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TECHNICAL REPORT

Presenting Uncertainty About Climate Change to Water-Resource Managers

A Summary of Workshops with the Inland Empire Utilities Agency

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Sponsored by the National Science Foundation

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APPENDIX B

Summary Statistics from Surveys

In this appendix, we present summary statistics in tabular form from the surveys administered to workshop participants over the three workshop sessions held between September and November 2006 at the IEUA offices. Data are presented here in the same four categories of analysis in which results are presented in Chapter Five:

- climate change: perceptions of the problem and expectations about its impacts
- uncertainty: preferences for presentations of uncertainty (a few simple scenarios without probabilities, a single probabilistic scenario, many scenarios without probabilities)
- risk reduction: managers' and planners' willingness to take risks and their preferences for specific measures to reduce risk of persistent supply disruptions
- modeling: relevance, accessibility, and utilization potential of quantitative models for planning and decisionmaking

Climate Change

Table B.1
Perceptions of Sudden Climate Change

Item	Before W1 (S1) Mean	Before W1 (S1) Standard Deviation	After Climate Data Presented (S2) Mean	After Climate Data Presented (S2) Standard Deviation	After Four-Scenario Model (S5) Mean	After Four-Scenario Model (S5) Standard Deviation	After Probabilistic Model (S6) Mean	After Probabilistic Model (S6) Standard Deviation	After W3 (S7) Mean	After W3 (S7) Standard Deviation
n	30	30	16	16	21	21	19	19	14	14
a. Climate change is a very slow process that happens over thousands of years.	2.93	1.31	2.81	1.47	2.76	1.14	2.95	1.27	3.71	1.27
b. Substantial climate changes over a period of 5–10 years are very possible.	2.10	.89	1.81	.83	2.24	1.00	2.32	.95	2.07	.92
c. We are likely to have plenty of notice that climate change is happening.	3.23	1.19	3.06	1.18	3.14	.91	3.21	.85	3.86	.77
d. Climate change may be upon us before we know it has happened.	2.73	1.17	2.31	.95	2.29	1.10	2.37	1.01	2.14	.86

Table B.2

Participants' Perceptions of Responsibility for the Future

Items	Before W1 (S1) Mean	Before W1 (S1) Standard Deviation	After W3 (S7) Mean	After W3 (S7) Standard Deviation
n	30	30	30	30
11a. In the next five years	1.67	.80	1.71	.61
11b 10 years from now	1.73	.67	1.86	.77
11c. 25 years from now	2.10	.67	2.14	.77
11d. 50 years from now	2.55	.95	3.14	.95
11e. 100 years from now	3.14	1.19	3.57	1.16
11f. 250 years from now	3.53	1.36	4.00	.88

NOTE: 1 = completely responsible, 2 = very responsible, 3 = somewhat responsible, 4 = a little responsible, 5 = not responsible at all.

Table B.3
Participants' Views About Their Ability to Manage Water in the Face of Climate Change

Statement	Before W1 (S1) Mean	Before W1 (S1) Standard Deviation	After W1 (S2) Mean	After W1 (S2) Standard Deviation	After Four-Scenario Models (S5) Mean	After Four-Scenario Models (S5) Standard Deviation	After Probability Weighted (S6) Mean	After Probability Weighted (S6) Standard Deviation	After W3 (S7) Mean	After W3 (S7) Standard Deviation
n	30	30	16	16	21	21	19	19	14	14
10a. We can't plan water supplies to respond to sudden climate change.	3.23	1.25	4.00	.89	3.67	1.15	3.68	.95	3.93	1.14
10b. We need good probabilistic information on potential climate change in order to prepare appropriately for climate change.	2.20	1.10	2.19	.98	2.05	1.02	2.21	1.03	2.71	1.14
10c. Planning for climate change effects far into the future is foolish.	3.97	.96	4.38	.72	3.85	.93	4.26	.65	4.07	1.00
10d. It's possible to manage water supplies to respond to sudden climate change.	2.30	1.09	2.00	1.10	2.05	.80	2.11	.81	2.07	.73

Table B.3—Continued

Statement	Before W1 (S1) Mean	Before W1 (S1) Standard Deviation	After W1 (S2) Mean	After W1 (S2) Standard Deviation	After Four-Scenario Models (S5) Mean	After Four-Scenario Models (S5) Standard Deviation	After Probability Weighted (S6) Mean	After Probability Weighted (S6) Standard Deviation	After W3 (S7) Mean	After W3 (S7) Standard Deviation
10e. There are things we can and should do despite an incomplete understanding about the effects of climate change	1.53	.57	1.63	.81	1.38	.50	1.47	.51	1.36	.50

NOTE: 1 = agree strongly, 2 = agree somewhat, 3 = neither agree nor disagree, 4 = disagree somewhat, 5 = disagree strongly.

Table B.4a
Ratings of Approaches to Presenting Scenarios: After Workshop 2

Item	Single Scenario Mean	Single Scenario Standard Deviation	Four-Scenario Mean	Four-Scenario Standard Deviation	Probability-Weighted Scenarios Mean	Probability-Weighted Scenarios Standard Deviation	Single Scenario Mean	Single Scenario Standard Deviation
n	15	15	16	16	15	15	14	14
A. It is easy to understand..	1.33	.49	1.56	.63	2.60	.63	1.07	.27
B. Represents sufficient information about climate change for planning purposes.	3.14	.66	2.25	.93	2.50	1.03	2.79	1.12
C. Enables a comparison of climate-related risks.	2.93	1.00	1.94	.68	2.06	.77	2.43	1.16
D. Presents information in an objective way.	1.73	.88	1.81	.83	1.75	.86	1.71	.99
E. Provides results that can be used in planning.	2.00	.85	1.75	.68	1.94	.68	2.14	.95
F. Is easy to explain to decision makers and stakeholders.	1.57	.76	1.73	.70	2.93	.80	1.50	.76
G. Provides results that support a choice among plans..	2.79	.97	1.87	.92	2.13	1.06	2.86	1.03

Table B.4a—Continued

Item	Single Scenario Mean	Single Scenario Standard Deviation	Four-Scenario Mean	Four-Scenario Standard Deviation	Probability-Weighted Scenarios Mean	Probability-Weighted Scenarios Standard Deviation	Single Scenario Mean	Single Scenario Standard Deviation
H. Provides you with useful information about how to evaluate and improve the 2005 UWMP	2.21	.70	1.67	.49	1.86	.77	2.86	1.03

NOTE: 1 = agree strongly, 2 = agree somewhat, 3 = disagree somewhat, 4 = disagree strongly.

Table B.4b
Ratings of Approaches to Presenting Scenarios: After Workshop 3

Item	Four-Scenario Mean	Four-Scenario Standard Deviation	Probability-Weighted Scenarios Mean	Probability-Weighted Scenarios Standard Deviation	RDM Mean	RDM Mean
n	14	14	14	14	14	14
A. It is easy to understand.	1.14	.36	1.79	.58	2.07	.73
B. Represents sufficient information about climate change for planning purposes.	2.21	2.21	1.86	1.86	1.71	1.71
C. Enables a comparison of climate-related risks.	1.86	.53	1.57	.51	1.46	.52
D. Presents informatino in an objective way.	1.93	1.00	1.79	.89	2.00	.96
E. Provides results that can be used in planning.	1.79	.80	1.64	.50	1.43	.51
F. Is easy to explain to decisionmakers and stakeholders.	1.86	.86	2.61	.92	2.82	.87
G. Provides results that support a choice among plans.	2.07	.62	1.86	.53	1.71	.47
H. Provides you with useful information about how to evaluate and improve the 2005 UWMP	1.71	.61	1.71	.47	1.64	.50

NOTE: 1 = agree strongly, 2 = agree somewhat, 3 = disagree somewhat, 4 = disagree strongly.

Risk Reduction

Table B.5
Management Risk-Taking Ratings at Baseline and After Workshop 3

Item	Baseline Mean	Baseline Standard Deviation	After W3 (S7) Mean	After W3 (S7) Standard Deviation
n	31	31	14	14
A. Uncertainty is inevitable, but a well-managed organization can deal with it effectively.	1.39	.50	1.71	.47
F. Even good management can't guarantee against bad outcomes in uncertain situations.	1.70	.70	1.57	.65
B. Making the wrong call in an uncertain situation can be a career ender.	2.48	.81	2.71	.99
H. "Win a few, lose a few" is a good philosophy to have when making decisions in uncertain situations.	3.77	1.00	3.50	1.09
L. When the result could be a disaster, even small increments in risk are unacceptable.	2.53	1.00	2.93	1.14
C. I would advocate changing strategy based on the results of a good quantitative model.	1.71	.53	2.00	.55
K. Modeling is a useful exercise, but in the end managers have to go with their instincts.	1.27	.52	3.14	.86
I. Promoting a high-cost strategy on the basis of a quantitative model is difficult to defend.	2.70	.95	2.29	.73
D. When considering uncertain situations, each one is unique and has to be considered on its own merits.	1.70	.60	2.07	1.07
J. Looking at the outcomes from similar situations in the past is a good guide to the future.	2.07	.58	2.29	.73
E. Picking a strategy and sticking with it is the right approach in uncertain situations.	3.23	.86	3.86	.95
G. In uncertain situations it's important to continually review results and change course if things are not going well.	1.47	.73	1.21	.58

NOTE: Items measured on a 1–5 scale: 1 = strongly agree, 2 = agree, 3 = neither agree nor disagree, 4 = disagree, and 5 = disagree strongly.

Table B.6a
Changes in View About Specific Approaches to Managing Water Supplies: Workshop 1

Item	Before W1 (S1) Mean	Before W1 (S1) Standard Deviation	After W1 (S2) Mean	After W1 (S2) Standard Deviatoin
n	31	31	16	16
A. Promote water conservation through public education.	1.35	.61	1.25	.45
E. Promote and subsidize "California Friendly" designs for housing and landscaping.	1.94	.63	1.81	.54
L. Increase the basin retention and beneficial use of storm water.	XXX	XXX	XXX	XXX
N. Bank excess wet-year supplies in GW basins.	1.27	.52	1.13	.35
I. Require dial plumbing for recycled use in new developments.	XXX	XXX	XXX	XXX
K. Require the use of recycled supply in new developments.	XXX	XXX	XXX	XXX
H. Increase GW recharge using injection wells or other means.	XXX	XXX	XXX	XXX
Q. Construct new transmission lines for recycled water.	XXX	XXX	XXX	XXX
M. Construct new GW desalting plants.	2.00	.93	1.88	.96
O. Improve the permeability of the basin to increase GW recharge.	XXX	XXX	XXX	XXX
B. Enact tighter water use appliance standards for existing users.	2.10	.85	1.87	.99

Table B.6a—Continued

Item	Before W1 (S1) Mean	Before W1 (S1) Standard Deviation	After W1 (S2) Mean	After W1 (S2) Standard Deviatoin
C. Require whites and gray water piping in new developments.	2.24	1.02	2.20	1.08
F. Making zoning changes to reduce landscaping demands.	2.43	1.00	2.36	.84
G. Increase water rates to reduce demand.	XXX	XXX	XXX	XXX
J. Make plans to increase imports of water.	XXX	XXX	XXX	XXX
P. Introduce recycled water directly to the water supply.	XXX	XXX	XXX	XXX
D. Slow new development through limiting housing starts and other zoning changes	3.72	1.13	3.73	.88

NOTE: 1 = must do it, 2 = high priority, 3 = moderate priority, 4 = low priority, 5 = not worth doing.

Table B.6b
Changes in View About Specific Approaches to Managing Water Supplies: Workshop 2

Item	Before W2 New (S3) Mean	Before W2 New (S3) Standard Deviation	Before W2 Repeat (S4) Mean	Before W2 Repeat (S4) Standard Deviation	During W2 (S5) Mean	During W2 (S5) Stanrdard Deviation	After W2 (S6) Mean	After W2 (S6) Standard Deviation
n	9	9	13	13	21	21	19	19
A. Promote water conservation through public education.	1.56	.73	1.15	.38	1.29	.56	1.37	.60
E. Promote and subsidize "California Friendly" designs for housing and landscaping.	2.25	.89	1.69	.63	1.71	.72	1.63	.68
L. Increase the basin retention and beneficial use of storm water.	1.43	.53	1.38	.65	1.67	.66	1.53	.61
N. Bank excess wet-year supplies in GW basins.	1.50	.53	1.38	.51	1.52	.60	1.47	.61
I. Require dial plumbing for recycled use in new developments.	2.00	.93	1.46	.52	1.62	.59	1.53	.51
K. Require the use of recycled supply in new developments.	2.00	.76	1.54	.66	1.57	.68	1.53	.51
H. Increase GW recharge using injection wells or other means.	2.00	.76	1.31	.63	1.62	.67	1.63	.68

Table B.6b—Continued

Item	Before W2 New (S3) Mean	Before W2 New (S3) Standard Deviation	Before W2 Repeat (S4) Mean	Before W2 Repeat (S4) Standard Deviation	During W2 (S5) Mean	During W2 (S5) Stanrdard Deviation	After W2 (S6) Mean	After W2 (S6) Standard Deviation
Q. Construct new transmission lines for recycled water.	2.00	.53	1.77	.73	1.86	.85	1.58	.51
M. Construct new GW desalting plants.	2.14	.69	1.92	.67	2.15	.67	1.94	.80
O. Improve the permeability of the basin to increase GW recharge.	2.00	1.20	1.67	.65	1.85	.75	1.89	.76
B. Enact tighter water use appliance standards for existing users.	2.00	.71	2.23	.73	2.00	.84	2.00	.88
C. Require whites and gray water piping in new developments.	2.56	.73	2.38	1.12	2.52	1.12	2.74	1.33
F. Making zoning changes to reduce landscaping demands.	2.44	.53	2.15	.80	2.40	.75	2.28	1.07
G. Increase water rates to reduce demand.	3.00	.71	2.42	.90	2.68	1.00	2.35	.93
J. Make plans to increase imports of water.	3.38	.74	2.62	.87	3.00	1.05	2.95	1.13

Table B.6b—Continued

Item	Before W2 New (S3) Mean	Before W2 New (S3) Standard Deviation	Before W2 Repeat (S4) Mean	Before W2 Repeat (S4) Standard Deviation	During W2 (S5) Mean	During W2 (S5) Stanrdard Deviation	After W2 (S6) Mean	After W2 (S6) Standard Deviation
P. Introduce recycled water directly to the water supply.	2.57	.79	3.17	.58	2.85	.93	2.63	1.16
D. Slow new development through limiting housing starts and other zoning changes	3.78	1.09	3.92	.90	3.58	.96	3.47	1.23

NOTE: 1 = must do it, 2 = high priority, 3 = moderate priority, 4 = low priority, 5 = not worth doing.

Table B.6c
Changes in View About Specific Approaches to Managing Water Supplies: Workshop 3

Item	After W3 (S7) Mean	After W3 (S7) Standard Deviation
n	14	14
A. Promote water conservation through public education.	1.36	.84
E. Promote and subsidize "California Friendly" designs for housing and landscaping.	1.79	.58
L. Increase the basin retention and beneficial use of storm water.	1.29	.47
N. Bank excess wet-year supplies in GW basins.	1.50	.65
I. Require dial plumbing for recycled use in new developments.	1.71	.91
K. Require the use of recycled supply in new developments.	1.64	.84
H. Increase GW recharge using injection wells or other means.	1.93	.62
Q. Construct new transmission lines for recycled water.	1.64	.63
M. Construct new GW desalting plants.	1.69	.63
O. Improve the permeability of the basin to increase GW recharge.	1.86	.95
B. Enact tighter water use appliance standards for existing users.	1.79	1.05
C. Require whites and gray water piping in new developments.	2.71	1.33
F. Making zoning changes to reduce landscaping demands.	2.31	.75
G. Increase water rates to reduce demand.	2.62	.87
J. Make plans to increase imports of water.	2.86	1.17
P. Introduce recycled water directly to the water supply.	3.36	1.15
D. Slow new development through limiting housing starts and other zoning changes	3.92	1.12

NOTE: 1 = must do it, 2 = high priority, 3 = moderate priority, 4 = low priority, 5 = not worth doing.

Modeling

We asked participants to rate how valuable or harmful quantitative models were in their own work for making decisions. Summary statistics are shown in Table B.7.

Table B.7
Value of Quantitative Modeling

Item	Before W1 (S1) Mean	Before W1 (S1) Standard Deviation	After W3 (S7) Mean	After W3 (S7) Standard Deviation
n	29	29	14	14
8a. Considering the range of factors that could be important	1.31	.47	1.36	.50
8b. Considering what levels of factors are critical in causing outcomes	1.45	.51	1.43	.51
8c. Considering how factors relate to each other in causing outcomes	1.45	.69	1.21	.43
8d. Considering the range of outcomes that could occur	1.41	.78	1.71	.47
8e. Considering how likely each outcome is	1.69	.81	2.00	.78
8f. Considering how beneficial or harmful each outcome is	1.71	.76	1.64	.63
8g. Considering short term outcomes	1.62	.73	1.71	.61
8h. Considering long term outcomes	1.45	.63	1.64	.50
8i. Forecasting the future in uncertain situations	1.93	.70	1.71	.61
8j. Helping to evaluate the likely success or failure of strategies in uncertain situations	1.86	.74	2.14	.53
8k. Identifying optimum plans	1.66	.67	1.71	.47
8l. Considering worst case scenarios	1.59	.57	1.71	.61
8m. Identifying robust plans	1.86	.58	1.86	.66

NOTE: Items measured on a 1–5 scale: 1 = very valuable, 2 = somewhat valuable, 3 = neither valuable nor harmful, 4 = somewhat harmful, and 5 = very harmful.

Table B.8
Ratings of Accessibility and Utilization Potential for Each Decision Aid

	W1			W2						W3		
Scale	Single Scenario Mean	Single Scenario Standard Deviation	Single Scenario Alpha	Four-Scenario Mean	Four-Scenario Standard Deviation	Four-Scenario Alpha	Probabilistic Mean	Probabilistic Standard Deviation	Probabilistic Alpha	Many Scenarios Mean	Many Scenarios Stanrdard Deviation	Many Scenarios Alpha
n	16	16	16	20	20	20	18	18	18	18	18	18
Accessibility (2 items)	3.10	.76	.73	2.70	.94	.75	3.25	.91	.71	2.83	1.00	.59
Planning utilization potential (8 items)	2.30	.44	.73	2.51	.71	.86	2.57	.68	.82	Not asked	Not asked	Not asked
Decision-making utilization potential (5 items)	2.40	.75	.71	2.53	.58	.56	2.93	.91	.78	Not asked	Not asked	Not asked

NOTE: 1 = must do it, 2 = high priority, 3 = moderate priority, 4 = low priority, 5 = not worth doing. Scales for accessibility, planning utilization potential, and decisionmaking utilization potential can be found in the lists in in Chapter Five.