TOC Working Group to Examine Refuge TP Concentrations in May and June 2005

September 15, 2005

Supporting Document Outline

Mike Waldon

Objective: To compile information related to answering the question – *Is there substantial evidence that the May and/or June excursions were due to error or extraordinary natural phenomena?*

1. Define "substantial evidence"
2. Unusual phenomena related to May/June 2005
    a. Rain & Wind
    b. Stage
    c. Inflows
    d. Inflow concentrations
    e. Inflow loads
    f. Aerial deposition
    g. Fire
3. Anomalies and exceptional values in the May/June sampling
    a. Observations
    b. TP percentiles
    c. TSS
    d. Conductivity and TDS
4. Contemporaneous observations in adjacent waters and wetlands
    a. LOXA enhanced monitoring sites
    b. XYZ sites
    c. Refuge perimeter (rim) canals
    d. WCA-2A
    e. STA-1W, STA-1E
5. Summary observations
6. Evidence for and against error – sources
    a. Outlier analysis for samples
    b. Lab QA (blanks etc.)
    c. Contamination
7. Evidence for and against natural and anthropogenic phenomena
    a. Loading
    b. Meteorological
    c. Aerial deposition
    d. Planktonic algae
    e. Fire
    f. Canal water intrusion
    g. Other?

1

1. SUBSTANTIAL EVIDENCE

-Substantial evidence means "more than a mere scintilla. It means such relevant evidence as a reasonable mind might accept as adequate to support a conclusion." Richardson v. Perales, 402 U.S. 389, 401 (1971). [w]here there is such relevant evidence as reasonable minds might accept as adequate to support a conclusion even if it is possible to draw two inconsistent conclusions from the evidence. Landes v. Royal, 833 F.2d 1365, 1371 (9th Cir. 1987).

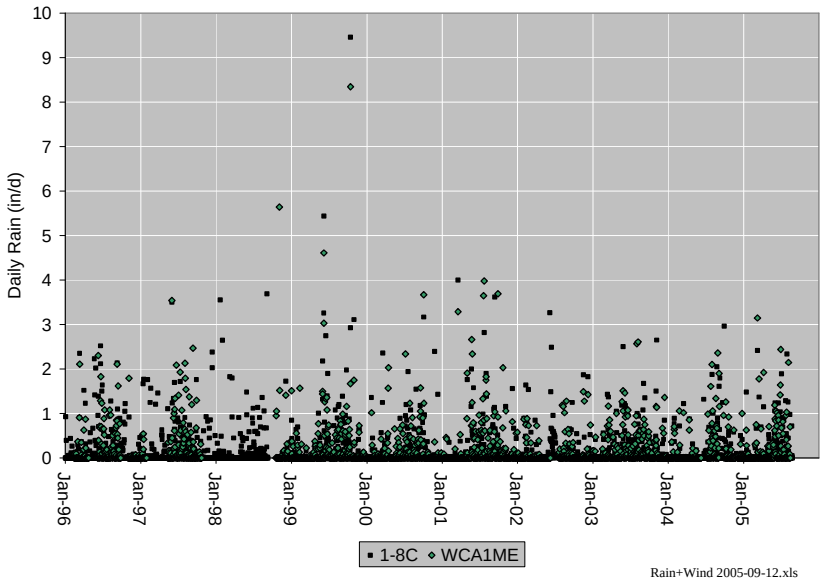
'Substantial' evidence is not synonymous with 'any' evidence. To constitute sufficient substantiality to support the verdict, the evidence must be 'reasonable in nature, credible, and of solid value; it must actually be "substantial" proof of the essentials which the law requires in a particular case.' (Estate of Teed (1952) 112 Cal.App.2d 638, 644; [citations].)" (Kruse v. Bank of America (1988) 202 Cal.App.3d 38, 51-52.) "It means such relevant evidence as a reasonable mind might accept as adequate to support a conclusion. " (Edison Co. v. Labor Board (1938) 305 U.S. 197, 229 [83 L.Ed. 126, 140, 59 S.Ct. 206].) "'Improbable conclusions drawn in favor of a party litigant through the sanction of a jury's verdict will not be sustained where testimony is at variance with physical facts and repugnance is material and self evident.'" (Estate of Teed (1952) 112 Cal.App.2d 638, 644, quoting from an Arkansas case.)

"While substantial evidence may consist of inferences, such inferences must be 'a product of logic and reason' and 'must rest on the evidence' ; inferences that are the result of mere speculation or conjecture cannot support a finding ." (Kuhn v. Department of General Services (1994) 22 Cal.App.4th 1627, 1633.)

http://www.lectlaw.com/def2/s087.htm

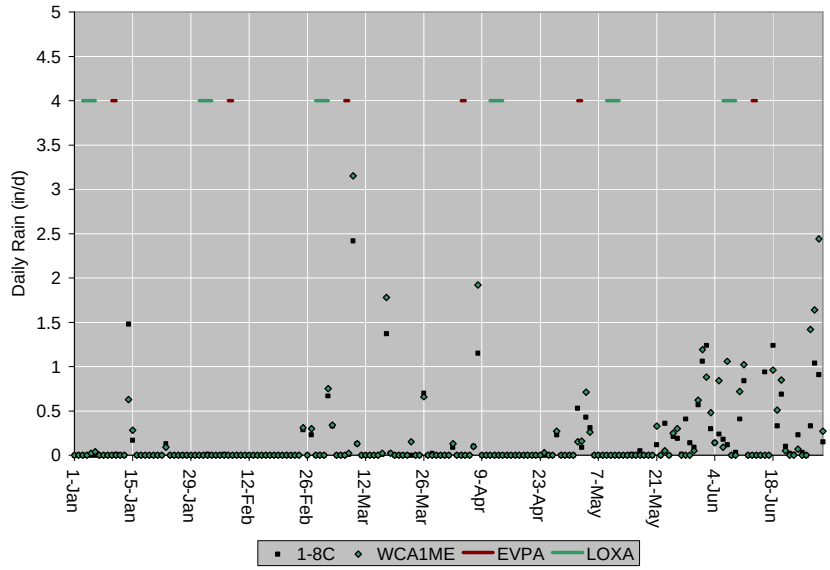
2

2.a Refuge Daily Rainfall

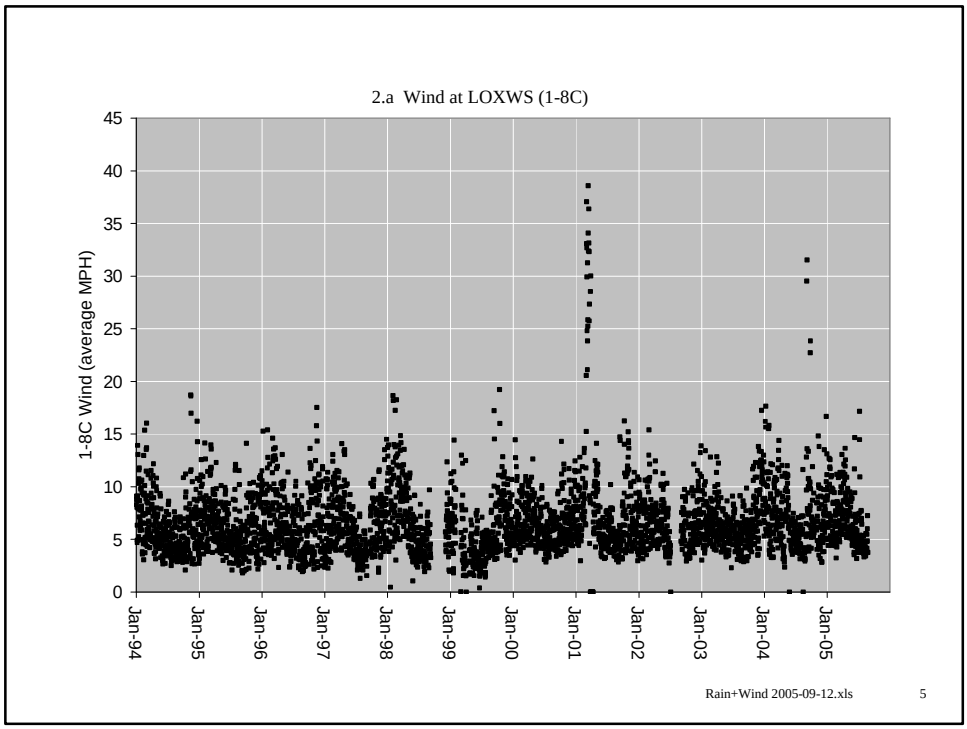


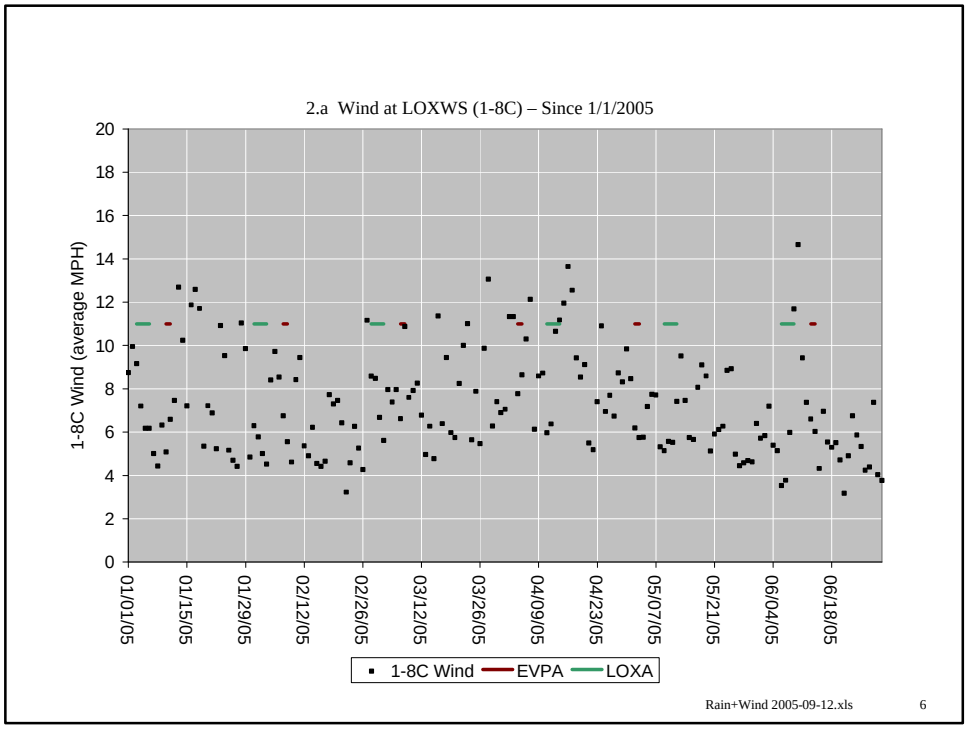
Rain+Wind 2005-09-12.xls 3

2.a Refuge Daily Rainfall CY 2005



Rain+Wind 2005-09-12.xls 4


2.a Wind at LOXWS (1-8C)
1-8C Wind (average MPH)
45
40
35
30
25
20
15
10
5
0
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Rain+Wind 2005-09-12.xls
5


2.a Wind at LOXWS (1-8C) – Since 1/1/2005
1-8C Wind (average MPH)
20
18
16
14
12
10
8
6
4
2
0
01/01/05
01/15/05
01/29/05
02/12/05
02/26/05
03/12/05
03/26/05
04/09/05
04/23/05
05/07/05
05/21/05
06/04/05
06/18/05
1-8C Wind
EVPA
LOXA
Rain+Wind 2005-09-12.xls
6

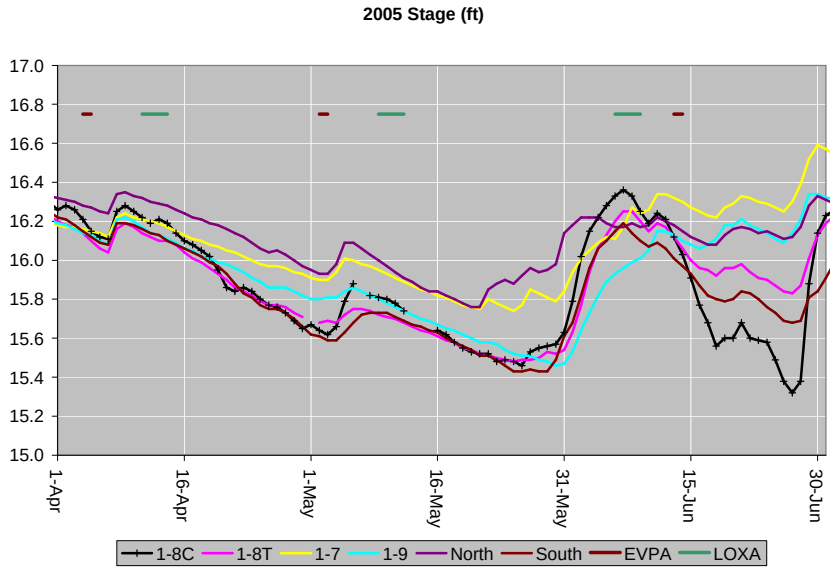
2.b Relevant stage relationships - Distances

Distance (km) From \ To	1-7	1-8C	1-8T	1-9	North	South	Canal
1-7	0.0	11.7	9.6	8.3	8.1	11.2	9.7
1-8C	11.7	0.0	2.2	8.1	16.8	15.0	0.0
1-8T	9.6	2.2	0.0	7.3	14.6	14.1	2.0
1-9	8.3	8.1	7.3	0.0	16.1	6.9	6.5
North	8.1	16.8	14.6	16.1	0.0	19.1	4.8
South	11.2	15.0	14.1	6.9	19.1	0.0	5.0

Distance between gages + slope.xls

7

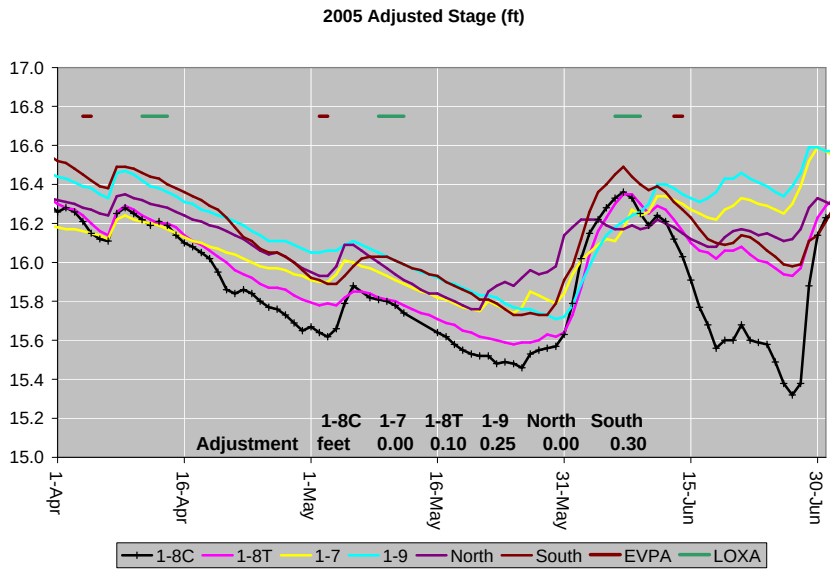
2.b Daily average stage in Refuge



Recent Stage 2005-08.xls

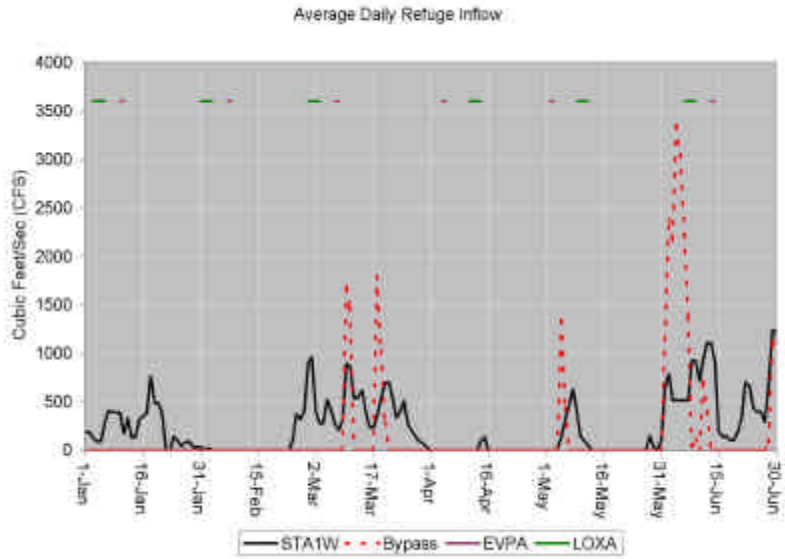
8

2.b Adjusted Daily average stage in Refuge



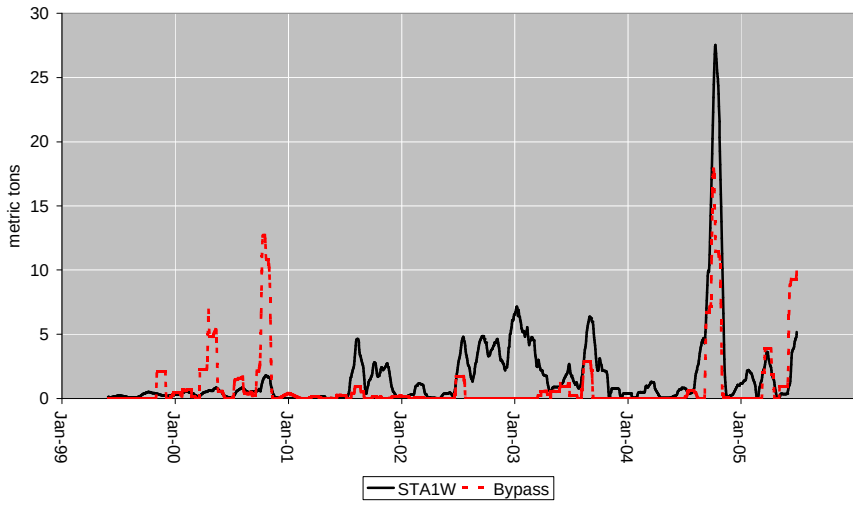
Recent Stage 2005-08.xls 9

2.c Refuge inflow and sampling dates



STA-1W-CY-2005-flows+loads.xls 10

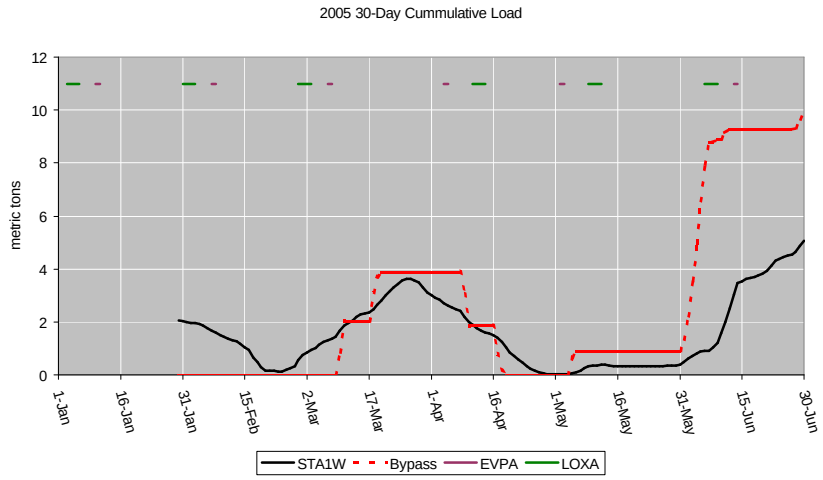
2.e 30-Day Cumulative TP load Since May 1, 1999



STA-1W-flows+loads.xls

11

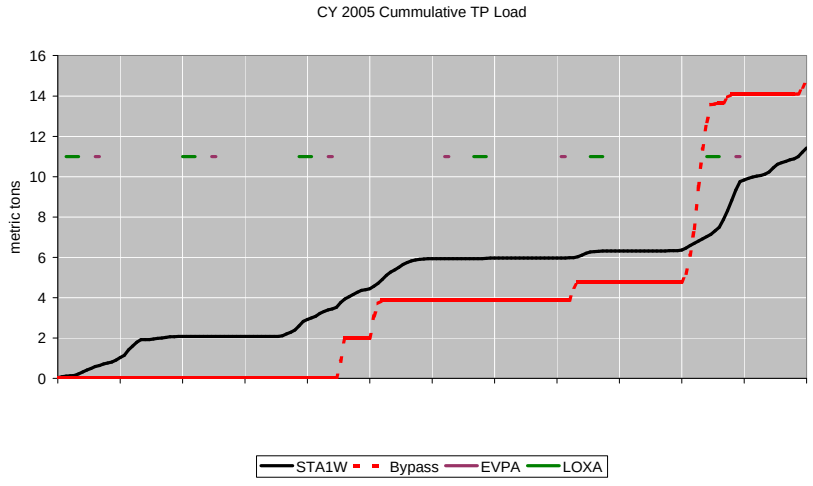
2.e 30-Day Cumulative TP load and Refuge sampling dates, CY 2005



STA-1W-CY-2005-flows+loads.xls

12

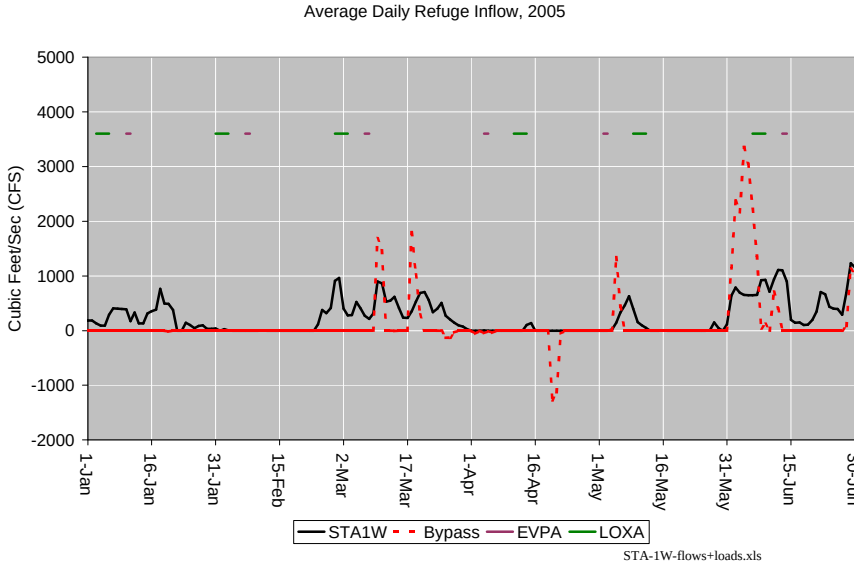
2.e Cumulative CY 2005 TP load to Refuge



STA-1W-CY-2005-flows+loads.xls

13

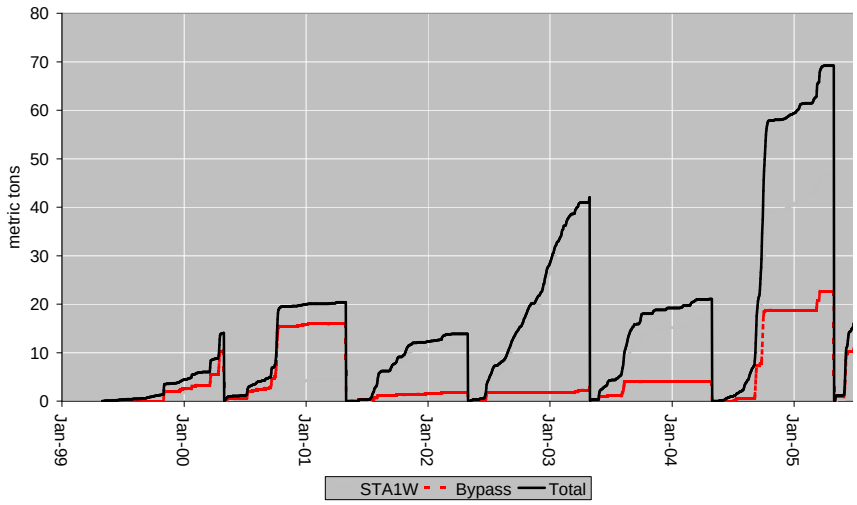
2.e Average Daily Inflow CY 2005 (STA1W = G-310+G-251, Bypass = G-300+G-301)



STA-1W-flows+loads.xls

14

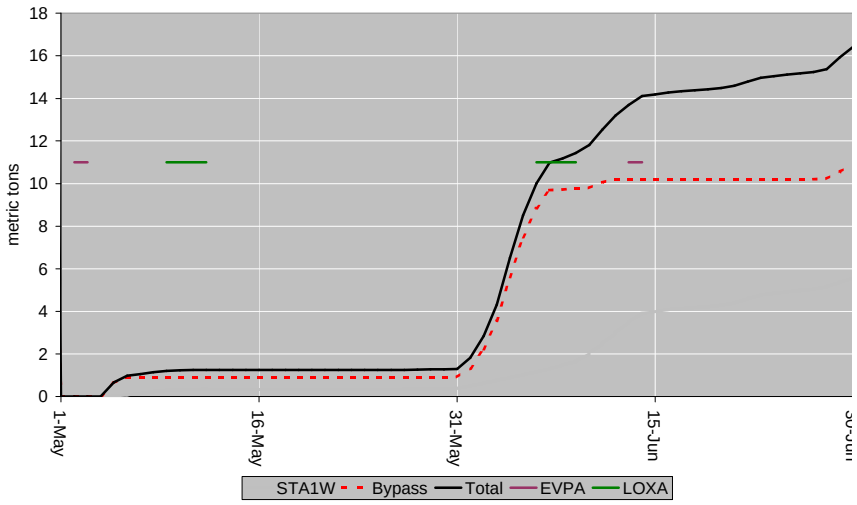
2.e Cumulative Load Over Florida Water Years Beginning May 1, 1999



STA-1W-flows+loads.xls

15

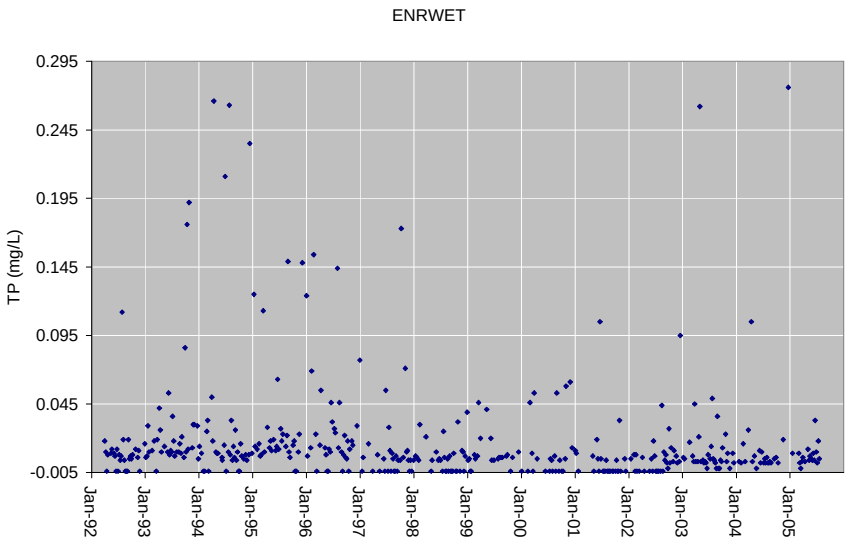
2.e Cumulative Load Over Florida Water Year 2006 (Beginning May 1, 2005)



STA-1W-flows+loads.xls

16

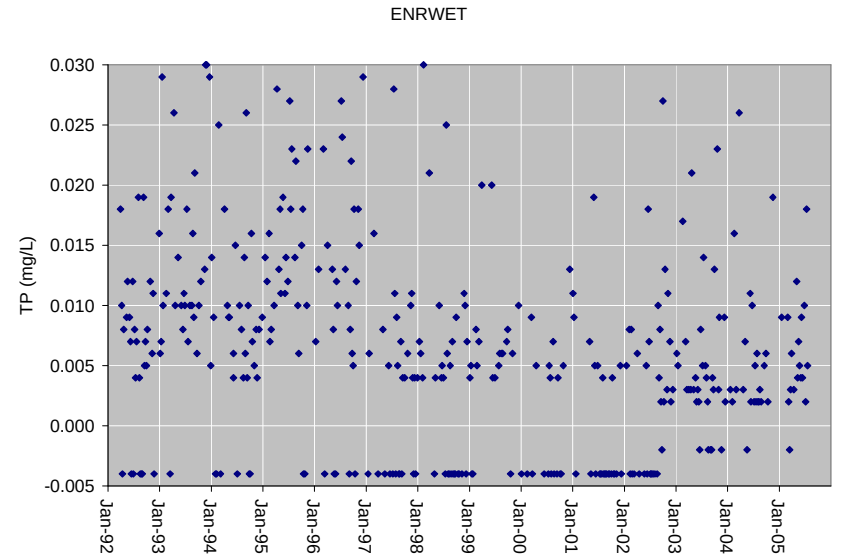
2.f ENRWET TP



ENRWET_data2005-09-07.xls

17

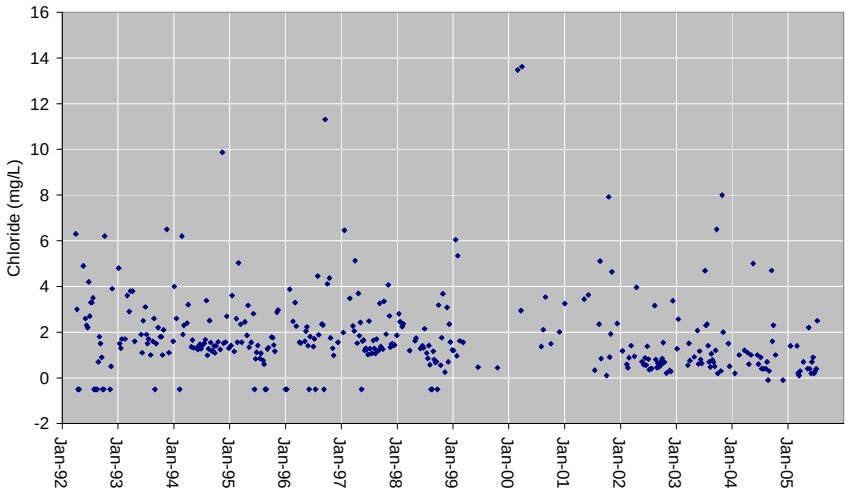
2.f ENRWET TP (Expanded Scale)



ENRWET_data2005-09-07.xls

18

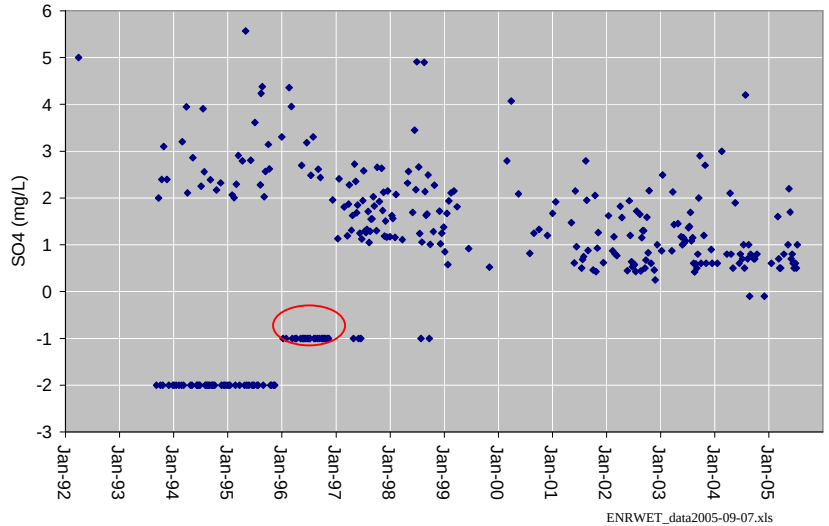
2.f ENRWET Chloride



ENRWET_data2005-09-07.xls

19

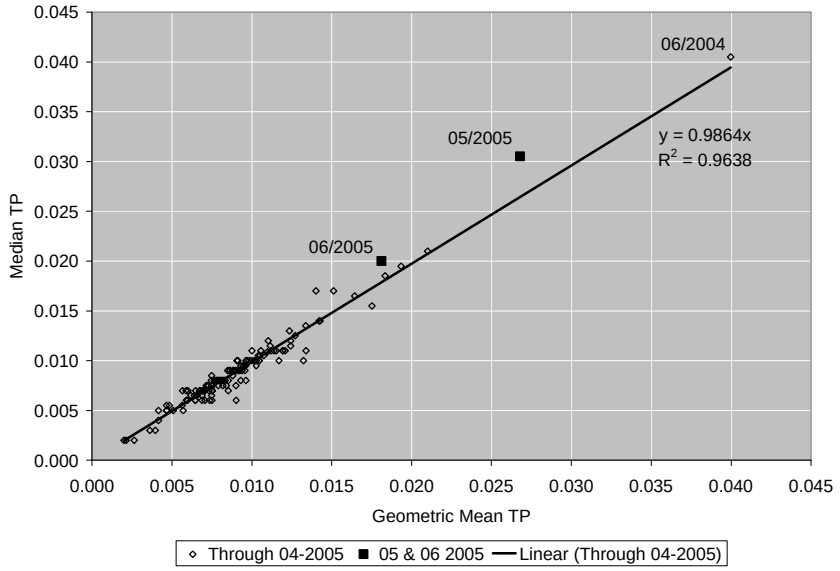
2.f ENRWET Sulfate



ENRWET_data2005-09-07.xls

20

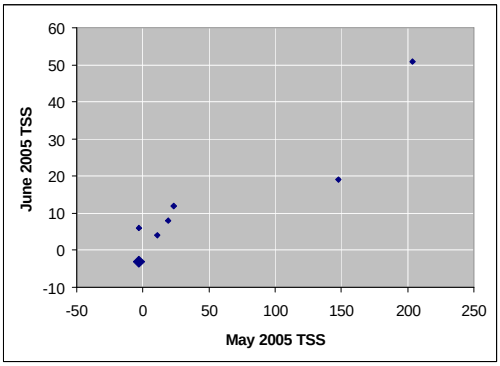
3.b How unusual were the LOX May and June TP data?



water_quality_data_CrossTab.xls

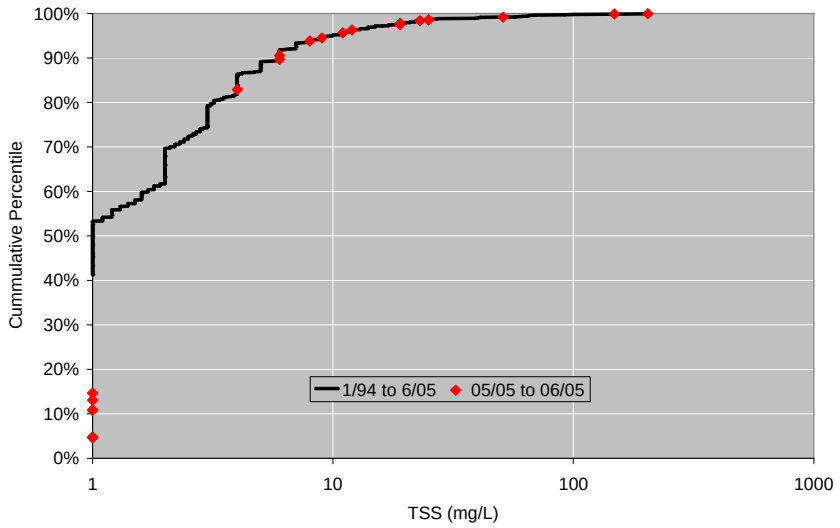
3.c How unusual were the LOX May and June TSS data?

Station	Date	Depth	TURB	T.SUS.SD
LOX12	20050503	0.30	1.0	-3
LOX12	20050614	0.38	0.6	-3
LOX15	20050503	0.30	0.6	-3
LOX15	20050614	0.33	1.1	-3
LOX16	20050503	0.31	0.7	-3
LOX4	20050613	0.16	1.0	-3
LOX13	20050614	0.20	0.9	4
LOX10	20050613	0.12	1.2	6
LOX16	20050614	0.26	0.9	6
LOX14	20050614	0.25	2.4	8
LOX6	20050614	0.16	1.1	9
LOX13	20050503	0.16	1.3	11
LOX8	20050613	0.16	1.5	12
LOX14	20050503	0.18	1.4	19
LOX7	20050613	0.18	2.0	19
LOX8	20050502	0.18	3.8	23
LOX9	20050613	0.11	5.5	25
LOX11	20050614	0.20	9.7	51
LOX7	20050502	0.08	43.8	148
LOX11	20050503	0.13	27.2	204



water_quality_data_CrossTab.xls

3.c How unusual were the LOX May and June TSS data?



water_quality_data_CrossTab.xls

23

3.d What other anomalies are there in the May & June data?

Conductivity values were flagged because of post-calibration failure and, in one case, a mass balance anomaly.

Conductivity
Missing values in DBHYDRO (as of 6/14/2005)

		COND
May-05		
	LOX8	173.6
	LOX12	211.3
Jun-05		
	LOX11	119
	LOX12	156
	LOX13	82.5
	LOX16	162

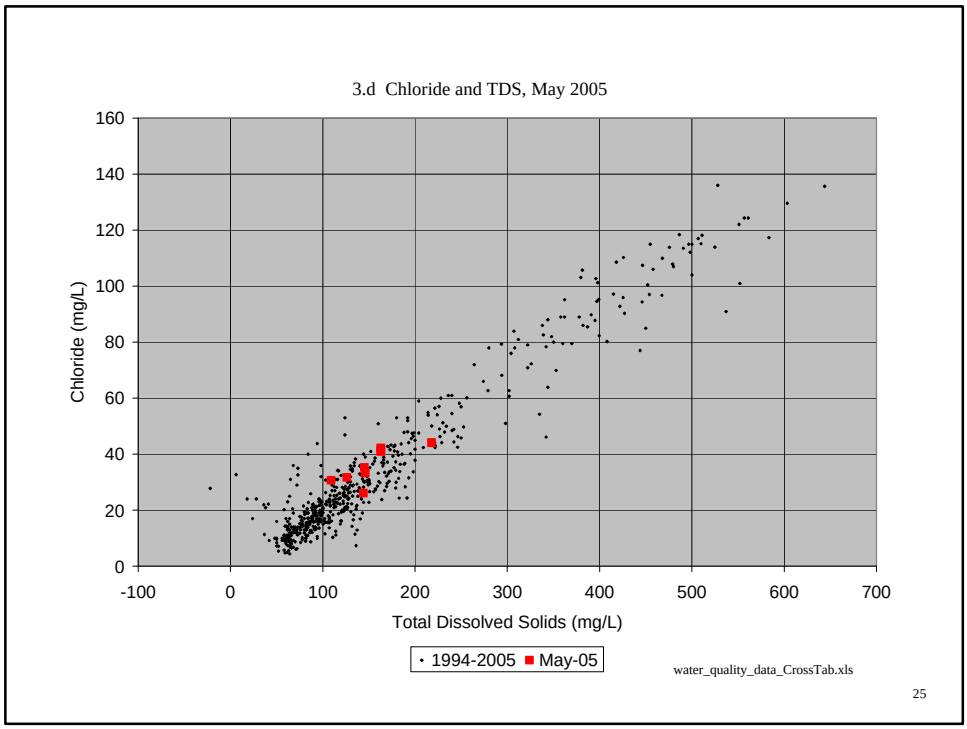
Anomalous TDS values

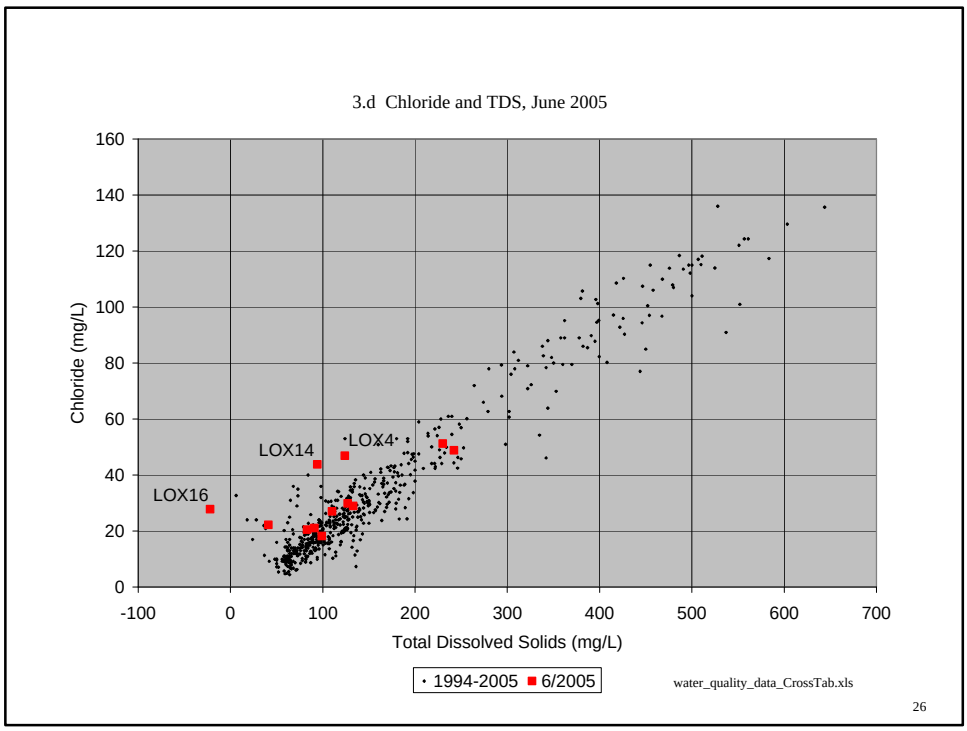
		COND	TDS	TDS/COND
Jun-05				
	LOX4	305	124	0.41
	LOX14	275	94	0.34
	LOX16	162	-22	<0.14

Note: typical historic value for TDS/COND is 0.69. Stdard Methods (20th ed., sect. 1030E.5, 1998) suggests ratio should not fall below 0.55 and not exceed 0.7 to 0.8.

Missing+AnomalousData.xls

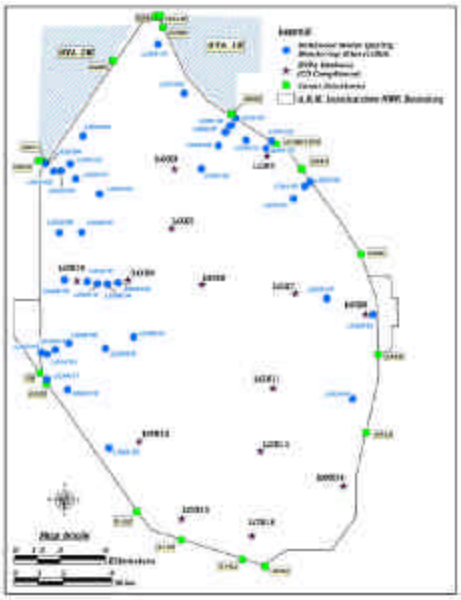
24


3.d Chloride and TDS, May 2005
Chloride (mg/L)
160
140
120
100
80
60
40
20
0
-100
0
100
200
300
400
500
600
700
Total Dissolved Solids (mg/L)
1994-2005
May-05
water_quality_data_CrossTab.xls
25


3.d Chloride and TDS, June 2005
Chloride (mg/L)
160
140
120
100
80
60
40
20
0
LOX14
LOX4
LOX16
-100
0
100
200
300
400
500
600
700
Total Dissolved Solids (mg/L)
1994-2005
6/2005
water_quality_data_CrossTab.xls
26

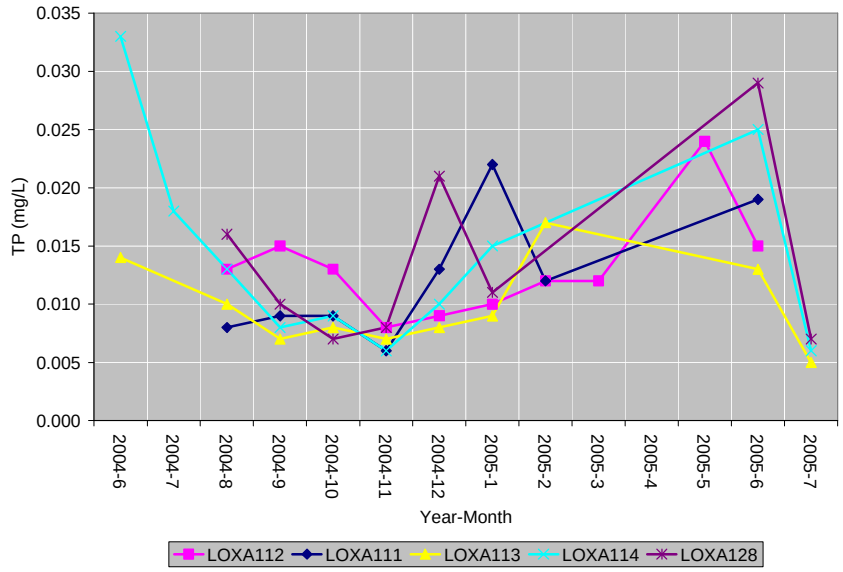
4. Sampling Site Maps (K. Weaver and G. Payne, 2005 SFER)

4.a Enhanced (LOXA) sampling sites



28

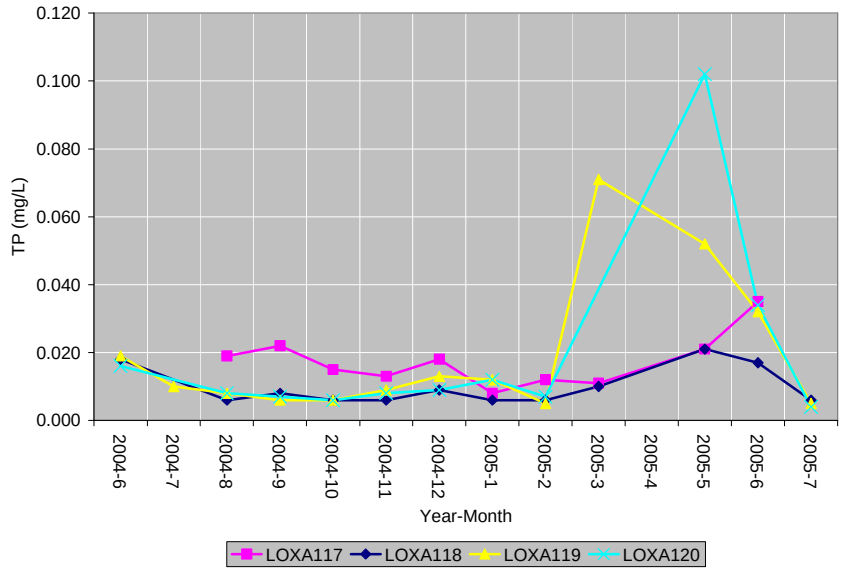
4.a Related Enhanced (LOXA) Observations: TP West Central Transect



LOXAWQ 2005-09-13.xls

29

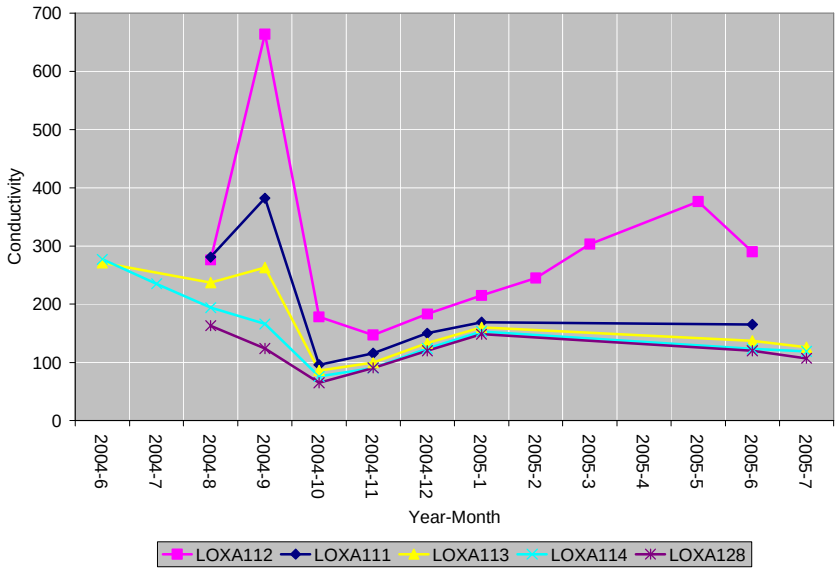
4.a Related Enhanced (LOXA) Observations: TP Southwest Transect



LOXAWQ 2005-09-13.xls

30

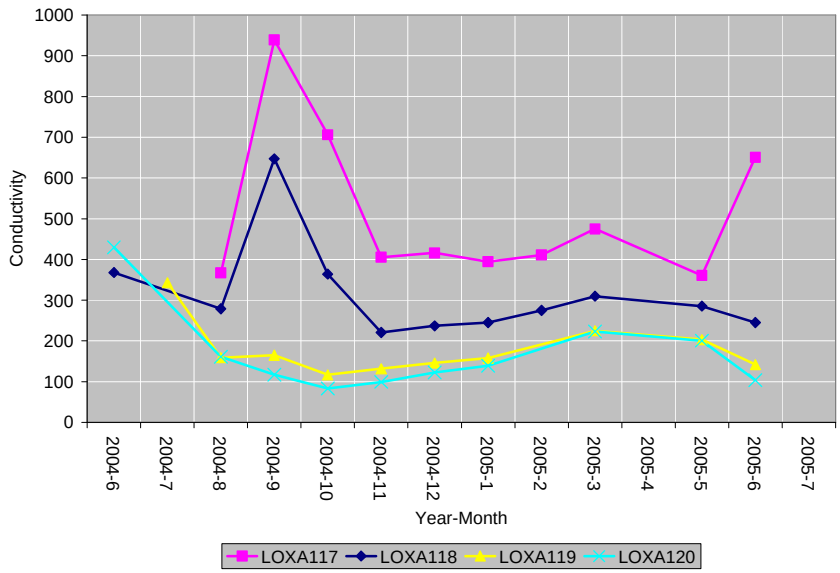
4.a Related Enhanced (LOXA) Observations: Conductivity West Central Transect



LOXAWQ 2005-09-13.xls

31

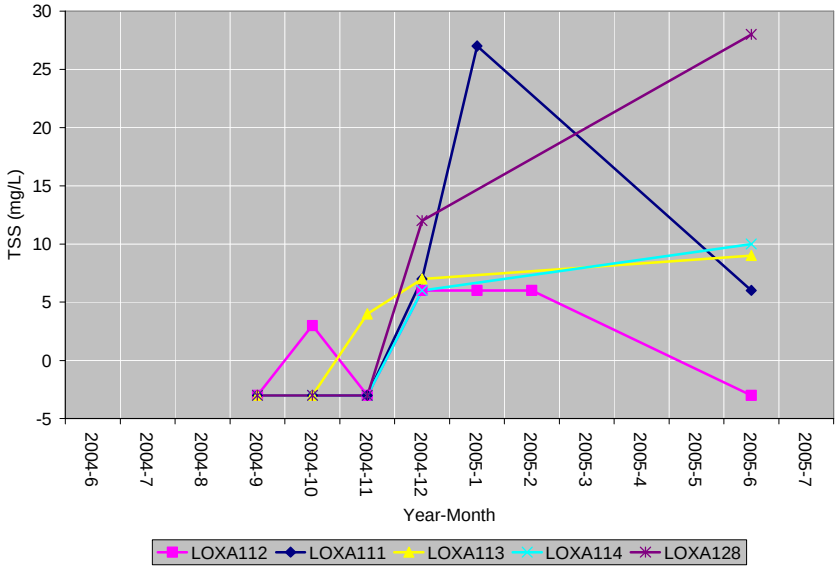
4.a Related Enhanced (LOXA) Observations: Conductivity Southwest Transect



LOXAWQ 2005-09-13.xls

32

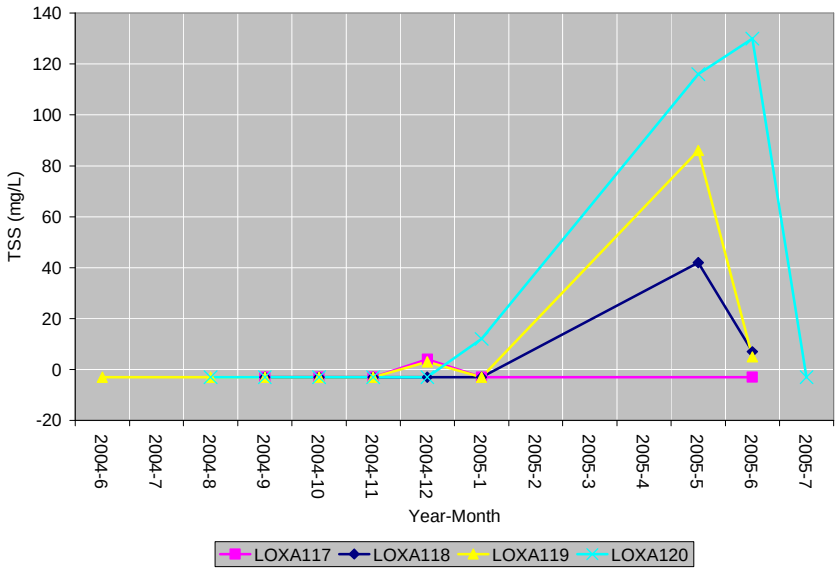
4.a Related Enhanced (LOXA) Observations: TSS West Central Transect



LOXAWQ 2005-09-13.xls

33

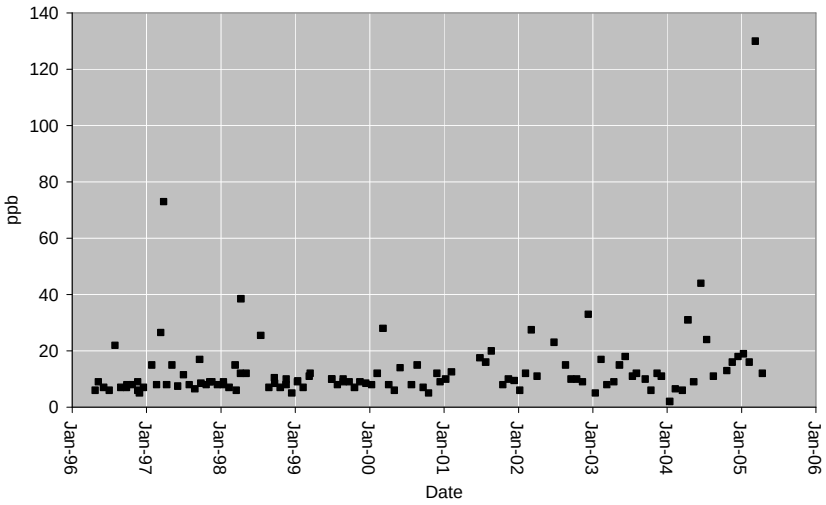
4.a Related Enhanced (LOXA) Observations: TSS Southwest Transect



LOXAWQ 2005-09-13.xls

34

4.b XYZ Transect in the Refuge – X4 had an unusually high value of 130 on 3/10/2005

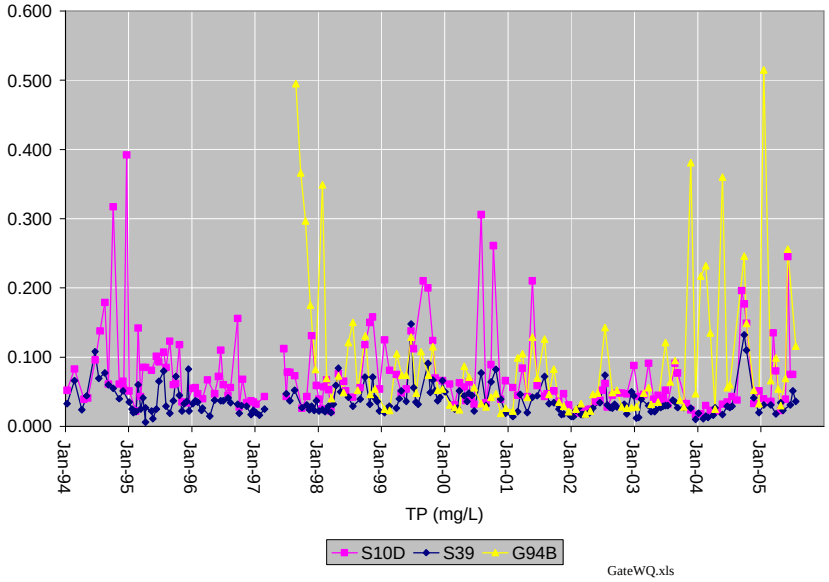


Note: May & June 2005 data were not yet available

Refuge_Transect_TP.xls

35

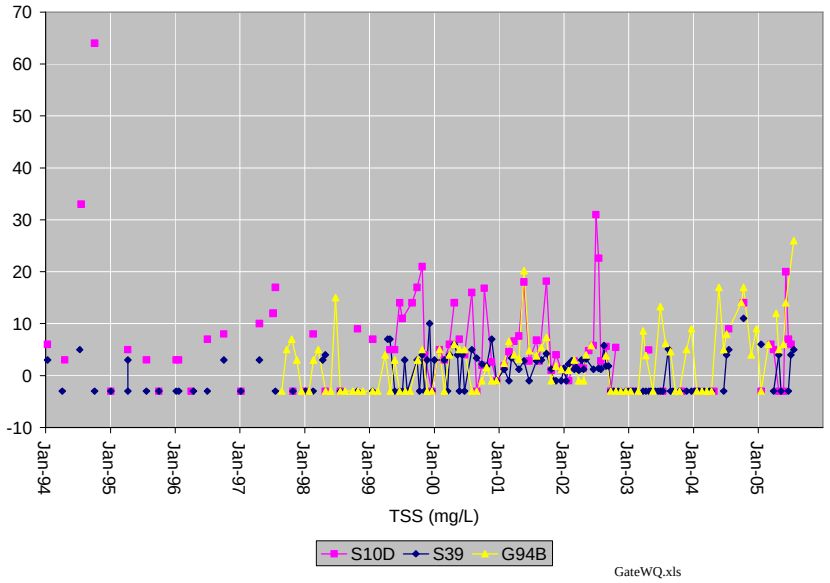
4.c Outflow structure TP



GateWQ.xls

36

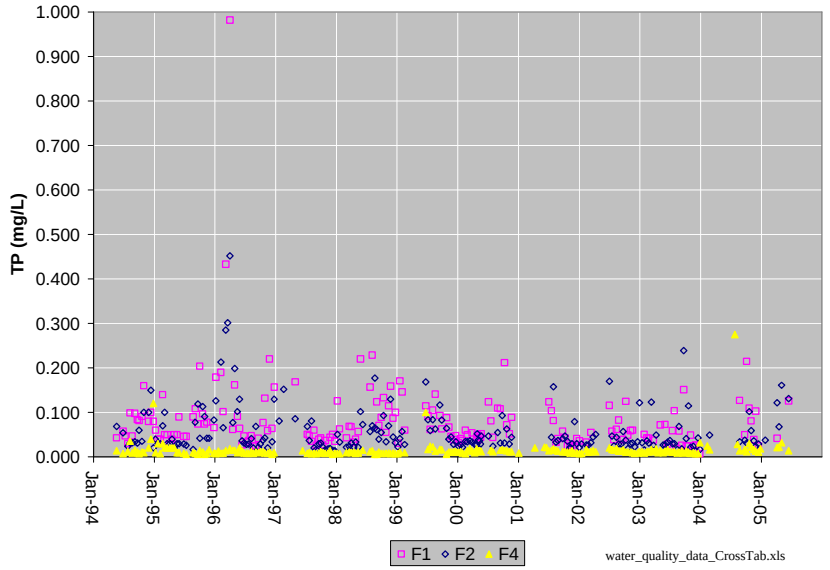
4.c Outflow structure TSS



GateWQ.xls

37

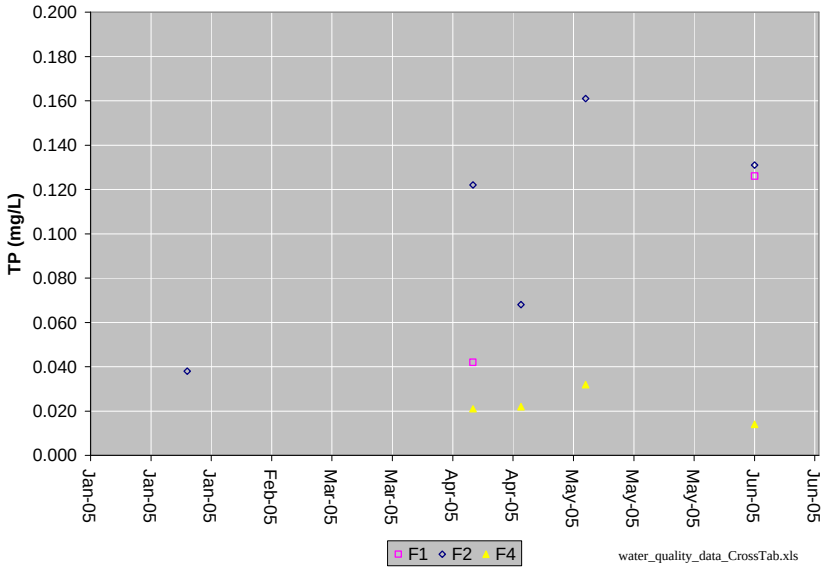
4.d WCA2A F-Transect TP Data



water_quality_data_CrossTab.xls

38

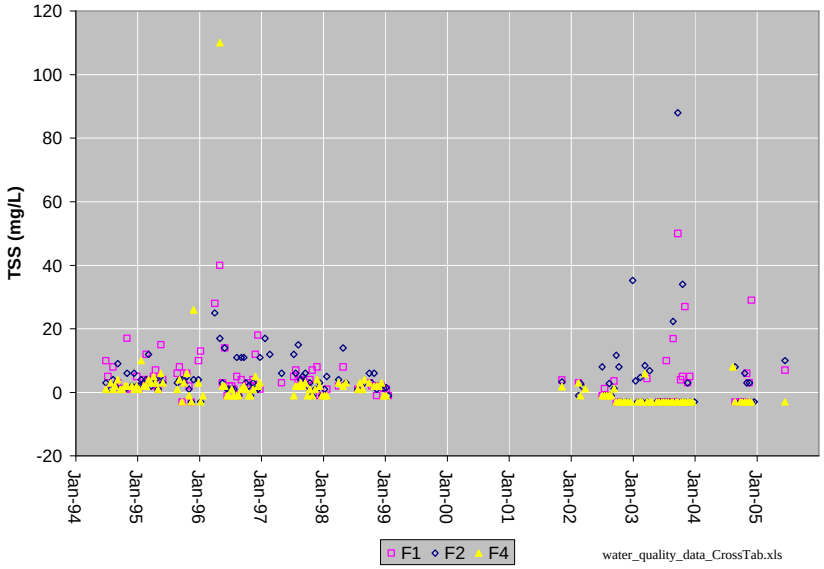
4.d WCA2A F-Transect TP Data CY 2005



water_quality_data_CrossTab.xls

39

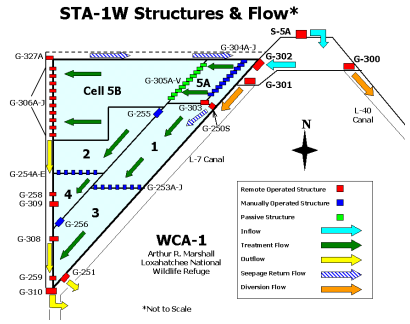
4.d WCA2A F-Transect TSS Data

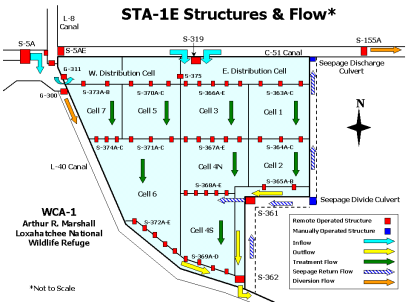


water_quality_data_CrossTab.xls

40

4.e STA-1E & STA-1W Diagrams

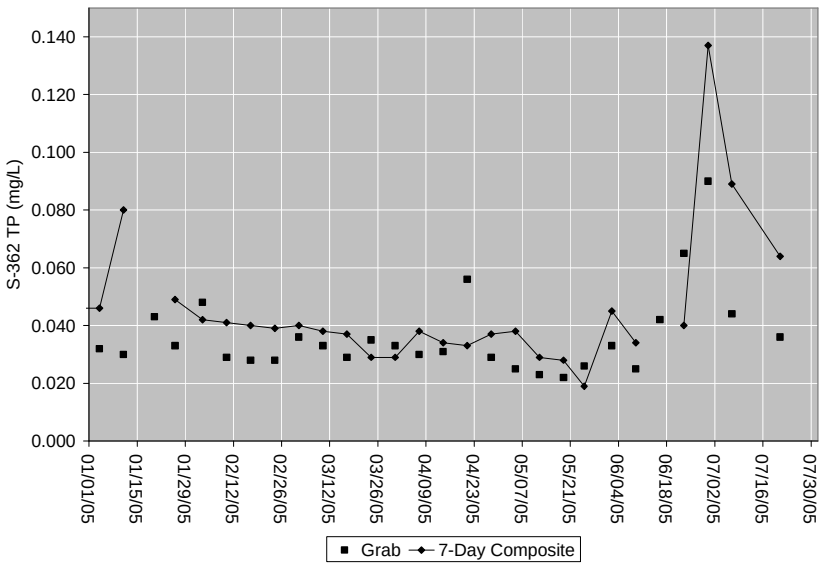




R. Meeker, SFWMD, 2002

41

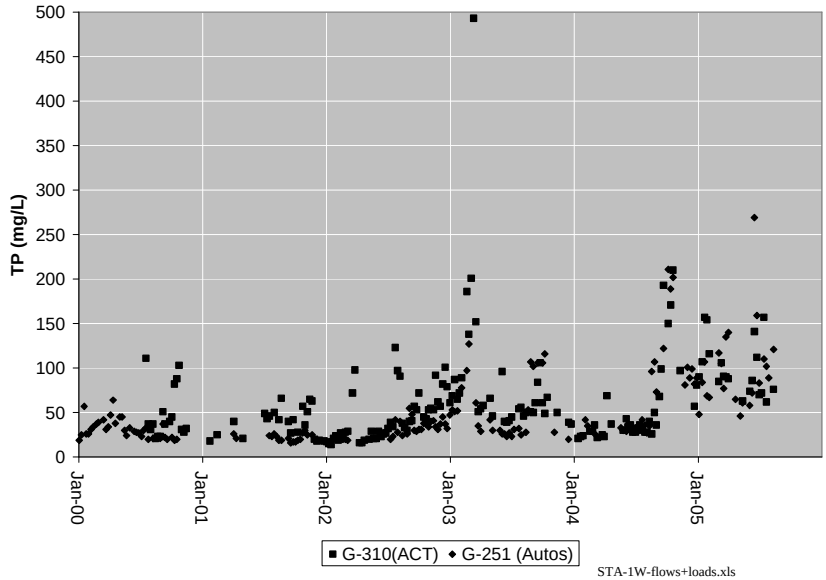
4.e STA-1E Outflow TP



S-362 WQ data 2005-09-12.xls

42

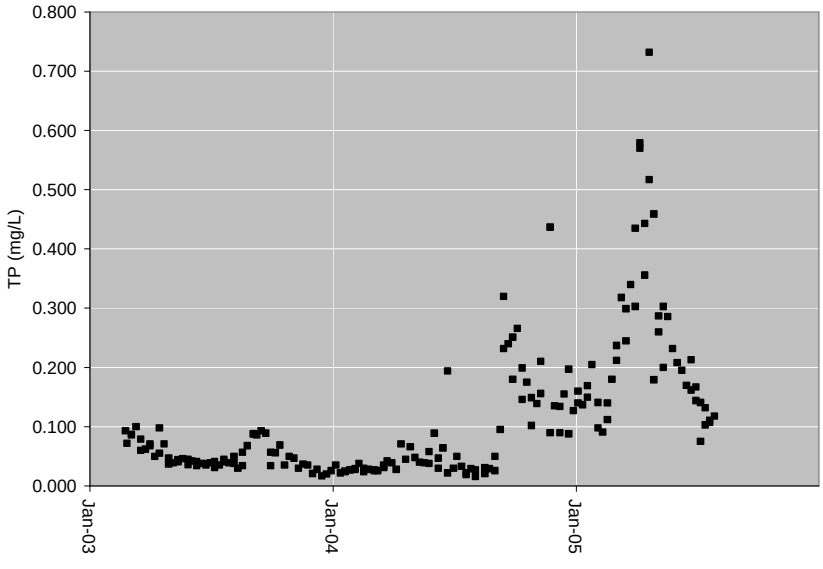
4.e STA-1W Outflow TP



STA-1W-flows+loads.xls

43

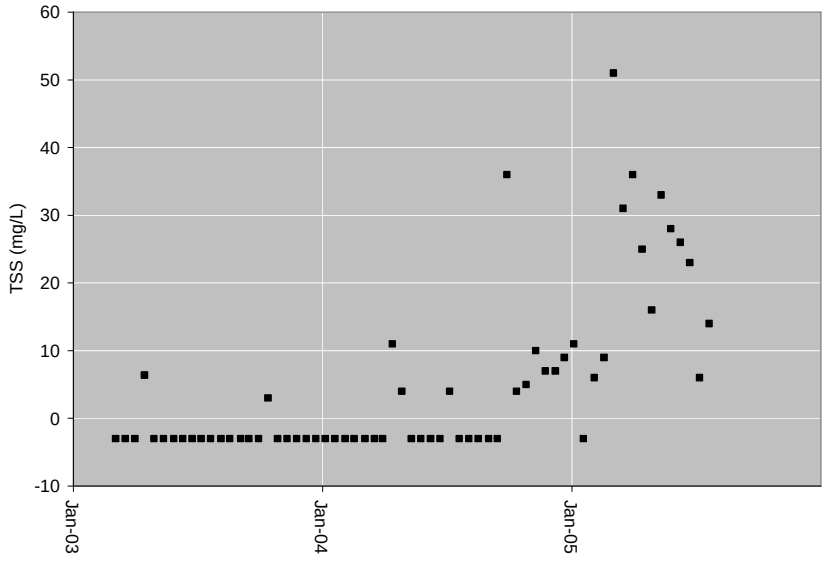
4.e STA-1W Cell 5 (G306C) TP



STA1W-C5-TP+TSS.xls

44

4.e STA-1W Cell 5 (G306C) TSS



STA1W-C5-TP+TSS.xls

45

5.2 Summary Observations

2. What were the conditions before and during May and June sampling? Were they exceptional?

- **Rain & wind (2.a)** were not exceptional. There was little rain prior to May EVPA, and some rain prior to June EVPA sampling.
- Stage (2.b) was not conducive to canal water intrusion in May. In May, stages were dropping and the canal was below interior elevation. In June, stages rose prior to sampling and canal stage was perhaps 0.2 ft above the southern and central marsh interior.
- **Inflows and loads (2.c-2.e)** – In May there was little inflow or load prior to EVPA sampling. In June there was very large inflow and load prior to EVPA.
- **Inflow concentrations (2.d)** have been very high during CY 2005 with very significant bypass of STA-1E.
- **Aerial deposition (2.f)** - There was no apparent increase in rainfall concentrations during CY 2005.
- **Fire (2.g)** – There is no information that any fires in or around the Refuge impacted water quality.

46

5.3 Summary Observations

3. What anomalies and exceptional values are present in the May and June data?

- **May TP (3.b)** - Of 10 samples, 4 were the higher than any value observed at that site over the period 1/94 to 4/05. If these 4 values are excluded the geometric mean drops from 27 to 15, and is below the calculated 17.7 interim-level.
- **June TP (3.b)** - Of 14 samples, 2 were the higher than any value observed at that site over the period 1/94 to 4/05. If these 2 values are excluded the geometric mean drops from 18 to 16.8, and is still above the calculated 13.9 interim-level. Replacing all observations above the 98 percentile by the site 90 percentile would reduce the geometric mean to 13.0.
- **Median and geometric mean TP (3.b)** are usually nearly equal. Deviation from this historic pattern could indicate that one or more high TP samples had skewed the TP distribution and raised the geometric mean. This was not the case in May and June; in both months the median exceeded geometric mean. Absence of low values more than presence of high values appears to have occurred.
- **TSS (3.c)** values in May and June were elevated above the 90 percentile level at some sites, but were below detection at others.
- **TSS (3.c)** was consistently high or low at sites in May and June. LOX 12 and 15 had TSS<detection in both months. LOX 11, 7, and 8 had elevated TSS values (greater than 10). This suggests site dependence rather than random sampling contamination was involved in high TSS observations.
- **Conductivity, chloride, and TDS (3.d)** were not extremely elevated at any sites.
- **TDS values (3.d)** at 4 sites in May are anomalously low indicating likely lab or transcription error.

47

5.4 Summary Observations

4. Were contemporaneous observations consistent with the May and June data?

- **LOXA observations (4.a)** in March-June 2005 often exhibited elevated concentrations of TP and TSS at more interior, less impacted sites relative to sites closer to the perimeter canal. This is opposite of the typical trend of higher values near the canal.
- **LOXA conductivity (4.a)** patterns were as expected, with higher values nearer the canal. There is no indication of significant canal water intrusion at the west central transect, and no indication of penetration beyond LOXA118 at the southwest transect.
- **The X-transect (4.b)** had a historic high TP value, 130 ppb, in March 2005. This is consistent with the pattern seen in the LOXA transects.
- **Perimeter canal (4.c)** TP concentrations were low in May 2005, and peaked in June 2005 at G94B and S10D to over 200 ppb.
- **TP and TSS in WCA2A (4.d)** values along the F-transect have been high but not atypical.
- **STA-1E (4.e)** outflow canal TP spiked in late June to July to a peak of nearly 140 ppb from values between 20-40 ppb. At this time inflow to STA-1E was primarily rain and seepage.
- **STA-1W (4.e)** outflow TP has been high throughout CY 2005. Concentrations declined to near 50 ppb in early May, but spiked up to over 100 ppb in June and July.
- **STA-1W Cell 5 (4.e)** has exhibited elevated TP over 100 ppb since September 2005. TP in cell 5 spiked to over 700 in April 2005, and then declined to near 100 ppb in July 2005. TSS spiked to over 50 mg/L in March 2005, and has declined to near 10 mg/L in July.

48

6. Evidence for and against error – sources

✓ Outlier analysis for samples – There is considerable evidence that some values are outliers. Samples values are very unusual/exceptional.

✓ Lab QA (blanks etc.) – One blank for LOXA sampling failed. It appeared to be a mislabeled bottle.

✓ Contamination – There is little evidence beyond speculation based on outlier analysis. Consistency of TSS values between May and June sampling suggests site-related causation.

7. Evidence for and against natural and anthropogenic phenomena

✓ Loading – There was very high loading, but no evidence that it played a direct role in these excursions.

✓Meteorological – No evidence that rain or wind near the time of sampling played a role.

✓Aerial deposition – No evidence of causation.

✓Planktonic algae – No evidence. DO values were not elevated in May and June.

✓Fire – No evidence.

✓Canal water intrusion – Appears to not have occurred in May, and to be minimal in June.

✓Other? – There is some evidence of a regional event of as-yet undetermined cause.

49