Memorandum

MIAMI-DADE COUNTY

Date:	May 5, 2009
To:	Honorable Chairman Dennis C. Moss and Members, Board of County Commissioners
From:	George M. Burgess County Manager
Subject:	Feasibility Study of Capturing, Storing, and Treating Water from the Canal System for Replenishing the Aquifer as Part of the County's Water Supply Plan

Agenda Item No. 12(B)1

On December 2, 2008, the Board of County Commissioners adopted Resolution No. R-1376-08 as amended.

Resolution No. R-1376-08 directed the County Mayor to conduct a feasibility study of capturing, storing and treating water from the canal system prior to its discharge to Biscayne Bay for replenishing the aquifer and for irrigation purposes as part of the County's water supply plan.

The resolution was amended to extend the due date from 90 days to five (5) months.

Attached for your review please find the Feasibility Study of Capturing, Storing, and Treating Water from the Canal System for Replenishing the Aquifer as Part of the County's Water Supply Plan.

This study was generated by DERM with contribution from the Water & Sewer Department.

Assistant County Manager

Feasibility Study of Capturing, Storing, and Treating Water from the Canal System for Replenishing the Aquifer as Part of the County's Water Supply Plan

On December 2nd, 2008 the Board of County Commissioners approved Resolution R-1376-08, directing the Mayor to conduct a feasibility study of capturing, storing and treating water from the canal system prior to its discharge to Biscayne Bay for replenishing the aquifer and for irrigation purposes as part of the County's Water Supply Plan.

Background

Water plays a critical role in the health and welfare of Miami-Dade County residents and in sustaining our sensitive natural resources. Too much water in the wrong place at the wrong time can result in flooding and property damage, while too little water can threaten water supplies and lead to salt intrusion with adverse impacts to groundwater resources.

Managing water levels in Miami-Dade County is accomplished through a network of primary canals maintained and operated by the South Florida Water Management District (SFWMD), and smaller secondary canals that are maintained and operated by Miami-Dade County. The system is driven by local and regional precipitation and associated water management practices. The system is managed to provide flood protection for residents and businesses while also maintaining adequate ground water levels to protect water supply from salt intrusion. Water management is achieved through use of a series of water control structures located along major canals that allow water managers to adjust water levels by draining water to the Biscayne Bay. During the rainy season, Miami-Dade County receives significant precipitation that results in increased groundwater and canal water levels. As the wet season progresses, ambient groundwater levels continue to increase and typically reach a seasonal high in October at the end of the wet season. Throughout the dry season, groundwater levels gradually decrease typically reaching their lowest levels in April immediately prior to the next approaching wet season. Any time water stages increase to critical levels that can threaten properties with flooding, water in the system must be removed. This can occur frequently throughout the wet season following storms or significant rainfall.

The highly seasonal variability of South Florida rainfall patterns presents great challenges in regional water management. Prior to urbanization and the associated drainage improvements necessary for development, much of the natural areas within the region were comprised of wetlands and low lying sloughs. These vast natural areas provided water storage and treatment, and also moderated the timing of water flowing through the system and into Biscayne Bay. The natural system was able to absorb sudden and often dramatic increases in water levels following significant rainfall in the wet season. Surface waters would slowly filter through wetlands and sloughs eventually flowing to Biscayne Bay. Wetland habitats and Biscayne Bay came to depend on this source of freshwater for their continued viability. However, with today's urbanized setting in Miami-Dade County, water levels must be highly managed within much narrower tolerances in order to protect residents and their property. Water that once naturally accumulated on land areas and then slowly flowed into Biscayne Bay must now be quickly drained from canals in order to protect properties from flooding. This water management practice can give the impression that these flows represent "excess" or "unused" water. However, while the timing and delivery of this water may not accurately represent historical natural patterns, the source of this freshwater has always been a necessary part of the overall water budget for Biscayne Bay. This challenges water managers to control water levels to

protect residents and property, while also assuring that adequate timing and distribution of freshwater flows are available for coastal wetlands and Biscayne Bay.

County Study Area

As part of this feasibility study, consideration was given to the various components necessary for capturing, treating, and storing canal water, as well as the availability of the water itself. The study area includes urban landscapes, wellfield protection areas, wetlands and agricultural lands. A large portion of the area in the south and western portions of the County are currently included in the Comprehensive Everglades Restoration Plan (CERP). The overarching goals of CERP aim to address improvements in water quantity, quality, distribution and timing of deliveries for both natural systems and human water supply needs through extensive land acquisitions, storage and treatment systems, and conveyance features. A major focus of the Comprehensive Everglades Restoration Plan is to "get the water right." For Biscayne Bay, too much water in the wrong place at the wrong time can lead to negative impacts from sudden decreases in salinity. Not enough freshwater flowing to the Bay can result in losses of nearshore estuarine habitats that are critical to sustaining the health of the Bay and its fisheries resources. As a result of extensive analysis, CERP project managers have developed recommended performance measure targets for freshwater flow deliveries to Biscayne Bay. CERP targets recommend that freshwater discharges to south Biscayne Bay and through the Miami River be increased, and that current freshwater discharge levels to northern portions of the Bay such as the Snake Creek and Oleta River areas be maintained. In particular, project objectives for the CERP Biscayne Bay Coastal Wetlands (BBCW) Project in southern Miami-Dade County include providing a more natural scheme of freshwater delivery to the Bay, including distribution of larger volumes of water through coastal wetlands, to establish a more stable, lower salinity pattern in the nearshore areas of south Biscayne Bay. Because of the additional water needed to achieve these CERP restoration goals in southern portions of the county, many Miami-Dade canals would not be good candidates for additional aquifer recharge or other consumptive uses such as irrigation projects.

Discussion of Potential Alternatives

This feasibility study considered three main approaches to address opportunities for the capture, storage and treatment of canal water for aquifer recharge and irrigation purposes. They include modification of Canal Stage Levels in primary and/or secondary canals, developing Stormwater Treatment Areas (STA), and creation of Aquifer Storage and Recovery (ASR) wells. Each of these approaches is also considered as part of CERP restoration alternatives, although they are more focused in achieving ecological restoration goals associated with freshwater deliveries to coastal areas and Biscayne Bay. Due to the highly seasonal rainfall patterns experienced in Miami-Dade County, the ideal alternative would allow for collecting water during wet periods and storing it for use during drier periods. A qualitative matrix analysis approach was used to identify and rank alternatives. Criteria included land availability, regulatory constraints, impact on flood protection, impact on water quality, ecological impacts, economic impacts, land acquisition, and construction, operational and maintenance costs.

I. Modification of Operational Criteria for Canal Stages

This approach would involve modifying operational criteria for water management structures to increase groundwater and canal stages to provide additional storage capacity. Raising groundwater

stages within specific portions of the County is contemplated as part of CERP. However, this approach is mainly being considered for hydrologic improvements that are geared toward ecological restoration in select areas, rather than for aquifer recharge or additional consumptive uses. The main drawback for any large scale application of this approach is the negative impact on flood protection. As canal levels rise, there is an expected and corresponding decrease in flood protection. With higher groundwater and canal stages, the effectiveness of existing french drain systems that are typically used for stormwater protection would also decrease. During periods of heavy rainfall, which could ideally be regarded as the time when the greatest volume of surface runoff can be collected, this type of operational change would result in reduced flood protection that may result in property damage within urbanized areas due to flooding. In addition, simply raising canal stages would not address water quality treatment, therefore costs associated with treatment requirements must also be considered. Most importantly, any consideration for modifying canal stage operational criteria would require full review and approval by state and federal water managers. Due to the higher risk for causing extensive flooding, this alternative is not considered to have a strong implementation potential for aquifer recharge at this time.

II. Stormwater Treatment Areas (STA)

The construction of Stormwater Treatment Areas (STA) is another alternative that may be considered to capture, store and treat water from the gravity-driven canal system. STAs are typically constructed in wetland areas with infrastructure such as pumps and water control structures added to deliver water to these areas from neighboring canals. Water quality treatment is achieved by natural processes through direct contact with wetland soils and vegetation. STAs can be very effective at water quality treatment. However, water storage capability for the purposes of this study is somewhat limited. Water delivery and water levels must be closely managed so as not to damage the wetlands resources that are providing water quality treatment. Because water levels within STAs must be closely controlled, the ability of STAs to store large volumes of excess water for any extended period of time is also limited. Furthermore, water levels within STAs would be affected by direct rainfall, and thus their capacity for storage of additional water would also be reduced. For these reasons, larger parcels of land would be necessary to achieve greater storage capacity. Because of the porous nature of our local geology, water levels within these areas would also be directly affected by seasonal groundwater fluctuations. As surrounding groundwater levels decrease during dry periods, water levels within the STA would also decrease. All of these factors would severely limit the amount of water that could be collected and stored during wet periods, yet still be available for aquifer recharge at a later date during dry periods. Other challenges for this alternative include the cost and availability of large parcels of lands in strategic locations (i.e. adjacent to canals).

III. Aquifer Storage and Recovery Wells

Aquifer Storage and Recovery (ASR) wells are used for the storage of water in an aquifer when water is readily available and the recovery of that water through the well when additional water is needed. The concept for use of ASR wells within Miami-Dade County would be to capture freshwater during wet periods and store it in the deeper Floridan Aquifer for later recovery. Use of the Floridan Aquifer could allow for storage of freshwater to occur without affecting water supply in the shallower Biscayne Aquifer, our primary source of drinking water. ASR wells seem to offer a viable opportunity for freshwater storage. Unlike other alternatives such as raising canal stages or using STAs which both have physical and practical limitations on the volume or duration of water storage for later use, ASR wells would allow freshwater captured during our seasonally wet periods

to be available months later when needed during dryer periods. By design, ASR wells alone would not provide water quality treatment. However, they could be paired with other features such as an STA in order to achieve both water quality treatment as well as storage. In addition to the cost of constructing, implementing and maintaining the necessary infrastructure, land availability, acquisition costs (including lands necessary for water quality treatment options), as well as any regulatory requirements must also be considered. Typical ASR well construction and testing costs are in the range of approximately $500,000 to $1,000,000 per million gallons/day (MGD) of water storage.

The Miami-Dade Water and Sewer Department (MDWASD) has constructed 5 ASR wells, three at the West Wellfield and two at the Southwest Wellfield. MDWASD is currently constructing ultraviolet treatment facilities at both wellfields to be able to treat the water prior to injection into the Floridan Aquifer for storage. Federal and state regulations require that the water meet primary drinking water standards prior to injection. MDWASD will be working with the SFWMD to establish the conditions, during the wet season, when water can be withdrawn from the Biscayne Aquifer and stored in the Floridan Aquifer. The stored water will be recovered in the dry season to reduce the stress on the Biscayne Aquifer. It is anticipated that MDWASD will start operational testing of these wells at the end of this year.

Conclusions

Water from the gravity-driven canal system can be captured for storage in various ways. However, changes in operational practices associated with increasing water levels (stages) in all canals, creation of Stormwater Treatment Areas, or the widespread implementation of Aquifer Storage and Recovery wells, are not anticipated to provide a comprehensive solution to the overall County water supply and consumptive use strategy. Analysis of implementing operational changes in canal stages shows that except in very limited situations as may be contemplated for restoration activities under CERP, increases in canal levels would result in substantial reductions in flood protection, would negatively impact stormwater collection and drainage infrastructure levels of service, and would increase the risk of damage to urbanized areas due to flooding. The construction of STAs may provide water quality treatment options, but would have limited applicability for storage of water volume or for durations necessary to achieve affective and meaningful aquifer recharge needed later during dry periods. The use of ASR wells seems to offer the most viable option for effective freshwater storage in limited applications. ASR wells could be paired with water quality treatment features to address both treatment and storage requirements.

It is important to note that while it may be physically feasible to employ some of these techniques to capture, store and treat water from the canals system for aquifer recharge, irrigation or other consumptive uses, it is not clear that this approach represents a sustainable strategy for additional water supply. The need for increasing or at least maintaining current levels of freshwater flow to various portion of Biscayne Bay has been identified by CERP project managers. This would limit opportunity for use of additional canal water for these purposes. Further study and modeling would be required prior to any substantial consideration of reductions in freshwater discharges into Biscayne and Florida Bays.