

Embracing Uncertainty: How Climate Change is Shifting Water Utility Planning

A Case Study White Paper for
Water Utilities

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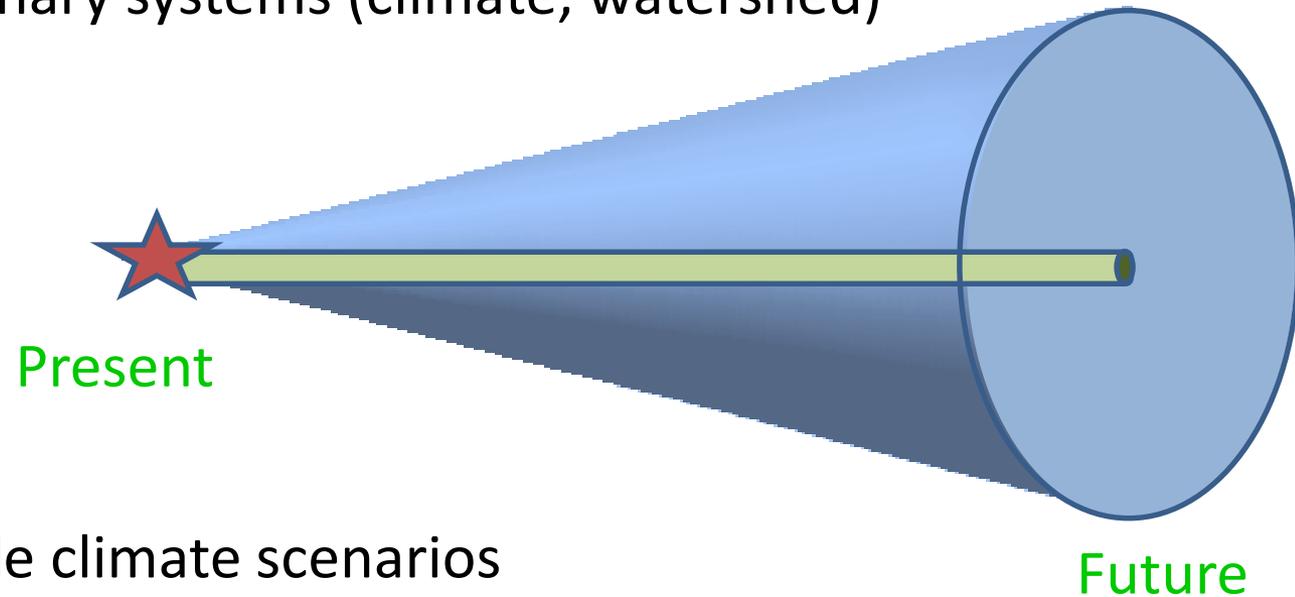
Cylinder of Certainty

- Predict then plan and deterministic thinking
- Uses observed weather and hydrology times series
- Assumes static natural systems (climate, watershed)



Cone of Uncertainty

- Predict then plan and deterministic thinking
- Uses recorded weather and hydrology times series
- Assumes stationary systems (climate, watershed)



- 100's of possible climate scenarios
- Many sources of uncertainty in addition to climate change
- New planning methods

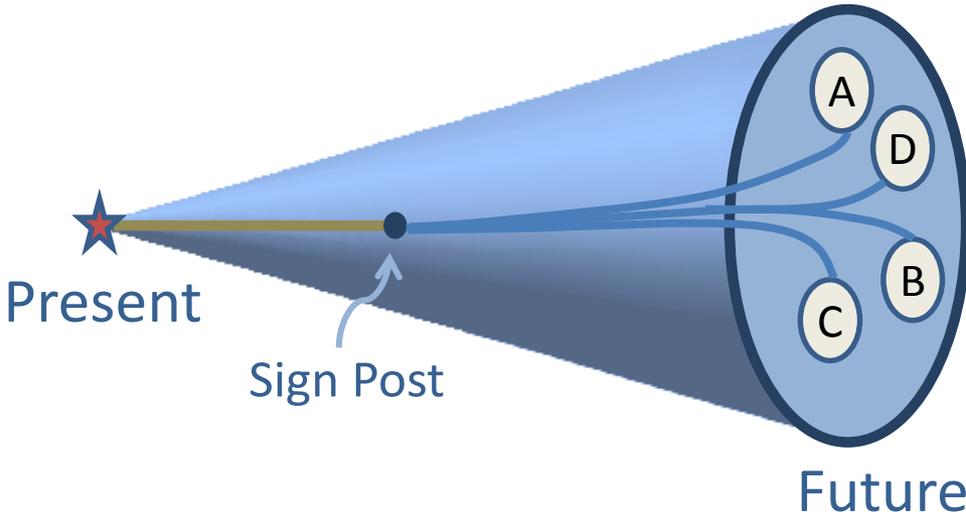
Water Utility Climate Alliance



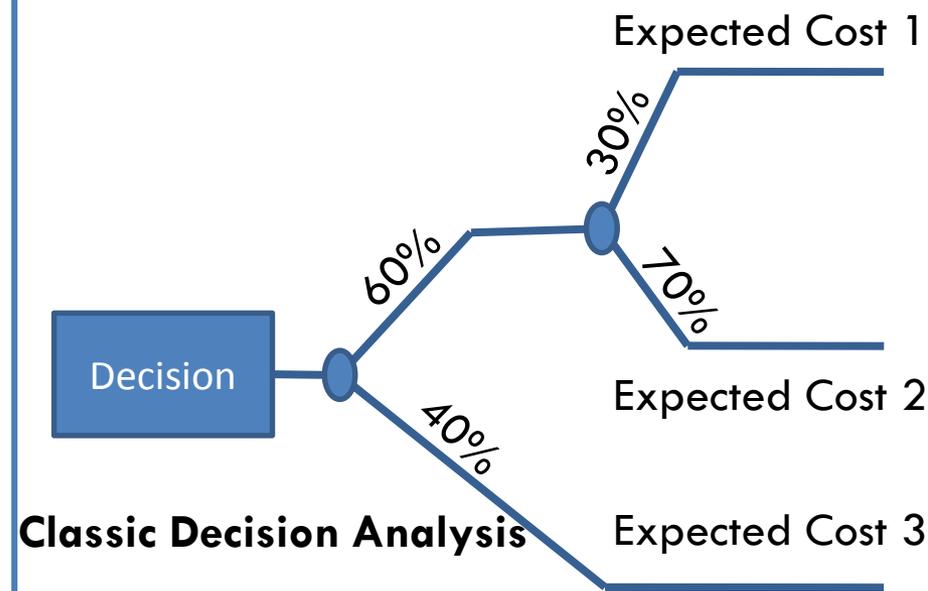
Mission Statement

The Water Utility Climate Alliances provides leadership in assessing and adapting to the potential effects of climate change through collaborative action. We seek to enhance the usefulness of climate science for the adaptation community and improve water management decision-making in the face of climate uncertainty.

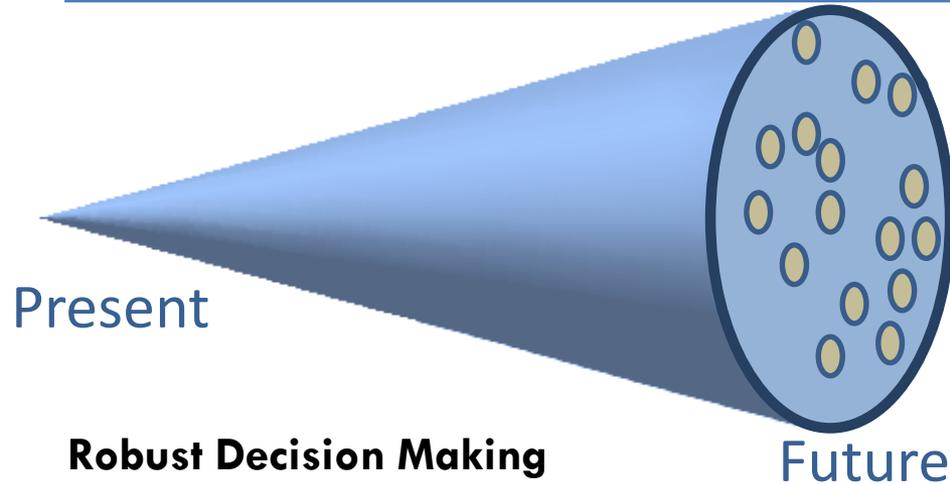
Planning for Multiple Futures



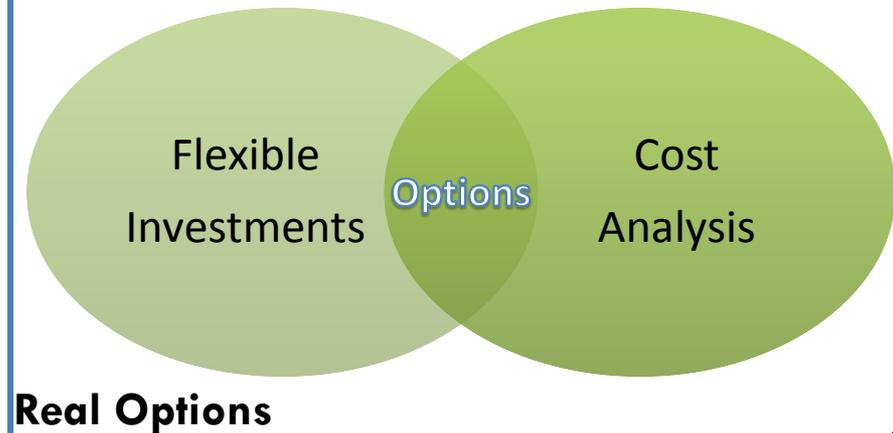
Traditional Scenario Planning



Classic Decision Analysis



Robust Decision Making



Real Options

Case Study White Paper

Deliver practical and relevant examples to water utility planners regarding how climate change information is being incorporated into water utility planning and decision-making

- Explore new methods and applications
 - Stories from the field
 - Learn from each other
 - Push boundaries
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Project Partners



- Water Utility Climate Alliance* (WUCA)
- American Water Works Association (AWWA) via the Water Industry Technical Action Fund*
- Water Research Foundation (WaterRF)
- Association of Metropolitan Water Agencies (AMWA)
- Stratus Consulting

* Project funder

Inquiries

- What prompted the need to change your planning method?
- What approach was chosen and why?
- What barriers were encountered?
- What level of support did you need and how much engagement was there from boards or city councils?
- Have you made decisions based on climate change information?
- How has this changed the way you view long-term planning?
- Did you discover any surprise findings or new ways of thinking about your system?
- Have you been able to change your organizations thinking from static to dynamic in terms of decisions made outside of the planning group or department?

Participants

Candidates Interviewed

1. Tampa Bay Water, FL
2. United Utilities, UK
3. Water Corporation of Western AU, AU
4. Denver Water, CO
5. Central Arizona Project, AZ
6. San Diego County Water Authority, CA
7. Sydney Catchment Authority, AU
8. New York Department of Environmental Protection, NY
9. Inland Empire Utilities Agency, CA
10. U.S. Bureau of Reclamation
11. California Department of Water Resources, CA
12. Little Electric Light and Water Department, MN
13. Southern Nevada Water Authority, NV
14. City West Water, AU
15. Seattle Public Utility, WA
16. Sonoma County Water Authority, CA
17. Massachusetts Water Resources, MA
18. Virginia Tidewater Region, VA
19. Russian River Utility, CA
20. District of Columbia Water and Sewer Authority, D.C.
21. International Upper Great Lakes Study Commission
22. Metropolitan Water District of Southern California, CA
23. Melbourne Water, AU
24. Department of Defense
25. US Forest Service

Case Studies

1. Water Corporation of Western AU
2. Denver Water, CO
3. U.S. Bureau of Reclamation
4. California Department of Water Resources, CA
5. Metropolitan Water District of Southern California, CA
6. Inland Empire Utilities Agency, CA
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10. International Upper Great Lakes Study Commission
11. Sydney Catchment Authority, AU
12. Sonoma County Water Authority, CA
13. Southern Nevada Water Authority, NV

Case Study Highlights

Perth, Australia

Developing a climate independent water supply

US Bureau of Reclamation

Application of Robust Decision Making

CA Department of Water Resources

1. Decision to add Robust Decision Making to their portfolio of tools
2. Formation of a climate technical committee

Metropolitan Water District of Southern California

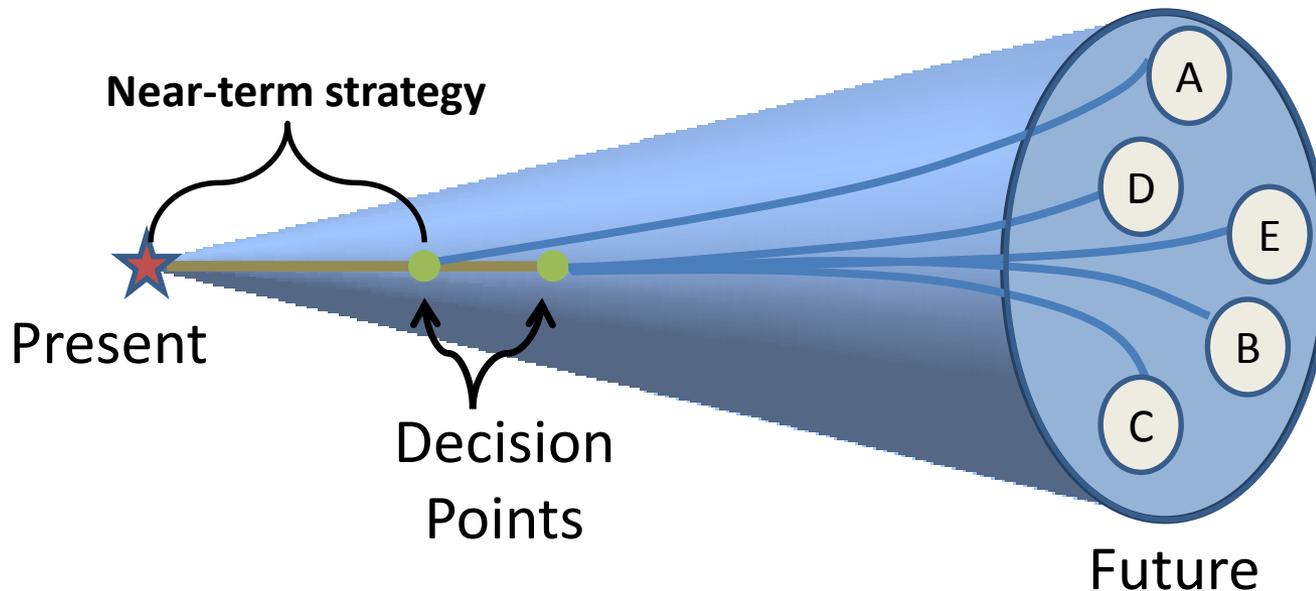
Designing adaptive management triggers with Robust Decision Making

Inland Empire

Comparison of Robust Decision Making and Scenario Planning

Denver Water: Scenario Planning

- **Planning futures represent uncertainties**
- **Near-term strategy to prepare for a range of future conditions**
- **Identifying and preserving options is vital**



Case Study Highlights

United Utilities, UK

1. Planning for more than the median value
2. Working with regulators for flexibility with extractions
3. Upsizing stormwater management

Tampa Bay

Incorporating climate information into operational and seasonal supply decisions

Seattle Public Utilities

Climate adaptation in capital planning with Stage Gate

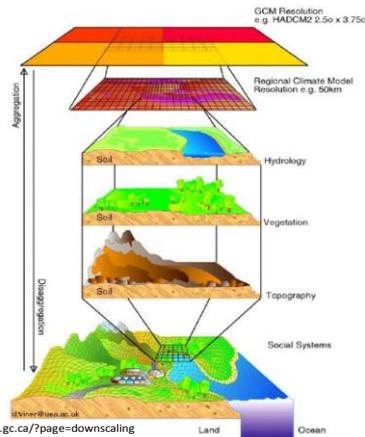


Upper Great Lakes: Decision Scaling



Traditional Approach

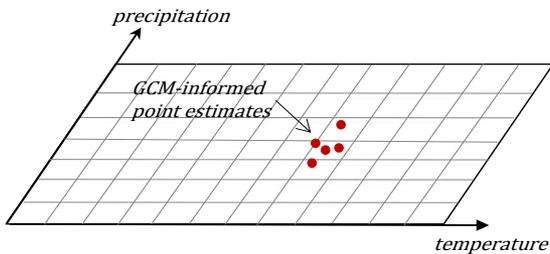
1. Downscale a few climate model projections



2. Generate a few water supply series

<http://www.ccsn.ec.gc.ca/?page=downscaling>

3. Determine whether system performance is acceptable for these series.



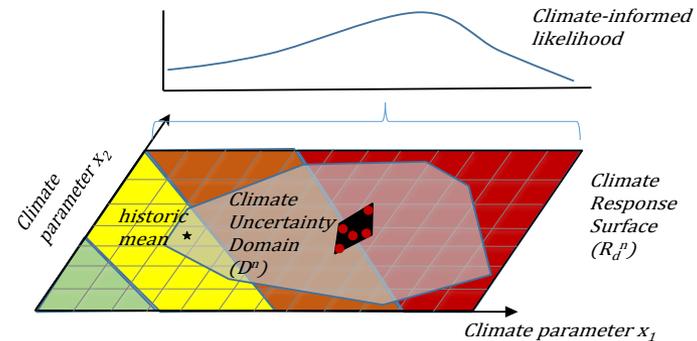
Expected Net Benefits (ENB)

Decision Scaling

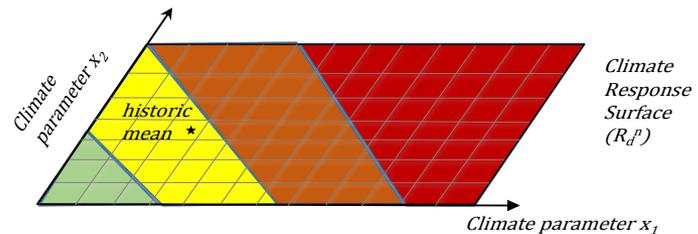
$$Risk\ to\ ENB = \sum_{s=1}^{\Omega} Impact \times Probability$$



3. Determine climate risks to project performance



2. Map climate domain onto vulnerability domain



1. Determine the vulnerability domain



Case Study Highlights

Sydney Catchment Authority

1. Using plausible ranges of future climate conditions
2. A need for more sophisticated modeling and assessments

Sonoma County Water Agency

Working with an independent science review panel

Southern Nevada Water Authority

Testing the CREAT tool



Findings

1. Climate change is being included across scales and processes of utility decisions
 2. Utilities are using scenarios and looking at a range of plausible futures
 3. Stakeholders are being included from the beginning
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Personal Insights

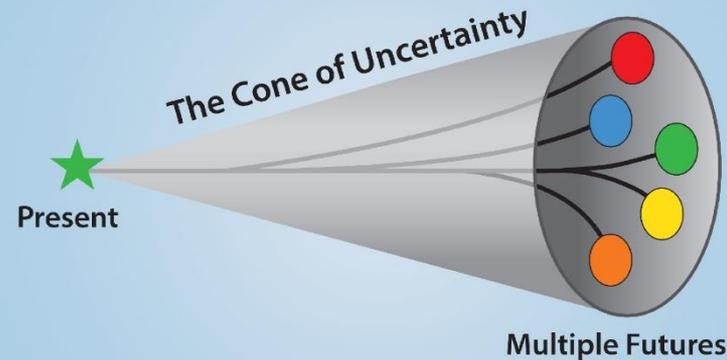
1. There is not a one-size-fits-all approach
2. Pick the parts of the methods and tools that work best for you
3. Adaptive planning = continuous iterations of learning and planning

EMBRACING UNCERTAINTY

A Case Study Examination of How Climate Change
is Shifting Water Utility Planning

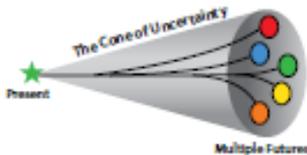
Available at

www.WUCAonline.org



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Prepared for:

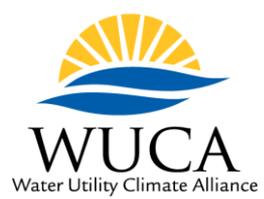
Water Utility Climate Alliance (WUCA)
American Water Works Association (AWWA)
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Association of Metropolitan Water Agencies (AMWA)

Project Manager: Laurna Kaatz, Denver Water

Society for Decision Making under Deep Uncertainty

Learn more: www.deepuncertainty.org

The Society is a multi-disciplinary association of professionals working to improve methods and tools in this field, facilitate their use in practice, and ultimately encourage sound decision making in our rapidly changing world.



Thank You

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www.WUCAonline.org