Strategy for Using Compartments B & C for Water Quality Improvement

Working Draft – July 12, 2004

Gary Goforth, P.E., Ph.D. and Tracey Piccone, P.E.
South Florida Water Management District

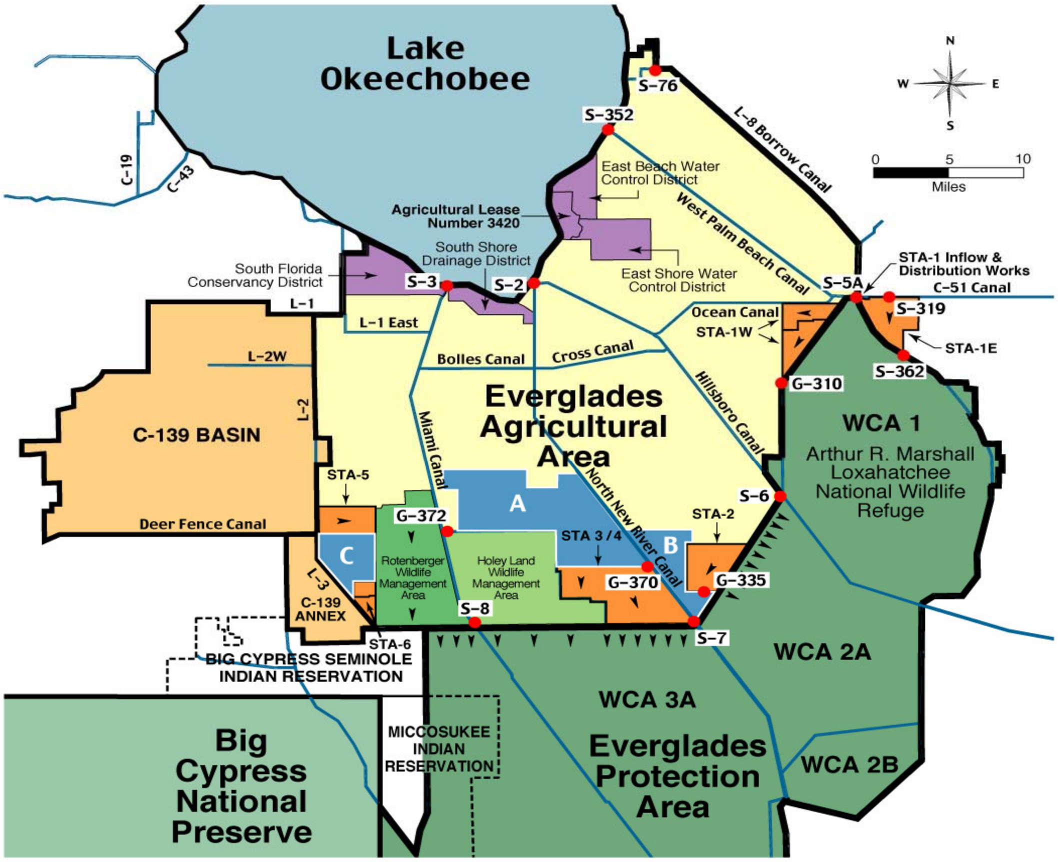
1.0 Executive Summary

The projects in the October 27, 2003 *Everglades Protection Area Tributary Basins Long-Term Plan for Achieving Water Quality Goals* (Long-Term Plan) were designed to achieve compliance with the water quality standards for the Everglades Protection Area (EPA) by December 31, 2006, based on specific assumptions and the best available information. The pre-2006 STA enhancements recommended in the Long-Term Plan are required by the 2003 amended Everglades Forever Act (EFA) to be implemented by the District without delay. These projects are currently in the design phase and are scheduled to begin construction in the near future. The Long-Term Plan was submitted to the Florida Department of Environmental Protection in accordance with the EFA requirement for a long-term permit application.

One of the key assumptions during the development of the Long-Term Plan was that Compartments B and C (see **Figure 1**) would be under consideration for use as part of the EAA Storage Reservoir (EAASR) project through FY 2010 and for this reason should not be considered for other Everglades restoration uses until FY 2011. Subsequent to completion of the Long-Term Plan, it was determined that all of the EAA Storage Reservoir Project's water storage goals could be achieved on Compartment A, and that Compartments B and C would not be needed to meet the storage objectives of the EAASR.

As part of the ***adaptive implementation process*** envisioned by the Long-Term Plan, it was anticipated that further refinements to the recommended water quality improvement measures would be made as more scientific and engineering information was obtained. In light of the recent availability of land in Compartments B and C, construction of additional treatment areas is proposed in association with STA-2, STA-5 and STA-6 to assist the STAs in improving water quality entering the EPA. These expanded treatment areas are proposed to be developed as soon as possible, with a target completion date of December 31, 2006, however, that date may be optimistic in light of issues such as permitting, real estate, cultural resources, and the major construction activities being proposed. It is also recommended to construct treatment areas on the remaining acreage of Compartments B and C to further assist the STAs in improving water quality entering the EPA. A regional feasibility study is also proposed to determine the best use of the remaining portions of Compartments B and C with the objective of assisting the STAs in improving water quality in the EPA. The feasibility study will evaluate alternatives for interbasin transfer of waters to optimize STA performance, and will include cost estimates, schedules and performance projections. It is further recommended to construct the structural and vegetation enhancements identified in the Long-Term Plan for STA-2 and STA-6 Section 1 after flow-through operation of the additional treatment cells begins, and if demonstrated to be necessary to achieve the water quality goals in the EPA.

Figure 1. Map of EAA with Compartments A, B and C

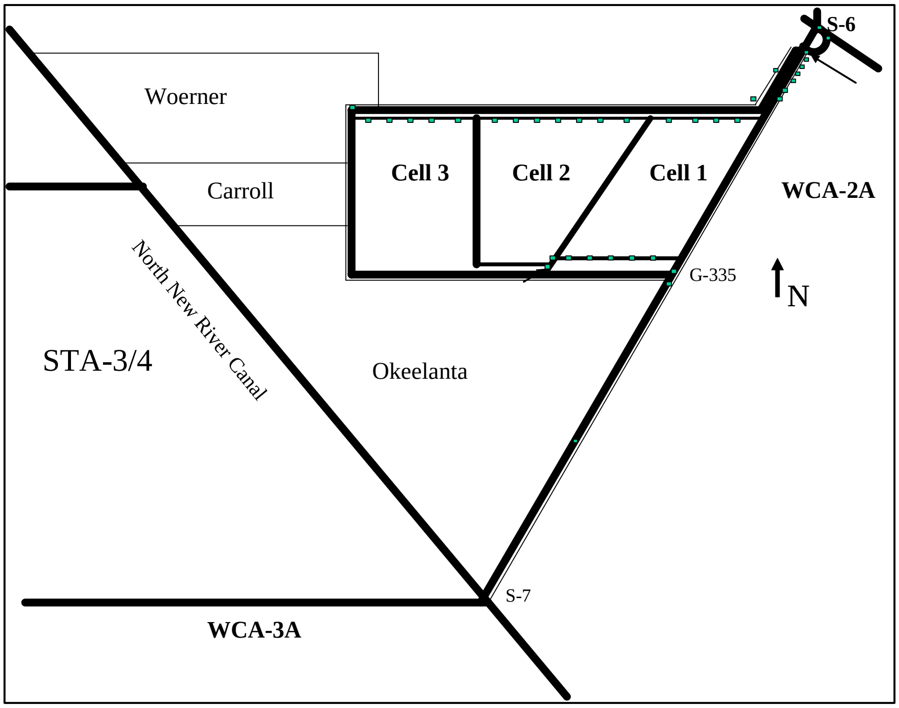


2.0 Compartment B

Recommendation #1: Expand STA-2 with a Fourth Parallel Cell on a 2,015-acre Portion of Compartment B; Construct the STA-2 Enhancements After the Expanded Treatment Area is in Flow-through Operation

The Long-Term Plan included recommendations for structural, vegetative and operational enhancements for STA-2 to improve hydraulic distribution and phosphorus removal performance. These enhancements included a new levee and associated water control structures within each treatment cell. Conversion of emergent vegetation to SAV was also recommended in the downstream portions of Cells 1 and 2. The availability of approximately 9,590 acres of land adjacent to STA-2 provides an opportunity to re-evaluate the water quality treatment measures in and around the STA. A schematic of STA-2 and the surrounding Compartment B (labeled "Woerner", "Carroll", and "Okeelanta") is shown in Figure 2.

Figure 2. Schematic of STA-2 and surrounding Compartment B (not to scale)



The following assumptions were used to develop a preliminary conceptual plan for adding additional treatment area to STA-2:

1. The entire 1,233 acres of the former Carroll property is available for immediate use.
2. Approximately 782 acres of the Okeelanta lease, located immediately west of the southwest corner of STA-2, along with a 500-ft strip of land adjacent to the southern boundary of STA-2, could be available for use within 6 months of notification by the District.
3. The Woerner South Farm 2 property (approximately 4,275 acres) will not be available in time for incorporation into an expanded treatment area by December 2006. However, a 200-ft strip of land adjacent to the northwestern reach of the seepage collection canal may be needed in association with extending the inflow canal south to the new Cell 4.
4. No additional inflows (beyond those included in the Long-Term Plan analyses) will be sent to the expanded treatment area during the near-term (i.e., prior to December 31, 2008).
5. The existing STA-2 inflow and discharge infrastructure can be utilized at its present capacity.
6. Design can proceed utilizing an existing engineering contract.
7. Construction can proceed without delay upon completion of the detail design.
8. The Florida DEP and the U.S. Army Corps of Engineers will be part of the development team to ensure expedited review, approval and issuance of all necessary permits or permit modifications so as not to delay construction or operation.

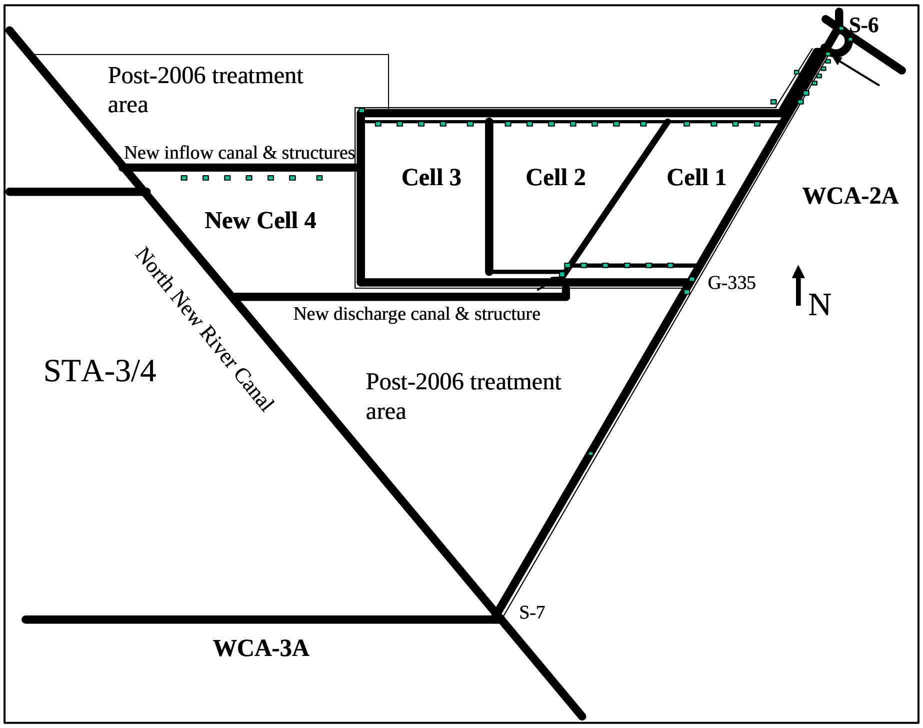
9. There will be no delays due to remediation of hazardous material resulting from prior land use.
10. Funding is not a constraint.
11. The recommendations will require revisions to the Long-Term Plan; it is assumed that the FDEP review and approval process will be completed expeditiously so as not to delay construction or operation.

Preliminary Conceptual Plan: A contiguous parcel of approximately 2,015 acres located between STA-2 and the North New River Canal is proposed for construction of a new Cell 4 for STA-2. Assuming 10% of the area would be required for levees, canals and water control structures, approximately 1,813 acres could be developed as effective treatment area. The existing STA-2 inflow canal could be extended south and west along the top of the new treatment cell, and five (5) inflow structures could introduce the water to the north end of Cell 4. Cell 4 could be developed as an SAV cell identical to Cell 3, and a new discharge canal could convey treated water south of the existing Cell 3 by expanding the existing seepage collection canal. A new Cell 4 outlet control structure (similar to G-334) could be constructed at the confluence of this new discharge canal and the existing canal immediately east and downstream of G-334. Seepage control could be provided by collection canals along the northern boundary of Cell 4 with direct connections to the North New River Canal, although this needs to be evaluated in light of the scheduled cessation of farming on adjacent lands. Approximately 2.5 miles of perimeter levees, six gated water control structures and one spillway would comprise the major construction features. A schematic of the expanded STA-2 is provided in Figure 3. Construction of this new Cell 4 is will be completed as soon as possible, subject to timely availability of land, permitting, and other factors outside the control of the District.

The projected nutrient removal performance of this expanded STA-2 was simulated using the April 2002 version of the DMSTA model developed by Walker and Kadlec, and resulted in outflow concentrations ranging from 10-12 ppb reported as a geometric mean, and 13-15 ppb reported as a flow-weighted mean (see Appendix 1 for the DMSTA modeling description). This compares favorably with the estimated range of performance shown in the Long-Term Plan of 10-14 ppb (geometric mean) and 17-28 ppb (flow-weighted mean). For these DMSTA simulations, the lower end of the performance projections used the calibration data set for STA-2 Cell 1 (from Bill Walker's website) for Cells 1 and 2, and SAV_C4 was used for Cells 3 and 4; the higher end of the performance projections used the calibration data set for STA-2 cells for the existing cells, and the STA-2 Cell 3 calibration data set was used for Cell 4. For both projections the inflow data set corresponding to the period 2007-2015 was adjusted to increase the flows and reduce TP inflow concentrations to reflect observed values over the last three water years. In addition to the predicted improvement in phosphorus removal performance, a fourth treatment cell will add operational redundancy and increased flexibility to the STA.

STA-2 is currently performing much better than was anticipated during the original design. Flow-weighted mean outflow concentrations have been averaging 16 ppb for the last three water years, which is actually better than the projected long-term average flow-weighted mean concentration with the enhancements recommended in the Long-Term Plan. There is concern that disrupting the operation of the STA to construct the recommended enhancements (the new internal levees, structures and vegetation conversion) prior to expansion may cause short-term bypass of phosphorus to the Everglades and may jeopardize the exceptional long-term performance of this STA. The recommendation is to begin construction of one of the new interior levees in STA-2 after the flow-through operation of Cell 4 commences. After the construction of this initial levee (target completion date of 2008), the resulting performance will be evaluated for a two-year period prior to construction of the remaining levees and vegetation conversion, if determined to be necessary to achieve the water quality goals in the EPA.

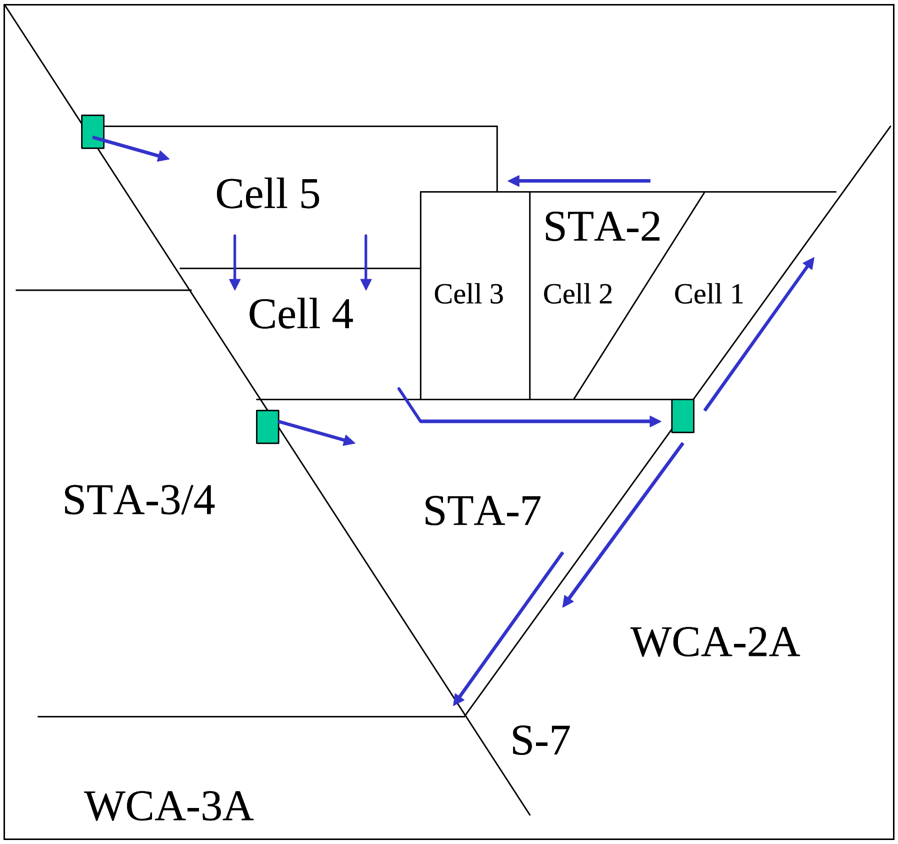
Figure 3. Schematic of Expanded STA-2 (not to scale).



2.1 Full Build-out of Compartment B as Treatment Area

It is also recommended to construct additional treatment areas on the remaining acreage of Compartment B. One possible configuration is presented in Figure 4. The details of this additional treatment acreage, including necessary operational modifications to accommodate interbasin transfers, are to be evaluated in a regional feasibility study. Construction is proposed to begin on these additional treatment areas in 2007, with completion as soon as possible thereafter.

Figure 4. One Alternative for Build-out of Compartment B (not to scale).



3.0 Compartment C

Recommendation #2. Construct the STA-5 Enhancements; Expand STA-5 with a Third Parallel Flow-way on a 2,560-acre Portion of Compartment C; Construct STA-6 Section 2 with Enhancements; Construct the STA-6 Section 1 Enhancements After the STA-6 Section 2 is in Flow-through Operation

The Long-Term Plan included recommendations for structural, vegetative and operational enhancements for STA-5 and STA-6 to improve hydraulic distribution and phosphorus removal performance. These enhancements included replacement of the interior structures in STA-5 and a new levee and associated water control structures within Cell 5 of STA-6 Section 1. Conversion of emergent vegetation to SAV was also recommended in Cell 2B of STA-5 and in the downstream portion of Cell 5 of STA-6 Section 1. Construction of STA-6 Section 2 was included in the Long-Term Plan with recommended enhancements including an internal levee and SAV in the downstream cell. A schematic of the existing STAs, STA-6 Section 2 and the 8,800-acre Compartment C (labeled "USSC Unit 2") is shown in Figure 5.

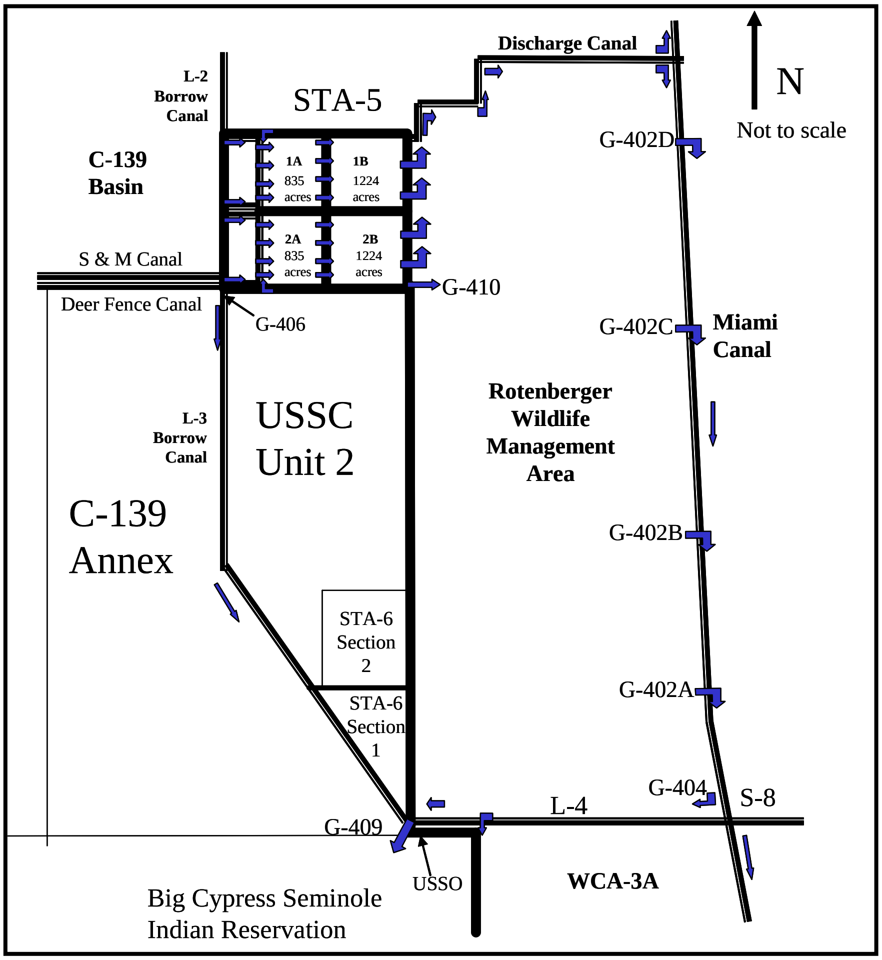
STA-5 has been experiencing higher than anticipated nutrient loading and as a result, outflows have not been as low as was anticipated during the original design. By contrast, STA-6 Section 1 is currently performing much better than was anticipated during the original design. Flow-weighted mean outflow concentrations have been averaging 19 ppb since December 1997, which is actually within the range of the projected performance with the enhancements recommended in the Long-Term Plan. For Water Year 2004, the outflow averaged 13 ppb, which is lower than the range of projected performance with the enhancements. The availability of the land between STA-5 and STA-6 provides an opportunity to re-evaluate the water quality treatment measures in and around those STAs.

The following assumptions were used to develop a preliminary conceptual plan for utilizing Compartment C:

1. The majority of the 8,800 acres of the former USSC Unit 2 property is available for immediate use; the balance, approximately 3,000 acres, will be available by April 2005.
2. Existing STA-6 Section 1 and planned Section 2 would receive runoff from C-139 Annex and approximately 6 inches of runoff per year from the fallow portion of Compartment C.
3. Additional inflows (beyond those included in the Long-Term Plan analyses) will be sent to the expanded treatment area. The increase is a result of updated information on the flow volumes and phosphorus concentrations from the C-139 Annex and the southern C-139 Basin.
4. Design can proceed utilizing an existing engineering contract.
5. Construction can proceed without delay.
6. The Florida DEP and U.S. Army Corps of Engineers will be part of the development team to ensure expedited review, approval and issuance of all necessary permits or permit modifications so as not to delay construction or operation.
7. There will be no delays due to remediation of hazardous material resulting from prior land use (responsibility of USSC).
8. Funding is not a constraint.

9. The recommendations will require revisions to the Long-Term Plan; it is assumed that the FDEP review and approval process will be completed expeditiously so as not to delay construction or operation.

Figure 5. Schematic of STA-5, STA-6, and Compartment C, also known as USSC Unit 2 (not to scale)



3.1 Preliminary Conceptual Plan

3.1.1. STA-5. It is recommended to construct a new 2,560 acres flow-way for STA-5 immediately south of STA-5 to capture and treat all of the southern C-139 Basin runoff. Assuming the same topographic limitations as in the existing STA, approximately 2,055 acres could be developed as effective treatment area. One spillway of the existing G-406 diversion structure could be utilized as the inflow structure for the new flow-way, with a new inflow distribution canal excavated. Interior water control structures could be installed in a new levee that would separate the 835-acre upstream cell (Cell 3A) from the 1,220-acre downstream Cell 3B. Cell 3A could be developed as an emergent marsh and Cell 3B could be developed as an SAV cell identical to Cell 1B and 2B, and new Cell 3B outlet control structures (similar to G-344A-D) could be constructed. A new discharge canal could convey treated water either north to the existing STA-5 discharge canal or south along the western boundary of the Rotenberger Wildlife Management Area to the existing STA-6 discharge canal. Additional discharge capability in the STA-6 discharge canal, as well as a possible new pump station to move water into WCA-3A may be required. The STA-5 enhancements are proposed to proceed as recommended in the LTP, with the exception of one small seepage return pump station which will not be necessary due to the cessation of farming operations in Compartment C.

The projected nutrient removal performance of this expanded STA-5 was simulated using the April 2002 version of the DMSTA model developed by Walker and Kadlec. A different input data set was used to simulate the performance of STA-5 than was used in the Long-Term Plan based on higher than anticipated flows and phosphorus loads for the C-139 Basin, as summarized in Table 1. The future flows and loads from the C-139 Basin may actually be less than estimated in Table 1, as approximately 42,000 acres of the watershed are removed from agricultural production and as the basin's best management practices become more effective.

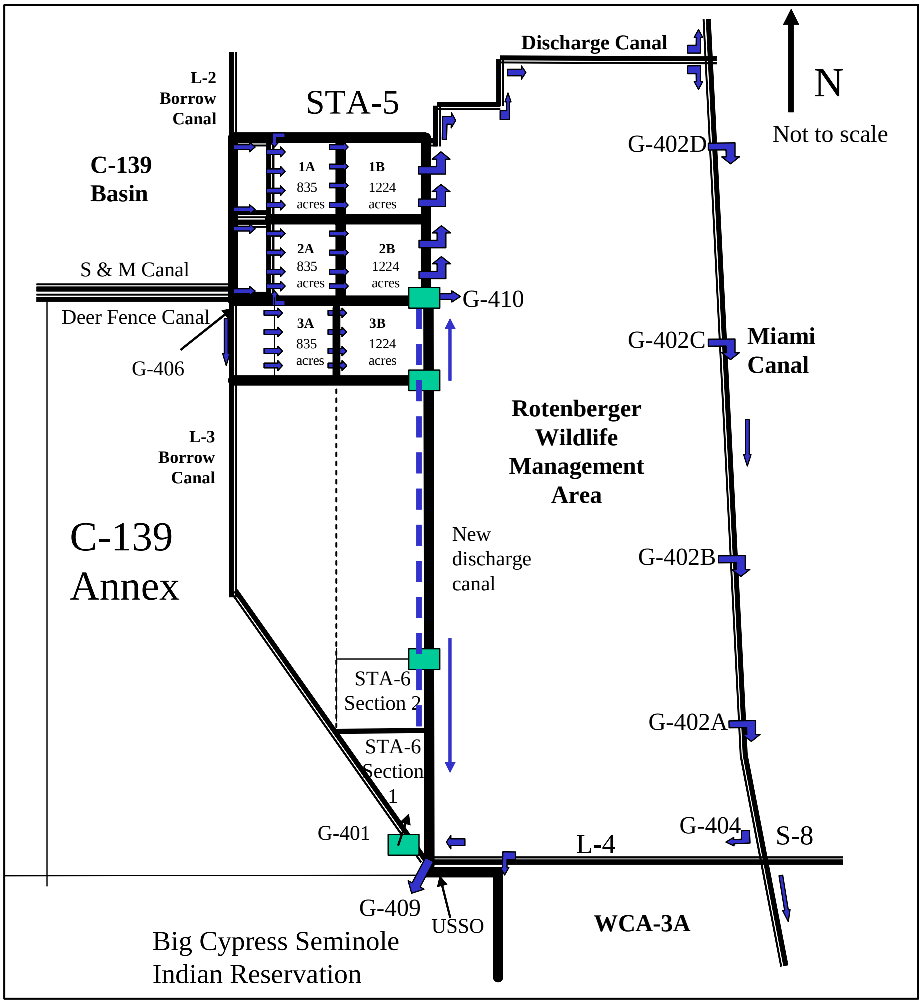
Table 1. Summary of Estimated Flows and Loads from the Southern C-139 Basin

	Annual Flow (acre-ft per year)	**Annual TP Load (kg/year)**	**TP Concentration (ppb)**
Long-Term Plan (1/1/65 – 12/31/95)	135,178	29,888	179
This Analysis (1/1/65 – 12/31/02)	137,260	33,656	199
Difference	2,082	3,768	20

The resulting outflow concentrations ranged from 10-12 ppb reported as a geometric mean, and 15-22 ppb reported as a flow-weighted mean, using SAV_C4 and NEWS_2, respectively. NEWS_2 was an August 2002 update to the NEWS calibration data set used in the development of the Long-term Plan. This range compares favorably to the estimated range of performance shown in the Long-Term Plan of 10-13 ppb (geometric mean) and 20-30 ppb (flow-weighted mean).

Based on these results, it is recommended to expand STA-5 by adding a third parallel flow-way which will reduce the load on the current STA-5 footprint, add treatment redundancy and increase operational flexibility for the STA. Approximately 4 miles of perimeter levee, 2 miles of inflow canal, 5 miles of a new discharge canal, and six gated water control structures would comprise the major construction features for the expanded STA-5. A schematic of the expanded STA-5 is presented in Figure 6. This expansion will be completed as soon as possible, subject to timely availability of land, permitting, and other factors outside the control of the District.

Figure 6. Schematic of Expanded STA-5 (not to scale).



3.1.2. STA-6. The Long-Term Plan assumed that through the year 2014, STA-6 Sections 1 and 2 would capture and treat runoff from the 8,800-acre Compartment C, the C-139 Annex, excess flows from the southern C-139 Basin diverted from STA-5, and supplemental water from Lake Okeechobee. With the cessation of active farming in Compartment C, the runoff flows and loads are assumed to decrease, and an areal runoff similar to that observed in the C-139 Basin (approximately 12 inches per year) was used in this analysis; the actual drainage may be less. With the expanded STA-5, it is assumed that all of the southern C-139 Basin flows would be captured and treated in STA-5, although bypass to the L-3 borrow canal would be provided by one spillway at G-406. Recent data collected just downstream of the C-139 Annex suggest significantly higher flows and loads may discharge from that basin into STA-6 than anticipated during the development of the Long-Term Plan. A revised inflow set for STA-6 was developed and is summarized in Table 2 (further details on this data set are provided in Appendix 1). The increased estimate of flows from the C-139 Annex more than offsets the reduction in flows from

Compartment C, resulting in greater estimated inflows to STA-6 than were anticipated in the Long-Term Plan.

Table 2. Summary of Revised STA-6 Inflows

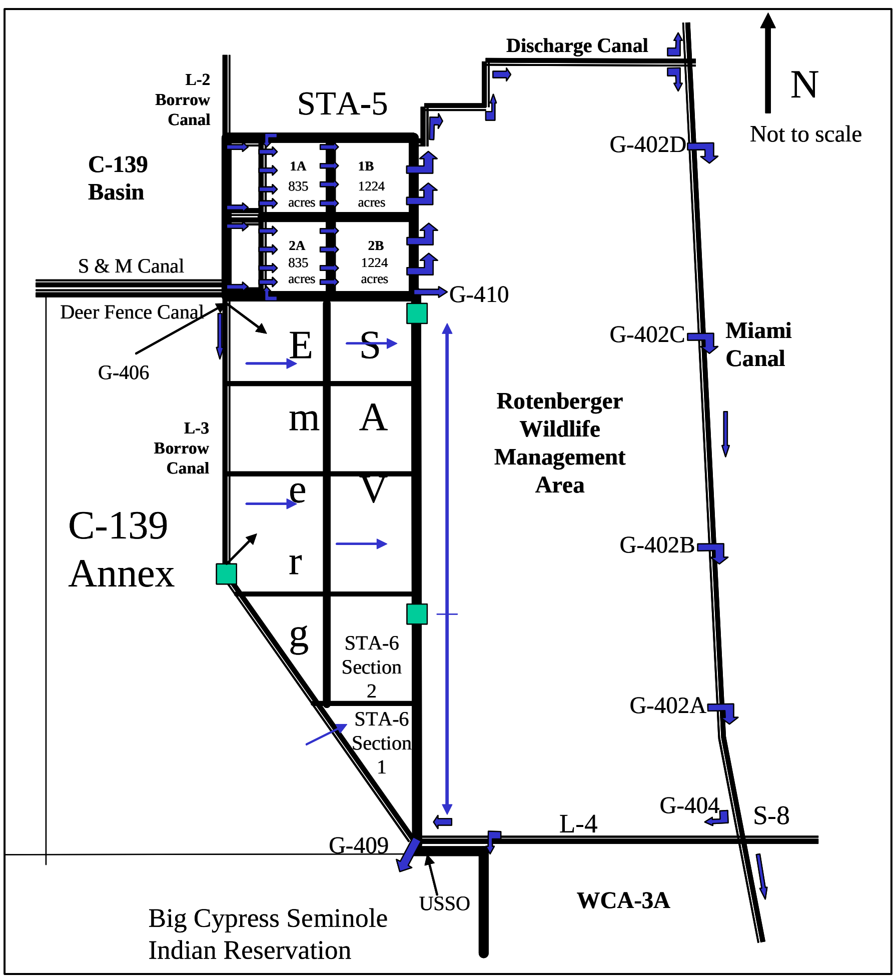
	Annual Flow (acre-ft per year)	Annual TP Load (kg/year)	TP (ppb)
Southern C-139 Basin			
Long-Term Plan	3,065	849	224
This Analysis	0	0	-
Difference	-3,065	-849	-
Compartment C			
Long-Term Plan	21,794 (excludes 5,476 AF/yr bypassed in LTP simulation)	2,095 (excludes 760 kg/yr bypassed in LTP simulation)	85
This Analysis	6,278	463	60
Difference	-15,516	-1,632	25
C-139 Annex			
Long-Term Plan	11,954	1,032	70
This Analysis	35,852	4,608	104
Difference	23,898	3,576	34
Total Runoff			
Long-Term Plan	36,813	3,976	76
This Analysis	42,130	5,071	98
Difference	5,317	1,095	22

The 870-acre STA-6 Section 1 is currently performing much better than was anticipated during the original design. Flow-weighted mean outflow concentrations have averaged 19 ppb, which is actually within the range of the projected performance with the enhancements recommended in the Long-Term Plan. For Water Year 2004, the outflow averaged 13 ppb, which is lower than the range of projected performance with the enhancements. There is concern that disrupting operation of the STA to construct the recommended enhancements, including the new internal levee, structures and vegetation conversion, prior to operation of STA-6 Section 2, may cause short-term bypass of phosphorus to the Everglades and may jeopardize the exceptional long-term performance of this STA. The current recommendation is to start construction of the STA-6 Section 1 enhancements after a two-year evaluation of STA-6 Section 2 performance, and if demonstrated to be necessary to achieve the water quality goals in the EPA. Assuming a 6-month start-up for STA-6 Section 2, the 2-year evaluation would cover the period June 2007-May 2009, and construction could start as early as October 2009, with completion by June 2010. The STA-6 Section 2 enhancements are proposed to proceed as recommended in the LTP. For this analysis, the projected nutrient removal performance of STA-6 (Sections 1 and 2) was simulated using DMSTA. For these simulations, updated calibrated data sets for STA-6 documented on Bill Walker's website were used for the emergent cells, and SAV_C4 and NEWS_2 were used for the SAV cells. The simulated performance for STA-6 resulted in outflow concentrations ranging from 10-11 ppb reported as a geometric mean, and 12-14 ppb reported as a flow-weighted mean. This range compares favorably to the estimated range of performance shown in the Long-Term Plan of 10-13 (geometric mean) and 17-24 ppb (flow-weighted mean).

3.2 Full Build-out of Compartment C

It is also recommended to construct additional treatment areas in the remaining acreage of Compartment C. In addition to the recommended construction of STA-6 Section 2 and the expansion of STA-5, one alternative would consist of an additional 4-mile long by 1-mile wide low-way and a 4-mile long by 1.5-mile wide flow-way to treat the southern C-139 Basin; and an extension of STA-6 Section 2 west to the L-3 borrow canal (see Figure 7) to assist in the treatment of the C-139 Annex. The DMSTA modeling represented STA-5 as 5 flow-ways, each receiving a proportional share of the hydraulic and phosphorus load of the southern C-139 Basin. STA-6 was modeled with an additional 720 acres of effective treatment area in Cell 1 upstream of STA-6 Section 2 Cell 2. Using the same inflows (except with no runoff from Unit 2) as modeled for STA-5 and STA-6 above, and using the same calibration data sets, the projected phosphorus concentrations for this expanded treatment area is 12-17 ppb, reported as flow-weighted means, and 10 ppb reported as a geometric mean for STA-5; and 10-12 ppb reported as a flow-weighted mean and 10 ppb reported as a geometric mean for STA-6 (see Tables 11-14). The details of this additional treatment area, including necessary operational modifications to accommodate interbasin transfers, are to be evaluated in a regional feasibility study. Construction is proposed to begin on this additional treatment area in 2007, with completion as soon as possible thereafter.

Figure 7. One Alternative for Build-out of Compartment C (not to scale).



4.0 Recommendation #3. Conduct a Regional Feasibility Study to Determine the Best Use of the Remaining Portions of Compartments B and C as Additional Treatment Areas.

As stated in previous sections of this paper, it is recommended to construct additional treatment areas on all of the remaining acreage of Compartments B and C. On a parallel path with implementing the expanded treatment areas for STA-2 and STA-5, a regional feasibility study should be initiated to determine the best use of the remaining portions of Compartments B and C with the objective of assisting the STAs in improving water quality in the EPA. The feasibility study should take into account the STA expansions described above, the other planned STA enhancements, the Bolles and Cross Canal Improvements, the EAA Storage Reservoir Project and other currently planned improvements in the EAA region.

The feasibility study should be conducted in increments, with the initial focus being an operational analysis of moving water and associated phosphorus loads from the eastern EAA basins (e.g., the S-5A basin) to the central and western treatment areas (the expanded STA-2 and STA-3/4). This operational analysis would identify potential changes to the District's canal system that would be needed to meet the water quality improvement goals, and would be closely linked to the Bolles and Cross Canal Improvements project. Specific areas to be evaluated in this initial phase include:

- Providing operational flexibility to redirect STA-1W inflows and/or outflows to the Hillsboro Canal and then to either STA-2 via the S-6 pump station, or to Compartment B and /or STA-3/4 via the North New River Canal
- Reducing flows and loads (up to an average of 30,000 AF/yr) to STA-1E from the S-5A Basin
- Balancing flows and loads across the STAs by taking into account the planned Bolles and Cross Canal Improvements and the recently completed Ocean Canal conveyance improvements. The analysis should also consider:
    - Whether or not additional conveyance capacity is needed in the 1,900-ft length of the Ocean Canal near S-5A
    - Whether or not additional conveyance capacity is needed in the North New River Canal

Subsequent tasks of the feasibility study should include an evaluation of benefits and opportunities associated with the construction of treatment areas on all of the remaining portions of Compartments B and C such as:

- Adding redundancy to current STA treatment facilities by providing the ability to take treatment cells off line for maintenance, construction of enhancements, or other purposes
- Minimizing potential for overloading the STAs during times of higher than normal runoff or Lake releases
- Improving the phosphorus removal performance of the STAs or otherwise reducing the risk associated with uncertainties in treatment performance projections in the LTP
- Integrating the 1,200-acre Snail Farm property into the regional water quality treatment system, assuming successful conclusion of land acquisition

- Providing a hydraulic connection of Compartment C to the Miami Canal (and Lake Okeechobee)
- Providing flow equalization for the STAs
- Adding a pump at G-136 to deliver water supply from the Miami Canal (and Lake Okeechobee) to the C-139 Basin (assuming the pump would provide water with lower phosphorus than groundwater, which is the current source of irrigation water supply)
- Improving the L-7 and L-40 conveyance to minimize potential adverse water quality impact to the interior of Refuge

The overall feasibility study could potentially include alternatives development and evaluation, capital and O&M cost estimates, implementation schedules, maps, environmental and cultural resource concerns and remediation, real estate acquisition schedules and costs, recommendations for interim land management activities, vegetation management activities, flood impact and protection analyses, environmental benefits, water quality performance projections for the STAs, and a funding analysis.

It is anticipated that the feasibility study would occur over a nine (9) month period.

Appendix 1. DMSTA Modeling In Support of Expanded Treatment Areas in Compartments B and C

1.0 Compartment B

1.1 STA-2 Inflow Volumes and Phosphorus Levels

It is assumed that no additional inflow sources (beyond those included in the Long-Term Plan analyses) will be sent to the expanded treatment area during the near-term (i.e., prior to December 31, 2008). The actual inflow volume to STA-2 over the last three years has averaged 250,826 acre feet per year, higher than anticipated in the Long-Term Plan (233,668 acre feet per year for the period prior to the EAA Storage Reservoir). The observed flow-weighted mean inflow phosphorus concentration for STA-2 has averaged 73 ppb over the last three years. This is significantly lower than the 100 ppb average anticipated in the Long-Term Plan. The observed inflow phosphorus load has averaged 22,662 kg/yr for the last three years, approximately 21.5% lower than anticipated in the Long-Term Plan. For the purpose of the performance projections of the expanded STA-2, the input data set was revised to reflect the higher inflows and lower phosphorus levels. Additional analyses can be conducted when better estimates of runoff volumes and loads are available. The revised inflow data sets (comprised of a new SFWMM simulation and new water quality information) that are to be completed during FY2005 will provide these better estimates.

1.2 Performance Analyses

The projected nutrient removal performance of this expanded STA-2 was simulated using the April 2002 version of the DMSTA model developed by Walker and Kadlec.

1.2.1 Calibration Data Sets

In a manner consistent with the method used in the Long-Term Plan, a range of expected phosphorus removal performance was simulated by utilizing two calibration data sets, summarized in Table 1. The lower end of the performance projections used the calibration data set for STA-2 Cell 1 (from Bill Walker’s website) for Cells 1 and 2, and SAV_C4 was used for Cells 3 and 4; the higher end of the performance projections used the calibration data set for STA-2 cells for the existing cells, and STA-2 Cell 3 was used for Cell 4. The calibration data sets on the Walker website have not been updated for over a year, and as such do not reflect the recent superior performance (annual flow-weighted mean of 14 ppb) of STA-2.

Table 1. Summary of STA-2 Calibration Data Sets

Performance Scenario	Cell 1	Cell 2	Cell 3	Cell 4
Lower End	STA-2 Cell 1	STA-2 Cell 1	SAV_C4	SAV_C4
Higher End	STA-2 Cell 1	STA-2 Cell 2	STA-2 Cell 3	STA-2 Cell 3

1.2.2 Modeling Results

The DMSTA modeling resulted in outflow concentrations ranging from 10-12 ppb reported as a geometric mean, and 13-15 ppb reported as a flow-weighted mean (see Tables 2-3). This compares favorably with the estimated range of performance shown in the Long-Term Plan of 10-14 (geometric mean) and 17-28 ppb (flow-weighted mean) for the 2007-2015 flow volumes and phosphorus levels.

Table 2. DMSTA Summary for Expanded STA-2, Using SAV_C4.

DMSTA Input Values

Run Model Menu

Warning: One or More Cells Outside of Calib. Range

Input Variable	Units	Value
Design Case Name	-	NEW adj 3
Starting Date for Simulation	-	01/01/65
Ending Date for Simulation	-	12/31/95
Starting Date for Output	-	01/01/65
Steps Per Day	-	3
Number of Iterations	-	2
Output Averaging Interval	days	7
Reservoir H2O Residence Time	days	0
Max Inflow / Mean Inflow	-	0
Max Reservoir Storage	hm3	0
Reservoir P Decay Rate	1/yr/ppb	0
Rainfall P Conc	ppb	10
Atmospheric P Load (Dry)	mg/m2-yr	20

Case Description: **Filename:** **2GG EX_Data adj.xls**

Cells 1 & 2 use STA2_1 calibrated values; Cells 3 and 4 use SAV_C4
Adjusted flows and loads to observed 3-yr averages

Output Variable	Units	Value
Water Balance Error	%	0.0%
Mass Balance Error	%	0.2%
Flow-Wtd Conc - With Bypass	ppb	13.0
Flow-Wtd Conc - Without Bypass	ppb	13.0
Geometric Mean Conc	ppb	10.1
95th Percentile Conc	ppb	17.0
Freq Cell Outflow > 10 ppb	%	34%
Bypass Load	%	0.0%

Cell Number -->		1	2	3	4	5	6
Cell Label	-	1	2	3	4		
Vegetation Type Conserv	------->	STA2_1	STA2_1	SAV_C4	SAV_C4		
Inflow Fraction	-	0.220777628	0.27842512	0.27842512	0.22237213		
Downstream Cell Number	-	0	0	0	0		
Surface Area	km2	7.280	9.190	9.190	7.340		
Mean Width of Flow Path	km	1.58	2.00	2.00	1.60		
Number of Tanks in Series	-	3	3	3	3		
Outflow Control Depth	cm	40	40	60	60		
Outflow Coefficient - Exponent	-	2.63	3.1	2.84	2.84		
Outflow Coefficient - Intercept	-	0.52	0.66	0.57	0.57		
Bypass Depth	cm	0	0	0	0		
Maximum Inflow	hm3/day	0	0	0	0		
Maximum Outflow	hm3/day	0	0	0	0		
Inflow Seepage Rate	(cm/d) / cm	0.008	0	0	0		
Inflow Seepage Control Elev	cm	76	0	0	0		
Inflow Seepage Conc	ppb	20	20	20	20		
Outflow Seepage Rate	(cm/d) / cm	0.004	0.006	0.01	0.01		
Outflow Seepage Control Elev	cm	-61	-61	-30	-30		
Max Outflow Seepage Conc	ppb	20	20	20	20		
Seepage Recycle Fraction	-	0.78	0.78	0.79	0.79		
Seepage Discharge Fraction	-	0	0	0	0		
Initial Water Column Conc	ppb	30	30	30	30		
Initial P Storage Per Unit Area	mg/m2	500	500	500	500		
Initial Water Column Depth	cm	50	50	50	50		
C0 = WC Conc at 0 g/m2 P Storage	ppb	*2*	*2*	*4*	*4*		
C1 = WC Conc at 1 g/m2 P storage	ppb	*22*	*22*	*22*	*22*		
K = Net Settling Rate at Steady State	m/yr	*41*	*41*	*80.10*	*80.10*		
Zx = Depth Scale Factor	cm	*60*	*60*	*60*	*60*		
C0 - Periphyton	ppb	*0*	*0*	*0*	*0*		
C1 - Periphyton	ppb	*0*	*0*	*0*	*0*		
K - Periphyton	1/yr	*0.00*	*0.00*	*0.00*	*0.00*		
Zx - Periphyton	cm	*0*	*0*	*0*	*0*		
Sm = Transition Storage Midpoint	mg/m2	*0*	*0*	*0*	*0*		
Sb = Transition Storage Bandwidth	mg/m2	*0*	*0*	*0*	*0*		

Output Variables	Units	1	2	3	4	5	6	Overall
Execution Time	seconds/yr	1.68	3.29	4.84	6.39			6.39
Run Date	-	05/26/04	05/26/04	05/26/04	05/26/04			05/26/04
Starting Date for Simulation	-	01/01/65	01/01/65	01/01/65	01/01/65			01/01/65
Starting Date for Output	-	01/01/65	01/01/65	01/01/65	01/01/65			01/01/65
Ending Date	-	12/31/95	12/31/95	12/31/95	12/31/95			12/31/95
Output Duration	days	11322	11322	11322	11322			11322
Cell Label		1	2	3	4			Total Outflow
Downstream Cell Label		Outflow	Outflow	Outflow	Outflow			-
Surface Area	km2	7.280	9.19	9.19	7.34008097			33.0
Mean Water Load	cm/d	2.6	2.6	2.6	2.6			2.6
Max Water Load	cm/d	26.0	25.9	25.9	25.9			25.9
Inflow Volume	hm3/yr	68.4	86.2	86.2	68.9			309.6
Inflow Load	kg/yr	5012.7	6321.6	6321.6	5048.9			22704.8
Inflow Conc	ppb	73.3	73.3	73.3	73.3			73.3
Treated Outflow Volume	hm3/yr	69.8	80.1	78.5	62.7			291.2
Treated Outflow Load	kg/yr	855.5	1014.6	1069.2	854.1			3793.4
Treated FWM Outflow Conc	ppb	12.3	12.7	13.6	13.6			13.0
Total Outflow Volume	hm3/yr	69.8	80.1	78.5	62.7			291.2
Total Outflow Load	kg/yr	855.5	1014.6	1069.2	854.1			3793.4
Total FWM Outflow Conc	ppb	12.3	12.7	13.6	13.6			13.0
Bypass Volume	hm3/yr	0.00	0.00	0.00	0.00			0.00

Table 3. DMSTA Summary for Expanded STA-2, Using STA2_Cell 3.

DMSTA Input Values Run Model Menu

Warning: One or More Cells Outside of Calib. Range

Input Variable	Units	Value
Design Case Name	-	NEW adj 1
Starting Date for Simulation	-	01/01/65
Ending Date for Simulation	-	12/31/95
Starting Date for Output	-	01/01/65
Steps Per Day	-	3
Number of Iterations	-	2
Output Averaging Interval	days	7
Reservoir H2O Residence Time	days	0
Max Inflow / Mean Inflow	-	0
Max Reservoir Storage	hm3	0
Reservoir P Decay Rate	1/yr/ppb	0
Rainfall P Conc	ppb	10
Atmospheric P Load (Dry)	mg/m2-yr	20

Case Description: **Filename: 2GG EX_Data adj.xls**

Cells 1 & 2 & 3 use calibrated values; Cell 4 use STA2_3
Adjusted flows and loads to observed 3-yr averages

Output Variable	Units	Value
Water Balance Error	%	0.0%
Mass Balance Error	%	0.2%
Flow-Wtd Conc - With Bypass	ppb	15.0
Flow-Wtd Conc - Without Bypass	ppb	15.0
Geometric Mean Conc	ppb	12.0
95th Percentile Conc	ppb	17.9
Freq Cell Outflow > 10 ppb	%	95%
Bypass Load	%	0.0%

Cell Number -->		1	2	3	4	5	6
Cell Label	-	1	2	3	4		
Vegetation Type Conserv	------->	STA2_1	STA2_2	STA2_3	STA2_3		
Inflow Fraction	-	0.220777628	0.27842512	0.27842512	0.22237213		
Downstream Cell Number	-	0	0	0	0		
Surface Area	km2	7.280	9.190	9.190	7.340		
Mean Width of Flow Path	km	1.58	2.00	2.00	1.60		
Number of Tanks in Series	-	3	3	3	3		
Outflow Control Depth	cm	40	40	60	60		
Outflow Coefficient - Exponent	-	2.63	3.1	2.84	2.84		
Outflow Coefficient - Intercept	-	0.52	0.66	0.57	0.57		
Bypass Depth	cm	0	0	0	0		
Maximum Inflow	hm3/day	0	0	0	0		
Maximum Outflow	hm3/day	0	0	0	0		
Inflow Seepage Rate	(cm/d) / cm	0.008	0	0	0		
Inflow Seepage Control Elev	cm	76	0	0	0		
Inflow Seepage Conc	ppb	20	20	20	20		
Outflow Seepage Rate	(cm/d) / cm	0.004	0.006	0.01	0.01		
Outflow Seepage Control Elev	cm	-61	-61	-30	-30		
Max Outflow Seepage Conc	ppb	20	20	20	20		
Seepage Recycle Fraction	-	0.78	0.78	0.79	0.79		
Seepage Discharge Fraction	-	0	0	0	0		
Initial Water Column Conc	ppb	30	30	30	30		
Initial P Storage Per Unit Area	mg/m2	500	500	500	500		
Initial Water Column Depth	cm	50	50	50	50		
C0 = WC Conc at 0 g/m2 P Storage	ppb	*2*	*2*	*2*	*2*		
C1 = WC Conc at 1 g/m2 P storage	ppb	*22*	*22*	*22*	*22*		
K = Net Settling Rate at Steady State	m/yr	*41*	*36*	*28.16*	*28.16*		
Zx = Depth Scale Factor	cm	*60*	*60*	*60*	*60*		
C0 - Periphyton	ppb	*0*	*0*	*0*	*0*		
C1 - Periphyton	ppb	*0*	*0*	*0*	*0*		
K - Periphyton	1/yr	*0.00*	*0.00*	*0.00*	*0.00*		
Zx - Periphyton	cm	*0*	*0*	*0*	*0*		
Sm = Transition Storage Midpoint	mg/m2	*0*	*0*	*0*	*0*		
Sb = Transition Storage Bandwidth	mg/m2	*0*	*0*	*0*	*0*		

Output Variables	Units	1	2	3	4	5	6	Overall
Execution Time	seconds/yr	1.71	3.36	4.97	6.52			6.52
Run Date	-	05/26/04	05/26/04	05/26/04	05/26/04			05/26/04
Starting Date for Simulation	-	01/01/65	01/01/65	01/01/65	01/01/65			01/01/65
Starting Date for Output	-	01/01/65	01/01/65	01/01/65	01/01/65			01/01/65
Ending Date	-	12/31/95	12/31/95	12/31/95	12/31/95			12/31/95
Output Duration	days	11322	11322	11322	11322			11322
Cell Label		1	2	3	4			Total Outflow
Downstream Cell Label		Outflow	Outflow	Outflow	Outflow			-
Surface Area	km2	7.280	9.19	9.19	7.34008097			33.0
Mean Water Load	cm/d	2.6	2.6	2.6	2.6			2.6
Max Water Load	cm/d	26.0	25.9	25.9	25.9			25.9
Inflow Volume	hm3/yr	68.4	86.2	86.2	68.9			309.6
Inflow Load	kg/yr	5012.7	6321.6	6321.6	5048.9			22704.8
Inflow Conc	ppb	73.3	73.3	73.3	73.3			73.3
Treated Outflow Volume	hm3/yr	69.8	80.1	78.5	62.7			291.2
Treated Outflow Load	kg/yr	855.5	1136.9	1320.1	1054.4			4366.9
Treated FWM Outflow Conc	ppb	12.3	14.2	16.8	16.8			15.0
Total Outflow Volume	hm3/yr	69.8	80.1	78.5	62.7			291.2
Total Outflow Load	kg/yr	855.5	1136.9	1320.1	1054.4			4366.9
Total FWM Outflow Conc	ppb	12.3	14.2	16.8	16.8			15.0
Bypass Volume	hm3/yr	0.00	0.00	0.00	0.00			0.00

2.0 Compartment C

2.1 STA-5

2.1.1 Inflow Volumes and Phosphorus Input

Based on updated C-139 Basin information, additional inflow volumes and phosphorus loads, beyond those included in the Long-Term Plan analyses, were assumed to be sent to the expanded STA-5. Using a 31-yr (1965-95) period of record, the Long-Term Plan anticipated that approximately 135,178 AF/yr and 29,888 kg/yr would be generated as stormwater runoff from the southern C-139 Basin. Recent data (January 1996 – April 2003) indicate higher flows and phosphorus levels, averaging approximately 137,260 AF/yr and 33,656 kg/yr for the 38.3-year period 1965-2003 (see Table 4). While future phosphorus loads can be expected to decrease in accordance with the recently-implemented C-139 Basin Rule, as a conservative assumption, the performance simulations used the observed flows and loads from the basin. Approximately 42,000 acres of the 179,000 acre watershed has recently been scheduled for acquisition, with a transition to less intensive agriculture, and eventually to a panther preserve. While it is anticipated that lower runoff volumes and phosphorus loads should accompany this significant change in land use, the input data sets for this analysis assumed no change in either flows or phosphorus loads (see Table 5). This constitutes a conservative assumption, and additional analyses can be conducted when better estimates of the effect of this change in land use are available. It was assumed that the entirety of the southern C-139 Basin flows and phosphorus loads would be captured and treated by the expanded STA-5, an increase of 2,082 acre-feet per year and 3,768 kg/yr over the input used in developing the Long-Term Plan projections.

Table 4. Updated Flows and Loads from the Southern C-139 Basin

Year	Flow (acre-feet)	TP Load (kg)	TP (ppb)
1965 - 1995	135,178	29,888	179
1996	149,548	42,000	228
1997	112,480	23,652	170
1998	162,531	38,158	190
1999	170,141	41,196	196
2000	56,984	15,974	227
2001	172,041	61,458	290
2002	202,307	71,255	286
1965 - 2002	137,260	33,656	199

Table 5. Summary of Estimated Flows and Loads from the Southern C-139 Basin

	Annual Flow (acre-ft per year)	Annual TP Load (kg/year)	TP Concentration (ppb)
Long-Term Plan (1/1/65 – 12/31/95)	135,178	29,888	179
This Analysis (1/1/65 – 12/31/02)	137,260	33,656	199
Difference	2,082	3,768	20

Note: The future flows and loads from the C-139 Basin may actually be less than estimated in this table, as approximately 42,000 acres of the watershed are scheduled to be removed from agricultural production and as the basin's best management practices become more effective.

2.1.2 Performance Analyses

The projected nutrient removal performance of this expanded STA-5 was simulated using the April 2002 version of the DMSTA model developed by Walker and Kadlec.

2.1.3 Calibration Data Sets

The EMERG calibration data set was used for the upstream cells. For the lower estimate of performance, the SAV_C4 data set was used for the downstream SAV cells. For the higher estimate of performance, the NEWS_2 calibration data set was used. The NEWS_2 data set was based on the original NEWS data set, as updated by Dr. Walker in August 2002.

2.1.4 Modeling Results

The resulting outflow concentrations ranged from 10-12 ppb reported as a geometric mean, and 15-22 ppb reported as a flow-weighted mean (see Tables 6-7). This range compares favorably to the estimated range of performance shown in the Long-Term Plan of 10-14 (geometric mean) and 14-21 ppb (flow-weighted mean), despite the increase in flows and loads.

Table 6. DMSTA Summary for Expanded STA-5, Using SAV_C4.

DMSTA Input Values Run Model Menu *Warning: One or More Cells Outside of Calib. Range*

Input Variable	Units	Value
Design Case Name	-	NEW 2
Starting Date for Simulation	-	05/01/65
Ending Date for Simulation	-	04/30/03
Starting Date for Output	-	05/01/65
Steps Per Day	-	3
Number of Iterations	-	2
Output Averaging Interval	days	7
Reservoir H2O Residence Time	days	0
Max Inflow / Mean Inflow	-	0
Max Reservoir Storage	hm3	0
Reservoir P Decay Rate	1/yr/ppb	0
Rainfall P Conc	ppb	10
Atmospheric P Load (Dry)	mg/m2-yr	20

Case Description: SAV_C4 in SAV cells
Filename: 5 NEW1_Data.xls

Output Variable	Units	Value
Water Balance Error	%	0.0%
Mass Balance Error	%	-0.2%
Flow-Wtd Conc - With Bypass	ppb	15.2
Flow-Wtd Conc - Without Bypass	ppb	15.2
Geometric Mean Conc	ppb	8.4
95th Percentile Conc	ppb	19.7
Freq Cell Outflow > 10 ppb	%	39%
Bypass Load	%	0.0%

Cell Number -->		1	2	3	4	5	6
Cell Label	-	1A	1B	2A	2B	3A	3B
Vegetation Type Conserv	------->	EMERG	SAV_C4	EMERG	SAV_C4	EMERG	SAV_C4
Inflow Fraction	-	0.333	0	0.333	0	0.333	0
Downstream Cell Number	-	2	0	4	0	6	0
Surface Area	km2	3.379	4.937	3.379	4.937	3.379	4.937
Mean Width of Flow Path	km	1.56	1.56	1.56	1.56	1.56	1.56
Number of Tanks in Series	-	3	3	3	3	3	3
Outflow Control Depth	cm	40	60	40	60	40	60
Outflow Coefficient - Exponent	-	2.8	2.15	2.91	1.78	2.91	1.78
Outflow Coefficient - Intercept	-	1.57	2.02	1.51	2.1	1.51	2.1
Bypass Depth	cm	0	0	0	0	0	0
Maximum Inflow	hm3/day	0	0	0	0	0	0
Maximum Outflow	hm3/day	0	0	0	0	0	0
Inflow Seepage Rate	(cm/d) / cm	0	0	0	0	0	0
Inflow Seepage Control Elev	cm	0	0	0	0	0	0
Inflow Seepage Conc	ppb	20	20	20	20	20	20
Outflow Seepage Rate	(cm/d) / cm	0.0015	0.0014	0.0015	0.0015	0.0015	0.0015
Outflow Seepage Control Elev	cm	-46	-38	-46	-38	-46	-38
Max Outflow Seepage Conc	ppb	20	20	20	20	20	20
Seepage Recycle Fraction	-	0.5	0.5	0.5	0.5	0.5	0.5
Seepage Discharge Fraction	-	0	0	0	0	0	0
Initial Water Column Conc	ppb	30	30	30	30	30	30
Initial P Storage Per Unit Area	mg/m2	500	500	500	500	500	500
Initial Water Column Depth	cm	50	50	50	50	50	50
C0 = WC Conc at 0 g/m2 P Storage	ppb	*4*	*4*	*4*	*4*	*4*	*4*
C1 = WC Conc at 1 g/m2 P storage	ppb	*22*	*22*	*22*	*22*	*22*	*22*
K = Net Settling Rate at Steady State	m/yr	*16*	*80*	*15.66*	*80.10*	*15.66*	*80.10*
Zx = Depth Scale Factor	cm	*60*	*60*	*60*	*60*	*60*	*60*
C0 - Periphyton	ppb	*0*	*0*	*0*	*0*	*0*	*0*
C1 - Periphyton	ppb	*0*	*0*	*0*	*0*	*0*	*0*
K - Periphyton	1/yr	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Zx - Periphyton	cm	*0*	*0*	*0*	*0*	*0*	*0*
Sm = Transition Storage Midpoint	mg/m2	*0*	*0*	*0*	*0*	*0*	*0*
Sb = Transition Storage Bandwidth	mg/m2	*0*	*0*	*0*	*0*	*0*	*0*

Output Variables	Units	1	2	3	4	5	6	Overall
Execution Time	seconds/yr	2.08	4.05	6.08	8.08	10.08	12.16	12.16
Run Date	-	06/20/04	06/20/04	06/20/04	06/20/04	06/20/04	06/20/04	06/20/04
Starting Date for Simulation	-	05/01/65	05/01/65	05/01/65	05/01/65	05/01/65	05/01/65	05/01/65
Starting Date for Output	-	05/01/65	05/01/65	05/01/65	05/01/65	05/01/65	05/01/65	05/01/65
Ending Date	-	04/30/03	04/30/03	04/30/03	04/30/03	04/30/03	04/30/03	04/30/03
Output Duration	days	13879	13879	13879	13879	13879	13879	13879
Cell Label		1A	1B	2A	2B	3A	3B	Total Outflow
Downstream Cell Label		1B	Outflow	2B	Outflow	3B	Outflow	-
Surface Area	km2	3.379	4.937	3.379	4.937	3.379	4.937	24.9
Mean Water Load	cm/d	4.6	3.1	4.6	3.1	4.6	3.1	1.9
Max Water Load	cm/d	43.2	30.0	43.2	30.0	43.2	30.0	17.6
Inflow Volume	hm3/yr	56.4	55.1	56.4	55.1	56.4	55.1	169.3
Inflow Load	kg/yr	11218.7	6176.7	11218.7	6104.1	11218.7	6104.1	33656.1
Inflow Conc	ppb	198.8	112.0	198.8	110.7	198.8	110.7	198.8
Treated Outflow Volume	hm3/yr	55.1	53.3	55.1	53.2	55.1	53.2	159.8
Treated Outflow Load	kg/yr	6176.7	812.3	6104.1	808.3	6104.1	808.3	2428.9
Treated FWM Outflow Conc	ppb	112.0	15.2	110.7	15.2	110.7	15.2	15.2
Total Outflow Volume	hm3/yr	55.1	53.3	55.1	53.2	55.1	53.2	159.8
Total Outflow Load	kg/yr	6176.7	812.3	6104.1	808.3	6104.1	808.3	2428.9
Total FWM Outflow Conc	ppb	112.0	15.2	110.7	15.2	110.7	15.2	15.2
Bypass Volume	hm3/yr	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 7. DMSTA Summary for Expanded STA-5, Using NEWS_2.

DMSTA Input Values

Run Model

Menu

Warning: One or More Cells Outside of Calib. Range

Case Description: NEWS_2 for SAV cells

Filename: 5 NEW1_Data.xls

Input Variable	Units	Value
Design Case Name	-	NEW 2
Starting Date for Simulation	-	05/01/65
Ending Date for Simulation	-	04/30/03
Starting Date for Output	-	05/01/65
Steps Per Day	-	3
Number of Iterations	-	2
Output Averaging Interval	days	7
Reservoir H2O Residence Time	days	0
Max Inflow / Mean Inflow	-	0
Max Reservoir Storage	hm3	0
Reservoir P Decay Rate	1/yr/ppb	0
Rainfall P Conc	ppb	10
Atmospheric P Load (Dry)	mg/m2-yr	20

Output Variable	Units	Value
Water Balance Error	%	0.0%
Mass Balance Error	%	-0.1%
Flow-Wtd Conc - With Bypass	ppb	21.8
Flow-Wtd Conc - Without Bypass	ppb	21.8
Geometric Mean Conc	ppb	11.7
95th Percentile Conc	ppb	28.4
Freq Cell Outflow > 10 ppb	%	56%
Bypass Load	%	0.0%

Cell Number -->		1	2	3	4	5	6
Cell Label	-	1A	1B	2A	2B	3A	3B
Vegetation Type (Conserv)	------->	EMERG	NEWS_2	EMERG	NEWS_2	EMERG	NEWS_2
Inflow Fraction	-	0.333	0	0.333	0	0.333	0
Downstream Cell Number	-	2	0	4	0	6	0
Surface Area	km2	3.379	4.937	3.379	4.937	3.379	4.937
Mean Width of Flow Path	km	1.56	1.56	1.56	1.56	1.56	1.56
Number of Tanks in Series	-	3	3	3	3	3	3
Outflow Control Depth	cm	40	60	40	60	40	60
Outflow Coefficient - Exponent	-	2.8	2.15	2.91	1.78	2.91	1.78
Outflow Coefficient - Intercept	-	1.57	2.02	1.51	2.1	1.51	2.1
Bypass Depth	cm	0	0	0	0	0	0
Maximum Inflow	hm3/day	0	0	0	0	0	0
Maximum Outflow	hm3/day	0	0	0	0	0	0
Inflow Seepage Rate	(cm/d) / cm	0	0	0	0	0	0
Inflow Seepage Control Elev	cm	0	0	0	0	0	0
Inflow Seepage Conc	ppb	20	20	20	20	20	20
Outflow Seepage Rate	(cm/d) / cm	0.0015	0.0014	0.0015	0.0015	0.0015	0.0015
Outflow Seepage Control Elev	cm	-46	-38	-46	-38	-46	-38
Max Outflow Seepage Conc	ppb	20	20	20	20	20	20
Seepage Recycle Fraction	-	0.5	0.5	0.5	0.5	0.5	0.5
Seepage Discharge Fraction	-	0	0	0	0	0	0
Initial Water Column Conc	ppb	30	30	30	30	30	30
Initial P Storage Per Unit Area	mg/m2	500	500	500	500	500	500
Initial Water Column Depth	cm	50	50	50	50	50	50
C0 = WC Conc at 0 g/m2 P Storage	ppb	*4*	*8*	*4*	*8*	*4*	*8*
C1 = WC Conc at 1 g/m2 P storage	ppb	*22*	*22*	*22*	*22*	*22*	*22*
K = Net Settling Rate at Steady State	m/yr	*16*	*90*	*15.66*	*90.40*	*15.66*	*90.40*
Zx = Depth Scale Factor	cm	*60*	*60*	*60*	*60*	*60*	*60*
C0 - Periphyton	ppb	*0*	*4*	*0*	*4*	*0*	*4*
C1 - Periphyton	ppb	*0*	*22*	*0*	*22*	*0*	*22*
K - Periphyton	1/yr	*0.00*	*31.30*	*0.00*	*31.30*	*0.00*	*31.30*
Zx - Periphyton	cm	*0*	*0*	*0*	*0*	*0*	*0*
Sm = Transition Storage Midpoint	mg/m2	*0*	*400*	*0*	*400*	*0*	*400*
Sb = Transition Storage Bandwidth	mg/m2	*0*	*80*	*0*	*80*	*0*	*80*

Output Variables	Units	1	2	3	4	5	6	Overall
Execution Time	seconds/yr	2.13	4.26	6.24	8.34	10.37	12.40	12.40
Run Date	-	06/20/04	06/20/04	06/20/04	06/20/04	06/20/04	06/20/04	06/20/04
Starting Date for Simulation	-	05/01/65	05/01/65	05/01/65	05/01/65	05/01/65	05/01/65	05/01/65
Starting Date for Output	-	05/01/65	05/01/65	05/01/65	05/01/65	05/01/65	05/01/65	05/01/65
Ending Date	-	04/30/03	04/30/03	04/30/03	04/30/03	04/30/03	04/30/03	04/30/03
Output Duration	days	13879	13879	13879	13879	13879	13879	13879
Cell Label		1A	1B	2A	2B	3A	3B	Total Outflow
Downstream Cell Label		1B	Outflow	2B	Outflow	3B	Outflow	-
Surface Area	km2	3.379	4.937	3.379	4.937	3.379	4.937	24.9
Mean Water Load	cm/d	4.6	3.1	4.6	3.1	4.6	3.1	1.9
Max Water Load	cm/d	43.2	30.0	43.2	30.0	43.2	30.0	17.6
Inflow Volume	hm3/yr	56.4	55.1	56.4	55.1	56.4	55.1	169.3
Inflow Load	kg/yr	11218.7	6176.7	11218.7	6104.1	11218.7	6104.1	33656.1
Inflow Conc	ppb	198.8	112.0	198.8	110.7	198.8	110.7	198.8
Treated Outflow Volume	hm3/yr	55.1	53.3	55.1	53.2	55.1	53.2	159.8
Treated Outflow Load	kg/yr	6176.7	1161.9	6104.1	1157.1	6104.1	1157.1	3476.0
Treated FWM Outflow Conc	ppb	112.0	21.8	110.7	21.7	110.7	21.7	21.8
Total Outflow Volume	hm3/yr	55.1	53.3	55.1	53.2	55.1	53.2	159.8
Total Outflow Load	kg/yr	6176.7	1161.9	6104.1	1157.1	6104.1	1157.1	3476.0
Total FWM Outflow Conc	ppb	112.0	21.8	110.7	21.7	110.7	21.7	21.8
Bypass Volume	hm3/yr	0.00	0.00	0.00	0.00	0.00	0.00	0.00

2.2 STA-6

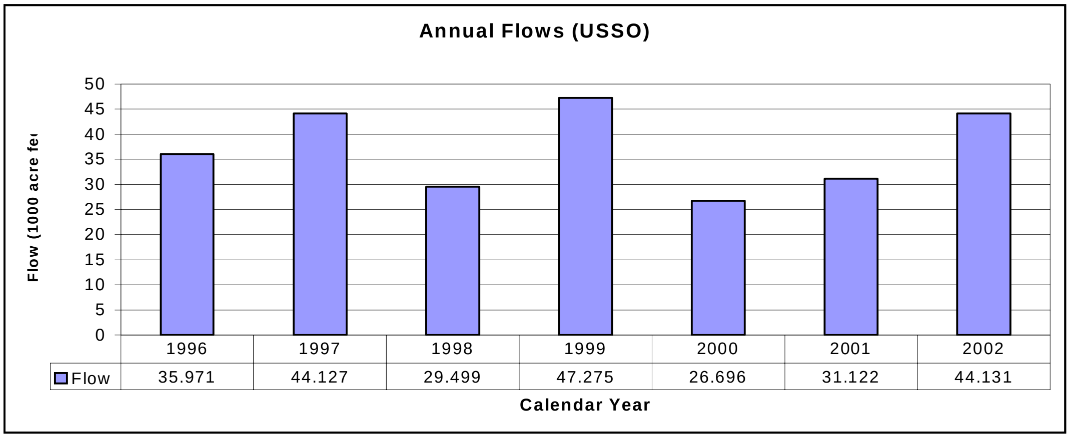
The Strategy Paper does not recommend any changes to the acreage of treatment area recommended in the Long-Term Plan for STA-6 Sections 1 and 2 prior to December 31, 2006. However, significant changes to the inflow volumes and phosphorus levels are anticipated, as described in the following section.

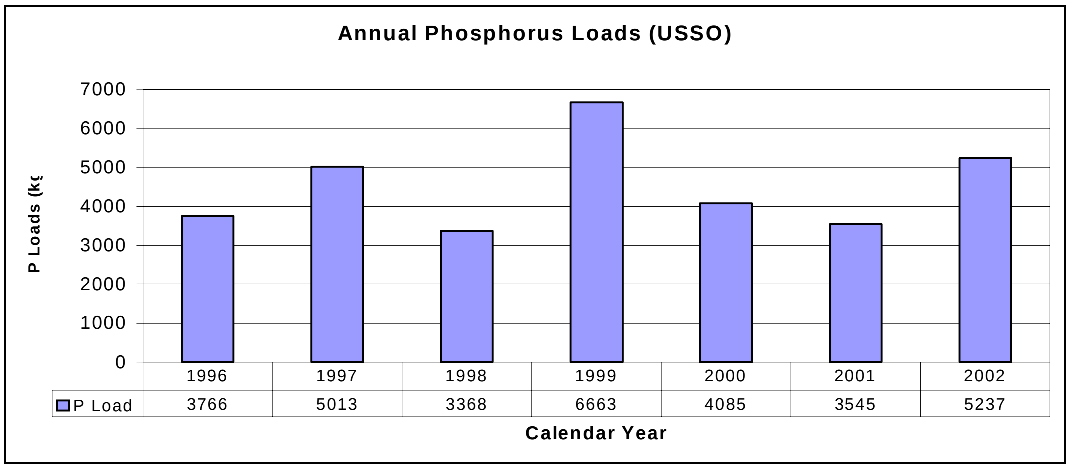
2.2.1 Inflow Volumes and Phosphorus Input

The Long-Term Plan assumed that through 2014, STA-6 Sections 1 and 2 would capture and treat runoff from the 8,800-acre Compartment C, the C-139 Annex, excess flows from the southern C-139 Basin diverted from STA-5, and supplemental water from Lake Okeechobee. With the cessation of active farming in Compartment C, the runoff flows and loads are assumed to decrease, and an areal runoff similar to that observed in the C-139 Basin (approximately 12 inches per year) was assumed in this analysis; the actual drainage may be less. With the expanded STA-5, it is assumed that all of the southern C-139 Basin flows would be captured and treated in STA-5, although bypass would be provided by one spillway at G-406. Flow and phosphorus loads from the C-139 Annex (also know as Unit 1) were estimated from records at the USSO station, located just downstream of the Unit 1 discharge. These are presented in Figure 1 and are significantly higher than estimated in the 1996 General Design Memorandum, the 1997 STA-6 Detailed Design Report (12,640 AF/yr; 1,090 kg/yr; 70 ppb), and in the development of the Long-Term Plan. A revised inflow set for STA-6, covering the period 1/1/65 – 12/31/2002 was developed and is summarized in Table 8. The increased estimate of flows from the C-139 Annex more than offsets the reduction in flows from Compartment C, resulting in greater estimated inflows to STA-6 than anticipated in the Long-Term Plan.

The 870-acre STA-6 Section 1 is currently performing much better than was anticipated during the original design. Flow-weighted mean outflow concentrations have averaged 19 ppb, which is actually within the range of the projected performance with the enhancements recommended in the Long-Term Plan. For Water Year 2004, the outflow averaged 13 ppb, which is lower than the range of projected performance with the enhancements. There is concern that disrupting operation of the STA to construct the recommended enhancements, including the new internal levee, structures and vegetation conversion, prior to operation of STA-6 Section 2, may cause short-term bypass of phosphorus to the Everglades and may jeopardize the exceptional long-term performance of this STA. The current recommendation is to start construction of the STA-6 Section 1 enhancements after a two-year evaluation of STA-6 Section 2 performance, and if demonstrated to be necessary to achieve the water quality goals in the EPA. The STA-6 Section 2 enhancements are proposed to proceed as recommended in the Long-Term Plan.

Figure 1. Summary of Flows and Phosphorus from Station USSO.





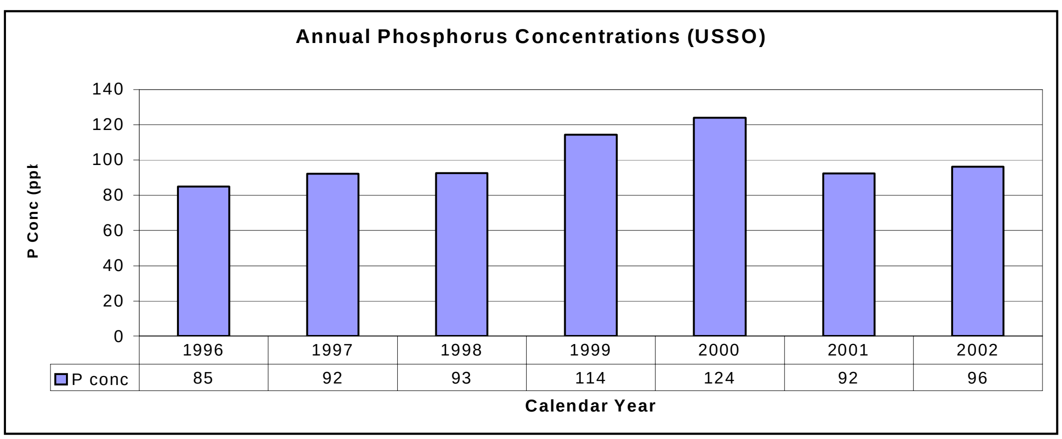


Table 8. Summary of Revised STA-6 Inflows

	Annual Flow (acre-ft per year)	Annual TP Load (kg/year)	TP (ppb)
Southern C-139 Basin			
Long-Term Plan	3,065	849	224
This Analysis	0	0	-
Difference	-3,065	-849	-
Compartment C			
Long-Term Plan	21,794 (excludes 5,476 AF/yr bypassed in LTP simulation)	2,095 (excludes 760 kg/yr bypassed in LTP simulation)	85
This Analysis	6,278	463	60
Difference	-15,516	-1,632	25
C-139 Annex			
Long-Term Plan	11,954	1,032	70
This Analysis	35,852	4,608	104
Difference	23,898	3,576	34
Total Runoff			
Long-Term Plan	36,813	3,976	76
This Analysis	42,130	5,071	98
Difference	5,317	1,095	22

2.2.2 Performance Analyses

The projected nutrient removal performance of STA-6 (Sections 1 and 2) was simulated using DMSTA.

2.2.3 Calibration Data Sets

For these simulations, updated calibrated data sets for STA-6 documented on Bill Walker's website were used for the emergent cells, and SAV_C4 and NEWS_2 were used for the new SAV cell, Cell 4.

2.2.4 Modeling Results

The simulated performance for STA-6 resulted in outflow concentrations ranging from 10-11 ppb reported as a geometric mean, and 12-14 ppb reported as a flow-weighted mean (see Tables 9-10). This range compares favorably to the estimated range of performance shown in the Long-Term Plan of 10-13 (geometric mean) and 17-24 ppb (flow-weighted mean).

2.3 Full Build-out of Compartment C as Treatment Area

It is also recommended to construct additional treatment areas in the remaining acreage of Compartment C. In addition to the recommended construction of STA-6 Section 2 and the expansion of STA-5, one alternative would consist of an additional 4-mile long by 1-mile wide low-way and a 4-mile long by 1.5-mile wide flow-way to treat the southern C-139 Basin; and an extension of STA-6 Section 2 west to the L-3 borrow canal (see Figure 2) to assist in the treatment of the C-139 Annex. The DMSTA modeling represented STA-5 as 5 flow-ways, each receiving a proportional share of the hydraulic and phosphorus load of the southern C-139 Basin. STA-6 was modeled as the same as in Section 3.2 with an additional 720 acres of effective treatment area in Cell 1 upstream of Cell2. Using the same inflows (except with no runoff from Unit 2) as modeled for STA-5 and STA-6 above, and using the same calibration data sets, the projected phosphorus concentrations for this expanded treatment area is 12-17 ppb, reported as flow-weighted means, and 10 ppb reported as a geometric mean for STA-5; and 10-12 ppb reported as a flow-weighted mean and 10 ppb reported as a geometric mean for STA-6 (see Tables 11-14).

Table 9. DMSTA Summary for Expanded STA-6, Using SAV_C4

DMSTA Input Values

Run Model | Menu

Input Variable	Units	Value
Design Case Name	-	NEW5
Starting Date for Simulation	-	05/01/65
Ending Date for Simulation	-	04/30/03
Starting Date for Output	-	05/01/65
Steps Per Day	-	3
Number of Iterations	-	2
Output Averaging Interval	days	7
Reservoir H2O Residence Time	days	0
Max Inflow / Mean Inflow	-	0
Max Reservoir Storage	hm3	0
Reservoir P Decay Rate	1/yr/ppb	0
Rainfall P Conc	ppb	10
Atmospheric P Load (Dry)	mg/m2-yr	20

Case Description: **Filename: 6 NEW 1 Data.xls**

Used calibration data sets from Walker; new - STA6_5 and SAV_C4
2656 ac addition to STA-5
C139 Annex and balance of Unit 2 inflows

Output Variable	Units	Value
Water Balance Error	%	0.0%
Mass Balance Error	%	-0.2%
Flow-Wtd Conc - With Bypass	ppb	11.8
Flow-Wtd Conc - Without Bypass	ppb	11.8
Geometric Mean Conc	ppb	9.8
95th Percentile Conc	ppb	15.2
Freq Cell Outflow > 10 ppb	%	18%
Bypass Load	%	0.0%

Cell Number -->		1	2	3	4	5	6
Cell Label	-	3	5	2	4		
Vegetation Type (Conserv)	------->	STA6_3	STA6_5	STA6_5	SAV_C4		
Inflow Fraction	-	0.108674679	0.27723132	0.614094	0		
Downstream Cell Number	-	0	0	4	0		
Surface Area	km2	0.991	2.639	2.242	3.363		
Mean Width of Flow Path	km	0.61	1.31	2.34	2.32		
Number of Tanks in Series	-	3	3	3	3		
Outflow Control Depth	cm	40	40	40	60		
Outflow Coefficient - Exponent	-	4	4	1.67	1.67		
Outflow Coefficient - Intercept	-	0.5	0.9	0.18	0.2		
Bypass Depth	cm	0	0	0	0		
Maximum Inflow	hm3/day	0	0	0	0		
Maximum Outflow	hm3/day	0	0	0	0		
Inflow Seepage Rate	(cm/d) / cm	0	0	0	0		
Inflow Seepage Control Elev	cm	0	0	0	0		
Inflow Seepage Conc	ppb	20	20	20	20		
Outflow Seepage Rate	(cm/d) / cm	0	0	0.0059	0.0017		
Outflow Seepage Control Elev	cm	0	0	-46	-46		
Max Outflow Seepage Conc	ppb	20	20	20	20		
Seepage Recycle Fraction	-	0	0	0.5	0.5		
Seepage Discharge Fraction	-	0	0	0	0		
Initial Water Column Conc	ppb	30	30	30	30		
Initial P Storage Per Unit Area	mg/m2	500	500	500	500		
Initial Water Column Depth	cm	50	50	50	50		
C0 = WC Conc at 0 g/m2 P Storage	ppb	*2*	*2*	*2*	*4*		
C1 = WC Conc at 1 g/m2 P storage	ppb	*22*	*22*	*22*	*22*		
K = Net Settling Rate at Steady State	m/yr	*39*	*26*	*25.82*	*80.10*		
Zx = Depth Scale Factor	cm	*60*	*60*	*60*	*60*		
C0 - Periphyton	ppb	*0*	*0*	*0*	*0*		
C1 - Periphyton	ppb	*0*	*0*	*0*	*0*		
K - Periphyton	1/yr	*0.00*	*0.00*	*0.00*	*0.00*		
Zx - Periphyton	cm	*0*	*0*	*0*	*0*		
Sm = Transition Storage Midpoint	mg/m2	*0*	*0*	*0*	*0*		
Sb = Transition Storage Bandwidth	mg/m2	*0*	*0*	*0*	*0*		

Output Variables	Units	1	2	3	4	5	6	Overall
Execution Time	seconds/yr	1.61	3.13	4.66	6.21			6.21
Run Date	-	05/21/04	05/21/04	05/21/04	05/21/04			05/21/04
Starting Date for Simulation	-	05/01/65	05/01/65	05/01/65	05/01/65			05/01/65
Starting Date for Output	-	05/01/65	05/01/65	05/01/65	05/01/65			05/01/65
Ending Date	-	04/30/03	04/30/03	04/30/03	04/30/03			04/30/03
Output Duration	days	13879	13879	13879	13879			13879
Cell Label		3	5	2	4			Total Outflow
Downstream Cell Label		Outflow	Outflow	4	Outflow			-
Surface Area	km2	0.991	2.639	2.242	3.363			9.2
Mean Water Load	cm/d	1.6	1.5	3.9	2.4			1.5
Max Water Load	cm/d	16.3	15.6	40.7	26.3			16.1
Inflow Volume	hm3/yr	5.7	14.5	32.0	29.8			52.2
Inflow Load	kg/yr	554.0	1413.3	3130.6	985.5			5097.9
Inflow Conc	ppb	97.7	97.7	97.7	33.1			97.7
Treated Outflow Volume	hm3/yr	5.6	14.4	29.8	28.7			48.6
Treated Outflow Load	kg/yr	58.0	216.4	985.5	298.7			573.1
Treated FWM Outflow Conc	ppb	10.3	15.1	33.1	10.4			11.8
Total Outflow Volume	hm3/yr	5.6	14.4	29.8	28.7			48.6
Total Outflow Load	kg/yr	58.0	216.4	985.5	298.7			573.1
Total FWM Outflow Conc	ppb	10.3	15.1	33.1	10.4			11.8
Bypass Volume	hm3/yr	0.00	0.00	0.00	0.00			0.00

Table 10. DMSTA Summary for Expanded STA-6, Using NEWS_2.

DMSTA Input Values Run Model Menu

Input Variable	Units	Value
Design Case Name	-	NEW6
Starting Date for Simulation	-	05/01/65
Ending Date for Simulation	-	04/30/03
Starting Date for Output	-	05/01/65
Steps Per Day	-	3
Number of Iterations	-	2
Output Averaging Interval	days	7
Reservoir H2O Residence Time	days	0
Max Inflow / Mean Inflow	-	0
Max Reservoir Storage	hm3	0
Reservoir P Decay Rate	1/yr/ppb	0
Rainfall P Conc	ppb	10
Atmospheric P Load (Dry)	mg/m2-yr	20

Case Description: **Filename: 6 NEW 1_Data.xls**

Used calibration data sets from Walker; new - STA6_5 and NEWS_2
2656 ac addition to STA-5
C139 Annex and balance of Unit 2 inflows

Output Variable	Units	Value
Water Balance Error	%	0.0%
Mass Balance Error	%	-0.2%
Flow-Wtd Conc - With Bypass	ppb	13.6
Flow-Wtd Conc - Without Bypass	ppb	13.6
Geometric Mean Conc	ppb	10.9
95th Percentile Conc	ppb	16.9
Freq Cell Outflow > 10 ppb	%	39%
Bypass Load	%	0.0%

Cell Number -->		1	2	3	4	5	6
Cell Label	-	3	5	2	4		
Vegetation Type Conserv	------->	STA6_3	STA6_5	STA6_5	NEWS_2		
Inflow Fraction	-	0.108674679	0.27723132	0.614094	0		
Downstream Cell Number		0	0	4	0		
Surface Area	km2	0.991	2.639	2.242	3.363		
Mean Width of Flow Path	km	0.61	1.31	2.34	2.32		
Number of Tanks in Series	-	3	3	3	3		
Outflow Control Depth	cm	40	40	40	60		
Outflow Coefficient - Exponent	-	4	4	1.67	1.67		
Outflow Coefficient - Intercept	-	0.5	0.9	0.18	0.2		
Bypass Depth	cm	0	0	0	0		
Maximum Inflow	hm3/day	0	0	0	0		
Maximum Outflow	hm3/day	0	0	0	0		
Inflow Seepage Rate	(cm/d) / cm	0	0	0	0		
Inflow Seepage Control Elev	cm	0	0	0	0		
Inflow Seepage Conc	ppb	20	20	20	20		
Outflow Seepage Rate	(cm/d) / cm	0	0	0.0059	0.0017		
Outflow Seepage Control Elev	cm	0	0	-46	-46		
Max Outflow Seepage Conc	ppb	20	20	20	20		
Seepage Recycle Fraction	-	0	0	0.5	0.5		
Seepage Discharge Fraction	-	0	0	0	0		
Initial Water Column Conc	ppb	30	30	30	30		
Initial P Storage Per Unit Area	mg/m2	500	500	500	500		
Initial Water Column Depth	cm	50	50	50	50		
C0 = WC Conc at 0 g/m2 P Storage	ppb	*2*	*2*	*2*	*8*		
C1 = WC Conc at 1 g/m2 P storage	ppb	*22*	*22*	*22*	*22*		
K = Net Settling Rate at Steady State	m/yr	*39*	*26*	*25.82*	*90.40*		
Zx = Depth Scale Factor	cm	*60*	*60*	*60*	*60*		
C0 - Periphyton	ppb	*0*	*0*	*0*	*4*		
C1 - Periphyton	ppb	*0*	*0*	*0*	*22*		
K - Periphyton	1/yr	*0.00*	*0.00*	*0.00*	*31.30*		
Zx - Periphyton	cm	*0*	*0*	*0*	*0*		
Sm = Transition Storage Midpoint	mg/m2	*0*	*0*	*0*	*400*		
Sb = Transition Storage Bandwidth	mg/m2	*0*	*0*	*0*	*80*		

Output Variables	Units	1	2	3	4	5	6	Overall
Execution Time	seconds/yr	1.63	3.16	4.68	6.26			6.26
Run Date	-	05/21/04	05/21/04	05/21/04	05/21/04			05/21/04
Starting Date for Simulation	-	05/01/65	05/01/65	05/01/65	05/01/65			05/01/65
Starting Date for Output	-	05/01/65	05/01/65	05/01/65	05/01/65			05/01/65
Ending Date	-	04/30/03	04/30/03	04/30/03	04/30/03			04/30/03
Output Duration	days	13879	13879	13879	13879			13879
Cell Label		3	5	2	4			Total Outflow
Downstream Cell Label		Outflow	Outflow	4	Outflow			-
Surface Area	km2	0.991	2.639	2.242	3.363			9.2
Mean Water Load	cm/d	1.6	1.5	3.9	2.4			1.5
Max Water Load	cm/d	16.3	15.6	40.7	26.3			16.1
Inflow Volume	hm3/yr	5.7	14.5	32.0	29.8			52.2
Inflow Load	kg/yr	554.0	1413.3	3130.6	985.5			5097.9
Inflow Conc	ppb	97.7	97.7	97.7	33.1			97.7
Treated Outflow Volume	hm3/yr	5.6	14.4	29.8	28.7			48.6
Treated Outflow Load	kg/yr	58.0	216.4	985.5	387.2			661.5
Treated FWM Outflow Conc	ppb	10.3	15.1	33.1	13.5			13.6
Total Outflow Volume	hm3/yr	5.6	14.4	29.8	28.7			48.6
Total Outflow Load	kg/yr	58.0	216.4	985.5	387.2			661.5
Total FWM Outflow Conc	ppb	10.3	15.1	33.1	13.5			13.6
Bypass Volume	hm3/yr	0.00	0.00	0.00	0.00			0.00

Figure 2. One Alternative for Build-out of Compartment C.

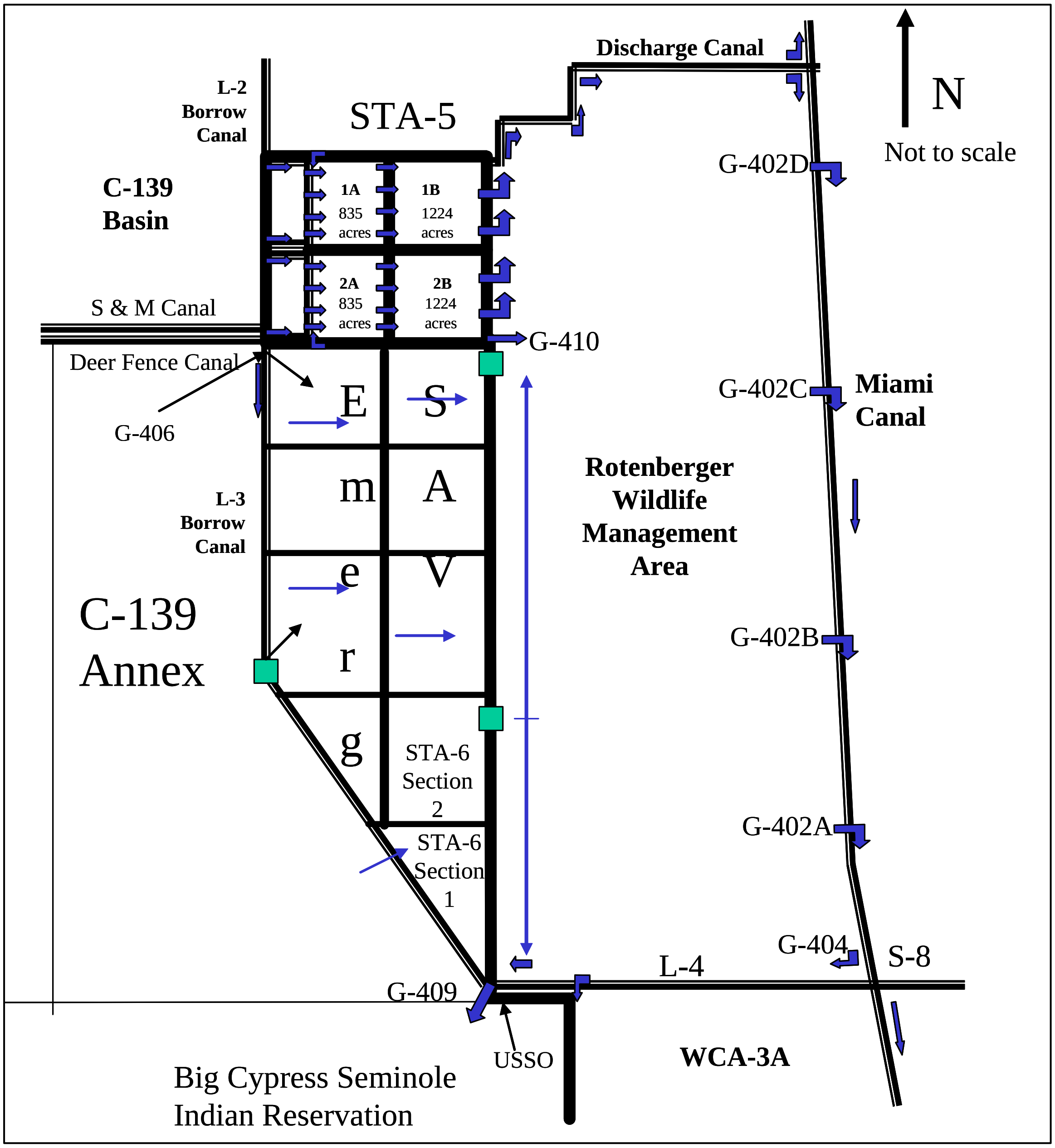


Table 11. DMSTA Summary for Full Build-out of STA-5, Using SAV_C4. Note: Output for Cell 1B reflects result of proportional loading to cells.

DMSTA Input Values

Warning: One or More Cells Outside of Calib. Range

Input Variable	Units	Value	Case Description:	Filename:	5 NEW1_Data rev.xls
Design Case Name	-	NEW 3	5 flow-ways; uniform loading		
Starting Date for Simulation	-	05/01/65	SAV_C4 for SAV cells		
Ending Date for Simulation	-	04/30/03			
Starting Date for Output	-	05/01/65			
Steps Per Day	-	3	**Output Variable**	**Units**	**Value**
Number of Iterations	-	2	Water Balance Error	%	0.0%
Output Averaging Interval	days	7	Mass Balance Error	%	-0.2%
Reservoir H2O Residence Time	days	0	Flow-Wtd Conc - With Bypass	ppb	20.2
Max Inflow / Mean Inflow	-	0	Flow-Wtd Conc - Without Bypass	ppb	20.2
Max Reservoir Storage	hm3	0	Geometric Mean Conc	ppb	12.1
Reservoir P Decay Rate	1/yr/ppb	0	95th Percentile Conc	ppb	26.5
Rainfall P Conc	ppb	10	Freq Cell Outflow > 10 ppb	%	72%
Atmospheric P Load (Dry)	mg/m2-yr	20	Bypass Load	%	0.0%

Cell Number -->		1	2	3	4	5	6
Cell Label	-	1A	1B	2A	2B	3A	3B
Vegetation Type	------->	EMERG	SAV_C4	EMERG	SAV_C4	EMERG	SAV_C4
Inflow Fraction	-	0.2	0	0.2	0	0.6	0
Downstream Cell Number	-	2	0	4	0	6	0
Surface Area	km2	3.379	4.937	3.379	4.937	3.379	4.937
Mean Width of Flow Path	km	1.56	1.56	1.56	1.56	1.56	1.56
Number of Tanks in Series	-	3	3	3	3	3	3
Outflow Control Depth	cm	40	60	40	60	40	60
Outflow Coefficient - Exponent	-	2.8	2.15	2.91	1.78	2.91	1.78
Outflow Coefficient - Intercept	-	1.57	2.02	1.51	2.1	1.51	2.1
Bypass Depth	cm	0	0	0	0	0	0
Maximum Inflow	hm3/day	0	0	0	0	0	0
Maximum Outflow	hm3/day	0	0	0	0	0	0
Inflow Seepage Rate	(cm/d) / cm	0	0	0	0	0	0
Inflow Seepage Control Elev	cm	0	0	0	0	0	0
Inflow Seepage Conc	ppb	20	20	20	20	20	20
Outflow Seepage Rate	(cm/d) / cm	0.0015	0.0014	0.0015	0.0015	0.0015	0.0015
Outflow Seepage Control Elev	cm	-46	-38	-46	-38	-46	-38
Max Outflow Seepage Conc	ppb	20	20	20	20	20	20
Seepage Recycle Fraction	-	0.5	0.5	0.5	0.5	0.5	0.5
Seepage Discharge Fraction	-	0	0	0	0	0	0
Initial Water Column Conc	ppb	30	30	30	30	30	30
Initial P Storage Per Unit Area	mg/m2	500	500	500	500	500	500
Initial Water Column Depth	cm	50	50	50	50	50	50
C0 = WC Conc at 0 g/m2 P Storage	ppb	4	4	4	4	4	4
C1 = WC Conc at 1 g/m2 P storage	ppb	22	22	22	22	22	22
K = Net Settling Rate at Steady State	m/yr	16	80	15.66	80.10	15.66	80.10
Zx = Depth Scale Factor	cm	60	60	60	60	60	60
C0 - Periphyton	ppb	0	0	0	0	0	0
C1 - Periphyton	ppb	0	0	0	0	0	0
K - Periphyton	1/yr	0.00	0.00	0.00	0.00	0.00	0.00
Zx - Periphyton	cm	0	0	0	0	0	0
Sm = Transition Storage Midpoint	mg/m2	0	0	0	0	0	0
Sb = Transition Storage Bandwidth	mg/m2	0	0	0	0	0	0

Output Variables	Units	1	2	3	4	5	6	Overall
Execution Time	seconds/yr	1.58	3.11	4.61	6.11	7.63	9.13	9.13
Run Date	-	07/11/04	07/11/04	07/11/04	07/11/04	07/11/04	07/11/04	07/11/04
Starting Date for Simulation	-	05/01/65	05/01/65	05/01/65	05/01/65	05/01/65	05/01/65	05/01/65
Starting Date for Output	-	05/01/65	05/01/65	05/01/65	05/01/65	05/01/65	05/01/65	05/01/65
Ending Date	-	04/30/03	04/30/03	04/30/03	04/30/03	04/30/03	04/30/03	04/30/03
Output Duration	days	13879	13879	13879	13879	13879	13879	13879
Cell Label		1A	1B	2A	2B	3A	3B	Total Outflow
Downstream Cell Label		1B	Outflow	2B	Outflow	3B	Outflow	-
Surface Area	km2	3.379	4.937	3.379	4.937	3.379	4.937	24.9
Mean Water Load	cm/d	2.7	1.8	2.7	1.8	8.2	5.6	1.9
Max Water Load	cm/d	26.0	18.1	26.0	18.0	77.9	53.9	17.6
Inflow Volume	hm3/yr	33.9	32.6	33.9	32.6	101.7	100.3	169.4
Inflow Load	kg/yr	6738.0	2889.4	6738.0	2831.6	20213.9	13921.5	33689.8
Inflow Conc	ppb	198.8	88.5	198.8	86.7	198.8	138.7	198.8
Treated Outflow Volume	hm3/yr	32.6	30.9	32.6	30.8	100.3	98.4	160.1
Treated Outflow Load	kg/yr	2889.4	362.0	2831.6	358.8	13921.5	2515.5	3236.3
Treated FWM Outflow Conc	ppb	88.5	11.7	86.7	11.6	138.7	25.6	20.2
Total Outflow Volume	hm3/yr	32.6	30.9	32.6	30.8	100.3	98.4	160.1
Total Outflow Load	kg/yr	2889.4	362.0	2831.6	358.8	13921.5	2515.5	3236.3
Total FWM Outflow Conc	ppb	88.5	11.7	86.7	11.6	138.7	25.6	20.2
Bypass Volume	hm3/yr	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bypass Load	kg/yr	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 12. DMSTA Summary for Full Build-out of STA-5, Using NEWS_2
Note: Output for Cell 1B reflects result of proportional loading to cells.

DMSTA Input Values

Warning: One or More Cells Outside of Calib. Range

Input Variable	Units	Value	Case Description:	Filename:	5 NEW1_Data rev.xls
Design Case Name	-	NEW 4	5 flow-ways; uniform loading		
Starting Date for Simulation	-	05/01/65	NEWS_2 for SAV cells		
Ending Date for Simulation	-	04/30/03			
Starting Date for Output	-	05/01/65			
Steps Per Day	-	3	**Output Variable**	**Units**	**Value**
Number of Iterations	-	2	Water Balance Error	%	0.0%
Output Averaging Interval	days	7	Mass Balance Error	%	-0.2%
Reservoir H2O Residence Time	days	0	Flow-Wtd Conc - With Bypass	ppb	26.0
Max Inflow / Mean Inflow	-	0	Flow-Wtd Conc - Without Bypass	ppb	26.0
Max Reservoir Storage	hm3	0	Geometric Mean Conc	ppb	14.0
Reservoir P Decay Rate	1/yr/ppb	0	95th Percentile Conc	ppb	31.7
Rainfall P Conc	ppb	10	Freq Cell Outflow > 10 ppb	%	75%
Atmospheric P Load (Dry)	mg/m2-yr	20	Bypass Load	%	0.0%

Cell Number -->		1	2	3	4	5	6
Cell Label	-	1A	1B	2A	2B	3A	3B
Vegetation Type	------->	EMERG	NEWS_2	EMERG	NEWS_2	EMERG	NEWS_2
Inflow Fraction	-	0.2	0	0.2	0	0.6	0
Downstream Cell Number	-	2	0	4	0	6	0
Surface Area	km2	3.379	4.937	3.379	4.937	3.379	4.937
Mean Width of Flow Path	km	1.56	1.56	1.56	1.56	1.56	1.56
Number of Tanks in Series	-	3	3	3	3	3	3
Outflow Control Depth	cm	40	60	40	60	40	60
Outflow Coefficient - Exponent	-	2.8	2.15	2.91	1.78	2.91	1.78
Outflow Coefficient - Intercept	-	1.57	2.02	1.51	2.1	1.51	2.1
Bypass Depth	cm	0	0	0	0	0	0
Maximum Inflow	hm3/day	0	0	0	0	0	0
Maximum Outflow	hm3/day	0	0	0	0	0	0
Inflow Seepage Rate	(cm/d) / cm	0	0	0	0	0	0
Inflow Seepage Control Elev	cm	0	0	0	0	0	0
Inflow Seepage Conc	ppb	20	20	20	20	20	20
Outflow Seepage Rate	(cm/d) / cm	0.0015	0.0014	0.0015	0.0015	0.0015	0.0015
Outflow Seepage Control Elev	cm	-46	-38	-46	-38	-46	-38
Max Outflow Seepage Conc	ppb	20	20	20	20	20	20
Seepage Recycle Fraction	-	0.5	0.5	0.5	0.5	0.5	0.5
Seepage Discharge Fraction	-	0	0	0	0	0	0
Initial Water Column Conc	ppb	30	30	30	30	30	30
Initial P Storage Per Unit Area	mg/m2	500	500	500	500	500	500
Initial Water Column Depth	cm	50	50	50	50	50	50
C0 = WC Conc at 0 g/m2 P Storage	ppb	*4*	*8*	*4*	*8*	*4*	*8*
C1 = WC Conc at 1 g/m2 P storage	ppb	*22*	*22*	*22*	*22*	*22*	*22*
K = Net Settling Rate at Steady State	m/yr	*16*	*90*	*15.66*	*90.40*	*15.66*	*90.40*
Zx = Depth Scale Factor	cm	*60*	*60*	*60*	*60*	*60*	*60*
C0 - Periphyton	ppb	*0*	*4*	*0*	*4*	*0*	*4*
C1 - Periphyton	ppb	*0*	*22*	*0*	*22*	*0*	*22*
K - Periphyton	1/yr	*0.00*	*31.30*	*0.00*	*31.30*	*0.00*	*31.30*
Zx - Periphyton	cm	*0*	*0*	*0*	*0*	*0*	*0*
Sm = Transition Storage Midpoint	mg/m2	*0*	*400*	*0*	*400*	*0*	*400*
Sb = Transition Storage Bandwidth	mg/m2	*0*	*80*	*0*	*80*	*0*	*80*

Output Variables	Units	1	2	3	4	5	6	Overall
Execution Time	seconds/yr	1.58	3.13	4.63	6.18	7.71	9.26	9.26
Run Date	-	07/11/04	07/11/04	07/11/04	07/11/04	07/11/04	07/11/04	07/11/04
Starting Date for Simulation	-	05/01/65	05/01/65	05/01/65	05/01/65	05/01/65	05/01/65	05/01/65
Starting Date for Output	-	05/01/65	05/01/65	05/01/65	05/01/65	05/01/65	05/01/65	05/01/65
Ending Date	-	04/30/03	04/30/03	04/30/03	04/30/03	04/30/03	04/30/03	04/30/03
Output Duration	days	13879	13879	13879	13879	13879	13879	13879
Cell Label		1A	1B	2A	2B	3A	3B	Total Outflow
Downstream Cell Label		1B	Outflow	2B	Outflow	3B	Outflow	-
Surface Area	km2	3.379	4.937	3.379	4.937	3.379	4.937	24.9
Mean Water Load	cm/d	2.7	1.8	2.7	1.8	8.2	5.6	1.9
Max Water Load	cm/d	26.0	18.1	26.0	18.0	77.9	53.9	17.6
Inflow Volume	hm3/yr	33.9	32.6	33.9	32.6	101.7	100.3	169.4
Inflow Load	kg/yr	6738.0	2889.4	6738.0	2831.6	20213.9	13921.5	33689.8
Inflow Conc	ppb	198.8	88.5	198.8	86.7	198.8	138.7	198.8
Treated Outflow Volume	hm3/yr	32.6	30.9	32.6	30.8	100.3	98.4	160.1
Treated Outflow Load	kg/yr	2889.4	514.3	2831.6	508.8	13921.5	3144.6	4167.7
Treated FWM Outflow Conc	ppb	88.5	16.6	86.7	16.5	138.7	32.0	26.0
Total Outflow Volume	hm3/yr	32.6	30.9	32.6	30.8	100.3	98.4	160.1
Total Outflow Load	kg/yr	2889.4	514.3	2831.6	508.8	13921.5	3144.6	4167.7
Total FWM Outflow Conc	ppb	88.5	16.6	86.7	16.5	138.7	32.0	26.0
Bypass Volume	hm3/yr	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bypass Load	kg/yr	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 13. DMSTA Summary for Full Build-out of STA-6, Using SAV_C4.

DMSTA Input Values

Input Variable	Units	Value
Design Case Name	-	NEW11
Starting Date for Simulation	-	05/01/65
Ending Date for Simulation	-	04/30/03
Starting Date for Output	-	05/01/65
Steps Per Day	-	3
Number of Iterations	-	2
Output Averaging Interval	days	7
Reservoir H2O Residence Time	days	0
Max Inflow / Mean Inflow	-	0
Max Reservoir Storage	hm3	0
Reservoir P Decay Rate	1/yr/ppb	0
Rainfall P Conc	ppb	10
Atmospheric P Load (Dry)	mg/m2-yr	20

Case Description: **Filename:** **6 NEW 1_Data rev.xls**

Existing, use calibration data sets from Walker; new - EMERG and SAV_C4
720 acres in Cell 1
C139 Annex only
proportional loading

Output Variable	Units	Value
Water Balance Error	%	0.0%
Mass Balance Error	%	-0.1%
Flow-Wtd Conc - With Bypass	ppb	9.9
Flow-Wtd Conc - Without Bypass	ppb	9.9
Geometric Mean Conc	ppb	7.6
95th Percentile Conc	ppb	12.5
Freq Cell Outflow > 10 ppb	%	12%
Bypass Load	%	0.0%

Cell Number -->		1	2	3	4	5	6
Cell Label	-	3	5	1	2	4	
Vegetation Type	------->	STA6_3	STA6_5	EMERG	SAV_C4	SAV_C4	
Inflow Fraction	-	0.082380632	0.210154674	0.707464694	0	0	
Downstream Cell Number	-	0	0	4	5	0	
Surface Area	km2	0.992	2.530	2.915	1.868	3.735	
Mean Width of Flow Path	km	0.61	1.31	1.60	2.34	2.32	
Number of Tanks in Series	-	3	3	3	3	3	
Outflow Control Depth	cm	40	40	40	40	60	
Outflow Coefficient - Exponent	-	4	4	1.67	1.67	1.67	
Outflow Coefficient - Intercept	-	0.5	0.9	0.2	0.18	0.2	
Bypass Depth	cm	0	0	0	0	0	
Maximum Inflow	hm3/day	0	0	0	0	0	
Maximum Outflow	hm3/day	0	0	0	0	0	
Inflow Seepage Rate	(cm/d) / cm	0	0	0	0	0	
Inflow Seepage Control Elev	cm	0	0	0	0	0	
Inflow Seepage Conc	ppb	20	20	20	20	20	
Outflow Seepage Rate	(cm/d) / cm	0	0	0	0.0059	0.0017	
Outflow Seepage Control Elev	cm	0	0	0	-46	-46	
Max Outflow Seepage Conc	ppb	20	20	20	20	20	
Seepage Recycle Fraction	-	0	0	0	0.5	0.5	
Seepage Discharge Fraction	-	0	0	0	0	0	
Initial Water Column Conc	ppb	30	30	30	30	30	
Initial P Storage Per Unit Area	mg/m2	500	500	500	500	500	
Initial Water Column Depth	cm	50	50	50	50	50	
C0 = WC Conc at 0 g/m2 P Storage	ppb	*2*	*2*	*4*	*4*	*4*	
C1 = WC Conc at 1 g/m2 P storage	ppb	*22*	*22*	*22*	*22*	*22*	
K = Net Settling Rate at Steady State	m/yr	*39*	*26*	*15.66*	*80.10*	*80.10*	
Zx = Depth Scale Factor	cm	*60*	*60*	*60*	*60*	*60*	
C0 - Periphyton	ppb	*0*	*0*	*0*	*0*	*0*	
C1 - Periphyton	ppb	*0*	*0*	*0*	*0*	*0*	
K - Periphyton	1/yr	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	
Zx - Periphyton	cm	*0*	*0*	*0*	*0*	*0*	
Sm = Transition Storage Midpoint	mg/m2	*0*	*0*	*0*	*0*	*0*	
Sb = Transition Storage Bandwidth	mg/m2	*0*	*0*	*0*	*0*	*0*	

Output Variables	Units	1	2	3	4	5	6	Overall
Execution Time	seconds/yr	1.61	3.11	4.61	6.13	7.63		7.63
Run Date	-	07/11/04	07/11/04	07/11/04	07/11/04	07/11/04		07/11/04
Starting Date for Simulation	-	05/01/65	05/01/65	05/01/65	05/01/65	05/01/65		05/01/65
Starting Date for Output	-	05/01/65	05/01/65	05/01/65	05/01/65	05/01/65		05/01/65
Ending Date	-	04/30/03	04/30/03	04/30/03	04/30/03	04/30/03		04/30/03
Output Duration	days	13879	13879	13879	13879	13879		13879
Cell Label		3	5	1	2	4		Total Outflow
Downstream Cell Label		Outflow	Outflow	2	4	Outflow		-
Surface Area	km2	0.992	2.530364372	2.914979757	1.867746289	3.735492578		12.0
Mean Water Load	cm/d	1.0	1.0	3.0	4.6	2.2		1.0
Max Water Load	cm/d	10.9	10.9	31.9	51.1	25.3		10.9
Inflow Volume	hm3/yr	3.7	9.4	31.5	31.4	29.8		44.6
Inflow Load	kg/yr	382.6	975.9	3285.4	1417.1	443.3		4643.9
Inflow Conc	ppb	104.2	104.2	104.2	45.1	14.9		104.2
Treated Outflow Volume	hm3/yr	3.6	9.3	31.4	29.8	28.6		41.5
Treated Outflow Load	kg/yr	30.3	114.4	1417.1	443.3	265.1		409.9
Treated FWM Outflow Conc	ppb	8.4	12.3	45.1	14.9	9.3		9.9
Total Outflow Volume	hm3/yr	3.6	9.3	31.4	29.8	28.6	33648.8	41.5
Total Outflow Load	kg/yr	30.3	114.4	1417.1	443.3	265.1		409.9
Total FWM Outflow Conc	ppb	8.4	12.3	45.1	14.9	9.3		9.9
Bypass Volume	hm3/yr	0.00	0.00	0.00	0.00	0.00		0.00
Bypass Load	kg/yr	0.00	0.00	0.00	0.00	0.00		0.00

Table 14. DMSTA Summary for Full Build-out of STA-6, Using NEWS_2.

DMSTA Input Values

Input Variable	Units	Value
Design Case Name	-	NEW10
Starting Date for Simulation	-	05/01/65
Ending Date for Simulation	-	04/30/03
Starting Date for Output	-	05/01/65
Steps Per Day	-	3
Number of Iterations	-	2
Output Averaging Interval	days	7
Reservoir H2O Residence Time	days	0
Max Inflow / Mean Inflow	-	0
Max Reservoir Storage	hm3	0
Reservoir P Decay Rate	1/yr/ppb	0
Rainfall P Conc	ppb	10
Atmospheric P Load (Dry)	mg/m2-yr	20

Case Description: **Filename:** **6 NEW 1_Data rev.xls**

Existing, use calibration data sets from Walker; new - EMERG and NEWS_2
720 acres in Cell 1
C139 Annex only
proportional loading

Output Variable	Units	Value
Water Balance Error	%	0.0%
Mass Balance Error	%	-0.1%
Flow-Wtd Conc - With Bypass	ppb	12.0
Flow-Wtd Conc - Without Bypass	ppb	12.0
Geometric Mean Conc	ppb	8.7
95th Percentile Conc	ppb	15.8
Freq Cell Outflow > 10 ppb	%	27%
Bypass Load	%	0.0%

Cell Number -->		1	2	3	4	5	6
Cell Label	-	3	5	1	2	4	
Vegetation Type	------->	STA6_3	STA6_5	EMERG	NEWS_2	NEWS_2	
Inflow Fraction	-	0.082380632	0.210154674	0.707464694	0	0	
Downstream Cell Number	-	0	0	4	5	0	
Surface Area	km2	0.992	2.530	2.915	1.868	3.735	
Mean Width of Flow Path	km	0.61	1.31	1.60	2.34	2.32	
Number of Tanks in Series	-	3	3	3	3	3	
Outflow Control Depth	cm	40	40	40	40	60	
Outflow Coefficient - Exponent	-	4	4	1.67	1.67	1.67	
Outflow Coefficient - Intercept	-	0.5	0.9	0.2	0.18	0.2	
Bypass Depth	cm	0	0	0	0	0	
Maximum Inflow	hm3/day	0	0	0	0	0	
Maximum Outflow	hm3/day	0	0	0	0	0	
Inflow Seepage Rate	(cm/d) / cm	0	0	0	0	0	
Inflow Seepage Control Elev	cm	0	0	0	0	0	
Inflow Seepage Conc	ppb	20	20	20	20	20	
Outflow Seepage Rate	(cm/d) / cm	0	0	0	0.0059	0.0017	
Outflow Seepage Control Elev	cm	0	0	0	-46	-46	
Max Outflow Seepage Conc	ppb	20	20	20	20	20	
Seepage Recycle Fraction	-	0	0	0	0.5	0.5	
Seepage Discharge Fraction	-	0	0	0	0	0	
Initial Water Column Conc	ppb	30	30	30	30	30	
Initial P Storage Per Unit Area	mg/m2	500	500	500	500	500	
Initial Water Column Depth	cm	50	50	50	50	50	
C0 = WC Conc at 0 g/m2 P Storage	ppb	*2*	*2*	*4*	*8*	*8*	
C1 = WC Conc at 1 g/m2 P storage	ppb	*22*	*22*	*22*	*22*	*22*	
K = Net Settling Rate at Steady State	m/yr	*39*	*26*	*15.66*	*90.40*	*90.40*	
Zx = Depth Scale Factor	cm	*60*	*60*	*60*	*60*	*60*	
C0 - Periphyton	ppb	*0*	*0*	*0*	*4*	*4*	
C1 - Periphyton	ppb	*0*	*0*	*0*	*22*	*22*	
K - Periphyton	1/yr	*0.00*	*0.00*	*0.00*	*31.30*	*31.30*	
Zx - Periphyton	cm	*0*	*0*	*0*	*0*	*0*	
Sm = Transition Storage Midpoint	mg/m2	*0*	*0*	*0*	*400*	*400*	
Sb = Transition Storage Bandwidth	mg/m2	*0*	*0*	*0*	*80*	*80*	

Output Variables	Units	1	2	3	4	5	6	Overall
Execution Time	seconds/yr	1.58	3.08	4.58	6.11	7.66		7.66
Run Date	-	07/11/04	07/11/04	07/11/04	07/11/04	07/11/04		07/11/04
Starting Date for Simulation	-	05/01/65	05/01/65	05/01/65	05/01/65	05/01/65		05/01/65
Starting Date for Output	-	05/01/65	05/01/65	05/01/65	05/01/65	05/01/65		05/01/65
Ending Date	-	04/30/03	04/30/03	04/30/03	04/30/03	04/30/03		04/30/03
Output Duration	days	13879	13879	13879	13879	13879		13879
Cell Label		3	5	1	2	4		Total Outflow
Downstream Cell Label		Outflow	Outflow	2	4	Outflow		-
Surface Area	km2	0.992	2.530364372	2.914979757	1.867746289	3.735492578		12.0
Mean Water Load	cm/d	1.0	1.0	3.0	4.6	2.2		1.0
Max Water Load	cm/d	10.9	10.9	31.9	51.1	25.3		10.9
Inflow Volume	hm3/yr	3.7	9.4	31.5	31.4	29.8		44.6
Inflow Load	kg/yr	382.6	975.9	3285.4	1417.1	595.0		4643.9
Inflow Conc	ppb	104.2	104.2	104.2	45.1	20.0		104.2
Treated Outflow Volume	hm3/yr	3.6	9.3	31.4	29.8	28.6	33648.8	41.5
Treated Outflow Load	kg/yr	30.3	114.4	1417.1	595.0	351.3		496.1
Treated FWM Outflow Conc	ppb	8.4	12.3	45.1	20.0	12.3		12.0
Total Outflow Volume	hm3/yr	3.6	9.3	31.4	29.8	28.6		41.5
Total Outflow Load	kg/yr	30.3	114.4	1417.1	595.0	351.3		496.1
Total FWM Outflow Conc	ppb	8.4	12.3	45.1	20.0	12.3		12.0
Bypass Volume	hm3/yr	0.00	0.00	0.00	0.00	0.00		0.00
Bypass Load	kg/yr	0.00	0.00	0.00	0.00	0.00		0.00

3.0 Summary

A summary of the projected performance of the expanded treatment areas is provided in Table 15. Copies of all data sets and DMSTA modeling results are available upon request.

Table 15. Summary Of Phosphorus Reduction Projections

STA	Est. Ave. Annual Discharge		Estimated TP Concentrations	
	Outflow (ac ft/yr)	TP Load (kg/yr)	Flow-weighted Mean (ppb)	Geometric Mean (ppb)
STA-2				
LTP	222,600	4.59 – 7.52	17 - 28	10 - 14
Expanded	236,042	3.79 – 4.38	13 - 15	10 - 12
STA-5				
LTP	125,500	3.03 – 4.55	20 - 30	10 - 13
Expanded	129,536	2.43 – 3.48	15 - 22	10 - 12
STA-6				
LTP	35,100	0.75 – 1.06	17 - 24	10 - 13
This Analysis	39,431	0.57 – 0.66	12 - 14	10 - 11
Full-build out of Comp. C				
STA-5	132,134	1.81 – 2.57	12 - 17	10
STA-6	33,649	0.41 – 0.50	10 - 12	10

Note: STA-2 and STA-6 Section 1 enhancements were not simulated.