UTILIZING AQUIFER STORAGE AND RECOVERY TECHNOLOGY TO MANAGE GEORGIA'S WATER RESOURCE CHALLENGES

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Abstract. The State of Georgia is faced with multiple water resource challenges, as agricultural, industrial, and public users compete for water from the major river basins and principal aquifer systems. Competition for these resources is also an interstate issue involving legal challenges with Alabama and Florida over surface water allocations in the Apalachicola-Chattahoochee-Flint watershed and long standing negotiations with South Carolina over unsustainable withdrawals and saltwater intrusion in the Upper Floridan Aquifer.

Aquifer Storage Recovery (ASR) can address many of Georgia's water resource challenges. The technology is becoming an increasingly important water management tool in the Atlantic Coastal Plain. Groundwater in the coastal aquifers of Georgia is the predominant source of water supply and its sustainability is threatened by increasing demand, saltwater intrusion, and limited freshwater recharge. Despite its internationally-recognized success, ASR has been prohibited in some counties of Georgia in the past and continues to be challenged by some environmentalists. ASR is a low-impact technology that utilizes a small footprint within an aquifer, usually within a 1,000-foot radius of an ASR well.

ASR provides the opportunity for water users to store treated drinking water and manage water resources seasonally. ASR has many other benefits, including disinfection by-product reduction, improvement in regional groundwater levels, and reduction of saltwater intrusion effects. The local hydrogeology is a major consideration for the implementation of ASR projects. The development of aquifers as storage zones requires great care to avoid potential well-plugging. Local aquifer geochemistry can affect recovered water quality after storage, and treatment or other operational measures may be required to make the project successful. We present the results of a few successful ASR projects in the Coastal Plain of South Carolina and review two attempted ASR projects in Georgia.

INTRODUCTION

ASR is the storage of water in a suitable aquifer through a well when water is available, and recovery from the same well or another well when needed (Pyne, 2005). ASR wells are dual purpose in that they are employed to inject and recover water. The regular recovery of water from an ASR well using an installed pump greatly reduces well plugging and the necessity of backflushing, which would be consistently required of an injection-only well (Pyne, 2005).

The utilization of ASR technology has rapidly spread over the last 50 years in both the United States and worldwide in more than 15 other countries. The primary use of ASR is the seasonal storage of treated drinking water. Surplus treated drinking water, available during periods of low demand, can be stored in ASR wells and recovered to meet seasonal demands. Ultimately ASR can reduce the amount of source capacity necessary to meet peak demands and defer water treatment plant expansions and additional raw water source development. As of November 2016, we estimate there are more than 500 ASR wells in 20 states in the US.

Although seasonal storage remains the primary application for ASR, there are over 29 additional applications that have been identified. Often water purveyors find that additional advantages can be gained from secondary applications, like the control of saltwater intrusion, disinfection by-product reduction during storage, and the maintenance of disinfection residuals and pressures in the vicinity of ASR wells located in the distal portions of distribution systems.

ASR storage zones include a variety of aquifer settings and at depths ranging from 150 to more than 3,000 feet. ASR is employed in fresh water aquifers; however, brackish aquifers with more than 30,000 milligrams per liter of total dissolved solids have been used to successfully store and recover treated drinking water.

A principal advantage of ASR is the small footprint necessary for the storage of large quantities of water when compared to traditional above-ground storage facilities. Traditional above-ground finished water storage often requires continually monitoring and maintenance of disinfection during storage, whereas the water recovered from ASR storage zones usually only requires simple disinfection upon recovery to the distribution system. The water stored is usually stored within 500 feet of the ASR well and there are no known instances exceeding 1,000 feet (Pyne, 2005).

BACKGROUND

The state of Georgia is faced with numerous water management issues; however, there are abundant water resources available for management.

Saltwater intrusion into the Floridan Aquifer System (FAS) in the vicinity of Savannah, Georgia is a long-term issue and water levels have declined by more than 150 feet. FAS groundwater withdrawals began with the initial development of flowing artesian wells in the 1880's and peak withdrawals regionally exceeded 80 million gallons per day (MGD) by the 1960s (Counts and Dronsky, 1963). Despite capacity restrictions in both Georgia and South Carolina, the cone of depression in the FAS associated with these withdrawals continues to extend to the northern end of Hilton Head Island, South Carolina, where ongoing saltwater intrusion has been documented since the 1960s.

The Apalachicola-Chattahoochee-Flint (ACF) River basin is approximately 20,000 square miles and includes portions of Alabama, Florida, and Georgia. The basin has experienced major increases in population and agricultural production that have led to combined surface water and groundwater withdrawals exceeding 1,645 MGD in 2010 (Lawrence, 2016). The maintenance of instream flows in the ACF basin has become an interstate issue that has led to litigation between Alabama, Georgia, Florida, and the US Army Corps of Engineers.

ASR has the ability to address each of these issues, especially if combined conjunctively with other water management practices. The State of Georgia has not developed or tested an ASR well, in part due to a moratorium on ASR in the coastal counties of Georgia from 1999 to 2014 (Georgia Report, 2014). Georgia has witnessed two attempts at ASR pilot projects.

Dalton Utilities funded a test well program intended to investigate the utilization of dolomitic limestone as a storage zone for future ASR wells in northwestern Georgia. The test program was designed to determine potential locations for ASR in an area recognized as having dramatic changes in well yields within short distances. Lack of funding for the project resulted in a decrease in test well locations from five to two. The two completed 6-inch test wells happened to be installed in areas of low yield.

The Georgia Environmental Finance Authority (GEFA) funded an ASR pilot study at the Elmodel Wildlife Management Area. The study was designed to investigate the hydrogeology, water quality, and water-bearing capacity of the Clayton and Claiborne aquifers (GEFA, 2015). This study involved core drilling, core sampling, test well and monitoring well construction, numerical groundwater modeling, and geochemical modeling. However, the project was abandoned as an ASR project due to the low yields of the two test wells completed in the Clayton and Claiborne aquifers. The project also resulted in the development of a FAS production well that is not used for ASR purposes.

There is a perception that the two ASR projects in Georgia have failed, however neither project actually resulted in ASR injection and recovery testing due to the problem of low well yields at both sites. Finding locations for ASR sites in Georgia with higher potential yields can be realized through desktop studies of available data on well yields, conversations with local well drillers, and/or exploration.

DISCUSSION

ASR has enormous potential for addressing Georgia's water resource issues. Seasonal ASR allows for water purveyors to store water during periods of low demand and/or periods of abundant raw water availability. Programs can be developed for discharge-based allocations that allow water systems to withdraw additional raw water during periods of exceptionally high in-stream flows, without impacting the environment. Recovered water from these ASR systems can ultimately be used to supplement capacity during drought periods, thereby reducing the amount of surface water withdrawals and maintaining in-stream flows.

Georgia can look to South Carolina for the potential successes that can be gained from ASR programs. South Carolina has been in the ASR business since the 1990's, when the Grand Strand Water and Sewer Authority (GSWASA) first developed an ASR system. The GSWASA developed their ASR system as an alternative to a more expensive surface water treatment plant expansion. GSWASA and other water purveyors in the area had been moving away from groundwater as a result of declining water levels in the Cretaceous-aged sands of the Black Creek Aquifer. New restrictions were placed on Black Creek Aquifer withdrawals with the passing of the Waccamaw Capacity Use Area rules in 1979. South Carolina water regulators consider ASR at GSWASA to be a pronounced success as water levels have dramatically rebounded in the Black Creek Aquifer (Ransom, 2016).

Water providers at Hilton Head Island have realized the benefit of ASR with the development of more than 6 MGD of recovery capacity. Hilton Head Public Service District has one ASR well in the Middle Floridan Aquifer that is capable of injecting up to 1,500 gallons per minute and was utilized to store more than 300 million gallons of water in its first year of operation. This is in an area plagued by the loss of multiple wells to saltwater intrusion and underlain by the same productive limestone aquifers of the FAS that underlie Savannah, Georgia.

The development of a successful ASR program requires careful site and aquifer selection. Use of a proven phased approach is strongly recommended, which starts with an initial feasibility assessment. Early identification of problematic hydrogeologic conditions or other site limitations can save time and money. Further investigations into the targeted ASR aquifer include sampling the aquifer matrix via coring, extensive aquifer testing, and water quality sampling. These data need to be considered along with the recharge water chemistry and often geochemical modeling is required by regulators and recommended by ASR consultants. Site investigations require local contamination surveys; considerations of setbacks and location of distribution system lines; and numerous permitting and site preparation tasks.

A major benefit of ASR is that it is usually more economical to develop an ASR program than to expand water treatment plants or develop new raw water sources. In a period where developing new sources is costly and demands are increasing, ASR provides the ability to manage existing resources in a more sustainable manner.

CONCLUSIONS

ASR can be a viable, cost-effective, and environmentally beneficial water management strategy for Georgia, as it is for Florida, South Carolina, and many other locations. Supplementing water storage in surface reservoirs, ASR storage can ensure water supply reliability during droughts and periods of high demand. ASR locations just below the Fall Line and in coastal Georgia will tend to have more favorable hydrogeology and greater individual well yields. There exists a proven, phased approach for achieving ASR success. Any future ASR projects in Georgia should follow this approach. ASR is a potent water management tool with many secondary advantages that can be utilized in conjunction with other water management tools to solve Georgia's diverse water resource problems.

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