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WATER RESOURCES RESEARCH CENTER

THE UNIVERSITY OF ARIZONA

COLLEGE OF AGRICULTURE & LIFE SCIENCES

Groundwater, Climate and Stakeholder Engagement (GCASE) for Water Resources Planning and Management

USIBWC - Southeast Arizona Citizens Forum

This work is funded under a grant from the Sectoral Applications Research Program (SARP) of the National Oceanic and Atmospheric Administration (NOAA) Climate Program Office. The views expressed in this report represent those of the authors and do not necessarily reflect the views or policies of NOAA

Susanna Eden
December 2013

wrrc.arizona.edu

Project Team

Investigators: Sharon Megdal, Susanna Eden WRRC – UA; Eylon Shamir, HRC; Karletta Chief, Soil Water & Environmental Science – UA; Christopher Castro, Atmospheric Sciences – UA

Graduate Students: Carlos Carrillo and Hsin-I Chang, Atmospheric Sciences - UA and Jacob Prietto, Hydrology and WRRC - UA

Advisory Committee: Representatives from Arizona Dept. of Water Resources, US Geological Survey, Salt River Project, and City of Nogales, AZ

Stakeholders

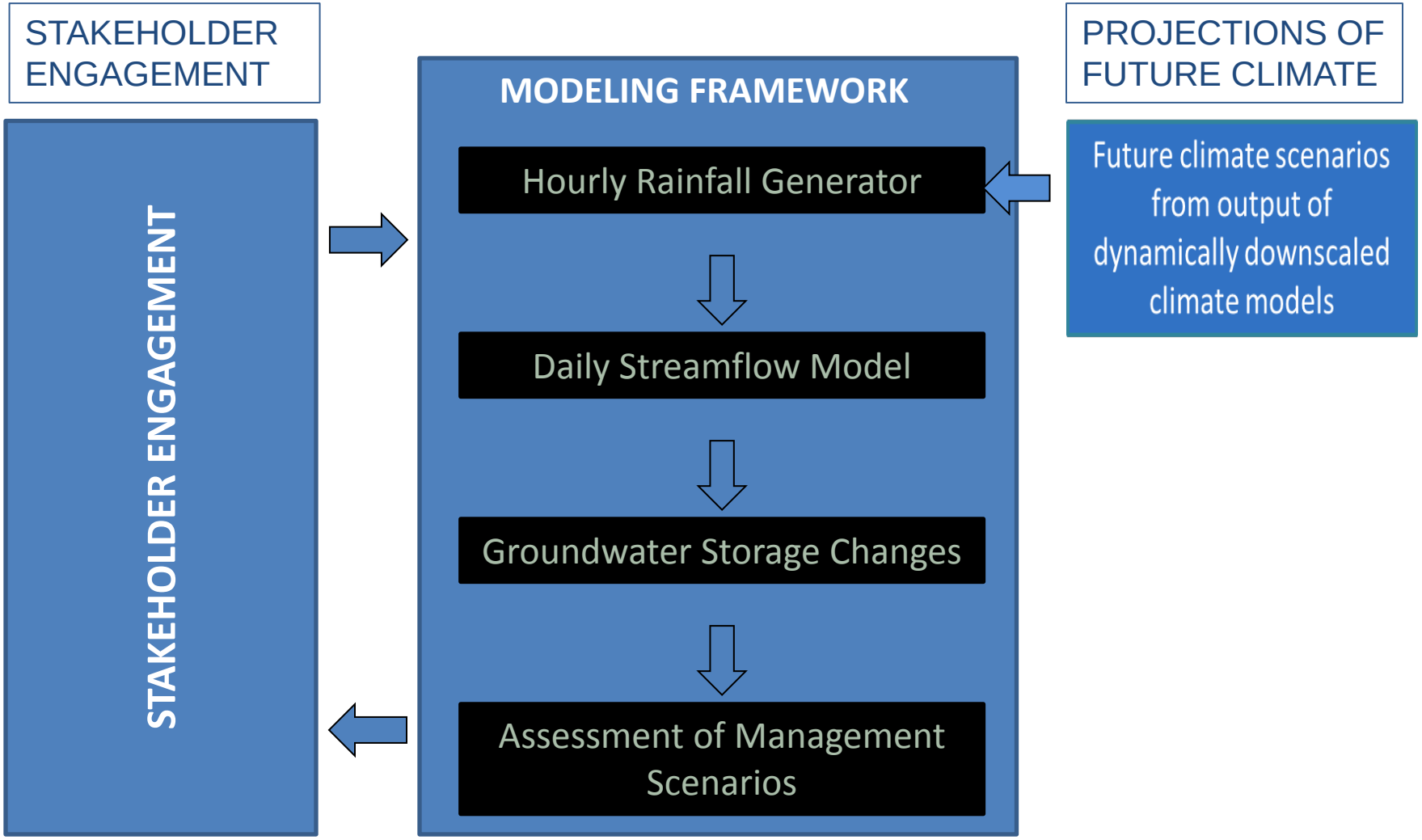
Presentation Outline

1. Project Goals, Approach and Roadmap
2. Case Study Background
3. Modeling Approach and Climate
4. Case Study Results
5. Next Steps

Project Goals

1. Enhance water resources decision support modeling framework to address future climate uncertainties
2. Increase stakeholders capacity to adapt water planning and management to future climate uncertainties
3. Establish transferability of the modeling approach and stakeholder engagement

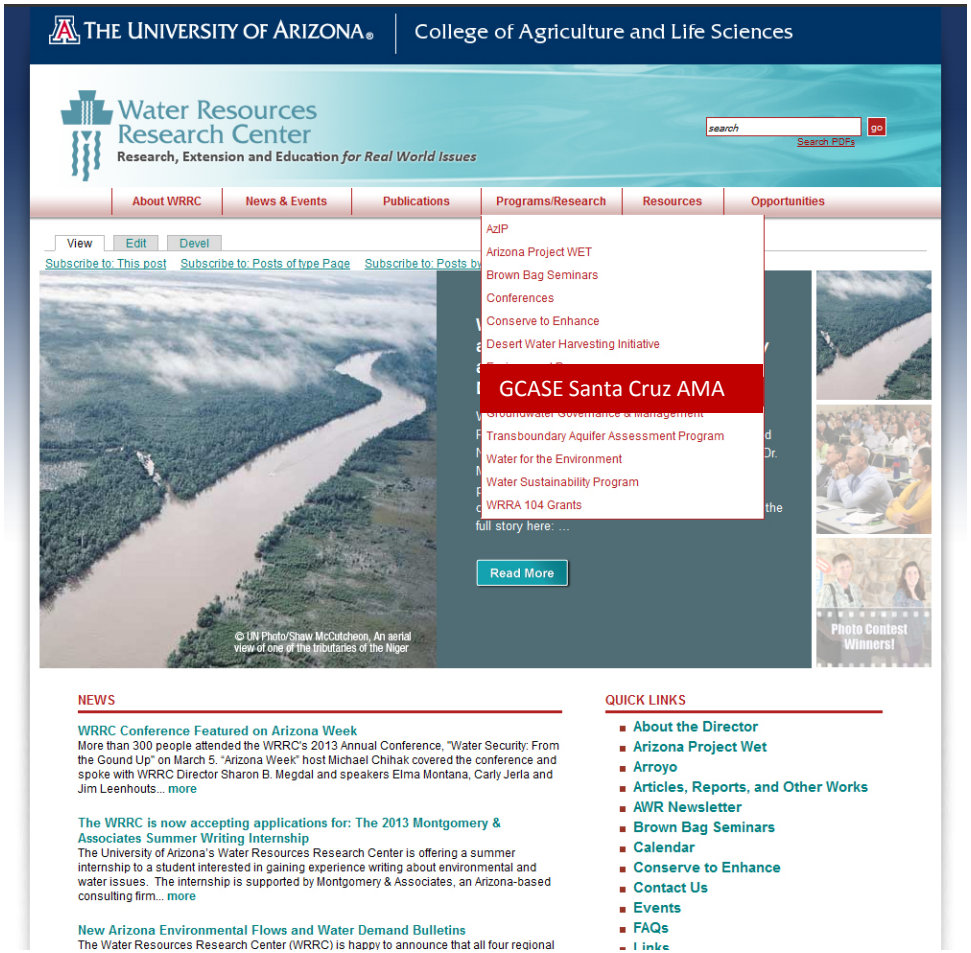
GCASE Project Approach

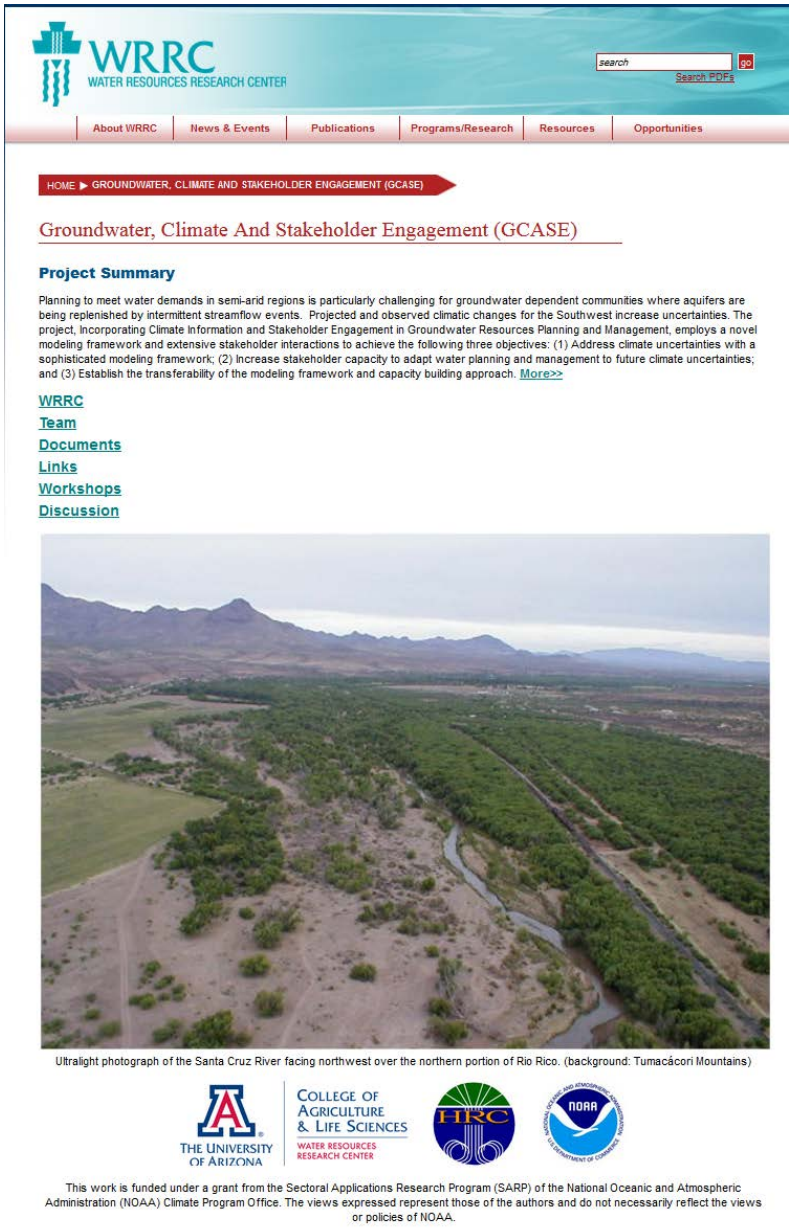


GCASE Stakeholder Engagement

- Kickoff Workshop
  - October 18, 2012
    - Presented modeling framework and developed case study; discussed stakeholder concerns
- Milestone No. 1 Workshop
  - April 11, 2013
    - Presented climate projection findings for the region and revised modeling framework; presented case study for comments
- Milestone No. 2 Workshop
  - November 20, 2013
    - Presented revised case study and discussed transferability
- Four additional workshops
  - Transferability

GCASE Stakeholder Engagement

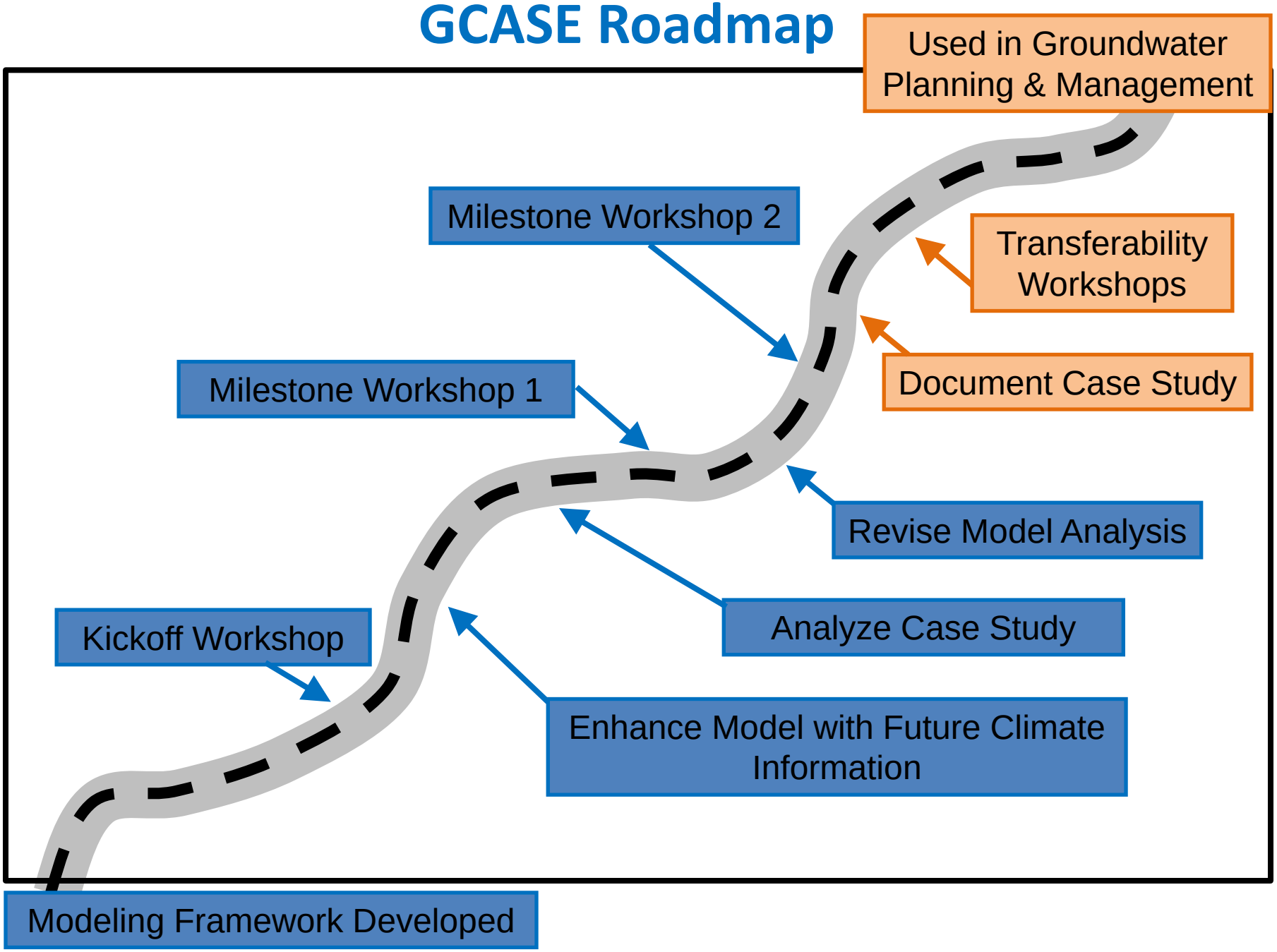




WEBSITE

wrrc.arizona.edu/GCASE

GCASE Roadmap



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Case Study Background

Santa Cruz AMA Goal

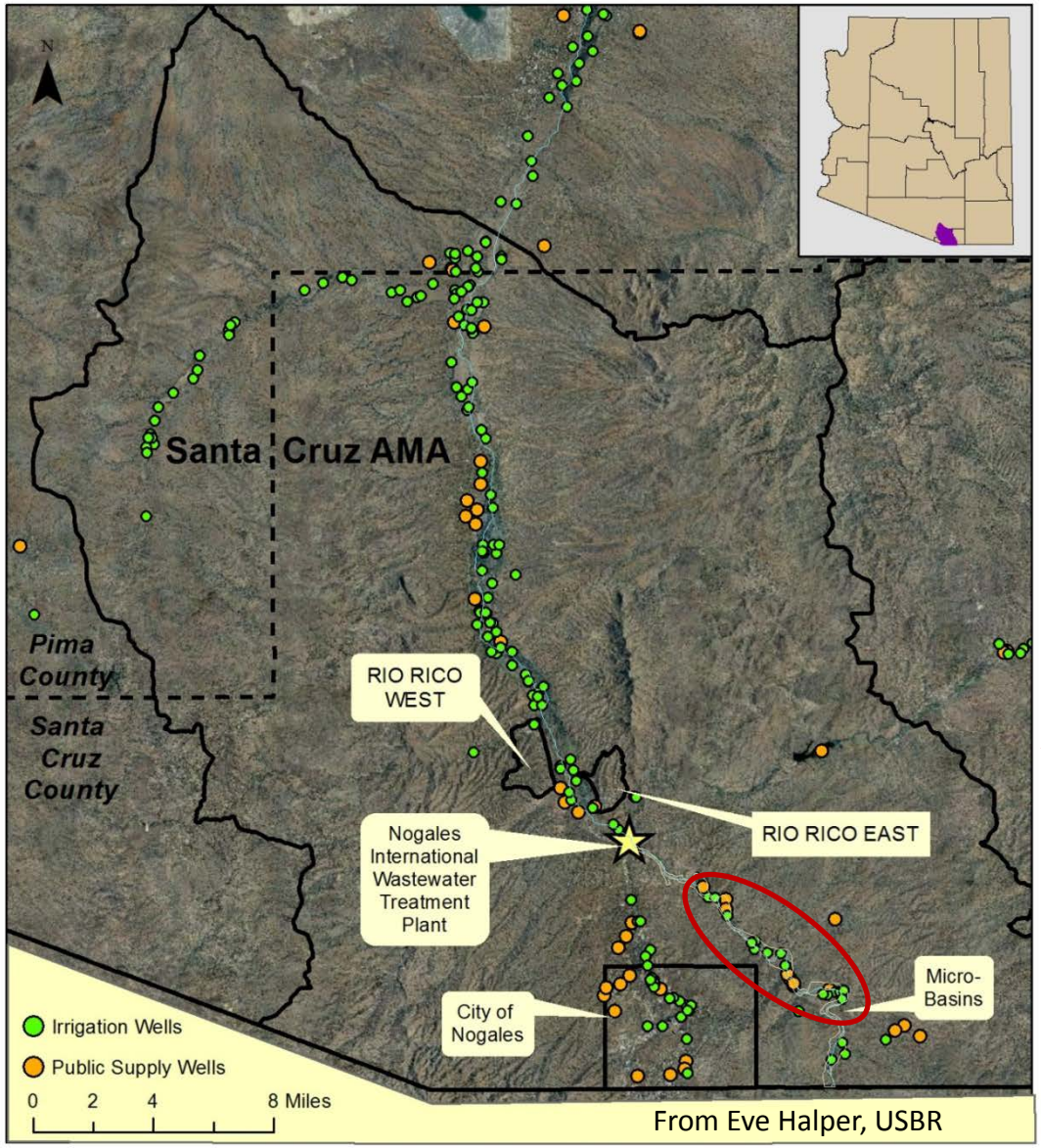
- To maintain a safe-yield condition in the active management area

and

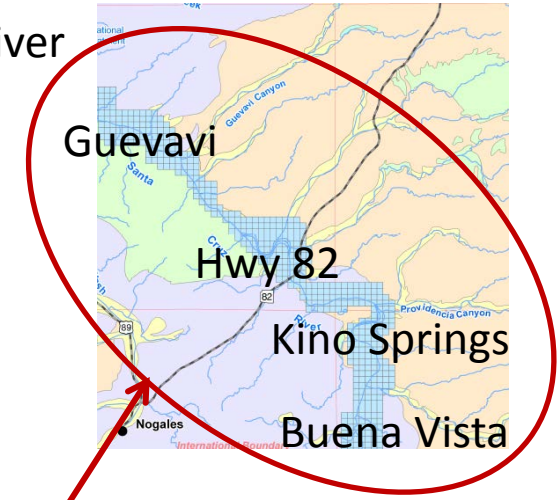
- To prevent local water tables from experiencing long term declines

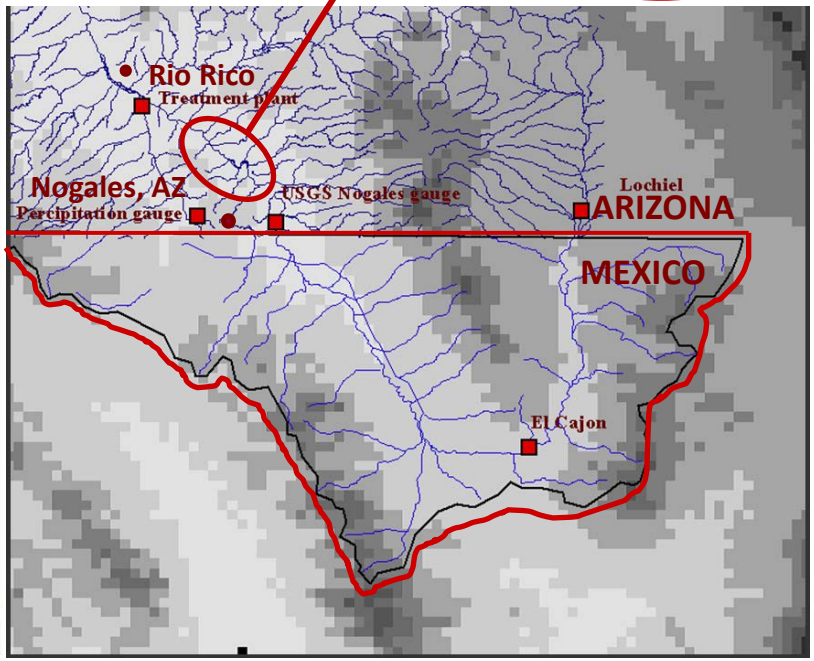
Assured Water Supply Rules on hold since statewide moratorium on rule making

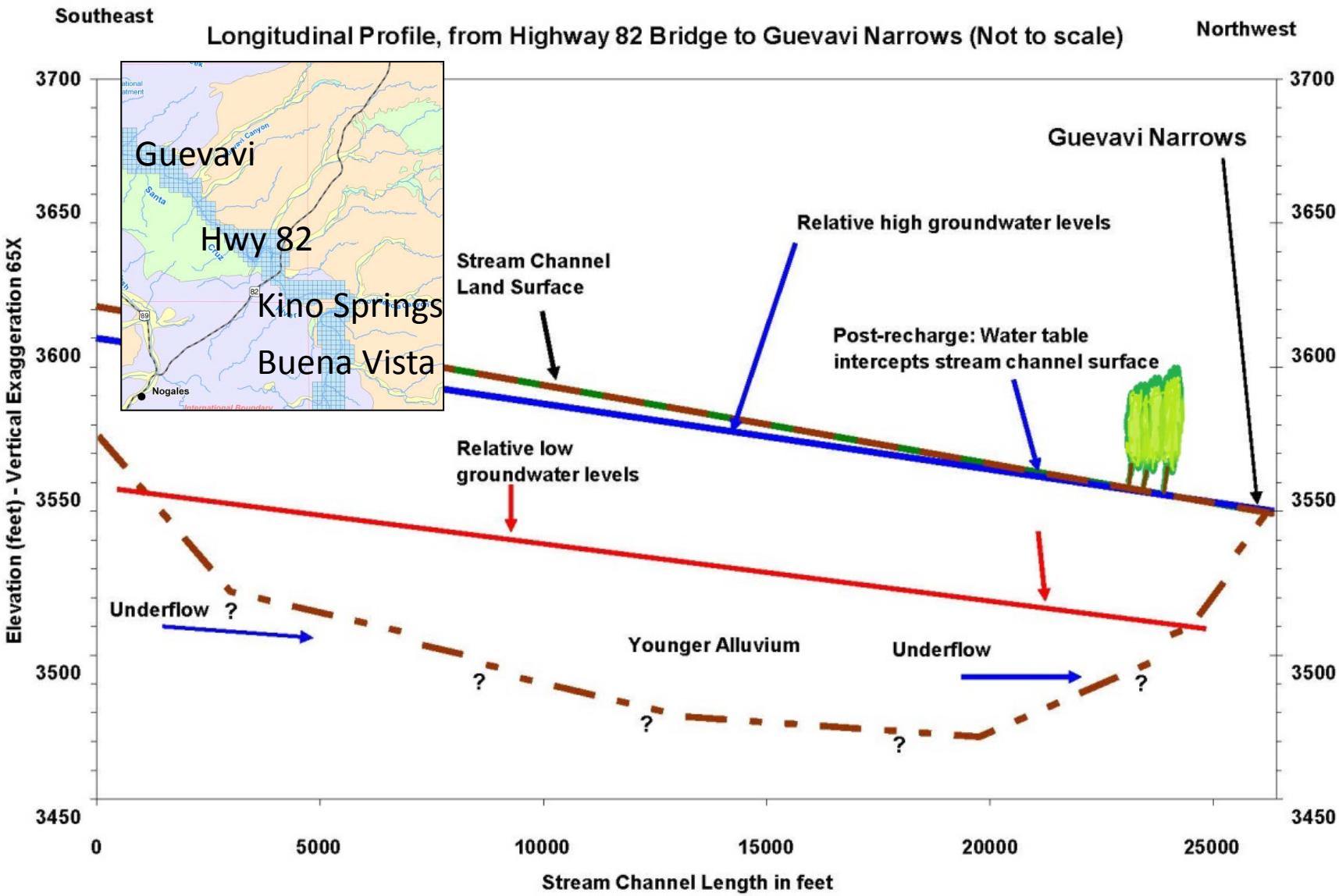
Santa Cruz River Aquifer Microbasins



From Eve Halper, USBR







Modified from K. Nelson, ADWR

Microbasin Streamflow Cycle

From Keith Nelson, ADWR

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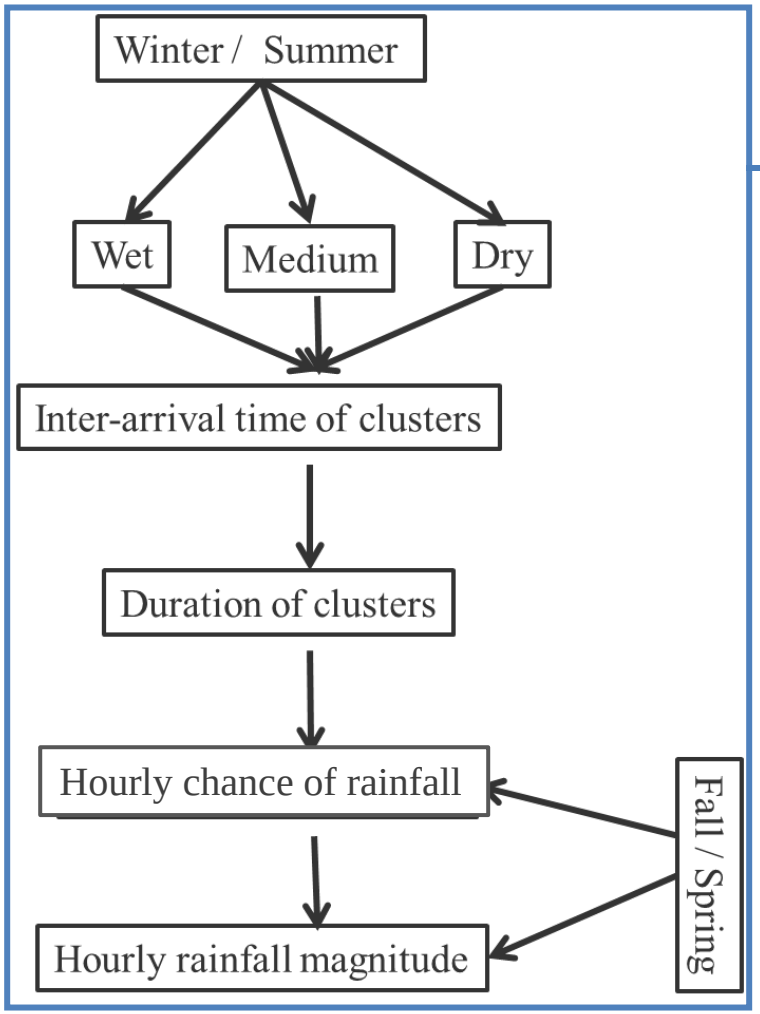
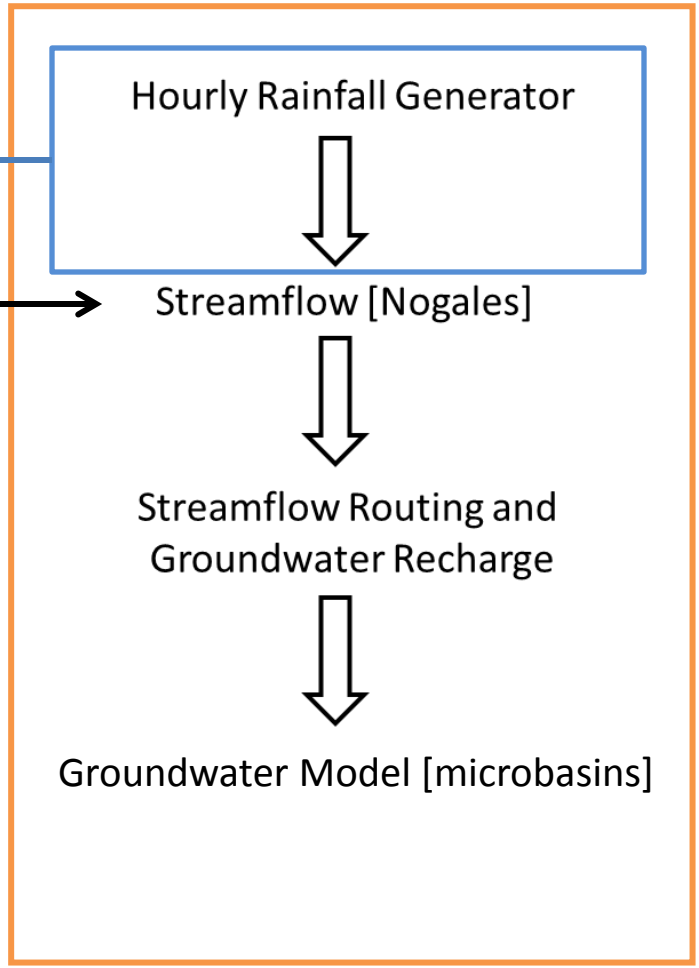
Rainfall Generator



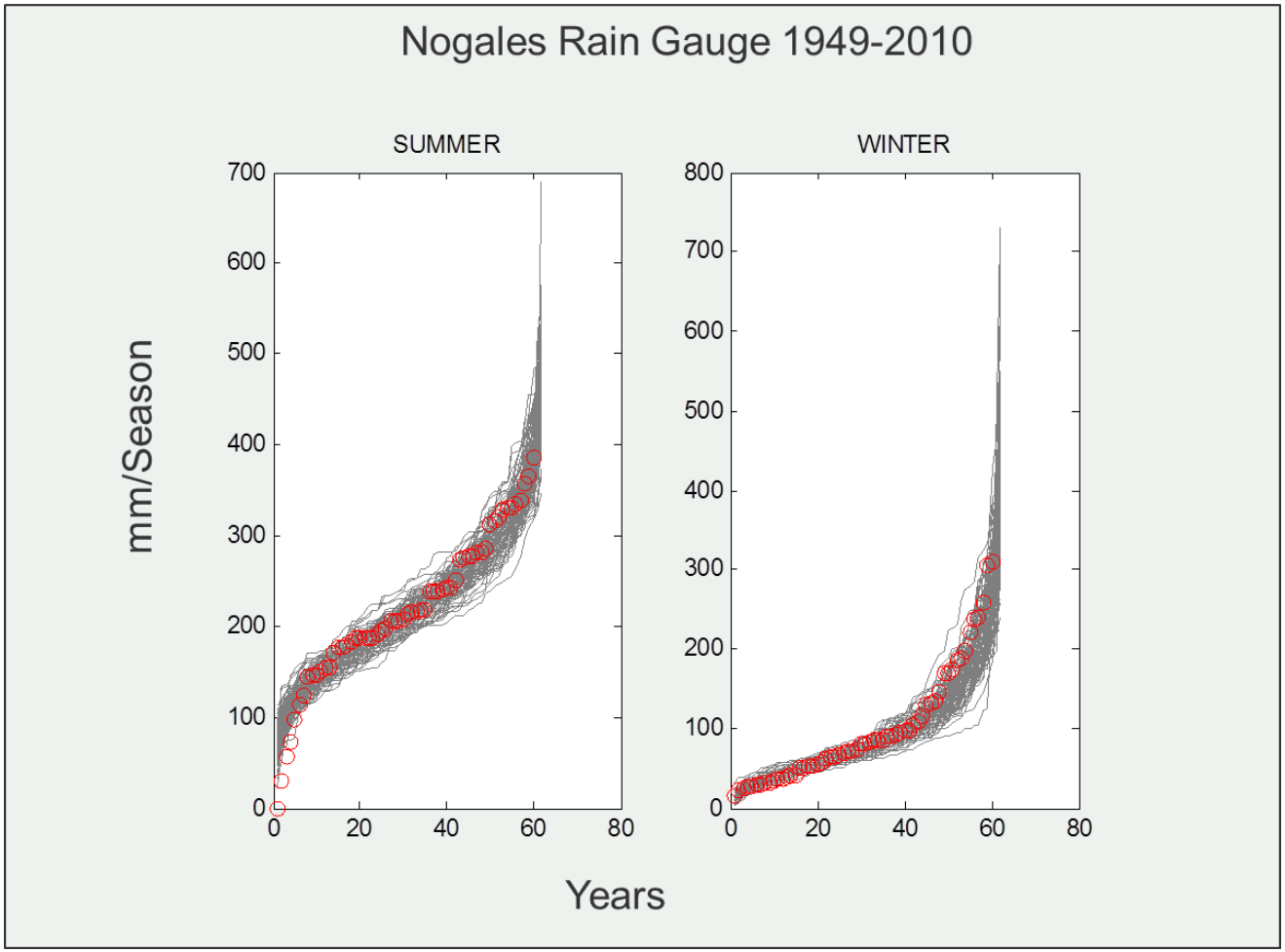
Multiple Likely Rainfall Scenarios

Modeling Framework



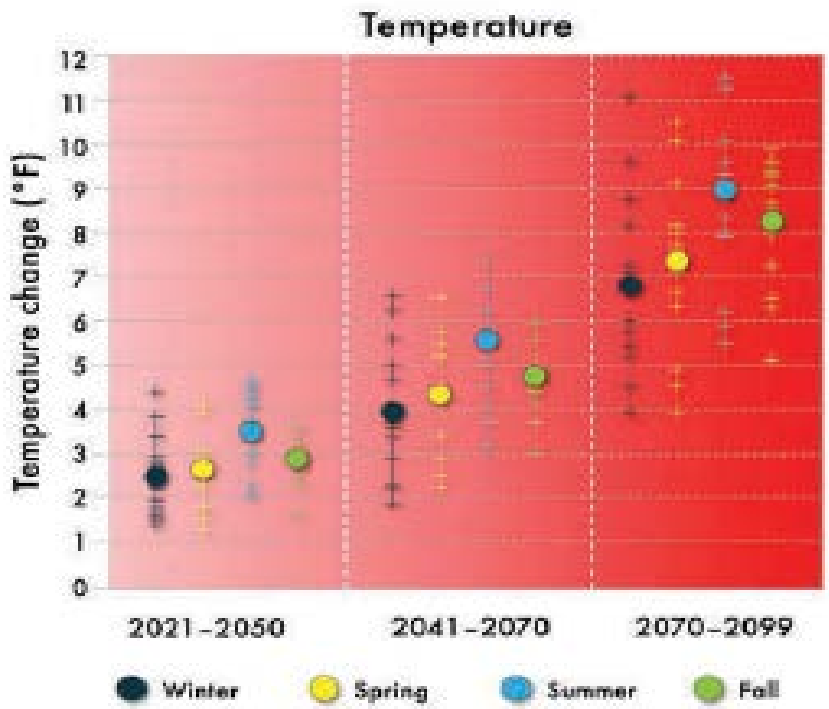
Multiple Likely Groundwater Response Scenarios

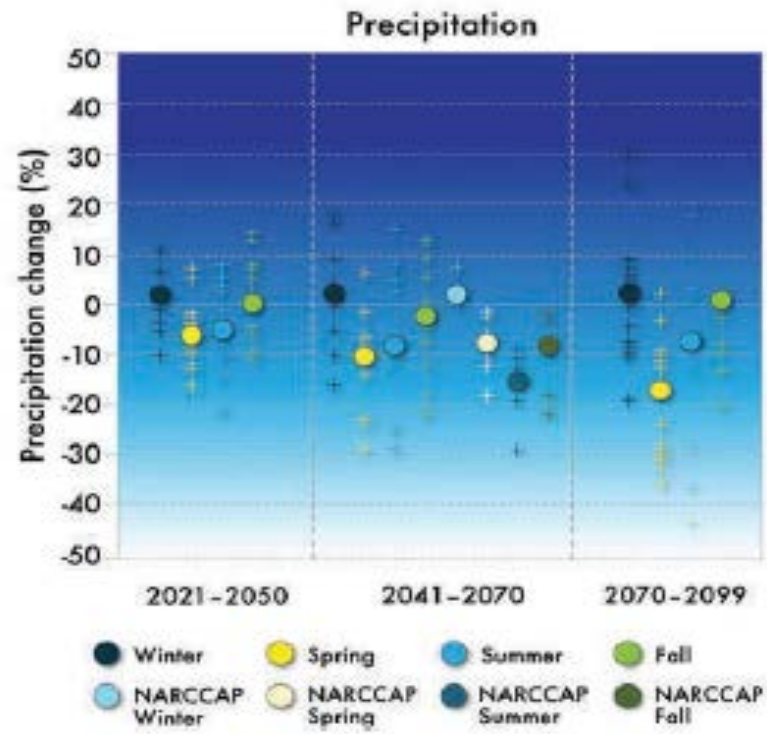
100 likely scenarios based on historic record
Each scenario is 60 years of hourly rainfall



Climate Projection for the Southwest

- **Summer**: precipitation decreases and temperature increases
- **Winter**: precipitation is substantially unchanged and temperature increases

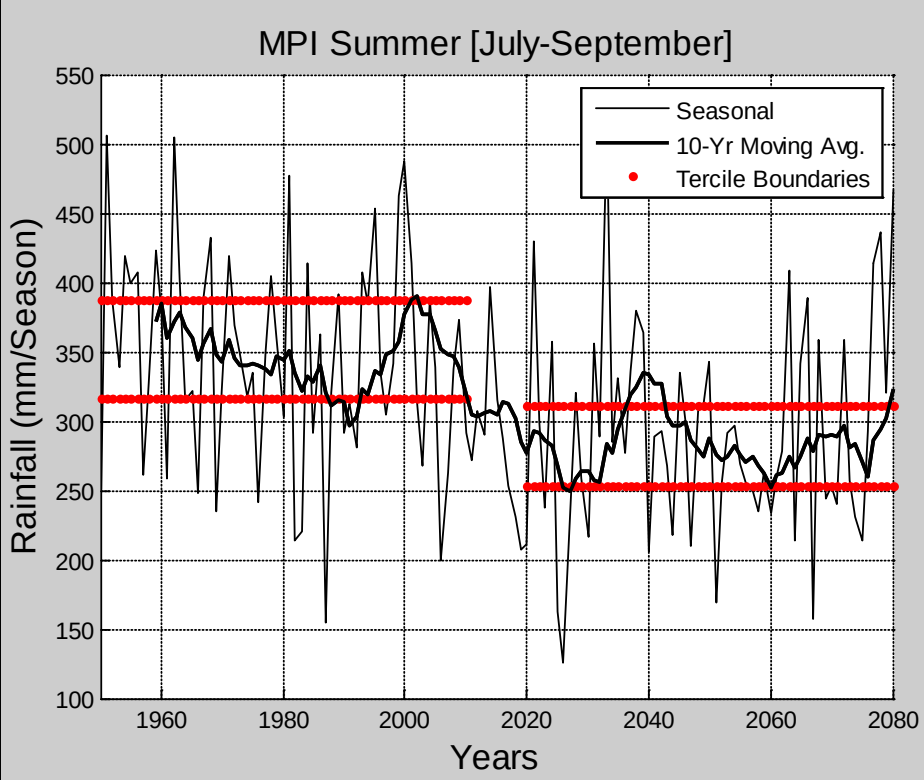


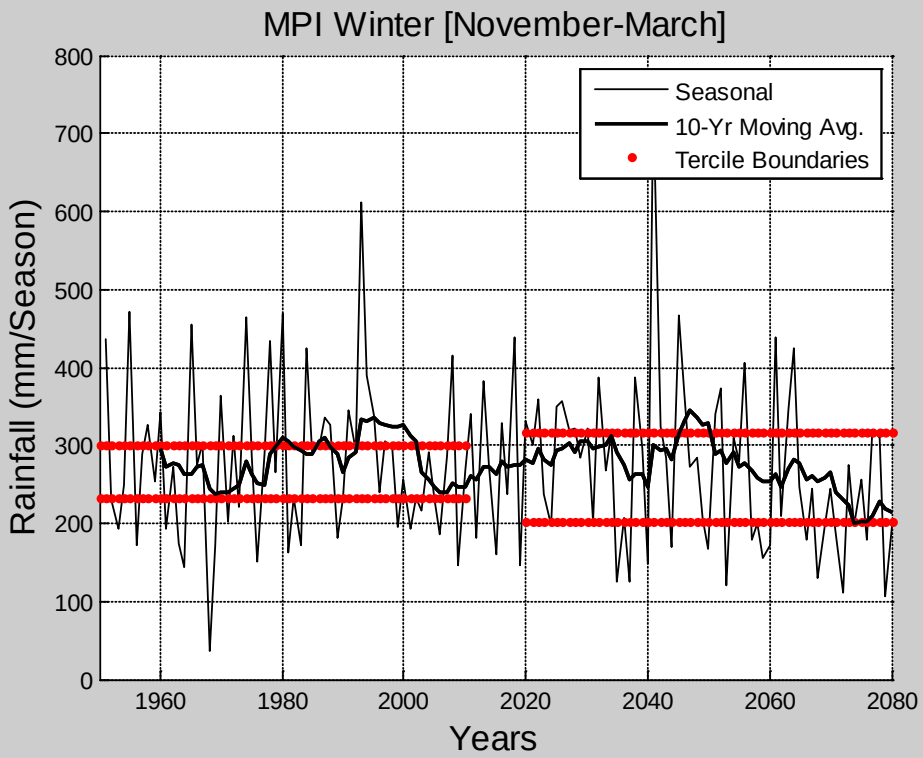


From H. Chang, ATMO

Rainfall Projection – Regional Climate Model Downscaled from Well-performing Global Climate Model

(Weather Research and Forecasting/Max Planck Institute)



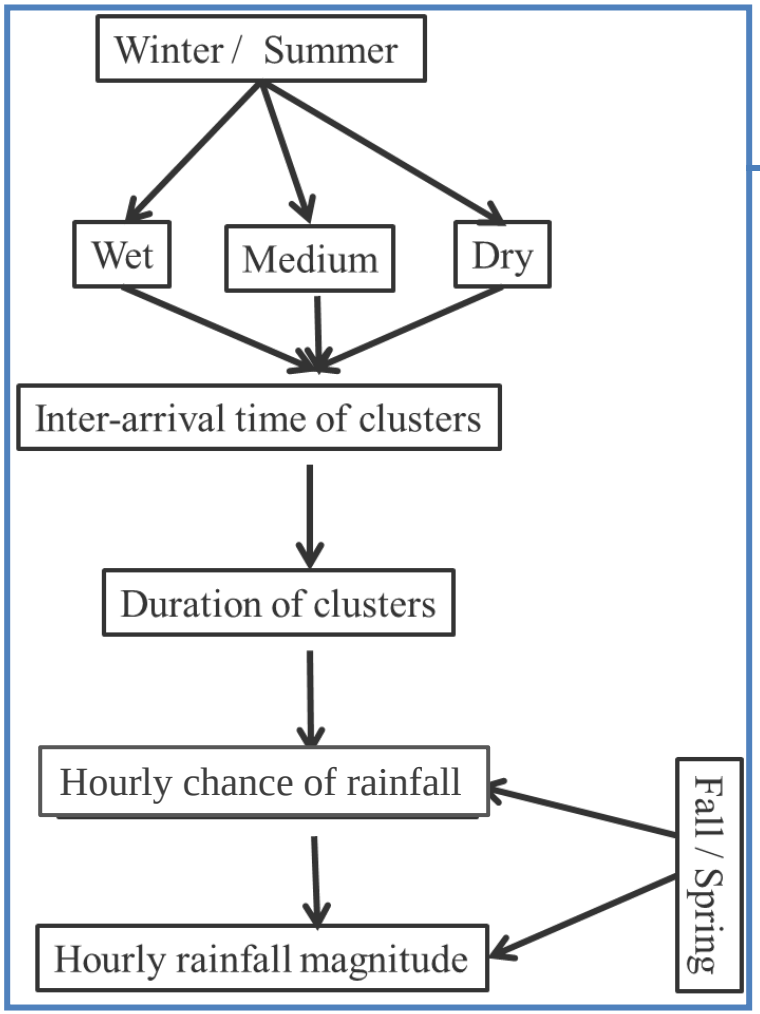


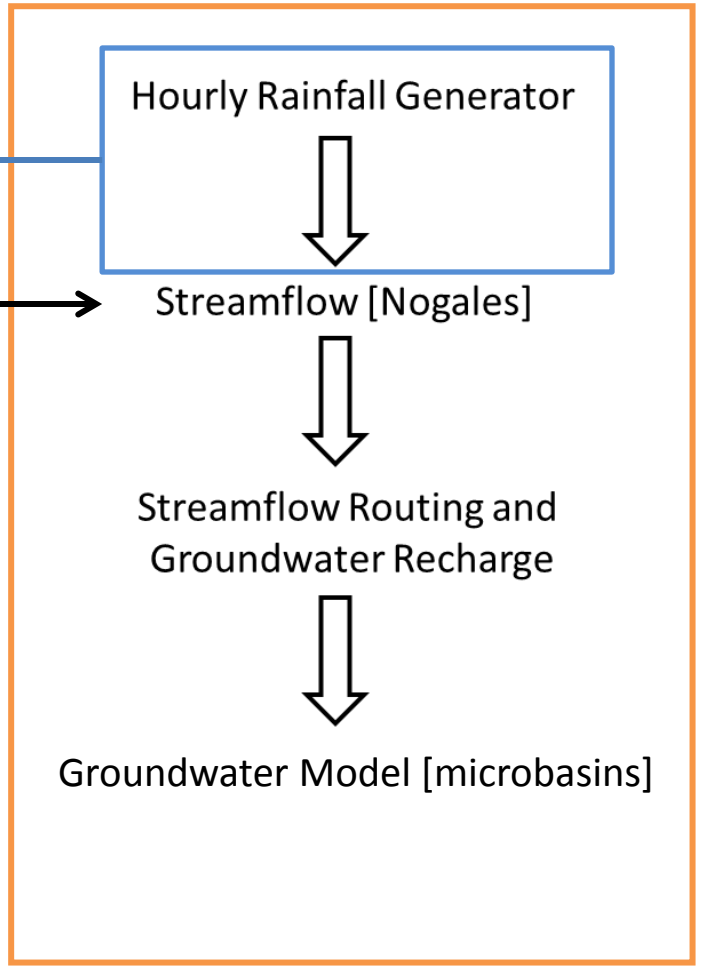
Reduction in summer precipitation

Higher variability in winter precipitation

Rainfall Generator

Modeling Framework





Multiple Likely Future Rainfall Scenarios

Multiple Likely Future Groundwater Scenarios

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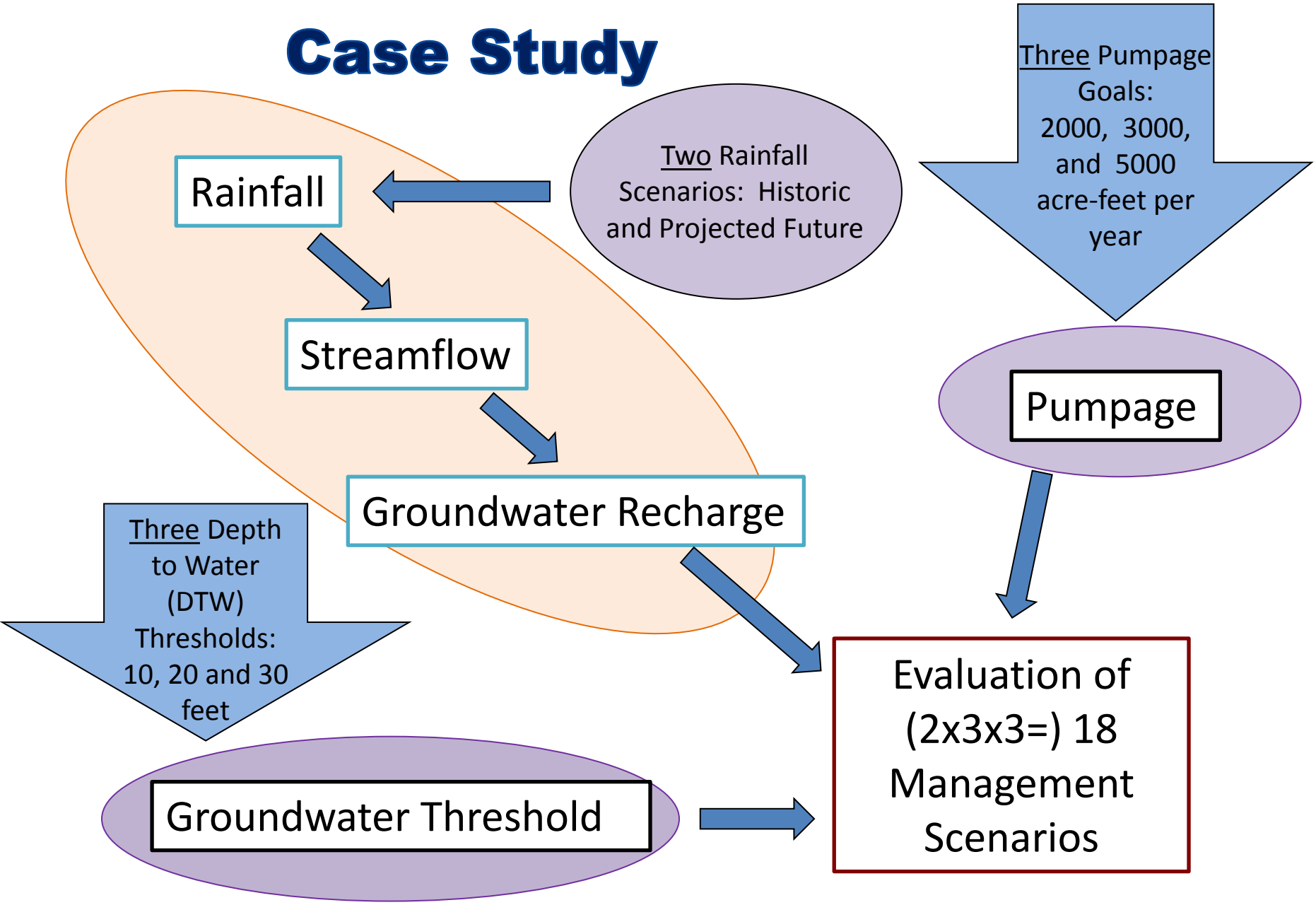
Case Study


Rainfall
Two Rainfall Scenarios: Historic and Projected Future
Three Pumpage Goals: 2000, 3000, and 5000 acre-feet per year
Streamflow
Pumpage
Groundwater Recharge
Three Depth to Water (DTW) Thresholds: 10, 20 and 30 feet
Evaluation of (2x3x3=) 18 Management Scenarios
Groundwater Threshold

Questions the Model Can Answer about Reliability and Uncertainty

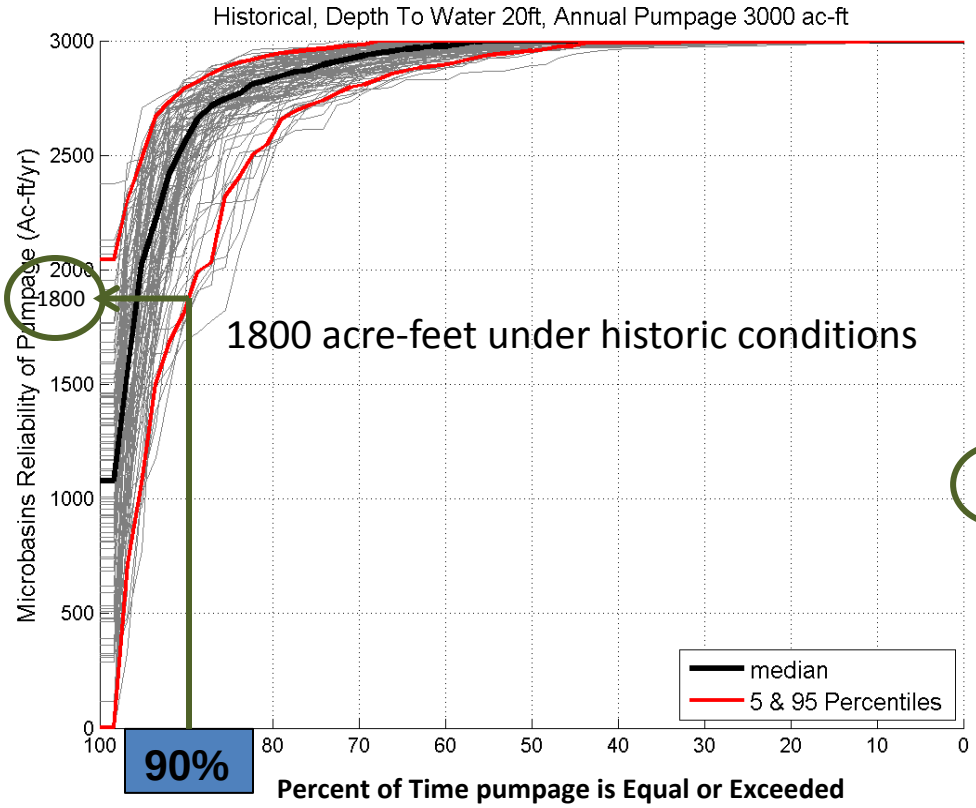
How much can you count on being able to pump from the microbasins

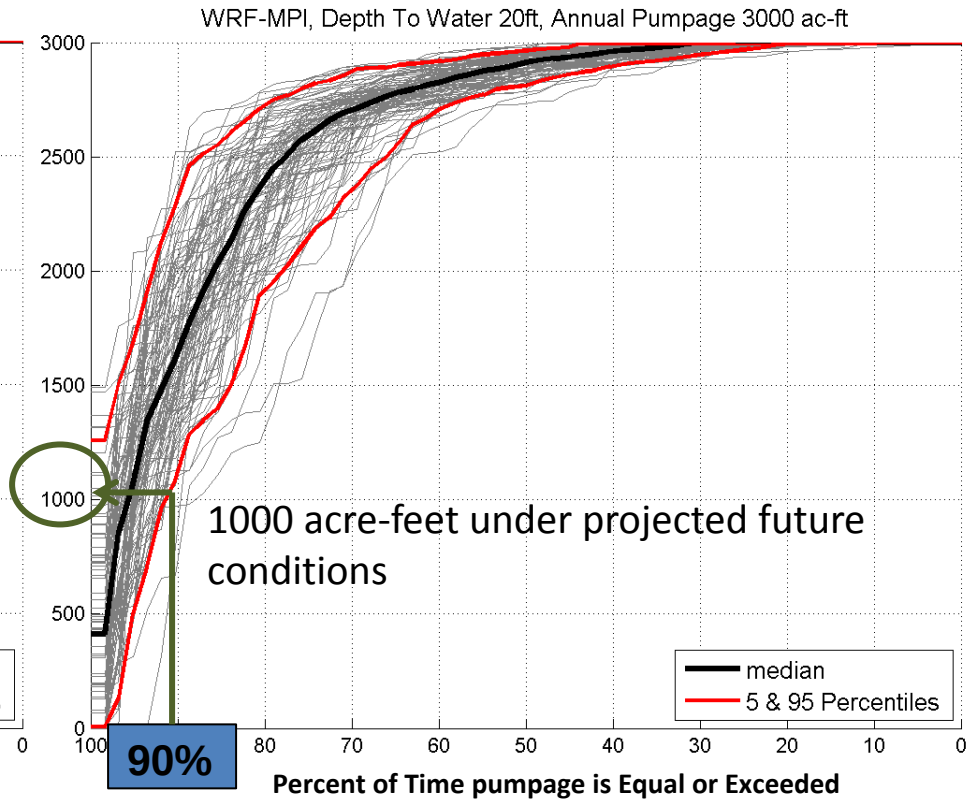
- 90% of the years with 95% confidence
- if your pumping rate is 3000 acre-feet per year
- if you stop pumping when groundwater levels fall below 20 feet?

Example Results of Hypothetical Pumping Strategy 100 realizations each 62 years long

HISTORIC
Threshold DTW 20 ft
Pumpage 3000 ac-ft/yr

FUTURE
Threshold DTW 20 ft
Pumpage 3000 ac-ft/yr

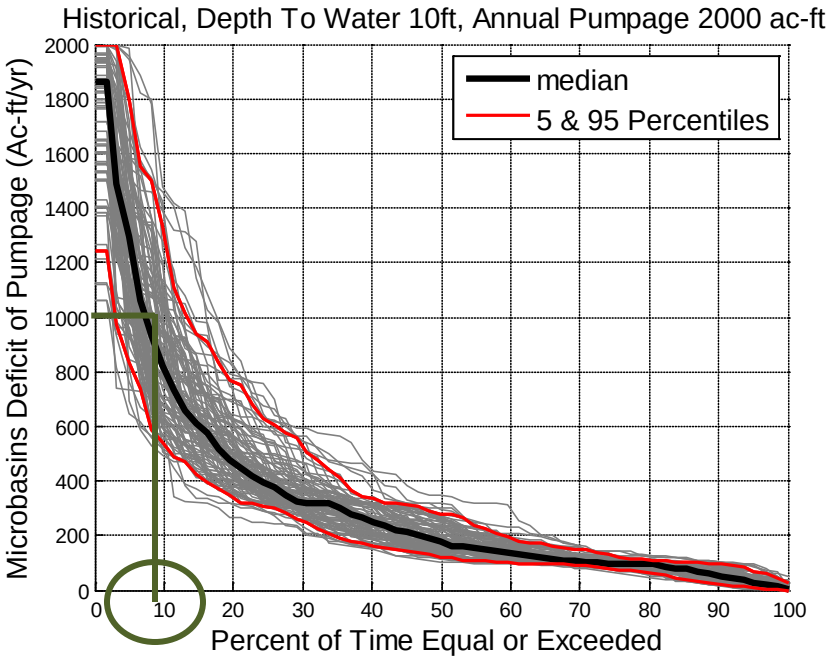




Questions the Model Can Answer about Reliability and Uncertainty

How often will you fall short of your annual pumping goal by up to 1000 acre-feet

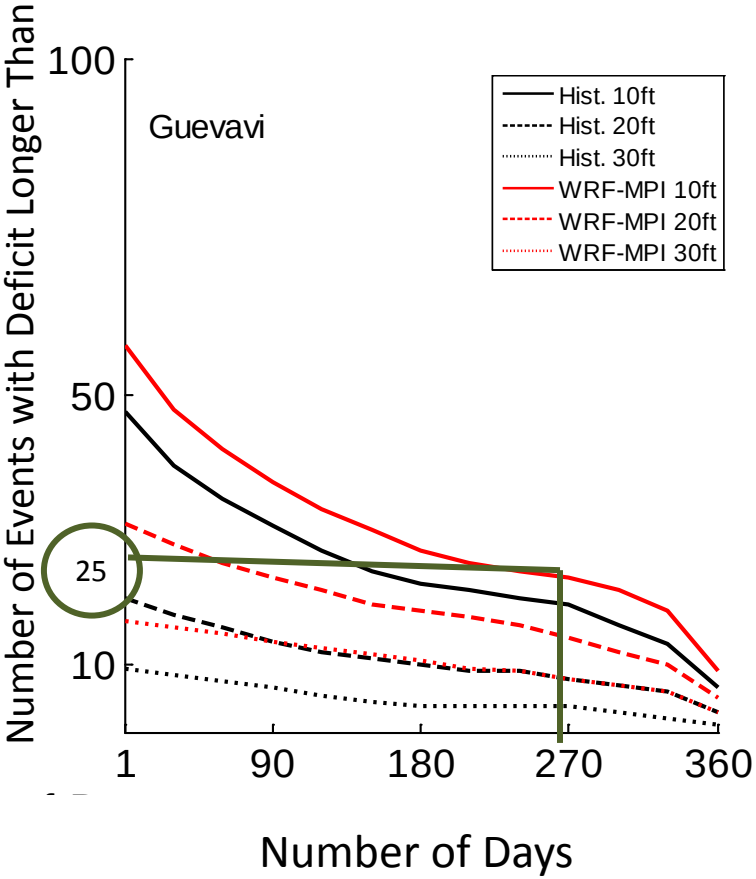
- on average [median]
- if your pumping goal is 2000 acre-feet per year
- if you stop pumping when groundwater levels fall below 10 feet?
  - Almost 10% of the time under historic conditions



Questions the Model Can Answer about Reliability and Uncertainty

How often will the groundwater level remain at or below the threshold of 10 feet in Guevavi basin for up to 300 days

- at the 95% confidence level
- at a pumping rate of 5000 acre-feet per year?
  - About 24 times in 60 years, under projected future conditions



Freemont Cottonwood – 27 Studies

Age	Ecology	Relationship	Depth (m)	Rate	Citation #
Seed	Abundance	Associated with	<0.8 to <1.6	< 4.4 cm/day	11
	Survivorship		<1.0	2 cm/day	13
	Abundance/Survivorship	Enhanced by	0.5 to < 2.6	< 2 to 3 cm/day, <0.5 m/year	5, 16
Juvenile	Abundance/Survivorship	Associated with	0.2 to 2		8, 13
Adult	Abundance/Composition	Associated with	1 to 3	< 1m/ year	4, 7, 8, 14
	Abundance/Survivorship/ Heath		0.1 to 5.1		2, 13
	Abundance	Enhanced by	< 1.5		6
			< 2.6 to 2.7		1, 5
	Health		0.5 to 2.3		15
	Survivorship/Health	Harmed by	>2 to 3	abrupt > 1m	2, 12, 15

From Water RAPIDS

Adult Cottonwood Survival Threshold Corresponds Approximately to the Case Study's 10-foot Threshold

Age/ Species
- Adult/ Cottonwood

Ecologic Relationship
- Survivorship Harmed By

Hydrologic Variable
- Maximum Groundwater Depth
- Rate of Decline

Photo from Keith Nelson

- >2 to 3m
- abrupt > 1m

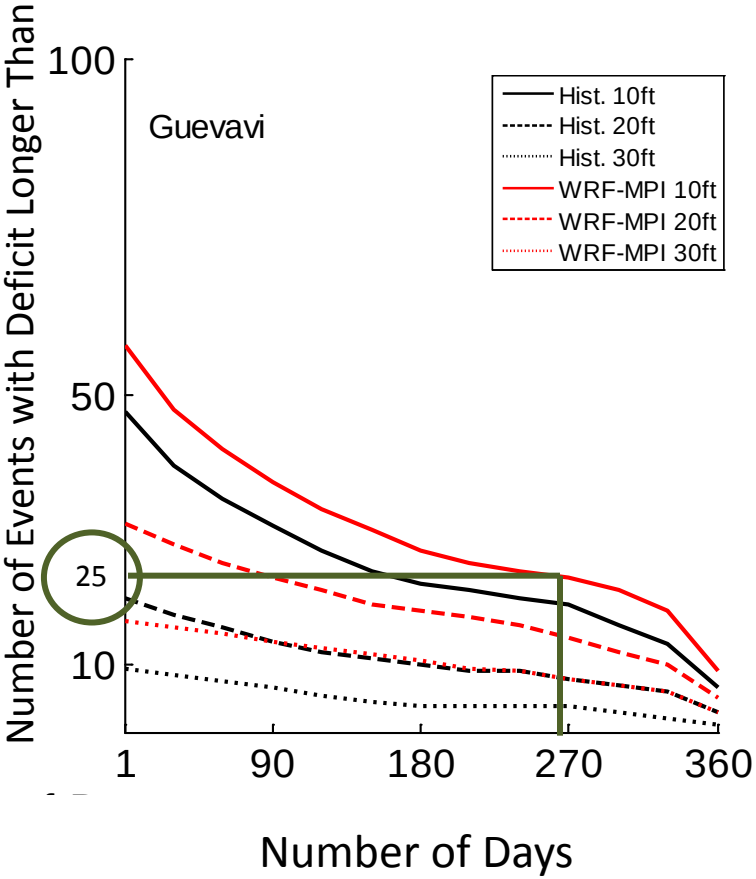
(>6.5 to 10 feet)

3 studies

Questions the Model Can Answer about Reliability and Uncertainty

How often will the groundwater level remain at or below the threshold of 10 feet in Guevavi basin for up to 270 days

- at the 95% confidence level
- at a pumping rate of 5000 acre-feet per year?
  - About 25 times in 60 years, under projected future conditions

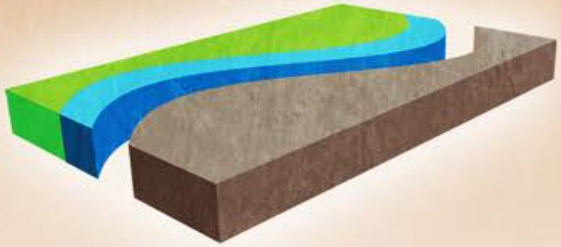


Next Steps

- Case study documentation
  - Technical and scientific documentation
  - Materials for stakeholders of diverse backgrounds
- Transferability workshops in four locations
  - Locations under consideration
    - Upper San Pedro watershed
    - Gila River watershed
    - Hassayampa/Tonopah Region
    - Prescott-Verde River area
    - Oro Valley region
    - Santa Cruz River downstream of the current study area, which receives outflows of binational wastewater treatment plant
    - Others?

WRRC CONFERENCE 2014

CLOSING THE GAP BETWEEN WATER SUPPLY AND DEMAND



TUESDAY, APRIL 8, 2014
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WRRC Weekly Wave
August 6, 2013
Vol. Staff Beta Test

In This Issue:
- Summer Arizona Water Resource
- Photo Recap: Jean McLain in Israel
- WSP Research Highlights
- New EnWaP Database

... And much more!

Upcoming Events

Aug. 9	Sept. 10	Sept. 12	Sept. 20	Oct. 10	Nov. 13
Brown Bag Seminar: Prof. Amit Gross (Ben Gurion Univ.)	National Protect Your Groundwater Day	Brown Bag Seminar: Tony Willardson (WSWC)	Ready or Hot? Climate Smart Southwest Water Conference (TCC)	Brown Bag Seminar: Dr. Benjamin Ruddell (ASU)	WSP Distinguished Speaker Series: Dr. Alon Tal (Ben Gurion Univ.)

WRRC CONFERENCE 2014

BROWN BAG BULLETIN

Save the Date: April 8, 2014

The WRRC's 2014 Annual Conference, "Closing the Gap Between Water Supply and Demand," will be held Tuesday, April 8, 2014 at the University of Arizona Student Union Memorial Center in Tucson, Ariz.

Up Next: Aug. 9, Prof. Amit Gross

Scarce Water Resources and Development of Appropriate Decentralized Technologies for Sustainable Water Supply in the Negev Desert

Location: WRRC Sol Resnick Conference Room (350 N. Campbell)
Time: 2 - 3:30 p.m.

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EnWaP Launches Database | Facebook Photo Recap: | WRRC in the News