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A Protocol for the Elicitation of Stakeholders' Concerns and Preferences for Incorporation into Environmental Policy Dialogue

--Working Paper*--

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A Protocol for the Elicitation of Stakeholders' Concerns and Preferences for Incorporation into Environmental Policy Dialogue

Introduction

The formulation and implementation of environmental policy can be challenging under the best of circumstances. This is especially so when the context is fraught with urgency, controversy, uncertainty, distrust, and heightened public interest. In these circumstances, it is unlikely that technocratic policies imposed by agency administrators and experts will find uncritical acceptance by those who perceive a stake in the outcome.

Such is the case regarding the management of impacts in the Illinois River basin in eastern Oklahoma. The river corridor is a popular tourist and recreation attraction and was the first river designated as a wild and scenic river by the State of Oklahoma. Each year more than 180,000 persons float the Illinois River by canoe, raft, or kayak. An estimated 350,000 enjoy swimming, fishing, camping, hiking, birding, and hunting opportunities. The Illinois River provides drinking water for Tahlequah and Watts, irrigates farms and nurseries, and is a habitat for several state and federal threatened and endangered species. (Bality et al. 1998).

Though the economy is based primarily on tourism, a substantial portion derives from agriculture, especially from poultry farming and cattle ranching, and from plant nurseries, forestry, and gravel and limestone mining. The city of Tahlequah, which hosts of University of Northeastern Oklahoma and the tribal government of the Cherokee Nation, also helps anchor the regional economy. (Bality et al. 1998).

Especially since the Oklahoma-Arkansas controversy in the late 1980s and early 1990s over discharges to the Illinois River by the city of Fayetteville, Arkansas wastewater treatment plant that culminated in a 1992 decision by the U.S. Supreme Court, interest by stakeholders and policy makers in protecting the river has heightened. A comprehensive river basin management plan, which had been under development for several years, was just issued in December 1998. However, this plan has not satisfied all parties.

In 1997, the US Environmental Protection Agency, in cooperation with the National Science Foundation, awarded a research grant to a team of collaborators at the University of Oklahoma, Oklahoma State University, and the University of Oklahoma Health Sciences Center to conduct a three year study of impacts in the basin and to test a protocol for policy making that will lead to impact management policy that is simultaneously technically effective, economically efficient, legally compliant, and sociopolitically acceptable. This paper outlines this protocol and presents preliminary findings from its first phase: the baseline sociopolitical assessment.

Description of the Policy Legitimation Protocol

The policy legitimation protocol that is the centerpiece of this study has as its goal the maximization of policy legitimacy. The protocol is divided into three phases. In Phase I, the research team will perform a baseline assessment (*qua* inventory) of extant impacts in the basin. This assessment will be provided to policy makers for their consideration in formulating three distinct alternatives for the management of these impacts. In Phase II, the research team will perform three alternative-specific impact assessments, which will also be provided to policy makers to inform policy deliberation. In Phase III, the revised alternatives will be presented to stakeholders in the basin for their reaction. A basin-wide survey of opinion at the conclusion of the study will serve as the evaluative mechanism to test the efficacy of the protocol to maximize policy legitimacy.

This paper will consider only the Phase I baseline assessment protocol.

Description of the Baseline Impact Assessment Protocol

The baseline assessment is divided into five components, or assessment types.

Physical Impact Assessment. Current impacts from basin activities that can cause erosion, sedimentation, streambank instability, streambed scouring, debris obstruction, channel braiding, river course changes, and other physical impacts in the river corridor form the core of this assessment.

Biological Impact Assessment. Current impacts of basin activities that can affect wildlife habitat, species abundance and diversity, water quality, and human health are evaluated.

Economic Impact Assessment. The current status of the regional economy and the factors that affect it are the subject of this assessment. This includes an evaluation of all economic sectors and the development of an economic model, with multipliers, that can be used to predict changes.

Political Impact Assessment. This assessment focuses on the network of legal requirements and political processes that govern or otherwise affect activities in the basin. In addition, agencies with jurisdiction over basin activities and which administer these laws are evaluated.

Social Impact Assessment. An inventory of the social, cultural, aesthetic, and community resources is conducted. Of primary importance, however, is the conduct of an assessment of the impact concerns and preferences for impact management expressed by stakeholders within and outside of the geographic boundaries of the basin.

The results of these assessments will be used to inform policy dialogue with the goal of maximizing policy legitimacy. The results of first two assessments will be used to ensure technical effectiveness. The third will inform efforts to maximize economic efficiency. The fourth will guide legal compliance efforts. The fifth will increase the likelihood that any policy developed from this process will be sociopolitically acceptable.

At the conclusion of the baseline impact assessments, the results will be integrated and converted into a powerful decision support tool: interactive, multimedia, impact visualization. Aerial and ground-based photography has been obtained and, combined with GIS base maps, will be used as background for the visualizations. These backgrounds will be overlain by the results of the baseline assessments and animated to produce visual images that simulate impacts. Policy makers and stakeholders will be able to interactively query the visualization tool to gain a better understanding of the impacts that currently affect the river corridor.

The remainder of this paper focuses only on the baseline sociopolitical assessment (SPA) protocol.

Description of the Baseline Sociopolitical Assessment Protocol

Like the entire policy legitimation protocol, the SPA protocol is multi-dimensional and multi-faceted. Eight different methodologies are being used to elicit stakeholder and policy maker impact concerns and impact management preferences. This information is essential to policy deliberation to reduce the probability of formulating policy that will not be sociopolitically acceptable. But, before describing the SPA methodologies, it is important to characterize the basin population and participant samples.

Description of the Participant Population, Sample Selection, and Interview Setting

To maximize the representativeness of the sample of stakeholders and policy makers contacted for participation in the SPA, the basin population was divided along two dimensions: geographic and demographic. These dimensions were selected because it is reasonably predicted that opinions regarding impacts and their management may vary by location (due to different activities, cultures, physiography, and so on) and by stakeholder characteristic (primarily occupation).

Geographically, the Illinois River and its two major tributaries (Flint Creek and Barren (Baron) Fork) is 119 miles long and drains a watershed of approximately 900 square miles located in three counties in Oklahoma (combined population = 80,000). To facilitate stakeholder representativeness, the basin was divided into nine regions, as follows.

Region I: Upper Illinois River (from the Arkansas-Oklahoma border to the confluence of Flint Creek at Chewey Bridge)

Region II: Middle Illinois River (from Chewey Bridge to the Highway 51 overpass)

Region III: Lower Illinois River (from the Highway 51 overpass to Etta Bend where the river begins to exhibit lacustrine characteristics)

Region IV: Barren (Baron) Fork (from the Arkansas-Oklahoma border to its confluence with the Illinois River)

Region V: Flint Creek (from the Arkansas-Oklahoma border to its confluence with the Illinois River)

Region VI: Upper Tenkiller Ferry Reservoir (from Etta Bend to Cookson's Bend, which includes about 1/3 of the lake's surface area)

Region VII: Caney Creek (from its headwaters to its confluence with upper Tenkiller Lake)

Region VIII: Outside Users (tourists, recreationists, and other visitors to the region who reside outside of the basin)

Region IX: Policy Elites (policy makers and policy experts working outside of the basin who had jurisdiction over or a professional interest in the basin)

Demographically, the participant population was divided into 15 stakeholder classes. These included agricultural workers (farmers), business owners, animal feeding operators (primarily poultry), nursery operators and employees, foresters, outfitters, recreationists (floaters, hikers, fishers, etc.), general recreation (secondary recreation stakeholders), local government officials, state government officials, federal government officials, Indian tribal government officials, environmentalists, journalists, and residents.

No attempt was made to randomly sample the population or otherwise ensure that the sample characteristics resembled the larger population with respect to sample size (this will be done, however, during the random telephone survey conducted at the conclusion of the study). Rather, the purpose of the baseline assessment is to obtain the maximum range of opinions that exist on impact concerns and management preferences. To accomplish this, participants were selected by either reputation (known opinion leaders, agency representatives, policy elites, organizational heads, etc.) or by "snowballing" (reference by previous interviewees who are known to have different perspectives). Initial contact with potential participants was made by telephone. If the individual agreed to participate, an interview time and place to meet in person was set. On a few occasions, an interview was conducted with a participant who had not been contacted previously (e.g., river basin users).

In all, 330 interviews were conducted with 270 different individuals, not including experts and research team members who participated in preliminary exercises. Every attempt was made to ensure that representatives from every stakeholder class in every region were included. All interview sessions were audiotaped for later transcription (with the permission of the participant) and were conducted at the home of the participant or at a public location of the participant's choosing. Though four interviewers were used, all but 70 were conducted by one person. The length of the interviews varied from 30 minutes to as long as four hours. The mean time of the first round of interviewing (open-ended discussion, cognitive mapping, etc; 150 participants) was about two and one-half hours. The mean time of the second round of interviewing (mental modeling, etc; 60 participants) was about one and one-half hours. The mean time of the third round of interviewing (Q sorting, etc; 120 participants) was also about one and one-half hours.

Baseline SPA Methodologies

The baseline sociopolitical assessment protocol includes both a social and a political-legal assessment. However, only the social impact assessment component related to identifying policy maker and stakeholder impact concerns and their preferences for impact management is discussed below.

Eight methodologies are being used to perform the baseline SPA. The first of these was used in all three rounds of interviews. The second, third, and fourth methodologies were performed in the first round of interviews with 150 participants during the second half of 1998. The fifth and sixth methodologies were conducted in the second round of interviews with 60 participants during the first thee months of 1999. The seventh methodology was conducted

during the third round of interviews with 120 participants during the first four months of 1999. The eighth methodology will be performed during the summer of 1999. Each is reviewed below.

Methodology #1: Statistical Analysis of Demographic Questionnaires

At the beginning of every interview, a brief demographic questionnaire was administered. The questionnaire included questions about gender, race, age, education, occupation, socioeconomic status, length of residence in the basin and in study regions, sources of information about the river, uses of the river, relationships with others in the basin, trust of political institutions, and other relevant information. The results of this methodology are not discussed in this paper.

Methodology #2: Content Analysis of Open-Ended Interviews

Open-ended discussions of river basin impact concerns and management preferences, usually lasting from one to two hours, were conducted in the first round of interviews. These discussions were conducted in a manner that reduced the introduction of interviewer bias. At every opportunity, the participant was encouraged to offer any opinion on any matter related to the river basin and to explain and expand upon whatever was said.

After transcription of the audiotaped discussions, the texts of the interviews were content analyzed to identify the concerns and management preferences contained therein. Weber (1990:9) defines content analysis as: "a research method that uses a set of procedures to make valid inferences from text." Krippendorff (1980:21) emphasizes validity and reliability: "Content analysis is a research technique for making replicative and valid inferences from data to their context."

Ethnographic content analysis stresses interactions between people. Quantitative content analysis is most useful in obtaining data to measure the frequency and extent of messages present (Berelson 1966). The latter method was adopted for use in this project.

Due to budget and time restrictions, only one coder was used (the interviewer), though the coding criteria were developed by the entire SPA research team.

Methodology #3: Statistical Analysis of Likert Scale Responses and Card Ranking Results

Several Likert scale items were incorporated into a brief survey instrument administered at the conclusion of the open-ended discussion that pertained to trust and policy-making procedures. Likert scale items concerned judgments about the certainty of relevant facts; judgments about the salience of both facts and values to decision making; perceived relative controversy; and trust of experts, state government officials, federal government officials, and other stakeholders.

The Likert scale exercise was followed by a card ranking exercise in which the participants were asked to rank, in order of personal preference, eight alternative decision making procedures. These differed across three dichotomies: whether coercive or persuasive strategies were proposed, whether expert-based or deliberative strategies were proposed, and whether the government or an independent neutral made (or facilitated) the decision.

The Likert scale responses were analyzed three ways. First, descriptive statistics were computed basin-wide and by regional and stakeholder classes to assess the levels of trust, controversy, factual certainty, fact-value salience, and decision making procedure preferences. All statistical analyses were performed using SPSS 8.0 for Windows©. Second, cluster analysis using Ward's method of hierarchical agglomerative clustering, was performed on the card ranking data to investigate how participants grouped the decision making procedures and how participants grouped themselves in ranking the procedures.

Third, the Likert scale responses were used to predict which of the eight decision making procedures were preferred. A model developed by the first author guided the predictions. A preliminary assessment of the model's predictive capabilities was conducted.

A discussion of the results of these three analyses is not included herein.

Methodology #4: Statistical and Qualitative Analysis of Cognitive Maps

The final methodology employed during the initial 150 interviews was cognitive mapping. Cognitive maps were used to elicit the schema that participants use to conceptualize river basin impacts about which they are concerned. Cognitive mapping methodology is based on the mapping of active symbols, or schema landmarks, whose identity and spatial relationships reflect the participant's cognitive representation of the phenomenon under study. Cognitive maps provide a unique understanding of how participants think about river basin impacts that no other method accomplishes quite as well.

The technique used to guide the preparation of the maps was adapted from the association-driven issue display procedure developed by Diane Austin (1994). First, the participants were asked to list their river basin impact concerns (many of these had been identified during the open-ended discussions). The participants were given an opportunity to add to their lists by consulting a "master list" of impacts assembled by the research team from documents and prior interviews of experts. Additions from the master list were encouraged only if the participants claimed the missing impacts had inadvertently been omitted. According to Eden et al. (1979), this process of reflective mapping gives cognitive mapping its special utility.

Once the lists of impact concerns were developed, participants were asked to write each concern on an index card. Three sizes of cards were available, depending on the relative importance attached to the concern. Participants were instructed to place those concerns that were judged most important on 5"x8" cards, those of moderate importance on 4"x6" cards, and those of least importance on 3"x5" cards. Participants were then asked to indicate the level of knowledge that they had about each concern by affixing a colored dot on each card: green dots to indicate high perceived knowledge, yellow dots to indicate moderate perceived knowledge, and red dots to indicate low perceived knowledge.

Next, the participants were asked to arrange the cards on a large sheet of paper such that the arrangement represented how they conceptualize river basin impacts. After the cards were arranged, the participants were asked to label each group or cluster of cards in the map by writing a descriptive title on a colored card and placing it next to the group to which the label referred. Grouped concern titles are useful in developing and interpreting both aggregate and congregate maps (discussed later).

Participants were next asked to write the word "self" on colored cards and place them in their maps to indicate how they conceptualized themselves with respect to the concerns identified therein. According to Kaplan (1973), the knowledge of the location of "self" within a map is the crucial starting point for "adaptive behavior."

Finally, participants were asked to articulate the resultant schematic representations by explaining the choices and arrangements of concerns, the relative importance of and perceived knowledge about each concern, and the placement of "self" in the maps. The explanations were audiotaped and transcribed for later use in map interpretation.

The mapping exercise required 30 to 60 minutes to complete. Altogether, 145 usable cognitive maps were obtained during the interviews.

Six analyses of the cognitive map data were conducted: frequency analysis of impacts included on cards, analysis of the relative importance of impacts, analysis of the level of perceived knowledge about impacts, analysis of the relationship between relative importance and perceived knowledge, cluster analysis of impact groups contained within the maps to identify groups shared across maps, and cluster analysis of the shared groups to identify aggregate maps. Each analysis is briefly reviewed below.

1. Frequency analysis of individual impacts. A total of 1112 concerns were identified in the 145 cognitive maps obtained from participants. Given that many of the concerns were identical or nearly so, it was possible to simplify data analysis by combining similar impacts into categories. Categorization was performed by content analysis using two researchers who, by consensus, combined similar impacts. To preserve the integrity of the original data, categorical groups were not formed on the basis of the researchers' beliefs about causal or associational connections, but rather based on participants' own tendencies to group and label similar concerns. At the conclusion of the categorization effort, 87 concern categories were identified. No effort was made to further combine categories that seemed to be similar, since the participants did not do so. Further grouping of

concerns was performed later, however, using cluster analysis (see group analysis below). The impact concern categories were used in computing frequency statistics basin-wide and by region and stakeholder class. These results were later combined with the results of the context analysis of interview texts to add validity to those findings (see discussion later in this paper).

2. Analysis of relative importance. Descriptive statistical analysis of the relative importance of the impact concern categories (based on median card size within each category) was computed basin-wide and by region and stakeholder class. The basin-wide statistics were later combined with the card ranking results obtained during the mental modeling interviews discussed later to increase the validity of those findings.

3. Analysis of perceived knowledge. Descriptive statistical analysis of the perceived knowledge ratings for the impact concern categories (based on the median dot color within each category) was computed basin-wide and by region and stakeholder class. The basin-wide statistics were later compared to the assessed knowledge levels determined during the mental modeling exercise discussed later.

4. Relationship between importance and knowledge. The existence of a statistically significant correlation between relative impact importance and perceived knowledge was investigated. It is conceivable that this relationship exists, either because stakeholders attach more importance to those impacts about which they believe they know more or because they learn more about those impacts about which they are more concerned. These results are also discussed later in this paper.

5. Cluster analysis of impact concern groups. As mentioned above, participants placed related impact concerns into labeled groups. A detailed review of the 145 maps reveals the presence of 416 impact groups. Before these groups could be analyzed for similarity, however, the concerns contained within them were recoded using the 87 concern categories developed previously. After recoding, categorized concerns in the 416 groups were cluster analyzed using Ward's method of hierarchical agglomerative clustering. Forty-five concern clusters were identified. However, 10 of these clusters were used only once and were eliminated from further analysis, reducing the number of eligible clusters to 35. Since cluster analysis combines data sets with similar, but not necessarily identical, attributes, clusters varied in the number of categorical concerns that were shared across member groups. Therefore, it became necessary to establish a membership rule by which concern categories would be included within a cluster: a concern category was included only if 75% or more of the concern groups in the cluster included it (see Table 2 for cluster definitions).

6. Cluster analysis of categorical group clusters. All cognitive maps were recoded using the 35 concern cluster definitions discussed above. Seven of the 145 maps could not be recoded because their concept groups were both dissimilar to the 35 common clusters and unique.[1] The recoded map data were cluster analyzed across participants, again using Ward's method, to identify common (aggregate) maps. Eight distinct aggregate maps were identified. The aggregate maps were interpreted by reference to the concern clusters contained within them and by reference to demographic information of those participants whose maps were members of the cluster (see discussion later in this paper).

Methodology #5: Statistical Analysis of Mental Modeling Exercise

The integrity of the baseline sociopolitical assessment is enhanced if an investigation of the factual knowledge that stakeholders have of actual and potential impacts is performed. Mental modeling is an ideal tool to accomplish this. In fact, mental modeling was incorporated into the SPA protocol for three reasons.

1. The model can be used as a decision support tool. With such a tool, a policy maker can qualitatively estimate the effects of various policy interventions throughout all subsystems. Moreover, if the model's influences were to be quantitatively determined, policy analysts and others could use the model to estimate the *magnitudes* of perturbations to the impact system.

2. The model can be used to design educational programs to correct knowledge deficiencies and misconceptions. Comparisons of lay mental models against an expert model will identify areas that may be amenable to education.

[1] The participants, however, do share meaning in a social system that can be represented by a congregate map. This will be discussed in a later report.

3. The model can be used to assess conflict. By determining what knowledge deficiencies and misconceptions exist, it is possible to identify conflicts that might arise due to differences in knowledge. Moreover, knowledge of misconceptions can be compared against value differences (discovered by using other techniques in this protocol) to determine whether extant conflicts are due to knowledge conflict, value conflicts, or both. This information is essential to fashioning and legitimating a policy that will be widely accepted among stakeholders.

The term mental modeling has been used inconsistently. As used in this research, mental modeling refers to an influence diagram that represents a person's knowledge structure (Bostrom et al. 1992). A knowledge structure is a person's factual understanding of the relationships between and among elements of the phenomenon under study. In this paper, the mental model represents the knowledge structure that a stakeholder has about impacts that may affect the Illinois River basin.

Bostrom et al. (1992) outline four steps in testing lay knowledge structures.

1. Create an expert influence diagram. The expert mental model developed for this study represents the best scientific understanding of Illinois River basin impacts and their inter-relationships available. Each directional node-arrow-node combination in the diagram portrays an influence. The concept in the node at the tail of an arrow influences in some way the concept in the node at the arrow's point. Causality between nodes should not be inferred nor is the relationship between nodes quantified. Rather, the model is intended only to identify impacts to the Illinois River basin and to illustrate how these impacts influence each other.
2. Elicit lay participants' relevant knowledge beliefs. To elicit lay knowledge beliefs, 60 interviews were conducted in which participants were asked relevant questions about the impacts identified in our expert diagram. These questions were asked in a manner that avoided researcher-induced bias in the responses (see discussion below).
3. Map those beliefs onto the expert diagram. During the interview process, participants' responses were coded on copies of the expert model. The coding system used in this study was adapted from the coding system used by Bostrom et al. (1994).
    - *Correct* = participant's response is accurate
    - *Indiscriminate* = participant knows that a node influences a distant node but is unfamiliar with influences between them
    - *Particularistic* = participant has limited knowledge about the relationship between two nodes but fails to connect this relationship to "the big picture"
    - *Incorrect* = participant's response is factually wrong
    - *Peripheral* = participant's response is accurate but irrelevant
    - *Missing* = participant is ignorant of the influence
4. Identify gaps in understanding and misconceptions. Coded responses were analyzed using descriptive statistics to identify gaps and misconceptions. These results are discussed later.

The expert model was developed based on the application of disturbance theory to the polity. At the lowest level of the model (level 0.0), the political subsystem circumscribes four other subsystems. From each of these subsystems, a terminal impact creates a disturbance that, if perceived as severe enough by stakeholders, triggers a political demand. The demand can stimulate a policy response to reduce the perceived subsystem impact. A brief review of each of the five subsystems follows.

1. Physical Subsystem. The smallest of the five subsystems, it includes only 58 influence links. The primary level of the physical subsystem specifies "stream channel deterioration" as the terminal adverse impact (disturbance), which is influenced by stream channel agradation (sedimentation) and degradation (erosion) processes. Both processes are further specified in higher level subsystems. Erosion/sedimentation processes are influenced by a activities such as gravel mining, timber harvest, livestock access to waterways, general vegetation removal, addition of vegetative debris to waterways by beavers, gravel roads construction and maintenance, and the collapse of the dam at Lake Frances.

2. Biological Subsystem. This subsystem is considerably more complex, with 168 influence links. The terminal adverse impact (disturbance) is defined as a threat to public health or the environment. The subsystem is divided into human health and ecologic health, which are both affected by nearly the same activities, though in different ways. In higher level subsystems, details of the biological subsystem impacts are specified. For example, factors affecting water quality include toxic contamination, nutrient loading, sediment load, temperature, and habitat quality. Toxic contamination, in turn, is influenced by urban runoff, pesticide applications and disposal practices, hazardous waste facility runoff and leachate, underground storage tank leachate, animal feeding operations, illegal chemical dumping, industrial point source discharges, and municipal wastewater treatment effluents.

3. Economic Subsystem. The economic subsystem is the largest, with 179 influence links. The specified terminal adverse impact is instability or stagnation of the economy. Influences on the terminal impact include employment, wages, and taxes (which are shown in an integrative relationship) as well as five economic development sectors: tourism and recreation, commercial, residential, industrial, and agricultural. Further details are elucidated in higher level subsystems. For example, each development sector is influenced by consumer demand, which, in turn, is affected by factors such as development costs, developer resources, consumer's net income, population, quality of exploitable natural resources, legal constraints, and public infrastructure.

4. Social Subsystem. The social subsystem is also a large subsystem, with 159 influence links. The terminal adverse impact is dissatisfaction with quality of life. This outcome will occur if stakeholders perceived that their quality of life is less than expected. Factors that influence quality of life judgments are scientific and educational valuation, recreational satisfaction, cultural preservation, aesthetic quality, and the psychosocial state of the stakeholder. Aesthetic quality includes factors such as sights, sounds, odors, and degree of solitude. Cultural preservation includes spiritual valuation and archaeological and historic site preservation. Recreational satisfaction includes type and availability of activities, visitor displacement and succession, and park conditions. The psychosocial state of the stakeholder is influenced by a variety of factors including cultural norms and traditions, community and political values, and demographic characteristics.

5. Political Subsystem. The terminal outcome of the political subsystem is policy that affects the other subsystems. This subsystem has 78 influence links (not including the legal subsystems[2]). Influences to policy include the level of policymaker and stakeholder dissensus, policy maker and stakeholder preferences, legal and knowledge constraints, and interest group pressures.

Representation of the Expert Model

A visual representation of the expert mental model, which represents how various impact processes within the Illinois River basin relate, was developed using Visio Standard 5.0. The model is arranged hierarchically. At its most basic level (model 0.0), the relationship among the five components of the impact management system is depicted: physical (model 1.0), biological (model 2.0), economic (model 3.0), social (model 4.0), and political (model 5.0). Each of the five major subsystems is further specified in higher level influence diagrams (secondary subsystems are numbered 1.1, 1.2, 2.1, etc.; tertiary subsystems are numbered 1.1.1, 2.1.2, etc.; and quaternary subsystems are numbered 3.2.1.1, etc.). Subsystems are not only related to the base and higher levels, but also to each other. Altogether, more than 700 influences are included within 42 subsystems.

Conduct of Mental Modeling Interviews

Mental modeling was conducted during the second round of interviews. The interview began with a description of the types of questions that would be asked; often the interviewee was shown the base model (level 0.0). The

[2] The details of legal subsystems have been specified but have not yet been incorporated into influence diagrams. The legal subsystems will address agencies that regulate land use, water use, and water quality in the basin, as well as agencies that provide incentive programs for establishing vegetated buffer zones along waterways in the basin.

participant was asked not to guess or speculate on an answer, but rather simply relate what they knew. Most participants had no preference on which subsystem to begin, so the order simply followed the numerical order of the subsystems (physical to biological to economic to social to political). Questioning on the physical subsystem began with a generic question. Participants would usually give long responses that covered many of the important topics. More specific questions would follow, as appropriate, about topics participants failed to mention or fully describe.

Response Coding

Measures were taken in coding responses to avoid false positives and false negatives. For example, false positives could occur if questions were too leading. False negatives could occur if participants simply did not happen to recall answers "off the top of their heads" that they in fact knew. False negatives were avoided by giving credit for knowledge on related influences without necessarily asking for descriptions of each influence in the group, if the interviewer believed that the influences were "common knowledge." This was usually only done in assessing knowledge in low level models, which include very general influences. Knowledge credit was also given if it was necessary to disclose the influences in order to proceed with questioning on higher levels (e.g., model 0.0). "Bi-directional" questioning, i.e., asking a question from both the impact and the source ends of an influence, or asking a follow-up question later, was also used to avoid false negatives. Often, these types of questions would stimulate participants to think in a different way about impacts and extract knowledge that had not been previously been revealed. Another technique used to avoid false negatives (and false positives) was to ask opinion questions in place of fact-based questions. In offering opinions, participants may reveal knowledge without feeling pressure to agree with suggestions made by the interviewer. Another method used to avoid false positives was to instruct the participant at the beginning of the interview to refrain from guessing answers, as that would jeopardize the integrity of the research.

Analysis of Responses

Two statistical analyses of mental modeling data were conducted. First, descriptive statistical analyses of participant responses, basin-wide and by region and stakeholder class, were performed using SPSS 8.0. Preliminary results are discussed later.

Second, the basin-wide assessment of knowledge was compared to the perceived knowledge data obtained from the cognitive mapping exercise. To accomplish this, a common set of knowledge areas between cognitive mapping and mental modeling was developed. A careful review of both data sets yielded 30 common knowledge areas. Knowledge scores (perceived and assessed) were computed for each of the 30 areas. These scores were then divided among three levels of knowledge: high, moderate, and low. For perceived knowledge, an average score was calculated based on the color of the dots [1=red (low perceived knowledge); 2=yellow (moderate); 3=green (high)] placed on the cognitive mapping index cards for impact concerns belonging to that knowledge area. Assignment into knowledge levels were made as follows: >2.33 = high, <1.67 = low, and 1.67 to 2.33 = moderate. For assessed knowledge, the percentage of correct responses in each knowledge area was used. Assignments were made as follows: >66% = high, <34% = low, and 34% to 66% = moderate. Of the 30 knowledge areas, perceived and assessed knowledge corresponded perfectly in 15 areas. In nine areas, assessed knowledge exceeded perceived knowledge. In the remaining six areas, perceived knowledge exceeded assessed knowledge. These results are also discussed later in this report.

Methodology #6: Statistical Analysis of Card Ranking Results

Following the mental modeling exercise, participants were asked to rank a series of 16 pollution sources in order of their perceived relative importance to contributing adverse impacts to the Illinois River basin.

Three statistical analyses of the pollutant source ranking data were performed. First, descriptive statistics were computed basin-wide and by region and stakeholder class for the 16 pollution sources. Second, cluster analyses of the pollution source rank scores, using Ward's method, by source and by participant were performed. This provided insight into why participants ranked the sources as they did and who shared similar priorities.

Third, the rank order of the pollution sources was compared with an implied rank ordering of equivalent impact concerns obtained during the cognitive mapping exercise. The implied rank order of impact concerns was computed

in three stages. First, the 87 impact categories that encompassed the 1112 impact concerns obtained from 145 cognitive maps were reclassified to correspond to the 16 pollution sources. Second, an average importance score based on card size [1=small (low relative importance); 2=medium (moderate importance); 3=large (high importance)] for those cards in the impact categories that were assigned to each of the 16 pollutant source groups was calculated. Third, the groups were ranked according to the average relative importance scores computed for each of the 16 groups. The rank orders of the two basin-wide assessments of relative importance were compared using the non-parametric correlation technique, Spearman's rank correlation. The result of this analysis (correlation coefficient, rho = .631??) proved to be statistically significant (at $p<0.05$), adding validity to the pollutant source prioritization finding.

Methodology #7: Factor Analysis of Q Sorts

Q methodology was employed to reveal the broad perspectives that stakeholders hold with respect to IRB impact concerns and their preferences for impact management. These findings can be compared to the findings of the other methods to derive a comprehensive understanding of stakeholders' views regarding the Illinois River basin.

Q Theory and Praxis

Most studies employ R methodology, in which a survey instrument that reflects the investigator's hypotheses is developed, administered to a random sample of respondents, statistically analyzed, and generalized to a larger population. Although this technique has powerful statistical capacity to generalize, it loses data richness because the subject's own definition of the phenomenon under study is subordinated to that of the researcher. The danger of misinterpreting responses according to the investigator's preconceptions, rather than the subject's own views, is always present.

Q Methodology was developed to overcome this limitation (Brown 1980; Stephenson 1978). Q methodology affords a direct measurement of an individual's subjective point of view. William Stephenson, a British physicist-psychologist, invented Q methodology in 1935 and fully articulated its theory and technique in 1953 (Stephenson 1935; 1953). Stephenson's primary interest was to provide a scientific way to reveal subjectivity in any situation, whether about political attitudes or artistic expression. The strength of Q methodology lies in its ability to generate grounded understanding (Verstehen) by abductively revealing subjectivities that are both self-referent and operant.

The factors created from a Q sort are categories of operant subjectivity. These factors are naturalistic because they are naturally occurring events. The statements from the concourse that create the Q sort are a function of an individual's point of view; thereby limiting the researcher's bias.

Q Concourse

A concourse is the flow of communication surrounding a topic (Stephenson 1950; 1953). "Concourse" originates from the Latin "concursus," which means "a running together" – as when ideas run together in thought (Stephenson 1978). The concourse provides a wellspring of creativity and ideas that can be discovered through Q methodology.

Based on the 150 open-ended interview transcripts, more than 3,000 statements relevant to impact concerns and management preferences were identified and included in the concourse. From this concourse, a preliminary sampling 500 statements was obtained by the SPA team. Screening criteria used to select statements were richness (to ensure that each item possesses excess meaning that will inform factor-analyzed perspectives), controversy (to reduce the number of consensus and social desirability items), salience to stakeholders (to ensure that existing perspectives will be revealed in the Q sorts), and representativeness (to capture the full range and diversity of sentiments that exist in the stakeholder and policy maker populations). The 500 item sample was then separated into impact concerns and impact management preferences. The impact concern collection was again reviewed by the SPA team and consensus was reached on the selection of 47 statements for inclusion in the concern Q sample. The management preference collection was reviewed by the SPA team, resulting in a preference Q sample of 58 statements. A balance of items across categories of potential meaning was checked through use of a factorial design, though strict adherence to the 20 categories included therein was not followed in order to ensure maximum representativeness.

Conditions of Instruction

The condition of instruction used to guide sorting of the 47-item impact concern Q sample was "What is your view of human and natural impacts on the Illinois River?" The condition of instruction used to guide sorting of the 58-

item management preference Q sample was "What are your preferences for the management of human and natural impacts to the Illinois River Basin?"

Structured Sort Form Boards

Two form boards, corresponding to the two Q samples, were created as a guide to conducting a structured sort. The arrangement of each form board reflected a quasi-normal distribution. This distribution was selected because it is believed that stakeholders feel strongly, either negatively or positively, about fewer items than they would feel less strongly. The 47-item form board utilized a nine column layout of 2, 3, 4, 5, 6, 7, 6, 5, 4, 3, 2. The 58-item form board utilized an eleven column layout of 2, 3, 3, 4, 6, 7, 8, 7, 6, 4, 3, 3, 2.

Q Sort Procedure

The researcher begins Q sorting exercises by asking participants to read each statement and then placing them into one of three piles: (1) those that they most agree with, feel most positively toward, or best reflects their point of view into the rightmost pile; (2) those that they most disagree with, feel most negatively toward, or least reflects their point of view into the leftmost pile, and (3) those that they feel neutral about, feel ambivalent toward, or do not understand into the middle pile. The researcher then encourages further division of the statements in each of the two end piles into two additional piles to indicate a finer distinction between agreement and disagreement. This procedure resulted in the placement of statements into five piles on a continuum from greatest agreement to greatest disagreement that aids the subsequent placement of items onto the form board. The placement of statements are a matter of opinion only; this is important because the participants' subjectivities are the phenomenon of interest (Brown 1993).

Participants were then instructed to place the two most agreeable items from the rightmost pile onto the two rightmost spaces on the form board. Participants continued placing cards in columns on the form board, moving to the left, until all items in the rightmost pile were exhausted. Participants were then instructed to continue placing statements on the form board in similar fashion until the second agreeable pile is exhausted. Participants were next asked to repeat this sorting process from the disagreeable piles. Statements from the leftmost pile, beginning at the leftmost two spaces, were placed first and additional statements were placed, moving toward the right, until all items in the disagreeable piles were exhausted. Last, the statements in the middle pile were sorted from relative agreement to relative disagreement in those spaces remaining in the middle portion of the form board. After the sorts were completed, participants were asked to review the sorts to determine whether the horizontal location of any of the statement should be changed. Usually, participants were happy with the original placement. Finally, they were asked to explain the sorts by narrating their overall perspectives on the condition of instruction. While the narrations were being rendered, the researcher examined the sorts in an attempt to relate the narrations to the sorts. If doubt arose about the placement of items given the interviewer's understanding of the narrations, participants were asked to clarify their perspectives. In such cases, the interviewer's confusion was usually due his misunderstanding of the meaning of one or more statements in the sorts; however, in a few cases, the participants would make minor changes to the sort. When the interviewer was satisfied that he understood the meanings of the sorts and the items included therein, he concluded the sessions.

This procedure was repeated in its entirety in the administration of the second sort concerning impact management preferences.

P Sample

Both Q sort exercises were administered in the third round of interviews to 120 Illinois River basin stakeholders representing all regions and stakeholder classes, a third of which had been interviewed during the first round of 150 interviews. Each interview generally required about two hours. All sorting exercises were audiotape recorded with the participant's permission. These tapes were later transcribed for use in interpreting the factors.

Q Factor Analysis

Item placements on the form boards were entered into a database for factor analysis to determine those perspectives held in common among the participants. The software used to perform the Q factor analysis was a PC version of the mainframe program Quanal (von Turbergen 1980). Factor analysis is performed on an n x n matrix of correlation coefficients that relates item placements between pairs of Q sorts. Q sorts that are highly correlated may be

considered to have a family resemblance (Stephenson 1980). Factor analysis was used to determine how many different families (factors) exist among the population of Q sorts.

The number of factors obtained is dependent on how the participants sorted the Q samples and is therefore purely empirical. Each Q sort has a factor loading among the community of sorts analyzed. The loading expresses the extent to which each sort is associated with each factor. Orthogonal factors were extracted by the principal component method and rotated to simple structure by varimax rotation to minimize unexplained variance.

Seven criteria were used to determine factor retention for later interpretation. A factor was retained if:

(1) it had an eigenvalue greater than one;

(2) it contributed at least 3% toward the total explained variance;

(3) the number of non-significant Q sorts was minimized;

(4) at least two significant Q sorts loaded on it;

(5) it was not simply a bipolar split of a preexisting factor (bipolar splitting criterion = 25%);

(6) the factor solution was stable; and

(7) the factor captured a perspective that has theoretical importance.

Q Factor Interpretation and Validation

Each common factor score array represents an average sort (common perspective) held by those stakeholders whose Q sorts loaded significantly on the factor and thus who sorted the statements similarly. To interpret the meaning of the common perspective, the researcher first examined the common factor score array and then compared it to other arrays.

The development of an interpretation began with an examination of those statements located at the extremes of the arrays (those having the highest importance, whether agreeable or disagreeable). This was followed by an examination of statements lying in the middle of the factor score array to clarify further the potential meaning of the perspective revealed by the factor.

After developing an initial interpretation, the factor arrays were compared to each other to investigate how statements are arranged similarly (consensus items) or differently (discriminating items). After factor comparisons were completed, unique characteristics among the perspectives revealed by the orthogonal factors were deduced and categorized.

The researcher then attempted to interpret each common perspective by developing a paragraph description that reflects its unique characteristics. A descriptive label that captured these unique characteristics was then given to each perspective.

To fine tune each interpretation (and label), the transcripts of those stakeholders whose Q sorts loaded most highly (their individual sorts most closely resemble the common sort) and most purely (their sorts share little in common with sorts defining other factors) on each factor, and therefore hold a perspective that is most representative of the common perspective, were examined.

Once satisfied with the interpretations, the high-pure loaders should be contacted for the purposes of validating the interpretations developed by the researcher. The participant is asked for their reactions to the paragraph descriptions and the proposed labels. Any discrepancies between the interpretation and reaction are resolved by comparing the validator's own Q sort and the common sort. Changes in interpretation and labels are then made, if necessary. The labels and interpretations discussed later have not yet been validated.

Methodology #8: Longitudinal Analysis of Archival Data

Two sources of archival data are available for analysis: newspaper clippings and audiotapes of previous Oklahoma Scenic River Commission meetings. The OSRC Executive Director has accumulated newspaper clippings concerning OSRC activities since he assumed the directorship in 1986. In addition, audiotapes of the bimonthly meetings of the Commission since 1986, including the testimonies of guest speakers and members of the public, were made. These two archives are essential in determining how stakeholder and policy maker concerns about impacts and their preferences for impact management have changed over the past 13 years.

An initial content analysis of newspaper stories over the past three years was conducted in order to develop a coding scheme. Content analysis of the entire collection of newspaper stories will be conducted this summer. The OSRC meeting tapes are being transcribed and will also be content analyzed this summer.

Selected Preliminary Results of the Baseline SPA

A wealth of data has been accumulated over the last nine months and analysis is still ongoing. Nevertheless, some preliminary findings can be reported that will demonstrate the utility of the SPA protocol. Preliminary findings are presented on the identification of concerns and management preferences, the relative importance of preferences, an assessment of knowledge and a comparison of assessed knowledge against perceived knowledge, shared schema on concerns, and shared perspectives on concerns and preferences.

Identification of Impact Concerns and Impact Management Preferences

From the content analysis of open-ended discussion and frequency analysis of cognitive mapping concepts, the following concerns are most frequently identified by stakeholders (only basin-wide results are included).

- Most frequently mentioned are those that are most visible and those that have received most media attention.
- Water quality is the most frequently mentioned concern. Interestingly, most mentioned it as an aesthetic concern; fewer as a health or recreation concern. Almost everyone believed that water quality will get worse if nothing is done to reduce impacts.
- Pollution from animal feeding operations, particularly poultry farms, is most frequently ranked as most important.
- With respect to recreation, unruly behavior, trash, and the lack of restrooms near the river were most often mentioned.
- Property-rights sentiments are most acute among farmers in the upper and middle Illinois River regions. Many farmers oppose any effort to restrict private land use or impose economic burdens from additional rulemaking. Some indicated that they might offer less resistance if they are given adequate consideration and financial assistance in implementing riparian buffer zones and other restrictions on use of property.
- Few stakeholders understand other stakeholders' concerns or their reasons for them. Most agree that there is much controversy about the management plan. Many people in the region distrust each other and the government. In the selection of interviews, many accepted an interview because they wanted to voice their concerns and opinions because they felt that no one was listening to their views.

Impact management preferences discovered include the following.

- Agreement is highest for the management of those impacts that are easily observed, such as recreational trash, unruly behavior, urinating in and near the river, and stream bank erosion.
- Most stakeholders favor management controls on impacts generated by others and disfavor controls on their own operations, usually citing a lack of evidence that their operations in fact generate significant impacts.
- Education is non-controversial in that it is seen as a non-invasive intervention.
- Dissensus exists over the need for and means of regulation of pollution sources and the protection of riparian zones.

Determination of Relative Importance of Impact Concerns

In the card ranking exercise performed after the mental modeling effort, participants were given sixteen sources of pollution to rank in order of importance. An analysis of participants' rankings revealed that three of the four most important sources are Fayetteville sewage, Arkansas animal wastes, and Siloam Springs sewage – confirming the fact that many participants prefer to place the blame for pollution on others. Oklahoma animal wastes are ranked third. All four are sources of nutrient loading to the river. Both animal wastes and Arkansas sources have been highly publicized as sources of pollutants to the river, as has the problem of nutrient loading.

Cluster analysis was also performed on the pollution source data to determine which cards were similarly ranked.

Cluster 1: Nutrient Impacts. Siloam Springs sewage, Fayetteville sewage, Oklahoma sewage (municipal), Oklahoma animal wastes, and Arkansas animal wastes were included in this cluster. These sources cause impacts that had received extensive media coverage; all contribute to nutrient loading. They average a high importance rating, probably due to widespread publicity. It is also possible that the high rating of human and animal waste is triggered by their inherently repulsive nature.

Cluster 2: Toxic Impacts. This cluster contains two smaller clusters: (1) local litter, illegally dumping, and rural septic systems, and (2) untreated sewage, litter/sewage from floaters, agricultural runoff, nurseries, and industrial discharges. The first subcluster includes sources that are small, dispersed, and private. The second subcluster contains sources that are larger, concentrated, and commercial. The reason for their combination in a cluster may be that they are sources of toxic pollution whose precise effects less understood than those sources contained in cluster 1. The average importance score of this cluster is intermediate.

Cluster 3: Physical Impacts. The last cluster contains five cards: forest cutting, urban runoff, highway construction wastes, gravel mining, and accumulated vegetative debris. These cards were generally ranked lowest in importance, since they are least well known. These sources are also the most important sources of physical impacts, which may explain this cluster.

Cluster analysis was also performed on the participants, producing four clusters. The mean importance scores for the pollution sources were recalculated for each participant cluster. These were compared to identify the distinguishing characteristics of each group.

Cluster 1: Arkansas Concerned. The largest cluster consists of 25 participants. They rank sewage treatment plants and Arkansas sources much higher than other groups. This group prefers to blame outsiders.

Cluster 2: Arkansas Considerate. Consisting of 15 participants, they rank sewage treatment plants and Arkansas sources near the middle. They may be less likely to blame Arkansas sources because of their desire to cooperate with them to solve pollution problems (due to their affiliation with the OSRC).

Cluster 3: Chemically Concerned. This group accords most importance to chemical sources such as industrial discharges and nurseries.

Cluster 4: Agricultural Sympathizers. This cluster contains participants who are notable for their low ranking of agricultural runoff.

The card ranking analysis, combined with mental modeling results, shows that participants with a moderate level of knowledge tend to rank issues more highly than do those with low or high levels. Participants with low knowledge may be unaware of the impact source and/or its affects. Participants with high knowledge may be so familiar with the sources and their impacts that they downgrade the source's importance – or they may be engaging in strategic bias.[3] Moderate knowledge may trigger a "I know enough to be afraid but not enough to be comfortable" response in participants.

[3] Evidence was found in reviewing the results of the assessment of lay mental models that some stakeholders may be engaging in strategic behavior that creates spurious results. In other words, stakeholders who have reason to believe that they are responsible for an impact may unconsciously or consciously deny this knowledge. In other cases, these same stakeholders may demonstrate high knowledge about other potential sources of these same impacts, which may indicate blame shifting. The following examples illustrate this finding.

In comparing the relative importance of pollution source results to the cognitive mapping relative importance results (card size), the validity of the importance rankings can be checked.

The order of the 16 impacts included in both rankings was subjected to a non-parametric measure of association known as Spearman's rank correlation coefficient. The rank order correlation coefficient, rho, was found to be significant at 0.68 ($p < .02$). This proves that, for these sixteen pollutant sources, two different techniques produced similar results. The reason, perhaps, that they are not correlated even more closely is that the card ranking includes only sixteen sources of pollution, whereas in cognitive mapping, participants could include any number and type of concerns.

Knowledge Assessment

Physical Subsystem Knowledge. The average score was 43% correct. Those living in areas affected by stream channel degradation are more familiar with these influences. Policy elites, environmentalists, and outfitters scored highest. The performance of the first two is probably due to professional interest, whereas the oufitters' knowledge was probably augmented by an awareness of stream braiding and floaters' comments on low water sections, which impairs floating.

Biological Subsystem Knowledge. The average correct score for this subsystem was 45%. Local policy makers, environmentalists, and the journalist scored highest. High scores by these stakeholder classes are also likely triggered by professional interest.

Economic Subsystem Knowledge. The average score was 86%. All classes scored high in economics, though local policymakers and the journalist scored highest, due largely to the fact that this subsystem is more general than the others and perhaps reflecting the motivation to learn based on self-interest.

Social Subsystem Knowledge. The average correct score was 58%. Again, local policy makers scored highest.

Political Subsystem Knowledge. The average correct score was 50%. Local policy makers, for the fourth time, scored highest.

Local policy makers are the most knowledgeable of all subsystem impacts except physical. Clearly, at least among the participants, local policy makers are well informed and presumably can participate effectively in a policy dialogue. Those stakeholders who prefer to rely on local policy maker judgments are justified in doing so. Environmentalists and the journalist also fared well. Interestingly, federal and state policy elites did not do as well as might have been expected.

Knowledge of impacts, their sources, and the influences between and among them is deficient in all areas except economics. The technical areas of physical and biological impacts were especially challenging. These results suggest that educational programs would likely serve a useful purpose.

One example of widespread misconception concerned the relationship between gravel road construction/maintenance and erosion. The regions scoring highest attained only 39%; two regions scored 0% and

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1. Several participants would avoid questions that related to potential impacts from their operations. More than one agriculture participant avoided questions pertaining to nutrient loading. When asked about nutrient loading, they would respond with, "That's not that big a problem."
2. At other times, participants would blame other sources of impacts to water quality, about which they would have extensive knowledge. For example, animal feeding operators demonstrated high scores about nursery impacts but low knowledge about potential impacts from their own operations.
3. Influence 2.0-24 relates dissolved oxygen to water quality. While 80% of the participants in Upper Tenkiller have correct knowledge about this influence, none of the participants in Flint Creek does.
4. With respect to the same dissolved oxygen to water quality influence, environmentalists, foresters, local policymakers, and nursery people scored very high (80 to 100%). However, participants from agriculture and animal feeding operations, whose activities may contribute substantially to this problem, scored only 60 and 40%, respectively.
5. Influence 2.1-10 relates septic systems to groundwater leachate. Outfitters scored lowest of all stakeholder classes on this influence, despite the fact that most have septic systems.
6. Knowledge of the link between nurseries and fertilizer runoff was highest in the Upper Tenkiller region, the location of a large nursery, as expected. However, outside users, local policymakers, and animal feeding operators also scored highly. Animal feeding operators (who demonstrated rather low knowledge of animal waste runoff from their own operations) may have scored high on this influence due to blame shifting.

two others scored only 5.6%. Though guidelines and best management practices have been promulgated for the building and maintenance of gravel roads within the state of Oklahoma, this finding suggests that an educational program is needed to heighten awareness of this problem, especially given the rate at which residential development is occurring in the area.

On the other hand, educational programs may be not required concerning the link between municipal wastewater treatment and direct discharges to the Illinois River watershed. Two regions - Upper Illinois and Flint Creek – demonstrated prefect knowledge. Both are near the Arkansas border and the relatively large and controversial treatment plants that are located there. Participants in the Caney Creek region also achieved a perfect score. The Stilwell wastewater treatment plant discharges into Caney Creek.

Some knowledge deficiencies could contribute to policy conflict.

- The regional analysis showed that most misconceptions about the relationship between livestock trampling and streambank erosion occurred in the Upper Illinois, Middle Illinois, and Barren Fork regions. This could lead to conflict because the OSRC wants to promote buffer zones along the river in these regions to minimize erosion. Yet, 80% of those working in agriculture, including ranchers, are unaware of this influence. A stakeholder class conflict could also be triggered between agricultural workers and environmentalists, the latter having scored a perfect 100% on this relationship.

- The highest knowledge of the gravel mining to dredging influence exists in the Middle Illinois and Barren Fork regions, where most gravel mining occurs. However, knowledge is much lower in other regions. If policy were formulated to restrict gravel mining in the Barren Fork and other tributaries to the Illinois River and Lake Tenkiller, this lack of knowledge contribute to conflict.

- A localized knowledge conflict also exists with respect to the Lake Frances to sedimentation influence. Participants in Flint Creek have 100% knowledge of this influence and those in Barren Fork average 71% correct knowledge. This finding is not surprising considering the proximity of these regions to the Lake. In contrast, participants in the Caney Creek region, who are least affected by sedimentation from Lake Frances, are unaware of the lake's effects (14%). Surprisingly, however, participants in the Upper Illinois, which directly drains Lake Frances and therefore is most exposed to the impacts, scored only 50%. This highlights a possible basis for the conflict that is known to exist in this region. Some wish to have the dam rebuilt and the lake restored whereas others believe that water quality has improved since the dam broke in 1990 and therefore do not want the dam rebuilt.[4]

Important knowledge deficiencies and misconceptions, as well as areas of knowledge dissensus, were successfully revealed by mental modeling. Though general knowledge of river basin impacts is largely equivalent throughout the basin and among outside users, large differences exist among stakeholder classes and regions with respect to localized impacts.

Perceived Versus Assessed Knowledge

A comparison between assessed and perceived knowledge was accomplished by comparing results from the mental modeling exercise with those from the cognitive mapping exercise. The average knowledge scores for those cognitive mapping concepts and mental modeling influences contained with 30 impact categories were used to generate two separate rank orders. Each rank order was divided into three groups of ten impact categories each. The top third of each ranking was given a high knowledge score, the middle third was given a moderate knowledge score, and the bottom third was given a low knowledge score. As reported previously in this paper, half of the impact categories were matched in assessed and perceived knowledge levels. The remaining 15 did not exactly match. There are several reasons for the discrepancies.

1. Assessed knowledge is greater than perceived knowledge. Nine impacts categories (septic systems, recreation, poultry, cattle, erosion/sedimentation, municipal wastewater, runoff, nurseries, and groundwater) are included in this set. Since assessed knowledge scores are based on participants' responses to terminal influences within

[4] Since there is disagreement among the experts we contacted about the effect that Lake Frances has had on river water quality, our coding of the "effects sedimentation" responses may not be correct.

the appropriate section of the mental model, the assessed knowledge score may be too high relative to perceived knowledge judgments. Participants may have included knowledge of a more complete construction of the impact (including both effects and sources) during the cognitive mapping exercise than they had to do to answer influence-specific questions.

2. Assessed knowledge is lower than perceived knowledge. For two impact categories (ecosystem carrying capacity and point sources), participants believe that they have high levels of knowledge but assessed knowledge levels are rated as moderate. Both of these impacts were mentioned by only a few participants (six and eight, respectively) during the mental modeling exercise. One possible reason for this discrepancy was suggested by an examination of the demographic characteristics of those few participants: the majority are policy elites. Apparently, these professionals are over-confident of their knowledge based on their professional standing. Another possible reason for overconfidence about impacts that are relatively unfamiliar is that participants may be rating their knowledge by comparing it to the knowledge they believe is possessed by others.

3. Assessed knowledge is much lower than perceived knowledge. Three impact categories (noise, odors, and debris removal) are included in this group. The explanation may be found by noting that they were mentioned by only four participants during the mental modeling exercise. Participants did not identify these because they were not perceived as important. However, such impacts were routinely suggested to the participants (through the master list of impacts) during cognitive mapping. It is likely that participants actually have high knowledge of these impact categories but they carry low salience.

Several impacts were rated low for both perceived and actual knowledge – engine waste (from motorized water vehicles), overuse, gravel mining, industrial waste, urination/defecation (by floaters), and animal waste. These are optimal topics for educational programs because participants are not already deluded into believing that they have nothing to learn.[5]

Those impact categories that participants rate their knowledge as high but their assessed knowledge proved to be low present the greatest challenge to educators. They may first need to reduce overconfidence and eliminate entrenched misconceptions before beginning an education program.

For those impacts in which both perceived and assessed knowledge is high, no education is necessary. These include population density, litter, behavior, wildlife, and aesthetics.

Perceived Knowledge versus Relative Importance

When perceived knowledge was compared to relative importance across all 1112 cognitive mapping impact concerns, no significant correlation was found (Pearson's correlation = .031??). Two reasons can be offered. First, participants likely ignored concerns in their cognitive maps about which they attached little importance or had little knowledge. If so, then low importance and/or low knowledge impacts are missing from the rankings, thus skewing the results. Alternatively, participants may have attached different levels of importance to an impact depending on the salience of the concern, as discussed above. A third explanation could be due to an interaction effect between perceived knowledge and perceived importance. For example, low importance may be attached to a low knowledge impact if it is a localized issue such as gravel mining. High importance may be attached to a low knowledge impact if they fear what they do not understand. Low importance may be attached to a high knowledge impact due to familiarity with its effects. Others may attach high importance to a high knowledge impact if they have invested heavily in learning about it.

Identification of Shared Schema on Impact Concern

Eight shared cognitive schema emerged from the aggregate analysis of cognitive maps.

Aggregate Map #1. Eleven participant maps are members of this aggregate. The major impact concerns revealed in these maps are nurseries and their impact on water quality. Specifically, chemical toxicant and nutrient impacts from nurseries were identified. This aggregate is clearly distinguishable from the other seven. Though like other

[5] Of course, education programs are not needed if the assessed actual or potential impact is low.

aggregates, participants in this aggregate are concerned about water quality, they are uniquely focused on chemical and nutrient impacts. Concerns such as animal waste, septic systems, chemical use, nursery pesticides, and herbicides dominated their maps.

Aggregate Map #2. This aggregate also includes 11 participants. The two clustered concerns that defined the aggregate are animal waste and septic systems. These maps center on nutrient impacts from animals and/or humans, though specific animals (e.g., poultry or cattle) were not targeted.

Aggregate Map #3. This aggregate includes 16 participants. The clustered concerns that make up this aggregate include water quality and behavior-induced impacts. Unacceptable behavior by tourists and recreationists adversely impact water quality through littering and overuse. These behaviors deteriorate the river experience by creating visible pollution.

Aggregate Map #4. This aggregate includes 11 participants. Litter, poultry, cattle, government, and septic systems are the clustered concerns that make up this aggregate. Their concern about the role of government parallels the anti-government sentiment expressed by many participants.

Aggregate Map #5. Seventeen participants define this aggregate. Two clustered concerns are dominant, both of which include litter, water quality, and urination/defecation. However, the first cluster also includes behavior, whereas the second cluster includes Arkansas and poultry. These concerns confirm the importance that visible pollution and unacceptable behavior have on participants' perceptions of water quality.

Aggregate Map #6. The second largest group of participants (26) are included in this aggregate. The clustered concerns include water quality, litter, and behavior. Again, participants related their concerns to water quality.

Aggregate Map #7. This aggregate includes 15 participants. This aggregate is defined by clustered concerns of population density and water quality. Population density includes concerns about the increasing number of "outsiders," both temporary (tourists and recreationists) and permanent (new residents). Though their concern about water quality still includes visible pollution, a new dimension is added with the concern about the impacts of new residents on lifestyle changes.

Aggregate Map #8. The largest number of participants (28) belong to this aggregate. Concerns were expressed about water quality as the central concept, with poultry, Arkansas including Siloam Springs and Fayetteville, and litter being related to it.

Participants focused primarily on protecting water quality. Since the entire region, from northwest Arkansas to east-central Texas is witnessing a population growth rate exceeding 6% and approaching 15% in some location, the basin is experiencing the pressures of new demands for increased resources, infrastructure, and services. The cognitive mapping results are instrumental in revealing how stakeholders conceptualize their concerns, which are important to formulating impact management policy that will be politically acceptable.

It appears that a consensus may already be developing within the basin social system, but it can easily be overlooked. The "blame game" that is finding expression in the news media is being expressed by only a few. The quiet majority believes that it is more likely that everyone is to blame and that impacts have been accumulating for a long time. Many also appreciate that it is going to take all stakeholder groups to cooperate to solve the problems that threaten the basin. Very few are under the delusion that problems will be solved in the short term.

Identification of Shared Perspectives on Impacts and Management Preferences

Five shared perspectives were identified from the factor analysis of impact concern Q sorts.

- Pessimistic Perspective. The participants sharing this perspective express concern about chemical and sewage pollution, unruly behavior and drinking, lack of safety, erosion, and over-development, and the damage effects these have on the regional economy and on the environment. Moreover, they believe that the situation is worsening. Recreation is being jeopardized by over-development and contamination; measures to control both are urgently needed to protect the river. They are uniquely sensitive to intrinsic environmental values. They are

convinced that adequate proof exists that the poultry industry, in both Arkansas and Oklahoma, is a large polluter in the basin.

- Stewardship Perspective. Individuals who hold this perspective are unwilling to "pass the buck" in protecting the river and peoples' experience of it. They favor constraints on behavior, land use, and development. They hold Oklahomans as much or more responsible for damage to the river as Arkansans. This perspective is most apt to connect the river's aesthetics with recreation. The perspective reflects a stewardship ethic of responsible use.

- Individualist-Traditionalist Perspective. This perspective is concerned with pollution from elsewhere, not from pollution that may emanate from themselves such as phosphate soaps, septic systems, poultry farms, and cattle. It embraces individualism and resents outsider intervention and restrictions on liberty. Subscribers to this perspective wish to preserve traditional lifestyles. They deny that water quality is dangerous and are least worried about the water quality deterioration.

- Chemically Concerned Perspective. This perspective is most worried about chemical pollutants, regardless of source. Appearance is a visual indicator of pollution. They favor land use, behavioral, and pollution controls to protect the environment.

- Local Recreation Perspective. This perspective is worried about recreation because they directly benefit from it. They are also the strongest proponents for protecting the river to make money. When it comes to aesthetics, they are specifically concerned about recreational aspects.

All perspectives value the environment for more than just making money. They also share a concern about unregulated trash dumping. Finally, they deny that behavior does not impact water quality.

With respect to stakeholders' concerns about impacts, the pessimistic and individualist-traditionalist perspectives most disagree on pollutant impacts. They disagree on property rights, who's to blame for nutrient loading and its affects on water quality, the extent that water quality has deteriorated, the relative importance of human versus environmental values, and the causes of erosion. The latter perspective is most unique of the five perspectives.

Four shared perspectives on impact management preferences emerged from the Q factor analysis.

- Rational Use Perspective. Those sharing this perspective favor a deliberate, rational, and cooperative approach to impact management policy. Policy that restricts activities, even on private land, are appropriate if they result in sustainable use of the river basin. A management plan is desperately needed and should be enforced. Finally, all those responsible for contributing impacts must be held accountable for doing their part to reduce them. They do not trust locals or the Cherokee Nation to manage impacts; but they do trust the Oklahoma Scenic Rivers Commission. These participants are most likely to seek help from outside stakeholders if it would help solve problems.

- Individualist-Traditionalist Perspective. This conservative perspective is resistant to rapid and unfounded change, especially change that is coercive. A "don't rock the boat" and "if it's not broken, don't fix it" element is manifest in this perspective. Those sharing this perspective are more distrustful of those who want change or government intervention, including both experts and outsiders. Property use restrictions are not welcome.

- Conservationist-Green Recreationist Perspective. Those sharing this perspective believe that though more research is needed, an impact management plan and protective action are needed now. They are less supportive of interventions that restrict recreational uses of the river. They recognize that all are responsible for adverse impacts and that all have a duty to protect the river as a resource. However, they also believe that government is captured by special interests and therefore they would likely be skeptical of their motives in implementing a management plan.

- Parochial Perspective. This perspective is primarily concerned with local control. Those with this perspective recognize the need for river basin protection and use restrictions but distrust outsiders, OSRC, and experts to respect local values.

All perspectives condone wise use of the river and that all stakeholders should accept this responsibility.

The greatest difference between stakeholder management preference perspectives is the degree of importance attached to pollution, recreation, and government control.

Conflict Assessment Using Q Methodology

Although Q methodology does not permit an extrapolation of the proportion of stakeholders in the basin who may hold one perspective or another, it does provide insight on the qualitative differences in perspectives shared among stakeholders with respect to impact concerns and management preferences. This information is essential to diagnosing potential conflicts so that a river basin impact management policy that is politically acceptable to all stakeholders can be fashioned.

With regard to impact concern conflicts:

- The pessimist and chemically concerned perspectives accord the environment intrinsic value, the individualist/traditionalist and local recreation perspectives adopt a more utilitarian view, and the stewardship perspective embraces a conservationist ethic – everyone should enjoy the resource and participate in protecting it.
- Much of the individualist/traditionalist perspective conflicts with the other perspectives. First, there is substantial disagreement on the magnitude of farming (e.g., cattle, poultry waste, fertilizer) impacts. They are more likely to blame other sources (e.g., Arkansas). Second, those sharing this perspective resent outsider influence and encroachment on their traditional and individualist lifestyle. Finally, they are not inclined to voluntarily accept government intervention, especially if it restricts property use or imposes economic burdens.
- The pessimist perspective is the only one that is inclined to agree voluntarily to limit access to and use of the basin to protect it. The chemically concerned perspective is most worried about chemicals that can't be seen. Both are worried that the river will degrade to the point that health may be threatened, in stark contrast to the individualist/traditionalist perspective. The local recreation perspective is more concerned about economic threats caused by pollution and other impacts.

Though the participants tended to blame the impacts on others, all but those sharing the individualist-traditionalist perspective recognize that all have a responsibility to protect the basin and must share in the burden. To avoid conflict, it may be prudent to combine an educational program on the types, magnitudes, and sources of impacts with a consensus building approach designed to gain a voluntary commitment to protection and risk mitigation.
With regard to impact management preference conflicts:

- Participants agree that sustainable use of the basin is important, but do agree on how to achieve this goal. For example, those sharing the parochial perspective prefer more aggressive law enforcement to regulate recreationist behavior. However, this policy may be opposed by others; banning alcohol would be particularly controversial.
- Vis-à-vis government intervention, the individualist-traditionalist and parochial perspectives are most insistent that outsiders, including visitors, experts, and government agencies, are not permitted to force their will in policy making if it imposes an economic burden or restricts personal freedoms. This hostility toward and distrust of the motives of outsiders reflects a populist orientation that insists that local people have an inviolable right of self-determination.
- In contrast, the rational use perspective strongly prefers expert-based, rational government intervention that is gradual and deliberate. While the conservationist-green recreationist perspective is not particularly sympathetic to government intervention, they do recognize that enforceable restrictions are necessary. Those sharing this perspective are most supportive of the designation of the Illinois River as a federal wild and scenic river.

These findings confirm that consensus does not exist on the appropriate role that government should play in managing impacts. A split exists between those that favor state and/or federal government intervention (rational use), those that favor local government intervention (parochial), those who are unsure (conservationist-green recreationist), and those who are suspicious of any government intervention (individualist-traditionalist). One resolution of this conflict may be to rely on neutrals to facilitate a policy dialogue among stakeholders, coupled with efforts to maximize the quality of stakeholder participation. No doubt, policy deliberation will need to be

augmented with expert technical analysis and consultation, but factual uncertainty and disagreement seem to be less a source of conflict than do value conflicts.

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Are Bureaucrats and Scientists Members of Advocacy Coalitions? Evidence From an Intergovernmental Water Policy Subsystem

--WORKING PAPER*--

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* This is a working paper developed for the US Environmental Protection Agency Office of Economy and Environment, Office of Research and Development and Region 10, for their workshop, "Economic Policy and Research Concerning Water Use and Watershed Management," held on April 21-22, 1999, at the Crowne Plaza Hotel in Seattle, Washington.

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ARE BUREAUCRATS AND SCIENTISTS MEMBERS OF ADVOCACY COALITIONS? EVIDENCE FROM AN INTERGOVERNMENTAL WATER POLICY SUBSYSTEM

For most of this century, many people in the U.S. and Western Europe have assumed that scientific/professional expertise concerning the magnitude of a policy problem, its causes, and the probable consequences of alternative solutions can and should be provided in an objective fashion—that is, uncontaminated by the values of the expert scientist or bureaucrat providing the advice. According to this model, value choices in a representative democracy should be made by elected officials responsible to the voters, and experts such as scientists and bureaucrats should be the sources of objective advice. This model makes a clear distinction between two types of bureaucratic officials: (1) political appointees, who are expected to exercise their values and policy preferences and/or the preferences of the elected officials who appointed them; and (2) civil servants, who are supposed to provide expert advice to political appointees and, once a decision is made, to implement it faithfully even if they disagree with it (Maranto 1993a). This view implicitly assumes that civil servants are "policy indifferent," i.e. that they either have no substantive policy views or, if they have policy belief systems, they don't act upon them.

The classic example is the British civil service. A civil servant should always obey the minister. If the minister is not available, the civil servant's task is make the decision that the minister would have made had s/he been able to make it personally (Brown and Steel 1979, 129; Drewry and Butcher 1988, 157). In the U.S., the argument for neutral expertise was part of the civil service reform movement which began in the latter 19th century and eventually became part of the broader Progressive movement. The Progressives believed that, if professionally trained people were hired and given security of tenure, much of government could be handled in an efficient, neutral fashion—meaning, at the very least, "free of partisan politics" (Knott and Miller, 1987). Despite this faith in the potential of neutral, nonpartisan expertise to solve social

problems, most Progressives acknowledged that elected political leaders had the right to establish the policy goals of bureaucracy and that the bureaucracy's task was to implement the law in an expert, efficient, and rule-bound manner (Goodnow 1900; Rosenbloom 1971). Within the field of public administration, Roberts (1994) has argued that the Rockefeller Charities—which played a major role in funding public administration programs in the 1920s and 30s—didn't want to support anything "political" and thus strongly encouraged the image of a neutral, objective science of administration. There continue to be supporters of the "neutral competence" role model for civil servants (Kaufman 1956; Heclo 1975).

The Progressives' faith in value-free science was, in many respect, a precursor of positivists' belief in value-free science (Brown, 1977). Clearly, many scientists believe that their analyses of the magnitude of the problem, its causes, and the probable consequences of alternative actions can and should be provided in an objective, value-free fashion. And much of the claim for the role of independent scientists in policy disputes rests upon this view of their objectivity (Greenwood, 1997; NIE, 1997).

Many political scientists have long viewed this model of a clear separation between value-laden politics and value-neutral administration as naive (Appleby 1949; Nathan 1983k). Particularly in the U.S., weak political parties and the constitutional separation of powers require agencies to seek political alliances with key legislators and interest groups in order to assure a steady supply of critical budgetary and legal resources. This bureaucratic politics argument is best seen in the work of Wildavsky (1974), Fritschler (1983), and Meier (1985), as well as research on agencies' efforts to organize supportive constituencies (McConnell 1966; Sabatier 1975).

Political scientists have given far less attention to the role of scientists and other professionals in public policy. But there are certainly arguments, first, that technical expertise is an important political resource and source of legitimacy (Rourke, 1976); second, that agency, corporate, and "think tank" scientists tend to reflect the dominant interests or policy views of their organizations (Wildavsky and Tenenbaum 1981; Jasonoff 1987); third, that agencies dominated by a specific profession tend to reflect the policy views of that profession (Kelman 1981; Bell 1985); and , fourth, that divergent paradigms within or between disciplines can contribute to major policy shifts (Eisner and Meier 1990; Hall 1993). The latter two echo recent arguments in the philosophy of science that disciplinary paradigms usually contain all sorts of normative assumptions that belie the image of "value free" science (Brown 1977).

While many political scientists have expressed considerable skepticism concerning the "objectivity" of advice provided by civil servants and scientists, they have not produced any compelling theoretical frameworks of the role of agency officials, outside scientists, legislators, and interest group leaders in public policy-making, particularly in complex intergovernmental systems. The interrelated literatures on bureaucratic politics and policy subsystems generally incorporate relatively simple conceptual frameworks based on resource dependency principles (Pfeffer and Salancik 1978). Individuals are viewed primarily as members of organizations and heavily constrained by organizational rules. Organizations are preoccupied with the acquisition of resources necessary for maintenance and survival: (a) for agencies, budgets and legal authority; (b) for interest groups, budgets (generally perceived to depend primarily upon providing policy outputs that benefit members); and (c), for legislators, reelection. Organizations develop strategies and exchange resources in pursuit of these objectives. In most cases, the optimal strategy is to confine policy-making authority to a small set of legislative

committee members, agency officials, and interest group leaders who share a general set of policy goals and seek to negotiate long-term, mutually-beneficial arrangements—while restricting access of outsiders. Examples include the classic iron triangles in public works, agriculture, and nuclear power (McConnell, 1966; Baumgartner and Jones, 1993).

While these loose resource dependency principles have provided a useful organizing framework for a lot of empirical research, they also suffer from several limitations. First, proponents differ on whether actors have very simple goal structures dominated by material self-interest and survival (e.g. Niskanen 1971)or more complex goals including professional and other conceptions of what constitutes good public policy (Derthick and Quirk 1985). Second, there is a general tendency to assume that the relationship between goals/interests and behavioral strategies is relatively clearcut and that actors' belief systems are quite simple. Relatively little attention is accorded problem definition or technical information concerning problem severity, causes, or impacts. Third, as a consequence, the range of actors has generally been limited to high agency officials, legislative committee members, and interest group leaders, to the exclusion of those interested in policy ideas (journalists, policy analysts) and relatively technical information (scientists and policy analysts in agencies, think tanks, and universities). Fourth, there has been a tendency to focus on relatively simple policy subsystems involving a restricted number of actors. This was fine in the 1950 and early 1960s. But, since the early 1970s, most policy subsystems have become much more complex as actors with entirely different values have become organized (consumers, environmentalists, minorities, religious fundamentalists), decision-making in Congress and some other legislatures has become increasingly decentralized, and as subsystems have become increasingly intergovernmental in

scope. From the vantagepoint of 1997, the Washington-based iron triangles of the 1950s look quaint indeed.[6]

In an effort to address some of these perceived deficiencies in relatively simple resource-dependent frameworks, Sabatier (1988; Sabatier and Jenkins-Smith 1993; 1998) developed the advocacy coalition framework of policy change. It assumes that actors have relatively complex belief systems incorporating multiple values and perceptions of problem severity, causes, and impacts. It specifically deals with the role of scientists and policy analysts in the process. And it is designed to deal with complex intergovernmental subsystems involving large numbers of actors. One of its fundamental arguments is that most agency officials and scientists involved in a specific policy domain (or subsystem) are not "policy indifferent," but instead can be grouped with like-minded interest group leaders and legislators into one or more "advocacy coalitions." Each coalition consists of actors from a wide variety of institutions who (a) share a set of basic and instrumental policy beliefs forming a relatively coherent belief system and (b) engage in some degree of coordinated activity in an effort to alter the behavior of governmental institutions consistent with those beliefs.

In this paper, we first sketch out the basic arguments of the advocacy coalition framework (ACF), including several specific hypotheses. The ACF is then applied to a complex intergovernmental policy dispute involving water policy in the San Francisco Bay/Delta. In particular, we present evidence from a survey of 465 policy elites that (a) university scientists and officials (primarily civil servants) from many federal and state agency have belief systems very similar to interest group leaders from environmental and water development groups; (b)

[6]This is, admittedly, a simplification of a vast literature. In particular, it neglects subsystem dynamics (cf. Fritschler 1983; Worsham 1997). For other attempts to develop conceptual frameworks of subsystem dynamics, see Kingdon (1984) and Baumgartner and Jones (1993).

civil servants have belief systems that are just as integrated (coherent) as more "political" elites; and (c) that both agency officials and university scientists perceive sets of allies and opponents--including interest groups, other agencies, and university scientists—that arguably reflect some degree of coordinated behavior within coalitions. The concluding section discusses the generalizability and some of the implications of these results.

I. The Advocacy Coalition Framework (ACF)

The advocacy coalition framework is designed to understand policy change over periods of a decade or more within a particular substantive domain/subsystem, such as air pollution control or K-12 education. Since one of its goals is to integrate political scientists' traditional preoccupation with socio-economic conditions, political ideologies, and political institutions with policy scholars' concern with the role of policy analysis/scientific information in the policy process, the ACF has to deal explicitly with the factors affecting the behavior of professionals and scientists working in agencies, consulting firms, universities, etc. It does so by developing the concept of an "advocacy coalition."

As indicated previously, an advocacy coalition consists of interest group leaders, legislators, agency officials, researchers, and journalists who share a set of basic beliefs (policy goals plus perceptions of important causal relationships and variable states) and who engage in some degree of coordinated activity in order to alter the rules of governmental institutions over time (Sabatier and Jenkins-Smith 1993, 25). In Lake Tahoe environmental policy, for example, Sabatier and Brasher (1993) found two quite distinct coalitions in the 1970s and early 1980s: an environmental coalition composed of environmental groups, federal and state pollution control agencies, university researchers affiliated with the Tahoe Research Group, and several out-of-Basin California legislators; they were opposed by an economic development/property rights

coalition composed of local chambers of commerce, realtors, and property rights groups, most local government officials, most public utility district officials, and most local legislators. Conflict among coalitions is mediated by "policy brokers," i.e. powerful actors more concerned with fashioning an acceptable compromise than with achieving specific policy goals.

The model of the individual—and, by extension, the coalition as a corporate actor—in the advocacy coalition framework assumes that goals are usually complex and that an individual's ability to perceive the world and to process that information is affected by cognitive biases and constraints (Schlager 1995; Sabatier, 1998a). The ACF does not assume that actors are necessarily driven by simple goals of material self-interest, nor does it assume that self-interested preferences are easy to ascertain (Green and Shapiro 1994). Instead, it assumes that actors' goals are normally complex and should be ascertained empirically. In processing information, the advocacy coalition framework assumes that actors suffer from a variety of cognitive biases and constraints. First, their ability to process and analyze information is limited by time and computational constraints, thus providing incentives for simplifying heuristics (Simon, 1985). Second, the ACF assumes that actors weigh losses more heavily than gains (Quattrone and Tversky, 1988) and that they remember defeats more than victories. Third, the ACF assumes—consistent with attribution and cognitive dissonance theories—that, on salient topics, actors' perceptions are strongly filtered by their preexisting normative and other beliefs (Lord et al, 1979; Fiske and Taylor, 1984;).

The belief systems of various coalitions are organized into an hierarchical, tri-partite structure, with broader levels generally constraining more specific beliefs (see also Peffley and Hurwitz, 1985; Sabatier and Jenkins-Smith 1993,221). At the broadest level, the "deep core" of the shared belief system includes fundamental normative beliefs, such as the familiar Left/Right

scale, which operate across virtually all policy domains. At the next level are "policy core" beliefs which represent a coalition's basic normative commitments, causal perceptions, and preferred institutional arrangements across a policy domain or subsystem. Finally, the "secondary aspects" of a coalition's belief system within a specific policy domain comprise a large set of narrower beliefs concerning the seriousness of the problem or the relative importance of various causal factors in specific locales, policy preferences regarding desirable regulations or budgetary allocations, the design of specific institutions, and the evaluations of various actors' performance.

This model of the individual and of belief systems has important implications for coalition dynamics. First, policy core beliefs—because they are fairly general in scope yet very salient—prove more efficient guides to behavior over a wide variety of situations than do either deep core beliefs (which give insufficient attention to domain-specific parameters) or secondary aspects (which are too narrow). This, in turn, contributes to the ACF's assumption that the policy core provides the principal "glue" of coalitions (Zafonte and Sabatier 1997). Second, since the ACF assumes that coalition actors use selective perception and a variety of other devices to screen their beliefs from challenge, particularly at the deep core and policy core levels, such beliefs are resistant to change, and the composition of coalitions is hypothesized to be stable over periods of a decade or more. Third, actors in different coalitions will perceive the world through different "lenses"and thus often interpret a given piece of evidence in different ways. This contributes to in-group cohesion. It also produces distrust of people (including experts) in other coalitions who, since they come to conclusions so different than ours, must be either incompetent or motivated by nefarious interests. When combined with the tendency to remember losses more than victories, it becomes easy in high-conflict situations for a mutual "devil shift" to

develop, as each coalition views the others as more evil and more powerful than they probably are (Sabatier et al, 1987). As a result, conflict resolution among coalitions is more difficult than classic rational actors models would predict, and coalitions tend to remain differentiated and stable over time [in contrast to Riker (1962)].

The advocacy coalition framework explicitly rejects the assumption that most bureaucrats and researchers involved in a policy area will be policy indifferent. Instead, it contends they will have policy belief systems that are about as internally coherent as, for example, interest group leaders. There are at least four reasons. First, people usually choose a career because it is consistent with their underlying values and norms (Friedson, 1994). Second, researchers and agency officials with advanced degrees will generally accept the paradigmatic assumptions of their discipline (Brown 1977), including its normative assumptions about what topics are worthy of interest and whose welfare is critical, e.g. in the analysis of risks.[7] The normative assumptions behind welfare economics and benefit-cost analysis, for example, have been widely discussed (Rhoads 1985; Jenkins-Smith 1990). There also appear to be rather systematic differences between civil engineers and wildlife biologists.[8] The former generally assume that nature exists

[7] For example, Barke and Jenkins-Smith (1993) provide evidence that biologists perceive significantly greater risks from nuclear waste disposal than do physicists, chemists, and engineers. The latter accept a certain degree of background radiation as "natural" and think in terms of dose-response curves, while biologists are more wary of the effects of *any* dose on living organisms.

[8] Following are the data from the 1992 survey of San Francisco Bay/Delta water policy elites discussed later in this paper. We present the mean values for respondents from five disciplines on two primarily normative scales, one indicating a Utilitarian View of Nature, the other a Concern for Bay/Delta Fisheries:

Discipline	Utilitarian View of Nature	Concern for Fisheries
Engineering (n=74)	3.26	4.72
Physics/Chemistry (11)	3.40	4.86
Earth Sciences (109)	2.85	5.44
Social Sci/Humanities (109)	2.46	5.50
Biology (101)	2.15	5.82
Overall mean	2.61	5.40

for human purposes and that they can mitigate virtually all negative impacts arising from their projects. In contrast, most wildlife biologists tend to view virtually all species as having intrinsic worth and are very skeptical of the ability of humans to manipulate natural systems without unforeseen adverse consequences on one or more species. Third, long-standing, high-conflict policy disputes tend to be rather nasty, with lots of misrepresentations and *ad hominem* attacks. University scientists and even many agency officials who do not have a strong interest in solving the problems at hand tend to depart, creating a selection bias in favor of those with tough hides and committed points of view.[9] Fourth, most agencies have clear missions and their personnel will generally come to believe in the importance of that mission because of self-recruitment, indoctrination, and interaction with the agency's supportive constituencies (Kaufman, 1960; Kelman, 1981).

We can summarize these arguments in a set of hypotheses. The first two are simply a restatement

of the basic contentions of this paper:

> Hypothesis 1: Most agency officials, including civil servants, involved in policy disputes will be members of advocacy coalitions, i.e. they (a) will have coherent policy belief

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F-value (one way ANOVA) 10.4*** 8.72***

As can be seen, engineers and biologists were on opposite ends of both scales and the differences were significant at the .001 level. By the way, over 60% of the civil servants responding to our survey had advanced degrees.

[9]For somewhat similar arguments, see Nelkin (1971), Primack and von Hippel (1974), and Mazur (1981). We're not arguing scientists manipulate or falsify data. Instead, disciplinary paradigms, the values underlying their discipline, and their desire to solve particular problems affect the topics they choose to research, the variables they focus on, the methods they utilize, where they place the burden of proof in situations of uncertainty, and how quickly they present various results. For example, wildlife biologists are much more likely than engineers to look for species in trouble because their disciplinary norms define species extinction as a serious problem. They are more likely to look to human technological interventions as a likely explanation because they tend to respect the beauty of natural systems. In contrast, engineers assume they can improve on nature. Members within each discipline will readily present results congruent with these assumptions, while incongruent results are likely to be interpreted as tentative and in need of further verification.

systems[10] similar to those of relevant interest groups and (b) they will engage in some non-trivial degree of coordinated behavior with interest group leaders and other people with similar beliefs.

Hypothesis 2: Most researchers, including university researchers, involved in policy disputes will be members of advocacy coalitions, i.e. they (a) will have coherent policy belief systems similar to those of relevant interest groups and (b) they will engage in some non-trivial degree of coordinated behavior with interest group leaders and agency officials with similar beliefs.

The advocacy coalition framework does not, however, assume that university scientists and agency officials will be indistinguishable from interest group leaders. Instead, agency officials will usually be more moderate in their beliefs—particularly in the public expression of those beliefs—because they must be cautious about offending their multiple principals/sovereigns upon whom they depend upon for legal and budgetary resources (Jenkins-Smith et al 1991; Sabatier and Jenkins-Smith 1993, 213).

Hypothesis 3: Agency officials will express beliefs that are more moderate than, but similar in structure to, their interest group allies.

Similarly, university researchers should be more willing than their professional colleagues in agencies and interest groups to alter important perceptions in the policy core and secondary aspects because they are not constrained by the official position of their organization on such topics. That same lack of constraint—"academic freedom"—would also predict greater variation among university researchers in their beliefs than officials from specific interest groups or administrative agencies.

[10]A coherent policy belief system is one which contains a logically-consistent set of beliefs pertaining to a given policy domain/subsystem from the three ACF levels: deep core, policy core, and secondary aspects. It should contain general normative commitments, perceptions of system parameters and causal relationships, and more specific policy preferences. In this paper, then, we need to examine both ranges of beliefs.

Hypothesis 4: University researchers involved in a policy dispute will demonstrate greater variation in beliefs than officials from interest groups and administrative agencies.

All the above hypotheses are consistent with the advocacy coalition framework, although the first two are clearly more critical than the latter two. As a contrast, we'll use the "policy indifference" argument as a null hypothesis:

Policy Indifference Hypothesis: Agency officials (especially civil servants) and university researchers do not have coherent policy belief systems.

The rationale is that people who don't care about substantive public policy have no incentive to develop coherent *policy* belief systems relating general values, perceptions of causal relationships and state parameters, and policy preferences. Instead, agency officials will be preoccupied with procedural due process, administrative efficiency, and obeying superiors—e.g., "neutral competence" (Kaufman 1956; Heclo (1975)[11]—while university researchers will be preoccupied with pursuing good science for its own sake. In both cases, their policy beliefs should be somewhat randomly related, rather than similar to those of specific interest groups.

The remainder of this paper explores these arguments with respect to water policy involving the San Francisco Bay/Delta. After briefly providing some background on that policy dispute and our data base, we examine the views of agency officials, university scientists, and interest group leaders on a variety of different beliefs, in addition to their perceptions of allies and opponents.

II. Background

A) **Case Selection: San Francisco Bay/Delta Water Policy**

[11]This is only one interpretation of the concept of "neutral competence." Another interpretation includes professional norms. Since the latter, however, involve normative assumptions, we would not regard them as value neutral.

The advocacy coalition framework seeks to understand "wicked problems" (Hoppe and Peterse (1993)—i.e. those characterized by (a) a large number of actors from multiple levels of government, (b) substantial technical complexity and uncertainty, and (c) high political conflict. These are the types of situations simpler resource dependency (Pfeffer and Salancik, 1978) and institutional rational choice (Scharpf 1997; Ostrom 1998) frameworks have difficulty with because of the large numbers of actors and the uncertainties of preference formation. Water policy in the San Francisco Bay/Delta clearly meets these criteria.

In addition, the San Francisco Bay/Delta is one of the most important bodies of water in the United States. It is the defining characteristic of "The Bay Area," home to 7.5 million people. The Bay/Delta constitutes the most valuable wetlands area in the Western U.S. and a critical link on the Pacific Flyway. In 1980, its fisheries were valued at $27 million, but have declined substantially in recent years. Most importantly, the Delta is the hub of the state's major water delivery system which transfers water from the Sacramento and other Northern California rivers to the South Delta, where massive pumps from the Federal Bureau of Reclamation's Central Valley Project (CVP) and the California Department of Water Resource's State Water Project (SWP) deliver it though hundreds of miles of canals to farming areas in the San Joaquin Valley (which supplies 45% of the nation's fruits and vegetables) and to over 15 million people in Southern California (San Francisco Estuary Project 1992).

[Insert Figure 1 about here]

San Francisco Bay/Delta water policy has witnessed a series of major controversies over the past thirty years. In the 1960s, the major issue was the filling of San Francisco Bay by land developers, ports, and airports. This led to the creation of the Bay Conservation and Development Commission (BCDC) in 1965 and its strengthening in 1969. In the late 1960s and throughout the 1970s, the major focus switched to water pollution from municipal treatment

plants, industries, and surface runoff. Then, in the late 1970s, attention shifted upstream to the Delta and particularly to the relative importance of various factors—water diversions, pollution, overfishing, and the 1984-92 drought—on the precipitous decline of most Delta fisheries. This is an issue of tremendous economic and political importance, since most efforts to protect specific fish populations will adversely affect water supplies to San Joaquin Valley agriculture and Southern California urban areas.

Over the past twenty years, there have been at least five major attempts to deal with water flows and fisheries in the Delta. In 1978, the State Water Resources Control Board (SWRCB) proposed water quality standards for the Delta which substantially affected diversions, but these were subsequently brought into question by a 1985 Federal appellate decision. Second, in 1980-82 Governor Jerry Brown sought an engineering solution—building a "Peripheral Canal" around the Delta with strong environmental protections—but this was defeated in a 1982 statewide referendum by a strange alliance of environmental groups, San Joaquin farmers, and Southern California fiscal conservatives (Munro 1993). Third, two of the critical fisheries, the winter run salmon and the Delta smelt, were listed as threatened under the Federal Endangered Species Act in November 1991 and April 1993, respectively. Fourth, in 1992 Congress approved the Central Valley Project Improvement Act (CVPIA), which seeks to substantially enhance the BOR's and U.S. Fish and Wildlife Service's role in fisheries enhancement within the CVP and to encourage the CVP to engage in water marketing with Southern California cities. Finally, in 1994 informal negotiations among water agencies, agricultural water districts, and environmental and fishery organizations (both agencies and interest groups) resulted in the Bay/Delta Accord, which established a new set of water quality standards to protect Delta fisheries at reasonable costs (Sabatier 1998b).

B. Data Base

The data base for this paper comes from responses to a 14-page questionnaire mailed in the winter of 1992-93 to our estimate of the set of actors who in 1992 were informed and actively seeking to influence some aspect of Bay/Delta water policy (e.g. fisheries, water quality, water supply, fill) The names were obtained from three sources: 1) people active in the San Francisco Estuary Project or in SWRCB hearings on the Bay/Delta; 2) the major actors in critical agencies and interest groups concerned with some aspect of Bay/Delta water policy, and 3) people nominated as influential by the advisory committee to our project.[12] This produced a census of 779 names, of whom 427 responded, for an overall response rate of 55%. [13] In addition, 20 people were added from a companion 1984-92 elite panel survey when they said they were as active in 1992 as they had been in 1984. Finally, since we are primarily interested in comparing the responses of elites from different institutions, 18 people are counted twice because they held

[12]The majority of names came from the various policy and technical advisory committees associated with the San Francisco Estuary Project, a mammoth forum of agency, interest group, and research leaders that attempted to compile assessments of various Bay/Delta resources and to suggest policies for alleviating identified problems (SFEP, 1992). Many others came from the boards and critical staff of agencies and interest groups playing important roles in various Bay/Delta issues. To fill in the holes, 20-30 names—primarily mid-level staff in state and federal agencies--were added by our advisory committee. We are quite confident this represents virtually the entire list of important Bay/Delta water policy elites. One of the items in our questionnaire asked respondents to name the individuals or organizations they relied upon most heavily for advice and information. Of the 1260 authorities listed by our respondents, all the organizations and all but two of the 378 individuals were included in our survey.

8Following are the number of respondents and the response rate for various categories of actors:

Category	Number of Respondents	Response Rate
Federal & state govt. (includes 3 legs.)	96	60%
Bay local & regional govt. & public dischargers	98	52%
Central Valley govt. & interest grps.	32	56%
Southern California govt. & interest grps.	22	65%
Bay business, ports, & private dischargers	56	44%
Environmental and sportsmen's groups	47	58%
Consultants, univ. researchers, educ. fora	62	55%
Journalists and misc.	6	33%
Unknown (removed ID)	8	dk
	427	55%

two elite positions: one on the board of a regional agency, the other as a state or local government official.[14] Thus our data set consists of 465 respondents.

III. Results

In order to test these hypotheses, we must first group our 465 respondents into a reasonable number of organizational affiliations. We then examine the distribution of opinions among officials from a variety of organizational categories on several deep core, policy core, and secondary beliefs. Next will come several regression analyses to see if civil servants have belief systems which are as coherent/constrained as those of other actors. Then we shall look at various actors' perceptions of their allies and opponents to see, on the one hand, if agencies and university researchers were perceived by interest group leaders as active political actors and, on the other, if agency officials and university researchers viewed each other as allies and opponents.

A. Categories of Organizational Affiliation

Cluster analysis using individuals as the unit of analysis would be the ideal way to test the ACF hypotheses concerning similarity of belief systems. Unfortunately, a cluster analysis of our 465 respondents is simply unmanageable—at least from a presentation standpoint. The individuals must be aggregated in some fashion. So we first do so by organization, on the assumption that individuals within an organization will have *relatively* homogeneous beliefs because of the self-selection and indoctrination processes discussed previously. Even this, however, is insufficient, since our 465 respondents come from about one hundred private groups and local, state, and federal agencies that play a recurring role in Bay/Delta water policy. In

[14] Of the 18, 14 were members of the BCDC Board who were also local or state government officials; 3 were members of the Board of the Central Valley Regional Water Quality Control Board (as well as leaders of water districts or major agricultural organizations); and 1 was with the Aquatic Habitat Institute (as well as the San Francisco Regional Water Quality Control Board).

order to reduce these to a reasonable number, we have further aggregated them into the following twenty categories of organizational affiliation. Different organizations have been collapsed into the same affiliation category (a) if they have similar functions and/or locale (e.g. Bay local governments) *and* (b) if their respondents expressed similar views on our attitudinal scales.

Agencies

1) *U.S.BOR/CA DWR* (n=20). These are officials, primarily civil servants, from the U.S. Bureau of Reclamation and the California Department of Water Resources, the agencies that operate the CVP and SWP water projects that send water from the Delta to the San Joaquin Valley and Southern California.

2) *U.S. Army Corps* (n=8). These are civil servants from the U.S. Army Corps of Engineers, the federal agency primarily responsible for regulating dredging and construction in wetlands.

3) USFWS/NMFS (n=13). These are officials, primarily civil servants, from the U.S. Fish and Wildlife Service and the National Marine Fisheries Service, the two federal agencies responsible for fisheries and endangered species.

4) *CA Fish and Game* (n=11). These are officials, primarily civil servants, from the California Department of Fish and Game. While their views generally parallel those of their biologist colleagues in the two federal wildlife agencies, state agency personnel differ on the Peripheral Canal and thus are kept separate.

5) *EPA/Misc. Resource Agencies* (n=30). About a third come from the U.S. Environmental Protection Agency, with the rest coming from a variety of federal and state natural resources agencies, including the State Lands Commission, the California EPA, and the U.S. Soil Conservation Service; almost all are civil servants.

6) *SWRCB* (n=11). These are officials, primarily civil servants, from the State Water Resources Control Board, the state agency primarily responsible for both water quality and water rights/flows. Under the state board are several regional boards, including two in our survey; respondents from the three organizations expressed different enough views that we decided not to aggregate them.

7) *San Francisco RWQCB* (n=13). These are board members and senior staff (most of the latter, civil servants) from the San Francisco Regional Water Quality Control Board which has jurisdiction over San Francisco Bay and a portion of the Delta.

8) *Central Valley RWQCB* (n=10). Similarly, these are board members and senior staff from the Central Valley Regional Water Quality Control Board, the board with jurisdiction over the Sacramento Valley, the San Joaquin Valley, and the remainder of the Delta.

9) *BCDC/Misc. Regional Agencies* (n=29). These are primarily board members and staff from the Bay Conservation and Development Commission (BCDC), which regulates building and fill along the Bay shoreline; also a few people from other Bay Area regional parks/planning agencies.

10) *Bay/Delta Local Govt* (n=43). These are elected officials and senior staff from general purpose local governments and water supply agencies in the Bay/Delta.

Interest Groups

11) *Southern California* (n=22). These are elected officials and senior staff from water agencies in Southern California who either testified at Bay/Delta hearings or are on the boards of the SWP or CVP Contractors Associations. They are treated here as interest groups because they have no formal governmental authority in the Bay/Delta (Salisbury 1984).

12) *San Joaquin Valley/Statewide Ag* (n=25). These are primarily elected officials or senior staff from water or irrigation districts in the San Joaquin Valley who testified at Delta hearings or were on the CVP/SWP Boards. It also includes 7 representatives of statewide agricultural organizations, such as the Farm Bureau, Grange, and Agricultural Chemicals Assn., who testified at the SWRCB hearings and whose responses were very similar to those from the San Joaquin Valley.

13) *Sacramento Valley* (n=10). These are officials from general purpose local governments slightly upstream of the Delta or from water districts in the Sacramento Valley (i.e. north of the Delta) who testified at the Delta Hearings or were active in the Estuary Project. They are treated as interest groups because they have no formal governmental authority in the Bay/Delta.

14) *Private Dischargers* (n=28). These are primarily water quality specialists with industries that discharge wastes either directly or indirectly (via sewer systems) into the Bay/Delta.

15*) Public Dischargers* (n=27). These include board members and senior staff from the five publicly-owned sewage treatment works (POTWs) in the Bay Area or the association of such dischargers.

16) *Business/Ports* (n=27). This includes 14 representatives from business associations (primarily the Bay Planning Coalition) and 13 from ports and airports—all in the Bay Area. These groups tend to have similar views, in part because of their common interest in development along the Bay shoreline.

17) *Environmental/Sportsmens Groups* (n=54). These are the senior staff and critical board members from the principal environmental and fishing/ hunting groups concerned with the Bay/Delta.

Researchers (and Misc)

18) *University/Misc. Researchers* (n=32). These are primarily university faculty who have been active in Bay/Delta research; it also includes a few researchers from institutes in the Bay Area, such as the Tiburon Center. Most were taken from the lists of technical advisors to the Estuary Project.

19*) Consultants* (n=23). These are researchers in consulting firms who have been active on Bay/Delta water issues, either as advisors to the Estuary Project or as participants before SWRCB hearings.

20*) Other* (n=28). This is a miscellaneous group composed of journalists, leaders of educational fora, union leaders, a few state legislators, and anonymous respondents. This category is not mentioned in most of our analyses, although its members are included in the overall means.

This diverse set of actors from agencies and legislators at multiple levels of government, interest groups, and researchers is typical of many policy subsystems—except perhaps for the relatively large number of university scientists (Marin and Mayntz 1991; Heinz et al. 1993; Knoke et al 1996).

B. Attitudes of Policy Actors

This section provides the mean scores for each organizational category for a variety of attitudes ranging from very broad ideological orientation to specific perceptions and preferences. Each figure also provides the overall mean, standard error bars for each organizational category, and an indication of whether the means for specific organizational categories are significantly different from the overall mean.[15] For most agency categories, there is no statistically

[15] We used a two-tailed t-test to determine if the mean for a specific organizational category was significantly different from the overall subsystem mean. If the variance for the organizational category differed significantly ($p<.05$) from the population mean, we used an unequal variance test. If it didn't, we used an equal variance test.

significant difference between civil servants and elected/appointed officials.[16] In cases where there is—chiefly involving the San Francisco and Central Valley Regional Water Quality Control Boards—these will be noted.

In general, the advocacy coalition framework predicts that agency officials and university researchers will have views similar to, but somewhat more moderate than, their interest group allies and that the same patterns will persist across all levels of their belief systems. The policy indifference hypothesis predicts that university researchers and agency officials (particularly civil servants) will cluster around the overall subsystem mean, as the easiest and safest point of view.

1)Deep Core: Conservatism Scale. Figure 2 presents the data on a 6-item Neo-Classical Conservatism Scale representing support for markets and property rights (see Appendix A for details). This scale is at the deep core since it applies to a wide variety of policy domains.

[Insert Figure 2 about here]

At the upper-right portion of the figure, representing the most conservative positions, were officials from San Joaquin Valley/statewide agricultural groups, Bay businesses and ports, Southern California water districts, and private dischargers from the Bay Area. All were significantly different from the overall subsystem mean. The two water export agencies (the BOR and DWR) were also on the conservative side of the spectrum, although not significantly

[16] We compared the views of civil servants versus elected officials and political appointees for six categories of agencies (BOR/DWR, EPA et al, BCDC et al, Bay local govts., Southern California water districts, and San Joaquin Valley water districts) on 10 attitudinal and perceptual items. There were statistically significant differences at the .05 level on 4 of those 60 relationships, or almost exactly what would be expected by chance. At the .10 level, there were differences on 7 of the 60 relationships. On the Central Valley and San Francisco Regional Water Quality Boards, however, there were significant differences ($p<.05$) on 8 of the 20 items, primarily in the deep core and policy core, plus the policy item concerning listing the Delta smelt as an endangered species. In both regional water agencies, the boards were more conservative and less environmental than the staff, which is what one would expect given that the boards were appointed by a Republican Governor politically indebted to San Joaquin farmers while the staff were primarily water quality engineers.

different from the mean. At the bottom-left, liberal end were environmental/sportsmen's groups, EPA and misc. federal/state resource agencies, BCDC and other Bay regional agencies,[17] university researchers, and, marginally, the two federal fisheries agencies ($p<.10$). Several agency categories, including Bay local governments and the water quality agencies, were near the overall mean, consistent with the policy indifference model. In the cases of the Central Valley and San Francisco Water Quality Agencies, however, this "indifference " was simply the average score between a conservative board (PA=political appointees) appointed by a Republican Governor and a relatively liberal staff (CS=civil servants) composed primarily of water quality engineers and biologists. University researchers were clustered at the liberal end of the scale, suggesting that not much has changed since the 1960s (Ladd and Lipset 1975).

2) Policy Core: Flows and Fisheries Scale. Now let's look at a scale containing a variety of normative and perceptual items related to fisheries and flows in the Bay/Delta (see Appendix A for details). We treat it as policy core because it deals with an extremely important aspect of Bay/Delta water policy that has ramifications for most other aspects (Zafonte and Sabatier 1997).

[Insert Figure 3 about here]

The results in Figure 3 support the advocacy coalition framework. At the pro-environmental end were officials from the two federal fishery agencies, environmental/sportsmen's groups, EPA et al, California Fish and Game, university researchers, and BCDC et al., as well as civil servants from the San Francisco Regional Water Board[18] At the

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[17] In this case, the 13 civil servants were not quite significantly different from the mean, while the 15 political appointees--and the category as a whole--were.

[18] Again, however, BCDC civil servants were not quite significantly different from the overall mean, while political appointees and the organizational category as a whole was.

other end of the scale—indicating skepticism that Bay/Delta environmental quality and fisheries were declining and opposition to strong measures to protect them—were officials from San Joaquin/statewide agricultural groups, Southern California water districts, the BOR/DWR, and political appointees from the Central Valley Regional Water Board. All had means significantly different from the overall mean. These patterns are quite similar to those seen previously on the Conservatism Scale.[19] They provide evidence for two distinct coalitions, each comprised of interest groups and officials from several different types of agencies, with the attitudes of university faculty placing them clearly in the environmental coalition. The data here (and elsewhere) also suggest that some aggregated categories, namely consultants and Bay Area local governments, tend to hold positions close to the overall mean.[20]

3) Critical Causal Perceptions. We now pass to a purely perceptual item involving a critical aspect of Bay/Delta fisheries. Figure 4 presents respondents' perceptions of the importance of water diversions (including the CVP and SWP pumps, but also upstream diversions) on the decline of Bay/Delta fisheries. In ACF terms, this is important enough to be labeled a policy core perception because it deals with Bay/Delta fisheries as a whole, and fisheries are a critical aspect of Bay/Delta water policy.

[Insert Figure 4 about here]

The results on diversions in Figure 4 are virtually a mirror image of the previous policy core scale. The federal and state fishery agencies, EPA et al, university researchers,

[19]The results are similar to those from several other deep core and policy core scales that could not be presented here because of space constraints (see Sabatier and Zafonte 1995, Tables 1-2).

[20]Of course, *specific* local governmental officials and consultants were sometimes members of various coalitions. Our practice of aggregating officials across similar organizations into categories of organizational affiliation represents a conservative test of the advocacy coalition framework since there will be some regression toward the overall subsystem mean for different organizations in the same category.

environmental groups, BCDC et al, and, marginally, SWRCB officials ($p<.10$) are at one end; the San Joaquin/state agricultural organizations, Southern California water districts, and BOR/DWR are at the other. Public and private dischargers, Bay businesses/ports, and Central Valley Regional Water Board officials occupied positions on the water development side of the overall mean, but did not attain the .05 significance threshold (except for Central Valley RWQCB political appointees).[21]

4) Specific Policy Proposals. Finally, Figures 5 and 6 present the positions of our organizational affiliation categories on two of the most important and controversial policy proposals affecting Bay/Delta fisheries: (1) the listing of the Delta smelt as a threatened species and (2) the construction of a Peripheral Canal around the Delta to provide water supplies to Southern California and the San Joaquin Valley while hopefully reducing the impact of the export pumps on Delta fisheries.

[Insert Figure 5 about here]

The lineup on the Delta smelt listing in Figure 5 provides further evidence of our familiar coalitions: an environmental coalition composed of the two federal fisheries agencies, environmental/sportsmen's groups, university researchers, EPA et al, BCDC et al, and California Fish & Game. At the other end was the familiar water development coalition composed of San Joaquin/statewide agricultural groups, Southern California water districts, and the BOR/DWR,--together with Bay businesses and ports, and public dischargers. The boards of both regional

[21] We also looked at different groups' perceptions of the importance of (a) entrainment of fish in CVP/SWP pumps and (b) overfishing/poaching as causes of the decline in Bay fisheries. The distribution of perceptions on the pumps were very similar to those for diversions. Those on overfishing were, as expected, basically the *reverse* image of the results on diversions (i.e. those ranking diversions high deemphasized the importance of overfishing, while those wishing to deflect attention from diversions pointed to overfishing as a cause). The most notable exception on the latter were university researchers, with a mean virtually identical to the population mean. Finally, elsewhere (Sabatier and Zafonte 1995, Tables 4-5) we have presented data indicating that these differences persist—albeit in somewhat attenuated form—regarding interpretations of a specific graph depicting fluctuations in Delta smelt populations over time.

water quality agencies favored the water development coalition, while staff were either neutral or favored the environmental coalition.

[Insert Figure 6 about here]

The lineup on the Peripheral Canal in Figure 6 has some familiar elements but also several anomalies. In strong support, as one would expect, were the BOR/DWR, Southern California water agencies, and San Joaquin/statewide agricultural groups. But also in strong support were officials from the California Department of Fish and Game and the SWRCB. These agencies had adopted the position in the early 1970s that (a) the export pumps were here to stay and (b) the best way to minimize their impact on fisheries was to build a canal from north of the Delta directly to the pumps. The defeat of the Peripheral Canal in the 1982 statewide referendum did not change their views.[22] At the opposing end of the scale were the familiar environmental groups, BCDC et al, university researchers, and officials from federal fisheries and resource agencies (although the latter were significant at only the .10 level). In addition, environmental groups were joined on this issue by an unusual ally, private dischargers. The probable explanation is that dischargers were worried the Canal would divert so much water around the Delta that not enough would be left to dilute pollution concentrations.

The results throughout this section indicate substantial support for the basic ACF propositions (Hypotheses 1 and 2) that most agency officials and university researchers will not be grouped around the overall subsystem mean (as suggested by the policy indifference hypothesis) but instead will consistently have positions close to their interest group allies. On

[22] The Peripheral Canal would obviously meet the needs of San Joaquin agriculture and Southern California cities. F&G and SWRCB officials argue it would also improve Delta fisheries by the pumps' effects on the Delta. At present, the pumps not only "entrain" (chew up) millions of fish but also alter flow patterns in the Delta, thereby confusing migratory fish such as salmon. The risk, which these groups feel is acceptable while environmental groups do not, is that the Canal could greatly increase the amount of water diverted south. We wish to thank Jerry

most issues, there were two coalitions with positions significantly different from the overall subsystem mean: An environmental coalition composed of environmental/fisheries interest groups, federal and state fisheries agencies, EPA and other federal/state resource agencies, BCDC and other Bay regional agencies, and university researchers. They were opposed by a water development coalition composed of San Joaquin/statewide agricultural groups, Southern California water agencies, the two major water export agencies (the Federal Bureau of Reclamation and the California Department of Water Resources), and the politically-appointed board of the Central Valley Regional Water Quality Control Board. On the other hand, consultants (as an aggregate category) and several agencies—including the U.S. Corps of Engineers, the SWRCB, and Bay Area local governments (as an aggregate category)—were *not* part of discernible coalitions, but instead seemed to be either near the subsystem mean or to approximate the positions of different coalitions on different issues.[23]

What about the hypothesis (# 3) that agency officials—particularly civil servants—will express more moderate beliefs than their interest group allies? Table 1 provides the means for various agencies and interest groups involved in the water development coalition and the environmental coalition on all the attitudinal items presented in this paper, together with an indication of whether the means of agency officials (in the aggregate) were significantly different from their interest group allies.

[Insert Table 1 about here]

In the water development coalition, on four of the five items BOR and DWR officials held more moderate views than their allies in San Joaquin and Southern California water districts

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Johns (SWRCB), John Budd (U.S. BOR) and Randy Brown (DWR) for their comments regarding the Canal on a previous version of this paper.

and these differences were statistically significant.[24] Within the environmental coalition, the specific agencies usually had more moderate views than their interest group allies, and these differences were significantly different in the aggregate on three of the five items. Note, however, that on two of the items—diversions as a cause of fishery decline and support for listing the Delta smelt as a threatened species—officials in the two federal fishery agencies held more extreme views than their interest group allies. On the whole, however, these results present fairly strong support for Hypothesis 3.

With respect to university researchers, the data in Table 1 indicate that, on four of the five items, their views were significantly more moderate than those of their interest group allies (although not necessarily more moderate than officials from specific agencies). The standard errors from Figures 2-6 do not, however, support the argument in Hypothesis 4 that university researchers in a policy dispute will demonstrate greater variation in beliefs than officials from interest groups and agencies. [25]

C. Do Civil Servants (and University Faculty) Have Coherent Policy Belief Systems?

The policy indifference hypothesis predicts that, since civil servants and university faculty are indifferent to policy issues, they should have poorly integrated policy belief systems. In contrast, the advocacy coalition framework predicts that, since most civil servants and university faculty involved in policy disputes are members of coalitions, their belief systems

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[23]Recall that specific individuals within these groupings might be members of coalitions, even if the overall mean for the category approximates the subsystem mean.

[24]If one runs a two-tailed test, the differences on the Delta smelt item cease to be marginally significant. Otherwise, the results for both coalitions are identical. We present the results from the one-tailed test because the moderation hypothesis posits a direction.

[25]Although the standard errors do not seem to suggest less variation among university researchers than within other categories, we should probably run F-tests on the standard deviations

should be as coherent/constrained as those of other policy elites, such as interest group leaders or legislators.

In order to test these competing hypotheses, Table 2 presents the results from two sets of multiple regression equations. The first set attempts to explain support for the Peripheral Canal and the second for listing the Delta smelt as a threatened/endangered species. The independent variables are two deep core scales, two policy core scales, and several relevant perceptual items.[26] For each policy proposal, we ran the same equation twice: once for the entire set of respondents (composed largely of interest group leaders and political appointees), and then only for civil servants.

[Insert Table 2 about here]

On both sets of equations, the results for civil servants are similar to those for the total set of respondents in terms of the percentage of variance explained (adjusted R2), as well as the sign and magnitude of the regression coefficients. In both cases, the Chow F-test for structural difference in all parameters was *not significant* (Greene 1993). These findings suggest that civil servants involved in Bay/Delta water policy in 1992 had belief systems which linked normative positions, causal perceptions, and policy preferences in about as coherent or constrained a manner as those of other policy elites—thus providing additional support for Hypothesis 1.

We ran the same equations for university faculty and, again, the Chow F-test revealed no significant differences between them and the population as a whole. [27] We don't present the

[26]Because of space constraints, data on some of these items has not been presented in this paper although they have been mentioned in the footnotes. See Sabatier and Zafonte (1995)—a paper written primarily for Bay/Delta policy practitioners—for details. We here present the results for the full model, although we strongly suspect that a truncated model would produce very similar results.

[27]For the Peripheral Canal equations, the Chow F-test=0.906 (p=.5114). For the Delta smelt listing, Chow F-test = 1.298 (p=.2440).

regression coefficients because of problems with multicollinearity and small degrees of freedom. But these results provide at least a little additional support for Hypothesis 2.

D. Perceptions of Allies and Opponents

Thus far we have presented evidence that the officials of most federal and state agencies—as well as university researchers—involved in Bay/Delta water policy have coherent belief systems that are fairly close to, although somewhat more moderate than, their interest group allies. Thus they have met the first of two conditions for being "members" of advocacy coalitions. But what about the second condition, i.e. engaging in "a non-trivial degree of coordinated activity over time" (Sabatier and Jenkins-Smith 1993,25)?

Although we lack direct measures of the behavior of agency officials and university researchers, our questionnaire does provide systematic data on who respondents perceived their allies and opponents to be. These are relevant in at least three ways. First, the advocacy coalition framework would expect agency officials and university researchers to admit having "allies" and "opponents"—at least to the extent that they admitted being members of coalitions. In contrast, the policy-indifference model would expect neither bureaucrats nor university researchers to have "allies" and, even less so, "opponents." Thus the policy indifference model would expect the non-response rate to these items to be much higher for agency officials and university researchers than for other policy elites. Second, the advocacy coalition framework would expect to find both interest groups and other agencies among the allies and opponents of both agency officials and university researchers, since all would be regarded as potential members of coalitions. In contrast, the policy indifference model would expect that, even if bureaucrats and university researchers admitted having allies and opponents, these would be limited to interest groups. It would make little sense to think of other agencies and researchers in

these terms, since the vast majority of such actors would, according to this model, be policy indifferent. Third, perceptions of allies and opponents are presumably based in part on the past behavior (rather than simply the private attitudes) of officials in those organizations. While our 1992 survey did not explore this assumption, a very preliminary analysis of a similar question in a 1997 survey of Bay-Delta water policy elites suggests this is, in fact, a reasonably valid indirect indicator of several types of coordinated behavior.[28]

One part of the questionnaire gave respondents a list of 20 types of organizations (roughly the same as our organizational affiliation categories) and asked them to indicate up to three "with whom you identify or regard as allies" and up to three "which you regard as your principal opposition." Table 3 indicates, for respondents from organizations in the two potential coalitions, their perceived allies, grouped by type of organization and coalition. Table 4 does the same for perceived opponents.

[Insert Table 3 about here]

[28]In response to Edella Schlager's (1995) criticism that our measures of perceived allies and opponents were not actually measuring coordinated behavior, our 1997 Bay/Delta questionnaire attempted to address this deficiency. For each ally listed by a respondent, it asked for the frequency (never, occasionally, often) with which they engaged in four types of activities: (a) share information, (b) voluntarily modify my behavior to assist them, with the expectation of future reciprocity, (c) voluntarily modify my behavior to assist them because we share similar goals, and (d) develop a joint policy position or stratery. Since the survey is still ongoing, we have only very preliminary data. But an analysis of 25 respondents (selected from the middle of a pile of 300 thus far) who listed a total of 66 allies reveals the following frequency distributions:

	Share Info	Modify b/c reciprocity	Modify b/c goals	Joint Strategy
Never	0%	36%	8%	21%
Occasionally	44%	44%	58%	41%
Frequently	56%	20%	34%	38%
Occasionally or more:	100%	64%	92%	79%

In sum, in 100% of cases, listing a person/organization as an ally involved at least occasionally sharing information; in 92% of cases, it involved at least occasionally modifying behavior because of shared goals; in 79% of cases, it involved at least occasionally developing a joint policy position or strategy; and in 64% of cases it involved at least occasionally modifying behavior in expectation of future reciprocity. Thus listing a person as an "ally" does appear to be an indirect indicator of several types of past and future coordinated behavior.

Looking first at the bottom row of the two tables for the percentage of non-respondents from each affiliation category, 0-15% of agency officials refused to list any perceived allies, compared to 4-8% from the various interest groups and 16% of university researchers. None of these differences among agency officials, interest groups, and university researchers were statistically significant at the .05 level. The percentage of agency officials refusing to list any opponents increased slightly (particularly for the BOR/DWR and EPA et al), but, even so, over 85% of federal and state agency officials listed at least one opponent. University faculty were comparable (19%), while respondents from interest groups were slightly more willing to acknowledge having opponents, but the differences between agency, interest group, and university personnel were, again, *not* significant.

Turning to various actors' perceptions of their allies and opponents, the results provide fairly strong support for the advocacy coalition framework.. In Table 3, for example, among BOR/DWR officials, 75% cited each other as allies, while 35% cited agricultural interests and Southern California cities. Generally only about 5% cited various members of the environmental coalition, with the exception of 30% citing the various fishery agencies and 15% citing university researchers. The data were similar for agricultural groups and Southern California water agencies. Both cited themselves and the BOR/DWR as allies about 75% of the time, while citing each other about 20%. Very seldom did either cite members of the environmental coalition as allies, with the exception of 23% Southern Calfiornia representatives citing environmental groups as allies. These anomalies reflect the politics of the recently-passed Central Valley Project Improvement Act, in which Southern California cities switched allegiance from San Joaquin agricultural interests to environmental groups over the issue of water transfers. The results are even stronger for members of the environmental coalition. With the exception of

a trivial percentage of university researchers, *none* of the respondents in the six categories listed members of the water development coalition as allies. In contrast, 55-87% of the actors in each category listed environmental groups as allies! In short, the citation patterns for allies in Table 3 reveals two rather distinct coalitions, each composed of both agencies and interest groups. In addition, the citation patterns by agency officials in the two coalitions were fairly similar to those of their interest groups allies.

[Insert Table 4 about here]

The citation patterns for opponent in Table 4 are similar to those for allies in Table 3. Members of the water development coalition tended not to list each other as opponents (except for the 23% of Southern California officials displeased with agricultural interests), while 59-92% listed environmental groups as opponents and 30-82% listed the U.S. EPA as an opponent. Among members of the environmental coalition, only very small percentages listed each other as opponents, while 30-90% listed members of the water development coalition as opponents. And the percentage of negative citations by agency officials and university researchers tended to be quite similar to those of their interest group allies. The possible exception was BOR/DWR officials, who tended to have a somewhat less negative view of the EPA than did their interest group allies.

One final comment: University faculty tended to view themselves as members of the environmental coalition, i.e. they perceived environmental groups, other researchers and, to a lesser extent, EPA and the fisheries agencies as their allies, while viewing agricultural interests, Southern California cities, and the BOR/DWR as opponents. Table 3 indicates, however, that only about 20% of the other members of the environmental coalition viewed university researchers as one of their three top allies, and Table 4 demonstrates that virtually none of the

members of the water development coalition perceived university researchers as opponents. In short, most members of the Bay/Delta waster subsystem in 1992 seemed to accept the popular portrait of university researchers as neutral, objective, policy indifferent, etc. That may change as findings from this study become known.

IV. Summary and Conclusions

The evidence from this analysis of Bay/Delta water policy elites provides substantial support for the basic contention of the advocacy coalition framework that agency officials and university researchers active in policy disputes are usually members of advocacy coalitions--rather than being "policy-indifferent." Officials in many agencies—including the BOR/DWR, state and federal fisheries agencies, EPA and other state/federal resource agencies, and BCDC/Bay regional agencies—had beliefs very similar to those of interest group leaders in their respective coalitions. These beliefs were as well integrated into coherent belief systems as those of other policy elites in the subsystem. Agency officials were about as likely as their coalition partners to see other agencies and interest groups as allies and opponents.

Most of these conclusions also hold for university researchers involved in Bay/Delta water policy. Their beliefs on a wide variety of policy issues placed them clearly in the environmental coalition. There is some evidence that their policy belief systems were as internally consistent (constrained) as those of other policy elites. And their perceptions of allies and opponents were very similar to those of other members of the environmental coalition. These findings for university researchers are all the more remarkable because we have made no effort to control for academic discipline or institution.

In terms of the hypotheses presented in the first section of this paper, the data in Figures 2-6 and Tables 1-2 clearly support the first part of Hypotheses 1 and 2. Both agency officials

and university researchers tended to have coherent belief systems similar in structure to those of their interest group allies. Whether one regards them as full-fledged "members" of advocacy coalitions depends upon the extent to which one views our data on perceived allies and opponents as reasonably valid indirect indicators of coordinated behavior. If one shares our cautiously favorable interpretation of the indicators, then the second part of Hypotheses 1 and 2 is also confirmed, and the officials of most state and federal agencies and university researchers involved in Bay Delta water policy were members of coalitions. To the extent that one remains skeptical about our indicators, the evidence for the second part is inconclusive. With respect to Hypothesis 3, the evidence in Table 1 provides fairly strong indication that officials in most agencies—with the exception of the two federal fishery agencies—tended to have more moderate views than their interest group allies. University researchers also tended to express more moderate views than their interest group allies (although not necessarily more moderate than their agency allies).

The question now arises, how generalizable are these results? Is there something peculiar about Bay/Delta water policy within the U.S.? If not, is there something about the U.S.—compared to other Western countries—that makes our agency officials and university researchers who are active in policy disputes behave more like members of advocacy coalitions?

Within the U.S., at least four types of evidence are relevant. First, several studies suggest that both federal and state/local bureaucrats are somewhat more liberal on social and economic issues than are the public as a whole, and these disparities increase within several policy domains (Meier and Nigro 1976; Garand et al 1991a,b; but Lewis 1990). Second, at least two other studies have compared bureaucrats' views to those of other elites in their policy subsystem. In an analysis of Forest Service employees in the intermountain states in the early 1970s, Culhane

(1981) found that agency officials' policy views were more or less equidistant between commodity interests, on the one hand, and environmental groups, on the other. While one might interpret this as evidence of policy indifference, Culhane viewed it as consistent with the Forest Service's traditional "multiple use" mandate. In a study of water policy elites at Lake Tahoe in the mid-1980s, Sabatier and McLaughlin (1988) found a situation similar to the Bay/Delta, with environmental groups and federal/state resource agencies clustered at one end of several attitudinal scales, while property rights groups, business associations, and public utility districts were at the other end. Third, numerous studies of the reaction of officials in social and regulatory agencies to the Reagan Administration's attempts to use political appointments and budgetary cutbacks to curtail their programs reveal that many civil servants were not policy indifferent but, instead, fought the cutbacks by leaking damaging information to sympathetic Members of Congress and interest groups (Cook and Wood 1989; Durant 1992; Maranto 1993a,b).

Finally, the principal-agent literature assumes that the ability of principals to control bureaucratic agents is problematic (Moe 1984). Public choice theorists, following Niskanen (1971), assume that the source of control problems resides in bureaucrats' desire to maximize their budgets and/or to minimize their workload.[29] On the other hand, the advocacy coalition framework and the evidence cited above concerning the Reagan Administration suggests that bureaucrats will seek to avoid control by principals when they have value/policy differences, and resistance will be particularly pronounced when principals seek to change the fundamental mission of the agency. Unfortunately, most of the empirical tests of principal-agent relationships have spent much more time analyzing the effectiveness of various type of instruments available

[29] Information asymmetries are less the *source* of the problem than the reason why bureaucrats are able to avoid control with some success.

to principals than in examining alternative explanations of bureaucratic resistance (Wood and Waterman 1991). [30]

Turning now to Western Europe, Aberbach et al's (1981) monumental study of the views of high-level bureaucrats and politicians in ten Western countries revealed that, while 48% of senior civil servants in the ten countries saw "neutral execution" as a desirable trait, an even higher percentage (59%) supported a "policymaking" role (p.104). With respect to Left/Right ideology, Aberbach et al (1981) found that civil servants in most countries had policy views slightly more centrist than most politicians, but their belief systems were as ideologically coherent as elected officials (pp. 122-129). Finally, about a dozen scholars have found the advocacy coalition framework to be useful in explaining policy change in a number of domains in European countries (Sabatier 1998a).

With respect to university faculty, several case studies indicate that many U.S. faculty active in policy disputes behave like coalition members (Primack and von Hippel 1974; Nelkin 1971; Mazur 1981). In Europe, there is certainly a long tradition of faculty political activity, particularly on the Left, and some evidence of faculty involvement in reform movements during the 1960s and 1970s (Wagner 1987).

In sum, we suspect our results from Bay/Delta water policy—indicating that many agency officials and university faculty actively involved in policy disputes are members of advocacy coalitions—are representative of many other policy areas in the U.S. and Western

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[30]We would recommend that principal-agent scholars pay greater attention to resolving different explanations for the sources of resistance. The same instrument can have different effects if applied to budget maximizers than to policy advocates—and, among advocates, the effects will obviously vary depending upon whether they share, or oppose, the views of principals.

Europe. But we'll have to wait for other scholars to do comparable analyses in other policy areas and countries in order to get a better sense of the generalizability of our results.

To the extent these results are generalizable, they will confirm some of the crucial assumptions of the advocacy coalition framework. That, in turn, will strengthen the ACF as a reasonably coherent alternative to the institutional rational choice frameworks currently dominating much of political science (McCubbins and Sullivan 1987; Scharpf 1997; Ostrom 1998).

Appendix A: Scale Construction

The attitudinal scales used here were constructed in two separate operations. First, we used a factor analytic procedure to identify survey items that shared common underlying dimensions. Second, we calculated additive scales using the results of the initial factor analysis and validated them using a reliability analysis.

The first scale was a *Neo-Classical Conservatism Scale* containing the following six items:

- Government laws and regulations should primarily ensure the prosperity of business since the health of the nation is dependent upon the well-being of business (r = .68).
- A first consideration of any good political system is the protection of property rights (r = .66).
- Decisions about development are best left to the economic market (r = .66).
- The best government is the one that governs the least (r = .64).
- Government planning almost inevitably results in the loss of essential liberties and freedoms (r = .61).
- The "welfare state" tends to destroy individual initiative (r = .59).

The second scale was a *Concern for Flows/Fisheries Scale*. It contains a total of three items focusing on the impacts of water quantity and timing (i.e., flows) on Bay-Delta fish populations. The items included in this scale are:

- Upstream dams and diversions have sufficiently reduced inflows to the Delta so as to pose serious problems for Bay/Delta fisheries (r = .67).
- Because political power in the state lies primarily in Southern California nd the San Joaquin Valley, water policy decisions by the Governor and Legislature are more likely to reflect those needs than concern with Bay water quality (r = .66).
- In-stream flow requirements from the Sacramento River to the Bay/Delta should be sufficient to restore fish populations to pre-1976 levels (r = .52).

A reliability analysis on these items produced an alpha of .78.

In calculating individual scores on each scale, we added respondents' scores on specific items and divided by the total number of items on the scale. To deal with missing data, we

retained all respondents who had answered at least one item, but changed the divisor to the number of items answered. If the respondent did not answer any of the items on the scale, their score on that scale was “missing.”.

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AFFILIATION CATEGORIES	BELIEF MEASURES Neo-Classical Conservatism	Flows-Fisheries Concern	Diversions Cause Fish Decline	List Delta Smelt	Build Peripheral Canal
Potential Water Development Coalition					
Interest Groups	***5.15***	***2.04***	***33.59***	***1.58***	***6.58***
Southern California Interests	4.69	2.11	39.09	1.90	6.90
San Joaquin Valley & Statewide Ag	5.56	1.97	28.54	1.30	6.32
Agencies - US BOR & CA DWR	***4.05 ******	***3.07 ******	***62.89 ******	***2.12 #***	***6.33***
Potential Environmental Coalition					
Interest Groups - Environment & Sportsmens	***2.57***	***6.35***	***93.80***	***6.29***	***1.57***
Agencies	***3.02 *****	***5.89 *****	***92.72***	***5.93***	***2.53 ******
USFWS & NMFS	3.01	6.08	97.31	6.73	2.09
CA Fish and Game	3.20	6.00	95.45	5.67	5.00
EPA & Misc. Resource Agencies	2.87	5.66	89.83	6.10	2.50
BCDC & Misc. Regional Agencies	3.11	6.02	92.50	5.45	1.86
Researchers - University & Misc. Bay	***3.04 ****	***5.73 *****	***93.28***	***5.56 ****	***2.16 ****

#, *, **, *** = significant at the .10, .05, .01, and .001 levels, respectively (one-tailed)

Economic and Environmental Tradeoffs at the Watershed Scale: Costs of Stream Temperature Reduction

--Working Paper*--

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Economic and Environmental Tradeoffs at the Watershed scale: Costs of Stream Temperature Reduction

Introduction

Public attention has been focused on resource use for multiple economic and environmental goals. In the U.S., watershed councils are working with local landowners, interest groups and a variety of government agencies to design and implement plans for watershed restoration and protection that balance both environmental and economic goals.

Participation by local landowners in enhancement plans is voluntary. Segerson and Miceli (1998) indicate that compliance with voluntary agreements is increased: i) if there is a perception that non-compliance increases the probability of regulation; and ii) incentives are provided. The success of watershed protection efforts depends on the economic and environmental tradeoffs asked of local landowners. Sectors within the watershed are likely to face different compliance costs and different probabilities of regulation (if any) from non-compliance with protection efforts. Estimates of the distribution of compliance costs between sectors will provide information regarding the likely adoption of enhancement plans. In addition a cost assessment could identify the magnitude of incentives required to achieve environmental goals. Some environmental protection efforts are a joint function of actions taken by several economic sectors in a watershed, highlighting the importance of obtaining compliance by all sectors.

The problem faced by many watershed councils can be considered as the following. The council has *a priori* goals to promote projects for environmental enhancement and protection, but no information regarding: the effectiveness of proposed measures to achieve project goals; the total costs associated with alternative project goals; and the distribution of costs between the

economic interests within the watershed. This paper describes a conceptual framework and associated methodology that can be used to identify economic and environmental tradeoffs at the watershed scale. An empirical model is developed for a case study watershed. The model has two interesting features in that, i) it accounts for the influence of changes in non-market attributes on residential property prices and ii) incorporates an estimate of stream temperature response to selected riparian planting proposals. Specifically this paper addresses tradeoffs associated with planting a riparian buffer to reduce stream temperature.

Study area and Problem Statement

The Mohawk watershed, western Oregon, is used as a case study for this analysis. The watershed spans 113,625 acres. Higher elevations are dominated by industrial timber-land (public and private). These transition through non-industrial timber-land to a mix of agricultural and residential lands on the valley floor (Figure 1).

One concern identified by the local watershed council is elevated summer stream temperatures.[31] These can reduce the survival, growth and reproduction rates of steelhead trout and salmon (Hostetler 1991) and reduce available dissolved oxygen for all aquatic biota (Boyd 1996). However, the council is uncertain how best to achieve this objective, what level of reduction could be achieved or the costs to local resource owners.

[31] The Oregon Department of Environmental Quality has listed the Mohawk River and one of its major tributaries, Mill Creek, as water quality limited on the basis of temperature (ODEQ 1996). High temperatures have also been recorded on other tributaries (BLM 1995).

Actions to Reduce Stream Temperature

The primary source of energy for heating streams during the summer months is incoming solar radiation (Beschta *et al.* 1987). One means of moderating stream temperature is to plant a riparian buffer that increases shade and reduces the direct solar radiation striking the water (Beschta *et al.* 1987; Boyd 1996; Sullivan *et al*. 1990; Brown 1983).[32]

A riparian buffer is a strip of vegetation (often trees) that buffers the stream area from adjacent activities. Riparian buffers run the length of the stream and can extend outward from the stream. Dense vegetation and a wide riparian buffer[33] are associated with more effective stream shading.[34] Riparian buffer width is measured perpendicular to the stream. The spatial location of shading between the headwaters and confluence of the stream is an important consideration (Beschta *et al.* 1987). Once stream temperature is elevated, heat is not dissipated easily, even if the water subsequently flows through a shaded reach (Beschta *et al.* 1987). It is, therefore, important to maintain shade along the headwaters and tributaries of a stream in addition to the mainstem without substantial gaps in the riparian buffer. This requirement stresses the importance of voluntary compliance with riparian plantings by all sectors with stream-side holdings. Non or poor compliance by one sector could negate some of the compliance efforts put forth by other sectors. The magnitude of this problem is dependent on the quantity and spatial location of stream-side land holdings.

Riparian buffer and tax policy scenarios developed for this study are presented in Table 1. **Bold** notation refers to the buffer scenario and *italics* to the tax scenario. Land within the

[32] Stream temperature can also be reduced by increased stream flow, stream bank stabilization (leading to narrower stream channels) and other factors (Moore and Miner 1997; Beschta *et al.* 1987*;* Sinokrot and Stefan 1993).
[33] Beschta *et al.* 1987 show that there are few gains from increasing buffer width beyond 100 ft wide.
[34] Riparian buffers provide additional benefits such as stream bank stabilization, wildlife habitat, reduced sedimentation and others.

watershed is classified into four categories: industrial timber; non-industrial private timber; agricultural; and residential. Buffer scenarios and tax policies vary by land use.

Buffer scenario **B** reflects current production patterns and residential activity. Riparian buffer widths on industrial timber-land are consistent with the Oregon Forest Practices Act i.e. 100 ft wide on large, 70 ft wide on medium and 50 ft wide on small streams with fish and domestic water use (Forest Practice Administrative Rules 1995). Observed buffer widths are used for other areas. In buffer scenario **AB**, riparian buffers consistent with the Oregon Forest Practices Act are assumed on large industrial and non-industrial timberlands. A 50-foot buffer is assumed on all agricultural land and existing buffer widths are assumed on residential lands. Buffer scenario **ARB** is similar to **AB** with the additional assumption of 50-foot buffers on residential lands. Buffer scenario **50B** assumes a 50-foot wide riparian buffer across the entire watershed regardless of stream size or adjacent land use. In buffer scenario **FPAB**, buffers consistent with the Forest Practices Act are assumed across the entire watershed regardless of land use.

Three tax policies are considered with the buffer scenarios. Policy *B*, is the *status quo*, or base tax policy. This policy, combined with the riparian buffer scenarios described above reflects the situation where there are no additional incentives to engage in riparian plantings. Policy *D* provides for a tax deferral[35] on all lands in the watershed that engage in the riparian planting scheme.[36] The tax deferral applies to the entire tax lot not just the area planted in trees and reduces the assessed value of the tax lot upon which riparian plantings are made.

Policy *TIP* is based on the Oregon riparian tax incentive program. All land areas with a *bona-fide* riparian protection plan are totally removed from the owners tax base (that is, their assessed

[35] Modeled on existing farm and forestland tax deferrals within Oregon.

value is zero).[37] The remaining area of the land parcel is assessed at the regular value. Policies *D* and *TIP* are incentives that could be used to encourage landowners to voluntarily adopt riparian plantings. Other incentive mechanisms could be used.

Conceptual framework

A cost-effectiveness analysis is a convenient way of combining economic and physical data in a manner that highlights the tradeoffs associated with a range of alternatives for environmental enhancement. The least cost alternatives are used to construct a cost-effectiveness frontier. The frontier in Figure 2, shows that total costs increase at an increasing rate as the environmental attribute is increased from its base level (consistent with the theoretical expectation of diminishing marginal returns). E_i is the predicted increase in the environmental attribute from its base level (where, $E_1 < E_2 < E_3$) and C_i is the cost of actions considered (where, $C_1 < C_2 < C_3$).

Points A, B, C and D represent different environmental enhancement/cost pairs associated with four alternative plans. Only the least cost points are represented on the frontier. For example A and B achieve the same increase in the environmental attribute to E_2, however, A achieves it at least cost $(C_1 < C_2)$ and is on the frontier. It is important to recognize that empirically generated frontiers may not be as smooth and will not necessarily exhibit this shape. If a larger number of alternatives are considered, the shape and position of the frontier could change.

[36] Industrial timberland is excluded from this tax incentive scheme as similar deferrals are already in place.

[37] The amount of tax paid per acre of land is a combination of the assessed value of that land and the tax rate per $1000 of assessed value. Every landowner is taxed at the same rate. However, landowners can receive a tax break by lowering the assessed value of their land. Policies *D* and *TIP* alter the assessed value of the land, not the tax rate.

Estimates of the economic costs and physical effectiveness[38] of enhancement plans are required to construct this frontier. Measures of cost and effectiveness are described in the following sections.

Economic cost

Connor, Perry and Adams (1995); Turner and Perry (1997) and; Qiu and Prato (1998), among others, have used mathematical programming techniques to estimate change in producer profit in response to new environmental constraints. A change in profit provides a measure of producer welfare change assuming that producers do not shut down.

Many watersheds contain a mix of production activities such as farming and forestry as well as land in residential use. It is likely that plans for environmental enhancement will influence the utility of residential property owners in addition to profits generated by landowners engaged in production activities. The economic costs of environmental enhancement are not complete without accounting for residential property owners as well as producers.

Welfare change experienced by residential property owners due a change in the quantity or quality of an environmental attribute on or adjacent to their property is commonly estimated with non-market techniques such as hedonic pricing. Hedonic pricing is based on the premise that observed differences in property values are a consequence of differences in the attributes possessed by each. Otherwise identical properties can have different sale prices as a result of differing environmental amenities at each location. For example, Kulshreshtha and Gillies (1993); Benson *et al.* (1998); Lansford and Jones (1995) and; Doss and Taff (1996) have used hedonic pricing to consider the impact of proximity to environmental features or access to views on residential property prices.

[38] In terms of changes in the environmental attribute of interest.

Money measures of welfare change for producers and residential property owners (consumers) can be combined to provide an estimate of the total costs of adopting practices for environmental enhancement at the watershed scale. The inclusion of residential property owners in the cost framework is an important extension of existing watershed modeling efforts.

Environmental Effectiveness

An assessment of economic/environmental trade-offs is not complete without an estimate of the effectiveness of plans for environmental enhancement. Biophysical models can be used to estimate the effectiveness of alternative practices for environmental enhancement at the watershed scale. Environmental effectiveness could be measured as increases in the physical units of the resource or the percentage of the resource that meets a particular standard.

Empirical Model

The empirical model is developed with several goals in mind. Firstly, to provide estimates of the total cost, distribution of cost and effectiveness (in terms of moderating stream temperature) of a range of riparian planting and tax scenarios. Secondly, the economic component of the model is designed so that it can be used in similar future analyses of economic/environmental tradeoffs to achieve other goals within the watershed.

Total welfare change across the watershed; the distribution of these changes; and stream temperature response to riparian buffer and tax prescriptions are estimated using an integrated mathematical programming and stream temperature simulation model. Riparian buffer prescriptions constrain economic activities and influence stream temperature, providing a link

between the economic and physical components of the model. Unlike previous integrated bio-physical/economic models, this model estimates welfare changes experienced by residential property owners as well as producers of agricultural and timber commodities. A schematic of the model design is presented in Figure 3 and its major components are described below.

Objective Function

The objective function maximizes producer profits from cropping, timber and livestock activities and sums these with the current 30-year annuity value of expenditure on residential property. The choice variables for the model are cropping, timber and livestock activities. Production decisions are constrained by resources, technology and riparian buffer requirements. Consumer welfare estimation is described in more detail in the following section. The quantity and type of residential properties are not decision variables within the model. The existing property distribution is assumed to represent the observable solution to consumers' utility maximization problems (in terms of housing choice).

Residential/consumer welfare change

Residential properties were divided into three groups based on their market value (low, medium or high). The change in total market value of each group in response to a change in riparian buffer width is estimated as:

(1) $P_{RP}^{c} = Po_{RP}^{c} - \gamma(\Delta RA)$

Where, P_{RP}^{c} is the total market value of residential property in class c (where c = low, medium, high); Po_{RP}^{c} is the original (or base) total market value of all properties in class c; γ is the marginal implicit price of an additional square foot of treed riparian buffer on the mean value property in class c and; ΔRA is the change in riparian buffer area from the base level. In the objective function, the total value for each classification is expressed as an annuity payment

The marginal implicit price of an additional square foot of treed riparian buffer was estimated using a hedonic pricing analysis. Equation (2) represents a hedonic price function, where P_i represents the price of property i, $\mathbf{L}_i$ is a vector of the characteristics of the lot, $\mathbf{R}_i$ is a vector representing the characteristics of the residence and E_i is an environmental attribute.

(2) $P_i = (\mathbf{L}_i, \mathbf{R}_i, \mathbf{N}_i, E_i)$

The partial derivative of (2) with respect to any attribute yields the marginal implicit price of the attribute. A utility maximizing consumer will select additional units of and attribute, for example E_i to the point where their marginal willingness to pay for E_i is equal to the marginal cost of E_i. The marginal cost associated with purchasing another unit of E_i, $\left(\frac{\partial P_i}{\partial E_i}\right)$, is an estimate of the marginal willingness to pay for E_i at current levels of consumption.[39] If the marginal willingness to pay function is assumed constant, an estimate of welfare change can be calculated from the product of the marginal implicit price of E_i at the original utility maximizing level of consumption and the quantity change in the amenity level E_i (Freeman 1993). This results in an overestimate of welfare change if the attribute E_i is desirable and an underestimate if E_i is undesirable. The hedonic pricing analysis indicated that an increase in the size of the

riparian buffer served to reduce residential property prices.[40] The assumption of a constant marginal implicit price (γ) results in an underestimate of welfare change as a wide riparian buffer is an undesirable property attribute.

Stream Temperature Estimates

Riparian buffer prescriptions and their spatial location are used by the stream temperature estimator to relate stream temperature response to a change in riparian buffer width. The estimator uses physically based descriptions of stream energy and hydrologic processes to provide reach based stream temperature profiles in response to changes in vegetation and atmospheric parameters. A reach is a discrete section of the stream. A full description is provided in Boyd (1996). Stream temperature at the headwaters of the system is used as a starting value to calculate temperature change over the first reach. Stream temperature change for the second reach is calculated using the final temperature for the first reach as a starting value. Temperature changes are estimated for 164 consecutive reaches to account for water movement from the headwaters to the confluence.

Oregon Department of Environmental Quality (ODEQ) classify streams as water quality limited on the basis of temperature if the average maximum daily water temperature exceeds 64^{o}F for the stream's warmest consecutive seven-day period during the year. The effectiveness of the riparian buffer scenarios is calculated as the percentage of reaches for which the maximum daily stream temperature at the downstream point is at or below 64^{o}F. A failure in terms of this

[39] The marginal willingness to pay function for E_i can be obtained from a second stage estimation and can be used to calculate the consumer welfare change as a result of changes in the quantity or quality of environmental attributes.
[40] See Mooney (1997) for this analysis.

standard differs from the conditions required to fail the standard set by ODEQ as it is based on a one day exceedence of 64 ^{o}F.

Data Collection

Data requirements for this study were considerable. Key data are described in this section. [41] Current land use was obtained using a geographical information system (GIS) and watershed analyses conducted by Weyerhauser Company (1994) and the BLM (1995).

Agricultural production practices were identified by county agents and a personal interview survey. The most common practices were livestock and hay production with some specialty crops such as filberts. The majority of agricultural enterprises were small scale and much of the agricultural area is underutilized. Agricultural production costs and output prices are obtained from enterprise budgets developed for the area.

Residential property characteristics, sale price and assessed value were obtained from records at the Lane County Department of Assessment and Taxation. Property tax rates were obtained from Lane County Department of Assessment and Taxation (1997).

Atmospheric, hydrologic, vegetation and shading parameters for the stream temperature estimator are collected from: Marron (personal communication); Oregon Atlas and Gazetteer (1991); BLM (1995); A. G. Crook Company ; ODFW (1994a); ODFW (1994b); and Weyerhauser (1994). The existing width of the riparian buffer along streams in the watershed is estimated using aerial photograph interpretation.

[41] For a full description of data see Mooney (1997).

Results

This section summarizes the results from the modeling scenarios. Estimates of economic cost and environmental effectiveness are combined to form an empirical cost-effectiveness frontier depicting economic and environmental tradeoffs resulting from the selected scenarios. The distribution of costs between broad economic sectors of the watershed is presented to illustrate their significance for evaluating alternative environmental enhancement scenarios.

Total Costs and Distribution

Total (watershed wide) welfare changes are calculated by taking the difference between the value of the objective function for scenario **B***B* (the base) and the objective function value under the other scenarios. The effectiveness of each scenario is represented as the percent of stream reaches that achieve a maximum temperature at or below 64 ^{o}F. Table 2 presents the dollar value and percentage change in total welfare under each scenario in addition to their effectiveness in reducing stream temperature. Total welfare change ranges from an increase of 0.25 percent in scenario **AB***D* to a decrease of 1.11 percent in scenario **FPAB***B*.

In addition to total welfare change, it is important to consider the distribution of welfare change between the different sectors in the watershed. The distribution can highlight sectors that might voluntarily comply with enhancement plans and those that would require incentives to adopt management proposals. Table 3 shows welfare change by sector expressed as the percentage change in sectoral welfare in comparison to sectoral welfare under the base scenario. It can be seen from comparing Table 2 and Table 3 that in some scenarios total welfare declines while individual sectors benefit and vice versa.

Welfare changes experienced in the forestry sector[42] are less than 0.2 percent for every scenario. The largest welfare change within the forest sector is experienced under buffer scenario **50B**. Sectoral welfare increases by approximately 0.2 percent and is similar under all tax policies. This benefit is due to an increase in available production area. Under the base buffer scenario (**B**) it was assumed that forest lands followed the Forest Practices Act guidelines resulting in buffers of 50 feet or wider.[43] Forest buffer prescriptions under scenario **50B** are narrower than the base scenario. Tax benefits provided under tax scenarios *D* and *TIP* do not generate large welfare changes as forest-land is already subject to favorable tax assessments under the base tax scenario.

The agricultural sector exhibits changes in sectoral welfare, ranging from a decline of 0.06 percent to an increase of approximately 26 percent. These changes are driven primarily by the tax policy scenarios. The base tax policy always results in a decline in sectoral welfare as land is taken from production with no offsetting incentive scheme. Policy scenarios that include a tax deferral (such as, *D* and *TIP*) result in an increase in welfare on agricultural lands. Tax scenario *D* increases sectoral welfare by almost 26 percent in comparison to the base case. This increase is a result of the significant tax savings on land in low valued crops (such as hay). Under the base scenario many low value crops did not generate enough revenue to cover production costs plus property taxes.[44] The tax savings from land areas taken out of production can help to offset losses created by low valued crops. Even with favorable tax policies many agricultural activities do not contribute a positive sum to the value of production from the watershed.

[42] Defined as industrial (public and private) and non-industrial private timberland use.
[43] Under buffer scenarios **AB**, **ARB** and **FPAB** buffer widths on industrial forest lands remain the same as the base buffer scenario (**B**). Small width changes are experienced on non-industrial forest lands.
[44] The majority of these land areas were in low yielding low quality hay. Local extension agents suggested that this land may be held for speculative purposes and the observed cropping activities are a response to factors such as fire risk or improvements in the aesthetic appearance of the area.

The residential sector experiences welfare changes ranging between a gain of 0.44 percent to a loss of 6.21 percent. Small gains in welfare under buffer scenario **AB** are a result of tax policies, the riparian buffer width on residential property is not altered from base under this scenario. Buffer scenarios **ARB** and **50B** combined with tax incentives achieve identical welfare declines for the sector as the buffer prescriptions for the residential sector under each policy are the same (i.e. residential properties are assigned a 50 foot buffer). The average buffer width on residential properties under the base scenario is 37-feet. As the buffer is widened to 50-feet under scenarios **ARB** and **50B** and then to 100-feet in scenario **FPAB**, welfare losses experienced by the sector increase. Even the most generous tax incentive, *D*, is not sufficient to offset the reduction in property value as a result of planting wider riparian buffers.

These results clearly indicate that the welfare implications of the proposed scenarios differ in magnitude between sectors. The forest sector experiences little welfare change primarily because they already comply with Forest Practices Act provisions that are similar to buffer scenarios used in this analysis. Residential landowners are shown to experience the greatest losses as a result of riparian plantings even when plantings are coupled with the tax incentives used in this study. It has been demonstrated that the agricultural sector in the Mohawk watershed could receive considerable benefits as a result of riparian plantings associated with incentives such as a tax deferral program. However, it is important to recognize that there could be agricultural landowners in the watershed that individually experience large welfare gains or losses as a result of riparian plantings. Landowners that might experience greater losses are those with efficient management practices producing high valued commodities on riparian lands. These losses will be exacerbated if the landowner has a large riparian frontage. Landowners that might benefit considerably are those with

inefficient management practices producing low valued commodities on riparian lands. These benefits will be increased by a long riparian frontage.

Effectiveness

The percent of stream reaches at or below 64 ^{o}F range from 10 percent under scenario **50B** to a high of 44 percent under buffer scenario **FPAB**. Table 2 indicates that 21 percent of stream reaches meet the standard under the base scenario, increasing to 36 percent under scenarios **AB** and **ARB**, dropping to a low of 10 percent under scenario **50B** and achieving a high of 44 percent under scenario **FPAB**. In many respects, scenario **50B** is identical to scenario **ARB** except for the narrower riparian buffer width on forested lands; most of which surround the headwaters and tributaries to the mainstem (Figure 1). This reduction in the effectiveness of riparian buffers underscores the importance of maintaining well-shaded headwaters and tributaries to reduce the rate of stream heating.

Empirical Cost Effectiveness Frontier

Figure 4 displays the welfare change and corresponding effectiveness of all buffer and tax policy alternatives reported in Table 1. The cost of each scenario is measured on the x-axis as the total watershed wide welfare change from the base scenario **B***B*. The effectiveness of each scenario is plotted on the y-axis. The physical effectiveness of each scenario in reducing stream temperature is the only benefit considered in this study. However, it is important to note that planting a riparian buffer to reduce stream temperature will provide secondary environmental benefits, such as stream bank stabilization, not accounted for in the decision criteria used in this study. The cost effectiveness frontier depicts the least cost alternatives (among those considered)

that can be used to decrease overall stream temperature (i.e. increase the percentage of model runs with a daily maximum temperature equal to or below 64 ^{o}F).

Scenarios **AB***D* and **FPAB***D* are on the cost-effectiveness frontier. Under scenario **AB***D* the welfare of watershed residents increases by $127,000 in comparison to the base scenario and the percentage of stream reaches with a maximum temperature at or below 64 ^{o}F increases from 21 percent to 36 percent. These results indicate that an additional 15 percent of stream reaches can achieve the temperature standard while increasing total welfare if the riparian planting scenario is accompanied by an incentive that grants a tax deferral for all lots on which a riparian buffer is planted. All sectors experience an increase in welfare under this scenario.

However, this welfare gain is generated at the expense of a decline in property tax revenues, which could reduce the services provided in the area or alternatively increase the tax burden faced by residents in other areas to make up the shortfall. The tax deferral will reduce tax dollars generated in the watershed by approximately $138,000 in comparison to the case where no tax incentive is offered for the same buffer requirement (scenario **AB***B*).

Scenario **FPAB***D* provides for a riparian buffer strip consistent with the Forest Practices Act in addition to a tax deferral. An additional 23 percent of stream reaches meet or exceed the temperature standard under **FPAB***D* in comparison to the base scenario (an increase from 21 percent to 44 percent) at a cost of $414,371 across the watershed. The reduction in tax revenues in comparison to the case where no tax incentive is offered for the same buffer requirement (scenario **FPAB***B*) is also approximately $138,000.[45] Although the scenario results in an overall welfare loss this tax deferral scheme increases the welfare of agricultural and non-industrial timber producers in relation to the base case scenario. The majority of costs associated with this

scenario are experienced by the residential sector in the form of a lower willingness to pay for properties with wider treed riparian buffers.

The policy choice from those on the frontier in Figure 4 is a choice to be made by the residents of the Mohawk watershed.[46] Both **FPAB***D* and **AB***D* increase the percentage of reaches that meet the 64 ^{o}F temperature standard. However, they differ in their effectiveness, total costs and distribution of costs. From the perspective of a policy maker, both policies cost the same in terms of a reduction in tax revenues ($138,000), but scenario **FPAB***D* is more effective in reducing stream temperatures. Although the policy may appear to place a disproportionately heavy burden upon residential land owners in comparison the agricultural and forestry sectors, this cost is skewed as it does not take into account the welfare losses already accepted by the forestry sector as a result of the Forest Practices Act (this was taken to be the *status quo*).

Conclusions

A cost effectiveness analysis was shown to be a suitable means of examining tradeoffs between economic and environmental goals at the watershed scale. The analysis provides information for decision-makers and planners about the costs their distribution and effectiveness of actions to reduce stream temperature. The economic model identified that, in the absence of mitigating tax programs, measures to reduce stream temperature did decrease welfare in the watershed. The largest reduction of net annual welfare was $552,133 (scenario **FPAB***B*, Table 2). Most of this decrease was experienced by the residential sector. The scenarios examined in

[45] The difference will be the same no matter how much of the tax lot is planted in a riparian buffer as the entire tax-lot is eligible for a deferral and so the tax cost is the same under this policy whether the area is planted in buffers 10 feet wide or 100 feet wide.
[46] It is assumed that the tax incentives discussed are acceptable in practice.

this study are not exhaustive. Results produced from this analysis can be used to refine or suggest additional planting and incentive scenarios that require consideration.

The model developed demonstrates the importance of examining the distribution effects of methods to achieve environmental enhancement and of including residential property owners within the analysis in addition to industry. Protection afforded by riparian plantings is a joint function of efforts by forestry, agriculture and residential sectors. The importance of voluntary compliance by any sector is a function of their spatial location and quantity of riparian frontage. The sectoral distribution of costs identify those sectors that would require incentives to comply with environmental goals.

Riparian buffers were demonstrated to be an effective means of reducing stream temperature over part of the Mohawk watershed. However, the buffer scenarios considered could not reduce temperature in all reaches sufficiently to meet the temperature standard. It might be possible to reduce stream temperatures further by combining the riparian buffer prescriptions with additional practices such as flow augmentation.[47]

The tax programs considered, i.e., a tax deferral and riparian tax incentive, indicate that it is possible to alter the distribution of welfare changes between resource users and in some cases reverse the direction of welfare change in comparison to scenarios that do not consider incentive programs. This effect is particularly apparent on agricultural lands in the scenarios that consider a tax deferral. This indicates that an improvement in environmental quality need not come at any welfare loss to residents if the right incentive programs can be identified for different sectors. In fact it is probably possible to increase agricultural welfare without offering a tax incentive. For example, riparian plantings could be combined with education to increase production efficiency, which could both increase the non-market amenities and agricultural welfare. The tax programs

also influence welfare changes in the residential sector. However, in general the analysis showed that a reduction in tax revenues is not sufficient to offset the perceived amenity loss resulting from wider treed riparian buffers on residential properties. The distribution of welfare changes between sectors will influence policy chosen from the frontier by local interest groups if riparian plantings are voluntary.

From a policy makers perspective each policy on the cost-effectiveness frontier results in the same decline in tax revenues. If the plantings were mandatory the choice of which policy to select will depend on whether a particular standard needed to be met or political factors such as the will of policy makers to request property owners to bear the welfare loss.

The location of riparian planting is an important consideration when designing riparian buffer prescriptions on the watershed scale. A comparison of the buffer prescriptions **50B** and **ARB** demonstrate the importance of keeping a stream shaded from the headwaters on down, to maximize the effectiveness of buffer prescriptions. This suggests that policies based on land use might not be as effective as policies that target lands on the basis of spatial location.

[47] Stream heating is inversely proportional to flow (Boyd 1996, Beschta *et al.* 1987).

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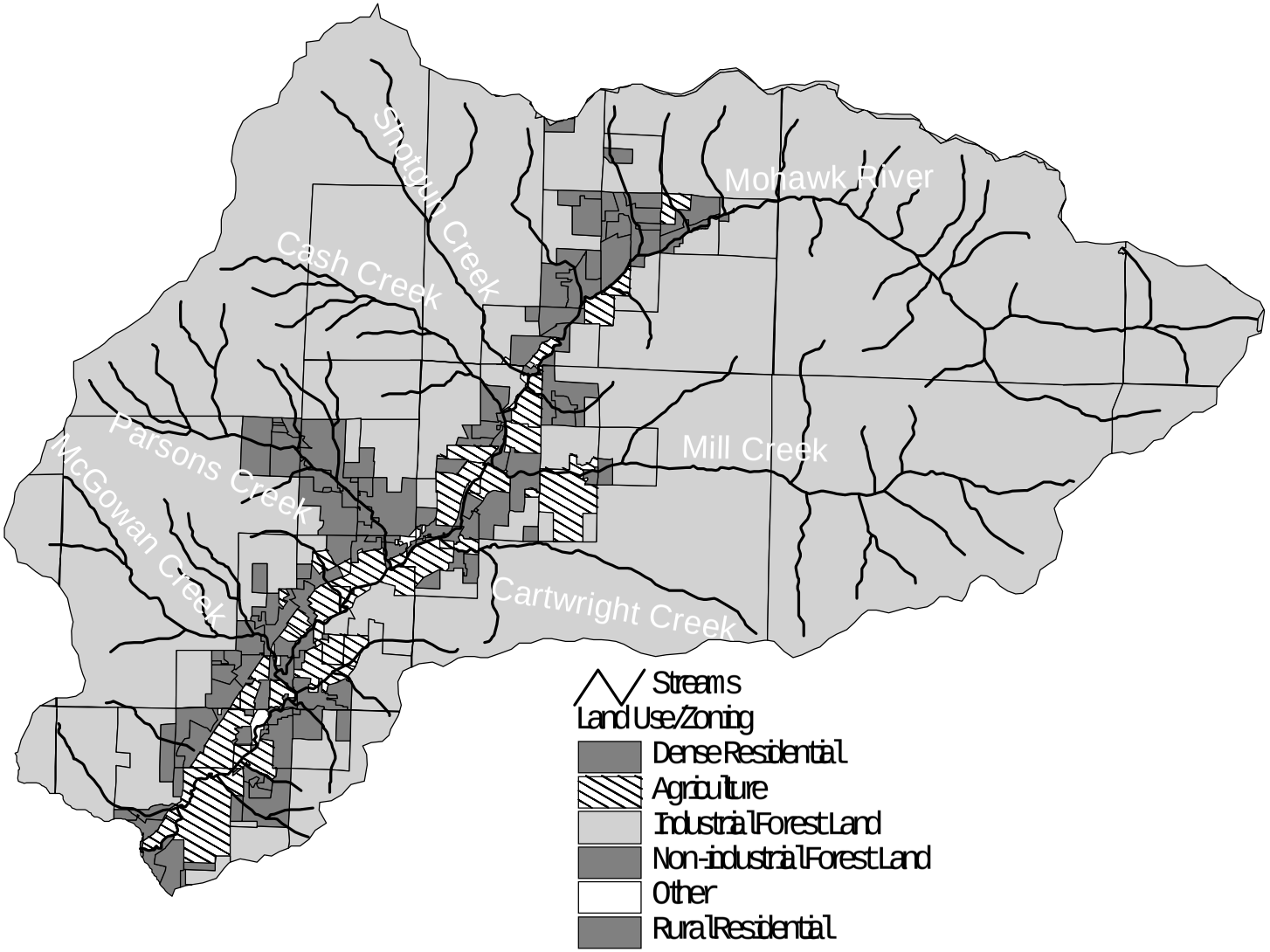


Figure 1. Land Use in the Mohawk Watershed

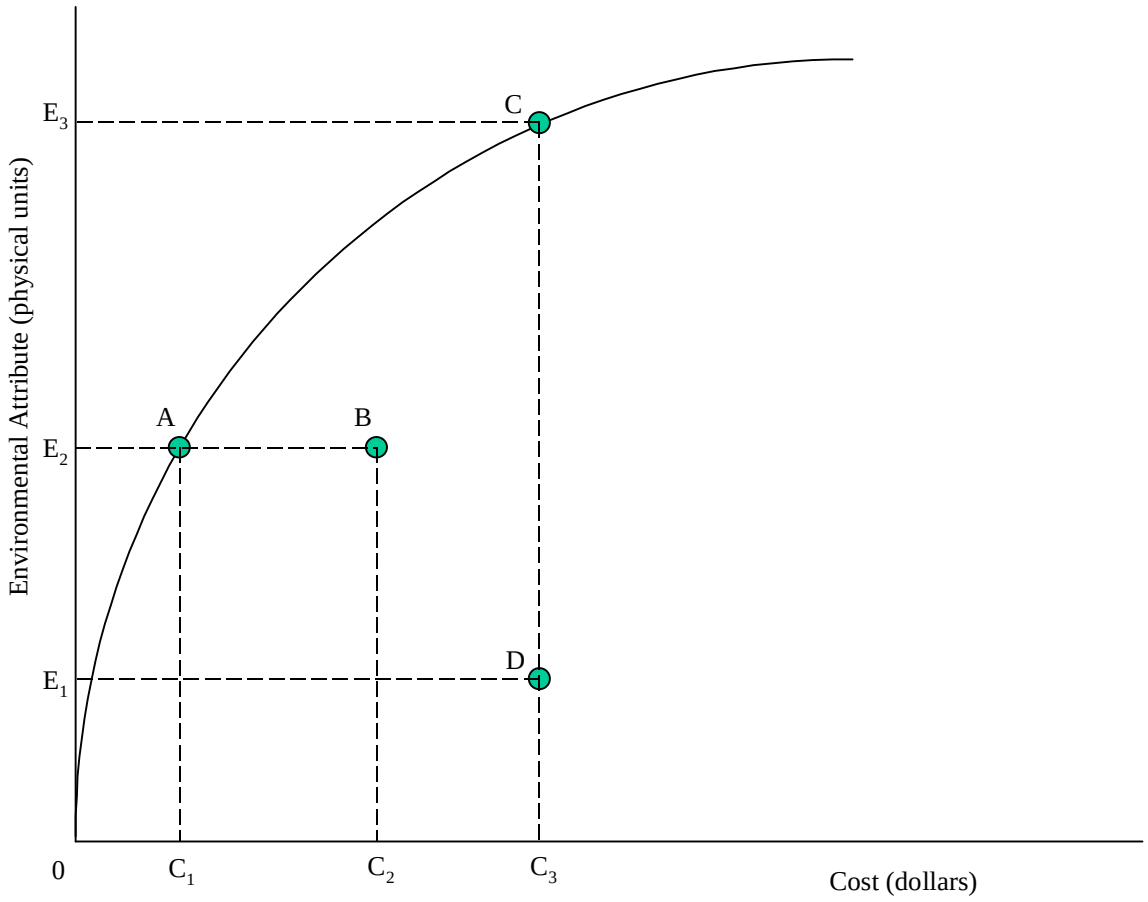


Figure 2. Cost-Effectiveness Frontier

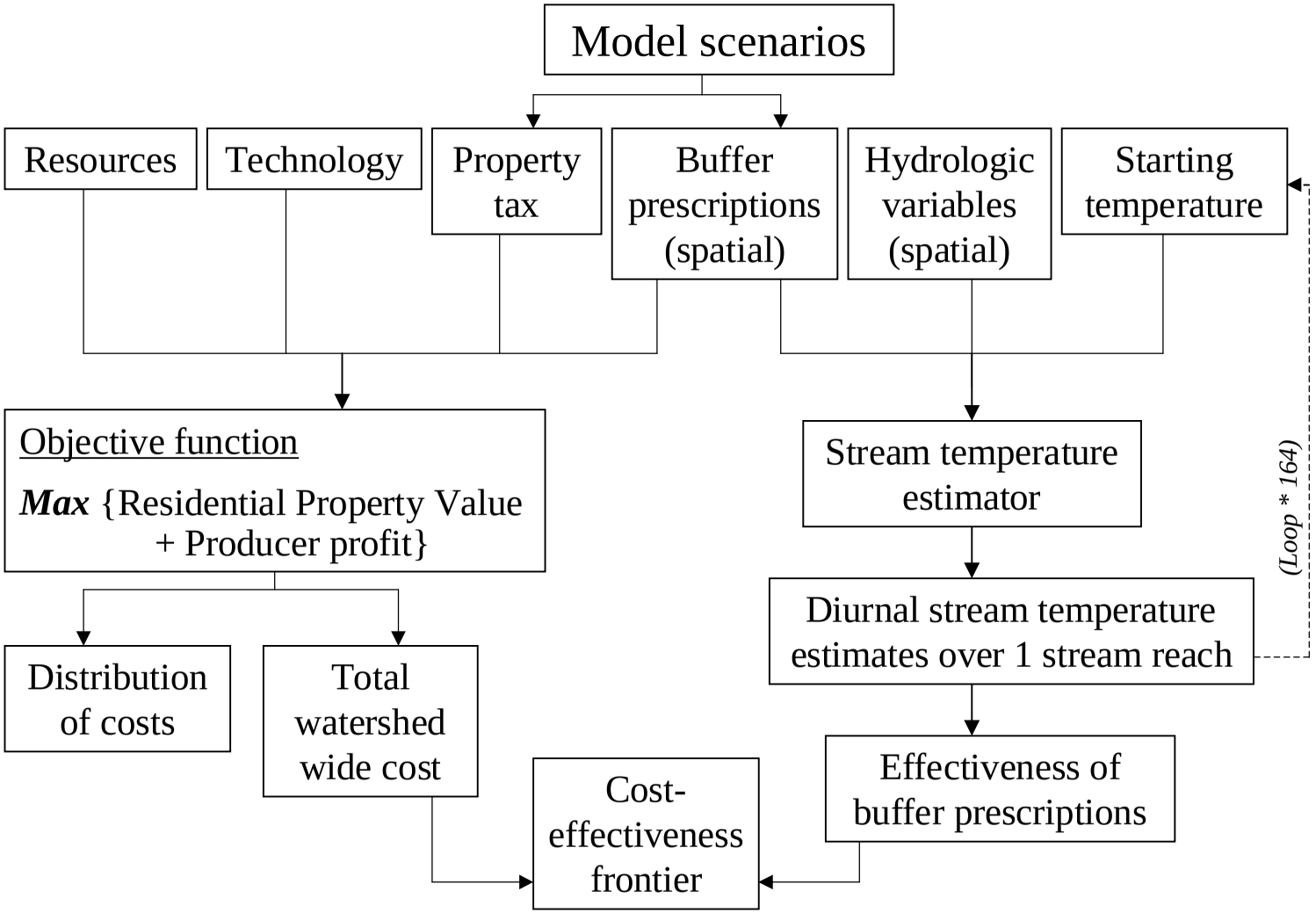


Figure 3. Schematic of Model

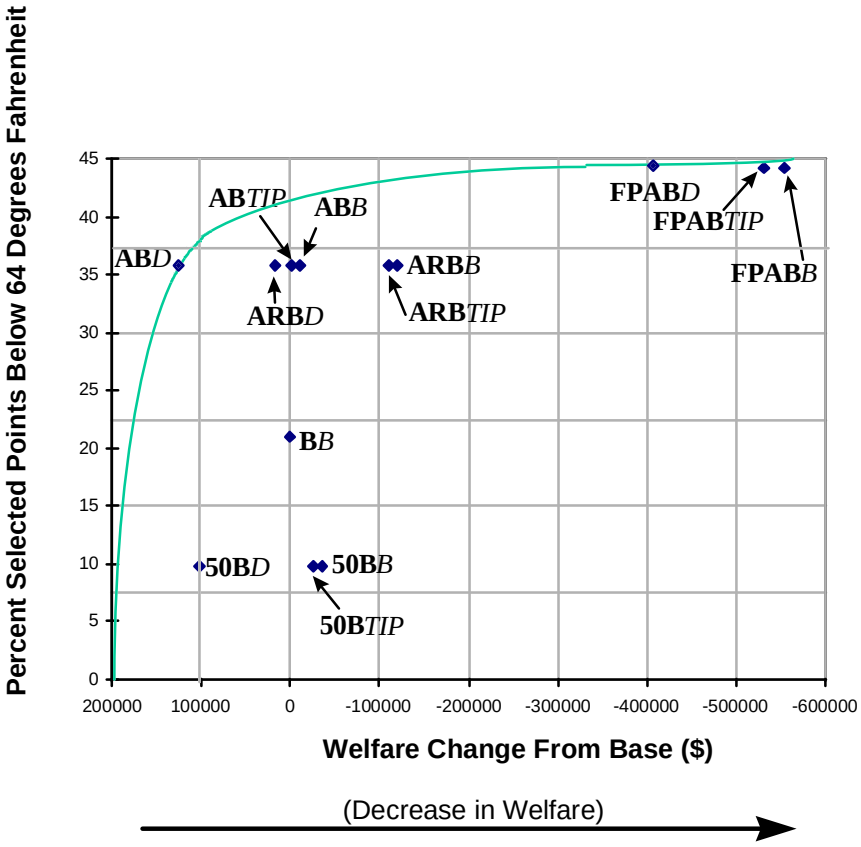


Figure 4. Cost and Effectiveness of Actions and Policies to Reduce Stream Temperature

Table 1. Summary of Riparian Buffer and Tax Policy Scenarios[a]

Tax Policies / ***Buffer scenarios***	Policy 1 *Status quo*	Policy 2 *Farm or Forest Deferral*	Policy 3 *Riparian Tax Incentive Program*
Scenario 1 *Current Conditions*	**B***B*		
Scenario 2 *Agricultural Buffer*	**AB***B*	**AB***D*	**AB***TIP*
Scenario 3 *Agricultural and Residential Buffer*	**ARB***B*	**ARB***D*	**ARB***TIP*
Scenario 4 *Complete 50 foot buffer*	**50B***B*	**50B***D*	**50B***TIP*
Scenario 5 *Forest Practices Act*	**FPAB***B*	**FPAB***D*	**FPAB***TIP*

[a]*The first part of the abbreviation refers to the buffer prescription and is noted in bold type. The second part of the abbreviation represents the tax policy and is noted in italics.*

Table 2. Total Welfare Change in Comparison to the Base Scenario **B**B and Effectiveness of Each Scenario

Scenario	Welfare change from scenario BB ($)	Percent Welfare Change from Base	Effectiveness, % reaches $\leq 64\ ^{o}F$
B*B*	0,000	0.00	21
AB*B*	-10,553	-0.02	36
AB*D*	127,209	0.25	36
AB*TIP*	-926	-0.00	36
ARB*B*	-120,628	-0.24	36
ARB*D*	17,134	0.03	36
ARB*TIP*	-110,890	-0.22	36
50B*B*	-34,946	-0.07	10
50B*D*	-102,816	-0.20	10
50B*TIP*	-25,404	-0.05	10
FPAB*B*	-552,133	-1.11	44
FPAB*D*	-414,371	-0.08	44
FPAB*TIP*	-533,121	-1.07	44

Table 3. Percentage Welfare Change by Sector

	Forestry	**Agriculture**	**Residential**
AB*B*	-0.03	-0.01	0.00
AB*D*	-0.02	25.72	0.44
AB*TIP*	-0.02	2.36	0.00
ARB*B*	-0.03	-0.01	-1.28
ARB*D*	-0.02	25.72	-0.85
ARB*TIP*	-0.02	2.36	-1.28
50B*B*	0.18	-0.01	-1.28
50B*D*	0.19	25.72	-0.85
50B*TIP*	0.18	2.36	-1.28
FPAB*B*	-0.03	-0.06	-6.32
FPAB*D*	-0.02	25.67	-5.88
FPAB*TIP*	-0.02	4.67	-6.31

Discussion of Focht, DeShong, Wood, and Whitaker paper and of Sabatier and Zafonte paper

by Dr. John Tanaka, Oregon State University

I am pleased to be able to provide comments on the papers by Focht et al. and Sabatier and Zafonte. The papers I reviewed were in draft form and/or focused on material that was only partially presented here at the workshop. In the case of Sabatier and Zafonte's paper, the data were only from the 1992 survey and did not include any analysis from the 1997 survey reported in Seattle. My remarks are intended to look at the papers from a positive aspect and also to raise issues that could affect their implementation or utility.

As the reader will note, I have some significant concerns with the Focht et al. paper as presented. Most of my concerns center on the fairly loose way that surveys and statistics were used and data manipulated. While I agree that the protocols used are generally accepted, I believe the authors are overstepping the bounds of what their data can show. The purposive sample they chose to interview is only appropriate in certain cases, "especially for exploratory research intended to generate new ideas that will be systematically tested later … to organize communities, identify leaders or build networks" (Salant and Dillman[48], p. 64). They go on to emphasize that it is imperative not to use these types of surveys if the goal is to learn about a larger population. On the other hand, the Sabatier and Zafonte paper use a similar sampling selection process, but use the data in a manner consistent with survey theory.

Specifically in both papers, the authors have used a nonrandom sampling procedure to obtain information about a target population. In neither paper did the authors discuss the limitations of their methods related to coverage, sampling, measurement, or nonresponse errors. It is not apparent that either set of authors spent much time considering the effect of these on their results. Sabatier and Zafonte did attempt to get an indication of coverage through their questioning process, but otherwise did not address the error sources. The issues are raised because each of these types of error leads to problems of accuracy of the results, and as Salant and Dillman point out in their book on *How to Conduct Your Own Survey*, "although none of the four can be completely avoided, each has the power to render survey results useless" (p. 15). In both cases, the use of nonprobability sampling renders knowing accuracy a moot point and the information gained can only be applied to the sample itself.

The Focht et al. paper

The Focht et al. paper obviously represents a small portion of an on-going large project. Not having ever spent much time in Oklahoma, I read it mostly from the perspective of trying to understand their protocol and how the results could be used. The authors outlined 8 different methodologies used in the sociopolitical assessment protocol. The baseline information will be used in developing a decision support tool that will enable interactive, multimedia, impact visualization. I will focus my comments on the participant population, sample selection, and interview setting, the 8 methodologies, and the preliminary results.

[48] Salant, P., and D.A. Dillman. 1994. *How to Conduct Your Own Survey*. John Wiley & Sons, Inc. New York.

The participant population is supposed to be the basin population. It should be noted that it is only the Oklahoma segment of the Illinois River basin population that is considered. This population was segmented by geographic and demographic criteria. Geographically, there are 7 regions within the basin plus two called "outside users" and "policy elites." The population was also divided into 15 stakeholder classes (16 presented in Seattle) based primarily on occupation. There was no attempt to utilize random sampling or ensure the participants resemble the general population. The purpose was to "obtain the maximum range of opinions that exist on impact concerns and management preferences." Selection was made by reputation or reference by previous interviewees. They attempted to have a representative from every stakeholder class in every region (9 x 15 = 135 or 9 x 16 = 144).

The first round of open-ended interviewing had 150 participants. The conclusion from this is that they generally had 1 person from each stakeholder class in each demographic region. The second round of interviews only included 60 interviewees so that they only got input from less than half of the stakeholder X region combinations. Finally, in the 3rd round of interviews, there were 120 participants and again did not fully sample.

The sampling protocol raises some large concerns on the applicability of the results, the usefulness of the results, and whether the researchers can achieve their purpose above. If the purpose was to obtain the maximum range of opinions, then clearly the only way to do that is to select the most radical elements of each stakeholder class. Sampling (if you call it that) less than the full range of geographic and demographic combinations in the second and third rounds of interviews with different interviewees makes cross comparisons across protocols extremely tenuous at best and probably misleading at worst.

Methodology 1 – While the results are not presented here, I have concerns about them regardless. I think the only thing they can do with their survey results is report simple means as descriptives. Given the paucity of data and nonrandom sampling, the use of any type of comparative statistic will be biased. In other words, about all it can do is confirm that a biased sample was selected. All of the statistics books I can find say the same thing, while nonrandom sampling can be done for reasons of cost savings and efficiency, the results will likely be (statistically) biased and all measures of statistical inference will be suspect.

Methodology 2 – The authors report using quantitative content analysis as a way to measure the frequency and extent of messages present. Going back to the selection of the sample, I question the accuracy of such data as meaningful to the basin.

Methodology 3 – Likert scales and card ranking exercises were subjected to various statistical procedures designed for random sampling experimental designs. The authors also report that Likert scale responses were used to predict which of the 8 decision-making procedures were preferred, but no details are provided.

Methodology 4 – The use of cognitive mapping were used to get "participants to conceptualize river basin impacts about which they are concerned." Given the methodology used (reflective mapping, 3 card sizes for importance, color dots for level of knowledge, and arrangement, self), are the results replicable? That is if another researcher conducted the session on a different day/time/place, would the results be the same? In other words, what is the degree of measurement error?

Analysis methods – *Frequency analysis* of individual impacts included two data reduction steps, one subjective by 2 researchers reaching consensus (87 groups – 69 reported in Seattle) and the other through cluster analysis. Impact concern categories (145 usable maps) were constructed basin-wide and for region and stakeholder classes. *Analysis of relative*

importance based on median card size within each category – there were 3 card sizes. Combined with mental modeling results to "increase the validity of those results." *Analysis of perceived knowledge* – descriptive statistics based on median dot color (3 colors). *Relationship between importance and knowledge* – Test for statistical significance between relative impact importance and perceived knowledge. *Cluster analysis of impact concern groups* – Recoded map groupings based on the 87 groups established by researchers were analyzed using cluster analysis which resulted in 45 clusters with 10 eliminated. *Cluster analysis of categorical group clusters* – Cognitive maps (138) recoded using the 35 concern clusters just defined. These were then clustered and 8 aggregate maps were identified.

Methodology 5 – Use of a mental modeling exercise whereby the developed model can be used to qualitatively estimate effects of various policy interventions throughout all subsystems. The authors try to tidy this up by stating that IF influences can be quantitatively determined, then magnitude of impacts can be determined. Claims model allows identification of areas amenable to education to correct knowledge deficiencies and misconceptions. Also claims model can identify potential conflicts that arise due to differences in knowledge.

In the analysis of responses, descriptive statistics were used and then average scores between the mental mapping exercise and the self-perceived knowledge were computed. The authors note that of 30 **selected** knowledge areas there was a distribution of 6, 15, and 9 for perceived greater than, equal, and less than assessed knowledge, respectively. The scoring system and arbitrary assignment to high, moderate, and low knowledge levels creates difficulty in knowing if this is due to random chance or actually measured responses.

Methodology 6 -- This methodology is entirely confusing in how the card ranking results were manipulated to obtain scores. It appears that the 87 (69 in Seattle) created impact categories from Methodology 4 were somehow reclassified into 16 pollution sources, then the respondents card size was used to calculate an average importance score, and then the 16 pollution groups (?) were ranked by the average relative importance scores.

Methodology 7 -- While Q methodology may be used in this field of inquiry, the explanation was pretty confusing with phrases such as "ability to generate grounded understanding (Verstehen) by abductively revealing subjectivities that are both self-referent and operant." Regardless, the authors identified 3,000 statements from their interviews relevant to impact concerns and management preferences. Out of these they selected 500 statements for their analysis. These selected statements were apparently carefully chosen to ensure that they get results. These were then further scrutinized to select 47 statements for the concern Q sample and 58 for the preference Q sample. They then checked these for "a balance of items across categories of potential meaning" using a factorial design but then state that strict adherence to the 20 categories was not followed to ensure maximum representativeness. This is a very curious statement. How can you not cover all the categories and then claim maximum representation?

The methodology then goes into a structured sort. The authors assume that the sort will be quasi-normally distributed and set up the sort to meet that assumption. The Q sorts were administered to 120 stakeholders, of which 40 were also the same respondents from interview 1.

The sorted responses were analyzed using factor analysis to determine common perspectives. The forced nature of the quasi-normal distribution will obviously miss the subjective strengths of agreement and disagreement that the method is designed to test. That is, it forced respondents to only have 2 most strongly held beliefs and similarly forced them to have 2 most strongly objected to beliefs.

Methodology 8 -- This methodology attempts to determine how stakeholder and policy maker concerns and management preferences have changed over time. I'm really not sure of the value or expense of conducting this exercise. The newspaper articles reflect what was "hot" at the time and obviously influenced by the writer's perspective and note-taking abilities. I doubt that any effort will be made to validate accuracy of the reports. The OSRC transcripts will also provide a slice of interest in what the hearings covered and who took the time to testify. Does putting a number or relative value on an issue tell us anything of change over time? Don't people that have been involved in the issues over the years know?

Selected Preliminary Results of the Baseline SPA

I cannot comment on the specific findings, but will rather try to address generalities of whether the results are meaningful from the perspective of making decisions. I come at this as a representative on a Federal Advisory Committee chartered under FACA that is responsible for providing advice to the BLM and FS on approximately 6 million acres. The test is whether the results would tell me anything.

From this perspective, I have serious doubts that the results will be useful to many policy makers. Noting that groups don't trust each other, items in the media are the most known, property rights are important to private landowners, there is a lack of scientific understanding of impacts (at least clear and convincing) as viewed by those impacted, and education in non-controversial issues are not ground-breaking revelations. The authors also make a case that "dissensus" exists. My dictionary does not define such a word. If they mean that there is not consensus, this again is not surprising.

The clustering of the 16 pollution source cards is singularly non-instructive. What a surprise that nutrient impacts, toxic impacts, and physical impact cards clustered similarly. The other clustering of participants at least makes some intuitive sense. The blame someone else mentality should be familiar to anyone involved in large-scale problems. In the PNW where we deal with spotted owls and anadromous fish, the blame game is a long-standing tradition. Finally, the authors seem willing to state that they have proved that the two different techniques of card ranking of 16 pollution sources and cognitive mapping produced similar results. What they didn't prove is whether the similar results are valid and accurate.

The knowledge assessment section of the results is somewhat disturbing. In this section we see that the authors are now willing to extend their small nonrandom sample results and infer results for the population of the basin. For example, they state that "80% of those working in agriculture, including ranchers, are unaware" of the influence of livestock trampling and streambank erosion compared to a "perfect 100%" correct for environmentalists. They go on to conclude that this may be a source of stakeholder class conflict.

In comparing perceived versus assessed knowledge, the focus seems to be on identifying educational opportunities. The authors conclude that in the case where perceived knowledge is high but assessed knowledge low, the role of educators is to reduce overconfidence and eliminate entrenched misconceptions before beginning an education program. I suggest that this is a very treacherous path being advocated. You have now chosen sides rather than going out with an educational program based on scientific results of impacts. Note that this is different than a program based on professional/scientific judgment. The real trick is to design and deliver an educational program to the proper audience.

The explanations for no significance between perceived knowledge and relative importance seem to indicate the need to reassess all of the results. If reason 1 is true that low importance and/or low knowledge impacts are missing from the rankings and the results are therefore skewed, then all of the results obtained using this data set are also skewed (regardless of any other concern on data gathering and measurement error). It also appears that the authors suggest that respondents change their relative rankings of importance depending on the context of the question. This would seem to be an important introduction of bias in the results.

The authors state in the section on the identification of shared schema on impact concern that the cognitive mapping results are instrumental in revealing how stakeholders conceptualize their concerns, which are important to formulating impact management policy that will be politically acceptable. While I agree with the former, I am not clear on how it relates to the latter part of the statement. The authors make 3 conclusions regarding a consensus that may be developing that seemed to have come out of thin air: quiet majority believes blame is shared and impacts accumulating over a long time, going to take all stakeholder groups to cooperate, and very few under the delusion have a short-term solution. While I agree that these are true, I don't know where they came from nor do I believe we need a study to tell us that.

The discussion of Q methodology is fairly well presented. The authors rightly depict the results as a qualitative difference in perspectives that does not indicate proportions of perspectives within the entire basin population. For the first time they also do not put the number of respondents in each cluster. This is the proper reporting for all of their data. In most of the earlier clusters they emphasize which is largest which implies relative proportions in the population. The authors conclude with a statement that to avoid conflict what is needed is a combination of education and a consensus building approach designed to gain a voluntary commitment to protection and risk mitigation. Again, I completely agree but don't see where that came out of the protocols.

The final conclusion is that there is varying trust among impact management preference clusters relative to the appropriate role of government in managing impacts. They suggest a resolution is to use "neutrals to facilitate a policy dialogue among stakeholders, coupled with efforts to maximize the quality of stakeholder participation."

To summarize, while I think the authors have collected a lot of information from a select group of stakeholders, there is a need for a more intensive study if the results are to be extended to the population. If the goal is to produce a multimedia tool, using the extremes will not be very instructive. If, as the author stated in his reply to these critiques, the nonrandom nature is adequate since the goal is to not infer to the population but rather get at qualitative differences, I can accept that IF AND ONLY IF they follow that rule. In most of their methodologies, they go through extensive attempts to quantify their qualitative data and then report frequencies, numbers, or other values. The inference from this is that these are relative proportions that can be extended to the population. If it is truly qualitative data, then why all the effort to quantify and make it look more scientific than it is supposed to be?

Sabatier and Zafonte

This paper is well written and I look forward to hearing the results of the comparison between years. The basic conclusion of the paper is that there is no such thing as a neutral or unbiased person, especially if they have chosen to get involved in a controversial issue. The authors go on to conclude that, at least for this case study, that the bureaucrats and scientists align themselves with specific interest based coalitions.

There are a few issues I would like to raise regarding the study design and applicability of the results to other areas. The second point first. As in the Focht et al. paper, the authors have chosen to select their sample rather than randomly sample the identified population. In this case, however, their approach is probably more justified given the small identified population of interest. The study (at least the first round of sampling) could have been improved if the researchers had validated the results more carefully. What I mean by this is that they received just over half of the surveys back. From what is reported, they did not follow-up to find out if there was any nonresponse bias in their results. That is, are the respondents similar in their characteristics to the nonrespondents. If they had done this, I would be much more comfortable in some of their conclusions. For example, the fact that they identified the scientists more closely with the environmentalists may have been due to the fact that only that portion of the scientific community returned the survey or it may actually be so. There is no way to know without the follow up.

The hypotheses laid out by the authors are good. I believe they need to tighten up the language some so that phrases such as "…will engage in some non-trivial degree of coordinated behavior" are restated so that they can actually be tested.

I was curious about a statement that indicated clustering 465 respondents is simply unmanageable. Instead the authors aggregated respondents on the assumption that individuals within an organization will have relatively homogeneous beliefs. They then further reduced this aggregation to an arbitrary 20 groups based on criteria of similar functions and/or location and if respondents expressed similar views on attitudinal scales. I question both the assumptions of forming their groups and why a cluster analysis was not conducted. Cramer et al.[49] showed in an attitudinal survey of Forest Service employees that beliefs varied by position in the agency as well as length of employment. So the question is whether the arbitrary grouping algorithm used by the authors leads to more defensible results than a formal cluster analysis or to pre-ordained results. My conclusion is that given the scope and objectives of the paper and the authors knowledge of the players, the cluster analysis may have uncovered different groupings but would not likely have added a whole lot more to the analysis.

The authors point out that researchers, as a group, fall into the environmentalist camp based on their attitudes and whom they consider as allies. It should be noted that the respondents to the survey were a very select group of researchers that came largely from a list of technical advisors to the Estuary Project. The obvious question is who hired these researchers and is that more of an explanation of why their beliefs, as a group, fall where they did?

The last comments have to do with perceptions of allies and opponents. The main concern I have that I cannot tell from the paper deals with question bias. In the selection of allies and opponents was none an option or were the respondents expected (or did it appear that they were expected) to answer something? This also relates to measurement error that is being addressed apparently better in the 1997 survey results.

For example, only 3-29% of the other groups listed university faculty as an ally. Based on one of 3 definitions of an ally being a top source of information this is disturbing. Based on the other 3 definitions (voluntarily modifying behavior to assist with expectations of future reciprocity, voluntarily modifying behavior because of shared goals, and developing joint policy positions or strategies) it is encouraging that the numbers are so low. This appears to be the case

[49] Cramer, L.A., J.J. Kennedy, R.S. Krannich, and T.M. Quigley. 1993. Changing Forest Service values and their implications for land management decisions affecting resource-dependent communities. Rural sociology 58(3):475-496.

since very few respondents listed researchers as opponents, regardless that those in the survey were more affiliated with the environmental coalition.

Discussion of Mooney and Eisgruber paper

by Charles Griffiths, US EPA Office of Economy and Environment

I. Overall Comments

-It is nice to see a cost-effectiveness study
-Benefits maybe important
-Not enough on the voluntary aspect
-Need more information on the mathematical programming
-Be careful about implied incentives

II. Residential Gains

Why would there be a 0.44% welfare gain to the residential sector if the tax deferral is only for farms and forest land? Back of the envelope calculation suggest that this gain is substantial (=$38,775).

III. Perverse Incentive

-"Many low valued crops did not generate enough revenue to cover production costs plus property taxes. The tax savings from land areas taken out of production can help offset losses created by low valued crops". Some of the welfare gain comes from removing low valued crops.
-Why not just take all of the low valued crops out of production?
-In the mathematical programming model, why would anyone plant low valued crops if cropping decisions are a choice variable?
-Would those who plan low-valued crops want to be regulated?

IV. Policy-maker's frontier

-Cost-effectiveness frontier for the policy maker is the dashed line
-"This welfare gain is generated at the expense of a decline in property tax revenues".
-A policy maker would consider tax policy B, the status quo.

V. Mixed Strategy

Scenario	Welfare Change	%Welfare Change	Effectiveness	Forestry	Ag	Residential
ABB	-10,553	-0.02	36	-0.03	-0.01	0.00
ABTIP	-926	-0.00	36	-0.02	-2.36	0.00
ARBB	-120,628	-0.24	36	-0.03	-0.01	-1.28
FPABB	-552,133	-1.11	44	-0.03	-0.06	-6.32

-There is no effectiveness gain between ABB and ARBB, suggesting little effectiveness gain to adding residential sector.
-Policy maker would consider ABB
-What about status quo for residential sector and FPABB for forestry and Ag sector?

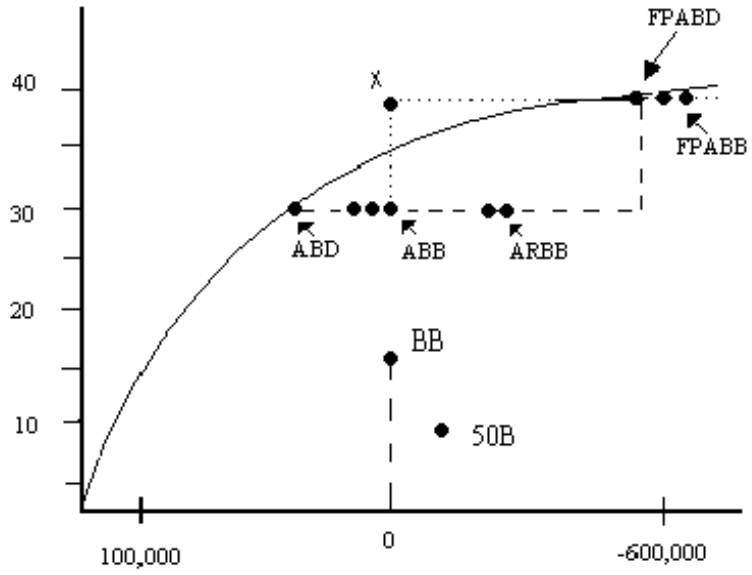
-Welfare loss calculations

-0.03f-0.01a=-10,553 ⇨ f=350,652

-0.02f-2.36a=-926 a=3,364

➪ -0.03f-0.06a=$-10,271 or -0.02% Δ from base

-If effectiveness contribution of residential sector is small, when the cost-effectiveness would lie some where around point x



Question and Answer Period for Session 4

The speakers for Session IV offered responses to some of the comments made by the discussants for the session. Will Focht, Oklahoma State University, responded to the concerns raised by John Tanaka, Oregon State University, about their research methodology. Mr. Focht pointed out that the "Q research" methodology employed by their group is intended to obtain people's *subjective* views, and to study people across traits. Q research does not claim that it applies to a larger population. This research pertains to conflict assessment, and is intended to identify the largest variety of views, not which views are most prevalent. Further, Q research is an attempt to prevent the researcher from imposing her own prior beliefs upon research subjects. Mr. Focht also clarified the definition of the term "self-referrent," which refers to the respondents' views of their own beliefs.

Paul Sabatier, University of California at Davis, responded to a question raised by Mr. Tanaka regarding the reason that university researchers were aligned in their views with environmental organizations. Mr. Sabatier stated that the interesting aspect of the result was that university researchers placed themselves in the environmentalist coalition, but nobody else perceived them that way.

Sian Mooney, Montana State University, responded to a question Charles Griffiths, US EPA Office of Economy and Environment, had regarding the presence of low-valued crops and how they affect farmers' decisions to plant riparian buffers. Ms. Mooney stated that the most common low-value crop was hay, and this was harvested not so much for profit, but to improve aesthetics and reduce fire risks. Ms. Mooney commented that it was possible that the cost-effectiveness frontier could be different if one took into account the lost hay production, but it would depend upon the policy options.

Maureen Sevigny, Oregon Institute of Technology, raised the point that riparian buffers do not lower stream temperatures, they prevent them from rising. An alternative to planting trees in riparian areas is to plant low vegetation, which also solves the problem of visibility. Ms. Sevigny noted, however, that trees also provide woody debris, which has other ecological benefits. Ms. Mooney acknowledged Ms. Sevigny's point, and added that the most critical problem is that gaps in stream coverage cause the temperature to rise, and allowing the temperature to cool is difficult.

Mitchell Mathis, Center for Global Studies, noted that his responsibilities include monitoring stream temperatures in the Rio Grande River, and has found that streamflow is also very important. Ms. Mooney agreed, noting that increased streamflow necessarily results in a lower temperature since there is a greater volume of water being subjected to the same amount of UV radiation. Mr. Mathis also asked if there were any programs that looked at the water allocation issues from the standpoint of increasing streamflow. Ms. Mooney suggested that Mr. Mathis contact the Oregon Water Trust, a non-profit organization that purchases water rights for water quality improvement.

Tony Prato, University of Missouri, pointed out that riparian buffers also provide other benefits, such as habitat for wildlife and prevention of nonpoint source pollution by trapping nutrients and pollutants from agricultural runoff.

Brian Garber-Yonts, Oregon State University, noted that there were two significant belief changes within federal agencies occurring at the time that Mr. Sabatier's study was conducted. Mr. Garber-Yonts asked Mr. Sabatier what he could conclude from institutional theory about his surprising results about the general lack of changes in beliefs. Mr. Sabatier replied that the interesting question was whether the interest group coalitions were moving together. Surprisingly, neither the California Department of Water Resoures and the Southern California interest groups seemed particularly interested in economic analysis. Mr. Sabatier interpreted this as a belief on their part of getting economic factors into the Endangered Species Act listing process is too difficult.

Thomas Leschine, University of Washington, proposed that perhaps the university faculty in Mr. Sabatier's study are an internalized group, in that they have uniform beliefs that stem from their training in the biological sciences, and are the academic opposites of those in the property rights movement, which have emerged form law schools and economics departments, and have followed their respective funding possibilities. Mr. Sabatier agreed that this was a possibility, and that this would reinforce his belief that people reflect the beliefs of their organizational values. For example, in the contentious San Francisco Bay-Delta hearings which have been held to help formulate water policy for the San Francisco Bay and the Sacramento-San Joaquin Delta, most of the participants who were biologists or hydrologists exhibited the strongest environmental beliefs. In 1997, more economists were included in the process, introducing a more conservative element. Another factor at work in the process was a form of selection bias whereby many participants were so dismayed by the acrimonious nature of the policy conflict that they left the process, leaving only those that were highly motivated to stay and continue to engage in conflict. John Tanaka, Oregon State University, pointed out that he also had a view of faculty members in the technical advisory committee, and cautioned against extrapolating these findings to university faculty.