Illinois River Watershed and Lake Tenkiller

WATER QUALITY MODELING PROJECT UPDATE

MARCH 6, 2018

Welcome

Proposed Agenda

Welcome — Garcia

- Re-engagement of Principals
- Meeting Objectives

Project Background and Context — Wooster

- Statutory and Regulatory Framework
- First Statement of Joint Principles and Actions (2003)
- Northwest Arkansas Conservation Authority – Regional WWTP (2008)
- Modeling Project History (November 2009 – Present)

Agenda Continued

Technical Issues and Resolutions — Shaikh

- Meteorological Data
- Litter and Fertilizer Applications
- Modeling Drought Years – Water Balance Function
- Modeling Surface and Upper Layer Fractionation of Nutrients
- Atmospheric Deposition of Nitrogen
- Denitrification Rates
- Baseline Model Run Conditions
- Conceptual Approaches and Scenarios
- Lake Tenkiller Calibration

Break

Agenda Continued

Proposed Next Steps — Dwyer

- Solicit Stakeholder Comments
- Revise Models as Appropriate
- Engage Principals Regarding Load Reduction Scenarios and Management Approaches
- Provide Models, Scenarios, and Narrative Discussion of Nutrient Reduction Strategies

Questions, Comments, Concerns — All

Wrap Up

Project Background and Context

Statutory and Regulatory Framework

First Statement of Joint Principles and Actions (2003)

Northwest Arkansas Conservation Authority – Regional WWTP (2008)

Modeling Project History (November 2009 – Present)

Technical Issues and Resolutions

Meteorological Data

Litter and Fertilizer Applications

Modeling Drought Years – Water Balance Function

Modeling Surface and Upper Layer Fractionation of Nutrients

Atmospheric Deposition of Nitrogen

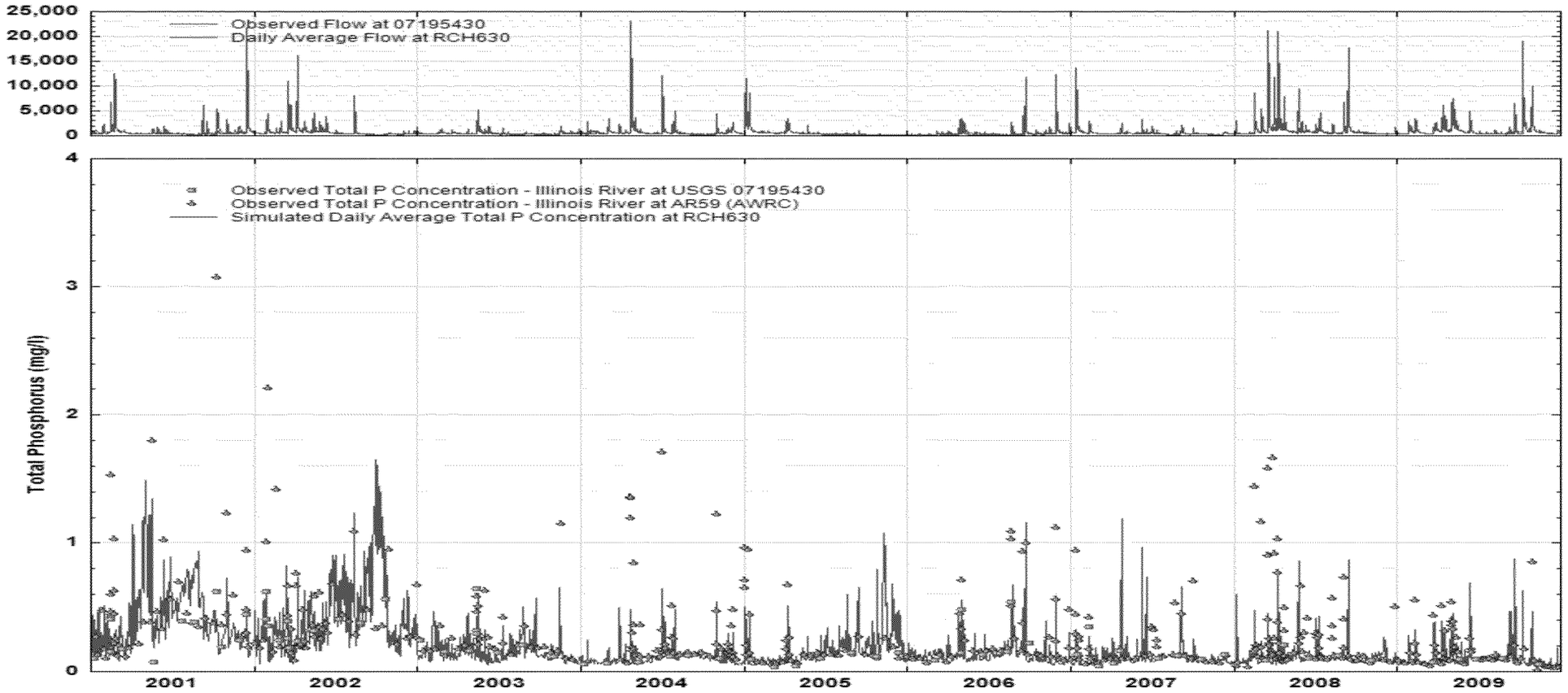
Denitrification Rates

Baseline Model Run Conditions

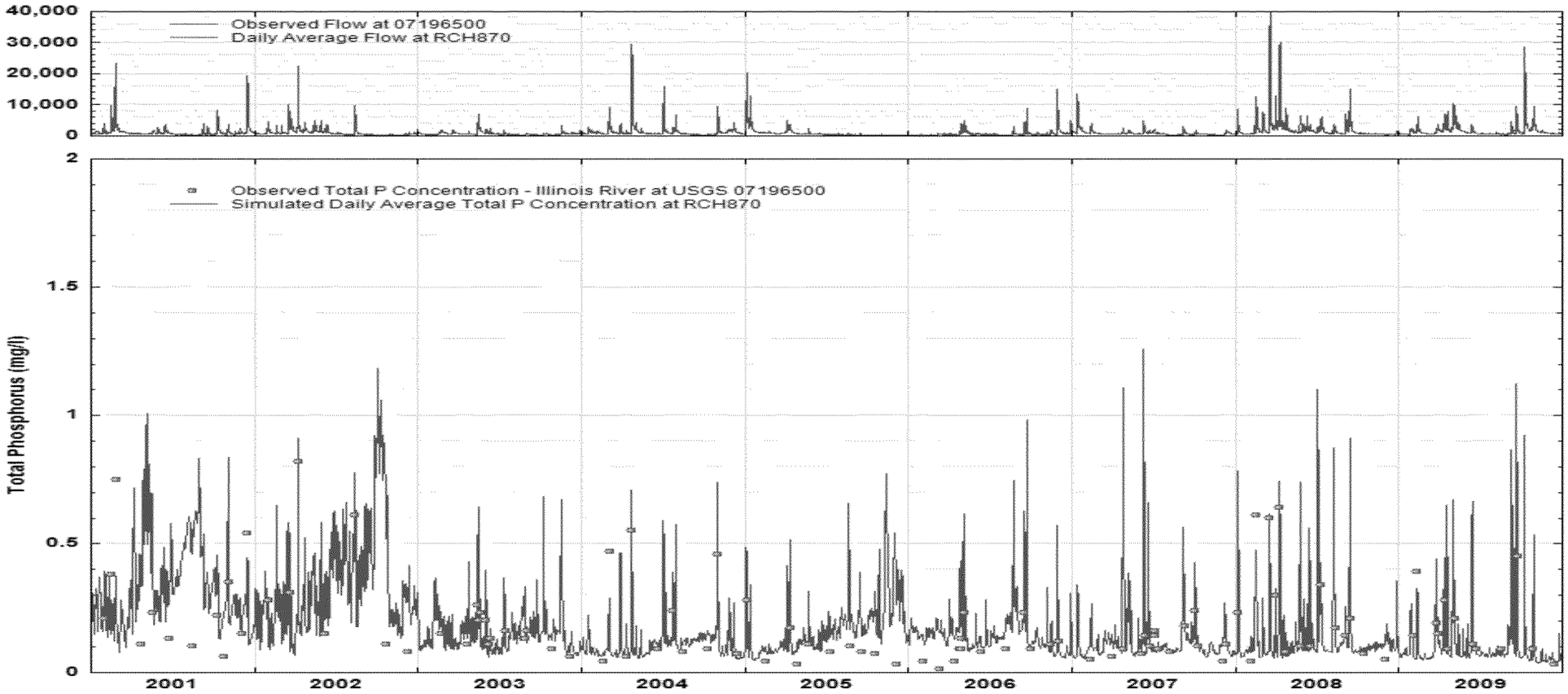
Conceptual Approaches and Scenarios

Lake Tenkiller Calibration

Total Phosphorus at Reach 630



Total Phosphorus at Reach 870

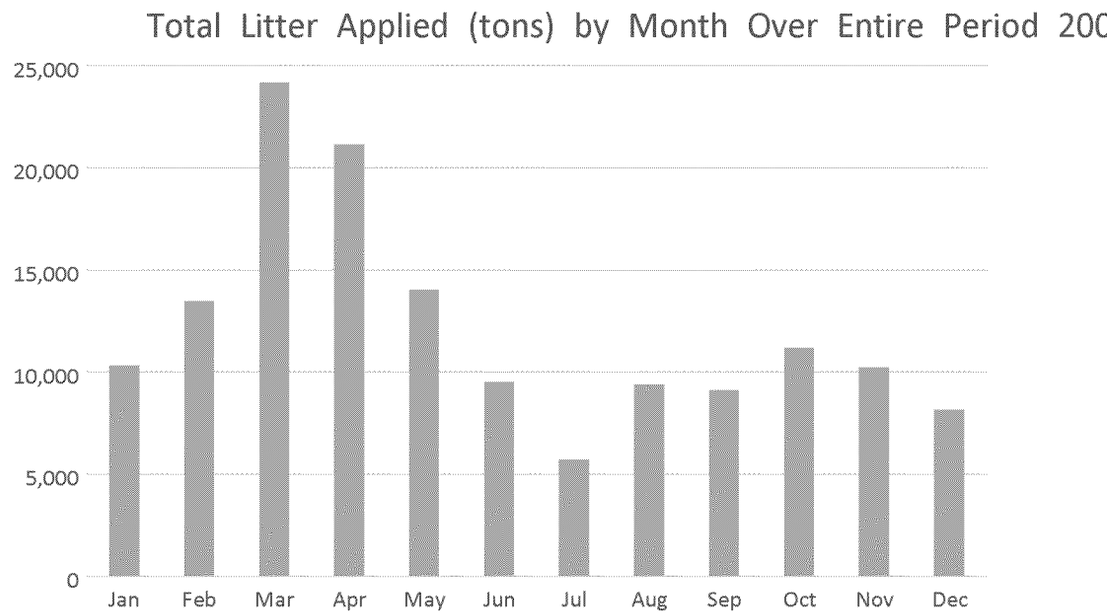


ODAFF Provided Data

	Tons Applied	% Applied	Combined months	Adjusted %
January	10306	7	16	8
February	13468	9		
March	24170	17	31	39
April	21160	14		
May	14032	10	16	16
June	9512	6		
July	5719	4	10	10
August	9407	6		
September	9108	6	14	17
October	11190	8		
November	10230	7	13	9
December	8169	6		

ALLOCATED 25% MORE TO MARCH/APRIL AND SEPTEMBER/OCTOBER FROM THE WINTER MONTHS

BASED ON TECHNICAL WORKGROUP RECOMMENDATION



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Temporal Litter Application

- Changes made to temporal application of litter
- Lumped into 2 month intervals
- 25% weighting applied for Spring Fall

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SPEC-ACTIONS
***                          addr
***                        <------>
*** kwd  varnam optyp  opn  vari  s1 s2 s3 tp multiply  lc ls ac as agfn ***
  <****> <----> <----> <-> <----><-><-><-><-><--------> <><-> <><-> <--> ***
  UVQUAN prec42 PERLND 442 SUPY             3                 DY  1 SUM
*** above in case we decide to use deferral for rain

*** DISTRB FUNCTION
*** DISTRB #1 = 5 applications of litter separated by two months
*** "5" refers to number of applications
*** "MO   2" means apply every two months
*** if deferred, shift
*** each application is 20% of total
*** EDIT by TAS on 07/06/2016 - 6 Applications on 2 month interval; using ODAFF data and 25% weighting on Spr/fall
*** kwd  ds  ct tc  ts  def     f1   f2   f3   f4   f5   f6   f7   f8   f9  f10
  <****>< > < > <> < > <--->  <---><---><---><---><---><---><---><---><---><--->
  DISTRB  1   6 MO   2 SHIFT    .08  .39  .16  .10  .17  .09

***  UVNAME FUNCTION ***
*** USER Defined Variable for Litter Application ***
*** litter applications assumed to be tons/ac
*** NO3 = 0.8 lb/ton
*** NH4 = 7.7 lb/ton
*** ORGN = 53.5 lb/ton
*** PO4 = 27 lb/ton (1.9 dissolved + 25.1 adsorbed)
*** ORGP = 3 lb/ton
*** split all constituents 50% Surface and 50% Upper Layer
*** assume all NH4 and PO4 applied to adsorbed forms
*** run 32 - change 50-50 to 70-30 for litter
  UVNAME  LITTER 10 SNO3             0.56 QUAN    UNO3             0.24 QUAN
                    SAMAD            5.39 QUAN    UAMAD            2.31 QUAN
                    SORGN           37.45 QUAN    UORGN           16.05 QUAN
                    SP4AD            18.9 QUAN    UP4AD             8.1 QUAN
                    SORGP             2.1 QUAN    UORGP             0.9 QUAN
```

Daily Flow Statistics

- Nash-Sutcliffe Efficiency & RMSE – Observation Standard Deviation Ratio are minimally affected by flow augmentation.

Augmented

		Reach									
		150	316	516	523	630	640	706	746	870	912
Mean (cfs)	Simulated	189.98	227.37	25.5	108.51	650.19	696.52	44.79	323.48	1007.3	94.1
	Observed	169.9	163.24	25.38	104.59	588.66	630.19	45.66	314.03	960.53	87.54
Geometric Mean (cfs)	Simulated	86.61	180.95	13.94	59.53	426.86	449.33	13.11	144.3	642.05	43.17
	Observed	54.24	118.29	14.2	60.67	344.81	362.63	NaN	144	534.07	41.22
Mean Error (cfs)		20.177	64.438	0.115	3.921	61.535	66.329	-0.861	9.437	46.746	6.554
Nash-Sutcliffe Efficiency		**0.627**	**0.463**	**0.402**	**0.564**	**0.665**	**0.627**	**0.491**	**0.777**	**0.581**	**0.567**
RMSE-Observation Standard Deviation Ratio		**0.61**	**0.733**	**0.773**	**0.66**	**0.579**	**0.61**	**0.713**	**0.472**	**0.647**	**0.658**

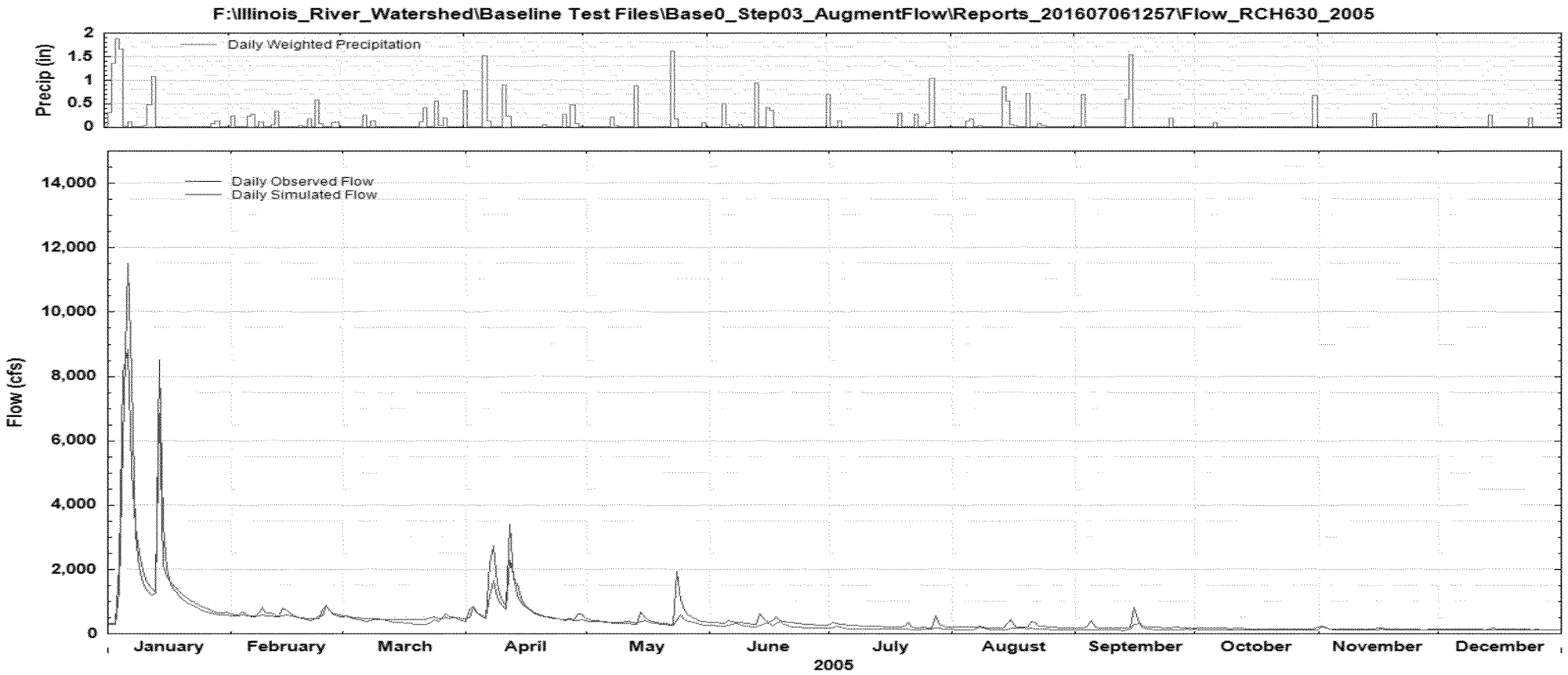
Unaugmented

		Reach									
		150	316	516	523	630	640	706	746	870	912
Mean	Simulated	179.94	177.33	25.5	108.51	589.98	636.4	44.79	323.48	947.13	94.1
	Observed	169.8	163.24	25.38	104.59	588.66	630.19	45.66	314.03	960.53	87.54
Geometric Mean	Simulated	68.19	122.68	13.94	59.53	348.07	369.16	13.11	144.3	560.59	43.17
	Observed	54.24	118.29	14.21	60.67	344.81	362.63	NaN	144	534.07	41.22
Mean Error (cfs)		10.133	14.093	0.115	3.921	1.313	6.206	-0.861	9.437	-13.395	6.554
Nash-Sutcliffe Efficiency		**0.628**	**0.516**	**0.402**	**0.564**	**0.667**	**0.63**	**0.491**	**0.777**	**0.584**	**0.567**
RMSE-Observation Standard Deviation Ratio		**0.609**	**0.696**	**0.773**	**0.66**	**0.577**	**0.608**	**0.713**	**0.472**	**0.645**	**0.658**

Augmented – Unaugmented

		Reach									
		150	316	516	523	630	640	706	746	870	912
Mean (cfs)	Simulated	10.04	50.04	0	0	60.21	60.12	0	0	60.17	0
	Observed	0.1	0	0	0	0	0	0	0	0	0
Geometric Mean (cfs)	Simulated	18.42	58.27	0	0	78.79	80.17	0	0	81.46	0
	Observed	0	0	-0.01	0	0	0	-	0	0	0
Mean Error (cfs)		10.044	50.345	0	0	60.222	60.123	0	0	60.141	0
Nash-Sutcliffe Efficiency		**-0.001**	**-0.053**	**0**	**0**	**-0.002**	**-0.003**	**0**	**0**	**-0.003**	**0**
RMSE-Observation Standard Deviation Ratio		**0.001**	**0.037**	**0**	**0**	**0.002**	**0.002**	**0**	**0**	**0.002**	**0**

Flow in 2005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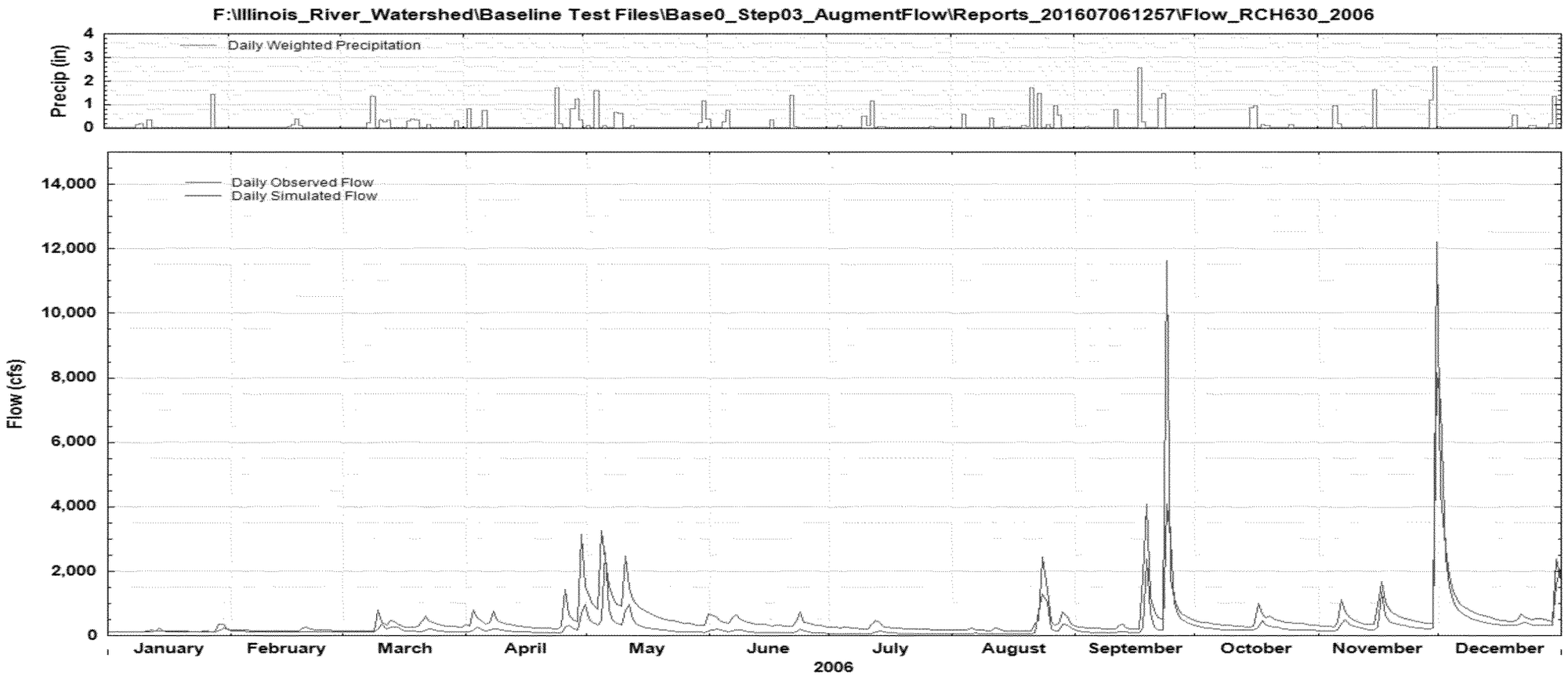
Daily Weighted Precipitation
Precip (in)
2
1.5
1
0.5
0
Daily Observed Flow
Daily Simulated Flow
Flow (cfs)
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
January
February
March
April
May
June
July
August
September
October
November
December
2005

Flow in 2006


F:\Illinois_River_Watershed\Baseline Test Files\Base0_Step03_AugmentFlow\Reports_201607061257\Flow_RCH630_2006
Daily Weighted Precipitation
Precip (in)
4
3
2
1
0
Daily Observed Flow
Daily Simulated Flow
Flow (cfs)
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
January
February
March
April
May
June
July
August
September
October
November
December
2006

Surface versus Upper Layer

Surface constitutes 0.3 inches

Upper layer rangers from 0.3 inches to 6 inches deep

Initial model results used 70% Surface and 30% Upper for litter and 30% Surface and 70% Upper for Fertilizer

Litter applications and manure were run varying from uniformly 90% Surface / 10% Upper to **10% Surface / 90% Upper**

Break

Proposed Next Steps

Solicit Stakeholder Comments

Revise Models as Appropriate

Engage Principals Regarding Load Reduction Scenarios and Management Approaches

Provide Models, Scenarios, and Narrative Discussion of Nutrient Reduction Strategies

Questions, Comments & Concerns

Wrap Up