4 Description of Alternatives Considered

4.1 REUSE OPTIONS INCLUDING CONSTRAINTS AND OPPORTUNITIES

There are various options for the reuse of treated wastewater. Each one has its own technical issues, regulatory requirements, and treatment standards. The following subsections present some of the criteria related to wastewater reuse for urban irrigation, agricultural irrigation, industrial reuse, aquifer recharge, canal recharge, saltwater barrier, wetland application, and potable reuse. Opportunities and constraints are discussed for each type of reuse and, in Section 4.2, specific projects are identified and reuse volumes are estimated. Also, satellite treatment, or sewer mining, is discussed along with tradeoffs between piping reuse water from MDWASD's regional wastewater treatment plants versus installing satellite treatment closer to reuse end-users.

4.1.1 Urban Irrigation

The most common reuse practice is irrigation of public access areas such as golf courses, parks, grassed medians, and residential lawns. Based on information collected in 2001, 44% of the reuse conducted in the State of Florida was via landscape irrigation (Reuse Coordinating Committee 2003). This type of reuse typically has the least restrictive treatment requirements per FDEP regulations, and the design and regulatory standards are well established.

Golf course irrigation is a common water reuse application.

Regulatory requirements for urban irrigation are defined under FDEP Chapter 62-610. Additionally, FDEP has recently established a new generic permit focused on facilities that have permitted flows less than 100,000 GPD and discharge solely to Slow Rate/Restricted Access Land Application Systems.

A summary of selected parameters established by FDEP in Chapter 62-610 Part II of the F.A.C. is presented in Table 4.1.1-1.

Table 4.1.1-1. Selected FDEP Parameters for Urban Irrigation

Parameters	Minimum Criteria
Minimum Treatment Level	Secondary treatment with HLD
Required Treatment Processes	Filtration and chemical feed facilities
Reliability	Classes I, II, and III
Effluent Quality	
pH	6 - 8.5
CBOD	< 20 mg/L
TSS	< 5 mg/L (continuous)
Fecal Coliform	75% of samples with no detection (25/100 mL) Maximum
Chlorine Residual	> 1 mg/L
Minimum Size Requirement	0.1 MGD
Setback Distances	
Potable water supply well	75 feet (application rate)
Non-potable water supply well	75 feet
Surface water (Class I, II, and III)	100 feet
Maximum Hydraulic Loading Rate	Design hydraulic loading rate maximum annual average of 2 inches per week is recommended

Key:
CBOD = carbonaceous biochemical oxygen demand.
HLD = high-level disinfection.
MGD – million gallons per day.
mg/L = milligrams per liter.
mL = milliliter.
TSS = total suspended solids.

> High infrastructure installation costs limit viable irrigation options to large tracts of land or new development with multiple users.

In order to provide water for irrigation to end-users, distribution pipelines are required. They are clearly distinguishable from potable water lines by their purple color. The reuse system is operated very similarly to a potable water system. The reclaimed water is delivered to customers at a minimum water pressure. Often, due to cost considerations, entities that implement this type of reuse have little or no storage capacity; hence, meeting dry season demands becomes a challenge. The City of Cocoa Beach, for example, provides reuse service to their customers at a discounted rate, but cannot guarantee reclaimed water will always be available. If the demand is too high during dry periods, customers must find an alternate water source for irrigation. Aboveground storage reservoirs can be incorporated into the system design to increase the availability of reclaimed water. For some large customers, water can be provided, but they may be required to provide their own onsite storage and pump station.

While it may appear that there are countless opportunities to irrigate green spaces, viable options are in actuality limited to larger tracts of land or new developments with a multitude of users. For example, a median on a major thoroughfare can be irrigated with reclaimed water. However, the amount of water used is very low while the cost to install the infrastructure in a highly urbanized area is very high. In the 1992 Reuse Feasibility Study, it was estimated that the installation of a "micro" distribution network off the main reuse line to service small users (residents, median irrigation, etc.), located within 1 mile of the proposed reuse lines in the North and Central Districts, would cost approximately $95 million for only 22 MGD of reuse. Therefore, in highly developed areas, it is much more cost effective to limit irrigation using reclaimed water to larger users. Figure 4.1.1-1 shows the potential urban irrigation reuse opportunities in Miami-Dade County.

With the aid of GIS and aerial photography, review of previous studies, and input from a number of stakeholders, a total of 33 golf courses and 17 Miami-Dade County-owned parks were identified for public access reuse. The golf courses were identified by creating a GIS-based database that included all golf courses based on existing Miami-Dade County coverage and local information searches. Initially, parcel data were obtained for each golf course to determine the area available for irrigation. Irrigable areas were then revised based on previous reports and by directly contacting each golf course. A survey was developed to document each response. Copies of the completed surveys are available in Appendix D. Per FDEP guidance, an application rate of 2 inches of water per week was used to estimate the volume of reclaimed water that can be used for irrigation. This application rate may differ based on soil type, turf type, and irrigation practice (time of day, type of irrigation technology, etc.). A more detailed analysis will be needed to further refine these application rates when the irrigation systems are designed.

Reuse volumes were calculated for irrigable areas on an individual basis. For all the golf courses identified, the estimated volume of reclaimed water for irrigation is 21 MGD. Currently, most of these golf courses are irrigated by private irrigation wells and do not rely on MDWASD for their potable water supply.

In similar fashion, individual parks were contacted to verify their potential irrigable area. The estimated volume of reclaimed water for irrigation of all the parks identified is 26 MGD. Most of the parks are currently not irrigated.

While irrigation of the golf courses and parks will be viewed very favorably by FDEP and the SFWMD, only a limited number of these facilities will be considered in offsetting future water demands. These include facilities that currently use potable water for irrigation, are located within designated wellfield protection areas, or that can recharge the wellfields. Since this study incorporates the potential to irrigate areas within designated wellfield protection areas with highly treated reclaimed water—an option that had not been previously considered—more golf courses and parks were identified in this effort than in previous studies.

Other opportunities for public access reuse irrigation include irrigation of residential areas in new developments. Irrigation volumes for the development of Biscayne Landings and new developments related to South Miami-Dade growth were estimated at 1.5 MGD and 4.51 MGD, respectively. New developments in Miami-Dade County have not yet been defined. To estimate the irrigation volume for these areas, 15% of the land designated as new residential in the future land use projections (see Section 3.1.1) was assumed to be green space in need of irrigation.

The City of North Miami Beach is proposing to implement reuse for irrigation of medians, parks, schools, universities, and other areas. They have estimated an irrigation usage of 5 MGD. The City of North Miami Beach has been in contact with MDWASD to explore opportunities for providing reclaimed water for this purpose. This volume was included in the reuse scenarios for this study.

Irrigation of the North Miami Stadium also was identified in previous reuse study efforts. This project includes a number of grassed areas and playing fields. MDWASD personnel indicated that a pipe from the NDWWTP to the proximity of this stadium is already installed, so this option also is included in the reuse scenarios.

The reclaimed water must not only meet the minimum regulatory requirements shown in Table 4.1.1-1, but also must be of suitable quality for irrigation of different grasses and plant species that have various sensitivities and tolerances to the constituents in the water. The most notable constituent of concern for Miami-Dade County is chloride due to its high concentrations in the CDWWTP effluent. Chloride levels above 400 mg/L can cause a number of problems to vegetation unless they are chloride-resistant species. Two golf courses in the area, the Miami Beach Golf Club (also known as Bayshore) and the Normandy Shores Golf Course, have chloride-resistant turf that survives high levels of chlorides.

In order to achieve suitable chlorides levels at the CDWWTP a combination of RO treatment and blending of treated water with existing plant effluent will be required. The RO plant will produce effluent with no detectable levels of chlorides.

In addition to RO at the CDWWTP, the effluent from all three plants must be disinfected for irrigation. Currently, only a small volume of the effluent at each of the three plants undergoes both filtration and disinfection. Additional filtering capacity and disinfection, through the use of chlorine or ultraviolet (UV) light, will need to be installed at each of the plants in order to implement any irrigation over what is currently in place. Additional filtration and disinfection is already planned at the SDWWTP and is scheduled to be implemented by 2011. Based on the recommendations for reuse and upcoming environmental regulations, additional treatment beyond the 2011 upgrades may need to be added at the SDWWTP. Table 4.1.1-2 summarizes the minimum treatment upgrades required for each plant to produce acceptable reclaimed water as stated in FDEP rules. Note that local ordinances may require additional treatment to ensure safe drinking water supplies. Additional standards and requirements may also apply for the protection of OFWs.

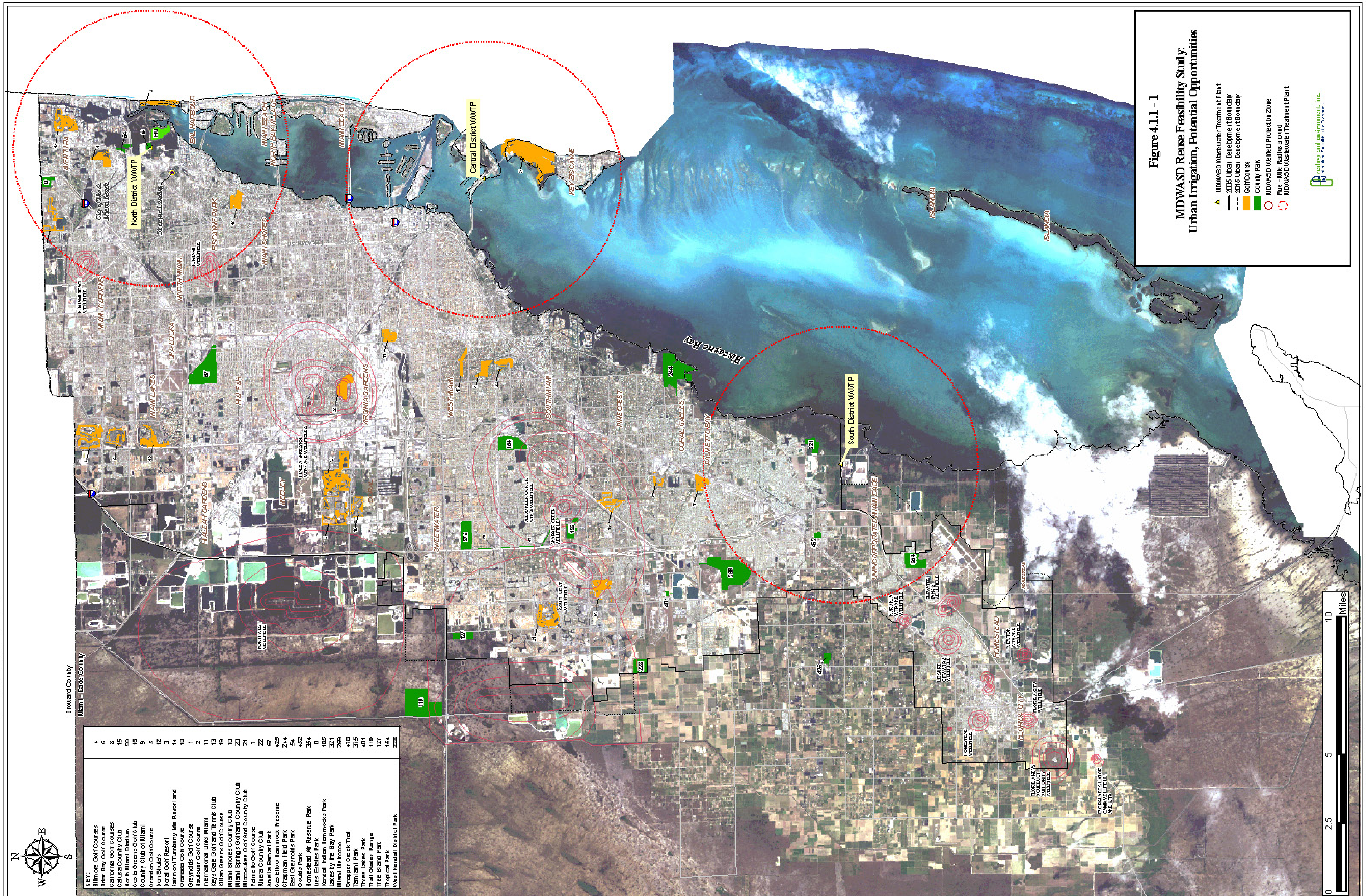
Figure 4.1.1 - 1
MDWASD Reuse Feasibility Study,
Urban Irrigation, Potential Opportunities
North District WWTP
Central District WWTP
South District WWTP
Biscayne Bay

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Table 4.1.1-2. Minimum Treatment Process Improvements Required for Reuse Options

Application		NDWWTP	CDWWTP	SDWWTP
Urban Irrigation		Additional filtration and HLD[a]	Additional filtration (pre-filters), RO and HLD[a]	Additional filtration and HLD[a],[b]
Agricultural Irrigation	Non-edible crops	No additional improvements necessary[c]	Additional filtration (pre-filters), RO and HLD[a]	No additional improvements necessary[c]
	Edible crops	Additional filtration and HLD[a]	Additional filtration (pre-filters), RO and HLD[a]	Additional filtration and HLD[a],[b]
Industrial Reuse		Varies[c]	Varies[c]	Varies[c]
Aquifer Recharge		Additional filtration and HLD[a], treatment of microconstituents suggested; RO, MF, UV disinfection, advanced oxidation	Additional filtration and HLD[a], treatment of microconstituents suggested; RO, MF, UV disinfection, advanced oxidation	Additional filtration and HLD[a], treatment of microconstituents suggested; RO, MF, UV disinfection, advanced oxidation
Saltwater Barrier		Additional filtration and HLD[a]	Additional filtration (pre-filters), RO and HLD[a]	Additional filtration and HLD[a],[b]
Canal Recharge		Likely treatment of microconstituents required; RO, MF, UV disinfection, advanced oxidation, and nutrient removal by chemical processes	Likely treatment of microconstituents required; RO, MF, UV disinfection, advanced oxidation, and nutrient removal by chemical processes	Likely treatment of microconstituents required; RO, MF, UV disinfection, advanced oxidation, and nutrient removal by chemical processes
Wetland Application		Likely treatment of microconstituents required; RO, MF, UV disinfection, advanced oxidation; additional nutrient removal by chemical processes[d]	Likely treatment of microconstituents required; RO, MF, UV disinfection, advanced oxidation; additional nutrient removal by chemical processes[d]	Likely treatment of microconstituents required; RO, MF, UV disinfection, advanced oxidation; additional nutrient removal by chemical processes[d]

Notes:

[a] Minimum treatment requirements per Florida Department of Environmental Protection (FDEP) regulations. Higher levels of treatment may be required per the Department of Environmental Resources Management.

[b] Treatment upgrades in progress for SDWWTP.

[c] Secondary treatment and basic disinfection required per FDEP rules, but more stringent requirements vary by end-user.

[d] Includes projects recharging wellfield protection areas and areas near Biscayne Bay.

Key:

CDWWTP = Central District Wastewater Treatment Plant.
HLD= high-level disinfection.
MF= microfiltration.
NDWWTP = North District Wastewater Treatment Plant.
RO= reverse osmosis.
SDWWTP = South District Wastewater Treatment Plant.
UV= (disinfection with) ultraviolet (light).

4.1.2 Agricultural Irrigation

Agricultural irrigation is another widely accepted reuse practice. In Florida, regulatory requirements differ for edible and non-edible crops. Agricultural irrigation is regulated by rules specified in Chapter 62-610 Part III. The rule allows spray irrigation of edible crops that will be peeled, skinned cooked, or thermally processed before consumption; such as citrus, corn, and soybeans. Spray irrigation of pasture lands, grasslands, and other feed and fodder crops is also allowed provided it has, at a minimum, secondary treatment with HLD. For edible crops that are consumed raw, irrigation water may not be in direct contact with the product. Practices such as drip and subsurface irrigation must be used. A summary of selected FDEP requirements for agricultural reuse is shown in Table 4.1.2-1.

Table 4.1.2-1. Selected FDEP Parameters for Agricultural Irrigation

Parameters	Criteria for Edible Crops (Only Those That Are Peeled, Skinned or Thermally Processed)	Minimum Criteria for Non-Edible Crops
Minimum Treatment Level	Secondary with HLD	Secondary with basic-level disinfection
Required Treatment Processes	Filtration and chemical feed facilities	Not Specified
Reliability	Class I	Not Specified
Effluent Quality		
CBOD	< 20 mg/L	Not Specified
TSS	< 5 mg/L	< 10 mg/L
Fecal Coliform	75% of samples with no detection (25/100 mL) Maximum	Not Specified
Chlorine Residual	>1 mg/L continuous	Not Specified
Turbidity	< 2 NTU continuous	Not Specified
Minimum Size Requirement	0.1 MGD	Not Specified
Setback Distances		
Potable water supply well	75 feet (application rate)	100 feet., 200 feet, or 500 feet, depending on Class I reliability
Non-potable water supply well	None	None
Surface water (Class II, and III)	100 feet	Not Specified
Maximum Hydraulic Loading Rate	Design hydraulic loading rate - maximum annual average of 2 inches per week is recommended	Design hydraulic loading rate maximum annual average of 2 inches per week is recommended

Key:
CBOD = carbonaceous biochemical oxygen demand.
FDEP = Florida Department of Environmental Protection
HLD = high-level disinfection.
MGD – million gallons per day.
mg/L = milligrams per liter.
mL = milliliter.
NTU = nephelometric turbidity unit
TSS = total suspended solids.

Currently, over 82,000 acres of land in Miami-Dade County are being used to grow crops. The majority of this land is located in the southwest portion of Miami-Dade County near the City of Homestead and immediately east of ENP (see Figure 4.1.2-1). This land encompasses almost 63,000 acres, 53,000 acres of which are located outside the UDB; however, this area is subject to intense development pressures. Based on the future land use information shown on Figure 4.1.2-1, it is expected that over 15,000 acres of agricultural land will be lost to development by 2015. Agricultural areas being converted to urban development greatly reduces the potential reuse volume.

In Miami-Dade County, 82,000 acres of land are used for crops and nurseries.

Existing crops consist predominately of vegetables and nurseries, with some groves (tropical fruits). According to discussions with the University of Florida Institute of Food and Agricultural Sciences (IFAS), in recent years, the acreage of nurseries has steadily grown, making the ornamental plant industry one of the top grossing agricultural industries in Miami-Dade County.

Predicting the types of crops at any given time presents an added challenge for reuse planning and implementation since this is a very dynamic industry that shifts from one type of crop to another very quickly based on economic conditions. Therefore, the utilization of irrigation water may change from year to year and the crop type and irrigation method will dictate whether reclaimed water can be used.

The 1998 Reuse Feasibility Study summarized several of the opportunities and constraints for agricultural reuse as follows:

- Areas dominated by tropical fruit production have the greatest potential to use reclaimed water for irrigation. These areas typically have more permeable soils than areas where other crops are grown, increasing their need for water. They are less sensitive to chlorides and other constituents that may be present in reclaimed water. Most of the fruit groves are irrigated by drip or low-pressure irrigation systems, which are more conducive to the use of reclaimed water when irrigating edible fruit crops.

- Irrigation of vegetable row crops with reclaimed water has less potential applicability. About half of the fields are irrigated with overhead spray irrigation systems. Since many of these crops are foods that are eaten raw with little to no processing prior to consumption, direct contact with reclaimed water, such as by spray irrigation, is prohibited by state regulations. About half of the crops grown are on leased lands. Obtaining long-term agreements with property owners, as required by state rules, would be difficult. Some of these crops, such as potatoes, are grown in peat soils where irrigation needs are minimal.

- Nurseries have the highest potential year-round water demand of the three crop types (tropical fruit, vegetable row, and nursery); however, these crops appear to be the most sensitive to water quality. Even when groundwater is used as an irrigation source, the growers continuously monitor water quality. This concern would limit the feasibility of serving reclaimed water to only those nurseries with the hardiest crops. Nurseries growing palms are located in the area predominated by peat soils, where irrigation needs are minimal.

The Miami-Dade County's agricultural manager as well as the University of Florida IFAS was contacted to discuss these previous findings and determine current and future agricultural trends in Miami-Dade County. Both parties indicated that currently the predominant tropical fruit crop is avocado. The type of irrigation used for avocados is spray irrigation. Drip irrigation systems are used more frequently in citrus groves, such as lemon and lime, which no longer exist in great quantities in Miami-Dade County.

In addition to water quality concerns, having a reliable supply of reclaimed water for irrigation is of major concern. Since the livelihood of the farmers depends on the water for their crops, having a dependable water supply year round, especially in the dry season, is essential. Water also must be available on demand for irrigating when freezing temperatures occur. This likely means that additional storage would be needed so that reclaimed water can be provided when demands spike. Alternatively, farmers could use their wells to supplement any shortfalls in supply. However, ensuring that farmers only use their wells as a backup supply may be difficult, particularly if there is a user charge for the reclaimed water. Currently, farmers with their own water withdrawal wells do not have a user fee for their source of irrigation water. In recent discussions with the University of Florida IFAS, this issue was identified as a key factor in the potential to implement reuse for agricultural use. Historically, attempts to meter water used for agricultural purposes have failed. Creating incentives for farmers to use reclaimed water will also be very difficult since most would need to modify irrigation practices and infrastructure to accommodate the use of reclaimed water.

> Since most of the agricultural operations, and certainly all the large operations, have their own wells and do not currently irrigate with potable water supplies, it is unlikely that using reclaimed water will help offset future potable water demand.

Reclaimed water for agricultural users would need to be provided from the SDWWTP since it is located closest to the majority of the agricultural activities. As discussed in Section 4.1.1, upgrades at the SDWWTP are already planned to produce treated wastewater that meets all the drinking water standards. Upon completion of the upgrades, the effluent from the SDWWTP would be available for agricultural irrigation of tropical fruits.

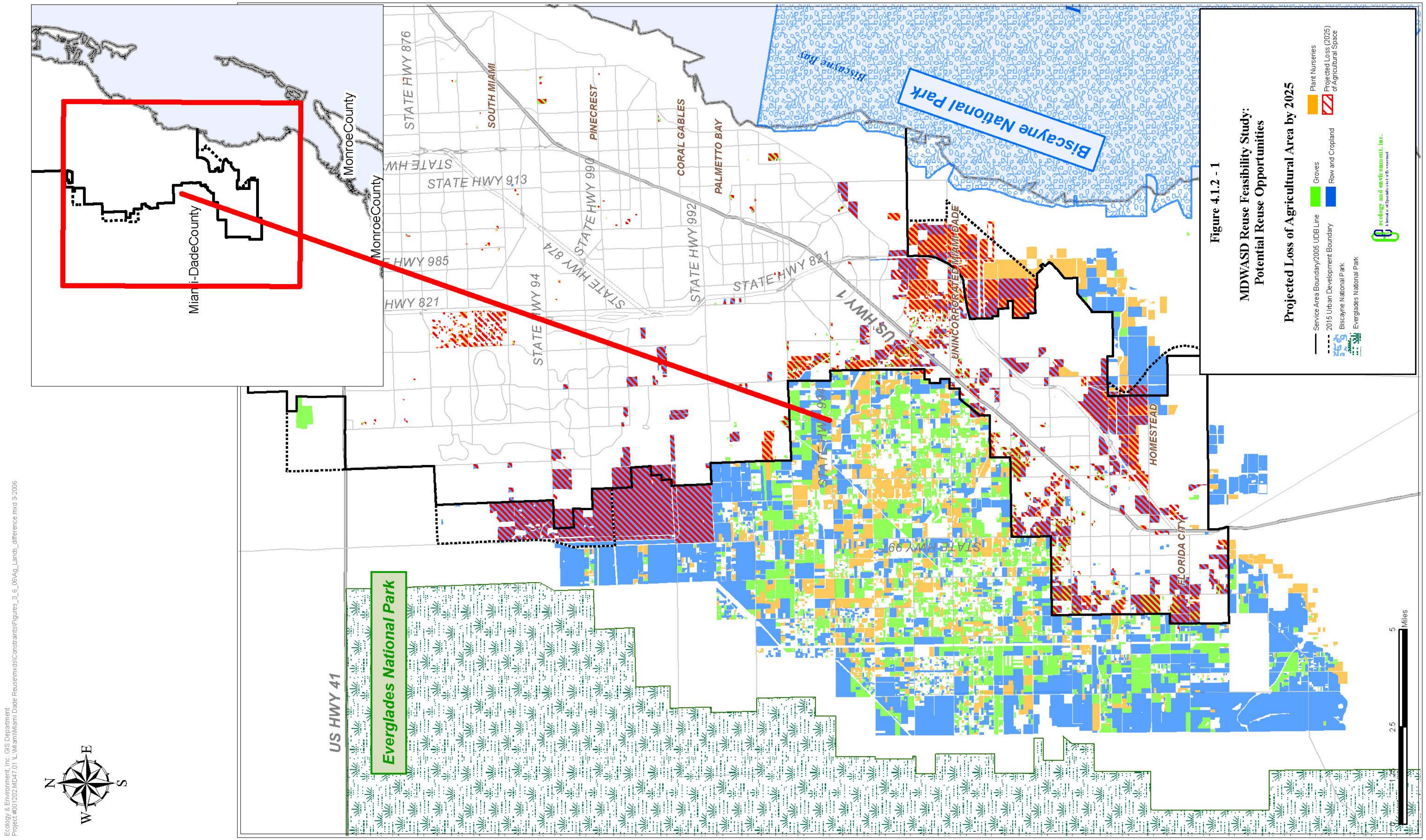

Figure 4.1.2 - 1
MDWASD Reuse Feasibility Study: Potential Reuse Opportunities
Projected Loss of Agricultural Area by 2025

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Under FDEP rules, non-edible crops could be irrigated with SDWWTP reclaimed water as well. However, as mentioned above, projecting the demand for irrigation at nurseries and for other non-edible crops is difficult due to the industry's volatility, and infrastructure planning is a challenge. For example, a 24-inch reclaimed water line could be routed to an agricultural area with a higher density of tropical fruits and nurseries that expects to use a significant volume of reclaimed water for irrigation. However, once the line is installed, economic conditions may change and the crops in half the area may be converted to row crops while the other half is converted to residential or commercial development. The new land use significantly diminishes the utilization of reclaimed water and the justification of the 24-inch line's installation cost.

Very little agriculture is located in the NDWWTP and CDWWTP service boundaries. In addition, treatment upgrades at both of these plants would be necessary to meet the regulatory requirements for use of reclaimed water for agricultural irrigation.

4.1.3 Industrial Reuse

Reclaimed water can be used by some industries for various applications, such as cooling water, boiler feed water, process water, and vehicle wash water. The location of the industry/potential user and the volume of water needed will play a role in the practicality of supplying reuse water. For example, providing reclaimed water to the corner gas station car wash in a highly developed area is not viable since the volume of water used is very small compared to the cost. On the other hand, a facility that uses at least several MGD may be worth consideration.

The use of wastewater for industrial purposes is regulated under Chapter 62-610 Part VII. In general, industrial applications require secondary treatment and basic disinfection which is the level of treatment currently provided by each of the WWTPs. Each individual industry may have additional water quality requirements that should be considered during planning.

Three major industrial users were identified in the previous reuse studies and include:

- Cooling Water for the Florida Power and Light (FPL) Power Plant at Turkey Point;
- Miami-Dade County Resource Recovery Facility; and
- Miami-Dade WWTP Facilities (North, Central and South Plants).

Of these three users, only the three Miami-Dade WWTP facilities have implemented process reuse.

E & E initiated efforts to reassess the opportunities to provide reclaimed water to FPL and to the Miami-Dade Resource Recovery Facility, and to determine if any other large industrial users with potential exist.

In the 1998 Reuse Feasibility Study, 130 to 195 MGD of cooling water needs were identified at the FPL Turkey Point Power Plant. At that time, those needs were being met with a “closed” cooling water system of canals, and that is still the case. There appear to be limited benefits of replacing or supplementing the canal water with reclaimed water. However, an opportunity did arise with the expansion of the fossil fuel portion of the plant. An additional 17 MGD was needed for cooling purposes in this expansion. Based on initial discussions with MDWASD, FPL indicated that they needed water with very strict water quality limits including very low levels for ammonia-nitrogen. After reviewing options, FPL decided to utilize the Floridan Aquifer for their water needs. While it is still possible to provide reclaimed water to FPL to meet the 17 MGD cooling water needs, the cost of treatment is significantly increased due to the low ammonia-nitrogen levels required. This type of reuse provides no offsets to public consumption and other more beneficial projects were identified at the SDWWTP.

Discussions with facility personnel indicated that very little potential for reuse currently exists at the Department of Solid Waste Management’s Resource Recovery Facility. Estimated needs in the previous reuse feasibility study likely included water used in the shredding process for dust control and equipment washing. The shredding operation was discontinued in 1994 (Casey 2006). Although the Department of Solid Waste Management is included on the list of large potable water users, the water consumption estimates were obtained from MDWASD billing records, and represent all Miami-Dade County’s Solid Waste Management Facilities rather than a single location.

As discussed in Section 2, E & E obtained records from MDWASD for the major potable water users from 2000 to 2004 in the county. From the list of consumptive users, a number of large industrial users were identified and contacted to discuss possible reuse opportunities. Among the top users were Miami-Dade County Parks and Recreation Department, Miami-Dade Aviation Department, various hotels, hospitals and laundry facilities, schools and universities, bottling facilities, and concrete production companies.

Many of the major water users, such as the Miami-Dade Seaport, cannot utilize reclaimed water since they need it for potable purposes. After speaking with facility personnel, it appears that the majority of the potable water (about 75 to 80%) used at the port is for cruise ships. The cruise ships dock at the port to dump and refill the potable water tanks onboard the ships. Only minimal wash down is done on the cargo ships that dock at the port, thus, reuse at this facility does not appear reasonable.

The Miami International Airport (MIA) is also a major user of water but much of the water is for potable use. While there are a number of grassed areas that could be irrigated, the amount of water reused may not justify the costs to install distribution piping under runways through a complex network of fuel piping and underground utilities, and throughout very active areas of the airport. The potential to use reclaimed water for washing airplanes was also discussed. Telephone conversations with MIA staff indicated that most airplane-washing activities are mainly conducted at other major airline hubs.

One major industrial user, which may have some reuse potential, is Rinker (Concrete Production). It was identified as a major potable water user for the past four years, and after speaking with facility personnel, there may be some potential water reuse at their facilities. Rinker is comprised of nine satellite batch facilities that mix concrete. Six of the nine batch facilities are supplied by onsite wells. The other three batch facilities use potable water and their locations include a downtown facility, an airport facility, and a mid-town facility. A few possible areas of potential reuse for Rinker include mixing concrete in trucks, spraying onsite aggregate piles, washing trucks before leaving the plant, filling water tanks on the trucks for slump and cleaning trucks at the job site, and irrigating landscaped areas onsite. Based on information from Rinker personnel, each facility individually can use only a small volume of reuse water (just over 0.1 MGD). There may be water quality concerns associated with mixing the reclaimed water with concrete. The Department of Transportation (DOT) would have to approve any water quality changes prior to implementation. Based on these constraints, Rinker is not being considered as a major industrial user for this planning-level effort. However, once reuse infrastructure is identified and potential reuse projects go into planning stages, additional communication with Rinker is encouraged to further identify reuse opportunities and discuss other areas such as quarries. Once the final design routing of reclaimed lines is established, it may be feasible to distribute reclaimed water to a few of the existing Rinker facilities if they are in close proximity to the main distribution lines.

The Miami-Dade Metro Zoo has 290 acres that are regularly irrigated, as well as 50 cages that are cleaned daily.

Another major industrial user that was identified from the major consumer list is the Miami-Dade Metro Zoo. After speaking with facility personnel, a few areas of potential reuse were identified. The zoo has approximately 290 acres that are irrigated on a regular basis with five onsite private wells. Reuse water is a viable option for this acreage. Also, to maintain cleanliness at the zoo, approximately 50 animal cages are washed out daily. The water provided for cleaning the cages also comes from an onsite well. All water that is runoff from the zoo is collected in a large collection basin and then discharged to the nearby sanitary sewer. All water that is discharged to the sanitary sewer system is metered and the zoo is charged. Recently, the zoo has begun taking actions to reduce the amount of water that is discharged into the sanitary sewer system. The zoo is looking for areas of improvement for reuse, and it may be possible to locate a satellite treatment plant onsite to provide reuse flow. This is an option that may be discussed further with the zoo. This type of facility would be a small plant, a fraction of 1 MGD, and would serve only the Miami-Dade Metro Zoo to save sewer charges. A cost-benefit analysis would have to be conducted to determine if this option is a worthwhile investment for the zoo. In discussions with the MDWASD, there are a number of concerns with having small scale plants throughout their service area, as discussed further in Section 4.1.9.

Another possible industrial user identified as part of stakeholder meetings was the City of North Miami Beach. The City is proposing to use reclaimed water for a vehicle-washing facility located approximately 200 yards from Biscayne Boulevard. The City is proposing to use a pipeline to provide irrigation to medians along Biscayne Boulevard, while providing reclaimed water for the vehicle washing facility as part of Phase 1 of their reuse proposal. Phase 1 amounts to approximately 0.25 MGD.

Of these potential users, only the City of North Miami Beach vehicle-wash facility has been included in the reuse alternatives presented in Section 4.2. By increasing the filtration and chlorination capacity at the NDWWTP, the quality of the reuse water produced at this plant would meet the requirements for vehicle washing and public access irrigation. Similar levels of treatment would be required to service the zoo and Rinker facilities that could be serviced by the other wastewater plants.

4.1.4 Aquifer Recharge

Aquifer recharge is the application of water to supplement a freshwater aquifer. As discussed in the 1998 Reuse Feasibility Study, infiltration trenches remain a more feasible alternative for aquifer recharge in terms of permitting and implementation when compared to injection wells. This type of reuse may be less costly to implement per gallon of water than other reuse options. The City of Homestead currently operates a 6 MGD plant, treats water to public assess standards, and recharges the groundwater via six infiltration galleries. Figure 4.1.4-1 shows a typical cross-section of such infiltration gallery or trench. Currently, most of the water is discharged in two of the trenches at a rate of approximately 6,600 GPD per linear foot of trench.

Aquifer recharge projects are regulated under Part V of Chapter 62-610, F.A.C. Under this rule, characterization of the TDS concentration of groundwater contained in the aquifer receiving the reclaimed water is required. This characterization shall be made at the time of the initial permit application and should be based on best available information. If the available information is not sufficient to classify a proposed project based on the TDS at the point of injection, a pilot well program shall be conducted before submittal of the engineering report in order to make a definitive determination of TDS at the point of injection. The reclaimed water shall not contain more than 5.0 mg/L of TSS before application of the disinfectant. Filtration shall be provided for TSS control and to remove pathogens. Total nitrogen shall be limited to 10 mg/L as a maximum annual average. Primary and secondary drinking water standards must be met in order for the reclaimed water to be injected in the aquifer.

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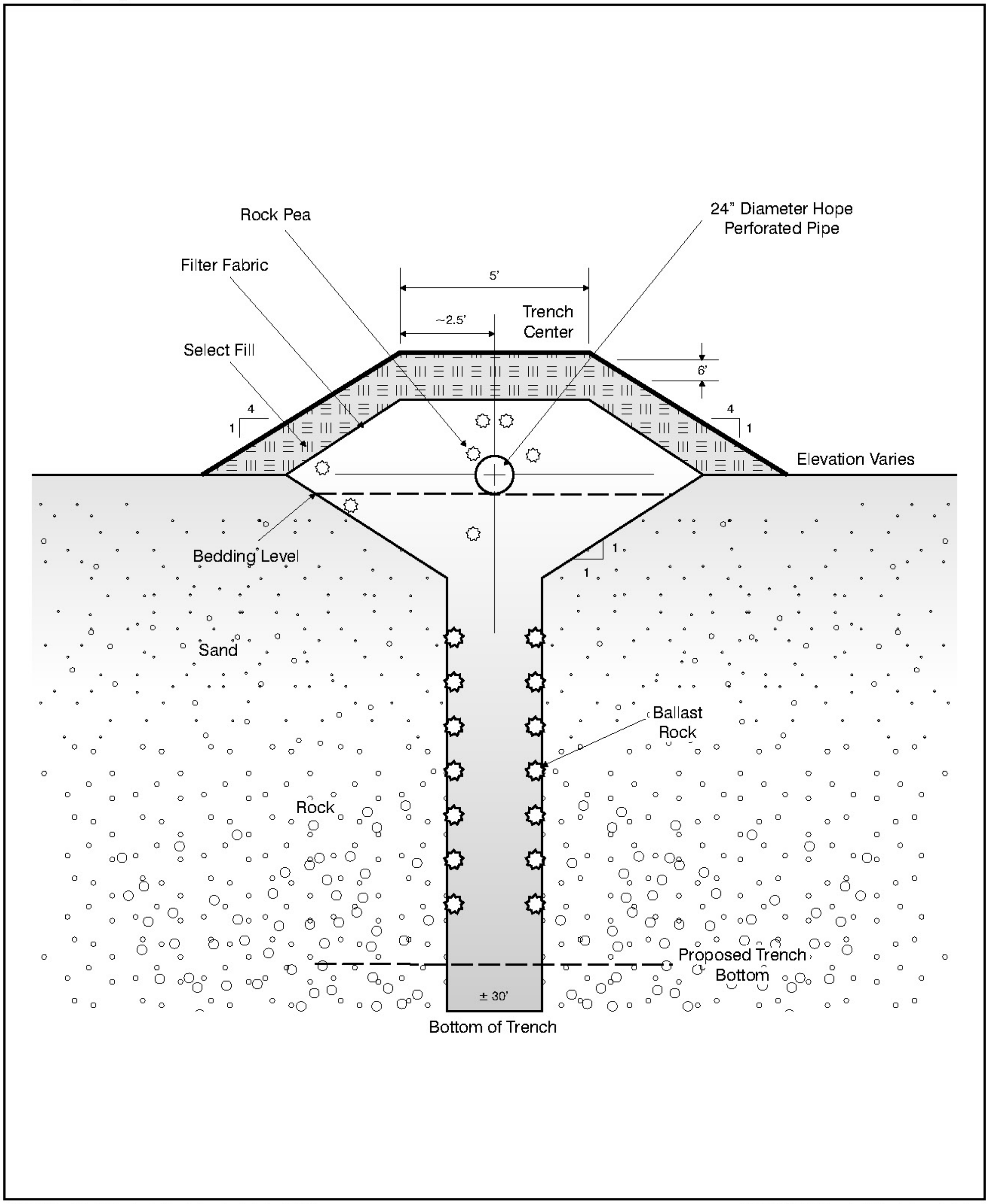

SOURCE: Ecology and Environment, Inc., 2006

Figure 4.1.4-1 TYPICAL RAPID INFILTRATION TRENCH CROSS SECTION DETAIL

For injection to G-II groundwater, the TDS determination shall be made at the point of injection and will not consider TDS in contiguous groundwaters. The TDS determination made at the time of the initial permit application shall remain unchanged, even if the injection of reclaimed water alters the TDS concentration over a period of time. Reclaimed water is used in a manner that is consistent with the permit, such that public health and environmental quality will be protected.

If aquifer recharge is achieved through rapid infiltration basins or trenches, this method is regulated under Chapter 62-610 Part IV. Because of the somewhat limited ability of these systems to further treat the reclaimed water, the permittee shall, in the engineering report, address (in detail) the ability of the proposed project to meet groundwater criteria at the edge of the zone of discharge. Projects having hydrogeologic or other project characteristics unfavorable for achieving the combined objectives of reuse of reclaimed water, and groundwater protection shall meet the requirements of Rule 62-610.525, F.A.C. New rapid-rate land application projects involving continuous loading to a single basin, percolation cell, or absorption field shall meet the requirements in Rule 62-610.525, F.A.C.

To maximize the potential for potable water offset credit, the best location to recharge the aquifer, based on feedback from the SFWMD, would be near the water supply wells which are within wellfield protection areas. However, the discharge of reclaimed water within the wellfield protection area is not consistent with the Wellfield Protection Ordinance established in Chapter 24 of Miami-Dade County Code. A variance from the Miami-Dade County Environmental Quality Control Board (EQCB) would be required to allow the discharge of highly treated reclaimed water within designated wellfield protection areas. Aquifer recharge applied further away from the wellfield protection areas may or may not result in consumptive use offsets but represents a viable means to reuse significant quantities of reclaimed water and provide localized groundwater recharge.

DERM has expressed concerns about aquifer recharge in areas immediately adjacent to Biscayne Bay. If locations adjacent to Biscayne Bay are considered for aquifer recharge, it will be necessary to evaluate whether or not groundwater and/or surface water exchanges from the rapid infiltration trenches (RITs) with Biscayne Bay exist and if this exchange would cause degradation to Biscayne Bay. If so, treatment to OFW criteria will be necessary.

Opportunities and priorities for aquifer recharge are heavily dependent on the location of the recharge project and required level of treatment. This reuse option was considered in parks and greens spaces close to the WWTPs as part of low reuse scenario. As part of the higher reuse scenarios, additional parks were identified farther away from the WWTPs and near or within wellfield protection areas, where implementation would be more difficult. To address some of the treatment questions that are being brought up by various stakeholders, a pilot effort is underway to determine the most appropriate level of treatment for aquifer recharge.

While water quality requirements for aquifer recharge may vary depending on where the recharge takes place, the reuse water would need to meet, at a minimum, FDEP drinking water standards. In order to meet those standards at the SDWWTP, the only necessary upgrades are additional filtration and chlorination. This additional treatment is already planned for the SDWWTP. As discussed in previous sections, effluent from the CDWWTP is high in chlorides, and RO would be required to reduce the chloride levels to meet drinking water standards. Higher levels of treatment at each of the plants may be required if the wellfields or OFWs are affected.

Some of the main concerns with discharging reclaimed water into or near the wellfield protection areas are the potential risks associated with microconstituents. Microconstituents include materials such as prescription and over-the-counter drugs (hormones, steroids, antibiotics, pain relievers, and others), personal care products (cosmetics, sunscreen, perfumes, among others), surfactants, plasticizers and other chemicals derived from the treatment process such as polychlorinated phenoxyphenols. Sampling performed by the USGS at the SDWWTP shows that a number of microconstituents, as one would expect, are currently present in the effluent from this plant. Should aquifer recharge impact the wellfield protection areas, treatment for microconstituents is recommended. Research indicates that some treatment trains incorporating microfiltration, RO, UV disinfection, and advanced oxidation may treat most of the microconstituents discovered to date. The Groundwater Replenishment System in Orange County, California is a good example of high-level treatment of reclaimed water for aquifer recharge. This system incorporates microfiltration, RO, and disinfection by UV and peroxide.

4.1.5 Saltwater Barrier

In the 1992 and 1998 Reuse Feasibility Reports, two types of saltwater barriers were discussed. The first one, shown on Figure 4.1.5-1, involved the injection of reclaimed water along the fringes of the saltwater intrusion line (saltwater front) near the coast (represented by the location of groundwater containing 1,000 mg/L of chloride at the base of the aquifer). The second type of saltwater barrier is the use of reclaimed water to keep the stages in the canals high enough to provide a head differential. This subsection focuses on the first type of barrier since canal recharge is presented below in subsection 4.1.6.

The most recent map showing the extent of saltwater encroachment, as provided by MDWASD, is represented on Figure 4.1.5-1. Several of the Miami-Dade County wellfields are threatened by this encroachment including the proposed South Dade wellfields.

The 1998 Reuse Feasibility Study Update recommended four locations in which to install injection wells along the coast. Each location consisted of ten 12-inch diameter wells spaced 500 feet apart along the saltwater front. Each well was proposed to be 120 feet deep. The SDWWTP would provide the reclaimed water to the injection wells. In concept, those assumptions are still reasonable and no changes were made.

Wells discussed above meet the Class V injection well definition and, thus, require individual UIC permits. Injection of reclaimed water is heavily regulated by state and federal agencies. These agencies' regulations prohibit injection of fluids that do not meet applicable water quality standards. Florida regulations prohibit the direct pumping of reclaimed water into any geologic formation of the Biscayne Aquifer containing less than 500 mg/L TDS. Additional concerns when considering saltwater intrusion barriers relate to the proximity of the barriers to Biscayne Bay and potential interactions with the Bay. These interactions would have to be studied in detail and defined in order to determine the water quality requirements necessary to protect the Bay while protecting Miami-Dade County's potable water source from saltwater intrusion.

Depending on the local geology/geologic profile and the TDS of the formation fluid, the following FDEP regulations and criteria apply:

1. Reclaimed water may be used to create fresh water barriers to impede landward or upward migration of salt water into Class F-I, G-I, or G-II groundwaters.

2. If rapid-rate land application systems are used to create such barriers, the requirements in Part IV of Chapter 62-610, F.A.C., shall apply. Rapid-rate land application systems are not subject to regulation under Part V of Chapter 62-610, F.A.C.

3. Except as provided in subsection 62-610.562(4), F.A.C., if injection systems are used, the requirements of Rule 62-610.560, F.A.C., shall apply.

4. Treatment requirements specified in subsection 62-610.560(3), F.A.C., shall apply to salinity barrier systems involving injection to Class G-II groundwater containing 1,000 to 3,000 mg/L of TDS, if certain criteria are met as specified in more details in the rule.

5. The Department shall approve less restrictive discharge limitations for parameters which are included as drinking water standards in either of the following circumstances:

    a. An aquifer exemption has been granted, as provided in subsection 62-528.300(3), F.A.C.

    b. A parameter exemption has been granted, as described in Rule 62-520.500, F.A.C.

6. If the Department establishes alternative discharge limitations in accordance with subsection 62-610.560(5), F.A.C., the alternative limit shall be applied as a single sample maximum.

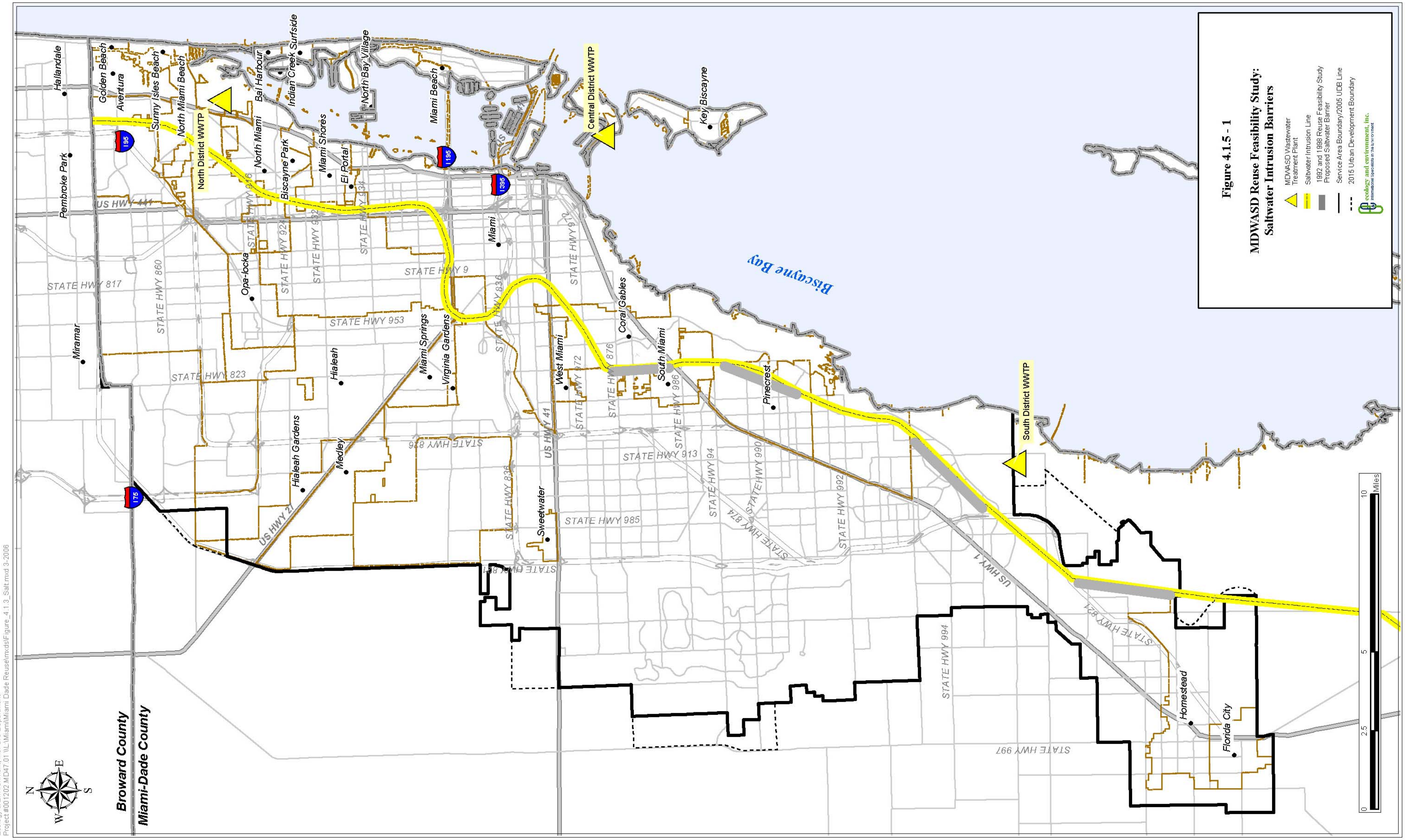
Figure 4.1.5 - 1
MDWASD Reuse Feasibility Study:
Saltwater Intrusion Barriers
MDWASD Wastewater Treatment Plant
Saltwater Intrusion Line
1992 and 1998 Reuse Feasibility Study Proposed Saltwater Barrier
Service Area Boundary/2005 UDB Line
2015 Urban Development Boundary
Miles
0
2.5
5
10
North District WWTP
Central District WWTP
South District WWTP
Biscayne Bay
Broward County
Miami-Dade County
Hallandale
Golden Beach
Aventura
Sunny Isles Beach
North Miami Beach
Bal Harbour
Indian Creek
Surfside
North Bay Village
Miami Beach
North Miami
Biscayne Park
Miami Shores
El Portal
Miami
Key Biscayne
Pembroke Park
Miramar
Opa-locka
Hialeah
Hialeah Gardens
Medley
Miami Springs
Virginia Gardens
West Miami
Coral Gables
South Miami
Pinecrest
Sweetwater
Homestead
Florida City

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Based on discussions to date, treatment requirements for use of reclaimed water as a saltwater intrusion barrier would be similar to those outlined in Section 4.1.4 for aquifer recharge outside the wellfield protection areas.

4.1.6 Canal Recharge

The concept behind canal recharge is the discharge of reclaimed water into select canals to recharge the aquifer and/or prevent saltwater intrusion. The primary focus in the previous reuse studies was to retard saltwater intrusion by raising canal stages. Due to their proximity to the South and North District WWTPs, the Black and Snake Creek Canals, respectively, were previously deemed as preferred locations for canal recharge. While this idea still has merit, the focus has shifted to recharging the aquifer and reducing reliance on the regional system. However, careful consideration of flood protection and further clarification of water quality requirements is needed to assess the full effects of canal recharge.

Based on model runs by the SFWMD as part of efforts for the CERP, an average of 105,000 acre-feet of water per year (on average over 94 MGD) was estimated to be delivered from Lake Okeechobee to the Lower East Coast Service Area 3 in year 2005 to maintain canal stages and rehydrate the wellfields. This number is much higher during dry periods since there is less recharge occurring from rainfall.

The SFWMD has a strong interest in further assessing the feasibility of this option since it may significantly reduce reliance on the regional system for water supply deliveries. The SFWMD and FDEP have jointly funded an effort to conduct an initial canal recharge feasibility study for Palm Beach, Broward, and Miami-Dade Counties. The primary emphasis is on water quality issues but subsequent efforts, including modeling, will be needed to address water quantity, recharge, and flood protection issues.

In Miami–Dade County, the C-2, C-4, C-6, C-9 and L-31 (north and west) Canals (as shown on Figure 2.1.2, Existing Wetland and Surface Water Features) are directly tied into the regional system. These canals should be considered first when evaluating canal recharge since they could have the greatest impact on reducing water deliveries from Lake Okeechobee. Based on a review of model runs (water budgets) conducted for baseline conditions for the CERP, the C-4 Canal seemed to be the only canal (with exception of C-2) that recharged the aquifer. While no model results were available, it is suspected that the C-2 Canal may be similar to the C-4 Canal since they are in the same area. All the other canals tend to serve as a drain on a net annual basis, and groundwater flows into them rather than the canal recharging the aquifer. The amount of water from the C-4 Canal that recharged the aquifer over a 12-year period of record ranged from 13 MGD to 61 MGD with an annual average of 44.3 MGD (unpublished SFWMD model runs). For the purposes of this study, it is assumed that a total of at least 40 MGD of reclaimed water can be used for recharge (in addition to help prevent salt water intrusion) in the C-4 Canal, potentially offsetting some water supplies. Additionally, reclaimed water could be used in several other canals, including those previously identified in the 1998 Reuse Feasibility Study, to maintain canal stages and prevent saltwater intrusion.

Nevertheless, additional assessment is needed. It is suspected that most of the reuse efforts would be limited to dry season conditions due to concerns with flood protection during rainy periods.

When discharges to surface waters are used as a backup to reuse systems, stormwater is frequently treated to reclaimed water standards before being discharged. Discharge to Class I drinking water requires principal treatment, which consists of secondary treatment and high-level disinfection. Discharge to waters contiguous to Class I waters requires review of the travel time of effluent to the drinking water intake; the discharge must also meet Technology Based Effluent Limits (TBELs) or Water Quality Based Effluent Limits (WQBELs), as established by the permit. TBELs and WQBELs are based on the characteristics of the discharge, the receiving-water characteristics, and the criteria and standards of Chapter 62-302 F.A.C. The FDEP may require that a facility meet additional water-quality-based effluent limits that provide and enforce more stringent requirements for effluent quality.

Effluent discharge must not exceed 10 mg/L total nitrogen (Chapter 62-600.402 F.A.C. (2)(a)(2)), and effluent must contain maximum pollutant levels less than those specified for community water systems in Chapter 62-550. These facilities must be designed to reduce TSS to 5.0 mg/L or less before the application of disinfectant (Chapter 62-600.540 F.A.C (5)(e)). Section 403.086, F.S., provides further guidelines and limitations.

Discharges to OFW and Outstanding National Resource Waters (ONRW), such as BNP and ENP, need to meet antidegradation requirements. No degradation of water quality, other than that allowed in subsections 62-4.242(2) and (3), F.A.C., is to be permitted in OFW or ONRW and notwithstanding any other FDEP rules that allow water quality lowering. FDEP will not permit or issue a water quality certification for any proposed activity or discharge within an OFW or ONWR which degrades the water resource.

Depending on the final location of canal recharge implementation, improvements at each of the WWTPs would be needed to meet water quality standards and to address potential concerns regarding microconstituents. Based on discussions with the regulatory agencies, it is likely that the treatment requirements for canal recharge will consist of microfiltration, RO, UV disinfection, advanced oxidation and chemical nutrient removal. Since most of the reclaimed water that would recharge into the groundwater would be better quality than existing water in the canals, and little to no reclaimed water would discharge to Biscayne Bay, it would not be unreasonable to assume that the antidegradation criteria for Biscayne Bay would not be applicable (subject to final confirmation from FDEP and DERM). If Biscayne Bay were to be affected, confirmation that treatment met OFW criteria would be required.

4.1.7 Wetland Application

The use of reclaimed water to restore wetlands is deemed a beneficial reuse of wastewater. Given the large amount of wetlands in the southeastern and western portions of Miami-Dade County, some opportunities to rehydrate wetlands exist. The two most prominent wetland areas that were identified as part of the CERP were the Biscayne Bay Coastal Wetlands and the Bird Drive Recharge Area (as seen on Figure 2.1.2-1, Existing Wetlands and Water Surface Features). These two areas were slated to be evaluated as CERP projects to provide regional water supply and environmental benefits. However, evaluation by the United States Army Corps of Engineers (USACE) and SFWMD of the reclaimed water component of these projects has been moved back in the CERP schedule, and funding is currently in limbo. As these are both large areas and rehydrating them will provide regional benefits, and since reclaimed water has already been identified as a source of water for this purpose, these projects have been included for consideration in this reuse study.

The purpose of the Biscayne Bay Coastal Wetlands Project is to improve conditions in the wetlands and nearshore bay by increasing sheet flow and rehydrating the wetlands.

The purpose of the Biscayne Bay Coastal Wetlands project is to improve conditions in the wetlands and nearshore bay by increasing sheet flow and rehydrating the wetlands. One of the biggest challenges is finding sufficient water supplies. One potential source (nearly 131 MGD) identified was reclaimed water from the SDWWTP.

The proposed Bird Drive Recharge Project covers 2,877 acres in western Miami-Dade County and was envisioned to recharge the groundwater and reduce seepage from the ENP buffer areas. Most of the land is in public ownership. The original plan for Bird Drive included a western sub-regional wastewater treatment plant. As part of the Wastewater Master Plan update, MDWASD will evaluate the feasibility of a west Miami-Dade Reuse facility. Alternatives to the sub-regional plant such as smaller satellite treatment or direct transmission from the existing regional treatment plants are considered in this study. Currently, the Bird Drive Recharge Project lies within the boundary of the West Wellfield Protection Zone and would require a variance from the Miami-Dade County EQCB for implementation. Alternatively, recent modeling efforts by the MDWASD based on actual pumpage rates and projected pumpages for 2025 result in a much smaller footprint for the West Wellfield than what is depicted in the currently adopted wellfield protection area boundary. The current boundary was based on 140 MGD pump rates and the current limit is 15 MGD. Reevaluation and delineation of the wellfield protection area would reduce the obstacles associated with this project. This option may need to be explored further with DERM if the Bird Drive Recharge Project is to be pursued.

During a Water Conservation and Reuse public meeting, a stakeholder group expressed specific interest in the Biscayne Bay Coastal Wetlands project and encouraged Miami-Dade County to consider it in the reuse plan. In general, stakeholders support the concept of using reclaimed water for wetland rehydration. This application can reuse large volumes of highly treated wastewater and provides multiple benefits. Increased freshwater flows to the Biscayne Coastal Wetlands can help reduce high salinity problems in Biscayne Bay, improve wetland function and habitat, and recharge the groundwater. Additionally, the use of reclaimed water for rehydration of coastal wetlands may be considered by the SFWMD as offsetting future water consumption. The specific details of which projects and how many water supply credits are granted for a given reuse project have not been fully defined though. Since Biscayne Bay is an OFW, the most significant constraint, as will be discussed in greater detail below, is very stringent water quality criteria.

Per FDEP rules, the definition of a "receiving wetland" is a wetland used to receive reclaimed water that contains, on an average annual basis, not more than the following concentrations:

- Carbonaceous Biochemical Oxygen Demand ($CBOD_5$) → 5 mg/L
- Total Suspended Solids (TSS) → 5 mg/L
- Total Nitrogen (N) → 3 mg/L
- Total Phosphorus (P) → 1 mg/L

Discharges to wetlands are subject to the requirements of Chapter 62-611, F.A.C. Discharges to other surface waters are subject to the requirements of Chapter 62-650, F.A.C. Discharges to a wetlands or other surface water which recharges groundwater through vertical percolation also are subject to regulation under the groundwater rules in Chapters 62-520 and 62-522, F.A.C. These surface water discharges are not subject to regulation under Chapter 62-610, F.A.C.

The use of wetlands as treatment or receiving wetlands shall not be permitted where:

- Wetlands are within Class I or Class II waters (Section 62-302.400, F.A.C.).
- The wetland is an herbaceous wetland, unless the herbaceous groundcover of the entire wetland is more than 50% cattail or is a hydrologically altered wetland.

- Wetlands are within an OFW as listed in Section 62-302.700, F.A.C. (treatment only).
- Wetlands are within areas designated as areas of critical State concern as of October 1, 1985 (treatment only).

When the receiving wetlands are tidal coastal wetlands adjacent to a water body designated OFW, such as Biscayne Bay, discharges are allowed as long as there will be no negative effect on the OFW. Discharges that are allowed by State Statutes to receiving wetlands are several orders of magnitude higher than requirements for sensitive receiving water bodies such as Biscayne Bay. Therefore, standards for receiving wetlands are not adequately protective and much higher levels of treatment are necessary for any discharges to OFWs. Such treatment should occur at the plant and/or in an upstream treatment wetland that is not part of the OFW.

The CERP South Miami-Dade Wastewater Reuse Pilot Project Delivery Team established performance measures (PMs) related to the quality of water required to rehydrate coastal wetlands and Biscayne Bay. These PMs required total phosphorous concentrations of 5 parts per billion (ppb) or less, nitrite/nitrate not to exceed 10 ppb, and ammonia (N) concentrations of 0.02 to 0.05 mg/L. Salinity concentrations near shore required concentrations between 10 and 20 parts per thousand. These values are based on antidegradation standards and were documented by actual ambient water quality as determined by long-term monitoring of surface waters in Biscayne Bay.

To meet the antidegradation criteria, chemical treatment for nitrogen will be necessary. However, it may be impossible to meet the total phosphorus target of 5 ppb at the end of the treatment train. Chemical treatment trains have been developed to reduce phosphorus levels below 0.010 mg/L; however, no data on systems treating to less than 0.005 mg/L have been found. The feasibility of treating wastewater streams to a level acceptable for use in the wetlands system in Miami-Dade County should be revisited following continued discussions with regulatory agencies on the Coastal Wetlands Rehydration Project.

In addition to the regulatory requirements, it will be necessary, based on stakeholder input and consideration, to provide the treatment of microconstituents. As discussed in Section 4.1.4, the treatment of microconstituents may not be complete since new compounds are frequently discovered in waste streams. Microconstituents are a concern in ecological settings, such as wetlands and estuaries, because of the exposure pathways that affect organisms at particularly sensitive life stages, throughout their entire life history, or that may be transmitted though an entire food web. Limited data are available documenting the response of ecological receptors to the wide class of microconstituents, thus their impact is not clearly understood at present.

4.1.8 Satellite Treatment

Satellite treatment, or sewer mining, is the practice of removing raw sewage from existing sanitary sewer pipelines or lift stations located near end users and treating it locally. In recent years, membrane bioreactors (MBRs) have come a long way in sewer mining applications due to their compactness, efficiency and level of treatment, and retrofitting capability. These small localized treatment plants discharge the solids back into the existing sanitary sewer pipeline to be processed further at the centralized wastewater treatment plant. Once the recovered wastewater flows through the MBR, the public access quality effluent can be used to irrigate residential lawns, public parks, playing fields, and landscapes. In Miami-Dade County, the use of satellite facilities may require levels of treatment higher than public access quality.

Examples of MBR plants that incorporate the visual character of the area.

Satellite treatment has become very popular in the recent years and is ideally suited for a number of applications in areas far removed from the centralized plants. The footprint that can be achieved with this type of plant is relatively small for the amount of wastewater that can be treated. For this reason, it is desirable in areas of high urbanization and in areas where aesthetics are important, such as a residential developments, commercial centers, office parks, or natural parks. For instance, in a new residential development, an MBR plant can be housed in a home within the development.

These packaged systems also allow for retrofitting for increased treatment capacity when more houses are built or if another end-user wants to connect to the system.

Cauley Creek Water Reclamation Facility.

The Cauley Creek Water Reclamation Facility in Fulton, Georgia is a good example of this technology for reclaimed water use. It was designed to resemble a barn and blend in with the rural surroundings. This facility treats and provides 5 MGD of wastewater for irrigation of homes, golf courses, churches, and schools. During the wet season, the treated effluent meets all required standards for surface water discharge into the nearby Chattahoochee River.

A potential location for a satellite mining pilot study or projects in Miami-Dade County might be in the central portion of the county in the vicinity of Doral Golf Course and Costa Greens Golf Clubs, particularly for urban irrigation projects. The MBR treatment plant could readily serve these two golf courses. Also, the existing Fontainebleau Golf Course, located just a few blocks south, is being developed as a new residential sub-division and could also be served by this MBR plant in the future.

Another potential location considered for sewer mining was the City of Hialeah. The City of Hialeah would like to develop a site located in northwest Miami-Dade County, and is considering ways to offset their future water demand. The City has considered reuse as well as treating water from the Floridan Aquifer with RO for this purpose. Subject to approval of the proposed development and further details of the reuse and alternative water supply plans, satellite treatment may be a viable option.

A number of factors must to be evaluated prior to implementation of a satellite treatment system. In-depth cost comparisons should be completed to verify the cost differences between satellite treatment and transmission of treated water from existing district WWTPs. Figures 4.1.8-1 and 4.1.8-2 consider typical MBR capital costs versus the capital costs for transmission of a given volume of treated wastewater from a centralized treatment facility. Note, these figures are based on treating the wastewater to public access reuse quality. As the figures show, at higher reuse volumes, transmission of treated water from a central facility, if possible, may be more cost effective than satellite treatment. While not evaluated, higher levels of treatment will make satellite facilities less cost effective. Additionally, the logistics of the operation and maintenance of multiple satellite treatment plants may be difficult to manage and economies of scale provided by few very large WWTPs for operation and maintenance will be lost.

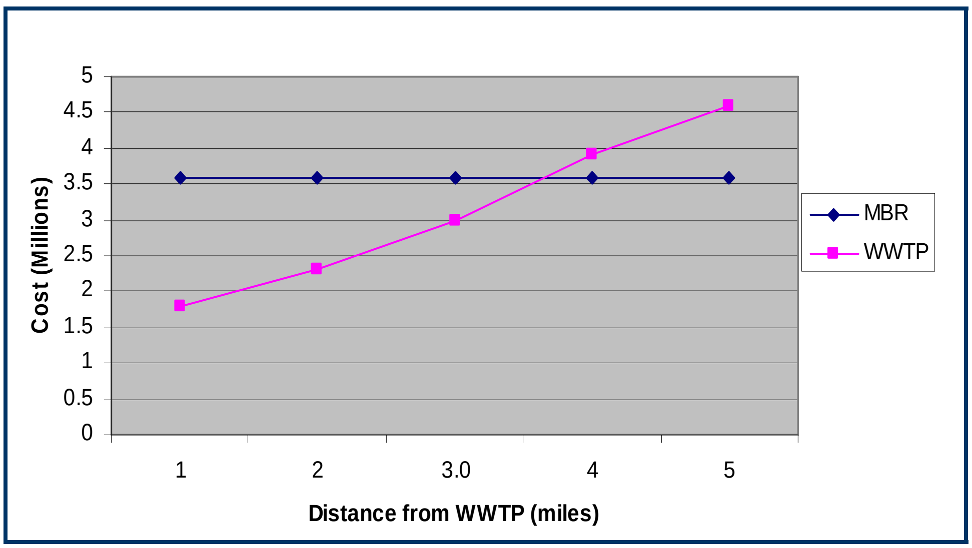

Figure 4.1.8-1. Membrane Bioreactor vs. Wastewater Treatment Plant (0.5 MGD Flow)

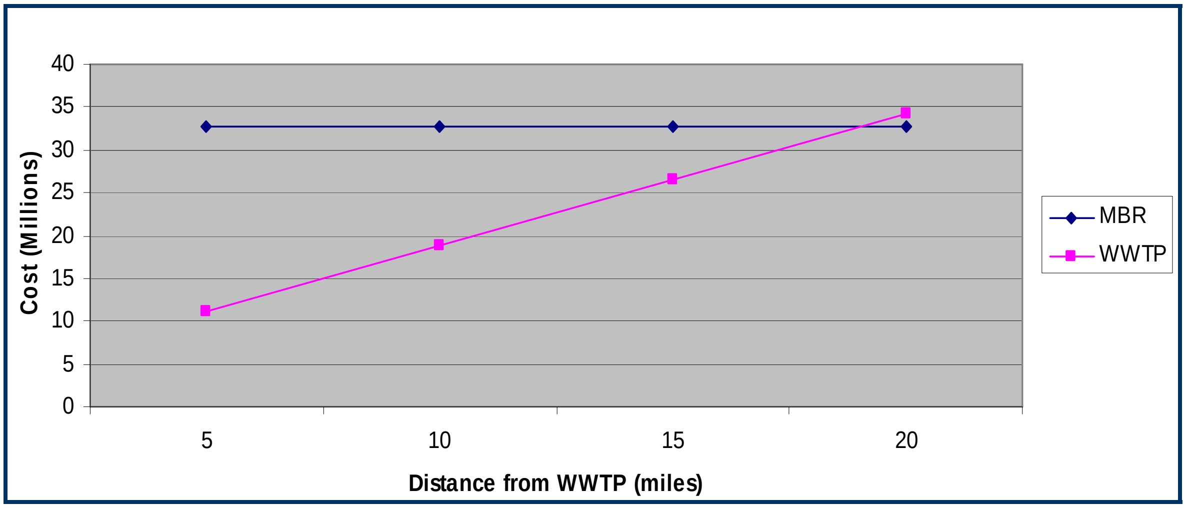

Figure 4.1.8-2 Membrane Bioreacter vs. Wastewater Treatment Plant (2.5 MGD Flow)

While the above-mentioned locations seem reasonable for satellite treatment, and the concept is favored by FDEP and SFWMD, the idea of having a number of smaller plants spread throughout the county creates an increased level of maintenance, compliance, and permitting issues for the MDWASD. In past decades, the MDWASD has worked closely with FDEP to establish a centralized wastewater treatment system, and do away with small facilities that are scattered throughout the county. In this effort, the Miami-Dade Board of County Commissioners' policy is to maintain an integrated, centralized wastewater treatment system rather than return to their previous practices.

4.1.9 Potable Reuse

Direct Potable Reuse is the most extreme alternative for wastewater reuse. Due to the constraints with this option, it is generally used as a last resort and in areas where water is very scarce. One of the first major constraints to direct potable reuse is the need for advanced wastewater treatment technologies to bring wastewater back to drinking water quality. The level of treatment may even be higher than that needed for aquifer recharge since there is no additional natural treatment of the reclaimed water with direct reuse.

The second, and even more difficult, constraint to resolve is the perception and negativity of end users. The public has a preconceived notion that reclaimed water will never be clean enough to drink, even though various projects have indicated otherwise. A number of pilot studies across the world have indicated that the effluent from advanced technology wastewater treatment plants is actually cleaner than the water delivered out of the tap from their potable waterlines. Since other viable options exist for alternative water supplies in Miami-Dade, including indirect water use, and due to public perception issues, reuse for direct potable purposes is not considered further in this reuse study.

4.2 DEVELOPMENT OF REUSE ALTERNATIVES

Per *FDEP Guidelines for Preparation of Reuse Feasibility Studies* (1991), at a minimum, a no-action alternative along with a reuse alternative must be identified and evaluated as part of the Reuse Feasibility Study. The reuse alternative consists of public access reuse for three sub-alternatives: maximum reuse, medium reuse, and low reuse. The maximum reuse sub-alternative is defined as public access reuse equivalent to "over 75 percent of the average annual daily flow of domestic wastewater generated in the design-year" (FDEP 1991). The medium reuse sub-alternative refers to a reuse volume between 40 and 75% of the wastewater generated, while the low reuse sub-alternative refers to less than 40% of the wastewater generated. Both the 1992 and 1998 Reuse Feasibility Studies concluded that a reuse alternative consisting of public access reuse projects equivalent to, or in excess of, 25% of the total future wastewater generation, as stated in FDEP's *Guidelines for Preparation of Reuse Feasibility Studies,* would not be economically feasible. The reuse alternatives evaluated incorporated other forms of reuse, in addition to public access, to achieve the maximum, medium, and low reuse alternatives. As in previous efforts, other types of reuse, such as aquifer recharge, wetland rehydration, and canal recharge, were evaluated to develop the reuse alternatives.

The alternatives developed and evaluated in this study are:

- Alternative A: Maximum Reuse Alternative;
- Alternative B: Medium Reuse Alternative;
- Alternative C: Low Reuse Alternative; and
- Alternative D: No-Action Alternative.

To develop each alternative, individual projects were identified based on opportunities and constraints, and input from various stakeholders. Initially, projects providing wastewater reuse as well as potable water supply offsets were given priority in order to satisfy MDWASD's consumptive use needs, as requested by the SFWMD. The SFWMD suggested identifying projects that would offset water supply for each service area and, potentially, for each wellfield. However, projects located within, or adjacent to a number of the wellfields may be limited due to physical constraints, availability of land, and concerns with the local wellfield protection ordinance. Table 4.2-1 provides a summary of the 2003 Biscayne Aquifer withdrawals and future finished water demands for 2025. The remaining gap, or balance, will have to be met by alternative water supplies including reuse. This study evaluated potential opportunities to recharge the service area in order to offset future potable water needs. Of particular concern for all reuse options are microconstituents such as pharmaceutical residuals typically found in wastewater. The fate and impact of these materials should be understood prior to implementing any particular treatment technology for any of the reuse alternatives. Whether and where tertiary treatment with disinfection is adequate to protect public health and the environment in Miami-Dade County will need to be established by competent factual data. Additional investigation/pilot studies are needed to develop local, scientific, and real-time data. Until these additional investigations and pilot studies (see Section 4.4) are finalized, the treatment assumptions included in this study may change.

Table 4.2-1. MDWASD's Existing Biscayne Aquifer Withdrawals and Future Average Annual Daily Potable Water Demands per Service Area

Service Area / Wellfield	2003 Biscayne Aquifer Withdrawal[(a)] (MGD)	Projected 2025 Finished Water Demand[(b)] (MGD)	Expected Water Conservation[(c)] (MGD)	Finished Water Gap[(d)] (MGD)
Hialeah-Preston Service Area	162.10	185.30	4.88	18.32
Alexander-Orr Service Area	169.40	215.21	5.58	40.23
South-Dade Service Area	6.80	17.09	0.38	9.91

Source: Valdes 2006b.
Notes:
(a) Biscayne withdrawals represent average annual daily flow for 2003.
(b) Assumes 155 gallons per capita per day.
(c) Part of MDWASD's 20-year water conservation plan.
(d) Anticipated finished water that will be offset by alternative water supplies.
Key:
MDWASD = Miami-Dade Water and Sewer Department.
MGD = million gallons per day.

4.2.1 Alternative A: Maximum Reuse Alternative

The maximum reuse alternative incorporates projects based on: the major user analysis discussed in Section 2.3.4; projects identified during stakeholder meetings with FDEP, SFWMD, MDWASD, DERM, and the National Park Service (NPS); previous studies; and all other potential ideas submitted through meetings and public comments. All ideas were evaluated based on MDWASD staff experience, successful case studies in other locations, and best available information. The projects were grouped to form Alternative A based on the following:

- The types of reuse include urban irrigation, industrial use, canal recharge, rapid infiltration (aquifer recharge), and wetland recharge. Irrigation and aquifer recharge projects within several of the wellfield protection areas are included.
- All the wastewater treatment plants will require some degree of upgrading.
- The amount of water that is shown in this alternative for the Biscayne Bay Coastal Wetlands is the balance of the remaining wastewater effluent not reused for other purposes. The amount estimated is a little over 52 MGD, but depending on needs and priorities, some or all of the other SDWWTP projects could be eliminated. Thus, higher volumes of reclaimed water could be available for the Biscayne Bay Coastal Wetlands.

- The reject stream from the RO facilities is estimated to be 25%. For this scenario, the concentrate is assumed to be reinjected in the wastewater treatment plant stream in order to achieve higher levels of reuse.
- Small-scale users in the North District (Southern Memorial Cemetery, the Justice Center, and Miami-Dade Fire and Rescue) were included because they are located in very close proximity to the NDWWTP.
- RITs are located on county-owned property.
- The proposed transmission routes are located along existing rights-of-way and/or on other Miami-Dade County-owned land. A more detailed assessment of the transmission routing for all the alternatives will need to be done in a subsequent phase since a number of logistical constraints are associated with pipeline installation (particularly large lines) in an urban area.

Table 4.2.1-1 shows the projects included in this alternative. Figure 4.2.1-1 shows the project locations. The total reuse volume for Alternative A (305.52 MGD) amounts to 81.7% of the future total wastewater for 2025. Figure 4.2.1-2 summarizes the type of reuse and corresponding volumes for this alternative.

Table 4.2.1-1. Summary of Reuse Projects for Alternative A (Maximum Reuse)

Application	Total Wastewater Used for Reuse Projects (MGD)	CUP Offset?	Minimum Offset Volume (MGD)	Comments
NDWWTP Wastewater Projected = 120 MGD				
Process Reuse (existing)	2.13	No		Existing, does not count towards future offset.
Florida International University (existing)	0.1	No		Existing, does not count towards future offset.
North Miami Stadium Irrigation (99)	0.27	Yes	0.27	Based on previous estimates from 1998 Reuse Feasibility Study estimate.
City of North Miami Beach Irrigation	4.9	Yes	4.9	City of North Miami Beach.
City of North Miami Beach Vehicle Washing	0.1	Yes	0.1	City of North Miami Beach.
Nearby Small Scale User Irrigation	0.1	Yes	0.1	
Ives Estates Park Irrigation (0)	0.73	No		Private wells.
Greynolds Park Golf Course Irrigation (1)	1.05	No		Private wells.
East Greynolds Park Irrigation (54)	0.33	No		Private wells. Adjacent to Biscayne Bay Aquatic Preserve.
California Golf Courses Irrigation (8)	0.89	No		Private wells.
Miami Shores Country Club Irrigation (10)	1.1	No		Private wells.
Biscayne Landing New Development Irrigation	1.5	Yes	1.5	Assume 15% green space to be irrigated. May reduce future potable water demand.
Amelia Earhart Park Irrigation (67)	4.11	No		Private well.
Haulover Golf Course and Marina Irrigation (2)[b]	1.35	Yes	1.35	Uses public water supply. Miami Beach (MDWASD). Adjacent to Biscayne Bay Aquatic Preserve.
Fairmount Turnberry Isle Resort & Club (14)	1.76	No		Private well.
Country Club Miami Irrigation (9)	2.56	No		Private well.
Don Shula's Golf Course Irrigation (12)	1.46	No		Lake water.
Amelia Earhart Park RIT (67)	10.45	Possibly		Not upgradient or adjacent to MDWASD wellfield.
Ives Estates Park RIT (0)	1.86	Possibly		Not upgradient or adjacent to MDWASD wellfield.
Greynolds Park (Golf Course) RIT (1)	3.23	Possibly		Not upgradient or adjacent to MDWASD wellfield.

Table 4.2.1-1. Summary of Reuse Projects for Alternative A (Maximum Reuse)

Application	Total Wastewater Used for Reuse Projects (MGD)	CUP Offset?	Minimum Offset Volume (MGD)	Comments
Canal Recharge (C-9)	20	Possibly		Unclear how much water from regional system is provided to C-9 to maintain stages to prevent saltwater intrusion. MGD assumed per 1998 Feasibility Report.
Total NDWWTP	**59.98**		**8.22**	Up to 35.54 MGD of additional offsets may be possible for NDWWTP.
CDWWTP Wastewater Projected = 142 MGD				
Process Reuse (existing)	9.73	No		Existing, does not count towards future offset
Crandon Park (Golf Course) Irrigation (5)	0.7	Yes	0.7	Currently using potable water. Adjacent to Biscayne Bay Aquatic Preserve
Key Biscayne Residential Irrigation	0.2	Yes	0.2	Currently using potable water. Estimated based on other residential irrigation. May be greater. Adjacent to Biscayne Bay Aquatic Preserve
Tree Island Park Irrigation (127)[a]	0.93	Yes	0.93	Recharge for West Wellfield
Tropical Park Irrigation (154)[a]	2.2	Yes	2.2	Recharge for Alexander Orr Jr. WTP/Wellfield
Tropical Park RIT (154)[a]	5.58	Yes	5.58	Recharge for Alexander Orr Jr. WTP/Wellfield
Trail Glades Range Irrigation (119)[a],[c]	5.5	Yes	5.5	Recharge for West Wellfield
Trail Glades Range RIT (119)[a], [c]	13.92	Yes	13.92	Recharge for West Wellfield
Kendall Indian Hammocks Park Irrigation (185)[a]	0.05	Yes	0.05	Private wells, currently irrigate 1 acre for ball field. Portion of site Protected Natural Forest Community.
Kendall Indian Hammocks Park RIT (185)[a]	0.8	Yes	0.8	Recharge for Alexander Orr Jr. WTP/Wellfield. Portion of site Protected Natural Forest Community
Calusa Country Club Irrigation (15) (closed)[a]	1.4	Yes	1.4	Recharge for Southwest Wellfield
Miccosukee Golf & Country Club Irrigation (21)[a]	1.75	Yes	1.75	Recharge for West Wellfield
Killian Greens Country Club Irrigation (19)[a]	1.05	Yes	1.05	Recharge for Alexander Orr Jr. WTP/Wellfield
Biltmore Gold Course Irrigation (4)	1.03	No		Private wells
Granada Golf Course Irrigation (18)	0.55	No		Private wells
Miami Springs Golf & Country Club Irrigation (20)[a]	1.45	Yes	1.45	Private wells but recharge for Hialeah-Preston WTP/Wellfield
Miami Springs Golf & Country Club RIT (20)[a]	3.69	Yes	3.69	Recharge for Hialeah-Preston WTP/Wellfield

Table 4.2.1-1. Summary of Reuse Projects for Alternative A (Maximum Reuse)

Application	Total Wastewater Used for Reuse Projects (MGD)	CUP Offset?	Minimum Offset Volume (MGD)	Comments
Canal Recharge (C-2, C-4)	40	Yes	40	Directly influences several wellfields. Exact offset depends on how much recharges groundwater and how much water is provided by regional system to maintain canal stages
Tree Island Park (RIT) (127) [(a)]	2.36	Yes	2.36	Recharge for West Wellfield
Tamiami Park (187)	0.57	Yes	0.57	Recharge for Alexander Orr Jr. WTP/Wellfield
Tamiami Park RIT (187)	4.96	Yes	4.96	Recharge for Alexander Orr Jr. WTP/Wellfield
Doral Golf Course Irrigation (3)	3.88	Yes	3.88	Recharge for Hialeah-Preston WTP/Wellfield
Costa Greens Golf Club Irrigation (16)	0.6	Yes	0.6	Lake/canal water but recharge for Hialeah-Preston WTP/Wellfield
Fontainbleau Golf Course: New Residential	1.03	Yes	1.03	New development on former golf course. Also recharge for Hialeah-Preston WTP/Wellfield
Riviera Golf Course Irrigation (22)	0.49	No	0.49	Private wells
International Links of Miami Golf Course Irrigation (11)	1.00	No	1.00	Private wells
Chapman Field Park Irrigation (244)	4.47	Possibly		Private well but adjacent to Biscayne Bay
Snapper Creek Trail Irrigation (478)	0.38	Possibly		Adjacent to Biscayne Bay
West Kendall Regional Park Irrigation (228)[(a)]	1.2	Yes	1.2	Small area within wellfield area
West Kendall Regional Park RIT (228)[(a)]	3.07	Yes	3.07	Small area within wellfield area
Total CDWWTP	**114.54**		**98.38**	Up to 4.85 MGD of additional offsets may be possible for CDWWTP.
SDWWTP Wastewater Projected = 131 MGD				
Process Reuse	4.25	No		Existing, does not count towards future offset.
Homestead Air Reserve Park (354)	0.78	No		Private wells.
Palmetto Golf Course Irrigation (7)	0.91	No		Private wells.
New Developments (residential irrigation)	4.51	Yes	4.51	Potable water use expected for irrigation.
New Developments (park irrigation)	0.88	Yes	0.88	Potable water use expected for irrigation.
New Development Parks RIT (in areas of new development)	30	Possibly		Due to total volume could benefit Biscayne Bay Coastal Wetlands to some extent.
Briar Bay Golf Course (6)	0.26	No		Private well.
Metrozoo Irrigation (269)	2.25	No		Private wells. Portion of zoo Protected Natural Forest Community.

Table 4.2.1-1. Summary of Reuse Projects for Alternative A (Maximum Reuse)

Application	Total Wastewater Used for Reuse Projects (MGD)	CUP Offset?	Minimum Offset Volume (MGD)	Comments
Metrozoo RIT (269)	15	Possibly		Portion of site Protected Natural Forest Community.
Goulds Park Irrigation (452)	0.24	No		Private well.
Goulds Park RIT (452)	2.49	Possibly		Due to total volume could benefit Biscayne Bay Coastal Wetlands to some extent.
Castellow Hammock Park RIT (425)	5.5	No		Probably to remote for irrigation recharge zone. Most of site protected natural forest community.
Three Lakes Park Irrigation (317)	0.12	No		
Three Lakes Park RIT (317)	1.2	Possibly		
Homestead Air Reserve Park RIT (354)	10	Possibly		Due to total volume could benefit Biscayne Bay Coastal Wetlands to some extent.
Lakes by the Bay Park Irrigation (321)	0.8	Possibly		Adjacent to Biscayne Bay
Coastal Wetlands Rehydration Project	50.81	Yes	50.81	Water remaining from all other projects. Volume may vary depending on implementation. For example, more reclaimed water could be used for the wetlands instead of new developments or Castellow Park).
Coastal Wetlands Rehydration Demonstration Project	1	Yes	1.0	
Total SDWWTP	**131**		**57.20**	Up to 59.49 MGD of additional offsets may be possible for SDWWTP.
Total/Potential Projects	**305.52**		**163.8**	Up to 99.88 MGD of additional offsets may be possible for Alternative A.

Notes:
(a) Lies partially or fully within existing wellfield protection area.
(b) Golf course being converted to lawn area with potential for additional irrigation.
(c) Potential for wetlands rehydration.
Key:
CDWWTP = Central District Wastewater Treatment Plant.
CUP = Consumptive Use Permit.
MDWASD = Miami-Dade Water and Sewer Department.
MGD = million gallons per day.
NDWWTP = North District Wastewater Treatment Plant.
RIT = rapid infiltration trench.
SDWWTP = South District Wastewater Treatment Plant.
WTP = water treatment plant.

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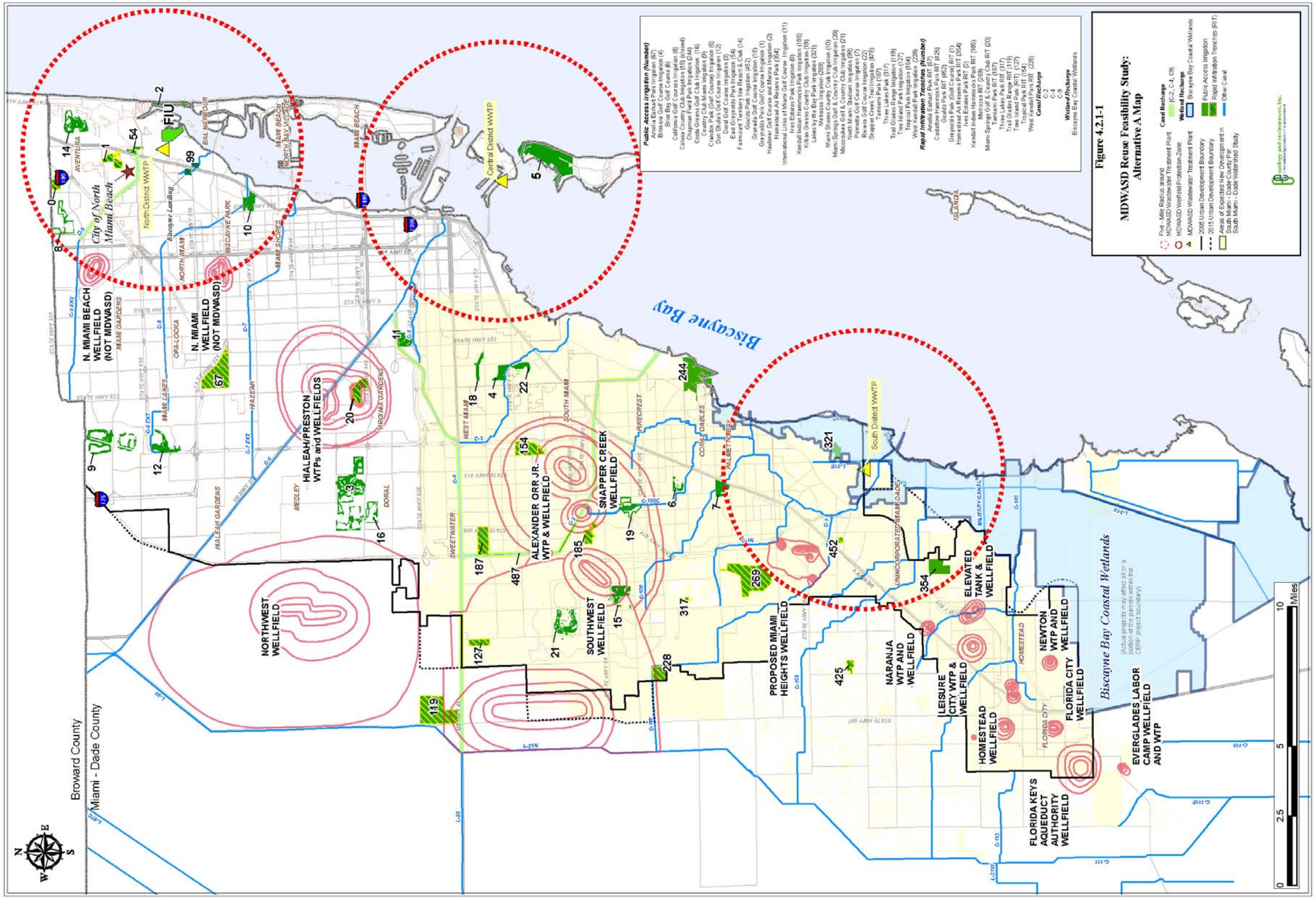

Figure 4.2.1-1
MDWASD Reuse Feasibility Study: Alternative A Map

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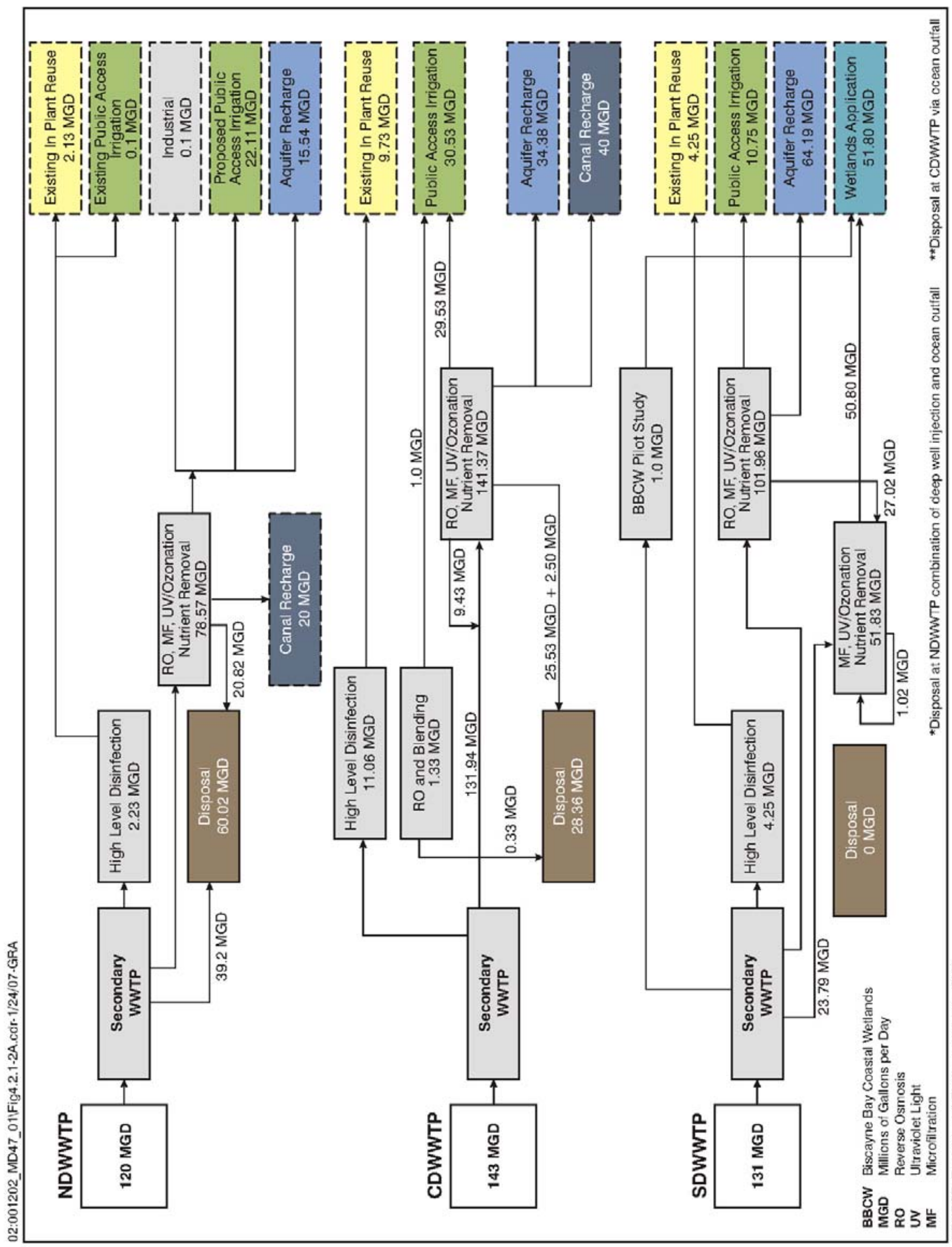


Figure 4.2.1-2 MDWASD WASTEWATER REUSE FEASIBILITY STUDY UPDATE ALTERNATIVE A: MAXIMUM REUSE ALTERNATIVE

4.2.2 Alternative B: Medium Reuse Alternative

The medium reuse alternative has fewer irrigation and rapid infiltration projects than the high reuse alternative, but more importantly does not include C-9 Canal recharge or the Biscayne Bay Coastal Wetlands project which made up over 70 MGD of the maximum reuse alternative. This medium reuse alternative (Alternative B) was developed based on the following:

- The types of reuse include urban irrigation, industrial use, rapid infiltration and canal recharge. Irrigation and aquifer recharge are included within several of the wellfield protection areas.
- All the wastewater treatment plants will require some degree of upgrading.
- The reject stream from the RO facilities is estimated to be 25%. The concentrate is assumed to be disposed of via deep-well injection.
- Small-scale users in the North District (Southern Memorial Cemetery, the Justice Center, and Miami-Dade Fire and Rescue) were included because they are located in close proximity to the NDWWTP.

This alternative represents a reuse potential of approximately 52.4% (195.85 MGD) of the total wastewater projected for the year 2025. The individual projects for Alternative B are listed in Table 4.2.2-1 and their locations are shown on Figure 4.2.2-1.

Figure 4.2.2-2 summarizes the type of reuse and corresponding volumes for this alternative.

Table 4.2.2-1. Summary of Reuse Projects for Alternative B (Medium Reuse)

Application	Total Wastewater Used for Reuse Projects (MGD)	CUP Offset?	Minimum Offset Volume (MGD)	Comments
NDWWTP Wastewater Projected = 120 MGD				
Process Reuse (existing)	2.13	No		Existing, does not count towards future offset.
Florida International University (existing)	0.1	No		Existing, does not count towards future offset.
North Miami Stadium Irrigation (99)	0.27	Yes	0.27	Based on previous 1998 Reuse Feasibility Report estimate.
City of North Miami Beach Irrigation	4.9	Yes	4.9	City of North Miami Beach.
City of North Miami Beach Vehicle Washing	0.1	Yes	0.1	City of North Miami Beach.
Nearby Small Scale User Irrigation	0.1	Yes	0.1	
Ives Estates Park Irrigation (0)	0.73	No		Private wells.
Greynolds Park Golf Course Irrigation (23)	1.05	No		Private wells.
East Greynolds Park Irrigation (54)	0.33	No		Private wells. Adjacent to Biscayne Bay Aquatic Preserve.
California Golf Courses Irrigation	0.89	No		Private wells.
Miami Shores Country Club Irrigation	1.1	No		Private wells.
Biscayne Landing New Development Irrigation	1.5	Yes	1.5	Assume 15% green space to be irrigated. May reduce future potable water demand.
Amelia Earhart Park Irrigation (67)	4.11	No		Private well.
Haulover Golf Course and Marina Irrigation[(b)]	1.35	Yes	1.35	Uses public water supply. Miami Beach (MDWASD). Adjacent to Biscayne Bay Aquatic Preserve.
Fairmount Turnberry Isle Resort & Club Irrigation	1.76	No		Private well and City of North Miami Beach.
NDWWTP Total	**20.42**		**8.22**	

Table 4.2.2-1. Summary of Reuse Projects for Alternative B (Medium Reuse)

Application	Total Wastewater Used for Reuse Projects (MGD)	CUP Offset?	Minimum Offset Volume (MGD)	Comments
CDWWTP Wastewater Projected = 142 MGD				
Process Reuse (existing)	9.73	No		Existing, does not count towards future offset.
Doral Golf Course Irrigation (3)	3.88	Yes	3.88	Recharge for Hialeah-Preston WTP/Wellfield.
Costa Greens Golf Club Irrigation (16)	0.6	Yes	0.6	Lake/canal water but recharge for Hialeah-Preston WTP/Wellfield.
Fontainbleau Golf Course: New Residential	1.03	Yes	1.03	New development on former golf course. Also recharge for Hialeah-Preston WTP/Wellfield.
Crandon Park (Golf Course) Irrigation (5)	0.7	Yes	0.7	Currently using potable water Adjacent to Biscayne Bay Aquatic Preserve.
Key Biscayne Residential Irrigation	0.2	Yes	0.2	Estimated based on other residential irrigation. May be greater. Adjacent to Biscayne Bay Aquatic Preserve.
Tree Island Park Irrigation (127)[a]	0.93	Yes	0.93	Recharge for West Wellfield.
Tropical Park Irrigation (154)[a]	2.2	Yes	2.2	Recharge for Alexander Orr Jr. WTP/Wellfield.
Tropical Park RIT (154)[a]	5.58	Yes	5.58	Recharge for Alexander Orr Jr. WTP/Wellfield.
Trail Glades Range Irrigation (119)[a]	5.5	Yes	5.5	Recharge for West Wellfield.
Trail Glades Range RIT (119) [a],[c]	13.92	Yes	13.92	Recharge for West Wellfield.
Kendall Indian Hammocks Park Irrigation (185)[a]	0.05	No		Private wells, currently irrigate 1 acre for ball field. Portion of site Protected Natural Forest Community.
Kendall Indian Hammocks Park RIT (185)[a]	0.8	Yes	0.8	Recharge for Alexander Orr Jr. WTP/Wellfield. Portion of site Protected Natural Forest Community.
Calusa Country Club Irrigation (15)[a]	1.4	Yes	1.4	Recharge for Southwest Wellfield.
Miccosukee Golf & Country Club Irrigation (21)[a]	1.75	Yes	1.75	Recharge for West Wellfield.
Killian Greens Country Club Irrigation (19)[a]	1.05	Yes	1.05	Recharge for Alexander Orr Jr. WTP/Wellfield.
Biltmore Gold Course Irrigation (4)	1.03	No		Private wells.

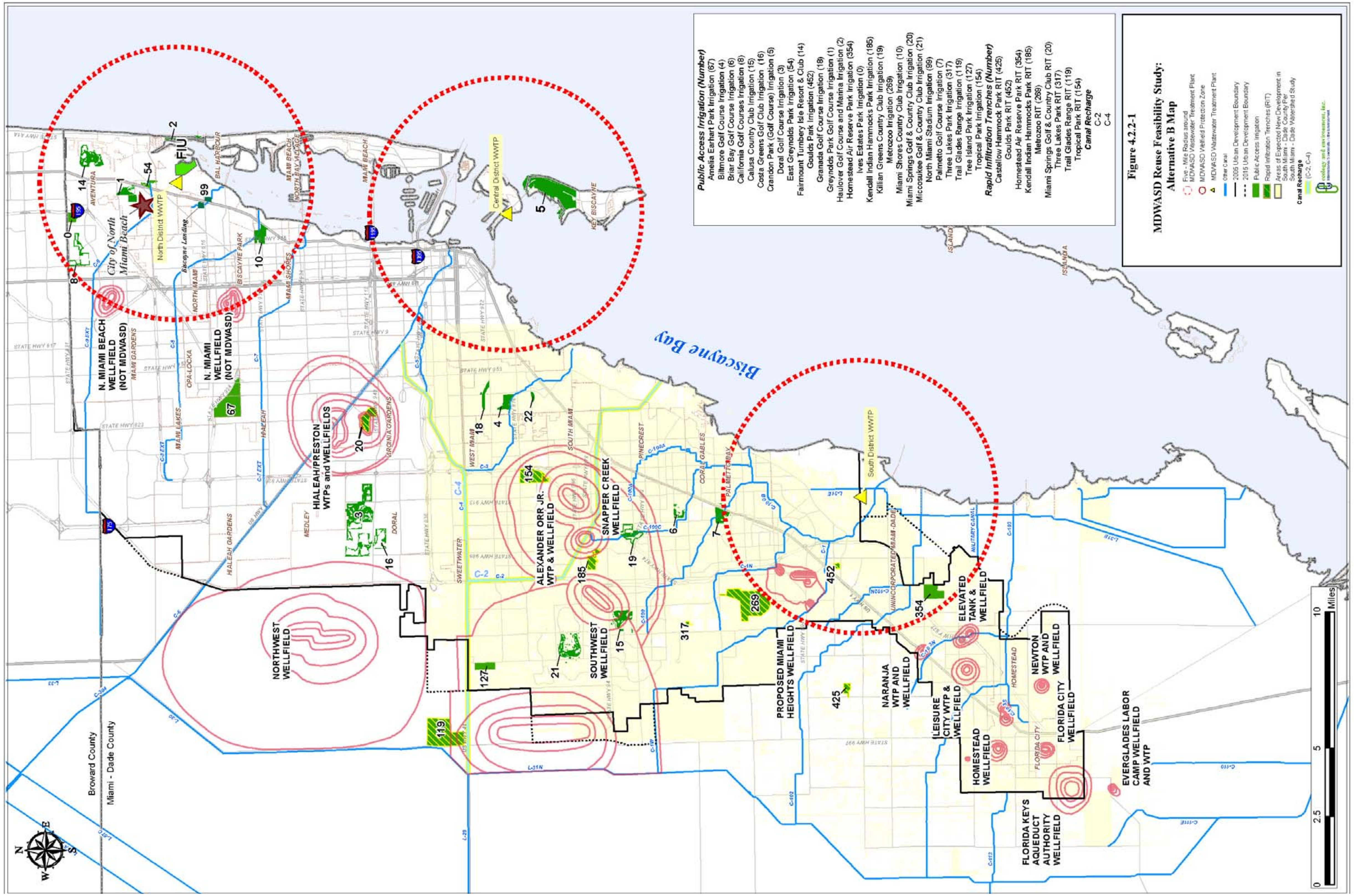
Table 4.2.2-1. Summary of Reuse Projects for Alternative B (Medium Reuse)

Application	Total Wastewater Used for Reuse Projects (MGD)	CUP Offset?	Minimum Offset Volume (MGD)	Comments
Granada Golf Course Irrigation (18)	0.55	No		Private wells.
Miami Springs Golf & Country Club Irrigation (20)[(a)]	1.45	Yes	1.45	Private wells but recharge for Hialeah-Preston WTP/Wellfield
Miami Springs Golf & Country Club RIT (20)[(a)]	3.69	Yes	3.69	Recharge for Hialeah-Preston WTP/Wellfield
Canal Recharge (C-2, C-4)	40	Yes	40	up to 40 mgd
CDWWTP Total	**96.04**		**84.68**	
SDWWTP Wastewater Projected = 131 MGD				
Process Reuse	4.25	No		Existing, does not count towards future offset
Homestead Air Reserve Park Irrigation (354)	0.78	No		Private wells
Palmetto Golf Course Irrigation (7)	0.91	No		Private wells
New Developments (residential irrigation)	4.51	Yes	4.51	Potable water use expected for irrigation
New Developments (park irrigation)	0.88	Yes	0.88	Potable water use expected for irrigation
New Development Parks RIT (in areas of new development)	30	Possibly		Due to total volume could benefit Biscayne Bay Coastal Wetlands to some extents
Briar Bay Golf Course Irrigation (6)	0.26	No		Private well
Metrozoo Irrigation (269)	2.25	No		Private wells. Portion of site Protected Natural Forest Community
Metrozoo RIT (269)	15	Possibly		Portion of site Protected Natural Forest Community
Goulds Park Irrigation (452)	0.24	No		Private well
Goulds Park RIT (452)	2.49	Possibly		Due to total volume could benefit Biscayne Bay Coastal Wetlands to some extents
Castellow Hammock Park RIT (425)	5.5	No		Probably to remote for irrigation recharge zone. Most of site protected natural forest community
Three Lakes Park Irrigation (317)	0.12	No		

Table 4.2.2-1. Summary of Reuse Projects for Alternative B (Medium Reuse)

Application	Total Wastewater Used for Reuse Projects (MGD)	CUP Offset?	Minimum Offset Volume (MGD)	Comments
Three Lakes Park RIT (317)	1.2	Possibly		
Homestead Air Reserve Park RIT (354)	10	Possibly		Due to total volume could benefit Biscayne Bay Coastal Wetlands to some extent
Coastal Wetlands Rehydration Demonstration Project	Potential for 1 MGD	Yes	1.0	
SDWWTP Total	**79.39**		**6.39**	Up to 58.69 MGD of additional offsets may be possible for SDWWTP
Total/Potential Projects	**195.85**		**99.29**	Up to 58.69 MGD of additional offsets may be possible for Alternative B

Notes:
(a) Lies partially or fully within existing wellfield protection area.
(b) Golf course being converted to lawn area with potential for additional irrigation.
(c) Potential for wetlands rehydration.
Key:
CDWWTP = Central District Wastewater Treatment Plant.
CUP = Consumptive Use Permit.
MDWASD = Miami-Dade Water and Sewer Department.
MGD = million gallons per day.
NDWWTP = North District Wastewater Treatment Plant.
RIT = rapid infiltration trench.
SDWWTP = South District Wastewater Treatment Plant.
WTP = water treatment plant.


Public Access Irrigation (Number)
Amelia Earhart Park Irrigation (67)
Biltmore Golf Course Irrigation (4)
Briar Bay Golf Course Irrigation (6)
California Golf Courses Irrigation (8)
Calusa Country Club Irrigation (15)
Costa Greens Golf Club Irrigation (16)
Crandon Park (Golf Course) Irrigation (5)
Doral Golf Course Irrigation (3)
East Greynolds Park Irrigation (54)
Fairmount Turnberry Isle Resort & Club (14)
Goulds Park Irrigation (452)
Granada Golf Course Irrigation (18)
Greynolds Park Golf Course Irrigation (1)
Haulover Golf Course and Marina Irrigation (2)
Homestead Air Reserve Park Irrigation (354)
Ives Estates Park Irrigation (0)
Kendall Indian Hammocks Park Irrigation (185)
Killian Greens Country Club Irrigation (19)
Metrozoo Irrigation (269)
Miami Shores Country Club Irrigation (10)
Miami Springs Golf & Country Club Irrigation (20)
Miccosukee Golf & Country Club Irrigation (21)
North Miami Stadium Irrigation (99)
Palmetto Golf Course Irrigation (7)
Three Lakes Park Irrigation (317)
Trail Glades Range Irrigation (119)
Tree Island Park Irrigation (127)
Tropical Park Irrigation (154)
Rapid Infiltration Trenches (Number)
Castellow Hammock Park RIT (425)
Goulds Park RIT (452)
Homestead Air Reserve Park RIT (354)
Kendall Indian Hammocks Park RIT (185)
Metrozoo RIT (269)
Miami Springs Golf & Country Club RIT (20)
Three Lakes Park RIT (317)
Trail Glades Range RIT (119)
Tropical Park RIT (154)
Canal Recharge
C-2
C-4
Figure 4.2.2-1
MDWASD Reuse Feasibility Study:
Alternative B Map
North District WWTP
Central District WWTP
South District WWTP
Biscayne Bay
N. MIAMI BEACH WELLFIELD (NOT MDWASD)
N. MIAMI WELLFIELD (NOT MDWASD)
HIALEAH/PRESTON WTPs and WELLFIELDS
NORTHWEST WELLFIELD
ALEXANDER ORR JR. WTP & WELLFIELD
SNAPPER CREEK WELLFIELD
SOUTHWEST WELLFIELD
PROPOSED MIAMI HEIGHTS WELLFIELD
ELEVATED TANK & WELLFIELD
NARANJA WTP AND WELLFIELD
LEISURE CITY WTP & WELLFIELD
NEWTON WTP AND WELLFIELD
HOMESTEAD WELLFIELD
FLORIDA CITY WELLFIELD
FLORIDA KEYS AQUEDUCT AUTHORITY WELLFIELD
EVERGLADES LABOR CAMP WELLFIELD AND WTP
Broward County
Miami - Dade County
Miles
0
2.5
5
10

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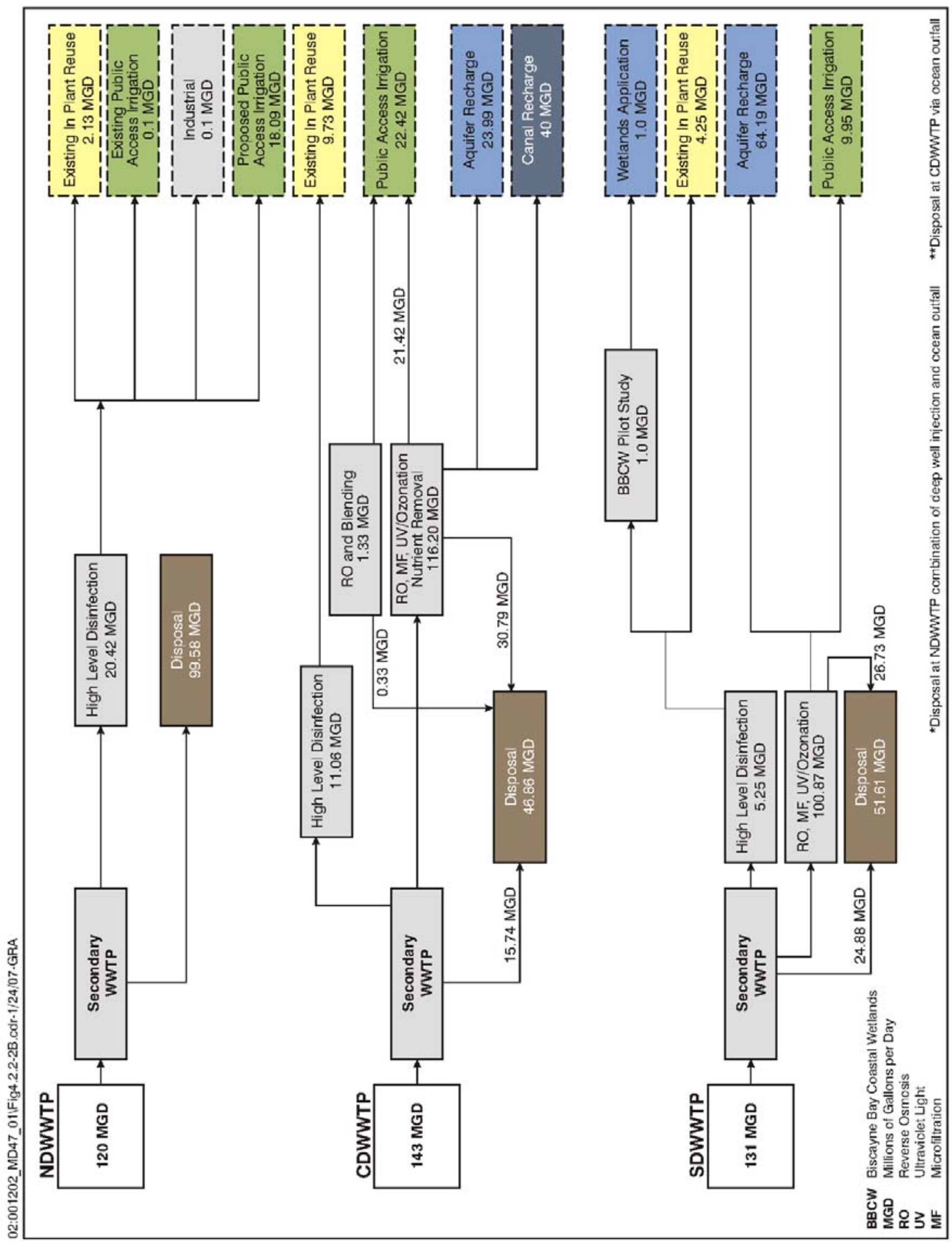


SOURCE: Ecology and Environment, Inc., 2007

Figure 4.2.2-2 MDWASD WASTEWATER REUSE FEASIBILITY STUDY UPDATE ALTERNATIVE B: MEDIUM REUSE ALTERNATIVE

4.2.3 Alternative C: Low Reuse Alternative

Alternative C relies predominantly on urban irrigation and rapid infiltration coupled with a small amount of industrial usage. Projects in close proximity to each of the existing wastewater treatment plants (within 5 miles) were identified to reduce transmission costs or satellite facilities (MBRs) were proposed for some of the more distant locations. Project associated with directly recharging the wellfields and canals were eliminated in this alternative. The total volume of reuse for this alternative is equivalent to approximately 26.0% (97.34 MGD) of the total wastewater volume projected for 2025. Key aspects of this alternative include the following:

- All reuse is in areas far outside the wellfield protection areas.
- Reuse is focused on large irrigation users (golf courses and parks) and the new growth corridor in South Miami-Dade County along U.S. Highway 1. Small-scale users in the North District (Southern Memorial Cemetery, the Justice Center, and Miami-Dade Fire and Rescue) were included because they are located in close proximity to the NDWWTP.
- The reject stream from the RO facilities is estimated to be 25%. The concentrate is assumed to be reinjected in the wastewater treatment plant stream or to be disposed of via deep-well injection.
- Projects were proposed relatively close to NDWWTP, with the exception of the irrigation of Amelia Earhart Park. An MBR was proposed at this park.
- An MBR was proposed for irrigation of an inland urban area that includes Doral Golf Course, Costa Green Golf Course, and Fontainebleau Development (former golf course currently being redeveloped into residential).

The individual projects for Alternative C are listed in Table 4.2.3-1 and their locations are shown on Figure 4.2.3-1.

The projects making up Alternative C offer water offsets strictly for the irrigation of urban areas where potable water is currently used. The offsets are somewhat limited since most of the parks and golf courses use private irrigation wells. Implementing this alternative will require Miami-Dade County to rely more on other alternative water supplies, such as the Floridan Aquifer, to meet future water demands. Additional assessment of the offsets that RITs may yield is needed to obtain a more accurate estimate of their offsets. While Alternative C is called by FDEP guidance as "minimal" or low, implementation of this scenario would place Miami-Dade County as one of the highest users of reclaimed water by volume in the state of Florida. Figure 4.2.3-2 summarizes the types of reuse and volumes for Alternative C.

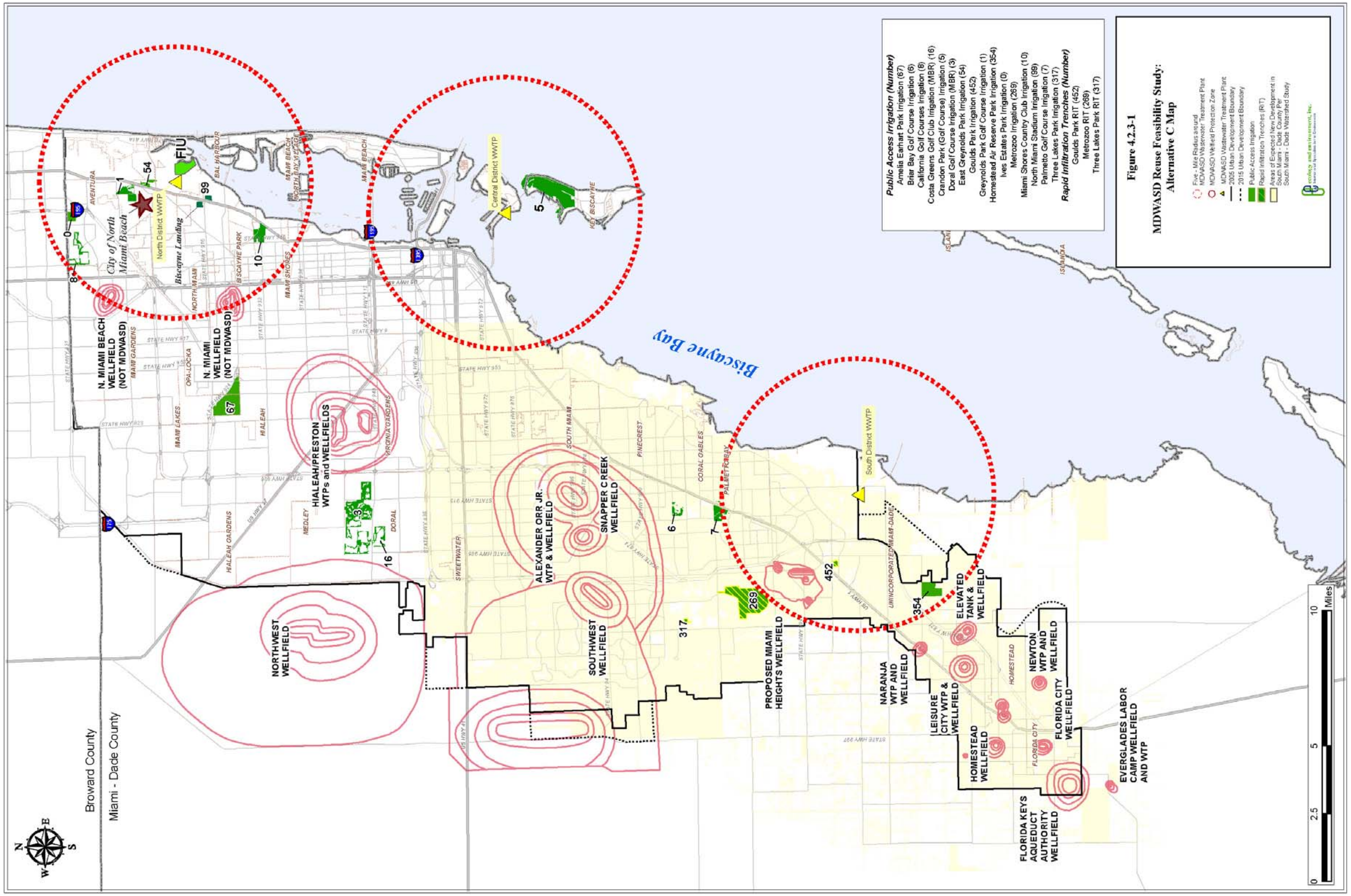
Table 4.2.3-1. Summary of Reuse Projects for Alternative C (Low Reuse)

Application	Total Wastewater Used for Reuse Projects (MGD)	CUP Offset?	Minimum Offset Volume (MGD)	Comments
NDWWTP Wastewater Projected = 120 MGD				
Process Reuse (existing)	2.13	No		Existing, does not count towards future consumptive use.
Florida International University (existing)	0.1	No		Existing, does not count towards future consumptive use.
North Miami Stadium Irrigation (99)	0.27	Yes	0.27	Based on previous 1998 Reuse Feasibility Report estimate.
City of North Miami Beach Irrigation	4.9	Yes	4.9	City of North Miami Beach.
City of North Miami Beach Vehicle Washing	0.1	Yes	0.1	City of North Miami Beach.
Nearby Small Scale User Irrigation	0.1	Yes	0.1	
Ives Estates Park Irrigation (0)	0.73	No		Private wells.
Greynolds Park Golf Course Irrigation (1)	1.05	No		Private wells.
East Greynolds Park Irrigation (54)	0.33	No		Private wells. Adjacent to Biscayne Bay Aquatic Preserve.
California Golf Courses Irrigation (8)	0.89	No		Private wells.
Miami Shores Country Club Irrigation (10)	1.1	No		Private wells.
Biscayne Landing New Development Irrigation	1.5	Yes	1.5	Assume 15% green space to be irrigated. Reduces future potable water demand.
Amelia Earhart Park Irrigation (MBR) (67)	4.11	No		Private well.
NDWWTP Total	**17.31**		**6.87**	
CDWWTP Wastewater Projected = 142 MGD				
Process Reuse (existing)	9.73	No		Existing, does not count towards future offset.
Doral Golf Course Irrigation (MBR) (3)	3.88	Yes	3.88	Recharge for Hialeah-Preston WTP/Wellfield.
Costa Greens Golf Club Irrigation (MBR) (16)	0.60	Yes	0.6	Lake/canal water but recharge for Hialeah-Preston WTP/Wellfield.
Fontainbleau Golf Course Irrigation: New Residential (MBR)	1.03	Yes	1.03	New development on former golf course. Also recharge for Hialeah-Preston WTP/Wellfield.
Crandon Park (Golf Course) Irrigation (5)	0.7	Yes	0.7	Currently using potable water Adjacent to Biscayne Bay Aquatic Preserve.
Key Biscayne Residential Irrigation	0.2	Yes	0.2	Currently using potable water. Estimate based on other residential irrigation; may be greater. Adjacent to Biscayne Bay Aquatic Preserve.
CDWWTP Total	**16.14**		**6.41**	

Table 4.2.3-1. Summary of Reuse Projects for Alternative C (Low Reuse)

Application	Total Wastewater Used for Reuse Projects (MGD)	CUP Offset?	Minimum Offset Volume (MGD)	Comments
SDWWTP Wastewater Projected = 131 MGD				
Process Reuse	4.25	No		Existing, does not count towards future offset.
Homestead Air Reserve Park Irrigation (354)	0.78	No		Private wells.
Palmetto Golf Course Irrigation (7)	0.91	No		Private wells.
New Developments (residential irrigation)	4.51	Yes	4.51	Potable water use expected for irrigation.
New Developments (park irrigation)	0.88	Yes	0.88	Potable water use expected for irrigation.
New Development Parks RIT (in areas of new development)	30	Possibly		Due to total volume could benefit Biscayne Bay Coastal Wetlands to some extent.
Briar Bay Golf Course Irrigation (6)	0.26	No		Private well.
Metrozoo Irrigation (269)	2.25	No		Private wells. Portion of site Protected Natural Forest Community.
Metrozoo RIT (269)	15	Possibly		Portion of site Protected Natural Forest Community.
Goulds Park Irrigation (452)	0.24	No		Private well.
Goulds Park RIT (452)	2.49	Possibly		Due to total volume could benefit Biscayne Bay Coastal Wetlands to some extent.
Three Lakes Park Irrigation (317)	0.12	No		
Three Lakes Park RIT (317)	1.2	Possibly		
Coastal Wetlands Rehydration Demonstration Project	Potential for 1 MGD	Yes	1.0	
SDWWTP Total	**63.89**		**5.39**	Up to 48.69 MGD of additional offsets may be possible for SDWWTP.
Total / Potential Projects	**97.34**		**19.67**	Up to 48.69 MGD of additional offsets may be possible for Alternative C.

Key:
- CDWWTP = Central District Wastewater Treatment Plant.
- CUP = Consumptive Use Permit.
- MBR = membrane bioreactor.
- MDWASD = Miami-Dade Water and Sewer Department.
- MGD = million gallons per day.
- NDWWTP = North District Wastewater Treatment Plant.
- RIT = rapid infiltration trench.
- SDWWTP = South District Wastewater Treatment Plant.
- WTP = water treatment plant.


Public Access Irrigation (Number)
Amelia Earhart Park Irrigation (67)
Briar Bay Golf Course Irrigation (6)
California Golf Courses Irrigation (8)
Costa Greens Golf Club Irrigation (MBR) (16)
Crandon Park (Golf Course) Irrigation (5)
Doral Golf Course Irrigation (MBR) (3)
East Greynolds Park Irrigation (54)
Goulds Park Irrigation (452)
Greynolds Park Golf Course Irrigation (1)
Homestead Air Reserve Park Irrigation (354)
Ives Estates Park Irrigation (0)
Metrozoo Irrigation (269)
Miami Shores Country Club Irrigation (10)
North Miami Stadium Irrigation (99)
Palmetto Golf Course Irrigation (7)
Three Lakes Park Irrigation (317)
Rapid Infiltration Trenches (Number)
Goulds Park RIT (452)
Metrozoo RIT (269)
Three Lakes Park RIT (317)
Figure 4.2.3-1
MDWASD Reuse Feasibility Study:
Alternative C Map
Five - Mile Radius around MDWASD Wastewater Treatment Plant
MDWASD Wellfield Protection Zone
MDWASD Wastewater Treatment Plant
2005 Urban Development Boundary
2015 Urban Development Boundary
Public Access Irrigation
Rapid Infiltration Trenches (RIT)
Areas of Expected New Development in South Miami - Dade County Per South Miami - Dade Watershed Study
Biscayne Bay
North District WWTP
Central District WWTP
South District WWTP
N. MIAMI BEACH WELLFIELD (NOT MDWASD)
N. MIAMI WELLFIELD (NOT MDWASD)
HIALEAH/PRESTON WTPs and WELLFIELDS
NORTHWEST WELLFIELD
ALEXANDER ORR JR. WTP & WELLFIELD
SNAPPER CREEK WELLFIELD
SOUTHWEST WELLFIELD
PROPOSED MIAMI HEIGHTS WELLFIELD
ELEVATED TANK & WELLFIELD
NARANJA WTP AND WELLFIELD
NEWTON WTP AND WELLFIELD
LEISURE CITY WTP & WELLFIELD
FLORIDA CITY WELLFIELD
HOMESTEAD WELLFIELD
FLORIDA KEYS AQUEDUCT AUTHORITY WELLFIELD
EVERGLADES LABOR CAMP WELLFIELD AND WTP
Broward County
Miami - Dade County
Miles

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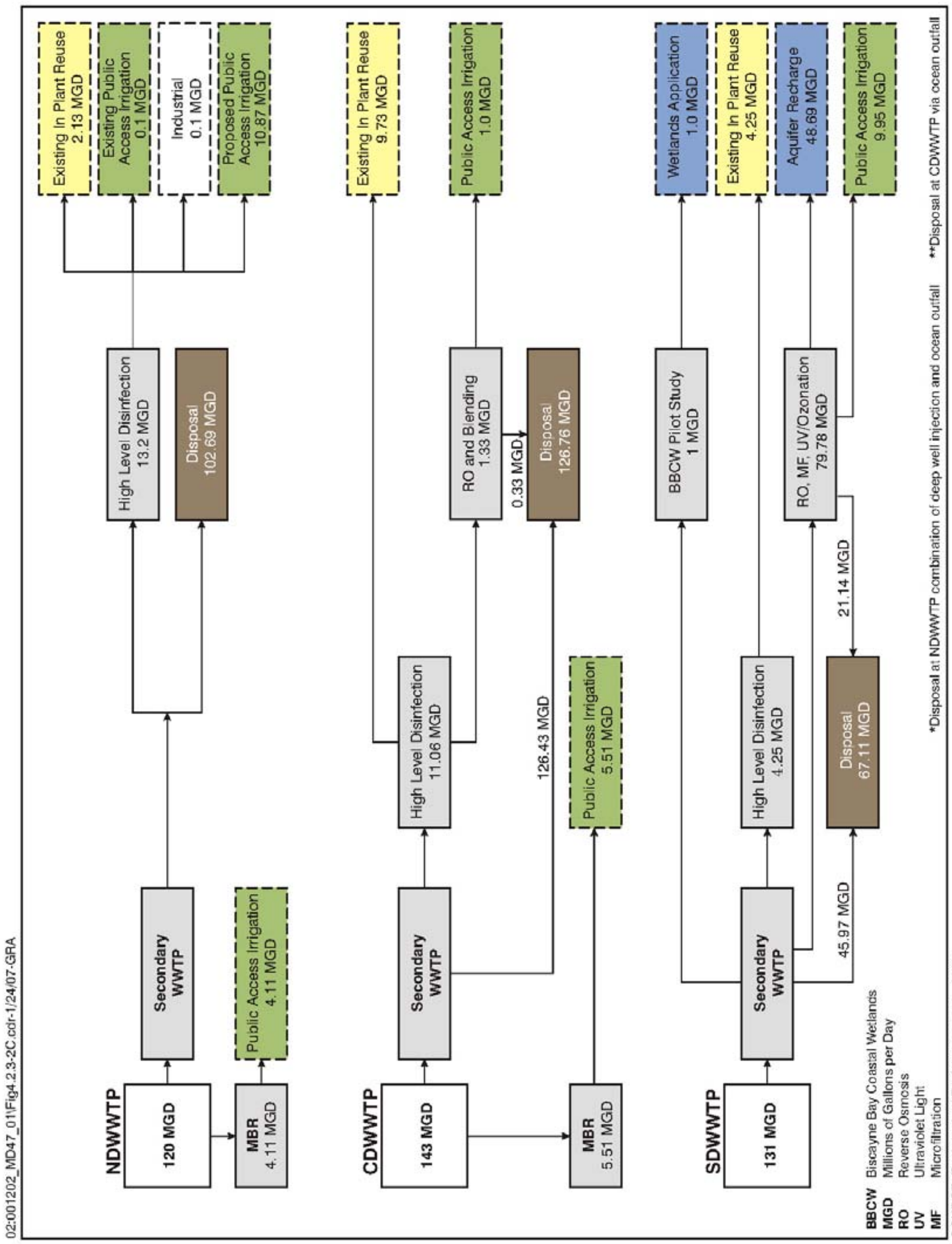

Figure 4.2.3-2 MDWASD WASTEWATER REUSE FEASIBILITY STUDY UPDATE ALTERNATIVE C: MINIMAL REUSE ALTERNATIVE

4.2.4 Alternative D: No-Action Alternative

The No-Action Alternative includes existing reuse practices and planned improvements. The volume of wastewater reused in this alternative amounts to approximately 16.21 MGD (approximately 4% of the projected wastewater flow for 2025). This reuse volume includes process and irrigation water at each of the District's WWTPs and for Florida International University's (FIU's) North Campus which is currently in place. Details of the reuse components of Alternative D (No-Action) are listed in Table 4.2.4-1. Figure 4.2.4-1 summarizes the types of reuse and volumes for Alternative D.

Table 4.2.4-1. Summary of Reuse Projects for Alternative D (No-Action)

Project Name	Reuse Volume (MGD)
NDWWTP	
Existing Process Reuse	2.13
Existing reuse at FIU	0.1
CDWWTP	
Existing Process Reuse	9.73
SDWWTP	
Existing Process Reuse	4.25
Project Total	**16.21**

Key:
CDWWTP = Central District Wastewater Treatment Plant.
FIU = Florida International University.
MGD = million gallons per day.
NDWWTP = North District Wastewater Treatment Plant.
SDWWTP = South District Wastewater Treatment Plant.

For the No-Action Alternative there will be no additional expansions or modifications to the WWTPs and associated effluent disposal systems other than what is currently underway or already planned. All the wastewater plants have adequate capacity to treat and dispose the wastewater based on current regulations for the next 20 years of growth. While collection system upgrades are already proposed in Miami-Dade County's Capital Improvement Plan (CIP) and additional improvements may be needed to address peak flows, and new regulations for ocean outfalls and deep-well injection, these projects will be completed regardless of whether reuse is implemented and are common to all the alternatives. Table 4.2.4-2 summarizes the system upgrades planned. Note, these projects are also included in Alternatives A through C; no other projects are planned under Alternative D.

This alternative currently offsets existing water consumption, but does not count as an offset for future water consumption. Given SFWMD's policy regarding the use of alternative water supplies to meet future growth, additional alternative water supply measures will be necessary to offset future demands. Under the No-Action Alternative, no portion of the future water demands will be met through reuse, and MDWASD will have to rely solely on other types of alternative water supplies to offset these future demands. Furthermore, MDWASD risks a potential moratorium for future growth and development under this alternative.

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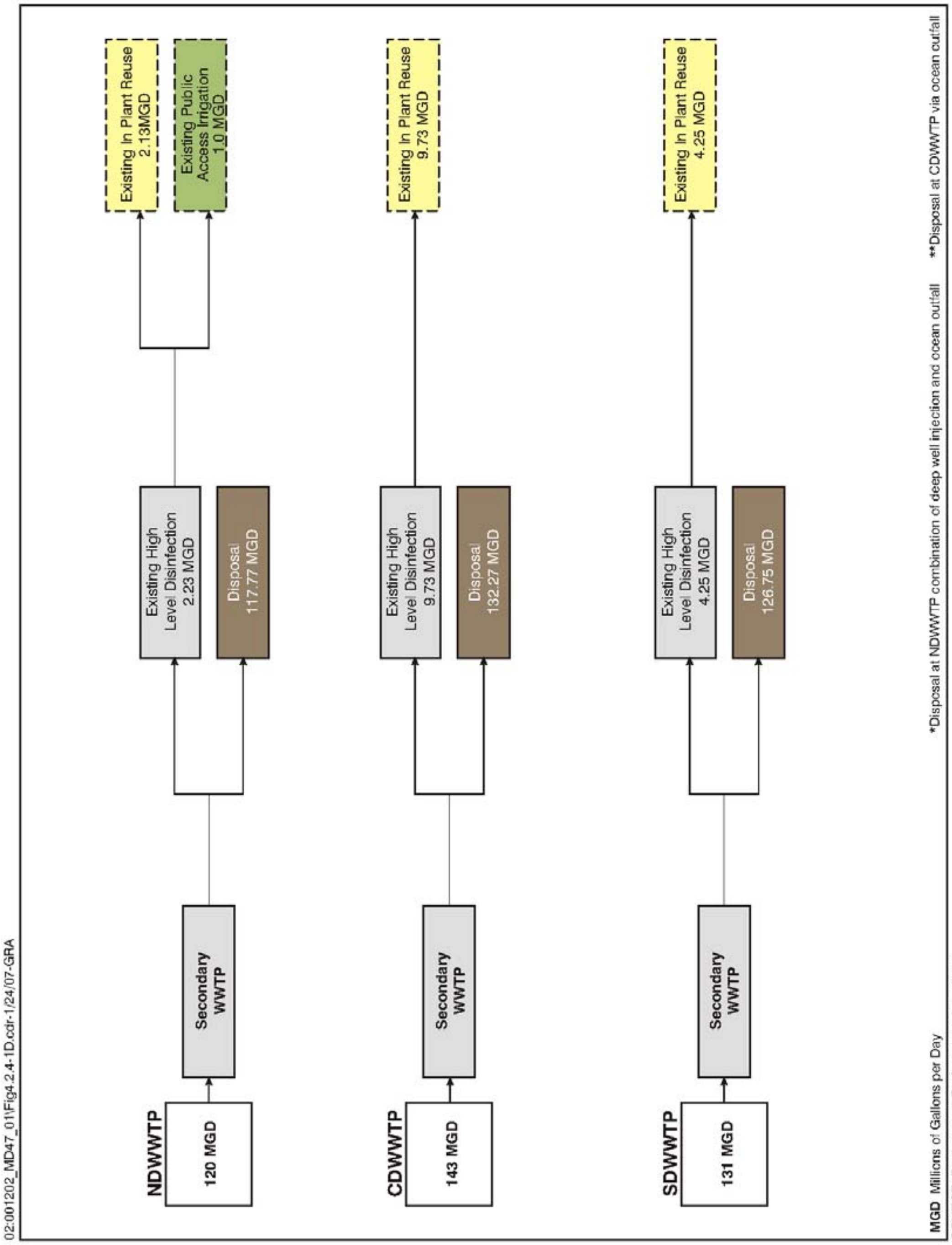

SOURCE: Ecology and Environment, Inc., 2007

Figure 4.2.4-1 MDWASD WASTEWATER REUSE FEASIBILITY STUDY UPDATE ALTERNATIVE D: NO-ACTION ALTERNATIVE

Table 4.2.4-2. Summary of CIP Projects and Other System Upgrades for MDWASD Wastewater System

NDWWTP
Force mains replacement / installation
Pump station improvements
Treatment improvements - Chlorine building, scum collection, sluice gates replacement (pretreatment screen room)
Injection well pump station
Outfall pump station and piping
New nutrient removal facilities for ocean outfall (98 MGD), and high level disinfection for deep injection wells (20 MGD)
CDWWTP
Force mains replacement / installation (incl. new force main from Miami Beach)
Pump station installations / improvements
Treatment improvements - Plant no. 2 digestor improvements, wet weather treatment, sludge handling facility
New nutrient removal facilities for ocean outfall (131 MGD)
SDWWTP
Force main installations
Pump stations and generators
Treatment expansion and improvements - treatment plant expansion, sludge treatment facilities, dewatering centrifuge, oxygen plant compressor, cogeneration units, deep bed sand filters, clarifies, disinfection facilities, wet weather plant
Effluent disposal wells & pump station
Land acquisition
Reject disposal pipeline
System-Wide
New maintenance centers
General facility center improvements
Sewer mains rehabilitation
Sanitary sewer improvements / extensions
Lateral pilot program
Pump station improvements
Emergency generators
Peak flow management facilities
Miscellaneous plant upgrades

Key:

CDWWTP = Central District Wastewater Treatment Plant.
CIP = Capital Improvement Plan
MGD = million gallons per day.
NDWWTP = North District Wastewater Treatment Plant.
SDWWTP = South District Wastewater Treatment Plant.

4.2.5 Summary

The reuse alternatives are summarized in Table 4.2.5-1.

Table 4.2.5-1. Summary of Total Wastewater used for Reuse Projects Alternatives A through C

	Alternative A	Alternative B	Alternative C
		(MGD)	
North District Wastewater Treatment Plant (NDWWTP)			
Existing Process and Irrigation	2.23	2.23	2.23
Urban Irrigation	22.11	16.49	13.38
Rapid Infiltration Trenches	15.54	0	0
Canal Recharge	20	0	0
Industrial (vehicle wash)	0.1	0.1	0.1
NDWWTP Total	**59.98**	**20.42**	**17.31**
Central District Wastewater Treatment Plant (CDWWTP)			
Existing Process and Irrigation	9.73	9.73	9.73
Urban Irrigation	30.43	22.32	6.41
Rapid Infiltration Trenches	34.38	23.99	0
Canal Recharge	40	40	0
CDWWTP Total	**114.54**	**96.04**	**16.14**
South District Wastewater Treatment Plant (SDWWTP)			
Existing Process and Irrigation	4.25	4.25	4.25
Urban Irrigation	10.75	9.95	9.95
Rapid Infiltration Trenches	64.19	64.19	48.69
Canal Recharge	0	0	0
Wetland Recharge	50.81	0	0
Pilot Project	1	1	1
SDWWTP Total	**131**	**79.39**	**63.89**
Total for All Alternatives	**305.52**	**195.85**	**97.34**

Key:
CDWWTP = Central District Wastewater Treatment Plant.
MGD = million gallons per day.
NDWWTP = North District Wastewater Treatment Plant.
SDWWTP = South District Wastewater Treatment Plant.

4.3 CONSUMPTIVE WATER USE OFFSETS

As discussed previously, there are regulatory issues associated with aquifer recharge within designated wellfield protection areas. Reuse of reclaimed water within a wellfield protection area will require an EQCB variance. If pilot studies and supporting data and ongoing research demonstrate that the RO, microfiltration, UV-ozone treatment train adequately protects the aquifer and a variance is granted, the potential for consumptive water use offsets for the system increases.

As part of this reuse study, the MDWASD and the Reuse Feasibility Study team coordinated, facilitated, and held an agency workshop, various meetings, and conference calls to discuss the regulatory concerns surrounding treatment requirements, develop intercommunication between the regulatory entities, and create a consensus on aquifer recharge as a means of reuse. Based on the input to date, it is assumed that aquifer recharge is most favorable in locations upgradient of the wellfield protection areas, where recharge would occur and water supply offset credits can be obtained.

When considering which wellfields would benefit from aquifer recharge using reclaimed water, not many opportunities exist within the Northwest Wellfield due to its westerly and somewhat remote location. Limited infrastructure exists in the area, so irrigation opportunities to offset existing potable water irrigation uses are scarce. Rapid infiltration opportunities may exist on the county-owned land that makes up the wellfield, but this option must be evaluated further if the regulatory agencies support this type of reuse. In the South Miami-Dade service area, opportunities to directly recharge each individual existing wellfield are also limited because the wellfields are quite small and their corresponding protection areas do not cover much area. The new South Miami-Heights wellfield will encompass a more sizeable area and provide recharge opportunities for the South District. There are a number of aquifer recharge projects in the South Miami-Dade area that could ultimately benefit the wellfields or Biscayne Bay. Taking into consideration that the water system in Miami-Dade County functions as an interconnected system, any type of project recharging the Biscayne Aquifer wellfields can be considered as recharging the system as a whole.

The projects that offer the most offset for future water consumption also provide for large volumes of wastewater reuse. Offsets were estimated with the assumption that a 1:1 ratio would be credited for reuse volumes that directly recharge the wellfields; directly add flow into Biscayne Bay, canals, and wetlands; and replace potable water use. Additional input from the SFWMD and modeling studies are needed to confirm the total amount of offsets and to account for various marginal projects, which are not included. Table 4.3-1 summarizes the offset volumes for each alternative based on the above assumptions, which may underestimate the actual offset. Based on preliminary estimates, Alternatives A and B offer full offset for future water demands through reuse. Alternative C will offset approximately 25.38% of the future water demand, and the remaining water will have to be offset by alternative sources. Alternative D, the No-Action Alternative, does not provide any offset for future water consumption. This table is for initial planning purposes and further input from the SFWMD will be required to determine actual offsets.

Table 4.3-1. Summary of Offset Volume for Each Reuse Alternative

Reuse Alternative	WWTP Service Area	Minimum Water Offset Volume (MGD)
Alternative A	NDWWTP	8.22
	CDWWTP	98.38
	SDWWTP	57.20
	Total	**163.80**
Alternative B	NDWWTP	8.22
	CDWWTP	84.68
	SDWWTP	6.39

Table 4.3-1. Summary of Offset Volume for Each Reuse Alternative

Reuse Alternative	WWTP Service Area	Minimum Water Offset Volume (MGD)
	Total	**99.29**
Alternative C	NDWWTP	6.87
	CDWWTP	6.41
	SDWWTP	6.39
	Total	**19.67**

Key:
CDWWTP = Central District Wastewater Treatment Plant.
MGD = million gallons per day.
NDWWTP = North District Wastewater Treatment Plant.
SDWWTP = South District Wastewater Treatment Plant.
WWTP = wastewater treatment plant.

Additional offsets for water consumption may be possible depending on modeling results and discussions with the SFWMD.

Other policies may be implemented to further encourage reuse in Miami-Dade County. For example, in areas where RITs are located, the county could create incentives for residents to install irrigation wells to recover the reclaimed water from the aquifer. These incentives may include partial or full payment for the irrigation well and pump. Rather than distributing the reclaimed water via a complex and costly pipe network, all homes within a certain radius of an RIT could "access" the reclaimed water from their irrigation wells. This would reduce the use of potable water for irrigation and offset future demands for growth. If considered, this concept of having "Reclaimed Water Reuse Zones" would increase the amount of offsets provided in all the scenarios above. For example, if 5% of the current users (16,500) can be taken off the public water supply and extract reclaimed water with their wells, several MGD could be offset. The designation of "Mandatory Reuse Zones" may also be implemented to encourage the beneficial use of reclaimed water in areas where it is available. Once reclaimed water is made available to a certain location, all users within a designated radius or zone is required to use the reclaimed water for public access reuse in lieu of potable water.

4.4 OTHER STUDIES AND INVESTIGATIONS

To address existing concerns regarding reuse to recharge canals, Biscayne Bay Coastal Wetlands, and wellfield protection areas, several pilot projects or investigations have been identified.

Coastal Wetlands Reuse Rehydration Demonstration Project

A "Coastal Wetlands Reuse Rehydration Demonstration Project" will be implemented to demonstrate that the appropriate levels of treatment can be attained on a consistent basis to discharge to the Biscayne Bay Coastal Wetlands. This project will use highly treated effluent from the SDWWTP and discharge into wetlands adjacent to the SDWWTP. MDWASD has estimated a cost of $12 million for a 1 MGD plant. As proposed under the

CERP Wastewater Reuse Pilot Project Technology Report, the pilot project will combine microfiltration, UV disinfection, and advanced oxidation to treat SDWWTP effluent. A separate stream will be treated with RO to evaluate the different treatment trains.

An extensive monitoring program will be implemented to assess nutrient treatment capacities, microconstituent removal, and, ultimately, the application of reuse in Biscayne Bay Coastal Wetlands. This monitoring program will also include monitoring for microconstituents, nutrients, and drinking water criteria to serve as a basis for other reuse applications within wellfield protection areas (WPAs) and for canal recharge.

Phase 1 Reuse Plant for Aquifer Recharge

Aquifer Recharge Pilot Study

MDWASD has entered into an Interim Consumptive Use Authorization and Agreement with the SFWMD requiring MDWASD to design, construct and operate a pilot system to investigate recharging the Biscayne Aquifer with treated reuse water in compliance with F.A.C. Chapter 62-610. This pilot system is currently being designed and is modeled after the Advanced Water Purification Facility that will soon replace Water Factory 21 in California to be commissioned sometime in 2007. A similar pilot system rated at 5,500 gpd was constructed and operated by Orange County Florida, south of Orlando, in 2005 and 2006 for investigation of aquifer recharge at a cost of $400,000. This pilot system included only advanced treatment (i.e., ultrafiltration, reverse osmosis, UV-disinfection and peroxide advanced oxidation) as primary and secondary treatment were provided by an existing full-scale WWTP. This is in contrast with MDWASD's pilot system which will be a dual-stage system that will include primary and secondary treatment in the first stage followed by advanced treatment in the second stage and be rated at 20,000 gpd, four times the size of Orange County's pilot system. The first stage would include a biological oxidation system to produce a treated effluent with an average biochemical oxygen demand (BOD) concentration of less than 15 milligrams per liter (mg/L), TSS concentration of less than 5 mg/L, TOC concentration of less than 10 mg/L, and total nitrogen (TN) concentration of less than 10 mg/L. The second stage would include an advanced physical treatment system and consist of membrane filtration (i.e., ultra-filtration) to remove bacteria and TSS followed by RO and UV light and hydrogen peroxide oxidation to remove TN, TOC, and most other pollutants of concern.

Monitoring efforts of existing reuse systems can also serve as a beneficial source of information on a local perspective. Several locations in Miami-Dade County currently use public access quality water for irrigation (e.g., FIU). In addition, the City of Homestead has a rapid infiltration system at their WWTP that is in operation and can be monitored. Data from these and other applicable studies will help finalize treatment technologies and appropriate trains for each reuse type and on a project by project basis.

At the request of DERM, a monitoring program to test water quality parameters for influent and effluent streams at each of the WWTPs has also been identified. This program would assess the treatment efficiencies of the district WWTPs for public access reuse, RO, and other treatment processes.

4.5 POTENTIAL OPPORTUNITIES

Several other opportunities have been identified based on stakeholder comments. Some of the options are more viable than others. One comment suggested looking at other cemeteries, parks, schools and municipal facilities. For the most part, the irrigation volumes would be small; therefore, for cost effectiveness, these types of facilities would need to be located in close proximity to the main reclaimed water distribution lines or WWTP. While they present only a small percentage of the total reuse volume, it is expected that these smaller scale opportunities may cumulatively add anywhere from 100,000 GPD to 200,000 GPD. Several of these facilities have been identified in very close proximity to the NDWWTP and, after more detailed engineering analysis, changes in the final routing of the distribution line may include additional facilities of this type.

Another opportunity identified included utilizing an existing 16-inch sludge line from the NDWWTP to the CDWWTP. Currently, this line is rarely used and serves as a backup. This line, if disinfected and flushed, could represent an opportunity to distribute reclaimed water to users located along the line. However, based on initial discussions, FDEP was not receptive to the idea of using this sludge line since it may be needed for sludge in the future; therefore, altering its use is not favorable at this time.

A new force main is proposed for Bal Harbour and is expected to be routed in close proximity to the NDWWTP effluent ocean disposal line. With the installation of a force main, it would appear to be an opportune time for the installation of reuse piping to tap into the effluent line. This would allow reclaimed water to serve portions of Bal Harbour and North Bay Village. Due to cost considerations, only a portion of the wastewater stream is being treated for reuse and the existing effluent line will still be used to dispose the rest of the wastewater to the ocean; thus, the water in the effluent line would not be suitable for reuse. A backup disposal line exists though that could be used to route only the public access reuse water. Further assessment of this option may be warranted.

The area of Virginia Key is undergoing redevelopment, and is in the master planning stages at the moment. This presents another opportunity to provide infrastructure (purple pipes) and implement reuse as part of their future development efforts. Similarly to the coordination that has occurred with the City of North Miami Beach and the Village of Key Biscayne, MDWASD can coordinate and participate in the planning process early on to incorporate reuse in the community.

As previously mentioned, it is likely that other potential projects may be identified. For example, depending on the final array of projects selected and final pipeline routing reclaimed water could be provided to Fairchild Gardens, Pinecrest Gardens, Montgomery Botanical Center, and the United States Department of Agriculture (USDA) Subtropical Research Station. These sites are located between the SDWWTP and the CDWWTP over

5-miles away from both. Fairchild Gardens is 83 acres. Montgomery Botanical Gardens totals 120 acres. As with other nurseries, these sites would have to be studied further to determine the potential for irrigation and to estimate the water consumption, since it will vary by plant species. Nurseries are also of concern due to the plant sensitivities to varying water qualities. This would not be of concern if high levels of treatment would be employed. Pinecrest Gardens is a multi-use facility with outdoor venues for recreation. Irrigation with reuse water may be possible at this site, but a more detailed assessment has to be completed to determine the potential volume. The USDA Subtropical Research Station is a 200-acre site located west of Chapman Field Park, which has been identified as a reuse project for the maximum reuse alternative. Due to its proximity to Biscayne Bay, Chapman Field Park irrigation may be difficult to implement readily even at very high levels of treatment. Although the 200-acre USDA Subtropical Research Station is less than half the size of the Chapman Field Park, it may serve as an alternative to this project. The irrigation needs of the USDA Subtropical Research Station would need to be assessed based on the types of crops and irrigation practices. Individually, however, the potential volume of reuse for these sites may not justify the transmission and distribution costs.