D R A F T

Revised Methodology for Measuring Compliance with Consent Decree Load-Reduction Requirements

prepared for

U.S. Department of the Interior

by

William W. Walker, Jr., Ph.D.
wwwalker.net

June 13, 2007

Introduction

Section 8A of the 1995 Amended Consent Decree specifies the following requirements for reduction of phosphorus loads to the Everglades Protection Area (EVPA) and Loxahatchee National Wildlife Refuge (Refuge):

> "Phosphorus loads discharged from the EAA will be reduced by approximately 80% to the EVPA by October 1, 2003 and will be reduced by approximately 85% to the Refuge by February 1, 1999, as compared with mean levels measured from 1979 to 1988."

The load reductions were originally specified under the 1992 Settlement Agreement (SA), which prescribed a control program to, among other things, accomplish the percentage reductions relative to historical loads of 205 metric tons per year ("mt/yr') to the EVPA and 105 mt/yr to the Refuge from the EAA pump stations and structures S5A, S6, S7, S150, and S8 (October 1978 - September 1979; Everglades SWIM Plan, Appendix F, 1992). Achievement of the prescribed load reductions would require that long-term average loads to the EVPA be no greater than approximately 41 mt/yr (20% of the historical load), and that long-term average loads to the Refuge be no greater than approximately 15.8 mt/yr (15% of the historical load). Based upon the STA design calculations presented in Table 1, the above target loads are "approximate" in the sense that they differ slightly from the actual projected loads to the EVPA (42 mt/yr) and to the Refuge (13 mt/yr). Using a slightly different procedure, Goforth (2004) derived load targets of 40.2 mt/yr to the EVPA and 15.5 mt/yr to the Refuge. Several other reports describe the derivation of these load targets in a similar manner and compare them with recent measured loads to the EVPA and Refuge (Goforth, 2004; Everglades Consolidated Reports, 2003-2004, South Florida Environmental Reports, 2005-2007; Walker, 2006).

A methodology previously adopted by the Everglades Consent Decree's Technical Oversight Committee (TOC) for measuring compliance with the load reduction requirement was based upon measured concentrations at inflows to the EVPA/Refuge instead of loads (Walker, 1996). That methodology assumed that if treatment objectives of the 1992 SA were met (long-term flow-weighted mean STA outflow concentrations less than or equal to 50 ppb with no untreated bypasses under 1979-1988 hydrologic conditions), the SA load reduction requirements would also be met. That test required concentrations in the combined inflows to the EVPA and Refuge from STAs and untreated bypasses to be less than 76 ppb each year and less than 50 ppb at least once in each consecutive 3-year period. The difference between 76 ppb and 50 ppb allowed for the expected year-to-year variability in concentration around the long-term mean, which was estimated based upon historical data from EAA pump stations. Nearhoof et al. (2006) subsequently derived a lower annual limit of 68 ppb based upon data from STA outflows.

In relying on concentration as a surrogate for load reduction, the 1996 load compliance methodology assumed that current and future flows into the EVPA and Refuge would be similar to those used in designing the STAs under the 1992 SA and 1994 Conceptual Plan (CP, Burns & McDonnell, 1994), which was adopted under the 1995 amended Consent Decree. That assumption has proven to be faulty. Figure 1 shows that hydraulic and phosphorus loads to the STA's were frequently above design values in 2002-2006, despite the fact that EAA rainfall was generally at or below the long-term mean. Walker and Kadlec (2003) showed that 12-month rolling-average flows and phosphorus loads from the West Palm Beach Canal in 1999-2003 frequently exceeded the mean and maximum annual values assumed in designing STA-1W and STA-1E. During that same period, the STA-1W outflow concentration increased but remained below 52 ppb (well below the 76 ppb limit), even though the total load from STA-1W reached 38 mt/yr and the total load to the Refuge (including untreated bypass) reached 40 mt/yr (about 2.5 times the 15.8 mt/yr target corresponding to an 85% load reduction).

The TOC subsequently agreed that the test should be modified to eliminate dependence on the faulty assumption that average inflow volumes to the EVPA and Refuge would be similar to STA design values. The revised methodology described below measures compliance based upon inflow loads to the EVPA/Refuge, instead of concentrations. Measuring loads is more direct and provides a more accurate test for determining whether the SA load reduction requirements are met without assuming that flows are unchanged relative to CP design assumptions. It reduces the risk that STA performance will be impaired by hydraulic and/or phosphorus loads exceeding design capacities. Tracking loads is also important because they determine the area of marsh potentially impacted when the discharge concentration exceeds the 10 ppb criterion (Walker & Kadlec, 2005).

The revised methodology develops annual limits for inflow loads to the EVPA and Refuge that are consistent with meeting the SA's 41.0 mt/yr and 15.8 mt/yr long-term-mean targets for loads to the EVPA and Refuge from sources treated under the 1992 SA, while accounting for diversions and other modifications associated with the 1994 CP, as well as for random variations in yearly loads associated with rainfall and other factors.

The assumptions and methods used in deriving the limits can be revised in accordance with TOC guidance.

Load Allocations Consistent with 1994 Conceptual Plan

Measurement of current and future direct loads from sources treated under the 1992 SA is complicated by that fact that they are mixed with loads from other sources introduced under the CP and subsequent plans. It is simpler and more complete to base compliance on total measured loads to the EVPA/Refuge from the CP sources, rather than attempting to parse out individual sources. This approach also follows the 1996 methodology, which measures compliance based upon the total inflow concentrations to the EVPA/Refuge and makes no attempt to parse out impacts of specific sources on those concentrations. The CP was based upon a more detailed accounting of the sources of flows and loads to each STA, as compared with the 1992 SA, which was based only on the total historical flows and loads through the EAA pump stations and structures. In addition, refinements to the flow data, concentration data, and load calculation procedures were also made between 1992 and 1994 to support the CP. Table 1 lists the flows and loads to the EVPA/Refuge expected to result from implementation of the 1994 CP, based upon data presented in the Burns & McDonnell (1994) report.

The projected total load to the EVPA is approximately 68.9 mt/yr, 43.2 mt/yr of which is attributed to EAA and Lake sources that were discharged historically to the EVPA and would have been treated in the control plan envisioned by the 1992 SA. The latter value is similar to the 41 mt/yr target consistent with an 80% reduction, as discussed above. As indicated in Table 1, the projected load assumes that approximately 50% of the STA-5 outflow loads do not reach the EVPA because they are discharged to the Rotenberger tract. That assumption can be revised based upon review of historical monitoring data and intended future operations. Without that assumption, the projected total load to the EVPA from STA discharges would increase from 68.9 to 71.6 mt/yr.

The projected total load to the Refuge is 16.7 mt/yr, 10.5 mt/yr of which are attributed to EAA, Lake, and C51W sources that were historically discharged to the EVPA and would have been treated in the control plan envisioned by the 1992 SA. While the latter value is considerably below the 15.8 mt/yr target consistent with an 85% reduction, approximately 2.0 mt/yr of the load reduction reflects diversion of S5A runoff away from the Refuge to STA-2. That load was essentially replaced by diversion of additional loads from the C51West basin into the Refuge via STA1East under the 1994 CP. Including that diversion, the total load from SA sources would be 12.5 mt/yr, which is similar to the 13.0 mt/yr projected load from STA1 under the 1992 SA design (Table 1).

The load projections in Table 1 suggest that SA's load-reduction requirements would be met if the total outflow loads from 1994 CP sources were similar to those anticipated. With that assumption, compliance with the load-reduction requirement can be determined by comparing measured total loads with mean target loads listed in Table 1 (preliminary estimates 84.4 mt/yr to the EVPA and 24.0 mt/yr to the Refuge). These target loads include the following components:

1. STA discharges (68.9 mt/yr to the EVPA and 16.7 mt/yr to the Refuge) are the primary components of the target loads.

2. No allocation is provided for untreated bypasses around the STA's. Both the SA and CP plans assumed that all basin flows would be treated under 1979-1988 hydrologic conditions. Consistent with the 1996 methodology, bypass loads would be included in measuring compliance, unless resulting from extreme hydrologic events not experiences in 1979-1988.

3. A load of 4.7 mt/yr from ACME Basin B at the estimated historical discharge concentration of 113 ppb is added to the target load. While not part of the SA or CP, current direct discharges from ACME-B into the Refuge will be diverted to STA-1East under the Long-Term Plan. To avoid having to separate this part of the STA-1E discharge in measuring compliance and to provide a complete accounting of loads into the Refuge, it is recommended that ACME historical load be included as an additional component of the target loads to the Refuge and EVPA used to measure compliance with the load-reduction requirement.

4. Loads associated with BMP Replacement water (10.7 mt/yr to the EVPA and 2.6 mt/yr to the Refuge), assumed to be at 50 ppb, are added to the target loads. They would offset the ~20% reduction in EAA runoff volume to the EVPA assumed in both plans. Since current information indicates that there has been essentially no reduction in runoff volume due to BMP's, it is unlikely that BMP Replacement water will actually be delivered from the Lake to the STAs. The allocated loads essentially account for the fact that runoff volume is about 20% higher than anticipated under either plan and were not considered in deriving the 80/85% load reduction requirements. Including this component also assures that the load allocations do not assume net reductions of EAA runoff to the EVPA/Refuge, relative to historical conditions.

Compliance would be measured against the total target loads (84.4 mt/yr to the EVPA and 24.0 mt/yr to the Refuge), not against the individual components. As indicated in Table 2, the target loads are more than twice those forecasted by the EAA Regional Feasibility Study for the 2006-2009 and 2010-2015 periods (SFWMD et al, 2005).

Measured loads for determining compliance would include STA outflows, STA bypasses, ACME-B discharges into the Refuge, and any other current or future discharges to the EVPA/Refuge from sources considered to be part of the 1994 CP. A summary of recent measured loads is given in Table 3. The allocations could be increased to reflect discharges from Section 2 of STA-6 that was subsequently added to the CP in order to provide treatment of runoff from C139 Annex basin. Since the load reductions and allocations are anchored in the historical 1978-1988 loads, the target loads would be independent of any future changes in water management made under the State's Long-Term Plan.

Yearly Limits

Because of the expected variations in yearly loads attributed to rainfall and other random factors, direct comparison of measured loads in each year with the long-term average targets is not sufficient for determining compliance. Yearly limits that account for random year-to-year variations associated with rainfall and other factors are derived in Figures 2 and 3 for the EVPA and Refuge, respectively. The statistical methodology is similar to that used in other SA compliance tests (Refuge Marsh Levels, ENP Inflow Limits) and used by SFWMD to measure BMP performance in the EAA and C139 basins. The limits are set at the 90th percentile of the yearly load expected at a given rainfall if the long-term-average load were equal to the target under 1979-1988 hydrologic conditions.

The limits are calibrated to historical loading data from sources treated under the 1994 CP. These include measured loads from the EAA and C139 basins, as well as load projections for the ACME-B and C51West basins developed under the Long-Term Plan. This is the same approach taken in deriving the 76 ppb annual concentration limit in the 1996 compliance methodology. While calibration to data from STA outflows would be preferable, the STA operational periods are too short to provide a sufficient basis for calibration. To reflect load variations after BMP implementation, data from Water Years 1994-2006 are used for calibration. The average loads in the calibration datasets do not impact the computed limits, since the rainfall/load regressions are rescaled so that the predicted mean loads for May 1979-April 1988 load equals the mean target loads derived in Table 2, based upon October 1979-September 1988 loads. The slight displacement in base periods reflects the current convention of tracking loads for May-April (vs. October-September) Water Years.

Rain-driven variations in annual loads are considered by correlating the EVPA source load to the EAA basin average rainfall ($R^2 = 0.70$) and by correlating the Refuge source load to the EAA S5A basin rainfall ($R^2 = 0.65$). While portions of the source loads come from basins outside of the EAA (C139, C51W, ACMEB), effects of spatial variations in rainfall are embedded in the residual variance used to compute the 90th percentile limits. Further analysis of regional rainfall data is recommended to explore alternatives. In measuring compliance, an allowance could be made if the measured load exceeds the limit because of spatial variations in annual rainfall that are unusual in the context of rainfall data from the 1994-2006 calibration period.

Hindcasts of the 1980-1993 data provide a basis for testing the regressions calibrated to 1994-2004 data. While the rain-driven variations predicted by the EVPA model (Figure 2) are similar to those observed, the EVPA model tends to under-predict loads in 1980-1993, as expected for the period prior to BMP implementation. In contrast, the 1980-1993 data are generally within the confidence interval predicted by the Refuge model (Figure 3). This indicates that there was little change in the average source loads over the 1980-2006 period, despite BMP implementation in the mid 1990's. Any effects of BMP implementation may have been offset by increases in Lake release volumes and concentrations and by diversion of loads from the East Beach 298 district into the S5A basin.

Both models tend to under-predict the source loads in Water Year 2005 when severe hurricanes were experienced. The correlations improve considerably when data from that year are excluded. TOC should consider whether that year should be included in the calibration period, depending upon whether a compliance determination would have been made in that year, given the unusual circumstances.

Implementation

Compliance would be based upon May-April Water Year loading data, as routinely reported in the South Florida Environmental Report. To provide more timely information, it is recommended that measured loads be reported on a 12-month rolling-average basis. The format would be similar to that currently used in reporting compliance with the ENP Inflow limits in the TOC Quarterly Reports. In addition to the total loads, the quarterly reports will include 12-month rolling-average flows, loads, and concentrations from the individual monitoring points used to compute the total loads.

Following the 1996 methodology, compliance would require that the measured loads be below the 90th percentile limit in each year and below the 50th percentile predicted by the rainfall regression in at least one year out in each consecutive three-year period. If these conditions are not met, the results might be justified if there is a TOC consensus that it is based upon one or more of the following factors:

1. The yearly rainfall exceeds the maximum value in the WY 1980-1988 design period (63 in/yr in the EAA basin as a whole for the EVPA limit or 64.4 inches in the EAA/S5A basin for the Refuge Limit).

2. The yearly rainfall is below minimum values in the 1980-1988 design period (35.1 in/yr in the EAA or 40.0 inches in the EAA/S5A basin), provided that sufficient water is not available for irrigating the STA's and the excessive load can be attributed to observed phosphorus releases from vegetation/soils triggered by dry conditions, as opposed to external inflows.

3. Excessive loads are linked to weekly or monthly rainfall events from the EAA or other tributary basins that are outside of the 1979-1988 period of record.

4. Excessive loads are linked to low-flow water-supply deliveries made under low stage, provided it is demonstrated that they pass through the Water Conservation Areas without contacting the marsh, either during or after the period of water-supply delivery.

These provisions, along with the structure and calibration of the compliance methodology described above will be further refined pending review and discussion by TOC.

Alternative Approach

Dr. Goforth (2007) describes an alternative approach that measures compliance by comparing the estimated number of tons currently removed with those anticipated based upon the assumed historical loads and required percentage reductions. There are numerous technical details and assumptions associated with the methodology that require further review. Overall, however, this methodology has the same major flaw as the existing TOC methodology in that it assumes that current source loads (before reductions by BMP's and STA's) are less than or equal to the historical (1979-1988) loads. That methodology places no cap on the actual inflow loads to the EVPA and the Refuge. For example, if the current source load were equal to the assumed historical load 205 mt/yr to the EVPA, compliance could be determined either by comparing the current inflow loads to the EVPA with 41 mt/yr (20% of historical loads, recommended method), or by comparing the estimated current load reduction (source loads - EVPA inflow loads) with 164 mt/yr (80% of historical, Dr. Goforth's alternative method). Theoretically, these methods would provide approximately the same results if source loads remained at or below the assumed historical values. If the source loads were to increase above historical values, however, the alternative method would allow loads to the EVPA to increase while maintaining apparent compliance with the load-reduction requirement. For example, under the Goforth 2007 methodology, if the source loads were to increase from 205 mt/yr to 250 mt/yr and the required 164 mt/yr load reduction were achieved, the load to the EVPA could be as high as 86 mt/yr while still in compliance. In that case, the load to the EVPA would be reduced by only 58% relative to historical values. The recommended direct method of measuring compliance against that measured inflow loads to the EVPA/Refuge would be independent of future variations in source loads and consistent with the approach taken in previous discussions of this topic (ECR, 2002-2004, SFER 2005-2006).

References

Burns & McDonnell, Inc., "Everglades Protection Project Conceptual Design" prepared for SFWMD, 1994.

Goforth, G., "Settlement Agreement Load Reductions", SFWMD, January 2004

Goforth, G. valuation of an Alternative Method for Assessing Compliance with the Load Reduction Expectations of the Settlement Agreement, February 2007.

Nearhoof F., Weaver K., Goforth G., and Xue, S., " Test for Determining Achievement of 50 Part Per Billion Phosphorus Initial TBEL For Everglades Stormwater Treatment Areas", August 2005.

South Florida Water Management District, "Everglades SWIM Plan, Appendix F", 1992.

SFWMD & FDEP, Everglades Consolidated Reports, 2003 - 2004.

SFWMD & FDEP, South Florida Environmental Reports, 2005 - 2007.

SFWMD, Burns & McDonnell, Inc, A.D.A Engineering Inc, "EAA Regional Feasibility Study", September 2005.

Walker, W., "Test for Evaluating Performance of Stormwater Treatement Areas" , prepared for U.S. Dept of the Interior, January 1996.

Walker, W. & R. Kadlec, "Everglades Phosphorus Gradient Model", prepared for U.S. Department of the Interior, August 1996.

Walker, W & R. Kadlec, "Compliance of Marsh Phosphorus Concentrations in A.R.M. Loxahatchee National Wildlife Refuge with Interim Levels Required under the Consent Decree", prepared for U.S. Department of the Interior, July 2003

Walker, W., "Expert Report Concerning Exceedances of the Interim Total Phosphorus Levels in A.R.M. Loxahatchee National Wildlife Refuge in July 2002 and August 2004", prepared for U.S. Dept of Justice, 2006.

Attachments

Table 1	STA Flow & Mass Balances for Settlement Agreement
Table 2	Derivation of Target Loads for Measuring Compliance with the Settlement Agreement Load-Reduction Requirements
Table 3	Measured Flows & Loads into the EVPA, Water Years 2002-2006.
Figure 1	STA Hydraulic and Phosphorus Loads, Water Years 1996-2006.
Figure 2	Derivation of Yearly Load Limits for the EVPA
Figure 3	Derivation of Yearly Load Limits for the Refuge

Figure 1 STA Hydraulic and Phosphorus Loads, Water Year 1996-2006

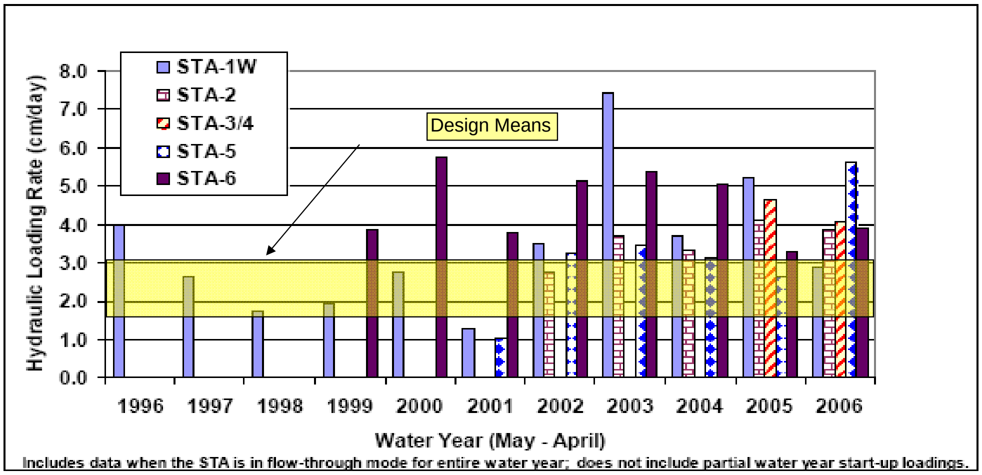


Figure 5-57. Hydraulic loading rates for the STAs when in flow-through mode.

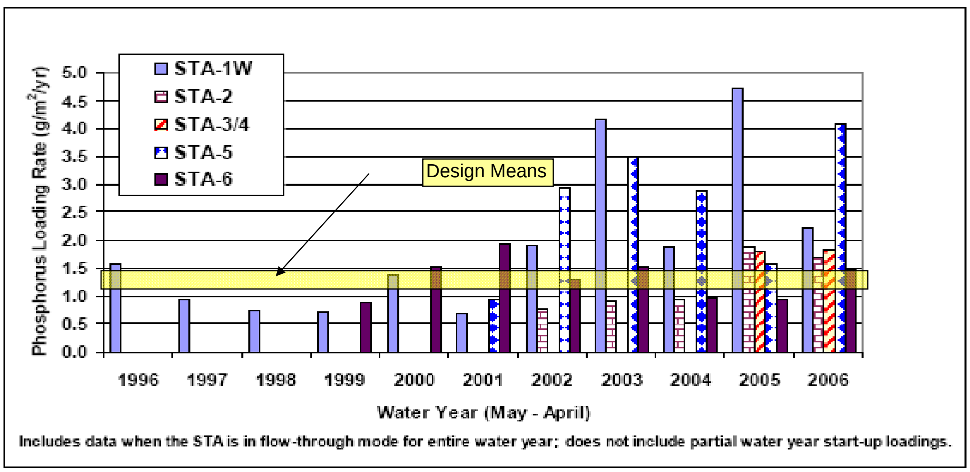
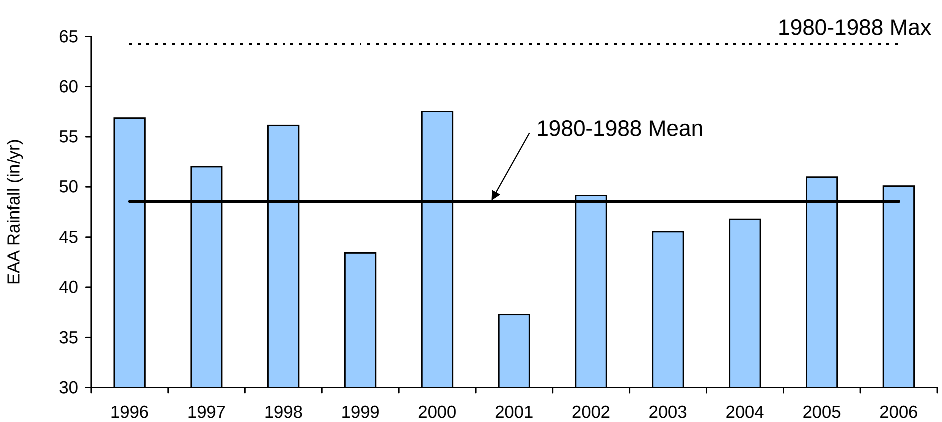


Figure 5-58. Phosphorus loading rates for the STAs when in flow-through mode.



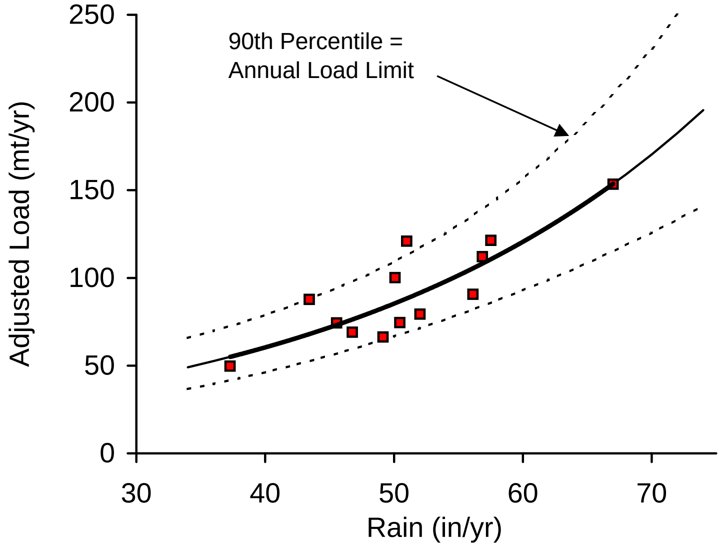
Top figures are from South Florida Environmental Report, 2007.

Shaded area added to top figures represent STA design means for 1994 Conceptual Plan.

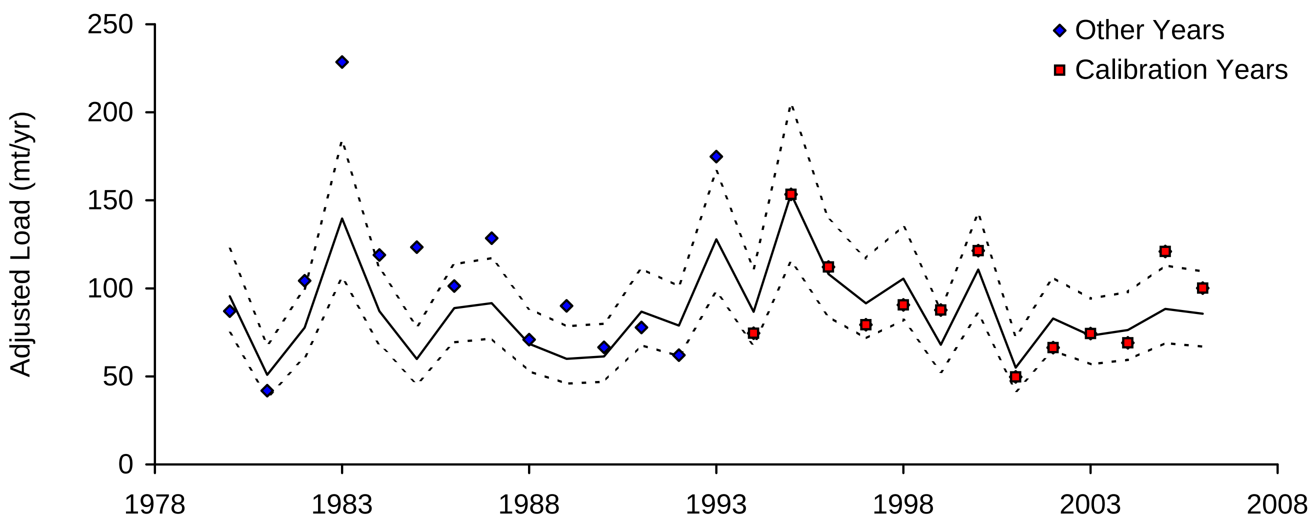
EAA Rainfall data are from basin averages from EAA Regulatory Rule.

STA hydraulic & phosphorus loads frequently exceeded design values in 2001-2006, when EAA runoff was at or below average.

Figure 2 # Derivation of Yearly Load Limits for the EVPA

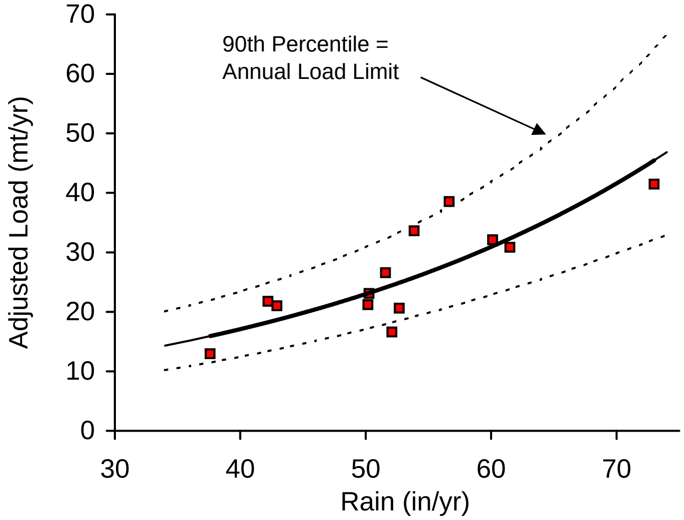


Regression model:	y = Exp (a + b X)	
Target Mean Load =	84.4	mt/yr
Regression R^2 =	0.70	
Std Error of Estimate	0.174	base e log
Intercept (a)	2.7184	
Slope (b)	0.0346	
Std Error of Slope	0.0068	
Number of Years	13	
Calibration years	1994	2006
Rainfall Statistics (in)	1980-1988	1994-2006
Mean Rain	48.6	51.0
Min Rain	35.0	37.3
Max Rain	64.2	67.0
Predicted Load mt/yr	84.4	91.2

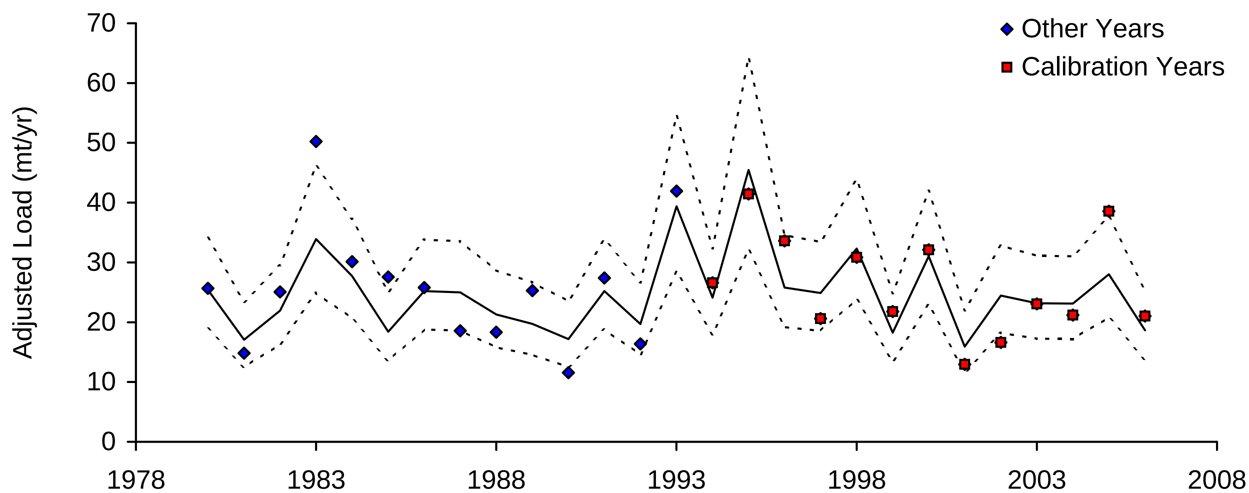


Adjusted Load	Historical source load adjusted to mean target load for EVPA inflows = 84.4 mt/yr, Water Years 1980-1988
Source Loads	Historical load from Sources to STA inflows and bypasses; approximating those treated under 1994 CP.
	Sources include historical data from EAA and C139 outflow pumps and structures.
	EAARFS forecasted loads from ACME-B and C51W are included.
	Historical loads back-pumped from the EAA to the Lake are also included.
	It is assumed that those loads would be treated in the STAs under the current water-management strategy.
Target Load	Mean load to EVPA consistent with achieving 80% load reduction of 1979-1988 load.
Rain	EAA Basin rainfall (EAA Regulatory Rule)
Load Limit	Set at upper 90th percentile of predicted load at given rainfaill
Year	May-April Water Year

Figure 3 Derivation of Yearly Load Limits for Refuge



Regression model:	y = Exp (a + b X)	
Target Mean Load =	24.0	mt/yr
Regression R^2 =	0.65	
Std Error of Estimate	0.208	base e log
Intercept (a)	1.6532	
Slope (b)	0.0296	
Std Error of Slope	0.0065	
Number of Years	13	
Calibration years	1994	2006
Rainfall Statistics (in)	1980-1988	1994-2006
Mean Rain	50.8	52.7
Min Rain	40.0	37.6
Max Rain	63.1	73.0
Predicted Load mt/yr	24.0	25.8



Adjusted Load	Historical source load adjusted to mean target load for Refuge inflows = 24 mt/yr, Water Years 1980-1988
Source Loads	Historical load from sources to treated under 1994 CP and discharged into the Refuge.
	Include measured loads from the S5A basin and EAARFS predicted loads from the C51W and ACMEB basins
	S5A loads in WY 2003 were adjusted to account for unusually high lake releases in that year.
	Lake release loads in WY 2003 set equal to the average values for the previous 5 years.
Target Load	Mean load to Refuge consistent with achieving 85% load reduction under 1979-1988 hydrologic conditions
Rain	S5A basin rainfall (EAA Regulatory Rule)
Load Limit	Set at upper 90th percentile of predicted load at given rainfaill
Year	May-April Water Year

Table 1
STA Flow & Mass Balances for Settlement Agreement

Variable	STA-1	STA-2	STA-3	STA-4	Total	Source - Appendix F
Source EAA Basin	S5A	S6	S7/S150	S8		
Effective Area (acres)	12185	4540	4705	11170	32600	Table 5, p. F-11
Flows (kac-ft/yr)						
Base Period Total Flow	312.8	155.7	275.6	311.3	1055.4	Table 3, p. F-5
Water Supply Bypass	7.9	23.5	33.2	40.5	105.2	Table 3, p. F-5
Base Period Adjusted Inflow	305.0	132.1	242.4	270.8	950.3	Calculated
Land Converted to STA's	31.6	4.9	8.9	26.8	72.2	Table 3, p. F-5
BMP Flow Reduction	54.5	25.1	47.0	49.5	176.1	Calculated
STA Inflow	218.9	102.2	186.5	194.6	702.1	Table 3, p. F-5
Precipitation on STA's	45.6	17.0	17.6	41.8	122.0	Calc. @ 1.14 m/yr
ET from STA's	53.7	20.0	20.7	49.2	143.7	Calc. @ 1.34 m/yr
STA Outflow	210.8	99.1	183.3	187.1	680.3	Calculated
Phosphorus Loads (mt/yr)						
Base Period Total Load	77.0	28.0	33.0	67.0	205.0	Table 4, p. F-6
Water Supply Bypass	1.0	3.1	4.2	2.7	11.0	Table 4, p. F-6
Base Period Adjusted Load	76.0	24.9	28.8	64.3	194.0	Calculated
Land Converted to STA's	7.7	1.0	1.0	5.6	15.3	Table 4, p. F-5
BMP Load Reduction	17.3	5.9	6.8	14.7	44.8	Calculated
STA Inflow	51.0	18.0	21.0	44.0	134.0	Table 4, p. F-5
STA Outflow	13.0	6.1	11.3	11.5	42.0	Calculated @ 50 ppb

Target Loads	To Refuge	To EVPA	
Base Period Load	105.0	205.0	from above; S5A+S6 to Refuge
Required Reduction	85%	80%	from SA Paragraph 4A
Computed Target Load	15.8	41.0	calculated
Predicted STA Outflows	13.0	42.0	from above; STA1 to Refuge

Data Source: Tables 3, 4 & 5 of Appendix F, Everglades SWIM Plan (SFWMD, 1992)

Table 2

Derivation of Target Loads for Measuring Compliance with Settlement Agreement Load· Reduction Requirements

		Flow kac-ft/yr	P Load mt/yr	Conc ppb	Notes
STA Outflows Projected Under 1994 Conceptual Plan					a
Source	Discharge To				
STA-1E	WCA-1	126.4	7.8	50	b
STA-1W	WCA-1	144.7	8.9	50	
STA-2	WCA-2A	175.8	10.8	50	
STA-34	WCA 2A & 3A	609.3	37.6	50	
STA-5	WCA 3A / Rotenb.	88.2	5.4	50	
STA-6 Section 1	WCA 3A	18.3	1.1	50	
STA-6 Section 2	WCA 3A				c
Total STA Outflows		1162.7	71.6	50	
Adjust for STA-5 Discharge to Rotenberger		-44.1	-2.7	50	d
Total Project Outflows to EVPA		1118.6	68.9	50	
From EAA & Historical Lake Discharges		700.1	43.2	50	e
Total Project Outflows to Refuge		271.1	16.7	50	
From EAA & Historical Lake Discharges		170.3	10.5	50	e , f
Load Allocation for EVPA					
Total from STA Outflows		1118.6	68.9	50	
STA Bypass (Untreated)		0.0	0.0		
ACME B		33.8	4.7	113	g
BMP Replacement Water		173.7	10.7	50	h
Target Load for Measuring Compliance		1326.1	84.4	52	
EAARFS Forecast for 2006-2009		1609.7	44.8	23	
EAARFS Forecast for 2010-2015 (Alt-2)		1540.5	31.1	16	
Load Allocation for Refuge					
Total from STA Outflows		271.1	16.7	50	
STA Bypass (Untreated)		0.0	0.0		
ACME B		33.8	4.7	113	g
BMP Replacement Water		42.3	2.6	50	h
Target Load for Measuring Compliance		347.2	24.0	56	
EAARFS Forecast for 2006-2009		417.6	11.9	23	i
EAARFS Forecast for 2010-2015 (Alt-2)		417.0	11.5	22	

a - all values refer to October 1978- September 1979 hydrologic conditions; derived from Table A-5 of the Concepual Plan (Burns & McDonnell,1994) adopted as part of the 1995 Amended Consent Decree

b - The STA-1E outflow load in CP Table A-5 (7.2 mt/yr) is an apparent typographic error; the value listed here (7.8 mt/yr) is consistent with the reported discharge volume of 126.4 kac-ft/yr and 50 ppb outflow concentration, as well as with the reported total outflow load of 71.6 mt/yr from all STA's.

c - Allocation for C139 Annex loads treated in STA-6 Section 2 would be added once it is operational.

d - see footnote CP Table A-5; a portion of the STA-5 outflow is discharged to the Rotenberger tract, where it receives further treatment before being discharged either into the Holeyland or EVPA. Pending further evaluation, this is assumed to be 50 % of the total STA outflow; the remaining 50% is assumed to reach the EVPA via S8.

e - from CP Tables III-5 & 6; adjusted for reductions in EAA watershed area attributed to STA's; includes 4.3 kac-ft/yr from C51W historically discharged to Refuge via S5A and included in the base load treated under the 1992 SA.

f - Refuge value accounts for 16.2% diversion of S5A runoff to STA-2 under 1994 CP; without that diversion, the total load to Refuge from SA sources would be 12.5 mt/yr, similar to the SA design (13.0 mt/yr, Table 1).

g - measured 1979-1988 loads not available; allocation for ACME B derived from EAA Regional Feasiblity Study inflow dataset; April Water Years 1980-1988

h - offsets reductions in STA inflows due to assumption that EAA runoff volume will decrease as a result of BMP's; computed from data in Tables III-2 & III-5 of 1994 CP; accounts for 16% diversion of S5A runoff to STA-2

I - from EAA Regional Feasibility Study forecasts, Tables 5.1 & 8.1; 1960-2000 means; including all of STA-5 discharge

Table 3 Measured Flows & Phosphorus Loads into the Everglades Protection Area, Water Years 2002-2006

	Water Year 2002			Water Year 2003			Water Year 2004			Water Year 2005			Water Year 2006		
	kacft	kg	ppb	kacft	kg	ppb	kacft	kg	ppb	kacft	kg	ppb	kacft	kg	ppb
Source	Flow	TP	Conc	Flow	TP	Conc	Flow	TP	Conc	Flow	TP	Conc	Flow	TP	Conc
Into WCA-1															
G300+G301	11.0	1607	118	10	2492	202	17.0	3104	148	69.1	27032	317	46.8	14007	242
G251	7.0	171	20	97	5276	44	55.0	3000	44	62.9	7786	100	34.2	4533	107
G310	261.0	12029	37	499	33415	54	243.0	14061	47	320.5	38703	98	103.7	14732	115
ACME1	16.0	1720	87	9	864	78	10.0	890	72	12.3	2021	133	14.2	1403	80
ACME2	18.0	3286	148	9	1362	123	10.0	1227	99	11.2	2948	213	12.8	1832	116
S362										15.9	7601	387	40.5	7292	146
Total	313.0	18813	49	624.0	43409	56	335.0	22282	54	491.8	86091	142	252.2	43799	141
Total - ACME	279.0	13807	40	606.0	41183	55	315.0	20165	52	468.3	81122	140	225.2	40564	146
Into WCA2															
G335	241.0	4895	16	308.0	6634	17	285.0	5031	14	371.0	9228	20	322.3	8238	21
S7	98.0	5783	48	143.0	9624	55	156.0	8578	45	132.9	3405	21			
S7 after STA34										176.8	2584	12	456.7	10841	19
Total	339.0	10678	26	451.0	16258	29	441.0	13609	25	680.7	15217	18	779.0	19079	20
Into WCA3															
L3 (G155+G89)	79.0	12020	123	32.0	8481	215	38.0	10827	231						
L3 (G409)										16.5	9450	464	78.5	43306	447
STA6				33.0	1046	26	35.0	512	12	22.2	520	19	26.3	848	26
S8	136.0	10015	60	292.0	29420	82	352.0	30862	71	260.6	6724	21			
S8 after STA34										67.9	1284	15	447.5	16964	31
S150	21.0	977	38	69.0	4086	48	10.0	454	37	55.5	850	12			
S150 after STA34										30.9	1304	34	38.4	749	16
G404/G357	113.0	6146	44	93.0	6622	58	67.1	3479	42	52.9	1842	28			
G404/G357 after STA34										18.9	432	19	104.0	4598	36
Total	349.0	29158	68	519.0	49655	78	502.1	46134	74	525.4	22406	35	694.7	66465	78
Into Everglades Protection Area															
Total	1001.0	58649	47	1594.0	109322	56	1278.1	82025	52	1697.9	123714	59	1725.8	129343	61
Total - ACME	967.0	53643	45	1576.0	107096	55	1258.1	79908	51	1674.4	118745	57	1698.9	126108	60
Total - ACME & C139	888.0	41623	38	1544.0	98615	52	1220.1	69081	46	1657.9	109295	53	1620.4	82802	41

All Data from Everglades Consolidated Reports or South Florida Environmental Reports, 2003-2007. Sources Treated under 1994 Conceptual Plan + ACME Drainage District.