Appendix 5-2: Annual Emergency Order Report for Interim Operational Plan for Protection of the Cape Sable Seaside Sparrow

Permit Report (May 1, 2009–April 30, 2010)
Permit Number: Ninth Amended EOGC Case Numbers: 00-0889 and 99-2242

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SUMMARY

Based on Florida Department of Environmental Protection (FDEP) permit reporting guidelines, **Table 1** shows cross-references for permit specific conditions in the permit and the specific reference pages. **Table 2** lists key permit-related information. **Attachment A**, Table A-1 of this appendix shows the specific pages, tables, and graphs where project status and annual reporting requirements are addressed.

Table 1. Permit specific conditions and reference in the permit.

Permit Conditions	Permit Reference: Ninth Amended EOGC Case Numbers: 00-0889 and 99-2242
Project Status	The construction of Detention Areas of S-332B, S-332C, and S-332D detention areas has been completed. The Everglades Restoration Transition Plan (ERTP) will replace the Interim Operational Plan (IOP) when the final Record of Decision is signed (expected in mid-2011),
Annual Monitoring Reports	Specific Condition 25 on Page 11 of Emergency Order #9.

[1] Affiliated with U.S. Environmental Protection Agency, Natl. Exposure Research Lab, Athens, GA, as of Aug. 2010

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Table 2. Key permit-related information.

Project Name	**Interim Operational Plan for Protection of the Cape Sable Seaside Sparrow**
Permit Number	Ninth Amended EOGC Case Numbers: 00-0889 and 99-2242
Issue and Expiration Date	Issue: January 31, 2004 Expiration: Remains in effect until implementation of ERTP
Project Phase	Completed
Relevant Period of Record	January 1, 2004–April 30, 2010
Report Generator	Shi Kui Xue, Steven Hill, Richard Pfeuffer, and Mark C. Gabriel[1] sxue@sfwmd.gov 561-682-2333

[1.] Affiliated with U.S. Environmental Protection Agency, Natl. Exposure Research Lab, Athens, GA, as of Aug. 2010

INTRODUCTION

The Central & Southern Florida Flood Control Project Comprehensive Review Study (Restudy; USACE and SFWMD, 1999) was authorized by the Water Resources Development Act of 1992 to determine the effects of the existing canal system on the Everglades and neighboring sensitive areas and to develop a conceptual plan to restore the remaining Everglades while maintaining the water supply and flood protection functions of the Central and Southern Florida Project (C&SF Project). Upon completion in 1999, the Restudy was renamed the Comprehensive Everglades Restoration Plan (CERP) (U.S. Congress, 2000).

The C-111 Canal Project modifications, authorized by the 1994 General Reevaluation Report (GRR), along with the Modified Water Deliveries to Everglades National Park (MWD ENP) Project, authorized by the 1992 General Design Memorandum (1992 GDM), must be completed before the decompartmentalization components of CERP can be initiated. Considerable portions of the C-111 Canal Project modification have been built and are operating under the Interim Operational Plan (IOP) for Protection of the Cape Sable Seaside Sparrow (CSSS) (see http://hpm.saj.usace.army.mil/csssweb/index.html). The IOP for Protection of the CSSS will be replaced by Everglades Restoration Transition Plan (ERTP) for the MWD ENP and C-111 Canal projects upon its completion.

The ERTP will replace the IOP when the final Record of Decision is signed (expected in mid 2011). The purpose of the ERTP is to define operations for the constructed features of the MWD and C-111 project until those projects are fully completed and a Combined Operation Plan (COP) is implemented. These projects consist of structural changes to the South Dade Canal Conveyance System to provide more natural water levels in Everglades National Park (ENP or Park), provide water to the ENP, reduce damaging discharges to Florida Bay, and maintain the historical drainage level of the South Dade canals. The C-111 Canal Project includes the construction of three pump stations (S-332B, S-332C, and S-332D) to move water from the L31-N reach located between S-331/S-173 and S-176 into the newly constructed detention areas located along the eastern boundary of Everglades National Park. **Figures 1** and **2** show the general location of the facilities monitored under this plan and the locations of major canals and roads in this vicinity.

The U.S. Army Corps of Engineers (USACE) submitted an application to the Florida Department of Environmental Protection (FDEP) on December 14, 1999, for an Environmental Resource Permit (ERP) to operate the S-332B, S-332C, and S-332D structures, in accordance with the IOP for Protection of the CSSS. The C-111 Canal Project's Ninth Amended Emergency Final Order (C-111 EO #9) (FDEP Nos. 00-0889 and 99-2242) authorizes the USACE to operate and monitor structures S-332B, S-332C, and S-332D pump stations and associated detention areas. Operations are in accordance with guidelines identified in Table 2.11 of the Final Environmental Impact Statement for the IOP for Protection of the CSSS and the Water Quality Monitoring Plan found in Exhibit B of C-111 EO #9. The S-332B, S-332C, and S-332D pump stations and associated facilities are operated for flood protection, water supply to the ENP and Miami-Dade County, and routing of water from Water Conservation Area 3A (WCA-3A). These pump stations and facilities compensate for the closures of S-343A, S-343B, S-344, S-12A, S-12B, and S-12C as specified in the IOP for Protection of the CSSS to improve sparrow nesting conditions to comply with the U.S. Fish and Wildlife Service's (USFWS) February 19, 1999, Biological Opinion.

The USACE is authorized by emergency order to construct and operate the accelerated (emergency) features of the C-111 Canal Project (S-332B to S-332C Detention Areas Offset Connector and Land Swap Detention Areas), as described in the IOP for Protection of the CSSS, and the modified weir scenario identified in Specific Condition 25(g). The Ninth Emergency Order was effective January 31, 2004 and states "The Department finds that this state of

emergency is expected to continue up until implementation of the CSOP. Therefore, this Emergency Final Order shall remain in effect until implementation of CSOP, unless rescinded, modified, or extended by further order of the Department". The Everglades Restoration Transition Plan (ERTP) is expected to supersede IOP until the long-term operation plan is implemented. This long term operating plan is now called the Combined Operations Plan (COP) and has replaced the Combined Structural and Operational Plan (CSOP). The Department will re-evaluate current project authorizations when proposed changes to current operational plans are finalized.

The first four annual reports for calendar years 2004–2007 were submitted to the FDEP. The next two annual reports for Water Year 2008 and 2009 ((May 1, 2008–April 30, 2009) are presented in Appendix 3A-8 of the 2009 and 2010 South Florida Environmental Reports (SFER) – Volume I. This appendix is the seventh annual water quality monitoring report under the Emergency Final Order and presents water quality results for Water Year 2010 (WY2010) (May 1, 2009–April 30, 2010).

This appendix includes the following supporting documentation to satisfy the permit-related reporting requirements:

- **Attachment A** – Specific Conditions and Cross-References
- **Attachment B –** Interim Operational Plan Water Quality Sampling Sites, Monitoring Schedule, Flow Volumes and Flow-Weighted Mean Concentrations for Water Year 2010
- **Attachment C –** Time-Series and Box Plots for Water Quality Monitoring Data Exhibiting Excursions from Class III Numeric Standards for Water Year 2010
- **Attachment D –** Summary Statistics of C-111 Water Quality Monitoring Data for Water Year 2010
- **Attachment E –** Time-Series and Box Plots of Total Phosphorus and Total Nitrogen at Monitoring Sites for Water Year 2010
- **Attachment F –** Supporting Information on Water Quality and Flow Data for the IOP for Protection of the CSSS Monitoring Locations for Water Year 2010

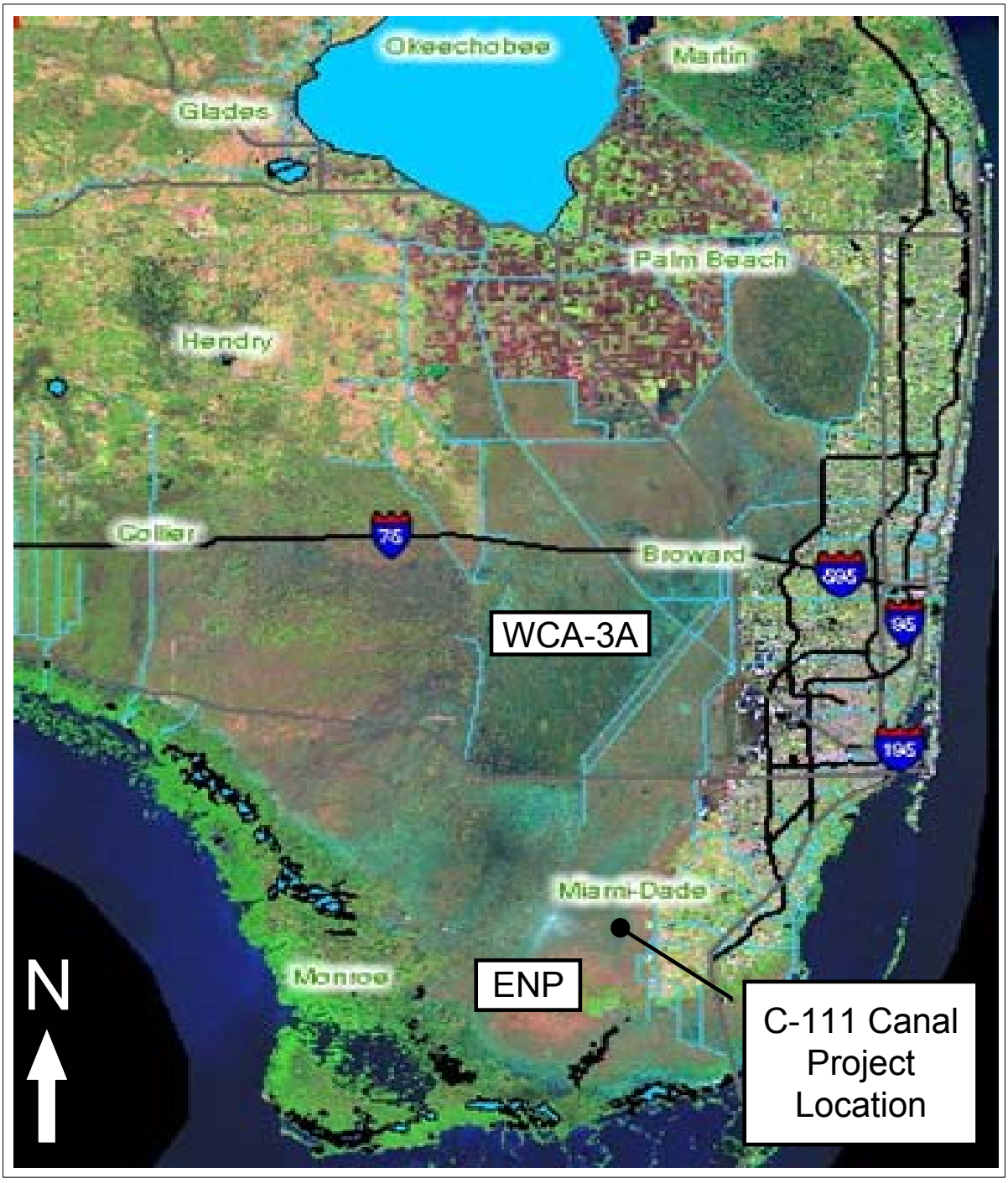


Figure 1. General location of facilities monitored under the Interim Operational Plan (IOP) for Protection of the Cape Sable Seaside Sparrow (CSSS).

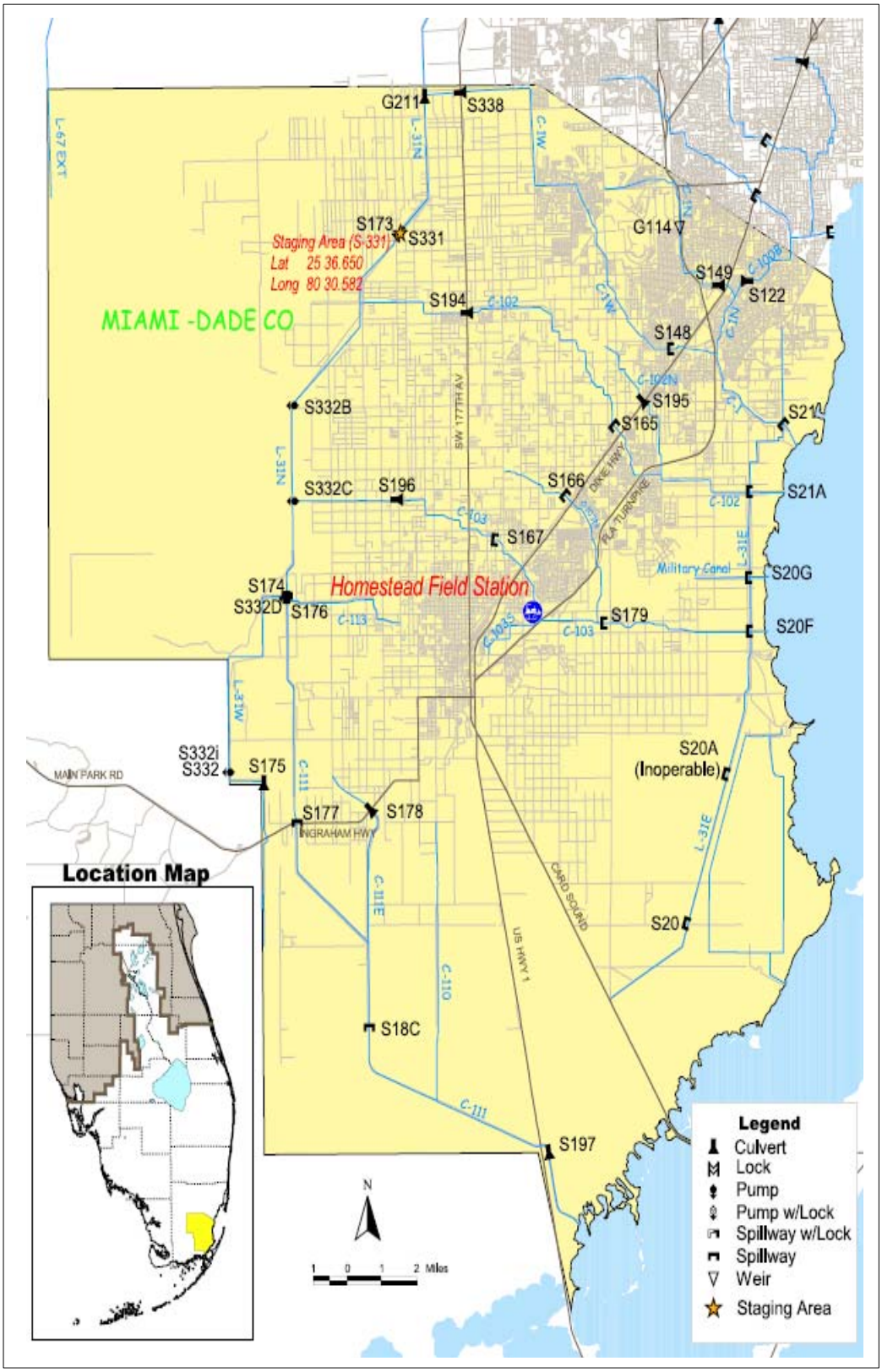


Figure 2. Major roads and canals within the C-111 Canal Project area.

METHODS

WATER QUALITY AND HYDROLOGIC DATA

The water quality and hydrologic data evaluated in this report are from the South Florida Water Management District's (SFWMD or District) hydrometeorologic database, DBHYDRO. Before water quality data are entered into the database, the District follows the strict quality assurance/quality control (QA/QC) procedures outlined in the FDEP-approved Quality Management Plan (SFWMD, 2010). The plan ensures that the water quality monitoring program provides accurate data.

Methods for hydrologic data collection are documented in the Guidelines for the Collection of Hydrologic and Meteorologic Data (SJRWMD et al., 1994). The QA/QC procedures for hydrologic data are included in the Guidelines for Quality Control and Quality Assurance of Hydrologic and Meteorologic Data (SJRWMD et al., 1999).

DESCRIPTION OF FACILITIES

This section describes the S-332B, S-332C, and S-332D detention and buffer areas, systems, and function. The C-111 Canal Project as modified by the 1994 GRR will provide seepage management and water supply along approximately 12 miles (mi) between Richmond Drive (S-331/S-173) and S-175. The following descriptions include changes from subsequent authorizations (e.g., 2000 GRR for the 8.5 Square Mile Area feature of the MWD ENP project) and design refinements contained within the Tentatively Selected Plan of the ERTP that are within the authorization of the 1994 GRR (e.g., slight adjustment in the alignment of detention area levees).

The USACE construction work, conducted under the work package identified as Contract 7, was started in 2007 and completed in 2009. An interconnected detention system now exists from the S-332B west discharge to the S-332D high head cell. Contract 7 included the following construction items:

- Degraded the existing S-332B west detention area and reconstruct the northern and western levees at a higher elevation of 13 feet in relation to the National Geodetic Vertical Datum of 1929 (ft NGVD 29), which is now the elevation of all other levees for the S-332B and S-332C features
- Demolished and removed the emergency overflow weir from the west side of the S-332B west detention area
- Continued levee work south from the S-332B western and eastern levees and connected to the S-332C detention cell
- Removed the north and south S-332C levees
- Continued construction of the levee from S-332C west and east levees to S-332D high head cell
- Connected the south discharge of S-332B and north discharge of S-332C west with the completion of the westernmost levee
- Removed the south partial connection levee from S-332B and the north partial connection from S-332B to complete the partial connector levee
- Completed the S-332D detention areas along the eastern and western sides of this newly created detention area

- Degraded the southern levee of the S-332C detention area
- Connected the northern portion of the C-111 detention system (S-332B and S-332C features down to the L31W) to the S-332D detention area with four sliding gated culverts with telemetry (S-332DX1) in the north S-332D detention area levee
- Constructed S-332DX1 between the east and west levee tie-ins to the S-332D high head cell
- Backfilled the L-31W levee canal because the levees crossed the canal to connect to the C-111 high head cell

This system will be operated under IOP guidance until another approved multiagency coordinated plan is available.

The C-111 South Dade County (SDC) project modifications to the Central & South Florida (C&SF) Project are defined by its authorizing legislation and the 1994 General Re-evaluation Report (GRR). There are 11 contracts in the C-111 SDC project. Contracts 1 through 7 have been constructed, and Contract 8 has been designed but not constructed to date. Contract 8 includes the L-31W Connection between 8.5 SMA to Northern Detention Area and is on-hold pending resolution of a cost-sharing/land crediting issues.

The planned contract 9 includes the following components:

- **Backfilling borrow canal.** The L-31W borrow canal is being backfilled to prevent the canal from acting as a sump and pulling water out of the ENP. While the groundwater losses from the ENP have not been quantified, the backfill is beneficial based on a qualitative analysis of the area and comparison to other similar projects.
- **Installing overflow weir.** During the 2002 CSSS Emergency Contract, a 2,000-foot reach of L-31W was degraded to grade (approximate elevation 4 feet NGVD29) to allow water flowing through the Frog Pond Detention System to be delivered to Taylor Slough. To make the flow-way area a more functional part of the detention system and augment the delivery of water to Taylor Slough, this gap will be closed and replaced with a concrete overflow weir.
- **Demolishing existing structures.** The S-174 culvert structure will no longer be able to operate when the L-31W borrow canal is filled. This culvert will be grouted in place and all superstructure will be removed.
- **Modifying pump station.** The S-332 pump station was originally planned to have a canal connecting it to C-111 to pump water to the west. However, this is no longer a viable option due to the filling in of the L-31W canal. Therefore, this structure will be removed and the existing footprint will be backfilled along with the adjacent canal area. The S-175 gated control structure will no longer be able to operate when the L-31W borrow canal is filled; therefore, this structure also will be completely removed.

Contract 10 includes permanent pump station S-332B and discharge canal; Permanent pump station S-332C and discharge above ground flow-way. Contracts 9, 10, and 11 are under design and are expected to be completed under a future project.

S-332B and S-332C Detention Areas

A segment of the L-31W canal was backfilled in September 2007 to allow construction of the detention area connecting S-332D and S-332C. Modification of S-332D's high head cell made northward flow possible after the S-332B and S-332C detention areas were completed. The S-332B and S-332C detention areas currently cover approximately 2.5 mi of the approximately 8 mi between the southern end of the 8.5 Square Mile Area Stormwater Treatment Area (8.5 SMA STA) and the S-332D system (L-31W, S-176, and C-113). **Figures 3** and **4** provide more detailed maps of the S-332B and S-332C facilities, respectively. The connector cell between S-332B and S-332C has been completed.

A land swap (about 1,000 acres) between the SFWMD and the ENP was completed in March 2006 to allow the construction of a continuous detention area from S-332B west to S-332D as shown in **Figure 5**. This construction was completed in August 2008. In addition, the connector cell has been built to receive water from the main cell when depths in the main cell approach 2 ft. In this same period, construction of additional eastern and western levees created a continuous detention area from S-332B west through what is now the S-332C detention area. This expanded detention area extended into the S-332D detention area northern levee (the L-31W levee). A continuous detention area extending from S-332B north to the 8.5 SMA STA will be constructed in a separate phase once the required land is acquired (**Figure 6**) and the required USACE authorization is obtained. The acquisition of the parcels required for this northern portion was negotiated in April 2008, and was executed at the June 2008 SFWMD Governing Board meeting.

The temporary S-332B and S-332C pump stations are currently operated (flow rate and durations) to create a groundwater ridge without meaningfully exceeding a depth of 2 ft or causing surface water overflow into the ENP. These operations are similar to, but more constrained than, the operation envisioned in the 1994 GRR. When sufficiently filled, the S-332B and S-332C detention system establishes a hydraulic ridge, thereby allowing the water levels in the ENP to be higher while maintaining existing drainage for the land located east of the L-31N canal. **Figures 7**, **8**, and **9** illustrate the existing problem and solutions.

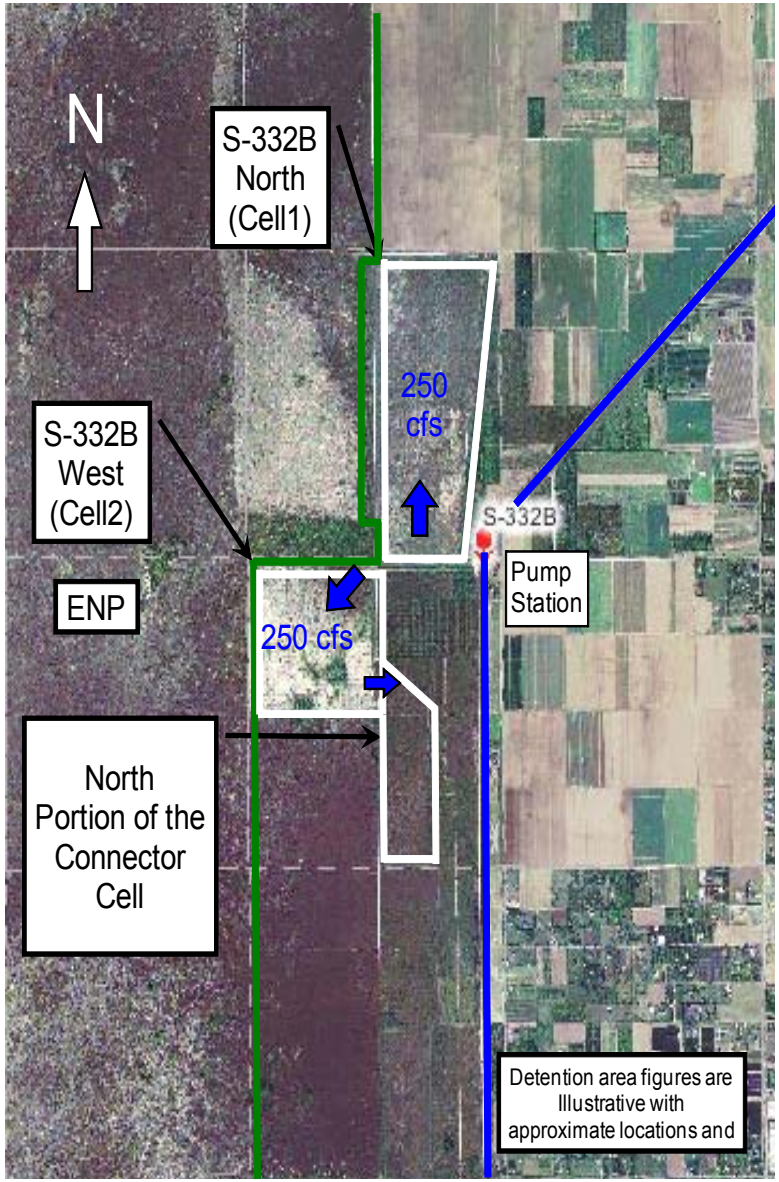


Figure 3. Location of S-332B pump stations and detention areas.

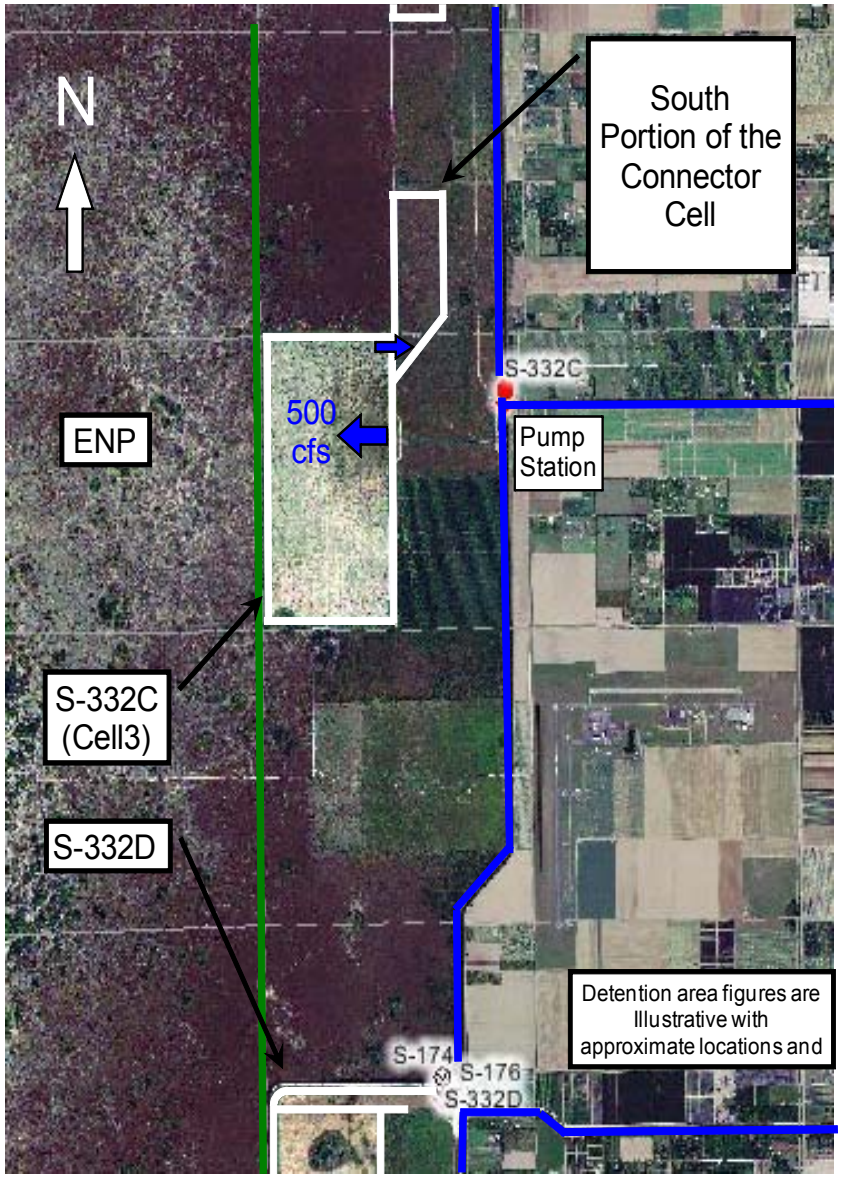


Figure 4. Location of S-332C pump stations and detention areas.

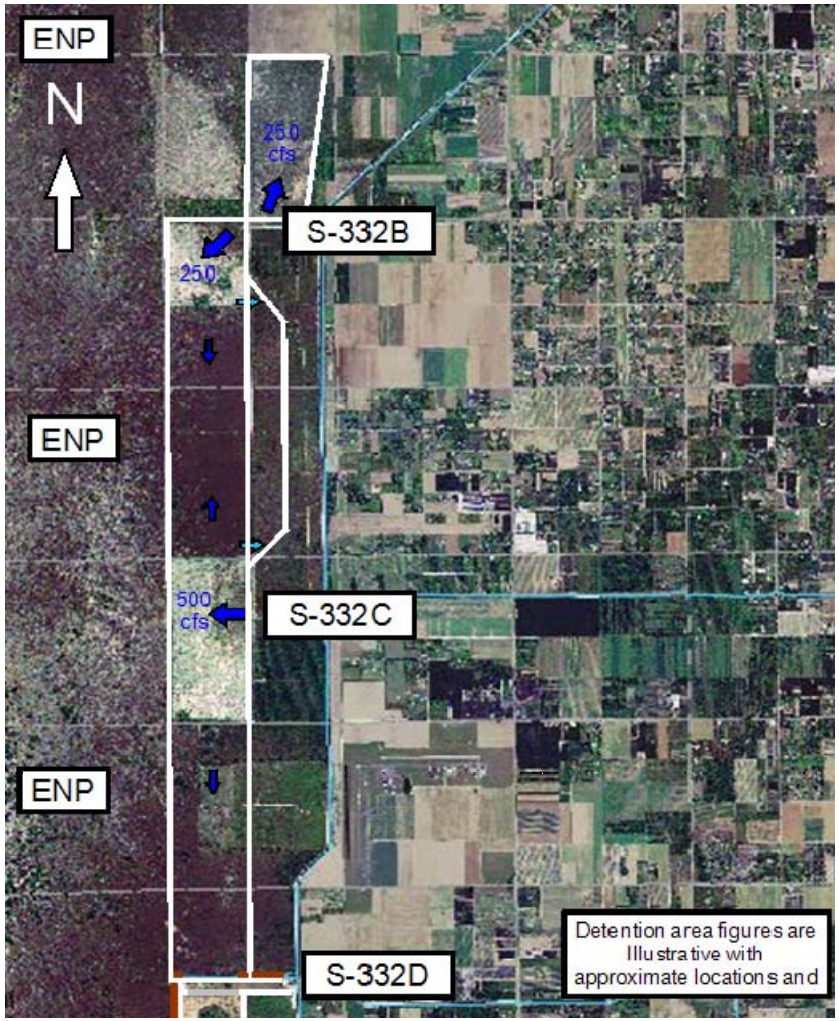


Figure 5. Location of S-332B, S-332C, and S-332D pump stations and detention areas (south).

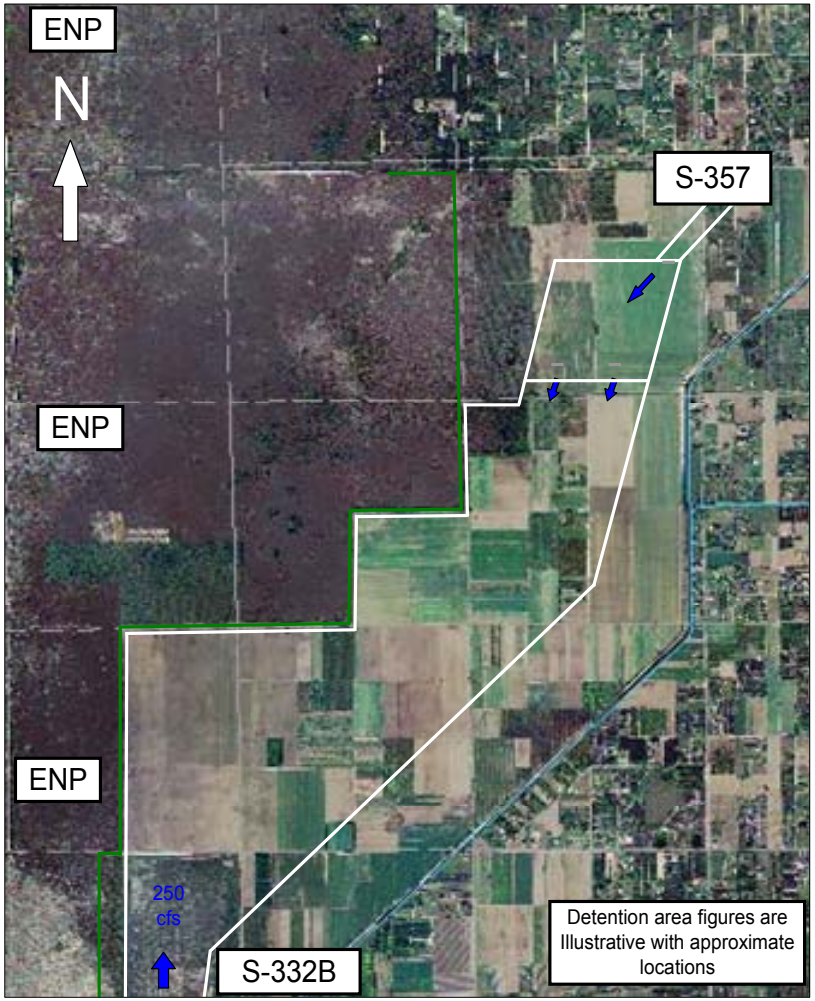


Figure 6. Location of S-332B pump station and detention area (north).

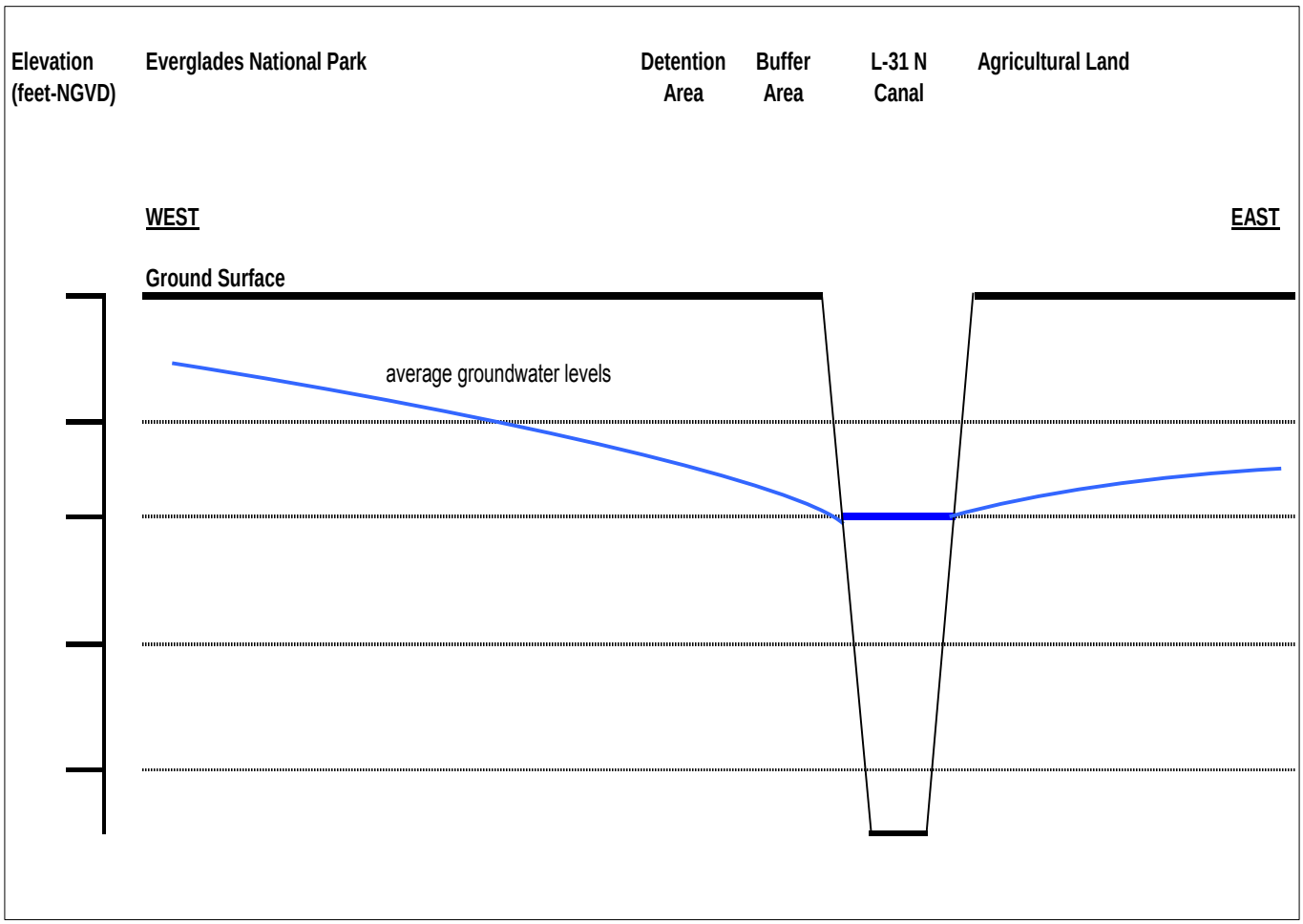


Figure 7. Generalization of groundwater flow near the L-31N canal without the project [Note: Figure is for illustration only and not to scale].

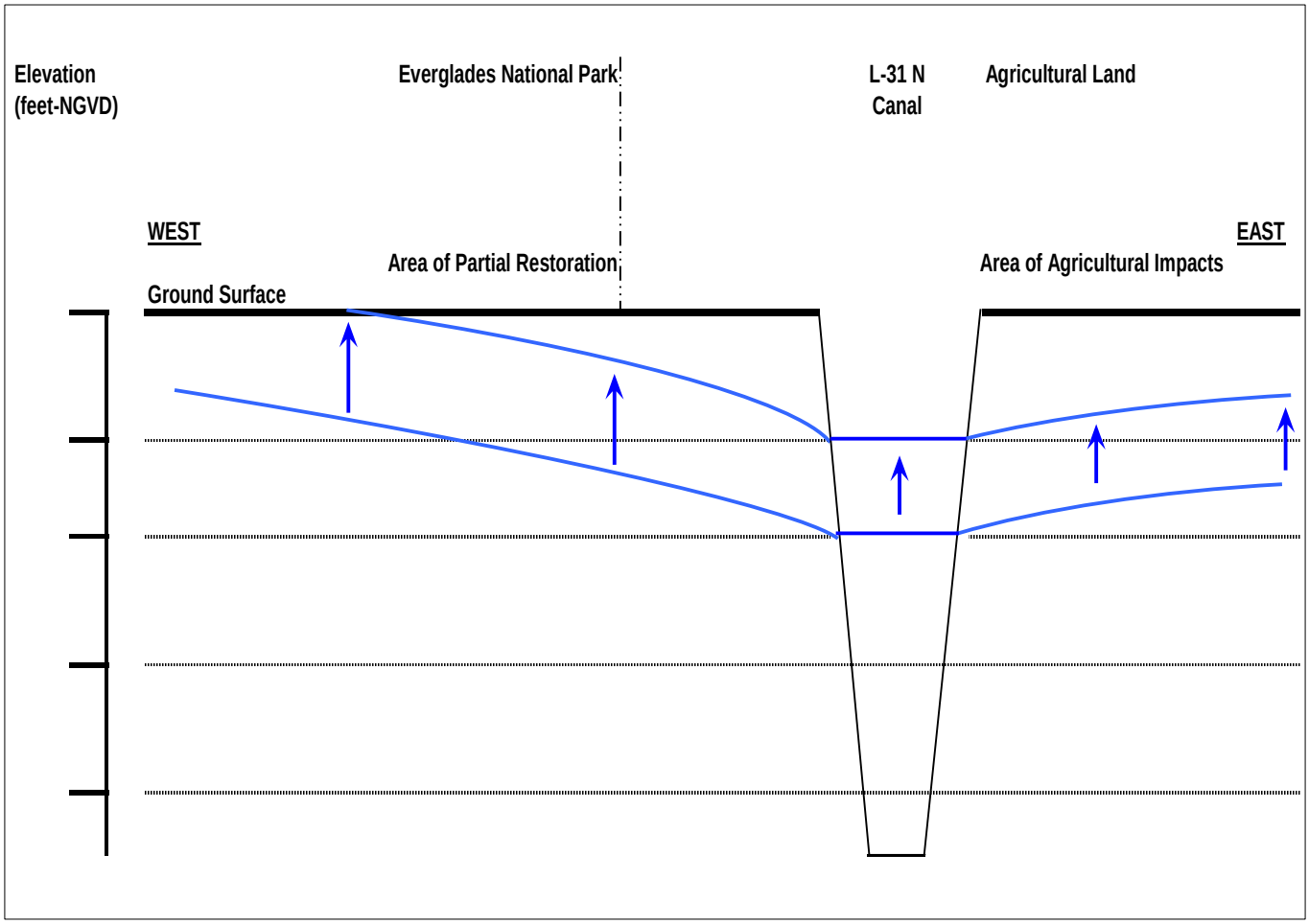


Figure 8. Illustration of potential impacts associated with partial restoration without the detention area [Note: Figure is for illustration only and not to scale].

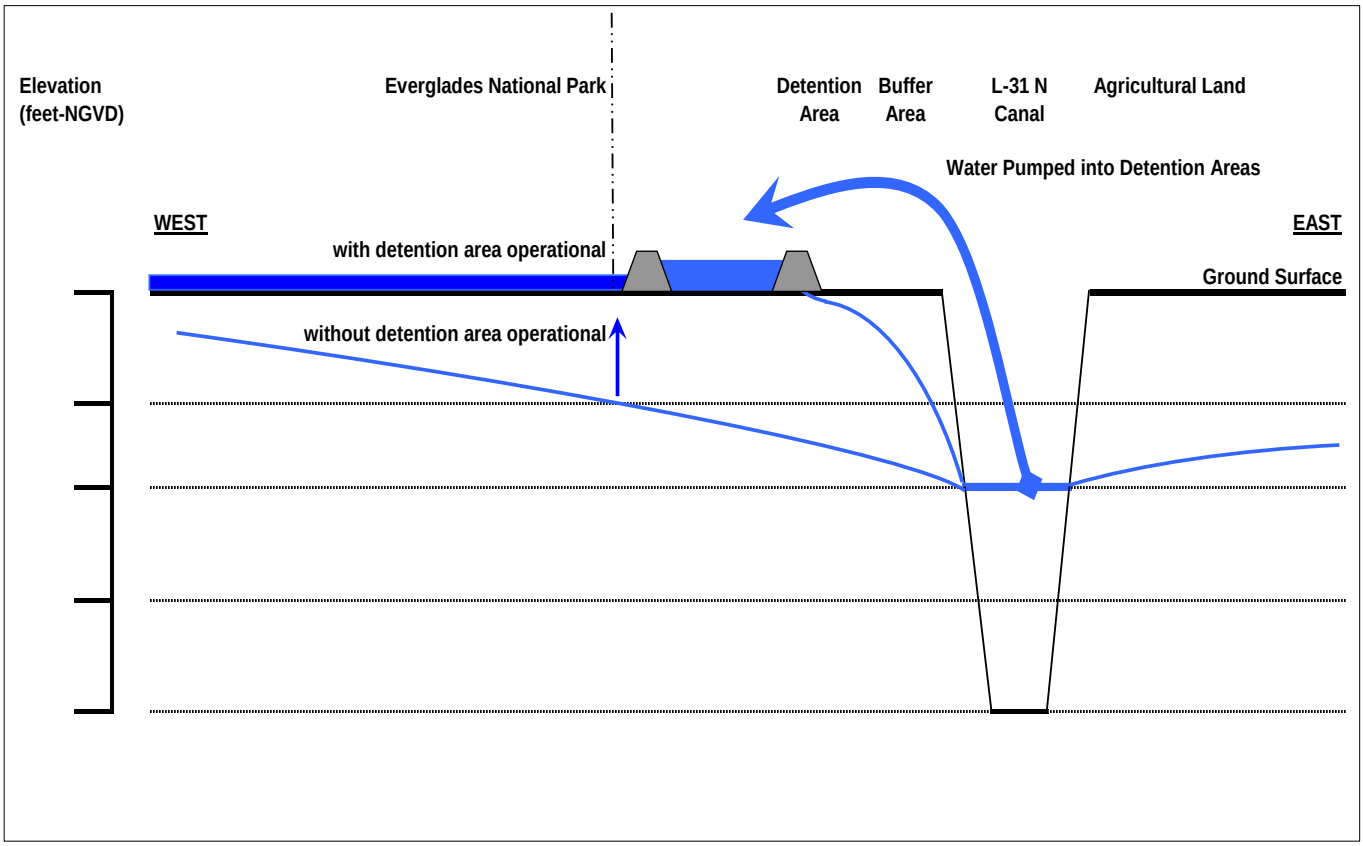


Figure 9. Generalization of groundwater flow near the L-31N canal with the detention area operational [Note: Figure is for illustration only and not to scale].

The S-332B north reservoir, renamed the S-332B north detention area, has been built. The connector cell and the raising of S-332B west's western levee and weir was completed. However, to comply with the intent of the IOP for Protection of the CSSS, given the additional operational flexibility provided by completion of the S-332B north detention area, the SFWMD operates S-332B west to minimize surface water discharges. Some water is still delivered to the ENP via groundwater seepage. However, most water pumped into the detention areas returns to the canal due to the proximity and stage of the L-31N canal. The amount of water pumped into S-332B north, S-332B west, and S-332C detention areas that return as seepage varies depending primarily on the water level in and around the detention areas (e.g., the ENP and the buffer area) and the stage in L-31N. The estimated seepage return rate ranges from 60 to 100 percent. The average seepage return rate is approximately 70 percent when the detention areas are operational.

The IOP for Protection of the CSSS limits the normal water depths to 2 ft in the S-332B, S-332C, and connector cell, but allows depths up to 4 ft for named storms (e.g., hurricanes, tropical storms, and tropical depressions) and unnamed storms when the USACE determines there is a flood emergency. The depth limit of 2 ft and desire to eliminate surface water discharges complicates and constrains the operation of the incomplete detention areas. The current conditions of the S-332B and S-332C detention areas are as follows:

- **S-332B north.** The S-332B north detention area covers approximately 240 acres (ac) and can receive flow from two of the four 125 cubic feet per second (cfs) diesel pumps located within the temporary S-332B pump station. The topsoil of this former agricultural land (created predominately by rock plowing) was scraped from the interior of the detention area and used for construction of the levees. This detention area has been functional since April 30, 2003, but operations have generally been limited to one 125 cfs pump to prevent impacts to nearby privately owned agricultural land.
- **S-332B west.** The S-332B west detention area covers approximately 160 ac and can receive flow from two of the four 125 cfs diesel pumps and one 75 cfs electrical pump in the temporary S-332B pump station. The topsoil of this land was scraped from the interior of the detention area and used for levee construction. This detention area initially became functional on April 17, 2000, but was taken offline for rerouting required for construction of the S-332B north detention area. It returned to operational status on April 17, 2002. During initial operations, before construction of S-332B north, S-332B west received the entire discharge from S-332B and was operated under the 2001 Interim Structural and Operational Plan. This allowed discharges of up to 325 cfs into the S-332B west detention area without a depth limit, resulting in regular overflow from the western weir.
- **S-332C detention area.** The S-332C detention area covers approximately 300 ac and can receive flow from four 125 cfs diesel pumps and one 75 cfs electrical pump in the temporary S-332C pump station. The topsoil of this land was scraped from the interior of the detention area and used for construction of the levees. This detention area has been functional since August 2, 2002.
- **Partial connector cell between S-332B west and S-332C.** The USACE was built a continuous detention area from S-332D to S-332B north as part of the emergency construction for the IOP for Protection of the CSSS. To provide some of the completed project function, the USACE designed the connector cell east of the ENP eastern boundary at that time (now moved west with the land exchange). The connector cell's relatively narrow design was to achieve a limited hydraulic ridge while maintaining sufficient distance from the L-31N canal to have

manageable seepage losses. Both the northern portion (connected to S-332B west) and southern portion (connected to S-332C) have a continuous levee with no western (ENP) discharge structure. Land ownership limited the use of these detention areas until 2005. The flashboard riser that conveys water into these detention areas was lowered before the 2006 wet season to increase the use and function of the two areas. Construction of the remaining portions of the connector cell was completed in 2009. The top soil of this land was scraped from the interior of the constructed portion of the connector cell and used for construction of the levees.

- **Final detention area between S-332B west and S-332D** (**Figure 5**). Construction of the final detention area between S-332B west and S-332D was completed in 2009. This detention area received inflow from both the S-332B (two 125 cfs diesel pumps and one 75 cfs electrical pump) and S-332C (four 125 cfs diesel pumps and the one 75 cfs electrical pump) pump stations. The final detention area extends from and includes the S-332B west and S-332C detention areas and ends at the S-332D system. The final detention area covers approximately 1,300 ac, which is about 840 ac more than the 460 ac provided by S-332B west and S-332C detention areas.
- **Final detention area between S-332B north and the 8.5 SMA STA (Figure 6)**. Construction of the final detention area between S-332B north and the 8.5 SMA STA (Contract 8) has not been completed. The remaining land was acquired in May 2008. This detention area can receive inflow from both the S-332B (two 125 cfs diesel pumps) and the S-357 pump stations (four 125 cfs diesel pumps and one 75 cfs electrical pump) via the 8.5 SMA STA. The final detention area will extend from and include what is now the S-332B north detention area and end at the 8.5 SMA STA. The final detention area will cover approximately 1,440 ac, which is about 1,000 ac more than the 460 ac provided by S-332B north.

S-332D Detention Areas

The IOP for Protection of the CSSS allows surface water discharges into Taylor Slough during the Cape Sable seaside sparrow (*Ammodramus maritimus mirabilis*) nesting season according to the following guidelines: (1) maximum of 500 cfs from July 16 (or end of the breeding season, as confirmed by USFWS) to November 30, (2) maximum of 325 cfs from December 1 to January 31, and (3) maximum of 165 cfs from February 1 to July 15.

As shown in **Figure 10**, the discharges from the S-332D pump station flow through a high head cell (west) and then through two detention areas (south then west) and finally through a flow-way area (south) before discharging into Taylor Slough near S-332. The high head cell and detention areas lose considerable flow to seepage both to the east (ultimately to the C-111 canal) and into the L-31W canal located along the western and northern sides of the S-332D detention system. The S-332D pump station became operational on August 31, 1999. Water from this pump station is discharged into the L-31W borrow canal. In June 2002, the S-332D detention (Frog Pond) area came online. Detailed descriptions of the individual components of the S-332D detention system follow:

- **S-332D header cell** (**Figure 10**, panels A and B). The S-332D header cell covers approximately 39 ac, has an average bottom elevation of approximately 5.5 ft NGVD 29, and has a 1,820-ft-long discharge weir with a crest elevation of 8.2 ft NGVD 29. The top soil of this land was scraped from the interior of the detention area and used for construction of the levees. S174 structure was plugged in September 2007 and the cell 4 was connected north detention area.
- **S-332D first detention area** (Cell 4 of **Figure 10**). The S-332D first detention area covers approximately 350 ac, has an average bottom elevation of approximately 5.3 ft NGVD 29, and has an earthen berm acting as a broad crested weir with a top elevation of approximately 6.7 ft NGVD 29. With the notable exception of the tree island located within this detention area, the top soil of this land was scraped from the interior and used for construction of the levees.
- **S-332D second detention area** (Cell 5 of **Figure 10**). The S-332D second detention area covers approximately 400 ac, has an average bottom elevation of 5.1 ft NGVD 29, and has a weir crest elevation of approximately 6.0 ft NGVD 29. The 1,900-ft-long weir is constructed of concrete and discharges into the scraped portion of the flow-way. With the notable exception of the tree island located within this detention area, the top soil of this land was scraped from the interior of the detention area and used for construction of the levees.
- **S-332D flow-way** (flow-way of **Figure 10**). The flow-way covers approximately 1,300 ac and discharges through an approximately 2,000-ft-long levee gap in the southwest corner near S-332. The scraped surface of limestone acts as the discharge weir for the flow-way (with an elevation of approximately 4 ft NGVD 29). Discharges from the flow-way are spread and conveyed to Taylor Slough by the L-31W canal. The ground surface within the flow-way is lower toward the southwest with all of the land below 5.0 ft NGVD 29, about a third of the land below 4.5 ft NGVD 29, and about 8 percent below 4.0 ft NGVD 29. An approximately 2,000-ft-wide portion of the flow-way was scraped, and this material was used for construction of the levees and stockpiled near the southeast corner of the flow-way.

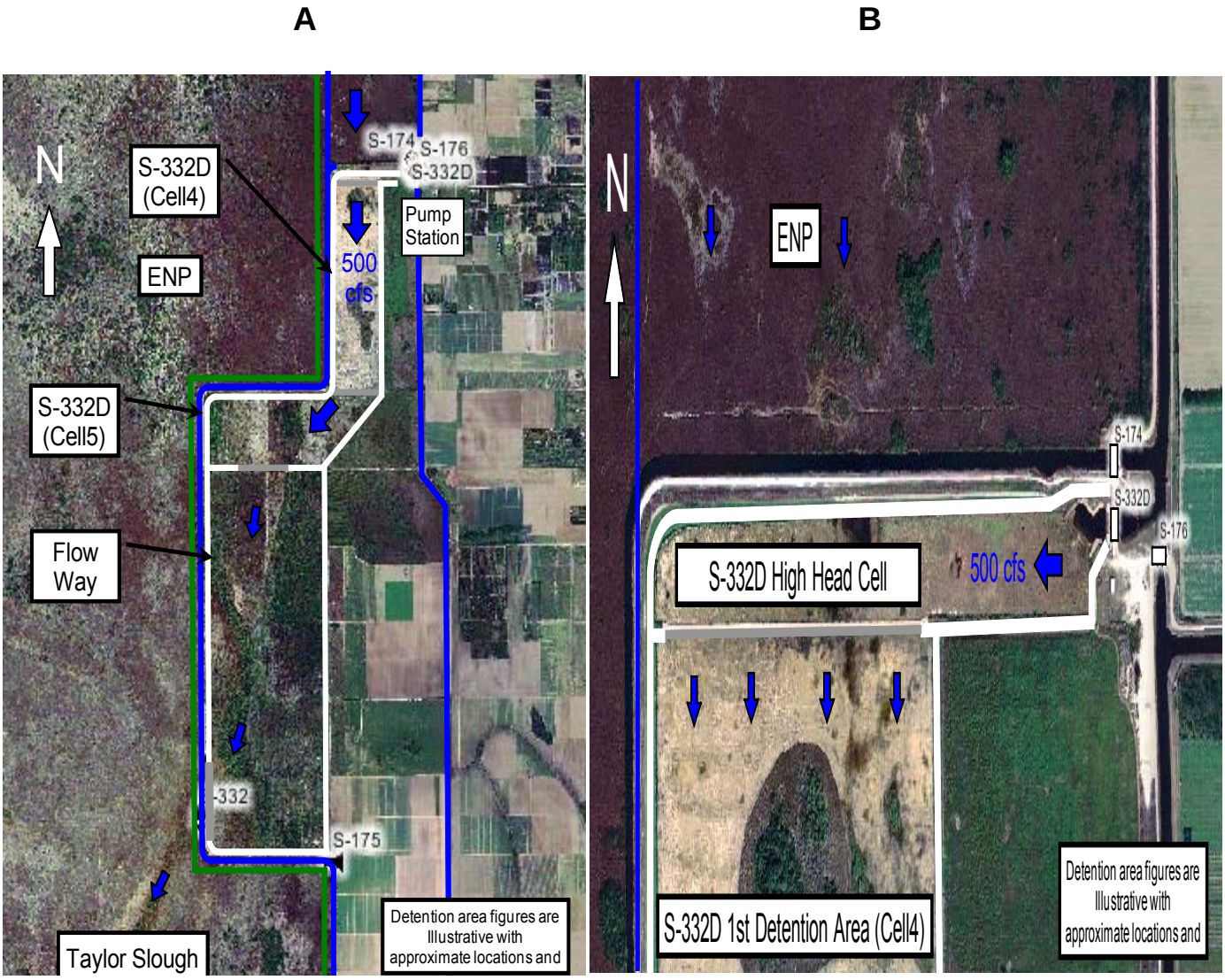


Figure 10. Location with flow arrows of S-33D pump station and detention areas (panel A), and a closer view of the S-332D pump station, high head cell, and first detention area (Cell 4)(panel B).

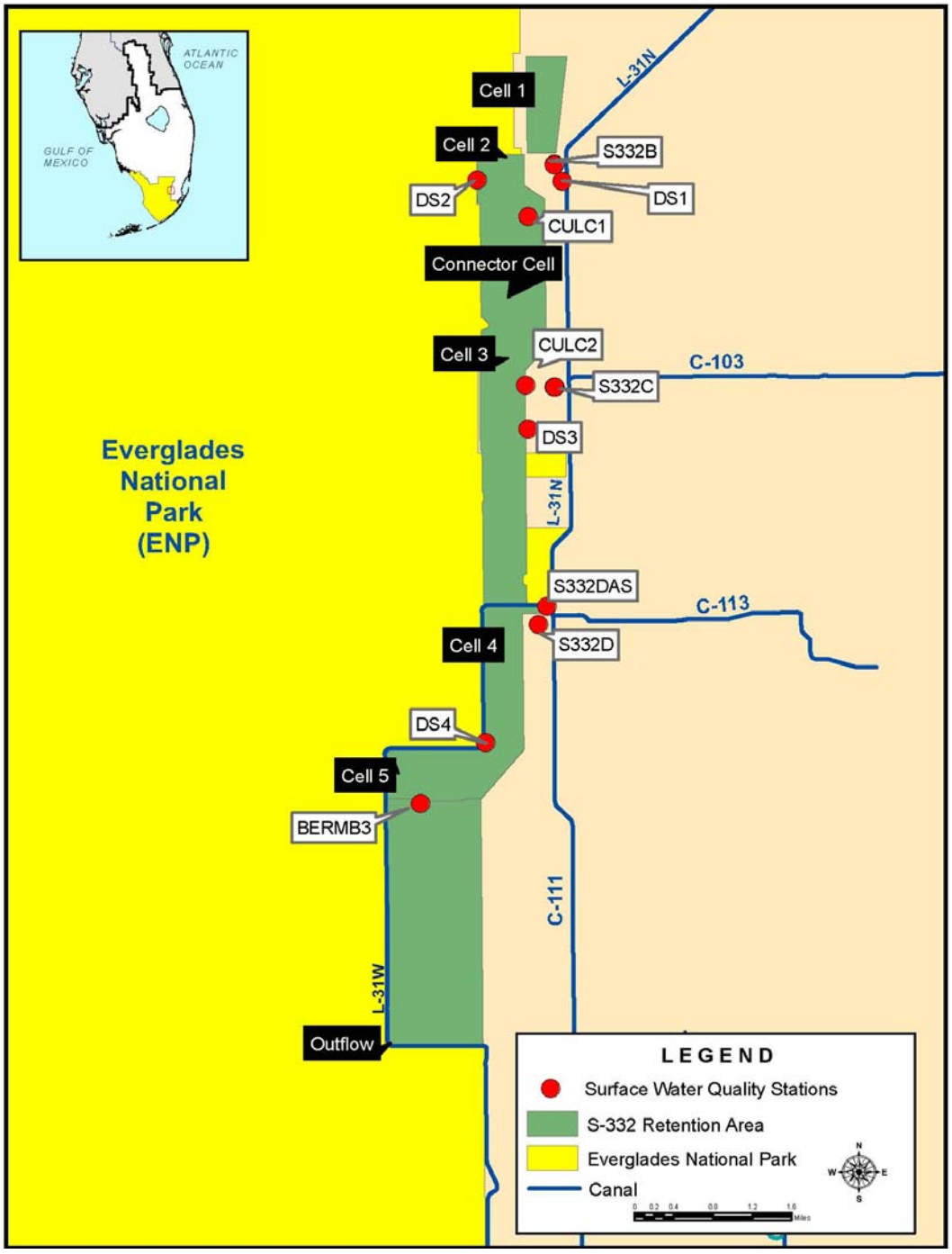


Figure 11. Monitoring locations for S-332B, S332C, and S-332D detention areas.

SAMPLING SITES

In addition to authorizing the operation and maintenance of certain structures, C-111 EO #9 requires a routine water quality monitoring program. This program characterizes the quality of water discharged from the three pump stations that move water from the L-31N canal reach between S-331/S-173 and S-176 into the detention areas (S-332B, S-332C, and S-332D), two interior detention areas (CULC1 and CULC2), four diversion structures (DS1, DS2, DS3, and DS4), and one outflow structure (BERMB3), as shown in **Figure 11**. Cell 5 is separated from the flow way by a concrete berm (B3). Flow way discharges into ENP through a degraded portion of the L31N levee, however, depending on water levels, water may flow from ENP into the flow way. Given the problems with measured flow at the degraded levee, berm B3 is used as a surrogate for both flow and nutrient discharges into ENP.

The DS1 and DS3 structures are the emergency overflow weirs for S-332B and S-332C. Both discharge to the east and therefore cannot discharge into the ENP. The DS2 structure can discharge into the ENP (to the west) if the stage within the detention area exceeds the crest elevation of approximately 8.39 ft NGVD 29 along the 1,700 lineal feet of weir. The DS4 structure consists of manually operated sluice gates that are opened only for emergencies (e.g., a detrimental fire) requiring more rapid delivery of water than provided by the S-332D detention system.

The District typically collects water quality samples at the structure or at a nearby location representative of the quality of water flowing through a structure. **Figure 11** shows structure locations for this project. The District previously submitted a monitoring plan to the FDEP on January 4, 2004, that included detailed information on the specific locations for sample collection for S-332B, S-332C, S-332D, and associated structures. The current monitoring program encompasses 10 locations that provide representative information to characterize the quality of water discharged through all structures. The structure names, representative water quality monitoring location names, and sampling frequencies of the various categories of chemical constituents and physical properties required by the monitoring schedule denoted in the C-111 EO #9 are shown in **Attachment B**, Table B-1.

DATA ANALYSIS PERIODS

The water quality characterization includes an evaluation of compliance with Class III criteria for each monitoring location representative of C-111 Canal Project emergency operation structures. This report provides the annual update of the C-111 EO #9 monitoring program and a comparison of water quality data at structures to state water quality standards for WY2010. These comparisons fulfill the C-111 EO #9 requirements to measure progress toward achieving and maintaining compliance with state water quality standards.

Method Detection Limits

Each water quality constituent has a method detection limit (MDL) that essentially defines the minimum concentration, or level, at which the constituent can be quantified. The MDL is usually twice the background noise level associated with a test and represents the level at which the presence of the analyte can be reliably determined. The MDL does not represent a level at which an exact measurement can be determined.

The practical quantitation limit (PQL) represents the lowest level achievable among laboratories within specified limits during routine laboratory operations and for which a measurement can be considered quantifiably reliable for a constituent. Generally, the PQL is four times the MDL, although different laboratories may establish PQLs at two to five times the MDL.

In this report, data reported to be less than the MDL were assigned a value equal to the MDL to provide a conservative basis for statistical analysis. For pesticide detections, concentrations greater than the PQL were considered reliable.

Excursion Analysis for Class III Constituents and Pesticides

To evaluate compliance with water quality criteria, constituent concentrations were compared to their respective Class III numeric criteria. If a constituent concentration exceeded its numeric criterion, then an excursion was recorded and the total number and percent of excursions for the C-111 EO #9 structures were tabulated.

Total Phosphorus

Total phosphorus (TP) data are presented in this report in time-series plots and statistical box plots. The Everglades Forever Act (EFA) (Section 373.4592, Florida Statutes [F.S.]) mandates that the numeric phosphorus criterion for Class III waters in the Everglades Protected Area (EPA) shall be a long-term geometric mean of 10 parts per billion (ppb), but shall not be lower than the natural conditions of the EPA, and shall take into account spatial and temporal variability [Chapter 62-302.540, Florida Administrative Code (F.A.C.), Water Quality Standards for Phosphorus Within the Everglades Protection Area]. There are additional TP concentration compliance limits for inflows to the ENP by way of Shark River Slough (e.g., S-343A, S-343B, S-344, S-12A, S-12B, S-12C, S-12D, S-333 minus S-334, S-355A, S-355B, and S-356), Taylor Slough (S-332D), and the coastal basin (S-18C) outlined in the Settlement Agreement; however, this report does not track compliance with the interim or long-term TP concentration limits set forth in that agreement.

The District's categories of concern, potential concern, and no concern are based on a common sense understanding of water resources protection. However, these terms are not intended to be interpretations of state water quality standards or state water quality law. The FDEP, not the District, is responsible for interpreting whether a given constituent violates (1) the numeric criterion, (2) the narrative criterion, (3) a water body's designated uses, or (4) the anti-degradation policy.

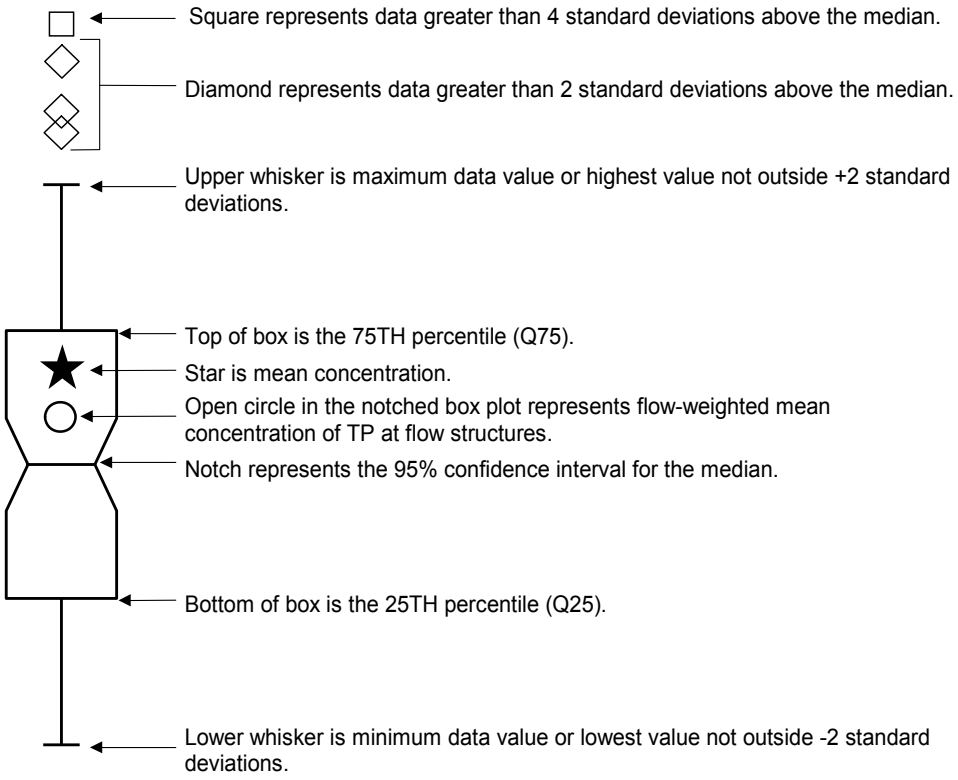
Mercury

The C-111 Canal Project has two mercury monitoring components: C-111D and C-111F as shown in Figure 11. Project C-111D is used for the collection of surface water for total mercury (THg) and methylmercury (MeHg) analysis. C-111F is used for the collection of various fish species for THg analysis. The District collected unfiltered surface water samples at the three potential surface water inflow locations (S-332B, S-332C, and S-332D), the single outflow (BERMB3), and at two interior sites (CULC1 and CULC2) on a quarterly basis and analyzed for THg, as stated in the monitoring plan. The District monitored water-column THg on an event basis. For example, samples were collected if water was diverted from the detention areas (through one of four diversion structures) to the ENP. In addition to water-column THg, the District collected mosquitofish (*Gambusia holbrooki*) at CULC2, DS2, and DS4 (due to low water levels, the interior mosquitofish collection site CULC1 was replaced with CULC2 and outflow site BERMB3 was replaced by diversion sites DS2 and DS4) on an annual basis. Largemouth bass (*Micropterus salmoides*) and sunfish (*Lepomis* spp.) were eliminated from C-111D monitoring following the approved mandate modification in 2006. The District also collected surface water samples at four sites immediately downstream of the flow-way cell for THg determination and sediment samples at four downstream sites for mercury analysis. Surface water samples were not collected when total depth was less than 20 centimeters (cm) in WY2010.

DESCRIPTION OF NOTCHED-BOX-AND-WHISKER PLOTS

Notched-box-and-whisker plots were created to summarize data for each constituent that exceeded its numeric criteria and to summarize the TP data collected at all monitoring locations. A notched-box-and-whisker plot summarizes selected statistical properties of the datasets. Notched-box-and-whisker plots can be used to test for statistical significance between datasets at a roughly 95 percent confidence interval, to detect changes in constituent concentration variability over time, and to determine if trends exist. The notched-box-and-whisker plots used for these summaries are based on McGill et al. (1978) (**Figure 12**).

It is recognized that using notched-box-and-whisker plots to determine differences between datasets with large differences in sample size may cause significant findings that are artifacts of the number of samples and the amount of variation in the datasets. The objective of providing the plots was to evaluate data from WY2010 and future changes for the discharge structures. Notched-box-and-whisker plots of total phosphorus and nitrogen (TP and TN) data for WY2010 are provided in **Attachment C**.



1.Notches surrounding the medians provide a measure of the significance of differences between notched box plots. If the notches about two medians do not overlap, then the medians are significantly different at about a 95-percent confidence level.
2.At times, the variability in a data set may be quite high. When highly variable data are presented in a notched box and whisker plot, the width of the notch may be greater than the 25th or 75th percentile. When this occurs, the box plot appears as if it is folded from the end of the notch back towards the median. This is done automatically by the statistics program to save space within the figure being presented.
3.Notches are calculated using the following equation:

$$Notch = Median \pm \frac{1.58(Q75 - Q25)}{\sqrt{n}}$$

Where: n = number of data points

Figure 12. Description of notched-box-and-whisker plots used in this appendix.

RESULTS: WATER QUALITY EVALUATION AND EXCURSION ANALYSIS

This section presents an update of constituent concentrations and physical properties measured during WY2010. For standards with numeric criteria, the data from the structures were assessed for compliance with those standards using the procedures in Chapter 62-302, F.A.C. (Surface Water Quality Standards) or Chapter 62-160, F.A.C. (Quality Assurance Rule). For parameters that have narrative water quality criteria, the concentrations obtained at each structure were reported using plots and summary statistics.

MONITORING OF PHYSICAL PARAMETERS, NUTRIENTS, MAJOR IONS

Descriptive Statistics

A summary of the data with descriptive statistics for all water quality constituent concentrations and physical properties (excluding pesticides and priority pollutants) measured for C-111 EO #9 monitoring locations during WY2010 is in **Attachment D**. A reference reflecting current state Class III criteria is provided in **Attachment D**, Table D-1. **Attachment D**, Table D-2 is a reference table for cross-referencing water quality monitoring sites with the C-111 EO #9 discharge structures. **Attachment D**, Table D-3 summarizes the descriptive statistics for each water quality parameter collected for all monitoring stations.

The statistical summary table (**Attachment D**, Table D-3) reports the range of constituent concentrations, median values, the number of sample observations, selected data percentiles (25^{th} and 75^{th}), and parameters exhibiting excursions from Class III numeric criteria. Concentrations observed to be less than the lower limit of the analytical MDL were set equal to the MDL for statistical analysis.

For parameters that only have narrative criteria (e.g., nutrients), the tables provide basic information to assist with identifying water quality constituents that might be of concern. TP is the nutrient deemed to be of particular concern for the C-111 EO #9 structures.

Excursions from Class III Criteria (Numeric)

Further analysis of excursions from Class III criteria was accomplished by summarizing the excursions, plotting the data for parameters exhibiting the excursions, discussing the parameters, and noting which ones are a concern. The excursion analysis is based on four water quality parameters (with a numeric criteria) that were collected for the C-111 EO #9 monitoring program and can be compared with applicable Class III water quality criteria listed in Chapter 62-302.530, F.A.C.

Of the parameters listed in **Table 3**, only dissolved oxygen (DO) exhibited excursions during WY2010. A summary of observed excursions from Class III criteria for individual C-111 EO #9 monitoring locations during WY2010 is in **Table 4**. The monitoring locations are categorized in the table as inflow, interior, diversion, and outflow. Calculated criteria for the parameters were derived from the equation listed in Chapter 62-302.530, F.A.C.

For parameters that exceeded Class III criteria during WY2010, time-series plots and notched-box-and-whisker plots are provided in **Attachment C**. These plots report the range of the data and the magnitude of the excursions. The plots also assist with detecting whether there are any increasing or decreasing trends observed in the data.

Dissolved Oxygen

Dissolved oxygen concentrations exhibited consistent excursions from Class III criteria during WY2010 (**Table 2**). About 84.1 percent (127 out of 151 samples) of DO concentrations measured at the C-111 EO #9 monitoring locations were less than the minimum criterion of 5 milligrams per liter (mg/L). The DO excursions occurred at all locations except for CULC1. The DO time-series and notched-box-and-whisker plots are shown in **Attachment C**.

It should be noted that even unimpacted areas of the Everglades commonly have DO concentrations that are below the 5 mg/L standard as part of the natural water conditions found in South Florida. Because natural levels commonly fall below the existing standard, the FDEP has adopted a site-specific alternative criterion (SSAC) for DO in the EPA that better reflects naturally occurring conditions.

Table 3. Summary of total number of excursions from state Class III criteria for all C-111 EO #9 monitoring sites.

PARAMETER	WY2010	WY2009	WY2008	CY2007	CY2006	CY2005	CY2004
Total Alkalinity	(0 : 0)	(0 : 0)	(0 : 2)	(0 : 5)	(0 : 10)	(0 : 20)	(0 : 11)
Dissolved Oxygen	**(127:151)**	**(116 : 159)**	**(88 : 144)**	**(84 : 141)**	**(110 : 128)**	**(144 : 173)**	**(121 : 129)**
Specific Conductance	(0 : 158)	(0 : 163)	(0 : 156)	(0 : 153)	(0 : 129)	(0 : 171)	(0 : 121)
pH	(0 : 155)	(0 : 163)	(0 : 156)	(0 : 153)	(0 : 131)	(0 : 174)	(0 : 130)
Turbidity	(0 : 9)	(0 : 10)	(0 : 31)	(0 : 39)	(0 : 68)	(0 : 104)	(0 : 69)
Un-ionized Ammonia	(0 : 0)	(0 : 0)	(0 : 8)	(0 : 18)	(0 : 55)	(0 : 103)	(0 : 77)
Total Iron	(0 : 0)	(0 : 0)	(0 : 2)	(0 : 4)	(0 : 10)	(0 : 13)	(0 : 9)
Total Cadmium	(0 : 0)	(0 : 0)	(0 : 0)	(0 : 1)	(0 : 11)	(0 : 11)	(0 : 6)
Total Copper	(0 : 0)	(0 : 0)	(0 : 0)	(0 : 1)	(0 : 11)	(0 : 11)	(0 : 5)
Total Zinc	(0 : 0)	(0 : 0)	(0 : 0)	(0 : 1)	(0 : 11)	(0 : 11)	(0 : 6)

Notes: 1st number indicates number of excursions. 2nd number indicates total number of samples collected.
CY = calendar year (January–December)
WY = water year (May–April)

Table 4. Summary of excursions from state Class III surface water criteria for individual C-111 EO #9 monitoring sites during Water Year 2010 (WY2010) (May 1 2009–April 30, 2010).

AREA	STRUCTURE	SAMPLING SITE	PARAMETERS									
			Alkalinity	DO	Specific Conductance	pH	Turbidity	Un-Ionized Ammonia	Iron	Cadmium	Copper	Zinc
Inflow	S332B	S332B	-ND-	**(45 : 49)**	(0 : 51)	(0 : 50)	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-
		S332BAuto	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-
	S332C	S332C	-ND-	**(39 : 49)**	(0 : 51)	(0 : 50)	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-
		S332CAuto	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-
	S332D	S332DX	-ND-	**(39 : 49)**	(0 : 51)	(0 : 50)	(0 : 6)	-ND-	-ND-	-ND-	-ND-	-ND-
Interior	C1	CULC1	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-
	C2	CULC2	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-
Diversion	DS1	DS1	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-
	DS2	DS2	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-
	DS3	DS3	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-
	DS4	DS4	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-
Outflow	BERMB3	BERMB3	-ND-	**(4 : 4)**	(0 : 5)	(0 : 5)	(0 : 3)	-ND-	-ND-	-ND-	-ND-	-ND-
Totals			-ND-	**(127 : 151)**	(0 : 158)	(0 : 155)	(0 : 9)	-ND-	-ND-	-ND-	-ND-	-ND-

1st number in parenthesis indicates number of excursions. 2nd number in parenthesis indicates total number of samples collected. Bold numbers indicate excursions from state Class III criteria. -ND- indicates that no data were collected.

Total Dissolved Solids and Dissolved Organic Carbon

Sampling for total dissolved solids (TDS) in groundwater and dissolved organic carbon (DOC) are required at S-332DX on a quarterly basis. DOC was proposed to be monitored monthly at the two interior structures; TDS, total organic carbon, and DOC were proposed to be monitored when there is flow at the diversion structures.

The summary results for TDS for WY2010 are presented in **Attachment D**, Table D-4. The TDS varied from 150 to 394 mg/L in groundwater samples. There was no flow at the diversion structures (DS1, DS2, DS3, and DS4) or at the outflow structure (BERMB3), so there were no TDS measurements during WY2010.

The summary results for DOC in WY2010 are presented in **Attachment D**, Table D-5. DOC was monitored in the past and historical data indicated there was very little variation in DOC concentrations among all structures; therefore, DOC was measured only at S-332DX and ranged from 12.6 to 16.0 mg/L in the surface water sampled at the inflow structure. There was no DOC measured for the surface water sampled at the interior structures, the diversion structures, and the outflow structure (BERMB3) during WY2010 because there was no flow at these structures.

Evaluation of Total Phosphorus

C-111 EO #9 established the monitoring schedule shown in **Attachment C** for the collection of TP at C-111 EO #9 structures. Sample collection is accomplished mainly through a grab sample collection program. Grab samples are collected biweekly for the inflow and outflow structures, monthly for the interior structures, and in the event of diversion during flood events or to move water directly to the ENP from the diversion structures. Nutrients are the most frequently sampled parameters in this monitoring program.

During WY2010, auto-samplers (sampling regimes for S-332B, S-332C, and S-332D are described in **Attachment D**, Table D-2) collected TP samples weekly at the inflow structures S-332B, S-332C, and S-332D (water quality id S-332DX) pump stations. As shown in **Table 5**, no samples were collected at the two interior detention areas (CULC1 and CULC2) and four diversion structures (DS1, DS2, DS3, and DS4). Seven TP samples were collected at outflow site BERMB3.

The TP concentration data collected for all monitoring locations during WY2010 are plotted in time-series and notched-box-and-whisker plots in **Attachment E**, Figures E-1 to E-25. The plots provide a comparison of TP concentration data to detect changes and trends in TP concentrations at C-111 EO #9 monitoring locations. TP concentrations are reported in ppb (or micrograms per liter [µg/L]) unless otherwise noted.

For WY2010, a statistical comparison of TP concentration data for all monitoring locations is presented as notched-box-and-whisker plots in **Figure 13**. This figure represents all samples at inflow structures. Summary statistics of TP data collected for all monitoring locations are presented as a separate table in **Attachment D**, Table D-3 (grab and auto-sampler data are reported separately). A discussion of the TP concentration data observed during WY2010 is provided in the following sections.

Table 5. Flow volumes and flow-weighted mean total phosphorus (TP) concentrations and TP loads of surface water during WY2010.

Type	Structure	Water Quality Station Id	Total Flow Volume (acre-feet)	Sample Size (Grab)	Number of Days with Positive Flow	Arithmetic Average (Grab)(µg/L)	Sample Size (Comp)	Sample Type	Total Samples Collected During Flow	Flow-Weighted Mean Concentration (µg/L)	TP Load (kg)
Inflow	S332B	S332B	164,800	52	290	7.3	41	Auto [1] & Grab [2]	81/93 [3]	7.6	1,554
	S332C	S332C	89,499	51	161	6.7	24	Auto & Grab	43/76	7.7	846
	S332D	S332DX	181,197	51	333	6.6	52	Auto & Grab	95/103	8.2	1,836
Interior	C1	CULC1	0	0	N/D [4]	N/D	N/D	Grab	0/0	N/F [5]	N/F
	C2	CULC2	0	0	N/D	N/D	N/D	Grab	0/0	N/F	N/F
Diversion	DS1	DS1	0	0	N/D	N/D	N/D	Grab	0/0	N/F	N/F
	DS2	DS2	0	0	N/D	N/D	N/D	Grab	0/0	N/F	N/F
	DS3	DS3	0	0	N/D	N/D	N/D	Grab	0/0	N/F	N/F
	DS4	DS4	0	0	N/D	N/D	N/D	Grab	0/0	N/F	N/F
Outflow	BERMB3	BERMB3	0	5	N/D	22.2	N/D	Auto & Grab	0/5	N/F	N/F

Notes:

1) Auto indicates that samples were collected by automatic composite samplers.
2) Grab indicates samples collected by grab sampling methodology.
3) 81/93 indicates 81 samples collected during flow events among 93 total collected samples
4) N/D - no data available
5) N/F - no flow.

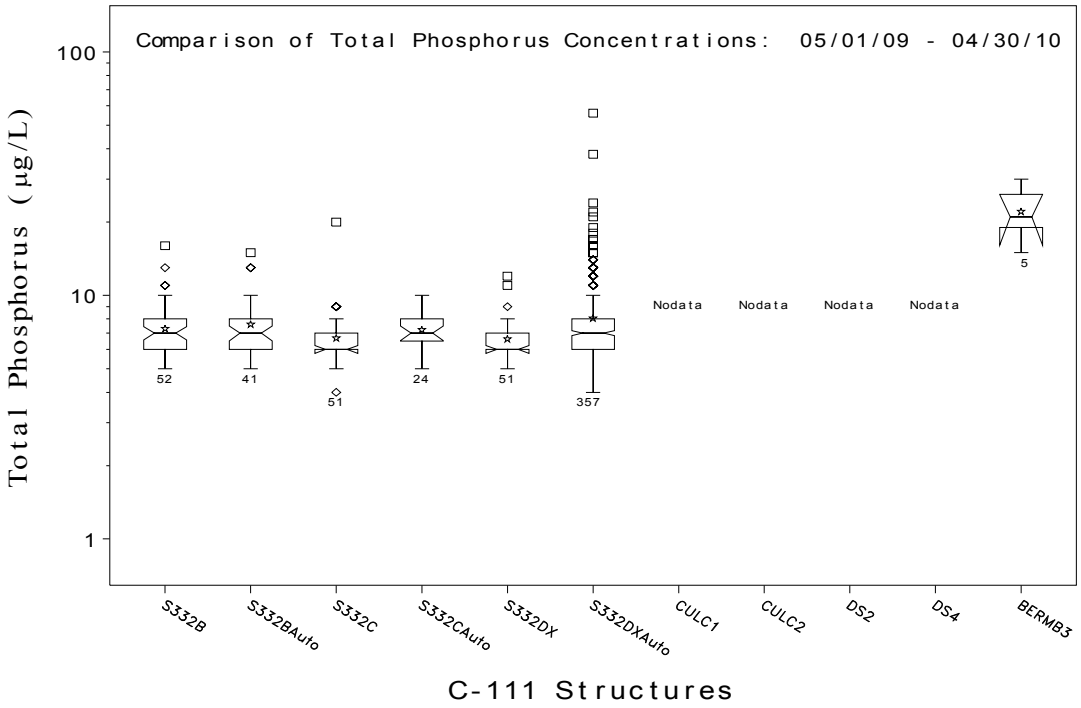


Figure 13. Comparison of TP concentrations for C-111 canal structures.

Inflow Structures

The TP concentrations for the C-111 EO #9 structures discharging directly to the detention areas during WY2010 varied around 10 ppb for all pump stations (**Figure 13**).

As shown in **Table 5**, 93 samples were collected by both grab and auto-samplers, with 81 flow events (a sample was collected when there was flow) at the S-332B site. At the S-332C site, 76 samples were collected by either grab or auto-samplers with 43 flow events. Grab and auto-samplers were used to collect 103 samples at the S-332D pump station (designated water quality station S332DX is at the upstream of S-332D pump station) with 95 flow events.

As shown in Table D-3 of **Attachment D**, more than 75 percent of the TP data collected at the S-332B monitoring sites was below 8 ppb for both grab and auto-sampler, with a median value of 7 ppb for both grab and auto-sampler. More than 75 percent of the TP data collected at the S-332C monitoring sites was below 7 ppb (grab) and 8 ppb (auto-sampler), with a median value of 5 ppb for grab and 7 ppb for auto-sampler. Discharge data monitored at pump stations during WY2010 [164,800 acre-feet (ac-ft) for S-332B and 89,499 ac-ft for S-332C, respectively] indicate the magnitude and occurrence of flow through the structures.

Similar TP concentrations were observed for structure S-332D. More than 75 percent of the TP data collected at the S-332D monitoring sites were below 7 ppb (grab) and 8 ppb (auto-sampler), with median concentrations of 6 ppb for grab and 7 ppb for auto-sampler. During WY2010, structure S-332D discharged 181,191 ac-ft to the detention area.

Interior Structures

As shown in **Table 5**, there was no flow for the two interior structures (CULC1 and CULC2), and no samples were collected at CULC1 and CULC2 in WY2010. Therefore, no TP data were collected at CULC1 or CULC2.

Diversion Structures

As shown in **Figure 11**, DS2 and DS4 are the only diversion structures that could actually discharge into the ENP. However, no flow occurred at any of the four diversion structures (DS1, DS2, DS3, and DS4), so no samples were collected.

Outflow Structures

BERMB3 is the only surface water outflow structure to the ENP. During WY2010, there was no flow from the detention area to the ENP via the BERMB3 structure. Five TP samples were collected at BERMB3 with a concentration of 22.2 ppb (see **Table 5** and **Figure 13**), which were the highest of the C-111 structure. The sampling disturbance probably caused the high concentration due to shallow water depth. Flow rarely occurs over BERMB3 due to the high seepage rates.

Flow-Weighted Mean TP Concentrations for All Structures

Flow-weighted mean (FWM) TP concentrations were calculated for each of the structures for WY2010. The analysis is useful for determining whether additional sampling is required during flow events and provides a more accurate depiction of expected concentrations during flow events. The calculation for FWM TP concentrations was accomplished for structures having sufficient TP and flow data for WY2010. The FWM TP concentrations and the annual and quarterly flow volumes for the inflow and outflow structures during WY2010 are provided in **Attachment B**, Table B-2.

Table 5 presents the results for the FWM TP concentrations at inflow sites during WY2010. The FWM TP concentration for all the inflow structures during WY2010 were around 8 ppb with 7.6 ppb at the S-332B, 7.7 ppb at the S-332C, and 8.2 ppb at the S-332D pump stations. FWM TP concentrations were below 10 ppb at inflow structures S-332C and S-332D. There was no flow at interior, diversion, and outflow structures; therefore, FWM TP concentrations could not be calculated for those sites.

Evaluation of Total Nitrogen

During WY2010, auto-samplers collected TN samples weekly at the S-332B and S-332C pump structures. Deployment of the auto-samplers at these locations was previously identified as an improvement in the monitoring program for collecting TN data at inflow structures. Weekly auto-sampler (time proportional) collection and biweekly grab samples at the respective monitoring locations (S-332B, S-332C, and S-332D) were initiated in 2003 and flow proportional auto-samplers were used later; a discrete time proportional auto-sampler was installed at S-332DX in October 2, 2007, as shown in Table C-2. Auto-samplers collected samples at the S-332D structures in the C-111 basin that discharge water into the S-332D detention area east of the ENP.

The TN concentration data collected for all monitoring locations during WY2010 are plotted in time-series and notched-box-and-whisker plots in **Attachment E**, Figures E-27 through E-44. The plots provide a comparison of TN concentration data to detect changes and trends in TN concentrations at the C-111 EO #9 monitoring locations. TN concentrations are reported in parts per million (ppm) or mg/L unless otherwise noted.

For WY2010, a statistical comparison of TN concentration data for all monitoring locations is presented as notched-box-and-whisker plots in **Figure 14**. The figure represents inflow. Summary statistics of TN data collected for all monitoring locations are presented as a separate table in **Attachment D**, Table D-3 (grab and auto-sampler data are reported separately). A discussion of the TN concentration data observed during WY2010 is provided in the following sections.

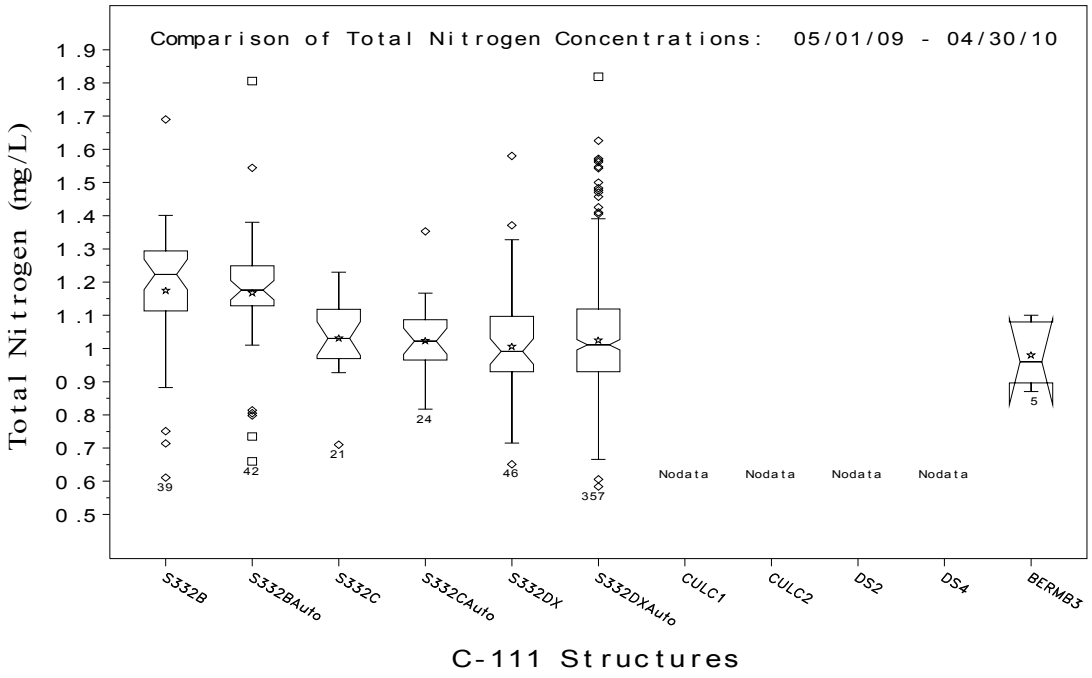


Figure 14. Comparison of total nitrogen (TN) concentrations for C-111 canal structures.

Inflow Structures

There was a similar average TN concentration in grab samples for all inflow structures (1.166 mg/L for S-332B, 1.057 mg/L for S-332C, and 1.042 mg/L for S-332D) discharging into the detention area during WY2010 (**Table 4** and **Figure 14**). As shown in Table D-3 of **Attachment D**, more than 75 percent of the TN data collected at the S-332B monitoring site was below 1.294 mg/L (grab) and 1.249 mg/L (auto-sampler), with median values of 1.223 mg/L (grab) and 1.176 mg/L (auto-sampler). More than 75 percent of the TN data collected at the S-332C monitoring site was below 1.118 mg/L (grab) and 1.087 mg/L (auto-sampler), with median values of 1.030 mg/L (grab) and 1.022 mg/L (auto-sampler).

Interior Structures

As shown in **Table 6**, there was no flow for the two interior structures (CULC1 and CULC2), so no TN grab samples were collected at those sites during WY2010.

Table 6. Flow-weighted mean TN concentrations and TN loads of surface water in WY2010.

Type	Structure	Water Quality Station Id	Total Flow Volume (acre-feet)	Sample Size (Grab)	Number of Days with Positive Flow	Arithmetic Average (Grab) (mg/L)	Sample Size (Comp)	Sample Type	Total Samples Collected During Flow	Flow-Weighted Mean Concentration (mg/L)	TN Load (kg)
Inflow	S332B	S332B	164,800	21	290	1.166	41	Auto [3] & Grab [2]	59/62 [5]	1.192	242,364
	S332C	S332C	89,499	10	161	1.057	23	Auto [3] & Grab [2]	30/33	1.027	113,408
	S332D	S332DX	181,197	27	333	1.042	50	Auto [3] & Grab [2]	72/77	1.005	224,662
Interior	C1	CULC1	0	0	0	N/D	N/D	Grab [2]	N/F [4]	N/F	N/F
	C2	CULC2	0	0	0	N/D	N/D	Grab	N/F	N/F	N/F
Diversion	DS1	DS1	0	0	0	N/D	N/D	Grab	N/F	N/F	N/F
	DS2	DS2	0	0	0	N/D	N/D	Grab	N/F	N/F	N/F
	DS3	DS3	0	0	0	N/D	N/D	Grab	N/F	N/F	N/F
	DS4	DS4	0	0	0	N/D	N/D	Grab	N/F	N/F	N/F
Outflow	BERMB3	BERMB3	0	5	N/D	0.984	N/D	Auto [3] & Grab [2]	0/5	N/F	N/F

Notes:

1) N/D no data available
2) Grab indicates samples collected by grab sampling methodology.
3) Auto indicates that samples were collected by automatic composite samplers.
4) N/F - no flow.
5) 59/62 indicates 59 samples collected during flow events among 62 total collected samples

Diversion Structures

As shown in **Table 6**, there was no flow for the four diversion structures (DS1, DS2, DS3, and DS4). As a result, no samples were collected from diversion structures during WY2010.

Outflow Structures

BERMB3 is the only outflow structure to the ENP. During WY2010, there were no discharges from the detention area to the ENP through the BERMB3 structure. Five outflow TN samples were collected from the upstream (north) side of the berm. This sample had an average TN concentration of 0.984 mg/L.

Flow-Weighted Mean TN Concentrations for All Structures

Flow-weighted mean TN concentrations were calculated for all inflow structures during WY2010. The analysis is useful in determining whether additional sampling is required during flow events and provides a more accurate depiction of expected concentrations during flow events. The calculation for FWM TN concentrations was accomplished for structures having sufficient TN and flow data for WY2010.

The FWM TN concentration and monthly and quarterly flow volumes for the inflow, interior, diversion, and outflow structures during WY2010 are provided in **Attachment B**, Table B-3.

A more detailed analysis of WY2010 FWM TN concentrations for each inflow structure is shown in **Table 6**. Similar FWM TN concentrations were observed at all inflow structures (1.192 mg/L for S-332B, 1.027 mg/L for S-332C, and 1.005 mg/L for S-332D pump station).

GROUNDWATER QUALITY

The groundwater monitoring sites are shown in **Figure 15**. As shown in **Table 7**, TP concentrations were less than 10 ppb at all 12 groundwater wells except S-332CED, where the TP concentration was ranked as a concern (58.3 ppb). However, this value is an anomaly. The high TP levels at S-332CED were investigated, and the well was redeveloped in December 2008 and March 2009. Field investigations indicate S-332CED is the deepest well (185 ft) among all of the wells sampled. The high TP concentration most likely results from mobilization of deep preexisting P-rich geological strata. The TP concentrations in the other shallow wells east of the detention areas (S-332BES, S-332BED, S-332DES, and S-332DED) are considerably lower than S-332CED, and groundwater flows east when the detention areas have flow. The low TP concentration in shallow wells indicates there should be no TP concern for groundwater in normal operation unless the water is pumped from the deep layer (185 ft).

As shown in **Table 8**, TN concentrations in groundwater ranged from 0.117 to 0.971 mg/L. TN concentrations are less than 1 mg/L, which is similar to or slightly lower than the TN in surface water (from 1.042 to 1.166 mg/L, as shown in **Table 6**). Water quality data for WY2010 will be available on request.

The TP and TN mass balances (**Tables 5** through **8**) were estimated based on water balance and concentrations of inflows and groundwater wells. The following assumptions were made for water balance:

- Negligible storage exists in impoundments
- Rainfall is equal to or exceeds evapotranspiration
- Net inflow (all inflows minus outflows) provides a reasonable estimate of seepage

The following assumptions were made for mass balance:

- Rainfall is equal to or exceeds evapotranspiration
- Rainfall contains no TP
- Net inflow (all inflows minus outflows) is lost to seepage to groundwater

As shown in **Table 5**, the flow pumped into the detention areas contained 793 kilograms (kg) of TP at S-332B, 1,441 kg of TP at S-332C, and 746 kg of TP at S-332D. Since no measurable surface water discharge occurred during this monitoring period, none of this load left the detention areas through surface flows. With the notable exception of the TP measured at S332CED, the groundwater wells located on both the western and eastern sides of the detention areas have average water quality similar to inflow concentrations. As shown in **Table 5** and

Table 7, the average surface water inflow (pumped) TP concentrations ranged from 7.6 to 8.2 ppb, whereas the average groundwater concentration in the western wells ranged from 5.0 to 6.3 ppb, and the average concentration in the eastern wells, with the notable exception of S332CED, ranged from 4.3 to 9.5 ppb. It is impossible to ascertain with any certainty that this slight improvement is due to treatment provided by the detention area. Other factors, such as dilution by rainfall and the heterogeneous nature of flow in the highly transmissive layers of the surficial aquifer system, limit the conclusions that can be made based on the water quality data obtained from the monitor wells. In addition, to calculate loading to the ENP, it would be necessary to quantify how much of the seepage flows west.

As shown in **Table 6**, the inflow (pumped) TN load was 242,364 kg at S-332B, 113,408 kg at S-332C, and 224,662 kg at S-332D. The average inflow (pumped) TN concentrations ranged from 1.042 to 1.166 mg/L (**Table 4**), whereas the average concentration in the western wells ranged from 0.712 to 0.976 mg/L, and the average concentration in the eastern wells ranged from 0.125 to 0.864 mg/L (**Table 6**). The TN concentrations in wells were generally slightly lower than TN concentrations of inflow structures.

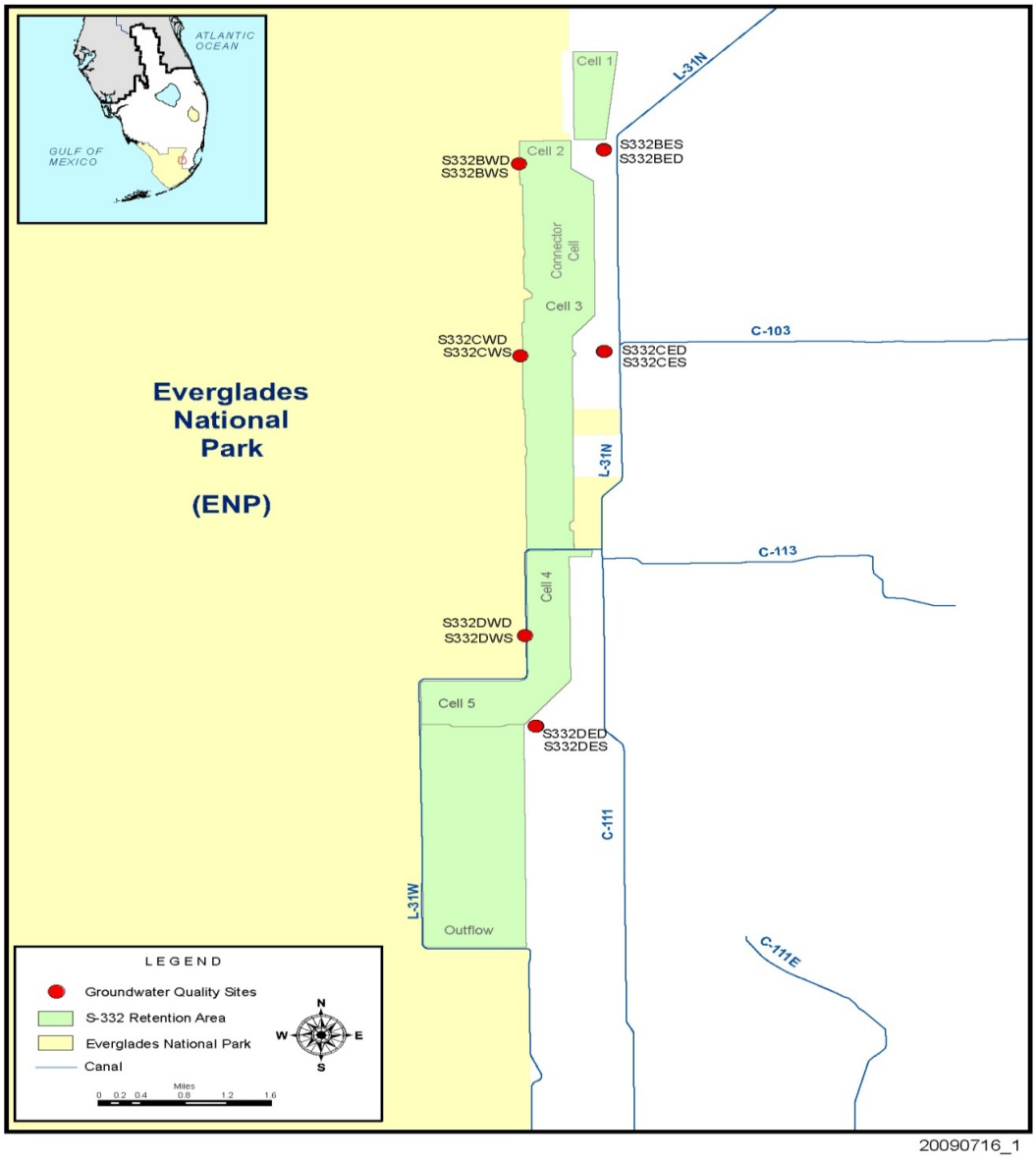


Figure 15. Groundwater monitoring locations and numbering for S-332B, S-332C, and S-332D.

Table 7. Average TP concentrations and TP loads of groundwater during WY2010.

Type	Structure	Water Quality Station Id	Total Flow Volume (acre-feet) [3]	Sample Size (Grab)	Arithmetic Average (Grab)(ug/L or ppb)	Sample Type	TP Load (kg)
Groundwater	S332B	S332BED[1]	164,800	4	6.3	Grab [2]	793
		S332BES		4	6.3	Grab [2]	
		S332BWD		4	6.0	Grab [2]	
		S332BWS		4	5.3	Grab [2]	
	S332C	S332CED	89,499	4	58.3	Grab [2]	1,441
		S332CES		4	9.5	Grab [2]	
		S332CWD		4	5.5	Grab [2]	
		S332CWS		4	6.3	Grab [2]	
	S332D	S332DED	181,197	4	4.3	Grab [2]	746
		S332DES		4	5.8	Grab [2]	
		S332DWD		3	5.0	Grab [2]	
		S332DWS		3	5.3	Grab [2]	

Notes:

1) S332BED: S332B=station name; E=east; W=west; D=deep and S=shallow.

2) Grab indicates samples collected by grab sampling methodology.

3) The following assumptions were made for water balance:

   a) negligible storage in impoundments

   b) rainfall and evapotranspiration are equal

   c) net inflow (all inflows minus outflows) is lost to seepage to groundwater

4) The following assumptions were made for mass balance:

   a) rainfall and evapotranspiration are equal

   b) net inflow (all inflows minus outflows) is lost to seepage to groundwater

   c) net mass balances (all inflows minus outflows, minus lost to seepage to groundwater) are due to sediment relase or sediment adsorption

Table 8. Average TN concentrations and TN loads of groundwater during WY2010.

Type	Structure	Water Quality Station Id	Total Flow Volume (acre-feet) [3]	Sample Size (Grab)	Arithmetic Average (Grab)(mg/L)	Sample Type	TN Load (kg)
Groundwater	S332B	S332BED[1]	164,800	4	0.856	Grab [2]	120,605
		S332BES		3	0.864	Grab [2]	
		S332BWD		4	0.918	Grab [2]	
		S332BWS		4	0.976	Grab [2]	
	S332C	S332CED	89,499	4	0.125	Grab [2]	44,473
		S332CES		4	0.828	Grab [2]	
		S332CWD		4	0.712	Grab [2]	
		S332CWS		4	0.790	Grab [2]	
	S332D	S332DED	181,197	2	0.640	Grab [2]	105,156
		S332DES		2	0.741	Grab [2]	
		S332DWD		2	0.759	Grab [2]	
		S332DWS		2	0.726	Grab [2]	

Notes:

1) S332BED: S332B=station name; E=east; W=west; D=deep and S=shallow.

2) Grab indicates samples collected by grab sampling methodology.

3) The following assumptions were made for water balance:

   a) negligible storage in impoundments

   b) rainfall and evapotranspiration are equal

   c) net inflow (all inflows minus outflows) is lost to seepage to groundwater

4) The following assumptions were made for mass balance:

   a) rainfall and evapotranspiration are equal

   b) net inflow (all inflows minus outflows) is lost to seepage to groundwater

   c) net mass balances (all inflows minus outflows, minus lost to seepage to groundwater) are due to sediment relase or sediment adsorption

PESTICIDE MONITORING

A modification was implemented on September 10, 2007, to eliminate pesticide monitoring at S-332B and S-332C sites and use S-331–S-173 as a surrogate pesticide monitoring site. The results of the quarterly surface water pesticide sampling events for WY2010 are presented in **Table 9**.

To evaluate the potential impacts on aquatic life, the observed concentration is compared to the appropriate criterion outlined in Section 62-302.530, F.A.C. If a pesticide compound is not specifically listed, acute and chronic toxicity criterion can be calculated as one-third and one-twentieth, respectively, of the amount lethal to 50 percent of the test organisms in 96 hours, using the lowest technical grade EC_{50} or LC_{50} reported in the summarized literature for the species significant to the indigenous aquatic community (Section 62-302.200, F.A.C.) (**Table 10**).

The draft atrazine ambient aquatic life water quality criteria identify a one-hour average concentration that does not exceed 1,500 µg/L more than once every three years on the average (USEPA, 2003). The highest atrazine surface water concentrations detected (0.034 µg/L) should not have an acute or chronic detrimental impact on fish or invertebrates (**Table 10**).

The only ametryn surface water concentrations found was 0.010 µg/L (**Table 10**). Using these criteria, these observed surface water concentration should not have an acute, detrimental impact on fish or aquatic invertebrates.

Table 9. Quarterly pesticide detections (µg/L) for WY2010.

			Compound	
Sampling Date	Flow	Site	Ametryn	Atrazine
4/28/2009	No	S332DX	BDL	0.034 I
	No	S331	BDL	0.022 I*
8/3/2009	Yes	S332DX	BDL	0.014 I
	Yes	S331	BDL	0.014 I
10/26/2009	Yes	S332DX	BDL	BDL
	Yes	S331	BDL	BDL
3/24/2010	Yes	S332DX	BDL	0.022 I
	No	S331	0.010 I	BDL

I – value reported is less than the practical quantitation limit, and greater than or equal to the method detection limit

BDL – below method detection limit

* – result is the average of replicate samples

Table 10. Toxicity of pesticides detected to freshwater aquatic invertebrates and fishes (µg/L).

Common Name	48 hr EC_{50} Water flea *Daphnia magna*	acute toxicity (*)	chronic toxicity (*)	96 hr LC_{50} Fathead Minnow (#) *Pimephales promelas*	acute toxicity	chronic toxicity	96 hr LC_{50} Bluegill *Lepomis macrochirus*	acute toxicity	chronic toxicity	96 hr LC_{50} Largemouth Bass *Micropterus salmoides*	acute toxicity	chronic toxicity	96 hr LC_{50} Rainbow Trout (#) *Oncorhynchus mykiss*	acute toxicity	chronic toxicity	96 hr LC_{50} Channel Catfish *Ictalurus punctatus*	acute toxicity	chronic toxicity
ametryn	28,000 (1)	9,333	1,400	16,000 (3)	5,333	800	4,100 (2)	1,367	205	-	-	-	8,800 (2)	2,933	440	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-	3,600 (3)	1,200	180	-	-	-
atrazine	6,900 (1)	2,300	345	15,000 (1)	5,000	750	16,000 (2)	5,333	800	-	-	-	8,800 (2)	2,933	440	7,600 (2)	2,533	380
	-	-	-	-	-	-	-	-	-	-	-	-	5,300 (4)	1,767	265	-	-	-

(*) Florida Administrative Code Section 62-302.200, for compounds not specifically listed, acute and chronic toxicity standards are calculated as one-third and one-twentieth, respectively, of the amount lethal to 50% of the test organisms in 96 hours, where the 96 hour LC_{50} is the lowest value which has been determined for a species significant to the indigenous aquatic community.
(#) Species is not indigenous. Information is given for comparison purposes only.

(1) U.S. EPA (1991)
(2) Hartley and Kidd (1987)
(3) U.S. EPA (2005)
(4) U.S. EPA (2006)

MERCURY MONITORING

This report summarizes mercury monitoring results for the C-111 Canal Project. This project has two mercury monitoring components: C-111D and C-111F. The monitoring locations for C-111D and C-111F are showed in Figure 11. Project C-111D is used for the collection of surface water for total mercury (THg) and methylmercury (MeHg) analysis and C-111F is used for the collection of various fish species for THg analysis. During the course of the entire project, THg surface water levels were well below the 12 nanograms per liter (ng/L) Florida Class III numerical water quality standard. Under the same approved mandate, largemouth bass and sunfish were eliminated from C-111F and mosquitofish (*Gambusia holbrooki*) monitoring was reduced to annual collection. Previous information on C-111D and C-111F sampling is provided in previous South Florida Environmental Report (SFWMD, 2009).

Figure 16 provides the latest information for C-111F. In 2009, mosquitofish levels were well below the Southern Everglades 75th percentile concentration of 0.08 mg/kg (for the period of record up to 2009) and the U.S. Fish and Wildlife Service predator protection criteria of 0.1 milligram per kilogram (mg/kg), therefore demonstrating no threat to piscivorous avian and mammalian wildlife. However, all locations show an apparent increasing trend for the period of record except the outflow location (BERM3). Mercury levels in C-111 mosquitofish are below average levels found in several Stormwater Treatment Areas and all downstream Everglades monitoring locations (see Volume I, Appendices 3B-1 and 5-5).

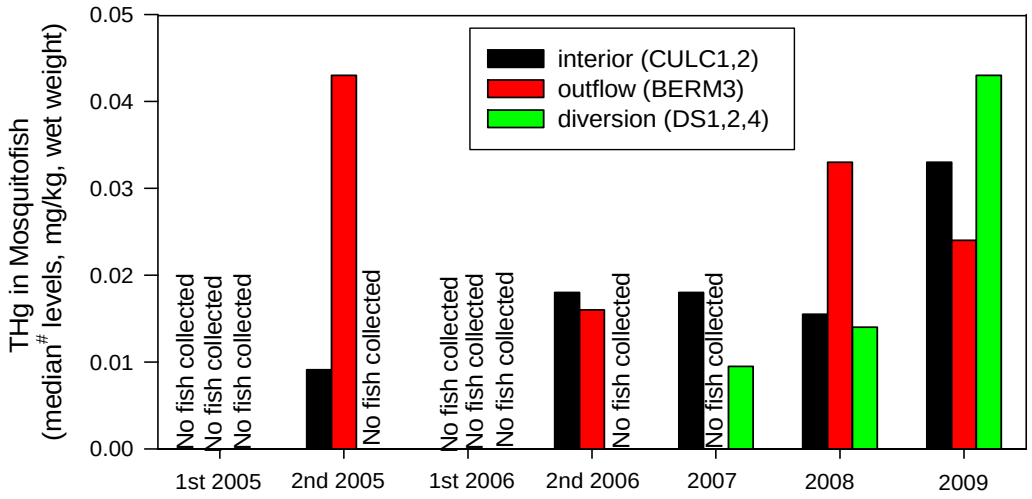


Figure 16. Monitoring results for THg in mosquitofish (# the average was calculated if n = 2; otherwise, the median was calculated). Semiannual collections were done in April and October; annual collections were done in October.

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Attachment A: Specific Conditions and Cross-References

Table A-1. Specific conditions and cross-references presented in this report.

Condition	Table	Narrative (pages)	Figure
Specific Condition 25: The USACE will conduct monitoring activities for operation of the S-332B, S332C, and S-332D pump stations and appurtenant structures as described in Exhibit B of this Emergency Final Order. All reports and data generated as a result of this monitoring shall be submitted to the Water Quality Standards and Special Projects Program (at the address listed above) upon receipt by the USACE and within a timely manner.	1–8	App. 5-2-1 – 5-2-42	1–16
Exhibit B	B-1–B-3	Att. B	---
Exhibit B	---	Att. C	C-1–C-16
Exhibit B	D-1–D-5	Att. D	---
Exhibit B	---	Att E	E-1–E-44
Exhibit B, page 5	---	Att. F	---

Attachment B: Interim Operational Plan Water Quality Sampling Sites, Monitoring Schedule, Flow Volumes and Flow-Weighted Mean Concentrations for Water Year 2010

Shi Kui Xue

Table B-1. Water quality monitoring schedule for the Interim Operational Plan (IOP) for Protection of the Cape Sable Seaside Sparrow (CSSS) discharge structures and associated monitoring locations.

AREA	EO #9 PERMIT STRUCTURE	WATER QUALITY SAMPLING SITE	WATER QUALITY MONITORING SCHEDULE							
			Physical	Nutrients	Major Ions	Trace Metals	Total Hg	THG in Bass	THg in Mosquitofish	Pesticides Water
Inflow	S332 B	S332 B	BW	BW,WF (autosampler)	QTR	QTR	QTR			QTR
	S332C	S332C	BW		QTR	QTR	QTR			QTR
	S332D	S332DX	BW		QTR	QTR	QTR			QTR
Interior	C1	CULC1	Monthly	Monthly	Monthly		QTR			
	C2	CULC2	Monthly	Monthly	Monthly		QTR			
Outflow	BERMB3	BERMB3	BW	BW,WF (autosampler)	QTR	QTR	QTR			QTR
Diversion	DS1	DS1	Event	Event	Event		Event			Event
	DS2	DS2	Event	Event	Event		Event			Event
	DS3	DS3	Event	Event	Event		Event			Event
	DS4	DS4	Event	Event	Event		Event			Event
Cell	1								Annually	
	2								Annually	
	3								Annually	
	4								Annually	
	5								Annually	
	Flow Way								Annually	
Groundwater	S332B	S332BES	QTR	QTR	QTR	QTR				SA
		S332BED	QTR	QTR	QTR	QTR				SA
		S332BWS	QTR	QTR	QTR	QTR				SA
		S332BWD	QTR	QTR	QTR	QTR				SA
	S332C	S332CES	QTR	QTR	QTR	QTR				SA
		S332CED	QTR	QTR	QTR	QTR				SA
		S332CWS	QTR	QTR	QTR	QTR				SA
		S332CWD	QTR	QTR	QTR	QTR				SA
	S332D	S332DES	QTR	QTR	QTR	QTR				SA
		S332DED	QTR	QTR	QTR	QTR				SA
		S332DWS	QTR	QTR	QTR	QTR				SA
		S332DWD	QTR	QTR	QTR	QTR				SA

Table Legend:
BW =Biweekly
WF=Weekly if flowing
QTR =Quarterly
SA =Semiannually

Table B-2. Flow volume and average total phosphorus concentrations for IOP for Protection of the CSSS structures during WY2010.

Type	EO #9 PERMIT STRUCTURE	WATER QUALITY SAMPLING SITE	FLOW		Quarterly Flow				Total Flow Volume (acre-ft)	Average TP Concentration (ppb) by quarter				TP Load (kg) by quarter				Total Load (kg)
			STATION	DBKEY	1st	2nd	3rd	4th		1st	2nd	3rd	4th	1st	2nd	3rd	4th	
inflow	S332B	S332B	S332B	TB064	37,036	63,384	34,545	29,835	164,800	8	8	6	10	348	594	254	359	1,554
	S332C	S332C	S332C	UT724	22,989	59,462	3,806	3,241	89,499	8	8	6	9	232	552	27	35	846
	S332D	S332D	S332D	TA413	32,202	83,066	40,306	25,622	181,197	8	9	8	7	299	945	384	208	1836
interior	C1	CULC1			NPF [3]	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF
	C2	CULC2			NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF
Diversion	DS1	DS1	DS1		NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF
	DS2	DS2	DS2		NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF
	DS3	DS3	DS3		NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF
	DS4	DS4	DS4		NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF
Outflow	BERMB3	BERMB3	BERMB3		NPF	NPF	NPF	NPF	NPF	NPF	22.0	30.0	15.0	NPF	NPF	NPF	NPF	NPF
Groundwater	S332B	S332BED	n/a [2]	n/a	n/a	n/a	n/a	n/a	164,800	7	7	5	6	n/a	n/a	n/a	n/a	793
		S332BES	n/a	n/a	n/a	n/a	n/a	n/a		9	6	5	5	n/a	n/a	n/a	n/a	
		S332BWD	n/a	n/a	n/a	n/a	n/a	n/a		4	7	6	7	n/a	n/a	n/a	n/a	
		S332BWS	n/a	n/a	n/a	n/a	n/a	n/a		6	5	5	5	n/a	n/a	n/a	n/a	
	S332C	S332CED	n/a	n/a	n/a	n/a	n/a	n/a	89,499	83	46	51	53	n/a	n/a	n/a	n/a	1,441
		S332CES	n/a	n/a	n/a	n/a	n/a	n/a		11	8	8	11	n/a	n/a	n/a	n/a	
		S332CWD	n/a	n/a	n/a	n/a	n/a	n/a		6	6	4	6	n/a	n/a	n/a	n/a	
		S332CWS	n/a	n/a	n/a	n/a	n/a	n/a		7	6	6	6	n/a	n/a	n/a	n/a	
	S332D	S332DED	n/a	n/a	n/a	n/a	n/a	n/a	181,197	5	3	3	6	n/a	n/a	n/a	n/a	744
		S332DES	n/a	n/a	n/a	n/a	n/a	n/a		6	5	6	6	n/a	n/a	n/a	n/a	
		S332DWD	n/a	n/a	n/a	n/a	n/a	n/a		n/a	4	6	5	n/a	n/a	n/a	n/a	
		S332DWS	n/a	n/a	n/a	n/a	n/a	n/a		n/a	5	6	5	n/a	n/a	n/a	n/a	

Notes: 1) Water quality sample site is located on upstream side of permitted structure, unless otherwise noted with different sampling location.

2) n/a indicates that flow and/or stage data are not available, or that structure is not appropriately instrumented to capture information.

3) NPF indicates either structure was closed or that no positive flow was recorded on sampling days, thus a flow-weighted mean could not be calculated.

4) M-Data were missing

Table B-3. Flow volume and average total nitrogen concentrations for IOP for Protection of the CSSS structures during WY2010.

Type	EO #9 PERMIT STRUCTURE	WATER QUALITY SAMPLING SITE	FLOW		Quarterly Flow				Total Flow Volume (acre-ft)	Average TN Concentration (ppm) by quarter				TN Load (kg) by quarter				Total Load (kg)
			STATION	DBKEY	1st	2nd	3rd	4th		1st	2nd	3rd	4th	1st	2nd	3rd	4th	
inflow	S332B	S332B	S332B	TB064	37,036	63,384	34,545	29,835	164,800	1.079	1.198	1.141	1.374	49352	93713	48679	50621	242,364
	S332C	S332C	S332C	UT724	22,989	59,462	3,806	3,241	89,499	0.900	1.077	0.999	1.018	25557	79082	4695	4074	113,408
	S332D	S332D	S332D	TA413	32,202	83,066	40,306	25,622	181,197	0.865	1.035	1.003	1.081	34405	106150	49900	34208	224,662
interior	C1	CULC1			NPF	NPF	NPF	NPF	NPF	1.905	NPF	0.560	NPF	NPF	NPF	NPF	NPF	NPF
	C2	CULC2			NPF [2]	NPF	NPF	NPF	NPF	0.870	NPF	0.588	NPF	NPF	NPF	NPF	NPF	NPF
Diversion	DS1	DS1	DS1		NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF
	DS2	DS2	DS2		NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF
	DS3	DS3	DS3		NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF
	DS4	DS4	DS4		NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF
Outflow	BERMB3	BERMB3	BERMB3	n/a	NPF	NPF	NPF	NPF	NPF	NPF	0.910	1.105	1.085	NPF	NPF	NPF	NPF	NPF
Groundwater	S332B	S332BED	n/a	n/a	n/a	n/a	n/a	n/a	164,800	0.715	0.935	0.899	0.875	n/a	n/a	n/a	n/a	113,510
		S332BES	n/a	n/a	n/a	n/a	n/a	n/a		0.803	0.865	0.014	0.925	n/a	n/a	n/a	n/a	
		S332BWD	n/a	n/a	n/a	n/a	n/a	n/a		0.851	0.885	0.979	0.955	n/a	n/a	n/a	n/a	
		S332BWS	n/a	n/a	n/a	n/a	n/a	n/a		0.765	1.025	1.130	0.985	n/a	n/a	n/a	n/a	
	S332C	S332CED	n/a	n/a	n/a	n/a	n/a	n/a	89,499	0.135	0.135	0.114	0.115	n/a	n/a	n/a	n/a	44,473
		S332CES	n/a	n/a	n/a	n/a	n/a	n/a		0.725	0.730	0.910	0.945	n/a	n/a	n/a	n/a	
		S332CWD	n/a	n/a	n/a	n/a	n/a	n/a		0.625	0.755	0.753	0.715	n/a	n/a	n/a	n/a	
		S332CWS	n/a	n/a	n/a	n/a	n/a	n/a		0.775	0.848	0.811	0.725	n/a	n/a	n/a	n/a	
	S332D	S332DED	n/a	n/a	n/a	n/a	n/a	n/a	181,197	M	0.629	0.651	M	n/a	n/a	n/a	n/a	105,156
		S332DES	n/a	n/a	n/a	n/a	n/a	n/a		M	0.700	0.782	M	n/a	n/a	n/a	n/a	
		S332DWD	n/a	n/a	n/a	n/a	n/a	n/a		M	0.695	0.823	M	n/a	n/a	n/a	n/a	
		S332DWS	n/a	n/a	n/a	n/a	n/a	n/a		M	0.686	0.766	M	n/a	n/a	n/a	n/a	

Notes: 1) Water quality sample site is located on upstream side of permitted structure, unless otherwise noted with different sampling location.

2) n/a indicates that flow and/or stage data are not available, or that structure is not appropriately instrumented to capture information.

3) NPF indicates either structure was closed or that no positive flow was recorded on sampling days, thus a flow-weighted mean could not be calculated.

4) M-Data were missing

Attachment C: Time-Series and Box Plots for Water Quality Monitoring Data Exhibiting Excursions from Class III Numeric Standards for Water Year 2010

Shi Kui Xue and Steven Hill

The graphs in this attachment (**Figures C-1** through **C-14**) correspond to the Interim Operational Plan (IOP) for Protection of the Cape Sable Seaside Sparrow (CSSS) water quality monitoring sites exhibiting excursions during Water Year 2010 (WY2010) (May 1, 2009–April 30, 2010), as shown in **Table 3**. The graph sequencing follows the station and parameter order shown in that table. The C-111 Canal Project's EO #9 structure locations are depicted in **Figure 1**. Additionally, the graphs are identified by the monitoring site name. In most cases, the monitoring site name corresponds to the structure. If the monitoring site is a surrogate location for a structure, then the structure name(s) is/are shown in parentheses below the monitoring site name.

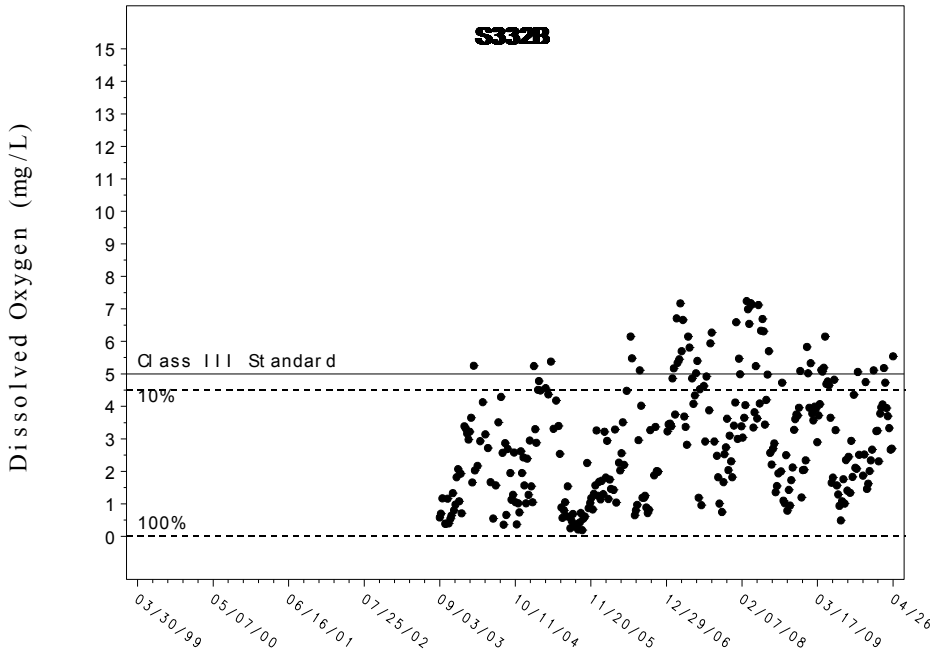

Figure C-1. Dissolved oxygen (DO) excursion at S-332B.

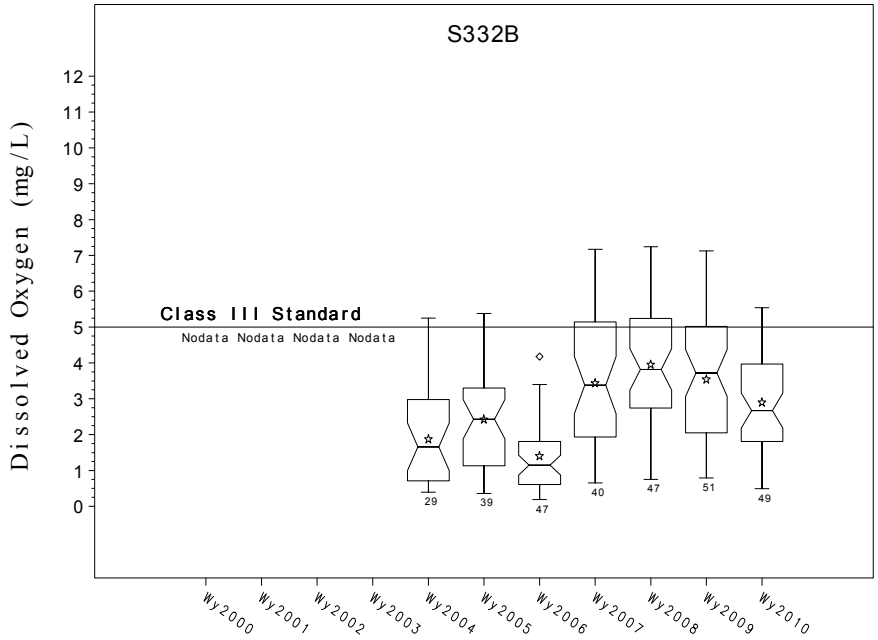

Figure C-2. DO notched-box-and-whisker plot at S-332B.

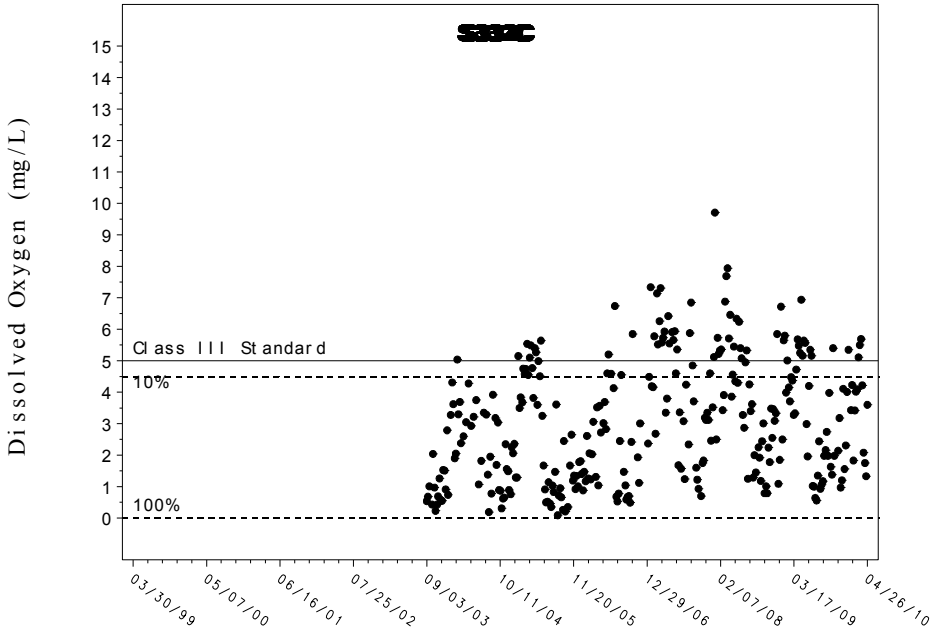

Figure C-3. DO excursion at S-332C.

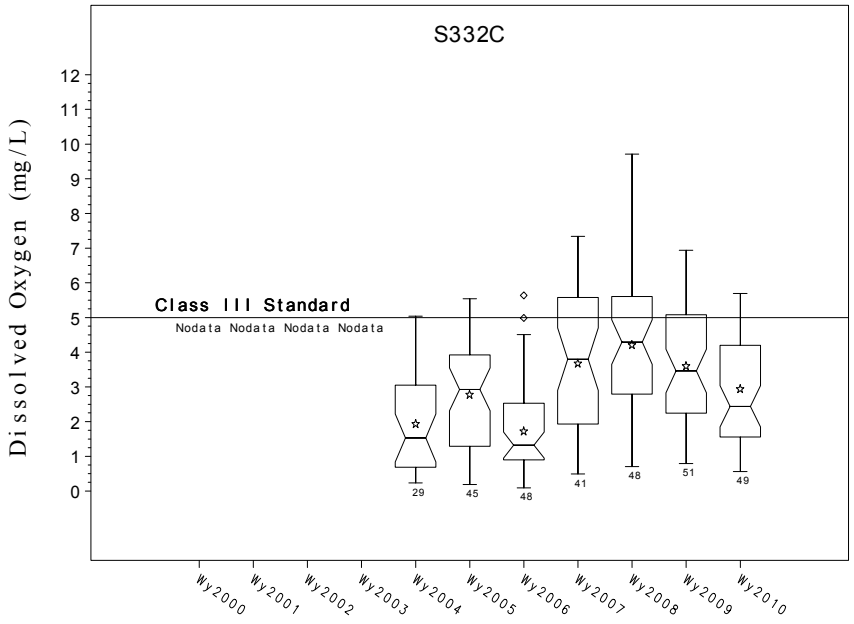

Figure C-4. DO notched-box-and-whisker plot at S-332C.

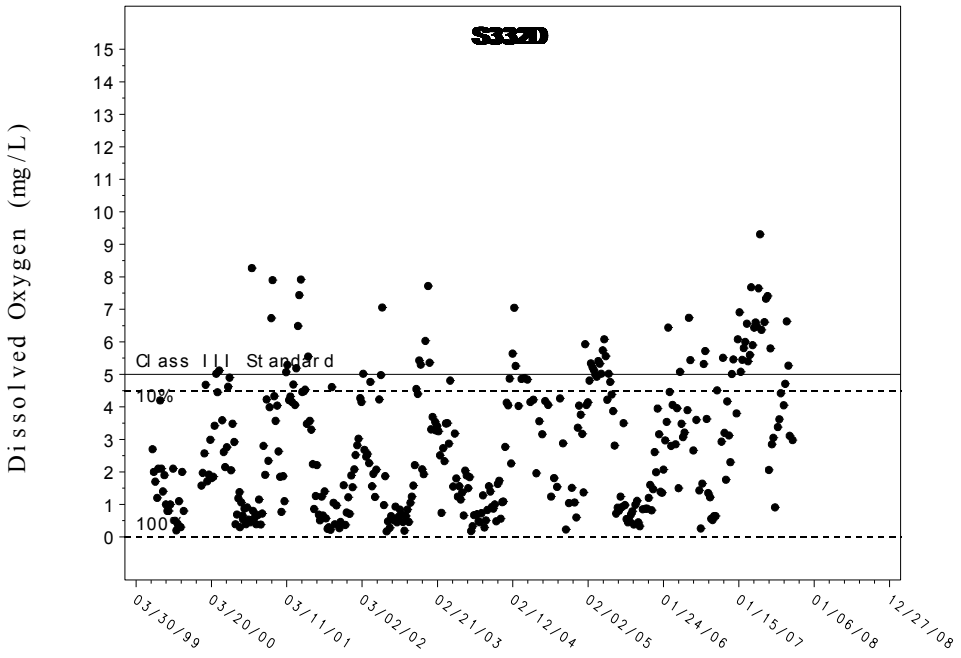

Figure C-5. DO excursion at S-332D.

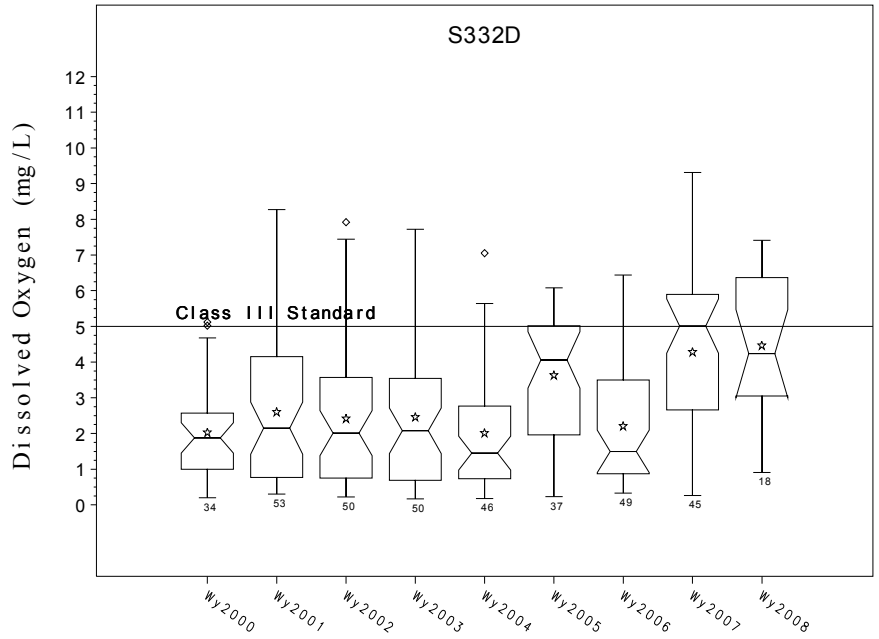

Figure C-6. DO notched-box-and-whisker plot at S-332D.

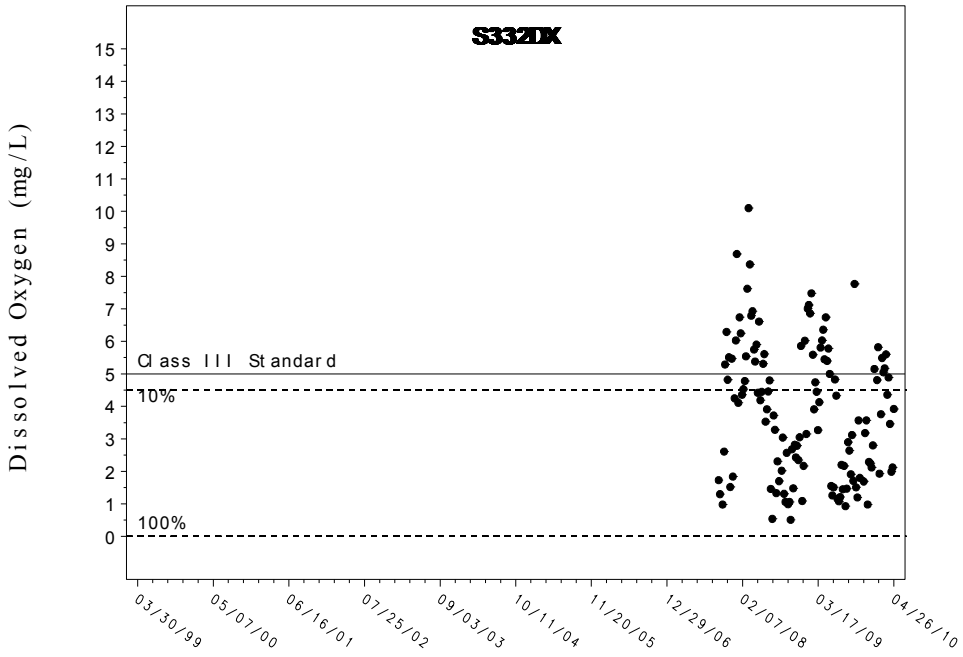

Figure C-7. DO excursion at S-332DX.

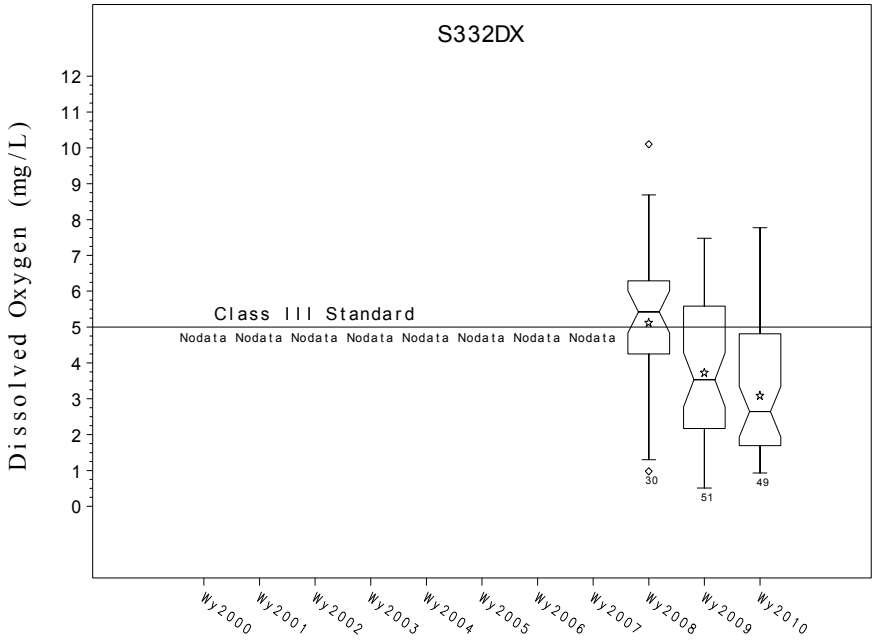

Figure C-8. DO notched-box-and-whisker plot at S-332DX.

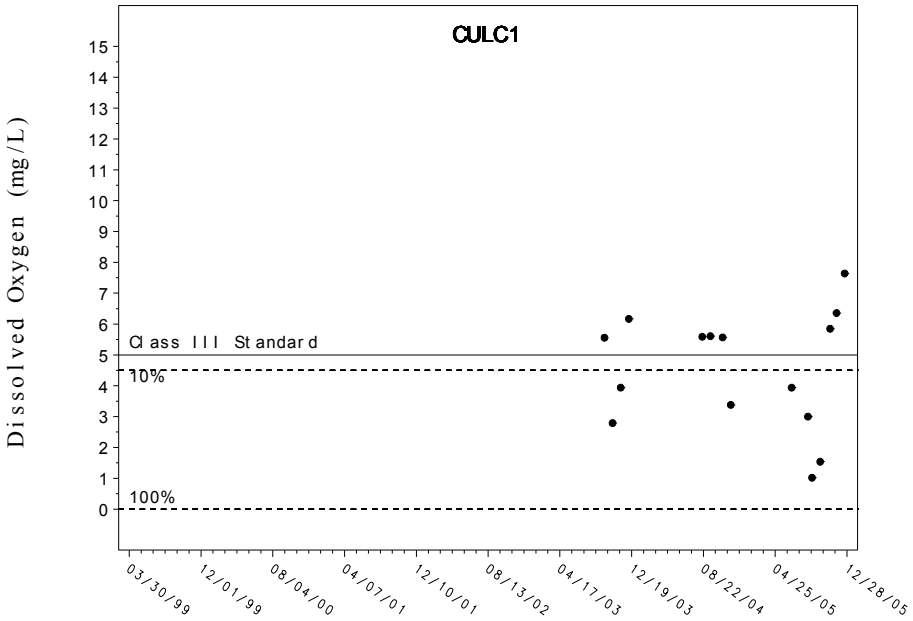

Figure C-9. DO excursion at CULC1.

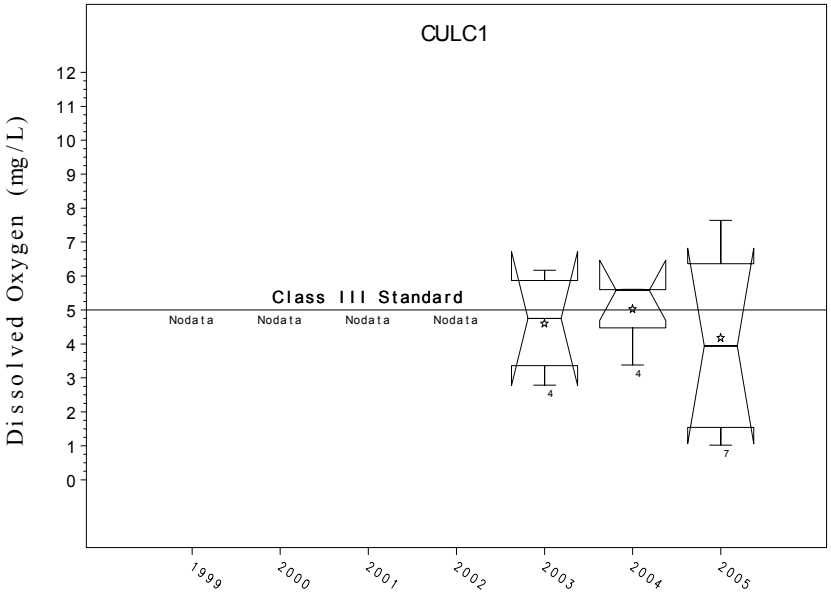

Figure C-10. DO notched-box-and-whisker plot at CULC1.

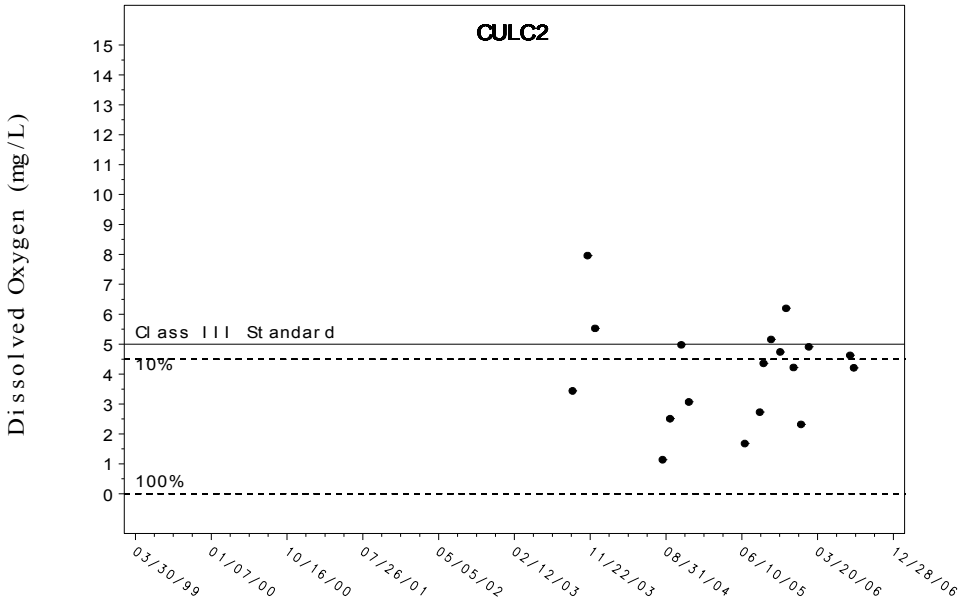

Figure C-11. DO excursion at CULC2.

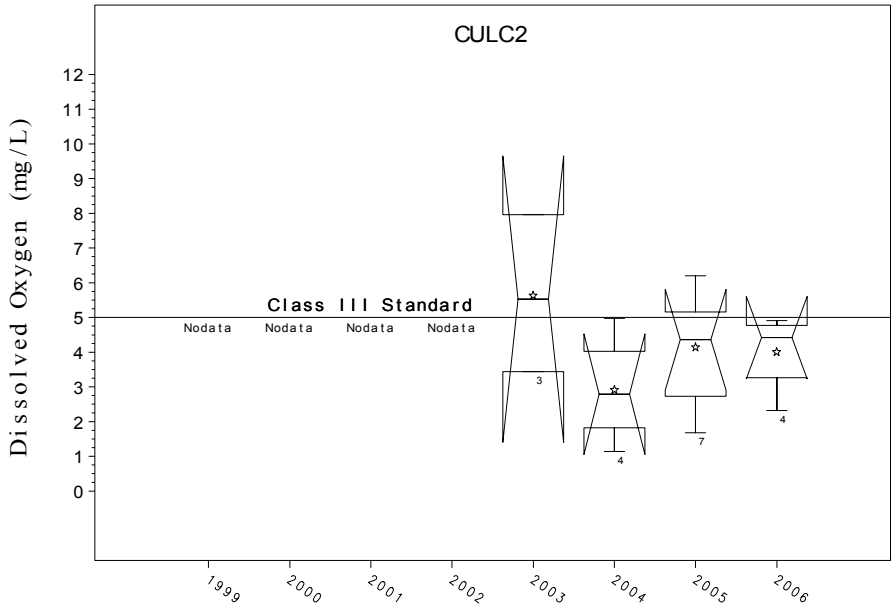

Figure C-12. DO notched-box-and-whisker plot at CULC2.

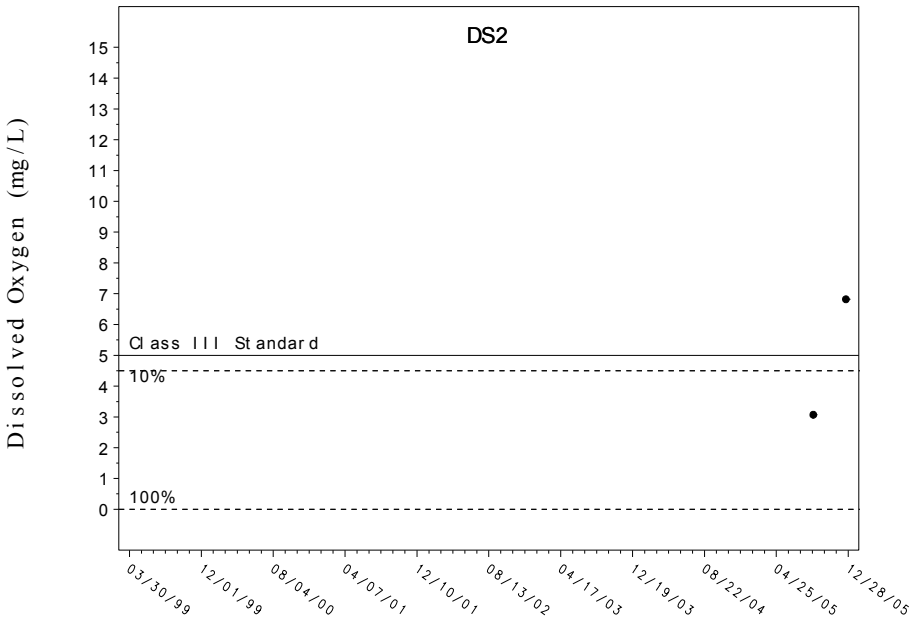

Figure C-13. DO excursion at DS2.

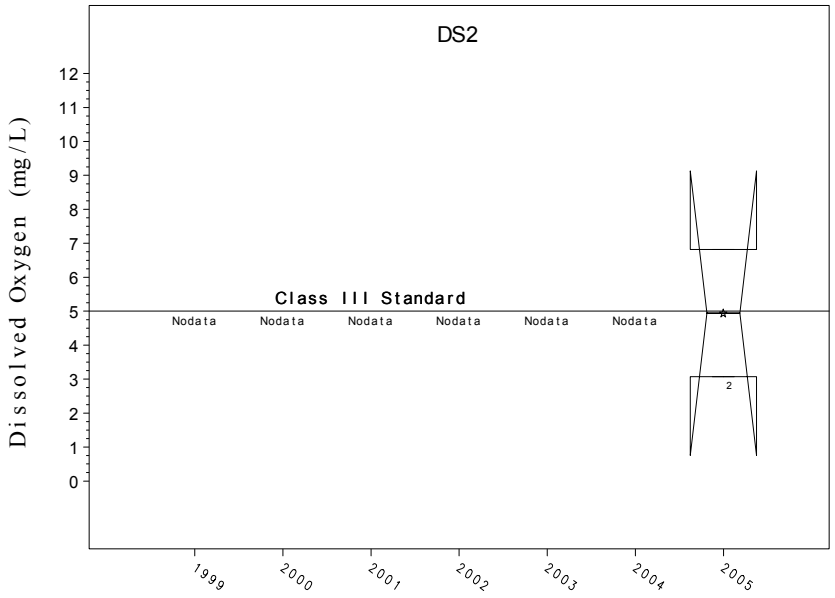

Figure C-14. DO notched-box-and-whisker plot at DS2.

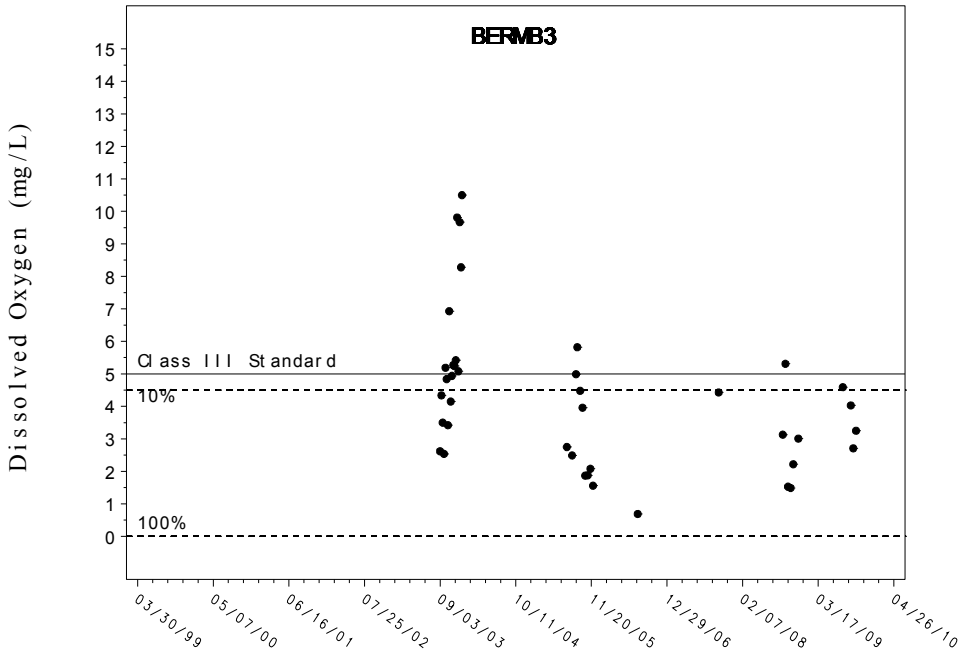

Figure C-15. DO excursion at BERMB3.

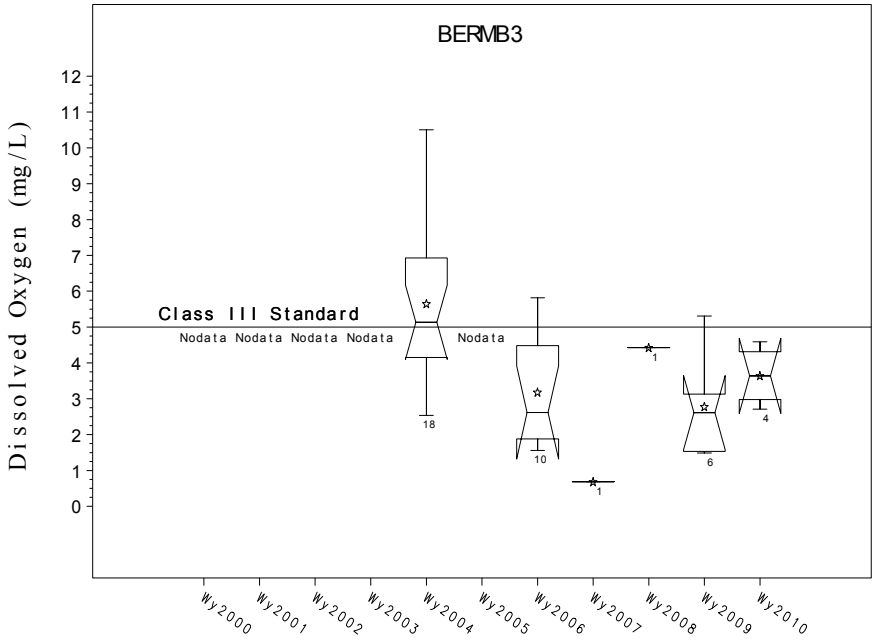

Figure C-16. DO notched-box-and-whisker plot at BERMB3.

Attachment D: Summary Statistics of C-111 Water Quality Monitoring Data for Water Year 2010

Shi Kui Xue and Steven Hill

Summary statistics are tabulated in **Table D-3** of this attachment for all parameters collected during WY2010 at the IOP for Protection of the CSSS water quality monitoring sites. **Table D-1** presents the water quality parameters associated with the summary statistics and their associated Florida Class III Fresh Surface Water Criteria [Chapter 62-302.530, Florida Administrative Code (F.A.C.)]. Additionally, the parameter summary statistics shown in **Table D-3** are sequenced according to the order shown in **Table D-1**. The monitoring sites are sequenced in the order shown in **Table D-2**. The C-111 EO #9 structure locations are depicted in **Figure 1**. **Table D-4** summarizes data of total dissolved solids and **Table D-5** summarizes data of dissolved organic carbon.

Table D-1. Class III criteria reference table for surface water quality parameters presented in summary statistics on **Table C-3**.

Parameter Name	Abbreviated Parameter Name	Units	SFWMD Lab Number	Class III Criteria Predominantly Fresh Surface Waters Section 62-302.530, F.A.C.
PHYSICAL				
Dissolved Oxygen	DO	mg/L	8	Not less than 5.0 mg/L
Specific Conductance (Field)	FLDCOND	µmhos/cm	9	Not greater than 50% above background or 1,275 µmhos/cm, whichever is greater
pH (Field)	PH	units	10	Not less than 6.0 or greater than 8.5
Turbidity	TURBIDITY	ntu	12	Less than or equal to 29 NTU above natural background
Total Suspended Solids	TSS	mg/L	16	None
Color	COLOR	units	13	None
Hardness	HARDNESS	mg/L as $CaCO_3$	35	None
Temperature	TEMP	centigrade	7	None
Alkalinity	ALKALINITY	mg/L	67	Not less than 20 mg/L
NUTRIENTS				
Total Nitrogen	TN	mg N/L	80	narrative criteria
Nitrite + Nitrate	NOX	mg N/L	18;180	narrative criteria
Nitrite	NO2	mg N/L	19	narrative criteria
Nitrate	NO3	mg N/L	78	narrative criteria
Ammonium	NH4	mg N/L	182	narrative criteria
Un-Ionized Ammonia	UN-IONIZED AMMONIA	mg/L as NH_3	NONE	Less than or equal to 0.02 mg/L
Total Kjeldahl Nitrogen	TKN	mg N/L	21	narrative criteria
Ortho-Phosphorus	OPO4	mg P/L	23	narrative criteria
Total Phosphorus	TP	mg P/L	25	narrative criteria
MAJOR IONS				
Dissolved Calcium	DIS. CA	mg/L	30	None
Dissolved Potassium	DIS. K	mg/L	29	None
Dissolved Magnesium	DIS. MG	mg/L	31	None
Dissolved Sodium	DIS. NA	mg/L	28	None
Dissolved Silica	DIS. SILICA	mg/L	27	None
Total Sulfate	TOT. SO4	mg/L	33	None
Total Chlorides	TOT. CL	mg/L	32	None
TRACE ELEMENTS				
Total Cadmium	TOT. CD	µg/L	103	$e^{(0.7852[\ln(\text{Hardness})-3.49])}$ µg/L
Total Copper	TOT. CU	µg/L	104	Less than or equal to calculated value using: $e^{(0.8545[\ln(\text{Hardness})-1.702])}$ µg/L
Total Mercury	TOT. HG	µg/L	102	Less than or equal to .012 µg/L
Total Zinc	TOT. ZN	µg/L	105	Less than or equal to calculated value using: $e^{(0.8473[\ln(\text{Hardness})+0.884])}$ µg/L
Total Iron	TOT. FE	mg/L	177	Less than or equal to 1.0 mg/L

Table D-2. Reference table for cross-referencing water quality monitoring sites with C-111 Canal Project's Emergency Order #9 (C-111 EO #9) discharge structures and the monitoring data summary statistics shown in **Table C-3**.

STRUCTURE CATEGORY	EMERGENCY ORDER #9 PERMIT STRUCTURE	WATER QUALITY SAMPLING SITE	TOTAL DEPTH (feet)	COMMENTS
Inflow	S332B	S332B	Surface	Weekly time composite auto-sampler was installed in 2003, 100 ml sample was drawn every 3 hours, changed from time proportional to flow proportional with triggering flow volume of 1.2 million cubic feet on 3/1/05
	S332C	S332C	Surface	Weekly time composite auto-sampler was installed in 2003, 100 ml sample was drawn every 3 hours, changed from time proportional to flow proportional with triggering flow volume of 0.906 million cubic feet on 5/18/05.
	S332D	S332D, S332DAS and S332DX	Surface	Auto-sampler was installed in 2003, S332DAS changed from time to flow proportional with triggering flow volume of 1.7 million cubic feet on 4/16/03, A new water quality station id S332DX was used since 10/2/2007 for both auto (discrete time proportional) and grab sample.
Interior	C1	CULC1	Surface	No sample during the first quarter
	C2	CULC2	Surface	No sample during the first quarter
Diversion	DS1	DS1	Surface	No sample during the first quarter
	DS2	DS2	Surface	No sample during the first quarter
	DS3	DS3	Surface	No sample during the first quarter
	DS4	DS4	Surface	No sample during the first quarter
Outflow	BERMB3	BERMB3	Surface	Auto-sampler was installed in 2003, and has not been activated because of no flow
Groundwater	S332B	S332BES	18	S-332B East Shallow
		S332BED	11	S-332 B East Deep
		S332BWS	14.4	S-332B West Shallow
		S332BWD	11.8	S-332B West Deep
	S332C	S332CES	180.1	S-332C East Shallow
		S332CED	19.5	S-332 C East Deep
		S332CWS	53.5	S-332C West Shallow
		S332CWD	26.6	S-332C West Deep
	S332D	S332DES	45	S-332D East Shallow
		S332DED	17.5	S-332D East Deep
		S332DWS	25.3	S-332D West Shallow
		S332DWD	17.2	S-332D West Deep
Notes:	Water quality sample site is located on upstream side of the structure unless otherwise noted with different representative sampling location.			

Table D-3. Summary statistics of IOP for Protection of the CSSS water quality monitoring data (physical parameters, nutrients, major ions and trace metals) collected during WY2010.

STATION	TEST NAME	UNITS	TEST NUMBER	PERIOD OF RECORD	# OF SAMPLES	MEAN	STD	MIN	Q25	MEDIAN	Q75	MAX	# BELOW DETECTION LIMIT	# OF EXCURSIONS	% EXCURSIONS
BERMB3	DIS. CA	mg/L	30	27JUL2009 - 02NOV2009	5	52.040	3.914	46.100	50.900	52.100	55.400	55.700	0	0	0.00%
BERMB3	DIS. K	mg/L	29	27JUL2009 - 02NOV2009	5	2.820	0.377	2.200	2.800	2.900	3.000	3.200	0	0	0.00%
BERMB3	DIS. MG	mg/L	31	27JUL2009 - 02NOV2009	5	7.160	1.571	4.700	6.900	7.300	8.000	8.900	0	0	0.00%
BERMB3	DIS. NA	mg/L	28	27JUL2009 - 02NOV2009	5	30.000	6.277	20.300	28.800	30.300	33.600	37.000	0	0	0.00%
BERMB3	DO	mg/L	8	27JUL2009 - 06OCT2009	4	3.645	0.831	2.710	2.980	3.640	4.310	4.590	0	4	100.00%
BERMB3	FLDCOND.	UMHOS/CM	9	27JUL2009 - 02NOV2009	5	475.800	56.193	389.000	460.000	487.000	505.000	538.000	0	0	0.00%
BERMB3	HARDNESS	mg/L CACO3	35	27JUL2009 - 02NOV2009	5	159.500	14.879	134.500	158.700	163.600	168.400	172.300	0	0	0.00%
BERMB3	NOX	mg N/L	18;180	08SEP2009 - 02NOV2009	4	0.005	0.001	<0.005	<0.005	<0.005	0.001	0.006	3	0	0.00%
BERMB3	OPO4	mg P/L	23	08SEP2009 - 02NOV2009	4	0.002	0.000	<0.002	<0.002	<0.002	0.000	0.002	3	0	0.00%
BERMB3	PH	UNITS	10	27JUL2009 - 02NOV2009	5	7.120	0.130	7.000	7.000	7.100	7.200	7.300	0	0	0.00%
BERMB3	TEMP	CENT	7	27JUL2009 - 02NOV2009	5	28.200	0.500	27.400	28.100	28.300	28.500	28.700	0	0	0.00%
BERMB3	TKN	mg N/L	21	27JUL2009 - 02NOV2009	5	0.980	0.106	0.870	0.890	0.960	1.080	1.100	0	0	0.00%
BERMB3	TN	mg N/L	80	27JUL2009 - 02NOV2009	5	0.981	0.105	0.870	0.896	0.960	1.080	1.100	0	0	0.00%
BERMB3	TOT. CL	mg/L	32	27JUL2009 - 02NOV2009	5	47.100	10.360	32.200	44.200	47.100	51.500	60.500	0	0	0.00%
BERMB3	TOT. SO4	mg/L	33	27JUL2009 - 06OCT2009	3	1.567	0.839	0.600	0.600	2.000	2.100	2.100	0	0	0.00%
BERMB3	TP	mg P/L	25	27JUL2009 - 02NOV2009	5	0.022	0.006	0.015	0.019	0.021	0.026	0.030	0	0	0.00%
BERMB3	TSS	mg/L	16	27JUL2009 - 02NOV2009	5	3.000	0.000	<3	<3	<3	<3	3.000	4	0	0.00%
BERMB3	TURBIDITY	NTU	12	27JUL2009 - 06OCT2009	3	1.200	0.300	0.900	0.900	1.200	1.500	1.500	0	0	0.00%
S332B	DIS. CA	mg/L	30	01JUN2009 - 26APR2010	39	71.597	4.913	59.800	67.300	71.400	74.500	81.700	0	0	0.00%
S332B	DIS. K	mg/L	29	01JUN2009 - 26APR2010	39	3.203	0.528	2.500	2.700	3.200	3.600	4.400	0	0	0.00%
S332B	DIS. MG	mg/L	31	01JUN2009 - 26APR2010	39	9.895	1.745	6.900	8.600	9.400	11.200	14.300	0	0	0.00%
S332B	DIS. NA	mg/L	28	01JUN2009 - 26APR2010	39	37.931	6.203	29.200	33.700	36.400	39.500	53.500	0	0	0.00%
S332B	DO	mg/L	8	04MAY2009 - 26APR2010	49	2.911	1.365	0.490	1.810	2.670	3.970	5.540	0	45	91.84%
S332B	FLDCOND.	UMHOS/CM	9	04MAY2009 - 26APR2010	51	616.255	41.715	571.000	588.000	611.000	632.000	799.000	0	0	0.00%
S332B	HARDNESS	mg/L CACO3	35	01JUN2009 - 26APR2010	39	219.590	9.939	199.700	212.800	219.900	226.200	238.000	0	0	0.00%
S332B	NOX	mg N/L	18;180	01JUN2009 - 13APR2010	21	0.043	0.069	0.009	0.012	0.021	0.051	0.330	0	0	0.00%
S332B	OPO4	mg P/L	23	01JUN2009 - 26APR2010	37	0.002	0.000	<0.002	<0.002	<0.002	<0.002	0.003	33	0	0.00%
S332B	PH	UNITS	10	04MAY2009 - 26APR2010	50	7.280	0.171	6.900	7.100	7.250	7.400	7.600	0	0	0.00%
S332B	TEMP	CENT	7	04MAY2009 - 26APR2010	52	25.144	2.883	17.000	23.100	25.500	27.500	28.900	0	0	0.00%
S332B	TKN	mg N/L	21	01JUN2009 - 26APR2010	39	1.153	0.189	0.560	1.100	1.180	1.280	1.380	0	0	0.00%
S332B	TN	mg N/L	80	01JUN2009 - 26APR2010	39	1.176	0.197	0.611	1.113	1.223	1.294	1.690	0	0	0.00%
S332B	TOT. CL	mg/L	32	01JUN2009 - 26APR2010	39	57.98974	10.1626	44	52.4	54.6	59.1	87.1	0	0	0.00%
S332B	TP	mg P/L	25	04MAY2009 - 26APR2010	52	0.007	0.002	0.005	0.006	0.007	0.008	0.016	0	0	0.00%
S332B	TSS	mg/L	16	01JUN2009 - 26APR2010	39	3.179	0.790	<3	<3	<3	<3	7.000	37	0	0.00%
S332BAuto	NOX	mg N/L	18;180	04MAY2009 - 26APR2010	41	0.035	0.031	0.009	0.013	0.025	0.045	0.133	0	0	0.00%
S332BAuto	TKN	mg N/L	21	04MAY2009 - 26APR2010	42	1.134	0.195	0.620	1.110	1.150	1.220	1.730	0	0	0.00%
S332BAuto	TN	mg N/L	80	04MAY2009 - 26APR2010	42	1.169	0.203	0.660	1.129	1.176	1.249	1.806	0	0	0.00%
S332BAuto	TP	mg P/L	25	04MAY2009 - 26APR2010	41	0.008	0.002	0.005	0.006	0.007	0.008	0.015	0	0	0.00%
S332C	DIS. CA	mg/L	30	29JUN2009 - 26APR2010	21	71.000	2.549	67.200	68.500	71.000	72.900	75.600	0	0	0.00%
S332C	DIS. K	mg/L	29	29JUN2009 - 26APR2010	21	2.957	0.189	2.500	2.900	3.000	3.100	3.200	0	0	0.00%
S332C	DIS. MG	mg/L	31	29JUN2009 - 26APR2010	21	8.900	0.667	7.400	8.400	9.000	9.400	9.700	0	0	0.00%
S332C	DIS. NA	mg/L	28	29JUN2009 - 26APR2010	21	35.767	2.130	32.000	34.500	36.000	36.500	41.300	0	0	0.00%
S332C	DO	mg/L	8	04MAY2009 - 26APR2010	49	2.950	1.638	0.560	1.560	2.440	4.200	5.690	0	39	79.59%
S332C	FLDCOND.	UMHOS/CM	9	04MAY2009 - 26APR2010	51	603.725	41.111	556.000	580.000	594.000	615.000	794.000	0	0	0.00%
S332C	HARDNESS	mg/L CACO3	35	29JUN2009 - 26APR2010	21	213.938	6.612	202.400	208.800	215.700	219.200	224.400	0	0	0.00%
S332C	NOX	mg N/L	18;180	13JUL2009 - 02NOV2009	10	0.011	0.003	0.007	0.008	0.010	0.011	0.017	0	0	0.00%

Table D-3. Continued.

STATION	TEST NAME	UNITS	TEST NUMBER	PERIOD OF RECORD	# OF SAMPLES	MEAN	STD	MIN	Q25	MEDIAN	Q75	MAX	# BELOW DETECTION LIMIT	# OF EXCURSIONS	% EXCURSIONS
S332C	OPO4	mg P/L	23	29JUN2009 - 26APR2010	21	0.002	0.000	<0.002	<0.002	<0.002	<0.002	0.003	20	0	0.00%
S332C	PH	UNITS	10	04MAY2009 - 26APR2010	50	7.246	0.180	6.900	7.100	7.200	7.400	7.600	0	0	0.00%
S332C	TEMP	CENT	7	04MAY2009 - 26APR2010	52	25.567	2.640	17.800	23.850	26.500	27.550	29.900	0	0	0.00%
S332C	TKN	mg N/L	21	29JUN2009 - 26APR2010	21	1.027	0.109	0.710	0.970	1.030	1.110	1.220	0	0	0.00%
S332C	TN	mg N/L	80	29JUN2009 - 26APR2010	21	1.032	0.109	0.710	0.970	1.030	1.118	1.230	0	0	0.00%
S332C	TOT. CL	mg/L	32	29JUN2009 - 26APR2010	21	54.533	3.629	48.400	52.300	54.100	55.900	66.900	0	0	0.00%
S332C	TP	mg P/L	25	04MAY2009 - 26APR2010	51	0.007	0.002	0.004	0.006	0.006	0.007	0.020	0	0	0.00%
S332C	TSS	mg/L	16	29JUN2009 - 26APR2010	21	3.048	0.218	<3	<3	<3	<3	4.000	20	0	0.00%
S332CAuto	NOX	mg N/L	18;180	29JUN2009 - 26APR2010	23	0.016	0.012	0.007	0.009	0.011	0.016	0.054	0	0	0.00%
S332CAuto	TKN	mg N/L	21	29JUN2009 - 26APR2010	24	1.009167	0.11519	0.8	0.955	1	1.075	1.31	0	0	0.00%
S332CAuto	TN	mg N/L	80	29JUN2009 - 26APR2010	24	1.024	0.117	0.817	0.965	1.022	1.087	1.353	0	0	0.00%
S332CAuto	TP	mg P/L	25	29JUN2009 - 26APR2010	24	0.007	0.001	0.005	0.007	0.007	0.008	0.010	0	0	0.00%
S332DX	CA_I	mg/L	188	03AUG2009 - 24MAR2010	2	2.600	0.424	2.300	2.300	2.600	2.900	2.900	0	0	0.00%
S332DX	DIS. CA	mg/L	30	04MAY2009 - 26APR2010	46	72.415	4.073	65.800	68.900	72.100	74.800	88.700	0	0	0.00%
S332DX	DIS. K	mg/L	29	04MAY2009 - 26APR2010	46	2.889	0.429	2.400	2.600	2.800	3.000	4.600	0	0	0.00%
S332DX	DIS. MG	mg/L	31	04MAY2009 - 26APR2010	46	8.917	1.482	7.200	8.100	8.750	9.100	14.800	0	0	0.00%
S332DX	DIS. NA	mg/L	28	04MAY2009 - 26APR2010	46	37.093	5.569	31.500	34.200	35.600	37.100	57.600	0	0	0.00%
S332DX	DIS. ORGAN. C	mg/L	89;181	13JUL2009 - 13APR2010	4	14.150	1.408	12.600	13.200	14.000	15.100	16.000	0	0	0.00%
S332DX	DO	mg/L	8	04MAY2009 - 26APR2010	49	3.099	1.701	0.930	1.690	2.640	4.810	7.770	0	39	79.59%
S332DX	FLDCOND.	UMHOS/CM	9	04MAY2009 - 26APR2010	51	599.431	45.143	528.000	570.000	587.000	611.000	753.000	0	0	0.00%
S332DX	HARDNESS	mg/L CACO3	35	04MAY2009 - 26APR2010	46	217.602	12.656	201.500	209.300	215.850	223.600	279.700	0	0	0.00%
S332DX	NOX	mg N/L	18;180	04MAY2009 - 13APR2010	27	0.050	0.061	0.007	0.013	0.025	0.064	0.300	0	0	0.00%
S332DX	OPO4	mg P/L	23	04MAY2009 - 26APR2010	44	0.002	0.000	<0.002	<0.002	<0.002	<0.002	0.004	38	0	0.00%
S332DX	PH	UNITS	10	04MAY2009 - 26APR2010	50	7.286	0.219	6.900	7.100	7.300	7.400	7.800	0	0	0.00%
S332DX	TEMP	CENT	7	04MAY2009 - 26APR2010	52	25.325	2.653	17.100	23.650	26.150	27.500	28.900	0	0	0.00%
S332DX	TKN	mg N/L	21	04MAY2009 - 26APR2010	46	0.977	0.134	0.630	0.920	0.980	1.040	1.280	0	0	0.00%
S332DX	TN	mg N/L	80	04MAY2009 - 26APR2010	46	1.007	0.166	0.651	0.930	0.991	1.097	1.580	0	0	0.00%
S332DX	TOT. CL	mg/L	32	04MAY2009 - 26APR2010	48	54.463	12.100	9.500	52.250	53.700	55.400	88.900	0	0	0.00%
S332DX	TOT. MTHY HG	ug/L	203	19OCT2009 - 14APR2010	3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0	0	0.00%
S332DX	TOT. SO4	mg/L	33	13JUL2009 - 13APR2010	4	4.625	3.304	0.700	2.000	4.800	7.250	8.200	0	0	0.00%
S332DX	TOT. ULTRA TR	ug/L	207	14JUL2009 - 14APR2010	4	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0	0	0.00%
S332DX	TP	mg P/L	25	04MAY2009 - 26APR2010	51	0.007	0.001	0.005	0.006	0.006	0.007	0.012	0	0	0.00%
S332DX	TSS	mg/L	16	04MAY2009 - 26APR2010	46	3.000	0.000	<3	<3	<3	<3	<3	46	0	0.00%
S332DX	TURBIDITY	NTU	12	13JUL2009 - 13APR2010	6	5.500	5.458	1.300	1.500	2.600	12.000	13.000	0	0	0.00%
S332DXAuto	NOX	mg N/L	18;180	04MAY2009 - 26APR2010	337	0.036	0.038	<0.005	0.009	0.016	0.059	0.211	5	0	0.00%
S332DXAuto	TKN	mg N/L	21	04MAY2009 - 26APR2010	357	0.992	0.157	0.560	0.920	0.990	1.080	1.690	0	0	0.00%
S332DXAuto	TN	mg N/L	80	04MAY2009 - 26APR2010	357	1.026	0.179	0.584	0.930	1.011	1.119	1.819	0	0	0.00%
S332DXAuto	TP	mg P/L	25	04MAY2009 - 26APR2010	357	0.008	0.004	0.004	0.006	0.007	0.008	0.056	0	0	0.00%

Table D-4. WY2010 summary results of C-111 EO #9 total dissolved solids (TDS).

Type	EO #9 PERMIT STRUCTURE	WATER QUALITY SAMPLING SITE	Total Flow Volume (acre-ft)	Total Dissolved Solids (mg/L) in Groundwater by quarter				Total Load (metric ton)
				1st	2nd	3rd	4th	
Groundwater	S332B	S332BED	164,800	366	339	313	334	64,903
		S332BES		274	314	326	266	
		S332BWD		372	330	310	332	
		S332BWS		326	313	313	280	
	S332C	S332CED	89,499	209	209	394	150	33,915
		S332CES		355	311	371	298	
		S332CWD		312	371	318	324	
		S332CWS		320	336	349	288	
	S332D	S332DED	181,197	301	278	317	268	66,323
		S332DES		286	305	306	308	
		S332DWD		M	286	293	286	
		S332DWS		M	318	320	282	

Notes: 1) Water quality sample site is located on upstream side of permitted structure, unless otherwise noted with different sampling location.

2) n/a indicates that flow and/or stage data are not available, or that structure is not appropriately instrumented to capture information.

3) NPF indicates either structure was closed or that no positive flow was recorded on sampling days, thus a flow-weighted mean could not be calculated.

4) M-Data were missing

Table D-5. WY2010 summary results of C-111 EO #9 dissolved organic carbon (DOC).

Type	Structure	Water Quality Station	Total Flow Volume (acre-feet)	Dissolved Organic Carbon (mg/L)				
				1st	2nd	3rd	4th	Annual Average
Inflow	S332B	S332B	164,800	N/D [1]	N/D	N/D	N/D	N/D
	S332C	S332C	89,499	N/D	N/D	N/D	N/D	N/D
	S332D	S332DX	181,197	12.6	13.8	14.2	16.0	14.2

Notes:

1) N/D no data available

Attachment E: Time-Series and Box Plots of Total Phosphorus and Total Nitrogen at Monitoring Sites for Water Year 2010

Shi Kui Xue and Steven Hill

The graphs (**Figures E-1** through **E-44**) in this attachment depict total phosphorus (TP) and total nitrogen (TN) concentration data collected during WY2009 for IOP for Protection of the CSSS water quality monitoring sites. The graph sequencing follows the station order shown in Attachment **B**, **Table B-1**. The C-111 EO #9 structure locations are depicted in **Figure 1**. Additionally, the graphs are identified by monitoring site name. In most cases, the monitoring site name corresponds to the structure. If the monitoring site is a surrogate location for a structure, then the structure name(s) is/are shown in parentheses below the monitoring site name.

Most graphs depict TP data collected by grab sampling. The graphs for sites with auto-sampler data are annotated (e.g., S-332B auto-sampler). The TP data collected by each method are shown as separate data in the graphs.

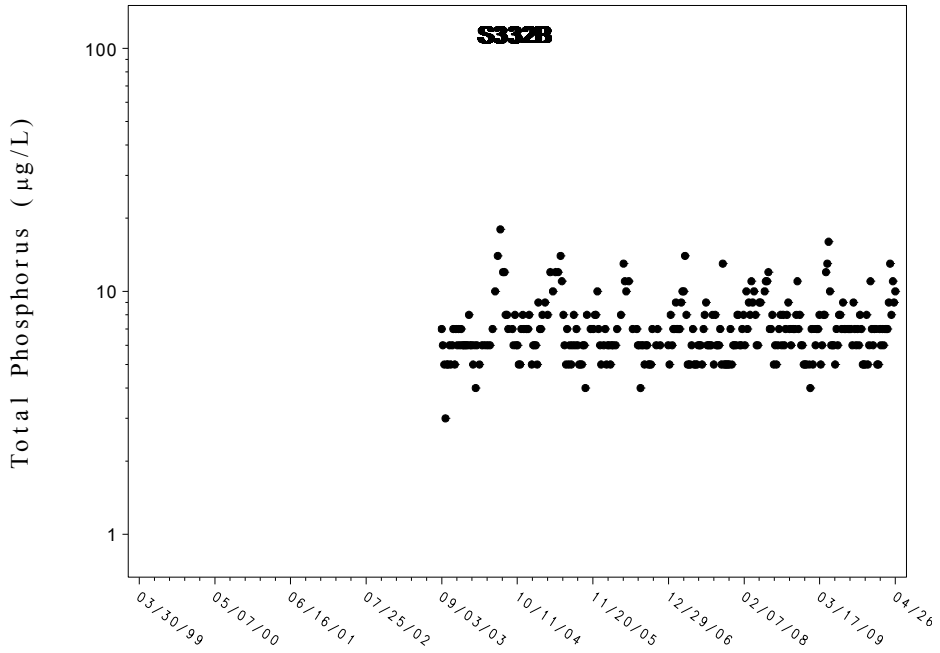

Figure E-1. TP concentration at S-332B.

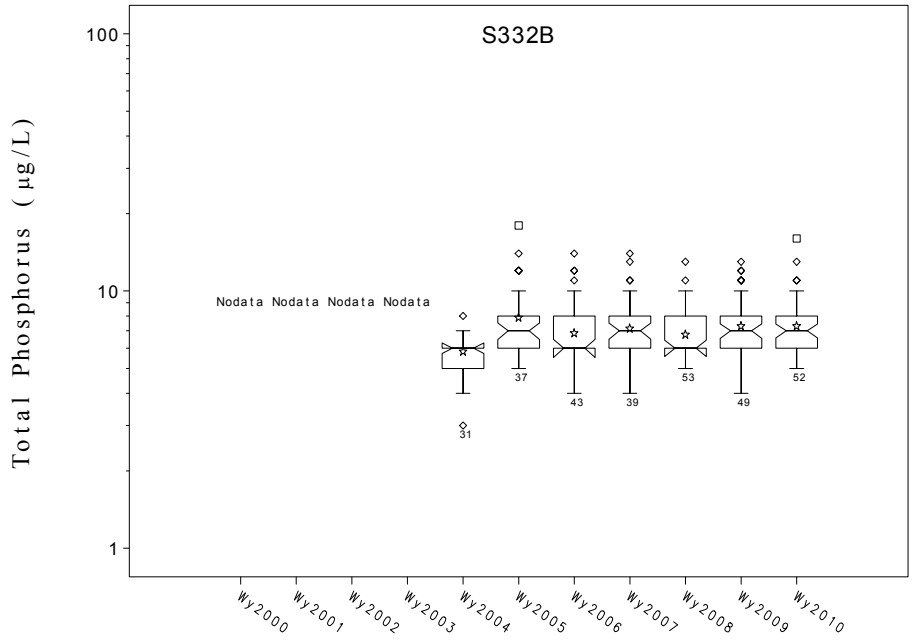

Figure E-2. TP notched-box-and-whisker plot at S-332B.

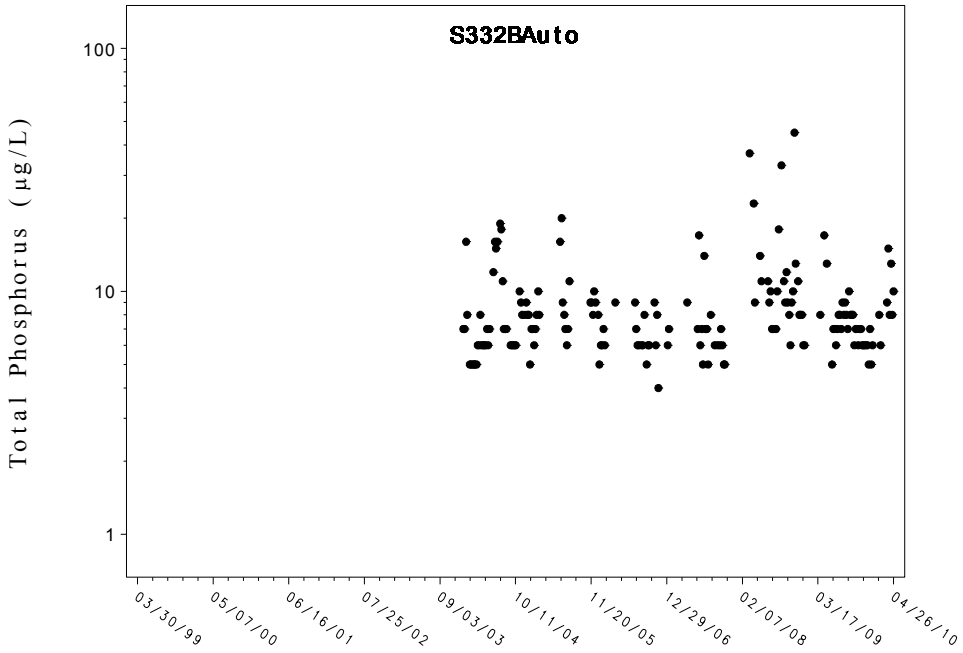

Figure E-3. TP concentration at S-332B auto-sampler.

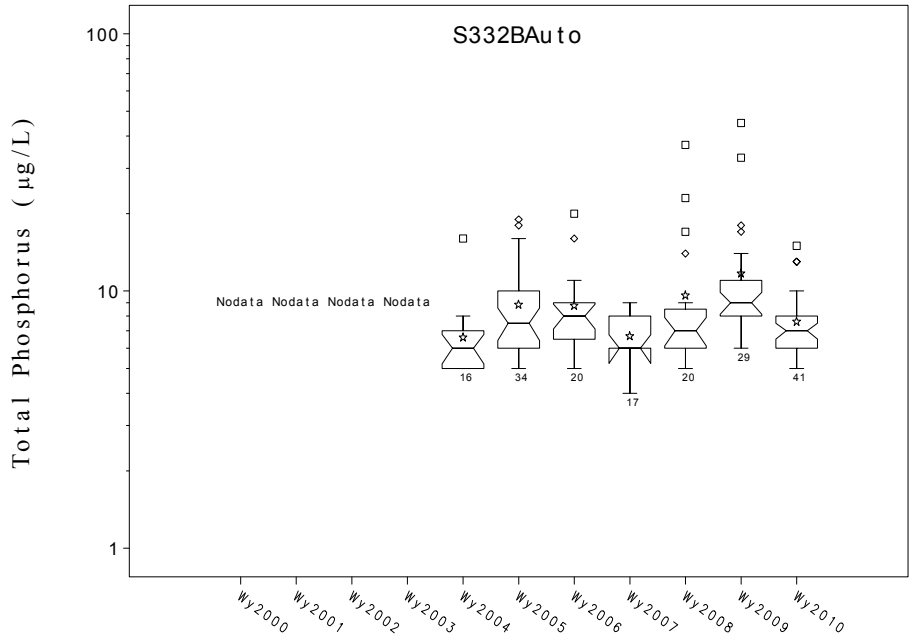

Figure E-4. TP notched-box-and-whisker plot at S-332B auto-sampler.

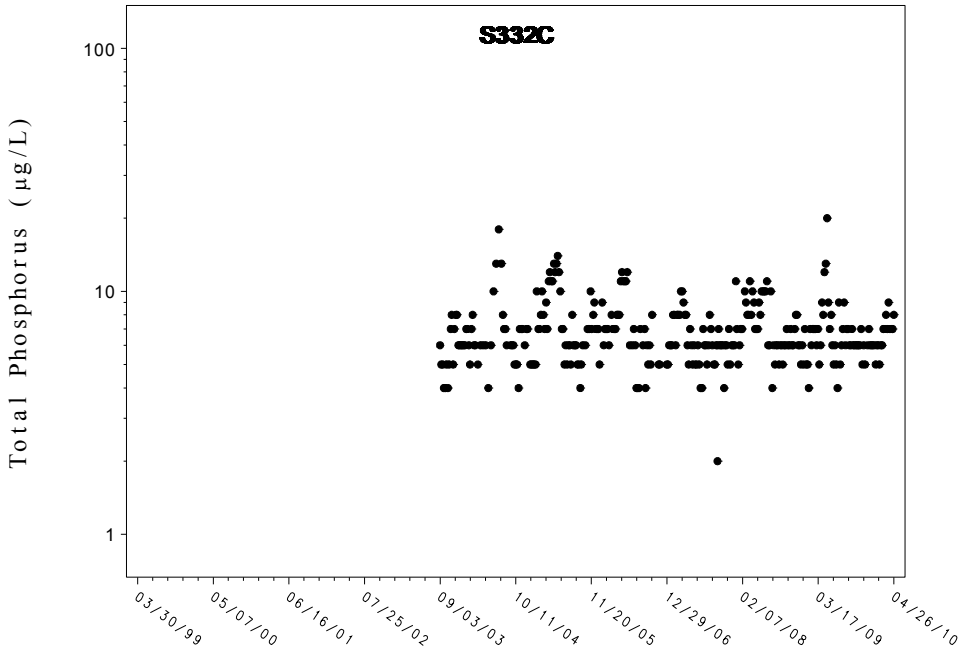

Figure E-5. TP concentration at S-332C.

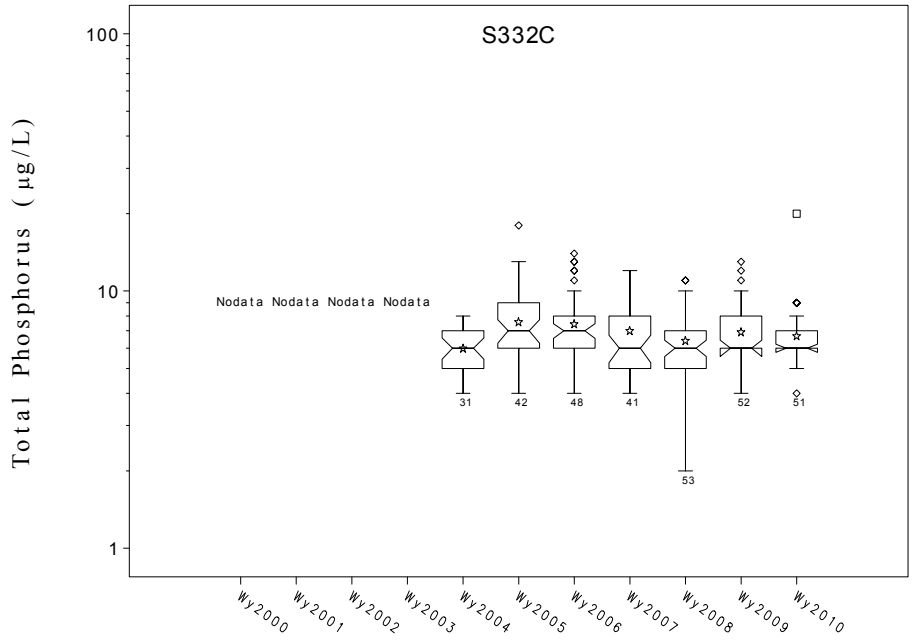

Figure E-6. TP notched-box-and-whisker plot at S-332C.

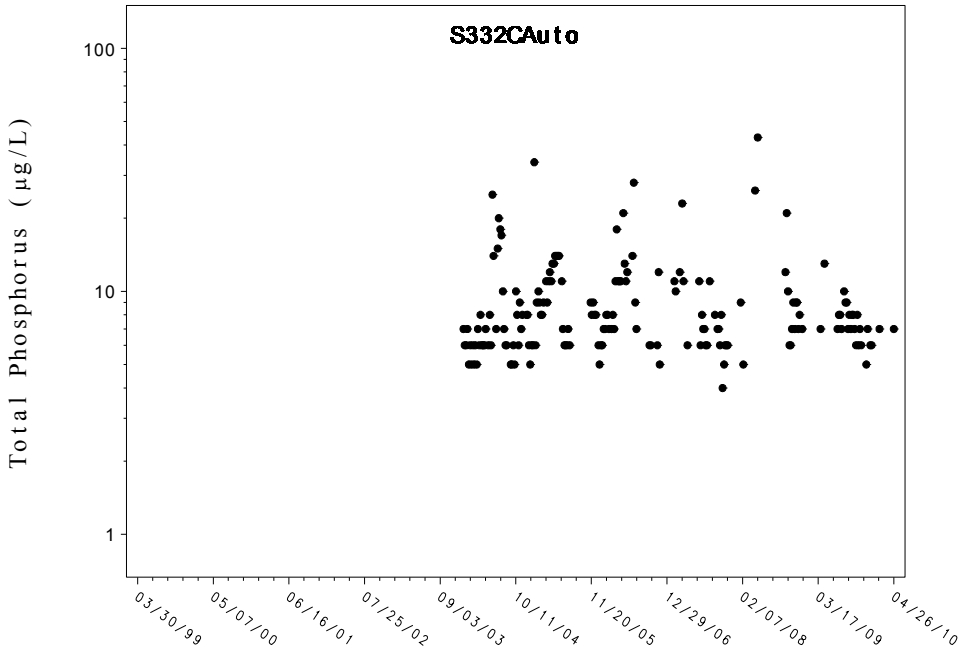

Figure E-7. TP concentration at S-332C auto-sampler.

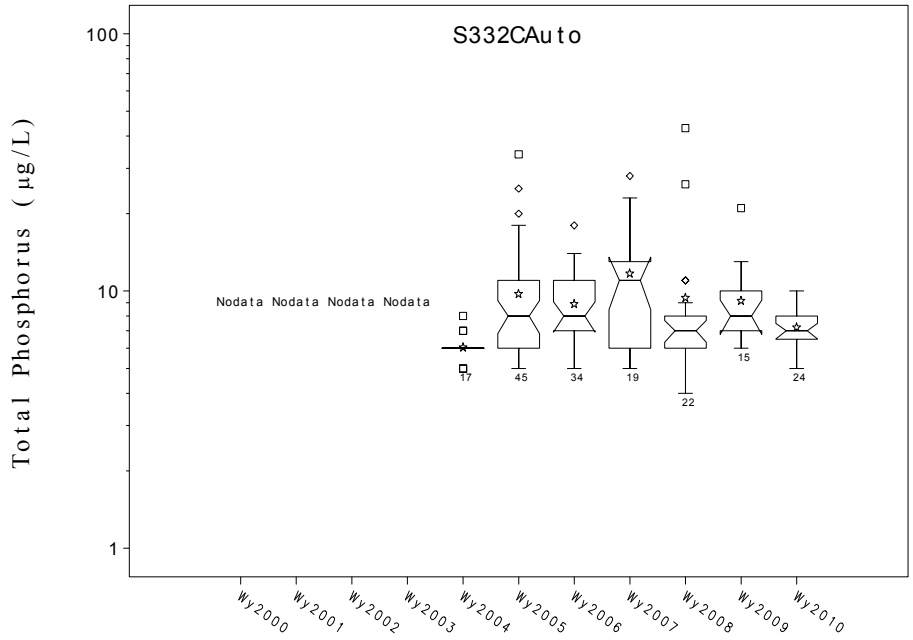

Figure E-8. TP notched-box-and-whisker plot at S-332C auto-sampler.

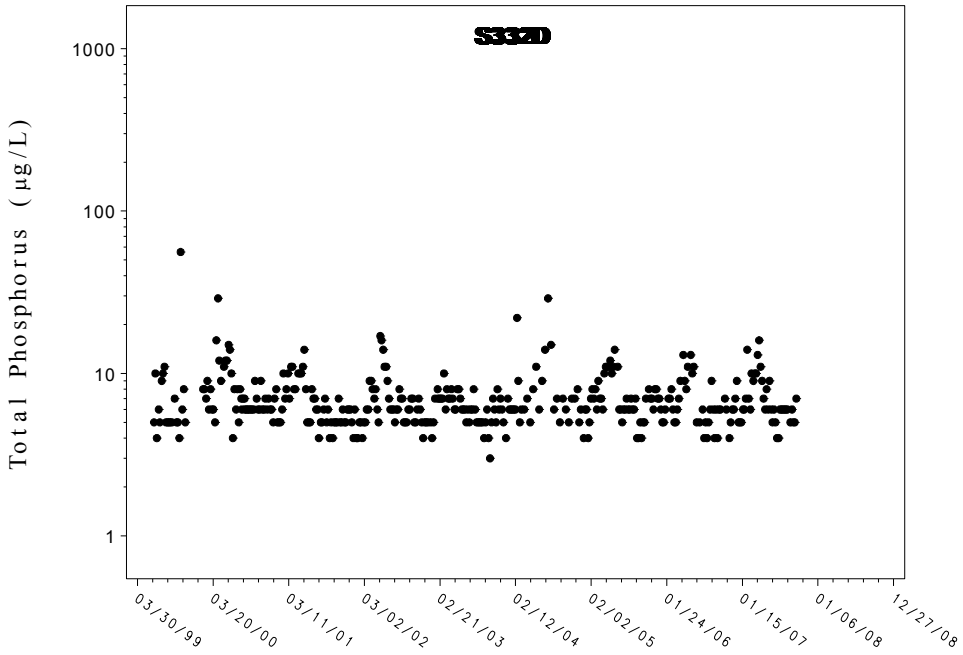

Figure E-9. TP concentration at S-332D.

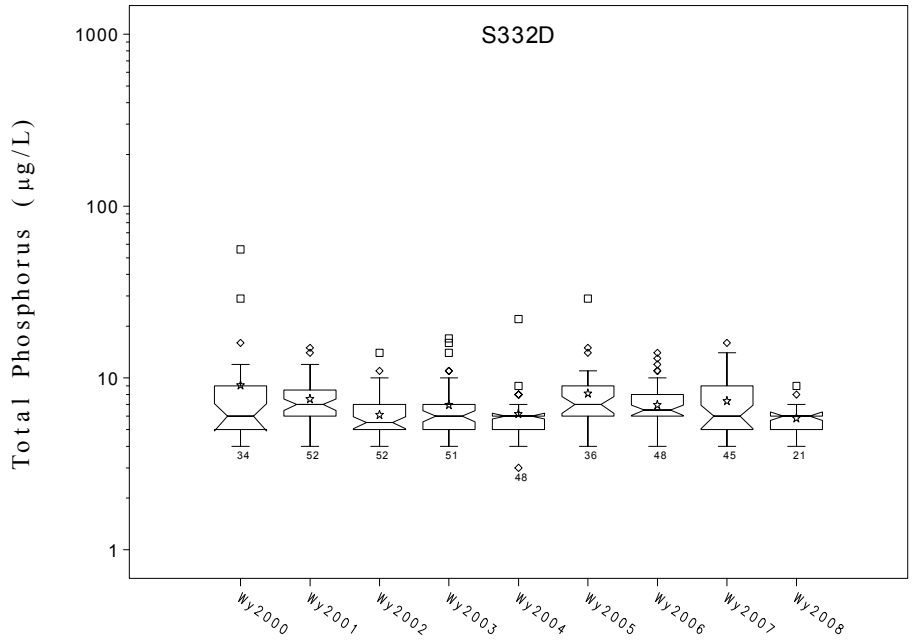

Figure E-10. TP notched-box-and-whisker plot at S-332D.

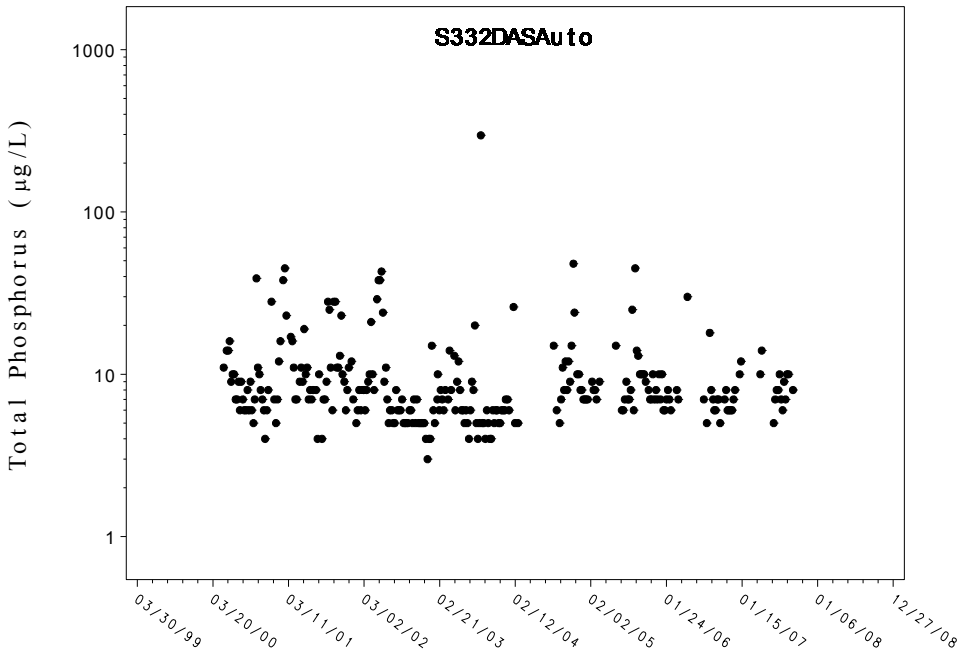

Figure E-11. TP concentration at S-332DAS auto-sampler.

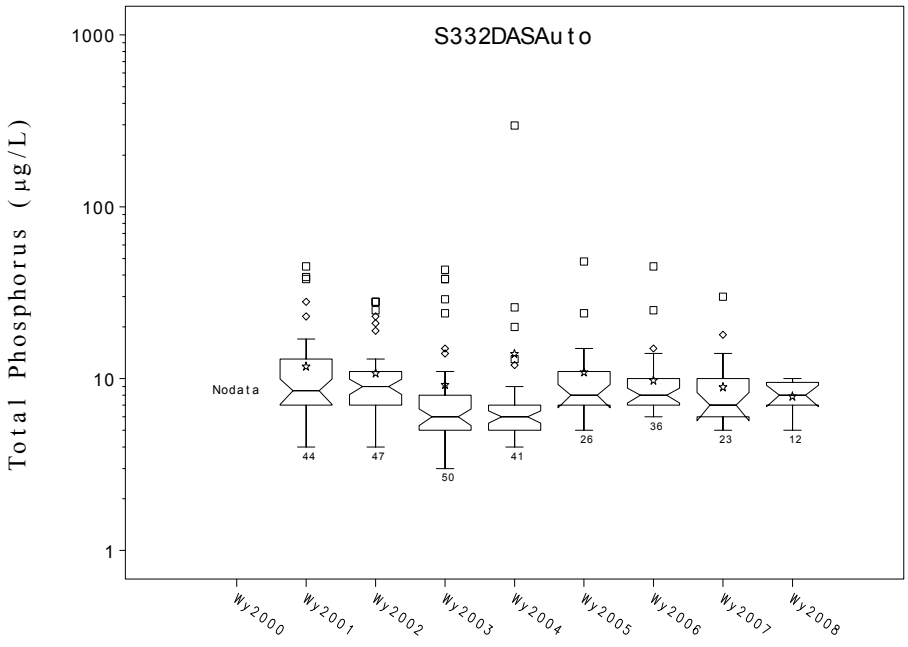

Figure E-12. TP notched-box-and-whisker plot at S-332DAS auto-sampler.

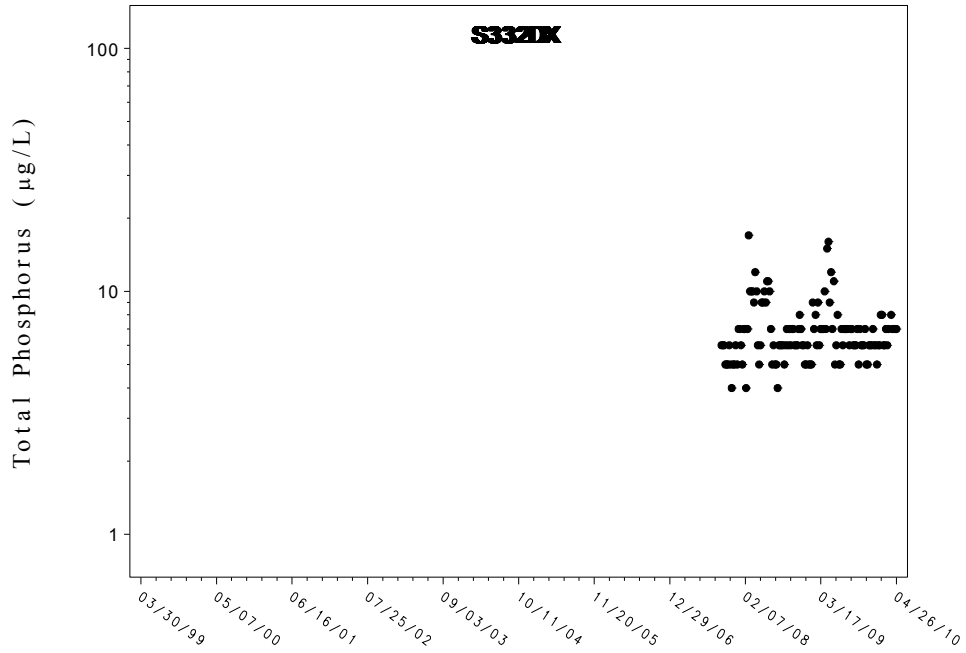

Figure E-13. TP concentration at S-332DX.

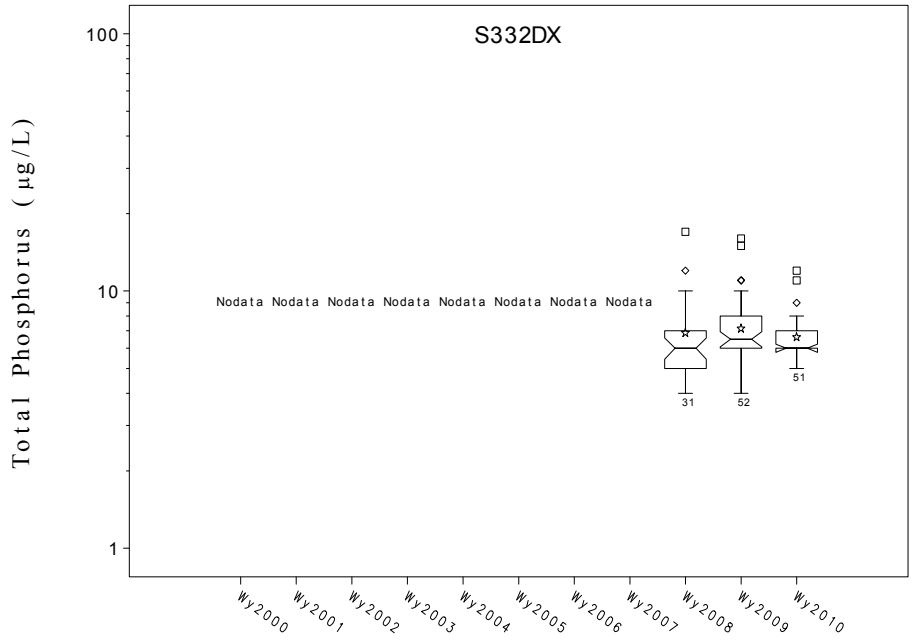

Figure E-14. TP notched-box-and-whisker plot at S-332DX.

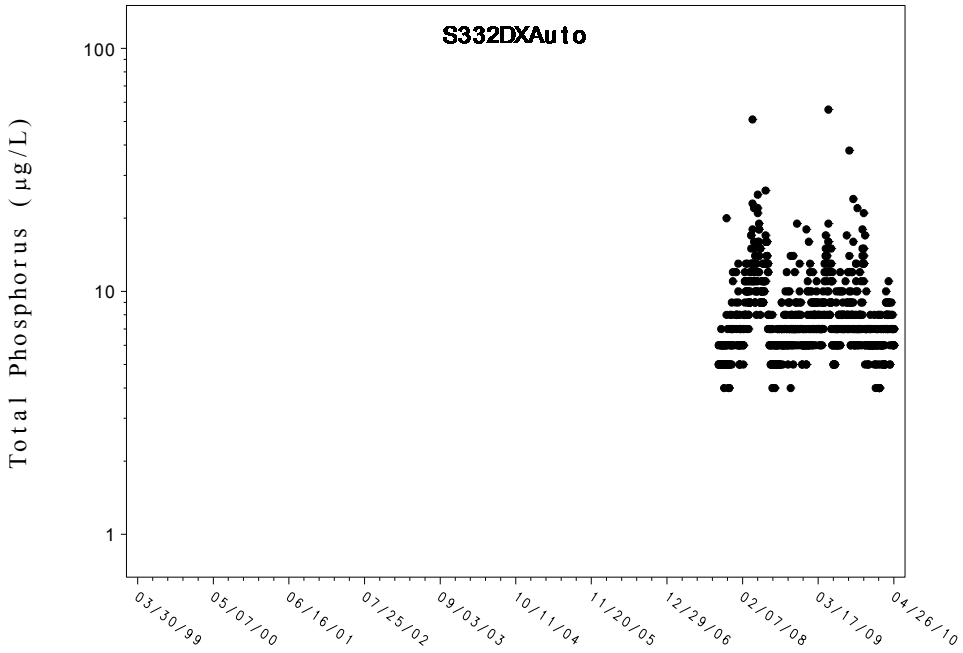

Figure E-15. TP concentration at S-332DX auto-sampler.

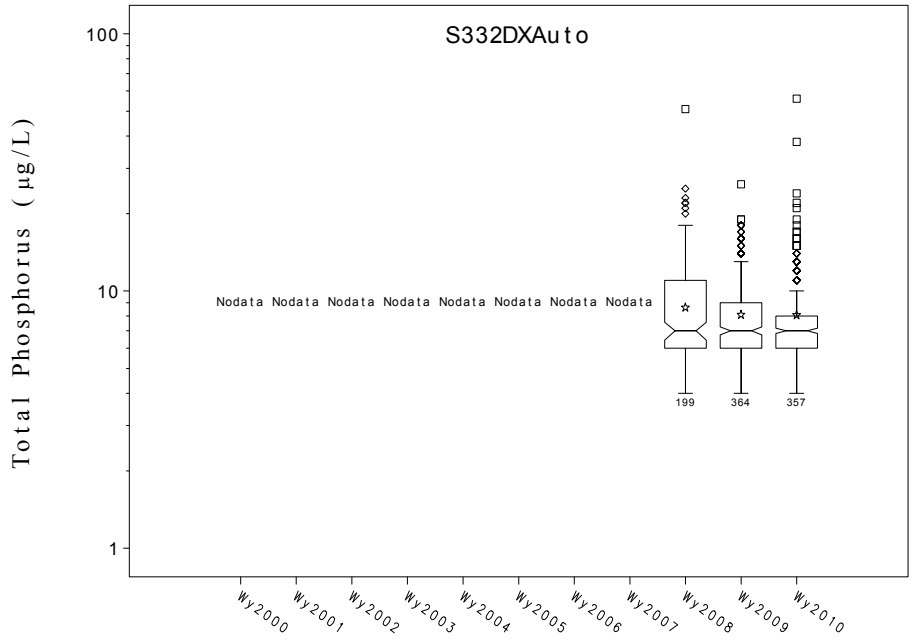

Figure E-16. TP notched-box-and-whisker plot at S-332DX auto-sampler.

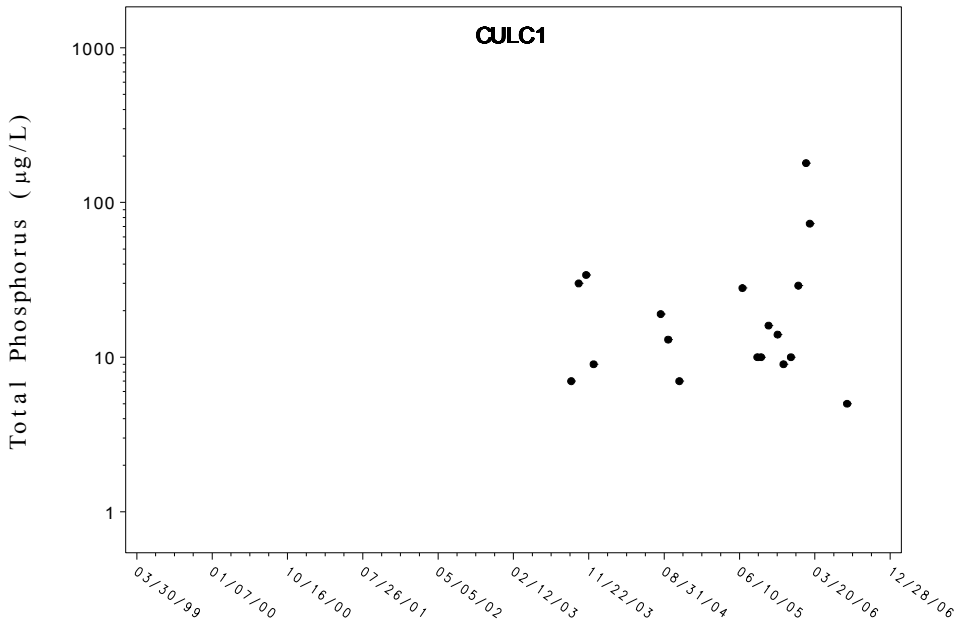

Figure E-17. TP concentration at CULC1.

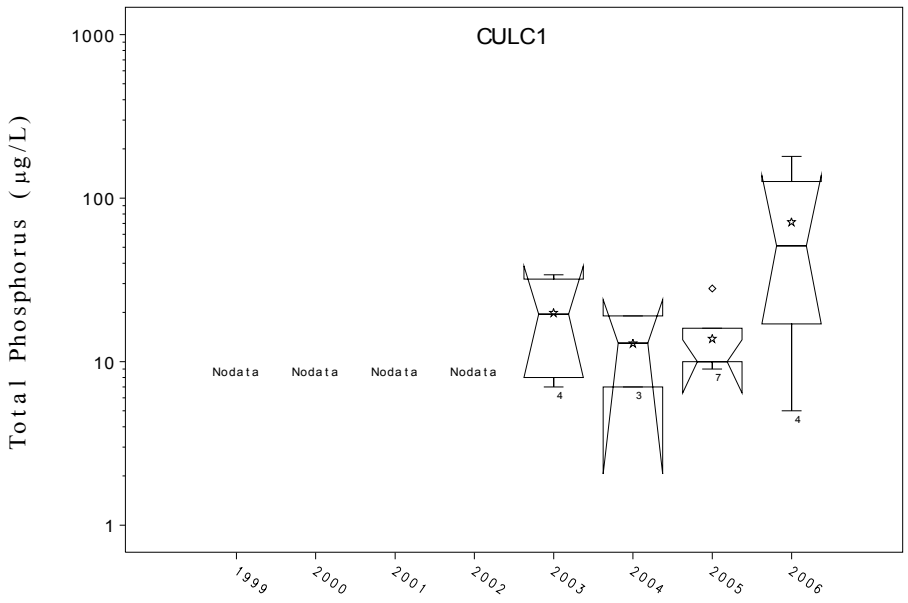

Figure E-18. TP notched box-and-whisker plot at CULC1**.**

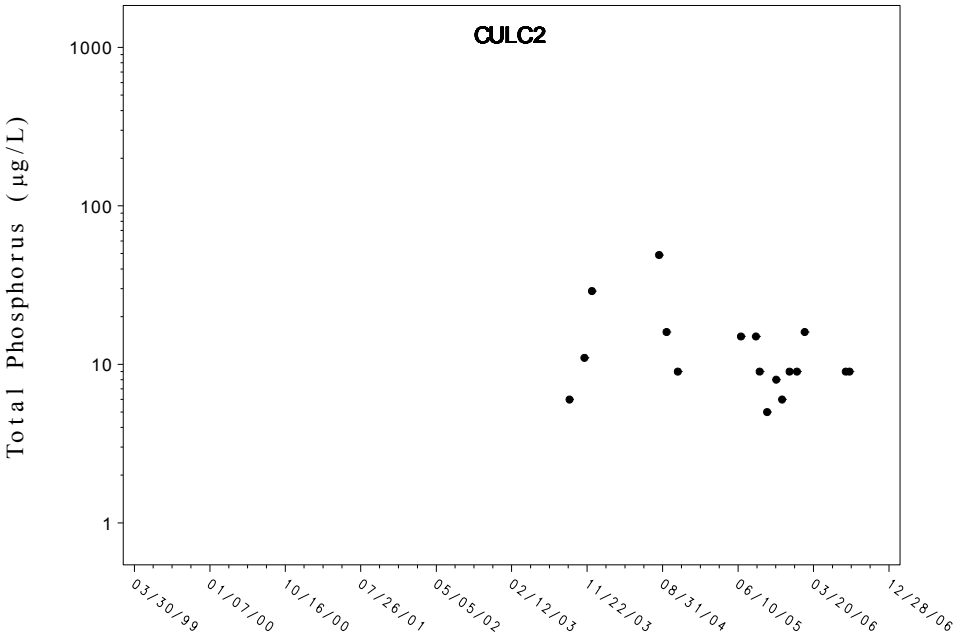

Figure E-19. TP concentration at CULC2.

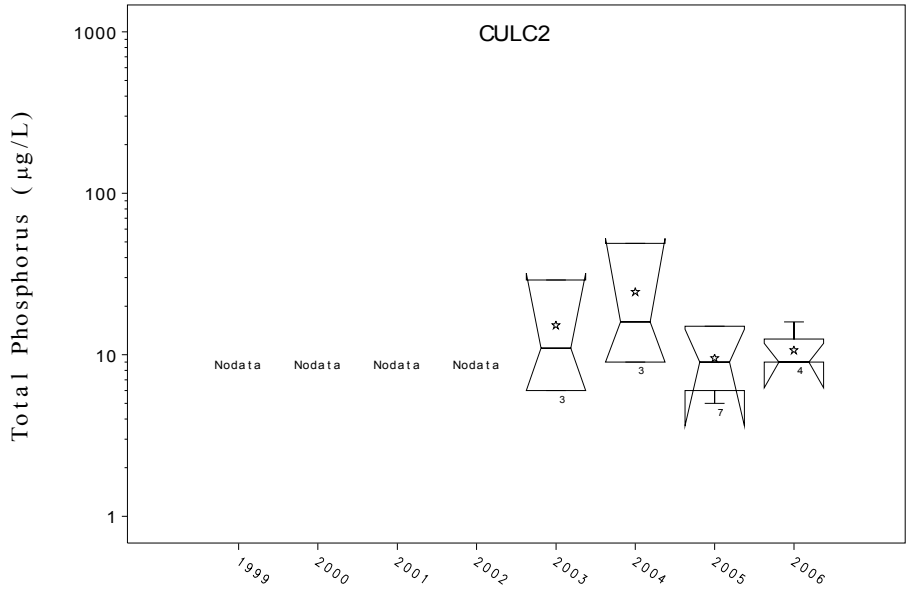

Figure E-20. TP notched box-and-whisker plot at CULC2**.**

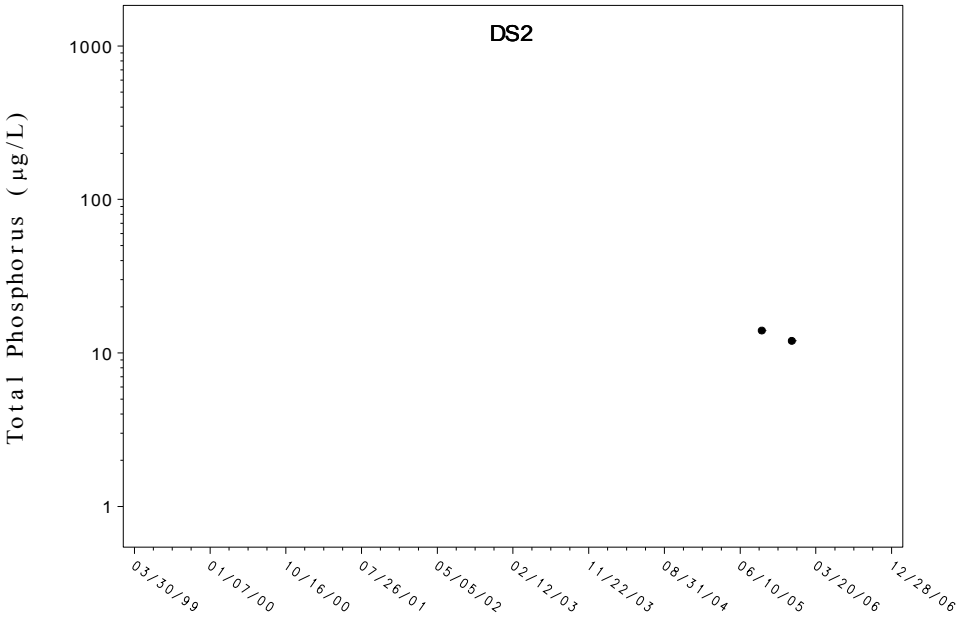

Figure E-21. TP concentration at DS2.

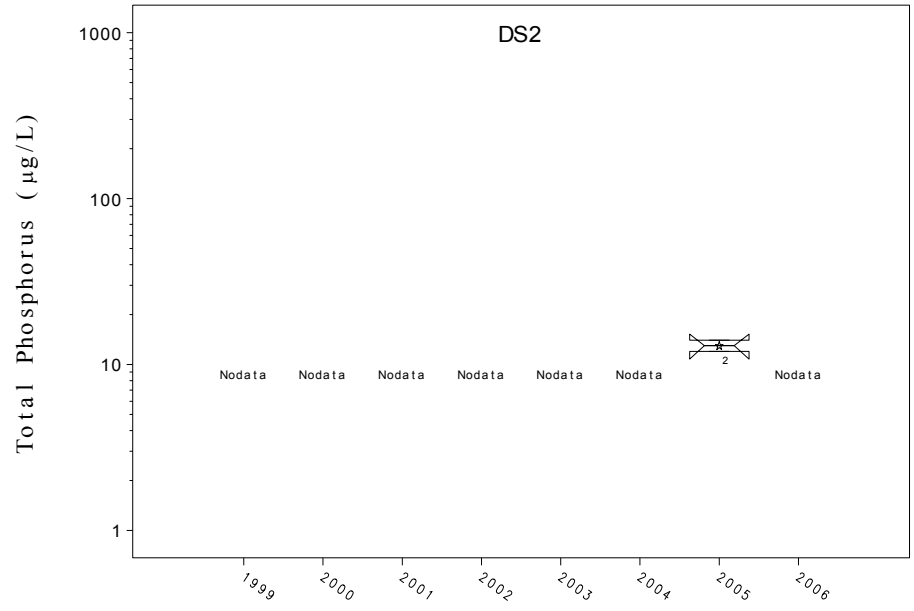

Figure E-22. TP notched box-and-whisker plot at DS2.

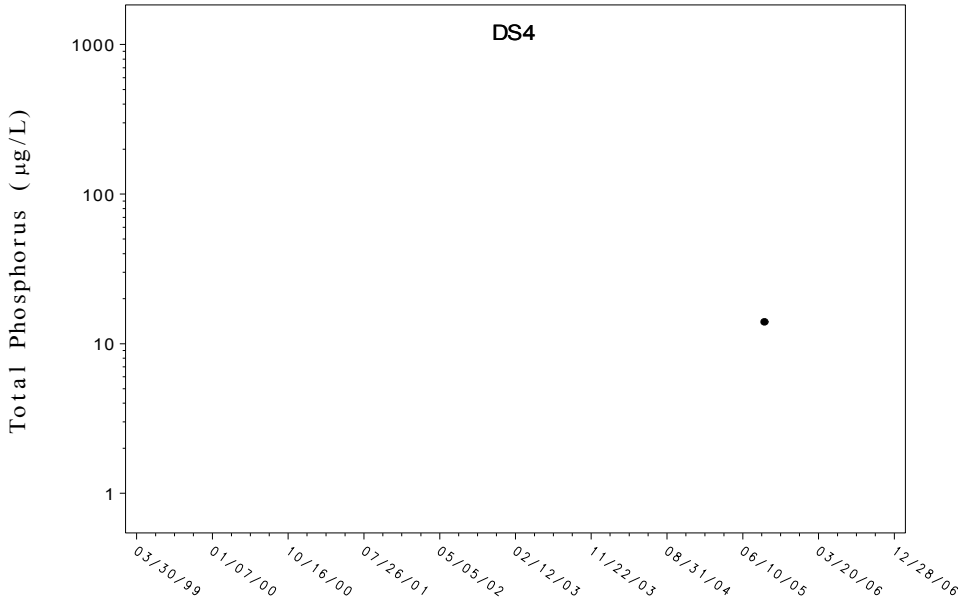

Figure E-23. TP concentration at DS4.

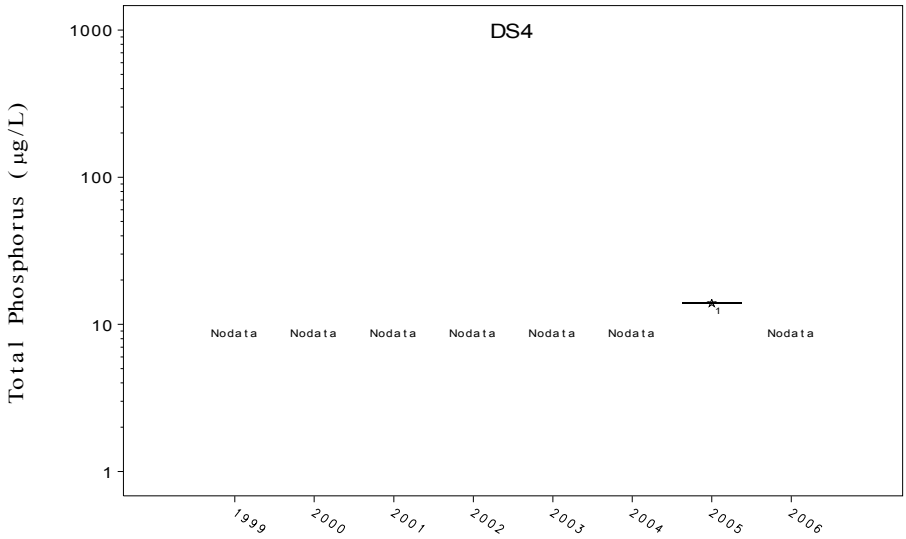

Figure E-24. TP notched box-and-whisker plot at DS4.

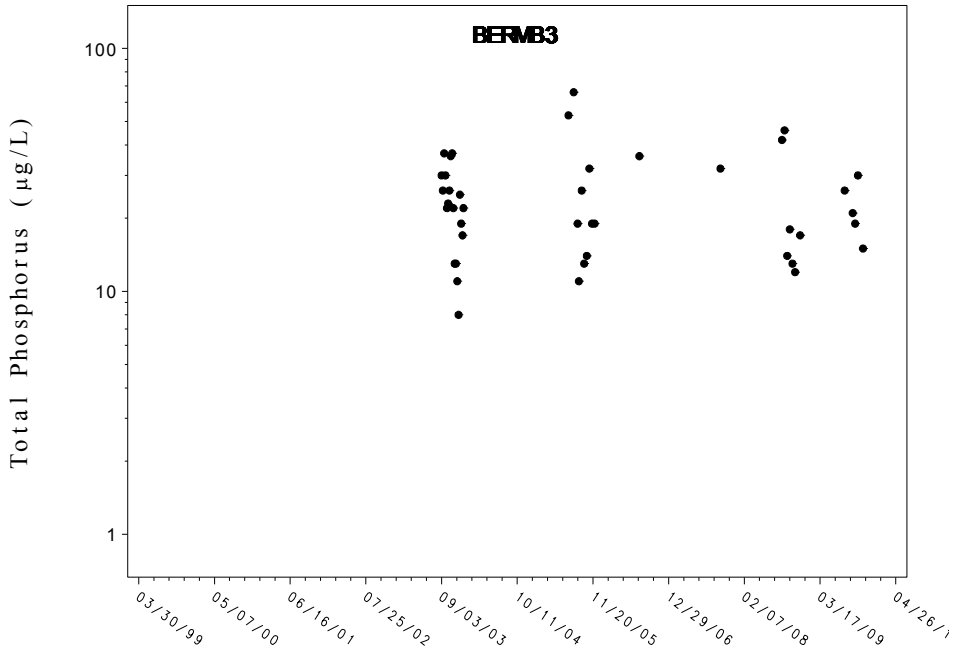

Figure E-25. TP concentration at BERMB3.

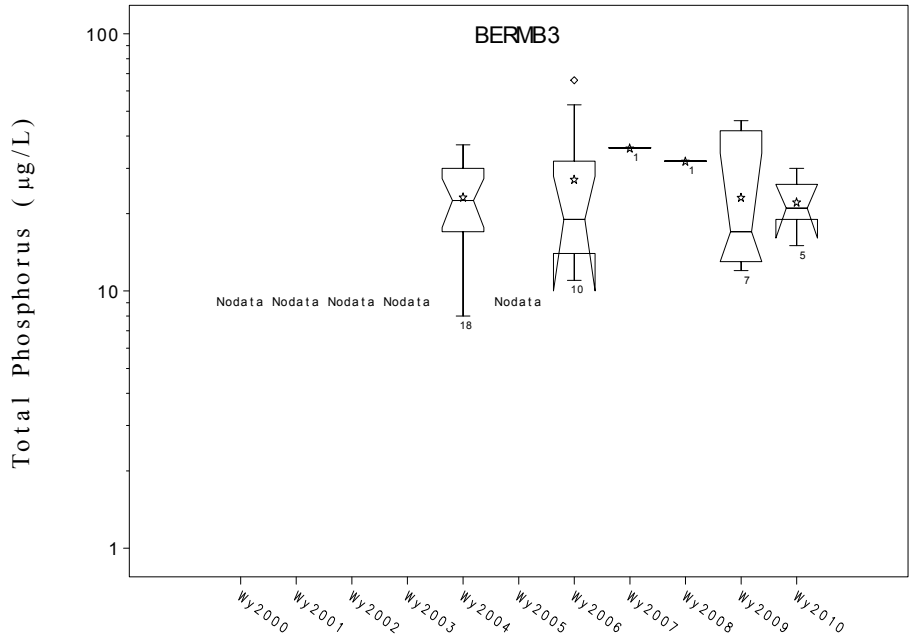

Figure E-26. TP notched-box-and-whisker plot at BERMB3.

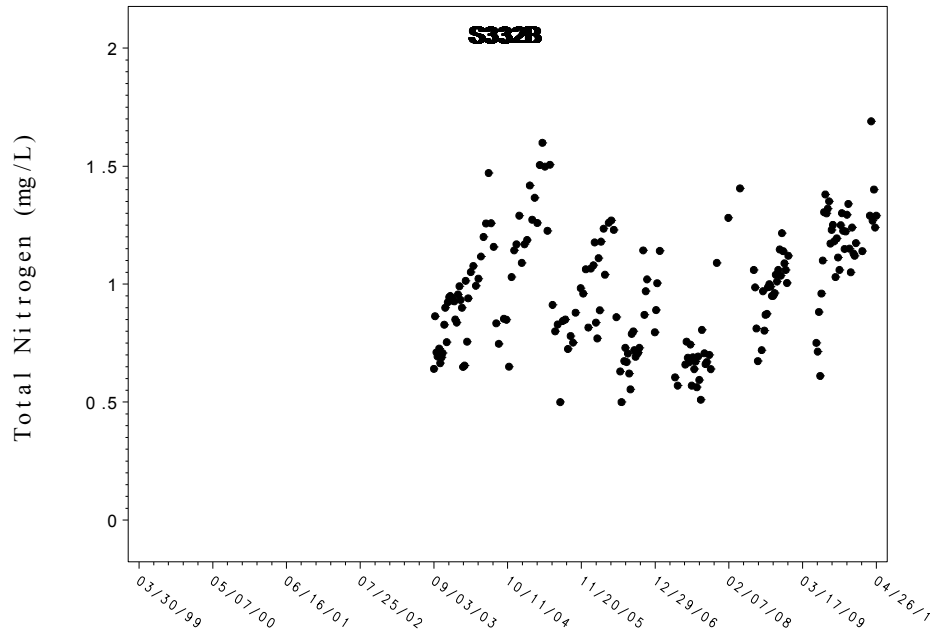

Figure E-27. TN concentration at S332B.

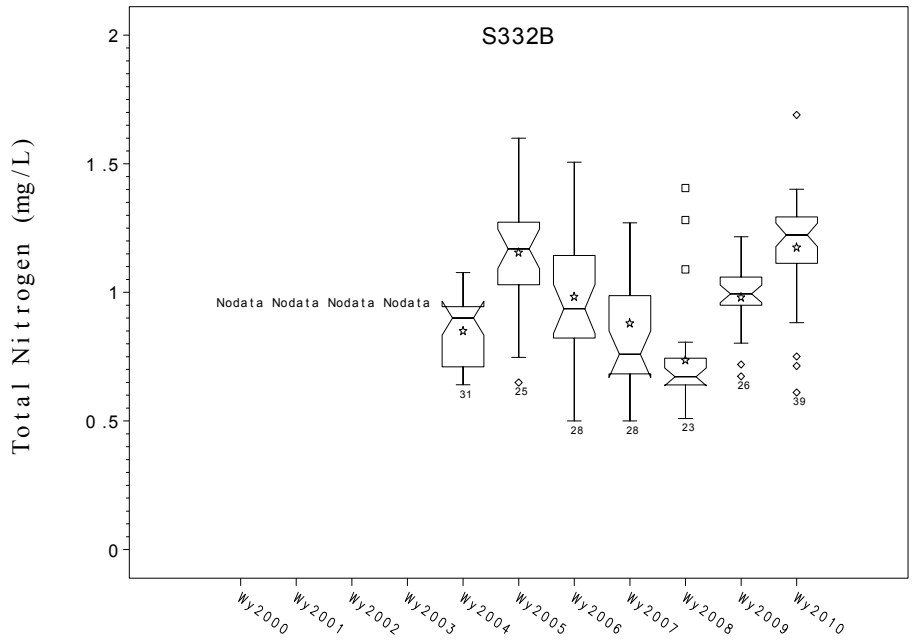

Figure E-28. TN notched-box-and-whisker plot at S332B.

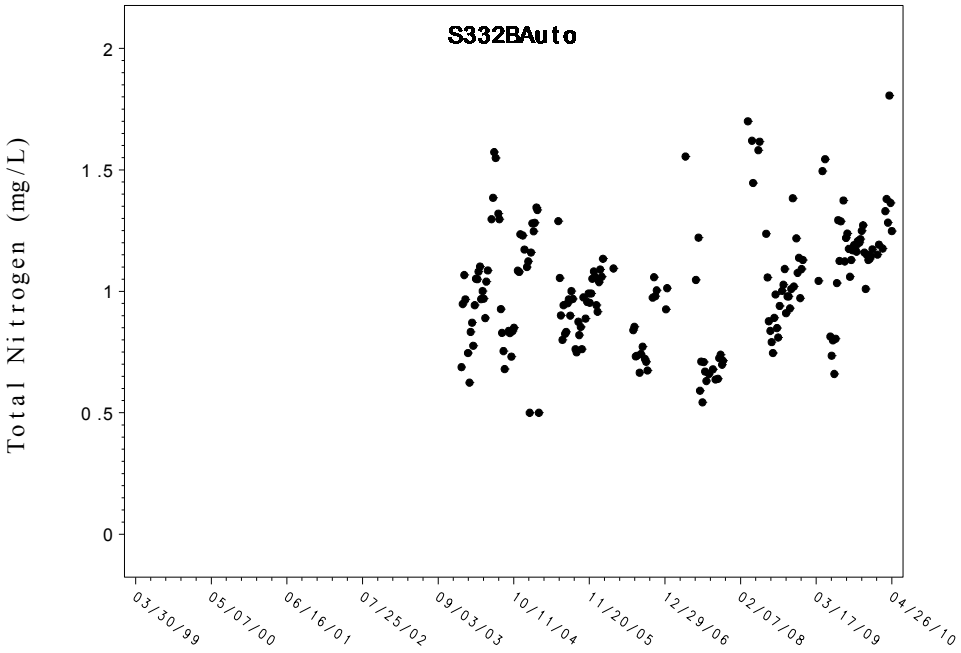

Figure E-29. TN concentration at S332B auto-sampler.

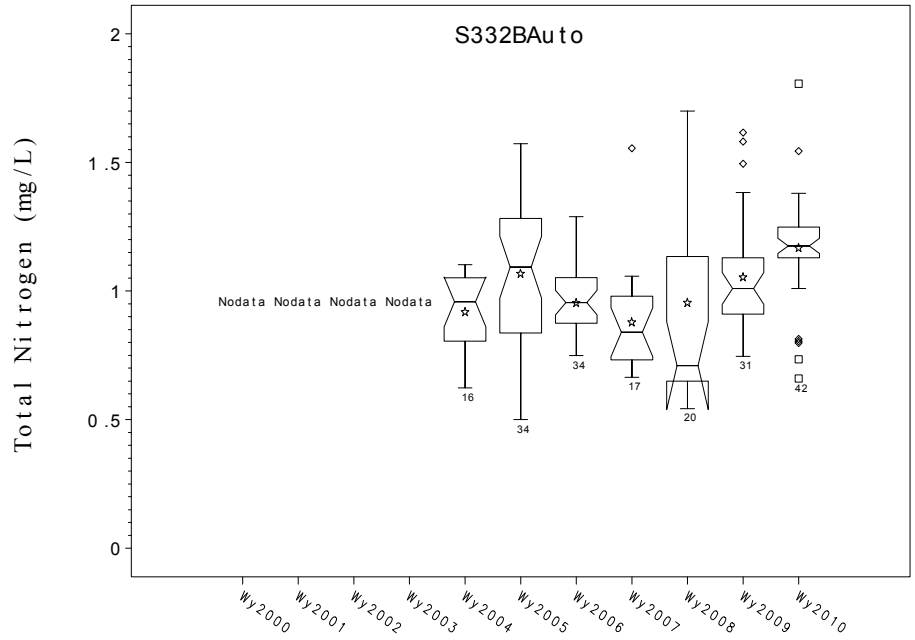

Figure E-30. TN notched-box-and-whisker plot at S332B auto-sampler.

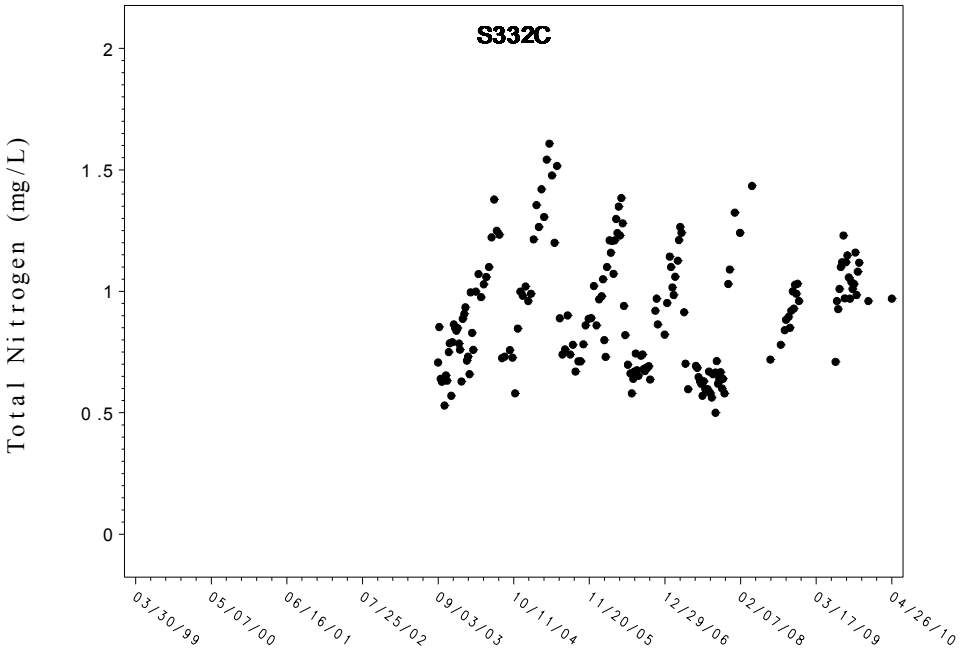

Figure E-31. TN concentration at S332C.

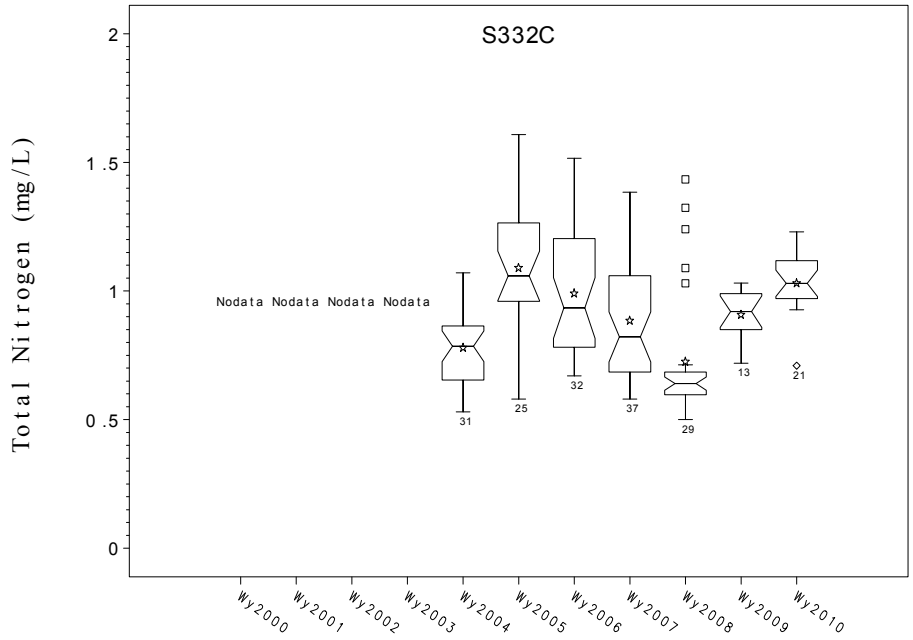

Figure E-32. TN notched-box-and-whisker plot at S332C.

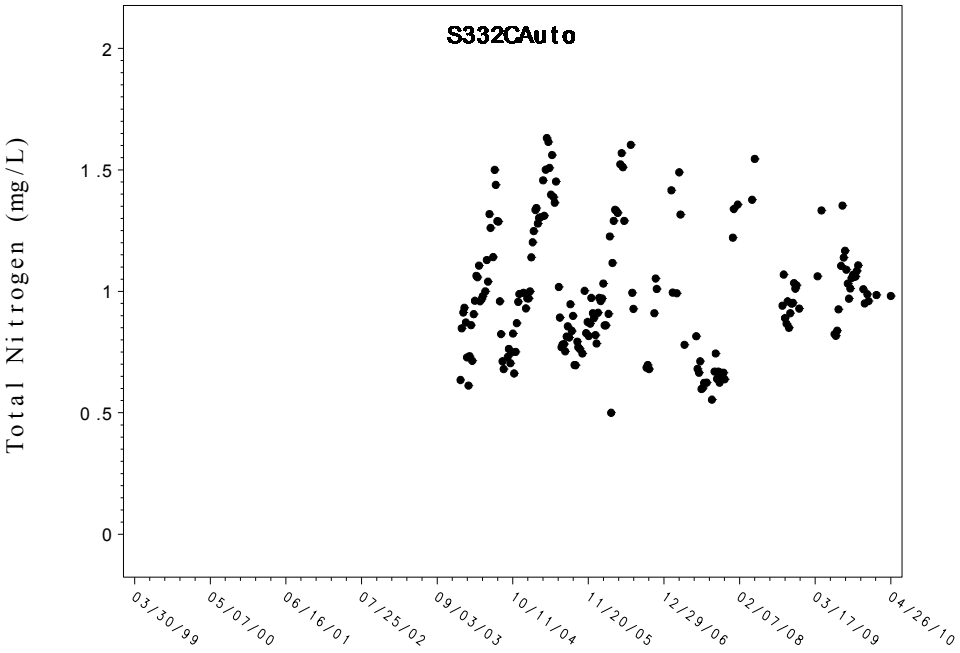

Figure E-33. TN concentration at S332C auto-sampler.

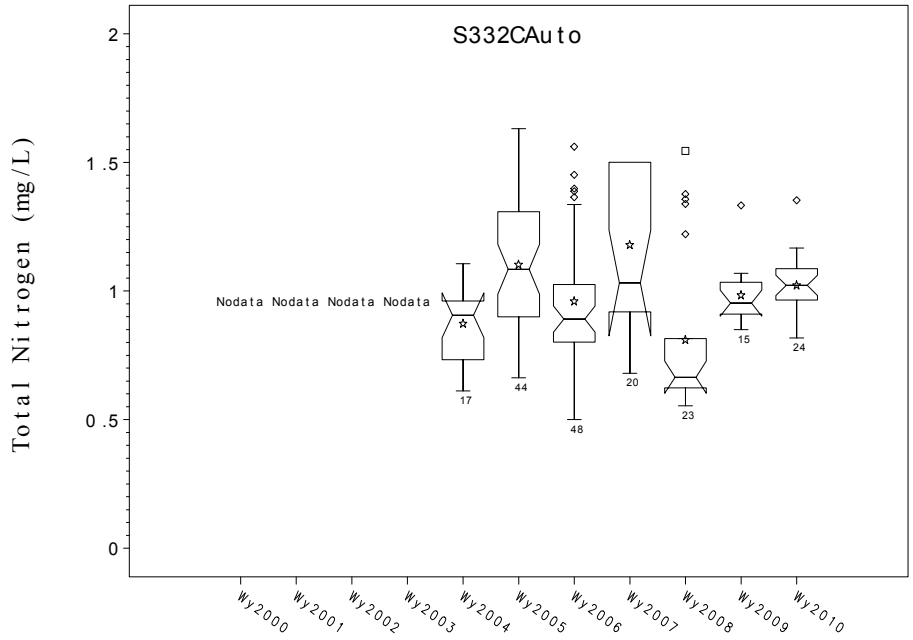

Figure E-34. TN notched-box-and-whisker plot at S332C auto-sampler.

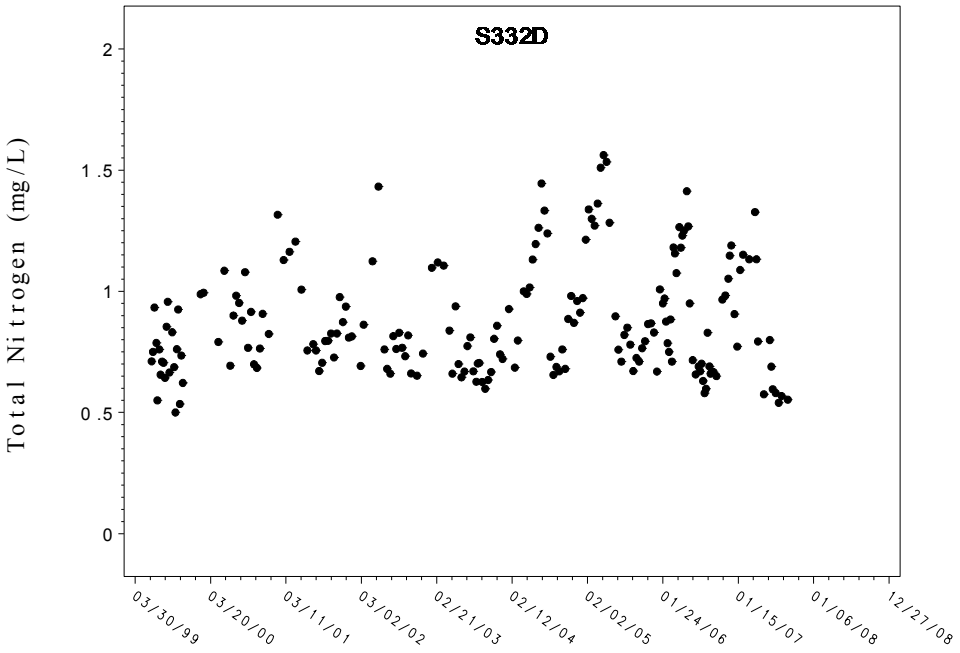

Figure E-35. TN concentration at S332D.

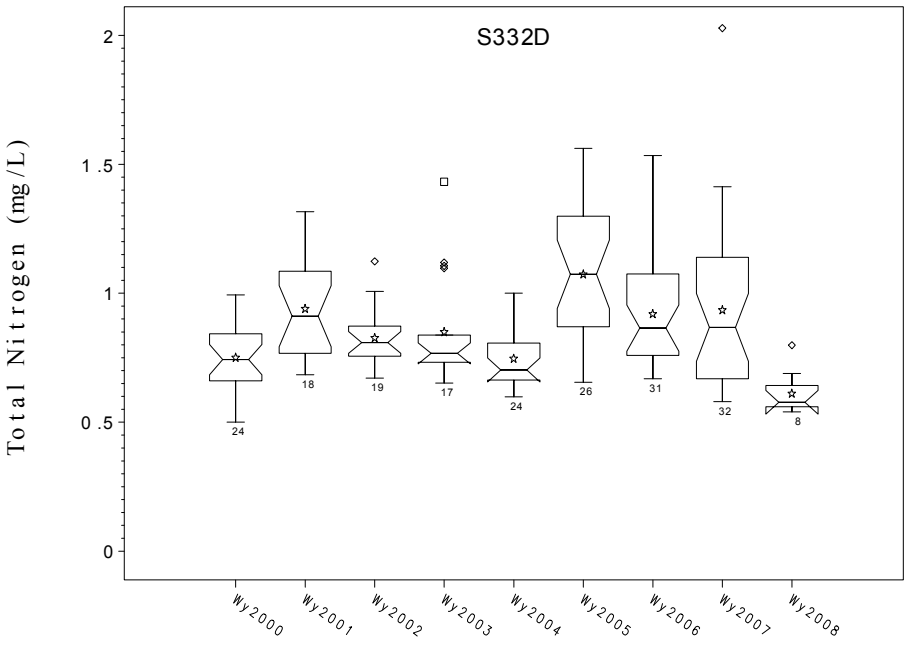

Figure E-36. TN notched box-and-whisker plot at S332D.

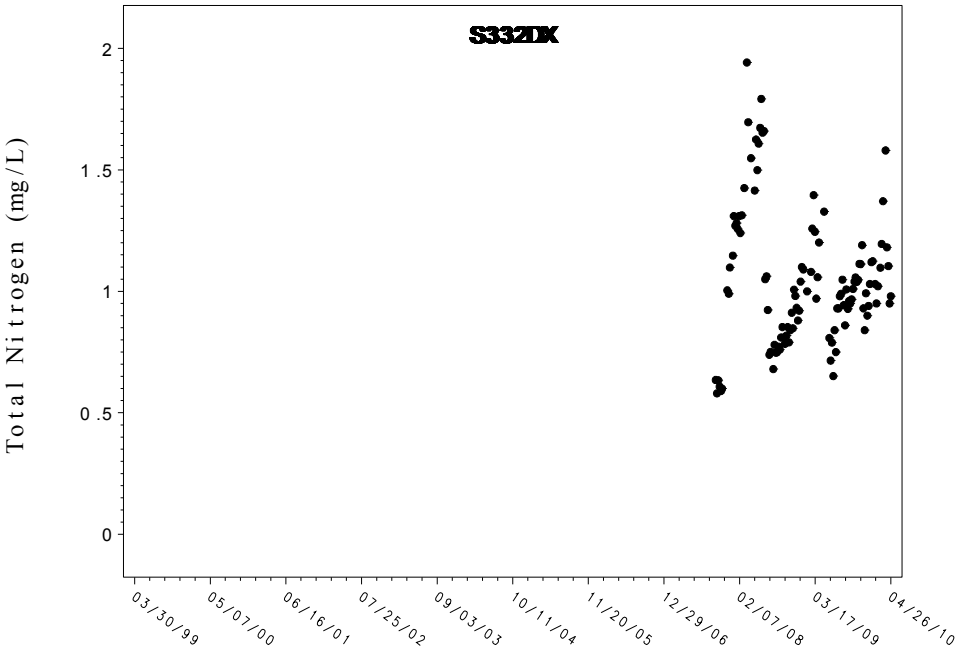

Figure E-37. TN concentration at S332DX.

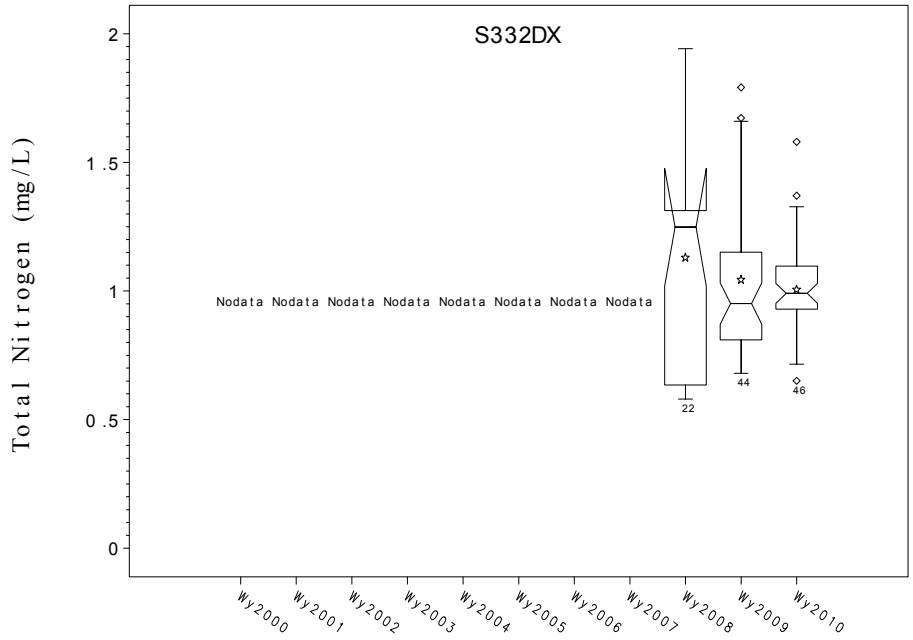

Figure E-38. TN notched-box-and-whisker plot at S332DX.

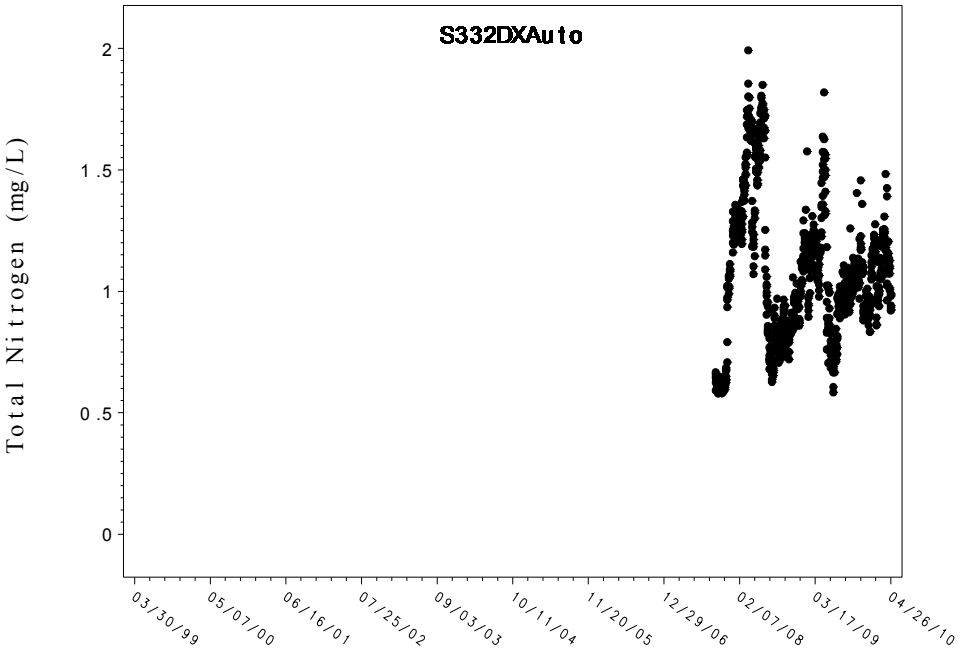

Figure E-39. TN concentration at S332DX auto-sampler.

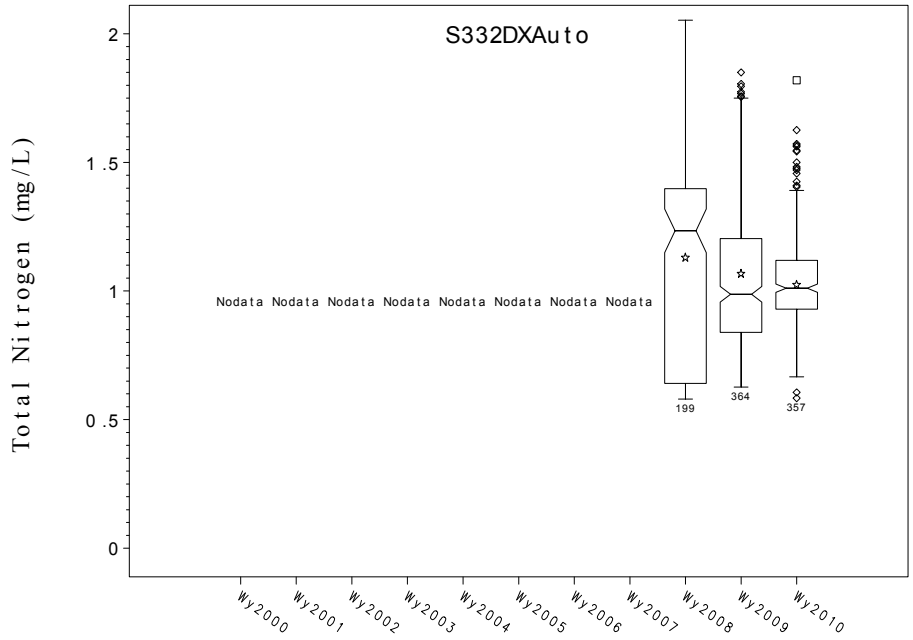

Figure E-40. TN notched-box-and-whisker plot at S332DX auto-sampler.

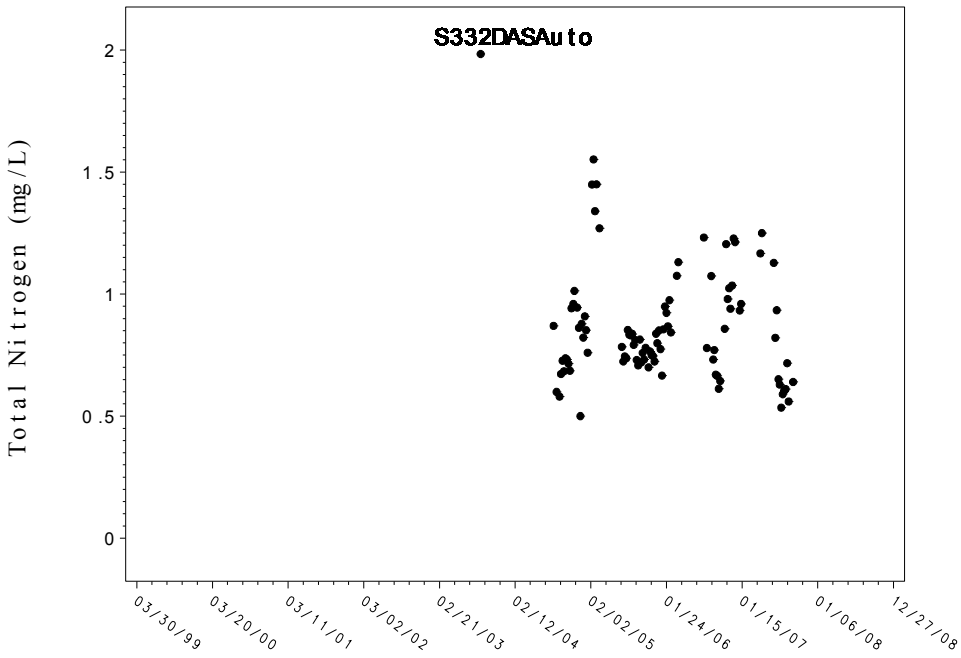

Figure E-41. TN concentration at S332DAS auto-sampler.

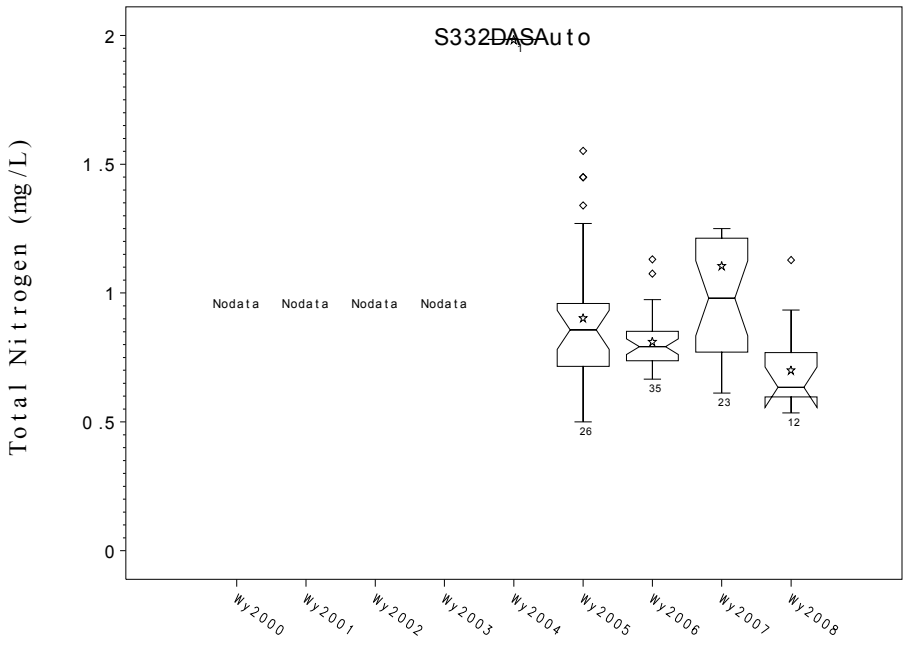

Figure E-42. TN notched box-and-whisker plot at S332DAS auto-sampler.

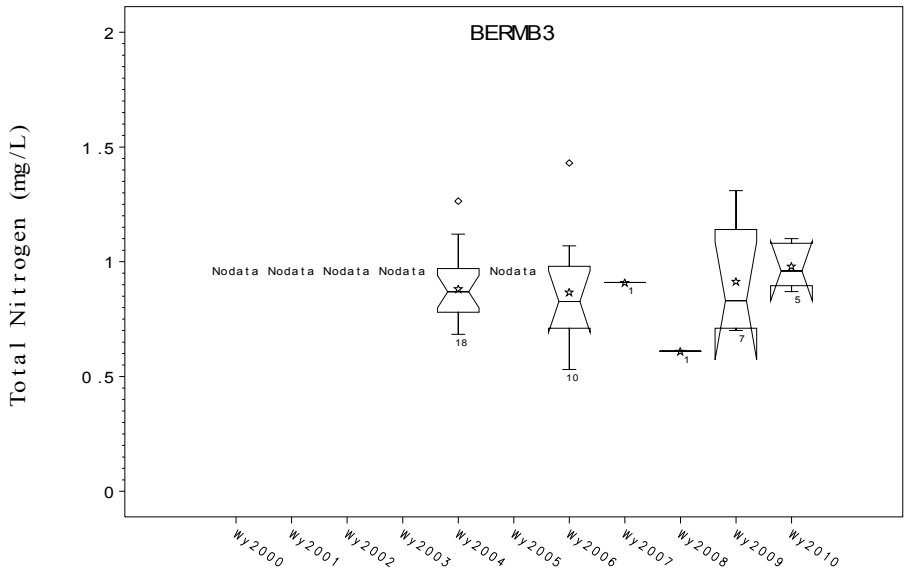

Figure E-43. TN concentration at BERMB3.

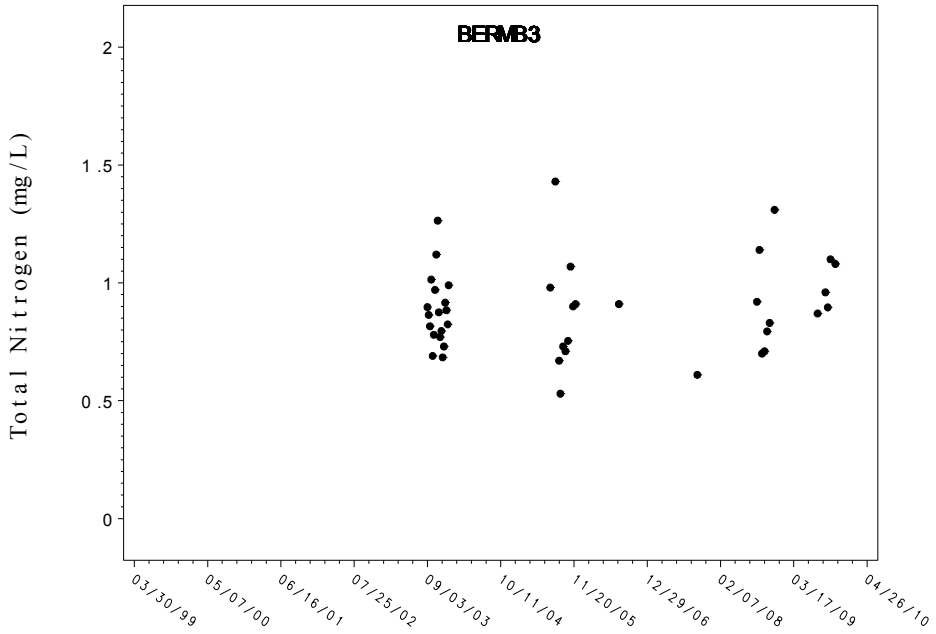

Figure E-44. TN notched-box-and-whisker plot at BERMB3.

Attachment F: Supporting Information on Water Quality and Flow Data for the IOP for Protection of the CSSS Monitoring Locations for Water Year 2010

Contact: Shi Kui Xue

In accordance with Specific Condition 25(g) of the IOP for Protection of the CSSS Emergency Contract (Emergency Order #9), this supporting information is available upon request.