Appendix 4-2: Annual Permit Report for the Taylor Creek Stormwater Treatment Area

Permit Report (May 1, 2012–April 30, 2013)
Permit Number: 0194485

Odi Villapando

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SUMMARY

Based on Florida Department of Environmental Protection (FDEP) permit reporting guidelines, **Table 1** lists key permit-related information associated with this report. **Table 2** lists the attachments included with this report. **Table A-1** in **Attachment A** lists specific pages, tables, graphs, and attachments where project status and annual reporting requirements are addressed. This annual report satisfies the reporting requirements specified in the permit.

Table 1. Key permit-related information.

Project Name:	Taylor Creek Stormwater Treatment Area
Permit Number:	0194485-002-GL
Issue and Expiration Dates:	Issued: 6/9/2006; Expires: 6/9/2016
Project Phase:	Post Stabilization Phase
Permit Specific Condition Requiring Annual Report:	16
Reporting Period:	May 1, 2012–April 30, 2013
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Table 2. Attachments included with this report.

Attachment	Title
A	Specific Conditions and Cross-References
B	Water Quality Data
C	Hydrologic Data

INTRODUCTION

The Taylor Creek Stormwater Treatment Area (TC-STA) operating permit 0194485-002-GL was issued to the South Florida Water Management District (SFWMD or District) on June 9, 2006, under the authority of the Lake Okeechobee Protection Act (LOPA), Chapter 373.4595, Florida Statutes (F.S.); Title 62, Florida Administrative Code (F.A.C.); and pursuant to Section 373.4595(9) of the LOPA, the FDEP's authority under Chapters 373 and 403, F.S. LOPA was subsumed by the Northern Everglades and Estuaries Protection Program (NEEPP) in 2007. The permit took effect on May 5, 2011, after the TC-STA project was transferred to the District by the U.S. Army Corps of Engineers (USACE), the federal sponsor of the project.

The TC-STA is one of two pilot-scale stormwater treatment areas (STAs) being implemented north of Lake Okeechobee as part of the Lake Okeechobee Watershed Construction Project - Phase 1 (**Figure 1**). Constructed in April 2006, this two-celled STA has an effective treatment area of 118 acres, which is small compared to the Everglades STAs. The TC-STA was designed to remove 2.02 metric tons (mt) of total phosphorus (TP) from the Taylor Creek drainage basin per year (Goforth, 2005; Stanley Consultants, Inc., 2003).

Flow-through operations at the TC-STA commenced on June 26, 2008. By the end of Water Year 2013 (WY2013) (May 1, 2012–April 30, 2013), the TC-STA had almost 37 months of flow-through: eight months in WY2009 (June 26, 2008–February 24, 2009), a little less than eight months in WY2011 (September 8, 2010–April 30, 2011), a full twelve months in WY2012, and nine months in WY2013 (May 1, 2012–January 31, 2013). From October 2012 through January 2013, the STA exhibited reversals in phosphorus (P) concentrations. "Reversal" means that the TP concentration measured at the outflow was higher than the TP concentration measured at the inflow. Consequently, flow-through operation at the TC-STA was temporarily suspended on February 1, 2013, to control release of P from the STA back into Taylor Creek. Water was pumped into the STA to maintain water levels at target stages, but the STA outflow structure (S-392) remained closed during the last three months of WY2013.

This report summarizes TC-STA monitoring activities performed during WY2013; however, the evaluation of STA permit compliance and project performance is based mainly on flow-through data collected from May 1, 2012 to January 31, 2013. This report is being submitted to the FDEP, in accordance with Specific Condition 16 ("Annual Monitoring Reports") of the permit.

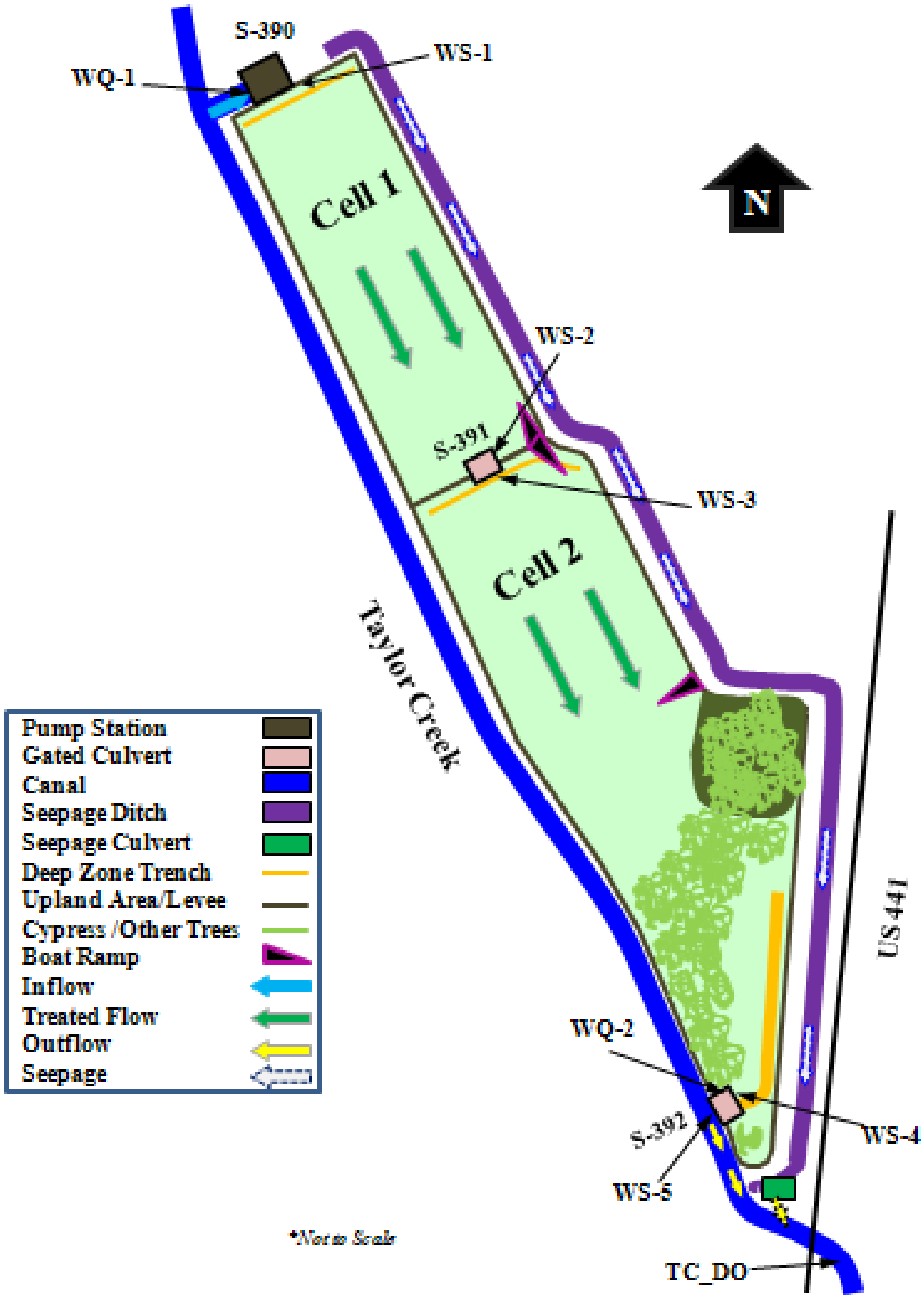

Figure 1. Schematic of the Taylor Creek Stormwater Treatment Area (TC-STA), showing structures, and flow and water quality monitoring stations (Note: WS - water stage sensor; WQ - water quality sample station; S-390 and S-392 are the permitted stations; TC_DO is Taylor Creek downstream).

OPERATION AND MAINTENANCE

OPERATIONS

The TC-STA followed normal operations during the first six months of WY2013. Two of the four 6-cubic feet per second (cfs) pumps were operated continuously, except for a few days in June 2012. During this period, pumping operation was temporarily suspended for the repair and subsequent relocation of the damaged headwater stilling well, from the in-ground well on the other side of the levee to its current location adjacent to the water quality monitoring platform at S-390. Also during this time, the maintenance dredging of a small sandbar that had formed in the creek near the S-390 storage pool was completed. Pumps were turned off again on August 25, 2012, in anticipation of Tropical Storm Isaac. The storm caused flooding in and around the STA (**Figure 2**) but did not produce any impacts of structural or operational significance.

Figure 2. Inaccessible water quality monitoring station (left) and sheet flow into the stormwater treatment area (STA) from adjacent property (right) due to high water levels in Taylor Creek.

A maximum stage of 25.32 feet NGVD of 1929 (ft NGVD) in Taylor Creek was recorded on August 28, 2012 (**Figure 3**). Pumping resumed on September 4, 2012, after water conditions returned to normal. Water depths across the TC-STA before and after the storm were kept within the normal limits of operation described in the water control plan (USACE, 2009). The average stage during WY2013 was 24.04 ft NGVD in Cell 1, and 23.35 ft NGVD in Cell 2 (**Figure 3**).

Several operational changes were implemented after pumping resumed in September 2012. In early October 2012, as the STA started to show reversals in weekly TP concentrations, the pumping rate was decreased from 12 to 6 cfs. The objective was to improve P treatment efficiency by increasing the hydraulic retention time (HRT) within the STA. This strategy seemed to help the STA rebound, so on November 6, 2012, the hydraulic loading rate was restored to 12 cfs by operating two pumps.

From November 20 to 29, 2012, flow into the STA was suspended again to facilitate plantings of bulrush (*Schoenoplectus californicus*) and alligator flag (*Thalia geniculata*). Over the next few weeks, water levels were gradually raised by operating one pump to allow new plants to become established. However, as reversals in TP concentrations persisted in the ensuing months, the District decided to temporarily cease pumping operations, effective February 1, 2013, in order to reduce P loading back into Taylor Creek from the STA. The STA did not discharge for the rest of WY2013. In May 2012, active nests of black-necked stilts (*Himantopus mexicanus*) were first spotted in the TC-STA, and their presence continued through June 2012. No operational changes were required in response to wildlife presence during WY2013.

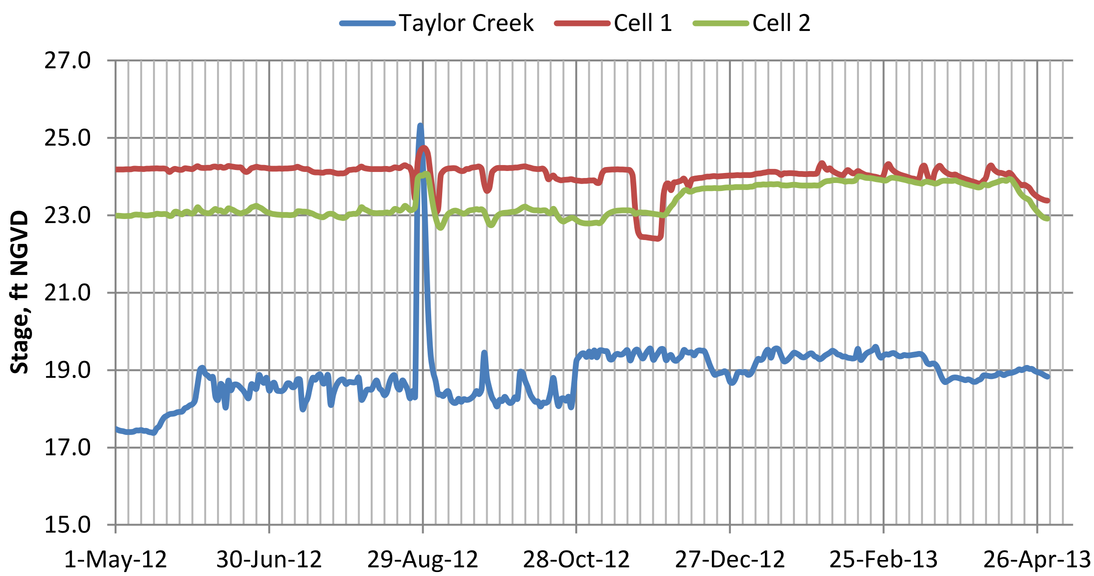

Figure 3. Daily mean stage (feet National Geodetic Vertical Datum of 1929, or ft NGVD) in Cells 1 and 2 of the TC-STA in relation to Taylor Creek during Water Year 2013 (WY2013)(May 1, 2012–April 30, 2013).

VEGETATION MANAGEMENT

During WY2013, vegetation management activities for the TC-STA centered on the implementation of an updated vegetation enhancement and maintenance plan (Toth, 2012). The primary objective of the vegetation management plan was to ensure maximum cover of desirable plant species to help establish a reliable and sustainable treatment system with maximum P uptake capability. Specifically, the plan was designed to (1) eliminate plant species that do not contribute to the primary goal of P uptake and removal, and species that can impact cover of desirable species for water quality treatment or STA function; (2) convert hydrilla (*Hydrilla* spp.) dominated areas of Cell 1 to an emergent plant community; and (3) eliminate hydraulic short circuits in Cell 2 that compromise P uptake in this cell.

The elimination of undesirable floating vegetation, mostly water lettuce (*Pistia stratiotes*), remained the focus of plant control efforts in WY2013. Water lettuce is by far the most difficult species to control because it can rapidly form dense mats during summer months, with the potential to clog the outflow structure and impact the existing cover of submerged aquatic vegetation. Herbicides were used to treat water lettuce infestations in the STA. Diquat, a non-selective, contact herbicide was used to treat infestations around and within existing stands of emergent vegetation. This was followed by applications of flumioxazin, a more selective new herbicide, to treat the remaining beds of water lettuce flanking the stands of emergents. Other plants species treated for maintenance and control included frogbit (*Limnobium spongia*), West Indian marsh grass (*Hymenachne amplexicaulis*), and primrose willow shrubs (*Ludwigia peruviana* and *L. leptocarpa*).

During WY2013, the District treated 66 acres (27 hectares) and applied 60.5 quarts (15.2 gallons) of diquat and 6.3 quarts (1.6 gallons) of flumioxazin to eradicate water lettuce in both cells, and 7.5 quarts (1.9 gallons) of glyphosate to treat aquatic grasses in Cell 2 (**Table 3**), using ground-based equipment. This information is provided in compliance with Specific Condition 16D of the permit.

Table 3. Herbicide usage for routine control and maintenance of undesirable vegetation within the Taylor Creek Stormwater Treatment Area (TC-STA) during Water Year (WY2013) (May 1, 2012–April 30, 2013).

Spray Date	Herbicide Name	Application Rate[a]	Acres Sprayed	Total Quantity Applied[b]	Targeted Vegetation	Cell
02-May-12	Diquat	2.00	4	8	Hyacinth / Water lettuce mix	1 & 2
13-Jun-12	Diquat	2.00	8	16	Floating plants	1
11-Jul-12	Diquat	1.50	2	3	Water lettuce	1
11-Jul-12	Flumioxazin	0.375	1.5	0.56	Water lettuce	1
12-Jul-12	Diquat	1.50	13	19.5	Water lettuce	1 & 2
12-Jul-12	Flumioxazin	0.375	4.5	1.69	Water lettuce	1
12-Jul-12	Diquat	1.50	4	6	Water lettuce	1 & 2
25-Jul-12	Flumioxazin	0.25	7	1.75	Water lettuce	1
25-Jul-12	Diquat	1.00	8	8	Water lettuce	1 & 2
09-Jan-13	Flumioxazin	0.188	6	1.13	Water lettuce	1 & 2
30-Jan-13	Flumioxazin	0.188	2	0.38	Floating plants	1
28-Mar-13	Glyphosate	3.75	2	7.5	Aquatic grasses	2
17-Apr-13	Flumioxazin	0.188	4	0.75	Water lettuce	2

[a] Recommended application rate – quarts/acre
[b] Application rate x acres sprayed (quarts)

Prior to WY2013, emergent vegetation covered only about 20 percent of Cell 1, with the remainder of the cell being dominated by dense beds of submerged aquatic vegetation, including hydrilla (*H. verticillata*) and coontail (*Ceratophyllum demersum*). To increase emergent vegetation coverage in Cell 1, several strips of bulrush and alligator flag were initially planted in November 2012, using donor plants from the existing stands within the STA. Additional plantings were conducted in both cells of the STA in May 2013, as part of the drawdown activities. During drawdown, water levels in the STA were incrementally lowered over a 30-day period. This created conditions conducive to plantings and natural recruitment of emergents in portions of the STA where there was little or no wetland vegetation and associated permanent P removal mechanisms. The STA was home to hundreds of birds during this period, and provided excellent opportunities for wildlife viewing and photography (**Figure 4**). Currently, emergents cover about 75 percent of Cell 1 (**Figure 5**).

Figure 4. Exposed wetland soils in the northern section of the STA (left) and hundreds of birds actively foraging in Cell 1 of the STA (right) during drawdown.

Figure 5. Hydrilla-dominated areas of Cell 1 looking north before (left) and after (right) plantings.

The plantings conducted in Cell 2 of the STA in November 2012 and May 2013, were part of an effort to eliminate the hydraulic circuits along channels that flank and meander through the emergent marsh and lead to the cypress stand at the outflow (**Figure 6**). Strategic plantings of bulrush and alligator flag in these channels should enhance P uptake and help contain growth of water lettuce that occurs within the cypress stand, which has made it inaccessible to airboats that are needed for herbicide control efforts.

Figure 6. Bulrush planting in the northeastern portion Cell 2 (left) and transplants of alligator flag in the south end near outflow (right).

WILDLIFE SURVEY

The TC-STA was surveyed for wildlife activities within the treatment cells during WY2013. Surveys were conducted in order to protect ground-nesting migratory birds that typically nest from January to mid-July in this area. Active black-necked stilt nests were first spotted in May 2012, and their nesting was completed by June 2012 (**Table 4**). No ground nests were observed between January and April 2013. During WY2013 there was evidence (in the form of newly hatched chicks) of successful nesting by several ground-nesting avian species, such as Florida sandhill cranes (*Grus canadensis pratensis)*, mottled ducks (*Anas fulvigula*), pie-billed grebes (*Podilymbus podiceps*), purple gallinules (*Porphyrio martinica*), and common gallinules (*Gallinula galeata*), but their nests were hidden well enough that they were not observed during the monthly surveys. One pair of Florida sandhill cranes was observed with chicks in April 2013. These cranes likely nested during February within unobservable portions of the tree island in Cell 2 of the TC-STA, or they nested outside the STA and then led their chicks into the STA to forage. While bird surveys were performed to help guide STA operations during the 2012 and 2013 nesting seasons, no operational changes were required in response to wildlife presence during WY2013.

During late 2011, two small sections of the fence that runs along the eastern side of the TC-STA were adjusted to allow flightless juvenile Florida sandhill cranes to follow adult sandhill cranes into nearby pastures to the east. These two areas of the fence were opened during March 2013, and later closed during July 2013, once young cranes were developed enough to fly over the fence.

Table 4. Results of migratory bird surveys conducted at TC-STA during WY2013.

Survey Date	Observations
10-May-12	• Four black-necked stilts nesting in Cell 2 • Two pairs of adult Florida sandhill cranes in Cell 2 (each pair had at least one chick)
08-Jun-12	• No nesting birds observed in TC-STA • Two pairs of adult Florida sandhill cranes in Cell 2 (each pair had at least one chick)
25-Jan-13	• No nesting birds observed in TC-STA
18-Feb-13	• No nesting birds observed in TC-STA
12-Mar-13	• No nesting birds observed in TC-STA
16-Apr-13	• No nesting birds observed in TC-STA • One pair of adult Florida sandhill cranes with two chicks near Cell 2

PERMIT MONITORING REQUIREMENTS AND COMPLIANCE

This section summarizes results of monitoring activities conducted during WY2013 while the TC-STA was in its first year of post-stabilization operations, and evaluates compliance with discharge requirements specified in Specific Conditions 8 and 12 of the TC-STA permit 0194485-002-GL. All monitoring activities were performed in accordance with Chapter 62-160, F.A.C., and the approved Water Quality Monitoring Plan (SFWMD, 2005), per Specific Condition 14 of the above-referenced permit. Pesticide monitoring at the TC-STA was eliminated effective October 7, 2011. The data summarized in this section are provided in Attachment B.

TOTAL PHOSPHORUS

The TC-STA moved into the post-stabilization phase in WY2013, after successful demonstration of a net reduction in 12-month flow-weighted mean TP concentrations from inflow to outflow in WY2012. During the post-stabilization period, the TC-STA was to be operated to maximize P load reductions to the maximum extent practicable, consistent with the design objectives set forth in the Operation Plan for the Taylor Creek Stormwater Treatment Area (Goforth, 2005). The TC-STA performed effectively during the first five months of flow-through operation; however, over the next four months it performed below expectations, exporting P in October, November, and January (see **Table 9**). In order to reduce P loading back into Taylor Creek from the STA, the District decided to temporarily suspend discharge operations, effective February 1, 2013, and initiated drawdown activities in April 2013. This management strategy was expected to help improve project performance by rejuvenating existing vegetation while providing an excellent opportunity to conduct additional plantings in open water areas of the STA. While the TC-STA fell short of the target load reduction this year, the benefits from drawdown activities are anticipated to enhance project performance in the next few years, keeping TC-STA in compliance with Specific Condition 8A2. Should the STA not perform in a manner consistent with its design objectives after the first three years of post-stabilization operation, the District and the FDEP shall confer and develop an optimization plan designed to improve its performance.

DISSOLVED OXYGEN

To determine whether the STA contributed to the degradation of dissolved oxygen (DO) in downstream receiving waters, DO concentrations measured at designated locations in the STA were evaluated as defined in the permit:

1. If the annual average outflow concentration is not less than applicable criteria [5 milligrams per liter (mg/L)], then the STA shall be deemed in compliance with this condition;
2. If the annual average outflow concentration is less than applicable criteria (5 mg/L) but is greater than or equal to average inflow concentration, then the STA is deemed in compliance with this condition;
3. If the annual average outflow concentration is less than applicable criteria (5 mg/L) and is not greater than average inflow concentration, but a demonstration can be made that the project results in a net DO benefit in receiving waters as a result of decreased nutrients and/or oxygen demand, then the STA is deemed in compliance with this condition; or
4. If the annual average outflow concentration is less than applicable criteria, and is not greater than the average inflow concentration, but the aforementioned demonstration cannot be made, then adaptive management measures (e.g., operational or structural modifications) should be taken to ensure that DO conditions are not degraded in receiving waters.

A notched box plot of the data was constructed to show differences in DO concentrations among locations for the following: smallest observation (sample minimum), lower quartile (Q1 or 25^{th} percentile), median (Q2 or 50^{th} percentile), upper quartile (Q3 or 75^{th} percentile), and largest observation (sample maximum) (**Figure 7**). DO concentrations measured at the inflow showed higher variability than those collected at other locations. Range, defined simply as the difference between the minimum and maximum values, was 16.8, 7.8, and 13.2 mg/L at the inflow (S-390), outflow (S-392), and downstream (TC_DO) locations, respectively. Percentile values were highest at the inflow structure, with 50 percent of the observations (median or 50^{th} percentile) having DO concentrations of greater than or equal to 5.37 mg/L. Compared to DO concentrations at the inflow station, DO concentrations at the outflow point were much lower, with 50 percent of the observations having DO concentrations of greater than or equal to 55 mg/L. DO levels below 5.0 mg/L are fairly common in macrophyte-dominated wetlands where photosynthesis and respiration result in wide diel swings in DO levels (Ivanoff et al., 2013). DO concentrations at the downstream location (TC_DO) were much higher than those measured at the outflow station, with a median value (50^{th} percentile) of 5.36 mg/L. In the notched box plots (**Figure 7**), if the notches of two boxes do not overlap, there is a statistically significant difference between medians. As such, the median DO value at the inflow point of the STA was significantly higher than the median DO concentration at the outflow structure but not at the downstream location. The calculated mean DO values (solid orange dots in **Figure 7**) were slightly higher than the median DO values at all locations. Mean DO levels at the inflow (6.04 mg/L) and downstream (5.73 mg/L) locations are slightly higher than DO values recorded in WY2012 (Villapando, 2013), and are above the lower limit of the Florida Class III criteria for predominantly fresh, surface water (5.0 mg/L, as specified in Section 62-302.530, F.A.C.; see **Table 5**) (dashed line in **Figure 7**). While the mean DO concentration at the outflow was not greater than the mean DO concentration at the inflow, the mean DO value of 5.73 mg/L at the downstream location, and the associated decrease in outflow TP concentrations (see **Table 8**) keep the TC-STA in compliance with Specific Condition 8B.

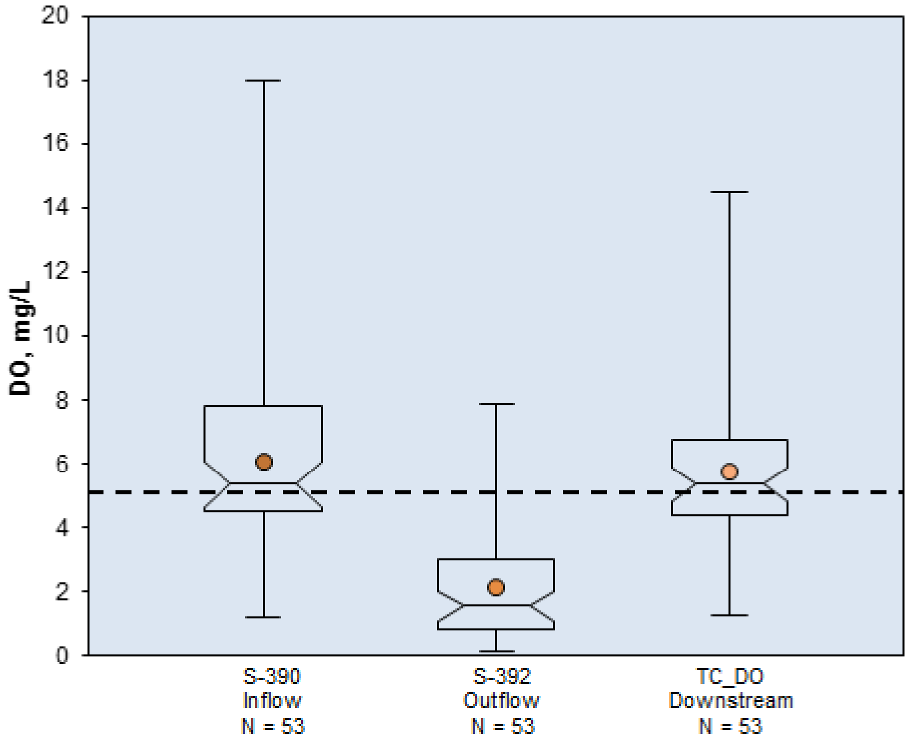

Figure 7. Notched box plot showing dissolved oxygen (DO) concentrations measured at the TC-STA in WY2013. Bottom and top of box are 25th and 75th percentiles, respectively, and line inside box is 50th percentile (median). Ends of whiskers represent minimum and maximum values; dashed line represents lower limit of the Florida Class III criteria for predominantly fresh, surface water (5.0 milligrams per liter or mg/L) and solid orange dots represent mean DO concentrations.

OTHER WATER QUALITY PARAMETERS

Monitoring results for all water quality parameters other than TP and DO, with (**Table 5**) and without Florida Class III standards, were evaluated. Permit compliance for these parameters was evaluated as follows:

1. If the average outflow concentration does not exceed applicable criteria, then the STA is deemed in compliance.
2. If the average outflow concentration causes or contributes to an exceedance of applicable criteria, but does not exceed or is equal to, the average inflow concentration, then the STA is deemed in compliance.
3. If the average outflow concentration causes or contributes to an exceedance of applicable criteria, and exceeds the average inflow concentration, then the STA is deemed out of compliance.

Table 5. Water quality parameters with Florida Class III surface water criteria specified in Section 62-302.530, F.A.C.

Parameter	Unit[a]	Class III Criteria
Dissolved Oxygen	mg/L	Greater than or equal to 5.0 mg/L
Specific Conductivity	µS/cm	Not greater than 50% of background or greater than 1,275 µS/cm, whichever is greater
pH	SU	Not less than 6.0 or greater than 8.5
Turbidity	NTU	Less than or equal to 29 NTU above background conditions
Alkalinity	mg/L	Not less than 20 mg/L
Unionized Ammonia	mg/L	Less than or equal to 0.02 mg/L

[a] Key to Units:
µS/cm – microSiemens per centimeter; mg/L – milligrams per liter; NTU – nephelometric turbidity unit; and SU – standard units.

Water year average inflow and outflow concentrations were compared to determine whether the STA contributed to a violation for any parameter (**Table 6**). Water pH averaged 7.11 at the inflow and 7.04 at the outflow, which are within the Florida Class III pH limits of 6.0–8.5. Average specific conductivity at the inflow (579 microsiemens per centimeter or µS/cm) was slightly higher than average conductivity at the outflow (560 µS/cm), but both are well below the Florida Class III standard of 1,275 µS/cm. Average turbidity values of 5.48 and 2.60 nephelometric turbidity units (NTUs) at the inflow and outflow stations, respectively, were several-fold lower than the allowable turbidity value of 29 NTUs. Alkalinity values were markedly greater than the Class III minimum standard of 20 mg/L, with an average of 79 mg/L at the inflow and 86 mg/L at the outflow. Unionized ammonia levels averaged 0.90 µg/L at the inflow, and 1.63 µg/L at the outflow. These values are considerably lower than the Class III standard of 20 µg/L. Sulfate levels at the inflow and outflow stations averaged 72.0 and 56.8 mg/L, respectively. There was a substantial reduction in nitrate+nitrite-N (N represents nitrogen) from inflow to outflow, but slight increases in orthophosphorus and total ammonia concentrations at the outflow were noted. Total nitrogen (Total Kjeldahl N + nitrate+nitrite-N) averaged 1.767 and 1.632 mg/L at the inflow and outflow, respectively. Average chloride concentrations at the inflow and outflow were 81 and 80 mg/L, respectively. As none of the water quality parameters with Class III standards caused or contributed to an exceedance of applicable water quality standards, in terms of average outflow concentrations, the TC-STA is deemed in compliance with Specific Condition 8C of the permit.

Table 6. Summary of other water quality parameters measured at the TC-STA during WY2013. [Note: includes number of excursions for parameters with Florida Class III surface water criteria, Section 62-302.530, Florida Administrative Code (F.A.C.).]

Parameter[a]	# of Obs.	Mean[b]	Standard Deviation	Minimum	Percentiles			Maximum	Excursions[c]
					25th	50th	75th		
Inflow (S-390)									
Water Temperature (°C)	53	24.1	4.0	16.6	20.6	25.1	27.4	30.9	
Water pH	52	7.11	0.30	6.40	6.90	7.10	7.30	8.30	0(52)
Specific Conductivity (µS/cm)	53	579	195	93	441	594	729	1000	0(53)
Total Suspended Solids (mg/L)	28	7.37	2.70	3.00	6.00	7.00	9.75	15.00	
Turbidity (NTU)	27	5.48	2.15	2.40	4.00	4.90	6.90	9.90	0(27)
Total Dissolved Solids (mg/L)	28	346	104	168	272	328	418	576	
Total Alkalinity (mg/L)	28	79	21	50	61	79	96	121	0(28)
Chloride (mg/L)	28	81	38	28	56	77	87	198	
Total Ammonia-N (mg/L)	28	0.116	0.195	0.006	0.024	0.054	0.130	1.037	
Unionized Ammonia (µg/L)	28	0.90	1.21	0.04	0.26	0.47	1.24	6.02	0(27)
Nitrate+Nitrite-N (mg/L)	41	0.361	0.305	0.005	0.018	0.348	0.630	0.904	
Total Nitrogen (mg/L)	41	1.767	0.632	0.945	1.296	1.662	2.096	3.870	
Orthophosphorus (mg/L)	46	0.221	0.225	0.012	0.055	0.130	0.324	1.014	
Sulfate (mg/L)	28	72.0	37.6	10.6	32.8	72.2	105.0	137.0	
Outflow (S-392)									
Water Temperature (°C)	53	23.6	4.0	15.6	20.2	24.7	27.2	29.0	
Water pH	52	7.04	0.24	6.40	6.90	7.00	7.20	7.80	0(52)
Specific Conductivity (µS/cm)	53	560	162	257	424	570	662	876	0(53)
Total Suspended Solids (mg/L)	28	3.28	3.98	1.50	1.50	1.50	3.75	20.00	
Turbidity (NTU)	26	2.60	1.48	0.80	1.30	2.25	3.50	6.10	0(26)
Total Dissolved Solids (mg/L)	28	340	104	110	274	360	399	506	
Total Alkalinity (mg/L)	28	86	15	53	72	88	94.8	110.0	0(28)
Chloride (mg/L)	28	80	32	40	54	77	91	165	
Total Ammonia-N (mg/L)	28	0.221	0.240	0.016	0.041	0.148	0.316	1.103	
Unionized Ammonia (µg/L)	27	1.63	2.50	0.12	0.41	1.03	2.05	13.34	0(27)
Nitrate+Nitrite (mg/L)	39	0.011	0.012	0.005	0.005	0.005	0.011	0.052	
Total Nitrogen (mg/L)	39	1.632	0.390	1.085	1.365	1.565	1.855	3.062	
Orthophosphorus (mg/L)	46	0.259	0.214	0.026	0.138	0.180	0.298	1.083	
Sulfate (mg/L)	28	56.8	25.3	12.2	38.5	63.2	78.8	96.4	
Downstream Monitoring Station (TC_DO)									
Water Temperature (°C)	53	24.1	3.9	17.2	20.6	25.5	27.5	29.8	
Water pH	52	7.18	0.27	6.40	7.00	7.20	7.38	7.90	0(52)
Specific Conductivity (µS/cm)	53	651	284	91	412	600	884	1245	0(53)

[a] Measured on either weekly or biweekly grab sample; nitrate+nitrite and total Kjeldahl nitrogen were measured on biweekly auto-samples.
[b] Arithmetic mean.
[c] Excursions from Florida Class III surface water standard, Section 62-302-530, F.A.C.; those parameters with Florida Class III criteria show number of excursions (total number of samples).

MERCURY

In accordance with Specific Condition 12 of the TC-STA permit 0194485-002-GL, mercury levels in surface water and fish tissue were monitored at the designated locations in the TC-STA during WY2013 under Phase 2 - Tier 1, as outlined in A Protocol for Monitoring Mercury and Other Toxicants (FDEP and SFWMD, 2011). Total mercury (THg) and methylmercury (MeHg) in surface water were monitored quarterly, while THg in fish tissue was monitored quarterly for mosquitofish (*Gambusia holbrooki*), and annually for bluegill sunfish (*Lepomis macrochirus*) and largemouth bass (*Micropterus salmoides*).

Averaged over three sampling events, the THg level was 3.4 nanograms per liter (ng/L) at the inflow (S-390), and 1.0 ng/L at the outflow (S-392) (**Table 7a**). These values are similar to THg levels reported in WY2012, and are well below the U.S. Environmental Protection Agency (USEPA) Class III numerical water quality standard of 12 ng/L. THg levels showed a net reduction of 70 percent from inflow to outflow. Average methylmercury MeHg levels were 0.37 and 0.13 ng/L at the inflow and outflow, respectively, for a net reduction of 65 percent (**Table 7a**).

Table 7a. Surface water total mercury (THg) and methylmercury (MeHg) levels (nanograms per liter, or ng/L) at the inflow (S-390) and outflow (S-392) stations of the TC-STA during WY2013.

Station	Collection Date	THg	MeHg
S-390	10-May-12	1.60	0.22
	19-Jul-12	3.30	0.40
	25-Oct-12	5.20	0.48
S-392	10-May-12	0.71	0.13
	19-Jul-12	1.00	0.18
	18-Oct-12	1.30	0.08

THg levels for the different fish species were generally low (**Table 7b**). Average THg levels in mosquitofish composite samples were 15 nanograms per gram (ng/g) at the interior (TCSTAC), and 35 ng/g at the downstream site (TCDS). These values are considerably below the USEPA trophic level 3 (TL3) criterion for fish (77 ng/g), and do not exceed the 75th percentile concentration of 100 ng/g for the period of record for the Everglades Protection Area. The average THg level in five bluegill sunfish samples collected from Cell 2 of the STA (TC2) was 7 ng/g (**Table 7b**). In 2008, a similarly low THg level of 11 ng/g in sunfish was also found in TC2. The average THg level in five bluegill sunfish samples collected at the downstream location (TCDS) was 74 ng/g, which is lower than the USEPA TL3 fish criterion of 77 ng/g. Largemouth bass samples collected at the downstream location (TCDS) had an average THg level of 362 ng/g, which is slightly higher than the USEPA recommended wildlife protection limit of 346 ng/g. However, THg levels in bluegill sunfish and largemouth bass did not exceed the 75th percentile concentrations of 240 and 679 ng/g, respectively, for the Everglades Protection Area. In summary, no violations of the Florida Class III numerical water quality standard of 12 ng/L were recorded for the TC-STA during WY2013. Similarly, average THg levels in the different fish species at the interior (TC2) and downstream location (TCDS) for WY2013 did not exceed the USEPA predator protection criteria.

On April 18, 2013, FDEP approved the District's request to reduce mercury monitoring at the TC-STA. In WY2014, the project-specific monitoring for surface water THg and MeHg will be discontinued, mosquitofish collection will change from quarterly to semiannually, and the frequency of bluegill sunfish and largemouth bass collection will change from annually to triennially (Gu, 2013).

Table 7b. THg concentrations in nanograms per gram (ng/g) in fish samples monitored at the TC-STA during WY2013. [Note: Values are on a wet weight basis.]

Station ID[a]	Collection Date	Fish Species[b]	THg
TC2	03-Dec-12	Bluegill sunfish	7
TCSTAC	10-May-12	Mosquitofish	16
	19-Jul-12	Mosquitofish	20
	17-Oct-12	Mosquitofish	11
	17-Jan-13	Mosquitofish	14
TCDS	10-May-12	Mosquitofish	17
	19-Jul-12	Mosquitofish	36
	17-Oct-12	Mosquitofish	40
	17-Jan-13	Mosquitofish	45
	03-Dec-12	Bluegill sunfish	46
	03-Dec-12	Largemouth bass	362

[a] TC2 – TC-STA Cell 2; TCDS – Taylor Creek downstream; TCSTAC – Composited mosquitofish sample from Cells 1 and 2.

STA PERFORMANCE EVALUATION

This section summarizes TC-STA performance for the current reporting year, and provides a comparison with the performance of previous years, as required in Specific Condition 16B of the TC-STA permit 0194485-002-GL. Flow-through operations at the TC-STA commenced on June 26, 2008. By the end of WY2013, the STA had almost 37 months of flow-through: eight months in WY2009 (June 26, 2008–February 24, 2009), a little less than eight months in WY2011 (September 8, 2010–April 30, 2011), a full 12 months in WY2012 (May 1, 2011–April 30, 2012), and nine months in WY2013 (May 1, 2012–January 31, 2013). The TC-STA was offline during WY2010, while construction repairs to a failed culvert at the outflow structure were being completed. The daily flow data used for this section are included in Attachment C.

The TC-STA performed effectively during the first 16 months of flow-through operation, removing 31 and 64 percent of the TP load it received in WY2009 and WY2011, respectively (**Table 8**). However, for the last two water years, the TC-STA performed below expectations. Of the 5.51 mt of TP loaded into the STA in WY2012, 4.40 mt were discharged back into Taylor Creek, giving a net TP load removal of 1.11 mt and a TP removal efficiency of only 20 percent. This was well below the projected long-term average reduction of 38 percent, or 2.02 mt TP per year. The relatively poor performance of the TC-STA during WY2012 was attributed to an unprecedented number of reversals in weekly TP concentrations. During WY2012, the TC-STA had fifteen reversals (averaging 43 micrograms P per liter), nine of which were recorded from November 10, 2011 to February 15, 2012. This same pattern was observed in WY2013, from October 2012 through January 2013, prompting the District to temporarily cease flow-through operation on February 1, 2013. The TC-STA was offline during the last three months of WY2013. Only limited pumping of water into the STA was conducted, to maintain water levels at target stages.

Table 8. Summary of calculated operational parameters and performance metrics for the TC-STA by water year. [Note: TC-STA was offline during WY2010.]

Parameter[a]	WY2009	WY2011	WY2012	WY2013
Period of operation, d	244	235	366	276
Total inflow volume, ac-ft	9,218	6,988	13,188	5,810
Hydraulic loading rate, cm/d	10.04	7.70	9.26	5.44
Inflow FWM TP conc., µg/L	408	167	341	368
Total inflow load, mt	4.64	1.44	5.51	2.63
TP mass loading rate, g/m^2/d	0.038	0.014	0.031	0.020
Total outflow volume, ac-ft	8,767	6,257	12,208	5,762
Outflow FWM TP conc., µg/L	295	68	292	289
Total outflow load, mt	3.12	0.52	4.40	2.05
Hydraulic residence time, d	6.34	7.75	6.52	9.72
TP mass removed, mt	1.44	0.91	1.11	0.58
TP concentration reduction, %	27.5	59.3	14.4	21.4
TP load reduction, %	31.1	63.6	20.2	22.0

[a.] Key to units: µg/L – micrograms per liter; ac-ft – acre-feet; cm/d – centimeters per day; d – day; g/m^2/d – grams per square meter per day; and mt – metric tons.

WY2013 marked the first year of post-stabilization operation for the TC-STA. During this period, the STA captured and treated 5,810 acre-feet (ac-ft) of runoff water from the Taylor Creek drainage basin, which is equal to an average hydraulic load of 5.44 centimeters per day (**Table 8**). The volume of treated water discharged back into Taylor Creek during the period was 5,762 ac-ft. HRT, the average length of time the runoff remained within the STA, averaged 9.72 days, which is longer than any previous HRTs for the project. The longer HRT was the result of operational changes made in response to reversals in weekly TP concentrations, and to accommodate new plantings in the STA. Only one pump was operated during this period. Flow-weighted mean TP concentrations measured at the inflow and outflow points of the STA averaged 368 and 289 micrograms per liter (µg/L), respectively. Although these values indicate a net reduction, the difference between inflow and outflow flow-weighted mean TP concentrations was not statistically significant using a two-tailed t-test with a 95 percent confidence interval ($t=0.792$, $P=0.440$). TP concentration reduction for WY2013 was 21 percent. TP loading over the effective treatment area of the TC-STA averaged 0.020 grams per square meter per day, which is considerably lower than TP loading recorded in WY2012, but slightly higher than TP loading in WY2011, which was an extremely dry year (Villapando, 2013). 2.63 mt of TP were loaded into the STA in WY2013, but only 0.58 mt were retained, for a TP removal efficiency of 22 percent. These results are well below the projected annual TP load reduction of 2.02 mt, and a treatment efficiency of 38 percent.

The performance of the TC-STA during WY2013, which was below the projected efficiency, was attributed to reversals in weekly TP concentrations, which were first observed in early October 2012. For 13 weeks between October 2012 and January 2013, the flow-weighted mean TP concentration measured at the outflow was higher than the TP concentration measured at the inflow (**Figure 8**). A total of 309 kilograms of TP were released back into Taylor Creek from the STA during this period (**Table 8**).

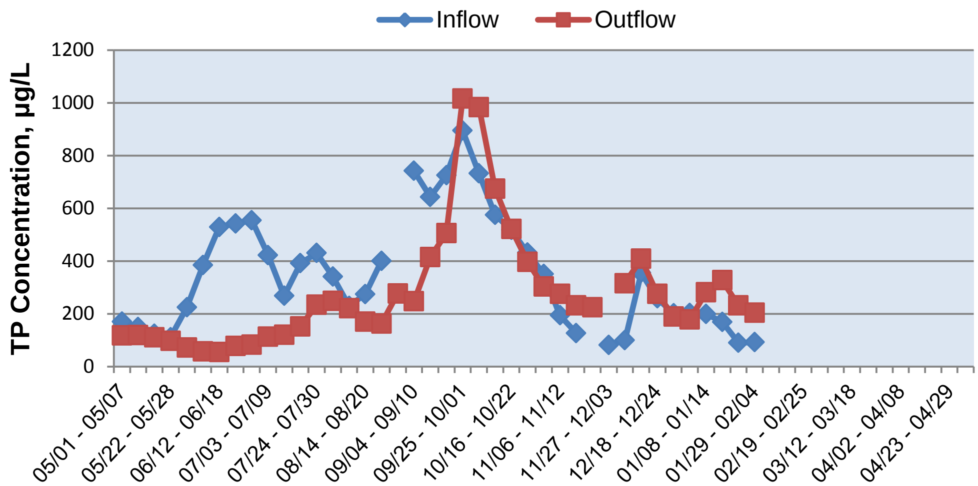

Figure 8. Weekly flow-weighted mean total phosphorus (TP) concentrations in micrograms per liter (µg/L) at the inflow (S-390) and outflow (S-392) points of the TC-STA for WY2013. The STA was offline from February to April 2013.

Table 9. Monthly summary of total phosphorus loads (metric tons) at the inflow (S-390) and outflow (S-392) of the TC-STA during WY2013.

Date	S-390	S-392	TP Load Removed[a]
May-2012	0.152	0.107	0.045
Jun-2012	0.388	0.060	0.328
Jul-2012	0.425	0.130	0.295
Aug-2012	0.253	0.178	0.075
Sep-2012	0.617	0.489	0.128
Oct-2012	0.487	0.717	-0.230
Nov-2012	0.109	0.150	-0.041
Dec-2012	0.113	0.095	0.018
Jan-2013	0.090	0.128	-0.038
Feb-2013	ND[b]	ND	ND
Mar-2013	ND	ND	ND
Apr-2013	ND	ND	ND
WY2013	**2.634**	**2.054**	**0.580**

[a] Negative value indicates net phosphorus export.

[b] ND = No Data. The STA did not discharge during the last three months of WY2013.

An investigation into the lack of system performance led to two internal water quality samplings in December 2012. Results of the study showed that water column TP concentrations were increasing in both cells of the STA, with inflow TP concentrations of about 100 μg/L, indicating that P was being released from the sediments or porewater to the water column (**Figure 9, left panel**). However, when the inflow TP concentration was around 250–300 μg/L, there was no discernible pattern in water column TP concentrations across the STA. This is an indication that the STA was in a state of "equilibrium" with respect to P conditions, at which there was no measurable flux of P from the sediment to the water column, and vice versa (**Figure 9, right panel**). These observations suggest that there exists a threshold Equilibrium P Concentration in the water column (EPC_w) or in the soil solution (EPC_o) that would dictate the extent and direction of P flux in the STA. EPC_w is the concentration of P in the water column at which no net flux, i.e. release or retention, occurs from the sediments to the water, and the P in solution is considered in equilibrium with P in the solid phase (EPC_o) (Reddy et al., 1999). It was hypothesized that when the overlying water column P concentration is above EPC_w or EPC_o, the underlying sediment/soil will remove P. Conversely, P will flux out of the sediments if P concentration in the water column is below EPC_w or EPC_o. A P flux study was initiated in May 2013 to identify various physicochemical factors and mechanisms causing release of P in the TC-STA. Surface and subsurface soil samples collected in March 2013 are being characterized for the different forms and distribution of P in the STA. Results of these studies will be included in the next annual report.

There is no concrete evidence that would link any soil, vegetation, and hydrologic conditions to the lack of STA performance in WY2013 at this time. The implementation of an updated vegetation management plan and cell enhancements conducted as part of drawdown activities that were initiated in April 2013 are anticipated to improve system performance in the long run.

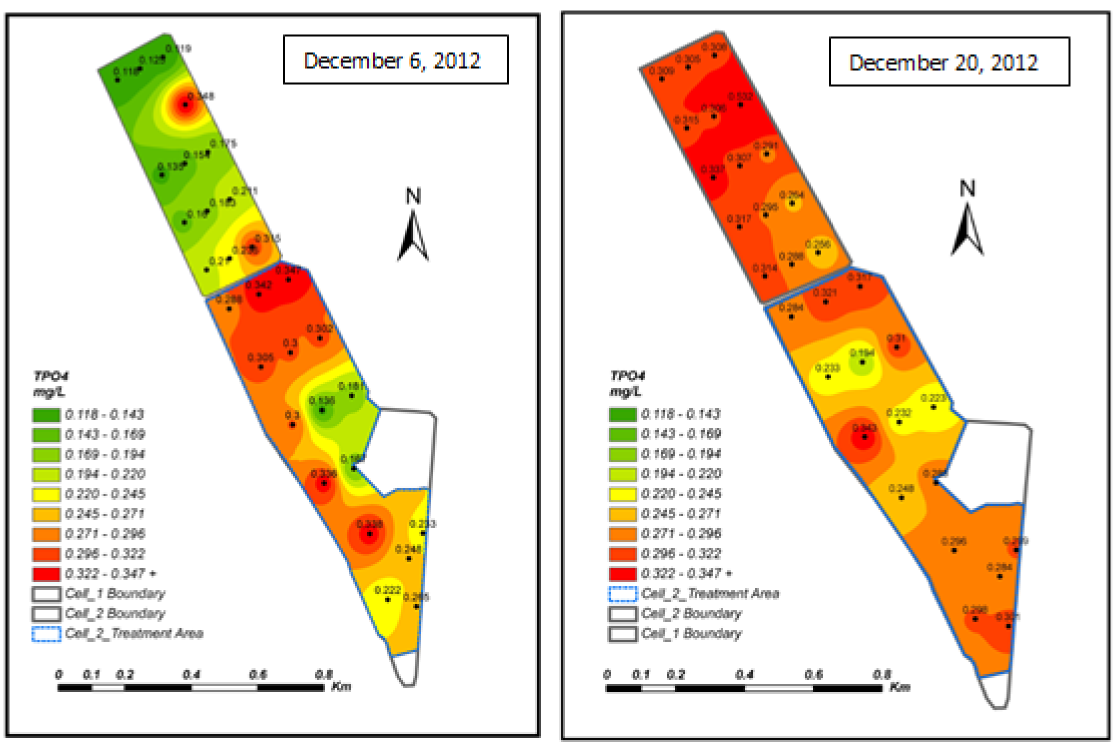

Figure 9. Spatial distribution of TP concentrations in the TC-STA on December 6, 2012 and December 20, 2012.

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Attachment A: Specific Conditions and Cross-References

Table A-1. Specific conditions, actions taken, and cross-references presented in this report for the Taylor Creek Stormwater Treatment Area project (NEEPP permit 0194485-002-GL).

Specific Condition	Description	Applicable Phase	Action Taken	Reported in 2014 SFER Vol. III, App. 4-2 in:			
				Narrative (page #s)	Figure	Table	Attachment
8	Stabilization/Post Stabilization	Post Stabilization	No action needed	1, 9, 16		1	
8A2	Phosphorus/Post Stabilization	Post Stabilization	Demonstrated net reduction in TP loads from inflow to outflow	9		8, 9	B
8B	Dissolved Oxygen	Post Stabilization	Water year average DO concentration at downstream location above applicable criteria	10–11	7		B
8C	Other Water Quality Parameters	Post Stabilization	No water quality parameters with Class III standards contributed to exceedance of applicable water quality standards in terms of average outflow concentrations	11–12		6	B
8E	Public Health, Safety, or Welfare	Post Stabilization	Discharges from TC-STA did not pose a serious danger to public health, safety, or welfare				
9	Vegetation Conditions	Post Stabilization	Continued to implement vegetation management and enhancement plan	5–8	4–6		
10	Factors Outside the Permittee's Control	Post Stabilization	No action needed				
11	Monitoring Requirements	Post Stabilization	Monitoring program conducted in accordance with Table 1 and Specific Condition 16	9			
12	Mercury and Pesticide Monitoring	Post Stabilization	Mercury monitoring was conducted in accordance with FDEP/SFWMD's protocol for monitoring mercury and other toxicants. Pesticide monitoring was eliminated effective October 7, 2011.	14–15		7a, 7b	B
13	Turbidity Monitoring	During Construction and Maintenance Activities That Cause Turbidity	No action needed				
14	Quality Assurance and Quality Control	Post Stabilization	Sampling and analysis performed per Chapter 62-160, F.A.C., and SFWMD's water quality monitoring plan for TC-STA	9			
15	Method Detection Limits	Post Stabilization	Collection and analysis methods, MDLs and PQLs are in accordance with permit requirements				B
16	Annual Monitoring Reports	Post Stabilization	Prepared and submitted as required	All	All	All	All

Table A-1. Continued.

Specific Condition	Description	Applicable Phase	Action Taken	Reported in 2014 SFER Vol. III, App. 4-2 in:			
				Narrative (page #s)	Figure	Table	Attachment
16A	Water Quality Data	Post Stabilization	Water quality data collected per Chapter 62-160, F.A.C. and SFWMD's water quality monitoring plan	9–15	7	5, 6, 7a, 7b	B, C
16B	Performance Evaluation	Post Stabilization	STA performance during WY2013 evaluated and compared with performance of previous water years	15–18	8, 9	8, 9	B, C
16C	Hydraulic Retention Time	Post Stabilization	No action needed				
16D	Herbicide and Pesticide Tracking	Post Stabilization	Herbicide usage during WY2013 was tracked and is summarized in this report	5–6		3	
16E	Implementation Schedules	Post Stabilization	No action needed				
17	Removal of Parameters	Post Stabilization	No action needed				
18	Addition of Parameters	Post Stabilization	No action needed				
20	Permit Modifications for Design Changes	Post Stabilization	No action needed				
21	Permit Renewal	Post Stabilization	No action needed				
22	Department Review and Approval	Post Stabilization	Mutual agreement reached on remedial actions and plan modifications				

Attachment B:
Water Quality Data

This project information is required by Specific Condition 16A of the Taylor Creek STA permit (0194485-002-GL), and is available upon request.

Attachment C:
Hydrologic Data

This project information is required by Specific Condition 16A of the Taylor Creek STA permit (0194485-002-GL), and is available upon request.