



MANAGED AQUIFER RECHARGE FOR THE ARIZONA DESERT:

The Development of Large Surface Water- Spreading Facilities

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A Historical Overview

MANAGED AQUIFER RECHARGE (M.A.R.) DEVELOPMENT IN ARIZONA

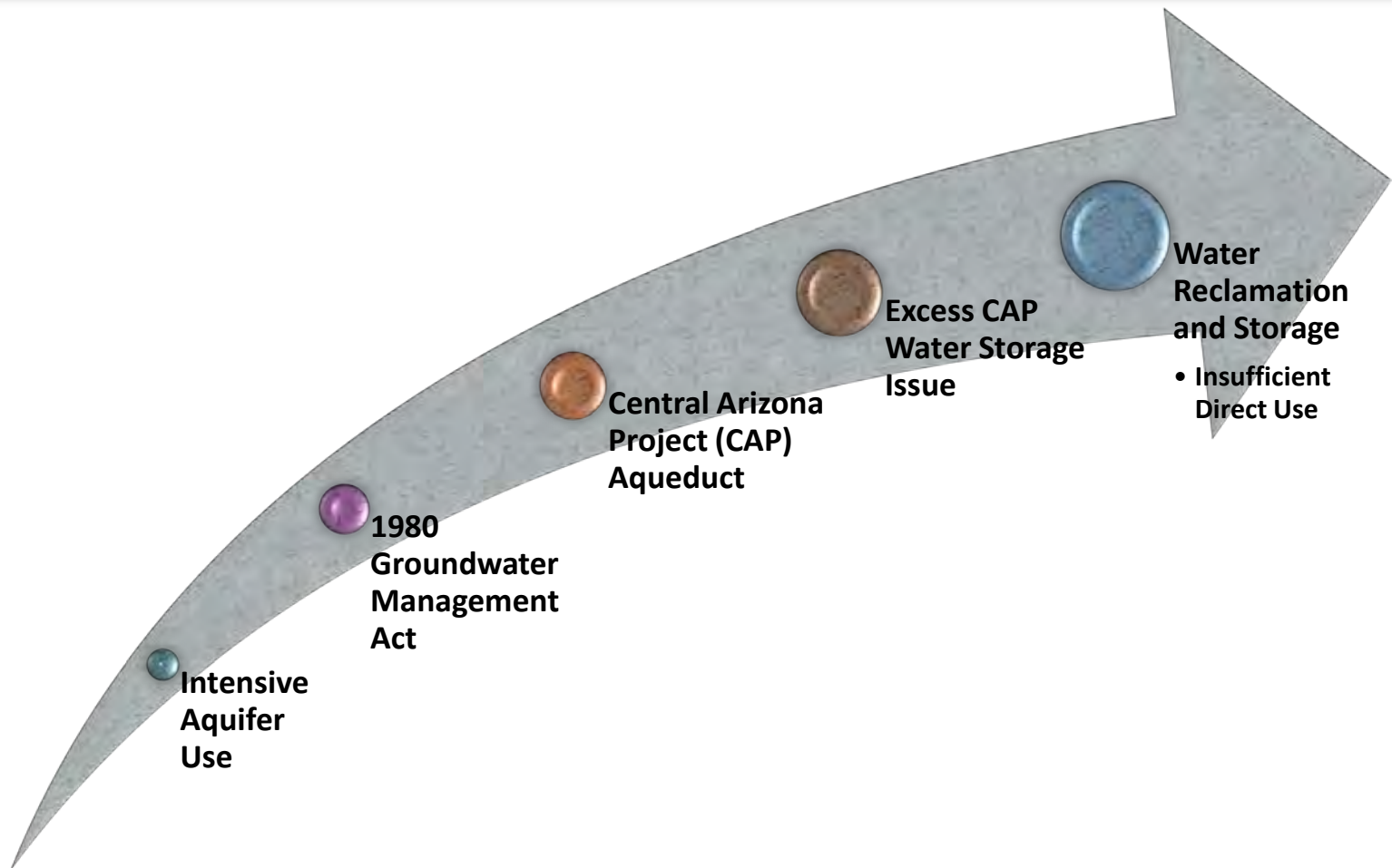


Presentation Contents

- M.A.R. Development
 - Main Reasons for its Progress
 - Development Phases
 - Regulatory Framework
 - Water-Spreading vs Well Recharge
 - Institutional Involvement
- Water-Spreading Facilities
- The Future of Water Spreading

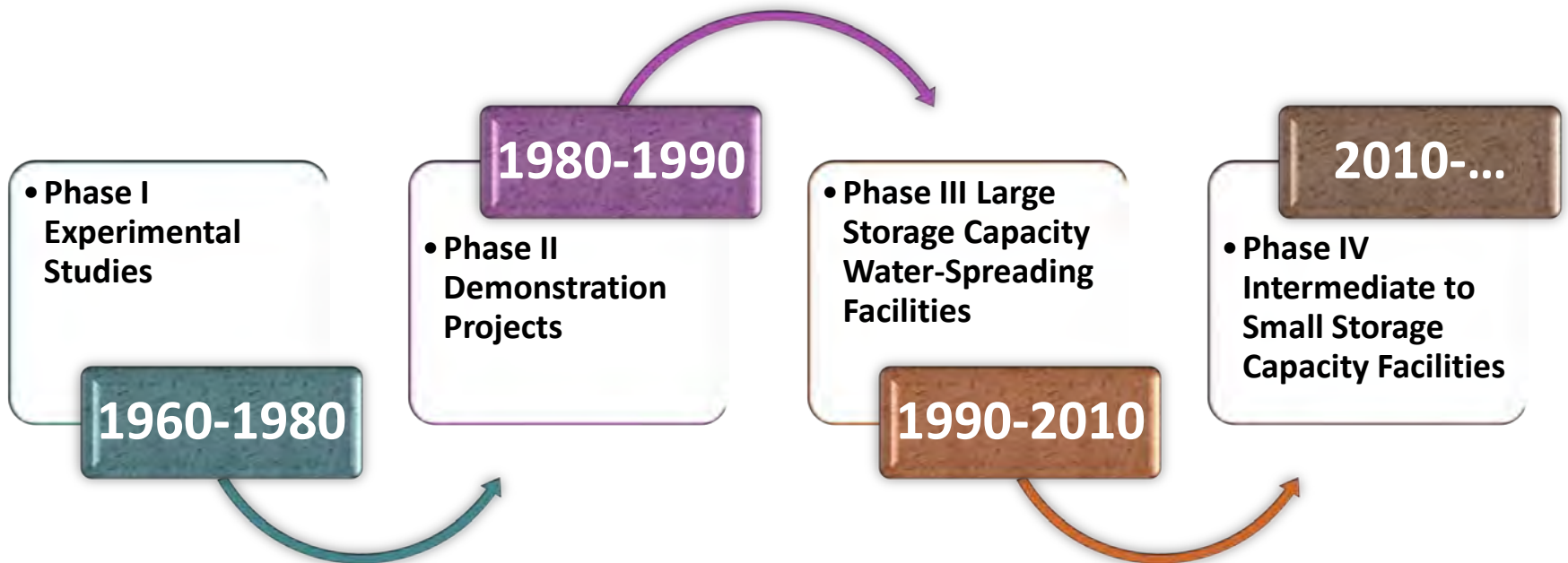


M.A.R in Arizona: Main Reasons For Its Progress





M.A.R in Arizona: Development Phases





M.A.R in Arizona: Development Phases

Phase I Experimental Studies (1960-1980)

This phase consisted mostly of tests by Universities and research centers



Flushing Meadow Project
Phoenix, AZ

- Off-channel basins in the Salt River
- Treated effluent
- SAT
 - Dr. Herman Bouwer, USDA / USWCL (1968-1978)



Basin Recharge in McMicken Dam*
Phoenix, AZ

- Well recharge using cooling tower effluent in Tucson
 - Dr. L.G. Wilson and others at University of Arizona WRRC (1960's)

*Photo: Flood Control District of Maricopa County



M.A.R in Arizona: Development Phases

Phase II Demonstration Projects (1980-1990)



Sweetwater Project*
Tucson, AZ

- Reclaimed water
- Four 0.75 acre (.3 hectares) basins



Granite Reef Underground
Storage Project
Phoenix, AZ

- Studies and design completed
- Full scale
- CAP water



Water Campus Project
Scottsdale, AZ

- Vadose zone recharge wells
- Reclaimed water



Cave Creek Recharge
Project
Phoenix, AZ

- First ASR well in Arizona



M.A.R in Arizona: Development Phases

Phase III Large Storage Capacity Water-Spreading Facilities (1990-2010)



Granite Reef Underground
Storage Project
Phoenix, AZ

- 1994 commenced operation
- Permitted for 200,000 ac-ft/yr (246,600,000 m³/yr)



9 Large Water-Spreading
Facilities

- 1994 -2010
- Capacity exceeding 50,000 ac-ft/yr (61,650,000 m³/yr)



CAP Aqueduct*

- Completed to Phoenix and Tucson



M.A.R in Arizona: Development Phases

Phase IV Intermediate to Small Storage Capacity Facilities (2010-...)



City of Surprise SPA-1
Surprise, AZ

- Vadose Zone Recharge Wells



Hassayampa Recharge
Facility
Near Prescott, AZ

- Water-Spreading by
river channel



Fountains Sanitary District
Fountain Hills, AZ

- ASR Wells

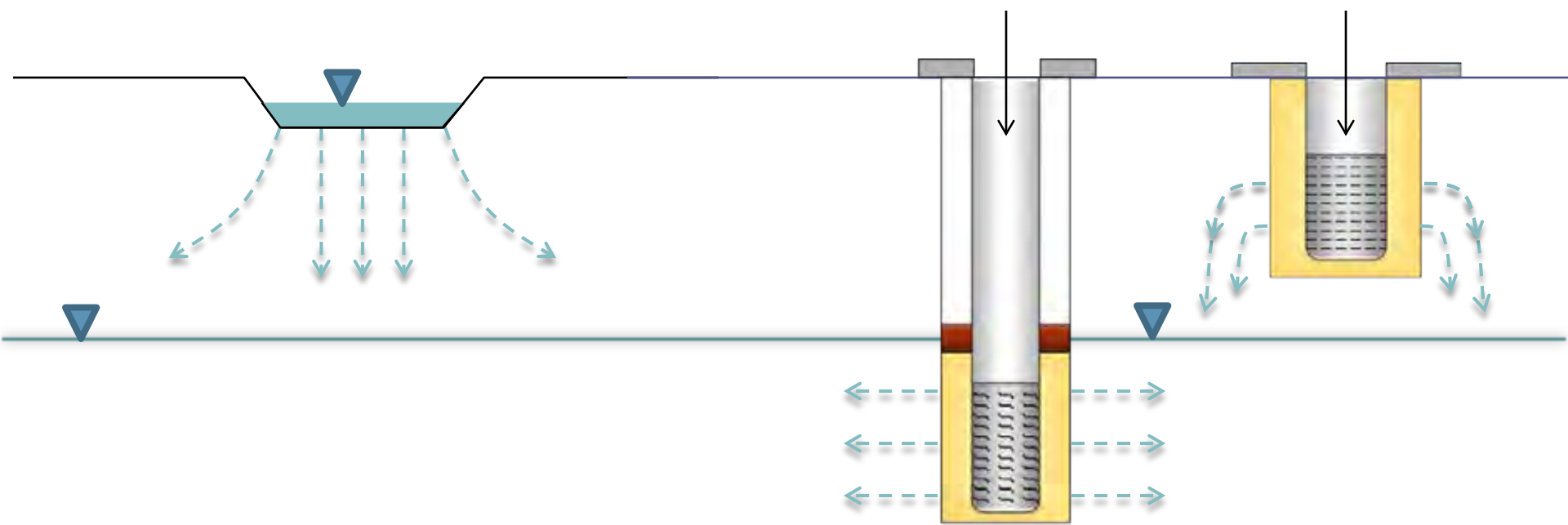


M.A.R. in Arizona: Regulatory Framework

	Federal		State		County / Municipality
Agencies	Army Corps of Engineers	Environmental Protection Agency	Arizona Department of Water Resources	Arizona Department of Environmental Quality	Flood Control District
Permits	404	401	<ul style="list-style-type: none">• Underground Storage Facility• Water Storage	Aquifer Protection Permit	Floodplain and Flood Use Permit
Laws	Clean Water Act	Clean Water Act	<ul style="list-style-type: none">• 1980 Groundwater Management Act• Recharge and Underground Storage and Recovery Act 1986	Environmental Quality Act 1986	Local Ordinance



M.A.R in Arizona: Water-Spreading vs Well Recharge



	Water-Spreading	ASR Well	Vadose Zone Well
Capacity	5,000 – 150,000 ac-ft/yr (6,165,000 – 184,950,000 m ³ /yr)	< 5,000 ac-ft/d (<6,165,000 m ³ /d)	1,000 – 15,000 ac-ft/yr (1,233,000 – 18,495,000 m ³ /yr)
Water Source	CAP, RW, S&V, Mixed	RW, CAP	RW
Unit Cost (\$/ac-ft)	Very low	High	Intermediate
Number of Facilities	38	9	19



M.A.R. in Arizona: Institutional Involvement

- Central Arizona Water Conservation District (CAWCD)
 - Colorado River Water Purveyor
- Arizona Water Banking Authority (AWBA)
 - Better Utilization of Arizona: Colorado River Entitlement
- Groundwater Replenishment Districts
- Salt River Project (SRP)
 - Salt and Verde Rivers Water Purveyor
- Municipalities
- Irrigation Districts
- Water Companies



Water-Spreading Facilities

- Water Sources Available for Aquifer Storage
 - Colorado River Water (CAP)
 - Salt and Verde River Water (SRP)
 - Reclaimed Water (treated municipal effluent) (RW)
 - Treated Industrial Effluent (IRW)



Water-Spreading Facilities

- Granite Reef Underground Storage Project
 - GRUSP
- New River Agua Fria Underground Storage Project
 - NAUSP
- MBT Ranch Recharge Project
- Lower Santa Cruz River Managed Recharge Project
 - LSCRMRP
- Hassayampa Recharge Facility

A small image of a Saguaro cactus in the top left corner.

Water-Spreading Facilities

The Salt River Project



Roosevelt Dam

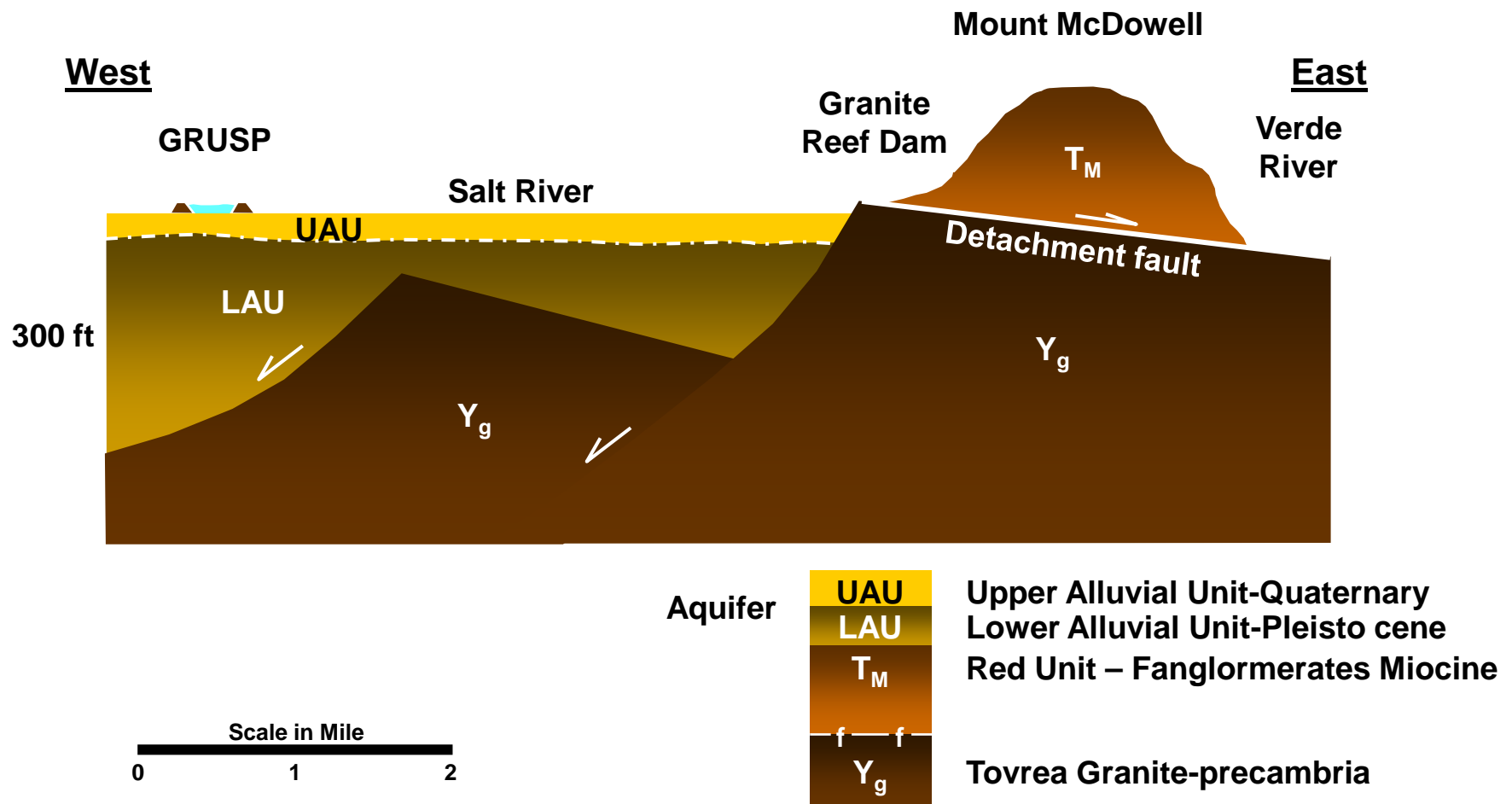


Arizona Canal



Water-Spreading Facilities: GRUSP

Site Geology






Water-Spreading Facilities: GRUSP

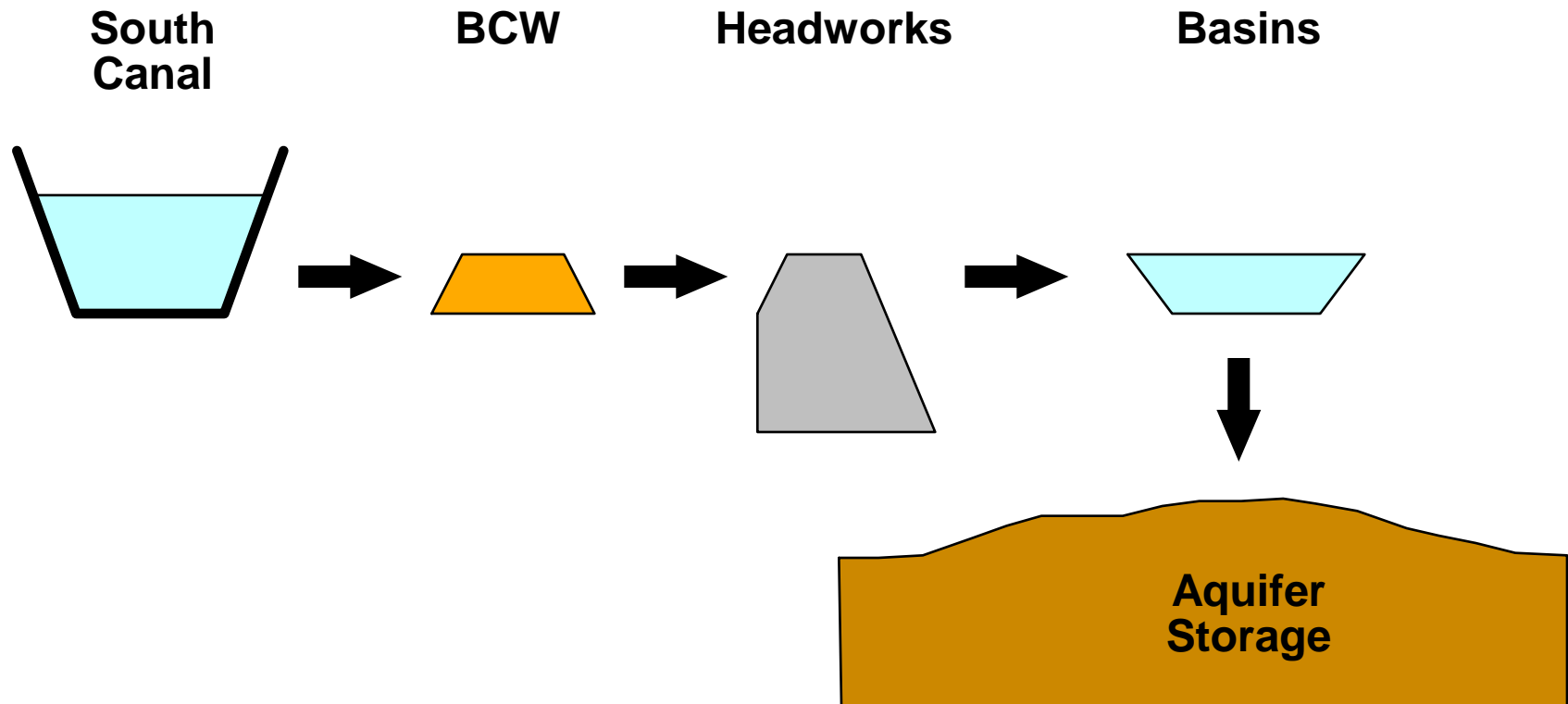
- Development
 - In-channel basins in the Salt River
 - Recharge capacity
 - 100,000 ac-ft/yr (123,300,000 m³/yr)
 - Near SRP and CAP water infrastructure
 - Started operation in 1994
 - Total cost
 - \$2.2M





Water-Spreading Facilities: GRUSP

Recharge System Operation





Water-Spreading Facilities: GRUSP

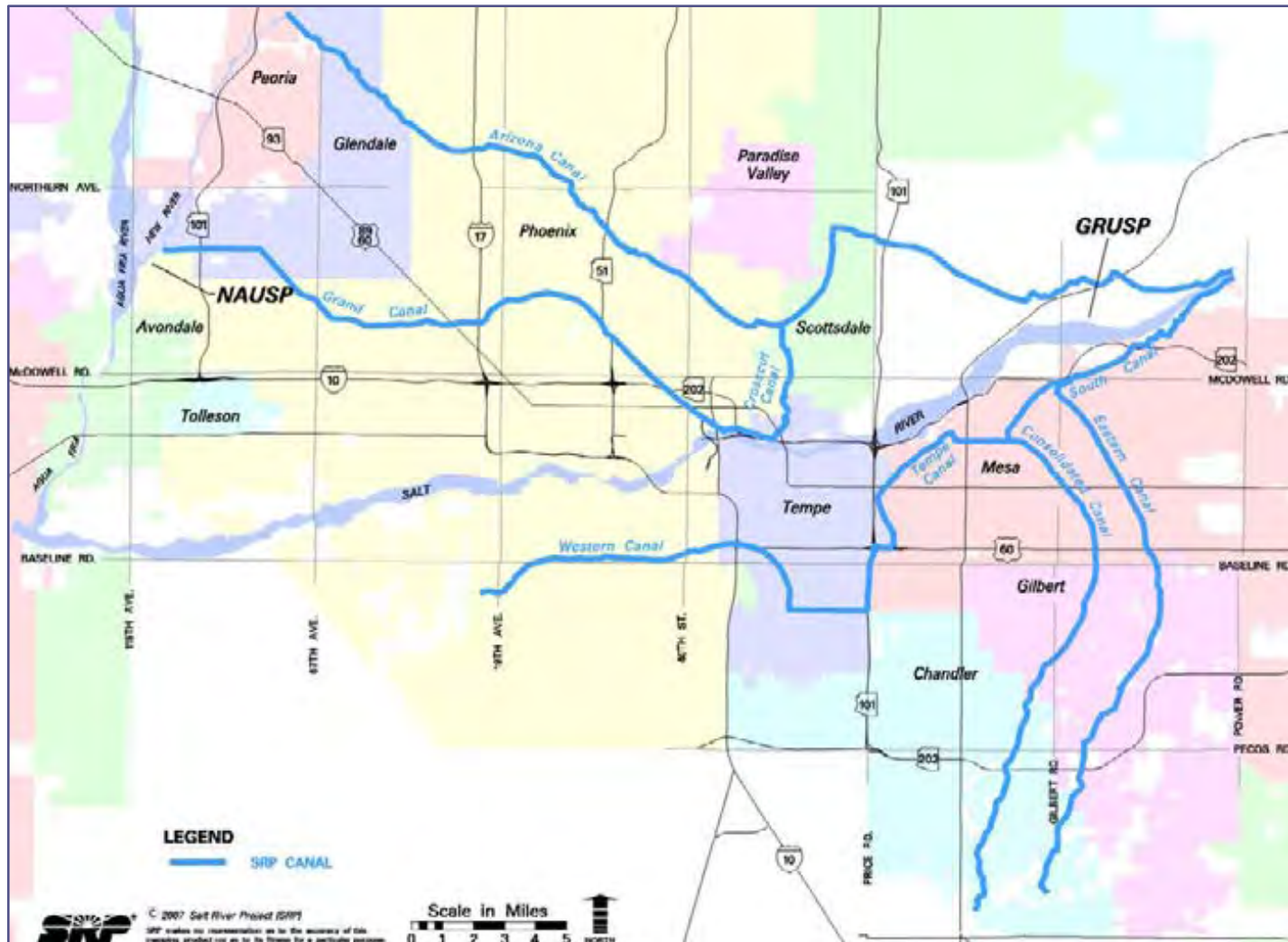
- System Components
 - Inflow Structures
 - SRP South Canal
 - Delivery Units
 - Delivery Channel
 - Recharge Units
 - 7 basins: 225 acres (91 hectares)
 - Monitoring System
 - BCWs
 - wells




Water-Spreading Facilities: GRUSP




Water-Spreading Facilities: GRUSP





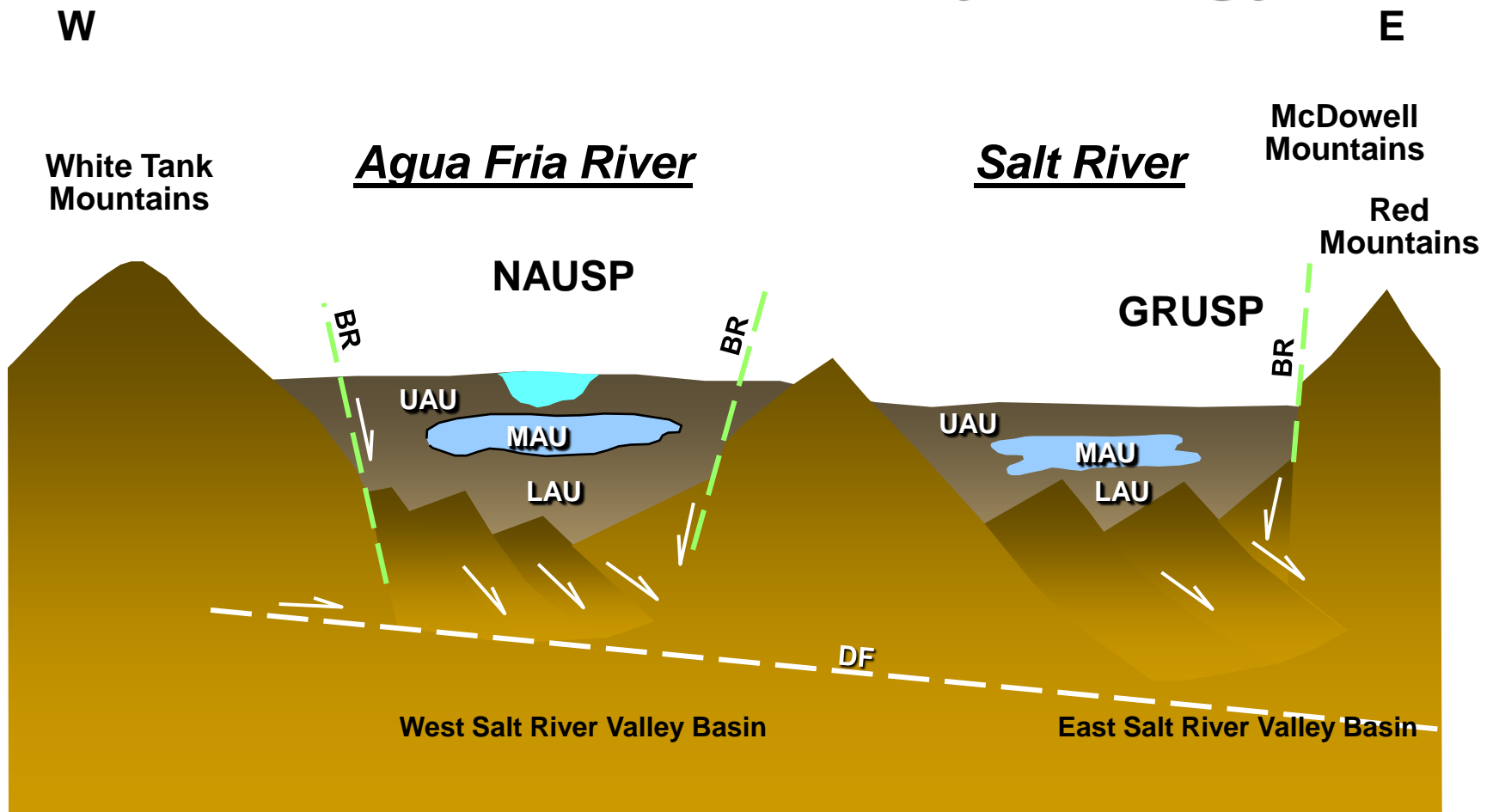
Water-Spreading Facilities: GRUSP

- Site Selection
 - Geology
 - Hydrogeology
 - Engineering infrastructure
 - Environmental factors

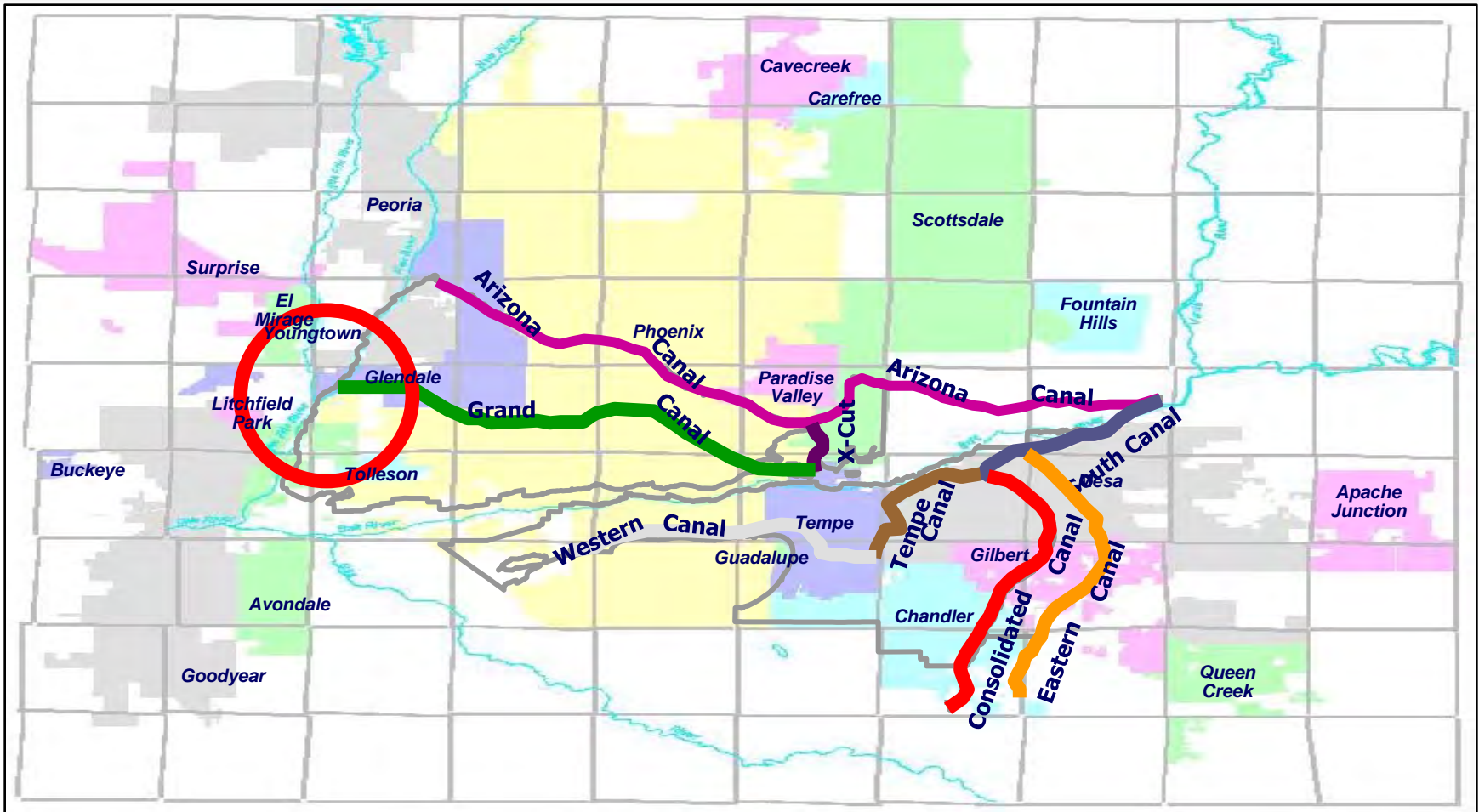



Water-Spreading Facilities: GRUSP and NAUSP

Lower Salt River Valley Geology



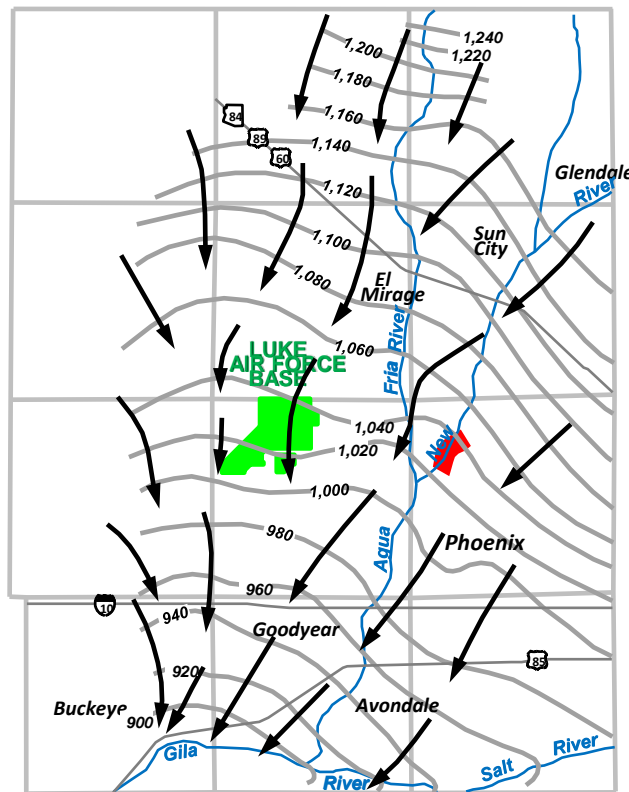
Water-Spreading Facilities: NAUSP



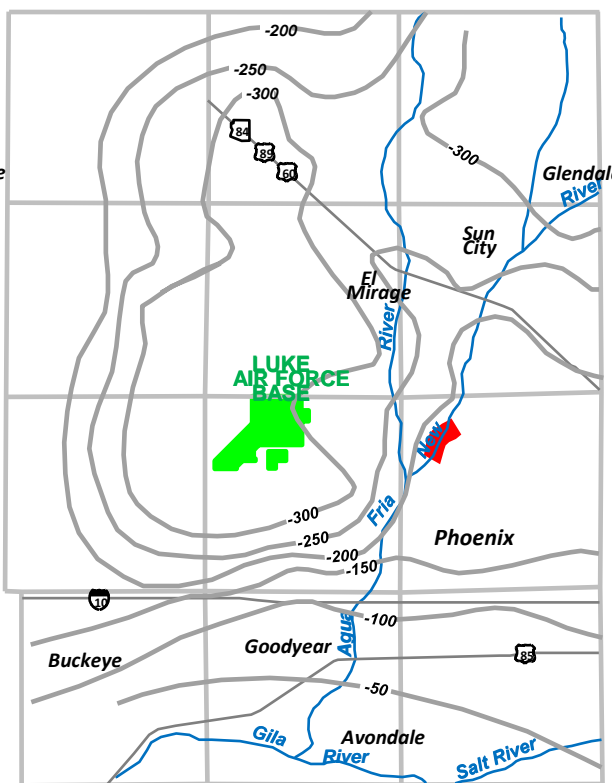


Water-Spreading Facilities: NAUSP

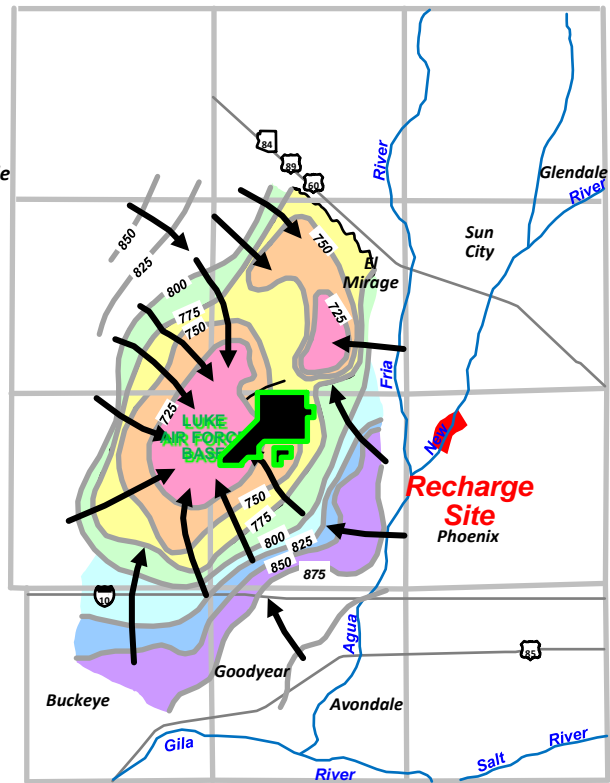
Altitude of Water Table




Spring 1923



Spring 1923-77




Spring 1991



Water-Spreading Facilities: NAUSP

- Started operation in 2006
- Basins
 - In-channel and off-channel
- Permit capacity
 - 75,000 ac-ft/yr (92,475,000 m³/yr)
- Near SRP water infrastructure
- Total cost
 - \$13M



Water-Spreading Facilities: NAUSP

- Recharge units
 - 6 off-channel
 - 1 in-channel basins

Basin 2




**Looking
Southwest**



East Side






Water-Spreading Facilities: NAUSP

- Delivery units
 - Grand Canal
 - Reclaimed water pipelines
- Monitoring units
 - 12 wells



A small image of a saguaro cactus against a blue sky with clouds, located in the top left corner of the slide.

Water-Spreading Facilities: MBT Ranch Recharge Project

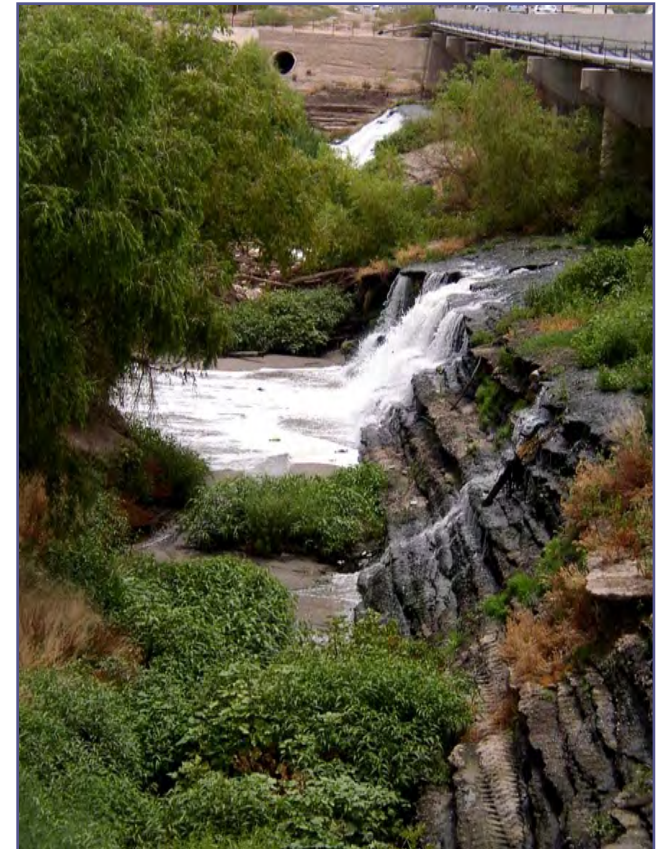
- Type
 - Water-Spreading/Basins
 - ADWR Constructed Recharge Facility
- Location
 - Maricopa County
- Ownership
 - Vidler Water Company
- Source Water
 - CAP
- Capacity
 - 75,000 ac-ft/yr (92,475,000 m³/yr)





Water-Spreading Facilities: LSCRMRP

- Type
 - Water-Spreading
 - ADWR Managed Recharge Facility
- Location
 - Santa Cruz River Channel, Tucson
- Operator
 - Pima County – City of Tucson
- Source Water
 - Reclaimed Water
 - Roger Road and Ina Road WWTPs
- Capacity
 - 45,000 ac-ft/yr (55,485,000 m³/yr)




A small inset image in the top left corner showing a green saguaro cactus against a blue sky with some clouds.

Water-Spreading Facilities: Hassayampa Recharge Project

- Type
 - Water-Spreading
 - ADWR Managed Recharge Facility
- Location
 - Hassayampa River, Maricopa County
- Ownership
 - Summit Global
- Operator
 - HydroSystems, Inc.
- Source Water
 - CAP
- Capacity
 - 25,000 ac-ft/yr (30,825,000 m³/yr)





The Future of Water Spreading in Arizona

- Availability of unused CAP water decreases
- More CAP water may become available as agriculture decreases
- California and Nevada could continue to recharge Colorado River Water in Arizona?
- More reclaimed water is available for aquifer storage
- New recharge projects will store predominantly reclaimed water
 - Medium to small projects (<5,000 ac-ft/yr)
(< 6,165,000 m³/yr)