

Aquifer Storage and Recovery Permitting – A Historical and Future Perspective

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Abstract

Aquifer Storage and Recovery (ASR), a proven method of storing and recovering large volumes of treated drinking water, has evolved over the years to include both partially treated groundwater, surface water and reclaimed water systems. Permitting for each of these various ASR projects in Florida has also evolved from simply a construction permit from the Florida Department of Environmental Protection (FDEP) and local health departments, to include Water Quality Criteria Exemptions, Limited Aquifer Exemptions and most recently Risk-Based Assessments.

Currently, ASR wells are regulated under the Underground Injection Control Rule and is administered by FDEP. The rule requires that water being recharged through an ASR well into an aquifer that is classified as a G-II (< 10,000 mg/L of Total Dissolved Solids), must meet drinking water standards (DWS). Water Quality Criteria Exemptions are required when water being recharged exceeds secondary DWS, which are aesthetic in nature (e.g., iron, color, odor, etc.). Projects where water quality criteria exemptions have been received include Broward County, Miami-Dade County, West Palm Beach and Marco Lakes. If the water exceeds primary DWS, then a Limited Aquifer Exemption (LAE) has been the path of choice by both Miami-Dade County and West Palm Beach – both of which have now received draft permits. This was a process initially developed by the United States Environmental Protection Agency (EPA) and FDEP, in conjunction with the above utilities to address these types of ASR systems.

Recently, EPA has placed on record that they would consider a risk based approach regarding permitting of surface water and groundwater ASR systems as part off the Comprehensive Everglades Restoration Plan (CERP), which would be in lieu of the LAE process. In furtherance of this approach and with help from the American Water Works Association (AWWA), Florida utilities, and the South Florida Water Management District (SFWMD), legislation was drafted during the 2000 Florida legislative session to expand EPA's risk-based approach beyond the CERP and include the rest of Florida. This legislation was written to help streamline the permitting process and will open up the doors for more, larger scale surface water and groundwater ASR systems, will reduce the reliance on surface water reservoirs for long-term storage of water, help to sustain minimum flows and levels, and save taxpayers millions of dollars. Although the legislation did not pass in this year's

session, work is already underway to pursue a similar bill in 2001, which will still be in time to address the schedule of ASR in the CERP.

Introduction

Aquifer Storage and Recovery (ASR) in Florida has developed over the last 17 years as a technique for storing fresh water in deep, confined brackish water aquifers. Typically ASR has involved treated drinking water from water treatment plants that is injected into a suitable aquifer and recovered from the same well or wells, generally requiring no additional post-treatment other than disinfection. However, as the need for better management of water resources increases in Florida due to increased growth and more scarce resources, ASR is being extended beyond its typical treated water applications. Two more recent and innovative uses of ASR include untreated ground and surface water and reclaimed water. In both of these cases, and not unlike treated water applications, ASR is used to manage a water resource.

With the typical treated water ASR applications, permitting was relatively straight forward requiring generally a construction and operational permits from the FDEP, a construction permit from the local Health Department, and in some cases a water use permit (WUP) modification from the local Water Management District (WMD). As the applications of ASR expand, so must the permitting mechanisms that regulate these facilities. Once untreated surface and groundwater and reclaimed water are introduced to the ASR picture, water that does not always meet drinking water standards, different permitting mechanisms have to be considered.

Unfortunately many of these permitting mechanisms have not proved to be highly efficient with respect to institutional processes and thus have left several completed ASR facilities inoperative. In addition, as the ASR market continues to expand as major regional ASR programs like those being considered in the United States Corp of Engineers (USACOE) Comprehensive Everglades Restoration Plan (CERP) (formerly the Restudy) (USACOE, 1999) and the South Florida Water Management District (SFWMD) Lower East Coast (LEC) Regional Water Supply Plan (SFWMD, 2000) are implemented a more efficient institutional process must be developed. A comprehensive approach to permitting these unconventional ASR facilities has already been introduced in the 2000 Florida State Legislature, and will be re-introduced in this next year's session. The regulatory community must come together and realize that with the recent passage by the Senate and House of the first round of Federal Funding for CERP projects, including ASR pilot projects, a more streamlined permitting must be developed. Otherwise this important cost-effective technology may be lost in a pile of bureaucratic paperwork.

The remainder of this paper will be focused on a comparison between the more traditional treated water ASR systems and the less conventional and proven untreated surface and groundwater systems.

ASR Concept

Many water supply facilities, local and regional, are faced with dry season demands that either approach, or exceed, dry season supplies, while wet season supplies are in excess of

the wet season demands. The concept of ASR involves storing water underground via wells during periods of low demand or excess supply. Water can then be recovered to meet annual peak season demands or "banked" for withdrawal at a later date, which defers costly supply or treatment system expansions constructed solely to meet peak demands.

In Florida, almost all of the ASR wells are constructed in the relatively brackish and confined Floridan aquifer and are recharged with treated, reclaimed and some untreated water. Although the native water quality in the Floridan is brackish and essentially non-potable without further treatment, according to Chapter 62-520, Florida Administrative Code (FAC) the Floridan aquifer is classified as a G-II aquifer and thus by definition is an Underground Source of Drinking Water (USDW). And it therefore receives the same level of protection as the shallower fresh water aquifers that are more frequently used for drinking water purposes.

Existing Facilities

About 32 ASR systems are in operation in the U.S. as of July 1999, compared with 3 in 1983. Each system has wells that recharge and recover fresh water to meet seasonal peak, emergency, long-term, or other water needs. Most systems are storing treated drinking water. In Florida there are currently six fully operational systems as shown in Exhibit 1.

EXHIBIT 1 Existing Operational Facilities in Florida	
ASR Facility	Year in Operation
Manatee County	1983
Peace River	1985
City of Cocoa	1987
Palm Bay	1989
City of Boynton Beach	1993
Florida Water Services, Marco Lakes	1998

Several other ASR projects in Florida are various stages of development and are shown, along with the fully operational ones, in Exhibit 2.

EXHIBIT 2 Locations of ASR Facilities in Florida	
Location	Type of Water
City of Bonita Springs	Treated Water
City of Boynton Beach	Treated Water
Broward County	Untreated Groundwater
City of Cocoa	Treated Water
City of Sunrise	Treated Water

EXHIBIT 2 Locations of ASR Facilities in Florida	
Location	Type of Water
City of Delray Beach	Treated Water
Manatee	Treated Water
Marathon and Stock Island, Florida Keys	Treated Water
Marco Lakes, Marco Island	Partially Treated Surface Water
Miami-Dade West and Southwest Wellfields	Untreated Groundwater
Hillsborough County	Reclaimed Water
Palm Bay	Treated Water
Peace River	Treated Water
City of Tampa	Treated Water
City of West Palm Beach	Untreated Surface Water

Of the facilities shown in Exhibit 2, 10 are treated water ASR facilities, 4 are untreated or partially treated (disinfection) groundwater or Surface water facilities, and 1 is a reclaimed water facility. Most of the wells shown are constructed in the limestone formations of the Floridan aquifer.

ASR Well Construction Permitting

ASR wells are regulated under Chapter 62-528, FAC, Underground Injection Control (UIC). The rule was written to protect the quality of the State's underground sources of drinking water and to prevent degradation of the quality of other aquifers adjacent to the injection zone that may be used for other purposes. This purpose is achieved through rules that govern the construction and operation of injection wells in such a way that the injected fluid remains in the injection zone, and that unapproved interchange of water between aquifers is prohibited.

This rule establishes a State Underground Injection Control Program that is appropriate to the hydrogeology of Florida and is consistent with the requirements of the federal Underground Injection Control Program. It is the intent of this Chapter that the injection of wastes underground shall not adversely interfere with any designated use of ground water or cause violations of water quality standards in underground sources of drinking water (USDW). A USDW is defined in the rule as "...an aquifer or its portion: (a) Which supplies drinking water for human consumption, is classified by Rule 62-520.410(1), F.A.C., as Class F-I, G-I or G-II ground water, or contains a total dissolved solids concentration of less than 10,000 mg/L; and (b) which is not an exempted aquifer."

In the rule, ASR wells are classified as Class V, Group 7 - Aquifer Storage and Recovery System Wells. These are defined as "wells associated with an aquifer storage and recovery facility where surface water or ground water is injected and stored for later recovery for potable or non-potable use." Wells used to store and recover effluent or reclaimed water

from a domestic wastewater treatment plant are permitted as Class V, Group 3 wells. Group 3 wells represent “wells which are part of domestic wastewater treatment systems excluding wells which are defined as Class I wells under Rule 62-528.300(1)(a)2., F.A.C., used to discharge effluent or reclaimed water from domestic wastewater treatment facilities”.

To begin construction of a Class V, Group 7 ASR well, a construction permit must be obtained from FDEP that defines minimum standards for well construction and testing. If the water used to recharge and recover from the ASR well does not meet all drinking water standards, more stringent Class I construction standards are enforced. Following FDEP’s review of the permit application, a draft construction permit is issued, and assuming that FDEP and the applicant agree on the permit conditions, a Notice of Intent to issued is prepared by FDEP and advertised by the applicant in a local newspaper. Included in the advertisement is the requirement to hold a public meeting to allow anyone, opposed or wishing to learn more about the permit, to address their questions and concerns. Public notice of the meeting must be at least 30 days prior to the date of the meeting. Assuming there are no public objections, FDEP then issues the final permit and requires the applicant to public notice the issuance of the permit including the opportunity for an Administrative Hearing. Issuance of the construction permit will generally allow the applicant to begin limited recharge and recovery testing on the ASR facility.

After approximately a six-month testing period, the applicant is required to obtain an operating permit from FDEP. This permit provides a basis for full-time operation of the facility and generally requires regular monitoring and reporting. If water being recharged and recovered meets all drinking water standards, only monitoring at the ASR wellhead is generally required. If, however, drinking water standards are not met, then additional monitoring within the ASR zone and many times in the next USDW overlying the ASR zone.

Local Health Departments

Local County Health Departments, local branches of the State Department of Health, are also responsible for permitting the ASR facilities. The mission of the Department of Health is to promote and protect the health and safety of all Floridians. One of their goals is to “...monitor the sanitary status of water and sewage systems”, which historically for ASR systems has been local water utilities. Most of time the local Health Departments permit the ASR facilities to insure that the water being recovered from the ASR well meets all drinking water standards before the water reaches the customers the ASR facility is serving. Either directly out of the ASR well in situations where the ASR facility is in the distribution system (e.g., Cities of Tampa and Delray Beach) or after further treatment at a water treatment plant (WTP) (e.g., Boynton Beach, West Palm Beach, and Miami-Dade Water and Sewer Department).

Water Management Districts

Historically Water Management Districts throughout the State have regulated ASR wells in varying degrees. For example in the St. Johns River Water Management District (SJRWMD) permit ASR as part of Consumptive Use Permitting, but essentially recognize the ASR wells as a “net zero” withdrawal. While at South Florida Water Management (SFWMD), they’ve

just recently begun water use permitting rule making that will include ASR well allocations. Historically SFWMD has only provided the water user with additional allocation from the source water (e.g., Biscayne Aquifer) for ASR recharge and storage purposes by including in their overall allocation, but never issued a specific allocation (i.e., recharge and recovery) for the ASR well.

Additional Permitting Requirements

The above permitting requirements generally apply to almost all ASR applications. According to Chapter 62-520, FAC, water recharging the ASR wells must meet drinking water standards. Therefore, additional permitting provisions are required for ASR facilities that are designed to recharge, store and recover water that may not always meet drinking water standards (DWS) such as raw groundwater, raw surface water and reclaimed water. The following describes some of the additional permitting requirements related to these sources of water.

Water Quality Criteria Exemption

For ASR systems that receive water that does not meet some secondary DWS, a water quality criteria exemption (WQCE) is required. Secondary standards are those water quality parameters that are secondary or aesthetic in nature, and are governed by the State. Secondary DWS for the State of Florida are shown in the following Exhibit 3.

EXHIBIT 3	
Secondary Standards for the State of Florida	
Parameter	Allowed Level
Aluminum	0.2 mg/L
Chloride	250 mg/L
Copper	1 mg/L
Fluoride	2.0 mg/L
Iron	0.3 mg/L
Manganese	0.05 mg/L
Silver	0.1 mg/L
Sulfate	250 mg/L
Zinc	5 mg/L
Color	15 color units (cu)
Odor	3 (threshold odor number [T.O.N.])
PH	6.5 – 8.5 (unitless)
Total Dissolved Solids	500 mg/L
mg/L – milligrams per liter	

For most raw groundwater and surface water ASR systems, a WQCE is required for each parameter that exceeds the standard. The exemption allows the applicant to recharge water into the ASR well even though certain parameters exceed the secondary DWSs, up to a limit generally established based on the highest historic concentration or value detected in the source water. Examples of WQCEs received to date include the City of West Palm Beach, MDWASD, Broward County and Marco Lakes. Exhibit 4 lists some example of the ASR facilities with WQCEs and the limit established for each parameter.

EXHIBIT 4		
Examples of ASR Facilities with Water Quality Criteria Exemptions		
ASR Facility	Exempted Parameter	Concentration Limit
West Palm Beach	Color	90 cu
MDWASD – West Wellfield	Color	60 cu
	Iron	2.0 mg/L
	Odor	6.0 T.O.N.
Broward County	Color	100 cu
	Iron	3.0 mg/l
	Odor	6.0 T.O.N

Limited Aquifer Exemption

Although secondary DWSs are those that are generally only aesthetic in nature, primary DWS are those mandated by the Federal Government and enforced locally by the State. In Florida most of the surface water bodies and some groundwater do not always meet primary standards. The most common primary standard not met is total coliform as a result of the surface and sometimes groundwater being impacted from mammals and birds. In the cases where this has been the only primary standard violation in the source water, two approaches have been taken.

Approaches

In the case of Marco Lakes, at Marco Island, Florida, where surface water is used to recharge the ASR well, a 0.5 mg/L dose of chlorine disinfectant is added to the water stream prior to recharge to kill the coliform. However, depending on the level of organics in the source water this can sometimes cause problems because of the potential for formation of Trihalo-methanes (THMs) which is also a regulated primary standard. In cases such as West Palm Beach, where they examined several disinfectant alternatives including chlorine, chloramines, and ozone, other issues had to also be considered. Issues such as the amount of contact time required for chloramines to kill the coliform, the high operational costs associated with ozone and the potential formation of bromate which is also now a regulated standard as a result of the Stage I Disinfection Byproducts (DBP) Rule.

A second approach is one that both the City of West Palm Beach and MDWASD have taken, and that is applying for a Limited Aquifer Exemption (LAE). The City of West Palm Beach withdrawals water from Clear Lake that has shown regularly to contain total coliform levels above the primary standard of 5% detection of coliform colonies. MDWASD withdrawals water from the prolific Biscayne Aquifer, but because of the location of some of their well-fields in relatively low lying areas of the County, they can be subject to flooding, standing water, and hence potential impacts from coliform present in the standing water.

Historically, MDWASD's West and Southwest wellfields have shown occasionally the presence of low levels of total coliform, just above the standard. Therefore, both of these facilities require the approval of a LAE.

Historically aquifer exemptions have been difficult to obtain because not only do they require the approval of both FDEP and the United States Environmental Protection Agency (EPA), but they've generally been associated with industrial waste injection wells which are generally not perceived as a "beneficial use" of the aquifer. Also, by exempting an aquifer from meeting the required standards, it can appear to open the door for total uncontrolled discharges and hence potential contamination of a USDW.

In response to this generally negative perception of aquifer exemptions, FDEP and EPA, in cooperation with the City of West Palm Beach and MDWASD, have worked together to develop a limited aquifer exemption process. Essentially the LAE is limited both spatially within the aquifer and on the number of water quality parameters it exempts. Both the City of West Palm Beach and MDWASD have submitted applications for an LAE to exempt the Floridan aquifer from total coliforms. They have both received comments and are now in various stages of the Draft Permit Issuance and Public Notice processes. MDWASD has received the draft LAE permit and is currently publicly advertising it. The next step will be to issue a Notice of Intent to Issue and submit it to EPA Region IV in Atlanta for their approval, denial or no comment, which after 45 days by default becomes an approval. After FDEP receives EPA approval, the Final Permit will be issued and again publicly noticed. For West Palm Beach the same sequence applies, however, they have not yet received the final draft permit, but are expected to receive it sometime soon.

Issues

During the FDEP review of both LAE applications, a number of issues had to be resolved regarding:

- the lateral and vertical extent of the exemption within the Floridan aquifer,
- the presence of other users of the aquifer or wells within the exempted portion of the aquifer, and
- the location of monitor wells and extent of the monitoring program.

Monitor wells were required within both the exempted aquifer and in the next productive interval within a USDW above the exempted aquifer, which in both cases was the base of the Surficial Aquifer System (e.g., Biscayne Aquifer in Miami-Dade County).

Of particular interest was the issue related to assurances from both applicants that "...the aquifer within the LAE area is not expected to be used as a source of drinking water" [Chapter 62-528.300(3)(c)(3), FAC]. In Miami-Dade County an Ordinance was approved the County Commission that has since provided the basis for MDWASD's argument that the aquifers in the area of the West and Southwest Wellfield LAEs are not expected to be used a source of drinking water by others.

On the other hand, in West Palm Beach the situation was much more difficult. Just as the City was about to reach closure with FDEP on the review comments, the Town of Palm Beach submitted a Water Use Permit application with the SFWMD to withdrawal water

from the Floridan aquifer in the area of LAE. At the time, the Town had been negotiating a long-term agreement with the City to continue to provide treated water to the Town. However, negotiations had broken down, and in response, the Town proceeded forward with the initial steps toward developing their own source of supply from the Floridan aquifer, along with their own water treatment plant. This created problems not only with a potential revenue shortage for the City, but also with the issuance of the City's much needed LAE. So as a result, the City was required to make sure the negotiations for the long-term water service agreement with the Town was finalized and brought to closure. The Town has since withdrawn their application for water use and FDEP is moving forward with the final draft LAE.

Time Frames

The permitting process surrounding ASR wells is very slow relative to the time it takes to construct these facilities, particularly with the strict UIC rule and exemption requirements. Based on some recent experience with MDWASD and West Palm Beach, Exhibit 5 depicts an example of the approximate time frames to complete the various forms of the permitting processes for the MDWASD West Wellfield ASR Facility.

EXHIBIT 5	
Example of ASR Permitting Time Frames - MDWASD West Wellfield	
Permit	Time Frame
Construction Permit (August 1994 – June 1995)	8 months
Water Quality Criteria Exemption for color, odor and iron	6 months
Limited Aquifer Exemption for coliform (to issuance of final draft permit)	31 months (12 months for MDWASD and 19 months for FDEP)

Since MDWASD submitted a construction permit for the West Wellfield ASR facility in August 1994, we have been seeking various permits from FDEP for 6 years so far, and they are still unable to fully utilize the facility for its intended purpose. It is clear from the above exhibit that both the construction and water quality criteria exemptions were completed in a relatively reasonable time. However, the limited aquifer exemption process has taken much too long to get to where MDWASD is today. In addition, MDWASD still has to wade through the cumbersome process of approval by the EPA, public notices and hearings, which according to FDEP's own schedule could take at least 6 more months – or a total of at least 37 months. This is entirely too long and will continue to be the major hurdle for future ASR facilities unless something is done to streamline the process.

Future of ASR

The future of ASR includes both more traditional treated water ASR systems or expansion of existing ones, and the less traditional, less conventional and proven untreated water systems. With the proposed regional ASR systems proposed in both the CERP and the LEC Regional Water Supply Plan, additional emphasis will need to be placed on the questions and concerns raised by the various peer review committees set up to oversee the CERP and

- A zone of discharge for aquifer storage and recovery wells shall not intersect or include any part of a 500-foot radius surrounding any well that uses the injection-storage zone to supply drinking water without additional treatment.
- The permit applicant shall provide written notice, including specific information about the proposed aquifer storage and recovery project, to each landowner whose wells are within the zone of discharge.

Secondly, one provision relates to the extended time frames of these permitting issues:

- The department shall make a reasonable effort to issue or deny a permit within 90 days after determining the permit application to be complete.

And finally, one provision relates to the ASR well discharge requirements:

- ASR wells that recharge waters from a water body and recover waters of the same or better water quality to the same water body, or a hydrologically-connected tributary or water body within 1,000 feet of the original water body, shall not constitute an addition of a pollutant, and shall not be subject to the National Pollutant Discharge Elimination System permitting program pursuant to Section 403.0885, F.S.

Although the Senate Bill passed, the House Bill was pulled at the last minute due to circumstance external and unrelated to the bill. Although this bill did not pass in 2000, work has begun to reintroduce it into the 2001 session, and sponsors from both the Senate and House are already being identified.

Summary and Conclusions

Aquifer Storage and Recovery (ASR), a proven method of storing and recovering large volumes of treated drinking water, has evolved over the years to include both partially treated groundwater, surface water and reclaimed water systems. Permitting for each of these various ASR projects in Florida has also evolved from simply a construction permit from the Florida Department of Environmental Protection (FDEP) and local health departments, to include Water Quality Criteria Exemptions, Limited Aquifer Exemptions and most recently Risk-Based Assessments.

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Works Cited

South Florida Water Management District, May 2000, *Lower East Coast Regional Water Supply Plan*, presented and approved by the Governing Board of the South Florida Water Management District.

United States Corp of Engineers, July 1999, *Comprehensive Everglades Restoration Plan* (formerly The Restudy), presented and approved by US Congress.