Status Report
Modeling Technical Review Group (MTRG)
Savannah Harbor Expansion Project
June 22, 2000

A meeting was held on Thursday, June 22, 2000 in Atlanta, GA at the EPA office. The goals of the meeting were as follows:

- Distribute Compact Disks and memo with completed sections of the 1999 Data Report. The compact disk is titled: *Sections completing April 27, 2000 Hydrodynamic and Water Quality Monitoring of the Lower Savannah River Estuary, August 2 through October 9, 1999*
- Draft Final Presentation for Task SEGDO2. The purpose of the draft final presentation is to provide a status of the work to refine, update and verify the hydrodynamic model
- Initial Presentation for Task SEGDO1. The purpose of the presentation is to discuss the development of the dissolved oxygen model.

The following persons attended the meeting and participated in the MTRG discussions:

William Bailey	USACE	912-652-5781	william.g.bailey@sas02.army.mil
Jim Greenfield	USEPA IV	404-562-9238	greenfield.jim@epa.gov
Larry Neal	Harbor Committee	770-499-6791	lneal@lawco.com
James Martin	USACE, WES	601-634-3714	martinj@wes.army.mil
Bo Ellis	ATM	843-884-8750	boellis@worldnet.att.net
Dan Mendelsohn	ASA	401-789-6224	mendo@appsci.com
Eduardo Yassuda	ATM	843-884-8750	eyassuda@asatm.com.br
Paul Conrads	USGS	803-750-6140	pconrads@usgs.gov
John Sawyer	City of Savannah	912-964-0698	jsawyer@ci.savannah.ga.us
Harvey Seim	Skidaway Institute	912-598-2361	seim@skio.peachnet.edu
Jack Blanton	Skidaway Institute	912-598-2457	jack@skio.peachnet.edu
Larry Keegan	Lockwood Greene	912-352-3000	lkeegan@lg.com

The following persons provided written comments, which were discussed at the meeting:

William Bailey (USACE, Savannah District)

General Discussion

Distribution of Compact Disks and Memos

Bo Ellis distributed compact disks titled: *Sections completing April 27, 2000 Hydrodynamic and Water Quality Monitoring of the Lower Savannah River Estuary, August 2 through October 9, 1999.* The compact disk contained sections that were incomplete for the April 27, 2000 distribution of the Data Report. Sections were incomplete due to lack of data and additional reporting requests. The MTRG now has all of the completed sections of the Draft Data Report. Comments on the Draft Data Report should be returned to Chris Ahern (cahern@atm-s2li.com) at ATM by July 15, 2000. ATM will compile all comments received and send them to the MTRG. The MTRG will meet on August 29, 2000 to resolve the comments and recommend revisions to the report.

Bill Bailey presented his written comment, which requested further explanation in the Data Report for some of the BOD data, which was rejected as a result of the Quality Control check. The MTRG recommended that a summary of the actions taken to reject the BOD data be included in Section 1, along with the sampling times and locations of the rejected data.

Draft Final Presentation for SEGDO2

Danny Mendelsohn presented model results and led discussion using the outline below. Discussion points are listed below the outline.

1) Tests and Calibration Methodology
    - Grid Refinement
    - Sigma Transport Tests
    - Statistical Methods

2) Hydrodynamic Model Calibration and Verification for 1997 and 1999
    - Surface Elevation
    - Mean Surface Elevation
    - Currents
    - Volume Flux

3) Salinity Model Calibration and Verification for 1997 and 1999
    - Time Series
    - Horizontal Gradients
    - Vertical Gradients
    - Salt Flux

4) Temperature Model Calibration 1999
    - Time Series
    - Horizontal and Vertical Gradients

MTRG Discussion Points:

A. SEGDO2 Task 3.1 Convergence Test Presentation:

A series of plots showing grid structure detail for each of 3 grids was shown (coarse, medium and fine grid). Comparison plots for surface elevations, currents, volume flow and statistics were then shown for three representative stations along the river.

Statistics for the barotropic grid convergence test results suggested that the selected model grid (medium grid) was satisfactory and were generally accepted by the MTRG. A request was made to

see a comparison between the fine and medium grid salinity predictions. Where volume flux was compared for the flow comparisons, salt flux would be used for the salinity comparisons.

B. As another test of salinity transport, a comparison between the predicted salinity from the hydrodynamic model (BFHYDRO, in coupled prognostic mode) and the water quality model (BFWASP, as a passive tracer) was also suggested. This test should be performed prior to the DO modeling task.

C. SEGDO2 Task 3.1 Sigma Test Presentation:

   An animation of model output predictions was shown for the sigma transport test case. A plot showing statistics for salinity variation over 1 tide and over 1 week was also shown. Maximum variation after 1 tide of 0.5% and 2.2% after 1 week were predicted at the bottom and no variation at the surface.

   Model simulation output and statistics for the sigma test were generally accepted by the MTRG as indications that no problems exist with the formulation of the pressure terms in BFHYDRO. Perturbations after 1 tidal cycle were insignificant. Minor perturbations in the density field were produced at locations of steep bathymetric gradients after 1 simulation week but were shown to be 2 orders of magnitude smaller that the tidal signal strength.

D. The statistical methods used in the following model-data comparison were described and discussed.

E. Hydrodynamic model calibration presentation:

   a. Model-data comparison plots were shown for 1997 and 1999:

      i. Surface elevation

      ii. Mean surface elevation

      iii. Harmonic constituents for surface elevations

      iv. Currents

      v. Harmonic constituents for Currents

      vi. Volume flow

   b. Plots for each parameter included:

      i. Time series comparisons

      ii. Low pass filtered time series comparisons

      iii. Statistics by station along the river (Front and Back River)

F. Discussion on the surface elevation, currents and flow calibration presentation:

   a. Slight lag in tidal signal at GPA-14 could be friction related. Increased friction was used to increase setup in river above I-95.

   b. Model predicted low pass filtered currents at GPA-04 not capturing general “in at the bottom, out at the top” profile seen in the data. Some of the discrepancy may be a function of the fact that the ADCP data layers remain fixed with respect to the bottom whereas the model layers shrink and grow with the tidal elevation. This effect was not taken into account for the comparison.

   c. A suggestion was made that depth averaged data for the harmonic analysis would be appropriate for the currents comparison.

d. A recommendation was made to use a consistent convention for flow upstream/downstream in the river regardless of direction, rather than the East/North convention used in the model.

e. The inflow to river from the drainage basin seaward of Clyo should be considered. Jim Greenfield agreed to forward some available data to ATM.

f. Vertical profiles of velocity (ADCP data) should be presented in comparison with model results.

G. Salinity model calibration presentation:

a. Salinity data analysis plots for 1997 and 1999 data were shown for :

i. Horizontal salinity gradients at the bottom for various stations for 1999 data

ii. Horizontal salinity gradients at the surface for various stations for 1999 data

iii. Horizontal salinity gradients at the bottom for various stations for 1997 data

iv. Horizontal salinity gradients at the surface for various stations for 1997 data

v. Horizontal salinity gradients at the surface for various stations for 1997 data vs 1999 data

vi. Horizontal salinity gradients at the bottom for various stations for 1997 data vs 1999 data

vii. Horizontal salinity gradients for the bottom vs the surface for 1997 data

viii. Horizontal salinity gradients for the bottom vs the surface for 1999 data

ix. Vertical salinity gradients for various stations for 1997 data

x. Vertical salinity gradients for various stations for 1999 data

xi. Vertical salinity gradients for various stations for 1997 vs 1999 data

b. Model to data comparison plots for 1997 and 1999 data were shown for:

i. Horizontal gradients at the bottom for various stations for 1997

ii. Horizontal gradients at the surface for various stations for 1997

iii. Vertical salinity gradients for various stations for 1997

iv. Horizontal gradients at the bottom for various stations for 1999

v. Horizontal gradients at the surface for various stations for 1999

vi. Vertical salinity gradients for various stations for 1999

vii. Time series for all GPA stations for 1997

viii. Low pass filtered time series for all GPA stations for 1997

ix. Along river statistics for 1997 data

x. Time series for all GPA stations for 1999

xi. Low pass filtered time series for all GPA stations for 1999

xii. Along river statistics for 1999 data

H. Discussion on salinity gradient analysis and comparisons:

a. The same stations should be used for the horizontal salinity gradient direct comparisons between 1997 and 1999.

b. The gradient plots should also include salinity values at both stations and tidal elevation as a stack plot.

c. The 1999 surface salinity gradient between GPA-08 and GPA-09 implies that salinity is greater at the upstream station. Salinity data for GPA-08 and GPA-09 will be checked.

d. For comparison of the 1997 to the 1999 salinity gradient, similar tidal regimes should be used, not the same dates.

e. Vertical salinity profiles from the intensive surveys should be included.

f. Vertical density gradients could be examined for some noted events.

g. The September 1999 events appear incorrect. The gradient sign is often reversed, implying higher salinity upstream. Data from that time period will be reviewed.

I. It was noted that the offshore salinity during the summer of 1999 was very high, higher than the value used as the offshore boundary condition. This observation could be used in the modeling. Harvey Seim may be able to obtain this data and forward to ATM.

J. Paul Conrads will get salinity data for the USGS stations in the estuary and forward to ATM as soon as possible. It was suggested that the USGS salinity values at Fort Pulaski could be used for the offshore boundary condition with the use of a transfer function similar to the way the tides are handled.

K. Temperature model calibration presentation:

a. 1999 meteorological data plots were presented

b. Temperature data analysis plots for 1999 data were shown for :

i. Horizontal temperature gradients at the bottom for various stations for 1999 data

ii. Horizontal temperature gradients at the surface for various stations for 1999 data

iii. Vertical temperature gradients for various stations for 1999 data

c. Model to data comparison plots for 1999 data were shown for:

i. Horizontal gradients at the bottom for various stations for 1999

ii. Horizontal gradients at the surface for various stations for 1999

iii. Vertical temperature gradients for various stations for 1999

iv. Time series for all GPA stations for 1999

v. Low pass filtered time series for all GPA stations for 1999

vi. Along river statistics for 1999 data

L. Discussion on the temperature model.

a. The temperature model may need to include heat transfer to and from the marsh cells.

b. Consideration should be given to the upstream temperature boundary condition. Hourly flows and temperature should be available for the station at Clyo. Jim Greenfield agreed to forward available data to ATM.

c. Consideration should also be given to the downstream temperature boundary condition. Data may be available for the USGS station at Fort Pulaski.

d. Harvey Seim is looking into the availability of atmospheric data from offshore. Atmospheric data parameters to include temperature, LW and SW radiation, humidity etc.

M. Consideration may be given to canals entering the river in the Savannah Harbor area. The canals could be regarded as river inflow boundaries.

Presentation of DO Model Inputs (Task SEGDO1)

Eduardo Yassuda made a presentation of the initial model inputs to be used for the development of the Dissolved Oxygen Model. He reviewed the scope of the Task Statement, with a discussion on whether or not to include the biogeochemical rates related to the phytoplankton component. The group reiterated the decision of setting the phytoplankton concentration to zero, so that there is no effect of primary production on the dissolved oxygen balance. In addition, the group asked that we perform a sensitivity analysis on the effects of primary production on the dissolved oxygen balance.

In order to test and assure consistency between the hydrodynamic and water quality model components, the group recommended that we also simulate salinity (as one of the conservative variables) in the water quality model.

The following table, presenting the initial input values for the water quality model (starting point for calibration), was handed out to the group and discussed.

LOWER SAVANNAH RIVER ESTUARY
DEFAULT VALUES FOR BFWASP COEFFICIENTS

	Model Coefficient	Symbol	Units	BFWASP
1	Reaeration rate @ 20 oC	K2C	1/day	Formula
2	Temperature coefficient	K2T	-	1.047
3	Endogenous respiration constant rate rate @ 20 ^{o}C	K1RC	1/day	0.2
4	Temperature coefficient	K1RT	-	1.045
5	Deoxygenation rate @ 20 Oc	KDC	1/day	0.06
6	Temperature coefficient	KDT	-	1.03
7	Half-saturation constant for oxygen limitation	KBOD	mg O2 / L	0.5
8	Sediment oxygen demand @ 20 oC	SODC	g / m2 - day	1.5
9	Temperature coefficient	SODT	-	1.047
10	Organic matter settling velocity	CVSETTLE5	m/day	0.1
11	Fraction of dissolved CBOD	fd1cbod	-	1
12	Organic Carbon decomposition rate (benthic layer)	KDSC	1/day	0
13	Temperature coefficient	KDST	-	1.08
14	Organic nitrogen mineralization rate @ 20 ^{o}C	K1013C	1/day	0.04
15	Temperature coefficient	K1013T	-	1.08
16	Nitrification constant rate @ 20 oC	K132OC	1/day	0.3
17	Temperature coefficient	K132OT	-	1.04
18	Half-saturation constant for oxygen limitation	KNIT	mg O2 / L	2

	Model Coefficient	Symbol	Units	BFWASP
19	Denitrification constant rate @ 20 oC	K14OC	1/day	0.15
20	Temperature coefficient	K14OT	-	1.08
21	Michaelis constant for denitrification	KNO3	mg O2 / L	0.1
22	Nitrogen/Carbon ratio	NCRB	-	0.2
23	Fraction of phytoplankton recycled to ON (1-fon goes to NH3)	FON	-	0.65
24	ON decomposition rate in the benthic layer @ 20 oC	KONDC	1/day	0.001
25	Temperature coefficient	KONDT	-	1.08
26	Dissolved fraction of organic nitrogen	fd1nitr	-	0.4
27	Oxygen/Carbon ratio in phytoplankton	OCRB	-	2.66
28	Maximum photosynthetic quantum yield	PHIMX	mgC/mole photon	720
29	Phytoplankton self-light attenuation	XKC	m2 / mg Chla	0.1
30	Nitrogen half-saturation for phytoplankton growth	KMNG1	ug-N / L	25
31	Phosphorus half-saturation for phytoplankton growth	KMPG1	ug-P / L	1
32	Non-predatory phytoplankton constant mortality rate	K1D	1/day	0.03
33	Zooplankton grazing constant rate	K1G	L / mgC - day	0
34	Decomposition constant rate in benthic layer @ 20 oC	KPZDC	1/day	0.0001
35	Temperature coefficient	KPZDT	-	1.08
36	Phytoplankton maximum growth rate @ 20 oC	K1C	1/day	2
37	Temperature coefficient	K1T	-	1.08
38	Carbon/Chlorophyll_a ratio for Di Toro option	CCHL	-	30
39	Saturating light intensity for phytoplankton growth	SATUL	langleys/day	300
40	Phosphorus/Carbon ratio	PCRB	-	0.025
41	DOP Mineralization constant rate @ 20 oC	K58C	1/day	0.2
42	Temperature coefficient	K58T	-	1.08
43	Fraction of phyto. Recycled to OP (1-fop goes to PO4)	FOP	-	0.25
44	Half-saturation constant for phosphorus recycle	KMPHYT	mg C / L	1
45	OP decomposition rate in the benthic layer @ 20 oC	KOPDC	1/day	0.001
46	Temperature coefficient	KOPDT	-	1.08
47	Dissolved fraction of organic phosphorus	fd1phos	-	0.04
48	Molecular diffusion coefficient	EDIF	m2 / s	0.0001
49	Benthic layer thickness	Dj	cm	10
48	Light Extinction	-	1/m	1.1~3.5

Future Activity

Comments and questions related to any particular issue should be directed to Chris Ahern of ATM (cahern@atm-s2li.com). Written comments for the Data Report are due to ATM by July 15, 2000.

The next MTRG meeting will be held in Atlanta at the EPA office on August 29th at 9:00 AM.