New Path to Permitting Aquifer Storage and Recovery Systems in Florida

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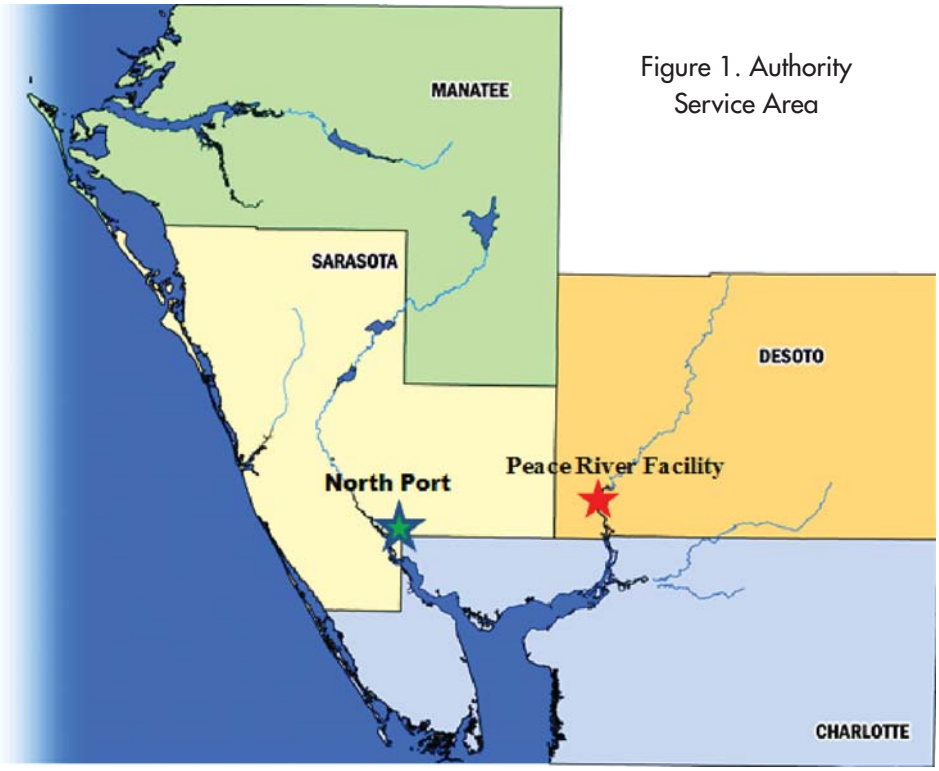

Figure 1. Authority Service Area

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For years, regulatory issues surrounding mobilization of arsenic in groundwater have stymied development of new aquifer storage and recovery (ASR) systems in Florida. Introduction of oxygenated water during the ASR recharge cycle can dissolve small amounts of arsenic and mobilize it in groundwater within the storage zone around the production wells causing exceedance of the drinking water standard for arsenic in groundwater. Monitoring data show that arsenic mobilization tends to be limited to short distances from the ASR production well, making it a

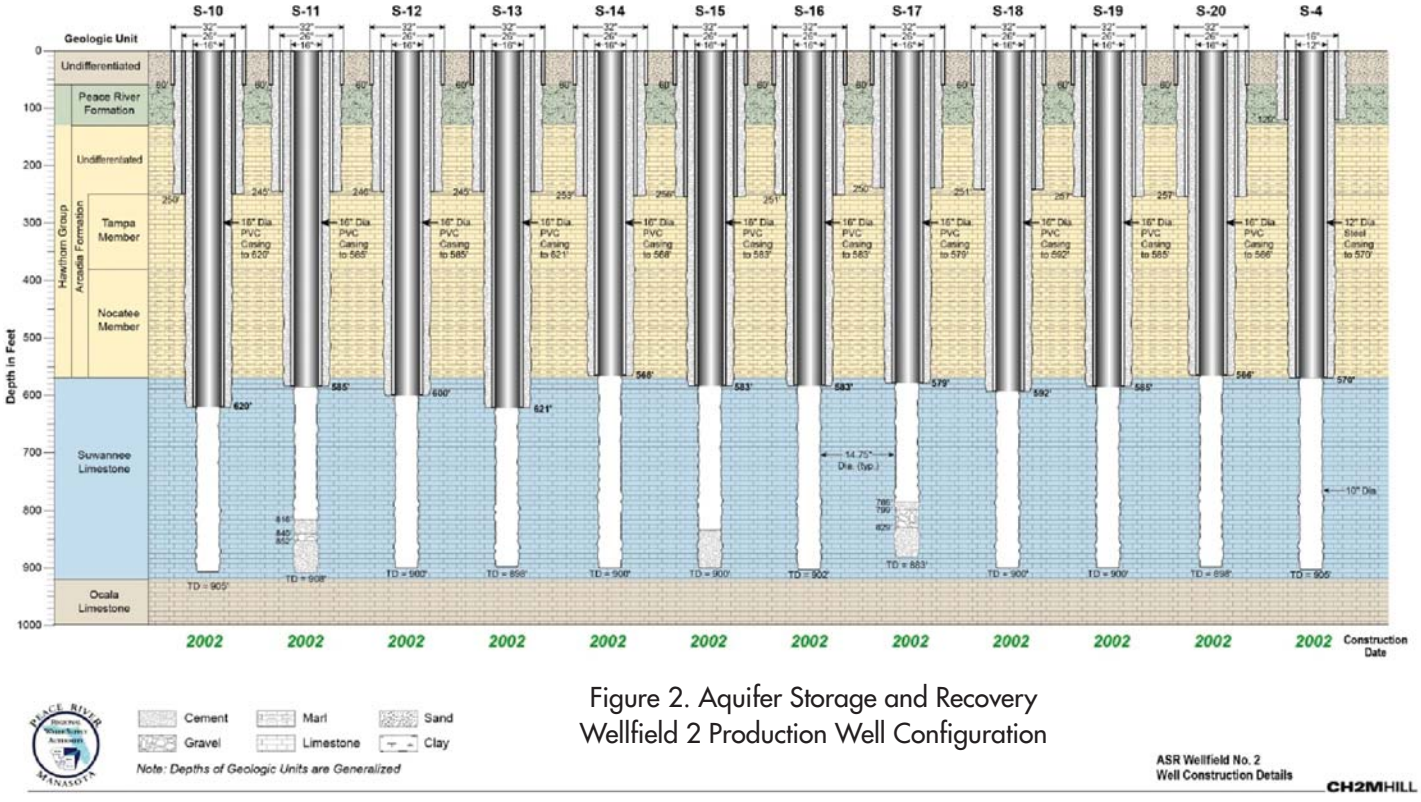

Figure 2. Aquifer Storage and Recovery Wellfield 2 Production Well Configuration

manageable situation where the ASR entity has ownership or control of surrounding land. These data provide support for the track pursued by the Peace River Manasota Regional Water Supply Authority (Authority) for the permitting of its ASR system, and a potential remedy to the regulatory barrier to future ASR development in Florida.

In August 2012, the Authority submitted an application to the Florida Department of Environmental Protection (FDEP) for a UIC Class V, Group 7 injection well operation permit to combine its two ASR wellfields under one permit at the Peace River Facility (Facility) site. The application was accompanied by a petition for water quality criteria exemption (WQCE) pursuant to Rule 62-550.500, F.A.C. The WQCE petition requested that arsenic concentrations be allowed to exceed the drinking water standard (10 ug/L) within the ASR storage zone on property owned or controlled by the Authority, as long as the arsenic standard is met at the property boundary. Issuance of the WQCE required demonstration of public interest, protection of public health, safety, and welfare, and a number of other requirements, including noninterference with use of the groundwater resources and adequate monitoring and protection of water resources.

Aquifer Storage and Recovery Defined

In this article, ASR involves the use of wells to inject water into a storage zone in the upper Floridan aquifer, and recovery of the stored supply when needed. Successful development of alternative water supplies using surface water in Florida depends on the availability of large volume storage such as ASR, which can be filled quickly when surface water resources are in abundance, allowing use of the stored water to meet water supply needs during the state's extended dry season when surface water resources are scarce.

In Florida, ASR systems are permitted under Chapter 62-528, Florida Administrative Code (F.A.C.), where they are designated as either Group 3 (reclaimed water) or Group 7 (potable or non-potable) injection wells. A review of FDEP records in 2011 indicated that of 88 ASR system permits issued in Florida, 38 percent store surface water, 34 percent store groundwater, and 28 percent store reclaimed water. Surprisingly, only four of the ASR systems in the state have been issued operation permits to allow the system to be used as needed to meet demand. Forty systems operate under a construction permit or a "letter of authorization to use," which typically requires a defined storage and recovery of water each year (i.e., cycle testing). Permits for 28 of the systems are expired and another 16 were under review by FDEP.

The very low percentage of operation permits, high percentage of ASR systems that continue, sometimes for decades, under construction permits, and the large number of inactive systems (expired permits), is the product of an uncertain regulatory climate surrounding ASR; specifically, the issue is mobilization of arsenic in groundwater. Arsenic, a naturally occurring element in the subsurface often associated with the mineral pyrite, is found in small quantities in the matrix of the limestone aquifers most often used in Florida for ASR. Introduction of oxygenated water during the ASR recharge cycle can dissolve and mobilize the arsenic, thereby degrading groundwater quality.

Arsenic mobilization gained a great deal of significance as an issue for ASR systems in January 2006 when the U.S. Environmental Protection Agency (EPA) changed the primary drinking water standard for arsenic from 50 ug/L (parts per bil) to 10 ug/L. Many ASR systems met the 50 ug/L arsenic standard after a small number of recharge and recovery cycles; however, the 10 ug/L standard essentially cur-

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tailed ASR development in Florida. Monitoring data at the Authority's ASR system shows that mobilized arsenic tends to migrate only short distances within the storage zone from the ASR production (injection/recovery) wells and usually attenuates further and further with each cycle period. As such, where the ASR entity has ownership or control of surrounding land, or some other form of institutional controls on use of the aquifer within the zone of influence, the arsenic issue becomes a manageable condition.

The ability to control the extent of dissolved arsenic migration and the use of groundwater resources by others within the area where arsenic standards may be exceeded provided the basis for a new track to permitting an ASR system by the Authority in southwest Florida. This has the potential to expand ASR development in Florida, improving opportunities for alternative water supply development and supporting the environment in the process.

Peace River Manasota Regional Water Supply Authority

The Authority is an interlocal governmental agency created in 1982 to supply drinking water to Charlotte, DeSoto, Manatee, and Sarasota counties, and the City of North Port in southwest Florida (Figure 1). The Authority water production and storage facilities in DeSoto County include a 120-mil-gal-per-day (mgd) water intake on the Peace River, a 48 mgd conventional surface water treatment plant, 6.5 bil gal in off-stream raw water storage, and 6.3 bil gal in finished water ASR storage capacity. The facilities currently serve an average demand of 25 mgd.

Peace River Aquifer Storage and Recovery System

The Authority owns and operates two ASR wellfields at the Facility. ASR Wellfield 1 includes nine production wells installed incrementally between 1984 and 1995. Eight of the wells utilize the Suwannee Limestone in the upper Floridan aquifer at depths of 600 to 900 ft below land surface as the storage zone, while one of the wells utilizes the Tampa Member of the Arcadia Formation at a depth of about 400 to 500 ft below land surface. Wellfield 2 includes 12 production wells completed in 2002, all of which utilize the Suwannee Limestone as the storage zone. Figure 2 (CH2M Hill, 2012) shows ASR production well characteristics and geologic sequence for the area. Figure 3 shows the ASR wellfield locations relative to the Peace River water treatment and reservoir storage facilities.

Figure 3. Peace River Facilities and Aquifer Storage and Recovery Wellfield Locations

In addition to the production wells, the Authority's ASR system also includes 24 monitoring wells (16 Suwannee zone, 4 Tampa zone, and 4 shallow Arcadia and Peace River formation). Native water quality in the Suwannee storage zone generally meets drinking water standards, with the exception of total dissolved solids and sulfate, which average about 900 mg/L and 300 mg/L, respectively.

Both ASR wellfields store fully-treated drinking water. The ASR system is generally recharged during the summer wet season when raw water reservoir storage is high, excess water is available from the Peace River, and water demand from Authority customers is relatively low. To address increased arsenic concentrations, water recovered from the ASR system is discharged and mixed into the raw water reservoir system and thereafter is fully retreated, removing arsenic before delivery to customers.

The ASR Wellfield 1 has operated since 1985 under a "letter of authorization to use" before it was issued a UIC Class V, Group 7 operation permit in 2008, along with an administrative order to address any exceedance of arsenic. While recovered water from wells in Wellfield 1 is generally below the 10 ug/L arsenic standard, after more than 20 years of operation, infrequent exceedance of the standard continues. Wellfield 1 is operated as-needed to aid in meeting regional water demand.

The ASR Wellfield 2 has operated under a UIC Class V, Group 7 construction permit since 1999, with a recent renewal in 2011. The construction permit requires cycle testing, which involves specified recharge quantities, storage timeframe, and recovery quantities on each cycle, whether those quantities are needed to meet demand or not. The wellfield is currently on cycle 13, and while arsenic concentrations in recovered water are declining, the wellfield average remains between 15 and 20 ug/L.

Arsenic Mobilization at Peace River Aquifer Storage and Recovery Facilities

Data collected from production and monitoring wells at the Authority's ASR facilities indicates that while arsenic concentrations periodically exceed drinking water standards in individual ASR production wells, dissolved arsenic concentrations attenuate within short distances from the production wells. This suggests that arsenic is reprecipitated in the aquifer. Maximum arsenic concentrations recorded in 2012 from ASR Wellfield 2 production and monitor wells are shown in Figure 4 (CH2M Hill, 2012). The short migration distances for arsenic make this a condition that can be managed within Authority-controlled property. Migration is expected to be influenced by the volume of water in storage and, potentially, the ASR recharge rate. Storage in Wellfield 2 during 2012 peaked at about 1.5 bil gal.

New Permitting Strategy

The 2013 expiration date for the Wellfield 1 operating permit, continuation of costly cycle testing at Wellfield 2 under the existing construction permit, and the general plight of ASR in Florida, led the Authority to consider a different permitting track for these facilities. Discussions with the FDEP staff indicated that the agency was interested in developing a mechanism to improve opportunities for ASR in the state, while ensuring resource protection. In 2010 the FDEP issued a white paper proposing use of a zone-of-discharge concept to address the regulatory issues associated with arsenic migration (FDEP, 2010). That concept provided the basis for a new ASR permitting strategy.

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Rule 62-528.630(3), F.A.C., states that "[n]o underground injection control authorization by permit or rule shall be allowed where a Class V well causes or allows movement of fluid containing any contaminant into underground sources of drinking water, and the presence of that contaminant may cause a violation of any primary drinking water regulation under Chapter 403, F.S., and Chapter 62-550, F.A.C., or which may adversely affect the health of persons." There are, however, exceptions provided in Rule 62-520.500, F.A.C., which allow an exemption from water quality criteria, may include primary drinking water standards, and may be applied to ASR facilities that meet specific criteria outlined in the rule.

On Aug. 20, 2012, the Authority petitioned the state for a WQCE pursuant to Rule 62-520.500, F.A.C. The exemption requested that the arsenic standard for the Authority's ASR system be applied at the boundary of property it owned or controlled. In conjunction with the WQCE petition, an application was submitted to FDEP to combine Wellfields 1 and 2 under a single UIC Class V, Group 7 ASR operation permit.

Water Quality Criteria Exemption Requirements

The WQCE rule requires submittal of a $6,000 fee per parameter with the petition. The petition is required to include alternative compliance levels for the parameters from which an exemption is being sought. The exemption will be granted if the petition affirmatively demonstrates that:

a) Granting of the exemption is clearly in the public interest.
b) Compliance with such criteria is unnecessary for the protection of present and future potable water supplies.
c) Granting the exemption will not interfere with existing uses or the designated use of the waters or of contiguous water.
d) The economic, environmental, and social costs of compliance outweigh the economic, environmental and social benefits of compliance.
e) An adequate monitoring program approved by FDEP has been established to ascertain the location and approximate dimensions of the discharge plume, to detect any leakage of contaminants to other aquifers or surface waters, and to detect any adverse effect of underground geologic formations or waters.
f) The requested exemption will not present a danger to public health, safety, or welfare.

If a WQCE is granted, either in whole or in part, the UIC Class V, Group 7 permit would be conditioned or modified to include the exemption. The exemption is effective for the duration of the permit and a petition for renewal of the exemption is required to follow the same procedures as would a petition for a new exemption.

On Feb. 12, 2013, FFDEP granted the Authority petition for Class G-II groundwater quality criteria exemption. The exemption provides relief only for arsenic in groundwater within the property owned or controlled by the Authority and identifies specific criteria and justification considered in the affirmative demonstration required for items "a" through "f" listed previously.

The WQCE was tied to the issuance of the Class V, Group 7 ASR well system operating permit for Wellfields 1 and 2, which was issued by FDEP on April 24, 2013. The combination of the WQCE and operation permit includes a rigorous groundwater monitoring and reporting program, and the use of sentinel wells in the storage zone and in shallower aquifers near the property boundaries. Actions required, including possible cessation of recharge activities, are described should arsenic concentrations in groundwater exceed the drinking water standard in the sentinel wells.

Figure 4. 2012 Maximum Arsenic Concentrations in Aquifer and Storage Recovery Wellfield 2

Conclusions

For years, regulatory issues surrounding mobilization of arsenic in groundwater have hindered development of new ASR systems in Florida. Introduction of oxygenated water during the ASR recharge cycle can dissolve small amounts of arsenic and mobilize it in groundwater within the ASR storage zone around the production wells. Often the dissolved arsenic concentrations exceed the 10 ug/L drinking water standard creating regulatory issues and uncertainty about the long-term viability of these systems.

However, many years of monitoring data from the Authority's ASR facilities show that arsenic mobilization tends to be limited to short distances from the ASR production well, making this a manageable situation where the ASR entity has ownership or control of surrounding land. That formed the basis for a new track to obtaining a UIC Class V, Group 7 operation permit for the ASR facilities at the Peace River site. The Authority operation permit application was submitted in conjunction with a petition for a WQCE pursuant to Rule 62-520.500, F.A.C. The WQCE requested that the arsenic standard (10 ug/L) for the ASR system be applied at the boundary of property owned or controlled by the Authority, essentially providing a compliance zone of discharge.

The successful completion of this permitting process, including issuance of a WQCE for arsenic and a Class V, Group 7 operation permit for the Authority's two ASR wellfields facilitates improved operational efficiency and lower costs for ASR at the Facility, and may provide a new path to a more certain permitting future at existing and proposed ASR facilities in the state.

References

- CH2M Hill, 2012. Peace River Facility ASR System 2011 Annual Report.
- FDEP, 2010. Nonendangerment Proposal – Permitting Aquifer Storage and Recovery Facilities with Increased Arsenic Levels (Submitted to EPA May 3, 2010).