Hi Zach:

A few comments on the issue papers:

The recharge and recovery issue brief assumes that all hydrologic disconnects are a bad thing. However, a hydrologic disconnect in a situation where recharge occurs in a cone of depression and recovery occurs away from that cone of depression would be a positive benefit for the aquifer. Maybe there are other beneficial situations that should be considered? We should also discuss incentives programs.

On the Exempt Well issue paper:

1. Not mentioned in the paper is that exempt wells have a huge impact on the ability to drill new non-exempt wells due to the well spacing regulations. Because of the proliferation of exempt wells in the Prescott AMA, municipal providers are forced to extend infrastructure further away than otherwise necessary to install new municipal wells. This allows exempt wells to avoid most of the requirements of the Groundwater Code, yet enjoy the protections of the Code.

2. The paper correctly mentions the fact that exempt wells sometimes go dry, but it should go further to state that property owners then typically shift the burden of their water supply needs onto nearby water providers as a source of supply for hauling water.

3. The paper’s conclusion that statewide standards on exempt wells are not necessary was made through a comparison of five AMA’s. Exempt wells have a large impact on some other rural groundwater basin. I understand that this subcommittee’s charge is to focus on AMA’s, but the impact of exempt wells on other basins should also be examined.

4. The paper should clarify that past attempt to regulate exempt well have failed due to politics (no measures have been passed) and not due to failed implementation, enforcement, etc.. It is important to note that incentive programs are being developed in the Prescott AMA that show promise and could provide reasonable solutions throughout the rest of the state.

Thanks for putting these document together.

Please let me know if you have any questions on the above.

John Munderloh
UNREPLENISHED GROUNDWATER WITHDRAWALS

ISSUE STATEMENT

In Arizona’s active management areas (AMAs), unreplenished groundwater withdrawals by all water-using sectors, combined with a lack of sufficient incentives to either reduce withdrawals or mitigate the impacts, limit the State’s ability to meet the AMA long-term groundwater management goals.

BACKGROUND

Unreplenished groundwater withdrawals refer to groundwater that is legally withdrawn without requirement or obligation to artificially replenish or replace that volume of water back into the aquifer and is not offset by incidental recharge. These withdrawals are also referred to as ‘allowable groundwater’. Through Arizona’s current regulatory framework, the State has sought to restrict the overall reliance on non-renewable groundwater supplies. The 1980 Groundwater Management Act (GMA or Code) was passed to specifically address issues associated with severe groundwater overdraft. The GMA established the Arizona Department of Water Resources (ADWR) to oversee the waters of the State and created AMAs where groundwater would be regulated by ADWR in order to mitigate the effects of groundwater withdrawals.

To do so, the State requires new development in the AMAs to occur on renewable water supplies and water users in all sectors are subject to mandatory conservation requirements that aim to reduce the amount of groundwater used over time. Despite these requirements, various existing and potential new groundwater users within the AMAs are permitted to continue or increase their use of unreplenished groundwater over time. Existing groundwater users’ rights were originally grandfathered into the new management system, and other exceptions were made that allowed for the continued use of groundwater in all sectors. Since, by definition unreplenished groundwater withdrawals are not required to be replenished, the amount occurring in excess of natural groundwater recharge contributes to aquifer overdraft.

UNREPLENISHED GROUNDWATER WITHDRAWALS BY SECTOR

Groundwater use is authorized under various rights and permits within each water-using sector. The subsectors and the types of current and ongoing allowable groundwater withdrawals are described below:

**Agricultural Sector**

As part of the adoption of the Code, Irrigation Grandfathered Groundwater Rights (IGFRs) were granted that allow farmers to withdraw groundwater for irrigation use. No new IGFRs may be created and the amount of land that may be irrigated is limited to that which was historically irrigated between 1975 and 1979. IGFRs represent a perpetual authority to withdraw groundwater without an artificial replenishment requirement. This type of groundwater withdrawal can be expected to continue, partly because the cost to pump and use groundwater is

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1 Phoenix Active Management Area Fourth Management Plan 11-3 (2020).
generally cheaper than the costs associated with delivering and using renewable supplies, when they are available. Some irrigation districts delivering water to IGFRs serve as groundwater savings facilities (GSFs), enabling them to utilize renewable water supplies in lieu of groundwater in a given year. However, for water accounting purposes, ADWR legally considers the irrigation district’s use of the renewable supply to be groundwater, because the volume of groundwater “saved” becomes a stored water credit (long-term or annual) for the entity who supplied the water; this functionally reduces the amount of groundwater in storage. This sector also includes groundwater demands associated with tribal agricultural uses.

Municipal Sector

The municipal sector is comprised of small and large undesignated and designated municipal water providers, both public- and privately-owned. Small municipal providers are those that use 250 AF or less water per year. Thus, large providers are those that use more than 250 AF of water per year. In addition to these provider types, several entities are regulated as large untreated providers in the PhxAMA. These include both cities, towns, private-water companies and irrigation districts. A large untreated provider serves 100 or more AF per year or 500 more people with untreated water for non-irrigation purposes, usually for residential or commercial flood irrigation of turf.

Under both the Code and the Assured Water Supply (AWS) Program, several allowable groundwater uses were ascribed to the municipal sector because it was understood the sector would be allowed to grow and increase its overall water use through time. However, some existing municipal groundwater uses were also exempt from the AWS Program. The Santa Cruz AMA was split off from the Tucson AMA around the same time that the other AMAs were adopting their AWS rules, and it has not yet adopted its own AWS Rules. Because of this, groundwater allowances and extinguishment credits are not available in the Santa Cruz AMA.

Pre-1995 subdivisions – A number of subdivisions in the Phoenix, Pinal, Prescott, and Tucson AMAs, served by small and large undesignated water providers and platted before the 1995 adoption of the AWS Rules, are not required to replace groundwater use with renewable supplies, either directly or through membership in the Central Arizona Groundwater Replenishment District in the AMAs where it’s an option. Groundwater continues to be pumped and delivered to these communities by undesignated providers across the four AMAs, without an artificial replenishment obligation.

Groundwater Allowances – Another type of municipal unreplenished groundwater withdrawal is the ‘groundwater allowance’ granted upon issuance of a Certificate or Designation of Assured Water Supply (CAWS or DAWS). Under the AWS Rules, a set volume of groundwater can be withdrawn by the CAWS-holder or DAWS provider and not be replenished or offset. These groundwater allowances, also referred to as ‘Phase-in Credits’ in some Designations, were initially designed to help municipal providers transition from groundwater to renewable supplies. However, unless the credits are exhausted quickly, groundwater allowances have long-term availability and therefore can be expected to continue to contribute to overdraft. The AWS Rules in the Phoenix, Pinal, and Tucson AMAs also allow for an annual addition to the groundwater allowance equal to 4% of total demand, based on the assumption that this volume is being “returned to the aquifer” via incidental recharge and thus would not

Commented [JM1]: Groundwater allocations were granted to subdivisions prior to the 1999 Declaration of Groundwater Mining in the Prescott AMA.

2 Ibid.
3 Id. at 5-3.
4 Id. at 3-10.
require replenishment. In recent years, groundwater allowances have been utilized by designated and undispatched providers in the four AMAs where they are available.

**Extinguishment Credits**—Existing agricultural IGFRs, Type 1 retired IGFRs, or Type 2 non-irrigation grandfathered rights may be extinguished until the year 2025 for credits, known as ‘extinguishment credits’, and pledged to a municipal water provider or CAWS located in the same AMA. Credits pledged to a municipal provider are added to the groundwater allowance associated with that provider’s DAWS or with a CAWS. The method of calculating extinguishment credits varies by AMA, as described in the AWS Rules. Since pledged extinguishment credits are added to the groundwater allowance of a CAWS or DAWS per the AWS Rules, any volume withdrawn by municipal water providers would be embedded in the volume pumped against their groundwater allowances.

**Exempt Wells**—Domestic exempt wells, those equipped to pump not more than 35 gallons per minute, are not regulated by ADWR nor subject to conservation requirements. The volume of pumping associated with these small wells is unmeasured and therefore contributes to the overall amount of unreplenished groundwater in all AMAs. ADWR creates estimates for these withdrawals each year based on the number of people in that AMA that are not served by municipal water providers.

**Remediated Groundwater**—Pumping of ‘remediated groundwater’ is incentivized in order to facilitate the treatment of contaminated groundwater, and it may also be deemed consistent with an AMA’s management goal. Although ADWR accounts for remediated groundwater differently than other groundwater in determining compliance with Management Plan conservation requirements, remediated groundwater retains its legal character as groundwater, and therefore contributes to overdraft in the two AMAs where it is permitted. In each of the Phoenix and Tucson AMAs, the amount of remediated groundwater pumping has averaged over 6,000 acre-feet per year. No remediated groundwater pumping has been reported in the Prescott, Pinal, or Santa Cruz AMAs to date.

**Industrial Sector**

The Code defines industrial use as a non-irrigation use of water, not supplied by a city, town or private-water company, including animal industry use such as dairies and feedlots, and expansions of those uses. Industrial sector has no renewable water resource requirements, yet it is expected to grow along with municipal growth as it is largely dependent on population growth and the economy. It includes electric power plants, sand and gravel facilities, turf facilities, mining, dairy, cattle feedlots, and other industrial uses. Industrial users withdraw water from their own wells and may acquire new groundwater withdrawal permits, called General Industrial Use Permits, from ADWR. They also may purchase or lease non-irrigation GFRs, which are an authority to pump groundwater for non-irrigation use (e.g., Type 1 retired IGFRs and Type 2 non-irrigation GFRs). Many of the industrial subsectors utilize a combination of these authorities. There is no regulatory or statutory authority at this time to require industrial water users to convert to renewable supplies.

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8 Arizona Administrative Code, Title 12, Chapter 15, Sections 724(A)(4), 725(3), and 727(A)(4).
9 Arizona Administrative Code, Title 12, Chapter 15, Sections 724, 725.01, 726 and 727.
10 Arizona Administrative Code, Title 12, Chapter 15, Section 723.
11 Arizona Administrative Code, Title 12, Chapter 15, Section 729.
12 Phoenix Active Management Area Fourth Management Plan 3-10 (2020).
14 Phoenix Active Management Area Fourth Management Plan 3-10 (2020).
15 “A turf-related facility is any facility, including schools, parks, cemeteries, golf courses, or common areas within a housing subdivision, with ten or more acres of water-intensive landscaped area.” Phoenix Active Management Area Fourth Management Plan 6-2 (2020).
16 Id. at 11-3.

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**Commented [JM2]:** I’m interested to know how much this allowance has been utilized in the Prescott AMA. I don’t know of any applicants receiving a groundwater allowance since the Declaration of Groundwater Mining.

**Commented [JM3]:** It’s important to note that extinguishments don’t add to the net withdrawals had the original grandfathered rights continued to use water and typically reduce the total by a significant margin. This results in groundwater savings.
Summary of Unreplenished Demand by Sector

Table 1 provides a breakout of 2012 through 2016 average annual groundwater demand pursuant to the unreplenished groundwater types described in this brief, by sector and AMA. These values include groundwater demands such as pumping and GSF demand, but do not include the recovery of water stored underground that is not legally classified as groundwater, such as effluent that had been stored for long-term storage credits. All values are shown to illustrate the extent to which allowable groundwater rights are exercised in each AMA. The table also includes the offsets to those demands that can be attributed to a given sector. Groundwater withdrawals, in combination with the use of other water supplies, may contribute to incidental recharge. CAGRD replenishment is also accounted for under the municipal sector. Overall, certain artificial recharge offsets are provided by sector in order to demonstrate the final average unreplenished groundwater demand by sector and AMA.

IMPACTS OF UNREPLENISHED GROUNDWATER WITHDRAWALS

One of the most difficult challenges for the State is that for the past 40 years, each water use sector has become accustomed to utilizing the various types of allowable groundwater withdrawals. Water users have made investments and economic decisions based upon these groundwater rights and their associated costs under the current framework. At the same time, rigorous groundwater management goals have been established in the AMAs. The State has recognized that unreplenished or “residual” groundwater withdrawals create a hurdle for AMAs to reach their respective management goals. In regard to the Phoenix AMA, ADWR acknowledged in its Third Management Plan that the authorization of continued groundwater use under the Code “was not made with a full understanding of its relationship to the attainment of safe-yield.” In addition, the continued and further development of these groundwater rights and withdrawal exemptions will exacerbate water management challenges, including overdraft and physical availability of groundwater, no matter what the management goals may be beyond 2025.18

In looking forward to the next 40 years, it is critical to assess the relationships between these types of groundwater withdrawals and their impact on the ability to achieve AMA management goals. Based on the perpetual nature and volume of these rights and exemptions alone, the State will need to determine whether additional conservation requirements, reductions in groundwater withdrawals, or other mitigating actions would provide a counterbalance to the amount of legally permitted groundwater withdrawals. Natural, incidental, and artificial recharge in each AMA has been and will most likely continue to be less than the volume of allowable groundwater withdrawals. ADWR and other entities have proposed several programs and authorities that might better align groundwater demand with the AMA goals and reduce the instances of groundwater declines, but none of those proposals have been substantially implemented.

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Table 1: 2012-2016 Average Unreplenished Groundwater Demand by AMA and Sector (AF/yr)

<table>
<thead>
<tr>
<th>Sector and Type</th>
<th>Prescott</th>
<th>Phoenix</th>
<th>Pinal</th>
<th>Tucson</th>
<th>Santa Cruz</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>GROUNDWATER DEMAND</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5-Year Average (2012-2016)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agricultural Sector</td>
<td>1,939</td>
<td>623,307</td>
<td>611,059</td>
<td>101,784</td>
<td>10,134</td>
</tr>
<tr>
<td>Groundwater</td>
<td>1,939</td>
<td>350,586</td>
<td>422,694</td>
<td>76,666</td>
<td>10,134</td>
</tr>
<tr>
<td>GSF Accounting</td>
<td>-</td>
<td>179,935</td>
<td>124,841</td>
<td>24,909</td>
<td>-</td>
</tr>
<tr>
<td>Tribal</td>
<td>-</td>
<td>92,786</td>
<td>63,524</td>
<td>209</td>
<td>-</td>
</tr>
<tr>
<td>Municipal Sector</td>
<td>12,970</td>
<td>226,061</td>
<td>30,996</td>
<td>36,345</td>
<td>6,448</td>
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<tr>
<td>Large Designated Providers</td>
<td>4,584</td>
<td>54,040</td>
<td>9,671</td>
<td>12,290</td>
<td>3,121</td>
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<tr>
<td>Large Undesignated Providers</td>
<td>5,098</td>
<td>89,468</td>
<td>16,290</td>
<td>16,560</td>
<td>2,845</td>
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<td>Small Providers</td>
<td>1,062</td>
<td>3,688</td>
<td>1,521</td>
<td>4,046</td>
<td>313</td>
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<tr>
<td>Large Untreated Providers/Urban Irrigation</td>
<td>-</td>
<td>68,690</td>
<td>21</td>
<td>-</td>
<td>-</td>
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<tr>
<td>Domestic Exempt Well Demand</td>
<td>2,227</td>
<td>10,175</td>
<td>3,494</td>
<td>3,450</td>
<td>170</td>
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<tr>
<td><strong>Industrial Sector</strong></td>
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<td>107,024</td>
<td>18,273</td>
<td>57,107</td>
<td>1,161</td>
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<tr>
<td>Sand &amp; Gravel</td>
<td>316</td>
<td>11,311</td>
<td>570</td>
<td>3,855</td>
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<tr>
<td>Mining</td>
<td>-</td>
<td>30</td>
<td>-</td>
<td>35,995</td>
<td>-</td>
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<tr>
<td>Turf</td>
<td>976</td>
<td>58,972</td>
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<td>Electric Power</td>
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<td>11,617</td>
<td>-</td>
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<td>-</td>
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<td>Dairy</td>
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<td>9,414</td>
<td>131</td>
<td>-</td>
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<tr>
<td>Cattle Feedlots</td>
<td>-</td>
<td>85</td>
<td>1,755</td>
<td>-</td>
<td>-</td>
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<tr>
<td>Other</td>
<td>300</td>
<td>13,793</td>
<td>2,518</td>
<td>4,762</td>
<td>125</td>
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OFFSETS TO GROUNDWATER DEMAND

<table>
<thead>
<tr>
<th>5-Year Average (2012-2016)</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Agricultural Sector</td>
<td>1,419</td>
<td>467,183</td>
<td>250,668</td>
<td>22,036</td>
<td>2,375</td>
</tr>
<tr>
<td>Incidental Recharge</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Municipal Sector</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Replenishment (CAGR)</td>
<td>-</td>
<td>35,942</td>
<td>394</td>
<td>2,796</td>
<td>-</td>
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<tr>
<td>Incidental Recharge</td>
<td>-</td>
<td>67,968</td>
<td>1,461</td>
<td>6,401</td>
<td>-</td>
</tr>
<tr>
<td>Industrial Sector</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Incidental Recharge</td>
<td>238</td>
<td>9,149</td>
<td>786</td>
<td>5,322</td>
<td>148</td>
</tr>
</tbody>
</table>

UNREPLENISHED GROUNDWATER DEMAND*

<table>
<thead>
<tr>
<th>5-Year Average (2012-2016)</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Agricultural Sector</td>
<td>520</td>
<td>156,125</td>
<td>360,391</td>
<td>79,748</td>
<td>7,758</td>
</tr>
<tr>
<td>Municipal Sector</td>
<td>12,970</td>
<td>122,151</td>
<td>29,142</td>
<td>27,148</td>
<td>6,448</td>
</tr>
<tr>
<td>Industrial Sector</td>
<td>1,354</td>
<td>97,875</td>
<td>17,487</td>
<td>51,785</td>
<td>1,013</td>
</tr>
</tbody>
</table>

*Average Unreplenished Demands are not the same as average Overdraft because they do not include natural recharge components.

Commented [JM4]: Referencing the Municipal Offsets to GW Demand in the Prescott AMA: 1) Prescott Valley contributes approximately 800 af/yr of effluent to aquifer recharge as non-credited recharge, or discharge to the Agua Fria Channel when the recharge facility is out of compliance. 2) Prescott AMA should receive same credit for 4% incidental municipal recharge as other AMAs (maybe more since we don’t then get the allowance to pump it back out). 3) Prescott contributes to a non-recoverable LSTA that should be considered.
Greetings,

Just a couple of thoughts pertaining to the issue papers.

1. **Hydrologic Disconnect Paper** - USF permits are issued for 20 years making it challenging to tie these current and future recharged water supplies with CAWS that require a 100-year demonstration. If you are designated the full volume of the entities reclamation facility capacity is taken into consideration for the water supply portfolio not the permitted USF. Also, new wells, owned by third parties, that are drilled within the area of hydrologic impact from a recharge facility may intersect the recharged water that could lessen the hydrologic benefit to the aquifer.

2. **Hydrologic Disconnect Paper** – ADWR has not yet developed a policy or guidance regarding comingling or volumetric accounting regarding the sole use of reclaimed water for CAWS for non-designated providers meaning that it is not allowed for a water provider to recover reclaimed water for a subdivision CAWS that is solely using reclaimed water because ADWR has indicated the water provider cannot overcome the comingling of both reclaimed and groundwater molecules comingling and having solely reclaimed water delivered to the subdivision. However, a designated water provider can accomplish this without having to deal with a comingling or volumetric accounting issue. Therefore a non-designated water provider is discriminated against versus a designated water provider. The goal of reclamation, recharge and recovery is to better recycle water supplies and increase efficiency and sustainability within the AMA however, this ADWR unwritten doctrine prevents a non-designated water provider form accomplishing this activity. ADWR has indicated that a separate well and pipe must be built to prevent comingling which is not feasible for a water provider.

3. **Exempt Wells Paper** – Regarding a dry-lot subdivision provision of not lowering the groundwater surface below 400’, there is also a water quality provision that I believe should be noted; water quality testing is required, from the location of the wells, and if the water quality does not meet safe drinking water standards, the dry-lot subdivision will not be granted by ADWR.

These are my comments regarding the issue papers topics.

Cheers,

Mark Holmes

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Hi Carol,

Item 1: USF permits are not always 20 years in duration. The full volume of the reclamation facility is not the only component used to set limits. The Program looks at projected availability of effluent. This includes population projections as well as system capacity.

Item 2: The Department has not allowed comingling when a non-designated water provider is providing water to a Certificate. The issue has to do with replenishment. Non-designated providers do not have the replenishment requirements of a designated provider. Mark’s comment on this is more of an expression of opinion.

Item 3: To clarify, the rule allows that the water quality must meet standards or treatment must be feasible if the standards are exceeded.

David L. McKay, Manager
Recharge, Assured and Adequate Water Supply
CAWCD/CAGRD ISSUE BRIEFS RESPONSE

Thank you for the opportunity to contribute to the draft issue brief on hydrologic disconnect. CAWCD/CAGRD staff think the draft was well done and provides a good starting point from which the Committee can develop a final issue brief. Please find an attached PDF file with our feedback. In addition, CAWCD/CAGRD staff provide the following comments, challenges and opportunities regarding hydrologic disconnect to consider as the Committee continues next steps in finalizing the brief and working on solutions.

- Evaluating water storage and recovery at the level of an individual sub-basin may provide a false sense of precision in accounting Arizona’s overall water balance as groundwater naturally flows between sub-basins. For example, recharge activities at the Agua Fria Recharge Project occur within the Lake Pleasant sub-basin, but replenishes the aquifer serving the West Salt River Valley.
- Land subsidence, fissures, aquifer compaction and other issues caused by overdraft of aquifers led to the 1980 Groundwater Management Act. Subsequent to the Act’s adoption, and through careful stewardship of groundwater, the rate of land subsidence in many areas of the Phoenix and Tucson Active Management Areas have decreased compared to rates in the 1990s. More research and analysis is needed to quantify and demonstrate actual impacts of hydrologic disconnect within Active Management Areas. This research and study may also quantify the vulnerability of certain areas allowing for more precise solutions in vulnerable areas.
- Storing water in areas of historic or ongoing groundwater decline and recovering water in less vulnerable areas – possibly outside of a given sub-basin – may ultimately be a useful approach for managing groundwater levels as well as preventing issues such as aquifer compaction, fissuring and land subsidence. Flexibility to manage dynamic situations across sub-basins is needed.

As you are aware, in the absence of state-wide regulation, the CAWCD Board of Directors directed the CAGRD to replenish in areas of hydrologic impact of member pumping to the extent feasible. In the spirit of this foresight and good stewardship of Arizona’s scarce water resources, CAWCD/CAGRD staff encourage the post-2025 AMAs Committee to develop next steps in addressing this issue through data- and science-driven consensus and we are ready to assist the Committee however we can.
HYDROLOGIC DISCONNECT

ISSUE STATEMENT

The storage and recovery of water supplies in hydrologically disconnected areas within AMAs may creates localized vulnerabilities in groundwater availability and quality with potential for greater impacts in the future when recovery of stored water becomes necessary.

BACKGROUND

Recharge and Recovery
The storage of renewable water supplies underground is one of Arizona’s key long-term water management tools. Across the five Active Management Areas (AMA), Arizona water users have stored (or saved through in-lieu storage) over 11 million acre-feet of water through 2016. The storage of water underground, recharge, and the eventual withdrawal of that water, recovery, are administered through the Arizona Department of Water Resources’ Recharge Program.

Recharge is accomplished through storage at either an underground storage facility or through the delivery of in-lieu water to a groundwater savings facility. When qualified water supplies are stored underground within an AMA those supplies can be recovered within the same calendar year via annual storage and recovery (AS&R) or they can generate a long-term storage credit (LTSC) for recovery in future years. Stored water retains its initial legal classification and is accounted as such when it is recovered. For instance, recharged Central Arizona Project (CAP) water that earns a LTSC will still be classified as CAP water when it is recovered at a later date. Recharged water is subject to physical losses as well as a cut to the aquifer depending on the type of water and method of storage. Typically, with some exceptions, there is a 5% cut to the aquifer for water stored at a recharge facility, intended to provide a general benefit to the aquifer from the recharge activity.

Arizona’s Recharge Program requires that the recovery of stored water, whether through AS&R or LTSC recovery, take place within the same AMA where the water was originally stored. This has allowed renewable supplies to be used earlier and more extensively than would have otherwise occurred, but also means that water can be stored in one groundwater sub-basin and recovered in a different sub-basin that is spatially and hydrologically separate. The Phoenix AMA alone covers 5,646 square miles and contains seven distinct groundwater sub-basins.

Pumping and Replenishment
Arizona’s Assured Water Supply (AWS) Program requires that new subdivision developments within AMAs have access to a water supply that is consistent with that AMA’s statutory Management Goal. This requirement is satisfied by securing access to a renewable supply of water or, if groundwater will be utilized, through

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1 ADWR, LTSC Summary Dashboard https://new.azwater.gov/recharge/accounting
2 Broadly governed by regulations in statute (Title 45, Chapter 3.1), administrative rules, and ADWR policy.
3 See definitions at A.R.S. § 45-811.01 and § 45-812.01
4 https://new.azwater.gov/sites/default/files/media/Cut%20to%20the%20Aquifer%20Table_Revised_May_07_2019.pdf
membership in the Central Arizona Groundwater Replenishment District (CAGRD). Membership in the CAGRD allows those water users, including water providers or individual subdivisions, to utilize groundwater today, while the CAGRD must find renewable water supplies to replenish that volume of groundwater within three years through future underground storage in the same AMA within a statutorily-defined timeframe. 5

Whereas recharging available renewable water supplies “up front” allows a water user to later recover that water under the legal classification in which it was stored, replenishment by the CAGRD serves to replace groundwater that has already been pumped by its members, so it is not intended for later recovery. However, much like recovery of a LTSC, replenishment must may take place in a location hydrologically distinct from the area where groundwater was pumped, so long as it’s within the same AMA.

THE HYDROLOGIC DISCONNECT

The ability to legally recover or replenish water that was respectively stored or pumped in a different location is referred to as the hydrologic disconnect. While the recharge of aquifers has led to a significant increase in water levels in certain areas, the hydrologic disconnect permits water users to pump water in areas that may not be benefiting from the recharge or replenishment tied to that pumping. For example, CAP water stored at a recharge facility in the Hassayampa subbasin (located on the west end of the Phoenix AMA) can legally be recovered in the East Salt River Valley subbasin, nearly 100 miles away. Similarly, CAGRD member lands that are served groundwater in the northern portion of the Tucson AMA may legally have their pumping replenished at facilities located in hydrologically distinct regions to the west and southwest. 5 These examples highlight the challenge that Arizona’s accounting framework for recovery and replenishment faces in balancing operational and economic considerations with hydrologic reality.

Most groundwater pumping in AMAs is unrelated to recovery or replenishment, but pumping groundwater that has been legally stored or replenished elsewhere in an AMA may exacerbate lead to localized groundwater declines in certain sub-basins. Subsidence, fissuring, aquifer compaction and storage loss, and water quality impacts are all potential consequences of overdraft. however subsidence rates have decreased between 25 and 90 percent compared to rates in the 1990s. 6 Localized overdraft also threatens economic growth, reducing the physical availability of groundwater in certain areas and reducing the likelihood that new development can secure an AWS Determination. Stakeholders in the Arizona water community have also expressed concerns about the ability for water that was stored by one user to physically be pumped from an area by another user, despite the storer retaining that LTSC.

In addition to groundwater depletion, recharge or replenishment sites certain aquifers must be managed to account for rising groundwater levels, especially if recovery takes place outside the area of recharge. Shallow groundwater tables can contribute to problematic waterlogging, and as operational constraints which may limit the amount of water that can be stored at a recharge facility. 6

The relationship between the current hydrologic disconnect and localized groundwater declines has not been well documented, though there is little question that a large and persistent disconnect could lead to problems. In the Phoenix AMA 100-year, groundwater modeling scenarios conducted by ADWR, demonstrated groundwater conditions drastically improved when both the recovery and LTSC and CAGRD’s replenishment of excess groundwater use was tied to the area where water was originally stored or pumped. 7 Those recovery and replenishment assumptions that improved model outcomes, however, are not mandated by policy. In the

5 A.R.S. § 48-3771
6 http://new.azwater.gov/tags/land-subsidence
7 See map of CAGRD member lands – Figure 2.3, 2015 CAGRD Plan of Operation; Overview of CAGRD replenishment location and capacity – http://www.cap-az.com/documents/meetings/2019-03-21/1741-032119-WEB-Final-Packet-CAGRD.pdf
8 For example, recharge at the Granite Reef Underground Storage Project is often curtailed as rising groundwater levels trigger regulatory alert levels designed to prevent encroachment on a nearby landfill.
9 ADWR Modeling Report No. 22, § 9.0, pg 75
Tucson AMA historical groundwater withdrawals led to water level declines, due to an imbalance between the majority of recharge which takes place in the Avra Valley sub-basin, and recovery which occurs in the Upper Santa Cruz sub-basin. 8 Efforts but efforts over the past two decades to shift pumping to the Avra Valley have yielded measurable improvements in water levels and decreased rates of land subsidence.

POLICIES & EFFORTS TO ADDRESS THE HYDROLOGIC DISCONNECT

There are several policy and regulatory requirements that govern the location of recovery and replenishment which also serve to mitigate some of the impacts stemming from the hydrologic disconnect:

1. ADWR’s well spacing requirements prohibit recovery of stored water if, among other things, the recovery would lead to ≥ 10 feet of drawdown of local groundwater levels after the first five years of recovery or would exacerbate existing subsidence issues. 9

2. The AMA Management Plans prohibit recovery of water in an area experiencing 4.0’ of annual decline in groundwater levels. 10

3. Recovery within the area of impact is considered physically available for assured water supply purposes 11

4. Though not mandatory, statute Statute requires the CAGRD to replenish groundwater in the East and West portions of the Phoenix AMA in proportion to the replenishment obligation generated in each portion of the AMA, to the extent reasonably feasible. 12

While these policies do have bearing on the location of recovery and replenishment, they do not provide a framework for water management tailored for sub-AMA application. Crafting policy to specifically address the hydrologic disconnect at such a scale has been a long-running discussion in the Arizona water community and part of a broader set of issues causing localized groundwater declines. The need for sub-regional groundwater management strategies was identified as a priority for ADWR as early as 1999 in the Third Management plans. 13 The hydrologic disconnect relating to CAGRD’s replenishment has also been repeatedly recognized as an issue, including by the Central Arizona Water Conservation District (CAWCD) Board which has directed the CAGRD to “to the extent feasible, replenish in areas of hydrologic impact of groundwater withdrawals by CAGRD members” in its last two Strategic Plans. CAGRD has implemented that direction, but in some cases is limited by recharge facility location and available capacity. More recent attempts to address the hydrologic disconnect took place through stakeholder engagement led by ADWR in 2012 as part of initial efforts to develop the Fourth Management Plans. While concepts for adjusting the cut to the aquifer and designating certain sub-basins for targeted management were proposed, no policies were ultimately adopted due to a lack of consensus on the extent of the problem, and ultimately a solution.

10 Phoenix AMA: 3MP § 8.7.2.3 / 4MP § 8-801
11 A.A.C. R12-15-716
12 A.R.S. § 48-3772(I)
13 Phoenix 3MP - § 8.2; Tucson 3MP - § 8.7.2.3; Pinal 3MP - § 8.6; Prescott 3MP - §8.2

Draft 4/9/20 GWAICC Post-2025 AMAs Committee – Hydrologic Disconnect
UNREPLENISHED GROUNDWATER WITHDRAWALS

ISSUE STATEMENT

In Arizona’s active management areas (AMAs), unreplenished groundwater withdrawals by all water-using sectors, combined with a lack of sufficient incentives to either reduce withdrawals or mitigate the impacts, limit the State’s ability to meet the AMA long-term groundwater management goals.

BACKGROUND

Unreplenished groundwater withdrawals refer to groundwater that is legally withdrawn without requirement or obligation to artificially replenish or replace that volume of water back into the aquifer and is not offset by incidental recharge. These withdrawals are also referred to as ‘allowable groundwater’. Through Arizona’s current regulatory framework, the State has sought to restrict the overall reliance on non-renewable groundwater supplies. The 1980 Groundwater Management Act (GMA or Code) was passed to specifically address issues associated with severe groundwater overdraft. The GMA established the Arizona Department of Water Resources (ADWR) to oversee the waters of the State and created AMAs where groundwater would be regulated by ADWR in order to mitigate the effects of groundwater withdrawals.

The State’s approach to groundwater management includes requiring new development in the AMAs to limit the amount of groundwater than may be pumped without replenishing the aquifer through recharge of a renewable supply, and water users. To do so, the State requires new development in the AMAs to occur on renewable water supplies and water users in all sectors are subject to mandatory conservation requirements that aim to reduce the amount of groundwater used over time. Despite these requirements, various existing and potential new groundwater users within the AMAs are permitted to continue or increase their use of unreplenished groundwater over time. Existing groundwater use was originally grandfathered into the new management systemCode, and other exceptions were made that allowed for the continued use of groundwater in all sectors. Since, by definition unreplenished groundwater withdrawals are not required to be replenished, the amount occurring in excess of natural groundwater recharge contributes to aquifer overdraft.

UNREPLENISHED GROUNDWATER WITHDRAWALS BY SECTOR

Groundwater use is authorized under various rights and permits within each water-using sector. The subsectors and the types of current and ongoing allowable groundwater withdrawals are described below:

Agricultural Sector

As part of the adoption of the Code, Irrigation Grandfathered Groundwater Rights (IGFRs) were granted that allow farmers to withdraw groundwater for irrigation use. No new IGFRs may be created and the amount of land that may be irrigated is limited to that which was historically irrigated between 1975 and 1979. IGFRs represent a perpetual authority to withdraw groundwater and lack a without an artificial-replenishment requirement earned.

1 Phoenix Active Management Area Fourth Management Plan 11-3 (2020).
by other types of groundwater withdrawals in an AMA. This type of groundwater withdrawal can be expected to continue, partly because the cost to pump and use groundwater is generally cheaper than the costs associated with delivering and using renewable supplies, when they are available. The agricultural sector does not have a replenishment requirement, but some replenishment occurs from water that is applied to crops and percolates below the root zone and reaches an aquifer. This replenishment is known as Incidental Recharge (IR).

Some irrigation districts and farming operations delivering water to IGFRs serve as groundwater savings facilities (GSFs), enabling them to utilize renewable water supplies in lieu of groundwater in a given year. However, for water accounting purposes, ADWR legally considers the irrigation district’s use of the renewable supply to be groundwater, because the volume of groundwater “saved” becomes a stored water credit (long-term or annual) for the entity who supplied the water. The stored water then which can then becomes either a long-term storage credit or can be recovered within the year annually; this functionally reduces the amount of groundwater in storage. This sector also includes groundwater demands associated with tribal agricultural uses.

**Municipal Sector**

The municipal sector is comprised of small and large undesignated and designated municipal water providers, both public- and privately-owned. Small municipal providers are those that use 250 AF or less water per year. Thus, large providers are those that use more than 250 AF of water per year. In addition to these provider types, several entities are regulated as large untreated providers in the Phoenix AMA. These include both cities, towns, private water companies and irrigation districts. A large untreated provider serves 100 or more AF per year or 500 or more people with untreated water for non-irrigation purposes, usually for residential or commercial flood irrigation of turf.

Under both the Code and the Assured Water Supply (AWS) Program, several allowable groundwater uses were ascribed to the municipal sector because it was understood the sector would be allowed to grow and increase its overall water use through time. However, some existing municipal groundwater uses were also exempt from the AWS Program. The Santa Cruz AMA was split off from the Tucson AMA around the same time that the other AMAs were adopting their AWS rules, and it has not yet adopted its own AWS Rules. Because of this, groundwater allowances and extinguishment credits are not available in the Santa Cruz AMA.

Pre-1995 Subdivisions — A number of subdivisions platted before the 1995 AWS Rules in the Phoenix, Pinal, Prescott, and Tucson AMAs and served by small and large undesignated water providers and platted before the 1995 adoption of the AWS Rules, are not required to replace groundwater use with renewable supplies. Most subdivisions in the Phoenix AMA platted before 2007 have minimal or no replenishment requirements, either directly or through membership in the Central Arizona Groundwater Replenishment District (CAGRD) in the AMAs where it’s an option. Groundwater continues to be pumped and delivered to these communities by undesignated providers across the four AMAs, without an artificial replenishment obligation.

Groundwater Allowances — Another type of municipal unreplenished groundwater withdrawal is the ‘groundwater allowance’ granted upon issuance of a Certificate or Designation of Assured Water Supply (CAWS or DAWS). Under the AWS Rules, a see-predetermined volume of groundwater can be withdrawn by the CAWS- holder or DAWS provider and not be replenished or offset. These groundwater allowances, also referred to as ‘Phase-in Credits’ in

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2 Ibid.
3 Id. at 5-3.
4 Id. at 3-10.
some Designations, were initially designed to help municipal providers transition from groundwater to renewable supplies. However, not all water providers have used them unless the credits are exhausted quickly, groundwater allowances have long-term availability and therefore can be expected to and may continue to contribute to overdraft. The AWS Rules Designated providers in the Phoenix, Pinal, and Tucson AMAs are also allowed for an annual addition to the groundwater allowance typically equal to 4% of total demand, based on the assumption that this volume is being “returned to the aquifer” via incidental Recharge and thus would not require replenishment associated with the provider’s service area. In recent years, groundwater allowances have been utilized by designated and undesignated providers in the four AMAs where they are available.

Extinguishment Credits – Existing agricultural IGFRs, Type 1 retired IGFRs, or Type 2 non-irrigation grandfathered rights may be extinguished until the year 2025 for credits, known as ‘extinguishment credits’, and pledged to a municipal water provider or CAWS located in the same AMA. Credits pledged to a municipal provider are added to the groundwater allowance associated with that provider’s DAWS or with a CAWS. The method of calculating extinguishment credits varies by AMA, as described in the AWS Rules. Since pledged extinguishment credits are added to the groundwater allowance of a CAWS or DAWS per the AWS Rules, any volume withdrawn by municipal water providers would be embedded in the volume pumped against their groundwater allowances no replenishment is required.

Exempt Wells – Pumping from Domestic exempt wells, those equipped limited to pump not more than 35 gallons per minute, are not regulated by ADWR nor subject to conservation requirements; exempt wells are largely but not exclusively, for domestic use. The volume of pumping associated with these small wells is unmeasured and therefore contributes to the overall amount of unreplenished groundwater in all AMAs. ADWR creates estimates for these withdrawals each year based on the number of people in that AMA that are not served by municipal water providers.

Remediated Groundwater – Pumping of ‘remediated groundwater’ is incentivized in order to facilitate the treatment of contaminated groundwater, and it may also be deemed consistent with an AMA’s management goal. Although ADWR accounts for remediated groundwater differently than other groundwater in determining compliance with Management Plan conservation requirements, remediated groundwater retains its legal character as groundwater, and therefore contributes to overdraft in the two AMAs where it is permitted. In each of the Phoenix and Tucson AMAs, the amount of remediated groundwater pumping has averaged over more than 6,000 acre-feet per year. No remediated groundwater pumping has been reported in the Prescott, Pinal, or Santa Cruz AMAs to date.

Industrial Sector

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8 Arizona Administrative Code, Title 12, Chapter 15, Sections 724(A)(4), 725(3), and 727(A)(4).
9 The Santa Cruz AMA has not yet adopted its own AWS rules; groundwater allowances and extinguishment credits are not available.
10 Arizona Administrative Code, Title 12, Chapter 15, Sections 724, 725.01, 726 and 727.
11 Arizona Administrative Code, Title 12, Chapter 15, Section 723.
12 Arizona Administrative Code, Title 12, Chapter 15, Section 729.
The Code defines industrial use as a non-irrigation use of water, not supplied by a city, town or private-water company, including animal industry use such as dairies and feedlots, and expansions of those uses. The industrial sector has no renewable water resource requirements, yet it is expected to grow along with municipal growth as it is largely dependent on population growth and the economy. The sector includes electric power plants, sand and gravel facilities, turf facilities, mining, dairy, cattle feedlots, and other industrial uses. Industrial users withdraw water from their own wells and may acquire new groundwater withdrawal permits, called General Industrial Use Permits, from ADWR. They also may purchase or lease non-irrigation GFRs, which are an authority to pump groundwater for non-irrigation use (e.g., Type 1 retired GFRs and Type 2 non-irrigation GFRs). Many of the industrial subsectors utilize a combination of these authorities. There is no regulatory or statutory authority at this time to require industrial water users to convert to renewable supplies.

**Summary of Unreplenished Demand by Sector**

Table 1 provides a breakout of 2012 through 2016 average annual groundwater demand pursuant to the unreplenished groundwater types described in this brief, by sector and AMA. These values include groundwater demands such as pumping and GSF demand, but do not include the recovery of water stored underground that is not legally classified as groundwater, such as effluent that had been stored for long term storage credits. All values are shown to illustrate the extent to which allowable groundwater rights are exercised in each AMA. The table also includes the offsets to those demands that can be attributed to a given sector. Groundwater withdrawals, in combination with the use of other water supplies, may contribute to incidental recharge. CAGRD replenishment is also accounted for under the municipal sector. Overall, certain artificial recharge offsets are provided by sector in order to demonstrate the final average unreplenished groundwater demand by sector and AMA.

**IMPACTS OF UNREPLENISHED GROUNDWATER WITHDRAWALS**

One of the most difficult challenges for the State is that for the past 40 years, each water use sector has become accustomed to utilizing the various types of allowable groundwater withdrawals. Water users have made investments and economic decisions based upon these groundwater rights and their associated costs under the current framework. At the same time, rigorous groundwater management goals have been established in the AMAs. The State has recognized that unreplenished or "residual" groundwater withdrawals create a hurdle for AMAs to reach their respective management goals. In regard to the Phoenix AMA, ADWR acknowledged in its Third Management Plan that the authorization of continued groundwater use under the Code "was not made with a full understanding of its relationship to the attainment of safe-yield." In addition, the continued and further development of these groundwater rights and withdrawal exemptions will exacerbate water management challenges, including overdraft and physical availability of groundwater, no matter what the management goals may be beyond 2025.

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12 Phoenix Active Management Area Fourth Management Plan 3-10 (2020).
15 Phoenix Active Management Area Fourth Management Plan 3-10 (2020).
16 "A turf-related facility is any facility, including schools, parks, cemeteries, golf courses, or common areas within a housing subdivision, with ten or more acres of water-intensive landscaped area." Phoenix Active Management Area Fourth Management Plan 6-2 (2020).
17 Id. at 11-3.
In looking forward to the next 40 years, it is critical to assess the relationships between these types of groundwater withdrawals and their impact on the ability to achieve AMA management goals. Based on the perpetual nature and volume of these rights and exemptions alone, the State will need to determine whether additional conservation requirements, reductions in groundwater withdrawals, or other mitigating actions would provide a counterbalance to the amount of legally permitted groundwater withdrawals. Natural, incidental, and artificial recharge in each AMA has been and will most likely continue to be less than the volume of allowable groundwater withdrawals. ADWR and other entities have proposed several programs and authorities that might better align groundwater demand with the AMA goals and reduce the instances of groundwater declines, but none of those proposals have been substantially implemented.

Commented [A1]: Examples of organizations and specific proposals would bolster and support this sentence.

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Table 1: 2012-2016 Average Unreplenished Groundwater Demand by AMA and Sector (AF/yr)

<table>
<thead>
<tr>
<th>Sector and Type</th>
<th>Prescott</th>
<th>Phoenix</th>
<th>Pinal</th>
<th>Tucson</th>
<th>Santa Cruz</th>
</tr>
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<tr>
<td><strong>GROUNDWATER DEMAND</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5-Year Average (2012-2016)</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<td>Agricultural Sector</td>
<td>1,939</td>
<td>623,307</td>
<td>611,059</td>
<td>101,784</td>
<td>10,134</td>
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<tr>
<td>Groundwater</td>
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<td>422,694</td>
<td>76,666</td>
<td>10,134</td>
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<td>GSP Accounting</td>
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<td>124,841</td>
<td>24,909</td>
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<tr>
<td>Tribal</td>
<td>-</td>
<td>92,786</td>
<td>63,524</td>
<td>209</td>
<td>-</td>
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<td>Municipal Sector</td>
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<td>226,061</td>
<td>30,996</td>
<td>36,345</td>
<td>6,448</td>
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<tr>
<td>Large Designated Providers</td>
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<td>54,040</td>
<td>9,671</td>
<td>12,290</td>
<td>3,121</td>
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<td>Large Undesignated Providers</td>
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<td>16,290</td>
<td>16,560</td>
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<td>Small Providers</td>
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<td>3,688</td>
<td>1,521</td>
<td>4,046</td>
<td>313</td>
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<tr>
<td>Large Untreated Providers/Urban Irrigation</td>
<td>-</td>
<td>68,690</td>
<td>21</td>
<td>-</td>
<td>-</td>
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<tr>
<td>Domestic Exempt Well Demand</td>
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<td>3,450</td>
<td>170</td>
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<td>Industrial Sector</td>
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<td>Sand &amp; Gravel</td>
<td>316</td>
<td>11,311</td>
<td>570</td>
<td>3,855</td>
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<tr>
<td>Mining</td>
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<td>30</td>
<td>-</td>
<td>35,995</td>
<td>-</td>
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<td>Turf</td>
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<td>-</td>
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<td>Dairy</td>
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<td>9,414</td>
<td>131</td>
<td>-</td>
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<td>Cattle Feedlots</td>
<td>-</td>
<td>85</td>
<td>1,755</td>
<td>-</td>
<td>-</td>
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<tr>
<td>Other</td>
<td>300</td>
<td>13,793</td>
<td>2,518</td>
<td>4,762</td>
<td>125</td>
</tr>
</tbody>
</table>

**OFFSETS TO GROUNDWATER DEMAND**

| 5-Year Average (2012-2016)                   |          |         |       |        |            |
| Agricultural Sector                          | 1,419    | 467,183 | 250,668 | 22,036 | 2,375      |
| Incidental Recharge                          |          |         |       |        |            |
| Municipal Sector                             | -        | 35,942  | 394    | 2,796  | -          |
| Replenishment (CAGRD)                        | -        | 67,968  | 1,461  | 6,401  | -          |
| Incidental Recharge                          | 238      | 9,149   | 786    | 5,322  | 148        |

**UNREPLENISHED GROUNDWATER DEMAND**

| 5-Year Average (2012-2016)                   |          |         |       |        |            |
| Agricultural Sector                          | 520      | 156,125 | 360,391 | 79,748 | 7,758      |
| Municipal Sector                             | 12,970   | 122,151 | 29,142  | 27,148 | 6,448      |
| Industrial Sector                            | 1,354    | 97,875  | 17,487  | 51,785 | 1,013      |

*Average Unreplenished Demands are not the same as average Overdraft because they do not include natural recharge components.
On behalf of the Home Builders Association of Central Arizona and Southern Arizona Home Builders Association, we have the following comments on the draft Issue Brief addressing “Hydrologic Disconnect”.

The paper generally deals with the fact that under the Groundwater Code, water can be stored in an Active Management Area (AMA) and then later withdrawn at a location within the same AMA that is physically distant from the storage location. The presumption is that this practice will result in declining water tables in certain areas of the AMAs while possibly resulting in water-logging issues in others, with collateral adverse impacts in terms of subsidence and water quality. While not included in the issue statement, the paper also expresses the related concern that replenishment of groundwater pumped by members of the Central Arizona Groundwater Replenishment District (CAGRD) can similarly occur at hydrologically disconnected locations from where member pumping occurs and could result in similar adverse effects.

While we agree that both of these issues may, at least theoretically, be problematic for long term aquifer management and may merit further discussion and consideration, we believe that the issues can be stated with more precision. To the extent available, data and analysis documenting actual examples, if any, of the concerns expressed should be included in the Issue Brief. Doing so would allow us to put the issues in proper perspective. To that end, we have the following specific comments.

Issue Statement

As drafted, the issue statement is somewhat vague. We suggest the following changes: “The storage and recovery of water supplies in hydrologically disconnected areas within AMAs is authorized by the Groundwater Code but has the potential to creates localized declines in depth to groundwater. Such groundwater declines may result in long term vulnerabilities in groundwater availability at locations where recovery occurs and excess groundwater in locations where storage occurs. A similar issue arises in the context of groundwater pumping under the assured water supply program, which either does not require replenishment in the same location as authorized pumping or does not impose a replenishment obligation for such pumping, as is the case with groundwater allowances and the exercise of other groundwater pumping rights under Arizona law.”

We deleted groundwater quality concerns as they are not discussed in any detail in the draft. If water quality concerns are included, there should be some documentation of water quality problems in areas of groundwater decline. We are aware that groundwater quality issues can arise at any depth and but have not seen documentation that pumping near or below the 1000-foot depth (1100 feet in the Pinal AMA) presents particularly unique or widespread water quality concerns. Further, if such water quality issues are of widespread concern, this is a topic for discussion well beyond the scope of this Issue Brief and should be addressed more comprehensively.

Background/Recharge and Recovery

In this section, we suggest adding at the end of the last paragraph: “Also, recovery of stored credits can occur theoretically at any time in the future, even after the stored water has migrated far from where it was originally recharged. There are no statutory time limitations on when or where stored water must be recovered.”
Background/Pumping and Replenishment

In this section, we think the discussion regarding CAGRD replenishment would benefit from a more thorough discussion of how CAGRD operates in practice, as this does have an ameliorating effect on the concerns raised in the paper. We suggest modifying the first paragraph to read:

“Arizona’s Assured Water Supply (AWS) Program requires that new subdivision developments within AMAs have access to a water supply that is consistent with that AMA’s statutory Management Goal. This requirement is satisfied by securing access to a renewable supply of water or, if groundwater will be utilized, through demonstrating that a 100-year supply of groundwater is physically, legally and continuously available to serve the proposed use. To meet the management goal requirement of the Assured Water Supply rules, most groundwater that is actually used by municipal providers that do not have rights to renewable water supplies must be replenished. This is accomplished through membership in the Central Arizona Groundwater Replenishment District (CAGRD). Membership in the CAGRD allows those water users, including water providers or individual subdivisions, to utilize groundwater to meet municipal demands. Per statute, the CAGRD must find renewable water supplies to replenish that volume of groundwater through future underground storage in the same AMA, within three years of its use. The Assured Water Supply Rules do allow designated providers to accumulate groundwater “allowances” based on the amount of water served by the provider. Those allowances can be pumped anywhere within the provider’s service area without incurring a replenishment obligation, a statutorily-defined timeframe. “

We suggest adding the following to the next paragraph and then adding an additional paragraph after that:

“Whereas recharging available renewable water supplies “up front” allows a water user to later recover that water under the legal classification in which it was stored, replenishment by the CAGRD serves to replace groundwater that has already been pumped by its members, so it is not intended for later recovery. Rather, it simply is returned to the aquifer where it is available for any groundwater pumpers to access. However, much like recovery of a LTSC, replenishment may take place in a location hydrologically distinct from the area where groundwater was pumped, so long as it is within the same AMA. Groundwater allowances – which do not have to be replenished – can similarly be withdrawn anywhere within a municipal provider’s service area.

The volume of CAGRD replenishment, both to date and into the future, is much more limited in scope than the recharge and recovery activities occurring throughout the AMAs. As noted above, over 11 million acre-feet of water has been stored underground across the 5 AMAs up to 2016. While limited to the Phoenix, Pinal and Tucson AMAs, the replenishment activities are much smaller in scope. As per the 2015 Plan of Operation, CAGRD reports that 336,065 acre-feet were replenished. Going forward, CAGRD projected its annual obligations for current and future members (i.e. those that would join under the ten-year term of the plan) would be 38,000 acre-feet per year in 2015 and rising to 113,000 acre feet in 2114. At this rate, the total amount of groundwater replenished by 2114 for these members will not have reached the amount stored under the recharge and recovery program as of 2016. It also is important to note that the amount of actual CAGRD replenishment obligation over the past four years has been significantly lower than projected under the ten-year plan and likely will remain so into the future.”
The Hydrologic Disconnect
This section needs more careful analysis and data as to exactly what the problem is and when and where we may expect the problem to emerge. Rather than suggesting text changes, we have the following conceptual comments that should be addressed in the Issue Brief:

- The first paragraph accurately describes the legal ability to recharge and recover in geographically distinct areas. A discussion of groundwater allowances, specifically volumes of groundwater that will be withdrawn without replenishment, should be included here.
- The second paragraph addresses the “parade of horribles” that the hydrologic disconnect can cause. But there is no factual support for the problems asserted and there is no context. Here, it would be helpful to have some analysis of how assured water supply works, how municipal providers manage their water systems, and what long term pumping and recharge patterns are likely to look like. The mere lack of a legal obligation to limit pumping to areas where recharge or recovery occurs does not tell us much about what is likely to occur in the future. For example, we know that CAGRD, as a matter of policy, plans to recharge in the same groundwater basin as the pumping occurs. How does this policy influence the concern about the hydrologic disconnect? Similarly, municipal providers engaging in recharge and recovery can significantly impact the likelihood of adverse conditions cited in this paragraph actually occurring.
- The issue of waterlogged areas does not seem to belong in this Issue Brief, even if it was discussed by some participants in the process. Current regulations effectively prohibit or restrict recharge of water in areas or in volumes that would add to or create waterlogged areas. If this issue is included, there should be a full explanation of why current regulations are not effective.
- The importance of context is illustrated by the fourth paragraph which discusses the impact of including CAGRD pumping in assured water supply modeling in the Phoenix AMA, and the effect of moving pumping in the Tucson AMA so that it occurs closer to recharge locations.
  - As to the first example, the paper states this: “In the Phoenix AMA, groundwater modeling scenarios conducted by ADWR demonstrated groundwater conditions drastically improved when both the recovery of LTSC and CAGRD’s replenishment of excess groundwater use was tied to the area where water was originally stored or pumped.” What is not mentioned in this issue paper is the fact that this report was the result of several Phoenix area designated providers attempting to maximize their claims to physically available groundwater during the re-designation process. These entities attempted to do so by artificially projecting use of storage in other locations and recovery within their water service areas rather than the use of their existing surface water treatment and delivery capacity. When ADWR changed the assumptions in the model to more realistically reflect actual water use patterns by these water providers, groundwater levels improved. Where projected water declines remained in the West Salt
River Valley, but less severe, these declines occurred as a result of projected groundwater demand by agricultural users, not municipal water users.

- The Tucson AMA example seems to be entirely out of context. Historical groundwater declines in the Tucson AMA did not occur because of a disconnect between the location of storage and recovery. The historical declines occurred because of agricultural pumping in the Avra Valley sub-basin and because of municipal pumping in the Upper Santa Cruz sub-basin, both of which began decades before any storage and recovery occurred in the AMA or even before CAP water was available for storage and recovery. The recent water level increases that have occurred in the Avra Valley sub-basin have occurred because of a substantial reduction in agricultural pumping as the City of Tucson purchased and retired farm land in the Avra Valley. In more recent years, the City of Tucson has stored more CAP water in its Avra Valley recharge facilities than it has recovered, leading to additional, but perhaps temporary, water level increases. At the same time, the indirect use of CAP water through storage and recovery in the Avra Valley also has allowed Tucson to drastically reduce its pumping of groundwater in the Central Wellfield, where the majority of the water level declines and land subsidence historically occurred. In either sub-basin, the historical water level declines were completely unrelated to the issue of the “hydrologic disconnect” discussed in this issue paper. The last two sentences of this paragraph should be deleted.

Policies and Efforts to Address the Hydrologic Disconnect
This section simply recites the policies but does not have a discussion or analysis of the effect of the policies on the underlying problem. For example, CAGRD’s policy to recharge in the same groundwater basin as the pumping occurs can influence the amount of groundwater available for municipal pumping, as the Phoenix AMA example above illustrated. Is there any reason to believe that this policy will not be followed in the future and, if the policy continues to be followed, what is the effect on the concerns raised by the “hydrologic disconnect?”

We appreciate the opportunity to comment. These are complex issues and merit careful analysis. We appreciate the efforts in putting together this draft and look forward to additional discussion.
SRP ISSUE BRIEFS RESPONSE

Hydro Disconnect

Attached are comments on the Hydro Disconnect paper. We also want to comment further on footnote 7. SRP’s comments on footnote 7 are included in the attached; however, we believe ADWR should provide more information on what it did that resulted in the conclusion in the sentence which is the subject of footnote 7. This is very important relative to the Assured Water Supply program and how recovery of long-term storage credits fits into the overall AWS designations and certificates, particularly where water providers have been expanding their water service as a result of continued popularity and growth in the Phoenix metropolitan area. More specifically, with many AWS designations coming up for renewal in the next few years, this topic is of heightened interest to municipal water providers and others who plan to recover long-term storage credits for their operations.

Exempt Wells

Overall, we believe ADWR has done a good job of explaining the issues with exempt wells, but we believe there are a couple of additional points we suggest ADWR evaluate and report in the brief. The first relates to the impact of exempt wells on the siting of non-exempt wells by water providers due to the well spacing regulations. This is an issue that applies in all of the AMAs. In some instances the development of non-exempt wells that are needed to serve customers of municipal water providers can be impacted because of nearby exempt wells. This is particularly important when it comes to recovering long-term storage credits given the number of such credits that exist in the AMAs and their locations relative the growing municipal and industrial water provider service areas. In effect, the well-spacing requirements for non-exempt wells allow exempt wells to avoid most of the requirements of the Groundwater Code, yet enjoy the protections of the Code. This should be further evaluated and discussed in the brief.

Our second observation relates to the methodology for quantifying water uses from exempt wells. With respect to the Prescott AMA, and Yavapai County in general, it is true that these two areas are the poster children for wildcat subdivisions. However, from our experience in quantifying the water use in these subdivisions, not every lot has a well, or if they do, not every well may actually be operating and not every lot where a 55 notice was filed actually has a well drilled. These factors should probably be taken into account in ADWR’s analysis. We would suggest that ADWR not simply look at the Wells55 database as the measure of exempt well water use, but rather look at Arizona Department of Revenue and Yavapai County tax records to determine whether improvements on subdivision parcels exists. Further some of these subdivisions may actually be served by community water systems, rather than an exempt well, or by water haulers. We are aware of areas in Yavapai County where large numbers of lots with exempt wells are no longer using wells, but rather, are now served by water haulers. We would suggest that ADWR consider taking into account these data sources and this type of analysis to better assess water use from exempt wells in the Prescott AMA. It may be quite a bit less than what has been estimated.

Unreplenished Groundwater Withdrawal

In addition to our specific comments on the Issue Brief, we feel it is important to keep the unreplenished volume of groundwater pumped in the Phoenix into context of total overall water use. Using ADWR’s data for the Phoenix AMA, the average total demand for the 2012-2016 was 2,339,176 acre-feet. The Issue Brief states that the average unreplenished groundwater in the Phoenix AMA over that same period was 376,151 acre-feet. This means the unreplenished piece is about 16% or so of total water use. To further put into context, prior to the Code, the amount of unreplenished groundwater was probably on the order of 60% or more of total water use. So, from that perspective water users in the Phoenix AMA have made significant progress toward reducing the amount of unreplenished groundwater use. We ask that ADWR develop the percentage of unreplenished groundwater measured against total water use for each of the AMAs to see where they all stack up. Further, we also ask for ADWR to look at the 1980 data (First MP data) and develop the same percentage to give us context on where we were, where we are, and then where we’ll be going. We think that having this perspective will help inform effective policy development.
HYDROLOGIC DISCONNECT

ISSUE STATEMENT

The storage and recovery of water supplies in hydrologically disconnected areas within AMAs creates localized vulnerabilities in groundwater availability and quality with potential for greater impacts in the future when recovery of stored water becomes necessary.

BACKGROUND

Recharge and Recovery

The storage of renewable water supplies underground is one of Arizona’s key long-term water management tools. Across the five Active Management Areas (AMA), Arizona water users have stored (or saved through in-lieu storage) over 11 million acre-feet of water through 2016.¹ The storage of water underground, recharge, and the eventual withdrawal of that water, recovery, are administered through the Arizona Department of Water Resources’ Recharge Program.²

Recharge is accomplished through storage at either an underground storage facility or through the delivery of in-lieu water to a groundwater savings facility.³ When qualified water supplies are stored underground within an AMA those supplies can be recovered within the same calendar year via annual storage and recovery (AS&R) or they can generate a long-term storage credit (LTSC) for recovery in future years. Stored water retains its initial legal classification and is accounted as such when it is recovered. For instance, recharged Central Arizona Project (CAP) water that earns a LTSC will still be classified as CAP water when it is recovered at a later date. Recharged water is subject to physical losses as well as a cut to the aquifer depending on the type of water and method of storage. Typically, with some exceptions, there is a 5% cut to the aquifer for water stored at a recharge facility, intended to provide a general benefit to the aquifer from the recharge activity.⁴

Arizona’s Recharge Program requires that the recovery of stored water, whether through AS&R or LTSC recovery, take place within the same AMA where the water was originally stored. This means that water can be stored in one groundwater sub-basin and recovered in a different sub-basin that is spatially and hydrologically separate. The Phoenix AMA alone covers 5,646 square miles and contains seven distinct groundwater sub-basins.

Pumping and Replenishment

Arizona’s Assured Water Supply (AWS) Program requires that new subdivision developments within AMAs have access to a water supply that is consistent with that AMA’s statutory Management Goal. This requirement is satisfied by securing access to a renewable supply of water or, if groundwater will be utilized, through

¹ ADWR, LTSC Summary Dashboard https://new.azwater.gov/recharge/accounting
² Broadly governed by regulations in statute (Title 45, Chapter 3.1), administrative rules, and ADWR policy.
³ See definitions at A.R.S. § 45-811.01 and § 45-812.01
⁴ https://new.azwater.gov/sites/default/files/media/Cut%20to%20the%20Aquifer%20Table_Revised_May_07_2019.pdf
membership in the Central Arizona Groundwater Replenishment District (CAGRD). Membership in the CAGRD allows those water users, including water providers or individual subdivisions, to utilize groundwater today, while the CAGRD must find renewable water supplies to replenish that volume of groundwater through future underground storage in the same AMA within a statutorily-defined timeframe.

Whereas recharging available renewable water supplies “up front” allows a water user to later recover that water under the legal classification in which it was stored, replenishment by the CAGRD serves to replace groundwater that has already been pumped by its members, so it is not intended for later recovery. However, much like recovery of a LTSC, replenishment may take place in a location hydrologically distinct from the area where groundwater was pumped, so long as it’s within the same AMA.

THE HYDROLOGIC DISCONNECT

The ability to legally recover or replenish water that was respectively stored or pumped in a different location is referred to as the hydrologic disconnect. While the recharge of aquifers has led to a significant increase in water levels in certain areas, the hydrologic disconnect permits water users to pump water in areas that may not be benefiting from the recharge or replenishment tied to that pumping. For example, CAP water stored at a recharge facility in the Hassayampa subbasin (located on the west end of the Phoenix AMA) can legally be recovered in the East Salt River Valley subbasin, nearly 100 miles away. Similarly, CAGRD member lands that are served groundwater in the northern portion of the Tucson AMA legally have their pumping replenished at facilities located in hydrologically distinct regions to the west and southwest. These examples highlight the challenge that Arizona’s accounting framework for recovery and replenishment faces in balancing operational and economic considerations with hydrologic reality.

Pumping groundwater that has been legally stored or replenished elsewhere in an AMA may lead to localized groundwater declines in certain sub-basins. Subsidence, fissuring, aquifer compaction and storage loss, and water quality impacts are all potential consequences of overdraft. Localized overdraft also threatens economic growth, reducing the physical availability of groundwater in certain areas and reducing the likelihood that new development can secure an AWS Determination. Stakeholders in the Arizona water community have also expressed concerns about the ability for water that was stored by one user to physically be pumped from an area by another user, despite the storer retaining that LTSC.

In addition to groundwater depletion, certain aquifers must be managed to account for rising groundwater levels, especially if recovery takes place outside the area of recharge. Shallow groundwater tables can contribute to problematic waterlogging, and operational constraints which limit the amount of water that can be stored at a recharge facility.

The relationship between the hydrologic disconnect and localized groundwater declines has been well documented. In the Phoenix AMA, groundwater modeling scenarios conducted by ADWR demonstrated groundwater conditions drastically improved when both the recovery of LTSC and CAGRD’s replenishment of excess groundwater use was tied to the area where water was originally stored or pumped. Those recovery and replenishment assumptions that improved model outcomes, however, are not mandated by policy.

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5 See map of CAGRD member lands – Figure 2.3, 2015 CAGRD Plan of Operation; Overview of CAGRD replenishment location and capacity – http://www.cap-az.com/documents/meetings/2019-03-21/1741-032119-WEB-Final-Packet-CAGRD.pdf
6 For example, recharge at the Granite Reef Underground Storage Project is often curtailed as rising groundwater levels trigger regulatory alert levels designed to prevent encroachment on a nearby landfill.
Tucson AMA historical groundwater withdrawals led to water level declines due to an imbalance between the majority of recharge which takes place in the Avra Valley sub-basin, and recovery which occurs in the Upper Santa Cruz sub-basin. Efforts over the past two decades to shift pumping to the Avra Valley have yielded measurable improvements in water levels and decreased rates of land subsidence.

POLICIES & EFFORTS TO ADDRESS THE HYDROLOGIC DISCONNECT

There are several policy and regulatory requirements that govern the location of recovery and replenishment which also serve to mitigate some of the impacts stemming from the hydrologic disconnect:

1. ADWR’s well spacing requirements prohibit recovery of stored water if, among other things, the recovery would lead to ≥ 10 feet of drawdown of local groundwater levels after the first five years of recovery or would exacerbate existing subsidence issues.

2. The AMA Management Plans prohibit recovery of water in an area experiencing 4.0’ of annual decline in groundwater levels.

3. Recovery within the area of impact is considered physically available for assured water supply purposes.

4. Though not mandatory, statute requires the CAGRD replenish groundwater in the East and West portions of the Phoenix AMA in proportion to the replenishment obligation generated in each portion of the AMA, to the extent reasonably feasible.

While these policies do have bearing on the location of recovery and replenishment, they do not provide a framework for water management tailored for sub-AMA application. Crafting policy to specifically address the hydrologic disconnect at such a scale has been a long-running discussion in the Arizona water community. The need for sub-regional groundwater management strategies was identified as a priority for ADWR as early as 1999 in the Third Management plans. The hydrologic disconnect relating to CAGRD’s replenishment has also been repeatedly recognized as an issue, including by the Central Arizona Water Conservation District (CAWCD) Board which has directed the CAGRD to “replenish in areas of hydrologic impact of groundwater withdrawals by CAGRD members” in its last two Strategic Plans. More recent attempts to address the hydrologic disconnect took place through stakeholder engagement led by ADWR in 2012 as part of initial efforts to develop the Fourth Management Plans. While concepts for adjusting the cut to the aquifer and designating certain sub-basins for targeted management were proposed, no policies were ultimately adopted.

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10 Phoenix AMA: 3MP § 8.7.2.3 / 4MP § 8-801
11 A.A.C. R12-15-716
12 A.R.S. § 48-3772(I)
13 Phoenix 3MP - § 8.2; Tucson 3MP - § 8.7.2.3; Pinal 3MP - § 8.6; Prescott 3MP - §8.2
ISSUE BRIEF

UNREPLENISHED GROUNDWATER WITHDRAWALS

ISSUE STATEMENT

In Arizona’s active management areas (AMAs), unreplenished groundwater withdrawals by all water-using sectors, combined with a lack of sufficient incentives to either reduce withdrawals or mitigate the impacts, may limit the State’s ability to meet the AMA long-term groundwater management goals.

BACKGROUND

Unreplenished groundwater withdrawals refer to groundwater that is legally withdrawn without requirement or obligation to artificially replenish or replace that volume of water back into the aquifer and is not offset by incidental recharge. These withdrawals are also referred to as ‘allowable groundwater’. Through Arizona’s current regulatory framework, the State has sought to restrict the overall reliance on non-renewable groundwater supplies. The 1980 Groundwater Management Act (GMA or Code) was passed to specifically address issues associated with severe groundwater overdraft. The GMA established the Arizona Department of Water Resources (ADWR) to oversee the waters of the State and created AMAs where groundwater would be regulated by ADWR in order to mitigate the effects of groundwater withdrawals.

To do so, the State requires new development in the AMAs to occur on renewable water supplies and water users in all sectors are subject to mandatory conservation requirements that aim to reduce the amount of groundwater used over time. Despite these requirements, various existing and potential new groundwater users within the AMAs are permitted to continue or increase their use of unreplenished groundwater over time. Existing groundwater users’ rights were originally grandfathered into the new groundwater rights management system, and other exceptions were made that allowed for the continued use of groundwater in all sectors. Since, by definition unreplenished groundwater withdrawals are not required to be replenished, the amount occurring in excess of the associated incidental recharge and natural groundwater recharge contributes to aquifer overdraft.

UNREPLENISHED GROUNDWATER WITHDRAWALS BY SECTOR

Groundwater use is authorized under various rights and permits within each water-using sector. The subsectors and the types of current and ongoing allowable groundwater withdrawals are described below:

**Agricultural Sector**

As part of the adoption of the Code, Irrigation Grandfathered Groundwater Rights (IGFRs) were granted that allow farmers to withdraw groundwater for irrigation use. No new IGFRs may be created and the amount of land that may be irrigated is limited to that which was historically irrigated between 1975 and 1979. IGFRs represent a perpetual authority to withdraw groundwater without an artificial replenishment requirement. This type of

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1 Phoenix Active Management Area Fourth Management Plan 11-3 (2020).

Commented [RDC1]: Not a fan of the premise of the Issue Statement.

Commented [BAM2]: No discussion on hydrologic cycles and how it impacts pumping e.g. wet versus dry-year pumping Salt/Verde River and shortages on the Colorado River. This is a large driver of unreplenished groundwater pumping today and will be in the future.
groundwater withdrawal can be expected to continue as long as the land is used for agricultural purposes. This is partly because the cost of pump and use groundwater pumping is generally cheaper than the costs associated with delivering and using renewable supplies, when they are available. Some irrigation districts delivering water to IGFRs serve as groundwater savings facilities (GSFs), enabling them to utilize renewable water supplies in lieu of groundwater in a given year. However, for water accounting purposes, ADWR legally considers the irrigation district’s use of the renewable supply to be groundwater, because the volume of groundwater use becomes a stored water credit (long-term or annual) for the entity who supplied the water, thus functionally reduces the amount of groundwater in storage. This sector also includes estimated groundwater demands associated with tribal agricultural uses.

**Municipal Sector**

The municipal sector is comprised of small and large undesignated and designated municipal water providers, both publicly- and privately-owned. Small municipal providers are those that use 250 AF or less water per year. Thus, large providers are those that use more than 250 AF of water per year. In addition to these provider types, several entities are regulated as large untreated providers in the Phoenix AMA. These include both cities, towns, private-water companies and irrigation districts. A large untreated provider serves 100 or more AF per year or 500 or more people with untreated water for non-irrigation purposes, usually for residential or commercial flood irrigation of turf.

Under both the Code and the Assured Water Supply (AWS) Program, several allowable groundwater uses were ascribed to the municipal sector: was granted certain allowable groundwater uses because it was understood the sector would be allowed to grow and increase its overall water use through time. However, some existing municipal groundwater uses were also exempt from the AWS Program. The Santa Cruz AMA was split off from the Tucson AMA around the same time that the other AMAs were adopting their AWS rules, and it has not yet adopted its own AWS Rules. Because of this, groundwater allowances and extinguishment credits are not available in the Santa Cruz AMA.

**Pre-1995 Subdivisions** – A number of subdivisions platted before the 1995 adoption of the AWS Rules in the Phoenix, Prescott, and Tucson AMAs, served by small and large undesignated water providers and platted before the 1995 adoption of the AWS Rules, are allowed to use groundwater without replenishment not required to replace groundwater use with renewable supplies, either directly or through membership in the Central Arizona Groundwater Replenishment District in the AMAs, where it’s an option. Groundwater continues to be pumped and delivered to these communities by undesignated providers across the four AMAs, without an artificial replenishment obligation.

**Groundwater Allowances** – Another type of municipal unreplenished groundwater withdrawal is the ‘groundwater allowance’ granted upon issuance of a Certificate or Designation of Assured Water Supply (CAWS or DAWS). Under the AWS Rules, a set volume of groundwater can be withdrawn by the CAWS-holder or DAWS provider and not be replenished or offset. These groundwater allowances, also referred to as ‘Phase-in Credits’ in some Designations, were initially designed to help municipal providers transition from groundwater to renewable

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2 Ibid.
3 Id. at 5-3.
4 Id. at 3-10.
supplies.\textsuperscript{6,7} However, unless the credits are exhausted quickly, groundwater allowances have long-term availability and therefore, if used, will count toward the amount of unreplenished groundwater pumping can be expected to continue to contribute to overdraft. The AWS Rules in the Phoenix, Pinal, and Tucson AMAs also allow for an annual addition to the groundwater allowance equal to 8\% of total demand based on the assumption that this volume is “returned to the aquifer” via incidental recharge and thus would not require replenishment.\textsuperscript{8} In recent years, groundwater allowances have been utilized by designated and undesignated providers in the four AMAs where they are available.

**Extinguishment Credits** – Existing agricultural IGFRs, Type 1 retired IGFRs, or Type 2 non-irrigation grandfathered rights may be extinguished until the year 2025 for credits, known as “extinguishment credits”, and pledged to a municipal water provider or CAWS located in the same AMA. Credits pledged to a municipal provider are added to the groundwater allowance associated with that provider’s DAWS or with a CAWS. The method of calculating extinguishment credits varies by AMA, as described in the AWS Rules.\textsuperscript{9,10} Since pledged extinguishment credits are added to the groundwater allowance of a CAWS or DAWS per the AWS Rules, any volume withdrawn by municipal water providers would be embedded in the volume pumped against their groundwater allowances and would contribute to the amount of unreplenished groundwater pumping.\textsuperscript{11}

**Exempt Wells** – Domestic exempt wells, those equipped to pump not more than 35 gallons per minute, are not regulated by ADWR nor subject to AWS or conservation requirements. The volume of pumping associated with these small wells is unmeasured, but nevertheless contributes to the overall amount of unreplenished groundwater in all AMAs. ADWR creates estimates for these withdrawals each year based on the number of people in that AMA that are not served by municipal water providers.

**Remediated Groundwater** – Pumping of “remediated groundwater” may be deemed consistent with an AMA’s management goal\textsuperscript{11} and thus not subject to a replenishment obligation\textsuperscript{12} in order to facilitate the treatment and beneficial use of contaminated groundwater, and it may also be deemed consistent with an AMA’s management goal.\textsuperscript{13} Although ADWR accounts for remediated groundwater differently than other groundwater in determining compliance with Management Plan conservation requirements, remediated groundwater retains its legal character as groundwater, and therefore contributes to overdraft in the two AMAs where it is permitted. In each of the Phoenix and Tucson AMAs, the amount of remediated groundwater pumping has averaged over 6,000 acre-feet per year. No remediated groundwater pumping has been reported in the Prescott, Pinal, or Santa Cruz AMAs to date.

**Industrial Sector**

The Code defines industrial use as a non-irrigation use of water, not supplied by a city, town or private-water company, including animal industry use such as dairies and feedlots, and expansions of those uses.\textsuperscript{14} The industrial sector has no renewable water resource requirements, yet it is expected to grow along with municipal growth as

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\textsuperscript{6} Prescott Active Management Area Fourth Management Plan 10-8 (2019).
\textsuperscript{7} Phoenix Active Management Area Fourth Management Plan 11-4 (2020).
\textsuperscript{8} Arizona Administrative Code, Title 12, Chapter 15, Sections 724(A)(4), 725(3), and 727(A)(4).
\textsuperscript{9} Arizona Administrative Code, Title 12, Chapter 15, Sections 724, 725.01, 726 and 727.
\textsuperscript{10} Arizona Administrative Code, Title 12, Chapter 15, Section 723.
\textsuperscript{11} Arizona Administrative Code, Title 12, Chapter 15, Section 720.
\textsuperscript{12} Arizona Administrative Code, Title 12, Chapter 15, Section 720.
\textsuperscript{13} Arizona Administrative Code, Title 12, Chapter 15, Section 720.
\textsuperscript{14} Phoenix Active Management Area Fourth Management Plan 3-10 (2020).
it is largely dependent on population growth and the economy. It includes electric power plants, sand and gravel facilities, turf facilities, mining, dairy, cattle feedlots, and other industrial uses. Industrial water users receive water from a number of sources, including surface water, Central Arizona Project water, effluent, and groundwater. Pre-code industrial groundwater users withdraw water from their own wells under grandfathered rights. Under certain circumstances, new industrial groundwater users and may acquire new groundwater withdrawal permits, called General Industrial Use Permits, from ADWR. They also may purchase or lease non-irrigation GFRs, which are an authority to pump groundwater for non-irrigation use (e.g., Type 1 retired GFRs and Type 2 non-irrigation GFRs). Many of the industrial subsectors utilize a combination of these authorities. There is no regulatory or statutory authority at this time to require industrial water users to convert to renewable supplies or replenish their groundwater use.

Summary of Unreplenished Demand by Sector

Table 1 provides a breakout of 2012 through 2016 average annual groundwater demand pursuant to the unreplenished groundwater types described in this brief, by sector and AMA. These values include groundwater demands such as pumping and GSF demand, but do not include the recovery of water stored underground that is not legally classified as groundwater, such as effluent that had been stored for long-term storage credits. All values are shown to illustrate the extent to which allowable groundwater rights are exercised in each AMA. The table also includes the offsets to those demands that can be attributed to a given sector. Groundwater withdrawals, in combination with the use of other water supplies, may contribute to incidental recharge. CAGRD replenishment is also accounted for under the municipal sector. Overall, certain artificial recharge offsets are provided by sector in order to demonstrate the final average unreplenished groundwater demand by sector and AMA.

IMPACTS OF UNREPLeniSHED GROUNDWATER WITHDRAWALS

One of the most difficult challenges for the State is that for the past 40 years, each water use sector has become accustomed to utilizing the various types of allowable groundwater withdrawals. Water users have made investments and economic decisions based upon these groundwater rights and their associated costs under the current framework. At the same time, rigorous groundwater management goals have been established in the AMAs. The State has recognized that unreplenished or “residual” groundwater withdrawals create a hurdle for AMAs to reach their respective management goals. In regard to the Phoenix AMA, ADWR acknowledged in its Third Management Plan that the authorization of continued groundwater use under the Code “was not made with a full understanding of its relationship to the attainment of safe-yield.” In addition, the continued and further development of these groundwater rights and withdrawal exemptions will exacerbate water management challenges, including overdraft and physical availability of groundwater, no matter what the management goals may be beyond 2025.

In looking forward to the next 40 years, it is critical to assess the relationships between these types of groundwater withdrawals and their impact on the ability to achieve AMA management goals. Based on the perpetual nature

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15 Phoenix Active Management Area Fourth Management Plan 3-10 (2020).
16 “A turf-related facility is any facility, including schools, parks, cemeteries, golf courses, or common areas within a housing subdivision, with ten or more acres of water-intensive landscaped area.” Phoenix Active Management Area Fourth Management Plan 6-2 (2020).
17 Id. at 11-3.
and volume of these rights and exemptions alone, the State will need to determine whether additional conservation requirements, reductions in groundwater withdrawals, or other mitigating actions would provide a counterbalance to the amount of legally permitted groundwater withdrawals. Natural, incidental, and artificial recharge in each AMA has been and will most likely continue to be less than the volume of allowable groundwater withdrawals. ADWR and other entities have proposed several programs and authorities that might better align groundwater demand with the AMA goals and reduce the instances of groundwater declines, but none of those proposals have been substantially implemented.

Commented [MCM19]: Separate issue from safe-yield. Should be addressed separately.

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Table 1: 2012-2016 Average Unreplenished Groundwater Demand by AMA and Sector (AF/yr)

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<thead>
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<th>Sector and Type</th>
<th>Prescott</th>
<th>Phoenix</th>
<th>Pinal</th>
<th>Tucson</th>
<th>Santa Cruz</th>
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<td>5-Year Average (2012-2016)</td>
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<tr>
<td>Mining</td>
<td>-</td>
<td>30</td>
<td>-</td>
<td>35,995</td>
<td>-</td>
</tr>
<tr>
<td>Turf</td>
<td>976</td>
<td>58,972</td>
<td>4,016</td>
<td>10,773</td>
<td>886</td>
</tr>
<tr>
<td>Electric Power</td>
<td>-</td>
<td>11,617</td>
<td>-</td>
<td>1,591</td>
<td>-</td>
</tr>
<tr>
<td>Dairy</td>
<td>-</td>
<td>11,216</td>
<td>9,414</td>
<td>131</td>
<td>-</td>
</tr>
<tr>
<td>Cattle Feedlots</td>
<td>-</td>
<td>85</td>
<td>1,755</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Other</td>
<td>300</td>
<td>13,793</td>
<td>2,518</td>
<td>4,762</td>
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<table>
<thead>
<tr>
<th>OFFSETS TO GROUNDWATER DEMAND</th>
<th>5-Year Average (2012-2016)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agricultural Sector</td>
<td>Incidental Recharge</td>
</tr>
<tr>
<td>Municipal Sector</td>
<td>Replenishment (CAGRD)</td>
</tr>
<tr>
<td></td>
<td>Incidental Recharge</td>
</tr>
<tr>
<td>Industrial Sector</td>
<td>Incidental Recharge</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>UNREPLENISHED GROUNDWATER DEMAND*</th>
<th>5-Year Average (2012-2016)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agricultural Sector</td>
<td>520</td>
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<tr>
<td>Municipal Sector</td>
<td>12,970</td>
</tr>
<tr>
<td>Industrial Sector</td>
<td>1,354</td>
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</tbody>
</table>

*Average Unreplenished Demands are not the same as average Overdraft because they do not include natural recharge components.