Do You Happen to Have a Place to Store 500 MG of Reclaimed Water?

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The Pasco County Master Reuse System (PCMRS) is an example of a system that must balance its dry weather demand with wet weather excess flows. The way Pasco County plans to achieve this balance is through the addition of the 500 mil gal (MG) Boyette Road Reclaimed Water Reservoir. The vision for the PCMRS, which beneficially reuses about 20 MG of water daily that's provided by seven wastewater treatment facilities, is to grow the system to serve over 25,000 residential customers over a 352 sq mi (912 sq km) service area. The PCMRS does not have a surface water discharge to help balance wet weather flows; all of the water that comes to the PCMRS is beneficially reused via Part III (unrestricted access), Part IV (rapid rate infiltration basin system, or RRIBS), or Part II (sprayfield).

Currently, about 12,000 residential customers are serviced by the PCMRS, in addition to golf courses and other bulk users of irrigation water, and one industrial facility, as shown in Figure 1. For the PCMRS, the Boyette Road Reservoir is an integral aspect of the growing system, both for flow equalization to meet customer demand and for meeting water quality requirements in the future.

For the reservoir to be a successful project, it must both be safe and effective. Safety includes considerations in design, construction, and operation; effectiveness includes maintaining water quality and operability. Some of the concerns that were tackled during design included off-site seepage and other technical considerations, including water quality. As the reservoir is completed, it is also envisioned that it will become the center of the PCMRS, serving as the main source (pressure and water) for the distribution system, as well as being the receiver of highly treated effluent before it goes out to users. This philosophy requires a change in the operational strategy for the PCMRS and this article examines some of the design considerations of the reservoir, as well as how the operational strategy is affected by the addition of the reservoir to the system.

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Design Considerations

The design of an off-stream pumped reuse water storage reservoir typically incorporates the containment of water, the management and prediction of seepage, the operational safety of the embankment or dam during filling and drawdown cycles, and the attainment of long-term operation and maintenance goals of the system. These reservoir design considerations were the key objectives during the design phase. A unique aspect of this project is that CH2M joined the project as a successor engineer; at that time, the original reservoir design was nearly complete. The firm's first task was to assess the original design to provide recommendations. During the assessment phase, there were two main areas where more conservativism was recommended. The first was related to the seepage cut-off design, and the second was the requirement to use select fill on-site to construct the reservoir embankments. Conceptual improvements to enhance the ability of the reservoir, when constructed, to meet the County's long-term operational goals for a reliable reuse water storage facility, were considered.

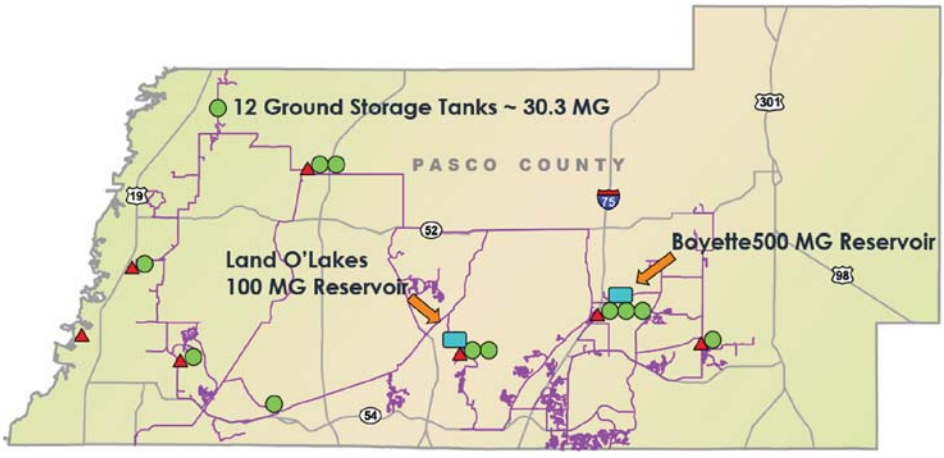

Figure 1. Pasco County Master Reuse System (Triangles represent wastewater treatment plants; circles, existing storage tanks. Pipes are in purple.)

Seepage Management

The site for the reservoir is unique for two reasons. First, it's an abandoned borrow pit that was partially excavated. Secondly, it is a regional topographical high point for the area, with all of the surrounding ground at a lower elevation.

In the intervening time between the original design and the CH2M assessment, there was a residential development constructed directly south of the reservoir site. This 700-plus home community had houses at elevations near 122 ft (all elevations are in NGVD1929). The design pool elevation for the reservoir is 136 ft. With the mixture of soils, including transmissive sandy soils, CH2M was concerned that the lack of a complete cut-off wall could result in seepage to these homes. Figure 2 details a cross section of the reservoir area, including the general elevation of the houses to the south.

Enhanced seepage management through the use of a seepage cut-off wall bridges the design gap between the upstream geomembrane erosion control lining and the clay layer lying between 50 and 60 ft below grade, thus creating a "bathtub" that significantly reduces the seepage out of reuse water and infiltration into the reservoir of the surficial groundwater, thereby maintaining storage volume. Adding the cut-off wall and tying the original erosion protection geomembrane into the cut-off wall creates a sealed reservoir to effectively manage seepage.

Seepage Cut-Off Wall

The seepage cut-off wall technology chosen for this project was trench remixing and cutting deep wall (TRD). This method mixes the soils in place, using an apparatus that cuts into the ground like an oversized chainsaw. While mixing, the apparatus also adds portland cement and bentonite and creates a homogenous mixture throughout the entire machine depth. Figure 3 shows the TRD wall installation at the Boyette Reservoir, and Figure 4 shows the head of the completed TRD wall on-site.

Because the site was an existing borrow pit, there was a considerable amount of water on-site before construction. It was not envisioned that the contractor could fully dewater the site, and some "in the wet" construction was expected. However, through means and methods, the contractor was able to dewater the site lower than the 122 ft assumed in the design. This opened up some value-added construction items that would not have been possible had the site remained wet.

Trench Remixing and Cutting Deep Wall Tie-In

One of the critical components of the reservoir is how the geomembrane ties into the TRD wall. A floating connection was considered the most robust connection method. Because of the concrete and bentonite added to the admixture in the TRD installation, there was about 50 percent more mixture that could fit in the wall profile. One of the management techniques on-site for these spoils is to excavate the upper 10 ft on both sides of the wall and have a wider TRD wall at the top, which left a "hammerhead" at the top of the TRD wall (Figure 5). This wide area created an ideal platform for the floating connection. The connection is layered, with bentonite powder on the bottom forming a seal and the geomembrane laid on top. Then, the geomembrane is covered with a geosynthetic clay liner (GCL) with 10 in. of compacted soil on top. To protect the compacted earth from upstream erosion over time, a geotextile is anchored on it before 12 in. of flowable fill is poured on top to protect the entire system. This system will maintain a water-tight connection between the geomembrane and the TRD throughout the project design life.

Embankment Construction with Select Soils

The soil profile at the Boyette Reservoir site is somewhat unusual for this area of Florida, which has significant clay composition. The original design called for the use of select clayey soils in construction of the embankment core. With the addition of the TRD and the tie-in of the geomembrane, the embankment is isolated from the pool water, which reduces the phreatic water levels within the embankment. During construction, this allowed the use of all on-site materials as engineered fill to build the earthen embankment, without the need for segregation of the on-site materials, e.g., clayey soils, to reduce the seepage through the embankment.

Operational Considerations

The reservoir is designed to allow the pool elevations to fluctuate from a maximum of 135.5 ft to a minimum elevation of 114 ft, corresponding to the designed depth of excavation and operational bottom of the reservoir. The anticipated operational scenario is filling during the summer (wet) months and draining during the winter (dry) months. Operational considerations were also studied during design, e.g., maintaining the pool elevation above122 ft; the TRD tie-in elevation; anticipated heavy wind conditions, such as hurricanes; and not maintaining the pool stationary below the elevation of 122 ft, but to either fill or discharge within this zone of pool elevations.

The original design included a low-pressure pump system to transport water out of the reservoir to a nearby wastewater treatment facility for

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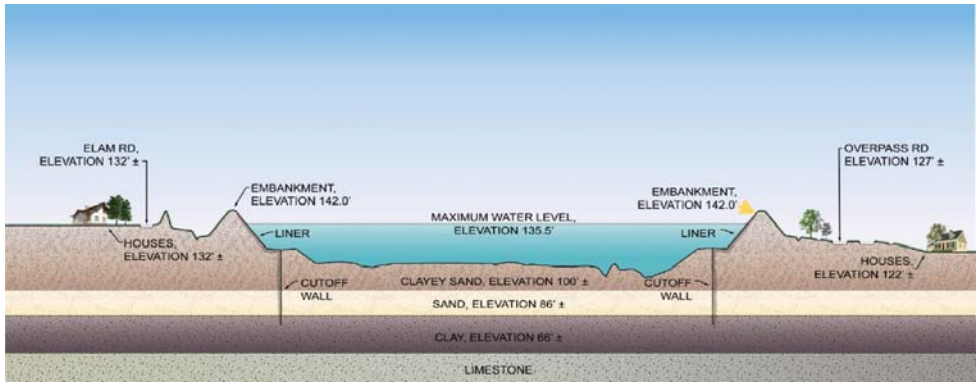

Figure 2. Reservoir Cross Section (North is to the left, south is to the right.)

Figure 3. Trench Remixing and Cutting Deep Wall (TRD) Installation

Figure 4. Trench Remixing and Cutting Deep Wall (TRD) Completed On-Site

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entry into the PCMRS. During the design and construction of the reservoir, the County was concurrently undergoing master planning activities with corresponding PCMRS model updates. Ultimately, it was recommended that the reservoir instead have a high-service pump station and discharge directly to the PCMRS.

To achieve this, three 100-horsepower (hp) pumps were replaced with three 500-hp variable frequency drive pumps, which was nearly enough pressure to drive the entire PCMRS. Because the PCMRS receives highly treated effluent from seven wastewater treatment facilities, management of the system is challenging. With the high-service pump station at the reservoir, the new operational strategy will be to bring all water to, and discharge all water from, the reservoir using the existing ground storage tanks to supplement the system. This will simplify operations and reduce cost, as the majority of reclaimed water customers are located near the reservoir.

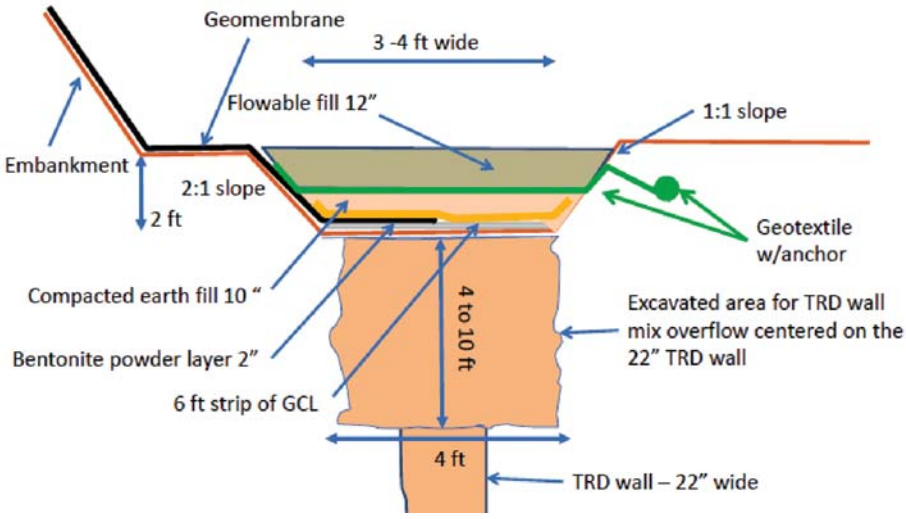

Figure 5. Trench Remixing and Cutting Deep Wall (TRD) – Geomembrane Connection

Conclusion

Not every reclaimed water system needs a 500 MG reservoir; however, the vision of the PCMRS is to continue operations without a surface-water discharge. To achieve this, the County must grow the residential customer base for reclaimed water. While the system has about 12,000 residential users today, the plan is for over 25,000 residential reuse customers. In the meantime, the County needs the reservoir to manage wet weather flows. However, as the County continues to grow, the reservoir will eventually switch from a wet weather flow management tool to a residential user supply source that will allow the PCMRS to grow well into the future.