Modeling Report

WBID 3084 Jane Green Creek/WBID 3073 Crabgrass Creek
for Nutrients and Dissolved Oxygen
Upper St. Johns River Basin

May 28, 2013

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Watershed Description

Jane Green Creek and Crabgrass Creek lies in southern Osceola County just west of the city of Melbourne. It is an element of the upper St. Johns River, being located upstream of where US Highway 192 crosses the Upper St Johns River.

The Jane Green and Crabgrass Creek WBIDs (Figure 1) is located in Osceola County and eventually drains to the St. Johns River.

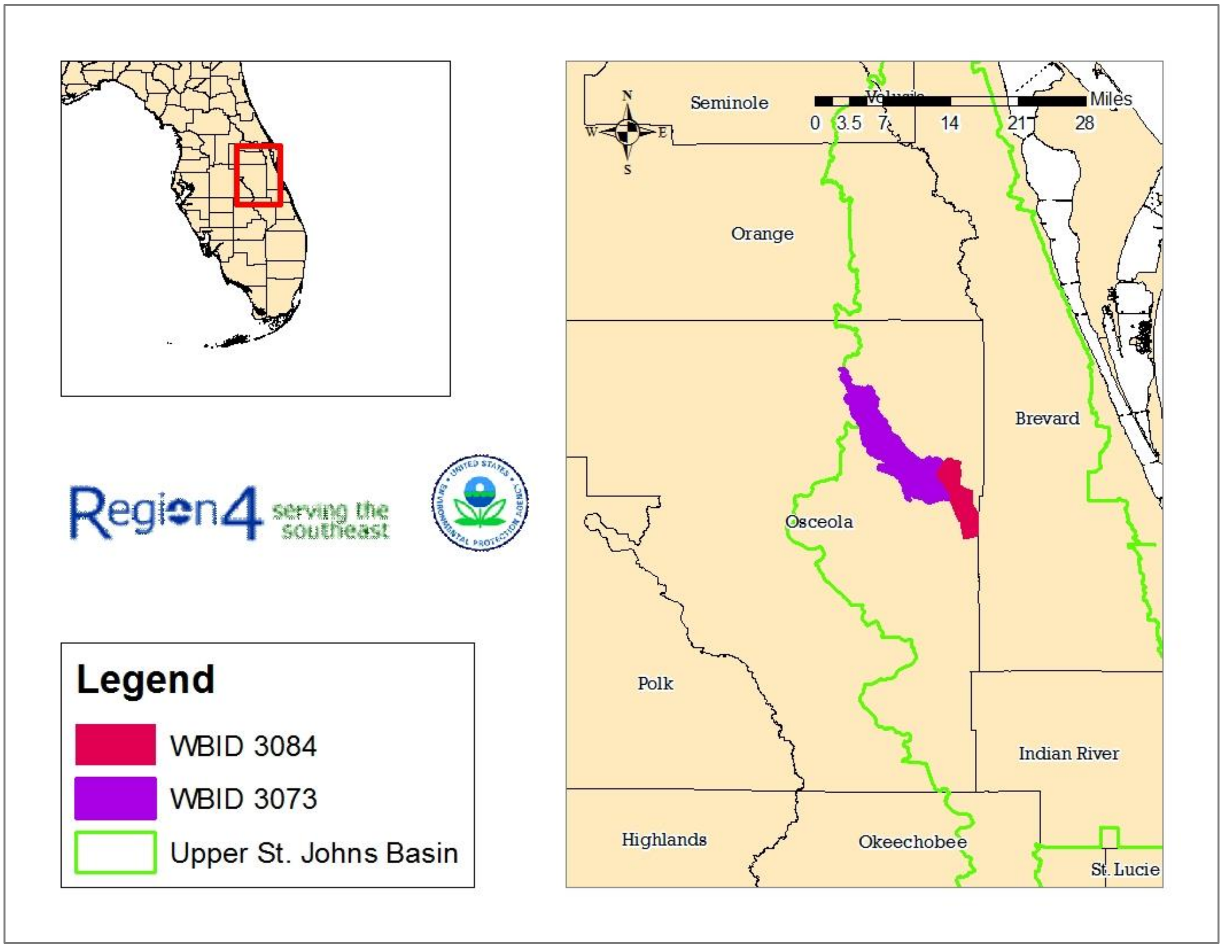


Figure 1 Location of Crabgrass and Jane Green Creeks Watershed and WBID

The landuse distributions for the Jane Green/Crabgrass Creek watersheds are presented in Figure 2. The predominant landuse in the watershed is agriculture.

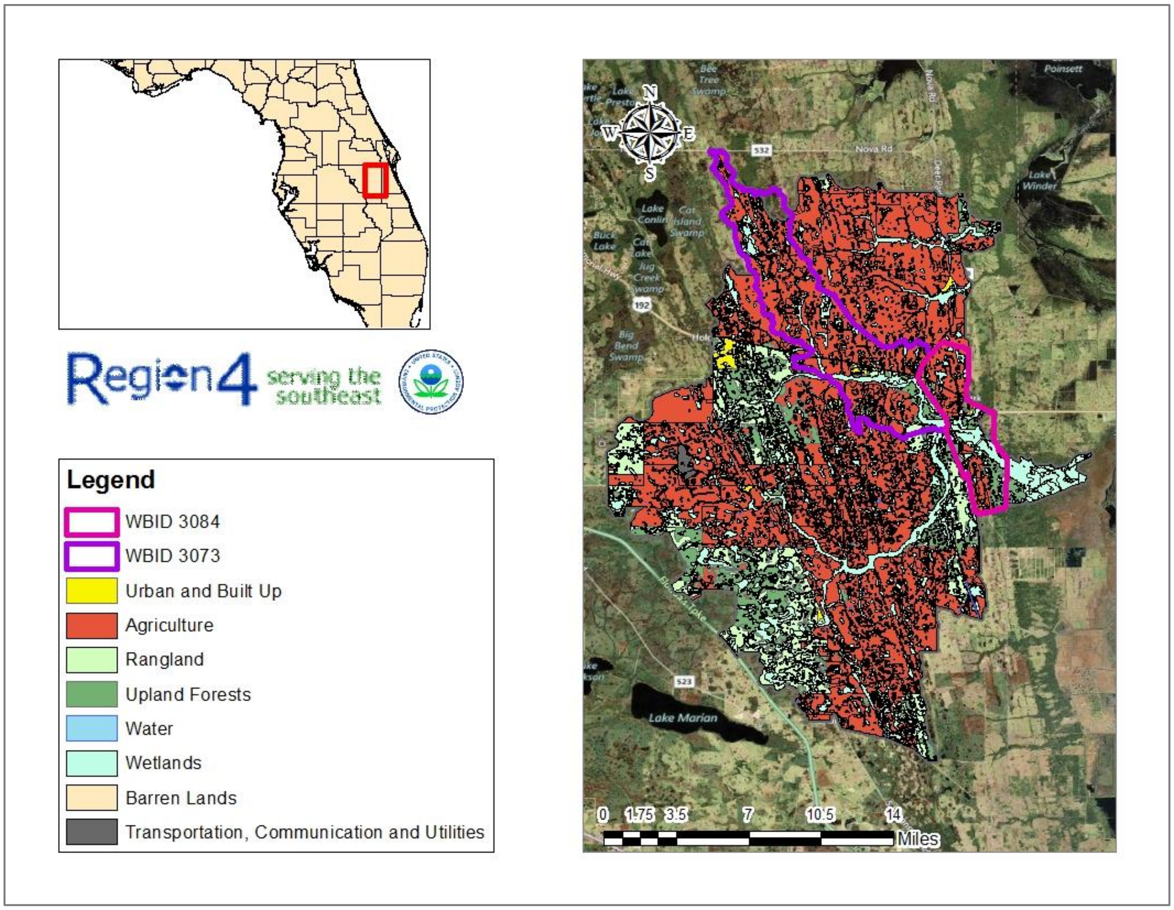


Figure 2 Landuse Distribution for Crabgrass and Jane Green Creeks Watershed

TMDL Targets

The TMDL reduction scenarios will be done to achieve a Florida's dissolved oxygen concentration of 5 mg/L and insure balanced flora and fauna within Jane Green/Crabgrass Creek or establish the TMDL to be consistent with a natural condition if the dissolved oxygen standard cannot be achieved.

The waterbodies in the Jane Green/Crabgrass Creek WBID are Class III Freshwater with a designated use of Recreation, Propagation and Maintenance of a Healthy, Well-Balanced Population of Fish and Wildlife. Designated use classifications are described in Florida's water quality standards. See Section 62-302.400, F.A.C. Water quality criteria for protection of all classes of waters are established in Section 62-302.530, F.A.C. Individual criteria should be considered in conjunction with other provisions in water quality standards, including Section 62-302.500 F.A.C., which established minimum criteria that apply to all waters unless alternative criteria are specified. Section 62-302.530, F.A.C. The WBIDs addressed in this report were listed due to elevated concentrations of chlorophyll *a*. While FDEP does not have a streams water quality standard specifically for chlorophyll *a*, elevated levels of chlorophyll *a* are frequently associated with a violation of the narrative nutrient standard, which is described below.

Nutrients

The designated use of Class III waters is recreation, propagation and maintenance of a healthy, well-balanced population of fish and wildlife. In 1979, FDEP adopted a narrative criterion for nutrients. FDEP recently adopted numeric nutrient criteria for many Class III waters in the state, including streams, which numerically interprets part of the state narrative criterion for nutrients. While those criteria have been submitted to EPA for review pursuant to section 303(c) of the CWA, EPA has accepted the FDEP criteria; however, on the criteria is not effective yet. Therefore, for streams in Florida, the applicable nutrient water quality standard for CWA purposes remains the Class III narrative criterion.

Narrative Nutrient Criteria

Florida's narrative nutrient criteria provide:

The discharge of nutrients shall continue to be limited as needed to prevent violations of other standards contained in this chapter. Man induced nutrient enrichment (total nitrogen and total phosphorus) shall be considered degradation in relation to the provisions of Sections 62-302.300, 62-302.700, and 62-4.242. Section 62-302.530(48)(a), F.A.C.

In no case shall nutrient concentrations of a body of water be altered so as to cause an imbalance in natural populations of aquatic flora or fauna. Section 62-302.530(48)(b), F.A.C.

Chlorophyll and dissolved oxygen (DO) levels are often used to indicate whether nutrients are present in excessive amounts. The target for this TMDL is based on levels of nutrients necessary to prevent violations of Florida's DO criterion, set out below.

Florida's adopted numeric nutrient criteria for streams

Florida's recently adopted numeric nutrient criteria interprets the narrative water quality criterion for nutrients in paragraph 62-302.530(48)(b), F.A.C. See section 62-302.531(2). The Florida rule provides that the narrative water quality criteria for nutrients in paragraph 62-302.530(47)(a), F.A.C., continues to apply to all Class III waters. See section 62-302.531(1).

Florida's recently adopted rule applies to streams, including the WBIDs in this TMDL. For streams that do not have a site specific criteria, Florida's rule provides for biological information to be considered together with nutrient thresholds to determine whether a waterbody is attaining 62-302.531(2)(c), F.A.C. The rule provides that the nutrient criteria are attained in a stream segment where information on chlorophyll a levels, algal mats or blooms, nuisance macrophyte growth, and changes in algal species composition indicates there are no imbalances in flora and either the average score of at least two temporally independent SCIs performed at representative locations and times is 40 or higher, with neither of the two most recent SCI scores less than 35, or the nutrient thresholds set forth in Table 1 below are achieved. See section 62-302.531(2)(c).

Florida's rule provides that numeric nutrient criteria are expressed as a geometric mean, and concentrations are not to be exceeded more than once in any three calendar year period. Section 62-302.200 (25)(e), F.A.C.

Table 1 Inland Numeric Nutrient Criteria

Nutrient Watershed Region	Total Phosphorus Nutrient Threshold	Total Nitrogen Nutrient Threshold
Panhandle West	0.06 mg/L	0.67 mg/L
Panhandle East	0.18 mg/L	1.03 mg/L
North Central	0.30 mg/L	1.87 mg/L
Peninsular	0.12 mg/L	1.54 mg/L
West Central	0.49 mg/L	1.65 mg/L
South Florida	No numeric nutrient threshold. The narrative criterion in paragraph 62-302.530(47)(b), F.A.C., applies.	No numeric nutrient threshold. The narrative criterion in paragraph 62-302.530(47)(b), F.A.C., applies.

Dissolved Oxygen Criteria

Numeric criteria for DO are expressed in terms of minimum and daily average concentrations. Section 62-302(30), F.A.C., sets out the water quality criterion for the protection of Class III freshwater waters as:

Shall not be less than 5.0 mg/l. Normal daily and seasonal fluctuations above these levels shall be maintained.

Biochemical Oxygen Demand Criteria

Biochemical Oxygen Demand (BOD) shall not be increased to exceed values which would cause dissolved oxygen to be depressed below the limit established for each class and, in no case, shall it be great enough to produce nuisance conditions. [FAC 62-302.530 (11)]

Natural Conditions

In addition to the standards for nutrients, DO and BOD described above, Florida's standards include provisions that address waterbodies which do not meet the standards due to natural background conditions.

Florida's water quality standards provide a definition of natural background:

"Natural Background" shall mean the condition of waters in the absence of man-induced alterations based on the best scientific information available to the Department. The establishment of natural background for an altered waterbody may be based upon a similar unaltered waterbody or on historical pre-alteration data. 62-302.200(15), FAC.

Florida's water quality standards also provide that:

Pollution which causes or contributes to new violations of water quality standards or to continuation of existing violations is harmful to the waters of this State and shall not be allowed. Waters having water quality below the criteria established for them shall be protected and enhanced. However, the Department shall not strive to abate natural conditions. 62-302.300(15) FAC

Modeling Approach

The modeling approach that was used for the development of the nutrient and dissolved oxygen TMDL for Jane Green/Crabgrass Creek considers 13 years of meteorological and flow conditions. The selection of a longer term continuous simulation insures that average, wet and dry conditions are considered in the TMDL determination. The modeling approach uses a dynamic watershed model that predicts surface runoff of pollutants (nitrogen, phosphorus and BOD) and flow as function of landuse and meteorological information. The 13 year simulation of watershed loadings and flow are fed forward to a water quality model that predicts the impacts of the loadings and flow on water quality in waterbody. The water quality model predicts: dissolved oxygen, nitrogen (ammonia, nitrate, and organic nitrogen), phosphorus (orthophosphate, organic phosphorus), chlorophyll a, biochemical oxygen demand as a function of loads and flows provided by the watershed model.

LSPC Watershed Model

The Loading Simulation Program C++ (LSPC) as the watershed model. LSPC is the Loading Simulation Program in C++, a watershed modeling system that includes streamlined Hydrologic Simulation Program Fortran (HSPF) algorithms for simulating hydrology, sediment, and general water quality on land as well as a simplified stream fate and transport model. LSPC is derived from the Mining Data Analysis System (MDAS), which was originally developed by EPA Region 3 (under contract with Tetra Tech) and has been widely used for TMDLs. In 2003, the U.S. Environmental Protection Agency (EPA) Region 4 contracted with Tetra Tech to refine, streamline, and produce user documentation for the model for public distribution. LSPC was developed to serve as the primary watershed model for the EPA TMDL Modeling Toolbox.

WASP Water Quality Model

Water Quality Analysis Simulation Program (WASP 7.5) (USEPA, 2011) is a generalized framework for modeling contaminant fate and transport in surface waters. Its flexible, compartmental approach allows it to address problems in one, two, or three dimensions. It is designed to allow easy substitution of user-written routines into the program structure. WASP has been used to answer questions regarding biochemical oxygen demand, dissolved oxygen dynamics, nutrients and eutrophication, bacterial contamination, and organic chemical and heavy metal contamination.

The WASP model integrates the predicted flows and loads from the LSPC model to simulate water quality responses in: nitrogen, phosphorus, chlorophyll a and dissolved oxygen. Both LSPC and WASP will be calibrated to current conditions, a natural condition. The WASP model will be used to determine the percent reduction in loadings that would be needed to meet water quality standards.

LSPC Application to Jane Green/Crabgrass Creek Watershed

The watershed model was applied to the Jane Green/Crabgrass Creek watershed model for the simulation period of 1996 through 2009. The 1996 year was used to equilibrate the initial conditions in the watershed model (soil moisture, buildup and washoff), from 1997 through 2009 was used to predict flows and loads under current conditions that will be passed onto the water quality model.

Watershed Delineation and Landuse

The surrounding watershed that drains directly to Jane Green/Crabgrass Creek WBID was included in the watershed model. This encompasses land areas outside the delineated Jane Green/Crabgrass Creek WBID. The watershed was delineated into 11 sub basins (Figure 3). The LSPC model will predict flow and loads coming from each of these sub basins into Jane Green/Crabgrass Creek.

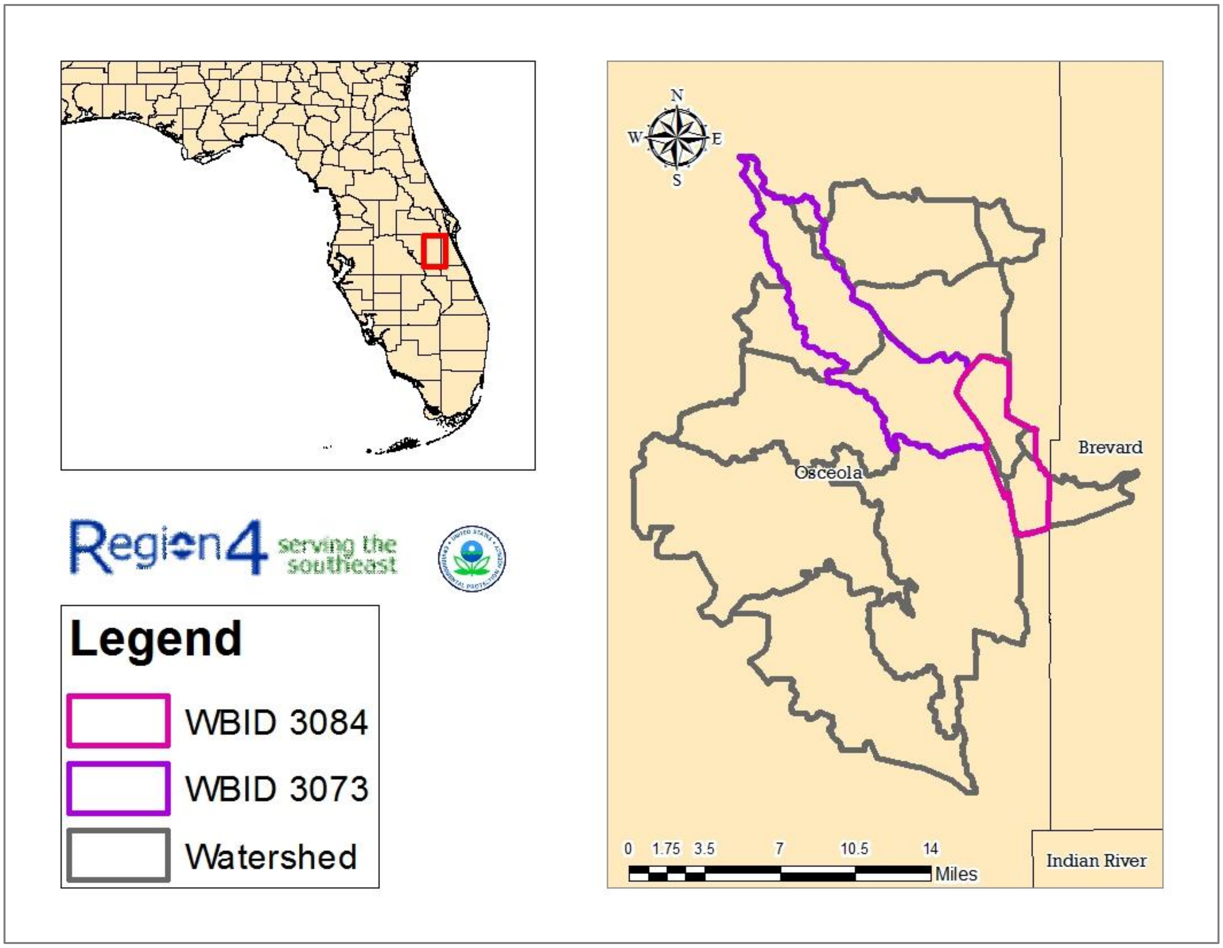


Figure 3 Jane Green/Crabgrass Creek Watershed Delineation

The initial model setup for Jane Green/Crabgrass Creek was obtained from EPA's application of LSPC for the purposes of nutrient criteria development; the model was further refined and calibrated to all local data and gages that were available in the watershed.

Landuse coverage was obtained from the St. Johns River Water Management District (Florida Landuse Classification Code) coverage developed from 2004. Table 2 provides the landuse distribution for each of the 7 sub basins being modeled.

Table 2 Landuse Distribution for Sub Basins

Subbasin Name	Agriculture	Barren Land	Rangeland	Special Classifications	Transportation, Communication And Utilities	Upland Forests	Urban And Built-Up	Water	Wetlands	Totals
130018	18548.3	8.2	1296.5	756.6	167.6	1756.1	179.4	80.7	7760	30834.8
130019	13352.4	11.7	140.8	678.2		443.6	3	53.8	5245.4	19928.8

130020	22200.9	30	1655.8	554.3	488.7	561.3	69.8	95.6	8367	34837.8
130021	23257.1	10.7	1927.1	2173.5	83.6	1311.1	43.2	1411.9	15719.1	46966.3
130022	11145	18.7	679.3	396.3	60.7	476.6	776.1	21.1	3584.4	17280.5
130024	6861	27.6	278.1	188.5	70.1	439.5	400.2	227.9	2451.4	10944.3
130025	13370.1	278.1	975	443.6	212.7	1256.5	124.2	208.8	7336.6	24205.5
130027	28559.3	95.6	141.8	1403.6	306.8	288.3	71	132.4	7226.1	38225
130234	1668	107.5	41.9	30.6	15.4	880.1	41	41.5	1008	3834.1
130237	476.3	56.6	38.5	45.3	13.6	13.2	11.8	17	209.6	881.9

Meteorological Information

Non-point source loadings and hydrological conditions are dependent on weather conditions. Hourly data from weather stations within the boundaries of, or in close proximity to the sub-watersheds were applied to the watershed model. An ASCII file (*.air) was generated for each meteorological and precipitation station used for the hydrologic evaluations in LSPC. Each meteorological and precipitation station file contains atmospheric data used for modeling of the hydrologic processes. These data include precipitation, air temperature, dew point temperature, wind speed, cloud cover, evaporation, and solar radiation. These data are used directly, or calculated from the observed data.

Figure 4 depicts the hourly rainfall for the Jane Green/Crabgrass Creek (083137) meteorological station. The period of record being simulated during this TMDL development contains average, wet and dry years.

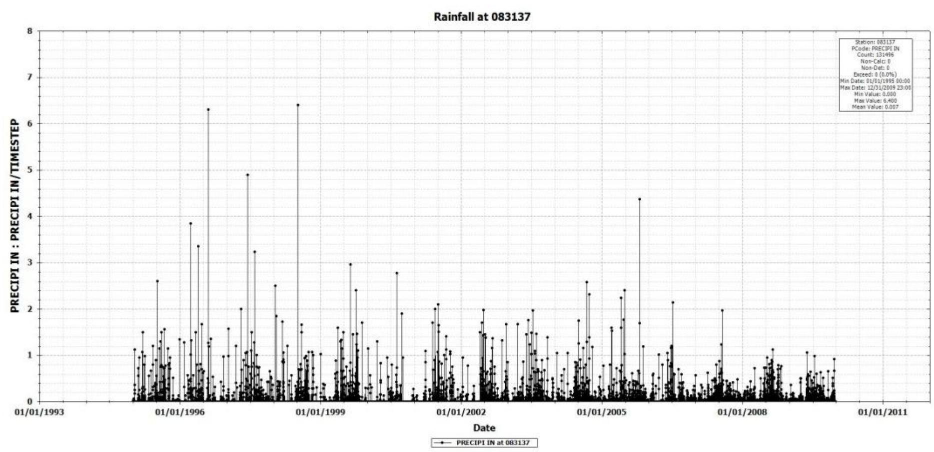


Figure 4 Hourly Rainfall Station 083137

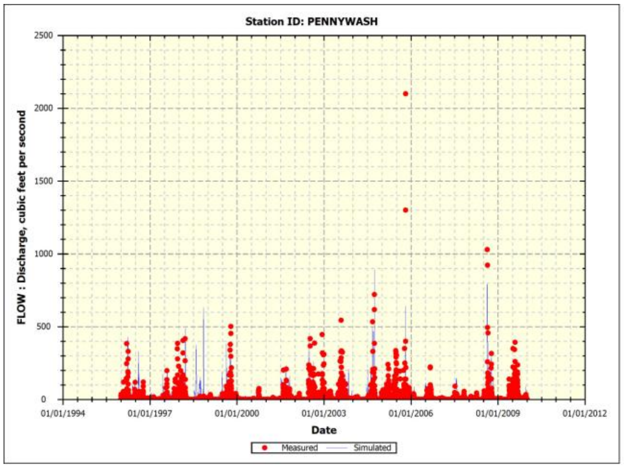
Table 3 provides the annual rainfall for each of the simulation years.

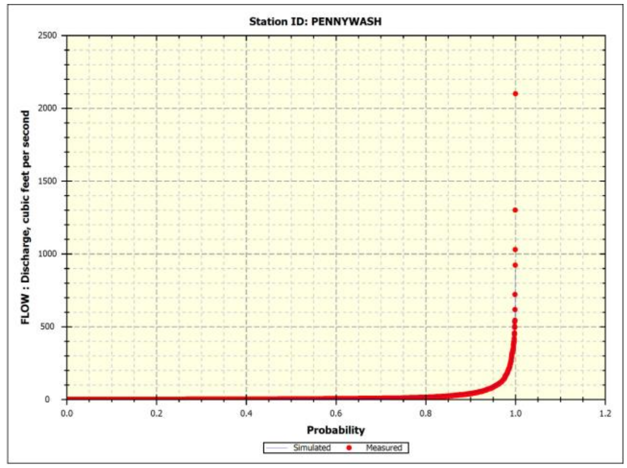
Table 3 Annual Rainfall for Simulation Period

Year	Rainfall (inches)
1/1/1996	67
1/1/1997	62
1/1/1998	63
1/1/1999	76
1/1/2000	65
1/1/2001	30
1/1/2002	58
1/1/2003	69
1/1/2004	62
1/1/2005	72
1/1/2006	66
1/1/2007	41
1/1/2008	57
1/1/2009	67

Hydraulic Calibration

The watershed and water quality model were calibrated for flow by comparing the predict flows to the USGS gage USGS 02232155 Pennywash Creek near Deer Park, FL. While this gage is not in the direct watershed that drains to Jane Green/Crabgrass Creek, it is the closest gage in which to calibrate the model. Figure 5 illustrates both a quantitative and qualitative comparison of the model flow predictions directly compared to the measurements at the USGS gage.





Calibration Statistics

Station: PENNYWASH; Parameter: FLOW

Statistic	Simulated	Measured
Count:	5114	5114
Mean:	18.987	18.322
Std Dev:	50.532	61.148
Min:	0.023	0.000
Max:	889.732	2,100.000
5 %tile:	0.196	0.100
10 %tile:	0.406	0.310
90 %tile:	46.049	40.000
95 %tile:	88.446	84.000
Corr (R^2):	0.36	
Mean Abs Error:	17.988	
RMS Error:	50.960	
Norm RMS Error:	1.088	
Index of Agreement:	0.75	

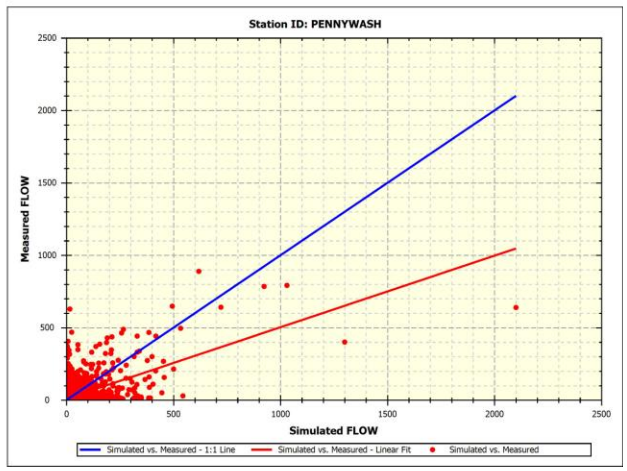


Figure 5 Flow Calibration for Jane Green/Crabgrass Creek Watershed

Water Quality Model Application

The WASP water quality model uses the kinematic wave equation to simulate flow and velocity and the basic eutrophication module to predict dissolved oxygen and Chlorophyll a responses to the BOD, total nitrogen and total phosphorus loadings. The waterbody geometry was determined from NHDPlus coverages of the free flowing stream sections.

Model Network

The Jane Green/Crabgrass Creek waterbody was broken into segments for the water quality model. The model segmentation was done based upon the NHDPlus coverage taking into account travel time, pore points for the watershed model and IWR monitoring stations.

Figure 6 illustrates the 11 water quality model segments that are simulated. The LSPC model flows and loads enter the water quality model at segments15, 14, 13, 12, 11, 8 and 7.

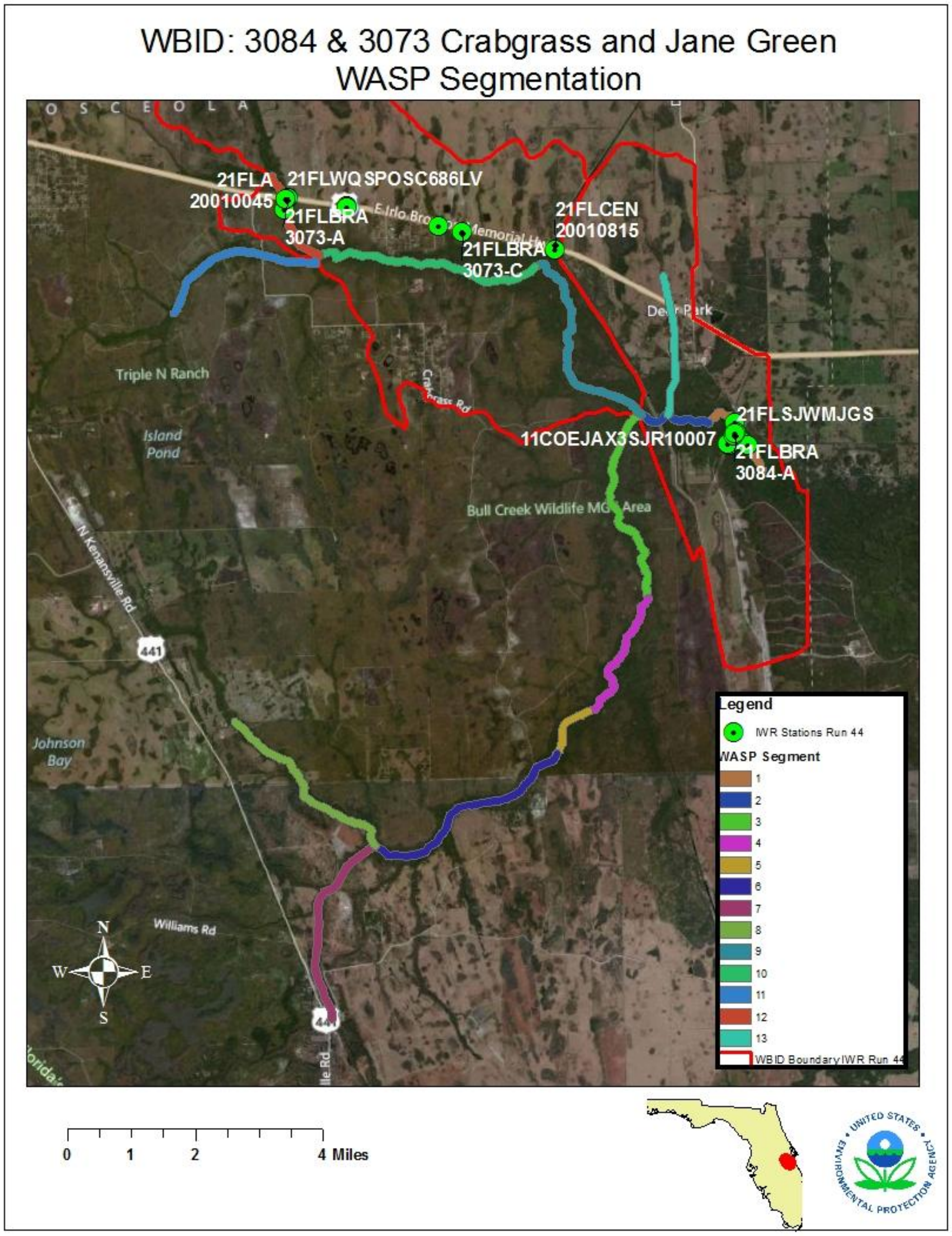


Figure 6 WASP Model Segmentation

Water Quality Model Calibration

The water quality model was calibrated to all available data. The fine tuning of the calibration of the model utilized the IWR station located at the lower end of the WBID that most of the monitoring data.

Table 4 and Table 5 provide a listing of the IWR stations that were used to calibrate the WASP model. All stations that had nutrient, BOD, dissolved oxygen and chlorophyll a measurements were used in the calibration process. The station highlighted in yellow was used for the water quality.

Table 4 Impaired Waters Rule Database Stations used in Water Quality Model Calibration Jane Green

Station	Station Name	First Date	Last Date
21FLBRA 3084-A	3084 - Jane Green Creek - one lane bridge on Kempfer	6/22/2007 9:44	5/15/2008 10:10
21FLBRA 3084-B	3084 - Jane Green Creek - 200m upstrm of A at cypress stand	9/5/2007 10:39	1/23/2008 11:00
21FLBRA 3084-C	3084 - Jane Green Creek - at mouth where stream gets wide	9/5/2007 11:15	5/15/2008 10:30
21FLBRA 3084-D	3084 - Jane Green Creek - 240m dwnstrm from B at fallen tree	9/5/2007 11:30	9/25/2007 10:46
21FLCEN 20010464	Jane Green Creek @ Kempfer Rd ~1.5mi SE of sawmill	4/14/2009 10:50	11/12/2009 11:15
21FLCEN 20010818	Jane Green Creek @ Kempfer Rd ~1.3 mi SE of sawmill	4/14/2009 10:29	3/8/2010 11:10
21FLSJWMJGS	Jane Green Creek at USGS Gage (Ten Mile Road)	7/14/2005 8:20	12/6/2011 14:00

Table 5 Impaired Waters Rule Database Stations used in Water Quality Model Calibration Crabgrass Creek

Station	Station Name	First Date	Last Date
21FLBRA 3073-A	3073 - Crabgrass Creek - crossing E of Crabgrass Rd	6/28/2007 10:00	5/6/2008 10:40
21FLBRA 3073-B	3073 - Crabgrass Creek - crossing on 192 at 1220 00 post	1/23/2008 9:58	1/23/2008 9:58
21FLBRA 3073-C	3073 - Crabgrass Creek - small trib E of B site	1/23/2008 10:17	2/27/2008 9:40
21FLGW 21203	USJ055	10/12/2010 11:00	8/8/2011 12:17
21FLWQSPOSC686LV	Crabgrass Creek at US192 (WBID 3073)	7/22/2005 12:24	7/29/2005 12:55

Table 6 provides a comparison of predicted annual average concentrations versus the annual average concentrations of the measured data. While it is important to capture seasonal variation, duration and frequency of water quality, it is very critical to approximate average conditions in the system. It is during these periods of times that nutrients are expressed.

Table 6 Predicted vs. Observed Annual Average Concentrations

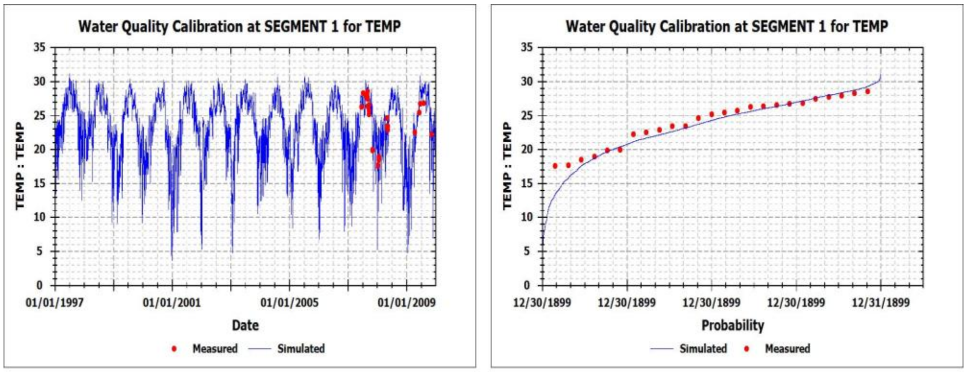
Constituent	Simulated	Observed
BOD (mg/L)	2.33	2.05
Chlorophyll a (ug/L)	1.38	1.86
DO (mg/L)	1.97	2.75
Total Nitrogen (mg/L)	1.09	1.22
Total Phosphorus (mg/L)	0.12	0.10

Figure 7 through Figure 15 provide calibration comparison for all of the major water quality constituents in which data is available.

Water Temperature

Water temperature is simulated in the water quality because of its influence on degradation, kinetic transformation, algal growth and decay rates. Because several modeling scenarios will be simulated, such as a natural condition, an estimate of water temperature under this condition could be important.

Figure 7 illustrates both a quantitative and qualitative comparison of the simulated water temperature compared to the direct measurements.



Calibration Statistics

Station: SEGMENT 1; Parameter: TEMP

Statistic	Measured	Simulated
Count:	25	25
Mean:	23.990	24.917
Std Dev:	3.512	3.378
Min:	17.570	20.197
Max:	28.500	28.579
5 %tile:	17.588	20.211
10 %tile:	18.146	20.249
90 %tile:	27.994	28.436
95 %tile:	28.413	28.537
Corr (R^2):	0.74	
Mean Abs Error:	1.740	
RMS Error:	2.022	
Norm RMS Error:	0.082	
Index of Agreement:	0.91	

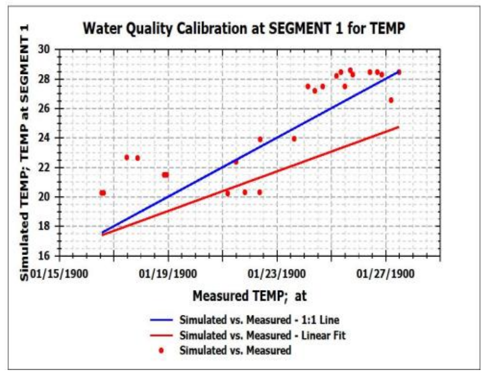
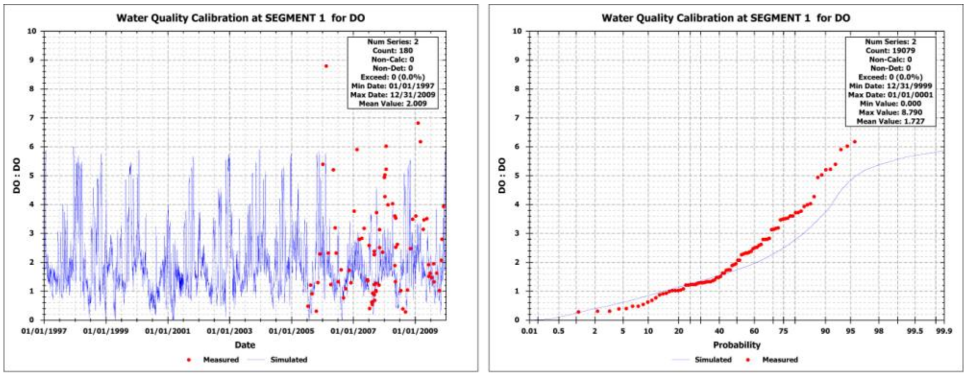


Figure 7 Water Temperature Calibration

Dissolved Oxygen

The dissolved oxygen calibration will be important in the development of this TMDL because it will be the primary response variable to determine the reductions.

Figure 8 illustrates both a quantitative and qualitative comparison of the predicted dissolved oxygen concentrations compared to the direct measurements.



Calibration Statistics

Station: SEGMENT 1; Parameter: DO

Statistic	Measured	Simulated
Count:	90	90
Mean:	2.448	1.893
Std Dev:	1.732	0.982
Min:	0.280	0.465
Max:	8.790	5.475
5 %tile:	0.396	0.658
10 %tile:	0.626	0.882
90 %tile:	5.182	3.415
95 %tile:	6.088	3.997
Corr (R^2):	0.17	
Mean Abs Error:	1.250	
RMS Error:	1.688	
Norm RMS Error:	0.731	
Index of Agreement:	0.57	

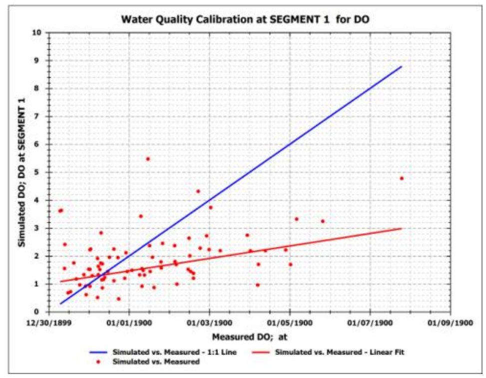
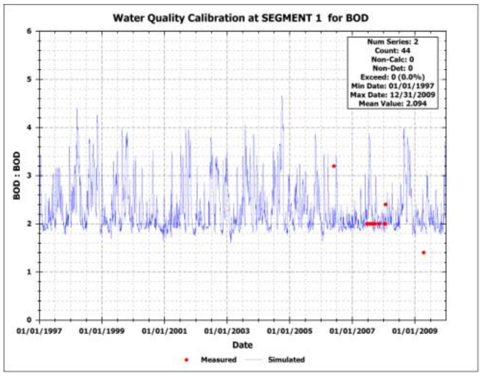


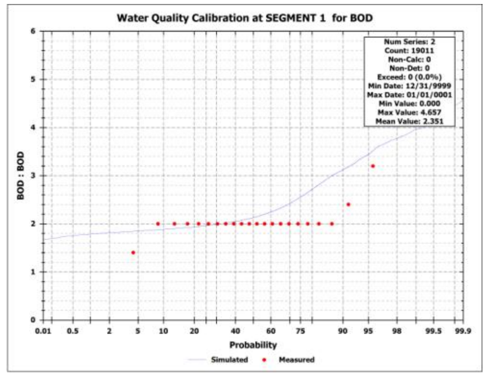
Figure 8 Dissolved Oxygen Calibration

Biochemical Oxygen Demand

There is very little BOD data available for the Jane Green/Crabgrass Creek WBID. The following presents BOD data that is available from the IWR Station Jane Green/Crabgrass Creek Creek at Florida Turnpike.

Figure 9 illustrates both a quantitative and qualitative comparison of the predicted dissolved oxygen concentrations compared to the direct measurements.





Calibration Statistics

Station: SEGMENT 1; Parameter: BOD

Statistic	Measured	Simulated
Count:	22	22
Mean:	2.045	2.136
Std Dev:	0.302	0.243
Min:	1.400	1.908
Max:	3.200	2.773
5 %tile:	1.490	1.908
10 %tile:	2.000	1.909
90 %tile:	2.280	2.660
95 %tile:	3.080	2.769
Corr (R^2):	0.01	
Mean Abs Error:	0.251	
RMS Error:	0.406	
Norm RMS Error:	0.194	
Index of Agreement:	0.27	

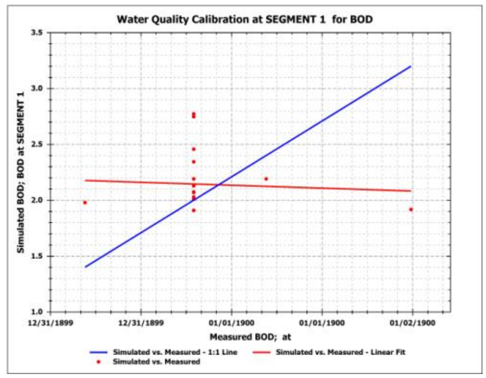
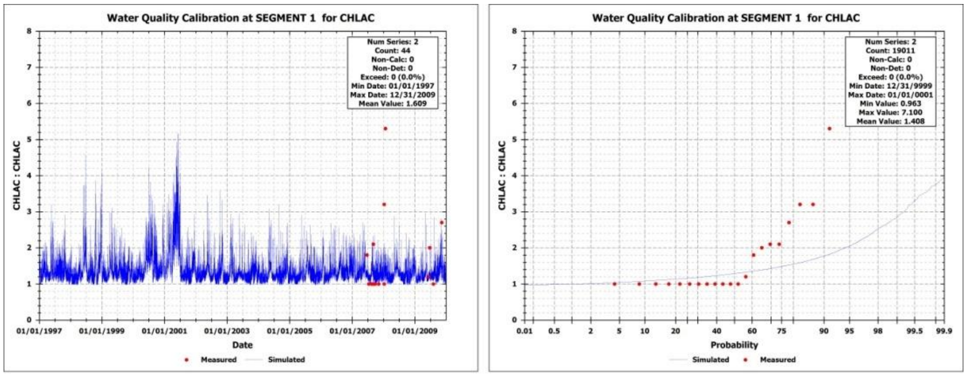


Figure 9 BOD Calibration

Chlorophyll a

There is very little chlorophyll a data available for the Jane Green/Crabgrass Creek WBID. The following presents chlorophyll a data that is available from the IWR Station Jane Green/Crabgrass Creek Creek at Florida Turnpike.

Figure 10 illustrates both a quantitative and qualitative comparison of the predicted dissolved oxygen concentrations compared to the direct measurements.



Calibration Statistics

Station: SEGMENT 1; Parameter: CHLAC

Statistic	Measured	Simulated
Count:	22	22
Mean:	1.941	1.256
Std Dev:	1.587	0.180
Min:	1.000	1.127
Max:	7.100	1.924
5 %tile:	1.000	1.128
10 %tile:	1.000	1.130
90 %tile:	4.670	1.413
95 %tile:	6.830	1.848
Corr (R^2):	0.14	
Mean Abs Error:	0.892	
RMS Error:	1.643	
Norm RMS Error:	1.031	
Index of Agreement:	0.14	

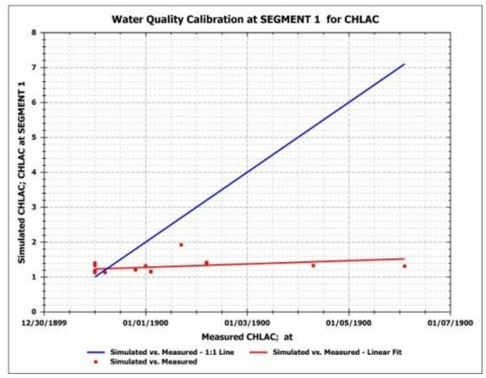
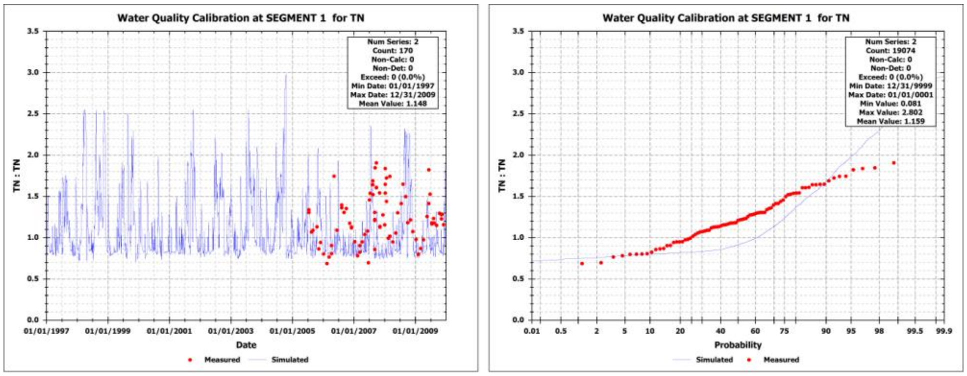


Figure 10 Chlorophyll a Calibration

Nitrogen

Figure 11 illustrates both a quantitative and qualitative comparison of the model predictions for total nitrogen to direct measurements.



Calibration Statistics

Station: SEGMENT 1; Parameter: TN

Statistic	Measured	Simulated
Count:	85	85
Mean:	1.238	0.965
Std Dev:	0.304	0.257
Min:	0.683	0.741
Max:	1.904	1.792
5 %tile:	0.784	0.762
10 %tile:	0.815	0.785
90 %tile:	1.663	1.468
95 %tile:	1.797	1.557
Corr (R^2):	0.02	
Mean Abs Error:	0.364	
RMS Error:	0.457	
Norm RMS Error:	0.417	
Index of Agreement:	0.44	

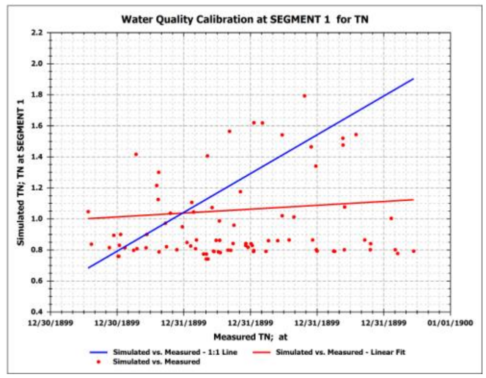
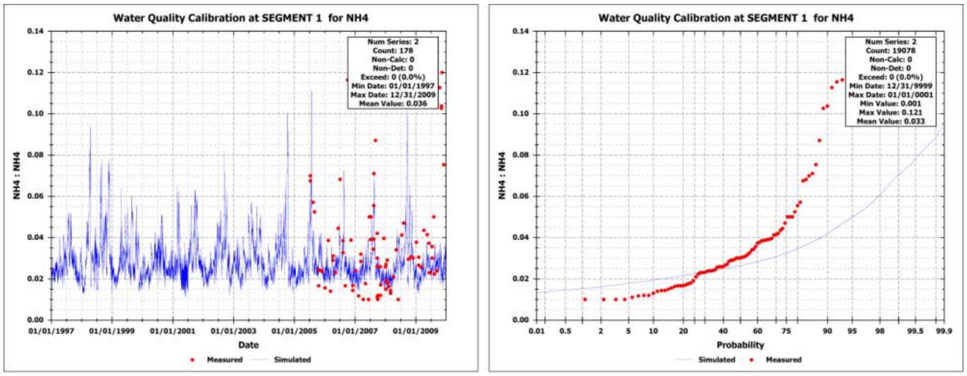


Figure 11 Total Nitrogen Calibration

Figure 12 illustrates both a quantitative and qualitative comparison of the model predictions for ammonia to direct measurements.



Calibration Statistics

Station: SEGMENT 1; Parameter: NH4

Statistic	Measured	Simulated
Count:	89	89
Mean:	0.041	0.027
Std Dev:	0.031	0.009
Min:	0.010	0.014
Max:	0.121	0.057
5 %tile:	0.011	0.017
10 %tile:	0.013	0.020
90 %tile:	0.104	0.041
95 %tile:	0.120	0.055
Corr (R^2):	0.03	
Mean Abs Error:	0.020	
RMS Error:	0.034	
Norm RMS Error:	0.991	
Index of Agreement:	0.26	

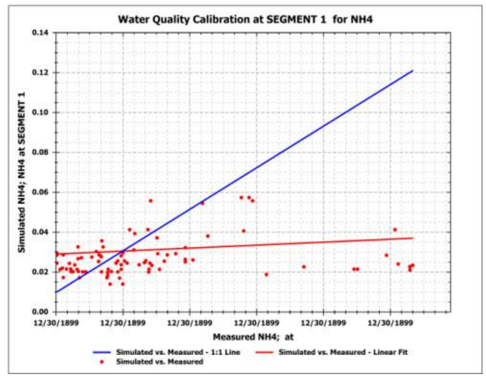
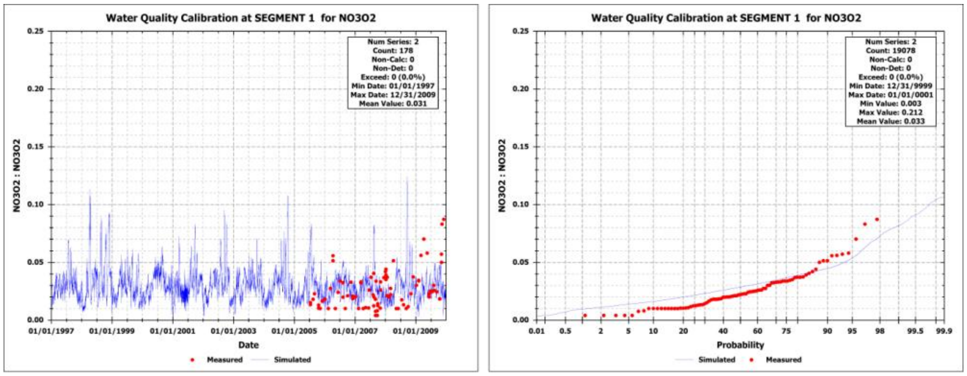


Figure 12 Ammonia Calibration

Figure 13 illustrates both a quantitative and qualitative comparison of the model predictions for nitrate to direct measurements.



Calibration Statistics

Station: SEGMENT 1; Parameter: NO3O2

Statistic	Measured	Simulated
Count:	89	89
Mean:	0.028	0.030
Std Dev:	0.026	0.015
Min:	0.004	0.010
Max:	0.212	0.081
5 %tile:	0.004	0.013
10 %tile:	0.010	0.016
90 %tile:	0.051	0.045
95 %tile:	0.064	0.077
Corr (R^2):	0.03	
Mean Abs Error:	0.021	
RMS Error:	0.032	
Norm RMS Error:	1.138	
Index of Agreement:	0.15	

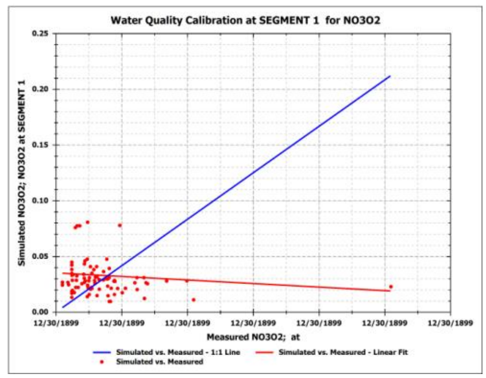
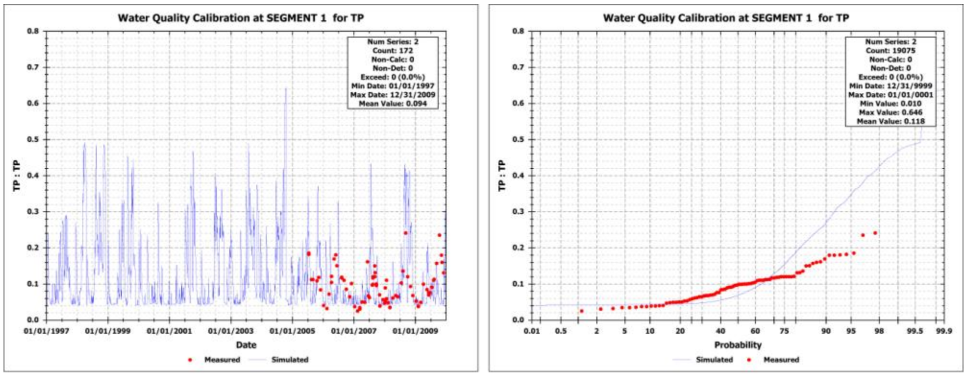


Figure 13 Nitrate Calibration

Phosphorus

Figure 14 illustrates both a quantitative and qualitative comparison of the model predictions for total phosphorus to direct measurements.



Calibration Statistics

Station: SEGMENT 1; Parameter: TP

Statistic	Measured	Simulated
Count:	86	86
Mean:	0.102	0.086
Std Dev:	0.071	0.064
Min:	0.025	0.042
Max:	0.590	0.303
5 %tile:	0.034	0.043
10 %tile:	0.039	0.043
90 %tile:	0.172	0.208
95 %tile:	0.184	0.241
Corr (R^2):	0.12	
Mean Abs Error:	0.056	
RMS Error:	0.079	
Norm RMS Error:	0.777	
Index of Agreement:	0.57	

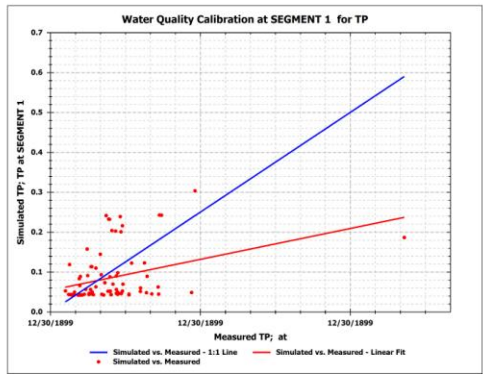
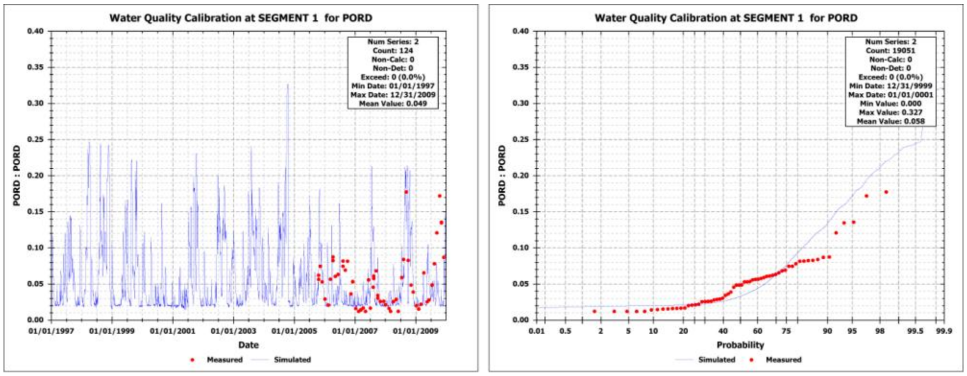


Figure 14 Total Phosphorus Calibration

Figure 15 illustrates both a quantitative and qualitative comparison of the model predictions for orthophosphate to direct measurements.



Calibration Statistics

Station: SEGMENT 1; Parameter: PORD

Statistic	Measured	Simulated
Count:	62	62
Mean:	0.052	0.045
Std Dev:	0.038	0.033
Min:	0.012	0.019
Max:	0.177	0.150
5 %tile:	0.012	0.020
10 %tile:	0.014	0.020
90 %tile:	0.087	0.100
95 %tile:	0.135	0.120
Corr (R^2):	0.05	
Mean Abs Error:	0.034	
RMS Error:	0.044	
Norm RMS Error:	0.861	
Index of Agreement:	0.52	

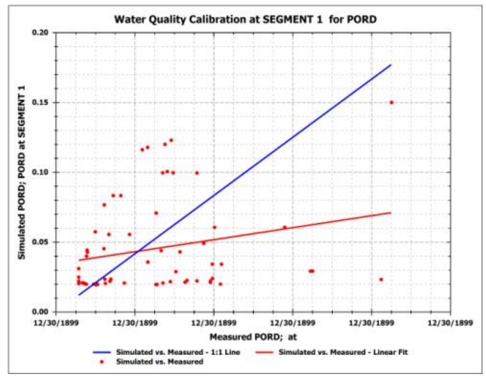


Figure 15 Orthophosphate Calibration

Current Loads

Table 4 provides the annual average total nitrogen, total phosphorus and BOD loads for the period of record 1997 through 2009. It is these loadings that the TMDL load reduction will be calculated from.

Table 7 Current Loads (1997-2009)

	Current Condition	
Constituent	WLA (Kg/Yr)	LA (Kg/Yr)
BOD	NA	919,833
Total Nitrogen	NA	379,496
Total Phosphorus	NA	61,073

Modeling Scenarios

Using the calibrated watershed and water quality models, up to two potential modeling scenarios will be developed. The first scenario will be to predict water quality conditions under a natural condition (remove point sources and returning landuses back to upland forests and wetlands). A second scenario will be developed if water quality standards can be met under natural conditions (balanced flora and fauna, dissolved oxygen greater than 5 mg/L); loads would be reduced from the current conditions until standards are met (balanced flora and fauna, dissolved oxygen greater than 5 mg/L).

Natural Condition Analysis

The purpose of the natural condition scenario is to determine the water quality in the Jane Green/Crabgrass Creek watershed without the influences of man. Because of Florida's regulation of not allowing abating of a natural condition, this scenario determines the maximum reduction that could be required. The natural condition scenario makes the following assumptions:

1. All man induced landuses in the watershed model are transformed back to wetlands and upland forest (50:50 & 75:25 ratio).
2. New hydrology is predicted under natural landuse assumption.
3. All point sources are removed (if any).
4. Water quality is predicted using the new flows and loads from the natural condition run from the watershed model.
5. Sediment oxygen demand is reduced based upon the percent reduction in nutrient loads.

Table 8 presents the predicted annual average concentrations under natural conditions. Without the impacts of anthropogenic sources the dissolved oxygen concentration in the Jane Green/Crabgrass Creek watershed. It should be noted that under natural conditions the dissolved oxygen standard of 5 mg/l would not be achieved. The natural condition scenario will be used to set the maximum loads for the TMDL.

Table 8 Natural Condition Annual Average Model Predictions

Constituent	Natural
BOD (mg/L)	1.94
Chlorophyll a (ug/L)	1.37
DO (mg/L)	2.60
Total Nitrogen (mg/L)	0.88
Total Phosphorus (mg/L)	0.09

Table 9 provides the annual average model predictions for total nitrogen, total phosphorus, and dissolved oxygen under a natural condition.

Table 9 Annual Average Loadings for Natural Condition

	Natural Condition	
Constituent	WLA (kg/yr)	LA (kg/yr)
BOD	NA	716,943
Total Nitrogen	NA	342,682
Total Phosphorus	NA	39,855

Figure 16 shows the probability distribution for dissolved oxygen concentration in Crabgrass and Jane Green Creeks under current and the natural condition scenario.

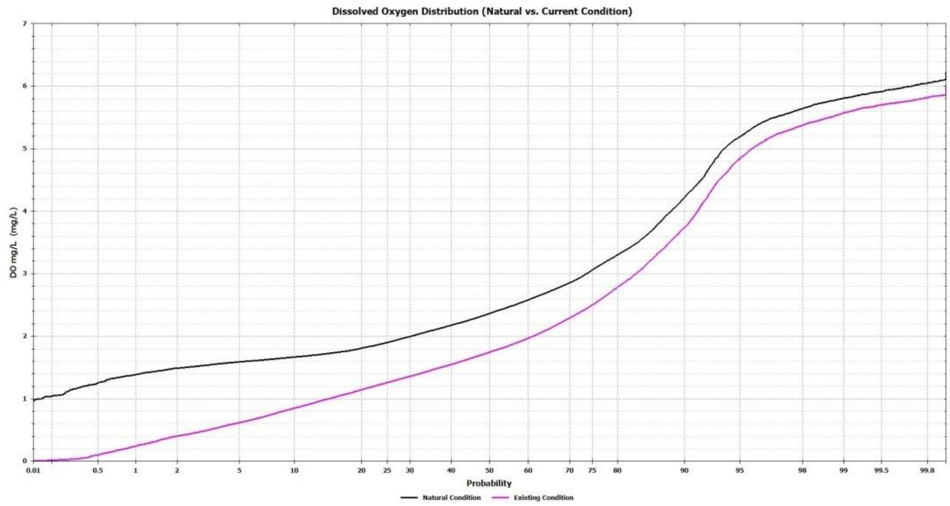


Figure 16 Dissolved Oxygen Concentration Probability Current vs. Natural Condition

TMDL Load Reductions

Because water quality standards cannot be met under natural conditions no other scenarios were conducted. The TMDL will be set to the natural conditions.

TMDL Determination

The TMDL load reduction was determined by reducing the current conditions to the natural conditions. The annual average loadings are given in Table 10 along with the prescribed load reductions.

Table 10 TMDL Determination

	Current Condition		TMDL Condition		MS4	LA
Constituent	WLA (kg/yr)	LA (kg/yr)	WLA (kg/yr)	LA (kg/yr)	% Reduction	% Reduction
BOD	NA	919,833	NA	716,943	NA	22%
Total Nitrogen	NA	379,496	NA	342,682	NA	10%
Total Phosphorus	NA	61,073	NA	39,855	NA	35%

Note: Both the watershed and water quality models including calibration and scenario input files are available upon request.