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Managing Water in the West

Talk 3:

What tools are available to help us address climate change in our Mission Areas?

U.S. Department of the Interior
Bureau of Reclamation

Outline

- **Focus on same five Mission Communities (Talk 2)**
- **Identify existing tools that support Mission Area activities, including high-level steering, assessments, data, and training**

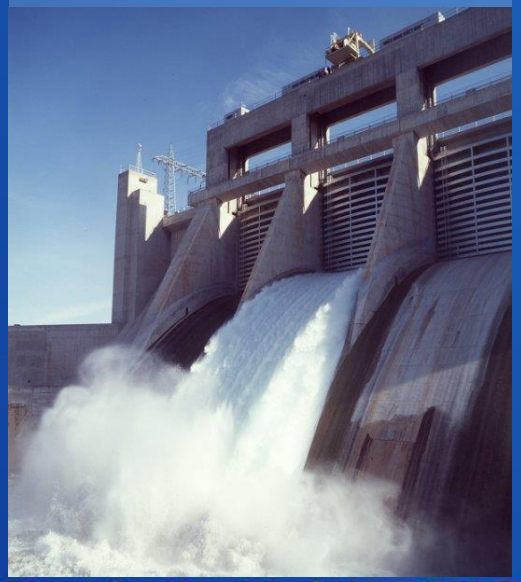
Example Mission Communities

Infrastructure Management

Species Recovery and Adaptive Management

Long-Term Planning

Reservoir Operations



Dam Safety

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Existing Tools

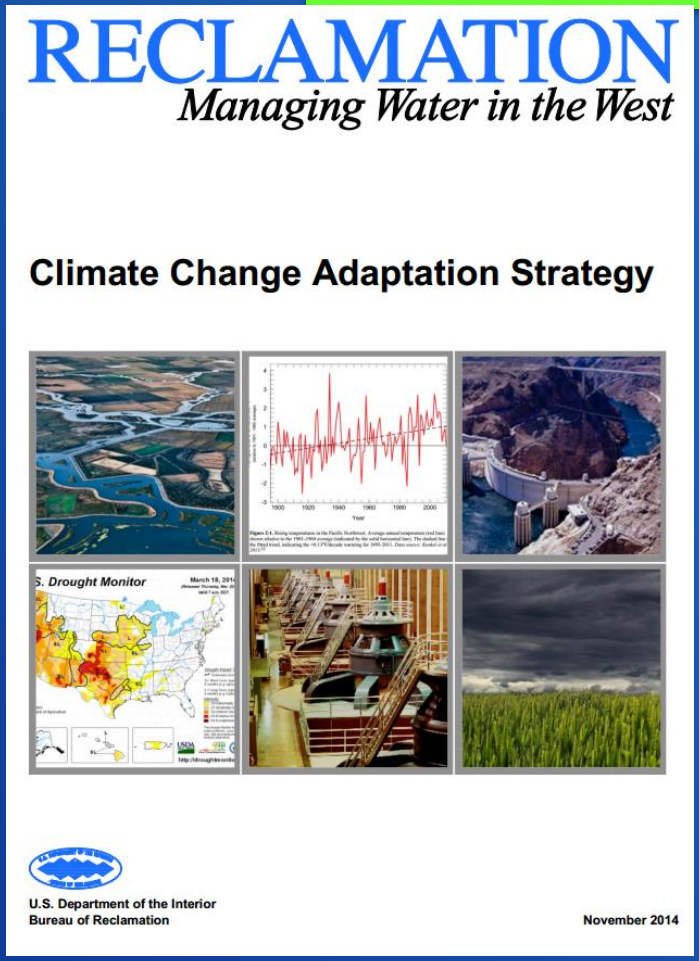
- High-level Steering
  - Strategy
  - Policy
- Assessment Resources
  - WaterSMART: Basin Studies
  - Science and Technology (S&T) Program Literature Syntheses
  - WaterSMART: West-Wide Climate Risk Assessment (WWCRA) Reports
- Technical Tools
  - S&T: Climate and Hydrology Projections ==> change scenarios
  - Guidance: Planning, Infrastructure Mngt, Dam Safety, Res Ops

  … building on Pilots to inform Guidance
- Training
  - S&T: Climate Training Pilots

Strategy

Solid: likely applicable
Dashed: maybe applicable
probably less so

- **Builds on past activities**
- **Indicates how we can pursue mainstreaming where it makes sense**
- **Strategic Goals**
  - **Increase Water Management Flexibility**
  - **Enhance Climate Adaptation Planning**
  - **Improve Infrastructure Resiliency**
  - **Expand Information Sharing**



http://www.usbr.gov/climate/docs/ClimateChangeAdaptationStrategy.pdf

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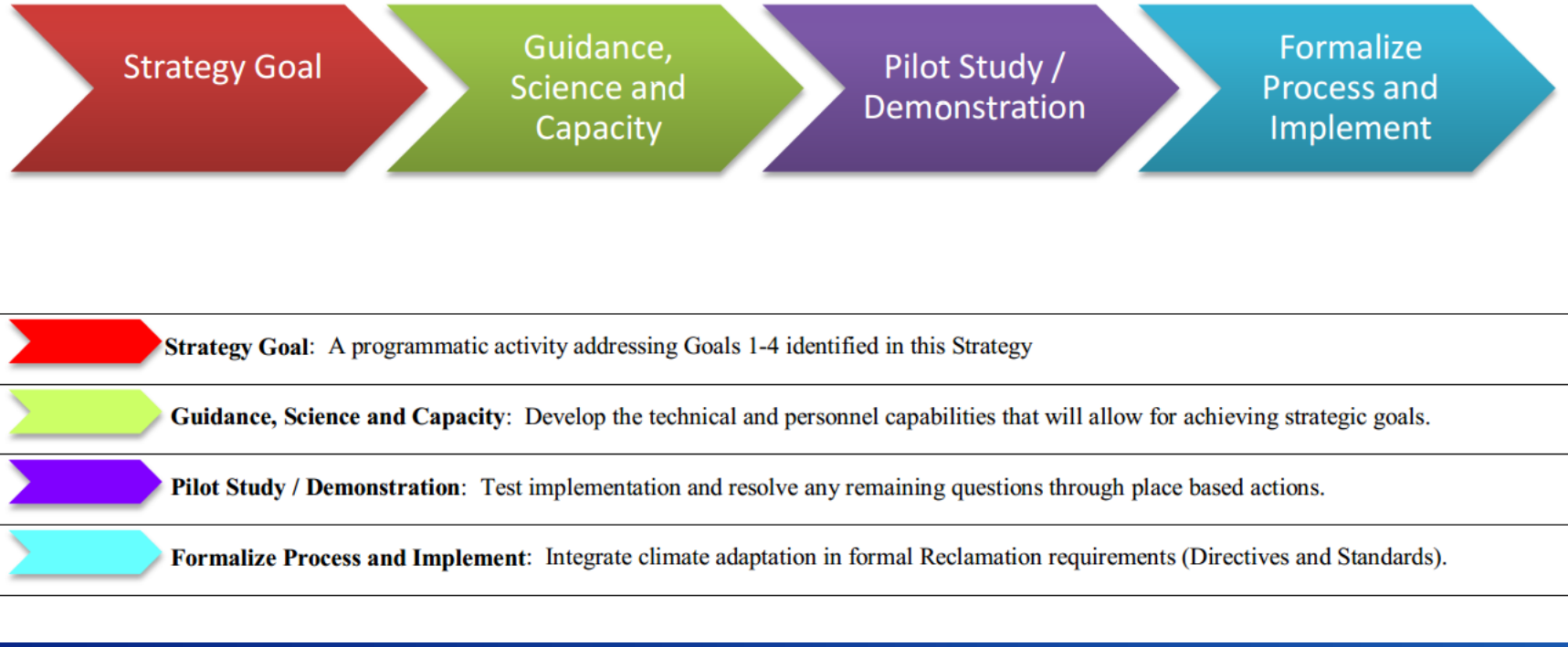
Strategy



Strategy Goal: A programmatic activity addressing Goals 1-4 identified in this Strategy

Guidance, Science and Capacity: Develop the technical and personnel capabilities that will allow for achieving strategic goals.

Pilot Study / Demonstration: Test implementation and resolve any remaining questions through place based actions.

Formalize Process and Implement: Integrate climate adaptation in formal Reclamation requirements (Directives and Standards).

http://www.usbr.gov/climate/docs/ClimateChangeAdaptationStrategy.pdf

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Strategy

Table 1: Goals and Implementation Actions

Goals	Implementation Actions		End Goals
1. Increase Water Management Flexibility	• **High Priority:** Reservoir Operations Pilot Initiative	• **Reservoir Operations Pilot Initiative** • Research and demonstration to improve canal lining and water treatment technology • Implementation of Adaptation Actions through WaterSMART Grants • Continued Support for water reuse and recycling projects through Title XVI • Optimizing hydropower production	• Conserve water, increase water delivery efficiency, and generate new sources of water to increase flexibility of supplies. • Identify opportunities to adapt reservoir operations to improve flexibility • Increase hydropower efficiency to optimize power generation and increase renewable energy development
2. Enhance Climate Adaptation Planning	• **High Priority:** Enhanced Basin Studies and WWCRA Impact Assessments	• **Enhanced Basin Studies and WWCRA Impact Assessments** • Research to advance understanding of climate impacts to extreme events and ecosystems • Drought Response Program • Expanded General Planning • Climate Change Training	• Incorporate climate change information into planning policy and guidance • Increase climate adaptation efforts across several mission areas, including delivery of water and power and maintaining ecosystems • Develop climate adaptation strategies
3. Improve Infrastructure Resiliency	• **High Priority:** Dam Safety Climate Change Assessments Pilots	• **Dam Safety Climate Change Assessment Pilots** • Western Watershed Enhancement Partnership • Climate-resilient infrastructure replacement, repair and renovations	• Ensure the longevity of Reclamation's infrastructure and support climate resilient infrastructure investments
4. Expand Information Sharing	• **High Priority:** Improve access to water and hydropower data	• **Improve access to water and hydropower data** • Coordinate climate adaptation activities with partners and stakeholders.	• Support Reclamation's partners in adapting to climate change

Reclamation Policy

- **Response to Department Manual requirement for bureaus to have climate change adaptation policy**
  - **523 DM 1**
- **Supports mainstreaming where it makes sense**

DOI 523 DM 1
http://elips.doi.gov/elips/0/doc/3741/Page1.aspx

New! Reclamation Policy
CMP-P16 released March 20, 2015
www.usbr.gov/recman/cmp/cmp-p16.pdf

Reclamation Manual
Policy

Subject:	Climate Change Adaptation
Purpose:	Address climate change impacts upon the Bureau of Reclamation's mission, facilities, operations, and personnel. This benefit of this Policy is it ensures compliance with Departmental Manual (DM) 523 DM 1.
Authority:	Executive Order (EO) 13514, *Federal Leadership in Environmental, Energy, and Economic Performance* (October 5, 2009); EO 13653, *Preparing the United States for the Impacts of Climate Change* (November 1, 2013); Council on Environmental Quality's Implementing Climate Change Adaptation in Accordance with EO13514 *Federal Leadership in Environmental, Energy, and Economic Performance* (March 4, 2011); and 523 DM 1 *Climate Change Policy.*
Approving Official:	Commissioner
Contact:	Science Advisor (91-10000)

Other Federal High-level Steering: Principles, Requirements and Guidelines

Principles and Requirements (finalized March 2013):

- **Guiding Principles**
  - **Healthy and resilient ecosystems**
- **General Requirements**
  - **Risk and Uncertainty - Climate Change**
  - **Water Use**
- **https://www.whitehouse.gov/administration/eop/ceq/initiatives/PandG**

Interagency Guidelines (finalized December 2014):

- **Projecting future conditions of the study area**
  - **Climate Change and Climate Variability**

PR&G took effect on June 15, 2015
DOI Agency Specific Procedures should be finalized soon

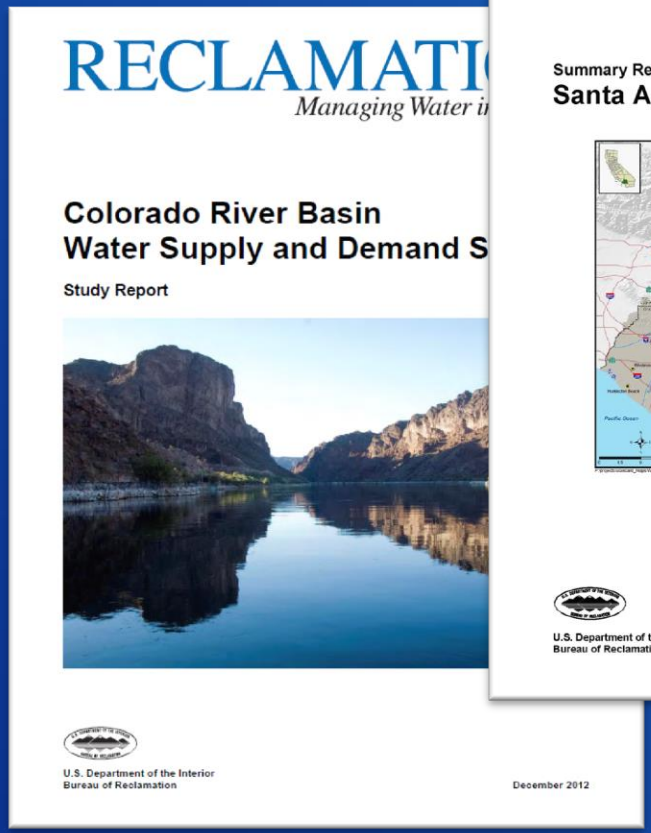
Other Federal High-level Steering: NEPA Guidance

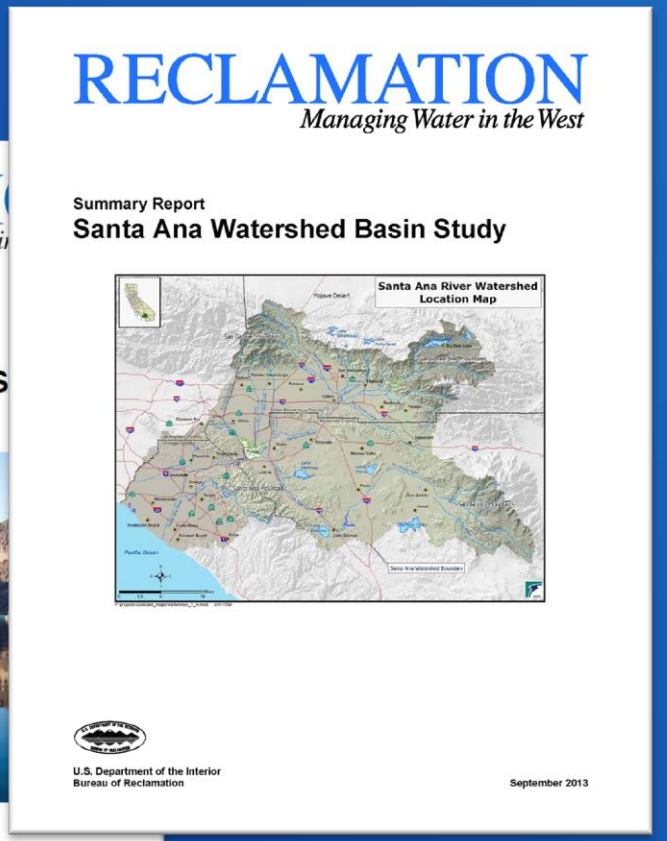
- **Draft CEQ Guidance (12/2014): "Revised Draft Guidance for Federal Departments and Agencies on Consideration of Greenhouse Gas Emissions and the Effects of Climate Change in NEPA Reviews"**
  - https://www.whitehouse.gov/sites/default/files/docs/nepa_revised_draft_ghg_guidance_searchable.pdf
  - In addition to agencies considering the potential effects of a proposed action on climate change, the draft guidance states that agencies should consider "the implications of climate change for the environmental effects of a proposed action." (Section I, page 3)
  - Also, "Inherent in NEPA and CEQ Regulations is a rule of reason which ensures that agencies are afforded the discretion, based on their expertise and experience, to determine whether and to what extent to prepare an analysis based on the availability of information, the usefulness of that information to the decision-making process and the public, and the extent of the anticipated environmental consequences." (Section II(A) page 5)

WaterSMART: Basin Studies

- **Similar to Appraisal-level Studies**
  - **Estimate future water supplies and water demands under climate change.**
  - **Assess vulnerabilities for future operations and/or infrastructure.**
  - **Develop options to address future vulnerabilities.**

- **Seven funded LC studies since 2009**





http://www.usbr.gov/WaterSMART/bsp/studies.html

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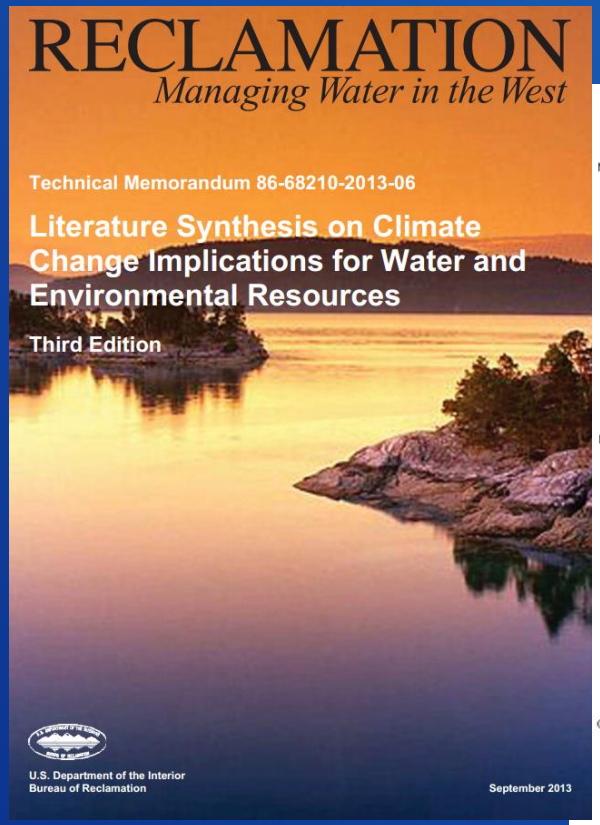
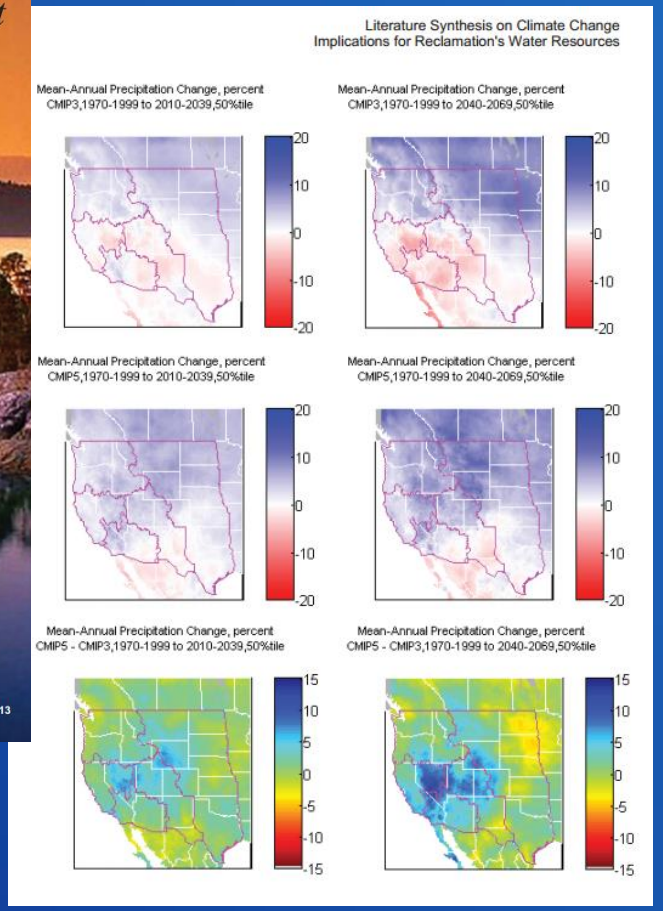
S&T Literature Syntheses

Boiler-plate narratives for planning documents: Region-specific summaries on historical climate trends, observed impacts, and projected future changes. Includes glossary of terms.

Maps for qualitative descriptions of future climate change (region-specific, westwide)

Updated every few years.





http://www.usbr.gov/climate/docs/ClimateChangeLiteratureSynthesis3.pdf

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WaterSMART Reports:
WWCRA Surface Water Hydrology Impacts

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SECURE Water Act
Section 9503(c) – Reclamation
Climate Change and Water
2011

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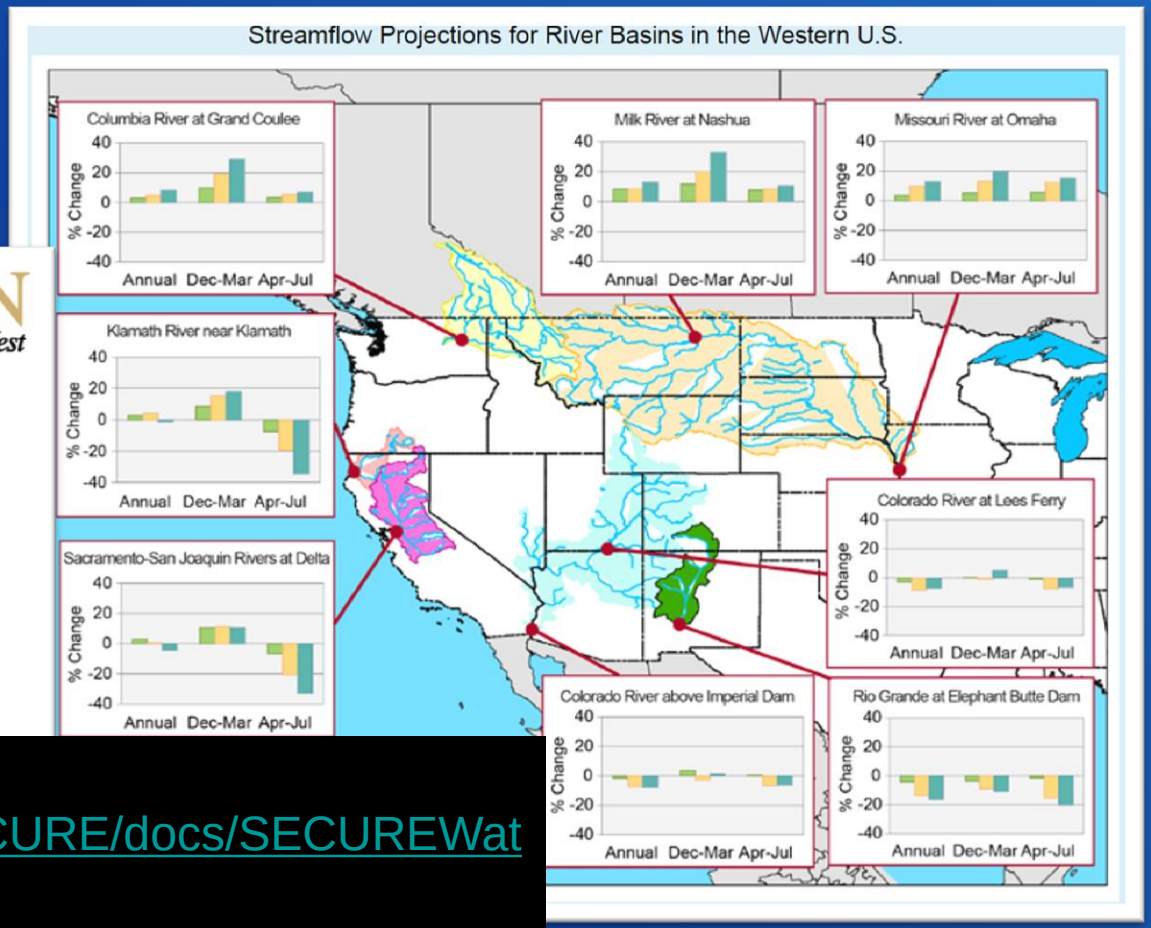
Technical Memorandum No. 86-68210-2011-01

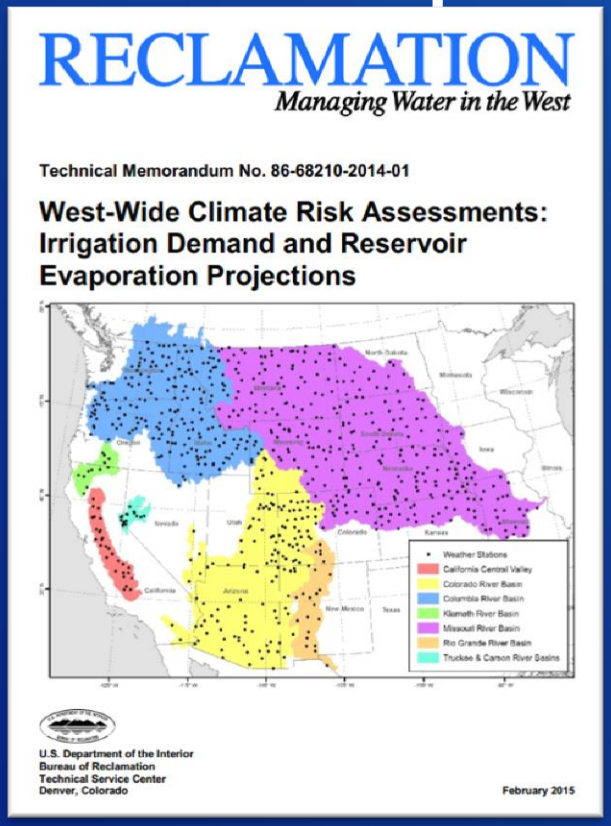
West-Wide Climate Risk Assessments: Bias-Corrected and Spatially Downscaled Surface Water Projections



SECURE Report 2011:
http://www.usbr.gov/climate/SECURE/docs/SECUREWaterReport.pdf

WWCRA Hydrology Report 2011:
http://www.usbr.gov/WaterSMART/docs/west-wide-climate-risk-assessments.pdf

WaterSMART Reports:
WWCRA Water Demand and Reservoir Evaporation Impacts



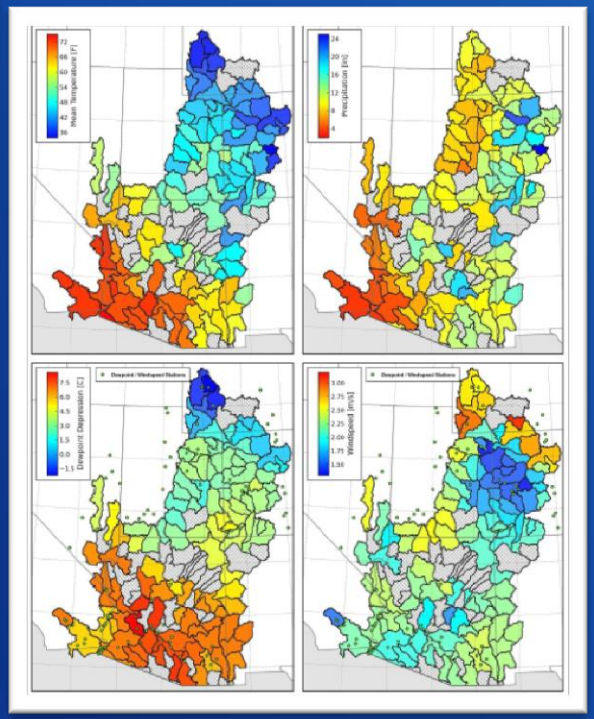
RECLAMATION
Managing Water in the West

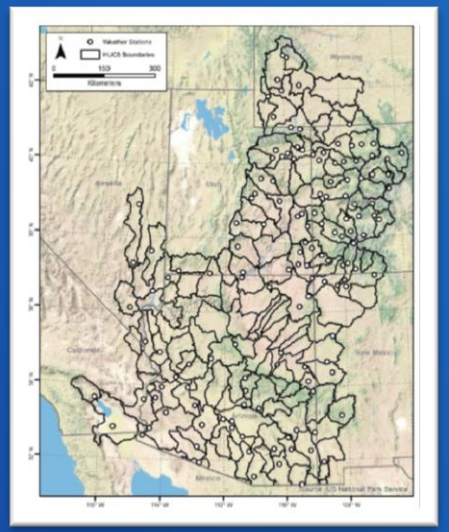
Technical Memorandum No. 86-68210-2014-01

West-Wide Climate Risk Assessments: Irrigation Demand and Reservoir Evaporation Projections

U.S. Department of the Interior
Bureau of Reclamation
Technical Service Center
Denver, Colorado

February 2015





http://www.usbr.gov/WaterSMART/wcra/docs/irrigationdemand/WWCRAdemands.pdf

Irrigation Demand: Analysis at small basin-scale, for range of future climates
Reservoir Evaporation: Site-specific projected trends with uncertainty

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WaterSMART Reports: Basin Impacts Assessment

- **Includes first two items of Basin Study scope**
  - **Estimate future water supplies and water demands under climate change**
  - **Assess vulnerabilities for future operations and/or infrastructure.**
  - **Develop options to address future vulnerabilities.**

- **Foundation for next-step efforts (e.g., developing and evaluating adaptation strategies)**

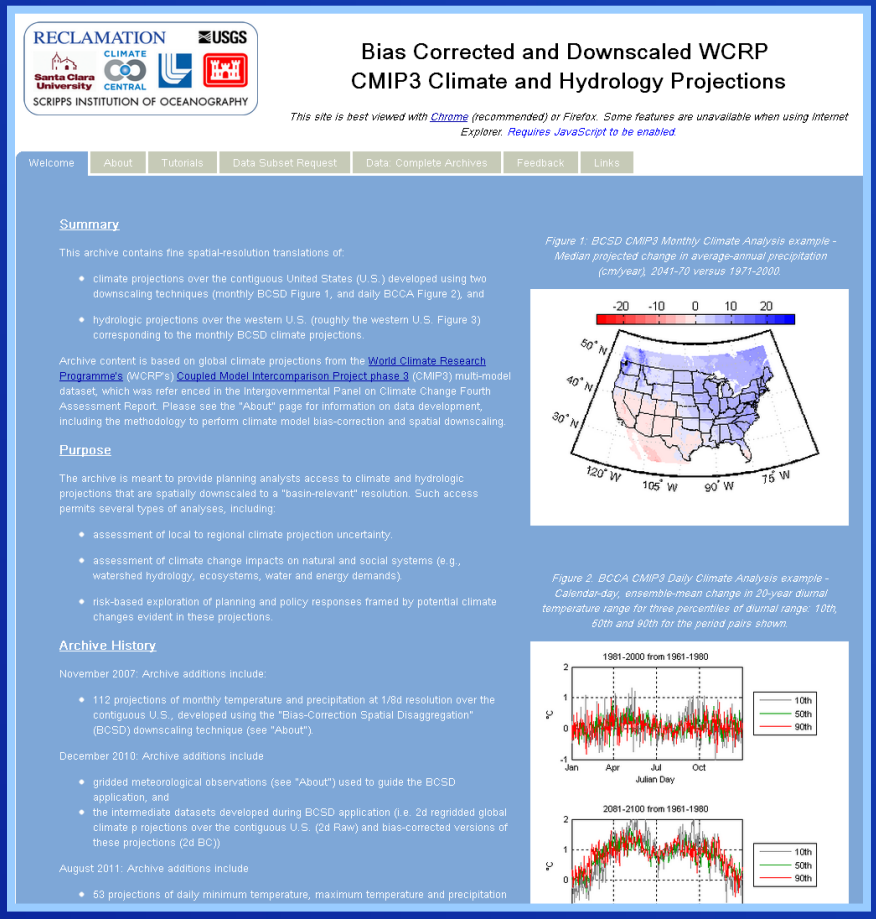
- ***No Impacts Assessments conducted for LC to-date; efforts have focused on Basin Studies.***

http://www.usbr.gov/WaterSMART/wcra/docs/ssjbia/ssjbia.pdf

S&T: Downscaled Climate and Hydrology Projections for local-scale assessment

http://gdo-dcp.ucllnl.org/downscaled_cmip_projections/dcpInterface.html

- **CMIP3**
  - Climate, monthly (BCSD), 2007
    - 16 GCMs
    - up to 3 emissions per GCM, multiple runs
    - 112 projections
    - **1950-2099, NLDAS, 1/8º**
  - **Climate, daily (BCCA), 2011**
    - **9 GCMs**
    - **3 emissions**
    - **57 projections**
    - **{1961-2000, 2046-2065, 2081-2100}, NLDAS, 1/8º**
  - **Hydrology (extend from BCSD), 2011**
    - **same attributes as BCSD CMIP3**
    - **only western U.S. coverage**
    - **Serve (a) monthly water balance variables, and (b) daily forcings and gridded runoff**



RECLAMATION USGS
Santa Clara University CLIMATE CENTRAL
SCRIPPS INSTITUTION OF OCEANOGRAPHY

Bias Corrected and Downscaled WCRP CMIP3 Climate and Hydrology Projections

This site is best viewed with Chrome (recommended) or Firefox. Some features are unavailable when using Internet Explorer. Requires JavaScript to be enabled.

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Summary

This archive contains fine spatial-resolution translations of:

- climate projections over the contiguous United States (U.S.) developed using two downscaling techniques (monthly BCSD Figure 1, and daily BCCA Figure 2), and
- hydrologic projections over the western U.S. (roughly the western U.S. Figure 3) corresponding to the monthly BCSD climate projections.

Archive content is based on global climate projections from the World Climate Research Programme's (WCRP's) Coupled Model Intercomparison Project phase 3 (CMIP3) multi-model dataset, which was refer enced in the Intergovernmental Panel on Climate Change Fourth Assessment Report. Please see the "About" page for information on data development, including the methodology to perform climate model bias-correction and spatial downscaling.

Purpose

The archive is meant to provide planning analysts access to climate and hydrologic projections that are spatially downscaled to a "basin-relevant" resolution. Such access permits several types of analyses, including:

- assessment of local to regional climate projection uncertainty.
- assessment of climate change impacts on natural and social systems (e.g., watershed hydrology, ecosystems, water and energy demands).
- risk-based exploration of planning and policy responses framed by potential climate changes evident in these projections.

Archive History

November 2007: Archive additions include:

- 112 projections of monthly temperature and precipitation at 1/8d resolution over the contiguous U.S., developed using the "Bias-Correction Spatial Disaggregation" (BCSD) downscaling technique (see "About").

December 2010: Archive additions include

- gridded meteorological observations (see "About") used to guide the BCSD application, and
- the intermediate datasets developed during BCSD application (i.e. 2d regridded global climate p rojections over the contiguous U.S. (2d Raw) and bias-corrected versions of these projections (2d BC))

August 2011: Archive additions include

- 53 projections of daily minimum temperature, maximum temperature and precipitation

Figure 1. BCSD CMIP3 Monthly Climate Analysis example - Median projected change in average-annual precipitation (cm/year), 2041-70 versus 1971-2000.

Figure 2. BCCA CMIP3 Daily Climate Analysis example - Calendar-day, ensemble-mean change in 20-year diurnal temperature range for three percentiles of diurnal range: 10th, 50th and 90th for the period pairs shown.

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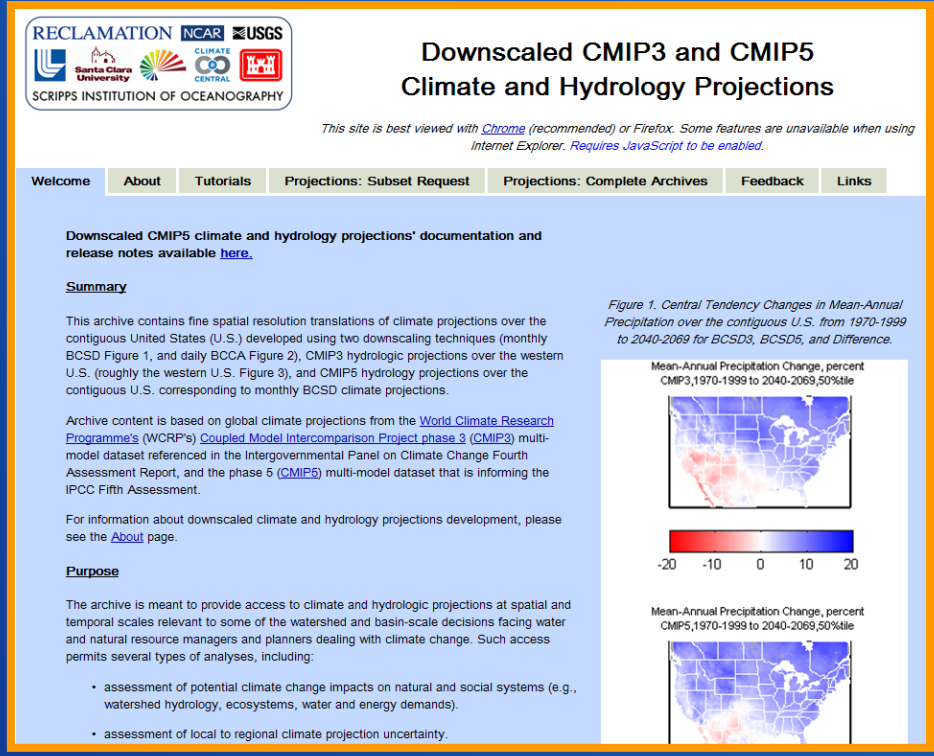
S&T: Downscaled Climate and Hydrology Projections for local-scale assessment

http://gdo-dcp.ucllnl.org/downscaled_cmip_projections/dcpInterface.html

- **CMIP5**
  - Climate, monthly (BCSD), 2013
    - 37 GCMs
    - **up to 4 emissions per GCM, multiple runs**
    - 234 projections
    - **1950-2099, NLDAS, 1/8º**
  - **Climate, daily (BCCA), 2013**
    - **21 GCM subset from BCSD CMIP5**
    - **up to 4 emissions per GCM, multiple runs**
    - **134 projections**
    - **1950-2099, NLDAS, 1/8º**
  - **Hydrology (extend from BCSD), 2014**
    - **31 GCM subset from BCSD CMIP5**
    - **up to 4 emissions per GCM, first run only**
    - **99 projections**
    - **same other attributes as BCSD**
    - **CONUS + Canadian portions of Columbia and Missouri River Basins**
    - **Serve (a) monthly water balance variables, and (b) daily forcings and gridded runoff**



Coming in FY15: New Climate Projections using new daily method from Scripps (LOCA)

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Guidance: Climate Change in Feasibility Studies

- **Supports implementation of Reclamation CMP09-02, which requires effects of climate change to be considered in future without-project condition.**

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Technical Guidance for Incorporating Climate Change Information into Water Resources Planning Studies

D&S:
http://www.usbr.gov/recman/cmp/cmp09-02.pdf
Guidance:
http://www.usbr.gov/WaterSMART/wcra/docs/WWCRATechnicalGuidance.pdf

U.S. Department of the Interior
Bureau of Reclamation

September 2014

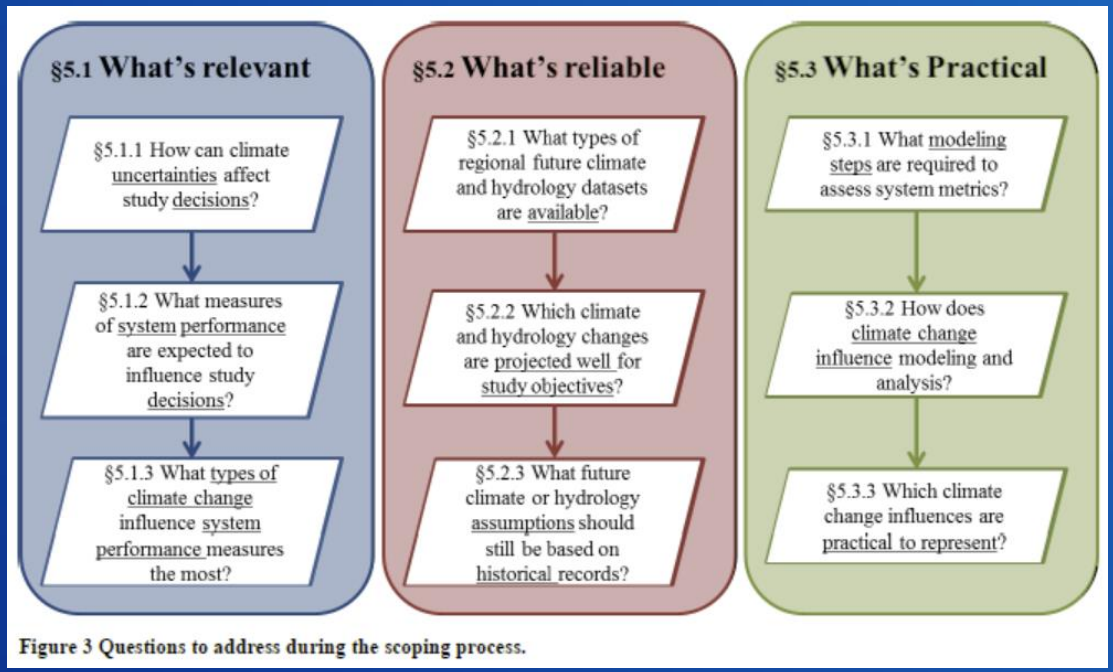

Figure 3 Questions to address during the scoping process.

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Pilots → Guidance: Infrastructure Management

- **FY15 Pilot: Integrate Climate Change into Extraordinary Maintenance (XM) planning**
  - **inform project development**
  - **add to set of criteria already informing projects selection**
- **FY16: Pilot lessons learned → inform implementation guidance**

- **FY 15 Pilot Stages**

1) Choose XM project for pilot activities	*Consider project adaptability and cost-share*
2) Select climate change criteria	*Consult internal design experts and Climate leads (WWCRA); assemble pH group*
3) Integrate criteria into Project Development	*Discuss design sensitivity to climate change criteria (e.g., flow, pH); review trends; judge which information is applicable*
4) Evaluate criteria impacts on Project Development	*Consider changes in design specs, costs, and performance*
5) Integrate criteria into projects selection process.	*Consider current project-selection criteria, how they're weighed, and adding climate change criteria to the mix*

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Pilots → Guidance: Dam Safety

Pilot: Screening Level Studies (2015)

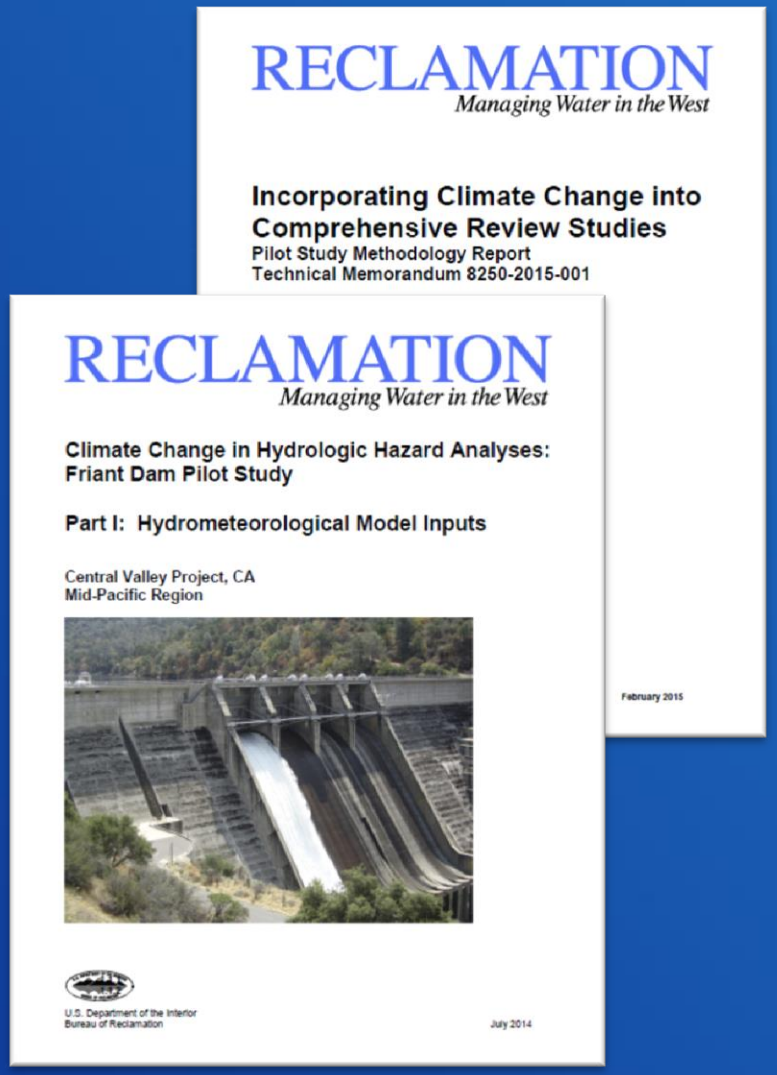
- Explore potential changes in average monthly streamflow for use in screening level studies

Pilot: Issue Evaluation Level Study, "Climate Change in Hydrologic Hazard Analyses: Friant Dam Pilot Study"

- Volume 1 – Hydrometeorological Model Inputs (2014)
- Volume 2 - Using the SEFM with Climate-Adjusted Hydrometeorological Inputs (*in review*)

Future Activities:

- Pilots: Hydrologic Hazard Analysis at Taylor Park Dam, CO; other basins with unique flood mechanisms and climate; also interested in piloting information use in decision-support
- Further Guidance Development: for three types of studies (Screening Level, Issue Evaluation, and Corrective Action)



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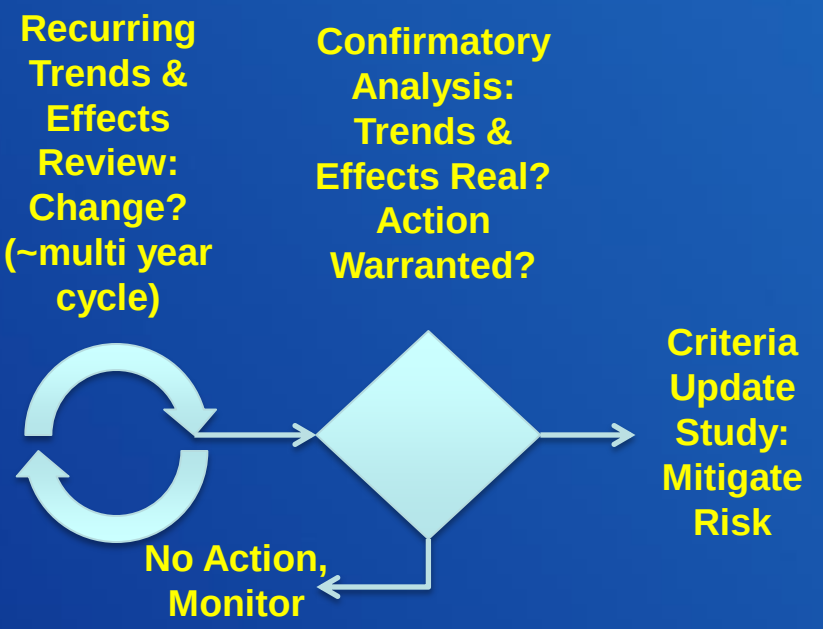
Pilots → Guidance: Reservoir Operations Criteria Update

- SECURE Reservoir Operations Team *
  - All Regions, Policy, TSC, and R&D
- Goals
  - Develop process to inform criteria updates in a changing climate
  - Pilot draft processes
  - Improve adaptation fitness through better use of forecast information in ops

Develop process similar to Dam Safety Risk Management Process (three phases)



* Contact: Katharine Dahm (Policy)

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S&T Climate Training Pilots (partners: CCAWWG, COMET)

Climate Change and Water Working Group

- Defining User Needs, Developing Research Strategy
- Fostering collaborative R&D
- **Developing Climate Change Training Capacity**
- Hosting Workshops on Emerging Topics (e.g., Nonstationarity, Portfolio of Assessment Approaches)

www.ccawwg.us

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What/Who is UCAR COMET?

http://comet.ucar.edu/

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S&T Climate Training Pilots (partners: CCAWWG, COMET)

- **Drivers**
  - pre-2011: CCAWWG recognition of limited staff expertise
  - October 2011, NAP Action 21
  - December 2012 (for Reclamation), DOI Climate Change Policy

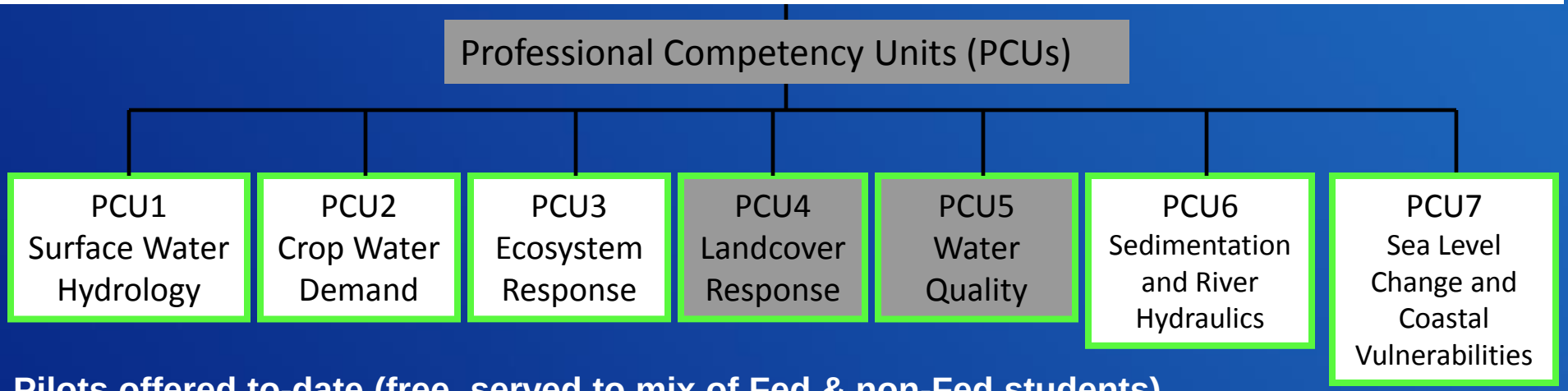
- **Approach**
  - Focus (for now) on building technical staff expertise
  - Develop and Pilot new Professional Development Series (PDS), “Assessing Natural Systems Impacts under Climate Change”
  - Develop Business Model for Sustained Delivery of PDS

- **Support from:**
  - Reclamation, USACE, NOAA-RISA, UCAR COMET

Technical Audiences Professional Development Series (PDS)

Assess Climate Change Impacts on Natural Systems

High level objective: To increase the ability of technical practitioners (like water resource analysts) to incorporate climate change information in the studies they conduct that inform water and water related resource management decisions.



<u>Pilots offered to-date</u> (free, served to mix of Fed & non-Fed students)

- 2012: "Preparing Hydroclimate Inputs…" (prerequisite for all PCUs, applies to any impacts subject; online self-paced; 100+ students to-date)
- 2013: PCU1, resident (27 students); PCU2, resident (22 students)
- 2014: PCU1, virtual (58 students, 30+ remote locations)
- 2014: PCU3 - Water Temperature, resident
- 2015: PCU6 – Sedimentation and River Hydraulics, resident

<u>Planned pilots</u>

- 2015: PCU1 virtual (again)
- 2016: PCU7 resident, others virtual

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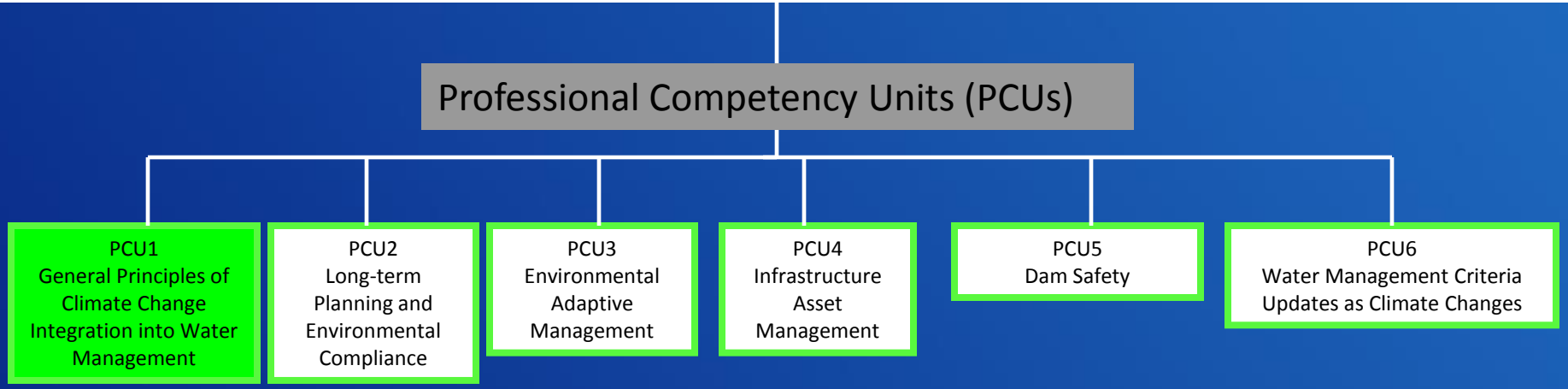
General-Audiences Professional Development Series: *Integrating Climate Change Adaptation into Water and Environmental Resources Management*

High level objective: Help general water resources practitioners integrate climate change adaptation into their water and water-related organizations' activities.



PCU1 is for all PDS audiences and serves as a pre-requisite for other PCUs.

Planned pilots (tentative)

- **Phase I (FY2015-2016): PCU1, PCU2, and planning for other PCUs.**
- **Phase II (new agreement, to be determined): remaining PCUs.**

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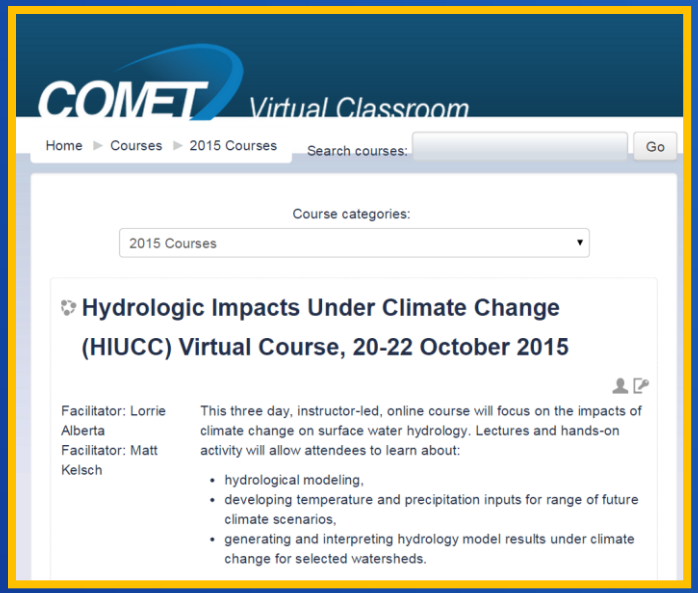
S&T Climate Training Pilots (partners: CCAWWG, COMET)

- **NEXT OFFERING!**
- **Hydrologic Impacts under Climate Change, October 20-22, 2015**
- **Learn about:**
  - **hydrological modeling,**
  - **developing hydrology model inputs for range of future climate scenarios,**
  - **generating and interpreting hydrology model results under climate change for different watersheds**

Free tuition for Reclamation students, no travel required, technical series

(http://courses.comet.ucar.edu/course/index.php?categoryid=37)



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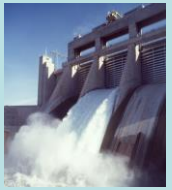
Tool	Long-Term Planning	Species Recovery / Adaptive Management	Infrastructure Management	Dam Safety	Reservoir Operations
					
Strategy	**X**	**X**	**X**	**X**	**X**
Policy	**X**	**X**	**X**	**X**	**X**
Basin Studies	**X**	**X**	?		**X**
S&T Literature Synthesis	**X**	**X**	?	?	**X**
WWCRA Supply	**X**	**X**	?	?	**X**
WWCRA Demand	**x**	?	?	?	**X**
WWCRA Impacts	**X**	**X**	?		**X**
S&T Climate and Hydrology Data	**X**	**X**	**X**	**X**	**X**
Guidance	**X**	partial, see Long-Term Planning	partial, see Long-Term Planning	partial, see Long-Term Planning	partial, see Long-Term Planning
Ongoing Pilots → inform Guidance			**X**	**X**	**X**
Training – Technical	some developed, more coming	some developed, more coming	some developed, more coming	some developed, more coming	some developed, more coming
Training – General	In development	In development	In development	In development	In development

Questions?

Tool	Contacts
Strategy	Avra Morgan (aomorgan@usbr.gov), David Raff (draff@usbr.gov)
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