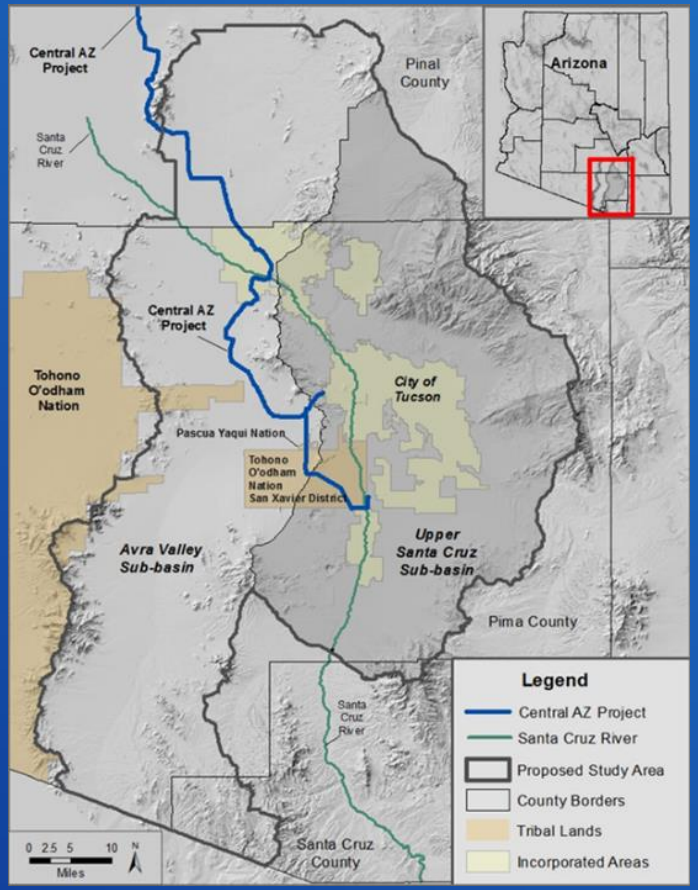
Lower Santa Cruz River Basin Study:

Study Purpose, Modeling Framework and Local Climate Scenarios

Eve Halper,
Water Resources Planner
Bureau of Reclamation, Phoenix Area Office
Public Meeting #2
March 12, 2018



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Key Terms

- ***Scenario –*** a set of assumptions used to help understand potential future conditions
- ***Representative Concentration Pathways*** - Scenarios that include time series of emissions and concentrations of the full suite of greenhouse gases….
- ***Risk -*** threats to life, health and safety, the environment, economic well-being, and other things of value
- ***Adaptation -*** Adjustment in natural or human systems to a new or changing environment that exploits beneficial opportunities or moderates negative effects

Source: U.S. Global Change Research Program,

Link to Global Change Glossary

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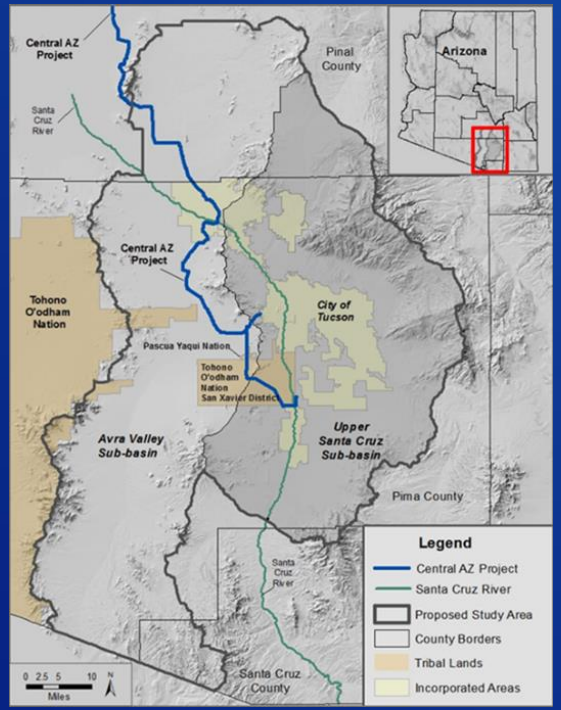
Lower Santa Cruz River (LSCR) Basin Study Summary



- Addresses the impacts of changing climate, population and other factors on water use through 2060
- Focuses on spatial distribution of water resources in the Tucson basin (Tucson Active Management Area)
- Includes analysis of environment (riparian areas)
- Employs a scenario approach to explore range of futures (with and without adaptation measures)
- Uses multiple climate projections as input to groundwater and surface water models
- ***Incorporates Input from Public and Stakeholder Advisors***

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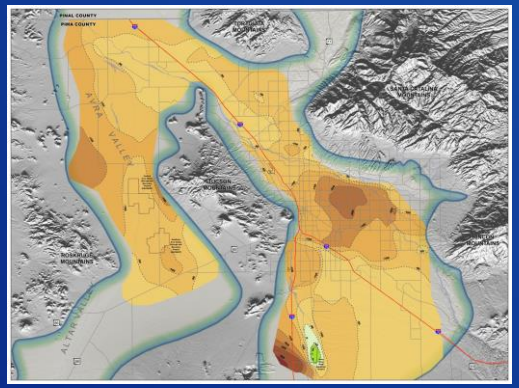
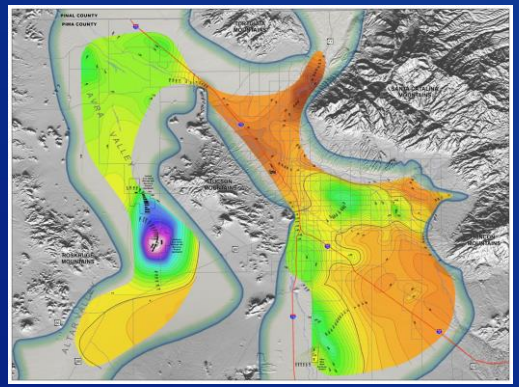
Tucson Area Groundwater Level Changes



1950 - 2000



2000 - 2016

LSCR Basin Study Objectives

1) Identify Where Physical Water Resources are Needed to Mitigate Supply-Demand Imbalances

2) Develop Adaptation Strategies to Improve Water Reliability for Municipal, Industrial, Agricultural and Environmental Sectors

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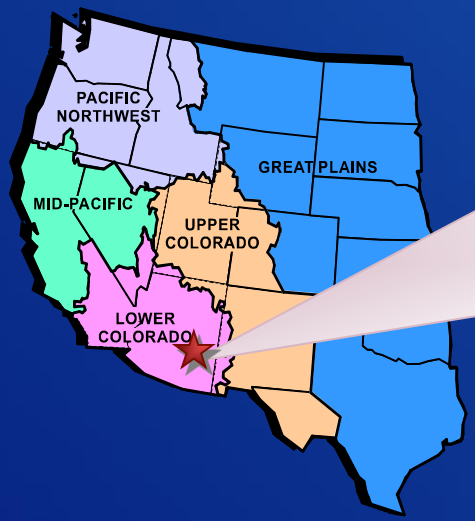
The Bureau of Reclamation operates in 17 Western States and is divided into five regions



Lower Colorado Region

Reclamation's Regions are defined by River Basins

Phoenix Area Office

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Reclamation is involved in many types of water management throughout the West

Central AZ Project

Conservation

Recharge

Water Treatment

Wetlands

Irrigation Efficiency

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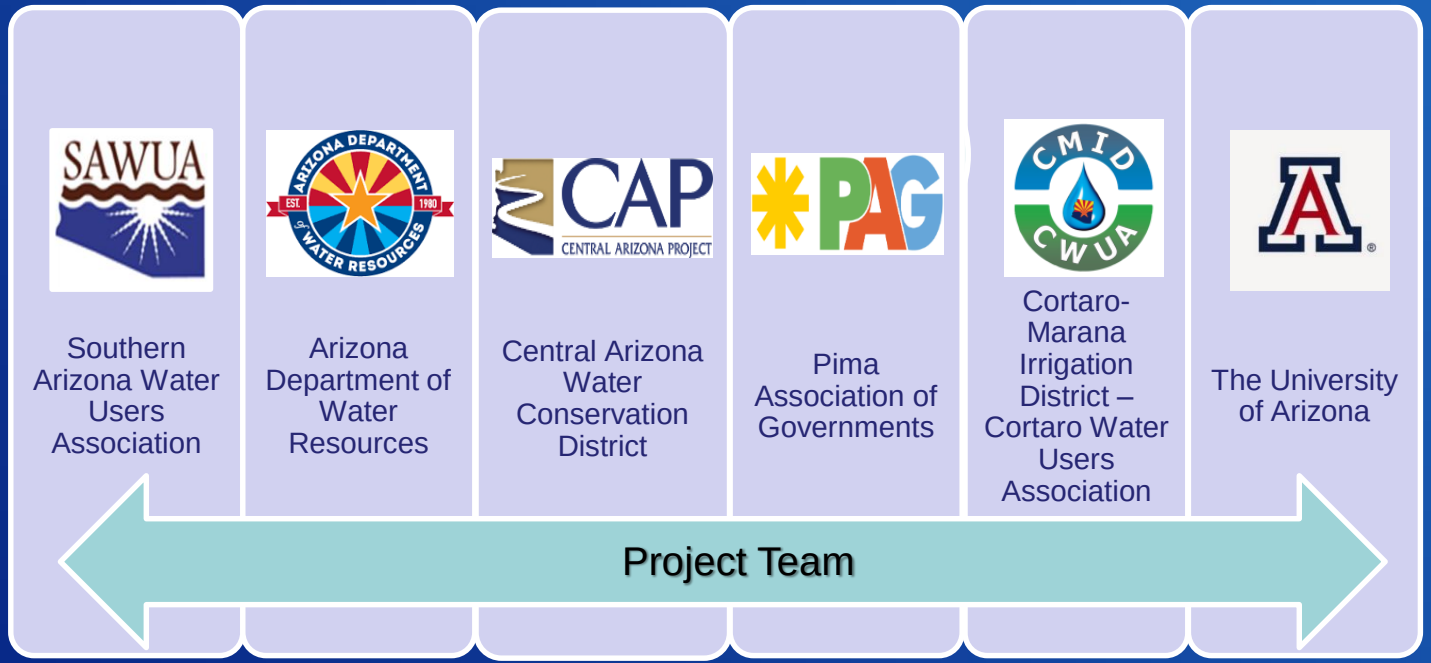
Cost-Share Partners



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SAWUA Members

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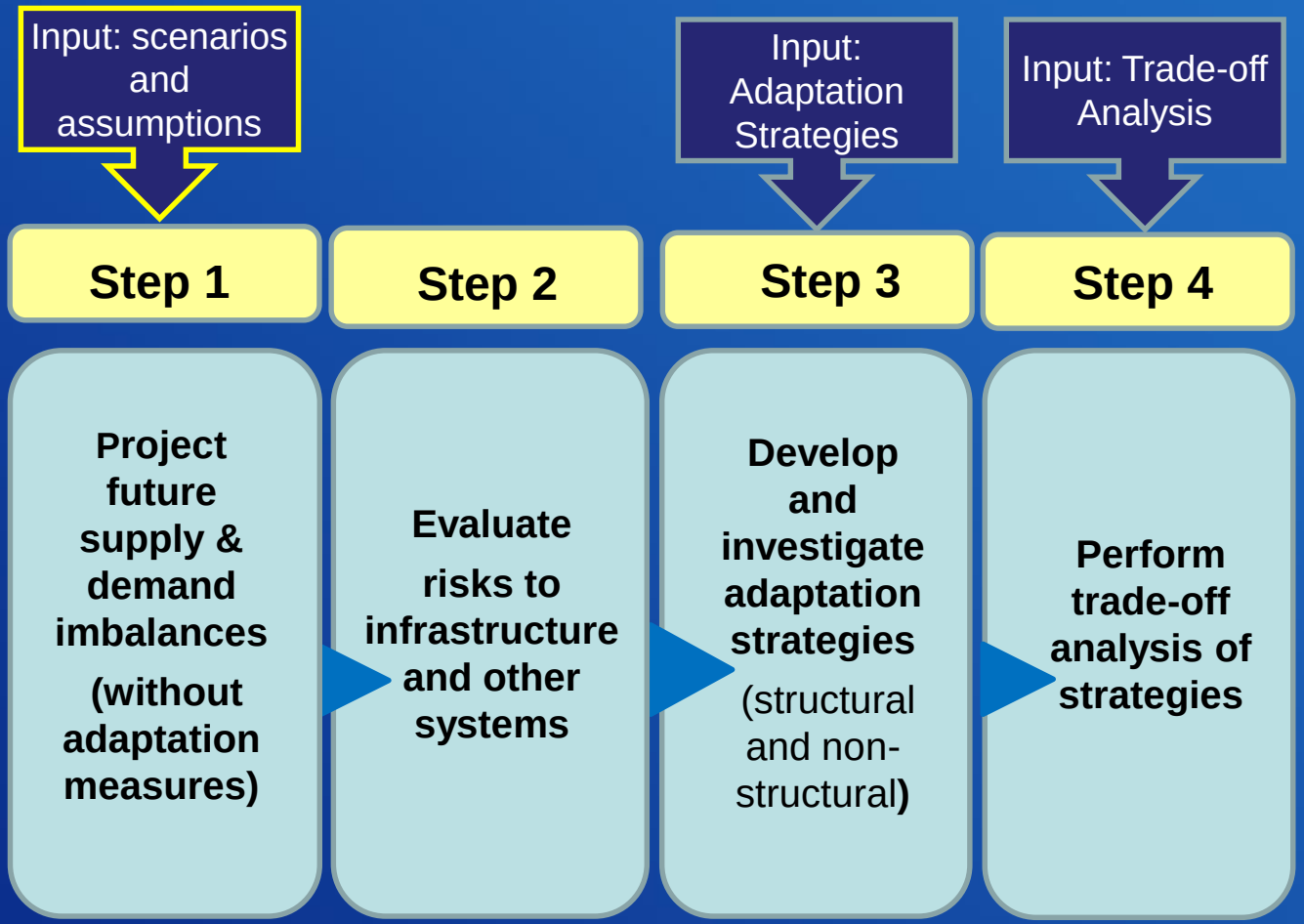
Other organizations with participating staff include:

- Tohono O'odham Nation
- Pascua Yaqui Tribe
- Vail Water
- Tucson Electric Power
- Pima County Flood Control District
- Sonoran Institute
- AZ Land and Water Trust
- Watershed Management Group
- Community Water Coalition
- Coalition for Sonoran Desert Protection
- Sky Island Alliance
- Tucson Audubon Society
- The Nature Conservancy
- American Rivers

Public Involvement: Key Part of Process

All Reclamation Basin Studies must have four required elements



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Public Outreach to Date

Public Meetings

- 1st Meeting November 2016
- 2nd Meeting March 2018

Stakeholder Advisors

- April 2017 (CAP-SAM Scenarios)
- Feb 2018 (Supply-Demand Scenario Matrix)

Pima Association of Governments

- Environmental Planning Advisory Committee
- Watershed Planning Sub-Committee

AZ Dept of Water Resources

- Groundwater Users Advisory Council
- Safe Yield Task Force

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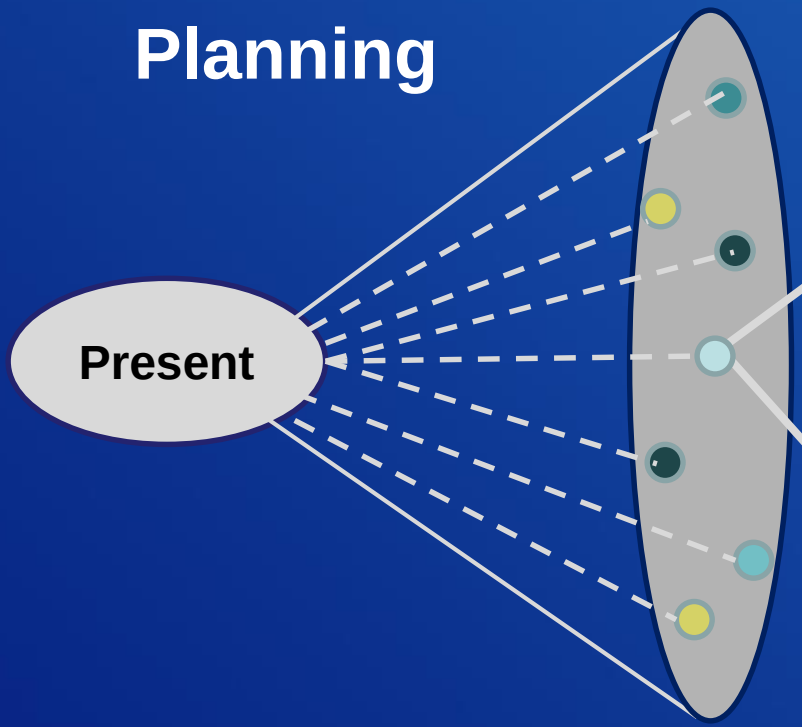
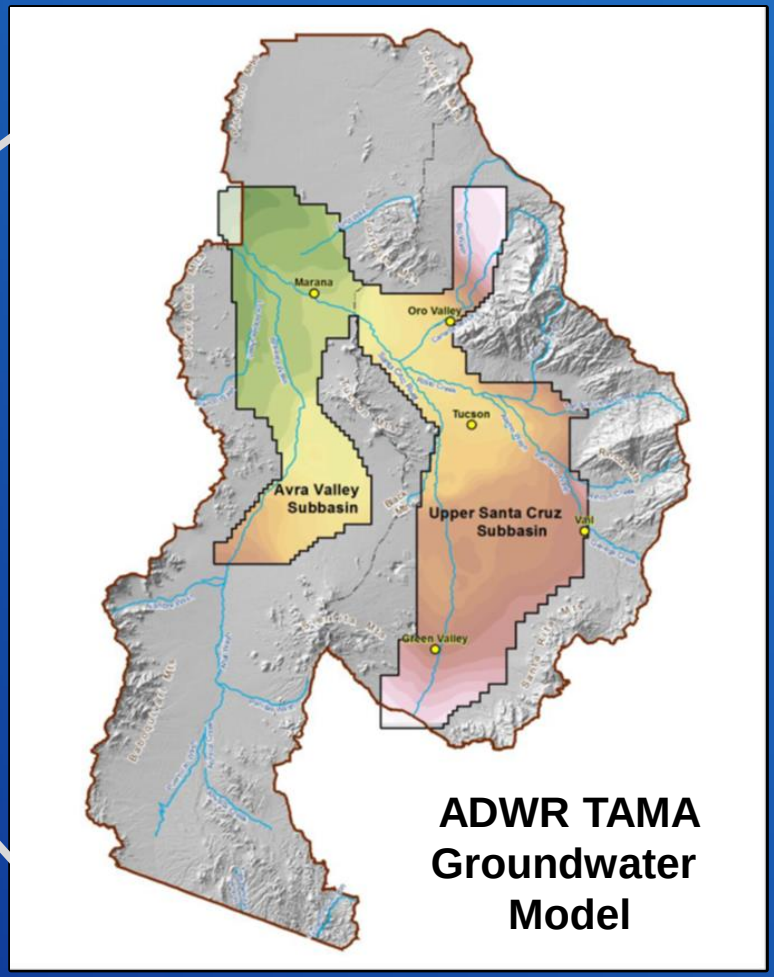
Scenario Planning





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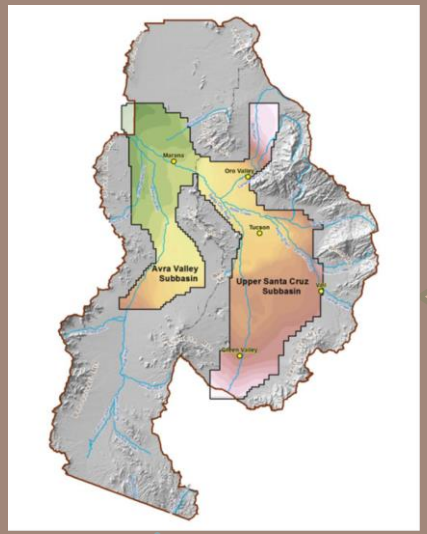
Simplified Modeling Overview

Tucson AMA Groundwater Model



Climate Driving Forces (Precipitation, Temperature)

GLOBAL CLIMATE MODELS

SURFACE HYDROLOGY MODEL

Socio-Economic Driving Forces (Demographics, Economics, Technological, Regulatory)

CAP SERVICE AREA MODEL

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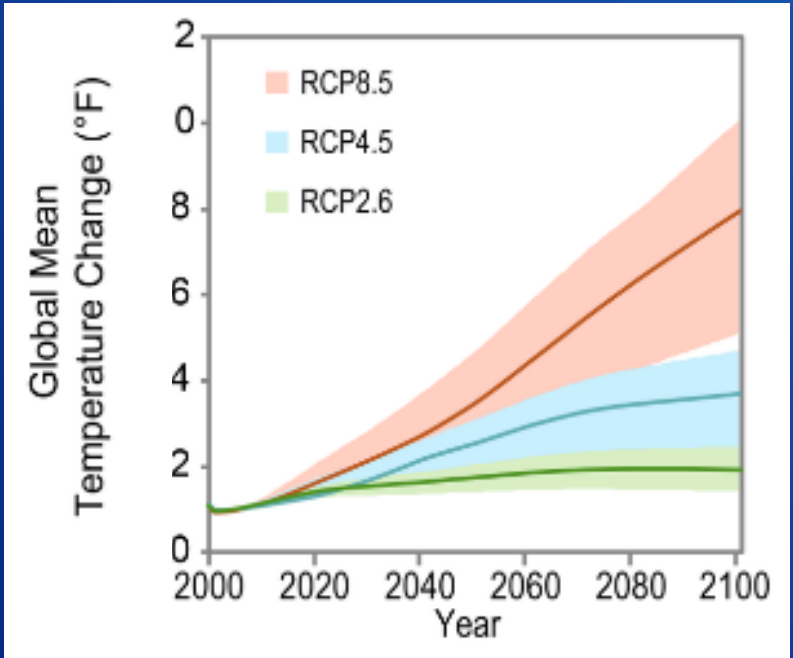

Source: **USGCRP**, 2017: *Climate Science Special Report: Fourth National Climate Assessment, Volume I*[Wuebbles, D.J., D.W. Fahey, K.A. Hibbard, D.J. Dokken, B.C. Stewart, and T.K. Maycock (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, 470 pp, doi: 10.7930/J0J964J6.

Representative Concentration Pathways (RCPs)

- Scenarios that include time series of emissions and concentrations of the full suite of greenhouse gases….
- Used to compare results of climate models
- Climate model projections available for **RCP 4.5 and RCP 8.5 only**
- RCP 4.5 - “Lower Risk / Best Case”
- RCP 8.5 – “Higher Risk/ Worse Case”

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Scenarios Focus on Risk

“Best Case”
Lower Emissions Future
(RCP 4.5)

“Worse Case”
Higher Emissions Future
(RCP 8.5)

“Base Case”
Without Climate Change
(For Comparison Purposes)

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CAP Service Area Model Scenarios

Kenneth Seasholes
Manager, Resource Planning and Analysis
Central Arizona Project

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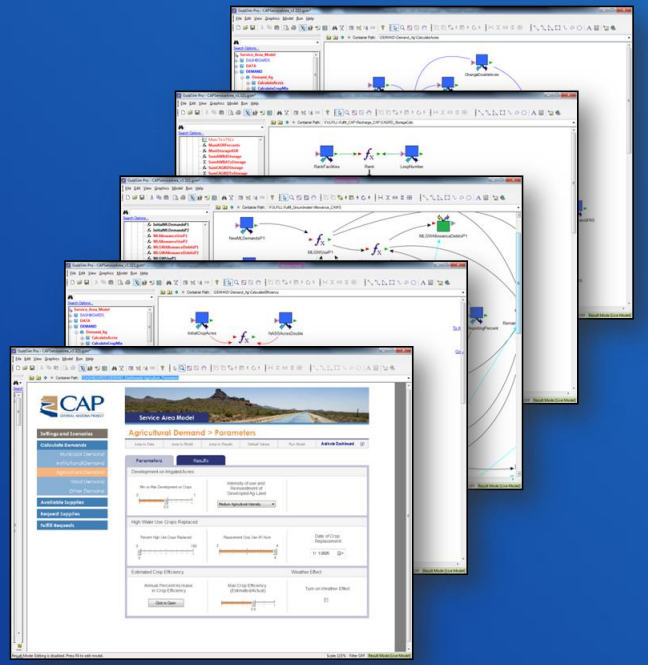
CAP Service Area Model (CAP:SAM)

- Tool for projecting supply and demand in CAP's three county service area
- Accounts for complex legal and physical characteristics of users and supplies
- Can simulate a wide range variations of "driving forces"
- Designed to generate "what if" scenarios



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Supply, Demand & Uncertainty

Some of the major factors that affect water supply, demand and reliability:

- Growth
- Shortage
- Climate
- Socioeconomics
- Sector Trends
- Policy Changes
- Behavioral Shifts
- ….

"Driving Forces"

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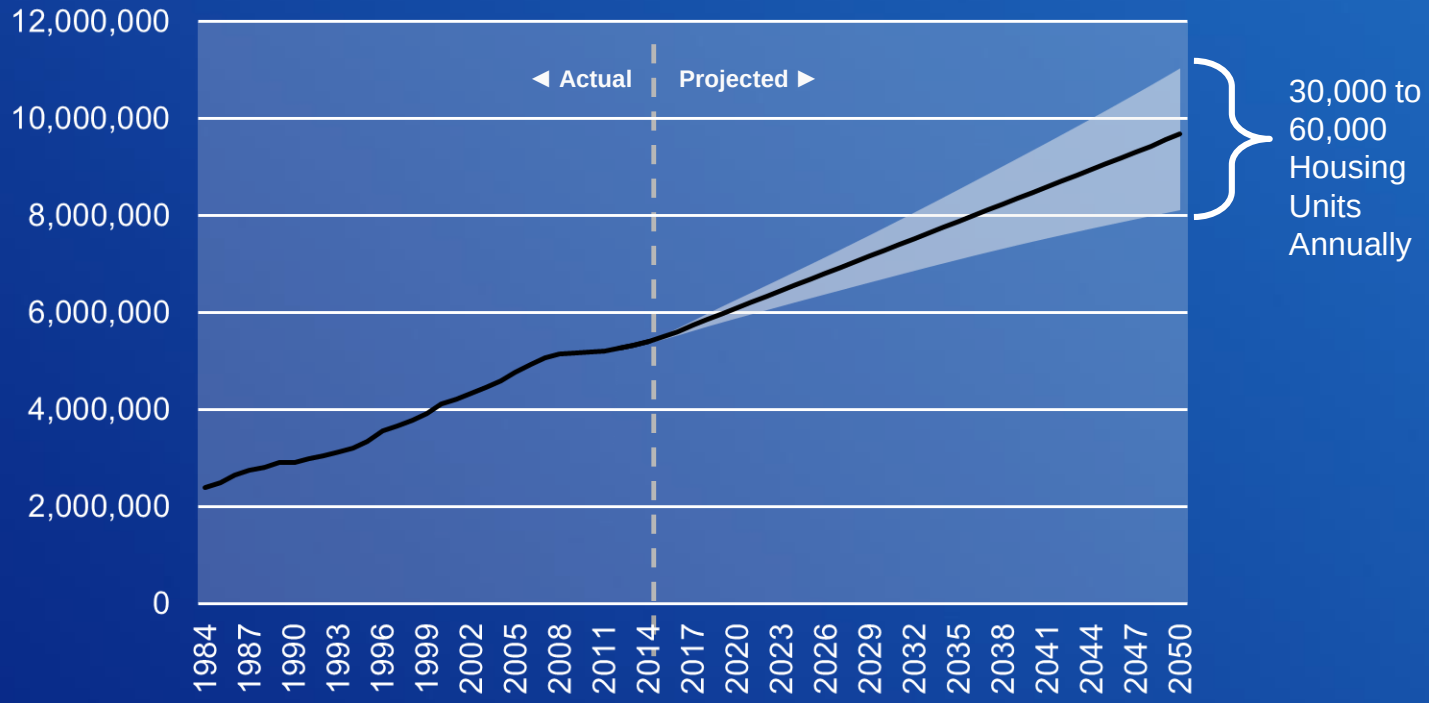
Growth Rate

AZ Department of Administration (Low, Med, High Series)



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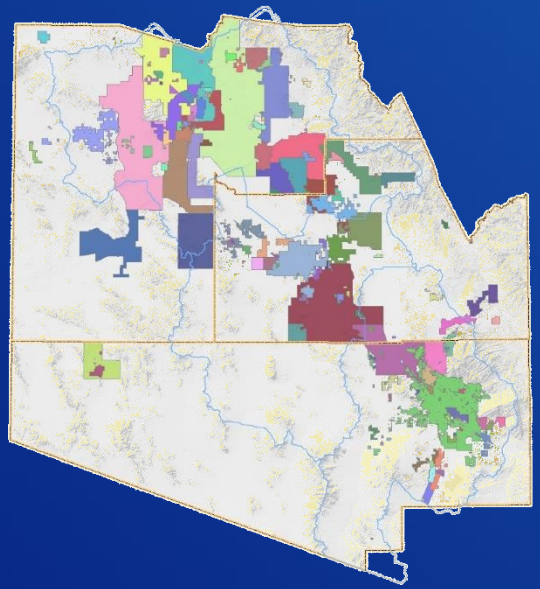
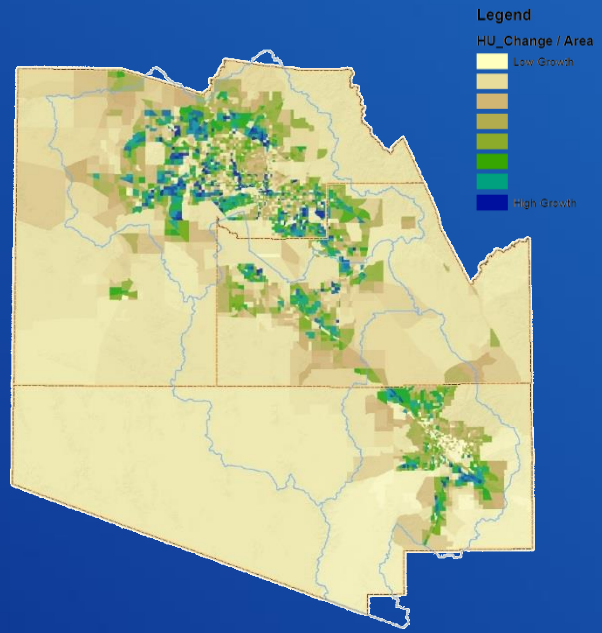
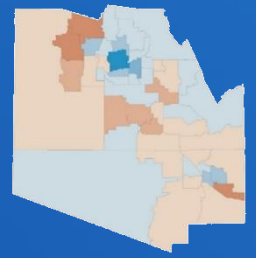
Growth Location



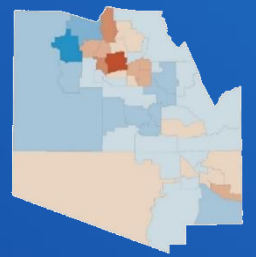
Water Providers



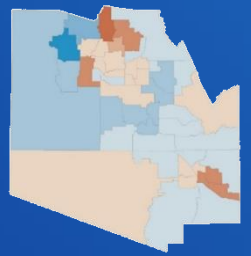
2040 Growth



Outward Growth



Infill



Redevelopment

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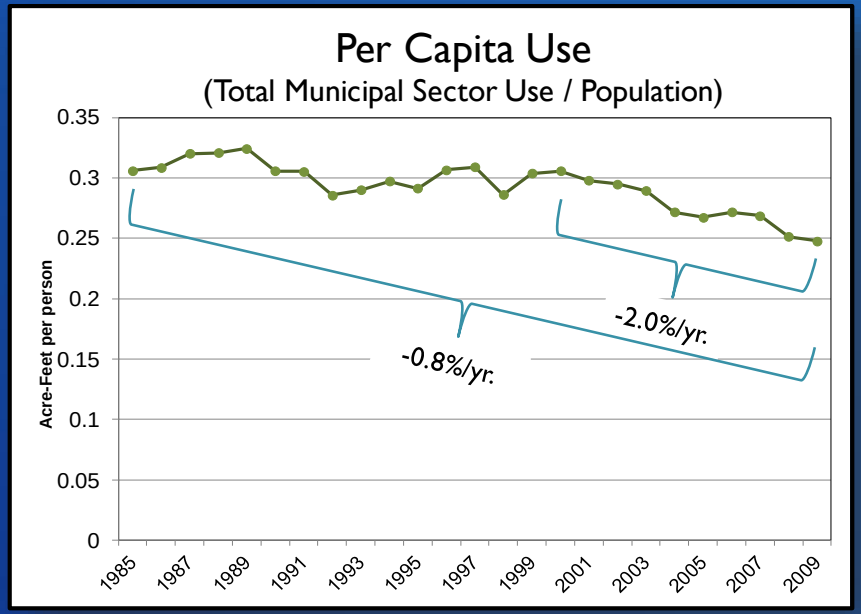
Demand Factors

- CAP:SAM differentiates between new and existing demand
- Rates of change can be varied to reflect conservation and climate effects



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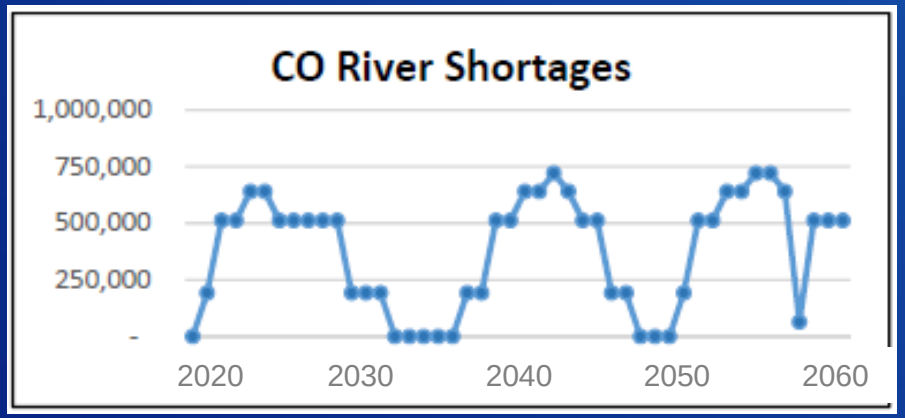
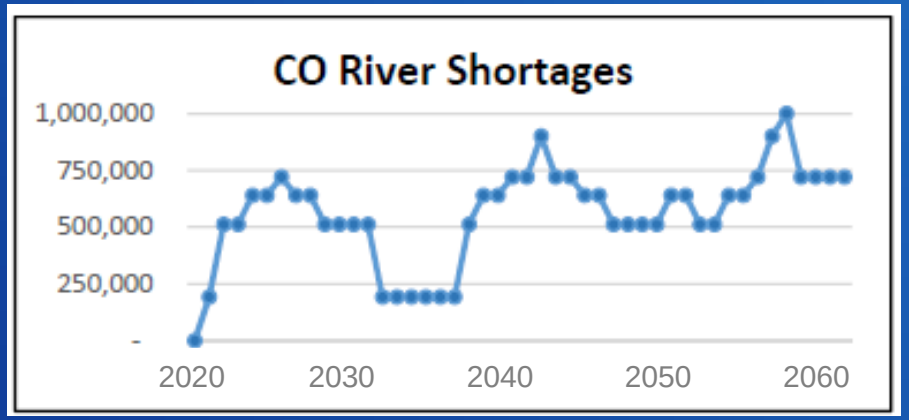
Colorado River Shortages

"Synthetic" shortage sequences were created to simulate periods of reduced supply and to test system resilience



"Historic Climate"



"Dry Climate"

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CAP Service Area Model Scenarios:

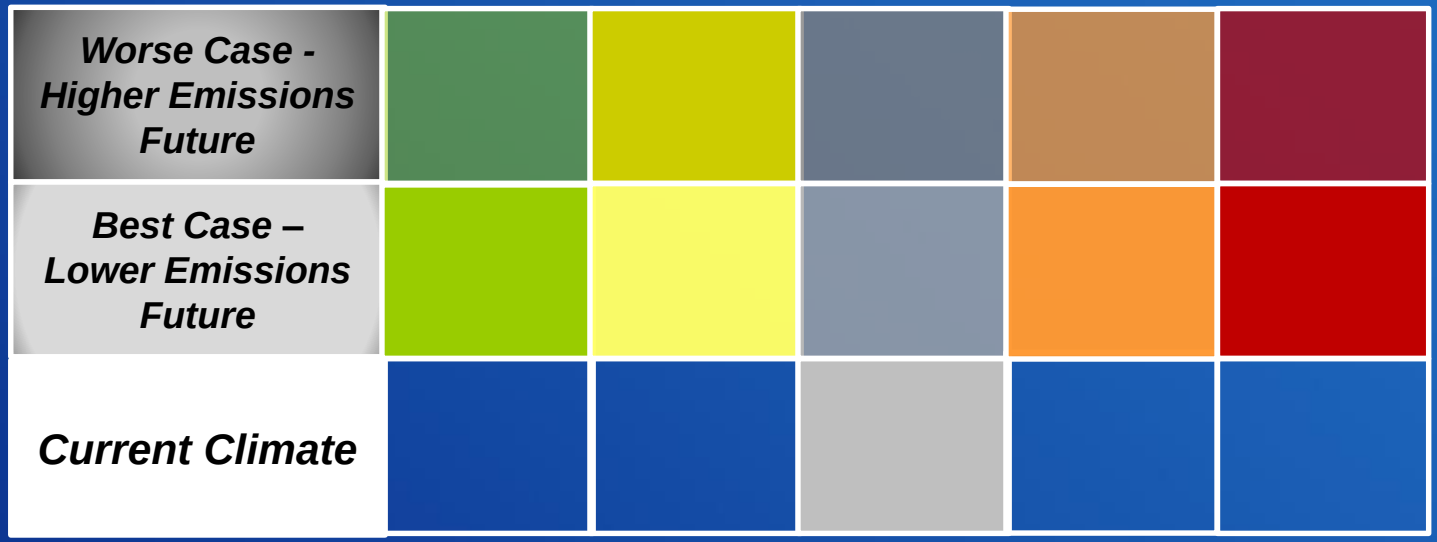
Slow Compact Growth to Rapid Outward Growth

	Low Risk →				High Risk
Driving Forces	**Demand Scenario 2 Slow Compact Growth**	**Demand Scenario 3 Slow Outward Growth**	**Demand Scenario 1 Baseline**	**Demand Scenario 4 Rapid Outward Growth**	**Demand Scenario 5 Rapid Outward Growth Plus Mining and no Replenishment**
Demand Scenario Summary	Low growth series: condensed growth pattern, no additional mines, no overdraft in Green Valley	Medium growth series: outward growth pattern, new mine development, replenish Green Valley	Medium growth series	High growth series: outward growth pattern, new mine development, replenish Green Valley	High growth series: outward growth pattern, mining growth, no replenishment in Green Valley
Municipal Demand: Population Growth Rate	Low Series	Medium Series	Medium	High Series	High Series
Municipal Demand: Infill vs. Outward Growth	In-Fill/Redevelopment	Slow Outward	Official Projection	Rapid Outward	Rapid Outward
Municipal Demand: Gallons Per Household Unit Per Day	Decline faster than expected	Decline as expected	Decline as expected	No change in current GPHUD	No change in current GPHUD
Municipal Demand: Additional recharge	Year 2020	Year 2030	per current CAP-SAM assumptions	Year 2030	Never
Municipal Demand: Develop Ag Land or Undeveloped Land	Low GPHUD development tends to replace high water use ag land.	CAP-SAM Baseline	Official Projection	Higher GPHUD development occurs on undeveloped land before replacing agriculture	Higher GPHUD development occurs on undeveloped land before replacing agriculture
Agricultural Demand: Consumptive Use (CU) Crop	Some ag areas convert to low CU crops	No change in CU crops	Official Projection	Some ag areas convert to higher CU crops	Some ag areas convert to higher CU crops
Agricultural Demand: Groundwater Savings Projects	Highest savings start 2018	Highest savings start in 2018	per current CAP-SAM assumptions	Half of highest savings start in 2025	No savings
Industrial Demand: Manufacturing	Slow economic growth and/or greatly improved water use efficiency	Moderate economic growth within existing water service areas, expected improvements in efficiency	Official Projection	Rapid economic growth that depends on groundwater, minimal improvements in efficiency	Rapid economic growth that depends on groundwater, minimal improvements in efficiency
Industrial Demand: Mining	No new mines	New mine in 2020-2030	Official Projection	New mine in 2020-2030, Existing mines expand	New mine in 2020, Existing mines expand
Environment's Demand: Riparian Evapotranspiration	Changes with climate and availability of surface water and shallow groundwater	Changes with climate and availability of surface water and shallow groundwater	Official Projection	Changes with climate and availability of surface water and shallow groundwater	Changes with climate and availability of surface water and shallow groundwater

Supply-Demand Scenario Matrix

Increasing Risk to Reliability

Local Climate Scenarios



CAP-Service Area Model Scenarios

Increasing Risk to Reliability

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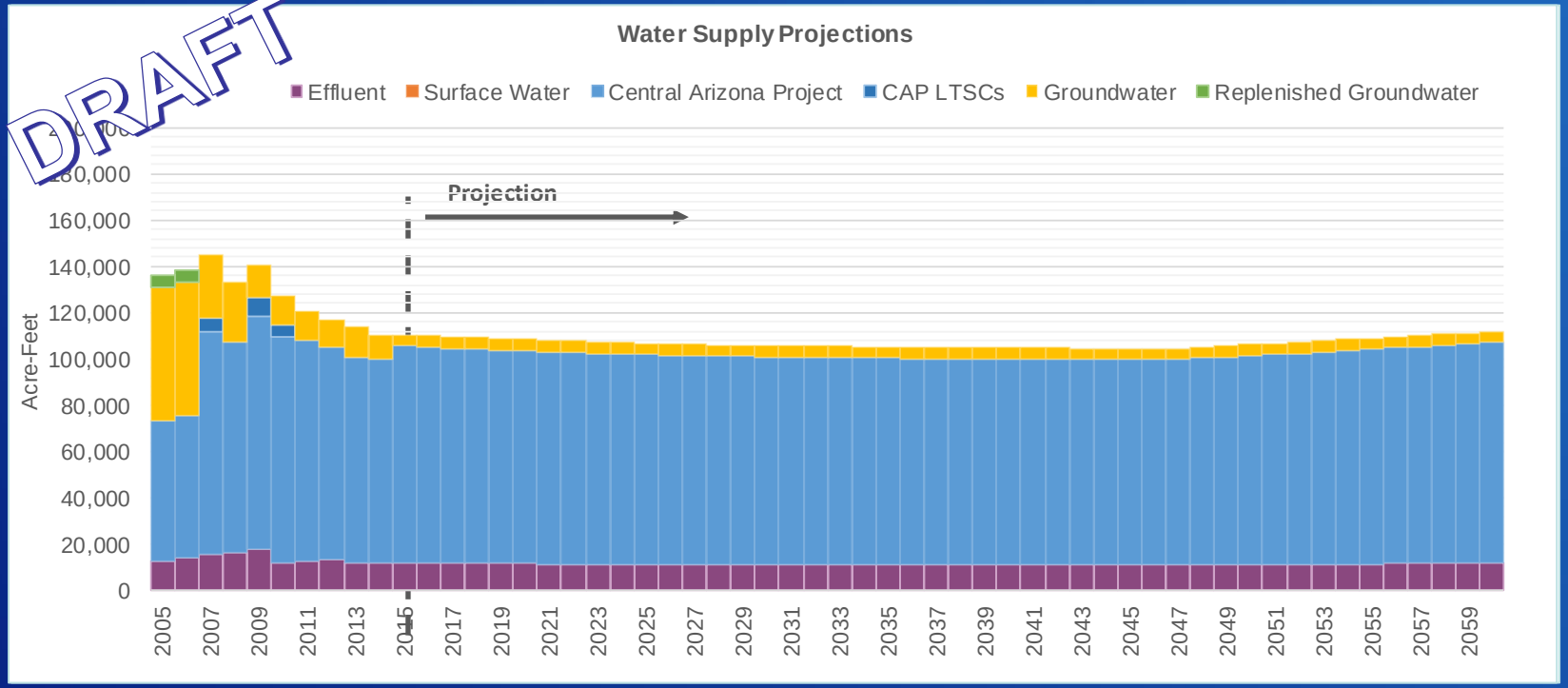
Tucson Water: Slow, Compact, Conserve



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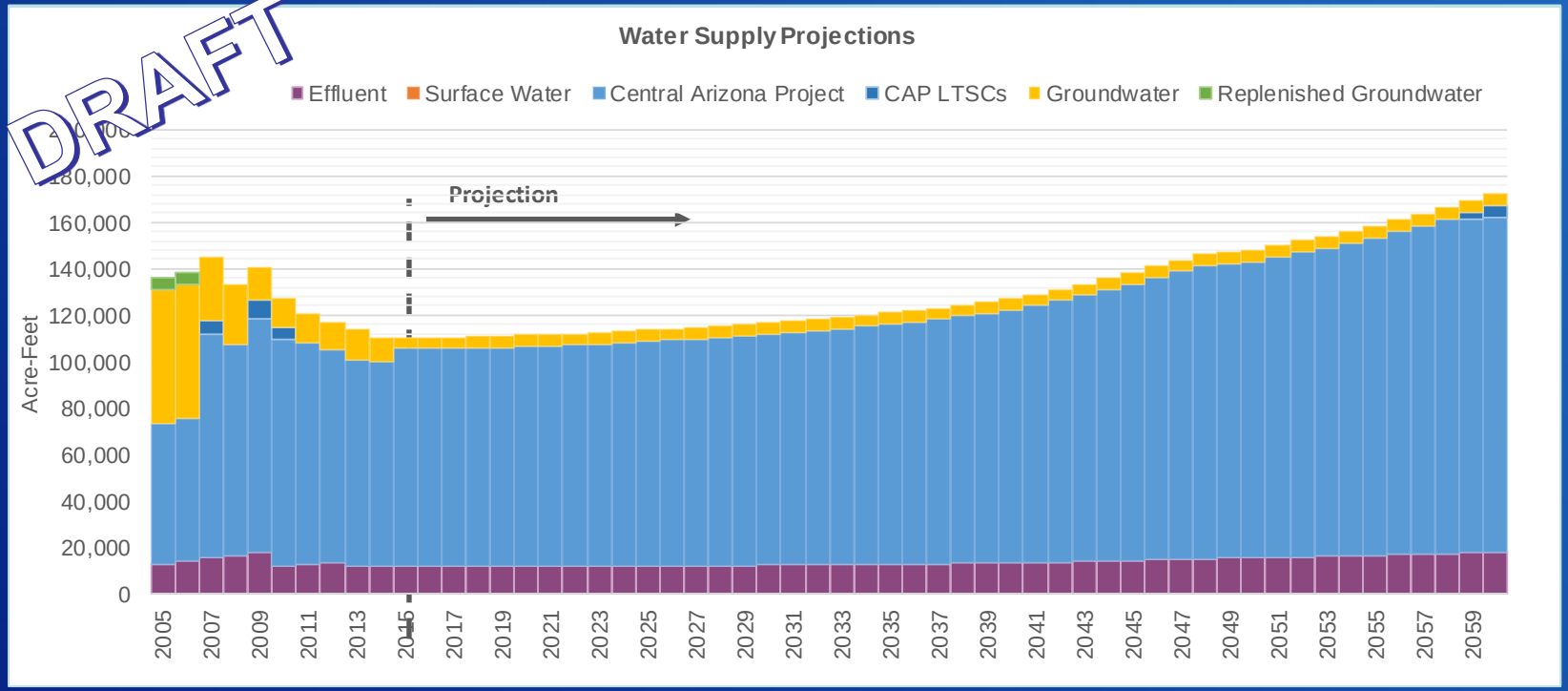
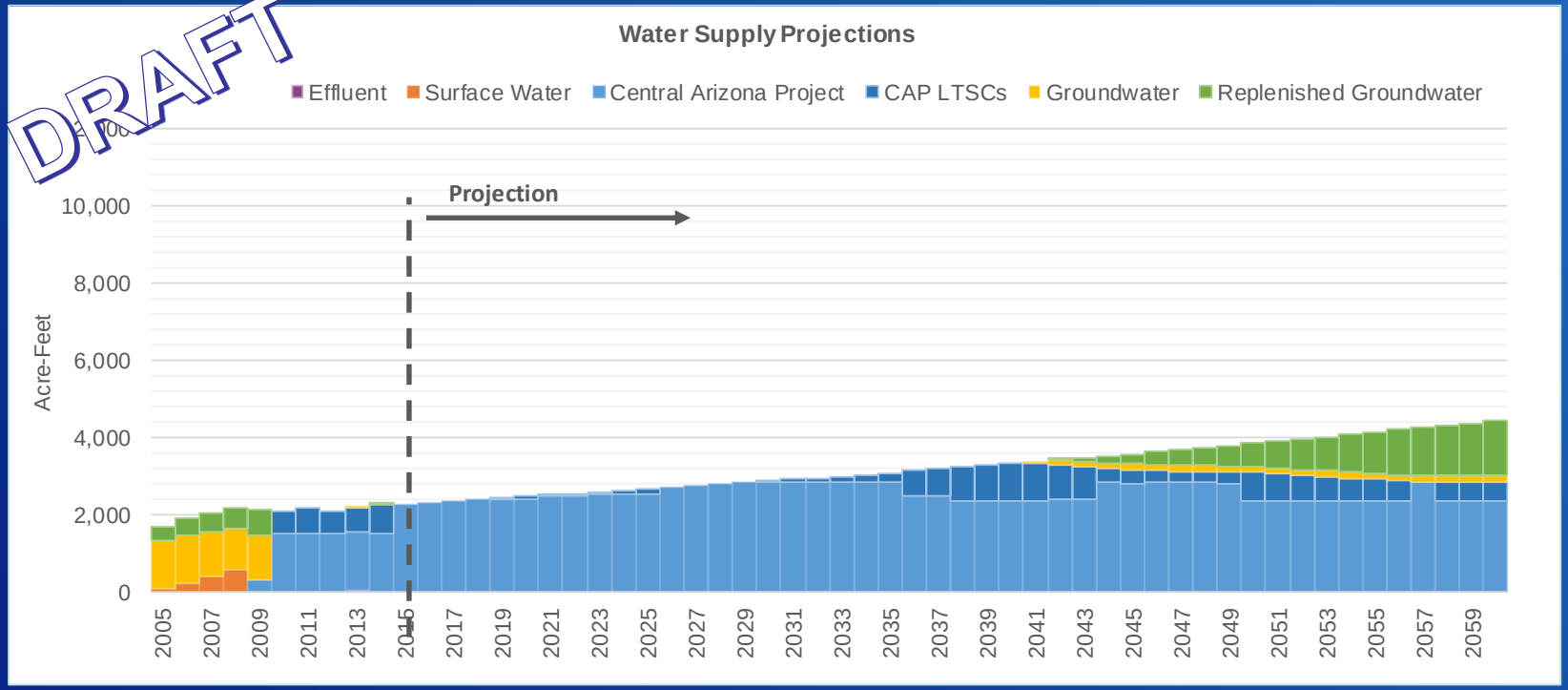
Tucson Water: Dry, Rapid Outward



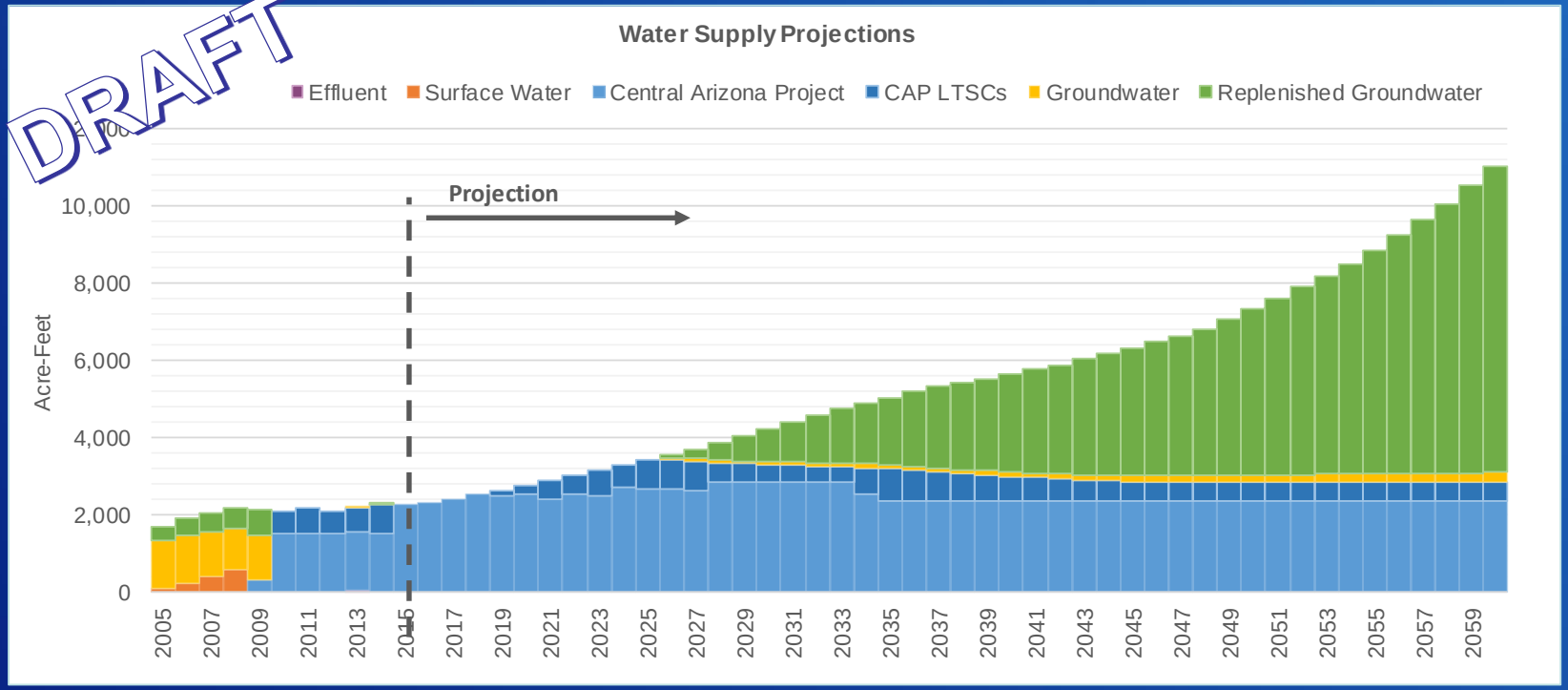
RECLAMATION

Marana: Slow, Compact, Conserve



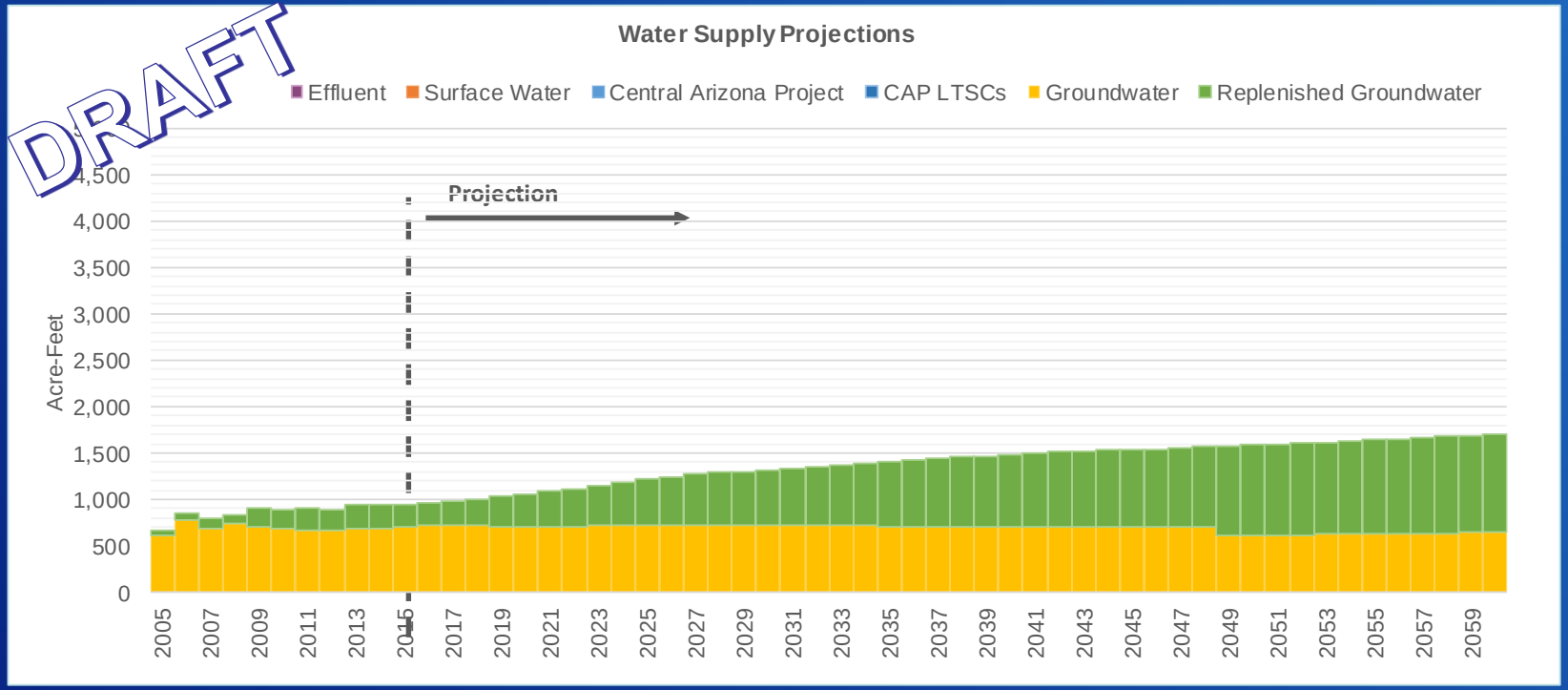
RECLAMATION

Marana: Dry, Rapid Outward



RECLAMATION

FICO: Slow, Compact, Conserve



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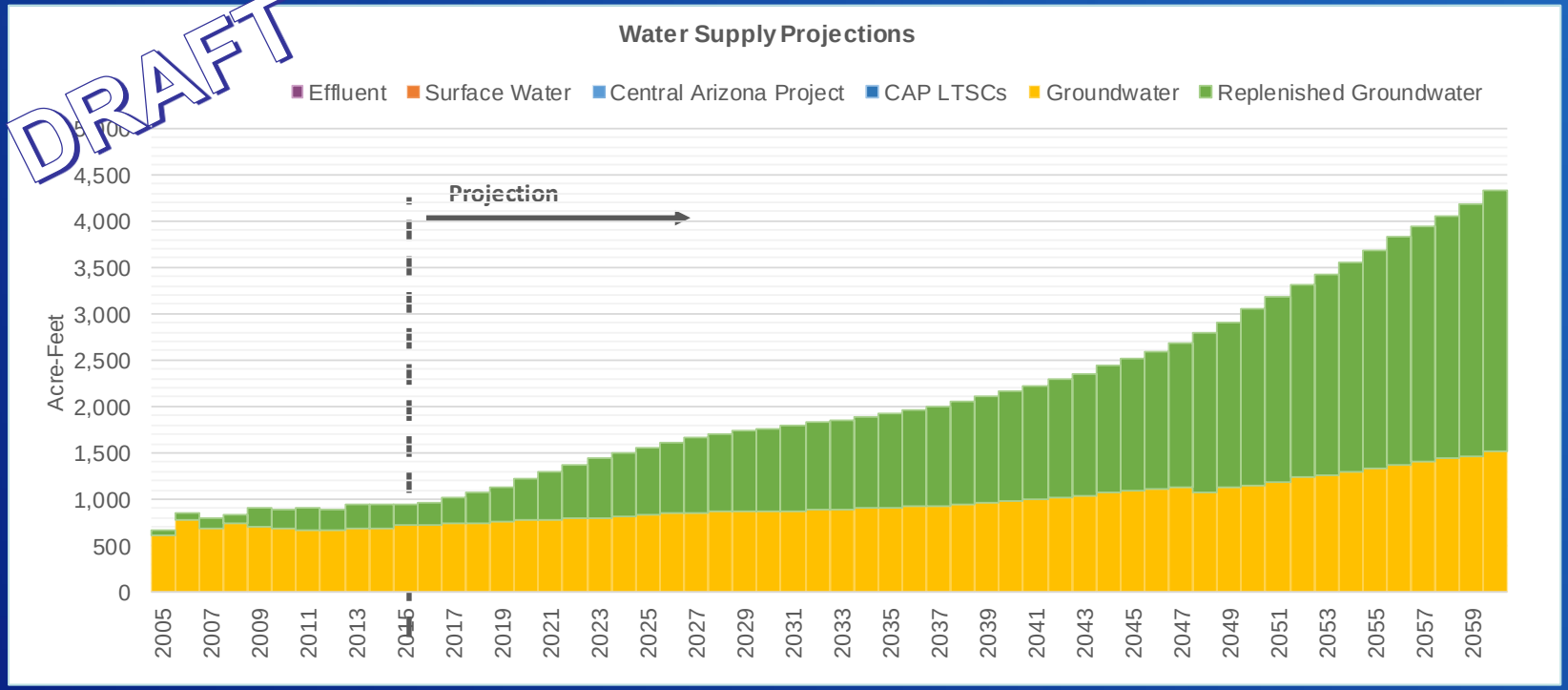
FICO: Dry, Rapid Outward



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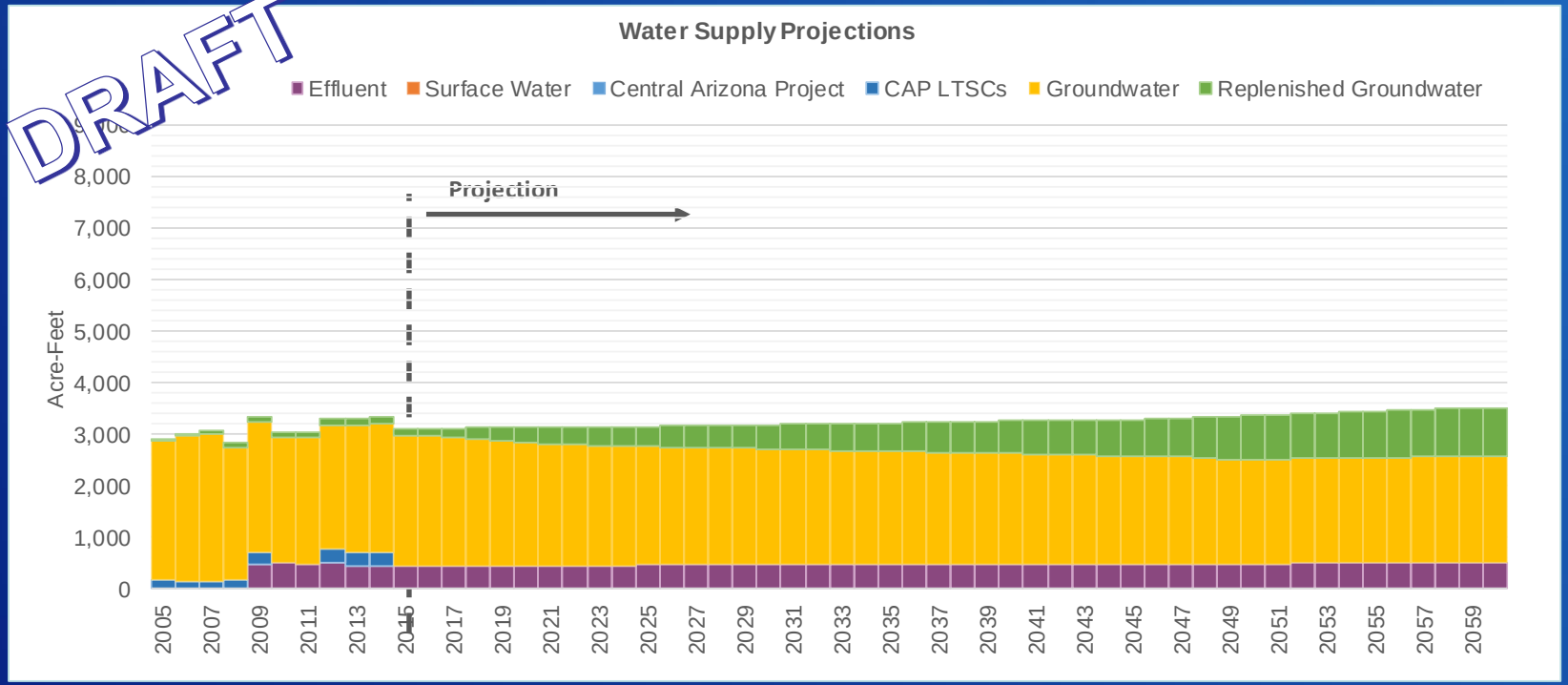
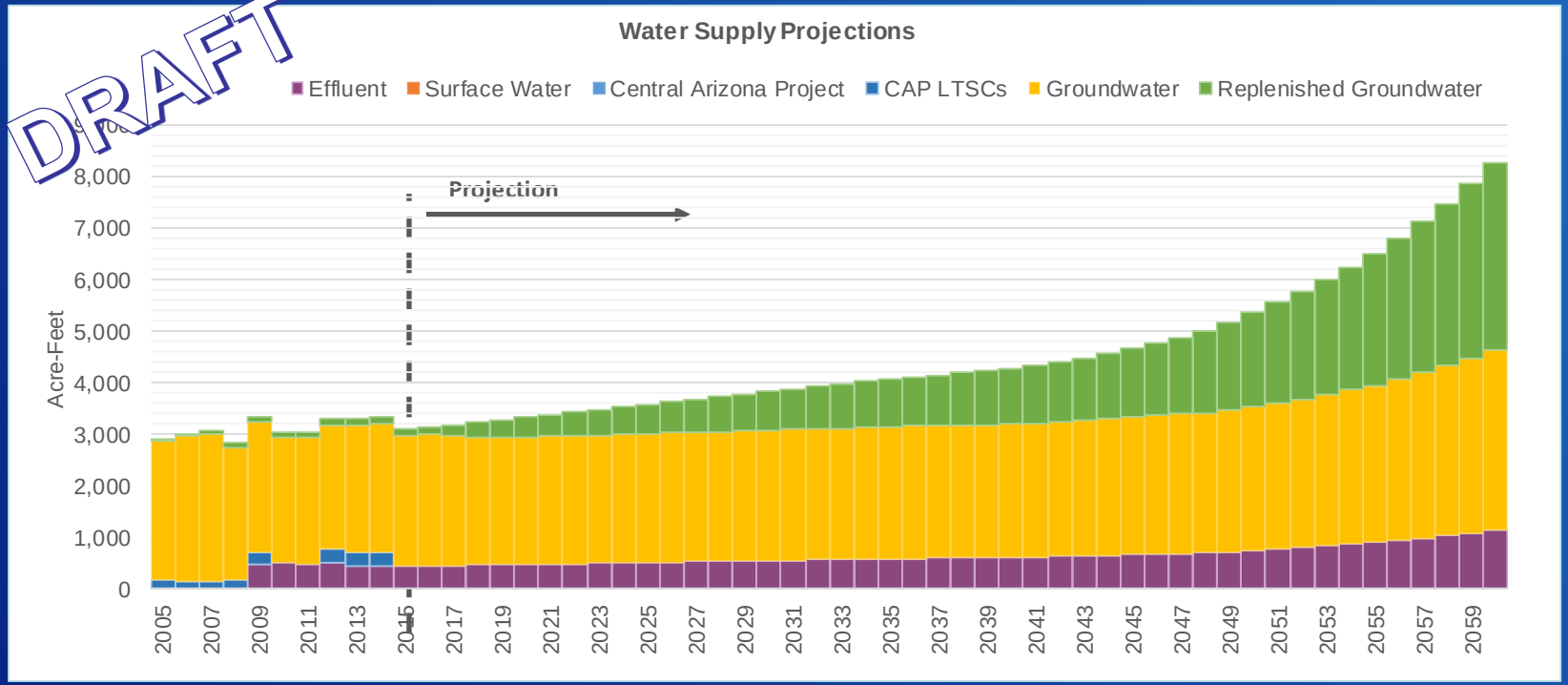
Lago Del Oro: Slow, Compact, Conserve



RECLAMATION

Lago Del Oro: Dry, Rapid Outward



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Supply – Demand Scenario Matrix

Kathy Chavez
Water Policy Manager
Pima County Office of Sustainability and Conservation

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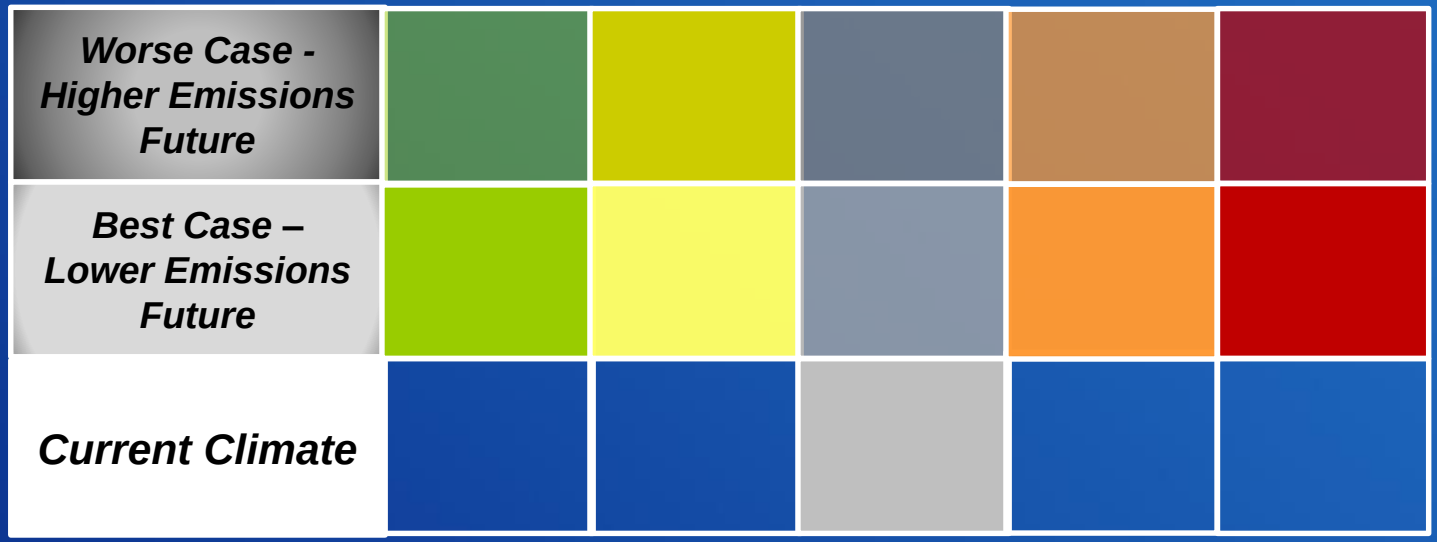
Supply-Demand Scenario Matrix Diagram

Increasing Risk to Reliability

Local Climate Scenarios



CAP-Service Area Model Scenarios

Increasing Risk to Reliability

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What is Next?

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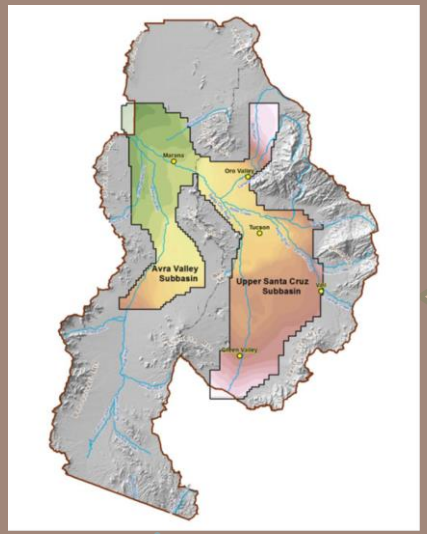
Supply and Demand Imbalances (Each Scenario)

Climate Driving Forces (Precipitation, Temperature)

GLOBAL CLIMATE MODELS

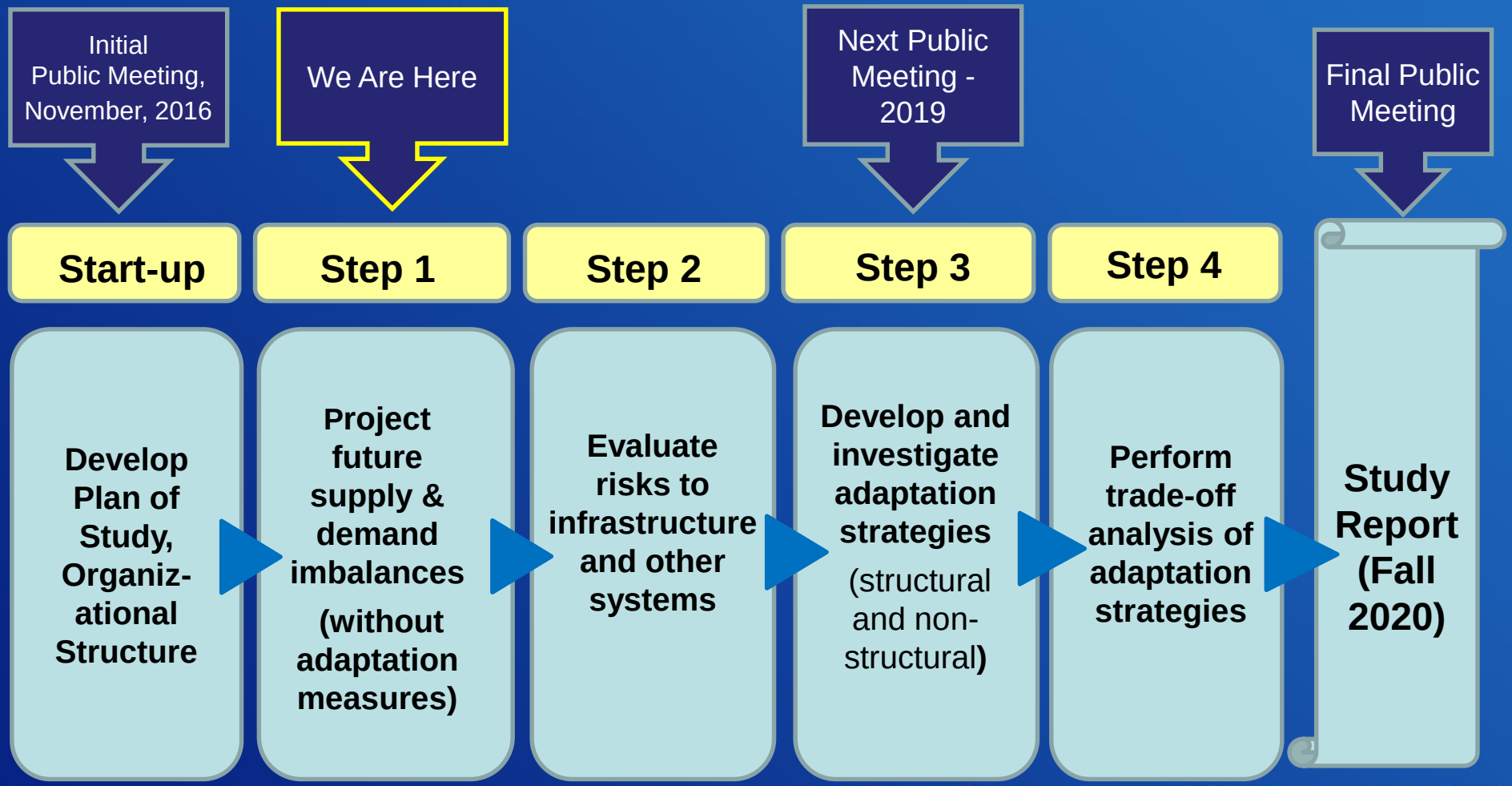
SURFACE HYDROLOGY MODEL



Socio-Economic Driving Forces (Demographics, Economics, Technological, Regulatory)

CAP SERVICE AREA MODEL

RECLAMATION



Schedule of Public Meetings

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Questions and Comments