

DOE/BP--2916



SOR USERS' GUIDE

U.S. DEPARTMENT OF ENERGY, BONNEVILLE POWER ADMINISTRATION

U.S. DEPARTMENT OF THE ARMY, CORPS OF ENGINEERS, NORTH PACIFIC DIVISION

U.S. DEPARTMENT OF THE INTERIOR, BUREAU OF RECLAMATION, PACIFIC NORTHWEST REGION

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

get
MASTER

Published August 1996

This document was published for the Columbia River System Operation Review, a joint project of the U.S. Bureau of Reclamation, U.S. Army Corps of Engineers, and Bonneville Power Administration.

Writing by Resource Writers Inc. with the assistance of agency staff.

Photo Credits: U.S. Bureau of Reclamation
U.S. Army Corps of Engineers
Bonneville Power Administration
U.S. Geological Survey

If you have any comments or questions, please contact:
Interagency Team
P.O. Box 2988
Portland, OR 97208-2988
Call: (503) 230-3478 (Portland) or 1-800-622-4519
To request documents, call: 1-800-622-4520.



Printed on recycled paper

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

DISCLAIMER

**Portions of this document may be illegible
in electronic image products. Images are
produced from the best available original
document.**

Ready, Set, Browse

The Columbia River System Operation Review (SOR) gave river managers, users, and the general public a chance to examine system operations in detail, to study how each river use affects others, and to consider the consequences of changing the way the system works. The task was enormous, and it was a multiyear undertaking.

In its wake, the SOR left a multitude of documents and six years of analysis that can and should be used broadly for other reference and research purposes. This catalog will introduce you to numerous SOR products to be found throughout the 20 appendices and the Final Environmental Impact Statement (EIS) Main Report. They include maps, models, data bases, current descriptions of Federal hydro projects and river resources, publications, and slide shows.

Several of the chapters are divided into two sections. Each chapter includes a sampling of the valuable information you will find in SOR documents. Some chapters also contain a comprehensive alphabetical listing to be used like any index to locate topics and materials in the SOR.

The SOR volumes represent the work of dozens of analysts, including staff from the three Federal system operating agencies, as well as other Federal, state, and local agencies, and a number of interest groups. In several cases, the volumes contain state-of-the-art information and analysis on the river uses and resources. We have also included the names of agency staff people who would be happy to talk to you and give you the benefit of their SOR studies.

There's no need to reinvent the wheel. If we didn't invent what you need, we may have refined it. We invite you to check the SOR first when you're looking for information on the Columbia River Basin.



C
O
N
T
E
N
T
S



**Current Information
on the System** 5



Data Bases 9



**Educational Publications
on the Columbia River System** 13



Maps 15



**Models, Analytical Tools
and Techniques** 19



**Public Opinion Inventory
on Columbia River
Basin Issues** 23



**Learn About
Public Involvement** 25

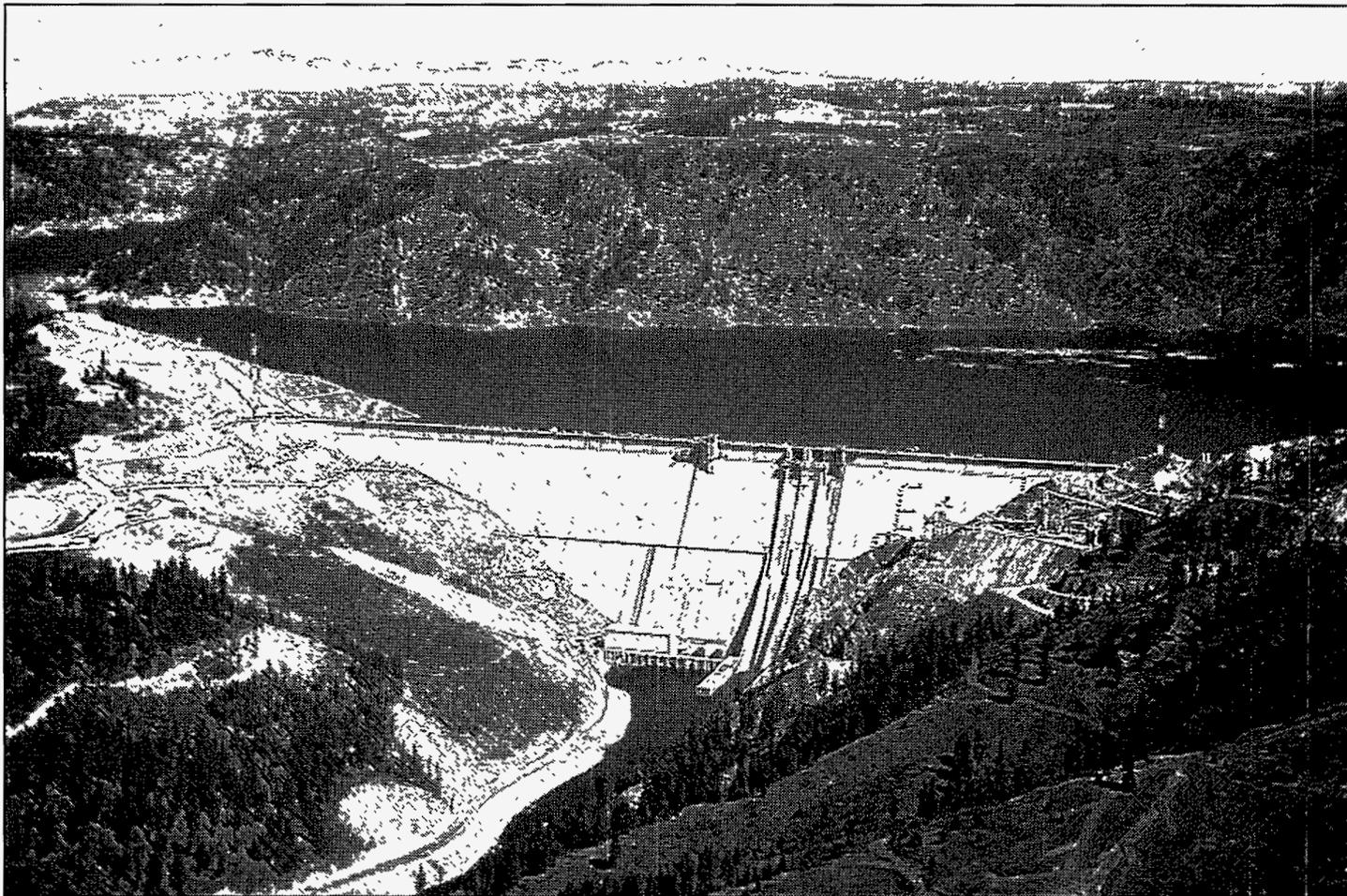


**SOR on
the Big Screen** 27



**Who's Who:
Sources of Information
and Mailing Lists** 29

Experts on the River System 30



Dworshak Dam on the North Fork Clearwater River at Ahsahka, Idaho.



Current Information on the System

It's your river, and welcome to it! From bald eagles to bull trout to barge traffic — there's a rich trove of information on the Columbia River available from the System Operation Review. It was put together over several years by a network of individuals seeking to compare what's happening today with what could happen tomorrow. Here are some examples of what's in the SOR.

Where Do Those Suckers Live Anyway?

Well as a matter of fact, the *Family Castotomidae* is native to the Columbia Basin, and its members live in a number of the region's water bodies. The Largescale sucker occurs commonly, while the Mountain sucker is found only in the Hanford Reach of the Columbia River. The **Resident Fish Appendix K** contains a complete narrative and tabular inventory of all of the non-anadromous fish that reside in reservoirs and river reaches throughout the basin. Check out the tables beginning on page 2–4, then read on to the reservoir-by-reservoir detail of fish habitat and which species call each location home. The appendix presents a comprehensive compilation of

species information from a number of agency and tribal sources. If you're researching fish, you'll be hooked.

Calling All Recreation Planners!

Who has the higher average income: the family that uses Columbia River Basin recreational sites or the family that does not? Are women or men more likely to use recreation facilities in the basin? What is the most popular activity? The SOR Recreation Work Group contributed new and original research to the body of knowledge about those who use recreation facilities in the Columbia River Basin and the kinds of activities they pursue. The **Recreation Appendix J** is a definitive work on recreational opportunities at the region's hydro projects, and it presents results of a users' survey that should be consulted by anyone who is planning for the region's future recreation needs. From boating to wind-surfing, Appendix J is a recreation planner's dream.



Discover the History and Prehistory of the Basin.

When did the horse come to the Columbia River Plateau and from where? Can you name historical sites significant to the fur trade era in the Northwest? Who were the first missionaries and where did they settle? What archeological studies have been carried out in the basin, what was found, and how can cultural resources at multipurpose reservoirs be protected? The **Cultural Resources Appendix D** contains all this information and more. Appendix D's "Exhibits" volume presents a cultural resources monitoring and protection plan. Armchair archeologists will enjoy digging into Appendix D.

Which Land Is Your Land?

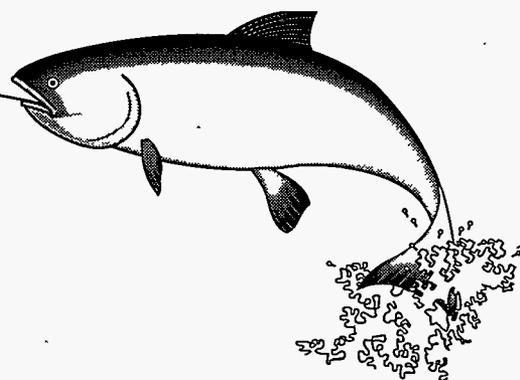
The Federal government owns over half the land in the Pacific Northwest. Read about how that came to be, and exactly what the seven major Federal land-owning agencies manage in the **Land Use and Development Appendix G**. Trace land ownership patterns and land uses — find out what percentage of land in each state is in crops, forests, or cities by consulting page 2–11 in the appendix. Take an in-depth look at land ownership and usage in the 10 major river corridors. **Holy hectares! There are acres, miles, and lots of information in Appendix G.**

The Game at Goose Does Not Include Moose.

It does, however, include mule deer, whitetail deer, and as the name implies, Little Goose Reservoir and the lower Snake River reach are roosting grounds

for Canada Geese. Chapter 2 in the **Wildlife Appendix N** is teeming with critters. There are inventories of the species of waterfowl, colonial nesting birds, shorebirds, nongame birds, raptors, terrestrial and aquatic furbearers, big game, and amphibians and reptiles at each of the projects and listings of the endangered, threatened, and sensitive species at each location: Little Goose alone has 10 such species of birds.

These wildlife tallies, coupled with listings of the type and acreage of wildlife habitat that exist at each of the Federal projects in the Columbia River Basin, provide a comprehensive picture of the basin's wildlife. **P.S.** The lower Kootenai River and the Libby project in Montana are the most likely spots in the U.S. portion of the basin for a moose sighting.



See the Columbia River Heritage Through the Eyes of the Earliest Inhabitants.

On the afternoon of May 29, 1855, U.S. Treaty Commissioners Joel Palmer and Isaac Stevens “sat beneath the arbor with their secretaries, agents and interpreters, while the Indians gathered in a vast semicircle before them.” Find out what happened at this historic meeting by turning to page F-9 in the **Cultural Resources Appendix D**. The Confederated Tribes and Bands of the Yakama Nation submitted this history of the 1855 Treaty, and their actual statements are reproduced, as are portions of the treaty. Exhibit F contains excerpts from oral histories recorded by the Yakama Indian Nation Cultural Resources Program.

Appendix D informs readers about the tribal point of view on Columbia River history, issues, culture, and concerns. Eight tribes describe how the hydro system has affected their people, lands, and way of life. The reader learns how sites and activities along the river are essential to the fabric of tribal culture and history. **Share in the tribal perspective today and yesterday by reading Appendix D.**

The Lowdown on Water Quality Regs.

Ever try to untangle the web of Federal and state water quality regulations? SOR analysts did and reported the results in Chapter 2 of the **Water Quality Appendix M**. Starting on page 2-11, there is an annotated list of laws and regulations, beginning with the Federal Clean Water Act and the rules it spawned. The list includes the Executive Orders that regulate development within floodplains, protect wetlands, and control environmental pollution. The chapter also explains water temperature, dissolved gas, and turbidity standards that have been adopted by Idaho, Montana, Oregon, and Washington to protect the waters of the Columbia Basin. **Appendix M is the place to turn if you need a comprehensive look at water quality laws and standards.**

The Four H's of Anadromous Fish.

Anadromous fish hatch in freshwater, migrate to and mature in the ocean, and return to freshwater as adults to spawn. **Anadromous Fish and Juvenile Fish Transportation Appendix C** describes the different anadromous fish in the SOR study area and the “four H’s” that affect these fish: habitat, hatcheries, hydro projects, and harvest. You can learn about the types of anadromous fish, their abundance (or lack thereof), their life cycles and behavior, and the many dangers they face. Consult pages 2-11 and 2-12 of the EIS Main Report to see the numbers of salmon and steelhead entering the Columbia River from 1938 to 1993, and a chart showing the rivers in which wild and hatchery runs of salmon and steelhead occur in the basin.

What’s “fish transportation?” Next time you’re migrating on the bus between home and work, you might take along Appendix C to learn more about the transit program the region has developed to help juvenile salmon and steelhead get past the dams and down the Columbia River. How do they get those fish into the barges anyway? Chapter 1 explains the

transportation program in depth, with photos and diagrams of collector and transportation facilities. Page 1–12 shows how many millions of fish have been transported at each dam since 1978.

Secrets of the lesser known A-Fish. Swimming in the shadow of the well-publicized salmon and steelhead is a less familiar Northwest anadromous fish: the American shad. In 1990, the shad run broke its previous population records when 4 million passed Bonneville Dam. But this may not be good news for migrating salmon — find out why in Appendix C. **You'll be immersed in the most current knowledge of salmon as well as the other creatures (lam-preys! sturgeon!) that nature has designed to travel between the rivers and oceans.**

Watch Out for Hot Spots and Contaminated Reaches.

The Columbia Slough, which flows parallel to the Columbia River from east Multnomah County to north Portland, is one of the most polluted water bodies in Oregon. Heavy metals, bacteria, pesticides, PCBs, and dioxin are found in the lower Columbia, downstream of major urban and industrial sites. And where else but in Dworshak Reservoir fed by Idaho's Clearwater River would you find some of the cleanest water in the basin? Chapter 2 in the **Water Quality Appendix M** contains narrative descriptions of the water quality in all of the major reaches of the Columbia River system as well as a chart that pinpoints dozens of river locations and the water quality concerns at each. The chapter also identifies areas where data are lacking. **Look to Appendix M to discover some fruitful avenues for water quality research.**

Here's the Key to Locks.

Can you picture how locks on the Columbia and Snake River dams lift or lower vessels 100 feet? If you can't, turn to page 2–3 of the **Navigation Appendix H** to see a cross-sectional drawing. Find a list of the export products that move through the locks and how the various Columbia and Snake River port facilities are used in Chapter 3 of the EIS Main Report. **Check out the commercial arteries whose waters are at the heart of the regional economy.**

Know Your Water Rights.

Approximately 90 percent of the water withdrawn in the Pacific Northwest is for irrigation. And when you talk about water uses, it's essential to understand water rights. The **Irrigation, Municipal and Industrial/Water Supply Appendix F** contains a useful summary of water rights in the Pacific Northwest, starting on page 2–7. That information is woven into a detailed description of irrigation history and practices, facts on irrigated acreage and irrigation diversions, and a discussion of irrigation issues at six Federal reservoirs. **Soak up information about water use in the Northwest by perusing this volume.**





The Big Picture.

Chapter 2, The Columbia River Basin, of the EIS Main Report provides a comprehensive inventory of the geology, landforms, soils, and air and water resources of the basin. It's an easy-to-use compilation of data on anadromous fish, resident fish, and animals and plants found in the Columbia River Basin. Chapter 2 also discusses cultural resources and cultural history, commerce and industry, land use and ownership, transportation, and the people and the economy of the Pacific Northwest.

Facts About the Physical System.

Turn to Chapter 3, The Columbia River System, of the EIS Main Report for a data profile of the 14 Federal dams and reservoirs in the SOR study area. Table 3-1 (page 3-3) lists general characteristics of the projects, such as location, year completed, and authorized purpose. Table 3-2 (page 3-5) indicates reservoir capacities and operating elevations. The chapter summarizes annual planning and operations; for a longer explanation, consult "The Columbia River System, The Inside Story" (in the publications listing in this catalog).

Flood Control — Now More Than Ever.

How the Columbia River system is operated for flood control is a hot topic in Chapter 3 of the EIS Main Report. It identifies areas of historical flood damage and where the major levees in the region are located. The **Flood Control Appendix E** explains storage reservation diagrams and includes one for Libby Dam on page 2-5. Appendix E also contains flood control frequency curves for all of the SOR alternatives. Appendix O's flood control section (Exhibit B) discusses potential flood damage areas on the upper Columbia, lower Columbia, and Clearwater Rivers. Data in the appendix correlate flood stages to dollar amounts of damages.

Power Stats.

Chapter 2 of the **Power Appendix I** presents data on the electric power system, with a chart of the generating capacity of the Federal projects. The sources of the power — coal, nuclear, hydro, gas — are identified, and the role of the Bonneville Power Administration in Northwest power generation is discussed. Did you know that hydro accounts for about three-quarters of the electricity generated in the Northwest?

Profiles in Socioeconomics.

The **Economic and Social Impact Appendix O** describes the socioeconomic history of the basin and its population growth and demographics. Look into the future through the population projections to the year 2015 on page 2-7. A **Social Impacts Analysis (Exhibit F)** focuses on 17 communities and Indian tribes in the region, providing socioeconomic profiles of population and housing, income and employment, and river-based resource activities. These tables begin on page F-61.

Hydroregulation Data.

The **River Operation Simulation Appendix A** contains extensive hydroregulation comparison tables and graphs based on the alternatives studied in the SOR. The data on flows and elevations, derived from the hydroregulation models used in the SOR, will be informative to people considering alternative river operations in the future. Since the SOR studied so many possible river operations, these outputs may keep others from reinventing many of the data wheels for some time.

Recreation.

Pages 3-26 to 3-31 of Chapter 3 of the Main Report indicate how and to what extent the Federal projects are used for recreation. Did you know Dworshak is one of the few lakes in the Northwest with boat-accessible campsites? The **Recreation Appendix J** takes the discussion to a more detailed level, providing tables which summarize not only historic recreation visitation at reservoirs and rivers, but also current patterns and projected future trends in visitation. Pages 2-10 to 2-20 present detailed data from a survey of water-related recreation users in the region.

Cultural Resources.

Consult Appendix C for information on archeological inventories conducted at each of the Federal projects. Page 2-23 contains a list of sites in the region on the National Register of Historic Places. Table 3-2 (pp. 3-14 and 3-15) summarizes site inventory work done at all the projects. It shows numbers of recorded sites per project, sites with elevation data available, and sites located above the maximum pool level. The table also indicates the estimated completeness of the data, based on a survey of the literature and discussions with archeologists who have worked at the projects.

Chapter 3 of Appendix D discusses how erosion, sedimentation, and changes in landforms at the reservoirs affect cultural resources. A diagram on page 3-7 depicts geomorphic processes at a typical storage reservoir, a table on page 3-8 shows how susceptible different soil types are to erosion, and a graphic on page 4-21 shows different reservoir impact zones and potential impacts on historic and cultural properties.



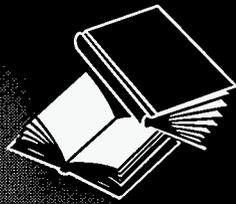
Index of All Major Data Bases in the SOR

- Air Quality — Emission factors for combustion turbines and coal plants, p. 3–16, Appendix B
- Air Quality — Federal and state standards, p. 2–2, Appendix B
- Air Quality — Maximum PM10 concentrations in the Columbia River Basin, 1992–94, pp. 2–7 and 2–8, Appendix B
- Air Quality — Wind direction and speeds for selected monitoring stations, p. 2–10, Appendix B
- Air Quality — Wind roses for representative weather stations, p. 2–11, Appendix B
- American Shad — Juvenile collection count, p. 2–40, Appendix C
- Anadromous Fish — Adult salmon and steelhead counts at selected projects, pp. 2–2 and 2–3, Appendix C
- Anadromous Fish — Columbia River Basin salmon runs, historic vs. current run size, p. 8, Appendix S
- Anadromous Fish — Columbia River salmon catch estimates, 1987–91, p. 3–23, Appendix O
- Anadromous Fish — Hatchery releases by species, p. 3–17, Main Report
- Anadromous Fish — Juvenile fish transported by dam from 1978 through 1993, p. 1–12, Appendix C
- Anadromous Fish — Status, pp. 2–11 and 2–15, Main Report
- Anadromous Fish — Timeline (from 1930s to present) of milestones in the juvenile fish transportation program, pp. B–13 to B–23, Appendix C
- Anadromous Fish — Wild and hatchery runs of salmon and steelhead, p. 2–12, Main Report
- Bald Eagles — Mean number of bald eagles observed on Pend Oreille Lake, 1971–1994, p. 2–23, Appendix N
- Cultural Resources — Archeological sites at Dworshak Reservoir affected by geomorphic processes, p. A–57, Appendix D
- Cultural Resources — Cultural chronologies of the Columbia River system, p. 2–10, Appendix D
- Cultural Resources — Known sites of particular cultural importance to the Confederated Tribes of the Umatilla Indian Reservation inundated by Columbia/Snake River reservoirs, p. xi, CTUIR submission, Appendix D
- Cultural Resources — Sites at the projects on the National Register of Historic Places, pp. 2–23 and 2–24, Appendix D
- Dams — Project purposes of Federal dams, p. 2–1, Appendix Q
- Dams and Reservoirs — General project characteristics, p. 3–3, Main Report
- Dams and Reservoirs — Reservoir operating characteristics, p. 3–5, Main Report
- Economics — Pacific Northwest subregions for analysis of indirect economic impacts, p. 3–53, Appendix O
- Fisheries — Operating expenditures for in-river commercial fisheries, p. E–12, Appendix O
- Fisheries — Operating expenditures for ocean commercial fisheries, p. E–13, Appendix O
- Fisheries — Operating expenditures for fish processing, p. E–14, Appendix O
- Fisheries — Recreation expenditures for sport fishing, p. E–21, Appendix O
- Flood Control — Control points and river reaches evaluated for flooding, p. 3–3, Appendix E
- Flood Control — Flood protection levee districts on the lower Columbia River between Bonneville Dam and river mile 40, p. B–39, Appendix O
- Irrigation — Crop production in Washington, Oregon, and Idaho (and the portion of production from irrigated lands), p. 2–4, Appendix F
- Irrigation — Diversions and net depletions by basin, p. 2–5, Appendix F
- Irrigation — Irrigated acreage by state, Columbia River Basin, p. 2–2, Appendix F
- Irrigation — Irrigated acreage in Columbia River Basin by state — 1989–90, p. 2–7, Appendix F
- Land Use — Designated Federal protected lands within SOR study area, p. 2–33, Main Report
- Land Use — Land cover and use by state in the Pacific Northwest, p. 2–11, Appendix G
- Land Use — Summary of land ownership in the Pacific Northwest, p. 2–5, Appendix G
- Navigation — Annual U.S. rail-to-port grain traffic at Northwest ports, p. 2–20, Appendix O
- Navigation — Columbia/Willamette River grain elevators, p. 2–15, Appendix O
- Navigation — Columbia/Snake River port facilities, p. 3–12, Main Report
- Navigation — Effects of lower Snake River drawdown, Appendix O
- Difference in bushels shipped by rail for drawdown during August, p. C–17
- Grain transportation costs, pp. C–11 to C–16
- Percent shift of grain movements from barge to rail by river port, p. C–11
- Navigation — Location of elevators with grain-handling capability, Columbia/Snake shallow-draft navigation channel, p. 2–18, Appendix O
- Navigation — Products exported from Columbia River, p. 3–13, Main Report
- Navigation — Receipts of wheat and barley at Columbia River export houses by mode of transportation, p. 2–20, Appendix O
- Navigation — River ports and elevators located on the shallow-draft waterway by pool and river mile, p. C–8, Appendix O
- Navigation — Top five export and import countries, p. 2–17, Appendix O
- Navigation — Volume of grain shipped by barge on the shallow-draft waterway, 1986–90, p. C–7, Appendix O
- Pacific Lamprey — Adult lamprey dam counts, 1938–1969, p. 2–49, Appendix C

(continued)

(continued)

- Pacific Lamprey — Juvenile lamprey incidental catch, p. 2-44, Appendix C
- Pacific Lamprey — Juvenile lamprey bypassed at Little Goose Dam, p. 2-45, Appendix C
- Plants — Scientific names of plants in the basin, pp. 2-98 to 2-100, Appendix N
- Population — Projections through 2015, p. 2-7, Appendix O
- Power — BPA generating resources, p. 2-5, Appendix I
- Power — Characteristics of mid-Columbia River hydroelectric projects, p. 2-27, Appendix K
- Power — Hydro project characteristics, p. 2-3, Appendix I
- Power — Pacific Northwest electric generating resources, p. 2-4, Appendix I
- Recreation — Annual recreation use by project or river reach, p. 3-27, Main Report
- Recreation — Annual recreation use at affected reservoirs, p. 3-13, Appendix B
- Recreation — Choice of lodging by overnight visitors to SOR Federal projects, p. E-47, Appendix O
- Recreation — Estimated future recreation demand in the Columbia River Basin, p. 2-10, Appendix J
- Recreation — Percent of visitor participation by activity, 1991, p. 2-6, Appendix J
- Recreation — Recreation areas and types of recreation activities, p. 2-23, Appendix O
- Recreation — Recreation expenditures of non-resident visitors to the SOR Federal projects, p. E-48, Appendix O
- Recreation — Residence origin and length of stay for recreation visitors at SOR Federal projects, p. E-47, Appendix O
- Recreation — Seasonality of Columbia River recreation use, 1989, p. 2-21, Appendix J
- Recreation — Sites and facilities and visitation summary, Appendix O
- Dworshak Lake, pp. 2-89 to 2-91
 - Hells Canyon National Recreation Area, pp. 2-83 to 2-85
 - Hungry Horse, pp. 2-54 and 2-55
 - Lake Koocanusa/Kootenai River, pp. 2-42 and 2-43
 - Lake Roosevelt, pp. 2-58 to 2-62
 - Lake Pend Oreille, pp. 2-67 and 2-68
 - Lower Snake River, pp. 2-91 to 2-97
 - Lower Columbia River, pp. 2-98 to 2-111
 - Middle Columbia River, pp. 2-75 to 2-77
 - Upper Columbia Reach, p. 2-47
- Recreation — Historic recreation visitation to Columbia River Basin reservoirs and rivers, 1987-1993, p. 2-5, Appendix J
- Resident Fish — Common and scientific names of resident fish in system, pp. 2-4 to 2-6, Appendix K
- Resident Fish — Matrix of resident fish in reservoirs and rivers, pp. 2-7 and 2-8, Appendix K
- Rivers — Major tributaries to the Columbia River downstream from Bonneville Dam, p. B-34, Appendix O
- Tribes — Key treaties with tribes, p. 2-28, Main Report
- Water Quality — Basinwide water quality parameter statistics, p. B-10, Appendix M
- Water Quality — Columbia River historic water temperature, dissolved oxygen, turbidity, conductivity, pH, nitrite plus nitrate, ammonia, phosphorus graphs, pp. B-11 to B-18, Appendix M
- Water Quality — Concerns by subbasin, pp. 2-28 to 2-30, Appendix M
- Water Quality — Long-term monitoring site sampling/analysis frequency summary, p. B-9, Appendix M
- Water Quality — Site-specific studies in the Columbia Basin, pp. 2-16 and 2-17, Appendix M
- Water Quality — Yakima River water quality, p. B-23, Appendix M
- Wildlife — Endangered, threatened, and sensitive species, Appendix N
- Chief Joseph (Rufus Woods Lake), pp. 2-35 and 2-36
 - Columbia River below Bonneville Dam to mouth of Willamette River, p. 2-98
 - Dworshak Project, p. 2-67
 - Hanford Reach, pp. 2-48 and 2-49
 - Hungry Horse, p. 2-15
 - Kootenai River, p. 2-7
 - Lake Koocanusa, p. 2-10
 - Lake Pend Oreille, p. 2-22
 - Lake Roosevelt, p. 2-30
 - Lower Clearwater River, p. 2-70
 - Lower Snake River, p. 2-77
 - Mid-Columbia River Projects, pp. 2-37 to 2-43
 - Snake River from Brownlee Dam to Oregon/Washington border, p. 2-56
- Wildlife — Scientific names of birds, mammals, reptiles, amphibians, fish, and invertebrates, pp. 2-102 and 2-103, Appendix N
- Wildlife — Major Federal laws affecting the wildlife community, p. 1-5, Appendix N
- Wildlife — State-protected plants and animals, Exhibit F in Appendix N



Educational Publications on the Columbia River System

Readers can get the “inside story” on Columbia River system operations and related topics by ordering these publications produced by the SOR. They’re free! Just call 1-800-622-4520.

The Columbia River: A System Under Stress. This four-pager explains the competing pressures on the river system that led to the System Operation Review. July 1990.

Scoping Document. This is the document that resulted from the EIS scoping. May 1991. 27 pages.

The Columbia River System: The Inside Story. A non-technical, well-illustrated explanation of the uses of the river, the tradeoffs, and how river operations are planned and managed. Used to brief Congress on the Northwest power system. September 1991. 82 pages.

Screening Analysis, Summary and Volumes 1 and 2. A guide to how over 90 alternatives for system operation were developed and then winnowed to the 10 studied in the

Draft EIS. The 41-page summary gives an overview; Volumes 1 and 2 are more technical. August 1992.

Modeling the System: How Computers Are Used in Columbia River Planning. Think like a Columbia system planner — this booklet shows how hydro operations are planned through the use of three complicated computer models that determine how the river system will respond to operating changes. December 1992. 43 pages.

Power System Coordination: A Guide to the Pacific Northwest Coordination Agreement. Overview of the Northwest’s power system and introduction to coordinated hydro operations, including the complex pact known as the “PNCA.” February 1993. 46 pages.

Daily/Hourly Hydrosystem Operation: How the Columbia River System Responds to Short-term Needs. This publication reviews the process and considerations that

Streamline: Lead Stories

Scoping Meetings, November 1990
A Mountain of Public Comment, March 1991
Getting Involved in Technical Studies, June 1991
Mark Your Calendar For Roundtables, November 1991
Managers on the Firing Line, February 1992
Work Groups Complete Screening, July 1992
Mid-Point Public Meetings, August 1992
Public Considers Candidate Strategies, November 1992
Operating Strategies Identified, February 1993
SOR Looks at Flood Control Adjustments, April 1993
Rivers, Reservoirs, and Recreation, June 1993
NW States Bring Unique Perspectives, August 1993
The Interlocking Pieces of SOR and SCS, October 1993
Look for the Draft EIS This Spring, January 1994
Highlights from Full-scale Analysis, March 1994
NMFS Calls For Spill, July 1994
Public Critiques SOR Options, December 1994
Final EIS Alternatives Under Study, April 1995
Biological Opinions Lead the Way, June 1995
SOR Team Releases Final EIS, December 1995.

determine the day-to-day operation of the river system. February 1993. 51 pages.

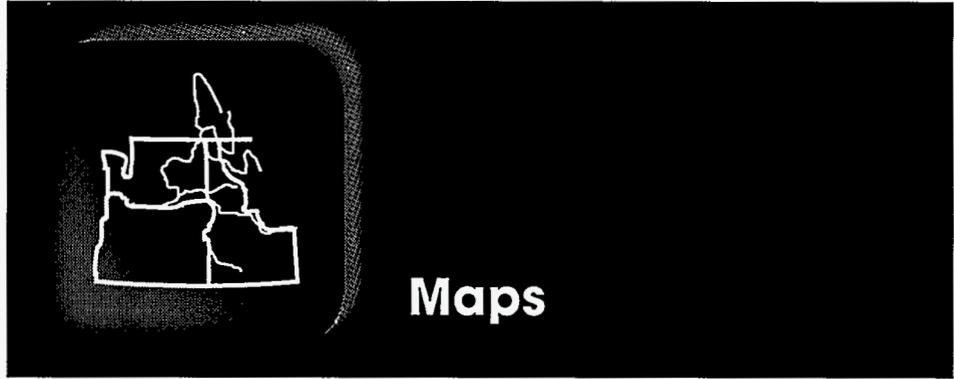
Mighty Columbia: Destiny of a Giant. Tabloid accompanying Draft EIS. July 1994.

Draft Environmental Impact Statement. July 1994. 22 volumes.

Final Environmental Impact Statement. December 1995. 26 volumes.

Streamline Newsletter. The 20 issues of this newsletter tracked how the SOR unfolded and featured short, well-written, educational articles. Back issues are available. 4-6 pages each.





You are here, but the map you need may be in the SOR map inventory. Here's a sample of some of the maps the SOR produced that are available.

Big Color Map! The Columbia River Basin.

There are many uses for this 24 by 24-inch color map of the Columbia River Basin used in the SOR. It is a digital data base map prepared for the Corps of Engineers' Columbia River and Tributaries study program. The original data files have been prepared using an Intergraph true mapping system, but are accessible through other systems as well. The map covers the Columbia River Basin and other river basins in the Pacific Northwest.

The map features are taken from 1:250,000 USGS quads, and include hydrology, political boundaries, dams, population centers, mountains, roads, and Indian reservations. There are also Federal and state wild and scenic designated waters, Federal and non-Federal hydro projects, military establishments, wilderness areas, irrigated and irrigable lands, national and provincial parks, national recreation sites, national monuments, and geographic grids. To get a copy, call Florence Guimary at the Corps, 503-326-6473.

Columbia River Dams.

The map on page 1-8 of the EIS Main Report shows where major Northwest dams are located in the Columbia River Basin. In the EIS Summary, page 46, and in most of the appendices, there is a map of the Federal projects studied in the SOR, annotated with facts and figures about each one. For example:

Chief Joseph Dam

*Columbia River, Washington
Corps of Engineers
In service August 20, 1955
2,069,000 kilowatts
of capacity
Project uses include power
and recreation
Run-of-river dam
Average annual discharge
of 108,000 cfs*

Recreation Maps.

The Recreation Appendix J has loads of maps of projects, parks, and recreation sites. For example, there's an annotated map on p. 2-71 showing state parks (with lists of their facilities) in relation to the mid-Columbia PUD projects.

For more information on recreation maps, call Matt Rea at the Corps, 503-326-6095.

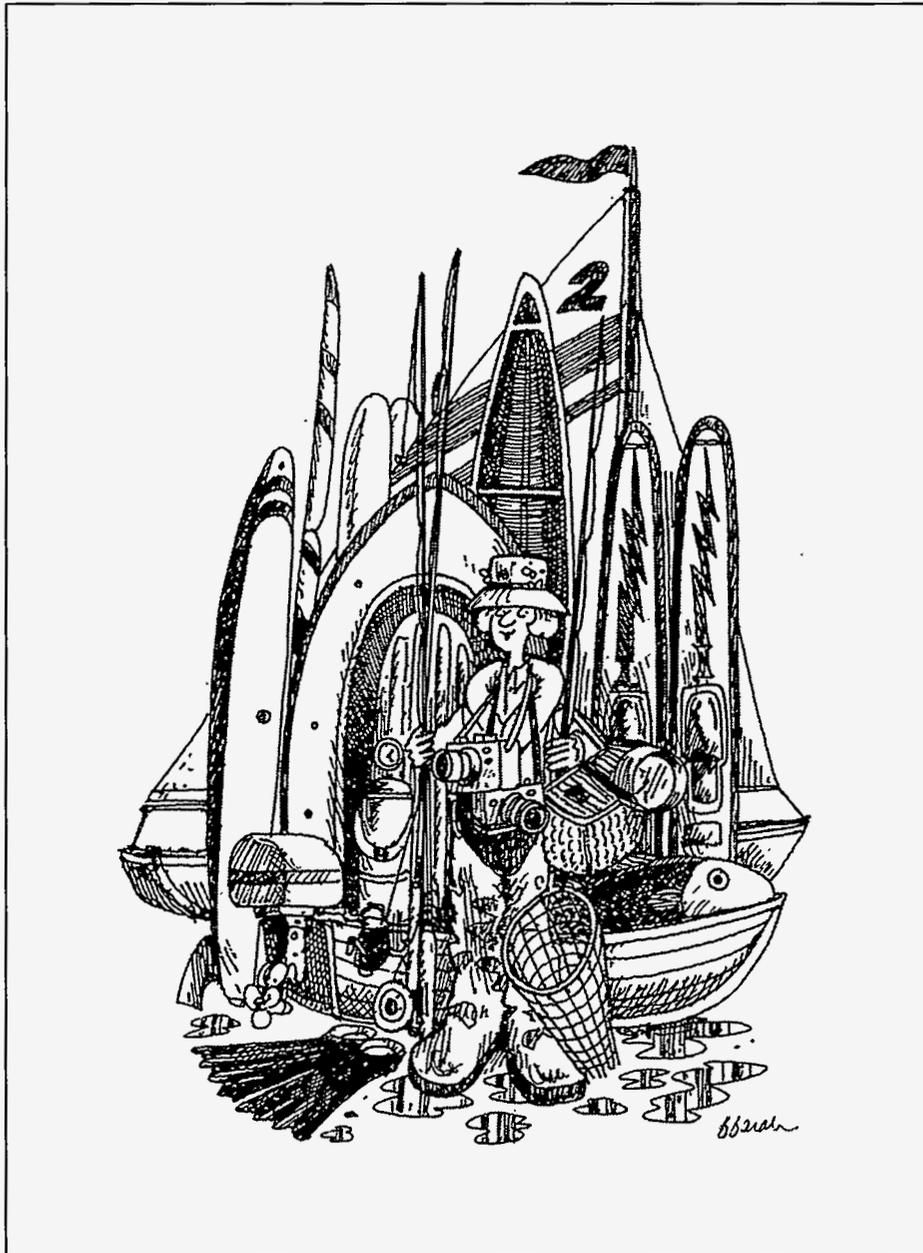


Hey Kids!

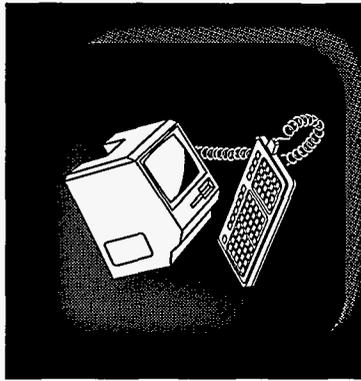
School children can learn from this lively map of the Columbia River Basin that uses clever symbols to represent uses and wildlife. It's on page 2-3 of the **Water Quality Appendix M**. Or how about the 3-D map of the Columbia River and its tributaries on p. 2-21!

Index of all Major Maps in the SOR

- Air Quality — PM10 non-attainment areas in the Columbia River Basin, p. 2-5, Appendix B
- Anadromous Fish — Accessible and blocked anadromous fish habitat in the Columbia River ecosystem, p. 7, Appendix S
- Anadromous Fish — Historic and present range of anadromous fish in the Columbia River Basin, p. 1-9, Appendix C
- Canadian hydropower projects and rivers, p. 2-13, Appendix K
- Columbia River and its tributaries, 3-D map, p. 2-21, Appendix M
- Columbia River Basin physiographic provinces, p. 2-3, Main Report
- Cultural Resources — 19th century distribution of tribes of the Columbia region in Washington, Oregon, Idaho, Montana, and British Columbia, p. 2-13, Appendix D
- Dams — Columbia Basin, showing Federal Columbia River Power System (FCRPS) dams, p. 2-3, Appendix K
- Dams — Columbia River Basin and Northwest dams, p. 1-8, Main Report
- Dams — Hydroelectric projects owned by PNCA parties, p. 2-7, Appendix R
- Dams — Major Columbia River Basin hydroelectric projects, showing Columbia River Treaty dams, p. 2-2, Appendix P
- Dams — Projects in the System Operation Review, p. v, Appendix A
- Flood Control — Analysis of flood damages, p. B-3, Appendix O
- Flood Control — Flood control study areas, p. 2-11, Appendix O
- Geology — Geologic setting of mid-Columbia River dams, p. 2-9, Appendix L
- Geology — Map of lower Columbia River, p. 2-11, Appendix L
- Groundwater pumpage from the surface overburden on the Columbia Plateau, p. 2-14, Appendix L
- Highway network in the SOR study area, p. 2-19, Appendix G
- Indian ceded lands, p. 2-14, Appendix D
- Indian reservations in the SOR study area, p. 2-27, Main Report
- Indian tribes — Land history of Colville Indian Reservation, p. D-78, Appendix D
- Indian tribes — Coeur d'Alene Reservation history, p. H-21, Appendix D
- Indian tribes — Locations of aboriginal tribal distributions of lands in Washington state and where tribes were located in the states before the first white settlers came to the Puget Sound area in 1845, p. D-82, Appendix D
- Irrigation — Grand Coulee Dam and irrigated lands of the Columbia Basin Project, p. 2-11, Appendix F
- Irrigation — Key irrigated areas and acreage in the SOR study area, p. 3-33, Main Report
- Navigation — Columbia-Snake River Inland Waterways, p. 1-3, Appendix H
- Railroads in the SOR study area, p. 2-21, Appendix G
- Recreation Sites along river reaches and projects, Appendix J
- Chief Joseph Project, p. 2-70
 - Dworshak Lake, p. 2-87
 - Hungry Horse Reservoir, p. 2-52
 - Lake Koocanusa — Canada, p. 2-39
 - Lake Koocanusa — USA, p. 2-38
 - Lake Pend Oreille, p. 2-66
 - Lake Roosevelt/Coulee Dam National Recreation Area, p. 2-60
 - Lower Columbia River, p. 2-99
 - Lower Snake River, p. 2-92
 - Middle Columbia PUD Projects, p. 2-71
 - Snake River Hells Canyon Reach, p. 2-82
 - Upper Columbia River, Canada, p. 2-46
- Resident Fish — Lake Pend Oreille, showing historical and recent location of shoreline kokanee spawners, p. 2-22, Appendix K
- Water Quality — Water quality concern areas, p. 2-31, Appendix M
- Water Quality — Location of dissolved gas monitoring stations, p. 2-10, Appendix M
- Water Quality — Long-term water quality sampling sites instream and at Bureau of Reclamation and Corps of Engineers projects, p. B-5, Appendix M



The public contributed valuable information to the SOR through a survey of recreational use in the Columbia River Basin.



Models, Analytical Tools and Techniques

The SOR analysts created several new computer models and improved upon some existing models or used them in new ways. Many of the work groups came up with their own innovative ways to analyze data on system resources using matrices and spreadsheets. Many of these models and analytical tools are adaptable to other projects, and the people who developed them are available to discuss their work.

Recreation Survey and Simulation Model.

The Recreation Work Group sponsored development of a model that predicts how changes in operation of the Federal Columbia River Power System (FCRPS) affect visitation at projects. The model is based on a survey of recreators and non-recreators conducted during the summer of 1993. The 12-page survey included questions covering the respondent's background and attitudes, participation in water-based recreation, number of trips in the region in the past 12 months, behavior response to hypothetical water-level changes, detailed trip information, and socioeconomic information.

The model derives expected monthly demand and average

expected monthly "consumer surplus" from the model's inputs. The consumer surplus is a calculation economists use to measure the net benefits of a particular action. The inputs to the model include estimates derived from the survey, and water level and flow information from the alternative System Operating Strategies considered in the SOR. For the SOR, the model's outputs were converted to visitation and consumer surplus measures, using data from the 1993 recreation season.

An interactive computer model also was developed to simulate changes in FCRPS operations that may be considered in the future. It combines a mathematical model in a spreadsheet that allows the user to vary conditions (reservoir elevations and river flows) throughout the FCRPS to estimate the resulting visitation and consumer surplus.

Call Matt Rea, Recreation Work Group Coordinator, Corps of Engineers, 503-326-6095, for any of the following materials: original survey, including color photo inserts of various scenarios; raw survey data files; final survey data files; model documentation; copies of model on diskettes.

A Closeup on Hydroreg Models.

Over the years, the Corps, BPA, and others have developed computer models to analyze operating scenarios and to develop the rule curves for planning system operations. **HYDROSIM**, **HYSSR**, and **HYDREG** are the region's three primary hydroregulation models, and they were used extensively in the SOR to analyze operating strategies and to prepare input data for the analyses. The models are described in the **River Operation Simulation Appendix A**, beginning at 2.4.1 on page 2-8. One of the SOR publications listed in this catalog was dedicated to explaining how the hydroregulation models work; look under the entry for *Modeling the System: How Computers are Used in Columbia River Planning*. Each of the three agencies have hydroregulation experts you can contact; start with **Jim Barton**, Corps of Engineers, 503-326-2084, who coordinated the River Operation Simulation Work Group.

Modeling Flood Scenarios.

Computers may not literally hold back flood waters, but they are invaluable in helping to predict damage under various runoff scenarios and to plan for that eventuality. The analytical techniques used by the Flood Control Work Group relied extensively on computer modeling. In the screening analysis, conducted early in the SOR, the work group evaluated alternatives using a spreadsheet that took monthly flows from the hydroregulation models and estimated annual peaks and associated damages. Beginning on page 1-3

and continuing into chapter 3, the **Flood Control Appendix E** describes the techniques and models used for analyzing the probability of flooding under various operating strategies. On page 3-2, there is a description of **AUTOREG**, the model developed specifically to interface with the **Streamflow Synthesis and Reservoir Regulation Model (SSARR)** and reduce the amount of time involved in simulating the complexities of the Columbia River system — for the SOR and future studies.

Spreadsheets of Power.

The Power Work Group developed a spreadsheet model to calculate the total costs to the power system of alternative operating strategies. The analytical techniques are explained in chapter 3 of the **Power Appendix I**, including a description of how the work group modified its preliminary model for the full-scale analysis; see page 3-7. The result was an analytical tool that calculated the amount and cost of new resources or purchases needed to meet load. In doing the calculation, the model operated the system (hypothetically, that is) to displace thermal plants and sell power outside the region, if possible. The output of the analysis was the total annual cost to the Northwest's power system in millions of 1996 dollars. **Audrey Perino**, BPA, 503-230-4260, spearheaded the power analysis.

Fish Models.

A number of computer models have been developed to analyze juvenile salmon migration out of the Columbia River system and estimate the number of adults that

will return to spawn. The models are controversial, and those used in the SOR were chosen carefully for their ability to analyze multiple operating strategies.

The computer models used to test assumptions about salmon travel and survival in the Columbia River system are among the most complex and sophisticated of any of the analytical tools used in the SOR. CRiSP1.5 was developed at the University of Washington to simulate the migration of juvenile salmonids downstream through reservoirs and around dams to the lower Columbia River. **Anadromous Fish Appendix C** presents a detailed description of CRiSP1.5, beginning on page 3-3, including the model's structure, calibration, assumptions, and parameters.

The **Stochastic Life Cycle Model (SLCM)** was used in the SOR to estimate adult salmon returns. A comprehensive description of SLCM is included on page 3-19 of Appendix C.

The Resident Fish Work Group adapted two computer models, LRMOD and HRMOD, developed by the Montana Department of Fish Wildlife and Parks for two Montana projects, Libby and Hungry Horse. Chapter 3 of **Resident Fish Appendix K** describes the roles these models played in the SOR. Constructed from physical and biological data collected for approximately 10 years, the models measure food production in the reservoirs as a function of hydrology. What this means for the SOR and the region's resident fish is just an appendix away.



Index of Models, Analytical Tools and Techniques Used in the SOR

- Air Quality — The ISCST2 model for modeling sources of non-reactive pollutants, p. 3-9, Appendix B
- Air Quality — Calculation of PM₁₀ (particulate matter) emissions, p. 3-2, Appendix B
- Anadromous Fish — Hydrologic and biological modeling, p. 3-2, Appendix C
- Anadromous Fish — CRiSP1.5 model description, p. 3-, Appendix C
- Anadromous Fish — Transportation modeling assumptions and parameters, p. 3-17, Appendix C
- Anadromous Fish — SLCM model description, p. 3-19, Appendix C
- Cultural Resources — Geomorphic analysis, p. 3-4, Appendix D
- Cultural Resources — Computer simulation analysis, p. 3-10, Appendix D
- Economic — Regional economic evaluation, using IMPLAN, p. 3-47, Appendix O
- Economic — Social impacts assessment process, p. 3-54, Appendix O
- Economic — SOR transportation model to analyze the direct economic impacts, p. 3-36, Appendix O
- Flood Control — SSARR model overview/data requirements, p. 3-2, Appendix E
- Flood Control — AUTOREG model description, p. 3-2, Appendix O
- Navigation — Dworshak Dam log transportation spreadsheet, p. 3-7, Appendix H
- Navigation — National Ocean Service dynamic wave model (DWOPR), p. 3-8, Appendix H
- Power — Spreadsheet model description, p. 3-1, Appendix I
- Power — Overall analytical approach, p. 3-3, Appendix I
- Recreation — Pilot simulation models, p. 3-2, Appendix J
- Recreation — Final EIS recreation demand model, p. 3-11, Appendix J
- Resident Fish — The pilot analysis, using LRMOD and HRMOD, p. 3-3, Appendix K
- Resident Fish — The full-scale analysis, using LRMOD and HRMOD, p. 3-6, Appendix K
- Resident Fish — Physical hydrology model component, p. 3-11, Appendix K
- Resident Fish — Biological response model component, p. 3-13, Appendix K
- River Operation Simulation — A closeup of the Columbia River models: HYDROSIM, HYSSR, and HYDREG, p. 2-9, Appendix A
- Water Quality — Models used: HEC-5Q for water temperature; GASSPILL for total dissolved gas; and HEC-6 for erosion and sediment transport; p. 3-14, Appendix M
- Water Quality — COLTEMP water temperature model, p. 3-23, Appendix M
- Wildlife — Wildlife matrix evaluation, p. 3-2, Appendix N



Public meetings were a crucial part of the SOR's public involvement effort.



Public Opinion Inventory on Columbia River Basin Issues

If you want to get an understanding of public opinion on Columbia River issues, there's a library available as a result of the SOR. Here is a list of meeting transcripts and comment summaries you can order. Call Philip Thor at BPA, 503-230-4235.

Scoping Meetings, August 6-23, 1990.

"Comment Summary, Letters, and Comment Cards" is a compilation of all the scoping comments received by topic. This 152-page document includes an executive summary of the comments. There are short, printed reports on each meeting, which contain all remarks, comments made, and the question-and-answer session. These reports are available on diskettes. You can also get a one-page summary of each meeting.

Roundtable Meetings, November 1991 and January 1992.

The February 1992 issue of *Streamline* covered these meetings; lists of attendees are available.

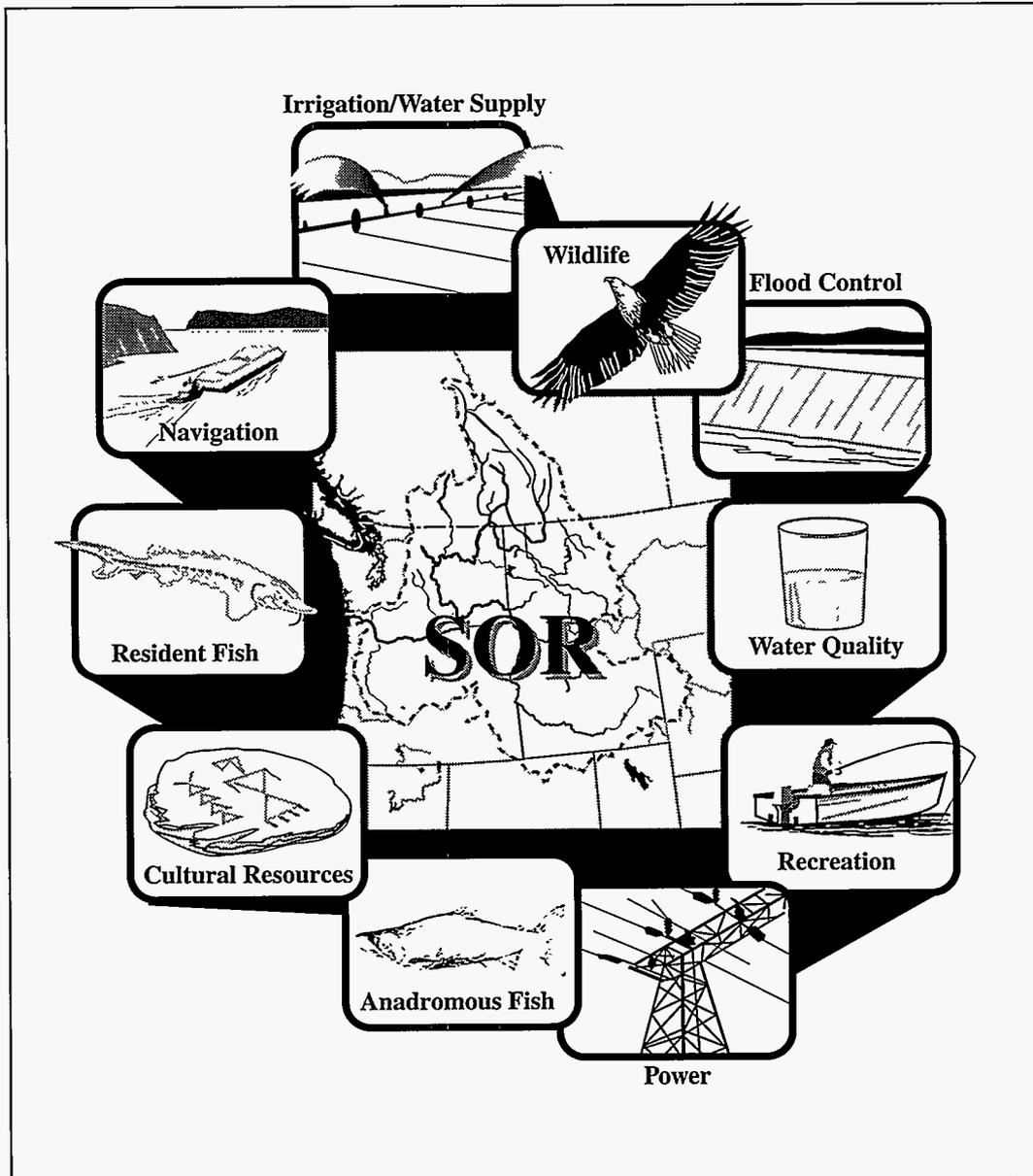
Mid-Point Meetings, September 8-30, 1992.

BPA has all the mid-point comment letters available in a three-ring binder. The "Mid-Point Public Comment Analysis" (42 pages) summarized written comments, as well as comments made at the 14 meetings. You can also order a set of meeting summaries.

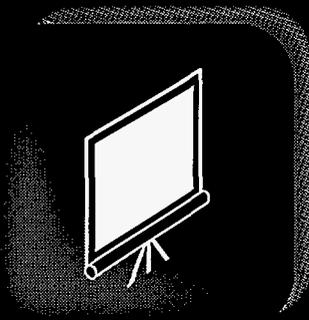
Draft EIS Meetings, September 19 - October 4, 1994.

Succinct summaries of the public comments and question-and-answer sessions at each meeting are available. The **Comments and Responses Appendix T** presents all the comments received on the Draft EIS and the agencies' responses.





Columbia River Resources



Learn About Public Involvement

Public involvement has become an important feature of government programs and a study topic at many universities. The SOR provides an extensive case study of how a large-scale public involvement program is planned, organized, and executed. Chapter 9 of the EIS Main Report describes the SOR public involvement program in some detail.

Former SOR public involvement manager Mark Danley at BPA has prepared a three-page paper

titled "Public Involvement Case Study — Lessons Learned from the System Operation Review." It discusses the approach used in the SOR, as well as insights gained and lessons learned. You can order a copy from the BPA document request line, 1-800-622-4520. You can also call Mark Danley, 503-230-7370.

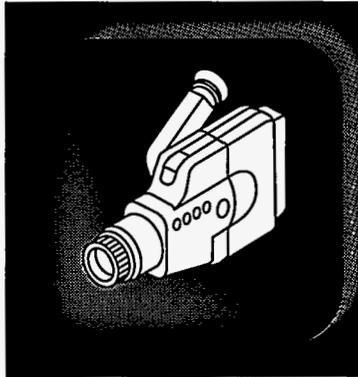


For Public Involvement Planners.

- Learn methods and tools for tapping into the opinion of thousands of people on a complex, multifaceted public policy issue.
- Find out what channels for public comment and participation worked best. Was it publications, meetings, slide shows, or something else?
- Read about the use of work groups as a vehicle for public involvement.
- Learn the best way to plan and carry out public involvement when several government agencies are working together.
- Request a copy of the SOR Public Involvement Plan to see the blueprint the agencies followed.
- The **Columbia River Regional Forum Appendix Q** discusses different alternatives for public involvement in decisions the Corps, the Bureau of Reclamation, and BPA make annually on operation of the Federal dams in the Columbia River system. Page 2-4 shows a diagram of the current Columbia River operations decision process.



An angler casts a line into the current near Bonneville Dam.



SOR on the Big Screen

The lights go out, the projector rolls, and a dark screen comes to life. Sunlight dances off the water. Sheer rock faces cast shadows on narrow river banks below, and an eagle glides effortlessly in a deep blue sky.

"The Columbia River: one of the most spectacular natural resources on the planet. In a single day, more than 120 billion gallons of water flow between the craggy walls of the Columbia River Gorge," a narrator tells us. "On its 1,200-mile journey to the sea, this great torrent of rain and snowmelt is asked to do many things. It generates electricity and irrigates crops. It's a playground for visitors from all over the world, a superhighway for waterborne commerce, and a vital habitat for salmon and other wildlife." And so begins our pictorial odyssey of "the greatest of all western rivers."

The SOR put much emphasis on public outreach and involvement. And what better way to capture an audience than by using the big screen!

For each of four sets of public meetings, the SOR team produced a slide show to educate the audience and portray the visual grandeur of the Columbia River and the power of the dams. All four productions are available if you'd like a succinct, lively slide show on the river for a public meeting or staff training.

Each of these productions is available. For information about how to obtain a copy, call Philip Thor, BPA, 503-230-4235; Ray Jaren, Corps, 503-326-5194; or Evelyn Dunbar, USBR, 503-872-2795.

Now "Roll on Columbia" and Roll 'em.

The SOR Productions.

1. **The Great Scoping Show** — An overview of the Columbia River system, with emphasis on the Federal projects under study in the SOR and the tradeoffs necessary in a multi-use river system. This production was used at the 14 scoping meetings held in 1990. 12 minutes.
2. **The Columbia River System/The Inside Story** — A general description of how the Columbia River system has traditionally operated. The slide show explains how the three Federal agencies plan and coordinate system operations. The script covers the seasonal operation of reservoirs and planning for major project uses. The SOR interagency team used this slide show at a series of six roundtable discussions held in November 1991. 12 minutes.
3. **Highlights of the Screening Analysis** — The results of the screening of alternatives that narrowed the field of 90 alternative strategies to 10 candidates for full-scale analysis. This production specifically addresses the results of the screening process and presents the candidate strategies, with options. It was used to inform and solicit comments from audiences at 14 mid-point meetings held in September 1992. 10 minutes.
4. **The SOR Draft EIS** — The outcome of the full-scale analysis conducted on seven alternative system operating strategies. This slide show presents in some detail the results of the work groups' analysis of how various operating strategies would affect river uses and resources. The show was presented at all 14 public meetings held in September and October 1994 to gather comment on the Draft EIS. 20 minutes.

BONNEVILLE
POWER ADMINISTRATION



US Army Corps
of Engineers
North Pacific Division





Who's Who: Sources of Information and Mailing Lists

Look no further if you want to contact people interested in and/or knowledgeable about the Columbia River. The SOR agencies assembled a directory of experts and contacts on various river management issues. Many of these people served on the SOR work groups. They are primarily Federal and state agency personnel, academics, consultants, and members of interest groups. In addition, the agencies compiled a hefty mailing list of people who indicated an interest in the issues under study in the review. There are four lists available from the SOR agencies:

Who's Who List 1. Experts on the River System. These are the work group coordinators and other key agency staff who oversaw some aspect of the SOR analysis.

Who's Who List 2. SOR Work Group Roster. These are people with knowledge about a particular resource area who worked actively on one of the river use analyses. Many are agency and interest group staff members.

Who's Who List 3. SOR Work Group Observers and Interested Parties. This is a list of people who were not active work group participants, but responded to the invitation to participate in SOR

studies by declaring their interest in a specific issue area. They were kept apprised of work group activities and progress of the SOR.

Who's Who List 4. Interested Public. This is a 5,000-person mailing list of people who requested information on the SOR. These people either called or wrote to one of the SOR agencies, or they signed up at public meetings and hearings that were held around the region. The list is available to Federal agencies only.

Whom Do I Call? Turn the page for List 1. For information or copies of the others, contact Evelyn Dunbar, Columbia River Coordination Office, Bureau of Reclamation, 825 N.E. Multnomah St., Suite 1110, Portland, OR 97232-2125, 503-872-2795; Ray Jaren, CENPD-ET-PP, U.S. Army Engineer Division, 220 N.W. Eighth, Portland, OR 97208-2870, 503-326-5194; or Philip Thor, Bonneville Power Administration, P.O. Box 3621-MGC, Portland, OR 97208-3621, 503-230-4235.



Experts on the River System

SOR Agency Managers

BPA — Philip Thor, 503-230-4235

CORPS — Ray Jaren, 503-326-5194

USBR — Catherine Konrath, 208-378-5008 (Boise)

Work Group Coordinators

RIVER OPERATION SIMULATION —
Jim Barton, CORPS, 503-326-2084

PNCA ALTERNATIVE ANALYSIS — Jim Fodrea,
USBR, 208-378-5080

ECONOMIC ANALYSIS — Tom White, CORPS,
503-326-3827

PUBLIC INVOLVEMENT — Julie Pipher, BPA,
503-230-5039

FLOOD CONTROL — Peter Brooks, CORPS,
503-326-3488

NAVIGATION — Sheryl Carrubba, CORPS,
503-326-6085

POWER — Audrey Perino, BPA, 503-230-4260

IRRIGATION — Allen Reiners, USBR,
208-378-5344

ANADROMOUS FISH — John Rowan, BPA,
503-230-4238

RESIDENT FISH — Jeff Laufle, CORPS,
206-764-6578

WILDLIFE — Don Treasure, USBR, 303-236-9336
x265

RECREATION — Matt Rea, CORPS, 503-326-6095

WATER QUALITY — Bolyvong Tanovan,
CORPS, 503-326-3764

CULTURAL RESOURCES — Linda Burbach,
BPA, 503-230-5146