Section 1
Introduction

1.1 Background

Biscayne Bay is a shallow subtropical estuary that is an important natural and economic resource. The historic groundwater and surface water flows to Biscayne Bay have been dramatically altered by anthropogenic effects such as farmland drainage and the creation and operation of the Central and Southern Florida (C&SF) Project. Although the total impact of these manmade changes is not fully understood, it is recognized that the freshwater flows necessary for a healthy estuarine system have been altered to the point of causing ecological impact. With the restoration of more natural freshwater flow patterns, including sufficient quantity, timing and distribution of overland flows, it is expected that native flora and fauna, including threatened and endangered species, will benefit.

The Central and Southern Florida Project Comprehensive Review Study Final Integrated Feasibility Report and Programmatic Environmental Impact Statement (Restudy or Yellow Book) recognized the value of Biscayne Bay and the importance of restoring the estuarine ecosystem. The Biscayne Bay Coastal Wetlands (BBCW) Project was thus selected as one of the components of the Comprehensive Everglades Restoration Plan (CERP) which was approved by Congress as part of the Water Resource Development Act (WRDA) of 2000. The South Florida Water Management District (SFWMD) also recognized the importance of restoring Biscayne Bay and incorporated Phase 1 of the BBCW project, consisting of the Deering Estate and Cutler Wetlands Flow Way components, into one of the SFWMD Acceler8 Program projects.

The Restudy, however determined that there will be insufficient water available in the natural system to restore the coastal wetlands and Southern Biscayne Bay. Because of this lack of freshwater, the CERP proposed to provide additional water to Biscayne Bay and the coastal wetlands through the South Miami-Dade Wastewater Reuse project. The South Miami-Dade Wastewater Reuse project proposed to provide a higher quality reuse water through additional treatment capabilities to the existing Miami-Dade Water and Sewer Department's South District Wastewater Treatment Plant (SDWWTP) secondary effluent. Because of concern over water quality and the associated treatment technologies that would be required to attain water quality high enough to discharge into Biscayne Bay's Outstanding Florida Waters (OFW), the Wastewater Reuse Project was established in CERP.

The CERP Wastewater Reuse Project proposed researching the level of treatment considered necessary to achieve the water quality criteria needed to discharge reclaimed water (highly treated wastewater) into natural areas, determining the level of advanced treatment necessary to achieve that water quality (Part 1), and the construction of a pilot project to demonstrate that the appropriate level of treatment can be attained on a consistent basis (Part 2). Although Part 1 of the Wastewater Reuse Project was completed in 2004, Part 2 of the project has been placed on hold

by the U.S. Army Corps of Engineers and the South Florida Water Management District until at least 2015. In the meantime, the Biscayne Bay Coastal Wetlands (BBCW) Acceler8 project, which is Phase 1 of the full CERP BBCW Project, is continuing with project design and has an anticipated construction completion date of 2009.

As with many communities in Southeast Florida, Miami-Dade County is developing reclaimed water programs as a means of conserving this resource. One potential reclaimed water project is to rehydrate coastal wetlands with highly treated wastewater, from the SDWWTP to enhance and restore wetlands habitats.

Miami-Dade County proposed to undertake two pilot reuse projects as part of the Alternative Water Supply Plan of the May 2006 Miami-Dade Interim Consumptive Use Authorization and Agreement (Interim Agreement) with the SFWMD. One of the two pilot projects, the subject of the February 2007 Technical Memorandum, was the Coastal Wetland Rehydration Demonstration Project (CWRDP). The CWRDP consisted of a Water Reuse Demonstration Plant (WRDP) at the SDWWTP, a constructed wetland in the Cutler (formerly Lennar) Flow Way, and a baseline assessment and monitoring program of the C-1 Canal, Cutler Flow Way, the WRDP, the constructed wetland, the coastal wetlands, and the Biscayne Bay. An aerial photograph of the site including the Cutler Flow Way and the rehydration area is provided in **Figure 1-1**. In accordance with the Agreement, 90 percent complete designs and permit applications for the construction of this pilot project were submitted by May 5, 2007. Subsequent to the preparation of the 90-percent plans and stakeholder involvement, the project scope was revised.

On July 11, 2007, the SFWMD Governing Board approved an Amendment to the Interim Agreement. The Amendment states that the CWRDP "*may be of a smaller capacity with greater focus on achievable water quality utilizing a variety of treatment technologies and microcosm experiments to determine more efficiently the initial feasibility of a large scale project than was originally envisioned with the demonstration project design*". The new project scope will incorporate aquatic toxicity and ecological testing studies, prior to determining the need for a constructed wetlands. Additionally, the pilot plant's design effluent flow was reduced from 1 MGD to 0.23 MGD. To summarize, the project's current scope includes a water reclamation demonstration plant (WRDP) to produce 0.23 MGD of effluent, aquatic toxicity and ecological testing studies, and an updated monitoring plan. This Report represents the conceptual design and basis of design for the pilot project to determine the feasibility of using highly treated reclaimed water for the Biscayne Bay Coastal Wetlands Rehydration Project, which includes the items in the above mentioned project scope.

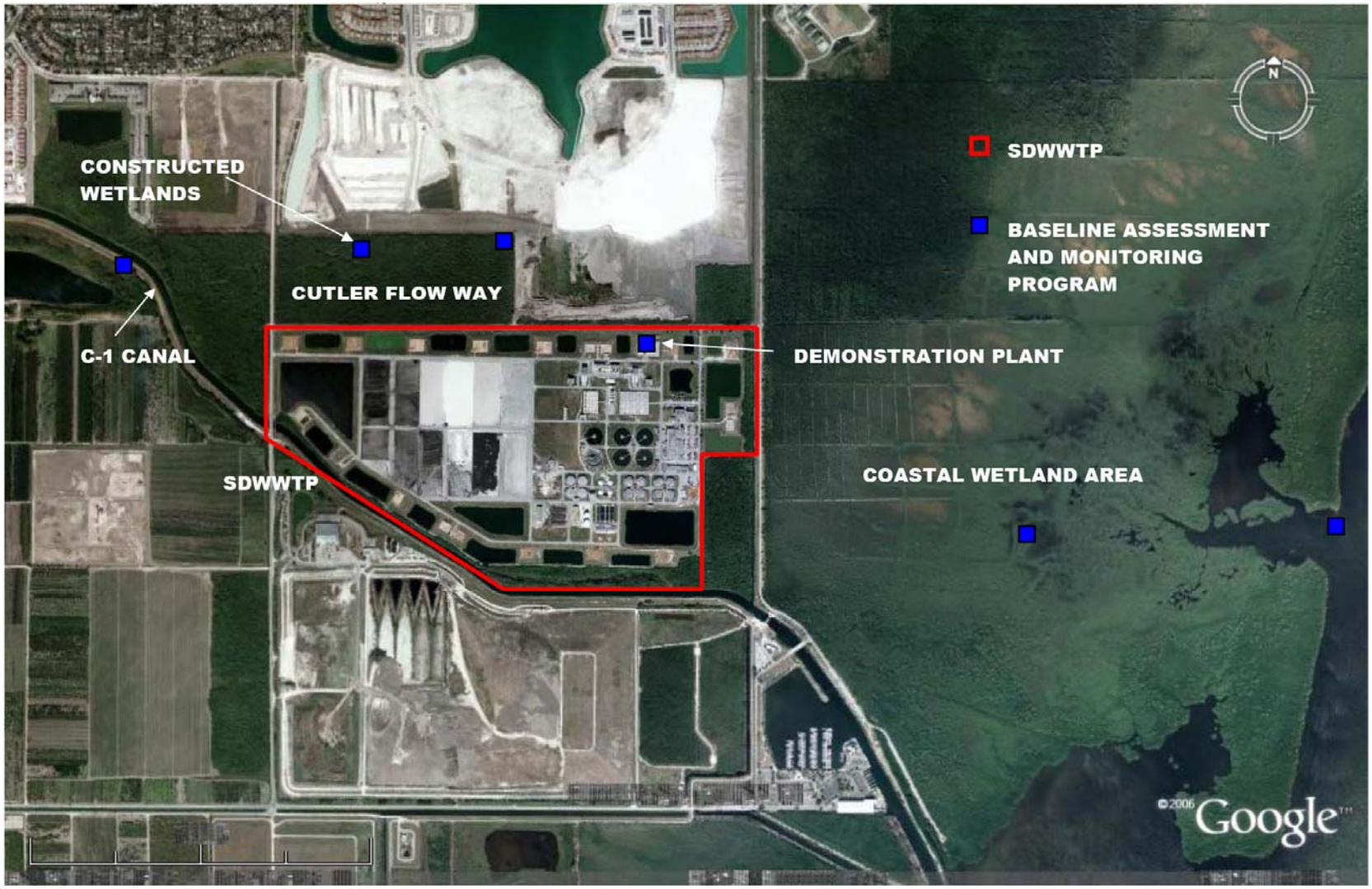

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Figure 1-1
Aerial Photograph

1.2 Purpose and Scope

The objectives of the Coastal Wetland Rehydration Demonstration Project (CWRDP) are as listed below:

- Test the performance of the advanced treatment technologies that comprise the WRDP for the reduction of nutrients, microconstituents, and other water quality parameters of interest that are currently in the feed water for this pilot plant. The feed water for this plant is South District the Wastewater Treatment Plant's (SDWWTP) secondary effluent.

- Evaluate the potential ecological impacts of using highly treated effluent to rehydrate the Biscayne Bay coastal wetlands, through aquatic toxicity testing and ecological testing.

- Develop the data necessary to assess the technological and economical feasibility of a large scale reuse project to rehydrate the coastal wetlands with this highly treated effluent.

The purpose of the WRDP is to determine the water quality that can be consistently produced with the advanced treatment processes identified by the CERP Wastewater Reuse Pilot Project Delivery Team in an effort to meet the water quality goals established by the 2004 USACE study.

The scope of the CWRDP conceptual plan and basis of design is broken down into four main parts: (1) the wetland rehydration pilot plant, (2) aquatic toxicity testing (3) ecological testing and (4) a draft monitoring plan. Each part is described below:

Part 1 consists of establishing preliminary process design criteria, determining facility sizing and selection of equipment, and preparing a conceptual design level opinion of construction and operating costs, implementation schedule, and list of the required permits for construction.

Part 2 consists of the conceptual plan for conducting aquatic toxicity testing studies. This conceptual plan is designed to evaluate the effects of highly treated reclaimed water on selected animal and plant species.

Part 3 consists of the methodology for preparing detailed design of ecological testing studies for the CWRDP. The ecological testing studies will evaluate the effects of highly treated reclaimed water on selected animal and plant species over several growth cycles.

Part 4 consists of updating the previous draft monitoring plan. The monitoring plan will assist in evaluating the treatment efficacy, water quality, and plant and animal effects from the WRDP effluent and to provide background data on existing conditions for Biscayne Bay, the coastal wetlands and associated areas. The updated monitoring

plan will provide proposed monitoring activities to be executed during the final design and/or construction phases to satisfy data gaps needed to generate a baseline and an effective monitoring program to assess groundwater, surface water and biological impacts, along with monitoring of the WRDP effluent.

Also included in the conceptual plan for the CWRDP is a summary of the anticipated stakeholder involvement and a project Peer Review Plan.

1.3 Conceptual Plan Organization

This technical memorandum, the CWRDP Conceptual Plan and Basis of Design, consists of the following sections:

- Section 1- Introduction
- Section 2- Water Quality Objectives
- Section 3 – Water Reclamation Demonstration Plant
- Section 4 – Description of Aquatic Toxicity Testing Studies Conceptual Plan
- Section 5 – Methodology for Developing an Ecological Testing Studies Plan
- Section 6 – Description of Update to Draft Monitoring Plan
- Section 7 – Stakeholder Involvement
- Section 8 – Peer Review Plan

In addition to these eight sections, this technical memorandum includes the following Appendices:

- Appendix A – WRDP Design Information
- Appendix B – Review of Regulatory Requirements and Coordination
- Appendix C – Aquatic Toxicity Testing Studies Conceptual Plan
- Appendix D – Draft Monitoring Plan
- Appendix E – USACE Task 5 Final Report South Dade Advanced Wastewater Treatment Alternatives
- Appendix F – Baseline Assessment and Monitoring Plan (February 2007)

Section 2
Water Quality Objectives

2.1 Introduction

During the 2004 CERP Wastewater Reuse Project, the Project Delivery Team (PDT) considered three water quality categories for the pilot project. These categories are described below:

- Reuse Water Quality – Water quality must meet the State of Florida standards for reuse of reclaimed water and land application (Chapter 62-610, FAC). Public access irrigation requires no more than 5.0 mg/L total suspended solids (TSS) and high level disinfection.

- Wetlands Application Standards – Water that meets State of Florida wetlands application rule standards (Chapter 62-611, FAC). Criteria for discharge to receiving wetlands include no more than 5.0 mg/L of TSS, 5.0 mg/L of 5-day carbonaceous biochemical oxygen demand ($CBOD_5$), 3.0 mg/L of total nitrogen (TN), and 1.0 mg/L of total phosphorous (TP).

- Class III / Outstanding Florida Water (OFW) Water Quality – Water quality must be sufficient to prevent degradation of the waters of Biscayne Bay. CERP team established water quality goals as treatment objectives to satisfy the OFW antidegradation regulations requirements for Biscayne Bay including associated wetlands.

The three water quality goals are summarized in **Table 2-1**.

2.2 Application of Water Quality Goals

The application of the water quality goals described in Section 2.1 of the Coastal Wetland Rehydration Demonstration Project (CWRDP) is discussed in this section.

Table 2-1: Effluent Water Quality Goals [(a)]

Parameter	Reuse	Wetlands Application	Class III / OFW
TSS, mg/ L	5(1)	5	3.5
$CBOD_5$, mg/ L	20(2)	5	NA
Total Nitrogen, mg/l as N	NA	3	0.27
Total Phosphorous, mg/L as P	NA	1	0.005
Fecal Coliform, # / 100ml	<1.0	<1.0	<1.0
Total Ammonia- N, mg/L			0.02 –0.05 mg/L(depends on method of collection and analysis)
Nitrite/Nitrate-N, mg/L			0.01 mg/L
TKN, mg/L			0.22 mg/L
Ortho-P (mg/L)			0.002 mg/L
Dissolved Oxygen range (mg/L)			5.0-7.3
Turbidity, NTU			0.5 NTU
Salinity			Shall not change salinity in test site by more than 5 ppt
pH range			6.5-7.5 (*)
Heavy Metals			See **Table 2-2**
Emerging Pollutant of Concerns (EPOC)			Lowest possible levels(**)
Cryptosporidium and Giardia			Lowest possible levels(**)

(1) Single sample maximum

(2) Annual average

(*) Appropriate limits for pH in the estuarine zone will require further evaluation.

(**) Even though, currently there are no established numerical criteria or antidegradation targets for these parameters, available information shall be gathered on removal efficiency of various treatment technologies and detectable levels after advanced treatment for these parameters for comparative assessment. In practical terms, the objective would be to identify the technology that reduces such contaminants to the lowest level.

(a) Task 5 – Final Report South Dade Advanced Wastewater Treatment Alternatives, (USCOE, 2004)

Table 2-2: Treatment Objectives and Method Detection Limit (MDL)/Practical Quantitation Limit (PLQ) for Metals of Interest [(a)]

Heavy Metals Except for those listed with **	Methodology Required or Equivalent	Required MDL (ug/L)	Required PQL (ug/L)	Sea Water Composition (ug/L) [1,2]	Target Levels (ug/L)
Aluminum**	EPA 200.9	7.8	30	10	10
Antimony	EPA 200.9	0.8	3	0.5	0.8
Arsenic, tot	EPA 200.9	0.5	2	3	3
Barium**	EPA 200.7	1	4	30	30
Cadmium	EPA 200.9	0.05	0.2	0.1	0.1
Chromium, total	EPA 200.9	0.1	0.4	0.05	0.1
Copper	EPA 200.9	0.7	3	3	3
Iron	EPA 200.7	7	30	10	10
Lead	EPA 200.9	0.7	3	0.03	0.7
Manganese	EPA 200.9	0.3	1	2	2
Mercury, total	EPA 1631C	0.0001	0.0005	0.03	0.03
Mercury, methyl	EPA 1630 Draft	0.00002	0.00005		0.03
Nickel	EPA 200.9	0.6	2	2	2
Selenium**	EPA 200.9	0.6	2	4	4
Silver	EPA 200.9	0.5	2	0.04	0.5
Thallium	EPA 200.9	0.7	3	< 0.01	0.7
Tin	EPA 200.9	1.7	7	3	3
Zinc	EPA 200.7	2	8	10	10
Bolded Metals: Indicates typical parameters monitored in wastewater					
Bolded and Italic Metals Metal added because it was part of the Class III Surface Water FDEP Rule					
Italic Metals: Total Mercury is monitored in wastewater and it is part of the Class III Surface Water FDEP Rule. Methyl and total mercury at low levels are not, but were added to be consistent with current District monitoring.					
1 - Geological Survey Water-Supply Paper 1473, Study and Interpretation of the Chemical Characteristics of Natural Water, Second Edition, p. 11 (1971) 2 - Horne R.A. , Marine Chemistry The Structure of Water and the Chemistry of the Hydrosphere, Wiley-Interscience, 1969					

(a) Task 5 – Final Report South Dade Advanced Wastewater Treatment Alternatives, (USCOE, 2004)

2.2.1 State of Florida Reuse Standards

Part III of Chapter 62-610, FAC contains the rules governing reclaimed water for areas of public access and irrigation. This section regulates water quality for irrigation of areas such as golf courses, parks, landscape, and edible crops. Under these standards, reclaimed water receives high-level disinfection (HLD) and meets, at a minimum, secondary treatment water quality standards. Moreover, the reclaimed water shall not contain more than 5.0 mg/L of total suspended solids (TSS) before the application of a disinfectant. NPDES permits issued by the FDEP typically include a requirement for continuous on-line monitoring of effluent turbidity to demonstrate the safety of the reclaimed water. Compliance with the TSS limit is monitored using grab samples. Continuous on-line monitoring is used in conjunction with an approved operating protocol for operational control and to ensure that only acceptable quality reclaimed water goes to the reuse system application sites.

The WRDP will provide filtration of the secondary effluent from the SDWWTP with deep bed filters and disinfection with ultraviolet (UV) light to meet reuse standards.

2.2.2 State of Florida Wetlands Application (Receiving Wetlands Discharge) Standards

Discharge to wetlands systems is governed by Chapter 62-611, FAC. Treatment criteria prior to discharge are dependent on the type of wetland. Wetlands are categorized as herbaceouse or woody, hydrologically altered or unaltered, treatment or receiving and natural or man made. Reclaimed water discharged to a receiving wetland must contain no more than, 5.0 mg/L TSS, 5.0 mg/L $CBOD_5$, 3.0 mg/L total nitrogen (TN), and 1.0 mg/L total phosphorus (TP) on an annual average basis.

The existing treatment at the SDWWTP provides secondary treatment which has no standard for either TN or TP; therefore, additional treatment technologies to comply with the receiving wetland standards for total nitrogen and total phosphorous are required.

The WRDP will provide tertiary treatment processes such as nitrification filters, denitrification filters, and chemical phosphorus precipitation for reduction of TN and TP to meet wetlands application standards.

2.2.3 Class III / Outstanding Florida Waters (OFW) Regulations

Discharge to OFW is regulated by Chapter 62-302.700 FAC. The regulations are stringent with respect to new or expanded surface water discharges. Discharges must not degrade the ambient water quality in Outstanding Florida Waters (OFW). The ambient water quality for discharge to the Biscayne Bay coastal wetlands has not been established. However, as indicated in Table 2-1, antidegradation goals for nutrients presented in the 2004 U.S. Army Corps of Engineers' (USACE) study, prepared as part of the CERP Wastewater Reuse Pilot Project, are stricter than standards for receiving wetlands, requiring additional treatment. In addition, goals for

microconstituents, also known as emerging pollutants of concern (EPOCs) are indicated as the "lowest possible".

There are a diverse number of treatment technologies that when used in combinations have the potential for meeting the antidegradation goals. It is important to note that the goals identified in the 2004 USACE Study goals are stricter than any water quality standards. Thus, there is a certain uniqueness of applying the best available technologies to meet such low water quality goals on a routine, daily basis. There is not much historical or documented data from other large capacity treatment facilities in operation with similar water quality goals.

In addition to the treatment technologies mentioned in Section 2.2.1 and 2.2.2 above, the WRDP will include membrane treatment such as ultrafiltration (UF) and optimization of chemical phosphorus removal to further reduce total phosphorus concentrations. Based on the data available for these technologies, the UF membrane and optimization of chemical phosphorus removal should be able to reduce the total phosphorus concentration to less than 0.1 mg/L. Total nitrogen concentrations after UF, are not expected to be lower than 2.5 mg/L TN due to the presence of refractory organic nitrogen.

In addition to the WRDP treatment technologies, provisions will be made for a sidestream of the demonstration plant effluent to flow through additional treatment steps at a pilot scale level to investigate their effectiveness and performance in further removing nutrients and microconstituents {Endocrine Disrupting Compounds (EDC) and Pharmaceuticals and Personal Care Products (PPCPs)}. The sidestream plant (SSP), with flows ranging from 30 to 40 gpm, will consider the following technologies:

- Reverse Osmosis (RO) to further remove orthophosphorus, refractory organic nitrogen, and microconstituents,
- Ion Exchange (IX) to further remove refractory organic nitrogen,
- Granular Activated Carbon (GAC) to further remove microconstituents, and
- Advanced oxidation process (AOP) to further remove microconstituents.

The SSP will also evaluate additional treatment benefits considering incremental capital and operational costs as well as the adverse effects of potentially hazardous by products and concentrated disposal of reject water.

A more detailed discussion of the proposed treatment processes at the WRDP and the SSP is presented in Section 3.

As part of the CWRDP, a baseline assessment and monitoring program will be undertaken concurrently with the WRDP final design, construction and operation. The program would include a full suite of chemical analysis including traditional pollutants, nutrients, micropollutants, metals, and pesticides. Sampling points should include the

C1 canal, the Cutler Flow Way, the WRDP, the coastal wetlands, and the Biscayne Bay. This sampling effort will establish whether or not the Biscayne Bay coastal wetlands would be degraded by discharge of the reclaimed water, and it will assist in determining water quality target concentrations for the future full-scale reuse plant effluent.