A RESOURCE SURVEY
OF
THE HYDROELECTRIC POTENTIAL
AT EXISTING AND PROPOSED DAMS
IN OREGON

By

Peter C. Klingeman
Principal Investigator

Oregon Water Resources Research Institute
Oregon State University
Corvallis, Oregon 97331

in cooperation with

State of Washington Water Research Center
Idaho Water Resources Research Institute
Montana University Joint Water Resources Research Center

The Work Reported Here is
Based on a Regional Study Funded by the
United States Department of Energy
CONTRACT NO. EG-77-S-07-1691
Through The
Idaho Water Resources Research Institute

This Report is Part of the
Information Dissemination Program of the
Oregon Water Resources Research Institute

WRRI-62 January 1980

ABSTRACT

A systematic, statewide investigation of the hydroelectric potential has been made for existing and proposed dams capable of producing 200 kW or more for at least 50 percent of the time. Assumptions made included the use of run-of-river conditions (rather than reservoir storage) and 100 percent efficiency in generating electrical energy from streamflow.

A total of 117 existing dams and 395 proposed dams were found to meet the criteria for study, out of several thousand existing and proposed dams of various sizes in Oregon. A third of the studied dams are located in the Willamette Basin.

The existing capacity at power projects in Oregon is 1,465 MW. This can be expanded by 860 MW (59%) at those same projects. Based upon streamflows exceeded 50 percent of the time, existing non-power dams could provide 117 MW (8%) more capacity than now exists through retrofitting. Also, a limited number of irrigation facilities might be retrofitted to provide 13 MW (1%) more capacity. Thus, existing facilities could be used to augment the present capacity by 990 MW (68%), based on P_{50} conditions.

Proposed dams might be developed to provide 3,856 MW (263%) more power than is presently produced, based on P_{50}. But environmental and transmission constraints make the potential more realistically on the order of 939 MW (64%). If all qualifying stream reaches were developed for low-head hydropower (not just those where dams have been proposed), a P_{50} potential of 6,292 MW might be achieved. Constraints greatly reduce this potential to about 228 MW.

If all existing facilities and proposed dams were developed, a P_{50} potential of 4,846 MW (331%) could be added to the existing capacity, for a total of 6,341 MW. However, constraints make practical a much lesser increment, amounting to 1,856 MW (127%), for a total of 3,321 MW.

Differences in the findings of this and other studies can be attributed in large part to different values obtained when reservoir storage use is considered, rather than ignored as in run-of-river operation. Reported values are also highly sensitive to the choice made for streamflow exceedance condition in calculating power, with a 20-fold range found between the P_{10} and P_{95} values.

FOREWORD

The Water Resources Research Institute, located on the Oregon State University Campus, serves the State of Oregon. The Institute fosters, encourages and facilitates water resources research and education involving all aspects of the quality and quantity of water available for beneficial use. The Institute administers and coordinates statewide and regional programs of multidisciplinary research in water and related land resources. The Institute provides a necessary communications and coordination link between the agencies of local, state and federal government, as well as the private sector, and the broad research community at universities in the state on matters of water-related research. The Institute also coordinates the inter-disciplinary program of graduate education in water resources at Oregon State University.

It is Institute policy to make available the results of significant water-related research conducted in Oregon's universities and colleges. The Institute neither endorses nor rejects the findings of the authors of such research. It does recommend careful consideration of the accumulated facts by those concerned with the solution of water-related problems.

ACKNOWLEDGEMENTS

The assistance and sharing of ideas among members of the Idaho, Montana and Washington study teams and the sponsoring U.S. Department of Energy and its representatives is gratefully acknowledged for the benefits derived by the Oregon study team in this regional research effort.

The contributions of the members of the Oregon study team are most particularly appreciated. Nasser Talebbeydokhti served as project engineer. He was ably assisted by Judy A. Kelly, Suzanne Townsen, Milo N. Ullstad, Alice Tullock and Maureen E. Sergent. Ronald C. Scheidt, William F. Galli, Heidi J. Linden, Carolyn J. Choquette and Susan B. Hammond helped by assembling much of the preliminary data on existing and proposed dams in Oregon.

TABLE OF CONTENTS

APPENDICES

The appendices are bound separately from this main report. There are two appendices, accompanied by explanatory notes.

Appendix A. Existing Non-Power Dams Having Potentials for Small-Scale Hydropower

Appendix B. Proposed Dams Having Potentials for Small-Scale Hydropower

LIST OF TABLES

LIST OF FIGURES

PROJECT OVERVIEW

A resource survey was conducted between September 1977 and August 1979 to assess the hydroelectric power and energy potentials for rivers and for existing and proposed dams in Oregon and The Pacific Northwest. Sponsored by the U.S. Department of Energy, the study was coordinated by the Idaho Water Resources Research Institute. The study was divided into two phases.

THE COMPLETED PHASE I STUDY

Phase I of the study involved the evaluation of the river power and energy potential for river reaches not having dams and capable of meeting "low-head" hydroelectric power criteria for future development. These criteria included production of 200 kW or more of power at least 50 percent of the time with gross hydraulic heads between the limits of 3 and 20 meters (10 and 66 feet). This requires median streamflows of at least 36 cubic feet per second. Run-of-river conditions (no reservoir storage) and 100 percent efficiency in generating electrical energy from streamflow were also assumed. The results of this work were reported in early 1979 (Gladwell, et. al., March 1979; Klingeman, 1979) and will be referred to frequently in the following discussion.

SCOPE OF THE PHASE II STUDY

Phase II of the study is reported here for the State of Oregon, based on a separately prepared regional report (Gladwell, et. al, September 1979). This phase consisted of the evaluation of power and energy potentials for two categories of dams. The first category included all "small" existing dams that do not presently have generating facilities but could have such facilities added through retrofitting or other project modifications (the nature of and means for such alteration were not part of this study, however). The second category included all proposed dams.

For Phase II, the "low-head" concept was replaced by that of "small hydro" at the request of the sponsoring agency to provide consistency with studies by others. "Small hydro" was defined as a dam or site with the potential to produce between 200 kW and 25 MW of power based on streamflow available at least 50 percent of the time and at 100 percent generating efficiency. (Such a definition excludes the smaller "backyard" or "micro-hydro" development range as well as the large hydropower developments that have already received extensive analysis by others.) For existing dams, no changes of storage capability were assumed in the analyses. All proposed dams were evaluated assuming run-of-river operating modes for the projects.

The existing dams studied were those previously identified in state dam registration lists, federal dam safety studies, and federal power reports. The proposed dams studied were those previously identified in various siting studies done by federal and state agencies. No effort was made to identify new sites that had not been previously reported.

For the regional report, a brief preliminary feasibility analysis was conducted for each existing non-power dam, involving transmission and load considerations. For proposed dams, the feasibility analysis also covered restraints of an environmental or physical nature, in addition to transmission and load considerations.

A limited amount of supplemental information, recently available, was used to update the regional Phase II report findings when preparing this state report. Because of continuing work on hydropower in Oregon, the state report also enlarges upon the preliminary feasibility analyses prepared for the regional study.

SUMMARY OF ANALYSIS TECHNIQUES

General Analysis Process

Analyses and evaluations were organized using the 18 major drainage basins identified by the Oregon Water Resources Department (OWRD) as analytical units for river basin planning. These natural subdivisions of the state are shown in Figure 1. Also shown are the major political subdivisions of the state.

The analysis process for existing and proposed dams involved several steps. First, the available literature and documents were used to obtain site data for

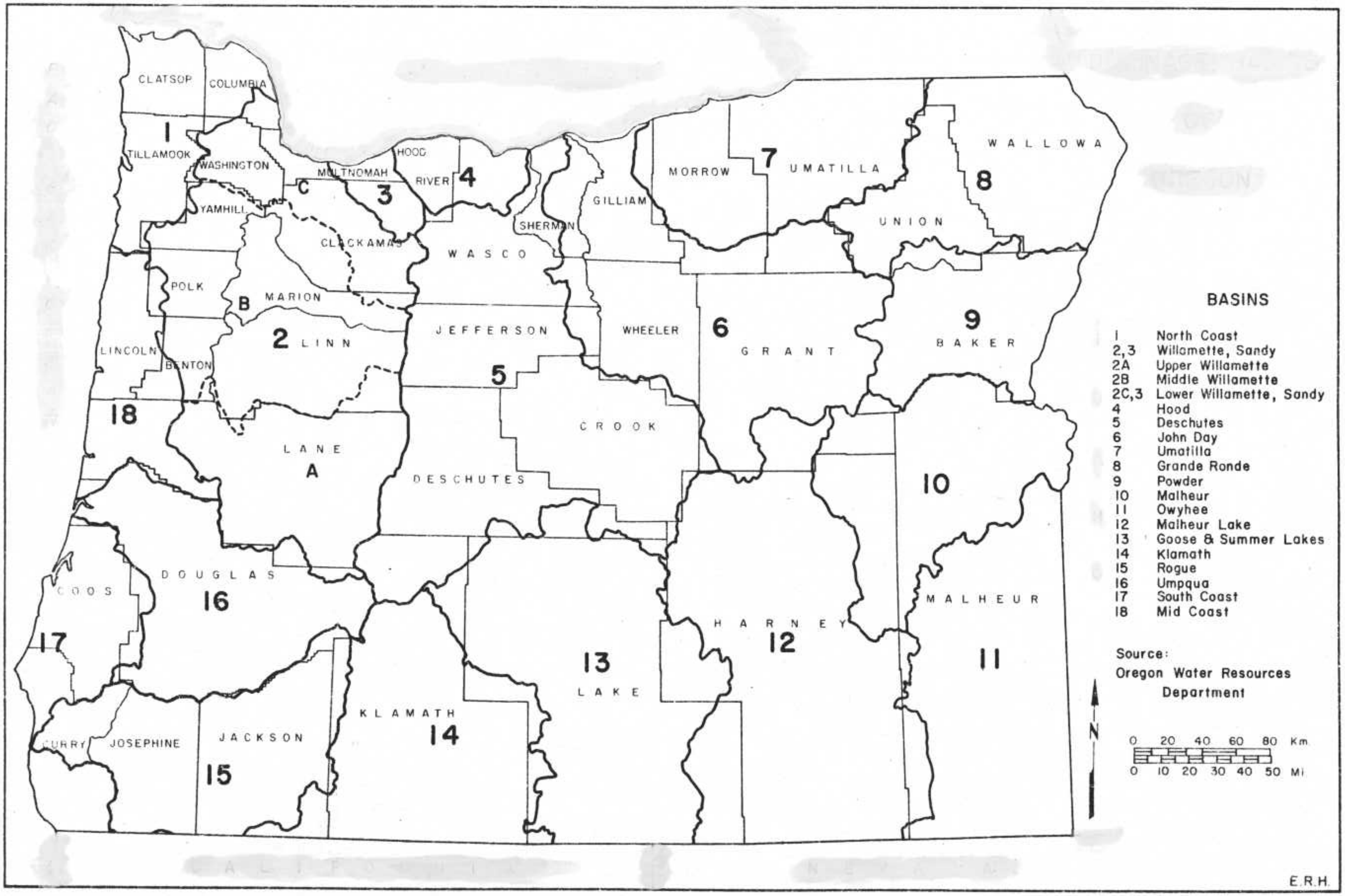


FIGURE 1. OREGON'S MAJOR DRAINAGE BASINS

each dam. The flows available at each dam or dam site were then determined. Next, the power and energy values for each existing or proposed dam were computed. This information was used to sort the dams into categories based on the existence of installed power generation capacity and on the magnitude of the power potential. Finally, a preliminary feasibility analysis was conducted for the existing non-power dams and for the proposed dams.

A separate, parallel analysis was conducted for existing and proposed irrigation structures that might incorporate small-scale hydropower in their use. The analyses and the results obtained are discussed separately from the discussion of dams in this report.

Dam Characteristics

The first step was to obtain information on the physical features of each existing or proposed dam from all available reports. These reports included those by state water resources agencies (State Engineer, 1973; Oregon State Water Resources Board, various), the U.S. Army Corps of Engineers (1975), the U.S. Geological Survey (1978), the Power Planning Committee, Pacific Northwest River Basins Commission (1978) and the Federal Power Commission (1976).

Streamflow Characteristics

In the second step of analysis, the streamflow regime at each existing or proposed dam was determined by means of a flow-duration curve (see Figure 2). This curve depicts the amount (or percent) of time during some total period that flow rates of a stream can be expected to equal or exceed any specified flow rate. (See the Phase I study reports for further details.) The flow-duration curve for each particular site was determined from the average annual flows and flow-duration curves developed in the Phase I study for the corresponding reach (segment) of stream. Where necessary, linear interpolations were made between the average annual runoff values for adjacent reaches in order to establish the average annual runoff and the flow-duration curve at the dam.

In the case of existing dams, the flow-duration curve used included the effects of existing streamflow regulation. In the case of proposed dams, however, the flow-duration curve for the site did not reflect the streamflow regulation that a future dam could impose on the existing flows. Therefore, in the latter case this curve can be considered to be that for run-of-river

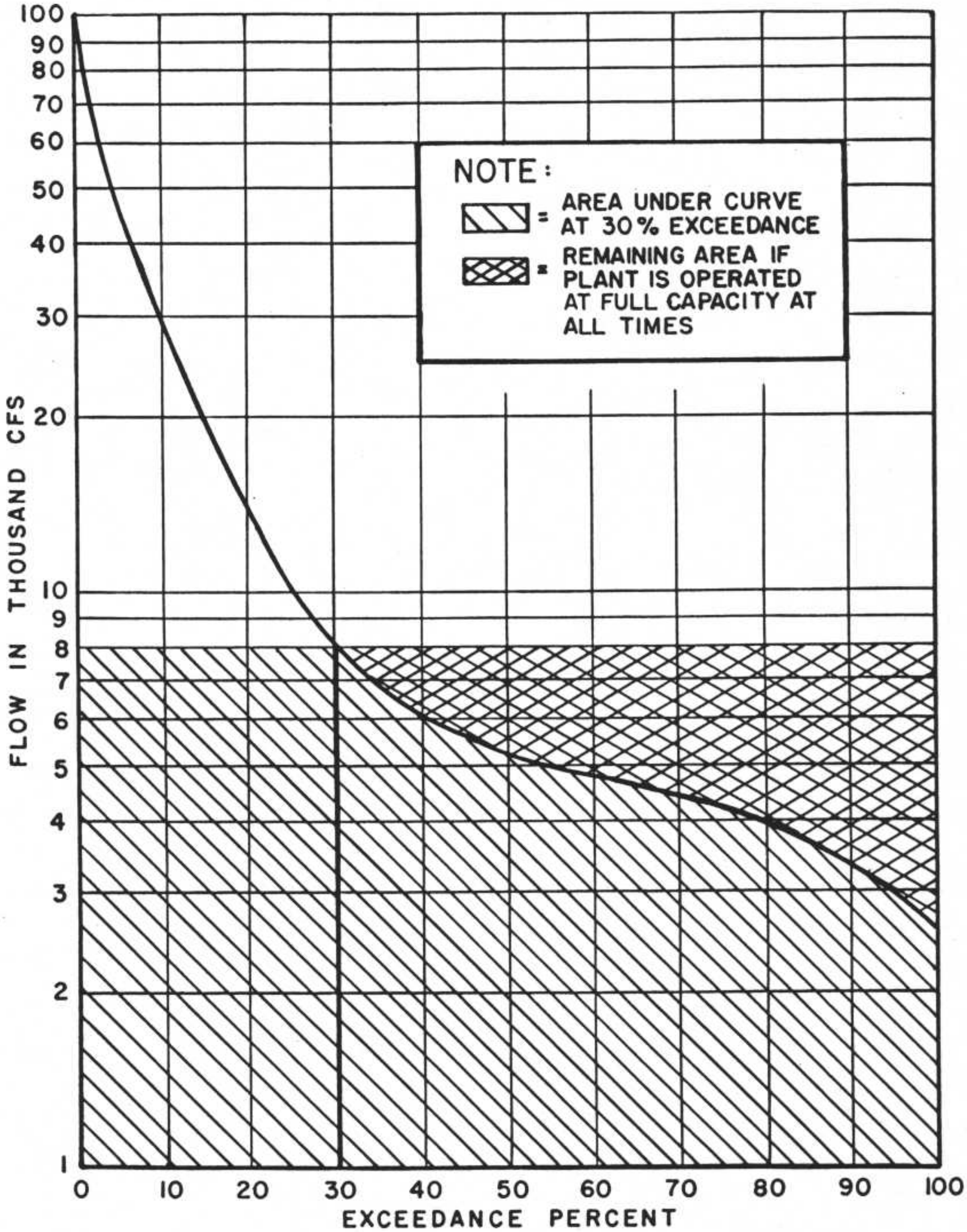


FIGURE 2. ILLUSTRATIVE FLOW-DURATION CURVE, SHOWING ENERGY AND PLANT FACTOR RELATIONSHIPS

project operation, subject to alteration if significant storage is developed behind the dam.

Power and Energy Characteristics

In the third step of analysis the power and energy potentials were computed for each existing or proposed dam. The basic power equation used was

$$P = \frac{QH}{11.8}$$

Where P is the power of kilowatts, Q is the streamflow in cubic feet per second, H is the hydraulic head available at the site in feet and 11.8 is a conversion factor. The calculation assumes 100 percent efficiency.

The plant capacity (power) was computed for five different flow rates, corresponding to the 10, 30, 50, 80 and 95 percent exceedance levels. Plant capacities at particular exceedance levels are shown with subscripts (e.g., P_{10} is that power that could be achieved 10 percent of the time).

To evaluate the hydraulic head at an existing or proposed dam, the preferred method was to use that listed in the source of site information. Where this was not given, the head was calculated as the difference in magnitude of the average headwater and tailwater elevations. Where neither of these methods could be used, due to insufficient data, the listed dam height was instead used as an approximation of the hydraulic head. (The method actually used in determining the hydraulic head is listed on the analysis sheet for each dam.) To eliminate the "double accounting" of any overlapping parts of the hydraulic heads at two or more adjacent sites, due to headwater or tailwater encroachment, a system head was assigned to each proposed site. The system head is defined as the head available at the site if all adjacent proposed sites were developed. System head is always equal to or less than hydraulic head. It was used in this study only in computing totals for complete stream system development; the power and energy values listed for individual sites were computed using the hydraulic head without any reduction for potential encroachment.

The energy developed is the product of power and time interval. Thus, the theoretical annual energy available from power plants sized at any specific exceedance value of Q was computed by integrating the area under the flow-duration curve below that Q value and multiplying this by the head available and the proper conversion factors to get the average energy output per year. Energy values at particular exceedance levels are shown with subscripts (e.g., E_{10}). Figure 2 shows the area under the curve for a plant capacity sized at the 30 percent exceedance value.

The plant factor was also computed. This is the ratio of the actual energy generated, computed by using the area under the curve, to the energy that would be generated if the plant was operated at full capacity 100 percent of the time for a given exceedance value of discharge (see Figure 2).

Dam Categorization

In the fourth step, the existing and proposed dams were sorted into categories before completion of the analyses. Figure 3 shows schematically the basis on which the analyzed sites were grouped.

For the regional study, all existing dams and proposed sites with a power potential of less than 200 kW were eliminated at the outset, as already stated. Most of these were actually eliminated at the first or second step by comparing the dam or site location with the reach maps available from the Phase I study. For this Oregon report, FPC-listed power-producing dams with less than 200 kW installed capacity were added back into the group of existing dams, since they did represent part of the currently developed hydropower base of the state.

Existing dams were then separated on the basis of whether or not they presently have any installed electric generation capacity. Summary information was tabulated for those that now generate electricity and each site was shown on a location map. For those that do not now generate electricity, the P_{50} value was calculated. If this exceeded the 25 MW upper limit for small hydro, only summary information was tabulated, since studies by others are analyzing such projects in detail. Each such site was shown on a location map. If the P_{50} value was between 200 kW and 25 MW, a detailed analysis was made and the site description and energy results were presented in more extensive tabular form. Sites were shown on a location map.

Proposed dams were evaluated to establish the potential P_{50} value for each site. If this exceeded the 25 MW upper limit for small hydro, summary information was tabulated and each site was shown on a location map. If the P_{50} value was within the range of 200 kW to 25 MW, detailed analyses were made and all site description and computation results were presented in more extensive form. Again, sites were shown on a location map.

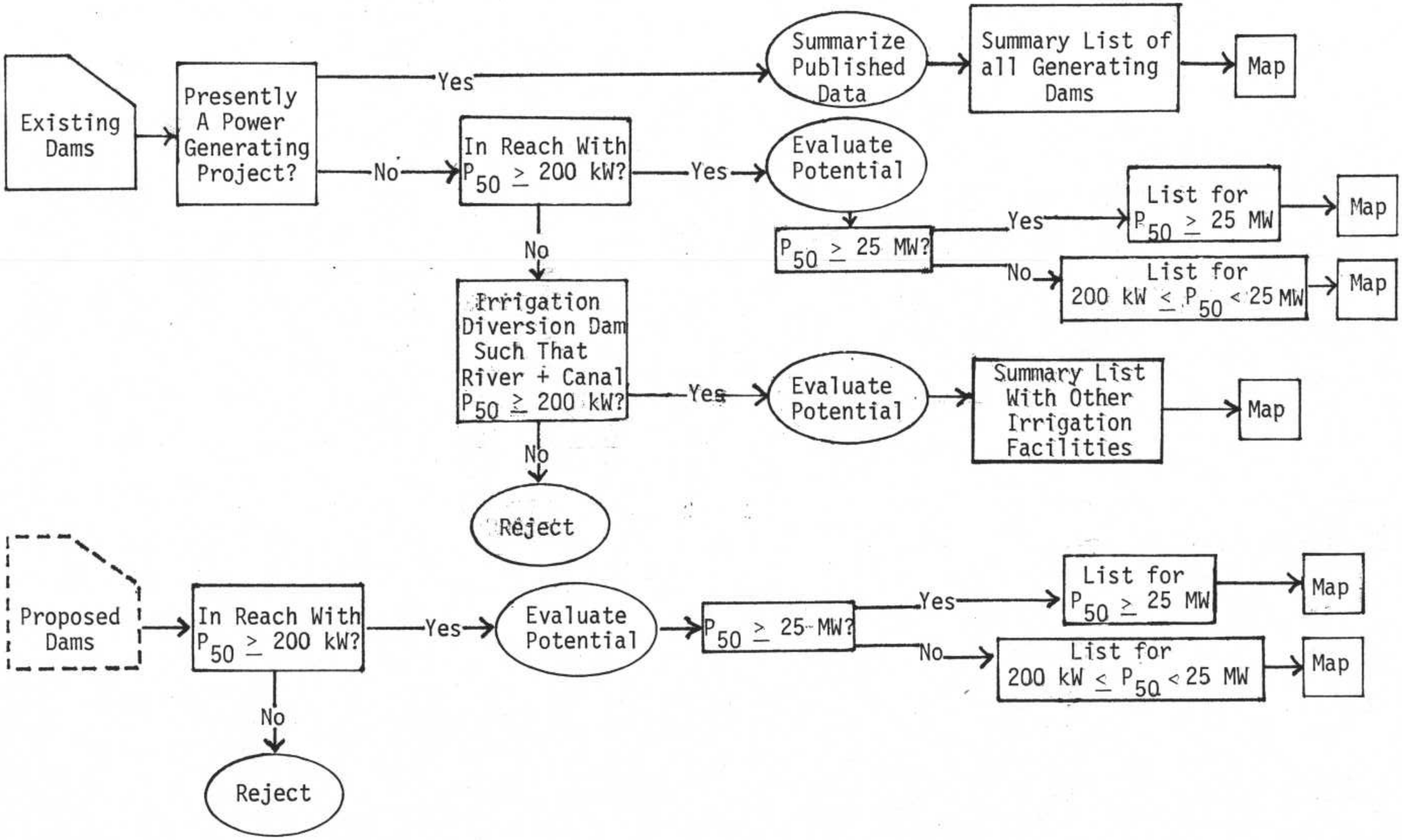


FIGURE 3. CATEGORIZATION PROCESS FOR HYDROPOWER POTENTIAL ANALYSIS

Preliminary Feasibility Analysis

The Phase II study involved transmission and load considerations that might affect the feasibility of retrofitting existing non-power dams for power generation. These considerations included the distance of the dam to the nearest power line, the capacity of that line, the owning or operating utility, the availability of a local market in the area closer than the transmission line and its type (industrial, residential or agricultural pumping), and the distance to the nearest population center of 1000 or more people (1970 census). These factors were identical to those used for undeveloped river reaches in the Phase I study. Hence, Phase I data were used for Phase II, requiring an approximation that the distance applicable for the middle of a reach was also applicable to a dam sited somewhere within that reach.

For the regional Phase II study of proposed dams, no preliminary feasibility analysis was made for each site. Instead, the reader was referred to the Phase I reach investigation reports, from which such information can be extracted by matching the dam site with the appropriate reach.

In preparing this Oregon report, it became evident that a summary of the feasibility constraints for existing non-power dams and for proposed dams was needed to facilitate ongoing state hydropower studies. Therefore, such information has been developed here from the Phase I reach analysis. That work involved environmental restraints as well as the transmission and load considerations described above.

Four categories were used to identify environmental restraints on reach development: land use restrictions, utility displacement, building displacement, and special fish problems. Land use restrictions included existing uses, federal special use designations (wild and scenic rivers, national recreation areas, national parks, national wilderness areas, known reserved natural areas) and identified archeological sites. Information on special uses was obtained from maps; that on archeological sites came from a review of reaches by the Department of Anthropology, University of Oregon. Utility displacement included highways, railroads, power lines, telephone lines and gas or oil pipelines. Available maps were the sources of information. Building displacement involved residential and commercial structures -- using the potential inundation of four or more buildings per mile as a restraint criterion. Special fish problems, beyond the expected disruption of the local aquatic ecosystem, included the presence of anadromous fish runs. Information came from the basin reports of the Oregon Department of Fish and Wildlife (and its predecessor agencies) and upon similar available documents from other sources.

Irrigation Structures

Irrigation structures that cause energy dissipation may have a potential use for developing hydropower during the irrigation season. Such structures include diversion dams, local chutes and drops of water elevation along irrigation canals, local drops from one irrigation canal to another, or drops that allow irrigation return water to reach a river. Therefore, a brief investigation was conducted of the small hydropower potential at existing and proposed irrigation structures. The analysis techniques used were similar to, but less extensive than, those for existing and proposed dams. Information on these structures came from contacts with U.S. Bureau of Reclamation staff and local irrigation districts.

POWER AND ENERGY POTENTIALS AT EXISTING DAMS

Number of Dams Analyzed

At the outset of the Phase II study, it was found that there are about 2500 dams in Oregon of sufficient height (10 feet or more) or storage capacity (9.2 acre-feet of water or more) to require registration with the Oregon State Engineer (now the OWRD). Hundreds of smaller dams also exist in Oregon. Most of the registered dams were found to be on small creeks with insufficient streamflow to achieve the lower limit of the "small hydro" criteria.

Elimination of all dams incapable of producing 200 kW with streamflow available 50 percent of the time left 107 projects for analysis. Of these, 48 presently have installed facilities and generate hydroelectric power and 59 do not. With respect to power size, 18 power projects have generation capacities of 25 MW or more. The remaining 30 power dams and 59 non-power dams are in the small-scale hydropower range of 200 kW to 25 MW. In addition to these 107 projects, there are 7 large power dams on interstate rivers: four on the Columbia River -- Bonneville, The Dalles, John Day, and McNary -- and three on the Snake River -- Hells Canyon, Oxbow, and Brownlee.

Potentials at Existing Hydropower Projects

Present Potential

Table I lists the 48 existing power projects in Oregon and 7 interstate power projects that presently have generating capabilities of 200 kW or more, regardless of size ("small" or "large"). Also included in Table I are two Oregon power projects smaller than 200 kW but listed by the Federal Power Commission (FPC) as having power generation.

The project identification numbers used in Table I and in subsequent tables and figures were developed for the Phase II study. In this report they are indexed to the OWRD drainage basins shown in Figure 1. The first one or two digits identify the basin number. (For basin 2, the subbasins 2A, 2B, 2C are identified by the 2-digit numbers 21, 23, 25, respectively). The last two digits are unique numbers for projects in a particular basin. All remaining information in Table I was taken from published sources. Most of the numerical values in the last four columns were taken from the FPC report "Hydroelectric Power Resources of the United States, Developed and Undeveloped, January 1,

TABLE I. EXISTING HYDROELECTRIC PROJECTS[1]

River Basin and Project Name	Project Number	Owner	River	Dam Height, ft.	Hydraulic Head, ft.	Developed Capacity MW	Developed Annual Energy GWh	Undeveloped Capacity MW	Undeveloped Annual Energy GWh
2. Willamette Basin									
Walterville	2109	City of Eugene	McKenzie R.	55	47	8.0	70.0	0	0
Leaburg	2103	City of Eugene	McKenzie R.	22	89	13.5	108.9	20.0	105.0
Couger	2105	Corps of Engineers	S.Fk. McKenzie R.	467	321	25.0	150.0	23.9	85.3
Trail Bridge Rereg Dam	2102	City of Eugene	McKenzie R.	87	78	10.0	46.0	0.5	4.6
Carmen-Smith Diversion Sys	2100	City of Eugene	McKenzie R.	225	489	80.0	101.6	21.6	27.4
Dexter Rereg Dam	2110	Corps of Engineers	Mid.Fk. Willamette R.	93	53	15.0	80.0	8.6	20.2
Lookout Point	2111	Corps of Engineers	Mid.Fk. Willamette R.	246	185	120.0	330.0	0	0
Hills Creek	2119	Corps of Engineers	Mid.Fk. Willamette R.	303	256	30.0	170.0	19.7	17.2
Baker Creek McMinnville	2325	Unknown	Baker Cr.	0	230	0.2	0.4	9.7	9.5
Stayton	2309	Pacific Power & Light Co.	N. Santiam R.	0	15	0.6	4.0	9.3	5.9
Marion Investment	2323	Santiam Wtr. Control Dist.	N. Santiam R.	0	14	0.9	3.9	0	0
Big Cliff Rereg Dam	2311	Corps of Engineers	N. Sanitam R.	101	91	18.0	100.0	16.4	39.2
Detroit	2313	Corps of Engineers	N. Santiam R.	364	285	100.0	367.7	6.9	57.1
Breitenbush	2324	Kennedy Electric Co.	Breitenbush R.	1	16	0.01	0.1	9.9	9.8
Albany	2315	Pacific Power & Light Co.	S. Santiam Canal	10	36	0.8	3.7	11.0	87.6
Foster	2318	Corps of Engineers	S. Santiam R.	123	110	20.0	110.0	51.6	60.4
Green Peter	2319	Corps of Engineers	Mid. Santiam R.	319	307	80.0	230.0	0	0
Lake Oswego	2505	Lake Oswego Corp.	Oswego Cr.	26	22	0.4	1.7	5.8	25.6
West Linn	2506	Crown Zellerbach Corp.	Willamette R.	0	43	13.9	30.0	0	0
Sullivan	2507	Portland Gen'l Elec. Co.	Willamette R.	40	37	15.4	80.0	277.1[2]	741.1[2]
Willamette Falls	2508	Publishers Paper Co.	Willamette R.	30	45	1.75	6.9	208.8[2]	914.3[2]
River Mill Dam	2510	Portland Gen'l Elec. Co.	Clackamas R.	78	81	19.05	104.5	15.6	39.8
Faraday Diversion/Forebay	2511	Portland Gen'l Elec. Co.	Clackamas R.	66	130	34.5	180.0	0	0
North Fork	2513	Portland Gen'l Elec. Co.	Clackamas R.	145	133	38.4	213.0	19.1	22.7
Oak Grove Diversion Sys	2517	Portland Gen'l Elec. Co.	Clackamas R.	65	879	51.0	245.0	0	0
25 Projects						696.4	2,737.4	492.5	1,445.0
3. Sandy Basin									
Bull Run (Lake Roslyn)	304	Portland Gen'l Elec. Co.	Bull Run R. & Sandy R.	40	321	21.0	141.0	0	0
4. Hood Basin									
Powerdale	401	Pacific Power & Light Co.	Hood R.	0	210	6.0	47.5	26.3	86.3

TABLE I. Cont'd.

River Basin and Project Name	Project Number	Owner	River	Dam Height, ft.	Hydraulic Head, ft.	Developed Capacity MW	Developed Annual Energy GWh	Undeveloped Capacity MW	Undeveloped Annual Energy GWh
5. Deschutes Basin									
Pelton	504	Portland Gen'l Elec. Co.	Deschutes R.	175	149	108.0	400.0	12.0	3.0
Round Butte	505	Portland Gen'l Elec. Co.	Deschutes R. & Metolius R.	430	338	247.0	946.0	0	0
Cline Falls	506	Pacific Power & Light Co.	Deschutes R.	0	270	1.0	5.3	19.7	86.3
Bend Power	508	Pacific Power & Light Co.	Deschutes R.	16	15	1.1	6.3	0	0
Jack Creek 5	510	Lundgren Leonard	Jack Cr.	0	51	0.09	0.4	9.8	9.5
5 Projects						357.2	1,358.0	41.5	98.8
8. Grand Ronde Basin									
Wallowa Falls	807	Pacific Power & Light Co.	E.Fk. Wallowa R.	17	800	1.1	8.0	0	0
9. Powder Basin									
Rock Cr.	907	Calif. Pacific Utility Co.	Rock Cr.	0	936	0.8	4.9	0	0
14. Klamath Basin									
John C. Boyle	1403	Pacific Power & Light Co.	Klamath R.	0	463	80.0	369.0	150	111
Link River (East-West)	1401	Pacific Power & Light Co.	Klamath R.	17	49	3.8	26.3	0	0
2 Projects						83.8	395.3	150	111
15. Rogue Basin									
Savage Rapids Diversion	1513	Bureau of Reclamation	Rogue R.	30	26	1.3	2.0	11.0	55.9
Eagle Point	1511	Pacific Power & Light Co.	Little Butte Cr.	0	409	2.8	20.0	0	0
Green Springs	1518	Bureau of Reclamation	Emigrant Cr.	23	1,768	16.0	63.0	0	0
Lost Creek	1505	Corps of Engineers	Rogue R.	332	275	49.0	303.0	29.2	31.5
Prospect No. 3 Sys.	1507	Pacific Power & Light Co.	S.Fk. & Mid.Fk. Rogue R.	0	720	7.2	50.0	4.0	26.3
Prospect No. 1,2,4 Sys.	1508	Pacific Power & Light Co.	Rogue R. & Mid.Fk. Rogue R.	0	720	36.8	313.2	16.0	60.0
6 Projects						113.1	751.2	60.2	173.7

TABLE I. Cont'd.

River Basin and Project Name	Project Number	Owner	River	Dam Height, ft.	Hydraulic Head, ft.	Developed Capacity MW	Developed Annual Energy GWh	Undeveloped Capacity MW	Undeveloped Annual Energy GWh
16. Umpqua Basin									
Lemolo #1	1610	Pacific Power & Light Co.	N. Umpqua R.	115	738	29.0	181.0	54.1	144.5
Lemolo #2	1604	Pacific Power & Light Co.	N. Umpqua R.	28	714	33.0	237.0	0	0
Clearwater #1	1614	Pacific Power & Light Co.	Clearwater R.	13	634	15.0	56.8	0	0
Clearwater #2	1613	Pacific Power & Light Co.	Clearwater R.	20	742	26.0	67.0	0	0
Toketee	1609	Pacific Power & Light Co.	N. Umpqua R.	50	420	42.5	261.0	0	0
Fish Creek	1612	Pacific Power & Light Co.	Fish Cr. & N. Umpqua R.	9	995	11.0	62.3	24.9	134.6
Slide Creek	1608	Pacific Power & Light Co.	N. Umpqua R.	25	166	18.0	105.7	0	0
Soda Springs	1607	Pacific Power & Light Co.	N. Umpqua R.	115	107	11.0	71.9	10.7	12.0
8 Projects						185.5	1,042.7	89.7	291.1
State Totals									
50 Projects						1,464.9	6,486.0	860.2	2,205.9
Columbia River (Interstate)									
Bonneville		Corps of Engineers	Columbia R.	76	59	518.4	4,540.0	1,303.0	3,221.0
The Dalles		Corps of Engineers	Columbia R.	114	83	1,806.8	8,199.0	739.0	2,598.0
John Day		Corps of Engineers	Columbia R.	113	105	2,160.0	11,283.0	540.0	300.0
McNary		Corps of Engineers	Columbia R.	74	55	980.0	6,720.0	1,050.0	300.0
4 Projects						5,465.2	30,742.0	3,632.0	6,419.0
Snake River(Interstate)									
Hells Canyon		Idaho Power Co.	Snake R.	318	210	391.5	1,996.0	750.0	131.0
Oxbow		Idaho Power Co.	Snake R.	140	119	190.0	1,044.0	286.0	173.0
Brownlee		Idaho Power Co.	Snake R.	272	231	360.4	2,308.0	809.0	530.0
3 Projects						941.9	5,348.0	1,845.0	834.0
Interstate Totals									
7 Projects						6,407.1	36,090.0	5,477.0	7,253.0

1. Data Sources: Federal Power Commission, 1976; U.S. Army Corps of Engineers, 1979; State Engineer of Oregon, 1973.
2. Undeveloped potential involves alternative sites; average used to obtain basin and state totals.

1976". Some of the projects involve diversion canals without dams; some involve more than one dam or diversion as part of the system.

The combined installed capacity at the 50 existing in-state power projects is 1,465 MW. The corresponding annual energy generation is 6,486 GWh. For comparison, the 7 Columbia and Snake River interstate dams have an installed capacity of 6,407 MW and generate 36,090 GWh annually. Of the 50 in-state power projects, 18 can be thought of as "large" in that they equal or exceed 25 MW of installed capacity.

Figure 4 shows the locations for all projects identified in Table I. The geographic distribution of installed capacity and energy production, by OWRD drainage basin, is shown in Figure 5. The influence of heavy precipitation and runoff from the western slopes of the Cascade Mountains in the Willamette, Umpqua and Rogue basins is reflected in Figures 4 and 5 by the concentration of power production there. The "large" projects are all found on the west-facing mountain slopes of the Cascade Range or on the main stems of the Deschutes and Klamath Rivers, fed by Cascade runoff (see Figure 4).

Future Expansion Potential

A significant expansion potential has been estimated (by others) for the 50 existing power projects. From Table I, the undeveloped capacity that could be tapped is 860 MW. This would yield 2,206 GWh of energy output. For comparison, the 7 interstate dams have an expansion potential of 5,477 MW and 7,253 GWh. Figure 6 shows the geographic distribution of the in-state expansion potential.

Constraints on Future Expansion

This expansion potential, as estimated by others, apparently assumes that all untapped streamflow will be available for turbines without competition for other water uses. No estimate has been made on the practical limits to which this potential can be developed. One factor, certainly, will be the timing of development, as the passage of time will allow more allocation of available streamflow for other uses. The practical expansion at existing power projects will depend upon basin plans for each stream, as developed and reviewed by the Water Policy Review Board and the Water Resources Department.

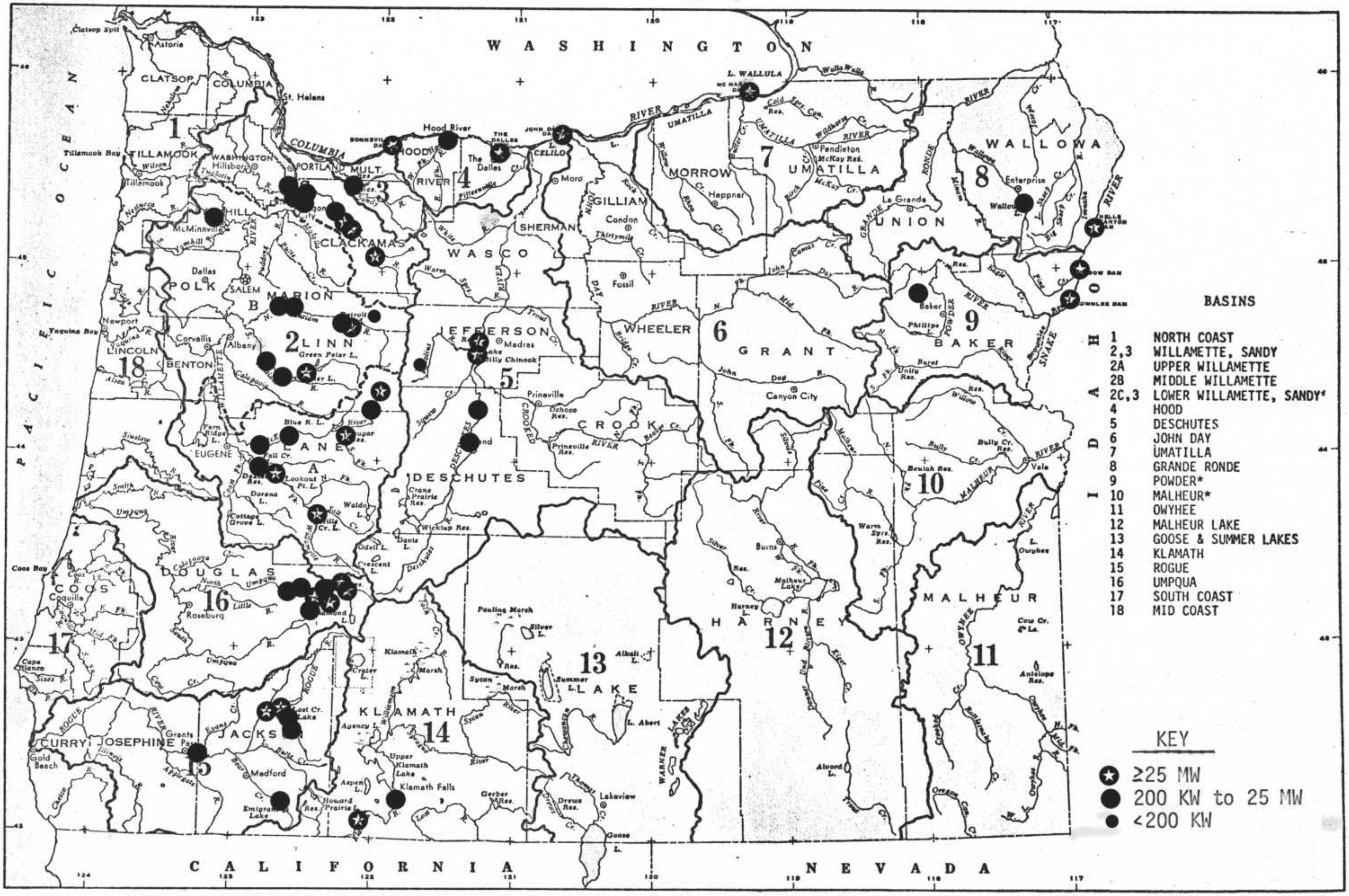
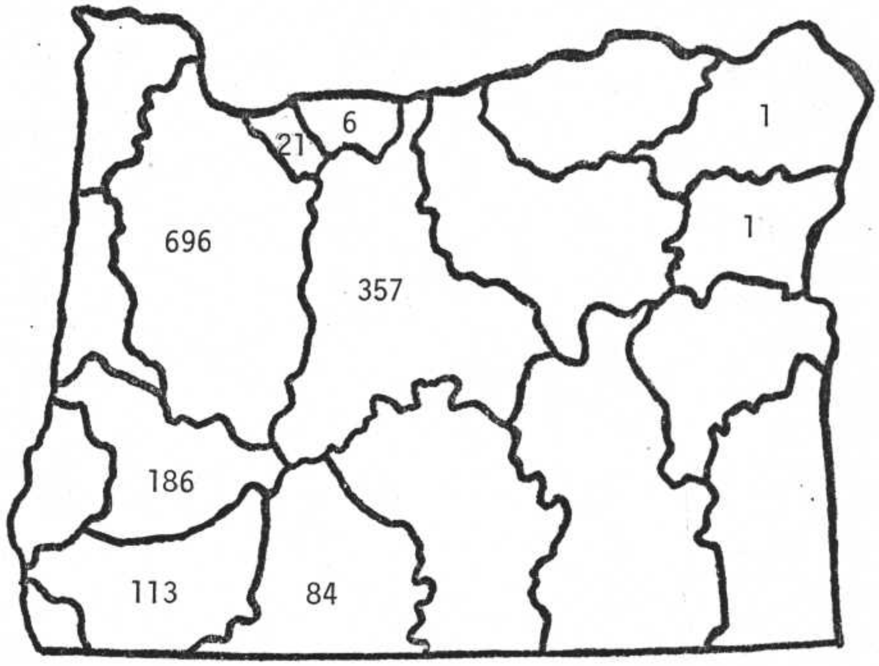
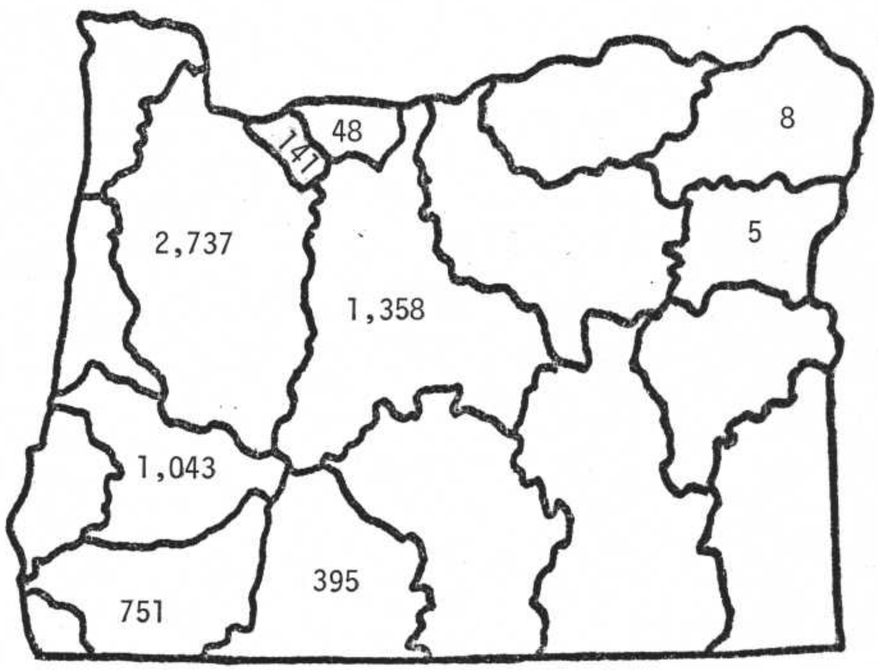


FIGURE 4. EXISTING HYDROELECTRIC PROJECTS

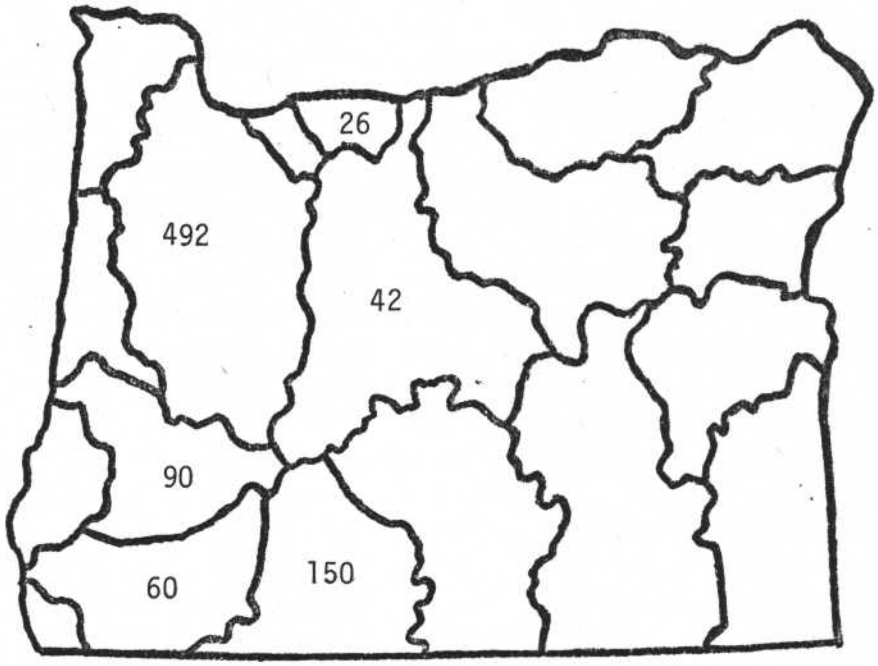


A. POWER, MW

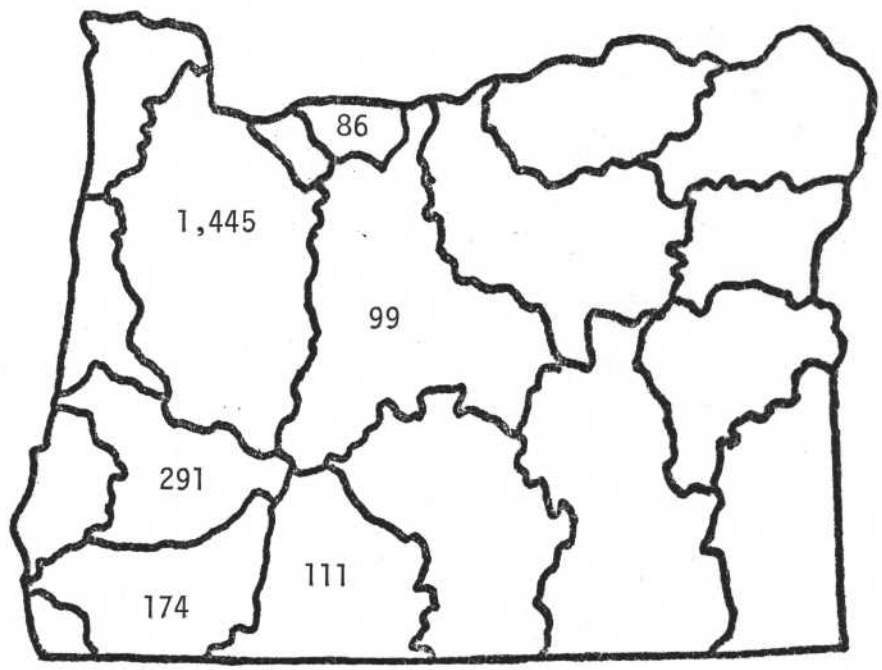


B. ENERGY, GWh

FIGURE 5. INSTALLED POWER AND ENERGY CAPABILITY AT EXISTING HYDROELECTRIC PROJECTS



A. POWER, MW



B. ENERGY, GWh

FIGURE 6. UNDEVELOPED POWER AND ENERGY POTENTIAL AT EXISTING HYDROELECTRIC PROJECTS

Potentials at Existing Non-Power Dams

Future Potential

Table II lists the 59 existing non-power dams in Oregon that have a P_{50} potential of 200 kW or more. The format used for Table II is similar to that for Table I. Hydroelectric power and energy values were obtained from the Phase II analyses. None of the existing non-power dams has a hydroelectric potential greater than 25 MW with their presently-regulated streamflow patterns. Therefore, Table II also may be considered as presenting the small-scale hydro potential at existing non-power dams.

The combined potential capacity of the 59 existing non-power dams for the 50 percent exceedance condition is estimated to be 117 MW. The corresponding potential annual energy generation is 784 GWh.

Figure 7 shows the locations for all non-power dams identified in Table II. The geographic distribution of their potential power and energy, by OWRD drainage basin, is shown in Figure 8.

Detailed power and energy potentials were calculated for the 59 existing non-power dams having P_{50} potentials of 200 kW or more. Five exceedance levels were used (10, 30, 50, 80, 95 percent), spanning the streamflow-duration curves, in order to characterize these potentials. Table III summarizes these power and energy potentials by OWRD drainage basin and for the entire state. The tabulated data for individual dams are given in Appendix A. Like Table II, Table III may be considered to deal with the small-scale hydro potential at existing non-power dams.

The analyses summarized in Table III show the influence of seasonal streamflow patterns. For example, using power summaries for the entire state, it is seen that the P_{95} potential, available almost all year-around, is only 27 MW whereas the median power potential (P_{50}) is 117 MW (noted earlier, in discussing Table II) and the near-maximum power potential (P_{10}) is 485 MW. Thus, streamflow variability causes almost a 20-fold range between the P_{95} and P_{10} values.

Constraints on Future Potential

A preliminary feasibility analysis was made for the existing non-power dams to identify possible constraints on future power development. The feasibility

TABLE II. EXISTING NON-POWER DAMS WITH HYDROELECTRIC GENERATION POTENTIALS (P_{50}) EXCEEDING 200 kW[1]

River Basin and Dam Name	Dam Number	River[a]	Dam Height, ft.	Hydraulic Head, ft.	Potential @50% Exceedance: Capacity MW	Potential @50% Exceedance: Annual Energy GWH
1. North Coast Basin						
Youngs River Reservoir	0101	Youngs R.	81	81	0.4	2.6
City of Seaside Reservoir	0102	Necanicum R.	17	17	0.2	1.3
2 Dams					0.6	3.9
2. Willamette Basin						
Blue River Reservoir	2104	Blue R.	312	278	3.1	19.7
Fern Ridge Reservoir	2106	Long Tom R.	49	40	0.4	2.2
W. Oregon Lumber Co. Pond	2107	McKenzie R.	7	7	2.4	18.9
Fall Creek Reservoir	2112	Fall Cr.	205	181	3.8	24.2
Rickini Mill Pond	2114	Coast Fk. Willamette R.	17	17	1.2	7.8
Dorena	2115	Row R.	154	129	4.0	26.2
Cottage Grove	2116	Coast Fk. Willamette R.	103	76	0.9	5.8
Pond C	2118	Culp Cr. & Row R.	17	17	0.4	2.5
Catching Reservoir	2121	N. Fk. Mid. Fk. Willamette R.	24	24	0.7	4.6
Mill Creek	2301	S. Yamhill R.	Unknown	20	0.7	4.1[2]
Mercer Reservoir	2307	Rickreall Cr.	83	71	0.2	1.3
Unnamed	2308	N. Santiam R.	32	32	5.4	34.4
Lyons Pond	2310	N. Santiam R.	10	9	1.1	6.9
Western Veneer & Plywood	2314	S. Santiam R.	12	9	1.4	9.1
Schneider Lumber Co. Reservoir	2320	Calapooia R.	10	10	0.3	2.0
Lebanon[3]	2322	S. Santiam R.	10	10	1.5[3]	9,4[3]
Scoggins	2501	Scoggins Cr.	150	95	0.3	2.0
Faraday Diversion	2512	Clackamas R.	44	38	7.2	53.0[2]
Frog Lake	2514	Oak Grove Fk. Clackamas R.	70	65	1.4	9.2[2]
Timothy Lake	2516	Oak Grove Fk. Clackamas R.	110	100	1.2	8.3[2]
Lake Harriet	2518	Oak Grove Fk. Clackamas R.	74	50	1.0	7.0[2]
21 Dams					38.6	258.6

TABLE II. Cont'd.

River Basin and Dam Name	Dam Number	River[1]	Dam Height, ft.	Hydraulic Head, ft.	Potential @50% Exceedance	
					Capacity MW	Annual Energy GWH
3. Sandy Basin						
Bull Run No. 2[4]	0301	Bull Run R.	125	110	4.6	29.7
Bull Run No. 1[4]	0302	Bull Run R.	200	194	4.0	26.5
2 Dams					8.6	56.2
5. Deschutes Basin						
Tygh Valley[3]	0501	Tygh Cr. & White R.	12	205	1.2	8.7
Pelton Reregulating Dam	0503	Deschutes R.	68	36	4.6[2]	38.1[2]
Prineville Dam	0509	Crooked R.	245	182	2.1	12.6
Crane Prairie	0511	W. Fk. Deschutes R.	31	27	0.3	2.2
Wickiup Reservoir	0512	Deschutes R.	100	81	0.9	6.7
5 Dams					9.1	68.3
7. Umatilla Basin						
Three Mile Falls Dam	0701	Umatilla R.	24	23	1.5	9.5
8. Grande Ronde Basin						
Arnoldus Loop Reservoir	0801	Grande Ronde R.	15	15	0.2	1.5
Fleet's Loop	0803	Grande Ronde R.	19	19	0.3	1.9
Elmer's Reservoir No. 3	0805	Grande Ronde R.	18	18	0.3	1.8
3 Dams					0.8	5.2
9. Powder Basin						
Thief Valley Reservoir	0901	Powder R.	65	58	0.4	2.5
Mason Dam	0905	Powder R.	167	159	0.6	3.6
Unity Reservoir	0906	Burnt R.	83	62	0.2	1.6
3 Dams					1.2	7.7

TABLE II. Cont'd.

River Basin and Dam Name	Dam Number	River[1]	Dam Height, ft.	Hydraulic Head, ft.	Potential @50% Exceedance Capacity MW	Potential @50% Exceedance Annual Energy GWH
10. Malheur Basin						
Agency Valley Reservoir	1001	N. Fk. Malheur R.	94	83	0.5	3.7
11. Owyhee Basin						
Owyhee Dam	1101	Owyhee R.	417	225	6.8	48.7
14. Klamath Basin						
Keno Dam	1402	Klamath R.	31	27	1.4	10.3
15. Rogue Basin						
Gold Hill[3]	1512	Rogue R.	Unknown	90	14.4	95.7[2]
Gold Ray Dam[3]	1515	Rogue R.	31	35	5.6	37.2
Lincoln Savage	1517	Applegate R.	10	10	0.6	4.0
Applegate Dam	1521	Applegate R.	242	211	3.3	21.8
4 Dams					23.9	158.7
16. Umpqua Basin						
Sutherlin Log Pond	1603	Calapooya Cr.	18	15	0.2	1.3
Mar-Linn Timber Corp. Log Pond	1605	N. Fk. Umpqua R.	20	17	2.3	15.2
Little River Log Pond	1606	Little R.	20	18	0.2	1.3
Iverson Lumber Co. Log Pond	1611	S. Umpqua R.	7	7	1.0	6.6
Log Pond at Green Sta.	1615	S. Umpqua R.	18	16	2.3	15.1
Pacific Plywood Corp. Log Pond	1616	S. Umpqua R.	13	12	1.7	11.1
Log Pond #2	1617	S. Umpqua R.	10	10	1.2	7.9
Round Prairie Log Pond	1618	S. Umpqua R.	9	9	1.1	7.1
Log Pond	1619	Cow Cr.	5	5	0.2	1.1[2]
Herbert Lumber Co. Log Pond	1620	S. Umpqua R.	12	10	0.5	3.2
Winchester[3]	1621	N. Umpqua R.	110	80	11.4	74.3[2]
11 Dams					22.1	144.2

TABLE II. Cont'd.

River Basin and Dam Name	Dam Number	River[4]	Dam Height, ft.	Hydraulic Head, ft.	Potential @50% Exceedance Capacity MW	Annual Energy GWH
17. South Coast Basin						
Myrtle Pt. Veneer Log Pond	1703	Coquille R.	8	6	0.6	3.5
Powers Pond	1704	S. Fk. Coquille R.	15	15	0.3	1.9
Port Orford Plywood Log Pond	1705	Sixes R.	35	15	0.3	1.6
3 Dams					1.2	7.0
18. Mid-Coast Basin						
Valsetz Lake Dam	1801	S. Fk. Siletz R.	40	40	0.2	1.5
State Totals						
59 Dams					116.5	783.5

[1] Data Sources: State Engineer of Oregon, 1978; U.S. Army Corps of Engineers, 1979; U.S. Bureau of Reclamation, 1977; Klingeman, 1979.

[2] Data Source: Energy Calculation with plant factor from Klingeman, 1979.

[3] Abandoned power generation facilities.

[4] Power facilities are presently under construction.

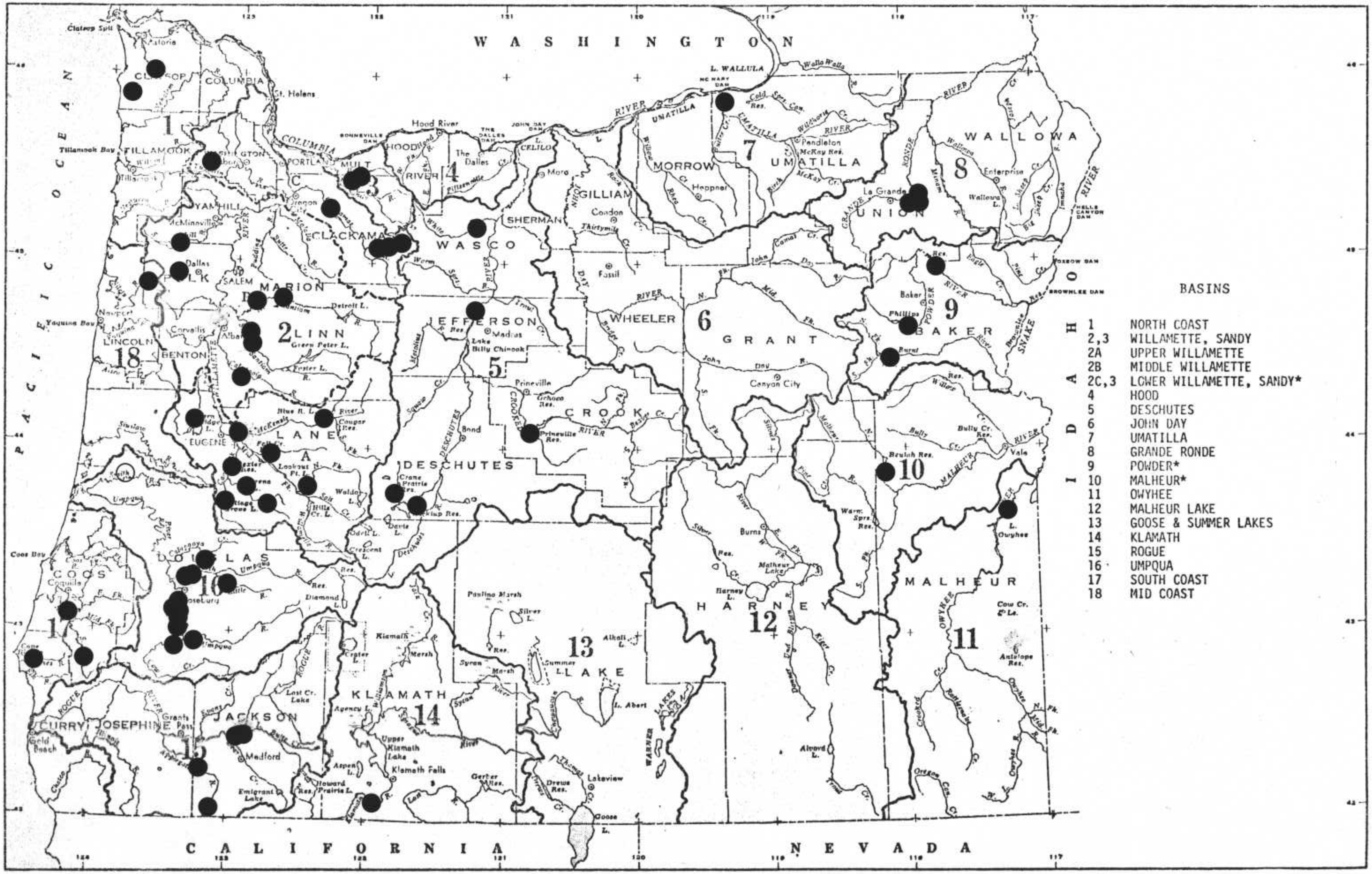
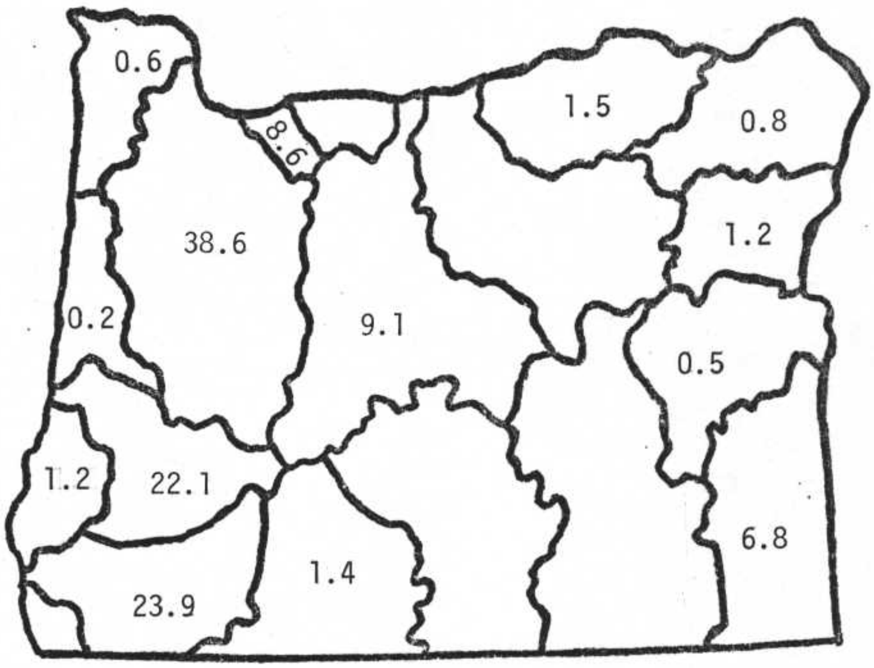
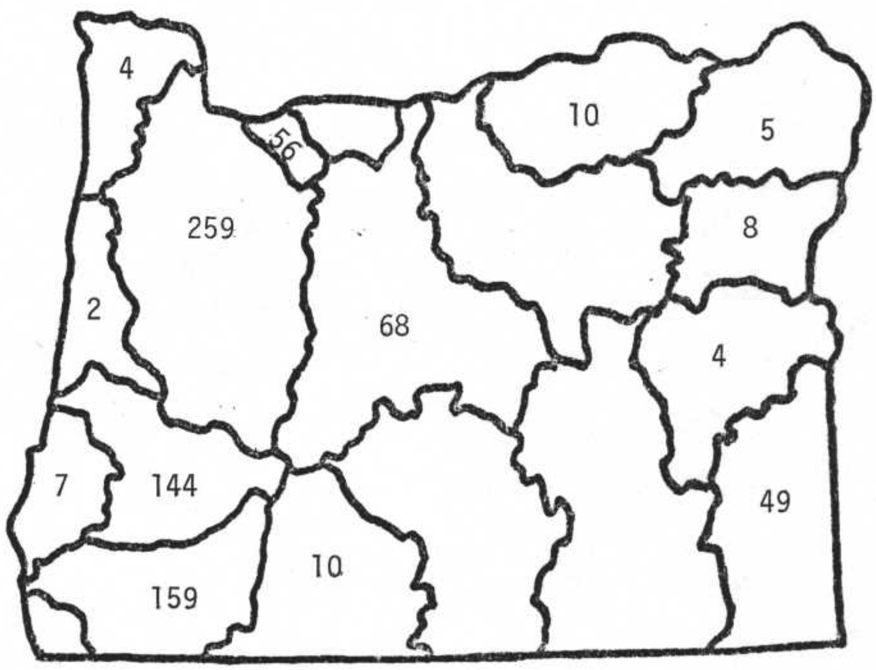


FIGURE 7. EXISTING NON-POWER DAMS WITH HYDROELECTRIC GENERATION POTENTIALS (P_{50}) EXCEEDING 200 kW



A. POWER, MW



B. ENERGY, GWh

FIGURE 8. POTENTIAL POWER AND ENERGY AT EXISTING NON-POWER DAMS WITH P_{50} POTENTIALS EXCEEDING 200 kW

TABLE III. DETAILED POWER AND ENERGY POTENTIALS AT EXISTING NON-POWER DAMS

DRAINAGE BASIN	POWER (MW)					ENERGY (GWh)				
	P_{10}	P_{30}	P_{50}	P_{80}	P_{95}	E_{10}	E_{30}	E_{50}	E_{80}	E_{95}
1. North Coast	3.6	1.4	0.6	0.1	0.1	10.4	6.6	3.9	1.2	0.6
2. Willamette	140.7	69.0	38.6	14.5	9.6	491.6	366.2	258.6	120.8	84.6
3. Sandy	26.0	14.6	8.6	2.6	1.6	96.8	77.0	56.2	21.7	13.7
5. Deschutes	31.5	15.1	9.1	3.2	1.7	132.5	98.4	68.3	27.3	15.0
7. Umatilla	6.5	3.3	1.5	0.5	0.1	21.5	15.9	9.5	4.0	0.5
8. Grande Ronde	6.5	2.4	0.8	0.2	0.1	18.1	10.9	5.2	1.8	0.8
9. Powder	7.1	2.6	1.2	0.4	0.2	20.7	12.7	7.7	3.5	1.7
10. Malheur	2.4	0.9	0.5	0.4	0.3	7.9	5.2	3.7	2.9	2.4
11. Owyhee	70.2	16.4	6.8	3.8	2.6	176.7	82.5	48.7	31.9	23.0
14. Klamath	3.8	2.1	1.4	1.0	0.7	15.9	13.0	10.3	8.1	5.9
15. Rogue	85.4	43.9	23.9	8.6	5.1	301.5	228.5	158.7	71.6	44.9
16. Umpqua	90.7	43.0	22.1	7.0	4.4	301.0	217.6	144.2	58.4	38.5
17. South Coast	9.2	3.1	1.2	0.2	0.1	24.5	13.8	7.0	1.7	1.10
18. Mid-Coast	1.4	0.5	0.2	0.1	0.0	4.2	2.6	1.5	0.4	0.2
State Totals	485.0	218.3	116.5	42.6	26.6	1623.3	1150.9	783.5	355.3	232.9

analysis for these dams included environmental restraints as well as transmission and load considerations.

Table IV summarizes the preliminary feasibility analysis. Each dam is identified by its number (see Table II). Four columns follow to identify environmental restraints. The next two columns provide transmission information and the last two columns show load possibilities. Of particular interest is the synopsis at the end of Table IV. This shows that of the 59 dams, 9 have land use restrictions, 40 involve utility displacements, 36 involve significant building displacements, and 46 are subject to special fish problems. None of the dams are more than 10 miles from a transmission line but 39 are without a local market closer than the nearest transmission line.

Screening for Minimally Constrained Dams

To indicate the "least constrained" dams, a practical but somewhat arbitrary screening process has been applied. First, dams were eliminated from consideration if they had a land use restriction. Second, for all remaining dams, if more than one feasibility restraint occurred among utility displacement, building displacement, or special fish problems, the dam was eliminated. Third, for dams still remaining, a transmission line within 10 miles or the availability of a local market were essential -- otherwise the dam was eliminated.

Applying these screening criteria, 19 dams were found to relatively unconstrained, 9 of them in the Willamette basin. They are identified in Table V. Collectively, these represent a theoretical developable power of 44 MW available 50 percent of the time (median conditions), corresponding to 295 GWh. As already stated, this assumes that future reservoir operation does not significantly modify the present streamflow release patterns. Altering storage capability at the same time as retrofitting the dam to generate power could modify the potential power and energy capability; however, the likely extent of storage and operation changes can not be anticipated without extensive analysis and is not included here.

TABLE IV. FEASIBILITY CONSTRAINTS ON DEVELOPING POWER AT EXISTING NON-POWER DAMS WITH P_{50} EXCEEDING 200 kW

BASIN AND DAM NUMBER	ENVIRONMENTAL RESTRAINTS				TRANSMISSION AND LOAD CONSIDERATIONS			
	LAND USE RESTRICTIONS	UTILITY DISPLACEMENT	BUILDING DISPLACEMENT	SPECIAL FISH PROBLEMS	DISTANCE TO NEAREST LINE Miles	LINE CAPACITY[1] KVA	LOCAL MARKET[2]	DISTANCE TO CITY > 1000, Miles
1. North Coast								
0101	X	-	-	X	3.8	115-PPL	-	6.8
0102	-	X	X	X	0.8	115-PPL	1,2	5.0
2. Willamette								
2104	-	-	-	X	7.0	115-B	-	26.0
2106	-	X	X	-	0.1	69-PPL	-	14.0
2107	-	-	X	X	1.0	115-E	1,2	5.0
2112	X	X	X	X	0.5	2-115-B	-	9.0
2114	X	X	X	X	0.5	115-PPL	1,2	4.0
2115	-	X	X	X	0.5	34.5 LE-C	1,2	4.0
2116	-	X	X	-	1.0	115-PPL	1,2	1.0
2118	-	X	X	-	0.1	34.5 LE-C	-	11.0
2121	-	-	-	-	2.0	12.5 LE-C	1	3.0
2301	-	X	X	X	1.2	57-P	-	18.5
2307	-	X	X	X	1.7	69-PPL	-	15.0
2308	-	-	-	X	1.1	69/115-PPL	-	19.4
2310	-	X	X	X	0.4	69-PPL	-	29.0
2314	-	-	-	X	2.0	2-230-B	1,2	6.0
2320	-	X	X	X	3.0	230-PPL	-	10.0
2322	-	X	X	X	1.0	230/287-B	1,2	2.0
2501	-	-	-	X	0.3	57-P	-	5.5
2512	-	-	-	X	2.5	2-115-P	1	5.0
2514	-	-	-	X	4.2	500-B	1	5.0
2516	-	-	-	-	3.2	500-B	-	10.6
2518	-	-	-	X	4.2	500-B	1	5.0

TABLE IV. Cont'd.

BASIN AND DAM NUMBER	ENVIRONMENTAL RESTRAINTS				TRANSMISSION AND LOAD CONSIDERATIONS			
	LAND USE RESTRICTIONS	UTILITY DISPLACEMENT	BUILDING DISPLACEMENT	SPECIAL FISH PROBLEMS	DISTANCE TO NEAREST LINE Miles	LINE CAPACITY[1] KVA	LOCAL MARKET[2]	DISTANCE TO CITY > 1000, Miles
3. Sandy								
0301	-	-	X	-	1.7	57-P	-	5.5
0302	-	-	-	-	3.9	500-B	-	14.0
5. Deschutes								
0501	-	-	-	X	2.0	500-B	-	24.5
0503	X	X	-	X	1.3	23-PPL	-	9.1
0509	-	-	-	X	3.5	750-B	-	9.9
0511	-	X	-	X	6.5	69-M-C	-	26.6
0512	-	X	-	X	6.5	69-M-C	-	26.6
7. Umatilla								
0701	X	X	X	X	0.8	69-U-C	-	27.0
8. Grande Ronde								
0801	-	X	X	X	2.0	23-CPU	-	10.0
0803	-	X	X	X	2.0	23-CPU	-	10.0
0805	-	X	X	X	2.0	23-CPU	-	10.0
9. Powder								
0901	-	-	-	-	1.8	230-IP	-	14.8
0905	-	X	-	-	1.6	138-IP	-	9.7
0906	-	X	-	-	1.0	69-IP	-	41.0
10. Malheur								
1001	-	-	-	-	2.5	69-IP	-	48.0

TABLE IV. Cont'd.

BASIN AND DAM NUMBER	ENVIRONMENTAL RESTRAINTS				TRANSMISSION AND LOAD CONSIDERATIONS			
	LAND USE RESTRICTIONS	UTILITY DISPLACEMENT	BUILDING DISPLACEMENT	SPECIAL FISH PROBLEMS	DISTANCE TO NEAREST LINE Miles	LINE CAPACITY[1] KVA	LOCAL MARKET[2]	DISTANCE TO CITY > 1000, Miles
17. South Coast								
1703	-	X	X	X	0.3	115-B	1,2	5.2
1704	-	X	X	X	1.3	20-PPL	-	13.4
1705	-	X	X	X	0.2	115/230-B	1	3.7
18. Mid Coast								
1801	-	X	X	X	9.8	23-CPI	-	20.2
Total Number of Dams	Total Number Having Environmental Restraints				Total Number More Than 10 Miles Away		Total Number Without Local Market	
59	9	40	36	46	0		39	

[1] Line operators are as follows: PPL = Pacific Power & Light Co.; B = Bonneville Power Adm.; E = Eugene Water & Electric Board; LE-C = Lane County Electric Coop, Inc.; M-C = Midstate Electric Coop, Inc.; U-C = Umatilla Electric Coop. Assn.; CPU = California-Pacific Utilities Co.; IP = Idaho Power Co.; USBR = U.S. Bureau of Reclamation; CPI = Consumers Power Inc.

[2] 1, 2 and 3 identify known local residential, industrial, and water pumping loads, respectively.

TABLE IV. Cont'd.

BASIN AND DAM NUMBER	ENVIRONMENTAL RESTRAINTS				TRANSMISSION AND LOAD CONSIDERATIONS			
	LAND USE RESTRICTIONS	UTILITY DISPLACEMENT	BUILDING DISPLACEMENT	SPECIAL FISH PROBLEMS	DISTANCE TO NEAREST LINE Miles	LINE CAPACITY[1] KVA	LOCAL MARKET[2]	DISTANCE TO CITY > 1000, Miles
11. Owyhee								
1101	-	-	-	-	1.2	69-USBR	-	14.0
14. Klamath								
1402	-	-	-	-	0.2	69-PPL	-	11.2
15. Rogue								
1512	-	X	X	X	0.2	69-PPL	-	11.5
1515	-	X	X	X	0.2	69-PPL	-	11.5
1517	-	X	X	X	0.2	69-PPL	-	8.5
1521	-	X	X	X	8.8	69-PPL	-	17.6
16. Umpqua								
1603	-	X	X	X	0.5	230-B	1	4.5
1605	X	X	X	X	2.0	69-PPL	-	6.5
1606	-	X	X	X	1.9	3-115-PPL	-	14.8
1611	-	X	X	X	0.1	69-PPL	1,2	1.4
1615	-	X	X	X	0.1	69-PPL	1,2	1.4
1616	X	X	X	X	1.8	69-PPL	1,2	5.2
1617	-	X	X	X	0.3	69-PPL	1	5.0
1618	-	X	X	X	0.3	69-PPL	1	5.0
1619	X	X	X	X	0.8	69-PPL	1	1.2
1620	-	X	-	X	1.0	2-230-PPL	-	5.2
1621	X	X	X	X	2.0	69-PPL	-	6.5

TABLE V. MINIMALLY CONSTRAINED EXISTING NON-POWER DAMS

Dam Number	Dam Name	Potential @ 50% Exceedance Capacity MW	Potential @ 50% Exceedance Annual Energy GWh
2. Willamette Basin			
2104	Blue River Res.	3.1	19.7
2121	Catching Res.	0.7	4.6
2308	Unnamed	5.4	34.4
2314	Western Veneer & Plywood	1.4	9.1
2501	Scoggins	0.3	2.0
2512	Faraday Diversion	7.2	53.0
2514	Frog Lake	1.4	9.2
2516	Timothy Lake	1.2	8.3
2518	Lake Harriet	1.0	7.0
		21.7	147.3
3. Sandy Basin			
0301	Bull Run No. 2	4.6	29.7
0302	Bull Run No. 1	4.0	26.5
		8.6	56.2
5. Deschutes Basin			
0501	Tygh Valley	1.2	8.7
0509	Prineville Dam	2.1	12.6
		3.3	21.3
9. Powder Basin			
0901	Thief Valley Res.	0.4	2.5
0905	Mason Dam	0.6	3.6
0906	Unity Res.	0.2	1.6
		1.2	7.7
10. Malheur Basin			
1001	Agency Valley Res.	0.5	3.7
11. Owyhee Basin			
1101	Owyhee Dam	6.8	48.7
14. Klamath Basin			
1402	Keno Dam	1.4	10.3
Totals:	19 Dams	43.5	295.2

POWER AND ENERGY POTENTIALS AT PROPOSED DAMS

Number of Dams Analyzed

The initial compilation of proposed dams in Oregon totaled about 2500 sites. However, considerable duplication existed among various lists of proposed dams, due to different names for the same dam or alternative dams at different locations along a particular reach of river. Once this was sorted out, those dams were eliminated that were proposed for river reaches where the streamflow was insufficient to allow P_{50} of 200 kW or more under the small-scale hydropower assumptions. Hence, 395 proposed dams remained for analysis. Of these, 53 were found to have potentials of 25 MW or more and 342 were found to fit the small-scale hydropower category.

Potentials at Proposed "Large" Dams

Potential Based on Run-of-River Operation

Table VI lists the 53 proposed dams having potentials of 25 MW or more of hydroelectric power. The site names are based on the cited sources of information, as are the head and storage (unless otherwise noted). The values for P_{50} were calculated from the reach data from the Phase I study. The format of Table VI essentially follows that for Table II, except that system head has also been included and is used to obtain the total power in a basin if adjacent proposed projects are built that involve headwater or tailwater encroachment.

The potential capacity at the 53 proposed large dams, based on 50 percent exceedance conditions, is estimated to be 2,017 MW if all projects are developed (i.e., using system head for calculations). This potential is based on run-of-river operation. No potential annual energy generation has been estimated for proposed dams exceeding 25 MW capacity. A primary reason for this is that the run-of-river operation assumption is questionable for large projects. It is likely that significant storage capability would be included in such large projects, so that greater power and energy potentials could be achieved. However, the analysis of storage and operation modes is far beyond the scope of the present resource assessment.

Figure 9 shows the locations for 49 of the 53 proposed large dams identified in Table VI. Specific locations within the basins are unavailable for the remaining four proposed large dams. The geographic distribution of potential

TABLE VI. PROPOSED DAMS WITH HYDROELECTRIC GENERATION POTENTIALS (P_{50}) EXCEEDING 25 MW[1]

River Basin and Site Name	Site Number	River	Dam Height, ft.	Hydraulic Head, ft.	System Head, ft.	Potential Capacity @ 50% Exceedance[2], MW	
						Based On Hydraulic Head	Based On System Head
1. North Coast Basin							
Nehalem Falls	0162	Nehalem Falls	88	330	306	35.6	33.0
2. Willamette Basin							
Vida No. 1	2207	McKenzie R.	Unknown	200	162	55.1	44.6
Eugene Municipal Site 3	2208	McKenzie R.	Unknown	138	43	33.9	10.6
Bear Creek	2209	McKenzie R.	Unknown	190	70	44.9	16.5
South Fork	2211	McKenzie R.	Unknown	140	140	25.9	25.9
Natron No. 1	2230	M. Fk. Willamette R.	160	160	20	33.4	4.2
Jasper	2231	M. Fk. Willamette R.	Unknown	140	140	29.2	29.2
Lookout Point Upper	2237	M. Fk. Willamette R.	Unknown	314	270	42.6	36.6
Salmon Creek	3	Salmon Creek	Unknown	1370	Unknown	30.0[3]	30.0[4]
Mehama No. 2	2426	N. Santiam R.	10	207	206	34.0	33.8
Niagara	2427	N. Santiam R.	Unknown	380	380	46.0	46.0
Carver	2603	Clackamas R.	225	225	225	51.9	51.9
South Fork	2606	Clackamas R.	206	200	132	33.6	22.2
Fish Creek	2607	Clackamas R.	215	233	233	34.0	34.0
Nowhere Meadows	2610	Clackamas R.	360	360	81	45.2	10.2
Lower Austin Point	2612	Clackamas R.	460	460	460	37.0	37.0
Collawash	2613	Clackamas R.	Unknown	600	162	48.2	13.0
Lower Clackamas	3	Clackamas R.	Unknown	180	Unknown	72.0[3]	72.0[4]
Shell Rock	2622	Oak Grove Fk. of Clackamas R.	Unknown	927	Unknown	16.9	16.9
18 Dam Sites						713.8	534.6
3. Sandy Basin							
Marmot	0356	Sandy R.	Unknown	600	600	45.5	45.5
5. Deschutes Basin							
Moody	0550	Deschutes R.	Unknown	132	132	57.0	57.0
Lockit	0551	Deschutes R.	94	70	70	30.2	30.2
Sinamox	0552	Deschutes R.	Unknown	90	90	38.8	38.8

TABLE VI. Cont'd.

River Basin and Site Name	Site Number	River	Dam Height, ft.	Hydraulic Head, ft.	System Head, ft.	Potential Capacity @ 50% Exceedance[2], MW: Based On Hydraulic Head	Potential Capacity @ 50% Exceedance[2], MW: Based On System Head
5. Deschutes Basin (Cont'd)							
Reclamation	0553	Deschutes R.	Unknown	95	95	41.0	41.0
Oak Brook	0554	Deschutes R.	98	65	65	28.0	28.0
Sherar Falls	0556	Deschutes R.	88	75	75	32.1	32.1
Maupin	0560	Deschutes R.	148	120	95	49.1	38.9
Frieda	0561	Deschutes R.	178	145	68	58.5	27.4
North Junction	0563	Deschutes R.	Unknown	65	65	26.2	26.2
Whitehorse Rapids	0564	Deschutes R.	122	138	131	55.7	52.9
Trout Creek	0566	Deschutes R.	Unknown	133	37	50.6	14.1
Coleman	0567	Deschutes R.	78	78	65	29.0	24.2
Mecca	0568	Deschutes R.	110	110	31	38.8	10.9
Tumalo	0579	Deschutes R.	Unknown	640	223	32.2	11.2
14 Dam Sites						567.2	432.9
6. John Day Basin							
Jack Knife	0651	John Day R.	Unknown	375	66	32.5	5.7
Butte Creek	0653	John Day R.	420	340	124	27.3	10.0
2 Dam Sites						59.8	15.7
8. Grande Ronde Basin							
Elbow Creek	0853	Grande Ronde R.	107	302	302	29.1	29.1
Beaver	0854	Wenaha R.	Unknown	1460	1460	30.4	30.4
Rondowa	0860	Grande Ronde R.	420	420	408	39.0	37.9
3 Dam Sites						98.5	97.4
14. Klamath Basin							
Salt Caves	3	Klamath R.	Unknown	411	Unknown	76.5[3]	76.5[4]
15. Rogue Basin							
Ramey Falls	1554	Rogue R.	Unknown	340	340	107.7	107.7
Cooper Canyon	1560	Rogue R.	Unknown	450	430	246.7	235.7

TABLE VI. Cont'd.

River Basin and Site Name	Site Number	River	Dam Height, ft.	Hydraulic Head, ft.	System Head, ft.	Potential Capacity @ 50% Exceedance[2], MW Based On Hydraulic Head	Based On System Head
15. Rogue Basin (Cont'd)							
Buzzard's Roost	1561	Illinois R.	Unknown	550	550	81.9	81.9
Gold Beach	1563	Rogue R.	Unknown	61	61	35.7	35.7
Bald Mountain	1566	Illinois R.	Unknown	480	336	45.3	31.7
5 Dam Sites						517.3	492.7
16. Umpqua Basin							
Scottsburg	1652	Umpqua R.	Unknown	100	100	49.2	49.2
Kelleys Smith Fy	1653	Umpqua R.	Unknown	85	85	36.3	36.3
Kellogg	1654	Umpqua R.	Unknown	70	43	29.6	18.2
Wolf Creek	1655	Umpqua R.	Unknown	145	145	58.1	58.1
Rock Creek	1656	N. Umpqua R.	Unknown	221	26	31.7	3.7
Perdue	1666	S. Umpqua R.	Unknown	150	150	63.4	63.4
6 Dam Sites						268.3	228.9
18. Mid-Coast Basin							
Upper Siuslaw	3	Siuslaw R.	Unknown	190	Unknown	52.4[3]	52.4[4]
Austa (new)	1880	Siuslaw R.	Unknown	230	Unknown	7.1	7.1
2 Dam Sites						59.5	59.5
State Totals							
53 Dam Sites						2442.0	2016.7

[1] Data Sources: State Engineer of Oregon 1973; U.S. Geological Survey, 1978; Federal Power Commission, 1976; Oregon State Water Resources Board, various dates; Power Planning Committee, 1978; U.S. Army Corps of Engineers, 1976; U.S. Bureau of Reclamation, 1977.

[2] P_{50} calculations are based on Phase II data and the given hydraulic head.

[3] Location unknown; power value based on FPC, 1976.

[4] Assumes that system head = hydraulic head.

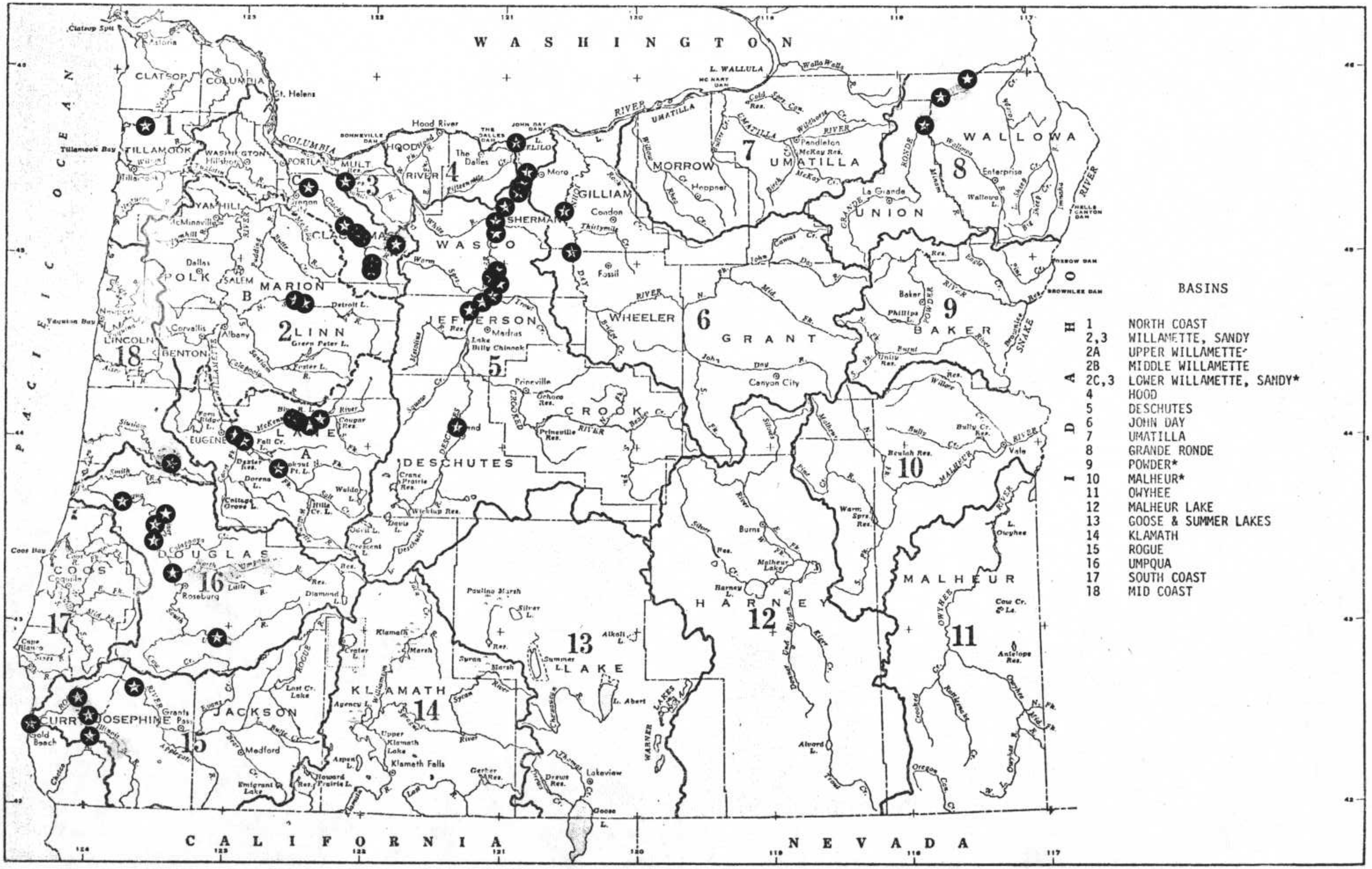
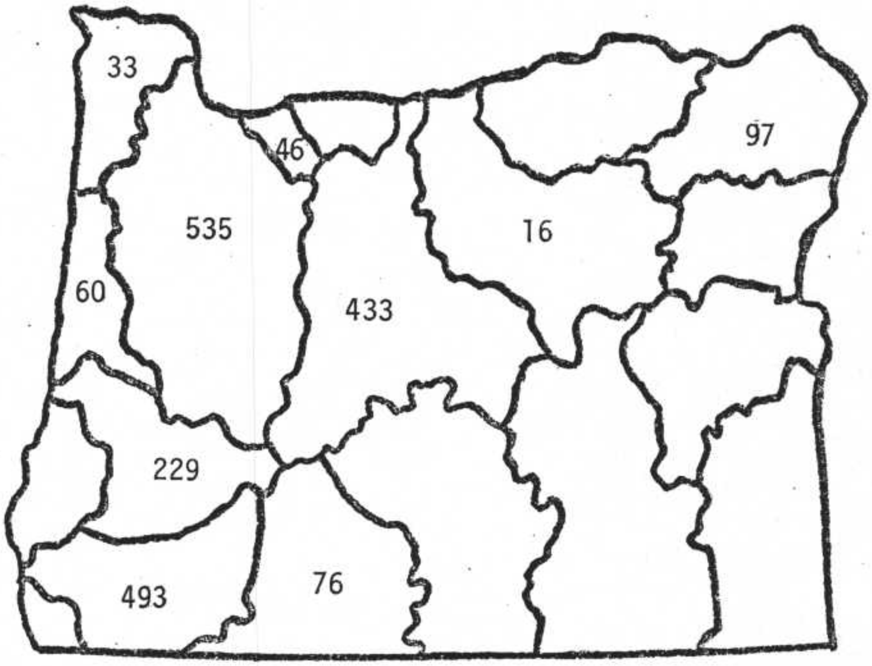


FIGURE 9. PROPOSED DAMS WITH HYDROELECTRIC GENERATION POTENTIALS (P_{50}) EXCEEDING 25 MW (SHOWING 49 OF 53 PROPOSED DAMS FOR WHICH LOCATIONS ARE KNOWN)



POWER, MW

FIGURE 10. POTENTIAL POWER AT PROPOSED DAMS WITH P_{50} EXCEEDING 25 MW, FOR RUN-OF-RIVER OPERATION

power, by OWRD drainage basin, is shown in Figure 10 for all 53 proposed large dams.

It is significant that nearly all of the proposed large dams would be located on the main stems of large rivers. These include the Clackamas, Santiam, McKenzie, Middle Fork of the Willamette, Sandy, Deschutes, John Day, Grand Ronde, Rogue, Illinois and Umpqua.

Constraints on Potential

A preliminary feasibility analysis was made for the proposed large dams to identify possible constraints on future power development. This analysis included environmental, transmission, and load considerations.

Table VII summarizes the preliminary feasibility analysis in the same manner as used earlier. The synopsis at the end of the table shows that of the 49 dam sites for which complete information is available, 23 have land use restrictions, 25 involve utility displacements, 18 involve significant building displacements, and 48 are subject to special fish problems. Three of the dams are more than 10 miles from a transmission line and 36 are without a local market closer than the nearest transmission line.

Screening for Minimally Constrained Dams

Applying the screening process described earlier, only 10 of the 49 fully-documented proposed dams were found to be relatively unconstrained. These are identified in Table VIII. Collectively, these represent a theoretical developable power of 311 MW available 50 percent of the time if all projects are developed (i.e., using system head for calculations). It should be remembered that the analysis assumes run-of-river operation.

Potentials at Proposed "Small-Scale Hydro" Dams

Potential

Table IX lists the 342 proposed dams having hydropower potentials between 200 kW and 25 MW. The table format is almost identical with that in Table VI.

The combined potential capacity at the 342 proposed small-scale hydropower sites, based on 50 percent exceedance conditions and using hydraulic heads (i.e., ignoring the encroachments of adjacent projects if all are developed), is estimated to be 2,136 MW. This corresponds to an estimated 14,076 GWh of

TABLE VII. FEASIBILITY CONSTRAINTS ON DEVELOPING POWER AT PROPOSED DAMS WITH P_{50} EXCEEDING 25 MW

BASIN AND SITE NUMBER	ENVIRONMENTAL RESTRAINTS				TRANSMISSION AND LOAD CONSIDERATIONS			
	LAND USE RESTRICTIONS	UTILITY DISPLACEMENT	BUILDING DISPLACEMENT	SPECIAL FISH PROBLEMS	DISTANCE TO NEAREST LINE Miles	LINE CAPACITY[1] KVA	LOCAL MARKET[2]	DISTANCE TO CITY > 1000, Miles
1. North Coast								
0162	-	X	X	X	5.5	115-PPL	-	20.0
2. Willamette								
2207	-	X	X	X	0.5	115-B	-	13.0
2208	-	X	X	X	0.5	115-B	-	20.0
2209	-	X	X	X	0.5	115-B	-	25.0
2211	-	X	X	X	1.0	115-B	-	28.0
2230	-	X	X	X	0.1	230-B	1,2	5.0
2231	-	X	X	X	0.1	230-B	1,2	5.0
2237	-	X	X	-	0.5	115-B	1	4.0
2426	-	-	-	X	0.3	69-PPL	-	21.0
2427	-	X	X	X	0.4	69-PPL	-	29.0
2603	X	-	-	X	1.2	230/500-B	-	7.8
2606	-	X	-	X	0.5	2-115-P	-	7.7
2607	-	X	-	X	0.4	2-115-P	1	4.1
2610	-	X	X	X	0.4	2-115-P	1	0.4
2612	-	-	-	X	2.0	500-B	1	4.8
2613	-	-	-	X	2.0	500-B	1	4.8
2622	-	-	-	X	4.2	500-B	1	5.0
Salmon Creek	*	*	*	*	*	*	*	*
Lower Clackamas	*	*	*	*	*	*	*	*
3. Sandy								
0356	-	X	X	X	0.1	2-230/287B	1,2	1.5

TABLE VII. Cont'd.

BASIN AND SITE NUMBER	ENVIRONMENTAL RESTRAINTS				TRANSMISSION AND LOAD CONSIDERATIONS			
	LAND USE RESTRICTIONS	UTILITY DISPLACEMENT	BUILDING DISPLACEMENT	SPECIAL FISH PROBLEMS	DISTANCE TO NEAREST LINE Miles	LINE CAPACITY[1] KVA	LOCAL MARKET[2]	DISTANCE TO CITY > 1000, Miles
5. Deschutes								
0550	X	-	-	X	1.6	115-B	1	12.0
0551	X	-	-	X	1.6	115-B	1	12.0
0552	X	-	-	X	2.7	2-500-B	-	20.4
0553	X	-	-	X	1.6	115-B	1	12.0
0554	X	-	-	X	2.7	2-500-B	-	20.4
0556	X	-	-	X	0.6	800-DC-B	-	24.2
0560	X	-	-	X	0.1	2-230/287B	-	28.7
0561	X	X	X	X	6.4	2-230/287B	-	27.7
0563	X	X	X	X	6.4	2-230/287B	-	27.7
0564	X	X	X	X	6.5	800 DC-B	-	19.5
0566	X	X	-	X	4.9	800 DC-B	-	14.4
0567	X	X	-	X	2.9	23-PPL	-	10.9
0568	X	X	-	X	1.3	23-PPL	-	9.1
0579	-	X	-	X	0.1	69-M-C	-	8.2
6. John Day								
0651	X	-	-	X	6.8	230-B	-	38.0
0653	X	X	-	X	13.0	23-CB-C	-	55.0
8. Grande Ronde								
0853	-	-	-	X	8.0	230-PPL	-	39.0
0854	-	-	-	X	7.0	34.5-CW	-	38.0
0860	-	-	-	X	9.8	230-PPL	-	34.0
14. Klamath								
Salt Caves	*	*	*	*	*	*	*	*

TABLE VII. Cont'd.

BASIN AND SITE NUMBER	ENVIRONMENTAL RESTRAINTS				TRANSMISSION AND LOAD CONSIDERATIONS			
	LAND USE RESTRICTIONS	UTILITY DISPLACEMENT	BUILDING DISPLACEMENT	SPECIAL FISH PROBLEMS	DISTANCE TO NEAREST LINE Miles	LINE CAPACITY[1] KVA	LOCAL MARKET[2]	DISTANCE TO CITY > 1000, Miles
15. Rogue								
1554	X	-	-	X	14.8	230-PPL	-	22.8
1560	X	-	-	X	0.4	24.9-CC-C	-	18.6
1561	X	-	-	X	4.6	24.9-CC-C	-	20.4
1563	X	X	X	X	0.6	24.9-CC-C	1	5.0
1566	X	-	-	X	13.2	24.9-CC-C	-	23.2
16. Umpqua								
1652	-	X	X	X	1.0	12.5/69D-E	-	15.3
1653	-	-	-	X	4.7	34.5-D-C	-	11.6
1654	-	-	-	X	7.8	34.5-D-C	-	15.8
1655	-	-	-	X	5.8	230-B	-	12.5
1656	X	-	X	X	2.3	69-PPL	-	6.0
1666	-	X	-	X	0.9	3-115-PPL	-	38.4
18. Mid-Coast								
1880	X	X	X	X	0.1	230-B	-	18.2
Upper Siuslaw	*	*	*	*	*	*	*	*
Total Number of Dams	Total Number of Environmental Restraints				Total Number More Than 10 Miles Away		Total Number Without Local Market	
53	23[3]	25[3]	18[3]	48[3]	3[3]		36[3]	

[1] Line operators are as follows: PPL = Pacific Power & Light Co.; B = Bonneville Power Adm.; E= Eugene Water & Electric Board; LE-C = Lane County Electric Coop, Inc.; M-C = Midstate Electric Coop. Inc.; U-C = Umatilla Electric Coop. Assn.; CPU = California-Pacific Utilities Co.; IP = Idaho Power Co.; USBR = U.S. Bureau of Reclamation; CPI = Consumers Power Inc.

[2] 1, 2 and 3 identify known local residential, industrial, and water pumping loads, respectively.

* Location unknown, other than basin and river.

[3] Excludes 4 dams for which exact location is unknown and constraint analysis can not be made.

TABLE VIII. MINIMALLY CONSTRAINED PROPOSED LARGE DAMS

Dam Site Number	Dam Site Name	Potential Capacity @ 50% Exceedance, MW: Based on Hydraulic Head	Potential Capacity @ 50% Exceedance, MW: Based on System Head
2. Willamette Basin			
2426	Mehama No. 2	34.0	33.8
2612	Lower Austin Point	37.0	37.0
2613	Collawash	48.2	13.0
2622	Shell Rock	16.9	16.9
		136.1	100.7
8. Grande Ronde Basin			
0853	Elbow Creek	29.1	29.1
0854	Beaver	30.4	30.4
0860	Rondowa	39.0	37.9
		98.5	97.4
16. Umpqua Basin			
1653	Kelleys Smith Fy.	36.3	36.3
1654	Kellogg	29.6	18.2
1655	Wolf Cr.	58.1	58.1
		124.0	112.6
Totals:	10 Dam Sites	358.6	310.7

annual energy generation. If possible encroachments among adjacent projects are considered (i.e., using system heads instead of hydraulic heads for calculations) the estimated combined potential capacity is 1,839 MW and the corresponding annual energy generation is 12,102 GWh. Both sets of estimates assume run-of-river operation.

Figure 11 shows the locations for the proposed sites identified in Table IX. The geographic distribution of their potential power and energy, by OWRD drainage basin, is shown in Figure 12. Numerical values shown in Figure 12 are based on hydraulic head. From Figure 11 it can be noted that those small-scale hydropower dams proposed in eastern Oregon are almost all "strung-out" along the largest streams. By contrast, those sites west of the Cascade crest are more widely scattered on streams of various sizes.

Detailed power and energy potentials were calculated for the 342 proposed small-scale hydropower sites, using the five exceedance levels discussed earlier. Table X summarizes the small-scale hydropower and energy potentials by OWRD drainage basin and for the state as a whole. The tabulated data for individual proposed dams are given in Appendix B. The summary in Table X is the total of individual analyses, based on hydraulic head. Because the potential encroachments of some dams on the hydraulic head for neighboring dams cause some reduction of system head over that for isolated individual dams, Table X values must be reduced by about 14 percent to take into account the head interference caused by developing the entire affected river system with all proposed dams.

As with Table III, the influence of seasonal streamflow patterns is apparent from Table X. For example, there is a 20-fold range between the P_{10} potential of 9,813 MW and the P_{95} potential of 462 MW, with P_{50} intermediate at 2,136 MW.

Constraints on Potential

The preliminary feasibility analysis made for proposed small-scale hydro dams was identical to that made earlier. This is summarized in Table XI. The synopsis at the end of the table shows that of the 341 dam sites for which complete information is available, 37 have land use restrictions, 150 involve utility displacement, 125 involve significant building displacements, and 265 are subject to special fish problems. Also, 65 of the dams are more than 10 miles from a transmission line and 306 are without a local market. Table XII shows how these constraints are distributed among the major drainage basins in Oregon and among the various constraint categories.

TABLE IX. PROPOSED DAMS WITH HYDROELECTRIC GENERATION POTENTIALS (P_{50}) BETWEEN 200 kW AND 25 MW[1]

River Basin and Site Name	Site Number	River	Dam Height, ft.	Hydraulic Head, ft.	System Head, ft.	Potential @ 50% Exceedance Capacity MW	Annual Energy GWh
1. North Coast Basin							
Young's River	0150	Young's River	50	225	225	1.2	7.3
Big Creek	0151	Big Creek	60	60	60	0.2	1.3
Lewis and Clark	0152	Lewis and Clark River	--	206	206	1.3	8.0
Squaw Creek	0153	Nehalem River	150	150	131	7.7	47.9
Necanicum	0154	Necanicum River	--	240	142	0.8	5.0
Tideport	0155	Nehalem River	163	163	29	10.2	63.8
God's Valley	0156	North Fork Nehalem River	160	340	340	2.4	15.2
Spruce	0157	Nehalem River	90	90	58	7.3	45.4
N-2	0158	Nehalem River	100	100	27	6.9	43.1
Elsie	0159	Nehalem River	165	205	93	14.2	88.3
Clear Creek	0160	Nehalem River	133	130	130	1.1	7.0
Stonehill	0161	Nehalem River	42	42	35	5.1	31.7
Wakefield	0163	Nehalem River	62	62	62	6.7	41.6
Salmonberry	0164	Nehalem River	100	100	100	8.7	54.3
Jordan	0165	Wilson River	--	175	135	4.3	26.6
Cedar Creek	0166	Wilson River	260	239	207	4.9	30.7
Mile 9	0167	Trask River	70	70	70	2.6	16.5
Fox	0168	Wilson River	--	222	222	8.0	49.9
Ginger Peak	0169	Trask River	250	250	250	8.3	51.8
Trask	0170	Trask River	--	200	3	6.6	41.3
T-2	0171	North Fork Trask River	120	120	120	4.5	28.2
Bark Shanty	0172	North Fork Trask River	200	180	180	3.2	20.2
Keyhole	0173	North Fork Trask River	110	110	95	1.3	8.3
Clear Creek	0174	North Fork Trask River	210	200	182	2.4	15.1
Hollywood	0175	South Fork Trask River	200	200	200	0.8	4.9
Blaine	0176	Nestucca River	250	240	240	4.1	25.5
Alder Glenn	0177	Nestucca River	--	500	500	5.3	33.1
Little Nestucca	0178	Little Nestucca River	--	280	280	2.5	15.4
28 Dam Sites						132.6	827.4
2. Willamette Basin							
Middle Falls	2200	McKenzie River	--	135	135	1.8	11.2

TABLE IX. Cont'd.

River Basin and Site Name	Site Number	River	Dam Height, ft.	Hydraulic Head, ft.	System Head, ft.	Potential @ 50% Exceedance	
						Capacity MW	Annual Energy GWh
Upper Falls	2201	McKenzie River	--	250	226	3.3	20.8
Mohawk #1	2202	Mohawk River	94	94	94	0.8	5.4
Upper Mohawk #1	2203	Mohawk River	39	39	39	0.2	1.3
Cook Creek	2204	Blue River	--	100	100	0.8	4.7
Olallie Creek	2205	McKenzie River	--	160	83	4.3	28.2
Gate Creek	2206	Gate Creek	240	260	260	3.3	21.2
Blue River	2210	Blue River	305	313	73	8.3	54.6
Strube	2212	South Fork McKenzie River	71	64	64	3.2	21.9
Lookout Creek	2213	Blue River	--	312	258	3.5	22.1
Combination Blue River	2214	McKenzie River	--	140	91	17.4	124.5
McKenzie Bridge	2215	McKenzie River	--	85	85	6.2	43.0
Lost Creek	2216	Lost Creek	--	250	250	3.0	19.1
Horse Creek	2217	Horse Creek	--	330	330	13.2	88.4
Foley Springs	2218	Horse Creek	--	280	153	11.2	75.0
Paradise	2219	McKenzie River	150	145	80	10.6	73.3
Foley Ridge	2220	McKenzie River	150	150	135	11.0	75.9
Belknap	2221	McKenzie River	--	385	311	20.8	141.2
Mohawk	2222	Mohawk River	75	75	75	2.8	18.9
Coburg	2223	McKenzie River	--	50	45	17.5	135.2
Deerhorn	2224	McKenzie River	--	45	45	12.4	93.9
Separation Creek	2225	Horse Creek	--	740	740	10.8	68.9
Eugene Creek	2226	Horse Creek	--	1280	878	18.7	119.3
Rainbow Creek	2227	Separation Creek	--	720	720	10.3	65.9
Harvey Creek	2228	Separation Creek	--	850	613	12.2	77.8
Springfield	2229	Willamette River	--	50	50	16.7	112.1
Augusta Creek	2232	South Fork McKenzie River	--	430	38	6.8	43.5
North Fork #2	2233	N.Fk. of Mid.Fk. Willamette R.	--	540	540	14.1	91.4
Upper North Fork	2234	N.Fk. of Mid.Fk. Willamette R.	--	555	367	9.4	60.6
Roaring River	2235	South Fork McKenzie River	--	850	694	13.4	86.0
Lakes Area Diversion	2236	South Fork McKenzie River	--	1000	737	15.8	101.1
Mile 6.7	2238	N.Fk. of Mid.Fk. Willamette R.	383	300	300	8.8	56.9
Huckleberry Creek	2239	N.Fk. of Mid.Fk. Willamette R.	--	360	30	10.5	68.3
North Fork #1	2240	Salmon Creek	--	580	580	6.0	37.7
Moolack Mountain	2241	N.Fk. of Mid.Fk. Willamette R.	--	400	400	4.8	30.2
Taylor Butte	2242	Coast Fork Willamette River	--	105	43	1.3	8.0

TABLE IX. Cont'd.

River Basin and Site Name	Site Number	River	Dam Height, ft.	Hydraulic Head, ft.	System Head, ft.	Potential @ 50% Exceedance	
						Capacity MW	Annual Energy GWh
Byar's Creek	2431	Breitenbush River	300	250	22	4.2	26.2
Hot Springs	2432	Breitenbush River	--	250	250	4.2	26.2
Hoskins	2433	Luckiamute River	99	260	260	1.3	7.6
Jordan	2434	Thomas Creek	130	130	130	1.9	11.8
Thomas Creek	2435	Thomas Creek	115	115	115	1.7	10.4
Red, Milk, Pamelia	2436	Pamelia Creek	--	1215	1215	6.1	37.8
Tunnel	2437	North Santiam River	225	290	290	13.7	86.3
Tom Creek	2438	North Santiam River	--	490	490	15.0	94.7
Tumtum	2439	Tumtum River	63	63	63	0.2	1.4
Wren	2440	Mary's River	132	132	132	1.1	6.7
Crabtree Creek	2442	Crabtree Creek	67	67	67	0.9	5.7
Sawmill Site	2443	Crabtree Creek	123	123	123	1.7	10.4
Packers Gulch	2444	Quartzville Creek	--	280	280	6.6	41.2
Independence Prairie	2445	Independence Prairie	--	800	567	11.0	69.3
Philomath	2446	Mary's River	--	220	220	2.2	13.4
Waterloo #3	2448	South Santiam River	150	150	133	22.1	140.4
Bear Creek	2449	Middle Santiam River	--	400	400	8.8	55.4
Chimney Peak	2450	Middle Santiam River	--	440	157	9.7	60.9
Pyramid Creek	2451	Middle Santiam River	--	240	92	1.6	9.7
Duffy Lake	2452	North Santiam River	--	1550	1148	10.2	63.7
Mowich Lake and Duffy Lake	2453	North Santiam River	90	1550	717	5.9	36.8
Marion Lake	2454	Marion Creek	65	1707	1707	6.4	39.6
Log Pond	2456	Wiley Creek	--	155	155	1.3	8.2
Sweet Home	2457	South Santiam River	--	45	9	6.0	38.4
Hatchery	2458	Middle Santiam River	--	39	16	2.9	18.3
Cascadia #1	2459	South Santiam River	80	320	320	13.2	83.3
Soda Fork	2460	South Santiam River	--	470	470	3.0	18.4
Holley	2461	Calapooya River	160	150	150	3.6	22.5
Wiley Creek	2462	Wiley Creek	226	280	280	2.4	14.9
Squaw & 7 Mile Cr. Junction	2463	South Santiam River	--	970	529	3.6	22.3
Dollar	2464	Calapooya River	--	525	525	9.4	59.0
Gales Creek #2A	2600	Gales Creek	90	90	90	0.4	2.4
Gaston	2601	Tualatin River	100	100	100	0.6	3.7
Forest Dale	2602	Tualatin River	--	500	404	3.0	18.3

TABLE IX. Cont'd.

River Basin and Site Name	Site Number	River	Dam Height, ft.	Hydraulic Head, ft.	System Head, ft.	Potential @ 50% Exceedance	
						Capacity MW	Annual Energy GWh
Rocky Point	2243	Row River	53	53	53	1.2	7.9
Disston	2244	Row River	150	150	150	1.8	11.6
Mosby Creek	2245	Mosby Creek	160	320	320	2.2	13.8
Kitson Hot Springs	2246	Hills Creek	--	940	940	4.5	28.3
Sand Prairie	2247	Middle Fork Willamette River	--	457	148	12.8	83.1
Boulder Creek	2248	Middle Fork Willamette River	--	370	177	10.4	67.5
Campers Flat	2249	Middle Fork Willamette River	--	480	350	10.5	68.1
Stacey Creek	2250	Middle Fork Willamette River	25	390	390	4.8	30.3
Hayden Bridge	2259	McKenzie River	--	90	90	27.2	207.6
Quartz Creek	2260	McKenzie River	--	80	--	18.5	138.9
Fairdale, Upper	2400	North Yamhill River	54	210	210	0.7	4.2
Willamina Creek, Lower	2401	Willamina Creek	99	99	99	0.6	3.8
Buck Hollow	2402	Willamina Creek	235	235	171	0.9	5.6
Dickey Bridge	2404	Molalla River	130	180	180	8.9	56.3
Dead Horse Creek	2405	North Fork Molalla River	--	700	700	5.8	36.0
Wallace Bridge	2406	South Yamhill River	108	70	70	1.0	5.8
Fort Yamhill, Lower	2407	South Yamhill River	100	100	52	0.8	5.0
Coal Creek	2409	Butte Creek	--	140	140	0.7	4.6
North Fork	2410	Molalla River	--	200	200	9.9	62.6
Pine Creek	2411	Molalla River	--	290	290	9.2	58.2
Gorge	2412	Mill Creek	--	250	250	1.0	6.3
Meridian, Lower	2414	Silver Creek	90	90	90	0.9	5.8
Unnamed	2416	Abiqua Creek	127	960	960	11.3	70.8
Grange	2417	Silver Creek	275	275	275	2.3	14.1
Silvercrest	2418	Silver Creek	110	300	17	2.5	15.4
Pelkey	2419	Molalla River	290	300	90	7.6	47.8
Headwaters	2420	Molalla River	--	480	480	12.2	76.5
Henline Creek	2421	Little North Santiam River	--	800	774	16.0	100.5
Unnamed	2422	Luckiamute River	150	150	150	0.7	4.4
Pedee	2423	Luckiamute River	113	113	113	0.5	3.0
Lewisville	2424	Little Luckiamute River	72	72	72	0.6	3.6
Aumsville	2425	North Santiam River	--	130	130	21.9	139.7
Unnamed	2428	Little North Santiam River	300	300	300	9.7	61.0
Elkhorn	2429	Little North Santiam River	230	460	93	9.2	57.8

TABLE IX. Cont'd.

River Basin and Site Name	Site Number	River	Dam Height, ft.	Hydraulic Head, ft.	System Head, ft.	Potential @ 50% Exceedance Capacity MW	Annual Energy GWh
Fischer's Mill	2604	Clear Creek	180	400	400	3.0	19.6
North Fork Diversion	2605	North Fork Clackamas River	--	676	676	2.9	18.9
Creek	2609	Fish Creek	--	730	730	4.0	26.1
Upper Austin Point	2611	Collawash River	405	600	600	20.2	139.1
Big Bottom	2614	Clackamas River	250	250	196	7.1	48.7
Clear Creek	2620	Clackamas River	--	40	--	9.7	71.9
110 Dam Sites						776.8	5103.0
3. Sandy Basin							
Troutdale	0350	Sandy River	127	127	127	17.1	107.4
Indian John	0351	Sandy River	180	180	170	22.9	143.8
Unnamed	0352	Gordon Creek	600	600	600	2.9	19.9
Blazed Alder Creek	0353	Bull Run River	--	756	756	11.4	75.3
Blazed Alder Creek	0354	Blazed Alder Creek	160	756	756	3.4	23.4
Lake Roslyn	0355	Little Sandy River	45	45	45	0.3	2.1
Zigzag	0357	Sandy River	--	250	250	5.2	33.7
Old Maids Flat	0358	Sandy River	--	700	700	11.2	73.6
Last Chance Mountain	0359	Sandy River	--	1200	1156	4.5	31.0
Rhododendron	0360	Zigzag River	--	900	900	17.1	112.2
Welches	0361	Salmon River	--	350	350	10.6	69.0
South Fork	0362	Salmon River	200	200	146	5.1	33.4
Linney	0363	Salmon River	160	820	820	15.4	101.3
Meadow	0364	Salmon River	80	420	420	4.4	29.5
14 Dam Sites						131.5	855.6
4. Hood Basin							
Unknown	0450	Lake Branch	186	186	186	0.8	5.6
5. Deschutes Basin							
Devil's Half Acre	0555	White River	--	400	400	7.9	58.4
White River	0557	White River	60	60	60	0.6	4.1
Smock Prairie	0558	White River	--	550	470	6.2	46.0

TABLE IX. Cont'd.

River Basin and Site Name	Site Number	River	Dam Height, ft.	Hydraulic Head, ft.	System Head, ft.	Potential @ 50% Exceedance Capacity MW	Potential @ 50% Exceedance Annual Energy GWh
Graveyard Butte	0559	White River	--	600	583	6.8	50.2
Schoolie	0562	Warm Springs River	100	100	100	0.9	6.5
Hot Springs	0565	Warm Springs River	--	20	20	0.5	3.9
Whitewater Creek	0569	Metolius River	78	260	260	23.7	194.8
Jefferson Creek	0570	Metolius River	--	400	400	18.6	151.1
Metolius Beach	0571	Metolius River	--	70	70	8.6	71.6
Jack's Creek	0572	Metolius River	172	300	115	14.0	113.3
Box Canyon, Lower	0573	Crooked River	155	155	35	2.3	13.9
Opal Springs	0574	Crooked River	--	490	490	7.1	43.6
Steelhead Falls	0575	Deschutes River	--	285	270	16.2	105.9
Lower Bridge	0576	Deschutes River	--	225	212	12.8	83.6
Ogden Park	0577	Crooked River	--	440	440	6.4	39.1
Aubrey Falls	0578	Deschutes River	65	410	410	20.6	135.1
Post	0580	Crooked River	137	137	97	0.6	3.5
Geneva	0581	Deschutes River	--	325	318	1.1	6.6
Lava Island Falls	0582	Deschutes River	25	225	225	15.8	102.0
Dillow Falls	0583	Deschutes River	--	100	100	9.7	62.4
Benham Falls	0584	Deschutes River	65	150	150	14.6	93.5
Black Rock	0585	Crescent Creek	52	52	52	0.5	3.3
Crescent Creek	0586	Crescent Creek	75	75	43	0.7	5.1
23 Dam Sites						196.2	1397.5
6. John Day Basin							
Ten Mile Falls	0650	John Day River	--	460	140	1.6	10.1
Bull Basin	0652	John Day River	120	120	120	10.4	70.5
Dale	0654	North Fork John Day River	270	270	270	1.5	9.6
Two Mile Canyon	0655	North Fork John Day River	--	300	300	9.1	59.8
Hicks	0656	John Day River	225	225	160	17.2	115.8
Long Creek	0657	Middle Fork John Day River	60	60	60	0.5	3.1
Sugarloaf Mountain	0659	Middle Fork John Day River	--	300	300	1.6	10.1
Johnson	0660	Middle Fork John Day River	55	200	83	1.1	6.7
Granite Creek	0661	North Fork John Day River	--	670	670	3.0	18.6
Twickenham	0662	John Day River	165	260	210	18.0	120.9
Hoogie Doogie	0663	John Day River	--	120	9	7.9	52.8

TABLE IX. Cont'd.

River Basin and Site Name	Site Number	River	Dam Height, ft.	Hydraulic Head, ft.	System Head, ft.	Potential @ 50% Exceedance Capacity MW	Annual Energy GWh
Alder Creek	0664	John Day River	90	90	80	5.9	39.6
Berry	0665	John Day River	50	50	50	3.2	21.3
Spray	0666	John Day River	112	112	25	7.1	47.7
Kimberly	0667	John Day River	--	300	300	19.0	127.7
Monument	0668	North Fork John Day River	160	160	160	5.4	35.9
Galena	0670	Middle Fork John Day River	--	220	220	0.8	4.7
Rock Creek	0671	Rock Creek	120	120	120	0.4	2.6
Humphrey Ranch	0672	John Day River	--	110	48	2.4	15.3
Picture Gorge	0673	John Day River	--	270	14	4.5	29.3
Dayville	0674	John Day River	193	193	193	3.2	21.0
Four Mile	0675	South Fork John Day River	115	350	350	1.2	7.3
Bridge Creek	0676	John Day River	--	150	150	1.6	10.6
Caynon Creek	0677	John Day River	--	650	650	5.1	32.6
Black Canyon	0678	South Fork John Day River	110	110	110	0.4	2.3
25 Dam Sites						132.1	857.9
7. Umatilla Basin							
Echo	0750	Umatilla River	--	70	70	3.2	20.1
Gibbon	0751	Umatilla River	--	100	33	1.4	8.5
Ryan Creek	0752	Umatilla River	258	310	310	1.6	9.8
Bingham Springs	0753	Umatilla River	--	290	290	1.4	8.3
Nolin	0754	Umatilla River	--	130	130	5.9	37.3
Yoakum	0755	Umatilla River	--	220	220	9.2	58.2
Pendleton	0756	Umatilla River	--	215	190	3.5	21.7
Mission	0757	Umatilla River	170	200	195	3.3	20.2
Thornhollow	0758	Umatilla River	230	230	230	3.5	21.6
9 Dam Sites						33.0	205.7
8. Grande Ronde Basin							
Fork	0850	Wenaha River	--	1000	602	7.9	56.6
Troy	0851	Grande Ronde River	243	90	90	12.4	86.2
State Line	0852	Joseph Creek	--	1055	1055	9.6	68.7
Mile 59	0855	Grande Ronde River	117	117	110	12.1	85.3

TABLE IX. Cont'd.

River Basin and Site Name	Site Number	River	Dam Height, ft.	Hydraulic Head, ft.	System Head, ft.	Potential @ 50% Exceedance: Capacity MW	Potential @ 50% Exceedance: Annual Energy GWh
Wildcat Creek	0856	Grande Ronde River	117	141	141	14.6	102.8
Paradise	0857	Joseph Creek	--	700	161	5.8	41.4
Mile 72	0858	Grande Ronde River	133	175	175	16.8	119.0
Viewpoint	0859	Joseph Creek	--	600	450	4.5	32.5
Chico	0861	Joseph Creek	140	400	400	2.0	14.4
Cow Creek	0862	Imnaha River	275	275	275	9.7	70.6
Minam	0863	Wallowa River	--	90	90	2.6	18.5
Log Creek	0864	Imnaha River	175	260	260	7.1	51.7
Wallowa Res.	0865	Wallowa River	--	690	690	17.6	127.8
Imnaha	0866	Imnaha River	--	440	440	5.8	42.0
Wade Gulch	0867	Wallowa River	--	160	40	1.7	12.4
Dunlap Creek	0868	Imnaha River	--	180	49	2.4	17.2
College Creek	0869	Imnaha River	--	240	240	3.2	22.9
Perry	0870	Grande Ronde River	--	220	220	2.2	13.9
Little Minam	0871	Minam River	--	670	670	9.5	68.4
Meadow Creek	0872	Meadow Creek	105	190	190	0.6	3.9
Grande Ronde, Lower	0873	Grande Ronde River	190	220	124	1.8	11.9
North Minam	0874	Minam River	--	500	284	4.8	34.1
Grouse Creek	0875	Imnaha River	--	360	360	4.3	31.0
Keener Gulch	0876	Imnaha River	--	400	400	3.5	24.8
Starkey	0877	Grande Ronde River	--	580	580	2.0	13.3
Gumboot	0878	Imnaha River	--	400	400	2.5	18.0
Sheep Ranch, Upper	0879	Grande Ronde River	233	233	120	0.8	5.3
Coverdale	0880	Imnaha River	245	2283	2113	14.3	102.8
28 Dam Sites						182.1	1297.4
9. Powder Basin							
Salt Creek	0950	Powder River	--	340	270	2.3	15.3
Lower Eagle Creek	0951	Eagle Creek	--	400	325	1.5	9.8
Big Timber Canyon	0952	Powder River	--	250	250	2.0	13.1
New Bridge	0953	Eagle Creek	--	520	455	2.0	13.4
Richland	0954	Powder River	--	223	176	1.8	12.0
Bowen	0955	Powder River	--	440	274	1.7	11.3
Durkee	0957	Powder River	--	150	150	1.2	7.9

TABLE IX. Cont'd.

River Basin and Site Name	Site Number	River	Dam Height, ft.	Hydraulic Head, ft.	System Head, ft.	Potential @ 50% Exceedance: Capacity MW	Potential @ 50% Exceedance: Annual Energy GWh
Hereford	0958	Burnt River	--	150	150	0.6	3.9
Dark Canyon	0959	Burnt River	101	450	450	2.2	14.9
9 Dam Sites						15.3	101.6
10. Malheur Basin							
McLoughlin	1051	Malheur River	--	225	225	1.8	12.6
Grange Site	1052	Malheur River	--	88	88	0.3	1.8
Namorff	1053	Malheur River	--	425	425	3.1	21.4
Reservoir No. 2	1054	Malheur River	--	300	300	1.6	10.9
Riverside	1055	Malheur River	--	145	53	0.8	5.2
5 Dam Sites						7.6	51.9
11. Owyhee Basin							
Upper Owyhee L.	1151	Owyhee River	90	90	42	2.5	18.1
Mahogany	1152	Owyhee River	--	200	200	5.6	40.3
Bogus Creek	1153	Owyhee River	--	320	320	8.6	61.9
Duncan Ferry	1154	Owyhee River	--	218	218	4.9	35.3
Arock	1155	Jordan Creek	--	462	462	2.5	15.7
Soldier Creek	1156	Owyhee River	--	412	412	7.6	55.0
Three Forks Dam	1157	Owyhee River	--	400	355	7.2	52.3
7 Dam Sites						38.9	278.6
12. Malheur Lake Basin							
Silvies River	1250	Silvies River	147	375	375	1.1	7.5
Frenchglen	1252	Donner Und Blitzen River	--	270	270	0.4	2.7
2 Dam Sites						1.5	10.2
13. Goose & Summer Lakes Basin							
Paisley	1350	Chewaucan River	--	320	16	1.8	12.6

TABLE IX. Cont'd.

River Basin and Site Name	Site Number	River	Dam Height, ft.	Hydraulic Head, ft.	System Head, ft.	Potential @ 50% Exceedance: Capacity MW	Potential @ 50% Exceedance: Annual Energy GWh
14. Klamath Basin							
Bear Springs	(2)	Klamath River	--	131	--	20.0[3]	100.0[3]
15. Rogue Basin							
Castle Creek	1550	Rogue River	--	200	200	3.9	25.6
Foster Creek	1551	Rogue River	--	220	85	3.0	19.9
Top Creek	1552	Rogue River	--	140	140	4.6	30.1
Union Creek	1553	Rogue River	--	280	280	8.0	52.7
Lewis Creek	1555	Rogue River	--	60	15	6.5	42.9
Butte Creek	1556	Rogue River	--	110	110	10.3	68.0
Cascade	1557	Rogue River	--	234	77	16.9	112.0
Ramsey Canyon	1558	Evans Creek	--	180	180	1.9	12.6
Trail Creek	1559	Rogue River	--	75	75	8.7	57.4
Long Creek	1562	Rogue River	--	65	65	7.5	49.7
Reese Creek	1565	Rogue River	--	85	10	11.8	78.4
Falls Creek	1567	Illinois River	--	360	360	24.9	164.4
Murphy	1568	Applegate River	--	150	150	2.8	18.0
McKee Bridge	1569	Applegate River	--	200	152	3.7	24.0
Elk Creek Dam	1570	Elk Creek	235	235	235	2.9	18.9
15 Dam Sites						117.4	774.6
16. Umpqua Basin							
Sawmill	1650	Smith River	--	250	250	10.9	69.3
Loon Lake Diversion	1651	Mill Creek	--	385	385	6.2	38.2
Oak Creek	1657	North Umpqua River	--	70	70	9.6	62.7
Horseshoe Bend	1658	North Umpqua River	--	90	90	11.9	77.7
Boundary	1659	North Umpqua River	--	187	187	16.5	106.5
Steamboat	1660	North Umpqua River	--	190	190	15.9	102.2
Copeland	1661	North Umpqua River	--	290	238	15.1	96.3
Ruckles	1662	South Umpqua River	--	130	18	19.9	130.6
South Umpqua Falls	1663	South Umpqua River	--	580	580	3.2	19.4
Riddle Diversion	1664	South Umpqua River	--	125	58	13.5	87.6
Days Creek	1665	South Fork Umpqua River	--	120	120	6.0	38.1

TABLE IX. Cont'd.

River Basin and Site Name	Site Number	River	Dam Height, ft.	Hydraulic Head, ft.	System Head, ft.	Potential @ 50% Exceedance Capacity MW	Potential @ 50% Exceedance Annual Energy GWh
Tiller	1667	South Umpqua River	--	160	160	4.8	30.3
Cow Creek, Iron Mountain	1668	Cow Creek	--	150	150	5.0	31.4
Pollock Creek	1669	Calapooya Creek	--	60	60	0.5	3.2
14 Dam Sites						139.0	893.5
17. South Coast Basin							
W. Fk. Millicoma River	1750	West Fork Millicoma River	86	86	86	0.4	2.1
Glenn Creek	1751	East Fork Millicoma River	200	200	33	1.5	9.0
Dellwood	1752	South Fork Coos River	--	410	410	10.9	66.8
Tidewater	1753	South Fork Coos River	50	50	50	1.2	7.3
Lower Flash Dam	1754	South Fork Coos River	100	100	100	2.0	12.3
Moon Creek	1755	North Fork Coquille River	--	250	171	1.7	9.9
Cedar Creek	1756	Williams River	100	100	100	0.5	2.8
Tioga Fork	1757	South Fork Coos River	--	300	300	6.0	36.8
Fairview Valley	1759	North Fork Coquille River	250	250	240	4.6	28.0
Brewster Valley	1760	East Fork Coquille River	--	490	490	7.1	42.8
Sugar Loaf Mountain	1761	Middle Fork Coquille River	--	160	160	4.0	24.5
Remote	1763	Middle Fork Coquille River	--	200	200	2.9	17.5
Camas Valley	1764	Middle Fork Coquille River	85	330	217	1.1	6.7
Floras Creek	1766	Floras Creek	69	69	69	0.4	2.4
Whobrey Mountain	1767	South Fork Coquille River	--	150	110	3.7	22.5
Myrtle Creek Lower	1768	Myrtle Creek	30	30	30	0.2	1.2
Panther Creek	1769	Middle Fork Coquille River	--	620	620	6.1	36.8
Powers	1771	South Fork Coquille River	--	320	320	6.6	40.5
Beaver	1772	Sixes River	--	140	111	2.4	14.5
Elephant Rock	1773	Sixes River	--	160	129	2.0	12.0
Avery Ranch	1774	Sixes River	110	110	104	0.7	4.3
Elk River, Intermediate	1775	Elk River	100	100	100	0.9	5.6
Slate Creek	1776	Elk River	--	500	486	4.7	28.2
Lockhart Dam	1777	South Fork Coquille River	--	1615	1615	10.5	63.7
Pistol	1778	Pistol River	--	200	200	0.9	5.4
Boulder Creek	1779	Chetco River	--	400	400	13.2	80.7
Redwood	1780	Chetco River	--	312	282	15.4	94.2

TABLE IX. Cont'd.

River Basin and Site Name	Site Number	River	Dam Height, ft.	Hydraulic Head, ft.	System Head, ft.	Potential @ 50% Exceedance Capacity MW	Annual Energy GWh
Chetco	1781	Chetco River	--	84	84	6.0	36.4
28 Dam Sites						117.6	714.9
18. Mid-Coast Basin							
Unnamed	1850	Salmon River	90	90	90	0.5	3.2
Unnamed	1851	Shooner Creek	60	60	60	0.2	1.2
Unnamed	1852	Drift Creek	58	58	58	0.4	2.8
Holman Creek	1853	Siletz River	--	170	78	4.0	24.9
Falls #1	1854	Siletz River	240	300	217	7.0	44.0
Gravel Creek	1855	Siletz River	--	250	38	5.9	36.6
Euchre Creek	1857	Siletz River	--	255	255	7.4	46.4
Sunshine Creek	1858	Siletz River	175	345	216	10.1	62.8
Sam Creek	1859	Siletz River	--	125	125	4.9	30.5
Elk City	1860	Yaquina River	250	250	250	5.9	37.1
Unnamed	1861	Elk Creek	100	100	100	0.9	5.5
Trout Creek	1862	Drift Creek	150	150	150	1.8	11.3
Slick Rock Creek	1863	Drift Creek	225	225	225	1.5	9.6
Tidewater	1864	Alsea River	--	80	80	4.1	25.8
Unnamed	1865	Crooked Creek	112	112	112	0.4	2.3
Scott Mountain	1866	Alsea River	320	270	239	13.0	81.2
South Fork	1867	South Fork Alsea River	100	300	300	1.0	6.4
Triangle Lake	1869	Lake Creek	60	240	240	2.2	13.9
Mapleton	1870	Siuslaw River	--	90	90	6.1	37.9
Swisshome	1872	Siuslaw River	--	300	226	10.6	66.1
Unnamed	1873	Siuslaw River	145	145	145	1.9	11.6
Alma	1874	Siuslaw River	--	132	43	1.5	9.2
22 Dam Sites						91.3	570.3
State Totals							
342 Dam Sites						2,135.5	14,076.3

[1] Data Sources: State Engineer of Oregon, 1973; U.S. Geological Survey, 1978; Federal Power Commission, 1976; Oregon State Water Resources Board, various dates; Power Planning Committee, 1978; U.S. Army Corps of Engineers, 1976.

[2] Location is not available.

[3] Power and energy based on FPC, 1976.

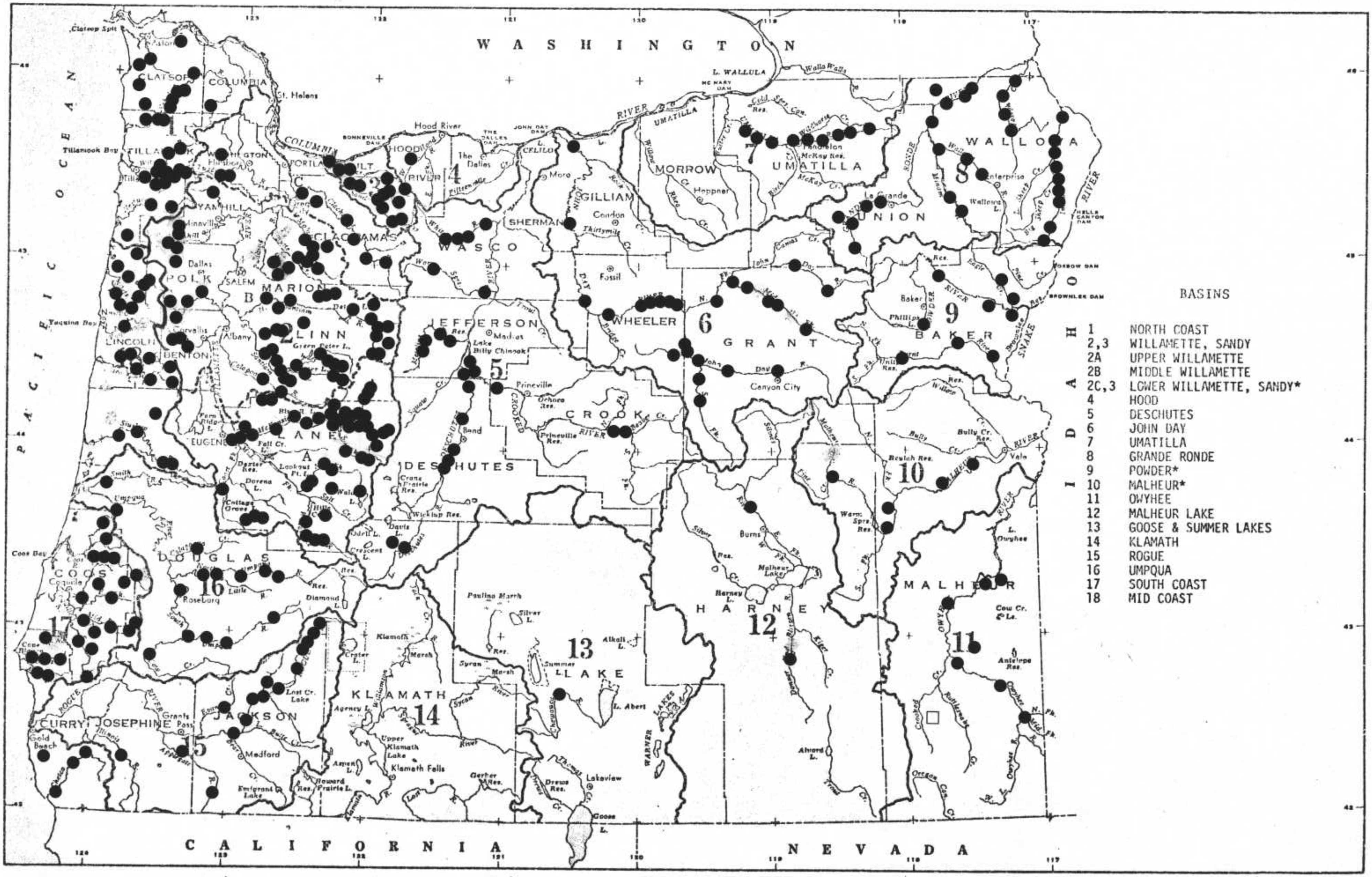
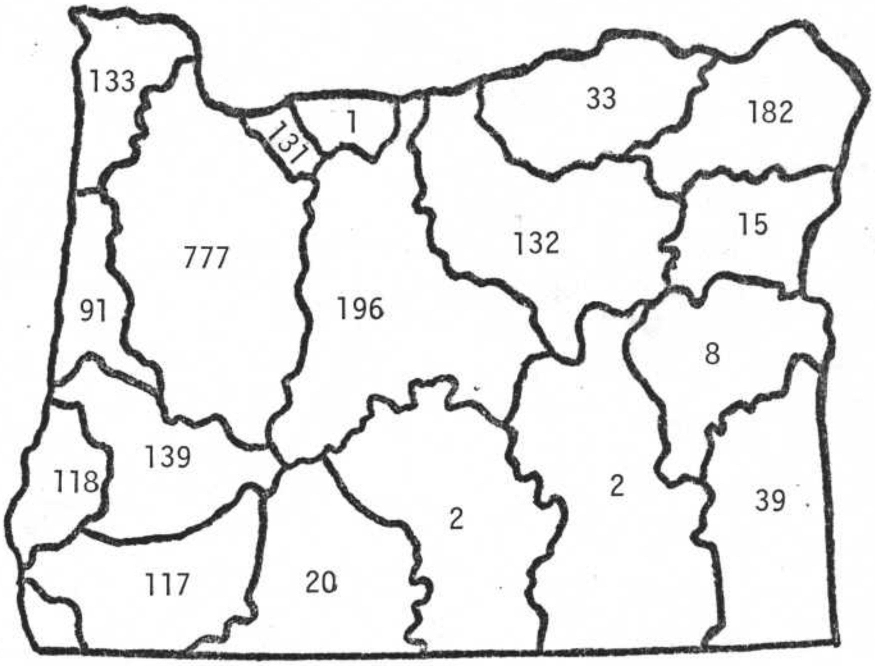
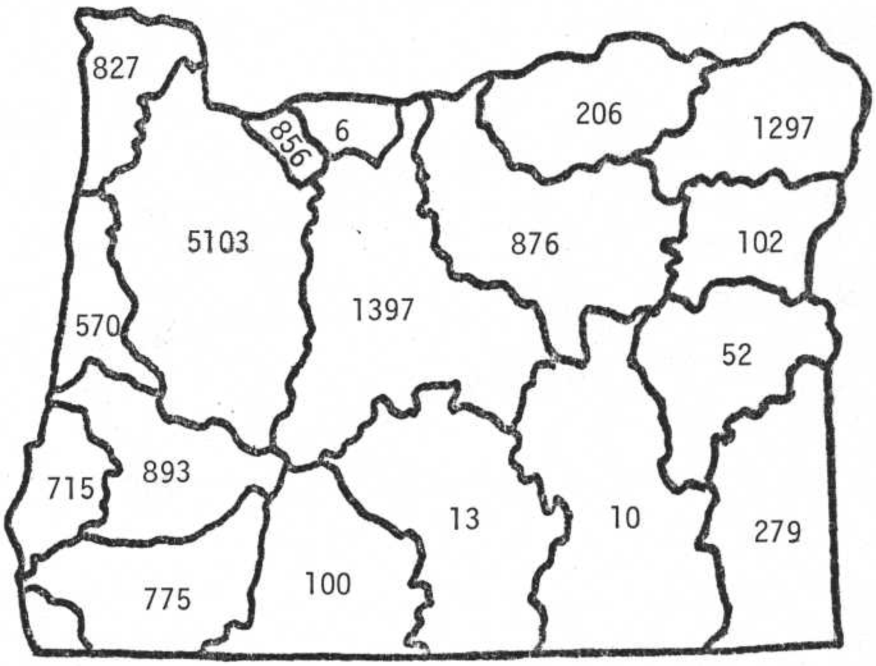


FIGURE 11. PROPOSED DAMS WITH HYDROELECTRIC GENERATION POTENTIALS (P_{50}) BETWEEN 200 kW AND 25 MW



A. POWER, MW



B. ENERGY, GWh

FIGURE 12. POTENTIAL POWER AND ENERGY AT PROPOSED DAMS WITH P_{50} POTENTIALS BETWEEN 200 kW AND 25 MW (TOTALS ARE BASED ON HYDRAULIC HEAD)

TABLE X. DETAILED POWER AND ENERGY POTENTIALS AT PROPOSED DAMS WITH P_{50} BETWEEN 200 kW AND 25 MW

DRAINAGE BASIN	POWER (MW)					ENERGY (GWh)				
	P_{10}	P_{30}	P_{50}	P_{80}	P_{95}	E_{10}	E_{30}	E_{50}	E_{80}	E_{95}
1. North Coast	729.9	283.5	132.6	28.4	15.2	2137.9	1355.9	827.4	233.8	132.3
2. Willamette	2773.6	1346.9	776.8	271.7	163.0	9583.8	7185.1	5103.0	2153.6	1411.4
3. Sandy	395.8	222.0	131.5	40.9	24.5	1477.0	1172.6	855.6	339.1	213.9
4. Hood	3.3	1.5	0.8	0.4	0.3	11.4	8.2	5.6	3.3	2.3
5. Deschutes	475.0	289.2	196.2	101.6	74.8	2049.3	1723.6	1397.5	859.5	654.3
6. John Day	824.5	325.5	132.1	52.1	20.6	2428.1	1553.9	875.9	421.0	179.4
7. Umatilla	177.8	83.7	33.0	8.8	0.9	548.5	383.3	205.7	68.2	7.7
8. Grande Ronde	1201.2	404.3	182.1	99.7	68.8	3470.9	2075.6	1297.4	807.4	601.8
9. Powder	101.7	35.4	15.3	5.8	2.8	288.2	171.9	101.6	47.1	24.1
10. Malheur	24.2	12.9	7.6	3.4	1.7	90.0	70.3	51.9	27.5	14.7
11. Owyhee	419.9	99.0	38.9	21.0	14.5	1051.3	489.1	278.6	176.9	126.7
12. Malheur Lake	13.2	3.3	1.5	0.6	0.3	33.8	16.5	10.2	4.8	2.2
13. Goose and Summer Lakes	12.7	3.7	1.8	1.0	0.6	35.2	19.5	12.6	8.1	5.4
14. Klamath	32.5	22.6	20.0	12.8	7.1	284.8	168.3	100.0	53.7	18.7
15. Rogue	433.8	222.3	117.4	41.6	23.8	1513.4	1142.8	774.6	344.2	207.6
16. Umpqua	626.5	287.1	139.0	39.2	23.6	2008.0	1413.0	893.5	325.8	206.0
17. South Coast	971.4	331.2	117.6	18.6	9.0	2589.0	1464.7	714.9	152.2	78.6
18. Mid-Coast	596.1	217.0	91.3	19.8	10.7	1674.8	1010.3	570.3	162.8	93.4
State Totals	9,813.1	4,191.1	2,135.5	763.4	462.2	31,275.4	21,424.6	14,076.3	6,189.0	3,980.5

TABLE XI. FEASIBILITY CONSTRAINTS ON DEVELOPING POWER AT PROPOSED DAMS WITH P_{50} BETWEEN 200 kW AND 25 MW

SITE NUMBER	ENVIRONMENTAL RESTRAINTS				TRANSMISSION AND LOAD CONSIDERATIONS			
	LAND USE RESTRICTIONS	UTILITY DISPLACEMENT	BUILDING DISPLACEMENT	SPECIAL FISH PROBLEMS	DISTANCE TO NEAREST LINE Miles	LINE CAPACITY[1] KVA	LOCAL MARKET[2]	DISTANCE TO CITY > 1000, Miles
1. North Coast								
0150	X	-	-	X	3.8	115 PPL	-	6.8
0151	-	-	-	X	5.4	230 B	-	17.0
0152	-	X	-	X	1.9	115 PPL	1,2	2.5
0153	-	X	X	X	7.0	34.5 WO	-	14.8
0154	-	X	X	X	4.0	115 PPL	-	9.0
0155	-	-	X	X	5.0	34.5 WO	-	16.2
0156	-	-	X	X	6.8	115 PPL	-	16.0
0157	-	-	X	X	4.0	34.5 WO	-	18.2
0158	-	-	X	X	1.0	34.5 WO	-	18.4
0159	-	-	X	X	1.0	34.5 WO	-	18.4
0160	-	X	X	X	0.6	34.5 WO	1	6.5
0161	-	X	X	X	2.2	115 PPL	-	16.8
0163	-	X	X	X	5.5	115 PPL	-	20.0
0164	-	-	-	X	8.0	34.5 WO	-	24.0
0165	-	X	-	X	0.2	25 TP	-	14.2
0166	-	X	-	X	0.3	115 B	-	15.4
0167	-	X	X	X	0.7	25 TP	1,2	3.0
0168	-	X	X	X	0.5	25 TP	-	8.6
0169	-	-	X	X	0.8	25 TP	-	8.0
0170	-	-	X	X	0.8	25 TP	-	8.0
0171	-	-	-	X	1.3	25 TP	-	13.3
0172	-	-	-	X	1.3	25 TP	-	13.3
0173	-	-	-	X	2.0	25 TP	-	13.6
0174	-	-	-	X	2.0	25 TP	-	13.6
0175	-	-	-	X	0.6	115/230 B	-	17.0
0176	-	-	X	X	6.3	115 B	-	15.5
0177	-	-	-	X	8.0	115/230 B	-	14.3

TABLE XI. Cont'd.

SITE NUMBER	ENVIRONMENTAL RESTRAINTS				TRANSMISSION AND LOAD CONSIDERATIONS			
	LAND USE RESTRICTIONS	UTILITY DISPLACEMENT	BUILDING DISPLACEMENT	SPECIAL FISH PROBLEMS	DISTANCE TO NEAREST LINE Miles	LINE CAPACITY[1] KVA	LOCAL MARKET[2]	DISTANCE TO CITY > 1000, Miles
0178	-	-	X	X	5.8	115 B	-	23.0
Basin Total 28	1	10	16	28	0		25	
2A. Upper Willamette								
2200	-	X	X	X	3.0	115 B	-	37.0
2201	-	X	X	X	3.0	115 B	-	37.0
2202	-	-	-	X	1.5	500 B	-	16.0
2203	-	-	-	X	5.0	500 B	-	11.0
2204	-	-	-	X	8.0	115 B	-	26.0
2205	-	X	-	X	0.5	115 B	-	35.0
2206	-	-	X	X	0.5	115 B	-	19.0
2210	-	-	X	X	1.5	115 B	-	26.0
2212	-	-	-	X	0.1	115 B	-	30.0
2213	-	-	-	X	7.0	115 B	-	26.0
2214	-	X	X	X	1.0	115 B	-	30.0
2215	-	X	X	X	1.0	115 B	-	35.0
2216	-	X	-	X	4.0	115 B	-	40.0
2217	-	-	-	X	2.0	115 B	-	36.0
2218	-	-	-	X	2.0	115 B	-	36.0
2219	-	X	X	X	1.0	115 B	-	35.0
2220	-	X	X	X	1.0	115 B	-	35.0
2221	-	X	-	X	1.0	115 B	-	37.0
2222	-	X	X	X	0.5	230/287 B	1,2	5.0
2223	-	-	X	X	1.0	115 E	1,2	5.0
2224	-	X	X	X	0.5	115 B	-	13.0
2225	-	-	-	X	7.0	115 B	-	35.0

2

TABLE XI. Cont'd.

SITE NUMBER	ENVIRONMENTAL RESTRAINTS				TRANSMISSION AND LOAD CONSIDERATIONS			
	LAND USE RESTRICTIONS	UTILITY DISPLACEMENT	BUILDING DISPLACEMENT	SPECIAL FISH PROBLEMS	DISTANCE TO NEAREST LINE Miles	LINE CAPACITY[1] KVA	LOCAL MARKET[2]	DISTANCE TO CITY > 1000, Miles
2226	-	-	-	X	7.0	115 B	-	35.0
2227	-	-	-	X	9.0	115 B	-	37.0
2228	-	-	-	X	9.0	115 B	-	37.0
2229	-	X	X	X	1.5	115 E	1,2	3.0
2232	-	-	-	X	14.0	115 B	-	25.0
2233	-	-	-	-	7.0	12.5 LE-C	-	8.0
2234	-	-	-	-	12.0	12.5 LE-C	-	13.0
2235	-	-	-	X	14.0	115 B	-	25.0
2236	-	-	-	X	14.0	115 B	-	25.0
2238	-	-	-	-	2.0	12.5 LE-C	-	1.0
2239	-	-	-	-	2.0	12.5 LE-C	-	1.0
2240	-	-	-	-	10.0	115 B	-	10.0
2241	-	-	-	-	18.0	115 B	-	19.0
2242	-	X	X	-	1.0	115 PPL	1,2	1.0
2243	-	X	X	-	0.1	34.5 LE-C	-	11.0
2244	-	X	X	-	2.0	34.5 LE-C	-	14.0
2245	-	X	X	X	0.1	34.5 LE-C	1,2	6.0
2246	-	-	X	-	5.0	115 B	-	8.0
2247	-	-	-	-	11.0	115 B	-	14.0
2248	-	-	-	-	11.0	115 B	-	14.0
2249	-	-	-	-	13.0	115 PPL	-	18.5
2250	-	-	-	-	11.5	115 PPL	-	17.0
2259	-	X	-	X	0.5	230/287-B	1,2	2.0
2260	-	X	X	X	0.5	115 B	-	25.0
Sub-Basin Total 46	0	18	18	32	10		40	

TABLE XI. Cont'd.

SITE NUMBER	ENVIRONMENTAL RESTRAINTS				TRANSMISSION AND LOAD CONSIDERATIONS			
	LAND USE RESTRICTIONS	UTILITY DISPLACEMENT	BUILDING DISPLACEMENT	SPECIAL FISH PROBLEMS	DISTANCE TO NEAREST LINE Miles	LINE CAPACITY[1] KVA	LOCAL MARKET[2]	DISTANCE TO CITY > 1000, Miles
2B. Mid Willamette								
2400	-	-	-	X	2.1	115/230 B	-	26.0
2401	-	X	X	X	3.1	57 P	-	26.0
2402	-	X	X	X	6.5	57 P	-	28.0
2404	-	X	X	X	4.0	57 P	-	16.5
2405	-	-	-	X	10.0	57 P	-	21.0
2406	-	X	X	-	1.0	57 P	-	26.0
2407	-	X	X	-	0.3	57 P	-	28.5
2409	X	-	-	X	7.6	500 B	-	23.0
2410	-	X	X	X	4.0	57 P	-	16.5
2411	-	-	-	X	9.5	57 P	-	23.0
2412	-	X	-	-	3.4	230 P	-	9.3
2414	-	X	X	-	1.0	500 B	-	14.3
2416	-	-	X	X	3.6	500 B	-	19.0
2417	-	X	X	-	1.4	500 B	-	17.5
2418	-	X	X	-	1.4	500 B	-	17.5
2419	-	-	-	X	7.0	500 B	-	28.0
2420	-	-	-	X	7.0	500 B	-	28.0
2421	-	-	-	X	1.0	230 P	-	34.0
2422	-	X	-	X	2.5	69 CPI	-	21.0
2423	-	X	-	X	4.8	69 CPI	-	16.0
2424	-	-	-	X	5.6	115 B	-	17.0
2425	-	-	-	X	1.1	69/115 PPL	-	19.4
2428	-	-	-	X	2.0	230 P	-	28.0
2429	-	-	-	X	1.0	230 P	-	34.0
2431	-	X	-	-	0.6	2-230/287B	-	52.0
2432	-	X	-	-	0.6	2-230/287B	-	52.0

TABLE XI. Cont'd.

SITE NUMBER	ENVIRONMENTAL RESTRAINTS				TRANSMISSION AND LOAD CONSIDERATIONS			
	LAND USE RESTRICTIONS	UTILITY DISPLACEMENT	BUILDING DISPLACEMENT	SPECIAL FISH PROBLEMS	DISTANCE TO NEAREST LINE Miles	LINE CAPACITY[1] KVA	LOCAL MARKET[2]	DISTANCE TO CITY > 1000, Miles
2433	-	X	-	X	2.5	69 CPI	-	21.0
2434	-	X	-	-	3.8	2-500 B	-	24.0
2435	-	X	-	-	3.8	2-500 B	-	24.0
2436	-	-	-	-	5.0	23 CPI	-	55.0
2437	-	X	-	-	1.0	23 CPI	-	54.0
2438	-	X	X	-	6.2	23 CPI	-	56.0
2439	-	-	-	-	0.3	115/230 B	-	7.9
2440	-	X	-	-	0.4	115/230 B	-	5.1
2442	-	X	X	X	5.0	2-500 B	-	15.0
2443	-	X	X	X	5.0	2-500 B	-	15.0
2444	-	-	-	X	8.0	115 B	-	23.0
2445	-	X	-	-	7.5	23 CPI	-	55.0
2446	-	X	X	-	0.2	115 CPI	1,2	3.4
2448	-	X	X	X	1.2	115 PPL	1,2	4.2
2449	-	-	-	-	14.0	115 B	-	31.0
2450	-	-	-	-	14.0	115 B	-	31.0
2451	-	-	-	-	19.0	115 B	-	37.0
2452	-	X	-	-	9.0	23 CPI	-	56.0
2453	-	X	-	-	11.0	23 CPI	-	57.0
2454	-	-	-	-	11.0	23 CPI	-	60.0
2456	-	-	-	X	2.8	23 PPL	-	20.0
2457	-	-	X	X	1.0	23 PPL	-	12.5
2458	-	X	X	-	1.0	115 B	-	18.0
2459	-	X	X	-	0.8	23 PPL	-	19.0
2460	-	X	X	-	16.0	115 B	-	34.5
2461	-	X	X	X	0.1	2-500 B	1	5.0
2462	-	-	-	X	2.8	23 PPL	-	20.0
2463	-	X	X	-	16.0	115 B	-	34.5

5

TABLE XI. Cont'd.

SITE NUMBER	ENVIRONMENTAL RESTRAINTS				TRANSMISSION AND LOAD CONSIDERATIONS			
	LAND USE RESTRICTIONS	UTILITY DISPLACEMENT	BUILDING DISPLACEMENT	SPECIAL FISH PROBLEMS	DISTANCE TO NEAREST LINE Miles	LINE CAPACITY[1] KVA	LOCAL MARKET[2]	DISTANCE TO CITY > 1000, Miles
2464	-	X	X	X	7.0	2-500 B	-	9.0
Sub-Basin Total 55	1	33	22	28	7		52	
2C. Lower Willamette								
2600	-	-	-	X	0.3	115 B	-	16.2
2601	-	X	X	X	1.5	57 P	-	6.8
2602	-	X	X	X	1.5	57 P	-	6.8
2604	-	X	X	X	0.7	230/500 B	-	10.8
2605	-	-	-	X	0.2	2-115 P	-	6.2
2609	-	-	-	X	3.2	2-115 P	1	4.3
2611	-	-	-	X	1.2	500 B	-	7.9
2614	-	X	-	X	0.2	500 B	-	8.3
2620	X	-	-	X	1.2	230/500 B	-	7.8
Sub-Basin Total 9	1	4	3	9	0		8	
Basin Total 110	2	55	43	69	17		100	
3. Sandy								
0350	X	X	X	X	1.5	230/500 B	1	2.0
0351	X	-	-	X	1.2	57 P	1	4.5
0352	-	X	-	X	1.2	57 B	-	5.2
0353	-	-	-	-	5.1	500 B	-	17.2

TABLE XI. Cont'd.

SITE NUMBER	ENVIRONMENTAL RESTRAINTS				TRANSMISSION AND LOAD CONSIDERATIONS			
	LAND USE RESTRICTIONS	UTILITY DISPLACEMENT	BUILDING DISPLACEMENT	SPECIAL FISH PROBLEMS	DISTANCE TO NEAREST LINE Miles	LINE CAPACITY[1] KVA	LOCAL MARKET[2]	DISTANCE TO CITY > 1000, Miles
0354	-	-	-	-	4.6	2-230/287B	-	16.8
0355	-	-	-	X	1.0	57 P	-	5.0
0357	-	-	X	X	0.4	2-230/287B	-	14.5
0358	-	-	X	X	0.1	2-230/287B	-	16.2
0359	-	-	-	-	3.0	2-230/287B	-	22.0
0360	-	X	X	X	0.9	57 P	-	14.2
0361	-	-	X	X	0.1	500 B	1,2	2.8
0362	-	-	-	X	0.3	57 P	-	13.0
0363	-	-	-	X	3.7	57 P	-	12.2
0364	-	-	-	-	3.5	57 P	-	13.0
Basin Total 14	2	3	5	10	0		11	
4. Hood								
0450	-	-	-	X	1.2	500 B	-	26.0
Basin Total 1	0	0	0	1	0		1	
5. Deschutes								
0555	X	-	-	X	0.5	69 PPL	-	24.5
0557	-	-	-	X	4.4	500 B	-	36.5
0558	-	-	-	X	0.8	500 B	-	33.9
0559	-	-	-	X	0.8	500 B	-	33.9
0562	X	-	-	X	4.4	2-230/287B	-	29.9
0565	X	-	X	X	7.8	800 DC B	-	15.2
0569	-	-	-	X	10.0	230 P	-	23.0
0570	-	-	X	X	12.3	69 C C	-	17.4

TABLE XI. Cont'd.

SITE NUMBER	ENVIRONMENTAL RESTRAINTS				TRANSMISSION AND LOAD CONSIDERATIONS			
	LAND USE RESTRICTIONS	UTILITY DISPLACEMENT	BUILDING DISPLACEMENT	SPECIAL FISH PROBLEMS	DISTANCE TO NEAREST LINE Miles	LINE CAPACITY[1] KVA	LOCAL MARKET[2]	DISTANCE TO CITY > 1000, Miles
0571	-	-	-	X	6.6	230 P	-	18.8
0572	-	-	X	X	12.3	69 C C	-	17.4
0573	-	-	-	X	0.1	230 P	1	8.7
0574	-	-	-	X	0.1	230 P	1	8.7
0575	-	X	-	X	2.2	69 PPL	-	10.7
0576	-	X	-	X	2.2	69 PPL	-	10.7
0577	-	-	-	X	0.1	230 P	1	8.7
0578	-	X	-	X	0.1	69 MC	-	8.2
0580	-	-	-	-	1.1	24.9 C C	-	34.9
0581	-	-	-	-	1.2	24.9 C C	-	38.3
0582	-	X	-	X	0.1	69 PPL	1	11.6
0583	-	X	-	X	0.5	69 M C	-	10.3
0584	-	X	-	X	0.5	69 M C	-	10.3
0585	-	-	-	X	5.2	23 M C	-	47.2
0586	-	-	-	X	1.7	69 M C	-	46.6
Basin Total 23	3	6	3	21	2		19	
6. John Day								
0650	X	-	-	X	1.0	500 B	-	28.0
0652	X	-	-	X	6.8	230 B	-	38.0
0654	-	X	X	X	9.8	69 CP	-	41.4
0655	-	-	-	X	25.2	69 CP	-	32.6
0656	X	-	-	X	2.7	69 CP	-	64.0
0657	-	-	-	X	24.2	69 CP	-	33.5
0659	-	X	-	X	22.5	69 CP	-	28.3
0660	-	X	-	X	22.5	69 CP	-	28.3
0661	-	-	-	X	12.1	23 CPU	-	40.2

TABLE XI. Cont'd.

SITE NUMBER	ENVIRONMENTAL RESTRAINTS				TRANSMISSION AND LOAD CONSIDERATIONS			
	LAND USE RESTRICTIONS	UTILITY DISPLACEMENT	BUILDING DISPLACEMENT	SPECIAL FISH PROBLEMS	DISTANCE TO NEAREST LINE Miles	LINE CAPACITY[1] KVA	LOCAL MARKET[2]	DISTANCE TO CITY > 1000, Miles
0662	X	-	-	X	13.2	69 CP	-	45.6
0663	X	X	-	X	2.6	69 CP	-	40.2
0664	X	X	-	X	2.6	69 CP	-	40.2
0665	-	X	-	X	10.7	69 CP	-	38.1
0666	-	X	-	X	10.7	69 CP	-	38.1
0667	-	X	-	X	10.7	69 CP	-	38.1
0668	-	X	-	X	18.5	69 CP	-	37.0
0670	-	-	-	X	17.8	23 CPU	-	22.9
0671	X	X	X	X	1.5	2-230/287B	-	40.0
0672	X	X	-	X	20.9	69 CP	-	35.0
0673	-	X	X	X	20.0	24.9 CC	-	29.9
0674	-	X	X	X	20.0	24.9 CC	-	29.9
0675	-	-	X	X	14.5	24.9 CC	-	28.7
0676	-	X	X	X	17.5	69 CPU	-	24.4
0677	-	X	X	X	0.5	69 CPU	1	6.7
0678	-	-	X	X	14.5	24.9 CC	-	28.7
Basin Total 25	8	15	8	25	17		24	
7. Umatilla								
0750	-	X	-	X	1.0	230 B	-	18.0
0751	X	X	X	X	10.0	230 B	-	22.8
0752	X	-	X	X	14.5	230 B	-	28.0
0753	X	-	X	X	16.8	230 B	-	31.0
0754	-	X	-	X	1.0	230 B	-	18.0
0755	-	X	-	X	1.0	230 B	-	9.2
0756	X	X	X	X	3.2	69 PPL	1,2	9.0
0757	X	X	X	X	3.2	69 PPL	1,2	9.0

TABLE XI. Cont'd.

SITE NUMBER	ENVIRONMENTAL RESTRAINTS				TRANSMISSION AND LOAD CONSIDERATIONS			
	LAND USE RESTRICTIONS	UTILITY DISPLACEMENT	BUILDING DISPLACEMENT	SPECIAL FISH PROBLEMS	DISTANCE TO NEAREST LINE Miles	LINE CAPACITY[1] KVA	LOCAL MARKET[2]	DISTANCE TO CITY > 1000, Miles
0758	X	X	X	X	8.0	230 B	-	20.0
Basin Total 9	6	7	6	9	2		7	
8. Grande Ronde								
0850	-	-	-	X	15.0	34.5 CW	-	45.0
0851	-	-	-	X	0.4	34.5 CW	-	31.5
0852	-	-	-	X	10.5	34.5 CW	-	35.0
0855	-	-	-	X	12.0	34.5 CW	-	44.0
0856	-	-	-	X	12.0	34.5 CW	-	44.0
0857	-	-	-	X	15.5	34.5 CW	-	41.0
0858	-	-	-	X	8.0	230 PPL	-	39.0
0859	-	-	-	X	18.0	230 IP	-	28.0
0861	-	-	-	X	10.0	230 IP	-	20.0
0862	-	-	-	X	0.1	230 IP	-	33.0
0863	-	X	-	X	0.2	69 PPL	-	30.0
0864	-	-	-	X	0.2	230 IP	-	25.0
0865	-	X	-	X	0.3	69 PPL	-	16.0
0866	-	-	-	X	0.1	230 IP	-	23.0
0867	-	X	X	X	0.2	69 PPL	1	2.5
0868	-	-	-	X	0.1	230 IP	-	23.0
0869	-	-	-	X	0.1	230 IP	-	23.0
0870	X	X	X	X	2.0	230 B	1	6.0
0871	X	-	-	X	9.0	230 PPL	-	23.0
0872	-	X	X	X	6.8	230 B	-	14.0
0873	X	X	-	X	4.8	230 B	1	11.0
0874	X	X	-	X	10.0	23 CPU	-	21.0
0875	-	-	-	X	0.1	230 IP	-	23.0

TABLE XI. Cont'd.

SITE NUMBER	ENVIRONMENTAL RESTRAINTS				TRANSMISSION AND LOAD CONSIDERATIONS			
	LAND USE RESTRICTIONS	UTILITY DISPLACEMENT	BUILDING DISPLACEMENT	SPECIAL FISH PROBLEMS	DISTANCE TO NEAREST LINE Miles	LINE CAPACITY[1] KVA	LOCAL MARKET[2]	DISTANCE TO CITY > 1000, Miles
0876	-	-	-	X	0.1	230 IP	-	25.0
0877	-	-	-	X	13.5	230 B	-	18.0
0878	-	-	-	X	2.0	230 IP	-	28.0
0879	-	-	-	X	13.5	230 B	-	18.0
0880	-	-	-	X	2.0	230 IP	-	28.0
Basin Total 28	4	7	3	28	8		25	
9. Powder								
0950	X	-	-	-	1.7	230 CPU	-	7.0
0951	-	-	-	-	2.7	230 IP	1	5.2
0952	X	X	-	-	1.2	230 IP	-	11.6
0953	-	-	X	-	2.1	230 IP	-	7.1
0954	-	X	-	-	1.2	230 IP	-	8.2
0955	-	X	-	-	2.0	138 IP	1,2	5.0
0957	-	X	-	-	11.0	138 IP	-	15.0
0958	-	X	-	-	3.1	69 IP	-	40.0
0959	X	X	-	-	12.5	69 IP	-	26.0
Basin Total 9	3	6	1	0	2		7	
10. Malheur								
1051	-	X	-	-	1.5	69 IP	-	13.0
1052	-	-	-	-	1.3	69 IP	-	68.0
1053	-	X	-	-	0.3	69 IP	-	28.5
1054	-	-	-	-	1.0	69 IP	-	44.0
1055	-	-	-	-	13.2	69 IP	-	52.0

TABLE XI. Cont'd.

SITE NUMBER	ENVIRONMENTAL RESTRAINTS				TRANSMISSION AND LOAD CONSIDERATIONS			
	LAND USE RESTRICTIONS	UTILITY DISPLACEMENT	BUILDING DISPLACEMENT	SPECIAL FISH PROBLEMS	DISTANCE TO NEAREST LINE Miles	LINE CAPACITY[1] KVA	LOCAL MARKET[2]	DISTANCE TO CITY > 1000, Miles
Basin Total 5	0	2	0	0	1		5	
11. Owyhee								
1151	X	-	-	-	23.0	69 IP	-	50.0
1152	X	-	-	-	23.0	69 IP	-	50.0
1153	X	-	-	-	34.0	69 IP	-	62.0
1154	-	-	-	-	31.0	69 IP	-	76.0
1155	-	-	-	-	27.0	69 IP	-	73.0
1156	-	-	-	-	23.0	69 IP	-	92.0
1157	-	-	-	-	28.5	69 IP	-	104.0
Basin Total 7	3	0	0	0	7		7	
12. Malheur Lake								
1250	-	-	-	-	9.0	138 CPU	-	16.0
1252	-	-	-	-	1.0	115 HC	-	40.0
Basin Total 2	0	0	0	0	0		2	
13. Goose and Summer Lakes								
1350	-	-	-	-	4.0	69 SV	-	35.0
Basin Total 1	0	0	0	0	0		1	
14. Klamath								
Bear Springs	*	*	*	*	*	*	*	*

TABLE XI. Cont'd.

SITE NUMBER	ENVIRONMENTAL RESTRAINTS				TRANSMISSION AND LOAD CONSIDERATIONS			
	LAND USE RESTRICTIONS	UTILITY DISPLACEMENT	BUILDING DISPLACEMENT	SPECIAL FISH PROBLEMS	DISTANCE TO NEAREST LINE Miles	LINE CAPACITY[1] KVA	LOCAL MARKET[2]	DISTANCE TO CITY > 1000, Miles
15. Rogue								
1550	-	X	X	-	11.3	69 PPL	-	46.9
1551	-	-	-	-	14.0	69 PPL	-	49.5
1552	-	-	-	-	2.5	69 PPL	-	37.2
1553	-	-	-	-	8.0	69 PPL	-	42.7
1555	-	X	X	X	0.8	69 PPL	-	22.6
1556	X	X	X	X	0.6	69 PPL	-	23.6
1557	-	X	X	X	0.5	115 PPL	-	27.2
1558	-	-	X	X	4.1	230 PPL	-	14.1
1559	-	X	X	X	1.0	69 PPL	-	15.4
1562	-	X	X	X	1.0	69 PPL	-	15.4
1565	-	X	X	X	0.1	115 PPL	-	8.0
1567	X	-	-	X	7.4	69 PPL	-	24.8
1568	-	X	X	X	8.8	69 PPL	-	17.6
1569	-	X	X	X	8.8	69 PPL	-	17.6
1570	X	-	-	X	3.8	69 PPL	-	28.5
Basin Total 15	3	9	10	11	2		15	
16. Umpqua								
1650	-	X	-	X	4.2	230 B	-	8.0
1651	-	-	-	X	3.3	12.5/69 D-E	-	14.0
1657	X	X	X	X	2.0	69 PPL	-	6.5
1658	X	X	X	X	0.5	2-230 PPL	-	8.4
1659	-	X	-	X	0.7	3-115 PPL	-	21.7
1660	-	X	-	X	0.5	3-115 PPL	-	29.1
1661	-	X	-	X	0.8	3-115 PPL	-	33.6

TABLE XI. Cont'd.

SITE NUMBER	ENVIRONMENTAL RESTRAINTS				TRANSMISSION AND LOAD CONSIDERATIONS			
	LAND USE RESTRICTIONS	UTILITY DISPLACEMENT	BUILDING DISPLACEMENT	SPECIAL FISH PROBLEMS	DISTANCE TO NEAREST LINE Miles	LINE CAPACITY[1] KVA	LOCAL MARKET[2]	DISTANCE TO CITY > 1000, Miles
1662	-	X	X	X	2.0	69 PPL	1,2	4.4
1663	-	-	-	X	15.8	115 PPL	-	30.7
1664	-	X	X	X	0.1	69 PPL	1	3.8
1665	-	X	-	X	1.0	2-230 PPL	-	5.2
1667	-	-	-	X	1.9	115 PPL	-	19.5
1668	-	X	-	X	3.9	230 PPL	-	6.4
1669	-	X	X	X	1.2	34.5 D C	1	2.0
Basin Total 14	2	11	5	14	1		11	
17. South Coast								
1750	-	-	-	X	11.2	115 B	-	11.6
1751	-	-	X	X	9.5	115 B	-	14.3
1752	-	X	X	X	5.0	115 B	-	7.2
1753	-	-	-	X	9.8	115 B	-	12.1
1754	-	-	-	X	14.3	115 B	-	17.9
1755	-	-	X	X	0.3	115 B	-	10.2
1756	-	-	-	X	8.3	34.5 D E	-	19.2
1757	-	-	-	X	14.3	115 B	-	17.9
1759	-	X	-	X	0.6	230 B	-	4.8
1760	-	X	X	X	1.0	230 B	-	12.9
1761	-	X	X	X	0.2	24.9 CC-C	1	4.0
1763	-	X	X	X	0.9	24.9 CC-C	-	10.6
1764	-	X	X	X	3.9	24.9 CC-C	-	17.3
1766	-	-	-	X	5.2	115 B	-	12.0
1767	-	-	-	X	1.1	20 PPL	-	8.5
1768	-	-	-	X	1.0	24.9 CC-C	-	8.7
1769	-	X	X	X	0.9	24.9 CC-C	-	17.0

TABLE XI. Cont'd.

SITE NUMBER	ENVIRONMENTAL RESTRAINTS				TRANSMISSION AND LOAD CONSIDERATIONS			
	LAND USE RESTRICTIONS	UTILITY DISPLACEMENT	BUILDING DISPLACEMENT	SPECIAL FISH PROBLEMS	DISTANCE TO NEAREST LINE Miles	LINE CAPACITY[1] KVA	LOCAL MARKET[2]	DISTANCE TO CITY > 1000, Miles
1771	-	X	X	X	1.3	20 PPL	-	13.4
1772	-	X	X	X	0.2	115/230 B	1	3.7
1773	-	-	-	X	5.0	115 B	-	5.6
1774	-	-	-	X	9.8	20 PPL	-	10.8
1775	-	-	-	X	2.5	115/230 B	-	5.3
1776	-	-	-	X	2.5	115/230 B	-	5.3
1777	-	-	-	X	11.5	20 PPL	-	23.2
1778	-	-	-	X	0.7	115 CC C	-	9.0
1779	-	-	-	X	12.4	69 CC C	-	16.0
1780	-	-	-	X	8.0	115 CC C	-	9.5
1781	-	X	X	X	2.5	115 CC C	1,2	3.4
Basin Total 28	0	10	11	28	5		25	
18. Mid-Coast								
1850	-	X	X	X	0.2	69/115 PPL	-	22.8
1851	-	-	X	X	0.1	69 OP PPL	-	21.4
1852	-	-	X	X	0.9	69 OP PPL	-	19.1
1853	-	-	-	X	8.9	23 CPI	-	18.6
1854	-	-	-	X	8.9	23 CPI	-	18.6
1855	-	-	-	X	8.9	23 CPI	-	18.6
1857	-	-	X	X	5.1	69 CPI	-	12.9
1858	-	-	X	X	5.1	69 CPI	-	12.9
1859	-	X	X	X	1.2	69 CPI	-	9.6
1860	-	X	X	X	0.2	69 CPI	1,2	2.3
1861	-	-	X	X	4.3	115/230 B	-	10.8
1862	-	-	X	X	1.2	230 B	-	14.2
1863	-	-	-	X	6.8	230 B	-	12.2

TABLE XI. Cont'd.

SITE NUMBER	ENVIRONMENTAL RESTRAINTS				TRANSMISSION AND LOAD CONSIDERATIONS			
	LAND USE RESTRICTIONS	UTILITY DISPLACEMENT	BUILDING DISPLACEMENT	SPECIAL FISH PROBLEMS	DISTANCE TO NEAREST LINE Miles	LINE CAPACITY[1] KVA	LOCAL MARKET[2]	DISTANCE TO CITY > 1000, Miles
1864	-	X	X	X	1.1	115 CPI	-	16.3
1865	-	X	X	-	2.8	115 CPI	-	13.1
1866	-	X	X	X	0.2	115 CPI	-	18.0
1867	-	-	-	X	5.8	115 CPI	-	16.7
1869	-	X	X	X	6.7	230 B	-	21.5
1870	-	X	X	X	0.1	34.5 BL-C	-	13.7
1872	-	X	-	X	2.2	230 B	-	19.0
1873	-	-	-	X	8.9	230 B	-	14.5
1874	-	-	-	X	10.2	230 B	-	14.6
Basin Total 22	0	9	14	21	1		21	
State Total 342	37	150	125	265	65		306	

[1] Line operators are as follows: PPL = Pacific Power & Light Co.; B = Bonneville Power Adm.; E = Eugene Water & Electric Board; LE-C = Lane County Electric Coop, Inc.; M-C = Midstate Electric Coop, Inc.; CPU = California-Pacific Utilities Co.; IP = Idaho Power Co.; CPI = Consumers Power Inc.; WO = West Oregon Electric Coop., Inc.; TP = Tillamook Co. PUD; P = Portland General Electric Co.; CC = Central Electric Coop.; CP = Columbia Power Coop.; CW = Clearwater Power Co; HC = Harney Electric Coop., Inc.; SV = Surprise Valley Electrification Corp.; D-E = D-C = Douglas Electric Coop.; CC-C = Coos-Curry Electric Coop.; BLC = Blachly Lane Co. Coop. Elec. Assn.

[2] 1, 2 and 3 identify known local residential, industrial, and water pumping loads, respectively.

TABLE XII. DISTRIBUTION OF FEASIBILITY CONSTRAINTS AFFECTING PROPOSED DAMS WITH P_{50} BETWEEN 200 kW AND 25 MW

Basin	Number of Sites	Number of Sites Having Feasibility Restraints Due to:				Number of Sites Having Transmission or Load Constraints Due to:	
		Land Use Restrictions	Utility Displacement	Building Displacement	Special Fish Problems	Distance to Nearest Line	Local Market
1. North Coast	28	1	10	16	28	0	25
2. Willamette	110	2	55	43	69	17	100
3. Sandy	14	2	3	5	10	0	11
4. Hood	1	0	0	0	1	0	1
5. Deschutes	23	3	6	3	21	2	19
6. John Day	25	8	15	8	25	17	24
7. Umatilla	9	6	7	6	9	2	7
8. Grande Ronde	28	4	7	3	28	8	25
9. Powder	9	3	6	1	0	2	7
10. Malheur	5	0	2	0	0	1	5
11. Owyhee	7	3	0	0	0	7	7
12. Malheur Lake	2	0	0	0	0	0	2
13. Goose & Summer Lakes	1	0	0	0	0	0	1
14. Klamath	1[1]	0	0	0	0	0	0
15. Rogue	15	3	9	10	11	2	15
16. Umpqua	14	2	11	5	14	1	11
17. South Coast	28	0	10	11	28	5	25
18. Mid-Coast	22	0	9	14	21	1	21
Totals	342	37[1]	150[1]	125[1]	265[1]	65[1]	306[1]

[1] Includes one dam site for which location is unknown, other than basin and river. No constraint analysis can be made.

Screening for Minimally Constrained Dams

Applying the screening process already described, 117 of the 341 fully-documented proposed dams were found to be relatively unconstrained. These are identified in Table XIII. Collectively, those represent a theoretical developable power of 628 MW available 50 percent of the time and a corresponding annual energy output of 4,155 GWh, assuming run-of-river operation. Calculations are based on hydraulic head rather than system head, since fewer encroachments would occur if only 117 of the 342 proposed small-scale hydropower dams were to be developed.

TABLE XIII. MINIMALLY CONSTRAINED PROPOSED DAMS WITH P_{50} BETWEEN 200 kW AND 25 MW

Dam Site Number	Dam Site Name	Potential @ 50% Exceedance Capacity MW	Potential @ 50% Exceedance Annual Energy GWh
1. North Coast Basin			
0151	Big Cr.	0.2	1.3
0164	Salmonberry	8.7	54.3
0171	T-2	4.5	28.2
0172	Bark Shanty	3.2	20.2
0173	Keyhole	1.3	8.3
0174	Clear Cr.	2.4	15.1
0175	Hollywood	0.8	4.9
0177	Alder Glenn	5.3	33.1
		26.4	165.4
2. Willamette Basin			
2202	Mohawk #1	0.8	5.4
2203	Upper Mohawk #1	0.2	1.3
2204	Cook Cr.	0.8	4.7
2212	Strube	3.2	21.9
2213	Lookout Cr.	3.5	22.1
2217	Horse Cr.	13.2	88.4
2218	Foley Springs	11.2	75.0
2225	Separation Cr.	10.8	68.9
2226	Eugene Cr.	18.7	119.3
2227	Rainbow Cr.	10.3	65.9
2228	Harvey Cr.	12.2	77.8
2233	North Fk. #2	14.1	91.4
2238	Mile 6.7	8.8	56.9
2239	Huckleberry Cr.	10.5	68.3
2240	North Fk. #1	6.0	37.7
2246	Kitson Hot Springs	4.5	28.3
		128.8	833.3
2400	Fairdale Upper	0.7	4.2
2405	Dead Horse Cr.	5.8	36.0
2411	Pine Cr.	9.2	58.2
2412	Gorge	1.0	6.3
2419	Pelkey	7.6	47.8
2420	Headwaters	12.2	76.5
2421	Henline Cr.	16.0	100.5
2424	Lewisville	0.6	3.6
2425	Aumsville	21.9	139.7
2428	Unnamed	9.7	61.0
2429	Elkhorn	9.2	57.8
2431	Byar's Cr.	4.2	26.2
2432	Hot Springs	4.2	26.2
2434	Jordan	1.9	11.8
2435	Thomas Cr.	1.7	10.4
2436	Red, Milk, Pamelia	6.1	37.8

TABLE XIII. Cont'd.

Dam Site Number	Dam Site Name	Potential @ 50% Exceedance Capacity MW	Potential @ 50% Exceedance Annual Energy GWh
2437	Tunnel	13.7	86.3
2439	Tumtum	0.2	1.4
2440	Wren	1.1	6.7
2444	Packers Gulch	6.6	41.2
2445	Independence Prairie	11.0	69.3
2452	Duffy Lake	10.2	63.7
2456	Log Pond	1.3	8.2
2462	Wiley Cr.	2.4	14.9
		158.5	995.7
2600	Gales Cr. #2A	0.4	2.4
2605	N. Fk. Diversion	2.9	18.9
2609	Creek	4.0	26.1
2611	Upper Austin Point	20.2	139.1
		27.5	186.5
		318.8	2015.5
3. Sandy Basin			
0353	Blazed Alder Cr.	11.4	75.3
0354	Blazed Alder Cr.	3.4	23.4
0355	Lake Roslyn	0.3	2.1
0359	Last Chance Mountain	4.5	31.0
0362	South Fk.	5.1	33.4
0363	Linney	15.4	101.3
0364	Meadow	4.4	29.5
		44.5	296.0
4. Hood Basin			
0450	Unknown	0.8	5.6
5. Deschutes Basin			
0557	White R.	0.6	4.1
0558	Smock Prairie	6.2	46.0
0559	Graveyard Butte	6.8	50.2
0569	Whitewater Cr.	23.7	194.8
0571	Metolius Beach	8.6	71.6
0573	Box Canyon, Lower	2.3	13.9
0574	Opal Springs	7.1	43.6
0577	Ogden Park	6.4	39.1
0580	Post	0.6	3.5
0581	Geneva	1.1	6.6
0585	Black Rock	0.5	3.3
0586	Crescent Cr.	0.7	5.1
		64.6	481.8

TABLE XIII. Cont'd.

Dam Site Number	Dam Site Name	Potential @ 50% Exceedance Capacity MW	Potential @ 50% Exceedance Annual Energy GWh
8. Grande Ronde Basin			
0851	Troy	12.4	86.2
0858	Mile 72	16.8	119.0
0861	Chico	2.0	14.4
0862	Cow Cr.	9.7	70.6
0864	Log Cr.	7.1	51.7
0866	Imnaha	5.8	42.0
0868	Dunlap Cr.	2.4	17.2
0869	College Cr.	3.2	22.9
0875	Grouse Cr.	4.3	31.0
0876	Keener Gulch	3.5	24.8
0878	Gumboot	2.5	18.0
0880	Coverdale	14.3	102.8
		84.0	600.6
9. Powder Basin			
0951	Lower Eagle Cr.	1.5	9.8
0953	New Bridge	2.0	13.4
0954	Richland	1.8	12.0
0955	Bowen	1.7	11.3
0958	Hereford	0.6	3.9
		7.6	50.4
10. Malheur Basin			
1051	McLoughlin	1.8	12.6
1052	Grange Site	0.3	1.8
1053	Namorff	3.1	21.4
1054	Reservoir No. 2	1.6	10.9
		6.8	46.7
12. Malheur Lake Basin			
1250	Silvies R.	1.1	7.5
1252	Frenchglen	0.4	2.7
		1.5	10.2
13. Goose & Summer Lakes Basin			
1350	Paisley	1.8	12.6
15. Rogue Basin			
1552	Top Cr.	4.6	30.1
1553	Union Cr.	8.0	52.7
		12.6	82.8
16. Umpqua Basin			
1651	Loon Lake Diversion	6.2	38.2
1657	Tiller	4.8	30.3
		11.0	68.5

TABLE XIII. Cont'd.

Dam Site Number	Dam Site Name	Potential @ 50% Exceedance Capacity MW	Potential @ 50% Exceedance Annual Energy GWh
17. South Coast Basin			
1753	Tidewater	1.2	7.3
1756	Cedar Cr.	0.5	2.8
1766	Floras Cr.	0.4	2.4
1767	Whobrey Mountain	3.7	22.5
1768	Myrtle Cr. Lower	0.2	1.2
1773	Elephant Rock	2.0	12.0
1774	Avery Ranch	0.7	4.3
1775	Elk River, Intermediate	0.9	5.6
1776	Slate Cr.	4.7	28.2
1778	Pistol	0.9	5.4
1780	Redwood	15.4	94.2
		30.6	185.9
18. Mid-Coast Basin			
1853	Holman Cr.	4.0	24.9
1854	Falls #1	7.0	44.0
1855	Gravel Cr.	5.9	36.6
1863	Slick Rock Cr.	1.5	9.6
1867	South Fk.	1.0	6.4
1873	Unnamed	1.9	11.6
		21.3	133.1
Totals:	117 Dam Sites	628.2	4155.1

POWER AND ENERGY POTENTIALS AT IRRIGATION STRUCTURES

Existing Irrigation Systems

A review of available information disclosed a few possibilities for retrofitting existing irrigation facilities for power production. Those involve canals at irrigation storage dams and local drops in irrigation canals. Table XIV identifies those irrigation facilities having a potential capacity of 200 kW or more.

The 10 irrigation dams listed in Table XIV are on rivers where the Phase I study disclosed insufficient streamflow to meet the low-head criteria. This was due in most cases to the diversion of streamflow into irrigation canals at the dams. Hence, the dams did not appear in Table II (showing hydroelectric power potentials at existing non-power dams). However, the heights of these storage dams and the flows diverted by them to irrigation canals could partially provide small-scale hydro power in at least 8 cases and perhaps in all 10 cases. Therefore, they are included in the "irrigation structure" category. Combined, they have an estimated potential capacity of about 8 MW and potential annual energy output of about 25 GWh. Due to the seasonal nature of irrigation releases and the annual variability of water supply, estimates of the potential annual energy output are quite uncertain.

Table XIV also shows that 9 irrigation drops, all in the Deschutes Basin, have a small-scale hydropower potential. Their combined potential capacity is about 5 MW. However, new structures would be required in order to develop this potential.

It may be that other potential power sites on existing canals were overlooked. There is sparse written information available on irrigation canals.

The 10 irrigation dams and 9 irrigation drops listed in Table XIV are shown in Figure 13.

Proposed Irrigation Systems

No detailed information was available regarding proposed irrigation canals that would allow an assessment of their hydro potential. Therefore, the future power potential at proposed irrigation developments has not been included in this assessment.

TABLE XIV. EXISTING IRRIGATION STRUCTURES WITH HYDROELECTRIC GENERATION POTENTIALS (P_{50}) EXCEEDING 200 MW

Project Name	Project Number	Owner or Irrigation District	River	Dam Height, ft., or Structure Type	Hydraulic Head, ft.	Average Irrigation Season Flow, cfs	Potential @ 50% Exceedance Capacity MW	Potential @ 50% Exceedance Annual Energy GWh
Irrigation Dams[1]								
Ochoco Dam	0519	DOI USBR	Ochoco Cr.	118	130	60	1.2	5.2
McKay Cr. Dam	0704	Herm./Stan/West. Irr. Dist.	McKay Cr.	100	74	51	0.8	3.4
Wallowa Lake Dam	0808	Associated Ditch Co.	Wallowa R.	35	35	135	1.2	2.9
Warm Springs Dam	1002	Warm Springs Irr. Dist.	Malheur R.	92	77	87	1.5	3.6
Bully Creek Dam	1004	DOI USBR	Bully Cr.	99	78	42	1.0	1.5
Harper	1005	DOI USBR	Malheur R.	21[2]	12[2]	200[2]	0.1[2]	Unknown
Fish Lake Dam	1522	DOI USBR	N. Fk. Little Butte Cr.	28	38	91	0.4	1.5
Howard Prairie	1523	Talent Irr. Dist.	Jenny Cr./S. Fk. Little Butte Cr.	105[2]	75[2]	55[2]	0.2[2]	Unknown
Emigrant Dam	1524	DOI USBR	Emigrant Cr.	190	181	50	1.7	6.9
Soda Creek Diversion	1525	Talent Irr. Dist.	Soda Cr.	13[2]	10[2]	Unknown	Unknown	Unknown
10 Dams							8.1[3]	25.0[3]
Irrigation Canals[2]								
Main, mile 1.5	0523	North Unit Irr. Dist.	Deschutes R.	Rock drop	10	550	0.3	
Main, mile 38.0	0517	North Unit Irr. Dist.	Deschutes R.	Chute	25	550	0.6	
Main, mile 40.0	0518	North Unit Irr. Dist.	Deschutes R.	Chute	40	400	0.8	
Main, mile 50.0	0515	North Unit Irr. Dist.	Deschutes R.	Chute	40	400	0.8	
Main, Mile 51.0	0516	North Unit Irr. Dist.	Deschutes R.	Chute	40	400	0.8	
Central Oregon, Mile 10.0	0524	Central Oregon Irr. Dist.	Deschutes R.	Chute	25	275	0.3	
Pilot Butte, Mile 1.5	0522	Central Oregon Irr. Dist.	Deschutes R.	Rock drop	30	650	0.9	
Pilot Butte, Mile 4.0	0521	Central Oregon Irr. Dist.	Deschutes R.	Rock drop	20	400	0.4	
Pilot Butte, Mile 10.0	0520	Central Oregon Irr. Dist.	Deschutes R.	Chute	25	375	0.4	
9 Canal Drops							5.3	

[1] Data Source: U.S. Army Corps of Engineers, 1979.

[2] Data Source: DOI USBR, Boise Office.

[3] Approximate, due to missing values of presumed small magnitude.

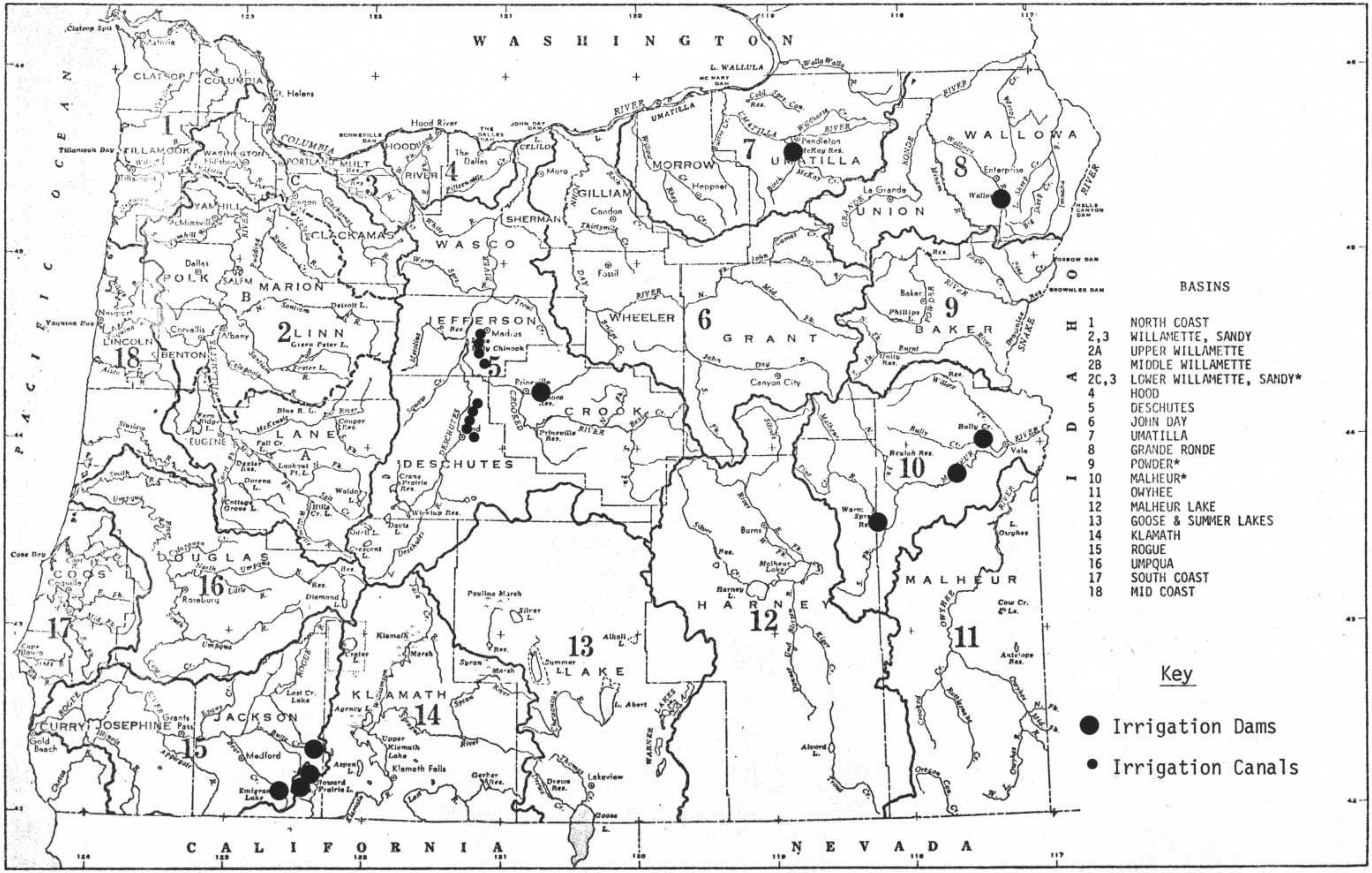


FIGURE 13. EXISTING IRRIGATION STRUCTURES WITH HYDROELECTRIC GENERATION POTENTIALS (P_{50}) EXCEEDING 200 kW

CONCLUSIONS

General Findings

The Phase I study provided basic data gathering, preliminary hydrologic analyses, related evaluations of power and energy, and preliminary feasibility-of-development assessments for 7,626 miles of river reaches in Oregon where no dams or reservoirs now exist and where streamflows and river slopes are adequate for low-head hydropower development of 200 kW or more using run-of-river operation. In the Phase II study, over 5,000 existing and proposed dams were reviewed to identify 48 existing power projects with 200 kW or more of installed capacity, 59 existing non-power dams having a potential for developing 200 kW or more, 10 existing irrigation diversion dams and 9 irrigation canal drops where 200 kW or more might be developed, and 395 proposed dams where 200 kW or more might be developed. Data characterizing these dams came from federal and state agencies and from the Phase I analyses.

The distribution of existing and proposed dams among the major drainage basins in Oregon is a revealing indicator of the importance of surface water development and use. Table XV shows this distribution for dams capable of providing at least 200 kW for 50 percent of the time under run-of-river operation. The Willamette Basin has the greatest existing development, followed distantly by the Umpqua, Rogue and Deschutes Basins. The Willamette Basin also has the greatest proposed development. Important development has also been proposed for the coastal basins (North Coast, Mid-Coast, South Coast) and for the Deschutes, John Day and Grande Ronde Basins, followed by the Umpqua and Rogue Basins. In all, 117 existing dams and 395 proposed dams have P_{50} potentials of 200 kW or more.

Specific Findings

A summary of the hydroelectric power potential in Oregon is presented in Table XVI. Most of the information shown results from the Phase II study. Also shown are data describing the potential at undeveloped river reaches, taken from the Phase I study. For completeness, some analyses which were not part of this study are also indicated (noted by "no est.", for no estimate). Except for existing and future power and energy potentials at existing power projects, all calculated values are based on run-of-river operation and median streamflow.

TABLE XV. DISTRIBUTION OF EXISTING AND PROPOSED DAMS IN OREGON[1]

Drainage Basin	Existing Power Projects		Existing Non-Power Dams			Total Existing Dams	Proposed Dams		Total Proposed Dams
	≥ 25 MW	200 kW to 25 MW	≥ 25 MW	200 kW to 25 MW	Irrigation Diversion Dams		≥ 25 MW	200 kW to 25 MW	
1. North Coast	-	-	-	2	-	2	1	28	29
2. Willamette	9	15	-	21	-	45	18	110	128
3. Sandy	-	1	-	2	-	3	1	14	15
4. Hood	-	1	-	-	-	1	-	1	1
5. Deschutes	2	2	-	5	1	10	14	23	37
6. John Day	-	-	-	-	-	-	2	25	27
7. Umatilla	-	-	-	1	1	2	-	9	9
8. Grande Ronde	-	1	-	3	1	5	3	28	31
9. Powder	-	1	-	3	-	4	-	9	9
10. Malheur	-	-	-	1	3	4	-	5	5
11. Owyhee	-	-	-	1	-	1	-	7	7
12. Malheur Lake	-	-	-	-	-	-	-	2	2
13. Goose and Summer Lakes	-	-	-	-	-	-	-	1	1
14. Klamath	1	1	-	1	-	3	1	1	2
15. Rogue	2	4	-	4	4	14	5	15	20
16. Umpqua	4	4	-	11	-	19	6	14	20
17. South Coast	-	-	-	3	-	3	-	28	28
18. Mid-Coast	-	-	-	1	-	1	2	22	24
State Totals	18	30	0	59	10	117	53	342	395

[1] Only dams with P_{50} potentials exceeding 200 kW under run-of-river operation are included.

TABLE XVI. SUMMARY OF HYDROELECTRIC POWER POTENTIAL IN OREGON

Power Production Source	Number of Projects or Sites	Existing Power MW	Existing Annual Energy GWh	Future[1] Power MW	Future[1] Annual Energy GWh
Existing Power Projects[2]					
≥ 25 MW Capacity	18	1,210	5,064	352	560
200 kW - 25 MW Capacity	30	255	1,421	488	1,627
< 200 kW Capacity	2[3]	0.1	1	20	19
		1,465	6,486	860	2,206
Existing Non-Power Dams					
Theoretical Potential					
≥ 25 MW Capacity	0	---	---	0	0
200 kW - 25 MW Capacity	59	---	---	117	784
< 200 kW Capacity	Unknown	---	---	No Est.	No Est.
Minimally Constrained Potential					
≥ 25 MW Capacity	0	---	---	0	0
200 kW - 25 MW Capacity	19	---	---	44	295
< 200 kW Capacity	Unknown	---	---	No Est.	No Est.
Existing Irrigation Facilities					
@ Dams	10	---	---	8	25
@ Canal Drops	9	---	---	5	No Est.
Undeveloped River Reaches[4]					
Theoretical Potential	7626 mi	---	---	6,292	42,505
Minimally Constrained Potential	374 mi	---	---	228	1,539
Proposed Dams					
Theoretical Potential					
≥ 25 MW Capacity	53	---	---	2,017	No Est.
200 kW - 25 MW Capacity	342	---	---	1,839	12,102
< 200 kW	Unknown	---	---	No Est.	No Est.
Minimally Constrained Potential					
≥ 25 MW Capacity	10[5]	---	---	311	No Est.
200 kW - 25 MW Capacity	117[6]	---	---	628	4,155
< 200 kW Capacity	Unknown	---	---	No Est.	No Est.

1 Based on run-of-river operation and streamflow available 50% of the time (P_{50}, E_{50}).

2 Power and energy values based upon published reports (FPC, 1976; U.S. Army Corps of Engineers, 1979).

3 Projects smaller than 200 kW that are listed by FPC, 1976.

4 Only includes reaches where low-head (< 20 m) development can provide $P_{50} \geq 200$ kW, based on data from Phase I study.

5 Based on screening 49 fully-documented proposed dams out of 53 proposed dams.

6 Based on screening 341 fully-documented proposed dams out of 342 proposed dams.

At existing power projects (see Table XVI), 1,465 MW are presently installed and 860 MW could be added (a 59 percent increase), for a total of 2,325 MW. Annual energy capability is now 6,486 GWh and could be augmented by 2,206 GWh (a 34 percent increase) to provide 8,692 GWh.

At existing non-power dams, 117 MW of median-flow, run-of-river capacity could be added, giving 784 GWh of annual energy. But environmental and transmission constraints reduce these figures to more realistic estimates of 44 MW and 295 GWh.

Existing irrigation facilities could provide 13 MW and perhaps 40 GWh of additional power and energy. Few constraints, other than possible economic constraints, are seen for this limited development potential.

Undeveloped river reaches have available water power of 6,292 MW 50 percent of the time, corresponding to 42,505 GWh. But fewer than 5 percent of the river miles are minimally constrained, offering 228 MW and 1,539 GWh of annual potential.

Proposed dams, operating as run-of-river projects sized to median flows, have a theoretical potential of 3,856 MW. This potential capacity is roughly equally divided between small-scale hydropower and large hydropower dams. The estimated potential annual energy is 12,102 GWh at the proposed small-scale hydropower dams. No corresponding estimate was made for the proposed large hydropower dams, but a similar amount might reasonably be expected. When constraints on developing proposed dams are considered, the minimally constrained potential drops to 311 MW for large dams and 628 MW (4,155 GWh) for small-scale dams, offering a total of 939 MW, about 24 percent of the theoretical potential. This total exceeds that for minimally constrained undeveloped river reaches because higher dams are proposed than the available reach elevation heads used in Phase I calculations, requiring encroachment on upstream reaches.

The power and energy potentials from different power production sources, shown in Table XVI, may be combined to indicate the total power that might be obtained from different types of development. Table XVII, based on Table XVI, shows several optional development schemes. These include: (1) relying only on the existing power potential; (2) expansion of power facilities at existing power projects; (3) retrofitting existing non-power dams for power generation; (4) retrofitting existing irrigation facilities for power generation; (5) combined expansion at existing power projects, retrofitting of existing non-power

TABLE XVII. OPTIONS FOR EXPANDING HYDROELECTRIC CAPABILITIES[1]

Option	Category of Power Development	Capacity, MW	Increase Over Existing Capacity, %
1	Existing Capacity	1,465	0
2	Expansion at existing power projects	860	59
3	Retrofitting existing non-power dams		
	(a) theoretical	117	8
	(b) minimally constrained	44	3
4	Retrofitting existing irrigation facilities	13	1
5	Combined expansion at existing power projects and retrofitting existing non-power dams and irrigation facilities		
	(a) theoretical	990	68
	(b) minimally constrained	917	63
6	Low-head development of river reach water power		
	(a) theoretical	6,292	429
	(b) minimally constrained	228	16
7	Full development of all proposed dams		
	(a) theoretical	3,856	263
	(b) minimally constrained	939	64
8	Combined expansion/retrofitting at existing facilities plus full development of all proposed dams		
	(a) theoretical	4,846	331
	(b) minimally constrained	1,856	127
	Total existing capacity plus combined expansion/retrofitting at existing facilities plus full development of all proposed dams		
	(a) theoretical	6,311	431
	(b) minimally constrained	3,321	227

[1] Capacities, other than for options 1 and 2, are based on run-of-river operation and streamflow available 50 percent of the time.

dams, and retrofitting of irrigation facilities; (6) developing all undeveloped river reaches with low-head hydropower; (7) developing all proposed dams; and (8) combined expansion/retrofitting of existing facilities (option 5) and development of all proposed dams (option 7). The percentage increase of capacity over the existing capacity for each option is also shown in Table XVII. Finally, the total achievable development with these options (option 1 plus option 8) is shown.

Development of existing facilities can yield a 63-68 percent increase in hydroelectric capacity, development of minimally constrained proposed dams can provide a similar increase in capacity. In combination, the hydroelectric capacity can be more than doubled. If minimal constraints are ignored, even greater hydropower production can be obtained, perhaps more than quadrupling the present capacity.

Reminders About Use of Findings

It is extremely important to remember, when considering the findings of this study, that an underlying assumption of run-of-river operation has been made. This assumption is viewed as crucial to minimize the impacts of low-head hydropower development. Because of the strongly seasonal patterns for streamflow runoff in Oregon, the run-of-river assumption tends to favor the minimization of streamflow alteration impacts at the expense of power and energy development. Conversely, larger dams with appreciable storage capability, so as not to be limited to run-of-river operation, would enhance hydropower development but produce greater impacts on the aquatic system. In other studies, most notably the recent (1979) preliminary inventory of hydropower resources by the U.S. Army Corps of Engineers, the opposite assumption prevails of maximizing storage aspects of proposed developments. This leads to much larger estimated power potentials but is expected to also lead to greater environmental impacts.

A second important reminder is that the data summarized in Tables XVI and XVII are generally based on median streamflows, equalled or exceeded about 50 percent of the time. Larger or smaller exceedance values might have been used to indicate the power and energy potentials, giving significantly different numerical results. For example, it was shown earlier that there is a 20-fold difference between power potentials that might be achieved if hydropower facilities were sized to handle very large flows, exceeded only 10 percent of the time, and potentials achievable if facilities were sized to handle low flow conditions exceeded most (95 percent) of the time. The 50 percent exceedance condition was used here for illustrative purposes because under run-of-river operating conditions it would not lead to over-sizing facilities and extended power plant operation at part-load. If facilities were instead sized to handle larger flows, greater installed capacities would result but power plants would operate at less than capacity for longer periods. For example, if facilities were sized to handle streamflows only exceeded 30 percent of the time, the potential capacity could be doubled (see Tables III and X), but power plants would operate at capacity only 30 percent of the time, instead of 50 percent of the time. The use of reservoir storage would enhance both the capacity and energy development potential by allowing storage of water when flows exceed power plant capacity and release of water when run-of-river flows are less than that for which the facilities are sized.

A third reminder is that hydroelectric development can not occur with 100 percent efficiency, as assumed here. Hydraulic, mechanical, electrical and other losses will reduce the efficiency of energy extraction. The resulting efficiency will vary from site to site and with the amount of turbine flow and head. For planning purposes, estimates made in this study might be realistically adjusted by an efficiency of 80 ($\pm$ 10) percent.

A fourth reminder is that constraint evaluation and screening, while involving practical criteria, were somewhat arbitrary. For example, the constraint imposed by transmission line distance might vary considerably with the type of terrain encountered. Or constraints on single-site development might disappear if multiple-site development is considered. Therefore, sites constrained by preliminary screening should not be completely discarded from further investigation.

A Final Note

The work reported here is a resource survey. Resource surveys are typically limited by the quality of the data available. In this study, much of the available information was out-of-date, sketchy, incomplete, contradictory, and subject to different interpretations. The impacts of hydroelectric power development were not specifically addressed, other than through preliminary environmental constraints and screening criteria. The findings and conclusions regarding the hydroelectric potential in Oregon do not constitute and should not be considered to constitute either an endorsement or a rejection of hydropower development. The historical importance of hydropower resources and continuing role of hydroelectric generation in the Pacific Northwest is recognized. It is hoped that the findings of this study will add useful information for continued serious assessment of hydropower as an available technology for meeting Oregon's energy needs.

REFERENCES

A. Methodology

Gladwell, J.S., et. al.; A Resource Survey of Low-Head Hydroelectric Potential, Pacific Northwest Region; Phase I Completion Report (Main Report and Appendices, 10 volumes) to U.S. Department of Energy; Idaho Water Resources Research Institute, University of Idaho, Moscow; March 1979.

Klingeman, Peter C.; A Resource Survey of River Energy and Low-Head Hydroelectric Power Potential in Oregon; (Synopsis Report, Main Report and 20 Appendices); Water Resources Research Institute, Oregon State University, Corvallis; April 1979.

Gladwell, J.S., et. al.; A Resource Survey of Low-Head Hydroelectric Potential at Existing Dams and Proposed Sites in the Pacific Northwest Region; Phase II Draft Completion Report (Main Report and 5 Appendices) to U.S. Department of Energy; Idaho Water Resources Research Institute, University of Idaho, Moscow; September 1979.

B. Data Sources

Federal Power Commission; Hydroelectric Power Resources of the United States, Developed and Undeveloped, January 1, 1976; Federal Power Commission; Washington, D. C.; 1976.

Oregon State Water Resources Board; Reports on Individual River Basins; 1958 through 1969; Salem, Oregon.

Power Planning Committee; Review of Power Planning in the Pacific Northwest, Calendar Year 1977; Power Planning Committee, Pacific Northwest River Basins Commission; Vancouver, Washington; 1978.

State Engineer; Oregon Reservoir Inventory; Chris L. Wheeler, State Engineer of Oregon; Salem, Oregon; 1973.

U.S. Army Corps of Engineers; Inventory of Dams in the United States: U.S. Army Corps of Engineers; Washington, D. C.; 1975.

U.S. Army Corps of Engineers; Summary of Northwest Hydroelectric Power Potential; U.S. Army Corps of Engineers, North Pacific Division; Portland; 1976.

U.S. Army Corps of Engineers; Preliminary Inventory of Hydropower Resources, Volume I: Pacific Northwest Region; National Hydroelectric Power Resources Study; U.S. Army Corps of Engineers, Institute for Water Resources; Ft. Belvoir, Virginia; 1979.

U.S. Bureau of Reclamation; Report on the Western Energy Expansion Study; U.S. Department of the Interior, Bureau of Reclamation; Denver, Colorado; 1977.

U.S. Geological Survey; Gross Theoretical Waterpower (developed and undeveloped); U.S. Department of Interior Geological Survey; Portland; Oregon 1963, revised draft 1978.