

# RECLAMATION

*Managing Water in the West*

## **Managing Water Conflict: a Survey of Reclamation Managers and Scientists**

**U.S. Department of the Interior  
Bureau of Reclamation**



**February 2011**

## **Mission Statements**

The mission of the Department of the Interior is to protect and provide access to our Nation's natural and cultural heritage and honor our trust responsibilities to Indian Tribes and our commitments to island communities.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

# **Managing Water Conflict:**

## **A Survey of Reclamation Managers and Scientists**

**Technical Memorandum 86-68251-11-01**  
**Technical Service Center**  
**Denver, Colorado**

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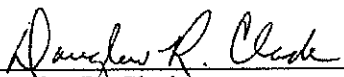
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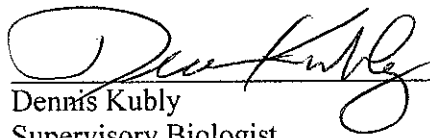
## Technical Approval

The results, findings, and recommendations provided in this document are technically sound and consistent with current Reclamation practice, and are consistent with the source document(s).

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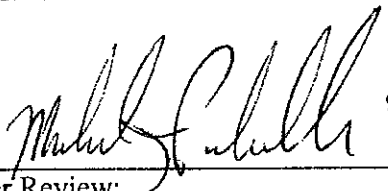
  
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## Background

Reclamation held three workshops for managers on the subject of the prevention and management of conflict over water resources between 2006-2008. At one of them, held in conjunction with the Western Water Institutional Solutions R&D project, an online survey of attendees was taken to determine current and future causes of water conflict and current and future tools for managing it. (The survey was jointly written by a team of Reclamation scientists, social scientists, and engineers: Beaudry Kock, Curtis Brown, Amy Cutler, Mark Mckinstry, Douglas Clark, and Dennis Kubly). This document provides a summary of the online survey results.

Respondents included 33 Reclamation personnel: 26 managers and directors (among them, 4 Area Managers and 4 Deputy Area Managers), 3 engineers, and 4 scientists. (Not all questions were answered by all respondents).

### A.1 Types of Conflict in Reclamation Offices

Respondents were asked what types of conflicts their offices had experienced in the previous five years ranked by the amount of time that had been taken up in addressing each issue type (Table 1, Appendix A). Total weight values were used for this analysis, i.e. number of selections multiplied by the time spent or weight. The maximum value was 121 for water rights issues. The minimum was 1 for climate change. The mean was 55.4 with a standard deviation of 39.6. Four broad, sometimes overlapping, categories of causes were given: those based in law or institutional policy, those rooted in biophysical conditions, those that arose from the failure to make optimal use of water resources, and those engendered by economic constraints.

Of the categories above the mean, five were institutional/legal. In rank order, they were: water rights issues, over-allocation of water, Native American issues, allocations between states and basins, and flood control. Four categories were bio-physical: ESA issues, drought-intensified scarcity, inter-annual variability of flow, and invasive species, again, in rank order. Three categories were related to the sub-optimal use or delivery of water: insufficient average supply, water quality, and inefficient water use. No economic factor received enough selections to put it above the mean. Economic factors included Reclamation charges for water and limited funding to undertake water savings projects.

Overall, legal-institutional factors carried a collective weight that made them predominate over biophysical factors in the genesis of water conflict, though biophysical factors were viewed as important. Optimal use came in at the mid range. Economic factors lagged behind.

## A.2 Types of Change Fostering Conflict in Reclamation Offices

Change is often associated with the genesis of water conflict. Conference attendees were asked about the types of change they had experienced that had contributed to water conflict (Table 2). The increasing number of shifting and competing uses of water and the growing intensity of water uses were among the top changes perceived to contribute to conflict (total weight 132). This reality probably goes along with increased size (and diversity) of the human population in the Western U.S., which was also near the top of the list (125). Once again, however, legal and policy changes figured prominently, though, this time, in the middle range. In rank order, changes in Congressional or Administration policy (98), changing Federal Regulations (87), changes in Reclamation's water management priorities or responsibilities (83), and/or changes in State regulations (83) were perceived to foster conflicts over water. Institutional change also figured into the mix. Changes in Reclamation's organizational structure (60) and/or changes in the Mexican government were problematic in a few localities (4). Changing public attitudes toward Reclamation were mentioned with some prominence (80), possibly reflecting Reclamation's traditional role as a provider of water for irrigated agriculture and publications such as *Cadillac Desert*. Inadequate and declining infrastructure (78) was also a growing contributor to conflict among some of the respondents. One economic factor received prominent mention: changes in Reclamation's budget allocations (78) from one budget cycle to the next and, presumably, from one administration and Congress to the next. Climate change was again at the lower end of the list (64). The most predominant change agents creating conflict were *use changes*: numbers of uses (132), shifting uses (116), intensity of uses (125), and population growth (i.e. use demand). Beyond that, as mentioned, legal changes, institutional policy changes, and changes within institutions, appeared in the middle range, but still generally trumped bio-physical changes with respect to the power to generate conflict.

## A.3 Change Management Practices

As a follow-up question, respondents were asked to identify methods they had used to handle or manage the change they had experienced in the previous question. Internal institutional changes received, by far, the most mentions. These included in rank order changes to staff assignments (19 of 33 respondents), management philosophy (19), budget allocations (18), and management style (10). Among changes in processes related to managing conflict, "the use of specific tools" (such as, GIS, mediation, public education, etc.) was the only category prominently mentioned (11). Collaboration, collaborative decision processes, independent science reviews, negotiations, communication, and "out of the box" thinking each received only one selection. Education and training were

not selected at all. Thus, faced with conflict-generating changes in the water usage landscape, it appears that Reclamation has primarily coped by undertaking institutional adjustments.

## A.4 Organizational Resources for Managing Change

By a 1.5 to 1 margin, respondents agreed with the statement that Reclamation was better positioned to manage gradual, as opposed to rapid change (Table 4). By a 2 to 1 margin attendees thought that *rapid or sudden change contributes to conflict*, as opposed to the statement that *no relationship exists* between the rate of change and the likelihood of conflict. It appears then, that the respondents agreed that change, especially rapid change, can contribute to the genesis of conflict. This appears to concur with Professor Aaron Wolf's assertion that the likelihood of change grows as the rapidity of change outpaces the institutional capacity to manage that change (Wolf, Stahl, and Macomber, 2003).

## A.5 Types and Usefulness of Collaborative Tools for Managing Conflict and Change

The technical tool considered *most helpful for responding rapidly* to change and conflict was geographic information systems (5 of 21 respondents who felt GIS made a positive contribution to managing water conflict) (Table 5). The two tools best suited to managing change *with less effort* were computer-aided decision-making (6 of 12) and tools for explaining and communicating science to stakeholders and the public (6 of 16). Tools best adapted to *lessening the severity* of conflict included collaborative decision-making processes (15 of 27), public education and outreach (12 of 29), and engaging high-level political figures with the collaborative process (11 of 18). The tool considered *best able to help users avoid conflict* altogether was collaborative decision making processes (5 of 27). By far, public education and outreach was considered to be the tool *best suited for improving the general perception of Reclamation* in conflicts (12 of 29). The two tools considered to be *of little or no help* were stakeholder analysis (4 of 7) and blue-ribbon panels of experts (4 of 18).

In rank order, the most helpful tools overall were viewed to be public education (29 positive responses out of 33 total responses), collaborative decision-making (27), geographic information systems (21), engaging high level political figures (18), collaborative modeling (17), and tools for communicating and explaining science to stakeholders and the public (16). Lagging far behind in overall helpfulness were stakeholder analysis (7) and blue ribbon panels of experts (6). The efficacy of public education and collaborative decision-making and the inefficacy of blue ribbon panels is noteworthy. Engaging affected populations in a meaningful way seemed to trump help from independent reviewers. Thus,

building institutional capacity appeared to be the best policy for preventing and managing conflict.

## **A.6 and A.7 Water Conflict Stemming from Differences Among Scientific Findings and Recommendations**

For a much more extensive discussion of this section of the survey, please consult Burkardt, et al., 2008. Fifteen of 33 survey respondents indicated that they had faced conflicts over science concerning water allocations (Table 6). Strategies as to how to proceed in conflicts over science could be classed into three bins (Table 7): “*scientific information seeking and review processes*”, “*ongoing learning and decision processes*”, and “*participatory and collaborative approaches*” (see Burkardt, et al., 2008). Examples of *scientific information seeking and review processes* included refining water supply estimates, engaging outside reviewers of the science, designing new experiments to answer critical questions, siding with Federal experts over State and Local experts when there was a disagreement, and convening a blue ribbon panel. *Ongoing learning and decision processes* might include conducting adaptive management experiments, using a flexible style of management, and convening technical subcommittees that meet regularly to discuss scientific differences. Instances of *participatory and collaborative approaches* included conducting peer-reviewed science and then balancing those findings against economic and political considerations, holding open meetings with multiple agencies that allow for public participation, working with partners to determine the basis of ongoing conflict in an effort to mitigate it, and continued negotiation amongst stakeholders.

Tools considered to be useful for managing conflict fell into the same three categories (Table 8) (see Burkardt, et al., 2008). Instances of *scientific information seeking and review processes* included watershed modeling for both quality and quantity, making use of geographic information system technology, employing population viability analyses, and using a National Academy of Sciences review panel. Responses in the *ongoing learning and decision processes* category included setting up regular meetings of the scientific teams using a flexible management style, and carefully managing risk and uncertainty. Instances of *participatory and collaborative approaches* were collaborative processes involving stakeholders, open and transparent meetings with stakeholders, and using tools such as multi-attribute tradeoff analysis to get at differences stemming from stakeholder values and interests.

Thus, no single method or tool emerged to resolve conflicts over science. Successful approaches seemed to combine technical and collaborative processes with stakeholder and public engagement.

## **B.1 Anticipated Causes for Water Conflict in the Near Future.**

Respondents were asked to indicate potential causes of severe water conflict in the near future. The response rate for this question was low. Table 9 displays the raw data and Table 10 is a summary table. Climate change (3 mentions) was the most frequently mentioned potential cause of future conflict, followed by loss of technical expertise primarily through retirement (2), rural to urban water transfers (2), and water quality issues (2). Other potential causes included climate extremes, ground water appropriation, expansion of irrigated lands, population growth, growth in recreation demand, unauthorized uses, and Wild and Scenic River designations.

## **B.2 Collaborative Tools and Resources Thought to Deserve Increased Support and Investment**

The most frequently mentioned tools thought to deserve increased support and investment were geographic information systems (5 of 26 total responses), tools for communicating and explaining science to stakeholders and the public (4), and collaborative decision-making (4) (Table 11). This accords with the previous findings with respect to the relative helpfulness of various tools, where enlarging institutional capacity was deemed to be of primary importance. GIS, though a technical tool, helps to provide a system-wide view of the conflict, and thus, can be seen as enlarging institutional capacity. Computer-assisted decision-making, general facilitated mediation, public education and outreach, collaborative modeling, and stakeholder analysis each received two mentions. Other tools and resources that were mentioned included regional ground water models for all major rural irrigation projects, blue ribbon panels of experts, and engagement of high-level political figures in the collaborative process. Enlarging institutional capacity for communication and collaboration was viewed as the approach most worthy of future investment.

## **B.3 Ideas for Development of Tools Considered to be Potentially Useful for Managing Water Conflict**

Training in collaborative processes and tools was mentioned as potentially useful (Table 12) for managing water conflict. In addition, bringing in experienced facilitators (disinterested parties) held out the possibility both of making collaboration run more smoothly and also providing live examples for Reclamation leaders as to how to manage conflict and foster collaboration..

## **B.4 Options Reclamation Could Take to Support the Availability and Application of Collaborative Tools and Resources**

By far, the highest rated option Reclamation could select as an organization to support the availability and application of collaborative tools and resources was training (weighted total of 111) (Table 13). This action was followed by the addition of more staff in the development and application of collaborative tools (99); dedicated funding for developing institutional and collaborative tools and resources (94), and web-based informational resources describing tools, which would also make technical elements of those tools available for download (90).

## **Discussion**

Many of the findings of this survey accord with the previous findings of Wolf, et al (2003). Change, especially rapid change, was viewed as an agent fostering conflict. Interestingly, legal, policy, and institutional changes appeared to predominate over bio-physical changes that were viewed as *fostering conflict* in the first place, though biophysical change was *viewed* as an important cause of conflict. Wolf, of course, found no connection between biophysical factors and the genesis of conflict. Obviously, what managers view as a cause for conflict may or may not actually be a cause of conflict. Respondents felt that Reclamation was much better positioned to manage gradual, rather than rapid change. This indicates that Reclamation should, perhaps, investigate strategies for managing rapid change. *Use changes*, including the number of competing uses, the intensity of use, shifting use, and growing demand were viewed as the most problematic.

With respect to managing conflict, respondents felt that public education campaigns, collaborative decision making, and stakeholder engagement held the most promise. This was reflected in the tools that were put forward as showing promise: geographic information systems (presumably for their ability to model the water system for both scientists and stakeholders), tools for communicating and explaining science to stakeholders and the public, and collaborative decision-making. In addition, respondents called for training in the use of these collaborative tools, staff to develop collaborative tools, and web-based information resources to those needing help dealing with a conflictive event.

# APPENDIX A

## Questions and Sorted Tables

### Question A.1.

What kinds of water conflict has your office experienced over the past five years? Please select from the following options or add your own below. For each option you select, please rank it according to how much of your office's time has been taken up in addressing that conflict over the last five years (0=little or no time; 5 = significant amount of time).

| <b>Table 1.</b>                                          |                 |                 |                 |                 |                 |                 |                   |                       |                      |
|----------------------------------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-------------------|-----------------------|----------------------|
| <b>Response A1: Conflict Origin Frequencies</b>          | <b>Rating 0</b> | <b>Rating 1</b> | <b>Rating 2</b> | <b>Rating 3</b> | <b>Rating 4</b> | <b>Rating 5</b> | <b>Tot. Resp.</b> | <b>Weighted Total</b> | <b>Weighted Mean</b> |
| Water rights issues                                      | 0               | 3               | 2               | 5               | 11              | 11              | 32                | 121                   | 3.8                  |
| ESA Issues                                               | 1               | 2               | 2               | 5               | 9               | 12              | 31                | 117                   | 3.8                  |
| Drought-intensified water scarcity                       | 0               | 1               | 4               | 9               | 6               | 11              | 31                | 115                   | 3.7                  |
| Overallocation of water                                  | 0               | 3               | 3               | 2               | 12              | 9               | 29                | 108                   | 3.7                  |
| Insufficient average water supply                        | 3               | 3               | 2               | 9               | 7               | 6               | 30                | 92                    | 3.1                  |
| Water Quality                                            | 1               | 3               | 8               | 9               | 6               | 3               | 30                | 85                    | 2.8                  |
| Native American issues                                   | 4               | 6               | 3               | 7               | 6               | 3               | 29                | 72                    | 2.5                  |
| Inefficient water use                                    | 4               | 3               | 9               | 5               | 6               | 2               | 29                | 70                    | 2.4                  |
| Allocations between states, or subbasins                 | 5               | 4               | 7               | 4               | 7               | 2               | 29                | 68                    | 2.3                  |
| Interannual variability in flow                          | 3               | 6               | 7               | 5               | 5               | 1               | 27                | 60                    | 2.2                  |
| Invasive species                                         | 4               | 10              | 5               | 6               | 4               | 1               | 30                | 59                    | 2.0                  |
| Flooding Control                                         | 6               | 7               | 5               | 3               | 4               | 3               | 28                | 57                    | 2.0                  |
| Unenforced or unenforceable policies                     | 3               | 8               | 2               | 7               | 5               | 0               | 25                | 53                    | 2.1                  |
| Unenforced or unenforceable laws                         | 5               | 6               | 3               | 7               | 4               | 0               | 25                | 49                    | 2.0                  |
| USBR charges to water users                              | 7               | 7               | 3               | 8               | 1               | 1               | 27                | 46                    | 1.7                  |
| Wild and Scenic River issues                             | 13              | 4               | 5               | 3               | 1               | 0               | 26                | 27                    | 1.0                  |
| Groundwater use on Surface water supplies                | 0               | 0               | 0               | 0               | 0               | 1               | 1                 | 5                     | 5.0                  |
| International issues: Mexico                             | 0               | 0               | 0               | 0               | 1               | 0               | 1                 | 4                     | 4.0                  |
| Other: funding/cost sharing to do water savings projects | 0               | 0               | 0               | 0               | 1               | 0               | 1                 | 4                     | 4.0                  |
| Unauthorized use of water                                | 0               | 0               | 0               | 1               | 0               | 0               | 1                 | 3                     | 3.0                  |
| Water Right Negotiation                                  | 0               | 0               | 0               | 1               | 0               | 0               | 1                 | 3                     | 3.0                  |
| Climate Change Impacts                                   | 0               | 1               | 0               | 0               | 0               | 0               | 1                 | 1                     | 1.0                  |

### Question A.2.

What kinds of change have you experienced during your tenure with Reclamation that could be promoting water conflict? Please select from the following options or add your own below. For each option you select, please rate it according to how much it affects your work (0=no effect; 5 = major effect).

| <b>Response A2: Kinds of Change Frequencies</b> | <b>Rating 0</b> | <b>Rating 1</b> | <b>Rating 2</b> | <b>Rating 3</b> | <b>Rating 4</b> | <b>Rating 5</b> | <b>Tot. Resp.</b> | <b>Weighted Total</b> | <b>Weighted Mean</b> |
|-------------------------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-------------------|-----------------------|----------------------|
| Increasing number of competing uses             | 1               | 0               | 1               | 4               | 12              | 14              | 32                | 132                   | 4.1                  |
| Uses becoming more intensive                    | 0               | 0               | 3               | 4               | 13              | 11              | 31                | 125                   | 4.0                  |
| Population growth                               | 1               | 4               | 2               | 1               | 9               | 14              | 31                | 117                   | 3.8                  |
| Shifting uses of water                          | 0               | 0               | 3               | 8               | 9               | 10              | 30                | 116                   | 3.9                  |
| Reclamation's budget allocations                | 1               | 4               | 5               | 7               | 9               | 6               | 32                | 101                   | 3.2                  |
| Congressional or administration policies        | 2               | 3               | 3               | 7               | 12              | 4               | 31                | 98                    | 3.2                  |
| Federal regulations                             | 2               | 4               | 3               | 10              | 8               | 3               | 30                | 87                    | 2.9                  |
| Reclamation's water management responsibilities | 2               | 5               | 3               | 9               | 10              | 1               | 30                | 83                    | 2.8                  |
| State regulations                               | 1               | 6               | 6               | 7               | 6               | 4               | 30                | 83                    | 2.8                  |
| Public attitudes towards Reclamation            | 2               | 7               | 5               | 9               | 9               | 0               | 32                | 80                    | 2.5                  |
| Inadequate or declining infrastructure          | 2               | 4               | 8               | 8               | 6               | 2               | 30                | 78                    | 2.6                  |
| Climate change                                  | 8               | 6               | 2               | 4               | 8               | 2               | 30                | 64                    | 2.1                  |
| Reclamation's organizational structure          | 5               | 10              | 2               | 8               | 3               | 2               | 30                | 60                    | 2.0                  |
| Legal vs Natural Water supply                   | 0               | 0               | 0               | 0               | 1               | 0               | 1                 | 4                     | 4.0                  |
| Mexico governmental changes                     | 0               | 0               | 0               | 0               | 1               | 0               | 1                 | 4                     | 4.0                  |

## Question A.3.

How do you handle the kinds of change you experienced above? Please select one or more from the list below, and add to the list if you think something's missing.

| <b>Table 3.</b>                                     |                  |                                  |
|-----------------------------------------------------|------------------|----------------------------------|
| <b>Means for Handling Change</b>                    | <b>Frequency</b> | <b>Percent of 33 Respondents</b> |
| Changes to staff assignments                        | 19               | 57.6                             |
| Changes to management philosophy                    | 19               | 57.6                             |
| Changes to budget allocations                       | 18               | 54.5                             |
| The use of specific tools                           | 11               | 33.3                             |
| Changes to management styles                        | 10               | 30.3                             |
| Collaboration                                       | 1                | 3.0                              |
| Collaborative decision processes                    | 1                | 3.0                              |
| Independent science reviews                         | 1                | 3.0                              |
| Negotiation/consensus building                      | 1                | 3.0                              |
| Communication                                       | 1                | 3.0                              |
| Thinking outside the box to find workable solutions | 1                | 3.0                              |
| Education/Training                                  | 0                | 0.0                              |

## Question A.4.

Please rate your level of agreement with the following statements (1=strongly disagree, 5=strongly agree).

| <b>Table 4.</b>                                                                 |                 |                 |                 |                 |                 |                   |                       |                      |
|---------------------------------------------------------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-------------------|-----------------------|----------------------|
| <b>Response A4: Rate of Change Frequencies</b>                                  | <b>Rating 1</b> | <b>Rating 2</b> | <b>Rating 3</b> | <b>Rating 4</b> | <b>Rating 5</b> | <b>Tot. Resp.</b> | <b>Weighted Total</b> | <b>Weighted Mean</b> |
| My organization has the resources necessary to manage gradual change.           | 1               | 2               | 15              | 12              | 3               | 33                | 113                   | 3.4                  |
| My organization has the resources necessary to manage rapid change.             | 6               | 16              | 7               | 4               | 0               | 33                | 75                    | 2.3                  |
| The more rapid or sudden the change, the greater the likelihood of conflict.    | 1               | 2               | 3               | 14              | 13              | 33                | 135                   | 4.1                  |
| There is no relation between the rate of change and the likelihood of conflict. | 16              | 8               | 5               | 2               | 2               | 33                | 65                    | 2.0                  |

## Question A.5.

From the following list of collaborative tools, please select those which you have made significant use of in the past. For each tool you select, please indicate what kind of support it was in helping you handle water conflict and change (select from the drop-down menu by each tool).

| Tools                                                                                                                                                                                           | N/A | Respond to<br>Change More<br>Rapidly | Respond to<br>Change with Less<br>Effort | Lessen Severity of<br>Conflict | Avoid Conflict<br>Altogether | Improve General<br>Perception of<br>Reclamation in<br>Conflicts | No Help at All | Responses | Sum of<br>Positive<br>Contributions<br>(C to G) |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|--------------------------------------|------------------------------------------|--------------------------------|------------------------------|-----------------------------------------------------------------|----------------|-----------|-------------------------------------------------|
| Public education and outreach (e.g. public meetings, general informational publications)                                                                                                        | 4   | 2                                    | 1                                        | 12                             | 2                            | 12                                                              | 0              | 33        | 29                                              |
| General facilitated mediation                                                                                                                                                                   | 19  | 2                                    | 0                                        | 7                              | 1                            | 2                                                               | 2              | 33        | 12                                              |
| Collaborative decision-making processes (e.g. joint-fact finding, consensus-building)                                                                                                           | 6   | 2                                    | 2                                        | 15                             | 5                            | 3                                                               | 0              | 33        | 27                                              |
| Computer-assisted decision-making (e.g. expert systems, decision-support tools, scenario simulation)                                                                                            | 19  | 2                                    | 6                                        | 3                              | 0                            | 1                                                               | 2              | 33        | 12                                              |
| Geographic Information Systems (e.g. map-based tools for improving public understanding of a problem)                                                                                           | 10  | 5                                    | 4                                        | 4                              | 1                            | 7                                                               | 2              | 33        | 21                                              |
| Collaborative modeling (i.e. computer-assisted decision-making where stakeholders have direct responsibility for helping create a model)                                                        | 14  | 3                                    | 4                                        | 8                              | 0                            | 2                                                               | 2              | 33        | 17                                              |
| Stakeholder analysis (i.e. studying the makeup of stakeholder groups and mapping their interactions within a conflict; e.g. some tools include USGS LIAM, classical stakeholder analysis, VISA) | 22  | 2                                    | 3                                        | 1                              | 0                            | 1                                                               | 4              | 33        | 7                                               |
| Negotiated rule-making (i.e. a process which brings together representatives of various interest groups and a federal agency to negotiate the text of a proposed rule (EPA definition))         | 20  | 1                                    | 1                                        | 7                              | 0                            | 3                                                               | 1              | 33        | 12                                              |
| Tools for communicating and explaining science to stakeholders and the public (e.g. publication tools, science communication specialists)                                                       | 15  | 1                                    | 6                                        | 7                              | 1                            | 1                                                               | 2              | 33        | 16                                              |
| Blue-ribbon panels of experts                                                                                                                                                                   | 23  | 1                                    | 1                                        | 1                              | 0                            | 3                                                               | 4              | 33        | 6                                               |
| Engaging high-level political figures with a collaborative process                                                                                                                              | 12  | 2                                    | 1                                        | 11                             | 0                            | 4                                                               | 3              | 33        | 18                                              |

## Question A.6.

Do you ever face a conflict over water allocation that stems, in a substantial way, from disagreements among scientists as to the amount of water that is required for various uses?

| Table 6.                                                      | Frequency |
|---------------------------------------------------------------|-----------|
| Faced Conflict Over Science Respecting Water Allocations: No  | 18        |
| Faced Conflict Over Science Respecting Water Allocations: Yes | 15        |

## Managing Water Conflict: A Survey of Reclamation Managers and Scientists

### Question A.7. If your answer was “yes”, how do you proceed in these cases?

Table 7.

| How to Proceed if there is Conflicting Science as to Water Allocations                                                                                                                                                                                               | Summary                                          |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------|
| Side with the federal experts over state and private. Side with the recognised federal party. For salmon- NOAA fisheries. for snails - USFWS. For chemistry - EPA etc                                                                                                | Side with Feds                                   |
| The conflict was more related to how much water was available for allocation. Currently developing a strategy to work with the state water board to reach consensus on the appropriate reservoir yield values to prevent further overallocation.                     | Work with State                                  |
| Work toward refining estimate of use, supplies, and uncertainty.                                                                                                                                                                                                     | Refine Supply Est.                               |
| Each case is different and this is somewhat rare in our area that this is the reason for the conflict. It might be supporting another issue that is at the heart of the conflict (i.e. non-traditional uses, population growth, drought, or new water right filing). | Work Collaboratively with Stakeholders           |
| The cases are either resolved through continued negotiation among stakeholders or proceed through litigation process.                                                                                                                                                | Continued Negotiation or Litigate                |
| Development of a technical subcommittee with regular meetings, task lists, meeting notes, and transparency in all documentation. The leader (myself) used a very flexible management style. A lot of mistrust in this project was eliminated through this process.   | Technical work group                             |
| Try to steer the conversations away from science and get the group focused on the big picture.                                                                                                                                                                       | Steer process away from science                  |
| Accept the scientific recommendation after a reasonable level of peer review and then temper implementation of the recommendation with economic and political reality.                                                                                               | Peer reviewed science and multicriteria approach |
| We try to define experiments which will answer the question.                                                                                                                                                                                                         | Refine science.                                  |
| More a case of disagreement on the probability of changes in water supply and implications of those changes.                                                                                                                                                         | Manage uncertainty                               |
| We have ensured that we are using the best science available to get our answers and proceed with that.                                                                                                                                                               | Peer reviewed science                            |
| Attempt to resolve issues by engaging outside reviewers and do more science that is designed to resolve issues among different scientific experts.                                                                                                                   | Outside reviewers                                |
| Conduct experiments under adaptive management; treat differences as competing hypotheses.                                                                                                                                                                            | Adaptive Management                              |
| Additional scientific studies, blue ribbon reviews                                                                                                                                                                                                                   | More science and Blue Ribbon                     |
| In the CCAO office, we sometimes encounter disagreement over how much water and when water should be released for protection of special status fish species. Currently in the lower American River watershed we have an established group where fishery agencies     | Work Collaboratively with Stakeholders           |

## Question A.8.

Are there tools or techniques that are particularly useful in helping you to resolve disagreements stemming from conflicting or diverging science?

**Table 8.**

**Useful Tools for Managing Conflict Over Science**

|                                                                                                                                                                                                                                                 |                                     |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|
| Science, data, and modeling have definite limits in resolving conflict.                                                                                                                                                                         | <b>Summary</b><br>Manage            |
| Management of risk and uncertainty is where true gains are made at dealing with these problems.                                                                                                                                                 | Uncertainty                         |
| Geographic Information Systems                                                                                                                                                                                                                  | GIS                                 |
| Listen AND understand what is being said. Many times conflicts develop because some don't take the time to listen with an open mind.                                                                                                            | Listening Skills                    |
| To shift the focus from conflicting science to something the parties can agree on and begin exploring the parties' underlying interests to find room for further cooperation.                                                                   | Shift Focus Away from Science       |
| A flexible leadership style, allowing all parties equal say and participation (build trust and team confidence) and strong facilitation of these discussions. Also, regular meetings helped the process move forward.                           | Flexible Leadership Style           |
| The most helpful tool I have found in minimizing or resolving differences is to have open, transparent meetings with all stakeholders.                                                                                                          | Transparency                        |
| Collaborative processes involving stakeholders.                                                                                                                                                                                                 | Collaborative Processes             |
| We are currently promoting using a PVA - population viability analysis which is suppose to get scientists to agree on what factors are most important for species survival.                                                                     | Population Viability Analysis       |
| No.                                                                                                                                                                                                                                             | No                                  |
| Difference usually is in the interpretation of results, which stems from stakeholder resource interests. Mechanisms that help to objectify these views, such as multi-attribute tradeoff analyses can help to reveal the subjective viewpoints. | Multi-attribute trade-off analysis. |
| Yes, watershed modeling efforts for both water quantity and water quality.                                                                                                                                                                      | Watershed modeling                  |
| Facilitation is one of the most valuable tools in this arena.                                                                                                                                                                                   | Facilitation                        |
| NAS panel review                                                                                                                                                                                                                                | NAS Review                          |
| N/A                                                                                                                                                                                                                                             | N/A                                 |

## Question B.1.

Aside from the conflicts already mentioned which may currently be a problem for you, please suggest any potential conflicts which Reclamation may encounter in the near future and which may be severe.

Our office has experienced a large personnel turnover. As Reclamation fills vacancies it has a domino effect. We are losing experienced personnel and not having enough experienced personnel to fill behind them.

Wild and Scenic River designations

Reclamation's technical ability is dwindling. This is a severe problem. Also, Reclamation needs to take more risks and be more aggressive in its approach to do the best science possible. Another problem area is the "we" vs "they" attitude among regions, area offices, etc.

(1) Urbanization and growth changing water needs from irrigation to domestic and industrial. (2) groundwater appropriation and lack of adjudication of groundwater (3) Climate extremes

Conversion of water use from agriculture to municipal use. Demand for river based recreation.

In dry years as we experienced in the Central Valley this year, groundwater pump-in to help meet demands becomes critical to farmers. But Groundwater pump-in into our canal may create regulatory issues for Reclamation especially if the quality of the ground water is not good.

The conflicts we are experiencing will continue to intensify due to increasing population and development pressures compounded by possible reductions in water supply associated with the changing climate.

Insufficient planning and failure to develop contingencies for water shortages stemming from climate change. The agency and the Department are not taking this threat seriously.

We have been held back from involvement in water quality issues within our watersheds because some feel water quality is not a Reclamation concern. However, we deliver water from several sources that have water quality issues and I do not believe Reclama

Unauthorized uses, conjunctive management and recharge.

Reduced project yield due to climate change

**Table 10.**

| <b>Suggestions about the Sources of Future Water Conflict</b> | <b>Frequency</b> |
|---------------------------------------------------------------|------------------|
| Climate Change                                                | 3                |
| Loss of Technical Expertise                                   | 2                |
| Rural to Urban Water Transition                               | 2                |
| Water Quality                                                 | 2                |
| Climate Extremes                                              | 1                |
| Groundwater Appropriation                                     | 1                |
| Growth in Irrigation                                          | 1                |
| Population Growth                                             | 1                |
| Recreation Demand Growth                                      | 1                |
| Unauthorized Use                                              | 1                |
| Wild and Scenic River Designations                            | 1                |

## Question B.2.

From the list below of currently available collaborative tools and resources: please indicate any tools and resources that you think deserve increased support and investment from Reclamation. If you think we've missed something, please add it in below.

| <b>Table 11.</b>                                                                                  |                  |
|---------------------------------------------------------------------------------------------------|------------------|
| <b>Tools that Deserve Increased Support</b>                                                       | <b>Responses</b> |
| Geographic Information Systems                                                                    | 5                |
| Tools for communicating and explaining science to stakeholders and the public                     | 4                |
| Collaborative decision-making processes                                                           | 4                |
| Computer-assisted decision-making                                                                 | 2                |
| General facilitated mediation                                                                     | 2                |
| Public education and outreach                                                                     | 2                |
| Collaborative modeling                                                                            | 2                |
| Stakeholder analysis                                                                              | 2                |
| Collaboratively created Regional groundwater models for all major Reclamation irrigation projects | 1                |
| Blue-ribbon panels of experts                                                                     | 1                |
| Engaging high-level political figures with a collaborative process                                | 1                |

## Question B.3.

Do you have any ideas for tools or resources that would potentially be useful if developed?

**Table 12.**

### **Ideas for Tools that would Potentially be Useful**

I have taken a great interest in the collaborative process and am currently in the final stages of writing a doctoral dissertation on collaborative leadership in water resources teams. Educating people on collaboration (formal degree programs or training classes) would be a good start, also bringing in experienced facilitators (disinterested parties) may help make collaboration run smoother and provide an example to Reclamation leaders of how to manage conflict and promote collaboration.

### **Summary**

Collaborative  
Processes  
Training

We should increase our focus and training in the Conflict Resolution program.

Conflict Resolution  
Training

n/a

## Question B.4.

The following list describes some options Reclamation could take as an organization to support the availability and application of collaborative tools and resources. Please rate each option in the list for how effective you think the measure would be in helping you handle conflict and change (0=no help, 5=substantial help). If you've got other ideas not listed, please add them in and also rate them.

| <b>Table 13.</b>                                                                                                              |                 |                 |                 |                 |                 |                 |                   |                       |                      |
|-------------------------------------------------------------------------------------------------------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-------------------|-----------------------|----------------------|
| <b>Response B4: Conflict Resolutions Road Map Options</b>                                                                     | <b>Rating 0</b> | <b>Rating 1</b> | <b>Rating 2</b> | <b>Rating 3</b> | <b>Rating 4</b> | <b>Rating 5</b> | <b>Tot. Resp.</b> | <b>Weighted Total</b> | <b>Weighted Mean</b> |
| Training programs in selecting and applying these tools                                                                       | 0               | 3               | 2               | 6               | 14              | 6               | 31                | 111                   | 3.6                  |
| More staff expert in the development and application of collaborative tools                                                   | 0               | 4               | 5               | 7               | 11              | 4               | 31                | 99                    | 3.2                  |
| Dedicated research and development funding for developing institutional and collaborative tools and resources                 | 1               | 5               | 6               | 5               | 8               | 6               | 31                | 94                    | 3.0                  |
| Web-based informational resources describing the tools and making any technical element of those tools available for download | 0               | 6               | 3               | 12              | 8               | 2               | 31                | 90                    | 2.9                  |

## Question B.5.

List a resource you have found personally useful in managing water conflict.

**Table 14.**

CDR

Observing peers and managers, mentoring received from others, experience and opportunities to resolve conflicts.

Systematic Development of Informed Consent

Various books and research papers

Speakers who have tremendous amounts of experience in water conflict.

Negotiation Training

On the job training/experience

mediation training

GIS

Environmental Problem Solving: Psychosocial Barriers to Adaptive Change

Situational Leadership and group dynamics

NAS

## Citations

- Burkardt, N., Ruell, E., Clark, D. 2008. *An exploration of Bureau of Reclamation approaches for managing conflict over diverging science.* (Technical Memorandum 86-68211-09-01). Dept. of the Interior, Bureau of Reclamation, Denver Technical Service Center.
- Wolf, A., Stahl, K., Macomber, M. 2003. "Conflict and cooperation within international river basins: the importance of institutional capacity." *Water Resources Update* Number 125: 31-40.