Lower Boise River AQUATOX Model Updates

Improving Simulation Performance and Sensitivity Analysis

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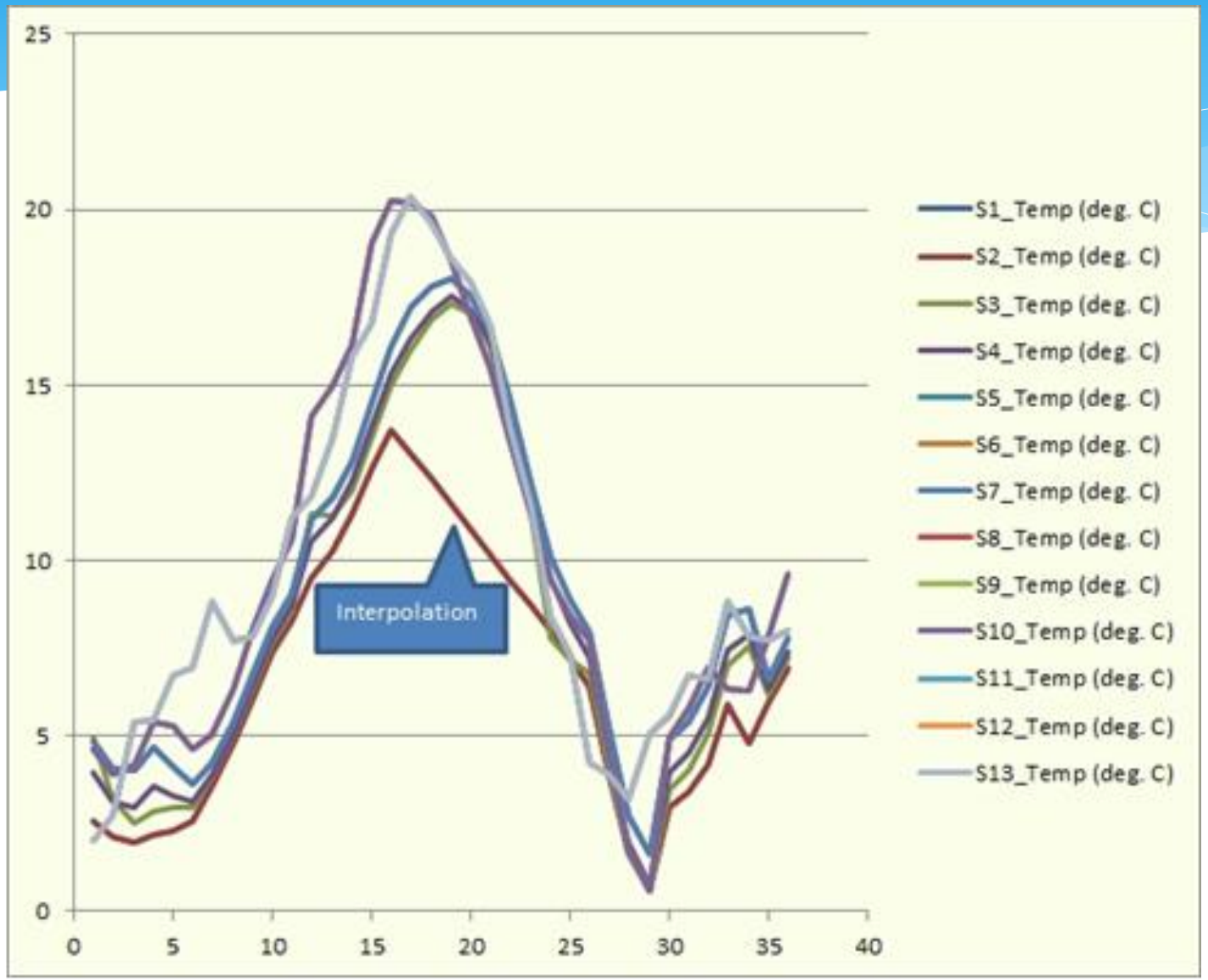
Progress Report

* Addressing issues brought up during calibration fiesta
* Examining Dick Park's work
* Running sensitivity analysis on loadings of state variables

Temperature

* Driving variable
* Temperature data collected by City of Boise for the study period at:
  * Segment 2 at Marden Bridge—applied to model segments 1 and 2
  * Segment 3 at Veteran's Parkway Bridge—applied to model segment 3
  * Segment 4 at Glenwood—applied to model segment 4
  * Segment 7 at Eagle Road, south channel—applied to model segment 5, 6, 7,
  * Segment 9 at Middleton—applied to model segments 8, 9, and 10
  * Segment 13 at Parma(USGS?COB?)—applied to model segments 11, 12, and 13

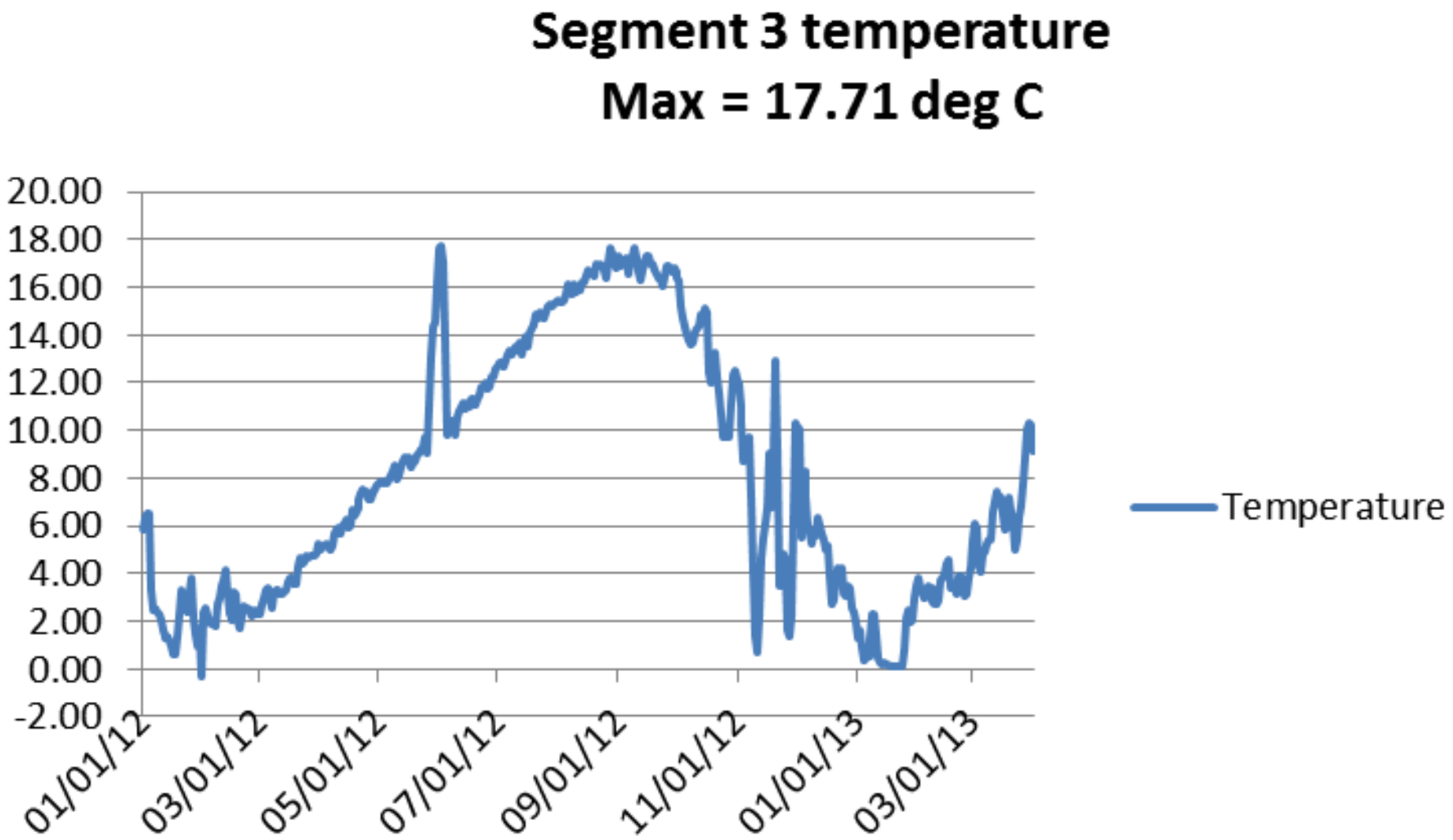
Temperature



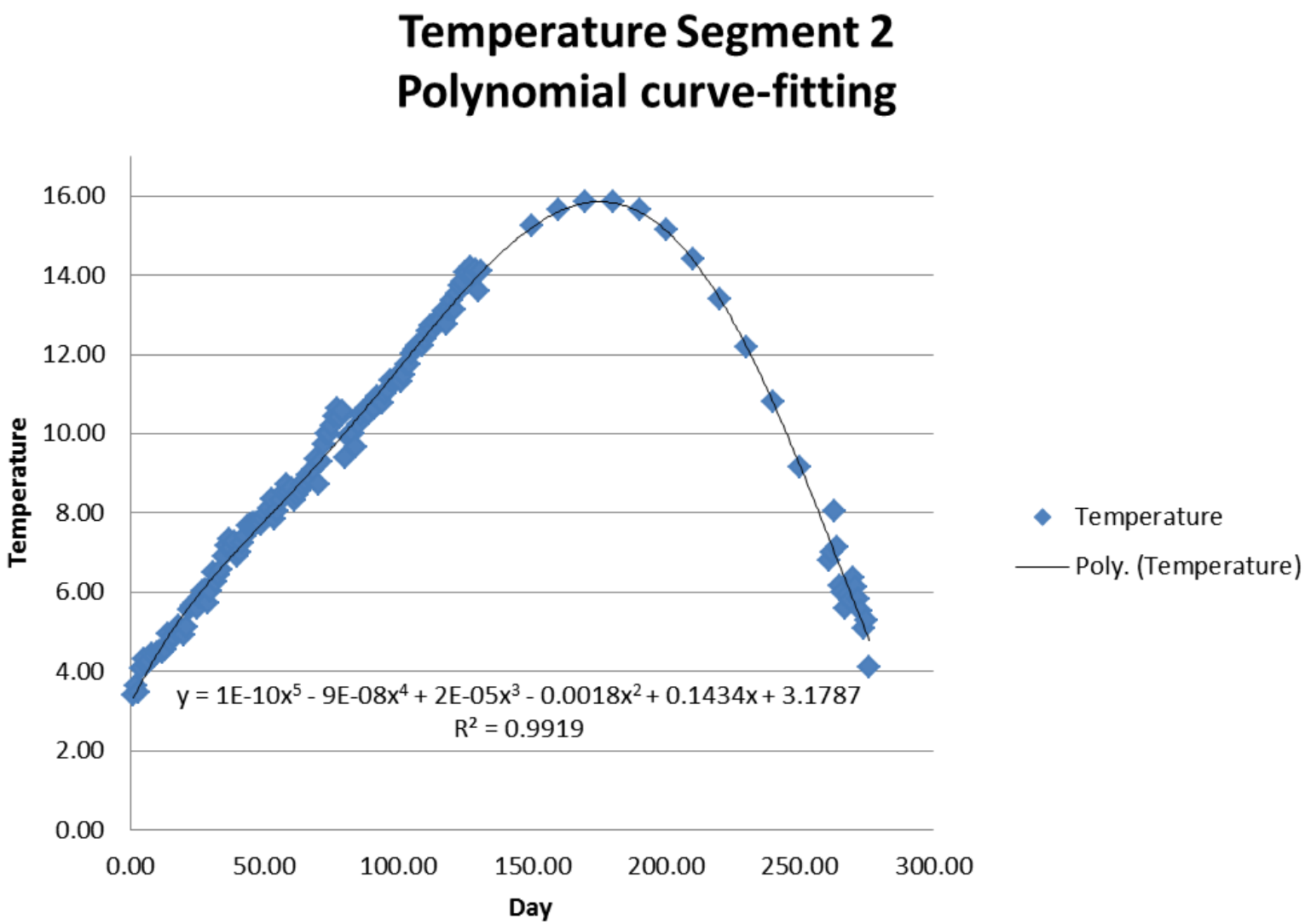
Temperature

1	***61.1***	Boise River at Diversion Dam	43.545312	-116.099469	Alex Synoptic
	58.3	Ridenbaugh			
2	*58.3*	Eckert Road	43.565723	-116.132058	USGS Site ID 13203760
	57.5	Bubb			
	56.8	Meeves			
	56.4	Rossi Mill			
	56.1	United Water			
	55.9	Boise City Canal			
	52	Settlers			
	51.8	Fairview Acres			
	51.5	Boise City Parks			
	51.1	Thurman Mill			
	50.7	Boise Water Corp.			
	50.4	Farmers Union			
3	***50.17***	Boise River at Veteran's Parkway	43.63605833	-116.2411417	USGS Site ID 13205642 - Alex Synoptic
	50.01	Boise WWTP Lander			

Temperature

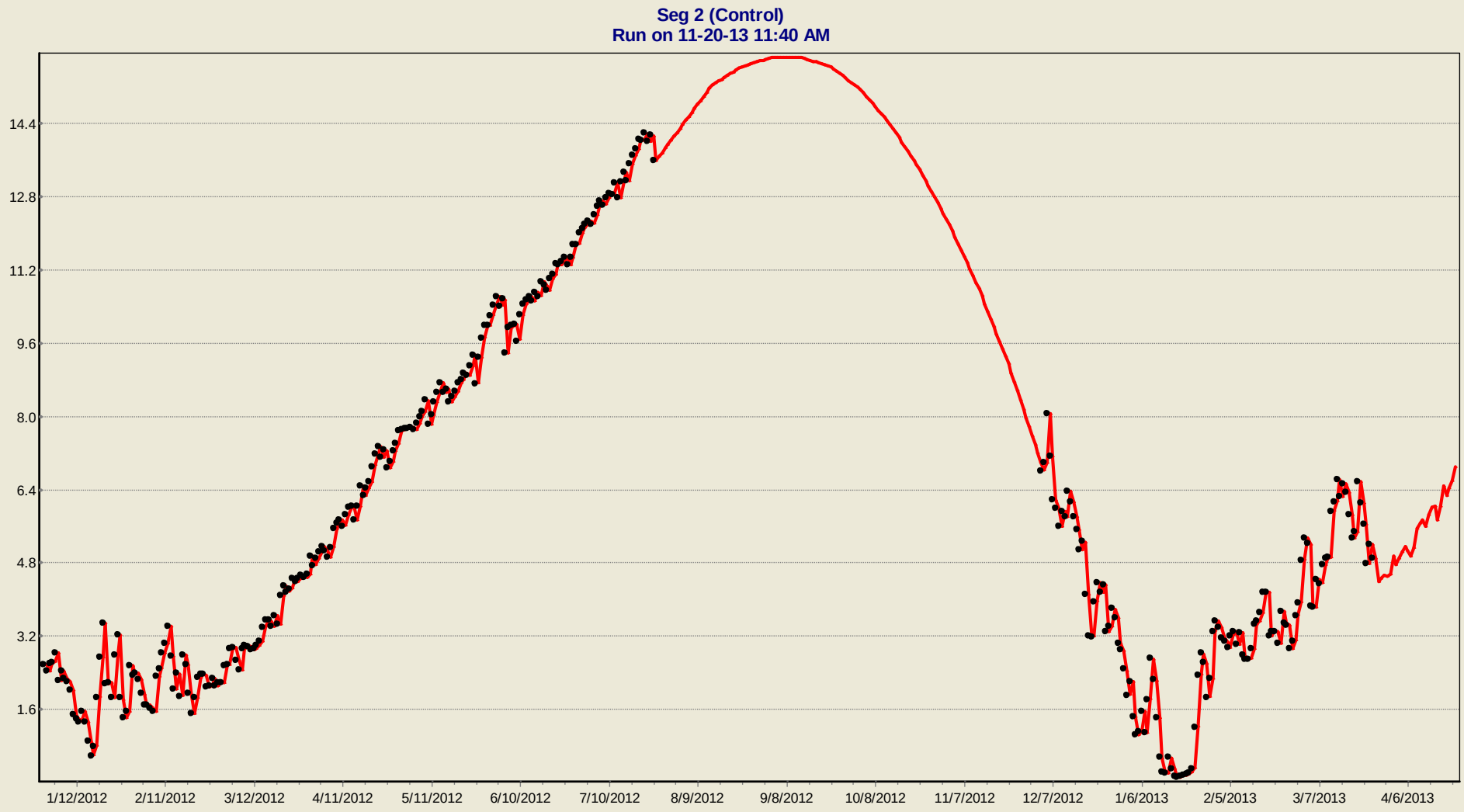


Temperature

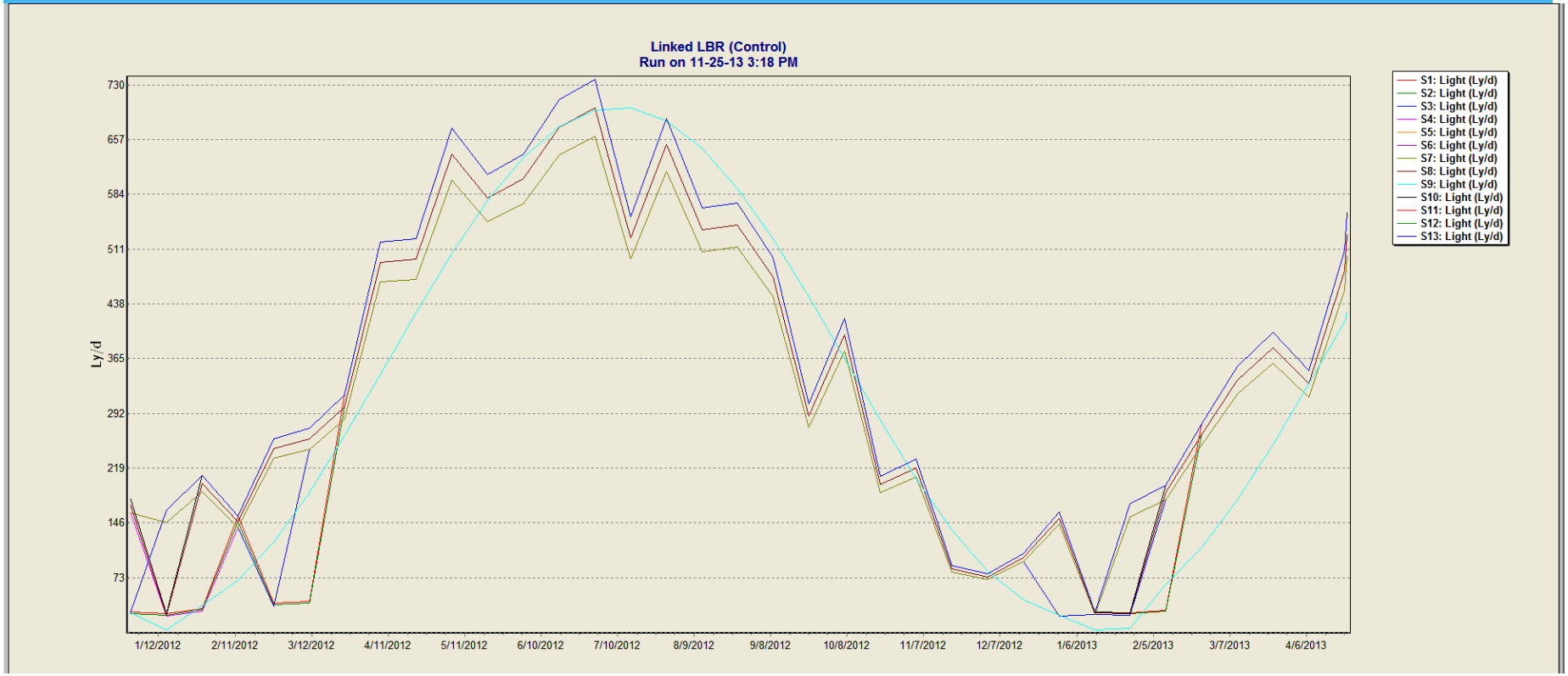


07/24/12	14.14
07/25/12	13.59
08/13/12	15.25
08/23/12	15.65
09/02/12	15.85
09/12/12	15.85
09/22/12	15.65
10/02/12	15.15
10/12/12	14.40
10/22/12	13.40
11/01/12	12.20
11/11/12	10.80
11/21/12	9.15
12/03/12	6.81
12/04/12	6.99

Temperature



Light


Linked LBR (Control)
Run on 11-25-13 3:18 PM
Ly/d
730
657
584
511
438
365
292
219
146
73
1/12/2012
2/11/2012
3/12/2012
4/11/2012
5/11/2012
6/10/2012
7/10/2012
8/9/2012
9/8/2012
10/8/2012
11/7/2012
12/7/2012
1/6/2013
2/5/2013
3/7/2013
4/6/2013
S1: Light (Ly/d)
S2: Light (Ly/d)
S3: Light (Ly/d)
S4: Light (Ly/d)
S5: Light (Ly/d)
S6: Light (Ly/d)
S7: Light (Ly/d)
S8: Light (Ly/d)
S9: Light (Ly/d)
S10: Light (Ly/d)
S11: Light (Ly/d)
S12: Light (Ly/d)
S13: Light (Ly/d)

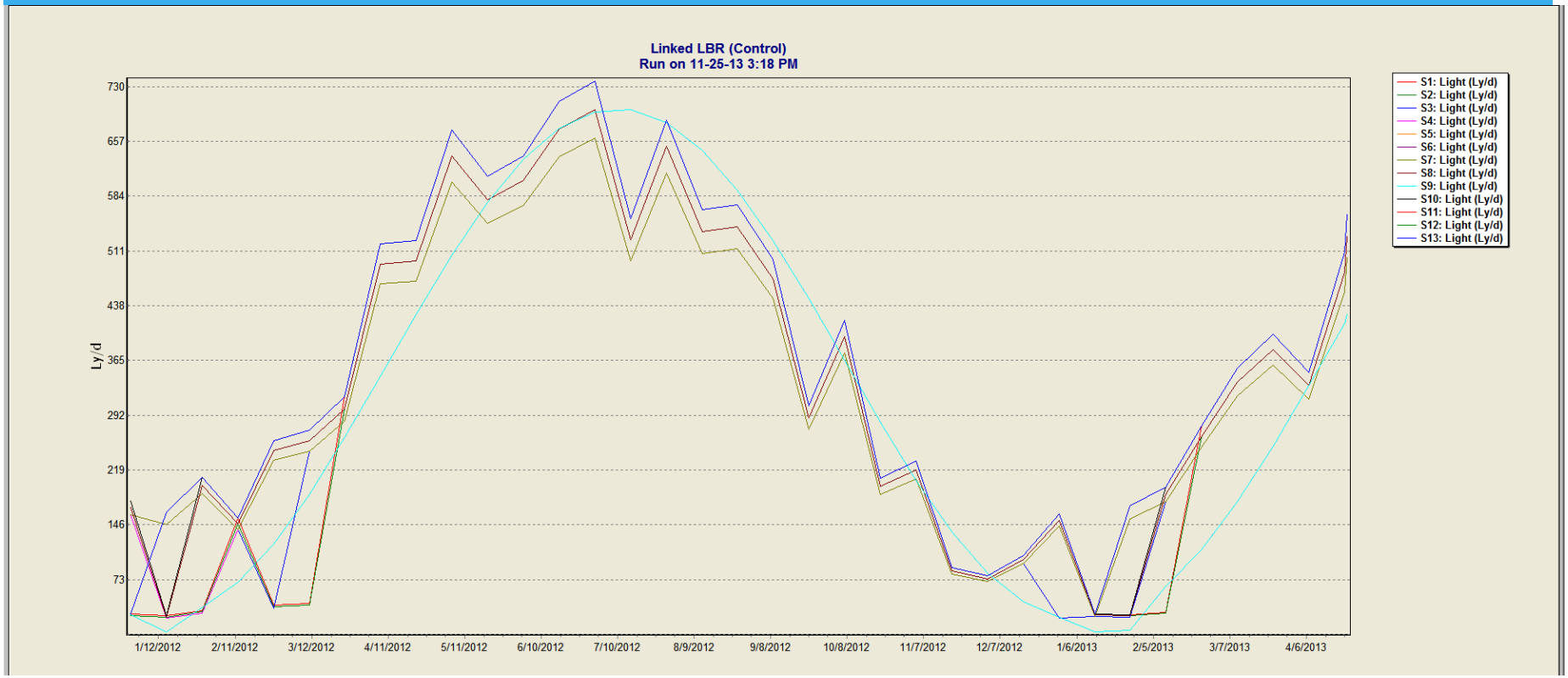
Light

http://www.usbr.gov/pn/agrimet/webarcread.html			
		Average light	378.9042
		Min	15.89
		Max	731
		Annual light range	715.11

Light

* Solar Radiation 5-day ave LY_xlsx
* Light.xls

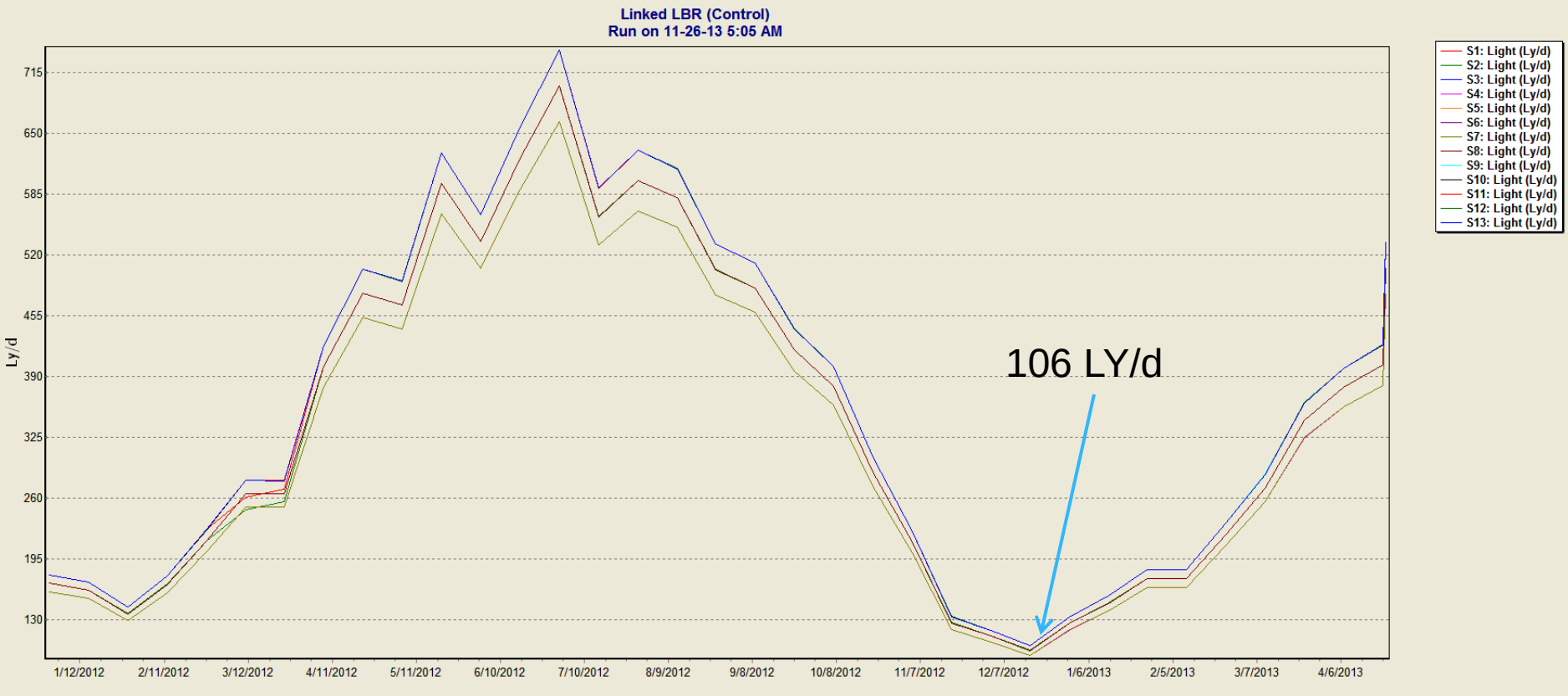
Light



The model is programmed to decrease transmitted light to 15% of incident radiation when the average water temperature drops below 3 deg.C. So, for instance, light on 1/1/2013 was 198.5 langleys per day, and 15% of that is 29.78, which looks like about what the model is simulating. See page 56 of the A-TOX technical documentation.

Light

* 2013_11_25_ATX_LBR_Linked_EC_Import_DDS_no3deg.xls



3.6 Light

Light is important as the controlling factor for photosynthesis and photolysis. The default incident light function formulated for AQUATOX is a variation on the temperature equation, but without the lag term:

Light: Simplifying Assumptions

- Ice cover is assumed when the average water temperature drops below 3 degrees centigrade.
- Photoperiod is approximated by Julian date (day of year)
- Average daily light is the program default, although hourly light may be simulated

$$Solar = LightMean + \frac{LightRange}{2} \cdot \sin(0.0174533 \cdot Day - 1.76) \cdot Frac_{Light} \tag{25}$$

$$Frac_{Light} = 1.0 - 0.98(Canopy)$$

where:

Solar	=	average daily incident light intensity (ly/d);
LightMean	=	mean annual light intensity (ly/d);
LightRange	=	annual range in light intensity (ly/d);
Day	=	day of year (d, adjusted for hemisphere);
$Frac_{Light}$	=	fraction of site that is shaded; and
Canopy	=	user input fraction of site that is tree shaded.

	Segment												
	1	2	3	4	5	6	7	8	9	10	11	12	13
Shade	0.05	0.1	0.15	0.15	0.15	0.15	0.15	0.1	0.05	0.05	0.05	0.05	0.05

Light

* Will cold-water algae and cyanobacteria respond appropriately?
* Jonathon Clough sent me a version of the executable that does not factor in light decreases when stream temperature drops below 3 degrees Celsius.
* Currently running aquatox_no_ICE_.exe on the actual temperature data.

State Variables in 2013_1017 version

State Variables	Initial condition	Dynamic or constant loading
Total Ammonia as N	None	Dynamic
Nitrate as N	0.06 mg/L	Dynamic
Total Soluble P	0.01 mg/L	Dynamic
CO2	0.5 mg/L	Constant loading of 0.7 mg/L
Oxygen	13 mg/L	Dynamic
TSS	5.15 mg/L	Dynamic
Refractory sediment detritus	1 g/m^2 dry	Constant loading of zero
Labile sediment detritus	0.3 g/m^2 dry	Constant loading of zero
Suspended and Dissolved Detritus*	1 mg/L dry as CBOD	Dynamic--historic CBOD for segment 1; constant loading of zero for all other segments
Buried refractory detritus	2 kg/cu m	
Buried labile detritus	1 kg/cu m	
Wind loading	1 m/s	1 m/s
Light	182 Ly/d	Using annual mean and range loadings

*10% particulate/90% dissolved
20% refractory/80% labile

State Variables
in 2013_1017 version

Driving Variables	TSS	Temperature	pH
Initial condition	5.15 mg/L	5 deg C	7.4 pH
Dynamic or constant loading	Dynamic	Dynamic	Dynamic

State Variables
in 2013_1017 version

	Segment 1			Segments 2 through 13		
PlantName	**Initial Condition**	**Constant Loading**	**Dynamic Loading**	**Initial Condition**	**Constant Loading**	**Dynamic Loading**
Peri Low-Nut Diatom	0.0024	0	None	0.0024	0	None
Peri High-Nut Diatom	0.22	0	None	0.22	0	None
Phyt High-Nut Diatom	0.02		1998 data series	0.02	0	None
Phyt Low-Nut Diatom	0.1		2005-2006 data series	0.1	0	None
Cladophora	0.0009	0	None	0.0009	0	None
Peri, Green	0.0015	0	None	0.0015	0	None
Phyto, Green	0.015	0	None	0.015	0	None
Phyt, Blue-Greens	0	0.00001	None	0	0.00001	None
Peri, Blue-Greens	0	0.00001	None	0	0.00001	None

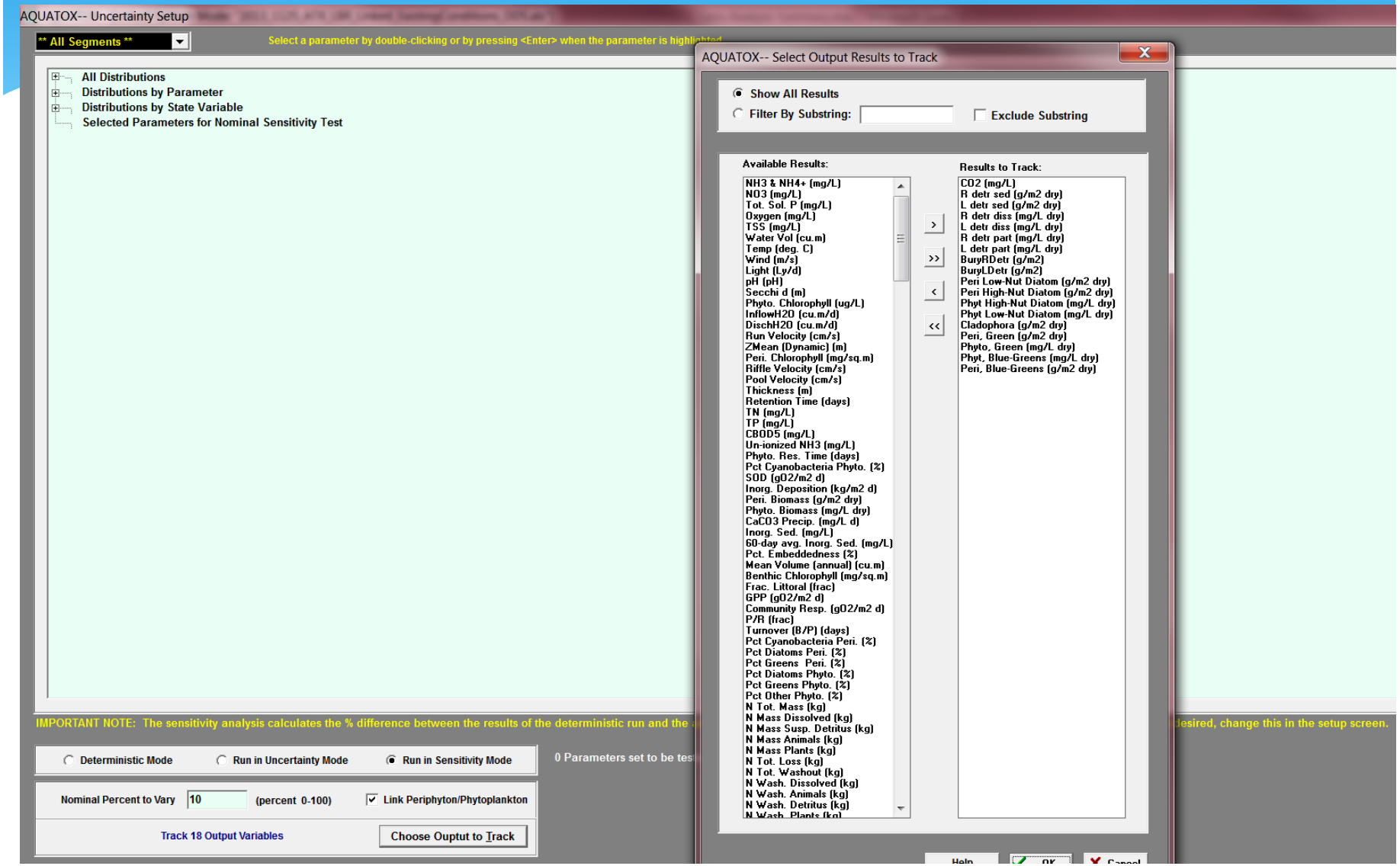
Algal Parameters

"Variables and Parameters in the 10_17 version.xlsx"

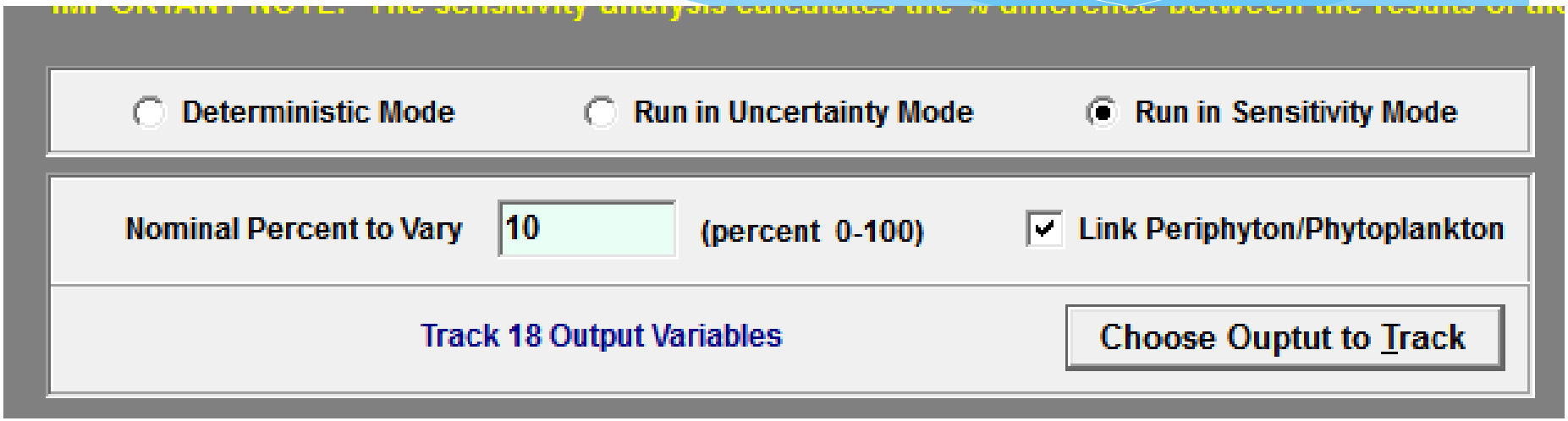
PlantName	Peri Low-Nut Diatom	Peri High-Nut Diatom	Phyt High-Nut Diatom	Phyt Low-Nut Diatom
ScientificName				
Taxonomic Type	Macrophytes	Diatoms	Diatoms	Diatoms
Plant Type	Periphyton	Periphyton	Phytoplankton	Phytoplankton
Saturating Light	64	22.5	45	224
Sat Light Ref	15WB; Hill 1996;Goldsborough	Hill, 1996 = 64 (22.5)	Hill, 1996 64 (22.5) ~Cyclotel	Collins & Wlosinski 1983 p. 41 ~
P Half-Saturation	0.006	0.055	0.055	0.006
P Half-Sat Ref	0.002, cal for WB, Borchardt, 1	cal.;Collins & Wlosinski '83, p. 33 0.05	C&W 0.055;Horne & Goldman, 1	0.002, cal for WB, Borchardt, 19
N Half-Saturation	0.07	0.117	0.117	0.0154
N Half-Sat Ref	0.008; Horne and Goldman, 19	Collins & Wlosinski '83, p. 36, EcoTox	Collins & Wlosinski '83, p. 36, C.	EcoTox
C Half-Saturation	0.054	0.054	0.054	0.054
C Half-Sat Ref	" (greens)	C & W '83, p. 39 (greens) = 0.054	C & W '83, p. 39 (greens)	" (greens)
Temp Resp Slope	2	1.8	1.8	2
Temp Resp Reference	DeNicola, 1996			DeNicola, 1996
Opt Temp	20	20	20	15
Opt Temp Reference	DeNicola, 1996 (20-28)	Collins & Wlosinski '83, p. 43 = 20	Collins & Wlosinski '83, p. 43 = 2	cal.; DeNicola, 1996 (20-28)
Max Temp	39	35	35	39
Max Temp Reference	DeNicola, 1996			DeNicola, 1996
Min Temp	2	2	2	2
Min Temp Reference	adapted to cold conditions	2		adapted to cold conditions
Max Photosynth Rate	0.77	2.06	1.87	1
Max Photo Ref	calibrated; Fragilaria = 0.77	Collins & Wlosinski '83; EcoTox 1-96	mean, C & W '83 = 3.4 max	Collins & Wlosinski 1983; EcoTo
Resp Coeff	0.026	0.026	0.026	0.05

Sensitivity Analysis

Built into AQUATOX



Sensitivity Analysis



* Finding the best load for initial conditions

Sensitivity Analysis

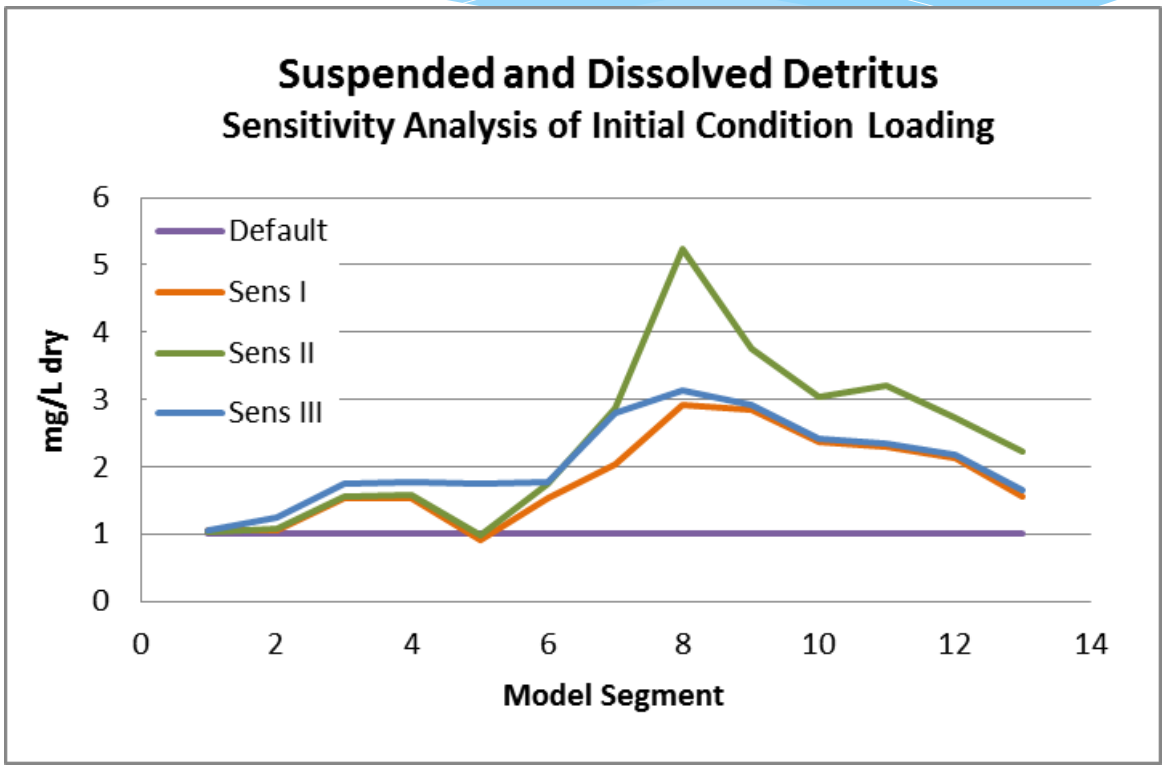
* State variables
  * Total ammonia as N
  * Nitrate as N
  * Total soluble P
  * CO_2
  * Oxygen
  * TSS
  * Refractory sediment detritus
  * Labile sediment detritus
  * Suspended and dissolved detritus
  * Buried refractory detritus
  * Buried labile detritus

Sensitivity Analysis

Algal Loads	
PlantName	**Initial Condition**
Peri Low-Nut Diatom	0.0024
Peri High-Nut Diatom	0.22
Phyt High-Nut Diatom	0.02
Phyt Low-Nut Diatom	0.1
Cladophora	0.0009
Peri, Green	0.0015
Phyto, Green	0.015
Phyt, Blue-Greens	0
Peri, Blue-Greens	0

Sensitivity Analysis
Suspended and Dissolved Detritus

Suspended and dissolved detritus load				
	Detritus Loads		mg/L dry	
Segment	Sens I	Sens II	Sens III	Default
1	1.05	1.04	1.05	1
2	1.05	1.08	1.24	1
3	1.54	1.57	1.74	1
4	1.534	1.578	1.77	1
5	0.918	0.985	1.75	1
6	1.534	1.76	1.78	1
7	2.027	2.87	2.81	1
8	2.912	5.25	3.13	1
9	2.84	3.76	2.93	1
10	2.38	3.03	2.41	1
11	2.29	3.2	2.35	1
12	2.14	2.72	2.19	1
13	1.56	2.24	1.65	1



Sensitivity Analysis

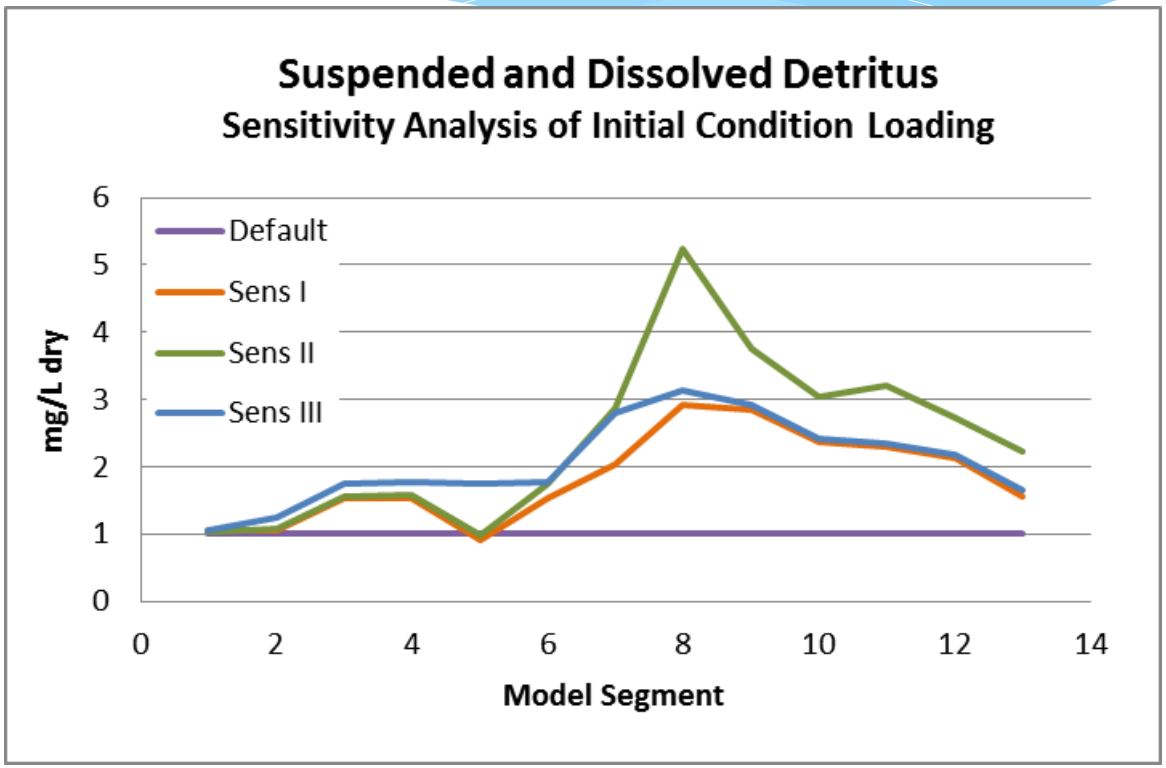
10% Sensitivity Test	Base Case
Parameter Value	N A
NH3 & NH4+ (mg/L)	0.005402
NO3 (mg/L)	0.060013
Tot. Sol. P (mg/L)	0.009266
CO2 (mg/L)	0.112261
Oxygen (mg/L)	7.965159
TSS (mg/L)	2.914984
R detr sed (g/m2 dry)	0.032806
L detr sed (g/m2 dry)	0.214006
R detr diss (mg/L dry)	0.001089
L detr diss (mg/L dry)	1.043161
R detr part (mg/L dry)	7.31E-05
L detr part (mg/L dry)	0.001979
BuryRDetr (g/m2)	2
BuryLDetr (g/m2)	1
Peri Low-Nut Diatom (g/m2 dry)	0.037482
Peri High-Nut Diatom (g/m2 dry)	0.00119
Phyt High-Nut Diatom (mg/L dry)	0.377487
Phyt Low-Nut Diatom (mg/L dry)	0.11251
Cladophora (g/m2 dry)	2.41E-12
Peri, Green (g/m2 dry)	8.52E-16
Phyto, Green (mg/L dry)	0
Phyt, Blue-Greens (mg/L dry)	0
Peri, Blue-Greens (g/m2 dry)	9.34E-12

10% Sensitivity Test	Base Case
Parameter Value	N A
NH3 & NH4+ (mg/L)	0.017119
NO3 (mg/L)	0.059899
Tot. Sol. P (mg/L)	0.013593
CO2 (mg/L)	0.441896
Oxygen (mg/L)	10.39302
TSS (mg/L)	8.165715
R detr sed (g/m2 dry)	0.127749
L detr sed (g/m2 dry)	2.72255
R detr diss (mg/L dry)	0.002206
L detr diss (mg/L dry)	1.052712
R detr part (mg/L dry)	0.001817
L detr part (mg/L dry)	0.024646
BuryRDetr (g/m2)	2.237512
BuryLDetr (g/m2)	1
Peri Low-Nut Diatom (g/m2 dry)	0.064747
Peri High-Nut Diatom (g/m2 dry)	0.267266
Phyt High-Nut Diatom (mg/L dry)	0.373203
Phyt Low-Nut Diatom (mg/L dry)	0.112593
Cladophora (g/m2 dry)	0.003425
Peri, Green (g/m2 dry)	8.47E-16
Phyto, Green (mg/L dry)	1.05E-17
Phyt, Blue-Greens (mg/L dry)	0.005252
Peri, Blue-Greens (g/m2 dry)	14.72366

Sensitivity Analysis
Suspended and Dissolved Detritus

Suspended and dissolved detritus load

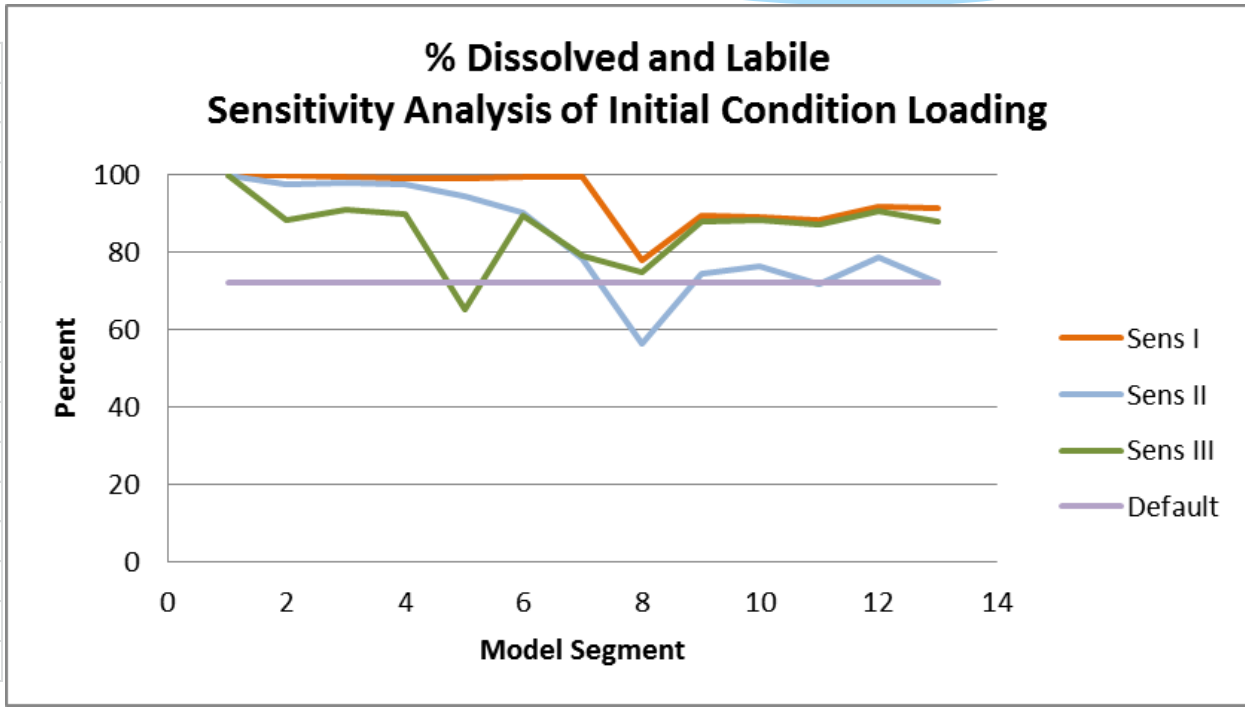
	Detritus Loads		mg/L dry	
Segment	**Sens I**	**Sens II**	**Sens III**	**Default**
1	1.05	1.04	1.05	1
2	1.05	1.08	1.24	1
3	1.54	1.57	1.74	1
4	1.534	1.578	1.77	1
5	0.918	0.985	1.75	1
6	1.534	1.76	1.78	1
7	2.027	2.87	2.81	1
8	2.912	5.25	3.13	1
9	2.84	3.76	2.93	1
10	2.38	3.03	2.41	1
11	2.29	3.2	2.35	1
12	2.14	2.72	2.19	1
13	1.56	2.24	1.65	1



Sensitivity Analysis

% Dissolved and labile fraction of suspended and dissolved detritus load

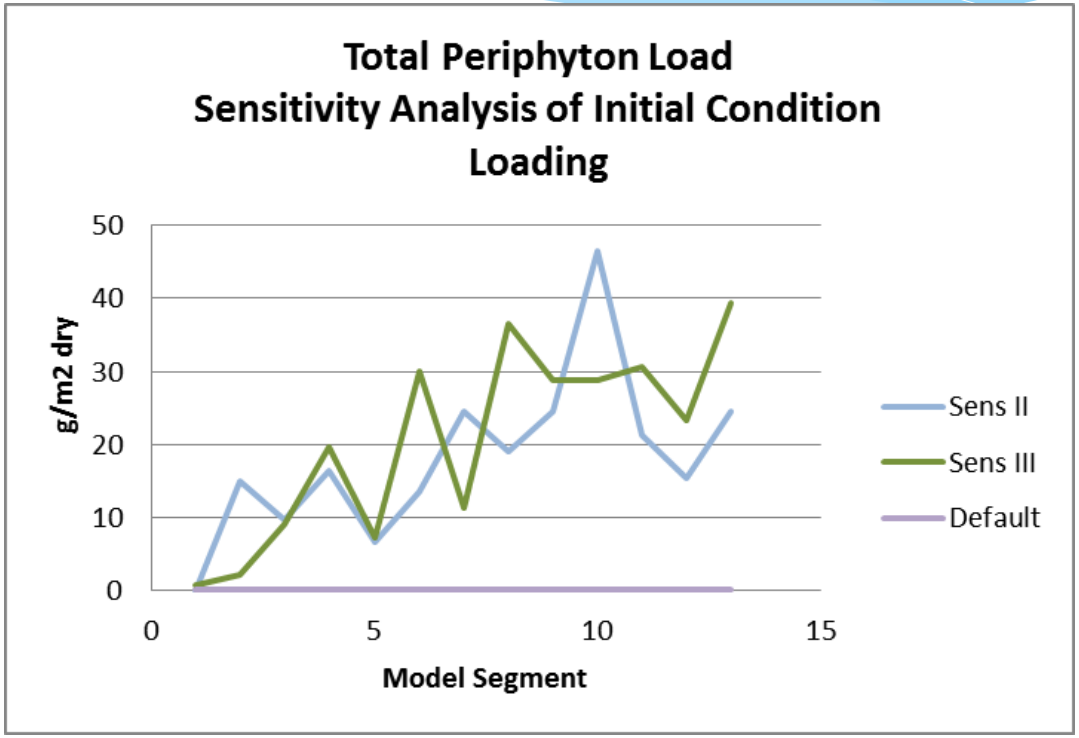
Suspended and dissolve detritus load				
% Dissolved and Labile				
Segment	Sens I	Sens II	Sens III	Default
1	99.7	99.7	99.6	72
2	99.5	97.3	88.3	72
3	99.2	97.7	90.7	72
4	99	97.3	89.7	72
5	99	94.3	65	72
6	99.1	90.2	89.2	72
7	99.2	78.1	79.1	72
8	77.9	56.2	74.7	72
9	89.2	74.5	87.6	72
10	88.9	76.2	88.1	72
11	88.1	71.7	86.8	72
12	91.7	78.5	90.4	72
13	91.2	72.2	87.8	72



Sensitivity Analysis

Total periphyton load

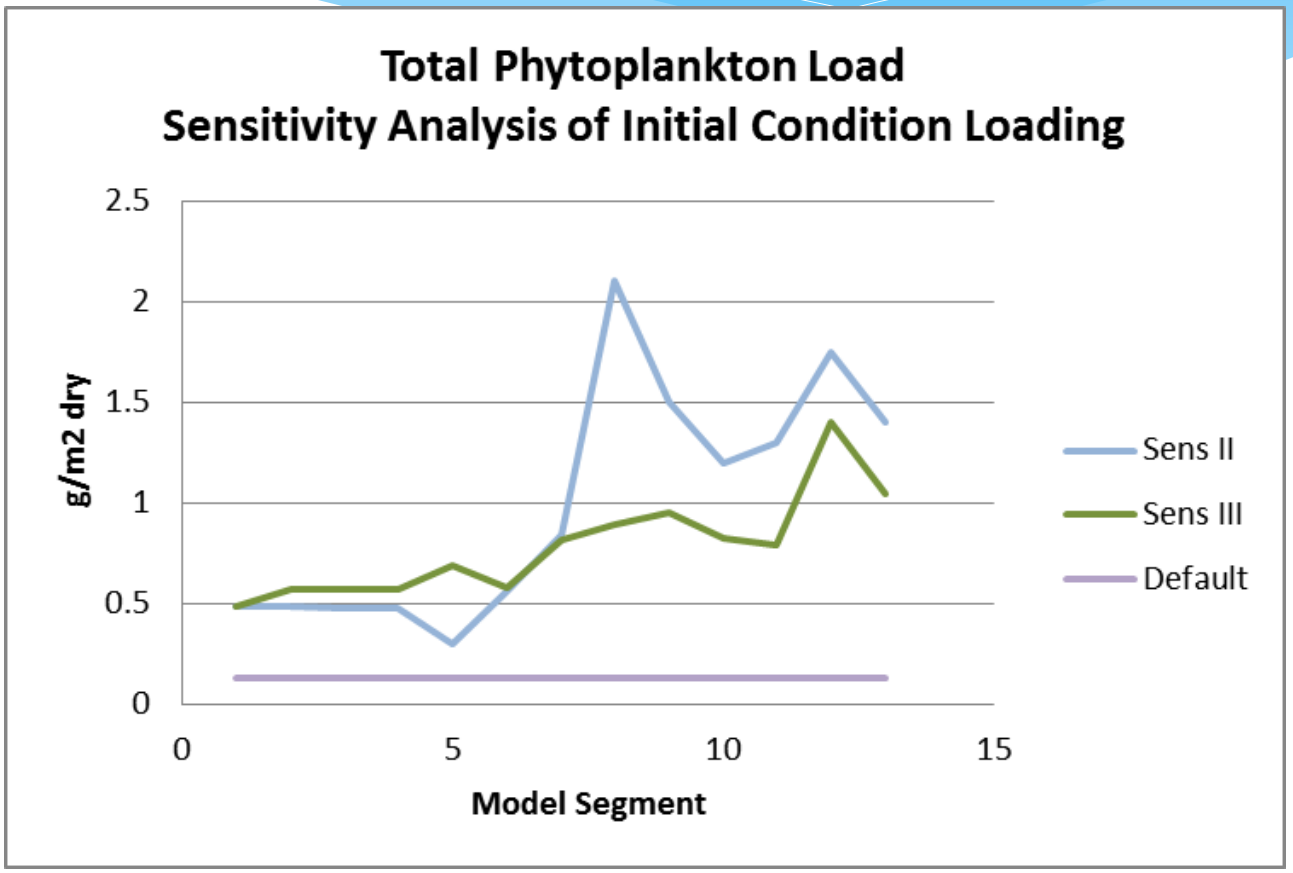
Algal Loads			
Total periphyton load g/m2 dry			
Segment	Default	Sens II	Sens III
1	0.2248	0.04	0.7
2	0.2248	15.1	2.3
3	0.2248	9.8	9.11
4	0.2248	16.4	19.6
5	0.2248	6.7	7.3
6	0.2248	13.6	30
7	0.2248	24.6	11.3
8	0.2248	19	36.6
9	0.2248	24.6	28.9
10	0.2248	46.4	28.9
11	0.2248	21.2	30.7
12	0.2248	15.4	23.3
13	0.2248	24.6	39.4



Sensitivity Analysis

Total phytoplankton load

Algal Loads			
Total phytoplankton load g/m2 dry			
Segment	Default	Sens II	Sens III
1	0.135	0.49	0.49
2	0.135	0.49	0.57
3	0.135	0.48	0.57
4	0.135	0.48	0.57
5	0.135	0.3	0.69
6	0.135	0.56	0.58
7	0.135	0.84	0.82
8	0.135	2.1	0.89
9	0.135	1.5	0.95
10	0.135	1.2	0.83
11	0.135	1.3	0.79
12	0.135	1.75	1.4
13	0.135	1.4	1.05



Expert Opinion

Changes in Dick's study					
State Variables	**Initial condition**	**Dynamic or constant loading**	**Point Source**	**Nonpoint source**	**Notes**
Total Ammonia as N	None	Dynamic	None	None	
Nitrate as N	0.06 mg/L	Dynamic	None	None	
Total Soluble P	0.01 mg/L	Dynamic	None	None	
CO2	0.5 mg/L	Constant loading of 0.7 mg/L			
Oxygen	13 mg/L	Dynamic	None	None	No direct precipitation
TSS	5.15 mg/L	Dynamic			
Refractory sediment detr	1 g/m^2 dry	Constant loading of			
Labile sediment detritus	0.3 g/m^2 dry	Constant loading of			
Suspended and Dissolved	1 mg/L dry as CBOD	Dynamic-historic	None	None	
Buried refractory detritus	2 kg/cu m				
Buried labile detritus	1 kg/cu m				
Wind loading	1 m/s	1 m/s			
Light	182 Ly/d	Dynamic			
* 10% particulate/90% dis	Particulate=constant percentage of .1 percent				
20% refractory/80% labile	Refractory =				
but 10% constant loading	used				

Driving Variables	**TSS**	**Temperature**	**pH**
Initial condition	5.15 mg/L	5 deg C	7.4 pH
Dynamic or constant load	Dynamic	Dynamic	Dynamic

Algal Loads

Algal Loads		Segment 1		Segments 2 through 13		
PlantName	Initial Condition	Constant Loading	Dynamic Loading	Initial Condition	Constant Loading	Dynamic Loading
Peri Low-Nut Diatom	0.0024	0	None	0.0024	0	None
Peri High-Nut Diatom	0.22	0	None	0.22	0	None
Phyt High-Nut Diatom	0.02		1998 data series	0.02	0	None
Phyt Low-Nut Diatom	0.1		2005-2006 data series	0.1	0	None
Cladophora	0.0009	0	None	0.0009	0	None
Peri, Green	0.0015	0	None	0.0015	0	None
Phyto, Green	0.015	0	None	0.015	0	None
Phyt, Blue-Greens	0	0.00001	None	0	0.00001	None
Peri, Blue-Greens	0	0.00001	None	0	0.00001	None

Park Changes

Algal Loads		Segment 1		Segments 2 through 13		
PlantName	Initial Condition	Constant Loading	Dynamic Loading	Initial Condition	Constant Loading	Dynamic Loading
Peri Low-Nut Diatom	0.0024	0		0.0024	0	
Peri High-Nut Diatom	0.22	0		0.22	0	
Phyt High-Nut Diatom	0.02		1998 data series	0.02	0	
Phyt Low-Nut Diatom	0.1		2005-2006 data series	0.1	0	
Cladophora	0.0009	0		0.0009	0	
Peri, Green	0.0015	0		0.0015	0	
Phyto, Green	0.015	0		0.015	0	
Phyt, Blue-Greens	0.001	0		0.001	0	
Peri, Blue-Greens	0.01	0		0.01	0	

Algal Parameters

PlantName	Peri Low-Nut Diatom	Park Changes	Peri High-Nut Diatom	Park Changes
ScientificName		Fragilaria		Cyclotella
Taxonomic Type	Macrophytes	Diatoms	Diatoms	Diatoms
Plant Type	Periphyton	Periphyton	Periphyton	Periphyton
Saturating Light	64	64	22.5	22.5
Sat Light Ref	15WB; Hill 1996;Goldsbor	15WB; Hill 1996;Goldsborough & R	Hill, 1996 = 64 (22.5)	Park et al. 2009; Hill, 1996 = 64
P Half-Saturation	0.006	0.006	0.055	0.055
P Half-Sat Ref	0.002, cal for WB, Borchar	0.002, cal for WB, Borchardt, 1996	cal.;Collins & Wlosinski '8	Collins & Wlosinski '83, p. 33 0.055
N Half-Saturation	0.07	0.07	0.117	0.117
N Half-Sat Ref	0.008; Horne and Goldma	0.008; Horne and Goldman, 1994, p	Collins & Wlosinski '83, p	Collins & Wlosinski '83, p. 36, EcoTo
C Half-Saturation	0.054	0.054	0.054	0.054
C Half-Sat Ref	" (greens)	" (greens)	C & W '83, p. 39 (greens)	C & W '83, p. 39 (greens) = 0.054
Temp Resp Slope	2	2	1.8	1.8
Temp Resp Referer	DeNicola, 1996	DeNicola, 1996		
Opt Temp	20	15	20	20
Opt Temp Referenc	DeNicola, 1996 (20-28)	prof opinion (cold-water), DeNicola,	Collins & Wlosinski '83, p	Collins & Wlosinski '83, p. 43 = 20
Max Temp	39	39	35	35
Max Temp Referen	DeNicola, 1996	DeNicola, 1996		
Min Temp	2	2	2	2
Min Temp Referenc	adapted to cold condition	adapted to cold conditions	2	2
Max Photosynth Ra	0.77	0.77	2.06	2.3
Max Photo Ref	calibrated; Fragilaria = 0.7	Park et al. 2009; Fragilaria = 0.77	Collins & Wlosinski '83; E	Park et al. 2009; EcoTox 1-96 = 2.06

Summary of changes to algal parameters

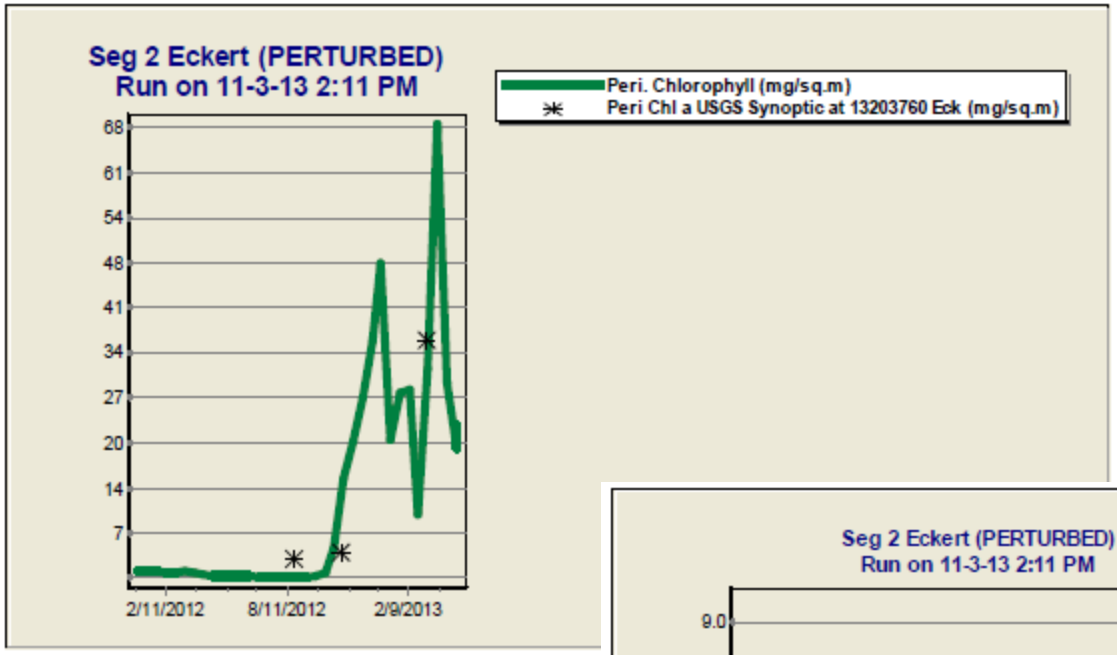
* Percent riffle was set to 50% in the habitat preferences wherever it was zero. This enables periphytic biomass to grow in reaches dominated by riffles
* Cyanobacteria parameterized as a cold-tolerant genus and initial conditions set to .01 g/m^2

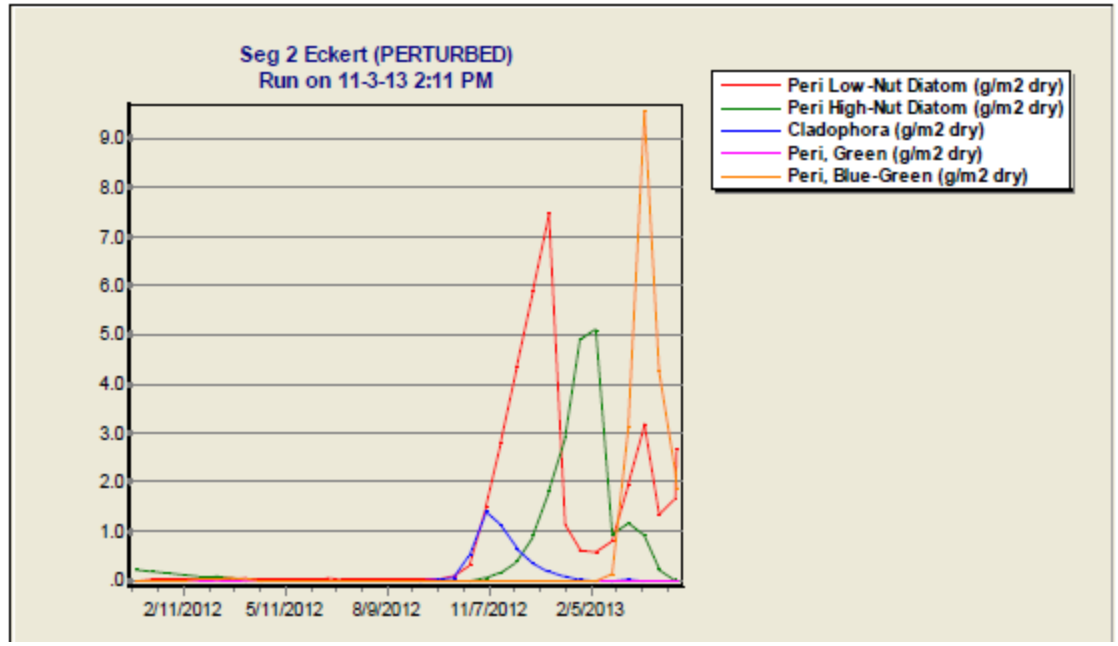
Summary of changes to algal parameters

Algal Parameter Values Used in Lower Boise River, Idaho, Simulations												
Periphyton	**Topt**	**Tmax**	**Tresp**	**LightSat**	**Pmax**	**Lightex**	**P half-sat**	**N half-sat**	**C half-sat**	**ExpMoCo**	**Fcrit**	**%sl**
Low-nutrient diatoms	**15**	39	2	64	**0.77**	0.03	0.006	0.07	0.054	0.01	**0.007**	**90**
High-nutrient diatoms	20	35	1.8	22.5	2.3	0.03	0.055	**0.117**	0.054	0.01	**0.008**	**90**
Greens	25	42	2	**110**	1.7	0.03	0.1	0.8	0.054	0.01	**0.007**	**90**
Cladophora	**15**	**25**	2	135	**1.08**	**0.22**	**0.01**	**0.0586**	0.054	0.05	**0.008**	**25**
Oscillatoria	**10**	50	**2.1**	**110**	**1.2**	0.03	**0.006**	**0.168**	0.024	0.01	**0.008**	90
Phytoplankton												
Low-nutrient diatoms	15	39	2	**224**	0.7	0.14	0.006	0.0154	0.054	0.05	NA	NA
High-nutrient diatoms	20	35	**1.8**	**45**	1.87	0.14	0.055	0.117	0.054	0.05	NA	NA
Greens	26	42	2	**220**	1.5	0.24	0.1	0.8	0.054	0.04	NA	NA
Blue-Greens	27	50	2	60	2.2	**0.099**	0.03	0.4	0.024	0.12	NA	NA

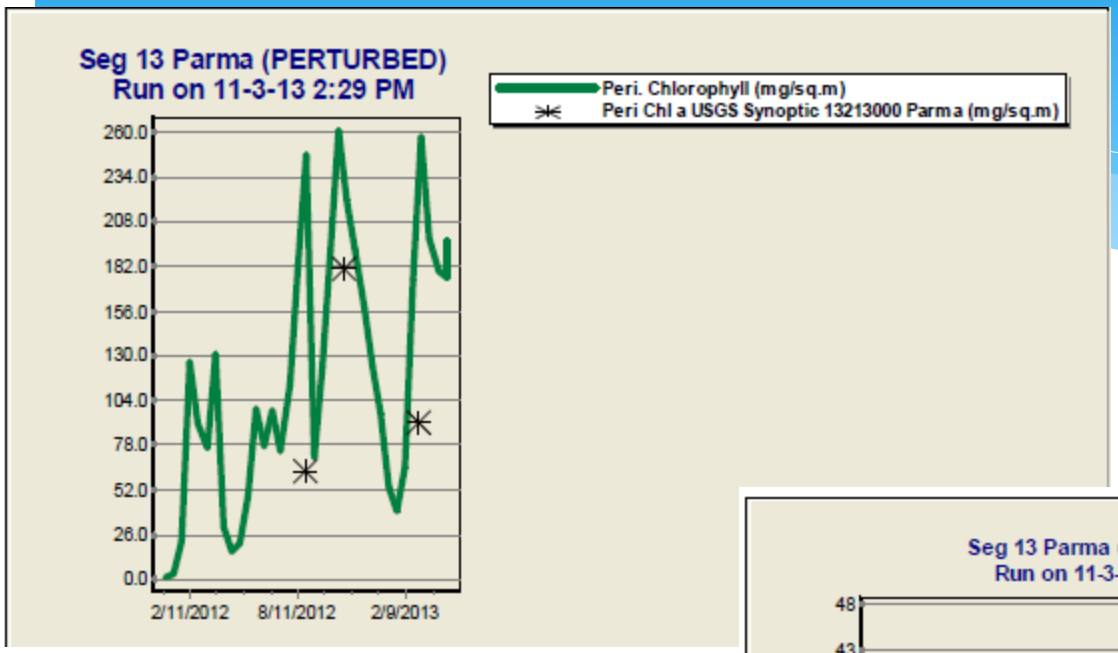
* 11-3-13 Summary Calibration of AQUATOX in LBR TMDL.pdf

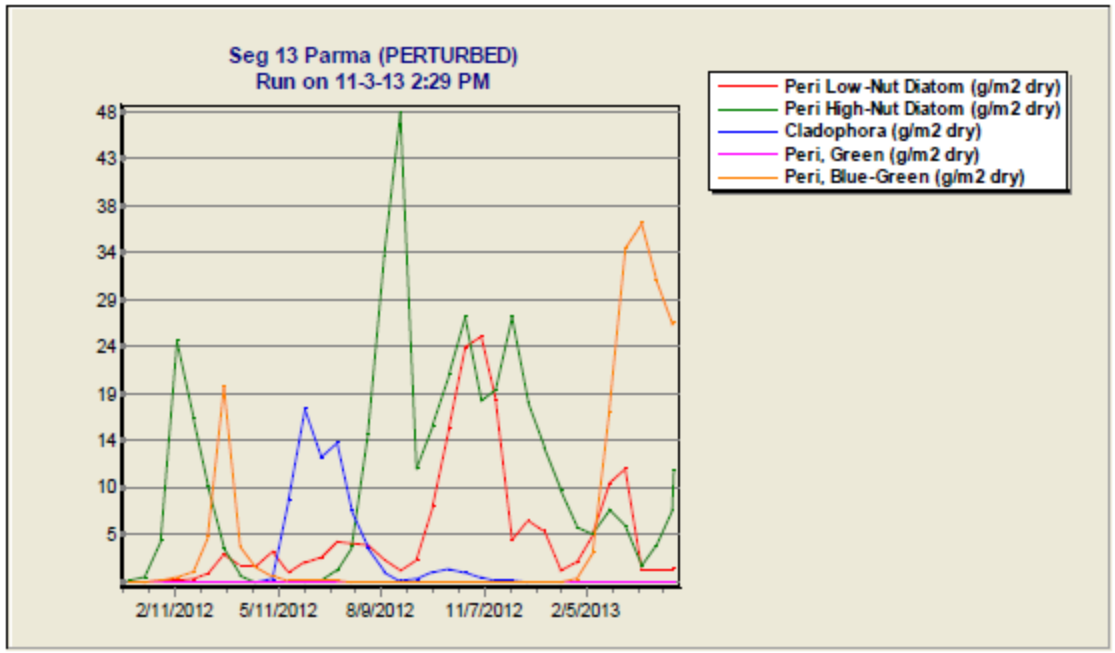
Results of changes to algal parameters

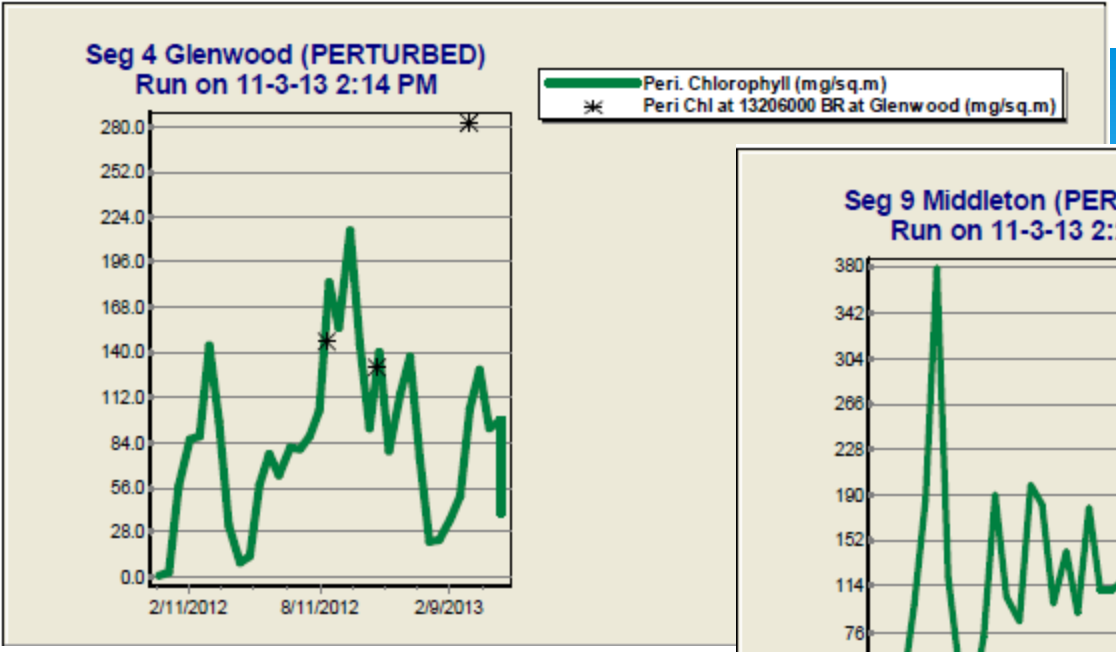


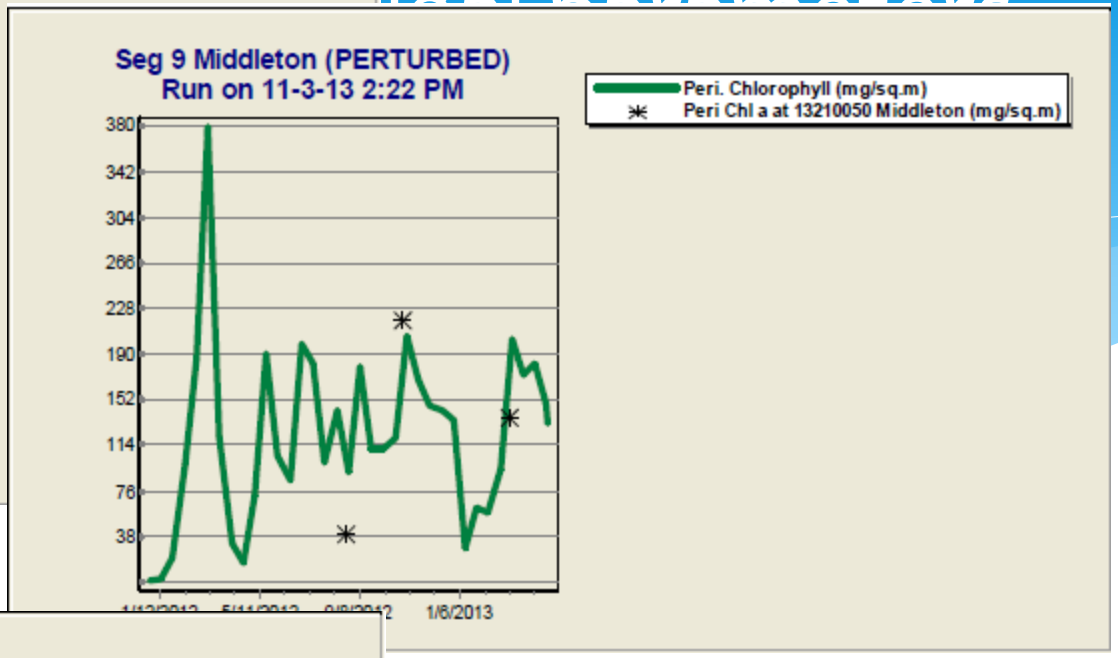


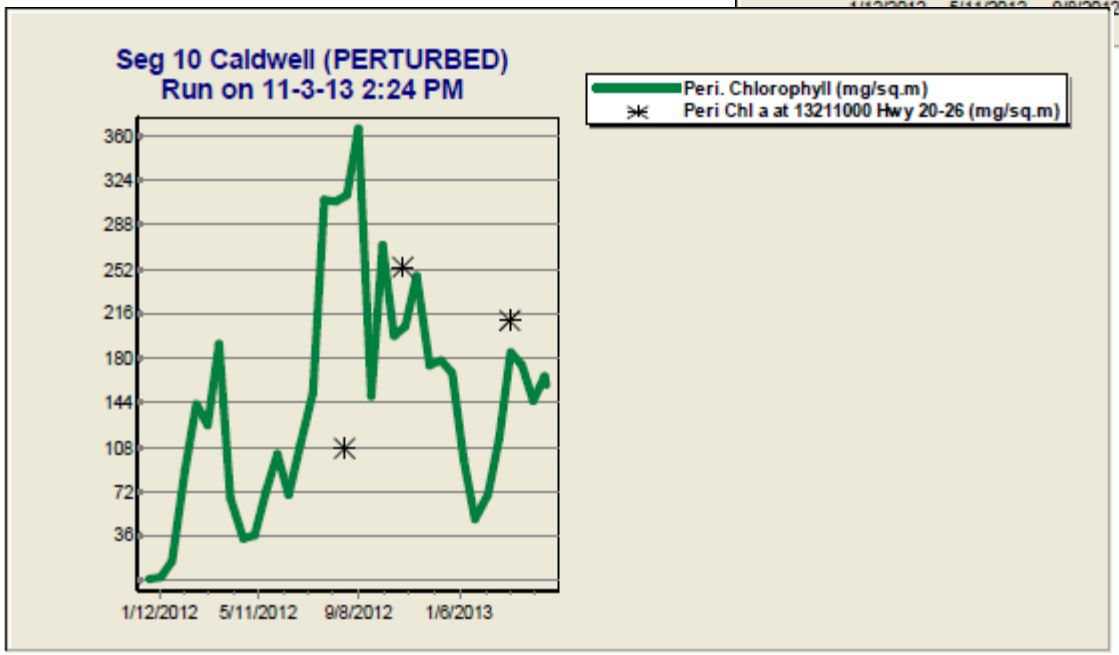
Results of changes to algal parameters

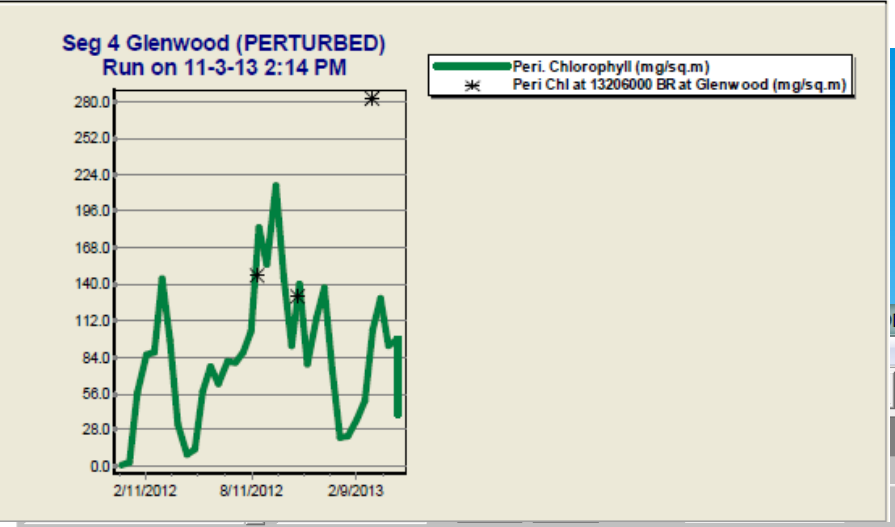


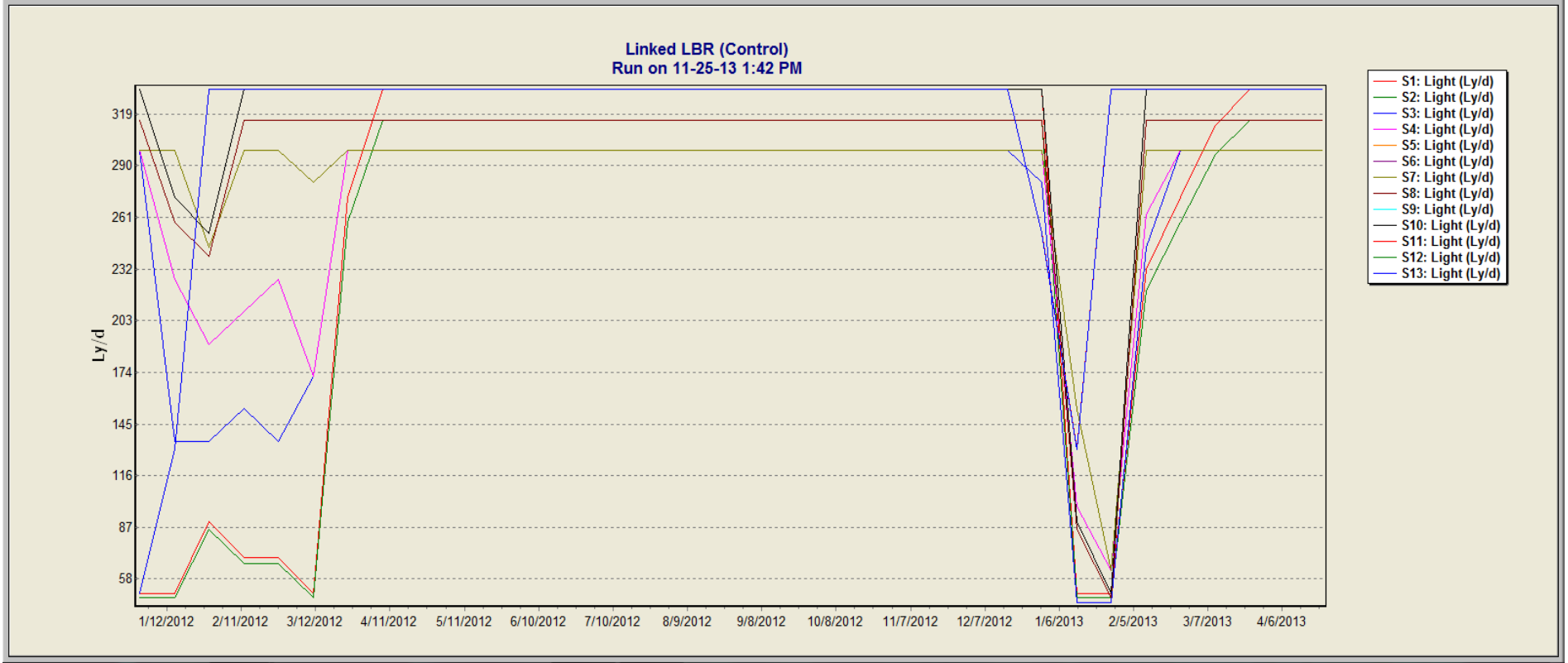



Seg 4 Glenwood (PERTURBED)
Run on 11-3-13 2:14 PM
Peri. Chlorophyll (mg/sq.m)
Peri Chl at 13206000 BR at Glenwood (mg/sq.m)
280.0
252.0
224.0
196.0
168.0
140.0
112.0
84.0
56.0
28.0
0.0
2/11/2012
8/11/2012
2/9/2013


Seg 9 Middleton (PERTURBED)
Run on 11-3-13 2:22 PM
Peri. Chlorophyll (mg/sq.m)
Peri Chl a at 13210050 Middleton (mg/sq.m)
380
342
304
266
228
190
152
114
76
38
1/6/2013


Seg 10 Caldwell (PERTURBED)
Run on 11-3-13 2:24 PM
Peri. Chlorophyll (mg/sq.m)
Peri Chl a at 13211000 Hwy 20-26 (mg/sq.m)
360
324
288
252
216
180
144
108
72
36
1/12/2012
5/11/2012
9/8/2012
1/6/2013





8:08 AM
11/26/2013

Light

* The model was programmed to decrease transmitted light to 15% of incident radiation when the average water temperature drops below 3 deg.C.
* aquatox_no_ICE_.exe removed the ice-forming condition in the code and I am running it now

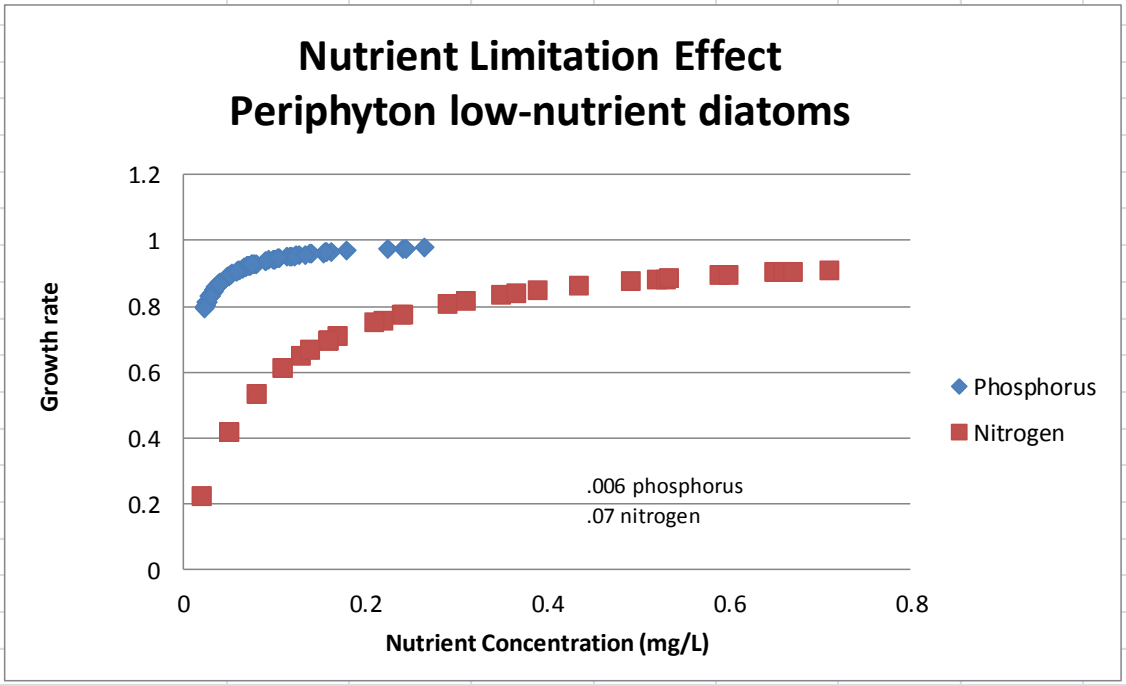
Further analysis of algal parameters

* Phosphorus and nitrogen half-saturation coefficient follow the Monod equation:

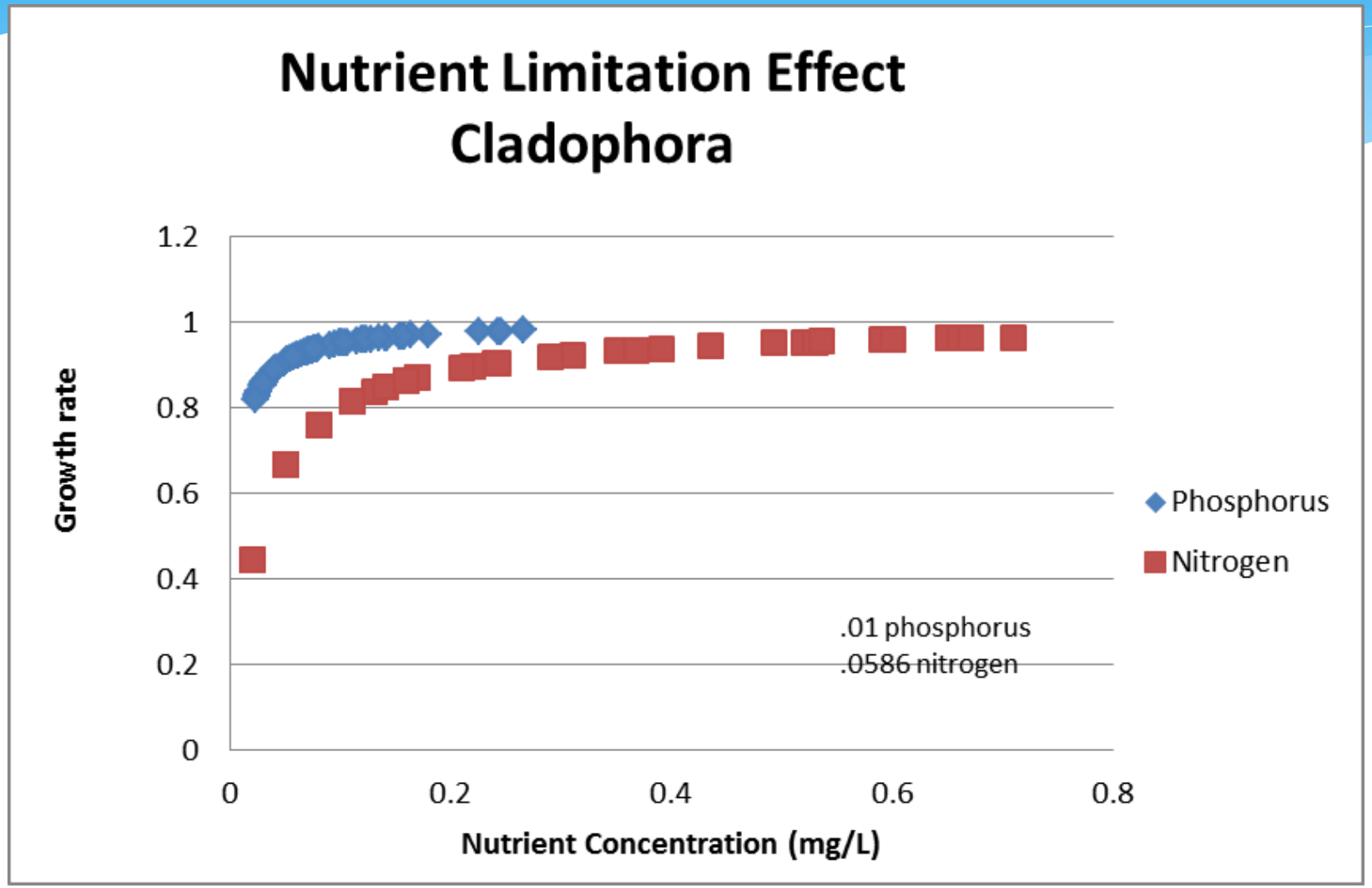
$G(N) = N/(Kmn + N)$
N = nutrient concentration
Kmn = half-saturation constant
G(N) = growth rate

Segment 4 Nutrient Limitation Effect Periphyton low-nutrient diatoms

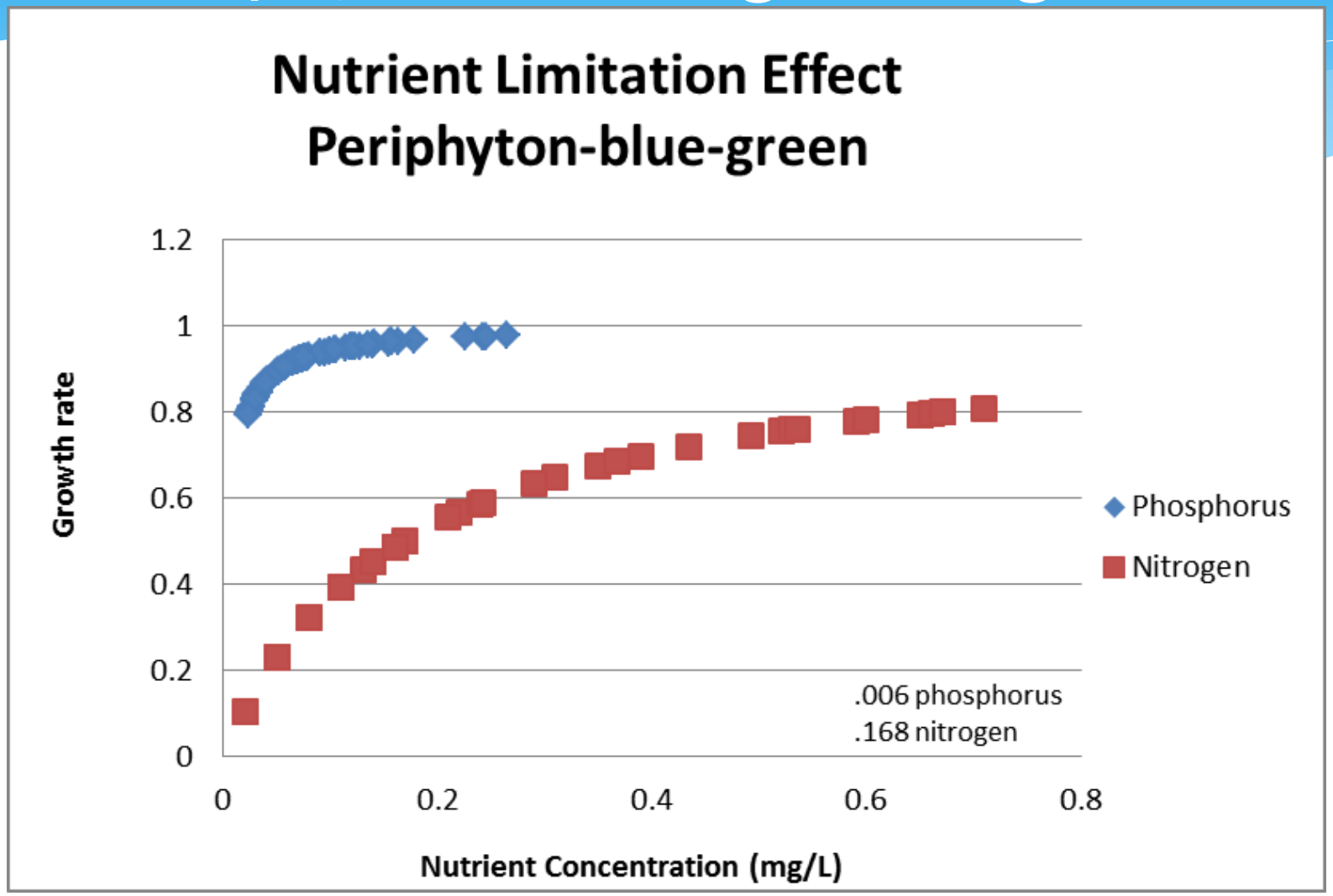
	Segment 4			G(N) = N/(Kmn + N)
	Nutrient limitation effect			N = nutrient concentration
	Periphyton low-nutrient diatoms			Kmn = half-saturation constant
	Phosphorus	**Nitrogen**		G(N) = growth rate
Half-sat	**0.006**	**0.07**		
	Phosphorus		**Nitrogen**	
1/3/2012	0.2426	0.975865	0.52	0.881356
1/3/2012	0.245	0.976096	0.59	0.893939
1/10/2012	0.2254	0.974071	0.65	0.902778
1/17/2012	0.265	0.97786	0.65	0.902778
1/24/2012	0.179	0.967568	0.66	0.90411
1/31/2012	0.14	0.958904	0.6	0.895522
2/7/2012	0.158	0.963415	0.31	0.815789
2/7/2012	0.154	0.9625	0.39	0.847826
2/14/2012	0.124	0.953846	0.22	0.758621
2/21/2012	0.1199	0.952343	0.17	0.708333
2/28/2012	0.0784	0.92891	0.16	0.695652
3/6/2012	0.0696	0.920635	0.08	0.533333
3/6/2012	0.0726	0.923664	0.05	0.416667
3/13/2012	0.0519	0.896373	0.05	0.416667
3/20/2012	0.0311	0.838275	0.11	0.611111
3/27/2012	0.0291	0.82906	0.35	0.833333
4/3/2012	0.0333	0.847328	0.05	0.416667



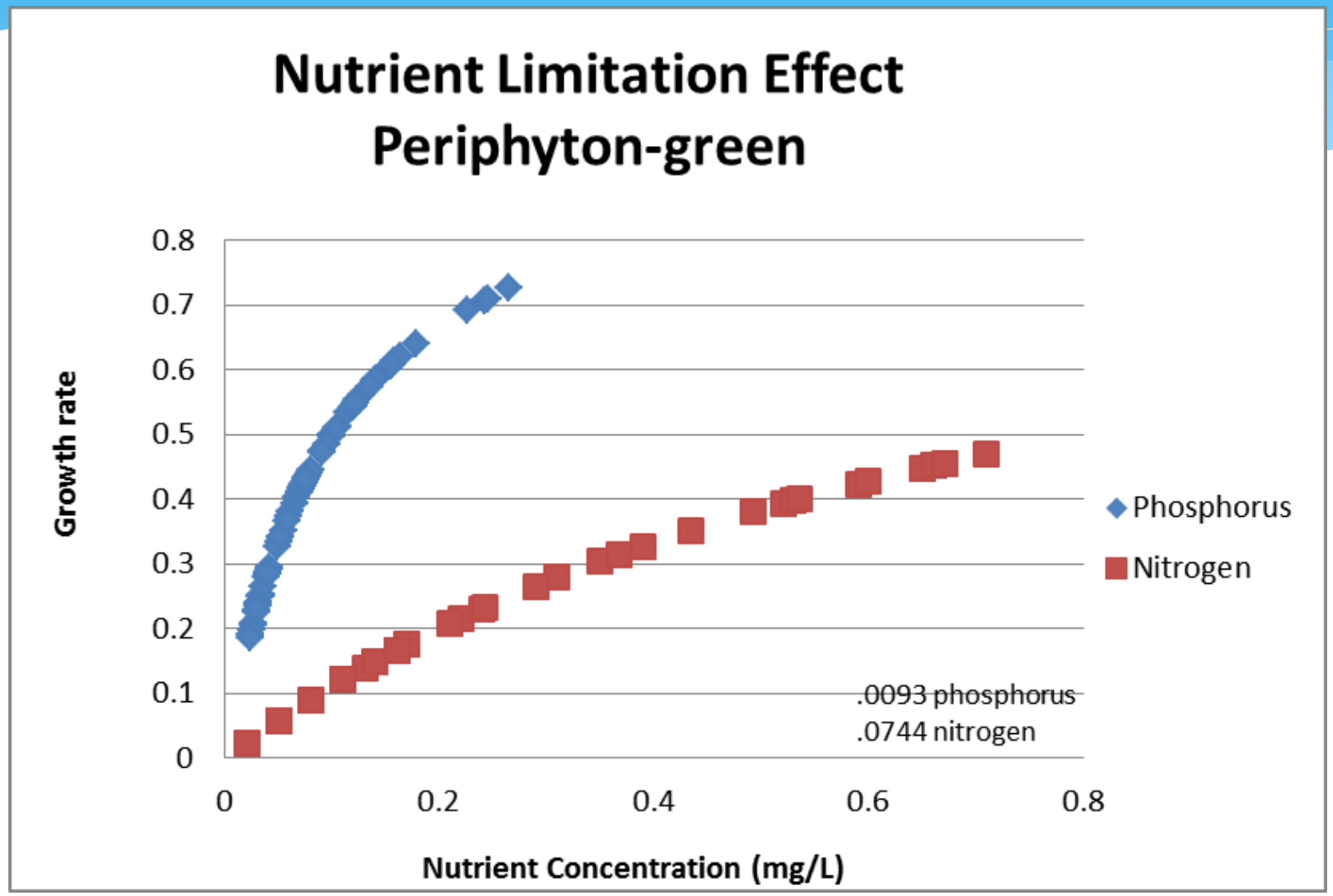
Segment 4 Nutrient Limitation Effect Cladophora



Segment 4 Nutrient Limitation Effect Periphyton—blue-green algae



Segment 4 Nutrient Limitation Effect Periphyton—green algae



Lower Boise River Periphyton Community Composition Analysis - March 2007

Division	Species	Site					
Cyanophyta:		Eckert	Veteran's	Glenwood	Middleton	Caldwell	Parma
	Audouinella violacea						R
	Chamaesiphon incrustans						R
	Chroococcus species					R	
	Lyngbya birgei			C/A			
	Oscillatoria agardhii	R	C	C		R	
	Oscillatoria amphibia			R		R	R
	Oscillatoria princeps		R				
	Phormidium incrustatum		C				
	Phormidium inundatum					C	
Chlorophyta:							
	Cladophora glomerata	R	R		C	R	A
	Closterium ehrenbergii		R				
	Cosmarium species		R	R	R	R	
	Mougeotia species	R			R		
	Oedogonium species	C	R				R
	Stigeoclonium polymorphum		R	R			
	Ulothrix aequalis		C	R			
	Ulothrix zonata			R	R		
Diatoms:							
	Centric diatoms		R				R
	Pennate diatoms	A	A	A	A	A	A
	Asterionella formosa	R					
	Fragilaria crotonensis						
	Fragilaria virescens	C	C	R	C	R/C	
	Melosira granulata						
	Melosira varians	C	C	R	C	C	R
	Stephanodiscus niagarae	R	R	R			R

R - Rare, present in only a single or few microscope fields
C - Common, present in up to 10% of microscope fields
A - Abundant, present in more than 10% of the microscope fields

Lower Boise River Periphyton Community Composition Analysis - September 2006

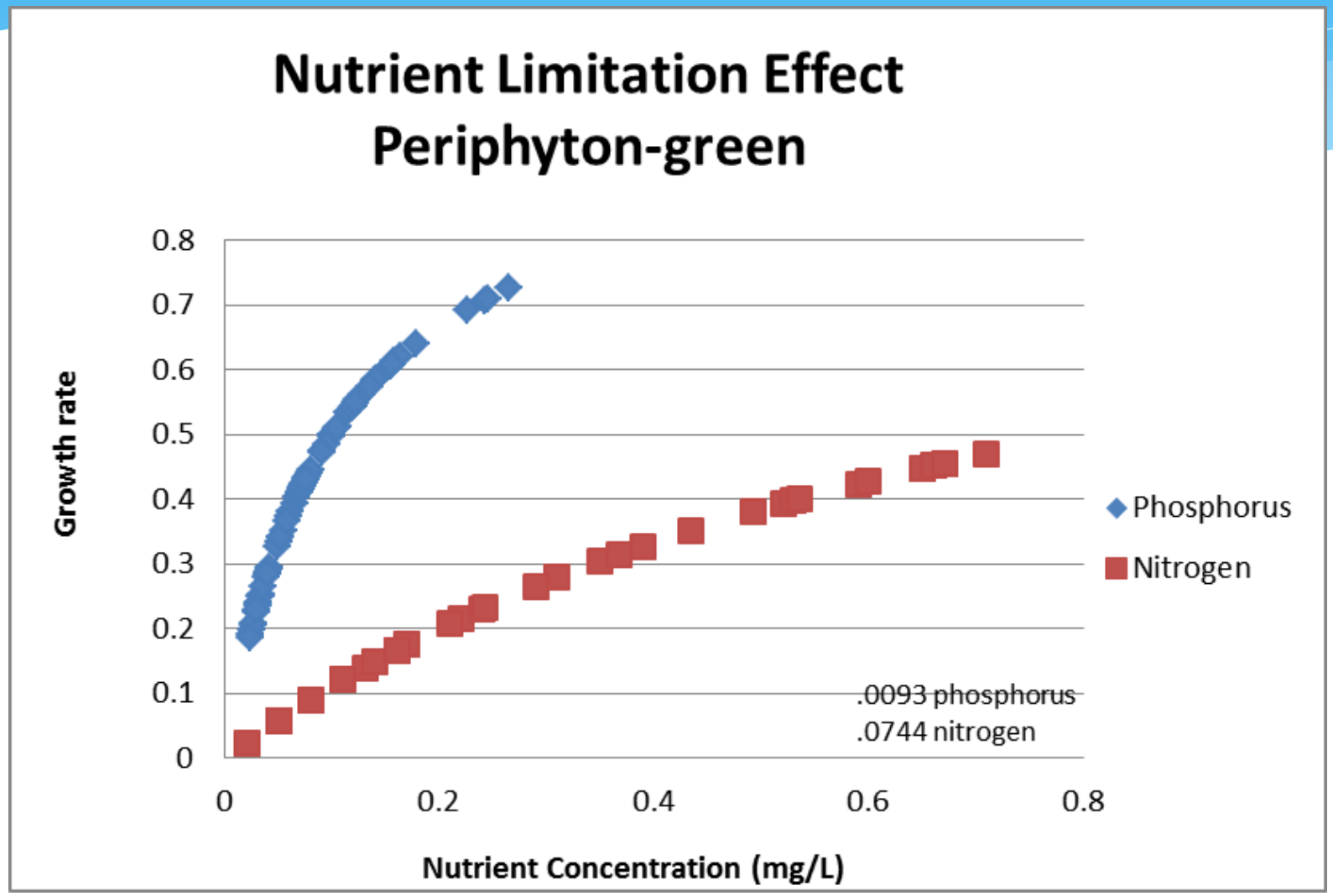
Division	Species	Site					
		Eckert	Veteran's	Glenwood	Middleton	Caldwell	Parma
	Oscillatoria agardhii					R	
Cyanophyta:	*Phormidium inundatum*				C	R	
	Phormidium species*		A				
	Rivularia species				C	R	
Chlorophyta:							
	Cladophora glomerata	A	R	A		R	C
	Closterium ehrenbergii				R	R	
	Cosmarium species				R/C	R	
	Oedogonium species	C				R	
	Scenedesmus quadricauda					R	
	Spirogyra species					R	
	Stigeoclonium polymorphum	R/C	R		C		C
	Ulothrix aequalis	R	R				C
	Ulothrix zonata				R		
Diatoms:							
	Centric diatoms				C		
	Pennate diatoms	A	A	A	A	A	A
	Fragilaria crotonensis						C
	Fragilaria virescens			R		A	
	Melosira granulata			R		R	
	Melosira varians	R	R	R	R		
	Stephanodiscus niagarae			R	R	R	

R - Rare, present in only a single or few microscope fields

C - Common, present in up to 10% of microscope fields

A - Abundant, present in more than 10% of the microscope fields

Segment 4 Nutrient Limitation Effect Periphyton—green algae



Next Steps

* Run the “No Ice” executable on existing model setup, which includes Dick Park’s edited algal parameters and my sensitivity analysis
* Finish calibrating algal groups until we hit the March bloom consistently
* Complete sensitivity analysis and report
* Release model and appropriate documentation for final calibration fiesta
* Answer compiled comments
* Begin uncertainty analysis