The Role of Science in Water Management in Washington State

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ABSTRACT

The Columbia Basin Project provides irrigation water to farmers in Eastern Washington State. Construction started in 1936, but the second half of the project as originally envisioned has not been built. This part of the project, the East High Canal, has been the subject of intense political debate and scientific controversy for decades. In this paper, the role of scientists and experts in the decades-long discussion over the East High Canal is explored. Three critical moments in the discussions are described, focusing on the ways in which scientists and experts participated in and influenced the political debate over the canal. The first attempt to build the canal ended in 1983, after experts could not agree on the calculation of costs and benefits. The second attempt began in 1985 and ended in 1994 after salmon in the river were listed under the Endangered Species Act. In 2001, the state legislature decided additional water storage was needed, and a third attempt to build the canal began. In all three instances, disagreement among experts regarding important aspects of the project allowed elected officials to postpone the decision about whether or not to build the irrigation canal. The uncertainties about the costs and benefits of the canal, and later about the impacts on salmon survival, were not resolved. Agreements between stakeholders over the allocation of costs and the distribution of water have not found broad support in the expert communities. This has prevented the emergence of a durable consensus around the basic facts and trade-offs of the project. Future attempts to develop this canal will have to consist of attempts to arrive at a basic level of agreement among experts on how to assess the costs and benefits of the project, and its impacts on salmon survival.

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1. Introduction.

1.1 Science and Policy

Irrigation planning is increasingly important given the prevalence of water shortages. At the same time, water management has become very difficult in the context of the uncertainties created by climate change, environmental degradation and complex legal decisions. As our knowledge and understanding of water supply and demand increase, the ability of planners to use technical knowledge effectively seems to decrease. The expertise of biologists, hydrologists and engineers is increasingly questioned and challenged in courts. While proposed interventions into natural systems are usually based on scientific information, interpretations of this information regularly conflict, as do the values and interests of the groups affected by these interventions. This leads to situations in which scientific knowledge is plentiful, but solutions to environmental problems are not implemented.

There is rapid growth in the number of ways in which information can be conveyed or used to organize opposition to the construction of a new dam. Both sources of complexity make it exceedingly difficult for planners, citizens and policymakers to take full advantage of the scientific information that is available about specific environmental problems. The ability of technical experts, local stakeholders and elected officials to make decisions that are supported by all of these groups is crucial to the success of environmental planning. This paper offers an analysis of the ways in which expertise has influenced irrigation planning in the Columbia Basin Project over 60 years. Between 1945 and 2008 the Eastern part of the State of Washington has been transformed from a desert to a productive agricultural community. This paper is an attempt to understand and draw lessons from shifting

interactions among scientists, policymakers and citizens and at the same time to inform future large scale irrigation projects, in the state of Washington and beyond.

1.2 The Columbia Basin Project

The United States Congress authorized the construction of the Columbia Basin Project (CBP) in 1943[1]. The Bureau of Reclamation was given the task of constructing an irrigation system that would draw water from the Columbia River and irrigate 1,029,000 acres. Currently, the CBP irrigates approximately 671,000 acres. This makes it the largest single irrigation project in the United States. The Bureau of Reclamation (USBR) submitted the original feasibility study to Congress in 1945. This formed the blueprint for the construction of the CBP. Based on this study, most of the remaining 400,000 acres were supposed to be served by a single, main irrigation canal, called the *East High Canal*.

In the decade following the authorization, the East Low Canal and the West Canal were built. The latter was finished in 1955. In the following decades the Bureau of Reclamation studied various designs of the East High Canal. While awaiting completion, the State of Washington issued water rights to farmers in the area, particularly the Odessa Sub-Area, so they would have access to irrigation. Groundwater wells were dug and a thriving agricultural business community developed, mainly around growing and processing potatoes.

In 1984 the Bureau organized a public meeting to initiate preparation of an Environmental Impact Statement for the construction of the East High Canal. In 1989

[1] Unless otherwise noted, the general information on the Columbia Basin Project is from the Ortolano, L., Kao Cushing, K., and Contributing Authors. 2000. *Grand Coulee Dam and the Columbia Basin Project, USA*, case study report prepared as an input to the World Commission on Dams, Cape Town, www.dams.org

the Bureau of Reclamation submitted a Draft Environmental Impact Statement, for what is sometimes referred to as the *second half* of the CBP. During the interactions leading up to the DEIS in 1989, it became clear that further expansion of the CBP would be very complicated and highly contested. One very visible opponent to further development was Professor Norman K. Whittlesey of Washington State University. His analysis of the projected costs and benefits of the Second Half of the CBP indicated that there would be no net benefit. The presumed costs and benefits of the project remained an issue through all subsequent discussions of the East High Canal.

A special committee on water conservation appointed by the USBR, in consultation with the Washington Department of Ecology[2], reviewed several initial design options in 1986 and offered recommendations. The USBR continued to study three alternatives in the DEIS: a no-build option, the East High Canal and an expansion of the existing East Low Canal.

In response to concerns raised at that time, The Bureau of Reclamation developed a *Fish and Wildlife Plan*. In 1991 and 1992, three species of salmon on the Snake River were listed under the Endangered Species Act of 1972. Many of the comments received in conjunction with preparation of the DEIS focused on anadromous fish since the proposed alterations to the river could result in lower salmon survival rates. The USBR submitted a supplement to the DEIS in 1993, addressing concerns about these fish by dedicating 1,6 Million Acre Feet (MAF) to

[2] USBR, 1989, Draft Environmental Impact Statement: Continued Development of the Columbia Basin Project Washington, Boise, Idaho. September, 1989

in-stream flow[3]. This water would remain in the Columbia River and be released at critical times to assist fish migration.

A Final Environmental Impact Statement was never released. In August of 1994 a public letter from the USBR indicated that a final decision would be deferred until more information was available[4]. At the time, USBR found that the East High did not have a sufficiently positive cost-benefit ratio to justify building it. The alternative to expanding irrigated acreage, by developing the East Low Canal, was no longer feasible due to the listing of anadromous fish under the Endangered Species Act. This put a moratorium on new diversions from the Columbia River.

In 2003, two scholars from Washington State University released a review of the potential economic effects of an ongoing water shortage in the Odessa Subarea, the area that was supposed to be served by the East High Canal[5]. The groundwater wells that were supposed to be a temporary source of irrigation-water until the East High Canal was completed were running dry at alarming rates. Dr. Sanjoy Bhattacharjee and Dr. David Holland, both with the Washington State University, Pullman, outlined different economic scenarios associated with the loss of potato-production and processing in the area. In one, regional sales were projected to decline by $630 million, regional income by $211 million, and 3,600 jobs would be lost. In this period, Washington State Governor Gary Locke entered into renewed discussions with lawmakers, interest groups and experts in an attempt to address a number of

[3] USBR, 1993, Supplement to the Draft Environmental Impact Statement: Continued Development of the Columbia Basin Project Washington, Boise, Idaho. September, 1993
[4] USBR, 1994, Letter from James V. Cole to the public. 2 August 1994
[5] Bhattacharjee, S and Holland, D. The Economic Impact of a Possible Irrigation-Water Shortage in the Odessa Sub-Basin: Potato Production and Processing. June 6th, 2005, Working Paper Series, WP 2005-4.

water-related issues in the state. These discussions resulted in the Columbia River Initiative (CRI), an agreement built around a number of management scenarios and the allocation of new water rights. In 2004 the National Research Council of the National Academies of Science issued a review of the existing science related to hydrology and fish survival in the Columbia River[6]. This review contained an appendix on the CRI's management scenarios and concluded that additional permits could be issued under certain circumstances. This led to a lifting of the moratorium on additional withdrawals from the Columbia River (in place since the listing of certain endangered salmon species).

The CRI was signed into law in 2006 under the newly elected Governor Chris Gregoire as the Columbia River Basin Resource Management Bill. One of the priorities under this bill is the delivery of water from the Columbia River to the Odessa Subarea. USBR is currently studying several ways of fulfilling this priority, including the construction of the East High Canal and expansion of the East Low Canal. This would constitute a third attempt to construct the Canal.

2. Research Question and General Framework.

2.1 Research Question

Based on this history of disagreement over environmental impacts and economic costs -- and the role scientists have continued to play in this conflict --, the question I seek to answer is. *How does the participation of scientists in public decision-making, particularly in the case of managing a river basin, influence the way*

[6] Committee on Water Resources Management, Instream Flows, and Salmon Survival in the Columbia River Basin *Managing the Columbia River. Instream Flows, Water Withdrawals, and Salmon Survival.* 2004, National Research Council, The National Academies Press, Washington, D.C.

the public (or other stakeholders) defines the resource management problems facing the community or selects appropriate solutions? To answer this question, I will build on work in three different fields: public dispute resolution, science/technology studies (STS), and public policy-analysis. Combining ideas from these three fields, I will define environmental decision-making as a series of interactions among stakeholders in a political setting that is complex, continually changing and often characterized by conflicting values and interests regarding desired outcomes and the best ways of achieving them.

The cases I propose to study involve the three separate efforts to develop the Columbia Basin Project. The assumption underlying my research is that the participation of scientists in public decision-making has an impact on the ways in which various stakeholders view the situation and assess potential courses of action. The history of the development of the second half of the CBP, as it is commonly recounted in various publications[7] and in my interviews with many of the stakeholders involved, suggest that scientists played a number of important roles. The scientific and technical complexity of the Columbia Basin Project has generated what might be seen as conflicting narratives regarding the appropriateness and usefulness of various policy approaches to managing the resources of the Basin.

Throughout the lifetime of the project the analysis of costs and benefits has also played a major role in discussions about the need to continue, as well as the direction the project should take. The narrative of the Grand Coulee Dam, the

[7] The main example here is probably the report by the World Commission on Dams: Ortolano, L., Kao Cushing, K., and Contributing Authors. 2000. *Grand Coulee Dam and the Columbia Basin Project, USA*, case study report prepared as an input to the World Commission on Dams, Cape Town, www.dams.org

centerpiece of the CBP as a "multi-purpose" dam,[8] has given rise to detailed forecasts of a wide variety of impacts on the natural, social and economic systems of which the dam is a part. The different outcomes of various cost-benefit analyses at different points in time allow for a comparison of the ways in which these various studies (and their creators) shaped the public decision-making process. The anadromous fish that migrate up and down the river have been counted and recounted many times. By studying three different approaches to constructing the same project in the same exact setting (at three different times), I hope to be able to understand the different ways in which scientists participated and shaped the thinking of others, particularly through their repeated studies of the fish population.

The first case study reviews the initial efforts to develop the East High Canal in the 1960's and '70's. These were halted in 1984. The second case study describes a renewed attempt by the Bureau of Reclamation to get permission to build the East High Canal. This ended in 1994 when the USBR declared that it lacked sufficient information to move forward. The third effort began with the Columbia River Initiative and continues today.

Thus, all three public decision-making efforts occurred in the same physical location, albeit in somewhat different legal, natural and cultural contexts, at different times. Changes in the legal context, as well as the addition of a great deal of new environmental legislation, altered the decision-making process profoundly. The ecological context changed as a result of continued development and the effects of the section of the CBP that was built. The cultural context changed as a result of increased environmental awareness, and other important socio-cultural shifts. I want

[8] Ellsion, K.D., *The making of a multiple purpose dam: engineering culture, the U.S. Bureau of Reclamation, and Grand Coulee Dam, 1917-1942* MIT Dissertation, 2000.

to understand the changing role of scientists in this constantly shifting setting, particularly the ways in which the information scientists provide is or isn't accepted as "fact."

2.2 General Framework

2.2.1 Public Dispute Resolution

Dispute resolution in the public sector has long been the focus of political scientists, legal scholars and political philosophers. In recent years, a sub-field of public dispute resolution has emerged within the broader arena of negotiation and conflict resolution. (cf. Susskind[9], Forester[10], Bingham[11], and Moore[12]) Drawing on the literature in public dispute resolution, ongoing efforts to develop the EHC can be regarded as a *distributional dispute*, a disagreement with a *" (...) focus on the allocation of funds, the setting of standards, or the siting of facilities (including how we use our land and water)."* (Susskind and Cruikshank, 1987: 17). To view the history of irrigation planning in the State of Washington as a distributional dispute suggests that interested stakeholders have tried to justify their claims and undercut the claims of others using different kinds of arguments and by amassing different kinds of information. This frame differs from a purely legal or technical analysis of the history of the EHC. In a public disputes framing of the EHC controversy, scientists are just one more group of stakeholders, broadly described as experts who are asked to

[9] Susskind, L and McKearnan, S. (1999) *The Evolution of Public Policy Resolution* in: he Journal of Architecture and Planning Research, Vol. 16 Issue 2, pp. 96-115
[10] Forester, J. (1992) *Envisioning the Politics of Pubic-Sector Dispute Resolution* in: Law, Politics and Society Vol. 12, pp. 247-286
[11] O'Leary, R. and Bingham, L., (eds.) (2003) *The Promise and Performance of Environmental Conflict Resolution* Washington, DC: Resources for the Future Press
[12] Moore, C. (1996) The Mediation Process: Practical Strategies for Resolving Conflict. San Francisco, CA: Jossey-Bass Publishers (2nd edition).

provide a certain kind of advice at key moments. The role played by scientists, however, is more complex than the role played by most other stakeholders. Scientists and organized scientific interests often claim to be disinterested or skeptical of the claims of others[13], and *"Based on the assumption that the scientific method does indeed ensure the political neutrality of knowledge thereby produced, stakeholders in environmental conflict have crafted four important roles for science. These are the roles of science as a discoverer, mechanism of accountability, shield, and a tool of persuasion."* (Ozawa, 1996: 222). In the context of public dispute resolution, the concept of scientific neutrality (or the neutrality of knowledge) is challenged. I will explore this further below, for now, though, all that is important to note is that scientists are themselves stakeholders, play a variety of roles in environmental and other kinds of public disputes, and seek to direct the resolution of such disputes in ways that meet their interests.

In this paper, I will describe the participation of scientists in both behavioral and linguistic terms. In the behavioral sphere, I'm interested in how scientists' interact with stakeholders, that is, I'm interested in how they perform in decision-making settings including hearings, public meetings and other forms of direct interaction, *"For if the individual's activity is to become significant to others, he must mobilize his activity so that it will express during the interaction what he wishes to convey."* (Goffman, 1959: 30). In the linguistic sphere, when reports are written and verbal testimony is given, I'm interested in the language (and imagery) that scientists use to communicate with, and influence other participants. This division of the activities of

[13] These four institutional imperatives are described in: "The Normative Structure of Science," in R.K. Merton, *The Sociology of Science: Theoretical and Empirical Investigations* (Chicago: University of Chicago Press, 1973), pp. 267-278.

scientists into separate spheres is artificial in the sense that *" (...) the more we consider a statement not as a sentence (or proposition) but as an act of speech (out of which the others are logical constructions) the more we are studying the whole thing as an act."* (Austin, 1975: 20). The distinction between the two spheres calls for different methods for analyzing the participation of experts.

2.2.2 Science and Technology Studies.

The Mertonian[14] view of scientists as neutral, disinterested providers of knowledge provides a rather narrow and highly constrained definition of their role in decision-making. Indeed, this image of science has been challenged in recent years by specialists in Science and Technology Studies[15] (STS). The STS community views scientists in the same way that the public dispute resolution field does – as stakeholders. That is, they are individuals with values, interests and personal concerns whose views should not be assumed to be unassailable by other stakeholders. This is opposed to more traditional thinking, in which scientists are accorded a privileged role in performing a variety of organizational or managerial tasks in policy-making. STS specialists especially question the extent to which science and scientists ought to be given a privileged role in formulating problem-definitions or suggesting potential solutions.

I propose to study the ways in which scientists have participated in the dispute over the Second Half of the CBP by focusing on what scientists have said and done, without presuming that their participation requires them to play a specific role. By

[14] See: "The Normative Structure of Science," in R.K. Merton, *The Sociology of Science: Theoretical and Empirical Investigations* (Chicago: University of Chicago Press, 1973), pp. 267-278.
[15] In Jasanoff, S. et al., eds., *Handbook of Science and Technology Studies* (Thousand Oaks, CA: Sage Publications, 1995)

following the scientists[16] I expect to find ways in which the scientists have influenced decision-making that fall outside of the scope of the traditional science impact narratives described by Ozawa.

One role scientists are presumed to play is as framers of environmental disputes. How do experts influence problem definition and the formulation of what are presumed to be appropriate solutions in policy debates concerning the development of the irrigation infrastructure in the Columbia Basin Project? Martin Rein writes of framing: *" (...) as a particular way of representing knowledge, and as the reliance on (and development of) interpretative schemas that bound and order a chaotic situation, facilitate interpretation and provide a guide for doing and acting."* (Laws and Rein, 2003: 173). All actors in an environmental disputes engage in framing, but tracing the ways in which scientists and scientific information frames important elements of a dispute allows for new ways of understanding the role of scientists.

The ability of scientists to convincingly frame certain aspects of environmental disputes not only depends on their actions in the behavioral and linguistic spheres, but also on the resources they can use to establish and maintain their credibility. For scientists, credibility is crucial since the role of science in decision-making is commonly thought of as one of "truth telling." The authority of scientists is closely tied to their ability to establish and maintain their credibility. The resources and tactics available to those wanting to establish credibility are likely to be

[16] This approach was pioneered by Bruno Latour in his *Laboratory Life: the Social Construction of Scientific Facts* (1979) , with Steve Woolgar, and has developed into a sort of maxim in the field of science and technology studies.

very diverse[17]. The role of scientists in environmental disputes as *providers of interpretative schemas* is an important element of my analysis, and will be analyzed using the actions and language of the scientists in my three case studies.

2.2.3 Public Policy Analysis

An important resource to establish credibility and authority is language. As Maarten Hajer writes: *"Determining the way a phenomenon is linguistically represented has repercussions for politically essential questions such as 'Who is responsible?', 'What can be done?', 'What should be done?'."* (Hajer, 2002: 62). [18] To analyze who is responsible, what the problems and potential solutions are and how these actually changed during the development of the CBP, I will draw on the work of John Kingdon, in which public decision-making is seen as involving multiple streams of activity including *the definition or framing of problems, the search for and assessment of possible solutions, the engagement of various participants and the creation of a range of choice opportunities*.

Taking this perspective, I will analyze the various linguistic representations used by the scientists involved and try to discover how their statements empowered or (dis)enfranchised other stakeholders, or altered the prospects or style of participation of others. The scientific publications that underlie the DEIS from 1989, the supplement to the DEIS from 1994 and the Appraisal Level Analysis from 2007 provide material for this portion of my research, as do the Impact Assessments themselves. The main questions I will ask are what were the most prominent linguistic

[17] This methodology of studying credibility draws heavily on S. Shapin, "Cordelia's Love: Credibility and the Social Studies of Science," *Perspectiveson Science* 3 (1995), pp. 255-275.
[18] (2002), *Discourse Analysis and the Study of Policy Making*, in: European Political Science, Autumn 2002, pp.61-65.

representations of key issues (such as the calculation of the costs and benefits associated with possible infrastructure enhancements, the likely impacts on anadromous fish, and the probable effects on other habitats), and if there were competing representations offered by other stakeholders, how were such differences used by the parties or resolved.

2.3 Research Methods

The question of who is considered an expert or a scientist cannot simply be answered by examining the professional affiliations of the stakeholders. Credibility of a stakeholder flows not just from the organization he or she works for or is affiliated with. Another approach to defining who is an expert is by asking stakeholders whom they perceived as experts and why. But as Maarten Hajer points out *"(...) conflicts are not to be conceptualized as semi-static plays in which actors have fixed and well memorized roles of an environmentalist, policy-maker, scientist, or industrialist. On the contrary, environmental politics becomes an argumentative struggle in which actors not only try to make others see the problems according to their views but also seek to position other actors in a specific way."* (Hajer, 1995: 53). This realization regarding a lack of fixed roles becomes even more important given the long period over which the dispute about the EHC transpired. Perceptions about what is and is not science, the proper role of science in society and the reliability of scientific information changed dramatically between 1950 and today. Following the work of Thomas Gieryn, I will argue that the boundary between science and society is messy, contentious and has practical significance in everyday life, or in his words that *"(...) no demarcation principles work universally and that the separation of science from*

other knowledge producing activities is instead a contextually contingent and interest-driven pragmatic accomplishment drawing selectively on inconsistent and ambiguous attributes." (Gieryn, 1995: 393). So, in trying to determine who is an expert I will describe the context in which information was offered, the discourse that was used to convey that information, and the perceptions of other actors regarding the information provided (and its producers).

Interviewing a range of participants has allowed me to assemble descriptions of interactions that took place in the behavioral sphere. I will be using information available from the Environmental Impact Studies as well as other sources including the report on the Grand Coulee Dam and Columbia Basin Project published by the World Commission on Dams in 2000[19]. The Environmental Impact Statements provide transcriptions of what was said at public meetings. They also provide information about the ways in which people interacted at meetings. Other secondary sources, such as the report by the World Commission on Dams, contain important accounts of the decision-making process. In addition, still other stakeholders have commented on these documents in great detail and added their own impressions about the decision-making process. Finally, I have conducted seventeen semi-structured interviews with the main scientists and stakeholders. Using all these sources, I have analyzed the discourse, and tried to pinpoint problem definitions and suggested solutions. This assessment comprises my analysis of the linguistic sphere of the development of the Second Half of the CBP.

[19] Ortolano, L., Kao Cushing, K., and Contributing Authors. 2000. *Grand Coulee Dam and the Columbia Basin Project, USA*, case study report prepared as an input to the World Commission on Dams, Cape Town, www.dams.org

3. The First Attempt to Complete the East High Canal.

3.1 Historical Description

3.1.1 Construction and Repayment

The construction of the Grand Coulee Dam officially started on July 16th, 1933[20]. The debate over the exact costs of this project and how these would be recovered predated that event and played an important role in the continued development of the Columbia Basin Project. The Columbia Basin Anti-Speculation Act of 1937[21] outlined how part of the costs of the Columbia Basin Project were to be repaid by the irrigators, organized in irrigation districts that were to be formed. In 1943, additional legislation[22] passed stipulating that USBR could only develop infrastructure after contracts that outlined methods of repayment were signed with landowners. This linked the construction of the infrastructure directly to irrigators' willingness and ability to repay part of the cost. The calculation of these costs therefore became a highly contentious issue. After years of negotiations, in 1945 the landowners in the Columbia Basin signed contracts with the Bureau of Reclamation that detailed how they would repay the government for the construction of the irrigation project that was made possible by the Grand Coulee Dam. In these contracts the landowners formally "hired" the Bureau of Reclamation to construct the Columbia Basin Project. The farmers agreed to repay about 25% of the irrigation cost, or $85,465,000, to the government over a 51-year period[23]. Part of the costs of the Grand Coulee Dam was to be repaid using the income from electricity generation. The

[20] Pitzer, P.C. (1994) *Grand Coulee: Harnessing a Dream,* Pullman, WA., Washington State University Press. Page 74.
[21] Columbia Basin Anti-Speculation Act of 1937, Passed on May 27, 1937, (50 Stat. 208).
[22] Columbia Basin Project Act of 1943, Passed on March 10, 1943, (57 Stat. 140)
[23] Sheperd, J.F. (2002) *The Benefits and Costs of the Columbia Basin Project: Earlier Perspectives and Changing Perceptions* in: Agricultural History, Vol. 76, No. 2, Water and Rural History, pp. 463-480.

calculation and allocation of these costs was central to the long conflict that followed between the irrigation districts and the Bureau of Reclamation.

3.1.2 Slowdown and Rising Cost

During the 1950's, rising costs associated with the need for drainage infrastructure slowed down the project and forced a renegotiation of the contracts between the landowners and the Bureau of Reclamation. The Bureau claimed it could no longer fund new construction, and farmers said they were unable to (re)pay more[24]. The cost of constructing the Grand Coulee Dam and the CBP was estimated at $740 million in 1954[25], and was projected to continue to rise. The repayment-issue returned to the forefront in 1957, when Reclamation Commissioner Dexheimer proposed a renegotiation of all contracts, and stated that all construction on the project would slow down in 1963 and stop in 1968 if Reclamation did not receive additional funding[26]. The actual negotiations started again in 1959, although farmers were very skeptical about Reclamation's claim that drainage costs had increased dramatically: *"Because of the existence of drainage ditches that were dry at least in part, farmers were convinced that the drainage program was based on guesswork. The revision of the estimate of costs from 8.2 million dollars to 44.5 million dollars for the entire million-acre project strengthened this viewpoint, and the unwillingness of the Bureau of Reclamation to guarantee that the revised estimate would cover costs of all*

[24] The history of repayment contracts is extremely complex and highly contested. A detailed description of this history is available in: Pitzer, P.C. (1994) *Grand Coulee: Harnessing a Dream,* Pullman, WA., Washington State University Press. Page 74.
[25] Moley, R. (1954) *What Price Federal Reclamation?* New York, American Enterprise Association, Inc., p. 44.
[26] Pitzer, P.C. (1994) *Grand Coulee: Harnessing a Dream,* Pullman, WA., Washington State University Press, page 298.

drainage crystallized the issue." (Macinko, 1963: 192). After almost a decade of negotiations, a new contract was signed between the irrigation district and USBR that altered the schedule for repayment and transferred maintenance and operations of the facilities from the Bureau to the districts[27]. Shortly afterwards, the Columbia Basin Commission ceased to exist, and Federal funding was cut since the operation and maintenance of the project was now in the hand of the de-centralized irrigation districts.

3.1.3 Stagnation and Conflict

At this point, about half of the acreage that was originally envisioned was irrigated using water from the Columbia Basin Project. Toni Rae Linenberger describes this period as follows: *"In the 1960s and into the 1970s, area farmers pressured Reclamation to bring water to more and more land within the project. Two things stood in the way of further development. When originally constructed, the Bacon Siphon and Tunnel were constructed to half their design capacity with provisions for enlargement by construction of a second siphon/tunnel at a later date, but the cost of modification was far beyond what planners had anticipated during the project planning stage. In addition, only six pumps were originally installed in the pumping plant, and as with the siphon and tunnel, the costs of installing the six remaining pumps threatened the feasibility of expanding the project."* (Linenberger, 1998: 11). Expecting that these two challenges would be overcome, the Washington State Department of Ecology issued temporary water permits to use groundwater in the area to be served by the East high Canal. Federal funding for the construction of

[27] Pitzer, P.C. (1994) *Grand Coulee: Harnessing a Dream,* Pullman, WA., Washington State University Press, page 307.

the Second Bacon Siphon and Tunnel was increasingly unlikely given the reluctance under the administrations of Lyndon Johnson and Richard Nixon to spend more on the Columbia Basin Project. Six additional pumps that were needed were installed, but only as replacements for existing pumps. These new pumps also generated electricity when capacity was needed by allowing water to flow back down. These so-called "pump-generators" were considered necessary to supply the growing demand for electricity, and were funded and installed between 1973 and 1979. The discussion over the construction of the Second Bacon Siphon and Tunnel was again linked to the issue of repayment, since this infrastructure did not yield any benefits for electricity generation.

In December of 1975 the State of Washington allocated $15 million for the construction of the Siphon and Tunnel. The Bureau of Reclamation was only allowed to use these funds if the system were large enough to allow for full development of the Second Half of the CBP and if construction commenced within 2 years[28]. On October 9th, 1976 construction started. The Columbia Basin Project Act required that USBR sign contracts with the landowners prior to the delivery of water. After the construction was completed in 1980, no settlement had been reached, and the Siphon and Tunnel were not used. In 1982 the Bureau signed new contracts with two of the three water districts, and water delivery began. This construction project was the last major piece of infrastructure built as part of the irrigation system of the Columbia Basin Project and signified the end of the first phase in the struggle over the development of the East High Canal. In the following section I will describe the

[28] Elder, E.E. (1985) *Economic impacts of irrigation development in Washington* PhD dissertation, Washington State University.

controversy over the costs and benefits of the CBP, and in particular the role scientists and experts played in this controversy.

3.2 Analysis of Expert Participation

3.2.1 Benefit-Cost Analysis

The farmers in the Columbia Basin questioned the expertise of the Bureau of Reclamation as early as 1959, in relation to the drainage ditches and the costs associated with providing additional drainage infrastructure[29]. This was a hotly contested issue as it shaped discussions about repayment and maintenance charges. This challenge did not, at the time, appear to fundamentally alter the development plan for the CBP for the simple reason that a significant part of the project had already been built. During the discussions about continuation of the development, particularly after the decision to install the "pump-generators", the cost-benefit question became the topic of public debate in which a variety of scientists participated. The pump-generators would surely generate electricity, so their benefit was hardly questioned. These machines were also able to pump enough water to irrigate the entire 1,029,000 acres. This is when the debate over the benefits and costs of additional, irrigation-specific, infrastructure, namely the Second Bacon Siphon and Tunnel, erupted.

During this phase, the description of the ways in which the costs and benefits of the East High Canal should be calculated, had a critical impact on the decision-making. From the beginning of the project, the allocation of costs was a contested issue, and many different ways of representing costs and benefits were proposed. The debate over costs and benefits was mentioned often in the comments on the Draft

[29] See the article by George Macinko quoted on page 17 for additional details.

Environmental Impact Statements, in part because of the highly publicized criticism offered by several scientists, among others the aforementioned testimony by Prof. Whittlesey in 1983. The history of differences between the way cost/benefit analysis is used by the US Army Corps of Engineers, the US Bureau of Reclamation and the US Department of Agriculture[30] suggests that quantification is intimately related to issues of power and decision-making: *"Cost-benefit analysis was intended from the beginning as a strategy for limiting the play of politics in public investment decisions. (...) The transformation of cost-benefit analysis into a universal standard of rationality, backed up by thousands of pages of rules, cannot be attributed to the megalomania of experts, but rather to bureaucratic conflict in a context of overwhelming public distrust."* (Porter, 1995: 189). In the case of cost/benefit analysis as a method of representing the trade-offs associated the East High Canal, the politics of quantification played out between the Bureau of Reclamation and opponents to continued development of the CBP. This description of the history of cost-benefit analysis shows that the relationship between politics and scientific expertise is critical to understanding how decisions are made. In the Columbia Basin Project, the discourse in the scientific publications, the impact statements and the comments sheds light on the ways in which the participation of scientists has influenced the public's understanding of the trade-offs involved in the Columbia Basin Project. The Bureau of Reclamation published a briefing document in 1984, outlining a two-phase development of the East High Canal as the preferred option for completion of the CBP. This briefing document was introduced to the State Legislature, which was voting on a proposed bond measure that would provide $100 million to fund ongoing

[30] T. Porter, *Trust in Numbers* (Princeton, NJ: Princeton University Press, 1995), Ch. 7 ("U.S. Army Engineers and the Rise of Cost-Benefit Analysis"), pp. 148-189.

development of the CBP. The briefing document included a calculation of the benefits and costs associated with both phases of the development. Federal agencies were allowed to use a 3% interest rate for the calculation of costs and benefits, even though the actual interest rate at the time was 8.125%. At 3% the Bureau of Reclamation calculated that the complete development of the CBP, which would deliver water to an additional 539,000 acres, would yield a benefit/cost ratio of 1.44 to 1. At an interest rate of 8.125%, this ratio would be 0.53 to 1, meaning that the costs would outweigh the benefits[31]. As early as 1978[32], Prof. Norman Whittlesey had argued that "Social Overhead Costs" had to be incorporated into the calculation of costs and benefits of irrigation development: *"SOC are those cost incurred beyond the primary costs of a project, but which are required to further the economic or social development of the project area."* (Whittlesey et al, 1978: 663). These included the costs of *"*(…) *additional roads, water and sewage facilities, fire and police protection, refuse collection, etc."* (Whittlesey et al, 1978: 663). The projected development of the East High Canal would also result in significant electrical costs, since the diverted water could no longer be used for hydropower production, and would actually require electricity to pump water from the reservoirs to higher ground. The loss of hydropower production capacity would increase the SOC of the East High Canal since electricity rates would increase. The cost of constructing the EHC would therefore amount to $1,978 per acre of additional irrigated land. Including these social overhead costs into the benefit/cost analysis of developing the EHC would result in a negative benefit/cost analysis even at the 3% interest rate. These different visions of

[31] See: Table 5-4 in: USBR, (1984) *Briefing Information on the Continued Development of the Columbia Basin Project*

[32] Whittlesey, N., Gibbs, K., and Butcher, W. (1978) *The Calculation of Social Overhead Capital Costs of Irrigation Development in Washington State* in: Water Resources Bulletin, Vol. 14, No. 3.

calculating the costs of irrigation development played important roles in the discussion over whether or not the State of Washington should fund part of the development of the East High Canal.

3.2.2 Behavioral Sphere

The relationship between the farmers and the Bureau of Reclamation was complex and often conflict-ridden, as exemplified in the distrust over the Bureau's estimates about the likely cost of drainage and their demands regarding repayment. In his history of the Grand Coulee Dam, historian Paul Pitzer describes a public meeting that took place in 1960, attended by the Commissioner of the Bureau of Reclamation, Floyd Dominy, and a group of citizens: *"In a three-hour meeting in Pasco with about 200 present, Dominy fielded angry questions. When one farmer shouted, "Don't try to get money out of us because we haven't got it," the others cheered."* (Pitzer, 1994: 302). Commissioner Dominy's presence at a meeting like that, presumably to explain and defend Reclamation's point of view, is remarkable since this was only one of the many efforts Reclamation was involved in at the time. These meetings allowed for direct interaction between engineers, civil servant and other experts of the Bureau and the local citizens, which gave citizens an opportunity to directly question those responsible. In Washington DC, the House Interior and Insular Affairs Committee held hearings on a bill intended to prevent the drainage charges from increasing. In this forum the farmers were told to *"Go home and work out your problem with the Bureau of Reclamation."* [33]. This conflict between Reclamation and the farmers was largely confined to meetings in the Columbia Basin and occasional public hearings on

[33] Wenatchee Daily World, (May 10, 1960) pp. 1, quoted in: Pitzer, P.C. (1994) *Grand Coulee: Harnessing a Dream,* Pullman, WA., Washington State University Press, page 304.

Capitol Hill. As early as 1955, the issue of the benefit-cost ratio for the CBP also attracted attention outside those circles. In that year Raymond Moley, a Professor at Columbia University, a former Assistant secretary of State and journalist wrote the following; *"I have little faith in more commissions and surveys and reports. We have had plenty of those, and few people read them or, in fact, read newspaper accounts of them. Meanwhile, the Department of the Interior, the congressmen and senators who come from reclamation states, and the people and organizations in those regions which have benefited at the expense of the nation are annually pouring out a flood of arguments for more irrigation of arid lands. The solution is to bring real and sufficient facts to the people in the great taxpaying states."* (Moley, 1955: vii). Moley delivered these *real and sufficient facts* in the form of a special issue of *National Economic Problems*, published by the American Enterprise Association, the predecessor of the American Enterprise Institute. Moley argued that accounting practices used by Reclamation were hiding the fact that reclamation projects were heavily subsidized. He calculated that power-users and taxpayers were underwriting a $115,000 subsidy per 160-acre farm in the CBP[34]. The notion of ratepayers subsidizing the irrigation project through payments for hydropower remained a powerful theme throughout the subsequent discussions of the East High Canal.

The next, highly publicized, attempt to question the benefit-cost ratio was Prof. Whittlesey testimony before the Washington State House of Representatives. In the words of historian Paul Pitzer: *"Norman K. Whittlesey dominated the hearings subsequently held by the House of Representatives. He testified against the project and accused local people in the area, sprinkler dealers, bankers and professionals, of*

[34] Moley, R. (1955) *What Price Federal Reclamation?* No. 455 in the Series "National Economic Problems" Pubished and Distributed by the American Enterprise Association.

backing the construction only because they hoped to benefit financially." (Pitzer, 1994: 328). Whittlesey's objection to the project was detailed in his 1978 journal article on social overhead costs. His objection to the development of the EHC based on his calculation of the costs was well publicized in the newspapers in the state of Washington. The projected increase in electricity rates was outlined in the *Columbia Basin Herald* (Jan. 19, 1984), the *Wenatchee World* (Jan. 15, 1984), the *Grant County Journal* (Jul. 12, 1984) and the *Tri-City Herald* (Oct. 26, 1985). According to historian Paul Pitzer, the director of the Bureau of Reclamation James Cole was quoted in the *Columbia Basin Herald* as saying that he could not argue with Wittlesey's numbers[35]. This is remarkable given the differences between the cost/benefit analysis that was submitted by the Bureau and the one by Whittlesey.

3.2.3 The Linguistic Sphere

The benefit-cost ratio of the construction of the East High Canal was contested before, during and after the construction of the Second Bacon Siphon and Tunnel. An Associated Press newswire story indicated that the *"Second Bacon Siphon and Tunnel Project is surrounded by a dollars-and-cents controversy, and the atmosphere is much different from the one that greeted its predecessor: the Columbia Basin Project.* (…) *The siphon-tunnel is like a faucet. The problem is that some irrigators aren't sure they want to pay for the hose – the miles of new canals, pumping plants, waterways, laterals, and drans* [sic] *necessary to get the water to individual*

[35] This statement is in footnote 100 to Chapter 18 on page 471 of Pitzer, P.C. (1994) *Grand Coulee: Harnessing a Dream,* Pullman, WA., Washington State University Press, but I was unable to locate the actual newspaper-article or find the exact quote mentioned anywhere else.

farms."[36]. The discourse of costs and benefits was used in this portrayal, although the disagreement was mostly about the allocation of the costs, not the calculation. This difference between agreement over allocation and calculation is critical. The new agreement between the irrigation districts and the Bureau showed that agreement could be found regarding how to allocate the costs. For this agreement, these costs were not re-calculated. The calculation of the costs of the EHC remained a contested issue that prevented the legislators from making a final decision on the EHC. Even though scholars like Whittlesey appeared to have an impact on decision-making through their compelling use of the cost-benefit analysis method, this was less a function of his estimate of the costs than the decision-makers unwillingness to move forward with the EHC without a better notion of the relative merits of the proposal. In the end, the ongoing controversy over the costs and benefits of the EHC was not resolved in a clear way. The state of Washington did not authorize funding to start the work on the East High Canal, as they did for the Second Bacon Siphon and Tunnel. The reasons the legislators had for voting against the bond-measure that would have funded the EHC are difficult to ascertain, but the state did fund the Bureau of Reclamation to start an environmental impact study for the EHC. The idea of constructing the EHC must have seemed appealing to enough legislators to vote for a continuation of the research on the project. This was the beginning of the second attempt to build the Second Half of the Columbia Basin Project.

[36] Kuglin, J. (February 2nd, 1977) The Associated Press.

4. The Second Attempt to Build the EHC

4.1 Historical Description

4.1.1 The Draft Environmental Impact Statement of 1989

In 1984, the State of Washington's legislature voted against issuing $100 million in bonds to fund the development of the EHC. In a concession to the Columbia Basin Development League and other proponent of further development, $100,000 was made available for the Bureau of Reclamation to develop a more detailed feasibility-study of the EHC. Scoping meetings for the EIS were conducted in four locations and described by the Bureau as follows; *"The public expressed particular interest in issues related to the strengthening and expanding the agricultural economy. Among other key areas of interest were (1) trade-off issues involving irrigation diversions versus hydropower production and other instream uses, (2) market structure impacts in the region and nation from increased agricultural production, (3) fish and wildlife issues, and (4) alleviating aquifer drawdown."* (USBR, 1984: 6-1). The Bureau then hired CH2M, an engineering and consulting firm to execute the feasibility study and write the Environmental Impact Statement. The original timeline included the publication of a draft of the EIS in 1987, but its publication was postponed several times. One of Prof. Whittlesey's doctoral students wrote a dissertation entitled: *Economic Impacts of Irrigation on Development in Washington* in 1985 in which he pointed out that *"The project farmers were the only group which showed direct benefits in excess of costs."* (Elder, 1985: 19). The loss of electricity production capacity downstream as a result of additional diversions for irrigation significantly contributed to Elder's calculation of a net loss in the benefit/cost analysis of construction of the EHC.

Finally, in September of 1989, the Bureau of Reclamation published the Draft Environmental Impact Statement for the Continued Development of the Columbia Basin Project, Washington. The DEIS included three alternatives, namely a full build-out of the East High Canal, enlargement and extension of the East Low Canal, and a no-action alternative. The second alternative was described as the preferred one. The USBR estimated the total cost of development of the EHC at $2.6 billion, at January 1988 prices. The enlargement and extension would cost $331 million, and the farmers themselves would finance the laterals that would deliver water from the ELC to actual farmlands. The benefit/cost analysis of the preferred alternative showed a net benefit at an interest rate of 3%. In November of 1989 The Bureau of Reclamation organized three public hearings to allow the public to comment on the DEIS in Eastern Washington and Seattle. The comments received were predominantly in favor of completing the CBP, even though concerns about the economic and environmental impacts were voiced as well. It seemed like financial support from the State of Washington, and a new round of negotiations with farmers over repayment contracts were the only things needed to complete the EIS and finalize the development of the preferred alternative, and thereby finish the Columbia Basin Project.

4.1.2 Endangered Species Act

The decline of salmonid species in the Columbia River was documented as early as 1939, when the American Association for the Advancement of Sciences published *The Migration and Conservation of Salmon*. In 1978, the National Marine Fisheries Service (NMFS) carried out a review of the biological status of pacific salmon. In the first half of the 1980-ies the Northwest Power Planning Council drafted

the first plans for the recovery of salmon in the Columbia, mainly through allocating water for the augmentation of flow in the river during critical times as part of a "water-budget". The decline in the number of salmon migrating up and down the Columbia continued, and in 1990 a consortium of environmental organizations filed a petition to list pacific salmon under the Endangered Species Act. In response to this petition, the NMFS published a paper outlining how the organization intended to define the various species and sub-species of salmon that were found in the Columbia and Snake Rivers. The concept Evolutionary Significant Unit (ESU) was introduced by Robin Waples, a scientist at NMFS, as: *"(...) a population (or group of populations) that: 1) Is substantially reproductively isolated from other conspecific population units, and 2) Represents an important component in the evolutionary legacy of the species."* (Waples, 1991: 2). The life-cycle of salmon made this an important distinction, since different groups of salmon spawned in different locations within the Columbia River watershed. This diversity was not reflected in the widespread practice of increasing salmon stocks through hatcheries. So in this delineation, salmon that originated from hatcheries were not automatically considered part of the ESU. This created complexities in the Pacific Northwest, where hatcheries had been used to increase salmon stocks for over a century. But the ESU concept, as outlined by NMFS, prevented the use of hatcheries as the single strategy to protect fish species. Habitat would also have to be improved, and hydropower and harvesting would have to be addressed. This multi-pronged strategy became known as the 4-H strategy for hatcheries, habitat, hydropower and harvesting. This strategy was not expanded into a broader framework to analyze the relative impact of each of these methods to improve salmon survival, nor were they critically compared to each other

or additional strategies. This lack of stable knowledge accumulation about the different salmon recovery strategies continued to play a role in the discussions over how to restore salmon populations, or mitigate the impacts of infrastructure. On November 20, 1991, NMFS declared Sockeye Salmon in the Snake River endangered under ESA. On April 17, 1992, Snake River Spring/summer Chinook salmon and Snake River fall Chinook were listed as threatened. Since then, 52 different salmonid ESU's have been identified, of which 13 in the Columbia and Snake Rivers are considered threatened or endangered[37]. This development forced the Bureau of Reclamation to review its Draft Environmental Statement for the Continued Development of the Columbia Basin Project.

4.1.3 The Supplement to the Draft Environmental Impact Statement

After pacific salmon was listed as an endangered species, the Bureau provided a supplement to the DEIS of 1989. This SDEIS, as it became known, was published in 1993 and outlined the impacts on salmon of the additional withdrawals from the Columbia River. These withdrawals would be needed to irrigate the 500,000 acres that would be served by constructing the second half of the Columbia Basin Project. In addition to the perceived impacts, the SDEIS also outlined two plans to mitigate these effects through a variety of measures. These mainly consisted of flow-augmentation during critical times, namely the spring migration period. Both plans would require changes to the operation of reservoirs, basically to store more water in the spring, and then use part of that water for irrigation, and part of it for flow-augmentation. Alternative 2A would provide 1.6 million acre-feet (MAF) of water

[37] See Appendix B.

for flow augmentation in the spring, and Alternative 2B would provide 216,000 acre-feet. The first number was based on the maximum amount the Bureau of Reclamation could make available and still meet contractual obligations with power producers and other parties, and the second amount equaled the proposed withdrawals for irrigation purposes as part of the EHC. In addition to these flow augmentation proposals, the SDEIS included language on the creation of additional fish and wildlife habitat areas. The additional restrictions on the production of hydropower that would result form the re-operation of the reservoirs and dams made significantly increased the projected costs of the development of the irrigation infrastructure. The Bureau of Reclamation presented the SDEIS to other agencies, but did not solicit comments from the public at large. And then, *"On 2 August 1994, Reclamation sent out a public letter to stakeholders interested in the fate of the EIS process related to the continued development of irrigated farmland on the Columbia Basin Project. In this letter, James Cole, Manager of the Upper Columbia Area Office, stated that a decision had been made "to defer further action on the DEIS [Draft EIS] until more information concerning" the new emphasis on water conservation by Reclamation and the uncertainty regarding flow requirements for threatened and endangered species was available."* (WCD, 2000: 122). This was the end of the second attempt to complete the development of the Columbia Basin Project.

4.2 Analysis of Expert Participation

4.2.1 Listing of Salmon

The historical decline of salmon runs in the Columbia River system has numerous causes. The National Marine Fisheries Service (NMFS) mentions a host of

causes in its technical memos *"overfishing, irrigation diversions, logging, mining, grazing, obstacles to migration, hydropower development, and questionable management practices and decisions"*[38]. The broad coalition of environmental groups that petitioned for he listing of the spring, summer, and fall, Chinook salmon on the Snake River consisted of Oregon Trout, Oregon Natural Resources Council, Northwest Environmental Defense Center, the Idaho and Oregon Chapters of the American Fisheries Society, and American Rivers. The NMFS decision-making process regarding the listing of species hinges on two questions; 1) Is the entity in question a "species" as defined by the ESA? and 2) If so, is the "species" threatened or endangered?[39].

The first question is difficult to answer with regards to pacific salmon, given the different species of fish that share this moniker. As Robin Waples of NMFS explains in a footnote: *" The term Pacific salmon has traditionally referred to species of the genus Oncorhynchus, five of which (O. gorbuscha, O. keta, O. kisutch, O. nerka, and O. tshawytscha) occur in North America. The recent decision to move the western trouts from the genus Salmo to Oncorhynchus calls this usage into question."* (Waples, 1991: 14). The scientific community had struggled with the definition of salmonids prior to the 1991 petition, as evidenced by the 1981 article *Biological Criteria for definition of species and distinct intraspecific populations of anadromous salmonids under the U.S. Endangered Species Act of 1973* by Fred Utter from the School of Fisheries at the University of Washington, Seattle.

[38] NOAA Tech Memo NMFS F/NWC-200: Snake River Chinook Salmon, http://www.nwfsc.noaa.gov/publications/techmemos/tm200/int.htm last accessed on 04/18/08.
[39] NOAA Tech Memo NMFS F/NWC-200: Snake River Chinook Salmon, http://www.nwfsc.noaa.gov/publications/techmemos/tm200/int.htm last accessed on 04/18/08.

The second question, whether or not the species is threatened is answered through calculations of the fish stocks, which was relatively simple, given the dramatic declines that had been witnessed in the area. The participation of scientists in the debate over the listing of salmon species under the ESA was crucial in the second attempt to construct the EHC. The decision to list the species significantly increased the projected costs of constructing and operating the EHC, since the additional diversions of Columbia River water would have to be mitigated. The scientific debate over how to define species also impacted the repertoire of mitigation actions that could be undertaken by the agencies, since hatchery fish were not considered part of the Evolutionary Significant Units, or ESU's.

4.2.2 Behavioral Sphere

The National Marine Fisheries Service solicited public comments on Utter's 1981 paper on the biological criteria used to define salmonid species and continued to discuss the issue in ESA Technical Committee meetings. In June of 1990, the United States Fish and Wildlife Service and NMFS organized a workshop on Vertebrate Populations to *"* (…) *develop a consistent approach for determining whether vertebrate populations are "distinct"* [emphasis in original, TvM] *under the Act."* (Waples, 1991: 14). The NMFS then released an interim policy[40] on the subject and solicited public comments on that document. Agency personnel from NMFS and USFWS reviewed the final manuscript that became the Final Policy outlined in a

[40] Waples, R. *Interim Policy on Applying the Definition of Species Under the Endangered Species Act to Pacific Salmon* (56 Federal Register 10542; March 13, 1991).

Technical Memorandum[41]. In a separate Technical Memorandum on the status of Sockeye Salmon, Waples describes a decision tree (See Appendix B for the full decision-tree) regarding the listing of sockeye. In case Sockeye salmon is found to be an ESU, the only choice available is to list it as endangered[42]. This image shows the direct link between the identification of salmon as an ESU, and the listing as an endangered species. The numbers of fish that were found in the headwaters of the Snake River had declined into single[43] digits in the early 1990-ies. The ESU-designation of the "wild" salmon by the experts from NMFS, and the decision to separate it from hatchery-born salmon therefore triggered the ESA-listing.

4.2.3 Linguistic Sphere

The focus of the debate over salmon explored the different ways in which the population could be restored, given that hatchery-fish were not considered part of the ESU. The dramatic decline in salmon was attributed to a number of causes, and this debate took center-stage. The discussion was held in scientific journals, in the newspapers, and throughout the State of Washington, and continues to this day. The agencies NMFS and ACOE and other organizations, like American Rivers, that were involved in the recovery efforts based their claims on different scientific articles. In 1991, when Chinook and Sockeye Salmon were listed, the Washington Post described the controversy as follows: *"The decline of the salmon runs of the Columbia and its*

[41] This description of the history of the policy is detailed in Waples, R. (1991) *Pacific Salmon, Oncorhynchus SPP., and the definition of "species" under the Endangered Species Act.* In: Marine Fisheries Review, Vol. 53, Issue 3, pp.11-25 The Technical Memo itself is available at: http://www.nwfsc.noaa.gov/publications/techmemos/tm194/waples.htm Last accessed on 04/20/2008.
[42] See figure 1 in NMFS Technical Memo 195, available at http://www.nwfsc.noaa.gov/publications/techmemos/tm195/tm195.htm Last accessed on 04/20/2008.
[43] Kenworthy, T. (1991) *U.S. Designates Sockeye Salmon an Endangered Species.* In: The Washington Post, Nov., 15, 1991.

tributaries, including the Snake and Salmon rivers, involves a complex web of factors including overharvesting and habitat destruction. But a major reason, according to most experts, is the hydroelectric dams constructed beginning in the 1930s (...) However, utilities, industries that rely heavily on cheap power and the federal agencies that control the dams and the power they produce are likely to fight any solutions that rely too heavily on drawing down those reservoirs. "Dams are not the only problem," said Jack Robertson, deputy administrator of the Bonneville Power Administration, "It's a huge, complex biological cycle and you could blow up the dams and still drive the fish to extinction." [44]. This description of the debate over causes of the decline, and potential avenues for the restoration of the salmon runs holds true to this day. In 1996, the National Research Council weighed in with the publication of *Upstream: Salmon and Society in the Pacific Northwest.* In this report, the NRC offered specific recommendations for the rehabilitation of salmon. The first recommendation was the creation of a *Scientific Advisory Board to Address the Salmon Problem* (NRC, 1996: 348). This board would specifically address the fundamental question related to salmon survival: *"The effectiveness of flow augmentation is difficult to appraise because annual flow volume is determined by nature, not humans; in essence the information comes at a rate of one data-point per year. A compilation of studies done in the 1970s constitutes the only data set available (Sims and Ossiander 1981), and it is sparse and unsatisfactory in the view of all participants."* (NRC, 1996: 351). The most common alternative to flow-augmentation was transportation. This method consisted of catching young salmon upriver, putting them in large trucks and then releasing them downstream. This is far

[44] Kenworthy, T. (1991) *U.S. Designates Sockeye Salmon an Endangered Species.* In: The Washington Post, Nov., 15, 1991.

cheaper than flow-augmentation, and was supported and carried out by the US Army Corps of Engineers and NMFS. These agencies argued that flow augmentation was not proven to significantly increase survival rates of young salmon migrating down the river, and that trucking the salmon allowed for clear quantification of the number of salmon that survived the migration. The ongoing scientific uncertainty over the relative efficacy of both strategies promoted conflict about what approach to take to restoration. It also effectively put all efforts to further develop the CBP on hold, since the likely effects of each mitigation strategy could not be verified.

5. The Third Attempt to Build the EHC

5.1 Description of Recent History

5.1.1 Columbia River Initiative

The two decisions made in the early nineties, namely the moratorium on additional water rights for withdrawals from the Columbia River (as a result of their listing as endangered) and the Bureau of Reclamation's decision to temporarily halt development of the EHC, were both deeply unpopular in the Eastern part of Washington. The use of water from the Columbia River remained a highly divisive political issue, and both Republican and Democratic elected officials advocated for a management plan for the Columbia River that would satisfy environmental groups, power producers, irrigators and Native American Tribes.

In an attempt to restore the salmon-runs in the Columbia River, the U.S. Congress had created the Northwest Power Planning Council in 1980[45]. One of the

[45] The Pacific Northwest Electric Power Planning and Conservation Act (aka Northwest Power Act) of Dec. 5, 1980, 94 Stat. 2697. Public Law No. 96-501, S. 885.

Planning Council's tasks was to develop and implement the Columbia River Basin Fish and Wildlife Program to *" protect, mitigate and enhance the fish and wildlife, including related spawning grounds and habitat, of the Columbia River and its tributaries, particularly anadromous fish which are of significant importance to the social and economic well-being of the Pacific Northwest and the Nation and which are dependent on suitable environmental conditions substantially obtainable from the management and operation of Federal Columbia River Power System and other power generating facilities on the Columbia River and its tributaries."* (Northwest Power Act, §2(6), 94 Stat. 2698, 16 USC §839). The listing of several species of salmon as endangered forced the Planning Council to review its strategies and plans, and an independent group of scientists was asked to review the Columbia River Basin Fish and Wildlife Program and its scientific underpinnings in 1994. A group of scientists, funded by the Bonneville Power Administration and calling itself the "Independent Scientific Group" prepared a report entitled, "Return to the River: Restoration of Salmonid Fishes in the Columbia River Ecosystem." This was presented to the Planning Council in 1996[46], several public hearings were organized in which the writers of the report answered questions and a shorter version was published in Environmental Law in 1998[47]. This report criticized the scientific underpinnings of both the recovery plan and the moratorium, and suggested an alternative way of managing the Columbia River and the salmon recovery efforts -- based on ecological principles – that could be described as an adaptive management approach to the Basin as a whole.

[46] This report is available online at: http://www.nwcouncil.org/Library/1996/96-6/ Accessed on: 04/02/2008.
[47] Williams, R. et al. (1998) *Return to the River: An Ecological Vision for the Recovery of the Columbia River Salmon* in: Environmental Law, Vol. 28, Issue 503.

In October of 1997, the State of Washington's Legislature lifted the moratorium on new appropriations of Columbia River water with the stipulation that an instream resources protection program had to be adopted by the Department of Ecology prior to the acceptance of water rights applications[48]. This instream resource protection program was never developed, but the Department started reviewing individual applications for water rights on a case-by-case basis anyway. These were quickly challenged in court, and parties on all sides continued to be dissatisfied with the management of the Columbia River. In 2002, the Department of Ecology was instructed by Governor Locke to develop a "Columbia River Initiative" to develop a comprehensive approach to the management of the Columbia River. The Initiative consisted of a series of negotiations between the stakeholders in the management of the Columbia River. The negotiations produced several recommendations, including a contract with the National Academy of Sciences to *"review existing science to determine what conditions Columbia River fish need to thrive and survive, and to advise Ecology about whether those conditions are affected by water use."*[49]. The Columbia River Initiative also included a provision that required the WADOE to study ways in which the groundwater irrigators in the Odessa Subarea could use surface water from the Columbia River to reduce the decline of the regional aquifer. This effectively started the third attempt to develop the Second Half of the Columbia Basin Project.

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[48] Engrossed Subsitute House Bill 1110, An act relating to water resources, can be accessed online at: http://www.leg.wa.gov/pub/BillInfo/1997-98/Pdf/Bills/Session%20Law%201997/1110-S.SL.pdf Accessed on 04/02/2008

[49] Press release by the Washington Department of Ecology, 10/22/2002, accessed on 02/04/2008 via: http://www.ecy.wa.gov/news/2002news/2002-197.html

5.1.2 National Academies Report

The National Research Council published *Managing the Columbia River: Instream Flows, Water Withdrawals, and Salmon Survival* in 2004. The report provided a nuanced description of the available information on salmon survival in the Columbia River but remained ambiguous: *"Clear understanding of how additional water withdrawals are likely to affect salmon species and their habitat is thus precluded by many factors.* (…) *Moreover, there are competing models and paradigms, and not all scientists agree on the fundamental relationships among such parameters as flow, temperature, predation, and salmon survival rates."* (NRC, 2004: 22). Despite this ambiguity, the authors of the report recommended certain actions in relation to the water-rights issue: *"With increases in water diversions - both in upstream areas and in the middle reach of the Columbia River – water available to salmon will diminish unless other regulatory programs, such as the requirements of the Endangered Species Act, will be triggered. These trends suggest that water resources managers and decision makers in the Columbia River Basin would be well advised to explore ways to better manage existing water supplies, create more flexible management regimes, and better manage the numerous risks and uncertainties that attend salmon and water management."* (NRC, 2004: 144). Not all stakeholders considered this report to be authoritative, or even accurate. The Columbia-Snake River Irrigators Association published a memorandum outlining the perceived shortcomings of the report: *"Prepared for WADOE, the NRC/NAS report on the impacts of future Columbia River water right withdrawals and water management has been haunted by a lack of quantitative explanation, or more appropriately termed, "Empirical Science"."* (Olsen, 2005: 1). The environmental community responded in

very different terms. Karen Allston of the Center for Environmental Law and Policy said, *"We are delighted that this distinguished panel of scientists has clearly stated that the Columbia River is tapped out during the critical summer months, something we have believed to be true for some time."* [50]. Despite these differences in how the report was perceived, the Columbia River Initiative continued. After the election of a new Governor, Chris Gregoire, the Initiative was renamed the Columbia River Water Management Program (CRWMP). In 2006, the discussions between the Governor, environmental organizations, agricultural organizations and tribal representatives resulted in a package of water management measures that was submitted to the state legislature as House Bill 2860. The bill received broad support in the House and unanimous support in the Senate. The CRWMP directed the Washington State Department of Ecology (DoE) to *"aggressively pursue development of water supplies"* [51]. Any new water supplies that were developed as part of this program would be divided into 2/3 for out-of-stream uses (such as irrigation and domestic water use) and 1/3 to augment instream flow (to improve salmon survival). This division allowed new diversions from the Columbia River, and with it a renewed effort to develop the East High Canal.

5.1.3 Odessa Subarea Special Study

The Columbia River Water Management Program resulted in a Memorandum of Understanding between WADOE and USBR to conduct the Odessa Subarea

[50] Press Release, American Rivers, *Stop Additional Water Withdrawals During Summer Months to Protect Salmon, National Science Panel Concludes*, (Mar. 31, 2004), Accessed on 04/02/2008 http://www.amrivers.org/index.php?module=HyperContent&func=display&cid=2741

[51] Engrossed House Bill 2860, Washington State Legislature, Chapter 6, Laws of 2006, Columbia River Basin – Water Supply.

Special Study. According to the agencies: *"The U.S. Bureau of Reclamation and Ecology are investigating continued phased development of the Columbia Basin Project. The investigation, known as the Odessa Subarea Special Study, focuses on project development for the purpose of replacing groundwater currently used for irrigation in the Odessa Ground Water Management Subarea with surface water."*[52] The depletion of the Odessa-aquifer in eastern Washington State has been occurring at such a rapid rate that most of the local, state and federal officials involved agree that the dependence on groundwater in the Odessa Subarea should be reduced significantly within the next 5-10 years. If the water table in this area continues to drop at the rate it has for the last decade, which has been about 10 feet per year, the water supply for municipalities, industries and agriculture in the region will be compromised. The Odessa Subarea Special Study will have to lead to a solution supported by the United States Bureau of Reclamation (USBR) as its preferred alternative and accompanied by an Environmental Impact Statement that is required under the National Environmental Protection Act (NEPA) of 1972. In the last 2 years the Bureau has cooperated with the Washington State Department of Ecology (DoE) to develop a set of options for the storage and supply of water from the Columbia River to the Odessa Subarea. During this study, these agencies used various sources of scientific and technical information and organized participatory forums to create a list of potential options to deliver water from the Columbia River to the Odessa Area to relieve the use of groundwater.

To develop the scope of the OSSS and the initial list of alternatives to be considered, the Bureau used the Project Alternative Solution Study (PASS) decision-

[52] Washington Department of Ecology website, accessed on 04/03/2008. http://www.ecy.wa.gov/PROGRAMS/wr/cwp/cr_odessa.html

making process[53]. This did not result in a final decision regarding what is or is not constructed in the area, but it framed the potential outcome by defining the objectives of the planning process and a limited set of alternatives to be considered. An "Objectives Team" that consisted of several stakeholders representing the major interest groups related to the Columbia River developed the objectives for the planning process. This group essentially formulated the goals and scope of the Special Study. These objectives are: to replace the groundwater with CBP water, to maximize the use of existing infrastructure, to retain the possibility of a full build-out of the CBP, to address endangered species and to provide recreational benefits[54]. A "Technical Team" that consisted of personnel of the Bureau of Reclamation, the Washington Department of Ecology and two Irrigation Districts developed the alternatives or solutions that will be considered during the planning process. The results of the PASS process were presented to the general public in a workshop and to several audiences in the Odessa Subarea in October 2006. Following the identification of these initial alternatives, the Bureau of Reclamation analyzed the alternatives. Four different options were developed to transport Columbia River water from the River to parts of the Odessa Subarea. Additional water storage capacity is needed too, since spring run-off has to be captured to allow for irrigation in the summer months. A total of 11 different storage options were outlined in the PASS-report. USBR announced in October of 2007 that one alternative for water delivery to the Odessa Subarea would be investigated further, and three alternatives to store water. This option for

[53] For a detailed description of the PASS process and the supporting documentation, go to: http://www.usbr.gov/pn/programs/ucao_misc/odessa/index.html Last accessed on: 04/28/08.
[54] These objectives are described in *Initial Alternative Development and Evaluation Odessa Subarea Special Study*, September 2006, USBR. Obtained through http://www.usbr.gov/pn/programs/ucao_misc/odessa/report-alternatives.pdf on 10/14/2007 and can be found in Appendix A.

water delivery consists of the construction of the Northern part of the East high Canal, and the expansion of the Southern part of the East Low Canal. The Environmental Review process for this new attempt to build part of the EHC will start in the fall of 2008.

5.2 Technical Committees and the Governance of Science

5.2.1 Salmon survival

The listing of three species of salmon as endangered and 10 species as threatened forced all decision makers in the Columbia River Basin to address this issue when discussing any proposed development of the river. According to the Bureau of Reclamation, the second attempt to build the East High Canal was interrupted because of a negative benefit–cost analysis[55]. The additional costs imposed because of protective measures for salmon played a significant role tipping the balance. But the effects of listing these species spread far beyond the East High Canal. The hydropower dams in the River were considered detrimental to the species, and their continued operation was therefore called into question. The report commissioned by the Northwest Planning Council should be seen as an important attempt by a stakeholder to bring scientific authority to the discussion on salmon survival. Scientific journals had been publishing articles on salmon survival since the early 1970's, but as the NAS report indicated, the complexity associated with salmon lifecycles seems to have obstructed any stable scientific consensus on the detailed causes of salmon survival and necessary actions to improve it. For example, several months after the NAS report was published, a group of biologists and ecologists

[55] Correspondence between author and USBR employee, 01/15/2008.

published an article in the journal Science[56], warning that the practice of using hatcheries to replenish salmon stocks in the Columbia River posed severe risks for the species' chances of survival. This shows that the discussion over the status of hatchery salmon, that was crucial to the listing of several ESU's, was still unresolved. A year after the publication of the NRC report, the journal Environmental Law published *"The Supreme Court of Science" Speaks On Water Rights: The National Academy Of Sciences Columbia River Report And Its Water Policy Implications"* [57]. As I described in the above section, the NRC report was actually very ambiguous when it came to water policy implications of its findings on salmon survival. To *"(...) better manage existing water supplies, create more flexible management regimes, and better manage the numerous risks and uncertainties that attend salmon and water management"* (NRC, 2004: 22) is far from a direct mandate to act in a particular way. Yet the response by the Columbia Snake River Irrigators Association indicates that not everybody accepted the report's findings. But the disagreement over the NRC report did not obstruct the agreement over the CRWMP and House Bill 2860. The centrality of salmon survival as a policy-issue in Washington State has seemingly decreased since the acceptance of Bill 2860. The CRWMP allowed both irrigators and environmentalists to claim victory. The former because they had secured additional water for irrigation, and the latter since more water would be available for flow augmentation during critical times of the year. The fundamental question of how much water is needed for flow augmentation to guarantee salmon survival remains unanswered, and may experts argue that other variables, such as the temperature and

[56] Myers, R. et al., (2004) *Hatcheries and Endangered Salmon,* in: Science. Vol. 303. March, 26, 2004.
[57] Benson, R. (2005) *The Supreme Court of Science" Speaks On Water Rights: The National Academy Of Sciences Columbia River Report And Its Water Policy Implications* In: Environmental Law, Vol. 35, Issue 85, Winter 2005.

nutrient load of the water are more important. But even as the decision to use 2/3 of any new water supply for out of stream uses, and 1/3 for instream uses seems to have little basis in scientific literature, it has allowed the Department of Ecology to issue new water rights and study new storage dams. In this case, the lack of a scientific consensus did not preclude a political consensus from emerging. The stability of this political consensus, especially given the history of litigation over salmon-issues, remains in doubt.

5.2.2 Behavioral Sphere

Scientists in this period of development of the Columbia Basin Project have taken on a number of different roles. Both the Independent Scientific Group and the National Research Council organized public meetings to solicit information from stakeholders, and in both reports the authors state that these resulted in valuable information. The NRC organized three public meetings in Washington State and one in Washington DC and invited experts and the general public to submit oral and written comments during and after those meetings. After those meetings the committee had two closed meetings to discuss the statement of work and the draft report. Since the report came out after these meetings, it is very difficult to ascertain the extent to which the comments actually impacted the report. But as the NRC's report states: *"Still, one group central to the committee's tasks did not speak – the various species of salmon, whose populations have been in general decline since the introduction of an industrial-based economy. But several people we visited with spoke on behalf of the salmon and n related environmental issues."* (NRC, 2004: ix). From

the perspective of Actor-Network Theory[58], the NAS report can be said to speak on behalf of the salmon species as well, since it forms an attempt to halt the decline of the species. Different groups such as American Rivers, NWF and several Native American Tribes have consistently advocated to better protect salmon species through the method of flow augmentation. The reaction by the CSRIA indicates that not all stakeholders agreed with the NRC report, and how it spoke on behalf of the salmon species. The efforts of the committee that wrote the NRC report to involve local scientists, policy makers and the general public in the process of developing the report, and the subsequent response from the CSRIA, seem to illustrate how difficult it is to produce a report that is broadly supported, even by "the Supreme Court of Science". The opportunities to submit comments were available, but the report didn't appear until after those meetings, and the diversity of opinions following the publication of the report indicates that stakeholders like the CSRIA did not feel their comments were taken into account.

To what extent this report actually impacted the policy making in the Columbia River is difficult to unravel, but from the major decisions taken since the report it appears that it has had a limited influence on those decisions. The Final Environmental Impact Statement for the Columbia River Water Management Program summarized the NAS report and stated that: *"The major theme of the conclusions drawn in the report is that there is scientific uncertainty in the importance of environmental variables on the survival of fish, and the allocation of existing water withdrawals is a policy decision."* (WADOE, 2007: 1-7). The

[58] See: M. Callon, "Some Elements of a Sociology of Translation: Domestication of the Scallops and the Fishermen of St. Brieuc Bay," in J. Law, ed., Power, Action, and Belief: A New Sociology of Knowledge? (London: Routledge and Kegan Paul, 1986), pp. 196-233.

Washington Department of Ecology prepared the EIS for the Columbia River Water Management Program. In the EIS, the 1/3-2/3 agreement on instream and out-of-stream uses of additional water storage was used as a benchmark to determine the amount of additional water storage that needs to be constructed. The out-of-stream uses are described in the EIS[59], and the amount of water needed for instream use is derived from that calculation. The construction of the EHC is presented as an option to relieve groundwater irrigators in the Odessa Subarea, since the decline of the aquifer has increased significantly over the last decade. The CRWMP EIS indicates that the USBR is conducting a separate Environmental Impact review to study all the options to relieve the pressure on the aquifer in the Odessa Subarea.

The Washington State Department of Ecology received 78 comment letters on the Draft EIS for the CRWMP, and organized four public meetings during which comments were taken[60]. These comments were from a wide variety of Tribes, federal agencies, state agencies, municipalities, non-governmental groups, and regular citizens. Most comment letters addressed several issues associated with the CRWMP[61]. The instream flow issue is mentioned 27 times, indicating that it has remained an important aspect, despite the political agreement on the 1/3-2/3split.

The boundary[62] between scientific information and policy decisions is particularly convenient for the Department of Ecology. It sidesteps the issues raised in the NRC report, and allows the EIS to formally incorporate the NRC's findings in its

[59] See Appendix C.
[60] For the Final Environmental Impact Statement on the Columbia River Water Management Program and the comments received on the Draft see: http://www.ecy.wa.gov/programs/wr/cwp/eis.html last accessed on 05/01/2008.
[61] For a more detailed breakdown of the issues mentioned in the comment letter, see Appendix D.
[62] I use boundary here in the sense described in: T.F. Gieryn, "The Boundaries of Science," in S. Jasanoff et al., eds., *Handbook of Science and Technology Studies* (Thousand Oaks, CA: Sage Publications, 1995), pp. 393-443.

report, while retaining decision-making authority over water rights decisions. The comments on the Draft EIS submitted by the Columbia Snake Rivers Irrigators Association (CSRIA) are informative on this issue of impact: *"The Programmatic EIS includes limited information regarding the efficacy of the NAS study, and prudently, the EIS authors do not attempt to overstate the study's findings and conclusions relative to the state's actions under a new Columbia River Water Management Program."* [63]. Given the vocal opposition of the irrigators association, it is important to note that House Bill 2860 that created the legal basis for the CRWMP codified the 1/3-2/3 division for instream and out-of-stream uses of any additional water supplies. The fundamental idea behind the compromise is that additional water storage can be built to capture spring run-off, and store it until the summer, when instream flow needs to be augmented to assist migration and farmers irrigate their crops. This split was mentioned nowhere in the NRC report, or any peer-reviewed publication on the survival rates of Columbia River salmon[64]. It is unclear if the additional water that will added to the instream-flow at critical times will be sufficient to lead to increased salmon survival during migration. There is no agreement on what the "correct" instream-flow is that guarantees salmon's survival as a species. So when WADOE states that there is scientific uncertainty over important environmental variables, that is in line with the NRC's findings. This opened up the opportunity for the stakeholders to negotiate an agreement on the allocation of water without being held to a certain amount, or any other clear benchmark. The statement on House Bill 2860 from environmental non-profit American Rivers describes the history of the bill as:

[63] Olsen, D. Comment nr. 30-5 in WADOE, Programmatic EIS for CRWMP, 2007.
[64] This statement is based on my own research of major US journals between 1990 and 2007, using LexisNexis, ISI Web of Science and JSTOR.

"The bill, which passed the legislature with overwhelming majorities in both chambers, was the product of negotiations among a small group of diverse stakeholders, including Washington Environmental Council and American Rivers." [65]. The scientists from the NAS were not involved in these negotiations, and the impact of their report is clearly marginal. In recent years, the conflict over salmon survival and the management of hydropower facilities has largely moved to the courts, where the Biological Opinions prepared by the US fish and Wildlife Service have been challenged. A coalition of environmental NGO's and Native American Tribes, headed by the National Wildlife Foundation (NWF) has argued that the Biological Opinion and the associated salmon recovery plan is insufficient to guarantee the survival of the endangered ESU's. Central to this disagreement is the management of hydropower dams on the Columbia and Snake Rivers. The NWF maintains that flow has to be augmented to aid salmon migration, whereas the agencies propose to aid salmon survival though a variety of measures that include constructing fish-ladders, spill-weirs and introducing hatchery-fish. The Ninth Circuit Court has found in favor of the environmental coalition in two instances, and the third draft of the BiOp remains under litigation[66]. The direct impact of the scientific efforts related to salmon affects the development of the Columbia Basin Project, which is separate from the hydropower system and litigation, mainly through the CRWMP, and this impact is modest compared to the ongoing research efforts associated with the hydropower system.

[65] Accessed through: http://www.americanrivers.org/site/PageServer?pagename=AMR_Columbiawaterbill on: 04/02/2008.
[66] For a detailed description over this legal struggle over salmon survival see: http://www.salmonrecovery.gov/

5.2.3 Linguistic Sphere

The publicity surrounding the ESA listing of the salmon species, the ongoing legal efforts of environmental NGO's and the NAS report have all contributed to making salmon survival an important political issue throughout the Pacific Northwest. The National Academy's Commission on Life Sciences published *Upstream: Salmon and Society in the Pacific Northwest* in 1996. This report concluded that long-term survival of salmon species depended on maintaining genetic diversity and the creation of an institutional framework that would operate at the right temporal and spatial scales to deal with salmon throughout the Pacific Northwest. These same themes are mentioned in the 2004 NAS report and the article in Science that pointed out that genetic diversity is not maintained by creating more salmon- hatcheries alone. The hatcheries were originally created to sustain the commercial salmon fisheries in the Pacific Northwest, and had been particularly controversial since Waples' finding that they did not contribute to the survival chances of "wild" salmon species..

Yet these themes of diversity and governance do not seem central to the public debate about salmon survival. This debate is usually cast in terms of removing obstructions to salmon migration, by breeching dams, or in terms of increasing the amount of water flowing through the river during spring and summer, by changing dam operations. In his *Compass and Gyroscope* Professor Kai Lee of the University of Oregon describes the role of science and law in this controversy in more detail, but for the purposes of this paper it is important to note that the "water for fish vs. water for people" frame that was tied to the need to increase flow at crucial times was essentially settled in Washington State, at least it seems to be for now, by the 1/3-2/3 split in the CRWMP.

6. Conclusion: Public Disputes, Expert Knowledge and Non-decision making

In 1943 the Columbia Basin Project was authorized for construction. Thirty-three years later construction began on the second Bacon Siphon and Tunnel, which would allow for the completion of the East High Canal. Today, thirty-two years later, the Bureau of Reclamation studies construction of the northern half of the EHC. The ongoing disagreement over the basic information about the benefits, costs and impacts of the construction of the East High Canal shows that expertise can only play a limited role in resolving public disputes. Between 1963 and now, a wealth of new information has been collected, published and discussed in relation to the EHC, yet no final decision has been made. The National Academies of Science published two lengthy reports that relate directly to the questions about salmon survival, management of the Columbia River and ongoing development, yet environmental organizations, irrigators and the public agencies remain at odds over some of the basic assumptions underlying the project. If anything, the history of the East High Canal shows the intractability of public disputes over infrastructure, and the limited capacity of expert knowledge in resolving these disputes. The first two attempts to construct the East High Canal both ended in a *non-decision*[67], meaning that the status-quo was preserved, without deciding to definitively scrap the plans to build the EHC. The debates about the costs and benefits of the project, and later the debate on the impacts on salmon survival, played an important role in those non-decisions, since the

[67] The importance of non-decisions and their role in the analysis of power was first described in: Bachrach, P. and Baratz, M. (1962) *The Two Faces of Power* In: The American Political Science Review, Vol. 56, Issue 4 (Dec. 1962).

uncertainty allowed decision-makers to simply push the project off, and requiring additional information to be gathered.

The Bureau of Reclamation's calculation of the costs and benefits of the first half of the Columbia Basin Project was contested as early as 1954 by Robert Moley and the American Enterprise Association. The partial repayment of the construction costs of reclamation projects by irrigators ensured that the costs of any additional construction would be an important issue, and experts within and outside the Bureau of Reclamation made their calculations. In 1982, when the Bureau of Reclamation signed new repayment contracts with two water districts, it seemed as though the conflict over the costs and benefits had been resolved. What had been resolved however, was the allocation of costs, not their exact calculation. The discussions over the repayment contracts were not based on an exact re-calculation of the costs, but on existing information, that was still contested. In 1983 the State of Washington legislature had to decide whether or not to fund a significant part of the construction of the EHC by releasing bonds worth $100 million. The Bureau of Reclamation and Prof. Whittlesey presented different calculations of the costs and benefits. The impact of the additional withdrawals on hydropower production and electricity prices was the main points of difference. Cost-benefit analysis was, and is, a very powerful frame for understanding the various aspects of infrastructure development. The language of cots and benefits was used in popular media to describe the questions surrounding the EHC. The dominance of the cost-benefit frame was used by both supporters and opponents of the project, as Whittlesey's testimony shows. The Bureau of Reclamation's calculation was unable to convince the Washington legislators to support the bond measure. Prof. Whittlesey's calculation was unable to convince the

same legislators that the EHC had no merit, since the legislature decided to fund additional research on the EHC. So the influence of the experts on the costs and benefits of the EHC was important, since it provided a basis for the decision to study the project further. The influence of the behavior of the experts was basically limited to existing forums for deliberation, either as expert witnesses in the Legislature, or in submitting papers to academic journals. It is difficult to establish if other types of behavior would have led to other outcomes, especially since the stability of the status-quo was reinforced because of the lack of agreement among experts. The role of cost-benefit experts in the first attempt to build the canal was one of maintaining stability. There was no clear consensus on how to calculate the costs and benefits of the EHC. This disagreement, and the complexity of a project of this scale allowed different experts to provide divergent calculations. This in turn allowed the elected officials in the legislature to not make a decision. There were ongoing discussions about how to calculate the costs and benefits, but during the negotiations over the repayment contracts these discussions were not incorporated. A more detailed analysis of the different methods of calculation during those negotiations could potentially have prevented the highly visible disagreement among experts in the Legislature. At a more conceptual level, the window of opportunity for the construction of the East High Canal opened because the farmers and the Bureau of Reclamation came to an agreement over the allocation of the costs of the Second Bacon Siphon and Tunnel. However, that same window closed because the calculation of the costs and benefits of the East High Canal remained fundamentally contested by experts that were considered reliable by the decision-makers. The *interpretative scheme* of cost-benefit analysis was provided and executed by a limited group of experts and was accepted

by the decision-makers as important to their process. The potential for disagreement over the application of this *interpretative scheme* had been apparent since Moley's early criticism in the 1950's, yet cost-benefit analysis remained dominant as a way of understanding the trade-offs involved in developing the EHC. The complex nature of the Columbia Basin Project and the Federal Columbia River Power System and the inherently conflicted relationships between power production and agricultural development in this system make the exact calculation of costs and benefits of intervention deeply, and permanently contested. Attempts to move beyond this disagreement to the allocation of costs briefly opened up a window of opportunity for discussions over the EHC, but the contests over costs and benefits quickly returned to the agenda and prevented a stable agreement on the EHC. Fundamentally, it should be questioned if the calculation of costs and benefits at an interest rate of 3% should be so dominant in the discussion over the merits of the EHC. There was widespread agreement that at the actual interest rates at the times, the EHC had a negative cost-benefit ratio. That did not, and does not, mean that the EHC has no significant benefits, but it does point to the dangers of an expert-driven decision-support tool like cost-benefit analysis.

The second attempt to build the East High Canal started with the additional research that the Washington State legislature called for and funded. This eventually led to the Draft Environmental Impact Statement of 1989. After the DEIS was made public in 1989, a new issue emerged, namely the listing of salmon as an endangered species. The fact that salmon populations in the Columbia River were struggling was hardly disputed among experts or laymen. However, the best way in which salmon

populations could be restored and protected was vehemently disputed among experts in the federal agencies and in universities. The debate over hatchery salmon versus flow augmentation is controversial to this day. Hatchery salmon are said to have an adverse impact on evolutionary processes within distinct salmon populations and flow augmentation is said to be an unproven hypothesis on salmon migration patterns. The Bureau of Reclamation supplemented the DEIS on the EHC with a detailed plan on how to ensure salmon survival in 1993, but never accepted comments on this supplement. Expert opinion was critical in determining several species as ESU's and declaring a moratorium on additional withdrawals from the Columbia River as a result. These developments made the construction of the EHC unfeasible. The moratorium on additional withdrawals, and the legal and scientific disputes over Pacific Salmon that have arisen since then show how the Endangered Species Act is a very blunt tool, especially in combination with profound scientific uncertainty to determine the relative efficacy of protective measures. Scientific uncertainty about salmon survival rates and instream flow in the Columbia River forced the USBR to temporarily halt their efforts and allowed the elected officials to call for additional research. The National Academies of Science summarized this additional research in two reports. Both of these reports essentially concluded that water management was a policy decision, only to be determined by elected officials. Clearly, the scientific community has an important role in salmon survival. It is unfeasible, and undesirable to force elected officials to make decisions on the survival of several species without a clear, or at least informed, notion of the state of knowledge on the impacts of that decision. The NAS report reiterated a traditional notion of a solid boundary between science and policy. Yet the decisions regarding delineating between the various

ESU's and the roles of hatchery fish and "wild" salmon show that the scientists have had a very direct impact on the policy-decisions in the Columbia Basin. The boundary between science and policy is already blurred and porous in the debate over salmon recovery. Reifying that boundary by moving all responsibility to elected officials is not conducive to resolving the underlying questions over how to protect the species. At a more conceptual level, the scientists in the salmon recovery debate have failed to provide any *interpretative scheme* to assist decision-makers in their thinking about the protection of species. The simple notion that more water at certain times of year is always beneficial to salmon survival is convenient. It does not take into account that decision-makers have limited resources, and will therefore want to use those in the most efficient way. Other ways of allocating those resources to aid salmonids, such as habitat restoration, efforts to reduce water temperature and pollutants have not been incorporated into a clear framework to support decisions. In a way, this behavior can be contrasted with the cost-benefit experts who have provided a very complex, and compelling frame to understand the impacts of the EHC.

The third and most recent attempt to build the EHC started in 2003, when the elected officials in the Washington Legislature made a decision about water management, in the form of the Columbia River Water Management Program, formalized in House Bill 2860. The decision to develop additional storage capacity and use 1/3 of the water for flow augmentation and 2/3 for out-of-stream uses did not have a clear basis in any particular quantified hypothesis about salmon survival. But the notion that increased flow during critical times is crucial to salmon migration has been continually advanced by fishery experts, and was present in the NAS-reports. Here scientific analysis had a direct impact on framing potential policy-options and

assessing potential outcomes. This framing has also limited the number of options that were deemed acceptable, and this limiting does not seem supported by the NAS report, which outlines a broad array of policy steps that could be taken, without providing clear information on the relative certainty about the efficacy of the different options. In relation to Kingdon's streams of the policy process, scientists were involved in all of these streams. The lack of a clear consensus on how to improve survival rates of migrating salmon is currently most visible in the litigation over the BiOp, but the decision over the 1/3-2/3 split did allow the elected officials to decide over the development of the EHC. This agreement has opened yet another window of opportunity for the decision about the EHC. Again, more research was considered necessary, and the USBR is currently conducting more studies on the EHC. It is unclear if this latest effort will lead to a definitive answer to the question of whether or not the EHC should be built. The agreement over the allocation of additional water that is yet to be stored is reminiscent of the earlier agreement over the allocation of costs. Without an agreed upon method to understand the exact impacts of this decision, an agreement between the stakeholders is used to move the decision-making process forward. It remains to be seen if a new Prof. Whittlesey will stand up to challenge the *interpretative scheme* that has been put forward by showing that this exact method can be used to come to the opposite conclusion. I doubt that any fisheries experts will come out and argue that flow-augmentation during the summer is bad for salmon survival. However, several fisheries experts already argue that flow is only one of the variables that need to be addressed to protect salmon. These experts find that water temperature, habitat quality and water quality are crucial as well. This will invariably complicate any decision about the construction of the EHC, but will

provide decision-makers with a more accurate notion of the impacts of the new infrastructure. The role of scientists and experts in this latest attempt to build the EHC cannot be analyzed yet, since it is still ongoing. The relationship between expert information and decision-making is complex. In the previous attempts to build the EHC, experts have profoundly impacted decisions by providing complex analyses of costs and benefits that resulted in different recommendations. At a later stage, fisheries experts have provided complex analyses of salmon survival methods, that have resulted in a broad recommendation to increase flow. Neither one of these *interpretative schemes*, nor the recommendations that followed from them have resulted in a final decision over the construction of the EHC. This points to the complex nature of the relationship between science and policy. The basic recommendation that flows from this analysis of the history of the EHC is that this relationship needs to be managed carefully to ensure a sound understanding of the potential impacts of a decision, without getting mired down in endless discussions over the exact application of a particular method of analysis. How to manage this relationship to achieve these decisions has been a topic of intense scholarly discussion, and this paper adds a basic insight to that discussion, namely that the boundary between science and policy constantly changes. The overly deterministic information provided by the cost-benefit analysts prevented effective decision-making since users of the method disagreed over its application. The overly simplistic information on flow-augmentation and salmon survival is preventing effective decision-making, since it obscures a host of other potential measures from scrutiny. Somehow, successfully spanning the boundary between science and policy depends on providing a detailed frame of analysis, that is robust, stands up to scientific

evaluation, and provides meaningful choices to decision-makers. The various interests groups and communities of experts in the Columbia Basin have not been able to assemble such a comprehensive method of analyzing the construction of the East High Canal.

From the history of the debate over this irrigation canal, it seems clear that the idea to build it is very persistent. The stability of this idea has mainly been caused by the fact that the area that is supposed to be irrigated by the canal has actually been developed into irrigable farmland using groundwater. This has created a powerful constituency for the development of the canal, one that is likely to continue to put this issue in the political agenda. The ability of elected officials to point to uncertainty over the complex aspects of the plan, namely the calculation of its costs and benefits and the impacts on salmon survival, has worked as a counterweight to those interests. The construction of the EHC has been on the political agenda in Washington in one way or another for three decades, and the role of science in public decisions has changed. Interest groups that are in favor of the EHC, and those that are against it, have all contracted studies and assembled evidence. The impact of the scientists and experts on the decision-making has been to maintain the status-quo. The ongoing discussions among experts about various aspects of the EHC has led to increased funding for research, and no clear decision about what to do. If the scientific community is to be regarded as an interest group, it has to be considered very successful at promoting its interests in the EHC. It is hard to determine how the behavior and discourse of individual scientists impacted the decision-making over the EHC. At the level of the scientific community, it is far easier to see how disagreement and debate have contributed to ongoing political stagnation and non-decision-making.

In trying to unravel how the interaction between scientists and other stakeholders affects policy-decisions, I have found that the behavior and language of scientists and experts has effectively removed the decision to build the EHC from the political agenda several times. The notion that science can play other roles in decision-making process as well remains important, yet this has hardly been the case in the discussion over the development of the East High Canal.

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Appendix A Endangered Species Act status of West Coast Salmon and Steelhead

Endangered Species Act Status of West Coast Salmon & Steelhead

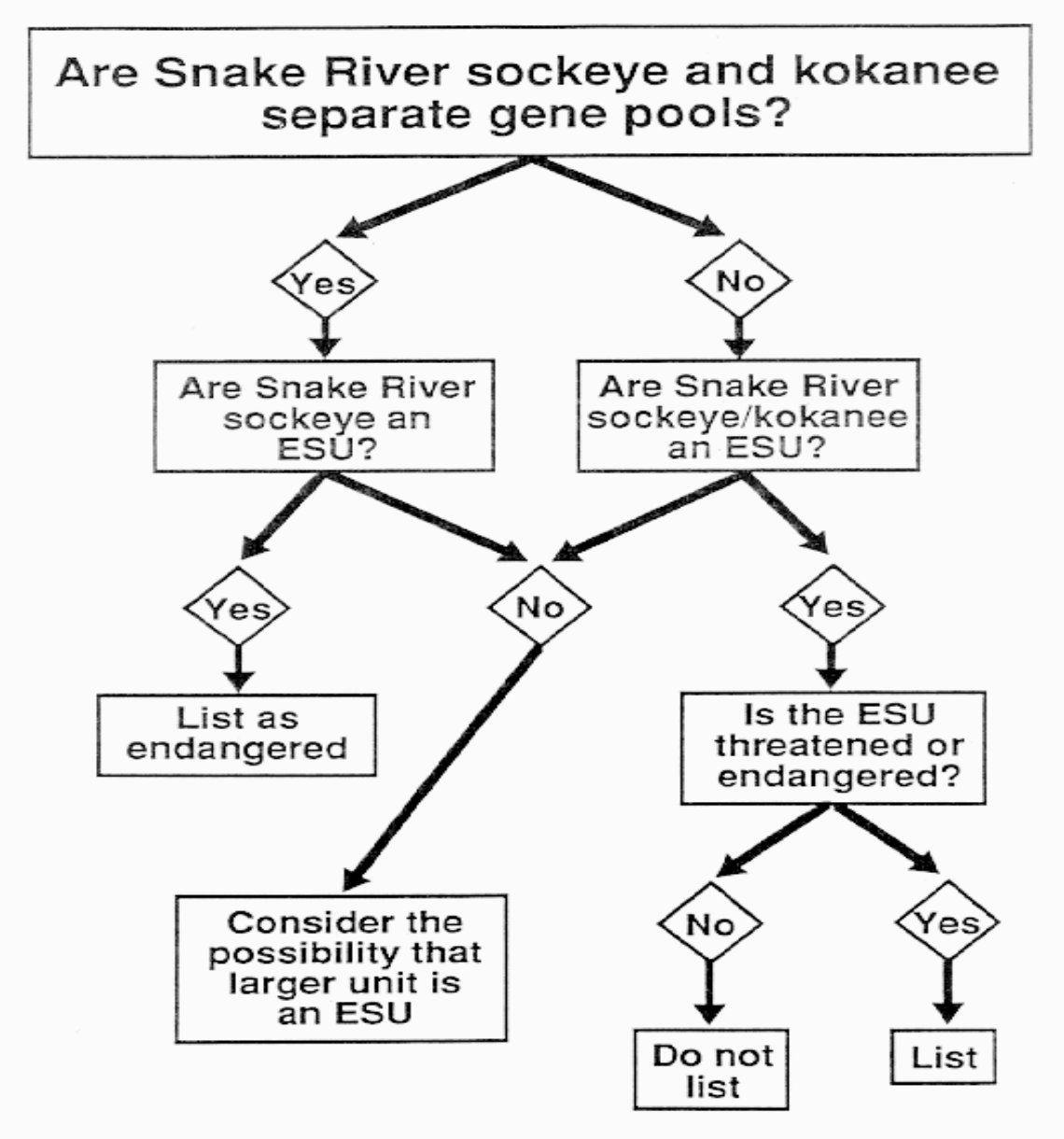
(Updated Feb. 26, 2008)

Species[1]			Endangered Species Act Listing Status[2]	ESA Listing Actions Under Review
Sockeye Salmon (*Oncorhynchus nerka*)	1	Snake River	Endangered	
	2	Ozette Lake	Threatened	
	3	Baker River	Not Warranted	
	4	Okanogan River	Not Warranted	
	5	Lake Wenatchee	Not Warranted	
	6	Quinalt Lake	Not Warranted	
	7	Lake Pleasant	Not Warranted	
Chinook Salmon (*O. tshawytscha*)	8	Sacramento River Winter-run	Endangered	
	9	Upper Columbia River Spring-run	Endangered	
	10	Snake River Spring/Summer-run	Threatened	
	11	Snake River Fall-run	Threatened	
	12	Puget Sound	Threatened	
	13	Lower Columbia River	Threatened	
	14	Upper Willamette River	Threatened	
	15	Central Valley Spring-run	Threatened	
	16	California Coastal	Threatened	
	17	Central Valley Fall and Late Fall-run	Species of Concern	
	18	Upper Klamath-Trinity Rivers	Not Warranted	
	19	Oregon Coast	Not Warranted	
	20	Washington Coast	Not Warranted	
	21	Middle Columbia River spring-run	Not Warranted	
	22	Upper Columbia River summer/fall-run	Not Warranted	
	23	Southern Oregon and Northern California Coast	Not Warranted	
	24	Deschutes River summer/fall-run	Not Warranted	
Coho Salmon (*O. kisutch*)	25	Central California Coast	Endangered	
	26	Southern Oregon/Northern California	Threatened	
	27	Lower Columbia River	Threatened	• Critical habitat
	28	Oregon Coast[2]	Threatened	
	29	Southwest Washington	Undetermined	
	30	Puget Sound/Strait of Georgia	Species of Concern	
	31	Olympic Peninsula	Not Warranted	
Chum Salmon (*O. keta*)	32	Hood Canal Summer-run	Threatened	
	33	Columbia River	Threatened	
	34	Puget Sound/Strait of Georgia	Not Warranted	
	35	Pacific Coast	Not Warranted	
Steelhead (*O. mykiss*)	36	Southern California	Endangered	
	37	Upper Columbia River	Endangered	
	38	Central California Coast	Threatened	
	39	South Central California Coast	Threatened	
	40	Snake River Basin	Threatened	
	41	Lower Columbia River	Threatened	
	42	California Central Valley	Threatened	
	43	Upper Willamette River	Threatened	
	44	Middle Columbia River	Threatened	
	45	Northern California	Threatened	
	46	Oregon Coast	Species of Concern	
	47	Southwest Washington	Not Warranted	
	48	Olympic Peninsula	Not Warranted	
	49	Puget Sound	Threatened	• Critical habitat • Protective Regulations
	50	Klamath Mountains Province	Not Warranted	
Pink Salmon (*O. gorbuscha*)	51	Even-year	Not Warranted	
	52	Odd-year	Not Warranted	

1 The ESA defines a "species" to include any distinct population segment of any species of vertebrate fish or wildlife. For Pacific salmon, NOAA Fisheries considers an evolutionarily significant unit, or "ESU," a "species" under the ESA. For Pacific steelhead, NOAA Fisheries has delineated distinct population egments (DPSs) for consideration as "species" under the ESA

2 On Feb. 11, 2008, NOAA Fisheries published a final determination listing Oregon coast coho as threatened (73FR7816). This final rule also designated critical habitat and issued final protective regulations. The listing, critical habitat and protective regulations are effective on **May 12, 2008**.

Appendix B. Decision-making Tree on Sockeye Salmon



Appendix C. Estimated Amount of Water Required to meet out-of-stream needs

	Estimated amount of water required to meet out-of-stream needs (KAF)*		
	Irrigation	**Municipal and Industrial**	**Total of Irrigation, Municipal and Industrial**
Drought permits to complement interruptible water rights	29	4	33
Permits issued in 2003	39	89	128
Pending Applications	237	33	270
Future Growth	47	7	54
Total	352	133	485

Source: Ecology 2004
*KAF= thousand acre-feet (an acre-foot is the amount of water it would take to cover an acre one foot deep.)

Appendix D. Calculation of Issues mentioned in comments on CRWMP DEIS

Issues mentioned in written and oral comments	**Total**
Process	**39**
Aquatic habitat	**35**
Project	**33**
Storage	**29**
Instream flows	**27**
Information	**24**
Economy	**21**
Dams	**19**
Water Quality	**19**
Conservation	**18**
Voluntary Regional Agreements	**16**
Tribal Impacts	**15**
Cultural Resources	**14**
Water Rights	**13**
Terrestrial Habitat	**10**
Hydrology	**9**
Equity	**7**
Hydropower	**6**
Recreation	**4**
Total	**358**