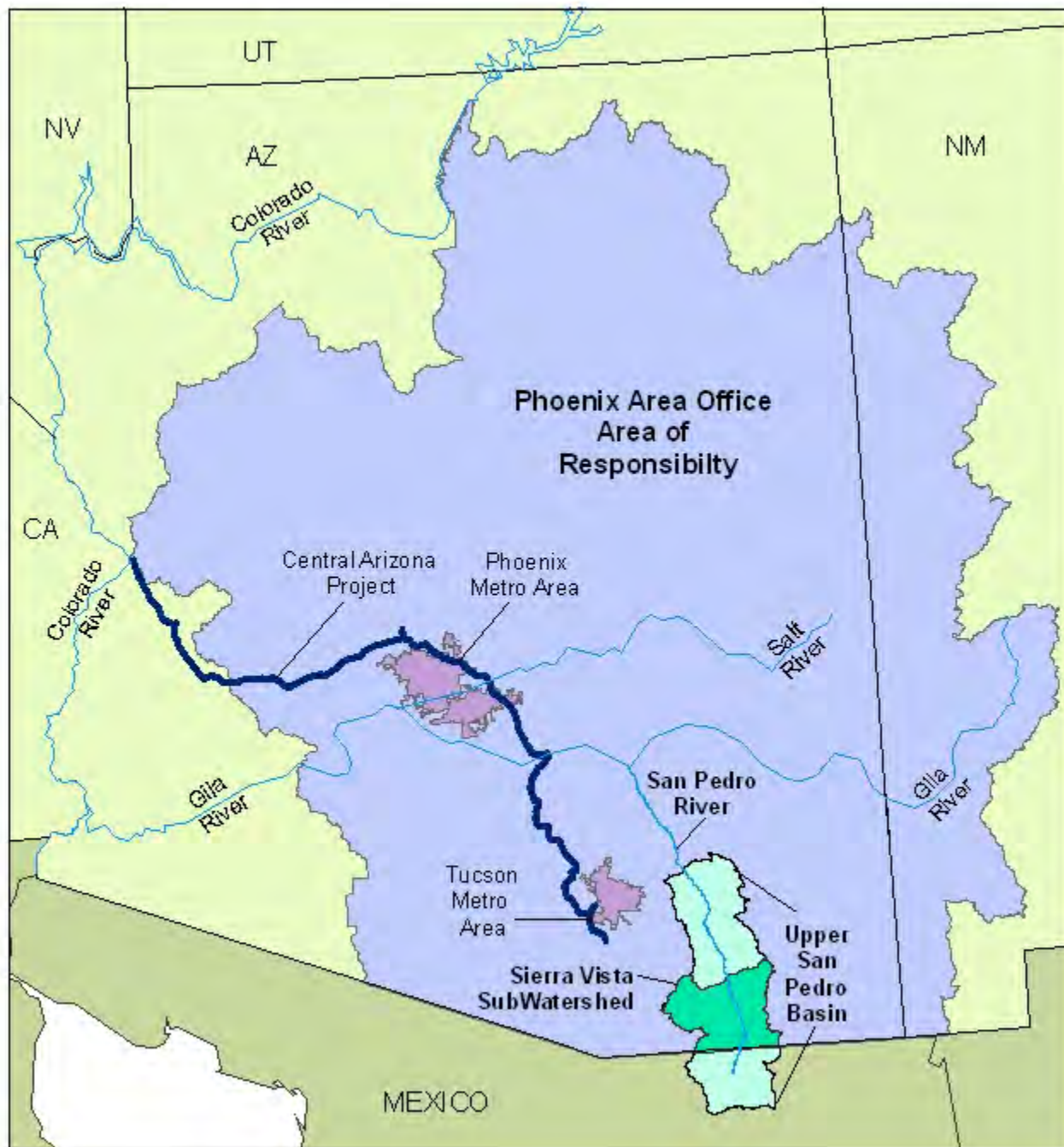




Augmentation Alternatives for the Sierra Vista Sub-watershed, Arizona

Presentation on
Final Report
March 2008





What is the Upper San Pedro Partnership (USPP)?

A consortium of 21 agencies and organizations working together to meet the water needs residents, while protecting the San Pedro River



Includes Federal, State of Arizona, local public agencies, as well as non-profits and private sector

RECLAMATION

USPP Members

Federal	Local
<p>Fort Huachuca Bureau of Land Management (BLM) U.S. Forest Service (USFS) National Park Service (NPS) Reclamation U.S. Geological Survey (USGS) U.S. Department of Agriculture, Agricultural Research Service (USDA-ARS) U.S. Fish and Wildlife Service (USFWS)</p>	<p>Cochise County City of Sierra Vista Huachuca City City of Bisbee City of Tombstone</p>
State	Private and non-governmental
<p>State Land Department Arizona Department of Environmental Quality (ADEQ) Arizona Department of Water Resources (ADWR) Hereford Natural Resource Conservation District</p>	<p>The Nature Conservancy Audubon Arizona Bella Vista Ranches Arizona Association of Conservation Districts</p>

RECLAMATION

Section 321 of 2004 Defense Appropriations Act:

- Recognizes Upper San Pedro Partnership as entity in charge of “collaborative water use management” to achieve sustainable yield
- Requires annual reports on measures necessary and progress to achieve “**sustainable yield**” by 2011 and beyond

RECLAMATION

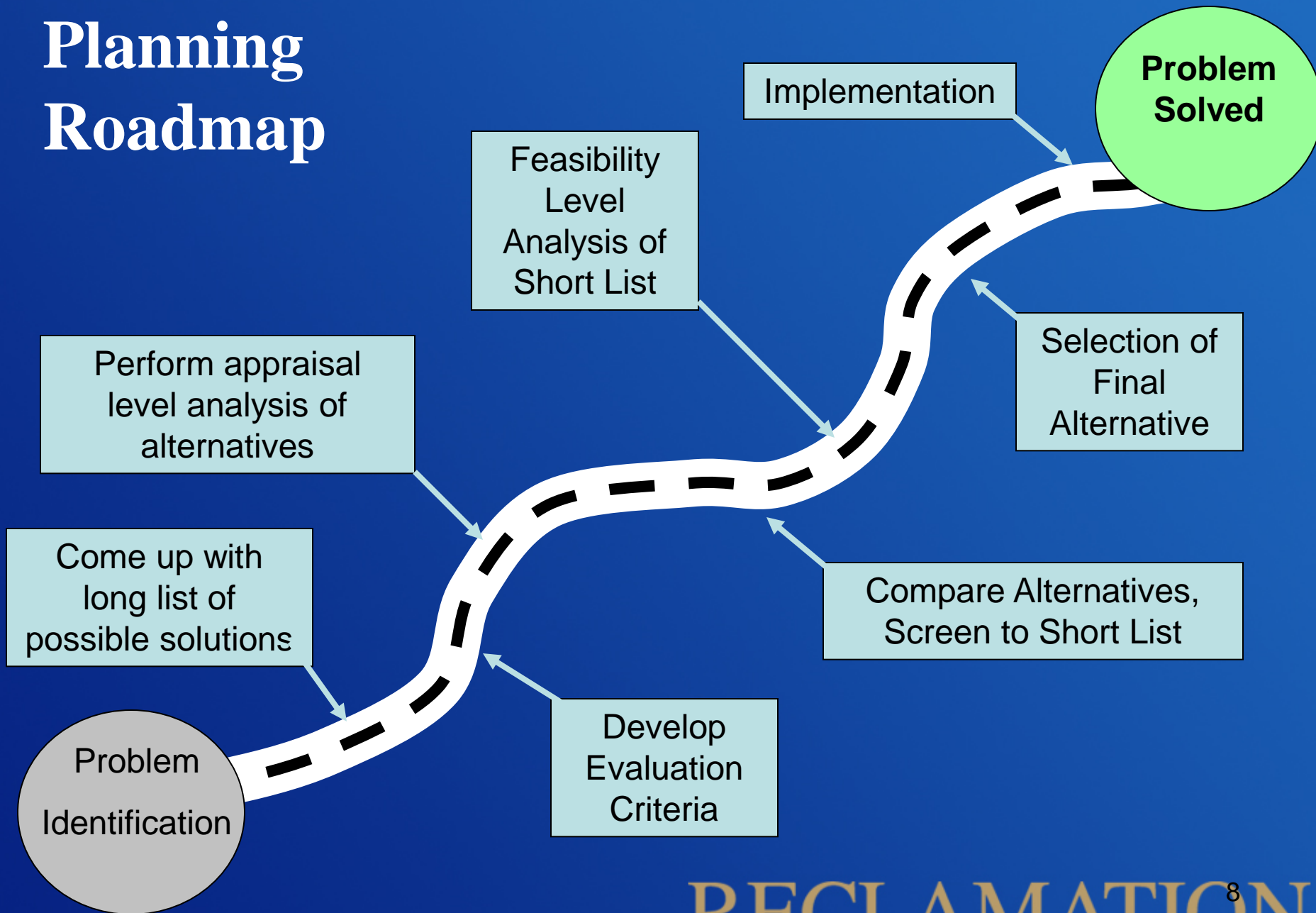
Overview

- Describe planning process, aka Planning Roadmap
- Overview of Appraisal Study (actually a “Special Study”)
 - Describe augmentation alternatives
 - Evaluation Criteria
 - Screening Process and Results
- Implementation “next steps”:
 - Legal & Institutional
 - Decision-making
- Status & Observations

Appraisal Study (Special Study)

- Process to determine whether to proceed to implementation.
- Identify plans for meeting objectives – clearly identify the problem.
- Identifies an array of alternatives, screened and evaluated to justify potential Federal involvement.

Planning Roadmap



Development of Problem Statement

How to translate concept of
“**sustainable yield**”

called for in Section 321 into:

- A volume of water to augment the supply in the SVS
- The best way(s) to use the augmentation water to address the problem

Problem Statement

Water levels in parts of the regional aquifer of the Sierra Vista Sub-watershed are declining, with the potential to impact the

hydrologic conditions of the San Pedro Riparian National Conservation Area.

Problem Statement

- A set of water augmentation solutions is needed that would add approximately

10,000 afy by 2011

and **26,000 afy by 2050**

to negate a portion of the 38,500 afy total demand projected by 2050.

Problem Statement Assumptions

- Calculation assumptions include:
 - **2050 sub-watershed population of 170,000 people**--based on 321 Report projections extrapolated out to 2050.
 - **Actual GPCD for 2004 (202 gpcd)** (includes all water uses—population, recreation, and industrial, agricultural).
 - All figures are estimates based on current available information for planning purposes only. They will need to be refined over time as new information becomes available.

Problem Statement Assumptions

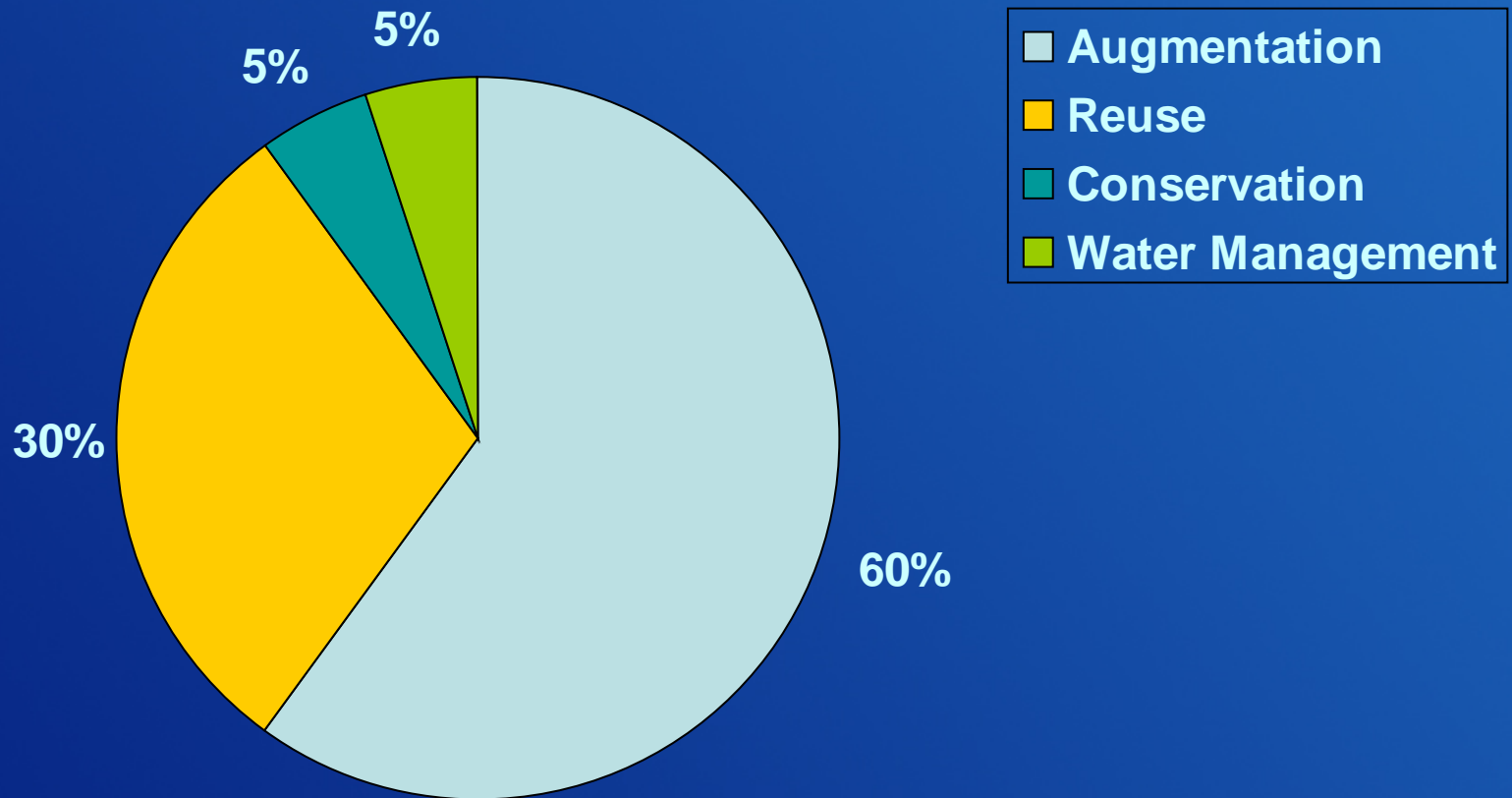
Water augmentation would:

supplement

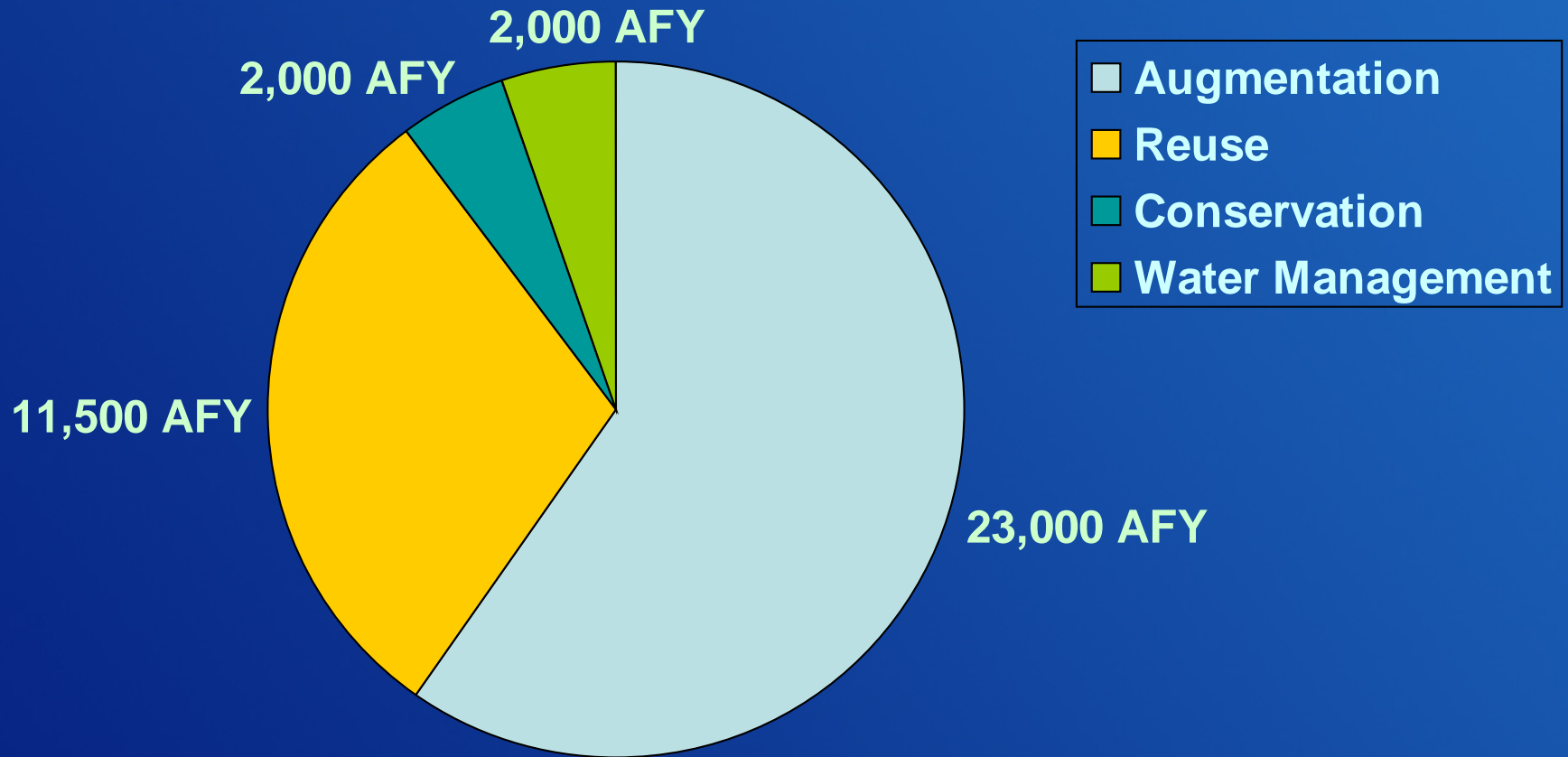
existing and future recharge, reuse, conservation and other water resource management solutions

An estimated **50%** of the augmentation project water can be reused.

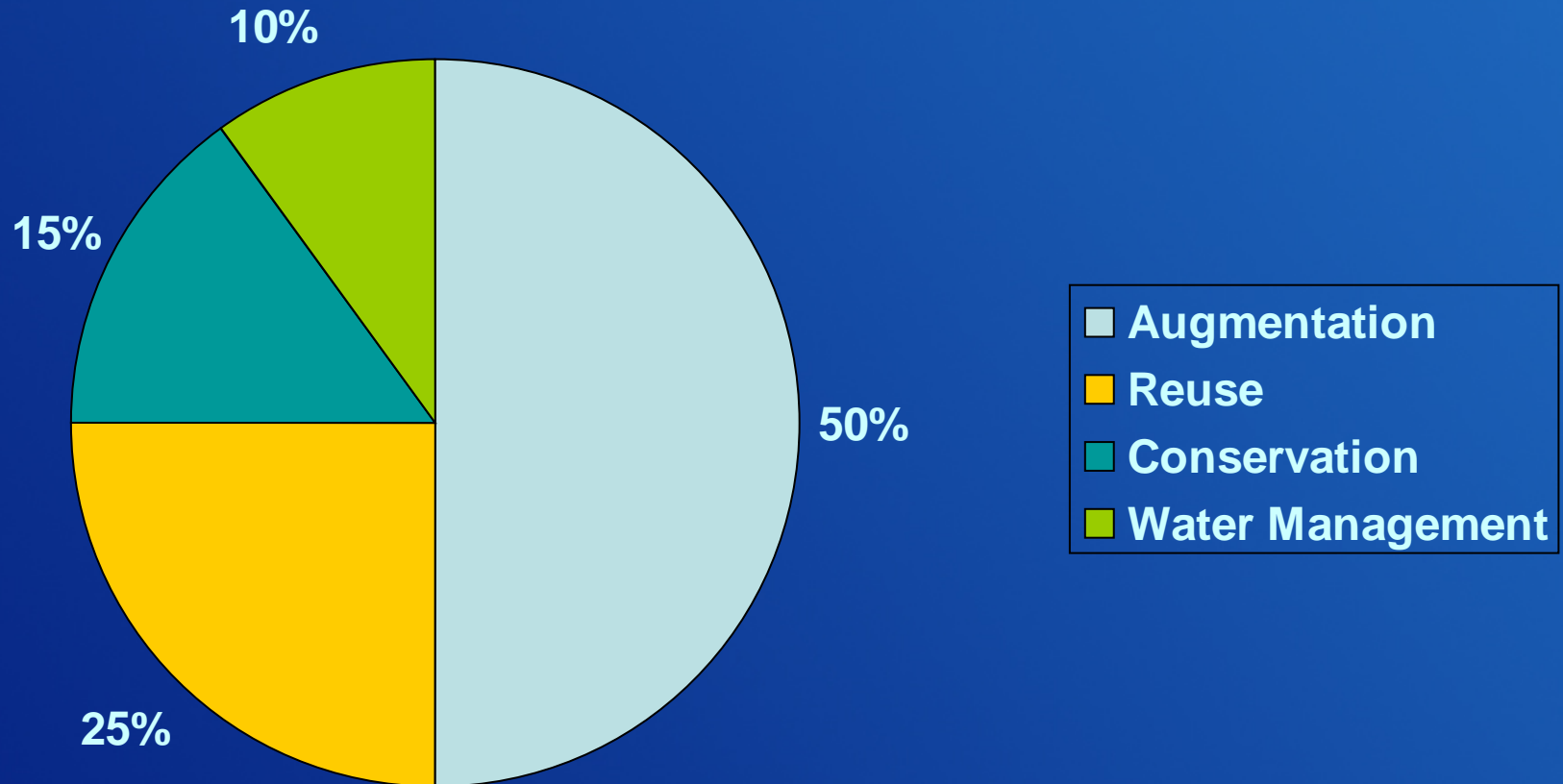
Water Resource Management Plan needed to attain sustainability



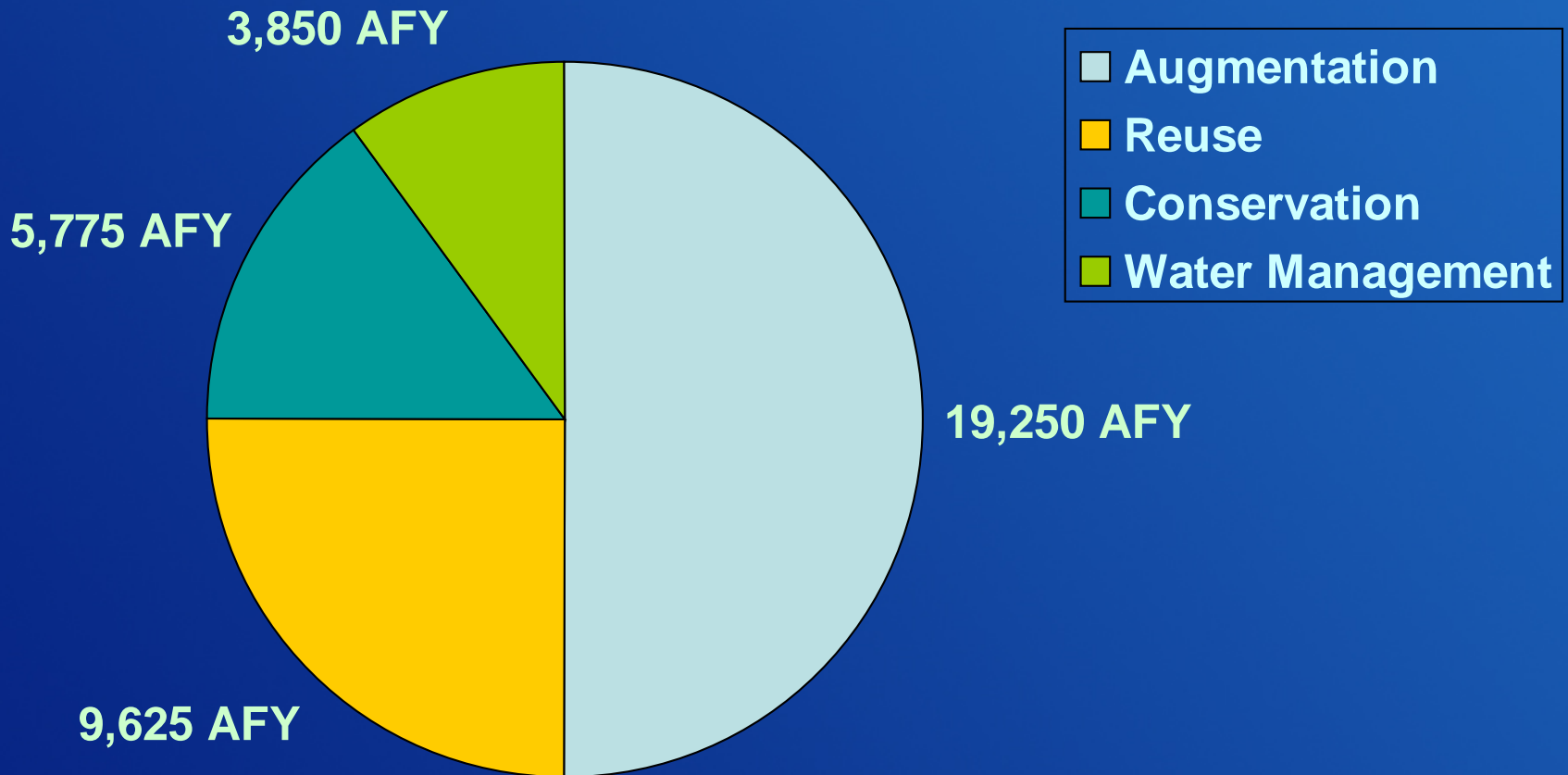
Water Resource Management Plan needed to attain sustainability



Water Resource Management Plan needed to attain sustainability



Water Resource Management Plan needed to attain sustainability

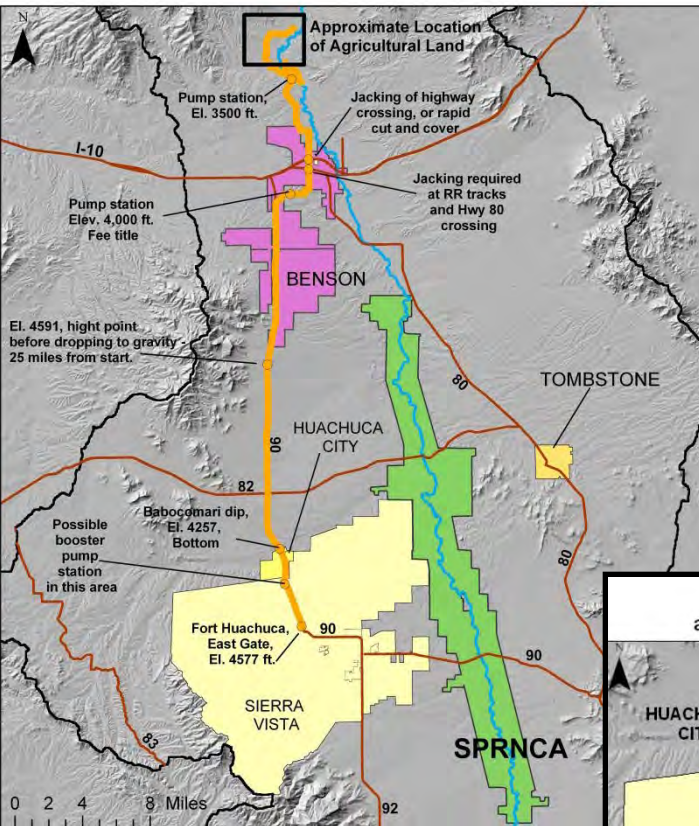


Augmentation Alternatives

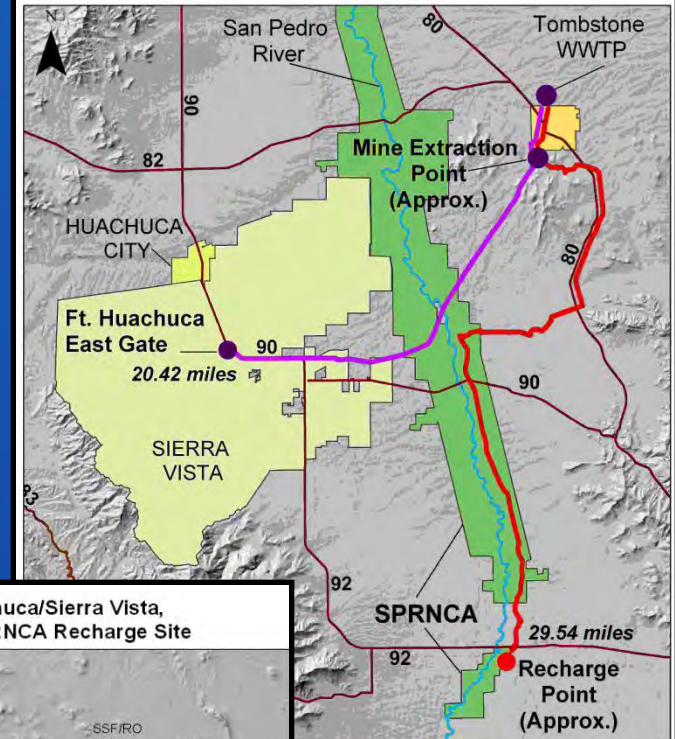
Intra-basin Transfer Alternatives

- **Water Development Potential of Underground Mine Workings in the Tombstone District**
- **Retire Agricultural Pumping North of Benson to Fort Huachuca/Sierra Vista**
- **Water Development Potential of the Copper Queen Mine in the Bisbee District**

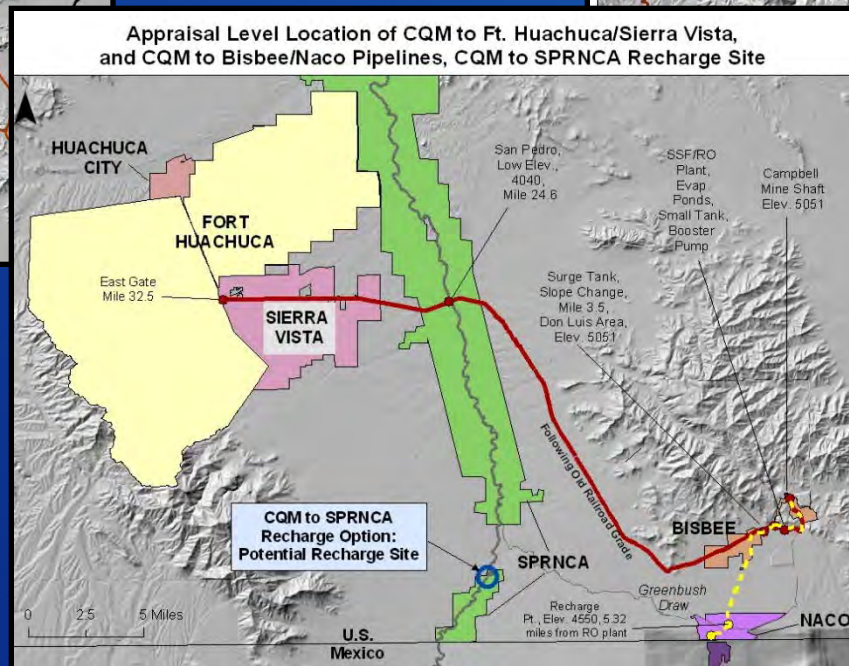
Appraisal Level Location of Benson Pipeline



Appraisal Level Location of Tombstone Pipelines



Appraisal Level Location of CQM to Ft. Huachuca/Sierra Vista, and CQM to Bisbee/Naco Pipelines, CQM to SPRNC Recharge Site

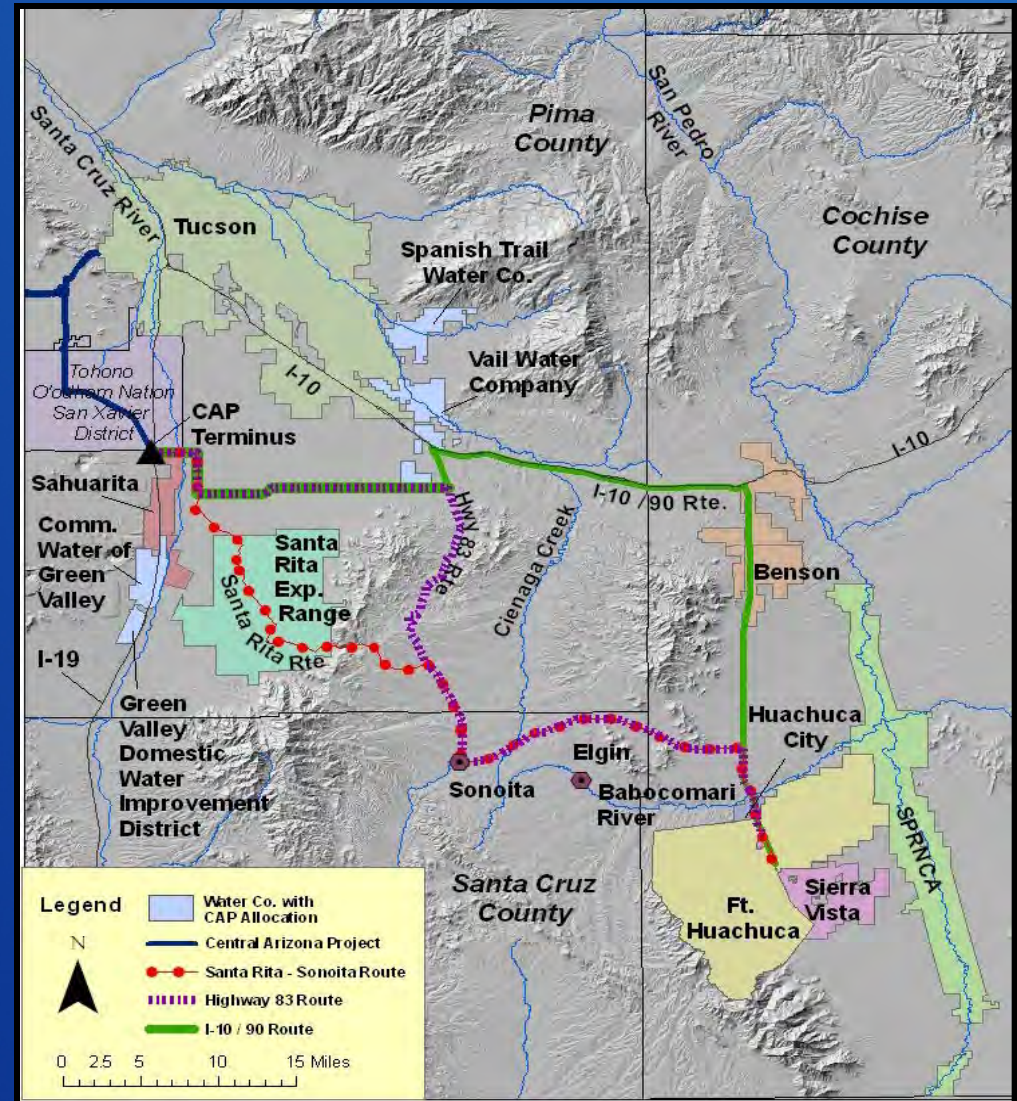


Augmentation Alternatives

Inter-basin Transfer Alternatives

Extend Central Arizona Project to Sierra Vista

- Recharge and Recovery of Municipal Supplies with San Pedro River Recharge
- Direct Delivery of Municipal Supplies with San Pedro River Recharge

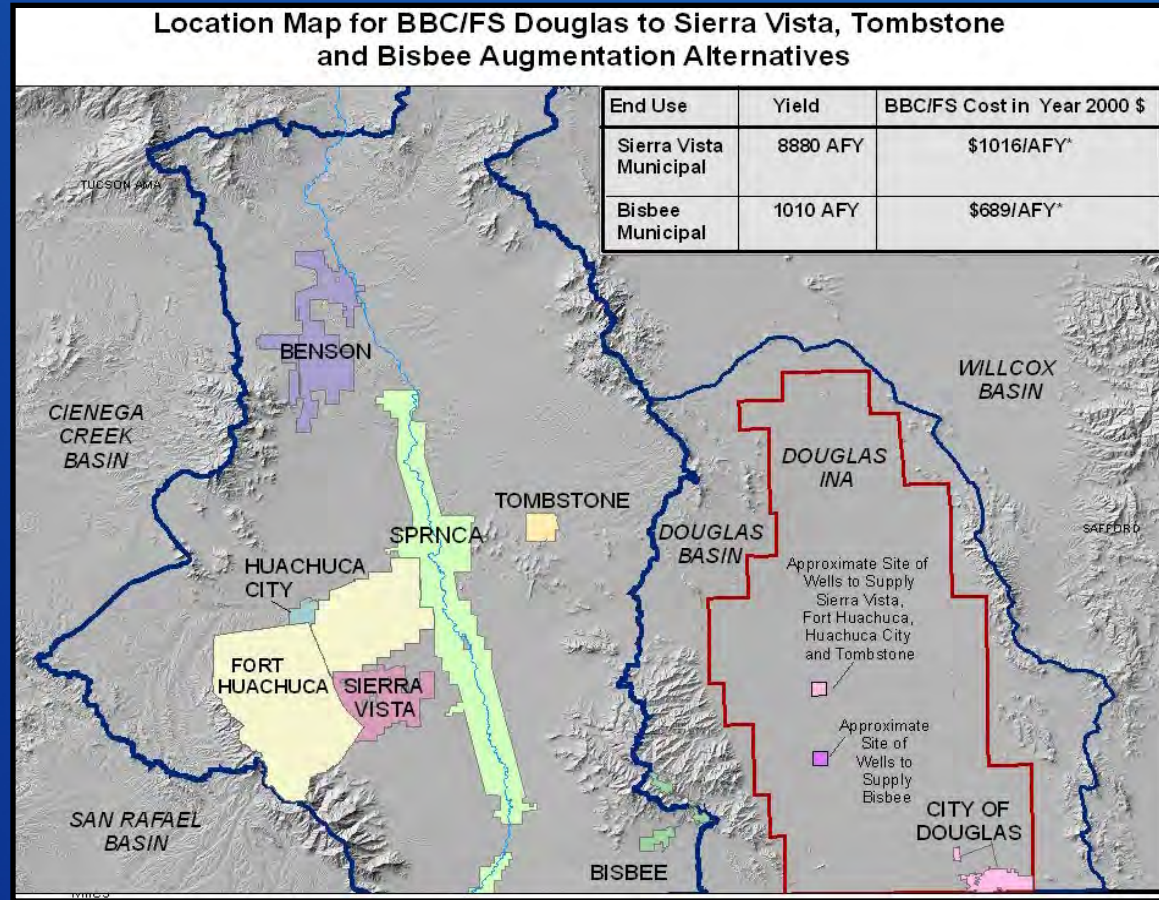


RECLAMATION

Augmentation Alternatives

Inter-basin Transfer Alternatives

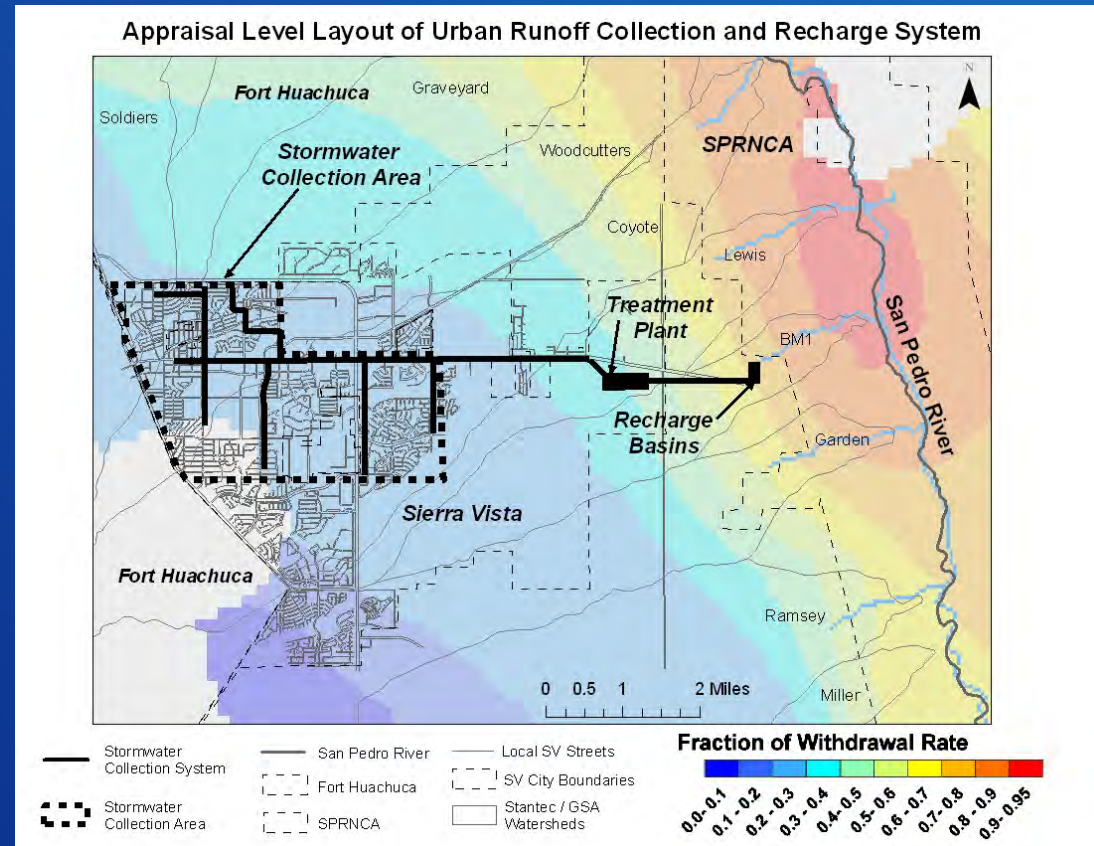
- Relocate Sierra Vista Sub-watershed Municipal Wells in Douglas Basin (BBC/Fluid Solutions)
 - Douglas Basin to Bisbee
 - Douglas Basin to Fort Huachuca and/or Sierra Vista



Augmentation Alternatives

Local Alternatives

- **Stormwater Harvesting: Water Recharge Potential of Collected Urban Runoff in the Sierra Vista Area**



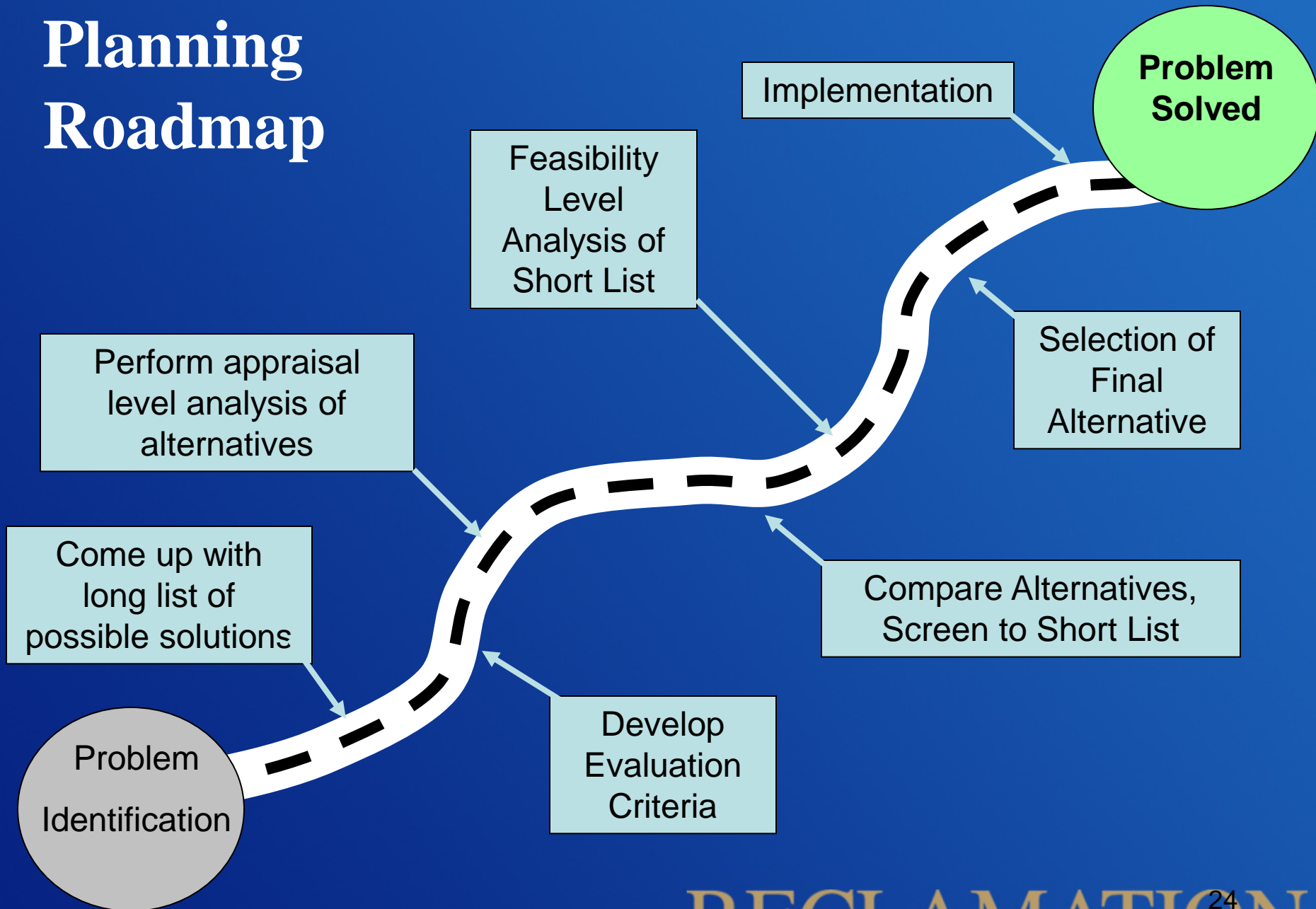
Augmentation Alternatives

Local Alternatives

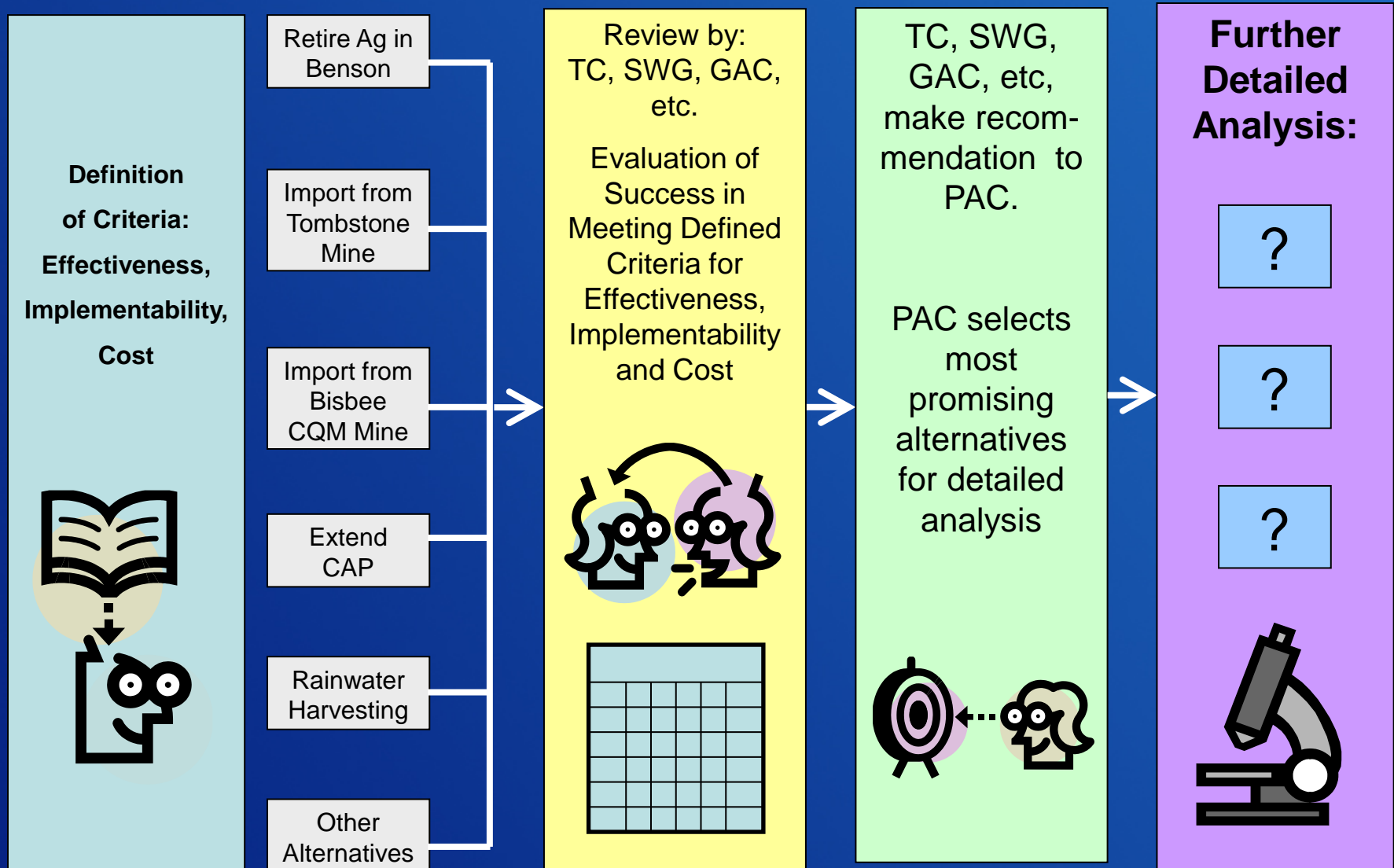
- **Stormwater Harvesting: Water Development Potential of Rainwater Collection for New Residential (and New Commercial - Industrial Businesses)**



Planning Roadmap



Analysis and Screening of Alternatives



Evaluation Process

Evaluation of the long list of alternatives on the basis of :

- **Effectiveness**
- **Implementability**
- **Cost**

Effectiveness

Effectiveness is a measure of how well each alternative meets the objectives.

- Technical aspects
- Geographic distribution of benefits and impacts
- Environmental impacts
- Reliability

USPP Effectiveness Criteria

- Yield (AFY)
- Benefits regional aquifer
- Benefits river (< 50 yrs)
- Benefits river (> 50 yrs)
- Sustains flood flows
- Reliable through drought
- Maintains or improves water quality
- Meets future population and SPRNCA needs
- Rainfall independent
- Complementary with other projects
- Short lead time for benefits
- Short regulatory timeline
- Replace or reduce groundwater demand
- Low potential for unintended consequences

USPP Joint SWG/Tech/GAC Consensus Ratings on Augmentation Alternatives with respect to Effectiveness Criteria

Criteria

Intra-basin Transfer

Inter-Basin Transfer

Local

* Estimated w/r/t estimated 2010 water balance deficit estimated by BBC/FS
 ** Annualized Yield to 2050, assuming population increase of 2055/year, 80% implementation rate, yield as estimated in Rooftop Capture Appraisal Studies

A1. Tombstone Mine to Fort Huachuca WWTp	A2. Tombstone Mine to SPRNCA Recharge	B. Retire Ag N of Benson to Fort/SV	C1. CQM to Fort/SV	C2. CQM to Bisbee/ Naco	C3. CQM to SPRNCA (hybrid)	D1. CAP - Recharge & Recovery, w/ SPR recharge (hybrid)	D2. CAP - Direct Delivery w/ SPR recharge (hybrid)	E1. Douglas Basin to Bisbee (BBC/FS)	E2. Douglas Basin to Fort/ SV (BBC/FS)	F1. Stormwater Capture & Reuse - New Res. Subdivision	F2. Stormwater Capture & Reuse - New Comm. Construction	G1. Recharge Urban Runoff near the SPRNCA	H. No Action Alternative	I. Linear Park Recharge (hybrid)
--	---------------------------------------	-------------------------------------	--------------------	-------------------------	----------------------------	---	--	--------------------------------------	--	---	---	---	--------------------------	----------------------------------

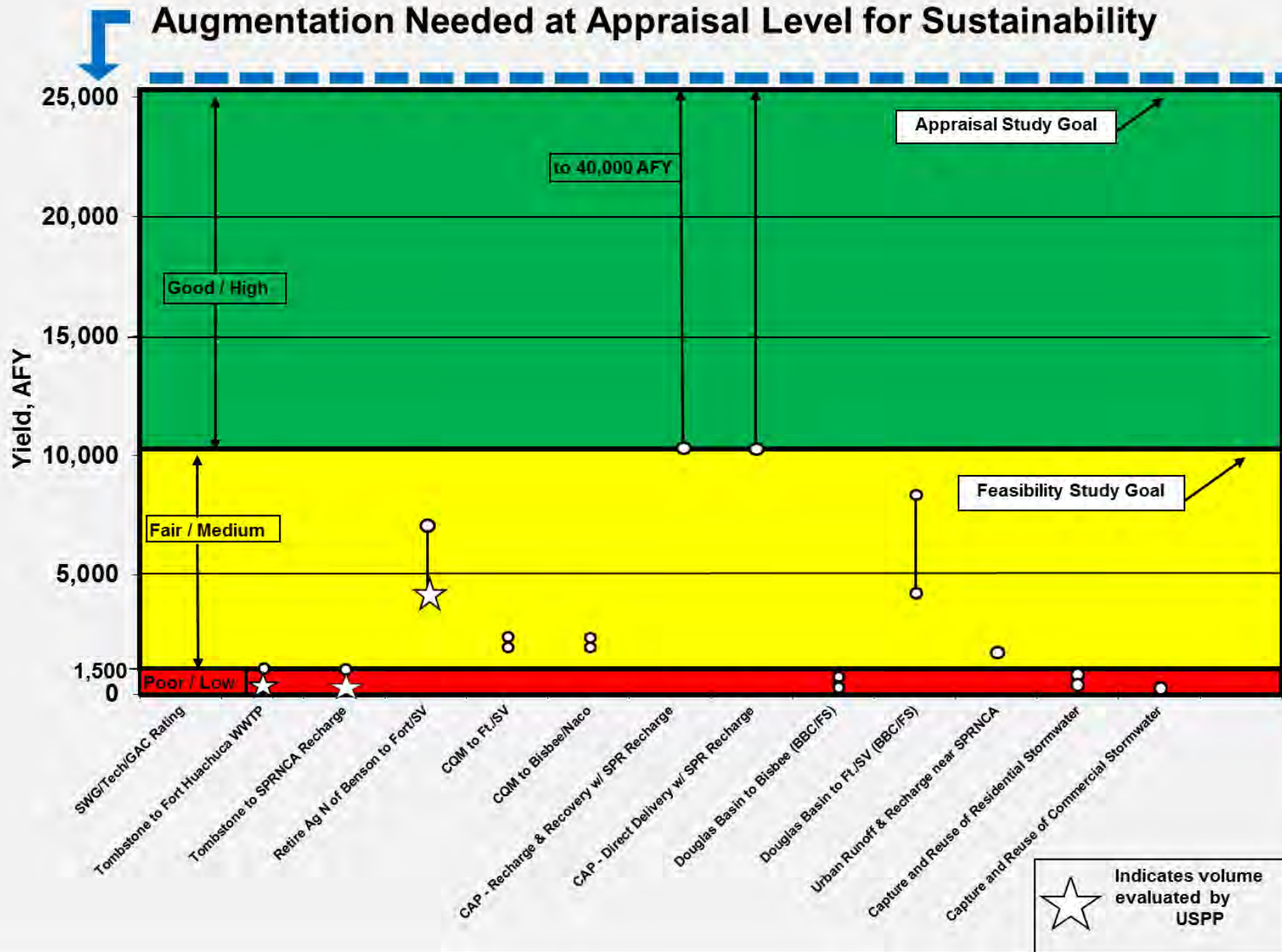
Yield (AFY) at which alternative is rated	500	500	3375	1800-2600	1800-2600	1800-2600	20,000 - 40,000	20,000 - 40,000	1010*	8430*	1095**	331**	1800	0	216
Expected Time Limit of Yield (years)	N/A	N/A	N/A	20	20	20	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
1) Yield Rating	POOR	POOR	FAIR	FAIR	FAIR	FAIR	GOOD	GOOD	POOR	FAIR	POOR	POOR	GOOD	POOR	POOR
2a) Benefits regional aquifer	POOR	POOR	FAIR	FAIR	FAIR	POOR	GOOD	GOOD	FAIR	GOOD	POOR	POOR	POOR	POOR	POOR
2b) Benefits river (< 50 years)	POOR	GOOD	POOR	POOR	POOR	GOOD	GOOD	POOR	POOR	POOR	POOR	POOR	GOOD	POOR	POOR
2c) Benefits river (> 50 years)	FAIR	POOR	FAIR	POOR	GOOD	GOOD	GOOD	GOOD	FAIR	GOOD	POOR	POOR	GOOD	POOR	POOR
3a) Sustains SPRNCA alluvial gw levels (< 50 yrs)	POOR	GOOD	POOR	POOR	POOR	GOOD	GOOD	POOR	POOR	POOR	POOR	POOR	GOOD	POOR	POOR
3b) Sustains SPRNCA alluvial gw levels (> 50 yrs)	FAIR	POOR	FAIR	FAIR	GOOD	FAIR	GOOD	GOOD	FAIR	GOOD	POOR	POOR	GOOD	POOR	POOR
4a) Sustains SPRNCA base flows (< 50 years)	POOR	GOOD	POOR	POOR	POOR	GOOD	GOOD	POOR	POOR	POOR	POOR	POOR	GOOD	POOR	POOR
4b) Sustains SPRNCA base flows (> 50 years)	FAIR	FAIR	GOOD	FAIR	FAIR	FAIR	GOOD	FAIR	FAIR	FAIR	POOR	POOR	GOOD	POOR	POOR
5) Sustains flood flows	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	FAIR	FAIR	FAIR*	POOR	FAIR
6) Maintains or improves river water quality	N/A	FAIR	N/A	N/A	N/A	FAIR	FAIR	FAIR	N/A	N/A	N/A	N/A	GOOD	N/A	GOOD
7) Reliable through long-term drought	FAIR	FAIR	FAIR	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	POOR	POOR	FAIR	N/A	FAIR
8) Meets future population and SPRNCA needs	POOR	POOR	POOR	POOR	POOR	FAIR	GOOD	GOOD	POOR	POOR	POOR	POOR	POOR	POOR	POOR
9) (Local) Rainfall independent	GOOD	GOOD	FAIR	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	POOR	POOR	FAIR	POOR	FAIR
10) Complementary w/ other USPP projects	FAIR	GOOD	FAIR	FAIR	GOOD	GOOD	GOOD	GOOD	FAIR	FAIR	FAIR	FAIR	FAIR	N/A	FAIR
11) Short lead time for benefits to river	POOR	GOOD	POOR	POOR	POOR	GOOD	GOOD	POOR	POOR	POOR	POOR	POOR	GOOD	POOR	POOR
12) Length of regulatory timeline	FAIR	FAIR	FAIR	FAIR	FAIR	FAIR	POOR	POOR	POOR	POOR	GOOD	GOOD	FAIR	N/A	GOOD
13) Replace / reduce gw demand	POOR	POOR	GOOD	GOOD	GOOD	POOR	GOOD	GOOD	FAIR	GOOD	FAIR	FAIR	POOR	POOR	POOR
14) Low potential for unintended environmental consequences	POOR	POOR	FAIR	FAIR	FAIR	GOOD	POOR	FAIR	FAIR	POOR	GOOD	GOOD	GOOD	N/A	GOOD
General Effectiveness Rating < 50 YRS	POOR	GOOD	POOR	POOR	POOR	GOOD	GOOD	GOOD	POOR	POOR	POOR	POOR	GOOD	POOR	POOR
General Effectiveness Rating . 50 YRS	POOR	FAIR	FAIR	FAIR	FAIR	GOOD	GOOD	GOOD	FAIR	FAIR	POOR	POOR	GOOD	POOR	POOR

Effectiveness

EFFECTIVENESS

RECLAMATION

Augmentation Needed at Appraisal Level for Sustainability



YIELD

RECLAMATION

Implementability

- Technical and Administrative constraints which could prevent or impede implementation
- Site specific considerations include:
 - land use,
 - hydrology,
 - geology, and
 - regulatory and permitting requirements.
- Political Constraints
- Public Acceptance Constraints

USPP Implementability Criteria

- **Spatial, Geologic, Hydrologic Constraints**
- **Environmental Impact Issues**
- **Uses well-developed technology**
- **Legal and Regulatory Issues (Federal, State and Local)**
- **Land ownership, rights-of-way, surface water rights issues**
- **Issues with water utility ownership**
- **Compatibility with adjacent uses**
- **Complexity of crossing jurisdictional boundaries**
- **Likely community support**
- **Impacts on water source area (political, env., economic)**

USPP Joint SWG/Tech/GAC Consensus Ratings on Augmentation Alternatives with respect to Implementability and Cost Criteria

Criteria		Intra-basin Transfer						Inter-Basin Transfer				Local				
		A1. Tombstone Mine to Fort Huachuca	A2. Tombstone Mine to SPRNCA Recharge	B. Retire Ag IV of Benson to Fort/SV	C1. CQM to Fort Huachuca / Sierra Vista	C2. CQM to Bisbee/ Naco	C3. CQM to SPRNCA (hybrid)	D1. CAP - Recharge & Recovery, w/ SPR recharge (hybrid)	D2. CAP - Direct Delivery w/ SPR recharge (hybrid)	E1. Douglas Basin to Bisbee (BBCFS)	E2. Douglas Basin to Fort/ SV (BBCFS)	F1. Stormwater Capture & Reuse- Subdivision	F2. Stormwater Capture & Reuse - New Comm. Const.	G1. Recharge Urban Runoff near SPRNCA	H. No Action Alternative	I. Linear Park Recharge (hybrid)
Implementability	* Cost estimated in Year 2000 dollars by BBC/Fluid Solutions, not updated for current construction costs.															
	15) Spatial, Geologic, Hydrologic Constraints	FAIR	FAIR	FAIR	FAIR	FAIR	FAIR	FAIR	FAIR	FAIR	FAIR	GOOD	GOOD	GOOD	N/A	GOOD
	16) Environmental Impact Issues	FAIR	FAIR	FAIR	FAIR	FAIR	FAIR	POOR	FAIR	UNKNOWN	UNKNOWN	GOOD	GOOD	GOOD	N/A	GOOD
	17) Uses well-developed technology	GOOD	FAIR	GOOD	POOR	POOR	POOR	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	N/A	GOOD
	18) Legal and Regulatory Issues (Fed. State, local)	FAIR	FAIR	FAIR	POOR	POOR	FAIR	POOR	POOR	FAIR	POOR	GOOD	GOOD	FAIR	N/A	GOOD
	19) Land ownership, ROW & surface water rights	POOR	POOR	FAIR	POOR	FAIR	POOR	POOR	POOR	UNKNOWN	UNKNOWN	GOOD	GOOD	GOOD	N/A	GOOD
	20) Issues with water utility ownership	GOOD	GOOD	POOR	POOR	POOR	N/A	POOR	POOR	POOR	POOR	GOOD	GOOD	GOOD	N/A	GOOD
	21) Land use & zoning	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	FAIR	FAIR	GOOD	GOOD	GOOD	GOOD	GOOD	N/A	GOOD
	22) Compatibility w/ Adjacent Uses	POOR	POOR	FAIR	GOOD	GOOD	GOOD	GOOD	GOOD	FAIR	POOR	GOOD	GOOD	GOOD	N/A	GOOD
	23) Complexity of crossing jurisdictional boundaries	POOR	FAIR	POOR	POOR	FAIR	FAIR	POOR	POOR	FAIR	POOR	GOOD	GOOD	GOOD	N/A	GOOD
Cost	24) Likely Community Support	POOR	POOR	POOR	FAIR/POOR	FAIR	GOOD	POOR	POOR	POOR	POOR	GOOD	GOOD	GOOD	N/A	GOOD
	25) Impacts on water source area (political, env., economic)	POOR	POOR	POOR	FAIR	FAIR	GOOD	UNKNOWN	UNKNOWN	POOR	POOR	GOOD	GOOD	GOOD	N/A	GOOD
	General Implementability	POOR	POOR	POOR	FAIR	FAIR	FAIR	POOR	POOR	FAIR	POOR	GOOD	GOOD	GOOD	N/A	GOOD
	Unit Cost (\$/AF)	\$1,449	\$1,466	\$1,282	1800 AFY - \$2,860 2600 AFY - \$2,062	1800 AFY - \$2,397 2600 AFY - \$1,635	More than CQM to Bisbee, less than CQM to Ft. Huachuca	20,000 AF: \$1,725 30,000 AF: \$1,594 40,000 AF: \$1,570	20,000 AF: \$1,411 - \$1,847 30,000 AF: \$1,281 - \$1,717 40,000 AF: \$1,257 - \$1,693	\$689*	\$1016*	\$23,780	\$7,778	\$2,675	\$0	\$6,944
Cost	Unit Cost (\$/kgal)	\$4.45	\$4.50	\$3.93	1800 AFY - \$8.78 2600 AFY - \$6.33	1800 AFY - \$7.36 2600 AFY - \$5.02	More than CQM to Bisbee, less than CQM to Ft. Huachuca	20,000 AF: \$5.29 30,000 AF: \$4.89 40,000 AF: \$4.82	20,000 AF: \$4.33 - \$5.67 30,000 AF: \$3.93 - \$5.27 40,000 AF: \$3.86 - \$5.20	\$2.11*	\$3.12*	\$72.98	\$23.87	\$8.21	\$0.00	\$21.31
	26) Unit Cost Rating/ General Cost	FAIR	FAIR	FAIR	POOR	FAIR	FAIR	FAIR	FAIR	GOOD	GOOD	POOR	POOR	POOR	GOOD	POOR

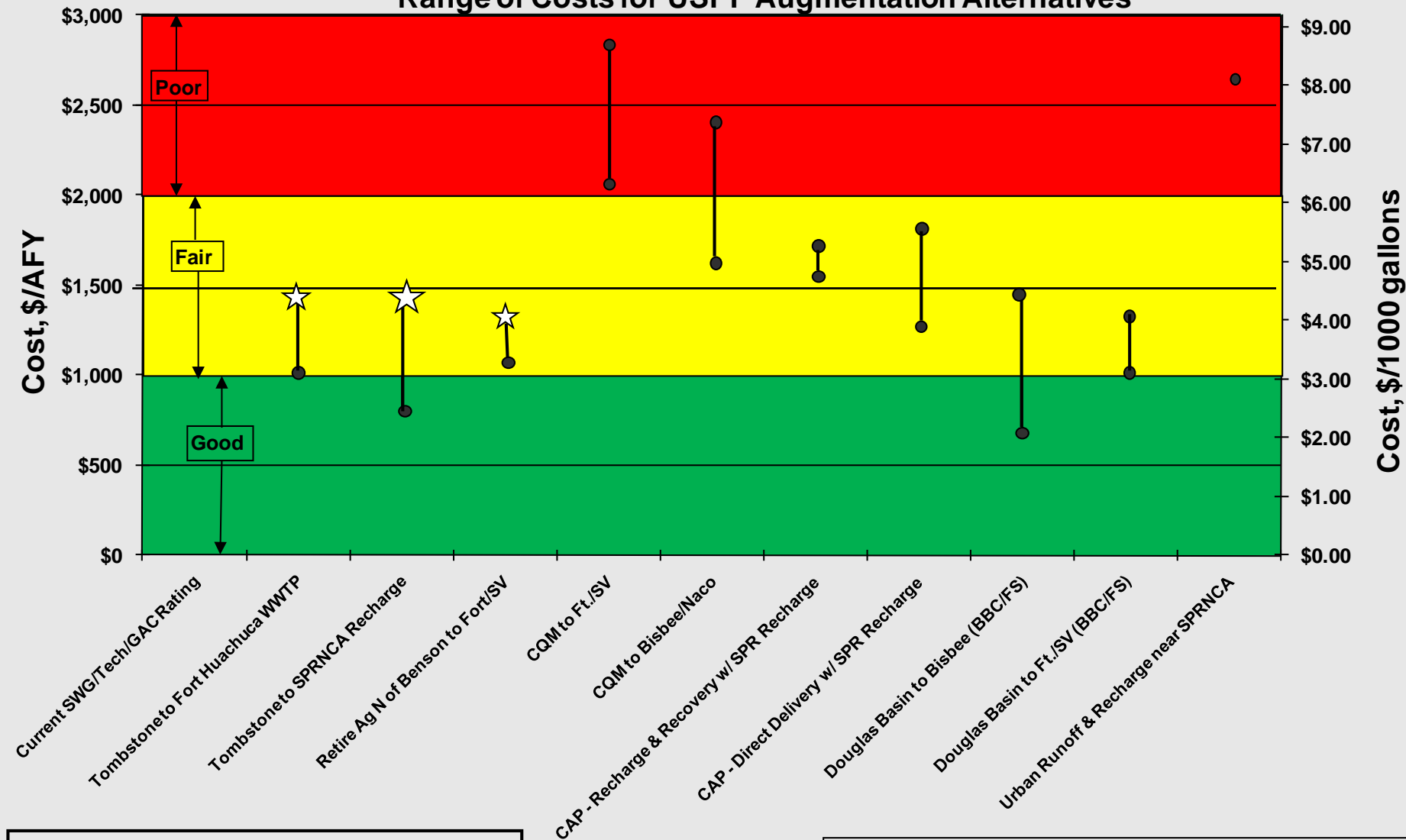
All cost estimates, including those performed by BBC/Fluid Solutions use a 4% interest rate and 20 year payback period

• IMPLEMENTABILITY

Cost

- Capital
- Operation and Maintenance (O&M) costs
- Total Annual Cost
(Amortized Capital + O&M) and
- Cost per Unit Volume
(\$ per AF or \$ per 1000 gallons) are used.

Range of Costs for USPP Augmentation Alternatives



Costs not plotted to avoid distortion of scale:
 Capture and Reuse of Res. Stormwater: \$23,780/AFY
 Capture and Reuse of Comm. Stormwater: \$7,778/AFY



Indicates price corresponding to volume
 selected by Joint SWG/Tech/GAC work group

COST

RECLAMATION

SUMMARY MATRIX

		Alternative	Overall Effectiveness w/r/t Problem Statement < 50 Years	Overall Effectiveness w/r/t Problem Statement > 50 Years	Overall Implementability	Overall Cost
Intra-Basin Transfer		Tombstone to Fort Huachuca WWTP	POOR	POOR	POOR	FAIR
		Tombstone to SPR Recharge	GOOD	FAIR	POOR	FAIR
		Retire Benson Ag to Fort/SV	POOR	FAIR	POOR	FAIR
		CQM to Fort/SV	POOR	FAIR	FAIR	POOR
		CQM to Bisbee/ Naco	POOR	FAIR	FAIR	FAIR
		CQM to SPRNCA Recharge	GOOD	GOOD	FAIR	FAIR?
Inter-Basin Transfer		CAP - Direct Delivery	GOOD	GOOD	POOR	FAIR
		CAP - Recharge & Recovery	GOOD	GOOD	POOR	FAIR
		Douglas to Fort/ SV (BBC/FS)	POOR	FAIR	POOR	GOOD
		Douglas to Bisbee (BBC/FS)	POOR	FAIR	FAIR	GOOD
Local		Rooftop Capture - New Residential Subdivision	POOR	POOR	GOOD	POOR
		Rooftop Capture - New Commercial Construction	POOR	POOR	GOOD	POOR
		Urban Runoff & Recharge	GOOD	GOOD	GOOD	POOR
		Garden Canyon Linear Park	POOR	POOR	GOOD	POOR
N/A		No Action	POOR	POOR	N/A	GOOD

Alternatives recommended for a feasibility report and further technical study

Short-term G1. Recharge urban runoff near to the SPRNCA

C3. CQM to SPRNCA recharge (hybrid)

Long-term D1. CAP Recharge and Recovery of municipal supplies with San Pedro River Recharge (hybrid)

D2. CAP Direct Delivery of municipal supplies with San Pedro River Recharge (hybrid)

Short and long-term H. No Action Alternative (Note that this will be refined so that we can compare action alternatives against it.)

Alternatives to pursue without further study

Short-term Linear Park Recharge

Long-term F1. Capture and Reuse of Residential Stormwater

F2. Capture and Reuse of Commercial Stormwater

Alternatives to be held for consideration later

Short-term A2. Tombstone Mine to SPRNCA Recharge

E1. Douglas Basin to Bisbee

C2. CQM to Bisbee/Naco

Alternatives set aside - no further action required

Short-term A1. Tombstone mine workings to Fort Huachuca WWTP

B. Retire agriculture north of Benson to Fort/Sierra Vista

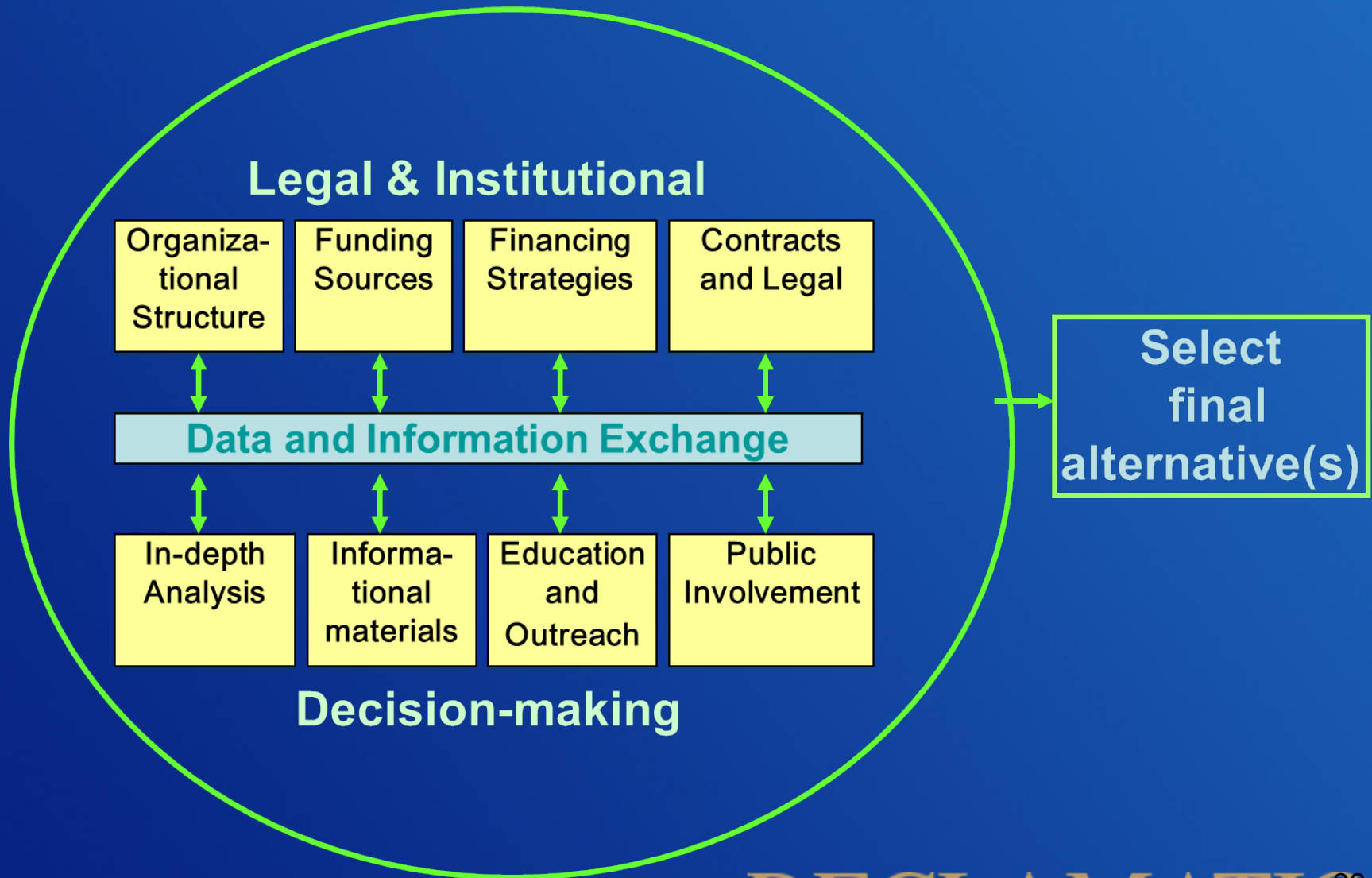
C1. CQM to Fort Huachuca/ Sierra Vista Area

E2. Douglas Basin to Fort Huachuca/Sierra Vista

Alternatives recommended for further technical study

<i>Short-term</i>	G1. Recharge urban runoff near to the SPRNCA C3. CQM to SPRNCA recharge
<i>Long-term</i>	D1. CAP Recharge and Recovery of municipal supplies with San Pedro River Recharge D2. CAP Direct Delivery of municipal supplies with San Pedro River Recharge
<i>Short and long-term</i>	H. No Action Alternative (Used for NEPA and comparison purposes)

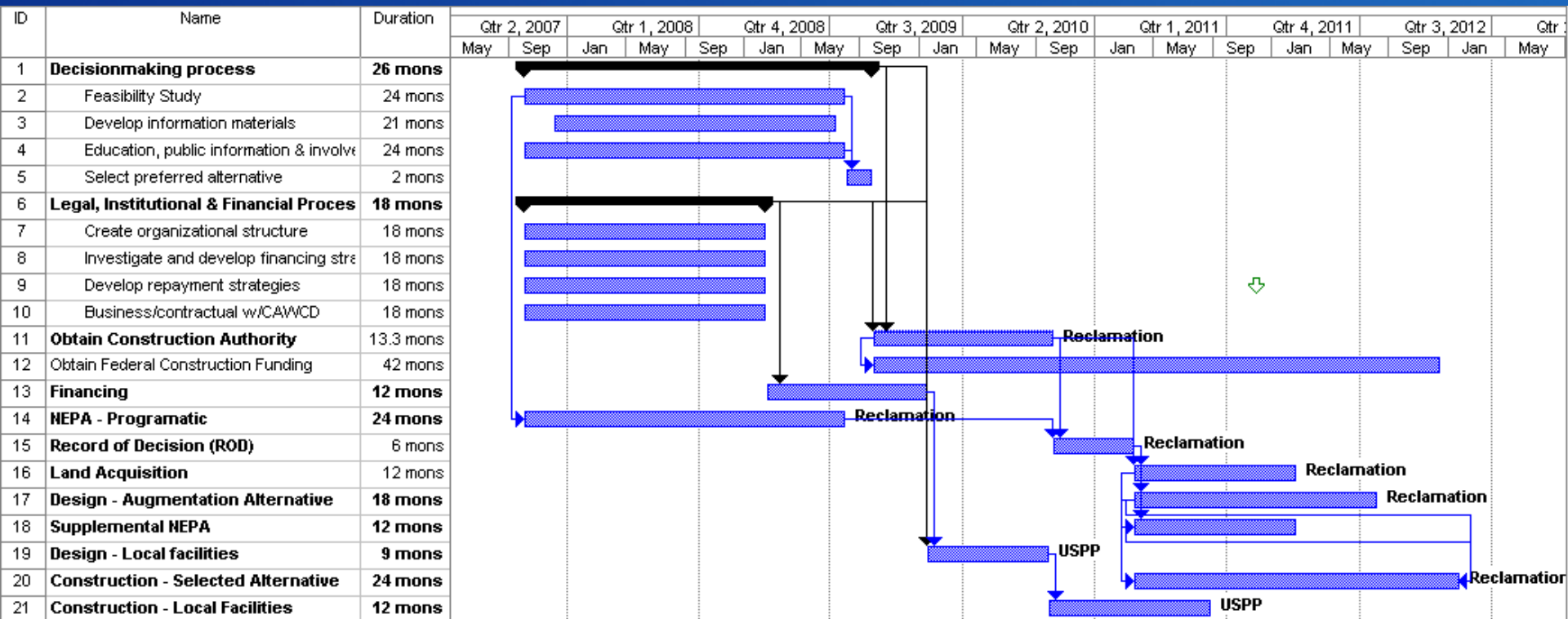
Recommended actions to implement augmentation alternatives (Chapter 5), describes two parallel, complementary, “tracks”



Follow-up Actions (Chapter 5):

- Entity to manage augmentation facilities
 - legal authority to construct, operate, and repay capital costs
 - wholesale water to private water companies
- Determine whether CQM water can be acquired
- Acquire CAP water
- End use of CAP water
- Implementability of Urban Runoff and Recharge alternative
- Identify best sites for recharge near the SPRNCA

Example of Possible Timeline for Implementation



Possible Next Step - A Feasibility Study

- Detailed investigation of each alternative.
- Must be authorized by Congress.
- Needed for Congressional authorization for implementation.
- Detailed environmental impact study pursuant to the National Environmental Policy Act and other related statutes.

Observations

- Only CAP alternative provides sufficient water to offset overdraft
- Significant legal hurdles in order to acquire CAP water
 - Extend CAP service area
 - Change State Law
 - Modify CAP Master Repayment contract
 - Fierce competition for Indian leases and remaining unallocated water

Strings attached? There might be a parallel in the history of how the CAP system was constructed.

1980 Groundwater Management Act

“Concern about groundwater overuse again made the legislative agenda when the Groundwater Management Act was passed in 1980. The Arizona Legislature passed the law at the urging - some claim it was in response to a threat - of the federal government. Whatever might have transpired between the two parties, a bargain was in fact struck: the state would take measures to control groundwater use and the federal government would complete the Central Arizona Project. The GMA was the result of political maneuvering, and water conservation became the law of the land. The GMA stands as the cornerstone of the state's water conservation efforts.” - **Arroyo (U of A WRRC)**

QUESTIONS AND CONTACTS

- Eve Halper, ehalper@usbr.gov
- F. Eric Holler, fholler@usbr.gov