# *Confronting Climate Change:*

## *An Early Analysis of Water and Wastewater Adaptation Costs*

**2010 Winter Conference**
Transcending Tradition…
The Expanding Roles & Relationships
of the Clean Water Utility


CH2MHILL

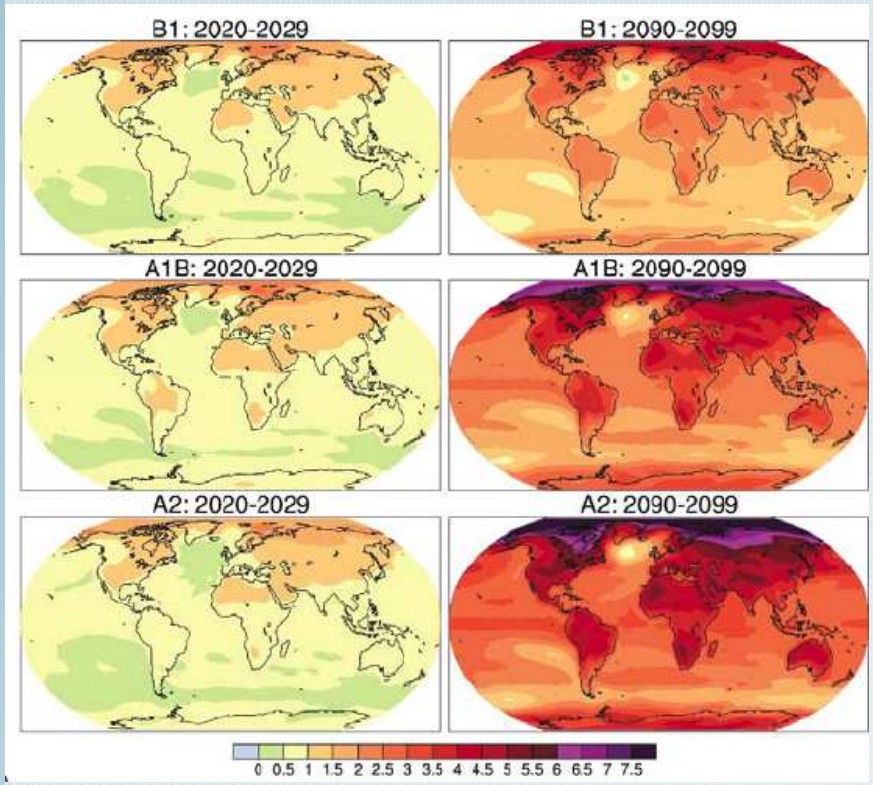
# *Genesis of the analysis*

- Recognition by NACWA and AMWA of climate change challenges to sustainable wastewater and drinking water services
- Need for an early analysis of impacts and an estimate of potential adaptation costs through 2050
- Support for NACWA/California Association of Sanitation Agencies (CASA) testimony to Congress on ***"The Clean Energy Jobs and American Power Act"*** (October 28, 2009)
- Support to help utilities understand climate change challenges and offer a basis for adaptation planning


# *Acknowledging our partners*

- Member Utilities
  - Metropolitan Water District of Southern California
  - Miami-Dade Water and Sewer Department
  - Metropolitan Water Reclamation District of Greater Chicago
  - New York City Department of Environmental Protection
  - Southern Nevada Water Authority
- Utility Reviewers
  - Ed Torres, Orange County Sanitation District
  - Tony Quintanilla, MWRD of Greater Chicago
  - Greg Adams and Sharon Green, Sanitation Districts of Los Angeles County
- The CH2M HILL Team
  - Water community technical experts

# *Climate change effects are here and are projected to grow*




**Projected Temperature Changes (IPCC 2007)**

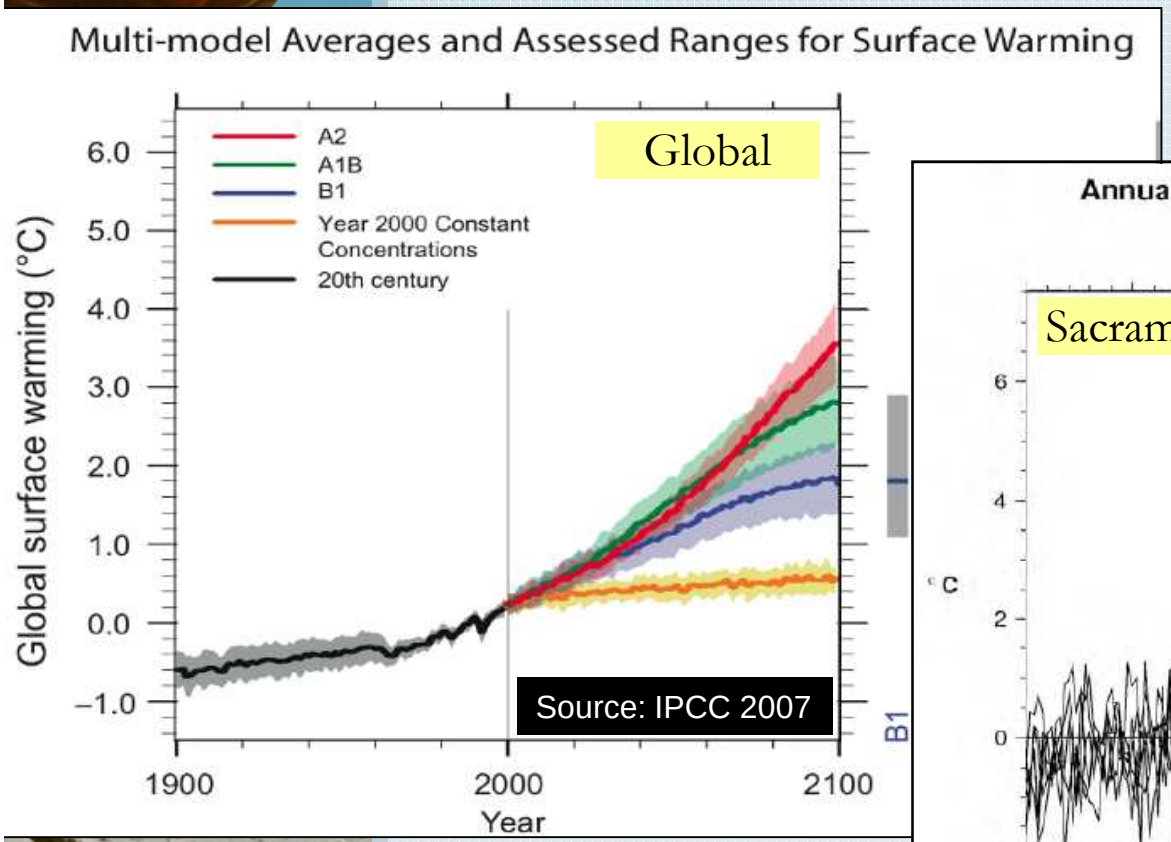
**General climate change effects:**

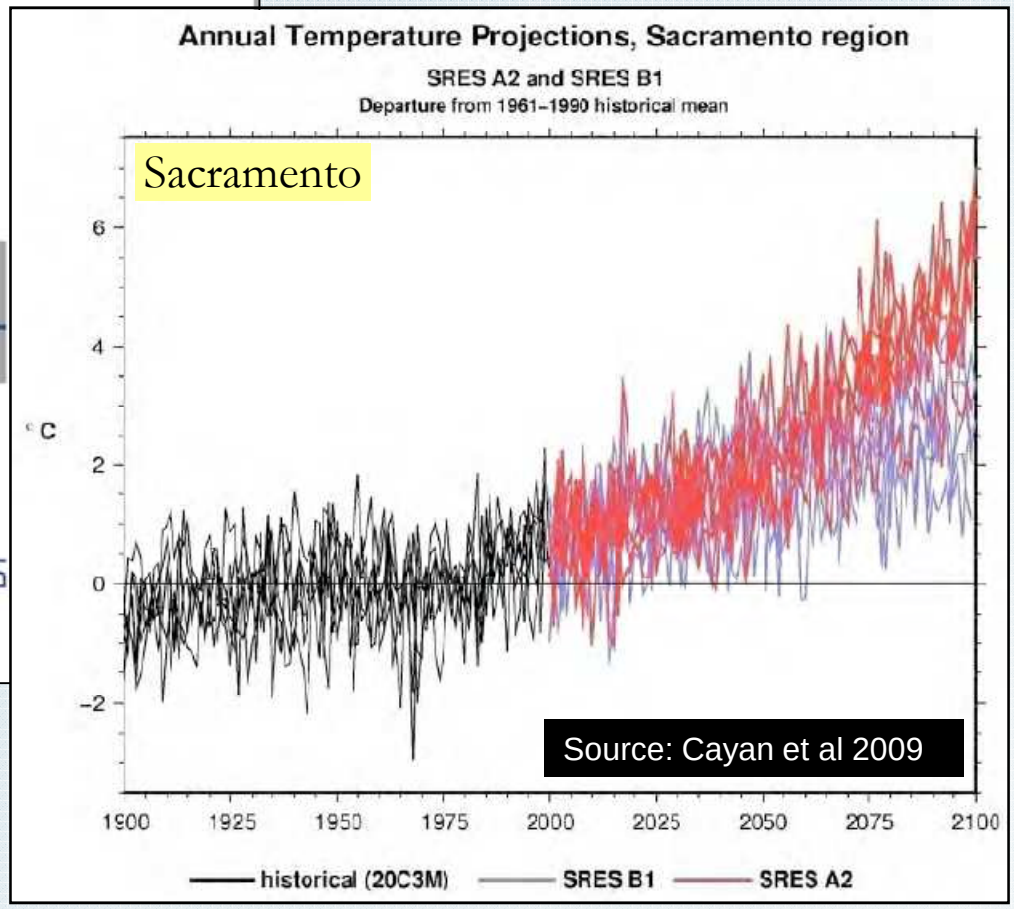
- Changes in temperature
- Changes in precipitation
- Increasing overall uncertainty

**Results:**

- Hydrograph changes
- Drought
- Flood
- Water quality changes
- Fire
- Increased energy costs
- Increased ER&R costs
- Ecosystem degradation

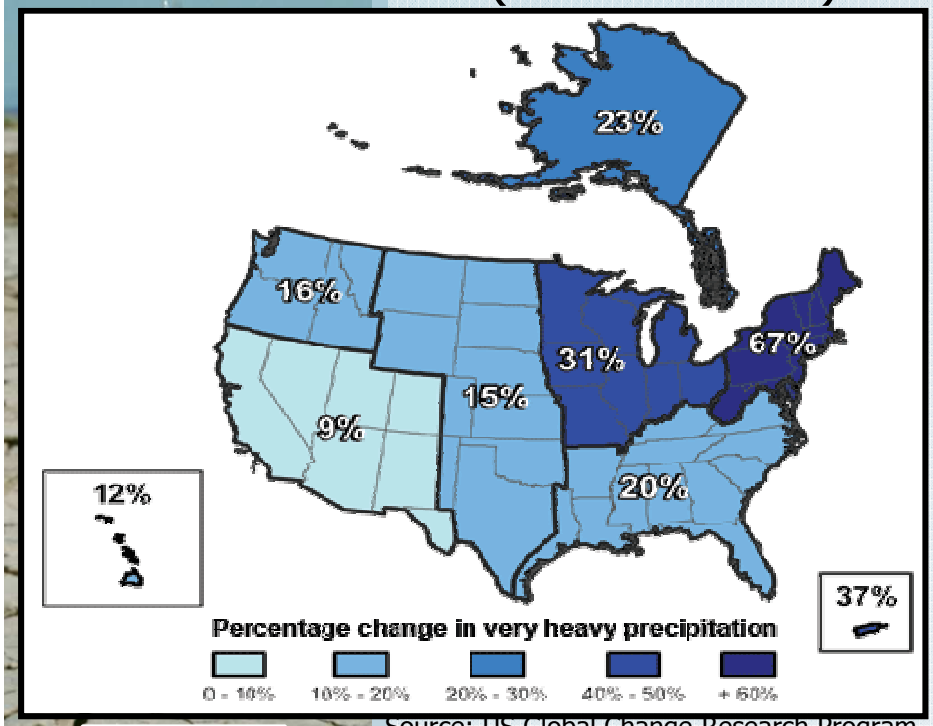
# Climate change effects are here and are projected to grow: Temperature



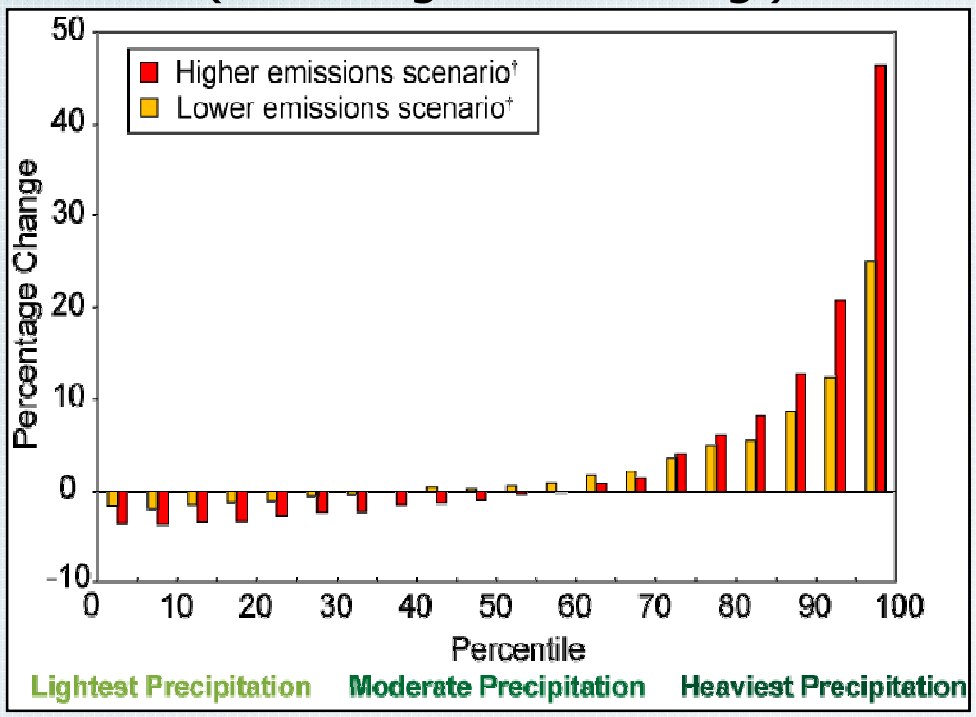

# Climate change effects are here and are projected to grow: Precipitation

Observed Increases in Very Heavy (top 1%) of Daily Precipitation (1958 to 2007)




Source: US Global Change Research Program

Projected Change in Precipitation Intensity (1990 avg. v 2090s avg.)



# Climate change effects create impacts to water and wastewater


# *Assumptions, methods, and tools:*

## *Similar processes for water and wastewater analyses allow comparable results*

- Assessed likely impacts for each U.S. region using projections from readily available models and databases
- Identified potential adaptations for impacts, assumed that utilities will employ a mix of adaptations and that adaptations will be customized by region, including coastal areas
- Developed cost estimates for potential adaptation mixes based on detailed cost assumptions for water and wastewater individually, then rolled them up to regional costs
- Reviewed and revised according to reviewer utility, NACWA, and AMWA feedback


# *Assumptions, Methods, and Tools:*

## *Simplifying assumptions and consistent methods are key to early cost estimates*

- 2009-2050 timeframe
- Public utility systems only; capital, operation, and maintenance costs
  - General distribution and sizes of utilities is constant
- 2 emission scenarios—3 GCMs, generally
  - Medium and high emission scenarios combined with appropriate General Circulation Models (GCMs) provide the basis for projections of future temperature and precipitation
- Climate scientists "comparabilized" available data for consistent assessment
- Temperature and precipitation projections translated to expected impacts per region

# *Assumptions, Methods, and Tools:*

## *Some costs are excluded*

- Increased incidence of and costs for Emergency Response and Recovery activities
- Costs to local, state, and federal agencies for modifying planning, implementing infrastructure adaptations not directly related to water and wastewater utilities
- Detailed cost estimates for Green Infrastructure adaptations
- Larger societal and human health costs for potential loss of water supply and sanitation services, including environmental costs, costs to agriculture and industry
- $500B in estimated infrastructure needs already identified by EPA not specifically related to climate change

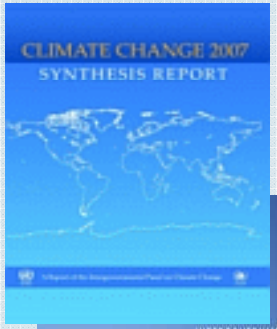
# Assumptions, Methods, and Tools:

## *Compressed time-frame requires rapid analysis through accessible tools*

The Nature Conservancy

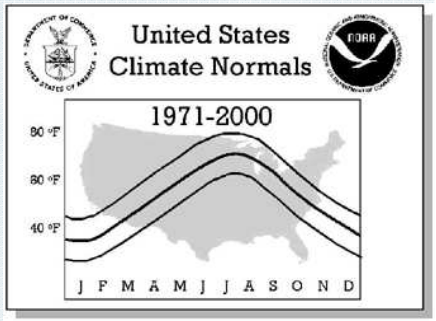
ClimateWizard


US Global Change Research Program
www.usgcrp.gov




ipcc
INTERGOVERNMENTAL PANEL ON climate change
WMO UNEP

National Climatic Data Center
U.S. Department of Commerce




CLIMsystems

SimCLIM

NACWA

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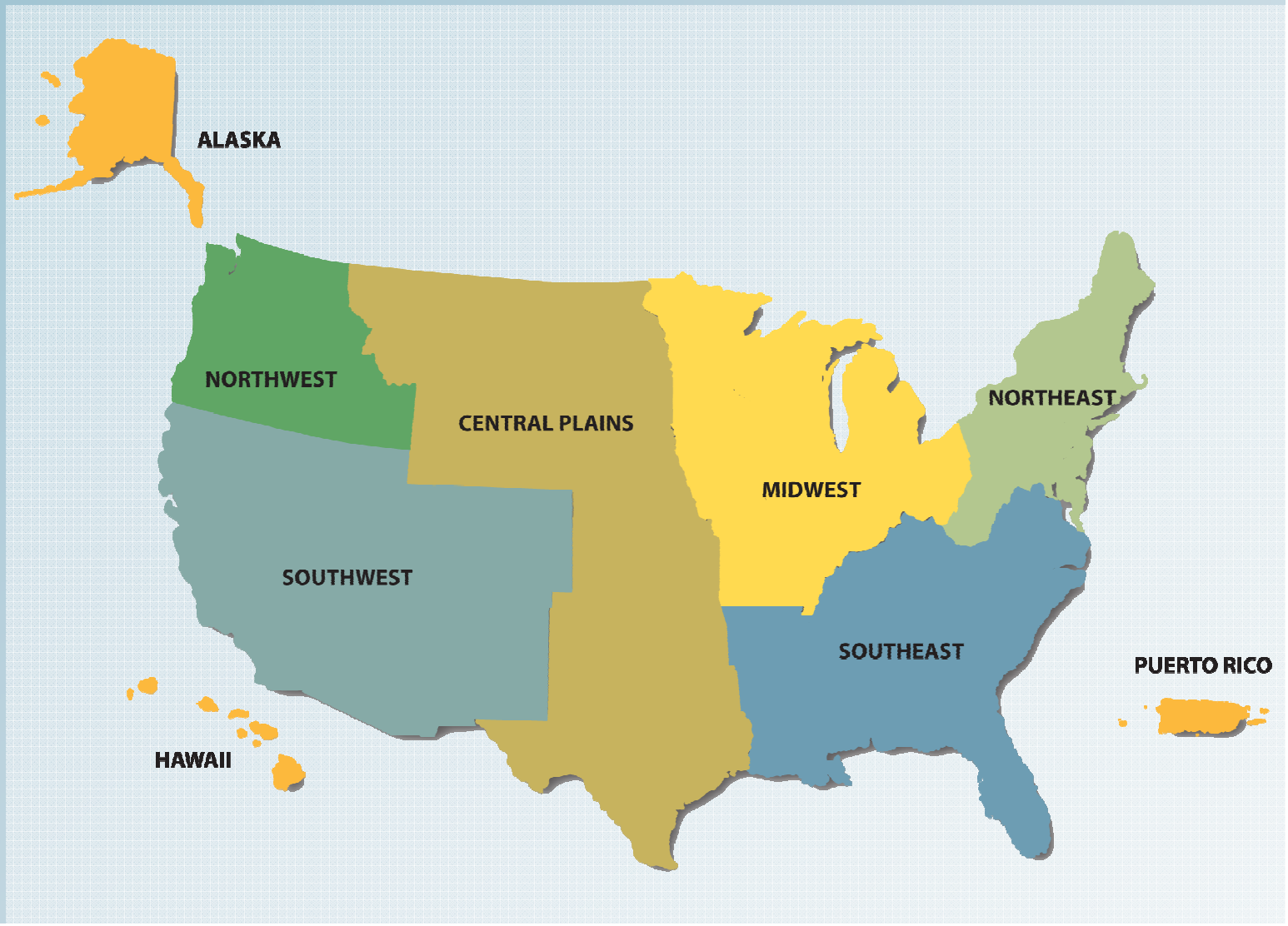
NACWA, AMWA, and multiple other utility and population data sources

# Assumptions, Methods, and Tools:

## U.S. Global Climate Research Group regions were adapted to databases and projected impacts

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# *Results:*

## *Summary of projected drinking water impacts*

- Source water impacts
  - Quantity of runoff
  - Timing of runoff
  - Seawater intrusion to aquifers
- Treatment impacts
  - Quality of runoff
  - Changes in maximum temperature
    - Toxicity and T&O problems
  - Regulatory changes
- Infrastructure flood protection
  - Sea level rise, storm surge and inland flooding

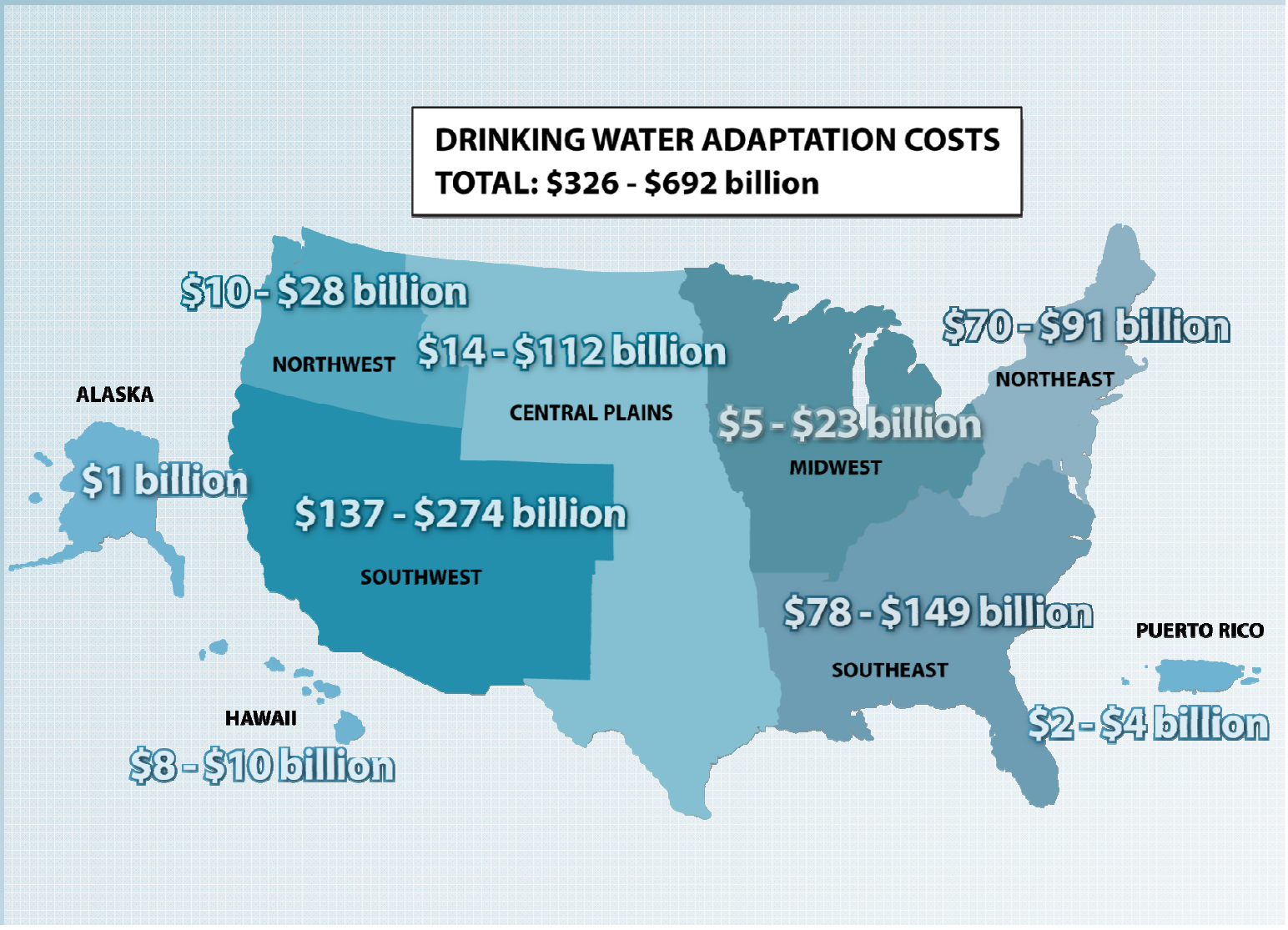
# *Results:*

## *Summary of potential drinking water adaptations*

- Source water adaptations
  - Diversify water management portfolio
  - Increased conservation/demand management
  - Additional and integrated sources
    - Integrated water cycle planning
    - Reuse
    - Desalination
    - Shifting between surface and ground sources
    - Increased storage/conveyance
- Treatment adaptations
  - Additional treatment
    - Filtration
    - With more marginal sources, microfiltration and reverse osmosis
- Infrastructure flood protection
  - Levees and sea walls, relocation of especially vulnerable infrastructure

# Results:

## *Early estimated range of drinking water costs for climate change adaptation through 2050*

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# Results:

## *Summary of projected wastewater impacts*

- Increased wet weather impacts
  - Changes in frequency and intensity of extreme storm events with need to reduce infiltration and inflow into sewers
  - Regulatory changes
- Effluent water quality impacts
  - Changes in maximum temperature and other environmental variables
  - Regulatory changes
- Infrastructure and Operations flood protection impacts
  - Sea level rise and storm surge in coastal areas
    - Outfall elevations
  - Increased inland flood events
    - Critical infrastructure and service at risk

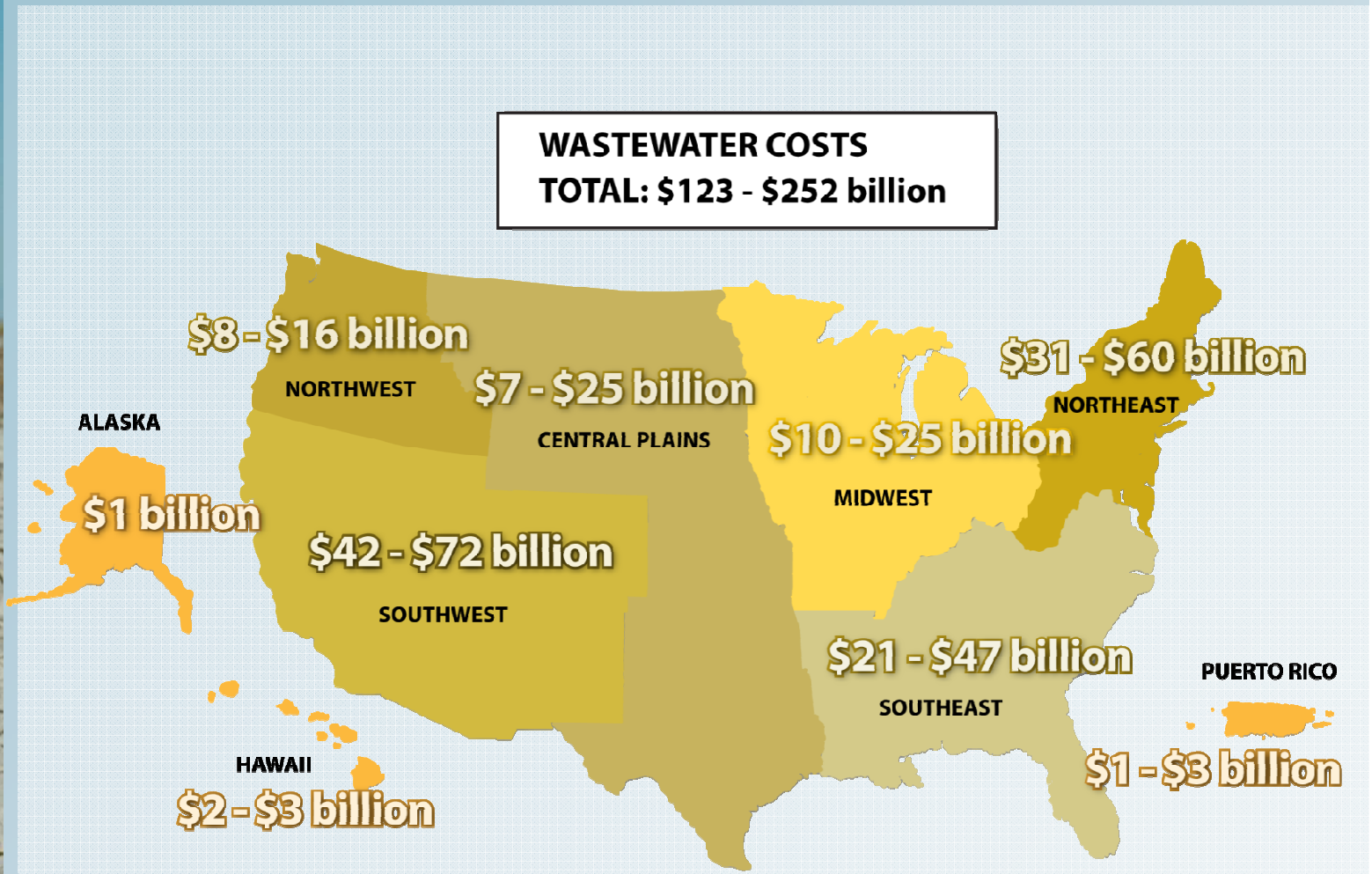

# Assumptions, Methods, and Tools:

## *Summary of potential wastewater adaptations*

- Increased wet weather impacts
  - Assess potential CC impacts during CSO and other wet weather infrastructure planning
  - Cooperation among stormwater , wastewater, and other planning agencies-integrated water cycle planning
  - Combined green (for site specific runoff) and grey infrastructure solutions
- Effluent water quality impacts
  - Potential cooling of effluent by various means
    - Wetland treatment
    - Riparian restoration
    - Mechanical, evaporative, blending options
- Infrastructure and Operations flood protection impacts
  - Levees and seawalls
  - Effluent pumping
  - Worst case scenario, infrastructure relocation

# Results:

## Early estimated range of wastewater costs for climate change adaptation through 2050

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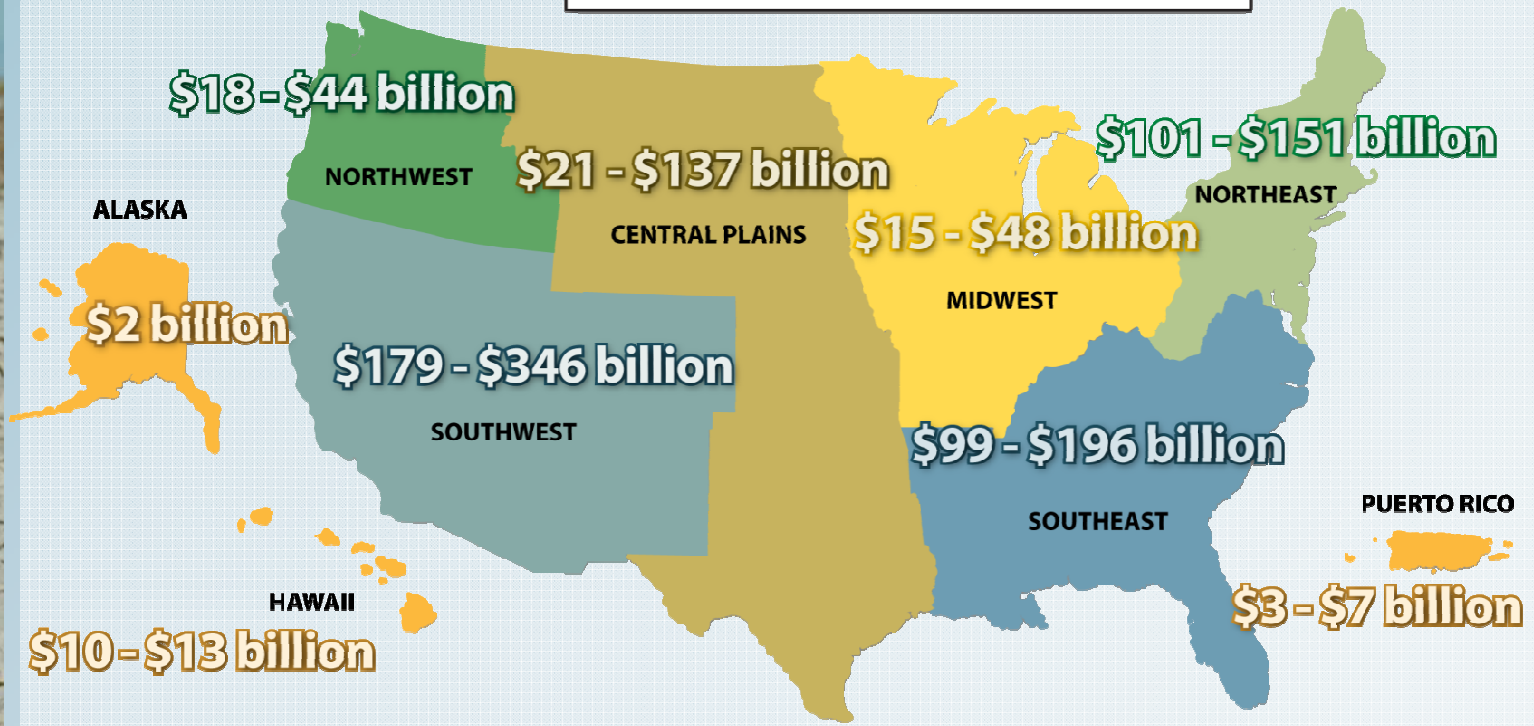
# Results:

## Combined early estimated range of drinking water and wastewater costs for climate change adaptation through 2050

**SUMMARY**
*Drinking Water = $325 - $692 billion*
*Wastewater = $123 - $252 billion*

**GRAND TOTAL**
*Drinking Water*
*and Wastewater = $448 - $944 billion*




Does not include $500B in estimated infrastructure needs already identified by EPA not specifically related to climate change

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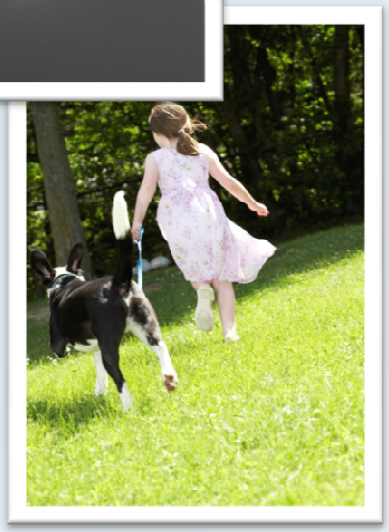
# *Considerations and qualifiers for climate change adaptation planning*

- Climate change uncertainty and model uncertainty
  - Science is evolving rapidly, but climate change continues to bring us surprises
  - Models are models, not hard numbers and not guarantees of future events
- Many adaptations can increase energy demand
  - Conventional energy sources increase GHG footprint; alternative renewable solutions are emerging
  - Integration between GHG management and potential adaptation options could lead to more efficient and cost effective outcomes
- Not all utilities will require all identified adaptations
  - For example, start with developing a phased portfolio of adaptations, focusing on "no regrets" options
- Climate change risk assessment and planning can be integrated with other water planning
  - Uncertainty is inherent in all water management planning; affects precision, but should not delay overall planning
  - Customized local and regional climate change risk assessment can focus planning and drive longer term sustainable water management

# *What's Next?*

- Build on positive Congressional response
- Increase interest in adaptation planning for utilities
- Continue to improve understanding of climate change impacts and adaptation costs

# Questions?

*Follow-up questions to:*
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