Chapter 8A: Achieving Long-Term Water Quality Goals

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SUMMARY

The long-term Everglades water quality objective is to implement the optimal combination of source controls, Stormwater Treatment Areas, Advanced Treatment Technologies, and/or regulatory programs to ensure that all waters in the Everglades Protection Area meet the phosphorus criterion established in Rule 62-302.540 of the Florida Administrative Code, consistent with the requirements of Florida's 1994 Everglades Forever Act, as amended by the Florida legislature in 2003.

Substantial progress toward reducing phosphorus levels discharged into the Everglades Protection Area has been made by the state of Florida and other stakeholders. The combined performance of the regulatory program in the Everglades Agricultural Area and of the Stormwater Treatment Areas constructed under the 1994 Everglades Construction Project, both mandated by the Everglades Forever Act, has exceeded expectations. As of the end of April 2003, the Everglades Agricultural Area's Best Management Practices and Stormwater Treatment Areas have removed more than 1,400 tons of phosphorus that otherwise would have entered the Everglades. Current projections suggest that, when all Stormwater Treatment Areas are operational, the best estimate of the long-term flow-weighted mean total phosphorus concentrations in discharges from the Everglades Construction Project to the Everglades Protection Area is approximately 35 parts per billion (ppb), with a potential range of 25-45 ppb, compared to the interim goal of 50 ppb established in the Everglades Forever Act. In addition, some source control measures have been implemented in urban and other tributary basins included in the Everglades Stormwater Program. Nonetheless, additional measures are necessary to ensure that all discharges to the Everglades achieve and maintain compliance with water quality standards.

Technical representatives of various agencies and other stakeholders used the results of the Basin-Specific Feasibility Studies, which were completed during the previous reporting period, to develop a Long-Term Plan for achieving the water quality goals of the Everglades Forever Act. The 2003 Florida legislature amended the 1994 Everglades Forever Act to include implementation of the Long-Term Plan as the optimal strategy for achieving the phosphorus criterion in the Everglades Protection Area. The total estimated expenditures through Fiscal Year 2016 for full implementation of the Long-Term Plan are $444 million.

INTRODUCTION

The 1994 Everglades Forever Act (EFA) established a long-term water quality goal for water delivered to the Everglades Protection Area (EPA) to achieve state water quality standards by December 31, 2006. By December 31, 2003, the EFA requires the South Florida Water Management District (SFWMD or District) to submit to the Florida Department of Environmental Protection (FDEP) a permit modification to incorporate proposed changes to the Everglades Construction Project (ECP), as well as permits issued for the other structures that discharge into, through, or from the EPA. By December 31, 2003, if discharges to the EPA are in compliance with state water quality standards, including the total phosphorus (TP) criterion, then the permit application shall include a plan for maintaining compliance in the EPA with state water quality standards. If the ECP or other discharges to the EPA are not in compliance with state water quality standards by December 31, 2003, then the permit application shall include the following:

1. A plan for achieving compliance with state water quality standards in the Everglades Protection Area.
2. Proposed cost estimates for the plan referred to in (1), above.
3. Proposed funding mechanisms for the plan referred to in (1), above.
4. Proposed schedules for implementation of the plan referred to in (1), above.

The 1994 EFA established an orderly process of research and rulemaking to develop a sound foundation for decision making regarding long-term water quality solutions. The EFA intended "to provide a sufficient period of time for construction, testing, and research so the benefits of the ECP will be determined and maximized prior to requiring additional measures." (Section 373.4592(1)(g), Florida Statutes). Presently, many scientific, engineering, regulatory, and other uncertainties remain and will significantly influence long-term discharges to the EPA. It is the District's intent to continue research and Stormwater Treatment Area (STA) optimization efforts to address the remaining scientific and engineering uncertainties. Other sections of the *2004 Everglades Consolidated Report*, particularly Chapters 3, 4B, and 8B, describe the numerous research, regulatory, and construction activities.

The 1994 EFA was amended in 2003 by the Florida legislature to reference the implementation of the Long-Term Plan as the most appropriate approach to achieving the phosphorus criterion in the Everglades Protection Area, and that is supportable by the current scientific and technical knowledge base. Other, presently unidentified, future steps may be needed. The Long-Term Plan presents a rational basis for identification and early implementation of those steps if and as they are needed. Implementation of the Long-Term Plan, according to the language in the amended EFA, is the current strategy for achieving long-term compliance with all water quality goals.

WATER QUALITY IMPROVEMENT STRATEGIES

As an important step toward development of the Long-Term Compliance Permit application required under the EFA, the District conducted Basin-Specific Feasibility Studies. These studies integrated information from research, regulation, and planning in order to meet the final water quality objectives for the EPA. The Basin-Specific Feasibility Studies identified and evaluated alternative solutions for seven basins included in the ECP and for six basins covered by the Everglades Stormwater Program (ESP).

The Basin-Specific Feasibility Studies were conducted according to the following steps:

1. Develop baseline flow and phosphorus data sets.
2. Develop a methodology to evaluate alternative water quality measures, based on the factors established in the 1994 Everglades Forever Act and on other appropriate considerations.
3. Develop basin-specific alternative combinations of water quality solutions (e.g., source control, STA optimization, and Advanced Treatment Technologies [ATTs]).
4. Evaluate alternative solutions developed in step 3 using the evaluation methodology developed in step 2.

The results of the Basin-Specific Feasibility Studies are documented in the October 2002 report, Evaluation of Alternatives for the ECP Basins, prepared for the South Florida Water Management District by Burns & McDonnell under Contract C-E023, and in the October 2002 report, Basin-Specific Feasibility Studies, Everglades Stormwater Program Basins, prepared for the District by Brown & Caldwell under Contract C-E024. A summary of the alternatives evaluated for both the ECP and ESP basins, as well as the methodology used to evaluate the alternatives, was provided in the *2003 Everglades Consolidated Report* (Chapter 8A). A summary of the basins that were included in the Basin-Specific Feasibility Studies is presented in **Table 8A-1**.

Table 8A-1. Everglades Protection Area (EPA) tributary basins included in the Basin-Specific Feasibility Studies.

Basin	Canal	STA	Receiving Water
S-5A (EAA)	West Palm Beach Canal	STA-1W, STA-1E, STA-2	WCA-1
S-6 (EAA)	Hillsboro Canal	STA-2	WCA-2A
S-7 (EAA)	North New River Canal	STA-3/4	WCA-3A
S-8 (EAA)	Miami Canal	STA-3/4, STA-6	WCA-3A
C-51 West & L-8 Basin	C-51 West	STA-1E, STA-1W	WCA-1
C-139 (including Annex)	L-3 Canal	STA-5, STA-6	WCA-3A
ACME Basin B	N/A	N/A	WCA-1
North Springs Improvement District	N/A	N/A	WCA-2A
North New River Canal (G-123)	North New River Canal	N/A	WCA-3A
C-11 West	C-11 West	N/A	WCA-3A
Feeder Canal	L-28 Interceptor Canal	N/A	WCA-3A
L-28	L-28	N/A	WCA-3A

The Basin-Specific Feasibility Studies were a fact-finding exercise. They were not intended to define the final arrangement, location, and character of water quality improvement strategies in the various basins. In addition, no specific recommendations were made for alternatives to be carried forward to implementation. Rather, the purpose of the evaluations was to develop the information necessary for informed decision making by the District's governing board and the Florida legislature relative to funding, final implementation schedule, rulemaking, and other necessary policy-level determinations.

LONG-TERM PLAN FOR ACHIEVING WATER QUALITY GOALS

Technical representatives from the District, the Florida Department of Environmental Protection (FDEP), the Everglades Agricultural Area Environmental Protection District, and other stakeholders used the results of the Basin-Specific Feasibility Studies to formulate a consensus approach for achieving the long-term water quality goals of the Everglades Forever Act. Their recommended approach is set forth in the Long-Term Plan for Achieving Water Quality Goals (Burns & McDonnell, 2003).

On March 12, 2003, the January 29, 2003 draft version of the Long-Term Plan was presented to the District's governing board. At that time, the governing board overwhelmingly endorsed the draft plan but requested incorporation of some minor modifications. The governing board also expressed the need for urgency in finalizing the draft Long-Term Plan in order to seek timely review and ratification by the Florida legislature. The Long-Term Plan was revised on March 17, 2003 to reflect the governing board's requested modifications. However, the board acknowledged the value and need for widespread public and interagency review and indicated a desire for additional review to take place as part of the legislative deliberations. As a result, the Long-Term Plan underwent an extensive public review and comment period between March and October of 2003.

During the 2003 Florida legislative session, the 1994 EFA was amended to include reference to the March 17, 2003 Long-Term Plan (with modifications) as the appropriate strategy for achieving the phosphorus criterion in the EPA. The amended EFA was subsequently revised during the same legislative session to address concerns about portions of the amended version. Following are the key points of the amended 1994 EFA, as well as the revised version of the amended 1994 EFA:

- The legislature finds that the Long-Term Plan provides the best available TP reduction technology based on a combination of the Best Management Practices (BMPs) and Stormwater Treatment Areas (STAs) described in the Long-Term Plan, provided that the plan shall seek to achieve the phosphorus criterion in the Everglades Protection Area.
- The pre-2006 projects identified in the Long-Term Plan shall be implemented by the District without delay, and shall be revised with the planning goal and objective of achieving the TP criterion.
- Revisions to the Long-Term Plan shall be approved by the FDEP.
- Implementation of the Long-Term Plan shall be integrated and consistent with the implementation of the projects and activities in the congressionally authorized components of the Comprehensive Everglades Restoration Plan (CERP) so that unnecessary and duplicative costs will be avoided.
- Nothing regarding integration of Long-Term Plan components with CERP projects shall modify any existing cost-share agreement or responsibility provided for projects included in the Water Resources Development Act of 1996 or in the Water Resources Development Act of 2000.

- The legislature does not intend for the provisions of the amended EFA to diminish commitments made by the state of Florida to restore and maintain water quality in the EPA, including the federal lands included in the Settlement Agreement.
- The legislature recognizes that the Long-Term Plan contains an initial 13-year phase (2003–2016) and a 10-year second phase. The legislature intends that a review of the EFA at least 10 years after implementation of the initial phase is appropriate and necessary to the public interest. The review is the best way to ensure that the EPA is achieving state water quality standards, including phosphorus reduction, and that the Long-Term Plan is using the best technology available. A 10-year second phase of the Long-Term Plan must be approved by the legislature and codified in the EFA prior to implementation of projects, but not prior to development, review, and approval of projects by the FDEP.
- The ad valorem tax proceeds not exceeding 0.1 mill levied within the Okeechobee basin shall also be used for design, construction, and implementation of the initial phase of the Long-Term Plan. This includes operation, maintenance, and research for the projects and strategies in the initial phase of the Long-Term Plan as well as the enhancements, operation, and maintenance of the Everglades Construction Project.

The Long-Term Plan was revised in October 2003 to incorporate direction received from the legislature in the 2003 amended EFA and to respond to comments received from the public, stakeholders and interagency reviewers. The revisions also refined, in certain instances, the originally projected schedules, budgets, and scope of certain of the recommended elements of the Long-Term Plan. A section was added to the introduction of the Long-Term Plan describing the proposed process for revisions to the Long-Term Plan, including a process for continued public involvement in the implementation of the Long-Term Plan. Following submittal of the revised Long-Term Plan to the FDEP in December 2003, members of the public or other stakeholders will have the opportunity to assist the FDEP and the District in developing proposed changes through numerous public forums, including quarterly communications meetings and annual public meetings. Appendix A and Appendix B of the October 2003 Long-Term Plan include summaries of the significant changes made to the March 2003 document.

The Long-Term Plan can be viewed at the following online location: http://www.sfwmd.gov/org/erd/bsfboard/bsfsboard.htm.

COMPONENTS OF THE LONG-TERM PLAN

The Long-Term Plan consists of three primary components:

1. **Pre-2006 Projects –** These are structural and operational modifications that can be supported by the current scientific and engineering knowledge base, to be implemented by December 31, 2006. They also include operation, maintenance, and monitoring of the Stormwater Treatment Areas (STAs). The pre-2006 recommended improvements and strategies are considered to be the maximum scientifically defensible steps that have been identified at this time. A brief summary of those recommended measures is presented in **Table 8A-2**. A summary of the projected total phosphorus (TP) reductions for the ECP basins is presented in **Table 8A-3**, and a summary of the projected TP reductions for the ESP basins is presented in **Table 8A-4**. A summary of the estimated performance of all pre-2006 projects is presented in **Table 8A-5**.

Following operation of the pre-2006 projects, discharges from the Everglades Construction Project, equal to approximately 88 percent of the water entering the Everglades, are predicted to range from 10-14 ppb. It is possible that these improvements and strategies will not, in and of themselves, provide adequate assurance of an ability to consistently meet that objective on a long-term basis. Therefore, the Post-2006 Strategy, discussed below, is included in the Long-Term Plan. The only basins that are predicted to have discharges above the 10-14 ppb range after December 31, 2006 are those basins that have future CERP projects. These include the North Springs Improvement District (NSID), C-11 West, L-28 and Feeder Canal basins. Those basins' discharges will account for approximately 12 percent of the total surface flows to the Everglades after completion of the pre-2006 projects and the CERP projects scheduled for completion prior to December 2006.

2. **Process Development and Engineering (PDE) –** These are activities designed to:
   - Further understanding and optimization of water quality performance in existing and proposed facilities.
   - Facilitate integration with the Comprehensive Everglades Restoration Plan (CERP).
   - Maintain and improve on the contribution of source controls to overall water quality improvement goals.
   - Investigate ways to accelerate the recovery of previously impacted areas in the EPA.

3. **Post-2006 Strategy –** This is the identification and adaptive implementation of additional water quality improvement measures that may be considered necessary to achieve the planning objective following completion of the pre-2006 activities and based on ongoing analysis of the PDE effort. It also includes implementation of steps identified that are capable of accelerating the recovery of previously impacted areas in the EPA, including final implementation of the hydropattern restoration activities directed by the EFA once water quality standards are achieved.

   The Long-Term Plan was developed in recognition that:

   - Achieving the phosphorus criterion (Rule 62-302.540, Florida Administrative Code [F.A.C.]) will involve an adaptive management approach, whereby the best available information is used to develop and implement incremental improvement measures as soon as their need and utility is confirmed, consistent with informed and prudent expenditure of public and private funds.
   - Continued investigations are necessary to further improve the overall operation and performance of integrated water quality improvement strategies.
   - Significant performance and economic benefits can be realized by integrating Everglades water quality improvement measures with CERP projects, even to the extent that existing schedules should be reevaluated in some basins and synchronized with CERP project schedules. Modifications to the design and operation of planned CERP projects should also be considered.

The total estimated expenditure through Fiscal Year 2016 for full implementation of the Long-Term Plan (excluding expenditures for presently identified CERP efforts) is $444 million. Of that total, approximately $272 million is associated with the operation, maintenance, and monitoring of the STAs modified and enhanced as described in the Long-Term Plan. The incremental investment recommended in the Long-Term Plan totals $172 million. Of this amount, $36 million is included for adaptive implementation as described in the Post-2006 Strategy component of the Long-Term Plan.

Substantial reliance is placed on source controls and full integration with CERP, particularly in the Everglades Stormwater Program basins. The majority of phosphorus reduction associated with CERP projects is not a result of the addition of water quality treatment measures; rather, it is a result of diversion of stormwater away from the Everglades, consistent with the authorized scope of CERP projects. This will result in significant cost avoidance, without cost increases to CERP projects, to achieve significant water quality benefits to the Everglades. The Long-Term Plan presents technical recommendations for water quality improvement strategies in those basins; it is intended that those recommendations be given full consideration in the CERP planning process. Projected costs for all components of the water quality improvement strategies that are recommended in the Long-Term Plan are summarized in **Table 8A-6**. Those projected funding needs include allowances for cost escalation at an average annual rate of 3 percent, and they extend from Fiscal Year 2004 through Fiscal Year 2016.

It is intended that adoption and implementation of the strategies recommended in the Long-Term Plan will result in compliance with the water quality standards and improvement goals of the EFA, including the phosphorus criterion established in Rule 62-302.540, F.A.C. Nonetheless, it remains possible that other, more extensive measures might eventually be required if the strategies recommended in the Long-Term Plan eventually prove inadequate, or if the intended full integration with CERP is not realized. Analyses and discussions of such future possible measures are included in Part 6 of the Long-Term Plan. Those measures, none of which are presently recommended for implementation, might include expansion of the STAs in the ECP basins or diversion works and new treatment facilities in the ESP basins.

Given the significant magnitude of additional expenditures for the future possible measures described in Part 6 of the Long-Term Plan, it is intended that the District submit a December 31, 2008 comprehensive report to the Florida governor and the Florida legislature on the status and progress of the Long-Term Plan. That report should include specific identification of which, if any, more extensive measures are then considered necessary and defensible to achieve water quality standards and the goals of the EFA. It is the intent of the Long-Term Plan to prevent the need for more extensive measures, if at all possible.

Table 8A-2. Pre-2006 strategies.

Basin	Strategies and Activities	Schedule (Note 1) Construction Complete	Schedule (Note 1) Full Operation
STA-1E	Convert Downstream Cells to SAV	10/01/2005	12/31/2006
STA-1W	Additional Compartmentalization; Improved Flow Control; Convert Additional Areas to SAV	05/01/2006	12/31/2006
STA-2	Additional Compartmentalization; Convert Additional Areas to SAV	05/01/2006	12/31/2006
STA-3/4	Additional Compartmentalization; Convert Additional Areas to SAV	05/01/2006	12/31/2006
STA-5	Improved Flow Control; Convert Additional Areas to SAV; Improved Management and Control of Seepage	10/01/2006	12/31/2006
STA-6	Additional Compartmentalization; Improved Flow Control; Convert Additional Areas to SAV; Add Water Supply Capability	10/01/2006	12/31/2006
Acme B	The CERP process will make the final determination of the appropriate strategy and be responsible for implementation. The most promising alternative appears to be diversion to STA-1E for treatment.	10/01/2006	12/31/2006
NSID	CERP Diversion & Elimination of Direct Discharge to EPA (Hillsboro Site 1 Project); Assist Local Communities in Developing & Evaluating Urban BMPs	12/31/2007 (Note 2)	12/31/2007 (Note 2)
NNRC	CERP Diversion & Elimination of Direct Discharge to EPA (Component YY4); Discontinue Use of G-123 if No Adverse Flooding Impacts	12/31/2006	2018 (Note 2)
C-11 West	CERP Diversion & Substantial Elimination of Direct Discharge to EPA (Western C-11, North Lake Belt Storage); Fund Add'l Analyses to Modify Project for Increased Reliability of Diversion; Assist Local Communities in Developing & Evaluating Urban BMPs	12/31/2006 (Note 2, Western C-11) 2036 (Note 2, North Lake)	2036 (Full complete) Majority of Diversion Complete in 2006
L-28	The CERP process will make the final determination of the appropriate strategy and be responsible for implementation. The most promising alternative appears to be construction of Miccosukee and Seminole Tribal STAs.	10/01/2008 (Note 3)	10/01/2010
Feeder Canal	Seminole Water Control Plan; McDaniel Ranch Property Owners Agreement; Additional BMPs in West Feeder Basin for Target TP Conc. of 50 ppb; Accelerate Completion of CERP Project for Diversion of L-28 Interceptor	12/31/2006 (Source controls)	10/01/2009 (Note 3)

Notes: 1. Anticipated earliest completion schedule for construction and full operation.

2. Actual completion schedule controlled by CERP; schedule taken from latest CERP documents.

3. Actual completion schedule controlled by CERP; schedule shown is accelerated from that shown in latest CERP planning documents.

Table 8A-3. Projected total phosphorus (TP) reductions in the Everglades Construction Project (ECP) basins.

Basin	Period		Est. Ave. Annual Discharge		Estimated TP Concentrations		Remarks
	From	Through	Volume (ac-ft)	TP Load (tonnes)	Flow-Weight Mean (ppb)	Geometric Mean (ppb)	
STA-1E	2004	2006	148,400	7.03	38	34	For Current Design of STA-1E
	2007	2056	175,000	3.31 - 3.64	15 - 24	10 - 11	After Enhancement of STA-1E and Diversion of Acme Basin B
STA-1W	2004	2006	188,100	5.65 - 6.12	24 - 30	24 - 26	For Existing STA-1W
	2007	2056	183,300	3.15 - 4.09	14 - 22	10 - 13	After Enhancement of STA-1W
STA-2	2004	2006	223,300	9.08 - 9.63	33 - 37	33 - 35	For Existing STA-2
	2007	2014	222,600	4.59 - 6.42	17 - 28	10 - 14	After Enhancement of STA-2
	2014	2056	197,500	3.52 - 4.58	14 - 24	10 - 13	After Full Completion of CERP
STA-3/4	2004	2006	623,700	28.01	36	36	For Current Design of STA-3/4
	2007	2014	621,200	10.98 - 15.37	14 - 21	10 - 14	After Enhancement of STA-3/4
	2015	2056	588,600	10.19 - 15.28	14 - 21	10 - 15	After Full Completion of CERP
STA-5	2004	2006	125,900	6.93 - 7.36	45 - 50	32 - 34	For Existing STA-5
	2007	2014	125,500	3.03 - 3.94	20 - 30	10 - 13	After Enhancement of STA-5
	2015	2056	125,500	3.03 - 3.94	20 - 30	10 - 13	After Full Completion of CERP
STA-6	2004	2006	35,300	1.23	28	20	For Existing STA-6 (With Section 2 Completed)
	2007	2014	35,100	0.75 - 0.97	17 - 24	10 - 13	After Enhancement of STA-5
	2015	2056	57,600	1.20 - 1.44	17 - 22	10 - 12	After Full Completion of CERP
All	2004	2006	1,344,700	57.93 - 59.39	35 - 36	20 - 36	Existing (No Project) Conditions
ECP	2007	2014	1,362,700	25.80 - 34.44	15 - 20	10 - 14	After STA Enhancements
Basins	2015	2056	1,327,500	24.40 - 32.97	15 - 20	10 - 15	After Full Completion of CERP

Table 8A-4. Projected TP reductions in the Everglades Stormwater Program (ESP) basins.

Basin	Period		Est. Ave. Annual Discharge		Estimated TP Concentrations		Remarks
	From	Through	Volume (ac-ft)	TP Load (tonnes)	Flow-Weight Mean (ppb)	Geometric Mean (ppb)	
Acme	2004	2006	31,500	2.75	71		Existing Conditions, with 25% reduction in TP load due to BMPs
Basin B	2007	2056	0	0.00	N/A		After Diversion to STA-1E (Included in STA-1E Discharge Summary)
NSID	2004	2007	6,800	0.29	39		Existing Conditions Discharge to WCA-2A
	2008	2056	0	0.00	N/A		After Diversion to Hillsboro Site 1
NNRC	2004	2006	1,800	0.04	18		Existing Conditions Discharge to WCA-3A
	2007	2018	0	0.00	N/A		Assumes Discontinuation of G-123 Does Not Reduce Flood Protection
	2018	2056	0	0.00	N/A		After Completion of WCA-2 and WCA-3 Diversion Project
C-11	2004	2006	194,000	4.06	17		Current Discharges Prior to Completion of Critical Project at S-9 (S-9A); Some Reduction Prior to 2006
	2007	2036	18,300	0.49	22		After Critical Project and Diversion to Western C-11 Impoundment; Excludes Seepage Return at S-9A
	2037	2056	900	0.03	28		After Completion of North Lake Belt Storage Project; Excludes Seepage Return at S-9A
L-28	2004	2010	84,000	3.98	39		Existing Conditions, Flows and Loads Adjusted to Reflect C-139 Annex Discharges Directed to STA-6
	2011	2056	84,000	1.43	14	10	Following Completion and Full Stabilization of Miccosukee & Seminole Tribal STAs
Feeder	2004	2006	77,000	14.85	156		Existing Conditions
Canal	2007	2010	77,000	4.76	50		Following Completion of Seminole Big Cypress WCP; McDaniel Ranch BMPs; West Feeder Basin BMPs
	2011	2056	0	0.00	N/A		Full Diversion to Big Cypress National Preserve (Big Cypress/L-28 Interceptor Modifications)
All	2004	2006	395,100	25.98	53		
ESP		2007	186,100	9.53	42		
Basins	2008	2010	179,300	9.24	42		
	2011	2036	102,300	1.92	15		
	2037	2056	84,900	1.46	14		

Table 8A-5. Estimated TP reduction performance of pre-2006 projects.

Period		Estimated Average Annual Discharges										
From	Thru	All ECP Basins				All ESP Basins			All Basins		
		Volume (ac-ft)	Load (metric tons)	TP Conc. (ppb) F.W. Mean	TP Conc. (ppb) Geo. Mean	Volume (ac-ft)	TP Load (metric tons)	FW TP Conc (ppb)	Volume (ac-ft)	Load (metric tons)	FW TP Conc (ppb)
2004	12/30/06	1,344,700	57.9 - 59.4	35 - 36	20 - 36	395,100	26.0	53	1,739,800	83.9 - 85.4	39 - 40
12/31/06	12/31/07	1,362,700	25.8 - 34.4	15 - 20	10 - 14	186,100	9.5	42	1,548,800	35.3 - 44.0	18 - 23
2008	2010	1,362,700	25.8 - 34.4	15 - 20	10 - 14	179,300	9.2	42	1,542,000	35.0 - 43.7	18 - 23
2011	2014	1,362,700	25.8 - 34.4	15 - 20	10 - 14	102,300	1.9	15	1,465,000	27.7 - 36.4	15 - 20
2015	2036	1,327,500	24.4 - 33.0	15 - 20	10 - 15	102,300	1.9	15	1,429,800	26.3 - 34.9	15 - 20
2037	2056	1,327,500	24.4 - 33.0	15 - 20	10 - 15	84,900	1.5	14	1,412,400	25.9 - 34.4	15 - 20

Table 8A-6. Projected costs through Fiscal Year 2016 by Long-Term Plan Component.

Fiscal Year	Summary of Projected Expenditures by Function (in $1,000s)									
	Pre-2006 Projects		PD&E Process	Recovery of Impacted Areas	Operation & Maintenance	Monitoring		Program Management	Funds for Adaptive Implement.	Fiscal Year Total Expenditure
	ECP Basins	ESP Basins				Permit Compliance	Operations Support			
2004	$5,049	$500	$8,835	$1,283	$9,433	$3,640	$2,208	$916	$0	$31,864
2005	$15,044	$750	$8,650	$1,317	$10,894	$3,475	$3,167	$1,248	$0	$44,544
2006	$11,426	$667	$6,268	$1,351	$12,085	$3,363	$3,580	$1,108	$0	$39,847
2007	$0	$0	$5,827	$279	$12,173	$3,450	$3,673	$1,970	$9,000	$36,372
2008	$0	$0	$5,404	$460	$12,545	$3,581	$3,812	$979	$9,000	$35,782
2009	$0	$0	$4,648	$1,199	$12,917	$3,674	$3,911	$994	$9,000	$36,343
2010	$0	$0	$1,050	$3,207	$12,816	$3,785	$4,029	$964	$9,000	$34,851
2011	$0	$0	$799	$15,525	$13,201	$3,898	$4,150	$1,073	$0	$38,644
2012	$0	$0	$626	$15,878	$13,593	$4,000	$4,258	$1,098	$0	$39,454
2013	$0	$0	$847	$2,000	$14,538	$4,135	$4,402	$706	$0	$26,628
2014	$0	$0	$666	$2,000	$14,974	$4,260	$4,534	$719	$0	$27,153
2015	$0	$0	$757	$0	$15,423	$4,387	$4,670	$681	$0	$25,919
2016	$0	$0	$563	$0	$15,893	$4,536	$4,829	$695	$0	$26,518
Total	**$31,518**	**$1,917**	**$44,942**	**$44,498**	**$170,484**	**$50,185**	**$51,224**	**$13,151**	**$36,000**	**$443,918**

Note: The above projections are expressed in escalated dollars, considering average annual inflation of 3% throughout the planning period.

CHALLENGES TO ACHIEVING LONG-TERM WATER QUALITY GOALS

Successful implementation of the Long-Term Plan will require integration of numerous research, planning, regulatory, and construction activities, as introduced in Chapter 1. The District and the FDEP are committed to achieving these long-term water quality goals. Some of the more significant challenges for doing so include regulatory issues, uncertainties in long-term performance of source control and in regional treatment technologies, and integration with CERP projects.

REGULATORY ISSUES

The state of Florida's Environmental Regulation Commission (ERC) adopted a water quality standard for phosphorus within the Everglades Protection Area (EPA) that includes the following:

1. A numeric criterion of 10 ppb for total phosphorus (TP) in the EPA.

2. Moderating provisions, which authorize discharge to the EPA where net improvement is provided in impacted areas or where hydropattern restoration benefits clearly outweigh adverse impacts in unimpacted areas.

3. A method for determining achievement of the criterion.

An administrative hearing is scheduled for November 2003 to resolve challenges to the ERC's adopted rule. The rule must also be submitted to the U.S. Environmental Protection Agency (USEPA) for approval upon resolution of the challenges. The Long-Term Plan being implemented by the District has the planning goal of achieving water quality standards, including the phosphorus criterion. During the initial phase of implementation (pre-2016) of the Long-Term Plan, permits issued by the FDEP shall be based on Best Available Phosphorus Reduction Technology, as defined by the recently revised EFA, and shall include Technology Based Effluent Limits consistent with the Long-Term Plan. Details on TP criterion development are presented in Chapter 5.

In addition, the FDEP must evaluate water quality standards for parameters other than TP for the EPA and Everglades Agricultural Area (EAA) canals. As a part of this evaluation, the FDEP is also specifically directed by the EFA to recognize by rulemaking the existing beneficial uses of the EAA conveyance canals. Although the EFA does not set a specific deadline for this rulemaking, it is assumed that it will be completed by December 31, 2006. Other regulatory issues are discussed in Chapter 3.

STORMWATER TREATMENT AREA OPTIMIZATION AND ADVANCED TREATMENT TECHNOLOGY RESEARCH

Current research results have yet to identify full-scale Advanced Treatment Technologies (ATTs) that reliably and consistently produce TP levels of 10 ppb at the point of discharge (referred to as "end-of-pipe"). Chapter 4B presents a summary of STA optimization and ATT research. While critical research is continuing on STA optimization and ATTs, the Long-Term Plan includes a process of adaptive implementation to incorporate the best available and scientifically defensible information during implementation of the Long-Term Plan.

SOURCE CONTROL MEASURES

While landowners within the Everglades Agricultural Area (EAA) as a whole have implemented effective source control BMPs, the Long-Term Plan includes funding for identification of "hot spots" within the EAA and for implementation of source control measures in these locations. The Long-Term Plan also includes funding for identification and implementation of source control measures in other rural (non-ECP) basins and in urban basins. However, comparatively little is known about the technical efficacy and economics of controlling total phosphorus (TP) loads from these other non-ECP basins.

SYNCHRONIZATION WITH CERP PROJECTS

The majority of Everglades tributary basins contain proposed CERP projects. There is potential for significant cost savings by integrating some of the Long-Term Plan components with the CERP projects. Many of the CERP projects are currently in the early planning and design phases. Therefore, uncertainty exists in how CERP projects would influence flows and water quality, as well as their implementation schedules. Close coordination is needed between members of the CERP project delivery teams and staff implementing the Long-Term Plan components to ensure that project goals are met on schedule.

PHOSPHORUS LOADS TO THE EVERGLADES PROTECTION AREA

The Everglades Protection Area (EPA) is a complex system of marsh areas, canals, levees, and inflow and outflow water control structures covering almost 2.5 million acres. In addition to rainfall inputs, surface water inflows regulated by water control structures from agricultural tributaries, such as the EAA and the C-139 basin, feed the EPA from the north and western boundaries. The EPA also receives surface water inflows originating from Lake Okeechobee to the north and from predominantly urbanized areas to the east. The timing and distribution of the surface inflows from the tributaries to the EPA are based on a complex set of operational decisions that account for natural and environmental system requirements, water supply for urbanized and natural areas, aquifer recharge, and flood control.

Each year the EPA receives amounts of surface water inflows based on hydrologic variability. These inflows, regulated according to previously mentioned operational decisions, also contribute a certain amount of TP loading to the EPA system. The load schematic presented in **Figure 8A-1** depicts a generalized overview of surface water inflow sources and relative contributions of TP loading to the EPA for Water Year 2003 (WY2003) (May 1, 2002 through April 30, 2003). **Figure 8A-1** also illustrates all connecting tributaries to the EPA: Lake Okeechobee, the EAA, the C-139 basin, other agricultural and urbanized areas, and the STAs. In some cases, surface water inflows represent a mixture of water from several sources as the water passes from one area to another before finally arriving in the EPA. For example, water discharged from Lake Okeechobee can pass through the EAA and then through an STA before arriving in the EPA. As another example, runoff from the C-139 basin can pass through STA-5 and then into the EAA before ultimately arriving in the EPA. The conveyance and delivery system is complex; however, the schematic in **Figure 8A-1** attempts to identify the amount of TP load and its associated pathways to the EPA.

It is also recognized that a certain amount of TP loading to the EPA emanates from atmospheric deposition. **Figure 8A-1** depicts a long-term average range of atmospheric deposition of TP between 107 and 143 tons as the total contribution to the Water Conservation

Areas (WCAs). This range is based on data obtained from long-term monitoring that was evaluated and reported in 2002 in a District technical publication (Redfield, EMA-403, February 2002). The TP loads and the relative percent contribution to the region from each source, including and excluding the contribution of atmospheric deposition, are tabulated in **Table 8A-7**. Detailed estimates of TP loads by structure are presented in **Table 8A-8**.

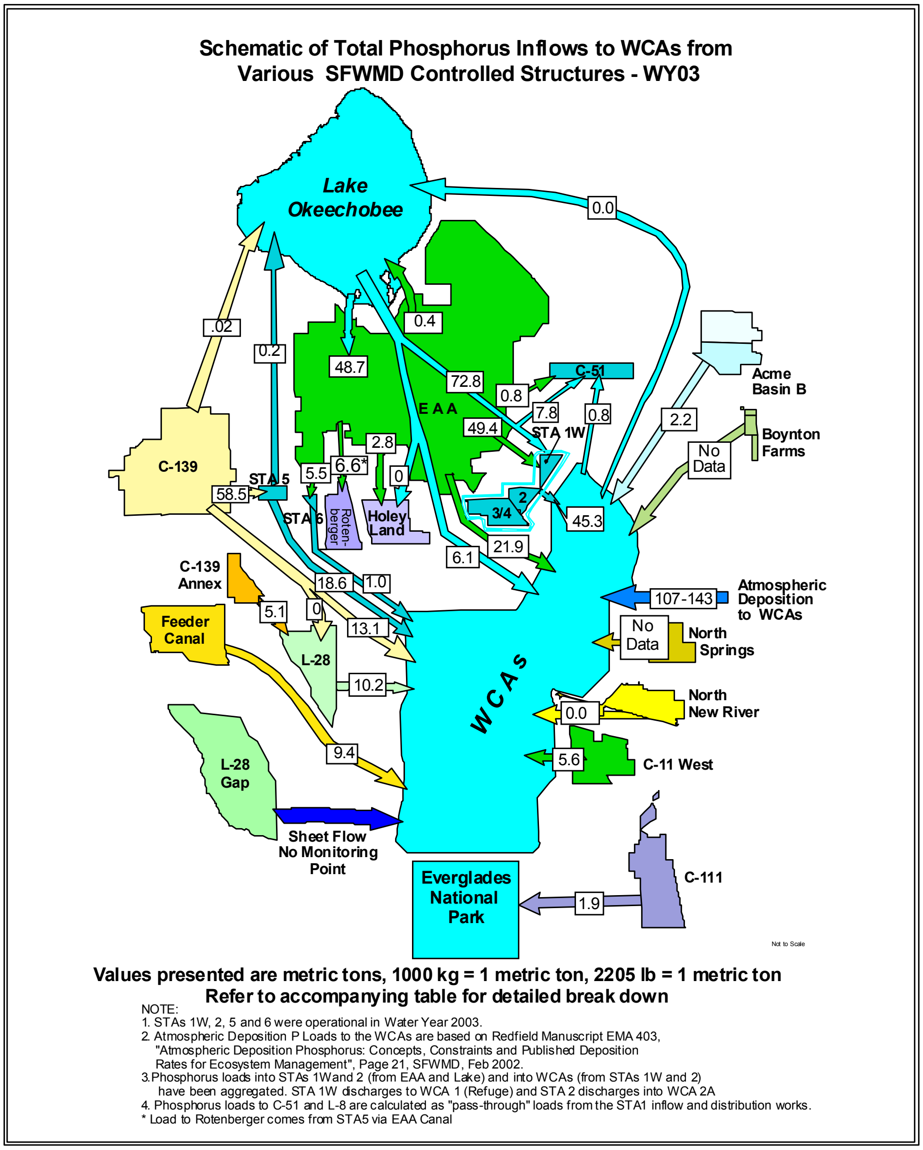

Figure 8A-1. Overview of surface water inflow sources and relative contributions of phosphorus loading to the Everglades Protection Area (EPA) for Water Year 2003.

Table 8A-7. Water Year 2003 phosphorus loads to the EPA and other waters.

Data provided by Everglades Regulation Division

Source Water	Receiving Water	Phosphorus Load (metric tons)	Portion of Surface Inflows	Portion of Total Inflows
Lake Okeechobee	EPA (WCAs)	6.1	4.5%	1.9%
	EAA	48.7		
	STAs	72.8		
	C-51 Canal	7.8		
	Total from Lake O	**135**		
Everglades Agricultural Area	EPA (WCAs)	21.9	16.1%	6.7%
	Lake Okeechobee	0.4		
	STAs	54.9		
	Holey Land	2.8		
	C-51 West Basin	0.8		
	Total from EAA	**80.8**		
Stormwater Treatment Areas (STAs)	EPA (WCAs)	64.9	47.7%	19.7%
	Lake Okeechobee	0.2		
	Holey Land and Rotenberger	7.8		
	Total from STAs	**72.9**		
Rotenberger	EPA (WCAs)	0.8	0.6%	
C-51 West Basin	EAA	0.1		
	STAs	1.5		
	Total from C-51W Basin	**1.6**		
Acme Basin B	EPA (WCAs)	2.2	1.6%	0.7%
Boynton Farms	EPA (WCAs)	No data		
North Springs Improvement District	EPA (WCAs)	No data		
North New River Canal Basin	EPA (WCAs)	0.0	0.0%	0.0%
C-11 West Basin	EPA (WCAs)	5.6	4.1%	1.7%
C-111 Basin	EPA (ENP)	1.9	1.4%	0.6%
Feeder Canal Basin	EPA (WCAs)	9.4	6.9%	2.8%
L-28 Canal Basin	EPA (WCAs)	10.2	7.5%	3.1%
C-139 Basin	EPA (WCAs)	13.1	9.6%	4.0%
	STAs	58.5		
	Lake Okeechobee	0.02		
	Total C-139 Basin	**71.6**		
C-139 Annex	L-28 Canal	5.1		1.5%
L-28 Gap Basin	EPA (WCAs)	No data		
Total Surface Inflows	EPA (WCAs)	**136**	100%	41.3%
Atmospheric Deposition	WCA-1 (35 mg/m2/yr)	20.0		
	WCA-2 (35 mg/m2/yr)	18.8		
	WCA-3 (25 mg/m2/yr)	70.4		
	ENP (20 mg/m2/yr)	84.1		
	Total atmospheric deposition	**193**		58.7%
Total Loads to the EPA	**EPA (WCAs)**	**329**		100%
Loads From the EPA	STAs	*0.7*		
	Hillsboro Canal (S-39)	*7.7*		
	C-51 West Basin	*0.8*		
	Total loads from the EPA	**9.2**		

Notes on atmospheric deposition:

1: The Everglades National Park area is delineated by coastal line coverage and does not includes Florida Bay.

2: Estimates of areal deposition rates from "Atmospheric Deposition Phosphorus: Concepts, Constraints and Published Deposition Rates for Ecosystem Management", Page 21, SFWMD, Feb 2002. (EMA Report No. 403)

Table 8A-8. Water Year 2003 summary of flow and total phosphorus by structure.

Into WCA1

Structure	Flow	Phosphorus	
	1000 ac-ft	Load (kg)	FWMC (ppb)
G300 & G301	10	2492	198
from EAA		*2086*	
from Lake O		*154*	
from East Beach		*252*	
from Inflow Basin		*0*	
G251 *(from STA-1W)*	97	5276	44
G310 *(from STA-1W)*	499	33415	54
ACME1 *(from Basin B)*	9	864	80
ACME2 *(from Basin B)*	9	1362	117
Total	**624**	**43409**	**56**

From WCA1

Structure	Flow	Phosphorus	
	1000 ac-ft	Load (kg)	FWMC (ppb)
S10A	121	5526	37
S10C	55	2591	38
S10D	67	4252	51
S10E	0	0	n/a
S39	207	7718	30
G300	8	979	103
G301	3	563	214
Total	**461**	**21628**	**38**

Into WCA2

Structure	Flow	Phosphorus	
	1000 ac-ft	Load (kg)	FWMC (ppb)
G335 *(from STA-2)*	308	6634	17
S7	143	9624	55
from EAA		*4961*	
from Lake O		*4663*	
S10A *(from WCA1)*	121	5526	37
S10C *(from WCA1)*	55	2591	38
S10D *(from WCA1)*	67	4252	51
S10E *(from WCA1)*	0	0	n/a
N. Springs Improv. District	1	n/a	no data
Total	**695**	**28626**	**33**

From WCA2

Structure	Flow	Phosphorus	
	1000 ac-ft	Load (kg)	FWMC (ppb)
S7	17	489	23
S11A	109	2565	19
S11B	58	792	11
S11C	134	4189	25
S38	34	1057	25
S34	114	3683	26
Total	**464**	**12774**	**22**

Into WCA3

Structure	Flow	Phosphorus	
	1000 ac-ft	Load (kg)	FWMC (ppb)
S140 *(from L28 Canal)*	136	10191	61
S190 *(from Feeder Canal)*	88	9358	86
L3 (G88+G155) *(from C139)*	32	8481	216
STA-6	33	1046	26
S8	292	29420	82
from EAA		*11039*	
from Lake O		*1251*	
from C-139		*4291*	
from STA-5		*12296*	
from Rotenberger		*543*	
S150 *(from EAA)*	69	4086	48
G204 *(from Holey Land)*	0	0	n/a
G404	93	6622	58
from EAA		*-241*	
from C-139		*351*	
from STA-5		*6300*	
from Rotenberger		*213*	
S11A *(from WCA2)*	109	2565	19
S11B (*from WCA2)*	58	792	11
S11C *(from WCA2)*	134	4189	25
G123 *(from N. New River)*	0	0	n/a
S9 *(from C-11 West)*	264	5580	17
Total	**1306**	**82329**	**51**

From WCA3

Structure	Flow	Phosphorus	
	1000 ac-ft	Load (kg)	FWMC (ppb)
S150	0	0	n/a
S8	0	0	n/a
G204	0	0	n/a
S31	0	0	n/a
S337	24	1415	49
S343A	16	155	8
S343B	18	174	8
S344	13	180	12
S12A	112	1191	9
S12B	98	847	7
S12C	188	2008	9
S12D	227	3354	12
S333	207	2979	12
S14	0	0	n/a
Total	**902**	**12303**	**11**

Into Everglades National Park (ENP)

Structure	Flow	Phosphorus	
	1000 ac-ft	Load (kg)	FWMC (ppb)
S12A *(from WCA3)*	112	1191	9
S12B *(from WCA3)*	98	847	7
S12C *(from WCA3)*	188	2008	9
S12D *(from WCA3)*	227	3354	12
S333 *(from WCA3)*	207	2979	12
S14 *(from WCA3)*	0	0	n/a
S174 *(from L-31W)*	6	66	8
S332D *(from L-31W)*	90	659	6
S18C *(from C-111 Canal)*	135	1200	7
Total	**1064**	**12303**	**9**

From ENP

Structure	Flow	Phosphorus	
	1000 ac-ft	Load (kg)	FWMC (ppb)
S334	76	1099	12
S197	16	128	6
Total	**92**	**1227**	**11**

FWMC = flow weighted mean concentration

Comparison of WY2003 Phosphorus Loads to 1979–1988 Baseline

This section reports phosphorus loading into the Everglades Protection Area for WY2003.

October 1978 through September 1988 has been identified as a comparative baseline period (called the 1979–1988 baseline period) for various planning purposes, including the 1992 Everglades Surface Water Improvement and Management Act (SWIM) Plan, the design of the Everglades Construction Project, the 1991 Everglades Settlement Agreement, and the Everglades Forever Act, as amended. During that 10-year period, annual phosphorus loads in surface inflows to the EPA ranged from approximately 100 metric tons to over 350 metric tons, with an average of 270 metric tons (1992 Everglades SWIM Plan). Included in this 270-ton annual average were approximately205 tons to the Water Conservation Areas (WCAs) from the EAA, Lake Okeechobee, and L-8 and C-51W basins through the S-5A, S-6, S-7, S-150, and S-8 structures. This 205-ton annual average was the basis of design for the four original STAs of the Everglades Settlement Agreement. During that same 1979–1988 baseline period, phosphorus loads in surface inflows to the Refuge ranged from approximately 40 metric tons to over 150 metric tons per year, with an average of about 110 metric tons (1992 Everglades SWIM Plan). Included in this 110-ton annual average were approximately 105 tons from the EAA, Lake Okeechobee, L-8 and C-51W basins through the S-5A and S-6 pump stations. This 105-ton annual average load to the Refuge was the basis of design for the original STA-1 and STA-2 of the Everglades Settlement Agreement.

As set forth in Appendix C of the Everglades Settlement Agreement, the Settling Parties assumed that if the STAs and BMPs performed as designed, there would be an approximate 80-percent reduction of stormwater-borne phosphorus loads to the WCAs from the EAA (i.e., excluding other sources such as Lake Okeechobee water supply releases). Using the loads that occurred during the baseline period (1979–88) and the Appendix C assumptions, the anticipated 10-year average load equating to this 80-percent reduction is approximately 40.2 metric tons from the EAA to the WCAs.

Similarly, the Settlement Agreement also envisions an approximate 85-percent reduction of phosphorus loads from the EAA to the Refuge if the STAs and BMPs achieve their design assumptions. Using the loads that occurred during the baseline period (1979–88) and the Appendix C assumptions, the anticipated 10-year average load equating to this 85-percent reduction is approximately 15.5 metric tons from the EAA to the Refuge.

In 2002, the Technical Oversight Committee (TOC) established, pursuant to the Settlement Agreement, a methodology developed by Walker (1996) for reviewing the load reductions based on annual phosphorus concentrations of water entering the WCAs and Refuge. That methodology assumes compliance with the reduction requirements unless the annual phosphorus inflow concentration to the WCAs (and Refuge) from the EAA and bypassed flows is greater than 76 ppb in any water year or is greater than 50 ppb in three or more consecutive water years (Walker, 1996). Compliance will not be tested in water years when the EAA adjusted annual rainfall, as defined in SFWMD Rule 40E-63, is above 63.8 inches. Compliance will also not be tested in water years when the EAA adjusted rainfall is below 35.1 inches, if sufficient water is not available to maintain wet conditions in the STAs. The following discussion of WY2003 loads does not substitute for the compliance review activities of the TOC but is simply a public presentation of relevant data as requested by the TOC.

Phosphorus loads to the EPA during WY2003 were significantly lower than the 1979–1988 baseline period. As shown in **Tables 8A-7** and **8A-8**, loads to the EPA totaled approximately 136 metric tons, with a flow-weighted mean concentration of 48 ppb. It should be recognized that not all of this load came from the EAA. Phosphorus loads to the WCAs from the EAA were calculated as:

1. a proportion of STA-1W and STA-2 discharges, adjusted to reflect contributions from non-EAA sources [STA-1W (from EAA: 37 percent), STA-2 (from EAA: 79 percent)],

2. STA-6 discharges, and

3. direct EAA discharges from the S-7, S-8, S-150, G-300, and G-301 structures.

Phosphorus loads to the WCAs from the EAA during WY2003 totaled about 42.8 tons. This annual load is slightly higher than the 10-yr average expectation of 40.2 tons. However, it should be noted that the 42.8 tons is not a multiple-year average value (as is the 10-yr average of 40.2 tons) and that compliance with the load reduction is not scheduled to begin until WY2004. The average of the WY2002 and WY2003 loads from the EAA to the WCAs was 36.2 tons, slightly below the anticipated 10-year average load of 40.2 tons. This relatively low average load is significant considering STA-1E and STA-3/4 were not operational during WY2003.

Phosphorus loads from all sources to the Refuge during WY2003 totaled approximately 43.4 tons, the majority resulting from regulatory releases from Lake Okeechobee. The phosphorus load to the Refuge from the EAA during WY2003 was approximately 16.6 tons, slightly above the anticipated 10-year average load of 15.5 tons. This small degree of overage is significant in that STA-1 East was not yet operational. The average of the WY2002 and WY2003 loads from the EAA to the Refuge was 14.6 tons, slightly below the anticipated 10-year average load of 15.5 tons. The flow-weighted mean phosphorus concentration entering the Refuge from the EAA and bypass flows during WY2003 was 55 ppb, which is below the annual maximum of 76 ppb established by the TOC methodology and slightly higher than the 49 ppb observed during WY2002.

LITERATURE CITED

Brown and Caldwell. 2002. Basin Specific Feasibility Studies for the Everglades Stormwater Program Basins. October 2002. Report prepared for the South Florida Water Management District, West Palm Beach, FL.

Burns & McDonnell. 2002. Evaluation of Alternatives for the ECP Basins. October 2002. Report prepared for the South Florida Water Management District, West Palm Beach, FL.

Burns & McDonnell. 2003. Conceptual Plan for Achieving Long-Term Water Quality Goals. March 2003.

Burns & McDonnell. 2003. Everglades Protection Area Tributary Basins Long-Term Plan for Achieving Water Quality Goals. October 2003.

Case No. 88-1886-HOEVELER. 1991 (amended 2001). Everglades Settlement Agreement.

Goforth, G. and T. Piccone. 1999. Preliminary Baseline Data for the Basin-Specific Feasibility Studies to Achieve the Long-Term Water Quality Goals for the Everglades. South Florida Water Management District, West Palm Beach, FL.

Goforth, G. and T. Piccone. 2001. Baseline Data for the Basin-Specific Feasibility Studies to Achieve the Long-Term Water Quality Goals for the Everglades. South Florida Water Management District, West Palm Beach, FL.

Goforth, G. and T. Piccone. 2002. Evaluation Methodology for the Water Quality Improvement Strategies for the Everglades. South Florida Water Management District, West Palm Beach, FL.

PB Water (division of Parsons Brinckerhoff Quade and Douglas, Inc.). 1999. Peer Review of Preliminary Baseline Data for the Basin-Specific Feasibility Studies to Achieve the Long-Term Water Quality Goals for the Everglades. Report prepared for the South Florida Water Management District, West Palm Beach, FL.

Redfield, G. 2002. Atmospheric Deposition of Phosphorus: Concepts, Constraints and Published Deposition Rates for Ecosystem Management. Report No. EMA 403, February 2002. South Florida Water Management District, West Palm Beach, FL.

SFWMD. 1992. Everglades Surface Water Improvement and Management Act (SWIM) Plan. South Florida Water Management District, West Palm Beach, FL.

Walker, W.W. 1996. Test for Evaluating Performance of Stormwater Treatment Areas, prepared for the U.S. Department of the Interior.

Walker, W.W. and R.H. Kadlec. 2002. Development of a Dynamic Model for Stormwater Treatment Areas. Report and model prepared for the U.S. Department of the Interior.