The Politics and Economics of Columbia River Water

Proceedings of a conference

Airport Holiday Inn
Portland, Oregon
October 26, 1984

Editors:
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The Columbia River: Many Demands and Many Uses


Michael S. Spranger and
Charles F. Broches

The Columbia River has influenced the quality of life and the nature of economic development in the Pacific Northwest to an enormous degree. The river system ties the region together geographically, politically, economically, and historically, and it is the foundation upon which the Pacific Northwest has prospered.

The languages of politics and economics shape the formulation of public policy and, in turn, the future uses of the Columbia River. While technical factors, such as the quantity of water available at specific locations at specific times, constrain alternatives, ultimately decisions to allocate water among uses are made on political and economic criteria.

For these reasons, it is important to understand how the major users of this vital resource perceive its development and the guidelines they envision that will shape its future. That was the purpose of this conference on the "Politics and Economics of Columbia River Water."

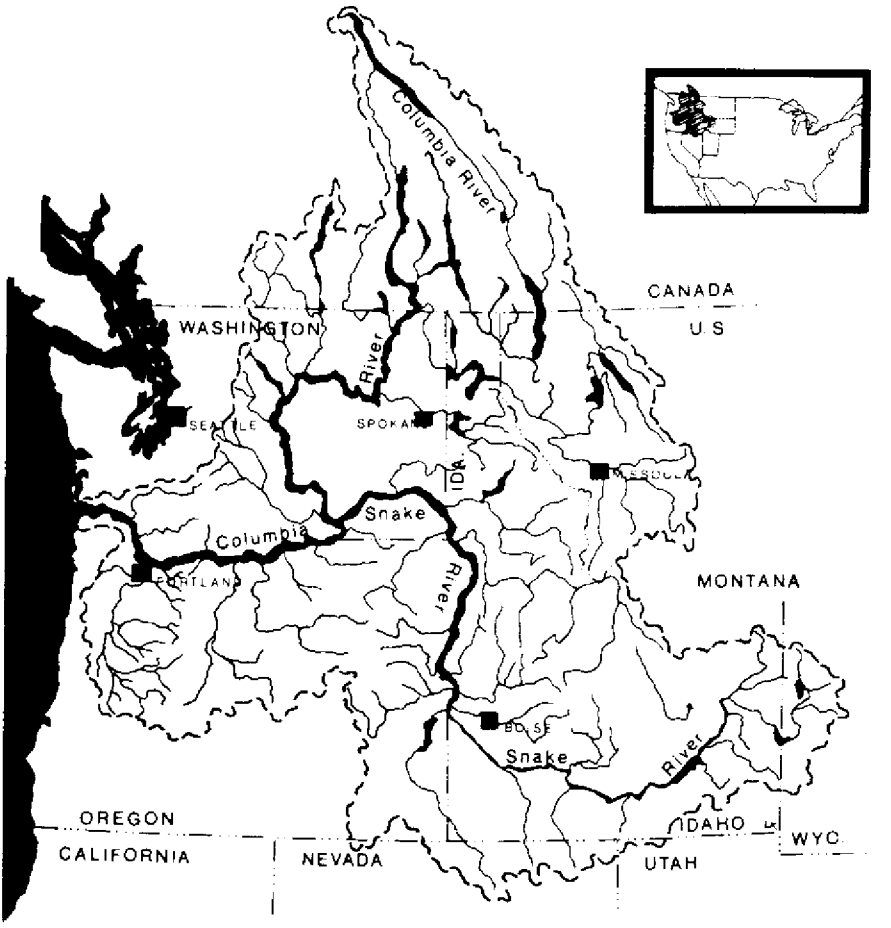
The River, A Mighty Resource

The Columbia River is the largest river in the Western Hemisphere that flows into the Pacific Ocean. The river and its tributaries drain major portions of the Pacific Northwest, covering nearly 260,000 square miles--an area comparable in size to France. This includes approximately 39,500 square miles in Canada and another 219,000 square miles in the states of Washington, Oregon, Idaho, Montana, Wyoming, Nevada, and Utah.

The river begins in Columbia Lake on the west slope of the Rocky Mountains in British Columbia, Canada, and flows more than 1,200 miles before it joins the Pacific Ocean near Astoria, Oregon.

The course of the river is varied. It flows northwest for the first 218

THE COLUMBIA/SNAKE DRAINAGE SYSTEM



miles, then south for 280 miles, crosses the Canada-United States border into northeast Washington, flows south, then west, and again south across central Washington in a sweeping curve called the Big Bend. Many deep channels have been cut by the river, leaving a series of coulees or dry canyons, the biggest of which is the Grand Coulee located in central Washington. Just below the mouth of the Snake River, the Columbia turns west for 210 miles and cuts across the Cascade Range through the scenic Columbia River Gorge, forming the boundary between Washington and Oregon. At Vancouver, Washington, it turns briefly north for 50 miles, then west for the final 55 miles to the Pacific Ocean. The river meets the tide 145 miles from its mouth.

From a mere few feet at its source, the river widens to 1½ miles

below the Cascade Range, to a maximum of 6 miles near its mouth, and discharges into the Pacific Ocean between jetties 2 miles apart. Major tributaries that make up the Columbia River system include: Kootenai, Pend Oreille, Spokane, Okanogan, Wenatchee, Yakima, Snake, Lewis, Cowlitz, John Day, Deschutes, and Willamette rivers.

The river's rate of flow increases greatly as it makes its way to the ocean. Near Birchbank, British Columbia, the flow is 32 million gallons a minute; at The Dalles Dam, it is 88 million gallons a minute; and at the river's mouth, it is 123 gallons a minute. Its flow is more than ten times that of the Colorado River, and in the United States, it is second only to the Mississippi River in average annual runoff.

With such vast quantities of fresh water mixing with the salt water of the sea, the mouth of the Columbia is a dynamic environment. The river's outflow creates a plume of fresh water that is detectable several hundred miles out into the Pacific. The Columbia River Bar, where the river meets the ocean, has long been regarded as the Pacific's most violent, dangerous, and unpredictable crossing for ships to navigate. In most respects, it remains so today, threatening even the largest vessels and challenging the skills of the most experienced pilots.

An Historical Perspective

The Columbia River was the last major waterway discovered and developed in the United States. For eons it remained a river of mystery known only to the Indians of the Pacific Northwest. From the dawn of Indian civilization, two great native cultures flourished along its banks. From the Canadian Bend of the River, south to the Great Basin and from the Cascades to the Rockies lived the Plateau Indians. At a spot midway through the Columbia River Gorge where sand hills and pines give way to green hillsides thick with Douglas firs, the land of the Coastal Indians began. While all tribes were dependent upon the bountiful Pacific salmon, each culture was highly individualistic. A common meeting place was Celilo Falls, the ancient fishing grounds at the east end of the Columbia Gorge, where natives of the interior traded dried salmon, hides, and baskets for the shells and woven bark of the coastal tribes.

Archaeological studies show that men and women have lived along the Columbia River for the last 12,000 years. One of the earliest settlements was found near The Dalles, Oregon, where archaeologists found remnants of a village site that flourished over 10,000 years ago.

The first "discovery" and exploration of this area by white man came from the sea in the late 18th century; land expeditions followed in the early 19th century.

Many European explorers followed Columbus, charting the Atlan-

tic coastline of the Americas looking for inland waterways. After Balboa discovered the Pacific Ocean in 1513, others surveyed the Pacific Coast. It was not until 1792 that Captain Robert Gray arrived at the mythical river of the West—the Columbia.

In 1804, President Thomas Jefferson dispatched the Lewis and Clark expeditions to secure a route between the Missouri and Columbia rivers. Beyond carefully documenting the flora, fauna, and native peoples of the West, the expedition helped establish the new nation's claim to the Pacific Northwest.

Early white settlements were the result of attempts to Christianize the native Indians, and early missions were established along the Columbia. By the 1840s, growing numbers of rugged pioneers made the arduous 2,000-mile trek along the Oregon Trail, through the Columbia Gorge to the fertile Willamette Valley.

By the late 1840s, the westward trickle of settlers became a flood, and the swift waters of the Columbia River Gorge became their highway. The river was the center of early life and the steamboat was queen. In 1882 a railroad was built along the Columbia's south bank between Walla Walla and Portland. Soon there were two railroads in the Gorge, the Northern Pacific and the Union Pacific. Later, the scenic Columbia River Highway was completed in 1915.

The next major reshaping of the Columbia began in the 1930s with construction of the Bonneville and Grand Coulee dams. Damming the river drastically changed the shape and character of the Pacific Northwest. These dams marked the dawn of hydropower in the region. They provided jobs during the Depression years, irrigated fields for farming, increased the navigational capability of the river, and generated electricity for use in the home, farm, and workplace. These dams, however, also had negative effects. They disrupted the life cycle of the salmon, destroyed traditional Indian fishing grounds, drowned the turbulent, but beautiful, rapids, and marred, to some extent, the wild scenic qualities of the Columbia River Gorge. Bonneville Dam, which was the first federal hydroelectric project on the Columbia, was dubbed by several national magazines a "white elephant" and a "dam of doubt" during its construction by the U.S. Army Corps of Engineers.

Today, the river system has been developed into one of the largest hydroelectric energy systems in the world, despite early skepticism that the power would ever be needed. The rapid growth and development of the Pacific Northwest in the last 50 years can be attributed largely to the Columbia River and its abundance of inexpensive electricity.

The River at a Crossroads

The Columbia River was once considered an unlimited resource. However, over the years, increasing demands have been placed on it. Today, in addition to being a power resource, it is used extensively for transportation, flood control, irrigation, municipal and industrial water supply, flow augmentation, fishing, recreation, tourism, and as habitat for anadromous and resident fish, wildlife, and water fowl.

Despite having an average flow of 123 million gallons per minute at its mouth, the river may well be facing a water scarcity problem. This problem within the Columbia system revolves around three factors: time, place, and use. The simple truth is that the Columbia can no longer supply water to meet all the demands placed upon it, at all times, and at every location within its drainage basin. Each of the river's uses is beneficial, but the uses often come into conflict with one another, especially in low-water years.[1]

The time is fast approaching when we will need to make difficult choices about how the river will be used. These decisions are momentous indeed, for they will affect not only the citizens of today, but future generations as well, both within and beyond the borders of the Pacific Northwest. Trade-offs and compromises will be necessary. In order to make the best decisions, it is essential to have an understanding of the major users and uses of the river and to identify those issues that may require compromise.

Major Uses of the River

Power

The Columbia River is most commonly associated with the production of hydroelectric power. The system accounts for one-half of the hydroelectric generating capacity in the entire United States, and it supplies seventy percent of the region's energy needs. Inexpensive energy from federally developed projects on the river was crucial to economic development of the region during the late 1930s and 1940s. As the major projects came on-line, the federal government established the Bonneville Power Administration (BPA) to market and distribute the electrical energy produced by the river. In the beginning there was a huge surplus of hydroelectric energy. Inexpensive electrical power encouraged new energy-dependent industries, notably aluminum manu-

[1] For a discussion on low-water year questions, see C. F. Broches, M. S. Spranger, and B. H. Williamson, ed. Are We Prepared for the Next Drought? Managing Low Water Year Emergencies. 1983. Washington Sea Grant Program, Seattle, WA. WSG-WO 83-2.

facturers, to locate in the Northwest. Accompanying growth in residential and commercial consumption imposed new demands on the river, causing the electrical energy surplus once enjoyed in this region to be replaced by projected shortages in the late 1960s. It became clear that the era of inexpensive and plentiful hydroelectric power would soon be over. The presumed alternative was to be thermal power (coal or nuclear) since all prime hydroelectric sites on the mainstem Columbia had already been developed.

To facilitate the transition from a hydro-base to a thermal-base, BPA developed a Hydro-Thermal Plan during the late 1960s. The objective of this plan was to meld more expensive thermal power with the inexpensive hydroelectric power of the river to supply the energy demands of the Pacific Northwest. Under this scheme, the hydroelectric resources would be used for "peak power loads."

Simply put, the dams would be used to store energy by holding back water. When demand exceeded the output of the thermal plants, water would be released to provide power. The reservoirs would, in essence, become large storage batteries.

By the late 1970s and early 1980s, the energy picture in the Pacific Northwest dramatically changed again when forecasts projected an energy surplus, rather than an energy shortage. Changes in consumer demand, coupled with a sluggish economy and high construction costs, ultimately forced the cancellation of several coal and nuclear plants that were under construction in the region.

In 1980, Congress passed the Pacific Northwest Electric Power Planning and Conservation Act (Public Law 96-501), which created a four-state regional council charged with responsibility to restore fish and wildlife on the Columbia and develop an energy plan for future needs of the Pacific Northwest.

At present, there are 38 major hydroelectric projects within the Columbia system managed by both federal agencies and private and public utility companies. The Bonneville Power Administration extends beyond the Columbia system, linking 55 hydroelectric dams in an eight-state grid, through a network of nearly 13,600 miles of high-voltage transmission lines. This network of transmission entities permits BPA to sell surplus or off-peak electrical energy generated in the Northwest to energy-short consumers outside the basin.

There are some trade-offs in using this hydroelectric power. With the completion of a second powerhouse in 1982 at the Bonneville Dam, it is now possible to use every drop of water in the Columbia River system to turn hydroelectric turbines. This carries dramatic implications for other uses of the Columbia River. It means that every gallon of water

used for fish passage, for navigational locks, and for irrigation represents a loss of potential electrical energy. And conversely, of course, water held back to meet energy demands means losses to other potential uses. Furthermore, future use of hydro plants for "peaking power" may produce extreme water fluctuations, which could have serious effects on fish, wildlife, recreation, navigation, waste assimilation, and environmental values.

In times of low water and energy shortages, these conflicts will be exacerbated and will need to be resolved.

Irrigation

The development of large-scale irrigation in the Columbia River Basin coincided with the building of hydroelectric facilities. Early on, inexpensive electricity and unused flows of spring runoff each year seemed to imply unlimited development prospects for vast acreages of potentially irrigable land. Today, irrigation accounts for more than 90 percent of the total water diversion and consumption in the Columbia River drainage area. Some of this water, of course, reenters the river after use. The total acreage presently under irrigation is between 7 and 8 million acres. Within the next 20 years, another 2 to 4 million acres could be added to this total.

Crops currently produced by irrigation in the Columbia River drainage area include alfalfa, seed crops, mint, peas, dry beans, lentils, potatoes, tomatoes, sweet corn, asparagus, melons, apples, pears, cherries, and increasing quantities of wine grapes. The area also supports important commercial livestock production operations. Regionally, irrigated farm products were valued at roughly $3 billion in 1977 and represent an important component of the Northwest's economy. Much of this agricultural output finds its way into export markets and thus provides significant secondary employment, as well as contributing positively to the nation's balance of trade.

Water used to irrigate agricultural land involves costs in terms of other uses of the resource. Much of the water used for irrigation does not reenter the river because of retention by plants or loss by evaporation. This means a loss of potential hydroelectric generation. Although relatively minor in normal years, the impact could be severe in years of low-water flow, especially during summer and fall when major users are in most need of water.

Furthermore, the lifting and distribution of irrigation water require considerable energy. In some cases of high-lift irrigation projects, the energy required to pump the water to the fields exceeds the electricity that the diverted water could have produced by passing through the turbine generators.

Irrigated land presently in production is unquestionably an important and viable part of the Pacific Northwest region's economy. However, several of the proposed future developments in the Columbia River Basin have come under criticism. Much of the proposed development would require enormous inputs of water, energy, and chemical fertilizer. According to some experts, if the marketplace were free to work, the high cost of these inputs would likely have an adverse effect on the profitability of most *new* irrigated farming ventures. Because federal funding will underwrite these large-scale water projects, some researchers have argued that the real cost of the water input will be subsidized by the taxpayer and only a small fraction of the true cost will actually be charged to the user.

Irrigation withdrawals also affect total river flow, particularly in low-flow years. If the increase in irrigation reaches the upper projected level of 4 million acres, annual stream flow in the Columbia drainage would be reduced approximately 10.8 million acre-feet. This represents approximately 6 percent of the flow at The Dalles in an average water year, but more than 10 percent in low-flow years like 1973 and 1977. These figures represent *net* reductions. During some periods of the years, the reduction could be even more severe. Reductions of this magnitude would adversely affect such instream uses as anadromous and resident fish, wildlife, navigation, and recreation, as well as hydropower generation.

Agricultural runoff may also affect water quality since it often carries eroded soil particles, herbicides, pesticides, and chemical fertilizer compounds, all of which may affect fish and wildlife habitat and recreational and municipal uses of the water.

Fisheries

Increased use of the Columbia's water has had the most drastic impact on one of the river's most prized resources—its fisheries. Anadromous fish of the Columbia River have a unique life cycle which has been severely threatened in modern times by other uses of the river. After spawning or being artificially produced in fresh water, the fish migrate down the river system to the ocean where they mature, only to return to their freshwater spawning grounds several years later to reproduce. The Columbia/Snake River system was once one of the most productive salmon and steelhead areas in the world. In 1883 a record catch of 43 million pounds of Chinook salmon occurred. Since that time, the catch has declined dramatically in the Columbia River proper to an annual average catch of about 5 million pounds for all salmon species. It has been estimated that over 44 million adult salmon were lost between 1960-1980 at an estimated cost of $6.5 billion. The princi-

pal cause of this loss has been the erection of dams along the Columbia. Other factors such as overfishing, poor land management practices, stream pollution, and water demand for irrigation have also played a role in this loss.

Initial depletion was the result of commercial overfishing in the early 1900s. Later on, high dams—namely the Grand Coulee and Hells Canyon—were built without fish ladders, thus cutting off about one-half of the spawning habitat of anadromous fish. Dams have also slowed the flow of the river, in essence creating a series of lakes behind the dams. This reduced flow increases the downstream migration time for young fish and lessens their chances of survival since they are on a limited time schedule to reach the ocean. Passage through the dams is another serious problem. In fact, 5 to 15 percent of the downstream migrants have been lost passing through turbines at each dam. With up to eight dams to contend with, some downstream runs have experienced a 90 percent loss in low-flow years. Furthermore, fish delayed by the dams and fish ladders during upriver migration may not reach the spawning area in time for successful spawning. Predators are also a constant problem.

Efforts are now underway to protect and improve this resource. In November 1982, the Pacific Northwest Power Council recommended the implementation of several technical and institutional changes that would restore the annual run of anadromous fish by more than 1 million (about 5 to 6 times the runs of several upriver species that are now approaching extinction).

Restoration of anadromous fish does not come without costs. It is estimated that over the next 20 years, these costs could escalate to $500 million. In turn, ratepayers could see electricity costs increase from $2-10 a month to pay for these changes. A significant portion of this cost will come from loss of some 550 megawatts of hydroelectric generating capacity on the river, which represents about 3 percent of the Pacific Northwest's power needs.

Navigation

Commercial navigation on the Columbia and Snake is another instream use of considerable economic importance. River-based commerce both influences and is influenced by other major river uses. As competition over allocation and management of water becomes more acute, navigation interests are being drawn into the conflict.

Commercial navigation on the Columbia dates back to the 19th century when sternwheelers moved goods and people along the watercourse. By the late 1850s, steamboats dominated travel on the Columbia. In fact, they were often the only means of communication for early

settlements. Steamboats also provided a livelihood for many settlers. Since the steamboats burned up to 4 cords of wood an hour, cutting cordwood became the main source of income for many. In the Columbia River Gorge area, wood was carried to the river by flumes, with scows sailing much of this wood up to The Dalles.

Steamboat traffic transformed the Columbia River into a busy commercial highway; however, even these powerful sternwheelers could not ascend the falls and rapids of the Gorge. The federal government authorized construction of two locks to circumvent these rapids. In November 1896, Cascade Locks was completed, which bypassed the Great Cascades of the Columbia; and in 1915, a series of five locks, 8 miles long, bypassed the Long Narrows and Celilo Falls. However, by this time, because of competition from the railroads, river travel had nearly vanished. River traffic would not have a resurgence until major dams with locks were built on the Columbia during the 1930s.

With the completion of the four mainstem dams on the lower Snake River, a modern inland water transportation system consisting of eight locks now allows commercial vessels to travel as far east as Lewiston, Idaho, some 465 miles from the Pacific. This corridor, averaging a minimum of 14 feet, is one of the deepest navigation systems in the United States. Barges with a capacity of more than 3,000 tons can be accommodated on the river, compared to a 1,500-ton capacity on the Mississippi system. Historically, shipments have consisted of bulk commodities, which have high volume but low value. These include agricultural commodities, wood and paper products, fertilizers and chemicals, and petroleum products. Ports now receive agricultural shipments for downriver export from as far east as Nebraska and the Dakotas, extending the Columbia's economic reach more than halfway across the continent.

One remaining constraint in this system is the Bonneville Locks. Constructed in the 1930s, they constitute a bottleneck on the system, with barge traffic often backed up and delayed. A new enlarged lock has been proposed that would make all locks on the Columbia uniform in size (85 feet by 675 feet). Proponents claim that the new lock is the key to the Northwest in its quest to be a major exporter of agricultural products. Efforts to secure funding for this new lock remain trapped in Congress.

As indicated, potential conflicts exist between navigation and other river uses. In low-flow periods, water required to operate locks reduces power generation. On the other hand, use of the dams for peak load generation and the resulting water fluctuations could endanger navigation. To complicate the situation still further, decisions made about navigation could have direct impacts on the agricultural and rec-

reational sectors of the economy. Dredging and related activities of commercial use often compromise water quality standards, thus creating a most complex set of relationships.

On the lower Columbia below the dams, commercial navigation is more diverse and less dependent on management programs on the mid and upper reaches of the river. The Corps of Engineers maintains a 40-foot navigation channel between the mouth of the river and Portland/Vancouver, 105 nautical miles upriver. Ports on the Columbia, dominated by the Port of Portland, actively participate in world trade, bringing the benefits of this economic activity to the entire Columbia region. Authorization to deepen the river's entrance to 55 feet was approved by Congress in 1984 and will allow vessels to utilize fully the 40-foot navigation channel to Portland and Vancouver.

Maintenance of the entrance channel requires the Corps of Engineers to remove more than 2 million cubic yards of bottom material from the river's mouth each year. The Corps continues to explore options to make the lower Columbia "self-scrubbing." However, until appropriate technologies are developed and the threat of future eruptions by Mt. St. Helens subsides, dredging will continue.

Recreation

One of the most economically and socially important, yet often not considered, uses of the Columbia's water is for recreation. Water-related recreation, such as fishing, power boating, sailing, swimming, and water skiing on the Columbia, is a Northwest tradition and contributes much to the region's economy. In fact, tourism is the Northwest's fourth largest industry. Many millions of dollars are generated in the region's economy through retail sales, equipment wholesaling and manufacturing, and support/service enterprises. While not all of the region's tourism and recreation depend on the Columbia and the Snake, the river system accounts for a significant and growing share.

Much of the attraction in terms of recreation depends on continued access to a clean and safe natural environment. Managing hydroelectric dams to meet peak loads, as discussed earlier, could seriously limit and perhaps even preclude this access. Under such a management scheme, reservoir levels fluctuate rapidly in response to peak generation needs. At Grand Coulee, for example, peaking could result in a very rapid 23-36-foot fluctuation in the river level below the dam twice a day. These rapid reservoir fluctuations, combined with increased irrigation drawdowns, accompanying low stream flow, and water quality problems during the summer, would isolate boat ramps and docks, create difficult and perhaps dangerous access to the shoreline, and produce aesthetically unattractive settings. The implications for recreation are clear.

Municipal and Industrial Uses and Pollution Abatement

Although neither glamorous nor well known, use of the river to meet municipal and industrial requirements remains an important consideration for resource planners. In addition to supplying drinking water, municipal, industrial, and agricultural waste disposal is also important. Historically, we have used our waterways to dilute and assimilate the chemical, biological, and thermal byproducts that are generated by our modern society. We will continue to use our waterways for this purpose. Agencies such the Environmental Protection Agency ensure that we do not overuse and abuse the Columbia River. Overuse in this area could well result in regional water pollution problems affecting severely the other commercial and aesthetic uses of the river.

Historically, withdrawal of water from the river has involved relatively minor quantities in rural areas. Given that any withdrawal reduces the natural flushing of the river, concern has centered on retention of high water quality standards for municipal drinking water and waste treatment disposal.

The development of the hydrothermal plan to meet the region's projected electricity demand added a new pressure on the river. The cooling of nuclear plants located near rivers impacts the Columbia in two ways: cooling towers require the diversion of fresh water; this water is then heated in order to cool the reactor. This heated water is subsequently returned to the river and the thermal plume is dissipated as it flows downstream.

The complexity of problems arising from the region's vulnerability to low-water conditions is clearly illustrated by the problems presented by potential thermal pollution. In low-water years, events occur simultaneously. First, reduced river flows decrease the amount of water available for hydroelectric generation. Second, reduced flows require careful management of existing water reserves to meet fish flows mandated by the water budget and navigation requirements. Third, electricity demand requires that thermal plant operation is raised to meet the power deficit, increasing the thermal plume in the river. Because flows are restricted and the mass of water available to absorb the plume is smaller, the impact of the plume is increased, in turn raising demand for additional flows to meet water quality standards.

The situation approaches a zero-sum game. The question that will be resolved during the middle of the next drought is which river uses will not be fully satisfied because of inadequate water.

Political Complexities and Citizen Responsibility

As indicated, management of the Columbia River is complicated and highly complex. The Columbia Basin includes parts of seven states, plus the Canadian province of British Columbia. Some tributaries of the system cross the international border three times before entering the Pacific Ocean. Management authority for power generation, flood control, commerce, and other use is fragmented among local, state, regional, federal, and international agencies. Dozens of specific interest groups, as well as local, regional, and national committees, are also involved in some aspect of Columbia Basin policy. Because of the complexity and variety of institutions and interests involved, what has evolved over time is a piecemeal, fragmented approach toward the management of the waters of the Columbia River Basin.

It is urgent that something be done. The Columbia River is no longer resilient and inexhaustible. It has clearly begun to show its vulnerability to overuse and to inadequate, uncoordinated, and inconsistent management. The hydrological record tells us that the region experiences a drought on the average of one every few years. The last low-water years were the 1976-1977 experience. Few of the institutional memories remain in place from that drought. Old institutions, such as the Pacific Northwest Basin Commission, no longer exist. New organizations, such as the Northwest Power Council, have come into being. Equally important, the demands on the river continue to increase.

This discussion has shown that the river has been extensively developed for some uses with little or no regard for other uses. Future demands will intensify the debate over how these resources are utilized.

Over the next few years, the region will be faced with vital public policy choices about how, where, and under what conditions the water resources should be used. It will be a difficult time of decision and a question of balancing the competing needs of diverse uses. These decisions will have implications for generations to come. In this decision-making process, each citizen has a role to play. By becoming aware and understanding the issues and conflicts, we have an opportunity to voice our concerns so that rational decisions regarding the Columbia River will be made. By getting involved, we can help to ensure that the waters of the Columbia system are allocated in the future to allow a compatible mix of resource use for the benefit and enjoyment of all.

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PANEL I.
Who Runs the River

Moderator:
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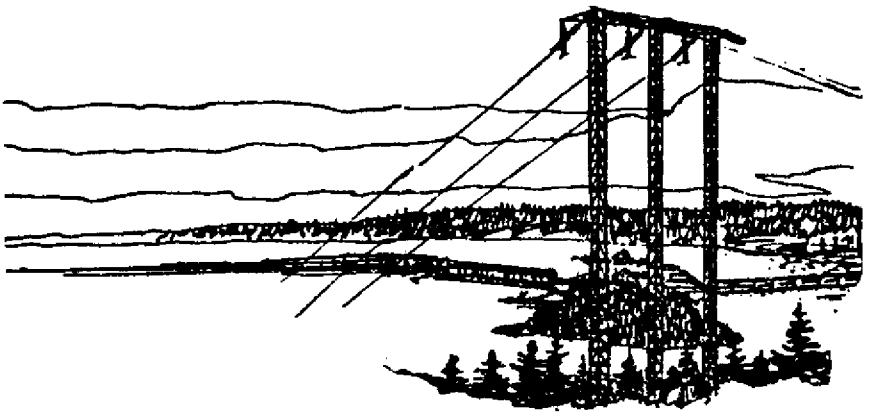

Who Runs the River

Charles F. Broches

This panel was given the task of providing a general familiarity with the central themes associated with managing the Columbia River. While not exhaustive, they summarize some of the central factors that serve to enhance either cooperation or conflict over how the region's most important water resource is utilized.

In the first paper, Philip Wandschneider presents seven principles for effective cooperative management of the Columbia River. Key among these is the recognition that the river serves a multitude of uses, and successful managers must acknowledge and cater to this pluralistic environment.

From Wandschneider's general principles, Edward Sheets, Executive Director of the Northwest Power Planning Council, focuses his attention on the roles and responsibilities of the newest actor to enter the political environment of river management. Given that the Power Council is primarily a planning body, it is only natural that many people look toward it to balance the demands of agricultural, fish and wildlife, hydropower, navigation, and recreational claims. However broad this concern is, the Power Council, Sheets explains, recognizes that its charter is narrower than this broad function, and that carrying out its mandate requires the cooperation of the various consumers of the Columbia's water.

The Columbia is not strictly a concern of American politics and public policy. As Neil Swainson points out in his paper, rational and effective management requires that Canada and the United States cooperate as coequal users of the river. Canada and the United States have structured the operation of the river through constraints contained in the Boundary Water Treaty of 1901 and the Columbia River Treaty of 1964. The Columbia River Treaty established a formula through which

the U.S. received substantial benefits from the Canadian portion of the river in exchange for $254.4 million in prepaid American funds. Canada is entitled to begin reclaiming its share of these benefits between 1997 and 2003. How Canada chooses to use its share of these benefits will have a substantial impact on what takes place south of the Canada-United States border.

Seven Principles of River Management

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Providing an overview of the complicated management structure of the Columbia River in a few pages is indeed a difficult task. There are so many agents, with so many different responsibilities, that it would be impossible to introduce them all adequately. What I will try to do is provide an outline to which much of the more detailed discussions to come can be oriented. I will do this by suggesting a series of principles that capture the essence of the Columbia River management and control system.

Principle No. 1: Pluralistic Control

The first principle is that Columbia River management is pluralistic. No single human agency exercises control over the levers on the dams, reservoirs, canals, and drains by which we attempt to domesticate the Columbia River. No agency is dominant; indeed no agency can even independently affect the river. Instead each agency is bound in a web of institutional, hydrological, and economic relationships. Each agency is constrained by the decisions of others, and in turn, limits the choice of others.

Of course not all agencies have the same weight in this web. Agencies such as the Corps of Engineers, the Northwest Power Planning Council, the state water agencies, the Bureau of Reclamation, and the Bonneville Power Administration (BPA) speak with rather more authority than a small ditch company, a rural electric coop, or a chapter of Trout Unlimited. But even these more significant agencies are greatly circumscribed in what they can and cannot do.

For example, consider the BPA. First, its activities are restricted by the congressional legislation by which it is chartered. It cannot own

power plants. Its rate-making is subject to certain mandated goals and practices and to public review and Federal Energy Regulatory Commission (FERC) approval. Congressional committees review its budget. Power sales outside the region are restricted. Power resource acquisition and some other activities must be guided by the plans constructed by the Northwest Power Planning Council. Additionally, BPA has various contractual and informal obligations with the Corps, the Bureau, and others in the electrical industry. It also has obligations under the Columbia River Treaty with Canada. And finally, BPA must meet its legal and commercial commitments to the various utilities that constitute its market. In short, though BPA is powerful in the Northwest, its choices are greatly circumscribed by numerous commitments and restrictions that bind it to the actions of others.

Principle No. 2: Institutional Framework

The principle of pluralistic management is basic. Many of the other principles specify how this pluralism is structured to avoid anarchy. For instance, the second principle is that the various organizations and agencies that manage the Columbia River make their decisions within a legal and institutional framework. This framework specifies the relative authority and responsibility of each agency, and the legal relationships between the agencies. Several of the most important elements of this framework will be briefly described.

One basic element is state law, particularly the state water codes. Most water users must apply for and receive state permits for their intended water use. Historically, the state served mainly as a referee and enforcer of rights that were self-created by the act of applying water to beneficial use. The states are becoming more active managers of their water resources. In particular, states have begun to draft water use plans to guide allocation, and water regulations to protect and control instream water uses.

Besides writing the basic water law, states also create other laws that guide water use and agencies that share in river management. These include the various water and irrigation districts, state agencies governing water, environmental and energy affairs, and fish and wildlife regulations and agencies.

The federal government has superior constitutional authority, but a more piecemeal approach to water use than the states. There is no uniform federal water code. One can, however, identify three loose bodies of federal water law. The first body of federal water law charters the various water development and management agencies. The Corps of Engineers, the Bureau of Reclamation, the Bonneville Power Admin-

istration, the Federal Energy Regulatory Commission, and federal fish and wildlife agencies play significant roles in Columbia River management. Another agency, the Northwest Power Planning Council, is a joint federal-state agency, but looks to federal law for its basic authority.

For the most part, the basic responsibilities of these federal agencies are well known. The Corps and Bureau build and operate water development projects. The BPA markets power from the Federal Columbia River Power System (FCRPS) and serves as required power broker. The Power Council is a new agency, charged with oversight of new power acquisition by the BPA and with direction of certain fish and wildlife mitigation efforts. The FERC exercises the federal control over nonfederal public utilities, which must operate under FERC licenses.

Besides chartering these agencies, the other two bodies of federal water law 1) authorize and finance specific water projects (e.g., the Columbia Basin Project), and 2) govern certain water uses, especially environmental and recreational uses. Examples of the latter include the Endangered Species Act, the act creating the Wild and Scenic River Systems, and the National Environmental Policy Act, which, among other things, mandates preparation of Environmental Impact Studies (EIS).

The division between federal and state water law can be loosely related to the division between instream and consumptive water uses. federal law tends to focus on hydropower, navigation, recreational, flood control, and environmental issues, although the Bureau's considerable role in irrigation cannot be overlooked. State law tends to guide irrigation and other consumptive uses, though recent efforts to regulate instream efforts should be noted.

Elements of the institutional framework besides state and federal law include: 1) the international treaty with Canada, 2) the various Native American treaties, and 3) numerous private contracts and voluntary associations that band together various subsets of organizations concerned with river management. The Columbia Treaty was discussed by Professor Swainson. The Native American treaties have had increasing impact on management with regard to fishery habitat. Currently the 9th Circuit Court is debating the extent to which state and federal agencies will need to consider the impact of their water-related decisions on the Native American fishery habitat. The private contracts and voluntary associations are publicly less visible but perhaps more significant influences on river management. A notable example is the Northwest Coordination Agreement specifying some utility practices. For in-

stance, it is partly responsible for institutionalizing the critical water year approach to streamflow management.

Principle No. 3: User Cluster and Management Policy

The third management principle is that policy tends to be made within groups or clusters of organizations focused on particular uses of the river. Consider four important policies that shape river management: 1) the Hydrothermal Power Program (HTPP), 2) critical year water planning, 3) the completion of the Columbia Basin Project, and 4) fish flow/water budget policy. The hydrothermal power program and critical year water planning both are examples of policies essentially constructed within the energy cluster. The utilities, operating within organizations such as the Pacific Northwest Conference Committee, hammer out such policies themselves. The HTPP affects water management because it contemplates using hydropower for peak loads to complement thermal resources for base loads. The critical water year approach to planning sets policy about seasonal reservoir drawdowns. In counterpoint to these energy cluster decisions, the completion of the Columbia Basin Project is now being debated largely within the boundaries of the irrigation cluster: the Bureau of Reclamation, the private irrigation industry, and state water agencies.

In recent years, there has been a tendency to open up decision-making to groups who are outside the specific use clusters, but nonetheless affected by the decision. For example, discussion of the Columbia Basin Project has expanded to include some of the general citizenry because of the potential impact of the project on state taxes and electricity rates. The best example of the decreasing rigidity of the clusters can be found in the fish flow/water budget policy, however, Here the fishery and energy clusters have entered a dialogue to work out a policy that clearly affects both water uses.

Principle No. 4: Three-Phase Operational Decision-making

The fourth principle guiding Columbia River management is the three-phase process by which operational decisions are made. The decisions that determine how the natural streamflow is altered to become the regulated streamflow can be thought of as occurring in three phases, although they take place simultaneously not sequentially. However, there is a hierarchy in terms of management. The first phase is the withdrawal of water by consumptive users. By and large, decisions to divert water are made independently by thousands of irrigating units, although they are shaped by state and federal water agricultural and irri-

gation policies. The water remaining in or returning to the river is next managed for non-hydropower, instream purposes. Management in this phase is extremely pluralistic. State instream regulators and federal environmental laws are involved. Native American treaty rights are involved. But largely these management decisions are made by the project owners under the constraint of the various laws, regulations, and obligations that bind them. Two agencies have authority beyond their own projects, however. The Corps has responsibility for flood control and navigation at all water control facilities, and the Water Budget Center has authority to modify general streamflows. Moreover, management at this phase is characterized by a great deal of formal and informal communication between project owners and other groups (e.g., fishery agencies) that have access to the owners.

The third phase comprises streamflow management for maximum hydropower production given water withdrawals and the constraints set for non-hydropower instream uses. Management for hydropower is done through a combination of individual utilities managing the projects they own rights in, and the industry, acting as a whole, establishing an overall set of plans and procedures. The goal is to coordinate operations to achieve some of the efficiencies that would obtain if a single utility managed the river. The unified management plan centers around reservoir drawdown rules designed to assure power deliveries in the event of a recurrence of worst case or critical water flows.

Of the utilities, the largest is the Federal Columbia River Power System. The FCRPS includes BPA as marketer and scheduler of power, and the Corps and Bureau as project owners and power producers. The BPA, in consultation with the project owners, has the central role in determining power scheduling for the federal projects.

Principle No. 5: Making It Work

The fifth principle of Columbia River management is that the myriad of organizations that share in the management of the Columbia River are glued together by numerous contracts, voluntary agreements, coordinating committees, associations, and constant formal and informal communication. Given the economic and hydrological interdependence of the Columbia River, it is hard to understand how the pluralism of the river management does not break down into inefficient and contentious anarchy. The secret is in these agreements and communications. Examples include the Water Management Group, the Coordination Agreement, the Committee on Fishery Operations, and the Columbia Basin Teletype Circuit (a communication system).

Principle No. 6: People Left Out

The sixth principle of Columbia River management is that the process of decision-making in clusters and the system of formal and informal agreements that coordinates actions and institutionalized policies can mean some parties may be left out of decisions that affect them. For instance, energy and fishery interests will have little to say about whether or not approval is given for completion of the Columbia Basin Project; yet water withdrawals will affect the streamflows they now use. A second example is the Hydrothermal Power Program, a policy conceived by the energy industry, but having potential impacts on, for instance, recreational and navigational users of the river due to the requirements for large fluctuations in streamflows. Another example is that, for years, fishery interests had little input into the operational decisions governing streamflows, even though streamflows have significant impacts on migration survival rates. The voluntary fish flow program and its successor, the Water Budget, have changed the rules so that fishery interests now have some input into streamflow decisions.

An important aspect of this principle of exclusion is that sometimes rules and laws exclude parties who recognize that their interests are at stake, and try to get in. At other times, standard procedures simply bypass some parties who either remain ignorant or know about, but are indifferent to, the issue under consideration.

Principle No. 7: Change

The seventh principle of Columbia River management is that the one constant is that the system is in a continual state of flux. Changes in economic conditions, in social values, and in hydrological conditions induce changes in institutions. For example, the Power Council is the result of changes in economic conditions (perceived impending power shortages) in the energy industry and changes in the political clout of fishery interests. The Coordination Agreement and associated documents followed from political and economic factors in the negotiations with Canada over the treaty, especially from recognition of the economies of unified river management with the vastly increased storage capacity of the Canadian projects.

Two areas that are currently in transition concern fishery versus hydropower and hydropower versus irrigation uses of the river. Changes regarding fishery-hydropower issues are being sorted out in the implementation of the regional Power Act and the Power Planning Council's Fish and Wildlife Program and in the continuing court battles over treaty fishing rights. Certainly these issues are still in transition. Concerning hydropower-irrigation, the issue is the degree to which hy-

dropower losses must be considered in making irrigation development decisions. Recently, the Idaho Supreme Court ruled that the Idaho Power Company had water rights to streamflows (at Swan Falls) holding equal legal status to consumptive water rights. The automatic subordination of hydropower uses to diversions for irrigation is no longer tenable, at least in Idaho. The degree of consideration the proposed completion of the Columbia Basin Project will need to give hydropower losses is now under debate.

Conclusions

I have presented seven fundamental principles that I believe capture the major features of the extremely complicated structure of management institutions controlling the Columbia River. The necessarily simplified picture that results will be richly amplified in the other presentations of this proceedings.

Roles and Responsibilities of the Northwest Power Planning Council

Edward Sheets
Executive Director
Northwest Power Planning Council

I appreciate very much this opportunity to discuss issues that have been in the forefront of this region's history and will dominate its future. In substantial measure, the Columbia River has unified a region in which variety seems the only denominator. The river is more than a powerful symbol. It is the lifeblood of the Pacific Northwest. Our economy and way of life would be vastly different without it.

As the Columbia winds its 1,200 mile course to the sea, it cuts across numerous jurisidictions and is met by heavy human demands—including hydropower, agricultural, recreational, navigation, and fish and wildlife claims. The tensions produced by these circumstances are nowhere more dramatic than in the effort to accommodate the region's energy needs while restoring Columbia River fish and wildlife.

In 1980, Congress recognized the difficulty of this task when it adopted the Northwest Power Act. The focus of the Act was developed principally in response to the region's electrical energy crisis. For that reason, many of the Act's most detailed provisions concern the development of the twenty-year energy plan. The legislation created the Northwest Power Planning Council and placed it squarely in the center of the region's fish versus power dilemma. The Council was explicitly charged with the duty to ensure a balance between power and fish and wildlife concerns—largely because the fish and wildlife agencies and the tribes felt strongly about the issue and persuaded Congress of its importance. Representative John Dingell championed the fish and wildlife provisions and worked closely with members of the Pacific Northwest delegation to ensure their adoption.

The Act structured the Council as an interstate compact—composed of two members appointed by each of the governors of the four Northwest states. In this way, Congress announced a clear intention

that the states should play a central role in development of the region's planning priorities.

Congress specified a long list of ambitious goals and duties for the new Council:

1. The Council must assure the region an adequate, efficient, economical, and reliable power supply.

2. The Council must provide protection for Columbia River Basin fish and wildlife, including spawning and rearing habitat. Special attention is to be paid to the anadromous salmon and steelhead resources so central to the region's social and economic well-being. The adopted language of the Act is instructive. The Act requires that the Bonneville Administrator use his legal authorities and the Bonneville fund to protect, mitigate, and enhance fish and wildlife to the extent they were adversely affected by hydroelectric projects in the basin. In addition, agencies operating or regulating hydroelectric facilities must take the Council's Columbia River Basin Fish and Wildlife Program into account to the fullest extent practicable at each relevant stage of the agencies' decision-making processes. The point of the requirement is to ensure that fish and wildlife are provided equitable treatment with the other values for which the hydro system is operated. The authors of the Act clearly intended that fish and wildlife needs should be placed on a par with the use of the river for electricity generation.

According to a recent Ninth Circuit Court of Appeals decision, the language of the Act contains both substantive and procedural obligations for Bonneville Power Administration, which has the authority to acquire and market power, and for the Corps of Engineers, Bureau of Reclamation, and Federal Energy Regulatory Commission, which license and operate hydroelectric projects in the basin.

3. The Council must balance these sometimes competing goals without overriding the proper authority of state and local governments, tribes, water management agencies, electric utilities, and others.

4. The Council must ensure widespread public involvement in developing its policies.

5. The Council is not given the authority to alter or grant any water rights or affect treaty rights.

It is a tall order. The Council entered on its new duties as only one of the many actors having authority and decision-making status with respect to Columbia River water. In the past, many decisions on uses of the river were made without opportunities for sustained public involvement. The Council was put into the position of being a new referee for some long-festering disputes. Its obligations under the Northwest Power Act made clear the need to build the proper consensus and identify a balance for future resource use.

One of the most difficult tasks confronting the Council was the need to assist juvenile anadromous fish in their effort to reach the ocean. Before the Columbia River was dammed, the migrating smolts were swept rapidly to sea by the high spring runoffs. However, construction of the dams dramatically altered the river flows. In fact, the river became a virtual string of lakes. Water was now being stored during the spring and the cross-section area of the river was increased. The result was that fish passage was being delayed substantially. This subjected the juveniles to increased predation, disease, and other adverse effects. In short, the slower travel time resulted in fewer fish reaching the ocean.

As the Council grappled with this problem, it became clear that there was more than a biological problem at stake. There existed an institutional difficulty as well. The fish and wildlife agencies and tribes had very little influence over decisions affecting river management. They lacked experience in this area and they had virtually no money to devote to the complicated task.

The agencies recommended that the Council impose a monthly sliding scale minimum flow requirement year-round at The Dalles and Priest Rapids dams. The tribes urged that the Council provide optimum flows to insure maximum smolt survival at each hydroelectric project in the basin. The tribes were concerned that the agency approach would not provide sufficient survival levels and would not enhance their long-undermined treaty fishing rights.

Both the agencies and tribes were in agreement that they needed funding in order to coordinate effectively with power operations on the river. Only with adequate funding could they obtain the needed skills to become genuine partners in the power system decisions that have such substantial impacts on the fishery resource.

The Council consulted with all parties and decided to address both the flow and institutional problems. It concluded that increased flows were needed in both the Columbia and Snake river systems at Priest Rapids and Lower Granite dams during the spring of the year. It appeared that flows for the remainder of the year were adequate. To ensure that increased flows were provided when actually needed—in order to maximize effectiveness and minimize power system impacts—the Council developed the unique concept of the Water Budget.

The Water Budget allows the fish and wildlife agencies and the tribes to shape river flows during the critical migration period—April 15 to June 15. According to the Council's fish and wildlife program, a Water Budget manager is funded by Bonneville for the agencies and tribes. The managers work with the Corps of Engineers and other entities to ensure that flows are adequate for expeditious juvenile migration.

The total size of the budget is 78 kcfs-months or some 4.64 Maf. In the unlikely event of a very dry year—one in which Water Budget flows

would essentially evacuate the reservoirs or harm firm non-power activities—the Council program provides for immediate consultations with the Corps and Water Budget managers in order to find an acceptable solution. The power system doesn't automatically have first call on the water.

The Council program leaves many details to be worked out between the operators of the dams and the fish and wildlife managers and the agencies. But it does specify the priorities for competing uses of the system: firm power to meet firm loads, Water Budget, reservoir refill, and secondary energy generation. And of course the Water Budget is not free. Recent estimates put the price tag at some $58 million per year in an average water year.

Well, how is it working? The Water Budget has been tested for two successive years now. Although, as with any new change of this magnitude, there are some important issues still to be resolved, the experience has been surprisingly successful. Coordination between the Water Budget managers and the Corps has developed reasonably well; essential flows have been provided in nearly all cases; BPA-funded research on the effects of the Water Budget is proceeding; and a dispute resolution procedure is in place. Recently, a number of agencies authored a Memorandum of Understanding that will help resolve some of the outstanding issues.

I believe that Water Budget implementation shows that the complex system of Columbia River water allocation can adjust to new realities and legal obligations. It is never easy, and there is much more work to be done, but the task is under way and we can be reasonably optimistic that next spring's first year of formal Water Budget operation will be a good one.

If the Water Budget is a fair example of the difficulties associated with changing the historical practices on the river, it is clear that the task is complicated and requires painstaking consensus building. But making the decision in a publicly accountable way that gives all the affected interests an opportunity to have their seat at the table will improve the chances for success.

The Council is committed to carrying out the mandate of Congress to protect and restore fish runs that have been damaged by the hydroelectric system. We will continue to work with all of the parties that are involved in the Columbia River system. Working together, we can, I feel confident, successfully rebuild the important salmon and steelhead resources of the Columbia River Basin.

The Impact of Canada on Management of the Columbia River

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Those of you familiar with latter-day political science and economics will be well aware of the manner in which those provocative colleagues of ours, the public choice theorists, have sensitized us to the fact that institutional complexity and jurisdictional overlaps need not be equated with decision-making pathology. My first observation (albeit one I shall leave to others to follow up on) is that the system we are about to probe, while extraordinarily complicated, is by no means insensitive or irrational. The making, re-making, and implementing of public policy within it have had difficulties, but the system has not been estopped, and continues to display a good deal of logic and flexibility. The following remarks will be restricted, as my title suggests, to one aspect of this system only—the legal/institutional frameworks applied first to the Canadian portion of the Columbia Basin, and then to the management of the entire watershed from an international perspective.

As many of you know, Canada's national government has jurisdiction over the "Canadian Columbia" via its navigation and shipping, fisheries, and Indian Affairs powers. None of these really, however, has had a major bearing on its approach to this area since 1945. It does have a jursidictional competence to license works in the Canadian watershed that might affect rights across the border, and it has a monopoly in Canada also of the right to negotiate, sign, and ratify treaties. Unlike your federal government, however, it has no automatic power to implement such agreements if the subject matter of them falls within provincial jurisdiction. As the Canadian Columbia's water is essentially subject to provincial regulation (and proprietary rights), the involvement with this watershed of the Canadian federal government, its Inland Waters Directorate (in its Department of the Environment), and its Depart-

ment of External Affairs in recent years has been a comparatively modest one.

We do not have time today to trace the varying institutional resources upon which the British Columbia cabinet has relied in the last half century for help with its water management responsibility. All that we need note here is that *its* Ministry of the Environment now administers its *Water Act*, licenses and supervises users of water, and conducts extensive hydraulic studies. Concurrently, this cabinet receives advice on energy matters from a Ministry of Energy, Mines and Petroleum Resources, plus reports on the merits of all proposed new utility projects from the province's Public Utilities Commission. This last-mentioned regulatory authority also has jurisdiction over utility rates. Final decisions on the projects themselves, however, are made at Cabinet level. It is also pertinent to recall that there are four power producers in the Canadian watershed, the most important of which are the West Kootenay Power and Light Company, its parent Cominco Ltd., and, much the largest, the provincially owned B.C. Hydro and Power Authority—with cabinet member representation on its board.

It is fair to say that the two Canadian governments that share responsibility for the upper Columbia Basin face a conflicting mix of claims to use its water for consumption, some irrigation, power generation, flood control, navigation, fishery, other recreational and general environmental protection purposes. These claims are advanced by individuals, groups of individuals (incorporated and otherwise), and by local governments, in a political culture that now provides its own version of participative democracy. Major project proposals now educe in my country, as in yours, extended public hearings. Not unreasonably, then, one can characterize our decision-making environment apropos of water use decision-making as pluralist—but modestly so, when compared with yours. Interest groups interact with each other, the utilities, and the Utilities Commission. Ultimately, however, at present the major decisions concerning the use of Canadian Columbia River water appear to derive from the interaction of the chief users of it (including Hydro) with the two provincial ministries already mentioned, and then, in varying combinations, from their interactions when necessary with the provincial cabinet—where, in our political system, ultimate responsibility for synthesizing the range of competing values finally rests.

It is important to remember that the management of the water in the Canadian portion of the watershed, and the American portion also, is subject to two important sets of constraints contained in the Boundary Waters Treaty of 1901 and the Columbia River Treaty of 1961-64. The Boundary Waters Treaty is relevant here primarily because the Co-

lumbia and five of its tributaries (one, twice) are transboundary waters. The constraints in fact under the BWT for long were minimal, as there were no mainstream developments on the Columbia in Canada prior to the Columbia treaty, and Article II of the BWT in any case left upstream riparians great freedom of action—subject only to claims for damages suffered downstream across the border. The BST's Article IV was a different matter, however, as it required the International Joint Commission—which it in effect created—to license works below the boundary on transboundary rivers, if these were to affect the natural level of waters across the boundary. The IJC has issued a number of Article IV orders since the first in 1928 permitted the reclamation of lands near Creston, B.C., including the 1938 order allowing for the raising of Kootenay Lake, together with the creation of the International Kootenay Lake Board of Control, and the 1954 order permitting the Waneta Project. (The recent agreement to allow a 15-foot raising of the Seven Mile Reservoir would normally have required IJC licensing, but I understand that this has been incorporated in a treaty as part of the "Skagit River package.")

The IJC was also involved in its investigation and reporting role (under the BWT's Article IX) with the long analytic run-down to the Columbia River Treaty, but for reasons that we cannot pursue here, it really passed off the scene insofar as the drafting of that agreement was concerned, once the formal negotiation of it began in September 1960. This treaty, of course, signed in January 1961 and proclaimed in September 1964, established an elaborate set of agreed-upon rules and conditions governing the management of streamflows over its projected sixty-year life. It is subject to cancellation thereafter on ten years' notice. Perhaps a brief reminder of its basic provisions will be helpful. Under it, Canada agreed to construct three projects, committing 15.5 million acre-feet of water to regulated storage and releases. The United States was given an option to build Libby. Canada agreed to commit 8.45 million acre-feet of storage (largely at Arrow and Duncan Lake) to flood control operation, under conditions specified in Annex A of the treaty, and to meet additional calls for flood control operation if circumstances so warrant. Canada also agreed to operate the entire 15.5 million acre-feet under detailed operating plans specified in Annex A, and prepared five years in advance, to achieve optimum power generation first downstream in the United States, and after Mica and /or other Canadian facilities downstream are machined to achieve ". . . optimum power generation at site in Canada and downstream in Canada and the United States . . . including consideration of any agreed electrical coordination between the two countries." The downstream power benefit thus created (and calculated according to Annex B) was to be shared equally. Canada's half of it was to be returnable to Canada, although

provision was made for disposing of portions of it in the United States.

The same fifty-fifty sharing rule was applied to the downstream flood control benefit, only in this case Canada's entitlement—one half of the then present value of the flood damage prevented ($64.4 million US)—was to be paid when the three Canadian treaty storages became operational. The downstream flood control and power benefits derived from Libby *in* Canada were not to be shared. On the other hand, Canada undertook to acquire and prepare the Libby flowage area north of the boundary. Canada was given the right to divert approximately 20, 75, and 90 percent of the Kootenay's flow north into the Columbia's, twenty, sixty, and eighty years after ratification. Libby, of course, was constructed in this country after 1964, and the three Canadian treaty storages were completed (in two cases ahead of schedule), and have been operated since in accord with the provisions of the treaty. In addition, Canada's power-generating capacity in the basin has been substantially increased with the completion of the Kootenay Canal, Seven Mile, and Revelstoke projects.

The one characteristic of the Columbia treaty to which I wish to direct your attention is its specificity, which was not the original goal of some of its leading draftsmen, but became one in the context of a host of strategic decisions evoked by the complex polycentric bargaining from which the treaty emerged. This bargaining, furthermore, continued in Canada for two years after the treaty was signed, enmeshed in a bitter domestic Canadian debate over the merits of the treaty, and led ultimately in 1963 to a treaty protocol that clarified some ambiguities in, and made some modest changes to, the agreement, but that also had the effect of heightening the specificity referred to. In addition, the protocol paved the way for the sale of Canada's entitlement to the first thirty years of the downstream power benefit—for $254.4 million (US) prepaid. Note that this sale ends in 1997, 1998, and 2003—not now that far away.

The Columbia River Treaty included several specific provisions for its implementation, of which the most important was a requirement that Canada and the United States nominate entities responsible for this process. The chairman of B.C. Hydro, and the administrator of the Bonneville Power Administration, together with the division engineers of the Corps of Engineers, were so designated. These two entities established internal working groups of their own, and in time created an eight-member Columbia River Operating Committee, with equal numbers of technical personnel drawn from their staffs on each side of the border. Furthermore, the treaty provides for a four-member Permanent Engineering Board with membership nominated by the two countries' governments, substantially to oversee the work of the entities, to keep

records of Columbia and Kootenay flows, and to report annually to the two national governments. Often now this body meets just once a year. Its Canadian section is backed up by a federal-provincial committee of engineers.

Obviously, B.C. Hydro, with basic responsibility for building and operating the Canadian treaty storage projects, has required strong support from the Government of B.C. It has got it. Nevertheless, in spite of the earlier emphasis in these comments on the crucial role of the provincial cabinet, the fact remains that most of the *new* policy decisions taken in B.C. since 1964 concerning the Columbia's regulation have been handled by technical personnel. In a sense, the intermix of political and technical effort that was such a characteristic of the twenty years of effort prior to the ratification of the treaty, in Canada at least, has been superseded. Perhaps because the big decisions were taken earlier, or because the Columbia's management in B.C. (and Canada) has moved well down (if not right off the political agenda), politicians in B.C. have largely turned to other matters. This remains true in spite of the fact that ten years ago a provincial premier did call for the treaty's renegotiation.

While technical personnel in B.C. have thus had to play a leading role in the "implementing" decision-making, their task has not always been an easy one—for a variety of reasons. One is the sheer complexity of parts of the treaty. Annex B, for example, raises issues over which the most sophisticated technically disagree. A second source of difficulty has derived from the fact that while the treaty was comprehensive, it did not provide solutions for all of the problems that it evoked. It advanced no clear guidelines, for example, to deal with the filling of the last 4.5 million acre-feet of storage at Mica, and none at all for an issue that recently faced the river's "managers"—the impounding of 4.3 million acre-feet of storage in the Revelstoke Reservoir. Here lawyers coopted by the two entities, as so often happens, gave quite contradictory interpretations of the rights and obligations of B.C. Hydro as it faced this task. Ultimately a solution to this difficulty was found in a sharing of the cost of this reservoir filling—in the course of which sharing Canada exports energy to make up for American losses attributable to the Revelstoke impoundment.

Still another difficulty facing operating personnel on both sides of the border has been a notable loss of "organizational memory," as key personnel involved in the formative years of the treaty have left government, retired, and/or died. In Canada only two engineers who worked on the treaty's negotiations remain in public service—one at the federal level, one provincial. To complicate Hydro's experience, many of the most knowledgeable anent the treaty left within a short period of time.

My impression is that your entity in this country has had the same experience, perhaps even complicated by the transfers and early retirements associated with careers of military personnel.

These considerations notwithstanding, as personnel present today may well testify later, those charged with implementing the treaty have really been remarkably successful in coordinating and to some extent integrating two complex systems across an international border, and successful also in hitting upon ways not always anticipated by the treaty to generate additional benefits, which both countries can enjoy. One of the features of the Revelstoke agreement is the way in which it provides for a sharing of these augmented benefits; I gather, indeed, that it really amounts to a Columbia Basin Coordinating Agreement.

It is a truism that those responsible for implementing the Columbia River Treaty now face a world with some quite different values, or different weights attributed to values—as compared with the world of 1960. A heightened environmental sensitivity, for instance, is now very much a part of the political culture of B.C., as it is in the American Pacific Northwest. This sensitivity accounts in large measure for the fact that B.C. has not acted this year, as it could have under the treaty, to build a Copper Creek (Canal Flats) Kootenay River to Columbia Lake diversion, even though *small-scale* projects, like this one, tend to be "beautiful" now in B.C. (Let me just add here that personally I hope that this diversion—a subset of the late General Naughton's plan for Columbia development—is never proceeded with.)

Another value change in recent years affecting Canadian Columbia River management has been reflected in a massive increase in the water rentals now levied by the provincial government annually, and indexed annually, on B.C. Hydro (and other water users). These water rentals have had a direct bearing on some recent Columbia decision-making, and nearly scuttled the Revelstoke agreement already referred to. Their impact in this case did go to cabinet, and resulted in an order-in-council providing an exemption from these rentals for the compensatory energy exported by Hydro as its contribution to the cost of filling the Revelstoke Reservoir.

Nearly two years ago, while discussing the likelihood of B.C. Hydro modifying its treaty storage releases to meet the needs of American fishery enhancement, I suggested in Portland that I thought the Canadian response would be sympathetic, but that it would not involve a willingness to depart from the explicit control regimen that the treaty requires. This is still my impression. It can be argued, probably, that such a position reflects a desire to avoid acting in such a way as to reduce (although I am not sure of this) the magnitude of the downstream power benefit. (Current indications, by the way, suggest that Canada

plans to "take back" the remaining entitlement once the sale ends. While it will be larger and more valuable than once expected, it will not be nearly as large in relation to B.C.'s base load as would have been the case fifteen years ago, and hence it will not be at all "indigestible.")

There are, nevertheless, other explanations for the position about which I am speculating. One is that sticking with the provision of the treaty recognizes the point made so well by Irving Fox and David LeMarquand over a decade ago, to wit, that the ultimate provisions in any international river agreement may reflect a consideration of almost the whole range of problems shared by the countries involved. There are real uncertainties, in short, associated with a treaty reopening, or modification, well recognized by the limited number of British Columbians (nearly all technicians) who think about Columbia management at all. This remains so even though these few individuals are well aware of the fact that in recent years the downstream power entitlement now being realized in the United States has turned out, since the mid 1970s, to be significantly larger than the one British Columbia appeared to be selling in 1963.

A further consideration is that there are still a few powerful decision-makers in Canada (and in B.C. especially) who remember with embarrassment an issue raised by the United States when the power sale was being negotiated. At that time, American representatives did not hesitate to argue that the prepayment was eliminating for B.C. for the period of the sale the constraint of self-interest in ensuring that Canadian storage would be so operated as to optimize first American and then both countries' power production. The determination on the part of these Canadians to demonstrate that their country is prepared to live up to the terms of the treaty and sale, as a matter of principle, just should not be underestimated.

Whether the bargain can be or will be modified, in time, to take into account such additional values as fishery enhancement or expanded irrigation use in the United States, and expanded energy exports from Canada (which latter would make sense to me), remains an interesting question for speculation. But it is just that. My hunch is that some major initiatives from this side of the border would be required to make such a development possible.

PANEL II.
Who Wants the Water: Resource Allocation

Moderator:
Michael S. Spranger
Extension Marine Resources Specialist
Washington Sea Grant

Who Wants the Water: Resource Allocation

Michael S. Spranger

There have always been a variety of people in the Pacific Northwest wanting to use the waters of the Columbia River. Early Native American Indians used the resources and water of the river for food and travel. Later, explorers and settlers used the river for similar purposes. Generally, there was enough water to go around.

It was not until the early part of this century that man began to have a major effect on the waters of the Columbia when he started to develop the river for power, for irrigation, and for navigation.

In those early years, the water was thought to be unlimited. For example, J.P. Ross, first administrator of the Bonneville Power Administration, once proclaimed in looking at the river as a power resource:

> The Columbia was an oil well that would never run dry and a coal seam that would never thin out.

However, we have found that this is simply not the case; there *is* a limit on the use of the water.

Today, we have many groups, agencies, and individuals who want use of the waters of the Columbia. These uses are all beneficial, legitimate uses, especially in the eyes of those using the water.

The problem we now face is that we have a limited resource that may no longer be able to keep up with the demands, particularly in low-water years. The result is often conflict and competition for this water resource. The Corps of Engineers stated in a 1976 report:

> Conflicts among river uses are already occurring in our increasingly severe and low water years. If demands on the available resource continue to grow as projected, the competition for the existing storage supplies will increase substantially in the next decade. Past flexibilities are fast disappearing. Decisions on the use of existing supplies for

hydropower irrigation in supplementing minimum in-stream flows will involve a definite limit in allocation to one or more of the competing uses.

(U.S. Army Corps of Engineers, Columbia River and Tributaries Review Study—Planning Issues—Columbia and Lower Snake Rivers, V. 16, 1976.)

In addition to more demands being placed on the Columbia, we are also having to cope with changing attitudes and values placed on the river and how it is used. A use that we once cherished and considered above reproach (e.g., hydropower) may fall into disfavor among those groups now adversely impacted by the use (e.g., fisheries, white-water recreationists, etc.). Who are these groups that want the water? What are their attitudes and values?

To give you an idea of who these groups are and what they represent, we have assembled this panel to discuss their desired uses for the waters of the Columbia and the values they place on them. Although there are certainly other uses and groups, we believe that this panel represents the major user groups. We asked them to consider three questions in their remarks:

1. What is the importance of the Columbia River for your use and perspective?

2. How could the river best be managed (optimized) for your particular use?

3. What are the pressing political and economic problems that you foresee now or in the future?

I am sure that you may find some disagreement among the panel members on how the water should be used. Our goal is *not* to create additional conflict and controversy, but to stimulate discussion on these important uses. It is hoped that by being better informed about *all* uses, we will be able to make rational decisions on how best to allocate the water among the users to maximize the benefits to the Pacific Northwest. A later panel will address some "Lessons Being Learned" on how we can use the waters in a cooperative manner, with a minimum of conflict.

River Transportation and Development: Competition or Cooperation?

Peggy Bird
Executive Director
Pacific Northwest Waterways Association

When I was growing up on the East Coast a few years back, I didn't know a whole lot about the Pacific Northwest. I knew the state capitals from geography class, knew about Lewis and Clark and Sacajawea from history class, and I knew about the dams that were being built on the Columbia from my father who was machining the turbines for the powerhouses.

In the last twenty years of living here, I've learned a lot more. What I'm learning convinces me that the use of water resources on the Columbia-Snake system is as complex and complicated a process as you'll see anywhere.

For starters, the river system in its drainage basin, includes seven states in the United States as well as Canada. There are more than 120 utilities, public and private. There are 20 major fishery agencies and councils. There are 36 ports in the Columbia-Snake marketing group. There are dozens of irrigation districts. And that doesn't count the cities, towns, counties, and tribal jurisdictions.

Then there are groups like the Pacific Northwest Waterways Association. The PNWA is a 51-year-old organization. We represent a broad base of members interested in the appropriate development of waterway resources. The Association was formed (as the Inland Empire Waterways Association) by a group of farmers who were interested in convincing the federal government that a lock should be included in the plans for the Bonneville Dam that allowed passage of their grain barges. And, if you think that issue sounds familiar, you're right. Only now, we're trying to get the lock *enlarged* to accommodate grain tows.

In any case, PNWA covers five states—Alaska, Oregon, Washington, Idaho, and western Montana. Our 170-plus members include farmers, grain coops, irrigation districts, ports, towboat companies, private

and public utilities, construction companies, and engineers. The Association's purpose is to develop regional multi-interest consensus on important waterway-related economic development issues and represent those issues to federal agencies and the five-state congressional delegation.

I go into all this background so that you will understand my remarks on the topic of this panel "Who Wants the Water."

I suspect that I represent the schizophrenia of the politics of the Columbia-Snake system as well as, if not better, than any other single individual you will hear today. Within PNWA's membership, there are different interests. The ports compete with each other. The interests of public and private utilities are not always the same. The towboat companies are having problems with the wind surfers running in front of their grain tows in the Gorge, but the ports are prospering from the tourist business wind surfing is bringing in. The coastal ports are suffering from the disastrous fishing seasons we've seen over the last few years. The utilities are fingered as the culprits for the decline in the fish runs. Every time a lock is filled to allow passage of a barge or pleasure boat, potential energy is lost from the diversion of the water from the turbines to the lock. Spilling water for fish passage is another opportunity cost for energy producers. Diverting water for agricultural use upstream lowers the amount available downstream for energy and navigation. Dams built for flood control or power production can interfere with navigation. Increasing power costs hit irrigated agriculture hard and this affects port business; this in turn hurts the construction business and engineers. And that list covers only the potential conflicts between my members for the resource.

It is no accident that the major cities of the Northwest are located where they are. Early European explorers and white settlers used the plentiful rivers and waterways to reach inland and to ship cargo out. Like the original American Indian inhabitants of the region, the white settlers fished the rivers and used them for transportation and commerce. Logs float more easily than they drag over the ground. They still float cheaper than they truck, and you don't need fire suppression systems when logs are stored on the river.

As we became more populated, we began to generate power, irrigate dryland farms to increase production, control floods with reservoirs, use the river for recreation. And it seemed as though we had enough resource to go on forever. In the words of Woody Guthrie's WPA project song, "Roll on, Columbia, Roll on."

Well, the luxury of an endlessly increasing pie of water resources to slice up is one we no longer enjoy. We are now facing trade-offs for

water use. The river has been managed for multiple use in the past. That is a concept my members wholeheartedly support. But clearly, a mechanism for identifying the balance and trade-off costs is necessary.

Let me give you a few pieces of information to chew on about who uses the river:

1. One of every five jobs in the Portland area relates to port activities.

2. The Pacific Northwest is the only region in the United States currently in trade surplus. That trade is overwhelmingly grain. We are an international trader of great importance.

3. The Columbia-Snake River system as a slack water navigation system from Astoria to Lewiston is only ten years old. It is in its adolescence. The potential for increase by the year 2000 is in the neighborhood of one-third in cargo through Bonneville.

4. The hinterland of the river for commerce is now Nebraska and Iowa, where we are "stealing" grain shipments from the congested Mississippi.

5. Tourism to the Columbia Gorge is up, thanks to things like wind surfing and the Cascade Locks sternwheeler, as well as the sheer beauty of the Gorge.

6. Our hydro-based power is still the envy of the rest of the country and one of the selling points for every trade mission and trade show. Utilities are getting involved in economic development, as well as states and businesses.

7. We have some of the most productive and efficient farmers in the world. We are the breadbasket and fruit bowl for both sides of the Pacific Rim.

From the perspective of PNWA's members,*who* wants the water is easy—we *all* do. And we all have historic and economic justification for our use of it. We have developed where we are and how we've done it because of this river system.

For PNWA's members, the real issue is competition for the resource. Everyone who uses or oversees the management of the river makes allocation decisions either formally or informally. We need to decide among ourselves how best to do that.

There are opportunities through seminars like this and organizations like PNWA to work with our common interests and past our differences. We developed this river system by deciding what we wanted, together, and then moving on from there. It is in all of our interests to work out a consensus of how the competing interests—transportation,

commerce, fisheries, irrigation, agriculture, trade, tourism, power generation, flood control, recreation—how they fit together and how they can avoid major conflict.

If we don't, someone will do it for us. In the end, the decision is a political one. Politics is the art of compromise, allocating who gets what, when, and how much it costs. If we work it right, the decision will not be based on who has the loudest voice or who has the most expensive hired gun. If we present a united front, our chances of seeing a multiple use river system that serves *well* the needs of the citizens of the region increases. If we are fragmented, one sector of our economy prospers at the expense of another. And, as I've alluded to earlier, we are too interdependent for that.

Decisions made on the use of the resource that consider only one of the uses without taking into account the costs to the other users are not going to serve the interests of the region's citizens in the long run.

We are beginning to bump up against one another in our use of the river. It won't get better. It can only get worse. As we look at things like expanding the Bonneville Lock to accommodate our increasing grain trade, as we look at BPA rate cases and how power costs are allocated, completion of the second half of the Columbia Basin irrigation project, projects like the Yakima Enhancement Project and user fees on shipping, we *must* look at them in the context of the whole river system and understand the web of interdependency we have.

If we are successful at reaching a consensus on this among all the users, our region will prosper. It is the key to everything else we're trying to accomplish.

Fish and Wildlife Needs for Columbia River Water

Joseph R. Blum
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Western Region

Major uses of Columbia River water include irrigation, power generation, navigation, recreation, Indian water rights, and fish and wildlife. This paper concentrates on the last of these uses, with the focus on the following three categories:

1. the importance of the water to fish and wildlife;
2. managing the water use for fish and wildlife;
3. problem areas for fish and wildlife.

The Importance of the Water to Fish and Wildlife

Water of sufficient quantity and quality is essential for perpetuating and enhancing the fish and wildlife resources of the Columbia River. When viewed from an economic and recreational standpoint, salmon and steelhead by far form the bulk of this resource base that is dependent upon Columbia River water. However, other important fish and wildlife resources, some of which are difficult or inappropriate to measure in economic terms, also rely on Columbia River water for sustenance and shelter.

In relation to endangered species, the Columbia River watershed, including its many tributaries and riparian zones, provides habitat essential for the recovery of the endangered Columbian white-tailed deer and threatened bald eagle. The Columbia White-Tailed Deer National Wildlife Refuge—a 4,800-acre complex of federal and private lands near Cathlamet, Washington—has secured a small part of the species' historical habitat, which extended at one time from near Roseburg, Oregon, north to the southern tip of Puget Sound, Washington. The river and its many islands form one of the last safe havens for this unique population.

Bald eagle use of the watershed includes all aspects of the species'

life history. Nesting territories in more remote areas may exist within a few hundred feet of waterways, with seasonal roosting areas scattered throughout the basin. A local bald eagle population will concentrate along the smaller tributary streams during the salmon spawning seasons when spent salmon carcasses become the bird's prime food item.

The Columbia River system is also vital as a major waterfowl migration, wintering, and production region. Flooding and degradation of island, wetland, and other riverine habitats through impoundment, clearing, water level manipulation, and other water development activities are serious concerns for the management of waterfowl such as the Canada goose.

There are both positive benefits and negative impacts to waterfowl regarding the various uses of Columbia River water. For example, irrigation of crops that serve as a food source benefit wintering waterfowl such as the mallard and the Canada goose. However, nesting and brood habitat have decreased with the building of dams. There are fewer nesting islands, and water fluctuations may impact both fish and waterfowl. In general, we can say that there are probably more waterfowl in the Columbia Basin now than were present 100 years ago. We are now averaging a carrying capacity of 750,000 wintering waterfowl, and could increase that figure to one million.

Although the agricultural use of water and the development of "seep lakes" have been advantageous for waterfowl, raptor populations and colonial nesting bird populations (herons, gulls) are reduced. Agricultural lands no longer support a lot of rodents for the raptors, and there is less nesting habitat for the colonial birds. Dam and reservoir construction can result in an immediate loss of bald eagle habitat or a long-term loss due to the impacts of power transmission lines. Commercial and residential development to accommodate an increasing human population within the basin has various impacts on fish and wildlife.

Although migrating birds, endangered species, and other populations of fish and wildlife rate high on the Fish and Wildlife Service's list of priorities and objectives, all seem to pale when we consider the importance of anadromous fish to the region. The important anadromous stocks in the Columbia River Basin include chum, sockeye, coho, and spring, summer and fall chinook salmon, and steelhead trout. Less than one-half of the original habitat of the basin remains accessible to migratory salmonids, and much of this remaining habitat has been largely converted into a series of reservoirs by construction of hydroelectric dams. As a result, the annual commercial and recreational harvest of many of the salmonid stocks has been reduced to a small fraction of former levels. But despite man's efforts in drastically modifying

the habitat in the river, the potential still exists for Columbia River water to sustain very productive populations of salmon and steelhead.

In its 1981 Framework Plan, the Columbia River Fisheries Council estimated that the economic value to ocean and in-river fisheries would be approximately $250-300 million annually if all runs were restored to their potential productive levels (about 6.5 million adult salmon and steelhead produced annually). However, the value of restoring depressed stocks of salmon and steelhead cannot be measured in dollars alone. Salmon and steelhead are an essential element of the quality of life in the Pacific Northwest for all people, including Indians and non-Indians, whether actively participating or not participating at all in the fishery.

Managing the Water Use for Fish and Wildlife

The most serious impediment to achieving the productive potential of the salmon and steelhead stocks in the Columbia River Basin has been the development and operation of the hydroelectric system. Dam-related mortalities have severely reduced the ability of natural stocks to return in sufficient numbers to adequately seed the available habitat. The result is that in many areas of the Columbia River Basin, habitat ideal for salmon and steelhead production is not being utilized. Of course there are many areas where habitat and its production potential are limited by serious problems such as irrigation withdrawals, logging activities, road building, etc. We must continue to aggressively pursue the correction of these problems to maintain and improve the existing habitat base.

Without safe passage, the unique and varied natural populations that depend on the habitat base will continue to decline. The overriding question is: "What can we, as managers and competing users of the salmon and steelhead resources, do to reverse these trends?"

In the past, the managers of the river's resources have worked with the power system operators and regulators to seek solutions to the passage problems. Adult and juvenile fish collection and bypass systems at the dams have been improved through research and engineering. Screened turbine intakes and bypass systems have been shown to be effective in safely directing many of the downstream migrants around the dams and have been installed at some of the dams. Sequential generation to guide concentrations of out-migrants to the safety of the spillway and over the dam rather than through the turbines has been used with some success at some dams where there are no bypass facilities.

Because facilities for safe passage have not been provided at all of the mainstem dams, other means of safely moving the fish downstream have been pursued, including the use of spill and transportation via

barge or tank truck. Juvenile fish collection and transport facilities have been installed at McNary Dam on the Columbia River and Lower Granite and Little Goose dams on the Snake River. Over 8 million juvenile salmon and steelhead were collected and transported in 1984. Transportation has been particularly effective in improving the survival of steelhead but has not been an effective means of safely moving juvenile spring chinook downstream. In addition, the collection facilities do not intercept a large number of fish that must migrate past dams downstream that do not have effective bypass facilities. At these dams, spill must be provided to move the juvenile fish downstream safely.

Adequate instream flows are also essential to move the juvenile migrants downstream in a timely fashion to ensure their survival. At lower flows, it takes the fish much longer to migrate the length of the river. This exposes them to increased predation and disease and can interfere with their successful transition from fresh water to salt water. In the severe drought year of 1977, the use of special flow releases from upstream storage impoundments was essential to avert catastrophic losses of migrating salmon and steelhead.

We have made substantial progress in developing the technology and the skills for safely passing adult and juvenile salmon and steelhead up and down the Columbia River. But not only does power production affect the production of fish, safe passage and fish production affect the production of power. Past management of the Columbia River has focused primarily on maximizing the production of power. The technology and skills that have been developed for fish protection need to be more fully utilized to achieve more equitable treatment for fish and wildlife.

In the past, legislative mandates such as the Fish and Wildlife Coordination Act, gave much of the latitude to the federal water managers to decide what remedial measures were best for the fish. Compensation for salmon and steelhead losses was delayed for several years and in some cases for decades. For example, production to compensate for the four lower Snake River dams, which were constructed from 1961 to 1975, did not begin until only recently. Most of the production facilities are nearing completion, but full production levels may not be achieved for some time to come.

In passing the Pacific Northwest Electric Power Planning and Conservation Act of 1980 (Power Act), it was Congress's intent to require that fish and wildlife receive more equitable treatment with power production. The Power Act requires a balance between a program to protect, mitigate, and enhance fish and wildlife with a power plan designed to provide an adequate, efficient, economical, and reliable power supply. We view the passage of the Power Act as the dawn of a

new era of management of fish and wildlife and power production in the Columbia River Basin. Future decisions affecting fish and wildlife and power production must be planned jointly and simultaneously in order to maximize the benefits from both. We, and the other fish and wildlife agencies and Indian tribes, are essential partners with the power managers in this effort. This new era of interdependence among traditional adversaries over water use is exemplified by the fact that much of the storage needed to meet future hydropower and irrigation needs will not be economically feasible without instream flow enhancement for salmon and steelhead.

With respect to safe passage for salmon and steelhead, one of the most important components of the Fish and Wildlife Program developed under the Power Act is the Water Budget. The Water Budget is a volume of water set aside for the fish and wildlife agencies and tribes to use to shape flows during the downstream migration period of April 15 to June 15. The Water Budget is added to firm power flows when needed to maintain optimum instream flow for migration. In conjunction with spill and bypass systems, which are designed to move fish safely around the dams, the Water Budget is designed to reduce travel time and improve survival.

The Power Planning Council and its Fish and Wildlife Program have also helped to focus attention and speed up the resolution of other passage problems in the Columbia River, including the installation of effective bypass systems where none exist now and the development of bypass plans. The Program is also designed to determine the extent of unmitigated and uncompensated losses of salmon and steelhead due to hydroelectric development and operation. This effort should help correct some of the deficiencies and delays associated with past mitigation and compensation efforts.

Problem Areas for Fish and Wildlife

Breaking away from the traditional management of the Columbia River primarily for power to an era in which more equitable treatment of fish and wildlife is required has created a number of problems:

1. *Policies for managing water for fish and wildlife protection, power production, flood control, and other uses are not well defined and have not been meshed in a manner to assure equitable treatment for fish and wildlife.*

For example, the generation of secondary or nonfirm energy often conflicts with the need for spill at dams that do not have adequate bypass facilities. The fish and wildlife agencies and tribes have developed spill policies for fish protection but had a difficult time in 1984 sorting out conflicting policies of the power system managers regarding secon-

dary energy generation. Power generation, flood control, navigation, and other water uses and fish and wildlife all vie for the same water in a balancing process that currently has no set of clear ground rules. Clear and consistent policies will help everyone effectively mesh our needs and develop innovative means to achieve equitable treatment for fish and wildlife.

2. *The roles of the power system operators and regulators, the Northwest Power Planning Council, and the fish and wildlife agencies and tribes in meshing the water needs of all water users need to be better defined.*

The recent hearings over the Federal Energy Regulatory Commission's (FERC) role in hydroelectric development in the Columbia River are a good example of the kind of metamorphosis of agency roles and responsibilities that must occur to mesh yesterday's management and regulatory structures with today's problems. This is not a problem unique to FERC—all involved management and regulatory entities need to strive to better, collectively, their respective roles.

3. *Open lines of communication need to be maintained and improved at all levels of management to make sure that we are all addressing the underlying causes rather than the symptoms of our most pressing problems.*

It goes without saying that when you are in a major transition period such as we are experiencing now, innovative approaches to communication need to be used to ensure that lack of communication or misunderstandings do not hinder progress toward problem resolution. The most recent meeting of representatives of the Corps of Engineers, Bonneville Power Administration, and the directors of the fish and wildlife agencies and Columbia River Inter-Tribal Fish Commission, in seclusion at Silver Falls State Park, is an example of the kind of direct communication essential for effective problem resolution. The meeting was the first step in defining policy questions that affect balancing fish protection with power production and should help focus attention on the major policy problems rather than the symptoms of those problems.

The resolution of these problems will go a long way to assure that a balance is achieved between protection, mitigation, and enhancement of fish and wildlife and the development of an adequate, efficient, economical, and reliable power supply. We recognize that definition of some of the legal boundaries within which the Power Planning Council, power system managers and regulators, and fish and wildlife agencies and tribes must operate may remain unclear for some time to come. But this should be an incentive, rather than an obstacle, in moving forward as rapidly as possible to define our partnership roles and responsibilities with respect to implementing water use policies and priorities.

Maintaining Water Quality

Robert Burd
Director of Water Programs
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My intent is to address the water quality aspect of "Who Wants the Water" and the importance of water quality for all users of the Columbia. Obviously, you can give fish all the water available in the Pacific Northwest, but if the quality isn't high enough for those fish, they aren't going to survive. So water quality is something we should think about. I think the answer to the question "Who Wants the Water" is found by taking a look at the various water quality standards in Washington, Oregon, Idaho, and all the other states in the Union. Comprehensive water quality standards were adopted in the mid-1960s by federal law and were to be reviewed and updated every three years. These standards were adopted after much public participation and, theoretically, represented all the users that we've been hearing about this morning.

Now for some background on water quality standards. The Columbia River, from its mouth up to Grand Coulee, is classified as Class A. That is a high classification, including all the major uses of the river. Water supply goes for domestic use, industrial irrigation, public water supply purposes, fish migration, spawning, rearing, shellfish growing, wildlife habitat, recreation, commercial navigation, and waste water assimilation. Now from the Grand Coulee to the Canadian border, the river is classified as Class AA and the uses associated in the water quality planning in Class AA are the same as those in Class A. All the uses are, by the way, consistent with the Northwest Power Council's charge. The difference between the Class AA and Class A classification concerns the criteria adopted to support those uses.

All the water quality standards include scientific parameters, such as dissolved oxygen and temperature. These things are very important to fish life. The standards for the Columbia River are among the highest in the nation, and the difference between Class AA and Class A deals with how

much dissolved oxygen there is in the river: for Class A, it is 8 mg per liter, and for Class AA, 9.5 mg per liter. All the standards are set at a high level for oxygen, temperature, and nitrogen supersaturation. All the standards speak to the fact that toxics and radioactive substances must not interfere with the uses we've been hearing about.

Water quality standards also very importantly include something that we identify as anti-degradation policy, which is something that goes back historically. The League of Women Voters back in the 1950s requested Stewart Udall to incorporate these into water quality standards and they have been incorporated ever since then by all fifty states. This anti-degradation policy has been important in the West because we have those streams that this policy refers to—that is, those with a water quality higher than the standards that are set. For example, there are a lot of streams in the Northwest where the dissolved oxygen is higher than 8 mg per liter and also where it is higher than 9.5 mg per liter. Anti-degradation policy says that you must maintain the level that is above the standards at all times unless there is some overwhelming economic or social reason to lower it down to the existing standard. In my fourteen years of experience in the Northwest, we have gone through that process only once, and that was in Idaho when we wanted to rebuild the American Falls Dam. Here a request was made to lower the dissolved oxygen standard to some extent. We didn't put the state of Idaho through the process of justifying lowering the standard on a social and economic basis, but they did it anyway. That is an example of an anti-degradation policy, and I think it's important, particularly here in the West.

It seems obvious, from all the uses that are in the standards, that everyone wants the river, and there seem to be many more uses than when Lewis and Clark were here in 1804 and 1805. With multiple uses of the river, there is bound to be some competition here locally. That doesn't even include the lust in the hearts of the Southern Californians who might want to irrigate their avocado groves; but then again, I guess those Southern Californians are getting tired of their warm sunny weather and are moving to the Northwest. But for the sake of history, I'd like to review some of the conflicting uses that I personally have been involved with on the mainstem Columbia River, from the water quality point of view.

One controversy was the waste water discharge from the pulp mills on the Columbia River. Because of these discharges, a kind of filamentous growth was clogging fishing nets and was also causing some increase in the bacterial level beyond the water quality standards. That controversy was resolved when secondary waste treatment, a biological form of waste treatment, was installed at all the pulp mills. You can get a good view of the waste water treatment process at Camas at the Crown Zellerbach plant.

Another controversy I had to deal with was temperature standards. This issue involved getting compatibility in the standards between Oregon and Washington and also getting standards adopted that did protect fish life. This issue was settled satisfactorily and resulted in the cooling towers we see at power plants, such as the one at the Trojan nuclear plant, designed to keep the temperature discharge within a satisfactory limit.

Another controversy that consumed a lot of time at the EPA and other agencies was the nitrogen supersaturation problem in the river. There is a specific standard in Washington and Oregon water policy standards dealing with nitrogen supersaturation. This issue was at least partially solved by flip lids installed on the spillways of dams. The problem still exists to some extent, but it is not as extensive as it was back in the 1970s.

Still another controversy with which I was involved was that of the potential construction of a new dam at the Hanford Reach of the Columbia River, which is evidently the last free-flowing reach of the mainstem Columbia. I think that this proposal is probably dead, although perhaps not completely.

And, finally, there was a problem involving the Portland Airport, where there was a proposal to extend the runway out into the Columbia River. This would have involved a large amount of fill, which would have affected the river current and possibly some of the fish life. This was solved by not expanding out into the river.

These are some of the examples dealing with water quality that the EPA has been concerned with. Our authority to "participate" in those controversies is provided through the Clean Water Act, which allows the EPA and the states to issue permits for waste water discharges to make sure that national water quality standards are met. These permits reference those standards, and we back up into the pipe from those standards to ensure that the standards are met. There are also other permit programs, such as the 404 dredge and fill program. The Corps of Engineers issues those permits, using guidelines set by the EPA. As I mentioned, the state adopts water quality standards that EPA has to approve, and those standards are based on guidelines and regulations from EPA.

And finally, we are very much involved with the environmental impact statement process of the National Environmental Policy Act (NEPA). We review a great many proposals at EPA and run them through the EIS process. These are the laws and regulations that get us involved in all the issues on the mainstem of the Columbia, as well as on the tributaries.

I'd like to emphasize that the regulations currently used by EPA stress protection of all the existing historic uses of the Columbia River and its tributaries. There was a move a few years ago to have EPA liberalize the regulations or make them more flexible. That very much alarmed Congress, and Congress was preparing to adopt specific legislation that said, "No way can any past existing use of these waters be denied or changed." We, in effect, convinced Congress not to pass that legislation by saying that we would put out regulations that, in effect, said the same thing. So the policy worked out with Congress is that existing uses of the river must be protected and we won't allow downgrading of those uses.

Congress is also very much interested in the anti-degradation policy and we affirm the importance of the anti-degradation policy. Therefore, from the EPA perspective, we want the river managed to protect all those uses. It seems that fisheries uses are the ones in which we get most involved and over which there is the most controversy. We are interested in decisions that affect the river, and we'd like to see water quality standards as the basis of decision-making.

Now I believe that we have high standards on the river, and many things have been done to protect its uses. I don't think that we are completely out of the woods yet because there will be other issues that will arise associated with the water quality/water quantity equation. I'd like to emphasize again that quantity is not an EPA mandate, so we'll pass over that and talk about water quality.

Two issues we still face that I want to mention are the control of nonpoint sources of pollution and toxic wastes. Every day you probably read about the toxic chemical of the month. In the past ten years throughout the country, cities and industries have spent $50 billion putting in waste treatment facilities for waste that comes through a pipe, but we believe that in the Northwest 60 percent of the pollution that comes into the rivers is from nonpoint sources of pollution, primarily from agricultural sources, but also to a great extent, from silviculture and from mining and urban runoff. This type of pollution affects the tributaries more than the mainstem, but much of it goes from the tributaries and ends up in the mainstem. We think it's important to establish controls on those sources, controls that we call best management practices. Russ Smith and I had some discussions about this back in the early 1970s in relation to irrigation and return flow. As a good example of power politics, EPA at one time was thinking that we ought to regulate irrigators and ask them to apply for permits. Political scientists would be amazed at how quickly Congress, after hearing from many irrigators, passed a law, taking EPA out of the business of regulating irrigators through the permit process. But there has been a lot of

progress. Best management practices such as trickle irrigation, rather than rigid furrow irrigation, and that kind of thing have helped to protect water quality. But we need to do more.

We also need to be concerned about toxic chemical wastes. For years we, in the water quality business, have been looking at what we call the water column, the water that may be a few feet below the surface. We measured dissolved oxygen and water temperatures, thinking that all that was important to protect fish life. We found out, in many places, and most recently in Puget Sound, that all those toxic chemicals in the water are settling down onto the bottom and into the sediment. The fish are feeding on the bottom. All of a sudden, we're getting diseased fish and other sorts of problems, so that's a problem we didn't pay enough attention to in the past. We are definitely going to pay attention to it in the future, however.

To summarize, we have demonstrated in many ways that we can solve water quality problems so that all the uses we're talking about will be protected, but there still needs to be vigilance and work in the future, particularly on these nonpoint sources of pollution and toxic chemicals. Solutions will require the full participation of industry, farmers, and state and local governments. EPA has a critical role to play in providing technical assistance and other support, but many control measures must be decided at the local level. By paying more attention to these problems and to the congressional goal of maintaining all of our waters in a fishable, swimmable condition, we will be able to maintain the water quality found in the Pacific Northwest. This will require all of us to work together on behalf of the environment.

The Perspective of a Citizen's Group

R. Kahler Martinson
Columbia River Citizens Compact

During the winter of 1979, some one hundred people met at the Menucha Conference Center in the Columbia Gorge to discuss the Columbia River, its resources, and its future. This group recognized that demands upon the river are increasing. Peaking power seemed an ever-present threat to migrating fish and to wildlife. Ownership rights to the water were hotly debated among federal, state, private, and tribal entities. The Northwest Power Act would help protect the basin's fisheries but only as a trade-off to power development. The interest of this group to preserve the future of the Columbia Basin's natural resources evolved into a formal organization, the Columbia River Citizen's Compact (CRCC). The CRCC is a broad-based environmental group with membership presently from Idaho, Oregon, and Washington. The interests and expertise of the membership include both fish and wildlife as well as energy, land, and water management as they affect fish, wildlife, and the environment in the Northwest. The CRCC has been involved in instream flows, wilderness, gorge preservation, and in the development of the Northwest Power Planning Council's (NPPC) Fish and Wildlife Program.

Members of CRCC value the natural life that the Columbia and its tributaries and watershed sustain. They recognize the worth of the fish and wildlife, the riparian habitats, and the river itself. The membership includes hunters and fishermen, both sport and commercial, who pursue their sport or livelihood in, on, and alongside the Columbia. Others are wildlife watchers. Some merely appreciate the fact that fish and wildlife are there. Some are backpackers, hikers who appreciate the diversity offered by a river traveling from sagebrush through mountains and forests to the ocean. Perhaps all enjoy the special physical features of the Columbia: the broad estuary and lower Columbia islands, the spectacular Gorge, the free-flowing Hanford Reach.

Members of CRCC recognized the man-caused alterations to the Columbia that depleted the runs of salmon and destroyed important wildlife habitats when they joined to help sustain and restore these resources. Toward this end, the CRCC adopted the following principles with which to measure the present operation and every proposed project that may affect the Columbia River, its tributaries, and watersheds:

1. Fish and wildlife shall be entitled to equal rights with power, transportation, municipal and industrial uses, and agriculture in the consideration of any proposed project in the Columbia River system.

2. No government agency or publicly licensed entity shall operate or manage the Columbia River system in any manner which would discriminate against protection of fish and wildlife habitat in favor of power, transportation, municipal and industrial uses, or agriculture.

3. Legal protection shall be provided for optimum flows, as distinguished from minimum flows, for fish and wildlife on every occasion when a public water right is to be established or recognized.

4. Legal and political support shall be given to protect aboriginal and public water rights for instream flows.

5. For both the present operation and any proposed project, public agencies must recognize that the Columbia River system is for the benefit of the entire Pacific Northwest rather than any private interest or local area.

6. Every government agency or publicly licensed entity seeking approval of any dam or water-related project shall provide funding for independent expert analysis and investigation of the project and shall guarantee full public hearings in the affected area and also in Portland, Seattle, Boise, and Missoula.

7. In every project the ultimate total direct and indirect costs shall be identified and the real beneficiaries shall be disclosed. There shall be an end to public subsidies to destroy fish and wildlife resources.

8. No proposed project shall be approved unless it makes good ecological and good economic sense.

9. Government agencies and publicly licensed entities shall be required to pay up their long past due debts for full compensation and enhancement owing for destruction of fish and wildlife.

10. New projects shall not be started until full funding has been provided for compensation for destruction of fish and wildlife habitat.

In addition, these citizens advocate flow regimes in the river to optimize production of salmon and steelhead and to avoid short-term fluctuations that may destroy riparian habitats valuable for wildlife.

Concerns at the present time are for obtaining unpaid compensation for past fish and wildlife losses and lack of equitable treatment of fish and wildlife in the management of the river. Although the Northwest Power Planning and Conservation Act and the NPPC's Fish and Wildlife Program should resolve compensation and equity issues, much of the solution lies in the response of the Corps of Engineers, the Washington PUD's, and Idaho Power Company through the Federal Energy Regulatory Commission and the Bureau of Reclamation. Unless these entities are able and willing to pay past debts and to change current operations, compensation and equitable treatment for fish and wildlife on the Columbia will not be achieved.

A current and future threat to the fishery resources of the Columbia can be the sale of power out of the Northwest. Additional agreements to provide power may constrain the management of river flows for fisheries and/or create fluctuations inimical to fish and wildlife needs. If power is contracted to the extent that spilling of water over dams is precluded, salmon and steelhead production will be reduced. (At some dams, young fish must either go over spillways or pass through turbines on their migration downstream to the sea. At others, the facilities that guide them safely past the turbines are not completely effective. Therefore, some water must be passed over the spillway to carry young fish over the dam to avoid the hazardous passage through the turbines.) Fish and wildlife needs must take priority over new sales of power and thus must be considered and satisfied before commitments for power are made.

In summary, citizens from the Northwest from a variety of interests and background view the Columbia River as an important part of their life. They enjoy its fish, wildlife, and natural features. And they are willing to actively help maintain and restore its natural resources. They see the operations of the federal agencies that manage the projects and regulate the river as the key to the restoration of the Columbia and its resources. If these agencies give fish and wildlife equitable treatment with power and other uses, there is hope.

Resource Allocation and Electric Energy Production

Merrill Schultz
Director
Intercompany Pool

When I agreed to make a presentation at this conference, I was asked to speak on behalf of the "Power Interest" in the Columbia River, as if that interest could be served to the exclusion of all others. The basic questions to be addressed were identified as:

1. What is the importance of the Columbia River for your use and perspective?

2. How could the river best be managed (optimized) for your particular use?

This paper, therefore, is not intended to present a position of balance; it is supposed instead to state the unalloyed preferences of the "Power Interest."

First, it is revealing to identify the so-called "Power Interest." That phrase conjures up an image of arrogant managers, sleek investors, and complacent bureaucrats; if there are such people, their welfare is largely unaffected by the extent to which the river is operated for electrical energy. The individuals who have a real interest in the optimization of river operation for power production are the consumers of electric energy. Whether hydroelectric facilities were developed by investor-owned utilities, publicly owned utilities or by the federal government, it is their customers who comprise the real Power Interest. And since almost all of us are ratepayers, *we* are the Power Interest.

Therefore, I will not address the assigned questions in terms of the desires of a sinister-sounding Power Interest, but rather on the basis of what is required to minimize all of our monthly electric bills.

Importance of the Columbia River

The overwhelming importance of hydroelectric energy, most of

which is produced by the Columbia River and its tributaries, to the economy of this region has been demonstrated by many distinguished observers, and I do not propose, once again. to document that fact. Despite the rate increases of the last decade, electric energy is still being retailed in the Northwest at a price less than half the national average, and it provides one of the few economic pluses for commercial and industrial undertakings to locate in this region.

Hydroelectric energy will make up more than 80 percent of the total production of electric energy in the Northwest in this operating year, even under recurrence of the lowest streamflows in history. All new electric energy resources, including conservation in significant quantities, have unit costs many times larger than the unit costs of hydroelectric facilities already in our regional rate base; any loss of existing hydroelectric capability will eventually have to be replaced, and with a cost impact far out of proportion to the energy impact.

Optimizing the River for Power

To minimize power bills through optimization of Columbia River management for power production, three things are necessary, and the first two are obvious:

1. Mazimize the amount of water in the river

Water extracted from the river for consumptive uses cannot be used to produce electric energy. Thus, consumption of Columbia River water for manufacturing, irrigation, or domestic use obviously raises regional power bills. In some cases, there is a double effect; water pumped from Grand Coulee Reservoir (FDR Lake) into Banks Lake for irrigation is not only removed from power production, but it also requires a significant amount of the remaining capability to be dedicated to its pumping.

2. Minimize the amount of turbine bypass (spill)

Water left in the river but required to bypass the turbines at the various projects also does not produce energy. For maximum electric power bill reduction, such energy losses as represented by lockage, leakage, fish ladder flow, releases of fish attraction water and direct requirements for spillway discharge must obviously be minimized.

3. Regulate flow to match electric load requirements

Equally important as the first two needs, but much less generally understood, is the requirement that river flows be regulated in time to meet the fluctuating needs of electric energy consumption. In other regions, where electric load is met largely with thermal generation, the small amounts of hydro generation are almost incidental; utilities in those areas can use streamflows whenever they occur, chiefly to displace more expensive forms of generation. In the Northwest, the most

efficient operation is to flat-load our nuclear and coal generation and to depend on hydro power to carry the load swings. If the river could be fully developed and operated for power, the hydrograph would be transformed to look exactly like the regional load profile. This regulation is accomplished by alternately storing and releasing water in and from reservoirs and smaller impoundments, so that the elevations of the ponds and reservoirs fluctuate widely, as well as the flows themselves. This kind of "shaping" occurs simultaneously over several time intervals:

Annual shaping. To maximize the ability of the river to meet firm load requirements, we must balance capability from year to year. We depend on our major reservoirs, like storage batteries, to tide us over particularly bad hydro years in the expectation that two or more extremely bad years will not occur in sequence. This means that, in a low water year, there will be no spring freshet and reservoirs will not be full for recreation and other uses during the summer.

Seasonal shaping. Because of the applications of electric energy in the Northwest, customers use much more electric power in the winter than in the summer. Natural Columbia River flows are much higher in summer than in winter. We need essentially to reverse the seasonal pattern of flows, again using major reservoirs, to get the most load-carrying capability out of the river. The Water Budget, established by the Northwest Power Planning Council, has agreed to reduce regional electric load-carrying capability by 350-550 average megawatts, an amount equal to the energy output of a large coal-fired plant. Yet the Water Budget does not materially reduce the total annual hydroelectric capability; it merely forces more of that generation to occur in the spring, when it isn't needed, and therefore less to be available in the winter, when it would be usable.

Daily shaping. Because people use much more electric energy on weekdays than they do on weekends, reservoirs and ponds are put through a weekly cycle. Storage is drafted for flow augmentation during the week, and flows are cut back to very low levels on Saturday and Sunday.

Hourly shaping. People use a lot more power when they are awake than when they are asleep. Off-peak, we would frequently like to reduce flows to a level as close to zero as possible at all projects and to increase the flows substantially through the peak hours. The daily and hourly cycles have significant impacts on navigation and recreation.

Thus, although the effects of the first two imperatives—maximize the amount of water left in the river and minimize turbine bypass—are obvious to everyone, the significance of the third factor is less widely appreciated. But it is equally important.

It is an old saw in the industry that electricity is one product that cannot be stored; it must be produced at the precise instant when it is demanded by the customer. However, even if we cannot store electricity directly, we can store (and release) water so that the total hydroelectric energy production most efficiently matches the demand.

Of the three things desired by the "Power Interest," this one perhaps represents the greatest tampering with the natural order and causes the greatest conflict with other uses of the river. Because we are all constituents of the Power Interest, we should all at least be keenly aware of the cost of measures that either limit increased river flow regulation for power or restore the river to more nearly natural conditions.

Demands, Desires, Determination and Enforcement of Water Permits and Rights

Russell D. Smith
Secretary-Manager
South Columbia Basin Irrigation District

All living things within the Columbia River drainage basin have some demands on the water resources of the Columbia River, including Mother Nature, who has the most capricious and devasting demand of all. The hydrologic cycle and weather patterns alone control the amount and type of water deposited in the basin.

The existing geology of the area gives evidence of the catastrophic management of the water resources of the area in the past. Such evidence includes the rise of mountains, the remnants of lakes, the several great gaps, the great coulees, and the Columbia Gorge. Gone are the mastodon and bison that excavations have revealed once existed in the area. Currently there are concerns that the anadromous salmon are on the decline while the shad is on the increase.

Historically man, in his miniscule competency, has endeavored to manage the water resources by exercising prayer and sacrifice to the deity, by dance and ceremony, by rain machine, and currently by seeding the clouds with chemicals. There is little evidence of man's success unless you associate Noah with the great flood he rode out in his ark.

The only success man can claim in regard to management of the water resources has been his construction, operation, and maintenance of several small dams on the Columbia River and its tributaries, including Bonneville, Grand Coulee, Hells Canyon, and Jackson. I use the term "small" because of the potentials existing at each site and the comparison they make to the natural dams created by the Gros Ventre Slide, the Hebgin Slide, the Fernie Creek Slide, and the Mount St. Helens Eruption. Each of these natural dams took only a few minutes to create. Utilizing these small dams, man has been able to conserve the high spring and flood run-offs for later uses to improve flood control, improve navigation, provide dependable supplies of water for the pro-

duction of food and fiber, and to generate electricity to make the work of man and woman much lighter.

In earlier days, there were contests and conflicts between animals for the use of water, then between animals and man, and now between men. In the history of the western United States, we have written water codes of laws intended to manage the rights to use water among the competing interests. In Europe and the Eastern United States where rainfall is plentiful and the resultant streams are conveniently located, the old riparian laws were adequate. In the arid and semi-arid areas of the West, the streams were not dependable and were very poorly located; hence the need to appropriate water from one stream and divert it to another drainage area. As a result, there was the development of laws for appropriation. In Washington State, there is some disagreement among legal counsel as to the existence of riparian laws in our code and the need therefor. To me, an old water mechanic, some riparian laws do exist and there is a need for riparian law in our water code.

Our state Water Code Act of 1917, Chapter 90.03.011 R.C.W., provided that "The power of the state to regulate and control the water within the state shall be exercised as hereinafter in this chapter provided." I am in agreement that each state should regulate and control the waters within its boundaries. Our Water Resources Act of 1971, Chapter 90.54.020(1), provides that "Uses of water for domestic, stock watering, industrial, commercial, agricultural, irrigation, hydroelectric power production, mining, fish and wildlife maintenance and enhancement, recreational, and thermal power production purposes, and preservation of environmental and aesthetic values, and all other uses compatible with the enjoyment of the public waters of the state, are declared to be beneficial." Personally, until the price of fish (red salmon $5.15/lb. and shrimp $8.18/lb., Pasco, October 1, 1984) becomes more competitive with beef, pork, and poultry, I see little need to enhance the production of fish.

My interest includes all of these uses listed by the state as beneficial; however, my interests are directed primarily at conservation for food production, hydroelectric power generation, and navigation. I have been actively involved in the irrigation of land, the reclamation of land for irrigation, and the production of hydroelectric energy for over forty years.

I am told that there exists a surplus of food and electric energy. For this I am very grateful. An abundance of these two, particularly the food, makes a good diet readily available at a very reasonable cost. Food (including drinking water), clothing, and protection from the elements still constitute the basic needs of mankind. These things can best be assured in the arid western United States by the development of reclamation through irrigation.

The economics of irrigation development are very impressive and beneficial to the area, region, and country. Quoting from the U.S. Bureau of Reclamation 1980 Annual Report, I present the following highlights:

Water Deliveries: 30,200,000 acre-feet, which includes 27,500,000 acre-feet to irrigation, 2,000,000 acre-feet for municipal and industrial uses, and 700,000 acre-feet to other uses.

Population Served: Was 22,100,000, 19,000,000 receiving municipal and industrial water with only 3,100,000 receiving irrigation water.

Value of Crops at the Farm Gate: $7.4 billion for an average value of $737 per acre or $2.69 per acre-foot of water delivered for irrigation. Those waters irrigated 10,093,000 acres of cropland and produced 54,500,000 tons of food and fiber—enough to feed 39,000,000 people for a year; provided 66,500,000 man-days of recreation; and produced 46 billion kilowatt hours of electrical energy.

In the Columbia River drainage basin, the United States Bureau of Reclamation's 1980 Annual Report shows that they delivered irrigation water to 2,786,339, acres of cropped land for a crop value of $1,504,959,300 or $540 per irrigated acre.

Over a hundred kinds of crops were grown throughout the reclamation area, including dates, grapes, oranges, asparagus, tomatoes, potatoes, avocados, alfalfa, and wheat. On the Columbia Basin Project in Central Washington in 1980, the United States Bureau of Reclamation provided 1,801,890 acre-feet of water to 514,390 acres of irrigated crop land, which produced $275,009,365 of crops at the farm gate for a value of $535 per acre or $154 per acre-foot of water.

I must point out that the same water flowing through all the turbines and generators below Grand Coulee Dam at that time would have produced 790 kilowatt hours of electrical energy for a value of only $7.50 per acre-foot, which is only 5 percent of the irrigation crops grown with that same acre-foot of water.

Economics, therefore, demand that the water be used for the production of food and fiber.

The population involved in food production using irrigation is only 19 percent of the population in the reclamation states and is even a lesser percentage in the country as a whole. Therefore, as a political force, irrigation food producers are not a dominant group, even if they could be solidified.

What the irrigation food and power producers need is for the general population to acknowledge their contribution to the country and to have the water managers of the West enforce the water code of the West as originally authored.

What we do not need is the current attitudes of the Northwest Power Planning Council and the Bonneville Power Administration.

The irrigation load of the Northwest was only 752 megawatts as compared to 6,130 megawatts by the industrial user, 2,762 megawatts by the commercial user, 5,812 megawatts by the residential user. The summation is 15,456 megawatts of total load, of which the irrigation load is only 4.87 percent.

In its planning, the Northwest Power Planning Council devoted a great deal of time and many pages to that less than 5 percent of the load, and indicated it could and would be reduced by increasing the rates.

Now Bonneville Power Administration, yielding to pressure by the aluminum industry, has elected to decrease its rates to the aluminum processors and increase the rates to other users, including the irrigator.

For the sake of all people who desire good food at low cost, I request that management and allocators of water administer their functions and responsibilities to ensure that we will always have an abundant supply of low cost food, fiber, and electrical energy.

River Use: A Tribal Viewpoint

William F. Yallup
Chairman, Fish and Wildlife Committee
Yakima Indian National Tribal Council

In the context of the allocation of the water resources in the semi-arid Columbia Basin, the question "Who wants the water?" is akin to asking "Who breathes air?" There are a myriad of interlocking and conflicting demands for greater and greater shares of what is, on a year-to-year basis, a finite resource. This writer could exhaust the page limits for this paper listing the entities—federal, tribal, state, local, corporate, and individual—who "want the water." The same can be said for the list of aquatic and terrestrial organisms dependent upon the water for their existence. Unfortunately, members of the former list have for too long imposed their will upon the members of the latter to their substantial detriment. Hopefully, conferences of this type can present a number of creative solutions to the problems created by previous uncoordinated development throughout the basin.

From the perspective of the Yakima Indian Nation, allocation of the water resource must be considered in light of the Yakima Nation's treaty-reserved right to an adequate supply of water to fulfill the purposes of the treaty. Prior to the coming of the white man, the Yakima people exercised dominion over all of Central Washington and depended upon the abundant water to supply their food, medicine, and to a very great extent, their culture. Nature dictated how much water was available, and the dependent organisms adapted accordingly. On June 9, 1855, the Yakima Nation executed its treaty with the United States. The Yakimas ceded to the United States approximately 12 million acres in return for numerous promises by the United States, retaining various rights unto themselves. In that treaty, the Yakima Nation reserved for its use a 1.3 million-acre reservation bordered on the east by the Yakima River and on the west by the Cascade Mountains. Central to the treaty was the retention of the reservation as a homeland for the Yakima people and continued exercise of hunting, fishing, and

gathering rights both on and off reservation. A clear agricultural purpose for the reservation is reflected in Article IV of the treaty:

> . . . sixty thousand dollars to be expended under the direction of the President of the United States the first year after ratification of this Treaty, in providing for their removal to the reservation, *breaking up and fencing farms* . . . (emphasis added)
> Treaty with the Yakimas 12 Stat. 95.

Article III reflects the retention of the fishing, hunting, and gathering rights:

> The exclusive right of taking fish in all the streams, where running through or bordering said reservation, is further secured to said confederated tribes and bands of Indians, as also the right of taking fish at all usual and accustomed places, in common with the citizens of the Territory, and of erecting temporary buildings for curing them; together with the privilege of hunting, gathering roots and berries, and pasturing their horses and cattle upon open and unclaimed land.

The Yakima Treaty, like international treaties, is considered to be part of the supreme law of the land, and as such is generally paramount to other conflicting laws. [United States *v.* Oregon and Washington, 302 F. Supp. 899 (1969); aff'd 529 F.2d 570 (1976); Worcester *v.* Georgia, 31 U.S. 515, 8 L.Ed. 483 (1832)]. With regard to the use of water and its allocation among parties, the courts of this land have consistently held that Indian treaties reserved sufficient waters to fulfill all purposes of the reservation. Where, as in the case of the Yakima Nation, the treaty has several purposes, the treaty reserved sufficient waters to fulfill each of those purposes. [U.S.*v.* Adair, 723 F.2d 1394 (1984)]. Irrigation for farming was a portion of the purpose for the Yakima Reservation, and sufficient waters were reserved for that purpose. [Winters *v.* United States, 207 U.S. 564, 28 S.Ct. 207, 52 L.Ed. 340 (1908); U.S.*v.* Ahtanum Irrigation District, 236 F.2d 321 (9th Cir. 1956) cert. denied 352 U.S. 988 (1957)]. (Ahtanum Creek forms the northern boundary of the Yakima Reservation.) Commensurate with the irrigation reservation was the reservation of the fishery right. Inherent in that right was sufficient water for fishery survival in order that the "right of *taking* fish" was not an empty one. The United States Supreme Court, in Washington *v.* Washington State Commercial Passenger Fishing Vessel Assoc., 443 U.S. 658 (1871), characterized the reservation of the right to *take* fish as follows:

> Because the Indians had always exercised the right to meet their subsistence and commercial needs by taking fish from treaty area waters, they would be unlikely to perceive a "reservation" of that right as

> *merely the chance, shared with millions of other citizens, occasionally to dip their nets into the territorial waters.* Because it was the tribes that were given a right in common with the non-Indian citizens, *it is especially likely that a class right to a share of fish, rather than a personal right to attempt to land fish, was intended.* 443 U.S. at 678-679. (Emphasis added)

Accordingly, the Yakima Nation received a portion of the fish runs that could be harvested at their usual and accustomed places. With that reservation, the Yakima Nation and tribes with treaty provisions similar to Article III of the Yakima Treaty retained the right to have the fishery protected from environmental degradation by any users holding rights junior to the tribal right. Two recent Ninth Circuit Court of Appeals opinion reflect this right. In a case dealing specifically with the Yakima Treaty and protection of spring chinook redds spawned in the upper Yakima River Basin, the court ruled:

> The parties to a treaty bear a duty to refrain from actions interfering with either the Indian's access to fishing grounds or *the amount of fish present there. Id.* The government constructed the irrigation project subject to that duty. *When its operation of the project threatened further to deplete an already low Chinook salmon run, it violated its duties under the Treaty.* (Emphasis added) Kittitas v. Sunnyside Valley Irrigation District, Ninth Cir. Nos. 80-3500 3002, 1-3068, 3069 (Sept. 10, 1982).

The party impacted in *Kittitas* was the federal government acting through the Bureau of Reclamation's Yakima Irrigation Project. Under the decision the Bureau was (and is) required to supply sufficient waters to protect all redds spawned in the Yakima system, even if that protection results in use of waters stored specifically for irrigation purposes. The court based its decision upon the tribe's *fishery* reservation right rather than a strict water right theory, ruling simply that the *fishery* right required releases of water to prevent the *fishery* right from becoming illusory.

In a second recent opinion interpreting the Klamath Treaty, the Ninth Circuit adopted a *water right* theory to protect fish and wildlife rights of Klamath Tribal members:

> We therefore have no difficulty in upholding the district court's finding that at the time the Klamath Reservation was established, the Government and the Tribe intended to reserve a quantity of the water flowing through the reservation not only for the purpose of supporting Klamath agriculture, but also for the purpose of maintaining the Tribe's treaty right to hunt and fish on reservation lands. [U.S. v. Adair, 723 F.2d 1394 at 1410 (1984).] See also Colville Confederated Tribes v. Walton, 647 F.2d 42 (1981)

In discussing the date of priority of the water right implied in the Klamath Treaty, the court ruled that it dated not from the 1864 signing of the treaty but instead:

> *Such water rights necessarily carry a priority date of time immemorial.* The rights were not created by the 1864 Treaty, rather, the treaty confirmed the continued existence of these rights. (Emphasis added) *Adair* at 1414.

As noted, the courts have interpreted the tribal right to water for fishery protection both from a *fishery* right and also from a water right standpoint, and in both cases have ruled in favor of the tribal right. Further, the court in *Adair* ruled that the right dates from "time immemorial," obviously a priority date superior to any other claimant "who wants the water."

Importance of the Columbia River for Our Use and Perspective

"The right to resort to the fishing places in controversy was a part of the larger rights possessed by the Indians . . . which were not much less necessary to the Indians than the atmosphere they breathed." This statement, made by Supreme Justice MCKenna in the case of U.S. v. Winans, 198 U.S. 370, in 1905 rings as true in 1984 as it did then. The Columbia River and its waters play as large a role in the culture of its Indian people today as they did prior to the coming of the white man. While "progress" on the Columbia destroyed much of what once was for the Indian people, "The River" still provides the heart of our culture and a significant portion of our economy.

The Columbia River tribes continue to resort to the Columbia for continuation of our fish-eating way of life. Ceremonial and subsistence fisheries are still paramount, with ceremonies occurring as they have since time immemorial. Numerous tribal members still fish from platforms with hand-held nets for fish for subsistence purposes. Our people still construct drying sheds for their fish as was provided for in the Treaty of 1855.

With unemployment on most reservations standing upwards of 50 percent, the ability to fish commercially is also of paramount importance to the tribes. Because of these factors, protection, mitigation and enhancement of Columbia River Basin fish runs is a first priority of Columbia River tribes. The tribes will continue to use their priority rights to fishery protection and instream flows to seek the end of bringing back Columbia River runs.

How the River Could Be Managed for Our Particular Use

It is the tribal position that the treaty-reserved right to *take* fish in the Columbia carries with it the right to have significant numbers of fish of all species available. In order to accomplish that end, significant changes in river management must be made. First and foremost, present river use planners must revise their thinking and accept that fish and wildlife hold at least equal rights with other competing uses. Hopefully such revisions can be accomplished without the rancor and litigation that have previously been required to accomplish any change. The "handwriting is on the wall" that environmental concerns must have equal consideration with other uses. Witness the previous citations from *Adair* and the *Kittitas Irrigation District* cases. Also it is critical at this point to note the ruling by the Ninth Circuit in the case of Yakima Nation *v.* FERC (Rock Island),—F.2d—1984, wherein the court held that the fish and wildlife provision of the Northwest Power Act 16 U.S.C. 39, *et seq.* are *substantive* in nature, thereby requiring that hydro producers specifically implement the provision of the Act as interpreted by the Northwest Power Planning Council. *Rock Island* also requires compliance with NEPA prior to the relicensing of Rock Island Dam for an additional 50-year period.

Once the fish and wildlife resources are placed upon an equal footing, the river should be managed to optimize all resources within the constraint that the fishery resource must no longer be the primary segment of river use to suffer if there is a water shortage.

The mandate of the Northwest Power Act that there be protection, mitigation, and enhancement of Columbia River runs, coupled with treaty rights, requires that there be an immediate, coordinated effort to change river management. Adequate passage both up and down-stream for all migration periods must be expedited. Instream flows and dam operations designed to minimize impacts on fish must be implemented. Offsite mitigation and enhancement must move forward rapidly and in a manner that complements present planning.

The tribes of the Columbia River sincerely believe that significant portions of these runs can be restored with creative and good faith efforts by all. "Business as usual" cannot continue if results are to be achieved. The fish have borne the brunt of development to date. In order to accomplish what must be done to comply with federal law and the treaties, other users must now agree to share a portion of that burden. How much depends on how well we work together to make it happen.

Pressing Political and Economic Problems Now and in the Future

Obviously the major political problem extant is that current river users see solutions to fishery issues as large economic problems. Therefore, those users are tempted to push for political solutions inimical to fishery interests. Fortunately most of those battles were decided in favor of fish during the intense discussions prior to passage of the Northwest Power Act. Treaty rights and the Act, coupled with the *Rock Island* ruling, hopefully will convince all users that cooperation is the best policy. This is not to say that intense political pressure is not constantly applied on both sides of the issue. Interpretations of treaty rights and the Act are constantly questioned by those who may be adversely impacted. A primary example is the continued insistence by the Federal Energy Regulatory Commission (FERC) that it is somehow above consideration of these issues.

The FERC's position on these issues permeates every aspect of water allocation in the basin. Litigation and continued congressional oversight of FERC activities appear to be the only means of dealing with FERC's position.

Every Columbia River user views allocation or reallocation as a political-economic issue. Any change in the status quo is viewed with suspicion and alarm, often coupled with a call or letter to one's senator or representative. How that can be alleviated calls for one with more wisdom than this writer possesses.

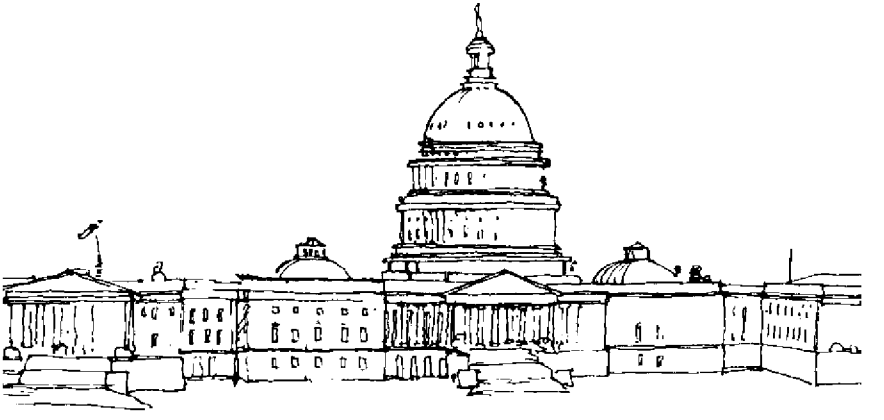
Obviously the continuing power surplus leaves a question much in everyone's mind. Will it end and if so, when? If it continues, will power producers be willing to supply more flow for fish or will they fear that if they pass excess waters now, that they won't get them back in the future? Will Congress continue to allow Northwest power users cheap rates? All of these questions have both political and economic consequences that cannot be forecast, but that assuredly have the potential for confrontation in the future.

As long as there is water in the river and people who compete for its use, there will be problems. How these are dealt with by the various players will decide the fate of the river and its resources. The Columbia River tribes, particularly the Yakimas, pledge to insure that fish and wildlife will receive equal treatment in the future.

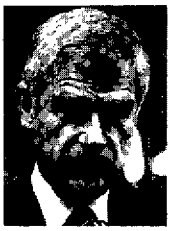
Luncheon Address

A National Water Policy: Our Next Urgent Need

The Honorable Mark Hatfield
United States Senator from Oregon



A National Water Policy: Our Next Urgent Need



The Honorable Mark Hatfield
United States Senator from Oregon

When I looked at the program for today and saw that I was to give an appropriate discussion in relation to politics and economics, as a former political scientist, I realized I was in a no-win situation. The economists don't consider political science a science and we consider economics to be somewhere this side of witchcraft. I have often said that if economists built bridges, they'd all be in jail, so I'm supposed to do the impossible today. Speaking of being in a no-win situation, there's a story I've frequently told of the collegian who would date various and sundry young ladies, but never could quite find one who would please his mother. Every time he brought a date home, his mother found some fault. Well, one day he noticed a young lady striding across campus and what attracted his attention was that she had a stride precisely like his mother's. As he encountered her, lo and behold, she looked just like his mother, and her voice was precisely that of his mother's. While engaging in conversation, she demonstrated that she thought like his mother, so he thought he had a real winner. Well, he took her home to introduce her to the family, and his father didn't like her!

I have decided that the federal government does *not* like orderly programs dealing with life. That may be a cynical view to express, but perhaps it is greatly influenced by the closing days of the 98th Congress. In those days we were attempting to create a base upon which the government could continue to function by appropriating monies through a continuing resolution. We got hung up on an issue called "water projects." Now, the reason I have taken these few moments to express my concern about the federal government's inability to come to grips with the matter of orderly development and orderly management of water is that when the President of the United States—and, in order to keep this bipartisan today—when the speaker of the House referred to water development projects as "pork barrel" and as "budget busters," it demonstrates that

there is no consensus about what the federal role should be in water resource development. The Bonneville Lock became the focal point in part of this debate and part of this political maneuvering. When one recalls that Congress has failed to enact any project authorization on any authorization bill for fourteen years, it also demonstrates the paralysis which has struck our federal government in dealing with these problems. When you consider that it's been eight years since the legislation pertaining to water policy was enacted, it again demonstrates this neglect.

Let me suggest that the whole theme of my remarks today is to advocate as strongly as I can and to urge your consideration of demanding that the federal government adopt a comprehensive national water policy. We faced a crisis in the 1970s, as it related to the energy crisis brought about by the Arab boycott of Middle Eastern oil. Out of that crisis came the recognition that we should have long before established a comprehensive energy policy. As you know, government tends to respond only during times of crisis, unfortunately, rather than to anticipate problems and deal with them in a calm, effective way. But since 1977 when the U.S. established a comprehensive energy policy, as imperfect as it is, we have been able to cut the importation of Arab OPEC oil by 75 percent. We have also seen the opportunity to shift our reliance on oil supply to Mexico, Canada, and Venezuela—the top three foreign suppliers today of U.S. crude. In addition, the strategic petroleum reserve is four times as large as it was three years ago, now containing 430 million barrels of oil, a supply for 90 days of net imports, and it will grow more—part of our comprehensive energy policy.

Now let me move back to the lack of a water policy to illustrate what I consider to be a desperate and important need for that. I think there is a crisis that is not only ominous, but that could go far beyond the impact of the energy crisis of the '70s. Bear in mind that water is the only substance necessary to *all* life. We're dealing with fundamentals here. Many organisms can live without oxygen, but none can live without water. Countries could survive without oil, but not without water. Besides consumption, water is needed for energy production, most industrial operations, transportation, and we could go on with all the other multiple uses and demands for water. Let me also indicate to you again by illustration the degree of our dependency upon this great water resource. Over the past thirty years, the United States has doubled its consumption of water. Today, it is 450 billion gallons of water per day, or as that averages out in all uses, to about 2,000 gallons for every American. Of course 90 percent of the water goes into agricultural and industrial purposes and uses. For example, to produce a hamburger, french fries, and a coke at a McDonalds's hamburger establishment, it takes 1,500 gallons of water; to produce the average car, it takes 100,000 gallons of water, and just to produce the tires for that car, it requires 30 gallons of water. The average American con-

sumes about 90 gallons of water per day, of which only two gallons per day are required for drinking and cooking and that, of course, is the basis of survival.

Now the supply problem also points to the impending water crisis that we have, not only the increased demand and use, but also in what's happening to our supply base. The largest aquifer in the country, the Ogallala, stretches 800 miles from South Dakota to Texas. There are 200 wells in this strip of land, pumping up water in 8 different states. The water table in those states has dropped 10-15 feet. By the year 2020, only one-third of the southern portion of the aquifer will be left if future use follows this trend. Also, don't forget that this particular strip of territory is America's breadbasket and has some of the largest percentages of the world's food production; therefore, depletion of this water resource not only has implications for this country, but for other countries as well.

In terms of further problems of supply, when the federal government completes the Central Arizona Project, which was to be a living memorial for Carl Hayden (former legislator from Arizona), we will find that massive quantities of water will be diverted from the Colorado River to Arizona. Bear in mind what's going to happen when you do that. Southern California will lose one-third of the water it gets from the river. Presently, no replacement for that water is on the drafting board. Let's look at another section of the country. In Florida, seawater intrusion and plummeting water tables have caused sudden creation of sink holes; the experts are telling us now that there are many more to come. We might ask, then, the basic bottom-line question: How will America cope with the dwindling water supplies, the conflicting regional water needs and the skyrocketing water demands of agriculture and industry? The answer: a coordinated comprehensive national water policy. And what should be the goals of such a policy? Well in my view, those goals should be very simple, very straightforward. We should develop a national policy to coordinate the nation's water supply and distribution system. We should also seek ways to augment present water supplies, and we should increase our conservation efforts.

Our water supplies are dictated largely by nature, but we can still manipulate nature through our technology and our genius. Let me illustrate by saying that the western part of the United States has 60 percent of the nation's land mass, but we only get 25 percent of the annual rainfall, and therefore we have to recognize the role of conservation as we talk about the matter of water availability. Remember this, many people have said that it was the six-gun that won the West. I am convinced it was not the six-gun that won the West, but water impounded that won the West and that still presents us with certain unique needs and re-

quirements. It seems to me the West should be again the leader in the conservation movement as it relates to water, in agriculture, in public use, and in industrial use of water. We are not doing that. In the field of agriculture alone, we find that in the eastern part of the United States, 140 billion gallons of water per day are drawn, 88 percent of which is returned. In the western part of the United States, 165 billion gallons of water are drawn per day, but only 48 percent is returned, a much lower percentage. The low return in the West is due largely to outdated irrigation methods. Even though we are making some strides and improvements, we still have basically outdated irrigation methods. National water policy should focus on improved irrigation; improved irrigation systems, it is estimated, could reduce the agricultural water demand by half.

Let us focus our attention on private industry. There are so many changes occurring in private industry today that it's awfully hard to keep track of them. Let me just give you one example. In the sweetener line of sugar, we used to depend a great deal upon sugar cane and sugar beets. I understand now that these agricultural products are fast being replaced by the use of corn as a base for sweetener. In the preparation process, you have to soak the corn for a period of time before you begin the processing; this adds to the demand of water just to produce the sweetener for our table. In Bend, Oregon, there is a research company doing a lot of work with some very fantastic breakthroughs, in the utilization of membranes. In this process they are finding different ways of purifying our water but they are also working on ways to take the water from the corn soaking process, and through the membrane, retrieve what they need in their other industrial processes, then return that water back into the environment. These are just a few of the things that illustrate the conservation and reutilization of water in industry. It is cost-effective.

The general public also has opportunities to conserve water. The flow restrictors on faucets and toilets have been long known and are inexpensive; in fact, they only cost $10.00. In Arizona we have a contrast between Tucson and Phoenix in their water conservation efforts. In Tucson, the consumption of water per capita is 140 gallons per day with restrictors. In Phoenix, without restrictors, it averages 800 gallons per person per day. Now that's a dramatic contrast and I'm not suggesting that they all will follow those lines, but wherever we can conserve, it seems to me, we must apply that conservation knowledge; in fact, it takes more than knowledge, it takes a whole ethic. I could digress here and do a little philosophizing with you for a few moments on what I perceive to be one of the great weaknesses of our culture. Today we have succumbed to the convenience factor: use it and then throw it away. Instead, we should be returning to the conservation ethic, which

is a culture value system and something more than a mechanical technique.

Now let me take up the coal slurry pipeline; we've had a lot of arguments in Congress on this issue. I'm sure one of these days, we're going to see the full realization of some of those dreams of a coal slurry pipeline, taking tons and tons of water. In fact, it is estimated it will take one ton of water to move one ton of coal. We also have another estimate that a 55-billion-ton per year pipeline would require 13 billion gallons of water per year, (now I've moved from tons to gallons, in my measurement of water for this use). In Congress we've debated the rivalry between the railroads and the coal slurry pipeline, but haven't had any real discussion or done an analysis of the role of water, in any comprehensive way. Here we could conceivably be legislating projects that would have a tremendous impact on our water supply without ever having put it into our decision-making.

We also have to look at the matter of water storage; this is primarily a federal role. There are roles for everyone: citizens, local government, state government, and the federal government, as well as the private sector. Dams and reservoirs on the rivers of the West, of course, accomplish this. Precipitation in the West over the past several months should be a reminder of the need for improved storage. Adequate storage of water in areas lacking surplus will prevent pitting one regional interest against another regional interest or within the region, one interest against another, such as the agriculture, industry, navigation, fishing interests within a region, as well as between regions.

Turning to the distribution facilities in this whole comprehensive plan that I think we should have, the role should primarily be a local one. The East has allowed their distribution facilities to become antiquated. In fact, I would suggest to you that the whole nation's infrastructure is becoming antiquated. We ought to look upon it not as an infrastructure for the benefits of our own communities and domestic people, but as benefits for the entire nation. All we need to do is to look at the policies and thinking of President Dwight D. Eisenhower who understood that the nation's infrastructure is an important component of a nation's security. When Dwight Eisenhower announced the interstate highway system, he didn't announce it as a transportation system; he announced it as a national defense program, which it is. These programs that deal with the infrastructure are as fundamentally important to our national security as they are to maintain the life and the culture in our communities. We also have to recognize that water quality is one of those components that is often neglected and then after the fact, we try to clean it up. With this mentality it takes us billions of dollars to do

the job that we could have done with millions, if we'd have been a little more the anticipating-type.

The national policy should focus on the quality of water that the states are now distributing. Recent news which has reported the failures in toxic waste programs is highly disturbing. The EPA (Environmental Protection Agency) spent between 25 and 30 billion dollars to improve water quality, after the fact. Yet only one-third of the 18,000 cities of this country are meeting clean water requirements and scores of Oregon communities have clean water problems. I'm sure that the same would be true in our sister states. So put simply, national water policy should coordinate the nation's need with water availability, water storage and distribution systems. If we are to be responsible stewards within the conservation ethic, then the nation must have a comprehensive water policy.

At the present time, there is no independent group to coordinate federal water resource programs and activities and our water resource research programs are ineffective because of underfunding. Those water programs are not put into the context of a national requirement; they're still looked upon in some instances as "pork barrel." We need a high-level executive agency to conduct water policy. I'm not suggesting we create *another* agency or that we create more federal employees—— that should let the conservatives rest a moment. But I do say that we have to at least set up an interagency program that will bring together the expertise we now have under some kind of an aegis and designate a lead agency that can bring together the U.S. Dept. of Agriculture experts, the Environmental Protection Agency experts, the Corps of Engineers experts, and the Bureau of Reclamation experts to coordinate their efforts. To resolve this would, of course, be a great problem. There's not going to be an easy way, but, my friends, we'd better start and we better anticipate because once we get deeper into this water crisis, and it's inevitable, then we're going to have to exercise far more creativity, spend far more money, and probably be less effective than if we started this now, or as we should have done, about ten years ago.

Let me close with one last thought. What I have said today is not terribly earth-shaking or, for that matter, terribly new. I always have to be reminded from time to time that some of the ideas that seem to float into our minds as political leaders (because it's such an ego-centered profession that I represent), we begin to think germinated and were created out of our own great genius. So we begin to go around prattling, "I had a vision, I had a dream, I had an idea," and we like to take credit for those. Well, to try to keep some degree of humility in this business, I do a lot of reading of history. If you want to realize how there is nothing new under the sun, you go back and read a little history. There's a little

book that was written out of a speech that Mr. Herbert Hoover gave as he was installed as the President of the National Izaac Walton League in 1921, when he was Secretary of Commerce...In this little book called *A Remedy for Disappearing Game Fish*, he incorporated a program for a comprehensive water policy for the United States in which he talked about saving the rivers that are saveable at this moment, and preserving the rivers that are still preservable, and recognizing the fundamental importance and role that water plays in our life in 1921! After he had retired from political life and had become our elder statesman, around the age of 88, he published a second book called *Fishing for Fun - or How to Wash One's Soul*, which William O. Douglas, former Justice of the United States Supreme Court, said was a classic. This book actually is a book of basic philosophy and conservation. As I read those books, I could not help feeling again that when we talk about a comprehensive water policy, we have to put it beyond the technology and the mechanics. We have to set it within a framework of value, a value system, or a philosophy, if you please. We have to move beyond the pragmatics and recognize that it has to have a philosophical base. This philosophical base is, of course, the conservation ethic—the survival of the human race. We are now reaching a point where, unless we begin to deal with those values of the sanctity of life and the importance of preserving life, we are going to find ourselves overwhelmed, and destroyed by our own "progress."

So a national water policy will end the nation's paralysis, in my view on water projects and water planning. This policy will bring the Bonneville Lock project to Oregon and Washington as a result, but also more importantly, it will move this nation closer to a future security in this water management policy and the basis for survival of the human race.

Questions and Answers

Q: Does the Senator believe that we will get a U.S.-Canada salmon intervention treaty this year?

A: The question you ask can be answered only by Senator Ted Stevens of Alaska. We have reached an agreement between Oregon and Washington but we still lack that final agreement that must be reached with Alaska. I believe that with proper orchestration and persuasion, we can get that agreement. Senator Stevens feels that there are some unique fine points that affect Alaska that he wants to nail down. He has assured me that it's not an insurmountable question, but he wants to get some of the details worked out. When that happens, I think we will see the realization of that treaty.

Q: What is the possibility of an omnibus water resource bill?

A: An omnibus water resource bill passed the House by a vote of about 333 to 34. It has a price tag of some $18 billion on it, which scared David Stockman into a second coronary and created the basis for the horrible ending of this Congress and the confrontation between the White House, Mr. O'Neill, and me. After some deliberation, the Committee of the Senate came out with a budget that had a price tag of about $11 billion, spread out over a twenty-year period. In the Senate Appropriations Committee, we came up with a proposal of about $5 billion and twenty-nine projects, nineteen of them to be authorized in the authorization process; the others were already authorized. These also were to be spread out over the next twenty years; again, Mr. Stockman failed to buy off on any one of these proposals.

We then made a proposal that would have included a proviso allowing construction of those projects already authorized, under a cost-sharing plan that would be worked out by Congress. The cost-sharing plan in the Rowe Bill of the House and in the Senate Bill were both unsatisfactory to the Administration. I support the basis and theory of cost-sharing; I'm not an anti-cost-sharer in the waterway and in port development. I do have colleagues who are totally opposed to the whole concept of cost-sharing. But the cost-sharing formula has to be carefully worked out so that it does not, in effect, favor, say, the deep-water port as against an inland port, or the large port against the small port. We have worked out a coalition of senators from the Gulf States, from the Eastern Seaboard, from the Great Lakes, and from the West Coast on a cost-sharing plan that we felt was equitable. We offered to fund 50 percent at the local level of a deep-water port; we offered to propose funding for the inland ports and waterway replacements of 35 percent based on the trust fund, which is still, I think, a most equitable formula.

I frankly believe—and I will be very candid—that Mr. Stockman was trying to find an excuse for the President to veto the whole continuing resolution; I think he felt it would be political suicide to approve it. Because he could not justify a veto on the dollar question because we were $800 million under what the President had asked for in a non-defense discretionary funding program, the White House glommed onto the idea of "Ah ha, pork barrel, water project." This was the mentality Mr. Carter had in January 1977 when he announced his Western "water hit list" that he thought would play well politically.

Mr. Stockman is a very bright man, though he tends to be a little cute at times in some of these political maneuvers. So what I am saying to you is that then we deleted the whole water project, even the ones that Secretary of the Interior, Bill Clark, was up logrolling for because

the Administration asked for eleven of them. My view was that we get a comprehensive and a composite package, or we get nothing. So we didn't get any; we excised. Now in the new session, we'll come back to square one with water project authorization and we'll get a negotiated agreement before we start down that track with the White House on cost-sharing. Then I think we'll be on track. But again, we still have to deal with that superficial understanding of which water projects really constitute pork barrel and which deal with the infrastructure.

Let me add one final point. When the Bonneville Lock was built and started operation in 1938, the first year it had 160 tons of commerce. We are now anticipating that it will require the shipment of 20 million tons of commerce through that lock by the year 2000. Two years ago, the barges had to wait 55 minutes to maneuver the lock; now it's over 2 hours. You can see how that impacts upon the economics of the waterways. If we could get that out of our way, we could become the gateway of the whole Asian market, and God only knows we need to do something to improve our balance of trade. We started 2 years ago with a 42 billion deficit; this year it will jump to a 130 billion deficit. So those are some of the economic implications as well as the political issues in dealing with one of the uses of the Columbia River.

Q: Why can't we budget our water projects as part of our annual budget process, as is done with defense experiments?

A: What you're suggesting is an off-budget item. We have a number of off-budget programs that are not computed into that single-year budget, which gives you a distorted view as to what the budget demand is. It's much like some of our military procurements; we put a hundred million dollar down payment on $4 billion weapons, which do not become due until the second, third, or maybe fifth or sixth year in production; therefore, we get a distorted view in 1985 of what that hundred million really means. In terms of the water projects, you have a down payment that's going to repay itself so that you have an amortization effect upon that whole project. That's an idea I have heard discussed; it's a valid idea and I'd welcome it. I'm not sure that even with that kind of a proposal we could get through a comprehensive water program without some kind of cost-sharing; we still have to go back to that fundamental. But to get the full budgetary impact, that could be a very helpful thing.

Q: How do you think that the Regional Power Act is being implemented?

A: Let me summarize my view. Senator Jackson and I were the basic authors of the bill, along with Senator Frank Church of Idaho. We knew precisely what our intent was and we established what we

thought was a fairly good and complete legislative record to refer to for implementation. I think that the Regional Power Act, being as comprehensive a piece of legislation as it is, may need some fine-tuning. We anticipated that it would need some review and some oversight; I think the time has arrived for that oversight. I have taken advantage of Senator Evans from Washington coming to the Senate. He was certainly one of the major factors in the launching of the Act. Out of those discussions, we hope to set forth a plan for an oversight hearing to clarify some of those matters and perhaps to amend the Act. I'm not suggesting that I'm being critical, although I do think that I could be critical on certain things that have happened in its implementation. I'd rather preserve that base in the relationship than to be publicly critical at this time and see about the possibility of an oversight to work out some of these things. I think it's fundamental; I'm just as enthusiastic today for the regional power concept as I was when we wrote it up. I am less than happy with some of the interpretations.

Q: Could you comment on the dredging of the Columbia River Bar and what its effects will be?

A: The question has to do with the dredging of the Columbia River Bar to the 55-foot channel, which previously had an authorized channel depth of 48 feet. The Corps of Engineers not only came up with a cost-benefit ratio of 11 to 1 on that, but they also did some correlated studies on the impact upon the flow. As you know, the currents of the mouth have been a great puzzlement ever since Captain Robert Gray came along and traversed that bar in 1792. We have even had some special studies on the shoaling around the docks and navigational channel near Astoria that have almost defied engineering solution. These studies indicated that the deepening of the bar would be not only economically sound, but would improve the safety factors in the traversing of the bar, with no long-term impact on currents, shoaling, or other things that happen as a result of manipulating the bar.

With that study in hand, Congress appropriated our money to do this project. We completed the dredging in September 1984. It is too early to evaluate any effects, but we certainly have not had any changes that anybody has noted. There have been three basic bottlenecks on the Columbia for full navigation potential, the Columbia Bar being one that we just took care of. The Burlington Northern Railroad Bridge in Portland is the second, and we just got the appropriations completed on that to replace that bridge, which is a hazard to navigation. Bonneville Lock is the third and final impediment. Once we replace the Bonneville Lock, we will have the Columbia River up to its full waterway potential, fully utilizing the 145 miles of water from Lewiston, Idaho, to the Pacific Ocean for slackwater navigation.

PANEL III.
How the River is Run

Moderator:
Michael S. Spranger

How the River is Run

Michael S. Spranger

We have learned about the historical development of the river and how the river is used. Now we shall turn our attention to some technical issues on how the river is run.

We don't often think about the importance of a coordinated, integrated river system managed for multiple purposes, but management of the system is an hour-by-hour, day-by-day, year-by-year process. It is a complex process that is not very well understood by most of us.

As with uses of the river, we have also found technical constraints and concerns in managing the system. There have been discussions and debates in the region over such technical issues as implementation of the water budget, new spill policies, downstream shaping of flows, and the need for, and adequacy of, bypass facilities.

In order to manage the river for multiple purposes and uses, it is extremely important that we learn more about the technical issues and constraints that are imposed upon the Columbia River system. To discuss some of these technical issues and concerns, we've assembled individuals who work on these issues on a daily basis. All have technical background and a vast amount of experience in managing and operating the river system.

Water Management Activities of the Corps of Engineers

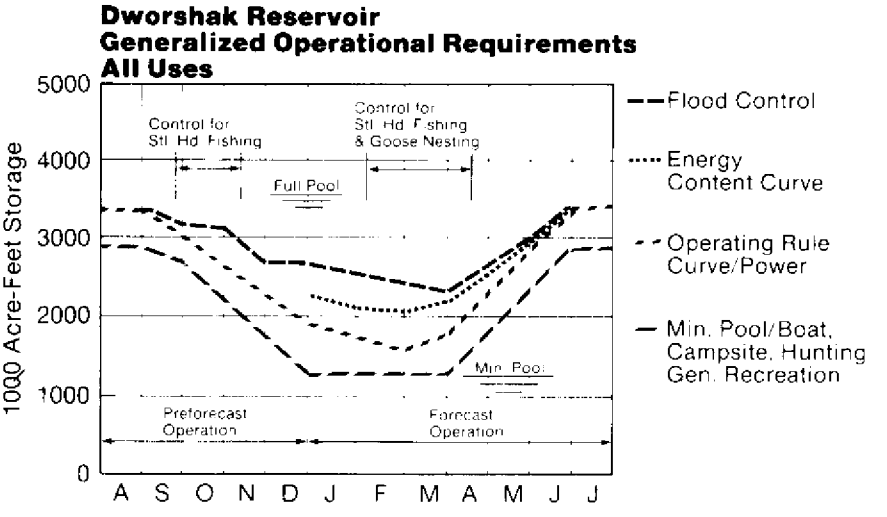
Nicholas A. Dodge
Chief, Water Management Branch, NPD
U.S. Army Corps of Engineers

It has been noted by Phillip Wandschneider[1] that the management and control of the Columbia River stem from three levels: law making, policy making, and an operations level. Each level generally forms an umbrella for the succeeding one. It was also observed that the boundaries between them are somewhat murky because management authority is divided among so many different organizations many of which spring from specific legislative acts. This makes the institutional system quite pluralistic. If this structure is not already complex enough by itself, one look at the legislation aimed at establishing the federal government's role in the relatively uncontested function of flood control reveals at least five congressional acts that set out a major charter for the Corps of Engineers (COE). These acts recognized flood control as a national problem, the solution of which is in the interest of general welfare; they prescribed the principles of economic justification, cost sharing, recognition of interstate compacts, furnishing of lands and easements; held the government free of damages incident to the work; defined O&M criteria; and established flood control functions for other federal and nonfederal projects. The point is that each water resource function has a similar hierarchy of legislation, which is routinely interpreted by affected entities, and it is through this interpretation that the many institutional arrangements (reflecting policy) are consummated.

Probably one of the best examples of institutional arrangements is the Pacific Northwest Coordination Agreement. Under this agreement, sixteen signatories agree to a process that leads to the development of an annual operating plan. The basic principle behind the agreement is that by pooling resources, Pacific Northwest utilities and the federal energy producers, through load and hydrologic diversity, storage, and thermal coordination, can effectively increase their combined resources when operating similarly to a single entity. This is a benefit to

the ratepayer. It can be achieved even though some reservoir parties (signatories) have a multiplicity of reservoir functions which, by congressional mandate or FERC license, does not allow a maximization of the power function but only approaches it. This is physically effected through the joint use of storage wherein reservoir regulation for one function benefits another one.

The net outcome of the annual plan, then, is to provide a firm agreement on the energy capability of the system consistent with all laws, non-power operating requirements, and other contractual arrangements. Each storage project is, in effect, assigned a part of the system load through the development of "rule curves" that guide the regulation (Figure 1).



Temperature Control. All Season • Min. Release: 2000 CFS Min. Instantaneous Rel. 1000 CFS • Max. Tailwater Swing: 2 ft. hr. • Max. Peck Gage Swing: 1 ft. hr., May-Sep • Max. Normal Draft: 5 ft. Summer

Figure 1

In spite of the joint-use water concept, if any or all the single-interest groups desire to increase their "share of the pie" beyond a certain amount, there will be conflicts. In the 1970s local interests became concerned when greater hydro load demands were suggested because of the resource deficits then forecast and the desire of utilities to maximize secondary energy production. The concern was that storage drafts would be significantly larger than was originally envisioned and that local concerns such as tourism, fishing, and irrigation might suffer. This problem was exacerbated by adoption of the Water Budget, which brought into play:

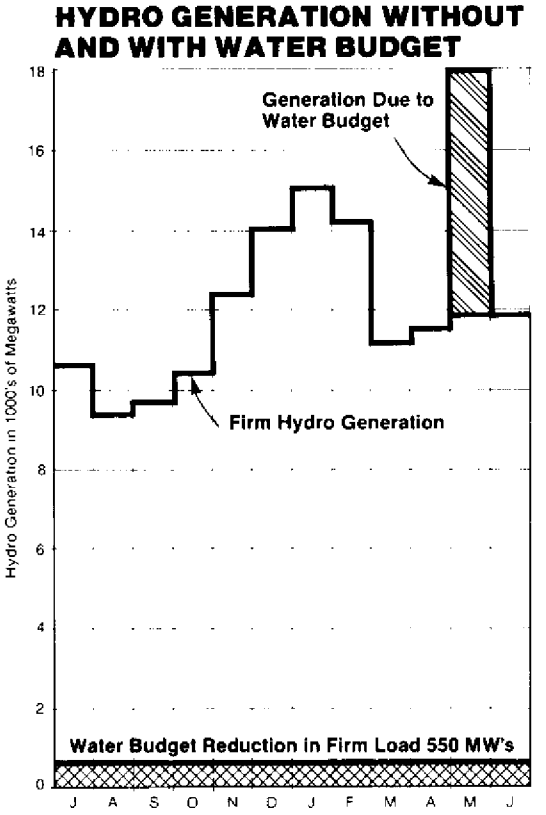


Figure 2

1. Reduction and adverse shaping of FELCC for the utility industry (Figure 2);

2. Negative impact on local interests who want high reservoir levels maintained; and

3. Flood control mandatory space requirements, which, when maintained, would either reduce the assurance of Water Budget or assurance of refill (Figure 3).

Pertinent to this problem is the Power Planning Council's Fish and Wildlife Program Measure 304(a)(6), which requests reexamination of COE flood control responsibilities to assure a proper balance among the various uses of the projects, including fisheries. This study is currently underway. A companion measure in the program is Measure 304(a)(8), which recommends a prioritization of actions by the reservoir owner. This measure has been subject to a variety of interpretations, by single-interest groups, usually in a way that favors the goal of the group. It is only fair to note that the measure is not an absolute requirement upon

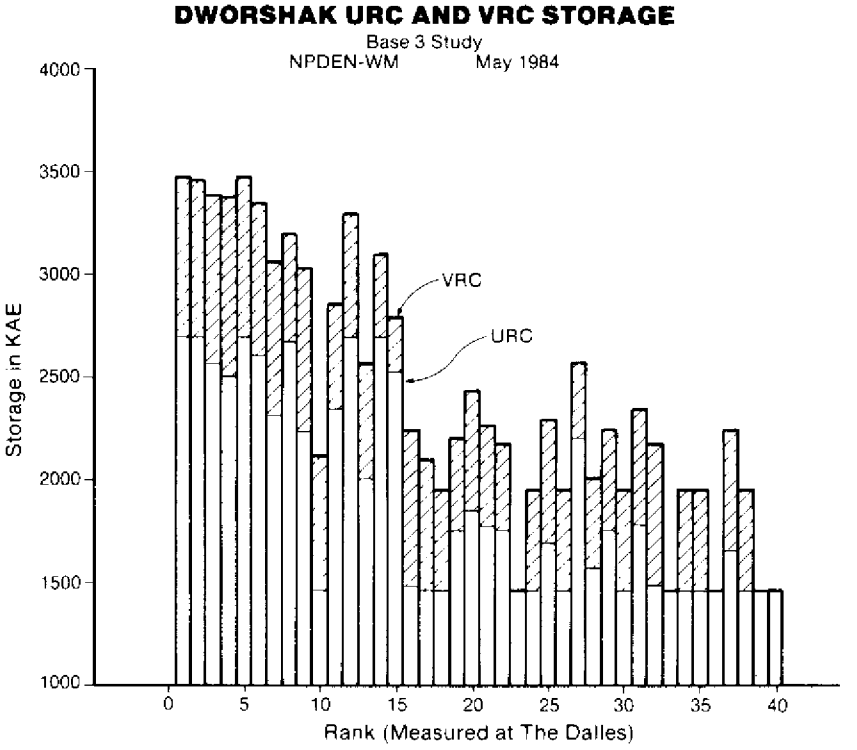


Figure 3

the Corps. The Corps is required to consider the program measure and is doing so. However, that consideration must encompass other water management arenas that the Corps is also required to fulfill.

The COE, by virtue of its water management responsibilities, has had to make some unpopular decisions for the 1984-85 operating plan in that the desires of the various single interests can no longer be met to the former extent. This can be described as a balancing of functions between power, fish, and other uses that the COE is required to fulfill for its multiple-purpose projects. This balancing is undertaken in consideration of the Power Planning Council's Fish and Wildlife Program as well as the Corps' evaluation of the acceptability of impacts of non-power requirements.

At the operating level, the COE continues to play a significant role as it does in operational planning. During the freshets, COE manages the entire system storage with regulation instructions issued to reservoir owners on a daily basis, if needed. In the daily operation for

power, COE schedules its headwater projects hour by hour, in consultation with the Bonneville Power Administration (BPA) and consistent with other needs. The lower Columbia River projects are scheduled and dispatched for power by the BPA, recognizing project limits set out by the COE. Canadian storage is managed for flood control and power by BPA and the Corps as set out by the Treaty documents. The Water Budget Center, created by the Council as provided by the Fish and Wildlife Program, requests Water Budget flows through face-to-face contact with the Corps' Reservoir Control Center and in conjunction with BPA schedulers. The execution of these requests results from the reservation of storage on a firm basis developed in the annual operating plan.

At the operating level the conflicts are similar to those in the operational planning arena except that they tend to detail or result from faulty or incomplete planning. Examples such as defining Water Budget schedule flexibility, accounting methods, etc., are details that eventually will be resolved and rules codified. However, before this can be accomplished, a complete understanding between the executive level directors must be reached, which relates to the responsibilities of each entity involved and the method of resolving disputes. Such an action is now in progress but is not yet completed.

In conclusion, it is quite obvious that the management of the Columbia River is a complicated exercise. The river drains a basin of 259,000 square miles, and most of the 9 million people in the Pacific Northwest are touched in one way or another by this great resource. That its management will become completely centralized is very unlikely, but a considerable degree of centralization does exist now. The COE—because of its ability to manage a significant part of the basin's storage, because of the strategic location of its thirty-one projects, because fish protection is a crucial issue at these same projects, and because the COE is the largest energy producer in the region—probably comes closer than any other entity to what might be generally termed "centralized management." Notwithstanding, negotiation and contract will always play an important role in management decisions pertaining to the Columbia River. It seems apparent that these powerful vehicles will continue to be employed as long as the river remains a shared responsibility of the state and federal agencies and the Indian tribes.

[1] Control and Management of the Columbia-Snake River System, Washington State University Report XB0937. 1984.

Operating Hydroelectric Projects on the Mid-Columbia

Donald E. Long
Director of Power Management
Grant County Public Utility District

My purpose is to give you a feeling of the complexities involved in operating the seven dam mid-Columbia system from the point of view of the hydroelectric project owners and operators. The mid-Columbia consists of the seven uppermost dams on the mainstem Columbia River; that is, Grand Coulee Dam, Chief Joseph Dam, Wells Dam, Rocky Reach Dam, Rock Island Dam, Wanapum Dam, and Priest Rapids Dam.

This seven dam system represents approximately 13,000 megawatts of generating capacity, or about one-third of the Northwest Power Pool's forecasted 1984-85 winter peak. Of that capacity, roughly 65 percent is federally owned, and the remaining 35 percent is non-federally owned. At the head of the mid-Columbia is Franklin D. Roosevelt Lake, with 5,200,000 acre feet of seasonal storage. That is 36 percent of the total federal storage in the Pacific Northwest and is the largest single federal storage reservoir.

In order to develop the maximum amount of usable head for generation in the mid-Columbia, each project was designed and is operated to encroach on the project immediately upstream from it. This means that at normal operating levels, each project's reservoir will cause the tailwater elevation at the upstream project to be higher than it would otherwise be. Hydraulic capacities of the turbines at the projects range from 178,000 cubic feet per second (cfs) to 260,000 cfs. Travel time for water released from one project to reach the next downstream project is about one hour.

Since there are no navigation locks on any of the mid-Columbia projects, the fluctuations of river flows are not constrained by navigation requirements. Therefore, both BPA and non-federal project owners and participants have tended to use the mid-Columbia to meet a large proportion of the load-following requirements of the Pacific Northwest.

That is, the moment-by-moment changes in load are met by changes in mid-Columbia generation and many of the other resources in the Pacific Northwest are run at a more steady generation level and changed only on an hourly or daily basis.

It is easy to see that if any one project were to operate without considering the impact its operation has on other projects, serious problems could arise. For example, if one project wished to peak, it could draft its reservoir rapidly if upstream projects were not peaking, or could cause spill at downstream projects if they were not ready to peak or do not have sufficient powerhouse hydraulic capacity to use all the inflow.

The potential for operating conflicts came to a head in the early 1970s when additional units were installed at Grand Coulee and Chief Joseph dams. The mid-Columbia project owners and participants got together and developed the Mid-Columbia Hourly Coordination Agreement, through which the projects optimize the use of the mid-Columbia.

This "hourly coordination" attempts to operate the seven dams as if they were owned and operated by a single utility. Basically, it has three primary objectives: first and foremost is to meet the total load requested by all parties, second is to minimize inadvertent spill, and third is to keep the reservoirs as full as possible to maximize the efficient use of the water available. These criteria sometimes conflict with one another. For example, keeping the reservoirs full increases the risk of spill.

While attempting to meet these objectives, other constraints must be recognized. Each project has its own unique set of constraints. I will mention a few just to give you a flavor of the system. Grand Coulee has a forebay draft constraint of 1½ feet per day and a tailwater rate of change constraint that can be as low as 2 feet per hour. Chief Joseph has a reservoir with 26 feet of draft capability, but only the top 6 feet can be used during the summer months. Wells Dam has turbine blade problems that restrict the band of allowable generation on each unit. Rocky Reach has a limited reservoir capability but a very large hydraulic capability. Rock Island has the smallest reservoir on the mid-Columbia and has no allowance for overfill. Wanapum Dam has the lowest hydraulic capability of the mid-Columbia dams and its capability has been further reduced by problems with both turbines and generator windings. Priest Rapids has an FERC license minimum discharge constraint of 36,000 cfs and is just 4 miles upstream from the Vernita Bar, an important spawning area for fall chinook salmon.

In addition to these constraints, other normal constraints and nu-

merous special flow requests limit the flexibility of the system. For example, a request may be made for a reservoir to be held down so a boat launching ramp can be built, or a request may be made to hold a project's discharge down so divers can inspect one of the dams. Meanwhile, we're supposed to try to meet the total load request, avoid spill, and keep the reservoirs full.

Recently, three new constraints have been added to the system. These are the spring spill program, the "Water Budget" flows, and Vernita Bar spawning flows.

There is still some controversy over what the rate of mortality is of downstream migrant fish passing through turbines, but almost everyone can agree that the mortality is less through spillways than it is through turbines. The mid-Columbia PUDs have agreed to spill a significant amount of water (in some cases up to a maximum of 25 percent) during the downstream migrant season in order to increase survival. This spill results in a direct loss of energy to the mid-Columbia project owners and participants. In addition, the mid-Columbia PUDs have voluntarily agreed to spill additional water for which BPA supplies replacement energy. This "nitrogen abatement" spill is used to minimize nitrogen supersaturation in the Columbia River system by transferring spill to projects where the spill causes less nitrogen supersaturation.

The Water Budget is a part of the Regional Power Council's Fish and Wildlife Program which is intended to simulate the spring freshet. The purpose is to increase the average velocity of flows in the river so that downstream migrants will be encouraged to move through the system faster. The major impact of the Water Budget on mid-Columbia operations is the shifting of the release of stored water from wintertime use when loads are highest and energy is most valuable, to springtime use where loads are significantly lower and energy therefore less valuable.

The Vernita Bar flow constraints are required to accommodate spawning, hatching, rearing, and emergence of fall chinook salmon at the Vernita Bar. This constraint limits Priest Rapids discharges from mid-October to mid-April. During the mid-October to late November period, discharges are controlled at Priest Rapids to encourage salmon to spawn at lower levels on the Vernita Bar. From December through April, minimum discharge restrictions are imposed at Priest Rapids in order to protect the majority of the incubating eggs, rearing fry, and emerging fry. This constraint both limits the peaking capability of Priest Rapids and can cause drafts of reservoirs throughout the mid-Columbia to maintain the Priest Rapids outflow when inflows supplied from Grand Coulee are low.

All these constraints mean that in only three months of the year—July, August, and September—are there no special operational considerations on the mid-Columbia system regarding anadromous fish. Those months may soon also be restricted if protection measures are found to be necessary and effective for summer chinook.

In conclusion, it should be apparent that the mid-Columbia operation is a complex balancing act. Any new operational regime proposed for the river will have impacts on all other uses of the river. This interaction requires that at all times we strive for balanced consideration of all uses of the river.

Maximizing the Survival of Migrating Salmon and Steelhead

Malcolm H. Karr
Water Budget Manager
Columbia Basin Tribes

I am speaking today as Water Budget manager for the Columbia Basin Tribes. Any opinions that I express, therefore, are not necessarily those of the fishery agencies.

Within the panel topic of "How the River Is Run," I have been asked to concentrate on river management to maximize survival of migrating salmon and steelhead, with emphasis on the water budget concept.

Fishery agencies and tribes have long pressed for a formal arrangement mandating inclusion of fishery needs as a Columbia River system operational constraint. These efforts intensified after large juvenile fish losses occurred during the 1973 and 1977 extremely low runoff years. Passage of the Northwest Power Planning and Conservation Act (Power Act) in 1980 was a major step toward achieving the desired arrangement.

The Power Act directs the Northwest Power Planning Council (NPPC), created by the Act, to develop a program to "protect, mitigate, and enhance" the fish and wildlife resources of the Columbia River Basin as affected by hydroelectric developments. Furthermore, it directs that programs formulated under the Act be consistent with Indian treaties.

The next step toward the desired arrangement was adoption of a Columbia River Basin fish and wildlife program by NPPC on November 15, 1982. The contents of this program were greatly influenced by fishery agency and tribal participation during program formulation. This program conforms to Power Act requirements by allocating a volume of both Columbia and Snake River waters specifically to protect migrating juvenile salmon and steelhead (smolts).

The basic concept, called the "Water Budget," is to provide enough

water to move smolts through the Columbia and Snake system of reservoirs in a biologically timely manner. This will reduce the huge smolt losses such as have occurred in drought years since the construction of dams. Before the existing impoundments, smolts could migrate from upper basin rearing areas to salt water in less than a week. Now, with the controlled flows possible with the existing dams and reservoirs, especially during low runoff years, travel time for the same distance can be eight weeks or longer. This unnatural delay causes large smolt losses, which greatly reduce the number of returning adult salmon and steelhead. The Water Budget, therefore, is for flow augmentation when needed during smolt migration to reduce travel time and increase survival. This will help to achieve the overall fisheries agencies and tribal goal of increasing upriver runs of salmon and steelhead.

Here are a few Water Budget specifics:

• The Water Budget can be used annually from April 15 through June 15.

• Water Budget usage is measured at Lower Granite Dam on the Snake River and Priest Rapids Dam on the mid-Columbia.

• Project operational requirements include maintaining specified power base flows at those two locations, to which the Water Budget can be added.

• The Snake River Water Budget allocation of 1.19 million acre-feet (maf) is equivalent to a sustained flow of 20,000 cubic feet per second (cfs) for one month; the mid-Columbia allocation of 3.45 maf is equivalent to 58,000 cfs for one month.

• Use of the Water Budget is at the discretion of the two Water Budget managers.

The next step toward achieving the arrangement sought by the fishery agencies and tribes, which we are now trying to carry out, is to implement the Fish and Wildlife Program in a manner that will achieve its intended results. This is where the Water Budget Center's responsibilities and the role of the Water Budget managers enter in.

The Water Budget managers were appointed by early January 1983. My appointment by the tribes includes authorization for me to work directly through the Columbia River Inter-Tribal Fish Commission. My counterpart, Mark Maher, was appointed by the fishery agencies and works through the Columbia Basin Fish and Wildlife Council.

It immediately became clear that many of the Fish and Wildlife Program measures specified to be carried out jointly by the fishery agencies and tribes could not be treated as separable items but must be handled as a unit. This led to establishment of a joint fishery agencies

and tribal office, called the Water Budget Center, where the Water Budget managers and essential supporting staff can operate together full time. Evolvement of the scope of responsibilities assigned by the fishery agencies and tribes to the Water Budget Center reflects this need for integration of directly related program components.

Simply stated, the Water Budget Center acts on behalf of the fishery agencies and tribes in overseeing and/or implementing management actions that impact adult and juvenile salmon and steelhead migration and passage through the Columbia/Snake system of dams and reservoirs. Major components assigned to the Water Budget Center under Water Budget managers' supervision include:

- managing the Water Budget so that the limited amount of allocated water is used judiciously and as effectively as possible in enhancing smolt migration through the system of reservoirs;
- designing and implementing the many components and objectives of a smolt monitoring program to provide information on migrating characteristics and survival of juvenile salmon and steelhead, and to provide the in-season data needed for appropriate flow, spill, and fish facilities management;
- designing and conducting a program to evaluate the effectiveness of the implementation actions.

Applicable fishery agencies and tribal policies, in addition to the Fish and Wildlife Program, provide overall guidance to the Water Budget Center. A major document setting forth these policies is the joint fishery agencies and tribes Detailed Fisheries Operating Plan prepared annually by the Water Budget Center. This plan lists the fishery agencies and tribes adult and juvenile fish passage objectives, and detailed operating criteria for each of the thirteen Columbia/Snake projects regarding flow and spill management, operation of by-pass and fish transportation facilities, and other applicable criteria.

These policies and criteria are translated by the Water Budget Center into system operational requests from the Water Budget managers to the Corps' Reservoir Control Center. This is done whenever fish movement and existing or impending passage conditions dictate a need for a change in system operations to protect the migrating fish; for example, when the runoff forecast or planned reservoir operations show that a drop in flows below that needed by the migrating smolts is expected, a Water Budget request is executed. This request will specify the level of flow needed, over what period of time, and at what location in order to shape flows to the movement and needs of the fish.

Another type of request is "spill for fish passage" specifying the amount and location of spill needed in order to reduce losses of smolts

passing dams either lacking bypass facilities or with facilities of too low effectiveness. At times, the amount of flow in the system exceeds that required for both meeting power demand and providing spill for fish passage, resulting in additional water that must be spilled. The Water Budget managers then transmit a "spill priority" request to the Reservoir Control Center specifying where to distribute the extra spill and in what order. This takes into account the location and movement of both adult and juvenile fish in order to prevent the buildup of high concentrations of dissolved gases, and to maintain good upstream and downstream passage conditions where needed. Time will not permit me to discuss Water Budget Center activities beyond these examples.

There have been problems, some that we consider serious, in terms of some of the system operational requests not being carried out in the manner expected by the fishery agencies and tribes. While misunderstandings did happen and are to be expected, more often the problems at the technical, implementation level stemmed from lack of policy-level agreement on questions such as: Who determines the migrational needs of the fish? Where do fishery needs fit in the priority order of competing system uses? Who controls the way Water Budget usage is shaped to the movement of juvenile fish?

I am able to report today that these and other policy questions have been carefully addressed in recent weeks by joint meetings at the policy level. The most notable outcome to this point is the execution of a Memorandum of Understanding signed by Tim Wapato for the Columbia River Inter-Tribal Fish Commission, Dick Myshak for the Columbia Basin Fish and Wildlife Council, and Colonel Jim Fry for the Corps of Engineers. Following are three of the items endorsed:

1. The parties recognize that the fish and wildlife agencies and tribes are the biological experts and are responsible for development of fish protection plans.

2. The parties recognize that the Corps is the operational expert and will operate Corps hydroelectric facilities and fulfill other hydroelectric system responsibilities.

3. The parties recognize and hereby adopt the recommended priorities for operation of the system as provided in Section 304 (a)(8) of the Regional Council's Fish and Wildlife Program. The parties recognize that the Corps must consider other uses and authorized purposes of its projects and act in accordance with Section 4(h)(11).

While these as yet are only words on paper, if adhered to in the future by all parties, many of the implementation problems encountered this year can be resolved. We will try hard to carry these out in the spirit intended.

PANEL IV.
Lessons Being Learned

Moderator:
Charles F. Broches

Lessons Being Learned

Charles F. Broches

The final panel's topic, "Lessons Being Learned," is intended to emphasize the reality that management of the Columbia River is a continuing learning experience for all those involved in utilizing this valued resource.

The key problem facing those who manage the river is determining how to allocate water. It should be kept in mind that there is no river czar who possesses the power to unilaterally set levels of water use. Instead, competition for water is coordinated through a complex set of international, regional, and local agreements involving an array of different decision-makers with diverse degrees of authority and responsibility. To add to this complex environment is the fact that the availability of water is not guaranteed from year to year. There is little serial correlation between water years. Thus, the region's water users and decision-makers cannot pretend to predict with complete accuracy how their desires will correlate with the availability of water.

The papers that follow are inclined toward reporting the positive aspects of learning to cooperate. There is much evidence to suggest that a great many positive steps have already been taken to promote better utilization of the river. While guarded optimism is the general theme that runs through each of the papers, it is important to remember that decades of distrust and conflict are not easily undone.

The history of water resources policy-making suggests that institutional conflict can best be resolved through the interaction among those with conflicting claims to the water. If the conflicting parties can come to recognize that each claim to the resource is based on a legitimate beneficial use of the water, the chance for the parties-at-interest to resolve disputes around a conference table rather than in a courtroom is increased. Indeed, the central conclusion of the following papers is the

growing recognition that all of the users of the Columbia River have a legitimate claim for using the river and that by listening carefully, a substantial reservoir of commonality exists that can reduce future tensions.

Adaptive Management: Learning from the Columbia River Basin Fish and Wildlife Program

Kai N. Lee
Associate Professor of Environmental Studies and Political Science, University of Washington and Member, Northwest Power Planning Council

Jody Lawrence
Policy Specialist, Washington State Energy Office and Northwest Power Planning Council

In its recently amended Columbia River Basin Fish and Wildlife Program, the Northwest Power Planning Council adopted a biological policy framework of adaptive management.[1] Our primary purpose here is to explain this policy approach and its role in the program, which is now the largest effort at biological restoration on the planet.

There is a second theme implicit in our story. This conference delineates the sometimes intense competition over the resources of the Columbia River. Competition is not only unavoidable; it can lead to better utilization of resources. For that benefit to be realized, however, competition must produce more than conflict. It must foster solutions as well. Congress created in the Power Council a body that makes analytically based, informed judgments on behalf of the Northwest. We believe a problem-solving approach based upon science can contribute to the difficult problems of salmon enhancement—and that that has broader implications for users of Columbia River water.[2]

The Council's Fish and Wildlife Program responds to an extraordinary mandate: the restoration of naturally reproducing fish and wildlife in the Columbia River Basin, in compensation for damage from hydropower development. The program prepared under the Northwest Power Act[3] takes major steps to elevate the place of fish and wildlife—salmon and steelhead in particular—among the multiple uses of the Columbia River.

It will take more than law and money, however, to improve the situation of the basin's anadromous fish: scientific uncertainties abound. The recent abrupt shift in oceanic and atmospheric conditions labeled "el Niño" underscores our limited understanding of the population dynamics of anadromous fish. Mixed-stock fisheries force the imposition of conservative harvest regulations. And the history of

hatcheries, until now the principal form of enhancement, is at best mixed. The point is simply put. If organisms that range from the Clearwater and Deschutes rivers to the Gulf of Alaska are to be protected and enhanced, the ecosystems they inhabit must be guarded, augmented, and above all better understood.

Adaptive management is a policy framework that recognizes biological uncertainty as a reality, while accepting the congressional mandate to proceed on the basis of the "best *available* scientific knowledge."[4] Adaptive management asks what information the elements of the program could yield, thinking of them as experiments designed to test and extend the scientific basis of fish and wildlife management. By learning from the implementation of the program itself, the Council and resource managers are able to act affirmatively on behalf of living resources both in the short run and the long term.

Background

The Northwest Power Act of 1980 revised the charter of the Bonneville Power Administration and established a planning and cost-allocation framework for the region's electric power industry. Planning responsibilities were assigned to a new interstate-compact agency, the Northwest Power Planning Council.[5]

In Section 4(h) of the Act, Congress rejuvenated a long neglected responsibility of the region's hydropower system: the protection and enhancement of fish and wildlife in the Columbia Basin, to mitigate damage from the development and operation of hydropower facilities. The Council was assigned the task of developing a Fish and Wildlife Program, with substantial guidance from the Basin's Indian tribes and federal and state fish and wildlife agencies. That program was adopted in 1982 and amended earlier this month. Organized into eleven substantive sections, the program contains well over 200 "measures"—studies, projects, operating procedures, and other actions to benefit fish and wildlife.

The centerpiece of the program is a regional effort to restore the once-prolific runs of salmon and steelhead in the Columbia River and its tributaries, emphasizing naturally reproducing stocks in the upper river. These are the runs most severely affected by hydropower development and operations. Declines in these populations affect all users, especially the tribes whose legal claims are tied to traditional fishing sites. The program's upriver emphasis is reflected in its three costliest elements: the Water Budget, which restores part of the spring freshet that helps to flush migrating young fish to the sea; a capital construction program to increase the survival of salmonids as they migrate

through and around dams in the main stem of the Columbia and Snake Rivers; and an effort to enhance anadromous fish in the Yakima River Basin of Washington.[6]

The program is ambitious and comprehensive. In addition to the anadromous fish sections, the program includes efforts to protect and enhance resident fish and terrestrial wildlife, to coordinate Council activities with those responsible for regulating harvest of Columbia River stocks, and to define responsibilities for program implementation by the Bonneville Power Administration, federal and non-federal hydro project operators and regulators, and the tribes and resource agencies. It should be noted that the Council has no formal authority in harvest control nor in resource management *per se*.

Throughout, the Fish and Wildlife Program must engage with two human frailties: limited knowledge, mentioned above, and conflicting interests. As the anadromous fisheries dwindled, conflict became endemic. Indian rights, virtually ignored for decades, have gained dramatically in legal stature over the last ten years. Conflicts between states and tribes have been the result, superimposed upon troubled relations among the states, over issues such as Idaho's exclusion from the compact regulating inriver fisheries of the Columbia.

While there is no doubt that hydropower development has had a major impact on fish and wildlife, the Council and the electric power industry are mindful of the tendency to regard the ratepayers as a deep pocket, to provide benefits unrelated to power development.[7] The current cost of implementing the Fish and Wildlife Program is approximately $30 million per year, one percent of the annual revenues of the Bonneville Power Administration; revenues lost because of the Water Budget are estimated at $58 million per year, but these depend on conditions in the power market and on water levels in the reservoirs. Concerns about the costs of the program have been pursued, thus far constructively, by the Pacific Northwest Utilities Conference Committee. But the potential for disputes on these and other grounds is indicated by fears that the program will affect water rights, or in suggestions that nonpower interests should share the costs of protection and enhancement.

In sum, the program outlines a means for the region to accord fish and wildlife "equitable treatment"[8] among the multiple purposes of the hydroelectric projects of the Columbia Basin. Such treatment will be historically unprecedented.[9]

Adaptive Management: A Biological Policy

Despite the scope and ambition of the Fish and Wildlife Program, Congress contemplated little research prior to action. Instead, the Act

directs the Council to rely upon the "best available scientific knowledge." Many of the measures in the program have been carried out on a limited scale within the Columbia Basin. The Council's mandate is distinctive, nonetheless, in that we are directed "to deal with the Columbia River and its tributaries *as a system.*"[10] The Act's bias toward action, combined with the Council's systemwide responsibility, leads logically to the policy perspective we call adaptive management.[11]

Adaptive management is learning by doing: by treating measures in the Fish and Wildlife Program as experiments, the implementation of the program becomes a set of opportunities to test and improve the scientific basis for action. Those opportunities, in turn, structure a systemwide planning regime that makes use of information produced by implementation of the program.

Adaptive management is both a conceptual approach and a strategy of implementation. As a conceptual approach, it sets a scientifically sound course that does not make action dependent on extensive studies. As a strategy of implementation, adaptive management provides a framework within which measures can be systematically evaluated as they are carried out.

Adaptive management rests on five principles which must be shared by those involved in implementation:

1. *Protecting and restoring fish and wildlife is a common objective.* Hunters, fishers, scientists, and naturalists all benefit from enhancement. Yet short-run human interests are often poorly aligned with the needs of the natural system. The focus of the Council's program is the shared long-term interest in protecting and rebuilding stocks.

2. *Projects are inevitably experiments;* the choice is to make them good ones or poor ones. Given the current state of knowledge, no measure can be guaranteed to perform as intended. Some will fail; others will do better than expected.

3. *Action is overdue.* We should not defer action until "enough" is known. Acting with the expectation of surprise is an important kind of study in its own right.

4. *Information has value,* not only as a basis for action but also as a product of action. Designing projects so as to develop their learning benefits is an important planning objective.

5. *Enhancement measures may be limited in time,* but *management is forever.* The obligation of the program is to rebuild a self-sustaining resource within an environment modified and maintained by human action. Enhancement activities must include deliberately designed means for learning and remembering how better to manage the resource.

Action can produce knowledge, but only if learning is an objective from the outset. Thus, in addition to restoring depleted stocks of fish and wildlife, adaptive management seeks to assure that future managers will be able to draw upon a stronger body of knowledge. By stressing what is to be learned, the Fish and Wildlife Program can be more than a collection of measures; it becomes a method of increasing the likelihood of success over time.

Adaptive management provides a unified approach within which a wide variety of measures can be designed and then assessed during implementation. Those that produce dramatic results will not need much evaluation beyond a summary of what is needed to succeed elsewhere. But only rarely will failure be unequivocal and swift. If outplanting of hatchery fish were followed in some cases by disease in naturally reproducing fish, it would be hard to tell whether outplanting led to disease—unless that possibility were anticipated and appropriate records kept. Moreover, without a firm grounding in biological analysis, managers may read incomplete results as failure, narrowing options for the future by incorrectly inferring the lessons of experience. Adaptive management encourages deliberate design of measures, to assure that both successes and failures are detected as early as feasible and interpreted properly as guidance for future action.

It is obvious that one should learn from experience. What science adds is the habit of thinking in terms of experiments and the information they can provide. Experiments are disciplined interventions into natural processes. The Fish and Wildlife Program is a set of interventions into the natural processes of the Columbia Basin: measures are experiments. If measures are well designed, much will be gained, especially in the long term.

Were there certainty about how to restore and enhance the fish and wildlife of the Basin, the program could be judged simply on the basis of its near-term effectiveness. Because there is little certainty, the program should be evaluated on both its short-term success and its ability to take account of new information. A program that learns poorly will be defeated by uncertainty; one that learns well can prevail despite the poor state of knowledge initially. Acting in light of new information is adaptive management.

The Role of the Council

No Council member is a biologist. The program is a biological plan for restoring and enhancing fish and wildlife. It may be unclear how a scientific perspective should affect the work of the Council.

The Council's task is different from that of those who carry out the

measures in the program. The Council's role is institutional—helping to define purposes, within the framework of the Act; working with utilities, Congress, and others to provide funding to achieve those purposes; and influencing the selection of people to lead implementation efforts.

Between the Council's institutional guidance and the execution of the program measures, there is a set of organizations: the Bonneville Power Administration, the Army Corps of Engineers, the Bureau of Reclamation, the Federal Energy Regulatory Commission, Indian tribes of the Columbia Basin, and federal and state fish and wildlife agencies. These organizations implement; they employ and direct those who carry out the actual work; they transform measures into detailed operational programs; they budget resources. Given their operational imperatives and the history of conflict that surrounds fisheries management, none of the implementing organizations has been in a position readily to heed the principles of adaptive management.

The Council, however, with its systemwide planning responsibility, can work with agencies and tribes to instill such an approach to action and lay the foundation for long-term, basinwide management. Central to that perspective is the fact that enhancement actions can provide information relevant to continuing redesign of the program—that one can learn by doing.

High-output Learning

If projects are to be experiments, there must be something to observe. This idea has several significant consequences:

1. *Measures should be formulated as hypotheses.* What is the intention of the measure, precisely? Given the experience of biologists and resource managers, what unintended consequences might ensue? By making expectations specific, concrete, and quantitative in advance, one can identify surprises as they emerge.

It is crucial, however, that expectations be treated as hypotheses rather than predictions: managers must not be punished for being "wrong" in the sense of making a prediction that is not borne out by events; surprise is the key to learning.

2. *Measures should make an observable difference.* Natural populations of fish and wildlife fluctuate for reasons beyond human control or prediction. If an experimental probe is to have a discernible signal, it must have an impact sufficient to overcome the noise of natural variations.

Thus, instead of improving fish passage at widely scattered proj-

ects, it makes sense to undertake improvements simultaneously in adjacent dams. The effects of modifications will then be compounded, making it easier to see a statistically reliable effect on fish survival.

3. *Monitoring must be designed at the outset.* One cannot see what one does not look for. The program already requires careful monitoring of the biological effects of the Water Budget;[12] adding scientifically coherent monitoring to other key sections is a high priority in translating adaptive management into explicit directives.

4. *Biological confirmation is the fundamental measure of effectiveness.* The Act calls for review of the Council's energy plan and fish and wildlife program "not less frequently than once every five years";[13] the Council began to amend the 1982 Fish and Wildlife Program on the first anniversary of its adoption. But it takes four or five years for a steelhead or chinook salmon to grow to adulthood and return to the river. Adaptive management heeds biologically relevant information, even when it may be slow in coming.

5. *Quantitative models can sharpen hypotheses, organize large numbers of observations, and facilitate an overall perspective on the consequences of intervention.* For all these reasons, models can be of great utility in guiding implementation.

Quantitative modeling results, however, should *always* be presented together with sensitivity analyses that put the predictions in context. When the measures available are sensitive to uncertainties in input data, it is important to measure the uncertain parameters or to control their impact. Conversely, models can demonstrate that some parameters are not important to the measures under consideration; this tends to quiet disagreements over those parameters and improves the likelihood of consensus.

The basic message is called "power of test" in statistics: to distinguish one effect (the measure) from a multitude of others (natural fluctuations), it is necessary to make that effect a large enough one to be seen.

Application to the Program

What might adaptive management mean concretely?[14] Adaptive management has been broadly outlined in Section 1500 of the program; the approach set forth there implies that the Council will:

* urge managers, scientists, and the utilities to address uncertainty in their resource management and implementation activities and in research;

* encourage flexibility in operations and program implementation, as new information becomes available;

* improve the power of test of key measures in the program; and

* emphasize evaluation, paying attention particularly to measures on which work is just beginning.

Adaptive management affects both what the Council does and how implementing entities approach what they do. We plan a workshop in the next few months, to discuss with scientists and resource managers the application of adaptive management to the amended program. For example, the adaptive management concept can be integrated into the program's anadromous fish goals.[15] In setting production objectives, one must face the uncertainties of rebuilding naturally reproducing runs. Adaptive management is a way to establish objectives (hypotheses) that can be revised in light of new information.

Adaptive management also provides a systematic approach to implementing the Fish and Wildlife Program. Which measures are likely to produce information that will reduce critical uncertainties? Those are the ones that need to be designed with maximal power of test. Measures that promise useful information deserve high Council priority.

The Yakima hatchery, for example, approved in the amended Program[16] is of central importance to the Program because it is intended to produce fish for outplanting, to initiate naturally reproducing runs throughout the Columbia system. This facility can also become a unique laboratory for the study of hatching, rearing, and disease control in salmonids. The master plan to be developed for this hatchery should define questions to be investigated by the operation of the facility, such as the importance of genetic variability in stocks selected for outplanting.

It is also important to make clear what adaptive management is not. Standing alone, adaptive management cannot answer the economic questions that arise in salmon enhancement.[17] The Council, among others, is responsible under the Act for assuring the Pacific Northwest of "an adequate, efficient, economical, and reliable power supply."[18] Thus far, the cost of carrying out the program—roughly one percent of annual BPA revenues—has been too small to affect the economics of power. In addition, it has proven difficult to estimate the costs of achieving the congressional objective of protecting and enhancing the region's fish and wildlife. More generally, there are low-cost measures that are likely to be of little benefit, and high-cost ones—such as improving the survival of juvenile fish in the main stem of the river—that can return large benefits. In supporting the Council's initiative in the Yakima Basin, the utilities agreed, cautiously, that a pilot

scale test of the program's anadromous fish enhancement strategy was sensible.[19]

Information gained from adaptive management will also be useful in improving the cost-effectiveness of the program. The adoption of adaptive management by the Council, indeed, reflects a concern for economically sound use of ratepayer funds. The level of biological uncertainty makes it necessary to obtain additional information before reliable judgments about systemwide cost effectiveness can be made. But there is no doubt that a scientifically sound framework is indispensable for assessing the value of program measures; adaptive management is such a framework.

It is also important to see that adaptive management is not a substitute for efforts to achieve equitable treatment for fish and wildlife. Some elements of the program, such as the Water Budget, were designed in part to create for fish and wildlife interests a "place at the table" when decisions affecting living resources are made. Such measures are bound to encounter resistance, since their effect is to reallocate decision-making influence. That resistance must be met with strong leadership from the Council in settling disputes and sustaining the thrust of the program.

The Fish and Wildlife Program is public policy; adaptive management is something narrower, a scientific policy. Adaptive management is not sufficient in itself to guide the program even though it is clearly necessary.

Reluctances, Reservations, and Cautions

Adaptive management has been accorded a cautious reception by the resource management community and utilities. That was in part the normal reaction to a new idea whose operational implications are not entirely clear. But it is certainly true that the experimental approach raises hard questions.

Consider scientific validity. Adaptive management is one of the few ways to achieve sufficient power of test to advance our limited understanding of fish and wildlife management. This is not to say, of course, that every large-scale intervention is technically justifiable. Even those that are sound must be interpreted carefully. Some measures, such as the Water Budget, may yield clear results only after a long period of implementation. Some measures such as fish passage facilities are highly site-specific, limiting our ability to transfer lessons learned to other locations. Moreover, the natural world is highly variable, so that choosing control groups and baselines against which to measure change is a difficult task.

Fish are oblivious to whether they are being managed in an experimental fashion, but the humans implementing the program care about how their work is being evaluated. This introduces additional subtleties into experimental design. An attempt to introduce unorthodox procedures into well-established craft technologies such as hatchery management is likely to be met with resistance. Conversely, the perception by resource managers that a change is positive may bias data reporting, producing falsely optimistic results.

At the policy level there are parallel hazards. Adaptive management could be misinterpreted as a license to undertake poorly conceived measures, justifying them as experiments. Alternatively, the fact that a measure is being implemented using an experimental framework could be mistaken as evidence that the technique is unproven, and that further use of it should be delayed until the "test" is completed.

In the long run, the greatest hurdle may turn out to be the problem of adverse results. Measures are undertaken to enhance or to protect a living resource. Adaptive management requires clear specification, in advance, of anticipated outcomes. Given biological uncertainty, one must expect even perfectly implemented measures to fail sometimes, either because of natural fluctuations or because the underlying concept is flawed. Thus adaptive management increases the likelihood of both visible success and visible failure. Resource managers whose careers hang in the balance will regard this prospect with mixed feelings.

There are two challenges here. The first is to redefine success so that nominal failure can be evaluated on the basis of the information it does, in fact, provide. Second, one should encourage resource managers to recognize the potential value of surprising outcomes, since they often contain the most valuable information. Experimental scientists typically measure success by whether the measurements were correctly carried out, not whether they agree with theory. Even though resource managers are often trained as scientists, the organizational culture in which they work is at best indifferent to the experimenting spirit of adaptive management. This barrier is likely to be a formidable one.

Finally, the tribes and agencies responsible for resource management may wonder if the Council is the appropriate entity to undertake a scientific policy like adaptive management. Science has not played a prominent role in the Council's decision-making thus far, nor has the Council settled upon a single concept of its planning responsibilities in fish and wildlife.

Adaptive management is a scientific policy. It can succeed only if the Council is able to fashion a working relationship with the scientific and resource management communities. In bringing adaptive manage-

ment to life, the Council will need expert assistance in two ways. First, the scientific perspective is a vital ingredient of the policy judgments that comprise an adaptive management approach. Technical considerations are not always controlling—learning is not the only benefit of the program—but the value of learning can only be assessed within a process in which scientists participate. Second, adaptive management requires measures to be designed as experiments; for this, scientific experience is instrumental.

More fundamentally, at the heart of adaptive management there must be pooled scientific judgment. From this perspective, adaptive management is a decision-making process through which a community of peers determines whether the experiment embodied in a program measure is worth carrying out, not only if it succeeds, but for its learning benefits if it produces surprise. Peer review of this kind would provide expert, disinterested regional judgments to guide the production of information from program implementation. How to define the community of peers is one of the primary institutional issues to be taken up in the Council's goals process, as well as in the forthcoming workshop on adaptive management.

It is important, finally, to sustain the momentum of the program. Of all the obligations of science to society, none outranks the ethical: the point of experimenting is to protect and enhance living resources more effectively; for the imperiled fish and wildlife of the Columbia Basin, there is little time left to act.

The ancients lamented the folly of human action. They put it poetically in the saying that the owl of Minerva flies at dusk: wisdom, symbolized by the owl, is apparent only at the end of the day, when the battle is over.

But when we learn from action, the owl can fly at dawn.

Note: The authors welcome comments on this paper. They may be sent to Professor Lee at the Institute for Environmental Studies, University of Washington, FM–12, Seattle, WA 98195.

Notes

[1] Northwest Power Planning Council, 1984. Columbia River Basin Fish and Wildlife Program, (Portland, OR: Council, forthcoming), section 1500. Cited hereafter as "Fish and Wildlife Program."

[2] The ideas developed here for fish and wildlife bear a family resemblance to the power planning strategy adopted by the Council. See Northwest Power Planning Council, 1983 Northwest Conservation and Electric Power Plan (Portland, OR: Council, 1983) Chap. 3.

[3] Pacific Northwest Electric Power Planning and Conservation Act of 1980, 16 U.S.C. 839; cited hereafter as "Northwest Power Act" or "Act."

[4] *Ibid.*, Sec. 4(h)(6)(B)m emphasis supplied.

[5] See the paper by Edward Sheets for this conference.

[6] Fish and Wildlife Program, sections 300, 400, 600, 900, and 1500. Also see the papers by Nicholas Dodge, Malcolm Karr, William Lloyd, Don Long, Kahler Martinson, and Timothy Wapato at this conference.

[7] The Act directs that "Consumers of electric power shall bear the cost of . . . deal[ing] with adverse impacts caused by . . . electric power facilities and programs only." Sec. 4(h)(8)(B).

[8] Ibid., Sec. 4(h)(11)(A)(i).

[9] The change in priorities is suggested in the Council's decision in Sec. 404(b)(5) of the Program to require closure of the new second powerhouse at Bonneville Dam, when needed, to protect migrating young fish.

The powerhouse is equipped with the most advanced fish screens and bypass technology. Unfortunately, the flow of water into the dam apparently defeats these $23 million fish passage facilities. Instead, the current, cascading over the remains of a cofferdam built during the construction of the powerhouse, carries more than two thirds of the migrants underneath the fish screens and into the turbines; there, 15 percent are killed.

The Fish and Wildlife Program provides that the Corps of Engineers will develop a solution to the fish bypass problems at Bonneville Dam. In the meantime, the Corps, in consultation with the fish and wildlife agencies and tribes, will operate the dam to achieve 85 percent fish passage efficiency. That figure—comparable to the best levels achieved in the Columbia system—would require closure of the second powerhouse for substantial parts of the migration season. The program still assures that firm power loads would be met. The economic impact of the interim operating procedures is estimated at roughly $5 million per year of lost power revenues.

[10] *Ibid.*, Sec. 4(h)(1)(A), emphasis supplied.

[11] The term originated in research conducted at the Institute of Animal Resource Ecology at the University of British Columbia. See Adaptive Environmental Assessment and Management, ed. C.S. Holling (New York: John Wiley & Sons, 1978); Environmental and Social Systems Analysts Ltd., Review and Evaluation of Adaptive Environmental Assessment and Management (Vancouver, B.C.: Environment Canada, 1982).

The idea that enhancement activities should be carried out using an experimental framework had been stated earlier in P.A. Larkin, "Play It Again Sam—An Essay on Salmon Enhancement," J. Fish. Res. Bd. Can. 31 (1974) 1433-56.

An experimental approach to social welfare policy is discussed in Alice M. Rivlin, Systematic Thinking for Social Action (Washington, D.C.: Brookings Institution, 1971) Chap. 5.

[12] See, Fish and Wildlife Program, Section 304.

[13] Northwest Power Act, Sec. 4(d)(1).

[14] The authority to translate these ideas into Council actions is straightforward. Even without a close legal analysis, it seems clear that the five aspects of experimental design discussed above can be grounded in the Act's requirement to plan in accord with the best available scientific knowledge. The practical and political feasibility of adaptive management is another question, however.

[15] See, Fish and Wildlife Program, Sec. 201. A Council staff issue paper proposing a goals development process will be circulated shortly after this conference. Adoption of goals would occur in 1985, according to that proposal.

[16] See, Fish and Wildlife Program, Sec. 704(i)(3).

[17] In his paper for this conference, Timothy Wapato discusses the dispute over the economic principles that should guide salmon enhancement.

[18] Northwest Power Act, Sec. 2(2).

[19] See Egil Krogh's paper for this conference.

Indian Treaty Rights and Economic Considerations

S. Timothy Wapato
Executive Director
Columbia River Inter-Tribal Fish Commission

Several recently enacted federal statutes direct anadromous fisheries restoration, enhancement, and management in the Pacific Northwest. These laws are significant for the breadth of activity they subsume; for instance, the overriding principle of the Northwest Power Act provides that fish and wildlife interests and power interests shall cooperate as partners in the development, operation, and management of the Columbia River hydroelectric system for the benefit of all citizens of the Pacific Northwest. In effect, Congress has placed fish and wildlife concerns on an equal footing with power production in the Columbia River Basin.

Other federal statutes govern various aspects of anadromous fisheries management. The Magnuson Fisheries Conservation and Management Act, for instance, provides binding principles for harvest management of ocean fisheries. What have we learned from our efforts to implement such laws? What role has economics played and what are some common criticisms of economics as applied to natural resources management? This paper will briefly address these questions. The following comments, regarding the application of economics in fisheries management, preface a discussion of fisheries-related statutes.

Two general models of economic analysis are frequently used in water resources and fisheries planning. The first and most familiar is cost-benefit analysis. Less familiar, but perhaps more broadly applied, is the cost-sensitive model. ("cost-sensitive" is used here in the sense of "cost-effective.") No single definition for either model is uniformly accepted. With this caution in mind, cost-benefit analysis may be described as a technique in which data are assigned dollar values and are formatted to arrive at a direct comparison of monetary costs and benefits. Cost-sensitive analysis entails identification and consideration of

monetary costs, but does not require monetization of benefits or a direct comparison of benefits and costs in pecuniary terms.

From the perspective of a person whose job is to protect and effectuate Indian treaty rights, the cost-benefit model has several faults that limit its usefulness in dealing with fishery resources. Implicit in cost-benefit analysis is a rigorous definition of the pecuniary worth of different factors. The most common indices of worth are market prices or a system of shadow prices based on estimated market behavior. In the business setting, costs and benefits are readily identifiable as pecuniary losses and gains. However, the marketplace is not well equipped to place a monetary value on legally and constitutionally secured rights, which typically are not bought or sold.

Moreover, in the government setting, the identification of costs and benefits is often difficult. The public, which government represents, will have conflicting views on what results should be considered costs and what results should be considered benefits. More fundamentally, conflicts develop when cost-benefit analysis is used to implement a legislative decision to correct a marketplace failure. (Pollution is often considered a market failure or "externality.") Such conflict has the potential to erode both the solution and the process by which it was reached, insofar as the market-oriented solution may be at odds with the solution legislatively or judicially determined.

In addition to problems with defining cost and benefits, cost-benefit analysis has historically glossed over considerations of distribution. These considerations involve who receives the benefit or bears the cost, and at what time the benefits and costs arise. The individual economist may be ill-suited to resolve such questions, which are legal and political in nature.

Temporal distribution may be thought of as a question of equity between generations. To the Columbia River treaty tribes, preservation of their heritage and culture for future generations is and always has been the first order of business. However, this commitment, which is a way of life to Indian fishers and the tribes, may be easily lost in the complexities of the quantitative cost-benefit model.

The inability of cost-benefit analysis to deal with questions of social distribution has been a particularly vexing problem for the Columbia River treaty tribes. Their treaties with the United States reserve a right of taking fish, which the Supreme Court has recognized is meaningful only if fish are available for taking. This treaty right is not subject to diminution, except by an unequivocally expressed and explicit act of Congress. Yet cost-benefit analysis ignores the distribution of costs and benefits among different groups within society. Aside from the legal is-

sues that such an approach portends, a number of more mechanical problems arise when considerations of social distribution are ignored.

Allocation of both costs and benefits has the greatest marginal effect on the poorest segment of society. Any loss or gain to the wealth of a low-income person will be much more significant than the same loss or gain to a wealthy person. Similarly, different sectors of society will have greater or lesser buying power. Because of the greater buying power of wealthy consumers, their preferences will tend to be overrepresented, while lower income persons will exhibit less apparent willingness to pay.

A more fundamental question is the validity of using consumer sovereignty principles to measure religious, philosophical, or intellectual pursuits, which are ordinarily enjoyed without engaging in market transactions. It should not be surprising that attempts to monetize Indian religious and cultural values are met with great skepticism and disfavor by Indian tribes.

The cost-sensitive model accommodates many of these concerns, not by more rigorous attempts to monetize intangibles, but through multidisciplinary analyses and decision-making. In this model, the uncertainties and imperfections found in more abstract economic analyses are recognized and accorded proper weight in light of legal, biological, political, and other considerations.

What have we learned from implementing various statutes?The Fish and Wildlife Coordination Act has taught us two painful lessons: 1) When Indian tribes are not consulted in the development of fisheries mitigation and compensation plans, Indian rights are neglected, and 2) application of cost-benefit analysis to fish and wildlife mitigation has frustrated efforts to repair biological disruption due to water project development.

The Coordination Act does not explicitly require consultation with Indian tribes, though such consultation is certainly authorized. We believe that failures to recognize tribal governments in fish and wildlife management are in part due to the lack of such a requirement.

Equally troubling has been a misperception that Coordination Act mitigation or compensation, however styled, must meet the test of a favorable cost-benefit ratio. The legislative history of the Coordination Act demonstrates that Congress intended that this law not be interpreted in such a fashion. Congress intended that the Act would provide full accounting for all fish and wildlife costs in water project development, not merely those costs that are justified by some projected level of benefits.

Fortunately, the Northwest Power Act remedies these failings of

the Coordination Act. First, the Northwest Power Act requires consultation with Indian tribes of the Columbia River Basin which are given roles coequal with those of state and federal fish and wildlife agencies in planning, which addresses fish and wildlife impacts arising from hydroelectric development.

Second, fish and wildlife decisions that were formally vested with hydroelectric project development agencies such as the Bureau of Reclamation are now carefully structured by the language of the Act and the Columbia River Basin Fish and Wildlife Program. These agencies no longer have the discretion to reject fish and wildlife measures based on their own considerations of merit. Notably, Congress followed the cost-sensitive model in the provisions of the Act instructing the Northwest Power Planning Council to develop a program to protect, mitigate, and enhance Columbia Basin fish and wildlife.

The Salmon and Steelhead Conservation and Enhancement Act, enacted contemporaneously with the Northwest Power Act, has brought together the Columbia River tribes and Oregon and Washington fisheries agencies to solve fisheries management problems shared by these jurisdictions. Economics in this forum has taught us the basic lesson of the "tragedy of the commons," where "rational" individual behavior has depleted a common resource. The Enhancement Act has resulted in constructive dialogue and commitments in principle to cooperative fisheries management.

To summarize: Application of rigid economic models to implementation of statutes such as the Coordination Act has proven to be problematic. As a consequence, fish and wildlife resources have borne costs that should have been paid as a part of water project development. Even when mitigation was carried forward in the Columbia River Basin, Indian fisheries have borne the consequence of decisions to place fish hatcheries below mainstem dams, for mitigation of impacts in the upper basin. The result has been a severe redistribution of the resource to the detriment of Indian fishermen, whose traditional fisheries are above the mitigation hatcheries. Such a redistribution is facially at odds with the treaties that the Columbia River tribes signed with the United States. As explained by two federal judges:

> Maybe everybody is going to have to suffer for awhile like the Yakimas have suffered. . . . As I've said before, this Court is concerned with the fundamental law of the land and that is Indian fishing rights under the treaties of Governor Stevens; and secondly, the conservation of the salmon fishery, whatever may be the species.
>
> Whatever happens economically is down the ladder as far as the court is concerned and I have a firm belief, at least at this stage, that if the parties work together to adequately conserve the fish [and] fulfill

the terms of the Stevens treaty, the economics will take care of themselves because under an adequate conservation program you are going to increase the number of fish instead of decrease them.[1]

The whole approach of the Secretary . . . was to arrive at a reasonable compromise. . . . I think the Secretary has been under a lot of pressure to accommodate a lot of interests, and [the Secretary] has tried to do that, but that is not compliance with what the Supreme Court has required. . . . [Y]ou can't subordinate the United States treaty obligations to management considerations. Specifically . . . the treaty obligations are a legal obligation that takes precedence.[2]

These rulings, which arose in the context of ocean fisheries management, are representative of a broad principle. Economic considerations can be and are subordinate to Indian treaty rights. As we proceed with rebuilding anadromous fish runs to the upper Columbia River Basin, the lessons we have learned should not be forgotten: 1) Indian tribes should be consulted to the maximum practicable extent; and 2) Treaty rights must not be subordinated through economic methods such as cost-benefit analysis.

[1] Confederated Tribes and Bands of the Yakima Indian Nation v. Baldrige, no. C80-342T (W.D. Wash. oral ruling Aug. 4, 1984).

[2] Confederated Tribes v. Kreps, no. 79-541 (D.Or. oral ruling July 11, 1979).

Bureau of Reclamation Activities: From Ideas to Actions

L. William Lloyd
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U.S. Bureau of Reclamation

I have been asked, along with others on this panel, to bring you a brief discussion of "lessons being learned" from our operation to improve fish facilities in the Pacific Northwest region. While I will be reporting on the Northwest Power Planning Council's Fish and Wildlife Study, as it affects the Bureau of Reclamation's operation, my remarks will go well beyond this.

As an initial background, it may be well to recap briefly how we have the projects we do and where we are. First, we in the Bureau of Reclamation, as an agency of the Department of the Interior, are operating under the Reclamation Act of 1902, as amended, and other applicable laws. Our projects generally begin as an expressed need of some segment of the population for power, irrigation, flood control, or other benefits.

Most likely, there are more than one. What generally happens is that a constituency will approach its congressional delegation and ask for a study on a certain project or need. If Congress is favorably disposed to studying such a project, it will authorize a study and provide the funds to conduct it. Then the Bureau will study the project from an economic, environmental, and local acceptability standpoint. If the project shows feasibility, the plan will be developed to present to the administration and then to the Congress for authorization. Included in the feasibility, in addition to the justifications I have mentioned, are a repayment entity or entities that will contract with the United States for repayment of their share of the project's construction and operation and maintenance costs. Our projects are subject to, and operate under, state water rights. If authorized by the Congress and funded, the project will then be built.

The flexibility of an operating project, once it is built, depends on a

number of things. One is the physical limitations—the amount of storage it will hold, capacity of the outlet works, powerplant capacities, etc. Another restraint is the operational considerations, such as the need to keep a certain amount of water in the reservoir for a given purpose or conversely to have a certain amount of storage space available to control spring runoff. A very important restraint on our flexibility is statutory—the project's authorization. On many of our older projects, these are very limiting since many of the old authorizations were for a single purpose or a couple of purposes at best.

As you know, the Bureau of Reclamation has been in operation since 1902 and has a long history of water enhancement throughout the seventeen Western States. The Bureau of Reclamation, for instance, has been working to improve water supply conditions in the Yakima River Basin since early in the century. One of the most recent efforts there to develop additional storage was the Bumping Lake Enlargement Feasibility Study published jointly in early 1976 with the Fish and Wildlife Service. The plan was developed and presented for public and congressional consideration, but there were concerns that the enlargement of Bumping Lake alone would not represent a comprehensive solution to the competing water needs of the Yakima River Basin.

Following the 1977 drought, the state of Washington asked that a comprehensive study be undertaken to review basin needs and to find solutions to the basin's water problems. Congress agreed and authorized the Yakima River Basin Water Enhancement Project (YRBWEP) Study in late 1979. The major objectives of the YRBWEP study are: 1) to provide supplemental water to presently irrigated lands; 2) to provide water for new irrigation development on the Yakima Indian Reservation; 3) to provide water to increase instream flows to protect and enhance anadromous fish; 4) to improve fish passage and protective facilities; and 5) to develop a comprehensive management plan for the basin to enable efficient utilization of the water supply. Additional objectives, including recreation enhancement, hydropower development, and municipal and industrial water supplies, would be pursued if they did not conflict with the major objectives. The state provided $500,000 to assist us in funding the study and is working with Reclamation as a partner in the study to develop a basin plan.

Since the initiation of that study in early 1981, we have had a preliminary report, which recommended that early action be taken to construct a reregulating dam on the Yakima River at the East Selah site to improve regulation of water supplies. Also recommended was early action to improve fish passage and protective facilities throughout the basin. Also, the report recommended that detailed studies of water stor-

age sites, water conservation opportunities, and other study objectives continue.

The Washington State Legislature has passed legislation to fund construction of the East Selah Reregulating Facility, and the state is now considering project details prior to proceeding with construction. Although the Bumping Lake Enlargement Study identified some fish passage and protective facilities needed in the basin, the number of sites has now been expanded to twenty and includes sites where fish facilities were not previously provided. These twenty sites are included in the Northwest Power Planning Council Fish and Wildlife Program. Facilities needed at sites include newer and improved ladders, screens, barriers, and bypasses.

It should be noted here that the existing fish passage and protection facilities, where they exist, were designed and constructed to "state-of-the-art" technology at the time they were built, using the expertise of the fish and wildlife agency.

Reclamation, at the request of the Bonneville Power Administration (the agency responsible for implementing the Power Planning Council's Fish and Wildlife Program), is doing predesign studies for fish passage and protective measures at eight sites in the Yakima River Basin. Also, work toward construction is also progressing at some of the privately owned diversion sites in the basin included in the twenty identified sites.

The fish passage and protective facilities program, which is beginning this fall, will be funded by Bonneville, the Bureau of Reclamation, the state of Washington, and the Bureau of Indian Affairs, at a total cost of about $40 million. Completion of the fish passage and protective facilities is expected to increase the annual return of adult anadromous fish from the present level (2,000 fish) to 10,000 or more fish. If minimum streamflows can also be provided, the total adult returning population could be increased to 70,000 or more, provided that such flows would require additional storage in the basin.

Perhaps this would be a good point to interject one of the "lessons learned" pertaining to the fish passage facilities and other hoped-for Yakima Basin improvements. As I mentioned, Reclamation has not been oblivious to needs of the fish in the basin, but it took the total resources of the many agencies, individuals, organizations, and the Northwest congressional delegation to provide the catalyst that has finally gotten the program started. One of the major catalysts was the passage of the Yakima River Basin Water Enhancement Project Study in late 1979. The state of Washington, along with other sponsors, recognized that there had to be a major effort and basin-wide cooperation if

the Yakima River Basin's water and related problems were to be addressed. For the first time in memory, this study has brought virtually all of the players together around one table to discuss their mutual problems.

While there have been, and will continue to be, problems in undertaking this study of the difficult solutions to the basin's problems, the study is moving forward, and we expect to have concrete results beyond the fish facilities when it concludes in 1986.

Another catalyst has been the Pacific Northwest Electric Power Planning and Conservation Act. As all of you are aware, the Act provided for the Power Planning Council not only to come up with a plan to take care of the region's power needs, but also to provide for fish and wildlife in the region. While the Power Planning Act has given the Council authority to proceed with its plans, it has explicitly kept in place all other statutory authority and requirements. This simply means that for the Power Planning Act to work, it will take the cooperative effort of all agencies, organizations, and individuals throughout the region. The Act does provide a funding mechanism through power production, which has been very helpful, especially in the Yakima Basin.

So far I have talked mainly about issues directly affecting the Yakima River Basin, but there are, of course, other lessons being learned. By the very nature of Grand Coulee Dam and its large storage reservoir, it becomes involved in almost any other consideration on the Columbia River system. As you are no doubt aware, Grand Coulee Dam is the key feature of the Columbia Basin multipurpose project and the emphasis for its being built originally came from those who wanted to irrigate agricultural crops. Of course power generation has been one of the strong benefits of the project. Flood control, recreation, and fish and wildlife have also benefited from Grand Coulee Dam. Although we have not yet been able fully to test the Water Budget—because we have not had a low water year yet—we do know that in the time of crunch there will be impacts. While we have been able to satisfy most of the competing needs on FDR Lake and downstream uses in recent years, it doesn't take much to upset the apple cart. A case in point was the power drawdown this summer, which caused a number of marinas and boats to become high and dry on the reservoir. Even though it was a fully authorized operation, within the operating constraints of the project, the negative results are the types we try to avoid. But it does vividly illustrate that relatively minor changes in the operation can present some very difficult situations.

We were able to rectify the situation by calling on part of the load and/or water requirements to be provided from other projects. But in a time of real water shortage, this may not be possible. The lesson here is

that even with the very formidable system that we have in place, it may not be possible to fill all of the needs to everyone's satisfaction.

At Cascade Reservoir, on the Payette River in Idaho, we have the case of a reservoir that has had excess capacity to the immediate irrigation needs for which it was authorized. As a result, the reservoir has become one of the key recreation and fishing areas in the entire state. This has been largely a result of our ability to have a "de facto minimum pool," although it has not been specified in any authorization. This is similar to the situation on the Prineville Reservoir in Central Oregon. The lessons here are that projects can provide additional benefits not envisioned in the planning stage and that it is a real challenge to maintain the full benefit of the original plan and also take advantage of recreational and other opportunities which—although not specifically authorized—present themselves.

An example of one of our studies that is endeavoring to make a cooperative effort in solving a serious water problem is our Umatilla River Basin Study. In that basin there is a classic conflict between the Indians and their desires for fish flows and the water user needs for irrigation purposes. In our study we are proposing to install a pumping plant on the Columbia River to feed Cold Springs Reservoir, thus freeing up water in the Umatilla River Basin—water traditionally used for irrigation—for instream flow purposes for anadromous fish. There are a number of other elements in the plan, including a small storage reservoir on one of the tributaries to provide late summer flows for fish migration. The Umatilla Study, if it jells into a project, would be a real example of solving a potentially serious litigation problem between two competing uses of the river system.

In virtually all of the situations where there are conflicts, the key to trying to solve those conflicts is a cooperative approach. We are not saying that this cooperative approach will always end in the desired result, but it will at least give them a chance. In facing such a problem the first thing we have to look at are constraints—legal, physical, economic, and other—that would forgo a cooperative solution. The process demands good communications among all of the parties. It is inevitable that trade-offs and compromises have to be made to arrive at this type of solution. These cooperative approaches, once they are installed, need to have "post-project monitoring."

Can BPA Satisfy Everyone?

Robert E. Ratcliffe
Deputy Administrator
Bonneville Power Administration

The title of this conference is "The Politics and Economics of Columbia River Water." Some individuals would argue that the title is redundant, that the politics are controlled by the economics, but I don't think that's true. The fact that there are politics *and* economics relating to Columbia River water is very, very true.

I was impressed with the purpose of this particular panel—to talk about lessons *being* learned, because we haven't yet learned a lot of lessons, but we *are* learning.

Some may consider that it is a mistake for the Bonneville Power Administration to address the topic of balancing competing interests, but that's the world we live in.

Bonneville doesn't own any dams on the river. The Corps of Engineers and the Bureau of Reclamation own all those dams. They built them. One of the earlier speakers referred to the Coordination Agreement. The signators of that agreement were all those utilities in the region that owned hydroelectric resources. The Corps has taken great delight in asking BPA: "Where are your resources? You don't own any of them." But that doesn't mean that we don't have some influence in operating them. We do, but we operate them within the constraints that are imposed by the Bureau of Reclamation and by the Corps of Engineers.

The Corps is charged with responsibility for navigation and flood control, and those come *first*. Then BPA comes along and says, "We need to release some water so that we can generate some power." The Corps answers, "All right, as soon as we take care of navigation and flood control." Sometimes they say, "We're going to draw the resources down because we've got to make room for some flood that's coming." All we can say is "Yes, sir!"

This is just one of the interests that impact our operation of the system.

As far as the Bureau of Reclamation is concerned, their responsibility is primarily just what their name says, reclamation. They are interested in reclaiming the land for agriculture. The Bureau of Reclamation is concerned with protecting their agricultural interests, their reclamation interest. They impose constraints upon the operation of their projects that give first priority to irrigation.

At times we quarrel with these agencies over the proposed uses. Once in a while, recreation is mentioned. Recreation is not one of the authorized purposes of these dams, and it doesn't contribute anything to the cost of these projects. However, when a community like Pasco plans a hydroplane race, we better not touch that water. We need to keep the reservoir level; we don't draw it down to generate power because that community is dependent on the economic impact of the races. Economics play a major role in the politics of this, no question about it.

In balancing the various interests, we have a whole slew of them that we must consider. I mentioned navigation, agriculture, irrigation, and flood control. Now certainly, electrical generation comes in and we have a very great interest in that. Bonneville's charge from Congress was to market the electric generation from all of these federal projects. Initially, there was only the Bonneville Dam and then Grand Coulee Dam; now there are more than thirty dams.

We also have fish. Fish is of tremendous interest to us. When we're talking about fish, we must be protective of the Indian interests in fishing. This includes both protection of their treaty rights as well as their economic well-being. As Tim Wapato said, fishing is a way of life with the Indians. It is virtually a religion. Their interest is fraught with emotion. We also have the commercial fishermen and the sports fishermen. I venture to say that there are a large number of sports fishermen sitting here in this room. Fish, to this group, can become a highly emotional topic. The fervor with which your interests are expressed can influence the political viewpoint on it. We find many members of Congress are avid fishermen. They get very emotional about it, sometimes to the exclusion of the economic consequences. Bonneville is the marketing agent for federal power generated in the region. It's also the cash register from which the mitigation, enhancement, and enablement of other interests are paid.

The dams are operated and we receive a bill not only for the repayment of the federal investment and the costs of operation but also for all these other interests. As a consequence, we sometimes sit back and say,

"These expenditures are too high." This or that expenditure has got to be reasonable. It's got to lead somewhere. This is especially true for the fishery. Fishing is an imprecise science; those fish do not act as we say they will—we don't really know how they'll act. I think that Kai Lee's comment that we need some innovation, experimentation, and successes and failures to learn more is correct. We subscribe to that. Not every activity is going to produce beneficial results. But at the same time, we can't simply say "Yes" to everybody who is coming to ask for money. The funds that come out of our cash register must be replaced—dollar for dollar—out of the pockets of our ratepayers.

As an example, our fish commitment alone, our direct implementation of the Council's Fish and Wildlife Program, is now running about $34 million a year and getting higher. There is a capital investment in fish facilities of more than $500 million in the federal Columbia River Power System and we do have to repay that investment out of Bonneville revenues, with interest. The operations and maintenance costs of the Corps and the Bureau and the U.S. Fish and Wildlife Service associated with the fish facilities in the Columbia system are running about $15 million annually. The cost of the water budget that has been mentioned several times in lower power is up to $58 million annually. Combined, these costs get rather expensive; they come out of power revenues, which we must provide for and at the same time repay the federal treasury for the federal investment in facilities. There is no question that the hydroelectric projects on the river have had an adverse impact upon the fish; we have never denied that, but we don't feel that the diminished fish runs are due solely to those projects.

The Regional Act has imposed on Bonneville the obligation to work to mitigate and enhance the fishery. I think we are doing that and making good strides. We're trying hard to do this; sometimes I think the Power Council may not believe this, but we are trying to make the Council look good. We want that political experience, or experiment, if you will, to be a success. Because it is a political experiment, this regional planning concept may be adopted in other areas. There is always that possibility. In the Pacific Northwest, I think it's very important that we continually look at this experiment and ensure that it will function. Senator Hatfield stated that he had some problems with the Power Council and Regional Act. I'm sure he does; we all have problems with what's happened with the Regional Act. Nothing has worked out as we dreamed it might in our fondest dreams, but that's life; that's a reality. We will cope with that and I think we can correct the deficiencies.

I began by saying that there are lessons *being* learned; I don't know what we have really learned, except that, like a fellow who's going to dig a ditch, the first thing he finds is a shovel. Well, we've learned some

of the tools that we need. Those tools are patience, commitment, understanding, good faith, innovation, hard work and, I suppose, because there are federal agencies involved, elimination of red tape. I would like to tell you that Bonneville is noted by all of its customers as having a great ability to cut red tape. I see one or two people snickering at that: they know we're cutting it lengthwise.

We are very much interested in the Fish and Wildlife Program which is now being implemented, since the funds are coming out of the coffers of Bonneville. There are a number of fish and wildlife programs that start "Bonneville shall fund." I was quite impressed with page after page of seeing that. We're not objecting to that as a general proposition, but at the same time, we do have to meet our other obligations. We intend to meet them and we do intend to comply with the Regional Act, not only because the act tells us to, but also because it is a wise thing to do for the good of the region. We feel that Bonneville does contribute to the well-being of the Pacific Northwest and we are a Pacific Northwest agency. Sometimes our masters in Washington, D.C., object that we're a little too much a Northwest agency, but we intend to stay that way. We are very much interested in the well-being of the Pacific Northwest. We also feel that conferences such as this one, where people have an opportunity to recognize that there are competing interests, all of which are valid, are important. These uses all have a place here, and they all contribute to the well-being of the Pacific Northwest.

Remember Us: The Vantage Point of a State Agency

Donald W. Moos
Director
Washington State Department of Ecology

To begin with, I would like to say that I hope there have been many lessons learned over the past few years. It would be rather disheartening for someone to stand up here and proclaim that nobody has learned anything in spite of all the intensive management efforts that are underway. From my standpoint, there are several important lessons that have resulted from the last few years of effort.

First, I believe the record clearly shows that an open exchange of technical information, ideas, and philosophies is an excellent mechanism to narrow the gaps between numerous single purpose interests with highly divergent opinions.

I believe there has been a tremendous increase in the amount of communication that is occurring between these various users and user groups. While there are still very distinct differences of opinion on a number of issues, I believe each of the major agencies and groups that are involved is more aware than ever of the thinking of others. Along with this improved communication have come a number of cooperative agreements that are of substantial help in managing a resource such as the Columbia River for all uses. In fact, I believe conferences like this one are an excellent example of this increased communication which allows for a wide variety of opinions to be exposed.

To some degree, I believe this increase in communication occurred with the development of the Columbia River Instream Resources Protection Program by the Department of Ecology in 1979 and 1980. I believe that this effort, followed as it was by the development of the Northwest Power Planning Council's Fish and Wildlife Program, was instrumental in starting the trend toward increased communication and cooperation.

A second lesson (and one which I hope is being learned) is that the

management of a resource like the Columbia River necessarily must address the multi-objective needs of all the users. Because of this, I believe it is becoming increasingly critical that multi-objective agencies such as the state water resource management agencies be fully involved in the communication and decision-making process. I believe that such agencies can be instrumental in reaching the kinds of compromises that are required in managing such complicated and varied resources.

A third lesson and one which is becoming increasingly important is one that has not yet been fully learned...but needs to be. In the past, traditional water resources management did not give adequate recognition to the fishery and instream resource values that are now recognized as critical issues. As a result, there has been a tendency to view water left in a stream as wasted or, at least, unused. Recent experience has certainly demonstrated that nothing could be further from the truth. In the case of the Columbia River, the water left in the stream serves a number of vital functions. For example, such water is extremely important for navigation, aesthetics, recreation, fish and wildlife utilization, water quality, and, of course, for hydropower production. The hydraulic capacity of the mainstem Columbia River power plants has increased to the point that hydropower can use virtually all of the water all of the time. This capacity is a very important consideration in management of this river and should not lead to the conclusion that water left in the stream is not being used.

As entities in other parts of the West express an interest in Columbia Basin water, it becomes increasingly important that the following lesson be passed along: the water of the Columbia River flowing into the Pacific Ocean has not been wasted because it is still within its banks. In fact, it has been very heavily used on its journey to the sea and such uses are crucial to the economic well-being of the region and the nation as a whole.

I suspect everyone here today would agree that it would have been nice if some of the things we know now had been known years ago. If they had, the conditions of the river might have been considerably different. In the next decade, we will once again have an excellent opportunity to apply our knowledge of the river in renegotiating the Columbia River Treaty. I am hopeful that these negotiations will reflect the most thorough and well-informed view of how the river should be managed. Because of this schedule, I feel it is extremely important that everyone involved in the management of the Columbia River begin to think about the Treaty and what changes they would like to see occur. This will be a very major undertaking but should be well worth each of our efforts.

Perhaps the most important single lesson to be learned is that we

have not yet learned all our lessons! A resource like the Columbia River represents some real challenges. It is a complicated ecosystem when taken alone. It becomes even more complicated when a series of management constraints are imposed upon it. Although much is known about the river system, we may well find that we are only "scratching the surface" with regard to our current understanding. Certainly much has been learned in recent years. In addition, the dissemination and availability of that information have improved considerably. But in spite of these improvements, we aren't there yet. There is still a lot to learn. Because of the urgency of improving conditions for fish and wildlife, it is imperative that actions continue to be taken and that we not wait until all the facts are in.

Mr. Broches sent me a copy of a paper from the Northwest Power Planning Council on *Adaptive Management*. The principal premise of this paper and definition of adaptive management is simply "learning by doing." The author argues that such management can result in an increasing likelihood of success over time because of improvements in the body of knowledge. I am aware that a number of fisheries interests are very sensitive to this point. They feel that this is no place for a trial and error approach, but I do not feel this is what is intended. I believe that this approach is basically what is being practiced today. There are innumerable examples of fish-related activities on the Columbia River that are based on current levels of information and knowledge. But I am unaware of any actions that do not also include study of the results. These study results can be used in determining the course of future policies. In the long run, such an approach achieves two things:

First, it allows efforts to improve fish and wildlife conditions to begin immediately, without waiting for more studies to be completed. Second, it should result in an increased understanding of the resource and an increased ability to design a management regime that is acceptable to all uses, including fish and wildlife.

This, in turn, leads to a final lesson which I think is being learned. This is that we, as water managers, have a difficult job that is likely going to keep getting harder. Demands have grown to the point that there are serious conflicts between the various uses. As demands for this water continue to grow both within and outside the region, there will be more and more pressures on decision-makers to make difficult and critically important decisions. While this will not be easy, I believe the new spirit of communication and cooperation bodes well for the future for all the uses of this most precious natural resource.

Developing a Viable Fish and Wildlife Program

Egil "Bud" Krogh
Attorney
Culp, Dwyer, Guterson & Grader

I appreciate the opportunity to make a few remarks about lessons being learned. The focus of my remarks is that cooperation works better than confrontation—maybe. At the outset, I should note that my experience on behalf of the Pacific Northwest Utilities Conference Committee has been restricted, in large measure, to the fish and wildlife matters mentioned in several previous papers. For this reason, my remarks will be limited to that subject area.

As counsel for the PNUCC Fish and Wildlife Committee for the past three and a half years, I've had the opportunity to observe and to participate in a major effort by the utility community to contribute actively to development by the Council of a strong fish and wildlife program. Given the experience with WPPSS litigation and other energy disputes in the region, you may well ask, in badly paraphrasing a famous American, Clara Peller, "Where's the brief?"

Well, except for one recent exception, which I will comment on later, PNUCC decided from the outset to try through cooperative means to help develop and implement a strong fish and wildlife program that would put more fish back into the river. (I might add that to see PNUCC follow this cooperative route rather than an adversarial approach was, at times, to me as a lawyer, a source of substantial personal tension.)

The key lesson that I think has been learned over the past four years and that we are still learning is that when parties in the region, particularly the Regional Council, the concerned federal agencies such as BPA, the Corps, the Bureau of Reclamation, BPA customer groups, the tribes, fish and wildlife agencies work together in good faith, they can accomplish a great deal. We encouraged the Council and its staff right after the regional power bill was passed to approach the fish and wildlife agenda with the idea of developing consensus in the region on

what should be done. On balance, I think they have been successful in doing this. This is not to say that PNUCC, along with many other participants in the development of the program, did not have strong disagreements with the Council on many issues. We did. But the Council consistently afforded all parties ample opportunities to discuss these differences and to work out compromise positions when at all possible. On occasion, individual entities have tried to pursue courses of action that might maximize their individual interests at the expense of what BPA customers thought was the larger interest and had been agreed to in a cooperative manner. When this has happened, we have tried to emphasize that this can only result in disappointment. We're all in this together.

This essential cooperative spirit was clearly manifested in the creation of Section 4(h) of the regional power bill, the statutory section that provides for the development of the Columbia Basin Fish and Wildlife Program. It was really a remarkable event that took place back in 1980. For the first time, power people sat down with fish people to draft jointly fish and wildlife provisions for inclusion in the Regional Power Bill. The meetings took place in Portland under the auspices of the Public Power Council and the Columbia River Fisheries Council. The power people included representatives of BPA, public power, private power, direct service industries, and the Corps. The fish people included representatives of all state and federal agencies that comprise the Columbia River Fisheries Council and, additionally, as self-designated observers, representatives of the Columbia River Inter-Tribal Fish Commission. The group called itself the Ad hoc Pacific Northwest Fish Power Committee or, more briefly, the Ad hoc Committee.

After five months of sometimes turbulent effort, the Ad hoc Committee succeeded in writing a comprehensive fish and wildlife proposal the committee members were prepared to recommend to the respective organizations and to Congress. The organizations discussed the committee's legislative proposal and accepted it. So did Congress. On August 28, 1980, the House Interior Committee adopted the Ad hoc Committee's proposed amendments, including some last-minute changes, as a block and incorporated in the committee report an abbreviated version of the Ad hoc Committee's written explanations of the amendments. These amendments survived with few modifications, the reconciliation process between House committees that produced a single version of the Power Bill for consideration on the House floor and thus, as so modified, became, after the Senate accepted the House Pass Bill, the fish and wildlife provisions of the Regional Power Act.

The Ad hoc Committee would not have been formed and its proposals could not have become the fish and wildlife provisions of the

Regional Act but for Representative John Dingell, who was mentioned earlier, and his staff. The events that compelled the formation of the Ad hoc Committee were the adoption by the House Commerce Committee during March 1980 of very different fish and wildlife provisions than Dingell and his staff had drafted and the explanation of those provisions that Dingell's staff included in the committee's report on the Power Bill. Had Dingell not taken these actions, the bill might have been passed without the inclusion of any significant fish and wildlife provisions. Yet, if Dingell's amendments and the explanation of them and the Commerce Committee had remained the last word, no legislation might have been passed at all. The Commerce Committee fish and wildlife provisions were simply unacceptable to BPA customers, particularly public power, national public groups, and key congressional supporters.

The dilemmas facing power people and fish people after the Commerce Committee's action were readily apparent. The power people could not get their Power Bill without fish and wildlife provisions acceptable to Congressman Dingell as well as to various electric power constituencies. The fish people could not get their fish and wildlife provisions unless a Power Bill became law. In other words, they needed fish and wildlife provisions acceptable to the electric power groups as well as to Congressman Dingell and the fish and wildlife constituences. Since agreement on a compromise was a prerequisite to success for both power people and fish people, a body to write the compromise was necessary and the Ad hoc Committee was born.

It is important to understand that the Ad hoc Committee and the Interior Committee did not act to ratify what the Congress Committee had done—they acted to change it. And the fish and wildlife provisions as changed were the provisions the House and Senate approved and the provisions that became law. I think that it is clear, too, that Congress will enact regional legislation and amendments to the Regional Act *only* where the regional interests are united. And in 1980, in Section 4h, the fish and wildlife provisions of the Regional Power Bill, it was a product of a united effort.

I have emphasized this brief legislative history because I think there have been a few instances in which some of the key players in the region have not adhered as closely to the spirit and intent of Section 4h—a section that both power and fish interests carefully crafted—as PNUCC feels they should have. Another lesson that emerges from this is that we need constantly to refer back to the legislative structure that Congress created to ascertain the authority of the Regional Power Council and the specific limitations that Section 4h placed on its development of the fish and wildlife program. It is a delicate matter to remind a

new government entity that in your view it might be overstepping its statutory authority. This is particularly true when, from that government entity's perspective, the ends seem so desirable and the opposition of some parties seems so unreasonable. As a planning body, the Council will continue, I think, to enjoy much success in gaining consensus and maintaining a cooperative spirit among the many entities that participate in the fish and wildlife program.

Just yesterday, as both Don Moos and Bill Lloyd have already mentioned, we saw one outstanding example of this cooperative spirit. The groundbreaking ceremony for the Yakima Basin Enhancement Project took place at Sunnyside Dam. The Council from the outset had targeted this Yakima program as its major enhancement project, and PNUCC supported it because we thought it would be an excellent case to test out the regional act's enhancement authority. A concern we have had, however, is that this enhancement approach may be extended indiscriminately throughout the region before the results from the Yakima project have been properly evaluated. This brings me to one final comment on the adaptive management approach presented to this program by Kai Lee.

I think it's a major step forward to emphasize scientific analysis in the implementation of the fish and wildlife program. But I think it should be pointed out that many of the utilities have been hard at work over the past few years trying to determine as scientifically as possible which programs for fish passage upstream and downstream work the best. There will be, I am sure, much cooperation between PNUCC and the Council as it implements its adaptive management approach. We do have concerns quite obviously about the cost of programs that are defined as "experiments." The more expensive the cost of a mitigation "experiment," the more persuasive and substantial should be the data that support that "experiment." Kai Lee has certainly noted this concern in his paper when he points out the tendency of some to regard the ratepayers as a "deep pocket" to pay for fish and wildlife measures that might not be directly related to the adverse impacts caused by electric power facilities and programs. We think that it is clearly important to establish careful monitoring regimes for all of the measures that the Council has adapted, and to the extent that adaptive management will promote this monitoring, we would, I think, support it.

I believe that most of us on the Fish and Wildlife Committee are convinced that cooperation is still the best approach to work out most matters related to the Fish and Wildlife Program. And we hope that we will be cooperating the same time next year.

BIOGRAPHICAL DATA

DONALD BALMER is Professor of Political Science and Public Administration at Lewis and Clark College. He has served as consultant to several regional natural resource projects, including the Northwest Energy Policy Project. He is the author of numerous articles on natural resource policy, and has coordinated many federal/state agency in-service training seminars. He holds B.A., M.A., and Ph.D. degrees from the University of Washington.

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MARK O. HATFIELD is the senior United States Senator from Oregon, having served in this position since 1966. He is presently Chair of the Senate Appropriations Committee and the Energy and Water Resources Appropriations Subcommittee. Prior public service in the state of Oregon includes serving as Governor (1959-1967), Secretary of State (1957-1959), and as a State Legislator (1951-1957). He also has held a position as Associate Professor of Political Science at Willamette University (1949-1957). Mr. Hatfield has a B.A. degree from Willamette University and an M.A. degree from Stanford University.

MALCOLM H. KARR is Water Budget Manager for the twelve Columbia Basin tribes, and he co-supervises the Water Budget Center, jointly operated by the Columbia Basin fishery agencies and tribes. He has worked for 35 years in water and related resources planning, management, and research throughout the Pacific Northwest, especially the Columbia Basin. A licensed professional engineer in Oregon and Washington, Mr. Karr earned his B.S. in Civil Engineering from Oregon State University and an M.S. degree in water resources management from the University of Wisconsin.

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KAI N. LEE represents the state of Washington as a member of the Northwest Power Planning Council. He is presently on partial leave from the University of Washington, where he is Associate Professor of Environmental Studies and Political Science. He is the author of many articles on energy and environmental policy issues including *Electric Power and the Future of the Pacific Northwest*. He holds an A.B. degree from Columbia University and a Ph.D. from Princeton.

L. WILLIAM LLOYD is Regional Director of the North Pacific Region of the Bureau of Reclamation, U.S. Department of the Interior at Boise, ID. Prior to that, Mr. Lloyd was Regional Director for the Upper Missouri Region in Billings, MT. He began his career with the Bureau in 1961. For 18 months in 1976 and 1977, he served as U.S. Chairman of the International Garrison Diversion Study Board, formed to evaluate potential impacts of the Garrison Diversion Irrigation Project on Canada. Mr. Lloyd graduated from Worcester Polytech, Worcester, MA, with a degree in Electrical Engineering.

DONALD E. LONG is Director of Power Management for the Public Utility District of Grant County. He has an extensive background in electrical operations and management. He has worked for Grant County for 15 years, 11 of them in the power planning and operations area. He has a degree in electrical engineering from Washington State University.

KAHLER MARTINSON is representing the Columbia River Citizens Compact, an organization of private citizens of which he has been a member and president. He is presently the Executive Secretary for the Columbia Basin Fish and Wildlife Council made up of the state and federal fish and wildlife agencies in the Columbia Basin. He formerly worked for the U.S. Fish and Wildlife Service in the Northwest and has degrees in Fish and Wildlife Management from South Dakota State University and the University of Missouri.

DONALD MOOS is Director of the Washington State Department of Ecology. Prior to this appointment, Mr. Moos held a variety of positions in which water-related issues have figured, including Deputy Regional Administrator of the Environmental Protection Agency (1972-1973), Special Assistant to Governor Daniel J. Evans for Natural Resources (1973-1975), Director of the Washington State Department of Fisheries (1975-1977), and Fisheries Coordinator for Clallam, Douglas,

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