ARIZONA DEPARTMENT OF WATER RESOURCES

Enhanced Aquifer Management

Stakeholder Process

October 9, 2013

Enhanced Aquifer Management
Background

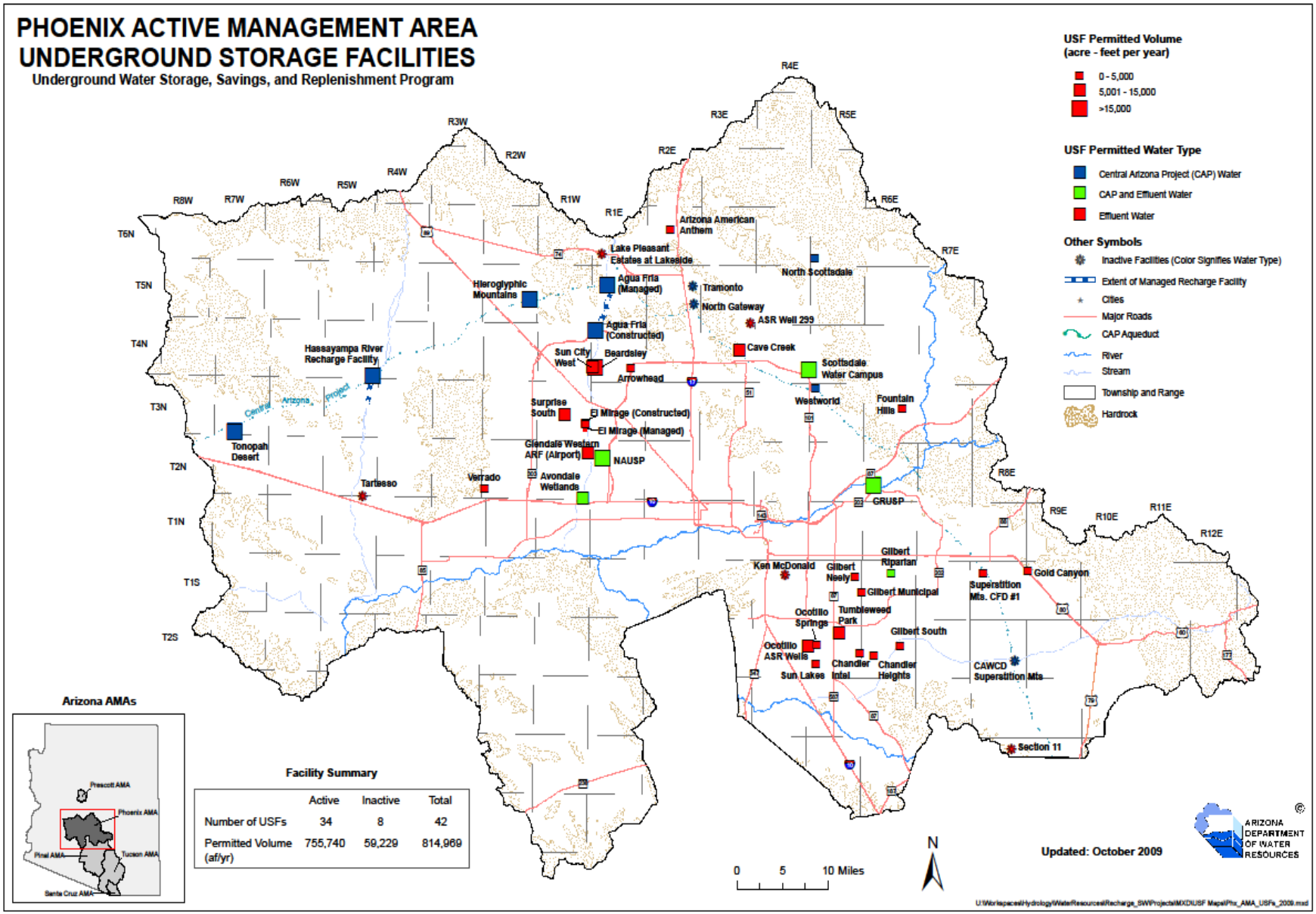
- **The underground water storage program has been beneficial for storage of renewable supplies for future use**
  - **Flexibility**
    - **Storer can potentially store in one location, recover in a different location/subbasin within same AMA**
  - **Drawbacks**
    - **Recovery at locations far from storage (or replenishment far from pumping) can create problems**

Enhanced Aquifer Management
Background

- Local groundwater declines can result in land subsidence, earth fissures, increased pumping costs, decreased water quality, possible physical availability issues
- Recharge in proximity to areas of groundwater level decline is ideal (though not always 100% feasible)
- Recharge/recovery or pumping/replenishment may not occur in same location for several reasons:
  - Proximity of renewable supply infrastructure
  - Suitability of recharge sites
  - Cost of building recharge facility
  - Economy of scale
  - Lack of storage capacity in some recharge sites

PHOENIX ACTIVE MANAGEMENT AREA
UNDERGROUND STORAGE FACILITIES

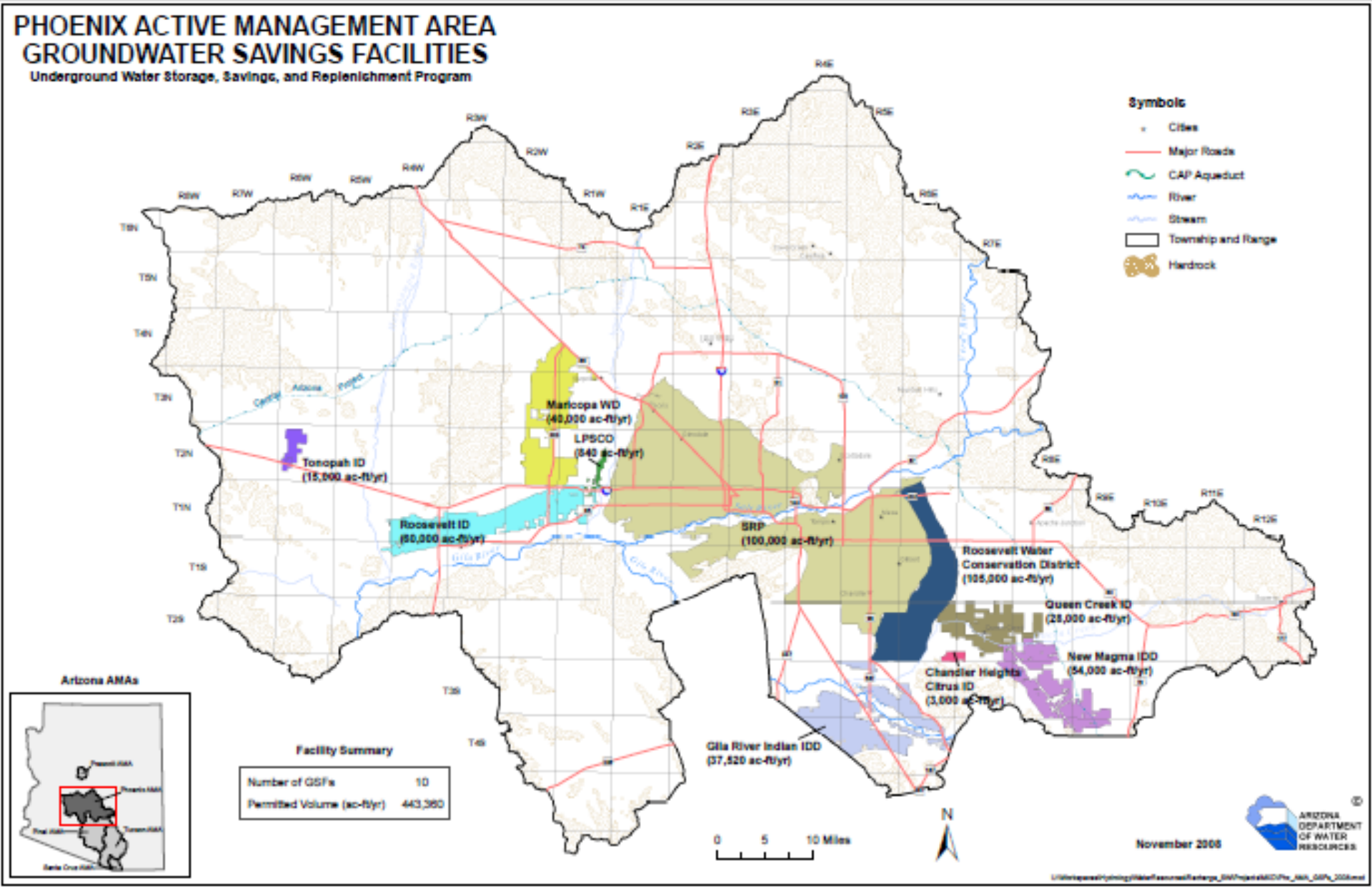
Underground Water Storage, Savings, and Replenishment Program

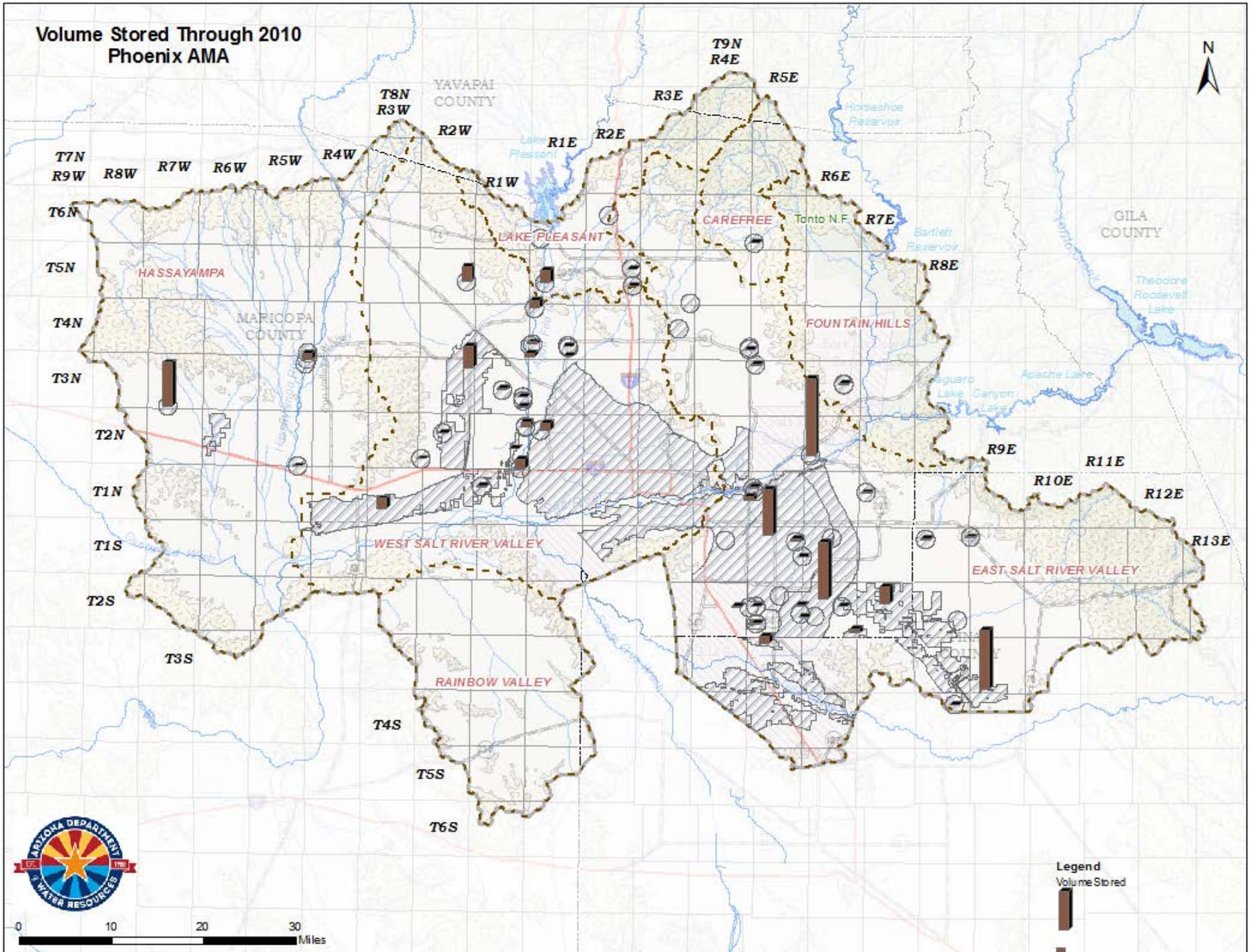


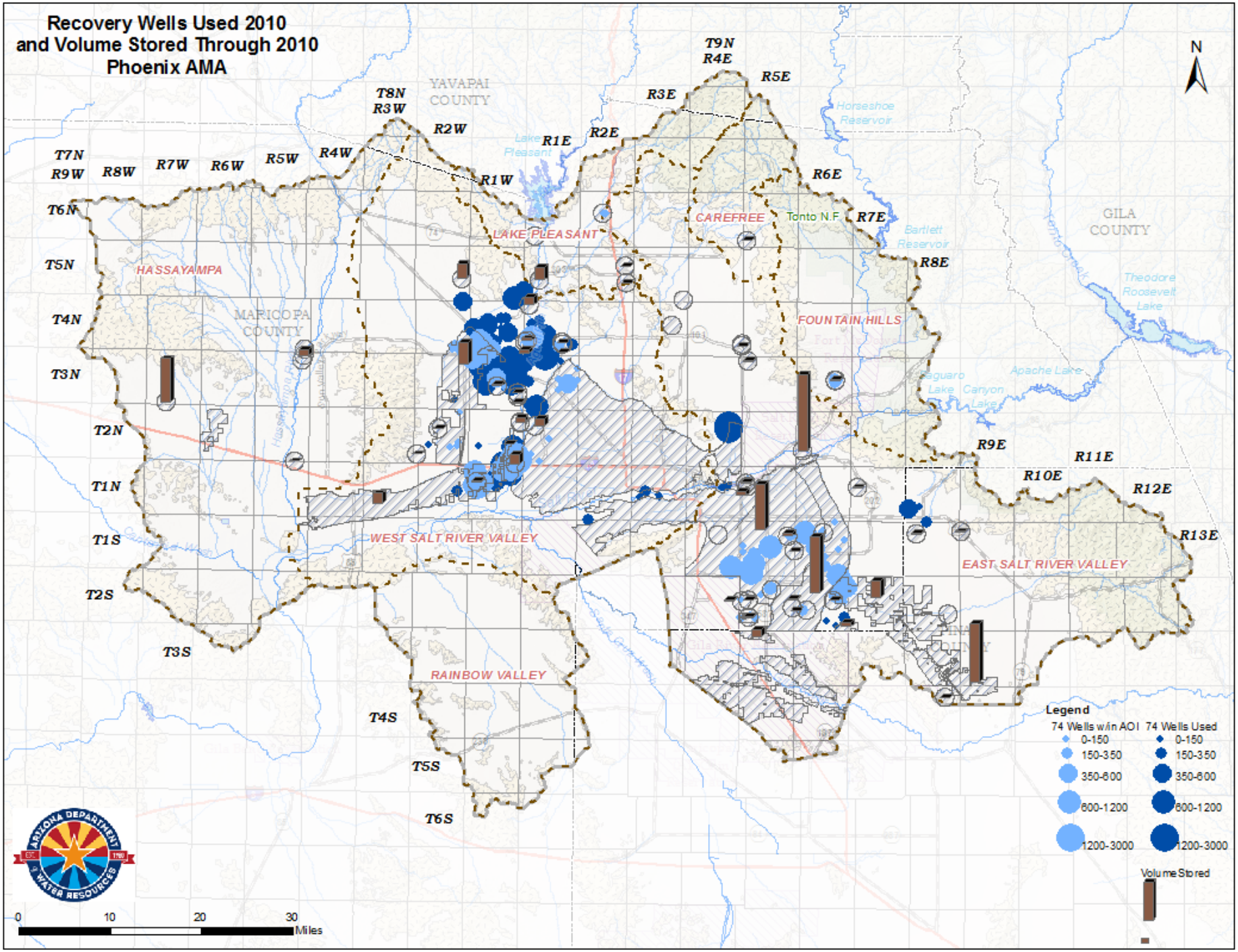
Arizona AMAs

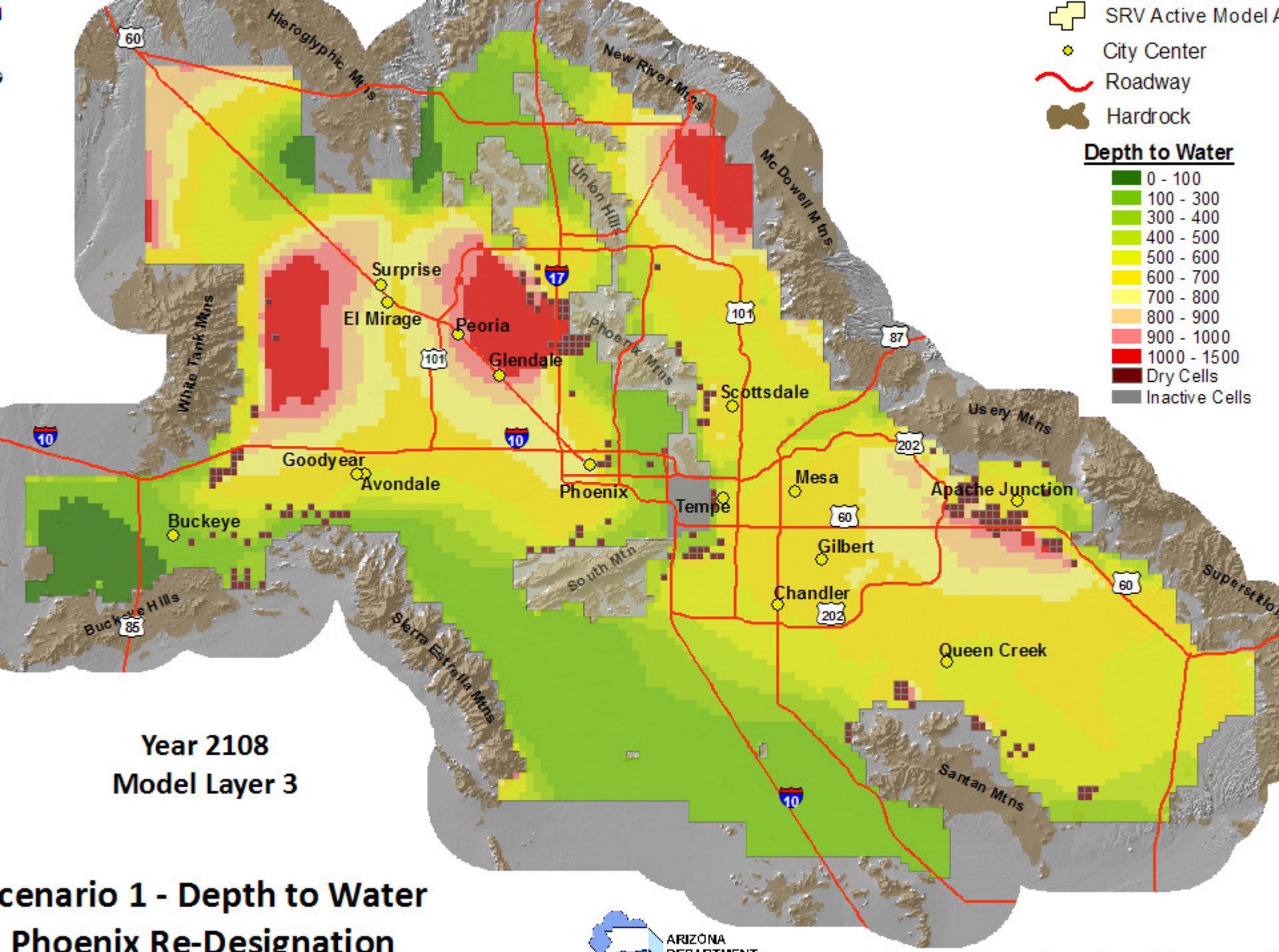
Facility Summary

	Active	Inactive	Total
Number of USFs	34	8	42
Permitted Volume (af/yr)	755,740	59,229	814,969


PHOENIX ACTIVE MANAGEMENT AREA
GROUNDWATER SAVINGS FACILITIES
Underground Water Storage, Savings, and Replenishment Program
Symbols
Cities
Major Roads
CAP Aqueduct
River
Stream
Township and Range
Hardrock
Maricopa WD
(40,000 ac-ft/yr)
LPSCD
(540 ac-ft/yr)
Tonopah ID
(15,000 ac-ft/yr)
Roosevelt ID
(60,000 ac-ft/yr)
SRP
(100,000 ac-ft/yr)
Roosevelt Water
Conservation District
(105,000 ac-ft/yr)
Queen Creek ID
(28,000 ac-ft/yr)
New Magma IDD
(54,000 ac-ft/yr)
Chandler Heights
Citrus ID
(3,000 ac-ft/yr)
Gila River Indian IDD
(37,520 ac-ft/yr)
Arizona AMAs
Facility Summary
Number of GSFs 10
Permitted Volume (ac-ft/yr) 443,360
0 5 10 Miles
N
November 2008
ARIZONA DEPARTMENT OF WATER RESOURCES

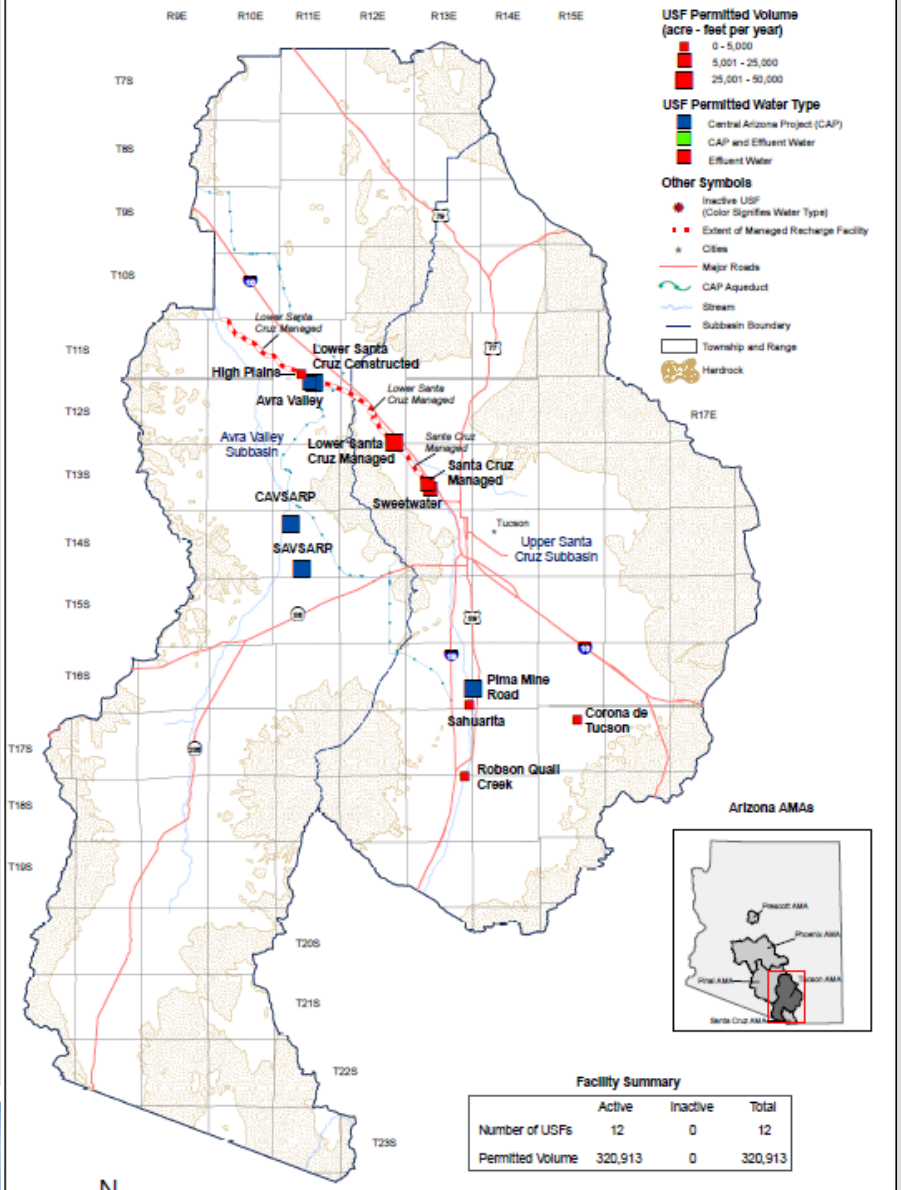

Volume Stored Through 2010
Phoenix AMA
N
T9N
R4E
R5E
R3E
T8N
R3W
R2W
R1E
R2E
R6E
T7N
R9W
R8W
R7W
R6W
R5W
R4W
R1W
T6N
R7E
T5N
R8E
T4N
R9E
R11E
R10E
R12E
T3N
T2N
T1N
R13E
T1S
T2S
T3S
T4S
T5S
T6S
YAVAPAI COUNTY
MARICOPA COUNTY
GILA COUNTY
Horseshoe Reservoir
Lake Pleasant
Bartlett Reservoir
Theodore Roosevelt Lake
Apache Lake
Saguaro Lake
Canyon Lake
Tonto N.F.
CAREFREE
LAKE PLEASANT
HASSAYAMPA
FOUNTAIN HILLS
WEST SALT RIVER VALLEY
EAST SALT RIVER VALLEY
RAINBOW VALLEY
ARIZONA DEPARTMENT OF WATER RESOURCES
0
10
20
30
Miles
Legend
Volume Stored


Recovery Wells Used 2010
and Volume Stored Through 2010
Phoenix AMA
N
YAVAPAI COUNTY
MARICOPA COUNTY
GILA COUNTY
T9N
T8N
T7N
T6N
T5N
T4N
T3N
T2N
T1N
T1S
T2S
T3S
T4S
T5S
T6S
R4E
R5E
R3E
R3W
R2W
R1E
R2E
R1W
R9W
R8W
R7W
R6W
R5W
R4W
R6E
R7E
R8E
R9E
R10E
R11E
R12E
R13E
HASSAYAMPA
LAKE PLEASANT
CAREFREE
FOUNTAIN HILLS
WEST SALT RIVER VALLEY
EAST SALT RIVER VALLEY
RAINBOW VALLEY
Horseshoe Reservoir
Lake Pleasant
Tonto N.F.
Bartlett Reservoir
Theodore Roosevelt Lake
Apache Lake
Canyon Lake
Legend
74 Wells w/in AOI
0-150
150-350
350-600
600-1200
1200-3000
74 Wells Used
0-150
150-350
350-600
600-1200
1200-3000
Volume Stored
0
10
20
30
Miles


SRV Active Model A
City Center
Roadway
Hardrock
Depth to Water
0 - 100
100 - 300
300 - 400
400 - 500
500 - 600
600 - 700
700 - 800
800 - 900
900 - 1000
1000 - 1500
Dry Cells
Inactive Cells
Hieroglyphic Mtns
New River Mtns
Mc Dowell Mtns
Union Hills
White Tank Mtns
Phoenix Mtns
Usery Mtns
South Mtn
Buckeye Hills
Sierra Estrella Mtns
Santan Mtns
Superstition
Surprise
El Mirage
Peoria
Glendale
Scottsdale
Goodyear
Avondale
Phoenix
Tempe
Mesa
Apache Junction
Buckeye
Gilbert
Chandler
Queen Creek
60
17
101
10
87
202
85
Year 2108
Model Layer 3
cenario 1 - Depth to Water
Phoenix Re-Designation
ARIZONA
DEPARTMENT

TUCSON ACTIVE MANAGEMENT AREA
UNDERGROUND STORAGE FACILITIES

Underground Water Storage, Savings, and Replenishment Program



Facility Summary

	Active	Inactive	Total
Number of USFs	12	0	12
Permitted Volume	320,913	0	320,913

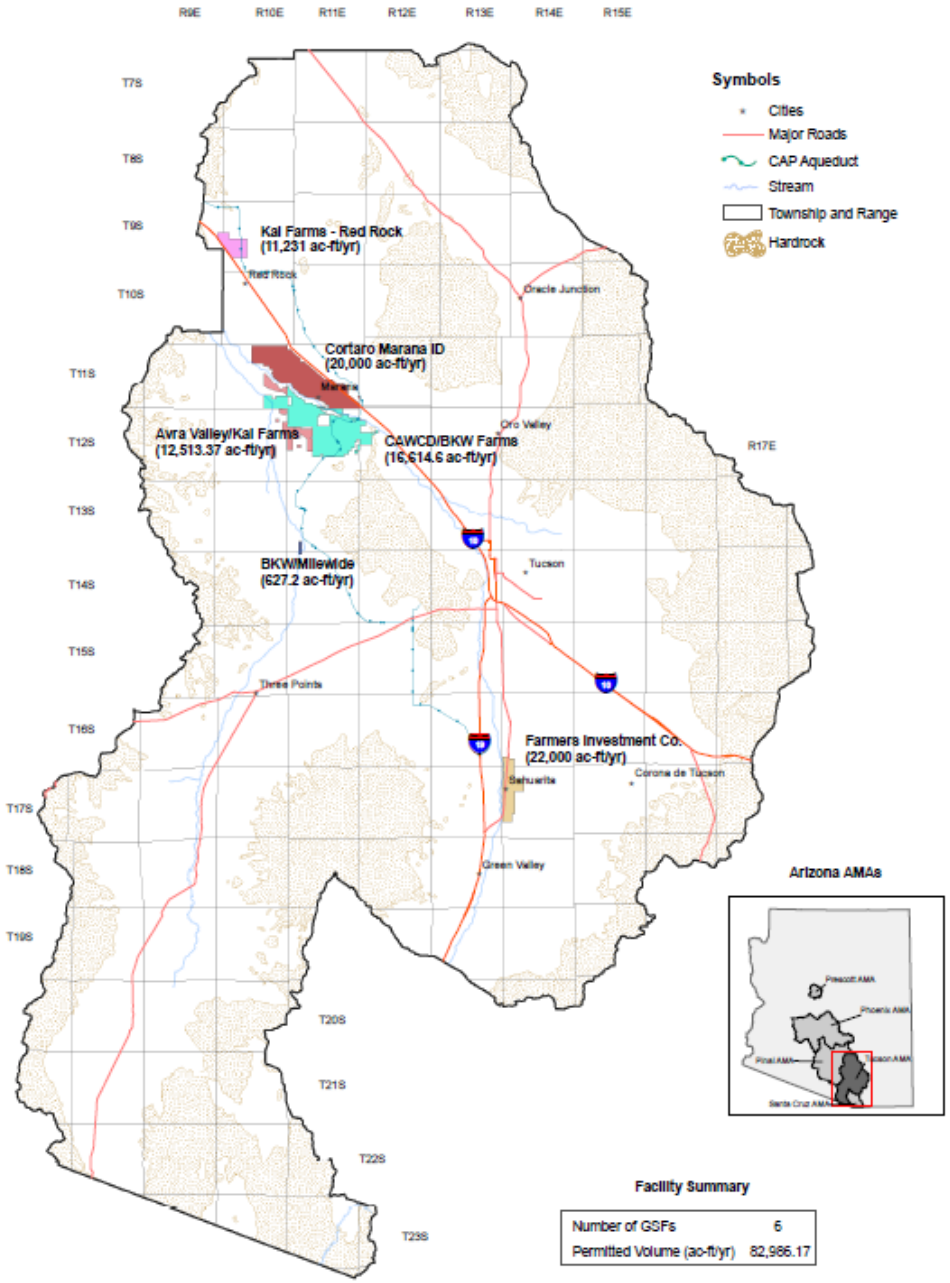
Updated: October 2009

ARIZONA DEPARTMENT OF WATER RESOURCES

U:\Workspaces\Hydrology\WaterResources\Recharge_SW\Projects\MXD\USF Maps\Tuc_AMA_USFs_2009.mxd

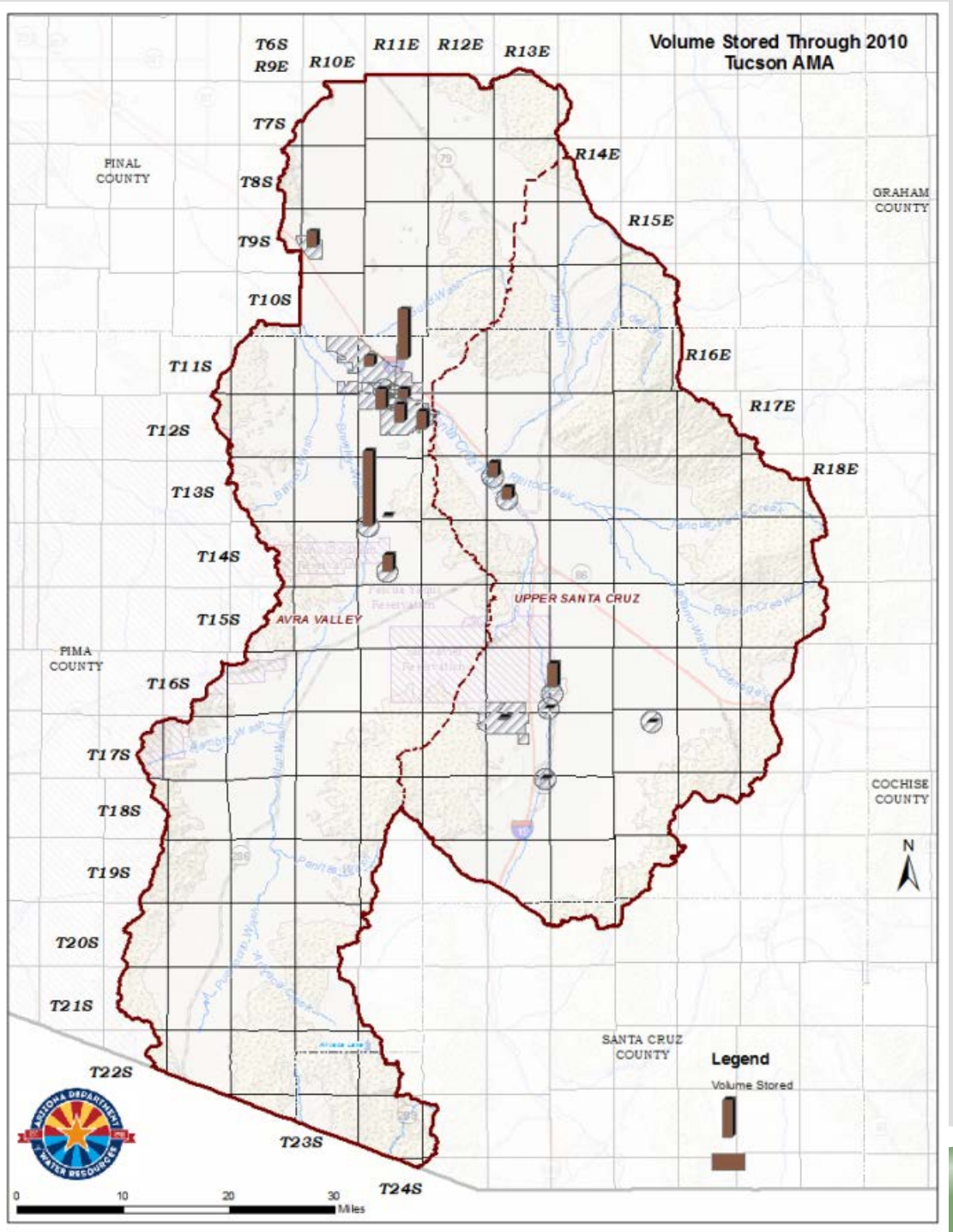
TUCSON ACTIVE MANAGEMENT AREA
GROUNDWATER SAVINGS FACILITIES

Underground Water Storage, Savings, and Replenishment Program



Facility Summary

Number of GSFs	6
Permitted Volume (ac-ft/yr)	82,986.17


Volume Stored Through 2010
Tucson AMA
T6S
R9E
R10E
R11E
R12E
R13E
T7S
R14E
T8S
R15E
T9S
T10S
R16E
T11S
R17E
T12S
R18E
T13S
T14S
T15S
AVRA VALLEY
UPPER SANTA CRUZ
T16S
T17S
T18S
T19S
T20S
T21S
T22S
T23S
T24S
PINAL COUNTY
GRAHAM COUNTY
PIMA COUNTY
COCHISE COUNTY
SANTA CRUZ COUNTY
N
Legend
Volume Stored
0
10
20
30
Miles

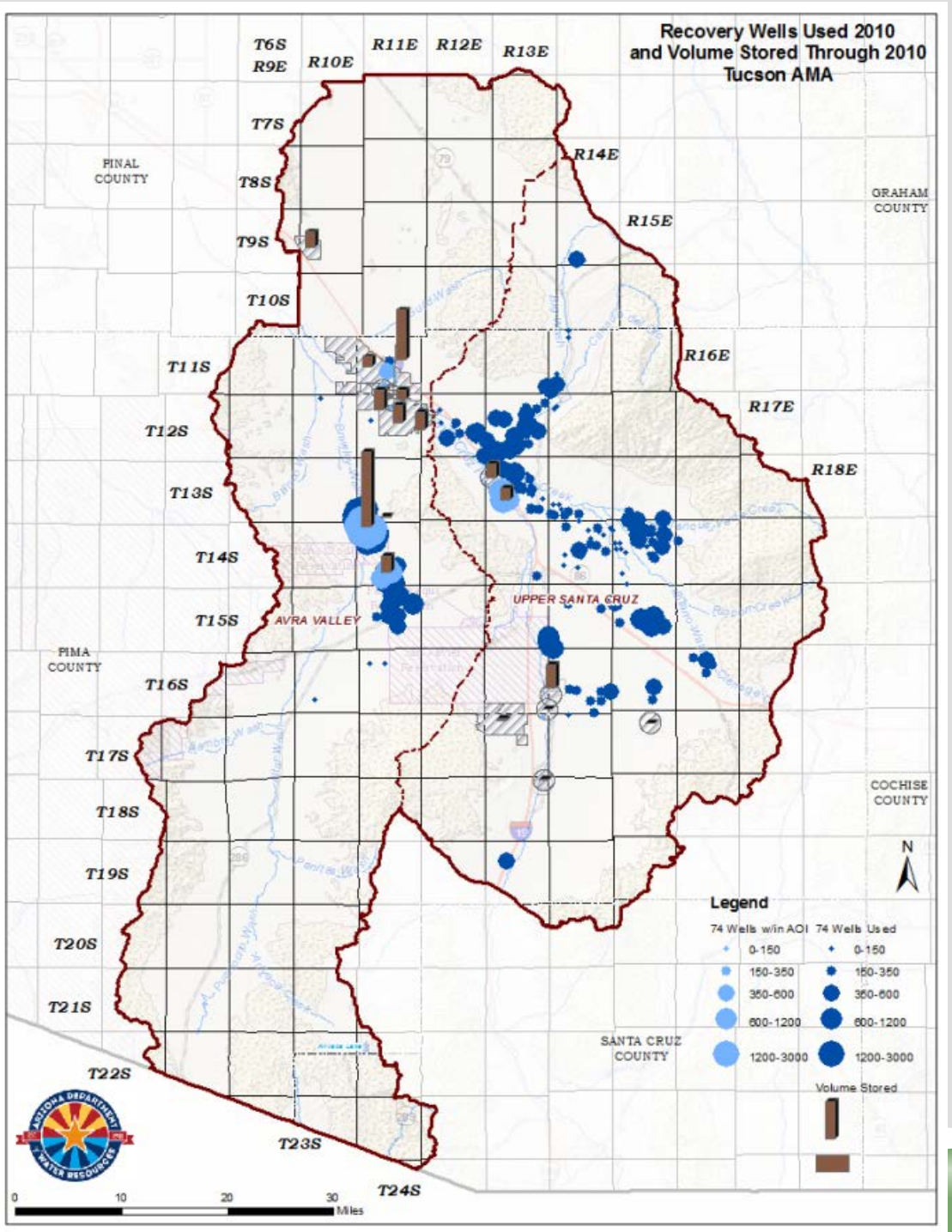
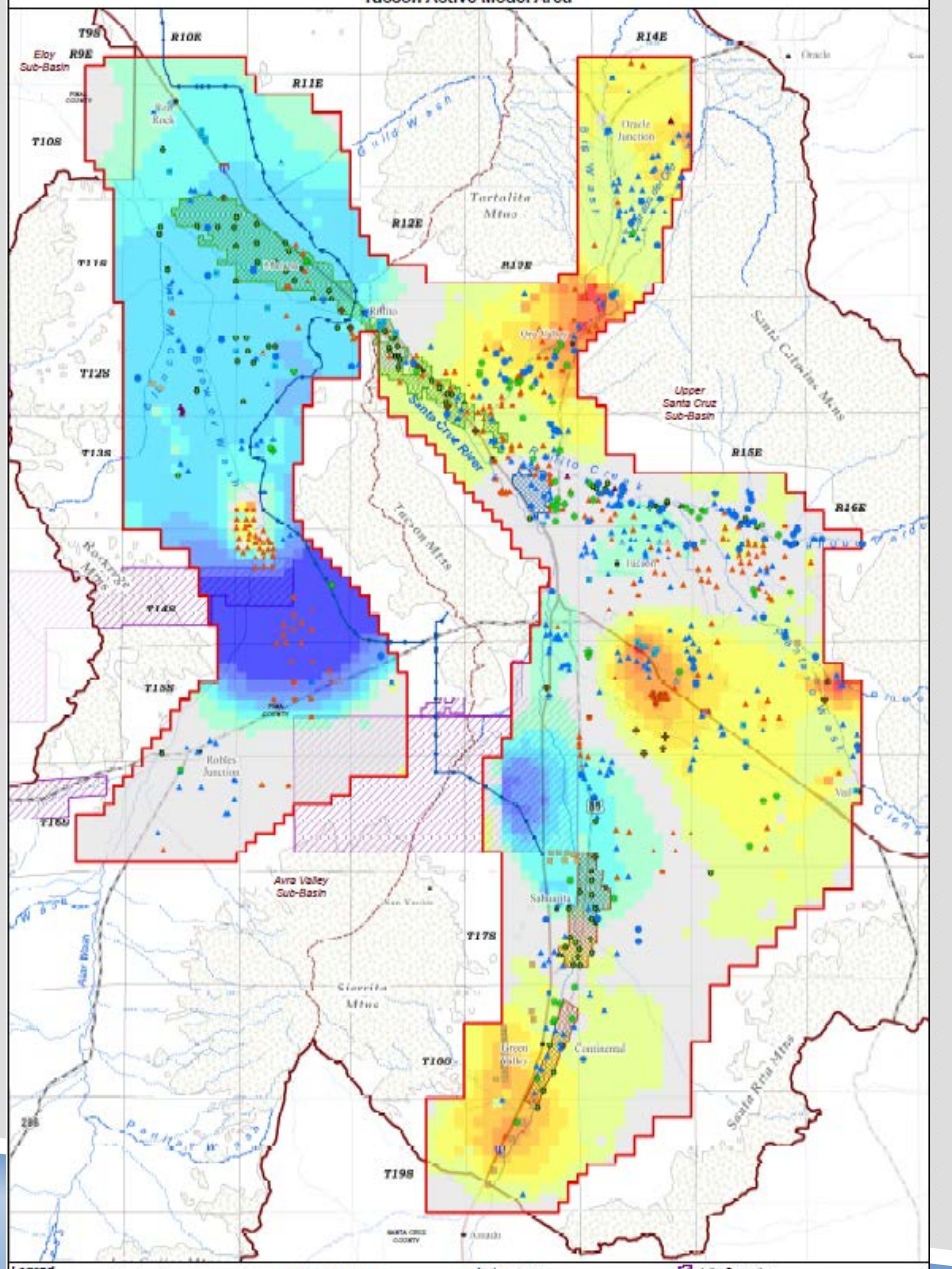
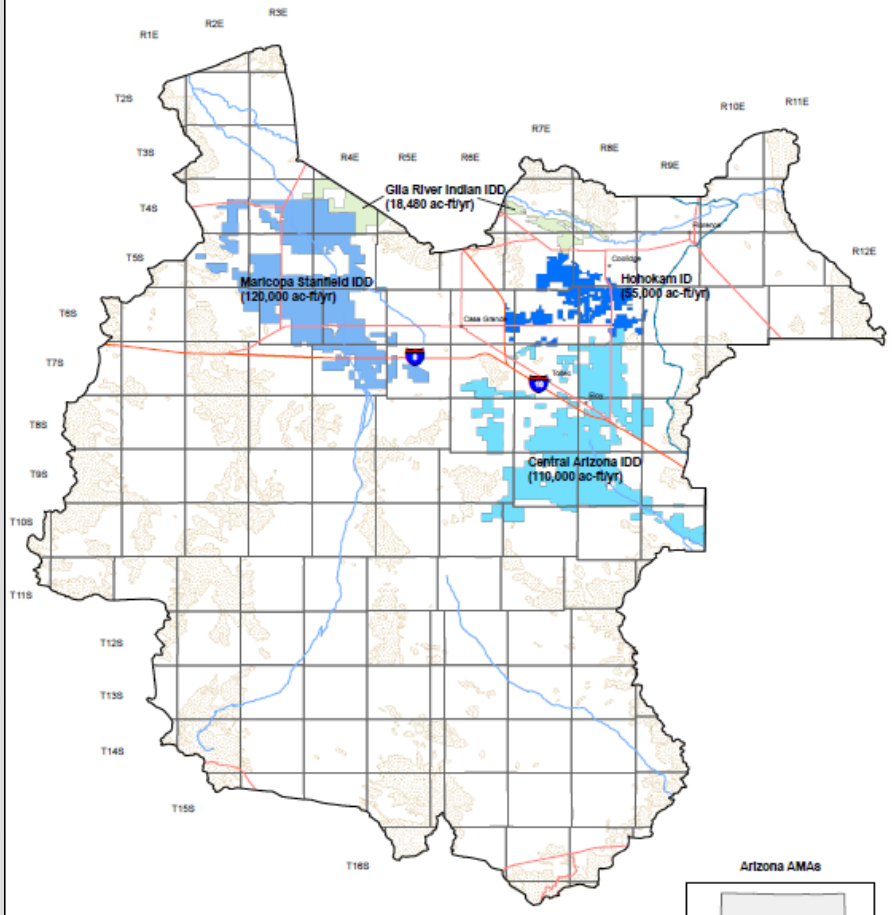

Recovery Wells Used 2010
and Volume Stored Through 2010
Tucson AMA
T6S
R9E
R10E
R11E
R12E
R13E
T7S
R14E
T8S
R15E
T9S
T10S
R16E
T11S
R17E
T12S
R18E
T13S
T14S
T15S
AVRA VALLEY
UPPER SANTA CRUZ
T16S
T17S
T18S
T19S
T20S
T21S
T22S
T23S
T24S
PINAL COUNTY
GRAHAM COUNTY
PIMA COUNTY
COCHISE COUNTY
SANTA CRUZ COUNTY
N
Legend
74 Wells w/in AOI
74 Wells Used
0-150
150-350
350-600
600-1200
1200-3000
Volume Stored
0
10
20
30
Miles

Figure 2. Pumping Locations and
Projected Water Level Change Between 2010 - 2025
Tucson Active Model Area



PINAL ACTIVE MANAGEMENT AREA
UNDERGROUND STORAGE FACILITIES

Underground Water Storage, Savings, and Replenishment Program



N

0 5 10 20 Miles

Symbols

- Cities
- Major Roads
- CAP Aqueduct
- Stream
- Township and Range
- Hardrock

Arizona AMAs

Facility Summary

Number of GSFs	4
Permitted Volume (ac-ft/yr)	303,480

ARIZONA DEPARTMENT OF WATER RESOURCES

November 2008

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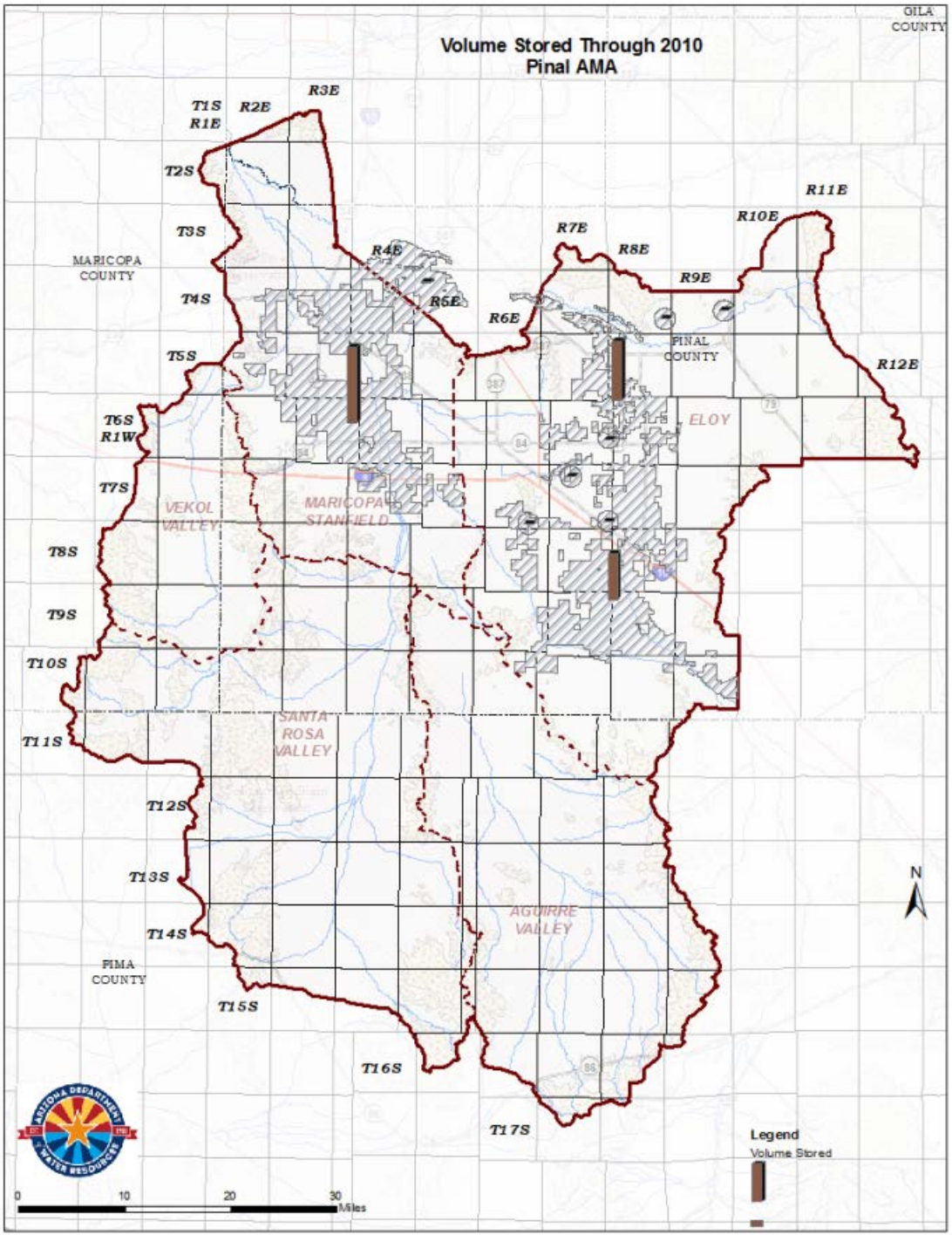
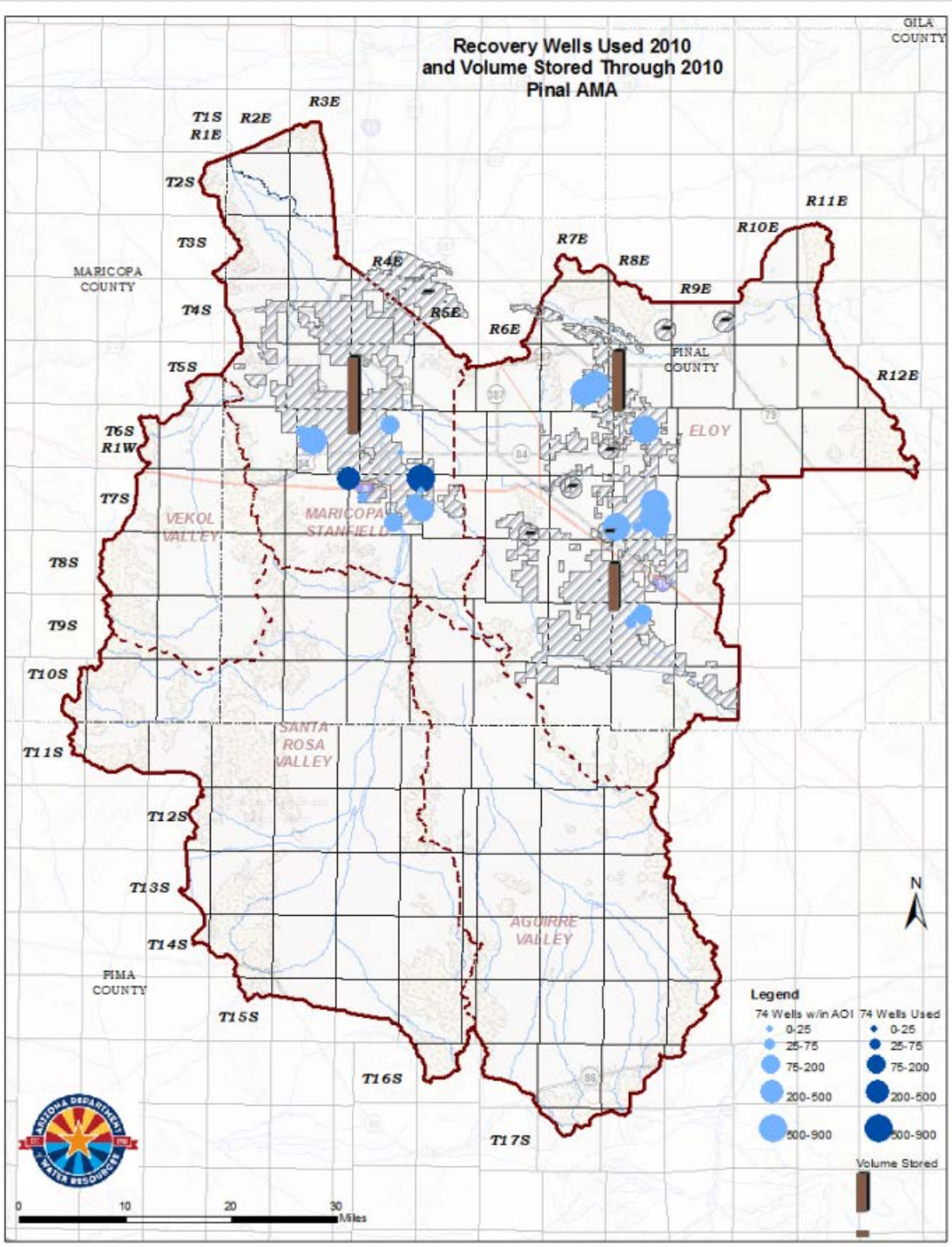
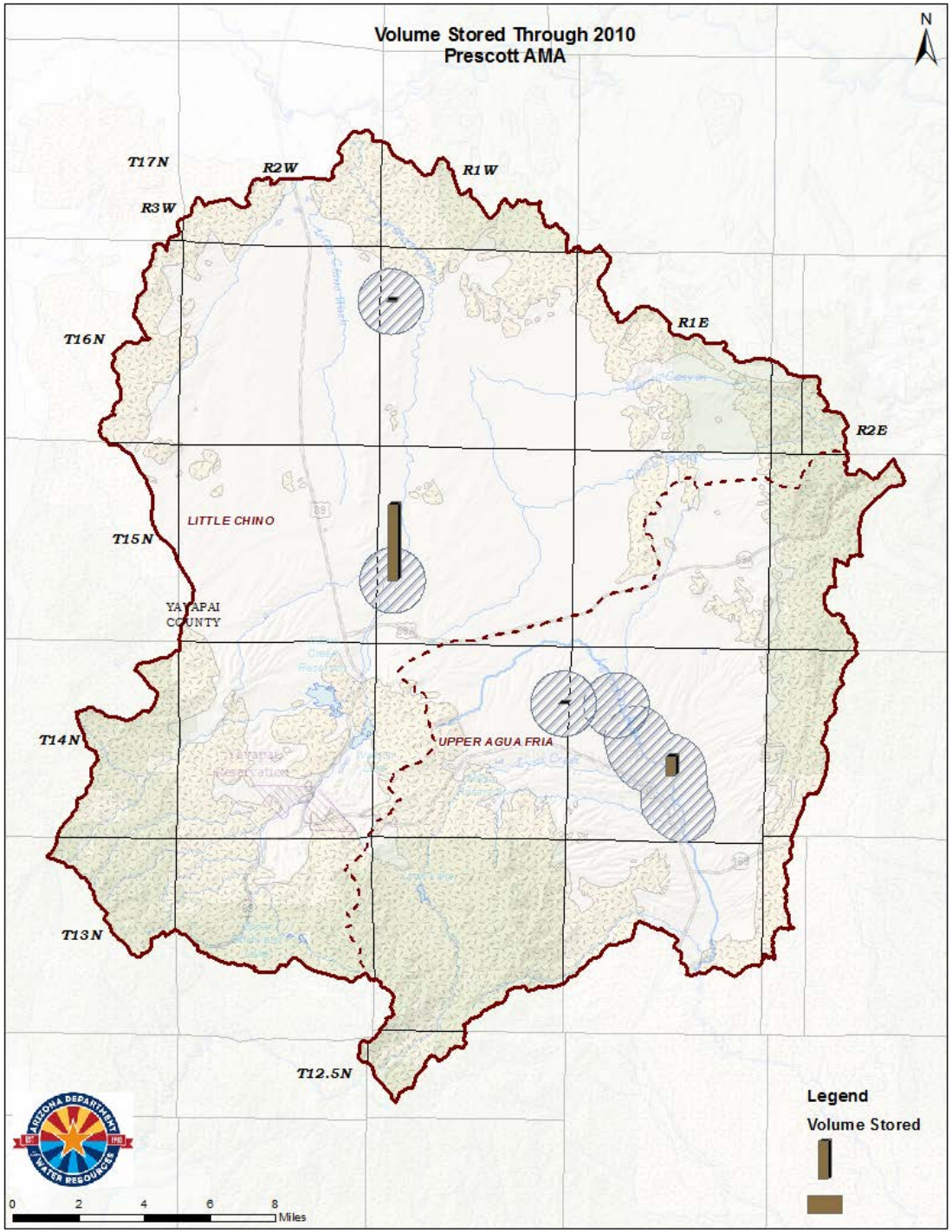
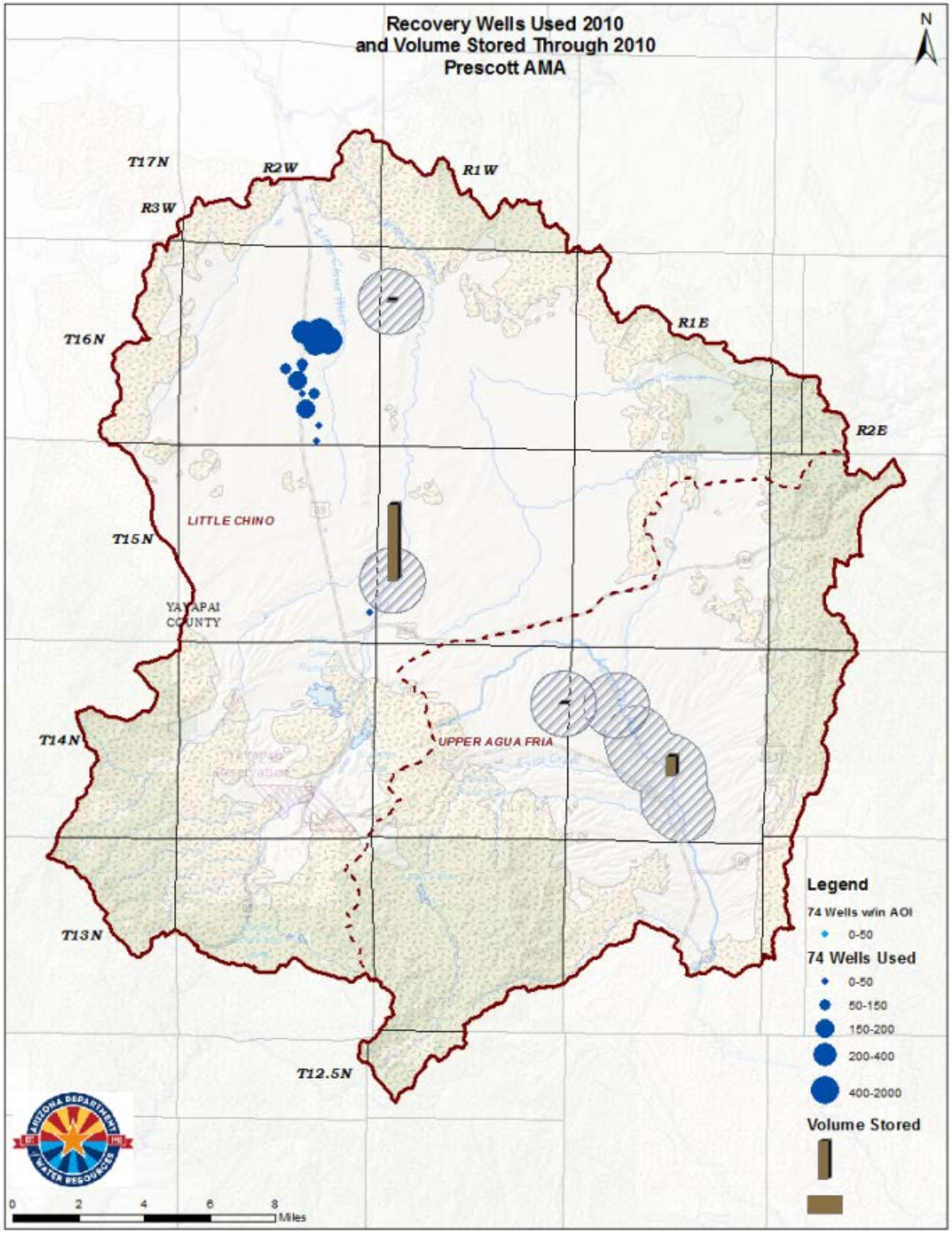

Volume Stored Through 2010
Pinal AMA
GILA COUNTY
MARICOPA COUNTY
PINAL COUNTY
PIMA COUNTY
R3E
T1S R1E
R2E
T2S
T3S
R4E
R5E
T4S
T5S
R6E
R7E
R8E
R9E
R10E
R11E
R12E
T6S R1W
T7S
T8S
T9S
T10S
T11S
T12S
T13S
T14S
T15S
T16S
T17S
ELOY
VEKOL VALLEY
MARICOPA STANFIELD
SANTA ROSA VALLEY
AGUIRRE VALLEY
N
Legend
Volume Stored
0
10
20
30
Miles


Recovery Wells Used 2010
and Volume Stored Through 2010
Pinal AMA
GILA COUNTY
MARICOPA COUNTY
PINAL COUNTY
PIMA COUNTY
ELOY
MARICOPA
STANFIELD
VEKOL VALLEY
SANTA ROSA VALLEY
AGUIRRE VALLEY
R1E
R2E
R3E
R4E
R5E
R6E
R7E
R8E
R9E
R10E
R11E
R12E
T1S
T2S
T3S
T4S
T5S
T6S
T7S
T8S
T9S
T10S
T11S
T12S
T13S
T14S
T15S
T16S
T17S
N
Legend
74 Wells w/in AOI
0-25
25-75
75-200
200-500
500-900
74 Wells Used
0-25
25-75
75-200
200-500
200-900
Volume Stored
0
10
20
30
Miles


Volume Stored Through 2010
Prescott AMA
N
T17N
R3W
R2W
R1W
R1E
R2E
T16N
T15N
T14N
T13N
T12.5N
LITTLE CHINO
YAVAPAI COUNTY
UPPER AGUA FRIA
Legend
Volume Stored
0 2 4 6 8
Miles


Recovery Wells Used 2010
and Volume Stored Through 2010
Prescott AMA
N
T17N
R3W
R2W
R1W
R1E
R2E
T16N
T15N
T14N
T13N
T12.5N
LITTLE CHINO
YAVAPAI
COUNTY
UPPER AGUA FRIA
Legend
74 Wells w/in AOI
0-50
74 Wells Used
0-50
50-150
150-200
200-400
400-2000
Volume Stored
0
2
4
6
8
Miles

Enhanced Aquifer Management

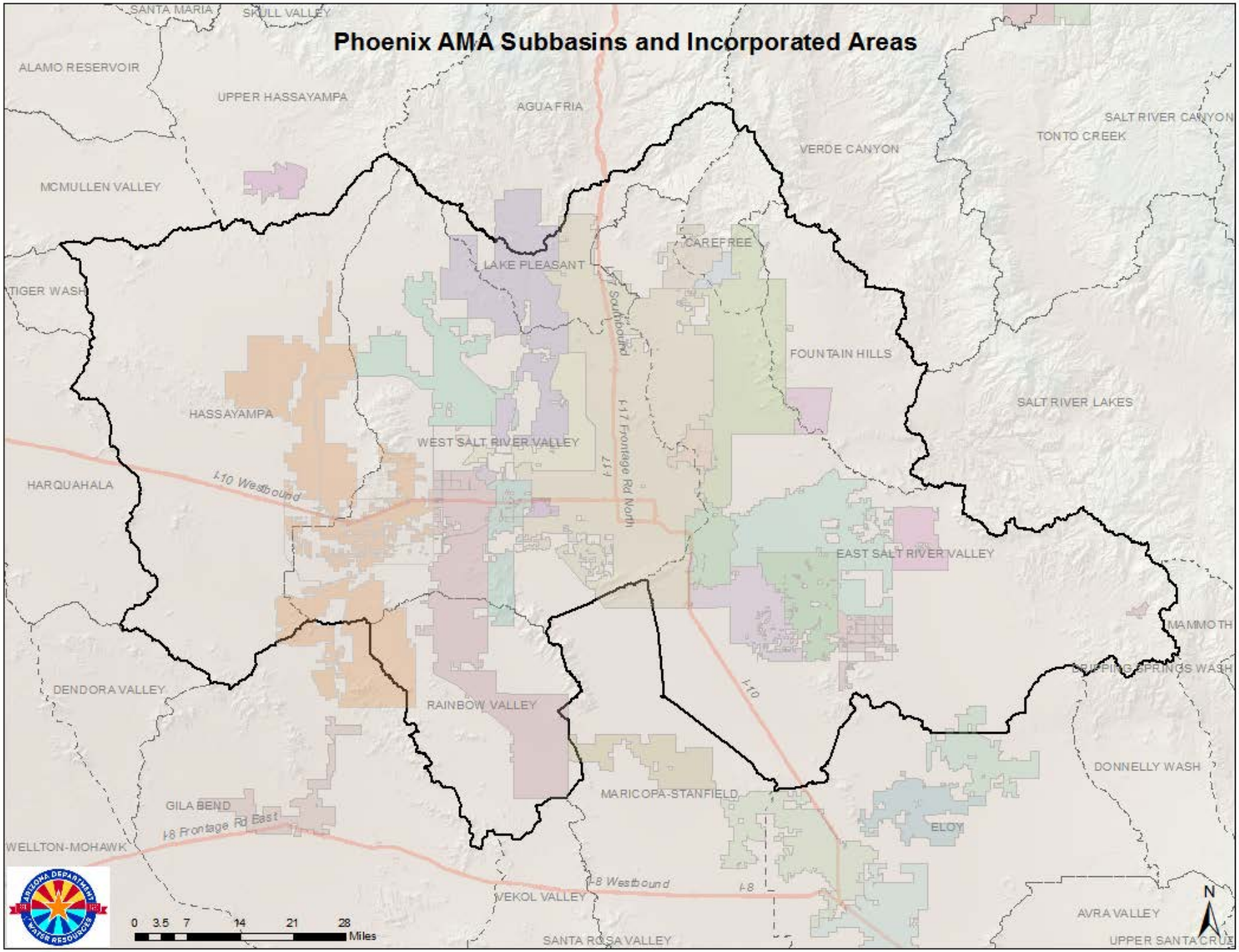
- **To help deal with the problem of hydrologic disconnect, there has been thought given toward providing incentives for recharge and recovery in same location, and/or disincentives to recover farther from the location of storage.**

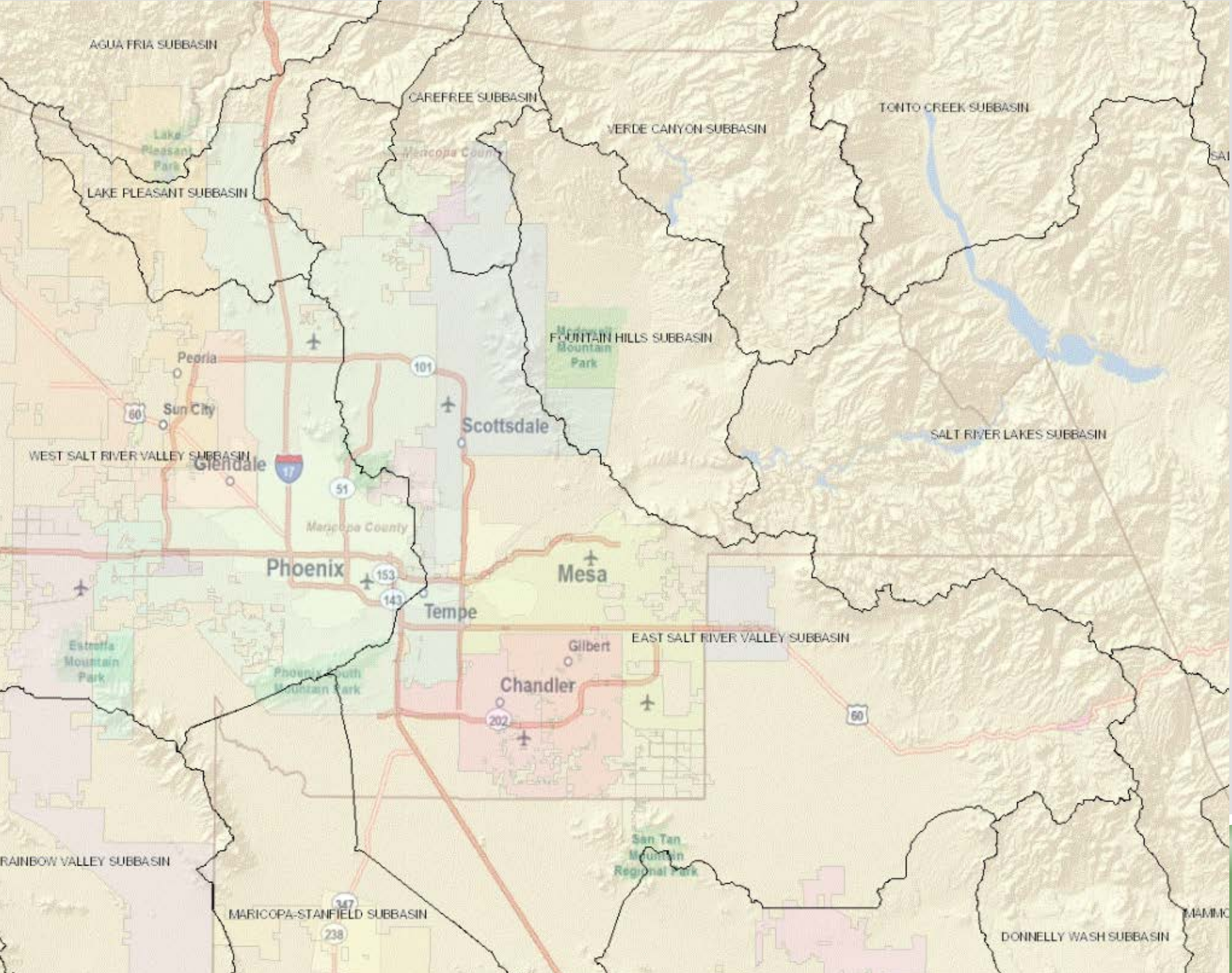
Cuts to the Aquifer - Currently

- **Long-Term Storage Credits - Currently 5%**
- **No cut for annual storage and recovery**
- **No cut for storage of effluent at constructed facilities**
- **50% cut for storage of effluent at managed (in-stream) facilities**

Enhanced Aquifer Management

- **ADWR Concept Paper October 2012**
  - **0% cut to aquifer if recovery within 1 mile of underground storage facility (USF), or inside boundaries of Groundwater Savings Facility (GSF)**
  - **10% cut if recovery outside 1 mile of USF or outside boundaries of GSF, but within same sub-basin**
  - **20% cut if recovery in different sub-basin than where recharge occurred**
  - **ADWR may consider granting greater than100% credit for water recharged in areas that will uniquely benefit from recharge (e.g. areas of water level declines)**
  - **Would apply to <u>future</u> storage/recovery activities; credits currently in place would not be affected**


Phoenix AMA Subbasins and Incorporated Areas
SANTA MARIA
SKULL VALLEY
ALAMO RESERVOIR
UPPER HASSAYAMPA
AGUA FRIA
SALT RIVER CANYON
TONTO CREEK
VERDE CANYON
MCMULLEN VALLEY
CAREFREE
LAKE PLEASANT
TIGER WASH
I-17 Southbound
FOUNTAIN HILLS
HASSAYAMPA
SALT RIVER LAKES
WEST SALT RIVER VALLEY
I-17 Frontage Rd North
I-17
HARQUAHALA
I-10 Westbound
EAST SALT RIVER VALLEY
MAMMOTH
DENDORA VALLEY
RAINBOW VALLEY
I-10
DONNELLY WASH
MARICOPA-STANFIELD
GILA BEND
I-8 Frontage Rd East
ELOY
WELLTON-MOHAWK
I-8 Westbound
I-8
VEKOL VALLEY
AVRA VALLEY
SANTA ROSA VALLEY
UPPER SANTA CRUZ
0 3.5 7 14 21 28
Miles
N


AGUA FRIA SUBBASIN
CAREFREE SUBBASIN
TONTO CREEK SUBBASIN
VERDE CANYON SUBBASIN
LAKE PLEASANT SUBBASIN
FOUNTAIN HILLS SUBBASIN
Peoria
Sun City
Scottsdale
SALT RIVER LAKES SUBBASIN
WEST SALT RIVER VALLEY SUBBASIN
Glendale
Maricopa County
Phoenix
Mesa
Tempe
EAST SALT RIVER VALLEY SUBBASIN
Gilbert
Chandler
RAINBOW VALLEY SUBBASIN
MARICOPA-STANFIELD SUBBASIN
DONNELLY WASH SUBBASIN

Enhanced Aquifer Management

- **Comments received from**
  - **AWBA**
  - **CAWCD**
  - **SRP**
  - **Prescott and Tucson AMAs**
  - **Freeport McMoRan**
  - **AMWUA**
  - **Others**

Enhanced Aquifer Management

- **Comments received – posted on web site**
  - **www.azwater.gov Link under Hot Topics**

Enhanced Aquifer Management

- General Questions/Comments
  - What types of storage to be included
  - What types of water to be included
  - Which permitted entities to be included
  - Needs more specifics and analysis
  - Would benefit from stakeholder process

Enhanced Aquifer Management

- **General Questions/Comments cont'd**
  - **May need different palette of solutions for each AMA**
  - **Concern about unintended consequences**
  - **Uncertainty about value of credits until recovery occurs**
  - **Concern about ADWR resources to administer program**

Enhanced Aquifer Management

- **AMWUA proposal**
  - **Different cuts depending on:**
    - **Location – does recovery/replenishment occur in same or different sub-basin**
    - **Type of water stored**
    - **Annual Storage/Recovery vs. Long Term Storage**
  - **Special Enhancement Areas (SEAs) designated by ADWR, reviewed periodically**
  - **Restrictions on wells drilled/used with Type 2 rights within service areas**

Enhanced Aquifer Management

- **Issues for Discussion:**
  - **Location of most significant problems in AMAs**
  - **Discussion of location of pumpage/recharge/replenishment – incentives and disincentives**
    - **Cuts to Aquifer (disincentives)**
      - **Location: Area of impact / 1-mile safe harbor vs. sub-basin**
      - **Types of water stored**
      - **Levels of cut to aquifer**
    - **Additional credits earned for storage in areas of concern (incentives)**
      - **Areas that would uniquely benefit from recharge**
      - **SEAs**
      - **Reward for storage (credits, other benefits)**

Enhanced Aquifer Management

- **Issues for Discussion (cont'd):**
  - **Types of storage/recovery to be included in proposal:**
    - **Long-Term Storage Credits**
    - **Annual Storage/Recovery**
    - **Central Arizona Groundwater Replenishment District (CAGRD) activities**
    - **Arizona Water Banking Authority (AWBA) Storage/Recovery**
  - **Types of water that would be considered**
    - **Effluent**
    - **Sources other than effluent**

Enhanced Aquifer Management

- **Issues for Discussion (cont'd):**
  - **WATERBUD (WATER stored may accrue long term storage credits only if that water cannot Reasonably Be Used Directly – A.R.S. 45-852.01)**
  - **Current 50% Cut to Aquifer for Managed Effluent Recharge Projects**
  - **4-foot Decline Criteria for Recovery Wells**
  - **Remediated Groundwater Exemption - currently expires 2025**
  - **Effluent Exemption also expires in 2025 (part of WATERBUD)**
  - **Others?**

Enhanced Aquifer Management

- **Process:**
  - **With input from stakeholders, ADWR will create a concept paper that provides a policy/regulatory framework for managing storage and recovery to meet water management objectives.**
  - **Basic ground rules**
    - **Everyone may participate**
    - **Agenda and presentation will be posted beforehand**
    - **Homework may be assigned**
  - **End product – concept paper**
  - **Stakeholder group will advise ADWR**
  - **Coordination with 4th Management Plans**

Current Credit Process

Current Credit Process

Methodology

- **Cut is assessed on water credited to a Long Term Storage Account (LTSA) after:**
  - **Physical Losses**
  - **Annual Recovery**
- **Cut is based on:**
  - **Type of Facility**
    - **USF (managed or constructed)**
    - **GSF**
  - **Type of Water**
    - **Effluent**
    - **Other than Effluent (CAP, Surface Water)**

Current Credit Process

Methodology

- **No cut assessed for water stored directly into CAGRD Replenishment Reserve Account (RRA) or Conservation District Account (CDA)**
  - **Credits transferred into the RRA or CDA have had cuts assessed when credited to the original account**
- **Water levels are currently regulated by**
  - **TMP-Recovery Well Siting criteria (4' decline)**
  - **Hydrologic Feasibility and Unreasonable Harm Policies (how far can entities cause water level to fall or rise)**
  - **Assured and Adequate Water Supply Rules (physical availability)**

Current Credit Process

Reporting

- Each facility operator reports delivered volumes by
  - Water Storage Permit Number
  - Type of Water
- Each water storer reports volumes delivered to each facility by
  - Water Storage Permit Number
  - Type of Water

Current Credit Process

Reporting

- **Recovery**
  - **Schedule 74: Permittee reports volume of water recovered by:**
    - **Well Number (55-)**
    - **Water Storage Permit under which storage occurred**
    - **Inside/Outside of 1-mile of facility**
    - **Type of Water**
    - **Annual or LTS Credits**
  - **Schedule A: Reports volume of water used by:**
    - **Well Number (55-)**
    - **GW pumping or**
    - **Recovery of CAP, Surface water, Effluent within 1 mile of facility, Effluent outside 1 mile of facility**

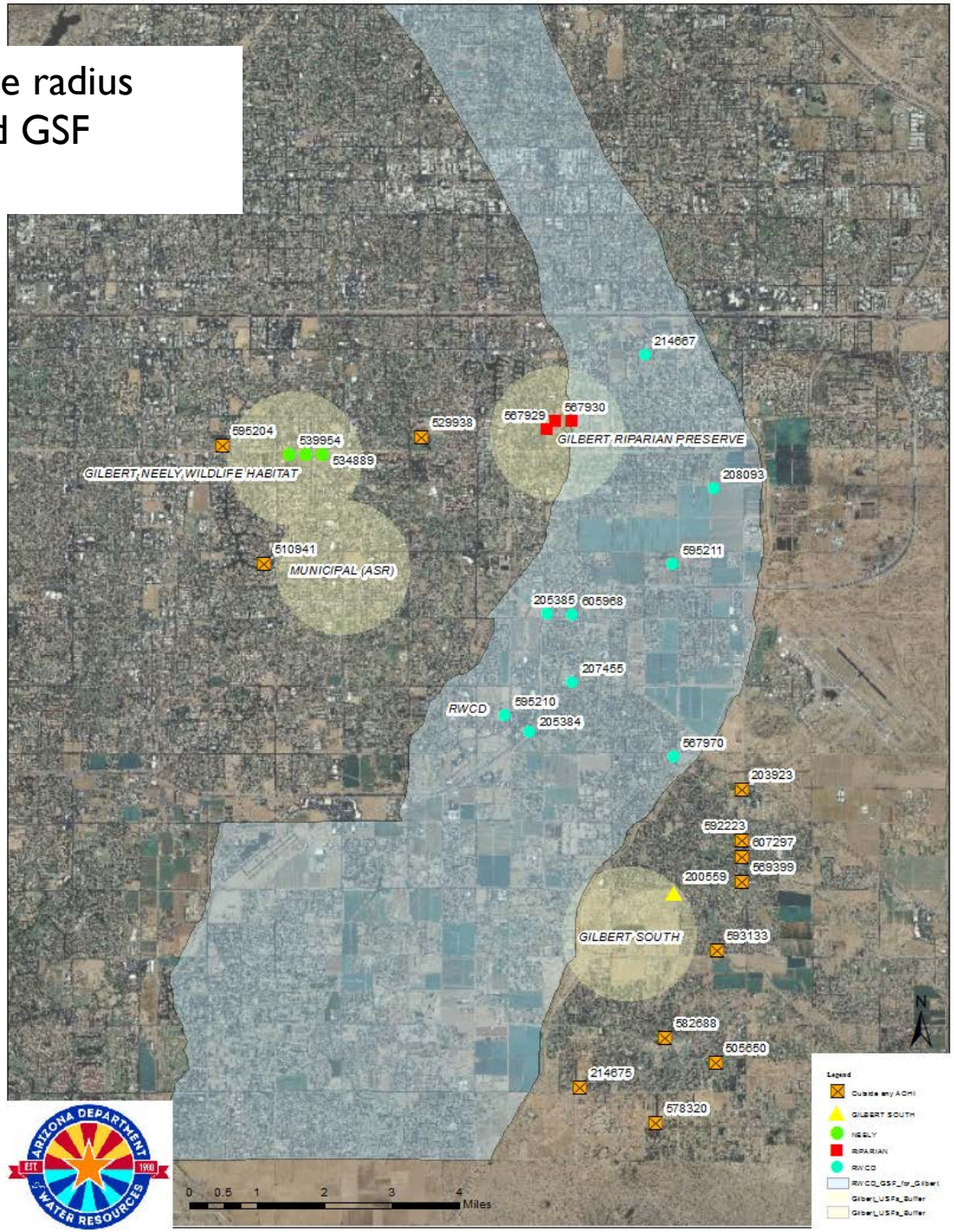
ADWR Proposed Enhanced Aquifer Management
Credit Issuance Methodology

- **Cuts would be assessed upon recovery of stored water**
  - **Physical Losses subtracted**
  - **Balance in LTSA would be a pre-recovery balance (water credited to a LTSA would not be assessed a cut until it is recovered)**
  - **Recovering party would have to calculate the volume available for recovery**
    - **Annual reports would need to be modified**
    - **ADWR may be able to provide Excel workbook to automatically calculate**

ADWR Proposed Enhanced Aquifer Management
Credit Issuance Methodology cont'd

- **Cut is based on:**
  - **Location of each Recovery Well (55-) in relation to location of storage facility**
    - **Inside or outside 1 mile of underground storage facility (USF)**
    - **Inside or outside Groundwater Savings Facility (GSF)**
    - **Within same sub basin as storage/replenishment, or separate sub basin**

Example of 1-mile radius around USFs, and GSF boundary



Issues / Considerations

- **Existing credits are grandfathered – cut already taken, so not assessed on recovered water**
  - **Two "buckets" of credits**
- **Pre-recovery balance in LTSA**
  - **LTSA balance would be delivered volume minus losses only**
  - **Recovering party would have to calculate volume available for recovery based on where storage and recovery occurred**
- **Will water type matter?**
- **Recovery in areas that will uniquely benefit by that recharge / SEAs**
  - **Recovery > Stored volumes would exacerbate WL declines**
  - **Would recovery outside of special areas lead to cuts?**
- **Would annual recovery be subject to cuts to aquifer?**
  - **(inside/outside 1-mile from facility)**

Issues / Considerations (continued)

- **Tracking the year the credits are earned and the year that those credits are recovered (especially if only partial recovery) could be challenging**
- **Giving incentive for recovery inside the boundaries of a GSF can lead to over pumping in an area where water was not physically added to the aquifer.**