate over that same period.

For every 1 cent per pound decrease in the market price of aluminum below 61 cents per pound, the electricity price decreases 1 mill per kilowatthour. Since BPA has alternative markets in which this power may be sold, the rate contains a lower rate limit below which changes in aluminum prices do not result in additional changes in electricity prices. The lower rate limit is seasonally differentiated to recognize that BPA's revenues in alternative markets vary by season, primarily because of streamflow conditions. In the spring, which is defined for this purpose as March through July, the average lower rate limit (including demand and energy charges) is initially 13.8 mills per kilowatthour. In the remaining months, August through February, the average lower rate limit is initially 18.8 mills per kilowatthour. The lower rate limits were established to balance recognition of BPA's alternative markets and the promotion of DSI loads. Seasonal differentiation is expected to lessen the revenue losses to BPA of DSI load fluctuations during periods of very low aluminum prices. Seasonal differentiation is further discussed in section V.F.

F. Upper Rate Components

The upper pivot point, the upper slope and the upper rate limit form the upper rate components. The upper rate components increase the average electricity price, enabling BPA to offset the revenue decrease resulting from the lower rate components.

The upper rate components are designed so that the price of electricity increases after the market price of aluminum exceeds the long-run variable cost at the region's highest cost smelter. The long-run variable cost includes total alumina, labor, electricity, and other costs. The long-run variable cost does not include a return on equity nor does it include interest, depreciation, or amortization associated with plant investment in place at the time the rate is offered. BPA has estimated the long-run variable cost of the highest cost smelter currently to be 72 cents per pound (see Table 3, column E, line 10). Another factor that influenced the choice of the upper pivot point is the desirability of having the forecasted average aluminum price over the Variable rate period roughly in the middle of the plateau.

The upper portion of the proposed Variable rate provides for the price of electricity to increase more gradually in response to an increase in aluminum prices than the speed at which the rate decreases when aluminum prices are below the lower pivot point. An upper slope as steep as the lower

slope is not necessary in order to achieve the IP Standard rate on average. The reason being that DSI power purchases can be expected to be higher when the electricity price is determined by the upper rate components rather than the lower rate components. The proposed rate is set so that a 1 cent per pound increase in the market price of aluminum above 72 cents per pound causes the electricity price to increase one-half mill per kilowatthour. This results in a sharing of the benefits of prosperous aluminum markets between BPA and the DSIs. BPA revenues are higher than under a fixed tariff, and the smelters' potential net earnings are not all lost to higher power rates.

The rate also contains an upper rate limit above which changes in aluminum prices do not result in additional changes in electricity prices. The upper rate limit initially is 29.1 mills per kilowatthour, which is an equal difference in mills per kilowatthour from the plateau rate as the weighted average lower rate limit.

G. Annual Adjustments

1. Inflation Adjustment

The Variable rate provides for an adjustment to the aluminum prices establishing the upper and lower pivot points to reflect changes over time in aluminum prices and production costs resulting from increases in general price levels, or inflation. This adjustment for general inflation is distinct from the cyclical changes in aluminum price that the Variable rate design is intended to address. Over time, the inflation adjustment should result in the upper and lower pivot points generally tracking the actual production costs facing the aluminum industry. Specifically, the pivot point aluminum prices will be adjusted annually for inflation using a weighted price index of electricity costs and other production costs. The weighted average cost index proposed by BPA includes the U.S. index of intermediate materials less food and energy calculated monthly by the Bureau of Labor Statistics (75 percent weight) and an index of electric power rates to the PNW aluminum industry assuming the "plateau rate" is in effect (25 percent weight). The 75 percent and 25 percent weightings assigned respectively, to the intermediate materials index and the electricity cost index are derived from the approximate average current share of the industry's total costs (including a return on capital) represented by electricity costs.

Table 5 and Figure 4 show historical values for the GNP implicit price deflator (IPD-GNP), the wholesale price index, the index for intermediate materials excluding energy and food, average U.S. aluminum industry total costs, and average U.S. aluminum industry costs less electricity. Specific "shocks", such as rapid increases in energy prices due to political events, and the 1981-82 recession have caused temporary divergence between these various measures of price and cost escalation. Nevertheless, over the period as a whole they have moved together for the most part, with the deflator for GNP being least volatile. While the other measures have been relatively more volatile than the GNP deflator, they have tended to move together also. Overall, the index of prices of intermediate materials less food and energy has more closely tracked the aluminum industry's costs than has the GNP deflator.

Table 6 and Figure 5 show projected values for the IPD-GNP, the wholesale price index, the index for intermediate materials excluding energy and food, and BPA's weighted average index. Generally, all the variables are moving relatively close together during the period. The indices of wholesale prices and prices of intermediate materials show slower growth than the GNP deflator, as does the BPA weighted index. BPA's index, however, moves closer to the GNP deflator during the 1987-89 period, then diverges again after 1992.

The data presented in Tables 5 and 6 and Figures 4 and 5 are provided for illustrative purposes only. They were not used in any of the analyses prepared for this study.

2. Historical Aluminum Price Adjustment

In addition to the inflation adjustment, in the last five years of the Variable rate (1991 through 1996) the pivot points will be adjusted to reflect the aluminum prices that occurred during the previous five years of the rate.

As noted previously, the aluminum prices associated with the upper and lower pivot points (61 cents per pound and 72 cents per pound, respectively) are based on the long-run and short-run variable costs at the region's highest cost smelter. The plateau defined by these pivot points also encompasses the forecasted average price of aluminum over the rate period, for the two price forecasts obtained from outside consultants: RSI forecasts aluminum prices averaging 65.4 cents per pound and Chase forecasts an average price of 68.7 cents per pound. If actual aluminum prices turn out as projected, the Variable rate will recover the plateau rate over the ten year period. If aluminum costs and prices remain within the relationship modeled in the design of the rate, the inflation adjustments will result in pivot points appropriate to the costs of the smelters. Nevertheless, future events may prove that the relationships originally assumed in the design of the Variable rate no longer exist. The historical aluminum price adjustment may be viewed as a "truing up" mechanism if events do not occur as expected.

Specifically, in each year of the rate period beginning with the sixth year, and concurrent with the inflation adjustment, the aluminum prices defining the upper and lower pivot points will be adjusted based on the average aluminum price over the preceding 5 years. Each year the average of the previous 5 years' aluminum prices, expressed in the dollars of the last year of the 5-year period, will be calculated. If the 5-year average price is more than the lower pivot aluminum price, previously adjusted for inflation, then the upper pivot aluminum price will be adjusted so that it is the same amount above the 5-year average price as the amount the lower pivot aluminum price is below the average price. The result would be either a narrowing or widening of the range of aluminum prices between the upper and lower pivot point, depending on whether the 5-year average price is above or below the midpoint of the previous range.

If on the other hand, the 5-year average price is less than the lower pivot aluminum price adjusted for inflation, the variable rate structure "collapses" to a single pivot point equal to the 5-year average price, or 55 cents per pound, adjusted for inflation, whichever is greater. The 55 cents per pound minimum was chosen to be equal to the short-run variable cost of the highest cost smelter, assuming further wage concessions and other cost reductions due to plant modernization.

H. Rate Case Adjustments

The plateau rate level will be adjusted concurrently with adjustments to BPA's other wholesale power rates, following the procedures of section 7(i) of the Pacific Northwest Power Act, and subject to approval by FERC. The overall rate level will be determined following the rate directives contained in section 7 of the Pacific Northwest Power Act and other applicable legislation. The demand and energy charges and first quartile service discount will be adjusted by a uniform percentage based on the percentage change in the overall rate level. The lower and upper rate limits will be adjusted based on the change in the mills per kilowatthour of the plateau energy charge less the discount for the first quartile service.

If on an actual basis, BPA over- or under-recovers its revenue requirement due to a variance between actual and forecasted DSI revenues, those over/under recoveries will be handled according to BPA's cash management practices and will affect future rates in the same way as over/under recoveries for other reasons.

There is a possibility that in developing the rates during a given general rate case, the forecast of revenues from the Variable rate may differ from the forecast of revenues from the IP Standard rate. This difference will be included with the 7(c)(2) delta and allocated to customers' rates. (The 7(c)(2) delta is the difference between the costs allocated to the DSIs and the revenues forecasted at the IP rate determined according to the 7(c)(2) rate directives.) Therefore, in every rate case BPA will continue to develop its rates to recover its overall revenue requirement.

I. Take-or-Pay Obligations

The proposed rate does not contain any additional take-or-pay provisions beyond the curtailment charge provided in section 9(c) of the DSIs' Power Sales Contract. The Power Sales Contract states that when an industrial purchaser curtails power purchases below 75 percent of its Operating Demand, the purchaser shall pay BPA an additional charge based on a percentage of the demand charge currently in effect.

V. Analysis of Impacts

A. Long-Run Industry Decisionmaking

1. General Methodology

Smelter-specific net cash flows were used to evaluate whether each smelter would prefer the Standard or the Variable rate and, given either rate, whether the smelter would continue operation or close. Discounted cash flows were calculated for two discount rates, to test the sensitivity of the results to an additional risk premium facing aluminum companies in evaluating whether to take the variable rate when offered and whether to keep all existing smelters open or to close some that do not appear viable. The analysis used a relatively risk-free discount rate of 7.5 percent and a risk-adjusted discount rate of 15 percent. All else equal, the following decision rules are used:

a. Given the choice of rate structures by a given smelter (i.e., IP Standard or Variable rate), a larger positive (or smaller negative) discounted cash flow would be preferred; and

b. For a given plant, discount rate, and aluminum price scenario, a negative discounted cash flow implies a plant is not economically viable over the period being examined, while a positive discounted cash flow implies that it is viable.

2. Results

Tables 8-10 summarize the discounted cash flows for each smelter with three alternative aluminum price projections and two discount rates. The discounted cash flows are presented for two periods, 1986-96 and 1991-96. The data for the first period are relevant to the smelters' initial decision whether to select the Variable rate. With the Random Low price scenario, the Variable rate appears preferable to the IP Standard rate for every plant with either discount rate. All plants have negative discounted cash flows with either rate and either discount rate.

With the RSI price scenario, the Variable rate appears preferable to the IP Standard rate for every plant except one (Reynolds-Troutdale) with either discount rate. All plants except Intalco have negative discounted cash flows with the IP Standard rate and either discount rate; and with the Variable rate and the risk-adjusted discount rate (i.e., 15 percent); however, Alcoa-Wenatchee shows a slight positive discounted cash flow with the Variable rate and risk-free discount rate (i.e., 7.5 percent)

With the Chase price scenario, the Variable rate appears preferable or essentially equal in benefit for the majority of plants with either discount rate. The Wenatchee and Troutdale smelters would appear to prefer the Standard rate with either discount rate, and the Intalco and

Commonwealth smelters would appear to prefer the Standard rate with the 7.5 percent discount rate. Intalco, Alcoa-Wenatchee, and Commonwealth show positive discounted cash flows with either rate structure and either discount rate, and Kaiser-Tacoma and Reynolds-Longview also show positive discounted cash flows with the Variable rate and the 7.5 percent discount rate.

3. Conclusions

The discounted cash flow analysis leads to several general conclusions:

a. With most aluminum price outlooks, the Variable rate initially appears preferable to the IP Standard rate for all or most of the regional smelters.

b. Most of the regional smelters have negative discounted cash flows under most combinations of projected aluminum prices and discount rates. Thus, unless significant improvements occur in aluminum markets, even with the variable rate, the economic viability of many of the regional smelters is in doubt.

c. The smelters that previously were identified as being "at risk" consistently show the greatest negative discounted cash flows: Alcoa-Vancouver, Columbia Falls, Kaiser-Mead, The Dalles, and Reynolds-Troutdale.

A number of significant caveats should be noted regarding these results and conclusions:

a. The outlays used in calculating the net cash flows do not include a return on capital. Over the long run, such a return is necessary to prevent the shift of capital into other industries or regions.

b. It is difficult to determine what discount rates the aluminum industry might actually use for decisionmaking, given the current conditions in aluminum markets and the precarious financial condition of some of the companies. Companies in relatively poor financial condition or those with the highest cost plants likely would use a higher discount rate than companies in good financial condition and/or with low-cost plants.

c. It is difficult to determine which (if any) of the alternative aluminum price scenarios evaluated by BPA the companies actually would use for decisions as significant as plant closures or selection of an alternative rate structure for 10 years.

d. The discounted cash flow analysis does not reflect the impacts of various companies' specific tax situations, corporate strategies, and other similar factors on long-range decisionmaking. These factors could either reinforce or offset the factors modeled in this analysis.

B. Aluminum Load Analysis

1. General Methodology

The ASM is the primary tool used to project aluminum loads for different Variable rate and aluminum price scenarios. After the ASM has been run, however, further exogenous adjustments are made in the load analysis. First, ASM output (monthly loads for each smelter) is adjusted to correct for any minor irregularities or inconsistencies in the results. Specifically, projected loads sometimes exhibit month-to-month cyclicality that seem unreasonable. This is usually the result of seasonal factors in the BPA power rates that the smelters would be able to foresee. In adjusting for these apparent anomalies, a simple rule is observed: no potline is allowed to increase or decrease to a given level and then reverse if it has been at that level for less than six months. This adjustment is necessary to reflect BPA's judgment that potlines are not brought on-line (or taken off-line) for less than 6-month periods.

After the ASM loads have been smoothed in this manner, they are fed into an auxiliary program called Plot Value. The Plot Value program plots aluminum loads and calculates aluminum revenues. In addition, it plots the aluminum price forecast along with the electricity price calculated under the Variable rate structure, and thus serves as a diagnostic check on the accuracy of results with respect to input values. The Plot Value program and sample output are provided in the Documentation to the Variable Rate Study. VI-86-E-BPA-01A.

2. Results and Conclusions

A large number of runs of the ASM were made in order to test the sensitivity of loads to varying aluminum prices and assumed plant closures with and without the Variable rate. In all, both the IP Standard and Variable rate were analyzed using four different aluminum price forecasts (Chase, Medium Cycle, RSI, and Random Low) and eight different plant closure scenarios. Almost without exception, loads were higher with the proposed Variable rate than with the IP Standard rate. From this larger set of load scenarios, a subset of seven was selected for further analysis of the impact on BPA revenues. This particular subset was chosen to capture a wide range of possible revenue impacts. The seven scenarios which were evaluated for revenue impacts are:

a. Chase aluminum price forecast; IP Standard rate; no plant closures

b. Chase aluminum price forecast; proposed Variable rate; no plant closures

c. RSI aluminum price forecast; IP Standard rate; closures: The Dalles (1/85), Columbia Falls (4/86), Mead (9/86)

d. RSI aluminum price forecast; proposed Variable rate; closures: The Dalles (1/85)

e. Random Low price forecast; IP Standard rate; closures: high cost plants (1/85 - 9/88)

f. Random Low price forecast; proposed Variable rate; closures: high cost plants (1/85 - 7/91)

g. RSI aluminum price forecast; low cost plants remain on IP Standard rate, high cost plants select proposed Variable rate; closures: high cost plants (7/91)

The rationale for assuming these particular configurations of price, rate structure, and plant closings is as follows.

With the Chase price forecast, no plant closures were assumed to occur with either the IP Standard or Variable rate. This price forecast, which increases more rapidly and has the highest average price of those tested, was assumed to be high enough to prevent any capacity closures as well as to ensure the reopening of the closed smelter at The Dalles.

With the RSI price forecast, The Dalles remains closed with the Variable rate because the price is assumed not sufficient to ensure its restart under new ownership. This assumption is not based on BPA analysis of the economics of a specific set of costs and alumina tolling contracts faced by the new owners, but rather on the facts that the plant is currently closed and that no specific information has been provided to BPA to demonstrate that it definitely will reopen under specific conditions. With the RSI price and the IP Standard rate, two more smelters also are assumed to close: Columbia Falls and Kaiser, Mead. Columbia Falls is assumed to close because it has been disclosed publicly that the Montana State Board of Investments' financing assistance for the restart of this smelter is contingent upon receiving a Variable power rate. Kaiser's smelter at Mead is assumed to close because it is considered one of the smelters most "at risk" in the region based on the judgment of independent expert industry analysts as well as the Long-Term Decisionmaking Analysis described in section V.B. In addition, Kaiser has been experiencing severe financial problems resulting from poor aluminum markets over the last few years. As with The Dalles, this assumption is not based on specific analysis which demonstrates that the Kaiser plant definitely will close, but rather is intended to reflect BPA's judgement that additional plant closures in the region are likely unless the Variable rate and/or other factors enhance the viability of the smelters in the near future. Alternative assumptions with similar likelihood and impacts would be: (1) closure of the Troutdale smelter which BPA data show as the highest cost smelter in the region; or (b) closure of the Vancouver smelter, in light of Alcoa's recent announcement of permanent closure of 25 percent of its domestic smelting capacity during 1986.

With the Random Low price forecast and IP Standard rate, the five highest cost plants are uneconomic (Section V.A) and are assumed to close on the following dates: The Dalles, January 1985; Columbia Falls, April 1986; Mead, September 1986; Troutdale, September 1987 and; Vancouver, September 1988. The Dalles is already closed and assumed not to reopen. Columbia Falls is assumed to close according to their current operating demand schedule, and the remainder of the closures occur with higher seasonal (fall) power rates over a three year period. In addition, in this scenario it is assumed that Commonwealth would close its Goldendale smelter because it is Comalco's highest cost plant.

With the Random Low prices and the proposed Variable rate, plant closures are assumed to be delayed until the plateau adjustment (which occurs in 1991 because of prevailing low prices) causes power rates to escalate rapidly. Besides The Dalles and Columbia Falls, which are assumed to close in January 1985 and April 1986, respectively, the other four smelters are assumed to close in July 1991.

Results of these load scenarios are presented in Table 7. The results indicate that the proposed Variable rate will induce significantly higher loads than the IP Standard rate over both the 10-year and 5-year periods. For example, with the Chase price scenario, 10-year loads average 2,734 MW with the IP Standard rate and 2,897 MW with the proposed Variable rate. In the first year the of Chase Scenario, loads with the proposed Variable rate are slightly lower than with the IP Standard rate, the only example of this situation in all the analyses performed. The plant closure scenarios with the RSI and Random Low price forecasts result in much lower load levels with both the IP Standard or proposed Variable rate although loads with the Variable rate would still be higher than those with the IP Standard rate. For example, with the RSI price forecast, 10-year loads average 2,623 MW if the proposed Variable rate is in place and The Dalles remains closed. Whereas, with the IP Standard rate, if three smelters close, 10-year loads will average 1,804 MW. If the RSI price prevails and only the high cost smelters take the Variable rate, but then close in 1991 when the historical aluminum price adjustment is made, the 10-year load average drops to 1,975 MW from the 5-year average of 2,567 MW. With the Random Low prices, six plants are assumed to close, during 1985-88 with the IP Standard rate, and during 1985-91 with the proposed Variable rate. Ten-year loads average 642 MW with the IP Standard rate and 1,010 MW with the proposed Variable rate under these assumptions.

C. Revenue and Sensitivity Analysis

Revenue analyses were conducted to assess the impact of the proposed Variable rate for the aluminum smelters. The revenue analyses consist of three separate components. The first component is the analysis of total BPA revenues from the time of implementation of the Variable rate through the end of FY 1987, with and without the Variable rate. The second component is the analysis of total DSI revenue and total BPA revenues with and without the Variable rate for the 10-year period from July 1986 through June

1996. The third component is the analysis that compares the 10-year average electricity price paid by the DSIs with and without the Variable rate. These comparisons were made to assess whether the Variable rate meets the goals identified in section I.F. of this study.

BPA performed sensitivity analyses to determine the revenue and rate effects of variations in the price of aluminum. The objective of the sensitivity analyses was to ascertain whether or not BPA's financial integrity might be jeopardized by implementing the Variable rate if low aluminum prices were to occur. Additionally, the sensitivity analyses delineate the widest probable variation in DSI sales, and the widest probable variation in total BPA revenues resulting from variation in DSI sales, over the 10-year rate period.

1. General Methodology

The general methodology for performing revenue analyses starts with the choice of a base case for evaluating the Variable rate. For this study, BPA chose the RSI aluminum price forecast as the base case for forecasting aluminum smelter loads. Aluminum price forecasts are discussed in detail in section III.A. above. The base case analysis compares revenues and electricity prices that are projected with the IP Standard rate to the revenues and electricity prices projected with the Variable rate, given the RSI projection of aluminum prices.

By using aluminum price forecasts other than the RSI forecast, BPA produced alternate DSI load forecasts and electricity price forecasts. The sensitivity analyses use the alternate aluminum price forecasts and resulting load forecasts to calculate total BPA revenues, average DSI electricity prices, and average DSI sales over the 10-year rate period. The alternate price and load forecasts are discussed in sections III.A. and V.B.

BPA forecasted revenues and average prices paid by the DSIs over the 10-year rate period. For these analyses, all BPA's rates were kept constant in real terms, other than changes in the proposed Variable rate resulting from aluminum price changes. This is a simplifying assumption that is supported by BPA's current rate forecasts, which show rates staying relatively constant in real terms over this period. However, forecasted changes in resource operations, contractual obligations, loads, and power sales were incorporated into the analyses. These changes reflect the dynamic environment of power marketing over the 10 year term of the rate.

2. Assumptions

BPA used the Nonfirm Revenue Analysis Program and the Revenue Estimating program to perform the revenue analyses, which then were used to analyze opportunity costs. The NFRAP and REVEST are described in section II.B. and C. above. The following are brief descriptions of the assumptions used in those models.

The analyses used BPA's 1985 wholesale power and transmission rates throughout the 10 year period. The average of 40 historical water conditions was used for estimating sales and revenues that vary in response to water conditions in the Pacific Northwest. Firm surpluses of generating resources for the Federal system were obtained from other BPA planning and forecasting models used in the development of BPA's resource strategy. These models used BPA's July 1985 long term load forecast. DSI loads in that forecast were not the same as those estimated in any of the scenarios for the Variable rate. Therefore, firm surpluses from the planning and forecasting models were adjusted for the differences in firm DSI loads from those appearing in the July 1985 long-term load forecast.

The planning and forecasting models used for BPA's resource strategy assumed that Washington Nuclear Projects (WNP) 1 and 3 would not come on line within the ten-year rate period. In the Variable rate revenue analyses, WNP-1 was assumed to come on line in September 1993 and WNP-3 in March 1992. This assumption was chosen in order to maintain consistency with BPA models used in analyzing other DSI options, in particular, the IP-PF link. The generation from these projects was assumed to be all Federal generation, therefore the assumed output from these two projects was added to Federal resources and thus affected projected firm surpluses and deficits.

New Resource (NR) sales included Puget Sound Power and Light (PSP&L) commitments to purchase through Operating Year (OY) 1992, and one-half of any firm resource deficits of Pacific Northwest investor-owned utilities.

BPA's planning and forecasting models determine that the Federal system will have surplus firm resources for a given number of operating years. Consistent with BPA's 1985 rate proceeding, the analyses assume that 75 percent of surplus firm Federal resources is sold at the Surplus Firm Power Contract (SP) rate. The sales at the SP rate are made in equal amounts each month, other than May, at 100 percent load factor. Billed amounts are reduced for transmission losses. Surplus firm power sales are all made to purchasers in the Pacific Southwest, and a portion of the PNW/PSW Intertie market modeled in the NFRAP is reserved for those transactions. The remaining 25 percent of surplus firm Federal resources is sold at nonfirm energy rates.

The market for PSW purchases of PNW nonfirm energy and surplus firm power used in the NFRAP is based on BPA's estimates of PSW marginal cost for resources displaceable with PNW economy energy. The marginal costs, which are inputs to BPA's System Analysis Model, decrease as increasing amounts of energy serve the PSW economy energy market. For the NFRAP, BPA calculates the amount of the market that has marginal costs high enough that BPA's NF Standard rate can serve it (up to the capability of the Intertie). This market is adjusted for firm contracts that use the Intertie. A second PSW market that could be served at the NF High Cost Displacement rate is also calculated. BPA modeled the sizes of PSW NF-Standard and High Cost Displacement rate markets over the ten-year rate period, consistent with projected Intertie upgrades. This study incorporates Intertie upgrades to

5,156 MW in July 1986; 6,186 MW in January 1989; and 7,786 MW in May 1991. Intertie capabilities are decreased for maintenance and loopflow before the PSW markets are calculated. This decrease in capability potentially decreases one or both Intertie markets, depending on PSW marginal cost conditions in that month.

In the sensitivity analyses, BPA investigated the impact of different aluminum price forecasts on sales, revenues, and electricity prices. Again, both IP Standard rate and Variable rate scenarios were run with each aluminum price forecast. The Random Low and Chase aluminum price forecasts were used. These forecasts are discussed in section III.A. above.

In addition to assuming that either all smelters adopt the Variable rate or all smelters remain on the IP Standard rate in each aluminum price scenario, another analysis considered the case in which, at RSI forecast prices, low-cost smelters would elect to remain on the IP Standard rate and high-cost smelters would elect service at the Variable rate.

3. Calculations

All load, firm resource, and contract information for the 10 years of the rate period was obtained from BPA's planning and forecasting models, which used BPA's July 1985 long-term load forecasts.

The IP Standard rate and Variable rate load and electricity price scenarios obtained from the RSI aluminum price forecast were used for testing total revenues and average rates. Revenues were calculated using demand and energy charges proposed in the VI-86 rate schedule. The level of the energy charge in any given month was based on the monthly aluminum price in the ASM.

BPA surplus firm resources were adjusted for changes in the firm portion of the DSI loads. This was done by obtaining operating year averages of firm surplus and firm DSI loads from BPA's planning and forecasting models, and then calculating the operating year averages of firm DSI loads for the IP Standard and Variable rate scenarios. The differences between the July 1985 long-term forecast operating year averages and the IP Standard or Variable rate scenarios were added to operating year firm surpluses.

The firm surpluses were modified further for assumed operation of WNP-1 and -3. Operating year average outputs for the two projects were added to the previously calculated BPA firm surpluses as modified by the revised DSI firm load estimates. BPA firm surpluses were decreased for assumed purchases from BPA at the NR rate. To estimate the purchases, IOU deficits were obtained from the BPA planning and forecasting models. In years when IOU firm resources were deficit, one half of the annual deficit was added to NR sales. NR sales were assumed to be equal each month of the operating year, at 100 percent load factor. Generation level sales were reduced to billing levels by removing transmission losses.

The BPA firm surplus resources remaining after these adjustments then were averaged over operating years, and three-fourths of the annual averages were assumed to be sold at the SP rate. The remaining one-fourth was added to resources available for sale at nonfirm energy rates, in the NFRAP. Surplus firm resources sold at the SP rate were assumed to be equal over 11 months (excluding May) of the operating year. Sales were reduced by monthly transmission loss factors to determine billing levels. These SP sales, assumed to be sold to the PSW, were used to reduce the PSW market available for PNW nonfirm energy in the NFRAP by reserving Intertie capability for the firm sales. In any year that IOU firm resources were surplus, Intertie capability was reserved for that surplus (up to 500 average megawatts) and a portion of the PSW market also was assumed to be served by that resource. Thus the market for PNW nonfirm energy was decreased further.

The NFRAP and REVEST were used to calculate 10 years of monthly revenues. DSI load forecasts were based on RSI aluminum price forecasts at both IP Standard and Variable rates. Finally, total revenues in the IP Standard rate scenario were increased to reflect the additional revenues that most likely would have been received due to implementing the Incentive rate. The expected increase in BPA revenues that resulted from BPA's implementation of Incentive rates in OY 1985 and OY 1986 averaged approximately $10 million per year. Therefore, revenues were increased by $10 million for the one operating year that average aluminum prices were forecast to fall below 56.5 cents per pound (the average forecasted aluminum price for BPA's three Incentive rates). These revised revenues, based on the RSI aluminum price forecast and IP Standard rate, then were used as the base case for comparison with the Variable rate scenario. (Average annual aluminum price forecasts are presented in section V.A. of the Documentation, VI-86-E-BPA-01A.)

4. Results and Conclusions

Table 11 compares annual and 10-year total DSI and BPA revenues for the RSI price scenario using both the IP Standard and the Variable rates. For the 10 years, total DSI revenues with the RSI/IP Standard rate are $3,982 million as compared to $5,472 million with the RSI/Variable rate. BPA revenues for the 10 years total $31,459 million with the RSI/IP Standard rate, including additional Incentive rate revenues, and $31,764 million with the RSI/Variable rate. Thus, total BPA revenues for the 10 years are $305 million greater with the Variable rate than with the IP Standard rate including Incentive rate revenues.

Tables 12 and 13 compare the average DSI rates and sales over the 10-year rate period with the RSI price forecast using both the IP Standard and the Variable rates. As shown, the 10-year average DSI price for electricity with the Variable rate is nearly equal to that with the IP Standard rate; 22.69 and 22.85 mills per kilowatthour, respectively. However, as shown in Table 13, average DSI sales over the 10 years are considerably greater with the Variable rate, averaging 2,753 average megawatts, than with the IP Standard rate, averaging 1,989 average megawatts.

Table 14 shows the results of revenue analyses for all seven load scenarios. Columns A and B summarize the base case RSI aluminum forecast with both the IP Standard and Variable rate, discussed above. Columns C through G reflect the sensitivity analyses.

The RSI mixed aluminum case, where some aluminum companies elect the Variable rate and others elect the IP Standard rate, can be compared to the RSI/IP Standard rate case. This comparison shows that the mixed aluminum case compares favorably with the IP Standard rate case in terms of total BPA revenues (adjusted for Incentive rate revenues) for the 10 years, and sales to the DSIs. Total BPA revenues are approximately $28 million greater, while average DSI sales are greater, by over 150 average megawatts. The average electricity price (DSI rate) under the mixed aluminum case is only slightly lower than the electricity price under the IP Standard rate case, 22.68 mills per kilowatthour compared to 22.85 mills per kilowatthour.

With the Random Low aluminum price forecast, total BPA revenues for the 10-year period are slightly lower with the Variable rate than with the IP Standard rate. This occurs in part because the IP Standard rate case is adjusted to reflect additional Incentive rate revenues of $10 million for each year that aluminum prices are forecast to average below 56.5 cents per pound (the forecast average aluminum price for BPA's first three Industrial Incentive rates.) This adjustment increases IP Standard rate revenues by $60 million, and causes total BPA revenues with IP Standard rate to exceed Variable rate revenues by approximately $48 million for the 10 year period. Average sales to the DSIs with the Variable rate are 359 average megawatts higher than sales with the IP Standard rate. The average electricity price, however, is nearly 2 mills per kilowatthour lower (20.91 mills per kilowatthour versus 22.84 mills per kilowatthour) with the Variable rate than with the IP Standard rate.

Finally, under the Chase aluminum price forecast, the Variable rate results in about $85 million more revenues than with the IP Standard rate. Sales to the DSIs also are greater with the Variable rate, by 150 average megawatts for the 10 year period, and the average electricity price is slightly higher with the Variable rate, 22.95 versus 22.89 mills per kilowatthour.

These sensitivity analyses show that if aluminum prices are substantially different from those forecast for the the base case, BPA's customers are unlikely to suffer substantial harm by implementation of the Variable rate. It is apparent that total BPA revenues will not be affected to a high degree, and at most, the average electricity price paid by the DSIs will change less than two mills per kilowatthour. Aside from revenue and rate impacts precipitated by the Variable rate, aluminum company loads surely will be increased.

In addition, this analysis demonstrates that the proposed VI-86 rate is designed to achieve the objectives outlined in section I.F. Smelter shutdowns are discouraged in the near term and smelter load levels are

increased. Also BPA revenues are increased and average revenues are virtually equal to the IP Standard rate.

D. BPA's Cash Flow and Financial Obligations

The Pacific Northwest Power Act requires BPA to establish rates at levels "which recover, in accordance with sound business principles, the costs associated with the acquisition, conservation, and transmission of electric power, including the amortization of the Federal investment in the Federal Columbia River Power System."

Rates currently in effect were designed for a 27-month rate period beginning on July 1, 1985 and ending on September 30, 1987. The 1985 rate filing set rates at levels designed to assure that BPA fully meets its repayment obligations. Implementation of the Variable rate proposal does not change BPA's repayment obligations. For rate periods beyond FY 1987, rates will continue to be designed to recover all costs. If the forecast of DSI Variable rate revenues over future cost evaluation period is less than revenues computed under the 7(c)(2) rate, then the difference will be allocated to other customer classes. On a prospective basis, the DSI Variable rate should have no adverse consequences on BPA's cash flows required to recover all costs.

Concern for BPA's ability to meet its repayment obligations is, however, directly relevant to the current 27-month rate period, since the Variable rate would be effective prior to the end of this period. Current rates were designed for a 27-month rate period to recover costs through September 30, 1987. The costs to be recovered included scheduled Treasury amortization payments of $190.8 million in FY 1986 and $148.6 million in FY 1987. Thus, rates were designed to provide sufficient funds from operations to recover all costs including repayment of $339.4 million in scheduled FY 1986 and FY 1987 Treasury amortization payments.

Implementation of the Variable rate does not significantly affect the overall level of total revenues during the FY 1986-87 period (see Tables 17-24). Total revenues for the FY 1986-87 period under the Variable rate, $5,685.6 million, are only $7.6 million less than those expected under the IP Standard rate, $5,693.2. BPA still expects to meet its Treasury payment obligations in FY 1986 and FY 1987 with either the IP Standard or Variable rates. Tables 18-19 provide the documentation for such a demonstration.

BPA's financial performance in FY 1985 provided funds from operations beyond those necessary to make the scheduled FY 1985 Treasury amortization payment (see Table 15). The total revenues during the FY 1986-87 period under the Variable rate - RSI forecast are approximately $106.4 million less than those forecast in the final 1985 rate case. This reduction in forecasted revenues is less than the $144.2 million in funds from operations net of amortization generated in FY 1985 (see Table 16). Thus, under the base case Variable rate forecast, BPA expects to be able to amortize $339.4 million of the Federal investment in the FCRPS as scheduled over the remaining current rate period, in addition to recovering all other costs.

E. Impact on BPA's Other Customers

Based on the results and conclusions of the analyses prepared in support of the Variable rate, BPA concludes that BPA's other customers will not be harmed by BPA's offer of the proposed Variable rate to its aluminum DSIs customers. This conclusion holds across the various aluminum price forecasts. (1) With the RSI aluminum price forecast, BPA's ability to meet its financial obligations in FY 1987 will not be impaired if the Variable rate is implemented July 1, 1986. Over ten years, BPA's total revenues as well as revenues from the DSIs are forecasted to be substantially higher with the Variable rate. (2) With the Chase aluminum price forecast, BPA's total revenues are forecasted to be substantially higher with the Variable rate than with the Standard/Incentive rate combination. (3) With the Random Low aluminum price forecast, which can be considered the "worst case" of those considered, the Variable rate forecasts of BPA's total revenues are not significantly different than with the Standard/Incentive rate. Given relatively small likelihood that the Random low price forecast actually would occur, BPA's other customers can expect to benefit from the adoption of the proposed Variable rate.

F. Opportunity Cost and Seasonal Differentiation

The objective for performing analyses of seasonal differentiation is to determine if seasonal differentiation of the proposed Variable rate is justified by opportunity costs.

1. General Methodology

BPA analyzed the potential for seasonal differentiation of the lower rate limit by analyzing the opportunity cost of changing sales to the aluminum companies. Opportunity costs were analyzed by comparing sales and revenues with the IP Standard rate to sales and revenues with the Variable rate. The IP Standard rate and Variable rate comparisons used aluminum company load forecasts that were both based on the RSI aluminum price forecast. Opportunity costs were determined by calculating the change in revenues from all other rate classes per unit change in sales to the aluminum companies.

2. Calculations

BPA's analysis of seasonal differentiation was based on the 10-year estimates of total BPA revenues. Monthly data for each of the 10 years was obtained from the REVEST in order to calculate opportunity costs. Both IP Standard rate and Variable rate REVEST runs were used. The difference between Variable rate non-DSI revenues and IP Standard rate non-DSI revenues was divided by the difference between Variable rate DSI sales and IP Standard rate DSI sales. The result is the opportunity cost (in mills per kilowatthour) of changing sales to the DSIs. Because the loads of non-aluminum DSI customers are unchanged, all of the change in total DSI sales would occur because of change in aluminum company sales. See Table 25.

3. Results

The calculated opportunity costs fall into two seasonal levels, March through July and August through February. While the general levels of opportunity costs by month are informative, the monthly values of opportunity costs are not precisely related to the changes that occur in sales to the DSIs in a particular month. There are two reasons for this lack of precision. First, the firm surplus resources and adjustments to firm surpluses are averaged over the operating year rather than being reflected only in the month in which they occurred. Second, sales of firm surplus are assumed to be even over 11 months of the year rather than being made in any single month in which firm surplus became available. When averaged over the 10-year period, however, there is a consistent pattern of seasonal opportunity costs.

As shown in Table 26, on the whole, opportunity costs of increased DSI loads in the August through February period are over twice those in the March through July period. As shown by operating year 1989 (Table 25), monthly opportunity costs for March through July are fairly homogeneous (other than for May) with none being lower than approximately -15 mills per kilowatthour. Likewise, opportunity costs for August through February all fall between approximately -20 and -26 mills per kilowatthour. These analyses indicate that BPA can offer a lower rate limit during the spring months (March through July) than during the fall and winter months (August through February).

APPENDIX H

TABLES AND FIGURES

Figure 1

Variable Rate Concept

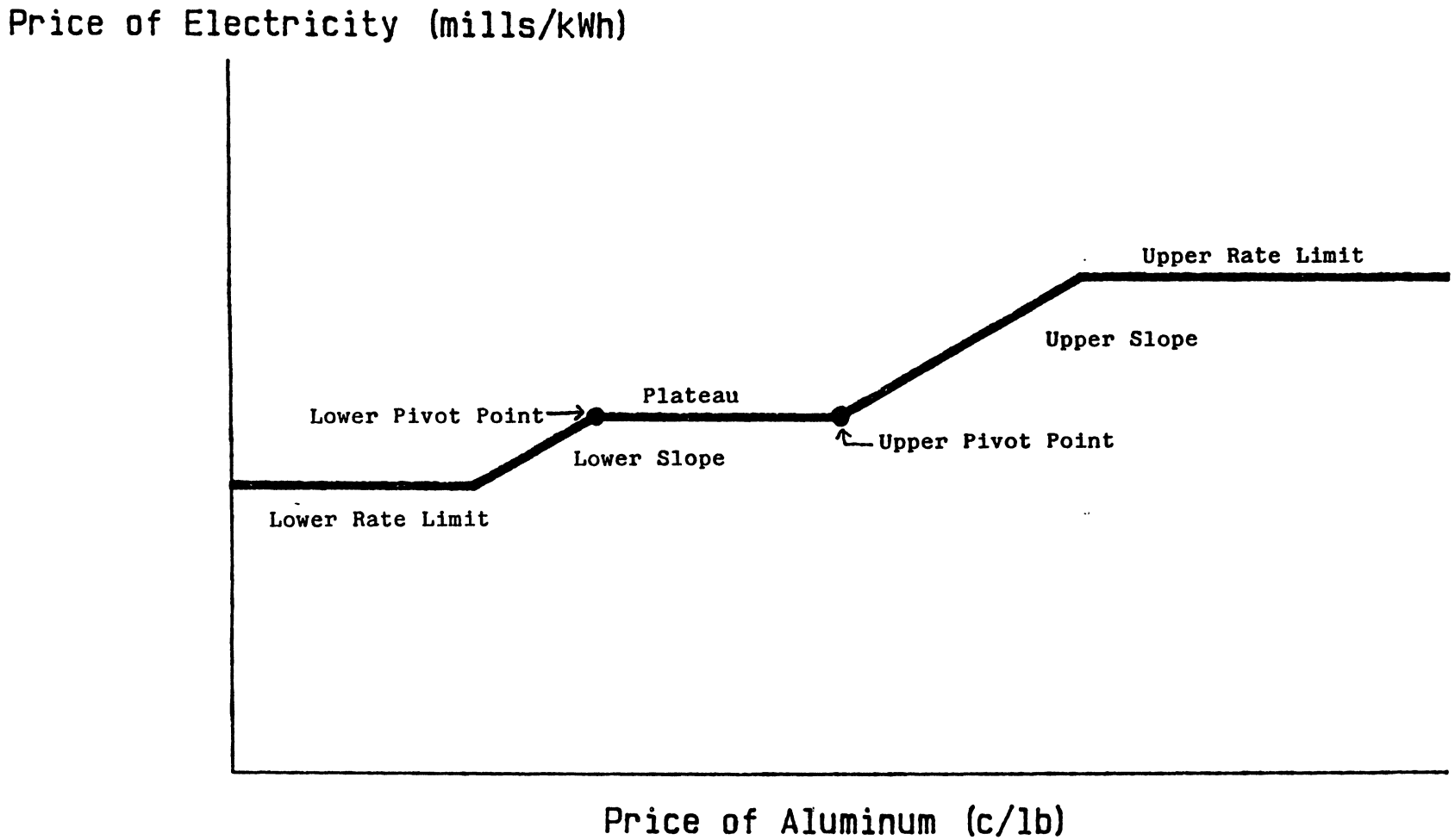
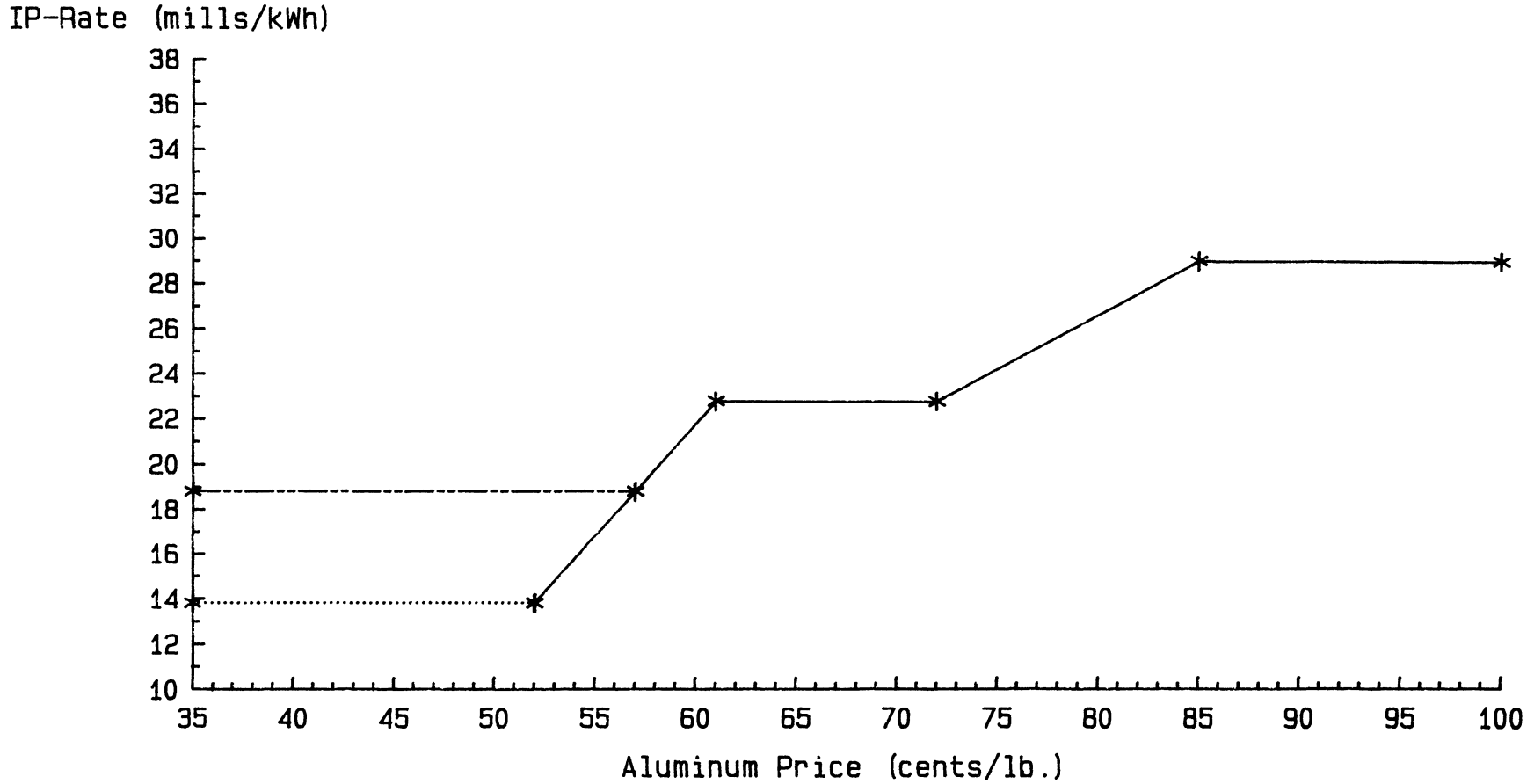


FIGURE 2

DSI Variable Rate

BPA Proposal



LEGEND:
URL: (Upper Rate Limit) power rate 29.1 mills/kWh - aluminum price 85¢/lb.
UPP: (Upper Pivot Point) power rate 22.8 mills/kWh - aluminum price 72¢/lb.
LPP: (Lower Pivot Point) power rate 22.8 mills/kWh - aluminum price 61¢/lb.
LRL: (Lower Rate Limit) Fall: power rate 18.8 mills/kWh - aluminum price 57¢/lb.
Spring: power rate 13.8 mills/kWh - aluminum price 52¢/lb.

TABLE 1

ALUMINUM PRICE FORECASTS
(U.S. Market-¢/lb in 1985 $)

Line No.	(A) Year/Qtr	(B) Chase 1/	(C) RSI 2/	(D) Random Low 3/	(E) Medium Cycle 3/
1.	1986.1	51.87	49.77	48.03	53.97
2.	1986.2	56.73	52.73	49.80	60.17
3.	1986.3	62.60	54.07	51.80	68.17
4.	1986.4	66.27	55.10	52.77	75.97
5.	1987.1	67.27	56.27	51.93	81.43
6.	1987.2	68.07	57.47	52.67	78.93
7.	1987.3	65.90	59.27	51.83	73.30
8.	1987.4	62.23	61.10	50.70	62.70
9.	1988.1	58.60	63.00	49.37	51.63
10.	1988.2	55.00	64.67	50.07	52.47
11.	1988.3	55.80	65.40	45.13	51.63
12.	1988.4	58.80	66.00	46.10	48.83
13.	1989.1	61.90	66.60	44.07	48.57
14.	1989.2	64.90	67.03	50.63	50.90
15.	1989.3	68.03	66.30	53.97	53.77
16.	1989.4	71.17	65.40	60.57	68.17
17.	1990.1	74.27	64.50	63.77	75.97
18.	1990.2	77.43	63.87	64.90	81.43
19.	1990.3	78.47	65.03	64.70	78.97
20.	1990.4	78.37	66.50	62.00	73.30
21.	1991.1	78.27	68.00	59.67	62.70
22.	1991.2	78.20	69.47	52.73	51.63
23.	1991.3	75.83	70.90	48.20	52.47
24.	1991.4	72.30	72.30	45.67	51.63
25.	1992.1	68.77	73.80	46.87	48.83
26.	1992.2	65.27	75.03	47.03	48.57
27.	1992.3	64.30	74.90	50.27	50.90
28.	1992.4	64.60	74.60	53.77	53.77
29.	1993.1	64.93	74.20	62.00	68.17
30.	1993.2	65.33	73.83	62.50	75.97
31.	1993.3	66.00	72.40	66.00	81.43
32.	1993.4	66.70	70.83	65.20	78.97
33.	1994.1	67.40	69.27	61.90	73.30
34.	1994.2	68.10	67.27	54.70	62.70
35.	1994.3	69.30	65.90	48.90	51.63
36.	1994.4	70.73	64.10	46.30	52.47
37.	1995.1	72.20	62.30	46.63	51.63
38.	1995.2	73.63	60.57	44.00	48.83
39.	1995.3	74.43	59.30	44.93	48.57
40.	1995.4	74.93	58.10	50.50	50.90
41.	1996.1	75.37	56.90	56.37	53.77
42.	1996.2	75.83	55.77	62.77	68.17
43.	1996.3	76.33	55.23	64.10	75.97
44.	1996.4	76.77	54.77	65.57	81.43

1/ Chase Econometrics, Midyear 1985 World Aluminum Outlook.
2/ Resource Strategies, Inc., Aluminum Industry Analysis, July 1985, October 1985.
3/ BPA, Division of Power Forecasting, December 1985.

FIGURE 3

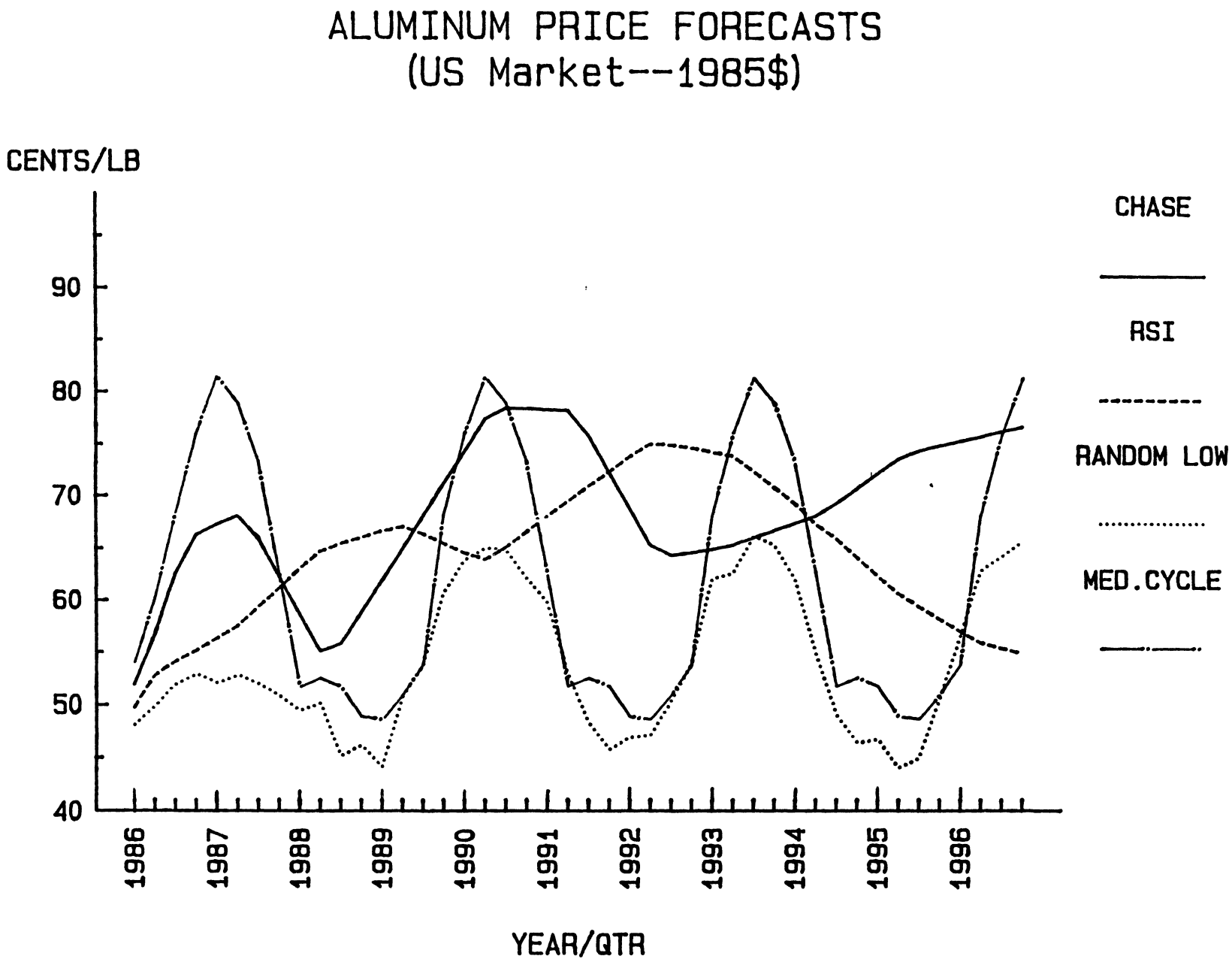

ALUMINUM PRICE FORECASTS
(US Market--1985$)
CENTS/LB
90
80
70
60
50
40
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
YEAR/QTR
CHASE
RSI
RANDOM LOW
MED.CYCLE

TABLE 2

ALUMINUM SMELTER PRODUCTION COSTS
1985 DOLLARS
(dollars/pound)

Line No.	(A) Plant	(B) Labor	(C) Other	(D) Alumina	(E) Electricity 2/	(F) Electricity Efficiency (kWh/lb) 3/	(G) Total Variable Cost 1/
		SHORT-TERM VARIABLE COSTS					
1.	Alcoa Vancouver	.106	.130	.151	.200	(8.77)	.587
2.	Alcoa Wenatchee	.085	.127	.160	.173	(7.60)	.545
3.	ARCO	.100	.135	.157 4/	.179	(7.80)	.571
4.	Intalco	.079	.122	.161	.150	(6.60)	.512
5.	Kaiser Mead	.087	.133	.166	.197	(8.66)	.583
6.	Kaiser Tacoma	.096	.132	.156	.189	(8.30)	.573
7.	Commonwealth	.106	.140	.140	.168	(7.40)	.554
8.	Martin Marrietta The Dalles	.121	.135	.157 4/	.168	(7.40)	.581
9.	Reynolds Longview	.093	.137	.156	.182	(7.98)	.568
10.	Reynolds Troutdale	.130	.135	.159	.198	(8.24)	.612

1/ Assumes the following for variable costs as a percent of total: Labor 85 percent, other 65 percent, Alumina 95 percent, electricity 100 percent.
2/ Assumes 22.8 mills/kWh
3/ Represents weighted averages of two or more potline vintages for some smelters.
4/ At aluminum price of 60¢/lb.

TABLE 3

ALUMINUM SMELTER MODEL PRODUCTION COSTS 1/
ALTERNATIVE ASSUMPTIONS
(cents/pound)

Line No.	(A) Plant	(B) Short-Term Variable Costs 2/	(C) Medium-Term Variable Costs 3/	(D) Reduced Variable Costs 4/	(E) Long-term Variable Costs 5/
1.	Alcoa, Vancouver	58.7	61.6	53.2	68.6
2.	Alcoa, Wenatchee	54.5	57.0	51.5	63.8
3.	ARCO	57.1	61.8	55.2	69.1
4.	Intalco	51.2	53.5	48.3	60.1
5.	Kaiser, Mead	58.3	60.9	54.7	68.1
6.	Kaiser, Tacoma	57.3	60.0	54.8	67.1
7.	Commonwealth	55.4	58.2	51.7	65.7
8.	Martin Marietta	58.1	57.2	50.4	64.5
9.	Reynolds, Longview	56.8	59.5	52.9	66.9
10.	Reynolds, Troutdale	61.2	64.4	55.2	71.7
11.	Average	56.9	59.4	52.8	66.6

1/ Costs assume 100 percent operating rates.
2/ Assumes the following percentages of individual cost components are variable: electricity - 100 percent, alumina - 95 percent, labor - 85 percent, other - 65 percent.
3/ Assumes electricity, labor, and alumina costs are 100 percent variable.
4/ Assumes cost savings from implementing conservation/modernization and labor cost concessions similar to those recently negotiated by Kaiser.
5/ Does not include capital cost.

TABLE 4

CALCULATION OF VARIABLE RATE

Line No.		(A)
1.	Demand Charge 1/ $= \frac{(\$7.13/\text{kW-month} \times 5 \text{ months}) + (\$3.96/\text{kW-month} \times 7 \text{ months})}{12 \text{ months}}$	
2.	$= \$5.28/\text{kW-month}$	
3.	DSI Floor Rate (mills/kWh) 2/	24.7
4.	less VI-86 Demand (mills/kWh) 3/	(7.3)
5.	less value of Reserves Credit (mills/kWh) 4/	(1.9)
6.	plus First Quartile Discount (mills/kWh) 5/	.5
7.	Adjusted Energy Charge (mills/kWh) 6/	16.0

1/ Demand charge equal to IP Standard Rate demand charges gross of value of reserved credit.

2/ DSI Floor determined in 1985 Wholesale Power Rate Proceeding

3/ Demand charge expressed in mills per kilowatthour assuming .985 load factor

$$\frac{(\$5.28/\text{kW-mo})\ (12 \text{ months})}{(.985)(8.760 \text{ hours})}$$

4/ Average Value of Reserves Credit based on demand and energy billing credits determined in 1985 Wholesale Power Rate Proceedings

$$\frac{(\$0.36/\text{kW-mo} \times 12) + (1.4 \text{ mills/kWh} \times (.985)(8.760 \text{ hours})}{(.985)(8.760 \text{ hours})}$$

5/ Source: 1985 Final Section 7(c)(2) Industrial Margin Study

6/ The energy rate of 16.0 mills per kilowatthour will be used in the determination of a purchasers total bill unless a purchaser requests first quartile service with other than Surplus Firm Energy Load Carrying Capability. If a purchaser requests such service, then the first Quartile Service Discount is credited against the 16.0 mills per kilowatthour plateau energy charge.

TABLE 5

HISTORICAL PRICE INDICES: 1974-1984
1984 = 1.0

Line No.	(A) Year	(B) Implicit Price Deflator for GNP	(C) Wholesale Price Index	(D) Price Index Intermediate Materials Without Food and Energy	(E) U.S. Avg., Aluminum Industry Total Costs	(F) U.S. Avg., Aluminum Industries Costs Excluding Electricity
1.	1974	0.515	0.491	0.516	0.424	0.479
2.	1975	0.563	0.550	0.575	0.535	0.637
3.	1976	0.592	0.583	0.609	0.576	0.678
4.	1977	0.627	0.622	0.646	0.629	0.733
5.	1978	0.673	0.666	0.693	0.704	0.789
6.	1979	0.731	0.752	0.771	0.764	0.848
7.	1980	0.799	0.869	0.862	0.917	0.953
8.	1981	0.876	0.954	0.933	1.002	1.049
9.	1982	0.928	0.971	0.955	1.023	1.123
10.	1983	0.964	0.976	0.971	0.973	1.042
11.	1984	1.000	1.000	1.000	1.000	1.000

Source: Columns B, C, and D from Data Resources, Inc., U.S. PRICE Data Bank, Converted to 1984 = 1.0 by BPA staff.
Columns E and F from Paine-Webber, World Aluminum Dynamics (May 1985), converted to index form by BPA staff.

FIGURE 4

HISTORICAL PRICE INDICES: 1974–1984

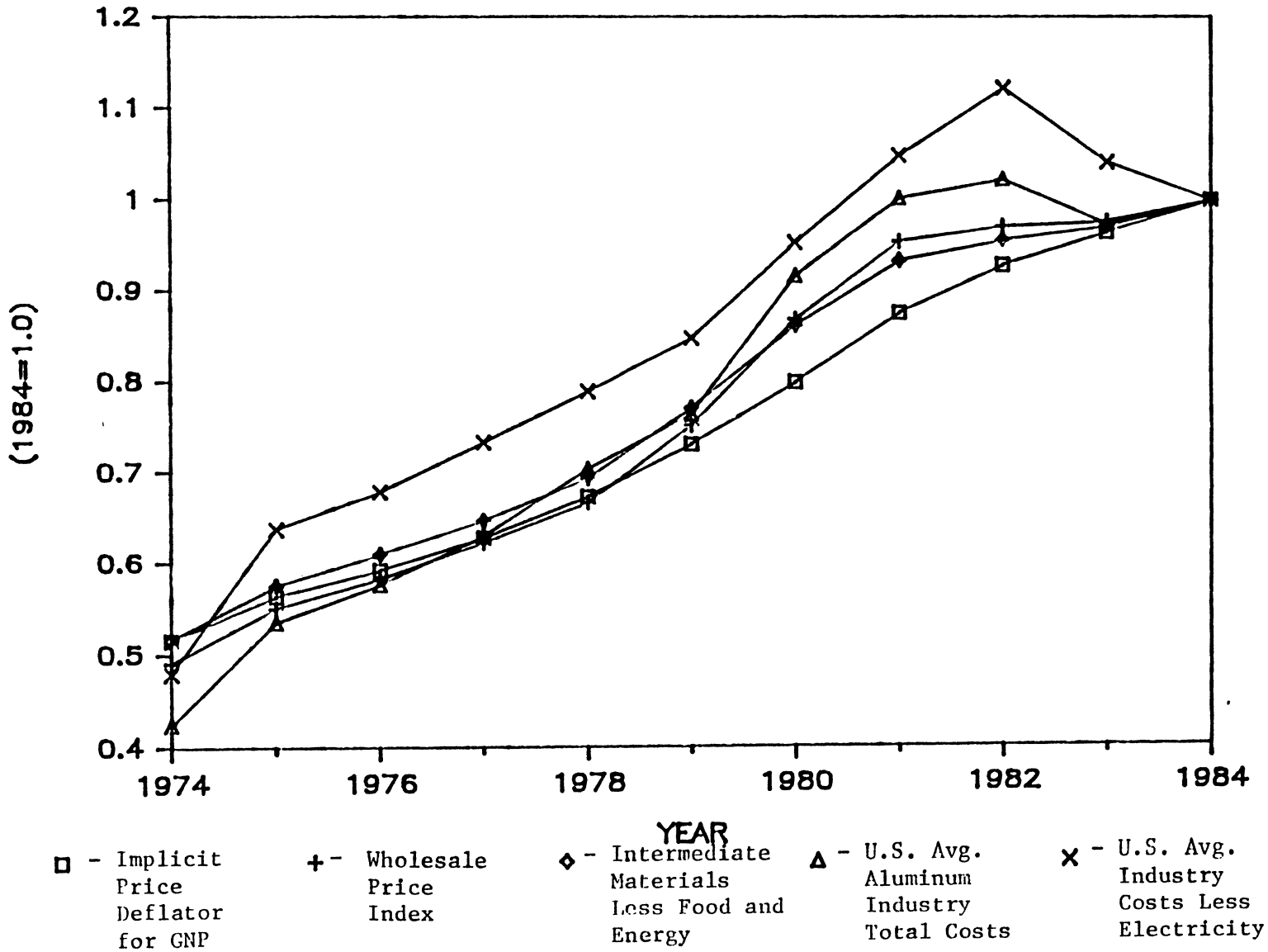


TABLE 6

PRICE INDEX PROJECTIONS: 1985-1996
1985 = 1.0

Line No.	(A) Year	(B) Implicit Price Deflator for GNP 1/	(C) Wholesale Price Index 1/	(D) Index Intermediate Materials Without Food and Energy 2/	(E) BPA Weighted Average Index 3/
1.	1985	1.000	1.000	1.000	1.000
2.	1986	1.033	1.013	1.024	1.020
3.	1987	1.074	1.043	1.057	1.045
4.	1988	1.123	1.078	1.098	1.092
5.	1989	1.172	1.119	1.141	1.162
6.	1990	1.228	1.166	1.192	1.207
7.	1991	1.291	1.222	1.250	1.276
8.	1992	1.361	1.281	1.314	1.347
9.	1993	1.437	1.345	1.379	1.412
10.	1994	1.517	1.414	1.444	1.473
11.	1995	1.603	1.492	1.517	1.539
12.	1996	1.696	1.587	1.607	1.626

1/ Data from Data Resources, Inc., Trendlong 11/85 extended 1995-1996 by BPA staff.

2/ Projection based on a simple regression of the index for intermediate materials less food and the index for fuels and power, over the period 1973 - 1984. The regression has the form:

$$PPI\text{-}FE_t = -.029 + 1.107\ PPI/F_t - .082 PPI/E_t$$

Where: PPI/FE_t = Index, in year t, of prices of intermediate materials less food and energy
PPI/F_t = Index, in year t, of prices of intermediate materials less food
PPI/E_t = Index, in year t, of prices of fuels and power

The two independent variables in the regression also are from the same source as Columns B and C.

3/ Weighted average calculated by BPA staff based on Column D and the projection of electricity costs from BPA's 1985 Long Term Forecast.

FIGURE 5

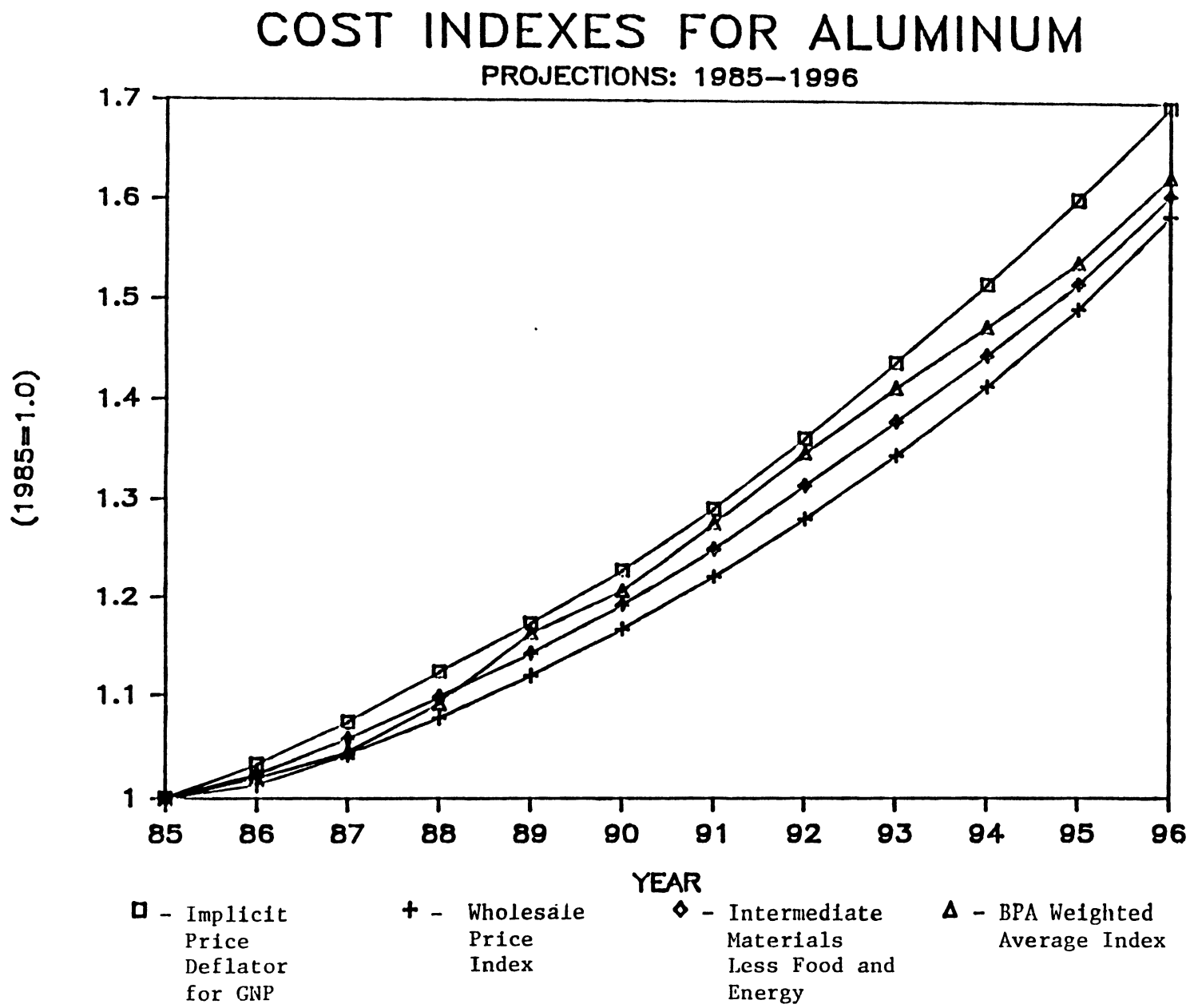

COST INDEXES FOR ALUMINUM
PROJECTIONS: 1985–1996
(1985=1.0)
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1
85
86
87
88
89
90
91
92
93
94
95
96
YEAR
□ - Implicit Price Deflator for GNP
+ - Wholesale Price Index
◇ - Intermediate Materials Less Food and Energy
Δ - BPA Weighted Average Index

TABLE 7

ALUMINUM LOADS
(Average MW)

Line No.	(A) Aluminum Price/Load Scenario	(B) Standard Rate 1 Year	(C) Standard Rate 5 Years	(D) Standard Rate 10 Years	(E) Variable Rate 1 Year	(F) Variable Rate 5 Years	(G) Variable Rate 10 Years
1.	Chase	2,938	2,528	2,734	2,915	2,851	2,897
2.	RSI (Dalles, Col. Falls, Mead Closed)	1,119	1,748	1,804	--	--	--
3.	RSI (Dalles Closed)	--	--	--	1,941	2,503	2,623
4.	RSI (Low Cost-SR Hi Cost-VR)	1,737	2,567	1,975	1,737	2,567	1,975
5.	Random Low (Hi Cost Close-88)	560	678	642	--	--	--
6.	Random Low (Hi Cost Close-91)	--	--	--	1,062	1,394	1,010

Source: ASM, See Documentation for the Variable Rate Study, VI-86-E-BPA-01A.

TABLE 8
DISCOUNTED CASH FLOWS
RANDOM LOW PRICE SCENARIO
(Dollars Per Pound of Capacity)

	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)
		15% Discount Rate				7.5% Discount Rate			
		1986		1991		1986		1991	
Line No.	Plants	Standard Rate	Variable	Standard Rate	Variable	Standard Rate	Variable	Standard Rate	Variable
1.	Vancouver	-.649	-.615	-.462	-.464	-.837	-.800	-.531	-.536
2.	Wenatchee	-.508	-.496	-.355	-.358	-.647	-.637	-.408	-.414
3.	Columbia Falls	-.637	-.605	-.441	-.442	-.816	-.782	-.507	-.511
4.	Intalco	-.404	-.311	-.250	-.226	-.498	-.391	-.281	-.257
5.	Mead	-.626	-.598	-.456	-.450	-.810	-.777	-.524	-.519
6.	Tacoma	-.712	-.631	-.496	-.465	-.911	-.816	-.569	-.538
7.	The Dalles	-.671	-.579	-.477	-.435	-.868	-.753	-.548	-.502
8.	Commonwealth	-.670	-.579	-.464	-.422	-.862	-.746	-.535	-.488
9.	Longview	-.671	-.607	-.456	-.446	-.862	-.784	-.527	-.516
10.	Troutdale	-.774	-.699	-.599	-.510	-1.017	-.908	-.696	-.589

TABLE 9
DISCOUNTED CASH FLOWS
RSI PRICE SCENARIO
(Dollars Per Pound of Capacity)

	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)
		15% Discount Rate				7.5% Discount Rate			
		1986		1991		1986		1991	
Line No.	Plants	Standard Rate	Variable	Standard Rate	Variable	Standard Rate	Variable	Standard Rate	Variable
1.	Vancouver	-.288	-.276	-.009	-.029	-.332	-.320	-.390	-0.560
2.	Wenatchee	-.066	-.020	+.169	+.164	-.036	+.018	+.164	+.167
3.	Columbia Falls	-.390	-.347	-.123	-.129	-.471	-.420	-.161	-.159
4.	Intalco	+.189	+.217	+.344	+.339	+.297	+.328	+.368	+.369
5.	Mead	-.267	-.258	+.007	-.009	-.305	-.294	-.021	-.032
6.	Tacoma	-.221	-.201	+.047	+.033	-.241	-.221	+.024	+.017
7.	The Dalles	-.303	-.284	-.072	-.077	-.362	-.337	-.104	-.101
8.	Commonwealth	-.149	-.118	+.098	+.093	-.148	-.110	+.082	+.085
9.	Longview	-.212	-.183	+.057	+.045	-.227	-.195	+.036	+.030
10.	Troutdale	-.421	-.426	-.125	-.150	-.513	-.519	-.170	-.194

TABLE 10
DISCOUNTED CASH FLOWS
CHASE PRICE SCENARIO
(Dollars Per Pound of Capacity)

	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)
		15% Discount Rate				7.5% Discount Rate			
		1986		1991		1986		1991	
Line No.	Plants	Standard Rate	Variable	Standard Rate	Variable	Standard Rate	Variable	Standard Rate	Variable
1.	Vancouver	-.127	-.119	+.103	+.077	-.097	-.094	+.123	+.093
2.	Wenatchee	+.146	+.145	+.294	+.271	+.260	+.252	+.345	+.318
3.	Columbia Falls	-.240	-.234	-.034	-.058	-.263	-.263	-.033	-.062
4.	Intalco	+.391	+.392	+.467	+.449	+.578	+.574	+.545	+.524
5.	Mead	-.116	-.096	+.120	+.095	-.081	-.064	+.143	+.114
6.	Tacoma	-.039	-.031	+.165	+.138	+.017	+.019	+.196	+.164
7.	The Dalles	-.187	-.179	+.023	-.000	-.186	-.184	+.032	+.005
8.	Commonwealth	+.042	+.046	+.221	+.201	+.125	+.123	+.260	+.236
9.	Longview	-.032	-.015	+.175	+.151	+.028	+.041	+.207	+.179
10.	Troutdale	-.285	-.301	-.028	-.050	-.308	-.333	-.028	-.054

TABLE 11

DSI AND TOTAL BPA REVENUES
(1985 $000)

Line No.	(A) Operating Year	(B) RSI Aluminum Prices (¢/lb)	(C) DSI Revenues RSI Standard	(D) DSI Revenues RSI Variable	(E) BPA Revenues RSI Standard	(F) BPA Revenues RSI Variable
1.	1987	55.7	244,256	355,882	2,908,904	2,902,463
2.	1988	62.0	377,914	467,591	2,999,053	3,019,009
3.	1989	66.3	437,812	580,743	3,056,744	3,087,634
4.	1990	65.0	434,151	580,667	3,062,368	3,094,245
5.	1991	67.3	436,607	579,607	3,089,763	3,118,351
6.	1992	73.0	434,942	667,115	3,078,615	3,191,279
7.	1993	74.4	437,936	603,989	3,181,658	3,231,269
8.	1994	70.0	442,780	586,492	3,328,140	3,360,090
9.	1995	63.2	420,532	579,539	3,372,835	3,407,436
10.	1996	57.5	314,749	470,748	3,371,285	3,352,704
11.	TOTAL	65.4	3,981,679	5,472,373	31,449,365	31,764,480
12.	Incentive Revenues				10,000	
13.	TOTAL + Incentive Revenues				31,459,365	31,764,480

Source: Section V.A. of the Documentation, VI-86-E-BPA-01A.

TABLE 12

AVERAGE DSI RATE
(mills/kWh)
(1985 $)

Line No.	(A) Operating Year	(B) RSI Standard	(C) RSI Variable
1.	1987	22.34	19.07
2.	1988	22.90	22.52
3.	1989	22.89	22.87
4.	1990	22.88	22.87
5.	1991	22.89	22.87
6.	1992	22.93	26.45
7.	1993	22.89	23.77
8.	1994	22.89	22.87
9.	1995	22.87	22.77
10.	1996	22.82	19.68
11.	10-Year Average	22.85	22.69

Source: Section V.A. of the Documentation, VI-86-E-BPA-01A.

TABLE 13

ANNUAL DSI SALES
(Average MW)

Line No.	(A) Operating Year	(B) RSI Standard	(C) RSI Variable
1.	1987	1248	2130
2.	1988	1884	2370
3.	1989	2183	2899
4.	1990	2166	2898
5.	1991	2178	2893
6.	1992	2165	2879
7.	1993	2184	2900
8.	1994	2208	2927
9.	1995	2099	2906
10.	1996	1575	2730
11.	AVERAGE	1989	2753

Source: Section V.A. of the Documentation, VI-86-E-BPA-01A.

TABLE 13

SEASONAL DSI SALES
(Average MW)

Line No.	(D) Operating Year	(E) RSI Standard Aug-Feb	(F) RSI Standard Mar-Jul	(G) RSI Variable Aug-Feb	(H) RSI Variable Mar-Jul
1.	1987 1/	1194	1342	2093	2157
2.	1988	1869	1980	2215	2731
3.	1989	2178	2199	2880	2934
4.	1990	2166	2165	2874	2931
5.	1991	2167	2191	2867	2927
6.	1992	2151	2187	2850	2922
7.	1993	2175	2201	2877	2937
8.	1994	2204	2216	2910	2952
9.	1995	2159	1963	2914	2853
10.	1996 2/	1746	1177	2715	2751

Source: Section V.A. of the Documentation, VI-86-E-BPA-01A.

Footnotes

1/ The seasons August-February and March-July do not correspond to the operating year, July-June. Each operating year above starts in August and ends in July. (July 1986 is not included in this analysis.)

2/ OY1996 runs through June 1996 here.

TABLE 14

LOAD SCENARIO SUMMARIES
(10 YEAR TOTALS)
July 1986-June 1996

Line No.		(A) RSI Standard Rate	(B) RSI Variable Rate	(C) RSI Mixed Aluminum	(D) Random Low Standard Rate	(E) Random Low Variable Rate	(F) Chase Standard Rate	(G) Chase Variable Rate
1.	Total BPA Revenues ($000)	31,459,365 1/	31,764,480	31,487,268	30,881,781 2/	30,834,260	31,853,207	31,937,916
2.	Average DSI Sales (Avg MW)	1,989	2,753	2,141	846	1,205	2,854	3,004
3.	Average DSI Rate (mills/kWh)	22.85	22.69	22.68	22.84	20.91	22.89	22.95
4.	Average Aluminum Price (¢/lb.)	65.4	65.4	65.4	53.5	53.5	68.7	68.7

Source: Section V.A. of the Documentation, VI-86-E-BPA-1A

1/ Includes Incentive Rate revenues of $10 million.

2/ Includes Incentive Rate revenues of $60 million.

TABLE 15

FUNDS FROM OPERATIONS - FY 1985 1/
($000)

Line No.		(A)
1.	Total Revenues	$2,881,859
	Less:	
2.	Total Expenses	(2,658,411)
3.	Net Revenues	$223,448
	Plus:	
	Charges Not Requiring Funds:	
4.	Depreciation	128,999
5.	Amortization of Deferred Conservation Costs	17,586
6.	Funds Provided from Operations	$370,033
	Less:	
7.	Actual FY 1985 Treasury Amortization Payment	(225,874)
8.	Funds Provided from Operations Net of FY Amortization	$144,159

1/ Based on preliminary unaudited financial statements for FY 1985.

TABLE 16

USE OF FY 1985 FUNDS FROM OPERATIONS
TO MEET PROJECTED REDUCTION IN FY 1986-87 REVENUES
($000)

Line No.		(A)
1.	Total FY 1986-87 Revenues 1/ Variable Rate - RSI Forecast	$5,685,600
2.	Total FY 1986-87 Revenues 2/	5,792,000
3.	Projected Reduction in Total FY 1986-87 Revenues	(106,400)
4.	Funds Provided from 3/ FY 1985 Operations	144,200
5.	Funds after FY 1986-87 Treasury Amortization Payments	$37,800

Sources:

1/ Variable Rate Study, Tables 17-24.

2/ Documentation for Revenue Requirement Study, Final 1985 Rate Case, (WP-85-FS-BPA-07A), page G-1.

3/ Variable Rate Study, Table 15.

FISCAL YEAR 1986

TABLE 17

STANDARD RATE RSI FORECAST (JULY-SEPTEMBER)
TOTAL BPA REVENUES
($000)

Line No.		(A) OCT-85	(B) NOV-85	(C) DEC-85	(D) JAN-86	(E) FEB-86	(F) MAR-86	(G) APR-86	(H) MAY-86	(I) JUN-86	(J) JUL-86	(K) AUG-86	(L) SEP-86	(M) TOTAL
1	PRIORITY FIRM (PF)													
2	GENERATING PUBLICS	25028	26636	31720	31196	26703	26968	22479	12372	11705	9289	13800	17971	255867
3	RESIDENTIAL EXCHANGE	59681	67522	99058	107356	94869	91268	70917	54937	51278	55069	53791	57731	863477
4	OTHER PF	45818	49236	68197	67079	59336	59756	48443	37574	35996	38399	39021	41861	590716
5	TOTAL PF	130527	143394	198975	205631	180908	177992	141839	104883	98979	102757	106612	117563	1710060
6	INDUSTRIAL FIRM (IP)													
7	3 QUARTILES	23311	22784	29451	29422	27701	28527	26190	22756	20980	17581	17082	16205	281990
8	FIRST QUARTILE	5156	5163	6674	5598	5669	5614	4295	3617	3094	5854	5697	5406	61837
9	TOTAL IP	28467	27947	36125	35020	33370	34141	30485	26373	24074	23435	22779	21611	343827
10	INDUSTRIAL HANNA (IH)	78	76	78	172	169	177	181	187	181	380	380	368	2427
11	NONFIRM ENERGY (NF)													
12	PACIFIC SOUTHWEST	0	0	0	39356	33631	31560	31627	38635	32367	17198	13571	10441	248386
13	PACIFIC NORTHWEST	0	0	0	474	159	2	62	0	2	0	0	0	699
14	CONTRACT	0	0	0	0	0	0	0	0	0	0	0	0	0
15	DISPLACEMENT	0	0	0	1521	2018	3521	2076	4172	3120	3015	2687	353	22483
16	TOTAL NF	0	0	0	41351	35808	35083	33765	42807	35489	20213	16258	10794	271568
17	INTERTIE ADDER	913	1579	1625	2501	2151	2077	2118	2459	2231	2669	2428	2220	24971
18	SURP PWR/ENR (SP/SE)	20084	32338	33269	5732	5506	5695	6852	4446	7849	40160	40139	39225	241295
19	NEW RESOURCE (NR)	622	602	622	622	562	622	492	509	492	777	777	919	7618
20	FIRM CAPACITY (CF)	6865	5347	5347	5347	5347	5347	5347	5347	6865	6865	6865	6865	71754
21	OTHER POWER SALES	326	277	276	276	276	279	304	396	439	475	466	393	4183
22	TRANSMISSION	9039	9039	9039	8198	8313	8371	8506	6917	7515	8802	9605	9431	102775
23	MISCELLANEOUS	988	903	1812	1314	1387	845	1333	806	476	488	-16	-17	10319
24	TOTAL	197909	221502	287168	306164	273797	270629	231222	195130	184590	207021	206293	209372	2790797

Source: Section V.A. of the Documentation, VI-86-E-BPA-01A.

TABLE 18

FISCAL YEAR 1986

STANDARD RATE RSI FORECAST (JULY-SEPTEMBER)
TOTAL BPA POWER SALES
(AVG MW)

Line No.		(A) OCT-85	(B) NOV-85	(C) DEC-85	(D) JAN-86	(E) FEB-86	(F) MAR-86	(G) APR-86	(H) MAY-86	(I) JUN-86	(J) JUL-86	(K) AUG-86	(L) SEP-86	(M) TOTAL
1	PRIORITY FIRM (PF)													
2	GENERATING PUBLICS	1674	1760	1770	1750	1590	1495	1449	836	827	635	1025	1198	1334
3	RESIDENTIAL EXCHANGE	3727	4318	5331	5783	5456	4912	4363	3941	3879	3955	3872	3694	4436
4	OTHER PF	2883	3170	3699	3735	3483	3189	2928	2606	2606	2711	2794	2666	3039
5	TOTAL PF	8284	9248	10800	11268	10529	9596	8740	7383	7312	7301	7691	7558	8809
6	INDUSTRIAL FIRM (IP)													
7	3 QUARTILES	1893	1893	1893	1863	1864	1817	1763	1712	1615	1259	1223	989	1649
8	FIRST QUARTILE	416	429	429	360	385	361	292	274	240	419	408	330	362
9	TOTAL IP	2309	2322	2322	2223	2249	2178	2055	1986	1855	1678	1631	1319	2011
10	INDUSTRIAL HANNA (IH)	15	15	15	33	36	34	36	36	36	73	73	73	40
11	NONFIRM ENERGY (NF)													
12	PACIFIC SOUTHWEST	0	0	0	2541	2396	2068	2124	2553	2197	1098	828	678	1374
13	PACIFIC NORTHWEST	0	0	0	28	10	0	3	0	0	0	0	0	3
14	CONTRACT	0	0	0	0	0	0	0	0	0	0	0	0	0
15	DISPLACEMENT	0	0	0	292	429	676	412	801	619	579	516	70	366
16	TOTAL NF	0	0	0	2861	2835	2744	2539	3354	2816	1677	1344	748	1743
17	INTERTIE ADDER	0	0	0	0	0	0	0	0	0	0	0	0	0
18	SURP PWR/ENR (SP/SE)	1023	1828	1820	261	271	259	328	201	385	1892	1891	1892	1004
19	NEW RESOURCE (NR)	38	38	38	38	38	38	38	38	38	58	58	58	43
20	FIRM CAPACITY (CF)	0	0	0	0	0	0	0	0	0	0	0	0	0
21	OTHER POWER SALES	43	3	2	2	2	4	36	111	151	175	168	112	67
22	TRANSMISSION	0	0	0	0	0	0	0	0	0	0	0	0	0
23	MISCELLANEOUS	106	90	287	178	215	74	188	66	-6	-4	-115	-119	80
24	TOTAL	11818	13544	15284	16864	16175	14927	13960	13175	12587	12850	12741	11641	13797

Source: Section V.A. of the Documentation, VI-86-E-BPA-01A.

FISCAL YEAR 1986

TABLE 19

VARIABLE RATE RSI FORECAST (JULY-SEPTEMBER)
TOTAL BPA REVENUES
($000)

Line No.		(A) OCT-85	(B) NOV-85	(C) DEC-85	(D) JAN-86	(E) FEB-86	(F) MAR-86	(G) APR-86	(H) MAY-86	(I) JUN-86	(J) JUL-86	(K) AUG-86	(L) SEP-86	(M) TOTAL
1	PRIORITY FIRM (PF)													
2	GENERATING PUBLICS	25028	26636	31720	31196	26703	26968	22479	12372	11705	9745	14331	18047	256930
3	RESIDENTIAL EXCHANGE	59681	67522	99058	107356	94869	91268	70917	54937	51278	55069	53791	57731	863477
4	OTHER PF	45818	49236	68197	67079	59336	59756	48443	37574	35996	38399	39021	41861	590716
5	TOTAL PF	130527	143394	198975	205631	180908	177992	141839	104883	98979	103213	107143	117639	1711123
6	INDUSTRIAL FIRM (IP)													
7	3 QUARTILES	23311	22784	29451	29422	27701	28527	26190	22756	20980	20416	22766	22137	296441
8	FIRST QUARTILE	5156	5163	6674	5598	5669	5614	4295	3617	3094	6611	7186	7112	65789
9	TOTAL IP	28467	27947	36125	35020	33370	34141	30485	26373	24074	27027	29952	29249	362230
10	INDUSTRIAL HANNA (IH)	78	76	78	172	169	177	181	187	181	375	370	358	2402
11	NONFIRM ENERGY (NF)													
12	PACIFIC SOUTHWEST	0	0	0	39356	33631	31560	31627	38635	32367	20631	12502	7266	247575
13	PACIFIC NORTHWEST	0	0	0	474	159	2	62	0	2	0	0	0	699
14	CONTRACT	0	0	0	0	0	0	0	0	0	0	0	0	0
15	DISPLACEMENT	0	0	0	1521	2018	3521	2076	4172	3120	2885	1885	222	21420
16	TOTAL NF	0	0	0	41351	35808	35083	33765	42807	35489	23516	14387	7488	269694
17	INTERTIE ADDER	913	1579	1625	2501	2151	2077	2118	2459	2231	2369	1893	1574	23490
18	SURP PWR/ENR (SP/SE)	20084	32338	33269	5732	5506	5695	6852	4446	7849	28889	28868	28216	207744
19	NEW RESOURCE (NR)	622	602	622	622	562	622	492	509	492	777	777	919	7618
20	FIRM CAPACITY (CF)	6865	5347	5347	5347	5347	5347	5347	5347	6865	6865	6865	6865	71754
21	OTHER POWER SALES	326	277	276	276	276	279	304	396	439	475	466	393	4183
22	TRANSMISSION	9039	9039	9039	8198	8313	8371	8506	6917	7515	9255	10417	10558	105167
23	MISCELLANEOUS	988	903	1812	1314	1387	845	1333	806	476	488	-16	-17	10319
24	TOTAL	197909	221502	287168	306164	273797	270629	231222	195130	184590	203249	201122	203242	2775724

Source: Section V.A. of the Documentation, VI-86-E-BPA-01A.

TABLE 20

FISCAL YEAR 1986

VARIABLE RATE RSI FORECAST (JULY-SEPTEMBER)
TOTAL BPA POWER SALES
(AVG MW)

Line No.		(A) OCT-85	(B) NOV-85	(C) DEC-85	(D) JAN-86	(E) FEB-86	(F) MAR-86	(G) APR-86	(H) MAY-86	(I) JUN-86	(J) JUL-86	(K) AUG-86	(L) SEP-86	(M) TOTAL
1	PRIORITY FIRM (PF)													
2	GENERATING PUBLICS	1674	1760	1770	1750	1590	1495	1449	836	827	675	1072	1204	1342
3	RESIDENTIAL EXCHANGE	3727	4318	5331	5783	5456	4912	4363	3941	3879	3955	3872	3694	4436
4	OTHER PF	2883	3170	3699	3735	3483	3189	2928	2606	2606	2711	2794	2666	3039
5	TOTAL PF	8284	9248	10800	11268	10529	9596	8740	7383	7312	7341	7738	7564	8817
6	INDUSTRIAL FIRM (IP)													
7	3 QUARTILES	1893	1893	1893	1863	1864	1817	1763	1712	1615	1733	1632	1587	1772
8	FIRST QUARTILE	416	429	429	360	385	361	292	274	240	561	515	510	398
9	TOTAL IP	2309	2322	2322	2223	2249	2178	2055	1986	1855	2294	2147	2097	2170
10	INDUSTRIAL HANNA (IH)	15	15	15	33	36	34	36	36	36	72	71	71	39
11	NONFIRM ENERGY (NF)													
12	PACIFIC SOUTHWEST	0	0	0	2541	2396	2068	2124	2553	2197	1293	760	461	1366
13	PACIFIC NORTHWEST	0	0	0	28	10	0	3	0	0	0	0	0	3
14	CONTRACT	0	0	0	0	0	0	0	0	0	0	0	0	0
15	DISPLACEMENT	0	0	0	292	429	676	412	801	619	554	362	44	349
16	TOTAL NF	0	0	0	2861	2835	2744	2539	3354	2816	1847	1122	505	1719
17	INTERTIE ADDER	0	0	0	0	0	0	0	0	0	0	0	0	0
18	SURP PWR/ENR (SP/SE)	1023	1828	1820	261	271	259	328	201	385	1361	1360	1361	872
19	NEW RESOURCE (NR)	38	38	38	38	38	38	38	38	38	58	58	58	43
20	FIRM CAPACITY (CF)	0	0	0	0	0	0	0	0	0	0	0	0	0
21	OTHER POWER SALES	43	3	2	2	2	4	36	111	151	175	168	112	67
22	TRANSMISSION	0	0	0	0	0	0	0	0	0	0	0	0	0
23	MISCELLANEOUS	106	90	287	178	215	74	188	66	-6	-4	-115	-119	80
24	TOTAL	11818	13544	15284	16864	16175	14927	13960	13175	12587	13144	12549	11649	13806

Source: Section V.A. of the Documentation, VI-86-E-BPA-01A.

FISCAL YEAR 1987

TABLE 21

STANDARD RATE RSI FORECAST (JULY-SEPTEMBER)
TOTAL BPA REVENUES
($000)

Line No.		(A) OCT-86	(B) NOV-86	(C) DEC-86	(D) JAN-87	(E) FEB-87	(F) MAR-87	(G) APR-87	(H) MAY-87	(I) JUN-87	(J) JUL-87	(K) AUG-87	(L) SEP-87	(M) TOTAL
1	PRIORITY FIRM (PF)													
2	GENERATING PUBLICS	21349	24590	30197	29864	24369	22524	19232	15830	9093	10312	14911	18668	240939
3	RESIDENTIAL EXCHANGE	60611	68344	98628	109074	96786	91654	71286	56096	53785	55949	54577	58671	875460
4	OTHER PF	48480	52481	70224	71295	62171	61669	50270	38652	37087	39247	39888	42648	614112
5	TOTAL PF	130440	145415	199049	210233	183326	175847	140788	110578	99965	105508	109376	119987	1730511
6	INDUSTRIAL FIRM (IP)													
7	3 QUARTILES (ALUM)	13282	11837	12059	12059	11294	12059	10151	11501	14243	16317	17319	20311	162432
8	TOP QUARTILE (ALUM)	4438	3968	4033	4033	3777	4033	3395	3828	4742	5444	5735	6742	54168
9	TOTAL IP (ALUM)	17720	15805	16092	16092	15071	16092	13546	15329	18985	21761	23054	27053	216600
10	3 QUARTILES (NOALUM)	2753	2685	2704	2823	2649	2823	2812	2325	2271	2224	2325	2685	31078
11	TOP QUARTILE(NOALUM)	906	884	888	928	871	928	926	770	753	743	770	884	10251
12	TOTAL IP (NOALUM)	3659	3569	3592	3751	3520	3751	3738	3096	3024	2967	3096	3569	41329
13	TOTAL IP	21379	19374	19684	19843	18591	19843	17284	18425	22009	24728	26150	30621	257929
14	INDUSTRIAL HANNA (IH)	380	368	380	380	343	380	368	380	368	380	375	363	4466
15	NONFIRM ENERGY (NF)													
16	PACIFIC SOUTHWEST	11707	19078	23016	19176	17176	16797	17403	50332	12274	22353	13645	7771	230728
17	PACIFIC NORTHWEST	0	0	9	1036	110	58	59	0	0	0	0	0	1272
18	CONTRACT	0	0	0	0	0	0	0	0	0	0	0	0	0
19	DISPLACEMENT	594	766	2380	4250	4276	3896	2228	6229	1603	3114	1849	192	31375
20	TOTAL NF	12301	19844	25405	24462	21562	20751	19690	56561	13877	25467	15494	7963	263375
21	INTERTIE ADDER	2399	2657	2922	3096	2779	2897	2885	2969	2465	2507	1998	1642	31216
22	SURP PWR/ENR (SP/SE)	42134	39121	39990	39948	37216	40054	39163	0	39163	29950	29929	29253	405921
23	NEW RESOURCE (NR)	949	919	949	949	857	949	752	777	752	777	777	919	10326
24	FIRM CAPACITY (CF)	6865	5347	5347	5347	5347	5347	5347	5347	6865	7227	5709	5709	69801
25	OTHER POWER SALES	314	265	264	264	263	266	293	386	430	465	456	383	4048
26	TRANSMISSION	10398	10132	9913	8633	8725	8841	8891	8979	8826	9661	10808	11101	114906
27	MISCELLANEOUS	973	1352	1546	1001	570	483	1009	1777	694	489	-15	-16	9863
28	TOTAL	228531	244793	305447	314155	279579	275657	236469	206178	195413	207158	201056	207925	2902358

Source: Section V.A. of the Documentation, VI-86-E-BPA-01A.

FISCAL YEAR 1987

TABLE 22

STANDARD RATE RSI FORECAST (JULY-SEPTEMBER)
TOTAL BPA POWER SALES
(AVG MW)

Line No.		(A) OCT-86	(B) NOV-86	(C) DEC-86	(D) JAN-87	(E) FEB-87	(F) MAR-87	(G) APR-87	(H) MAY-87	(I) JUN-87	(J) JUL-87	(K) AUG-87	(L) SEP-87	(M) AVERAGE
1	PRIORITY FIRM (PF)													
2	GENERATING PUBLICS	1371	1618	1673	1659	1413	1181	1177	1137	597	719	1118	1246	1242
3	RESIDENTIAL EXCHANGE	3743	4299	5289	5847	5474	4880	4319	3949	3935	4007	3923	3754	4452
4	OTHER PF	2937	3277	3662	3761	3504	3227	2978	2623	2624	2775	2857	2719	3079
5	TOTAL PF	8051	9194	10624	11267	10391	9288	8474	7709	7156	7501	7898	7719	8773
6	INDUSTRIAL FIRM (IP)													
7	3 QUARTILES (ALUM)	793	725	604	604	604	604	604	826	1048	1172	1244	1244	839
8	TOP QUARTILE (ALUM)	265	243	202	202	202	202	202	275	349	391	412	413	280
9	TOTAL IP (ALUM)	1058	968	806	806	806	806	806	1101	1397	1563	1656	1657	1119
10	3 QUARTILES (NOALUM)	161	161	131	137	137	137	161	163	163	156	163	161	153
11	TOP QUARTILE(NOALUM)	53	53	43	45	45	45	53	54	54	52	54	53	50
12	TOTAL IP (NOALUM)	214	214	174	182	182	182	214	217	217	208	217	214	203
13	TOTAL IP	1272	1182	980	988	988	988	1020	1318	1614	1771	1873	1871	1322
14	INDUSTRIAL HANNA (IH)	73	73	73	73	73	73	73	73	73	73	72	72	73
15	NONFIRM ENERGY (NF)													
16	PACIFIC SOUTHWEST	702	1188	1389	1586	1561	1358	1450	3325	964	1397	828	490	1353
17	PACIFIC NORTHWEST	0	0	0	62	7	3	3	0	0	0	0	0	6
18	CONTRACT	0	0	0	0	0	0	0	0	0	0	0	0	0
19	DISPLACEMENT	114	152	457	816	909	748	442	1196	318	598	355	38	512
20	TOTAL NF	816	1340	1846	2464	2477	2109	1895	4521	1282	1995	1183	528	1871
21	INTERTIE ADDER	0	0	0	0	0	0	0	0	0	0	0	0	0
22	SURP PWR/ENR (SP/SE)	1985	1887	1884	1882	1885	1887	1889	0	1889	1411	1410	1411	1618
23	NEW RESOURCE (NR)	58	58	58	58	58	58	58	58	58	58	58	58	58
24	FIRM CAPACITY (CF)	0	0	0	0	0	0	0	0	0	0	0	0	0
25	OTHER POWER SALES	43	3	2	2	2	4	36	111	152	175	168	112	68
26	TRANSMISSION	0	0	0	0	0	0	0	0	0	0	0	0	0
27	MISCELLANEOUS	102	191	228	108	15	-5	113	279	42	-4	-115	-119	70
28	TOTAL	12400	13928	15695	16842	15889	14402	13558	14069	12266	12980	12547	11652	13852

Source: Section V.A. of the Documentation, VI-86-E-BPA-01A.

FISCAL YEAR 1987

TABLE 22 - NOTES

STANDARD RATE RSI FORECAST (JULY-SEPTEMBER)
TOTAL BPA POWER SALES
(AVG MW)

POWER SALES (PK MW)

LINE	
2	CHELAN, COWLITZ, DOUGLAS, EUGENE, GRANT, PEND OREILLE, TACOMA, SEATTLE, AND SNOHOMISH.
3	IOU AND PA RESIDENTIAL EXCHANGE.
4	NON-GENERATING PUBLICS, IOU WNP-1, AND FEDERAL AGENCIES.
21	ANNUAL AND SEASONAL CAPACITY.
22	SUPPLEMENTAL, ENTITLEMENT CAPACITY, RESERVE POWER, EMERGENCY CAPACITY, AND US BUREAU OF RECLAMATION.

REVENUES ($000)

2	CHELAN, COWLITZ, DOUGLAS, EUGENE, GRANT, PEND OREILLE, TACOMA, SEATTLE, AND SNOHOMISH.
3	IOU AND PA RESIDENTIAL EXCHANGE.
4	NON-GENERATING PUBLICS, IOU WNP-1, AND FEDERAL AGENCIES.
12	NONFIRM PACIFIC SOUTHWEST INCLUDES CAPACITY/ENERGY EXCHANGE (3 MILLS/KWH); EXCLUDES EXPORTABLE AGREEMENT.
13	NONFIRM PACIFIC NORTHWEST INCLUDES FLOW-THROUGH NONFIRM.
21	ANNUAL AND SEASONAL CAPACITY.
22	SUPPLEMENTAL AND ENTITLEMENT CAPACITY, RESERVE POWER, US BUREAU OF RECLAMATION, EMERGENCY CAPACITY.
23	CSPE GENERATING PUBLICS, CSPE NON-GENERATING PUBLICS, CSPE IOU, SUPPLEMENTAL CAP. TRANS., FRM PWR TRANS/INT OF RES, DOWNSTREAM BENEFITS INTERCHG, DOWNSTREAM BENEFITS OTHER, ENERGY TRANSMISSION, OPERATION MAINTENANCE, USE OF FACILITIES, TRANS., CANADIAN INTERTIE, SOUTHERN INTERTIE , EASTERN INTERTIE.

POWER SALES (AVG MW)

2	CHELAN, COWLITZ, DOUGLAS, EUGENE, GRANT, PEND OREILLE, TACOMA, SEATTLE, AND SNOHOMISH.
3	IOU AND PA RESIDENTIAL EXCHANGE.
4	NON-GENERATING PUBLICS, IOU WNP-1, AND FEDERAL AGENCIES
12	NONFIRM PACIFIC SOUTHWEST INCLUDES CAPACITY/ENERGY EXCHANGE (3 MILLS/KWH); EXCLUDES EXPORTABLE AGREEMENT.
13	NONFIRM PACIFIC NORTHWEST INCLUDES FLOW-THROUGH NONFIRM.
21	US BUREAU OF RECLAMATION, AND RESERVE POWER.
24	DOWNSTREAM BENEFITS INTERCHG.

FISCAL YEAR 1987

TABLE 23

VARIABLE RATE RSI FORECAST (JULY-SEPTEMBER)
TOTAL BPA REVENUES
($000)

Line No.		(A) OCT-86	(B) NOV-86	(C) DEC-86	(D) JAN-87	(E) FEB-87	(F) MAR-87	(G) APR-87	(H) MAY-87	(I) JUN-87	(J) JUL-87	(K) AUG-87	(L) SEP-87	(M) TOTAL
1	PRIORITY FIRM (PF)													
2	GENERATING PUBLICS	21496	24780	30370	30182	24796	23179	19758	15873	9473	10606	15157	18706	244375
3	RESIDENTIAL EXCHANGE	60611	68344	98628	109074	96786	91654	71286	56096	53785	55949	54577	58671	875460
4	OTHER PF	48480	52481	70224	71295	62171	61669	50270	38652	37087	39247	39888	42648	614112
5	TOTAL PF	130587	145605	199221	210551	183753	176501	141314	110620	100345	105802	109622	120025	1733947
6	INDUSTRIAL FIRM (IP)													
7	3 QUARTILES (ALUM)	19846	19453	19846	19846	18666	19896	19927	20765	21399	22511	23287	23437	248879
8	TOP QUARTILE (ALUM)	6402	6315	6512	6443	6021	6495	6437	6920	6920	7174	6940	7204	79783
9	TOTAL IP (ALUM)	26248	25768	26358	26289	24686	26391	26365	27685	28319	29685	30227	30641	328661
10	3 QUARTILES (NOALUM)	2753	2685	2704	2823	2649	2823	2812	2325	2271	2224	2325	2685	31078
11	TOP QUARTILE(NOALUM)	873	868	888	908	852	908	909	770	725	697	684	815	9898
12	TOTAL IP (NOALUM)	3626	3552	3592	3731	3501	3731	3721	3096	2997	2922	3009	3500	40977
13	TOTAL IP	29873	29320	29950	30020	28188	30121	30085	30781	31315	32607	33235	34141	369638
14	INDUSTRIAL HANNA (IH)	375	363	375	375	334	375	358	380	363	370	359	353	4380
15	NONFIRM ENERGY (NF)													
16	PACIFIC SOUTHWEST	8417	15596	21409	22976	19480	20110	20258	50108	17054	24174	13150	6346	239078
17	PACIFIC NORTHWEST	0	0	0	559	39	12	20	0	0	0	0	0	630
18	CONTRACT	0	0	0	0	0	0	0	0	0	0	0	0	0
19	DISPLACEMENT	302	207	1380	1479	2822	3052	1794	5994	1819	2864	1489	121	23325
20	TOTAL NF	8719	15803	22789	25014	22341	23174	22072	56102	18873	27038	14639	6467	263033
21	INTERTIE ADDER	1748	2006	2360	2800	2458	2573	2545	2953	2252	2327	1694	1299	27015
22	SURP PWR/ENR (SP/SE)	30863	28133	28762	28740	26772	28804	28175	0	28175	23391	23370	22847	298032
23	NEW RESOURCE (NR)	949	919	949	949	857	949	752	777	752	777	777	919	10326
24	FIRM CAPACITY (CF)	6865	5347	5347	5347	5347	5347	5347	5347	6865	7227	5709	5709	69801
25	OTHER POWER SALES	314	265	264	264	263	266	293	386	430	465	456	383	4048
26	TRANSMISSION	11498	10828	10644	9144	9272	9379	9350	8990	9217	9928	11187	11492	120927
27	MISCELLANEOUS	973	1037	1127	811	471	419	1009	1777	694	489	-15	-16	8776
28	TOTAL	222764	239625	301788	314014	280056	277908	241301	218114	199280	210420	201033	203618	2909917

Source: Section V.A. of the Documentation, VI-86-E-BPA-01A.

FISCAL YEAR 1987

TABLE 24

VARIABLE RATE RSI FORECAST (JULY-SEPTEMBER)
TOTAL BPA POWER SALES
(AVG MW)

Line No.		(A) OCT-86	(B) NOV-86	(C) DEC-86	(D) JAN-87	(E) FEB-87	(F) MAR-87	(G) APR-87	(H) MAY-87	(I) JUN-87	(J) JUL-87	(K) AUG-87	(L) SEP-87	(M) AVERAGE
1	PRIORITY FIRM (PF)													
2	GENERATING PUBLICS	1382	1632	1686	1682	1447	1228	1222	1141	631	745	1139	1249	1265
3	RESIDENTIAL EXCHANGE	3743	4299	5289	5847	5474	4880	4319	3949	3935	4007	3923	3754	4452
4	OTHER PF	2937	3277	3662	3761	3504	3227	2978	2623	2624	2775	2857	2719	3079
5	TOTAL PF	8062	9208	10637	11290	10425	9335	8519	7713	7190	7527	7919	7722	8796
6	INDUSTRIAL FIRM (IP)													
7	3 QUARTILES (ALUM)	1426	1426	1426	1426	1426	1461	1461	1461	1490	1490	1490	1490	1456
8	TOP QUARTILE (ALUM)	460	463	468	463	460	477	472	487	482	475	444	458	467
9	TOTAL IP (ALUM)	1886	1889	1894	1889	1886	1938	1933	1948	1972	1965	1934	1948	1924
10	3 QUARTILES (NOALUM)	161	161	131	137	137	137	161	163	163	156	163	161	153
11	TOP QUARTILE(NOALUM)	51	52	43	44	44	44	52	54	52	49	48	49	49
12	TOTAL IP (NOALUM)	212	213	174	181	181	181	213	217	215	205	211	210	201
13	TOTAL IP	2098	2102	2068	2070	2067	2119	2146	2165	2187	2170	2145	2158	2125
14	INDUSTRIAL HANNA (IH)	72	72	72	72	71	72	71	73	72	71	69	70	71
15	NONFIRM ENERGY (NF)													
16	PACIFIC SOUTHWEST	504	965	1288	1782	1692	1525	1587	3308	1248	1504	796	402	1383
17	PACIFIC NORTHWEST	0	0	0	33	2	0	1	0	0	0	0	0	3
18	CONTRACT	0	0	0	0	0	0	0	0	0	0	0	0	0
19	DISPLACEMENT	58	41	265	284	600	586	356	1151	361	550	286	24	380
20	TOTAL NF	562	1006	1553	2099	2294	2111	1944	4459	1609	2054	1082	426	1767
21	INTERTIE ADDER	0	0	0	0	0	0	0	0	0	0	0	0	0
22	SURP PWR/ENR (SP/SE)	1454	1357	1355	1354	1356	1357	1359	0	1359	1102	1101	1102	1188
23	NEW RESOURCE (NR)	58	58	58	58	58	58	58	58	58	58	58	58	58
24	FIRM CAPACITY (CF)	0	0	0	0	0	0	0	0	0	0	0	0	0
25	OTHER POWER SALES	43	3	2	2	2	4	36	111	152	175	168	112	68
26	TRANSMISSION	0	0	0	0	0	0	0	0	0	0	0	0	0
27	MISCELLANEOUS	102	120	136	66	-9	-19	113	279	42	-4	-115	-119	49
28	TOTAL	12451	13926	15881	17011	16264	15037	14246	14858	12669	13153	12427	11529	14121

Source: Section V.A. of the Documentation, VI-86-E-BPA-01A.

FISCAL YEAR 1987

TABLE 24 - NOTES

VARIABLE RATE RSI FORECAST (JULY-SEPTEMBER)
TOTAL BPA POWER SALES
(AVG MW)

NOTE : AMOUNTS MAY NOT ADD TO TOTALS DUE TO ROUNDING.

POWER SALES (PK MW)

LINE	
2	CHELAN, COWLITZ, DOUGLAS, EUGENE, GRANT, PEND OREILLE, TACOMA, SEATTLE, AND SNOHOMISH.
3	IOU AND PA RESIDENTIAL EXCHANGE.
4	NON-GENERATING PUBLICS, IOU WNP-1, AND FEDERAL AGENCIES.
21	ANNUAL AND SEASONAL CAPACITY.
22	SUPPLEMENTAL, ENTITLEMENT CAPACITY, RESERVE POWER, EMERGENCY CAPACITY, AND US BUREAU OF RECLAMATION.

REVENUES ($000)

2	CHELAN, COWLITZ, DOUGLAS, EUGENE, GRANT, PEND OREILLE, TACOMA, SEATTLE, AND SNOHOMISH.
3	IOU AND PA RESIDENTIAL EXCHANGE.
4	NON-GENERATING PUBLICS, IOU WNP-1, AND FEDERAL AGENCIES.
12	NONFIRM PACIFIC SOUTHWEST INCLUDES CAPACITY/ENERGY EXCHANGE (3 MILLS/KWH); EXCLUDES EXPORTABLE AGREEMENT.
13	NONFIRM PACIFIC NORTHWEST INCLUDES FLOW-THROUGH NONFIRM.
21	ANNUAL AND SEASONAL CAPACITY.
22	SUPPLEMENTAL AND ENTITLEMENT CAPACITY, RESERVE POWER, US BUREAU OF RECLAMATION, EMERGENCY CAPACITY.
23	CSPE GENERATING PUBLICS, CSPE NON-GENERATING PUBLICS, CSPE IOU, SUPPLEMENTAL CAP. TRANS., FRM PWR TRANS/INT OF RES, DOWNSTREAM BENEFITS INTERCHG, DOWNSTREAM BENEFITS OTHER, ENERGY TRANSMISSION, OPERATION MAINTENANCE, USE OF FACILITIES, TRANS., CANADIAN INTERTIE, SOUTHERN INTERTIE, EASTERN INTERTIE.

POWER SALES (AVG MW)

2	CHELAN, COWLITZ, DOUGLAS, EUGENE, GRANT, PEND OREILLE, TACOMA, SEATTLE, AND SNOHOMISH.
3	IOU AND PA RESIDENTIAL EXCHANGE.
4	NON-GENERATING PUBLICS, IOU WNP-1, AND FEDERAL AGENCIES
12	NONFIRM PACIFIC SOUTHWEST INCLUDES CAPACITY/ENERGY EXCHANGE (3 MILLS/KWH); EXCLUDES EXPORTABLE AGREEMENT.
13	NONFIRM PACIFIC NORTHWEST INCLUDES FLOW-THROUGH NONFIRM.
21	US BUREAU OF RECLAMATION, AND RESERVE POWER.
24	DOWNSTREAM BENEFITS INTERCHG.

TABLE 25

MONTHLY OPPORTUNITY COSTS OY 1989 EXAMPLE
RSI VARIABLE

Line No.	(A) Month	(B) DSI Revenues ($000)	(C) Total BPA Revenues ($000)	(D) DSI Sales Avg MW	(E) Opportunity Cost mills/kWh
1	July 1988	48,184	223,416	2,884	-13.47
2	August	47,069	211,742	2,818	-24.12
3	September	47,760	213,122	2,889	-23.83
4	October	48,879	224,247	2,891	-24.01
5	November	48,422	245,132	2,929	-25.85
6	December	49,862	309,145	2,914	-23.93
7	January 1989	49,133	332,330	2,870	-20.05
8	February	45,571	299,568	2,849	-19.68
9	March	49,506	296,080	2,892	-14.91
10	April	48,251	260,175	2,909	-15.23
11	May	50,245	251,363	3,008	-1.51
12	June	47,861	221,314	2,930	-10.46

Source: Section V.A. of the Documentation, VI-86-E-BPA-01A.

TABLE 26

SEASONAL OPPORTUNITY COSTS
RSI VARIABLE
(Mills/kWh)

Line No.	Year	August-February	March-July
1.	OY 1987 1/	-19.44	-8.84
2.	OY 1988	-29.29	-7.59
3.	OY 1989	-23.11	-11.30
4.	OY 1990	-22.88	-11.48
5.	OY 1991	-22.96	-12.47
6.	OY 1992	-23.83	-12.63
7.	OY 1993	-23.25	-12.25
8.	OY 1994	-22.25	-12.04
9.	OY 1995	-23.05	-11.94
10.	OY 1996 2/	-25.14	-8.29
11.	AVERAGE	-23.18	-10.52

Source: Section V.A. of the Documentation, VI-86-E-BPA-01A.

Footnotes

1/ The seasons August-February and March-July do not correspond to the operating year July-June. Each operating year above starts in August and ends in July. (July 1986 is not included in this analysis.)

2/ OY1996 runs through June 1996 here.

APPENDICES

APPENDIX H-A
MODELS USED IN VARIABLE INDUSTRIAL POWER RATE DESIGN STUDY

I. Introduction

A number of models were relied upon to conduct impact analysis and provide support for the Variable Industrial Firm Power rate proposed by BPA. This document describes each of the models in more detail. The Aluminum Smelter Model (ASM) forecasts aluminum smelter loads. The Nonfirm Revenue Analysis Program (NFRAP) estimates sales, revenues, adjustments to sales and wheeling values for revenue categories that vary in response to water conditions in the Pacific Northwest. The Smelter Net Cash Flow Analysis examines the economic viability of specific smelters over the mid- to long-term. This document provides a brief overview of each of the models as well as a discussion of the various inputs and the modeling assumptions used in performing the various analyses.

II. Aluminum Smelter Model

The ASM Model is a short-run plant-specific simulation model of regional aluminum operations. The ASM incorporates an economic modeling approach to forecast DSI loads, which compares the cost of production to the market price received for the output. As a modeling tool, the ASM forecasts production and electricity load over the short-term. Long-term capacity planning and investment decisionmaking by the regional aluminum companies are approximated exogenously, using a discounted cash flow approach. (See discussion on Smelter Net Cash Flow, III. below.)

The ASM was developed and first used in BPA's 1983 rate adjustment proceedings. It continues to serve as the basic tool for forecasting DSI aluminum loads. Results from the ASM have been used in subsequent BPA rate proceedings and the model logic served as the reference for determining short-term aluminum operating decisions in the DSI Decision Analysis Model. There are five categories of production cost used in the ASM: power, labor, alumina, transportation, and other raw materials. The development of these costs is discussed in section III.B. of the Variable Industrial Power Rate Design Study.

A number of modifications to the ASM were necessary in order to accommodate the analysis of variable power rates. In general, these changes were required to allow the ASM to model accurately the variable rate concepts and/or to reflect information, data, and parameters developed during the DSI Options Study modeling effort. The major changes to the ASM are described below.

A. Subroutine to Calculate Variable Power Rate

For the variable rate analysis, code changes were incorporated in the ASM to model the variable rate concept. A subroutine to calculate the variable power rate as a function of aluminum prices was added. This routine determines the power rate for any given aluminum price according to the

specific rate parameters (i.e., pivot points, slopes, rate limits, etc.) that are supplied as inputs. The calculation includes the adjustment mechanism to the pivot points based on the 5-year rolling average aluminum price proposed for years 6-10 of the program (see historical aluminum price adjustment description in section IV.G.2. of the Variable Industrial Power Rate Design Study.) The ASM also prints out a diagram of the variable rate structure as well as a table of pivot points and electricity prices over time, for diagnostic purposes.

B. Calculation Based on Constant Dollar Costs and Prices

All production costs and prices used in the ASM for this study are in constant 1985 dollars. Previously the ASM has been used with nominal (current year) costs and prices. This reflects the latest estimates of production costs developed in the DSI Options Study modeling process, that were developed in real terms (these are described in more detail in the Variable Industrial Firm Power Rate Design Study, section III.B. of the Variable Rate Study). In addition, this provides for a more easily compared set of market price forecasts, which originally come to BPA from a number of different consultants. Nominal dollar forecasts from different sources generally have different implicit assumptions regarding inflation expectations.

C. Smelter-Specific Alumina, Labor, and Other Costs

Previous versions of the ASM assumed that all smelters faced the same costs for alumina, labor wages (labor efficiency has always been smelter-specific), and other costs. Essentially this reflected a lack of data that would allow differentiation among smelters. Over the past year developments within the industry (e.g. labor renegotiations) and consultant reports to BPA have made available information that allows smelter-specificity for these costs. The ASM input files and code were therefore adjusted to accommodate this new information.

D. Capacity Adjustment Procedure

An adjustment mechanism has been coded into the ASM to allow the user to specify smelter closures on specific dates. This facilitates the sensitivity analysis of the Variable rate under different smelter closure scenarios. BPA analysis related to smelter closure is described in, in the Variable Industrial Firm Power Rate Design Study, section V.A., Long-run Industry Decisionmaking.)

E. Changes to Labor and Energy Efficiencies

Previously the ASM allowed only a fixed efficiency level for labor and energy. Code changes permit these efficiencies to change over time. This capability will be of interest in the assessment of different levels of modernization in the smelters over time.

III. Smelter Net Cash Flow

A Smelter Net Cash Flow analysis was conducted to address long-term smelter decisions. The discounted cash flow analysis approach to determine smelter long-term operations was first used in the 1985 wholesale rate proceeding to evaluate the long run impact of a DSI customer charge. Similar logic was incorporated in the DSI Decision Analysis Model to determine smelter profitability over the long term. To determine a smelter's net cash flow for the Variable rate analysis the following calculations were performed.

First, the revenues for each plant for each year of the period were calculated by multiplying the average aluminum price for the year by the plant's production for the year. The plant's production was calculated by multiplying its capacity in pounds of aluminum by an average operating rate for the year. The average operating rate was calculated by dividing the average megawatts of load predicted by the ASM for the plant for the year by its capacity in megawatts.

$$\text{Revenue}_{\text{Plant } j,\ \text{Year } t} = \text{Average Price}_{t} * \text{Production}_{j,t} \qquad (A.1)$$

$$\text{Prod'n}_{\text{Plant } j,\ \text{Year } t} = \text{Operating Rate}_{j,t} * \text{Capacity (lbs/yr)}_{j} \qquad (A.2)$$

$$\text{Operating Rate}_{\text{Plant } j,\ \text{Year } t} = \frac{\text{Average Load (MW)}_{j,t}}{\text{Capacity (MW)}_{j}} \qquad (A.3)$$

Next, the outlays for each plant for each year of the period were calculated by summing the plant's variable costs and fixed costs, plus any restart costs incurred in varying the plant's operating rate over the period. The variable costs used were the short-run marginal costs calculated for each plant by the ASM, multiplied by the plant's production for the given year. The fixed costs were calculated by multiplying the fixed portion of each variable cost category in the ASM except electricity (i.e., alumina, labor, and other) by the plant's capacity. The fixed portions, expressed as cents per pound of capacity, were based on the values developed during BPA's DSI Options Study (i.e., 5 percent for alumina, 15 percent for labor, 35 percent for other). The restart costs were calculated by multiplying (a) the number of a plant's potlines started in a given year by (b) the average addition to short-run variable cost calculated by the ASM (i.e., three cents/pound) by (c) the annual production capacity of the potline(s) by (d) 0.25. The last value adjusts the production from an annual value to a three month value, the period over which the restart costs are assumed to be spread by a smelter considering the restart of an inoperative potline.

$$\text{Outlay}_{\text{Plant } j,\ \text{Year } t} = (\text{Var. Cost}_{j,t} * \text{Prod'n}_{j,t}) + (\text{Av'g Fixed Costs}_{j,t} * \text{Capac. (lbs/yr)}_{j}) + \text{Restart}_{j,t} \qquad (A.4)$$

$$\text{Restart}_{\text{Plant } j,\ \text{Year } t} = N_t * .03 * \text{Potline Capacity (lbs/yr)} * 0.25 \qquad (A.5)$$

Third, the net present value of each smelter's cash flow over the period was calculated by subtracting the outlays in each year from the revenues for the year, discounting the difference for each year back to the beginning of the period using an appropriate discount rate, and summing the discounted values for all the years in the period.

$$\text{Net Present Value}_{\text{Plant } j} = \sum_{t=1986}^{1996} \frac{(\text{Rev}_{j,t} - \text{Outlay}_{j,t})}{(1+r)^{t-1986}} \qquad (A.6)$$

Finally, the net present value of each smelter's cash flow was normalized by capacity, to permit comparisons among plants.

$$\text{Normalized Net present Value}_{\text{Plant } j} = \frac{\text{Net Present Value}_j}{\text{Capacity (lbs/yr)}_j} \qquad (A.7)$$

IV. Nonfirm Revenue Analysis Program

The Nonfirm Revenue Analysis Program (NFRAP) has been used in providing sales and revenue forecasts for several of BPA's rate proceedings. The inputs and assumptions used in the NFRAP, as well as the uses of NFRAP outputs, were described most recently in BPA's May 1985 Rate Analysis Model.

A. NFRAP Operation

The NFRAP receives tables of secondary energy from the hydro study and the Federal Secondary Energy Analysis (FSEA) for each month of each of the 40 historical water years. Additionally, from the FSEA, the NFRAP receives tables of monthly values for service to the first quartile of industrial loads and monthly values for interchange sales under the Coordination Agreement. The NFRAP uses any or all of the 40 years of data, depending on what is chosen for a particular study.

The NFRAP adds Federal firm surplus not sold under firm contracts to the secondary energy data. This is added to both Federal and regional secondary energy resources. In the NFRAP this unsold firm surplus first is used to serve any portion of DSI first quartile loads that were unserved because of insufficient nonfirm energy due to streamflow conditions.

Non-Federal firm surplus not sold under firm contracts is added to the regional data. The total of regional secondary energy resources, as adjusted by firm surplus (less transmission losses), then is compared to total markets in the PNW and PSW that potentially can be served at the NF Standard and High Cost Displacement nonfirm energy rates. If enough regional resources are available to serve all NF Standard and High Cost Displacement rate markets, both Federal and non-Federal resources are used to serve the PSW Standard and High Cost Displacement rate markets. The allocation of the PSW markets is in proportion to the amount of non-Federal and Federal resources available. This is modeled in compliance with the allocation provisions of the Exportable Agreement. The remaining markets are served sequentially with non-Federal and then Federal resources.

If not enough regional resources are available to serve all NF Standard and High Cost Displacement rate markets, then resources are used to serve highest cost markets first (the Intertie being the second market) and Canadian resources are added to non-Federal resources and allowed to serve all or a portion of unserved markets.

The resources remaining, after all NF Standard and High Cost Displacement rate markets are served, are available for service to Low Cost Displacement rate markets, for displacement of firm purchases from BPA and for spill. In the case of the computed requirements customers, a portion of their remaining resources are used to displace firm energy purchases from BPA. By decreasing firm purchases from BPA, this displacement actually increases the Federal secondary energy resources available for sale.

The estimate of displaced firm purchases from BPA is termed the "displacement adjustment" or "scheduled firm adjustment." The displacement adjustment is calculated as 43.0 percent of the non-Federal resources remaining after NF Standard and High Cost Displacement rate markets have been served. The 43.0 percent is an estimate of the portion of non-Federal secondary energy resources that are available to the computed requirements customers.

The Intertie market consists of two separate markets in the NFRAP for modeling NF Standard rate and High Cost Displacement rate sales to PSW markets. Both markets are determined by assuming projected Intertie capability, based on expected Intertie upgrades, and adjusted for maintenance and loopflow. The NF Standard rate market is the amount of PSW resources that are displaceable at the NF Standard rate, based on marginal costs of those resources. The NF Standard rate market is adjusted for assumed and contractual firm sales over the Intertie. The High Cost Displacement rate market is the amount of PSW resources that are displaceable at the High Cost Displacement rate, based on marginal costs of those resources.

All sales made to the NF Standard rate market are: assumed sales of Federal or non-Federal firm surplus, non-Federal sales of nonfirm energy, or Federal nonfirm energy sales at the Standard rate. Fifteen percent of Federal Standard rate sales to the PSW is assumed to be guaranteed. All Federal and non-Federal sales to the High Cost Displacement rate market are assumed to be made at the High Cost Displacement rate.

When regional resources are sufficient to serve all NF Standard and High Cost Displacement rate markets, the NFRAP assumes that the allocation provisions of the Exportable Agreement will be in effect. When the Exportable Agreement is in effect, the NFRAP uses Federal and non-Federal resources to serve the High Cost Displacement market, before serving other Displacement rate markets. The sales to the High Cost Displacement rate market are allocated between Federal and non-Federal resources in the same proportion that concurrent NF Standard rate sales are allocated.

After all NF Standard and High Cost Displacement rate markets have been served with Federal and non-Federal resources, the remaining resources serve Low Cost Displacement rate markets. Non-Federal resources serve the markets first, until they are used up or the markets are completely served. If the markets are completely served, the remaining resources are spilled. If unserved markets remain, then Federal resources serve the markets until the resources are exhausted or the markets are completely served. If Federal resources remain after all markets are served, they are spilled.

Finally, the NFRAP applies rates to estimated sales in order to estimate revenues for each rate category. The NFRAP applies an Intertie adder to those rate categories for which Intertie transmission is required.

B. Recent Modifications of the NFRAP

The most significant change to the NFRAP since the 1985 wholesale power rate proceeding has been to the Intertie markets for nonfirm energy and surplus firm power. One change is the Intertie markets for nonfirm energy and surplus firm power now are obtained from BPA inputs to the System Analysis Model, for future years in which Intertie capability is expected to be expanded. This results in monthly estimates of PSW markets, often less than total Intertie capability. Additionally, NF Standard and High Cost Displacement rate markets are determined distinctly and are based on PSW costs rather than on specific times of the day or week. This removes the daytime and nighttime market distinction previously modeled in the NFRAP. NF Standard rate sales now are made entirely to the NF Standard rate market. Firm contracts using the Intertie and assumed firm sales are reductions to what otherwise would be the markets for NF Standard rate nonfirm energy. As before, Intertie capability is reduced for maintenance and loopflow. Intertie markets are reduced to the extent they would be affected by the reduced Intertie capability.

A second change to the NFRAP is that the displacement adjustment now is estimated at 43.0 percent of non-Federal resources remaining after NF Standard and High Cost Displacement rate markets have been served. Previously this number was 27.9 percent. Finally, the NFRAP has been modified to separate aluminum and non-aluminum DSIs for calculating service to the DSI first quartile.

APPENDIX H-B

RATE SCHEDULE VI-86

VARIABLE INDUSTRIAL POWER RATE

SECTION I. AVAILABILITY

This schedule is available to direct service industrial (DSI) customers for both the contract purchase of Industrial Firm Power and the purchase of Auxiliary Power if requested by the DSI customer and made available by BPA. This schedule is only available for that portion of a DSI's load used in primary aluminum reduction. DSIs electing to purchase power under this rate schedule must contractually agree to the terms and conditions under this rate schedule and waive future rights to purchase under the Industrial Firm Power Rate Schedule for ten years from the effective date of this rate schedule. This rate schedule shall be effective July 1, 1986. General Rate Schedule Provisions (GRSPs) effective July 1, 1985 as modified herein are applicable to this rate schedule.

SECTION II. RATE

This rate schedule provides for the energy charge to vary monthly in response to changes in the average price of aluminum in U.S. markets. The energy charge contained herein has already been reduced for the value of reserves provided by purchasers of Industrial Firm Power; therefore a separate billing adjustment for the value of reserves will not be made.

A. Base Variable Industrial Rate

1. Demand Charge

a. $5.28 per kilowatt of billing demand occurring during the Peak Period for all billing months.

b. No demand charge during Offpeak Period hours.

2. Energy Charge

a. Plateau Energy Charge

When the average monthly aluminum price is between the Lower Pivot Aluminum Price, which is initially 61 cents per pound, and the Upper Pivot Aluminum Price, which is initially 72 cents per pound, the monthly energy charge shall be 16.0 mills per kilowatthour of billing energy for all billing months.

b. Reductions to Plateau Energy Charge

When the monthly aluminum price is less than the Lower Pivot Aluminum Price, the monthly energy charge shall be the greater of:

1) the Plateau Energy Charge - (LP - AMP)*(LS)

where

LP = the Lower Pivot Aluminum Price, initially set at 61.0 cents per pound.

AMP = the average monthly aluminum price in cents per pound determined pursuant to section III of this rate schedule.

LS = lower slope = $\frac{\text{1 mill per kilowatthour}}{\text{1 cent per pound}}$

or;

2) the applicable Lower Rate Limit

a) Fall Lower Rate Limit

12.0 mills per kilowatthour for the billing months August through February.

b) Spring Lower Rate Limit

7.0 mills per kilowatthour for the billing months March through July.

c. Increases to Plateau Energy Charge

When the monthly aluminum price is greater than the Upper Pivot Aluminum Price, the monthly energy charge shall be the lesser of:

1) the Plateau Energy Charge + (AMP - UP)*(US)

where:

AMP = the average monthly aluminum price in cents per pound determined pursuant to section III of this rate schedule.

UP = the Upper Pivot Aluminum Price, initially set at 72.0 cents per pound.

$$US = \text{upper slope} = \frac{0.5 \text{ mills per kilowatthour}}{1 \text{ cent per pound}}$$

or;

2) the upper rate limit of 22.3 mills per kilowatthour.

SECTION III. MONTHLY AVERAGE ALUMINUM PRICE DETERMINATION

A. Calculation of the Monthly Average Aluminum Price

The monthly average price of aluminum shall be determined by BPA for each billing month. For purposes of this rate schedule, the monthly average aluminum price shall be based on the U.S. market price. The price of aluminum in U.S. markets for the billing month shall be defined as the average U.S. Transaction Price for that calendar month reported by Metals Week, in cents per pound, rounded to the nearest tenth of a cent.

B. Notification of the Monthly Average Aluminum Price

BPA shall provide written notification and documentation to purchasers under this rate schedule of the monthly average aluminum price to be used for billing purposes as soon as possible after the 10th of the month and prior to rendering the final monthly bill.

C. Changes in Aluminum Price Indicators

In the event that BPA determines that factors outside its control render the monthly average U.S. Transaction Price unusable as an approximation of U.S. market prices, BPA may develop and substitute another indicator for prices in U.S. markets. BPA shall notify interested parties of its intent to do so at least one complete billing month prior to substitution of another aluminum price indicator. In this notification, BPA shall explain the reason for the substitution and specify the replacement indicator it intends to use. BPA shall also describe the methodology to determine the monthly average aluminum price to be used for billing purposes under this rate schedule and shall provide the necessary data to be used in the calculation. Interested persons will have until close of business three weeks from the date of the notification to provide comments. Consideration of comments and more current information may cause the final methodology and the substitute aluminum price index to differ from those proposed. BPA shall notify all affected parties, and those parties that submitted comments, of its final determination prior to the billing month the new indicator shall be effective.

SECTION IV. BILLING FACTORS

A. Billing Demand

The billing demand for power purchased shall be the BPA Operating Level during the Peak Period as adjusted for power factor. If there is more than one BPA Operating Level during the Peak Period within a billing month, the

billing demand shall be a weighted average of the BPA Operating Levels during the Peak Period for the billing month. The BPA Operating Level is defined in section III.A.10 of the GRSPs.

However, if BPA has agreed, pursuant to section 4 of the direct-service industrial power sales contract, to sell Industrial Firm Power on a daily demand basis (transitional service), this section of the rate schedule shall not apply, and BPA shall bill the purchaser in accordance with the provisions of section V.C of the GRSPs.

B. Billing Energy

The billing energy for power purchased shall be the Measured Energy for the billing month, minus any kilowatthours on which BPA assesses the charge for unauthorized increase.

SECTION V. ADJUSTMENTS TO THE LOWER AND UPPER PIVOT ALUMINUM PRICES

Effective July 1, 1987, and every July 1 thereafter, the Lower and Upper Pivot Aluminum Prices in sections II.A.2.b and II.A.2.c, respectively, shall be subject to change for billing purposes.

A. Implementation Procedures

Each year beginning in 1987 and every year thereafter, prior to April 1 BPA shall provide the purchasers under this rate schedule preliminary written estimates of changes to the Upper and Lower Pivot Aluminum Prices. By the last working day in the month of April, BPA shall notify interested parties in writing of BPA's revised determinations concerning changes to the Upper and Lower Pivot Aluminum Prices. BPA shall describe how the adjustments were determined and provide the data used in the calculations. In addition to written notification, BPA may, but is not obligated to, hold a public comment forum to clarify its determinations and solicit comments. Interested persons may submit comments on the determinations to BPA and other parties. Comments will be accepted until close of business on the third working Friday in May. Consideration of comments and more current information may result in the final adjustment differing from the proposed adjustment. By June 1, BPA shall notify all affected parties, and those parties that submitted comments, of the final determination.

B. Inflation Escalator

An inflation escalator shall be calculated prior to the July 1 adjustment date following the procedures set forth below:

1. The average VI-86 rate for the previous calendar year, assuming the plateau energy charge and the Discount for Quality of First Quartile Service were in effect for the entire year and a load factor of 98.5 percent, will be divided by 22.8 mills per kilowatthour to obtain an Electricity Cost Index.

2. The average U.S. Producer Price Index for Intermediate Materials Less Foods and Energy (PPI-FE) will be obtained for each month of the previous calendar year from the monthly report, Producer Price Indexes, published by the U.S. Department of Labor, Bureau of Labor Statistics (BLS). The index for each month used by BPA for this purpose will be the revised index for the month published by the BLS in the fourth month following each given month.

3. The revised PPI-FE for each month of the calendar year will be summed and divided by 12 to obtain the average PPI-FE for the year.

4. The average PPI-FE for the previous calendar year will be divided by the PPI-FE for calendar year 1985 to obtain an Other Cost Index.

5. A Weighted Average Cost Index will be calculated by averaging the Electricity Cost Index and Other Cost Index calculated above, using the following weights:

   a. electricity costs .25

   b. other costs .75

In the event that the PPI-FE series is discontinued or revised by the Bureau of Labor Statistics (BLS) in a way that BPA determines has rendered it unusable for calculating a consistent cost index, BPA will adjust it or substitute another similar price index available from the BLS, following advance notification and opportunity for public comment described in section V.A.

C. Rolling Average Aluminum Price

Prior to the July 1, 1991 adjustment date, and each annual adjustment date thereafter, a five year average aluminum price shall be calculated for the previous five calendar years following the procedures set forth below:

1. The average U.S. Transaction Price for aluminum reported by Metals Week for each of the first four calendar years of the five-year period shall be escalated to current dollars of the fifth year by multiplying the reported price by the ratio of (a) the Weighted Average Cost Index calculated for the fifth year to (b) the Weighted Average Cost Index for the given year. Both cost indexes are calculated pursuant to procedures described in section V.B.

2. The escalated U.S. Transaction Price for each of the first four calendar years, rounded to the nearest tenth of a cent, shall be added to the average U.S. Transaction Price of the fifth year reported by Metals Week. This sum shall be divided by five and rounded to the nearest tenth of a cent to obtain the 5-Year Average Price.

In the event that BPA determines that factors outside its control render the average U.S. Transaction Price for aluminum unusable for calculating average annual U.S. market prices, BPA will substitute another indicator of prices in U.S. markets following advance notice and opportunity for public comment as described in section V.A.

D. Annual Adjustment Procedures

1. For the period beginning July 1, 1987 and ending June 30, 1991.

The initial Lower and Upper Pivot Aluminum Prices in section II shall be multiplied by the weighted average cost index determined in section V.B.5 of this rate schedule to obtain adjusted Lower and Upper Pivot Aluminum Prices, rounded to the nearest tenth of a cent. These adjusted aluminum prices shall replace, respectively, the initial Lower and Upper Pivot Aluminum Prices and shall be used to determine the energy rate in the subsequent twelve billing months.

2. For the period beginning July 1, 1991 and ending June 30, 1996.

To determine the Lower and Upper Pivot Aluminum Prices beginning July 1, 1991, the following calculations shall be made by BPA:

a. The Lower Pivot Aluminum Price shall be multiplied by the weighted average cost index determined in section V.B.5 of this rate schedule and rounded to the nearest tenth of a cent to obtain an adjusted Lower Pivot Aluminum Price.

b. If the adjusted Lower Pivot Aluminum Price determined in section V.D.2.a is less than the 5-Year Average Price determined pursuant to section V.C.2:

(1) the Lower Pivot Aluminum Price shall equal the adjusted Lower Pivot Aluminum Price determined in section V.D.2.a.

(2) the Upper Pivot Aluminum Price will be adjusted so that the 5-year Average Price will be equidistant between the Lower and Upper Pivot Aluminum Prices. The Upper Pivot Aluminum Price shall equal:

$$2M - ALP$$

where

M = the 5-Year Average price

ALP = the adjusted Lower Pivot Aluminum Price calculated in V.D.2.b.(1) above.

c. If the adjusted Lower Pivot Aluminum Price, determined in section V.D.2.a, is equal to or greater than the 5-Year Average Price determined pursuant to section V.C.2, then both the Lower and Upper Pivot Aluminum Prices are set equal to the greater of:

(1) 55.0 cents per pound escalated to current dollars of the fifth year of the five years used to calculate the 5-Year Average Price by applying the escalation factor determined in section V.B.5, or;

(2) the 5-Year Average Price.

These adjusted aluminum prices shall replace, respectively, the initial Lower and Upper Pivot Aluminum Prices and shall be used to determine the energy rate in the subsequent 12 billing months.

SECTION VI. OTHER ADJUSTMENTS AND SPECIAL PROVISIONS

A. Rate Adjustments

This rate shall be subject to adjustments in BPA's general wholesale power rate case following the procedures of section 7(i) of the Northwest Power Act. In such a process, the rate level shall be determined consistent with the rate directives contained in sections 7(c)(2) and 7(c)(3) of the Northwest Power Act and other applicable legislation. The Demand Charge, Plateau Energy Charge, and First Quartile Service Adjustment contained in this rate schedule shall be adjusted by a uniform percentage based on the percentage change in the overall rate level. The lower and upper rate limits contained in section II.A shall be adjusted by an amount equal to the change in the mills per kilowatthour in the Plateau Energy Charge net of the discount for the first quartile service. The Upper and Lower Pivot Aluminum Prices and corresponding slopes shall not be adjusted in the rate case; rather they shall be adjusted pursuant to the procedures described in section V of this rate schedule. The rate for unauthorized increase shall be separately determined in each rate case.

B. Discount for Quality of First Quartile Service

When a purchaser requests that First Quartile service be provided with other than Surplus FELCC, a discount of 0.5 mills per kilowatthour shall be granted. This billing credit shall be applied to the monthly billing energy under section IV.B for all power purchased under this rate schedule. No credit shall be applied to those purchases subject to unauthorized increase charges under section VI.D of this rate schedule. By making such a request for discounted service, the purchaser waivers any right to First Quartile service with Surplus FELCC, and BPA shall have no obligation to conserve Surplus FELCC for future First Quartile service to any purchaser under the discounted rate.

C. Curtailments

BPA shall charge the customer for curtailments of the lower three quartiles in accordance with the provisions of section 9 of the power sales contract. BPA shall apply the demand charge in effect at the time of the curtailment in the computation of the amount of the curtailment charge.

D. Unauthorized Increase

1. Rate for Unauthorized Increase

82.2 mills per kilowatthour.

2. Application of the Charge

During the billing month, BPA may assess the unauthorized increase charge on the number of kilowatthours associated with the DSI Measured Demand in any one 60-minute clock-hour, before adjustment for power factor, that exceed the BPA Operating Level for that clock-hour, regardless of whether such Measured Demand occurs during the Peak or Offpeak Period.

E. Power Factor Adjustment

The adjustment for power factor, when specified in this rate schedule or in the power sales contract, shall be made in accordance with the provisions of both this section and section III.C.1 of the GRSPs. The adjustment shall be made if the average leading power factor or average lagging power factor at which energy is supplied during the billing month is less than 95 percent.

To make the power factor adjustment, BPA shall increase the billing demand by one percentage point for each percentage point or major fraction thereof (0.5 or greater) by which the average leading power factor or average lagging power factor is below 95 percent. BPA may elect to waive the adjustment for power factor in whole or in part.

F. Outage Credit

Pursuant to section 7 of the General Contract Provisions, BPA shall provide an outage credit to any DSI to whom BPA is unable to deliver the full billing demand for all hours during the billing month due to an outage on the facilities used by BPA to deliver Industrial Firm Power. Such credit shall not be provided if BPA is able to serve the DSI's load through the use of alternative facilities or if the outage is for less than 30 minutes. The amount of the credit shall be calculated according to the provisions of section III.C.2 of the GRSPs.

SECTION VII. RESOURCE COST CONTRIBUTION

In compliance with section 7(j) of the Northwest Power Act, BPA has made the following determinations:

A. The approximate cost contribution of different resource categories to the VI-86 rate is 95 percent Exchange and 5 percent New Resources.

B. The forecasted average cost of resources available to BPA under average water conditions is 17.6 mills per kilowatthour.

C. The forecasted cost of resources to meet load growth is 33.0 mills per kilowatthour.

SECTION VIII. GENERAL PROVISIONS

Sales of power under this schedule shall be subject to the GRSPs and the following Acts, as amended: the Bonneville Project Act, the Regional Preference Act (Pub. L. 88-552), the Federal Columbia River Transmission System Act, and the Pacific Northwest Electric Power Planning and Conservation Act.

SECTION IV. GENERAL RATE SCHEDULE PROVISIONS (GRSP)

The GRSPs effective July 1, 1985 are applicable to the VI-86 rate with modifications proposed for Auxiliary Demand and Operating Demand contained in section III.A.9 and III.A.10, respectively of the GRSPs.

1. Auxiliary Demand

Auxiliary Demand is the number of kilowatts of Auxiliary Power that a DSI requests and that BPA agrees to make available to serve a portion of the DSI's load during the period specified in the DSI's request. The DSI may request up to three levels of Auxiliary Demand during a billing month.

If BPA agrees to a request for Auxiliary Power but later becomes unable to supply such demand, the Restricted Demand for Auxiliary Power is deemed to be the Auxiliary Demand for such period of restriction. Auxiliary Power may be curtailed by the DSI according to the provisions of section 9(a) of the DSI's power sales contract.

BPA shall make Auxiliary Power available to Industrial Firm Power purchasers under the Industrial Firm Power Rate Schedule at the Standard Industrial Rate, except that the Industrial Incentive Rate shall apply if the DSI is making its purchases under the IP-85 Industrial Incentive Rate.

Auxiliary Power sales to DSIs purchasing under the Variable Industrial Rate Schedule shall be made at the rate determined pursuant to section II of the VI-86 Rate Schedule. Auxiliary Power sales to DSIs purchasing under the Special Industrial Rate will be made only at the Standard Special Industrial Power Rate.

2. BPA Operating Level

The BPA Operating Level is, for the purpose of these rate schedules and GRSPs, an hourly amount of industrial power (Industrial Firm Power or Special Industrial Power) for a DSI that is equal to the lowest of the following demands during that hour:

a. Operating Demand plus Auxiliary Demand, if any;

b. Curtailed Demand; or

c. Restricted Demand.

The weighted average BPA Operating Level for the DSI can be determined by summing the hourly BPA Operating Levels and dividing by the number of hours in the billing month.

Each DSI must request service from BPA for each billing month in accordance with the terms of the power sales contract. The requested level of service will be the BPA Operating Level, provided BPA does not need to restrict the DSI and provided BPA agrees to supply any requested Auxiliary Demand. Each requested level of service may include a designation for both the Peak Period and the Offpeak Period. A DSI may request and BPA may agree to a level of service for the Offpeak Periods other than that in the Peak Period. If a DSI does not separately designate a requested level of service for the Peak and Offpeak Periods, the BPA Operating Level will be the same for both periods. The BPA Operating Level is the basis for determining if a DSI has incurred an unauthorized increase.

Any DSI whose Measured Demand, before adjustment for power factor, during any one hour exceeds the BPA Operating Level for that hour shall be subject to unauthorized increase charges for each kilowatthour of unauthorized increase associated with each overrun.

Only the BPA Operating Level applicable during the Peak Period will be used in determining the Billing Demand for power purchased under the Industrial Firm Power Rate Schedule, the Variable Industrial Power Rate Schedule, and the Standard Rate under the Special Industrial Rate Schedule. During the Peak Period the BPA Operating Level may be no greater than the Operating Demand for the billing month unless the customer has requested, and BPA has agreed to supply, the Auxiliary Demand.

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