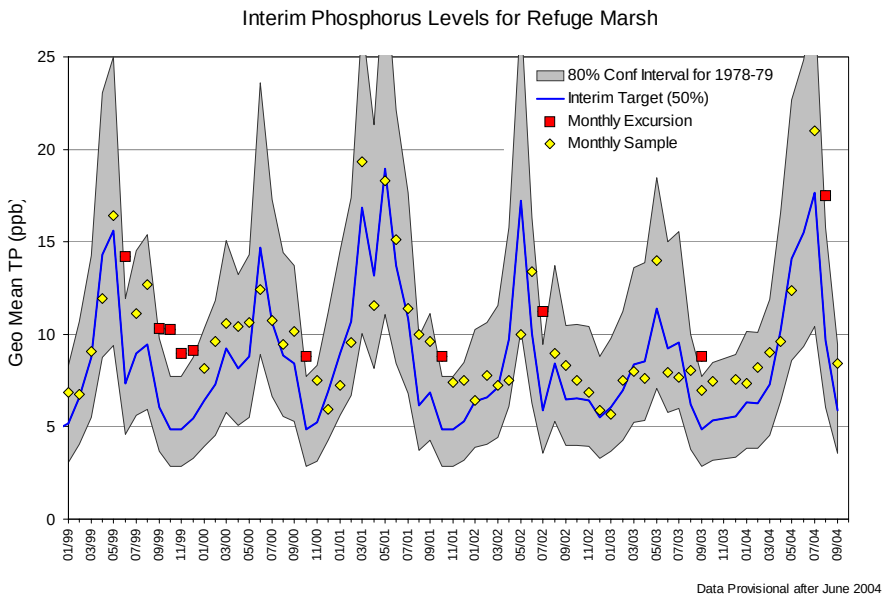
Analysis of Refuge Interim P Level Excursions
September 2003 & August 2004

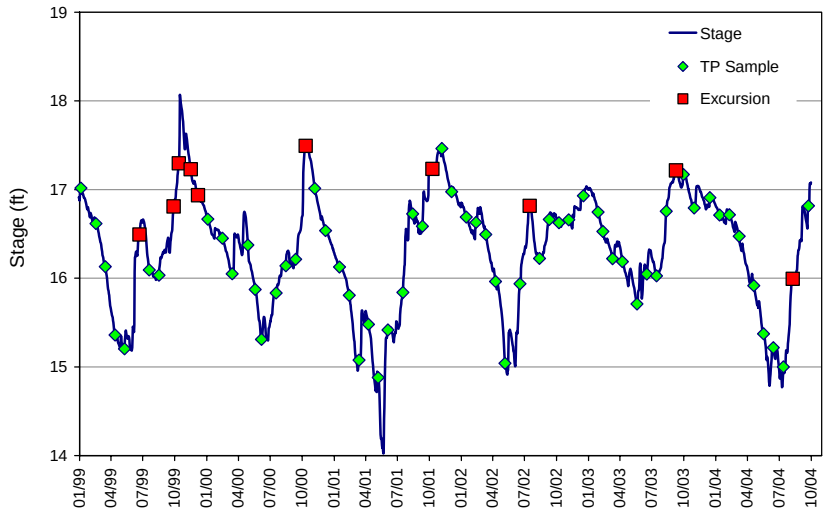
W. Walker for U.S Dept of the Interior

TOC Meeting

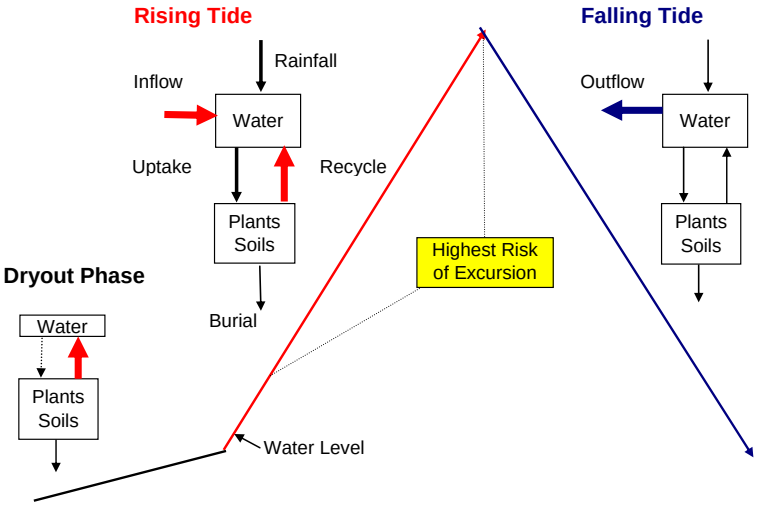
November 8, 2004



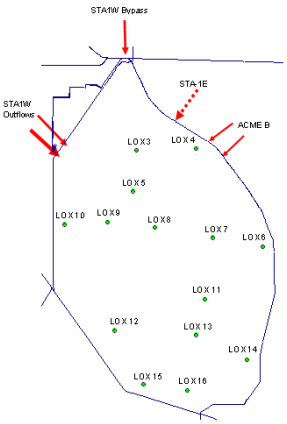
Daily Stage & Interim P Level Excursions

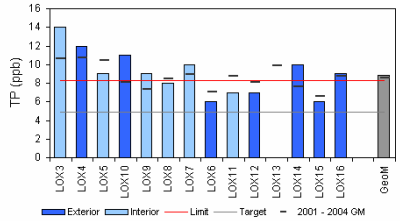


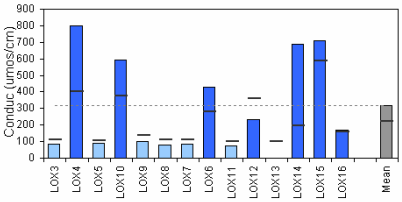
Phosphorus Fluxes over Yearly Stage Cycle

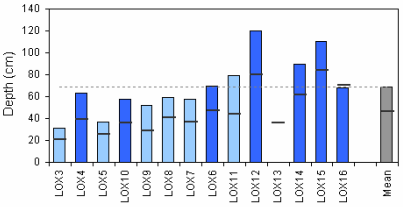


Refuge Marsh Phosphorus Levels Month: September-2003





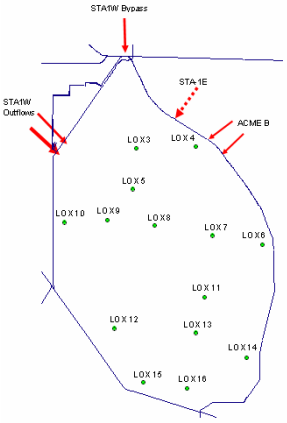


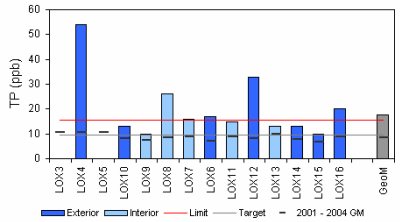


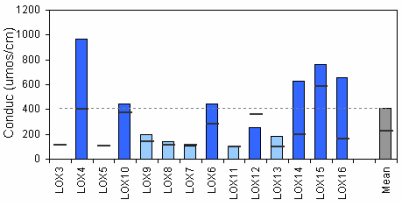
Sampled Dates	09/08/03	-	09/09/03
Mean Stage	17.2	ft	
Sites Monitored	13	/ 14	
Median TP	9.0	ppb	
Geometric Mean TP	8.8	ppb	
Interim Target	4.8	ppb	
Interim Limit	8.3	ppb	Excursion
Longterm Target	4.2	ppb	
Longterm Limit	7.2	ppb	Excursion
Mean Sampled Depth	69	cm	

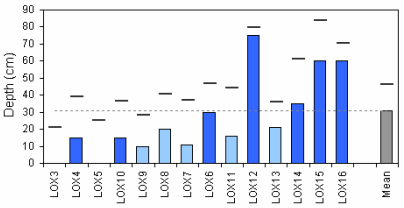
Sites Sorted North --> South

Refuge Marsh Phosphorus Levels Month: August-2004 Provisional Data



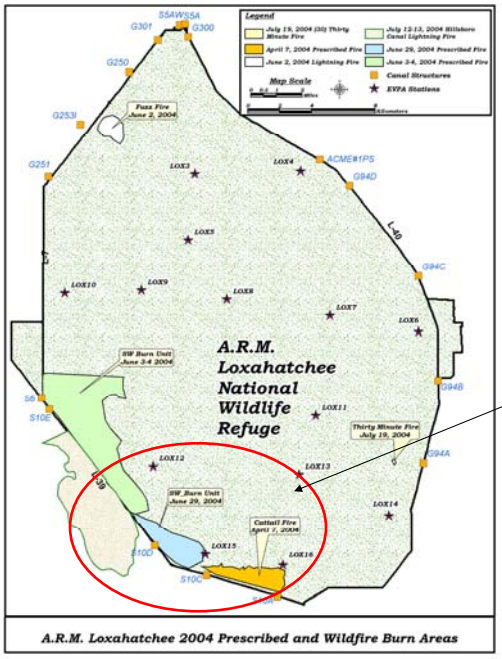






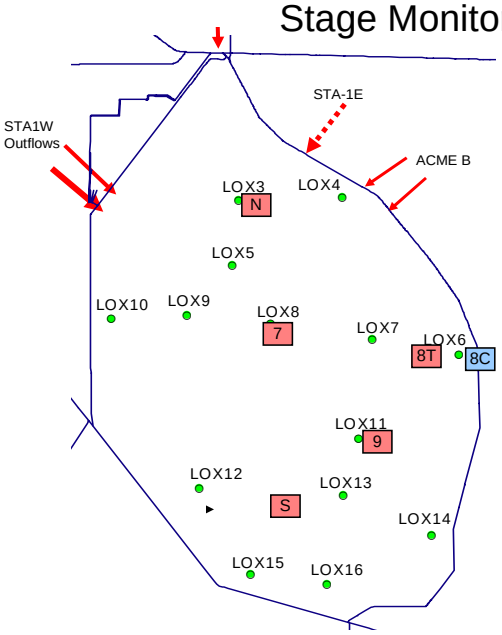
Sampled Dates	08/09/04	-	08/10/04
Mean Stage	16.0	ft	
Sites Monitored	12	/ 14	
Median TP	15.5	ppb	
Geometric Mean TP	17.5	ppb	
Interim Target	9.7	ppb	
Interim Limit	15.4	ppb	Excursion
Longterm Target	7.9	ppb	
Longterm Limit	12.5	ppb	Excursion
Mean Sampled Depth	31	cm	

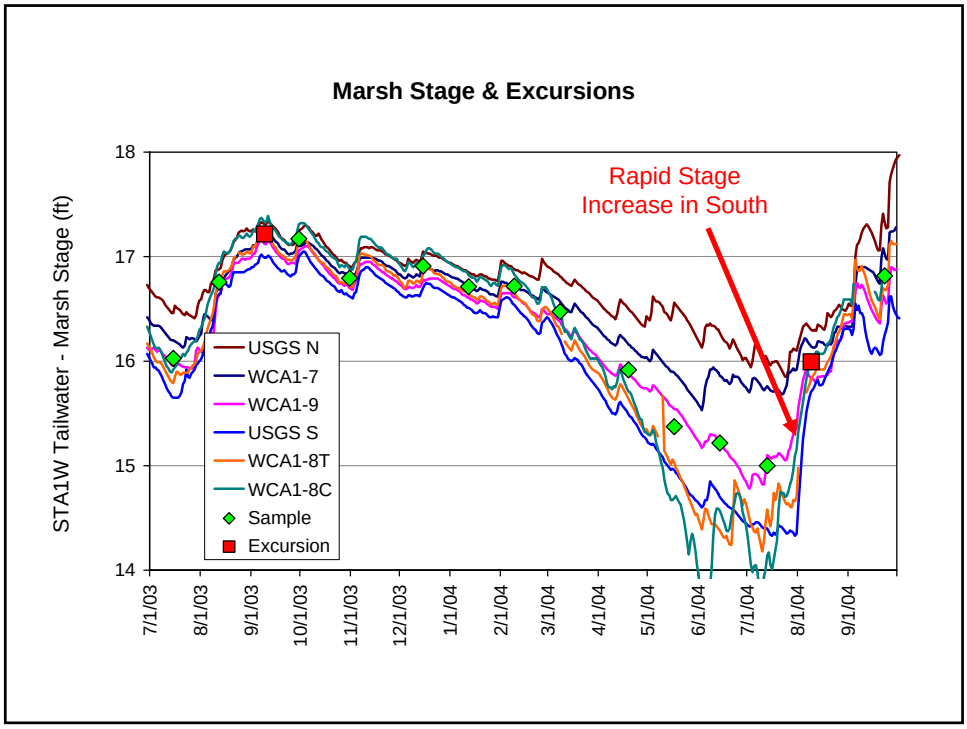
Sites Sorted North --> South

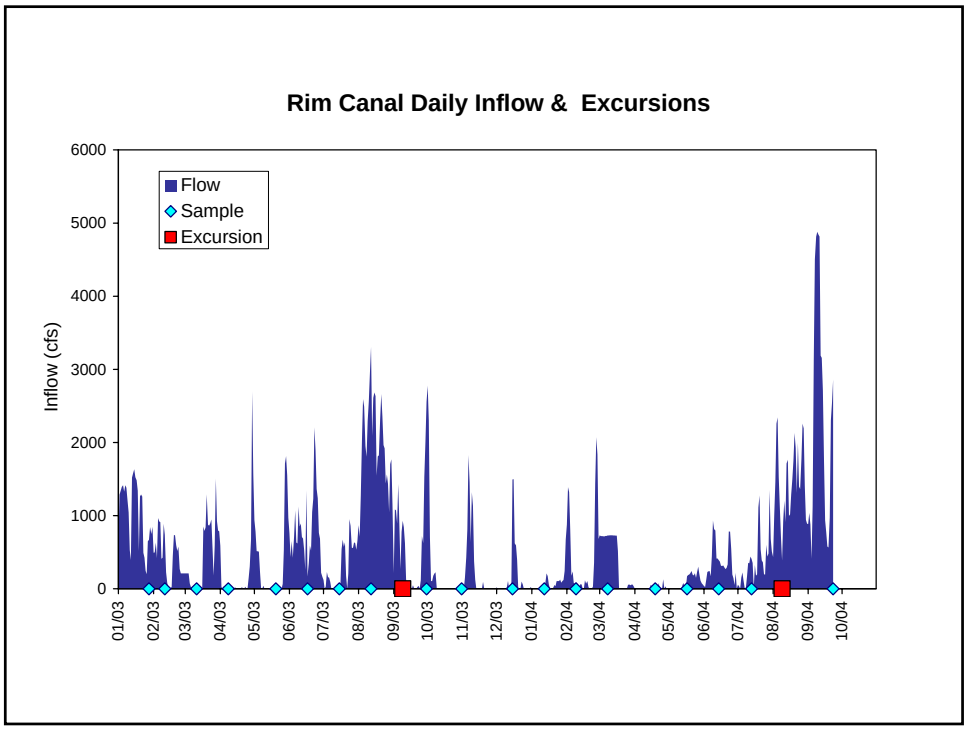


Sites 12, 15, 16
Adjacent To
Burned Areas
April-June 2004

Stage Monitoring Sites




Marsh Stage & Excursions
STA1W Tailwater - Marsh Stage (ft)
18
17
16
15
14
Rapid Stage
Increase in South
USGS N
WCA1-7
WCA1-9
USGS S
WCA1-8T
WCA1-8C
Sample
Excursion
7/1/03
8/1/03
9/1/03
10/1/03
11/1/03
12/1/03
1/1/04
2/1/04
3/1/04
4/1/04
5/1/04
6/1/04
7/1/04
8/1/04
9/1/04


Rim Canal Daily Inflow & Excursions
Inflow (cfs)
6000
5000
4000
3000
2000
1000
0
Flow
Sample
Excursion
01/03
02/03
03/03
04/03
05/03
06/03
07/03
08/03
09/03
10/03
11/03
12/03
01/04
02/04
03/04
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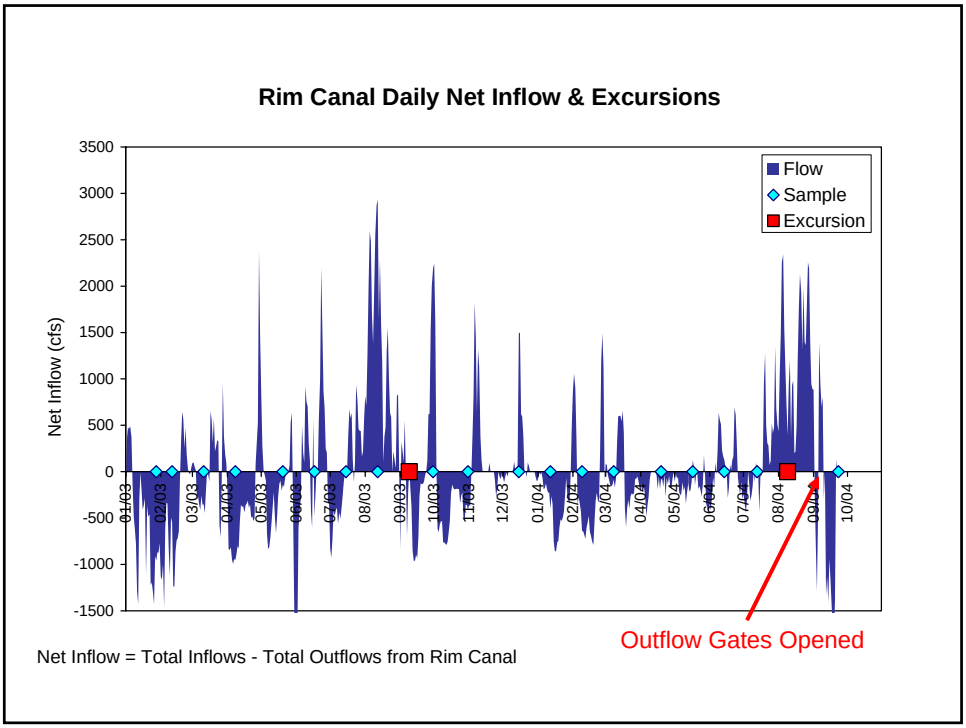
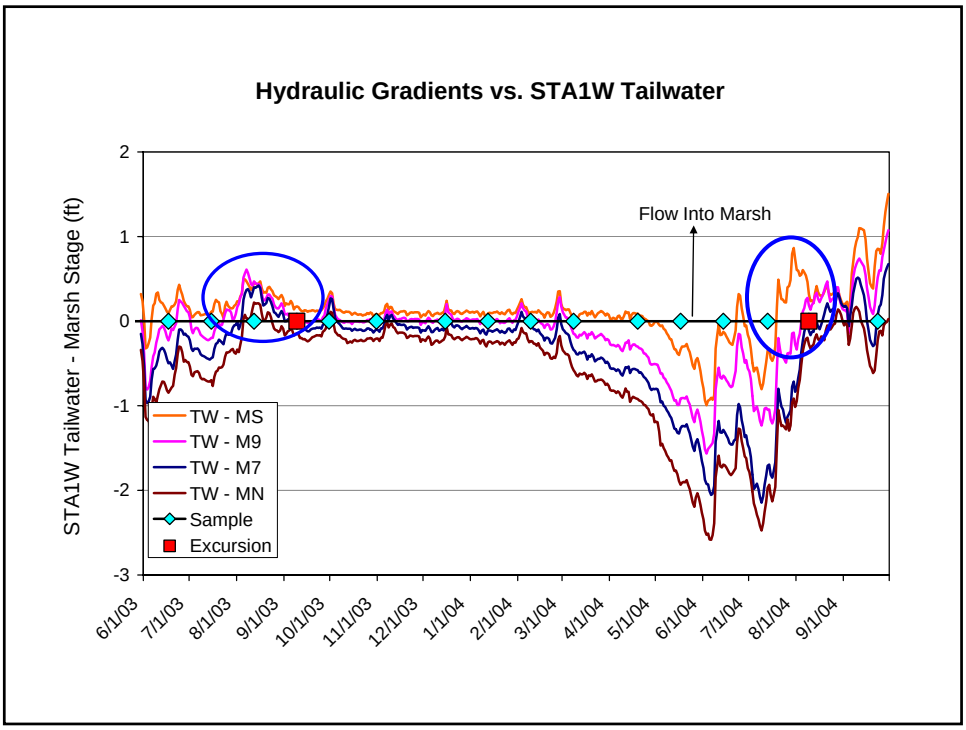
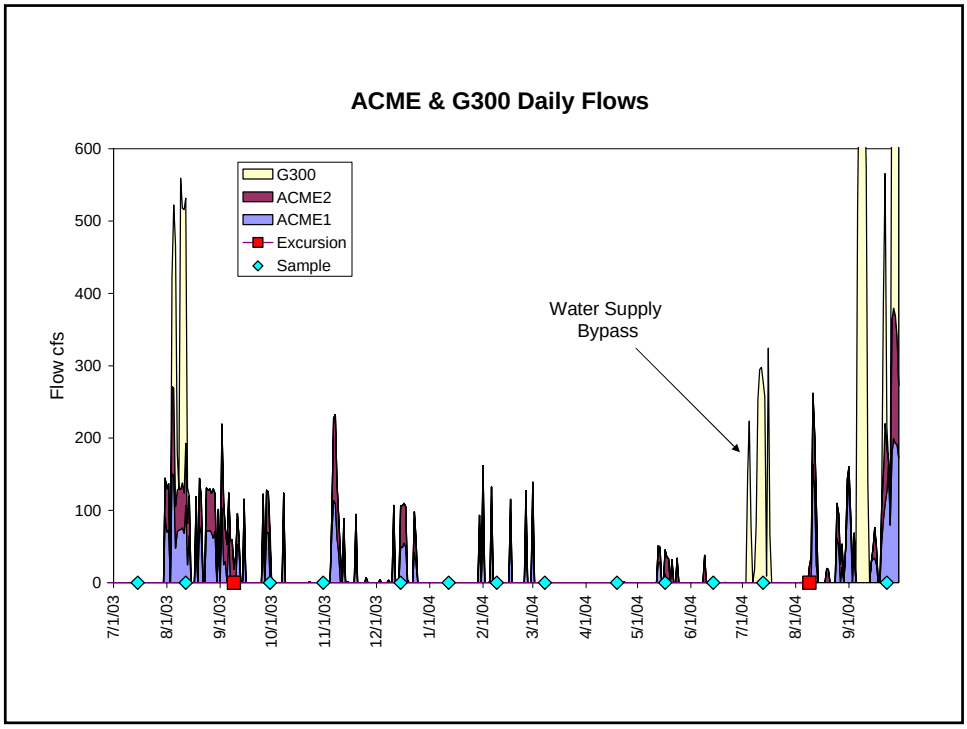
05/04
06/04
07/04
08/04
09/04
10/04


Rim Canal Daily Net Inflow & Excursions
Net Inflow (cfs)
3500
3000
2500
2000
1500
1000
500
0
-500
-1000
-1500
01/03
02/03
03/03
04/03
05/03
06/03
07/03
08/03
09/03
10/03
11/03
12/03
01/04
02/04
03/04
04/04
05/04
06/04
07/04
08/04
09/04
10/04
Flow
Sample
Excursion
Outflow Gates Opened
Net Inflow = Total Inflows - Total Outflows from Rim Canal


Hydraulic Gradients vs. STA1W Tailwater
STA1W Tailwater - Marsh Stage (ft)
2
1
0
-1
-2
-3
Flow Into Marsh
TW - MS
TW - M9
TW - M7
TW - MN
Sample
Excursion
6/1/03
7/1/03
8/1/03
9/1/03
10/1/03
11/1/03
12/1/03
1/1/04
2/1/04
3/1/04
4/1/04
5/1/04
6/1/04
7/1/04
8/1/04
9/1/04


ACME & G300 Daily Flows
Flow cfs
600
500
400
300
200
100
0
G300
ACME2
ACME1
Excursion
Sample
Water Supply
Bypass
7/1/03
8/1/03
9/1/03
10/1/03
11/1/03
12/1/03
1/1/04
2/1/04
3/1/04
4/1/04
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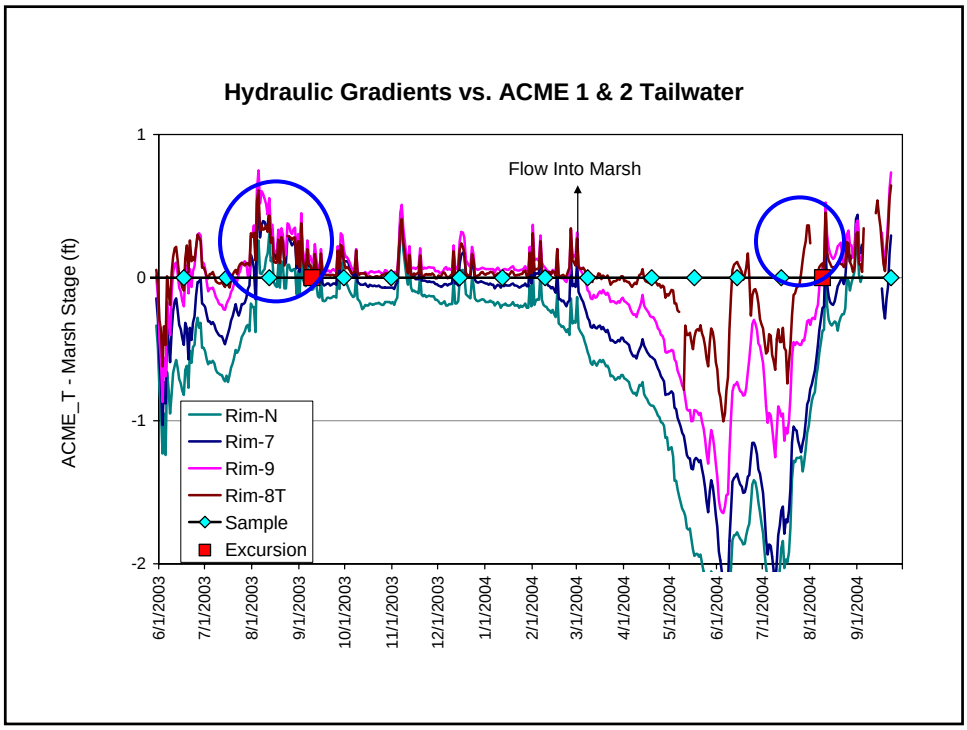
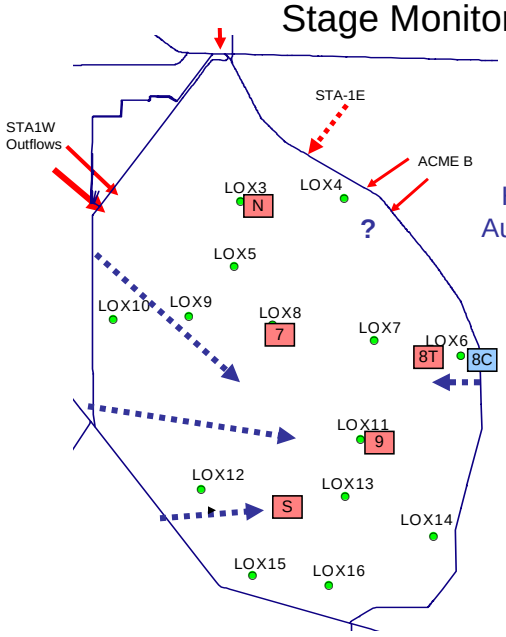
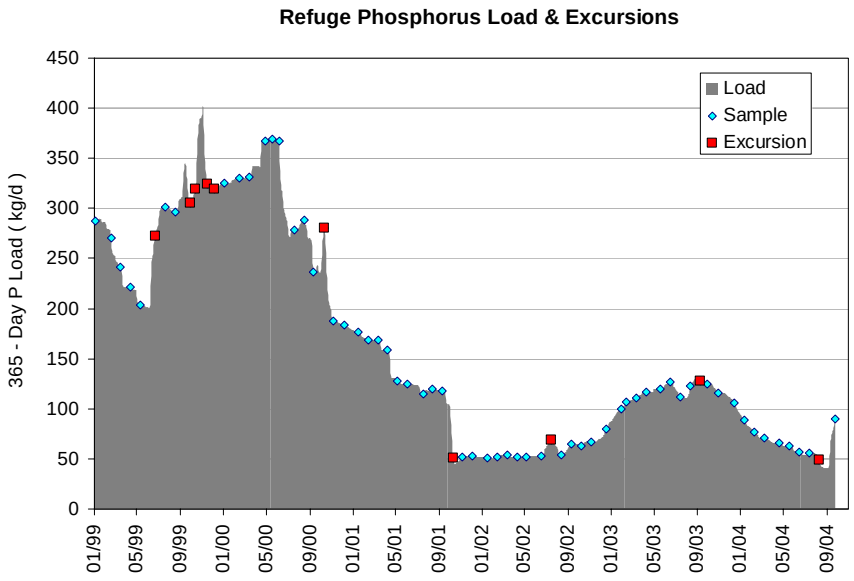
6/1/04
7/1/04
8/1/04
9/1/04


Hydraulic Gradients vs. ACME 1 & 2 Tailwater
ACME_T - Marsh Stage (ft)
1
0
-1
-2
Flow Into Marsh
Rim-N
Rim-7
Rim-9
Rim-8T
Sample
Excursion
6/1/2003
7/1/2003
8/1/2003
9/1/2003
10/1/2003
11/1/2003
12/1/2003
1/1/2004
2/1/2004
3/1/2004
4/1/2004
5/1/2004
6/1/2004
7/1/2004
8/1/2004
9/1/2004

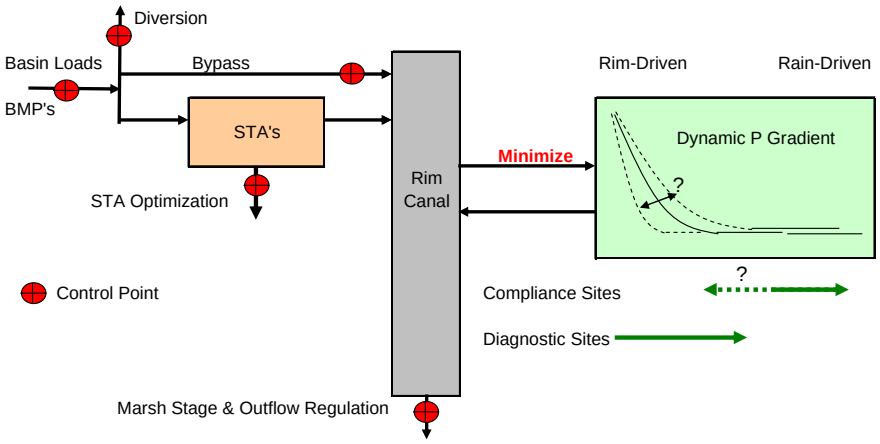
Stage Monitoring Sites



Hydraulic Gradients
August 2004 Excursion



Conceptual Phosphorus Transport Model



Summary

Factors Contributing to P Excursions
- Phosphorus Sources
  - Atmospheric Deposition
  - External Inputs
- Transport Mechanisms Linked to Both Sources
  - Recycling from Plants/Soils Enhanced by Drought
  - Surface Flows

Direct Inflows Cannot be Discounted in Either the 9/03 or 8/04 Excursions
- Antecedent Inflows & Hydraulic Gradients
- Transport Model Needed to Assess Magnitude

Cumulative Data Suggest that Site 4 is Impacted by External Loads

Controlled Burn in April-June 2004 Potentially Contributed to 8/04 Excursion
- Confounded by Extreme Drought

Need for Further Diagnostics (Outer Marsh Monitoring, Modeling)

Continued Focus on Reducing Total and Net Loads to Marsh
- External Load Controls
- Stage/Outlet Regulation