A Literature Review of the History and Future of Reclaimed Water Use in Florida

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Introduction

Groundwater comprises 95% of the world's available freshwater resources. Surface water is also a significant source of freshwater, and includes lakes, rivers, streams, springs, and wetlands. From 1950 to 2005, total fresh and saline water withdrawals for all uses in Florida increased 600%, primarily as a result of increasing population. In 2005, approximately 18,359 million gallons per day (mgd) of saline and freshwater was withdrawn for use in Florida. Of those withdrawals, 4,247 mgd was from groundwater, primarily from the Floridian Aquifer, and 2,626 mgd was fresh surface water, primarily from the southern Florida hydrologic unit subregion. As shown in Figure 1, the largest water use was for the agricultural industry (87%), with the public water supply coming in second at 65%. Florida saw a small decline in withdrawals between 2000 and 2005 as a result of increased rainfall, water conservation restrictions, reduced agricultural acreage, increased reclaimed water reuse, and implementation of best management practices (Marella, 2009).

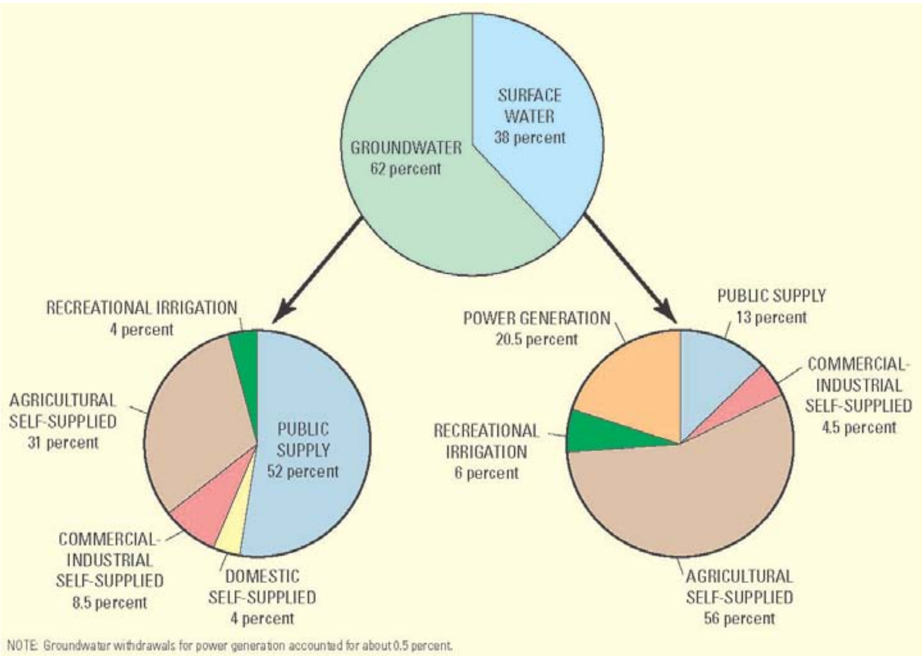

Figure 1. Fresh groundwater and surface-water withdrawals in Florida categorized by use in 2005 (Marella, 2009).

In 2005, domestic public-supply per capita water use alone accounted for 95 gallons per day of freshwater withdrawals (Marella, 2008). It is estimated that 100 gallons per day of wastewater is produced for every person in Florida. Proper treatment of this wastewater and disposal or reuse activities is critical to the protection of Florida's ground and surface water (FDEP, 2011). According to the FDEP's 2010 annual reuse inventory, the total amount of reclaimed water reused for beneficial purposes was 659 mgd, which represents 42% of the domestic wastewater produced in Florida. It is estimated that the reclaimed water used for public access irrigation, fire protection, edible crop irrigation, toilet flushing, and industrial uses replaced approximately 419 mgd of potable-quality water that would have otherwise been used (FDEP, 2011).

Rapid growth of the world urban population is resulting in an increasing demand on water needed for agricultural, domestic, commercial, and industrial uses (EPA, 2004). Therefore, considering the world's limited fresh water resources, reclaimed water use will continue to be a key component in meeting these increased water demands.

What is reclaimed water?

Definition

As defined in Rule 62-600.200(67), Florida Administrative Code (F.A.C.), reclaimed water is water that has received at least secondary treatment and is reused after flowing out of a wastewater treatment facility. Rule 62-600.200(68), F.A.C., further defines reuse as the deliberate application of reclaimed water, in compliance with Department and District rules, for a beneficial purpose. The beneficial purposes include:

- Landscape irrigation (such as irrigation of golf courses, cemeteries, highway medians, parks, playgrounds, school yards, retail nurseries and residential properties);
- Agricultural irrigation (such as irrigation of food, fiber, fodder and seed crops, wholesale nurseries, sod farms, and pastures);
- Aesthetic uses (such as decorative ponds and fountains);
- Ground water recharge (such as slow-rate, rapid-rate, and absorption field land application systems);
- Industrial uses (such as cooling water, process water, and wash waters);
- Environmental enhancement of surface waters resulting from discharge of reclaimed water having received at least advanced wastewater treatment or from discharge of reclaimed water for wetlands restoration;
- Fire protection; or
- Other useful purpose

This Rule excludes overland flow application systems, rapid-rate land application systems providing continuous loading to a single percolation cell, other land application systems involving less than secondary treatment prior to application, septic tanks, and ground water disposal systems using Class I wells injecting effluent or wastes into Class G-IV waters from the definition of reuse.

Treatment Process

The wastewater treatment process generally follows the steps outlined in Figure 2 (below). The first step in the treatment process is preliminary treatment, where debris and other inert material, such as sand and gravel, are removed before treatment begins. Physical removal of these materials reduces mechanical fouling and accumulation of these materials in various treatments tanks, which may reduce treatment capacity (RCC, 2003).

The next step is primary treatment, where primary clarifiers are used to remove large floatable and settable solids. This step has the potential to reduce the total suspended solids (TSS) content by 50-65% and the carbonaceous biochemical oxygen demand ($CBOD_5$) by 30-40%. However, this step is not always present and secondary treatment may replace it as the first step following preliminary treatment (RCC, 2003).

Secondary treatment is a biological treatment process responsible for the removal of organic matter, nutrients and further total suspended solids. In this step, air is usually added to promote microbial activity and followed by settling to achieve a 90% reduction in TSS and $CBOD_5$. This level of treatment is meant to satisfy the limitations set forth in Rule 62-600.420(1)(a), F.A.C. In order to produce reclaimed water, secondary treatment must be followed by tertiary treatment, where TSS and $CBOD_5$ are further reduced through filtration (RCC, 2003).

Advanced treatment is any further treatment beyond secondary treatment that removes nutrients through biological or chemical processes to achieve compliance with the following limits: 5 mg/L $CBOD_{5,}$ 5 mg/L TSS, 3 mg/L total nitrogen, and 1 mg/L total phosphorus. This treatment is typically reserved for National Pollutant Discharge Elimination System (NPDES) wastewater treatment facilities that discharge to surface waters of the state (RCC, 2003).

The final step in most wastewater treatment processes is disinfection. Chlorination is the most common disinfection method used to reduce or remove pathogens that may pose an environmental or public health risk. Ultraviolet radiation or ozonation may also be used to achieve disinfection. If chlorination is used for disinfection, NPDES wastewater treatment facilities must remove chlorine from the final effluent prior to discharging to state waters. Dechlorination in Florida is typically achieved through the addition of sodium bisulfate (RCC, 2003).

Settled solids, known as biosolids, are removed for further treatment prior to their disposal or distribution as fertilizer (FDEP, 2011).

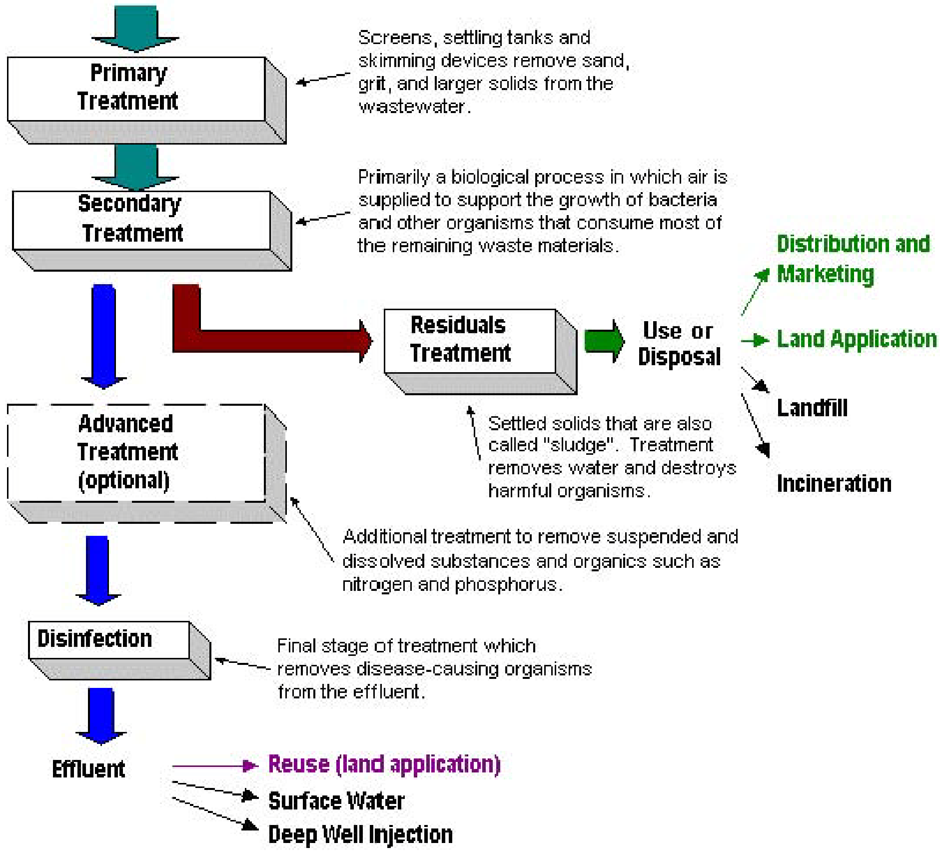

Figure 2. The domestic wastewater treatment process overview (FDEP, 2011).

General Rules and Regulations for Reclaimed Water Treatment and Use

Sections 403.064 and 373.250, Florida Statutes (F.S.), set forth water conservation and reclaimed water promotion as official state objectives. The Florida Administrative Code provides the regulations by which reclaimed water can be produced and used, which are outlined in

Chapters 62-600, 62-601, 62-610 and 62-620, F.A.C. The Florida Department of Environmental Protection (FDEP) is the regulatory agency tasked with monitoring and enforcing these rules.

Chapter 62-610, F.A.C., limits public-access reclaimed water production to those wastewater treatment facilities with permitted capacities of 0.1 mgd or more.

The following effluent limitations apply to reclaimed water:

1. In a month period, at least 75% of the daily fecal coliform results must be below the detection limit, and no single sample should exceed 25 fecal coliforms per 100 mL (Rule 62-600.440(5)(f), F.A.C.). In contrast, a wastewater treatment facility that only requires basic disinfection for the production of effluent that does not meet reclaimed water standards is required to adhere to a limit of 800 fecal coliforms per 100 mL per single sample (Rule 62-600.440(4)(c), F.A.C.).
2. A total chlorine residual of 1.0 mg/L must be maintained at all times (62-600.440(5)(b), F.A.C.). In addition, the chlorine contact time at peak hourly flow shall be no less than 25 minutes (Rule 62-600.440(5)(c), F.A.C.). In contrast, a wastewater treatment facility that only requires basic disinfection for the production of effluent that does not meet reclaimed water standards is required to maintain a total chlorine residual of 0.5 mg/L, with a minimum contact time of ten minutes (Rule 62-600.440(4)(b), F.A.C.).
3. A total suspended solids limit of 5.0 mg/L per single sample must not be exceeded for reclaimed water that is distributed to the user (Rule 62-600.440(5)(f), F.A.C.). In contrast, the allowable TSS limit for a wastewater treatment facility that only requires basic disinfection for the production of effluent that does not meet reclaimed water standards is 60 mg/L (Rule 62-600.740(1)(b), F.A.C.). It is important to note that

ground water containing less than 10,000 mg/L of TDS can be used as a source of potable water (RCC, 2003).

4. The carbonaceous biochemical oxygen demand single sample limit of 60 mg/L is the same for reclaimed water facilities and facilities that produce effluent of lesser quality (62-600.740(1)(b)1.d., F.A.C).
5. Reclaimed water facilities are also required to monitor for the pathogens Giardia and Cryptosporidium at least once every two years. The limit for potentially viable Giardia cysts is 5 per 100 liters, and the limit for potentially viable oocysts of Cryptosporidium is 22 per 100 liters (Rule 62-610.472(3)(d), F.A.C.).

The frequency of sampling for the above parameters is substantially greater for wastewater treatment facilities that produce reclaimed water than those facilities that produce effluent of lesser quality. Continuous monitoring of turbidity and total chlorine residual is required to ensure that treated wastewater water that does not meet the limits described above does not get discharged into the public-access reclaimed water reuse system (Chapter 62-601, F.A.C.). An approved operating protocol is required to be maintained and must describe how these parameters will be monitored and what safeguards, including alarms and telemetry, are in place to prevent subpar water from entering the reclaimed water distribution system (Rules 62-610.320(6) and 62-610.463(2), F.A.C.). Chapter 62-699, F.A.C., details the licensed operator staffing requirement for the facility based on its size, design, and safeguards.

In addition, the public is required to be notified of the use of reclaimed water through the use of advisory signs, golf scorecards, or other acceptable methods. Advisory signs are required to state the nature of the reuse and to have the phrase “do not drink” in English and Spanish, along with the equivalent standard international symbol be posted where reclaimed water is used for irrigation. The phrase “do not swim” must also be added to signs posted at lakes or ponds where reclaimed water is stored (Rule 62-610.468, F.A.C.).

Rule 62-610.475, F.A.C., requires that crops intended for human consumption be peeled, skinned, cooked or thermally processed if directly irrigated (i.e., spray irrigation) with reclaimed water. Crops that are not processed in this manner are prohibited from coming in direct contact with reclaimed water, but can be indirectly irrigated. Examples of approved indirect irrigation methods include ridge and furrow, subsurface and drip irrigation systems. The permittee of the wastewater treatment facility providing reclaimed water for crop irrigation must maintain an inventory of the agricultural operations supplied and report annually to the FDEP.

History of Reclaimed Water Use in Florida

Prior to the mid 1980s, wastewater reuse activities were very limited and the term “reuse” was not written into Florida’s Rules. This period was known as the “Age of Disposal,” since treated wastewater was primarily disposed of through ocean outfalls, surface water discharges, and Class I deep injection wells. It was not until the late 1980s that the state’s reuse objectives were added to Chapter 403, Florida Statutes, and all-inclusive reuse rules were adopted to support the mandatory reuse program (York, 2002). From here, reclaimed water use expanded rapidly with utilities enticing customers with low flat rates for reclaimed water and promises of endless supplies (Ferraro and York, 2001).

The use of reclaimed water for agricultural irrigation in Florida dates back as early as the 1960’s at Southeast Farms in Tallahassee (Southwest Florida Water Management District, 1999). Between 1986 and 2005, reclaimed water use increased from 206 mgd to 660 mgd (Marella, 2009). In 2007-2008, Florida was responsible for 70% of the United States citrus production (Florida-Agriculture.com, n.d.). As a result, citrus groves have historically claimed between

600,000 and 950,000 acres in Florida, all of which require some irrigation (Fig. 3) (Marella, 2009).

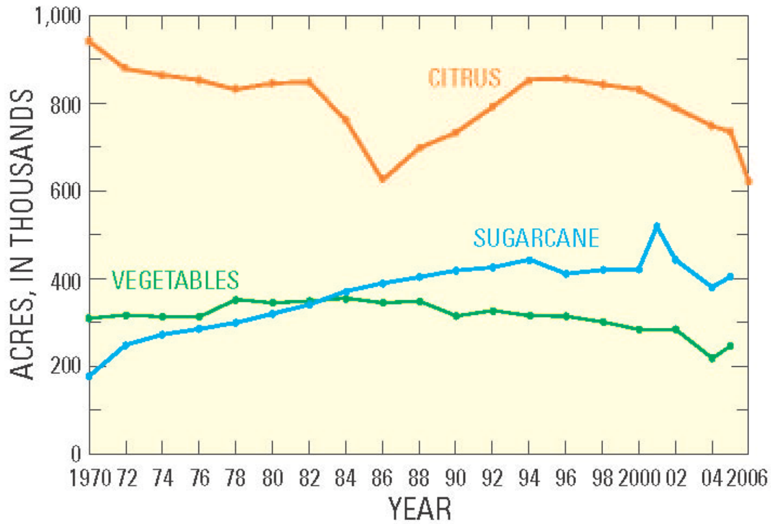

Figure 3. Historical agricultural acreage in Florida for selected crops, 1976-2006 (Marella, 2009).

As one of Florida's most valuable industries, citrus has been proven to benefit from irrigation with reclaimed water. Water Conserv II, established in 1987, was the first reuse project permitted by FDEP that allowed for reclaimed water irrigation of edible crops. The project irrigates 2,737 acres of citrus groves annually in Orange County, Florida, as well as other crops. Extensive research over the past 24 years has been conducted at the site to determine the effects of irrigating citrus with reclaimed water, but no negative impacts on citrus has been observed. In fact, reclaimed water use benefited citrus growth by improving rates of young tree growth. Reclaimed water use also improved fruit quality and abundance. The presence of calcium, boron and phosphorus in reclaimed water allows farmers to reduce their rate of fertilizer application. Also, the soil pH range resulting from reclaimed water has also been determined to be ideal for citrus production. In the Water Conserv II studies, weed growth within the citrus groves irrigated with reclaimed water was higher than the groves irrigated with well water, which has required some farmers to increase herbicide applications (Morgan et al., 2008).

From 1986 to 2001, reclaimed water use for wetland enhancement and restoration increased 53%. These wetland projects typically serve to enhance, restore, or create wetland systems, allow for additional treatment prior to discharge to a water body, or provide alternative wastewater disposal during wet weather periods. Considering that over half of the wetlands in the United States have been destroyed in the past 200 years, these wetland reclaimed projects have the potential to provide much needed flood attenuation, water quality improvements, wildlife habitat and aquifer recharge (EPA, 2004). A notable reclaimed water wetland project in Florida is the Iron Bridge Reclaimed Water Facility located in Orlando, where a 1,640-acre, 20 mgd manmade wetland system was created for additional disposal. The system provides wildlife habitat, nutrient removal, and additional disposal prior to discharging into the St. John's River (DEP, 2011).

Historically, reclaimed water has been priced low to encourage users to conserve potable quality water and eliminate the need for metering. During the rapid expansion of reclaimed water use from the late 80s to early 2000s, overuse of reclaimed water was prevalent, especially during the dry season. Poorly designed facilities, which often lacked adequate storage, found it difficult to compensate for the extreme seasonal fluctuation in use and often resorted to supplementing reclaimed supplies with groundwater, surface water, and even treated potable water. A 2002 study revealed that the average single family residence used 534 gallons per day of reclaimed water when metered, while the average use for unmetered residences was 980 gallons per day. The need for the restructuring of reclaimed water rates was evident, but met with great opposition from customers that were promised a low cost, drought-proof solution (RCC, 2003).

In 2001, the Water Reuse Work Group was established as part of the Water Conservations Initiative to ensure water availability in the future through water conservation. The Work Group identified the use of reclaimed water meters and volume-based rates, groundwater recharge and indirect potable reuse as important strategies in efficiently and effectively using reclaimed water to ensure the availability of water in the future (FDEP, 2001). A 2003 report published by the Reuse Coordinating Committee, a committee established in 1992 to promote coordination among the agencies involved in water use, and the Water Reuse Work Group laid forth the current and future strategies for the effective use of reclaimed water (RCC, 2003).

In 2004, Florida ranked number one in the country for reclaimed water use with 584 million gallons of reclaimed water used each day, with a goal of reaching one billion gallons of reclaimed water use each day by 2010. California was ranked second with 525 mgd, and Texas and Arizona ranked third and fourth with under half of California's usage. These four states account for most of the country's reclaimed water use. Twenty-seven states total have reclaimed wastewater treatment facilities (Gritzuk, 2003). Florida has several regulations in place that require those responsible for wastewater management to prepare reuse feasibility studies, but offers grants to offset the cost of their preparation. More importantly, Florida has a history of providing grant funding for the creation and expansion of reuse facilities, which greatly contributed to its success as a leader in reclaimed water use. More than $180 million in grants have been awarded to over 200 reclaimed water projects in the Department of Environmental Protection's Southwest District alone from 1987 through 2002 (SWFWMD, 2002).

Current Reclaimed Water Use in Florida

As of 2010, 73% of the wastewater treatment facilities in Florida did not meet the size requirement of 0.1 mgd or larger to become a reclaimed facility (FDEP, 2011). Of the 547 domestic wastewater treatment facilities that were 0.1 mgd or larger, 65 did not provide reuse in 2010. Therefore, these 65 facilities disposed of 134 mgd that could have otherwise been used for beneficial purposes. The other 482 reclaimed facilities produced 1,425 mgd of reclaimed water in 2010, with 659 mgd of it used for beneficial purposes, including the irrigation of 324 schools, 525 golf courses, 877 parks, 281,781 residential properties, and several other reuse projects. The 2010 average reuse flow per capita in Florida was 35.08 gallons per day per person (FDEP, 2011). In comparing this average to the estimated 100 gallons per day per person of wastewater produced, approximately 65 % of the wastewater is not being used for beneficial purposes. Therefore, there is still much room for improvement in Florida's reuse program.

Only 11% of the reclaimed water used in 2010 was used for agricultural irrigation, including edible, feed and fodder crops, while over half of the reclaimed water produced is used for irrigation of other public accessed lands (Fig. 4). Nearly 40% of the reclaimed water used for agricultural irrigation was produced in the Northwest Florida Water Management District (NWFWMD). The NWFWMD ranked fourth out of the five districts for the number of treatment facilities that provide reclaimed water and total reuse capacity. However, it is important to note that approximately 83% of the total capacity of treatment facilities that are 0.1 mgd or greater in size is dedicated to reuse capacity. Since population density influences the size of the wastewater treatment facilities in rural areas, and these areas often rely on septic systems and small facilities, reclaimed water use may not be technically and economically feasible in the rural setting (FDEP, 2011).

Of the 73.2 mgd of reclaimed water used in agricultural irrigation during 2010, only 15.9 mgd of reclaimed water was used to irrigate edible crops. Reports indicate that 77 farms used reclaimed water for the irrigation of 13,110 acres of edible crops in 2010. In 2010, 78% of all crop acreage irrigated with reclaimed water was occupied by citrus groves. Other edible crops irrigated with reclaimed water included strawberries, tomatoes, figs, pecans, peaches, grapes, blueberries, peas, beans, corn, herbs, and other unnamed fruits and vegetables. Micro-irrigation was the primary irrigation method used among the reclaimed users (FDEP, 2011).

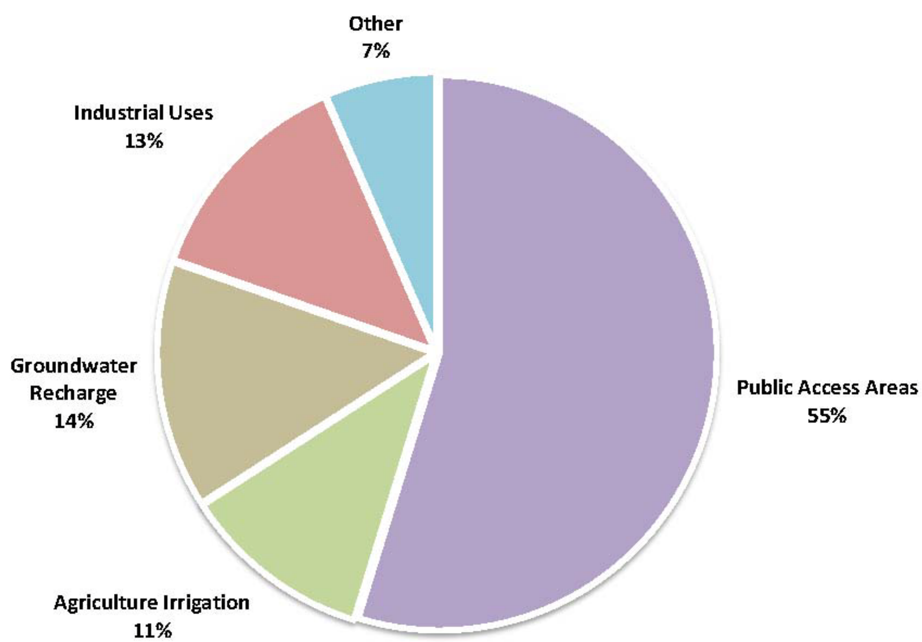

Figure 4. Reclaimed water utilization by flow (FDEP, 2011).

Currently, 67 reclaimed water utilities reported that they do not charge their customers, residential and/or non-residential, any fee for reclaimed water use. The remaining utilities charge flat rates, by the gallon, or a combination of flat rates and per gallon to recoup costs to maintain the treatment and distribution system. In keeping with the strategies of the WCI Water Reuse Workgroup to increase the efficient and effective use of reclaimed water through potable quality water offset and recharge, 659 mgd of reclaimed water offset the use of 331 mgd of potable quality water in 2010. At the same time, 219 mgd was used to recharge available water supplies (FDEP, 2011).

Benefits of Reclaimed Water Use

Reclaimed water use has increased not only to supplement the increase demand on our freshwater resources, but also to reduce the nitrogen and phosphorus load to surface waters of the state. Replacing a wastewater treatment facility that discharges to surface waters with one that produces reclaimed water reduces pollution and reduces the cost of treatment for municipalities. Furthermore, upgrading an existing facility to produce reclaimed water allows facilities to reduce their disposal needs, while producing treated wastewater of much better quality (EPA, 2004).

Chapter 62-40, F.A.C., required the five water management districts to identify "water resource caution areas" (Fig. 5) that have or will have significant water supply shortages as a result of traditional water resources not meeting the current or expected demand. Reclaimed water will play a significant role in relieving the drain on water resources in these areas. When compared to other food commodities, potable quality water is incredibly undervalued, with an average cost per 1,000 gallons of $1.90 in the United States (RCC, 2003). The cost of reclaimed water in Florida is even more enticing with an average cost per 1,000 gallons of $0.87 or less (FDEP, 2011). These low costs significantly affect the public's perception of the importance of water conservation and the impending shortage. Although, the low cost of reclaimed water is a benefit for its customers, it is important to increase the rates of both water and reclaimed water in order to avoid excessive use of either (RCC, 2003).

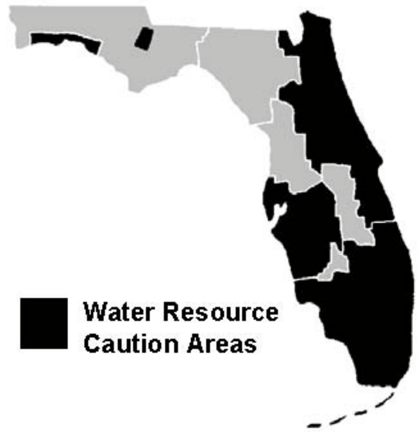

Figure 5. Water Resource Caution Areas (EPA, 2004).

Substituting the use of ground or surface water with reclaimed water benefits not only the environment, but also the users. Reclaimed water provides farmers with a dependable water supply for irrigation during times of drought and freeze. It also has the potential to eliminate the need for a consumptive use permit required for irrigation wells, as well as eliminate the operation and maintenance costs associated with pumping ground or surface water. Furthermore, fertilizer costs can be significantly reduced because nutrients in reclaimed water can be utilized by crops (Morgan et al., 2008). Surface water withdrawals for irrigation come from Class III (recreational and fish and wildlife) and Class IV (agricultural supplies) waters of the state, both of which have lesser standards for fecal coliform limits than reclaimed water. As such, these waters may pose a greater public health risk than reclaimed water (York, n.d.).

Challenges of Reclaimed Water Use

The use of reclaimed water in a community requires an increase need for regulation to ensure that the treatment facility is producing high quality reclaimed water, that customers use the non-potable reclaimed water properly, and that the reclaimed water does not contaminate the potable water system. Costly programs must be implemented to ensure proper color-coding of lines, public advisory signage, and the presence of backflow prevention devices where appropriate (EPA, 2004).

There are several constituents of concern when it comes to reclaimed water, including chlorides. Coastal cities may experience saltwater intrusion into their sanitary sewer collection and transmission lines, which causes increased levels of chloride in the reclaimed water. Also, other practices, including industrial uses and water softeners, may result in increased salt content. Wastewater treatment facilities are not required to monitor or control chloride concentrations in the final effluent (EPA, 2004). In terms of crop productivity and plant survival, there are concerns regarding the high salt content of reclaimed water, and these concerns may greatly vary by crop type. Overwatering with reclaimed water may result in salt accumulation in the soil, resulting in poor root growth and water uptake by crops (Harivandi, 1982).

Although the organic and inorganic nutrient content of reclaimed water can benefit farmers by reducing the need for fertilizers, high nitrogen concentrations may result in excessive microbial growth and activity, and be detrimental to crops (Magesan et al., 2000). Furthermore, if overwatering leads to runoff, these nitrogen and phosphorus may also pose a water quality risk to surface water bodies of the state. Best management practices should be employed by farmers to prevent overwatering and subsequent runoff. Trace amounts of these nutrients may remain in the reclaimed water even after advanced treatment (EPA, 2004).

Another possible concern when it comes to reclaimed water use dependence for irrigation needs is that the seasonal fluctuation in supply often differs from the seasonal fluctuation in need, as demonstrated in Figure 6. Limited storage facilities and overwatering by users further exacerbate this concern (EPA, 2004).

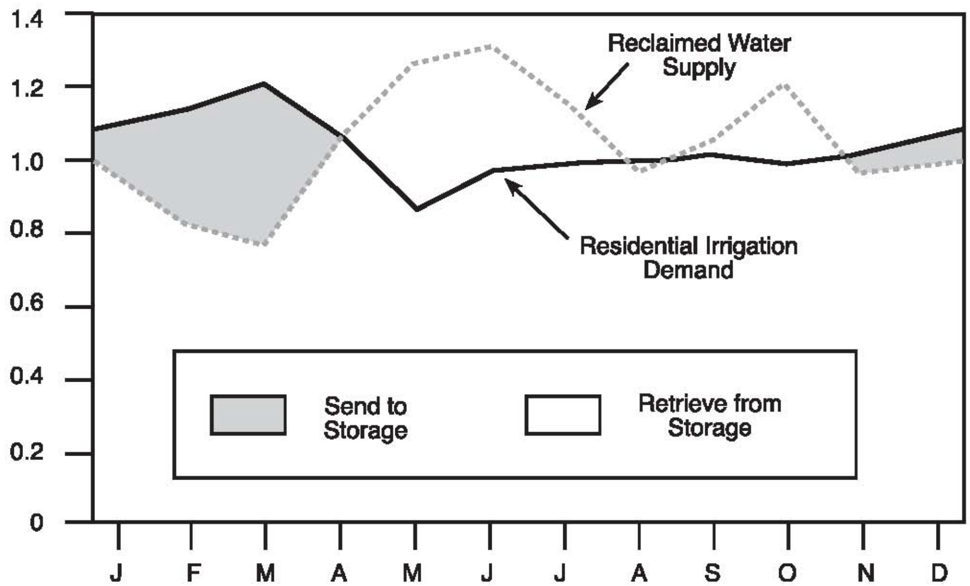

Figure 6. Reclaimed water supply vs. irrigation demand (EPA, 2004).

One of the biggest challenges to reclaimed water use on edible crops and the recharge of potable resources is public perception, mostly resulting from a lack of adequate education (Krauss, 1997). Public health concerns include the presence of pathogens and heavy metals, which are typically of little concern following proper treatment of domestic wastewater (Toze, 2006). The route of infection that is of most concern is through the consumption of water or foods processed with water that contains feces. There are several diseases resulting from oral ingestion of water containing urine, but these diseases are rare in the United States, and therefore, are of little concern with reclaimed water (EPA, 2004).

Considering the treatment process that reclaimed water undergoes, it would take very special conditions for an individual to contract an infectious disease from indirect or direct contact with reclaimed water. The infectious agent would have to be present in the community to end up in the final treated wastewater, and the agents would have to survive the treatment processes. The individual would then have to come into contact with the infected reclaimed water, and then they would only become infected if the pathogen level is significant. The wastewater treatment process does not necessarily eliminate the infectious agents found in untreated domestic wastewater (Table 1), but does significantly disrupt the transmission chain (EPA, 2004).

Table 1. Infectious agents potentially present in untreated domestic wastewater (National Research Council, 1996; Sagik *et al*., 1978; and Hurst *et al*., 1989).

Pathogen	Disease
Bacteria	
Shigella (spp.)	Shigellosis (bacillary dysentery)
Salmonella typhi	Typhoid fever
Salmonella (1700 serotypes spp.)	Salmonellosis
Vibro cholerae	Cholera
Escherichia coli (enteropathogenic)	Gastroenteritis and septicemia, hemolytic uremic syndrome (HUS)
Yersinia enterocolitica	Yersiniosis
Leptospira (spp.)	Leptospirosis
Campylobacter jejune	Gastroenteritis, reactive arthritis
Protozoa	
Entamoeba histolytica	Amebiasis (amebic dysentery)
Giardia lamblia	Giardiasis (gastroenteritis)
Cryptosporidium	Cryptosporidiosis, diarrhea, fever
Microsporidia	Diarrhea
Helminths	
Ascaris lumbricoides	Ascariasis (roundworm infection)
Ancylostoma (spp)	Ancylostomiasis (hookworm infection)
Necator americanus	Necatoriasis (roundworm infection)
Ancylostoma (spp.)	Cutaneous larva migrams (hookworm infection)
Strongloides stercoralis	Strongyloidiasis (threadworm infection)
Trichuris trichiura	Trichuriasis (whipworm infection)
Taenia (spp.)	Taeniasis (tapeworm infection)
Enterobius vermicularis	Enterobiasis (pinwork infection)
Echinococcus granulosus (spp.)	Hydatidosis (tapeworm infection)
Viruses	
Enteroviruses (polio, echo, coxsackie, new enteroviruses, serotype 68 to 71)	Gastroenteritis, heart anomolies, meningitis, others
Hepatitis A and E virus	Infectious hepatitis
Adenovirus	Respiratory disease, eye infections, gastroenteritis (serotype 40 and 41)
Rotavirus	Gastroenteritis
Parvovirus	Gastroenteritis
Noroviruses	Diarrhea, vomiting, fever
Astrovirus	Gastroenteritis
Calicivirus	Gastroenteritis
Coronavirus	Gastroenteritis

The presence of emerging contaminants in reclaimed water is of notable concern, especially considering the lack of research, monitoring, and regulatory standards currently in place for these contaminants. These emerging contaminants include synthetic chemicals attributed to the use of pharmaceuticals, personal care products, endocrine disrupting compounds, and other organic materials. These contaminants typically result from anthropogenic activity and can be found in low concentrations in industrial wastewater, domestic wastewater, stormwater, agricultural runoff, and surface waters (RCC, 2003).

Future of Reclaimed Water Use in Florida

Florida has been a leader in the nation for reclaimed water use, but there is still room for improvement. From 1986 to 2010, Florida saw a 75% increase in the number of facilities providing reuse and a 69% increase in the flow of reclaimed water produced (FDEP, 2011). A 2003 report prepared by the Reuse Coordinating Committee and the Water Conservation Initiative identified several reclaimed water use goals for 2020. The report recognized the importance of expanding reclaimed water production capabilities to all wastewater treatment facilities 0.1 mgd or larger, and limiting ocean outfalls, deep injection wells, and other surface water discharges to those facilities that serve as backup to reclaimed facilities. This action would reduce the amount of reusable treated wastewater that is made unavailable for future use through these disposal methods (RCC, 2003).

The 2003 report also encourages the promotion of the “water is water” philosophy for water management among the public, utilities, and state and local government agencies. This philosophy recognizes water as a finite resource, and no matter the terminology used all water is considered the same and should be reused, including stormwater, wastewater, groundwater, etc (RCC, 2003).

The need for a state funding program focused on water reuse issues, including potable water offset and recharge, has been identified. Funding is also needed to encourage metering and volume-based rate structures for reclaimed water. Visions for the future include a focus on the use of reclaimed water to not only conserve, but recharge potable water resources. Strategies are in place to make groundwater recharge and indirect potable water reuse projects the norm. For example, potable water used for toilet flushing will be replaced by reclaimed water in industrial, commercial, hotels, and multi-family housing settings. It has also been recognized that funding for further studies on the presence and control of pathogens and emerging contaminants found in reclaimed water will be needed prior to promoting the augmentation of potable water supplies with reclaimed water through ground water recharge and indirect potable reuse (RCC, 2003).

Technologies that will be promoted for future reclaimed water treatment include ultraviolet (UV) irradiation for disinfection, membrane processes, and sewer mining. UV irradiation already has replaced the use of gas and liquid chlorine for disinfection purposes at several larger wastewater treatment facilities. A major benefit of this type of treatment is the lack of disinfection byproducts, which are produced when chemicals used for disinfection, such as chlorine, react with inorganic and organic matter present in the water. Long-term exposure to high levels of these byproducts can cause several health problems, including an increased risk of cancer. Membrane filters and bioreactors are also promising treatment technologies for the control of pathogens and organic compounds (RCC, 2003).

Conclusion

While there is much research still needed on the long-term environmental and public health effects of reclaimed water use, it remains a promising, cost-effective solution to Florida's overuse of freshwater resources. If properly treated and monitored for pathogens, nutrients, heavy metals, and emerging contaminants, reclaimed water can be a promising solution to Florida’s potable water shortage. Not only can reclaimed water offset potable water use and increase recharge, but an increase in its use can reduce pollution caused by other wastewater disposal methods.

Farmer and public education is a critical component to the success of reuse projects, and must also be incorporated into the future planning process. Stakeholders must focus on altering the mindset of the public to one that values both freshwater resources and reclaimed water. Without this appreciation, goals for efficient and effective reclaimed water use will not be met.

Future planning to further increase reuse of reclaimed water, especially for agricultural irrigation, has great potential to alleviate the strain on one of Florida’s most valuable natural resources, water.

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