FIVE-YEAR SUMMARY OF OPERATIONS AFFECTING WCA-1

Prepared for the South Florida Water Management District
By Gary Goforth, P.E., Ph.D.

1.0 EXECUTIVE SUMMARY

At the May 23, 2006, TOC meeting, members requested an examination of the water management operations affecting Water Conservation Area 1 (WCA-1) for WY2002-2006, with a focus on changes that may have occurred in WY2006. This request follows the May and June 2005 TOC discussions, four action items relating to water management practices and water quality in WCA-1, and the August 16, 2005, "Recommendations to Principals for Water Management Activities Relating to Water Quality". Of the four action items, the South Florida Water Management District (District) had the lead on one action item (evaluation of more frequent monitoring), which resulted in an analysis, subsequent discussion by the TOC and a recommendation for additional sampling. Staff of the A.R.M. Loxahatchee National Wildlife Refuge (Refuge) and the U. S. Army Corps of Engineers (Corps) had the lead for the remaining three action items:

1. improved coordination of inflow pump and outflow gate operations,
2. delay stage rise until after wet-season rain on Refuge begins, and
3. re-distribution of flows through the S-10 gates.

No follow-up feasibility analyses have been presented to the TOC on these three action items.

In response to the most recent request by the TOC, summaries of the various operational and hydrologic components affecting WCA-1, along with hydrologic and total phosphorus attributes of WCA-1 were compiled for the period May 1, 2001 through April 30, 2006. The primary operations affecting WCA-1 include

1. the introduction of treated stormwater from STA-1W and STA-1E,
2. the introduction of untreated stormwater from the Village of Wellington Acme Basin B,
3. the introduction of treated Lake Okeechobee releases for water supply and regulatory releases, although the latter operation was terminated in February 2003,
4. the introduction of untreated stormwater that exceeded the capacity of the STAs,
5. the introduction of water preceding water supply withdrawals from WCA-1, when the stage of Lake Okeechobee is above WCA-1 or within 1 foot of the stage of WCA-1,
6. the withdrawal of water to meet downstream water supply demands,
7. the release of water when the WCA-1 stage was above its flood regulation schedule, and
8. other releases of water when the WCA-1 stage was below its flood regulation schedule.

For WY2002-2006, structure inflows averaged approximately 405,000 AF/yr, approximately 30% less than the long-term (WY1978-2005) average. For WY2006, the total surface inflow was approximately 252,000 AF, less than half the long-term average annual flows. For WY2002-2006, structure outflows averaged approximately 357,000 AF/yr, approximately 30% less than the long-term average. For WY2006, the total surface outflow was approximately 207,000 AF, less than half the long-term average annual flows. Operations in WY2006 were driven largely by the reduced inflows. While the phosphorus dynamics of the interior marsh is very complex, because of the reduced inflows in WY2006, the interior marsh water levels and phosphorus concentrations were likely dominated more by rainfall-driven dynamics and local phenomena as opposed to external dynamics. There were two changes to water management operations during WY2006, however, they may not have influenced marsh phosphorus levels due to the reduced potential for penetration that existed as a result of the reduced inflows. STA-1E discharged for the second year, and as a result the water levels in the eastern perimeter canals will continue to be higher than in previous years. A reference elevation discrepancy was identified at the canal gage 1-8C which is used for establishing Consent Decree compliance levels for the Refuge, and elevations of the associated gages should be re-surveyed. During WY2006, the Corps of Engineers released over 45,000 AF of water through the S-10 structures to WCA-2A when the WCA-1 stage was below the regulatory release zones; these discharges were in anticipation of potential hurricane-related inflows. The WY2006 magnitude was more than twice the average for the prior four years and reflects the extremely active 2005 hurricane season. It is possible during some years that S-10 discharges in anticipation of storm-related inflows may inadvertently result in higher phosphorus loads to WCA-2A directly, and to WCA-1 indirectly, if hydrologic conditions occur during the subsequent dry season that require deliveries to WCA-1 per the regulation schedule. A temporary deviation to the WCA-1 regulation schedule governing inflow requirements under certain conditions did not affect operations, as the triggering conditions did not materialize.

It is hoped that this analysis will assist the TOC in their efforts, and provide information for the Refuge and Corps to use in their subsequent feasibility analyses associated with the action items stemming from the 2005 TOC discussions.

2.0 OPERATIONS AFFECTING WCA-1

More than a dozen water control structures allow surface inflows to and withdrawals from Water Conservation Area 1 (WCA-1, **Figure 1**). While the majority are operated by the District (G-300, G-301, G-251, G-310, S-362 and S-39), several are operated by the Corps (S-10A, S-10C & S-10D), and a few are operated by the Lake Worth Drainage District (G-94A-D) and the Village of Wellington (ACME1 and ACME2). These structures are operated for multiple water resource purposes, including flood protection for upstream basins, water supply withdrawals for municipal well fields and agricultural demands, releases of water when the WCA-1 stage is above its regulation schedule (**Figure 2**), and prior to February 2003, for movement of regulatory releases from Lake Okeechobee. Other smaller scale operations assist in water management of the Stormwater Treatment Areas (STAs) and other regional activities. In addition to structural operations, the hydrology of WCA-1 is affected significantly by direct precipitation, evapotranspiration and seepage losses to adjacent areas. For most of the year, the hydrology of WCA-1 is primarily rainfall-driven, with limited interaction between the interior marsh and the perimeter canals (L-7, L-40 and Hillsboro Canal). Summaries of the various operation and hydrologic components affecting WCA-1, along with hydrologic and total phosphorus attributes of WCA-1 were compiled for the period May 1, 2001 through April 30, 2006, and are discussed below. An overall 5-yr summary is presented in **Figure 3 and 4** and **Table 1**. The DBHydro dbkeys used in this analysis are presented in **Attachment 1**.

2.1 INFLOWS

For the five water years 2002-2006, surface inflows totaling approximately 2,000,000 AF entered WCA-1, with an annual average of approximately 405,000 AF/yr. **(Figure 5 and Table 2**). For WY2006, the total surface inflow was 252,197 AF, significantly lower than the 5-year average. Individual inflow components are discussed below.

2.1.1 STA Discharges. STA-1E and STA-1W capture and treat stormwater from upstream basins (EAA, C-51W, L-8). In addition, prior to February 2003, regulatory releases from Lake Okeechobee were treated in STA-1W. In addition, limited amounts of Lake water have been delivered to the STAs in accordance with the WCA-1 regulation schedule requiring inflows preceding water supply withdrawals under certain conditions. A temporary deviation from this “preceding deliveries” requirement was requested by the District in January 2005 and approved by the Corps, however the trigger conditions were not achieved, resulting in no impact from this deviation (see **Attachment 2** for a thorough description of the temporary deviation by Susan Sylvester). A renewal of this deviation is underway. The hurricanes of September 2004 necessitated extreme operations to ensure upstream flood protection. Operations associated with the 2005 hurricane were not as extreme, however, the treatment performance of the STAs were adversely impacted. STA operations are also periodically affected by performance enhancements. Currently, two flow-ways of STA-1W and one flow-way in STA-1E are off-line due to enhancement activities. The 5-year annual average discharge from these combined STAs for the period WY2002-2006 was approximately 365,000 AF/yr. Of that, approximately 269,000 AF per year was treated stormwater, approximately 66,000 AF/yr was Lake Okeechobee regulatory releases (terminated in February 2003), and approximately 13,000 AF/yr in Lake releases to precede water supply withdrawals. For WY2006, approximately 194,000 AF of treated stormwater was discharged from the STAs, a significant reduction from prior years. The completion of a new divide structure (G-341) adjacent to STA-1W in 2005 was effective in providing additional operational flexibility for moving water among the S-5A (STA-1W) and S-6 (STA-2) basins. When closed, the structure prevents stormwater intended to go to STA-2 from being captured by the STA-1W inflow pumps. Between September 2005, the date records began for G-341, through April 2006, the structure was closed 46% of the time. The structure was opened to discharge approximately 29,000 AF of S-5A basin runoff to STA-2 between September 2005 through April 2006. This operation assisted to reduce inflows to STA-1W as Cell 5 was taken off-line. In addition, when desirable to relive flooding in the area immediately west of the structure, the structure was opened to move approximately 24,000 AF from the west to the West Palm Beach Canal. It is difficult to quantify the effect of the divide structure on STA-1W inflows as a result of 1 year’s operation; WY2006 inflows to STA-2 increased by approximately 24,400 AF (9%). Summaries of STA-1W and STA-1E flows, phosphorus loads and flow-weighted mean concentrations are presented in **Figures 6 and 7.**

STA outflow pumping durations. In order to minimize the hydraulic pulses entering the Refuge, the District's Operations staff utilizes a combination of remotely-operated small electric pumps and larger diesel powered units. Experience has shown that for most of the storm events passing through the STAs, the hydraulic restriction imposed by the vegetation limits the rate and duration of the outflow pumps. To assess whether there were significantly different operations during WY2006 than previous years, hourly breakpoint data were analyzed for both the STA-1W and STA-1E outflow pump stations. A summary of pumping duration characteristics are presented in **Table 3** below. **For STA-1W** the analysis indicates that the electric pumps at G-251 and G-310 generally ran for a duration of 1-2 days (based on the range between the 25th and 75th percentile of their cumulative distributions). Specifically in WY2006, the average pumping durations decreased from WY2005, a consequence of fewer hurricanes than the previous year, treatment flow-ways off-line, and overall reduced flow through STA-1W. For the larger diesel units at G-310, the pumps generally ran for a duration of 5-11 hours (based on the range between the 25th and 75th percentile of their cumulative distributions). During WY2006, the average pumping durations decreased slightly from WY2005, due primarily to the significant reduction in flows. The cumulative distribution of pump durations at G-310 is shown in **Figure 8**.

Pumping records for **STA-1E** are still undergoing initial QA/QC. This analysis on the preliminary data indicates that the electric pumps at S-362 generally ran for a duration of 1-2 days (based on the range between the 25th and 75th percentile of their cumulative distributions). For the diesel units at S-362, the pumps generally ran for a duration of 5-8 hours (based on the range between the 25th and 75th percentile of their cumulative distributions). During WY2006, the average pumping durations were almost identical to WY2005, when an Emergency Authorization for discharge was obtained to provide flooding relief from the 2004 hurricanes. STA-1E is still ramping up its flow-through volumes as the vegetation in the treatment cells mature, and outflow pump durations should increase as the flow-through volumes increase. Since operations began in September 2004, approximately 56,500 AF has been discharged through S-362, with flow occurring only 35% of the time. Refuge staff previously indicated that minimal to no adverse impacts to the marsh along the L-40 canal would occur at flow rates up to 550 cfs, and 90% of the time S-362 discharged at or below 550 cfs. On a volumetric basis, approximately 68% of the discharge volume occurred at a pumping rate below 550 cfs. Flow exceedance curves are shown in **Figure 9.**

2.1.2 G-300/G-301 Diversion. Prior to STA-1E becoming fully operational, excess stormwater flows from the S-5A pump station were diverted through the G-300 and G-301 structures. The 5-year average annual diversion was approximately 33,000 AF/yr. Diversions during WY2006 were approximately 47,000 AF, associated with several large storm events in June 2005, the hurricane in October 2005 and a large event in February 2006 which occurred while STA cells were off line. Summaries of G-300 and G-301 flows, phosphorus loads and flow-weighted mean concentrations are presented in **Figure 10.**

2.1.3 ACME. The Village of Wellington discharges stormwater into WCA-1 through their ACME pump stations. The 5-year average annual inflow from the ACME pumps was approximately 24,150 AF/yr. Inflows during WY2006 were approximately 27,000 AF.

Summaries of ACME flows, phosphorus loads and flow-weighted mean concentrations are presented in **Figure 11.**

2.1.4 Precipitation. The District Operations Division maintains a data base of average rainfall for the WCA-1 and WCA-2 basin. The 5-year average annual rainfall for this basin was approximately 577,000 AF/yr, corresponding to approximately 48.4 inches. Precipitation during WY2006 was approximately 574,000 AF. A summary of rainfall for the WY2002-2006 period is presented in **Figure 12.**

A summary of the cumulative inflows to WCA-1 is presented in **Figure 13.**

2.2 OUTFLOWS

Outflows from WCA-1 primarily comprise water supply withdrawals and regulatory releases, activated when the WCA-1 stage is above its regulation schedule (**Figure 2**). These components are discussed below. In addition, estimates of evapotranspiration and seepage are provided. Although these components are largely uncontrollable, and therefore not strictly "operations", their consideration may help understand the hydrologic effect of operations on WCA-1. An overall summary of WCA-1 outflows is provided in **Figure 14.**

2.2.1 Releases Through the S-10s and S-39. The U.S. Army Corps of Engineers (Corps) operates the S-10 structures, located at the boundary of WCA-1 and WCA-2A. The regulation schedule for WCA-1 contains specific provisions to discharge water through the S-10 and S-39 structures when the stage is in zones A1 or A2, and these are referred to as regulatory releases (see **Figure 2**). The 5-year average annual regulatory releases through these structures were approximately 227,000 AF/yr. WCA-1 regulatory releases during WY2006 were approximately 88,500 AF, approximately one-third of the average for the prior four years. Summaries of S-10 flows, phosphorus loads and flow-weighted mean concentrations are presented in **Figure 15.** In addition to regulatory releases, other discharges to WCA-2A were made at the S-10s 24 to 48 hours prior to the potential onset of hurricanes. During WY2006, the Corps of Engineers released over 45,000 AF of water through the S-10 structures to WCA-2A when the WCA-1 stage was below the A1 and A2 zones; these discharges were in anticipation of potential hurricane-related inflows. The WY2006 magnitude was more than twice the average for the prior four years and reflects the extremely active hurricane 2005 season. It is possible during some years that S-10 discharges in anticipation of storm-related inflows may inadvertently result in higher phosphorus loads to WCA-2A directly, and to WCA-1 indirectly, if hydrologic conditions occur during the subsequent dry season that require deliveries to WCA-1 per the regulation schedule.

The May 2005 DOI Briefing Paper presented to the TOC identified increasing the distribution of flows through the S-10 D structure as a possible operation to improve water quality in the Refuge (DOI 2005). Staff of the Refuge and Corps had the lead in further evaluating the feasibility of this re-distribution; it is not clear what if any progress has been made. **Figure 16** presents the distribution of flows through the S-10s. During WY2006, approximately 49% of the total S-10 discharges were routed through S-10 D, little changed from the average of 46% for the prior four water years.

The S-39 structure also is used to meet water supply demands of the Lower East Coast. The 5-year average annual water supply deliveries through S-39 were approximately 40,000 AF/yr. These releases during WY2006 were approximately 41,000 AF. Summaries of S-39 flows, phosphorus loads and flow-weighted mean concentrations are presented in **Figure 17.**

2.2.2 Withdrawals Through the G-300/-301 Structures. Periodic water supply and other withdrawals from WCA-1 are made through the G-300 and G-301 structures. The 5-year average annual water supply deliveries through G-300 and G-301 was approximately 21,000 AF/yr. These releases during WY2006 were approximately 134 AF. Summaries of G-300/G-301 withdrawal flows, phosphorus loads and flow-weighted mean concentrations are presented in **Figure 18.**

2.2.3 Water Supply Withdrawals to Lake Worth Drainage District. Withdrawals are also made to meet the water supply needs of the Lake Worth Drainage District (LWDD). These deliveries are made through the G-94 structures located on the eastern boundary of WCA-1. The 5-year average annual water supply deliveries through the G-94 structures was approximately 44,000 AF/yr. These releases during WY2006 were approximately 32,000 AF. Summaries of G-94 withdrawal flows, phosphorus loads and flow-weighted mean concentrations are presented in **Figure 19.**

2.2.4 Evapotranspiration. With the expansive surface area of WCA-1, the loss of water through evapotranspiration (ET) is a large component of the overall water budget. The District maintains an estimate of the Potential ET (PET), understood to be the maximum amount of water lost to the atmosphere due to the combined process of open water evaporation and plant transpiration under the daily meteorological conditions of solar radiation, humidity and wind. Generally, PET values can be applied without a correction factor to shallow freshwater marshes such as an STA that is continuously flooded (Abtew et al., 2006). However, these values require adjustment to take into account periods of time when the marsh surface is dry, as occurs in the northern portion of WCA-1 during the dry season. A correction factor of 0.8 was applied to the PET values to represent conditions in WCA-1. The 5-year average annual ET for WCA-1 was estimated at approximately 441,000 AF/yr, corresponding to approximately 37 inches. ET losses during WY2006 were estimated at approximately 441,000 AF. A summary of ET estimates for the WY2002-2006 period is presented in **Figure 20.**

2.2.5 Estimate of Seepage From WCA-1. A significant component of the water and phosphorus budgets for WCA-1 is the seepage leaving the conservation area. The water level in WCA-1 is maintained at or above the surrounding ground elevation, which induces the movement of water through the perimeter levees. Rates of seepage through the levees have been estimated at 1.18 – 3.53 cfs per mile of levee per foot of head (i.e., difference in water levels) across the levee (Burns and McDonnell 2000). An estimate of seepage was obtained by determining the daily difference between the water levels in the perimeter canals and an external reference elevation, and using this range of seepage rates multiplied by the length of the levees. This resulted in a range of estimated seepage between 176,000-518,000 acre feet per year. The lower (i.e., conservative) estimate of seepage is presented below. The lower estimate is approximately three times more than the net surface inflows to WCA-1, i.e., the difference between the structure inflows and the structure outflows, suggesting a contribution of excess rainfall from the interior marsh of WCA-1. Seepage losses carry phosphorus away from WCA-1. Assuming an average phosphorus concentration equal to the monthly flow-weighted mean of the structure outflows (37 ppb), and using the estimates of seepage losses above yield a conceptual estimate of between 8.1 and 23.9 metric tons of phosphorus lost from WCA-1 each year, further reducing the net retention within WCA-1. The stage stations used in the calculations are presented in **Table 3**. The 5-year average annual seepage for WCA-1 was estimated at approximately 176,000 AF/yr. Seepage losses during WY2006 were estimated at approximately 157,000 AF. A summary of canal stages and seepage estimates for the WY2002-2006 period is presented in **Figure 21.** Additional unquantifiable losses result from deep percolation to the underlying aquifer system.

Using the estimates of structure inflows, outflows, rainfall, ET, seepage and change in stage yielded an overall water balance for WCA-1 with an error term of approximately 8,500 AF/yr, with a range of -85,000 AF/yr to 74,000 AF/yr. In light of the sensitivity of the overall water budget to the correction factor applied to the PET term, the assumed seepage rate, and the inability to account for deep percolation, these estimates should be considered as approximations.

For most of the year, the hydrology of WCA-1 is primarily rainfall-driven, with limited interaction between the interior marsh and the perimeter canals (L-7, L-40 and Hillsboro Canal). Potential water movement between the marsh and the perimeter canals is a function of the respective hydraulic gradient. **Figure 22-23** present the difference in stage between the interior marsh, measured at the 1-7, 1-8T and 1-9 gages, and the eastern and western perimeter canals. The canal stages are sensitive to STA discharges, as is evidenced by generally higher stages in the western L-7 canal than in the eastern L-40 canal prior to operation of STA-1E. Gage 1-8C will likely have higher readings when STA-1E is discharging. In the analysis of canal stage data, it was discovered that there may be a datum bust at the 1-8C gage, as it appears to be reading too high relative to the other stations along the L-40 canal (G-300 tailwater, S-362 tailwater and S-39 headwater). Gage 1-8C is roughly halfway between G-300 and S-39, and intuitively the stage at 1-8C should be roughly halfway between the stage at G-300 and S-39. However, as shown in **Figure 24**, the stage at 1-8C is uniformly higher than the stage at G-300 by an average of approximately 0.3 ft. A comparison of the stages at G-300 an S-362 reveals very close agreement, suggesting that the gage at 1-8C is reading too high. It is recommended that the gage elevation datum be surveyed at each structure and appropriate revisions made to the records. If the 1-8C gage is biased to higher readings, erroneously low phosphorus compliance levels would result from the equations in Appendix B of the Consent Decree.

A summary of the cumulative outflows from WCA-1 is presented in **Figure 25**.

3.0 SUMMARY

A summary of individual and composite inflow to and outflows from WCA-1 are presented in Tables 4 through 6. For WY2002-2006, structure inflows averaged approximately 405,000 AF/yr, considerably less than the long-term (WY1978-2005) average of approximately 592,000 AF/yr (Abtew et al. 2006). For WY2002-2006, structure outflows averaged approximately 357,000 AF/yr, considerably less than the long-term average of approximately 534,000 AF/yr (Abtew et al. 2006). For WY2006, the total surface inflow was approximately 252,000 AF and the total surface outflow was approximately 207,000 AF; both of these volumes are less than half the long-term average flows.

Operations in WY2006 were driven largely by the reduced inflows. While the phosphorus dynamics of the interior marsh is very complex, because of the reduced inflows in WY2006, the interior marsh water levels and phosphorus concentrations were likely dominated more by rainfall-driven dynamics and local phenomena as opposed to external dynamics. There were two changes to water management operations during WY2006, however, they may not have influenced marsh phosphorus levels due to the reduced potential for penetration that existed as a result of the reduced inflows. STA-1E discharged for the second year, and as a result the water levels in the eastern perimeter canals will continue to be higher than in previous years. A reference elevation discrepancy was identified at the canal gage 1-8C which is used for establishing Consent Decree compliance levels for the Refuge, and elevations of the associated gages should be re-surveyed. During WY2006, the Corps of Engineers released over 45,000 AF of water through the S-10 structures to WCA-2A when the WCA-1 stage was below the regulatory release zones; these discharges were in anticipation of potential hurricane-related inflows. The WY2006 magnitude was more than twice the average for the prior four years and reflects the extremely active 2005 hurricane season. It is possible during some years that S-10 discharges in anticipation of storm-related inflows may inadvertently result in higher phosphorus loads to WCA-2A directly, and to WCA-1 indirectly, if hydrologic conditions occur during the subsequent dry season that require deliveries to WCA-1 per the regulation schedule. A temporary deviation to the WCA-1 regulation schedule governing inflow requirements under certain conditions did not affect operations, as the triggering conditions did not materialize.

For most of the year, the hydrology of WCA-1 is primarily rainfall-driven, with limited interaction between the interior marsh and the perimeter canals (L-7, L-40 and Hillsboro Canal). The influence of external operations on interior phosphorus concentrations is poorly understood, with minimal correlation to external loading (Goforth 2005). Monthly contour plots of water column total phosphorus concentrations within WCA-1 (displayed in **Figure 26)** demonstrate the relative independence of the interior marsh and the perimeter canals (Iricanin personal communication).

It is hoped that this analysis will assist the TOC in their efforts, and provide information for the Refuge and Corps to use in their subsequent feasibility analyses associated with the action items stemming from the 2005 TOC discussions.

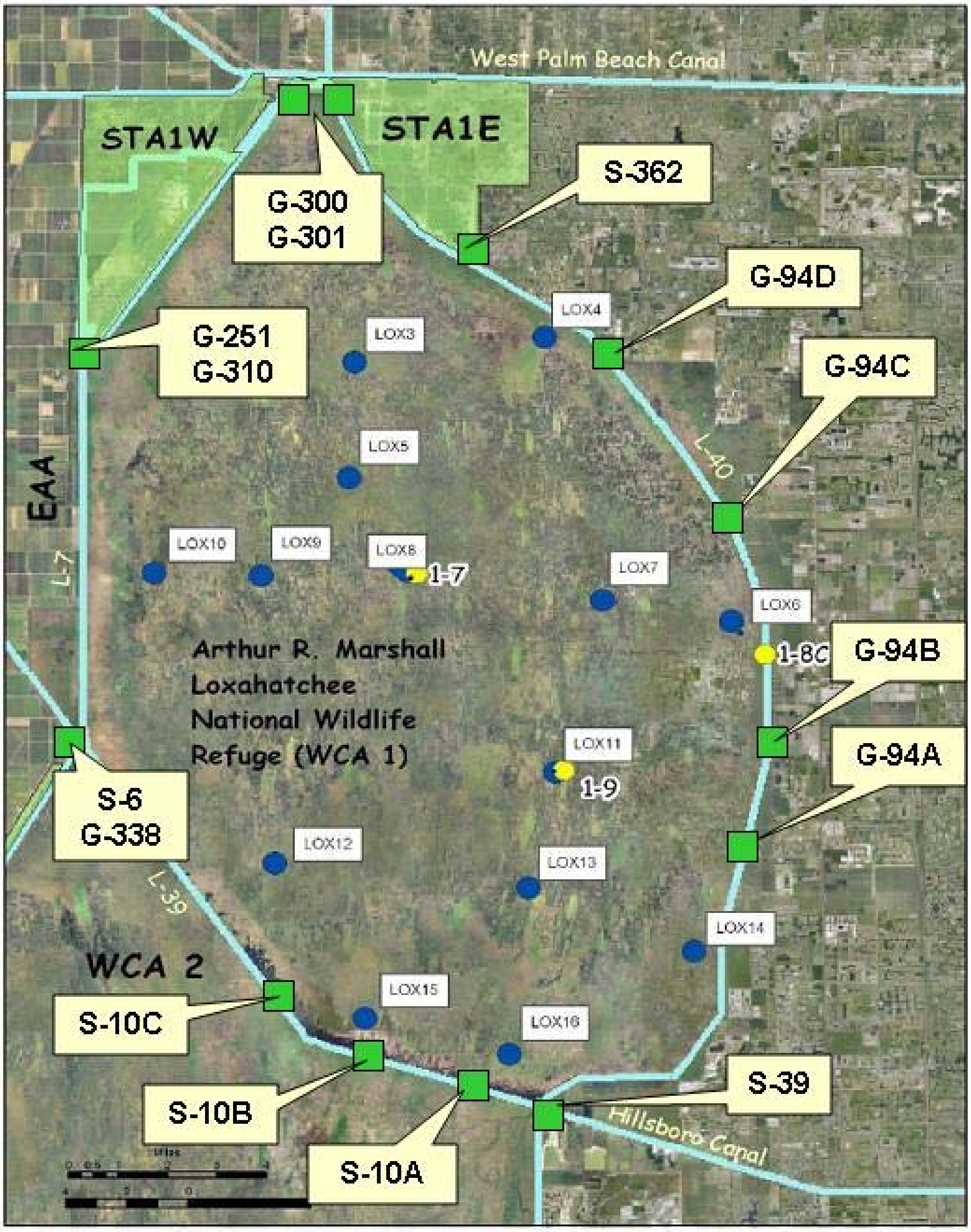
4.0 REFERENCES

Abtew, W., R. S. Huebner and V. Ciuca 2006. Hydrology of the South Florida Environment, Chapter 5 in the South Florida Environmental Report. March 2006.

DOI 2005. DOI-TOC Briefing Paper: Alternative Operational Strategies to Reduce Refuge Impacts. May 17, 2005.

Goforth, G. 2005. Expert Reports for Special Master Hearing. August 5, 2005 and August 15, 2005.

Figure 1. Map of WCA-1 Showing Water Control Structures.



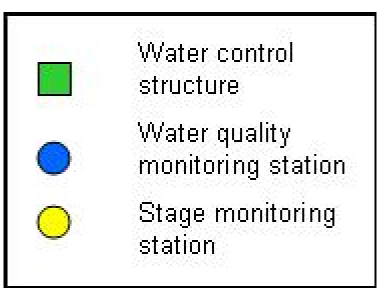
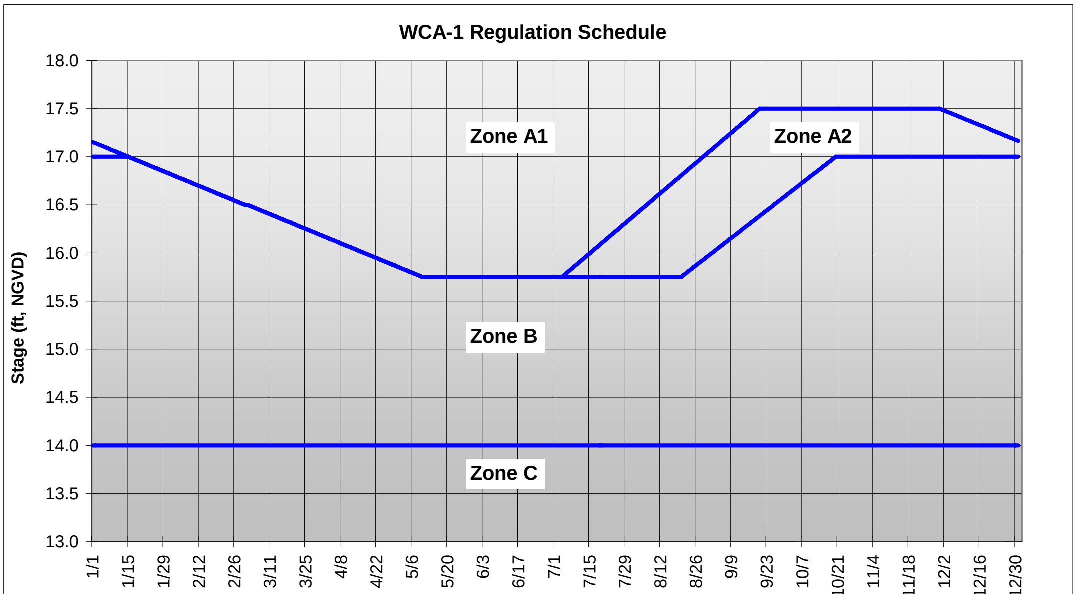


Figure 2. WCA-1 Regulation Schedule.



ZONE	RELEASES
A1	UP TO MAXIMUM AT S-10 (AND S-39 WHEN AGREED BETWEEN CORPS AND SFWMD). WATER SUPPLY RELEASES AS NEEDED.
A2	S-10 RELEASES BASED ON CORPS FORECASTS. WATER SUPPLY RELEASES AS NEEDED. IF LAKE OKEECHOBEE STAGE IS ABOVE WCA-1 STAGE OR NO MORE THAN ONE FOOT BELOW WCA-1 STAGE, THEN WATER SUPPLY RELEASES FROM WCA-1 MUST BE PRECEEDED BY AN EQUIVALENT VOLUME OF INFLOW.
B	WATER SUPPLY AS NEEDED. IF LAKE OKEECHOBEE STAGE IS ABOVE WCA-1 STAGE OR NO MORE THAN ONE FOOT BELOW WCA-1 STAGE, THEN WATER SUPPLY RELEASES FROM WCA-1 MUST BE PRECEEDED BY AN EQUIVALENT VOLUME OF INFLOW.
C	NO NET RELEASES FROM WCA-1. ANY WATER SUPPLY RELEASES MUST BE PRECEEDED BY AN EQUIVALENT VOLUME OF INFLOW.

DATES	USE GAGE	CONDITIONS
1 JAN - 30 JUN	1-8 CANAL	ALL
1 JUL - 31 DEC	1-8 CANAL	EXCEPT AS NOTED BELOW
	AVG. 1-7, 1-8T, 1-9	DURING RISING STAGES WHEN CANAL STAGE EXCEEDS AVERAGE.

CENTRAL AND SOUTHERN FLORIDA
INTERIM REGULATION SCHEDULE

WATER CONSERVATION AREA NO. 1

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA
DATED: 03 MAY 1995

Figure 3. Estimates of Average Flows for WY2002-2006

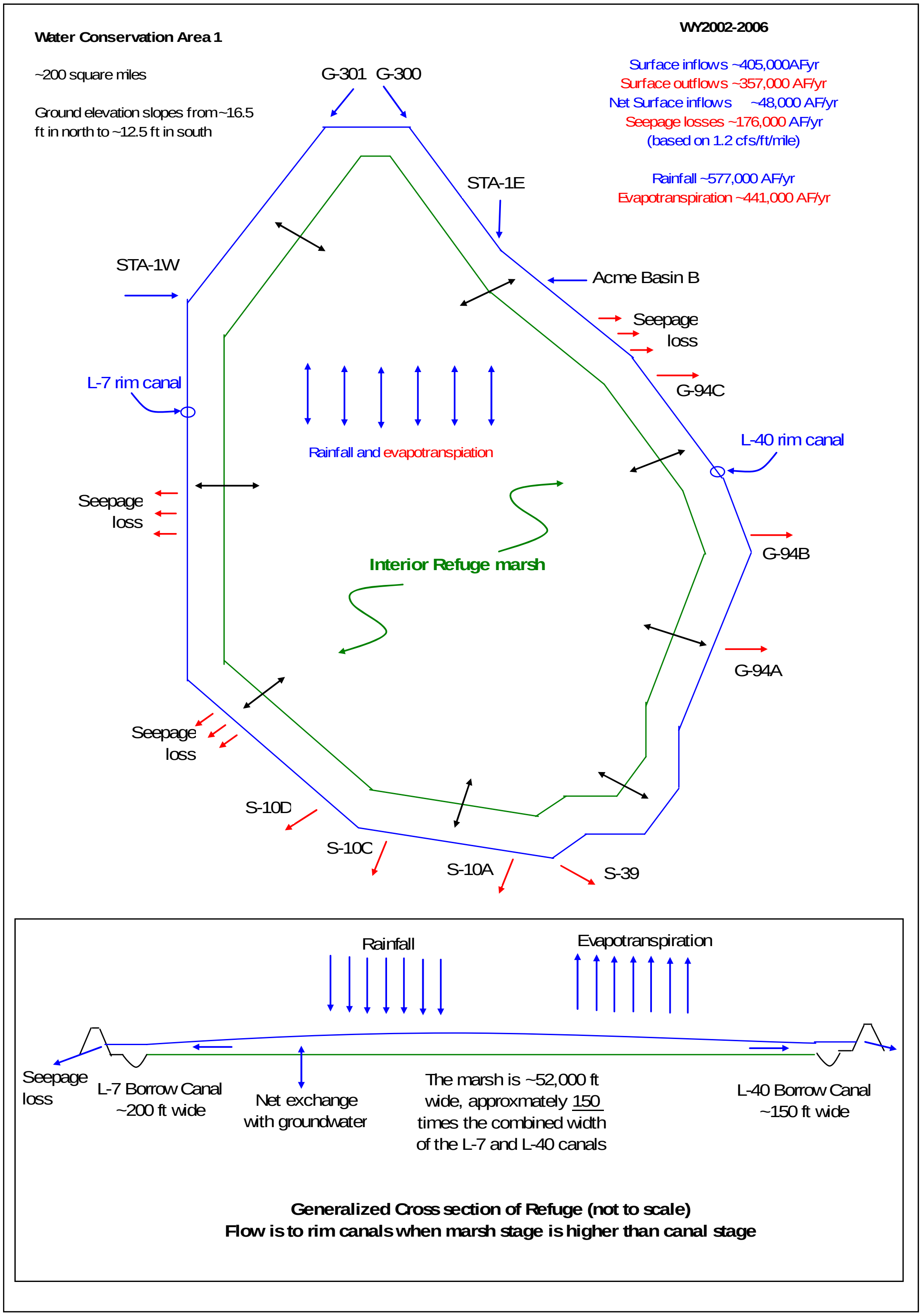
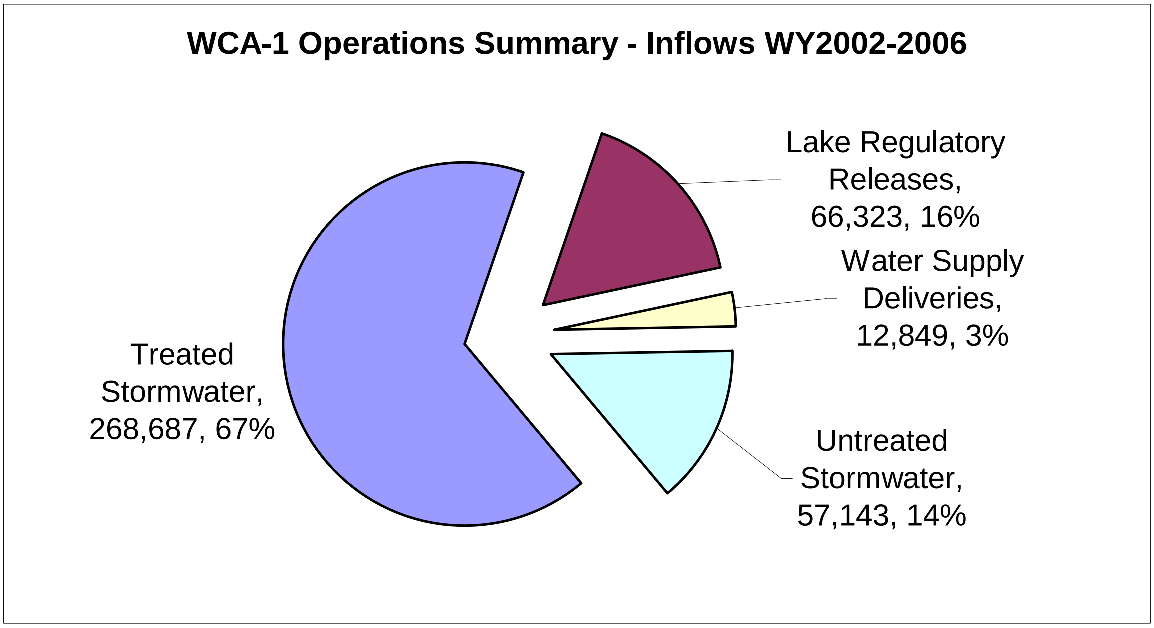
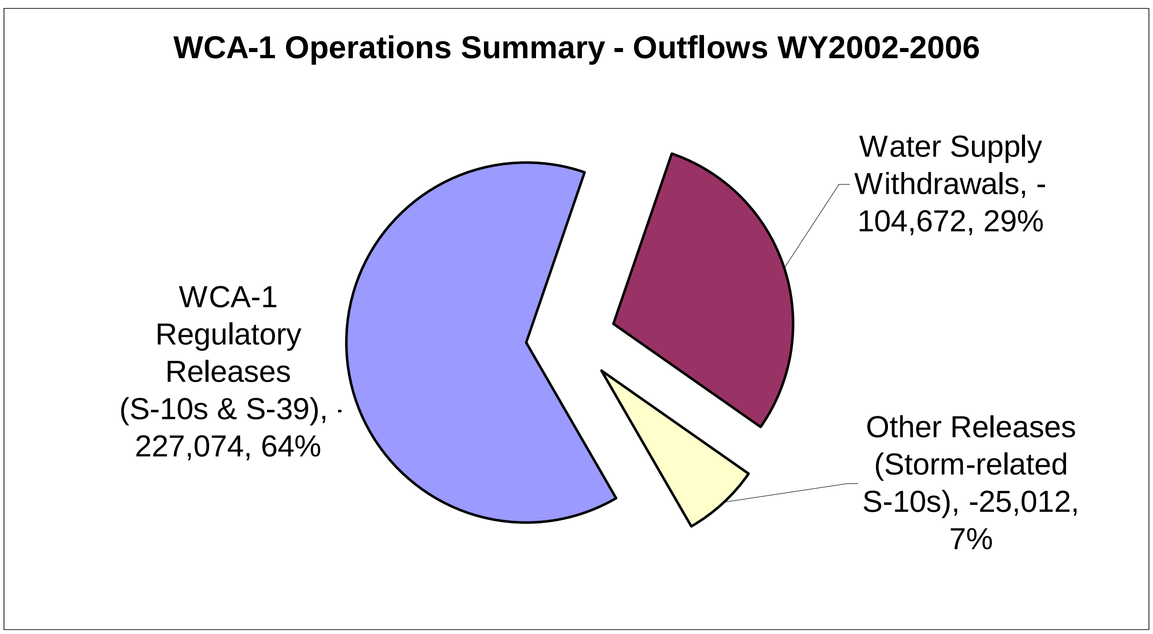


Figure 4. Overall Summary of WCA-1 Inflow and Outflow Operations.





FIVE-YEAR SUMMARY OF OPERATIONS AFFECTING WCA-1

Table 1. Summary of Operations Affecting WCA-1 for WY2002-2006.

Facility	Water Year	Treated Stormwater Inflows AF	Treated Lake Regulatory Releases AF	Water Supply Deliveries per Regulation Schedule AF	Untreated Stormwater Inflows AF	WCA-1 Regulatory Releases AF	Water Supply Withdrawals AF	Other (Primarily in Anticipation of Tropical Storms) AF	Net Flows AF
STA-1W									
	WY2002	265,078	2,547	0	0	0	0	0	267,624
	WY2003	266,932	329,067	0	0	0	0	0	595,999
	WY2004	251,981	0	45,622	0	0	0	0	297,603
	WY2005	365,062	0	18,600	0	0	0	0	383,662
	WY2006	137,890	0	0	0	0	0	0	137,890
	Total	**1,286,943**	**331,614**	**64,222**	**0**	**0**	**0**	**0**	**1,682,779**
	Ave. Annual	**257,389**	**66,323**	**12,844**	**0**	**0**	**0**	**0**	**336,556**
STA-1E									
	WY2002	0	0	0	0	0	0	0	0
	WY2003	0	0	0	0	0	0	0	0
	WY2004	0	0	0	0	0	0	0	0
	WY2005	15,921	0	0	0	0	0	0	15,921
	WY2006	40,572	0	0	0	0	0	0	40,572
	Total	**56,492**	**0**	**0**	**0**	**0**	**0**	**0**	**56,492**
	Ave. Annual	**11,298**	**0**	**0**	**0**	**0**	**0**	**0**	**28,246**
G-300/301									
	WY2002	0	0	0	14,913	0	-49,095	0	-34,181
	WY2003	0	0	0	11,651	0	-12,345	0	-695
	WY2004	0	0	25	22,531	0	-34,741	0	-12,185
	WY2005	0	0	0	69,064	0	-9,737	0	59,327
	WY2006	0	0	0	46,808	0	-134	0	46,674
	Total	**0**	**0**	**25**	**164,968**	**0**	**-106,053**	**0**	**58,940**
	Ave. Annual	**0**	**0**	**5**	**32,994**	**0**	**-21,211**	**0**	**11,788**
ACME									
	WY2002	0	0	0	33,953	0	0	0	33,953
	WY2003	0	0	0	18,290	0	0	0	18,290
	WY2004	0	0	0	19,890	0	0	0	19,890
	WY2005	0	0	0	21,688	0	0	0	21,688
	WY2006	0	0	0	26,928	0	0	0	26,928
	Total	**0**	**0**	**0**	**120,748**	**0**	**0**	**0**	**120,748**
	Ave. Annual	**0**	**0**	**0**	**24,150**	**0**	**0**	**0**	**24,150**
To LWDD via G-94s									
	WY2002	0	0	0	0	0	-28,059	0	-28,059
	WY2003	0	0	0	0	0	-76,542	0	-76,542
	WY2004	0	0	0	0	0	-32,528	0	-32,528
	WY2005	0	0	0	0	0	-49,963	0	-49,963
	WY2006	0	0	0	0	0	-31,739	0	-31,739
	Total	**0**	**0**	**0**	**0**	**0**	**-218,830**	**0**	**-218,830**
	Ave. Annual	**0**	**0**	**0**	**0**	**0**	**-43,766**	**0**	**-43,766**
To WCA-2A vis S-10s									
	WY2002	0	0	0	0	-159,759	0	0	-159,759
	WY2003	0	0	0	0	-201,188	0	-48,140	-249,328
	WY2004	0	0	0	0	-64,978	0	-12,289	-77,268
	WY2005	0	0	0	0	-280,187	0	-19,513	-299,700
	WY2006	0	0	0	0	-72,442	0	-45,120	-117,562
	Total	**0**	**0**	**0**	**0**	**-778,555**	**0**	**-125,062**	**-903,617**
	Ave. Annual	**0**	**0**	**0**	**0**	**-155,711**	**0**	**-25,012**	**-180,723**
S-39									
	WY2002	0	0	0	0	-76,242	-26,972	0	-103,214
	WY2003	0	0	0	0	-129,546	-77,315	0	-206,861
	WY2004	0	0	0	0	-119,410	-16,875	0	-136,284
	WY2005	0	0	0	0	-15,576	-36,252	0	-51,828
	WY2006	0	0	0	0	-16,042	-41,064	0	-57,106
	Total	**0**	**0**	**0**	**0**	**-356,816**	**-198,477**	**0**	**-555,293**
	Ave. Annual	**0**	**0**	**0**	**0**	**-71,363**	**-39,695**	**0**	**-111,059**
Total									
	WY2002	265,078	2,547	0	48,867	-236,000	-104,126	0	-23,635
	WY2003	266,932	329,067	0	29,940	-330,735	-166,202	-48,140	80,863
	WY2004	251,981	0	45,647	42,421	-184,388	-84,143	-12,289	59,228
	WY2005	380,983	0	18,600	90,752	-295,763	-95,951	-19,513	79,108
	WY2006	178,462	0	0	73,736	-88,484	-72,937	-45,120	45,656
	Total	**1,343,436**	**331,614**	**64,247**	**285,716**	**-1,135,371**	**-523,360**	**-125,062**	**241,220**
	WY2002-2005 Average	**291,243**	**82,903**	**16,062**	**52,995**	**-261,722**	**-112,606**	**-19,986**	**48,891**
	WY2002-2006 Average	**268,687**	**66,323**	**12,849**	**57,143**	**-227,074**	**-104,672**	**-25,012**	**48,244**

Figure 5. Summary of WCA-1 Inflows.

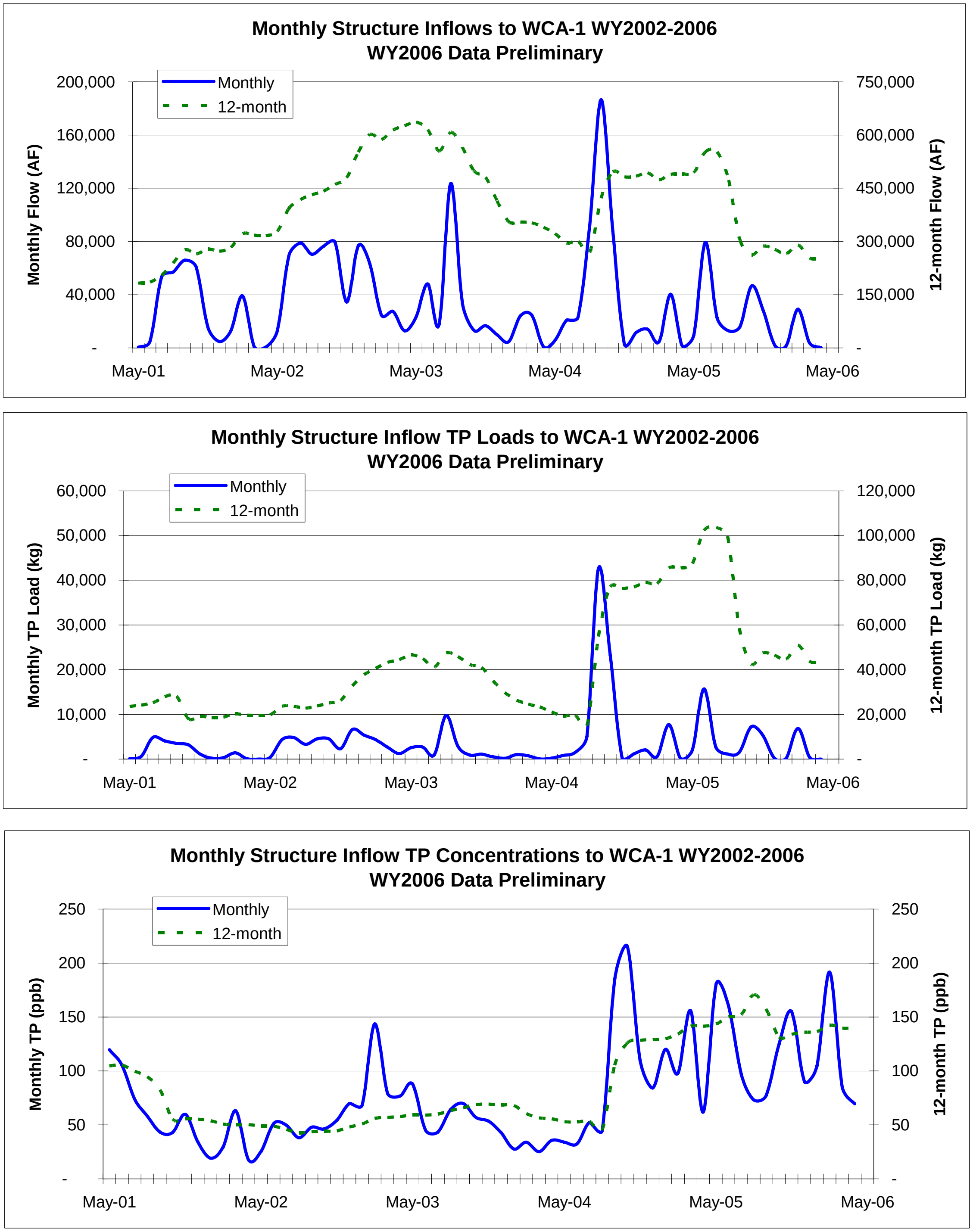
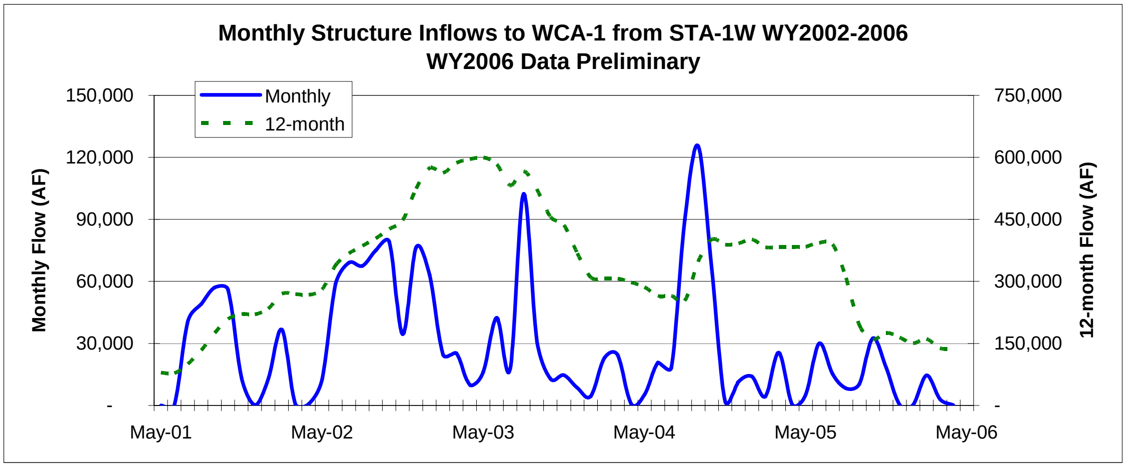
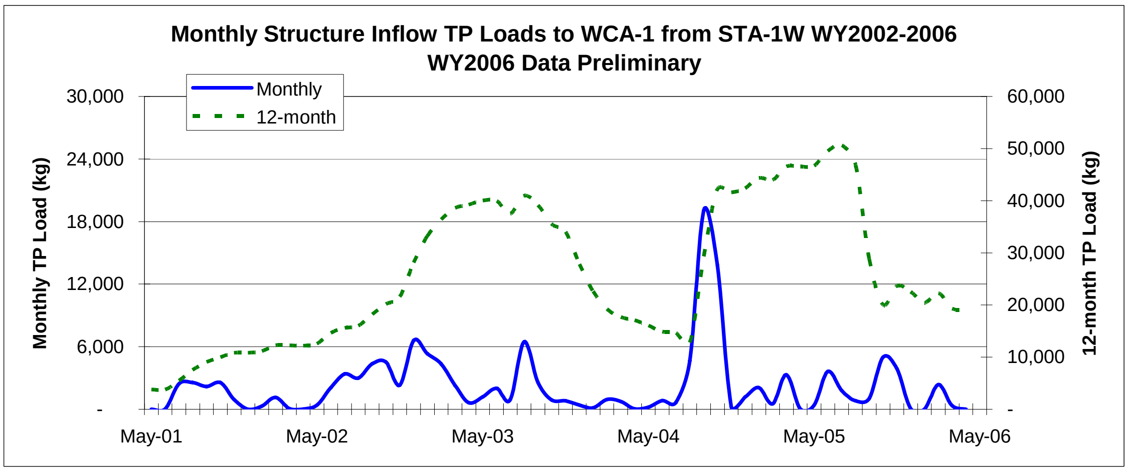


Table 2. Cumulative Inflows To and Outflows From WCA-1.

Structure	Cumulative Inflows AF	Cumulative Outflows AF	Cumulative Inflows kg	Cumulative Outflows kg
G-251	255,365	0	20,846	0
G-310	1,427,414	0	113,458	0
G-300	77,752	59,863	22,465	4,343
G-301	87,241	46,189	28,014	3,668
S-362	56,492	0	14,896	0
ACME1	61,147	0	6,684	0
ACME2	59,601	0	10,112	0
G-94C	0	142,476	0	6,036
G-94B	0	24,951	0	1,121
G-94A	0	51,403	0	1,930
S-10A	0	287,637	0	25,181
S-10C	0	260,899	0	8,907
S-10D	0	355,073	0	42,457
S-39	0	555,293	0	16,982
Structures	2,025,012	1,783,784	216,475	110,625
Annual Ave.	405,002	356,757	43,295	22,125
Rainfall	2,885,922	0	101,484	0
ET	0	2,206,512	0	0
Seepage	0	880,175	0	40,566
Deep percolation		?		?
Total	4,910,934	4,870,471	317,960	151,191
Annual Ave.	982,187	974,094	63,592	30,238

Figure 6. WY2002-2006 Inflows from STA-1W.





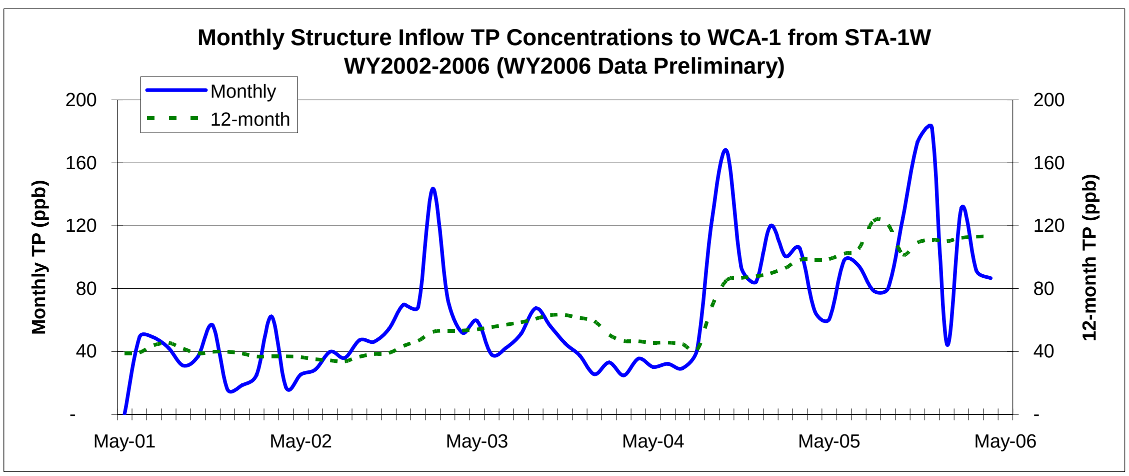
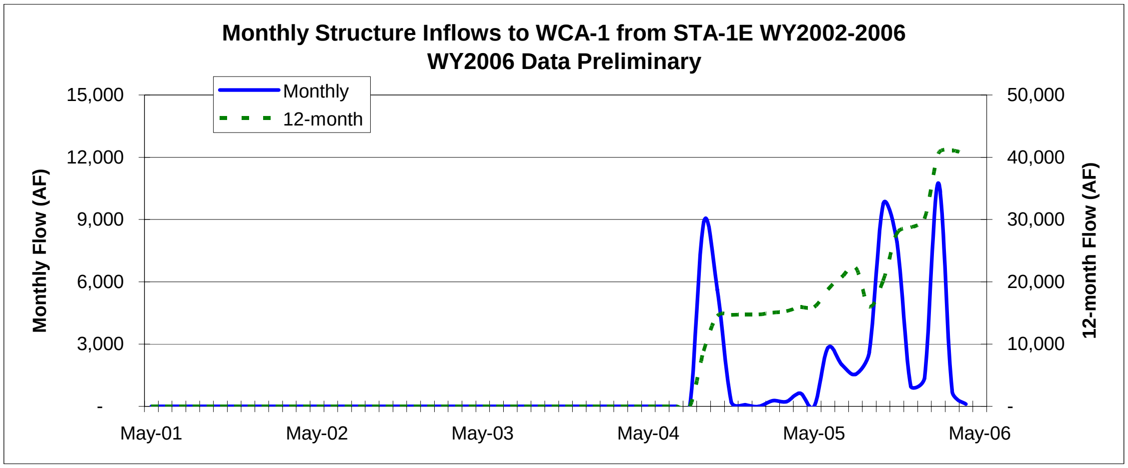
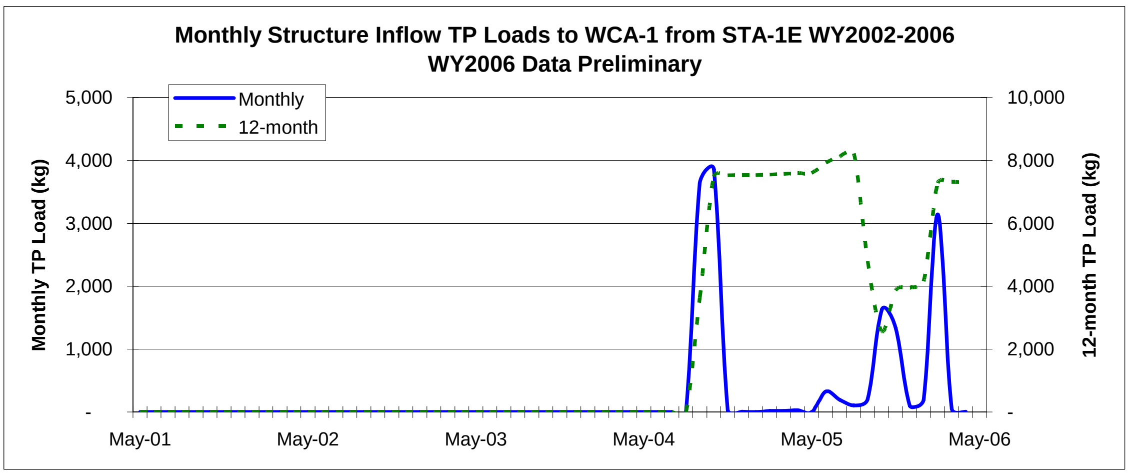


Figure 7. WY2002-2006 Inflows from STA-1E.





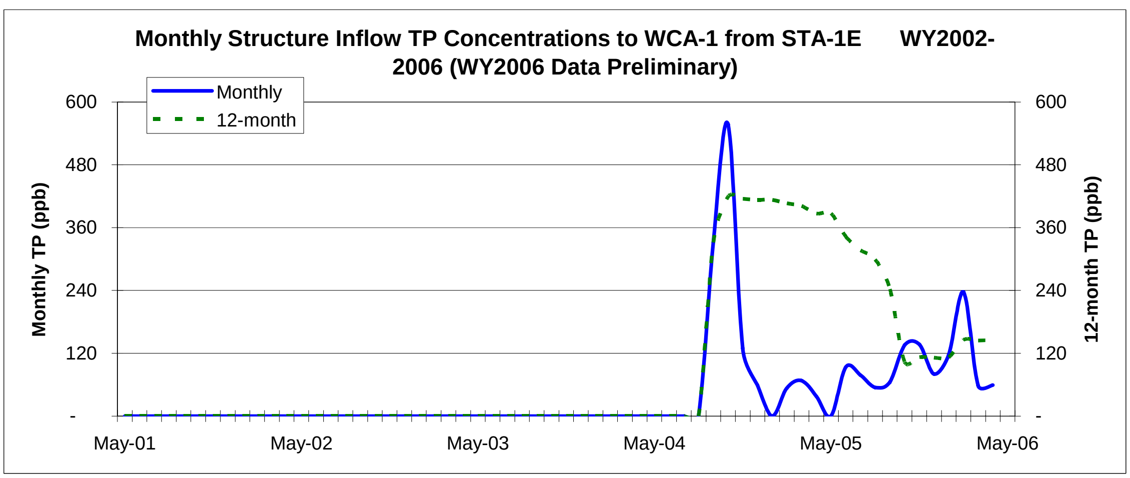
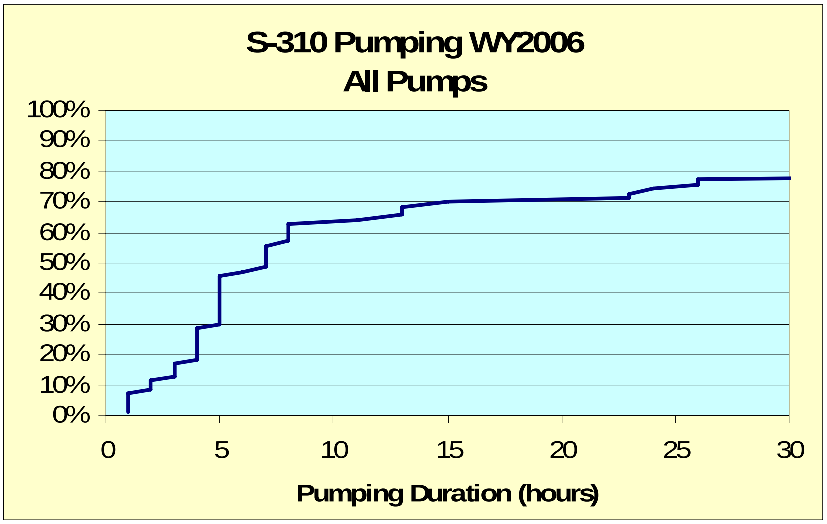


Table 3. STA-1E and STA-1W Outflow Pumping Durations (WY2006 Preliminary Data)

Pump	Water Year	# of Pumping Events	Average Duration Hours	25th %-ile Duration Hours	Median Duration Hours	75th %-ile Duration Hours	Maximum Duration Hours
G-251							
	2002	41	14.4	2.0	8.0	16.0	194
	2003	81	57.8	17.0	22.0	84.0	487
	2004	50	53.1	7.0	20.5	63.0	403
	2005	59	65.7	5.0	18.0	57.0	692
	2006	63	35.9	8.5	20.0	41.5	217
	Average	59	45.4	7.9	17.7	52.3	399
G-310 - all pumps							
	2002	65	50.4	5.0	7.0	11.0	734
	2003	100	57.4	7.0	13.0	32.0	938
	2004	94	38.7	7.0	9.0	18.5	777
	2005	53	82.6	5.0	24.0	74.0	586
	2006	70	44.3	4.0	7.0	25.5	705
	Average	76	54.7	5.6	12.0	32.2	748
G-310 - large pumps							
	2002	40	14.0	2.0	6.0	8.3	104
	2003	183	17.2	8.0	11.0	14.5	287
	2004	71	28.6	7.0	8.0	12.0	489
	2005	56	35.6	6.0	8.0	12.0	421
	2006	72	18.0	4.8	7.0	8.0	231
	Average	84	22.7	5.6	8.0	11.0	306
S-362 - all pumps							
	2005	24	75.3	5.0	28.0	62.8	586
	2006	70	44.3	4.0	7.0	25.5	705
	Average	47	59.8	4.5	17.5	44.1	646
S-362 - large pumps							
	2005	23	26.2	5.0	7.0	8.0	405
	2006	72	18.0	4.8	7.0	8.0	231
	Average	48	22.1	4.9	7.0	8.0	318

Figure 8. Pumping Durations at STA-1W Outflow Pump Station G-310.



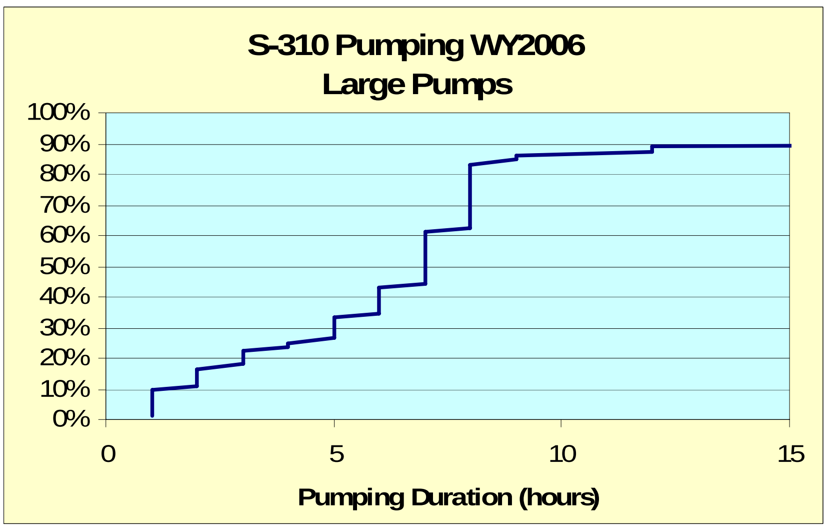
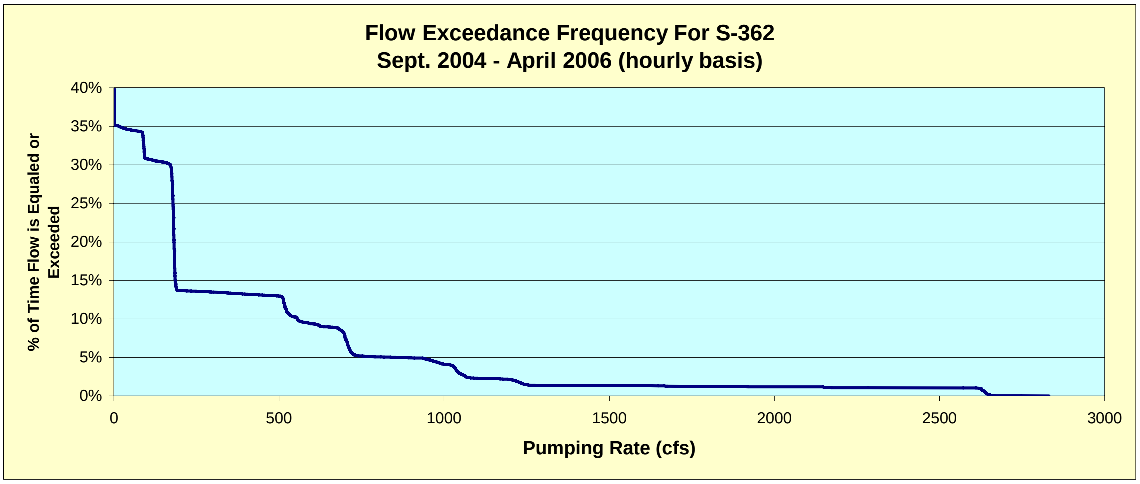


Figure 9. Exceedance Frequency for STA-1E Outflow Pumps.



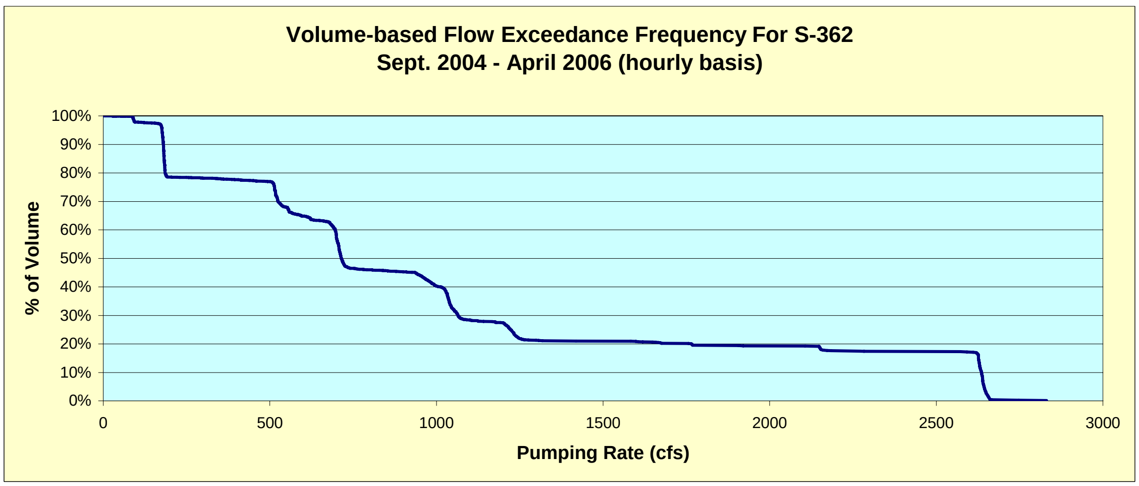


Figure 10. WY2002-2006 Inflows from G-300 & G-301.

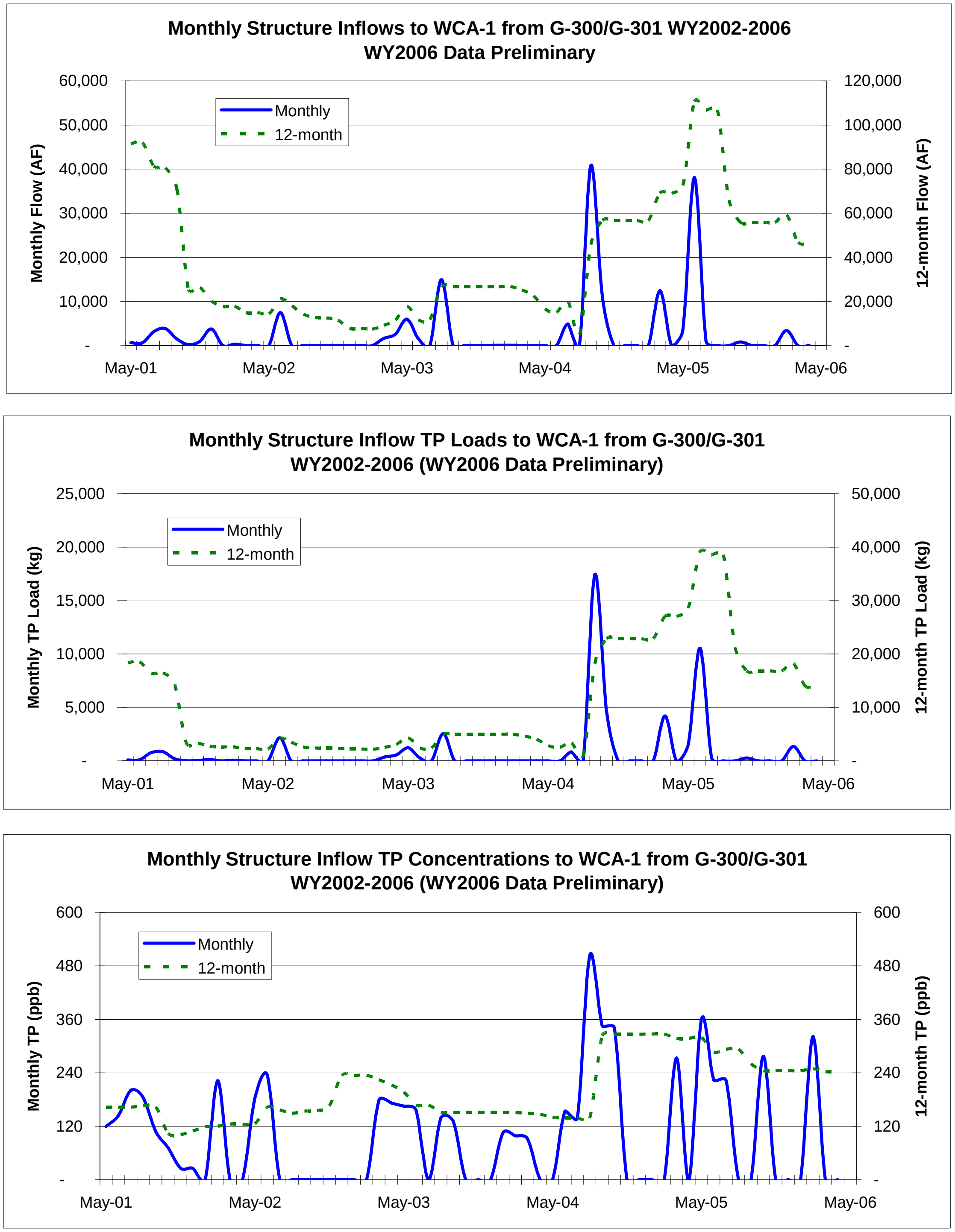
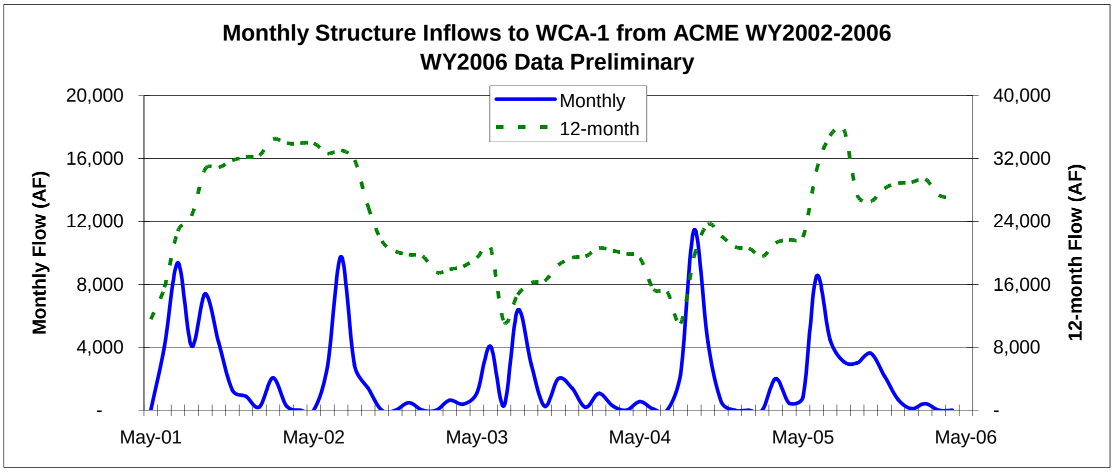
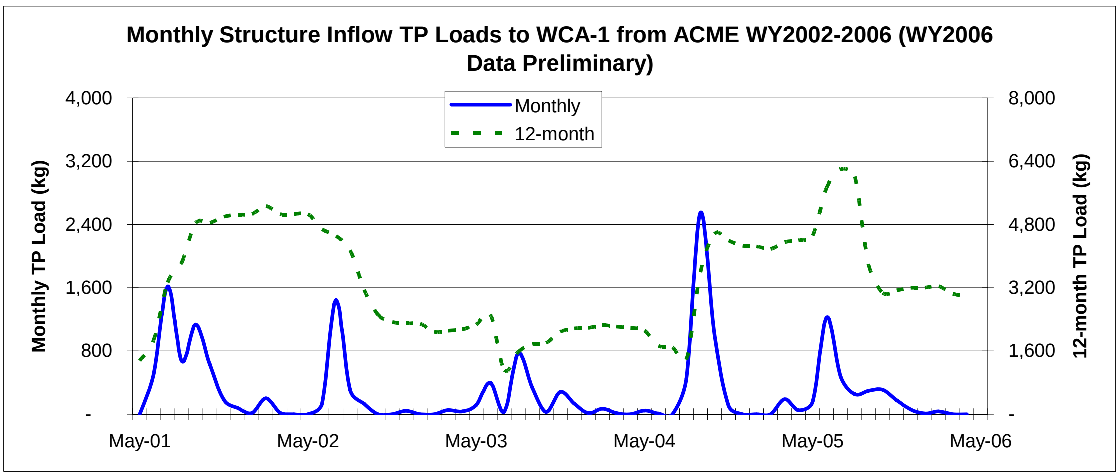


Figure 11. WY2002-2006 Inflows from Village of Wellington.





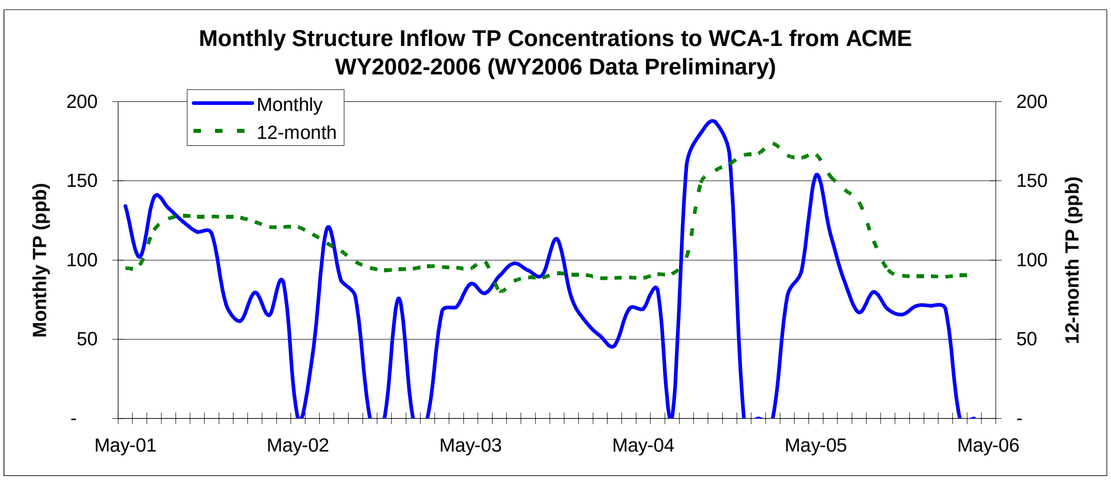


Figure 12. Rainfall for WY2002-2006.

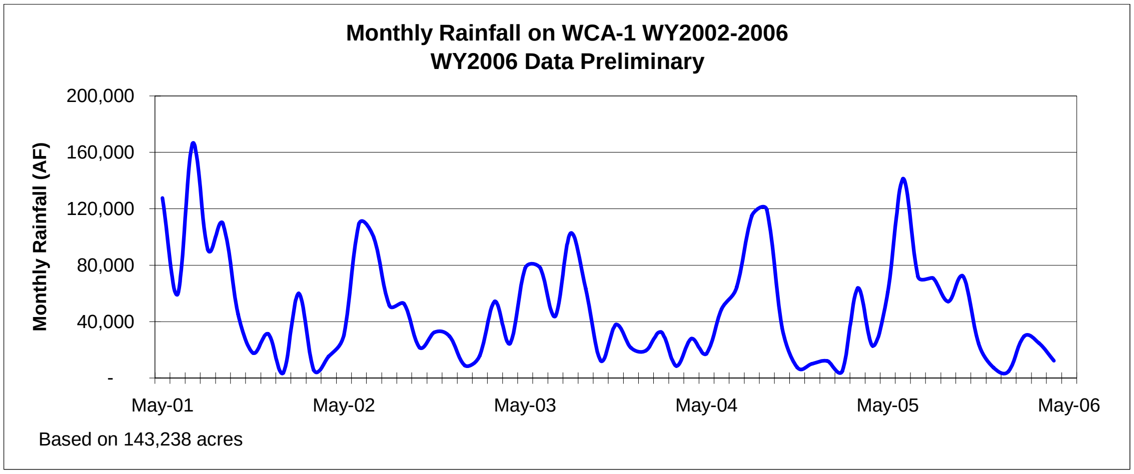
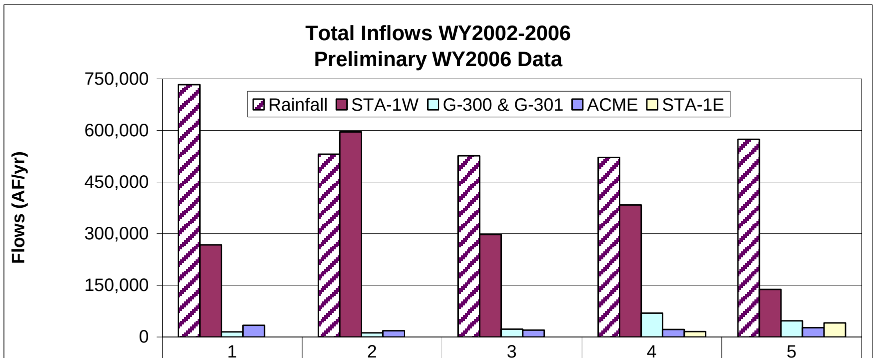
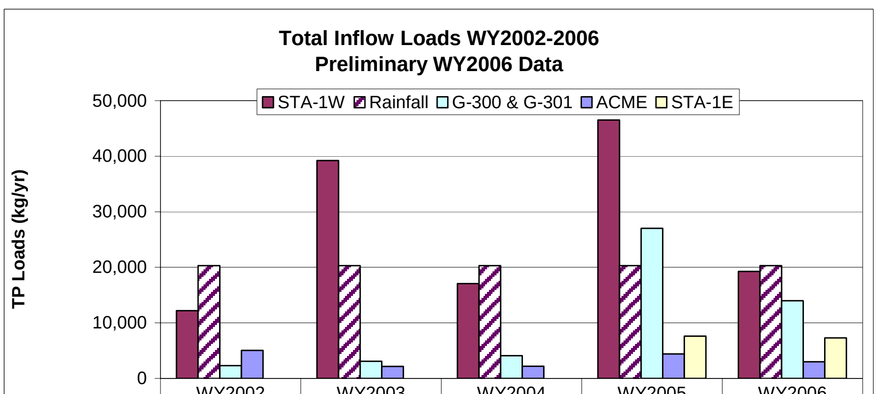


Figure 13. Summary of WCA-1 Inflows.

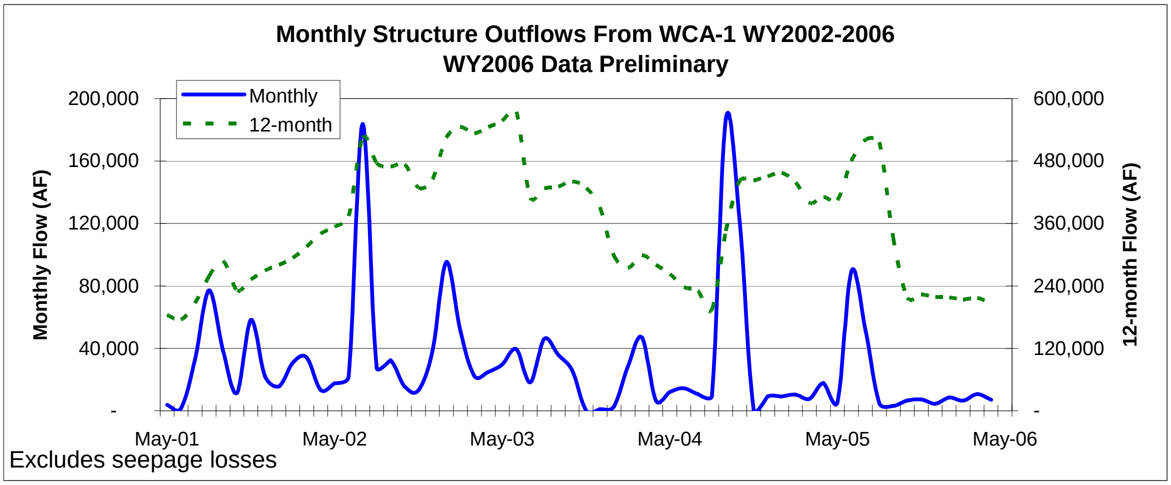


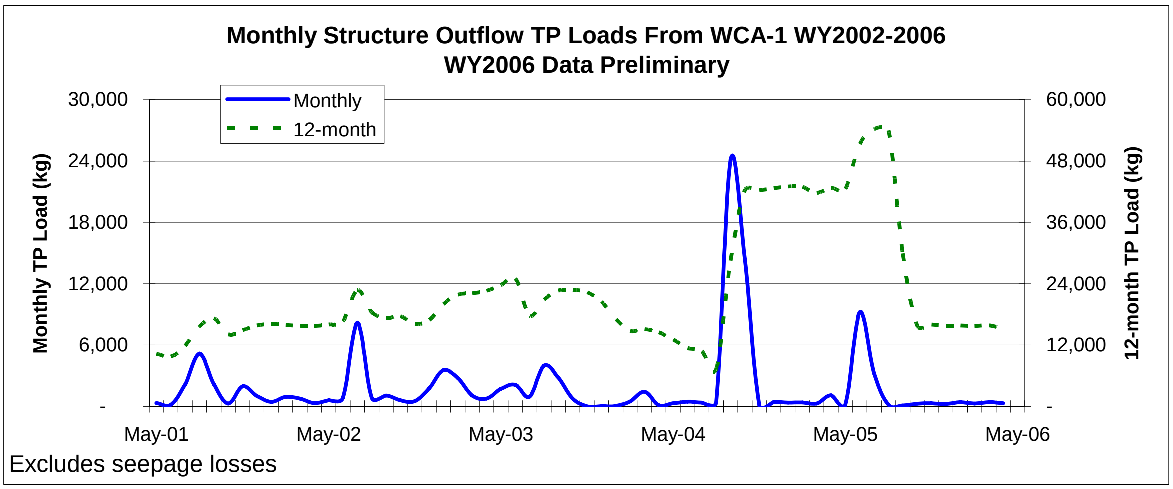
	1	2	3	4	5
Rainfall	733,174	530,697	526,161	521,864	574,026
STA-1W	267,624	595,999	297,603	383,662	137,890
G-300 & G-301	14,913	11,651	22,556	69,064	46,808
ACME	33,953	18,290	19,890	21,688	26,928
STA-1E	0	0	0	15,921	40,572



	WY2002	WY2003	WY2004	WY2005	WY2006
STA-1W	12,200	39,234	17,073	46,532	19,265
Rainfall	20,297	20,297	20,297	20,297	20,297
G-300 & G-301	2,300	3,059	4,081	27,032	14,007
ACME	5,064	2,147	2,184	4,402	2,999
STA-1E	0	0	0	7,601	7,295

Figure 14. Summary of WCA-1 Outflows.





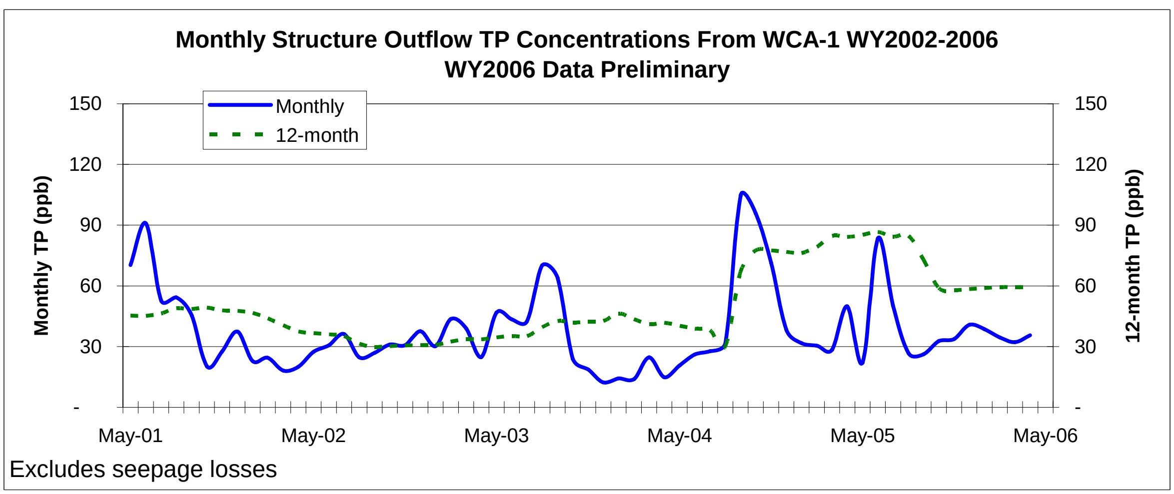


Figure 15. WY2002-2006 Releases to WCA-2A Through the S-10 Structures.

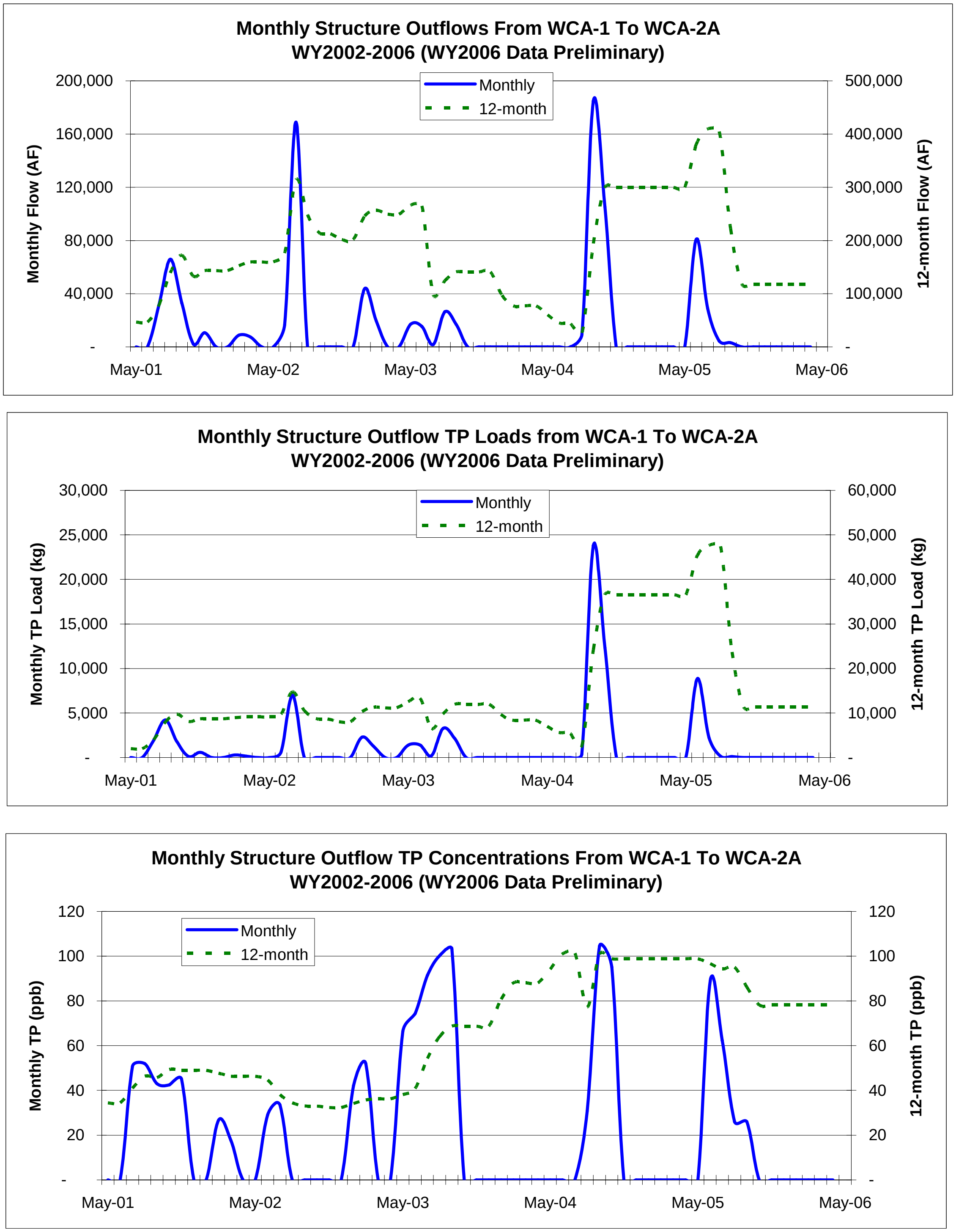


Figure 16. Distribution of Flows Among the S-10 Structures.

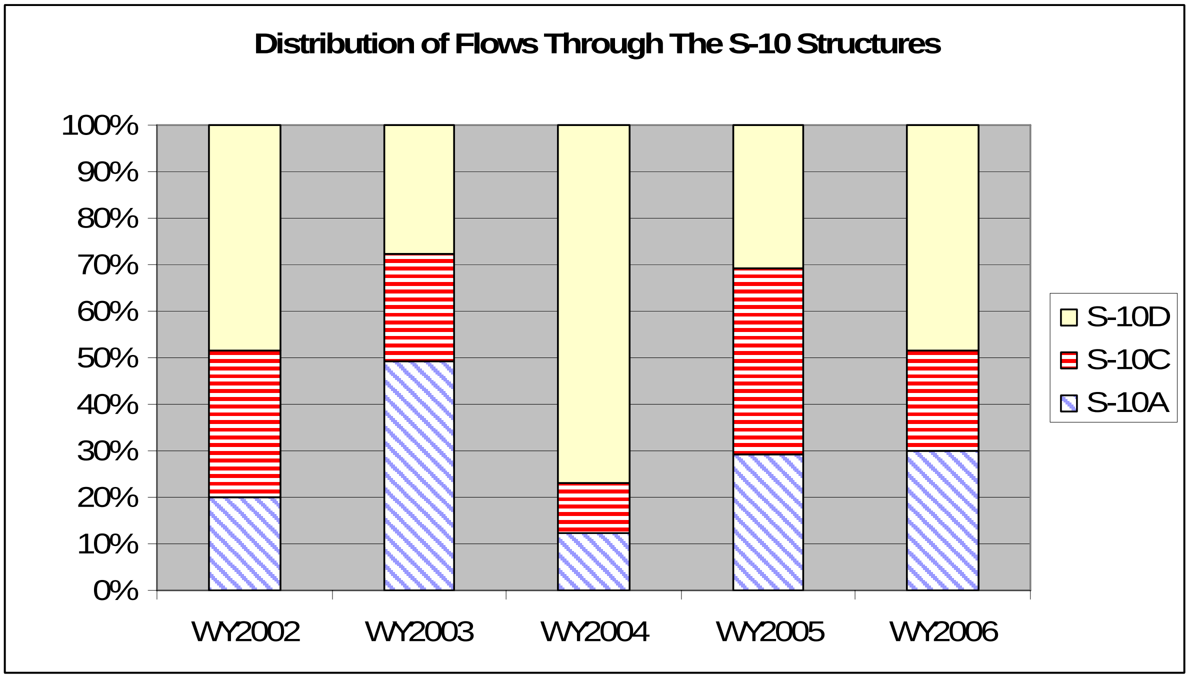
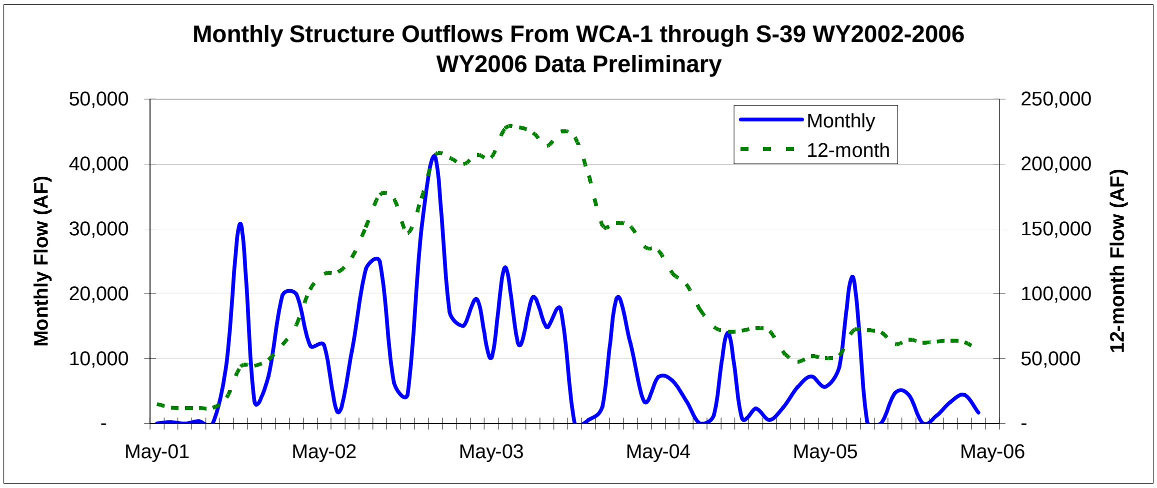
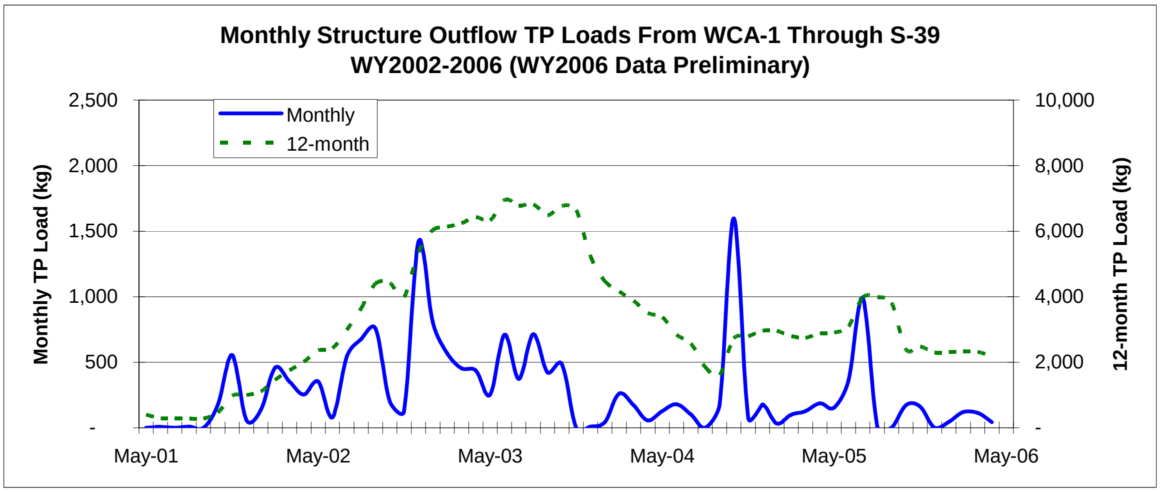


Figure 17. WY2002-2006 Releases Through the S-39 Structure.





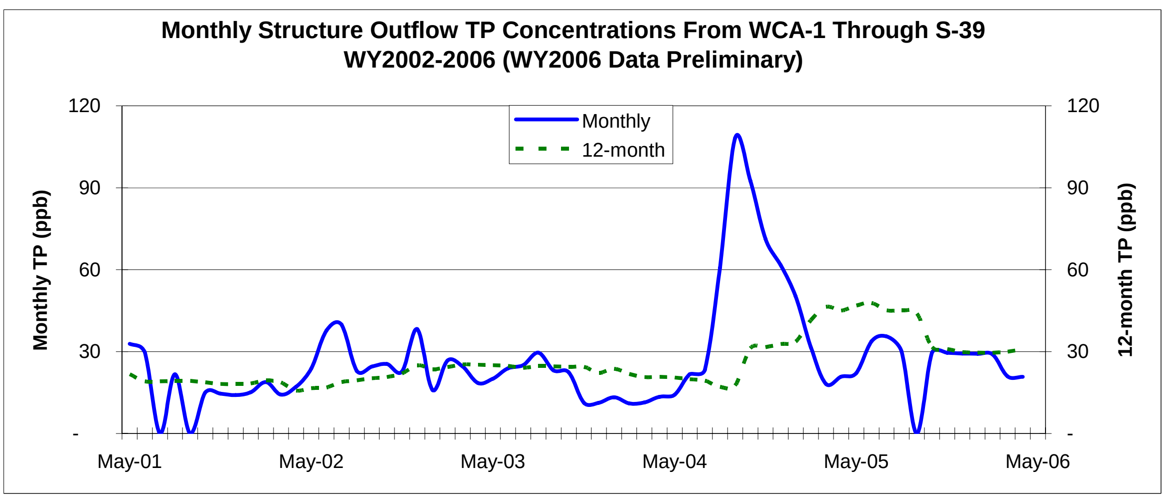
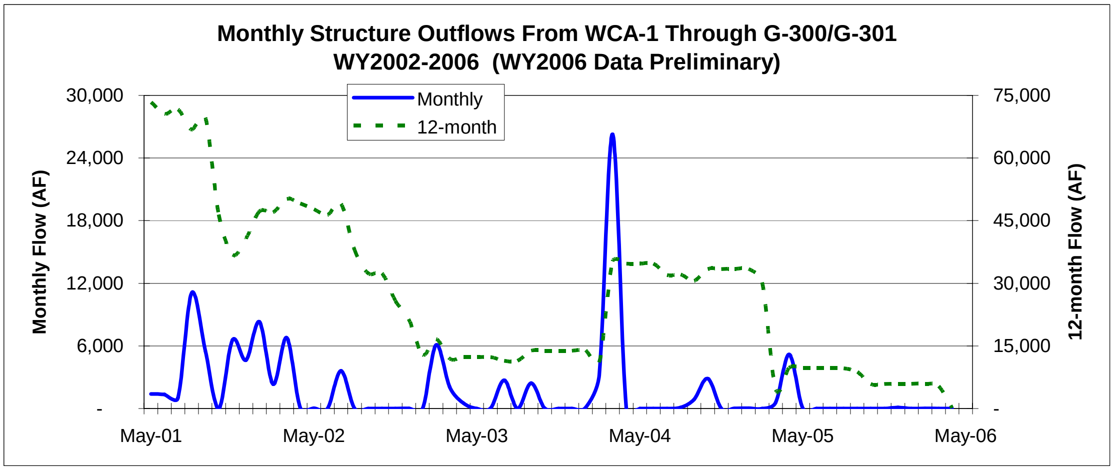
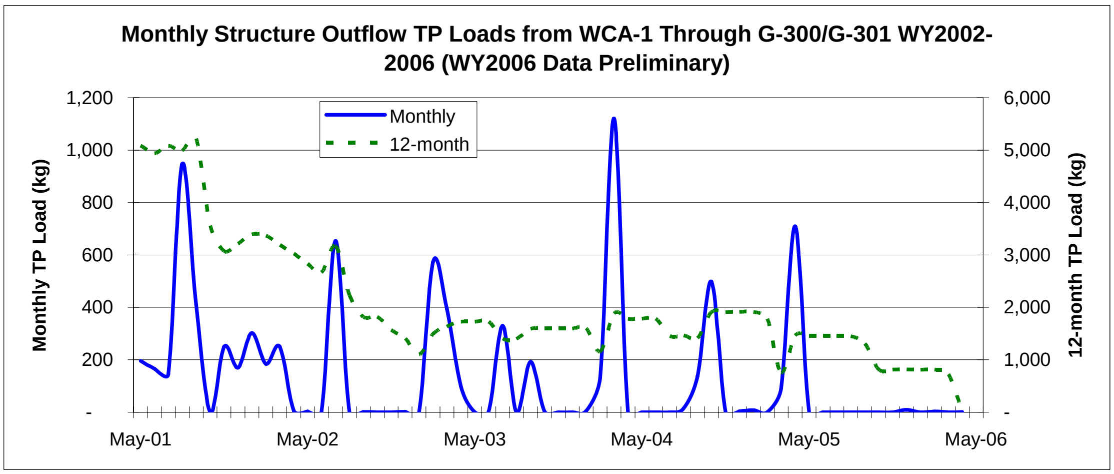


Figure 18. WY2002-2006 Releases Through the G-300 and G-301 Structures.





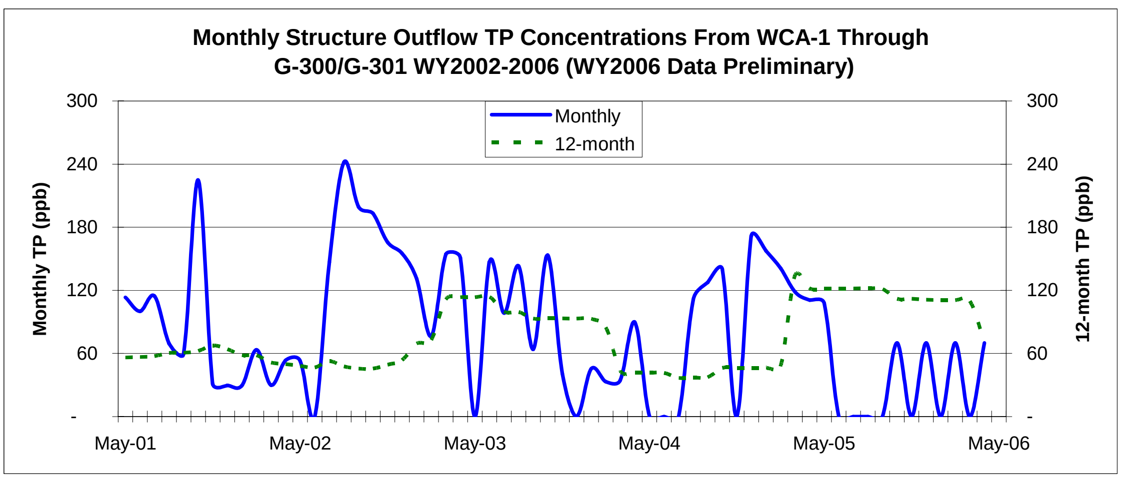
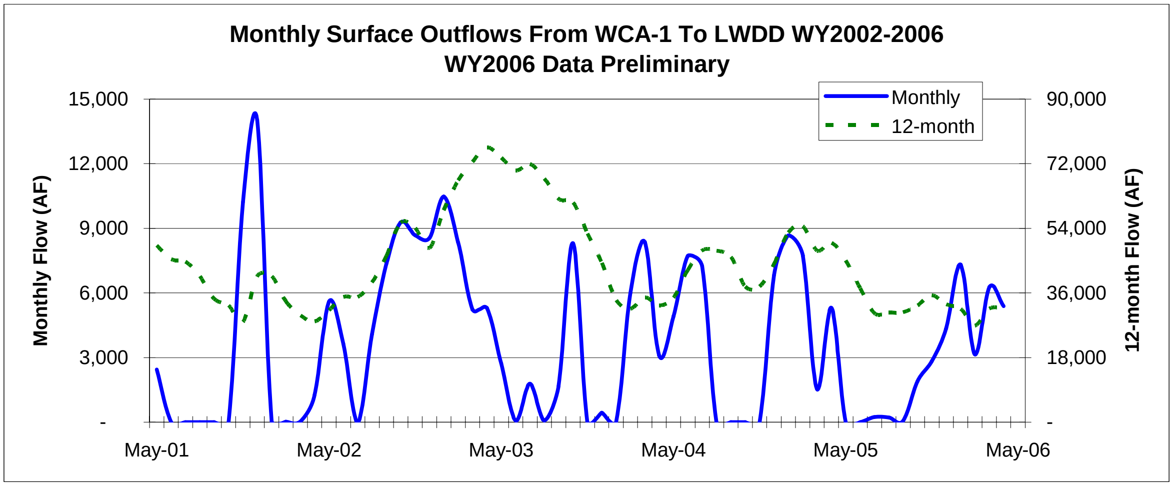
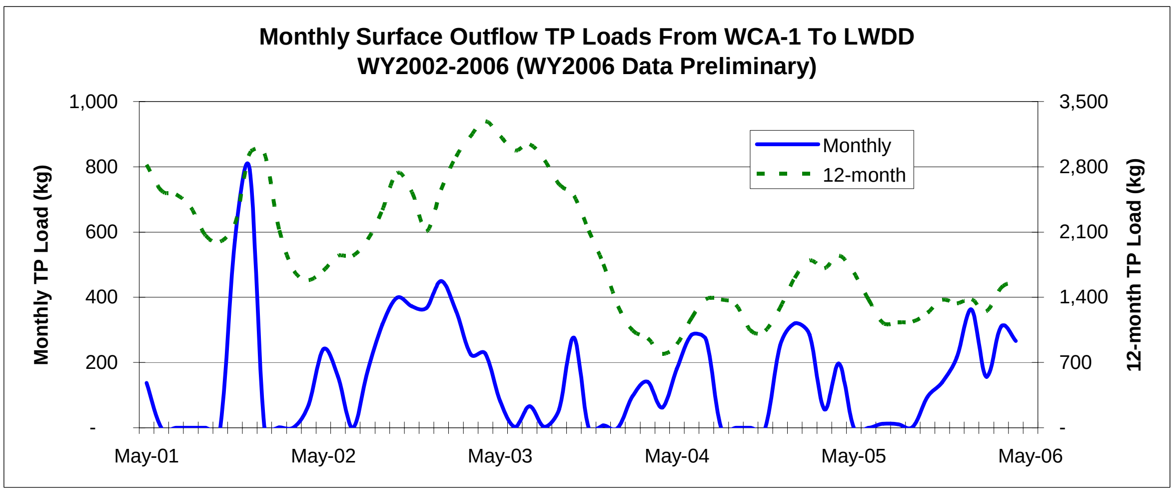


Figure 19. WY2002-2006 Releases Through the G-94 Structures.





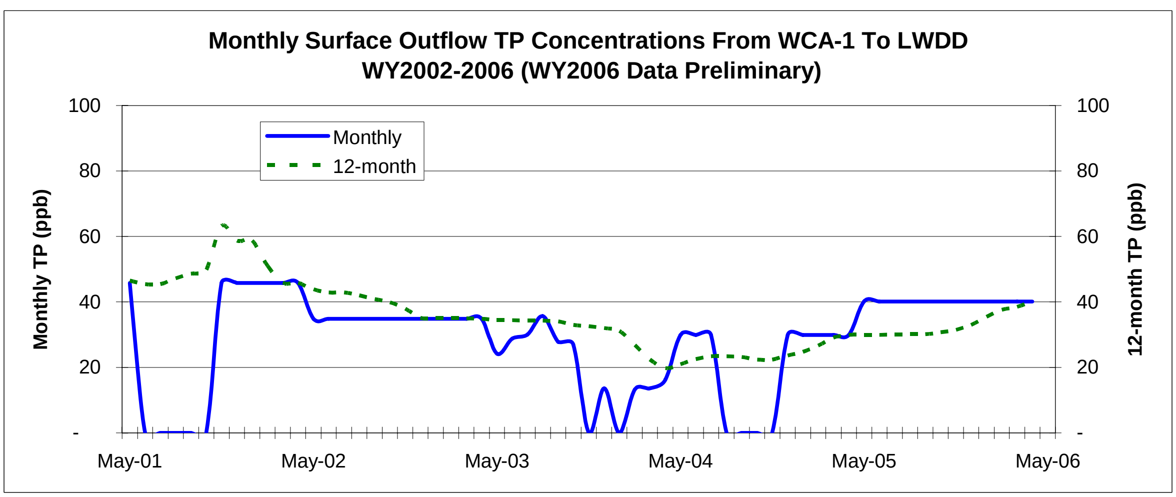


Figure 20. Estimates of Evapotranspiration for WY2002-2006.

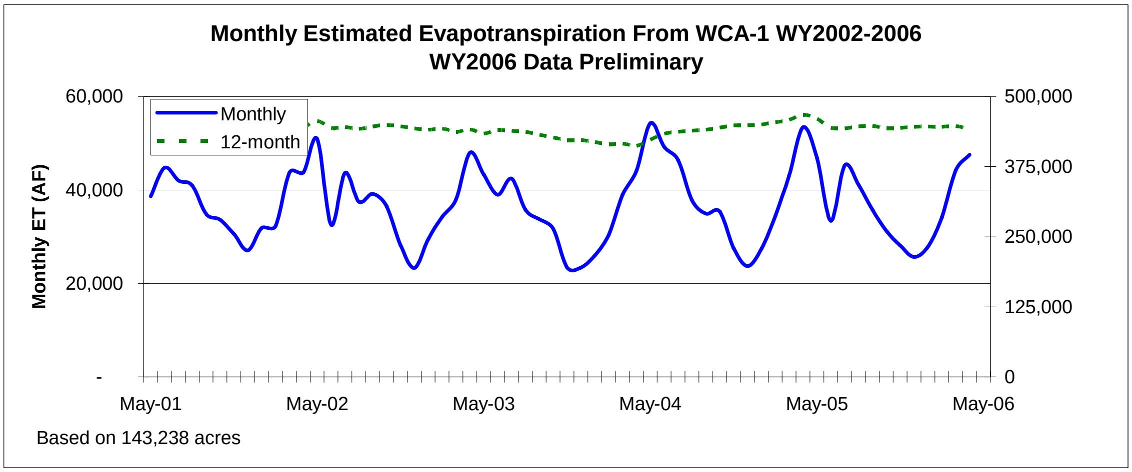
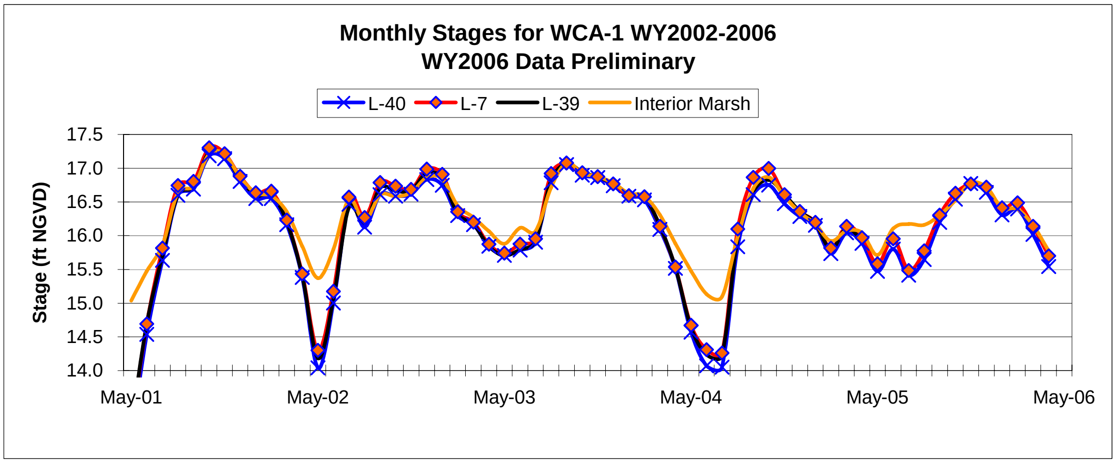
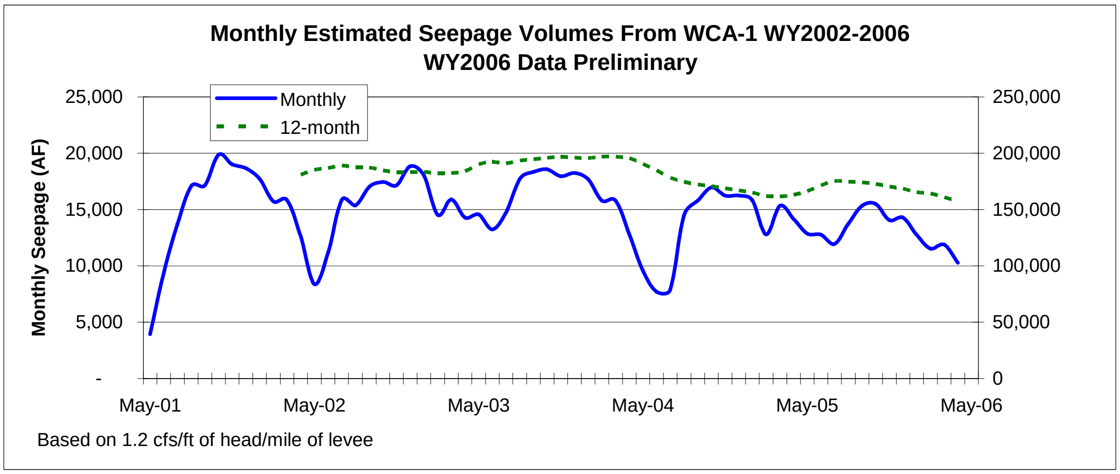


Table 4. Stations Used in Seepage Estimates.

Water Segment	Stations Used for Daily Stage
L-40	G-300 Tailwater
	S-18C
	S-39 Headwater
L-7	G-300 Tailwater
	G-251 Tailwater
	S-10E Headwater
Hillsboro Canal (L-39)	S-10C Headwater
	S-10E Headwater
WCA-2A	S-10C Headwater
	S-10E Headwater
Interior Marsh	1-7
	1-8T
	1-9

Figure 21. Canal and Marsh Stages and Estimated Seepage Losses from WCA-1.





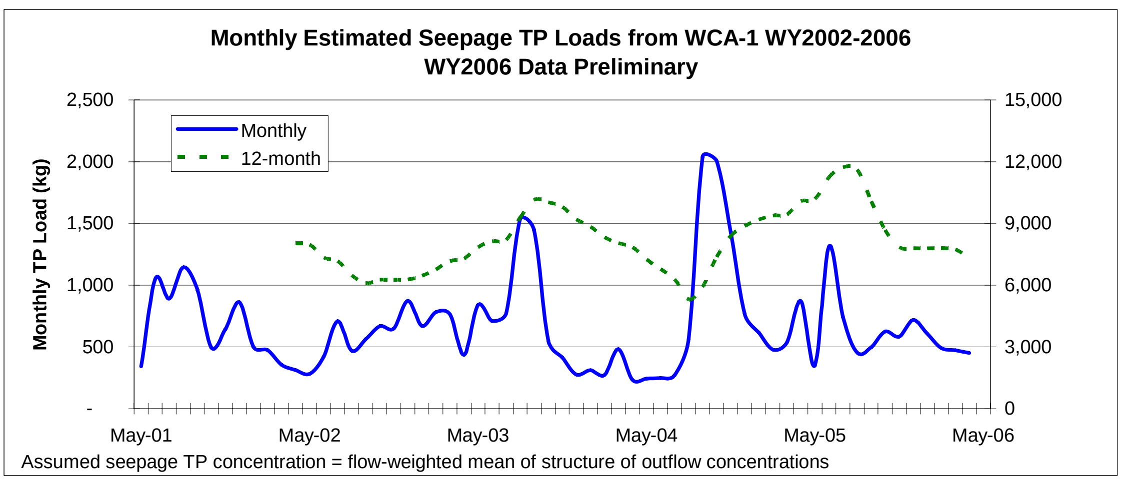
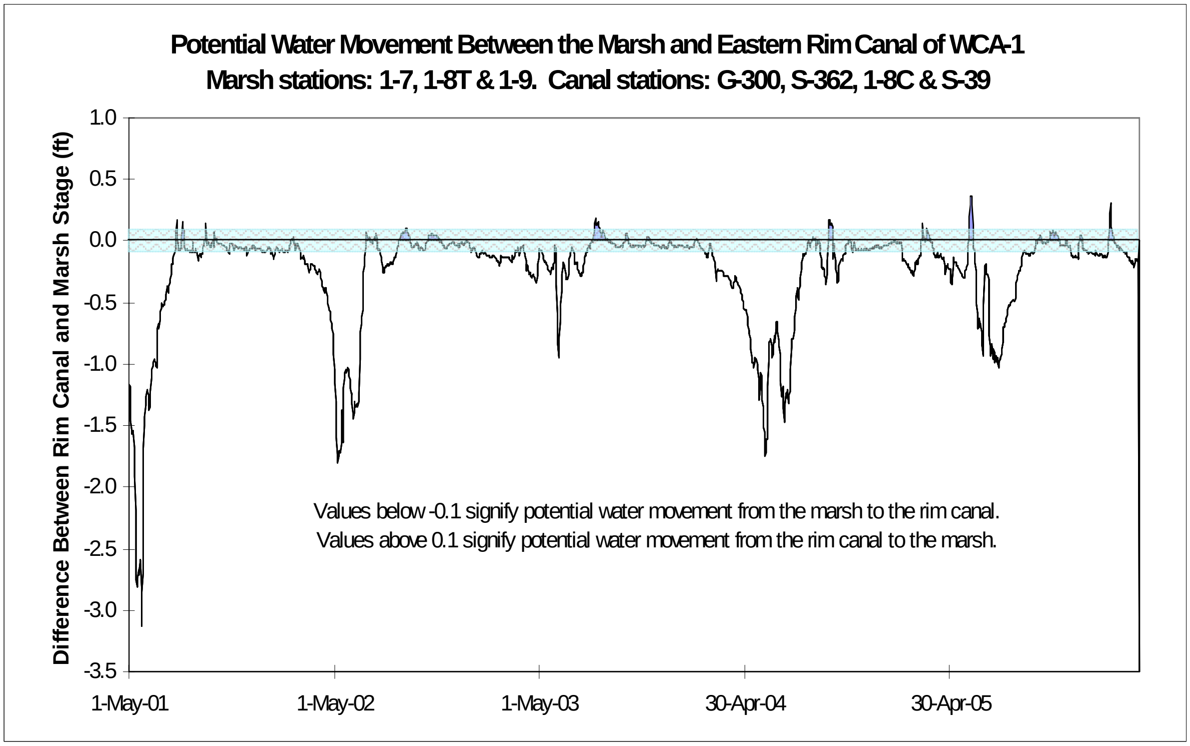


Figure 22. Stage Difference Between Interior Marsh and Eastern Rim Canal.



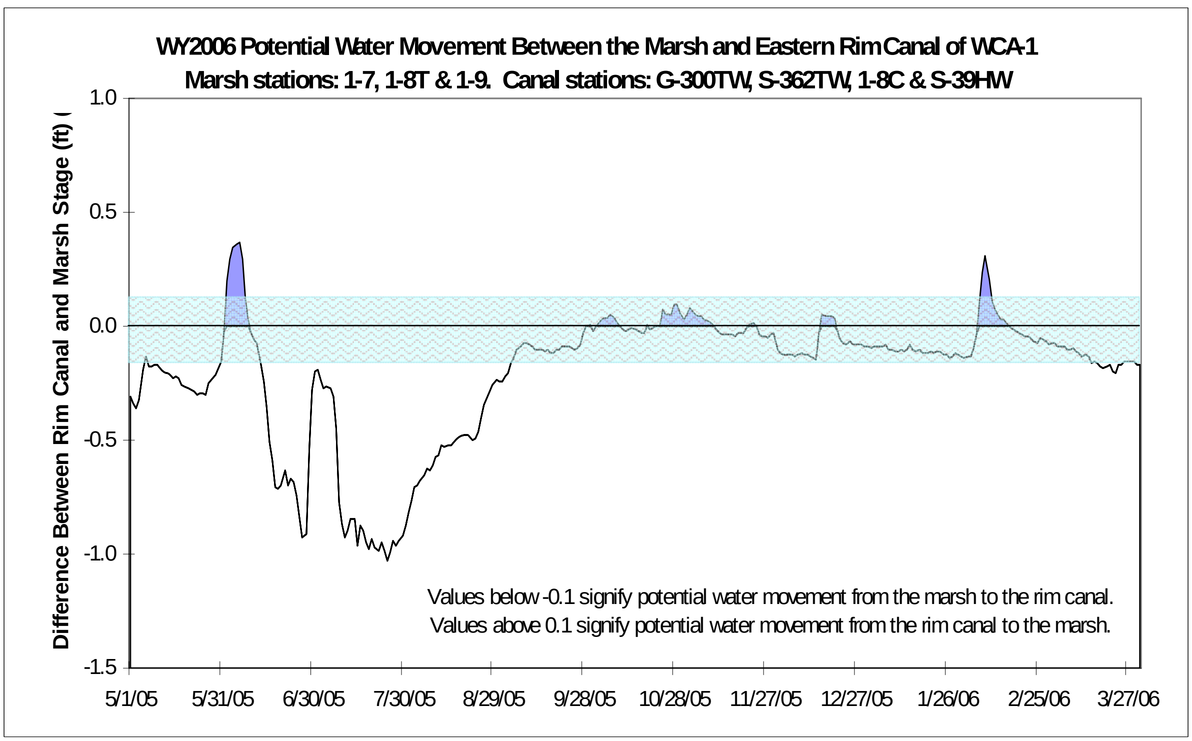
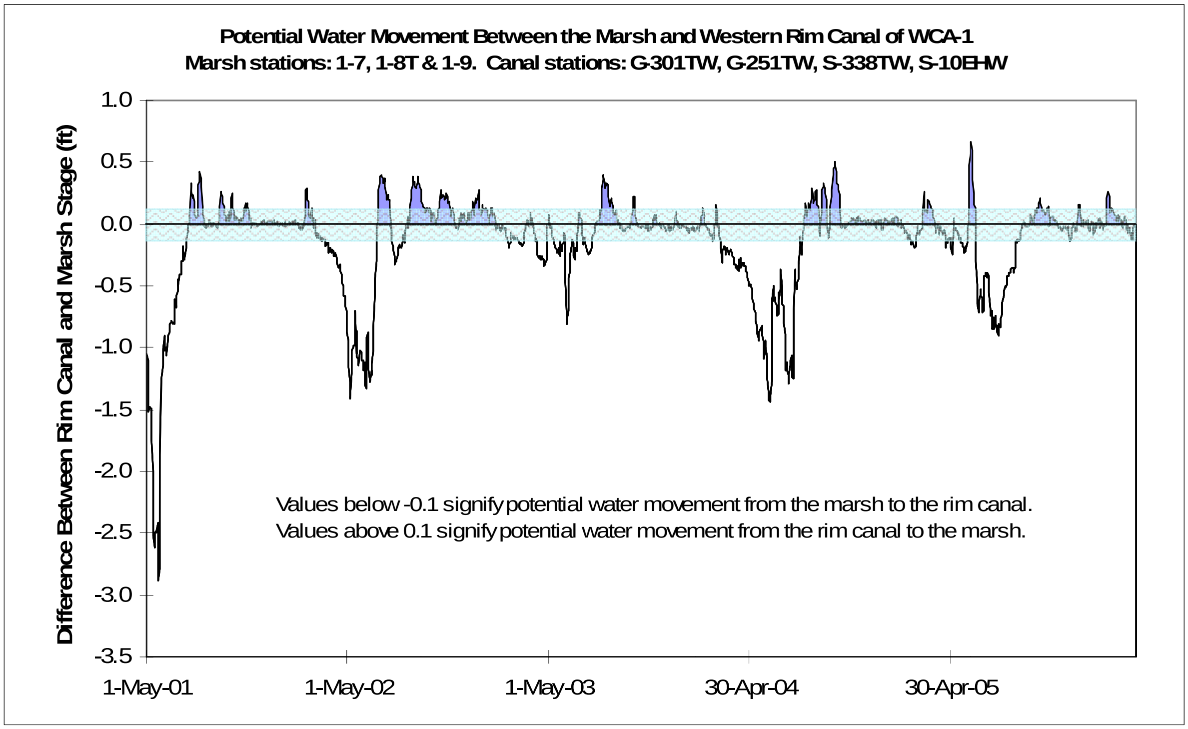


Figure 23. Stage Difference Between Interior Marsh and Western Rim Canal.



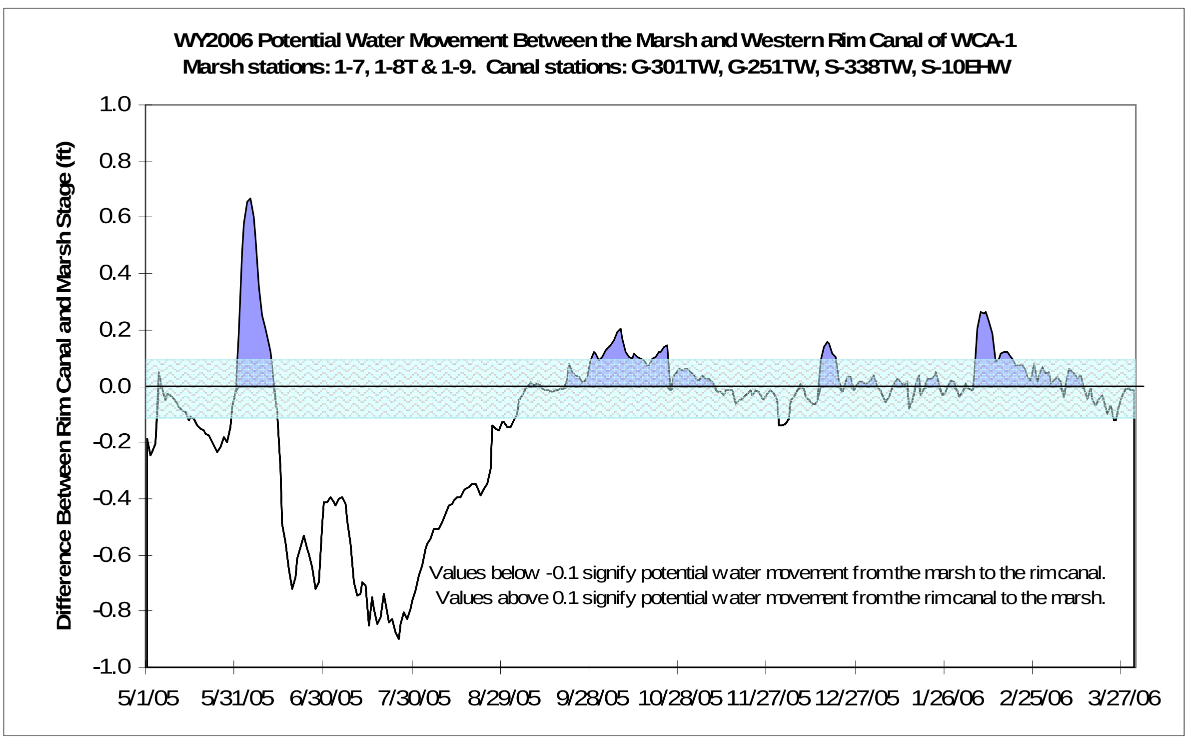
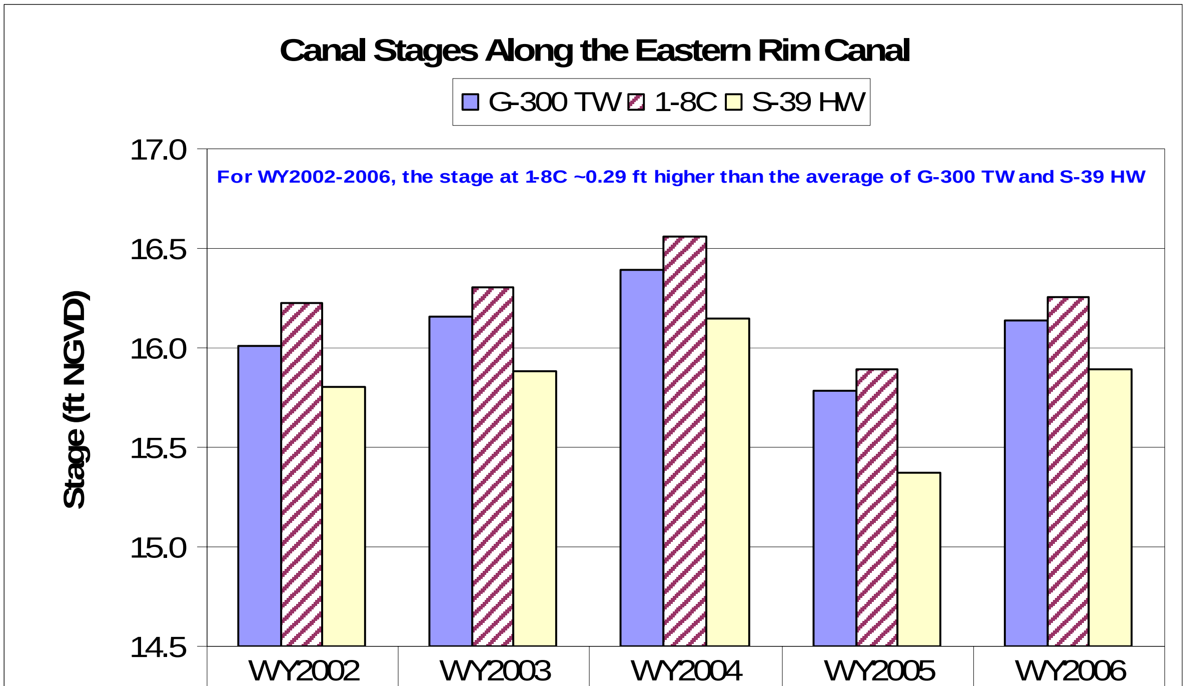
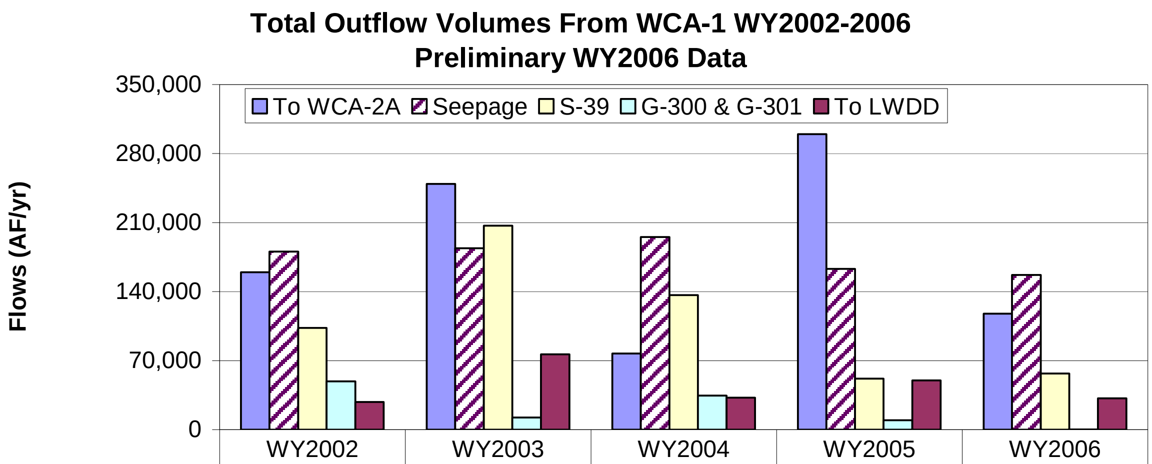


Figure 24. Comparison of Stages Along the L-40 Canal.

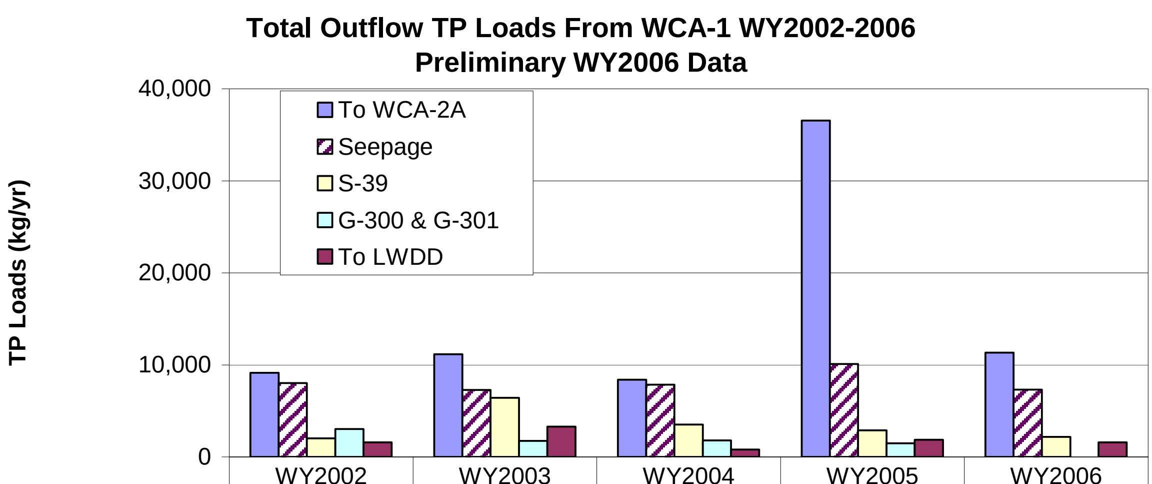


	WY2002	WY2003	WY2004	WY2005	WY2006
G-300 TW	16.01	16.16	16.39	15.79	16.13
1-8C	16.23	16.31	16.56	15.89	16.25
S-39 HW	15.80	15.88	16.15	15.38	15.89

Figure 25. Summary of WCA-1 Outflows.



	WY2002	WY2003	WY2004	WY2005	WY2006
To WCA-2A	159,759	249,327	77,260	299,700	117,563
Seepage	180,726	183,961	195,429	163,104	156,955
S-39	103,214	206,861	136,285	51,828	57,106
G-300 & G-301	49,095	12,345	34,741	9,737	134
To LWDD	28,059	76,542	32,528	49,963	31,739



	WY2002	WY2003	WY2004	WY2005	WY2006
To WCA-2A	9,128	11,147	8,396	36,539	11,335
Seepage	8,036	7,289	7,844	10,086	7,311
S-39	2,007	6,425	3,499	2,878	2,173
G-300 & G-301	3,026	1,727	1,785	1,462	12
To LWDD	1,585	3,288	795	1,847	1,573

Table 5. Summary of WCA-1 Flow Volumes.

Structure	WY2002 Flow AF/yr	WY2003 Flow AF/yr	WY2004 Flow AF/yr	WY2005 Flow AF/yr	WY2006 Flow AF/yr	Total Flow AF/yr	Average Flow AF/yr
G-251	6,834	96,523	54,677	63,144	34,187	255,365	51,073
G-310	260,791	499,476	242,926	320,518	103,703	1,427,414	285,483
G-300	12,989	4,278	7,954	31,848	20,682	77,752	15,550
G-301	1,925	7,373	14,602	37,216	26,126	87,241	17,448
S-362	0	0	0	15,921	40,572	56,492	11,298
ACME1	16,422	8,817	10,018	11,729	14,161	61,147	12,229
ACME2	17,531	9,473	9,871	9,959	12,767	59,601	11,920
Structures In	**316,491**	**625,939**	**340,049**	**490,335**	**252,197**	**2,025,012**	**405,002**
Rainfall	733174	530,697	526,161	521,864	574,026	2885922	577,184
Total In	**1049665**	**1,156,636**	**866,210**	**1,012,199**	**826,224**	**4910934**	**982,187**
G-300	48,352	8,703	713	2,089	6	59,863	11,973
G-301	743	3,643	34,028	7,648	128	46,189	9,238
G-94C	23,247	51,873	24,563	18,614	24,179	142,476	28,495
G-94B	1,242	13,242	0	2,910	7,558	24,951	4,990
G-94A	3,570	11,427	7,965	28,439	2	51,403	10,281
S-10A	32,194	122,803	9,463	88,060	35,118	287,637	57,527
S-10C	50,011	57,323	8,422	119,875	25,267	260,899	52,180
S-10D	77,554	69,201	59,375	91,765	57,177	355,073	71,015
S-39	103,214	206,861	136,285	51,828	57,106	555,293	111,059
Structures Out	**340,126**	**545,075**	**280,814**	**411,228**	**206,542**	**1,783,784**	**356,757**
ET	444,117	441,386	412,116	467,617	441,276	2,206,512	441,302
Seepage	180,726	183,961	195,429	163,104	156,955	880,175	176,035
Total Out	**964,969**	**1,170,422**	**888,359**	**1,041,949**	**804,773**	**4,870,471**	**974,094**

Facility	WY2002 Flow AF/yr	WY2003 Flow AF/yr	WY2004 Flow AF/yr	WY2005 Flow AF/yr	WY2006 Flow AF/yr	Total Flow AF/yr	Average Flow AF/yr
STA-1W	267,624	595,999	297,603	383,662	137,890	1,682,779	336,556
STA-1E	0	0	0	15,921	40,572	56,492	11,298
G300/301	14,913	11,651	22,556	69,064	46,808	164,993	32,999
ACME	33,953	18,290	19,890	21,688	26,928	120,748	24,150
Structures In	**316,491**	**625,939**	**340,049**	**490,335**	**252,197**	**2,025,012**	**405,002**
Rainfall	733,174	530,697	526,161	521,864	574,026	2,885,922	577,184
Total In	**1,049,665**	**1,156,636**	**866,210**	**1,012,199**	**826,224**	**4,910,934**	**982,187**
G300/301	49,095	12,345	34,741	9,737	134	106,053	21,211
LWDD	28,059	76,542	32,528	49,963	31,739	218,830	43,766
S-10s	159,759	249,327	77,260	299,700	117,563	903,609	180,722
S-39	103,214	206,861	136,285	51,828	57,106	555,293	111,059
Structures Out	**340,126**	**545,075**	**280,814**	**411,228**	**206,542**	**1,783,784**	**356,757**
ET	444,117	441,386	412,116	467,617	441,276	2,206,512	441,302
Seepage	180,726	183,961	195,429	163,104	156,955	880,175	176,035
Total Out	**964,969**	**1,170,422**	**888,359**	**1,041,949**	**804,773**	**4,870,471**	**974,094**

Table 6. Summary of WCA-1 Flow Phosphorus Loads.

Structure	WY2002 TP Load kg/yr	WY2003 TP Load kg/yr	WY2004 TP Load kg/yr	WY2005 TP Load kg/yr	WY2006 TP Load kg/yr	Total TP Load kg/yr	Average TP Load kg/yr
G-251	171	5,313	3,000	7,829	4,533	20,846	4,169
G-310	12,029	33,921	14,073	38,703	14,732	113,458	22,692
G-300	1,802	1,165	1,373	12,083	6,042	22,465	4,493
G-301	499	1,894	2,708	14,949	7,965	28,014	5,603
S-362	0	0	0	7,601	7,295	14,896	2,979
ACME1	1,777	844	957	1,796	1,311	6,684	1,337
ACME2	3,286	1,303	1,227	2,607	1,689	10,112	2,022
Structures In	**19,564**	**44,440**	**23,338**	**85,568**	**43,566**	**216,475**	**43,295**
Rainfall	20297	20,297	20,297	20,297	20,297	101484	20,297
Total In	**39861**	**64,737**	**43,635**	**105,864**	**63,863**	**317960**	**63,592**
G-300	2,822	1,116	116	288	1	4,343	869
G-301	204	611	1,669	1,174	11	3,668	734
G-94C	1,313	2,228	608	688	1,198	6,036	1,207
G-94B	70	569	0	108	375	1,121	224
G-94A	202	491	187	1,051	0	1,930	386
S-10A	1,211	5,812	904	16,084	1,171	25,181	5,036
S-10C	2,487	2,665	350	1,813	1,592	8,907	1,781
S-10D	5,430	2,671	7,142	18,643	8,572	42,457	8,491
S-39	2,007	6,425	3,499	2,878	2,173	16,982	3,396
Structures Out	**15,745**	**22,587**	**14,474**	**42,726**	**15,093**	**110,625**	**22,125**
ET	0	0	0	0	0	0	0
Seepage	8,036	7,289	7,844	10,086	7,311	40,566	8,113
Total Out	**23,781**	**29,875**	**22,318**	**52,813**	**22,404**	**151,191**	**30,238**

Facility	WY2002 TP Load kg/yr	WY2003 TP Load kg/yr	WY2004 TP Load kg/yr	WY2005 TP Load kg/yr	WY2006 TP Load kg/yr	Total TP Load kg/yr	Average TP Load kg/yr
STA-1W	12,200	39,234	17,073	46,532	19,265	134,304	26,861
STA-1E	0	0	0	7,601	7,295	14,896	2,979
G300/301	2,300	3,059	4,081	27,032	14,007	50,479	10,096
ACME	5,064	2,147	2,184	4,402	2,999	16,796	3,359
Structures In	**19,564**	**44,440**	**23,338**	**85,568**	**43,566**	**216,475**	**43,295**
Rainfall	20,297	20,297	20,297	20,297	20,297	101,484	20,297
Total In	**39,861**	**64,737**	**43,635**	**105,864**	**63,863**	**317,960**	**63,592**
G300/301	3,026	1,727	1,785	1,462	12	8,011	1,602
LWDD	1,585	3,288	795	1,847	1,573	9,087	1,817
S-10s	9,128	11,147	8,396	36,539	11,335	76,545	15,309
S-39	2,007	6,425	3,499	2,878	2,173	16,982	3,396
Structures Out	**15,745**	**22,587**	**14,474**	**42,726**	**15,093**	**110,625**	**22,125**
ET	0	0	0	0	0	0	0
Seepage	8,036	7,289	7,844	10,086	7,311	40,566	8,113
Total Out	**23,781**	**29,875**	**22,318**	**52,813**	**22,404**	**151,191**	**30,238**

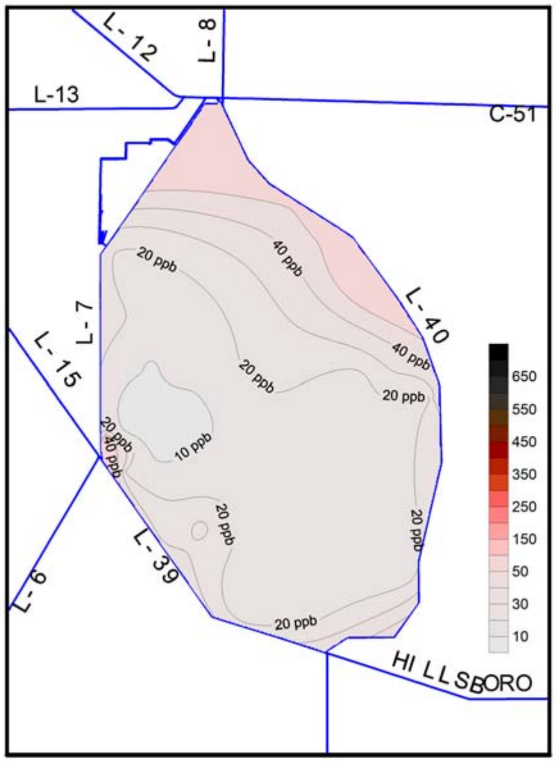
Table 7. Summary of WCA-1 Flow Phosphorus Concentrations.

Structure	WY2002 TP Conc ppb	WY2003 TP Conc ppb	WY2004 TP Conc ppb	WY2005 TP Conc ppb	WY2006 TP Conc ppb	Average TP Conc ppb
G-251	20	45	44	101	107	66
G-310	37	55	47	98	115	64
G-300	112	221	140	308	237	234
G-301	210	208	150	326	247	260
S-362	-	-	-	387	146	214
ACME1	88	78	77	124	75	89
ACME2	152	112	101	212	107	138
Structures In	**50**	**58**	**56**	**141**	**140**	**87**
Rainfall	22	31	31	32	29	29
Total In	**31**	**45**	**41**	**85**	**63**	**52**
G-300	47	104	132	112	70	59
G-301	222	136	40	124	70	64
G-94C	46	35	20	30	40	34
G-94B	46	35	-	30	40	36
G-94A	46	35	19	30	40	30
S-10A	30	38	77	148	27	71
S-10C	40	38	34	12	51	28
S-10D	57	31	98	165	122	97
S-39	16	25	21	45	31	25
Structures Out	**38**	**34**	**42**	**84**	**59**	**50**
ET	-	-	-	-	-	-
Seepage	36	32	33	50	38	37
Total Out	**20**	**21**	**20**	**41**	**23**	**25**

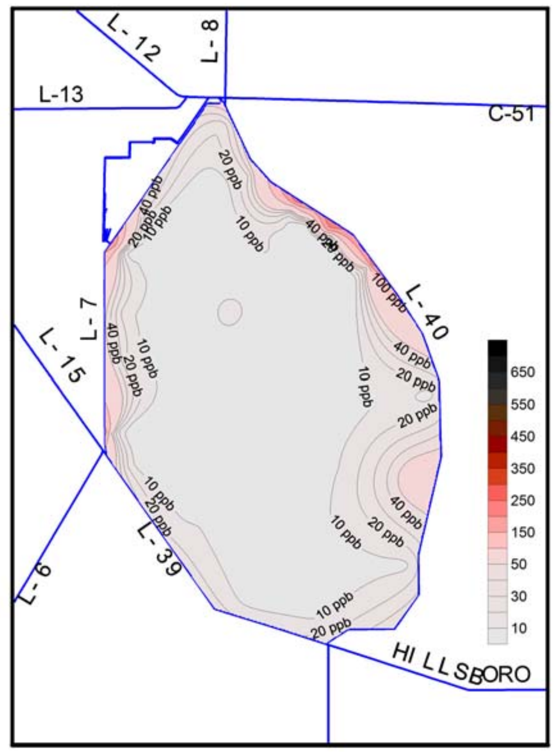
Facility	WY2002 TP Conc ppb	WY2003 TP Conc ppb	WY2004 TP Conc ppb	WY2005 TP Conc ppb	WY2006 TP Conc ppb	Average TP Conc ppb
STA-1W	37	53	47	98	113	65
STA-1E				387	146	214
G300/301	125	213	147	317	243	248
ACME	121	95	89	165	90	113
Structures In	**50**	**58**	**56**	**141**	**140**	**87**
Rainfall	22	31	31	32	29	29
Total In	**31**	**45**	**41**	**85**	**63**	**52**
G300/301	50	113	42	122	70	61
LWDD	46	35	20	30	40	34
S-10s	46	36	88	99	78	69
S-39	16	25	21	45	31	25
Structures Out	**38**	**34**	**42**	**84**	**59**	**50**
ET	-	-	-	-	-	-
Seepage	36	32	33	50	38	37
Total Out	**37**	**33**	**38**	**75**	**50**	**46**

Figure 26. Monthly Contour Plots of TP Within WCA-1 (EVPA and LOXA data).

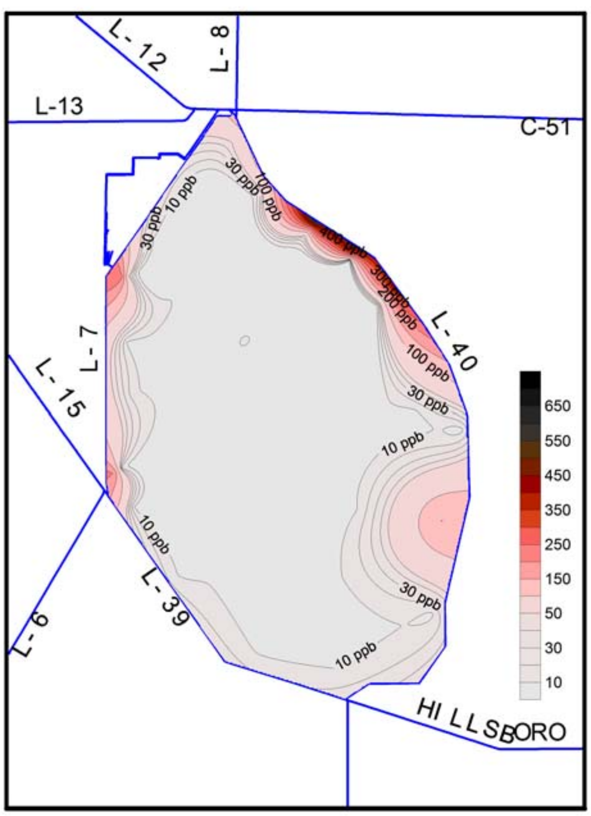
August 2004



September 2004



October 2004



November 2004

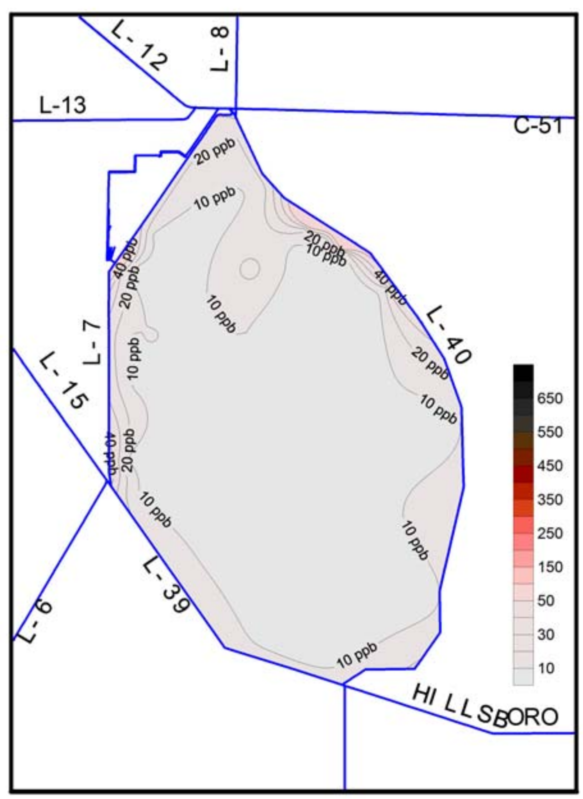
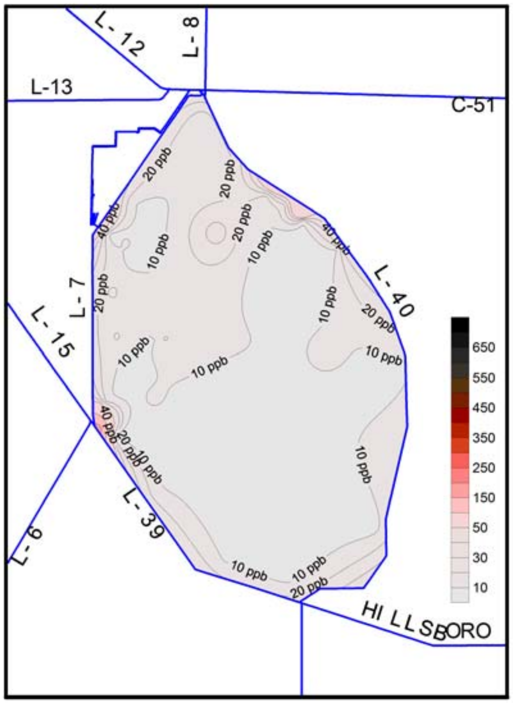
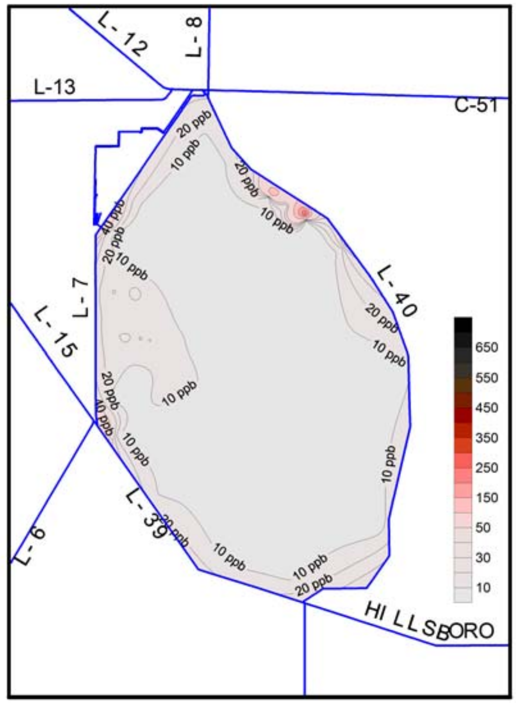


Figure 26 (continued).

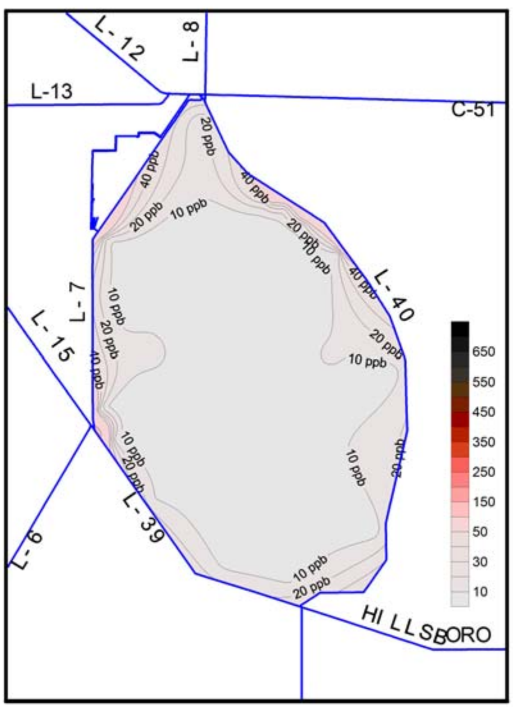
December 2004



January 2005



February 2005



March 2005

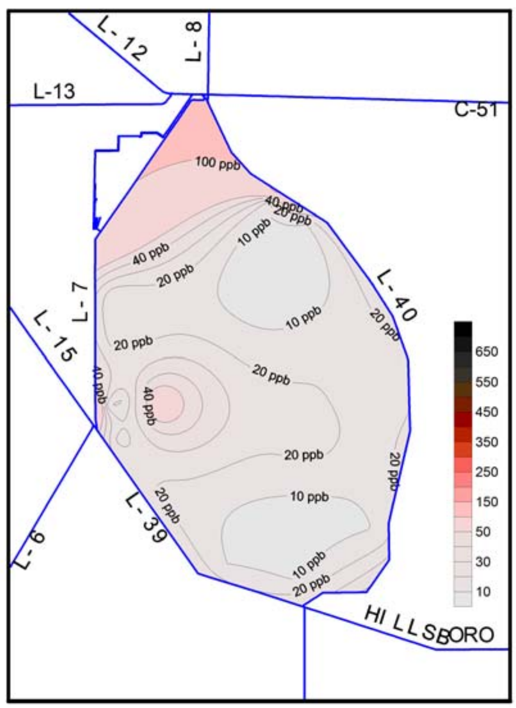
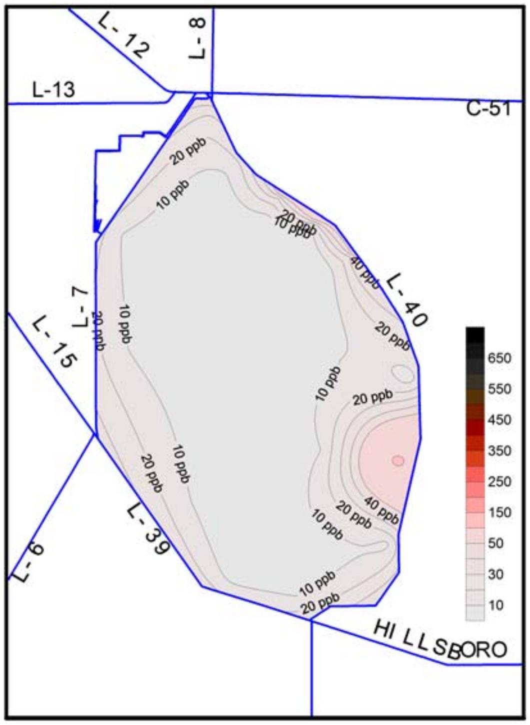
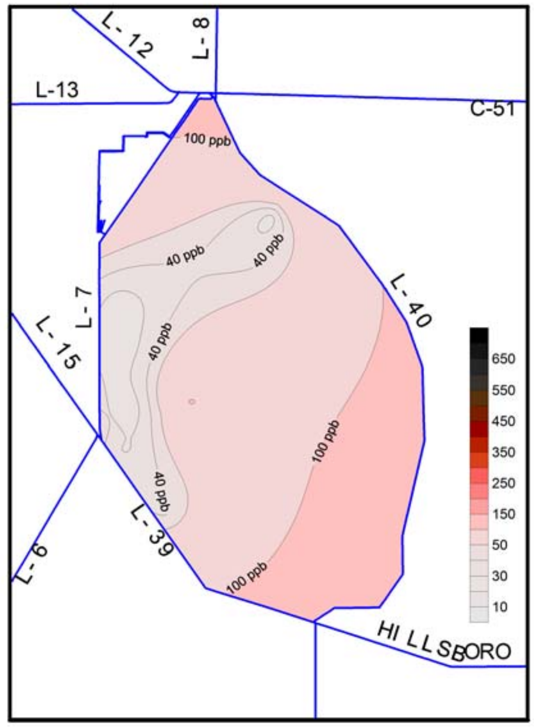


Figure 26 Continued.

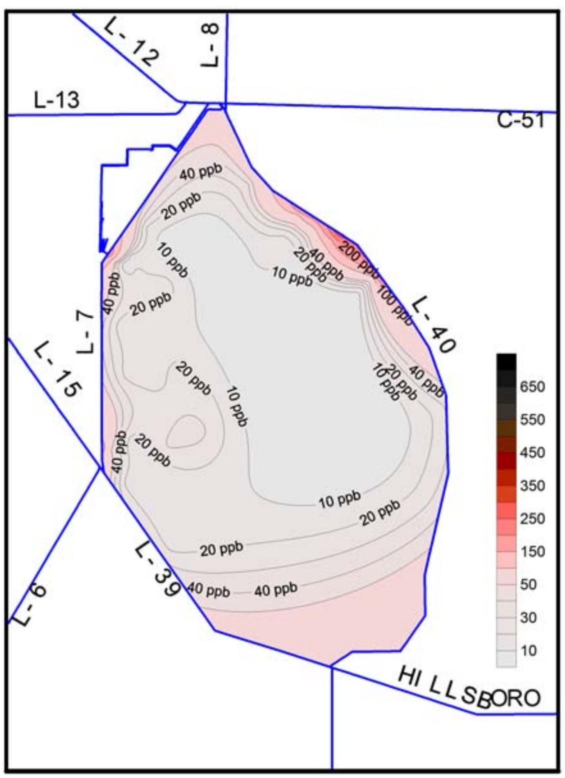
April 2005



May 2005 (Data Invalidated)



June 2005 (Data Invalidated)



July 2005

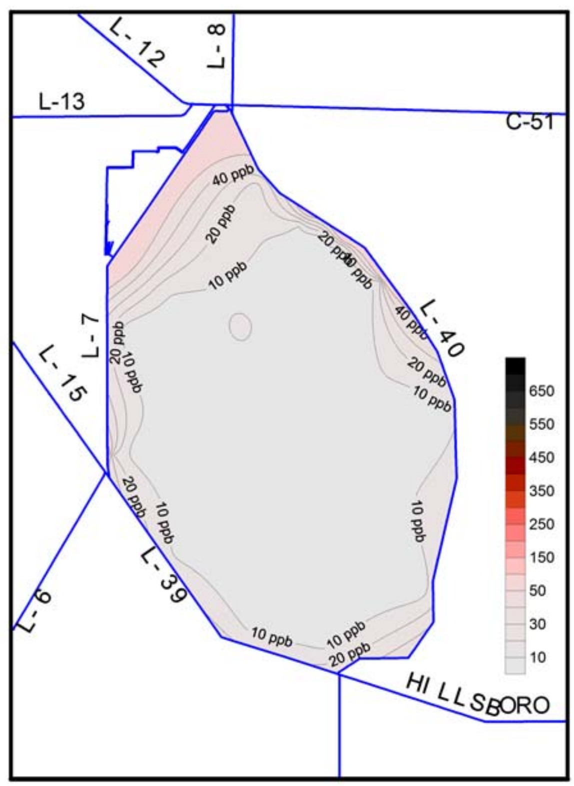
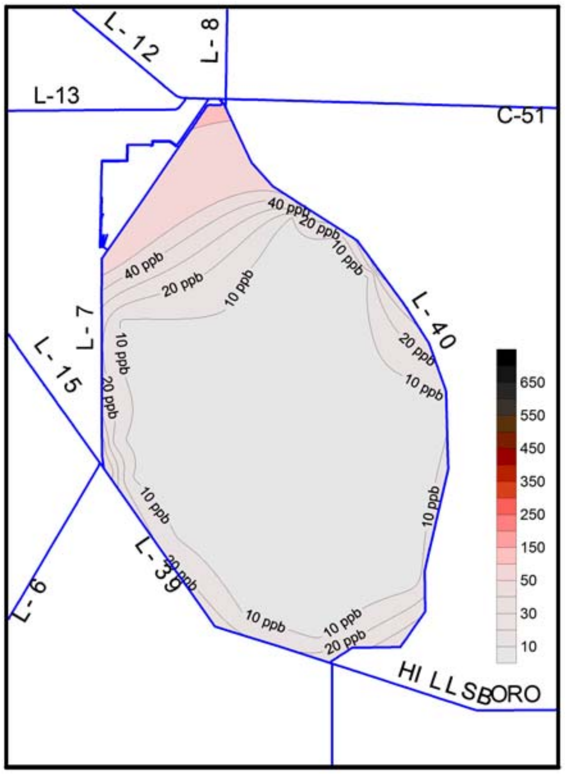
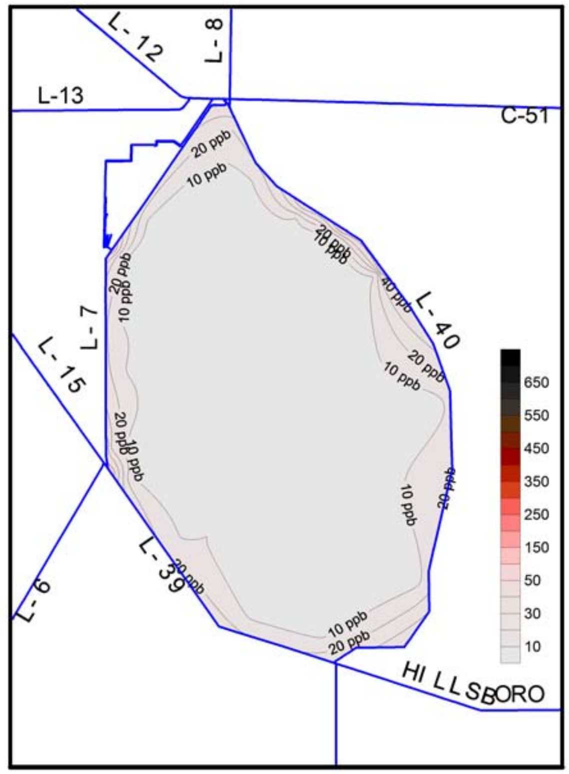


Figure 26 Continued.

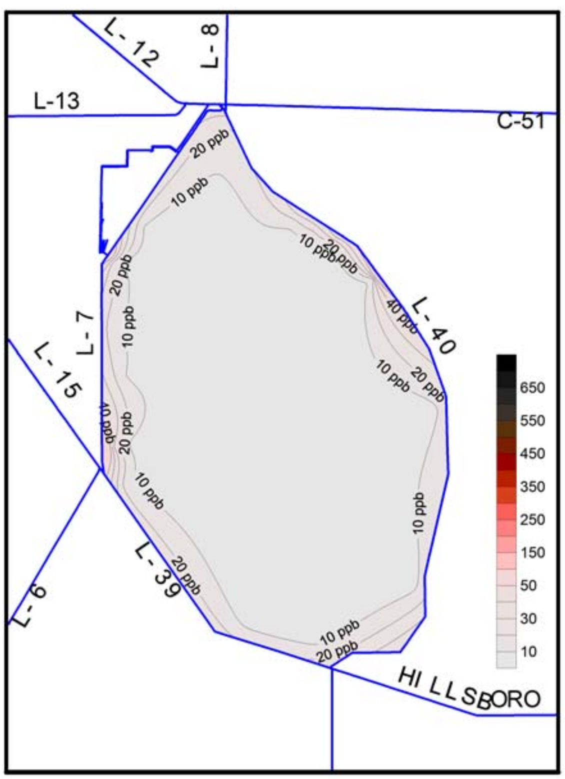
August 2005



September 2005



October 2005



November 2005

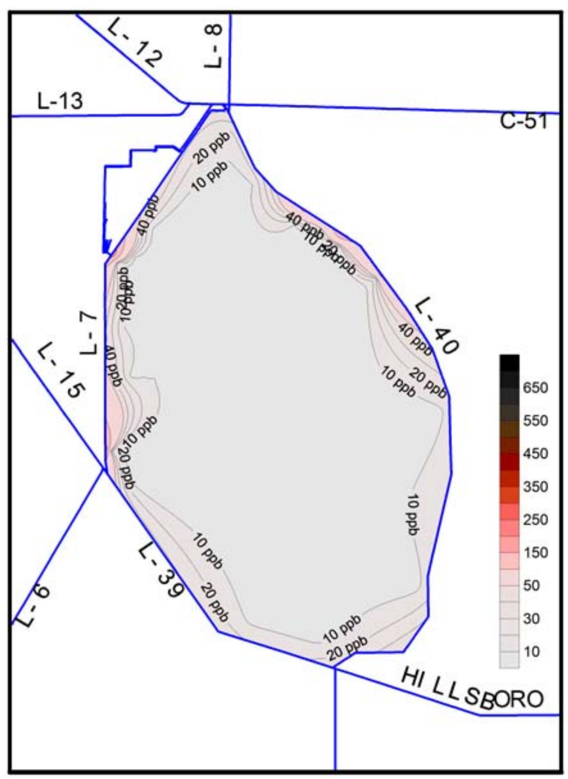
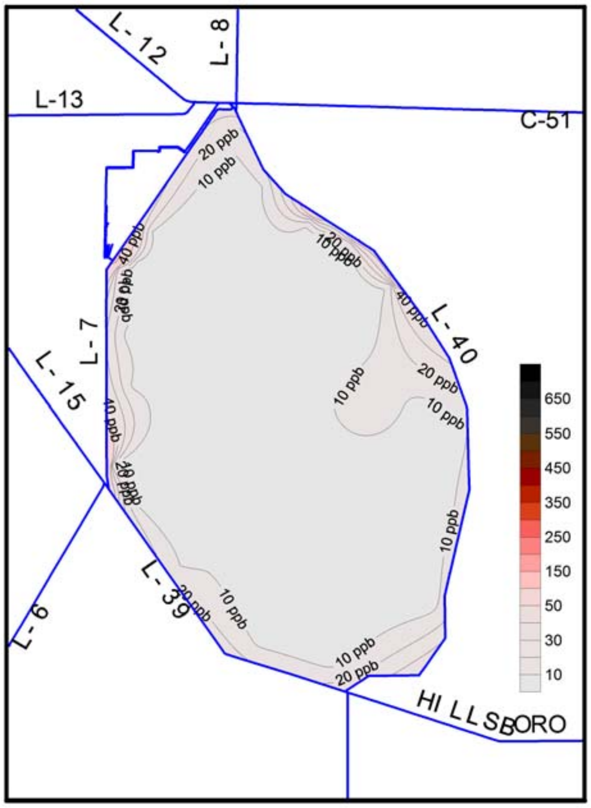
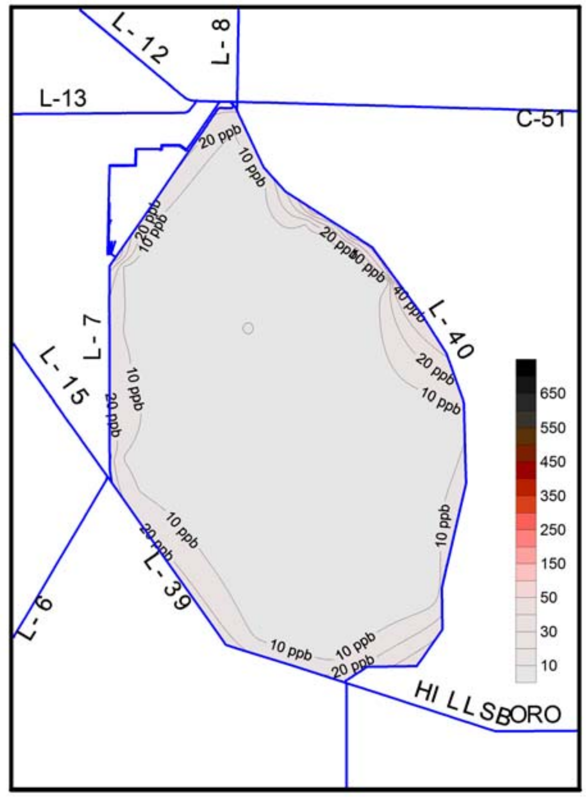


Figure 26 (Concluded).

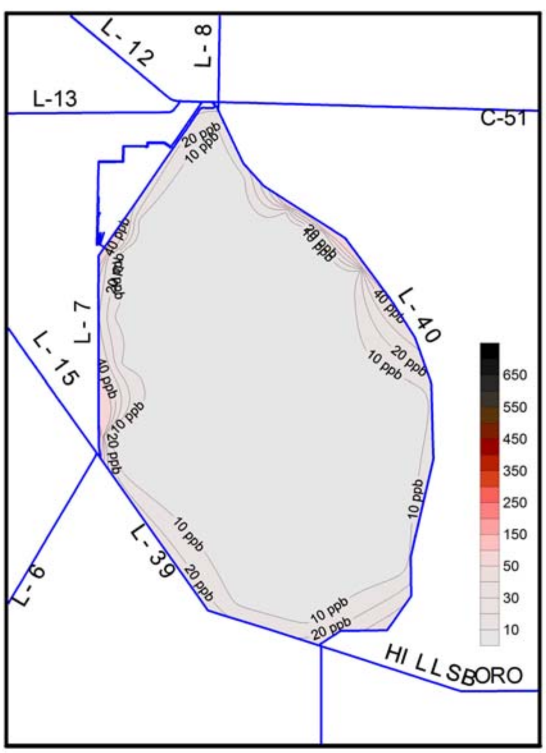
December 2005



January 2006



February 2006



Attachment 1. DBHydro Keys

Station	Parameter	DBHYDRO Key
ACME1	Flow	OH647
ACME1	Flow	JO088
ACME1	TP	SZ163
ACME2	Flow	OH648
ACME2	Flow	JO089
ACME2	TP	SZ199
G-94A	Flow	NI751
G-94A	Flow	SX614
G-94B	Flow	NI750
G-94B	Flow	SX615
G-94B	TP	R3659 / H6538
G-94C	Flow	MW385
G-94C	Flow	OR446
G-300	Flow	TA411
G-300	TP	R3512
G-300	TW stage	KN628
G-301	Flow	TA412
G-301	TP	JJ353
G-301	TW stage	KS686
G-251	Flow	JW222
G-251	Flow	15848
G-251	TP	JJ344
G-251	TW stage	16219
G-341	Flow	TA816
G-310	Flow	M2901
G-310	TP	PK919
G-338	TW stage	TA865
S-10A	Flow	15261
S-10A	TP	TA419
S-10C	Flow	15262
S10C	TP	TA420
S-10C	HW stage	G5070
S-10C	TW stage	G5071
S-10D	Flow	15263
S-10D	TP	TA421
S-10E	Flow	K5484
S-10E	HW stage	16229
S-10E	TW stage	16230
S-39	Flow	K5489
S-39	TP	06733
S-39	HW stage	6660
S-362	Flow	TA974
S-362	Flow	TP369
S-362	TP	R3502
S-362	TW stage	TA972
1-7	Stage	FE775
1-8C	Stage	FE776
1-8T	Stage	15809
1-9	Stage	FE777
LOXWS	Potential ET	RW485

Attachment 2.

From: Sylvester, Susan [ssylvest@sfwmd.gov]
Sent: Friday, May 26, 2006 3:04 PM
To: Redfield, Garth
Cc: Burns, Kirk; Neidrauer, Calvin; Kosier, Thomas; Powell, Dean; gary@garygoforth.net; Ashley, Jonathan A SAJ
Subject: Summary and information regarding the WCA-1 temporary deviation (TD)

Attachments: WCA-1_TD_20Apr2005.jpg; hydrograph1.jpg
Garth
As discussed at the TOC meeting this week, I have put together a summary and provided information regarding the WCA-1 temporary deviation.

The temporary deviation (TD) for WCA-1 has been in place since 22-April-2005 and expires on 31-July-2006. The SFWMD is working with LNWR, Mark Musaus and the USACE to extend the expiration date.

The EA for this action is available on the USACE planning documents website under Palm Beach County:
http://planning.saj.usace.army.mil/envdocs/envdocsb.htm

The following is a summary of the WCA-1 TD:

The WCA-1 Regulation Schedule that has been in place since 1995 has two conditions under which water supply releases from WCA-1 must be preceded by an equivalent volume of inflow, i.e. replacement water. The conditions are as follows:

A. When the WCA-1 water level elevation (stage) is in Zone A2 or Zone B of the regulation schedule, water supply releases can be made as needed, but must be preceded by an equivalent volume of inflow from Lake Okeechobee (LOK) unless the LOK stage is lower than one foot below the WCA-1 stage.

B. When the WCA-1 water level is in Zone C of the regulation schedule, there can be no water supply releases unless preceded by an equivalent volume of inflow (preceding inflows) from LOK, regardless of LOK level.

The purpose of requiring preceding inflows has been to reduce the frequency of annual dry outs and improve hydrologic conditions for wading birds and aquatic organisms utilizing the LNWR.

Post hurricane Jeanne in 2004 the condition of LKO water was very poor and the requirement for preceding inflows was evaluated by the USACE, LNWR and SFWMD. STA-1E was not up and running and STA-1W suffered damage from the Hurricanes. The staff at the LNWR concluded that it would be better to tolerate some lower water levels in the Refuge rather than force the flow of water through STA-1W during the dry season, further damaging the STA and lengthening its recovery time. It was expected that deviating by not providing make-up water from Lake Okeechobee would reduce the phosphorus load to LNWR and reduce the stress on Storm-water Treatment Area -1 West (STA-1W).

Objectives of the temporary deviation:
A. Minimize the potential increase of phosphorus load.

B. Maximize recovery of STA-1W by deferring the preceding inflow requirement during water supply operations without increasing environmental stress when in Zones A2 and B of the WCA-1 regulation schedule.

C. Provide reasonable opportunity for water supply releases without significantly reducing protection of fish and wildlife resources in the Refuge.

The language for the interim (TD) regulation schedule was developed as follows:

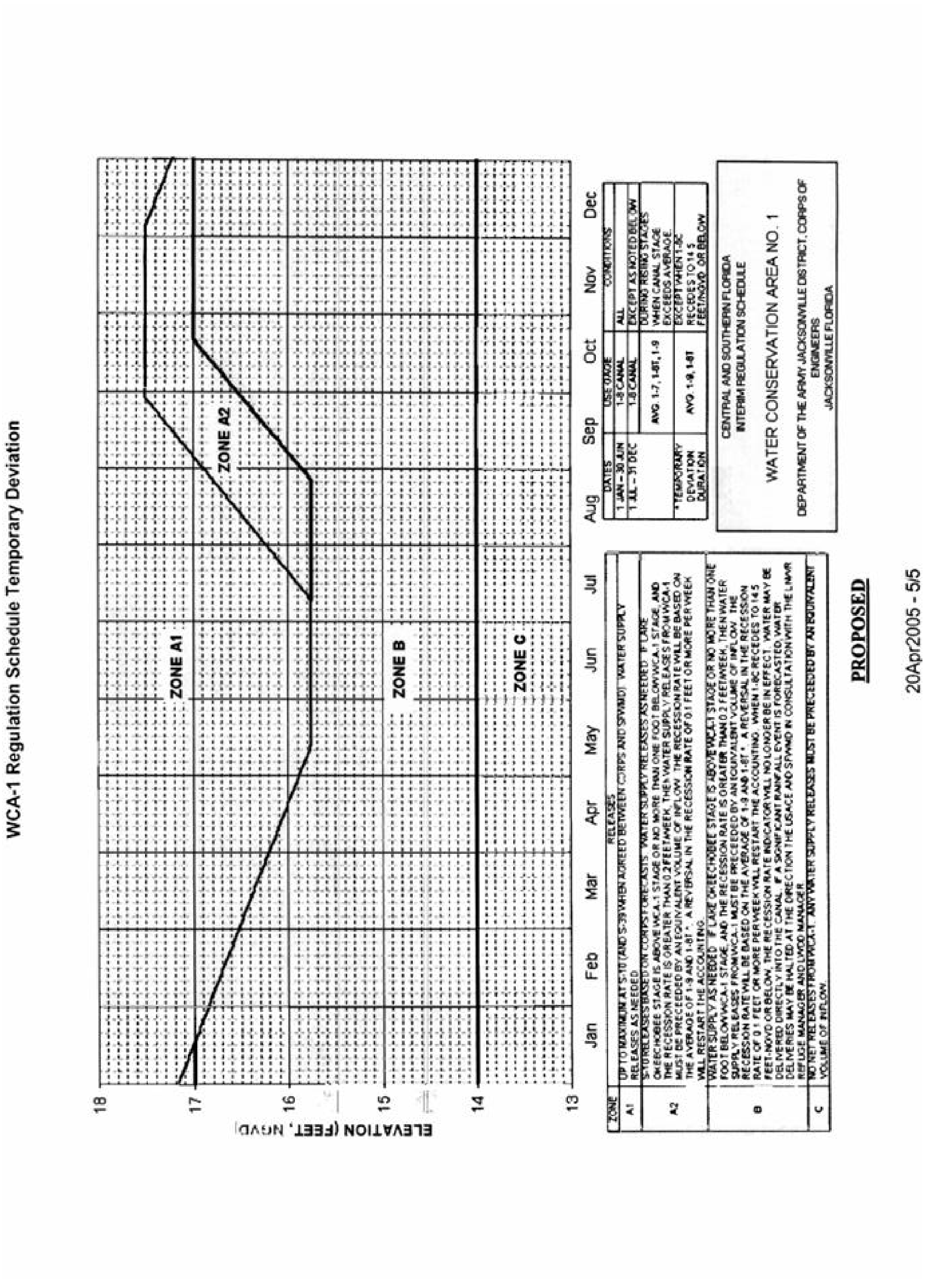
If Lake Okeechobee stage is above WCA-1 stage or no more than one foot below WCA-1 stage, and the recession rate is greater than 0.2 feet/week, then water supply releases from WCA-1 must be preceded by an equivalent volume of inflow. The recession rate will be based on the average of 1-9 and 1-8t.

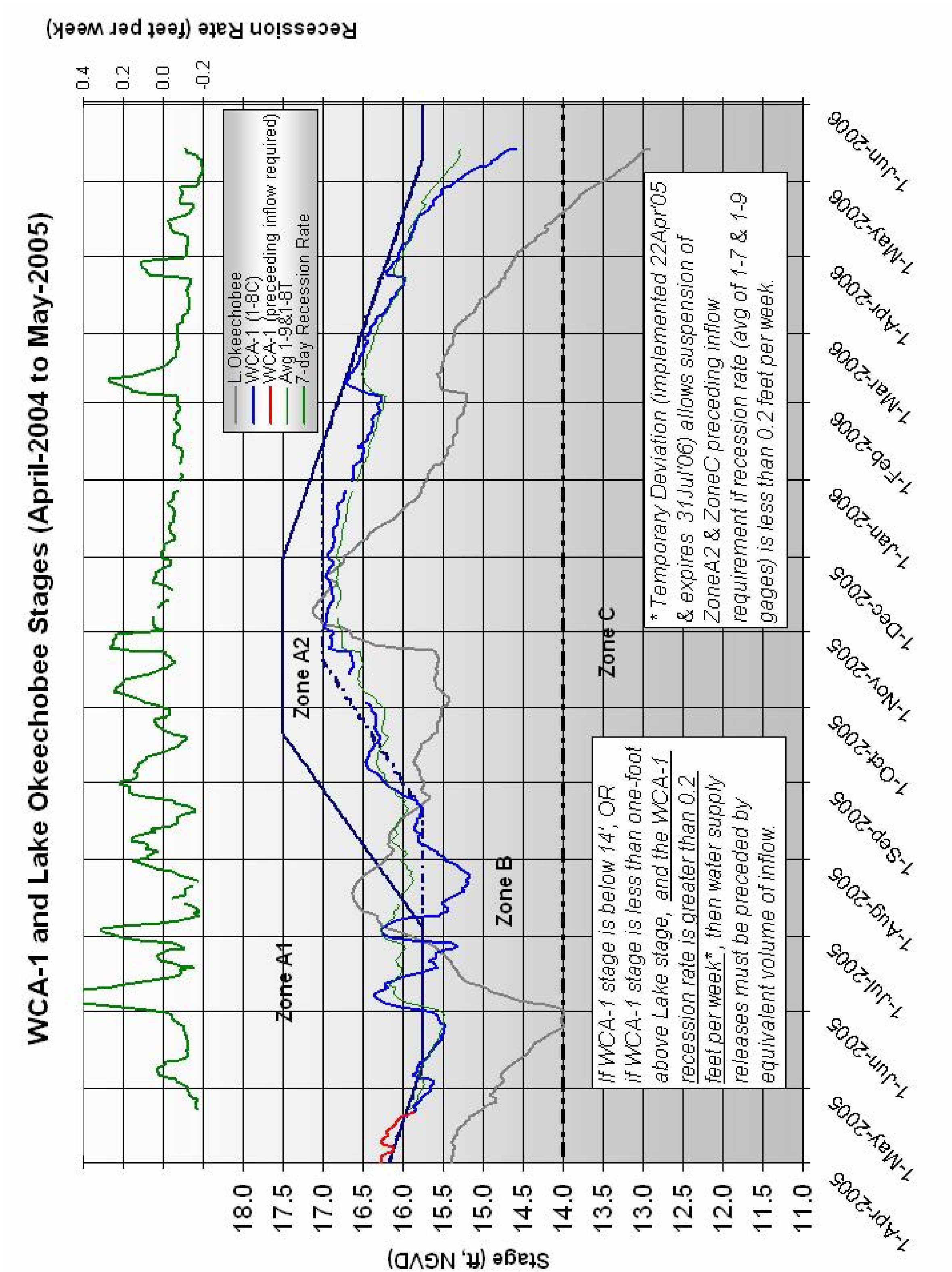
There were a few times when this recession rate was reached (late April – early May of 2006), but the WCA-1 stage was more than a foot above the lake stage & the WCA-1 schedule criteria did not require matching inflows. Thus the recession rate criteria were not relevant in those cases.

The attached graphic (hydrograph1.jpg) shows the WCA-1 stage compared with the LOK stage and the 2 gage average. The USACE confirmed that since inception of the TD, there have been no events that required preceding inflows. Note that the red hydrograph represents the conditions requiring preceding inflows. This condition occurred prior to the implementation of the TD on 22-April-2005. But there has been no preceding inflow requirement since the TD was implemented.

Thanks to Cal Neidrauer (SFWMD) and Andy Ashley (USACE) for helping to pull this information together.

Susan B. Sylvester
Deputy Director, Operations Control Department
South Florida Water Management District
(561) 682-6152


WCA-1 Regulation Schedule Temporary Deviation
ELEVATION (FEET, NGVD)
18
17
16
15
14
13
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
ZONE A1
ZONE A2
ZONE B
ZONE C
CENTRAL AND SOUTHERN FLORIDA
INTERIM REGULATION SCHEDULE
WATER CONSERVATION AREA NO. 1
DEPARTMENT OF THE ARMY JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE FLORIDA
PROPOSED
20Apr2005 - 5/5


WCA-1 and Lake Okeechobee Stages (April-2004 to May-2005)
Recession Rate (feet per week)
Stage (ft, NGVD)
L.Okeechobee
WCA-1 (1-8C)
WCA-1 (preceeding inflow required)
Avg 1-9&1-8T
7-day Recession Rate
Zone A1
Zone A2
Zone B
Zone C
If WCA-1 stage is below 14', OR if WCA-1 stage is less than one-foot above Lake stage, and the WCA-1 recession rate is greater than 0.2 feet per week*, then water supply releases must be preceded by equivalent volume of inflow.
* Temporary Deviation (implemented 22Apr'05 & expires 31Jul'06) allows suspension of ZoneA2 & ZoneC preceding inflow requirement if recession rate (avg of 1-7 & 1-9 gages) is less than 0.2 feet per week.
1-Apr-2005
1-May-2005
1-Jun-2005
1-Jul-2005
1-Aug-2005
1-Sep-2005
1-Oct-2005
1-Nov-2005
1-Dec-2005
1-Jan-2006
1-Feb-2006
1-Mar-2006
1-Apr-2006
1-May-2006
1-Jun-2006