

A First for Florida: Lake Augmentation Integrates Water Reuse and Water Supply

By **Brian J. Megic**, Orlando, Florida, 1-407-587-7873, megic@pbworld.com; **Tim Madhanagopal**, Orange County Utilities; **Gabe Delneky**, Orange County Utilities; and **Wayne A. Mather**, PBS&J

Aquifer recharge proved to be the most viable solution to managing additional supplies of reclaimed water and avoiding or mitigating effects of increasing draw downs on an area's water table and aquifer. The authors tell about a type of aquifer recharge never used in Florida—lake augmentation—and its application to Lake Marden.

In 1997, Orange County expanded the treatment capacity of its Northwest Water Reclamation Facility (NWWRF) (Figure 1) from 3.5 mgd (13 MI/d) annual average daily flow to 7.5 mgd (28.5 MI/d) annual average daily flow. As part of this expansion, Orange County completed a Reuse Feasibility Study that evaluated alternatives to expand the facility's reuse/reclaimed water management capacity to match its treatment capacity. The reclaimed water management system at that time consisted of 13 on-site rapid infiltration basins (RIBs) with a rated capacity of 4.5 mgd (17 MI/d) annual average daily flow, resulting in a 3 mgd (11.5 MI/d) water management capacity deficit (i.e., more treated water was being produced than could be used).

The primary alternatives investigated for using this water were:

- Public access (agricultural or landscape) reuse irrigation
- Aquifer recharge via new on-site RIBs, new off-site RIBs, and the augmentation of Lake Marden.

Alternatives Investigated

Public Access Reuse Irrigation. Orange County first considered agricultural irrigation due to the abundance of nurseries, greenhouses and ferneries in the portion of its service area where NWWRF was located. NWWRF was in a relatively isolated area of unincorporated Orange County, however, and was constrained by service areas of adjacent reclaimed water utilities. It was ultimately determined that the irrigation needs in the area were not sufficient to meet Orange County's entire reclaimed water management capacity deficit.

Aquifer Recharge. Simultaneous to solving its reclaimed water management capacity deficit at NWWRF, Orange County was also keeping an eye on regional water resource issues. Indications were that projected withdrawals from the Floridian aquifer by various water utilities near the NWWRF were going to result in unacceptable drawdowns in the aquifer and the surficial aquifer groundwater table in the same area. These issues became particularly evident when Orange County began to renew its Consumptive Use Permit from the St. John's River Water Management District for the County's Western Regional Water Supply Facility located 3.2 km (2 miles) east of the NWWRF.

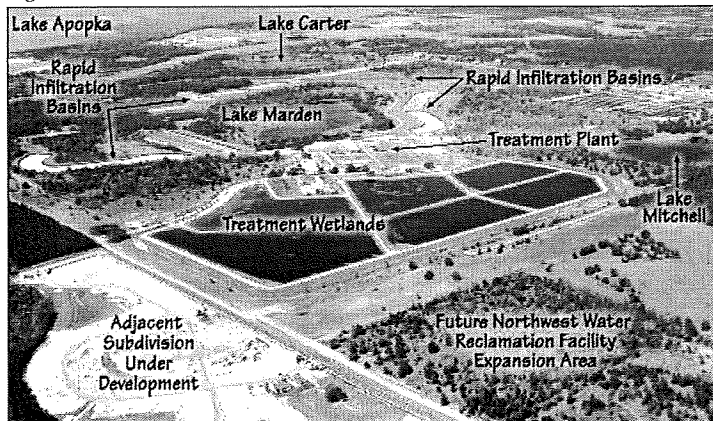
Orange County's independent evaluations of the water resources of east-central Florida indicated that one way to potentially avoid or mitigate these potential drawdown constraints

was to find a means of increasing recharge to the Floridian aquifer. For this reason, and because of the low potential for public access reuse irrigation in the area, the focus for reclaimed water management capacity at NWWRF became aquifer recharge.

One aquifer recharge method examined was the implementation of additional RIBs. However, RIB capacity at the site tends to be constrained because a relatively thin layer of high permeability sands limits the conveyance capacity of the surficial aquifer. It was determined that providing the needed 3.0 mgd (11.5 MI/d) annual average daily flow of additional capacity through RIBs was not feasible. ▶

Acronyms/ Abbreviations	
mgd:	Million gallons per day
MI/d:	Million litres per day
NWWRF:	Northwest Water Reclamation Facility
RIB:	Rapid infiltration basin

Figure 1: Lake Marden.



Another aquifer recharge method examined was to augment the on-site Lake Marden directly as a surface water discharge. Lake Marden is wholly owned by Orange County so it was exempt from federal surface water discharge requirements, making the permitability of the project considerably more feasible than a surface water discharge at a lake not wholly owned by Orange County.

PB teamed with another firm, PBS&J, on the implementation of the Lake Marden Augmentation Project. We performed the groundwater flow modeling of the proposed aquifer recharge project and assisted in the permitting and design of the proposed system.

The results of our ground flow modeling, which were the basis for the design and permitting for the project, indicated that the entire 3.0 mgd (11.5 MI/d) annual average daily flow of needed reclaimed water capacity could be recharged through lake augmentation.

Permitting Challenges

The Lake Marden Augmentation Project was the first aquifer recharge project of its kind in Florida, so obtaining permits for the proposed facilities was one of the most challenging aspects of implementing the project. The Florida Department of Environmental Protection (FDEP) was initially concerned that augmenting a lake that directly recharged the underlying Floridian aquifer, which was the primary source of potable water for the area, would result in adverse impacts to surface and groundwater quality in the area.

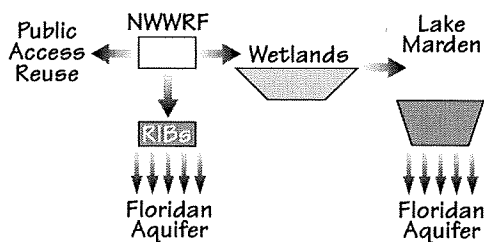
As a result of this concern, the FDEP required the implementation of a constructed wetland treatment system to provide additional nutrient removal (nitrates, phosphorus, etc.) prior to the discharge of reclaimed water to Lake Marden. This wetland system was ultimately located at the top of a large on-site hill primarily comprised of sandy soils. This location was the only portion of the existing property large enough to accommodate the required treatment wetland.

In addition to concerns from the FDEP, nearby homeowners and an adjacent borrow pit/landfill owner protested the county's wastewater operational and environmental resource permits, alleging that the project would increase water levels in the area and potentially inundate their properties. Of particular concern was the location of the proposed wetlands. Local residents were concerned that locating the wetland at the top of a hill comprised of sand would result in reclaimed water seeping out of the wetlands and onto their property.

PB used groundwater flow modeling to develop the preliminary design of a slurry wall within the outer berm of the treatment wetlands to reduce the potential for off-site seepage of reclaimed water. This concept was then included in the final design of the project.

Ultimately in 2003 all permit protests were resolved and the Lake Marden Augmentation Project (Figure 2) received a permit from the Florida Department of Environmental Protection (FDEP) and construction began. Construction was completed in February 2005. At the time of writing in early 2006, an operational load test of the system was underway. Results of the load test are anticipated in 1 to 2 years.

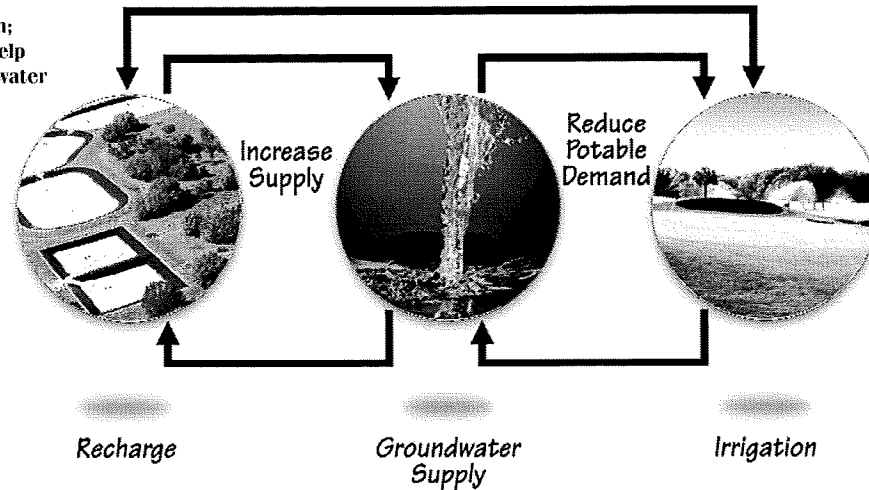
Figure 2: Northwest Water Reclamation Facility (NWWRF) Recharge Flow Diagram



Additional Benefit

In addition to the Lake Marden project, Orange County negotiated additional time and withdrawal capacity in its St. John's River Water Management District consumptive use permit allocation issued in 2000 in return for a commitment to develop and implement a plan to increase recharge (thereby avoiding future potential groundwater drawdowns) in two areas of western Orange County. One of these two areas, which became a special condition of this permit, was between the Western Regional Water Supply Facility and NWWRF. Aquifer recharge projects at the NWWRF are being used to meet this permit condition.

Figure 3: Reuse optimization; recharging the aquifer can help to sustain additional groundwater withdrawals.



Similar Solution to Be Applied Again

In 2003, Orange County performed additional studies to evaluate future phases of expansion at the NWWRF. Once again, alternatives for managing the additional reclaimed water included irrigation, RIBs and lake augmentation as well as groundwater recharge via direct injection, and surface water discharge. Based on these studies, it was determined that the augmentation of nearby Lake Cora Lee and the implementation of new RIBs adjacent to the existing NWWRF property were the most feasible options to further expand the reclaimed water management capacity of the plant while simultaneously meeting Orange County's consumption use permit special conditions.

This phase of expansion is currently (early 2006) under design and being permitted through the FDER. The Lake Cora Lee Augmentation Project is similar to the Lake Marden Augmentation Project, and is again facing challenges from adjacent landowners. The new RIBs are similar to the existing RIBs utilized at the NWWRF. PB is performing the groundwater flow modeling, permitting, design and construction management of both of these expansion facilities.

In summary, an integrated system wide approach to water resources planning helps to facilitate the development of sustainable sources of water as illustrated in Figure 3. ■

Brian Megic, P.E. is a water resources engineer and project manager. In his seven years with PB, he has worked on numerical and analytical groundwater modeling (natural systems analysis and modeling), water resources planning, reclaimed water and water system design, hydrologic design and analyses, pipeline design, environmental permitting, and civil engineering design.

Tim Madhanagopal, P.E., Diplomat of Environmental Engineering (DEE) has been the plant manager of Orange County Utilities' Eastern Water Reclamation Facility and Northwest Water Reclamation Facility for the past eleven years.

Gabe Delnecky, P.E. is a chief engineer for Orange County Utilities and has worked as a wastewater engineer in central Florida for more than 20 years.

Wayne Mather, P.E., DEE, has been working as an environmental engineer for 39 years, predominantly in central Florida, and is an associate vice president with PBS&J.

