



TETRA TECH

Caloosahatchee River Basin Modeling Support

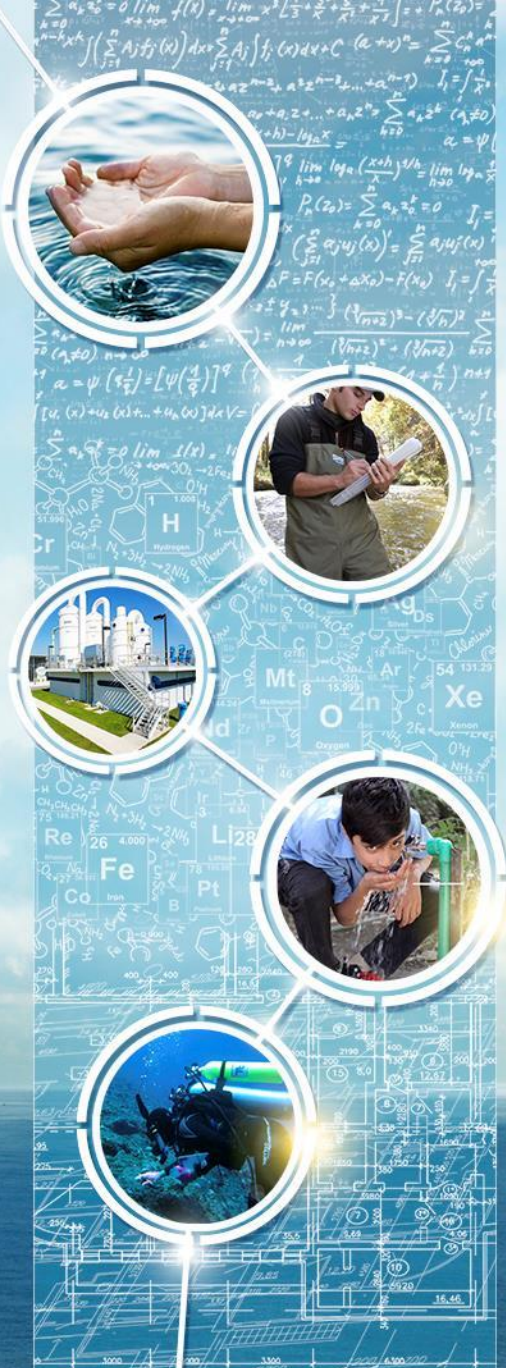
Task 3 HSPF Water Quality Draft Calibration &
Task 6 EFDC Water Quality Draft Calibration

November 3, 2016

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Project Task Updates

Project Tasks

- Task 1. Evaluate HSPF and EFDC Model Integrity and Development of Project Templates
 - Completed and approved by DEP on April 19th
- Task 2. Evaluate Current HSPF Hydrology Calibration and Recalibration of HSPF Model
 - Stakeholder comments submitted to DEP on August 25th
 - Final model and memo submitted to DEP on September 29th
 - Approved by DEP on September 29th
- Task 3. Evaluate HSPF Water Quality Model Calibration and Recalibration of HSPF Water Quality Model
 - Received stakeholder comments on October 17th
 - Stakeholder comment responses, final model, and memo will be submitted to DEP mid- to late-November

Project Tasks, continued

- Task 4. Convert the Existing Proprietary EFDC Model into a Public Domain Application and Incorporate the Light Module
 - Completed and approved by DEP on May 5th
- Task 5. Evaluate the EFDC's Existing Hydrodynamic Model Calibration and Recalibration of EFDC Hydrodynamic Model
 - Stakeholder comment responses submitted to DEP on August 25th
 - Final model and memo submitted to DEP on October 12th
 - Completed and approved by DEP on October 21st
- Task 6. Evaluate the EFDC's Existing Water Quality Model Calibration and Recalibration of EFDC Water Quality Model
 - Submitted final draft model and memo to DEP on October 14th
 - Stakeholder comment responses, final model, and memo will be submitted to DEP late November

Project Tasks, continued

- Task 7. Create a Background Land Use Plus Lake Okeechobee Meeting its TMDL Scenario Run
 - Draft memo and model runs due to DEP in December 2016
- Task 8. Communications and Meetings
 - Occurs throughout to coordinate with DEP and stakeholders
- Task 9. Documentation Final Report
 - Draft report documenting revisions and recalibration of models due to DEP in early January 2017
- Task 10. Training and Department Staff Support
 - Training and technological transfer for HSPF and EFDC models
 - Project completed end of February 2017



Task 2: HSPF Model Setup Hydrodynamic Calibration

Task 2: Major Updates

- Provided additional clarity and documentation throughout the Task 2 memo to address stakeholder comments
- Reviewed AFSIRS data used in model and did comprehensive comparison to ET data from DBHYDRO and WBAN data
- Removed Improved Pasture irrigation from model
- Reclassified Rangeland/Unimproved Pasture/Woodland Pasture/Shrub Impervious as Agricultural Impervious classification
- Updated Cape Coral and Lee County septic tank representation



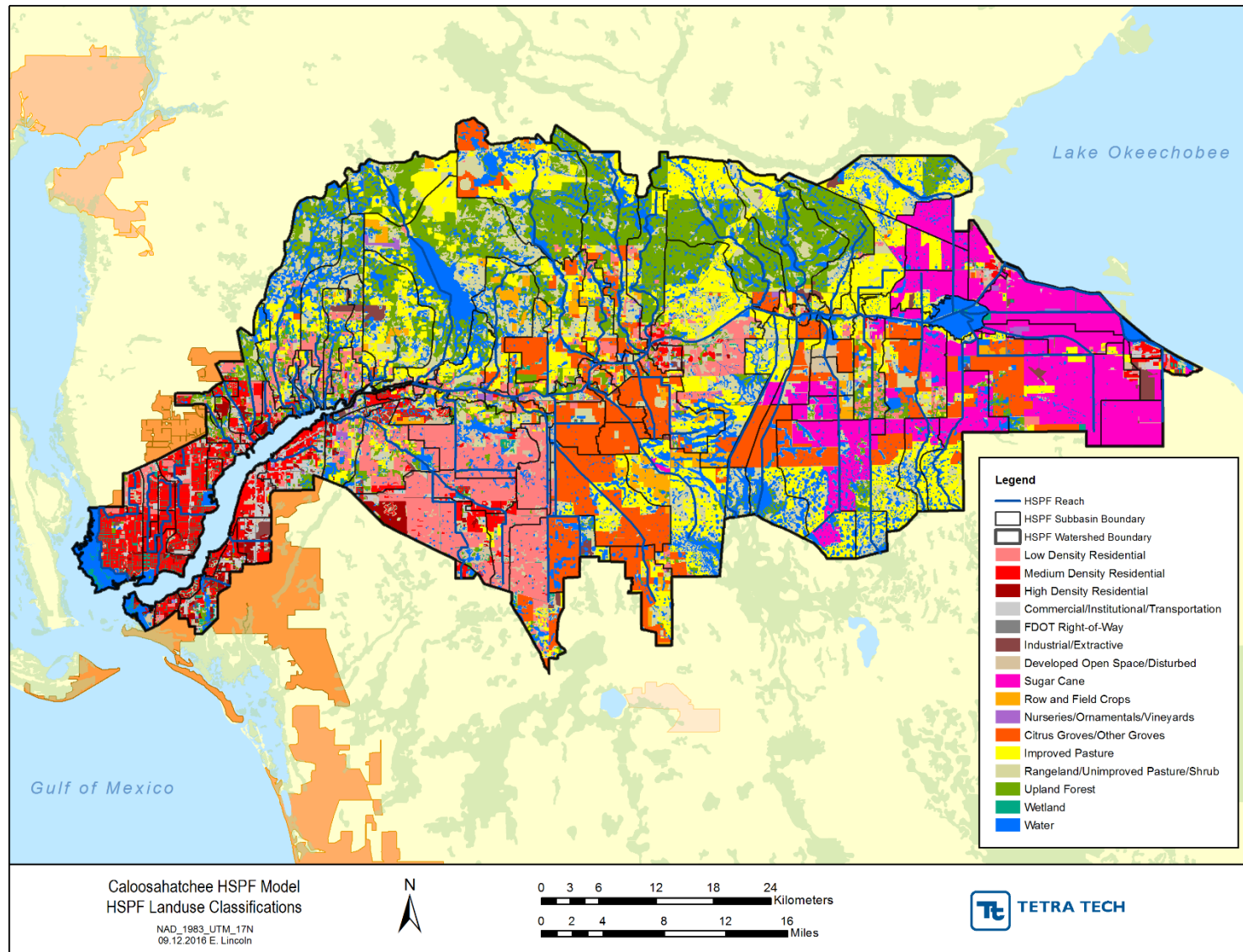
Task 3: Draft HSPF Water Quality Calibration

Task 3: HSPF Model Water Quality Calibration

- Direct source loading time series developed as part of Task 2
 - Septic systems, point sources, reuse facilities
- Atmospheric deposition added to model
- Used previous HSPF models for initial parameterization
 - Revised land uses and associated loadings to correspond with SWET agricultural loads, Harvey Harper loads, and FDOT EMCs
- Model parameterization consistent across all land uses and NEXRAD zones

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- Caloosahatchee HSPF Model
Water Quality Station
- NAD_1983_UTM_17N
09.12.2016 E. Lincoln
- Legend
- Water Quality Station
 - Calibration
 - Validation
 - HSPF Reach
 - HSPF Subbasin Boundary
 - HSPF Watershed Boundary
- 0 3 6 12 18 24 Kilometers
0 2 4 8 12 16 Miles

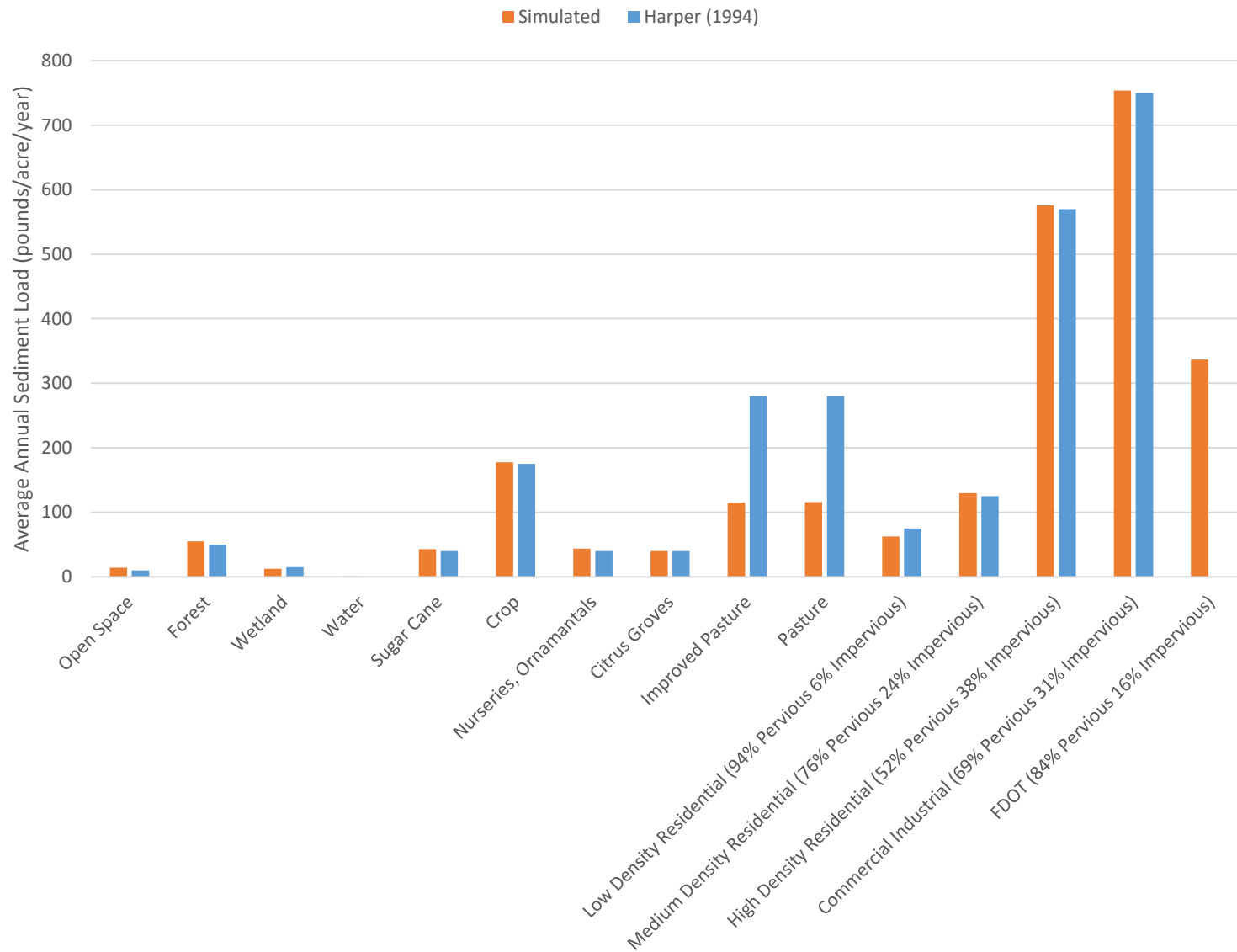
Task 3: HSPF Model Water Quality Calibration



Task 3: HSPF Sediment Calibration

- Calibrated modeled sediment loads to be similar to observed unit area loads in Harper (1994)
- Updated parameterization using recommended ranges from *BASINS Technical Note 8: Sediment Parameter and Calibration Guidance for HSPF* (USEPA 2006)
- Modified instream transport by updating TAUCS (critical shear stress for scour) and TAUCD (critical shear stress for deposition) for each individual reach

Task 3: HSPF Sediment Calibration



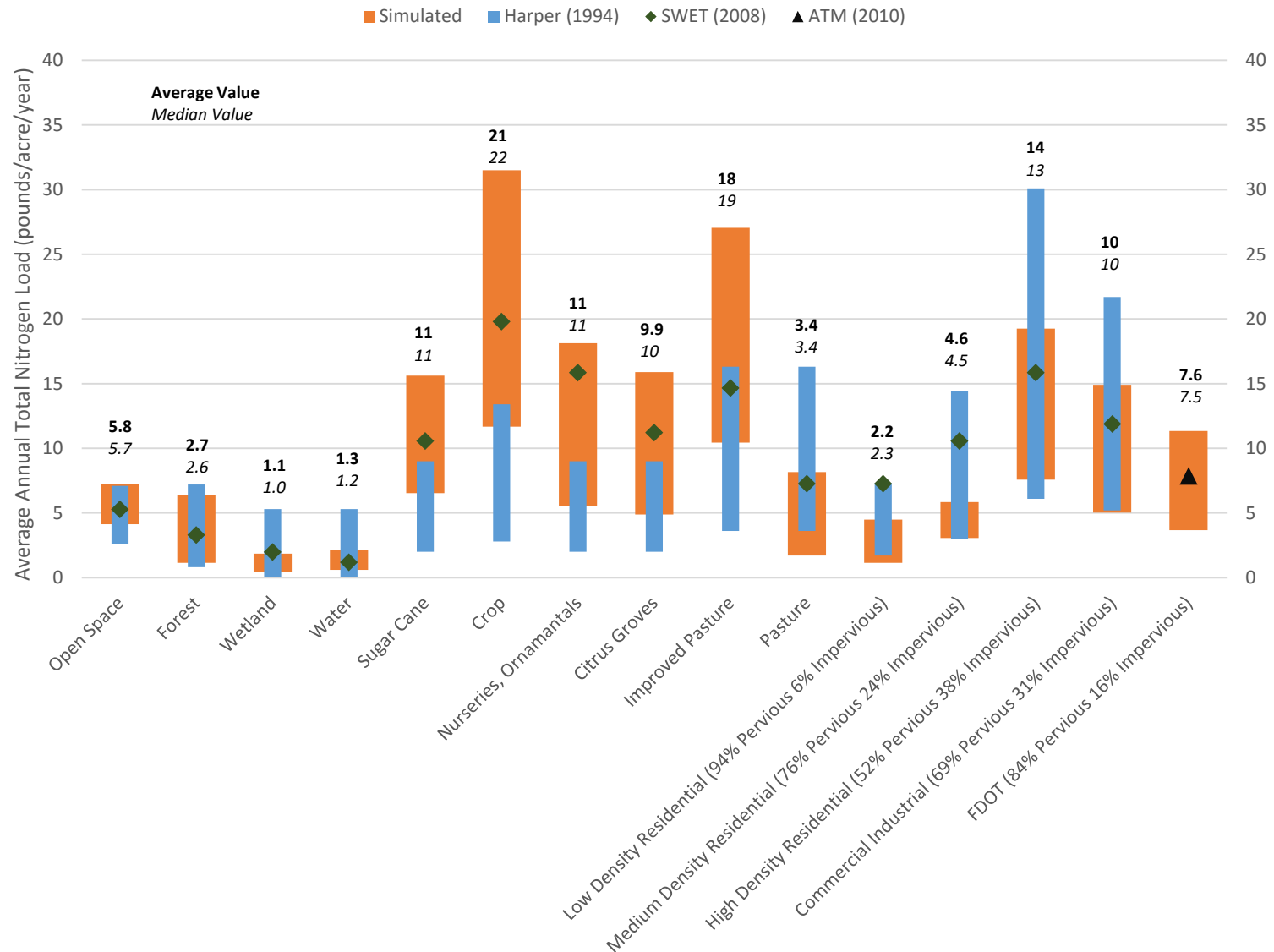
Task 3: HSPF Sediment Calibration

Station ID	Station Name	Average Annual % Error	Average Annual % Error Rating	Median Annual % Error	Median Annual % Error Rating	R ²	R ² Rating
21FLEECOCES01SUR	Caloosahatchee River (S-79)	145.5	P	109.1	P	0.00	P
CAPECRD 390	San Carlos Canal	-4.1	VG	-2.8	VG	0.12	P
21FLEECOWHISGR10	Whiskey Creek	524.6	P	1005.5	P	0.13	P
21FLEEC040-18GR, 21FLFTM CALUSA0023FTM	Orange River	-9.5	VG	60.4	P	0.00	P
21FLEEC023-5GR	Popash Creek	-32.2	F	-8.8	VG	0.04	P
21FLEEC029-8GR, 21FLFTM CALUSA0024FTM	Telegraph Creek	63.6	P	62.1	P	0.09	P
21FLFTM CALUSA0026FTM, 21FLFTM S78, 21FLSFWMS78	Caloosahatchee River (S-78)	110.5	P	137.6	P	0.15	P
21FLFTM 28020247FTM, 21FLFTM RECON-MH2-FTM, 21FLFTM RECON-MH-FTM, 21FLSFWMMHASRDIS, 21FLSFWMS77, 21FLSFWMS77-SW	Caloosahatchee (S-77)	-4.1	VG	-2.8	VG	0.12	P
21FLEECODEEPGR10	Deep Lagoon	-6.7	VG	4.5	VG	0.57	P
21FLEECOBILLGR20	Billy Creek	-20.4	G	2.8	VG	0.06	P
21FLEEC038-3GR	Hickey Creek	86.6	P	111.5	P	0.02	P
21FLEEC037-4GR	Bedman Creek	91.8	P	182.2	P	0.30	P
21FLEEC016-18GR, 21FLFTM 28020337FTM	Yellow Fever Creek	20.5	G	97.1	P	0.43	P
21FLEECOPOWLGR20, 21FLFTM POWLGR20	Powell Creek	49.5	P	91.6	P	0.11	P
21FLEEC024-7GR, 21FLFTM 28020039	Stroud Creek	-38.9	P	-20.6	G	0.01	P
21FLSFWMINDUSCAN	Industrial Canal	51.0	P	51.7	P	0.18	P

Task 3: HSPF Nutrient Calibration

- Varied the pollutant accumulation rates and limits by land use
- Simulated land use loadings for NO_x, NH₃, PO₄, and organic matter
 - NO_x and organic matter were partitioned at stream network entry point
 - PO₄ and organic matter were simulated used sediment-associated loads
- Calibrated model to literature land use nutrient loading rates for TN and TP “edge of field” values (Harper 1994 and SWET 2008)
- Updated land use nutrient loading rates and instream kinetics to further improve agreement between observed and modeled concentrations

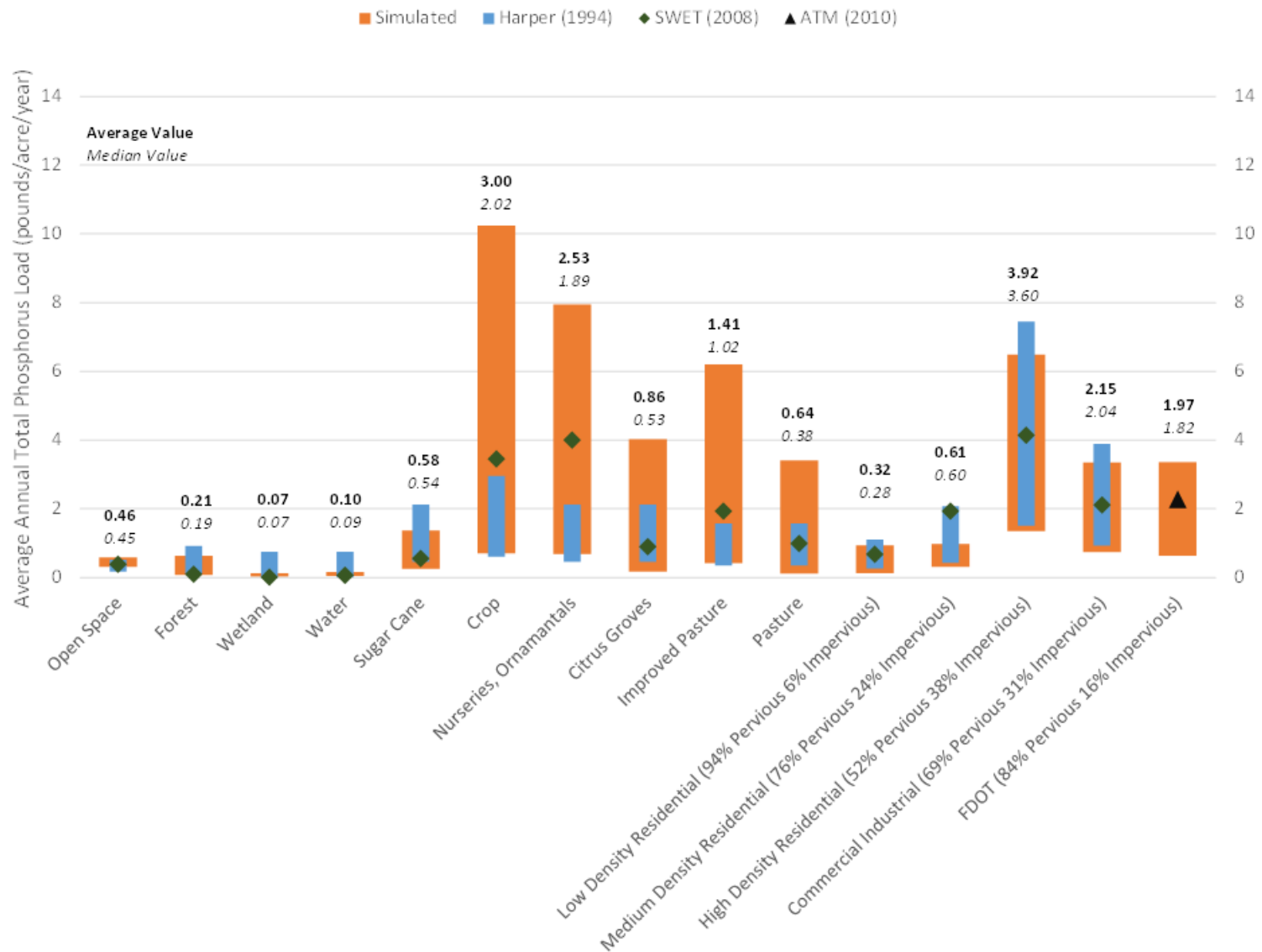
Task 3: HSPF Nutrient Calibration (TN)



Task 3: HSPF Nutrient Calibration (TN)

Station ID	Station Name	Average Annual % Error	Average Annual % Error Rating	Median Annual % Error	Median Annual % Error Rating	R ²	R ² Rating
21FLEECOCES01SUR	Caloosahatchee River (S-79)	-1.5	VG	0.0	VG	0.22	P
CAPECRD 390	San Carlos Canal	4.3	VG	0.3	VG	0.07	P
21FLEECOWHISGR10	Whiskey Creek	17.2	VG	28.2	VG	0.04	P
21FLEEC040-18GR, 21FLFTM CALUSA0023FTM	Orange River	-17.1	VG	-15.9	VG	0.01	P
21FLEEC023-5GR	Popash Creek	0.7	VG	13.6	VG	0.00	P
21FLEEC029-8GR, 21FLFTM CALUSA0024FTM	Telegraph Creek	50.8	F	58.3	F	0.13	P
21FLFTM CALUSA0026FTM, 21FLFTM S78, 21FLSFWS78	Caloosahatchee River (S-78)	23.8	VG	21.7	VG	0.38	P
21FLFTM 28020247FTM, 21FLFTM RECON-MH2-FTM, 21FLFTM RECON-MH-FTM, 21FLSFWMMHASRDIS, 21FLSFWS77, 21FLSFWS77-SW	Caloosahatchee (S-77)	4.3	VG	0.3	VG	0.07	P
21FLEECODEEPGR10	Deep Lagoon	-28.9	VG	-31.6	G	0.00	P
21FLEECOBILLGR20	Billy Creek	-40.8	G	-38.8	G	0.11	P
21FLEEC038-3GR	Hickey Creek	-20.2	VG	-14.4	VG	0.05	P
21FLEEC037-4GR	Bedman Creek	7.3	VG	17.4	VG	0.08	P
21FLEEC016-18GR, 21FLFTM 28020337FTM	Yellow Fever Creek	-33.6	G	-27.9	VG	0.11	P
21FLEECOPOWLGR20, 21FLFTM POWLGR20	Powell Creek	12.6	VG	23.5	VG	0.00	P
21FLEEC024-7GR, 21FLFTM 28020039	Stroud Creek	11.9	VG	20.4	VG	0.04	P
21FLSFWMINDUSCAN	Industrial Canal	-29.2	VG	-31.0	G	0.02	P

Task 3: HSPF Nutrient Calibration (TP)



Task 3: HSPF Nutrient Calibration (TP)

Station ID	Station Name	Average Annual % Error	Average Annual % Error Rating	Median Annual % Error	Median Annual % Error Rating	R ²	R ² Rating
21FLEECOCES01SUR	Caloosahatchee River (S-79)	0.5	VG	6.8	VG	0.08	P
21FLEECOWHISGR10	Whiskey Creek	136.9	P	162.3	P	0.21	p
21FLEEC040-18GR, 21FLFTM CALUSA0023FTM	Orange River	37.0	G	34.2	G	0.11	P
21FLEEC023-5GR	Popash Creek	-54.0	F	-53.9	F	0.01	P
21FLEEC029-8GR, 21FLFTM CALUSA0024FTM	Telegraph Creek	12.0	VG	14.6	VG	0.00	P
21FLFTM CALUSA0026FTM, 21FLFTM S78, 21FLSFWS78	Caloosahatchee River (S-78)	6.2	VG	12.7	VG	0.00	P
21FLFTM 28020247FTM, 21FLFTM RECON-MH2-FTM, 21FLFTM RECON-MH-FTM, 21FLSFWMHASRDIS, 21FLSFWS77, 21FLSFWS77-SW	Caloosahatchee (S-77)	422.5	P	421.7	P	0.04	P
21FLEECODEEPGR10	Deep Lagoon	32.8	G	13.9	VG	0.00	P
21FLEECOBILLGR20	Billy Creek	-22.8	VG	-30.2	G	0.08	P
21FLEEC038-3GR	Hickey Creek	2.7	VG	5.3	VG	0.00	P
21FLEEC037-4GR	Bedman Creek	145.1	P	142.1	P	0.00	P
21FLEEC016-18GR, 21FLFTM 28020337FTM	Yellow Fever Creek	-81.9	P	-80.0	P	0.26	P
21FLEECPOWLGR20, 21FLFTM POWLGR20	Powell Creek	-52.7	F	-50.2	F	0.09	P
21FLEEC024-7GR, 21FLFTM 28020039	Stroud Creek	-23.1	VG	-15.6	VG	0.01	P
21FLSFWMINDUSCAN	Industrial Canal	8.6	VG	24.7	VG	0.07	P

Task 3: Temperature and DO Calibration

- Modified stream bed temperature interactions, solar radiation, and soil temperature regressions to improve temperature
- Modified partitioning of organic matter into CBOD to improve BOD
- Increased benthic oxygen demand and set reaeration to O'Connor-Dobbins to improve DO
- Compared modeled % DO saturation to measured % DO saturation
 - Will reduce SUPERSAT from 1.15 to 1.00 in some reaches

Task 5: EFDC Model Setup and Hydrodynamic Calibration

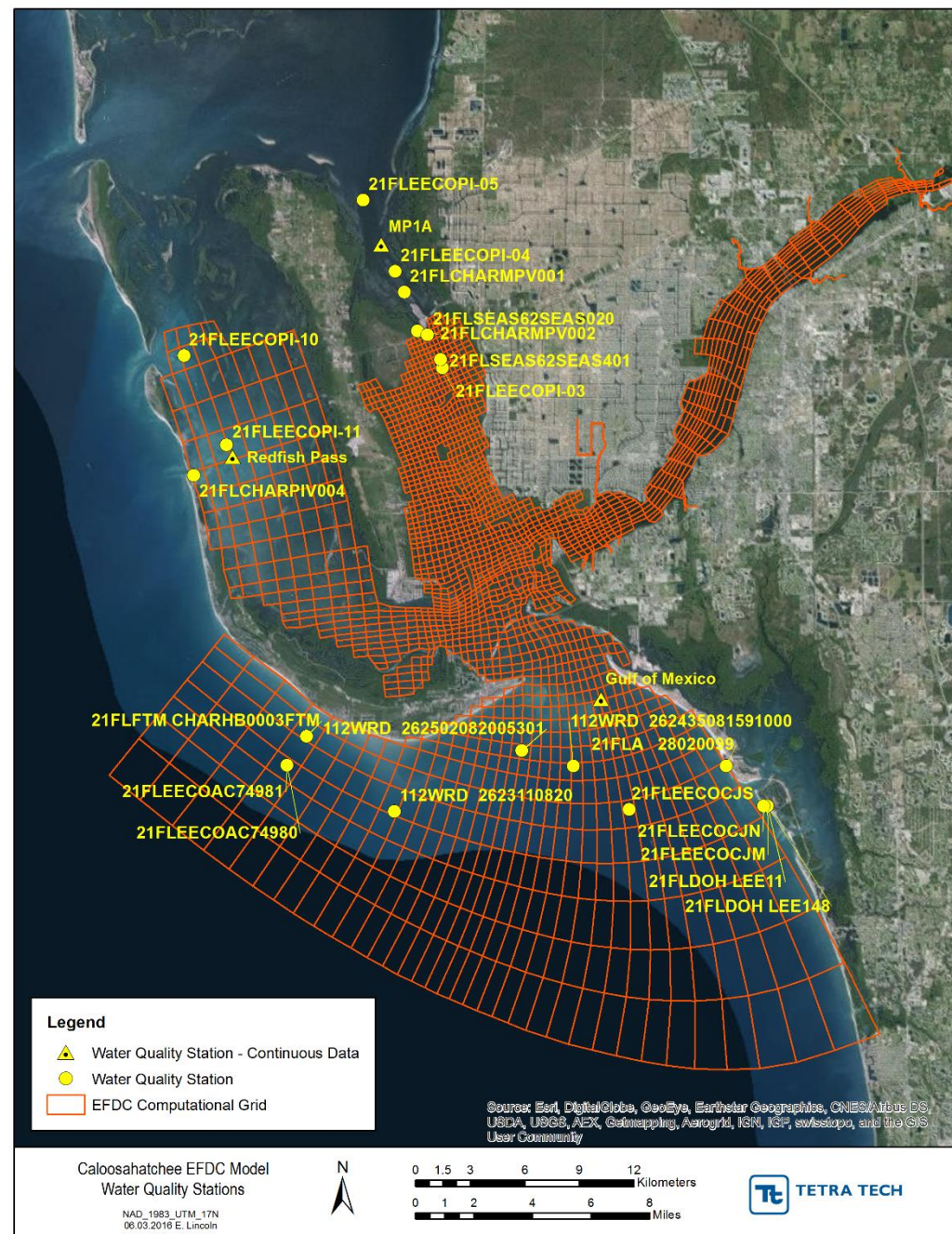
Task 5: Major Updates

- Provided additional clarity and documentation throughout the Task 5 memo to address stakeholder comments
- Received continuous data at northern boundaries and near southern boundary
 - Temperature, salinity, and DO boundaries updated using continuous data
 - Change to model calibration is negligible
- Changing Florida Power and Light to a paired withdrawal-return facility
 - Water and associated loads withdrawn from Caloosahatchee River will be discharge to Orange River
 - Temperature and nutrient delta loads will be added to discharge

Task 6: Draft EFDC Water Quality Model Calibration

Boundary Conditions

- HSPF modeled supplied freshwater boundary conditions
- Open water boundaries developed using data from multiple stations

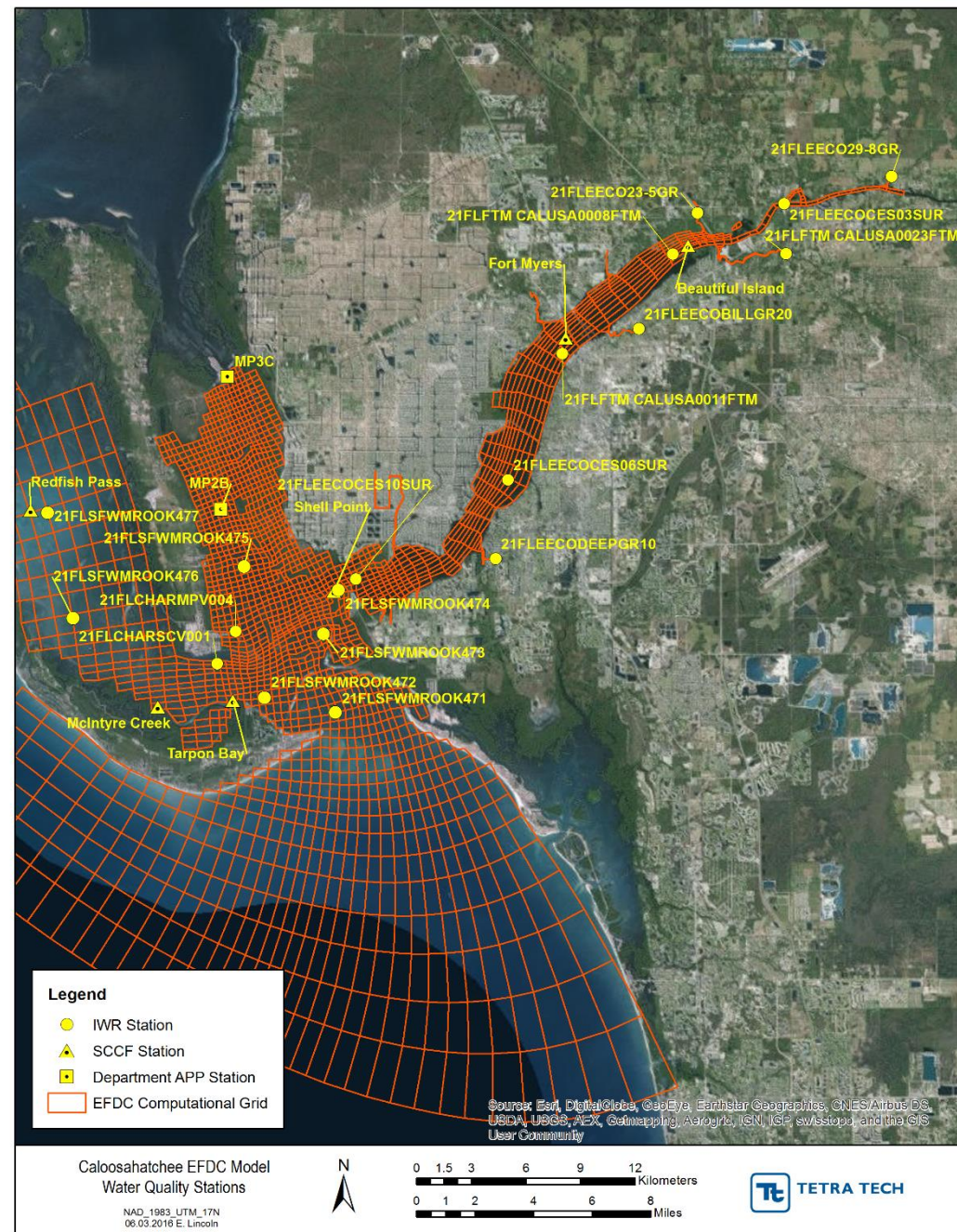


Task 6: EFDC Model Water Quality Calibration

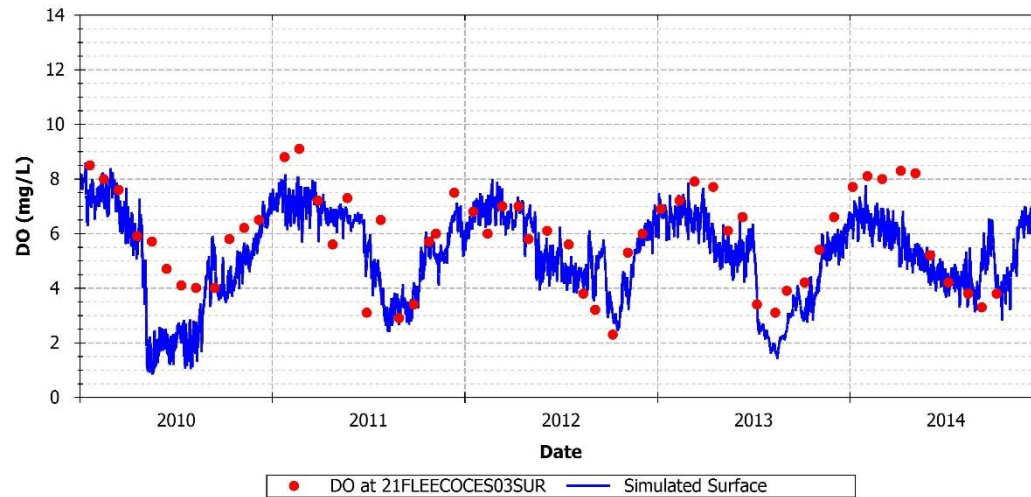
- Included 6 point source loads
 - Time series developed as part of Task 2
- Used previous EFDC model for initial parameterization
 - Updated to improve calibration
- Additional modification have been to improve NO3 simulation and improve timing of chlorophyll-a blooms

Calibration Stations

- Water quality calibration stations
- Continuous and discrete samples
- Calibrated to data from 2010-2014
- Validated to data from 1996-2009

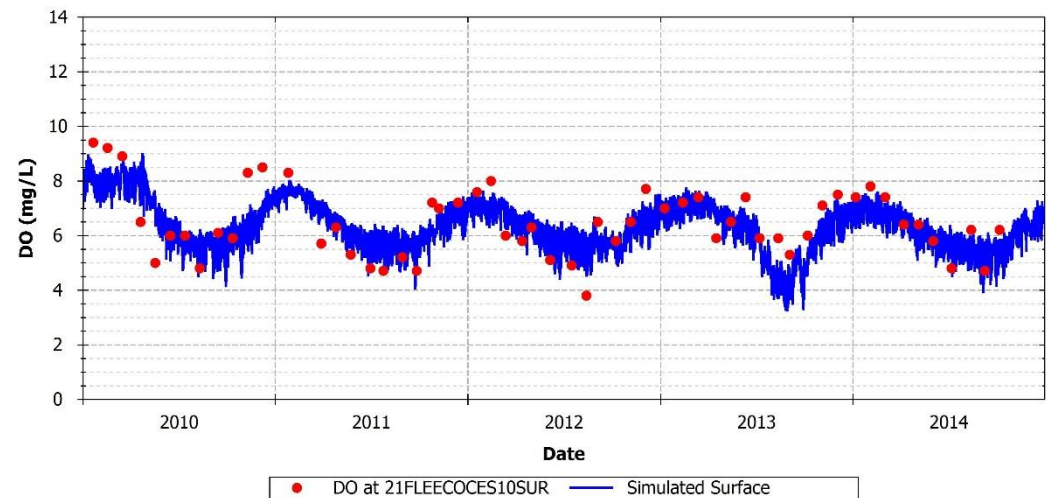


Task 6: DO Calibration

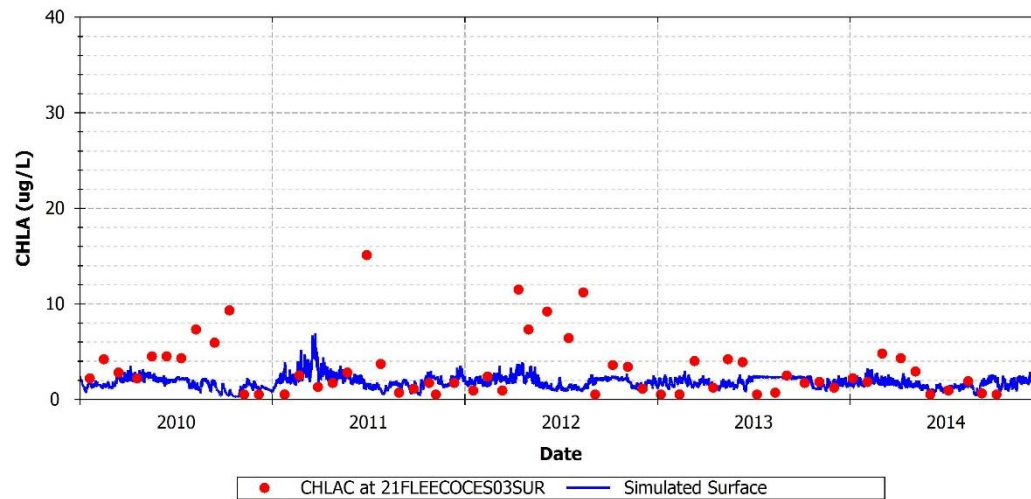


21FLEECOCES03SUR (SR31)

21FLEECOCES10SUR (Mouth)

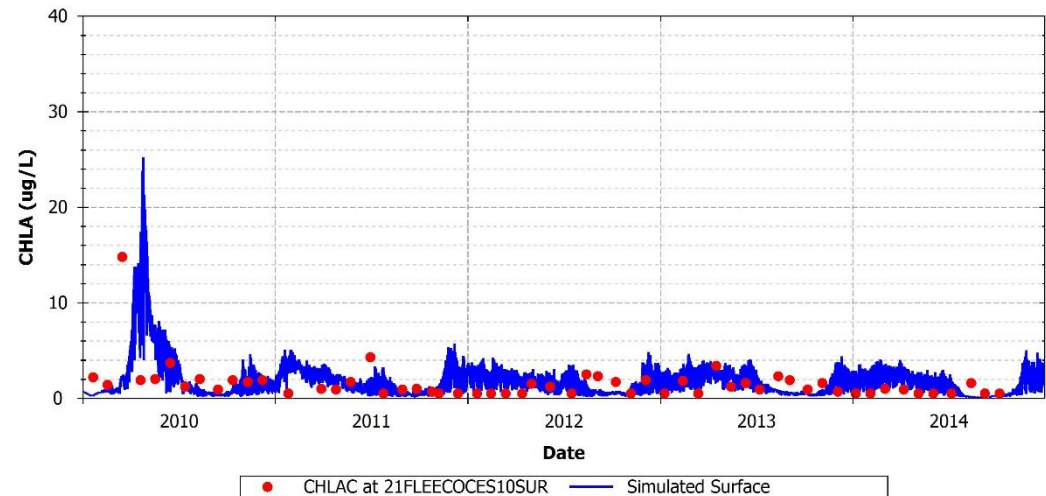


Task 6: Chlorophyll-a Calibration

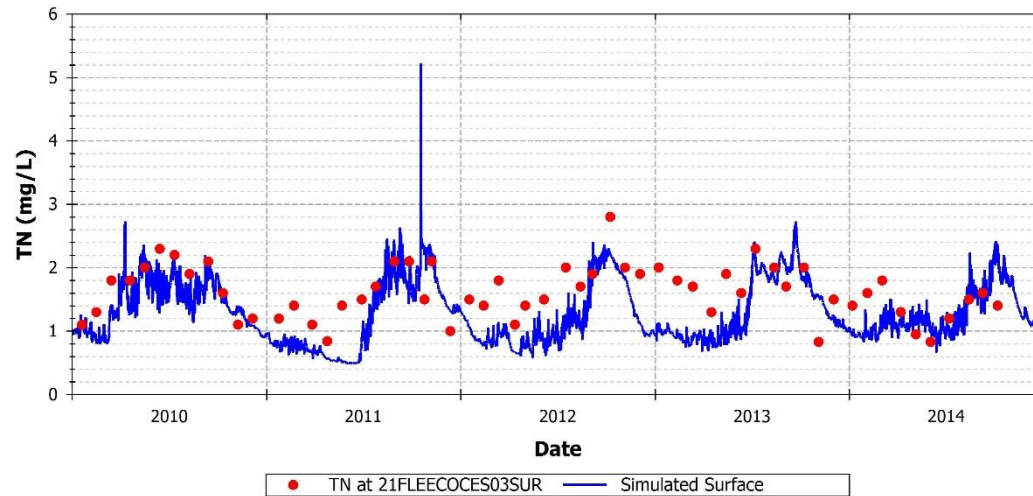


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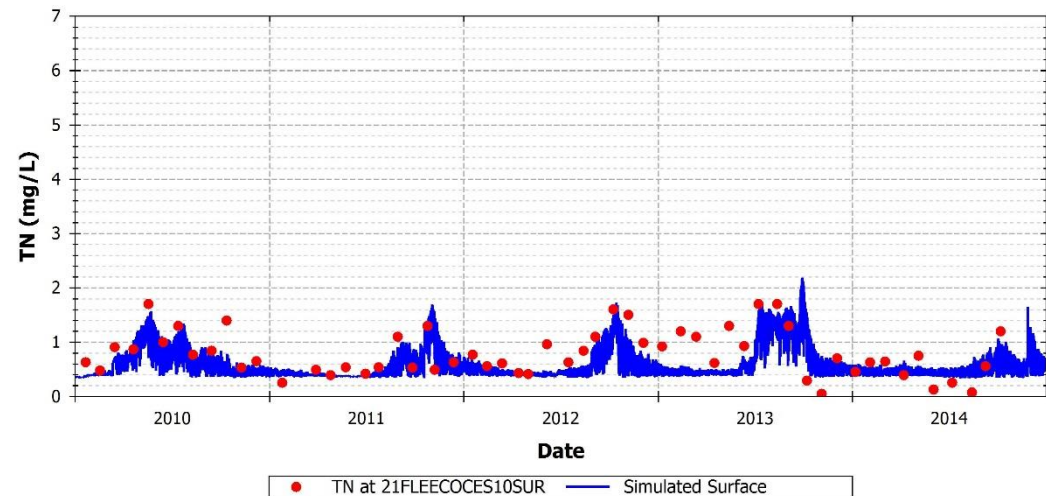


Task 6: Total Nitrogen Calibration

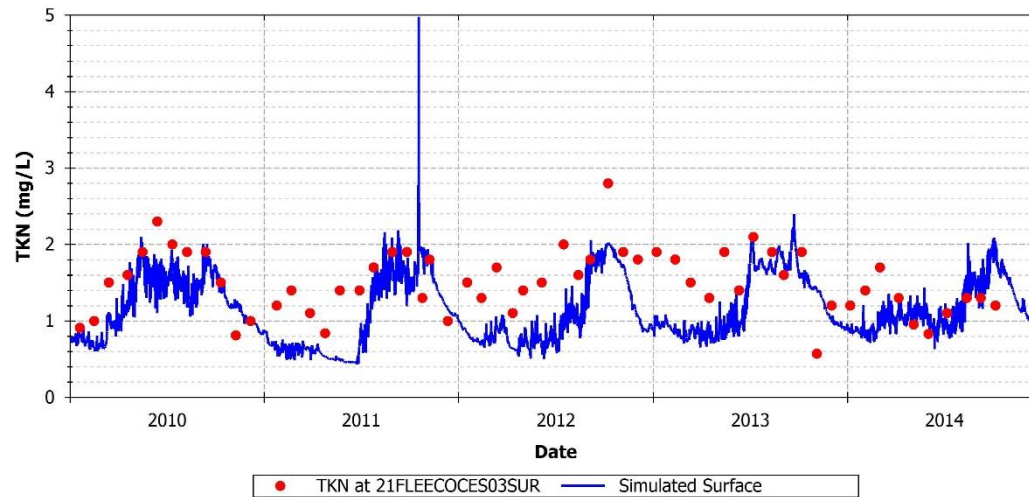


21FLEECOCES03SUR (SR31)

21FLEECOCES10SUR (Mouth)

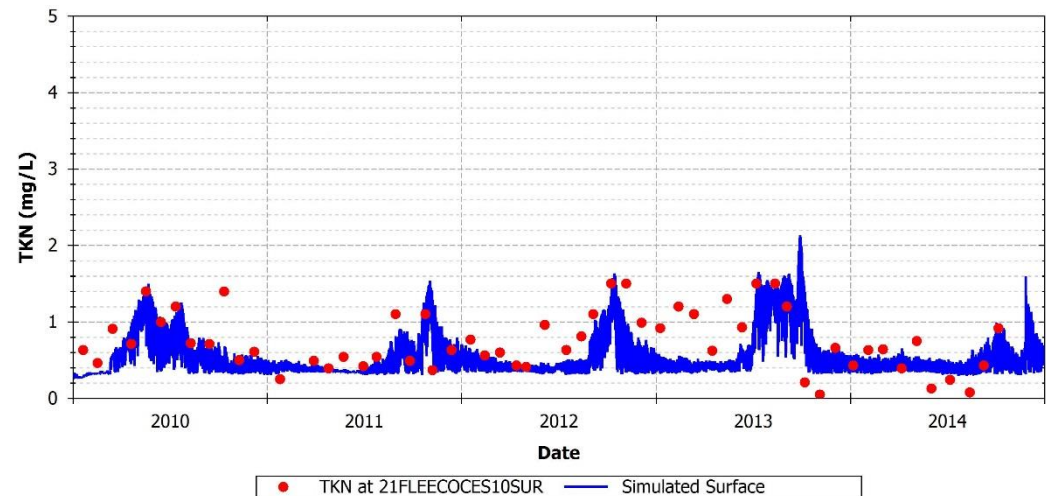


Task 6: Total Kjeldahl Nitrogen Calibration

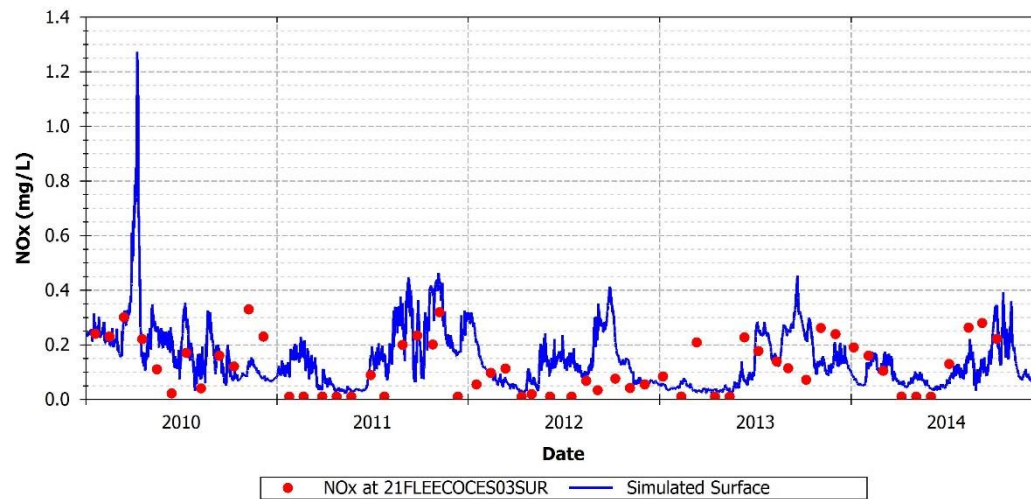


21FLEECOCES03SUR (SR31)

21FLEECOCES10SUR (Whiskey Creek)

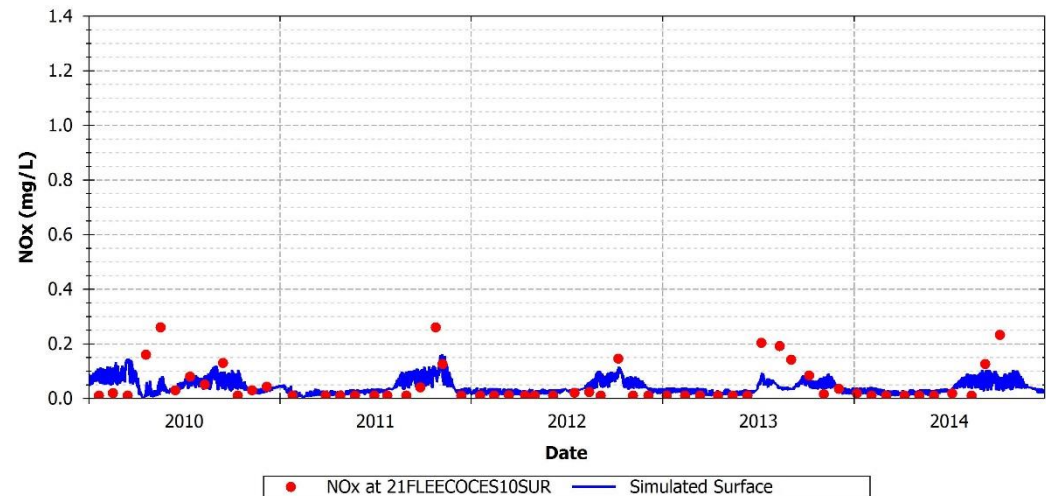


Task 6: Nitrate-Nitrite Calibration

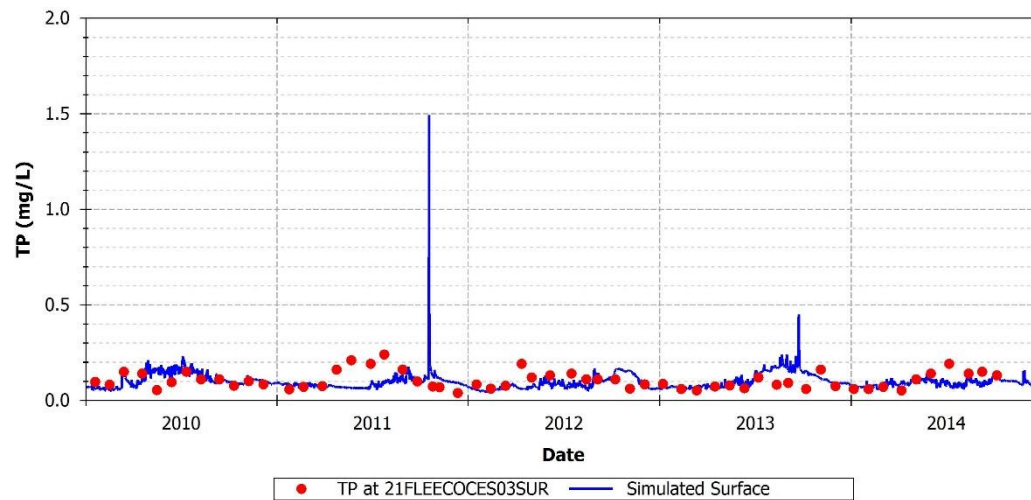


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21FLEECOCES10SUR (Mouth)

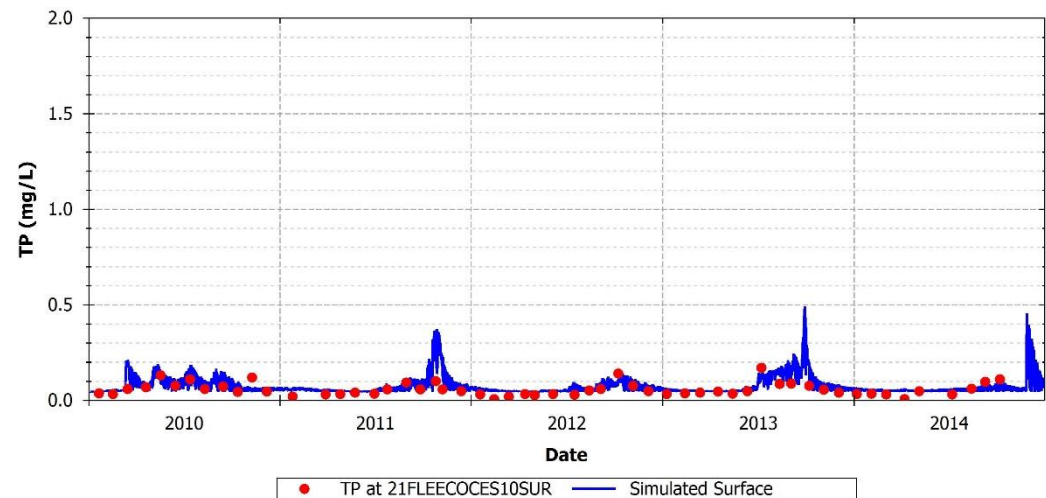


Task 6: Total Phosphorus Calibration

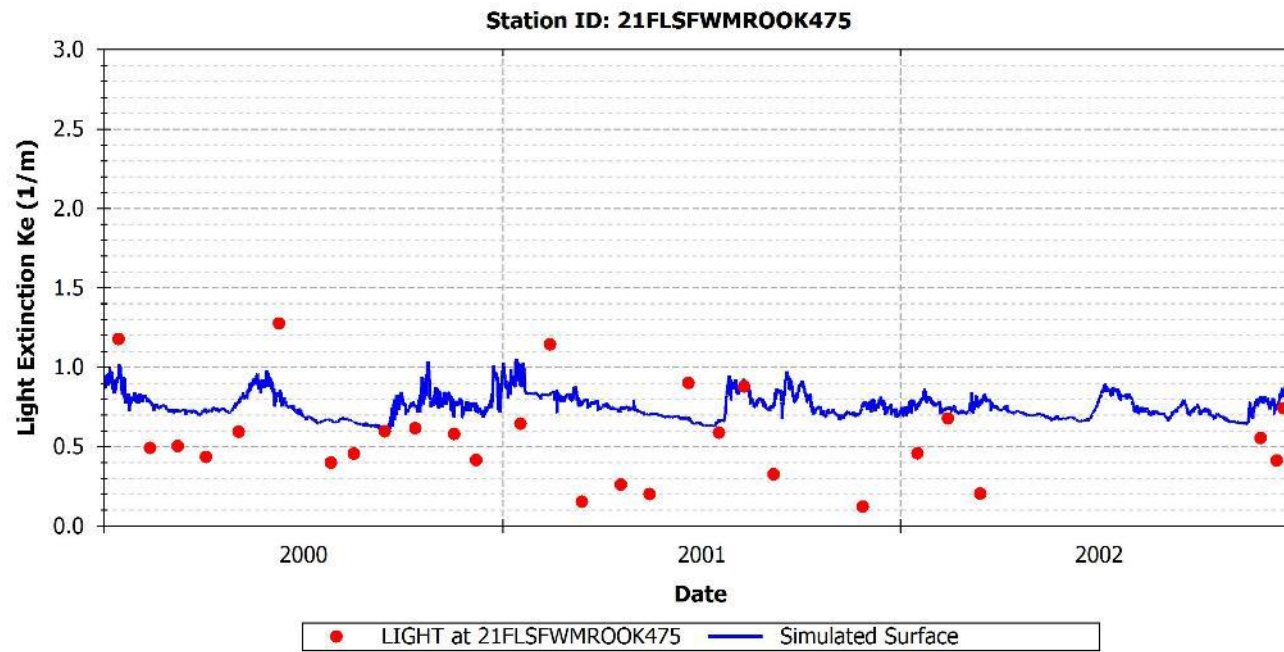


21FLEECOCES03SUR (SR31)

21FLEECOCES10SUR (Mouth)



Task 6: Light Extinction





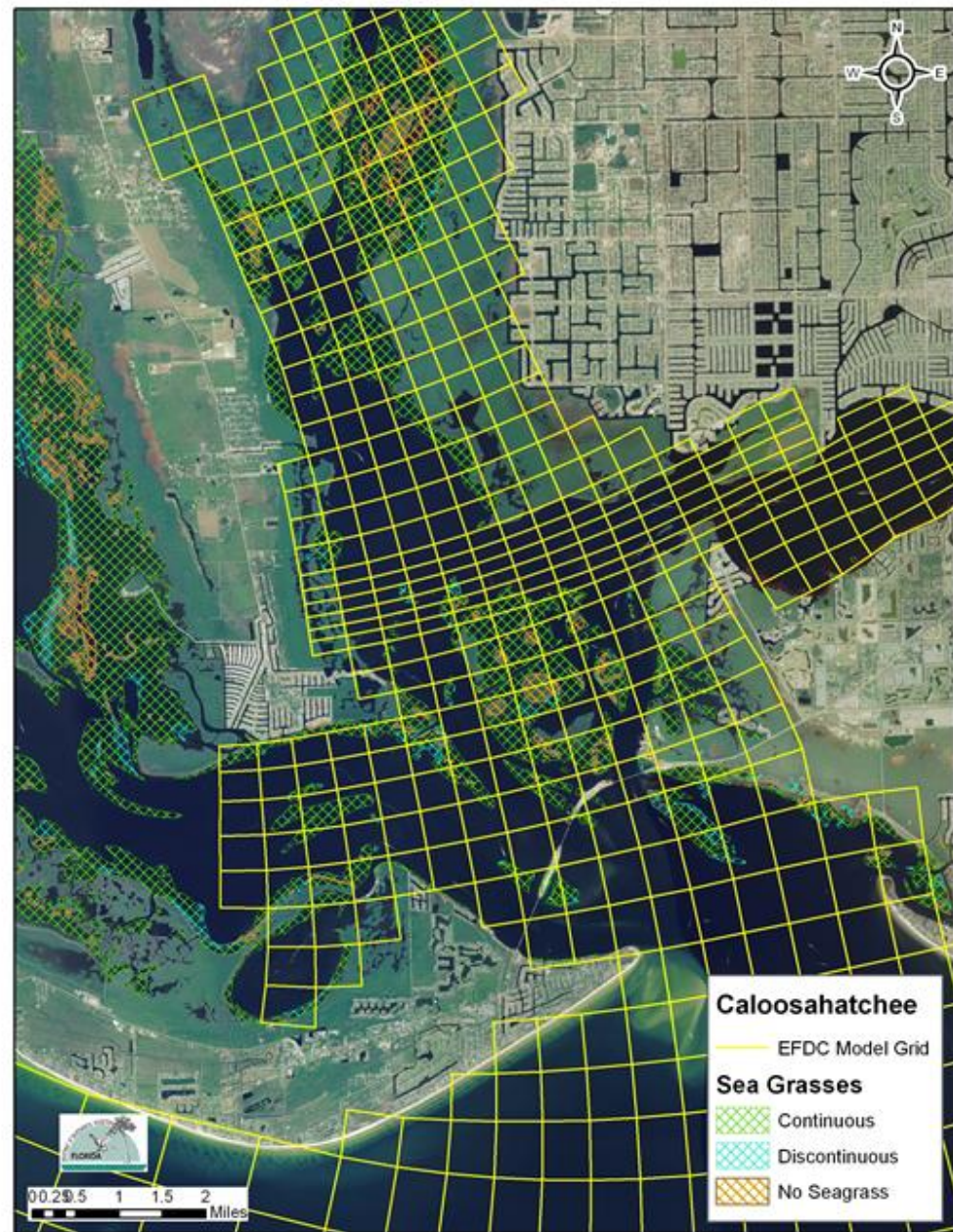
Next Steps

Next Steps

- Complete and Finalize HSPF (Task 3) and EFDC (Task 6) Water Quality Calibration:
 - Final HSPF model water quality memo, calibration, and model files due to DEP mid- to late-November
 - Receive and address stakeholder comments on Task 6, due November 11th
 - Final EFDC model water quality memo, calibration, and model files due to the department late-November
- Develop Background Plus Scenario Run (Task 7)
- Process HSPF model outputs for Existing and Background Plus annual per acre loads by land use and watershed (Task 11)

Light Attenuation

- Evaluate light attenuation using same methodology as 2009 TMDL
- Reduce nutrient loads to reduce chlorophyll-*a* growth
- Evaluate percent irradiance (PAR) in San Carlos Bay
- Areas <2.2 m deep receive at least 25% PAR



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