Appendix I
Model Configuration, Calibration and Validation

Basin: Lake Pontchartrain Drainage (LPont)

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Watershed Background

The Lake Pontchartrain drainage study area was selected as one of the 15 non-pilot application watersheds for the 20 Watershed study. Watershed modeling for the non-pilot areas is accomplished using the SWAT model only, and model calibration and validation results are presented in abbreviated form.

Water Body Characteristics

The Acadian-Pontchartrain NAWQA study area encompasses 26,408 mi^2 in the southern half of Louisiana and includes downstream portions of major rivers, such as the Mississippi with drainage areas far larger than the target size for this project. Therefore, the focus of modeling in this study was the Pontchartrain portion of the study area, including the rivers that drain to Lake Pontchartrain and the cities of New Orleans and Baton Rouge (Figure 1). The resulting model area encompasses over 5,800 mi^2 and seven HUC8s within HUCs 0807 and 0809.The watershed includes the Calcasieu, Mermentau, Vermilion-Teche, Grosse Tete/Verret, Terrebonne, Barataria, and Pontchartrain basins (USGS 2002).

The entire model area is near sea level and frequently impacted by tropical storms from the Gulf of Mexico. The climate is classified as humid subtropical, with an average annual temperature around 70 °F and average annual precipitation of 64 inches per year (USGS, 2002).

Ecosystems and communities in the watershed include cypress-tupelo swamp; freshwater marsh; saltwater marsh; wet prairie; oak cheniers; bottomland hardwood forest; Piney Hills; and longleaf pine savanna. The coastal zone of the watershed is affected by the ocean and its tides. Different wetland types are determined by the salinity of the water in them, which may infiltrate naturally through bayous or reach further inland through canals.

Land uses include a mixture of urban and rapidly urbanizing/industrial areas (12 percent), large areas of mixed forest and pasture (34 percent), wetlands (32 percent) and areas of rice and sugarcane crops (5 percent). Population is rapidly increasing on the north shore of Lake Pontchartrain and surrounding Baton Rouge, causing changes in rainfall-runoff characteristics and quality. Urban streams in the Baton Rouge area are usually channelized, and cleared of woody vegetation to speed drainage during high water.

Surface water in the watershed includes the lower Mississippi delta and wet prairie streams as well as upland streams. Lower Mississippi delta and wet prairie streams tend to have very slow flow, and water can also be pushed upstream by tides or wind causing generally stagnant, backwater conditions. Wetlands develop naturally in poorly drained areas. Streams in the uplands have a moderate flow gradient and sandy, shifting beds that are reshaped quickly in the fast water that is usual for flood conditions.

Modifications to flow include levees, and canals and drainage. Levees are created both naturally during the flooding process (sediment drops out of floodwater next to the waterbody) and by man along many bayous and rivers to reduce floods and to maintain a deeper channel for shipping.

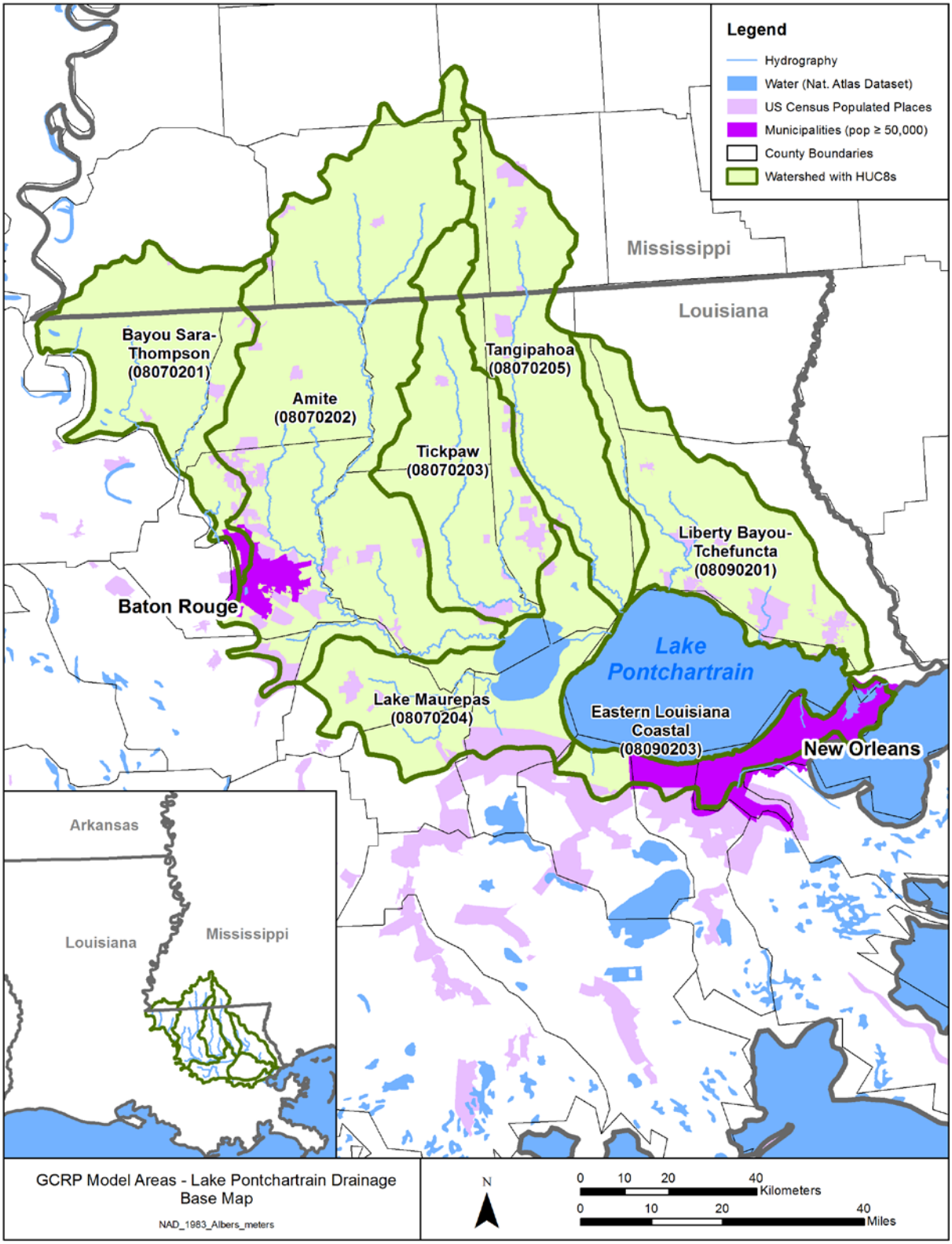

Figure 1. Location of the Pontchartrain watershed

Soil Characteristics

Soils in the watershed, as described in STATSGO soil surveys, fall primarily into hydrologic soil groups (HSGs) C (moderately low infiltration capacity, 58%) and D (low infiltration capacity, 31%). SWAT uses information drawn directly from the soils data layer to populate the model.

Land Use Representation

Land use/cover in the watershed is based on the 2001 National Land Cover Database (NLCD) coverage and is predominantly wetland (32 %) and forest (Figure 2). NLCD land cover classes were aggregated according to the scheme shown in Table 1 for representation in the 20 Watershed model. SWAT uses the built-in hydrologic response unit (HRU) overlay mechanism in the ArcSWAT interface. SWAT HRUs are formed from an intersection of land use and SSURGO major soils. The distribution of land use in the watershed is summarized in Table 2.

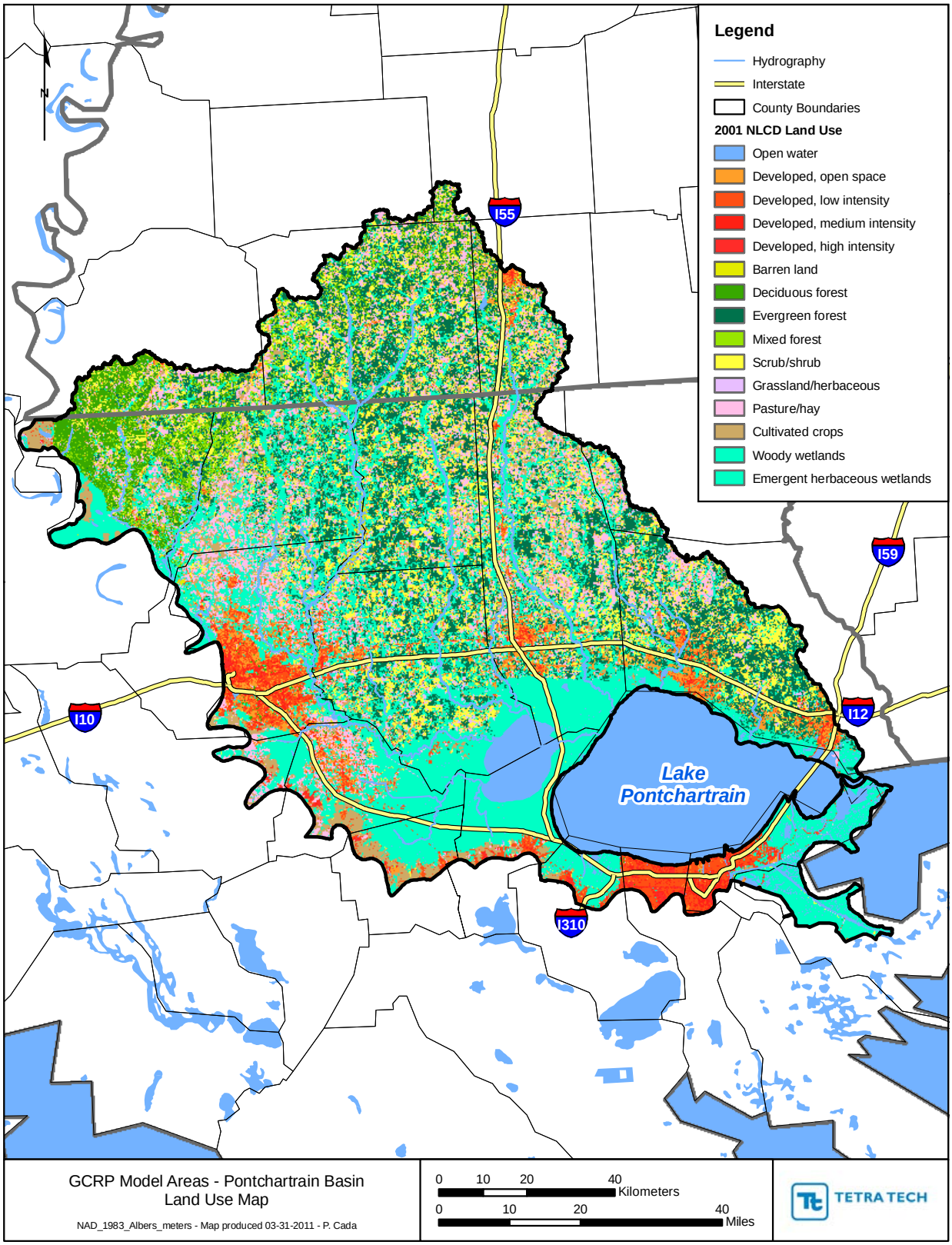

Figure 2. Land use in the Pontchartrain watershed

Table 1. Aggregation of NLCD land cover classes

NLCD Class	Comments	SWAT class
11 Water	Water surface area usually accounted for as reach area	WATR
12 Perennial ice/snow		WATR
21 Developed open space		URLD
22 Dev. Low Intensity		URMD
23 Dev. Med. Intensity		URHD
24 Dev. High Intensity		UIDU
31 Barren Land		SWRN
41 Forest	Deciduous	FRSD
42 Forest	Evergreen	FRSE
43 Forest	Mixed	FRST
51-52 Shrubland		RNGB
71-74 Herbaceous Upland		RNGE
81 Pasture/Hay		HAY
82 Cultivated		AGRR
91-97 Wetland	Emergent & woody wetlands	WETF, WETL, WETN
98-99 Wetland	Aquatic bed wetlands (not emergent)	WATR

Table 2. Land use distribution for the Pontchartrain watershed (2001 NLCD) (mi^2)

HUC 8 watershed	Open water	Developed[a]				Barren land	Forest	Shrubland/ Grassland	Pasture/ Hay	Cultivated	Wetland	Total
		Open space	Low density	Medium density	High density							
Liberty Bayou-Tchefuncta. Louisiana. **08090201**	7.9	28.0	10.7	6.0	3.3	4.2	285.4	77.6	72.9	45.7	153.1	**694.9**
Bayou Sara-Thompson. Louisiana, Mississippi. **08070201**	15.7	113.1	76.7	29.2	5.9	11.0	455.9	296.1	246.5	82.5	551.1	**1,883.8**
Amite. Louisiana, Mississippi. **08070202**	3.1	46.3	15.9	3.4	0.8	1.7	188.8	159.9	66.0	16.7	223.5	**726.0**
Tickpaw. Louisiana, Mississippi. **08070203**	100.3	22.1	41.7	7.0	4.7	0.6	8.7	11.8	30.5	59.8	425.8	**712.9**
Lake Maurepas. Louisiana. **08070204**	7.0	38.7	11.8	2.5	0.7	1.7	201.9	152.6	123.5	46.2	188.9	**775.5**
Tangipahoa. Louisiana, Mississippi. **08070205**	11.6	63.9	23.0	8.4	1.7	1.4	213.0	138.2	63.1	9.8	160.2	**694.3**
Eastern Louisiana Coastal. Louisiana. **08090203**	50.0	3.6	69.8	30.4	18.5	0.5	0.6	2.1	0.7	2.9	185.6	**364.7**
Total	**195.6**	**315.7**	**249.7**	**86.9**	**35.7**	**21.1**	**1,354.3**	**838.3**	**603.1**	**263.6**	**1,888.0**	**5,852.0**

[a]The percent imperviousness applied to each of the developed land uses is as follows: open space (7.53%), low density (32.91%), medium density (60.11%), and high density (88.08%).

Point Sources

There are numerous point source discharges in the watershed. Only the major dischargers, with a design or observed flow greater than 1 MGD are included in the simulation (Table 3). The major dischargers are represented at long-term average flows, without accounting for changes over time or seasonal variations.

Table 3. Major point source discharges in the Pontchartrain watershed

NPDES ID	Name	Design flow (MGD)	Observed flow (MGD) (1991-2006 average)
LA0000841	EXXON CORP-BATON ROUGE RESIN	2.00	0.18
LA0044695	PONCHATOULA, CITY OF	1.00	1.19
LA0002933	OCCIDENTAL CHEMICAL CORP. FKA	1.31	1.99
LA0003191	ENTERGY LOUISIANA,LLC- LITTLE	11.11	0.36
LA0004090	ETHYL CORP-BATON ROUGE	8.68	1.79
LA0005401	EXXON CHEM CO-BATON ROUGE	11.03	5.98
LA0005479	EXXON CHEMICAL AMERICAS	3.90	2.61
LA0005851	ENTERGY GULF STATES, INC-WILLO	8.40	1.71
LA0046361	TAMINCO HIGHER AMINES, INC.	9.31	0.31
LA0045730	DENHAM SPRINGS, CITY OF	2.90	1.58
LA0004464	EXIDE CORP-SCHUYLKILL METALS	3.36	0.27
LA0050962	SHELL CHEMICAL LP-NORCO CYPRES	5.11	0.57
LA0003522	MOTIVA ENTERPRISES, LLC	6.41	11.37
LA0003280	AIR PROD & CHEM INC-NEW ORLEAN	1.17	0.64
LA0005355	EXXON CHEM CO-BATON ROUGE	15.23	1.20
LA0045446	COAST WATERWORKS-EDNE ISLES	0.96	0.85
LA0052256	LOCKHEED MARTIN CORPORATION	13.82	0.21
LA0041718	UOP LLC	4.21	1.70
LA0000914	LION COPOLYMER, LLC	2.70	2.90
LA0006149	FORMOSA PLASTICS-BATON ROUGE	44.92	5.19
LA0032328	HAMMOND CITY OF SOUTH POND	2.50	2.16
LA0038431	AMITE CITY, TOWN OF	0.80	1.20
LA0064092	ST JOHN THE BAPTIST PAR-SD #2L	3.30	0.66
LA0047180	SLIDELL, CITY OF	6.00	4.10
LA0068730	H2O SYSTEMS, INC- GREENLEAVES	4.92	0.52
LA0084336	COVINGTON, CITY OF	1.75	1.62

Most of these point sources have reasonably good monitoring for total suspended solids (TSS), but often lack detailed nutrient monitoring. The point sources without nutrient monitoring were represented in the model with typical nutrient concentrations by SIC code (Tetra Tech 1999).

Meteorological Data

The required meteorological time series for the 20 Watershed SWAT simulations are precipitation and air temperature. The 20 Watershed simulations do not include water temperature simulation and use a degree-day method for snowmelt. SWAT estimates Penman-Monteith potential evapotranspiration using a statistical weather generator for inputs other than temperature and precipitation. These meteorological time series are drawn from the BASINS4 Meteorological Database (USEPA 2008), which provides a consistent, quality-assured set of nationwide data with gaps filled and records disaggregated. Scenario application requires simulation over 30 years, so the available stations are those with a common 30-year period of record (or one that can be filled from an approximately co-located station) that covers the year 2001. A total of 22 precipitation stations were identified for use in the Minnesota River model with a common period of record of 10/1/1973-9/30/2005 (Table 4). Temperature records are sparser; where these are absent temperature is taken from nearby stations with an elevation correction.

Table 4. Precipitation stations for the Pontchartrain watershed model

COOP ID	Name	Latitude	Longitude	Temperature	Elevation (ft)
LA166686	NEW ROADS 5 NE	30.7268	-91.3671	X	14
MS229793	WOODVILLE 4 ESE	31.0929	-91.2327	X	122
LA160549	BATON ROUGE METRO AP	30.5372	-91.1469	X	20
MS225070	LIBERTY 5 W	31.1632	-90.8944	X	105
MS221578	CENTREVILLE	31.0943	-91.0686		113
LA161899	CLINTON 5 SE	30.8178	-90.9732	X	61
LA166911	OAKNOLIA 2 N	30.7531	-90.9938		46
LA163867	GREENWELL SPRINGS	30.5590	-90.9856		18
LA165620	LSU BEN HUR FARM	30.3644	-91.1671	X	6
LA164034	HAMMOND	30.4839	-90.4731	X	27
LA164859	KENTWOOD	30.9434	-90.5117		70
LA167304	PINE GROVE FIRE TOWER	30.7111	-90.7519		58
LA160205	AMITE	30.7094	-90.5250	X	52
LA162534	DONALDSONVILLE 4 SW	30.0717	-91.0275		9
LA167767	RESERVE	30.0565	-90.5802	X	5
MS225614	MCCOMB AIRPORT	31.1829	-90.4707	X	126
LA162151	COVINGTON 4 NNW	30.5273	-90.1114	X	12
LA168539	SLIDELL	30.2651	-89.7697	X	3
LA166660	NEW ORLEANS AP	29.9934	-90.2510	X	1
LA166666	NEW ORLEANS ALGIERS	29.9519	-90.0502	X	1
LA168108	ST BERNARD	29.8722	-89.8299	X	2
LA160021	ABITA SPRINGS FIRE TOWER	30.4397	-90.0464		9

Watershed Segmentation

The Pontchartrain watershed was divided into 37 subwatersheds for the purposes of modeling (Figure 3). The initial calibration watersheds correspond to the USGS gages shown on the figure. The model encompasses only complete watersheds that drain to Lake Pontchartrain or the Mississippi and does not require specification of any upstream boundary conditions for application.

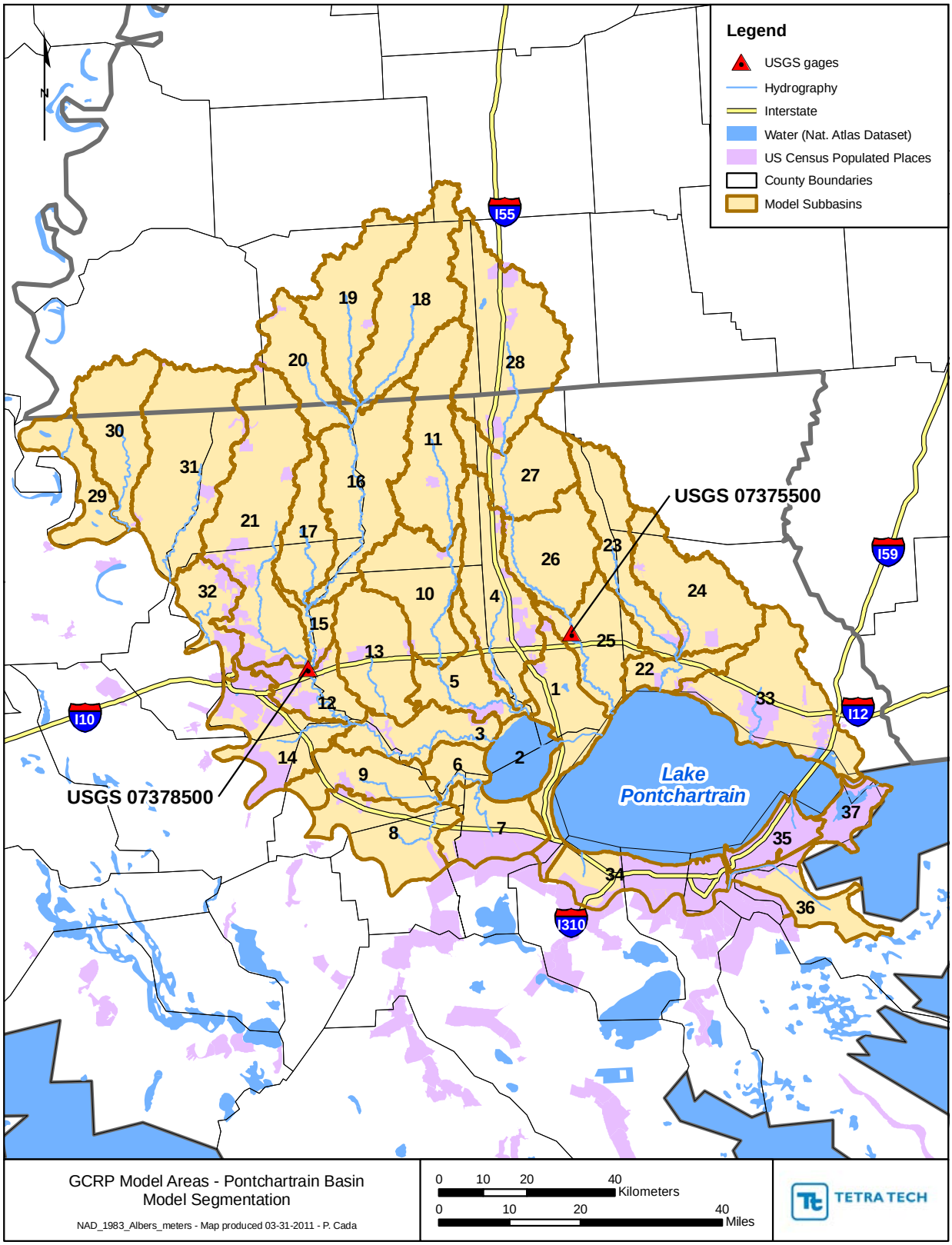

Figure 3. Model segmentation and USGS stations utilized for the Pontchartrain watershed

Calibration Data and Locations

Only limited flow gaging is available in the watershed. The specific site chosen for initial calibration was the Amite River near Denham Springs (USGS 07378500). The Amite watershed was selected because there is a good set of flow and water quality data available and the watershed lacks major point sources and impoundments. Calibration and validation was ultimately pursued at several locations (Table 5). Parameters derived on the Amite were not fully transferable to other portions of the watershed, and additional refinements to the calibration were conducted at the other gage locations.

Table 5. Calibration and validation locations in the Pontchartrain watershed

Station name	USGS ID	Drainage area (mi^2)	Hydrology calibration	Water quality calibration
Amite River near Denham Springs, LA	07378500	1,280	X	X
Tangipahoa River at Robert, LA	07375500	646	X	X
Tickfaw River at Holden, LA	07376000	247	X	

The model hydrology calibration period was set to Water Years 1995-2004 (within the 30-year period of record for modeling). Hydrologic validation was then performed on Water Years 1985-1994. Water quality calibration used available data for calendar years 1984-1999. Insufficient water quality data were available for a separate validation time period.

SWAT Modeling

Assumptions

The modeled portion of the Pontchartrain watershed does not contain major dams or impoundments. It does, however, contain large amounts of low lying land with swamp land cover and high water tables which may not be a good fit for SWAT's curve number approach to hydrology. The watershed is also characterized by the presence of many canals and distributary streams that complicate the flow of water. The USGS gages are located in more upland areas where these issues are of less importance, but the extrapolation of calibration parameters to downstream, swampy areas may be suspect.

Due to the flat topography, the boundary between land and water is often ill-defined in this watershed and is changing over time in response to storms and sea level rise. This modeling exercise does not address the changes in topography and hydrology that have occurred or will occur in the basin; instead, fixed conditions associated with the 2001 NLCD are assumed.

Hydrology Calibration

A partial spatial calibration approach was adopted for GCRP-SWAT modeling for the Pontchartrain watershed, with calibration at three USGS gages with long periods of record. The majority of the calibration effort was geared toward getting a closer match between simulated and observed flows at the outlet of calibration focus area.

The calibration focus area (Amite River) includes seven subwatersheds and is representative of the general land use characteristics of the more upstream portions of the watershed. The parameters were adjusted within the recommended ranges to obtain reasonable fit between the simulated and measured flows in terms of Nash-Sutcliffe modeling efficiency and the high flow and low flow components as well as the seasonal flows.

The average annual water balance of the entire Pontchartrain watershed predicted by the SWAT model over the 32-year simulation period is as follows:

```
PRECIP =   1658.2 MM
SNOW FALL =    8.87 MM
SNOW MELT =     8.74 MM
SUBLIMATION =     0.12 MM
SURFACE RUNOFF Q =   699.14 MM
LATERAL SOIL Q =    2.03 MM
TILE Q =     0.00 MM
GROUNDWATER (SHAL AQ) Q =   158.64 MM
REVAP (SHAL AQ => SOIL/PLANTS) =   29.16 MM
DEEP AQ RECHARGE =   181.07 MM
TOTAL AQ RECHARGE =  368.91 MM
TOTAL WATER YLD =   639.74 MM
PERCOLATION OUT OF SOIL =  155.42 MM
ET =    790.9 MM
PET =   1522.1MM
TRANSMISSION LOSSES =   220.07 MM
```

Hydrologic calibration adjustments focused on the following parameters:

- CN2 (initial SCS runoff curve number for moisture condition II)
- ESCO (soil evaporation compensation factor)
- SURLAG (surface runoff lag coefficient)

- SOL_AWC (available water capacity of the soil layer, mm water/mm of soil)
- ALPHA_BF (baseflow alpha factor, days)
- GW_DELAY (groundwater delay time, days)
- GWQMIN (threshold depth of water in the shallow aquifer required for return flow to occur, mm)
- GW_REVAP (groundwater "revap" coefficient)
- CH_N1 (Manning's "n" value for tributary channels)
- CH_N2 (Manning's "n" value for main channels)
- CH_K1 (Effective hydraulic conductivity in tributary channel alluvium)
- CH_K2 (Effective hydraulic conductivity in main channel alluvium)
- SFTMP (Snowfall temperature)
- SMTMP (Snowmelt base temperature)
- SMFMX (Maximum melt rate for snow during the year)
- SMFMN (Minimum melt rate for snow during the year)

The same general area was modeled with SWAT by Wu and Xu (2006). While the 20 Watershed model did not adopt parameter values directly from this paper, the results and quality of model fit are generally similar.

Calibration was performed for the period of water year 1995 – 2003. Results for the Amite River are summarized in the following figures and table (Figure 4, Figure 5, Figure 6, Figure 7, and Table 6). The overall quality of fit is good to excellent.

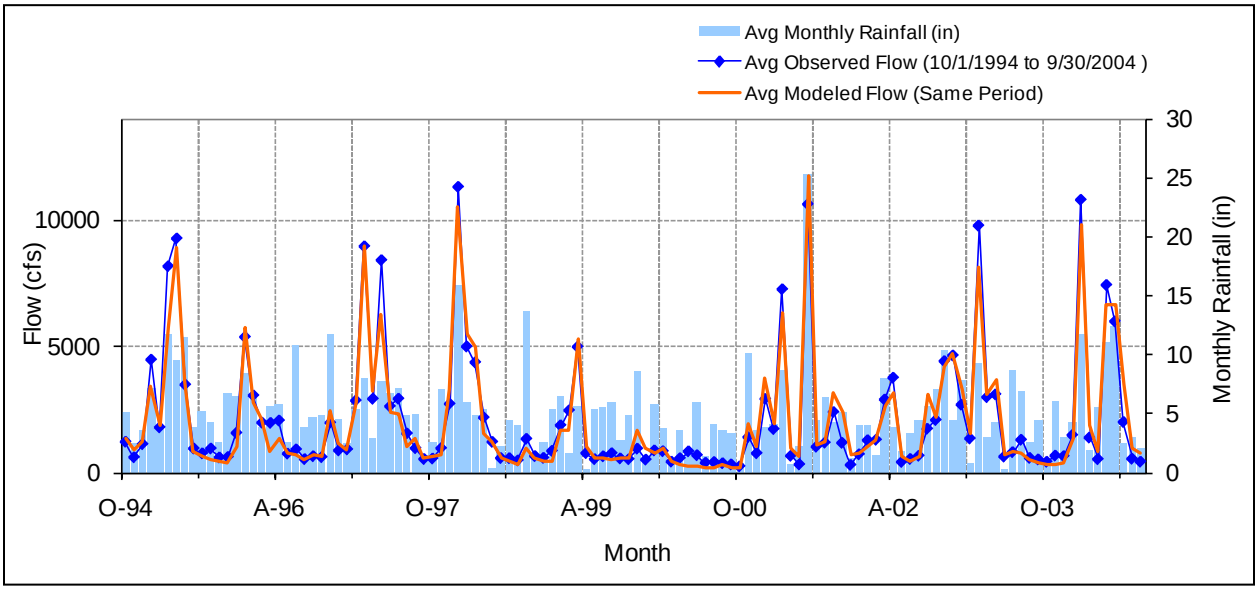

Figure 4. Mean monthly flow at USGS 07378500 Amite River near Denham Springs, LA – calibration period

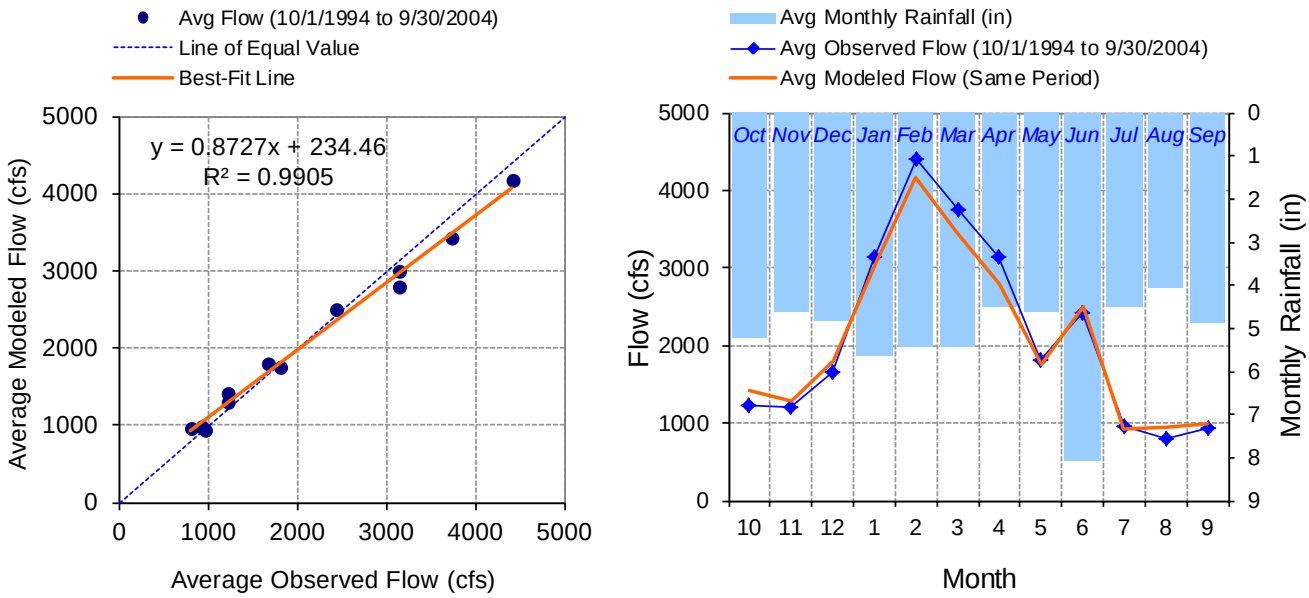

Figure 5. Seasonal regression and temporal aggregate at USGS 07378500 Amite River near Denham Springs, LA - calibration period

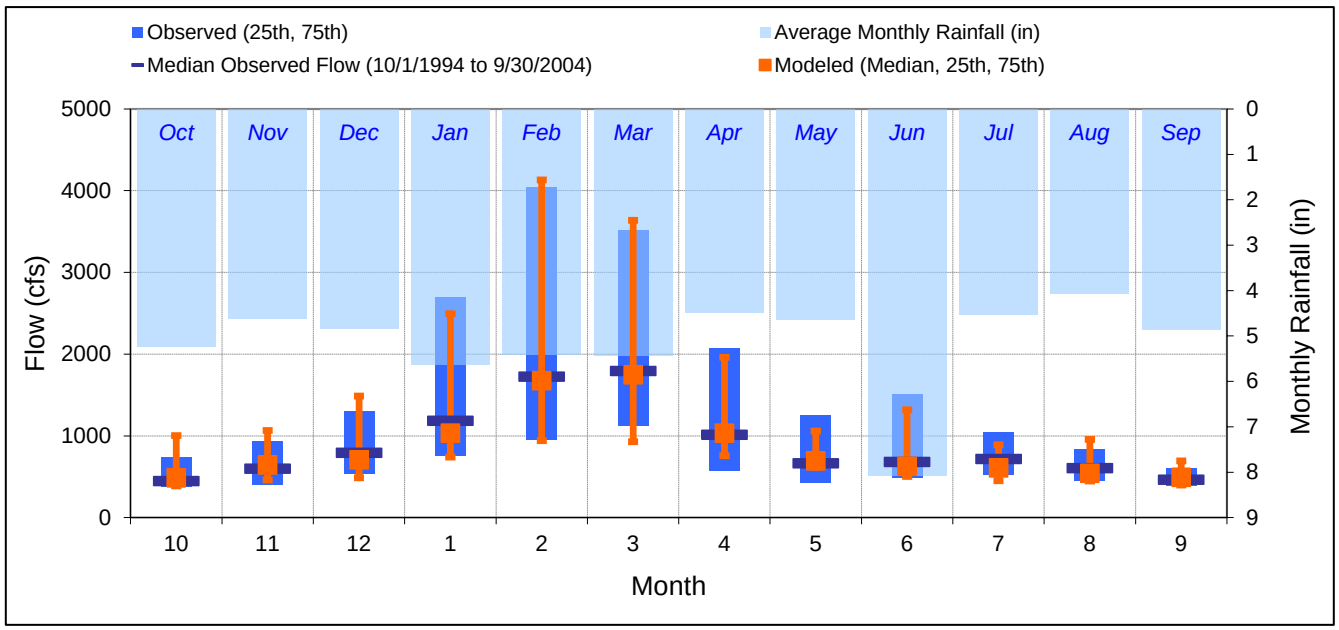

Figure 6. Seasonal medians and ranges at USGS 07378500 Amite River near Denham Springs, LA – calibration period

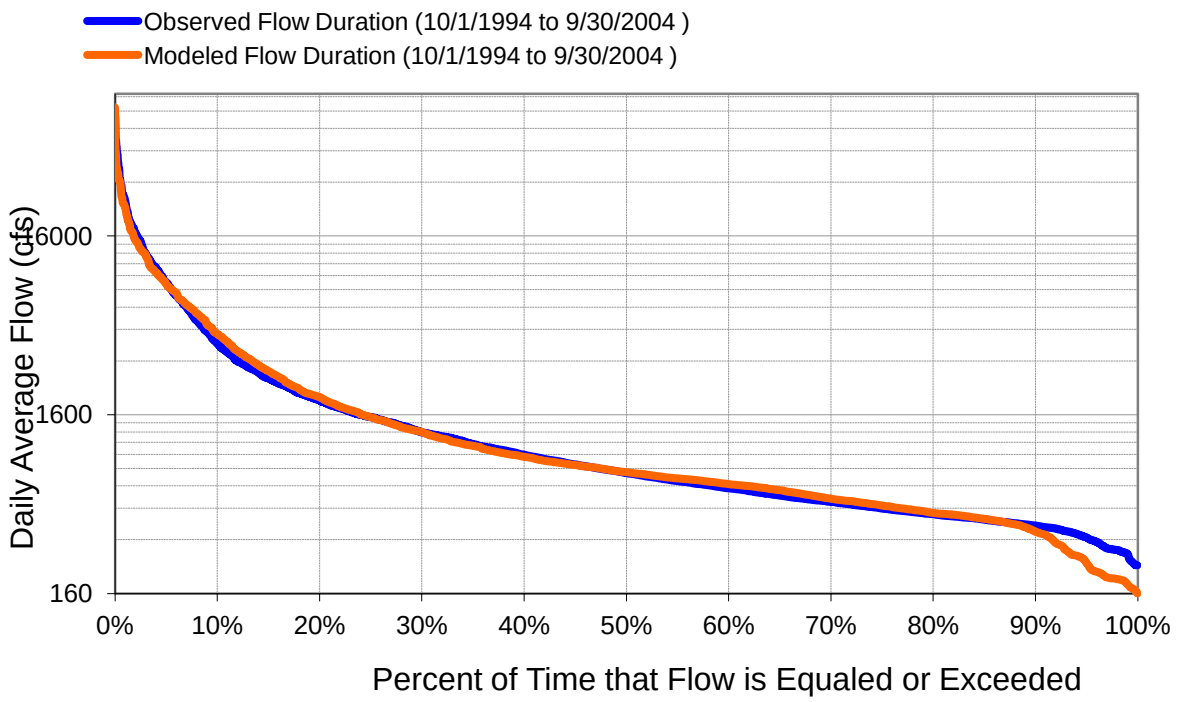

Figure 7. Flow exceedance at USGS 07378500 Amite River near Denham Springs, LA - calibration period

Figure 8. Summary statistics at USGS 07378500 Amite River near Denham Springs, LA - calibration period

SWAT Simulated Flow		Observed Flow Gage	
REACH OUTFLOW FROM OUTLET(S) 15, 21 10-Year Analysis Period: 10/1/1994 - 9/30/2004 Flow volumes are (inches/year) for upstream drainage area		USGS 07378500 Amite River near Denham Springs, LA Hydrologic Unit Code: 8070202 Latitude: 30.464079 Longitude: -90.99038 Drainage Area (sq-mi): 1280	
Total Simulated In-stream Flow:	**21.98**	Total Observed In-stream Flow:	**22.34**
Total of simulated highest 10% flows:	**12.53**	Total of Observed highest 10% flows:	**13.16**
Total of Simulated lowest 50% flows:	**2.62**	Total of Observed Lowest 50% flows:	**2.62**
Simulated Summer Flow Volume (months 7-9):	**2.57**	Observed Summer Flow Volume (7-9):	**2.39**
Simulated Fall Flow Volume (months 10-12):	**4.02**	Observed Fall Flow Volume (10-12):	**3.65**
Simulated Winter Flow Volume (months 1-3):	**9.21**	Observed Winter Flow Volume (1-3):	**9.82**
Simulated Spring Flow Volume (months 4-6):	**6.19**	Observed Spring Flow Volume (4-6):	**6.49**
Total Simulated Storm Volume:	**12.81**	Total Observed Storm Volume:	**13.76**
Simulated Summer Storm Volume (7-9):	**0.97**	Observed Summer Storm Volume (7-9):	**0.93**
Errors (Simulated-Observed)	*Error Statistics*	*Recommended Criteria*	
Error in total volume:	-1.61	10	
Error in 50% lowest flows:	0.29	10	
Error in 10% highest flows:	-4.83	15	
Seasonal volume error - Summer:	7.32	30	
Seasonal volume error - Fall:	10.13 >>	30	Clear
Seasonal volume error - Winter:	-6.17	30	
Seasonal volume error - Spring:	-4.61	30	
Error in storm volumes:	-6.92	20	
Error in summer storm volumes:	4.05	50	
Nash-Sutcliffe Coefficient of Efficiency, E:	0.789	Model accuracy increases	
Baseline adjusted coefficient (Garrick), E':	0.619	as E or E' approaches 1.0	
Monthly NSE	0.950		

Hydrology Validation

Hydrology validation for the Amite River was performed for the period 10/1/1984 through 9/30/1994. Results are presented in Figure 9, Figure 10, Figure 11, Figure 12, and Table 6. The validation also achieves a high quality of fit, but does overpredict the average flows in summer. This is apparently associated with several tropical storms.

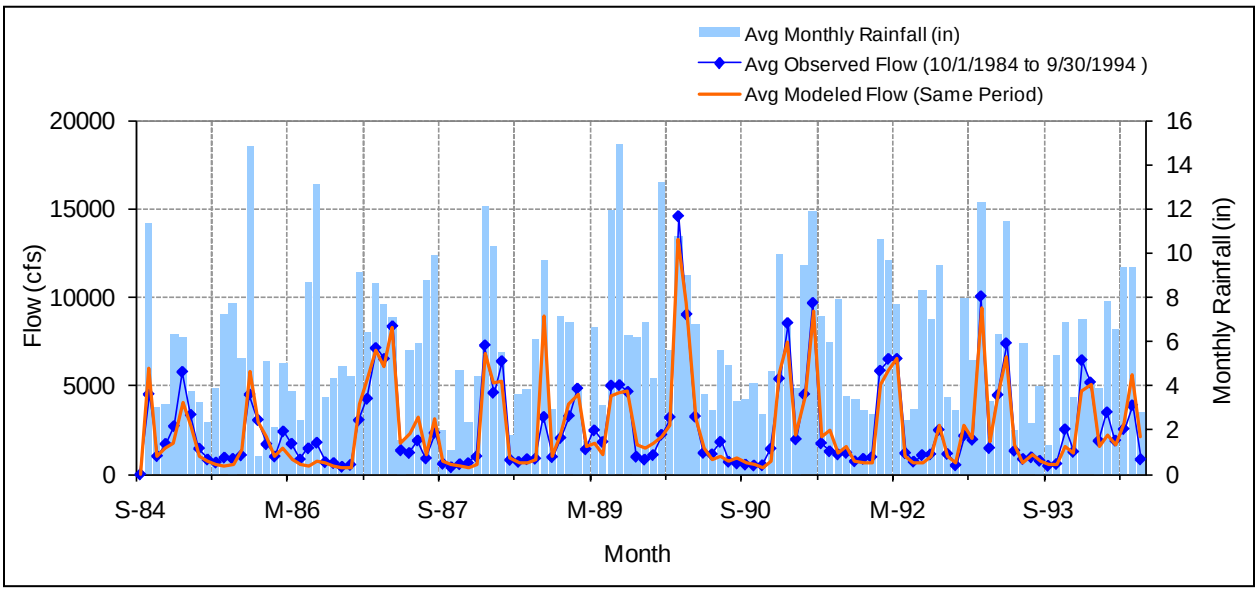

Figure 9. Mean monthly flow at USGS 07378500 Amite River near Denham Springs, LA – validation period

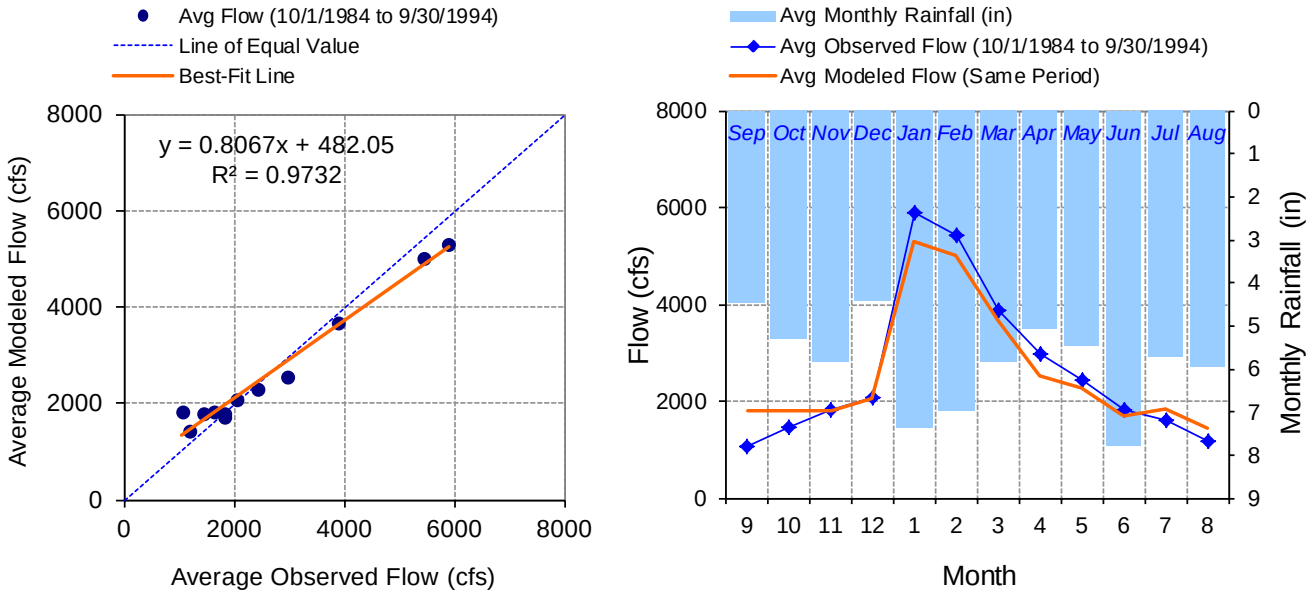

Figure 10. Seasonal regression and temporal aggregate at USGS 07378500 Amite River near Denham Springs, LA - validation period

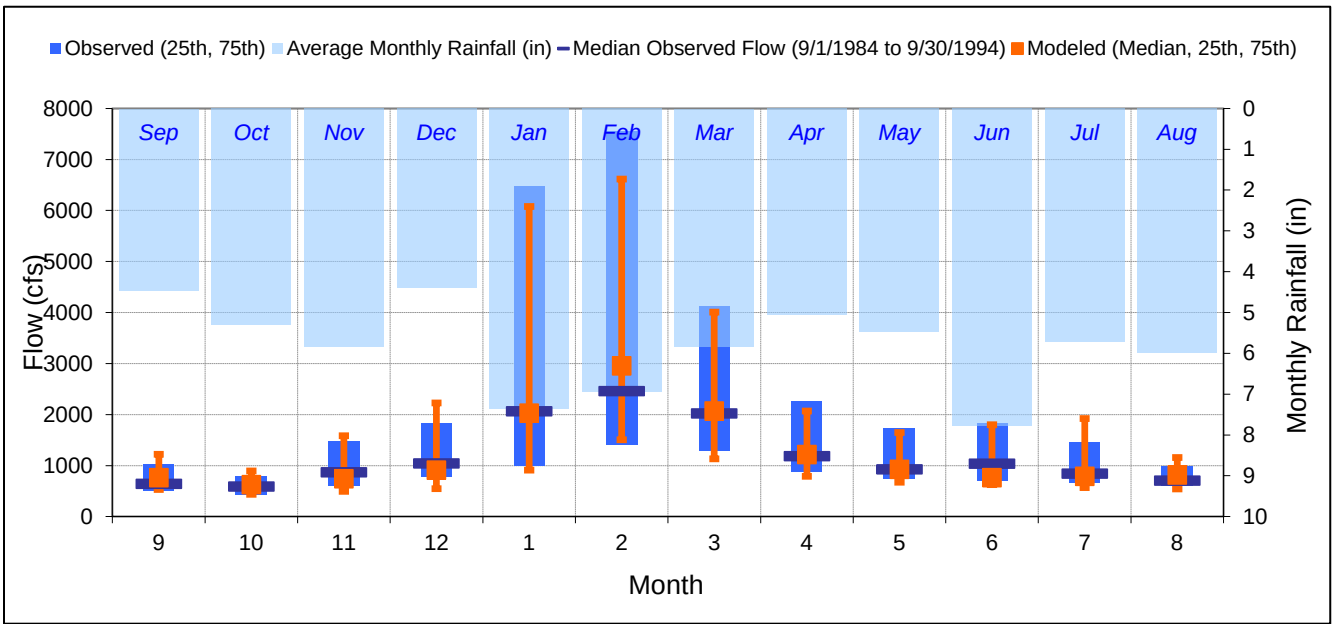

Figure 11. Seasonal medians and ranges at USGS 07378500 Amite River near Denham Springs, LA – validation period

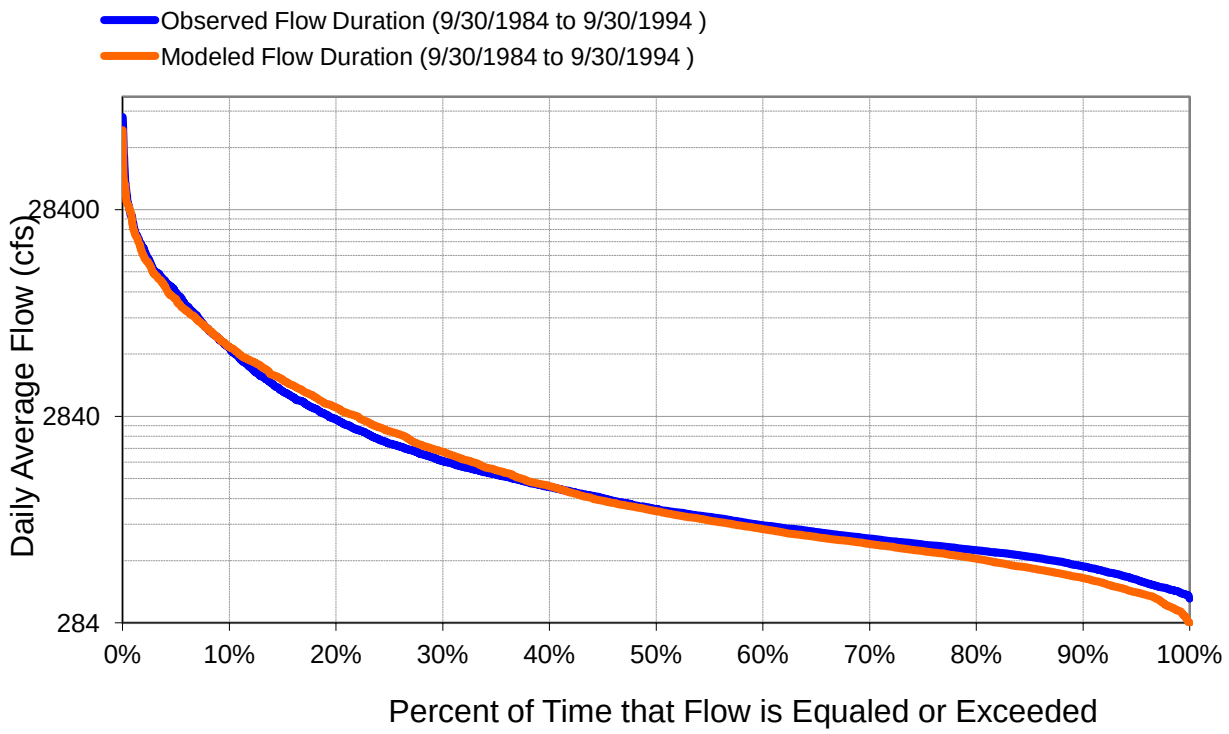

Figure 12. Flow exceedance at USGS 07378500 Amite River near Denham Springs, LA - validation period

Table 6. Summary statistics at USGS 07378500 Amite River near Denham Springs, LA - validation period

SWAT Simulated Flow		Observed Flow Gage	
REACH OUTFLOW FROM OUTLET(S) 15, 21 10-Year Analysis Period: 10/1/1984 - 9/30/1994 Flow volumes are (inches/year) for upstream drainage area		USGS 07378500 Amite River near Denham Springs, LA Hydrologic Unit Code: 8070202 Latitude: 30.464079 Longitude: -90.99038 Drainage Area (sq-mi): 1280	
Total Simulated In-stream Flow:	**27.52**	Total Observed In-stream Flow:	**27.78**
Total of simulated highest 10% flows:	**14.04**	Total of Observed highest 10% flows:	**14.86**
Total of Simulated lowest 50% flows:	**3.38**	Total of Observed Lowest 50% flows:	**3.65**
Simulated Summer Flow Volume (months 7-9):	**4.53**	Observed Summer Flow Volume (7-9):	**3.43**
Simulated Fall Flow Volume (months 10-12):	**5.04**	Observed Fall Flow Volume (10-12):	**4.74**
Simulated Winter Flow Volume (months 1-3):	**12.19**	Observed Winter Flow Volume (1-3):	**13.24**
Simulated Spring Flow Volume (months 4-6):	**5.76**	Observed Spring Flow Volume (4-6):	**6.37**
Total Simulated Storm Volume:	**15.89**	Total Observed Storm Volume:	**16.60**
Simulated Summer Storm Volume (7-9):	**2.25**	Observed Summer Storm Volume (7-9):	**1.57**
Errors (Simulated-Observed)	*Error Statistics*	*Recommended Criteria*	
Error in total volume:	-0.93	10	
Error in 50% lowest flows:	-7.29	10	
Error in 10% highest flows:	-5.54	15	
Seasonal volume error - Summer:	**32.16**	**30**	
Seasonal volume error - Fall:	6.20	30	
Seasonal volume error - Winter:	-7.94	30	
Seasonal volume error - Spring:	-9.49	30	
Error in storm volumes:	-4.31	20	
Error in summer storm volumes:	43.74	50	
Nash-Sutcliffe Coefficient of Efficiency, E:	0.693	Model accuracy increases as E or E' approaches 1.0	
Baseline adjusted coefficient (Garrick), E':	0.567		
Monthly NSE	0.899		

Hydrology Results for Larger Watershed

In addition to Amite River, calibration and validation was pursued at a two other gages in the watershed. Similar to the Amite River, these are in upland areas; there is no gaging of a single pour point of the watershed. Calibration results were acceptable at all gages (Table 7).

Results of the validation exercise are summarized in Table 8. Problems similar to those experienced on the Amite River gage were seen at all the tributary gages, with overprediction of seasonal flows in summer. However, as noted above, this is likely due to the use of land use and model parameters that are more reflective of current conditions and is not believed to present a bar to application of the model.

Table 7. Summary statistics (percent error): all stations - calibration period

Station	07378500 Amite River near Denham Springs, LA	07375500 Tangipahoa River at Robert, LA	07376000 Tickfaw River at Holden, LA
Error in total volume:	-1.61	2.89	-0.81
Error in 50% lowest flows:	0.29	-8.14	-9.73
Error in 10% highest flows:	-4.83	-5.50	-6.86
Seasonal volume error - Summer:	7.32	20.46	33.29
Seasonal volume error - Fall:	10.13	4.34	13.05
Seasonal volume error - Winter:	-6.17	-0.45	-9.84
Seasonal volume error - Spring:	-4.61	-4.40	-10.75
Error in storm volumes:	-6.92	-12.99	4.38
Error in summer storm volumes:	4.05	18.66	82.23
Nash-Sutcliffe Coefficient of Efficiency, E:	0.789	0.644	0.481
Monthly Nash-Sutcliffe Coefficient	0.950	0.900	0.778

Table 8. Summary statistics: all stations - validation period

Station	07378500 Amite River near Denham Springs, LA	07375500 Tangipahoa River at Robert, LA	07376000 Tickfaw River at Holden, LA
Error in total volume:	-0.93	4.45	-6.39
Error in 50% lowest flows:	-7.29	-4.83	-1.25
Error in 10% highest flows:	-5.54	-4.59	-13.26
Seasonal volume error - Summer:	32.16	20.94	24.25
Seasonal volume error - Fall:	6.20	15.67	1.25
Seasonal volume error - Winter:	-7.94	0.24	-15.19
Seasonal volume error - Spring:	-9.49	-7.16	-8.84
Error in storm volumes:	-4.31	-11.28	-2.76
Error in summer storm volumes:	43.74	23.91	55.01
Nash-Sutcliffe Coefficient of Efficiency, E:	0.693	0.564	0.589
Monthly Nash-Sutcliffe Coefficient	0.899	0.850	0.840

Water Quality Calibration and Validation

Initial calibration of water quality was done on the Amite River (USGS 07378500), using data from 1984 – 1994. Insufficient data were available to support a separate validation period. Instead, the performance of the calibration parameters was checked against limited additional data collected from the Tangipahoa River.

Calibration adjustments for sediment focused on the following parameters:

- SPCON (linear parameter for estimating maximum amount of sediment that can be re-entrained during channel sediment routing)
- SPEXP (exponential parameter for estimating maximum amount of sediment that can be re-entrained during channel sediment routing)
- CH_COV (channel cover factor)
- CH_EROD (channel erodibility factor)
- USLE_P (USLE support practice factor)

Simulated and estimated sediment loads at the Amite River station are shown in Figure 13 and statistics for the two stations are provided in Table 9. The key statistic in Table 10 is the relative percent error, which shows the error in the prediction of monthly load normalized to the estimated load. Table 10 also shows the relative average absolute error, which is the average of the relative magnitude of errors in individual monthly load predictions. This number is inflated by outlier months in which the simulated and estimated loads differ by large amounts (which may be as easily due to uncertainty in the estimated load due to limited data as to problems with the model) and the third statistic, the relative median absolute error, is likely more relevant and shows better agreement. Overall, the model appears to somewhat underpredict TSS due to the estimated loads associated with major storm events.

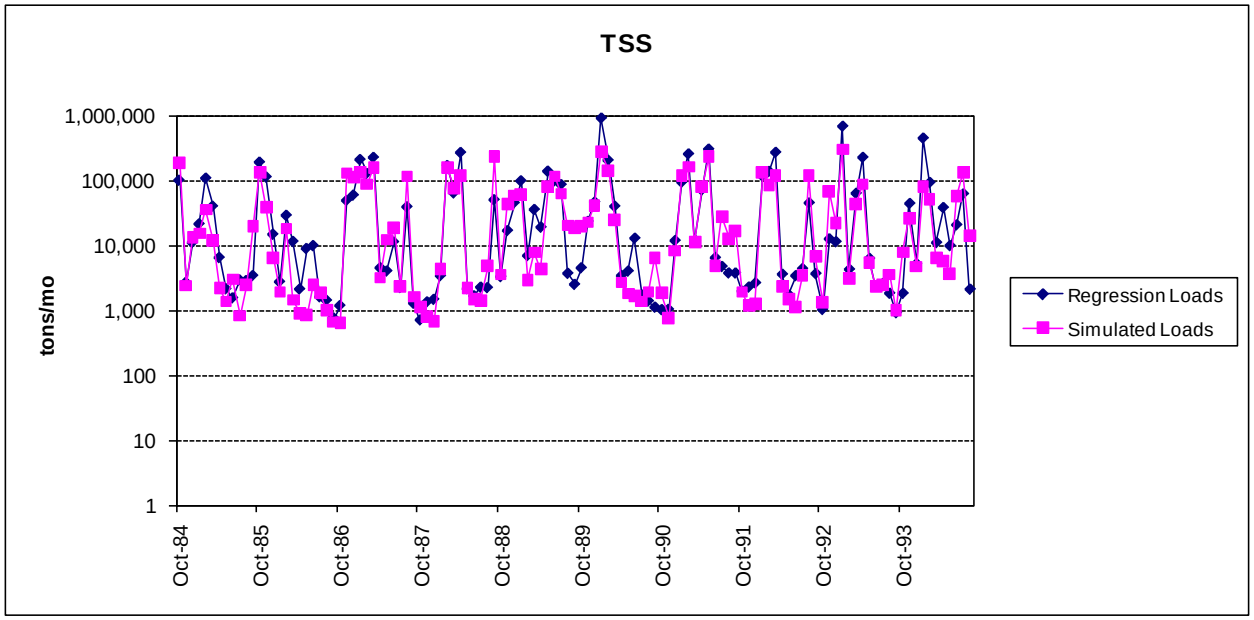

Figure 13. Fit for monthly load of TSS at USGS 07378500 Amite River near Denham Springs, LA

Table 9. Model fit statistics (observed minus predicted) for monthly sediment loads using stratified regression

Statistic	07378500 Amite River near Denham Springs, LA (1984-1994)	07375500 Tangipahoa River at Robert, LA (1984-1999)
Relative Percent Error	9.2%	9.0%
Relative Average Absolute Error	36%	65%
Relative Median Absolute Error	9.1%	14.3%

Calibration adjustments for total phosphorus and total nitrogen focused on the following parameters:

- RHOQ (algal respiration rate at 20° C)
- PHOSKD (phosphorus soil partitioning coefficient)
- PSP (phosphorus availability index)
- RS1 (Local algal settlement rate in the reach at 20° C)
- AL1 (Fraction of algal biomass that is nitrogen)
- AL2 (Fraction of algal biomass that is phosphorus)
- MUMAX (Rate of oxygen uptake per unit NO_2-N oxidation at 20° C)
- RHOQ (Algal respiration rate at 20° C)
- RS2 (benthic source rate for dissolved P in the reach at 20° C)
- RS3 (Benthic source rate for NH_4-N in the reach at 20° C)
- RS5 (organic P settling rate in the reach at 20° C)
- BC4 (rate constant for mineralization of organic P to dissolved P in the reach at 20° C)
- RS4 (rate coefficient for organic N settling in the reach at 20° C)
- CH_ONCO (Channel organic nitrogen concentration)
- CH_OPCO (Channel organic phosphorus concentration)
- SDNCO (Denitrification threshold water content)
- CDN (Denitrification exponential rate constant)

Results for the phosphorus simulation are shown in Figure 14 and Table 10. Results for the nitrogen simulation are shown in Figure 15 and Table 11. The model fit is generally reasonable for nutrients at both stations.

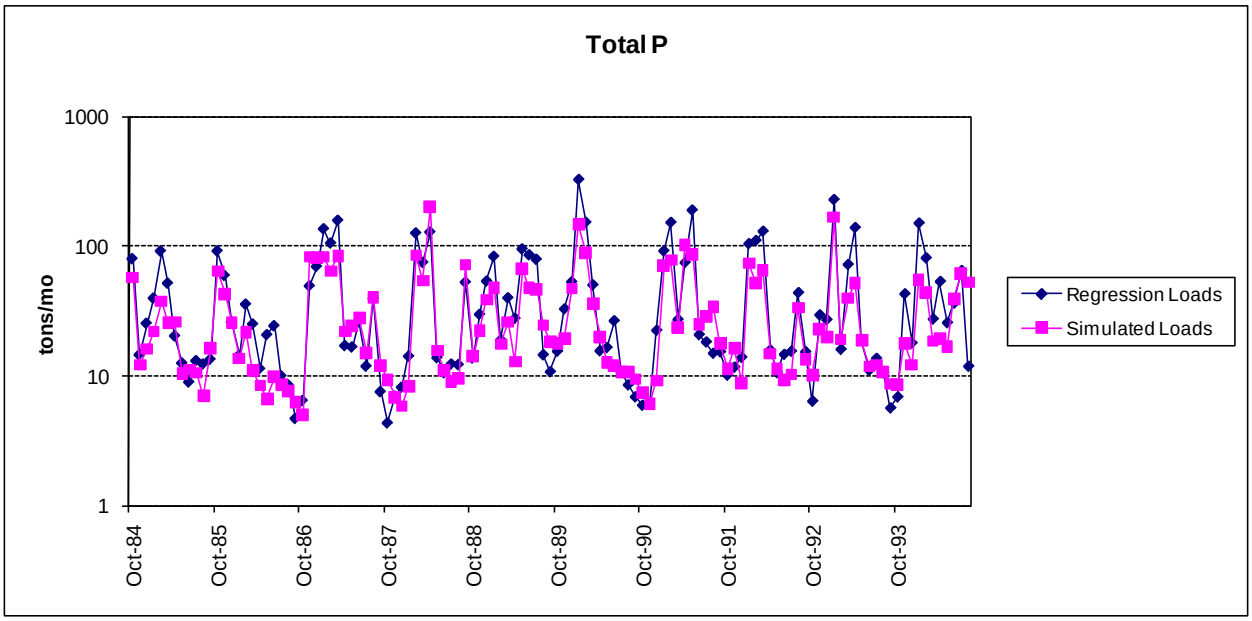

Figure 14. Fit for monthly load of total phosphorus at USGS 07378500 Amite River near Denham Springs, LA

Table 10. Model fit statistics (observed minus predicted) for monthly phosphorus loads using stratified regression

Statistic	07378500 Amite River near Denham Springs, LA (1984-1994)	07375500 Tangipahoa River at Robert, LA (1984-1999)
Relative Percent Error	2.4%	-31.2
Average Absolute Error	46%	84%
Median Absolute Error	13.0%	9.3%

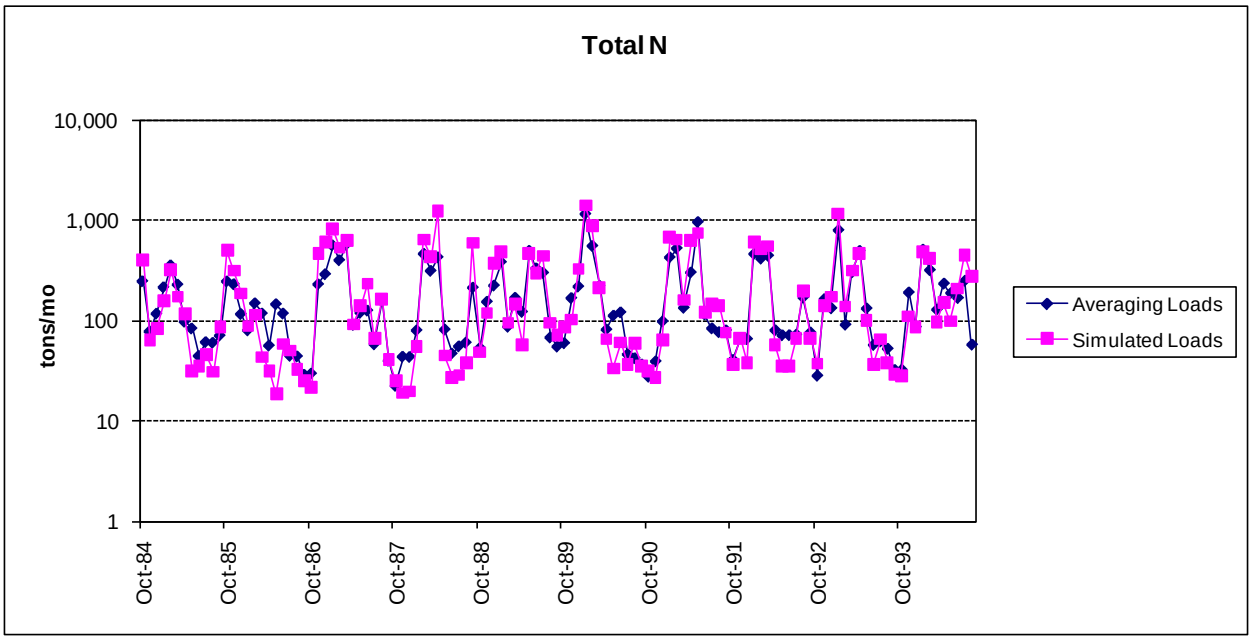

Figure 15. Fit for monthly load of total nitrogen at USGS 07378500 Amite River near Denham Springs, LA

Table 11. Model fit statistics (observed minus predicted) for monthly total nitrogen loads using averaging estimator

Statistic	07378500 Amite River near Denham Springs, LA (1984-1994)	07375500 Tangipahoa River at Robert, LA (1984-1999)
Relative Percent Error	-8.9%	-1.3%
Average Absolute Error	54%	65%
Median Absolute Error	24.4%	28.7%

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