Can Reclaimed Water to Wetlands Serve as Alternative Wet Weather Discharge?

Brendan Brown, Lee Wiseman, Danielle Honour, and Benjamin M. Hayner

Wetland Application Systems as Reuse

In the state of Florida, the application of reclaimed water to wetlands qualifies as "reuse" under 62-610.810(2)g, Florida Administrative Code (FAC), when the project creates, restores, or enhances wetlands. Throughout Florida, these systems either supplement existing disposal locations or receive 100 percent of the discharge from the reclamation facilities (Figure 1). The application of reclaimed water to wetland systems is regulated pursuant to Chapter 62-611, FAC, which is known as the wetland application rule. These systems can provide multiple benefits to reclamation facilities and provide an additional reuse option.

Wetland Application Rule

The wetland application rule defines the quality and quantity of wastewater applied to wetlands, the quality of water subsequently discharged from these wetland systems, and the monitoring required for permit compliance. Pursuant to this rule, wetlands are categorized as natural receiving wetlands, natural treatment wetlands, hydrologically altered wetlands, or man-made treatment wetlands. The regulatory requirements of the reclaimed water quality discharged to and from the wetland, the hydraulic loading rates, and monitoring vary according to the wetland category. In general, wetland application systems constructed using man-made and hydrologically altered wetlands are allowed to receive more water with higher nutrient loads for a given area than systems using natural, unaltered wetlands. Less monitoring is also required for systems using man-made and hydrologically altered wetlands compared to natural wetlands.

The use of wetland application systems is not permitted within outstanding Florida waters, Class I (potable water supplies) or Class II (shellfish propagation or harvesting) surface waters, or unaltered herbaceous wetlands unless the entire wetland has greater than 50 percent coverage of cattail (*Typha* spp.) or other nuisance exotic vegetation species. Also, reclaimed water to wetland systems cannot have adverse effects on endangered or threatened species.

Brendan Brown, PWS, is an environmental scientist; Lee Wiseman, P.E., BCEE, is an associate water resource engineer; and Danielle Honour, P.E., DWRE, is principal water resource engineer with CDM Smith in Maitland. Benjamin M. Hayner, P.E., is engineering division manager with City of Cocoa.

Pursuant to the wetland application rule, annual average hydraulic loading rates cannot exceed 2 in. per week, except in hydrologically altered wetlands (where the annual average hydraulic loading rate cannot not exceed 6 in. per week). This 2-in. annual average loading rate is equivalent to the application of 1 mil gal per day (mgd) of reclaimed water to 130 acres of wetlands; however, once the system is operational, this limit can be increased based on operational performance data.

Wetland Application Benefits and Challenges

While wetland application systems require

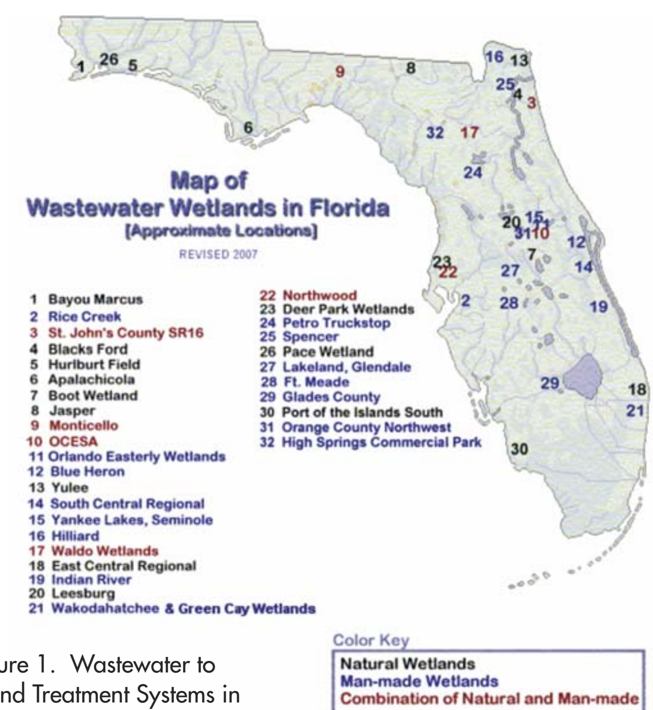

Figure 1. Wastewater to Wetland Treatment Systems in Florida as of 2007 *(FDEP, 2016)*

Figure 2. Emerald Coast Utility Authority Bayou Marcus Wastewater to Wetland Treatment System

upfront design and capital costs, once operational, the cost–benefit ratios are favorable and decrease with time. The initial costs include feasibility studies, hydrologic and hydraulic (H/H) modeling, background wetland monitoring, permitting, preliminary and final design, operations and maintenance, property ownership/agreement(s), opinion of probable costs, funding, and construction. Wetland application systems can benefit reclamation facilities by providing alternative disposal locations, higher levels of treatment, and operational flexibility by providing an alternative disposal location from direct point discharges to rivers, bays, lakes, and lagoons.

Wetland application systems can also receive and treat reclaimed water under wet weather conditions when other reuse alternatives have lower demand (Figure 2). Even in areas with a high percentage of traditional reuse, such as in central Florida, wetland application systems are a vital component of many reclamation facilities. Approximately 100 mgd are successfully treated by wetland application systems every day in central Florida, according to the Florida Department of Environmental Protection (FDEP, 2017), with an average system capacity of 9 mgd.

Typically, wetlands application can enhance treatment by reducing nitrogen, carbonaceous biochemical oxygen demand ($CBOD_5$), and sometimes phosphorus, thereby helping to protect surface water resources that are part of alternative water supplies by reducing nutrient loads to these receiving surface waters. Reclaimed water to wetland projects can be eligible for grant funding and provide opportunities to partner with multiple agencies, while improving water quality.

Figure 3. City of Cocoa Jerry Sellers Water Reclamation Facility Proximity to Indian River Lagoon and 166-Acre Conservation Area Property

Total Maximum Daily Loads

Reduction of discharges to surface waters has become a focal point to improved water quality in Florida with the establishment of total maximum daily loads (TMDLs) and the implementation of Florida's numeric nutrient criteria standards. The required reductions assigned under a TMDL can result in significant reductions in wasteload allocations to point source discharges, such as municipal water reclamation facilities. This can present challenges to municipalities meeting water quality standards and limiting discharges to impaired surface waters.

The application of reclaimed water to wetlands can help reclamation facilities adapt to changes in wasteload allocations (WLAs) associated with TMDLs by providing an alternative discharge location under wet and dry weather conditions, while also providing a higher level of treatment prior to discharge. These wetland systems can be incorporated into existing ones to provide wet weather backup and additional operational flexibility. Due diligence should be performed to identify any impaired waters downstream of a proposed wetlands application system.

Antidegradation

Florida's antidegradation policies are a component of its water quality standards that function to prevent the degradation of the state's waters (Chapters 62-302.300 and 62-4.242, FAC); therefore, FDEP cannot permit a project that "*will reduce the quality of the receiving waters below the classification established for them.*" Thus, a permit applicant must first demonstrate that the proposed project will not degrade water quality within the receiving water.

While a wetland application system can meet background concentrations when sized and designed correctly, net nutrient loading can increase due to the additional hydraulic and nutrient loads added to the systems; however, there are several provisions within the water quality standards that allow for new or expanded discharges when the discharge is in the public interest. Therefore, if wetland application systems cannot demonstrate no degradation of surface waters, it still may be possible to permit these types of projects when they work to reduce total nutrient loading to sensitive waterbodies and are in the public interest because they benefit the environment, wildlife, and recreational value of Florida's waterways.

Wetland Application System Evaluation

Every water reclamation facility has its own unique operational constraints, effluent treatment levels, water quality requirements, and reuse options. Wetland applications may not be able to provide the necessary level of treatment or be able to receive the necessary volume of flow that is required by a reclamation facility; therefore, feasibility studies should be used to determine if a wetland application system could meet the particular needs of a reclamation facility.

Continued on page 40

Continued from page 39

Feasibility studies can determine if a particular site is suitable or assess the best site from several possible alternatives prior to moving into the design phase. These studies are vital to identifying critical success factors and typically include evaluating the extent of the wetlands and uplands onsite, background water quality, protected species concerns, preliminary hydraulic and nutrient modeling, potential offsite impacts, and permitting feasibility. Identifying the nutrient that requires the greatest wetland area for treatment is important in a feasibility study to determine if pretreatment is necessary. Often, phosphorus is the nutrient that requires the greatest area for treatment in wetland application systems. Pretreatment to reduce the concentrations of phosphorus prior to wetland application can help the overall performance of wetlands from a water quality perspective. Information gathered in a feasibility study is then used to determine how much reclaimed water could be treated by a wetland application system pursuant to Chapter 62-611, FAC, for a particular site.

Determining if the wetland application system can meet the requirements of state and federal permitting is also a vital component of a feasibility study. Several state and federal permits are typically required to implement a wetland application system, including modification to a reclamation facility's National Pollutant Discharge Elimination System (NPDES) wastewater discharge permit, a state Environmental Resource Permit (ERP), and a U.S. Army Corps of Engineers (USACE) 404 (dredge and fill) permit. The ERP program regulates any project that changes the landscape affecting surface water flows and/or wetlands and generally restricts the increase of offsite flood stages under various storm events.

The components of the ERP program include stormwater and wetland impact evaluation. Wetland application projects permitted under the ERP program must meet the management requirements for surface waters regulated under Florida Statutes, sections 373.403 to 313.468.

Figure 4. City of Cocoa Property Considered for a Wastewater to Wetlands Treatment System

City of Cocoa Objectives and Goals

The City of Cocoa's (city) Jerry Sellers Water Reclamation Facility (WRF) is currently permitted to discharge 4.5 mgd annual average daily flow using a slow-rate public access irrigation reuse system. The typical annual average daily reclaimed water flow from the WRF is approximately 2 mgd and the facility has a permitted wet weather discharge of 0.99 mgd annual average daily flow to the Indian River Lagoon (IRL).

A TMDL was established for the IRL in 2009 by FDEP. The IRL's TMDL identifies nutrients and dissolved oxygen (DO) as the parameters of concern that have contributed to the excessive loss of seagrasses within the IRL system. Required reductions for both point and nonpoint source loads in the IRL system are addressed by the TMDL. As part of the TMDL, existing permitted WLAs were modified by FDEP to point source discharges into the IRL. As a result, the city's WRF NPDES Permit No. FL0021521, identified as a major point source discharge, had its previous WLA adjusted by FDEP, as follows:

- Permit annual load for total nitrogen (TN) – reduced from 41,007 lb/yr to 5,556 lb/yr (86.5 percent reduction)
- Permit annual load for total phosphorus (TP) – reduced from 13,669 lb/yr to 1,423 lb/yr (89.6 percent reduction)

Once the TMDL was adopted by FDEP, the city's wastewater facility permit was subsequently modified to reflect these more-stringent WLA limits. The city has proactively worked to eliminate some of the wet weather discharge to the IRL though alternative disposal methods (e.g., temporary storage in the Bracco Reservoir system and recovery of the reclaimed water for reuse when needed) that would help the city in meeting its reduced WLA.

The city wanted to evaluate the feasibility of implementing a wetland application system that could serve as an alternative wet weather discharge location to further reduce its discharge to the IRL (Figure 3). The potential system would need to be able to receive and treat approximately 0.5 to 1 mgd of advanced wastewater treatment (AWT)-quality reclaimed water ($CBOD_5$ = 5 mg/L, total suspended solids (TSS) = 5 mg/L, TN = 3 mg/L, and TP = 1 mg/L).

City of Cocoa Site Evaluation

The city identified a 166-acre parcel that it

Continued on page 42

Continued from page 40
owned (Figure 4), with natural wetlands and uplands known as the City of Cocoa Conservation Area (site), that could potentially serve as an alternative wet weather discharge location. A feasibility study was conducted by CDM Smith to determine if the site wetlands could accept reclaimed water under the wetland application rule. The feasibility study included evaluation of wetland and upland extents, wetland conditions, H/H constraints of the site and downstream receiving waters, background water quality and quantity, analysis of hydraulic and nutrient loading, regulatory permitting, and initial consultation and coordination with regulatory agencies.

Site Assessment

Site data were collected, including limited topographic survey data, surface water elevation data, and background water quality data, in support of H/H modeling and wetland treatment performance evaluation. A wetland assessment was conducted to determine the extents and conditions of the site wetlands, as well as to confirm tributary areas and surface water flowpaths through the site. During field visits, the natural vegetative communities were mapped and evaluated concerning the potential for protected species to occur within the parcel.

Topographic Survey

Topographic survey data were collected along select transects to capture wetland and floodplain elevation information. A survey reconnaissance was also conducted to determine downstream flowpaths leaving the site. Surface flows from the site discharge to offsite wetlands, and then to ditches and canals, which eventually flow into Lake Poinsett. The topographic survey also included onsite culvert inverts and diameters, and offsite (downstream) culvert inverts and diameters, for incorporation into the H/H model. Staff gauges and water level data loggers were installed and surveyed at two locations within the site wetlands to evaluate wetland hydroperiods and provide site data for H/H model calibration. Seasonal high-surface water elevations and normal pool elevations were field-marked and surveyed in support of the wetland assessment.

Water Quality

Surface water quality samples were collected from a stream channel, which flows through the site wetlands, on four separate dates representing wet season and dry season conditions. Water samples were collected at the downstream discharge point from the site and near an upstream discharge point to the site wetlands. Samples were analyzed for ammonia as nitrogen, nitrate as nitrogen, nitrite as nitrogen, total Kjeldahl nitrogen (TKN), TN, TP, $CBOD_5$, TSS, and fecal coliform. These background water quality data were incorporated into the nutrient model.

Figure 5. 2016 Photo of the Wetlands at the Cocoa Site Showing the Dominant Canopy Species

Wetland Types and Extents

The site wetlands consist of a mix of forested and scrub shrub wetlands that would be classified as natural woody wetlands under the wetland application rule. The dominant canopy species throughout the forested wetland is red maple (*Acer rubrum*), shown in Figure 5. Wetland groundcover consists primarily of wetland ferns, including royal fern (*Osmunda regalis*) and swamp fern (*Blechnum serrulatum*).

Normal pool elevations were generally 2 to 6 in. above ground surface, while seasonal high water levels ranged from 1 to 2 ft above land surface. While approximately 112 acres of wetlands cover the site, it was determined that the entire area of wetland acreage would not be useable for treatment due to topography and preferential flow paths towards a stream that runs through the site. Within the site, there were 91 acres of wetlands that could provide treatment as part of a wetland application system. These 91 acres were subdivided into four wetland treatment areas (WTA) for wetland treatment performance modeling (Figure 6). Subdividing the total wetlands area allowed for a more detailed evaluation of wetland treatment area performance, including a more robust evaluation of potential hydraulic impacts.

In support of the evaluation, potential locations of reclaimed water application were identified. These application locations provide the longest wetland flow paths and help promote sheet flow, which increases nutrient transformation and uptake within the wetlands. Wetland application systems have points of regulatory compliance under the wetland application rule and ERP program. The likely points of compliance for a wetland application system were determined and incorporated into the model to evaluate if the wetlands were providing treatment to the applicable regulatory levels.

Protected Species

A desktop review of protected species was conducted in state and federal databases, followed by a field evaluation of suitable habitat at the site. Based on the field assessments and habitat present at the project site, it was determined that four protected species have a high likelihood of occurring on the site, or were observed during the field visits, including wood stork (*Mycteria americana*), eastern indigo snake (*Drymarchon corais couperi*), Florida scrub jay (*Aphelocoma coerulescens*), and gopher tortoise

(*Gopherus polyphemus*).

While protected species have the potential to inhabit the site, design alternatives and/or mitigation measures should be possible to avoid adverse effects to these species. These mitigation measures could include surveying and avoiding gopher tortoise burrows, avoiding the destruction of Florida scrub jay habitat, and following the U.S. Fish and Wildlife Service standard protection measures for the eastern indigo snake. Thus, protected species concerns would not preclude the implementation of a wetland application system at the site. A wetland application at the site could benefit the federally listed wood stork by enhancing wetland habitat in some areas. Potential impacts and benefits to protected species would be further evaluated, mitigated, and permitted during the design phase.

Hydrologic and Hydraulic Evaluation

A comprehensive H/H evaluation of the project area and the surrounding watershed was performed to determine if a wetland application system would cause offsite flooding impacts, and to provide input data for incorporation into the wetland treatment performance model, including flows and water levels. Using an existing regional interconnected channel and pond routing (ICPR) model and available topographic, meteorological, soils, and land use data, a long-term continuous simulation of the existing conditions H/H model was developed and evaluated, the results of which were used to support the wetland treatment performance modeling and evaluate compliance with the ERP program.

An ICPR model of the west Cocoa watershed, which covers the project area, was originally developed by others for Brevard County (Pegasus, 2012), which was updated and further refined to support the feasibility study. Modifications included adding detail to the hydraulic model based on the topographic survey and other existing data, converting the hydrologic portion of the model from the Technical Release 55 (NRCS, 1986), or "curve number" method, to the U.S Environmental Protection Agency (EPA) stormwater management model (SWMM) method (EPA, 2015), and refinement of sub-basin boundaries to provide appropriate resolution to support the modifications of the hydraulic model.

These model refinements allowed the development of a long-term continuous simulation (LTCS) that demonstrates how the system responds to local runoff conditions on a seasonal basis and how sensitive the system will be to the addition of water from the city's reclaimed system. This effort provided a more accurate evaluation of the existing and proposed condition flood stages (onsite and offsite) and provided inputs for the wetland treatment performance modeling. Three years of LTCS modeling were performed to assess the quantities (flows) and depths of flow in the project area. The three-year period (1992 through 1994) was selected as the simulation period as this represents a typical average (1992), dry or low rainfall (1993), and wet or high rainfall (1994) year per the records available from the Melbourne National Oceanic and Atmospheric Administration (NOAA) weather forecast office.

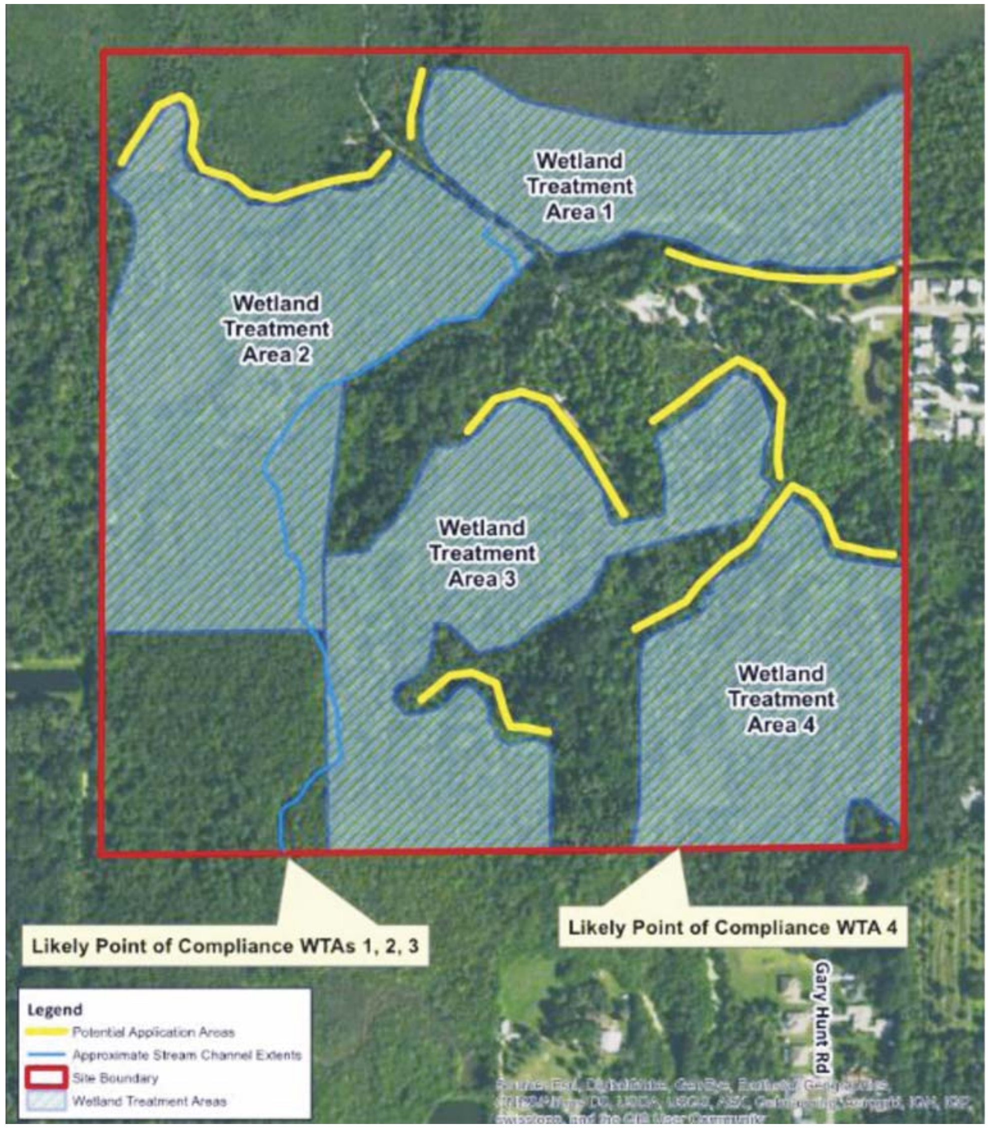

Figure 6. The Four Potential Wetland Treatment Areas Within the Potential Cocoa Site Reclaimed Water to Wetland Treatment System

Nutrient Modeling

Two different models were used to evaluate predicted wetland treatment performance at the potential site: the k-C* model and the Dynamic Model for Everglades Stormwater Treatment Areas (DMSTA2) model. The k-C* model, developed by Kadlec and Knight (1996), provides gross-scale estimates of predicted wetland treatment for planning purposes and incorporates wetland size, inflow rate, inflow concentrations, and background wetland concentrations to determine predicted effluent concentrations using first-order areal rate constants.

This model has been used to predict treatment performance of multiple wetland application systems permitted under the wetland application rule in Florida. The k-C* model was initially used to evaluate treatment performance for all target nutrients at the site: TP, TN, $CBOD_5$, TSS, and fecal coliform. Initial model results indicated that TP would be the nutrient that requires the greatest area for treatment at the site in terms of treatment efficiency; therefore, the DMSTA2 model, developed by Drs. William W. Walker and Robert H. Kadlec, was used to determine treatment of TP.

The DMSTA2 was developed specifically to simulate phosphorus dynamics in wetland

Continued on page 44

Continued from page 43

stormwater treatment areas and allows for a more robust evaluation of phosphorus treatment capacity, not only during average conditions, but also during wet and dry season conditions. The model simulates daily water and mass balances for reservoirs and wetland treatment cells, each with specified morphometry, hydraulics, and phosphorus cycling parameters, to provide estimates of phosphorus treatment performance. The DMSTA2 has been calibrated to 35 datasets, with data from October 1974 through March 2005 derived from full-scale STAs, wetland treatment areas, lakes and reservoirs, and natural wetlands located in Florida. The DMSTA2's calibration to full-scale systems with dynamic inflows and depths makes it a powerful tool for evaluating phosphorus treatment performance of wetland areas.

Model Configuration Model Results

Existing loads entering the wetland were combined with the proposed reclaimed water application loads for modeling purposes. Figure 7 shows the conceptual load models for k-C* and DMSTA2 for the proposed wetland application system. The models were used to evaluate treatment performance in the four WTAs for an average-, dry-, and wet-year period, with the proposed reclaimed water application rate of 0.7 mgd allocated to the four wetland areas based on acreage. This application rate of 0.7 mgd represented the maximum allowable discharge rate to the wetlands.

The application of reclaimed water to the onsite wetlands is feasible based on the H/H and wetland treatment performance modeling. The modeling results indicated that a wetland application system at the site would have a high capacity to treat TN, $CBOD_5$, and TSS at an application rate of 0.7 mgd under the likely range of seasonal conditions. Predicted treatment of these parameters was to background the wetland concentrations currently leaving the site at the likely points of compliance. The DMSTA2 modeling results indicated that application of reclaimed water at TP concentrations of 1.0 mg/L or higher would not be feasible due to the inability of the wetlands to provide treatment to background concentrations currently leaving the site; however, with pretreatment of TP to 0.5 mg/L, the application of reclaimed water is feasible during the wet season, but not the dry season. With pretreatment of TP to 0.2 mg/L, application of reclaimed water is feasible during the wet season and in portions of the wetlands in the dry season.

Permitting

Environmental Resource Permitting

Results of the H/H modeling indicated that the proposed reclaimed water applications should meet the water quantity requirements of the ERP program. As typically required for ERP applications, existing and proposed condition models were run for the mean annual, 25-year, and 100-year, 24-hour design storms. Flood-stage results indicated that no offsite increases in flood stages are expected for any of the design storms. The pre- and post-application peak discharge rates into the receiving water were compared for site flows. The results indicate that no measurable increase in peak discharge rates from the project area is expected for any of the design storms, and only a negligible 0.4 percent increase in discharge volume is expected for the 25-year event. These results suggest that there are no water quantity issues that would preclude permitting a wetland application system at the site under the ERP program.

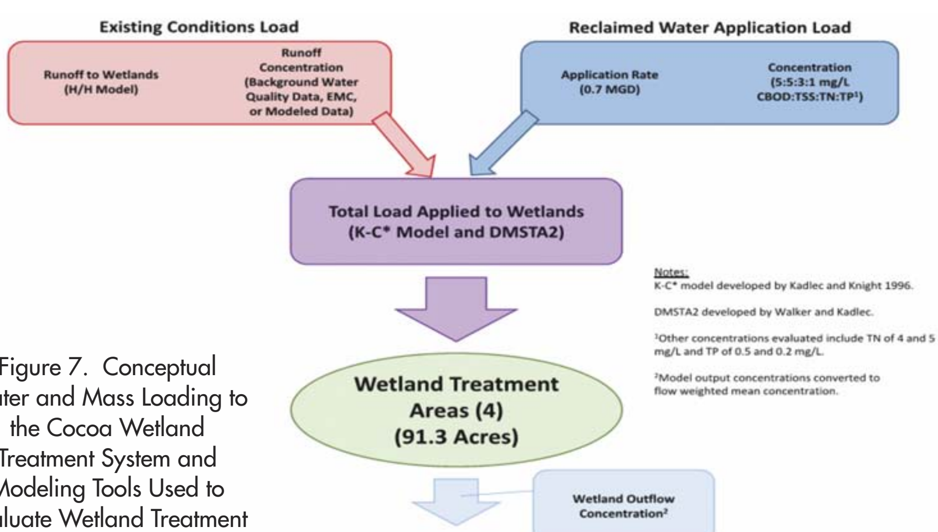

Figure 7. Conceptual Water and Mass Loading to the Cocoa Wetland Treatment System and Modeling Tools Used to Evaluate Wetland Treatment Performance

Pollutant Load Analysis

The site is part of the west Cocoa watershed that ultimately discharges to Lake Poinsett. The overall pollutant load from the watershed to downstream receiving waters was estimated under both existing and proposed conditions to determine if the wetland application system would have a significant effect on pollutant loading to this receiving water. Runoff pollutant loads for TN and TP were estimated based on annual runoff volumes simulated for the average rainfall year (1992) and published event mean concentrations (EMCs) composited over the applicable land uses in the watershed (FDEP, 2013; ERD, 1994).

As a conservative estimate, the proposed project would result in a slight increase in overall TN and TP loading to the watershed based on a continuous (year-round) 0.7 mgd application rate of reclaimed water to the proposed WTAs. The increase in loading represents a less than 2 percent increase in TN and a 2 percent increase in TP watershed-wide loading. Therefore, if the potential wetland application system was operated only as a wet weather discharge, then the loading impact would be even less.

Benefits to the Indian River Lagoon

A wetland application system at this site would also function to reduce TN and TP loading to the IRL. Under the city's current permit, there is a limited wet weather discharge allowed to the IRL as a backup to the public access reuse system. This allows for surface water discharge of 0.99 mgd of reclaimed water to the IRL, for a total of 91 days per year. Given that the proposed project has the potential to accept 0.7 mgd of reclaimed water application, it is estimated that the project has the potential to remove 1,826 lb of TN and 670 lb of TP from the IRL over the 91 days the city is allowed to discharge during wet weather conditions.

Summary

City of Cocoa Wetland Application Site

The application of reclaimed water to the wetlands at the city's conservation area was determined to be feasible based on the H/H and wetland treatment performance modeling. Feasibility evaluation included analysis of wetland treatment performance, offsite water quantity and quality impacts, project permitting, and impacts to protected species. The wetland treatment performance modeling results indicated

Continued on page 46

FWPCOA TRAINING CALENDAR

SCHEDULE YOUR CLASS TODAY!

April

2-5 ......**Backflow Tester** ....Deltona $375/405

9-11 ......**Backflow Repair*** ....St Petersburg ..$275/305

27 ....**Backflow Tester Recert*** *** ....Deltona $85/115

May

7-9 ......**Backflow Repair** ....Deltona $275/305

14-17 ......**Backflow Tester** * ....St. Petersburg..$375/405

14-18 ......**Reclaimed Water Field Site Inspector**....Deltona $350/380

21-25 ......**Water Distribution Level 2**........................Deltona $225/255

21-25 ......**Reclaimed Water Distribution B**.............Deltona $225/255

June

11-14 ......**Backflow Tester** ....Deltona $375/405

29 ......**Backflow Tester Recert*** *** ....Deltona $85/115

Course registration forms are available at http://www.fwpcoa.org/forms.asp. For additional information on these courses or other training programs offered by the FWPCOA, please contact the FW&PCOA Training Office at (321) 383-9690 or training@fwpcoa.org.

** Backflow recertification is also available the last day of Backflow Tester or Backflow Repair Classes with the exception of Deltona*

*** Evening classes*

**** any retest given also*

YOU ARE REQUIRED TO HAVE YOUR OWN CALCULATOR AT STATE SHORT SCHOOLS AND MOST OTHER COURSES.

Continued from page 44

that a wetland application system at the site would have a high capacity to treat TN, $CBOD_5$, and TSS under the likely range of seasonal conditions and application loads.

The DMSTA2 modeling results indicate that the application of reclaimed water at TP concentrations of 1 mg/L would not be feasible due to the inability of the wetlands to provide treatment to existing background concentrations; however, with pretreatment of TP to 0.5 mg/L prior to wetland discharge, the application of reclaimed water is feasible during the wet season, but not the dry season. With pretreatment of TP to 0.2 mg/L, the application of reclaimed water is feasible during the wet season in all WTAs.

Results of the H/H modeling indicate that a reclaimed water application system at the site is feasible under the ERP program. No measurable increase in peak discharge rates from the project area are expected for any of the design storms. Likewise, flood-stage results indicate that no offsite increases in flood stages are expected for any of the design storms.

The project is also feasible with regard to state and federal permitting. The wetland treatment performance data indicate that the system would be able to treat to or near background concentrations, and thus are not anticipated to contribute to downstream water quality degradation. While some protected species have been observed onsite, such as the gopher tortoise, avoidance and mitigation measures should be able to be implemented during design to avoid potential impacts to protected species.

Grant Funding for Wetland Application Systems

Numerous opportunities exist to receive grant funding to implement wastewater to wetland projects. The St. Johns River Water Management District and FDEP have cost-share funding programs for projects that result in nutrient load reduction to springsheds and other water bodies, such as the middle and lower St. Johns River, IRL, and Northern Coastal Basin. This funding totaled more than $24 million in fiscal year 2015–2016 for projects that promote water conservation, improvements in water quality, and nutrient load reductions (SJRWMD, 2017). Projects that would reduce loads to impaired water bodies with adopted TMDLs are scored higher and are more likely to be funded; therefore, wetland application systems could be strong candidates to receive funding.

Wetland Application System Opportunities

Reclaimed water to wetland systems present a unique opportunity for Floridians to protect environmentally sensitive and economically important water bodies within the state. This can be achieved by providing a higher level of treatment to reclaimed water, thus reducing net nutrient loading to waterways, while allowing water reclamation facilities more flexibility during wet weather conditions. While upfront costs are higher, state funding opportunities and lower long-term operation and maintenance costs can make reclaimed water to wetland application systems more economical. The goals of these systems are consistent with the overall objectives of the state and water quality mandates; therefore, wetland application systems should be considered environmentally beneficial projects.

Figure 8. Indian River Lagoon Near the City of Cocoa

References

- CDM, 2001. CDM Southeast U.S. EMC Database.
- CDM Smith, 2015. Reclaimed Water Application to Wetlands Preliminary Feasibility Study. Prepared for City of Cocoa, Fla.
- ERD, 1994. Estimation of Stormwater Loading Rate Parameters for Central and South Florida-Revised. Prepared for the Florida Department of Environmental Protection.
- FDEP, 2013. NPDES Phase I Municipal Separate Storm Sewer System (MS4) Permitting Resource Manual.
- FDEP, 2017. Domestic Wastewater to Wetlands Program. http://www.dep.state.fl.us/water/wastewater/dom/wetinfo.htm. Accessed March 18, 2017.
- Florida Natural Areas Inventory. Biodiversity Matrix Report. http://www.fnai.org/biodiversitymatrix/index.html. Accessed Dec. 1, 2014.
- Kadlec, R. and R. Knight, 1996. *Treatment Wetlands*. First Edition. CRC Press.
- Kadlec, R. and S. Wallace, 2009. *Treatment Wetlands*. Second Edition. CRC Press.
- Knight, R.L., Ruble, R.W., Kadlec, R.H., and S.C. Reed, 1993. *Database: North American Wetlands for Water Quality Treatment*. Phase II Report. Prepared for USEPA.
- National Oceanic and Atmospheric Administration, 1942-2015. *Annual Climatological Summary for Florida, Volumes 46-119*. U.S. Department of Commerce.
- Pegasus Engineering, 2012. *West Cocoa Watershed Evaluation*. Prepared for Brevard County, Fla.
- St Johns River Water Management District. 2017. http://sjrwmd.com/funding. Accessed March 18, 2017.
- Streamline Technologies Inc., 2002. *ICPR - Interconnected Channel and Pond Routing Model, Version 3*; Winter Springs, Fla.
- U.S. Department of Agriculture National Resource Conservation Service, 1986. *Urban Hydrology for Small Watersheds*. NRCS Technical Release 55.
- U.S. Environmental Protection Agency, 2015. Storm Water Management Model (SWMM), Version 5. https://www.epa.gov/water-research/storm-water-management-model-swmm.
- U.S. Environmental Protection Agency, 2009. Proposed Total Maximum Daily Loads for Lake Poinsett and the St. Johns River Above Puzzle Lake, WBIDs 2893K & 2893I, Dissolved Oxygen and Nutrients. Document dated Sept. 30, 2009.