Agenda

• Study Purpose and Background
• Impacts Assessment
• Trade-off Analysis
• Key Findings
San Diego Basin Study Objectives

1. Determine how climate change will impact the water supply system

2. Develop structural and non-structural adaptation strategies to manage climate change impacts
San Diego Basin Study Overview

• Project time frame April 2015 – September 2019
• Total project cost $2.1 million
  – $1 M Bureau of Reclamation
  – $759,460 SD IRWM Program Prop 50
  – $300,000 City of San Diego
• Project managed by the Bureau of Reclamation and City of San Diego
San Diego Basin Study Participants

• Project Management
  – Reclamation Southern California Area Office
  – City of San Diego

• Technical Team
  – Reclamation Lower Colorado Region Engineering Services Office
  – Reclamation Denver Technical Services Center
  – Reclamation Mid-Pacific Region Planning Group
  – City of San Diego
  – San Diego County Water Authority
  – CH2M/Jacobs

• Study Technical Advisory Committee (STAC)

• Public Stakeholders
  – IRWM RAC
  – IRWM Stakeholder List
San Diego Basin Study Tasks & Status

- Water Supply and Water Demand Projections (Task 2.1)
- Downscaled Climate Change and Hydrologic Modeling (Task 2.2)
- Existing Structural Response and Operations Guidelines Analysis (Task 2.3)
- Structural and Operations Concepts (Task 2.4)
- Trade-Off Analysis and Opportunities (Task 2.5)
- Final Report and Executive Summary Report (Task 2.6)

Final reports can be found at: https://www.usbr.gov/lc/socal/basinstudies/SDBasin.html

Complete Report & Submit for Approval August 2019
Planning for the Future

- Basin Study Motivation: Complexities + Demands + Climate Change

- Do Nothing (Baseline) → Negative Consequences
  - Increased water shortages

- Do Something → Reduced Impacts
  - Questions/Constraints
    - Cost
    - Complexity of implementation
    - Effects on environment, community
    - Effects on other aspects of water system (flooding, recreation, energy)

- Basin Study Findings
  - Strengths and weaknesses of various approaches
  - Diverse supply options can put the region on a positive path to the future
Study Area: Many Complexities
# Climate Change

## Mean Changes in Temperature and Precipitation for All RCPs and Models

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### Central Tendency

- **Hot-Dry**
- **Hot-Wet**
- **Warm-Dry**
- **Warm-Wet**

### Diagram

The diagrams illustrate the distribution of temperature and precipitation changes for different scenarios. The graphs show the central tendency and variability for the 2020s and 2050s across RCP 4.5 and RCP 8.5, highlighting the shifts in climate conditions due to climate change.
Water Demands

Current and Future Climate Gross Demand Volume for All Portfolios

- Current climate
- Central Tendency
- Hot-Dry
- Hot-Wet
- Warm-Dry
- Warm-Wet

Demand Year:
- 2015 Demands
- 2025 Demands
- 2050 Demands

Average Annual Gross Demand Volume [AF]
Concepts for Water Supply/ Water Management

- Conveyance Improvement
- Drought Restriction/Allocation*
- Enhanced Conservation
- Firm Water Supply Agreements*
- Gray Water Use
- Groundwater
- Imported Water Purchases
- Local Surface Water Reservoirs*
- Potable Reuse
- Recycled Water
- Seawater Desalination
- Stormwater BMPs
- Stormwater Capture
- Urban and Agricultural Water Use Efficiency
- Watershed and Ecosystem Management

*Baseline Concept: Only analyzed in Impacts Assessment
Impacts Assessment Process

1. Simulate system operations with varying:
   a) Demand and Climate scenarios
   b) Portfolios of Water Supplies/Water Management Strategies

2. Compare metrics across Scenarios and Portfolios
SDBS Demand and Climate Scenarios

2015 Demands + Current Climate

2025 Demands + Current Climate + Central Tendency

2050 Demands + Current Climate + Central Tendency
Impacts Assessment Portfolios

Portfolios

• Baseline (B)
• Baseline Plus (B+)
• Increase Supplies (IS)
• Enhanced Conservation (EC)
• Optimize Existing Facilities (OEF)
• Watershed Health and Ecosystem Restoration (WE)
Impacts Assessment Metrics

- Flood Control
- Energy
- Recreation
- Water Delivery

15
Sources of additional water deliveries to meet increasing demands vary by Portfolio. Baseline: Increase in Imported Water Purchases

Increase in Imported Water Purchases
Sources of additional water deliveries to meet increasing demands vary by Portfolio. Baseline+: Increase in Surface Water and Potable Reuse
Sources of additional water deliveries to meet increasing demands vary by Portfolio. EC: Demand reduction by conservation
Impacts Assessment Key Findings – Water Delivery

Sources of additional water deliveries to meet increasing demands vary by Portfolio IS Deliveries: Increase in Potable Reuse & Desalination
Impacts Assessment Key Findings – Water Delivery

- Shortages occurred in all Portfolios for some scenarios
- Largest shortages in B, Smallest in EC
- No shortages above shortage threshold in EC or IS

28% of shortages above threshold for mitigation

0% of shortages above threshold for mitigation
Impacts Assessment Key Findings – Energy

Highest consumption in B, lowest in EC

### Average Annual Energy Consumption

#### 2015 Demands

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**Baseline**

**Enhanced Conservation**
Impacts Assessment Key Findings – Recreation

- Boat ramps generally available at Hodges and San Vicente
- Boat ramps frequently inaccessible at El Capitan, except in OEF
- Boat ramp accessibility improved at Lower Otay for all Portfolios beyond B
Impacts Assessment Key Findings – Flood Control

- No flooding at San Vicente or Olivenhain
- More days with flood outflows at El Capitan for IS
- Days with flood outflows decreased at Hodges in B+ and beyond

[Graph showing average annual number of days with flood outflows for different climate scenarios and demands]

Implementation of Hodges Water Quality Improvement Program in B+
Trade-Off Analysis: Comparing Concepts

The Challenge:
- Each Concept has a variety of benefits and costs
- Benefits and costs may be
  - direct and/or indirect
  - inside and/or outside the project area
  - quantifiable and can be monetized
    OR
  - quantifiable but cannot be monetized
    OR
  - unquantifiable and cannot be monetized.

The Need: A framework for comparing benefits and costs on a “level playing field”

The Solution: Trade-Off Analysis - provides a framework for comparing the effects of Concepts across different types of benefits and costs
Trade-Off Analysis Steps

1. Identify Evaluation Objectives

2. Determine the Relative Importance of Evaluation Objectives

3. Place Values on Evaluation Objectives using Performance Measures

4. Evaluate and Combine Evaluation Objective Scores for Each Concept
Step 1: Identify Evaluation Objectives

- Address Climate Change Through Greenhouse Gas Reduction
- Climate Resilience
- Cost Effectiveness
- Environmental Justice
- Optimize Local Supplies/Independence
- Project Complexity
- Protect Habitats, Wildlife, and Ecosystem Services
- Provide for Scalability of Implementation
- Provide Reliability and Robustness
- Quality of Life/Recreation
- Regional Economic Impact
- Regional Integration and Coordination
- Water Quality and Watersheds
Step 2: Relative Importance of Evaluation Objectives - Survey

San Diego Basin Study: Task 2.5 – Tradeoff Analysis
The City of SAN DIEGO

**Optimize Local Supplies/Independence:**
Adaptation Concepts that improve or support the region’s ability to use local water supplies and/or reduce the reliance on imported water.

1 2 3 4 5 6 7 8 9 10

**Cost Effectiveness:**
Adaptation Concepts that reduce the total present value capital, operation and maintenance costs to the region and/or have a strong potential for external funding.

1 2 3 4 5 6 7 8 9 10

**Regional Integration and Coordination:**
Adaptation Concepts that support community engagement, education, and coordination with regional partners to leverage existing assets and projects, reduce project barriers, and/or build community support and knowledge of water issues.

1 2 3 4 5 6 7 8 9 10
## Step 2: Relative Importance of Evaluation Objectives – Survey Results

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<tr>
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Step 3: Place Values on Evaluation Objectives using Performance Measures

Diagram:
- **Final Evaluation Objective Score**
  - **Weighting of Score**
    - **Raw Evaluation Objective Score**
      - **Average**
        - **Performance Measure Score**
          - **GIS**
          - **Survey**
        - **Performance Measure Score**
          - **Survey**
        - **Performance Measure Score**
          - **GIS**
        - **Performance Measure Score**
          - **Model Metric**
Data for Calculating Performance Measures

Concept-Level Surveys

Model Metrics

Project-Level Surveys

GIS
Step 4: Evaluate and Combine Evaluation Objective Scores for Each Concept

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Trade-off Analysis Results Using All Evaluation Objectives

Weighted Evaluation Objective Scores

Concepts Scored for All Evaluation Objectives
- Urban & Ag. Water Use Efficiency
- Stormwater Capture
- Recycled Water
- Watershed and Ecosystem Management
- Potable Reuse
- Stormwater BMPs
- Groundwater
- Conveyance Improvement

Concepts Not Scored for All Evaluation Objectives
- Gray Water Use
- Seawater Desalination
- Imported Water Purchases
- Enhanced Conservation

- Not scored for 1 Evaluation Objective
- Not scored for 2 Evaluation Objectives
- Not scored for 3 Evaluation Objectives

- Address Climate Change through Greenhouse Gas (GHG) Reduction
- Cost Effectiveness
- Optimize Local Supplies
- Protect Habitats, Wildlife, Ecosystems
- Quality of Life/Recreation
- Regional Integration and Coordination
- Water Quality and Watersheds
- Climate Resilience
- Environmental Justice
- Project Complexity
- Provide for Scalability of Implementation
- Regional Economic Impact
- Reliability and Robustness

Note: Not scored for Environmental Justice (maximum weighted score 51.80 points)
Not scored for Environmental Justice (maximum weighted score 51.80 points)
Not scored for Climate Resilience, Environmental Justice, and Water Quality and Watersheds (maximum weighted score 42.00 points)
Scored only on Regional Economic Impact (maximum weighted score 3.90 points)
Customized Trade-Off Analysis Tool

### Trade-off Analysis

**Customization Name**

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**Customization Notes**

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### Evaluation Objective Weights

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### Concepts to Use

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**RECLAMATION**
Trade-Off Analysis for a Subset of Evaluation Objectives: Cost/Feasibility

Weighted Evaluation Objective Scores for the Trade-Off Analysis with Cost and Feasibility Evaluation Objectives

Concepts Scored for All Evaluation Objectives

- Urban & Ag. Water Use Efficiency
- Gray Water Use
- Recycled Water
- Watershed and Ecosystem Management
- Stormwater BMPs
- Stormwater Capture
- Potable Reuse
- Imported Water Purchases
- Conveyance Improvement
- Groundwater
- Seawater Desalination

Concepts Not Scored for All Evaluation Objectives

- Enhanced Conservation

Cost Effectiveness | Project Complexity | Provide for Scalability of Implementation | Regional Integration and Coordination

Maximum weighted score 16.00 points

Not scored for any Evaluation Objectives in the cost and feasibility subset (maximum weighted score 0.00 points)
Trade-Off Analysis for a Subset of Evaluation Objectives: Environmental

Weighted Evaluation Objective Scores for the Trade-Off Analysis with Environmentally-Related Evaluation Objectives

Concepts Scored for All Evaluation Objectives
- Watershed and Ecosystem Management
- Stormwater BMPs
- Stormwater Capture
- Urban & Ag. Water Use Efficiency
- Groundwater
- Potable Reuse
- Recycled Water
- Conveyance Improvement

Concepts Not Scored for All Evaluation Objectives
- Gray Water Use
- Seawater Desalination
- Imported Water Purchases
- Enhanced Conservation

- Not scored for any Evaluation Objectives in the environmentally-related subset

Legend:
- Address Climate Change through Greenhouse Gas (GHG) Reduction
- Climate Resilience
- Environmental Justice
- Protect Habitats, Wildlife, Ecosystems
- Water Quality and Watersheds

Notes:
- Not scored for Environmental Justice (maximum weighted score 18.50 points)
- Not scored for any Evaluation Objectives in the environmentally-related subset (maximum weighted score 0.00 points)
Key Findings

Continuing the region’s active investments (as simulated in the Baseline Plus Portfolio) will have a number of benefits:

– Improvements in water supply reliability, as indicated by a decreased occurrence of shortages (although shortages may not be completely eliminated)
– Less dependence on imported water
Key Findings

There are promising options for future investments to further secure reliable water supplies while supporting other aspects of water management such as flood control, recreation, and energy.
Key Findings

Conservation and Water Use Efficiency (analyzed in the Enhanced Conservation and Urban and Agricultural Water Use Efficiency Concepts) would have a number of positive benefits for the region:

- Reduced energy consumption
- Fewer pipeline capacity issues
- Increased reservoir storage, providing a direct benefit to recreation
- Less dependence on imported water
- Cost effective and scalable
- Potentially large energy cost reduction
Key Findings

Increasing supply volumes through Potable Reuse would have a variety of potential benefits:

- Reduced shortage volumes
- Lower dependence on imported water
- Lower energy consumption
Key Findings

Concepts such as Stormwater Capture, Watershed and Ecosystem Management, and Stormwater BMPs may have significant benefits and would be worth considering for implementation as part of the overall water system in the San Diego region.

- Enhanced quality of life/recreation
- Reduced vulnerability to climate change
- Support environmental justice
- Support healthy watersheds and improved water quality
Key Findings

Many Concepts and projects are complementary and could be implemented as part of a suite of strategies to benefit the region in many ways

Example: Water Use Efficiency (Lower energy costs) + Potable Reuse (Higher energy costs) = Improved supply reliability Minimized energy cost impacts
Basin Study Products

- **Interim Reports (Tasks 2.1 through 2.5):** Details of methods and results for each task of the Basin Study

- **Customized Trade-Off Analysis Tool:** Spreadsheet tool for performing trade-off analyses

- **Final Report:** Comprehensive report covering final version of all Basin Study tasks including details of methods and findings

- **Executive Summary Report:** Short overview of Basin Study focusing on key findings
How to Use the Basin Study

• Gain insight into the impacts of Concepts or projects being considered for implementation
  – What positive impacts can be expected?
  – What negative impacts will need to be mitigated?

• Understand strengths and weaknesses of Concepts

• Compare Concepts to help guide future investments
  – Use customized trade-off analysis tool to make comparisons based on your organization’s preferences
Questions?

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https://www.usbr.gov/lc/socal/basinstudies/SDBasin.html