PERFORMANCE EFFICIENCY EVALUATION OF UNDERDRAIN FILTRATION AND DRY DETENTION BEST MANAGEMENT PRACTICES

Final Report – June 2015

Prepared For:

Florida Department of Environmental Protection
FDEP Contract No. WQ010

Prepared By:

Environmental Research & Design, Inc.
3419 Trentwood Blvd., Suite 102
Belle Isle (Orlando), FL 32812-4864
Phone: 407-855-9465
Harvey H. Harper, Ph.D., P.E.
Chip Harper
David M. Baker, P.E.

TABLE OF CONTENTS

TABLE OF CONTENTS -- CONTINUED

TABLE OF CONTENTS -- CONTINUED

TABLE OF CONTENTS -- CONTINUED

TABLE OF CONTENTS -- CONTINUED

TABLE OF CONTENTS -- CONTINUED

Appendices

LIST OF FIGURES

LIST OF FIGURES -- CONTINUED

LIST OF FIGURES -- CONTINUED

LIST OF FIGURES -- CONTINUED

Number/Title **Page**

LIST OF FIGURES -- CONTINUED

LIST OF FIGURES -- CONTINUED

LIST OF FIGURES -- CONTINUED

LIST OF FIGURES -- CONTINUED

LIST OF TABLES

LIST OF TABLES -- CONTINUED

LIST OF TABLES -- CONTINUED

LIST OF TABLES -- CONTINUED

SECTION 1

INTRODUCTION

The discharge of stormwater within the State of Florida has been subject to regulation since the early 1980s to prevent pollution of Waters of the State and to protect the designated beneficial uses of surface waters. Currently, stormwater management is regulated at the State level by the Florida Department of Environmental Protection (FDEP), at the regional level by water management districts, and at the local level by local governments.

The goals for stormwater management within the State of Florida are outlined in Chapter 62-40 of the Florida Administrative Code (FAC), titled "Water Resource Implementation Rule". This rule establishes that stormwater design criteria adopted by FDEP and the water management districts shall achieve at least 80% reduction of the average annual load of pollutants that cause or contribute to violations of State Water Quality Standards. When the stormwater system discharges to an Outstanding Florida Water (OFW), the design and performance criteria increases to 95% reduction.

The most commonly used stormwater treatment systems in Florida include wet detention, dry retention, and dry detention (which is used primarily in South Florida). Significant previous research has been conducted into the effectiveness of wet detention and dry retention systems, and removal process and relationships for these BMPs are well established. However, only a limited number of previous research studies have been conducted on dry detention systems, in spite of the fact that these are the most commonly used treatment systems in South Florida, and the studies that have been conducted have reported a wide range of treatment efficiencies.

Another treatment type which is gaining popularity in the St. Johns River Water Management District (SJRWMD) is a pond underdrain system which uses native soil to filter the runoff before collection in a series of underdrains beneath the pond. SJRWMD previously allowed side bank dry detention filtration systems which were ultimately discontinued due to poor performance, clogging, and maintenance activities. The revised design is an attempt to address the issues associated with the previous side bank design. However, no studies have been conducted to evaluate the hydrologic and pollutant removal effectiveness of these systems.

1.1 Scope of Work

This report provides a discussion of work efforts performed by Environmental Research & Design, Inc. (ERD) for the Florida Department of Environmental Protection (FDEP) as part of Agreement WQ010 titled "Performance Efficiency Evaluation of Underdrain Filtration and Dry Detention Best Management Practices". The primary objective of this project is to evaluate the performance effectiveness of underdrain filtration systems designed according to SJRWMD criteria and to better define the effectiveness of dry detention systems which are commonly used in South Florida. Research sites using underdrain filtration and dry detention ponds were identified with the assistance of SJRWMD and the South Florida Water Management District (SFWMD). Hydrologic and water quality monitoring instrumentation was installed at each of the selected monitoring locations, and a 12-month field monitoring program was conducted at each site to evaluate the hydrologic and pollutant removal effectiveness for the evaluated systems. The underdrain filtration monitoring site is located in Orlando, with dry detention sites located in Bonita Springs, Naples, and Pembroke Pines. More than 12,000 individual laboratory analyses and 20,000 hydrologic measurements of flow rates, water level, and rainfall were collected as part of this project. Complete hydrologic and pollutant budgets are developed for each evaluated system to assist in characterizing pollutant removal effectiveness.

The specific objectives of this project are to:

1. Evaluate the hydrologic and pollutant removal effectiveness of dry detention ponds constructed according to SFWMD design criteria

2. Evaluate the hydrologic and pollutant removal effectiveness of underdrain filtration systems designed according to SJRWMD design criteria

3. Contribute to the existing runoff characterization database with additional data from low-intensity commercial land use

1.2 Report Organization

This report is divided into seven separate sections for presentation and discussion of the analyses and results of this project. Section 1 provides an introduction to the report, along with a summary of work efforts performed by ERD. A discussion of design criteria and site characteristics for each monitoring location is given in Section 2. Field monitoring activities are discussed in Section 3. Section 4 contains an analysis and discussion of the hydrologic characteristics of each site, including complete hydrologic budgets. A discussion of water quality characteristics of collected inflow, outflow, bulk precipitation, and groundwater samples is given in Section 5. Calculated mass removal efficiencies for the evaluated sites are given in Section 6, and a summary and recommendations are given in Section 7. Appendices are also attached which contain supporting data and calculations utilized to generate the results and conclusions presented in this report.

SECTION 2

DESIGN CRITERIA AND SELECTED MONITORING SITES

This section provides a discussion of current design criteria for dry detention systems constructed in the South Florida Water Management District (SFWMD) and underdrain systems constructed in the St. Johns River Water Management District (SJRWMD) which form the basis of design for the evaluated systems. Detailed descriptions are also included for each of the selected dry detention and underdrain monitoring sites, including physical and hydrologic characteristics.

2.1 Design Criteria

2.1.1 Dry Detention Design in the SFWMD

A dry detention system is a stormwater best management practice (BMP) consisting of an excavated area which is normally dry except during and immediately following storm events. The storage area is designed to store a defined quantity of runoff, often referred to as the water quality treatment volume, which is slowly released through an outlet structure to adjacent surface waters. The outlet structure for a dry detention system is generally constructed at or below the bottom of the pond to maintain dry conditions between storm events and to eliminate breeding areas for mosquitoes and other nuisance insects. Dry detention basins are normally dry, similar to a retention system, except a retention system is designed to recover the treatment volume by infiltration of the runoff into groundwater, while a dry detention pond relies primarily upon controlled discharges through the outfall structure to recover the storage volume. Dry detention ponds are typically designed to be dry within a specified period of time following a storm event, often 72 hours. A schematic of a typical dry detention pond system is given on Figure 2-1 and a photograph of a typical dry detention pond is given on Figure 2-2.

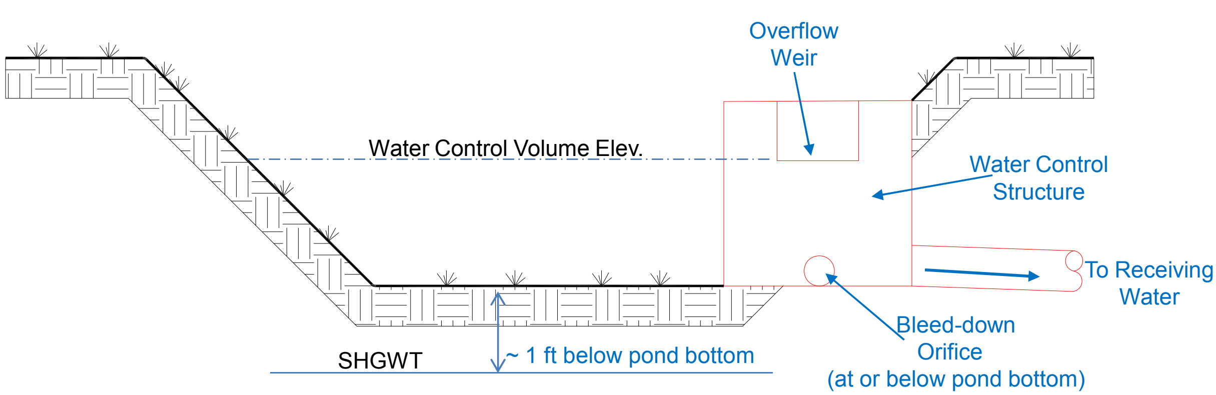


Figure 2-1. Schematic of a Typical Dry Detention Pond System.

Figure 2-2. Photograph of a Typical Dry Detention Pond System.

Due to the relatively short residence time for runoff within a dry detention pond, sedimentation is generally the primarily pollutant removal mechanism which occurs in these systems. Biological activity, which is responsible for a large portion of the removal for dissolved nutrients, is severely limited in a dry detention pond, and removal efficiencies for dissolved constituents are generally low. Dry detention systems are commonly used in areas where high groundwater table conditions or poorly draining soils limit the feasibility of other BMPs, such as dry retention. Dry detention basins are also popular for treatment of runoff generated in small drainage basins, such as gas stations and fast food operations, where more effective BMPs, such as wet detention, could not be constructed.

Design criteria for dry detention systems constructed in the SFWMD are outlined in the document titled **Environmental Resource Permit Applicant's Handbook – Volume II**, with the most recent version dated August 10, 2014. Basic standards for stormwater management systems are outlined in "**Part IV – Stormwater Quality**". Volumetric design requirements for retention/detention systems are outlined in *Section 4.2.1-Volumetric Requirements*, and applicable portions of these design criteria are summarized below:

> *Retention, detention, or both retention and detention in the overall system, including swales, lakes, canals, greenways, etc., shall be provided for one of the three following criteria or equivalent combinations thereof:*
>
> *(1) Wet detention volume shall be provided for the first inch of runoff from the developed project, or the total runoff of 2.5 inches times the percentage of imperviousness, whichever is greater.*

(2) *Dry detention volume shall be provided equal to 75 percent of the above amounts computed for wet detention*

(3) *Retention volume shall be provided equal to 50 percent of the above amounts computed for wet detention. Retention volume included in flood protection calculations requires a guarantee of long-term operation and maintenance of system bleed-down ability.*

Based upon the above design criteria, dry detention treatment volume shall be provided for the first 0.75 inch (1 inch x 0.75) of runoff from the developed project or 1.875 inches (2.5 inches x 0.75) times the percentage of imperviousness, whichever is greatest.

Further volumetric design requirements for dry detention systems are provided in *Section 4.2.2-Land Use and Coverage Criteria* which is summarized below:

Commercial or industrial zoned projects shall provide at least one-half inch of dry detention or retention pre-treatment as part of the required retention/detention, unless reasonable assurances can be offered that hazardous materials will not enter the project's surface water management system. Such assurances include, for example, deed restrictions on property planned for re-sale, type of occupancy, recorded lease agreements, local government restrictive codes, ordinances, licenses, and separate containment systems designed to prevent discharge.

None of the sites evaluated as part of this project included the 0.5-inch of pre-treatment due to a lack of hazardous materials. Subsequent sub-sections in Section 4.2.2 outline additional requirements for projects that discharge to impaired waters, OFWs, or specifically listed receiving waters. However, this supplemental language did not impact any of the project sites evaluated as part of this study.

Additional design criteria are provided in *Section 4.7-Impervious Areas* which requires projects with substantial impervious areas to include provisions for removal of oil, grease, and sediment from stormwater discharges and is summarized below:

Runoff shall be discharged from impervious surfaces through retention areas, detention devices, filtering and cleansing devices, or subjected to some other type of BMP prior to discharge from the project site. For projects which include substantial paved areas, such as shopping centers, large highway intersections with frequent stopped traffic, and high-density developments, provisions shall be made for the removal of oil, grease, and sediment from stormwater discharges.

Additional design and construction criteria for stormwater management systems constructed in the SFWMD are outlined in **Part V of the <u>Applicant's Handbook – Volume II</u>**. Specific design criteria for discharge structures are outlined in *Section 5.1-Discharge Structures*:

A. *All design discharges shall be made through structural discharge facilities. Earth berms shall be used only to disperse or collect sheet flows from or to ditches, swales or other flow conveyance mechanisms served by discharge structures.*

B. Discharge structures shall be fixed so that discharge cannot be made below the control elevation, except that emergency devices may be installed with secure locking devices. Use of emergency devices must be coordinated with Agency personnel prior to opening or as soon as possible thereafter. The Agency's Executive Director or Secretary is authorized to specify the use of emergency devices pursuant to Rule 40E-1.611, F.A.C.

C. Discharge structures must be non-operable unless approved otherwise.

D. It is recommended that discharge structures include gratings for safety and maintenance purposes. The use of trash collection screens is desirable.

E. Discharge structures shall include a baffle system to encourage discharge from the center of the water column rather than the top or bottom. Discharge structures from areas with greater than 50 percent impervious area or from systems with inlets in pave areas shall include a baffle, skimmer, or other mechanism suitable for preventing oil and grease from discharging to or from retention/detention areas. Designs must assure sufficient clearance between the skimmer and concrete structure or pond bottom to ensure that the hydraulic capacity of the structure is not affected.

Supplemental criteria included in Section 5.1 (not listed above) include requirements that the rate of discharge from the stormwater system be compatible with the capacity of receiving waters.

Design requirements for bleed-down mechanisms for both wet and dry detention systems are summarized in *Section 5.2-Control Devices/Bleed-down Mechanisms for Detention Systems*:

A. Agency criteria require that gravity control devices shall be sized based upon a maximum design discharge of one-half inch of the detention volume in 24 hours. The devices shall incorporate dimensions no smaller than 6 square inches of cross-sectional area, two inches minimum dimension, and 20 degrees for "V" notches. Systems which are limited by a discharge structure with an orifice no larger than the minimum dimensions described herein shall be presumed to meet the discharge quantity criteria except for projects which are required to have zero discharge. Applicants are advised that local drainage districts or local governments may have more stringent gravity control device criteria.

B. Gravity control devices shall be of a "V" or circular-shaped configuration whenever possible, to increase detention time during minor events.

C. Pumped control device, if pump discharge is permitted, shall be sized based on a design discharge of 20 percent of the detention volume in one day.

The design criteria specify that one-half inch of the required detention volume be released within 24 hours through an outfall device no smaller than 6 square inches, 2 inches in diameter, or 20 degrees for "V" notches. Whenever possible, the District prefers the more circular-shaped outfall control devices which increase detention times during minor events. Although the design criteria require that gravity control devices not release more than one-half inch of the detention volume in 24 hours, there does not appear to be any time requirement to achieve complete bleed-down of the dry detention system.

Additional design criteria for dry retention/detention areas are found in *Section 5.3.3-Dry Retention/Detention Areas (Nor Applicable to Natural or Mitigation Wetland Areas)*:

A. *Dry retention/detention areas shall have mechanisms for returning the groundwater level in the area to the control elevation. The bleed-down rate for these systems is the same as in Section 5.2(a), herein.*

B. *Mosquito control ditches or other appropriate features for such purposes, shall be incorporated into the design of dry retention/detention areas.*

C. *The design of dry retention/detention areas shall incorporate considerations for regular maintenance and vegetation harvesting procedures.*

This language requires dry detention areas to provide a mechanism for returning the groundwater level in the area to the control elevation. In practice, the control elevation for dry detention ponds in the SFWMD is designed to be approximately one foot below the pond bottom to ensure complete bleed-down of the pond following storm events.

The **SFWMD Applicant's Handbook** provides detailed dimensional criteria for the design of wet retention/detention areas which include information on minimum size, width, depth, side slopes, and bulkheads. However, no comparable dimensional criteria are provided for dry detention systems.

It is common practice in the SFWMD for engineers to design multiple smaller interconnected dry detention ponds which cumulatively provide the required water quality treatment volume rather than a single larger pond. This design technique allows the ponds to be placed into vacant or unusable areas within the development instead of devoting a large area to a single pond. However, current design criteria do not require that each individual pond be sized for the contributing watershed, only that the overall detention volume provided by the interconnected system meet the applicable volume.

2.1.2 Underdrain System Design in the SJRWMD

Stormwater underdrain systems permitted by SJRWMD consist of an excavated dry stormwater basin which is underlain with perforated drainage piping that is used to collect and convey stormwater which percolates through the bottom of the basin and the on-site soils. Underdrain systems are a hybrid of dry retention and dry detention systems since the stormwater percolates into the ground similar to a dry retention basin but is then collected and discharged directly into the receiving waterbody, similar to a dry detention system. Underdrain systems are generally used in areas with permeable soils but high water table conditions that prevent the recovery of the stormwater treatment volume through infiltration into the groundwater alone. The addition of the underdrain allows the pond to recover to the normally dry conditions while providing treatment for the runoff as it infiltrates through the native on-site soils.

A schematic of a typical underdrain system is given on Figure 2-3. Underdrain systems provide control of the water table elevation beneath the pond as well as provide for the drawdown of the treatment volume by filtration through on-site soils.

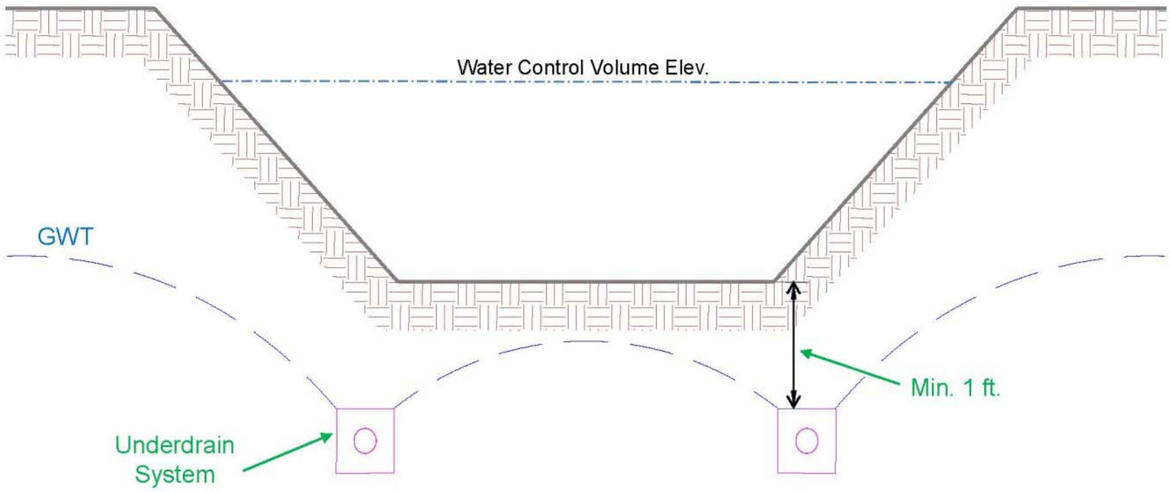


Figure 2-3. Schematic of a Typical Underdrain System.

The underdrain schematic shown on Figure 2-3 illustrates underdrains located around the bottom perimeter of the pond. However, depending upon the size and configuration of the pond bottom, a network of interlinked underdrains may be necessary to accomplish the objectives of the treatment process.

Design criteria for underdrain stormwater treatment systems constructed in the SJRWMD are provided in the **SJRWMD Permit Information Manual**, with the latest edition dated October 1, 2013. Design and performance criteria for underdrain systems are outlined in *Section 6.0-Underdrain Design and Performance Criteria*. Specifications for the required treatment volume for an underdrain system are outlined in *Section 6.2-Treatment Volume*:

The first-flush of runoff should be detained in a dry detention basin and percolated through the soil. Dry detention systems that discharge to Class III receiving waterbodies shall provide for either of the following treatment volumes:

A. Off-line retention of the first one-half inch of runoff or 1.25 inches of runoff from the impervious area, whichever is greater, or

B. On-line retention of an additional one-half inch of runoff from the drainage area over that volume specified for off-line treatment.

For direct discharges to Class I, Class II, OFWs, or Class III waters which are approved, conditionally approved, restricted, or conditionally restricted for shellfish harvesting, the Applicant shall provide retention for either of the following:

A. *At least an additional 50 percent of the applicable treatment volume specified for off-line retention in (A) above. Off-line retention must be provided for at least the first one-half inch of runoff or 1.25 inches of runoff from the impervious area, whichever is greater, of the total amount of runoff required to be treated.*

B. *On-line retention of the runoff from the 3-year, one-hour storm or an additional 50 percent of the treatment volume specified in (B) above, whichever is greater.*

Design and performance criteria for recovery of the treatment volume are provided in *Section 6.3-Recovery Time*:

The system should be designed to provide for the drawdown of the appropriate treatment volume specified in Section 6.2 within 72 hours following a storm event. The treatment volume is recovered by percolation through the soil with subsequent transport through the underdrain pipes. The system should only contain standing water within 72 hours of a storm event.

The pipe system configuration (e.g., pipe size, depth, pipe spacing, and pipe inflow capacity) of the underdrain system must be designed to achieve the recovery time requirement.

To ensure that the system maintains adequate infiltration capability throughout the intended design life, SJRWMD requires that the system be over-designed, as outlined in *Section 6.4-Safety Factor*:

The underdrain system must be designed with a safety factor of at least two unless the Applicant affirmatively demonstrates based on plans, test results, calculations, or other information that a lower safety factor is appropriate for the specific site conditions. Examples of how to apply this factor include, but are not limited to, the following:

A. *Reducing the design percolation by half*

B. *Designing for the required drawdown within 36 hours instead of 72 hours*

Design specifications for the underdrain media and filter fabric are provided in *Section 6.5-Underdrain Media* and *Section 6.6-Filter Fabric*:

Underdrain Media: To provide proper treatment of the runoff, at least two feet of indigenous soil must be between the bottom of the basin storing the treatment volume and the outside of the underdrain pipes (or gravel envelope as applicable).

Filter Fabric: Underdrain system shall utilize filter fabric or other means to prevent the soil from moving into and clogging perforated pipe.

SJRWMD also provides design criteria for stabilization of the basin bottom, with a permanent vegetative cover. This language is outlined in *Section 6.8-Basin Stabilization*:

The underdrain basin shall be stabilized with permanent vegetative cover and should contain standing water only immediately following a rainfall event.

2.2 Monitoring Sites

As discussed in Section 1, three separate monitoring sites were selected to evaluate the hydrologic and pollutant removal effectiveness of dry detention systems designed according to SFWMD design criteria, with one site selected to evaluate underdrain systems constructed according to SJRWMD design criteria. In addition to providing information on the performance efficiencies of the evaluated BMPs, each of the monitoring sites was also selected to include commercial activities to enhance existing runoff emc data for the commercial land use category.

Assistance with selection of the dry detention and underdrain monitoring sites were provided by SFWMD and SJRWMD, respectively. SFWMD staff provided a parsed list of commercial sites designed and constructed according to SFWMD design criteria. Each of these sites received a post-construction inspection which verified that the system was constructed according to the approved design documents. Assistance was also provided by SJRWMD staff which identified the locations of underdrain filtration systems constructed according to SJRWMD design criteria with post-construction inspection to verify that the systems were constructed according to the approved design documents. Multiple potential monitoring sites were recommended by both SFWMD and SJRWMD. ERD staff visited each of the recommended proposed monitoring sites and conducted a review which included issues such as suitability for monitoring, site access and security, site maintenance activities, and potentially complicating factors such as excessively high tailwater conditions. A scoring system was developed based upon these factors, and each of the sites was ranked in order of monitoring preference.

ERD then began contacting each of the property owners to obtain permission for site access and conducting the proposed monitoring activities. Many of the contacted property owners would not agree to allow on-site monitoring due to concerns over liability and potential non-compliance issues with the respective water management districts if the monitoring program were to detect design or construction issues with the stormwater management systems. Property owners which were initially agreeable to the proposed monitoring insisted that the proposed activities be reviewed by legal counsel along with indemnification letters from both FDEP and the water management districts. After approximately 14 months of negotiations, three dry detention system systems were identified in the SFWMD area and one underdrain site in the SJRWMD area.

Locations of the selected dry detention and underdrain monitoring sites are indicated on Figure 2-4. Commercial parcels using dry detention for stormwater treatment were monitored in Bonita Springs and Naples on the west coast of Florida and in Pembroke Pines on the east coast. Each of these three monitoring sites consists of “big box” commercial shopping centers with smaller ancillary commercial out-parcel activities. The underdrain monitoring site is located in Orlando at the regional maintenance facility for Lynx, the Central Florida mass transportation agency.

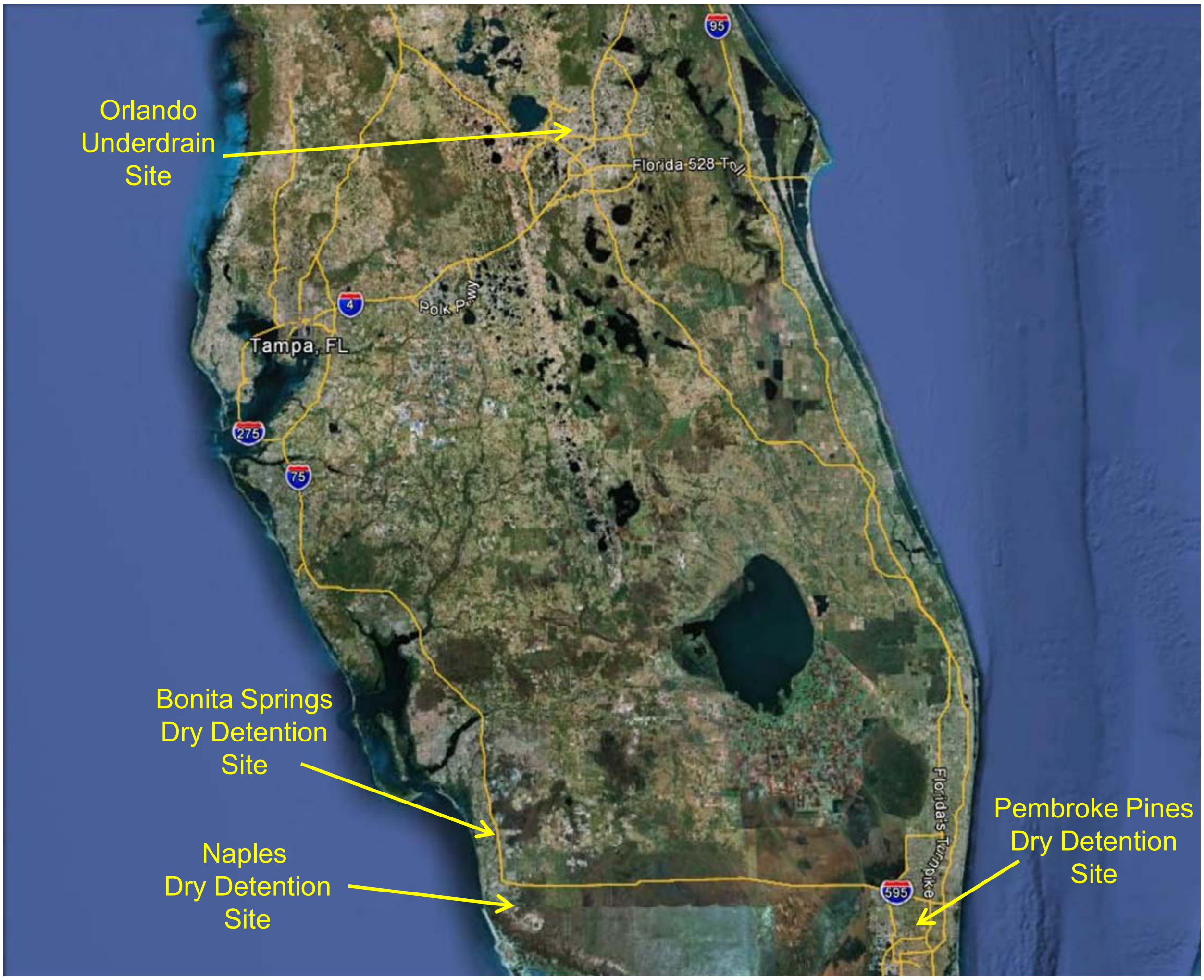


Figure 2-4. Locations of the Selected Dry Detention and Underdrain Monitoring Sites.

2.2.1 Dry Detention Sites

2.2.1.1 Bonita Springs Dry Detention Site

A location map of the Bonita Springs monitoring site is given on Figure 2-5. The shopping center site is located in the northwest quadrant of the intersection of Tamiami Trail (US 41) and Wiggins Pass Road (CR 888), approximately 3.4 miles southwest of the City of Bonita Springs.

An overview of the Bonita Springs monitoring site is given on Figure 2-6. This site consists of a large "big box" commercial store with associated parking areas. Three separate out-parcel shopping and restaurant areas are also part of the overall site development. The site was permitted through SFWMD during 2006.

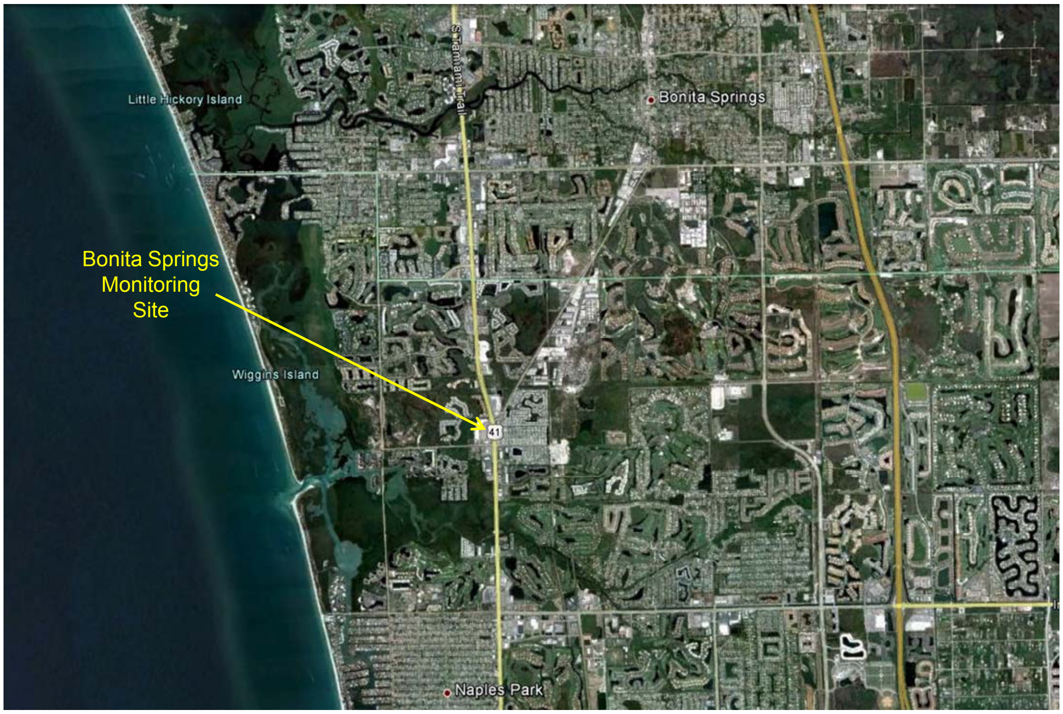


Figure 2-5. Location Map for the Bonita Springs Dry Detention Site.

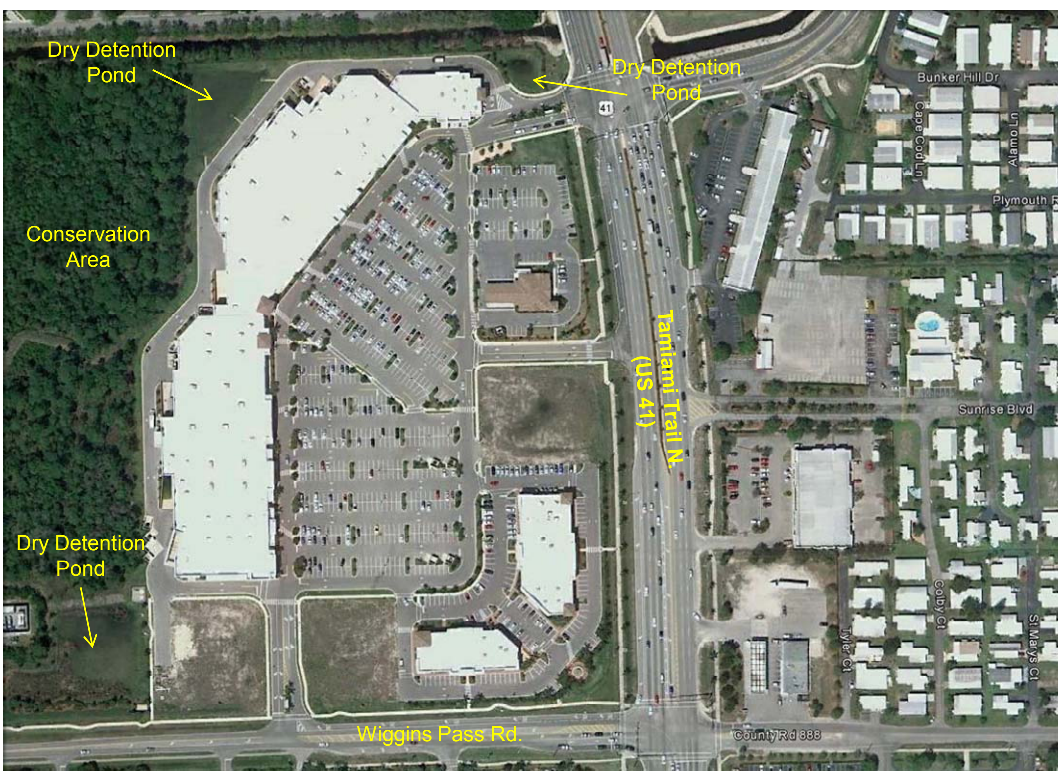


Figure 2-6. Overview of the Bonita Springs Dry Detention Site.

Drainage features for the Bonita Springs dry detention site are illustrated on Figure 2-7. Stormwater generated within the site is directed to one of three interconnected dry detention areas. Pond 1 has a surface area of 0.09 acres (TOB) and receives drainage from approximately 2.92 acres of parking lot areas. Pond 2, covering approximately 0.45 acres (TOB), also receives drainage from approximately 2.92 acres of pavement and rooftop areas. Pond 3, covering approximately 1.11 acres (TOB), receives drainage from approximately 16.27 acres of parking lot and rooftop areas. The outfall control structure is located in Pond 3 and discharges through a 15-inch RCP into the conservation area located west of the project site.

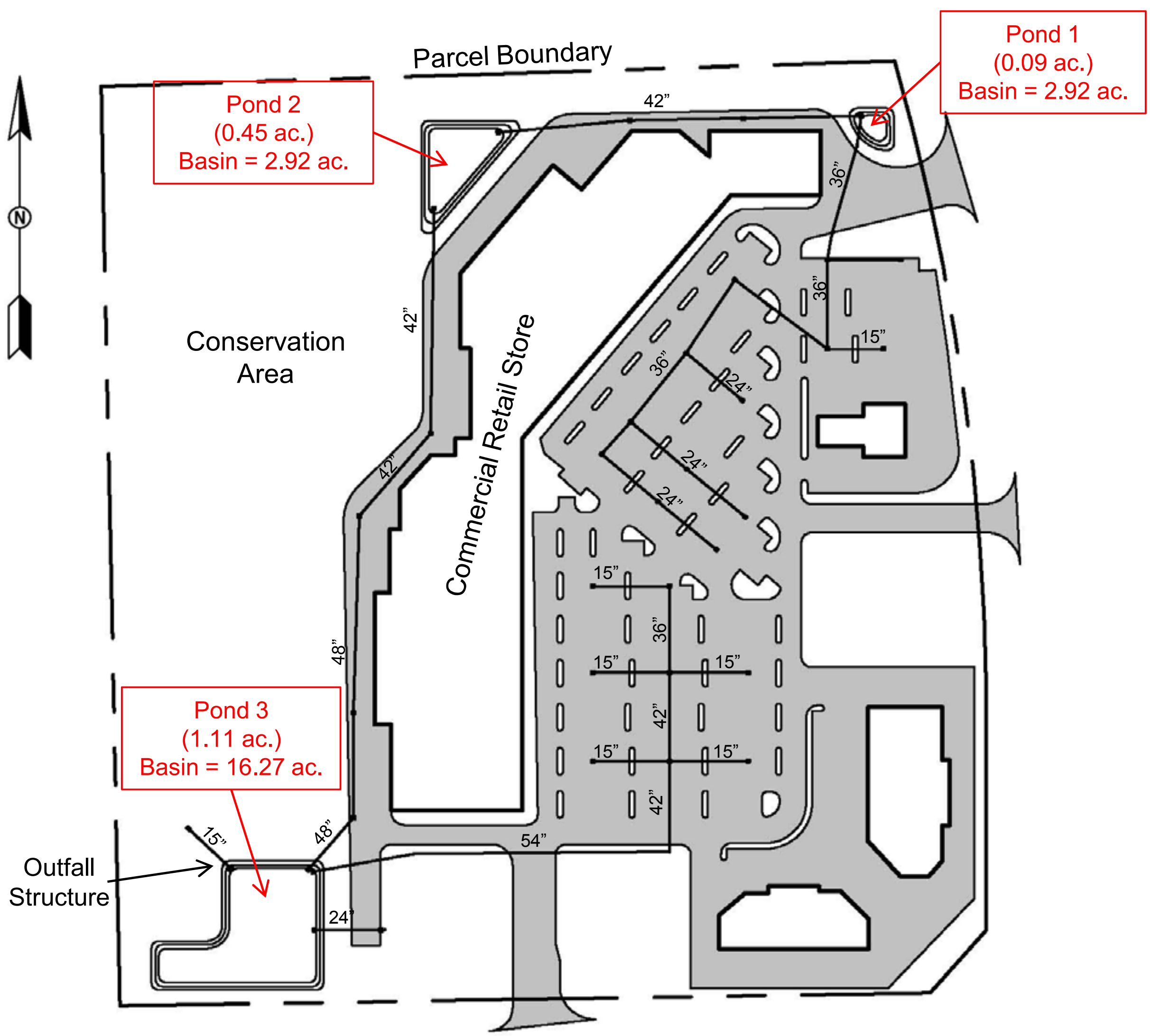
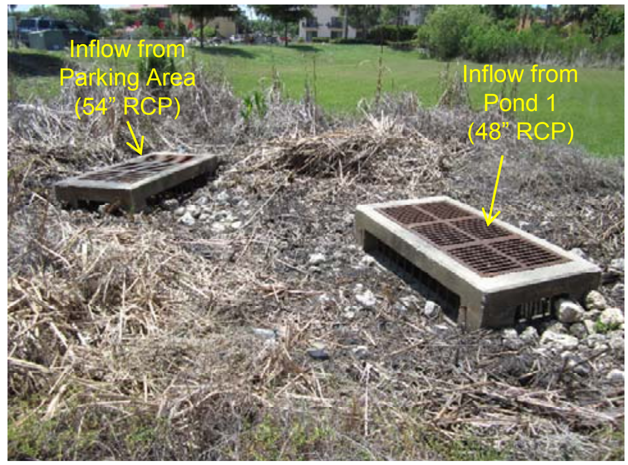


Figure 2-7. Drainage Features for the Bonita Springs Dry Detention Site.

Photographs of inflow and outflow structures at the Bonita Springs dry detention site are given on Figure 2-8. Inflows into each of the ponds consist of bubble-up structures with a top grate elevation equal to or slightly above the pond bottom. The outfall structure consists of a simple raised inlet with a circular orifice used for bleed-down. A half-section of a corrugated metal pipe is attached as a skimmer device.

Inflow to Pond 1 from Parking Lot



Inflows to Pond 3

Inflow to Pond 3 from Vacant Out-Parcel

Pond 3 Outfall Structure

Figure 2-8. Photographs of Inflow/Outflow Structures at the Bonita Springs Dry Detention Site.

A schematic of the outfall control structure for the Bonita Springs dry detention site is given on Figure 2-9. The water elevation within the dry detention pond is controlled by a 4-inch diameter orifice with an invert elevation of 7.0 ft. This elevation is approximately 1 ft lower than the typical pond bottom in the dry detention ponds of 8.0 ft and is designed to maintain dry conditions within the three interconnected ponds. High level overflows from the pond system begin to occur at elevation 9.0 ft.

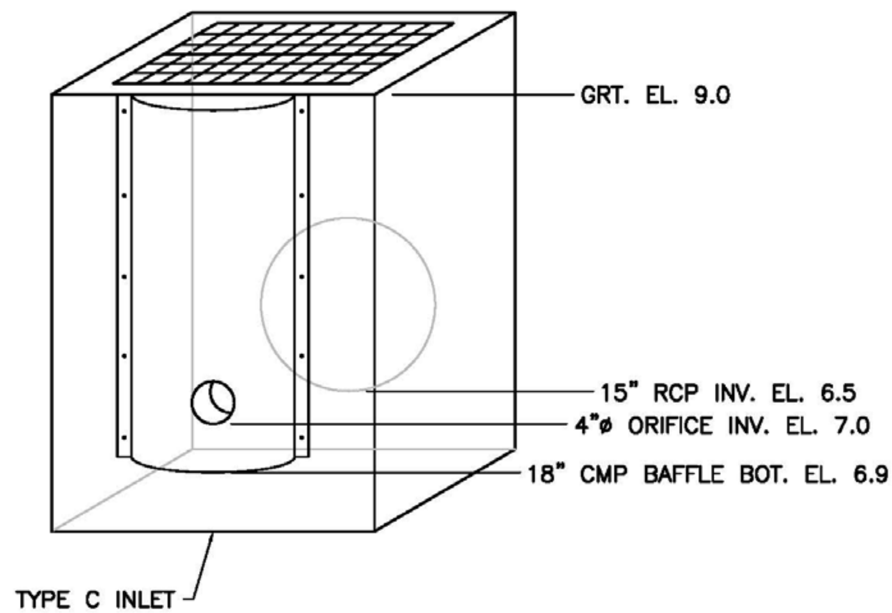


Figure 2-9. Schematic of the Outfall Structure for the Bonita Springs Dry Detention System.

Hydrologic characteristics of the Bonita Springs dry detention site are summarized on Table 2-1. The total project area discharging to the dry detention ponds is approximately 22.11 acres, including 16.68 acres of impervious area. Assuming that 100% of the impervious area is directly connected, the DCIA percentage for the site is approximately 75.4%. The three stormwater management areas cover approximately 1.57 acres or 7.1% of the total site area. Pervious areas cover approximately 5.43 acres of the site and are categorized in hydrologic soil groups (HSG) A/D and B/D, indicating permeable soils limited by high water table conditions. Based on estimates performed by ERD, the water quality volume provided by the three dry detention ponds below the outfall overflow weir elevation is approximately 1.54 ac-ft.

TABLE 2-1

HYDROLOGIC CHARACTERISTICS OF THE BONITA SPRINGS DRY DETENTION SITE

PARAMETER	UNITS	VALUE
Total Project Area	acres	22.11
Impervious Area	acres	16.68
DCIA	%	75.4
Stormwater Management Area	acres % of total area	1.57 7.1
Pervious Area Soil HSG	--	A/D 0.81 acres B/D 4.62 acres
Pervious CN Value	--	63.1
Stormwater Management Type	--	Dry detention
Water Quality Volume Provided	ac-ft	1.54[1]
Treatment Volume Depth Over Basin Area	inch	0.84
Land Use	--	Commercial
Year Permitted	--	2006

1. Calculated independently by ERD

2.2.1.2 Naples Dry Detention Site

A location map for the Naples dry detention site is given on Figure 2-10. The monitoring site is located approximately 8.3 miles southeast of downtown Naples, south of the intersection of US 41 and Collier Blvd.

An overview of the Naples dry detention site is given on Figure 2-11. The site consists of a "big box" commercial shopping center with associated parking areas. The shopping center is located on the southeast corner of Collier Blvd. and Eagle Creek Dr.

An overview of drainage features for the Naples dry detention site is given on Figure 2-12. Stormwater treatment for the site is provided by two interconnected dry detention ponds. Pond 1, with a surface area of 1.55 acres (TOB), receives stormwater from approximately 16.45 acres of parking lot and paved surfaces. Pond 2 contains the outfall structures for the system and is 0.46 acres (TOB) in size and receives runoff from 5.11 acres of parking lot and impervious surfaces. Roof runoff at the Naples site bypasses the treatment system altogether. Pond 2 contains two separate outfall structures. Outfall Structure 1 contains the bleed-down orifice for the dry detention system and discharges due east through a 24-inch SD pipe into the wet detention pond for the adjacent residential community (Figure 2-10). Roof runoff discharges into the 24-inch SD pipe downstream from the pond outfall. Outfall Structure 2 provides high level overflow only and discharges into the wetland area located due north of Pond 2.

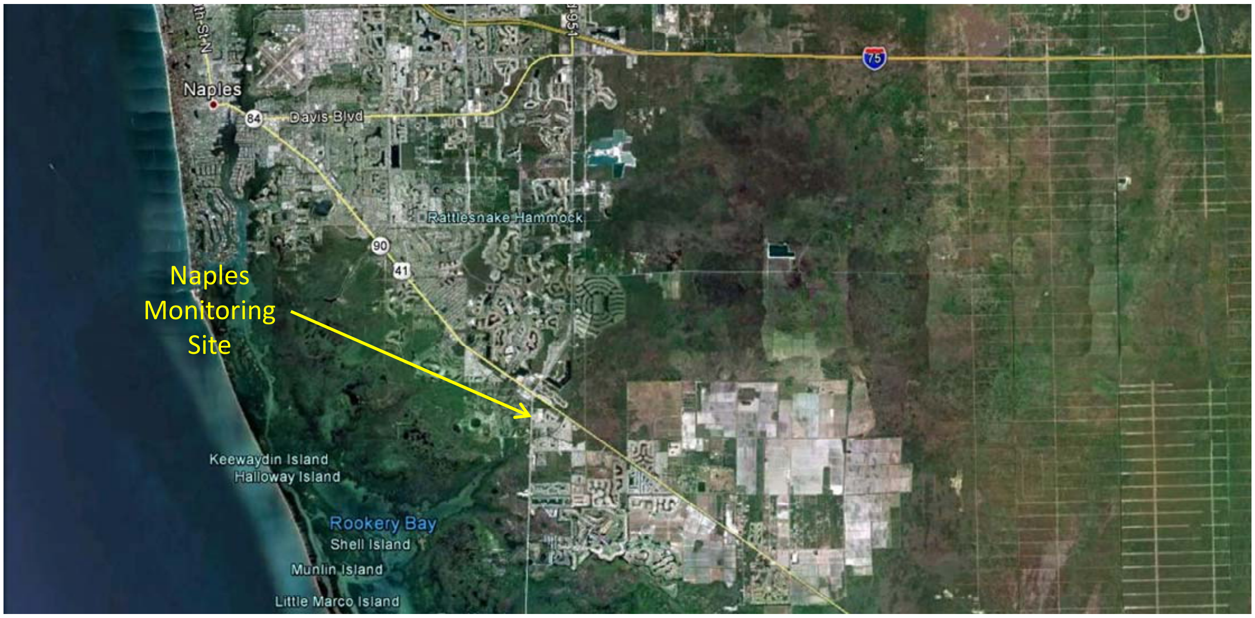


Figure 2-10. Location Map for the Naples Dry Detention Site.

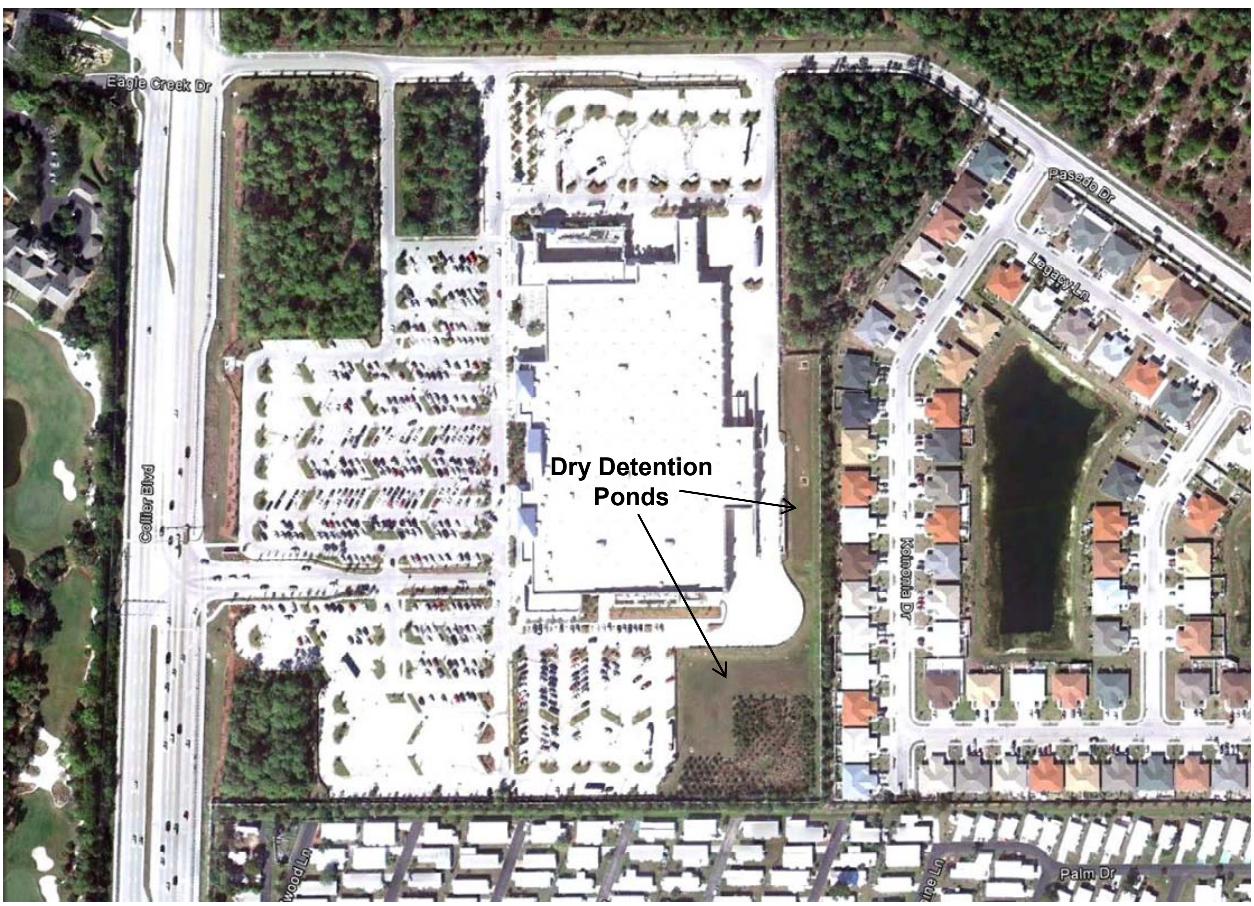


Figure 2-11. Overview of the Naples Dry Detention Site.

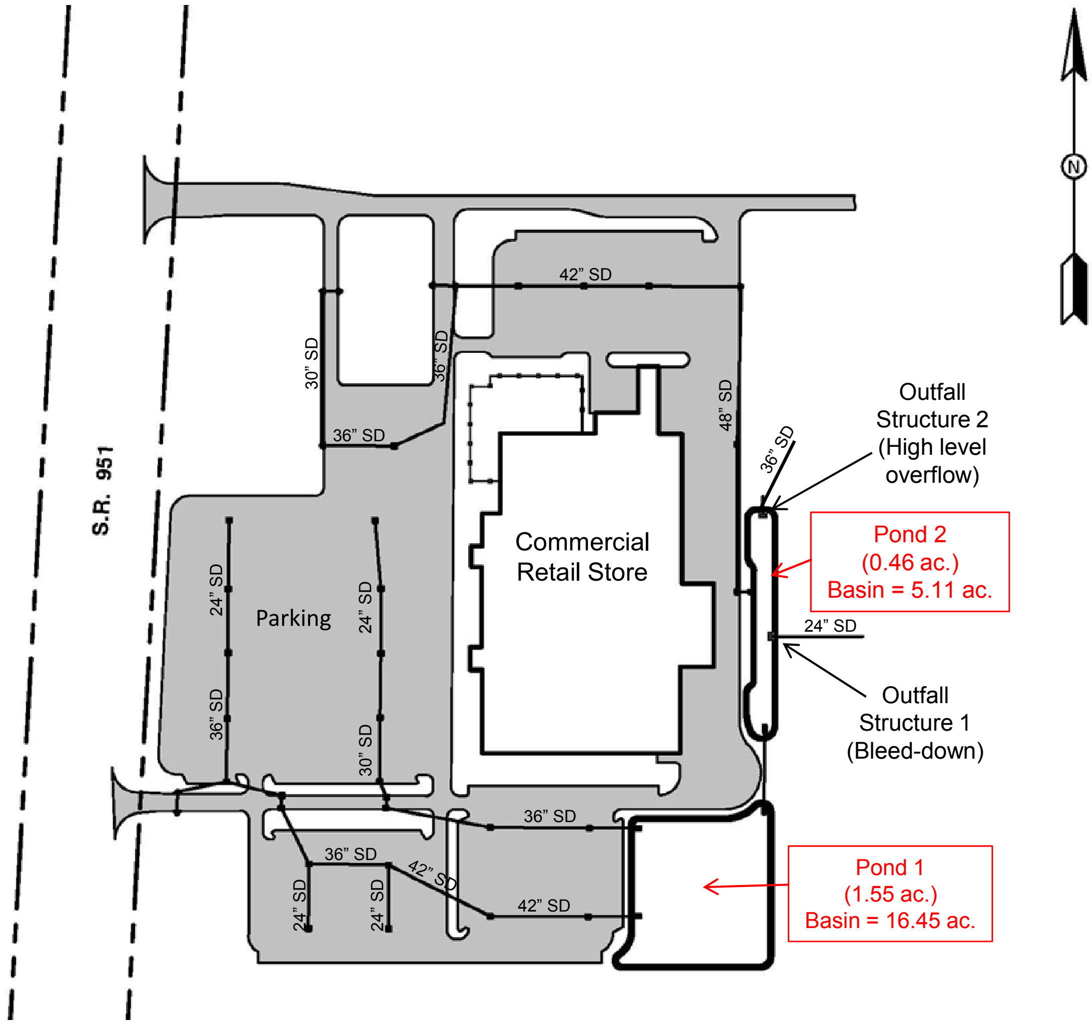
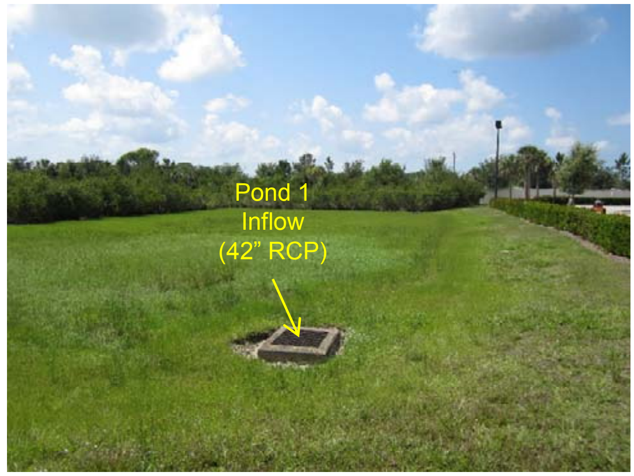


Figure 2-12. Drainage Features for the Naples Dry Detention Site.

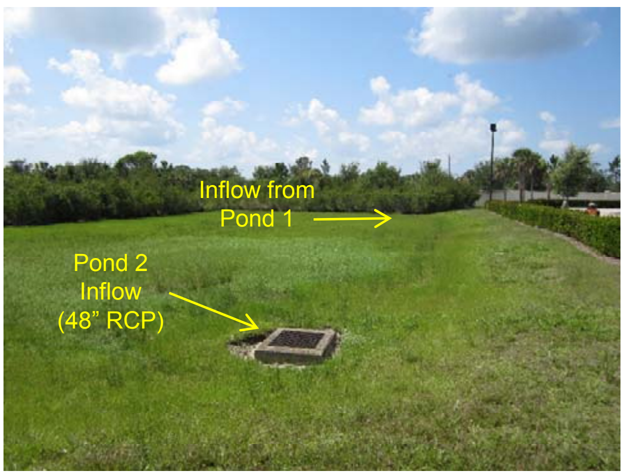
Photographs of inflow and outflow structures at the Naples dry detention site are given on Figure 2-13. Inflows into each of the two ponds consists of bubble-up structures with the top grate elevation equal to or slightly above the bottom of the pond. The outfall structure consists of a raised inlet with two bleed-down orifices constructed in a sump area to ensure adequate bleed-down of water levels within the pond. An aluminum skimmer is constructed around the inlet structure to prevent floatable materials from discharging from the pond.

An overview of Outfall Structure 1, containing the bleed-down orifices for the dry detention system, is given on Figure 2-14. The outfall structure contains two separate 5-inch diameter orifices with one orifice set at an invert of 3.10 ft and the second orifice set at an invert of 5.10 ft. Discharges from the outfall structure occur through a 24-inch SD pipe.

Inflow to Pond 1 from Parking Lot (36-inch RCP)



Inflow to Pond 1 from Parking Lot (42-inch RCP)



Inflows to Pond 2

Pond 2 Outfall Structure

Figure 2-13. Photographs of Inflow/Outflow Structures at the Naples Dry Detention Site.

Hydrologic characteristics of the Naples dry detention site are summarized in Table 2-2. The total project area discharging to the dry detention system is 21.56 acres which excludes the roof of the commercial building. Approximately 16.84 acres are covered with impervious area which corresponds to a DCIA percentage of 78.1%. Stormwater management systems cover approximately 2.01 acres (TOB) or approximately 9.3% of the project site. Approximately 4.72 acres of the project are covered by pervious areas, with 3.97 acres classified in HSG A/D and 0.75 acres in HSG C/D. Based on estimates conducted by ERD, the water quality volume provided by the dry detention system is approximately 1.77 ac-ft. The Naples dry detention site was permitted during 2006.

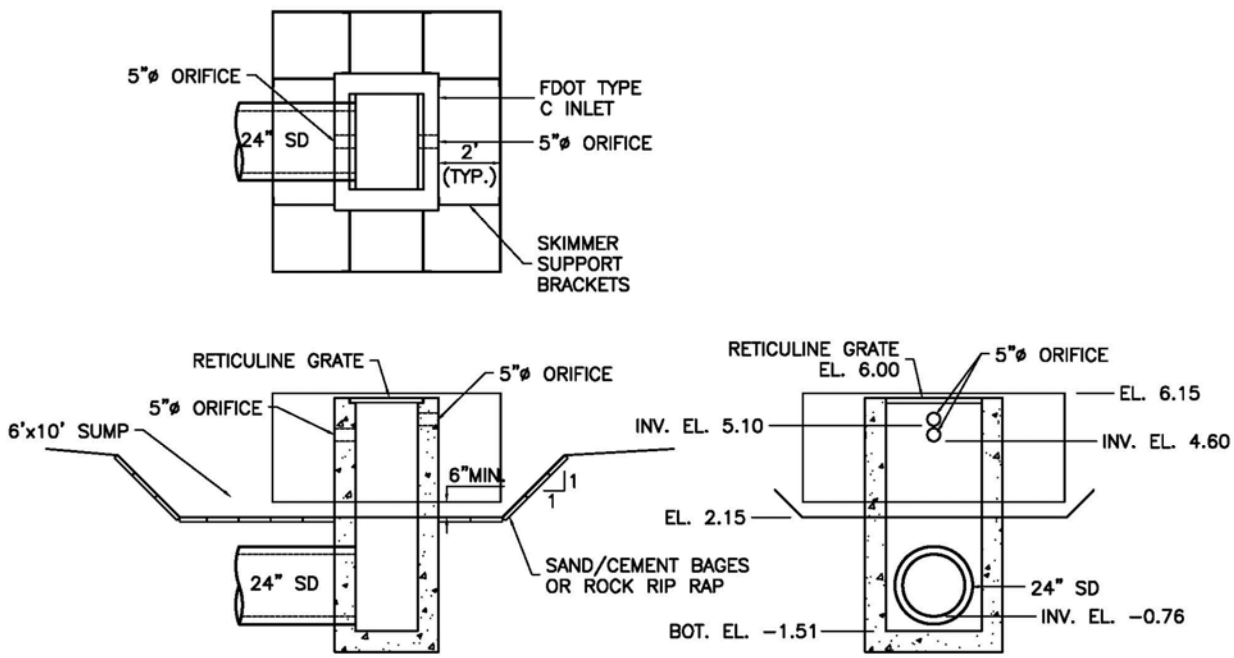


Figure 2-14. Overview of Outfall Structure 1 at the Naples Dry Detention Site.

TABLE 2-2

HYDROLOGIC CHARACTERISTICS OF THE NAPLES DRY DETENTION SITE

PARAMETER	UNITS	VALUE
Total Project Area	acres	21.56
Impervious Area	acres	16.84
DCIA	%	78.1
Stormwater Management Area	acres % of total area	2.01 9.3
Pervious Area Soil HSG	--	A/D 3.97 acres C/D 0.75 acres
Pervious CN Value	--	52.7
Stormwater Management Type	--	Dry detention
Water Quality Volume Provided	ac-ft	1.77[1]
Treatment Volume Depth Over Basin Area	inch	0.99
Land Use	--	Commercial
Year Permitted	--	2006

1. Calculated independently by ERD

2.2.1.3 Pembroke Pines Dry Detention Site

A location map for the Pembroke Pines dry detention site is given on Figure 2-15. The site is located within the City of Pembroke Pines in southeast Florida, approximately 3.1 miles west of I-75 and 2.5 miles east of the Everglades urban boundary. An overview of the Pembroke Pines dry detention site is given on Figure 2-16. The site consists of a large "big box" commercial shopping center with several associated commercial and retail out-parcels. The project site is located on the southeast corner of Collier Blvd. (SW 184th Ave.) and West Pines Blvd. in Pembroke Pines.

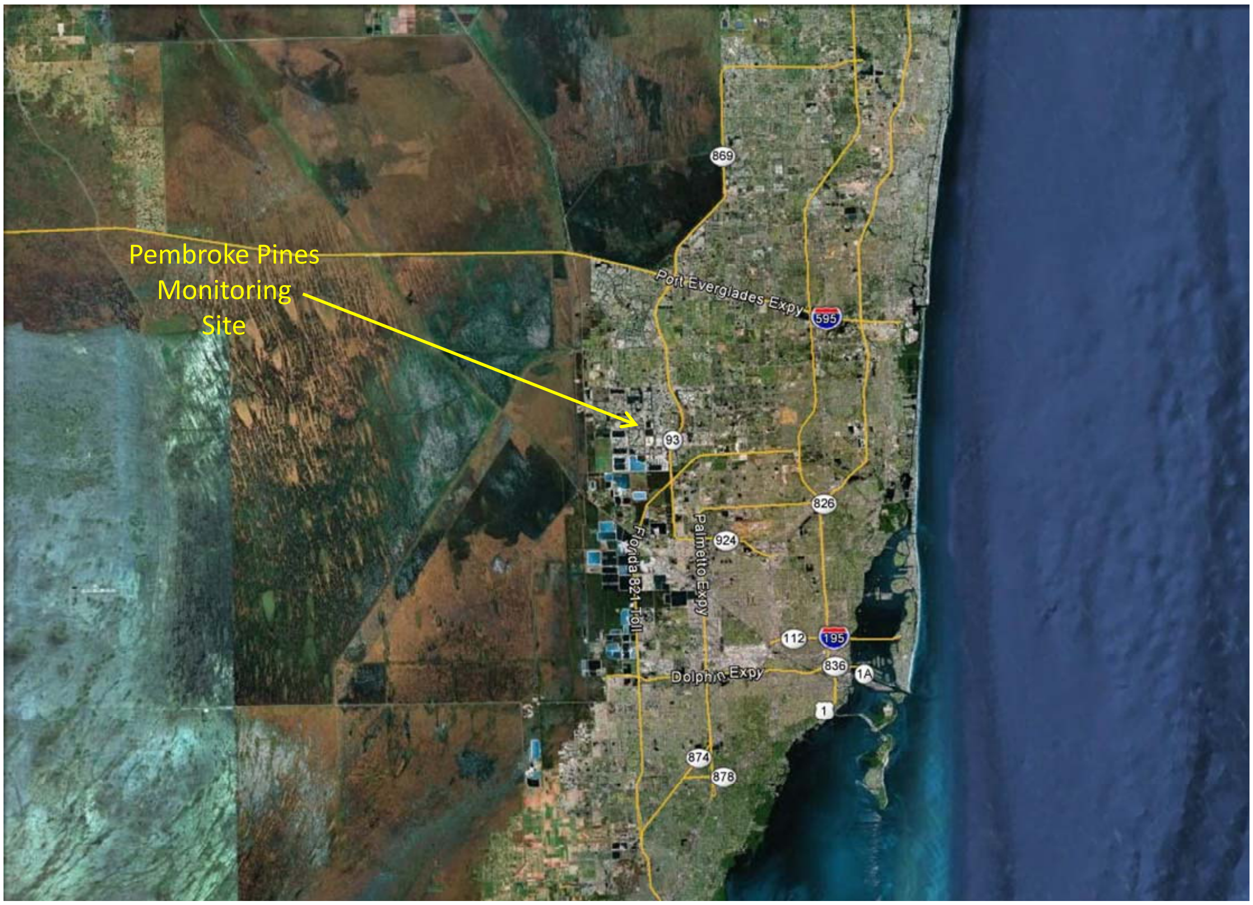


Figure 2-15. Location Map for the Pembroke Pines Dry Detention Site.

Drainage features for the Pembroke Pines dry detention site are illustrated on Figure 2-17. Drainage generated within the site is treated within three dry detention ponds. The ponds labeled as Pond 1 and Pond 2 are interconnected and receive inputs from the majority of the parking area associated with the commercial site. An additional pond is located in the northeast corner of the project site which receives drainage from perimeter areas around the "big box" store, roof areas for the store, and several out-parcel areas. However, additional construction activities were occurring in the vicinity of the out-parcels during the field monitoring program, and as a result, the northeast pond was not included in the field monitoring program.

Figure 2-16. Overview of the Pembroke Pines Dry Detention Site.

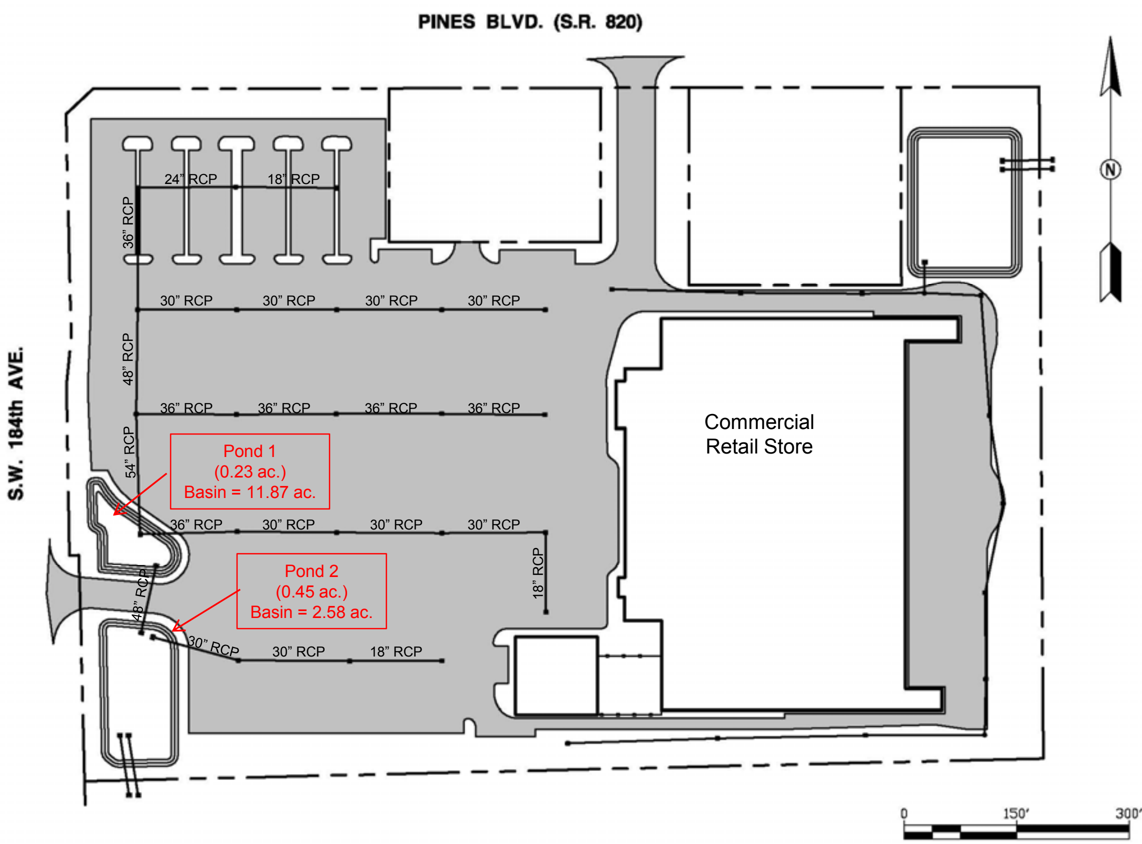
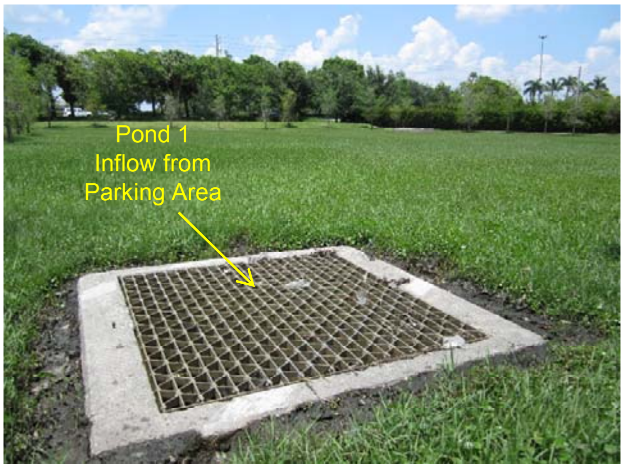


Figure 2-17. Drainage Features for the Pembroke Pines Dry Detention Site.

Photographs of inflow and outflow structures at the Pembroke Pines dry detention site are given on Figure 2-18. Inflows into each of the two ponds are introduced using bubble-up structures with the top elevation of the metal grate equal to or slightly greater than the pond bottom. The outfall for the system contains two identical outfall structures which consist of raised inlets with identical orifice structures used to bleed-down the water treatment volume. The outfall structures are located in a sump area to ensure complete drawdown of the water within the pond.



Inflow to Pond 1 from Parking Lot

Inflows to Pond 2

Dual Outfall Structures in Pond 2

Pond 2 Under Flooded Conditions

Figure 2-18. Photographs of Inflow/Outflow Structures at the Pembroke Pines Dry Detention Site.

An overview of the outfall structure for Pond 2 is given on Figure 2-19. Bleed-down of the detention volume is regulated by a 2.7-inch diameter circular orifice with an invert elevation of 4.03. The overflow elevation for the outfall structure is 6.21. As indicated on Figure 2-15, two separate outfall structures were constructed in Pond 2, with identical physical configurations. Each of the two outfall structures discharge into an adjacent waterway through 48-inch RCP pipes.

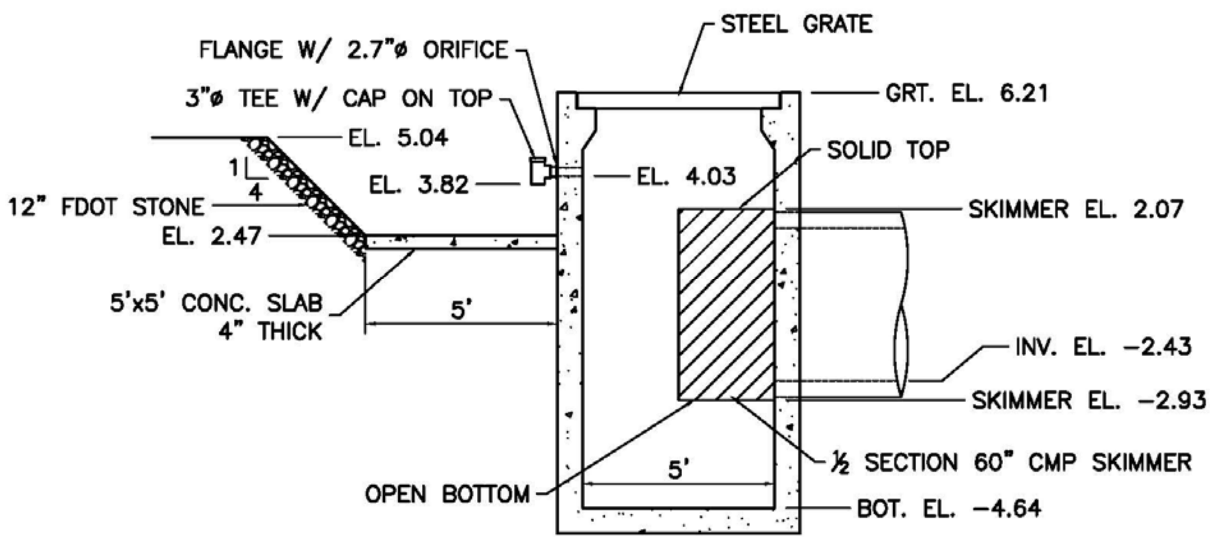


Figure 2-19. Overview of the Outfall Structure for Pond 2 at the Pembroke Pines Site.

Hydrologic characteristics of the Pembroke Pines study site are summarized on Table 2-3. The information summarized in this table was developed independently by ERD. The total project area discharging to Ponds 1 and 2 is approximately 14.45 acres of which 11.68 acres is impervious parking and paved areas, reflecting a DCIA of 76.8%. The two stormwater management ponds cover approximately 0.68 acres (TOB), reflecting 4.8% of the basin area discharging to the ponds. Pervious areas cover 2.77 acres of the project site and are classified in HSG A/D. Based upon independent calculations conducted by ERD, the water quality volume provided by Ponds 1 and 2 is equivalent to 0.60 ac-ft. The project site was permitted during 2002.

TABLE 2-3

HYDROLOGIC CHARACTERISTICS OF THE PEMBROKE PINES DRY DETENTION SITE

PARAMETER	UNITS	VALUE
Total Project Area	acres	14.45
Impervious Area	acres	11.68
DCIA	%	76.8
Stormwater Management Area	acres % of total area	0.68 4.8
Pervious Area Soil HSG	--	A/D (2.77 acres)
Pervious CN Value	--	49.3
Stormwater Management Type	--	Dry detention
Water Quality Volume Provided	ac-ft	0.60[1]
Treatment Volume Depth Over Basin Area	inch	0.50
Land Use	--	Commercial
Year Permitted	--	2002

1. Calculated independently by ERD

2.2.2 Underdrain Site

A location map for the Orlando underdrain monitoring site is given on Figure 2-20. The site is located in the Greater Orlando area, approximately 4.2 miles northwest of downtown Orlando between North John Young Parkway and North Orange Blossom Trail. An overview of the Orlando underdrain site is given on Figure 2-21. The underdrain system is located west of the Lynx General Maintenance Facility and receives runoff primarily from parking and driveway areas.

An overview of drainage features for the Orlando underdrain site is given on Figure 2-22. The dry detention system site receives untreated runoff from adjacent parking and travel lanes associated with the bus maintenance facility. Runoff infiltrates through the permeable pond bottom and is collected in a series of underdrains which discharge the treated water into the wet detention pond located southwest of the dry detention system.

A summary of hydrologic characteristics of the Orlando underdrain site is given on Table 2-4. The total area discharging to the dry detention pond is approximately 7.26 acres of which 5.47 acres are impervious areas, equivalent to a DCIA of 71.6%. The area of the underdrain pond is 0.88 acres (TOB), equivalent to 12.1% of the basin area. Soils in the vicinity of the underdrain pond are well drained and classified in HSG A. The calculated water quality treatment volume provided in the Orlando underdrain system is 0.97 ac-ft which is equivalent to 1.60 inches over the contributing drainage basin area of 7.26 acres. The Orlando underdrain system was permitted during 2010.

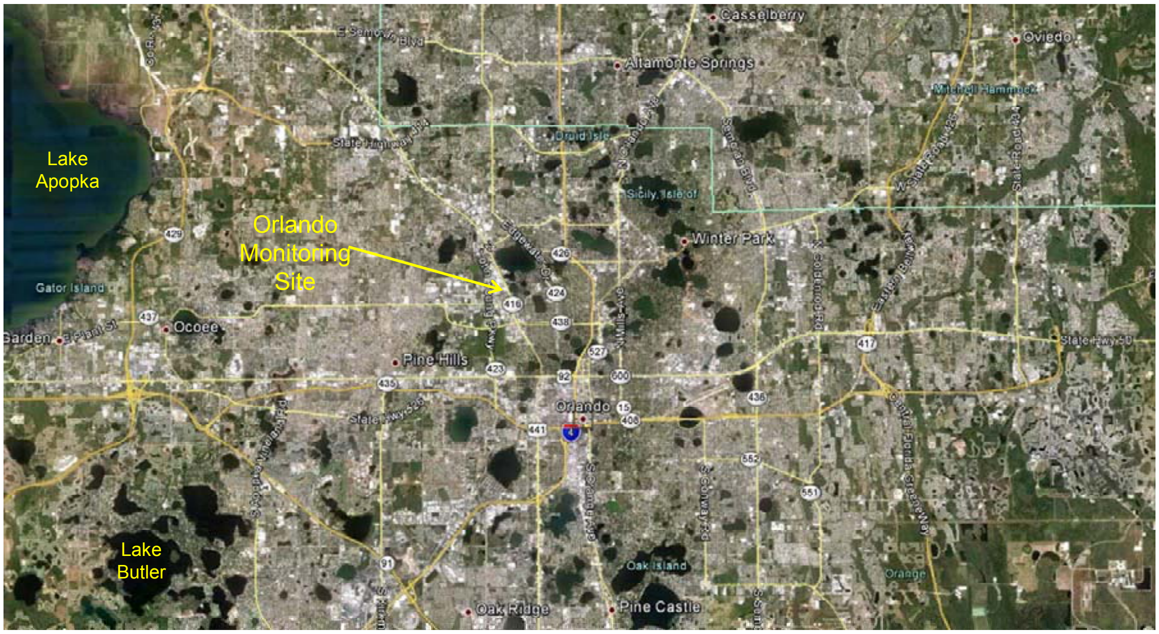


Figure 2-20. Location Map for the Orlando Underdrain Monitoring Site.

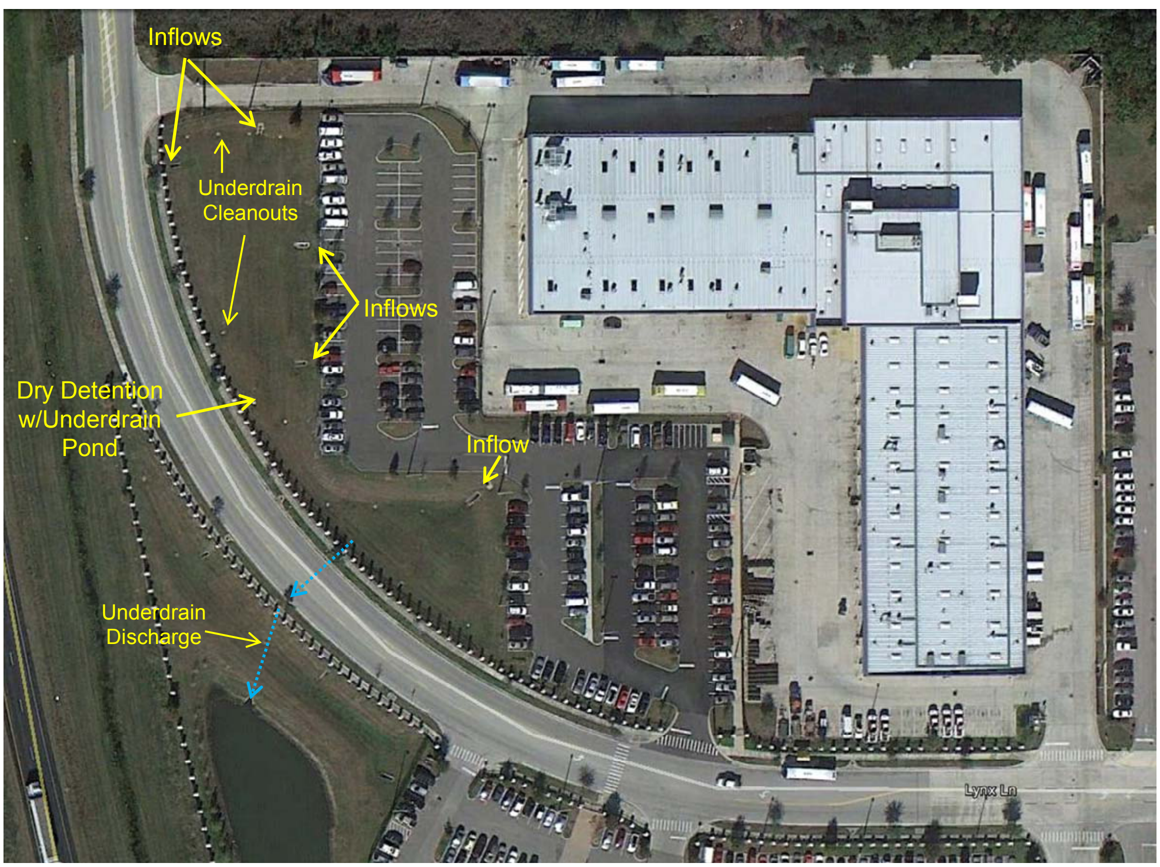


Figure 2-21. Overview of the Orlando Underdrain Site.

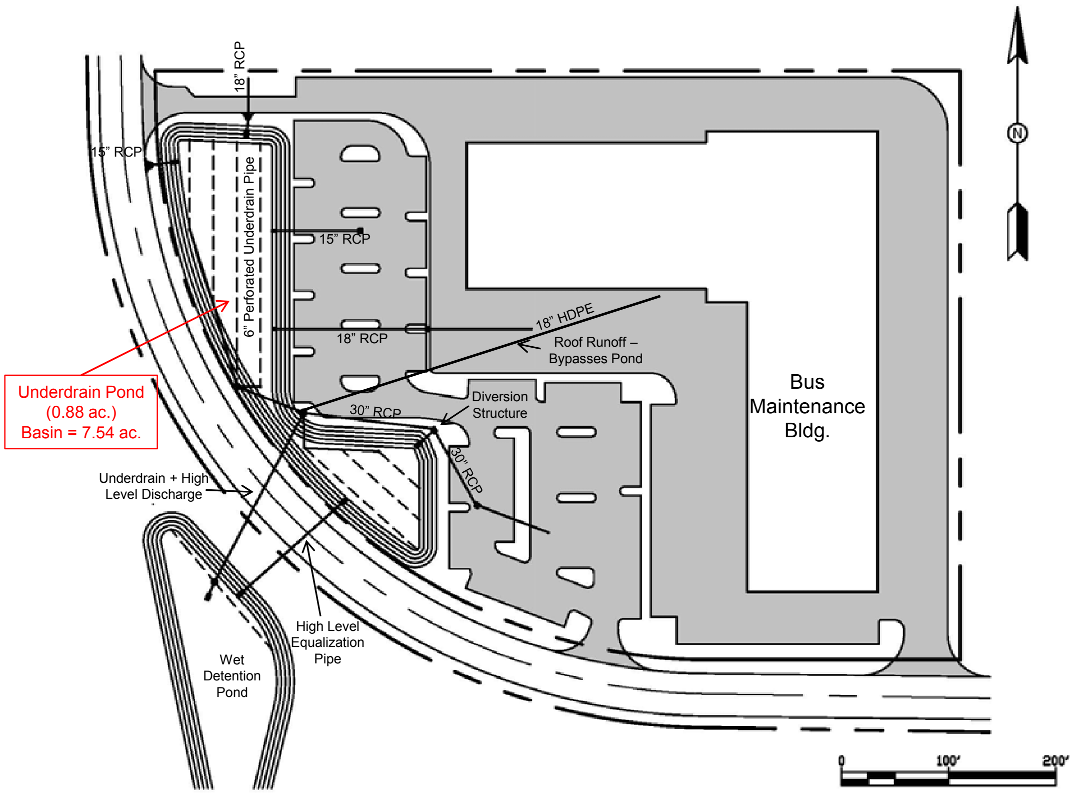


Figure 2-22. Drainage Features for the Orlando Underdrain Site.

TABLE 2-4

HYDROLOGIC CHARACTERISTICS OF THE ORLANDO UNDERDRAIN MONITORING SITE

PARAMETER	UNITS	VALUE
Total Project Area	acres	7.26
Impervious Area	acres	5.47
DCIA	%	71.6
Stormwater Management Area	acres % of total area	0.88 12.1
Pervious Area Soil HSG	--	A
Pervious CN Value	--	46.8
Stormwater Management Type	--	Underdrain filtration
Water Quality Volume Provided	ac-ft	0.97[1]
Treatment Volume Depth Over Basin Area	inch	1.60
Land Use	--	Commercial
Year Permitted	--	2010

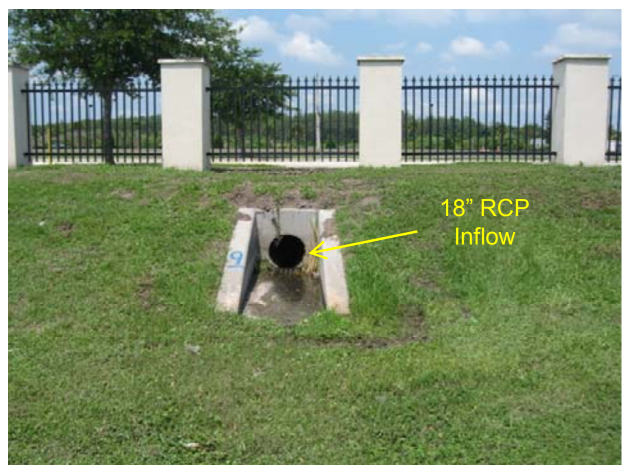
1. Calculated independently by ERD

Photographs of inflow and outflow structures at the Orlando underdrain site are given on Figure 2-23. Significant inflows into the dry detention pond consist of one 30-inch RCP, two 18-inch RCPs, and one 15-inch RCP.

Inflow to Pond 1 from Parking Lot

18-inch RCP Inflow to Pond

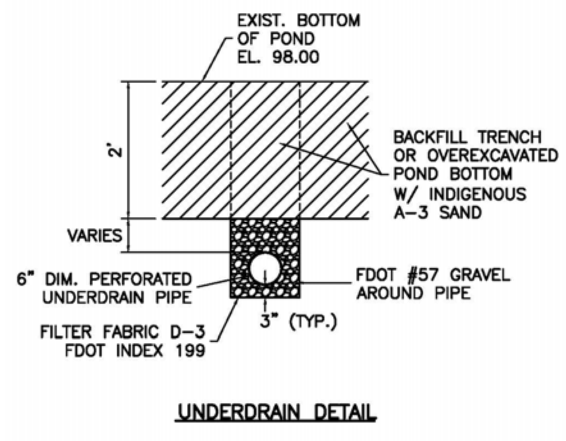
18-inch RCP Inflow to Pond

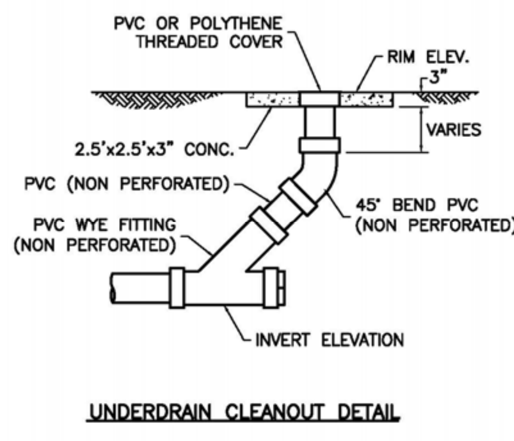


15-inch RCP to Pond from Entrance Roadway

Figure 2-23. Photographs of Inflow/Outflow Structures at the Orlando Underdrain Site.

Schematics of the underdrain system are provided in Figure 2-24. The underdrain piping consists of 6-inch diameter perforated piping, surrounded by a filter fabric and FDOT #57 gravel. Runoff entering the pond must infiltrate through a minimum of 2 ft of indigenous soils from the pond bottom before entering the underdrain system. Clean-outs are provided at the end of each underdrain run to provide access in the event of clogging.





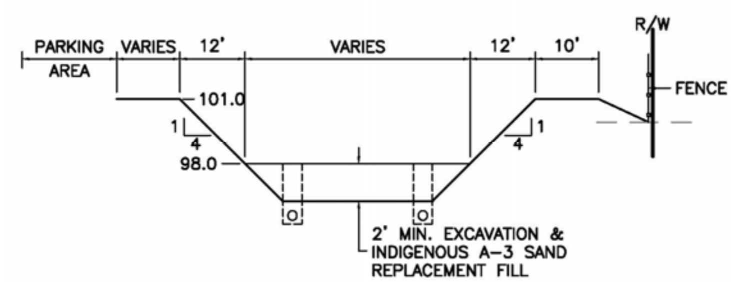


Figure 2-24.

Schematics of the
Orlando Underdrain System.

Photographs of underdrain system components are given on Figure 2-25. The underdrain system contains multiple clean-out access locations to allow cleaning of the underdrain system in the event of clogging. Discharges from the underdrain enter into a manhole structure which also receives runoff inflows which occur above the water control elevation for the underdrain pond.

Underdrain Clean-out Structure

18-inch RCP Inflow to Pond

Figure 2-25. Photographs of Underdrain System Components.

SECTION 3

FIELD AND LABORATORY ACTIVITIES

Field and laboratory investigations and analyses were conducted by ERD over a 12-month period from December 2012-November 2013 to evaluate the performance efficiency of the selected dry detention and underdrain filtration systems. Field monitoring was conducted at significant inflows and outflows for each of the evaluated systems which included a continuous record of inputs and outputs to each of the treatment ponds and collection of flow-weighted composite samples. Hydrologic instrumentation such as recording rain gauges and water level recorders were also installed at each site to assist in developing hydrologic budgets. Laboratory analyses were conducted on each of the collected flow-weighted samples for general parameters, nutrients, and selected metals to assist in identifying concentration-based and mass removal efficiencies for each of the evaluated sites. Specific details of monitoring efforts conducted at the dry detention and underdrain filtration sites are given in the following sections.

3.1 Field Instrumentation and Monitoring

An overview of field monitoring activities conducted at each of the dry detention and underdrain monitoring sites is given in the following sections. Details concerning installation of groundwater monitoring wells at each of the four monitoring sites are provided in a subsequent section.

3.1.1 Bonita Springs Dry Detention Site

A schematic of monitoring locations and hydrologic instrumentation used to evaluate the effectiveness of the Bonita Springs dry detention pond is given on Figure 3-1. The treatment system consists of three interconnected dry detention ponds which, combined together, provide the treatment volume for the project site. Inflows into the dry detention system were monitored at four separate locations which included the inflow to Pond 1 (Site 1) and the three individual inflows to Pond 3 (Sites 2, 3, and 4). Inflow monitoring was not conducted at Pond 2 since this pond is a pass-through for discharge from Pond 1 and does not receive direct untreated stormwater runoff. A fifth monitoring location (Site 5) was established at the outfall structure for the final dry detention pond.

In addition to measuring inflows and outflows for the pond system, hydrologic instrumentation was also installed to provide a record of rainfall events which occurred at the monitoring site and provide a record of changes in water level elevations within the pond. Shallow groundwater monitoring wells were also installed in each of the three ponds and monitored on a monthly basis. Details concerning installation and monitoring of the supplemental hydrologic instrumentation are provided in subsequent sections.

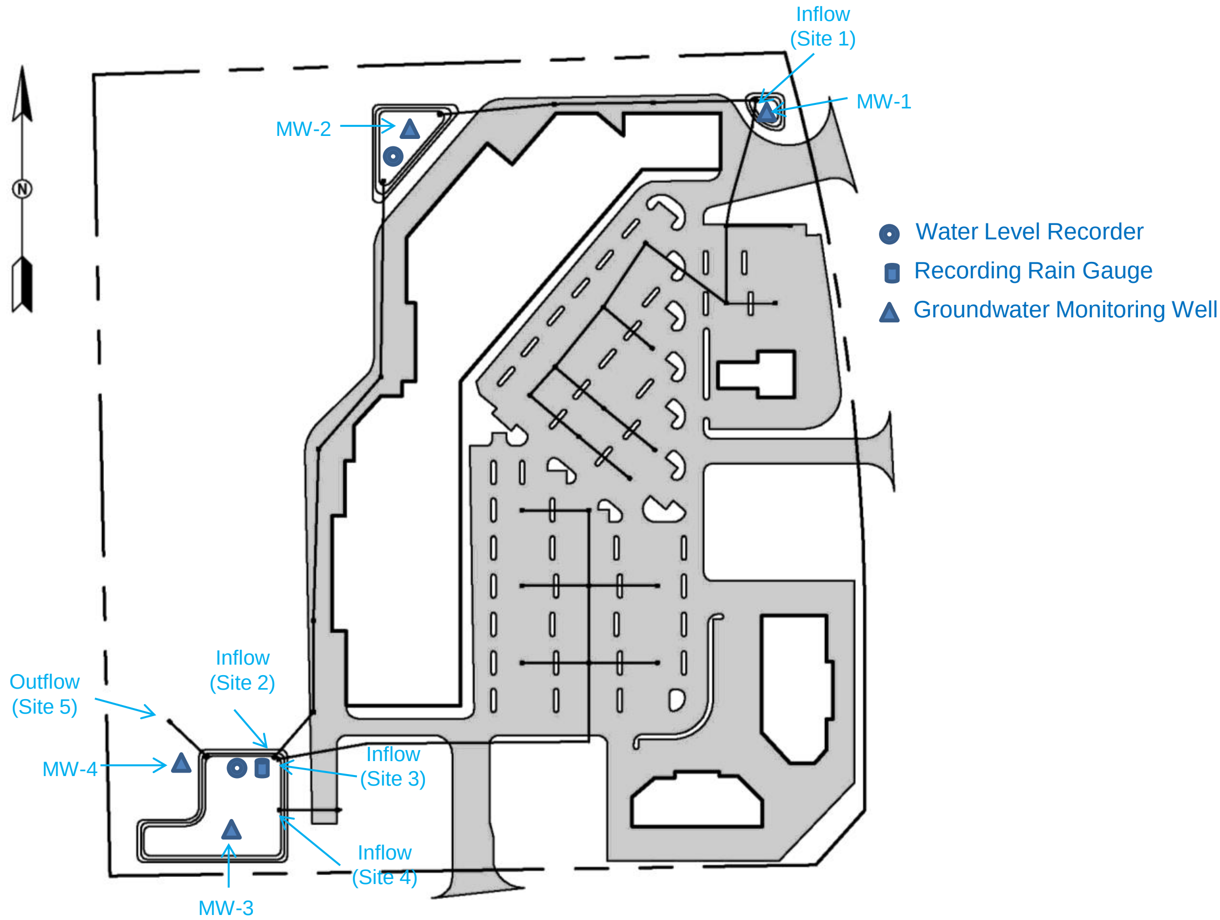


Figure 3-1. Overview of Field Monitoring Locations and Activities Conducted at the Bonita Springs Dry Detention Pond Site.

3.1.1.1 Site 1

Monitoring Site 1 is intended to measure inflows into Pond 1 which is located on the northeast corner of the project site. Photographs of monitoring equipment installed at Site 1 at the Bonita Springs site are provided on Figure 3-2. Inflows to Pond 1 occur through a 36-inch RCP which terminates in a bubble-up structure located on the bottom of the pond, with the top grate of the structure roughly equivalent to the bottom pond elevation. An insulated aluminum equipment shelter was installed adjacent to the pond, and a protective 3-inch PVC conduit for sample tubing and flow meter cables was installed from the equipment shelter to the bubble-up structure. Stormwater monitoring at this site was conducted using an ISCO Avalanche Refrigerated Autosampler with an integral flow meter. Flow measurements were conducted inside the 36-inch stormsewer which transports runoff to the pond.

Site 1 – Inflow to Pond 1 from Parking Lot

Site 1 –Pond 1 Inflow Monitoring Equipment

Figure 3-2. Photographs of Monitoring Equipment Installed at Bonita Springs Site 1.

Discharge measurements at Site 1 were conducted using a area-velocity (AV) flow probe which provided simultaneous measurements of water depth and water velocity in the 36-inch RCP. The measured water depth was converted into a cross-sectional area based upon the geometry of the 36-inch RCP and the depth of water. Discharge was then calculated using the Continuity Equation:

$$\boldsymbol{Q = V \times A}$$

where: Q = discharge (ft^3/sec or cfs)

A = cross-sectional area of the pipe (ft^2)

V = flow velocity (ft/sec or fps)

Field discharge measurements recorded by the autosampler were verified manually by ERD, when possible, during the weekly monitoring events by conducting manual measurements of discharge in the 36-inch RCP and comparing the manual measurements with the automated measurements.

The internal flow meter for the autosampler provided a continuous measurement of discharge through the bubble-up structure, with measurements stored in internal memory at 15-minute intervals, as well as providing input for collection of flow-weighted samples of the discharge over a wide range of flow conditions. The autosampler used at this site contained 14 individual 950-ml polyethylene bottles with samples pumped into discrete bottles at pre-set intervals of discharge. The refrigerated sampler kept the samples chilled until collection by field personnel. After retrieving the collected samples, the hydrograph information was used to identify samples collected during individual storm events so that a single composite runoff sample could be generated for each significant rain event. Since 120 VAC power was not available at the site, the automatic sampler was operated on a large 12 VDC battery which was recharged using a photocell panel. The bubble-up structure in Pond 1 was submerged during a majority of the field monitoring program.

3.1.1.2 Sites 2 and 3

As indicated on Figure 3-1, monitoring Sites 2 and 3 are located in close proximity in the final dry detention pond. Inflows to the pond at Site 2 (48-inch RCP) reflect the combined discharges from Ponds 1 and 2, while the inflow at Site 3 (54-inch RCP) measures runoff from a large portion of the parking lot area.

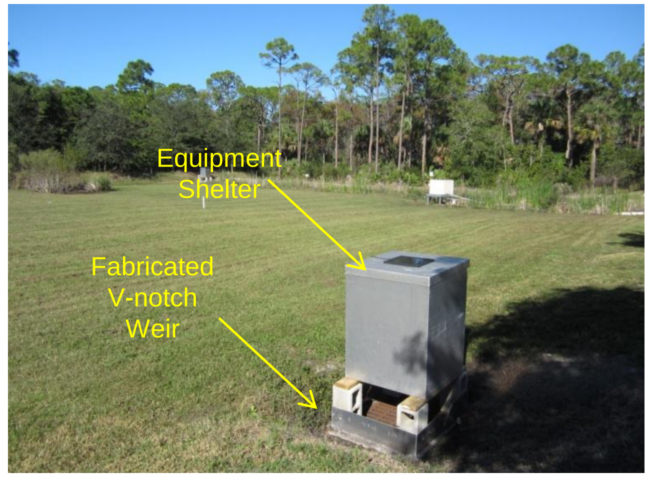
Photographs of monitoring equipment installed at Sites 2 and 3 at the Bonita Springs site are given on Figure 3-3. The inflows for both Site 2 (48-inch RCP) and Site 3 (54-inch RCP) consist of bubble-up structures with top elevations similar to the ground elevation within the pond. A larger insulated aluminum equipment shelter was used at this site, with sufficient capacity to house both of the two autosamplers for Sites 2 and 3. The autosamplers for each site consisted of ISCO Avalanche Refrigerated Autosamplers with integral flow meter attachments. Sample collection tubing and flow meter wiring were extended through 2-inch conduits from the equipment shelter to each of the monitoring locations. Flow monitoring at each site was conducted using the area-velocity method as described previously. Each of the autosamplers contained fourteen 950-ml polyethylene bottles which were sequentially filled at pre-set intervals of discharge volume. Since 120 VAC power was not available at the site, the automatic samplers were operated on a large 12 VDC battery which were recharged using a solar panel attached to the top of the equipment shelter.

Figure 3-3. Photographs of Monitoring Equipment Installed at Bonita Springs Sites 2 and 3.

3.1.1.3 Site 4

As indicated on Figure 3-1, Site 4 (24-inch RCP) is located on the east side of Pond 3 and collects runoff from an out-parcel area. Photographs of monitoring equipment installed at Site 4 at the Bonita Springs site are provided on Figure 3-4. The inflow at Site 4 consists of a bubble-up structure similar to the structure previously described in Pond 1.

Site 4 – Inflow to Pond 3 from Pond 2



Site 4 – Monitoring Equipment

Figure 3-4. Photographs of Monitoring Equipment Installed at Bonita Springs Site 4.

However, since the bubble-up structure at Site 4 was not submerged, a more accurate V-notch monitoring protocol was used at this site for measuring discharge. An aluminum frame, 8 inches in height, was fabricated by ERD to be slightly smaller than the external dimensions of the concrete structure which supports the bubble-up grate. This 8-inch rectangular aluminum frame was attached to the top of the concrete using waterproof silicon glue. A schematic of the aluminum structure for discharge measurements is given on Figure 3-5. Ninety-degree V-notch weirs were cut into two of the four sides of the aluminum frame, and discharge rates were calculated based upon water height above the bottom of the V-notch structure using a standard 90-degree V-notch weir equation:

$$Q = 2.47 \times h^{2.5}$$

where: Q = discharge (cfs)

h = water height above bottom of notch (ft)

The bottom of the V-notch weir was constructed approximately 1.5 inches above the elevation of the bubble-up grate to minimize the hydraulic impacts of the flow measurement structure. This structure allowed a much more accurate measurement of inflow rates than methods based on measurement of velocity.

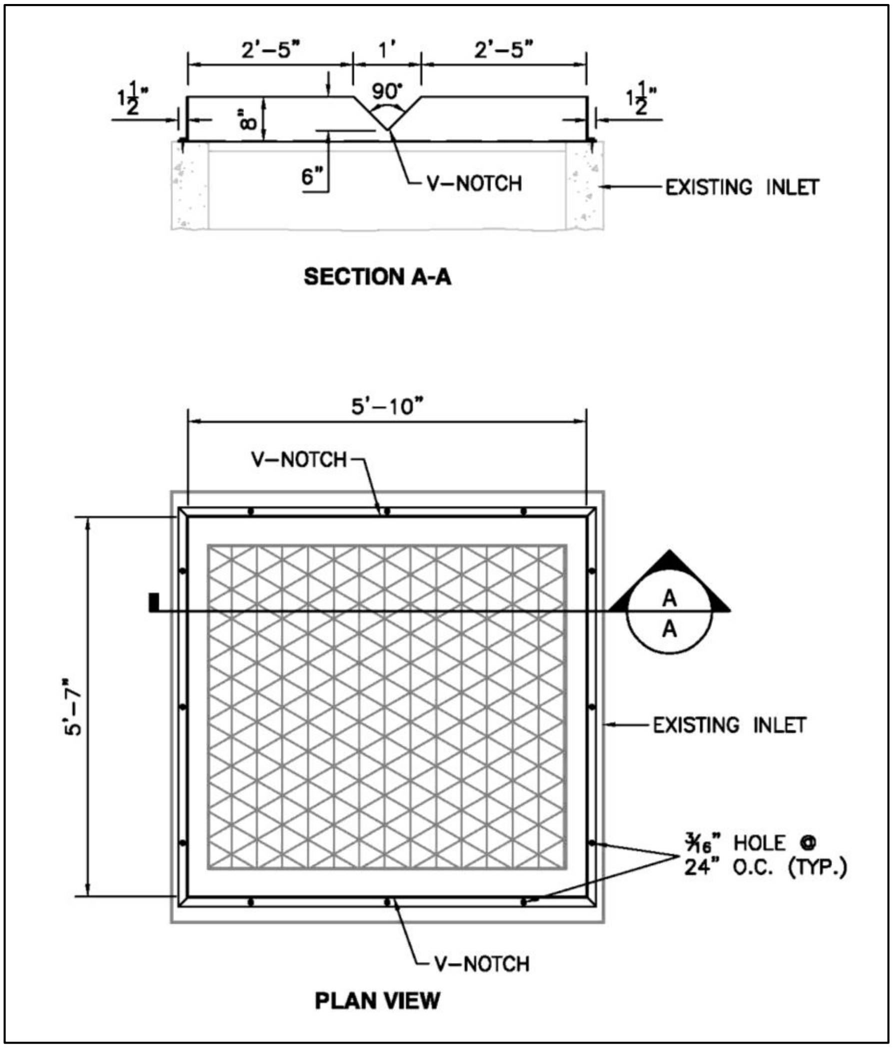


Figure 3-5.

Schematic of V-Notch Structure Used for Flow Measurement.

Sample collection at Site 4 was conducted using an ISCO Avalanche Refrigerated Sequential Stormwater Sampler with integral flow meter. Sample collection tubing was extended from the equipment shelter into the bubble-up structure located in the equipment shelter. A sensitive water level pressure transducer was attached to the inside of the aluminum frame structure to provide continuous measurements of water level elevations above the bottom of the V-notch weir. Flow composite samples were collected at pre-determined intervals of runoff volume, with individual samples placed into separate 950-ml polyethylene collection bottles. Each of the individual discrete samples was returned to the ERD Laboratory, and a composite runoff sample was generated for each event based upon an evaluation of the recorded hydrographs during the sampling period. Since 120 VAC power was not available at the site, the automatic sampler was operated on a large 12 VDC battery which was recharged using a solar panel attached to the top of the equipment shelter.

An overview of field monitoring equipment installed in Pond 3 at the Bonita Springs site is given on Figure 3-6. Visible in the picture are inflow monitoring Sites 2 and 3, inflow Site 4 from the incomplete out-parcel area, the pond outfall structure, and groundwater monitoring Well 3.

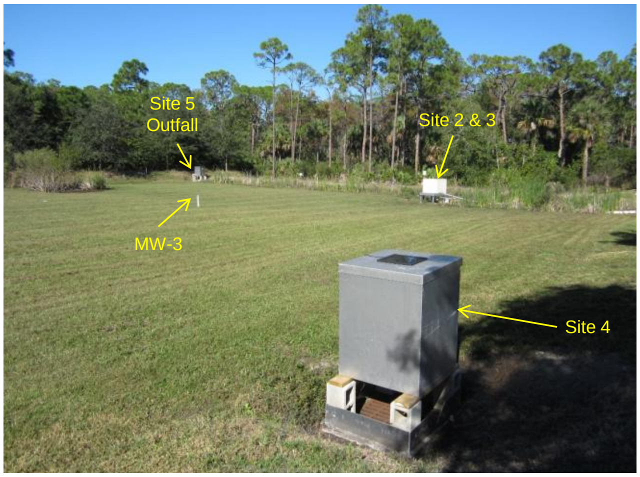
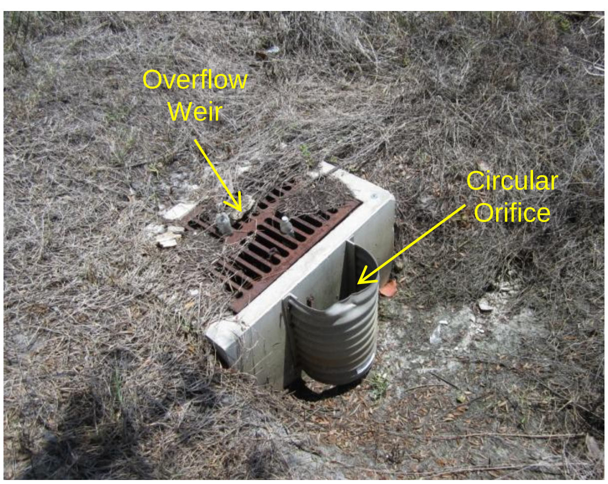


Figure 3-6.

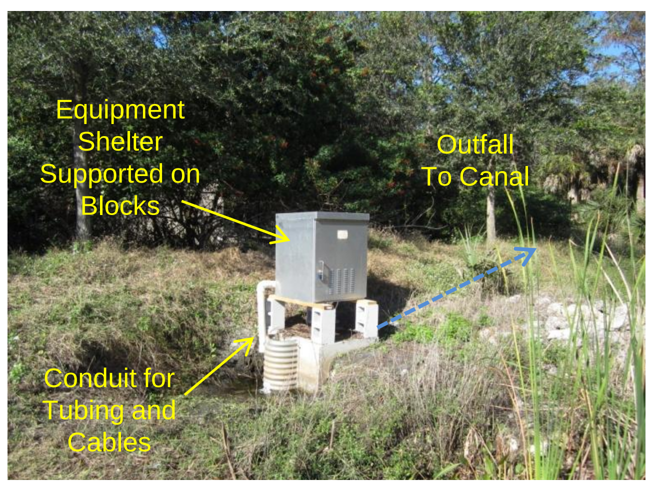
Overview of Field Monitoring Equipment Installed in Pond 3 at Bonita Springs Site.

3.1.1.4 Site 5

As indicated on Figure 3-1, Site 5 reflects the discharge from the final detention pond at the Bonita Springs site. Photographs of monitoring equipment used at Site 5 are given on Figure 3-7. The outflow weir contains a circular orifice used to bleed-down the water quality volume, with an overflow weir provided for volumetric inflows in excess of the treatment volume. An insulated aluminum equipment shelter was installed on top of concrete blocks above the outfall structure. Conduit for sample tubing and flow meter cables was extended through a 3-inch PVC pipe to the point of flow measurement and sample collection.



Site 5 – System Outfall to Canal



Site 5 – Monitoring Equipment

Figure 3-7. Photographs of Monitoring Equipment Installed at Bonita Springs Site 5.

An ISCO Avalanche Refrigerated Autosampler was used at this site which contains fourteen 950-ml polyethylene bottles. Flow monitoring was conducted using a depth sensor probe which calculates the discharges through the circular orifices based upon water elevation within the pond. When the water elevation exceeded the top of the overflow weir, discharge measurements also included direct discharges through the overflow grate structure. For discharges through the circular orifice, the measured water depth was converted into discharge using a standard orifice equation:

$$Q = C_d \bullet A_o \sqrt{2gH}$$

where:

C_d = discharge coefficient = 0.62

A_o = area of orifice (ft^2)

H = height of water above centerline of the orifice (ft)

Field discharge measurements recorded by the autosampler were verified by ERD during each weekly monitoring event by conducting manual measurements of discharge in the outflow channel downstream from the outfall structure.

3.1.2 Naples Dry Detention Site

A schematic of monitoring locations and hydrologic instrumentation used to evaluate the effectiveness of the Naples dry detention pond is given on Figure 3-8. The treatment system consists of two interconnected dry detention ponds which, combined together, provide the treatment volume for the project site. Inflows into the dry detention system were monitored at three separate locations which included two inflows to Pond 1 (Sites 1 and 2) and one inflow into Pond 2 (Site 3). The fourth monitoring location (Site 4) was located at the outfall structure for the final dry detention pond.

In addition to monitoring inflows and outflows for the pond system, hydrologic instrumentation was also installed to provide a record of rainfall events which occurred at the monitoring site as well as changes in water elevations within the ponds. Shallow groundwater monitoring wells were installed in each of the two dry detention ponds and monitored on a monthly basis. Details concerning installation and monitoring of the supplemental hydrologic instrumentation are provided in subsequent sections.

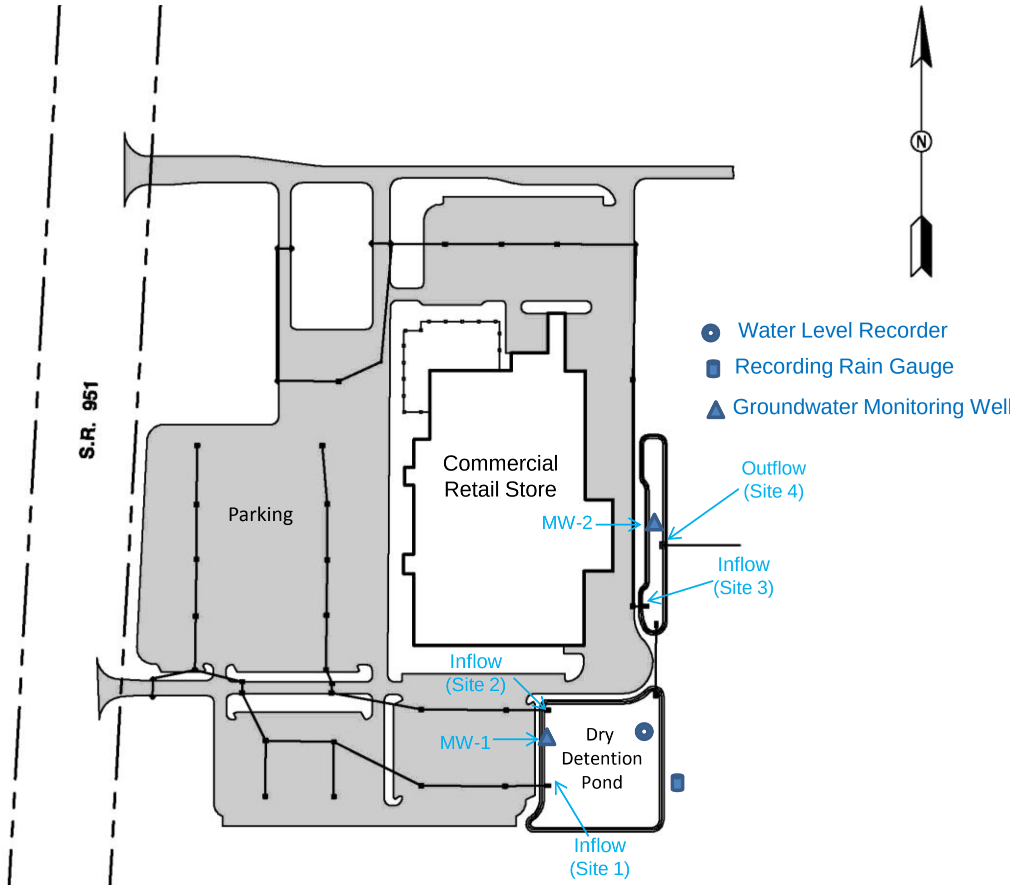


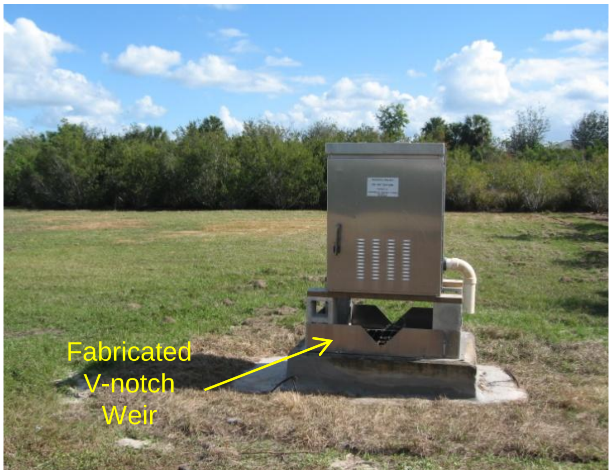
Figure 3-8.

Schematic of Monitoring Locations and Hydrologic Instrumentation Used at the Naples Dry Detention Pond Site.

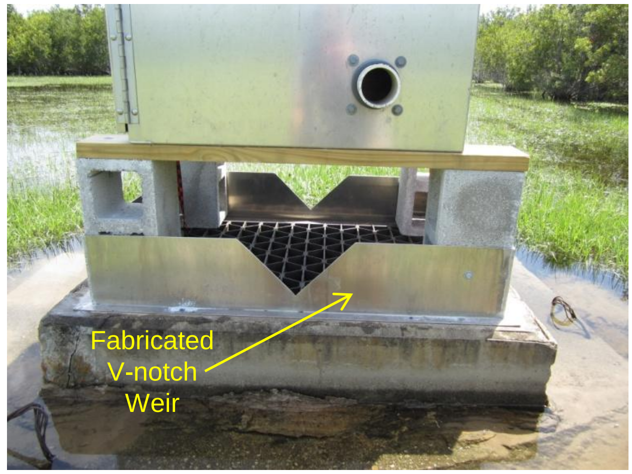
3.1.2.1 <u>Sites 1 and 2</u>

Photographs of monitoring equipment installed at Sites 1 and 2 are given on Figure 3-9. Monitoring Sites 1 and 2 consisted of bubble-up structures which discharged runoff from large portions of the parking lot for the commercial store. Prefabricated V-notch weirs, similar to the design illustrated on Figure 3-5, were installed at each of the two monitoring sites and used to measure inflows into the detention pond based upon water height above the V-notch weir. Insulated aluminum equipment shelters were installed at each of the two sites on top of concrete blocks above the outfall structure. Conduit for sample tubing and flow meter cables were extended through a 3-inch PVC pipe to the point of flow measurement and sample collection.

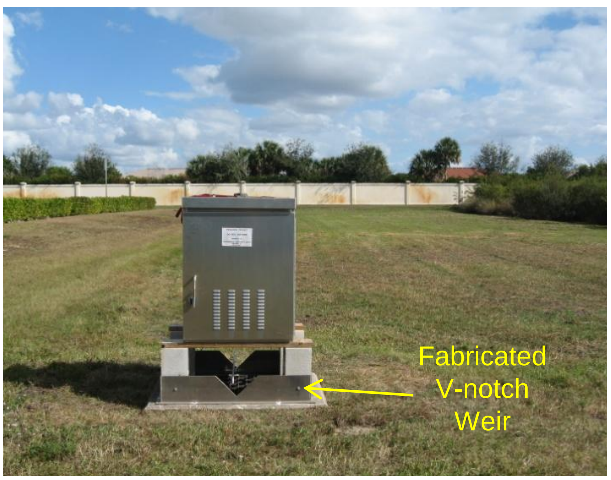
Each of the two equipment shelters contained an ISCO Avalanche Refrigerated Autosampler which contained fourteen 950-ml polyethylene bottles. Flow measurements at these sites were conducted using a pressure transducer probe which provided measurements of water height above the V-notch weir structures. Continuous inflow hydrographs were recorded at each of the two sites, with information stored to digital memory at 15-minute intervals. The autosampler was programmed to collect individual discrete runoff samples at pre-selected inflow volumes. The collected runoff samples were returned to the ERD Laboratory, and the inflow hydrographs were used to combine samples by event to produce composite samples for each measured storm event at the site.



Site 1 – Parking Lot Inflow Monitoring Site



Site 1 – Parking Lot Inflow Equipment



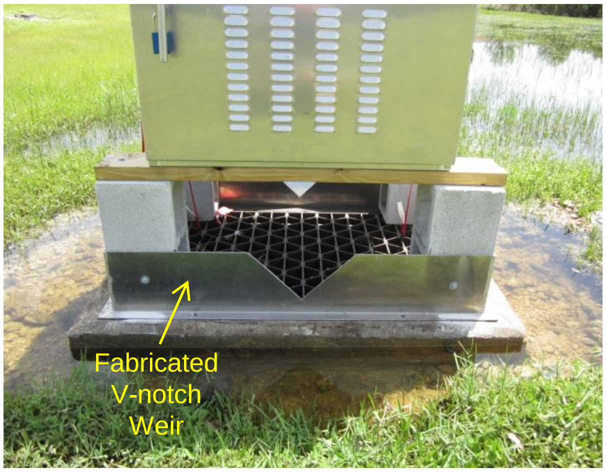
Site 2 – Parking Lot Inflow Site

Site 2 – Parking Lot Inflow Equipment

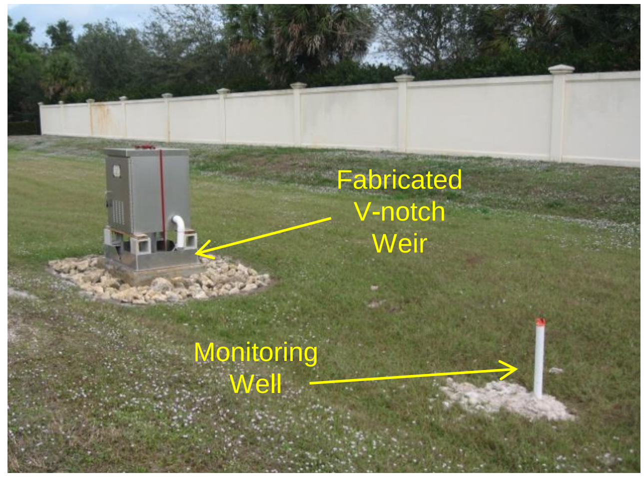
Figure 3-9. Photographs of Monitoring Equipment Installed at Naples Sites 1 and 2.

3.1.2.2 Site 3

Photographs of monitoring equipment installed at Naples Site 3 are given on Figure 3-10. The monitoring equipment installation at Site 3 was virtually identical to the installations conducted at Sites 1 and 2. Flow measurements at Site 3 were conducted using a prefabricated V-notch weir structure, with flow measurements conducted using a sensitive water level transducer which provided measurements of water heights above the V-notch weirs.



Site 3 - Rear Store Area Inflow Site



Site 3 - Monitoring Equipment

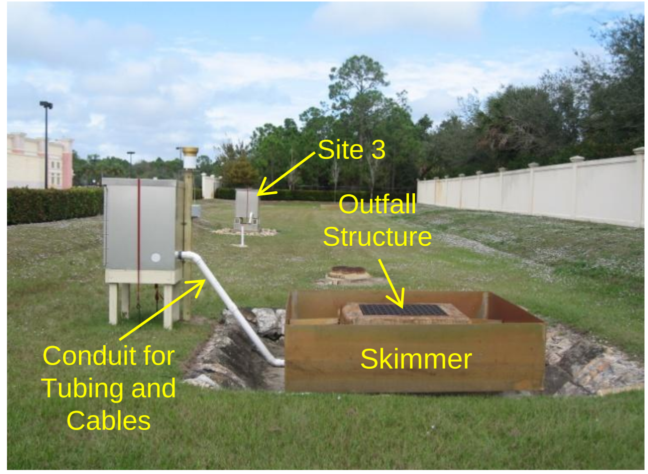
Figure 3-10. Photographs of Monitoring Equipment Installed at Naples Site 3.

Sample collection at Site 3 was conducted using an ISCO Avalanche Refrigerated Autosampler which contained fourteen 950-ml polyethylene bottles. The autosampler was programmed to collect individual discrete runoff samples at pre-selected inflow volumes. The collected runoff samples were returned to the ERD Laboratory and the inflow hydrographs were used to combine samples by event to produce composite samples for each measured storm event at the site.

3.1.2.3 Site 4 – System Outfall

Photographs of monitoring equipment installed at Naples Site 4, reflecting the outfall structure for the treatment system, are given on Figure 3-11. An insulated aluminum equipment shelter was installed adjacent to the outfall structure and contained an ISCO Avalanche Refrigerated Autosampler with integral flow meter. A 3-inch PVC conduit was extended from the equipment shelter to the outfall structure and housed the tubing and cables for flow measurement and sample collection. Flow monitoring was conducted using a sensitive water level probe which provided estimates of water levels at the circular orifice structures used to provide bleed-down for the treatment volume. The autosampler installed at this site contained a single 15-liter polyethylene bottle, and samples were collected in a continuous composite mode since it is difficult to distinguish water generated from individual events at the outfall structure.

Site 4 – System Outfall



Site 4 – Monitoring Equipment at Outfall Structure

Figure 3-11. Photographs of Monitoring Equipment Installed at Naples Site 4 (System Outfall).

3.1.3 Pembroke Pines Dry Detention Site

A schematic of monitoring locations and hydrologic instrumentation used to evaluate the effectiveness of the Pembroke Pines dry detention pond is given on Figure 3-12. The treatment system consists of two separate treatment systems. The first treatment system, consisting of dry detention Ponds 1 and 2, receives inflow from virtually all of the parking areas associated with the commercial retail store site. Field monitoring was conducted in each of these two ponds as part of this project. Another dry detention pond is located in the northeast corner of the project site which receives runoff from a vacant out-parcel site, driveways along the sides and rear of the retail store, and portions of the roof area for the store. However, since portions of the drainage basin discharging to this pond were still under development at the time of the field monitoring program, this separate pond system was not included in the monitoring program.

3.1.3.1 Site 1

Photographs of monitoring equipment installed at Pembroke Pines Site 1 (36-inch SD and 54-inch SD pipes) are given on Figure 3-13. Inflows at Site 1 occur through a bubble-up structure with a top elevation slightly above the bottom elevation for the pond. An insulated aluminum equipment shelter was used to house an ISCO Avalanche Refrigerated Autosampler which was programmed to collect inflow samples into the pond on a flow-weighted basis. A prefabricated V-notch weir was used for inflow measurements, with a pressure transducer probe used to provide estimates of water level elevations above the V-notch weir. Sample tubing was extended from the equipment shelter through the bubble-up grate and approximately one foot into the bubble-up structure. Discharge rates at this site were calculated using a standard V-notch weir equation. The autosampler at this site contained fourteen separate 950-ml polyethylene bottles which were filled sequentially based upon pre-determined intervals of runoff inflow. Upon return to the ERD Laboratory, the collected discrete samples were combined together by rain event to provide composite runoff samples for individual monitored rain events.

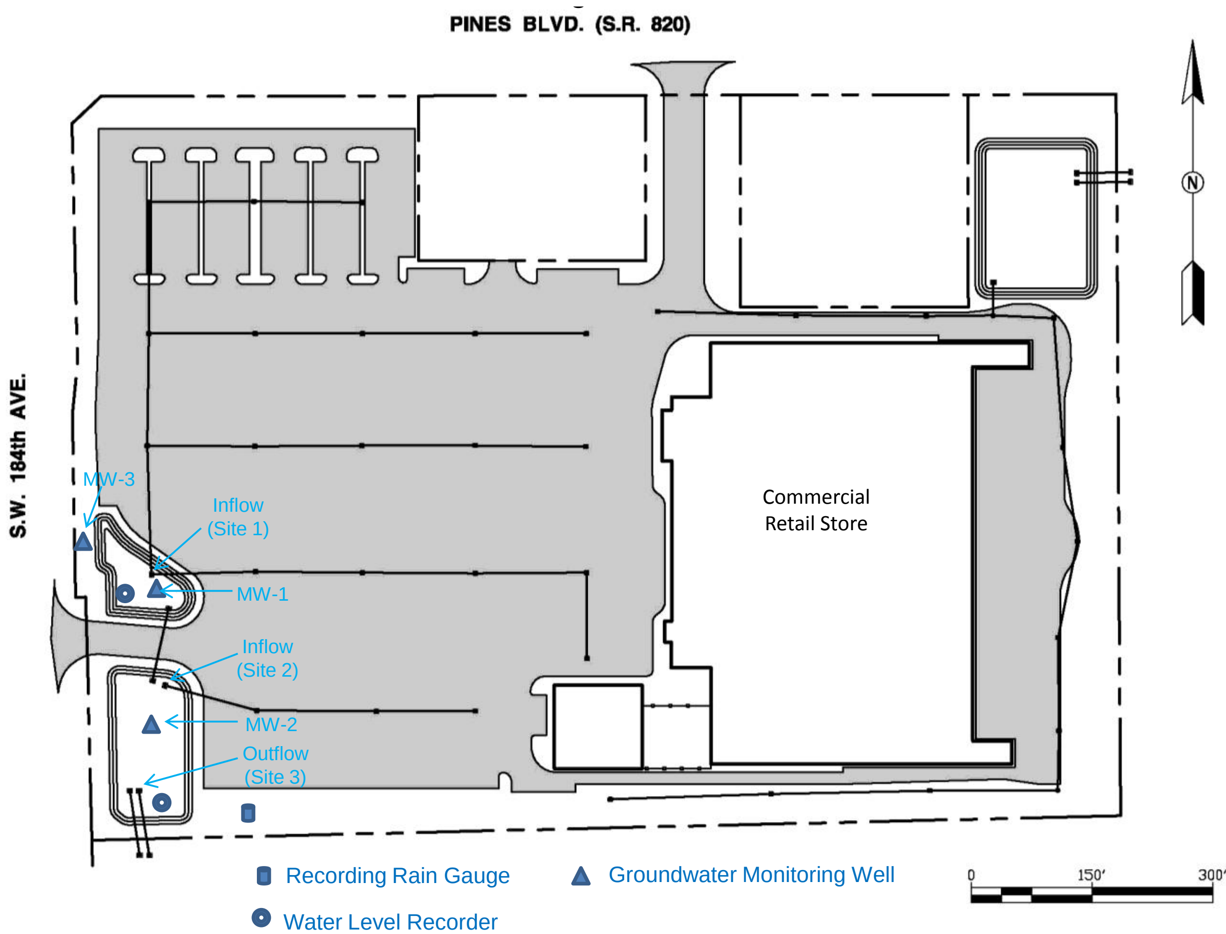


Figure 3-12. Schematic of Monitoring Locations and Hydrologic Instrumentation Used at the Pembroke Pines Dry Detention Pond Site.

Site 1 – North Pond Monitoring Equipment

Site 1 – Storm Event Conditions

Figure 3-13. Photographs of Monitoring Equipment Installed at Pembroke Pines Site 1.

3.1.3.2 Site 2

Photographs of monitoring equipment installed at Pembroke Pines Site 2 (30-inch RCP) are given on Figure 3-14. In general, the equipment installation at this site is virtually identical to the installation previously described for Site 1. An insulated aluminum shelter was used to house an ISCO Avalanche Refrigerated Autosampler which was programmed to collect inflow samples into the pond on a flow-weighted basis. Pond inflows occur at this site through a bubble-up structure, and a pre-fabricated V-notch weir was used for inflow measurements. The sample tubing was extended from the equipment shelter through the bubble-up grate approximately 1 ft into the bubble-up structure. Flow measurements were conducted using a sensitive water level recorder which measured water level heights above the bottom of the V-notch weir, with discharge rates calculated using a standard V-notch weir equation.

Site 2 – Overview of South Pond

Site 2 – Inflow Monitoring Site

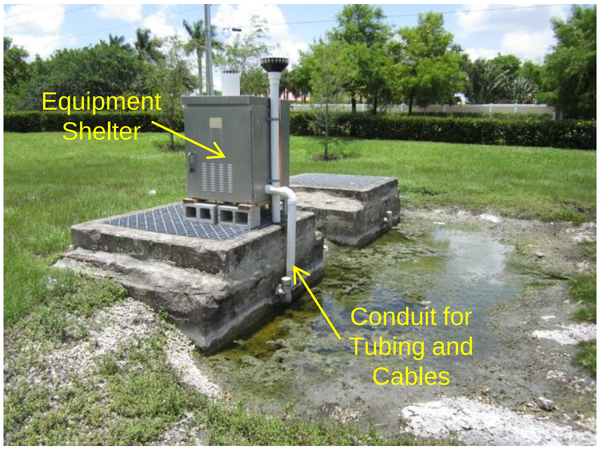
Site 2 – Monitoring During Storm Conditions

Site 2 – Pond 2 After Storm Event

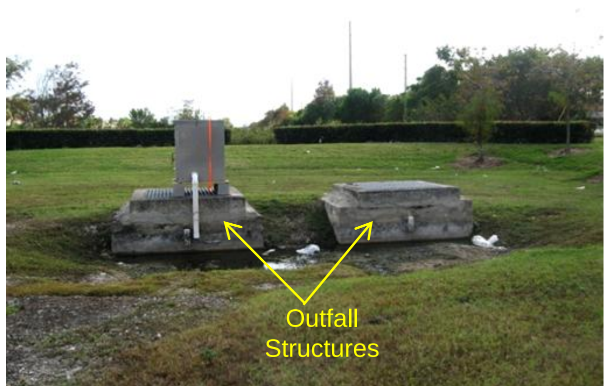
Figure 3-14. Photographs of Monitoring Equipment Installed at Pembroke Pines Site 2.

3.1.3.3 Site 3

Photographs of monitoring equipment installed at Pembroke Pines Site 3 are given on Figure 3-15. Site 3 reflects the final outfall structure for the treatment system. As discussed in Section 2.2.1.3, two separate, but identical, outfall structures are provided to discharge water from the pond. Discharge monitoring was conducted at only one of the two outfall structures since the chemical characteristics and measured discharge rates would be expected to be virtually identical for the two structures. An equipment shelter was installed on top of one of the two outfall structures, with tubing and cables extended from the shelter through a 3-inch PVC conduit. The tubing intake was attached to the front of the concrete outfall structure below the orifice invert elevation. A sensitive water level recorder was also installed below the invert for the bleed-down orifice to provide measurements of water levels discharging through the circular orifices and was used to calculate discharge rates using a standard orifice equation. The automatic sampler installed at this location contained a single composite polyethylene bottle which was used to collect composite samples of discharges from the treatment system between individual monitoring events.



Site 3 – System Outfall and Sampling Equipment



Site 3 – Dual Outfall Structures

Final Pond Following Storm Event

Figure 3-15. Photographs of Monitoring Equipment Installed at Pembroke Pines Site 3.

3.1.4 Orlando Underdrain System Site

An overview of field monitoring locations and activities conducted at the Orlando underdrain site is given on Figure 3-16. Monitoring at this location was conducted at five separate sites, with Sites 1-4 reflecting runoff inflows into the underdrain pond and Site 5 consisting of the filtered underdrain discharge.

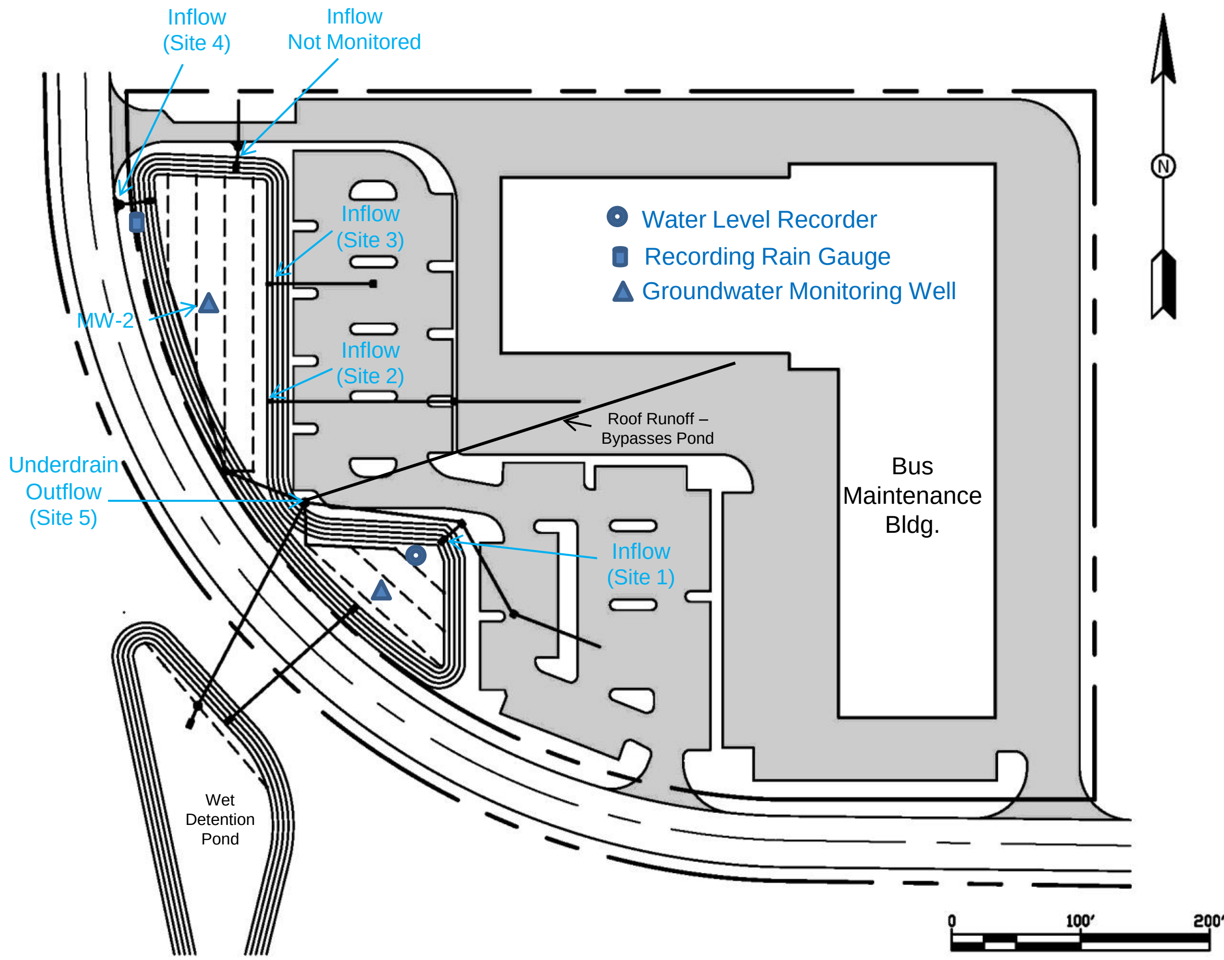
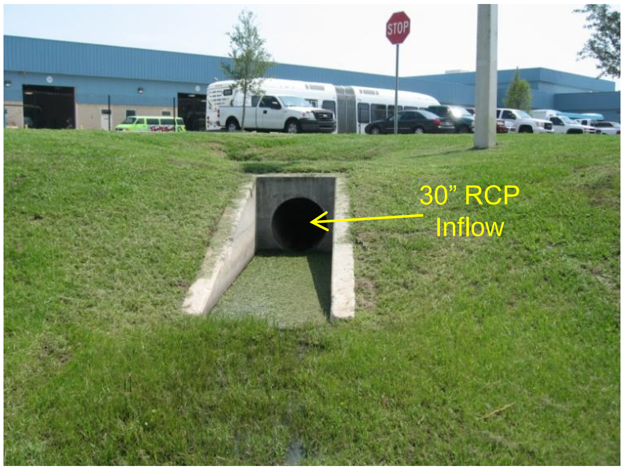


Figure 3-16. Overview of Field Monitoring Locations and Activities Conducted at the Orlando Underdrain Site.

3.1.4.1 Site 1

Photographs of monitoring equipment installed at the Orlando underdrain Site 1 are given on Figure 3-17. This site reflects the primary inflow into the underdrain pond which consists of a 30-inch RCP stormsewer. Inflow into the pond is regulated by a smart box structure located upstream from the 30-inch RCP inflow. The smart box contains a diversion weir which diverts runoff into the pond until the pond water level exceeds the top of the diversion weir. The excess runoff is diverted into the discharge system for the underdrain outflow and ultimately discharges into the wet detention pond located south of the underdrain pond.



Site 1 – 30-inch RCP Inflow

Site 1 – Inflow Smart Box with Diversion Weir

Figure 3-17. Photographs of Monitoring Equipment Installed at Orlando Underdrain Site 1.

Inflow monitoring equipment at Site 1 was installed inside an insulated aluminum equipment shelter which housed an ISCO Avalanche Refrigerated Autosampler. The autosampler contained fourteen 950-ml polyethylene bottles and was programmed to collect runoff inflow samples in a flow-weighted mode at pre-determined intervals of stormwater volume. Flow monitoring was conducted using a pressure transducer probe, with discharge calculated using the Manning equation.

3.1.4.2 <u>Sites 2 and 3</u>

Photographs of monitoring equipment installed at the Orlando underdrain Sites 2 and 3 are given on Figure 3-18. Each of these stormsewers introduces discharge runoff into the east side of the underdrain pond from adjacent parking lot and pavement areas. Site 2 consists of a 15-inch RCP inflow, while Site 3 consists of an 18-inch RCP inflow. Individual equipment shelters were installed at each of the two locations and contained ISCO Avalanche Refrigerated Autosamplers. Sample intake tubing and flow meter probes were installed into each of the two stormsewers. The flow probes consisted of sensitive digital pressure transducers which provided measurements of water depth in the stormsewer system that were converted into discharge rates using the Manning equation and the pipe geometry.

Site 2 – 15-inch RCP Inflow from Maintenance Yard

Site 2 – Equipment Shelter

Site 3 – 18-inch RCP Inflows from Parking Lot

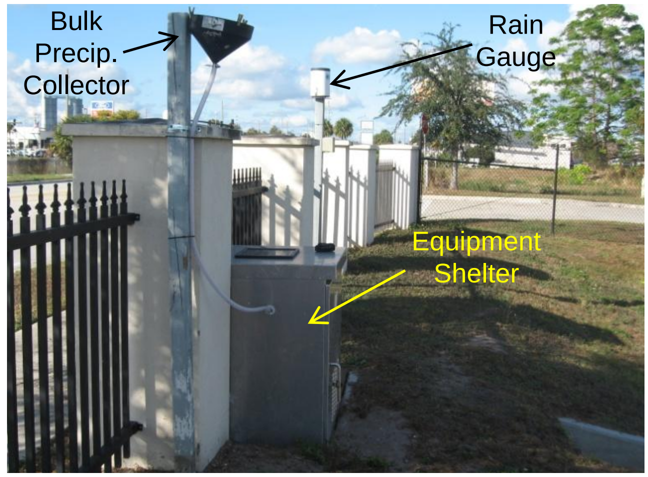
Site 3 – Equipment Shelter

Figure 3-18. Photographs of Monitoring Equipment Installed at Orlando Underdrain Sites 2 and 3.

3.1.4.3 Site 4

Photographs of monitoring equipment installed at the Orlando underdrain Site 4 are given on Figure 3-19. Site 4 receives runoff from the adjacent entrance roadway which discharges into the underdrain pond through an 18-inch RCP. Stormwater monitoring at this site was conducted using an ISCO Avalanche Refrigerated Autosampler with an integral water level sensor flow monitoring probe. The probe provided continuous measurements of water level in the 18-inch RCP stormsewer which were converted into discharge measurements using the Manning equation. This site also contained equipment used for monitoring rainfall and collection of bulk precipitation.

Site 4 – 18-inch RCP from Entrance Roadway



Site 4 – Equipment Shelter, Rain Gauge, and Bulk Precipitation Collector

Figure 3-19. Photographs of Monitoring Equipment Installed at Orlando Underdrain Site 4.

3.1.4.4 Site 5

Photographs of monitoring equipment installed at the Orlando underdrain Site 5 are given on Figure 3-20. Monitoring for the underdrain system was conducted inside the access manhole indicated on Figure 3-20. An ISCO Model 6712 Autosampler was installed inside the manhole using a harness device. A pressure transducer probe was installed inside the underdrain discharge pipe which provided measurements of water levels in the discharge piping that were converted to discharge rates using the Manning equation. The underdrain flows ultimately discharge into the wet detention pond located south of the underdrain pond.

Site 5 – Underdrain Monitoring Site

Site 5 – Underdrain High Level Overflow to Wet Pond

Figure 3-20. Photographs of Monitoring Equipment Installed at Orlando Underdrain Site 5.

3.1.5 Hydrologic Instrumentation

In addition to the inflow and outflow monitoring sites discussed previously, hydrologic instrumentation was also installed at each of the monitoring sites to provide information on rainfall and water levels during the field monitoring program. Locations of installed hydrologic instrumentation are indicated on Figures 3-1 (Bonita Springs), 3-8 (Naples), 3-12 (Pembroke Pines), and 3-16 (Orlando). The additional hydrologic equipment included a rain gauge and digital water level recorders.

Rainfall at each of the four monitoring sites was monitored using a continuous rainfall recorder which was attached to a 4-inch x 4-inch wooden post. The rainfall recorder (Texas Electronics Model 1014-C) produced a continuous record of all rainfall which occurred at each site, with a resolution of 0.01 inch. Rainfall data were stored inside a digital storage device (Hobo Event Rainfall Logger) which was also attached to the wooden post inside a waterproof enclosure. The rainfall record is used to provide information on general rainfall characteristics in the vicinity of the monitoring sites and to assist in completing the hydrologic budgets for the pond.

Digital water level recorders (Global Water Model WL16) were installed at each of the locations indicated on Figures 3-1 (Bonita Springs), 3-8 (Naples), 3-12 (Pembroke Pines), and 3-16 (Orlando) to provide continuous measurements of water levels in the various treatment areas during the monitoring program. This information is used to assist in completing the hydrologic budget for the ponds and to corroborate and verify elevations and corresponding discharge measurements recorded by the stormwater samplers.

3.1.6 Groundwater Monitoring Wells

As indicated on Figures 3-1 (Bonita Springs), 3-8 (Naples), 3-12 (Pembroke Pines), and 3-16 (Orlando), groundwater monitoring wells were installed in each of the evaluated ponds to assist in identifying potential impacts of the treatment system on shallow groundwater. Reference wells located outside of the treatment ponds were also installed at the Bonita Springs and Pembroke Pines sites to provide information on groundwater characteristics in areas not impacted by the ponds. Reference wells were not installed at the Naples or Orlando sites due to site limitations.

Each of the groundwater monitoring wells consisted of a 2-inch slotted casing which was hand-augered (at most sites) to a depth of approximately 3-4 ft below the surficial groundwater table at the time of installation. The soil strata at the Pembroke Pines site consisted of a shallow soil layer, about 2-3 inches thick, followed by dense limerock. Installation of the monitoring wells at this site required a jackhammer to develop holes for the monitoring wells. Typical construction details for groundwater monitoring wells are given in Figure 3-21. Each of the wells contained a bottom slotted PVC screen, approximately 4 ft in length, with slot widths of 0.01 inches. The bore hole for each well, except the Pembroke Pines site, was constructed using a 4-inch diameter hand auger.

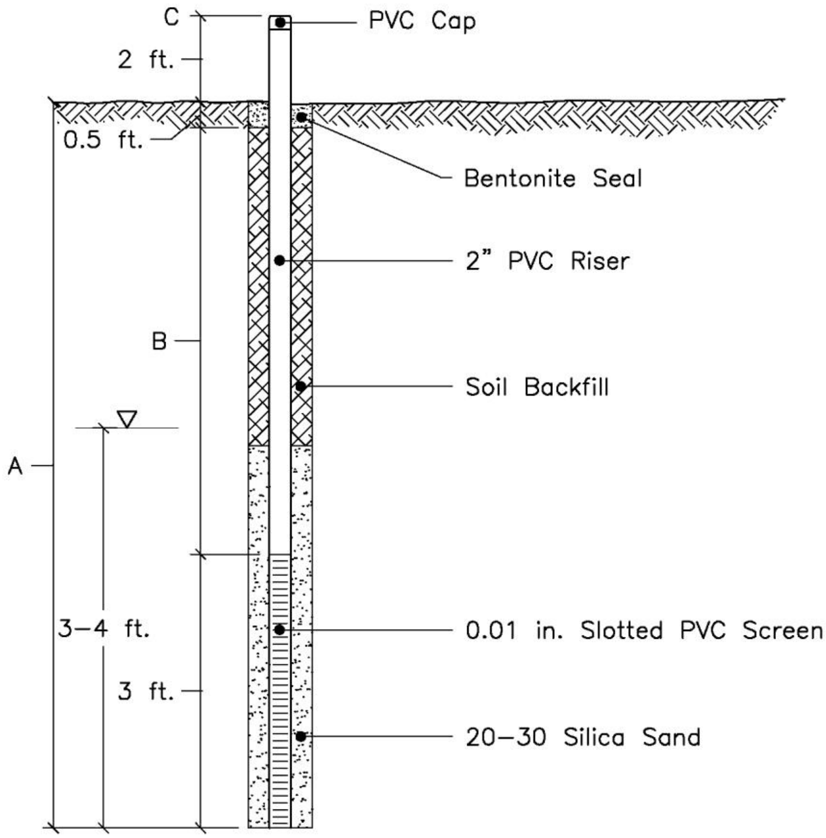


Figure 3-21.

Construction Details for Groundwater Monitoring Wells.

The void space around the well was filled with 20-30 silica sand to a level above the slotted PVC screen. Soil backfill from the excavated hole was then placed around the well to a level approximately 6 inches below the ground surface. A 6-inch thick bentonite pellet seal was then added to prevent short-circuiting of water through the well bore hole. The 2-inch PVC riser extended 24 inches above the ground, with a vented PVC cap placed on the top to prevent contamination of the well between monitoring events.

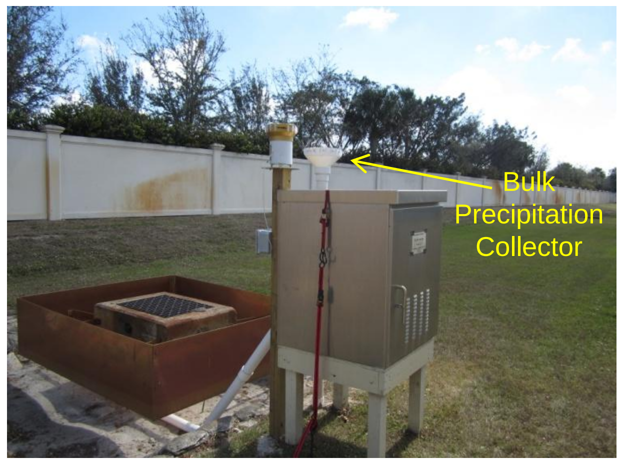
Monitoring of piezometric elevations in the monitoring wells was conducted during each weekly site visit and sample collection for groundwater characteristics was conducted on a monthly basis. During each monitoring event, the depth to the surficial groundwater table was measured using a Solinst Model 101 water level sounder, consisting of a submersible pressure transducer with an accuracy of 0.008%. The approximate water volume within the well was calculated, and the well was purged by removing a water volume equivalent to three times the initial well volume.

After the purging was completed, the well was allowed to equilibrate, and a groundwater sample was collected using a submersible battery-powered centrifugal pump. The groundwater sample was field- filtered using a disposable 0.45-micron groundwater filter. The filtered samples were placed in ice and returned to the ERD Laboratory for analysis of the parameters listed previously for surface water, with the exceptions of particulate nitrogen, particulate phosphorus, and TSS, since the groundwater samples were field filtered. This monitoring regime generated a total of 132 samples (11 sites x 12 events) during this program. Additional samples were also collected to meet applicable QA criteria.

3.1.7 Bulk Precipitation

Field monitoring of the characteristics of bulk precipitation was conducted at each of the four monitoring sites from December 2012-November 2013. A bulk precipitation collector was installed at each site and used to collect continuous samples of both wet and dry fallout. Photographs of typical bulk precipitation collectors are given on Figure 3-22. Bulk precipitation samples were collected continuously as a composite of wet and dry fallout over periods ranging from approximately 1-2 weeks. The bulk precipitation samples were collected in the field and returned to the ERD Laboratory for analysis of general parameters, nutrients, and selected metals.

Bulk Precipitation Collector at Pembroke Pines



Bulk Precipitation Collector at Naples

Figure 3-22. Photographs of Typical Bulk Precipitation Collectors.

3.1.8 Sampling Equipment

All field sampling procedures and documentation followed procedures outlined in the document titled "Department of Environmental Protection Standard Operating Procedures for Field Activities," DEP-SOP-001/01, dated February 1, 2004. A listing of sampling equipment used for this project is given in Table 3-1.

TABLE 3-1

FIELD SAMPLING EQUIPMENT

EQUIPMENT DESCRIPTION		CONSTRUCTION MATERIALS	USE
Sampling Equipment	Geotech Submersible Geosquirt Purging/Sampling Pump	Plastic case, S.S. impeller, vinyl tubing	Purging for monitoring wells; Sample collection for general parameters and nutrients
	Nalgene Syringe Filter System - Surface Water	Acrylic/polyethylene	Filtration for Orthophosphorus
Filtration Equipment	Geotech 0.45 μ high-capacity disposable filter	Plastic casing glass fiber filter	Filtration for groundwater samples
	Masterflex E/S Portable Sampler	Silicon tubing	Filtration for groundwater samples
Field Measurement Equipment	SonTek FlowTracker Hand-held ADV	Polyethylene, S.S.	Measure discharge at inflow and outflow to calibrate autosampler flow meters

3.1.9 Monitoring Activities

ERD field personnel visited each of the monitoring sites at least once each week to retrieve collected stormwater, baseflow, and outflow samples and to download stored hydrologic data from the inflow and outflow automatic samplers as well as the additional hydrologic instrumentation. Data collected during each weekly visit were evaluated for quality control purposes and, if acceptable, compiled into a continuous data set for use in evaluating the hydrologic performance efficiency of each system.

3.2 Laboratory Analyses

A summary of laboratory methods and MDLs for analyses conducted on water samples collected during this project is given in Table 3-2. All laboratory analyses were conducted in the ERD Laboratory which is NELAC-certified (No. E1031026). Details on field operations, laboratory procedures, and quality assurance methodologies are provided in the Quality Assurance Project Plan (QAPP), outlining the specific field and laboratory procedures to be conducted for this project. The QAPP was submitted to, and approved by, FDEP prior to initiation of any field and laboratory activities.

TABLE 3-2

ANALYTICAL METHODS AND DETECTION LIMITS FOR LABORATORY ANALYSES

PARAMETER	METHOD OF ANALYSIS	METHOD DETECTION LIMITS (MDLs)[1]
pH	SM-21, Sec. 4500-H^+ B[2]	N/A
Conductivity	SM-21, Sec. 2510 B	0.2 µmho/cm
Alkalinity	SM-21, Sec. 2320 B	0.5 mg/l
Ammonia	SM-21, Sec. 4500-NH_3 G	0.005 mg/l
NO_x	SM-21, Sec. 4500-NO_3 F	0.005 mg/l
Total Nitrogen	SM-21, Sec. 4500-N C	0.025 mg/l
Ortho-P	SM-21, Sec. 4500-P F	0.001 mg/l
Total Phosphorus	SM-21, Sec. 4500-P B.5	0.001 mg/l
Turbidity	SM-21, Sec. 2130 B	0.3 NTU
Color	SM-21, Sec. 2120 C	1 Pt-Co Unit
TSS	SM-21, Sec. 2540 D	0.7 mg/l
Hardness	EPA 130.2	0.3 mg/l
Chromium	EPA 218.1	5 µg/l
Copper	EPA 220.1	2 µg/l
Lead	EPA 239.1	3 µg/l
Zinc	EPA 289.1	1.1 µg/l

1. MDLs are calculated based on the EPA method of determining detection limits
2. Standard Methods for the Examination of Water and Wastewater, 21st Ed., 2005.

3.3 Routine Data Analysis and Compilation

All data generated during this project, including hydrologic, hydraulic, and water quality information, were entered into a computerized database and double-checked for accuracy. Hydrologic and hydraulic information was tabulated and summarized on monthly intervals. This information is used to develop a hydrologic budget for the pond for use in evaluating system performance.

Data collected during this project were analyzed using a variety of statistical methods and software. Simple descriptive statistics were generated for runoff inflow, pond outflow, rainfall, and pond water levels to examine changes in water quality characteristics and system performance throughout the research period. The majority of these analyses were conducted using statistical procedures available in Excel.

Statistical procedures such as multiple regression or analysis of variance (ANOVA) were also conducted to examine predicted relationships between water quality characteristics and hydrologic or hydraulic factors, such as pond water elevation, antecedent dry period, cumulative event rainfall, and other variables. The majority of these analyses were conducted using the SAS (Statistical Analysis System) package.

Distribution patterns for the inflow, outflow, and bulk precipitation data sets were evaluated using both normal probability and log probability plots. These analyses indicated that the data most closely observe a log-normal distribution which is commonly observed with environmental data. As a result, statistical analyses were conducted using log transformations of each of the data sets. The data were then converted back to untransformed data at the completion of the statistical analyses.

3.4 Statistical Treatment of Data

Measured concentrations less than MDL values were obtained for various samples, particularly for heavy metals. For statistical purposes, these data are assigned concentrations equal to one-half of the MDL value, and these values are used in all statistical analyses and estimates of central tendency.

All estimates of central tendency in this document are calculated using geometric mean values. Virtually every evaluation of runoff data indicates that the data exhibit a log-normal distribution which suggests that a log-normal or geometric mean is the appropriate metric to characterize central tendency. Data evaluations using correlation or analysis of variance techniques were conducted using log-transformed data.

SECTION 4

HYDROLOGIC CHARACTERISTICS OF MONITORED SITES

Field monitoring, sample collection, and laboratory analyses were conducted by ERD from December 1, 2012-November 30, 2013 to evaluate the hydrologic performance and pollutant removal efficiencies of the evaluated dry detention and underdrain facility sites. A discussion of the hydrologic performance of these sites is given in the following sections.

4.1 Rainfall Characteristics

A continuous record of rainfall characteristics was collected at each of the four monitoring sites from December 1, 2012-November 30, 2013 using a tipping bucket rainfall collector with a resolution of 0.01 inch and a digital data logging recorder. A discussion of rainfall events and characteristics measured at each of the four monitoring sites is given in the following sections.

4.1.1 Bonita Springs Dry Detention Site

A tabular summary of the characteristics of individual rain events measured at the Bonita Springs dry detention pond site from December 2012-November 2013 is given in Table 4-1. Information is provided for event rainfall, event start time, event end time, event duration, antecedent dry period, and average rainfall intensity. For purposes of this analysis, average rainfall intensity is calculated as the total rainfall divided by the total event duration.

A total of 69.94 inches of rainfall fell at the Bonita Springs dry detention pond site over the 365-day monitoring period from a total of 166 separate storm events. A summary of rainfall characteristics measured at the Bonita Springs site from December 2012-November 2013 is given in Table 4-2. Individual rainfall amounts measured at the Bonita Springs site ranged from 0.01-5.28 inches, with an overall mean of 0.42 inches per event. Rainfall event durations measured at the site ranged from 0.01-30.25 hours, with antecedent dry periods ranging from 0.26-23.7 days.

A comparison of measured and typical "average" rainfall in the vicinity of the Bonita Springs site is given in Figure 4-1. Measured rainfall in this figure is based upon the field measured rain events at the Bonita Springs site presented in Table 4-1, summarized on a monthly basis. "Average" rainfall conditions are based upon historical average monthly rainfall recorded at the Fort Myers Southwest Florida Regional Airport over the 30-year period from 1981-2010. Historical average annual rainfall in the Fort Myers and Bonita Springs area is approximately 53.23 inches per year.

TABLE 4-1

SUMMARY OF RAINFALL EVENTS AND CHARACTERISTICS MEASURED AT THE BONITA SPRINGS MONITORING SITE FROM DECEMBER 2012 – NOVEMBER 2013

EVENT START		EVENT END		EVENT RAIN (inches)	DURATION (hours)	ANTECEDENT DRY PERIOD (days)	AVERAGE INTENSITY (inches/hour)
Date	Time	Date	Time				
12/06/12	16:45	12/06/12	18:45	0.11	2.00	---	---
12/08/12	14:00	12/08/12	15:00	0.93	1.00	1.8	0.93
12/09/12	12:30	12/09/12	12:30	0.01	0.00	0.9	---
12/10/12	20:00	12/11/12	10:15	2.09	14.25	1.3	0.15
12/12/12	1:30	12/12/12	1:45	0.03	0.25	0.6	0.12
12/13/12	5:00	12/13/12	5:00	0.01	0.00	1.1	---
12/17/12	18:45	12/17/12	18:45	0.09	0.00	4.6	---
12/18/12	1:15	12/18/12	1:15	0.01	0.00	0.3	---
12/18/12	13:00	12/18/12	13:00	0.01	0.00	0.5	---
12/21/12	3:15	12/21/12	3:30	0.13	0.25	2.6	0.52
12/26/12	16:30	12/26/12	17:00	0.05	0.50	5.5	0.10
01/04/13	7:45	01/04/13	14:00	0.08	6.25	8.6	0.01
01/07/13	6:30	01/07/13	12:00	0.08	5.50	2.7	0.01
01/31/13	5:30	01/31/13	8:15	0.12	2.75	23.7	0.04
02/13/13	12:00	02/13/13	12:00	0.01	0.00	13.2	---
02/14/13	1:45	02/14/13	9:15	1.02	7.50	0.6	0.14
02/14/13	15:30	02/14/13	20:15	1.52	4.75	0.3	0.32
02/15/13	3:45	02/15/13	3:45	0.01	0.00	0.3	---
02/15/13	10:30	02/15/13	13:00	0.09	2.50	0.3	0.04
02/27/13	14:15	02/27/13	14:45	0.03	0.50	12.1	0.06
02/28/13	15:45	02/28/13	15:45	0.01	0.00	1.0	---
03/02/13	23:30	03/03/13	7:45	0.18	8.25	2.3	0.02
03/06/13	10:15	03/06/13	10:30	0.04	0.25	3.1	0.16
03/18/13	14:00	03/19/13	3:30	0.80	13.50	12.1	0.06
03/20/13	19:45	03/20/13	20:30	0.16	0.75	1.7	0.21
03/21/13	13:00	03/21/13	13:00	0.01	0.00	0.7	---
03/24/13	18:45	03/24/13	18:45	0.01	0.00	3.2	---
03/25/13	6:15	03/25/13	6:15	0.01	0.00	0.5	---
04/04/13	14:45	04/05/13	14:00	1.33	23.25	10.4	0.06
04/06/13	4:45	04/06/13	4:45	0.01	0.00	0.6	---
04/10/13	14:30	04/10/13	20:00	0.77	5.50	4.4	0.14
04/12/13	1:30	04/12/13	2:45	0.07	1.25	1.2	0.06
04/15/13	3:15	04/15/13	6:15	0.13	3.00	3.0	0.04
04/20/13	23:15	04/21/13	0:15	0.03	1.00	5.7	0.03
04/21/13	15:00	04/22/13	3:30	0.43	12.50	0.6	0.03
04/22/13	17:45	04/22/13	18:00	0.12	0.25	0.6	0.48
04/23/13	4:15	04/23/13	4:15	0.01	0.00	0.4	---
04/29/13	15:45	04/29/13	21:45	0.03	6.00	6.5	0.01
05/01/13	12:15	05/01/13	13:45	0.30	1.50	1.6	0.20
05/02/13	6:15	05/02/13	15:00	0.58	8.75	0.7	0.07
05/03/13	1:45	05/03/13	1:45	0.01	0.00	0.4	---
05/19/13	18:00	05/19/13	21:45	0.03	3.75	16.7	0.01
05/20/13	15:30	05/20/13	16:00	0.59	0.50	0.7	1.18
05/21/13	6:30	05/21/13	12:45	0.16	6.25	0.6	0.03
05/27/13	13:30	05/27/13	17:15	2.37	3.75	6.0	0.63
05/28/13	9:15	05/28/13	9:15	0.01	0.00	0.7	---
05/29/13	5:00	05/29/13	5:00	0.01	0.00	0.8	---
05/29/13	11:30	05/29/13	18:15	0.14	6.75	0.3	0.02
05/30/13	3:00	05/30/13	3:00	0.01	0.00	0.4	---
05/30/13	14:15	05/30/13	17:15	0.03	3.00	0.5	0.01
05/30/13	23:45	05/30/13	23:45	0.01	0.00	0.3	---
05/31/13	13:45	05/31/13	22:00	0.97	8.25	0.6	0.12
06/01/13	17:15	06/01/13	19:45	0.68	2.50	0.8	0.27
06/02/13	3:15	06/02/13	3:15	0.01	0.00	0.3	---
06/03/13	12:15	06/03/13	13:30	0.15	1.25	1.4	0.12
06/03/13	21:45	06/04/13	8:30	0.40	10.75	0.3	0.04
06/04/13	21:15	06/06/13	3:30	1.52	30.25	0.5	0.05

TABLE 4-1 -- CONTINUED

SUMMARY OF RAINFALL EVENTS AND CHARACTERISTICS MEASURED AT THE BONITA SPRINGS MONITORING SITE FROM DECEMBER 2012 – NOVEMBER 2013

EVENT START		EVENT END		EVENT RAIN (inches)	DURATION (hours)	ANTECEDENT DRY PERIOD (days)	AVERAGE INTENSITY (inches/hour)
Date	Time	Date	Time				
06/06/13	11:15	06/06/13	18:00	0.31	6.75	0.3	0.05
06/07/13	2:00	06/07/13	15:00	1.28	13.00	0.3	0.10
06/08/13	4:00	06/08/13	4:00	0.01	0.00	0.5	---
06/10/13	11:45	06/10/13	11:45	0.06	0.00	2.3	---
06/11/13	16:15	06/11/13	17:30	0.98	1.25	1.2	0.78
06/12/13	7:15	06/12/13	7:15	0.01	0.00	0.6	---
06/12/13	15:00	06/12/13	21:30	0.91	6.50	0.3	0.14
06/13/13	12:30	06/13/13	12:30	0.01	0.00	0.6	---
06/16/13	22:00	06/16/13	23:45	1.41	1.75	3.4	0.81
06/17/13	8:15	06/17/13	8:15	0.01	0.00	0.4	---
06/17/13	17:30	06/18/13	1:00	1.49	7.50	0.4	0.20
06/18/13	11:45	06/18/13	11:45	0.01	0.00	0.4	---
06/18/13	23:30	06/19/13	0:00	0.21	0.50	0.5	0.42
06/20/13	13:00	06/20/13	13:45	0.33	0.75	1.5	0.44
06/21/13	6:45	06/21/13	6:45	0.01	0.00	0.7	---
06/22/13	16:00	06/22/13	16:15	0.12	0.25	1.4	0.48
06/23/13	12:45	06/23/13	15:00	0.12	2.25	0.9	0.05
06/24/13	17:00	06/24/13	20:45	0.11	3.75	1.1	0.03
06/25/13	15:45	06/25/13	17:15	1.96	1.50	0.8	1.31
06/26/13	12:30	06/27/13	0:30	0.44	12.00	0.8	0.04
06/27/13	16:00	06/27/13	17:00	0.07	1.00	0.6	0.07
06/28/13	11:00	06/28/13	11:00	0.01	0.00	0.8	---
06/30/13	3:45	06/30/13	5:15	0.20	1.50	1.7	0.13
06/30/13	18:30	07/01/13	19:15	3.52	24.75	0.6	0.14
07/02/13	8:00	07/02/13	20:45	0.88	12.75	0.5	0.07
07/03/13	12:15	07/03/13	22:00	0.48	9.75	0.6	0.05
07/04/13	13:00	07/04/13	17:45	0.07	4.75	0.6	0.01
07/05/13	11:15	07/06/13	3:00	0.07	15.75	0.7	0.00
07/07/13	17:00	07/07/13	17:15	0.30	0.25	1.6	1.20
07/08/13	4:00	07/08/13	4:00	0.01	0.00	0.4	---
07/09/13	2:00	07/09/13	2:00	0.01	0.00	0.9	---
07/09/13	17:00	07/09/13	17:30	0.04	0.50	0.6	0.08
07/10/13	12:00	07/10/13	18:00	0.25	6.00	0.8	0.04
07/11/13	9:30	07/11/13	10:00	0.58	0.50	0.6	1.16
07/13/13	6:45	07/13/13	6:45	0.04	0.00	1.9	---
07/13/13	14:00	07/13/13	19:00	0.05	5.00	0.3	0.01
07/14/13	4:30	07/14/13	13:15	1.81	8.75	0.4	0.21
07/15/13	1:00	07/15/13	1:00	0.01	0.00	0.5	---
07/15/13	12:45	07/15/13	15:45	1.36	3.00	0.5	0.45
07/16/13	9:45	07/16/13	12:45	0.02	3.00	0.8	0.01
07/17/13	15:30	07/17/13	15:30	0.04	0.00	1.1	---
07/18/13	11:00	07/18/13	15:30	0.74	4.50	0.8	0.16
07/21/13	10:45	07/21/13	12:15	0.40	1.50	2.8	0.27
07/26/13	7:45	07/26/13	7:45	0.01	0.00	4.8	---
07/26/13	23:30	07/27/13	6:45	5.28	7.25	0.7	0.73
07/29/13	13:15	07/29/13	18:15	0.03	5.00	2.3	0.01
07/30/13	1:45	07/30/13	1:45	0.01	0.00	0.3	---
07/30/13	13:30	07/30/13	14:00	0.10	0.50	0.5	0.20
08/01/13	14:00	08/01/13	17:00	0.04	3.00	2.0	0.01
08/03/13	21:00	08/03/13	21:00	0.01	0.00	2.2	---
08/05/13	9:30	08/05/13	9:30	0.11	0.00	1.5	---
08/06/13	10:15	08/06/13	12:00	0.20	1.75	1.0	0.11
08/07/13	13:15	08/07/13	17:00	1.03	3.75	1.1	0.27
08/08/13	11:00	08/08/13	11:00	0.01	0.00	0.8	---
08/08/13	17:45	08/08/13	22:30	0.22	4.75	0.3	0.05
08/09/13	12:00	08/09/13	16:30	1.11	4.50	0.6	0.25
08/10/13	9:45	08/10/13	9:45	0.01	0.00	0.7	---

TABLE 4-1 -- CONTINUED

SUMMARY OF RAINFALL EVENTS AND CHARACTERISTICS MEASURED AT THE BONITA SPRINGS MONITORING SITE FROM DECEMBER 2012 – NOVEMBER 2013

EVENT START		EVENT END		EVENT RAIN (inches)	DURATION (hours)	ANTECEDENT DRY PERIOD (days)	AVERAGE INTENSITY (inches/hour)
Date	Time	Date	Time				
08/14/13	14:45	08/15/13	5:30	0.27	14.75	4.2	0.02
08/16/13	16:45	08/16/13	20:00	0.59	3.25	1.5	0.18
08/17/13	10:15	08/17/13	10:15	0.01	0.00	0.6	---
08/17/13	16:45	08/17/13	16:45	0.01	0.00	0.3	---
08/18/13	11:00	08/18/13	17:45	0.47	6.75	0.8	0.07
08/19/13	10:45	08/19/13	16:45	1.61	6.00	0.7	0.27
08/20/13	3:30	08/20/13	3:30	0.01	0.00	0.4	---
08/20/13	15:00	08/20/13	15:00	0.01	0.00	0.5	---
08/21/13	16:00	08/21/13	17:30	0.29	1.50	1.0	0.19
08/22/13	10:15	08/22/13	20:45	0.46	10.50	0.7	0.04
08/23/13	10:00	08/23/13	15:00	0.38	5.00	0.6	0.08
08/24/13	16:00	08/24/13	22:00	0.93	6.00	1.0	0.16
08/25/13	11:45	08/25/13	11:45	0.01	0.00	0.6	---
08/25/13	18:00	08/25/13	19:30	0.06	1.50	0.3	0.04
08/26/13	15:00	08/26/13	18:00	0.90	3.00	0.8	0.30
08/27/13	5:30	08/27/13	5:30	0.01	0.00	0.5	---
08/27/13	14:45	08/27/13	14:45	0.01	0.00	0.4	---
08/28/13	16:00	08/28/13	17:00	0.22	1.00	1.1	0.22
09/01/13	6:00	09/01/13	11:15	0.02	5.25	3.5	0.00
09/02/13	14:15	09/02/13	16:00	1.79	1.75	1.1	1.02
09/03/13	6:30	09/03/13	6:30	0.01	0.00	0.6	---
09/03/13	16:45	09/03/13	21:15	0.12	4.50	0.4	0.03
09/04/13	12:00	09/04/13	15:15	0.76	3.25	0.6	0.23
09/05/13	10:30	09/05/13	10:30	0.01	0.00	0.8	---
09/06/13	19:15	09/06/13	22:45	4.53	3.50	1.4	1.29
09/07/13	12:00	09/07/13	14:45	0.57	2.75	0.6	0.21
09/09/13	15:45	09/09/13	16:30	0.29	0.75	2.0	0.39
09/11/13	14:30	09/11/13	14:30	0.01	0.00	1.9	---
09/12/13	2:00	09/12/13	2:00	0.01	0.00	0.5	---
09/15/13	13:00	09/15/13	19:00	1.62	6.00	3.5	0.27
09/16/13	14:45	09/16/13	16:30	0.08	1.75	0.8	0.05
09/17/13	11:30	09/17/13	16:30	0.43	5.00	0.8	0.09
09/18/13	7:15	09/18/13	7:15	0.01	0.00	0.6	---
09/18/13	14:15	09/18/13	18:30	1.32	4.25	0.3	0.31
09/19/13	10:15	09/19/13	15:15	0.03	5.00	0.7	0.01
09/23/13	16:00	09/23/13	16:00	0.28	0.00	4.0	---
09/24/13	6:15	09/24/13	6:15	0.01	0.00	0.6	---
09/24/13	14:45	09/25/13	2:00	0.43	11.25	0.4	0.04
09/25/13	9:45	09/25/13	19:00	0.44	9.25	0.3	0.05
09/26/13	6:15	09/26/13	15:30	0.53	9.25	0.5	0.06
09/27/13	10:30	09/27/13	10:30	0.01	0.00	0.8	---
10/02/13	14:15	10/02/13	22:00	0.45	7.75	5.2	0.06
10/03/13	13:45	10/03/13	15:00	1.32	1.25	0.7	1.06
10/04/13	11:45	10/04/13	11:45	0.01	0.00	0.9	---
10/07/13	14:15	10/07/13	21:00	0.08	6.75	3.1	0.01
10/22/13	20:45	10/23/13	0:45	0.27	4.00	15.0	0.07
10/23/13	9:15	10/23/13	13:00	0.02	3.75	0.4	0.01
11/09/13	13:30	11/09/13	13:45	0.05	0.25	17.0	0.20
11/16/13	5:00	11/16/13	10:00	0.05	5.00	6.6	0.01
11/21/13	18:30	11/21/13	18:45	0.05	0.25	5.4	0.20
11/22/13	2:45	11/22/13	2:45	0.01	0.00	0.3	---
11/26/13	20:45	11/27/13	6:30	0.59	9.75	4.8	0.06
			Total:	**69.94**	**--**	**--**	**--**
			Mean:	**0.42**	**3.46**	**2.01**	**0.22**
			Minimum:	**0.01**	**0.00**	**0.26**	**0.00**
			Maximum:	**5.28**	**30.25**	**23.73**	**1.31**

TABLE 4-2

SUMMARY OF RAINFALL CHARACTERISTICS MEASURED AT THE BONITA SPRINGS SITE FROM DECEMBER 2012 – NOVEMBER 2013

PARAMETER	UNITS	MINIMUM VALUE	MAXIMUM VALUE	MEAN EVENT VALUE
Event Rainfall	inches	0.01	5.28	0.42
Event Duration	hours	0.01	30.25	3.46
Average Intensity	inches/hour	0.01	1.31	0.22
Antecedent Dry Period	days	0.26	23.7	2.01

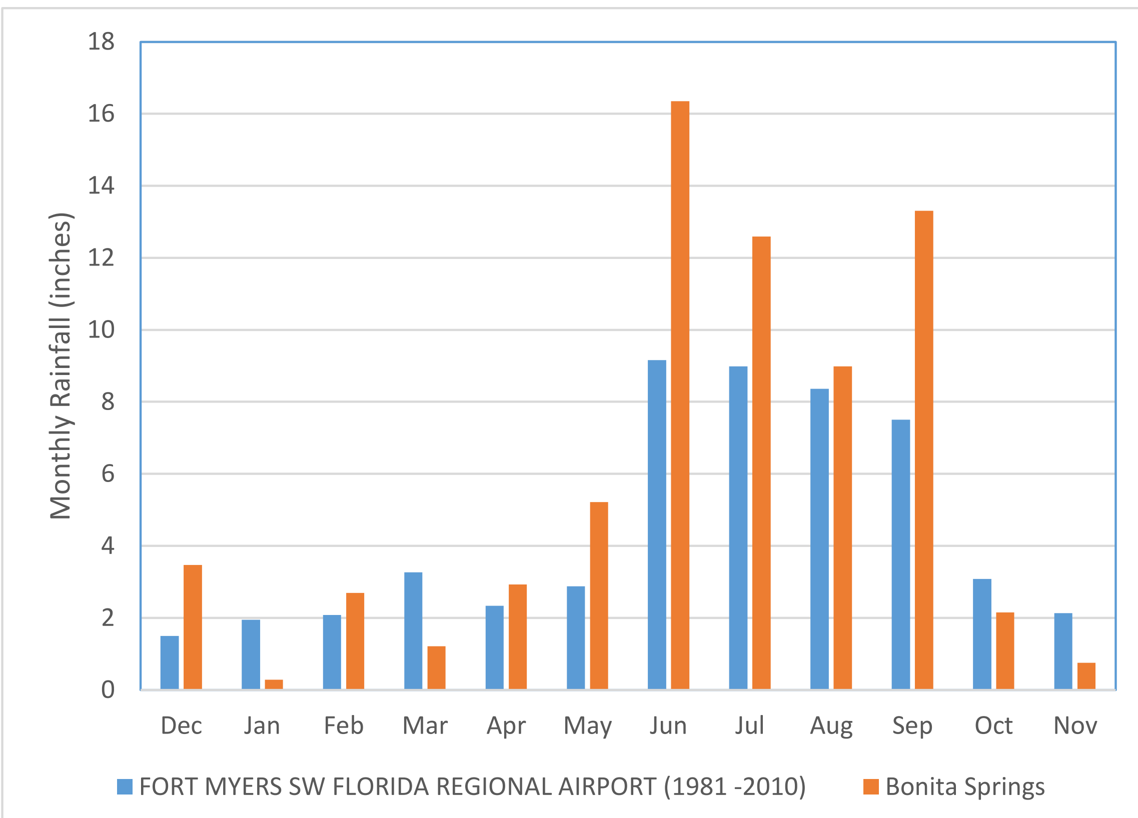


Figure 4-1. Comparison of Average and Measured Rainfall in the Vicinity of the Bonita Springs Site.

As seen in Figure 4-1, measured rainfall in the vicinity of the Bonita Springs site was substantially greater than normal during December 2012, and May, June, July, and September 2013, with "normal" or lower than "normal" rainfall during the remaining months. A tabular comparison of measured and "normal" rainfall for the Bonita Springs site is given in Table 4-3. The total rainfall of 69.94 inches measured at the Bonita Springs site is approximately 31% greater than the "normal" rainfall of 53.23 inches which typically occurs on an annual basis in the general area.

TABLE 4-3

COMPARISON OF MEASURED AND "NORMAL" RAINFALL FOR THE BONITA SPRINGS SITE FROM DECEMBER 2012 – NOVEMBER 2013

MONTH	FORT MYERS SOUTHWEST FLORIDA REGIONAL AIRPORT (1981-2010)	BONITA SPRINGS DRY DETENTION POND SITE
December	1.50	3.47
January	1.95	0.28
February	2.08	2.69
March	3.26	1.21
April	2.34	2.93
May	2.88	5.22
June	9.16	16.35
July	8.99	12.59
August	8.36	8.99
September	7.50	13.31
October	3.08	2.15
November	2.13	0.75
TOTAL:	**53.23**	**69.94**

4.1.2 Naples Dry Detention Site

A tabular summary of the characteristics of individual rain events measured at the Naples dry detention site is given in Table 4-4. Information is provided for event rainfall, event start time, event end time, event duration, antecedent dry period, and average intensity for each individual rain event measured at the monitoring site.

TABLE 4-4

SUMMARY OF RAINFALL EVENTS AND CHARACTERISTICS MEASURED AT THE NAPLES MONITORING SITE FROM DECEMBER 2012 – NOVEMBER 2013

EVENT START		EVENT END		EVENT RAIN (inches)	DURATION (hours)	ANTECEDENT DRY PERIOD (days)	AVERAGE INTENSITY (inches/hour)
Date	Time	Date	Time				
12/06/12	14:56	12/06/12	15:47	0.08	0.85	---	---
12/09/12	9:50	12/09/12	9:50	0.01	0.00	2.8	---
12/10/12	20:22	12/11/12	10:32	4.94	14.17	1.4	0.349
12/12/12	1:58	12/12/12	4:07	0.03	2.15	0.6	0.014
12/21/12	3:46	12/21/12	6:25	0.08	2.65	9.0	0.030
01/13/13	10:12	01/13/13	10:12	0.01	0.00	23.2	---
01/18/13	8:16	01/18/13	8:16	0.04	0.00	4.9	---
01/31/13	8:03	01/31/13	13:58	0.03	5.92	13.0	0.005
02/14/13	3:26	02/14/13	19:26	1.51	16.00	13.6	0.094
02/15/13	6:21	02/15/13	18:00	0.21	11.65	0.5	0.018
02/27/13	13:28	02/27/13	18:31	0.10	5.05	11.8	0.020
03/01/13	0:56	03/01/13	0:56	0.01	0.00	1.3	---
03/02/13	23:39	03/03/13	5:36	0.15	5.95	1.9	0.025
03/03/13	13:59	03/03/13	13:59	0.01	0.00	0.3	---
03/18/13	14:10	03/19/13	0:35	0.50	10.42	15.0	0.048
03/19/13	10:38	03/19/13	10:38	0.01	0.00	0.4	---
03/20/13	19:45	03/20/13	20:48	0.09	1.05	1.4	0.086
03/21/13	10:42	03/21/13	10:42	0.01	0.00	0.6	---
03/24/13	18:55	03/24/13	18:55	0.01	0.00	3.3	---
04/04/13	15:37	04/05/13	12:54	1.26	21.28	10.9	0.059
04/07/13	19:50	04/07/13	21:18	0.20	1.47	2.3	0.136
04/12/13	1:17	04/12/13	2:27	0.02	1.17	4.2	0.017
04/15/13	0:21	04/15/13	1:50	0.09	1.48	2.9	0.061
04/17/13	18:49	04/17/13	19:49	0.10	1.00	2.7	0.100
04/21/13	13:19	04/21/13	20:10	0.87	6.85	3.7	0.127
04/22/13	8:36	04/22/13	18:41	1.62	10.08	0.5	0.161
04/29/13	16:24	04/29/13	16:31	0.10	0.12	6.9	0.857
04/30/13	7:34	04/30/13	11:53	0.07	4.32	0.6	0.016
05/01/13	11:57	05/01/13	16:26	0.60	4.48	1.0	0.134
05/02/13	9:44	05/02/13	15:00	0.52	5.27	0.7	0.099
05/12/13	8:40	05/12/13	10:45	0.23	2.08	9.7	0.110
05/20/13	15:20	05/20/13	16:27	0.17	1.12	8.2	0.152
05/21/13	22:11	05/21/13	22:11	0.01	0.00	1.2	---
05/27/13	12:48	05/27/13	21:57	0.25	9.15	5.6	0.027
05/28/13	16:19	05/28/13	16:19	0.01	0.00	0.8	---
05/29/13	10:10	05/29/13	18:57	0.39	8.78	0.7	0.044
05/30/13	13:15	05/30/13	21:17	0.10	8.03	0.8	0.012
05/31/13	12:52	05/31/13	21:08	1.11	8.27	0.6	0.134
06/01/13	18:09	06/01/13	18:32	0.45	0.38	0.9	1.174
06/02/13	7:01	06/02/13	7:01	0.01	0.00	0.5	---
06/02/13	15:18	06/02/13	15:26	0.08	0.13	0.3	0.600
06/03/13	6:44	06/03/13	11:11	0.02	4.45	0.6	0.004
06/03/13	22:10	06/04/13	15:19	0.83	17.15	0.5	0.048
06/04/13	22:44	06/06/13	19:58	1.77	45.23	0.3	0.039
06/07/13	3:39	06/07/13	10:08	0.65	6.48	0.3	0.100
06/10/13	17:34	06/10/13	20:15	0.30	2.68	3.3	0.112
06/12/13	13:25	06/12/13	20:11	1.62	6.77	1.7	0.239
06/13/13	2:35	06/13/13	2:35	0.01	0.00	0.3	---
06/16/13	14:04	06/16/13	14:44	0.67	0.67	3.5	1.005
06/16/13	21:39	06/16/13	22:56	0.77	1.28	0.3	0.600
06/17/13	21:04	06/17/13	21:06	0.05	0.03	0.9	1.500
06/18/13	19:11	06/19/13	8:07	1.12	12.93	0.9	0.087
06/19/13	16:12	06/19/13	21:24	0.41	5.20	0.3	0.079
06/21/13	18:18	06/21/13	20:48	0.62	2.50	1.9	0.248
06/22/13	14:01	06/23/13	4:24	2.10	14.38	0.7	0.146
06/23/13	12:06	06/23/13	15:39	0.10	3.55	0.3	0.028
06/24/13	14:53	06/24/13	21:22	1.25	6.48	1.0	0.193

TABLE 4-4 -- CONTINUED

SUMMARY OF RAINFALL EVENTS AND CHARACTERISTICS MEASURED AT THE NAPLES MONITORING SITE FROM DECEMBER 2012 – NOVEMBER 2013

EVENT START		EVENT END		EVENT RAIN (inches)	DURATION (hours)	ANTECEDENT DRY PERIOD (days)	AVERAGE INTENSITY (inches/hour)
Date	Time	Date	Time				
06/25/13	9:10	06/25/13	20:48	0.43	11.63	0.5	0.037
06/26/13	17:31	06/26/13	21:12	1.68	3.68	0.9	0.456
06/27/13	8:42	06/27/13	8:42	0.01	0.00	0.5	---
06/30/13	9:13	07/01/13	4:49	1.47	19.60	3.0	0.075
07/01/13	11:01	07/01/13	18:23	1.12	7.37	0.3	0.152
07/02/13	6:26	07/02/13	20:47	0.35	14.35	0.5	0.024
07/03/13	9:31	07/03/13	23:04	0.44	13.55	0.5	0.032
07/04/13	10:24	07/04/13	13:44	0.06	3.33	0.5	0.018
07/05/13	10:39	07/05/13	22:52	1.36	12.22	0.9	0.111
07/07/13	15:02	07/07/13	18:34	0.20	3.53	1.7	0.057
07/08/13	5:35	07/08/13	5:35	0.01	0.00	0.5	---
07/09/13	17:52	07/09/13	17:52	0.01	0.00	1.5	---
07/10/13	17:01	07/10/13	18:23	0.04	1.37	1.0	0.029
07/11/13	9:29	07/11/13	10:51	0.21	1.37	0.6	0.154
07/13/13	7:28	07/14/13	13:38	5.39	30.17	1.9	0.179
07/14/13	20:19	07/14/13	20:19	0.01	0.00	0.3	---
07/15/13	14:10	07/15/13	17:43	0.05	3.55	0.7	0.014
07/16/13	12:49	07/16/13	13:43	0.31	0.90	0.8	0.344
07/17/13	3:36	07/17/13	3:36	0.01	0.00	0.6	---
07/17/13	14:50	07/17/13	14:50	0.01	0.00	0.5	---
07/18/13	11:59	07/18/13	15:30	0.62	3.52	0.9	0.176
07/19/13	3:40	07/19/13	3:40	0.01	0.00	0.5	---
07/27/13	1:13	07/27/13	6:02	0.33	4.82	7.9	0.069
07/27/13	20:21	07/27/13	20:37	0.24	0.27	0.6	0.900
07/28/13	5:53	07/28/13	5:53	0.01	0.00	0.4	---
07/29/13	14:34	07/29/13	19:52	1.55	5.30	1.4	0.292
07/30/13	9:09	07/30/13	20:59	0.50	11.83	0.6	0.042
07/31/13	13:11	07/31/13	15:43	0.52	2.53	0.7	0.205
08/01/13	14:27	08/01/13	19:52	1.41	5.42	0.9	0.260
08/06/13	11:46	08/06/13	14:28	0.97	2.70	4.7	0.359
08/08/13	14:31	08/09/13	0:00	0.30	9.48	2.0	0.032
08/09/13	13:57	08/09/13	18:55	0.02	4.97	0.6	0.004
08/10/13	7:25	08/10/13	7:25	0.01	0.00	0.5	---
08/13/13	15:33	08/13/13	15:57	0.54	0.40	3.3	1.350
08/14/13	3:06	08/14/13	3:06	0.01	0.00	0.5	---
08/14/13	13:41	08/15/13	6:00	0.83	16.32	0.4	0.051
08/15/13	14:41	08/15/13	14:41	0.01	0.00	0.4	---
08/16/13	18:39	08/16/13	20:56	0.85	2.28	1.2	0.372
08/17/13	15:08	08/17/13	17:24	0.43	2.27	0.8	0.190
08/18/13	10:35	08/18/13	18:33	0.58	7.97	0.7	0.073
08/19/13	1:24	08/19/13	1:24	0.01	0.00	0.3	---
08/19/13	13:40	08/19/13	19:14	3.55	5.57	0.5	0.638
08/20/13	5:26	08/20/13	5:26	0.01	0.00	0.4	---
08/20/13	12:06	08/20/13	12:58	0.39	0.87	0.3	0.450
08/21/13	12:05	08/22/13	0:04	0.32	11.98	1.0	0.027
08/22/13	14:12	08/22/13	15:19	0.04	1.12	0.6	0.036
08/23/13	13:09	08/23/13	13:59	0.92	0.83	0.9	1.104
08/24/13	6:13	08/24/13	6:13	0.01	0.00	0.7	---
08/24/13	14:51	08/24/13	22:13	1.51	7.37	0.4	0.205
08/25/13	7:09	08/25/13	7:09	0.01	0.00	0.4	---
08/26/13	12:55	08/26/13	18:29	0.27	5.57	1.2	0.049
08/27/13	14:15	08/27/13	17:27	0.74	3.20	0.8	0.231
08/28/13	9:38	08/28/13	9:38	0.01	0.00	0.7	---
09/02/13	10:01	09/02/13	14:52	0.88	4.85	5.0	0.181
09/03/13	16:23	09/03/13	17:04	0.34	0.68	1.1	0.498
09/04/13	11:47	09/04/13	14:00	0.21	2.22	0.8	0.095
09/05/13	15:11	09/05/13	15:11	0.01	0.00	1.0	---

TABLE 4-4 -- CONTINUED

SUMMARY OF RAINFALL EVENTS AND CHARACTERISTICS MEASURED AT THE NAPLES MONITORING SITE FROM DECEMBER 2012 – NOVEMBER 2013

EVENT START		EVENT END		EVENT RAIN (inches)	DURATION (hours)	ANTECEDENT DRY PERIOD (days)	AVERAGE INTENSITY (inches/hour)
Date	Time	Date	Time				
09/06/13	11:40	09/06/13	11:40	0.01	0.00	0.9	---
09/06/13	18:14	09/07/13	0:00	2.11	5.77	0.3	0.366
09/07/13	13:54	09/07/13	14:45	1.11	0.85	0.6	1.306
09/08/13	13:25	09/08/13	18:38	1.19	5.22	0.9	0.228
09/09/13	16:10	09/09/13	16:20	0.12	0.17	0.9	0.720
09/10/13	13:08	09/10/13	13:08	0.01	0.00	0.9	---
09/11/13	11:50	09/11/13	13:23	0.06	1.55	0.9	0.039
09/12/13	0:26	09/12/13	0:44	0.17	0.30	0.5	0.567
09/12/13	8:10	09/12/13	8:10	0.01	0.00	0.3	---
09/15/13	12:29	09/15/13	15:11	1.68	2.70	3.2	0.622
09/16/13	11:15	09/16/13	11:15	0.01	0.00	0.8	---
09/17/13	11:58	09/17/13	15:05	1.08	3.12	1.0	0.347
09/18/13	10:35	09/18/13	18:04	0.39	7.48	0.8	0.052
09/19/13	15:24	09/19/13	16:14	0.13	0.83	0.9	0.156
09/20/13	2:24	09/20/13	2:24	0.01	0.00	0.4	---
09/23/13	6:09	09/23/13	7:56	0.05	1.78	3.2	0.028
09/23/13	15:53	09/23/13	20:36	0.25	4.72	0.3	0.053
09/24/13	15:25	09/24/13	21:07	0.48	5.70	0.8	0.084
09/25/13	8:54	09/25/13	13:18	0.03	4.40	0.5	0.007
09/26/13	8:31	09/26/13	16:46	0.28	8.25	0.8	0.034
09/28/13	17:19	09/28/13	17:28	0.47	0.15	2.0	3.133
09/29/13	14:25	09/29/13	20:21	0.10	5.93	0.9	0.017
09/30/13	11:59	09/30/13	16:11	0.30	4.20	0.7	0.071
10/01/13	10:00	10/01/13	10:00	0.01	0.00	0.7	---
10/01/13	16:21	10/01/13	16:29	0.02	0.13	0.3	0.150
10/02/13	0:35	10/02/13	0:35	0.01	0.00	0.3	---
10/02/13	15:42	10/02/13	17:30	0.34	1.80	0.6	0.189
10/03/13	8:53	10/03/13	15:51	0.78	6.97	0.6	0.112
10/07/13	14:49	10/07/13	16:15	0.09	1.43	4.0	0.063
10/08/13	4:32	10/08/13	4:32	0.01	0.00	0.5	---
10/13/13	14:53	10/13/13	14:53	0.01	0.00	5.4	---
11/09/13	8:58	11/09/13	10:07	0.02	1.15	26.8	0.017
11/21/13	17:58	11/21/13	21:19	0.73	3.35	12.3	0.218
11/23/13	16:36	11/23/13	20:44	0.46	4.13	1.8	0.111
11/26/13	20:45	11/27/13	5:22	0.87	8.62	3.0	0.101
			Total:	**73.92**	**--**	**--**	**--**
			Mean:	**0.50**	**4.31**	**2.22**	**0.25**
			Minimum:	**0.01**	**0.00**	**0.26**	**0.00**
			Maximum:	**5.39**	**45.23**	**26.75**	**3.13**

A total of 73.92 inches of rainfall fell in the vicinity of the Naples dry detention site over the 365-day monitoring period from a total of 149 separate storm events. A summary of rainfall event characteristics measured at the Naples monitoring site from December 2012-November 2013 is given in Table 4-5. Individual rainfall amounts measured at the Naples site ranged from 0.01-5.39 inches, with an average of 0.50 inches per event. Durations for monitored events measured at this site ranged from 0.01-45.2 hours, with antecedent dry periods ranging from 0.26-26.8 days.

TABLE 4-5

SUMMARY OF RAINFALL CHARACTERISTICS MEASURED AT THE NAPLES SITE FROM DECEMBER 2012 – NOVEMBER 2013

PARAMETER	UNITS	MINIMUM VALUE	MAXIMUM VALUE	MEAN EVENT VALUE
Event Rainfall	inches	0.01	5.39	0.50
Event Duration	hours	0.01	45.2	4.31
Average Intensity	inches/hour	0.01	3.13	0.25
Antecedent Dry Period	days	0.26	26.8	2.22

A comparison of measured and typical "normal" rainfall in the vicinity of the Naples site is given on Figure 4-2. Measured rainfall presented in this figure is based upon field measured rain events at the Naples detention pond site presented in Table 4-4 and summarized on a monthly basis. "Normal" rainfall conditions are based upon historical average monthly rainfall recorded at the Naples National Weather Service (NWS) site over the 30-year period from 1981-2010. Historical average annual rainfall in the Naples area is approximately 55.64 inches per year.

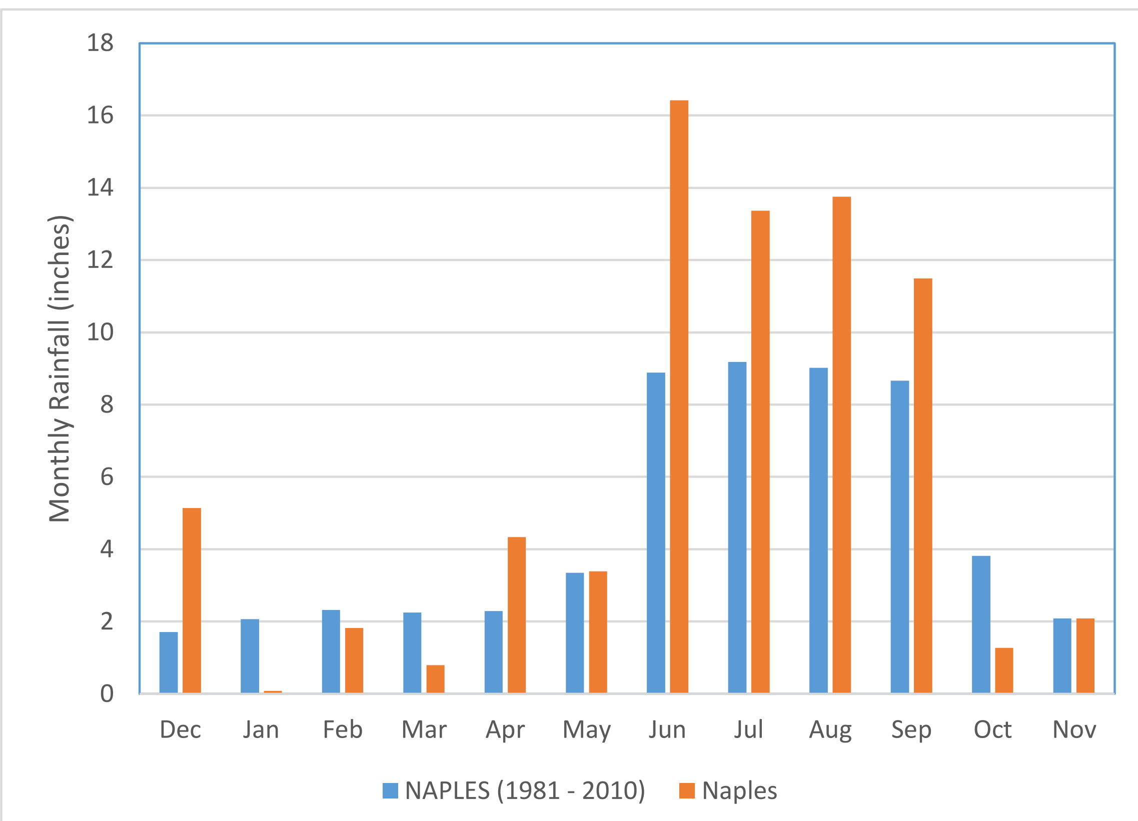


Figure 4-2. Comparison of Average and Measured Rainfall in the Vicinity of the Naples Site.

As seen in Figure 4-2, measured rainfall in the vicinity of the Naples detention pond site was substantially greater than "normal" during December 2012, and April, June, July, August, and September 2013, with "normal" or lower than "normal" rainfall during the remaining months. A tabular comparison of measured and average rainfall for the Naples site is given in Table 4-6. The total annual rainfall of 73.92 inches measured at the Naples monitoring site is approximately 33% greater than the "normal" rainfall of 55.64 inches which typically occurs on an annual basis in the Naples area.

TABLE 4-6

COMPARISON OF MEASURED AND "NORMAL" RAINFALL FOR THE NAPLES SITE FROM DECEMBER 2012 – NOVEMBER 2013

MONTH	NAPLES NATIONAL WEATHER SERVICE (1981-2010)	NAPLES DRY DETENTION POND SITE
December	1.71	5.14
January	2.06	0.08
February	2.32	1.82
March	2.25	0.79
April	2.29	4.33
May	3.35	3.39
June	8.89	16.42
July	9.18	13.36
August	9.02	13.75
September	8.66	11.49
October	3.82	1.27
November	2.09	2.08
TOTAL:	**55.64**	**73.92**

4.1.3 Pembroke Pines Dry Detention Site

A tabular summary of the characteristics of individual rain events measured at the Pembroke Pines dry detention site is given in Table 4-7. Information is provided for event rainfall, event start time, event end time, event duration, antecedent dry period, and average intensity for each individual rain event measured at the monitoring site.

TABLE 4-7

SUMMARY OF RAINFALL EVENTS AND CHARACTERISTICS MEASURED AT THE PEMBROKE PINES MONITORING SITE FROM DECEMBER 2012 – NOVEMBER 2013

EVENT START		EVENT END		EVENT RAIN (inches)	DURATION (hours)	ANTECEDENT DRY PERIOD (days)	AVERAGE INTENSITY (inches/hour)
Date	Time	Date	Time				
12/02/12	3:45	12/02/12	3:45	0.01	0.00	---	---
12/02/12	14:15	12/02/12	14:15	0.01	0.00	0.4	---
12/03/12	7:30	12/03/12	12:00	0.06	4.50	0.7	0.013
12/04/12	7:30	12/04/12	7:30	0.01	0.00	0.8	---
12/05/12	13:00	12/05/12	13:00	0.01	0.00	1.2	---
12/07/12	7:30	12/07/12	13:15	0.03	5.75	1.8	0.005
12/08/12	15:15	12/08/12	15:15	0.01	0.00	1.1	---
12/10/12	5:00	12/10/12	5:00	0.01	0.00	1.6	---
12/11/12	2:45	12/11/12	4:00	0.61	1.25	0.9	0.488
12/15/12	1:45	12/15/12	1:45	0.01	0.00	3.9	---
12/18/12	14:00	12/18/12	14:00	0.01	0.00	3.5	---
12/26/12	19:45	12/26/12	20:30	0.10	0.75	8.2	0.133
12/29/12	11:45	12/29/12	11:45	0.01	0.00	2.6	---
01/08/13	7:00	01/08/13	7:00	0.01	0.00	9.8	---
01/08/13	22:15	01/08/13	22:30	0.02	0.25	0.6	0.080
01/13/13	7:30	01/13/13	7:30	0.01	0.00	4.4	---
01/17/13	16:00	01/17/13	16:00	0.01	0.00	4.4	---
01/19/13	5:45	01/19/13	9:15	0.15	3.50	1.6	0.043
01/20/13	4:30	01/20/13	4:30	0.01	0.00	0.8	---
01/20/13	18:00	01/20/13	18:00	0.01	0.00	0.6	---
02/08/13	14:45	02/08/13	17:30	0.10	2.75	18.9	0.036
02/14/13	18:30	02/15/13	20:30	0.95	26.00	6.0	0.037
02/20/13	1:30	02/20/13	1:30	0.01	0.00	4.2	---
02/24/13	13:15	02/24/13	13:15	0.01	0.00	4.5	---
02/27/13	7:00	02/27/13	21:30	0.26	14.50	2.7	0.018
03/01/13	4:45	03/01/13	5:00	0.02	0.25	1.3	0.080
03/03/13	6:00	03/03/13	6:00	0.01	0.00	2.0	---
03/18/13	16:45	03/19/13	3:15	0.14	10.50	15.4	0.013
03/20/13	12:15	03/20/13	12:15	0.01	0.00	1.4	---
03/22/13	13:15	03/22/13	13:45	0.04	0.50	2.0	0.080
03/25/13	3:30	03/25/13	3:45	0.06	0.25	2.6	0.240
04/04/13	17:00	04/04/13	18:00	0.33	1.00	10.6	0.330
04/05/13	0:45	04/05/13	17:15	1.57	16.50	0.3	0.095
04/07/13	13:30	04/07/13	14:30	0.08	1.00	1.8	0.080
04/12/13	3:15	04/12/13	3:15	0.02	0.00	4.5	---
04/12/13	11:15	04/12/13	11:15	0.01	0.00	0.3	---
04/13/13	15:30	04/13/13	15:45	0.03	0.25	1.2	0.120
04/14/13	6:00	04/14/13	6:00	0.01	0.00	0.6	---
04/15/13	7:15	04/15/13	21:45	0.39	14.50	1.1	0.027
04/16/13	13:00	04/16/13	13:30	0.02	0.50	0.6	0.040
04/19/13	8:45	04/19/13	11:45	0.04	3.00	2.8	0.013
04/20/13	16:15	04/20/13	23:15	0.05	7.00	1.2	0.007
04/21/13	18:00	04/21/13	19:15	0.08	1.25	0.8	0.064
04/22/13	2:30	04/22/13	5:45	0.04	3.25	0.3	0.012
04/22/13	13:00	04/22/13	23:45	0.77	10.75	0.3	0.072
04/29/13	14:00	04/29/13	17:30	0.12	3.50	6.6	0.034
04/30/13	10:45	04/30/13	14:00	1.05	3.25	0.7	0.323
05/01/13	14:30	05/01/13	22:45	0.40	8.25	1.0	0.048
05/02/13	13:45	05/02/13	18:30	0.57	4.75	0.6	0.120
05/03/13	13:00	05/03/13	21:00	0.13	8.00	0.8	0.016
05/04/13	12:00	05/04/13	12:00	0.01	0.00	0.6	---
05/08/13	11:15	05/08/13	11:15	0.01	0.00	4.0	---
05/09/13	19:30	05/09/13	19:30	0.01	0.00	1.3	---
05/11/13	13:15	05/11/13	19:00	0.42	5.75	1.7	0.073
05/12/13	1:45	05/12/13	1:45	0.01	0.00	0.3	---
05/12/13	15:30	05/12/13	17:30	0.17	2.00	0.6	0.085
05/18/13	15:00	05/18/13	15:45	0.12	0.75	5.9	0.160

TABLE 4-7 -- CONTINUED

SUMMARY OF RAINFALL EVENTS AND CHARACTERISTICS MEASURED AT THE PEMBROKE PINES MONITORING SITE FROM DECEMBER 2012 – NOVEMBER 2013

EVENT START		EVENT END		EVENT RAIN (inches)	DURATION (hours)	ANTECEDENT DRY PERIOD (days)	AVERAGE INTENSITY (inches/hour)
Date	Time	Date	Time				
05/20/13	9:45	05/20/13	21:15	1.47	11.50	1.8	0.128
05/21/13	11:30	05/21/13	18:30	0.10	7.00	0.6	0.014
05/22/13	12:15	05/22/13	13:15	0.20	1.00	0.7	0.200
05/23/13	10:45	05/23/13	10:45	0.01	0.00	0.9	---
05/24/13	17:15	05/24/13	17:30	0.07	0.25	1.3	0.280
05/27/13	23:45	05/28/13	9:30	0.28	9.75	3.3	0.029
05/29/13	1:30	05/29/13	11:15	0.65	9.75	0.7	0.067
05/29/13	19:30	05/29/13	20:30	0.04	1.00	0.3	0.040
05/30/13	7:00	05/30/13	16:45	0.07	9.75	0.4	0.007
05/31/13	0:45	05/31/13	2:30	0.08	1.75	0.3	0.046
05/31/13	22:30	05/31/13	22:45	0.03	0.25	0.8	0.120
06/01/13	11:00	06/01/13	20:00	0.73	9.00	0.5	0.081
06/02/13	12:00	06/02/13	17:45	0.41	5.75	0.7	0.071
06/03/13	19:00	06/04/13	0:30	0.10	5.50	1.1	0.018
06/04/13	8:45	06/04/13	12:45	0.09	4.00	0.3	0.023
06/05/13	1:30	06/05/13	1:30	0.01	0.00	0.5	---
06/05/13	19:15	06/06/13	6:15	0.47	11.00	0.7	0.043
06/06/13	15:15	06/06/13	19:30	0.08	4.25	0.4	0.019
06/07/13	11:15	06/07/13	18:15	1.86	7.00	0.7	0.266
06/11/13	9:30	06/11/13	10:45	0.53	1.25	3.6	0.424
06/12/13	11:45	06/12/13	12:45	0.07	1.00	1.0	0.070
06/13/13	10:45	06/13/13	10:45	0.01	0.00	0.9	---
06/14/13	17:30	06/14/13	18:15	0.32	0.75	1.3	0.427
06/15/13	5:30	06/15/13	5:30	0.01	0.00	0.5	---
06/19/13	11:45	06/19/13	19:00	0.87	7.25	4.3	0.120
06/23/13	9:00	06/24/13	3:15	0.29	18.25	3.6	0.016
06/24/13	10:15	06/24/13	10:15	0.02	0.00	0.3	---
06/25/13	4:15	06/25/13	4:15	0.01	0.00	0.8	---
06/25/13	12:00	06/25/13	12:00	0.01	0.00	0.3	---
06/27/13	12:15	06/27/13	14:30	0.04	2.25	2.0	0.018
06/28/13	10:15	06/28/13	17:15	0.89	7.00	0.8	0.127
06/29/13	12:15	06/29/13	14:45	0.02	2.50	0.8	0.008
06/30/13	14:15	06/30/13	20:00	0.14	5.75	1.0	0.024
07/01/13	16:15	07/01/13	19:15	0.50	3.00	0.8	0.167
07/02/13	6:45	07/03/13	5:45	0.44	23.00	0.5	0.019
07/03/13	19:15	07/04/13	2:15	0.24	7.00	0.6	0.034
07/04/13	9:30	07/04/13	15:30	0.11	6.00	0.3	0.018
07/05/13	0:00	07/05/13	10:15	0.36	10.25	0.4	0.035
07/06/13	23:45	07/07/13	0:00	0.04	0.25	1.6	0.160
07/07/13	14:00	07/07/13	14:00	0.01	0.00	0.6	---
07/09/13	9:30	07/09/13	17:45	1.20	8.25	1.8	0.145
07/10/13	5:15	07/10/13	7:15	0.03	2.00	0.5	0.015
07/10/13	17:30	07/10/13	17:30	0.01	0.00	0.4	---
07/11/13	15:30	07/11/13	16:00	0.27	0.50	0.9	0.540
07/12/13	11:15	07/12/13	18:00	0.35	6.75	0.8	0.052
07/13/13	11:00	07/14/13	1:45	2.90	14.75	0.7	0.197
07/14/13	17:00	07/14/13	21:15	1.58	4.25	0.6	0.372
07/15/13	12:15	07/15/13	12:15	0.01	0.00	0.6	---
07/15/13	18:45	07/16/13	16:15	1.03	21.50	0.3	0.048
07/16/13	23:00	07/17/13	16:45	1.97	17.75	0.3	0.111
07/18/13	8:45	07/18/13	18:45	0.26	10.00	0.7	0.026
07/19/13	12:45	07/19/13	12:45	0.01	0.00	0.8	---
07/20/13	12:45	07/20/13	18:15	0.18	5.50	1.0	0.033
07/21/13	13:15	07/21/13	16:00	0.03	2.75	0.8	0.011
07/23/13	20:15	07/24/13	1:30	0.13	5.25	2.2	0.025
07/24/13	13:30	07/24/13	13:45	0.04	0.25	0.5	0.160
07/26/13	18:15	07/26/13	19:15	0.07	1.00	2.2	0.070

TABLE 4-7 -- CONTINUED

SUMMARY OF RAINFALL EVENTS AND CHARACTERISTICS MEASURED AT THE PEMBROKE PINES MONITORING SITE FROM DECEMBER 2012 – NOVEMBER 2013

EVENT START		EVENT END		EVENT RAIN (inches)	DURATION (hours)	ANTECEDENT DRY PERIOD (days)	AVERAGE INTENSITY (inches/hour)
Date	Time	Date	Time				
07/27/13	9:45	07/27/13	16:30	0.56	6.75	0.6	0.083
07/28/13	1:30	07/28/13	1:45	0.02	0.25	0.4	0.080
07/29/13	15:30	07/29/13	15:45	0.06	0.25	1.6	0.240
07/30/13	3:00	07/30/13	3:15	0.06	0.25	0.5	0.240
07/30/13	13:00	07/30/13	13:00	0.01	0.00	0.4	---
08/02/13	18:15	08/02/13	21:00	0.07	2.75	3.2	0.025
08/03/13	9:15	08/03/13	16:45	0.70	7.50	0.5	0.093
08/04/13	12:15	08/04/13	12:15	0.01	0.00	0.8	---
08/05/13	11:00	08/05/13	19:45	0.16	8.75	0.9	0.018
08/06/13	14:15	08/06/13	14:15	0.02	0.00	0.8	---
08/07/13	11:00	08/07/13	17:15	0.16	6.25	0.9	0.026
08/08/13	8:30	08/08/13	9:00	0.04	0.50	0.6	0.080
08/09/13	3:45	08/09/13	13:15	0.20	9.50	0.8	0.021
08/15/13	7:00	08/15/13	17:15	0.30	10.25	5.7	0.029
08/18/13	15:45	08/18/13	16:00	0.03	0.25	2.9	0.120
08/18/13	22:15	08/18/13	22:15	0.03	0.00	0.3	---
08/19/13	10:45	08/19/13	12:30	0.04	1.75	0.5	0.023
08/21/13	1:30	08/22/13	0:15	0.45	22.75	1.5	0.020
08/22/13	10:45	08/22/13	14:30	0.03	3.75	0.4	0.008
08/23/13	10:00	08/23/13	17:30	1.60	7.50	0.8	0.213
08/24/13	8:00	08/24/13	15:15	0.08	7.25	0.6	0.011
08/25/13	14:00	08/25/13	14:00	0.01	0.00	0.9	---
08/26/13	11:45	08/26/13	14:15	0.22	2.50	0.9	0.088
08/27/13	13:30	08/27/13	14:45	0.30	1.25	1.0	0.240
08/28/13	6:30	08/28/13	15:45	0.39	9.25	0.7	0.042
08/29/13	4:00	08/29/13	4:00	0.01	0.00	0.5	---
08/31/13	14:00	08/31/13	17:30	0.71	3.50	2.4	0.203
09/01/13	12:15	09/01/13	16:30	0.88	4.25	0.8	0.207
09/02/13	8:45	09/02/13	15:15	0.33	6.50	0.7	0.051
09/03/13	3:30	09/03/13	3:30	0.01	0.00	0.5	---
09/03/13	13:00	09/03/13	14:15	0.21	1.25	0.4	0.168
09/04/13	6:00	09/04/13	10:30	0.07	4.50	0.7	0.016
09/05/13	1:00	09/05/13	5:00	0.04	4.00	0.6	0.010
09/05/13	12:15	09/05/13	13:15	0.05	1.00	0.3	0.050
09/08/13	13:45	09/08/13	14:30	0.36	0.75	3.0	0.480
09/09/13	11:00	09/09/13	13:30	0.04	2.50	0.9	0.016
09/10/13	11:15	09/10/13	22:30	0.16	11.25	0.9	0.014
09/11/13	8:45	09/11/13	21:30	0.18	12.75	0.4	0.014
09/12/13	9:00	09/12/13	9:00	0.01	0.00	0.5	---
09/15/13	0:30	09/15/13	1:15	0.33	0.75	2.6	0.440
09/15/13	11:00	09/15/13	14:30	1.02	3.50	0.4	0.291
09/15/13	23:00	09/15/13	23:30	0.02	0.50	0.4	0.040
09/16/13	6:15	09/16/13	11:30	0.19	5.25	0.3	0.036
09/16/13	17:45	09/17/13	2:00	0.07	8.25	0.3	0.008
09/17/13	9:15	09/17/13	14:15	1.06	5.00	0.3	0.212
09/18/13	15:30	09/18/13	21:15	0.42	5.75	1.1	0.073
09/19/13	11:00	09/19/13	12:45	0.03	1.75	0.6	0.017
09/19/13	20:45	09/19/13	21:15	0.07	0.50	0.3	0.140
09/20/13	5:30	09/20/13	5:30	0.01	0.00	0.3	---
09/21/13	10:15	09/22/13	0:30	0.64	14.25	1.2	0.045
09/23/13	12:30	09/23/13	14:45	0.13	2.25	1.5	0.058
09/24/13	0:30	09/24/13	0:30	0.02	0.00	0.4	---
09/24/13	12:30	09/24/13	17:45	0.09	5.25	0.5	0.017
09/25/13	11:15	09/25/13	14:45	0.34	3.50	0.7	0.097
09/26/13	0:30	09/26/13	0:30	0.01	0.00	0.4	---
09/26/13	11:45	09/26/13	15:45	0.10	4.00	0.5	0.025

TABLE 4-7 -- CONTINUED

SUMMARY OF RAINFALL EVENTS AND CHARACTERISTICS MEASURED AT THE PEMBROKE PINES MONITORING SITE FROM DECEMBER 2012 – NOVEMBER 2013

EVENT START		EVENT END		EVENT RAIN (inches)	DURATION (hours)	ANTECEDENT DRY PERIOD (days)	AVERAGE INTENSITY (inches/hour)
Date	Time	Date	Time				
09/27/13	3:15	09/27/13	3:15	0.01	0.00	0.5	---
09/28/13	20:45	09/28/13	22:45	0.08	2.00	1.7	0.040
10/02/13	2:30	10/02/13	3:15	0.04	0.75	3.2	0.053
10/02/13	10:45	10/02/13	22:45	0.39	12.00	0.3	0.033
10/03/13	7:15	10/03/13	10:45	0.28	3.50	0.4	0.080
10/04/13	10:45	10/04/13	10:45	0.01	0.00	1.0	---
10/07/13	16:15	10/07/13	18:45	0.27	2.50	3.2	0.108
10/08/13	6:00	10/08/13	15:15	0.06	9.25	0.5	0.006
10/09/13	15:45	10/09/13	15:45	0.01	0.00	1.0	---
10/19/13	17:30	10/19/13	17:45	0.10	0.25	10.1	0.400
10/20/13	13:00	10/20/13	13:00	0.01	0.00	0.8	---
10/21/13	22:30	10/21/13	22:30	0.01	0.00	1.4	---
10/22/13	7:30	10/22/13	7:30	0.01	0.00	0.4	---
10/22/13	14:15	10/22/13	14:45	0.05	0.50	0.3	0.100
10/23/13	4:45	10/23/13	4:45	0.01	0.00	0.6	---
10/23/13	12:00	10/23/13	15:30	0.18	3.50	0.3	0.051
10/30/13	20:15	10/30/13	20:15	0.01	0.00	7.2	---
10/31/13	11:45	10/31/13	11:45	0.01	0.00	0.6	---
10/31/13	23:45	11/01/13	0:00	0.02	0.25	0.5	0.080
11/01/13	13:45	11/01/13	13:45	0.01	0.00	0.6	---
11/02/13	13:45	11/02/13	13:45	0.01	0.00	1.0	---
11/05/13	17:00	11/05/13	21:00	0.04	4.00	3.1	0.010
11/06/13	3:15	11/06/13	11:30	0.03	8.25	0.3	0.004
11/08/13	17:45	11/09/13	6:45	0.61	13.00	2.3	0.047
11/09/13	22:30	11/10/13	6:15	0.60	7.75	0.7	0.077
11/15/13	15:45	11/15/13	21:15	0.17	5.50	5.4	0.031
11/19/13	16:00	11/19/13	19:45	0.03	3.75	3.8	0.008
11/20/13	20:00	11/20/13	22:30	0.11	2.50	1.0	0.044
11/21/13	14:15	11/22/13	5:15	1.52	15.00	0.7	0.101
11/23/13	12:30	11/23/13	13:30	0.13	1.00	1.3	0.130
11/24/13	5:45	11/24/13	5:45	0.01	0.00	0.7	---
11/24/13	20:45	11/25/13	0:15	0.02	3.50	0.6	0.006
11/25/13	20:45	11/26/13	2:45	0.14	6.00	0.9	0.023
11/26/13	23:45	11/27/13	8:00	1.08	8.25	0.9	0.131
11/30/13	12:45	11/30/13	15:30	0.04	2.75	3.2	0.015
			Total:	**50.20**	**--**	**--**	**--**
			Mean:	**0.24**	**3.89**	**1.62**	**0.10**
			Minimum:	**0.01**	**0.00**	**0.26**	**0.00**
			Maximum:	**2.90**	**26.00**	**18.86**	**0.54**

A total of 50.20 inches of rainfall fell in the vicinity of the Pembroke Pines dry detention site over the 365-day monitoring period from a total of 203 separate storm events. A summary of rainfall event characteristics measured at the Pembroke Pines monitoring site from December 2012-November 2013 is given in Table 4-8. Individual rainfall amounts measured at the Pembroke Pines pond site ranged from 0.01-2.90 inches, with an average of 0.24 inches per event. Durations for monitored events measured at this site ranged from 0.01-26.0 hours, with antecedent dry periods ranging from 0.26-18.9 days.

TABLE 4-8

SUMMARY OF RAINFALL CHARACTERISTICS MEASURED AT THE PEMBROKE PINES SITE FROM DECEMBER 2012 – NOVEMBER 2013

PARAMETER	UNITS	MINIMUM VALUE	MAXIMUM VALUE	MEAN EVENT VALUE
Event Rainfall	inches	0.01	2.90	0.24
Event Duration	hours	0.01	26.0	3.89
Average Intensity	inches/hour	0.01	0.54	0.10
Antecedent Dry Period	days	0.26	18.9	1.62

A comparison of measured and typical "normal" rainfall in the vicinity of the Pembroke Pines site is given on Figure 4-3. Measured rainfall presented in this figure is based upon field measured rain events at the Pembroke Pines detention pond site presented in Table 4-7 and summarized on a monthly basis. "Normal" rainfall conditions are based upon historical average monthly rainfall recorded at the Weston National Weather Service (NWS) site over the 30-year period from 1981-2010. Historical average annual rainfall in the Pembroke Pines area is approximately 61.68 inches per year.

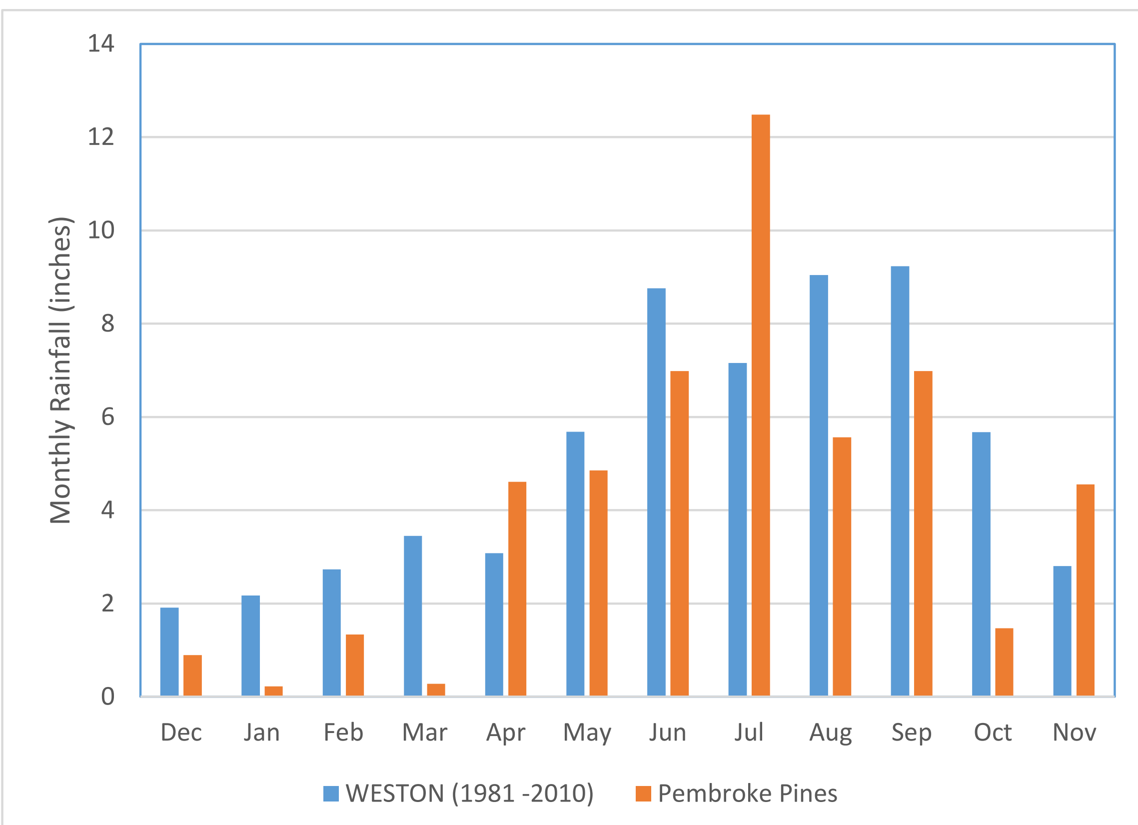


Figure 4-3. Comparison of Average and Measured Rainfall in the Vicinity of the Pembroke Pines Site.

As seen in Figure 4-3, measured rainfall in the vicinity of the Pembroke Pines detention pond site was substantially greater than "normal" during April, July, and November 2013, with "normal" or lower than "normal" rainfall during the remaining months. A tabular comparison of measured and average rainfall for the Pembroke Pines site is given in Table 4-9. The total annual rainfall of 50.2 inches measured at the Pembroke Pines monitoring site is approximately 19% less than the "normal" rainfall of 61.68 inches which typically occurs on an annual basis in the Pembroke Pines area.

TABLE 4-9

COMPARISON OF MEASURED AND "NORMAL" RAINFALL FOR THE PEMBROKE PINES SITE FROM DECEMBER 2012 – NOVEMBER 2013

MONTH	WESTON NATIONAL WEATHER SERVICE (1981-2010)	PEMBROKE PINES DRY DETENTION POND SITE
December	1.91	0.89
January	2.17	0.22
February	2.73	1.33
March	3.45	0.28
April	3.08	4.61
May	5.68	4.85
June	8.76	6.98
July	7.16	12.48
August	9.04	5.56
September	9.23	6.98
October	5.67	1.47
November	2.80	4.55
TOTAL:	**61.68**	**50.20**

4.1.4 Orlando Underdrain Site

A tabular summary of the characteristics of individual rain events measured at the Orlando underdrain site is given in Table 4-10. Information is provided for event rainfall, event start time, event end time, event duration, antecedent dry period, and average intensity for each individual rain event measured at the monitoring site.

TABLE 4-10

SUMMARY OF RAINFALL EVENTS AND CHARACTERISTICS MEASURED AT THE ORLANDO UNDERDRAIN MONITORING SITE FROM DECEMBER 2012 – NOVEMBER 2013

EVENT START		EVENT END		EVENT RAIN (inches)	DURATION (hours)	ANTECEDENT DRY PERIOD (days)	AVERAGE INTENSITY (inches/hour)
Date	Time	Date	Time				
12/10/12	8:53	12/10/12	8:53	0.01	0.00	---	---
12/18/12	4:26	12/18/12	6:39	0.12	2.22	7.8	0.05
12/20/12	15:41	12/20/12	15:41	0.01	0.00	2.4	---
12/21/12	1:55	12/21/12	1:56	0.02	0.02	0.4	1.24
12/22/12	6:36	12/22/12	6:36	0.01	0.00	1.2	---
12/26/12	5:52	12/26/12	5:52	0.01	0.00	4.0	---
01/01/13	4:52	01/01/13	5:28	0.11	0.60	6.0	0.18
01/03/13	14:43	01/03/13	14:43	0.01	0.00	2.4	---
01/13/13	9:36	01/13/13	9:36	0.01	0.00	9.8	---
01/23/13	2:57	01/23/13	2:57	0.01	0.00	9.7	---
01/31/13	3:38	01/31/13	3:39	0.03	0.02	8.0	1.89
02/06/13	1:39	02/06/13	1:42	0.08	0.05	5.9	1.75
02/13/13	11:28	02/13/13	11:28	0.01	0.00	7.4	---
02/18/13	1:54	02/18/13	1:54	0.01	0.00	4.6	---
02/24/13	4:53	02/24/13	4:53	0.01	0.00	6.1	---
02/28/13	3:20	02/28/13	3:20	0.01	0.00	3.9	---
03/12/13	0:29	03/12/13	3:55	0.11	3.43	11.9	0.03
03/13/13	2:50	03/13/13	2:50	0.01	0.00	1.0	---
03/20/13	2:14	03/20/13	2:34	0.49	0.34	7.0	1.44
03/22/13	11:06	03/22/13	12:18	0.06	1.21	2.4	0.05
03/23/13	0:18	03/23/13	0:30	0.22	0.20	0.5	1.09
03/23/13	8:28	03/23/13	8:30	0.05	0.03	0.3	1.61
03/24/13	7:40	03/24/13	9:08	0.85	1.46	1.0	0.58
04/03/13	13:53	04/03/13	16:26	0.30	2.55	10.2	0.12
04/04/13	7:05	04/04/13	8:17	0.04	1.19	0.6	0.03
04/05/13	2:58	04/05/13	3:45	0.06	0.80	0.8	0.08
04/11/13	5:55	04/11/13	5:59	0.12	0.07	6.1	1.75
04/11/13	13:09	04/11/13	13:10	0.02	0.02	0.3	1.31
04/14/13	10:27	04/14/13	15:12	1.76	4.75	2.9	0.37
04/19/13	9:42	04/19/13	9:54	0.08	0.20	4.8	0.40
04/21/13	6:21	04/21/13	16:21	2.65	9.99	1.9	0.27
04/29/13	7:43	04/29/13	15:47	1.90	8.08	7.6	0.24
04/29/13	23:18	04/30/13	1:19	0.22	2.02	0.3	0.11
04/30/13	12:03	04/30/13	14:58	1.02	2.92	0.4	0.35
05/01/13	6:40	05/01/13	6:55	0.59	0.25	0.7	2.39
05/01/13	20:29	05/02/13	13:44	4.32	17.25	0.6	0.25
05/02/13	22:49	05/02/13	22:49	0.01	0.00	0.4	---
05/10/13	11:23	05/10/13	11:23	0.01	0.00	7.5	---
05/19/13	8:25	05/19/13	10:14	0.80	1.82	8.9	0.44
05/29/13	3:30	05/29/13	6:36	0.15	3.10	9.7	0.05
05/29/13	21:38	05/29/13	21:43	0.06	0.08	0.6	0.72
05/30/13	6:43	05/30/13	6:43	0.01	0.00	0.4	---
06/01/13	13:17	06/01/13	13:21	0.06	0.06	2.3	0.94
06/02/13	14:34	06/02/13	14:34	0.01	0.00	1.1	---
06/03/13	9:47	06/03/13	9:58	0.07	0.19	0.8	0.37
06/04/13	10:26	06/04/13	14:51	0.11	4.42	1.0	0.02
06/05/13	9:46	06/05/13	11:09	0.28	1.39	0.8	0.20
06/05/13	20:21	06/06/13	12:30	2.27	16.15	0.4	0.14
06/08/13	9:21	06/08/13	11:48	1.40	2.44	1.9	0.57
06/09/13	8:41	06/09/13	8:43	0.03	0.02	0.9	1.21
06/10/13	10:05	06/10/13	11:12	0.60	1.12	1.1	0.53
06/11/13	7:20	06/11/13	10:55	0.46	3.59	0.8	0.13
06/15/13	0:45	06/15/13	1:29	0.06	0.73	3.6	0.08
06/16/13	6:54	06/16/13	7:00	0.04	0.10	1.2	0.39
06/16/13	17:34	06/16/13	19:58	0.55	2.40	0.4	0.23
06/17/13	7:44	06/17/13	17:54	2.03	10.17	0.5	0.20

TABLE 4-10 -- CONTINUED

SUMMARY OF RAINFALL EVENTS AND CHARACTERISTICS MEASURED AT THE ORLANDO UNDERDRAIN MONITORING SITE FROM DECEMBER 2012 – NOVEMBER 2013

EVENT START		EVENT END		EVENT RAIN (inches)	DURATION (hours)	ANTECEDENT DRY PERIOD (days)	AVERAGE INTENSITY (inches/hour)
Date	Time	Date	Time				
06/18/13	10:27	06/18/13	12:36	1.09	2.15	0.7	0.51
06/19/13	7:17	06/19/13	7:17	0.02	0.00	0.8	72.00
06/20/13	11:12	06/20/13	13:18	0.54	2.10	1.2	0.26
06/21/13	9:20	06/21/13	12:02	0.83	2.71	0.8	0.31
06/23/13	7:13	06/23/13	7:17	0.08	0.06	1.8	1.29
06/24/13	8:55	06/24/13	9:42	0.03	0.78	1.1	0.04
06/28/13	9:52	06/28/13	11:22	0.17	1.51	4.0	0.11
06/30/13	5:51	06/30/13	10:43	0.34	4.86	1.8	0.07
07/01/13	7:51	07/01/13	17:37	0.33	9.77	0.9	0.03
07/02/13	7:31	07/02/13	8:06	0.07	0.57	0.6	0.12
07/03/13	6:33	07/03/13	14:20	0.43	7.78	0.9	0.06
07/04/13	9:00	07/04/13	12:36	0.54	3.60	0.8	0.15
07/05/13	5:14	07/05/13	5:14	0.01	0.00	0.7	---
07/10/13	12:22	07/10/13	12:55	0.12	0.56	5.3	0.21
07/11/13	10:06	07/11/13	10:22	0.03	0.28	0.9	0.11
07/12/13	7:38	07/12/13	7:38	0.01	0.00	0.9	---
07/13/13	9:05	07/13/13	9:26	0.09	0.36	1.1	0.25
07/14/13	7:38	07/14/13	7:50	0.16	0.19	0.9	0.84
07/16/13	6:59	07/16/13	11:16	0.80	4.28	2.0	0.19
07/17/13	9:22	07/17/13	9:26	0.12	0.07	0.9	1.82
07/19/13	10:18	07/19/13	14:49	1.83	4.52	2.0	0.41
07/22/13	8:19	07/22/13	11:14	0.83	2.92	2.7	0.28
07/23/13	4:43	07/23/13	5:09	0.05	0.43	0.7	0.12
07/25/13	5:50	07/25/13	5:56	0.04	0.10	2.0	0.39
07/28/13	9:47	07/28/13	10:02	0.15	0.24	3.2	0.64
07/29/13	10:19	07/29/13	10:50	0.32	0.51	1.0	0.63
07/31/13	8:32	07/31/13	8:38	0.05	0.10	1.9	0.51
07/31/13	17:04	07/31/13	17:42	0.08	0.64	0.4	0.12
08/01/13	9:55	08/01/13	10:38	0.75	0.71	0.7	1.05
08/03/13	11:05	08/03/13	12:21	0.62	1.27	2.0	0.49
08/04/13	11:09	08/04/13	11:17	0.16	0.13	0.9	1.20
08/05/13	12:38	08/05/13	12:57	0.20	0.31	1.1	0.63
08/08/13	7:42	08/08/13	7:56	0.13	0.24	2.8	0.54
08/14/13	8:50	08/14/13	11:10	0.88	2.34	6.0	0.38
08/15/13	15:01	08/15/13	15:06	0.10	0.08	1.2	1.19
08/16/13	16:25	08/16/13	17:55	0.03	1.50	1.1	0.02
08/17/13	10:52	08/17/13	10:57	0.08	0.10	0.7	0.83
08/21/13	7:58	08/21/13	9:33	0.13	1.60	3.9	0.08
08/23/13	8:13	08/23/13	10:15	0.72	2.03	1.9	0.36
08/24/13	8:21	08/24/13	11:48	0.72	3.44	0.9	0.21
08/25/13	6:31	08/25/13	7:14	0.16	0.72	0.8	0.22
08/26/13	6:42	08/26/13	6:47	0.16	0.08	1.0	1.97
08/30/13	10:52	08/30/13	10:55	0.04	0.06	4.2	0.63
08/31/13	11:44	08/31/13	14:56	0.53	3.20	1.0	0.17
09/01/13	13:22	09/01/13	14:00	0.07	0.63	0.9	0.11
09/05/13	10:44	09/05/13	11:16	0.05	0.54	3.9	0.09
09/06/13	7:43	09/06/13	12:15	0.95	4.53	0.9	0.21
09/07/13	8:35	09/07/13	8:35	0.01	0.00	0.8	---
09/17/13	11:01	09/17/13	11:01	0.01	0.00	10.1	---
09/18/13	7:42	09/18/13	7:44	0.03	0.05	0.9	0.64
09/22/13	8:49	09/22/13	9:27	0.93	0.64	4.0	1.44
09/23/13	7:06	09/23/13	12:35	1.46	5.49	0.9	0.27
09/24/13	8:25	09/24/13	13:51	0.79	5.43	0.8	0.15
09/26/13	6:45	09/26/13	6:45	0.02	0.00	1.7	---
09/27/13	12:27	09/27/13	12:32	0.23	0.08	1.2	2.73
10/02/13	1:34	10/02/13	1:34	0.03	0.00	4.5	108.00

TABLE 4-10 -- CONTINUED

SUMMARY OF RAINFALL EVENTS AND CHARACTERISTICS MEASURED AT THE ORLANDO UNDERDRAIN MONITORING SITE FROM DECEMBER 2012 – NOVEMBER 2013

EVENT START		EVENT END		EVENT RAIN (inches)	DURATION (hours)	ANTECEDENT DRY PERIOD (days)	AVERAGE INTENSITY (inches/hour)
Date	Time	Date	Time				
10/05/13	5:19	10/05/13	5:23	0.09	0.08	3.2	1.15
10/06/13	11:05	10/06/13	11:18	0.10	0.22	1.2	0.45
10/07/13	6:01	10/07/13	10:53	0.60	4.85	0.8	0.12
10/07/13	21:14	10/07/13	21:14	0.01	0.00	0.4	---
10/14/13	2:40	10/14/13	2:41	0.10	0.01	6.2	12.41
10/22/13	7:28	10/22/13	7:28	0.04	0.00	8.2	10.29
11/02/13	2:31	11/02/13	6:05	0.50	3.56	10.8	0.14
11/15/13	11:21	11/15/13	11:21	0.01	0.00	13.2	---
11/15/13	17:32	11/15/13	18:09	0.04	0.62	0.3	0.06
11/16/13	5:34	11/16/13	9:00	0.05	3.43	0.5	0.01
11/18/13	2:40	11/18/13	2:40	0.01	0.00	1.7	---
11/20/13	13:35	11/20/13	13:35	0.01	0.00	2.5	---
11/21/13	7:59	11/21/13	8:08	0.04	0.15	0.8	0.27
11/26/13	17:14	11/27/13	1:07	0.15	7.88	5.4	0.02
			Total:	**45.25**	**--**	**--**	**--**
			Mean:	**0.36**	**1.70**	**2.74**	**2.51**
			Minimum:	**0.01**	**0.00**	**0.26**	**0.01**
			Maximum:	**4.32**	**17.25**	**13.22**	**108.00**

A total of 45.25 inches of rainfall fell in the vicinity of the Orlando underdrain site over the 365-day monitoring period from a total of 125 separate storm events. A summary of rainfall event characteristics measured at the Orlando underdrain monitoring site from December 2012-November 2013 is given in Table 4-11. Individual rainfall amounts measured at the Orlando underdrain site ranged from 0.01-4.32 inches, with an average of 0.36 inches per event. Durations for monitored events measured at this site ranged from 0.01-17.3 hours, with antecedent dry periods ranging from 0.26-13.2 days.

TABLE 4-11

SUMMARY OF RAINFALL CHARACTERISTICS MEASURED AT THE ORLANDO UNDERDRAIN SITE FROM DECEMBER 2012 – NOVEMBER 2013

PARAMETER	UNITS	MINIMUM VALUE	MAXIMUM VALUE	MEAN EVENT VALUE
Event Rainfall	inches	0.01	4.32	0.36
Event Duration	hours	0.01	17.3	1.70
Average Intensity	inches/hour	0.01	108	2.51
Antecedent Dry Period	days	0.26	13.2	2.74

A comparison of measured and typical "normal" rainfall in the vicinity of the Orlando underdrain site is given on Figure 4-4. Measured rainfall presented in this figure is based upon field measured rain events at the Orlando underdrain site presented in Table 4-10 and summarized on a monthly basis. "Normal" rainfall conditions are based upon historical average monthly rainfall recorded at the Orlando Executive Airport National Weather Service (NWS) site over the 30-year period from 1981-2010. Historical average annual rainfall in the Orlando area is approximately 53.17 inches per year.

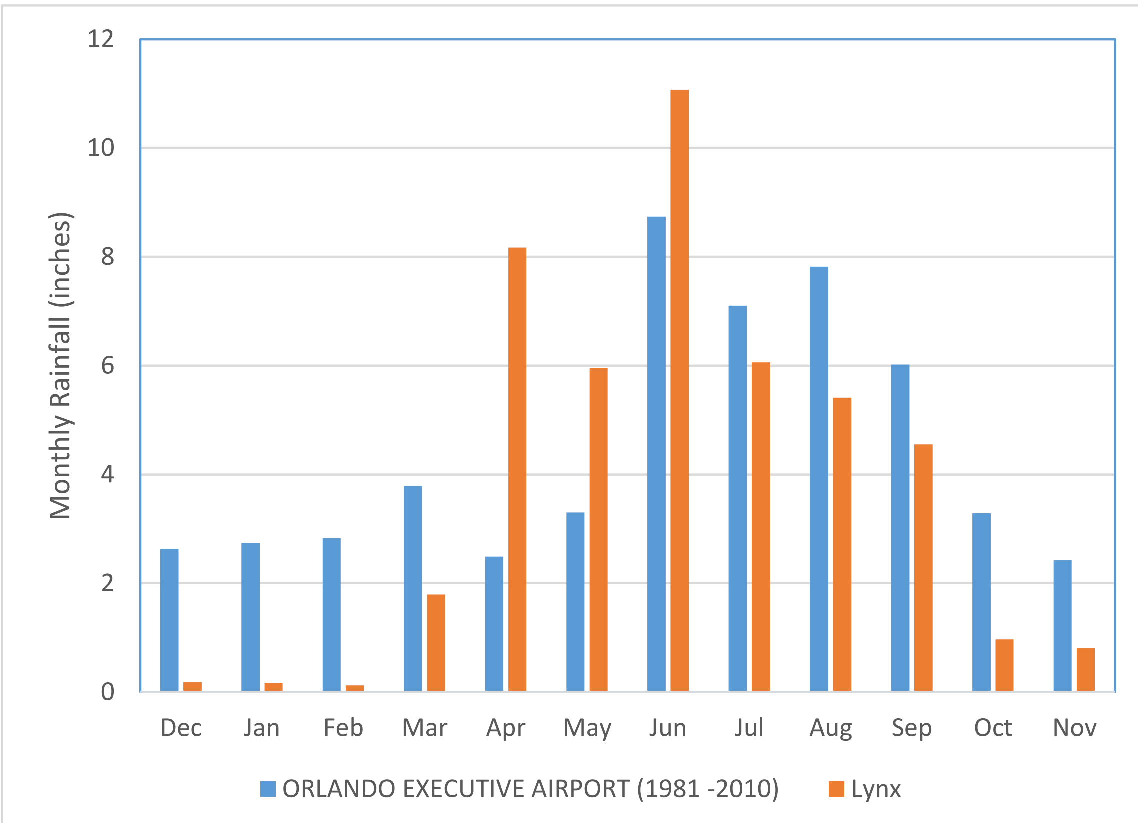


Figure 4-4. Comparison of Average and Measured Rainfall in the Vicinity of the Orlando Site.

As seen in Figure 4-4, measured rainfall in the vicinity of the Orlando underdrain site was substantially greater than "normal" only during April and June 2013, with "normal" or lower than "normal" rainfall during the remaining months. A tabular comparison of measured and average rainfall for the Orlando site is given in Table 4-12. The total annual rainfall of 45.25 inches measured at the Orlando monitoring site is approximately 15% less than the "normal" rainfall of 53.17 inches which typically occurs on an annual basis in the Orlando area.

TABLE 4-12

COMPARISON OF MEASURED AND "NORMAL" RAINFALL FOR THE ORLANDO UNDERDRAIN SITE FROM DECEMBER 2012 – NOVEMBER 2013

MONTH	ORLANDO EXECUTIVE AIRPORT NATIONAL WEATHER SERVICE (1981-2010)	ORLANDO UNDERDRAIN SITE
December	2.63	0.18
January	2.74	0.17
February	2.83	0.12
March	3.79	1.79
April	2.49	8.17
May	3.30	5.95
June	8.74	11.07
July	7.10	6.06
August	7.82	5.41
September	6.02	4.55
October	3.29	0.97
November	2.42	0.81
TOTAL:	**53.17**	**45.25**

4.1.5 Hydrologic Inputs

Hydrologic inputs from direct rainfall were calculated for each of the evaluated ponds at each of the four study sites as input data for developing overall hydrologic budgets for each site. Hydrologic inputs were calculated for each evaluated pond by multiplying the measured monthly rainfall times the measured area (TOB) for each pond. This analysis was conducted for each monthly period over the monitoring program which occurred from December 2012-November 2013.

A tabular summary of hydrologic inputs to the Bonita Springs dry detention ponds from direct rainfall over the period from December 2012-November 2013 is given on Table 4-13. Over the 12-month monitoring program, direct rainfall contributed approximately 0.51 ac-ft to Pond 1 (0.087 acres), 2.61 ac-ft to Pond 2 (0.448 acres), and 6.44 ac-ft to Pond 3 (1.105 acres).

A tabular summary of hydrologic inputs to the Naples dry detention ponds from direct rainfall over the period from December 2012-November 2013 is given on Table 4-14. During this period, direct rainfall contributed approximately 9.55 ac-ft to Pond 1 (1.55 acres) and 2.83 ac-ft to Pond 2 (0.46 acres).

TABLE 4-13

HYDROLOGIC INPUTS TO THE BONITA SPRINGS DRY DETENTION PONDS FROM DIRECT RAINFALL FROM DECEMBER 2012 – NOVEMBER 2013

MONTH	RAINFALL (inches)	INPUTS (ac-ft)		
		Pond 1	Pond 2	Pond 3
December	3.47	0.03	0.13	0.32
January	0.28	0.00	0.01	0.03
February	2.69	0.02	0.10	0.25
March	1.21	0.01	0.05	0.11
April	2.93	0.02	0.11	0.27
May	5.22	0.04	0.19	0.48
June	16.35	0.12	0.61	1.51
July	12.59	0.09	0.47	1.16
August	8.99	0.07	0.34	0.83
September	13.31	0.10	0.50	1.23
October	2.15	0.02	0.08	0.20
November	0.75	0.01	0.03	0.07
TOTAL:	**69.94**	**0.51**	**2.61**	**6.44**
POND AREA (acres):	**--**	**0.087**	**0.448**	**1.105**

TABLE 4-14

HYDROLOGIC INPUTS TO THE NAPLES DRY DETENTION PONDS FROM DIRECT RAINFALL FROM DECEMBER 2012 – NOVEMBER 2013

MONTH	RAINFALL (inches)	INPUTS (ac-ft)	
		Pond 1	Pond 2
December	5.14	0.66	0.20
January	0.08	0.01	0.00
February	1.82	0.24	0.07
March	0.79	0.10	0.03
April	4.33	0.56	0.17
May	3.39	0.44	0.13
June	16.42	2.12	0.63
July	13.36	1.73	0.51
August	13.75	1.78	0.53
September	11.49	1.48	0.44
October	1.27	0.16	0.05
November	2.08	0.27	0.08
TOTAL:	**73.92**	**9.55**	**2.83**
POND AREA (acres):	**--**	**1.55**	**0.46**

A tabular summary of hydrologic inputs to the Pembroke Pines dry detention ponds from direct rainfall over the period from December 2012-November 2013 is given on Table 4-15. During this period, direct rainfall contributed approximately 0.96 ac-ft to Pond 1 (0.23 acres) and 1.88 ac-ft to Pond 2 (0.45 acres).

TABLE 4-15

HYDROLOGIC INPUTS TO THE PEMBROKE PINES DRY DETENTION PONDS FROM DIRECT RAINFALL FROM DECEMBER 2012 – NOVEMBER 2013

MONTH	RAINFALL (inches)	INPUTS (ac-ft)	
		Pond 1	Pond 2
December	0.89	0.02	0.03
January	0.22	0.00	0.01
February	1.33	0.03	0.05
March	0.28	0.01	0.01
April	4.61	0.09	0.17
May	4.85	0.09	0.18
June	6.98	0.13	0.26
July	12.48	0.24	0.47
August	5.56	0.11	0.21
September	6.98	0.13	0.26
October	1.47	0.03	0.06
November	4.55	0.09	0.17
TOTAL:	**50.20**	**0.96**	**1.88**
POND AREA (acres):	**--**	**0.23**	**0.45**

A tabular summary of hydrologic inputs to the Orlando underdrain pond site from direct rainfall over the period from December 2012-November 2013 is given on Table 4-16. During this period, direct rainfall contributed approximately 8.22 ac-ft to Pond 1 (2.18 acres).

TABLE 4-16

HYDROLOGIC INPUTS TO THE ORLANDO UNDERDRAIN POND FROM DIRECT RAINFALL FROM DECEMBER 2012 – NOVEMBER 2013

MONTH	RAINFALL (inches)	INPUTS TO POND 1 (ac-ft)	MONTH	RAINFALL (inches)	INPUTS TO POND 1 (ac-ft)
December	0.18	0.03	July	6.06	1.10
January	0.17	0.03	August	5.41	0.98
February	0.12	0.02	September	4.55	0.83
March	1.79	0.33	October	0.97	0.18
April	8.17	1.48	November	0.81	0.15
May	5.95	1.08	**TOTAL:**	**45.25**	**8.22**
June	11.07	2.01	**POND AREA (acres):**	**--**	**2.18**

4.2 Water Level Elevations

As discussed in Section 3.1.6, shallow groundwater monitoring wells were installed in each of the evaluated dry detention and underdrain ponds, and water level elevations in the monitoring wells were recorded during each weekly site visit. A complete listing of measured groundwater elevations at each of the four study sites is given in Appendix A. Measured water elevations at each of the four monitoring sites are discussed in the following sections.

4.2.1 Bonita Springs Site

A graphical comparison of measured groundwater elevations in the dry detention ponds at the Bonita Springs site is given on Figure 4-5. As indicated on Figure 3-1, the monitoring well designations correspond to the pond designations which follow the sequential order of the interconnected dry detention ponds, with Monitoring Well 1 located in Pond 1 and Monitoring Well 3 located in the final discharge pond. In general, water level elevations in Ponds 2 and 3 followed each other very closely throughout the field monitoring program. However, water level elevations in Pond 1 generally exceeded water level elevations in the remaining ponds by 0.1->1 ft depending upon the time of year. Pond 1 also maintained standing water throughout much of the field monitoring program, while standing water in the remaining ponds was observed only sporadically during summer rainy season conditions.

The often substantial differences in water surface elevations observed in Pond 1 appear to be related to a relatively minor construction error related to the inflow/outflow grate structure for this pond. According to the design drawings, the inflow/outflow grates for each pond are supposed to be constructed level with the pond bottom. However, the inflow/outflow grate for Pond 1 sticks up approximately 6 inches above the bottom of the pond. This small construction difference causes standing water to remain within the pond throughout much of the year and prevents the pond from completely draining as occurs in the remaining ponds.

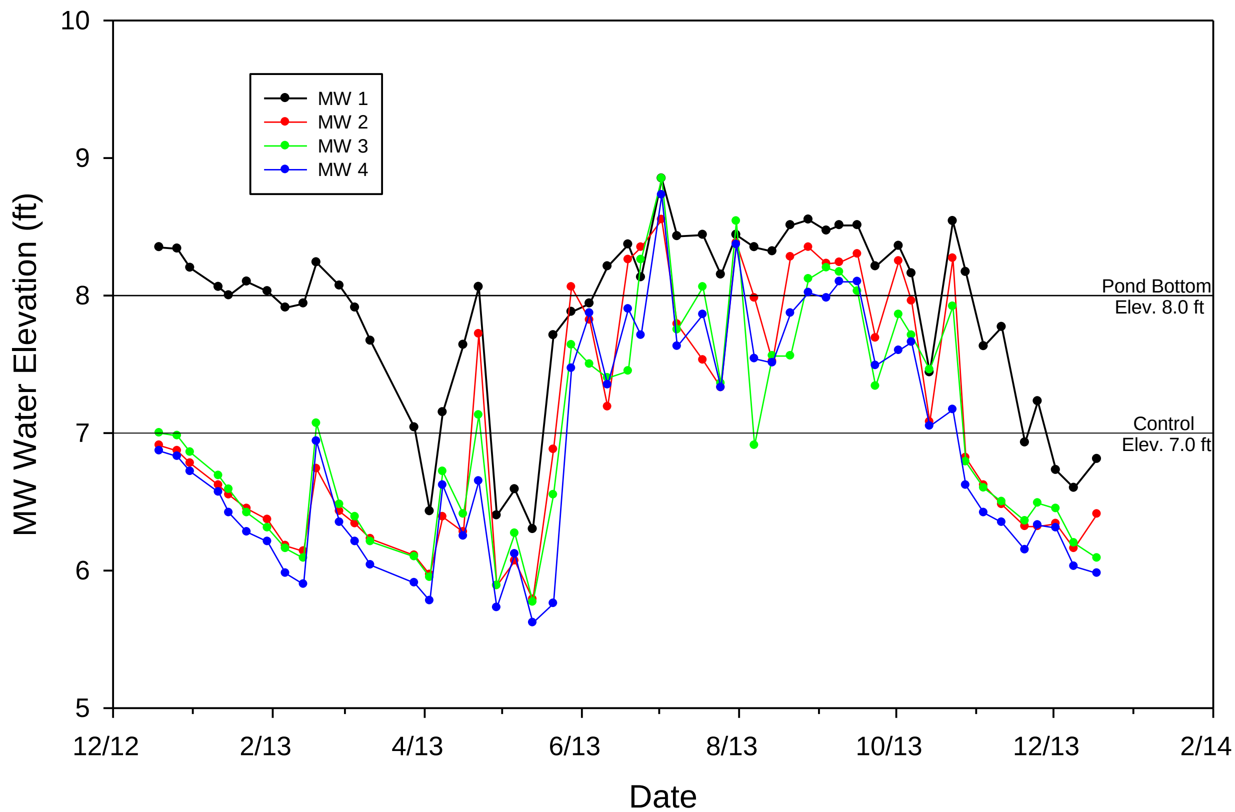


Figure 4-5. Measured Groundwater Elevations in the Dry Detention Ponds at the Bonita Springs Site.

As indicated on Figure 4-5, Monitoring Well 4 (reference area) typically exhibited water level elevations which are slightly lower than measured in the dry detention ponds during much of the year, suggesting that groundwater impacts decrease in areas outside of the ponds.

As discussed previously, standing water was present in Pond 1 throughout a majority of the field monitoring program. However, standing water was observed much less frequently in the remaining ponds where standing water was observed only during summer wet season conditions. The water level elevations summarized on Figure 4-5 suggest that large portions of the runoff inflows to Ponds 2 and 3 infiltrate into the pond bottom during dry season conditions, with water table elevations reaching near or above the pond bottom during wet season conditions.

4.2.2 Naples Site

A graphical comparison of measured groundwater elevations in the dry detention ponds at the Naples site is given on Figure 4-6. The monitoring well sites are numbered corresponding to the pond designations, with Monitoring Well 1 located in the initial pond (Pond 1) and Monitoring Well 2 located in the outfall pond (Pond 2).

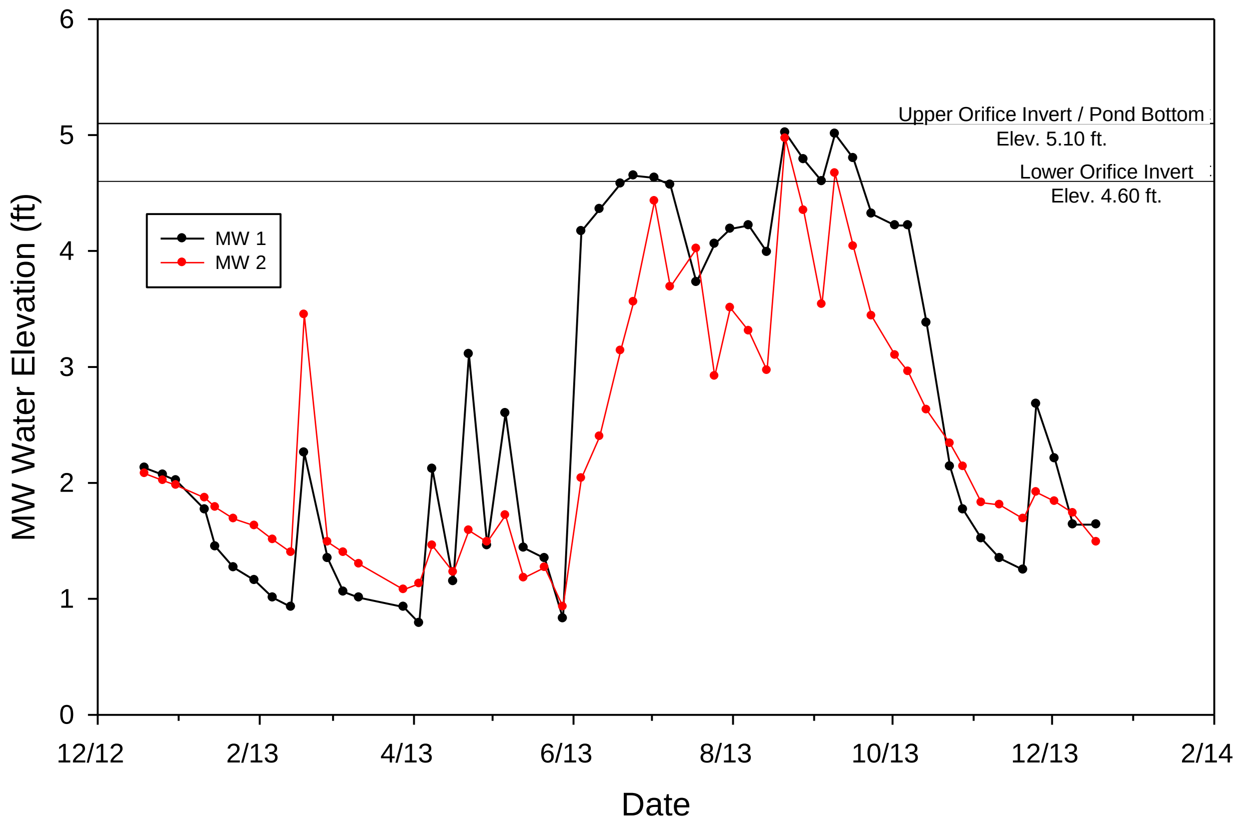


Figure 4-6. Measured Groundwater Elevations in the Dry Detention Ponds at the Naples Site.

As indicated on Figure 2-12, the Naples dry detention pond contains two bleed-down orifice structures, with the bottom orifice providing a control elevation of 4.6 ft and the upper orifice at a control level of 5.10 ft which is equivalent to the elevation of the pond bottom. As indicated on Figure 4-6, water level elevations within the two ponds were substantially below the lower control elevation of 4.6 ft during dry season conditions. However, during the rainy wet season, water elevations increased to levels near or above the lower control elevation of 4.6 ft. These data suggest that the two ponds maintained relatively dry conditions throughout the field monitoring program with the exception of brief periods during rainy season conditions.

4.2.3 **Pembroke Pines Site**

A graphical comparison of measured groundwater elevations in the dry detention ponds at the Pembroke Pines site is given on Figure 4-7. As indicated on Figure 2-16, the outfall structure for the Pembroke Pines site has a control elevation of 4.0 ft, with the pond bottom in each of the three ponds at elevation 5.0 ft. As discussed with the previous sites, the monitoring well designations correspond with the detention pond designations, with Monitoring Well 1 located in the most upstream pond (Pond 1) and Monitoring Well 2 located in the pond with the outfall structure (Pond 2). Monitoring Well 3 is a reference well located west of Pond 1.

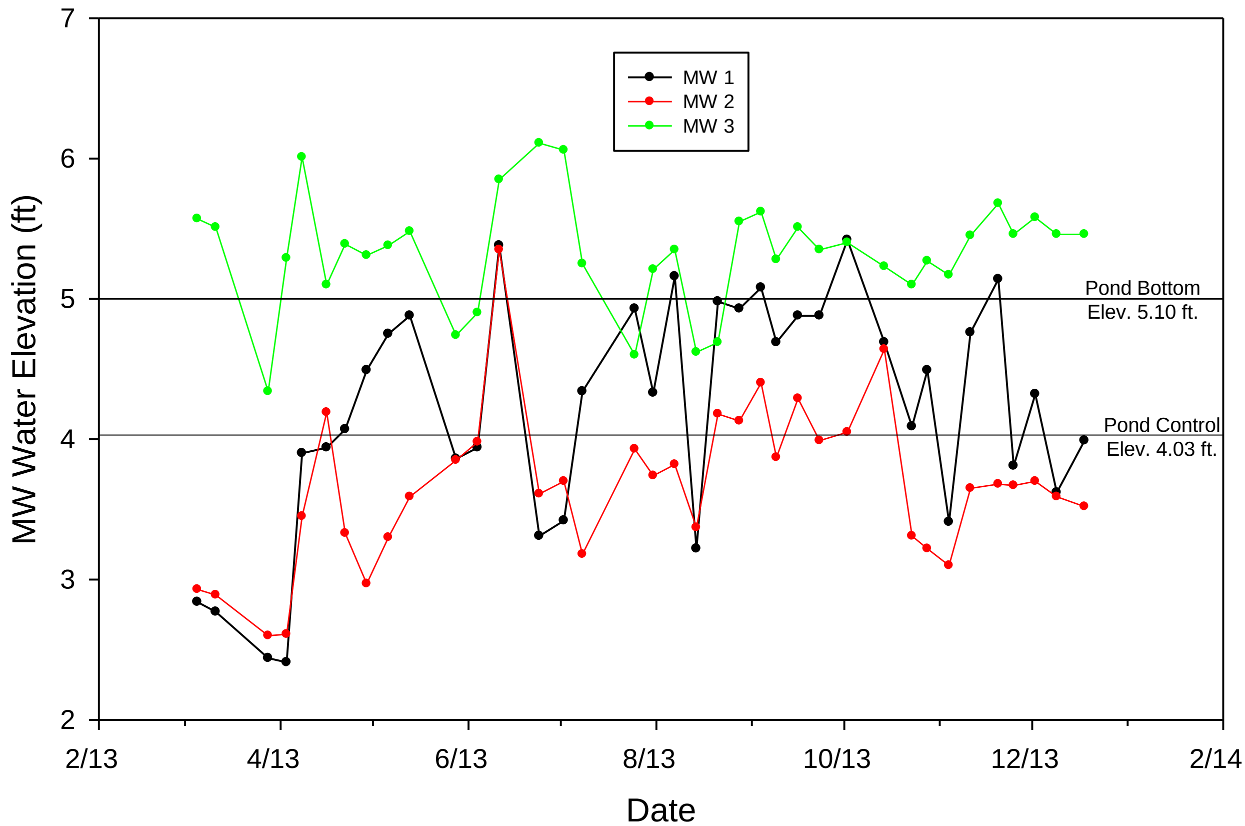


Figure 4-7. Measured Groundwater Elevations in the Dry Detention Ponds at the Pembroke Pines Site.

In general, water level elevations typically decrease from the initial pond to the final outfall pond, reflecting changes in the pond control elevations from 5.0 ft in Pond 1 to 4.03 ft in Pond 2. Water level elevations in Pond 1 were near or above the control elevation during only 5 of the 52 weekly site visits, suggesting that Pond 1 maintained relatively dry conditions during the study period. Water levels in Pond 2 were above the control elevation during approximately 60% of the study period, with water level elevations in the reference well (MW-3) above the control elevation of Pond 1 throughout the duration of the monitoring program. The data summarized on Figure 4-7 indicate a gradual lowering of the water table from the reference area to Ponds 1 and 2.

4.2.4 Orlando Site

A graphical comparison of measured groundwater elevations in the underdrain pond at the Orlando site is given on Figure 4-8. Each of the two monitoring wells was located inside the underdrain pond, with Monitoring Well 1 located closer to the primary inflow. As indicated on Figure 4-8, groundwater elevations at the Orlando site were consistently below the pond bottom elevation of 98.0 ft. However, groundwater level measurements were conducted on a weekly basis, and water level elevations in the pond could have temporarily exceeded the pond bottom for a short period of time following significant rain events, although overall the pond appears to have exhibited excellent infiltration characteristics throughout the monitoring program.

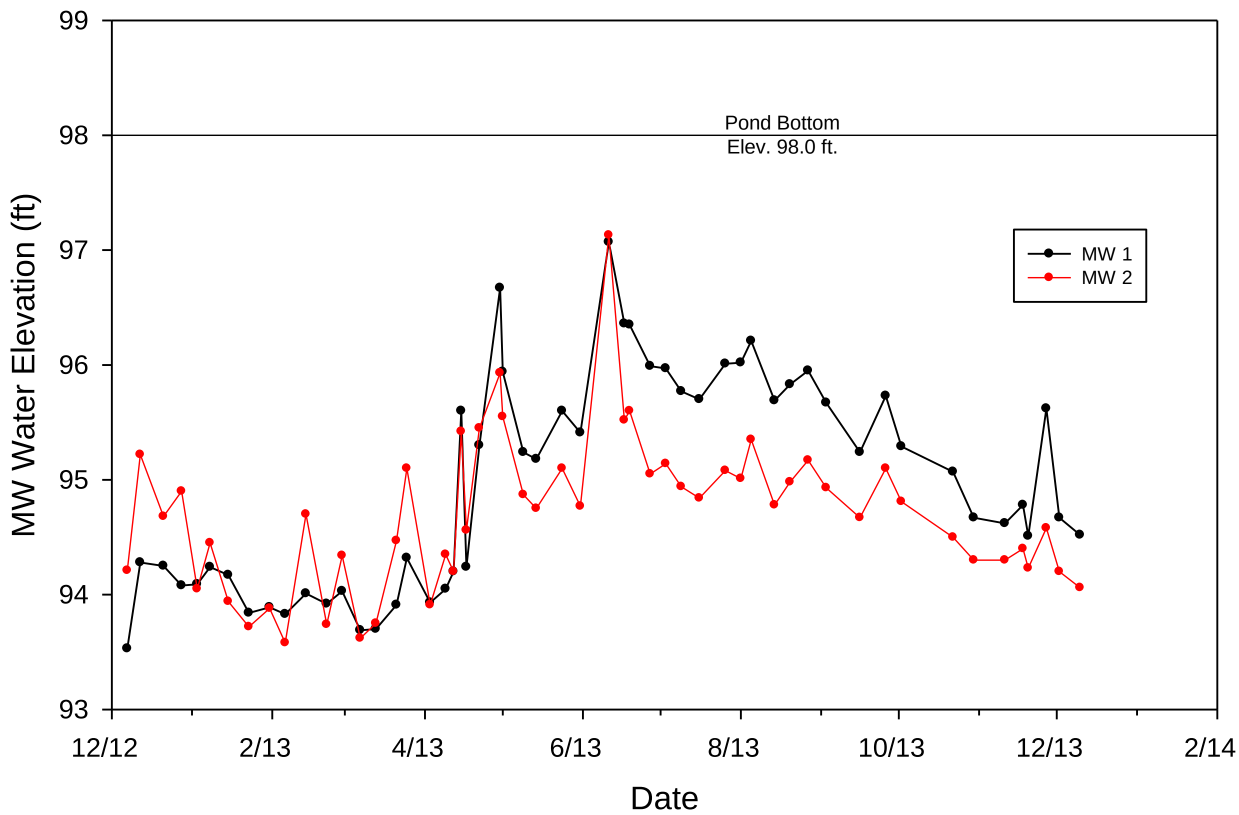


Figure 4-8. Measured Groundwater Elevations in the Underdrain Pond at the Orlando Site.

4.3 Hydrologic Inputs and Losses

As discussed in Section 3, continuous inflow hydrographs were recorded at significant inflows to each of the evaluated sites over the 12-month period from December 2012-November 2013. In addition, continuous hydrographs were also recorded at the primary discharge structures for each of the study sites to assist in evaluating the hydrologic characteristics of the study sites. A discussion of measured inflow and outflow hydrographs at each of the monitoring sites is given in the following sections.

4.3.1 Bonita Springs Site

4.3.1.1 Site 1

Measured inflow hydrographs at Bonita Springs Site 1 over the period from December 2012-November 2013 are illustrated on Figure 4-9. The inflow monitored at Site 1 consists of a 36-inch RCP which receives runoff from parking areas and travel lanes. Measured inflows at Site 1 were typically less than 3 cfs for common ordinary rain events. However, for rain events in excess of 1 inch, inflow hydrographs increased to approximately 5-10 cfs. Rainfall depths for monitored rain events at the Bonita Springs sites are also illustrated on Figure 4-9 for comparison purposes.

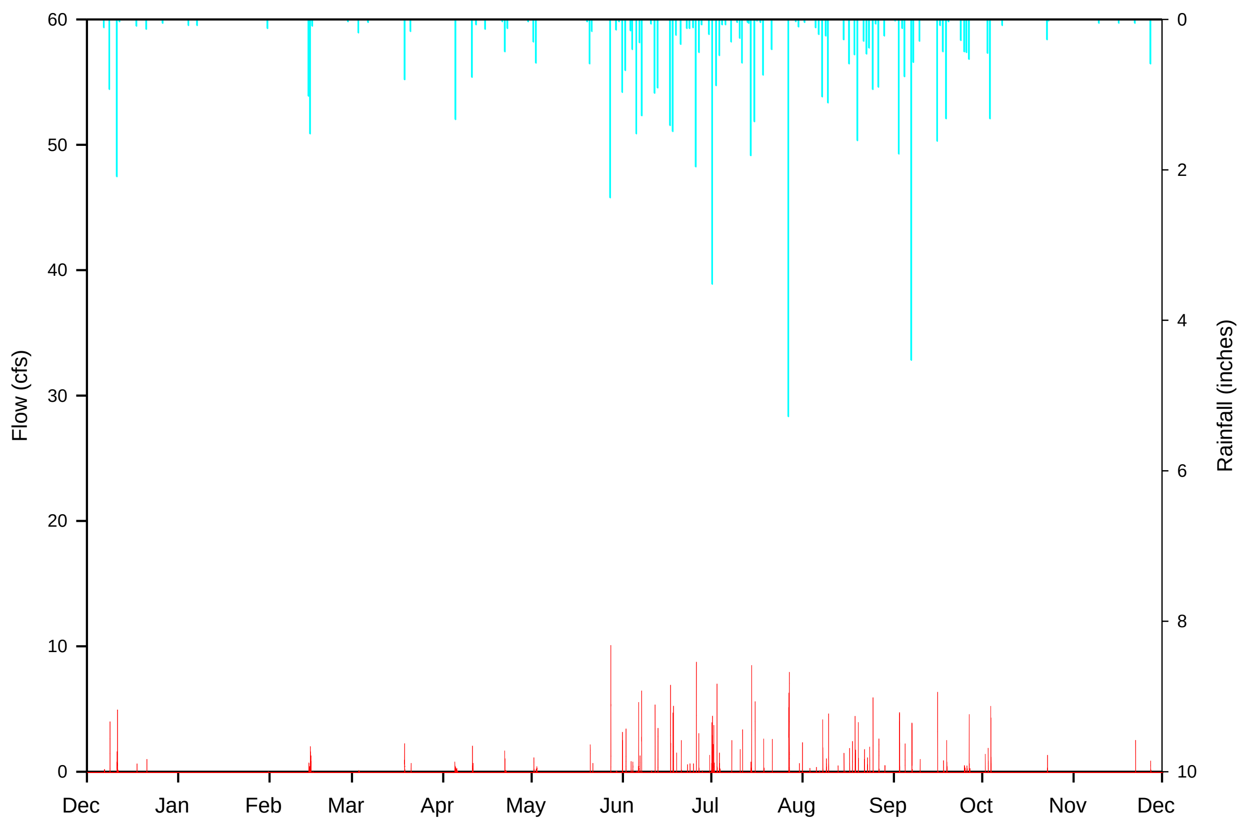


Figure 4-9. Measured Inflow Hydrographs at Bonita Springs Site 1 (36-inch RCP) from December 2012-November 2013.

4.3.1.2 Site 2

Measured inflow hydrographs at Bonita Springs Site 2 over the period from December 2012-November 2013 are illustrated on Figure 4-10. The inflow monitored at Site 2 consists of a 48-inch RCP which reflects inflows from Pond 2, drainage generated in rear portions of the commercial retail store, and the rooftop drainage for the retail store. In general, measured hydrographs at Site 2 appear to be slightly greater in value than hydrographs measured at Site 1. Storm events less than approximately 1 inch typically generated hydrographs with peak inflows of 5 cfs or less. Rainfall events substantially in excess of 1 inch generated inflow hydrographs with maximum discharges ranging from approximately 10-15 cfs. Rainfall depths for monitored rain events at the Bonita Springs sites are also illustrated on Figure 4-10 for comparison purposes.

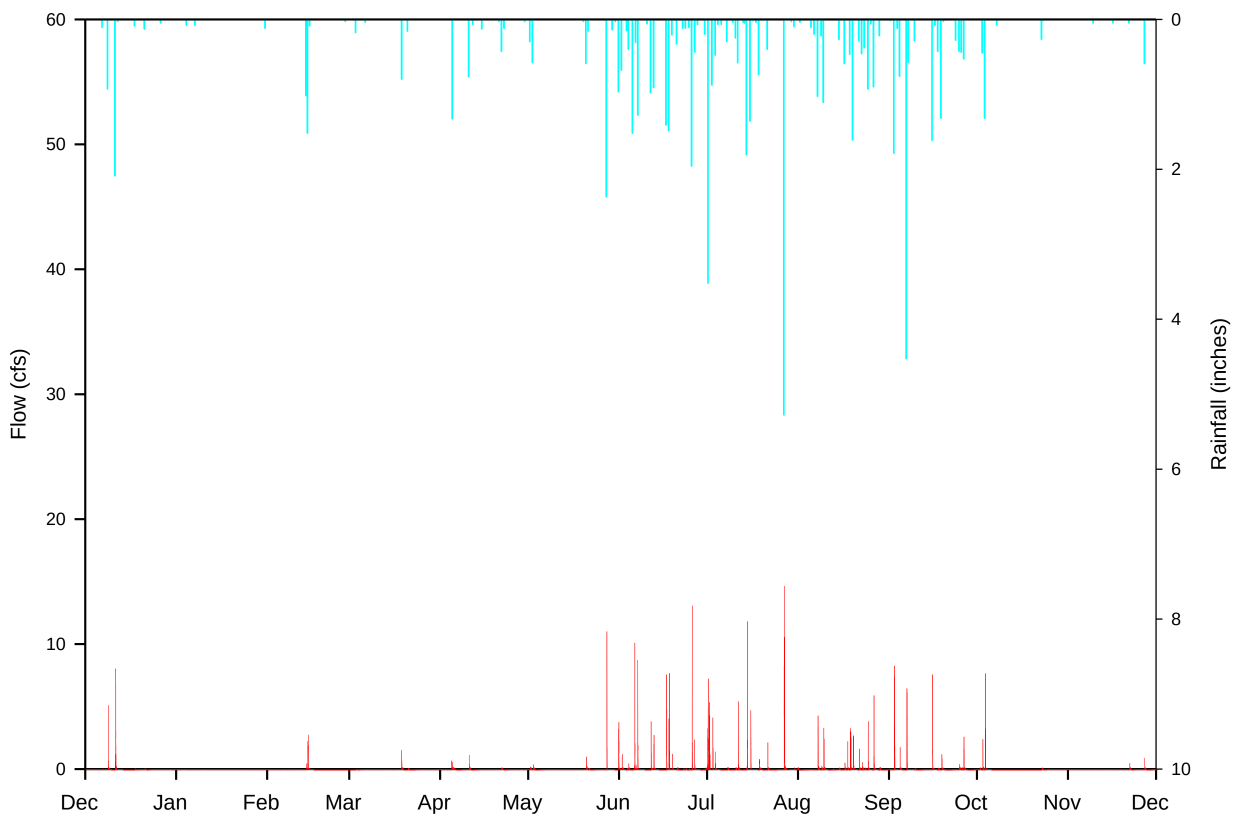


Figure 4-10. Measured Inflow Hydrographs at Bonita Springs Site 2 (48-inch RCP) from December 2012-November 2013.

4.3.1.3 Site 3

Measured inflow hydrographs at Bonita Springs Site 3 over the period from December 2012-November 2013 are illustrated on Figure 4-11. Inflows monitored at Site 3 originate from the southern half of the main parking area and discharge into Pond 3 through a 54-inch RCP. Measured runoff hydrographs at this site are substantially greater in value than hydrographs monitored at Sites 1 or 2. Ordinary daily rain events at the Bonita Springs site generated peak inflow hydrographs of approximately 5 cfs or less. However, inflow hydrographs during significant rain events reached values in the range of approximately 30-40 cfs. Rainfall depths for monitored rain events at the Bonita Springs sites are also illustrated on Figure 4-11 for comparison purposes.

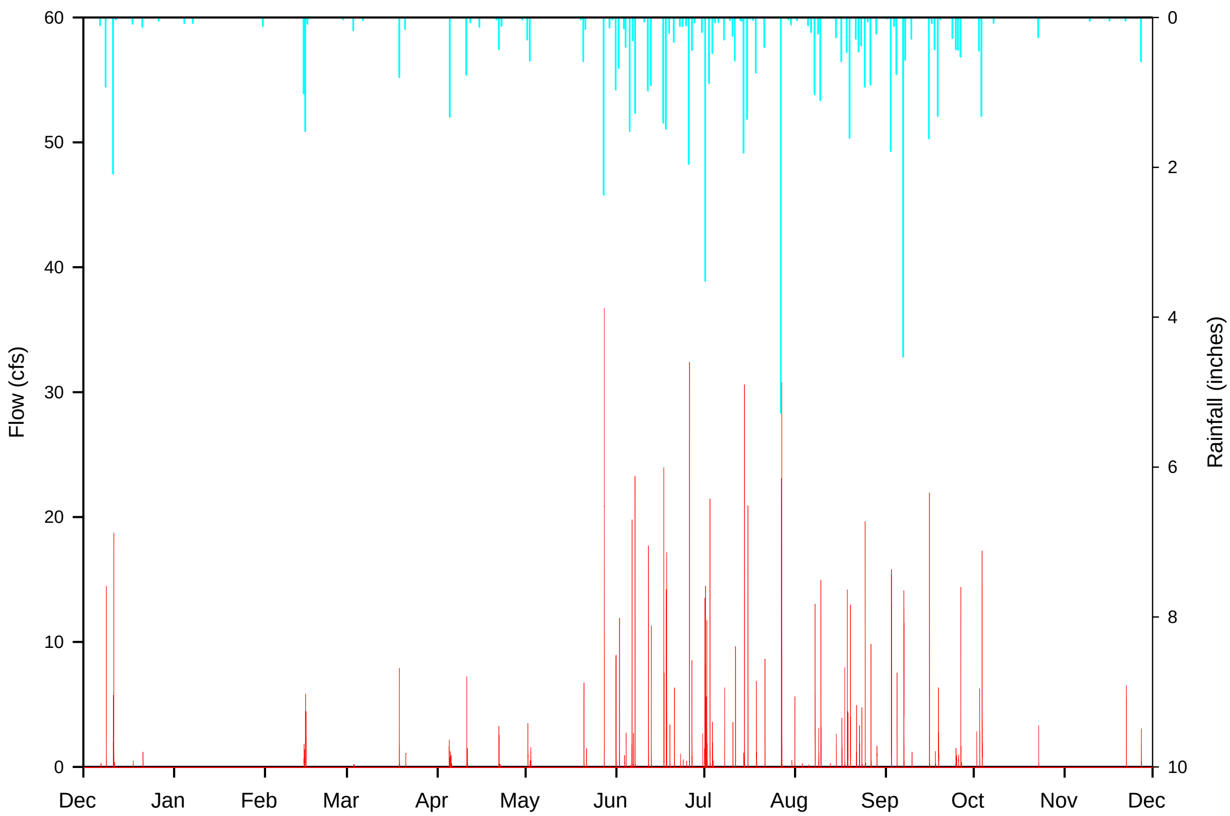


Figure 4-11. Measured Inflow Hydrographs at Bonita Springs Site 3 (54-inch RCP) from December 2012-November 2013.

4.3.1.4 Site 4

Measured inflow hydrographs at Bonita Springs Site 4 over the period from December 2012-November 2013 are illustrated on Figure 4-12. Inflows at Site 4 occur through a 24-inch RCP which provides drainage for an undeveloped out-parcel on the southern end of the shopping center site. As seen on Figure 4-12, runoff hydrographs generated at Site 4 were extremely low in value, with virtually all monitored inflows less than 1-2 cfs, even during significant rain events. The hydrographs summarized on Figure 4-12 suggest this undeveloped inflow had little significant impact on total runoff volumes within the treatment area. Rainfall depths for monitored rain events at the Bonita Springs sites are also illustrated on Figure 4-12 for comparison purposes.

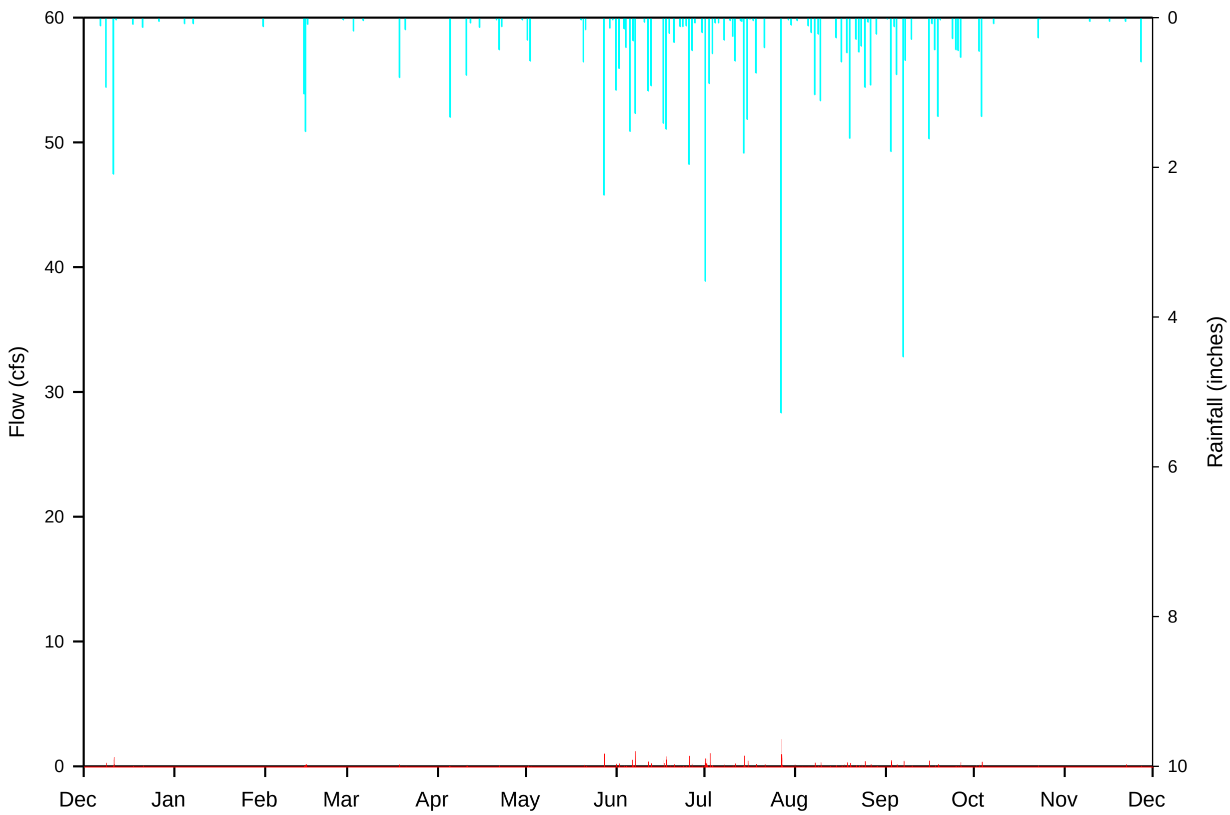


Figure 4-12. Measured Inflow Hydrographs at Bonita Springs Site 4 (24-inch RCP) from December 2012-November 2013.

4.3.1.5 <u>Site 5</u>

Measured inflow hydrographs at Bonita Springs Site 5 over the period from December 2012-November 2013 are illustrated on Figure 4-13. This site reflects discharges from the treatment system through the outfall structure and 15-inch RCP. In general, significant discharges from the outfall structure appear to occur primarily during rain events of approximately 0.5 inches or more, with smaller rain events generating discharges substantially less than 1 cfs. Virtually all monitored discharges from the Bonita Springs system were less than approximately 10 cfs, with two peak discharge rates of approximately 20 cfs and three rain events generating peak discharge rates of approximately 30-35 cfs. Rainfall depths for monitored rain events at the Bonita Springs sites are also illustrated on Figure 4-13 for comparison purposes.

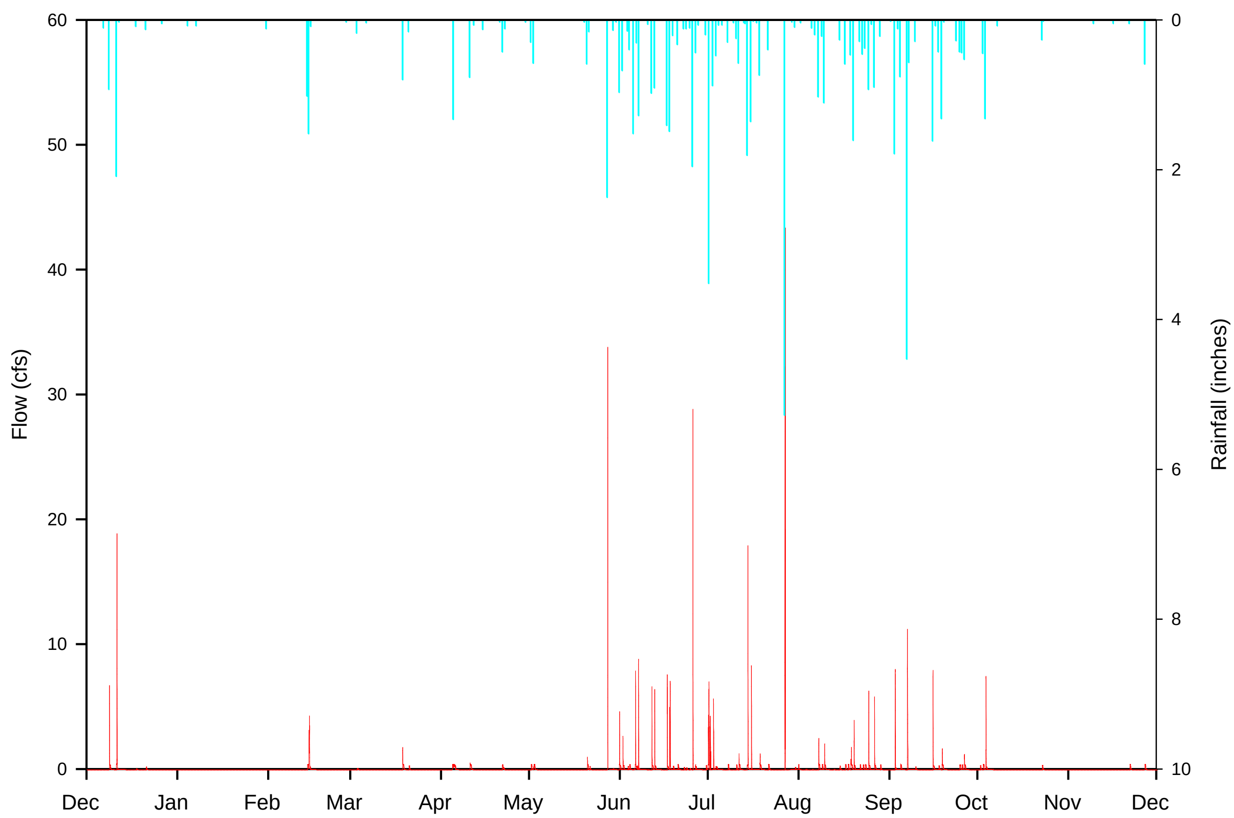


Figure 4-13. Measured Inflow Hydrographs at Bonita Springs Site 5 (Outfall Structure) from December 2012-November 2013.

4.3.2 Naples Site

4.3.2.1 Site 1

Measured inflow hydrographs at Naples Site 1 over the period from December 2012-November 2013 are illustrated on Figure 4-14. Inflows at Site 1 occur through a 42-inch SD pipe which collects drainage from approximately 40% of the overall parking area associated with the commercial site. In general, peak inflow hydrographs at Site 1 appear to correspond closely with monitored rain events which occurred at the site. The majority of ordinary daily rain events generated peak inflow hydrographs of approximately 5-6 cfs or less. However, hydrographs in excess of 20 cfs occurred at this site on multiple occasions as a result of significant rain events or multiple smaller rain events. Rainfall depths for monitored rain events at the Naples sites are also illustrated on Figure 4-14 for comparison purposes.

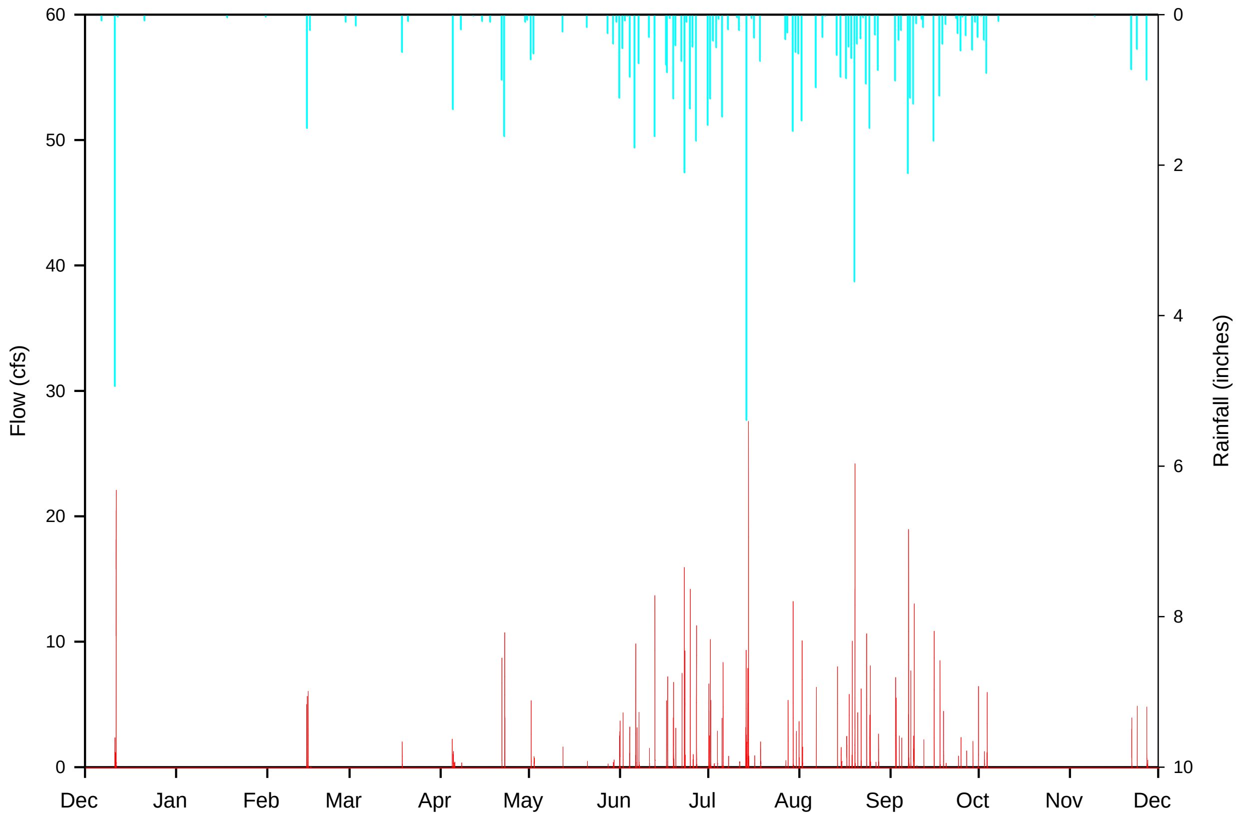


Figure 4-14. Measured Inflow Hydrographs at Naples Site 1 (42-inch SD) from December 2012-November 2013.

4.3.2.2 Site 2

Measured inflow hydrographs at Naples Site 2 over the period from December 2012-November 2013 are illustrated on Figure 4-15. Inflows monitored at Site 2 enter the pond through a 36-inch SD pipe which collects runoff from approximately 25% of the overall parking lot area. In general, runoff hydrographs at Site 2 appear to correspond relatively closely with rain events monitored at the site. Peak hydrographs at Site 2 have a shape similar to the hydrographs measured at Site 1, with the exception that the generated peak values are approximately 10-15% lower, presumably due to the smaller watershed size. Peak hydrographs generated at this site for ordinary daily events were typically 5 cfs or less, although multiple rain events resulted in hydrographs ranging from approximately 15-20 cfs. Rainfall depths for monitored rain events at the Naples sites are also illustrated on Figure 4-15 for comparison purposes.

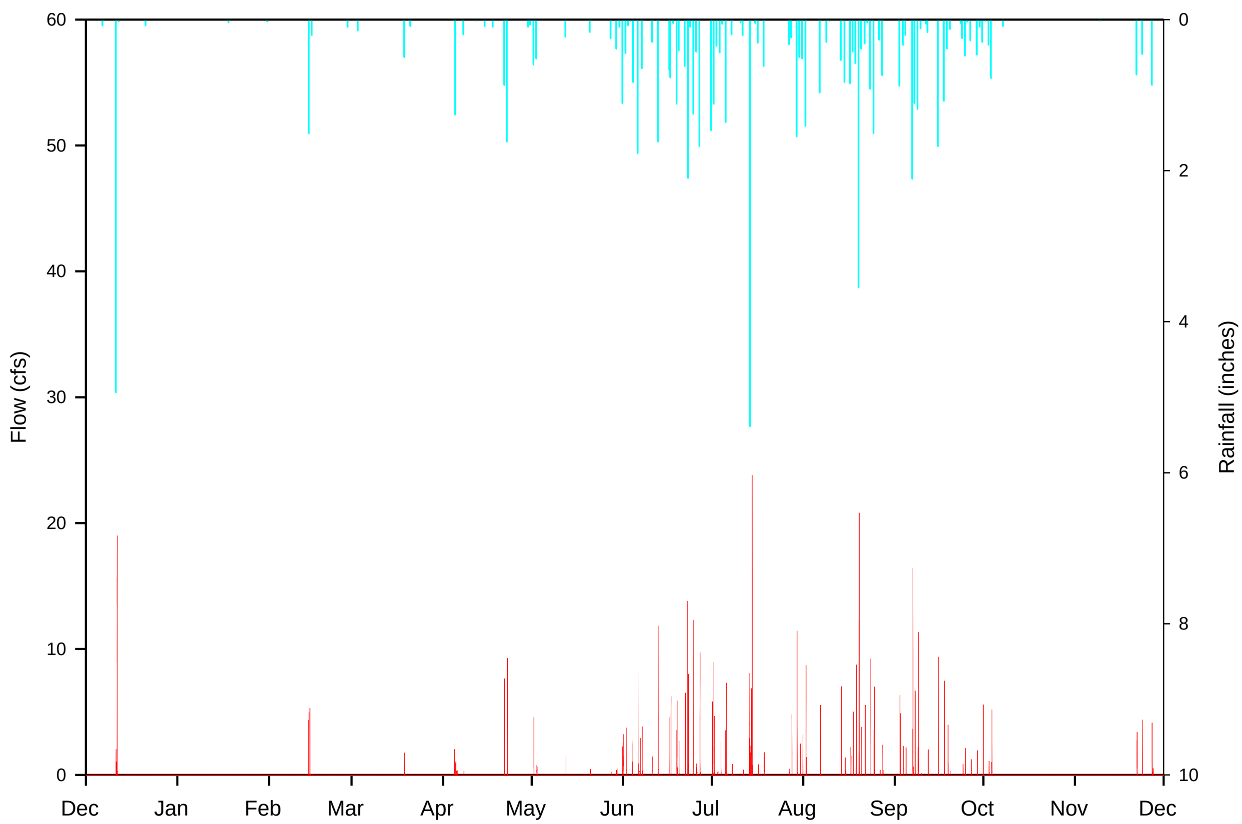


Figure 4-15. Measured Inflow Hydrographs at Naples Site 2 (36-inch SD) from December 2012-November 2013.

4.3.2.3 Site 3

Measured inflow hydrographs at Naples Site 3 over the period from December 2012-November 2013 are illustrated on Figure 4-16. Inflows at this site originated through a 48-inch SD pipe which collects runoff from parking areas, rear portions of the commercial retail store, and portions of the roof structure. In general, runoff hydrographs monitored at this site are similar in appearance to hydrographs monitored at Sites 1 and 2. The magnitude of hydrographs monitored at Site 3 are similar to hydrographs monitored at Site 1. Ordinary daily rain events monitored at this site typically generated inflow hydrographs of approximately 5 cfs or less. Rainfall depths for monitored rain events at the Naples sites are also illustrated on Figure 4-16 for comparison purposes.

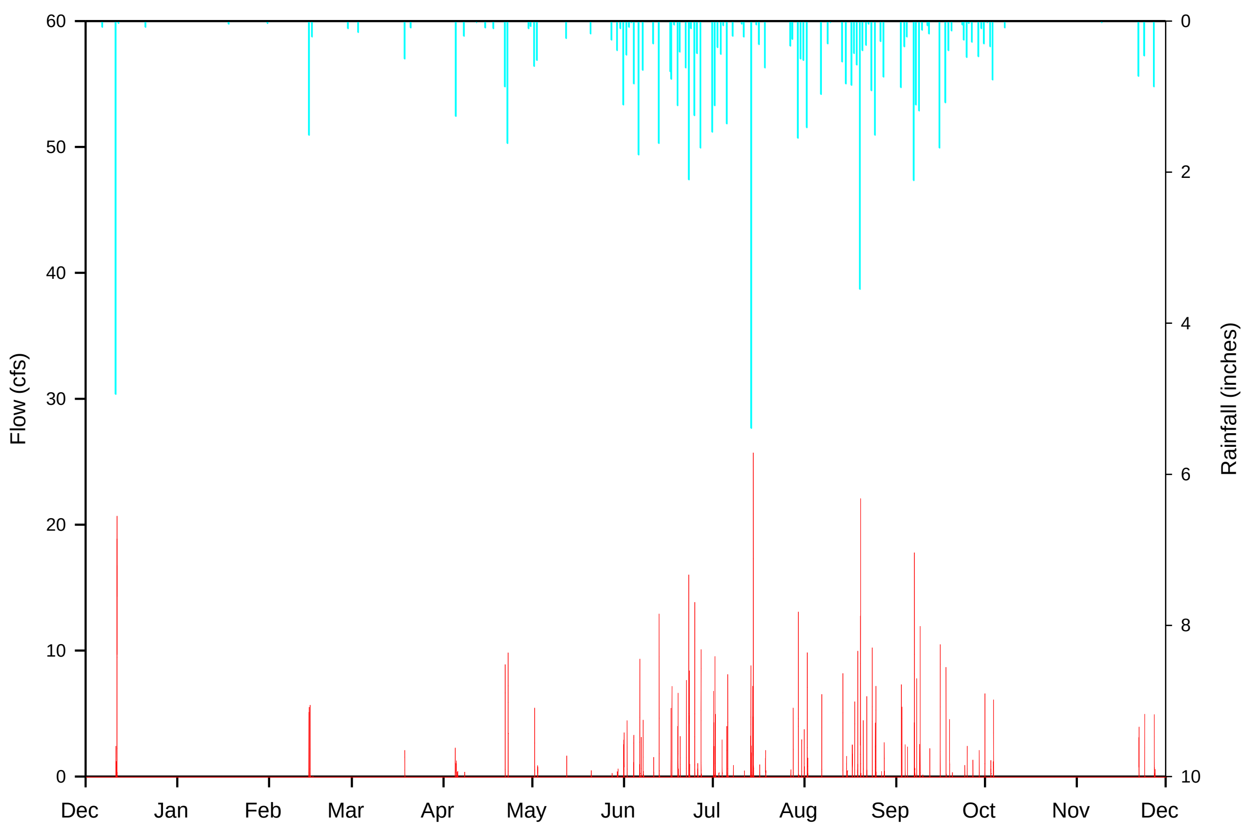


Figure 4-16. Measured Inflow Hydrographs at Naples Site 3 (48-inch SD) from December 2012-November 2013.

4.3.2.4 Site 4

Measured inflow hydrographs at Naples Site 4 over the period from December 2012-November 2013 are illustrated on Figure 4-17. Hydrographs monitored at this site reflect discharges through the outfall structure which typically consists of a slow bleed-down through the dual 5-inch orifices. Pond 2 contains two outfall structures which provide high level overflow, and when inflow volumes exceed the design treatment volume, discharge rates begin to increase rapidly. The vast majority of monitored discharges from Pond 2 were substantially less than 1 cfs, with substantially higher discharges, suggesting discharges through the overflow structures, observed on only four occasions during the 12-month field monitoring program. Rainfall depths for monitored rain events at the Naples sites are also illustrated on Figure 4-17 for comparison purposes.

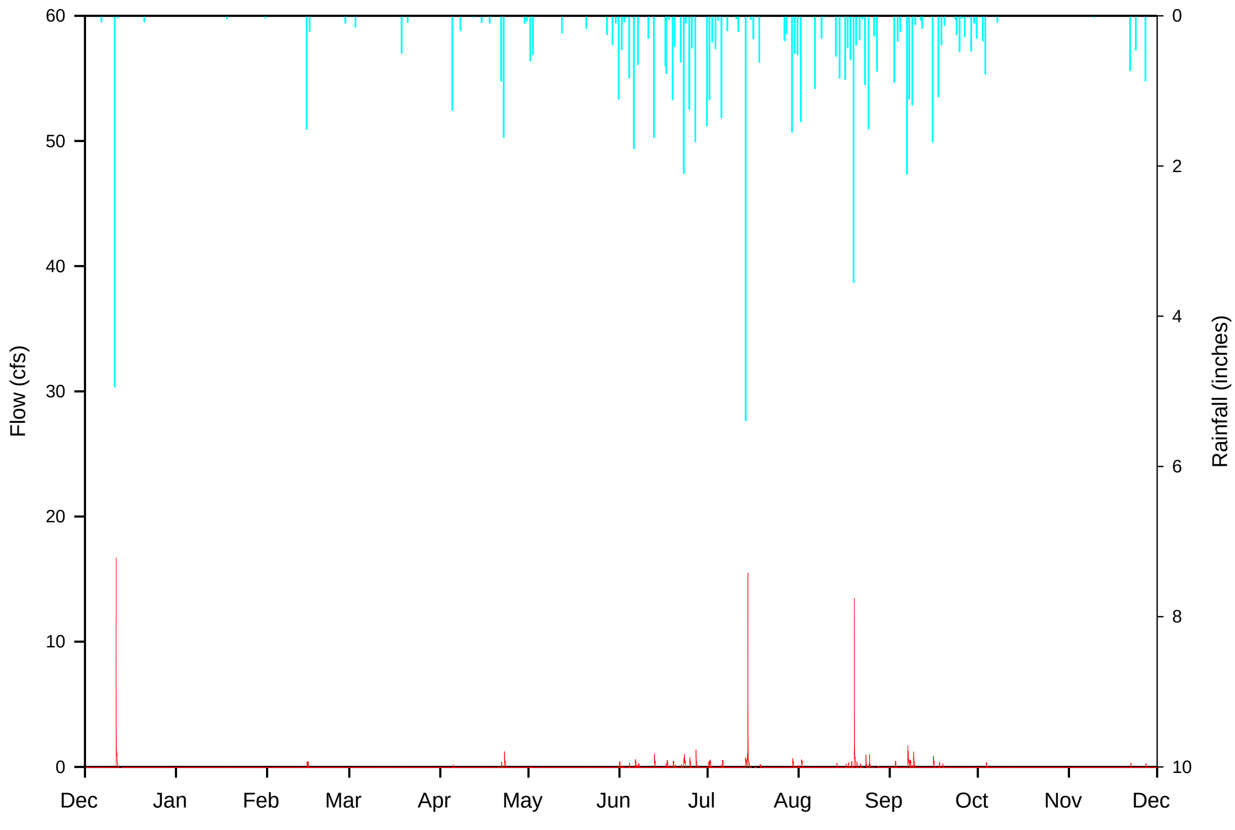


Figure 4-17. Measured Inflow Hydrographs at Naples Site 4 (Outfall Structure) from December 2012-November 2013.

4.3.3 Pembroke Pines Site

4.3.3.1 Site 1

Measured inflow hydrographs at Pembroke Pines Site 1 over the period from December 2012-November 2013 are illustrated on Figure 4-18. Inflows monitored at this site reflect the combined inputs of a 54-inch RCP and 36-inch RCP which receive runoff from approximately 90% of the total parking lot area associated with the commercial site. In general, inflow hydrographs at Site 1 appear to closely mimic rainfall events monitored at the site. Typical ordinary rain events generate inflow hydrographs of approximately 5 cfs or less. However, substantially higher inflow hydrographs were observed during large rain events, generally in excess of 1 inch, high-intensity events, or multiple successive events over a short period of time. During these events, inflow hydrographs generally exceed 20 cfs. Rainfall depths for monitored rain events at the Pembroke Pines sites are also illustrated on Figure 4-18 for comparison purposes.

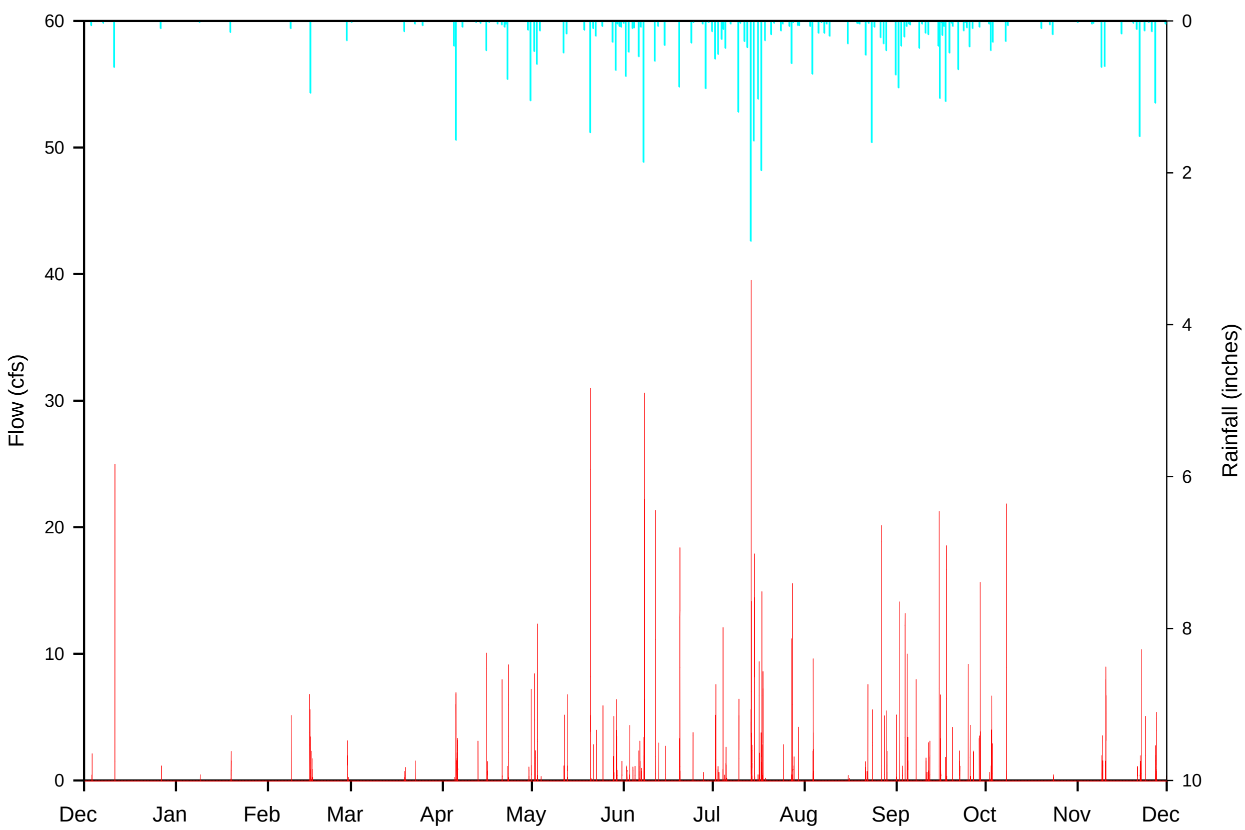


Figure 4-18. Measured Inflow Hydrographs at Pembroke Pines Site 1 (54-inch RCP and 36-inch RCP) from December 2012-November 2013.

4.3.3.2 Site 2

Measured inflow hydrographs at Pembroke Pines Site 2 over the period from December 2012-November 2013 are illustrated on Figure 4-19. Inflows monitored at this site originate through a 30-inch RCP which collects runoff from portions of the parking areas which are not collected by the inflows at Site 1. In general, inflow hydrographs at Site 2 are low in value, with the vast majority of monitored inflow rates less than approximately 3 cfs. Higher inflow hydrograph rates, typically ranging from approximately 5-10 cfs, were observed during large rain events, high-intensity rain events, or multiple consecutive rain events over a short period of time. Rainfall depths for monitored rain events at the Pembroke Pines sites are also illustrated on Figure 4-19 for comparison purposes.

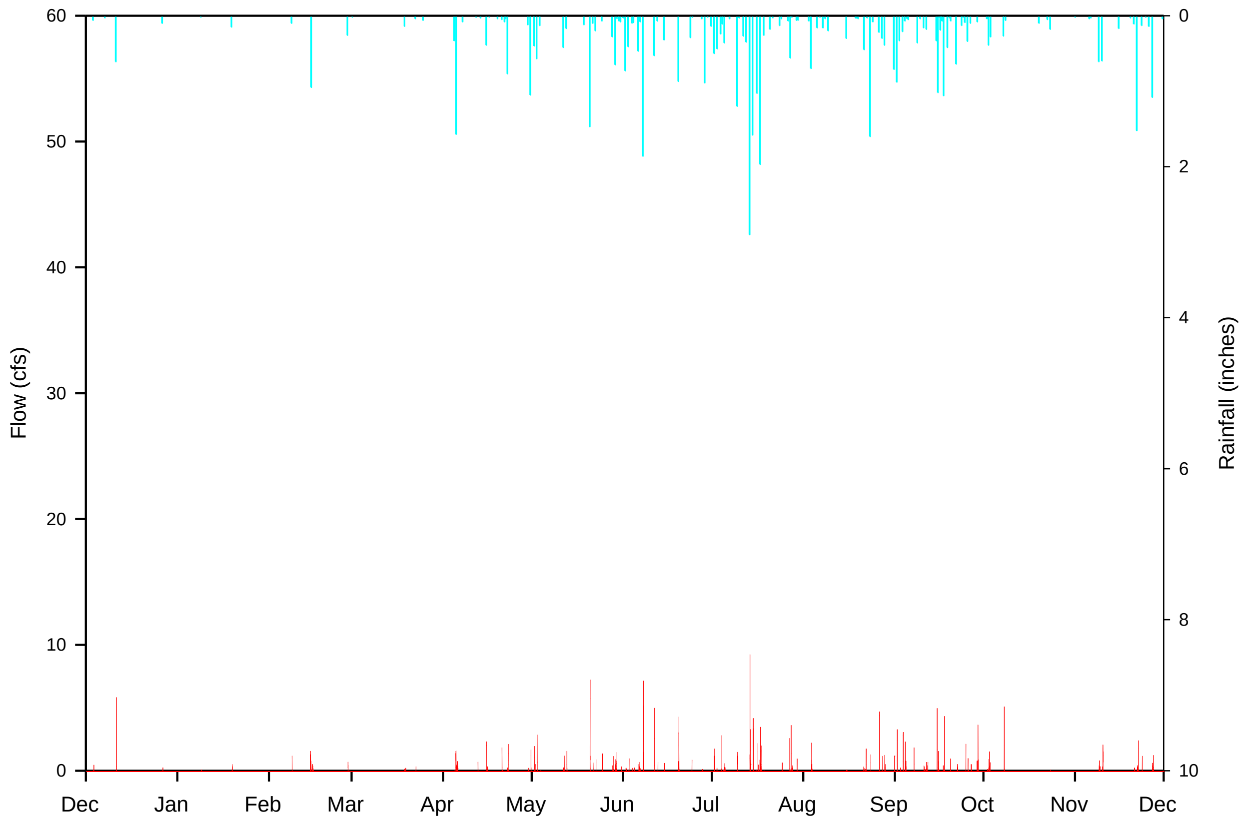


Figure 4-19. Measured Inflow Hydrographs at Pembroke Pines Site 2 (30-inch RCP) from December 2012-November 2013.

4.3.3.3 Site 3

Measured inflow hydrographs at Pembroke Pines Site 3 over the period from December 2012-November 2013 are illustrated on Figure 4-20. Hydrographs measured at this site reflect the discharges from the two identical outfall structures which discharge from the dry detention pond. In general, monitored discharges from the Pembroke Pines outfall structure were typically less than 1 cfs, reflecting bleed-down of the water quality treatment volume through the orifices in the outfall structure. However, flows substantially in excess of 1 cfs, ranging from approximately 5-40 cfs, were observed on multiple occasions as a result of large or high-intensity rain events. These more elevated discharge rates reflect discharges through the overflow structures associated with the outfall system. Rainfall depths for monitored rain events at the Pembroke Pines sites are also illustrated on Figure 4-20 for comparison purposes.

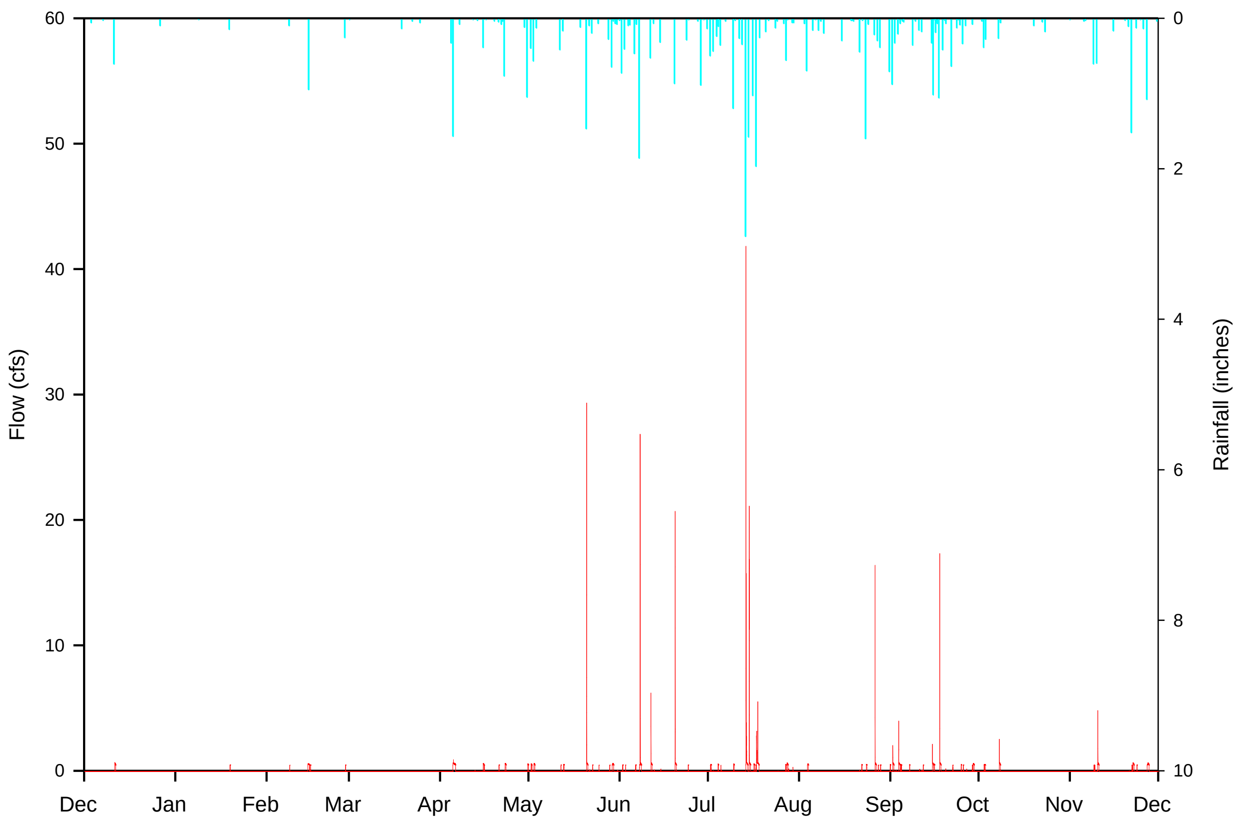


Figure 4-20. Measured Inflow Hydrographs at Pembroke Pines Site 3 (Outfall Structure) from December 2012-November 2013.

4.3.4 Orlando Underdrain Site

4.3.4.1 Site 1

Measured inflow hydrographs at Orlando underdrain Site 1 over the period from December 2012-November 2013 are illustrated on Figure 4-21. Inflows monitored at this site reflect runoff collected in a 36-inch RCP which provides drainage for approximately 50% of the associated parking areas. In general, monitored inflow rates at Site 1 were typically low in value, ranging from less than 1 cfs to approximately 9 cfs. The vast majority of measured inflows were equal to approximately 3-4 cfs or less, with higher inflow rates observed as a result of large or high-intensity rain events. Rainfall depths for monitored rain events at the Orlando underdrain sites are also illustrated on Figure 4-21 for comparison purposes.

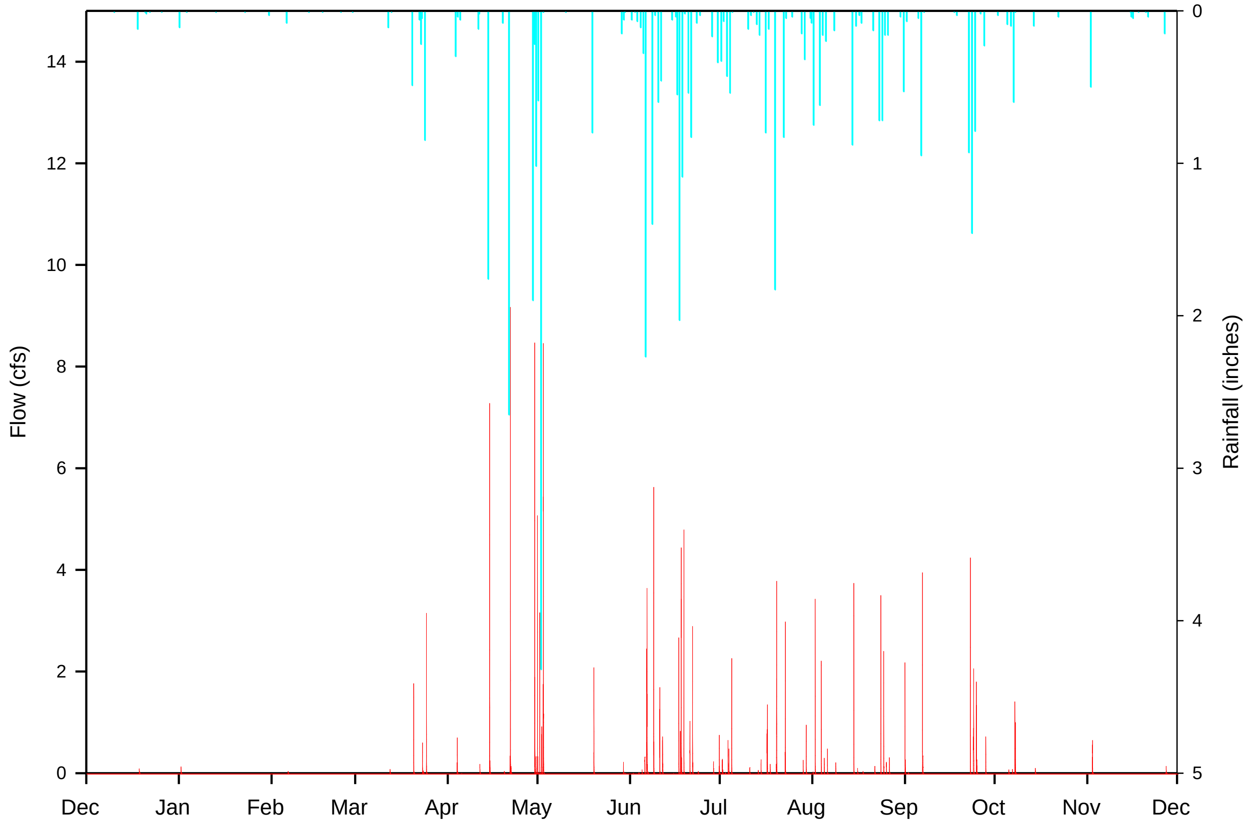


Figure 4-21. Measured Inflow Hydrographs at Orlando Underdrain Site 1 (30-inch RCP) from December 2012-November 2013.

4.3.4.2 Site 2

Measured inflow hydrographs at Orlando underdrain Site 2 over the period from December 2012-November 2013 are illustrated on Figure 4-22. Monitored hydrographs at Site 2 were typically low in value, with virtually all of the measured inflow rates less than 2 cfs. Typical ordinary daily rain events generated inflows that were substantially less than 1 cfs. Rainfall depths for monitored rain events at the Orlando underdrain sites are also illustrated on Figure 4-22 for comparison purposes.

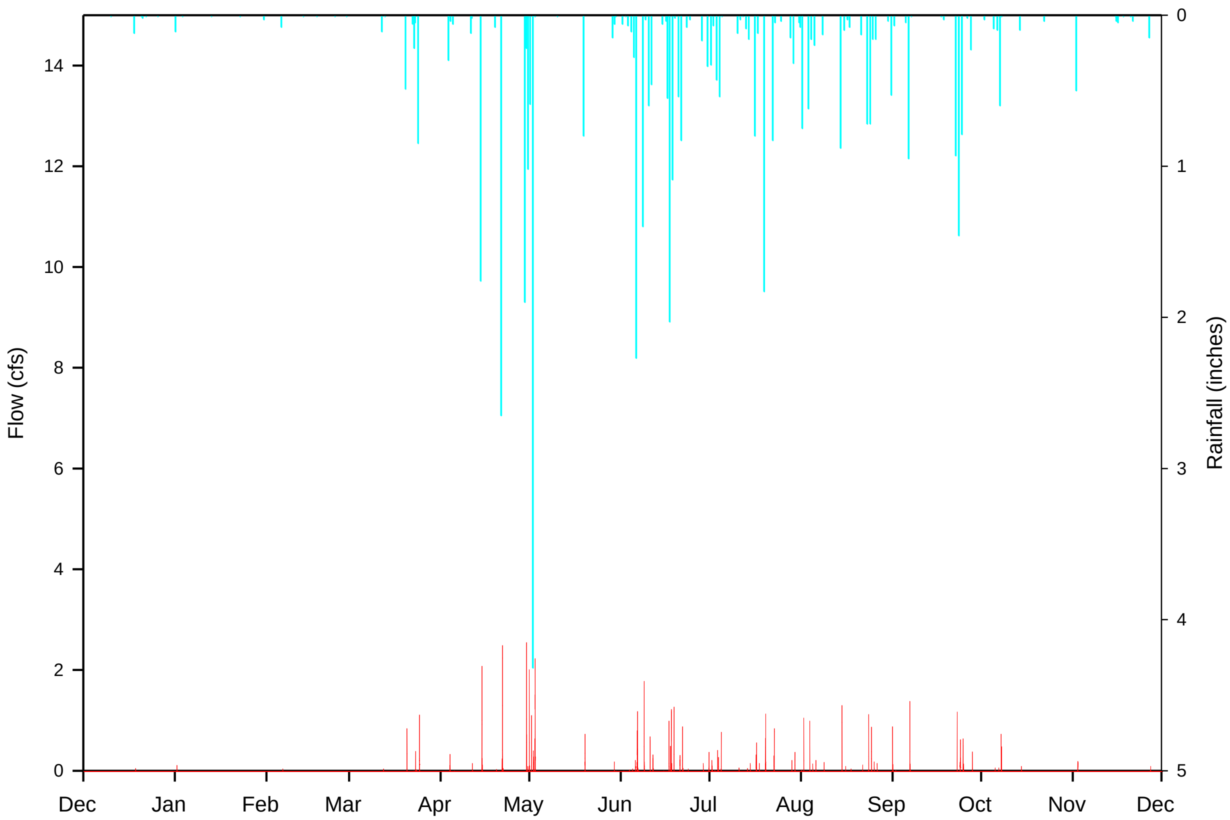


Figure 4-22. Measured Inflow Hydrographs at Orlando Underdrain Site 2 (18-inch RCP) from December 2012-November 2013.

4.3.4.3 <u>Site 3</u>

Measured inflow hydrographs at Orlando underdrain Site 3 over the period from December 2012-November 2013 are illustrated on Figure 4-23. The inflow monitored at this site consisted of a 15-inch RCP which collected runoff from a small adjacent parking area. Monitored inflows at Site 3 were also generally low in value, with the vast majority of monitored inflows less than approximately 1 cfs. Inflow rates of approximately 2 cfs or more were observed as a result of extremely large or high-intensity rain events. Rainfall depths for monitored rain events at the Orlando underdrain sites are also illustrated on Figure 4-23 for comparison purposes.

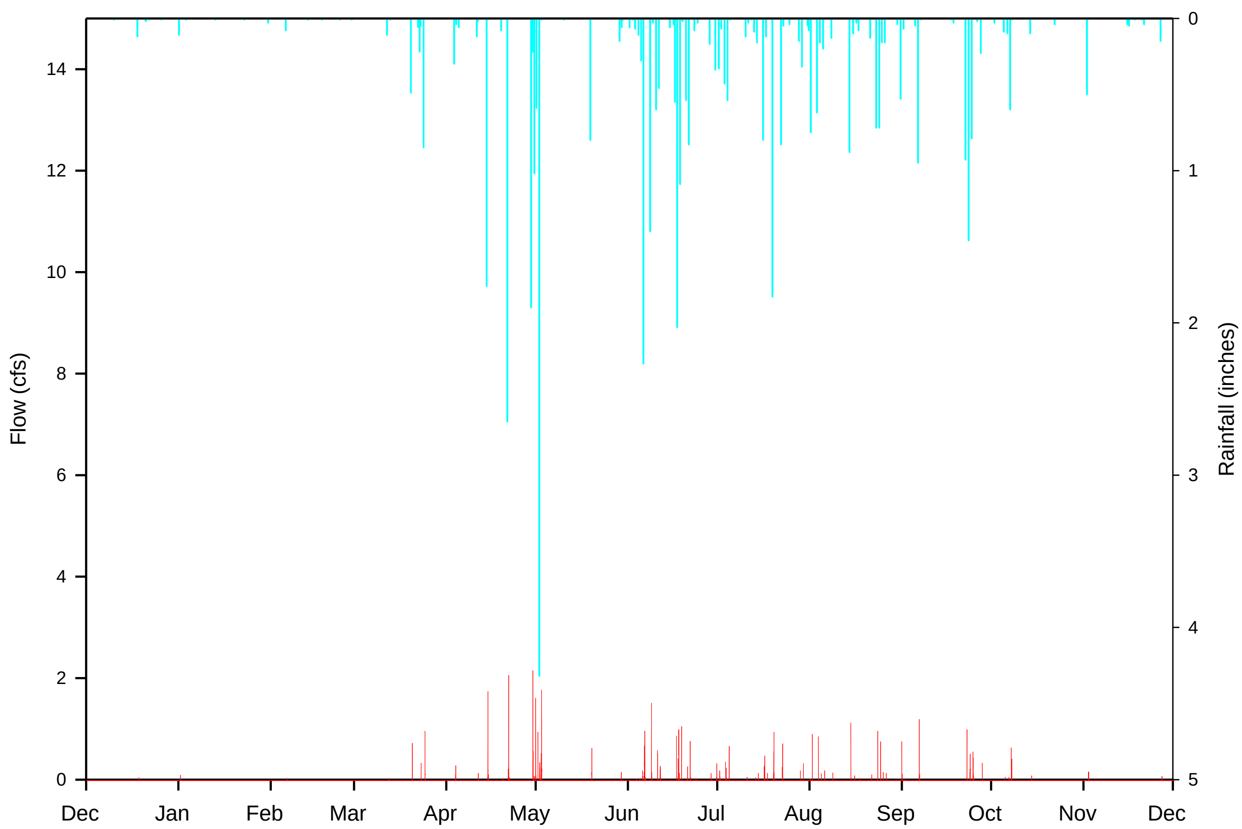


Figure 4-23. Measured Inflow Hydrographs at Orlando Underdrain Site 3 (15-inch RCP) from December 2012-November 2013.

4.3.4.4 Site 4

Measured inflow hydrographs at Orlando underdrain Site 4 over the period from December 2012-November 2013 are illustrated on Figure 4-24. Inflows monitored at this site originate from a 15-inch RCP which receives runoff from the adjacent entrance roadway. Monitored inflow rates at Site 4 were generally low in value, with the vast majority of monitored inflows equal to or less than 1 cfs. Inflow rates in excess of 2 cfs occurred on multiple occasions as a result of a significant or high-intensity rain event. Rainfall depths for monitored rain events at the Orlando underdrain sites are also illustrated on Figure 4-24 for comparison purposes.

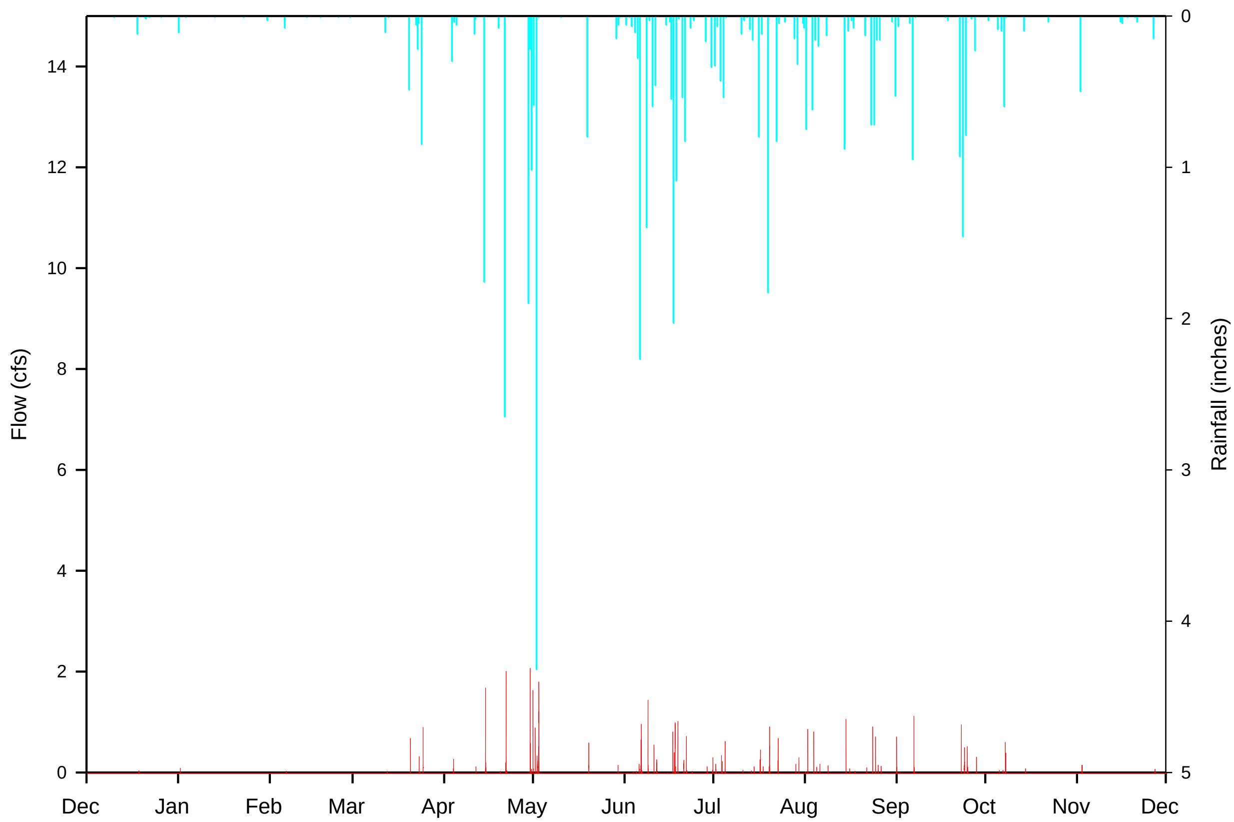


Figure 4-24. Measured Inflow Hydrographs at Orlando Underdrain Site 4 (15-inch RCP) from December 2012-November 2013.

4.3.4.5 Site 5

Measured discharge hydrographs at Orlando underdrain Site 5 over the period from December 2012-November 2013 are illustrated on Figure 4-25. This site reflects the discharges from the underdrain system as well as runoff inputs which exceed the capacity of the pond and are diverted into the underdrain outfall system. In general, the vast majority of measured hydrographs in the underdrain outflow system were approximately 1-2 cfs or less. However, flows in excess of approximately 2 cfs occurred on multiple occasions as a result of significant or high-intensity rain events. The higher discharge rates reflect the combined discharges from both the underdrain system as well as runoff which exceed the bypass level for the pond. Rainfall depths for monitored rain events at the Orlando underdrain sites are also illustrated on Figure 4-25 for comparison purposes.

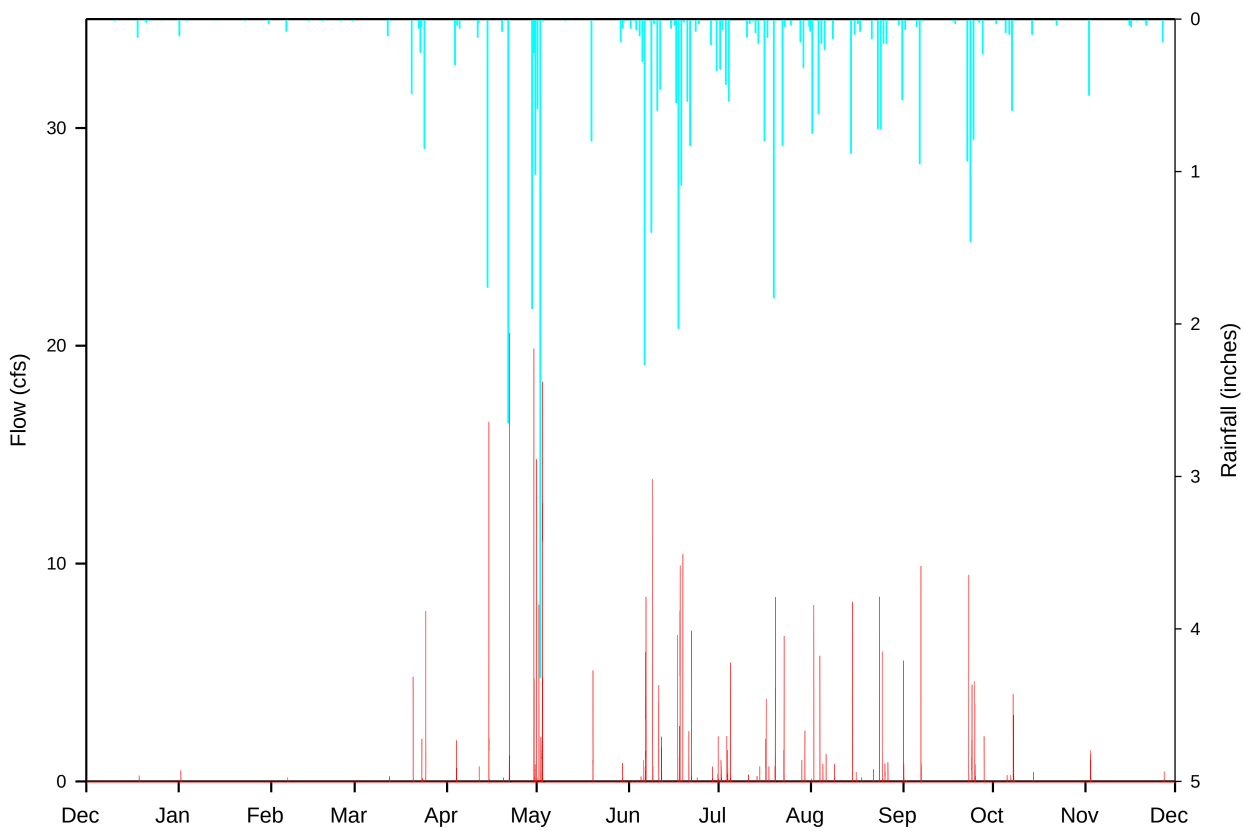


Figure 4-25. Measured Inflow Hydrographs at Orlando Underdrain Site 5 (Underdrain Outflow) from December 2012-November 2013.

4.3.5 Hydrologic Inputs/Losses

Estimates of volumetric inputs or losses were generated for each monitoring location at each of the four monitoring sites by integrating the inflow/outflow hydrographs discussed in the previous sections. These calculations were conducted on a monthly basis over the period from December 2012-November 2013 to provide an evaluation of the hydrologic performance of the treatment systems over an annual cycle. A discussion of measured inflows and outflows for each of the monitoring sites is given in the following sections.

4.3.5.1 Bonita Springs Site

A tabular summary of calculated inputs and losses at the Bonita Springs dry detention pond site from December 2012-November 2013 is given on Table 4-17. Calculated volumes are provided for each of the four inflow monitoring sites as well as losses through the outfall structure in Pond 3. In general, measured inflows and outflows appear to be closely correlated with rainfall characteristics during each month. Runoff inputs at the four monitoring sites ranged from 1.44-44.9 ac-ft, with an estimated total system discharge of 48.7 ac-ft.

TABLE 4-17

CALCULATED INPUTS AND LOSSES AT THE BONITA SPRINGS SITE FROM DECEMBER 2012 – NOVEMBER 2013

MONTH	VOLUME (ac-ft)				
	Inflow 1	Inflow 2	Inflow 3	Inflow 4	Outflow
December	0.63	1.14	2.43	0.07	3.11
January	0.00	0.03	0.00	0.00	0.00
February	0.37	0.57	1.37	0.04	1.55
March	0.18	0.16	0.66	0.01	0.60
April	0.38	0.24	1.37	0.03	1.20
May	0.97	1.24	3.68	0.11	4.14
June	2.57	4.43	9.84	0.32	11.32
July	3.09	5.42	12.00	0.54	12.36
August	1.44	1.66	5.44	0.11	5.03
September	1.51	2.77	5.90	0.16	7.11
October	0.43	0.72	1.66	0.04	1.91
November	0.14	0.02	0.55	0.01	0.36
TOTAL:	**11.71**	**18.40**	**44.90**	**1.44**	**48.69**

4.3.5.2 <u>Naples Site</u>

A tabular summary of calculated inputs and losses at the Naples dry detention pond site from December 2012-November 2013 is given on Table 4-18. Monthly inflow volumes are provided for each of the three inflow monitoring sites, as well as the estimated total discharge from the dual discharge structures located in the final pond. Volumetric inflows at the three monitoring sites ranged from 22.9-29.9 ac-ft, with an estimated system discharge of 15.75 ac-ft.

TABLE 4-18

CALCULATED INPUTS AND LOSSES AT THE NAPLES SITE FROM DECEMBER 2012 – NOVEMBER 2013

MONTH	VOLUME (ac-ft)			
	Inflow 1	Inflow 2	Inflow 3	Outflow
December	2.59	1.99	2.17	2.44
January	0.00	0.00	0.00	0.00
February	0.66	0.50	0.56	0.27
March	0.15	0.11	0.13	0.00
April	1.53	1.18	1.32	0.61
May	0.96	0.73	0.84	0.17
June	6.37	4.86	5.42	2.78
July	5.99	4.58	5.04	3.80
August	5.89	4.51	5.00	3.14
September	4.57	3.49	3.90	2.32
October	0.40	0.30	0.36	0.08
November	0.81	0.62	0.72	0.14
TOTAL:	**29.92**	**22.87**	**25.46**	**15.75**

4.3.5.3 <u>Pembroke Pines Site</u>

A tabular summary of calculated inputs and losses at the Pembroke Pines dry detention pond site from December 2012-November 2013 is given on Table 4-19. The overall estimated volumetric inflow to Pond 1 is 30.2 ac-aft, with approximately 8.4 ac-ft discharging into Pond 2. Discharges through the dual outflow system are estimated to be approximately 30.8 ac-ft during the field monitoring program.

TABLE 4-19

CALCULATED INPUTS AND LOSSES AT THE PEMBROKE PINES SITE FROM DECEMBER 2012 – NOVEMBER 2013

MONTH	VOLUME (ac-ft)		
	Inflow 1	Inflow 2	Outflow
December	0.59	0.15	0.40
January	0.13	0.05	0.11
February	1.01	0.31	0.95
March	0.01	0.03	0.00
April	2.48	0.70	2.34
May	3.41	0.98	3.56
June	4.66	1.25	5.17
July	7.92	2.07	8.71
August	2.05	0.60	2.00
September	4.53	1.31	4.34
October	1.04	0.30	0.93
November	2.32	0.66	2.30
TOTAL:	**30.15**	**8.41**	**30.81**

4.3.5.4 Orlando Underdrain Site

A tabular summary of calculated inputs and losses at the Orlando underdrain system site from December 2012-November 2013 is given on Table 4-20. Monitored inflow volumes are provided for each of the four inflow monitoring sites, as well as measured discharges through the underdrain system.

As indicated on Figure 2-19, an additional 18-inch RCP discharges into the northern end of the underdrain pond which was not monitored as part of the field monitoring program. A summary of hydrologic characteristics of the drainage basin for the unmonitored stormsewer inflow is given on Table 4-21. The watershed area for this inflow covers 0.75 acres, approximately 90% of which is impervious and DCIA. The small amount of pervious area consists primarily of a grassed median area with an assumed CN value of 39 based upon good grass cover in HSG A soils.

TABLE 4-20

CALCULATED INPUTS AND LOSSES AT THE ORLANDO UNDERDRAIN SITE FROM DECEMBER 2012 – NOVEMBER 2013

MONTH	VOLUME (ac-ft)					
	Inflow 1	Inflow 2	Inflow 3	Inflow 4	Additional Inlet	Underdrain
December	0.01	0.00	0.00	0.00	0.00	0.02
January	0.01	0.00	0.00	0.00	0.00	0.02
February	0.00	0.00	0.00	0.00	0.00	0.01
March	0.35	0.09	0.08	0.07	0.10	0.7
April	1.87	0.46	0.38	0.37	0.51	3.83
May	1.38	0.34	0.28	0.28	0.38	2.62
June	2.35	0.60	0.50	0.48	0.66	4.85
July	1.15	0.30	0.25	0.24	0.32	2.37
August	1.04	0.27	0.23	0.22	0.30	2.11
September	0.98	0.24	0.20	0.20	0.27	1.98
October	0.15	0.04	0.04	0.03	0.04	0.31
November	0.12	0.03	0.03	0.02	0.03	0.23
TOTAL:	**9.41**	**2.37**	**1.99**	**1.91**	**2.61**	**19.05**

TABLE 4-21

HYDROLOGIC CHARACTERISTICS OF THE DRAINAGE BASIN FOR THE UNMONITORED STORMSEWER INFLOW AT THE ORLANDO UNDERDRAIN SYSTEM SITE

PARAMETER	UNITS	VALUE
Area	acres	0.75
Impervious	%	90
DCIA	%	90
Pervious CN Value	--	39

Volumetric inputs from this inflow were calculated by ERD using an SCS simulation model. A continuous simulation was conducted by ERD which uses the monitored rain events at the Orlando underdrain site as the precipitation input data. This model provides an estimate of the runoff generated during each monitored storm event at the unmonitored site during the field monitoring program. The runoff volume for each rainfall event is calculated by adding the rainfall excess from the non-directly connected impervious area (non-DCIA) portion to the rainfall excess created from the DCIA portion for the basin. Rainfall excess from the non-DCIA areas is calculated using the following set of equations:

$$\text{Soil Storage, } S = \frac{1000}{nDCIA\ CN} - 10$$

$$nDCIA\ CN = \frac{[CN * (100 - IMP)] + [98\ (IMP - DCIA)]}{(100 - DCIA)}$$

$$Q_{nDCIAi} = \frac{(P_i - 0.2S)^2}{(P_i + 0.8S)}$$

where:	CN	=	curve number for pervious area
	IMP	=	percent impervious area
	DCIA	=	percent directly connected impervious area
	nDCIA CN	=	curve number for non-DCIA area
	P_i	=	rainfall event depth (inches)
	Q_{nDCIAi}	=	rainfall excess for non-DCIA for rainfall event (inches)

For the DCIA portion, rainfall excess is calculated using the following equation:

$$Q_{DCIAi} = (P_i - 0.1)$$

When P_i is less than 0.1, Q_{DCIAi} is equal to zero. This methodology is used to estimate the generated runoff volume within the unmonitored sub-basin area for each of the rainfall events listed in Table 4-10. The sum of runoff generated by each of the modeled events is equivalent to the estimated annual runoff volume. This methodology was developed by ERD for FDEP for use in the Statewide Stormwater Rule.

A summary of the results of the simulation model for the supplemental basin is included in Table 4-20 under the heading of "additional inlet". This information is used in developing an overall hydrologic budget for the underdrain pond site which is presented in a subsequent section.

4.4 Hydrologic Budgets

Hydrologic budgets were developed for each of the four study sites using the hydrologic inputs from rainfall (summarized in Section 4.1.5) and hydrologic inputs and losses from stormsewer inflows and outflows (summarized in Section 4.3.5). Differences between measured inputs and outputs at each site are assumed to either infiltrate into the pond bottom or evaporate from standing water within the pond.

4.4.1 Bonita Springs Site

A hydrologic budget for the Bonita Springs dry detention pond site from December 2012-November 2013 is given on Table 4-22. The hydrologic budget is calculated for the overall treatment system which includes Ponds 1, 2, and 3.

TABLE 4-22

HYDROLOGIC BUDGET FOR THE BONITA SPRINGS DRY DETENTION POND SITE FROM DECEMBER 2012 – NOVEMBER 2013

MONTH	VOLUME (ac-ft)			
	Rainfall	Runoff	Outflow	Losses
December	0.47	4.27	3.11	1.63
January	0.04	0.03	0.00	0.07
February	0.37	2.35	1.55	1.17
March	0.17	1.01	0.60	0.58
April	0.40	2.02	1.20	1.22
May	0.71	6.00	4.14	2.57
June	2.23	17.16	11.32	8.07
July	1.72	21.05	12.36	10.41
August	1.23	8.65	5.03	4.85
September	1.82	10.34	7.11	5.05
October	0.29	2.85	1.91	1.23
November	0.10	0.72	0.36	0.46
TOTAL:	**9.56**	**76.45**	**48.69**	**37.32**
LOSSES (%):	**--**	**--**	**57**	**43**

Overall, hydrologic inputs into the Bonita Springs dry detention system from rainfall and runoff contributed approximately 86.0 ac-ft during the 12-month monitoring program. Approximately 48.7 ac-ft discharged through the outfall structure, with the remaining volume (approximately 37.3 ac-ft) retained within the system by infiltration into groundwater or evaporation. Overall, approximately 57% of the inflows discharged through the outfall structure, with 43% of the volumetric inputs lost to groundwater or evaporation. A graphical comparison of measured inputs and losses at the Bonita Springs dry detention pond site is given on Figure 4-26.

4.4.2 Naples Site

A hydrologic budget for the Naples dry detention pond site from December 2012-November 2013 is given on Table 4-23. During the 12-month monitoring program, inputs from rainfall and runoff contributed approximately 90.6 ac-ft. Approximately 15.8 ac-ft of the inflow discharged through the outfall structure, with 74.9 ac-ft retained on-site by infiltration into groundwater or evaporation from the pond surface. Overall, approximately 17% of the hydrologic inputs discharged from the system through the outfall structure, with 83% lost to groundwater or evaporation. A graphical comparison of measured inputs and losses at the Naples dry detention pond site is given on Figure 4-27.

TABLE 4-23

HYDROLOGIC BUDGET FOR THE NAPLES DRY DETENTION POND SITE FROM DECEMBER 2012 – NOVEMBER 2013

MONTH	VOLUME (ac-ft)			
	Rainfall	Runoff	Outflow	Losses
December	0.86	6.75	2.44	5.17
January	0.01	0.00	0.00	0.01
February	0.30	1.72	0.27	1.75
March	0.13	0.39	0.00	0.52
April	0.73	4.03	0.61	4.15
May	0.57	2.53	0.17	2.93
June	2.75	16.65	2.78	16.62
July	2.24	15.61	3.80	14.05
August	2.30	15.40	3.14	14.56
September	1.92	11.96	2.32	11.56
October	0.21	1.06	0.08	1.19
November	0.35	2.15	0.14	2.36
TOTAL:	**12.38**	**78.25**	**15.75**	**74.88**
LOSSES (%):	**--**	**--**	**17**	**83**

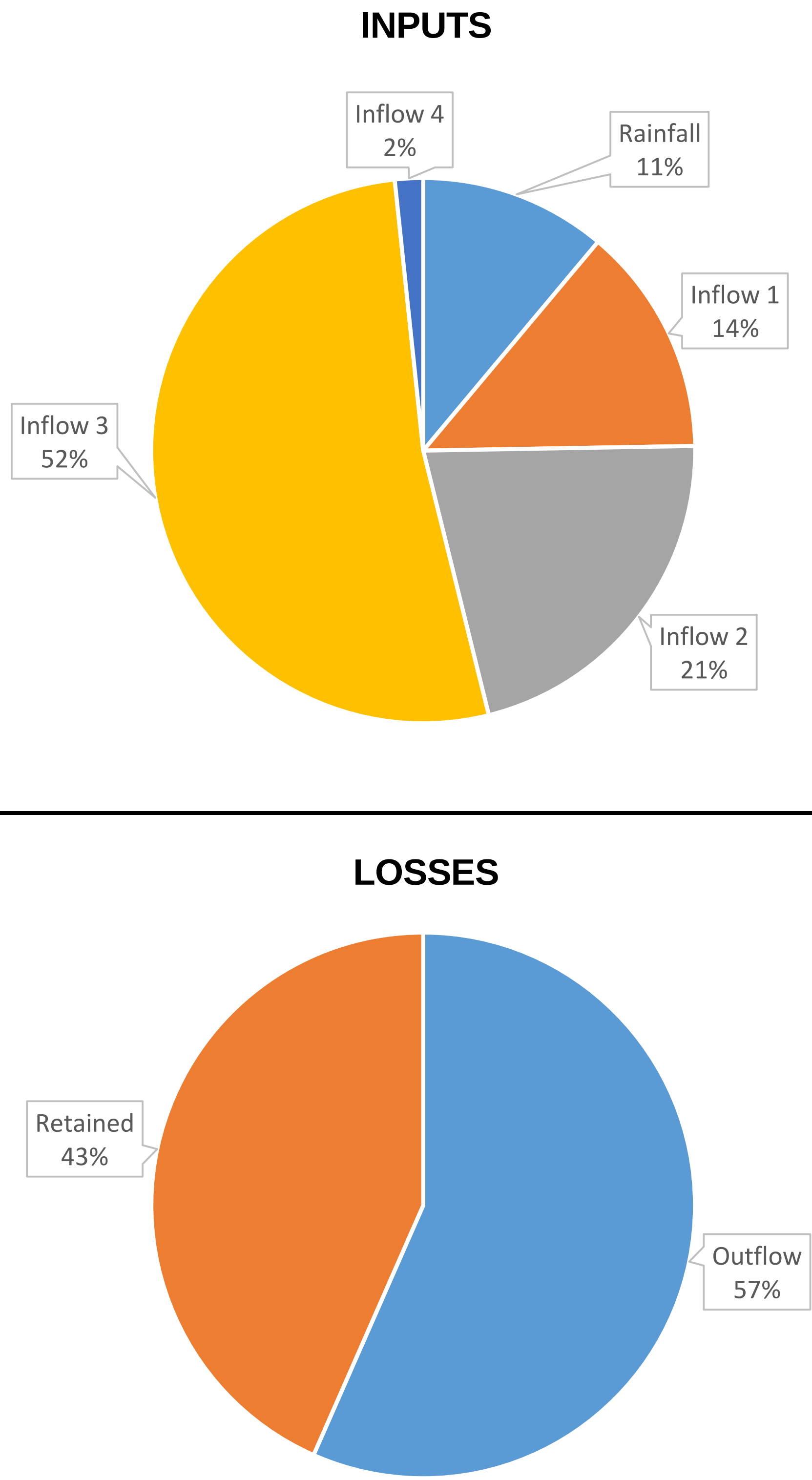
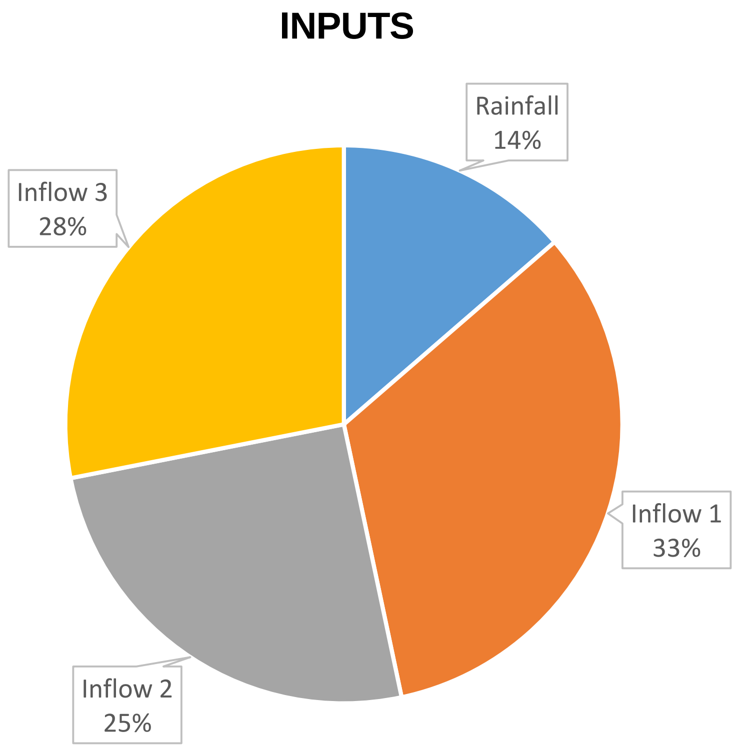


Figure 4-26. Comparison of Hydrologic Inputs and Losses at the Bonita Springs Dry Detention Site.



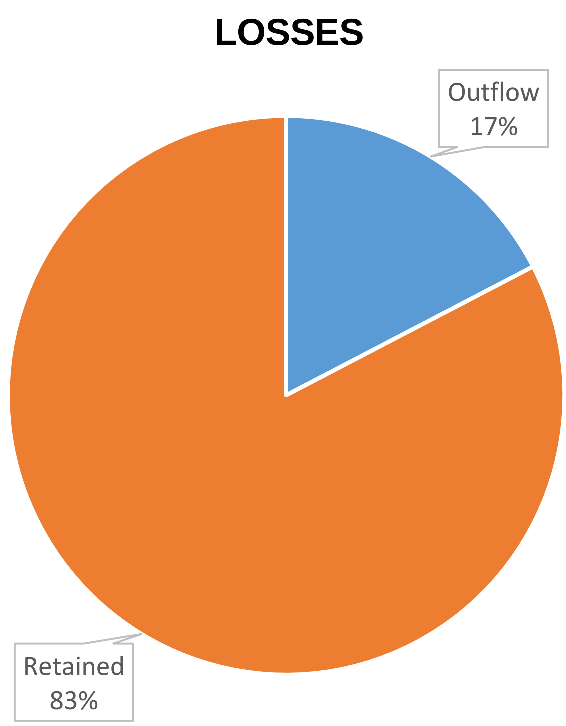


Figure 4-27. Comparison of Hydrologic Inputs and Losses at the Naples Dry Detention Site.

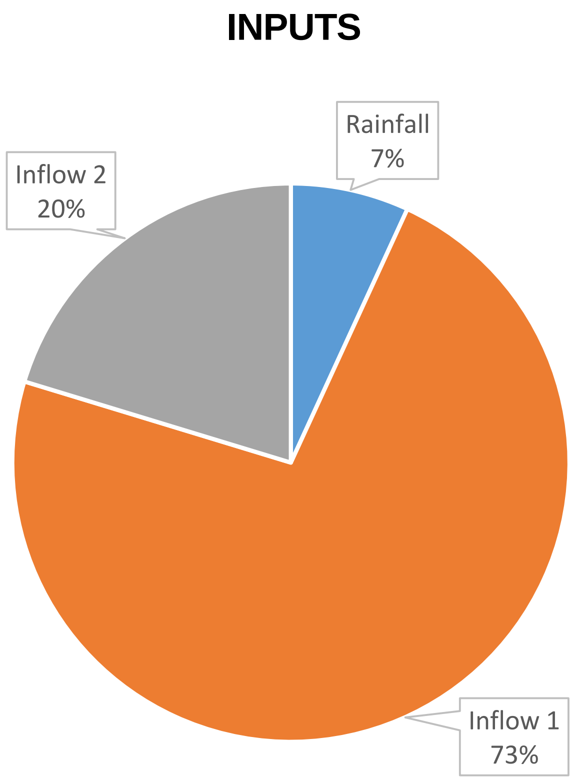
4.4.3 Pembroke Pines Site

A hydrologic budget for the Pembroke Pines dry detention pond site from December 2012-November 2013 is given on Table 4-24. During the 12-month field monitoring program, inputs from rainfall and stormwater runoff contributed 41.4 ac-ft to the dry detention system. Approximately 30.8 ac-ft discharged through the outfall structure, with the remainder (approximately 10.6 ac-ft) lost to groundwater or evaporation. Overall, approximately 74% of the inflows discharged through the outfall structure, with 26% lost. The relatively low fraction of water retained at the Pembroke Pines site is consistent with the presence of the dense limerock located beneath the site. A graphical comparison of measured inputs and losses at the Pembroke Pines dry detention pond site is given on Figure 4-28.

TABLE 4-24

HYDROLOGIC BUDGET FOR THE PEMBROKE PINES DRY DETENTION POND SITE FROM DECEMBER 2012 – NOVEMBER 2013

MONTH	VOLUME (ac-ft)			
	Rainfall	Runoff	Outflow	Losses
December	0.05	0.74	0.40	0.39
January	0.01	0.18	0.11	0.08
February	0.08	1.32	0.95	0.45
March	0.02	0.04	0.00	0.06
April	0.26	3.18	2.34	1.10
May	0.27	4.39	3.56	1.10
June	0.40	5.91	5.17	1.14
July	0.71	9.99	8.71	1.99
August	0.32	2.65	2.00	0.97
September	0.40	5.84	4.34	1.90
October	0.08	1.34	0.93	0.49
November	0.26	2.98	2.30	0.94
TOTAL:	**2.84**	**38.56**	**30.81**	**10.59**
LOSSES (%):	**--**	**--**	**74**	**26**



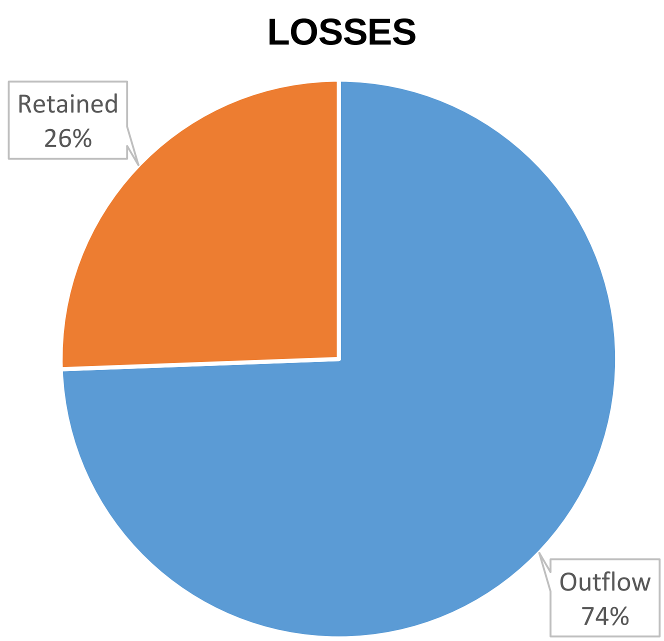


Figure 4-28. Comparison of Hydrologic Inputs and Losses at the Pembroke Pines Dry Detention Site.

4.4.4 Orlando Underdrain Site

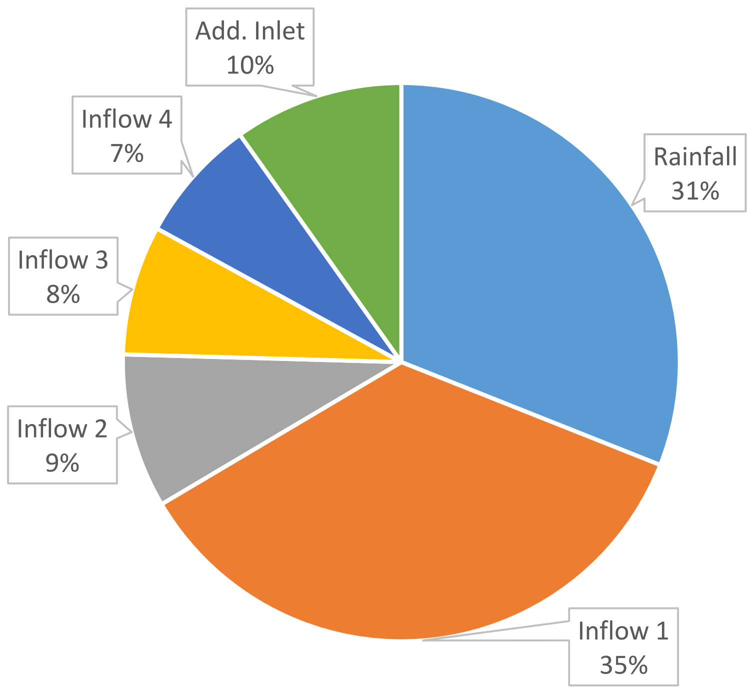
A hydrologic budget for the Orlando underdrain site from December 2012-November 2013 is given on Table 4-25. Inputs into the pond from direct rainfall contributed approximately 8.22 ac-ft of volume. Runoff inputs, including the four monitored sites plus the additional inlet, contributed approximately 18.3 ac-ft. Of this inflow volume, approximately 19.1 ac-ft discharged through the underdrain system, with 1.0 ac-ft bypassing the underdrain system through the high level overflow, and 6.46 ac-ft lost to groundwater infiltration which was not intercepted by the underdrain system and evaporation. Overall, approximately 72% of the monitored inflows discharged from the pond through the underdrain system, with 4% bypassing the system altogether through the high level overflow, and 24% lost as a result of groundwater infiltration not intercepted by the underdrain system and evaporation. A graphical comparison of measured inputs and losses at the Orlando underdrain pond site is given on Figure 4-29.

TABLE 4-25

HYDROLOGIC BUDGET FOR THE ORLANDO UNDERDRAIN SITE FROM DECEMBER 2012 – NOVEMBER 2013

MONTH	VOLUME (ac-ft)				
	Rainfall	**Runoff**	**Underdrain**	**Bypass**	**Losses**
December	0.03	0.01	0.02	0.01	0.01
January	0.03	0.01	0.02	0.00	0.02
February	0.02	0.00	0.01	0.00	0.01
March	0.33	0.69	0.70	0.01	0.31
April	1.48	3.59	3.83	0.23	1.01
May	1.08	2.66	2.62	0.31	0.81
June	2.01	4.59	4.85	0.24	1.51
July	1.10	2.26	2.37	0.06	0.93
August	0.98	2.06	2.11	0.05	0.88
September	0.83	1.89	1.98	0.09	0.65
October	0.18	0.30	0.31	0.00	0.17
November	0.15	0.23	0.23	0.00	0.15
TOTAL:	**8.22**	**18.29**	**19.05**	**1.00**	**6.46**
LOSSES (%):	**--**	**--**	**72**	**4**	**24**

INPUTS



LOSSES

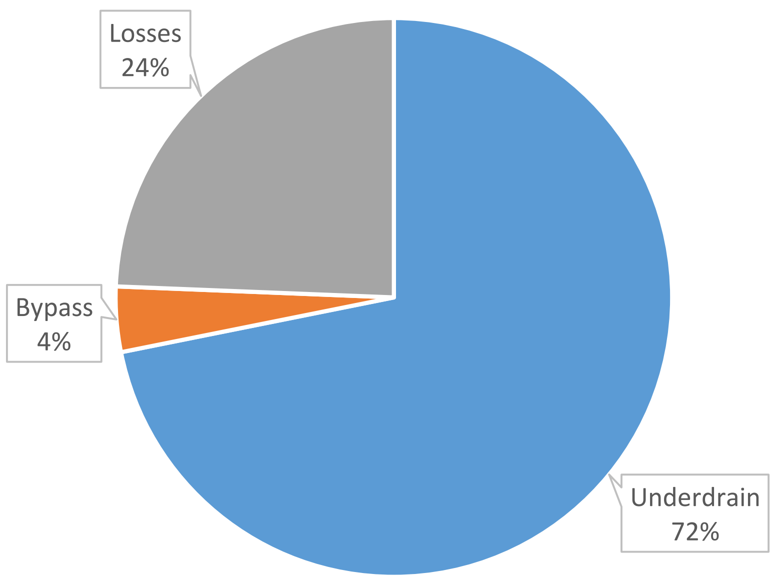


Figure 4-29. Comparison of Hydrologic Inputs and Losses at the Orlando Underdrain Pond Site.

SECTION 5

WATER QUALITY CHARACTERISTICS OF MONITORED INPUTS AND LOSSES

Field monitoring, sample collection, and laboratory analyses were conducted by ERD from December 1, 2012-November 30, 2013 to evaluate the chemical characteristics of inflows and outflows, bulk precipitation, and shallow groundwater at each of the evaluated sites and to calculate overall pollutant removal efficiencies for the evaluated dry detention and underdrain facilities.

5.1 Inflows and Outflows

During the 12-month field monitoring program, a total of 397 flow-weighted stormwater inflow and pond outflow samples was collected at the four study sites. A complete listing of the chemical characteristics of inflow and outflow samples collected at the dry detention and underdrain monitoring sites is given in Appendix B. A discussion of the chemical characteristics of inflow/outflow samples collected at the four monitoring sites is given in the following sections.

5.1.1 Bonita Springs Dry Detention Pond Site

A tabular summary of inflow/outflow samples collected at the Bonita Springs monitoring sites from December 2012-November 2013 is given in Table 5-1. A total of 30 composite runoff samples was collected at inflow Site 1, with 14 samples collected at Site 2, 26 samples collected at Site 3, 25 samples collected at Site 4, and 26 samples at inflow Site 5. Twenty-six composite samples were collected at the pond outflow. Overall, a total of 121 separate flow-weighted composite inflow/outflow samples was collected at the Bonita Springs site during the field monitoring program.

TABLE 5-1

SUMMARY OF INFLOW / OUTFLOW SAMPLES COLLECTED AT THE BONITA SPRINGS MONITORING SITE FROM DECEMBER 2012 – NOVEMBER 2013

SITE	TYPE OF SAMPLE	NUMBER OF SAMPLES COLLECTED
1	Parking Lot Runoff	30
2	Runoff, Upstream Pond Discharge, and Roof Areas	14
3	Parking Lot Runoff	26
4	Unfinished Out-Parcel Runoff	25
5	System Outflow	26
	TOTAL:	**121**

5.1.1.1 General Parameters

A statistical comparison of measured values of pH, alkalinity, conductivity, and total suspended solids (TSS) in the Bonita Springs inflows and outflows during the field monitoring program is given in Figure 5-1 in the form of Tukey Box Plots, also called "box and whisker plots". The bottom of the box portion of each plot represents the lower quartile, with 25% of the data points falling below this value. The upper line of the box represents the 75% upper quartile, with 25% of the data falling above this value. The **blue horizontal line** within the box represents the median value, with 50% of the data falling both above and below this value. The vertical lines, also known as "whiskers", represent the 10 and 90 percentiles for the data sets. Individual values which fall outside of the 10-90 percentile range are indicated as **red dots**.

In general, measured pH values at the inflows and outflows at the Bonita Springs dry detention site were approximately neutral in value, with the majority of measured values ranging from approximately 6.8-7.3. Measured pH values appear to be relatively similar between the inflow and outflow monitoring sites. Two of the measured inflow/outflow samples exhibited pH values of approximately 8.0 or greater, while three of the monitored samples exhibited pH values of approximately 6.5 or less. However, in general, the measured pH values at the Bonita Springs site are typical of pH measurements commonly observed in urban runoff and stormwater management ponds.

Measured alkalinity values were generally similar in value between the measured inflows and outflows at the Bonita Springs site. Inflow alkalinity concentrations generally ranged from approximately 40-90 mg/l, with discharges from the outfall structure typically exhibiting alkalinity values ranging from 50-70 mg/l. Measured alkalinity values in the discharge appear to exhibit a lower degree of variability than observed in the inflow samples.

Measured conductivity values in inflow/outflow samples collected at the Bonita Springs site were highly variable, particularly at inflow monitoring Site 1 which receives runoff from a majority of the parking lot area. Measured conductivity values at this site typically ranged from approximately 500-1500 μmho/cm. Conductivity values measured at inflow Sites 2, 3, and 4 and at the pond outfall exhibited a substantially lower conductivity which was generally equal to 500 μmho/cm or less. Site 1 receives stormwater inputs primarily from the parking lot area associated with the commercial facility, while inflow Site 2 monitors discharges from Pond 2 along with drainage generated in rear portions of the building. Inflow Site 3 includes runoff from a small portion of the parking lot area, with inflow Site 4 generating runoff from an incomplete out-parcel site. Conductivity values in the pond discharge appear to be similar to values measured at Sites 2, 3, and 4.

Measured concentrations of TSS at the Bonita Springs site were generally low in value, with the vast majority of measured concentrations less than 10 mg/l, although outliers as high as 140 mg/l were observed on several occasions. Measured TSS concentrations at Sites 1, 3, and 4 appear to be relatively similar in value, with lower concentrations observed at inflow Site 2 and at the pond outfall. Much of the inflow measured at Site 2 has received pre-treatment in Pond 2 before reaching the point of flow measurement and sample collection.

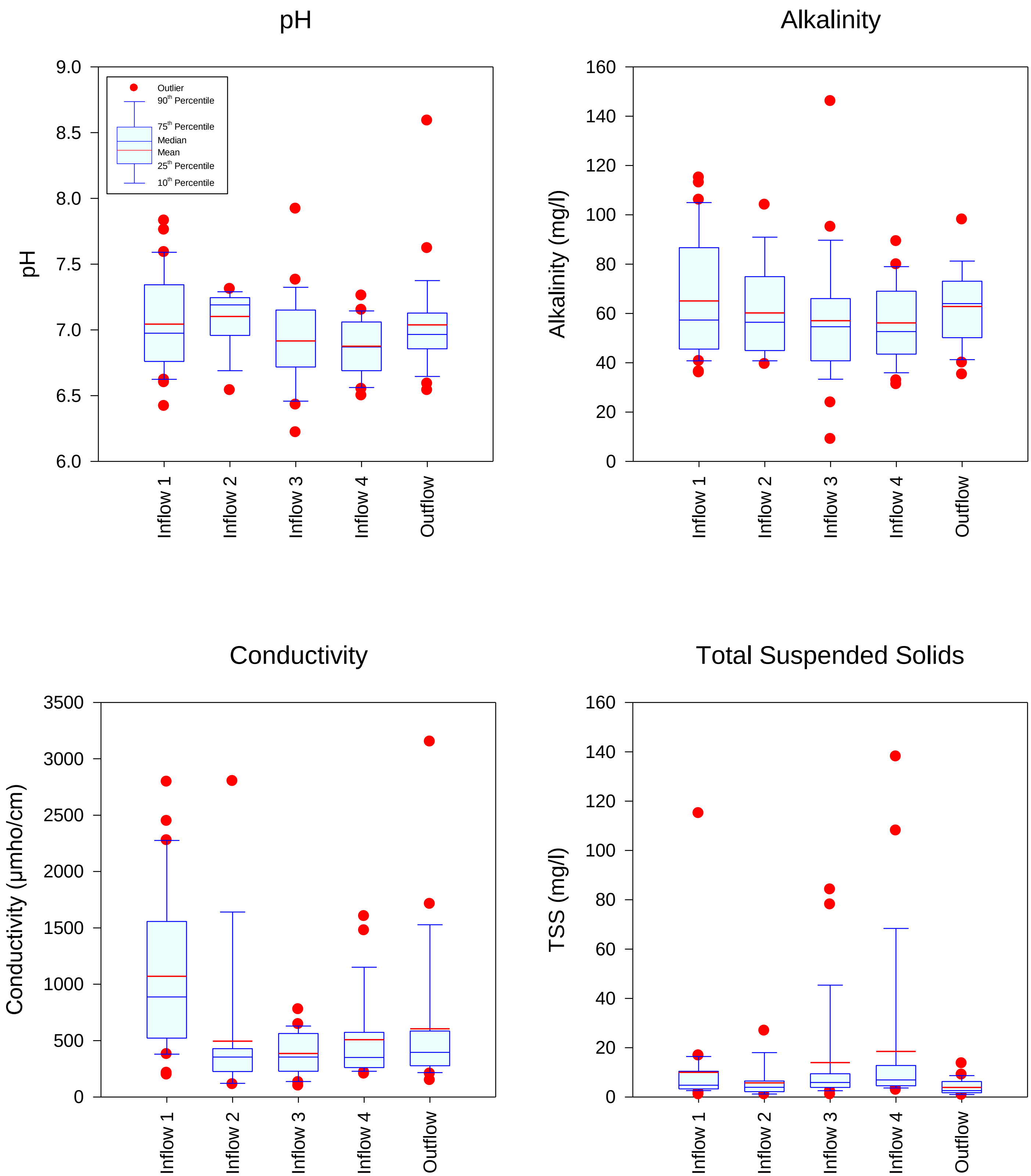


Figure 5-1. Statistical Comparison of Measured Values for pH, Alkalinity, Conductivity, and TSS at the Bonita Springs Dry Detention Site from December 2012-November 2013.

5.1.1.2 Nitrogen Species

A statistical comparison of measured concentrations of nitrogen species at the Bonita Springs dry detention site from December 2012-November 2013 is given on Figure 5-2. Measured concentrations of ammonia were generally low in value at each of the inflow and outflow sites, with a majority of concentrations less than approximately 100 μg/l, although outliers as high as 800 μg/l were observed on multiple occasions.

Relatively low concentrations of NO_x (nitrite + nitrate) were also observed at the inflow/ outflow monitoring sites, with the vast majority of measured concentrations less than approximately 200 μg/l. The pond outflow exhibited a substantially lower degree of variability in measured concentrations for NO_x than observed at the inflow sites, although the median concentration does not appear to be significantly lower.

Measured concentrations of particulate nitrogen at the Bonita Springs site exhibited a relatively high degree of variability, with measured concentrations at most sites ranging from approximately 50-300 μg/l, and outliers exceeding 800 μg/l on multiple occasions. Particulate nitrogen concentrations in the pond discharge exhibited a substantially lower degree of variability in measured values as well as a slightly lower median concentration.

A relatively high degree of variability was observed in measured total nitrogen concentrations at the Bonita Springs site, with the majority of measured values ranging from approximately 250-1400 μg/l. The highest degree of variability in total nitrogen concentrations was observed at Site 1, with substantially lower degrees of variability observed at inflow Sites 2, 3, and 4. A slightly lower median concentration for total nitrogen was observed in the pond outfall, although the degree of variability in measured values was similar to concentrations measured at Sites 2, 3, and 4.

5.1.1.3 Phosphorus Species

A statistical comparison of measured concentrations of phosphorus species at the Bonita Springs dry detention site from December 2012-November 2013 is given on Figure 5-3. Measured concentrations of SRP (soluble reactive phosphorus) were highly variable at the inflow/outflow monitoring sites. Measured SRP concentrations at inflow Sites 1, 3, and 4, as well as the outfall structure, were generally less than 50 μg/l, with outlier values substantially greater than 50 μg/l on multiple occasions. A higher range of SRP values was measured at monitoring Site 2, with the majority of measured values ranging from approximately 60-110 μg/l. Site 2 receives discharges from Pond 2 as well as roof runoff, and runoff generated in rear portions of the commercial retail store, and the more elevated SRP concentrations measured in this area may be indicative of elevated deposition of inorganic phosphorus in rear areas of the store. Measured concentrations of SRP in the pond outflow were generally low in value, with a median concentration substantially lower than observed at the inflow sites.

Measured concentrations of dissolved organic phosphorus were generally low in value at each of the inflow/outflow monitoring sites, with typical concentrations ranging from 5-40 μg/l, although more elevated outlier values were observed on multiple occasions. Inflow Sites 3 and 4 (which originate from parking areas and an out-parcel area, respectively) exhibited the highest values for dissolved organic phosphorus. Concentrations of dissolved organic phosphorus in the pond outflow appear to be similar to values observed at Site 1.

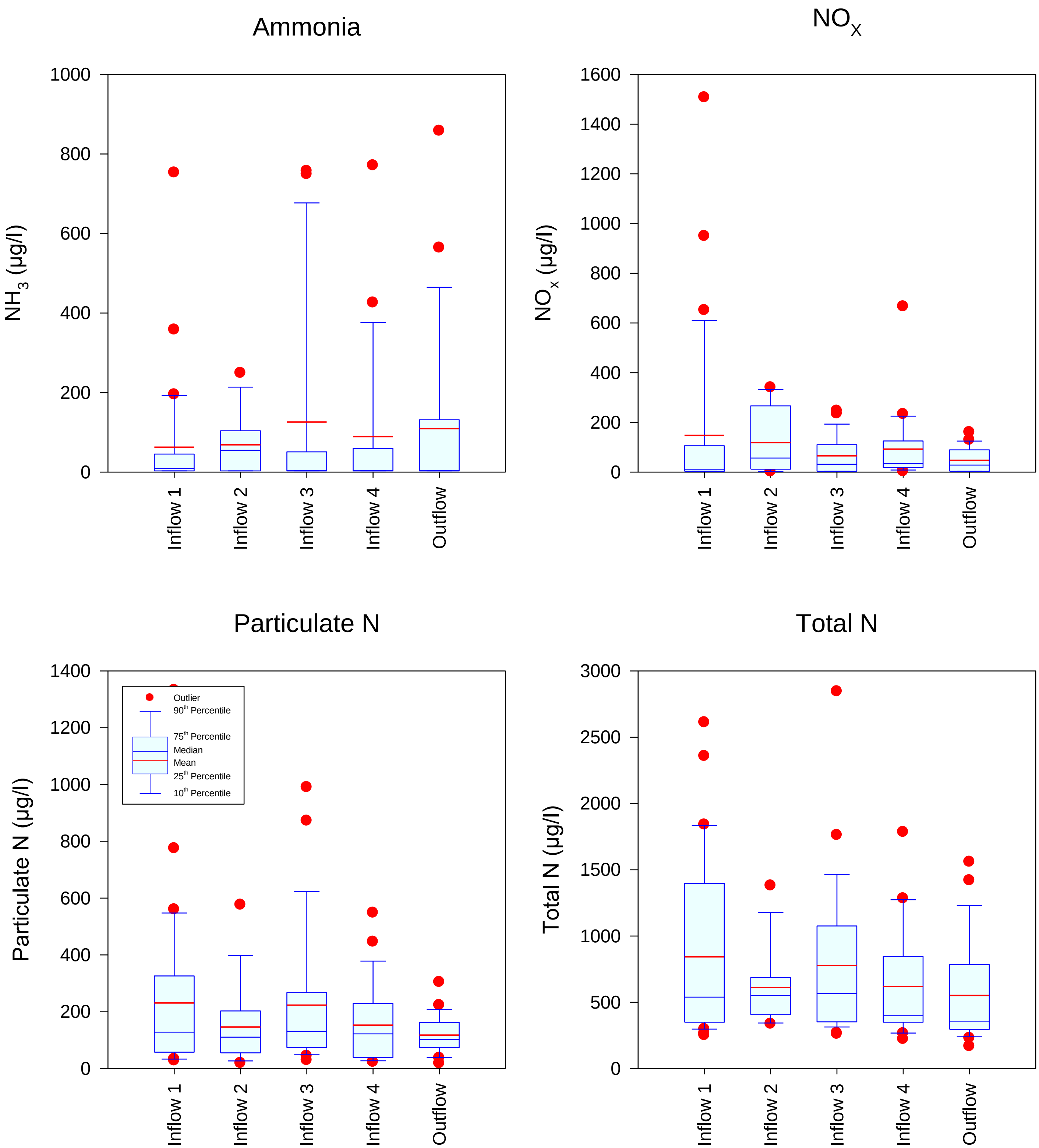


Figure 5-2. Statistical Comparison of Measured Concentrations of Nitrogen Species at the Bonita Springs Dry Detention Site from December 2012-November 2013.

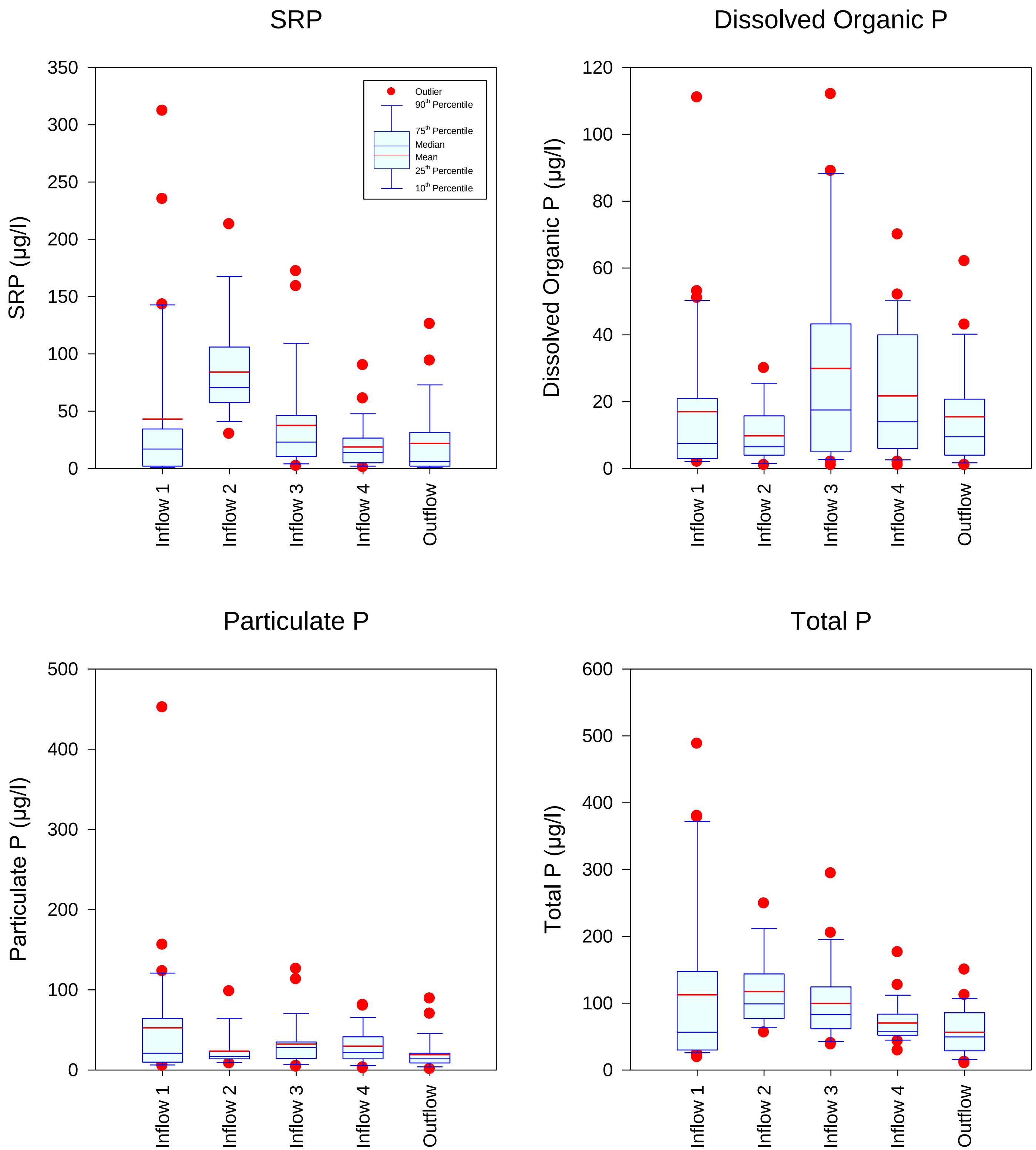


Figure 5-3. Statistical Comparison of Measured Concentrations of Phosphorus Species at the Bonita Springs Dry Detention Site from December 2012-November 2013.

Measured concentrations of particulate phosphorus were generally low in value at both the inflow and outflow locations, with the vast majority of measured values less than 50 µg/l, although outlier values in excess of 100 µg/l were observed on multiple occasions. The lowest inflow concentrations of particulate phosphorus were observed at Site 2 which receives treated stormwater runoff from Pond 2. Particulate phosphorus concentrations in the discharge exhibited a lower median value as well as a lower degree of variability than observed at the inflow sites.

In general, a moderate degree of variability was observed in measured total phosphorus concentrations at the Bonita Springs inflow and outflow monitoring sites. Measured concentrations of total phosphorus ranged from approximately 20-150 µg/l, although outlier values in excess of 200 µg/l were observed on multiple occasions. The most elevated inflow concentrations of total phosphorus were observed at Site 2 which provides further evidence that a phosphorus source may be present in the rear portions of the store which generate runoff monitored at this site. Some of the lowest total phosphorus concentrations were observed at Site 4 which reflects the incomplete out-parcel area. Overall, total phosphorus concentrations at the outfall from the treatment pond appear to be lower in value than observed in the pond inflows, suggesting that the system provides a removal of total phosphorus.

5.1.1.4 Turbidity, Color, and Hardness

A statistical comparison of measured concentrations of turbidity, color, and hardness at the Bonita Springs dry detention site from December 2012-November 2013 is given on Figure 5-4. In general, measured turbidity values were low in value, with the vast majority of turbidity measurements less than 5 NTU. Measured turbidity values at the pond outflow appear to exhibit a slightly lower median value than observed in the runoff inflows.

In general, a relatively high degree of variability was observed in measured color concentrations at the inflow and outflow monitoring sites, with the vast majority of color concentrations ranging from approximately 20-80 Pt-Co units. The most elevated color values were observed at monitoring Site 2 which primarily reflects discharges from Pond 2 into the final treatment pond, suggesting a source of organic matter decomposition in the pond. The color concentrations at the outflow exhibited a relatively low degree of variability although the median concentration appears to be similar to values measured at inflow Sites 1, 3, and 4.

Measured hardness concentrations at the inflow/outflow monitoring sites were generally low in value, with the majority of concentrations ranging from approximately 20-70 mg/l. A relatively high degree of variability was observed in hardness values measured at Sites 1 and 2, with a lower degree of variability observed at inflow Sites 3 and 4. Hardness concentrations at the pond outfall exhibited a relatively low degree of variability, with a median value similar to median concentrations observed at Sites 1, 3, and 4.

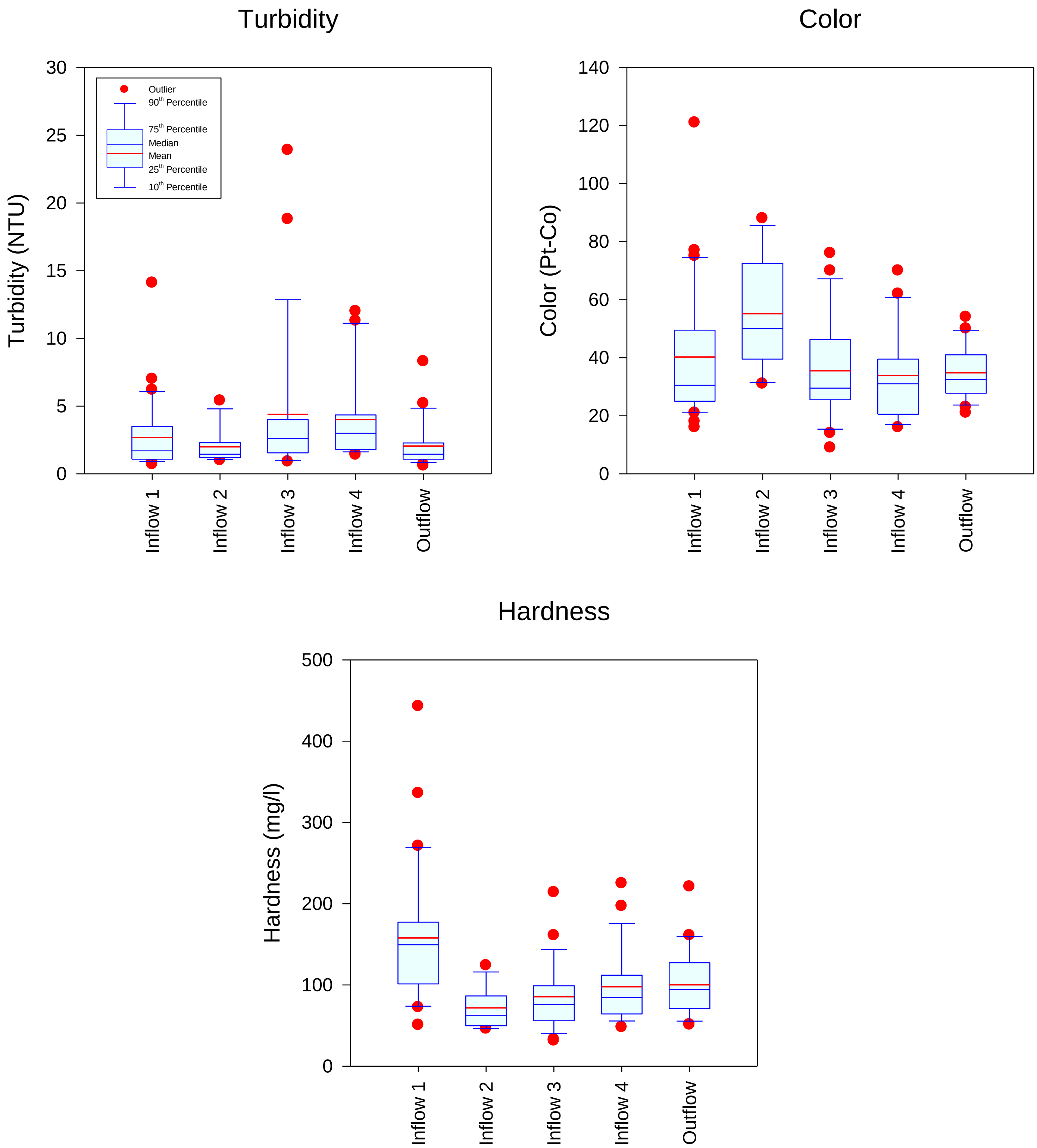


Figure 5-4. Statistical Comparison of Measured Values for Turbidity, Color, and Hardness at the Bonita Springs Dry Detention Site from December 2012-November 2013.

5.1.1.5 Chromium, Copper, and Zinc

A statistical comparison of measured concentrations of chromium, copper, and zinc at the Bonita Springs dry detention site from December 2012-November 2013 is given on Figure 5-5. Lead is not included on this figure since virtually all of the measured values were less than the laboratory detection limit. In general, chromium concentrations were low in value at each of the monitoring sites, with the vast majority of measured concentrations less than 10 μg/l. Chromium concentrations in the pond outflow appear to be similar to values measured in the untreated stormwater.

Low concentrations were also observed for copper, with the vast majority of measured values less than 5-6 μg/l. Copper concentrations in the pond outfall exhibited a slightly lower degree of variability and a slightly lower median value compared with runoff monitored at Sites 1, 2, and 3.

Measured concentrations of zinc were low in value at Sites 1, 2, 3, and in the pond outflow, with the vast majority of measured values less than 10 μg/l. However, substantially higher zinc concentrations were observed at Site 4, with typical values ranging from approximately 5-40 μg/l. Runoff monitored at this site reflects discharges from an incomplete out-parcel site, although undeveloped sites are not necessarily associated with elevated zinc values.

5.1.1.6 Site Comparison

A tabular summary of geometric mean values for measured parameters for each of the Bonita Springs inflow and outflow monitoring sites is given on Table 5-2. In general, mean pH values at each of the inflow and outflow sites were approximately neutral in value and moderately buffered, with mean alkalinity values ranging from approximately 50-60 mg/l. Relatively similar mean conductivity values were observed at inflows Sites 2, 3, and 4, as well as the outfall, with a substantially higher mean conductivity value of 853 μmho/cm measured at the Site 1 inflow.

In general, both inputs and outputs at the Bonita Springs site were characterized by low concentrations of both ammonia and NO_x. Mean concentrations of dissolved organic nitrogen were relatively similar in value between the various monitoring sites, with a slight trend of decreasing concentrations with increasing distance through the treatment system. Measured concentrations of particulate nitrogen were also relatively low in value, with the most elevated mean concentrations observed at inflow Sites 1 and 3, and the lowest concentration observed at the pond outfall. Overall, total nitrogen concentrations were approximately half of the values normally associated with low-density commercial activities. The measured mean concentration of 450 μg/l for nitrogen in the pond outflow was slightly lower than mean inflow concentrations which ranged from 522-640 μg/l.

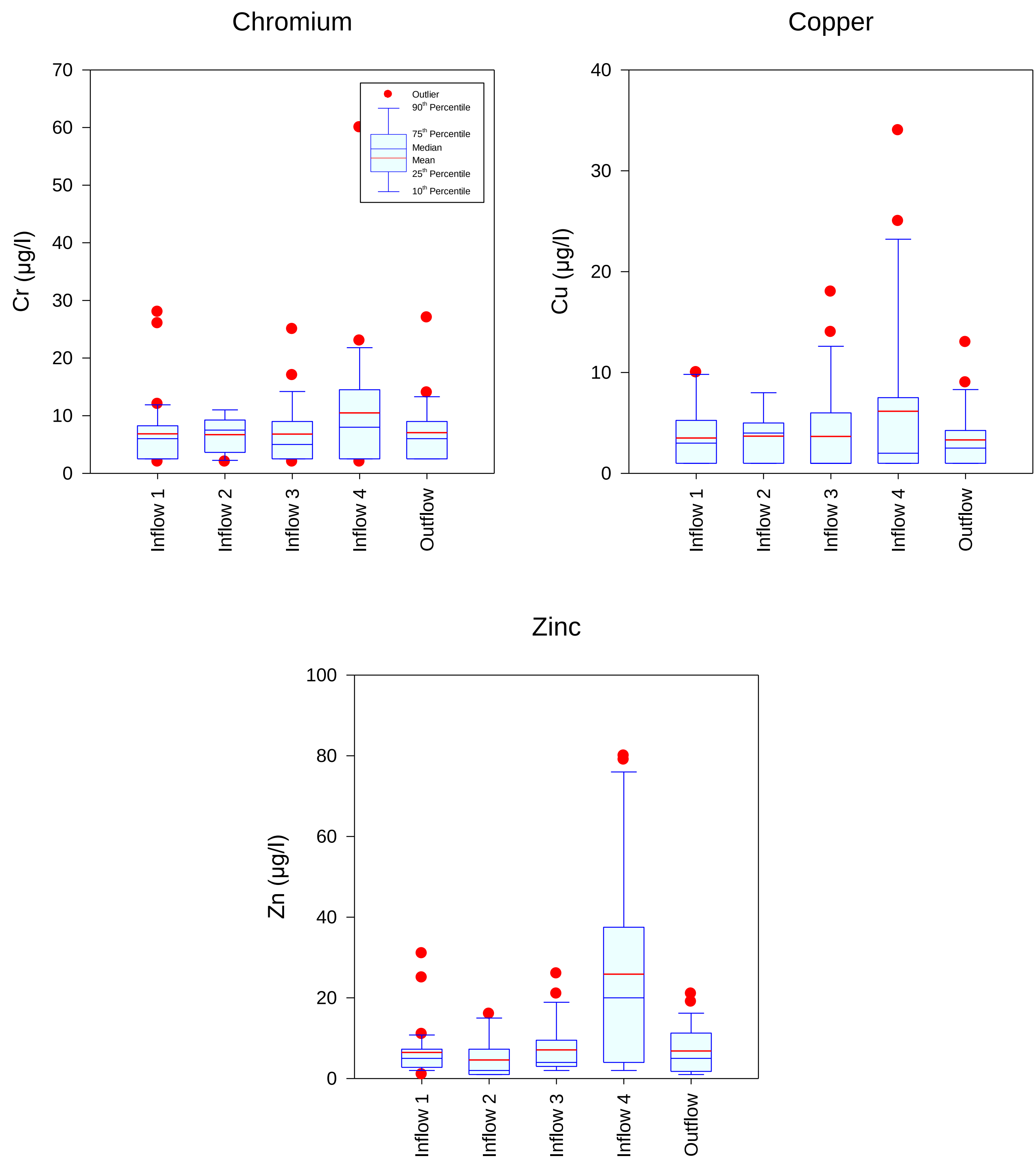


Figure 5-5. Statistical Comparison of Measured Concentrations of Chromium, Copper, and Zinc at the Bonita Springs Dry Detention Site from December 2012-November 2013.

TABLE 5-2

GEOMETRIC MEAN CONCENTRATIONS FOR INFLOW AND OUTFLOW SAMPLES AT THE BONITA SPRINGS DRY DETENTION SITE

PARAMETER	UNITS	INFLOW 1	INFLOW 2	INFLOW 3	INFLOW 4	OUTFALL
pH	s.u.	7.03	7.10	6.91	6.87	7.03
Alkalinity	mg/l	61.2	57.7	51.4	54.0	61
Conductivity	μmho/cm	853	341	339	425	451
Ammonia	μg/l	13	26	11	14	16
NO_x	μg/l	23	47	24	44	20
Dissolved Organic N	μg/l	310	255	265	239	220
Particulate N	μg/l	139	102	145	101	99
Total N	μg/l	640	565	632	522	450
SRP	μg/l	13	76	22	11	8
Dissolved Organic P	μg/l	9	7	16	13	9
Particulate P	μg/l	27	19	24	22	13
Total P	μg/l	71	109	87	65	46
Turbidity	NTU	2.0	1.7	2.8	3.1	1.6
Color	Pt-Co	36	52	31	31	34
TSS	mg/l	5.7	3.9	7.3	9.1	2.9
Chromium	μg/l	6.2	6.5	6.2	8.5	5.6
Copper	μg/l	3.3	3.6	3.2	4.1	2.3
Lead	μg/l	< 2	< 2	< 2	< 2	< 2
Zinc	μg/l	5.2	3.7	5.1	14.5	4.4
Hardness	mg/l	141	68.2	77.7	89.7	93.2

Relatively low levels of both SRP, dissolved organic phosphorus, and particulate phosphorus were observed at monitoring Sites 1, 3, 4, and at the pond outfall. As discussion previously, a somewhat more elevated concentration of SRP was monitored at Site 2 which includes contributions of runoff from rear portions of the commercial building. Overall, monitored total phosphorus concentrations at the four inflow sites are also somewhat lower in value than commonly associated with low-intensity commercial activities. These reduced concentrations may be associated with routine maintenance activities at the site which consist of periodic vacuum sweeping of the parking lot areas. The measured total phosphorus concentration of 46 μg/l in the pond outfall is substantially lower in value than mean input phosphorus concentrations, indicating a reduction in phosphorus within the treatment system.

Measured concentrations for turbidity, color, and TSS were low in value at each of the inflow and outflow monitoring sites, with lower mean values observed in the outfall than observed at the four inflows.

In general, low concentrations of chromium, copper, lead, and zinc were observed at each of the inflow and outflow monitoring sites. Measured concentrations of chromium, copper, and zinc appear to be lower in the outfall samples than observed in the inflow samples. No detectable levels of lead were observed in a majority of the inflow and outflow samples.

5.1.2 Naples Dry Detention Pond Site

A tabular summary of inflow/outflow samples collected at the Naples monitoring sites from December 2012-November 2013 is given in Table 5-3. A total of 26 composite runoff samples was collected at inflow Site 1, with 27 composite samples collected at Site 2, and 13 samples at inflow Site 3. Sixteen composite samples were collected at the pond outflow. Overall, a total of 82 separate flow-weighted composite inflow/outflow samples was collected at the Naples site during the field monitoring program.

TABLE 5-3

SUMMARY OF INFLOW / OUTFLOW SAMPLES COLLECTED AT THE NAPLES MONITORING SITE FROM DECEMBER 2012 – NOVEMBER 2013

SITE	TYPE OF SAMPLE	NUMBER OF SAMPLES COLLECTED
1	Parking Lot Runoff	26
2	Parking Lot Runoff	27
3	Parking Lot and Roof Runoff	13
4	System Outflow	16
	TOTAL:	**82**

5.1.2.1 General Parameters

A statistical comparison of measured values of pH, alkalinity, conductivity, and TSS in the Naples detention pond site from December 2012-November 2013 is given in Figure 5-6. Measured pH values at inflow Sites 1 and 2, both of which reflect inputs from the adjacent parking areas, appear to be relatively similar, with the majority of measured values ranging from approximately 6.7-7.1. A similar degree of variability and range of pH values was also observed at the pond outflow. However, substantially lower pH values were observed at the inflow monitored at Site 3. As indicated on Figure 3-7, Site 3 receives runoff from rear portions of the commercial retail store as well as portions of the roof structure which do not discharge to the bypass structure located downstream from the pond outfall. The lower pH values observed at this site are likely due to the large amount of direct rainfall which is collected at this site.

Measured alkalinity values in runoff inputs at Sites 1 and 2 were virtually identical, with the majority of measured values ranging from approximately 35-55 mg/l. A somewhat lower range of alkalinity values was measured in the inflow at Site 3, presumably due to the large amount of rainfall monitored at this site. A high degree of variability was observed in measured alkalinity values at the pond outfall, although the overall median value appears to be greater than observed at the inflow sites.

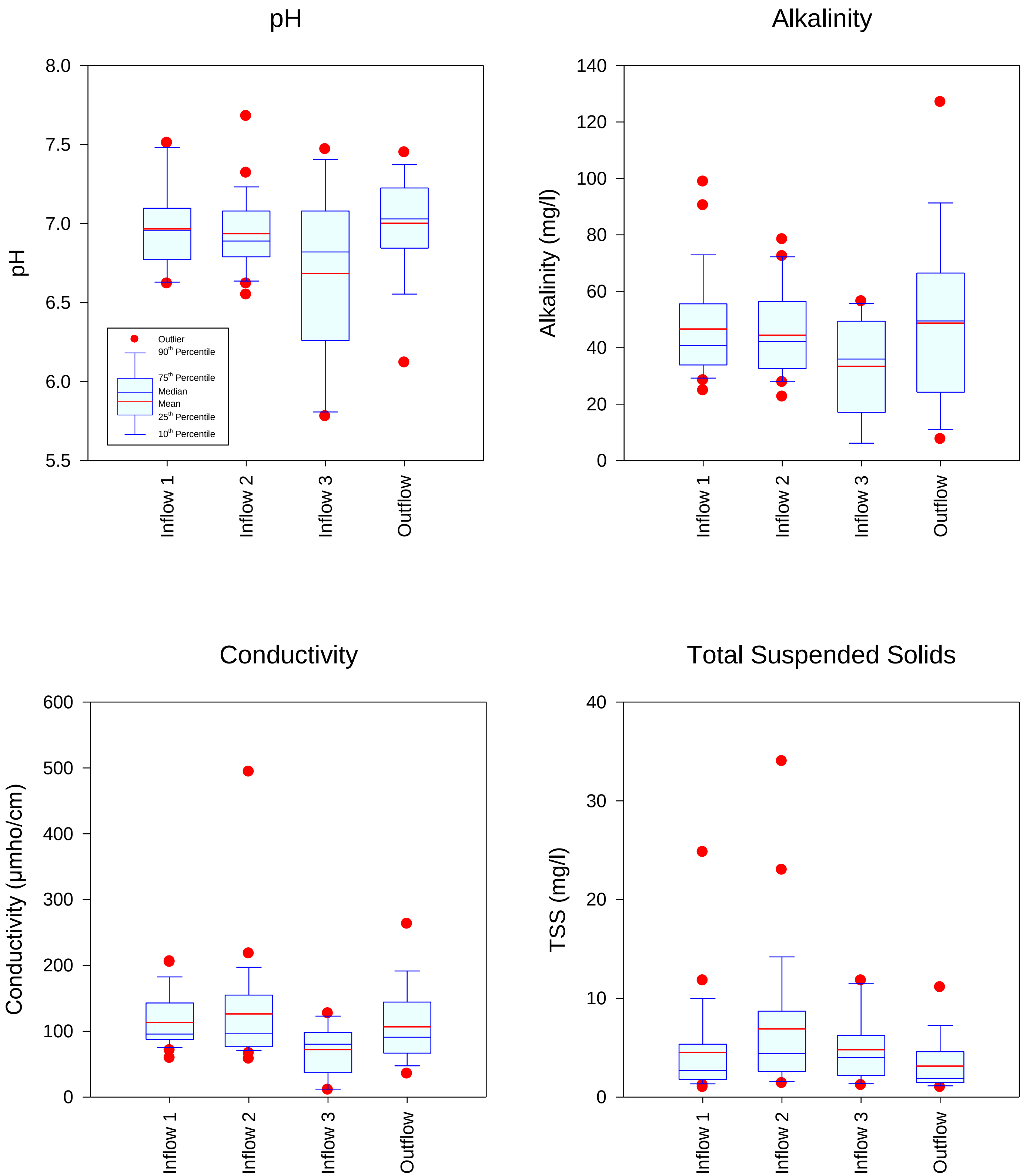


Figure 5-6. Statistical Comparison of Measured Values for pH, Alkalinity, Conductivity, and TSS at the Naples Dry Detention Site from December 2012-November 2013.

Measured conductivity values at inflow Sites 1 and 2, as well as the pond outflow, were relatively similar in value, with the vast majority of measured concentrations ranging from approximately 90-150 µmho/cm. A somewhat lower range of conductivity values was observed at Site 3, presumably due to the impact from direct rainfall.

Measured TSS concentrations at both the inflow and outflow monitoring sites were extremely low in value, with the majority of measured concentrations ranging from approximately 2-10 mg/l. TSS concentrations in the outflow appear to exhibit a lower degree of variability as well as a slightly lower median value than observed at the remaining sites.

5.1.2.2 Nitrogen Species

A statistical comparison of measured concentrations of nitrogen species at the Naples dry detention site from December 2012-November 2013 is given on Figure 5-7. Measured concentrations of ammonia were extremely low in value at each of the inflow and outflow monitoring sites, with the vast majority of measured concentrations less than approximately 25 µg/l. Relatively similar concentrations of ammonia were observed at each of the inflow monitoring sites, with a substantially lower median concentration of ammonia observed at the outflow.

Low to moderate concentrations of NO_x were observed at each of the inflow and outflow monitoring sites. Measured concentrations of NO_x at Sites 1 and 2 ranged from approximately 60-180 µg/l, although outlier values were observed both above and below this range. Somewhat lower concentrations of NO_x were observed at Site 3 which also exhibited a slightly lower degree of variability in measured values. NO_x concentrations in the outflow exhibited a relatively low degree of variability as well as a lower median value than observed at the inflow monitoring sites.

Measured concentrations of particulate nitrogen were also low to moderate in value at the inflow and outflow monitoring sites. Measured concentrations of particulate nitrogen at inflow Sites 1, 2, and 3 were similar in value, ranging from approximately 30-150 µg/l. A somewhat greater range of particulate nitrogen concentrations were observed at the pond outflow, with a median concentration greater than observed at any of the inflow sites. It appears that the pond is contributing particulate nitrogen to the runoff, perhaps from maintenance activities (such as mowing) since dried vegetation would tend to float and be measured at the outfall as particulate matter.

In general, measured concentrations of total nitrogen were low in value at each of the inflow and outflow monitoring sites. The vast majority of measured total nitrogen concentrations ranged from approximately 350-600 µg/l, reflecting concentrations somewhat lower than commonly observed in commercial runoff. Median concentrations of total nitrogen appear to be relatively similar between the inflow and outflow monitoring sites.

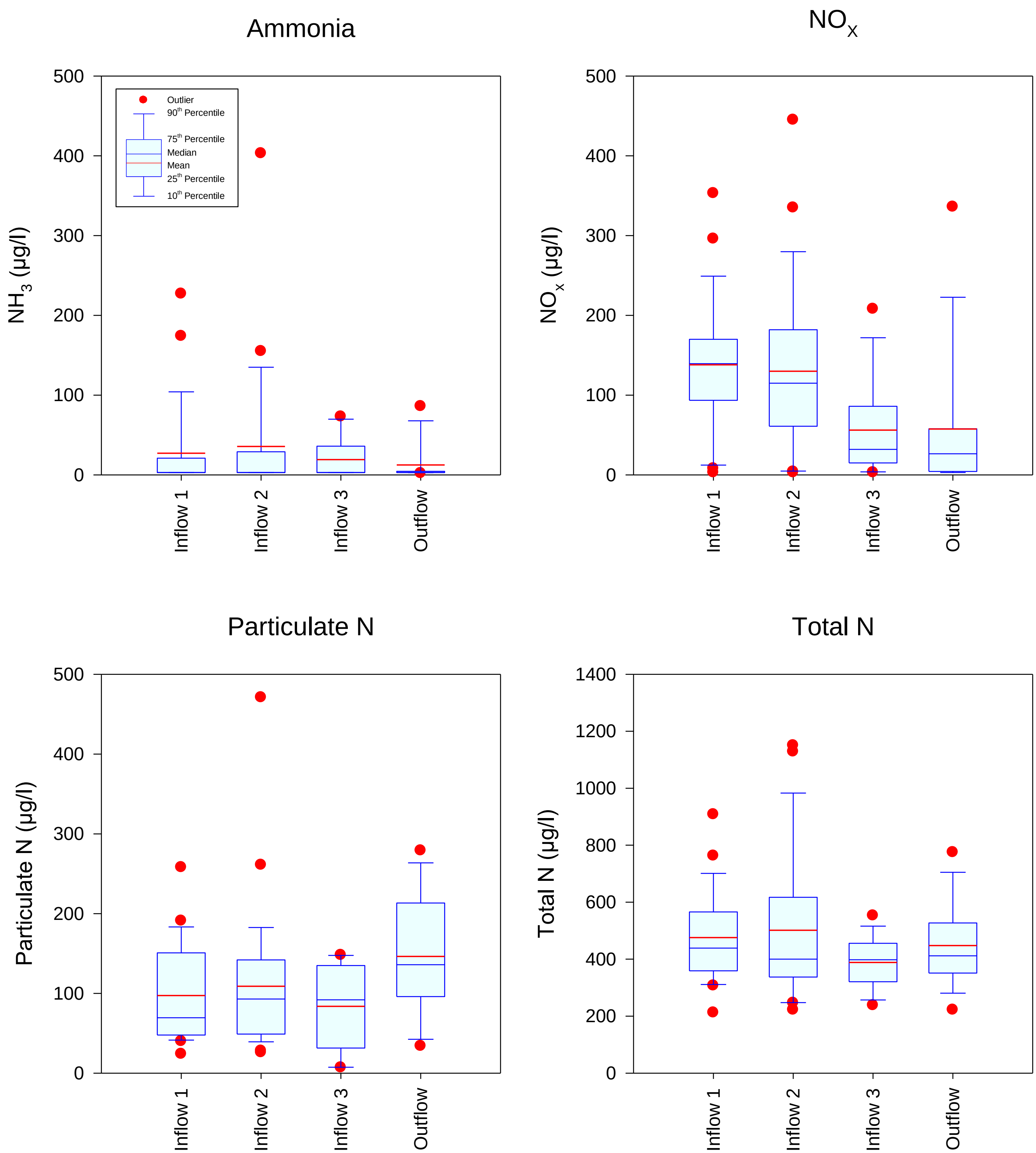


Figure 5-7. Statistical Comparison of Measured Concentrations of Nitrogen Species at the Naples Dry Detention Site from December 2012-November 2013.

5.1.2.3 Phosphorus Species

A statistical comparison of measured concentrations of phosphorus species at the Naples dry detention site from December 2012-November 2013 is given on Figure 5-8. Low levels of SRP were measured at each of the inflow and outflow monitoring sites, with the vast majority of measured concentrations less than 25 µg/l. Inflow concentrations of SRP exhibited a relatively narrow range of values, although individual values as high as 130 µg/l were observed on occasion. In general, the measured outflow concentration for SRP appears to be lower in value than the primary pond inflows at Sites 1 and 2. Measured SRP concentrations at Site 3, which includes roof runoff, were lower in value than observed at the other inflow sites.

Measured concentrations of dissolved organic phosphorus were generally low in value at each of the inflow and outflow monitoring sites. A relatively high degree of variability was observed in measured concentrations of dissolved organic phosphorus at Site 2, with the majority of measured concentrations ranging from approximately 5-40 µg/l, compared with values typically less than 15 µg/l at the remaining sites. A low degree of variability was observed in dissolved organic phosphorus concentrations at the pond outflow, although the median concentration does not appear to be significant different than median concentrations at the inflow sites.

Low concentrations of particulate phosphorus were measured at each of the inflow and outflow monitoring sites. Median particulate phosphorus concentrations at inflow Sites 1 and 3 were virtually identical to concentrations measured in the outflow samples. However, particulate phosphorus concentrations measured at Site 2 exhibited a higher degree of variability and a higher median concentration than observed at any of the other inflow or outflow monitoring sites.

In general, relatively low concentrations were observed for total phosphorus at each of the monitoring locations, with concentrations substantially lower than commonly observed in commercial runoff. Measured concentrations of total phosphorus at inflow Sites 1 and 3, as well as the outflow structure, were generally less than 60 µg/l. A somewhat higher degree of variability, as well as a higher median concentration, was observed at inflow Site 2. Overall, the total phosphorus concentration in the discharge appears to be slightly lower than concentrations measured at the inflow sites.

5.1.2.4 Turbidity, Color, and Hardness

A statistical comparison of measured concentrations of turbidity, color, and hardness at the Naples dry detention site from December 2012-November 2013 is given on Figure 5-9. In general, measured turbidity values were extremely low at each of the inflow and outflow monitoring sites, with the vast majority of measured values less than 4 NTU. The median value for turbidity in the outfall samples appears to be slightly lower than median values observed at the inflow sites.

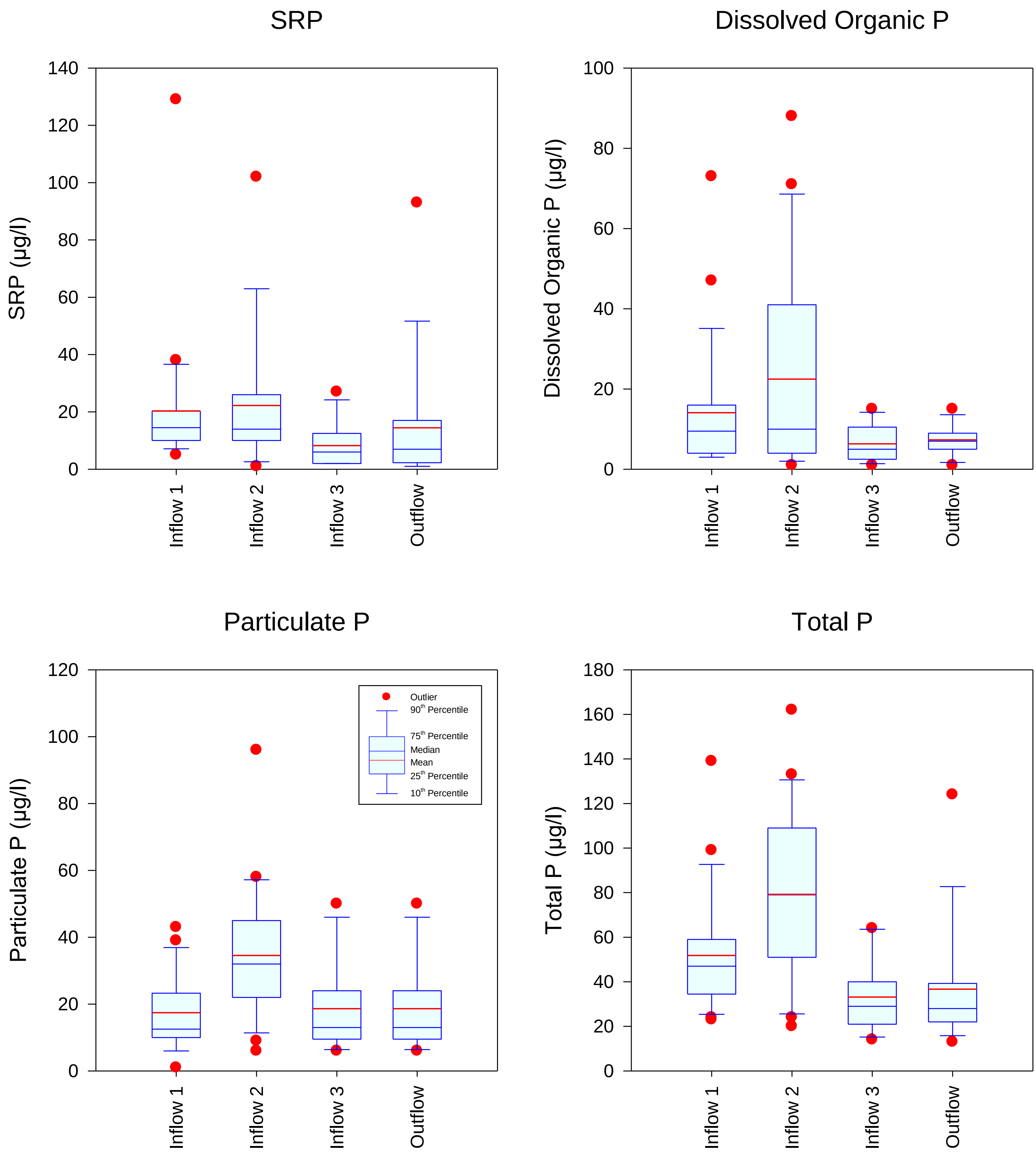


Figure 5-8. Statistical Comparison of Measured Concentrations of Phosphorus Species at the Naples Dry Detention Site from December 2012-November 2013.

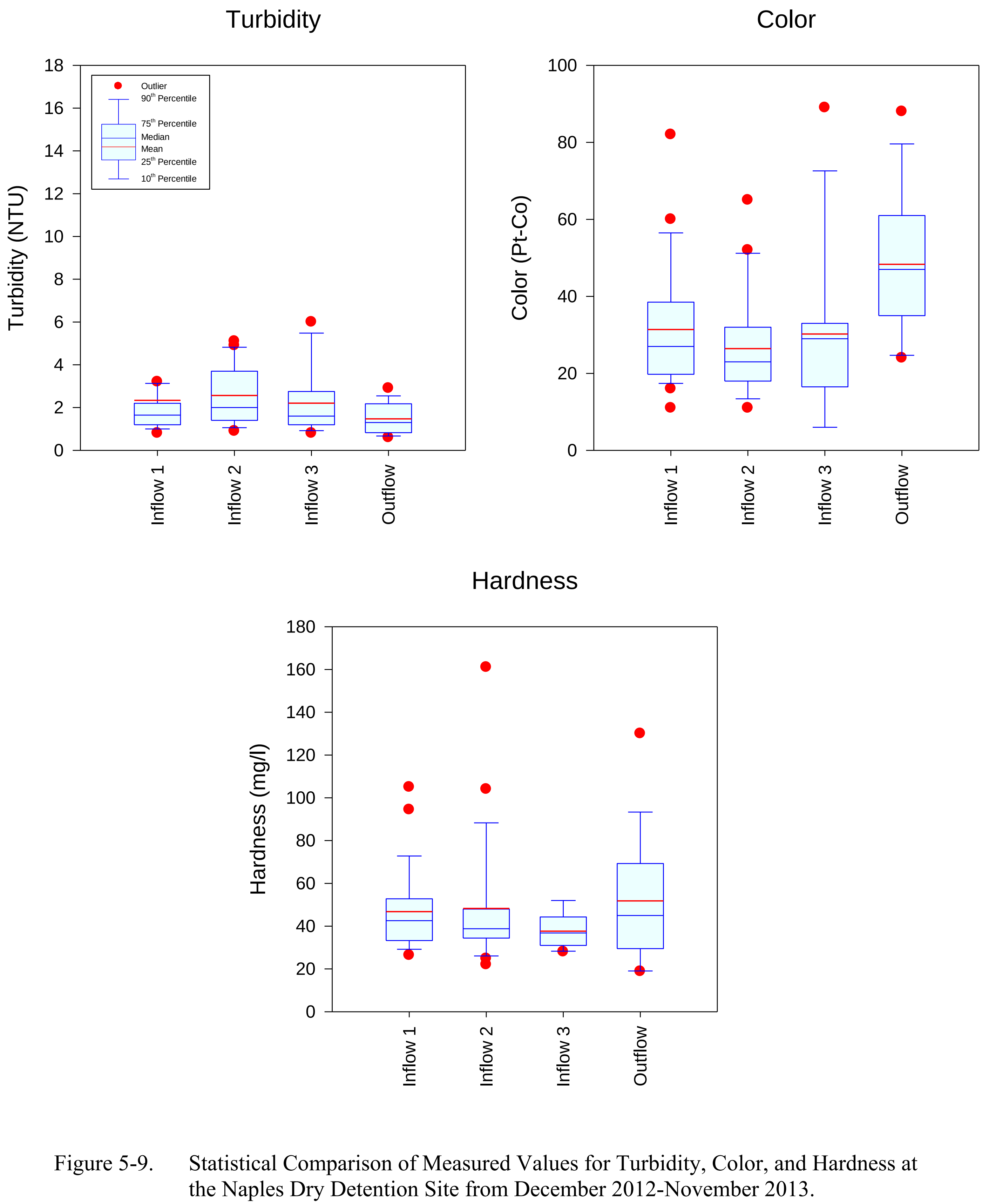


Figure 5-9. Statistical Comparison of Measured Values for Turbidity, Color, and Hardness at the Naples Dry Detention Site from December 2012-November 2013.

Inflow concentrations of color were generally low in value, typically ranging from approximately 20-40 Pt-Co units. However, more elevated color values were observed in the outflow which ranged from approximately 35-60 Pt-Co units. The median color concentration observed in the outflow at the Naples site was approximately twice the median color values observed at the inflow sites, suggesting that the inflows accumulate color after entering the final detention pond. Measured hardness concentrations were extremely low in value at each of the three inflow sites, with typical values ranging from approximately 20-40 mg/l.

5.1.2.5 Chromium, Copper, and Zinc

A statistical comparison of measured concentrations of chromium, copper, and zinc at the Naples dry detention site from December 2012-November 2013 is given on Figure 5-10. Lead is not included on this figure since virtually all of the measured values were less than the laboratory detection limit. In general, low concentrations of chromium were monitored at each of the inflow and outflow sites, with the vast majority of measured values less than 10 µg/l. The median chromium concentration in the outflow appears to be similar to concentrations measured in the inflows.

Measured copper concentrations were also extremely low in value at inflow Sites 1, 3, and at the pond outfall. A somewhat higher concentration for copper, combined with a higher degree of variability, was observed at inflow Site 2.

Relatively low concentrations were also observed for zinc at the inflow and outflow monitoring sites, with the vast majority of measured concentrations less than 10-15 µg/l. The most elevated median value for zinc was observed at inflow Site 2, with the lowest median concentration observed at the pond outfall.

5.1.2.6 Site Comparison

A tabular summary of geometric mean values for measured parameters at each of the Naples inflow and outflow monitoring sites is given on Table 5-4. In general, inflow and outflow samples collected at the Naples dry detention pond site were approximately neutral to slightly acidic in pH and relatively poorly buffered. Both the inflow and outflow samples were also characterized by low levels of conductivity which are substantially lower than conductivity values commonly observed in urban runoff.

Low levels of both ammonia and NO_x were observed at each of the inflow and outflow monitoring sites, with geometric mean concentrations for ammonia less than 10 µg/l at each monitoring site and mean concentrations for NO_x less than or equal to 100 µg/l at each site. The lowest mean concentrations for both ammonia and NO_x were observed at the pond outfall, suggesting uptake of these parameters within the treatment system. Low to moderate levels of dissolved organic nitrogen were observed at each site, with a slight increase in mean dissolved organic nitrogen observed in the pond outfall. Low concentrations were also observed for particulate nitrogen, with the highest concentration of particulate nitrogen observed at the pond outfall. Overall, measured concentrations of total nitrogen at each of the inflow and outflow monitoring sites were low in value and substantially lower than nitrogen concentrations commonly associated with low-intensity commercial development. No significant reduction in nitrogen concentrations was observed at the outfall compared with the inflow monitoring sites.

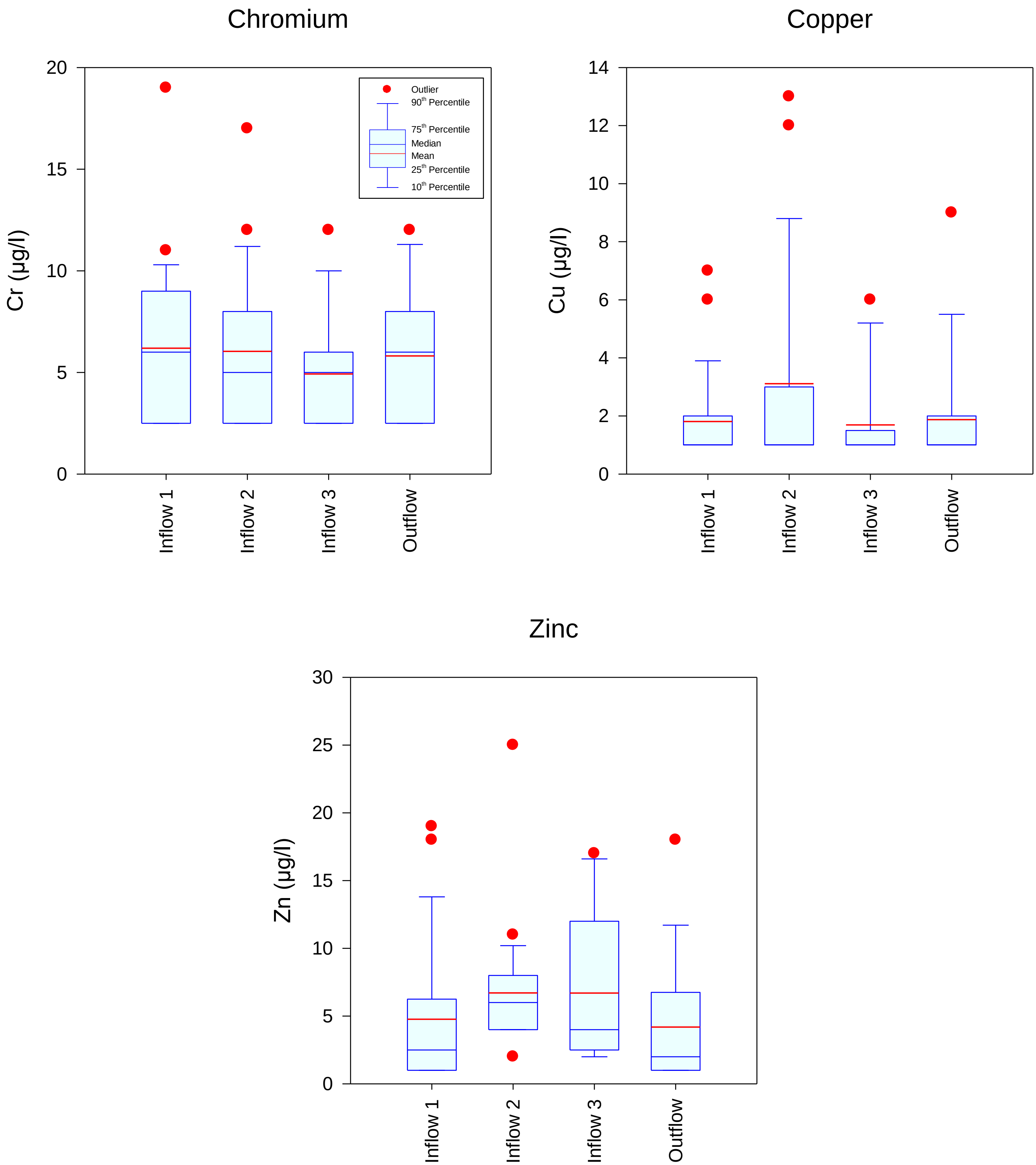


Figure 5-10. Statistical Comparison of Measured Concentrations of Chromium, Copper, and Zinc at the Naples Dry Detention Site from December 2012-November 2013.

TABLE 5-4

GEOMETRIC MEAN CONCENTRATIONS FOR INFLOW AND OUTFLOW SAMPLES AT THE NAPLES DRY DETENTION SITE

PARAMETER	UNITS	INFLOW 1	INFLOW 2	INFLOW 3	OUTFALL
pH	s.u.	6.96	6.93	6.66	6.99
Alkalinity	mg/l	44.0	42.2	26.8	39.4
Conductivity	μmho/cm	107	111	57	94
Ammonia	μg/l	7	8	8	5
NO_x	μg/l	100	81	31	22
Dissolved Organic N	μg/l	183	180	213	217
Particulate N	μg/l	81	86	59	126
Total N	μg/l	452	452	379	428
SRP	μg/l	15	14	6	7
Dissolved Organic P	μg/l	10	12	5	6
Particulate P	μg/l	14	29	15	13
Total P	μg/l	47	69	30	31
Turbidity	NTU	1.8	2.2	1.9	1.3
Color	Pt-Co	28	24	24	45
TSS	mg/l	3.2	4.9	3.9	2.5
Chromium	μg/l	5.2	5.1	4.4	5.0
Copper	μg/l	1.5	2.1	1.3	1.4
Lead	μg/l	< 2	< 2	< 2	< 2
Zinc	μg/l	3.0	5.9	4.9	2.6
Hardness	mg/l	44.0	43.3	36.9	45.3

Extremely low levels of SRP, dissolved organic phosphorus, and particulate phosphorus were observed at each of the inflow and outflow monitoring sites, with the lowest mean concentrations for these parameters observed in the outflow samples. Overall, extremely low levels of total phosphorus were observed at the inflow and outflow monitoring sites, with a somewhat lower mean concentration observed for total phosphorus in the outfall samples, suggesting that uptake of total phosphorus occurs within the treatment system. The observed low concentrations for total phosphorus and total nitrogen may be related to the on-going site management activities which include periodic vacuum sweeping of the parking and driveway areas.

Extremely low levels of turbidity and TSS were measured at each of the inflow and outflow sites, with the lowest mean values for turbidity and TSS observed in the pond outfall. Moderate levels of color were measured at the inflow sites, while the discharge color mean concentration was approximately twice the mean values observed at the inflow sites.

Low levels of chromium, copper, lead, and zinc were also observed at each of the inflow monitoring sites and pond outfall. Mean concentrations of chromium, copper, and lead in the pond outfall appear to be similar to values measured at the inflow sites. However, the mean outfall concentration for total zinc is somewhat lower in value than mean concentrations observed at the inflow sites.

5.1.3 Pembroke Pines Dry Detention Pond Site

A tabular summary of inflow/outflow samples collected at the Pembroke Pines monitoring sites from December 2012-November 2013 is given in Table 5-5. A total of 30 composite runoff samples was collected at inflow Site 1, with 33 composite samples collected at Site 2, and 27 flow-weighted composite samples were collected at the pond outflow. Overall, a total of 90 separate flow-weighted composite inflow/outflow samples was collected at the Pembroke Pines site during the field monitoring program.

TABLE 5-5

SUMMARY OF INFLOW / OUTFLOW SAMPLES COLLECTED AT THE PEMBROKE PINES MONITORING SITE FROM DECEMBER 2012 – NOVEMBER 2013

SITE	TYPE OF SAMPLE	NUMBER OF SAMPLES COLLECTED
1	Parking Lot Runoff	30
2	Parking Lot and Roof Runoff	33
3	System Outflow	27
	TOTAL:	**90**

5.1.3.1 General Parameters

A statistical comparison of measured values of pH, alkalinity, conductivity, and TSS in the Pembroke Pines detention pond site from December 2012-November 2013 is given in Figure 5-11. Measured pH values at the inflow and outflow monitoring sites were approximately neutral to slightly alkaline in value, with the majority of measurements ranging from approximately 6.8-7.8. Pond discharge pH values exhibited a slightly greater median value than observed in the inflows.

Measured alkalinity values at the Pembroke Pines inflow and outflow sites indicate poorly to moderately well buffered conditions. Relatively similar values and degrees of variability were observed for alkalinity at inflow Site 1 and at the pond outflow, with a somewhat lower alkalinity value observed in runoff collected at Site 2.

A similar pattern is also apparent for conductivity, with relatively similar conductivity values observed at inflow Site 1 and the pond outfall, and lower conductivity values observed at Site 2. The observed lower values for pH, alkalinity, and conductivity at inflow Site 2 suggest that inputs of roof runoff may also be occurring at this site.

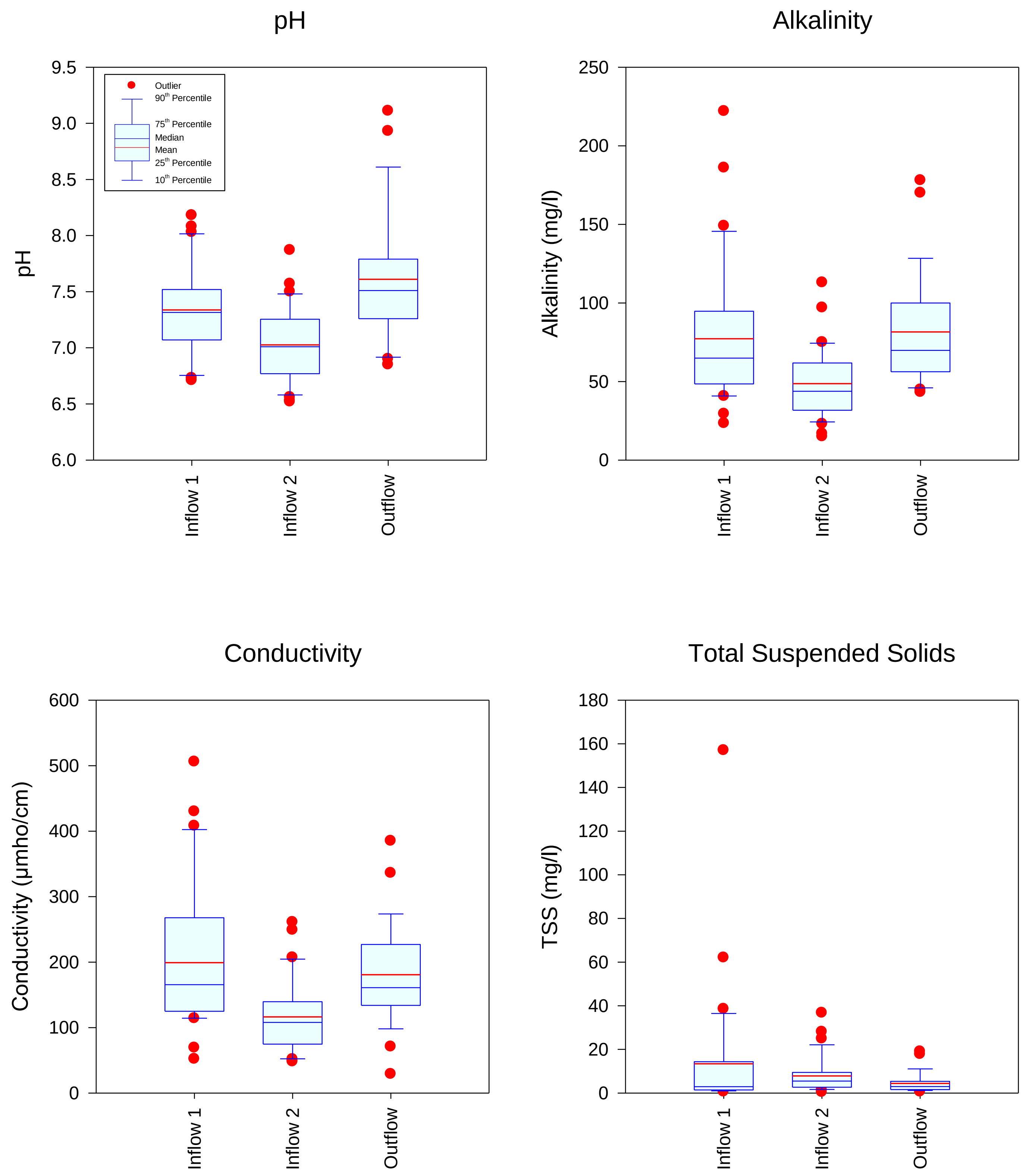


Figure 5-11. Statistical Comparison of Measured Values for pH, Alkalinity, Conductivity, and TSS at the Pembroke Pines Dry Detention Site from December 2012-November 2013.

Measured concentrations of TSS at the inflow and outflow monitoring sites were generally low in value, with the majority of measured concentrations less than 15 mg/l. The lowest values for TSS, along with the lowest degree of variability, were observed at the pond outflow.

5.1.3.2 Nitrogen Species

A statistical comparison of measured concentrations of nitrogen species at the Pembroke Pines dry detention site from December 2012-November 2013 is given on Figure 5-12. Measured concentrations of ammonia were generally low in value at each of the sites, with the vast majority of measured concentrations less than approximately 150 µg/l. The most elevated concentrations of ammonia were observed at Site 2, with the lowest concentrations observed in the pond outflow.

Measured concentrations of NO_x were generally low in value at the inflow and outflow monitoring sites, with the vast majority of measured concentrations less than 150 µg/l. Relatively similar concentrations of NO_x were observed at inflow Sites 1 and 2, with a somewhat lower concentration observed in the pond outflow.

Measured concentrations of particulate nitrogen were low to moderate in value at the inflow and outflow monitoring sites. The lowest median concentration for particulate nitrogen was observed at inflow Site 1, followed by inflow Site 2, with the most elevated median value observed in the pond outflow. The data suggests that biological activity may be occurring within the pond which is contributing to increases in particulate nitrogen in the outfall.

Overall, measured concentrations of total nitrogen appear to be relatively similar at the inflow and outflow monitoring sites. The dry detention pond appears to have little ability to significantly reduce overall concentrations of total nitrogen.

5.1.3.3 Phosphorus Species

A statistical comparison of measured concentrations of phosphorus species at the Pembroke Pines dry detention site from December 2012-November 2013 is given on Figure 5-13. Measured concentrations of SRP were low in value at each of the inflow and outflow monitoring sites, with the vast majority of measured concentrations less than 25 µg/l.

Low concentrations of dissolved organic phosphorus were measured at the inflow and outflow sites, with typical values ranging from approximately 10-80 µg/l. Outfall concentrations of dissolved organic phosphorus appear to be mid-way between the median values for the two inputs.

Relatively low concentrations of particulate phosphorus were also observed at the inflow and outflow monitoring sites. Particulate phosphorus concentrations at the two inflows are similar in value, with the majority of measurements ranging from 20-50 µg/l. Lower concentrations, combined with a lower degree of variability, were observed for particulate phosphorus in the outflow.

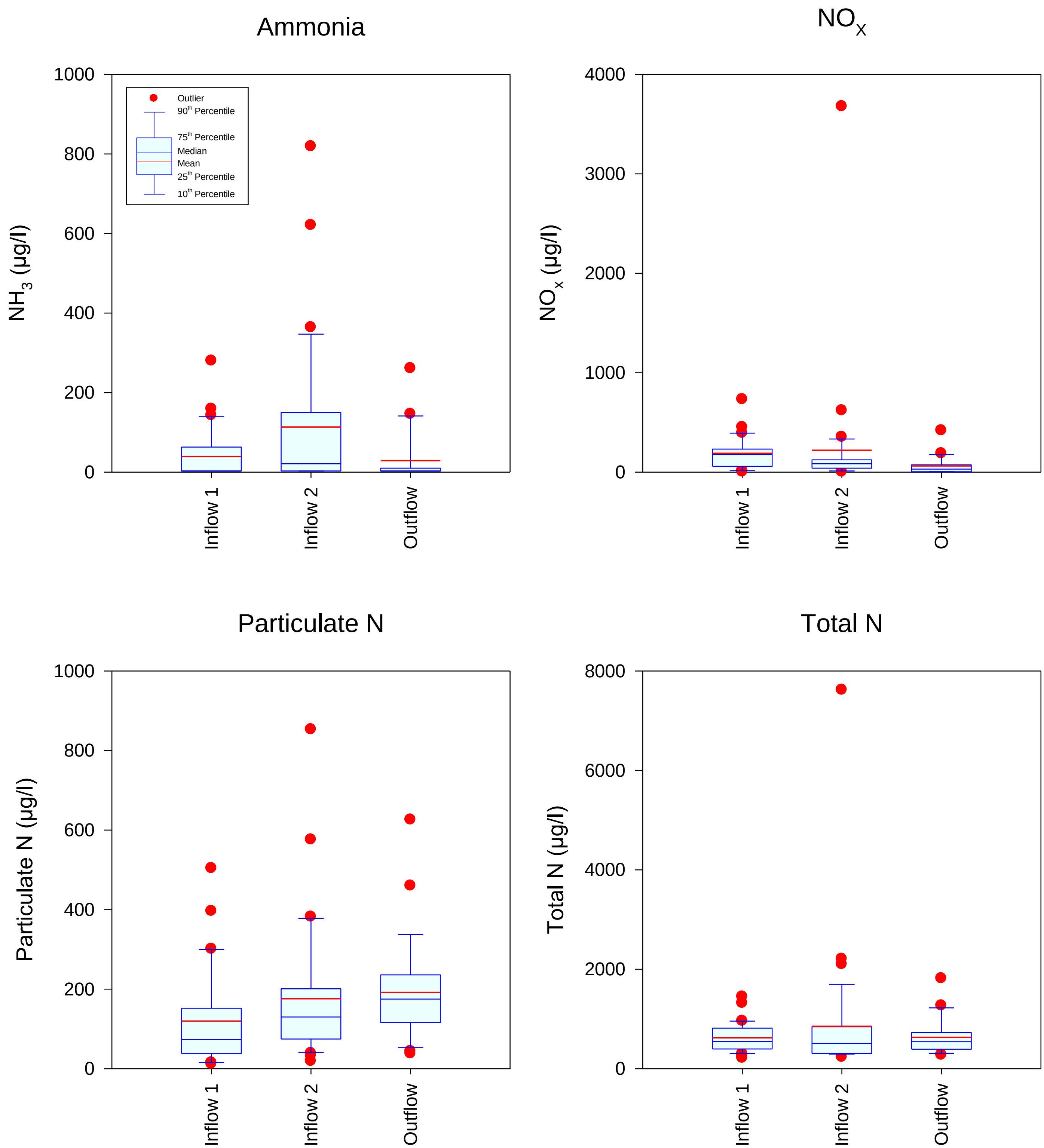


Figure 5-12. Statistical Comparison of Measured Concentrations of Nitrogen Species at the Pembroke Pines Dry Detention Site from December 2012-November 2013.

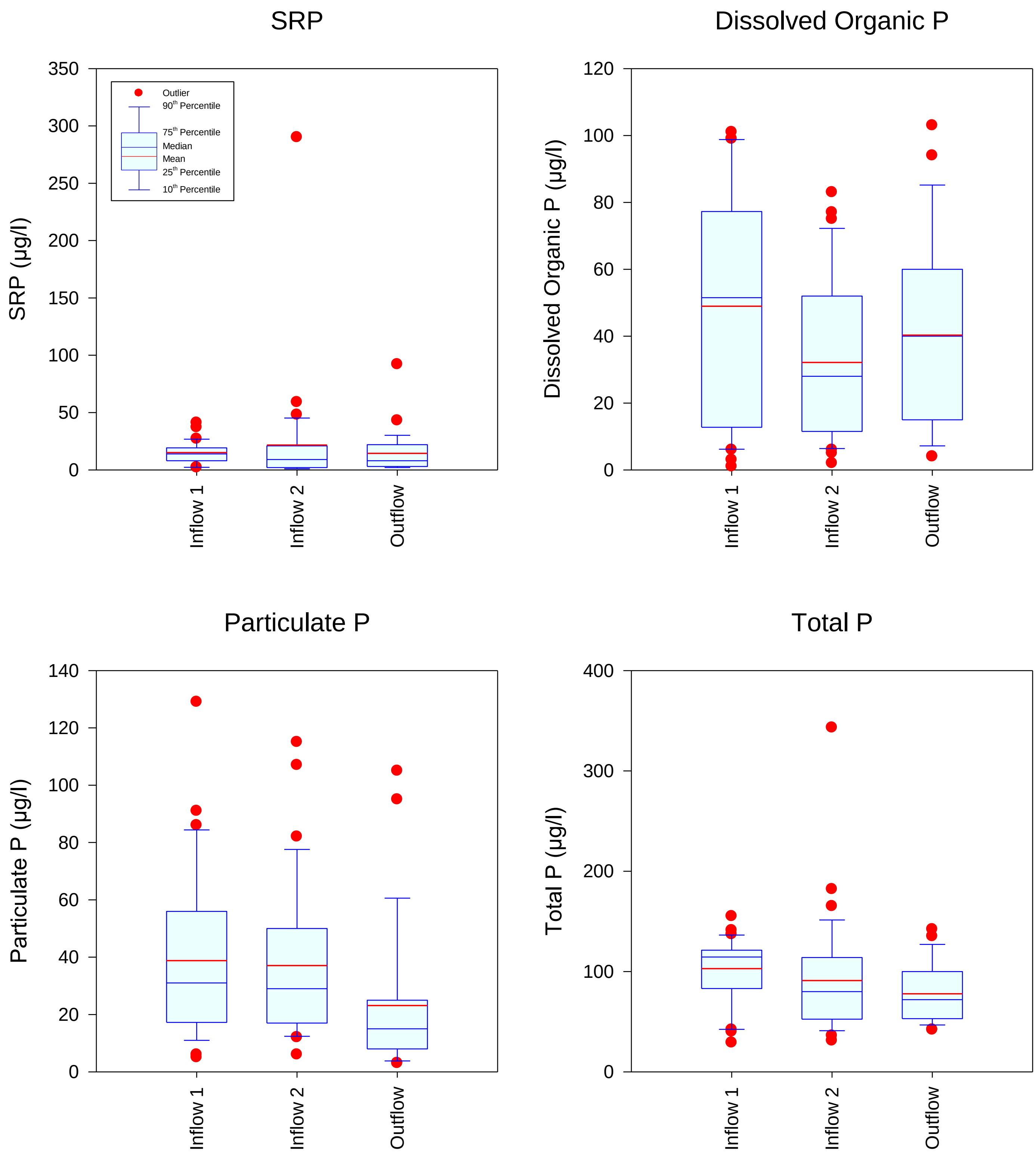


Figure 5-13. Statistical Comparison of Measured Concentrations of Phosphorus Species at the Pembroke Pines Dry Detention Site from December 2012-November 2013.

Overall, measured concentrations of total phosphorus were relatively low in value at the inflow and outflow monitoring sites, with the vast majority of measured values ranging from approximately 50-125 μg/l. Total phosphorus concentrations in the outflow appear to exhibit a slightly lower median value than observed in the two inflows.

5.1.3.4 Turbidity, Color, and Hardness

A statistical comparison of measured concentrations of turbidity, color, and hardness at the Pembroke Pines dry detention site from December 2012-November 2013 is given on Figure 5-14. In general, extremely low levels of turbidity were measured at the inflow and outflow monitoring sites, with the vast majority of measurements less than 5 NTU.

Measured color concentrations ranged from low to moderate, with relatively low color concentrations observed in the inflows and a somewhat higher color value measured in the pond discharges. The data suggest leaching of organic compounds is occurring in the final treatment pond which is contributing to increases in color. Measured hardness concentrations were low in value at each of the two inflow sites, with a somewhat higher concentration measured at the pond outflow.

5.1.3.5 Chromium, Copper, and Zinc

A statistical comparison of measured concentrations of chromium, copper, and zinc at the Pembroke Pines dry detention site from December 2012-November 2013 is given on Figure 5-15. Lead is not included on this figure since virtually all of the measured values were less than the laboratory detection limit. In general, relatively low concentrations of chromium were measured at each of the inflow and outflow monitoring sites, with the vast majority of measured values less than 8 μg/l. The median value measured at the pond outflow appears to be slightly lower than median values measured at the inflows.

Measured copper concentrations at the inflow and outflow sites were also relatively low in value, with the vast majority of measured concentrations less than 4 μg/l. Median values for the inflows and outflows appear to be relatively similar.

Low to somewhat elevated concentrations of zinc were measured at the Pembroke Pines site, with relatively low zinc concentrations observed at inflow Site 1 and in the pond outfall and substantially higher zinc concentrations observed in the inflow at Site 2. Overall, it appears that the dry detention pond is reducing concentrations of zinc, although to a limited degree.

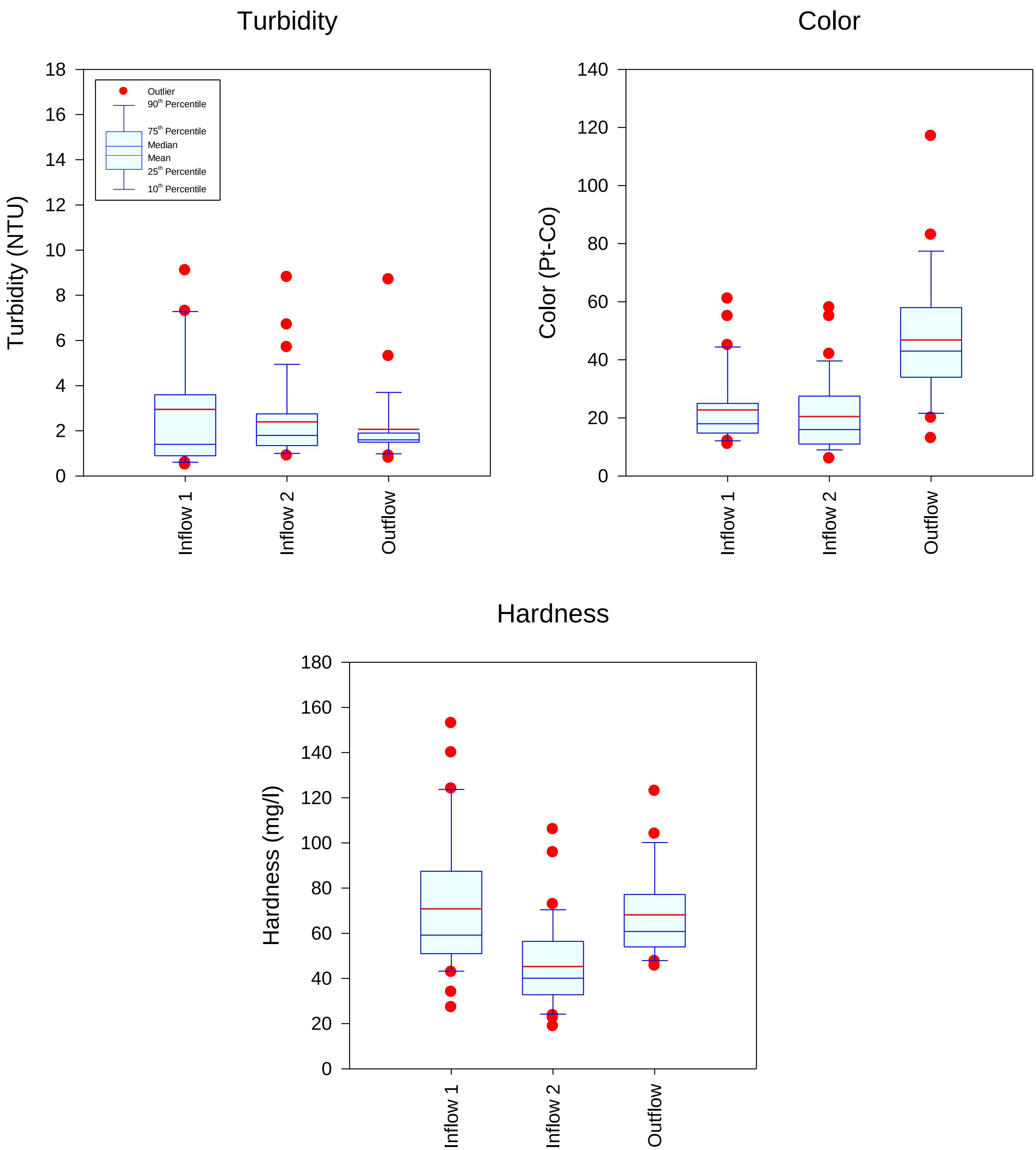


Figure 5-14. Statistical Comparison of Measured Values for Turbidity, Color, and Hardness at the Pembroke Pines Dry Detention Site from December 2012-November 2013.

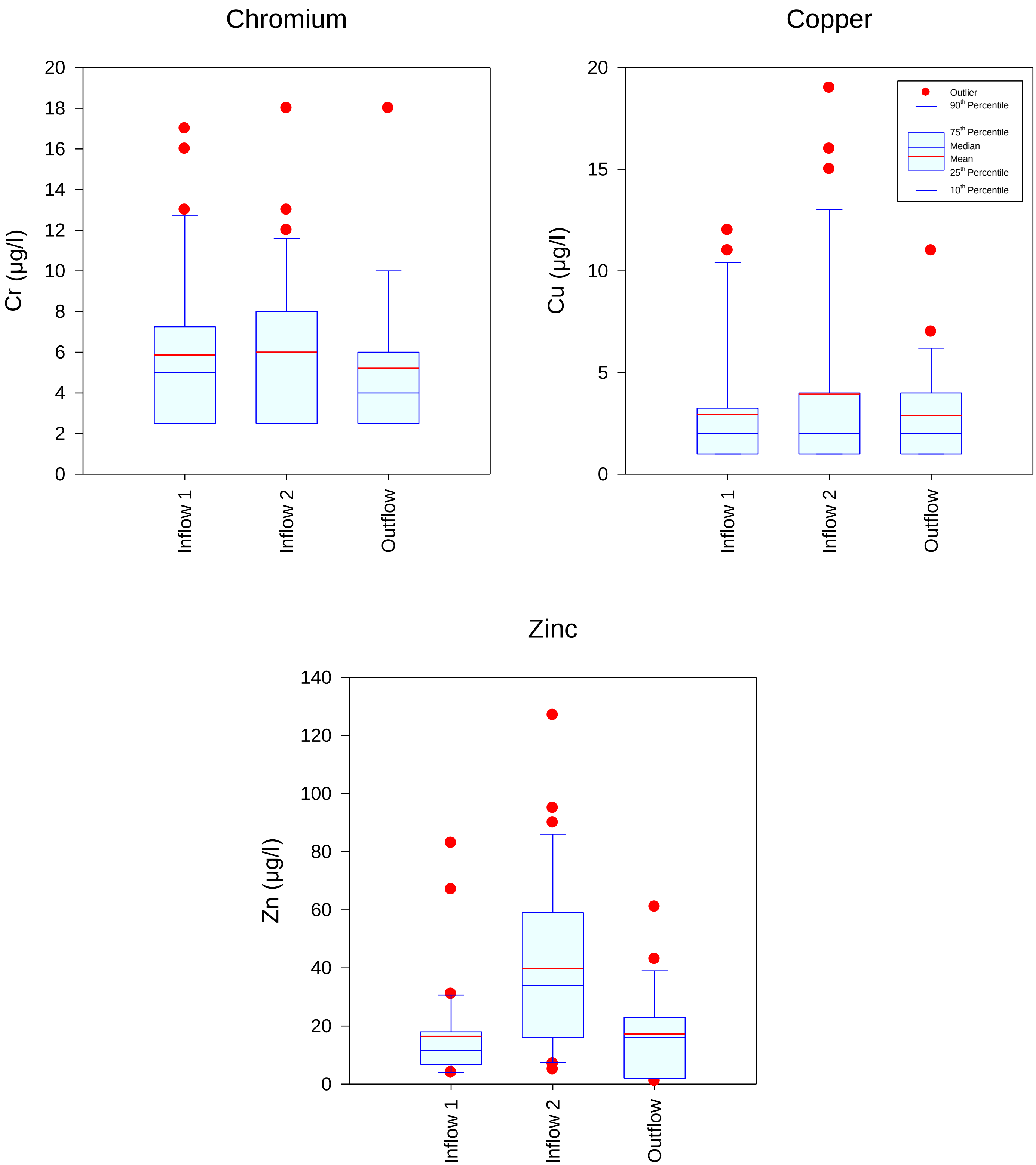


Figure 5-15. Statistical Comparison of Measured Concentrations of Chromium, Copper, and Zinc at the Pembroke Pines Dry Detention Site from December 2012-November 2013.

5.1.3.6 Site Comparison

A tabular summary of geometric mean values for evaluated parameters at each of the Pembroke Pines inflow and outflow monitoring sites is given on Table 5-6. In general, mean pH values at the inflow and outflow monitoring sites indicate neutral to slightly alkaline characteristics, with moderate to moderately well buffered conditions based upon mean alkalinity measurements. Measured conductivity values at each of the inflow and outflow sites were somewhat lower than conductivity values commonly observed in low-intensity commercial runoff. The lower values for pH, alkalinity, and conductivity suggest a potential input of roof drainage for inflow Site 2.

TABLE 5-6

GEOMETRIC MEAN CONCENTRATIONS FOR INFLOW AND OUTFLOW SAMPLES AT THE PEMBROKE PINES DRY DETENTION SITE

PARAMETER	UNITS	INFLOW 1	INFLOW 2	OUTFALL
pH	s.u.	7.33	7.02	7.59
Alkalinity	mg/l	68.2	44.1	75.9
Conductivity	µmho/cm	176	105	163
Ammonia	µg/l	10	26	6
NO_x	µg/l	112	63	23
Dissolved Organic N	µg/l	215	205	309
Particulate N	µg/l	76	127	160
Total N	µg/l	559	537	559
SRP	µg/l	12	8	8
Dissolved Organic P	µg/l	31	23	29
Particulate P	µg/l	29	29	15
Total P	µg/l	96	79	73
Turbidity	NTU	1.8	2.0	1.8
Color	Pt-Co	20	17	42
TSS	mg/l	4.3	5.1	3.0
Chromium	µg/l	5.0	5.2	4.4
Copper	µg/l	2.1	2.5	2.1
Lead	µg/l	< 2	< 2	< 2
Zinc	µg/l	11.7	29	9.7
Hardness	mg/l	65.3	41.8	65.7

Low levels of ammonia were measured at each of the inflow and outflow sites, with a slightly lower ammonia concentration at the outfall than observed at the inflows. Measured concentrations of NO_x were also relatively low in value, with a lower concentration observed at the outfall for this parameter as well. Moderate levels of dissolved organic nitrogen were observed at each of the inflow and outflow sites, with a somewhat higher mean concentration in the outfall compared with the inflows. Particulate nitrogen concentrations were also generally low in value, with a higher mean concentration in the outfall compared with the inflows. Overall, measured total nitrogen concentrations were relatively similar at each of the inflow and outflow monitoring sites, suggesting that the pond system has little affinity for reducing concentrations of total nitrogen. The observed mean nitrogen concentrations in the inflows are approximately half of the concentrations commonly associated with commercial runoff, and may reflect impacts from periodic vacuum sweeping which occurs within the parking areas.

Low levels of SRP, dissolved organic phosphorus, and particulate phosphorus were observed at each of the inflow monitoring sites. The mean outfall concentration of 8 μg/l for SRP is similar to the concentration measured at the Site 2 inflow. No significant reduction was observed for dissolved organic phosphorus in the pond outfall compared with the inflows, suggesting no significant concentration reduction for this parameter. However, a reduction in outfall concentrations was observed for particulate phosphorus, with the outfall concentration approximately half of the inflow concentrations. Overall, only a relatively modest concentration reduction was observed for total phosphorus within the treatment system.

Extremely low levels of both turbidity and TSS were observed at the inflows and outflows monitored at the Pembroke Pines site. A reduction in TSS concentrations was observed at the pond outfall compared with inflow concentrations. As observed at previous sites, an increase in color occurred within the treatment system which resulted in color concentrations in discharge approximately twice as high as color concentrations measured in the inflows.

Extremely low levels of heavy metals were measured at each of the monitoring sites, with outfall concentrations slightly lower than inflow concentrations measured for chromium, copper, and zinc.

5.1.4 Orlando Underdrain Site

A tabular summary of inflow/outflow samples collected at the Orlando monitoring sites from December 2012-November 2013 is given in Table 5-7. During the field monitoring program, a total of 23 separate composite runoff samples was collected at inflow Site 1, with 21 composite samples collected at inflow Site 2, 19 samples collected at inflow Site 3, 19 samples at inflow Site 4, and 22 samples collected of the underdrain outflow. Overall, a total of 104 separate flow-weighted composite inflow/outflow samples was collected at the Orlando underdrain site during the field monitoring program.

TABLE 5-7

SUMMARY OF INFLOW / OUTFLOW SAMPLES COLLECTED AT THE ORLANDO UNDERDRAIN MONITORING SITE FROM DECEMBER 2012 – NOVEMBER 2013

SITE	TYPE OF SAMPLE	NUMBER OF SAMPLES COLLECTED
1	Parking Lot Runoff	23
2	Parking Lot Runoff	21
3	Parking Lot Runoff	19
4	Entrance Road Runoff	19
5	Underdrain Outflow	22
	TOTAL:	**104**

5.1.4.1 General Parameters

A statistical comparison of measured values of pH, alkalinity, conductivity, and TSS at the Orlando underdrain site from December 2012-November 2013 is given in Figure 5-16. Measured pH values for inflows at the Orlando underdrain site exhibited neutral to slightly acidic conditions throughout the field monitoring program, with the vast majority of inflow pH values equal to or less than 7.0. In contrast, measured pH values in the underdrain outflow exhibited neutral to slightly alkaline conditions, ranging from approximately 7.1-7.5.

Measured alkalinity values in the inflow samples were low in value, with the majority of measurements ranging from 15-40 mg/l. In contrast, measured alkalinity values in the pond discharge were substantially greater in value, ranging from 50-80 mg/l for most samples.

A similar pattern is also apparent for measured concentrations of conductivity, with low values (ranging from 30-100 μmho/cm) measured in the inflow samples, and more elevated values (ranging from 120-180 μmho/cm) in the underdrain samples.

Measured concentrations of TSS in the inflow samples were low to moderate in value, with the majority of measurements ranging from 5-25 mg/l. Measured TSS concentrations in the underdrain discharge were substantially lower than values observed in the inflows.

5.1.4.2 Nitrogen Species

A statistical comparison of measured concentrations of nitrogen species at the Orlando underdrain site from December 2012-November 2013 is given on Figure 5-17. In general, measured concentrations of ammonia were low in value at each of the inflow and outflow monitoring sites, with the vast majority of measured concentrations less than 100 μg/l. Ammonia concentrations in the outflow appear to be lower in value than three of the four monitored inflow sites.

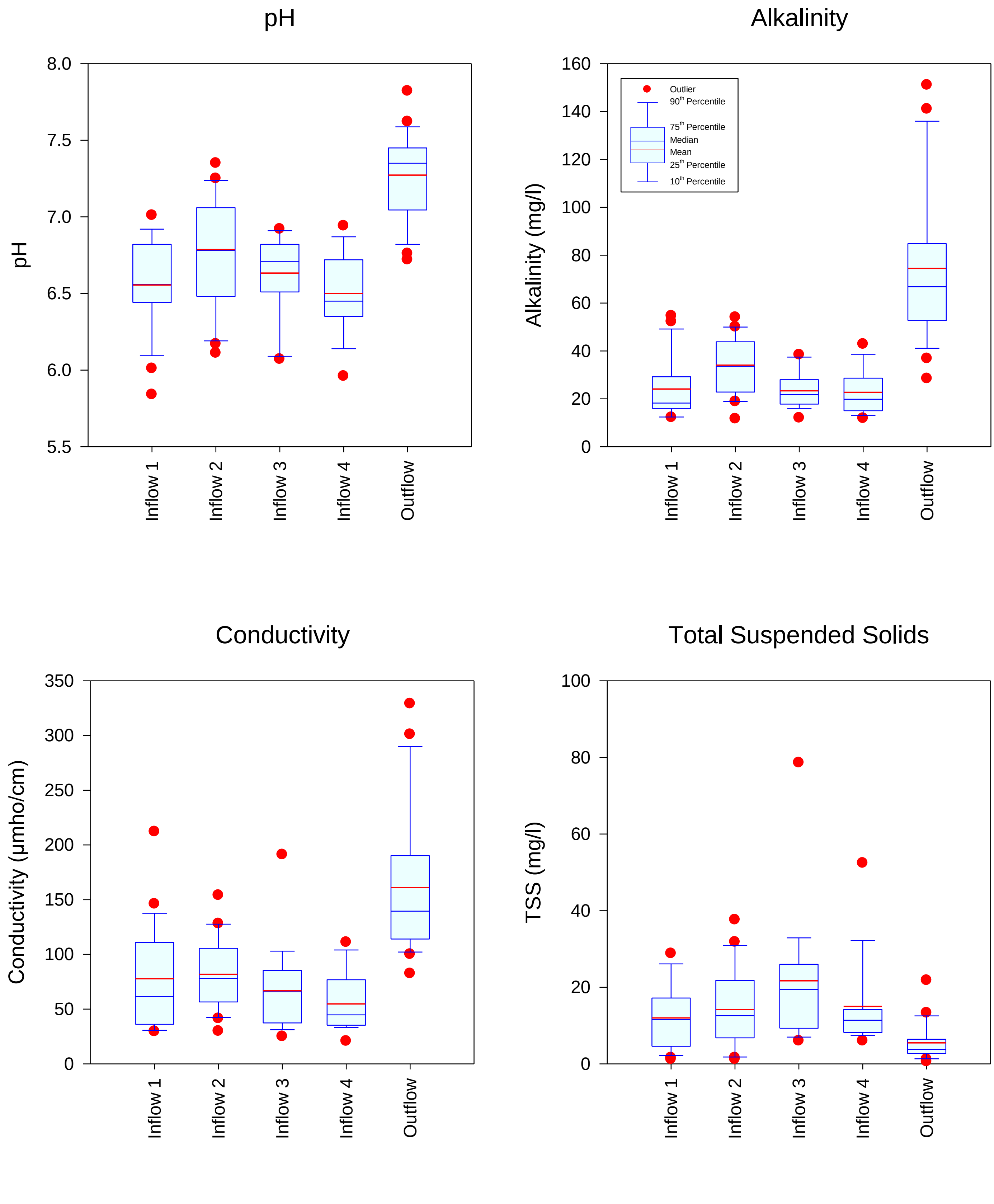


Figure 5-16. Statistical Comparison of Measured Values for pH, Alkalinity, Conductivity, and TSS at the Orlando Underdrain Site from December 2012-November 2013.

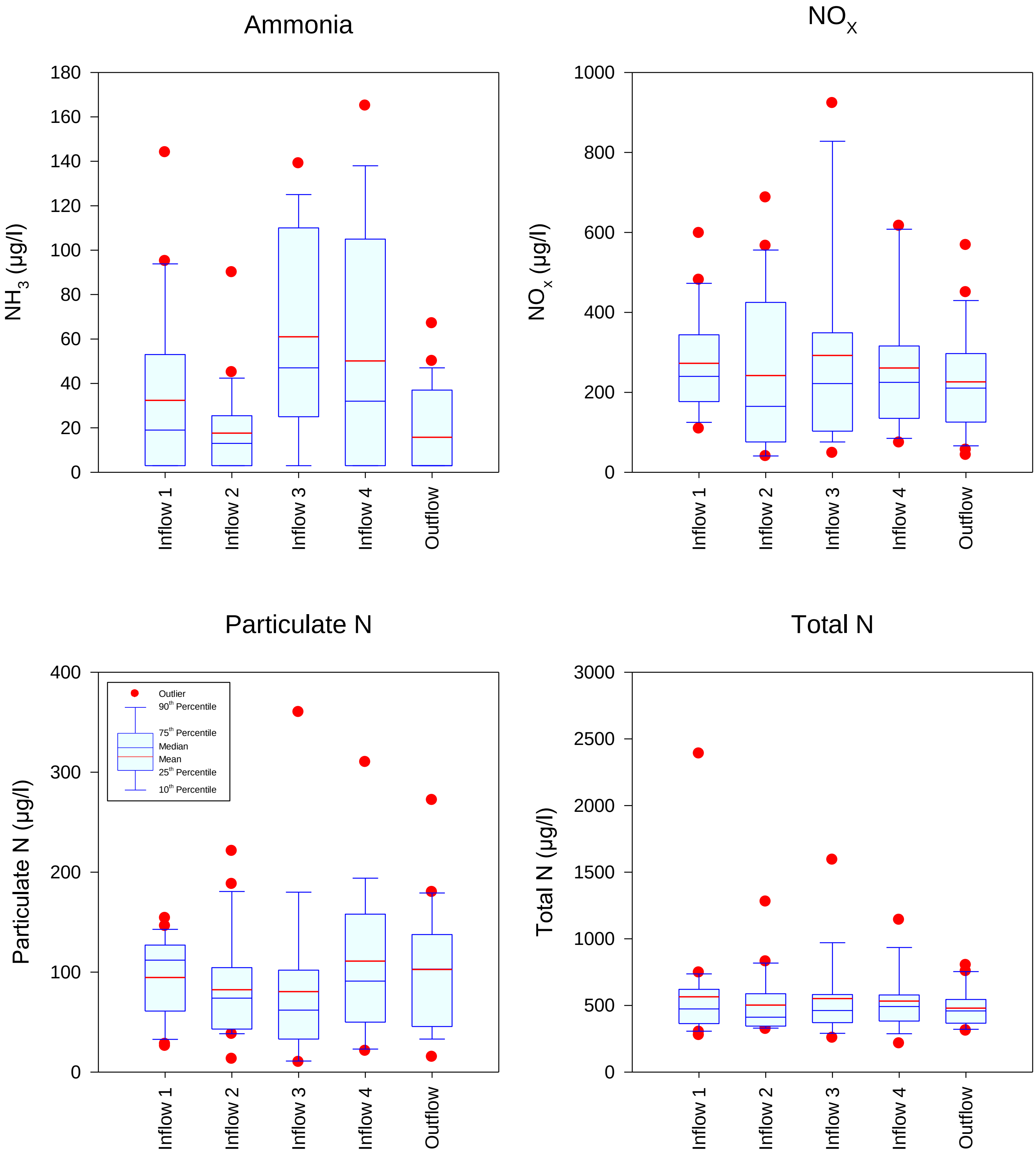


Figure 5-17. Statistical Comparison of Measured Concentrations of Nitrogen Species at the Orlando Underdrain Site from December 2012-November 2013.

Measured concentrations of NO_x in inflows and outflows at the Orlando underdrain site were moderate in value, ranging from approximately 100-400 µg/l. NO_x concentrations in the outflow appear to be similar to values measured at the inflow monitoring sites.

Measured concentrations of particulate nitrogen at the inflow and outflow monitoring sites were also low in value, with the majority of measurements ranging from 25-150 µg/l. Particulate nitrogen concentrations in the outflow appear to be equal to or greater than concentrations measured at the inflow sites.

Measured concentrations of total nitrogen at the inflow and outflow sites exhibited a relatively narrow range of values, ranging from 300-700 µg/l. Concentrations of total nitrogen in the outflow samples appear to be similar to values measured at the inflows, suggesting that the underdrain system has little affinity for removal of nitrogen.

5.1.4.3 **Phosphorus Species**

A statistical comparison of measured concentrations of phosphorus species at the Orlando underdrain site from December 2012-November 2013 is given on Figure 5-18. Extremely low levels of SRP were measured in inflows to the pond, with values ranging from 5-30 µg/l. In contrast, SRP concentrations in the discharge were substantially higher than the inflow values and ranged from approximately 40-80 µg/l. In contrast to the trends observed for SRP, dissolved organic phosphorus concentrations were moderately elevated at each of the four inflow sites, with substantially lower concentrations observed for dissolved organic phosphorus in the outflow.

Relatively low concentrations of particulate phosphorus were observed at each of the inflow monitoring sites, with typical values ranging from 10-40 µg/l. The median value for particulate phosphorus in the underdrain outflow appears to be lower than values measured at the inflows.

Measured total phosphorus concentrations in both the inflow and outflow samples were generally low in value, with the majority of measured concentrations ranging from approximately 40-120 µg/l. The outflow concentration for total phosphorus appears to be slightly lower than median values observed at the inflows, suggesting that the underdrain system has the ability to retain phosphorus within the soil media.

5.1.4.4 **Turbidity, Color, and Hardness**

A statistical comparison of measured concentrations of turbidity, color, and hardness at the Orlando underdrain site from December 2012-November 2013 is given on Figure 5-19. Measured turbidity values were low at each of the inflow monitoring sites, ranging from 2-7 NTU. A lower range of turbidity values (ranging from 2-4 NTU) was observed at the pond outflow.

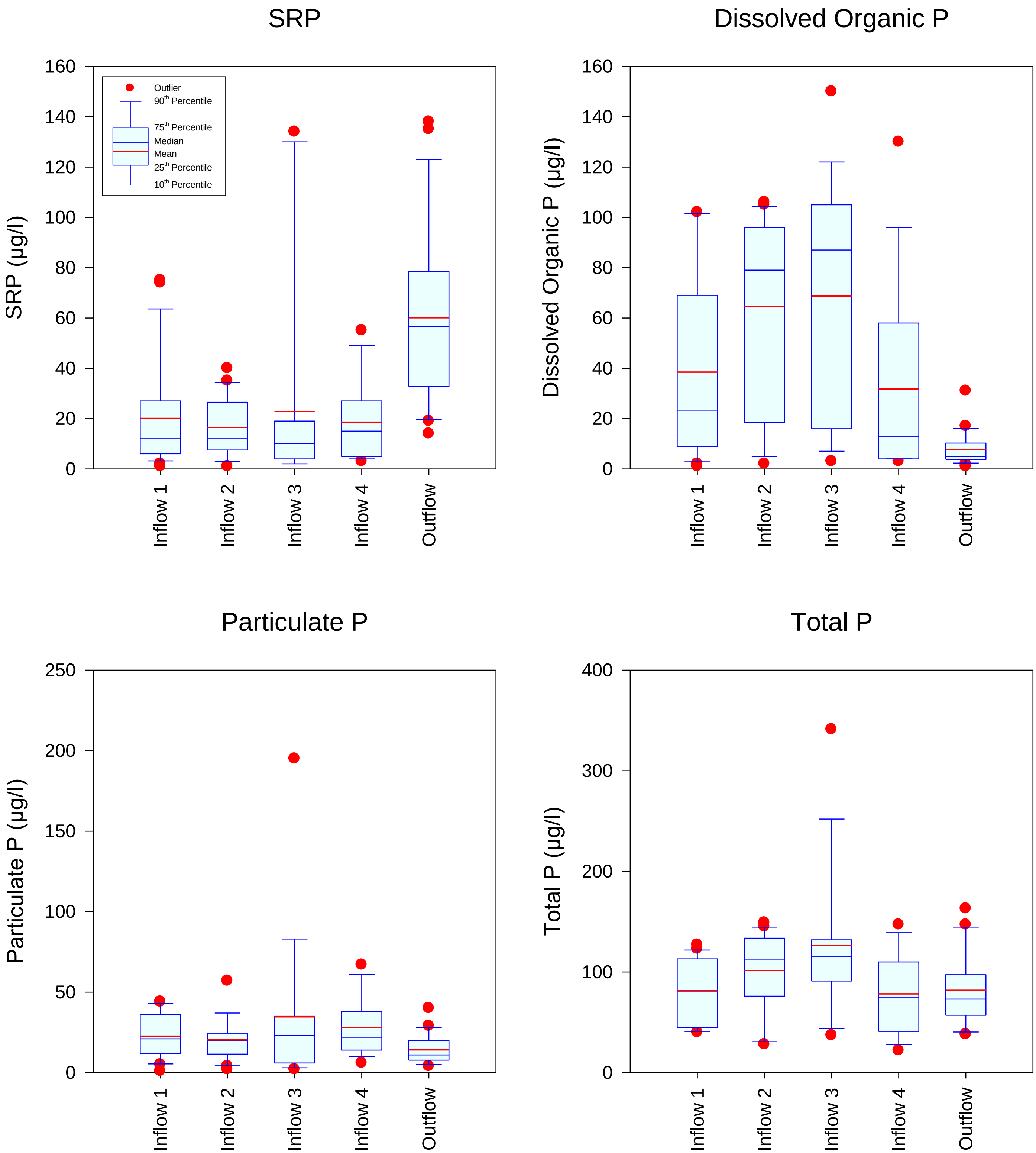


Figure 5-18. Statistical Comparison of Measured Concentrations of Phosphorus Species at the Orlando Underdrain Site from December 2012-November 2013.

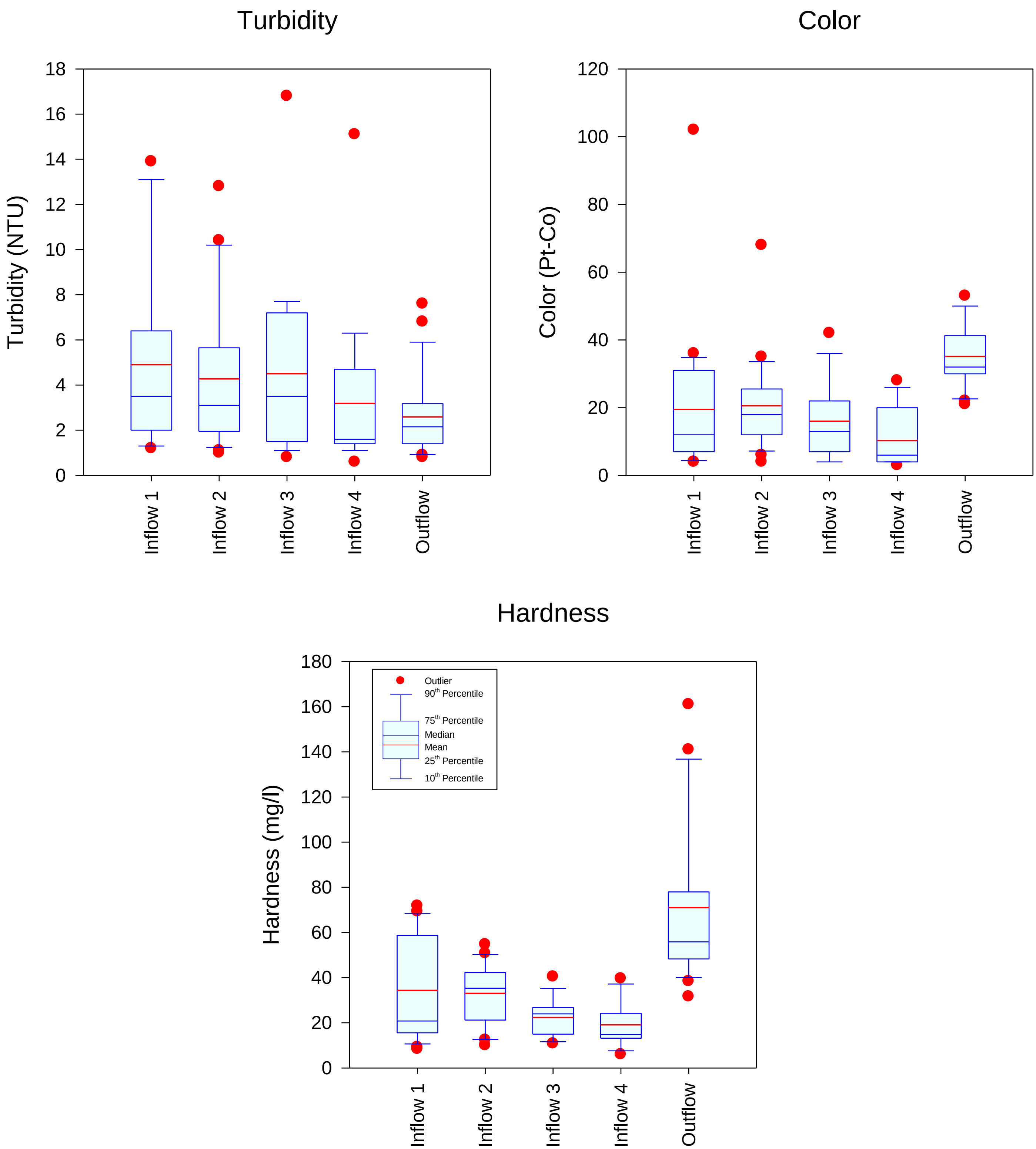


Figure 5-19. Statistical Comparison of Measured Values for Turbidity, Color, and Hardness at the Orlando Underdrain Site from December 2012-November 2013.

Relatively low levels of color were observed at each of the inflow monitoring sites, with typical values ranging from 5-30 Pt-Co units. In contrast, more elevated values for color were observed in the outflow, with values ranging from approximately 30-40 Pt-Co units. A similar pattern is also apparent for hardness, with relatively low values observed at each of the inflow sites and a somewhat higher hardness concentration observed in the outflow.

5.1.4.5 Chromium, Copper, and Zinc

A statistical comparison of measured concentrations of chromium, copper, and zinc at the Orlando underdrain site from December 2012-November 2013 is given on Figure 5-20. Lead is not included on this figure since virtually all of the measured values were less than the laboratory detection limit. In general, measured concentrations for chromium, copper, and zinc were low to moderate in value at each of the inflow monitoring sites. Underdrain concentrations of copper and zinc were substantially lower in value than observed in the inflows, with no significant change in concentration between inflow and outflow observed for chromium.

5.1.4.6 Site Comparison

A tabular summary of geometric mean values for measured values for each of the Orlando underdrain inflow and outflow monitoring sites is given on Table 5-8. In general, inflow samples collected at the Orlando underdrain site were slightly acidic in value, with slightly alkaline characteristics observed in discharges from the underdrain outfall. Inputs into the pond were also characterized by extremely low levels of both turbidity and conductivity, with more elevated values for each of these parameters observed in the underdrain outflow.

Measured concentrations of ammonia were low in value at each of the inflow monitoring sites, with a substantially lower ammonia concentration observed at the underdrain outfall, suggesting that the underdrain system has the ability to remove ammonia. Moderate levels of NO_x were observed at the inflow monitoring sites, with a slightly lower median value observed in the pond outflow, suggesting that the underdrain system may have a limited ability to reduce concentrations of NO_x. Measured concentrations of both dissolved organic nitrogen and particulate nitrogen were low in value in the inflows, with an increase in dissolved organic nitrogen observed in the underdrain outflow compared with inflows. The measured concentrations of particulate nitrogen in the underdrain discharge were similar to values measured in the inflows. Overall, measured total nitrogen concentrations in the pond inflows were approximately half of concentrations commonly observed at commercial sites. The overall total nitrogen concentration measured in the outfall of 462 μg/l is slightly lower than total nitrogen concentrations measured in the inflows, suggesting a slight reduction in nitrogen concentrations within the underdrain system.

Low levels of SRP, dissolved organic phosphorus, and particulate phosphorus were observed at each of the four inflow monitoring sites. A substantial increase in SRP appears to occur within the underdrain system, with reductions observed in concentrations for dissolved organic phosphorus and particulate phosphorus. Overall, measured total phosphorus concentrations at the pond inflows are substantially lower than values commonly observed in commercial runoff. The mean underdrain total phosphorus concentration of 76 μg/l is similar to mean concentrations measured in the inflows.

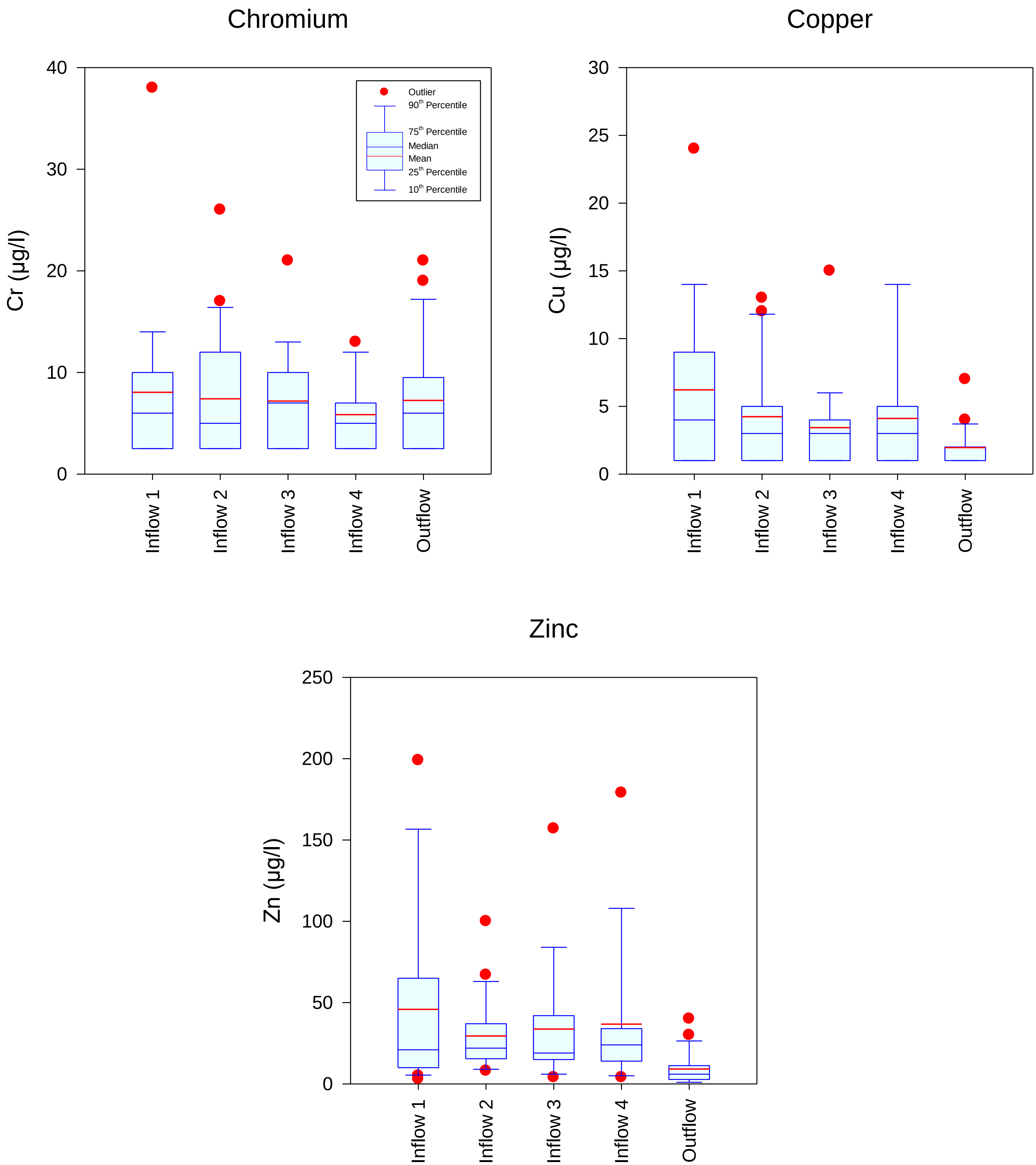


Figure 5-20. Statistical Comparison of Measured Concentrations of Chromium, Copper, and Zinc at the Orlando Underdrain Site from December 2012-November 2013.

TABLE 5-8

GEOMETRIC MEAN CONCENTRATIONS FOR INFLOW AND OUTFLOW SAMPLES AT THE ORLANDO UNDERDRAIN SITE

PARAMETER	UNITS	INFLOW 1	INFLOW 2	INFLOW 3	INFLOW 4	OUTFALL
pH	s.u.	6.55	6.78	6.63	6.49	7.27
Alkalinity	mg/l	21.4	31.8	22.4	21.2	68.2
Conductivity	µmho/cm	65	76	58	50	149
Ammonia	µg/l	16	10	37	23	8
NO_x	µg/l	245	168	213	220	190
Dissolved Organic N	µg/l	92	121	82	85	107
Particulate N	µg/l	84	68	54	90	84
Total N	µg/l	497	468	496	491	462
SRP	µg/l	12	12	10	13	51
Dissolved Organic P	µg/l	20	42	44	15	6
Particulate P	µg/l	17	16	18	23	12
Total P	µg/l	75	92	110	68	76
Turbidity	NTU	3.7	3.4	3.2	2.3	2.2
Color	Pt-Co	14	17	13	8	34
TSS	mg/l	8.9	10.0	17.7	12.6	4.0
Chromium	µg/l	5.7	5.4	5.9	5.1	5.7
Copper	µg/l	3.4	2.7	2.5	2.8	1.7
Lead	µg/l	< 2	< 2	< 2	< 2	< 2
Zinc	µg/l	24	24	22	23	5.5
Hardness	mg/l	27.4	29.8	21.0	16.9	64.4

Low levels of turbidity, color, and TSS were observed at each of the inflow monitoring sites. A slight reduction was observed in turbidity measurements in the pond outfall, with a more substantial reduction observed for TSS. However, color concentrations increased substantially during treatment in the underdrain system.

In general, measured concentrations of chromium and copper appear to be low in value in both the inflow and outflow samples. No significant reduction in chromium concentrations was observed within the underdrain system, although a reduction of approximately 50% appears to occur for copper. Somewhat more elevated levels were observed in the inflows for zinc, with a substantially lower value measured in the pond outfall, suggesting the underdrain system has an affinity for removal of zinc.

5.1.5 Commercial Runoff Characteristics

One of the objectives of this project is to provide additional runoff characterization data for low-intensity commercial land use projects. Low-intensity land use is defined as small strip malls and neighborhood shopping centers. Literature reviews on runoff characterization data for typical land use categories within the State of Florida have been conducted by ERD beginning in 1994, with periodic updates published as additional available characterization data became available. This information has been used extensively by FDEP and private consultants throughout Florida in TMDL and watershed studies.

The most recent summary of runoff characterization for low-intensity land use was conducted by Harper and Baker (2007) and summarized in the document titled "Evaluation of Current Stormwater Design Criteria within the State of Florida". A tabular summary of current runoff characterization data for low-intensity commercial land use summarized in the 2007 report is given in Table 5-9. Runoff characterization data for low-intensity commercial land use were obtained from nine separate studies conducted throughout the Florida. Geometric mean runoff concentrations for significant loading parameters, such as total nitrogen, total phosphorus, and TSS, in the low-intensity commercial studies are 1070 µg/l (1.07 mg/l), 179 µg/l (0.179 mg/l), and 47.5 mg/l, respectively. These studies were based upon field monitoring conducted from 1978-2005, with the most recent runoff data more than 10 years old.

A summary of geometric mean characteristics of runoff samples collected at the low-intensity commercial monitoring sites during the study is given on Table 5-10. In general, runoff characteristics for significant loading parameters are remarkably close in value between the sites which are scattered throughout Central and South Florida, which suggest that runoff characteristics on low-intensity commercial sites may be relatively consistent in value. The overall mean values for significant loading parameters are 510 µg/l for total nitrogen, 73 µg/l for total phosphorus, and 6.5 mg/l for TSS which are approximately one-half or less of the values currently listed in the emc database for low-intensity land use sites.

Over the past 10 years, a large emphasis has been placed on improving maintenance activities in efforts to reduce nonpoint source loadings from urban watersheds. Guidelines and regulations have been established governing the application of fertilizers on landscaping areas in commercial settings and many property managers currently utilize vacuum sweepers on a periodic basis to remove trash and general debris from parking areas. The data obtained in this research suggests that these enhanced maintenance activities may have resulted in substantial reductions in runoff concentrations of nutrients, solids, and heavy metals in low-intensity commercial runoff. The observed similarity in runoff characteristics (particularly for total nitrogen, total phosphorus, TSS, and metals) between the various sites located throughout Central and South Florida suggest that runoff characteristics from low-intensity commercial sites exhibit similar and consistent characteristics.

Based upon the revised runoff characterization data summarized in Table 5-9, it appears that the commonly used runoff characterization values for low-intensity commercial land use, based upon the historical literature values, may be over-estimating impacts from commercial areas, particularly for newer developments. It is recommended that the runoff characterization database for low-intensity commercial land use be modified to incorporate the revised and more current values which reflect maintenance and operational activities under current conditions.

TABLE 5-9

SUMMARY OF LOW-INTENSITY COMMERCIAL LAND USE RUNOFF CHARACTERIZATION DATA COLLECTED WITHIN FLORIDA

LOCATION	REFERENCE	REPORTED EMC (mg/l)										
		TN	**TP**	**BOD**	**TSS**	**Cd**	**Cr**	**Cu**	**Fe**	**Ni**	**Pb**	**Zn**
Orlando Areawide	ECFRPC (1978)	0.89	0.160	3.6	146.0	--	--	--	--	--	0.068	--
Coral Ridge Mall	Miller (1979)	1.10	0.100	5.4	45.0	--	--	0.015	--	--	0.387	0.128
Norma Park (Tampa)	US EPA (1983)	1.19	0.150	12.0	22.0	--	--	--	--	--	0.046	0.037
International Market	Harper (1988)	1.53	0.190	11.6	111.0	0.008	0.013	0.031	1.100	0.028	0.136	0.168
DeBary	Harper & Herr (1993)	0.76	0.260	6.9	79.1	0.0005	0.003	0.010	0.582	--	0.009	0.028
Bradfordville	ERD (2000)	2.14	0.160	9.0	38.3	--	--	--	--	--	--	--
Cross Creek (Tallahassee)	COT & ERD (2002)	0.93	0.150	8.0	15.0	--	--	0.008	--	--	0.002	0.045
Sarasota County	ERD (2004)	0.88	0.310	4.3	39.9	--	--	--	--	--	--	--
Florida Aquarium (Tampa)	Teague, et al. (2005)	0.76	0.215	--	42.4	0.003	--	0.019	1.170	--	0.008	0.090
	Mean Value:	**1.13**	**0.188**	**7.6**	**59.9**	**0.004**	**0.008**	**0.017**	**0.951**	**0.028**	**0.006**	**0.083**
	Median Value:	**0.93**	**0.160**	**7.5**	**42.4**	**0.003**	**0.008**	**0.015**	**1.100**	**0.028**	**0.008**	**0.068**
	Log-Normal Mean:	**1.07**	**0.179**	**7.00**	**47.5**	**0.002**	**0.006**	**0.015**	**0.908**	**0.028**	**0.005**	**0.067**

[Yellow highlight] Not included in mean or median value due to dramatic reductions in lead from removal of lead in gasoline

TABLE 5-10

GEOMETRIC MEAN CHARACTERISTICS OF RUNOFF SAMPLES COLLECTED AT THE LOW-INTENSITY COMMERCIAL MONITORING SITES

PARAMETER	UNITS	BONITA SPRINGS				NAPLES			PEMBROKE PINES		ORLANDO				GEOMETRIC MEAN VALUE
		Inflow 1	Inflow 2	Inflow 3	Inflow 4	Inflow 1	Inflow 2	Inflow 3	Inflow 1	Inflow 2	Inflow 1	Inflow 2	Inflow 3	Inflow 4	
pH	s.u.	7.03	7.10	6.91	6.87	6.96	6.93	6.66	7.33	7.02	6.55	6.78	6.63	6.49	6.86
Alkalinity	mg/l	61.2	57.7	51.4	54.0	44.0	42.2	26.8	68.2	44.1	21.4	31.8	22.4	21.2	38.9
Conductivity	µmho/cm	853	341	339	425	107	111	57	176	105	65	76	58	50	139
Ammonia	µg/l	13	26	11	14	7	8	8	10	26	16	10	37	23	14
NO_x	µg/l	23	47	24	44	100	81	31	112	63	245	168	213	220	78
Dissolved Organic N	µg/l	310	255	265	239	183	180	213	215	205	92	121	82	85	172
Particulate N	µg/l	139	102	145	101	81	86	59	76	127	84	68	54	90	89
Total N	µg/l	640	565	632	522	452	452	379	559	537	497	468	496	491	510
SRP	µg/l	13	76	22	11	15	14	6	12	8	12	12	10	13	13
Dissolved Organic P	µg/l	9	7	16	13	10	12	5	31	23	20	42	44	15	15
Particulate P	µg/l	27	19	24	22	14	29	15	29	29	17	16	18	23	21
Total P	µg/l	71	109	87	65	47	69	30	96	79	75	92	110	68	73
Turbidity	NTU	2.0	1.7	2.8	3.1	1.8	2.2	1.9	1.8	2.0	3.7	3.4	3.2	2.3	2
Color	Pt-Co	36	52	31	31	28	24	24	20	17	14	17	13	8	22
TSS	mg/l	5.7	3.9	7.3	9.1	3.2	4.9	3.9	4.3	5.1	8.9	10.0	17.7	12.6	6.5
Chromium	µg/l	6.2	6.5	6.2	8.5	5.2	5.1	4.4	5.0	5.2	5.7	5.4	5.9	5.1	5.6
Copper	µg/l	3.3	3.6	3.2	4.1	1.5	2.1	1.3	2.1	2.5	3.4	2.7	2.5	2.8	2.6
Lead	µg/l	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2
Zinc	µg/l	5.2	3.7	5.1	14.5	3.0	5.9	4.9	11.7	29	24	24	22	23	10
Hardness	mg/l	141	68.2	77.7	89.7	44.0	43.3	36.9	65.3	41.8	27.4	29.8	21.0	16.9	45.6

5.2 Bulk Precipitation

A summary of the number of bulk precipitation samples collected at each of the monitoring sites from December 2012-November 2013 is given in Table 5-11. During the 12-month field monitoring program, a total of 101 composite bulk precipitation samples was collected at the four study sites. A complete listing of the chemical characteristics of the bulk precipitation samples collected at the dry detention and underdrain monitoring sites is given in Appendix C. A discussion of the chemical characteristics of bulk precipitation samples collected at the four monitoring sites is given in the following sections.

TABLE 5-11

SUMMARY OF BULK PRECIPITATION SAMPLES COLLECTED AT THE SELECTED MONITORING SITES FROM DECEMBER 2012 – NOVEMBER 2013

SITE	NUMBER OF SAMPLES COLLECTED
Bonita Springs	25
Naples	26
Pembroke Pines	26
Orlando	24
TOTAL:	**101**

5.2.1 General Parameters

A statistical comparison of measured values of pH, alkalinity, conductivity, and TSS in bulk precipitation collected at the four monitoring sites from December 2012-November 2013 is given on Figure 5-21. Measured pH values in bulk precipitation at each of the four sites were acidic, with the majority of measured values ranging from approximately 5.2-6.0. Measured pH values at Bonita Springs, Orlando, and Naples monitoring sites appear to be relatively similar, with a slightly higher overall median pH value observed at Pembroke Pines.

Measured alkalinity values in the collected bulk precipitation samples were generally low in value, with the vast majority of measured alkalinity values less than approximately 5 mg/l. Alkalinity concentrations in this range are typical of values commonly observed in bulk precipitation.

Bulk precipitation samples at the four sites were also characterized by extremely low levels of conductivity, less than approximately 30 μmho/cm. Measured TSS concentrations in bulk precipitation were also generally low in value, with the vast majority of measurements less than approximately 5 mg/l. TSS concentrations collected at the Orlando and Naples monitoring sites appear to be slightly higher in value than samples collected at Bonita Springs and Pembroke Pines.

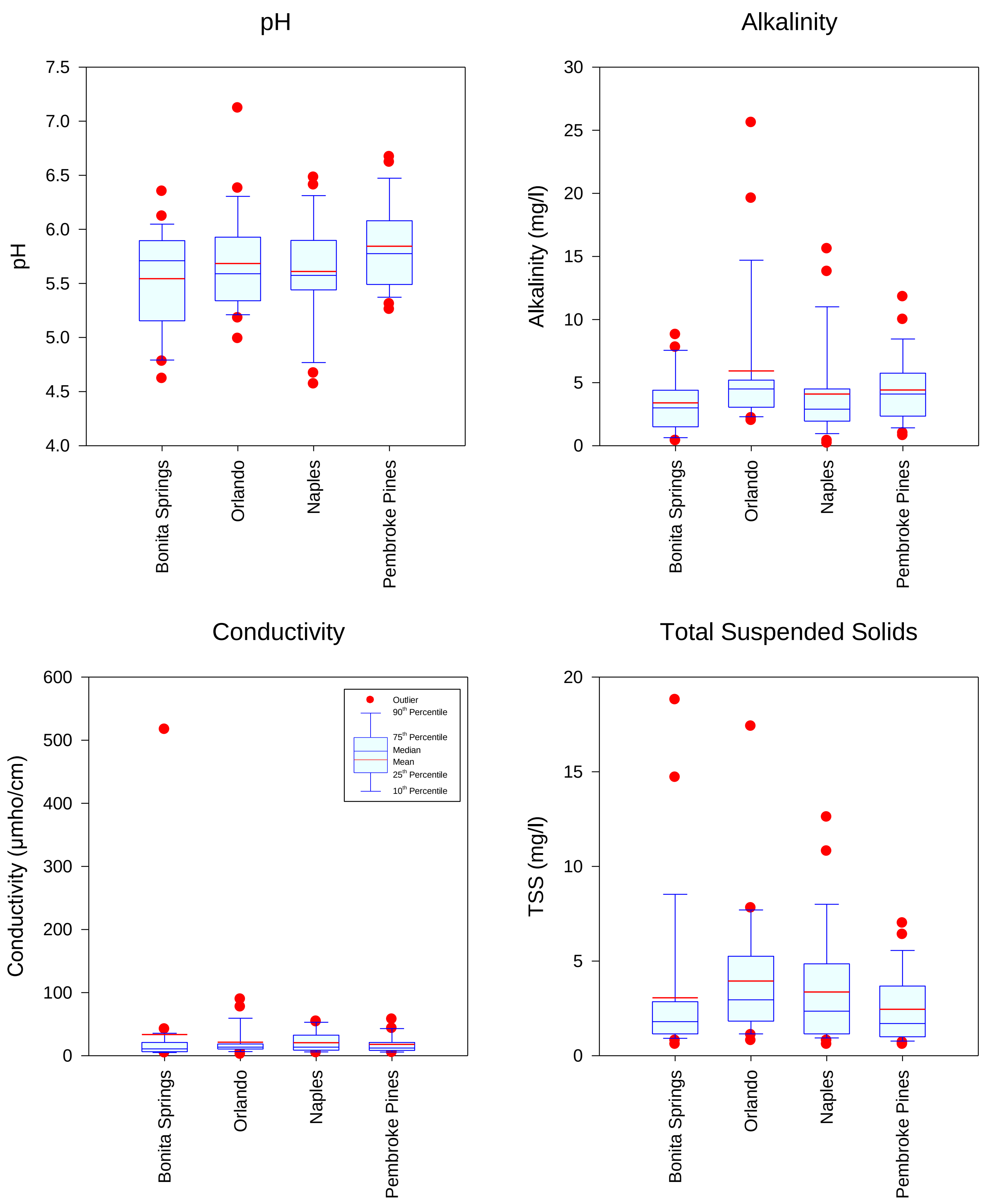


Figure 5-21. Statistical Comparison of Measured Values for pH, Alkalinity, Conductivity, and TSS at the Four Monitoring Sites from December 2012-November 2013.

5.2.2 Nitrogen Species

A statistical comparison of measured concentrations of nitrogen species in bulk precipitation samples collected at the four monitoring sites from December 2012-November 2013 is given on Figure 5-22. In general, measured concentrations of ammonia were low in value, with the vast majority of measurements less than approximately 100-200 µg/l. A substantial outlier value in excess of 2500 µg/l was observed on one occasion at the Orlando site.

Measured concentrations of NO_x in bulk precipitation were moderate in value and, in some cases, more elevated than concentrations measured in stormwater runoff. Measured concentrations of NO_x ranged from approximately 50-350 µg/l for a majority of the samples, although outlier values substantially above and below this range were observed on multiple occasions. Measured NO_x concentrations appear to be relatively similar in bulk precipitation at Bonita Springs, Naples, and Pembroke Pines, with a more elevated median value and a higher degree of variability observed at the Orlando site.

Measured concentrations of particulate nitrogen in bulk precipitation were typically low in value, with measured concentrations generally less than 100-200 µg/l. Particulate nitrogen concentrations appear to be relatively similar between the four monitoring locations.

Measured concentrations of total nitrogen in bulk precipitation ranged from approximately 100-800 µg/l in a majority of the collected samples, although outlier values both above and below this range were observed on multiple occasions. The lowest total nitrogen concentrations in bulk precipitation were measured at Bonita Springs, followed by relatively similar values at Naples and Pembroke Pines, and a slightly more elevated concentration observed at the Orlando site.

5.2.3 Phosphorus Species

A statistical comparison of measured concentrations of phosphorus species in bulk precipitation collected at the four monitoring sites from December 2012-November 2013 is given on Figure 5-23. Measured concentrations of SRP were generally low in value at the Bonita Springs and Pembroke Pines sites, with the vast majority of measured values less than 10 µg/l at these sites. More elevated SRP values were observed at the Naples site, with typical concentrations equal to approximately 20 µg/l or less. The most elevated levels of SRP were observed at the Orlando site, with measured values ranging from approximately 5-60 µg/l. A similar pattern is also apparent for measured concentrations of dissolved organic phosphorus, with extremely low levels measured at the Bonita Springs, Naples, and Pembroke Pines sites, and more elevated values measured at the Orlando site.

Measured concentrations of particulate phosphorus in bulk precipitation were extremely low in value at the Bonita Springs, Naples, and Pembroke Pine sites, with the vast majority of measured values equal to 15 µg/l or less. A higher range of particulate phosphorus values was measured at the Orlando site, with typical concentrations ranging from 5-25 µg/l.

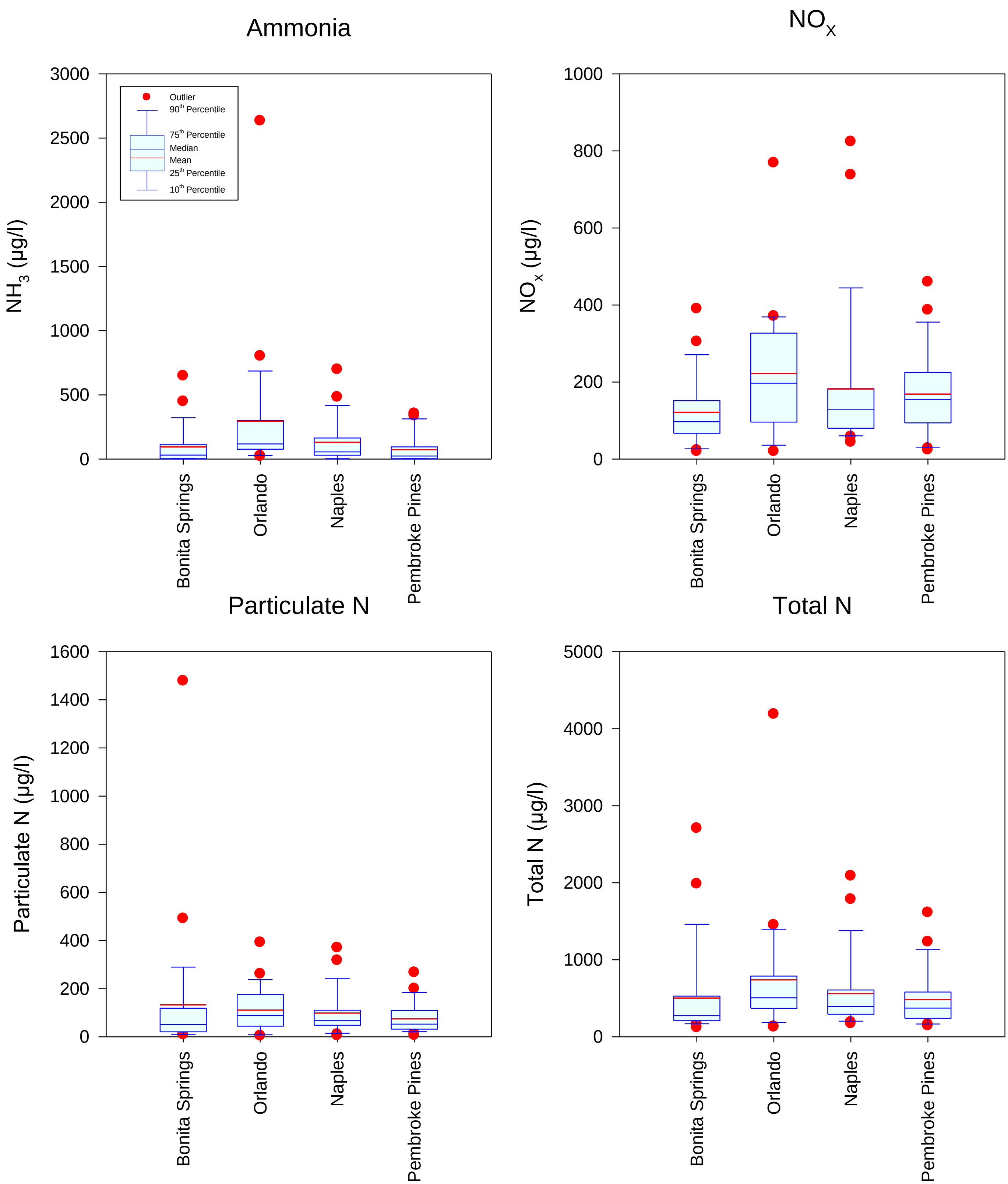


Figure 5-22. Statistical Comparison of Measured Concentrations of Nitrogen Species at the Four Monitoring Sites from December 2012-November 2013.

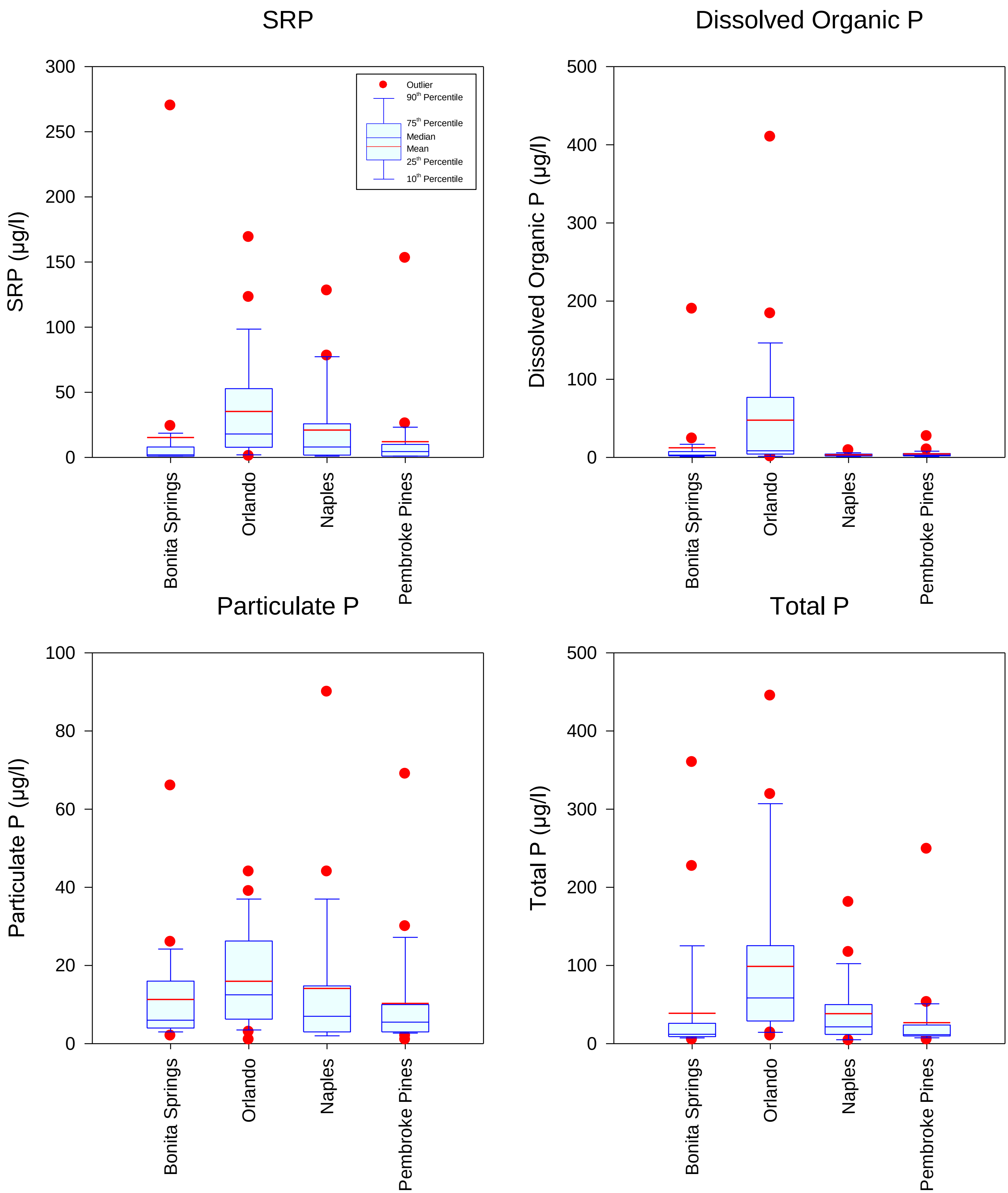


Figure 5-23. Statistical Comparison of Measured Concentrations of Phosphorus Species at the Four Monitoring Sites from December 2012-November 2013.

Overall, low levels of total phosphorus were measured in bulk precipitation at both the Bonita Springs and Pembroke Pines monitoring sites, with the vast majority of measured values less than 20 µg/l. Somewhat more elevated values were observed at the Naples site, with typical concentrations equal to approximately 40 µg/l or less. An even greater range of concentrations was observed at the Orlando site, with concentrations ranging from approximately 20-140 µg/l.

5.2.4 <u>Turbidity, Color, and Hardness</u>

A statistical comparison of measured concentrations of turbidity, color, and hardness in bulk precipitation samples collected at the four monitoring sites from December 2012-November 2013 is given on Figure 5-24. In general, extremely low levels of both turbidity and color were observed in bulk precipitation collected at each of the four sites. Measured turbidity values were generally less than 2 NTU, with color values typically less than 5 Pt-Co units. Low levels of hardness were also measured at each of the four sites, with typical values less than 5 mg/l.

5.2.5 <u>Chromium, Copper, and Zinc</u>

A statistical comparison of measured concentrations of chromium, copper, and zinc in bulk precipitation measured at the four monitoring sites from December 2012-November 2013 is given on Figure 5-25. Lead is not included on this figure since virtually all of the measured values for lead were less than the laboratory detection limit. In general, relatively low levels of both chromium and copper were measured at the four monitoring sites, with chromium concentrations virtually identical at each of the four locations. A higher degree of variability is apparent in measured copper concentrations at each of the four sites, although the vast majority of measured values are less than 3 µg/l.

In contrast, a high degree of variability was observed in measured concentrations of zinc at each of the four monitoring sites. The lowest levels of zinc were observed at the Bonita Springs site, with the vast majority of measured values less than 10 µg/l. Measured zinc concentrations in bulk precipitation at the Naples and Pembroke Pines site were typically equal to 20 µg/l or less. Substantially higher measured zinc concentrations were observed at the Orlando site, with the majority of measurements ranging from 20-50 µg/l.

5.2.6 <u>Site Comparison</u>

A comparison of mean bulk precipitation characteristics measured at the dry detention and underdrain monitoring sites is given on Table 5-12. In general, bulk precipitation at each of the four sites was acidic and extremely poorly buffered, with mean alkalinity values ranging from 2.6-4.7. Bulk precipitation samples were also characterized by extremely low levels of conductivity, with mean values ranging from 13-15 µmho/cm.

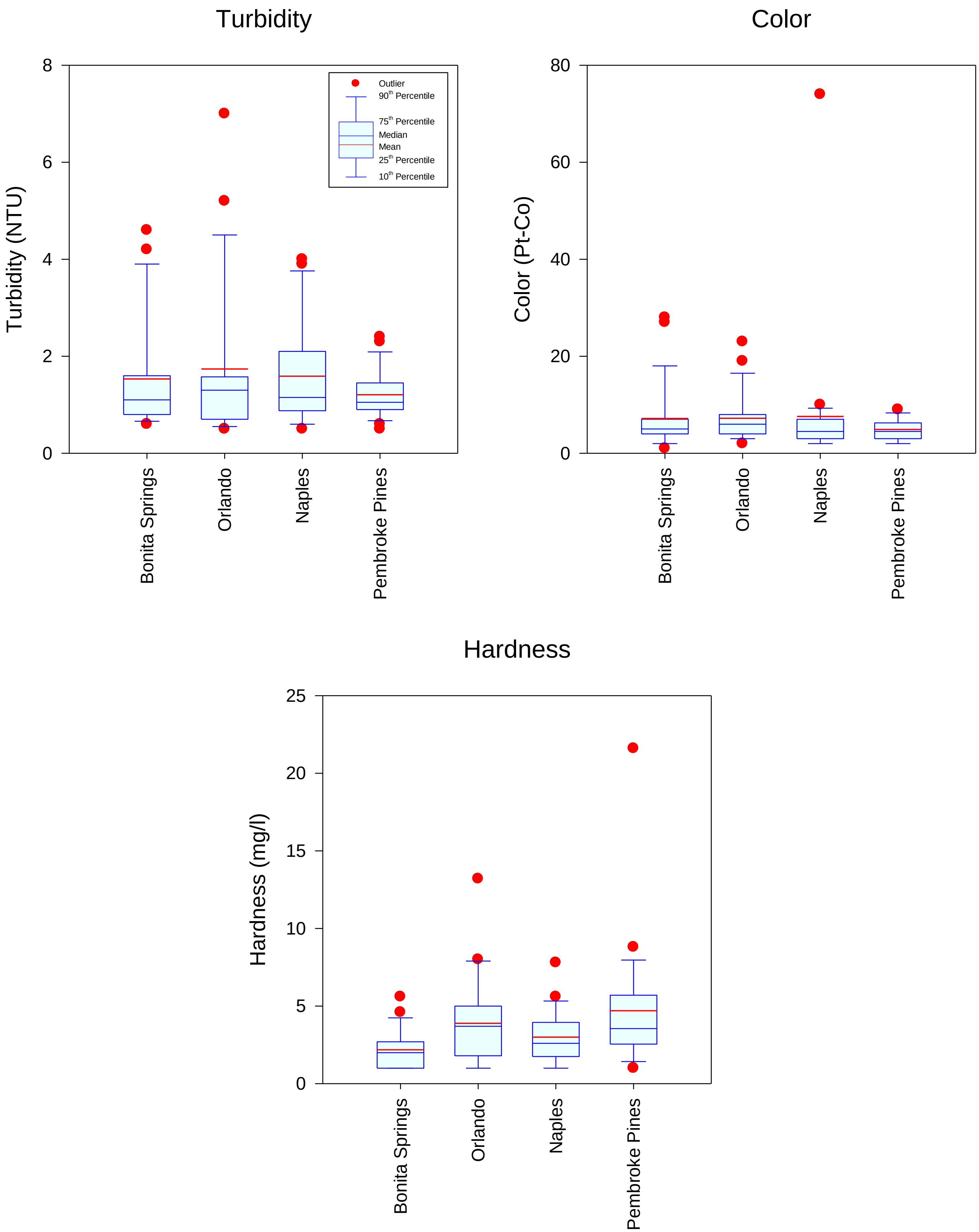


Figure 5-24. Statistical Comparison of Measured Values for Turbidity, Color, and Hardness at the Four Monitoring Sites from December 2012-November 2013.

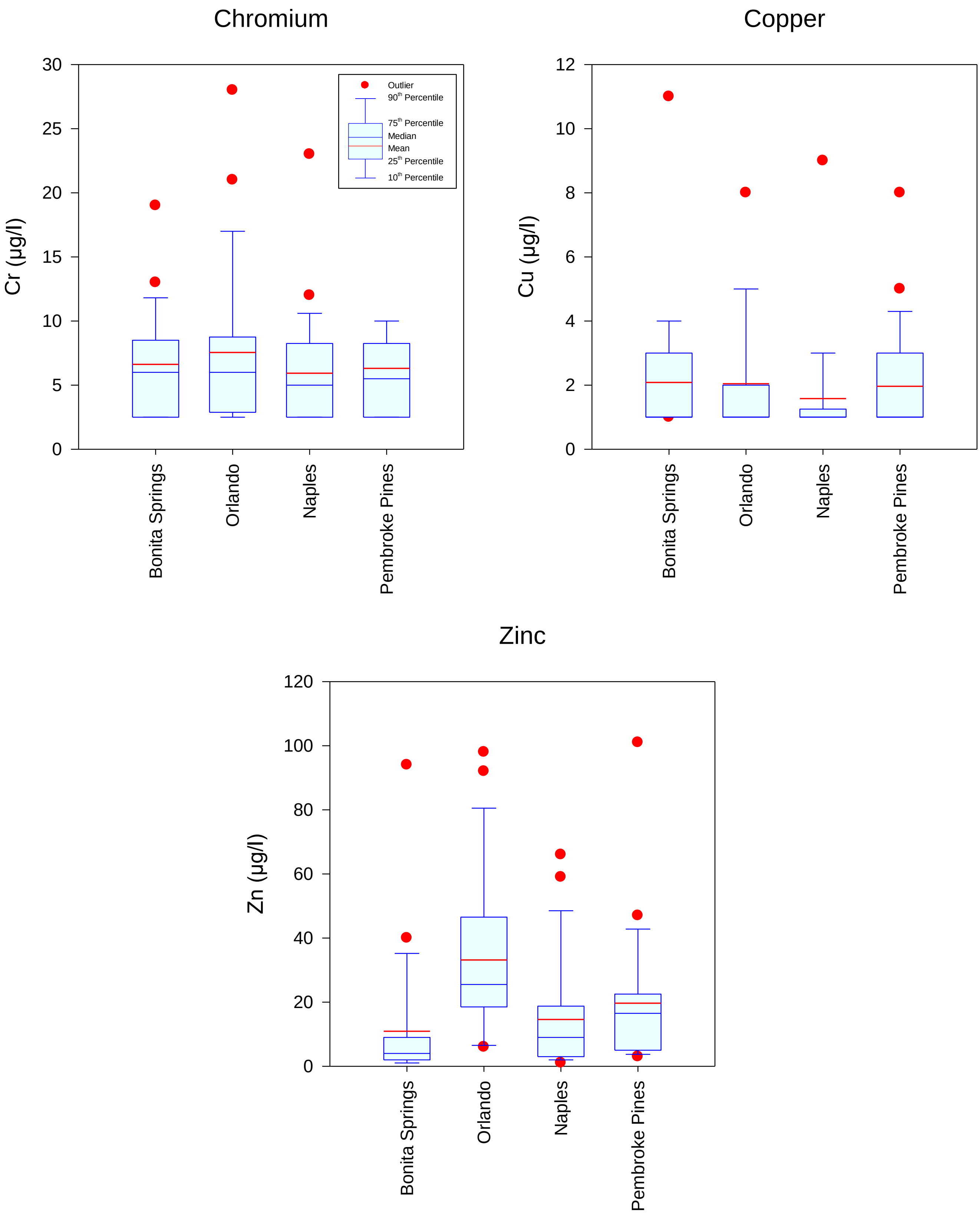


Figure 5-25. Statistical Comparison of Measured Concentrations of Chromium, Copper, and Zinc at the Four Monitoring Sites from December 2012-November 2013.

TABLE 5-12

SUMMARY OF BULK PRECIPITATION CHARACTERISTICS AT THE SELECTED MONITORING SITES

PARAMETER	UNITS	BONITA SPRINGS	NAPLES	PEMBROKE PINES	ORLANDO
pH	s.u.	5.52	5.59	5.83	5.67
Alkalinity	mg/l	2.6	2.8	3.6	4.7
Conductivity	µmho/cm	13	15	14	15
Ammonia	µg/l	26	56	20	141
NO_x	µg/l	94	136	131	166
Dissolved Organic N	µg/l	106	103	100	68
Particulate N	µg/l	54	66	54	70
Total N	µg/l	350	440	393	538
SRP	µg/l	3	8	4	18
Dissolved Organic P	µg/l	4	3	3	13
Particulate P	µg/l	8	8	6	11
Total P	µg/l	17	23	16	61
Turbidity	NTU	1.0	1.3	1.1	1.3
Color	Pt-Co	5	5	4	6
TSS	mg/l	2	2.4	1.9	3.0
Chromium	µg/l	6.3	4.8	5.3	6.2
Copper	µg/l	< 2	< 2	< 2	2.9
Lead	µg/l	< 2	< 2	< 2	< 2
Zinc	µg/l	4.8	8.1	13	25
Hardness	mg/l	1.9	2.6	3.7	3.0

Bulk precipitation samples collected at Bonita Springs, Naples, and Pembroke Pines exhibited low levels of ammonia, with substantially higher ammonia concentrations observed at the Orlando site. Measured concentrations of NO_x were low to moderate in value, with mean concentrations ranging from 94-166 µg/l. Relatively low levels were observed for both dissolved organic nitrogen and particulate nitrogen at each of the four sites. Overall, mean total nitrogen concentrations in bulk precipitation ranged from 350-538 µg/l, with the lowest value measured at the Bonita Springs site and the highest value measured at the Orlando site.

Low levels of SRP, dissolved organic phosphorus, and particulate phosphorus were measured in bulk precipitation collected at the Bonita Springs, Naples, and Pembroke Pines monitoring sites, with more elevated values for these parameters observed at the Orlando site. Mean concentrations of total phosphorus in bulk precipitation ranged from 16-23 µg/l at the Bonita Springs, Naples, and Pembroke Pines sites, with a substantially higher mean total phosphorus concentration of 61 µg/l measured at the Orlando site.

Low levels of turbidity, color, and TSS were observed at each of the four monitoring sites, with relatively similar mean values for each of these parameters. Extremely low levels of copper and lead were observed at each of the four monitoring sites, with slightly more elevated concentrations for chromium and zinc. Measured concentrations of chromium were relatively similar between the four sites, although a relatively high degree of variability is apparent between the mean values for zinc which range from 4.8 μg/l at Bonita Springs to 25 μg/l in Orlando. Measured hardness concentrations are relatively similar at each of the four sites.

5.3 Shallow Groundwater

As discussed in Section 3.1.6, shallow groundwater monitoring wells were installed in each of the evaluated ponds at the four monitoring sites. Background monitoring wells, located outside of the influence from the pond systems, were also installed at the Bonita Springs and Pembroke Pines sites. Overall, a total of 11 separate shallow groundwater monitoring wells were installed at the four sites.

A summary of the number of shallow groundwater samples collected at each of the monitoring sites from December 2012-November 2013 is given in Table 5-13. During the 12-month field monitoring program, a total of 132 separate groundwater monitoring samples was collected at the four study sites. A complete listing of the chemical characteristics of the shallow groundwater samples collected at the dry detention and underdrain monitoring sites is given in Appendix D. A discussion of the chemical characteristics of groundwater samples collected at the four monitoring sites is given in the following sections.

TABLE 5-13

SUMMARY OF SHALLOW GROUNDWATER SAMPLES COLLECTED AT THE SELECTED MONITORING SITES FROM DECEMBER 2012 – NOVEMBER 2013

SITE	NUMBER OF MONITORING WELL SITES	NUMBER OF SAMPLES COLLECTED
Bonita Springs	4	48
Naples	2	24
Pembroke Pines	3	36
Orlando	2	24
TOTAL:	**11**	**132**

5.3.1 Bonita Springs Dry Detention Site

As indicated on Figure 3-1, a total of three groundwater monitoring wells was installed at the Bonita Springs site. Monitoring wells 1, 2, and 3 were installed beneath Ponds 1, 2, and 3, respectively, with MW-4 installed in a background area west of Pond 3.

5.3.1.1 General Parameters

A statistical comparison of measured values of pH, alkalinity, conductivity, and color in groundwater samples collected at the Bonita Springs monitoring sites from December 2012-November 2013 is given on Figure 5-26. Locations of monitoring wells installed at the Bonita Springs site are given on Figure 3-1. Monitoring Wells designated MW-1 through MW-3 reflect monitoring wells installed in dry detention Ponds 1, 2, and 3, respectively. Monitoring Well 4 is the background site and is located outside of Pond 3 in an area which was not substantially impacted by the dry detention pond. Measured pH values in the groundwater samples were approximately neutral to slightly alkaline, with the vast majority of measured values ranging from 6.8-7.5. In general, pH values in groundwater samples appear to be slightly greater than pH values measured at the inflows to each pond.

Measured alkalinity values in the groundwater samples were moderate to high in value, indicating well buffered conditions. The vast majority of measured alkalinity values ranged from approximately 50-500 mg/l which is substantially higher than median concentrations measured in the inflows. It appears that groundwater concentrations of alkalinity are impacted by the surficial limerock formations common throughout the area. The highest measured alkalinity values occurred at the background monitoring well (MW-4), with typical values ranging from 350-450 mg/l.

Groundwater samples at the Bonita Springs site were characterized by elevated values for conductivity which are substantially greater than values measured in the inflow samples. A high degree of variability was observed in measured conductivity values in monitoring wells MW-1, MW-2, and MW-4, with a much lower degree of variability observed in MW-3 which is located in the final detention pond. Groundwater concentrations of conductivity appear to be impacted by factors other than the conductivity of the inflow samples.

Measured color concentrations in groundwater at the Bonita Springs site were highly variable, with a low degree of variability in measured values at any given site. Measured color concentrations beneath Pond 1 were similar to values measured in the inflows to Pond 1. However, color concentrations in groundwater beneath Ponds 2 and 3 were greater than color concentrations measured in the pond inflows, with substantially higher color concentrations measured in the background well. Color concentrations in groundwater appear to be impacted by factors other than runoff inputs to the ponds.

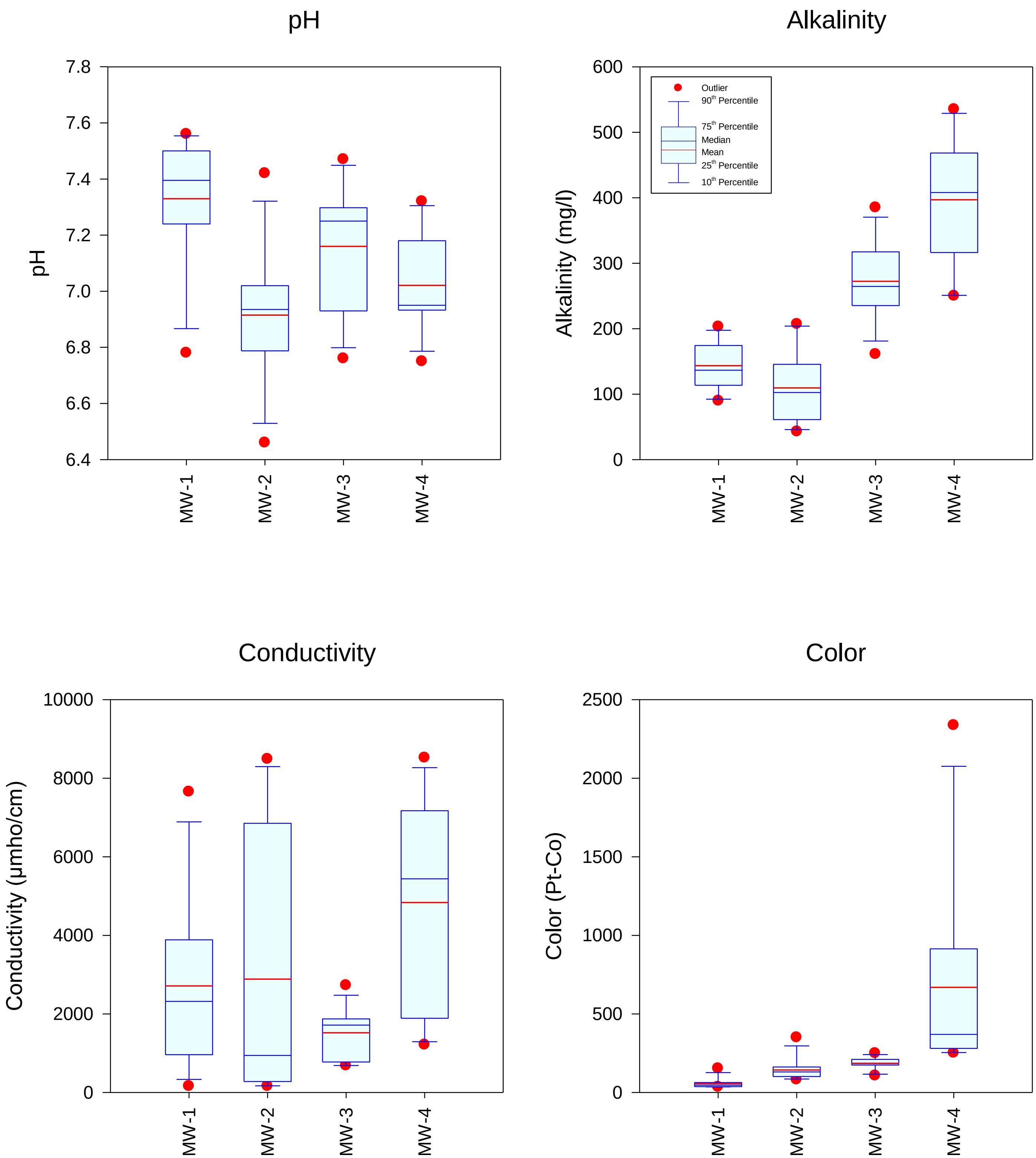


Figure 5-26. Statistical Comparison of Measured Values for pH, Alkalinity, Conductivity, and Color in Groundwater at the Bonita Springs Site from December 2012-November 2013.

5.3.1.2 Nitrogen Species

A statistical comparison of measured concentrations of nitrogen species at the Bonita Springs dry detention pond site from December 2012-November 2013 is given on Figure 5-27. In general, relatively elevated concentrations of ammonia were observed in groundwater samples collected at each of the four monitoring well sites, with measured concentrations ranging from approximately 50-3500 µg/l. These values are substantially greater than the ammonia concentrations measured in runoff inflows which exhibited mean values ranging from approximately 10-25 µg/l. Substantial enhancement of ammonia concentrations appears to occur beneath the pond and appears to originate from a source other than runoff inflows.

Measured groundwater concentrations of NO_x were low in value at each of the four groundwater monitoring sites, with measured concentrations ranging from approximately 5-15 µg/l in most samples. The NO_x concentrations measured in groundwater appear to be slightly lower than NO_x concentrations measured in the runoff inflows. The lower concentrations of NO_x observed in groundwater beneath the pond could be due to denitrification processes in anoxic shallow groundwaters beneath the pond.

Highly variable concentrations of dissolved organic nitrogen were measured in groundwater beneath the Bonita Springs detention ponds. In general, concentrations of organic nitrogen in groundwater appear to be similar to values measured in runoff inputs into the various detention ponds. A substantially higher range of organic nitrogen concentrations were observed in the background monitoring well, with typical values ranging from 3300-4500 µg/l. These values are substantially higher than organic nitrogen concentrations measured in pond inflows and suggest additional sources of organic nitrogen may be impacting groundwater other than runoff inputs.

Elevated concentrations of total nitrogen were measured in groundwater at each of the four monitoring sites, with typical values ranging from approximately 200-8000 µg/l. The observed total nitrogen concentrations in the groundwater are substantially higher than nitrogen concentrations measured in the runoff inflows, suggesting that additional sources may be impacting groundwater nitrogen concentrations other than inputs of stormwater runoff.

5.3.1.3 Phosphorus Species

A statistical comparison of measured concentrations of phosphorus species at the Bonita Springs dry detention pond site from December 2012-November 2013 is given on Figure 5-28. Measured concentrations of SRP in groundwater samples were low to moderate in value, with the majority of measured groundwater concentrations ranging from 10-130 µg/l. The most elevated concentrations of SRP were measured beneath Pond 1, with lower and relatively similar SRP concentrations measured beneath Ponds 2, 3, and at the background monitoring site. The observed SRP concentrations in groundwater beneath the ponds appear to be similar to or slightly greater than SRP concentrations measured in the inflows, suggesting a possible enhancement of SRP concentrations beneath the ponds.

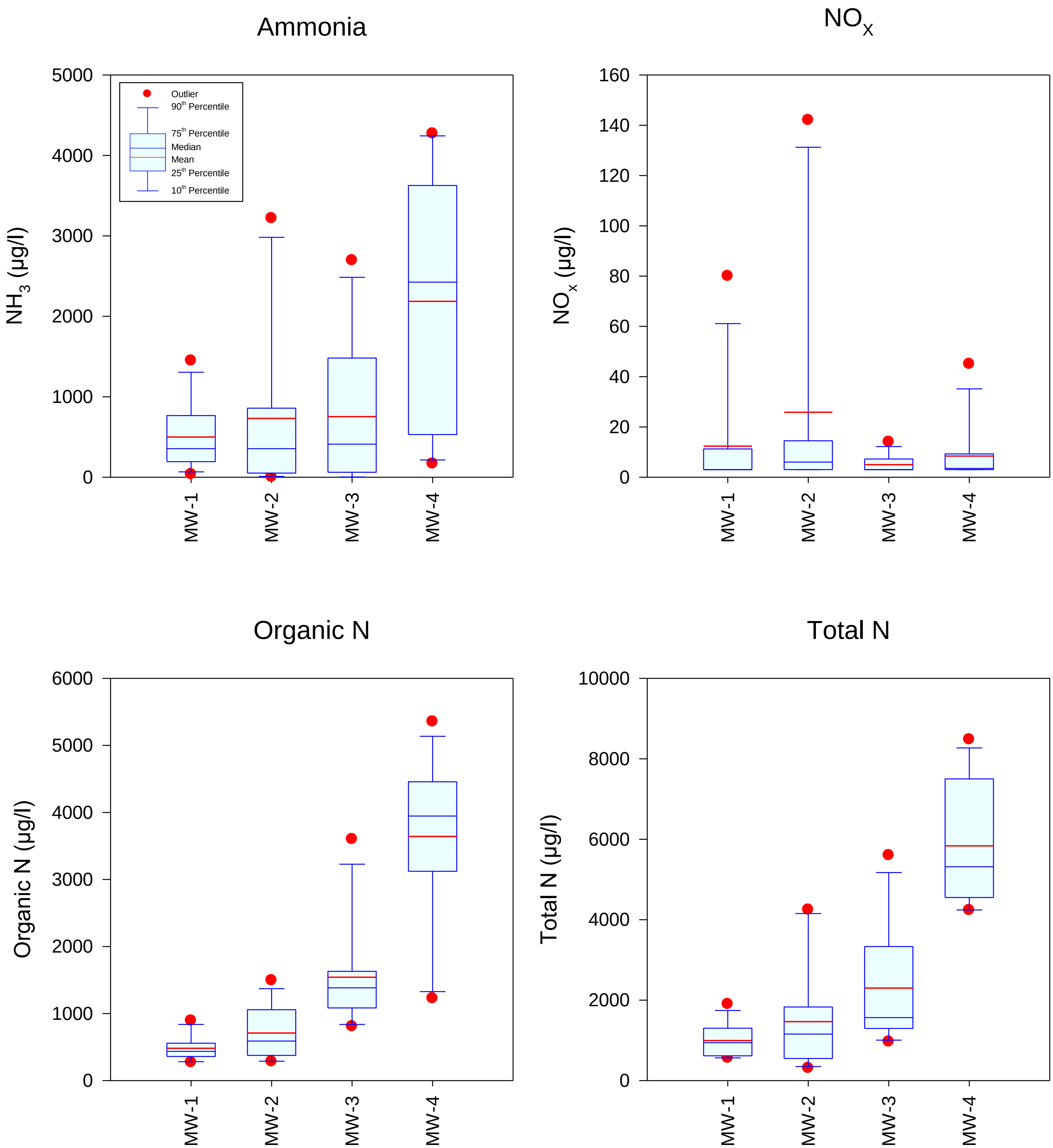


Figure 5-27. Statistical Comparison of Measured Concentrations of Nitrogen Species in Groundwater at the Bonita Springs Site from December 2012-November 2013.

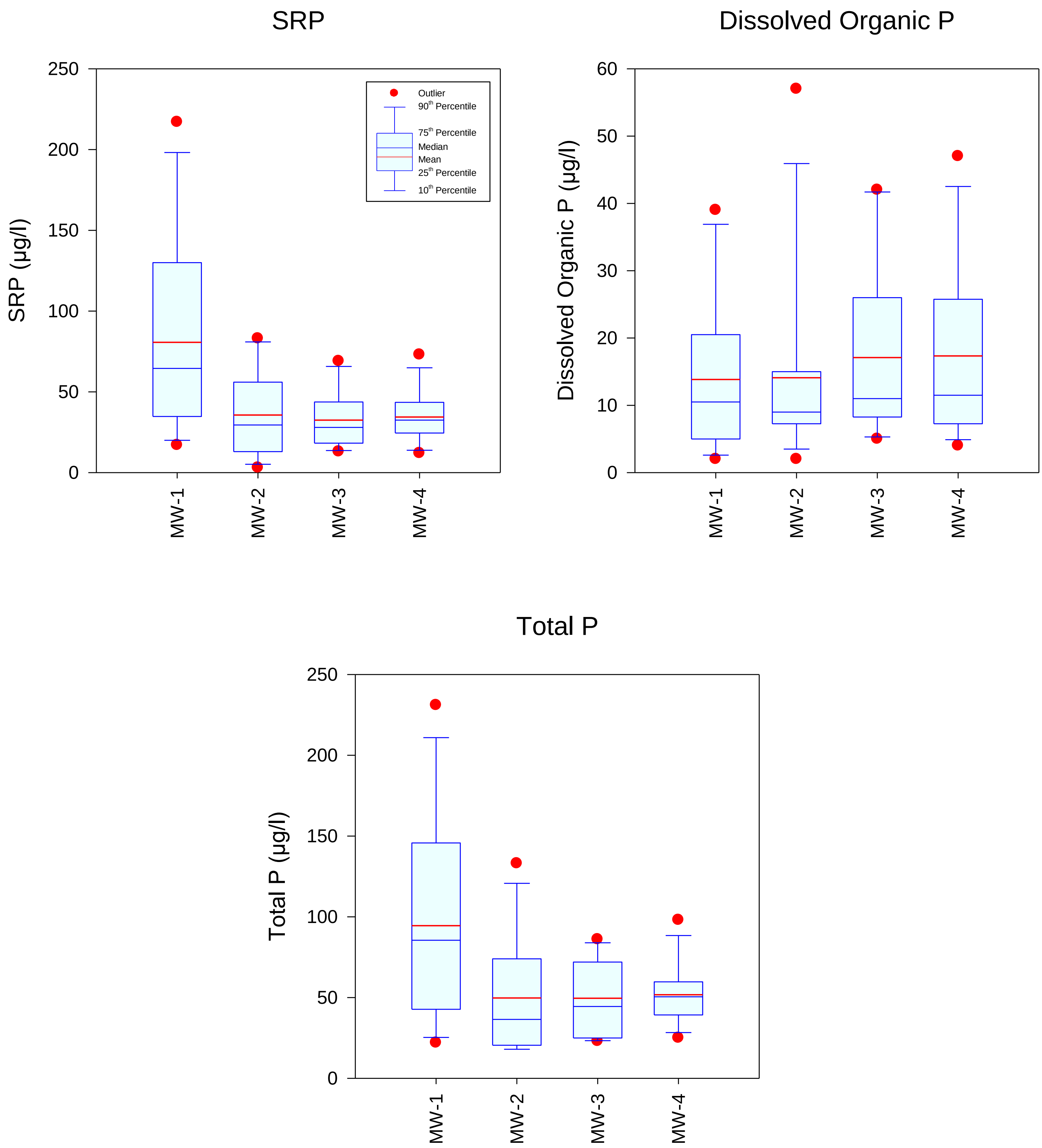


Figure 5-28. Statistical Comparison of Measured Concentrations of Phosphorus Species in Groundwater at the Bonita Springs Site from December 2012-November 2013.

Concentrations of dissolved organic phosphorus appear to be similar in value beneath each of the three ponds and at the background monitoring site. The observed groundwater concentrations appear to be similar to or slightly greater than concentrations of dissolved organic phosphorus measured in the runoff inflows.

Groundwater concentrations of total phosphorus were generally low in value, with the majority of measurements ranging from 20-150 μg/l. The observed groundwater total phosphorus concentrations appear to be lower than total phosphorus measured in the inflows, suggesting a removal of phosphorus during migration through the pond soils. No significant difference was observed in measured phosphorus concentrations at the background site compared with groundwater beneath the ponds.

5.3.1.4 Chromium, Copper, Zinc, and Hardness

A statistical comparison of measured concentrations of chromium, copper, zinc, and hardness at the Bonita Springs dry detention pond site from December 2012-November 2013 is given on Figure 5-29. In general, relatively low levels of both chromium and copper were observed in groundwater samples collected beneath the ponds and at the background monitoring sites. The observed groundwater concentrations of chromium appear to be slightly greater than chromium concentrations measured in the pond inflows, while measured copper concentrations in groundwater appear to be relatively similar to inflow concentrations. Extremely low levels of zinc were measured in groundwater samples beneath the ponds at concentrations substantially lower than observed in the inflows, suggesting that the pond soils have a significant affinity for removal of zinc during migration through the soil.

Hardness concentrations measured in groundwater beneath the ponds are substantially higher in value than hardness concentrations measured in the incoming runoff. It appears that additional inputs of hardness-causing ions, such as calcium and magnesium, enter into groundwater above those contributed by stormwater inflows. The observed increases in hardness, particularly at the background monitoring site, may be due to contact between the runoff and limerock which is abundant in this area.

5.3.1.5 Site Comparison

A comparison of geometric mean values for groundwater samples collected at the Bonita Springs site is given on Table 5-14. In general, groundwater concentrations for many parameters appear to exhibit either a steadily increasing or steadily decreasing mean concentration during migration through the detention pond system from Pond 1 to Pond 3. However, it appears unlikely that these patterns are impacted by runoff inputs and may be more likely related to changes in soil characteristics from upland to lower portions of the property near the location of Pond 3. Many parameters exhibited substantially higher mean concentrations in the background monitoring well than observed in the active dry detention ponds, suggesting that additional inputs other than runoff inputs may be impacting groundwater at the background monitoring sites.

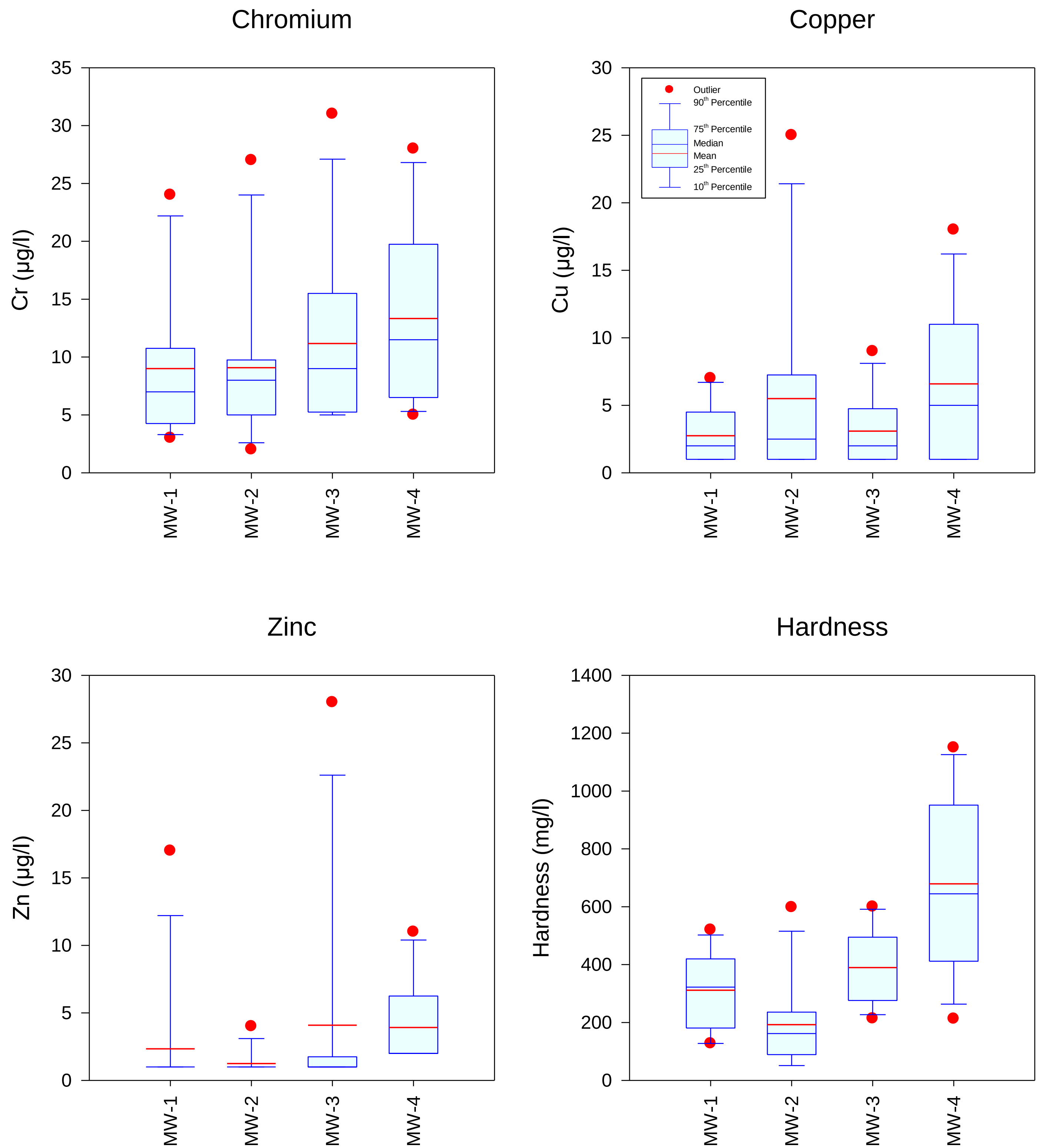


Figure 5-29. Statistical Comparison of Measured Concentrations of Chromium, Copper, Zinc, and Hardness in Groundwater at the Bonita Springs Site from December 2012-November 2013.

TABLE 5-14

COMPARISON OF GEOMETRIC MEAN CHARACTERISTICS OF GROUNDWATER SAMPLES COLLECTED AT THE BONITA SPRINGS SITE

PARAMETER	UNITS	MW-1	MW-2	MW-3	MW-4
pH	s.u.	7.33	6.91	7.16	7.02
Alkalinity	mg/l	139	96.6	266	386
Conductivity	µmho/cm	1,886	1,189	1,380	3,961
Ammonia	µg/l	346	214	195	1,445
NO_x	µg/l	6	9	4	5
Organic N	µg/l	456	617	1,415	3,377
Total N	µg/l	919	1,062	1,962	5,671
SRP	µg/l	62	25	28	31
Organic P	µg/l	10	10	13	13
Total P	µg/l	77	40	44	49
Color	Pt-Co	51	132	181	496
Chromium	µg/l	7	7	9	11
Copper	µg/l	2.1	2.8	2.2	8.3
Lead	µg/l	< 2	< 2	< 2	< 2
Zinc	µg/l	< 2	< 2	1.7	3.1
Hardness	mg/l	281	150	371	613

5.3.2 Naples Dry Detention Site

As indicated on Figure 3-8, a total of two shallow groundwater monitoring wells was installed at the Naples dry detention pond site, with wells designated as MW-1 and MW-2 located in Ponds 1 and 2, respectively.

5.3.2.1 General Parameters

A statistical comparison of measured values of pH, alkalinity, conductivity, and color in groundwater samples collected at the Naples monitoring sites from December 2012-November 2013 is given on Figure 5-30. As indicated on Figure 3-8, monitoring wells at the Naples site are located only beneath the two dry detention ponds, with no background reference site. In general, measured values for pH appear to be relatively similar in groundwater beneath the two dry detention ponds. Mean pH values beneath the ponds appear to be slightly alkaline, while mean pH values in the pond inflows were neutral to slightly acidic. Measured alkalinity concentrations in groundwater beneath the two ponds were substantially elevated, with typical values ranging from 150-350 mg/l, compared with pond inflows which ranged from approximately 30-45 mg/l. A substantial increase in alkalinity appears to occur in groundwater beneath the pond which may be related to the presence of limerock in the general area.

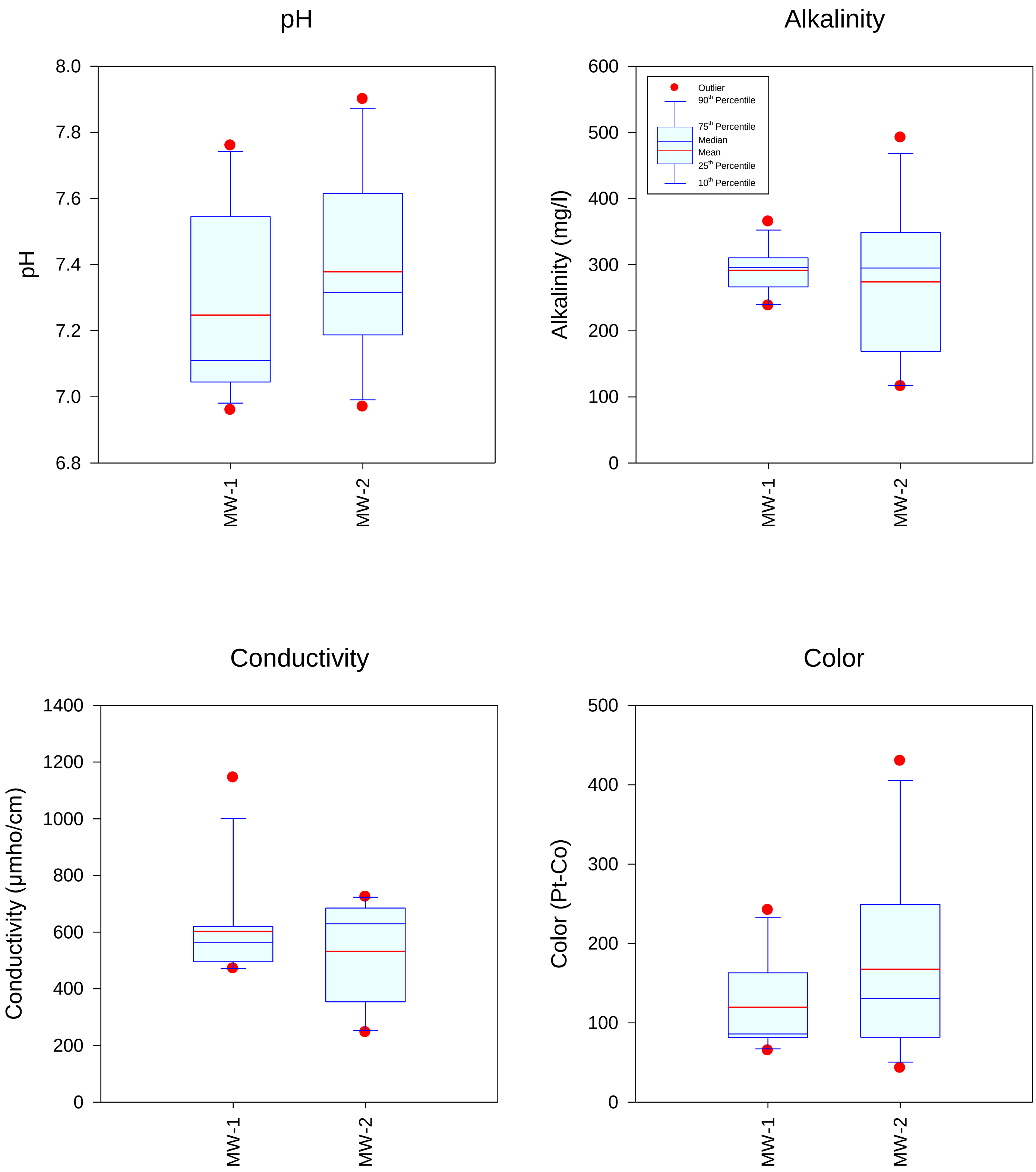


Figure 5-30. Statistical Comparison of Measured Values for pH, Alkalinity, Conductivity, and Color in Groundwater at the Naples Site from December 2012-November 2013.

Substantial increases in conductivity were also observed in groundwater samples compared with conductivity measured in the inflows. Mean inflow concentrations of conductivity ranged from approximately 60-110 μmho/cm, with typical groundwater conductivity values ranging from 400-700 μmho/cm. The increased conductivity in groundwater suggests substantial increases in dissolved ions beneath the pond. Measured color concentrations beneath the two ponds ranged from approximately 80-250 Pt-Co units, while color concentrations in the inflows ranged from approximately 25-45 Pt-Co units. Color concentrations also appear to increase substantially beneath the pond, although the increases do not appear to be related to runoff inflows.

5.3.2.2 Nitrogen Species

A statistical comparison of measured concentrations of nitrogen species at the Naples dry detention pond site from December 2012-November 2013 is given on Figure 5-31. In general, measured concentrations of ammonia, NO_x, organic nitrogen, and total nitrogen appear to be relatively similar in value in groundwater collected beneath each of the two ponds. However, measured concentrations of ammonia in the collected groundwater samples typically range from approximately 250-450 μg/l, compared with ammonia concentrations in the inflows which were typically less than 10 μg/l. A substantial enhancement in ammonia appears to occur beneath the pond. In contrast, low levels of NO_x were observed in groundwater collected beneath the pond, with typical values less than 10 μg/l. In comparison, mean NO_x concentrations in the inflows ranged from 31-100 μg/l, indicating a decrease in NO_x, possibly through denitrification processes beneath the pond.

Measured concentrations of organic nitrogen in groundwater beneath the dry detention ponds at the Naples site ranged from approximately 400-1200 μg/l, compared with concentrations of approximately 200 μg/l measured in the inflow. Organic nitrogen concentrations appear to increase substantially beneath the pond at levels much higher than measured in the inflow, suggesting that additional inputs of organic nitrogen may be impacting groundwater beneath the ponds other than from runoff.

Measured concentrations of total nitrogen in groundwater beneath the ponds ranged from approximately 600-1500 μg/l at the two monitoring sites. However, geometric mean concentrations of total nitrogen in the inflows ranged from approximately 380-450 μg/l, indicating a substantial enrichment of nitrogen in groundwater beneath the pond. This additional nitrogen likely originates from a source other than inputs of stormwater runoff.

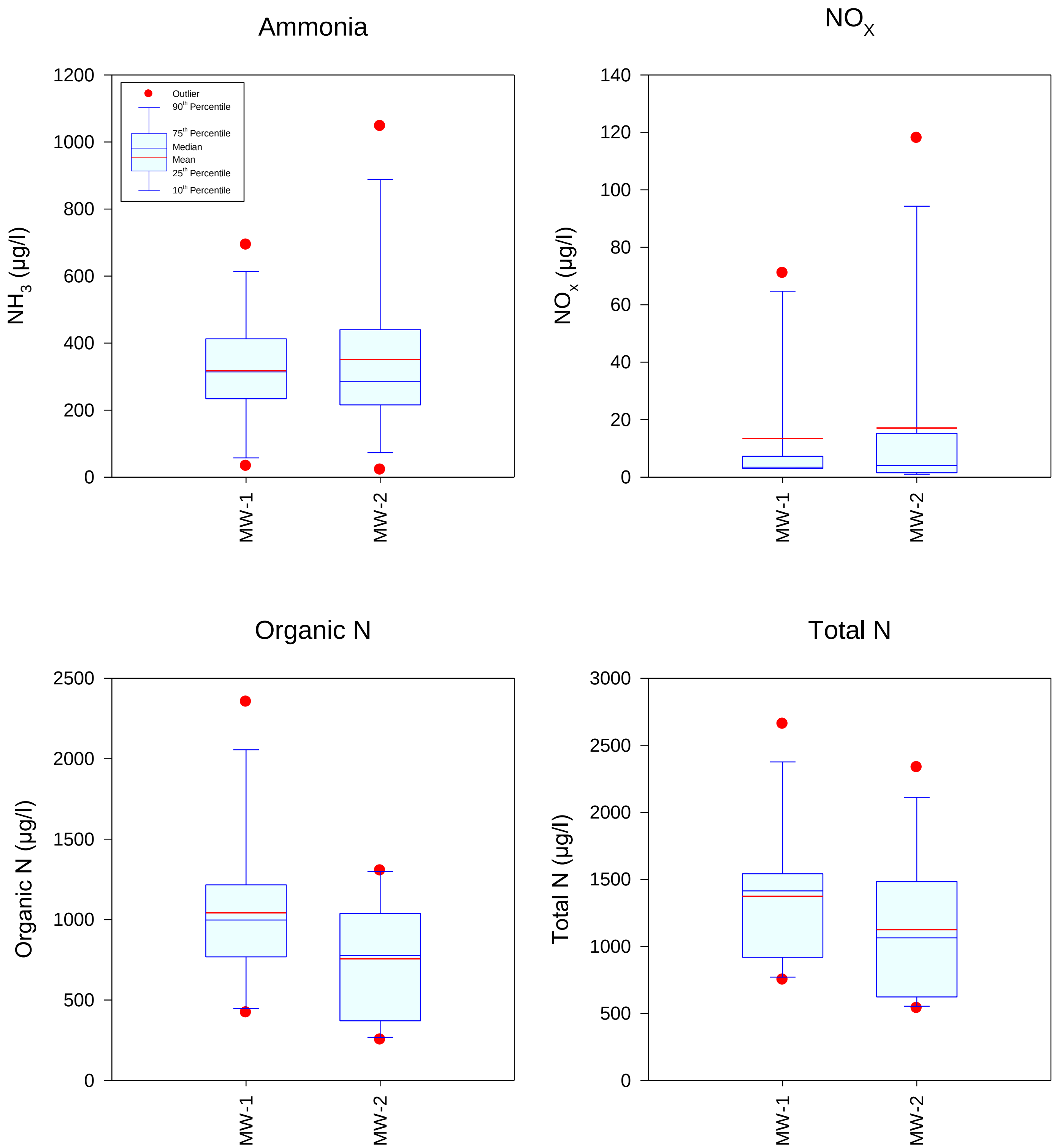


Figure 5-31. Statistical Comparison of Measured Concentrations of Nitrogen Species in Groundwater at the Naples Site from December 2012-November 2013.

5.3.2.3 Phosphorus Species

A statistical comparison of measured concentrations of phosphorus species at the Naples dry detention pond site from December 2012-November 2013 is given on Figure 5-32. Similar to the trends observed for nitrogen species, phosphorus species appear to be similar in value at each of the two groundwater monitoring sites. Typical values of SRP in groundwater ranged from approximately 18-30 μg/l, compared with mean inflow concentrations ranging from 6-15 μg/l. Enrichment of SRP appears to occur beneath the pond in excess of values measured at the inflow. In contrast, groundwater concentrations of dissolved organic phosphorus appear to be similar in value to concentrations measured in the pond inflows. Overall, measured concentrations of total phosphorus in groundwater ranged from approximately 25-45 μg/l compared with mean inflow concentrations ranging from 30-70 μg/l. Total phosphorus concentrations beneath the pond appear to be lower than values measured in the inflows, suggesting an affinity for removal of phosphorus during migration through the on-site soils.

5.3.2.4 Chromium, Copper, Zinc, and Hardness

A statistical comparison of measured concentrations of chromium, copper, zinc, and hardness at the Naples dry detention pond site from December 2012-November 2013 is given on Figure 5-33. Measured concentrations of chromium, copper, and zinc in groundwater collected beneath the pond appear to be similar to or less than concentrations of these parameters measured in the inflow samples, suggesting that filtration through the on-site groundwater may result in reductions in concentrations of measured metals, particularly zinc.

Somewhat elevated concentrations of hardness were measured in groundwater samples collected beneath the two dry detention ponds, with typical values ranging from 175-375 mg/l. Concentrations in this range are substantially higher than the hardness concentrations measured in inflows to the pond which were generally less than 45 mg/l. The increased concentrations of hardness in groundwater is likely due to the presence of limerock which lies beneath the soil surface throughout this area.

5.3.2.5 Site Comparison

A comparison of geometric mean values for groundwater samples collected at the Naples site is given on Table 5-15. In general, measured concentrations at the two groundwater monitoring sites appear to be similar in value, with no significant differences for any of the evaluated parameters.

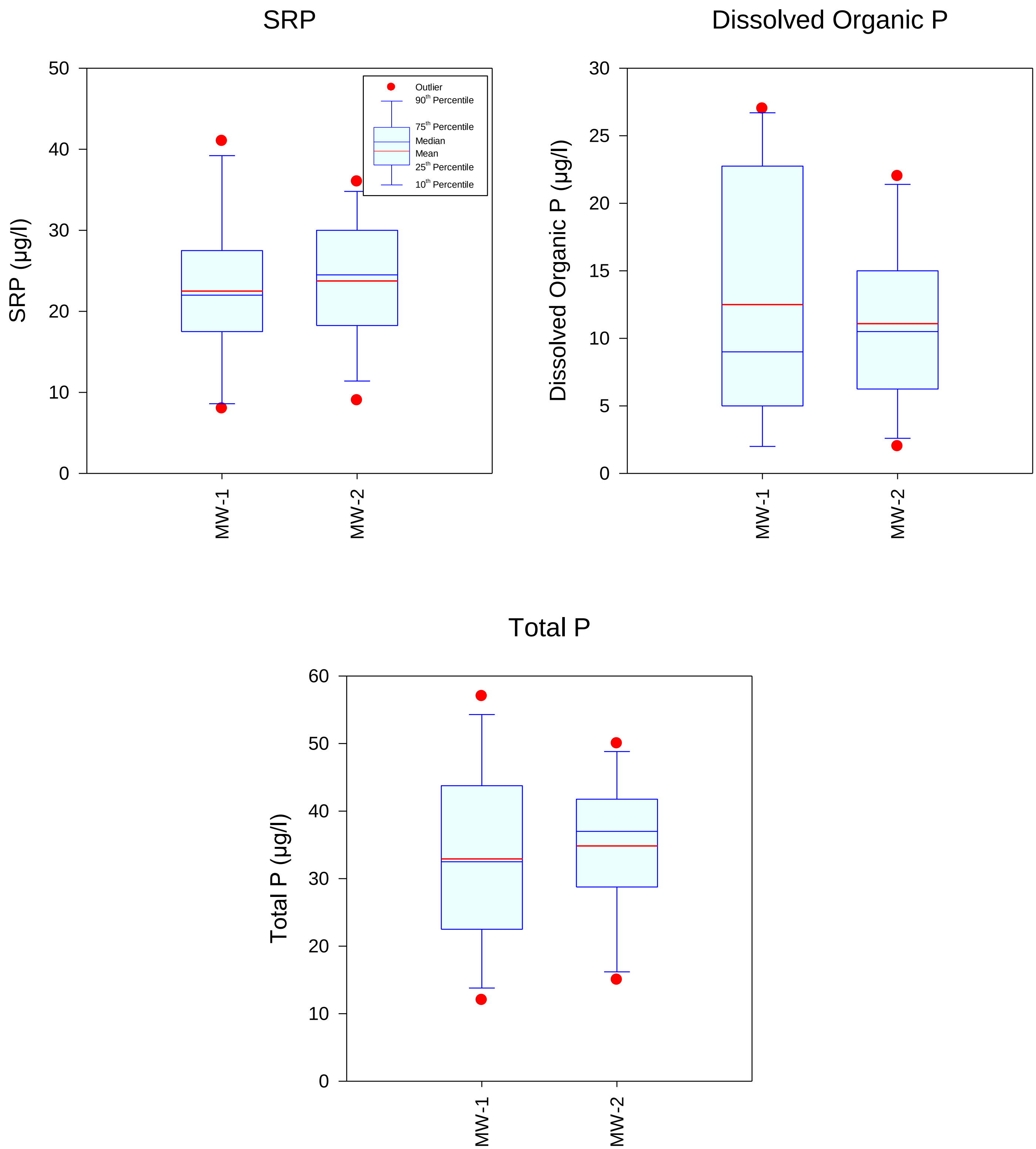


Figure 5-32. Statistical Comparison of Measured Concentrations of Phosphorus Species in Groundwater at the Naples Site from December 2012-November 2013.

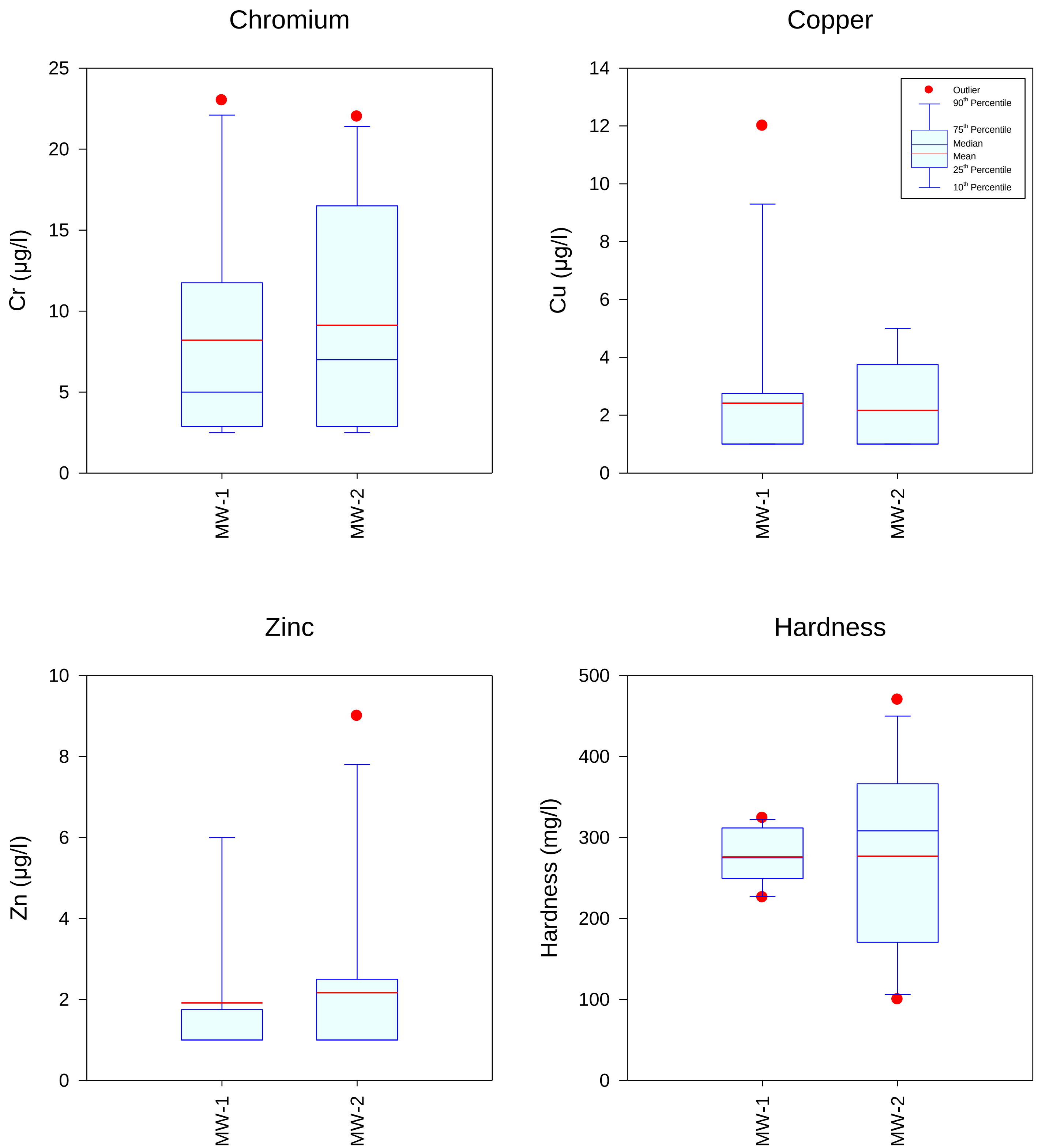


Figure 5-33. Statistical Comparison of Measured Concentrations of Chromium, Copper, Zinc, and Hardness in Groundwater at the Naples Site from December 2012-November 2013.

TABLE 5-15

COMPARISON OF GEOMETRIC MEAN CHARACTERISTICS OF GROUNDWATER SAMPLES COLLECTED AT THE NAPLES SITE

PARAMETER	UNITS	MW-1	MW-2
pH	s.u.	7.24	7.37
Alkalinity	mg/l	289	249
Conductivity	µmho/cm	584	498
Ammonia	µg/l	261	267
NO_x	µg/l	6	5
Organic N	µg/l	948	663
Total N	µg/l	1,295	1,018
SRP	µg/l	21	22
Organic P	µg/l	9	9
Total P	µg/l	30	33
Color	Pt-Co	109	134
Chromium	µg/l	6.1	6.8
Copper	µg/l	< 2	< 2
Lead	µg/l	< 2	< 2
Zinc	µg/l	< 2	< 2
Hardness	mg/l	274	250

5.3.3 Pembroke Pines Dry Detention Site

As indicated on Figure 3-12 a total of three groundwater monitoring wells was installed in the Pembroke Pines site. Monitoring Wells 1 and 2 were installed beneath detention Ponds 1 and 2, with the monitoring well designated as MW-3 is located in a background area outside of the influence of the two dry detention ponds.

5.3.3.1 General Parameters

A statistical comparison of measured values of pH, alkalinity, conductivity, and color in groundwater samples collected at the Pembroke Pines monitoring sites from December 2012-November 2013 is given on Figure 5-34. Measured pH values in the groundwater samples typically ranged from approximately 7.3-8.0 which appear to be equal to or greater than pH values measured in the pond inflows. The measured pH value at the background monitoring site (MW-3) is similar to values measured in the pond.

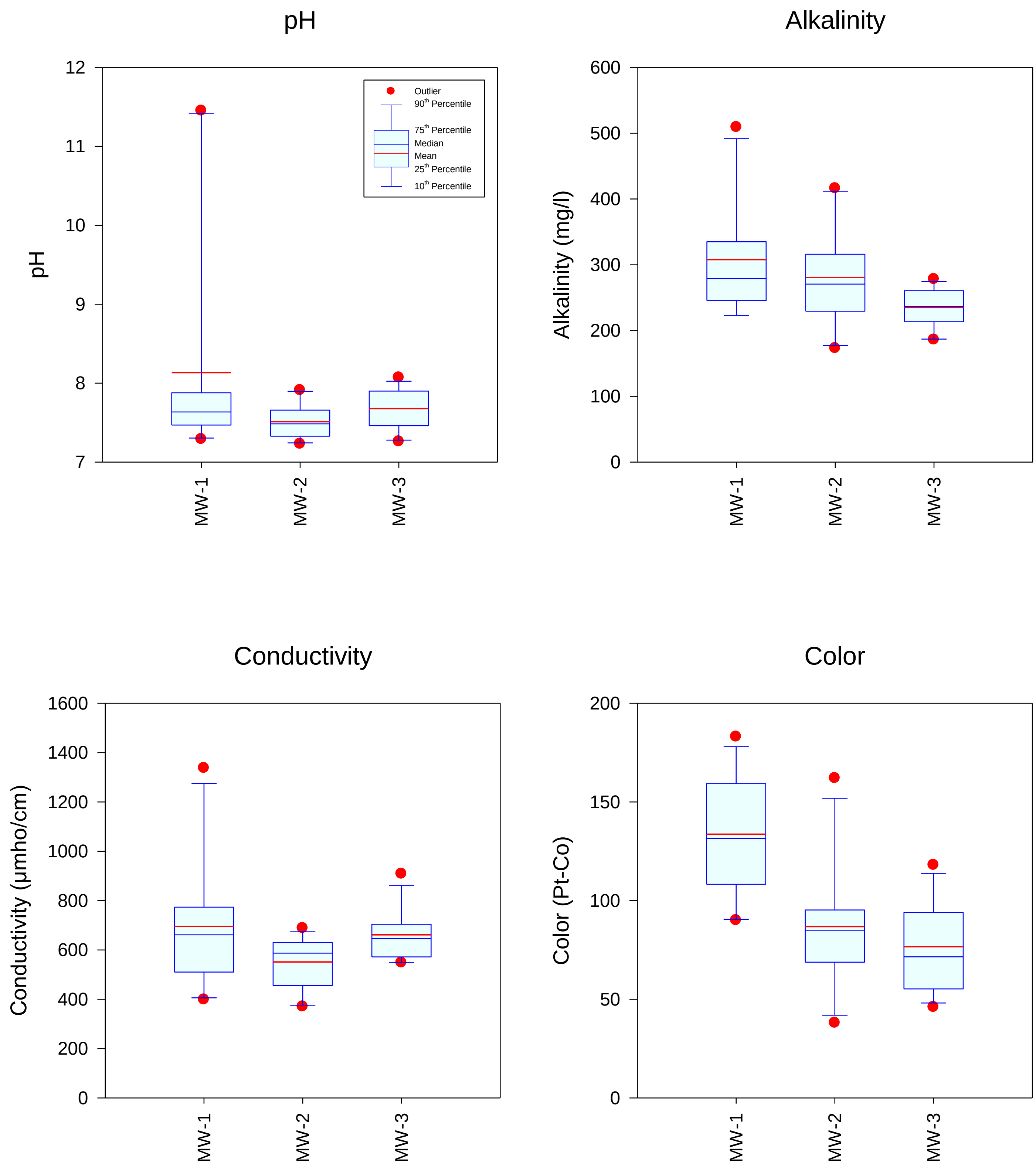


Figure 5-34. Statistical Comparison of Measured Values for pH, Alkalinity, Conductivity, and Color in Groundwater at the Pembroke Pines Site from December 2012-November 2013.

Relatively elevated alkalinity values were measured in groundwater at each of the three monitoring sites, with typical values ranging from 225-350 mg/l. These values substantially exceed the mean inflow alkalinity values which ranged from 44-68 mg/l. It appears that the limerock formations beneath the pond are increasing both pH and alkalinity measurements compared with the pond inflows.

Measured conductivity values in groundwater beneath the ponds ranged from approximately 500-800 μmho/cm which are substantially greater than the inflow conductivity values which were typically less than 200 μmho/cm. An enhancement in conductivity appears to occur beneath the pond which may be related to additional ions contributed by the limerock formations. Measured color concentrations in groundwater beneath the pond were slightly elevated in value and much higher than color concentrations observed in the inflows. The color concentrations observed at the background monitoring well site appear to be similar to values measured beneath MW-2. Overall, additional inputs of color appear to be impacting groundwater beneath the ponds other than stormwater runoff.

5.3.3.2 Nitrogen Species

A statistical comparison of measured concentrations of nitrogen species at the Pembroke Pines dry detention pond site from December 2012-November 2013 is given on Figure 5-35. Measured ammonia concentrations beneath the pond were generally low in value, particularly in MW-1 and MW-3. A more elevated range of ammonia concentrations was observed at MW-2. The observed groundwater concentrations of ammonia at MW-1 and MW-3 appear to be similar to values measured in the runoff inflows, while the more elevated levels of ammonia observed in MW-2 may be related to potential anoxic conditions which occur in groundwater at this site that enhances release of ammonia.

A high degree of variability was observed in measured NO_x concentrations in groundwater at the Pembroke Pines site. Measured concentrations of NO_x beneath Pond 1 appear to be similar to values measured in the runoff inflows. Low concentrations of NO_x were also observed in MW-2 which appear to be equal to or less than concentrations measured in the pond inflows, suggesting possible NO_x reductions through denitrification. In contrast, substantially higher concentrations of NO_x were observed in the background monitoring well, with measured concentrations ranging from 300-800 μg/l.

Measured concentrations of organic nitrogen in groundwater beneath the pond were found to be moderate to slightly elevated in value, with typical concentrations ranging from 600-1700 μg/l. These values far exceed organic nitrogen concentrations in the inflows to the pond, suggesting an additional source of organic nitrogen may be impacting groundwater beneath the pond. The organic nitrogen concentration measured at the background monitoring well appears to be similar to values measured beneath the two ponds.

Measured concentrations of total nitrogen beneath the ponds and at the background monitoring site appear to be relatively similar in value, with the majority of measurements ranging from approximately 800-2000 μg/l. These values substantially exceed the input concentrations of total nitrogen into the pond and further suggest a supplemental source of nitrogen beneath the pond other than inputs from stormwater runoff.

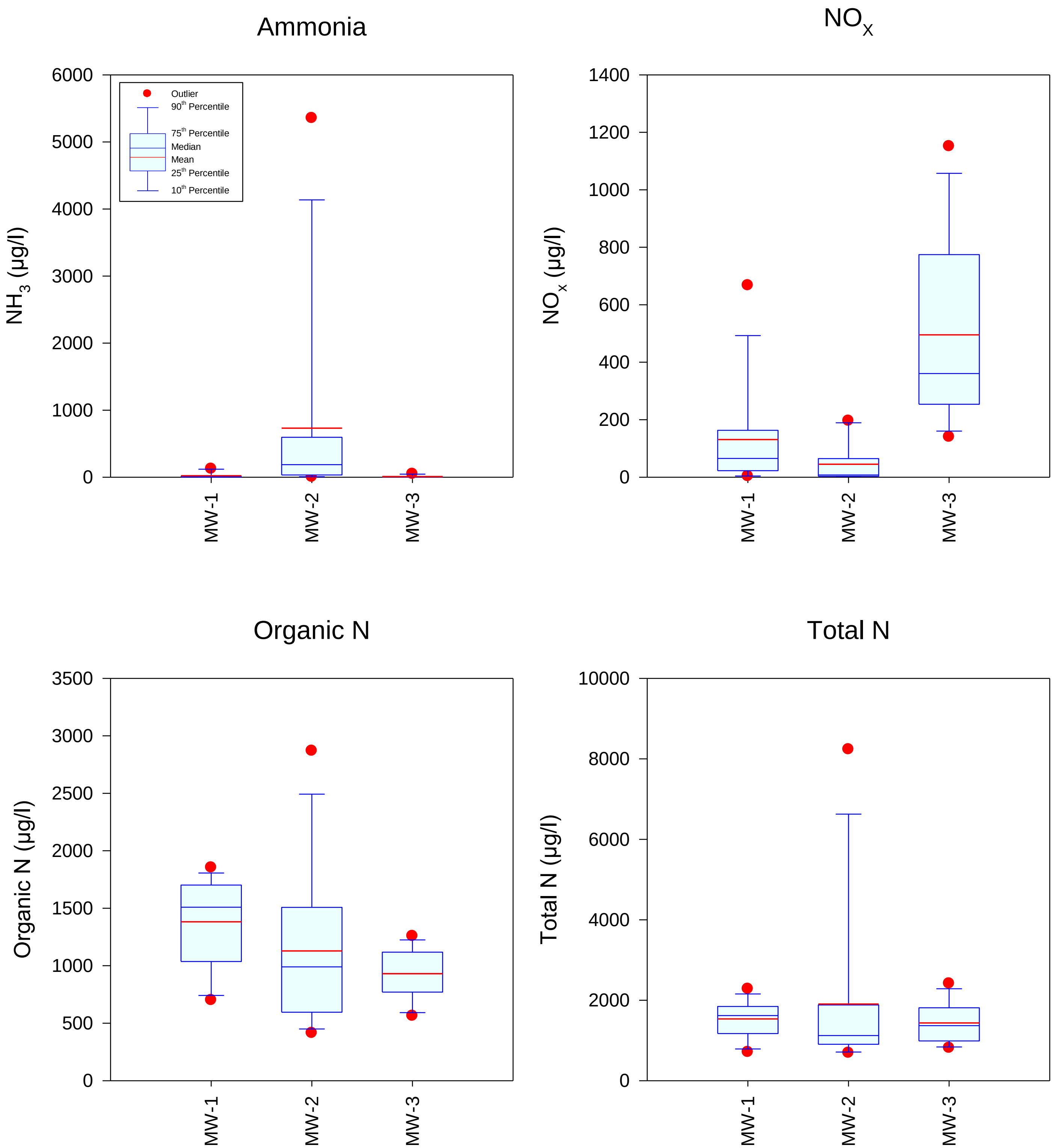


Figure 5-35. Statistical Comparison of Measured Concentrations of Nitrogen Species in Groundwater at the Pembroke Pines Site from December 2012-November 2013.

5.3.3.3 <u>Phosphorus Species</u>

A statistical comparison of measured concentrations of phosphorus species at the Pembroke Pines dry detention pond site from December 2012-November 2013 is given on Figure 5-36. Extremely low levels of SRP were observed in groundwater beneath the pond, particularly at MW-1 and MW-3 (background site) which appear to be similar to values measured in runoff inflows. A higher range of SRP values was observed beneath Pond 2 at values substantially greater than inflow concentrations of SRP. The data suggests an additional source of SRP may be impacting groundwater beneath Pond 2 other than runoff inputs.

Low levels of dissolved organic phosphorus were observed in groundwater beneath each of the three sites, with concentrations less than dissolved organic phosphorus values observed in the inflows. The data suggests a reduction in concentrations of dissolved organic phosphorus during migration through the on-site soils.

Overall, low concentrations of total phosphorus were measured in groundwater at each of the three monitoring sites, with measured values substantially lower than phosphorus concentrations observed in the inflows. The data suggests a substantial reduction in phosphorus during migration through the on-site soils. This behavior is consistent with the presence of large amounts of limerock beneath the pond which has a significant affinity for uptake of phosphorus species.

5.3.3.4 <u>Chromium, Copper, Zinc, and Hardness</u>

A statistical comparison of measured concentrations of chromium, copper, zinc, and hardness at the Pembroke Pines dry detention pond site from December 2012-November 2013 is given on Figure 5-37. In general, relatively low levels of chromium and copper were observed in groundwater collected beneath the ponds. The mean concentrations observed for these parameters in groundwater are similar to concentrations measured in runoff inflows. In contrast, measured concentrations of zinc in groundwater beneath the pond appear to be lower in value than zinc concentrations measured in the inflows, suggesting an affinity for removal of zinc during migration through the on-site soils.

Relatively low concentrations of hardness were measured in the pond inflows, compared with substantially elevated hardness values ranging from 200-350 mg/l, in shallow groundwater. The observed increases in hardness are likely related to the abundant limerock layers located beneath the pond.

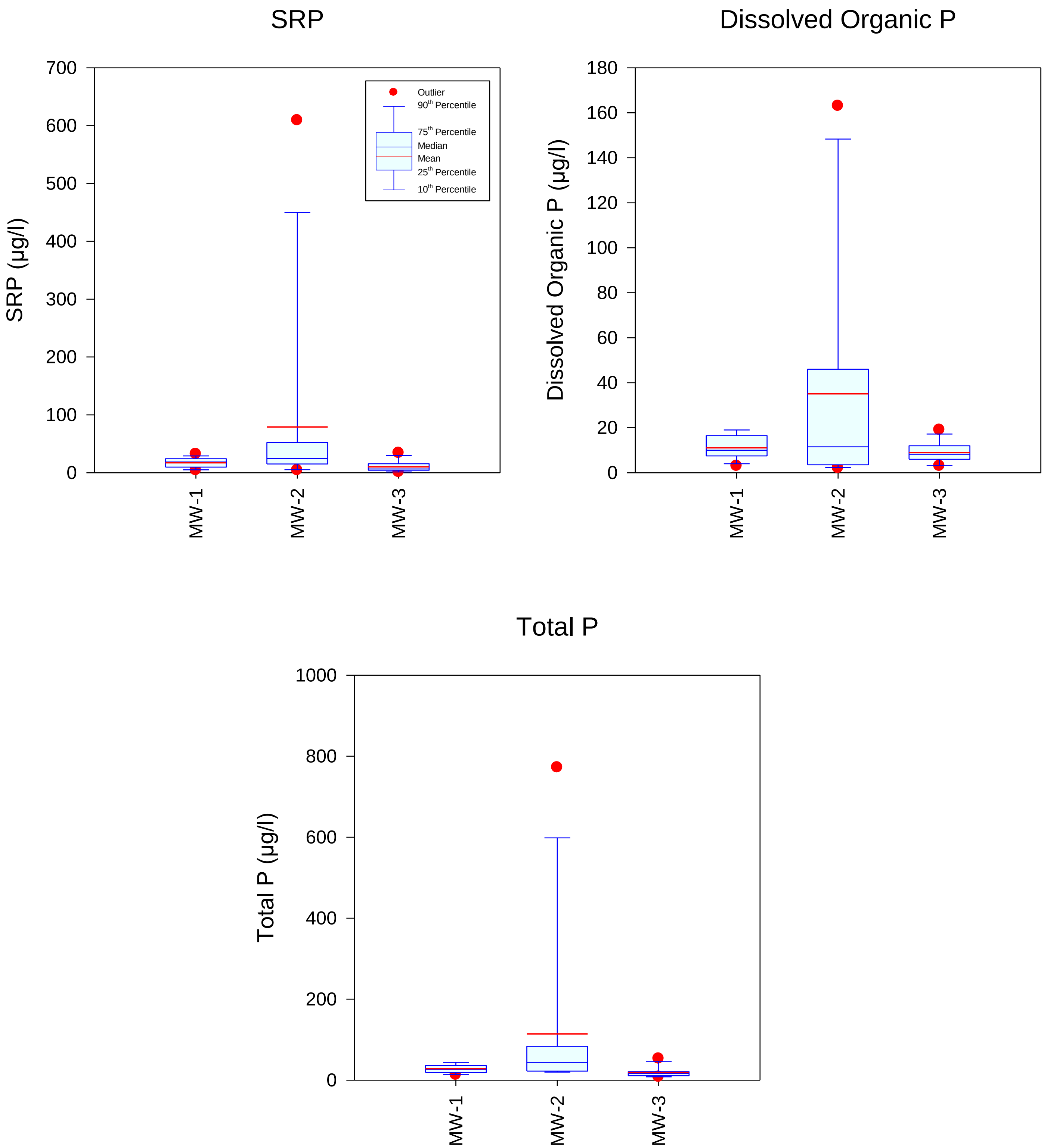


Figure 5-36. Statistical Comparison of Measured Concentrations of Phosphorus Species in Groundwater at the Pembroke Pines Site from December 2012-November 2013.

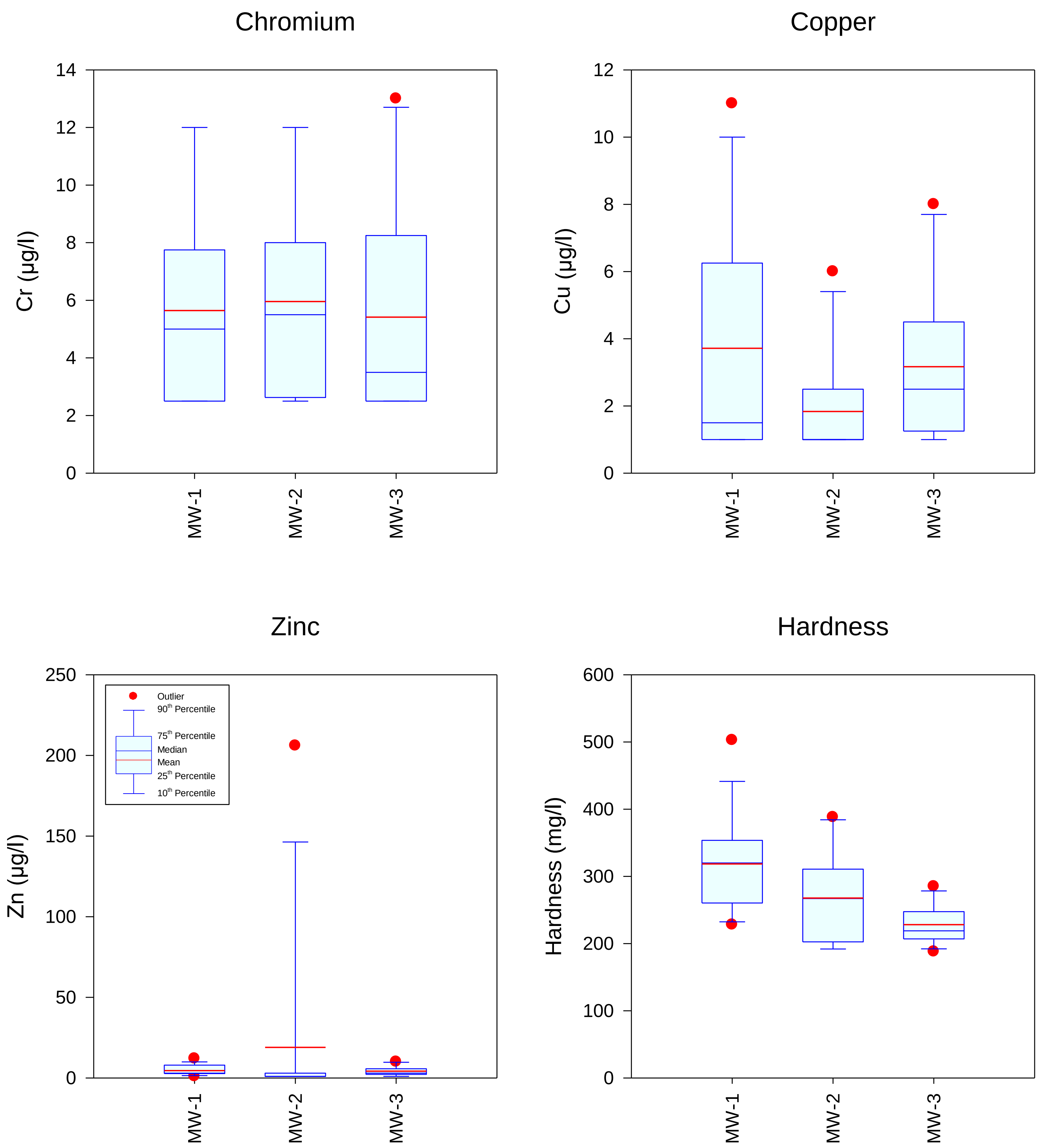


Figure 5-37. Statistical Comparison of Measured Concentrations of Chromium, Copper, Zinc, and Hardness in Groundwater at the Pembroke Pines Site from December 2012-November 2013.

5.3.3.5 Site Comparison

A comparison of geometric mean values for groundwater samples collected at the Pembroke Pines site is given on Table 5-16. In general, groundwater characteristics appear to be relatively similar beneath each of the two dry detention pond (MW-1 and MW-2), as well as the background monitoring site (MW-3). The only exceptions to this appear to be an increased concentration of NO_x at the background site compared with samples collected beneath the dry detention ponds and substantially lower concentrations of SRP and total phosphorus measured at the background site compared with samples collected beneath the ponds. Overall, operation of the dry detention ponds does not appear to have a significant impact on groundwater characteristics beneath the pond.

TABLE 5-16

COMPARISON OF GEOMETRIC MEAN CHARACTERISTICS OF GROUNDWATER SAMPLES COLLECTED AT THE PEMBROKE PINES SITE

PARAMETER	UNITS	MW-1	MW-2	MW-3
pH	s.u.	8.04	7.51	7.67
Alkalinity	mg/l	298	272	233
Conductivity	μmho/cm	653	541	654
Ammonia	μg/l	6	158	5
NO_x	μg/l	56	13	410
Organic N	μg/l	1,325	975	907
Total N	μg/l	1,460	1,419	1,363
SRP	μg/l	15	30	7
Organic P	μg/l	10	14	8
Total P	μg/l	26	52	17
Color	Pt-Co	130	81	73
Chromium	μg/l	4.8	5.00	4.4
Copper	μg/l	2.4	< 2	2.5
Lead	μg/l	< 2	< 2	< 2
Zinc	μg/l	3.7	2.3	3.4
Hardness	mg/l	312	260	227

5.3.4 Orlando Underdrain Site

As indicated on Figure 3-16, two separate groundwater monitoring wells were installed at the Orlando underdrain site. Each of the two wells was installed beneath the dry detention pond, with MW-1 located closer to the primary inflow to the pond. No suitable background monitoring location was available for groundwater at the Orlando site.

5.3.4.1 General Parameters

A statistical comparison of measured values of pH, alkalinity, conductivity, and color in groundwater samples collected at the Orlando underdrain monitoring sites from December 2012-November 2013 is given on Figure 5-38. Relatively similar values for pH were measured at each of the two monitoring well sites, typically ranging from 6.4-7.0, which are similar to pH values measured in inflows to the pond. Groundwater collected beneath the pond was poorly to moderately well buffered, with measured alkalinity values typically ranging from 40-120 mg/l. The most elevated alkalinity values were observed in MW-1 which is located closest to the primary point of inflow into the pond, with substantially lower alkalinity values measured in MW-2. The alkalinity values measured in the two monitoring wells are substantially higher than alkalinity values measured in inflows which typically ranged from 21-31 mg/l. Increases in alkalinity appear to occur for the runoff inputs during migration through the on-site soils.

Measured conductivity values in groundwater samples collected beneath the dry detention pond ranged from approximately 100-300 μmho/cm at the two monitoring sites. As observed with alkalinity, the most elevated values for conductivity were observed in MW-1 which is located closest to the primary point of inflow, with substantially lower conductivity values in the other pond well. Measured conductivity values in groundwater were substantially greater than conductivity values measured in the pond inflows which ranged from 50-76 μmho/cm, indicating a corresponding increase in conductivity for groundwater beneath the pond compared with the inflows.

Inflows into the underdrain pond contained low levels of color. However, substantially elevated levels of color were observed in groundwater samples, with typical values ranging from 70-170 Pt-Co units. Increases in color concentrations also appear to occur in groundwater compared with the inflows. The most elevated levels of color in groundwater were also observed in MW-1, with substantially lower color measurements observed at MW-2.

5.3.4.2 Nitrogen Species

A statistical comparison of measured concentrations of nitrogen species at the Orlando underdrain site from December 2012-November 2013 is given on Figure 5-39. In general, somewhat elevated values of ammonia were observed in groundwater collected beneath the dry underdrain pond compared with the extremely low values observed in runoff inflows. Enhancement of ammonia appears to occur within the groundwater which creates concentrations substantially greater than observed in the inflow. The observed increases in ammonia could be related to decomposition of organic compounds contributed by runoff which are broken down by bacteria in the soil, resulting in increased ammonia.

Somewhat elevated levels of NO_x were observed in groundwater samples beneath the underdrain pond which appear to be similar to NO_x concentrations measured in the inflow samples. No enrichment of NO_x appears to occur beneath the pond. Moderate to somewhat elevated levels of organic nitrogen were observed in groundwater collected beneath the underdrain pond, with typical concentrations ranging from approximately 200-1100 μg/l. In contrast, geometric mean concentrations of dissolved organic nitrogen in the inflows were less than 120 μg/l at all sites. It appears that organic nitrogen concentrations are also increased beneath the pond compared with concentrations measured in the inflows.

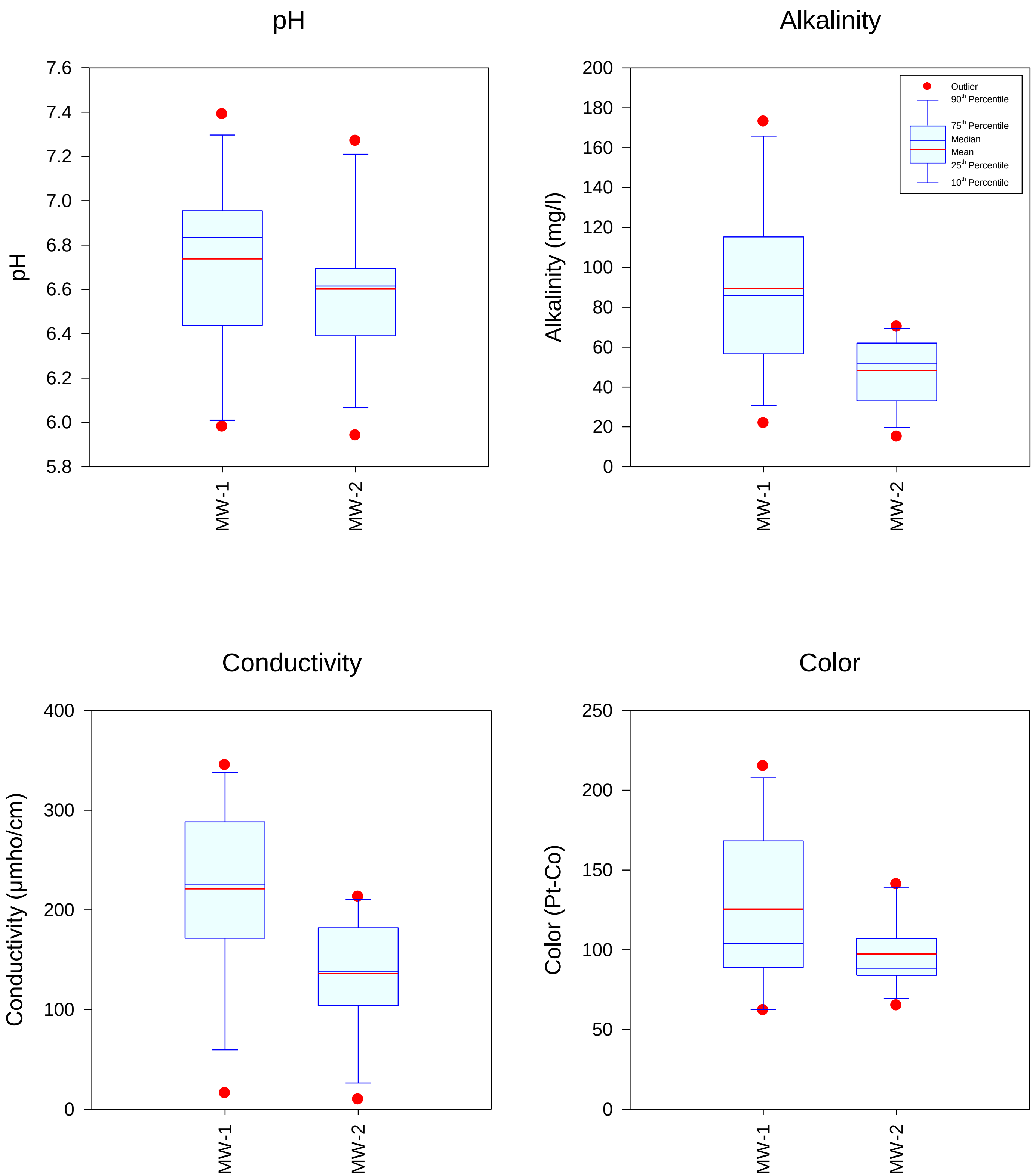


Figure 5-38. Statistical Comparison of Measured Values for pH, Alkalinity, Conductivity, and Color in Groundwater at the Orlando Underdrain Site from December 2012-November 2013.

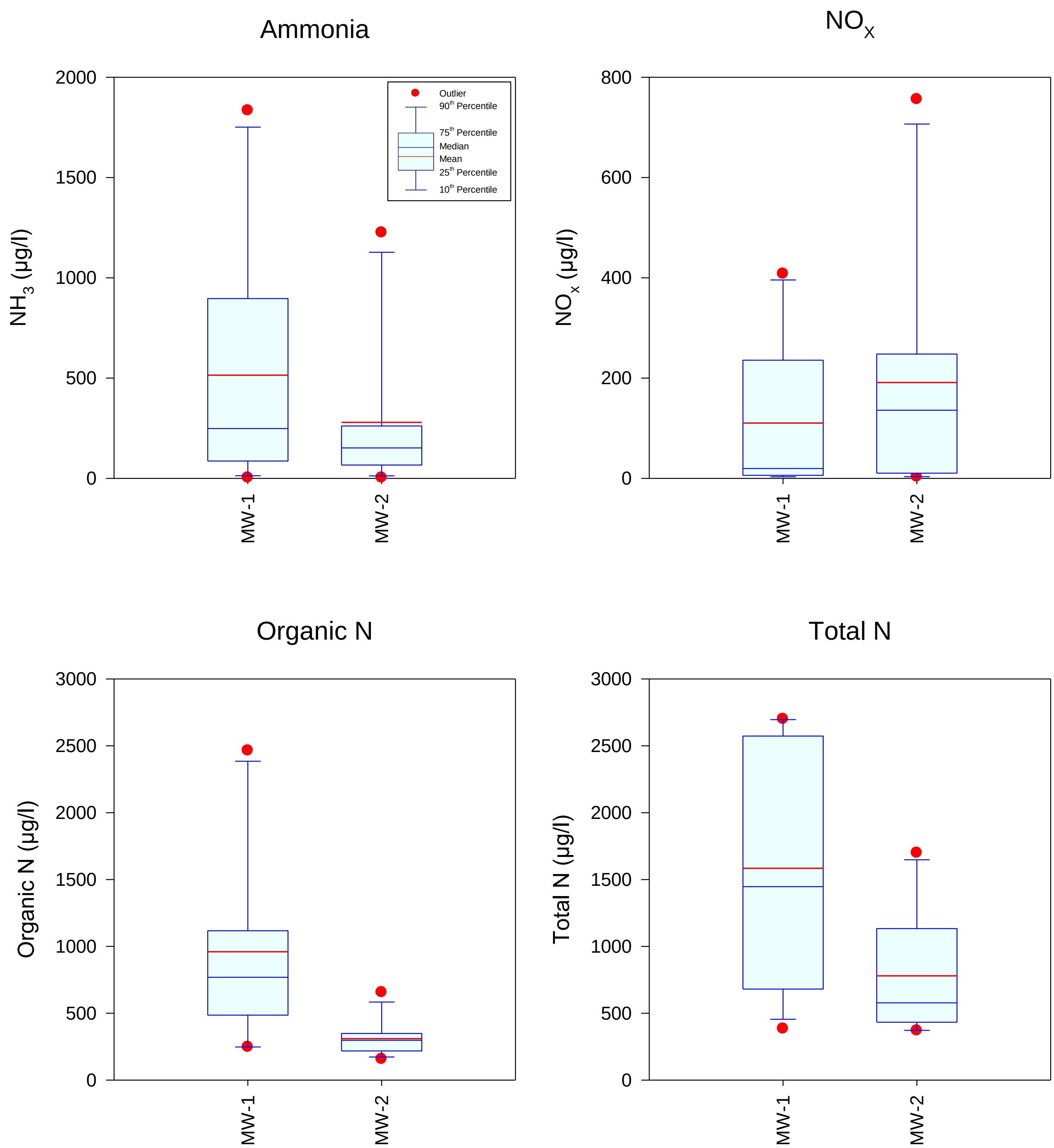


Figure 5-39. Statistical Comparison of Measured Concentrations of Nitrogen Species in Groundwater at the Orlando Underdrain Site from December 2012-November 2013.

Overall, low levels of total nitrogen were observed in pond inflows, with median values at all sites less than 500 µg/l. Somewhat higher concentrations of total nitrogen were measured in the groundwater samples, with typical values ranging from 426-600 µg/l. Enhancement of nitrogen concentrations appears to occur beneath the pond, although it is not known if these enhanced concentrations are directly related to impacts from the underdrain system.

5.3.4.3 Phosphorus Species

A statistical comparison of measured concentrations of phosphorus species at the Orlando underdrain pond site from December 2012-November 2013 is given on Figure 5-40. In general, low levels of SRP, dissolved organic phosphorus, and total phosphorus were observed in groundwater samples collected beneath the pond. The observed SRP concentrations in groundwater appear to be equal to or perhaps slightly greater than SRP concentrations measured in inflow samples. In contrast, concentrations of dissolved organic phosphorus in groundwater appear to be lower than runoff input concentrations. Overall, the observed concentrations of total phosphorus in groundwater are substantially lower than the mean inflow concentrations which ranged from 68-110 µg/l. The native soils beneath the pond appear to have a significant affinity for removal of phosphorus compounds.

5.3.4.4 Chromium, Copper, Zinc, and Hardness

A statistical comparison of measured concentrations of chromium, copper, zinc, and hardness at the Orlando underdrain site from December 2012-November 2013 is given on Figure 5-41. In general, relatively low levels of chromium, copper, and zinc were measured in groundwater samples beneath the pond. Concentrations of chromium in groundwater appear to be similar to or slightly greater than chromium concentrations measured in the inflows. Extremely low levels of copper were observed in both the inflows and groundwater samples. In contrast, substantially lower levels of zinc were observed in groundwater than in the runoff inflows, suggesting an affinity for removal of zinc through the on-site soils.

Substantially different hardness concentrations were observed in groundwater beneath the two monitoring wells. MW-1 (which is located closest to the inflow) was characterized by hardness values ranging from approximately 70-120 mg/l, with lower hardness values (ranging from 30-50 mg/l) at MW-2. The values observed at each of these sites are higher in value than hardness concentrations measured in the pond inflows, suggesting a supplemental source of hardness occurs as the runoff infiltrates through the on-site soils.

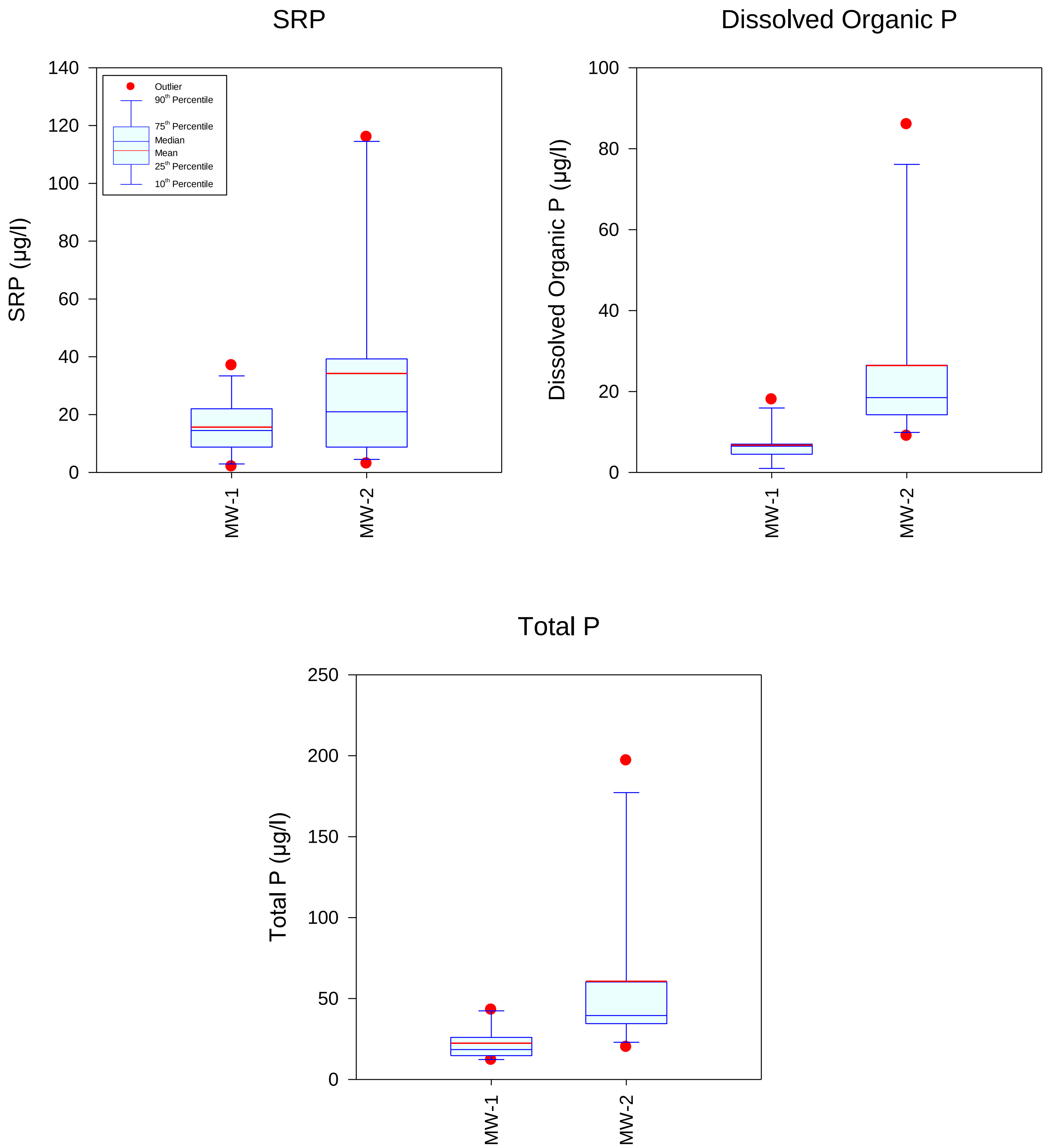


Figure 5-40. Statistical Comparison of Measured Concentrations of Phosphorus Species in Groundwater at the Orlando Underdrain Site from December 2012-November 2013.

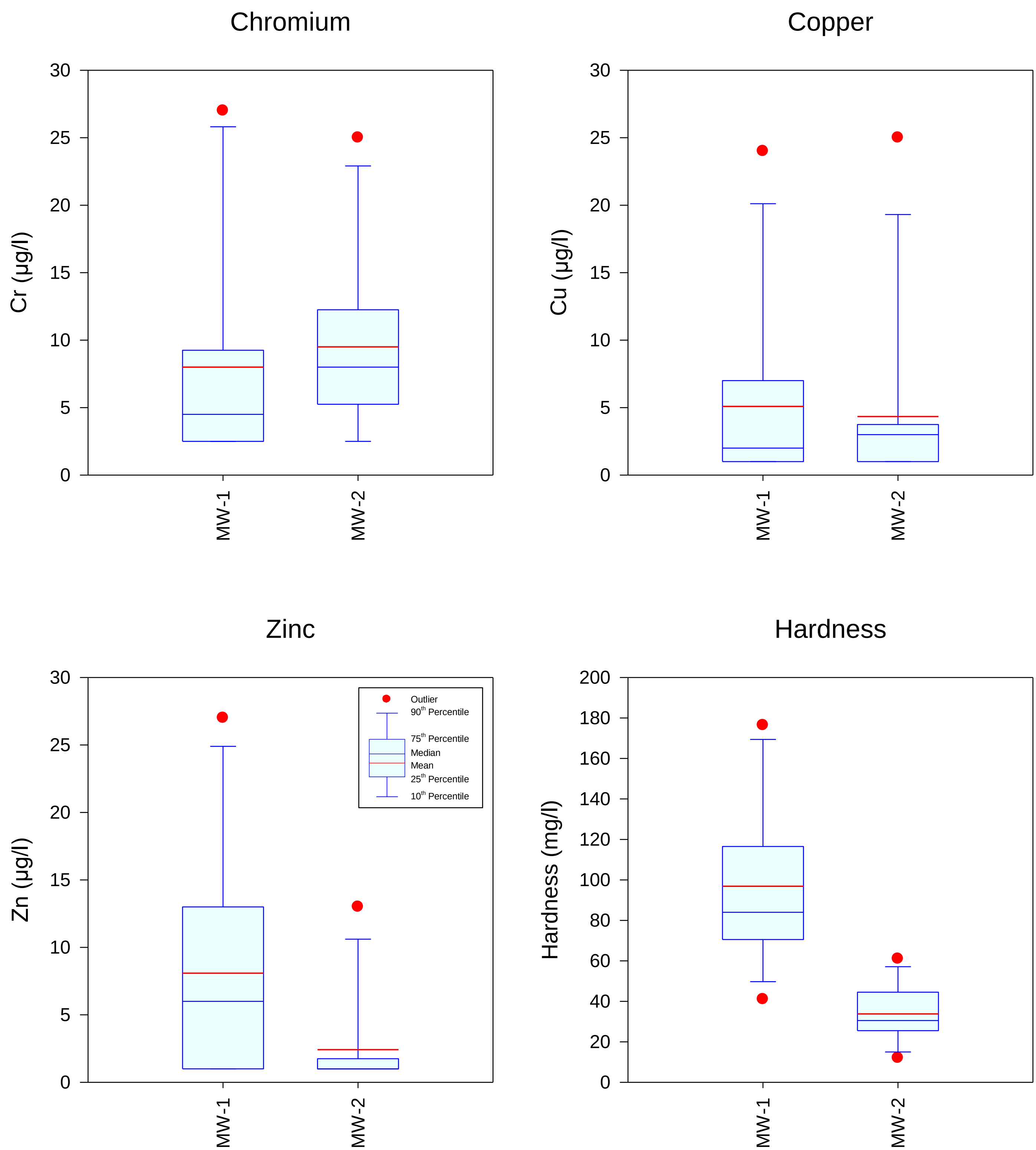


Figure 5-41. Statistical Comparison of Measured Concentrations of Chromium, Copper, Zinc, and Hardness in Groundwater at the Orlando Underdrain Site from December 2012-November 2013.

5.3.4.5 Site Comparison

A comparison of geometric mean values for groundwater samples collected at the Orlando underdrain site is given on Table 5-17. In general, groundwater characteristics measured between the two monitoring well sites, both of which were located inside the underdrain pond, exhibit substantially different values for many of the measured parameters. MW-1, which was located closest to the primary inflow to the pond, exhibited higher values for pH, conductivity, alkalinity, ammonia, organic nitrogen, total nitrogen, color, zinc, and hardness than observed in MW-2. These observed higher concentrations may be related to this area being the primary point of inflow for much of the runoff entering the pond. In contrast, higher measured concentrations for phosphorus species were observed at MW-2, compared with MW-1. However, the specific mechanisms involved which would create higher concentrations of phosphorus in MW-2, which receives a lower annual recharge volume, are not known.

TABLE 5-17

COMPARISON OF GEOMETRIC MEAN CHARACTERISTICS OF GROUNDWATER SAMPLES COLLECTED AT THE ORLANDO UNDERDRAIN SITE

PARAMETER	UNITS	MW-1	MW-2
pH	s.u.	6.73	6.59
Alkalinity	mg/l	79.2	44.8
Conductivity	µmho/cm	186	112
Ammonia	µg/l	203	122
NO_x	µg/l	29	59
Organic N	µg/l	761	290
Total N	µg/l	1,305	672
SRP	µg/l	12	21
Organic P	µg/l	5	21
Total P	µg/l	21	49
Color	Pt-Co	116	95
Chromium	µg/l	5.5	7.7
Copper	µg/l	2.6	2.5
Lead	µg/l	< 2	< 2
Zinc	µg/l	4.4	< 2
Hardness	mg/l	90.4	31.3

SECTION 6

REMOVAL EFFICIENCIES

This section provides an analysis and discussion of the overall pollutant removal efficiencies achieved by the evaluated dry detention and underdrain sites. A summary of concentration-based and overall mass load reductions for the evaluated systems is given in the following sections.

6.1 Concentration-Based Removal Efficiencies

Concentration-based removal efficiencies provide an evaluation of physical, biological, and chemical processes which occur within the treatment system to remove stormwater generated constituents. A concentration-based analysis does not include impacts from hydrologic losses within the system and provides an evaluation of pollutant removal processes associated with the evaluated BMP. Concentration-based evaluations are conducted by comparing volume-weighted inflow characteristics with the volume-weighted concentrations of constituents in the system discharge.

Volume-weighted inflow concentrations were calculated for each of the evaluated dry detention and underdrain monitoring sites. This analysis was conducted using the geometric mean inflow concentrations for each of the four monitoring sites (summarized in Section 5.1) and the geometric mean of bulk precipitation at each monitoring site (summarized in Section 5.2). The geometric mean inputs from stormwater runoff and bulk precipitation were weighted according to the hydrologic budget for each of the four sites (summarized in Figures 4-26 through 4-29). This process resulted in an overall volume-weighted inflow concentration which was then compared with the geometric mean outflow concentration measured at each of the study sites. A discussion of concentration-based removal efficiencies and processes for the dry detention and underdrain monitoring sites is given in the following sections.

6.1.1 Dry Detention System Monitoring Sites

A comparison of mean inflow and outflow concentrations of monitored constituents at the dry detention monitoring sites evaluated during this project is given in Table 6-1. Geometric mean chemical characteristics are provided for each of the inflows and outflows based upon information summarized in Sections 5.1 and 5.2. The fraction of annual input volume contributed by each input is also provided based on information contained in Figures 4-26 through 4-29. The weighted inflow concentration is calculated as the sum of the mean inflow concentrations weighted by the fraction of annual input volume.

TABLE 6-1

COMPARISON OF MEAN INFLOW AND OUTFLOW CONCENTRATIONS AT THE DRY DETENTION MONITORING SITES

PROJECT LOCATION	SITE	FRACTION OF ANNUAL INPUT VOLUME	PARAMETER																			
			pH (s.u.)	Alk. (mg/l)	Cond. (µmho /cm)	Ammo nia (µg/l)	NO_x (µg/l)	Diss. Org. N (µg/l)	Part. N (µg/l)	Total N (µg/l)	SRP (µg/l)	Diss. Org. P (µg/l)	Part. P (µg/l)	Total P (µg/l)	Turb. (NTU)	Color (Pt-Co)	TSS (mg/l)	Cr (µg/l)	Cu (µg/l)	Pb (µg/l)	Zn (µg/l)	Hardness (mg/l)
Bonita Springs	SW-1	0.136	7.03	61.2	853	13	23	310	139	640	13	9	27	71	2.0	36	5.7	6.2	3.3	< 2	5.2	141
	SW-2	0.214	7.10	57.7	341	26	47	255	102	565	76	7	19	109	1.7	52	3.9	6.5	3.6	< 2	3.7	68.2
	SW-3	0.522	6.91	51.4	339	11	24	265	145	632	22	16	24	87	2.8	31	7.3	6.2	3.2	< 2	5.1	77.7
	SW-4	0.017	6.87	54.0	425	14	44	239	101	522	11	13	22	65	3.1	31	9.1	8.5	4.1	< 2	14.5	89.7
	BP	0.111	5.52	2.6	13	26	94	106	54	350	3	4	8	17	1.3	5	2.0	6.3	2.0	< 2	4.8	1.9
	Weighted Inflow Conc.		**6.81**	**48.7**	**374**	**16**	**37**	**251**	**125**	**586**	**30**	**11**	**21**	**81**	**2.3**	**33**	**5.8**	**6.3**	**3.2**	**< 2**	**5.0**	**76.0**
	Weighted Outfall Conc.		**7.03**	**60.9**	**451**	**16**	**20**	**220**	**99**	**450**	**8**	**9**	**13**	**46**	**1.6**	**34**	**2.9**	**5.6**	**2.3**	**< 2**	**4.4**	**93.2**
	Change in Conc. (%)		**3**	**25**	**21**	**-3**	**-47**	**-12**	**-21**	**-23**	**-75**	**-19**	**-38**	**-44**	**-29**	**1**	**-50**	**-11**	**-28**	**--**	**-11**	**23**
Naples	SW-1	0.330	6.96	44.0	107	7	100	183	81	452	15	10	14	47	1.8	28	3.2	5.2	1.5	< 2	3.0	44.0
	SW-2	0.252	6.93	42.2	111	8	81	180	86	452	14	12	29	69	2.2	24	4.9	5.1	2.1	< 2	5.9	43.3
	SW-3	0.281	6.66	26.8	57	8	31	213	59	379	6	5	15	30	1.9	24	3.9	4.4	1.3	< 2	4.9	36.9
	BP	0.137	5.59	2.8	15	56	136	103	66	440	8	3	8	23	1.3	5	2.4	4.8	2	< 2	8.1	2.6
	Weighted Inflow Conc.		**6.68**	**33.1**	**82**	**14**	**81**	**180**	**74**	**430**	**11**	**8**	**17**	**45**	**1.9**	**23**	**3.7**	**4.9**	**2**	**< 2**	**5.0**	**36.2**
	Weighted Outfall Conc.		**6.99**	**39.4**	**94**	**5**	**22**	**217**	**126**	**428**	**7**	**6**	**13**	**31**	**1.3**	**45**	**2.5**	**5.0**	**1.4**	**< 2**	**2.6**	**45.3**
	Change in Conc. (%)		**5**	**19**	**16**	**-66**	**-73**	**21**	**69**	**0**	**-40**	**-22**	**-25**	**-30**	**-29**	**98**	**-34**	**2**	**-16**	**--**	**-48**	**25**
Pembroke Pines	SW-1	0.728	7.33	68.2	176	10	112	215	76	559	12	31	29	96	1.8	20	4.3	5.0	2.1	< 2	11.7	65.3
	SW-2	0.203	7.02	44.1	105	26	63	205	127	537	8	23	29	79	2.0	17	5.1	5.2	2.5	< 2	29	41.8
	BP	0.069	5.83	3.6	14	20	131	100	54	393	4	3	6	16	1.1	4	1.9	5.3	2.0	< 2	13	3.7
	Weighted Inflow Conc.		**7.16**	**58.9**	**150**	**14**	**103**	**205**	**84**	**543**	**11**	**28**	**27**	**87**	**1.8**	**19**	**4.3**	**5.1**	**2.2**	**< 2**	**15**	**56**
	Weighted Outfall Conc.		**7.59**	**75.9**	**163**	**6**	**23**	**309**	**160**	**559**	**8**	**29**	**15**	**73**	**1.8**	**42**	**3.0**	**4.4**	**2.1**	**< 2**	**9.7**	**65.7**
	Change in Conc. (%)		**6**	**29**	**9**	**-54**	**-78**	**51**	**90**	**3**	**-24**	**5**	**-45**	**-16**	**-3**	**127**	**-29**	**-13**	**-3**	**--**	**-37**	**17**

6.1.1.1 General Parameters

In general, slight increases in pH, alkalinity, and conductivity were observed between the inflow and outflow concentrations at each of the dry detention monitoring sites. The observed increases in alkalinity are caused by release of ions (such as calcium and carbonates) which are present in the surficial limerock formations common throughout South Florida. The neutral to sub-neutral pH characteristics of the inflows enhances the dissolution of the limerock which creates increases in conductivity and alkalinity. Overall, the observed increases for pH, alkalinity, conductivity, and hardness appear to be related more to the physical characteristics of the treatment pond soils rather than issues related to removal of stormwater constituents, and the observed increases in these parameters would likely be different if the evaluations had been conducted in areas with substantially different soil characteristics.

Reductions in measured concentrations of turbidity and TSS were observed between inflow and outflow samples at each of the three dry detention sites, with turbidity reductions ranging from 3-29%, and TSS reductions ranging from 29-50%. Reductions in both turbidity and TSS are common in stormwater ponds due to settling of solids within the treatment system. Although the input concentrations for each of these parameters were generally low in value, reductions were still observed between inflow and outflow samples. Therefore, it appears that the dry detention ponds have an affinity for reduction in turbidity and removal of TSS.

In contrast, increases in color were observed between inflow and outflow concentrations at each of the three monitoring sites, ranging from 1-127%. The inflow color concentrations in the collected stormwater and bulk precipitation samples were generally low in value, and observed increases are likely related to release of organic material from the pond sediments into the overlying water column. A modest color increase of only 1% was observed at the Bonita Springs site, with color increases of 98% and 127% observed at the Naples and Pembroke Pines sites. Unfortunately, the color analyses cannot determine the source of the color and whether the organic matter originated from stormwater generated constituents that settled within the pond or was present initially in the soils in the bottom of the detention basin.

6.1.1.2 Nitrogen Species

As discussed in Section 5.1, low concentrations of both ammonia and NO_x were observed in the inflow samples collected at each of the three dry detention sites. However, even though the input concentrations were low in value, substantial reductions in concentrations were observed for both ammonia and NO_x between the inflow and outflow samples. Uptake of dissolved inorganic nitrogen is expected in shallow grassed ponds as a result of uptake by vegetation and adsorption onto pond soils. Ammonia reductions at the three sites ranged from 3-66%, with NO_x reductions ranging from 47-78%. The data indicate that the ponds clearly have an affinity for reducing concentrations of inorganic nitrogen even when the input concentrations are already low in value.

In contrast to the relatively consistent patterns observed for ammonia and NO_x, dissolved organic nitrogen exhibited both uptake and generation at the three detention pond sites. Changes in concentrations of dissolved organic nitrogen ranged from -12% at the Bonita Springs site to increases ranging from 21-51% at the Naples and Pembroke Pines sites. Input concentrations of dissolved organic nitrogen at each of the three sites were generally moderate in value and similar to concentrations typically observed in urban runoff. The observed differences in uptake of dissolved organic nitrogen between the three sites may be related to differences in the characteristics of the bottom soils. The Bonita Springs site, which exhibited a reduction in dissolved organic nitrogen of 12%, also had a color increase of only 1% between the inflow and outflow, suggesting a low level of organic material present in the bottom pond sediments. However, the Naples and Pembroke Pines sites, each of which exhibited significant increases in dissolved organic nitrogen between inflow and outflow samples, also exhibited significant increases in color which ranged from 98-127%.

The observed increases in dissolved organic nitrogen and color suggest that organic compounds may have been released from the pond bottom sediments, contributing to both increases in dissolved organic nitrogen and color at the Naples and Pembroke Pines sites. However, it is not known if the organic matter was introduced through stormwater runoff inflows or was part of the soils originally placed on the pond bottom.

A similar pattern was also observed for concentrations of particulate nitrogen at the three dry detention monitoring sites, with a 21% reduction in particulate nitrogen observed at Bonita Springs between inflow and outflow concentrations, and 69-90% increases in particulate nitrogen observed at the Naples and Pembroke Pines sites. The observed behavior for particulate nitrogen mimics very closely the behavior observed for dissolved organic nitrogen. It is possible that the particulate nitrogen increases observed at the Naples and Pembroke Pines sites are due to release of extremely fine particles from the bottom sediments which are reflected as increased concentrations in the pond discharge. However, this behavior may also be related to the physical characteristics of the pond bottom rather than stormwater removal processes within the pond.

Overall, the dry detention ponds exhibited relatively poor removal efficiencies for total nitrogen, with a 23% reduction in concentration observed between the inflow and outflow at the Bonita Springs site, no significant change at the Naples site, and a 3% increase observed at the Pembroke Pines site. The monitored dry detention ponds appear to have little affinity for retaining total nitrogen within the pond system. However, large portions of the observed outfall concentrations are contributed by the observed increases in dissolved organic nitrogen and particulate nitrogen at the Naples and Pembroke Pines sites. If the observed increases in dissolved organic nitrogen and particulate nitrogen are indeed related to the characteristics of the pond bottom soils, then overall reductions in total nitrogen may have been observed between the inflow and outflow concentrations at these sites if the pond bottom soils were different. However, overall, it appears that concentration reductions for total nitrogen at the dry detention monitoring sites appear to be minimal in value.

6.1.1.3 Phosphorus Species

In contrast to the trends observed for nitrogen species, substantial concentration reductions were observed for virtually all of the measured phosphorus species. Concentration reductions for SRP ranged from 24-75%, with the highest removal efficiency occurring at the Bonita Springs site and the lowest concentration reduction observed at the Pembroke Pines site. SRP is an inorganic phosphorus source which is readily adsorbed by both plants and aquatic organisms, and the observed reductions in concentrations between inflow and outflow samples are not unexpected.

A substantially lower change in concentration was observed for dissolved organic phosphorus, with concentration reductions ranging from 19-22% at the Bonita Springs and Naples sites, with a 5% increase in concentration observed at the Pembroke Pines site. The measured inflow concentration of dissolved organic phosphorus are extremely low in value, and much lower than concentrations typically observed in urban runoff. However, in spite of the extremely low input concentrations, the pond systems were still capable of reducing concentrations at two of the three sites. Organic phosphorus cannot be utilized directly by plants and must first be transformed into SRP by bacteria before reductions can occur. It appears that this process may be occurring to a limited extent in the evaluated ponds. The observed increases in dissolved organic phosphorus at the Pembroke Pines site may be related to the release of phosphorus-containing organic matter from the sediments which results in concentration increases for dissolved organic nitrogen and color at this site.

Reductions in concentrations were observed between inflow and outflow samples for particulate phosphorus at each of the three sites, with reductions ranging from 25-45%. Particulate phosphorus is generally readily removed in quiescent aquatic environments, and the observed decreases in concentrations would be expected. The input concentrations of particulate phosphorus are extremely low in value compared with concentrations observed in urban runoff, and substantial removals were obtained for particulate phosphorus even at the low input concentrations.

Reductions in concentrations of total phosphorus were observed at each of the three dry detention monitoring sites, with removals ranging from 16-44%. The consistent reductions in concentrations observed for phosphorus species indicate that the dry detention ponds have a relatively significant affinity for reducing phosphorus concentrations in spite of the relatively low input concentrations measured at the three sites. Overall, the ponds appear to have a substantially higher affinity for removal of phosphorus species than nitrogen species.

6.1.1.4 Metals

In general, reductions in concentrations of chromium, copper, and zinc were observed between inflow and outflow samples at virtually all of the monitoring sites. Measured concentrations of chromium were reduced by 11% at the Bonita Springs site and by 13% at the Pembroke Pines site in spite of the extremely low input concentrations. In contrast, a slight increase of approximately 2% was observed for chromium at the Naples site. Overall, the ponds appear to have an affinity for reducing concentrations of chromium, although to a relatively small degree, even at the low observed input values.

Reductions in concentrations of copper were observed at each of the three dry detention monitoring sites, with concentration reductions ranging from 3-28%. The ponds also appear to have an affinity for reduction of copper in spite of the extremely low input concentrations.

Both input and output concentrations of lead were lower than the minimum detection limit (MDL) for the laboratory test of 2 μg/l. Therefore, no conclusions can be reached regarding reductions in lead concentrations since the input concentrations were already lower than the measurement level for the applicable laboratory testing.

Reductions in measured concentrations of zinc were observed between inflow and outflow concentrations at each of the three dry detention sites, with concentration reductions ranging from 11-48%. Zinc concentrations in the inflows were also low in value, and concentration reductions were still observed in spite of the low measured input values. Overall, the wet detention ponds appear to have a relatively significant affinity for reduction of concentrations of zinc.

6.1.1.5 Summary of Concentration-Based Removals

A tabular summary of changes in inflow/outflow concentrations at the dry detention monitoring sites is given in Table 6-2. On an overall basis, the dry detention pond exhibited increases between inflow and outflow concentrations for pH, alkalinity, conductivity, dissolved organic nitrogen, particulate nitrogen, color, and hardness. The observed increases for pH, alkalinity, conductivity, and hardness are likely related to the surficial limerock layers which are present throughout much of South Florida. Release of dissolved ions from slow dissolution of the limerock by the neutral to slightly acidic inputs results in dissolution of dissolved ions which increases values for the previously listed parameters. These increases appear to be more an artifact of the localized soil materials rather than processes which occur as part of the dry detention system alone. The observed increases for dissolved organic nitrogen and particulate nitrogen may be related to release of organic matter from pond bottom soils resulting from the accumulation of runoff generated inflows or from organic matter originally present within the soils.

The dry detention systems resulted in relatively modest reductions in measured concentrations of ammonia, NO_x, SRP, particulate phosphorus, total phosphorus, turbidity, TSS, chromium, copper, and zinc. These observed concentration-based reductions suggest that physical and biological removal processes occur within the pond systems which result in reductions in concentrations for these parameters. The observed reductions in concentrations of nitrogen and phosphorus species suggests biological uptake of nutrients by vegetation and soils within the ponds, while the observed reductions for turbidity and TSS likely reflect physical processes resulting in settling of particulate matter. Concentration reductions observed for chromium, copper, and zinc are likely a combination of physical settling of particulate matter, adsorption onto plant material and pond bottom soils, combined with a limited degree of biological uptake.

TABLE 6-2

SUMMARY OF CHANGES IN INFLOW / OUTFLOW CONCENTRATIONS AT THE DRY DETENTION MONITORING SITES

PARAMETER	CONCENTRATION CHANGE (%)			MEAN CHANGE (%)
	Bonita Springs	Naples	Pembroke Pines	
pH	3	5	6	5
Alkalinity	25	19	29	24
Conductivity	21	16	9	15
Ammonia	-3	-66	-54	-41
NO_x	-47	-73	-78	-66
Dissolved Organic N	-12	21	51	20
Particulate N	-21	69	90	46
Total N	-23	0	3	-7
SRP	-75	-40	-24	-46
Dissolved Organic P	-19	-22	5	-12
Particulate P	-38	-25	-45	-36
Total P	-44	-30	-16	-30
Turbidity	-29	-29	-3	-20
Color	1	98	127	75
TSS	-50	-34	-29	-38
Chromium	-11	2	-13	-7
Copper	-28	-16	-3	-16
Lead	--	--	--	--
Zinc	-11	-48	-37	-32
Hardness	23	25	17	22

Overall, the observed systems resulted in a mean concentration reduction of approximately 7% for total nitrogen, 30% for total phosphorus, and 38% for TSS, reflecting poor to modest concentration reductions for each of these common stormwater constituents. The field data suggest that a dry detention system has a low to moderate affinity for removal of nutrients and TSS during a typical flow-through situation. However, it should be noted that input concentrations for each of these parameters were low in value, and the observed concentration reductions may have been different with more elevated input values.

6.1.2 Underdrain Monitoring Site

A comparison of mean inflow and outflow concentrations for monitored constituents at the Orlando underdrain monitoring site is given on Table 6-3. A discussion of changes in chemical characteristics for evaluated parameters is given in the following sections.

TABLE 6-3

COMPARISON OF MEAN INFLOW AND OUTFLOW CONCENTRATIONS AT THE UNDERDRAIN MONITORING SITES

PROJECT LOCATION	SITE	FRACTION OF ANNUAL INPUT VOLUME	PARAMETER																			
			pH (s.u.)	Alk. (mg/l)	Cond. (µmho /cm)	Ammo nia (µg/l)	NO_x (µg/l)	Diss. Org. N (µg/l)	Part. N (µg/l)	Total N (µg/l)	SRP (µg/l)	Diss. Org. P (µg/l)	Part. P (µg/l)	Total P (µg/l)	Turb. (NTU)	Color (Pt-Co)	TSS (mg/l)	Cr (µg/l)	Cu (µg/l)	Pb (µg/l)	Zn (µg/l)	Hardness (mg/l)
Orlando	SW-1	0.355	6.55	21.4	65	16	245	92	84	497	12	20	17	75	3.7	14	8.9	5.7	3.4	< 2	24	27.4
	SW-2	0.089	6.78	31.8	76	10	168	121	68	468	12	42	16	92	3.4	17	10.0	5.4	2.7	< 2	24	29.8
	SW-3	0.075	6.63	22.4	58	37	213	82	54	496	10	44	18	110	3.2	13	17.7	5.9	2.5	< 2	22	21.0
	SW-4	0.072	6.49	21.2	50	23	220	85	90	491	13	15	23	68	2.3	8	12.6	5.1	2.8	< 2	23	16.9
	BP	0.310	5.67	4.7	15	141	166	68	70	538	18	13	11	61	1.3	6	3.0	6.2	2.9	< 2	25	3.0
	Weighted Inflow Conc.		**5.65**	**15.1**	**42**	**55**	**185**	**77**	**68**	**458**	**13**	**19**	**14**	**67**	**2.4**	**10**	**7.2**	**5.2**	**2.7**	**< 2**	**22**	**16.1**
	Weighted Outfall Conc.		**7.27**	**68.2**	**149**	**8**	**190**	**107**	**84**	**462**	**51**	**6**	**12**	**76**	**2.2**	**34**	**4.0**	**5.7**	**1.7**	**< 2**	**5.5**	**64.4**
	Change in Conc. (%)		**29**	**352**	**252**	**-86**	**2**	**40**	**23**	**1**	**301**	**-70**	**-16**	**13**	**-11**	**251**	**-44**	**9**	**-38**	**--**	**-75**	**300**

6.1.2.1 General Parameters

Similar to the trends observed at the dry detention sites, increases in concentrations were observed at the underdrain monitoring site between inflow and outflow samples for pH, alkalinity, conductivity, and hardness, with the observed increases for these parameters at the underdrain site substantially greater than the observed increases at the dry detention sites. Since the outflow samples at the underdrain site reflect impacts of migration of runoff through the soil, the observed increases in pH, alkalinity, and hardness are likely related to release of ions from the soil into the stormwater as it infiltrates through the soils. The soils appear to be releasing calcium and magnesium which is reflected as an increase in hardness, as well as carbonates which cause increases to both alkalinity and pH. The increase in dissolved ions also results in an increase in conductivity between the inflow and outflow concentrations. Input concentrations of alkalinity, conductivity, and hardness were extremely low in value, and the observed changes in concentrations may appear to be greater because of the low input values.

Reductions in concentrations were observed for both turbidity and TSS, with an 11% reduction in turbidity concentrations and a 44% reduction for TSS. Reductions in turbidity and TSS would be expected for stormwater passing through a soil layer. It is interesting that removals for each of these parameters occurred in spite of the extremely low input concentrations for these parameters.

Similar to the trends observed at the dry detention sites, an increase in color was observed between input and output concentrations for the underdrain system. The observed increase of 251% is partially related to the extremely low input concentration for color of only 10 Pt-Co units. The observed increase to 34 Pt-Co units in the underdrain discharge reflects release of organic constituents from the soil.

6.1.2.2 Nitrogen Species

During migration through the soil layers, reductions in concentrations for nitrogen species were observed only for ammonia, with increases in concentrations observed for the remaining nitrogen species. Ammonia concentrations were reduced by 86% from an already low weighted inflow concentration of 55 μg/l to 8 μg/l in the underdrain discharge. A slight increase in concentration of 2% was observed for NO_x. However, substantial increases in both dissolved organic nitrogen and particulate nitrogen, ranging from 23-40%, were observed between inflow and outflow concentrations. Overall, the underdrain system had little affinity for removal of total nitrogen, with virtually no change in concentration between inflow and outflow values. Since the primary removal mechanisms in an underdrain system are physical filtration by soil particles and adsorption onto organic matter, the clean soils used in the underdrain appear to contain few available mechanisms for these processes.

6.1.2.3 Phosphorus Species

Migration through the underdrain system resulted in a substantial increase in measured concentrations of SRP which increased from 13 μg/l in the weighted inflow to 51 μg/l in the outflow samples. The observed increase in SRP is likely related to decomposition of organic matter in the soil which is released through biological processes as SRP, and it appears that the underdrain soils have little affinity for uptake of this constituent.

In contrast, reductions in concentrations were observed for both dissolved organic phosphorus and particulate phosphorus in spite of extremely low input concentrations for each of these parameters. The behavior of dissolved organic phosphorus and particulate phosphorus appears to be opposite from the behavior exhibited by dissolved organic nitrogen and particulate nitrogen which increased substantially in value between the inflow and outflow. In fact, the removal and subsequent decomposition of organic and particulate phosphorus may be largely responsible for the observed increases in SRP.

Overall, total phosphorus concentrations increased approximately 13% between the weighted inflow and weighted outflow concentrations, primarily as a result of the observed increases in SRP concentrations. Based upon the field monitoring conducted at this site, the underdrain system has little or no affinity for long-term retention of phosphorus compounds in the soils used in the underdrain system.

6.1.2.4 Metals

In general, input concentrations of metals to the underdrain system were typically low in value. A slight increase was observed for chromium between inflow and outflow concentrations, although a reduction of 38% was observed for copper during migration through the soils. Copper is well known for an ability to absorb onto organic matter, creating organic-copper complexes. No conclusions could be drawn regarding the removal of lead in the underdrain system since both inflow and outflow concentrations were less than the minimum detection for the lead test. Similar to the trends observed at the dry detention sites, zinc was removed to a high degree in the underdrain filtration system, with an overall concentration reduction of 75%. Both the dry detention and underdrain sites appear to have a relatively significant affinity for retaining zinc.

6.1.2.5 Summary of Concentration-Based Removals

In summary, the native soils used in the underdrain system at the Orlando site appear to have little natural affinity for removal of either total nitrogen or total phosphorus. The removal of these constituents could likely be enhanced if the native soil was replaced with a media designed to have a specific affinity for removal of nitrogen and phosphorus species. However, based upon the current design, the underdrain system provides little benefit for removal of nutrients. In contrast, the system does appear to have an affinity for removal of turbidity, TSS, copper, and zinc, although these constituents were extremely low in value in the runoff inflows.

6.2 Mass Removal Efficiencies

Mass removal efficiencies incorporate both changes in concentrations between inflows and outflows as well as impacts of hydrologic losses (or inputs) during migration through the stormwater management system. Due to the high degree of variability observed in measured inflow and outflow concentrations and the quantity of hydrologic inputs and losses over the 12-month monitoring program, mass loadings for inputs and outputs were calculated on a monthly basis for both the dry detention and underdrain monitoring sites. Mean monthly concentrations were calculated for each of the monitored inflows and outflows at each of the wet detention and underdrain monitoring sites for each laboratory measured constituent. The monthly values were calculated as the geometric mean of concentrations of each individual inflow and outflow collected during each individual month over the 12-month field monitoring program. The evaluated inputs included runoff inflows at each of the identified monitoring sites as well as monitored inputs from bulk precipitation. Outflow losses are calculated based upon the concentrations of constituents measured in the outflow from each treatment system.

The monthly concentrations were calculated as the geometric mean value for all measurements of a given constituent collected during each calendar month from December 2012-November 2013. Monthly mean concentrations for periods during which no samples were collected were calculated as the geometric mean of samples collected during the months prior to and following the monthly period with no data. A summary of the calculated mean monthly concentrations for each monitored input and output at each of the four monitoring sites is given in Appendix E.1.

Monthly mass loadings for each of the monitored inflows and outflows were calculated by multiplying the geometric mean monthly concentrations (summarized in Appendix E.1), times the monthly hydrologic inputs and losses (summarized in Section 4.3.5), and the monthly hydrologic inputs from direct rainfall (summarized in Section 4.1). This analysis was conducted for each of the monitored species of nitrogen and phosphorus, as well as TSS and the monitored metals. A summary of calculated monthly mass inputs and losses for the evaluated parameters at each of the four monitoring sites is given in Appendix E.2.

The information summarized in Appendix E.2 was used to calculate monthly mass balances for each of the evaluated species of nitrogen and phosphorus, along with TSS and heavy metals, at each of the four monitoring sites. A summary of the results of this analysis is given in Appendix F. The measured monthly mass balances are highly variable throughout the year for each evaluated parameter, although no specific seasonal pattern is immediately apparent.

The monthly mass balance calculations provided in Appendix F were summarized over the 12-month monitoring period to provide estimates of the total mass inputs and losses for each of the evaluated dry detention and underdrain sites over the 12-month monitoring program from December 2012-November 2013. A summary and discussion of the overall mass removal efficiencies obtained at the dry detention and underdrain monitoring sites is given in the following sections.

6.2.1 Dry Detention Pond Sites

A summary of overall mass removal efficiencies obtained at the dry detention monitoring sites during the 12-month field monitoring program is given in Table 6-4. The efficiencies summarized in this table reflect the combined effects from reductions in concentrations during migration through the treatment system as well as hydrologic losses resulting from evaporation or infiltration into shallow groundwater.

TABLE 6-4

OVERALL MASS REMOVAL EFFICIENCIES FOR THE DRY DETENTION MONITORING SITES FROM DECEMBER 2012 – NOVEMBER 2013

PARAMETER	MASS REMOVAL (%)			MEAN REMOVAL (%)
	Bonita Springs	Naples	Pembroke Pines	
Ammonia	47	87	69	67
NO_x	64	89	85	79
Dissolved Organic N	53	53	14	40
Particulate N	57	71	46	58
Total N	59	69	50	59
SRP	73	84	59	72
Dissolved Organic P	60	82	51	64
Particulate P	63	72	63	66
Total P	66	80	52	66
TSS	78	68	73	73
Chromium	48	71	51	57
Copper	47	67	50	54
Lead	44	56	45	48
Zinc	59	68	48	58
Volume	**43**	**83**	**26**	**51**

Overall, the three evaluated dry detention sites exhibited relatively consistent mass removal efficiencies for each of the monitored nitrogen species, with a mean mass removal efficiency of 67% for ammonia, 79% for NO_x, 40% for dissolved organic nitrogen, 58% for particulate nitrogen, and 59% for total nitrogen. However, as indicated on the bottom of Table 6-4, approximately 51% of the observed overall mass removal was due to volumetric losses of runoff inputs through the combined processes of evaporation and infiltration into groundwater.

A similar pattern was also observed for measured mass load reductions for phosphorus species, with a 72% mass load reduction for SRP, 64% for dissolved organic phosphorus, 66% for particulate phosphorus, and 66% for total phosphorus. However, as mentioned previously for total nitrogen, approximately 51% of the overall observed mass load reduction is due to volumetric losses within the treatment system.

A relatively high removal efficiency of 73% was observed for TSS which exhibited concentration-based reductions at each of the dry detention monitoring sites. However, approximately 51% of the observed mass removal efficiency of 73% occurs as a result of hydrologic losses.

Moderate mass removal efficiencies were also observed for the evaluated metals, with a 57% load reduction for chromium, 54% for copper, 48% for lead, and 58% for zinc. However, as discussed previously, approximately 51% of the removal efficiencies for heavy metals are due to the hydrologic losses which occurred within the treatment systems. In the absence of hydrologic losses, the removal efficiencies for heavy metals would be single digits for all of the measured metals.

Overall, mass removal efficiencies for dry detention systems appear to be closely linked to hydrologic losses resulting from evaporation and infiltration into shallow soils. In the absence of hydrologic losses, removal efficiencies for the dry detention process itself are minimal, particularly for nutrients and metals. A dry detention system with impermeable soils would be expected to have an extremely low overall mass load reduction for virtually all parameters, while a dry detention pond with a large degree of volumetric losses (such as the Naples dry detention site) would be expected to exhibit removal efficiencies in excess of 70-80% for virtually all of the measured parameters.

Unlike the highly predictable removal efficiencies obtained in wet detention and dry retention systems, mass removal efficiencies for dry detention ponds are highly variable and closely linked to the hydrologic characteristics of the treatment site. Due to the high degree of variability in potential hydrologic characteristics from site to site, the magnitude of hydrologic losses is unpredictable, and it is difficult to predict "typical" hydrologic losses to assign a "typical" removal efficiency for dry detention systems. In a system with no significant volumetric losses, mass load reductions for dry detention systems would be similar to the concentration-based efficiencies summarized in Table 6-2 which would suggest a 7% load reduction for total nitrogen, 30% for total phosphorus, and 35-40% for TSS, while mass removal efficiencies would increase proportionally with the magnitude of hydrologic losses.

The observed poor performance for dry detention systems and high variability in hydrologic characteristics from site to site makes it difficult to estimate a "typical" effectiveness for dry detention. In order to provide reasonable assurance that a proposed dry detention system would provide load reductions in excess of the concentration-based reductions (summarized in Table 6-2), a corresponding hydrologic assessment would need to be conducted which estimates the anticipated hydrologic losses, based upon both surface and sub-surface infiltration rates, which accurately consider and include tailwater conditions for both surface water and groundwater. In the absence of significant hydrologic losses, dry detention appears to be a poorly performing stormwater BMP which falls far short of the regulatory standard for stormwater treatment systems outlined in Chapter 62-40.432-Surface Water Management Regulation which requires stormwater management systems to "achieve at least 80% reduction of the average annual load of pollutants that would cause or contribute to violation of State Water Quality Standards".

6.2.2 Underdrain Filtration Systems

A tabular summary of overall mass removal efficiencies for the underdrain filtration system from December 2012-November 2013 is given on Table 6-5. In general, overall mass removal efficiencies for the underdrain system were highly variable, depending upon the particular constituent. Mass removal of ammonia occurred at a 90% rate, with only 29% removal for NO_x, 92% for dissolved organic nitrogen, 18% for particulate nitrogen, and 30% for total nitrogen. However, as indicated on the bottom of Table 6-5, approximately 24% of the observed reductions in mass loadings were due to system losses which occurred as a result of evaporation or losses to groundwater which were not intercepted by the underdrain system. When the volumetric losses are considered, the overall mass removal for total nitrogen is less than 10%.

Large increases in mass loadings were observed between the inflow and outflow for SRP, with mass loadings more than doubling between inflows and outflows. This type of behavior for SRP has been previously observed by ERD in virtually all filter system evaluations where dissolved organic phosphorus and particulate phosphorus is typically trapped within the filter system but later decomposed and degraded into soluble SRP which is then flushed through the filter media. Overall, a mass load reduction of only 14% was observed for total phosphorus, and considering that 24% removal is due to hydrologic losses, it appears that a net export of total phosphorus would have occurred in the absence of the observed losses.

The observed removal of 66% for TSS within the underdrain system reflects a relatively moderate value for TSS, particularly considering the filtration aspects of the underdrain system. The granular particle size of the soil matrix must allow fine particles of TSS to pass through and enter the underdrain system. Relatively modest mass load reductions were obtained for chromium, copper, and lead, with a 26% overall load reduction for chromium, 57% for copper, and 31% for lead. Considering that 24% of the observed losses are a result of volumetric reductions, the only metal in this group which appears to exhibit a significant load reduction is copper. In contrast, a large mass removal was observed for zinc within the filter system, with a removal of 83%. This suggests that the filter system has a relatively strong affinity for removal of zinc compared with the other measured metals.

TABLE 6-5

OVERALL MASS REMOVAL EFFICIENCIES FOR THE UNDERDRAIN MONITORING SITE FROM DECEMBER 2012 – NOVEMBER 2013

PARAMETER	MEAN REMOVAL (%)
Ammonia	90
NO_x	29
Dissolved Organic N	92
Particulate N	18
Total N	30
SRP	-194
Dissolved Organic P	82
Particulate P	48
Total P	14
TSS	66
Chromium	26
Copper	57
Lead	31
Zinc	83
Volume	24

Overall, even when considering the supplemental hydrologic losses, the underdrain filter system exhibited poor removal efficiencies for total nitrogen (30%) and total phosphorus (14%). In the absence of the volumetric losses, the underdrain system would result in virtually no reduction in total nitrogen, total phosphorus, chromium, or lead.

The results summarized in Table 6-5 indicate that the evaluated underdrain system, which uses native sandy soils for filtration, is an extremely poorly performing stormwater BMP which, even when considering the volumetric losses, falls far short of the stormwater management system objectives outlined in Chapter 62-40.432. However, the performance of the underdrain system could be substantially enhanced if the existing soil media, which at the Orlando site consisted primarily of medium to coarse sand, were to be replaced with a designed pollutant removal media. There are numerous media blends available on the market today which provide significant removals for nitrogen, phosphorus, and heavy metals, and the effectiveness of the underdrain system could be substantially enhanced by substituting this media for a proportion or all of the existing native soil layer.

SECTION 7

SUMMARY AND RECOMMENDATIONS

7.1 Summary

7.1.1 Introduction

The most commonly used stormwater treatment systems in Florida include wet detention, dry retention, and dry detention (which is used primarily in South Florida). Significant previous research has been conducted into the effectiveness of wet detention and dry retention systems, and removal process and relationships for these BMPs are well established. However, only a limited number of previous research studies have been conducted on dry detention systems, in spite of the fact that these are the most commonly used treatment systems in South Florida, and the studies that have been conducted have reported a wide range of treatment efficiencies.

Another treatment type which is gaining popularity in the St. Johns River Water Management District (SJRWMD) is a pond underdrain system which uses native soil to filter the runoff before collection in a series of underdrains beneath the pond. SJRWMD previously allowed side bank dry detention filtration systems which were ultimately discontinued due to poor performance, clogging, and maintenance issues. The revised design is an attempt to address the issues associated with the previous side bank design. However, no studies have been conducted to evaluate the hydrologic and pollutant removal effectiveness of these systems.

7.1.2 Study Sites

Research sites which use underdrain filtration and dry detention ponds were identified with the assistance of SJRWMD and SFWMD. Hydrologic and water quality monitoring instrumentation was installed at four separate locations which included three dry detention ponds and one underdrain system. A 12-month field monitoring program was conducted at each site from December 1, 2012-November 30, 2013 to evaluate the hydrologic and pollutant removal effectiveness for each of the evaluated systems. The underdrain filtration site is located in Orlando, with the three dry detention sites located in South Florida in Bonita Springs, Naples, and Pembroke Pines. Complete hydrologic and pollutant budgets were developed for each evaluated system to assist in characterizing pollutant removal effectiveness.

One of the primary objectives of this project is to generate additional runoff emc characterization data for low-intensity commercial land use categories. The existing data in the Florida emc database for low-intensity commercial sites is limited, and the most recent study was conducted during 2005. Since that time, substantial enhancements have been made in the areas of watershed management and maintenance for low-intensity commercial sites such as “big box” stores and local shopping centers. Therefore, each of the three dry detention sites consisted of a “big box” shopping center, while the Orlando underdrain site consisted of a large parking area for a bus maintenance facility. Each of the sites evaluated as part of this project conduct routine vacuum sweeping as a maintenance activity to remove trash and debris from parking areas.

During this project, a total of 397 individual inflow and outflow samples was collected at the four monitoring sites, with 101 bulk precipitation samples and 132 shallow groundwater samples. Overall, more than 12,000 individual laboratory analyses were conducted in the ERD Laboratory for this project, along with more than 20,000 individual field hydrologic measurements of flow rates, water level elevations, and direct precipitation.

7.1.3 Runoff Characteristics

Runoff concentrations in inflow samples collected at each of the four monitoring sites were low in value and were equal to approximately one-third to one-half of runoff values reported for low-intensity commercial land use sites based upon data contained in the existing Florida emc database. However, the most recent entry into the database for the category of low-intensity commercial land use is based upon a study conducted during 2005, and since that time, substantial enhancements have occurred in management and maintenance of commercial sites.

The overall geometric mean emc value for total nitrogen at the dry detention and underdrain monitoring sites was 0.510 mg/l, with a value of 0.73 mg/l for total phosphorus and 6.5 mg/l for TSS. Current values listed in the low-intensity commercial land use database are 1.07 mg/l for total nitrogen, 0.179 mg/l for total phosphorus, and 47.5 mg/l for TSS. It appears that the enhanced maintenance activities which occur at these sites have substantially reduced runoff concentrations for low-intensity commercial activities constructed under current conditions.

7.1.4 Hydrology

Hydrologic budgets were calculated for each of the monitored sites based upon inputs from stormwater runoff and direct precipitation, with losses occurring as a result of discharges through the outfall structure, evaporation, and groundwater infiltration. The measured hydrologic budgets were extremely variable between each of the three dry detention sites. At the Bonita Springs site, approximately 43% of the inflows into the system were lost as a result of evaporation and infiltration into shallow groundwater. However, at the Naples dry detention pond site, the observed losses from evaporation and groundwater infiltration increased to 83%, while decreasing substantially to only 26% at the Pembroke Pines site. It appears that the hydrologic characteristics of the three sites vary significantly in spite of the fact that each of the sites is located in South Florida. At the underdrain site in Orlando, approximately 24% of the inputs into the pond were lost as a result of surface evaporation or groundwater infiltration which was not intercepted by the underdrain system.

7.1.5 Removal Efficiencies

7.1.5.1 Concentration-Based Removal Efficiencies

Concentration-based removal efficiencies were calculated for each evaluated parameter at each of the four monitoring sites. Concentration-based removals allow an evaluation of the physical and biological processes available in dry detention and underdrain systems for uptake of common constituents in stormwater runoff.

During migration through the dry detention systems, increases were observed for pH, alkalinity, conductivity, dissolved organic nitrogen, particulate nitrogen, color, and hardness between inflow and outflow measurements conducted at the three sites. Only modest reductions in concentrations were observed for ammonia, NO_x, SRP, particulate phosphorus, total phosphorus, turbidity, TSS, chromium, copper, and zinc. The observed reductions in concentrations of nutrients suggests that biological uptake may be occurring through uptake mechanisms by vegetation and soils within the ponds. However, the observed concentration-based reductions were typically low in value.

A similar situation was observed in the underdrain system which uses native soils as the filtration media. The underdrain system at the Orlando site had little natural affinity for removal of either nitrogen or total phosphorus. However, the system did provide a minimal removal for turbidity, TSS, copper, and zinc, although the concentrations of these constituents were initially low in value in the runoff inflows.

7.1.5.2 Mass Removal Efficiencies

Monthly mass loadings were calculated for each of the monitored inflows and outflows at each of the four monitoring sites by multiplying the geometric mean monthly concentration for inputs and losses times the monthly hydrologic inputs or losses for each monitoring site. This information was summarized over an annual period to provide an estimate of the overall mass load reduction achieved by each treatment system during the 12-month monitoring program.

7.1.5.2.1 Dry Detention Systems

Overall, the three evaluated dry detention sites exhibited relatively consistent mass removal efficiencies for nitrogen species, with a mean mass removal of 67% for ammonia, 79% for NO_x, 40% for dissolved organic nitrogen, 58% for particulate nitrogen, and 59% for total nitrogen. However, approximately 51% of the observed overall mass removal was due to volumetric losses of runoff inputs through the combined processes of evaporation and infiltration into groundwater.

The information obtained during this study suggests that the mass load reductions achieved by a dry detention pond are highly correlated with the amount of inflow lost as a result of evaporation or infiltration into groundwater. Sites with minimal infiltration, such as Pembroke Pines, exhibited only modest mass removal efficiencies for total nitrogen and total phosphorus. However, the Naples site, which lost 83% of the volumetric inputs through evaporation and groundwater losses, exhibited more elevated overall mass load reductions for total nitrogen and total phosphorus.

In general, mass removal efficiencies for dry detention systems appear to be closely linked to hydrologic losses resulting from evaporation and infiltration into shallow soils. In the absence of hydrologic losses, removal efficiencies for the dry detention process itself are modest, particularly for nutrients and metals. As a result, the performance efficiency of a dry detention facility is highly variable and unpredictable and cannot be relied upon to obtain a constant fixed mass load reduction for any given site. Due to the significant relationship between hydrologic losses and performance efficiencies for dry detention systems, designs should be accompanied by an assessment which incorporates both the concentration-based removals and the anticipated hydrologic losses based upon surface and sub-surface losses to provide an estimate of site-specific removal efficiencies for a given site. In the absence of significant hydrologic losses, dry detention appears to be a poorly performing stormwater BMP which falls far short of the design standard for stormwater treatment systems outlined in Chapter 62-40.432-Surface Water Management Regulation which requires stormwater management systems to "achieve at least 80% reduction of the average annual load of pollutants that would cause or contribute to violations of State water quality standards".

7.1.5.2.2 Underdrain Systems

In general, mass removal efficiencies achieved for underdrain systems were highly variable, with a 30% overall load reduction observed for total nitrogen, 14% for total phosphorus, and 66% for TSS. A large mass increase of 194% was observed for SRP during migration through the filter system. In the absence of the hydrologic losses, which removed approximately 24% of the inflow mass, a net export of total phosphorus would have occurred at the site, with a removal for total nitrogen in the single digits.

It appears that the native soil media used at the underdrain filtration site has little affinity for long-term retention of either nitrogen or phosphorus. The Orlando underdrain system, which uses native soils for filtration, is an extremely poorly performing stormwater BMP which, even when considering the volumetric losses, falls far short of the stormwater management system objectives outlined in Chapter 62-40.432. It is likely that the performance of the underdrain system could be substantially enhanced if the existing soil media were to be replaced with an engineered removal media specific for nutrients and metals.

7.1.5.3 Groundwater Impacts

Shallow groundwater monitoring wells were installed at each of the four monitoring sites to evaluate potential groundwater impacts from operation of the dry detention and underdrain treatment systems. Monitoring wells were installed in each of the evaluated dry detention ponds as well as the Orlando underdrain pond, with background monitoring wells also installed at the Bonita Springs and Pembroke Pines dry detention sites.

7.1.5.3.1 Dry Detention

In general, increases in groundwater concentrations, compared with runoff inflows, were observed for pH, alkalinity, conductivity, color, and hardness at each of the three dry detention monitoring sites. However, the observed increases for these parameters are likely related to the highly alkaline soils and limerock which is present in surficial soil layers throughout much of South Florida.

Significant increases in concentrations of total nitrogen were observed in groundwater beneath the dry detention ponds at each of the four sites, due primarily to substantial increases in ammonia and organic nitrogen. However, it is unclear whether the observed increases in nitrogen are a result of operation of the dry detention pond or are related to general soil characteristics in South Florida. The background monitoring well at the Bonita Springs site exhibited total nitrogen concentrations substantially higher than observed in groundwater beneath the pond which suggests that the observed nitrogen increases in groundwater are not related to the dry detention systems. However, the background monitoring well at the Pembroke Pines site exhibited nitrogen concentrations similar to those measured beneath the ponds.

Measured concentrations of phosphorus in groundwater at each of the three dry detention monitoring sites were lower in value than phosphorus concentrations measured in runoff inflows, suggesting that the soil layers at each of the three sites have a significant affinity for uptake of phosphorus. Groundwater concentrations of copper, chromium, and lead beneath the dry detention ponds were similar to values measured in runoff inflows. However, measured concentrations of zinc in groundwater were substantially lower in value than observed in runoff inflows, suggesting an affinity for uptake of zinc by the on-site soils.

Overall, operation of the dry detention systems does not appear to have any significant impact on groundwater characteristics at any of the three monitoring sites. Specific mechanisms for the observed increases in nitrogen concentrations in groundwater are not known, although the observed nitrogen groundwater concentrations beneath the detention ponds were equal to or less than nitrogen concentrations in background areas.

7.1.5.3.2 Underdrain System

Similar to the trends observed at the dry detention pond sites, groundwater concentrations of pH, alkalinity, conductivity, color, and hardness increased in value in groundwater beneath the underdrain pond site compared with concentrations measured in the incoming runoff inflows. The observed increases for these parameters are likely related to the characteristics of the native soil used for infiltration rather than any impacts from operation of the pond itself.

Substantial increases in measured concentrations of total nitrogen were observed in groundwater collected beneath the dry detention pond compared with concentrations measured in the runoff inflows. These observed increases in nitrogen were due to increases in ammonia, NO_x, and organic nitrogen. It is not known whether these observed increases are related to the operation of the underdrain system or are merely a reflection of increases in nitrogen as a result of leaching of nitrogen compounds from the soils during infiltration of the runoff inflows.

Substantial reductions in phosphorus concentrations were observed in groundwater samples collected beneath the underdrain pond, compared with runoff inflows. Similar to the conclusions reached at the dry detention pond sites, the soils at the underdrain site appear to have a significant affinity for removal of phosphorus species. Measured concentrations of metals in groundwater collected beneath the underdrain pond were generally similar to or less than concentrations measured in the runoff inflows. However, substantial reductions in concentrations were observed for zinc in the groundwater compared with the runoff inflows, suggesting a significant affinity for removal of zinc by the filter soils.

7.2 Recommendations

The field monitoring conducted during this project indicated that both dry detention and the underdrain system are poorly-performing stormwater BMPs which fall far short of the design standard for stormwater treatment systems outlined in Chapter 62-40.312 (FAC). If dry detention and underdrain systems are to be retained as permittable stormwater management systems, then design modifications will be necessary to enhance the effectiveness of these BMPs. Recommendations for enhancing the effectiveness of dry detention and underdrain filtration systems are summarized below.

7.2.1 Dry Detention

The analyses conducted as part of this project clearly demonstrate that volumetric water losses are the most significant removal mechanism associated with dry detention systems since the dry detention ponds appear to have little affinity for uptake of nutrients or metals in a flow-through situation. A simple method of enhancing the volumetric attenuation of runoff in a dry detention pond is to raise the invert elevation of the bleed-down orifice located in the outfall structure. Initial designs for dry detention ponds developed during the 1980s placed the invert elevation of the bleed-down orifice similar to the bottom elevation of the pond. However, at some point, SFWMD lowered the water control invert elevation for dry detention ponds to 1 ft below the bottom of the pond, presumably to enhance the removal of stored water within the pond between rain events. While this modification may keep the pond bottom in a drier condition and make routine maintenance activities (such as mowing) easier to accomplish, the enhanced bleed-down of the runoff inflows appears to have a negative impact on overall system performance.

1. **Therefore, it is recommended that consideration be given to raising the water control elevation back to an elevation equivalent to the bottom elevation of the pond or higher.** Given the relatively good permeability of the on-site soils at several of the study sites, a hybrid retention/dry detention system may even be possible which could provide a limited amount of water storage above the pond bottom. The recommended design modification of raising the control elevation for the pond back to a level equivalent with the pond bottom would be easy to test by simply modifying the outfall control structures for the three evaluated dry detention ponds and repeating the performance efficiency evaluation study. **ERD recommends that the outfall structures for the three ponds be modified and the performance efficiency monitoring be repeated to evaluate changes in nutrient retention.**

2. **Another potential modification to enhance the performance efficiency of the dry detention ponds would be to incorporate an outlet filtration system to provide additional treatment for discharges from the ponds.** This filter system could use either a horizontal or vertical flow path, depending upon the hydraulic conditions at a given site. Under most conditions, discharges from the dry detention ponds occur at a relatively slow rate which would be ideal for a filtration system. Numerous proprietary media blends are available which claim to be capable of removing nutrients and heavy metals. A blend incorporating dry alum sludge has also been highly effective in previous demonstration projects, and the filtration media could be obtained virtually free-of-charge.

7.2.2 Underdrain Filtration

The evaluated underdrain filtration system had very little affinity for removal of either nitrogen or phosphorus during migration through the on-site soils. The current design criteria for the system specifies the use of on-site soils as the filtration media. However, soils which exhibit rapid infiltration characteristics are often silica-based sands with little or no organic content and no corresponding affinity for adsorption or removal of dissolved constituents. Particulate matter which is captured initially may also decompose, releasing soluble nutrients which have little affinity to remain within the filter media.

An obvious method of enhancing the performance effectiveness of the underdrain filtration system is to substitute an engineered media for the native soils. As discussed previously, a wide variety of proprietary engineered media are currently available with a capacity to remove nutrients and heavy metals. A local media blend which has been effective in filtration systems is the *Bold and Gold* media developed by the University of Central Florida Stormwater Academy. An effective media can also be made using sand and dried alum sludge which can be obtained at little or no cost. Any of these media blends would substantially enhance the performance effectiveness of the underdrain system.

1. **Therefore, ERD recommends that a demonstration project be conducted by replacing the existing soil at the Orlando Lynx underdrain pond site with an engineered media and repeating the performance efficiency evaluation at this site.**

APPENDICES

APPENDIX A

MEASURED GROUNDWATER ELEVATIONS AT THE DRY DETENTION AND UNDERDRAIN SITES FROM DECEMBER 2012- NOVEMBER 2013

Bonita Springs

Date	Measured Groundwater Elevation							
	Site 1		Site 2		Site 3		Site 4	
	Meas. (ft)	Elev. (ft)	Meas. (ft)	Elev. (ft)	Meas. (ft)	Elev. (ft)	Meas. (ft)	Elev. (ft)
12/19/12	3.07	**8.35**	3.19	**6.91**	3.48	**7.00**	6.57	**6.87**
12/26/12	3.08	**8.34**	3.23	**6.87**	3.50	**6.98**	6.61	**6.83**
12/31/12	3.22	**8.20**	3.32	**6.78**	3.62	**6.86**	6.72	**6.72**
1/11/13	3.36	**8.06**	3.48	**6.62**	3.79	**6.69**	6.87	**6.57**
1/15/13	3.42	**8.00**	3.55	**6.55**	3.89	**6.59**	7.02	**6.42**
1/22/13	3.32	**8.10**	3.65	**6.45**	4.06	**6.42**	7.16	**6.28**
1/30/13	3.39	**8.03**	3.73	**6.37**	4.17	**6.31**	7.23	**6.21**
2/6/13	3.51	**7.91**	3.92	**6.18**	4.32	**6.16**	7.46	**5.98**
2/13/13	3.48	**7.94**	3.96	**6.14**	4.39	**6.09**	7.54	**5.90**
2/18/13	3.18	**8.24**	3.36	**6.74**	3.41	**7.07**	6.50	**6.94**
2/27/13	3.35	**8.07**	3.67	**6.43**	4.00	**6.48**	7.09	**6.35**
3/5/13	3.51	**7.91**	3.76	**6.34**	4.09	**6.39**	7.23	**6.21**
3/11/13	3.75	**7.67**	3.87	**6.23**	4.27	**6.21**	7.40	**6.04**
3/21/13	4.07	**7.36**	3.93	**6.17**	4.33	**6.16**	7.47	**5.98**
3/28/13	4.38	**7.04**	3.99	**6.11**	4.38	**6.10**	7.53	**5.91**
4/3/13	4.99	**6.43**	4.13	**5.97**	4.53	**5.95**	7.66	**5.78**
4/8/13	4.27	**7.15**	3.71	**6.39**	3.76	**6.72**	6.82	**6.62**
4/16/13	3.78	**7.64**	3.82	**6.28**	4.07	**6.41**	7.19	**6.25**
4/22/13	3.36	**8.06**	2.38	**7.72**	3.35	**7.13**	6.79	**6.65**
4/29/13	5.02	**6.40**	4.21	**5.89**	4.59	**5.89**	7.71	**5.73**
5/6/13	4.83	**6.59**	4.03	**6.07**	4.21	**6.27**	7.32	**6.12**
5/13/13	5.12	**6.30**	4.31	**5.79**	4.71	**5.77**	7.82	**5.62**
5/21/13	3.71	**7.71**	3.22	**6.88**	3.93	**6.55**	7.68	**5.76**
5/28/13	3.54	**7.88**	2.04	**8.06**	2.84	**7.64**	5.97	**7.47**
6/4/13	3.48	**7.94**	2.28	**7.82**	2.98	**7.50**	5.57	**7.87**
6/11/13	3.21	**8.21**	2.91	**7.19**	3.08	**7.40**	6.09	**7.35**
6/19/13	3.05	**8.37**	1.84	**8.26**	3.03	**7.45**	5.54	**7.90**
6/24/13	3.29	**8.13**	1.75	**8.35**	2.22	**8.26**	5.73	**7.71**
7/2/13	2.57	**8.85**	1.55	**8.55**	1.63	**8.85**	4.71	**8.73**
7/8/13	2.99	**8.43**	2.31	**7.79**	2.73	**7.75**	5.81	**7.63**
7/18/13	2.98	**8.44**	2.57	**7.53**	2.42	**8.06**	5.58	**7.86**
7/25/13	3.27	**8.15**	2.77	**7.33**	3.12	**7.36**	6.11	**7.33**
7/31/13	2.98	**8.44**	1.72	**8.38**	1.94	**8.54**	5.07	**8.37**
8/7/13	3.07	**8.35**	2.12	**7.98**	3.57	**6.91**	5.90	**7.54**
8/14/13	3.10	**8.32**	2.58	**7.52**	2.92	**7.56**	5.93	**7.51**
8/21/13	2.91	**8.51**	1.82	**8.28**	2.92	**7.56**	5.57	**7.87**
8/28/13	2.87	**8.55**	1.75	**8.35**	2.36	**8.12**	5.42	**8.02**
9/4/13	2.95	**8.47**	1.87	**8.23**	2.28	**8.20**	5.46	**7.98**
9/9/13	2.91	**8.51**	1.86	**8.24**	2.31	**8.17**	5.34	**8.10**
9/16/13	2.91	**8.51**	1.80	**8.30**	2.45	**8.03**	5.34	**8.10**
9/23/13	3.21	**8.21**	2.41	**7.69**	3.14	**7.34**	5.95	**7.49**

Bonita Springs

Date	Measured Groundwater Elevation							
	Site 1		Site 2		Site 3		Site 4	
	Meas. (ft)	Elev. (ft)	Meas. (ft)	Elev. (ft)	Meas. (ft)	Elev. (ft)	Meas. (ft)	Elev. (ft)
10/2/13	3.06	**8.36**	1.85	**8.25**	2.62	**7.86**	5.84	**7.60**
10/7/13	3.26	**8.16**	2.14	**7.96**	2.77	**7.71**	5.78	**7.66**
10/14/13	3.98	**7.44**	3.02	**7.08**	3.02	**7.46**	6.39	**7.05**
10/23/13	2.88	**8.54**	1.83	**8.27**	2.56	**7.92**	6.27	**7.17**
10/28/13	3.25	**8.17**	3.28	**6.82**	3.69	**6.79**	6.82	**6.62**
11/4/13	3.79	**7.63**	3.48	**6.62**	3.88	**6.60**	7.02	**6.42**
11/11/13	3.65	**7.77**	3.62	**6.48**	3.98	**6.50**	7.09	**6.35**
11/20/13	4.49	**6.93**	3.78	**6.32**	4.12	**6.36**	7.29	**6.15**
11/25/13	4.19	**7.23**	3.78	**6.32**	3.99	**6.49**	7.11	**6.33**
12/2/13	4.69	**6.73**	3.76	**6.34**	4.03	**6.45**	7.13	**6.31**
12/9/13	4.82	**6.60**	3.94	**6.16**	4.28	**6.20**	7.41	**6.03**
12/18/13	4.61	**6.81**	3.69	**6.41**	4.39	**6.09**	7.46	**5.98**

Naples

Date	Measured Groundwater Elevation			
	Site 1		Site 2	
	Meas. (ft)	Elev. (ft)	Meas. (ft)	Elev. (ft)
12/19/12	6.21	**2.13**	4.87	**2.08**
12/26/12	6.27	**2.07**	4.93	**2.02**
12/31/12	6.32	**2.02**	4.97	**1.98**
1/11/13	6.57	**1.77**	5.08	**1.87**
1/15/13	6.89	**1.45**	5.16	**1.79**
1/22/13	7.07	**1.27**	5.26	**1.69**
1/30/13	7.18	**1.16**	5.32	**1.63**
2/6/13	7.33	**1.01**	5.44	**1.51**
2/13/13	7.41	**0.93**	5.55	**1.40**
2/18/13	6.08	**2.26**	3.50	**3.45**
2/27/13	6.99	**1.35**	5.46	**1.49**
3/5/13	7.28	**1.06**	5.55	**1.40**
3/11/13	7.33	**1.01**	5.65	**1.30**
3/21/13	7.37	**0.97**	5.76	**1.19**
3/28/13	7.41	**0.93**	5.87	**1.08**
4/3/13	7.55	**0.79**	5.82	**1.13**
4/8/13	6.22	**2.12**	5.49	**1.46**
4/16/13	7.19	**1.15**	5.72	**1.23**
4/22/13	5.23	**3.11**	5.36	**1.59**
4/29/13	6.88	**1.46**	5.46	**1.49**
5/6/13	5.74	**2.60**	5.23	**1.72**
5/13/13	6.90	**1.44**	5.77	**1.18**
5/21/13	6.99	**1.35**	5.68	**1.27**
5/28/13	7.51	**0.83**	6.02	**0.93**
6/4/13	4.17	**4.17**	4.91	**2.04**
6/11/13	3.98	**4.36**	4.55	**2.40**
6/19/13	3.76	**4.58**	3.81	**3.14**
6/24/13	3.69	**4.65**	3.39	**3.56**
7/2/13	3.71	**4.63**	2.52	**4.43**
7/8/13	3.77	**4.57**	3.26	**3.69**
7/18/13	4.61	**3.73**	2.93	**4.02**
7/25/13	4.28	**4.06**	4.03	**2.92**
7/31/13	4.15	**4.19**	3.44	**3.51**
8/7/13	4.12	**4.22**	3.64	**3.31**
8/14/13	4.35	**3.99**	3.98	**2.97**
8/21/13	3.32	**5.02**	1.98	**4.97**
8/28/13	3.55	**4.79**	2.60	**4.35**
9/4/13	3.74	**4.60**	3.41	**3.54**
9/9/13	3.33	**5.01**	2.28	**4.67**
9/16/13	3.54	**4.80**	2.91	**4.04**
9/23/13	4.02	**4.32**	3.51	**3.44**

Naples

Date	Measured Groundwater Elevation			
	Site 1		Site 2	
	Meas. (ft)	Elev. (ft)	Meas. (ft)	Elev. (ft)
10/2/13	4.12	**4.22**	3.85	**3.10**
10/7/13	4.12	**4.22**	3.99	**2.96**
10/14/13	4.96	**3.38**	4.32	**2.63**
10/23/13	6.20	**2.14**	4.61	**2.34**
10/28/13	6.57	**1.77**	4.81	**2.14**
11/4/13	6.82	**1.52**	5.12	**1.83**
11/11/13	6.99	**1.35**	5.14	**1.81**
11/20/13	7.09	**1.25**	5.26	**1.69**
11/25/13	5.66	**2.68**	5.03	**1.92**
12/2/13	6.13	**2.21**	5.11	**1.84**
12/9/13	6.70	**1.64**	5.21	**1.74**
12/18/13	6.70	**1.64**	5.46	**1.49**

Pembroke Pines

Date	Site 1		Site 2		Site 3	
	Meas. (ft)	Elev. (ft)	Meas. (ft)	Elev. (ft)	Meas. (ft)	Elev. (ft)
12/19/12	2.15	**4.65**	2.12	**4.79**	1.09	**7.33**
12/26/12	2.40	**4.40**	2.37	**4.54**	1.34	**7.08**
12/31/12	2.63	**4.17**	2.61	**4.30**	1.58	**6.84**
1/11/13	2.87	**3.93**	2.85	**4.06**	1.82	**6.60**
1/15/13	3.04	**3.76**	3.06	**3.85**	1.93	**6.49**
1/22/13	3.21	**3.59**	3.23	**3.68**	2.10	**6.32**
1/30/13	3.35	**3.45**	3.37	**3.54**	2.24	**6.18**
2/6/13	3.46	**3.34**	3.48	**3.43**	2.35	**6.07**
2/13/13	3.52	**3.28**	3.54	**3.37**	2.41	**6.01**
2/18/13	3.50	**3.30**	3.52	**3.39**	2.39	**6.03**
2/27/13	3.86	**2.94**	3.88	**3.03**	2.75	**5.67**
3/5/13	3.96	**2.84**	3.98	**2.93**	2.85	**5.57**
3/11/13	4.03	**2.77**	4.02	**2.89**	2.91	**5.51**
3/21/13	4.20	**2.61**	4.17	**2.75**	3.50	**4.93**
3/28/13	4.36	**2.44**	4.31	**2.60**	4.08	**4.34**
4/3/13	4.39	**2.41**	4.30	**2.61**	3.13	**5.29**
4/8/13	2.90	**3.90**	3.46	**3.45**	2.41	**6.01**
4/16/13	2.86	**3.94**	2.72	**4.19**	3.32	**5.10**
4/22/13	2.73	**4.07**	3.58	**3.33**	3.03	**5.39**
4/29/13	2.31	**4.49**	3.94	**2.97**	3.11	**5.31**
5/6/13	2.05	**4.75**	3.61	**3.30**	3.04	**5.38**
5/13/13	1.92	**4.88**	3.32	**3.59**	2.94	**5.48**
5/21/13	2.43	**4.37**	3.19	**3.72**	3.31	**5.11**
5/28/13	2.94	**3.86**	3.06	**3.85**	3.68	**4.74**
6/4/13	2.86	**3.94**	2.93	**3.98**	3.52	**4.90**
6/11/13	1.42	**5.38**	1.56	**5.35**	2.57	**5.85**
6/19/13	2.46	**4.35**	2.43	**4.48**	2.44	**5.98**
6/24/13	3.49	**3.31**	3.30	**3.61**	2.31	**6.11**
7/2/13	3.38	**3.42**	3.21	**3.70**	2.36	**6.06**
7/8/13	2.46	**4.34**	3.73	**3.18**	3.17	**5.25**
7/18/13	2.17	**4.64**	3.36	**3.56**	3.50	**4.93**
7/25/13	1.87	**4.93**	2.98	**3.93**	3.82	**4.60**
7/31/13	2.47	**4.33**	3.17	**3.74**	3.21	**5.21**
8/7/13	1.64	**5.16**	3.09	**3.82**	3.07	**5.35**
8/14/13	3.58	**3.22**	3.54	**3.37**	3.80	**4.62**
8/21/13	1.82	**4.98**	2.73	**4.18**	3.73	**4.69**
8/28/13	1.87	**4.93**	2.78	**4.13**	2.87	**5.55**
9/4/13	1.72	**5.08**	2.51	**4.40**	2.80	**5.62**
9/9/13	2.11	**4.69**	3.04	**3.87**	3.14	**5.28**
9/16/13	1.92	**4.88**	2.62	**4.29**	2.91	**5.51**
9/23/13	1.92	**4.88**	2.92	**3.99**	3.07	**5.35**

Pembroke Pines

Date	Site 1		Site 2		Site 3	
	Meas. (ft)	Elev. (ft)	Meas. (ft)	Elev. (ft)	Meas. (ft)	Elev. (ft)
10/2/13	1.38	**5.42**	2.86	**4.05**	3.02	**5.40**
10/7/13	1.75	**5.06**	2.57	**4.35**	3.11	**5.32**
10/14/13	2.11	**4.69**	2.27	**4.64**	3.19	**5.23**
10/23/13	2.71	**4.09**	3.60	**3.31**	3.32	**5.10**
10/28/13	2.31	**4.49**	3.69	**3.22**	3.15	**5.27**
11/4/13	3.39	**3.41**	3.81	**3.10**	3.25	**5.17**
11/11/13	2.04	**4.76**	3.26	**3.65**	2.97	**5.45**
11/20/13	1.66	**5.14**	3.23	**3.68**	2.74	**5.68**
11/25/13	2.99	**3.81**	3.24	**3.67**	2.96	**5.46**
12/2/13	2.48	**4.32**	3.21	**3.70**	2.84	**5.58**
12/9/13	3.18	**3.62**	3.32	**3.59**	2.96	**5.46**
12/18/13	2.81	**3.99**	3.39	**3.52**	2.96	**5.46**

Orlando Lynx

Date	Measured Groundwater Elevation			
	Site 1		Site 2	
	Meas. (ft)	Elev. (ft)	Meas. (ft)	Elev. (ft)
12/7/12	6.33	**93.53**	5.78	**94.21**
12/12/12	5.58	**94.28**	4.77	**95.22**
12/21/12	5.61	**94.25**	5.31	**94.68**
12/28/12	5.78	**94.08**	5.09	**94.90**
1/3/13	5.77	**94.09**	5.94	**94.05**
1/8/13	5.62	**94.24**	5.54	**94.45**
1/15/13	5.69	**94.17**	6.05	**93.94**
1/23/13	6.02	**93.84**	6.27	**93.72**
1/31/13	5.97	**93.89**	6.11	**93.88**
2/6/13	6.03	**93.83**	6.41	**93.58**
2/14/13	5.85	**94.01**	5.29	**94.70**
2/22/13	5.94	**93.92**	6.25	**93.74**
2/28/13	5.83	**94.03**	5.65	**94.34**
3/7/13	6.17	**93.69**	6.37	**93.62**
3/13/13	6.16	**93.70**	6.24	**93.75**
3/21/13	5.95	**93.91**	5.52	**94.47**
3/25/13	5.54	**94.32**	4.89	**95.10**
4/3/13	5.93	**93.93**	6.08	**93.91**
4/9/13	5.81	**94.05**	5.64	**94.35**
4/12/13	5.66	**94.20**	5.79	**94.20**
4/15/13	4.26	**95.60**	4.57	**95.42**
4/17/13	5.62	**94.24**	5.43	**94.56**
4/22/13	4.56	**95.30**	4.54	**95.45**
4/30/13	3.19	**96.67**	4.06	**95.93**
5/1/13	3.92	**95.94**	4.44	**95.55**
5/9/13	4.62	**95.24**	5.12	**94.87**
5/14/13	4.68	**95.18**	5.24	**94.75**
5/24/13	4.26	**95.60**	4.89	**95.10**
5/31/13	4.45	**95.41**	5.22	**94.77**
6/5/13	3.62	**96.24**	4.04	**95.95**
6/11/13	2.79	**97.07**	2.86	**97.13**
6/17/13	3.50	**96.36**	4.47	**95.52**
6/19/13	3.51	**96.35**	4.39	**95.60**
6/27/13	3.87	**95.99**	4.94	**95.05**
7/3/13	3.89	**95.97**	4.85	**95.14**
7/9/13	4.09	**95.77**	5.05	**94.94**
7/16/13	4.16	**95.70**	5.15	**94.84**
7/26/13	3.85	**96.01**	4.91	**95.08**
8/1/13	3.84	**96.02**	4.98	**95.01**
8/5/13	3.65	**96.21**	4.64	**95.35**
8/14/13	4.17	**95.69**	5.21	**94.78**

Orlando Lynx

Date	Measured Groundwater Elevation			
	Site 1		Site 2	
	Meas. (ft)	Elev. (ft)	Meas. (ft)	Elev. (ft)
8/20/13	4.03	**95.83**	5.01	**94.98**
8/27/13	3.91	**95.95**	4.82	**95.17**
9/3/13	4.19	**95.67**	5.06	**94.93**
9/9/13	4.41	**95.46**	5.19	**94.80**
9/16/13	4.62	**95.24**	5.32	**94.67**
9/26/13	4.13	**95.73**	4.89	**95.10**
10/2/13	4.57	**95.29**	5.18	**94.81**
10/8/13	4.60	**95.32**	5.21	**94.84**
10/14/13	4.70	**95.20**	5.35	**94.67**
10/22/13	4.79	**95.07**	5.49	**94.50**
10/30/13	5.19	**94.67**	5.69	**94.30**
11/5/13	5.22	**94.65**	5.69	**94.30**
11/11/13	5.24	**94.62**	5.69	**94.30**
11/18/13	5.08	**94.78**	5.59	**94.40**
11/20/13	5.35	**94.51**	5.76	**94.23**
11/27/13	4.24	**95.62**	5.41	**94.58**
12/2/13	5.19	**94.67**	5.79	**94.20**
12/10/13	5.34	**94.52**	5.93	**94.06**

APPENDIX B

CHEMICAL CHARACTERISTICS OF INFLOW / OUTFLOW SAMPLES COLLECTED AT THE DRY DETENTION AND UNDERDRAIN MONITORING SITES FROM DECEMBER 2012 – NOVEMBER 2013

Characteristics of Stormwater Inflow and Outflow Samples Collected at the Dry Detention and Underdrain Monitoring Sites

Project Location	Site	Collection Date	pH (s.u.)	Alkalinity (mg/L)	Conductivity (µmho/cm)	Ammonia (µg/L)	NOx (µg/L)	Diss.Org. N (µg/L)	Part. N (µg/L)	Total N (µg/L)	SRP (µg/L)	Diss.Org. P (µg/L)	Part. P (µg/L)	Total P (µg/L)	Turbidity (NTU)	Color (Pt-Co)	TSS (mg/L)	Chromium (µg/L)	Copper (µg/L)	Lead (µg/L)	Zinc (µg/L)	Hardness (mg/L)
Bonita Springs	SW - 1	2/14/13	7.58	106	2,267	195	34	515	775	1,519	9	4	100	113	14.1	29	115	26	8	<2	11	250
Bonita Springs	SW - 1	3/2/13	7.51	74.4	1,503	171	31	237	1,332	1,771	34	5	156	195	1.3	26	4.8	<5	7	<2	25	176
Bonita Springs	SW - 1	3/18/13	6.92	73.9	1,865	3	3	379	178	563	2	3	39	44	3.7	48	6.6	7	10	<2	31	175
Bonita Springs	SW - 1	4/4/13	6.77	78.8	1,056	3	3	1,421	293	1,720	82	111	123	316	3.9	70	4.0	3	<2	<2	5	178
Bonita Springs	SW - 1	4/10/13	7.17	86.6	1,022	70	6	400	254	730	17	20	36	73	2.1	29	6.6	6	3	<2	8	177
Bonita Springs	SW - 1	4/21/13	7.08	93.6	1,718	65	3	462	375	905	28	51	67	146	6.2	44	13.6	6	10	<2	7	271
Bonita Springs	SW - 1	5/1/13	7.83	86.8	2,268	3	949	168	98	1,218	141	2	8	151	0.9	42	2.8	<5	<2	<2	2	336
Bonita Springs	SW - 1	5/2/13	6.86	63.2	563	3	5	218	338	564	1	3	64	68	4.9	26	16.8	<5	10	<2	7	149
Bonita Springs	SW - 1	5/20/13	6.82	90.6	2,276	20	10	1,114	362	1,506	45	7	48	100	7.0	75	16.7	<5	8	<2	7	214
Bonita Springs	SW - 1	6/4/13	6.62	49.6	1,123	3	3	365	322	693	13	7	65	85	1.9	45	7.0	8	4	<2	5	117
Bonita Springs	SW - 1	6/11/13	6.89	44.6	957	49	75	235	81	440	32	11	9	52	0.9	27	1.8	<5	6	<2	4	154
Bonita Springs	SW - 1	6/16/13	7.34	53.4	880	3	238	1,039	560	1,840	36	5	10	51	0.7	25	3.8	<5	3	<2	7	148
Bonita Springs	SW - 1	6/25/13	7.29	53.0	497	3	97	123	100	323	16	3	8	27	1.7	25	4.6	<5	5	<2	9	169
Bonita Springs	SW - 1	6/30/13	7.76	113	2,447	753	651	737	216	2,357	143	13	64	220	2.9	16	11.4	4	<2	<2	4	122
Bonita Springs	SW - 1	7/2/13	7.08	46.0	996	16	133	156	93	398	24	3	19	46	3.5	23	6.8	9	3	<2	8	150
Bonita Springs	SW - 1	7/18/13	7.01	36.4	389	11	91	81	114	297	9	9	6	24	1.5	21	4.8	11	4	<2	5	72.4
Bonita Springs	SW - 1	7/21/13	6.94	45.8	639	3	3	203	58	267	1	12	13	26	1.0	23	2.6	8	3	<2	4	111
Bonita Springs	SW - 1	7/26/13	7.01	59.4	428	26	3	320	57	406	1	43	20	64	1.6	77	3.6	6	3	<2	2	86.4
Bonita Springs	SW - 1	8/7/13	6.81	64.0	895	3	4	476	43	526	2	19	21	42	1.6	65	5.4	6	3	<2	9	159
Bonita Springs	SW - 1	8/16/13	6.42	42.2	538	3	3	281	49	336	2	4	13	19	1.8	36	12.8	28	<2	<2	2	108
Bonita Springs	SW - 1	8/22/13	6.60	36.0	213	3	11	210	82	306	1	35	452	488	1.5	42	10.6	3	<2	<2	6	50.8
Bonita Springs	SW - 1	8/28/13	7.35	40.6	379	20	83	162	33	298	17	3	6	26	1.8	29	3.8	8	<2	<2	5	94.0
Bonita Springs	SW - 1	9/6/13	7.04	43.4	587	11	136	179	28	354	10	8	8	26	1.0	18	1.0	12	2	<2	4	102
Bonita Springs	SW - 1	9/18/13	7.59	55.2	690	21	220	125	33	399	27	28	5	60	3.3	26	3.4	2	<2	<2	3	161
Bonita Springs	SW - 1	9/23/13	6.68	51.4	497	3	12	194	159	368	29	4	15	48	1.3	32	2.8	3	<2	<2	2	85.6
Bonita Springs	SW - 1	10/2/13	6.66	61.2	850	3	3	403	142	551	2	15	36	53	1.1	54	10.4	9	<2	<2	2	148
Bonita Springs	SW - 1	10/3/13	6.67	48.4	197	3	3	208	37	251	3	2	21	26	1.0	32	2.6	9	<2	<2	<2	50.4
Bonita Springs	SW - 1	10/22/13	6.73	95.2	1,031	44	4	877	436	1,361	235	53	92	380	3.5	121	8.2	3	<2	<2	4	178
Bonita Springs	SW - 1	11/26/13	7.48	115	2,795	358	1,507	551	195	2,611	312	24	42	378	1.7	58	3.4	5	<2	<2	3	443
	Minimum Value:		**6.42**	**36.0**	**197**	**3**	**3**	**81**	**28**	**251**	**1**	**2**	**5**	**19**	**0.7**	**16**	**1.0**	**2**	**<2**	**<2**	**<2**	**50.4**
	Maximum Value:		**7.83**	**115**	**2,795**	**753**	**1,507**	**1,421**	**1,332**	**2,611**	**312**	**111**	**452**	**488**	**14.1**	**121**	**115.0**	**28**	**10**	**<2**	**31**	**443**
	Geometric Mean:		**7.03**	**61.2**	**853**	**13**	**23**	**310**	**139**	**640**	**13**	**9**	**27**	**71**	**2.0**	**36**	**5.7**	**6.2**	**3.3**	**<2**	**5.2**	**141**
Bonita Springs	SW - 2	12/10/13	7.24	39.4	111	52	68	245	19	384	53	4	15	72	1.1	31	1.4	8	x	<2	<2	46.0
Bonita Springs	SW - 2	3/18/13	6.95	104	2,801	178	2	705	94	801	112	9	14	135	1.5	62	5.3	10	8	<2	7	124
Bonita Springs	SW - 2	5/20/13	6.54	50.6	399	249	252	303	576	1,380	62	10	98	170	5.4	70	26.8	8	5	<2	<2	60.0
Bonita Springs	SW - 2	6/4/13	6.84	48.0	396	47	3	326	219	595	213	7	29	249	4.2	62	9.2	11	<2	<2	5	57.0
Bonita Springs	SW - 2	6/11/13	6.96	64.8	312	3	125	394	127	649	87	15	19	121	1.8	83	8.0	<5	<2	<2	8	75.0
Bonita Springs	SW - 2	6/16/13	7.22	74.4	312	3	310	454	209	976	76	6	16	98	2.2	88	4.4	4	4	<2	<2	80.0
Bonita Springs	SW - 2	6/25/13	7.17	43.6	465	3	324	130	82	539	122	21	31	174	1.7	35	2.0	<5	3	<2	<2	48.8
Bonita Springs	SW - 2	7/2/13	7.27	62.2	195	3	39	171	201	414	30	5	21	56	1.4	42	2.2	8	<2	<2	4	61.6
Bonita Springs	SW - 2	7/18/13	7.07	42.2	236	3	340	80	141	564	81	2	11	94	2.6	32	6.0	9	4	<2	3	63.6
Bonita Springs	SW - 2	7/26/13	7.26	77.8	482	90	96	203	177	566	104	4	18	126	1.4	54	5.0	5	4	<2	<2	108
Bonita Springs	SW - 2	8/21/13	7.21	68.2	262	59	7	369	60	495	63	18	16	97	1.3	80	3.4	2	<2	<2	16	78.8
Bonita Springs	SW - 2	8/28/13	7.19	45.4	409	67	37	198	35	337	65	1	8	74	1.2	46	2.2	6	3	<2	<2	50.0
Bonita Springs	SW - 2	9/6/13	7.31	45.4	131	57	13	216	65	351	59	5	14	78	1.2	41	1.0	7	5	<2	<2	46.4
Bonita Springs	SW - 2	9/18/13	7.19	76.4	416	145	45	278	42	510	52	30	18	100	1.0	46	3.2	11	8	<2	14	106
	Minimum Value:		**6.54**	**39.4**	**111**	**3**	**2**	**80**	**19**	**337**	**30**	**1**	**8**	**56**	**1.0**	**31**	**1.0**	**2**	**<2**	**<2**	**<2**	**46.0**
	Maximum Value:		**7.31**	**104**	**2,801**	**249**	**340**	**705**	**576**	**1,380**	**213**	**30**	**98**	**249**	**5.4**	**88**	**26.8**	**11**	**8**	**<2**	**16**	**124**
	Geometric Mean:		**7.10**	**57.7**	**341**	**26**	**47**	**255**	**102**	**565**	**76**	**7**	**19**	**109**	**1.7**	**52**	**3.9**	**6.5**	**3.6**	**<2**	**3.7**	**68.2**

Characteristics of Stormwater Inflow and Outflow Samples Collected at the Dry Detention and Underdrain Monitoring Sites

Project Location	Site	Collection Date	pH (s.u.)	Alkalinity (mg/L)	Conductivity (µmho/cm)	Ammonia (µg/L)	NOx (µg/L)	Diss.Org. N (µg/L)	Part. N (µg/L)	Total N (µg/L)	SRP (µg/L)	Diss.Org. P (µg/L)	Part. P (µg/L)	Total P (µg/L)	Turbidity (NTU)	Color (Pt-Co)	TSS (mg/L)	Chromium (µg/L)	Copper (µg/L)	Lead (µg/L)	Zinc (µg/L)	Hardness (mg/L)
Bonita Springs	SW - 3	12/10/13	6.93	38.0	206	3	22	273	56	354	6	89	4	99	0.9	32	2.6	8	<2	<2	4	56.0
Bonita Springs	SW - 3	2/14/13	7.38	52.4	776	3	36	338	285	662	22	17	52	91	3.9	27	31.4	25	18	<2	4	77.0
Bonita Springs	SW - 3	3/2/13	7.92	146	560	646	27	323	144	1,140	56	7	35	98	1.6	32	5.1	<5	6	<2	2	214
Bonita Springs	SW - 3	3/18/13	7.15	66.0	140	81	101	363	213	758	18	6	22	46	10.1	34	28.5	11	14	<2	6	97.0
Bonita Springs	SW - 3	4/10/13	6.22	9.0	360	597	246	874	44	1,761	159	11	35	205	1.0	9	1.0	<5	12	<2	4	33.0
Bonita Springs	SW - 3	4/16/13	7.21	53.6	645	3	71	190	69	333	9	38	42	89	1.0	26	8.3	<5	6	<2	2	79.0
Bonita Springs	SW - 3	4/21/13	6.71	71.8	510	749	12	1,568	516	2,845	4	61	126	191	23.9	64	26.1	<5	6	<2	5	105
Bonita Springs	SW - 3	5/2/13	6.92	62.2	529	757	3	260	261	1,281	13	30	29	72	4.3	30	6.4	<5	4	<2	8	94.0
Bonita Springs	SW - 3	5/20/13	7.10	60.2	570	325	87	377	168	957	25	5	34	64	2.6	26	4.9	<5	7	<2	3	86.0
Bonita Springs	SW - 3	5/27/13	6.43	50.2	264	3	101	164	513	781	6	3	113	122	18.8	43	84.1	3	<2	<2	11	74.0
Bonita Springs	SW - 3	6/4/13	7.16	45.0	359	3	175	181	143	502	42	4	11	57	1.4	56	2.9	4	<2	<2	18	68.0
Bonita Springs	SW - 3	6/11/13	7.15	40.8	324	3	143	113	77	336	39	7	12	58	1.6	20	4.2	9	<2	<2	12	65.6
Bonita Springs	SW - 3	6/16/13	7.30	44.6	349	3	235	109	990	1,337	31	2	11	44	1.0	18	2.4	8	<2	<2	9	71.6
Bonita Springs	SW - 3	6/25/13	6.93	37.4	436	3	65	204	75	347	70	1	5	76	3.2	26	9.2	6	<2	<2	5	55.6
Bonita Springs	SW - 3	7/2/13	7.04	23.8	130	3	138	159	84	384	16	16	8	40	2.2	14	3.4	4	<2	<2	21	31.2
Bonita Springs	SW - 3	7/18/13	6.79	39.6	98	3	152	126	53	334	24	24	15	63	1.3	24	4.0	3	<2	<2	14	43.6
Bonita Springs	SW - 3	7/26/13	6.91	55.6	250	41	3	209	872	1,125	50	5	28	83	10.3	70	78.0	13	5	<2	26	72.0
Bonita Springs	SW - 3	8/16/13	6.93	66.0	570	3	3	775	117	898	172	88	34	294	3.2	38	5.4	9	<2	<2	4	124
Bonita Springs	SW - 3	8/22/13	6.58	58.6	310	3	3	267	203	476	21	66	44	131	2.6	66	10.0	3	<2	<2	8	74.8
Bonita Springs	SW - 3	8/28/13	6.72	57.8	276	3	3	328	101	435	12	42	28	82	2.9	59	5.2	6	<2	<2	3	86.8
Bonita Springs	SW - 3	9/6/13	6.84	76.4	515	3	35	446	123	607	88	37	34	159	4.5	29	8.4	8	<2	<2	2	161
Bonita Springs	SW - 3	9/18/13	6.81	40.8	231	19	16	87	139	261	32	38	15	85	2.0	26	2.8	17	<2	<2	3	56.0
Bonita Springs	SW - 3	9/23/13	6.47	61.4	219	3	9	51	354	417	45	18	20	83	1.8	29	4.0	2	<2	<2	2	84.8
Bonita Springs	SW - 3	10/2/13	6.87	87.4	577	3	3	489	29	524	11	47	23	81	1.8	76	9.0	10	<2	<2	3	124
Bonita Springs	SW - 3	10/3/13	6.49	43.0	198	3	3	194	68	268	4	4	30	38	3.2	16	8.6	9	<2	<2	2	52.8
Bonita Springs	SW - 3	10/22/13	6.83	95.0	623	3	3	946	107	1,059	2	112	28	142	2.9	33	6.4	4	<2	<2	3	136
	Minimum Value:		**6.22**	**9.0**	**98**	**3**	**3**	**51**	**29**	**261**	**2**	**1**	**4**	**38**	**0.9**	**9**	**1.0**	**2**	**<2**	**<2**	**2**	**31.2**
	Maximum Value:		**7.92**	**146**	**776**	**757**	**246**	**1,568**	**990**	**2,845**	**172**	**112**	**126**	**294**	**23.9**	**76**	**84.1**	**25**	**18**	**<2**	**26**	**214**
	Geometric Mean:		**6.91**	**51.4**	**339**	**11**	**24**	**265**	**145**	**632**	**22**	**16**	**24**	**87**	**2.8**	**31**	**7.3**	**6.2**	**3.2**	**<2**	**5.1**	**77.7**
Bonita Springs	SW - 4	12/10/12	6.57	38.4	218	3	19	323	32	377	8	52	3	63	2.2	48	4.4	8	<2	<2	6	55.6
Bonita Springs	SW - 4	2/18/13	7.06	50.0	820	12	666	231	189	1,098	90	39	47	176	12.0	17	138	23	4	<2	17	136
Bonita Springs	SW - 4	3/21/13	7.14	72.8	1,602	222	117	332	215	886	23	13	14	50	11.3	35	27.2	10	25	<2	80	197
Bonita Springs	SW - 4	4/8/13	6.96	51.2	1,477	343	51	419	56	869	39	3	16	58	1.9	28	5.4	6	22	<2	46	225
Bonita Springs	SW - 4	4/16/13	7.15	42.8	546	68	219	157	245	689	18	10	50	78	4.2	20	14.7	<5	8	<2	27	91.2
Bonita Springs	SW - 4	4/22/13	7.26	65.8	601	215	33	308	143	699	15	4	33	52	3.5	30	4.7	<5	5	<2	34	106
Bonita Springs	SW - 4	5/6/13	6.94	60.6	515	771	33	285	178	1,267	14	23	35	72	4.4	34	7.5	<5	4	<2	79	92.0
Bonita Springs	SW - 4	5/21/13	6.99	78.4	934	426	22	890	446	1,784	5	3	81	89	4.8	62	10.8	<5	6	<2	47	118
Bonita Springs	SW - 4	5/28/13	6.65	38.0	234	26	90	159	548	823	5	6	42	53	11.0	40	41.9	15	7	<2	22	57.0
Bonita Springs	SW - 4	6/4/13	7.07	65.8	460	10	106	393	243	752	61	8	22	91	3.0	70	6.9	<5	<2	<2	31	99.0
Bonita Springs	SW - 4	6/11/13	7.04	79.8	322	3	142	194	23	362	37	9	9	55	1.8	21	2.8	<5	6	<2	28	65.2
Bonita Springs	SW - 4	6/19/13	7.13	44.2	351	3	233	107	34	377	30	14	14	58	3.8	16	15.8	14	<2	<2	41	72.4
Bonita Springs	SW - 4	6/24/13	6.86	32.8	496	3	68	197	114	382	15	1	38	54	4.3	26	9.0	21	<2	<2	20	55.6
Bonita Springs	SW - 4	7/2/13	7.06	31.2	241	3	143	79	45	270	20	2	7	29	1.9	17	4.0	17	10	<2	18	48.0
Bonita Springs	SW - 4	7/18/13	6.83	89.2	769	3	133	136	66	338	26	15	2	43	1.7	33	5.2	<5	9	<2	32	154
Bonita Springs	SW - 4	7/31/13	6.87	56.6	255	51	16	287	199	553	2	20	80	102	10.1	39	108	9	34	<2	12	75.6
Bonita Springs	SW - 4	8/14/13	6.80	76.8	408	3	12	344	40	399	27	49	22	98	1.9	30	5.8	20	<2	<2	4	161
Bonita Springs	SW - 4	8/21/13	6.50	44.4	239	3	32	157	30	222	4	41	18	63	1.8	60	3.8	60	<2	<2	13	63.2
Bonita Springs	SW - 4	8/28/13	6.95	46.2	267	3	34	218	23	278	8	43	21	72	1.4	32	3.4	6	<2	<2	2	74.8
Bonita Springs	SW - 4	9/9/13	6.75	52.6	336	3	22	310	38	373	4	45	19	68	1.8	19	10.0	8	<2	<2	3	78.4
Bonita Springs	SW - 4	9/16/13	6.74	42.8	281	13	17	167	68	265	5	39	14	58	1.5	31	8.6	11	<2	<2	74	61.2
Bonita Springs	SW - 4	9/23/13	6.55	53.8	205	3	18	179	129	329	2	8	36	46	2.0	34	4.0	2	<2	<2	2	82.8
Bonita Springs	SW - 4	10/2/13	6.71	52.6	350	3	3	247	122	375	5	20	24	49	1.7	56	6.6	10	<2	<2	2	84.4
Bonita Springs	SW - 4	10/7/13	6.65	65.0	343	3	3	133	266	405	5	6	41	52	3.0	18	5.8	<5	<2	<2	2	86.4
Bonita Springs	SW - 4	10/23/13	6.67	72.2	442	30	75	845	333	1,283	1	70	56	127	3.2	30	8.2	<5	2	<2	4	104
	Minimum Value:		**6.50**	**31.2**	**205**	**3**	**3**	**79**	**23**	**222**	**1**	**1**	**2**	**29**	**1.4**	**16**	**2.8**	**2**	**<2**	**<2**	**2**	**48.0**
	Maximum Value:		**7.26**	**89.2**	**1,602**	**771**	**666**	**890**	**548**	**1,784**	**90**	**70**	**81**	**176**	**12.0**	**70**	**138**	**60**	**34**	**<2**	**80**	**225**
	Geometric Mean:		**6.87**	**54.0**	**425**	**14**	**44**	**239**	**101**	**522**	**11**	**13**	**22**	**65**	**3.1**	**31**	**9.1**	**8.5**	**4.1**	**<2**	**14.5**	**89.7**

Characteristics of Stormwater Inflow and Outflow Samples Collected at the Dry Detention and Underdrain Monitoring Sites

Project Location	Site	Collection Date	pH (s.u.)	Alkalinity (mg/L)	Conductivity (µmho/cm)	Ammonia (µg/L)	NOx (µg/L)	Diss.Org. N (µg/L)	Part. N (µg/L)	Total N (µg/L)	SRP (µg/L)	Diss.Org. P (µg/L)	Part. P (µg/L)	Total P (µg/L)	Turbidity (NTU)	Color (Pt-Co)	TSS (mg/L)	Chromium (µg/L)	Copper (µg/L)	Lead (µg/L)	Zinc (µg/L)	Hardness (mg/L)
Bonita Springs	SW - 5	12/10/12	6.84	50.4	243	3	9	143	96	251	4	14	10	28	0.7	24	1.0	8	<2	<2	4	68.8
Bonita Springs	SW - 5	2/14/13	7.27	79.2	3,151	422	44	595	89	1,150	126	3	21	150	2.5	40	8.3	7	6	<2	15	138
Bonita Springs	SW - 5	3/18/13	7.07	72.6	1,711	225	70	320	122	737	64	14	13	91	1.9	29	8.5	12	9	<2	21	159
Bonita Springs	SW - 5	4/4/13	7.27	71.8	1,449	263	23	603	37	926	40	4	10	54	1.2	33	2.6	5	13	<2	13	221
Bonita Springs	SW - 5	4/10/13	6.67	55.6	555	3	65	220	146	434	19	18	28	65	1.2	30	4.7	<5	7	<2	13	100
Bonita Springs	SW - 5	4/21/13	6.78	69.8	583	564	44	647	304	1,559	3	20	89	112	8.3	50	13.6	<5	5	<2	12	109
Bonita Springs	SW - 5	5/2/13	6.79	67.0	536	858	33	354	174	1,419	7	39	20	66	5.2	40	6.4	<5	4	<2	8	98.0
Bonita Springs	SW - 5	5/20/13	6.96	70.8	716	3	87	790	223	1,103	52	8	35	95	1.5	33	2.0	<5	3	<2	19	103
Bonita Springs	SW - 5	5/27/13	6.59	40.0	308	123	97	202	202	624	2	10	7	19	4.7	44	7.4	13	<2	<2	11	58.0
Bonita Springs	SW - 5	5/31/13	7.62	71.4	892	6	12	203	90	311	29	5	4	38	1.6	28	6.2	27	8	<2	4	125
Bonita Springs	SW - 5	6/4/13	6.54	35.2	370	42	117	163	160	482	24	4	17	45	2.2	54	4.1	<5	<2	<2	7	51.0
Bonita Springs	SW - 5	6/11/13	6.86	41.8	235	3	129	100	143	375	39	9	8	56	1.4	36	1.4	9	<2	<2	6	57.2
Bonita Springs	SW - 5	6/16/13	6.92	49.4	387	3	160	105	89	357	29	2	9	40	0.9	21	2.2	5	3	<2	<2	79.6
Bonita Springs	SW - 5	6/25/13	7.05	59.0	462	3	97	105	110	315	94	1	10	105	1.2	32	2.8	<5	<2	<2	4	71.6
Bonita Springs	SW - 5	7/2/13	7.12	52.4	405	3	3	181	171	358	1	62	25	88	0.9	36	1.0	8	3	<2	<2	86.8
Bonita Springs	SW - 5	7/18/13	6.91	61.0	386	3	82	97	122	304	10	4	15	29	1.7	25	2.9	<5	4	<2	<2	90.8
Bonita Springs	SW - 5	7/26/13	6.86	54.4	227	57	3	96	142	298	1	7	17	25	1.4	45	2.6	6	3	<2	2	161
Bonita Springs	SW - 5	8/16/14	7.06	81.2	357	3	3	290	43	339	1	1	10	12	1.1	32	0.8	14	<2	<2	3	101
Bonita Springs	SW - 5	8/22/13	6.92	44.0	148	3	3	123	39	168	4	5	1	10	0.9	27	2.0	9	<2	<2	11	51.2
Bonita Springs	SW - 5	8/28/13	7.02	42.6	206	3	3	166	78	250	7	6	4	17	3.4	27	9.0	6	<2	<2	<2	59.6
Bonita Springs	SW - 5	9/6/13	6.89	60.0	288	3	3	128	96	230	2	43	21	66	0.6	30	1.8	8	4	<2	<2	75.6
Bonita Springs	SW - 5	9/18/13	6.99	79.2	590	15	3	306	93	417	5	18	15	38	2.9	45	1.2	11	<2	<2	6	134
Bonita Springs	SW - 5	9/23/13	7.15	81.2	221	3	13	189	60	265	2	23	8	33	1.3	31	1.8	3	<2	<2	2	88.8
Bonita Springs	SW - 5	10/3/13	7.27	74.4	431	67	3	178	40	288	1	31	10	42	1.0	40	1.6	9	<2	<2	<2	104
Bonita Springs	SW - 5	10/14/13	8.59	70.4	290	3	123	177	18	321	3	37	18	58	1.5	23	2.6	3	<2	<2	5	74.4
Bonita Springs	SW - 5	10/22/13	6.97	98.0	574	157	3	734	174	1,068	1	14	70	85	1.9	49	2.4	3	2	<2	5	134
	Minimum Value:		**6.54**	**35**	**148**	**3**	**3**	**96**	**18**	**168**	**1**	**1**	**1**	**10**	**0.6**	**21**	**0.8**	**3**	**2**	**<2**	**<2**	**51.0**
	Maximum Value:		**8.59**	**98**	**3,151**	**858**	**160**	**790**	**304**	**1,559**	**126**	**62**	**89**	**150**	**8.3**	**54**	**13.6**	**27**	**13**	**<2**	**21**	**221**
	Geometric Mean:		**7.03**	**61**	**451**	**16**	**20**	**220**	**99**	**450**	**8**	**9**	**13**	**46**	**1.6**	**34**	**2.9**	**5.6**	**2.3**	**<2**	**4.4**	**93.2**
Lynx	SW - 1	12/18/12	6.92	44.6	100	23	259	227	112	621	11	9	41	61	13.9	33	26.1	14	14	<2	199	58.7
Lynx	SW - 1	3/20/13	6.46	29.2	89	3	206	17	138	364	48	9	34	91	4.2	36	15.6	<5	9	<2	51	38.4
Lynx	SW - 1	3/24/13	6.89	40.0	90	7	460	35	45	547	23	2	15	40	3.2	23	3.1	<5	3	<2	13	33.8
Lynx	SW - 1	4/14/13	6.82	52.2	111	3	219	103	44	369	5	45	31	81	2.0	17	7.6	<5	6	<2	84	37.6
Lynx	SW - 1	4/21/13	6.56	18.2	39	44	109	28	146	327	17	31	15	63	3.6	9	28.8	6	8	<2	16	54.0
Lynx	SW - 1	5/1/13	6.46	12.6	30	95	125	31	121	372	27	5	9	41	3.9	9	17.4	6	8	<2	77	9.2
Lynx	SW - 1	5/19/13	6.89	16.6	34	3	177	45	90	315	12	75	1	88	1.5	5	1.6	7	<2	<2	5	16.2
Lynx	SW - 1	6/5/13	6.44	18.2	121	3	316	155	154	628	6	1	36	43	4.4	23	1.2	<5	6	<2	32	56.7
Lynx	SW - 1	6/10/13	6.24	16.0	36	3	222	150	99	474	2	66	28	96	4.5	10	3.2	6	4	<2	27	15.6
Lynx	SW - 1	6/17/13	6.36	12.2	108	53	298	72	26	449	5	55	44	104	3.4	4	14.0	8	<2	<2	8	8.4
Lynx	SW - 1	6/20/13	6.59	16.2	125	92	344	157	129	722	75	4	44	123	9.6	31	16.6	7	14	<2	93	60.8
Lynx	SW - 1	6/30/13	7.01	19.4	146	19	393	61	61	534	6	19	16	41	3.0	15	5.3	38	9	<2	32	69.3
Lynx	SW - 1	7/3/13	6.67	20.8	118	57	443	62	28	590	74	22	14	110	6.4	32	19.6	10	12	5	61	66.8
Lynx	SW - 1	7/16/13	6.56	54.6	212	144	598	1,515	132	2,389	33	23	13	69	11.9	102	9.6	3	24	9	65	71.8
Lynx	SW - 1	7/19/13	6.67	17.4	38	17	125	63	71	276	10	69	36	115	1.6	7	7.6	<5	<2	<2	14	18.4
Lynx	SW - 1	8/1/13	5.84	12.4	30	78	133	30	120	361	1	90	29	120	1.3	6	4.2	12	<2	<2	12	12.8
Lynx	SW - 1	8/14/13	6.92	44.6	100	23	259	227	112	621	11	9	41	61	13.9	33	26.1	14	14	<2	199	58.7
Lynx	SW - 1	8/23/13	6.49	24.4	37	3	304	91	40	438	18	5	21	44	8.9	6	11.6	13	<2	<2	7	17.2
Lynx	SW - 1	8/31/13	6.22	12.4	32	11	205	181	73	470	5	102	6	113	1.3	4	8.0	8	<2	<2	21	14.0
Lynx	SW - 1	9/6/13	6.59	21.2	62	9	481	179	77	746	23	17	5	45	3.2	14	11.6	6	<2	<2	6	13.8
Lynx	SW - 1	9/22/13	6.55	13.8	44	21	240	171	118	550	6	101	12	119	2.4	7	17.2	<5	3	<2	18	20.8
Lynx	SW - 1	9/24/13	6.01	17.4	36	7	127	53	114	301	16	102	9	127	1.2	10	4.6	10	<2	<2	3	16.4
Lynx	SW - 1	10/7/13	6.59	19.6	53	27	228	145	127	527	28	24	21	73	3.5	12	15.0	<5	<2	<2	10	20.8
	Minimum Value:		**5.84**	**12.2**	**30**	**3**	**109**	**17**	**26**	**276**	**1**	**1**	**1**	**40**	**1.2**	**4**	**1.2**	**<5**	**<2**	**<2**	**3**	**8.4**
	Maximum Value:		**7.01**	**54.6**	**212**	**144**	**598**	**1,515**	**154**	**2,389**	**75**	**102**	**44**	**127**	**13.9**	**102**	**28.8**	**38**	**24**	**<2**	**199**	**71.8**
	Geometric Mean:		**6.55**	**21.4**	**65**	**16**	**245**	**92**	**84**	**497**	**12**	**20**	**17**	**75**	**3.7**	**14**	**8.9**	**5.7**	**3.4**	**<2**	**24**	**27.4**

Characteristics of Stormwater Inflow and Outflow Samples Collected at the Dry Detention and Underdrain Monitoring Sites

Project Location	Site	Collection Date	pH (s.u.)	Alkalinity (mg/L)	Conductivity (µmho/cm)	Ammonia (µg/L)	NOx (µg/L)	Diss.Org. N (µg/L)	Part. N (µg/L)	Total N (µg/L)	SRP (µg/L)	Diss.Org. P (µg/L)	Part. P (µg/L)	Total P (µg/L)	Turbidity (NTU)	Color (Pt-Co)	TSS (mg/L)	Chromium (µg/L)	Copper (µg/L)	Lead (µg/L)	Zinc (µg/L)	Hardness (mg/L)
Lynx	SW - 2	12/18/12	7.12	42.2	128	6	249	95	88	438	10	2	16	28	6.8	17	7.8	26	10	<2	29	35.3
Lynx	SW - 2	3/20/13	6.56	37.8	104	29	566	24	151	770	40	16	37	93	12.8	27	37.6	<5	13	<2	100	31.6
Lynx	SW - 2	3/24/13	7.06	29.2	72	25	687	66	51	829	10	48	57	115	3.2	21	2.6	<5	<2	<2	17	28.4
Lynx	SW - 2	4/14/13	7.19	54.0	122	3	508	112	13	636	7	93	4	104	1.1	35	1.6	<5	5	<2	33	48.0
Lynx	SW - 2	4/21/13	6.45	18.8	46	3	113	107	106	329	21	79	37	137	2.1	16	14.2	5	5	<2	10	12.4
Lynx	SW - 2	5/1/13	6.51	19.4	47	13	172	189	77	451	27	94	22	143	5.5	13	27.3	6	4	<2	30	16.0
Lynx	SW - 2	5/19/13	7.35	48.6	93	3	40	303	44	390	35	93	17	145	3.2	13	31.8	7	3	<2	22	54.7
Lynx	SW - 2	6/5/13	6.43	25.2	56	3	515	44	48	610	28	96	13	137	3.1	12	16.4	6	4	2	20	28.4
Lynx	SW - 2	6/10/13	6.94	33.6	67	3	70	193	56	322	32	71	11	114	2.9	12	6.2	<5	<2	<2	18	37.8
Lynx	SW - 2	6/17/13	7.02	31.4	78	18	266	30	78	392	11	5	12	28	5.8	24	12.6	17	5	<2	47	26.3
Lynx	SW - 2	6/20/13	6.11	22.0	65	3	157	301	40	501	13	94	5	112	1.9	6	2.6	<5	<2	<2	22	10.0
Lynx	SW - 2	6/30/13	7.25	49.8	126	26	353	81	41	501	26	5	36	67	9.4	27	22.4	11	12	10	67	41.7
Lynx	SW - 2	7/3/13	6.90	36.4	88	3	124	183	38	348	11	96	20	127	4.0	23	7.4	<5	<2	<2	16	41.0
Lynx	SW - 2	7/16/13	6.78	50.0	154	45	497	633	103	1,278	25	7	24	56	10.4	68	17.5	<5	11	8	43	41.8
Lynx	SW - 2	7/19/13	7.05	33.0	68	14	41	245	42	342	8	97	2	107	1.0	12	1.2	<5	<2	<2	35	36.0
Lynx	SW - 2	8/1/13	6.17	11.6	30	90	81	88	74	333	1	106	12	119	2.0	4	18.0	13	5	<2	39	14.0
Lynx	SW - 2	8/23/13	6.76	23.6	57	21	268	175	102	566	20	105	24	149	3.0	18	8.2	14	<2	<2	8	16.1
Lynx	SW - 2	8/31/13	6.27	40.6	90	3	41	174	121	339	3	21	20	44	1.8	12	8.5	10	<2	<2	29	42.8
Lynx	SW - 2	9/6/13	7.06	41.8	41	20	71	109	188	388	12	68	10	90	1.8	28	10.6	<5	3	<2	15	44.8
Lynx	SW - 2	9/22/13	6.75	45.4	107	32	96	63	221	412	3	60	22	85	5.1	24	21.2	13	<2	<2	9	50.8
Lynx	SW - 2	10/7/13	6.78	21.2	78	7	165	162	46	380	3	102	25	130	2.9	19	22.4	5	<2	<2	9	35.2
	Minimum Value:		**6.11**	**11.6**	**30**	**3**	**40**	**24**	**13**	**322**	**1**	**2**	**2**	**28**	**1.0**	**4**	**1.2**	**<5**	**<2**	**<2**	**8**	**10.0**
	Maximum Value:		**7.35**	**54.0**	**154**	**90**	**687**	**633**	**221**	**1,278**	**40**	**106**	**57**	**149**	**12.8**	**68**	**37.6**	**26**	**13**	**10**	**100**	**54.7**
	Geometric Mean:		**6.78**	**31.8**	**76**	**10**	**168**	**121**	**68**	**468**	**12**	**42**	**16**	**92**	**3.4**	**17**	**10.0**	**5.4**	**2.7**	**<2**	**24**	**29.8**
Lynx	SW - 3	12/18/12	6.91	37.4	102	125	923	184	360	1,592	130	3	70	203	6.0	36	32.9	13	5	3	33	25.0
Lynx	SW - 3	3/20/13	6.79	30.2	103	114	268	28	48	458	27	21	64	112	16.8	25	78.6	<5	15	<2	157	24.0
Lynx	SW - 3	3/24/13	6.86	26.4	66	50	637	92	81	860	7	7	23	37	7.7	16	24.0	7	4	<2	84	26.0
Lynx	SW - 3	4/14/13	6.78	25.0	191	139	291	78	23	531	4	16	24	44	7.2	20	32.8	<5	4	<2	69	27.6
Lynx	SW - 3	4/21/13	6.76	17.8	31	45	94	53	102	294	10	50	31	91	3.5	8	16.8	6	6	<2	42	12.8
Lynx	SW - 3	5/1/13	6.67	23.4	38	102	168	67	10	347	13	51	35	99	6.2	11	19.6	<5	<2	<2	18	10.8
Lynx	SW - 3	5/19/13	6.92	17.8	37	3	94	249	41	387	3	87	3	93	1.7	6	15.4	8	<2	<2	6	15.0
Lynx	SW - 3	6/5/13	6.09	19.0	85	122	349	62	49	582	15	46	20	81	7.6	13	26.0	<5	4	<2	35	14.0
Lynx	SW - 3	6/10/13	6.51	16.4	67	3	129	49	110	291	2	100	13	115	3.7	7	13.1	8	6	<2	19	17.0
Lynx	SW - 3	6/20/13	6.07	12.0	77	17	172	190	102	481	2	117	2	121	1.2	4	6.0	7	<2	<2	23	22.0
Lynx	SW - 3	6/30/13	6.59	23.8	67	3	828	125	15	971	7	98	16	121	2.2	21	9.3	<5	3	<2	18	26.8
Lynx	SW - 3	7/16/13	6.71	21.0	45	28	301	52	180	561	13	92	6	111	1.1	11	21.2	<5	<2	<2	9	24.4
Lynx	SW - 3	8/1/13	6.62	21.8	52	71	326	32	33	462	2	101	16	119	1.5	14	25.8	13	2	<2	15	25.6
Lynx	SW - 3	8/14/13	6.58	18.4	25	87	408	58	66	619	19	150	83	252	1.4	7	8.8	4	<2	<2	6	11.6
Lynx	SW - 3	8/23/13	6.16	16.0	33	25	117	258	62	462	6	119	5	130	0.8	4	7.0	9	<2	<2	17	18.4
Lynx	SW - 3	8/31/13	6.82	30.8	45	47	103	350	33	533	4	122	23	149	1.8	22	7.8	<5	2	<2	15	35.2
Lynx	SW - 3	9/6/13	6.82	28.0	68	110	222	9	72	413	12	9	26	47	7.5	27	32.3	21	4	<2	46	28.0
Lynx	SW - 3	9/22/13	6.47	20.0	37	39	76	245	11	371	24	105	3	132	1.5	10	15.2	13	<2	<2	4	19.6
Lynx	SW - 3	10/7/13	6.90	38.4	100	29	48	48	131	256	134	12	195	341	6.2	42	19.4	10	3	<2	24	40.4
	Minimum Value:		**6.07**	**12.0**	**25**	**3**	**48**	**9**	**10**	**256**	**2**	**3**	**2**	**37**	**0.8**	**4**	**6.0**	**4**	**<2**	**<2**	**4**	**10.8**
	Maximum Value:		**6.92**	**38.4**	**191**	**139**	**923**	**350**	**360**	**1,592**	**134**	**150**	**195**	**341**	**16.8**	**42**	**78.6**	**21**	**15**	**3**	**157**	**40.4**
	Geometric Mean:		**6.63**	**22.4**	**58**	**37**	**213**	**82**	**54**	**496**	**10**	**44**	**18**	**110**	**3.2**	**13**	**17.7**	**5.9**	**2.5**	**<2**	**22**	**21.0**

Characteristics of Stormwater Inflow and Outflow Samples Collected at the Dry Detention and Underdrain Monitoring Sites

Project Location	Site	Collection Date	pH (s.u.)	Alkalinity (mg/L)	Conductivity (µmho/cm)	Ammonia (µg/L)	NOx (µg/L)	Diss.Org. N (µg/L)	Part. N (µg/L)	Total N (µg/L)	SRP (µg/L)	Diss.Org. P (µg/L)	Part. P (µg/L)	Total P (µg/L)	Turbidity (NTU)	Color (Pt-Co)	TSS (mg/L)	Chromium (µg/L)	Copper (µg/L)	Lead (µg/L)	Zinc (µg/L)	Hardness (mg/L)
Lynx	SW - 4	12/18/12	6.72	28.6	77	105	608	139	83	935	55	13	38	106	3.3	20	9.3	12	9	<2	34	22.6
Lynx	SW - 4	3/20/13	6.68	42.8	111	118	271	54	70	513	26	8	67	101	15.1	26	52.4	5	14	<2	179	31.2
Lynx	SW - 4	3/24/13	6.94	36.6	87	19	616	165	21	821	28	3	14	45	3.4	28	8.2	6	<2	<2	26	35.8
Lynx	SW - 4	4/14/13	6.74	24.4	64	138	290	74	77	579	5	4	19	28	6.1	21	27.8	<5	4	<2	67	24.2
Lynx	SW - 4	4/21/13	6.37	18.2	21	32	74	58	50	214	16	16	6	38	1.1	5	8.2	7	5	<2	19	6.0
Lynx	SW - 4	4/29/13	6.42	18.0	45	111	210	510	310	1,141	26	4	16	46	4.9	7	32.2	<5	14	<2	57	14.8
Lynx	SW - 4	5/1/13	6.87	23.2	50	3	85	127	91	306	15	39	34	88	1.5	4	14.2	7	3	<2	108	15.7
Lynx	SW - 4	5/19/13	6.35	22.6	37	8	300	78	49	435	4	4	14	22	1.8	6	6.0	<5	3	<2	14	12.6
Lynx	SW - 4	6/10/13	6.45	15.8	36	3	145	74	161	383	12	4	22	38	1.5	5	8.2	7	6	<2	32	9.9
Lynx	SW - 4	6/20/13	5.96	11.8	43	3	204	100	181	488	5	58	36	99	1.4	4	11.2	5	4	<2	27	7.6
Lynx	SW - 4	6/30/13	6.26	19.8	53	3	467	125	138	733	12	6	47	65	1.2	7	9.8	<5	2	<2	19	16.8
Lynx	SW - 4	7/3/13	6.63	24.8	50	3	255	40	194	492	4	6	31	41	4.7	7	19.8	<5	<2	<2	31	19.2
Lynx	SW - 4	7/19/13	6.45	18.0	35	22	360	40	131	553	19	62	44	125	1.1	6	12.4	<5	3	<2	17	14.4
Lynx	SW - 4	8/1/13	6.36	14.6	35	75	134	105	111	425	3	51	61	115	1.6	3	11.4	13	2	<2	15	14.0
Lynx	SW - 4	8/14/13	6.14	13.0	33	34	316	15	134	499	38	6	15	59	1.5	5	14.2	<5	<2	<2	5	14.0
Lynx	SW - 4	8/23/13	6.17	14.2	35	23	135	142	158	458	4	96	10	110	1.5	4	11.4	12	<2	<2	13	14.4
Lynx	SW - 4	9/6/13	6.85	31.6	88	38	125	102	23	288	5	130	12	147	2.0	26	11.8	<5	3	<2	7	37.2
Lynx	SW - 4	9/24/13	6.44	15.0	37	49	135	105	42	331	27	79	33	139	0.6	4	7.4	11	<2	<2	4	13.2
Lynx	SW - 4	10/7/13	6.70	38.6	104	165	225	52	86	528	49	14	12	75	6.3	7	8.6	6	<2	<2	24	39.6
	Minimum Value:		**5.96**	**11.8**	**21**	**3**	**74**	**15**	**21**	**214**	**3**	**3**	**6**	**22**	**0.6**	**3**	**6.0**	**<5**	**<2**	**<2**	**4**	**6.0**
	Maximum Value:		**6.94**	**42.8**	**111**	**165**	**616**	**510**	**310**	**1,141**	**55**	**130**	**67**	**147**	**15.1**	**28**	**52.4**	**13**	**14**	**<2**	**179**	**39.6**
	Geometric Mean:		**6.49**	**21.2**	**50**	**23**	**220**	**85**	**90**	**491**	**13**	**15**	**23**	**68**	**2.3**	**8**	**12.6**	**5.1**	**2.8**	**<2**	**23**	**16.9**
Lynx	SW - 5	12/18/12	7.51	110	236	7	450	170	123	750	40	1	17	58	7.6	50	13.3	21	7	3	30	56.2
Lynx	SW - 5	3/20/13	6.76	52.2	135	37	568	65	132	802	138	4	21	163	3.8	53	3.4	<5	4	<2	6	52.9
Lynx	SW - 5	3/24/13	7.19	52.8	119	13	382	13	134	542	92	4	13	109	3.0	46	2.3	<5	<2	<2	10	47.8
Lynx	SW - 5	4/14/13	7.41	56.0	118	3	292	67	77	439	78	7	11	96	2.7	40	2.2	<5	2	<2	<2	48.4
Lynx	SW - 5	4/21/13	7.38	55.2	107	3	99	91	155	348	68	3	13	84	1.4	30	2.8	9	2	<2	<2	44.8
Lynx	SW - 5	5/1/13	7.37	53.8	110	3	127	97	122	349	72	12	5	89	1.9	32	3.0	6	<2	<2	<2	44.0
Lynx	SW - 5	5/19/13	7.36	51.2	100	3	56	73	177	309	57	10	7	74	1.5	24	5.4	7	<2	<2	5	55.5
Lynx	SW - 5	6/5/13	7.03	71.6	125	3	338	113	44	498	80	3	10	93	1.6	40	5.6	5	2	<2	5	62.3
Lynx	SW - 5	6/10/13	7.43	74.2	147	3	227	200	33	463	47	9	7	63	1.5	32	0.6	8	2	<2	8	60.8
Lynx	SW - 5	6/20/13	7.27	71.8	146	3	90	248	58	399	35	5	10	50	1.4	28	3.2	6	3	<2	11	72.4
Lynx	SW - 5	6/30/13	7.05	141	301	3	126	203	40	372	58	4	26	88	3.1	30	5.7	<5	2	<2	9	141
Lynx	SW - 5	7/3/13	7.19	151	329	3	43	252	100	398	56	11	5	72	3.4	31	4.7	<5	<2	<2	6	161
Lynx	SW - 5	7/16/13	7.51	67.8	144	4	312	123	15	454	95	31	13	139	2.5	50	3.6	19	3	<2	40	49.1
Lynx	SW - 5	7/19/13	7.34	54.8	116	3	157	110	69	339	56	4	11	71	1.0	30	3.4	<5	<2	<2	12	54.4
Lynx	SW - 5	8/1/13	7.16	69.8	151	50	209	219	111	589	19	17	29	65	2.2	31	21.8	11	2	<2	18	75.2
Lynx	SW - 5	8/5/13	7.51	65.8	151	67	212	77	46	402	26	3	9	38	2.1	33	4.4	13	2	<2	8	74.0
Lynx	SW - 5	8/14/13	7.62	124	264	3	292	354	106	755	14	9	40	63	6.8	45	10.7	13	<2	<2	4	127
Lynx	SW - 5	8/23/13	7.82	76.4	175	3	224	226	82	535	21	5	20	46	3.5	39	8.6	4	<2	<2	4	86.4
Lynx	SW - 5	8/31/13	6.98	51.2	114	40	124	136	180	480	25	2	11	38	0.8	22	3.9	6	<2	<2	15	55.2
Lynx	SW - 5	9/6/13	6.72	28.4	114	17	263	46	148	474	43	7	4	54	1.1	21	1.6	<5	2	<2	<2	31.6
Lynx	SW - 5	9/22/13	6.96	36.8	82	37	189	53	33	312	135	4	8	147	0.9	32	1.2	9	<2	<2	2	38.4
Lynx	SW - 5	10/7/13	7.41	122	258	39	199	41	272	551	67	14	20	101	3.1	34	9.4	5	<2	<2	3	124
	Minimum Value:		**6.72**	**28.4**	**82**	**3**	**43**	**13**	**15**	**309**	**14**	**1**	**4**	**38**	**0.8**	**21**	**0.6**	**<5**	**<2**	**<2**	**<2**	**31.6**
	Maximum Value:		**7.82**	**151**	**329**	**67**	**568**	**354**	**272**	**802**	**138**	**31**	**40**	**163**	**7.6**	**53**	**21.8**	**21**	**7**	**<2**	**40**	**161**
	Geometric Mean:		**7.27**	**68.2**	**149**	**8**	**190**	**107**	**84**	**462**	**51**	**6**	**12**	**76**	**2.2**	**34**	**4.0**	**5.7**	**1.7**	**<2**	**5.5**	**64.4**

Characteristics of Stormwater Inflow and Outflow Samples Collected at the Dry Detention and Underdrain Monitoring Sites

Project Location	Site	Collection Date	pH (s.u.)	Alkalinity (mg/L)	Conductivity (µmho/cm)	Ammonia (µg/L)	NOx (µg/L)	Diss.Org. N (µg/L)	Part. N (µg/L)	Total N (µg/L)	SRP (µg/L)	Diss.Org. P (µg/L)	Part. P (µg/L)	Total P (µg/L)	Turbidity (NTU)	Color (Pt-Co)	TSS (mg/L)	Chromium (µg/L)	Copper (µg/L)	Lead (µg/L)	Zinc (µg/L)	Hardness (mg/L)
Naples	SW - 1	12/11/12	6.96	58.4	156	3	156	211	191	561	8	3	39	50	2.5	22	3.0	<5	<2	<2	5	62.8
Naples	SW - 1	2/14/13	6.98	43.8	93	3	353	372	180	908	38	9	43	90	3.1	37	9.0	4	<2	<2	<2	44.8
Naples	SW - 1	3/18/13	6.79	40.8	97	3	3	271	42	319	5	7	11	23	1.2	23	1.8	10	2	<2	6	46.4
Naples	SW - 1	4/4/13	6.97	63.6	152	3	296	257	93	649	10	10	6	26	2.0	43	1.7	6	7	<2	19	63.6
Naples	SW - 1	4/21/13	6.63	59.4	160	74	187	244	258	763	5	10	36	51	16.7	27	24.8	<5	6	<2	7	62.8
Naples	SW - 1	5/1/13	7.51	46.2	94	57	159	110	40	366	15	13	12	40	1.8	11	3.9	6	3	<2	12	29.2
Naples	SW - 1	5/29/13	6.94	65.4	138	3	145	252	68	468	14	17	11	42	1.4	25	2.3	<5	3	<2	18	33.6
Naples	SW - 1	6/4/13	6.79	39.0	95	14	72	281	43	410	14	73	12	99	1.6	30	1.4	<5	<2	<2	8	41.5
Naples	SW - 1	6/12/13	7.21	54.6	120	3	100	157	47	307	129	3	7	139	1.5	27	3.2	8	3	<2	5	55.2
Naples	SW - 1	6/19/13	7.04	39.0	88	3	168	210	172	553	11	30	1	42	1.1	19	2.2	11	<2	<2	2	39.2
Naples	SW - 1	6/24/13	6.99	52.4	140	3	116	197	44	360	16	47	6	69	3.2	32	2.8	9	2	<2	4	43.6
Naples	SW - 1	7/1/13	6.82	32.2	71	3	199	15	119	336	18	30	9	57	1.0	27	1.2	<5	<2	<2	2	29.2
Naples	SW - 1	7/5/13	6.64	29.6	77	3	107	34	68	212	10	4	10	24	1.8	21	6.5	<5	<2	<2	<2	31.6
Naples	SW - 1	7/13/13	7.24	90.4	173	30	122	344	179	675	31	6	34	71	1.9	82	5.2	6	<2	<2	3	94.4
Naples	SW - 1	7/18/13	6.89	34.2	82	227	8	272	159	666	27	13	25	65	1.2	44	2.6	<5	<2	<2	2	38.8
Naples	SW - 1	7/29/13	7.51	98.8	205	174	14	252	140	580	21	8	23	52	1.8	60	3.8	5	2	<2	<2	105
Naples	SW - 1	8/6/13	6.95	40.8	90	3	134	195	65	397	16	6	11	33	1.1	34	2.2	6	<2	<2	2	43.2
Naples	SW - 1	8/13/13	7.06	40.2	94	3	159	158	48	368	10	16	22	48	2.1	18	5.8	19	<2	<2	<2	44.4
Naples	SW - 1	8/19/13	7.47	50.0	115	3	124	281	71	479	10	11	11	32	1.2	55	1.4	6	<2	<2	5	52.0
Naples	SW - 1	8/23/13	6.62	29.8	206	3	229	227	56	515	36	4	10	50	1.0	31	1.0	6	<2	<2	<2	32.4
Naples	SW - 1	9/2/13	6.72	39.4	97	58	61	203	85	407	8	4	23	35	3.0	16	11.8	10	<2	<2	6	46.8
Naples	SW - 1	9/6/13	6.96	28.4	59	18	161	84	50	313	17	16	13	46	1.5	18	2.6	10	<2	<2	<2	31.2
Naples	SW - 1	9/15/13	6.63	24.8	88	3	74	132	148	357	9	10	16	35	0.8	20	1.4	4	<2	<2	<2	26.4
Naples	SW - 1	9/24/13	7.21	35.4	78	3	176	244	76	499	11	4	18	33	1.5	44	4.8	9	<2	<2	<2	39.2
Naples	SW - 1	10/2/13	6.87	43.6	96	3	161	310	24	498	19	3	20	42	1.7	32	2.2	<5	<2	<2	<2	42.0
Naples	SW - 1	11/21/13	6.72	33.0	86	3	101	239	63	406	20	9	24	53	3.0	18	9.2	6	2	<2	9	37.2
	Minimum Value:		**6.62**	**24.8**	**59**	**3**	**3**	**15**	**24**	**212**	**5**	**3**	**1**	**23**	**0.8**	**11**	**1.0**	**4**	**<2**	**<2**	**<2**	**26.4**
	Maximum Value:		**7.51**	**98.8**	**206**	**227**	**353**	**372**	**258**	**908**	**129**	**73**	**43**	**139**	**17**	**82**	**25**	**19**	**7**	**<2**	**19**	**105**
	Geometric Mean:		**6.96**	**44.0**	**107**	**7**	**100**	**183**	**81**	**452**	**15**	**10**	**14**	**47**	**1.8**	**28**	**3.2**	**5.2**	**1.5**	**<2**	**3.0**	**44.0**
Naples	SW - 2	12/10/13	7.68	57.2	155	6	3	447	115	571	3	17	57	77	4.8	32	23.0	17	8	<2	7	35.3
Naples	SW - 2	2/14/13	7.17	72.2	218	130	166	691	163	1,150	63	3	45	111	4.8	51	11.7	12	3	<2	5	44.4
Naples	SW - 2	3/18/13	7.21	78.4	192	403	61	537	127	1,128	102	15	45	162	2.8	52	4.4	7	8	<2	11	72.0
Naples	SW - 2	4/4/13	6.79	42.2	102	3	114	272	261	650	7	1	58	66	5.1	23	12.0	6	12	<2	5	38.8
Naples	SW - 2	4/21/13	6.98	28.2	72	43	137	100	99	379	19	26	34	79	4.9	11	8.7	8	13	<2	4	24.8
Naples	SW - 2	5/1/13	6.88	52.4	172	9	72	317	61	459	21	9	22	52	4.2	23	6.5	<5	6	4	4	29.4
Naples	SW - 2	5/29/13	7.04	72.4	161	3	115	358	471	947	1	10	96	107	3.7	33	6.4	5	5	<2	4	32.5
Naples	SW - 2	6/4/13	6.95	58.8	153	3	335	424	142	904	53	10	40	103	2.9	43	4.2	7	3	<2	6	37.1
Naples	SW - 2	6/12/13	7.02	45.8	94	3	61	133	49	246	14	44	39	97	2.0	24	1.4	8	2	<2	8	38.8
Naples	SW - 2	6/19/13	6.62	22.6	58	3	192	43	69	307	1	41	45	87	2.9	19	10.0	<5	<2	<2	5	22.0
Naples	SW - 2	6/24/13	6.92	39.6	125	3	116	61	42	222	26	51	56	133	1.6	20	2.2	6	<2	<2	4	34.4
Naples	SW - 2	7/1/13	6.87	28.2	67	3	182	86	93	364	12	88	9	109	1.1	17	2.6	<5	2	<2	6	58.0
Naples	SW - 2	7/5/13	6.79	40.2	95	3	80	143	156	382	11	3	6	20	0.9	26	2.0	<5	<2	<2	6	40.4
Naples	SW - 2	7/13/13	7.09	64.2	494	101	51	102	146	400	7	2	29	38	3.4	28	9.2	<5	<2	<2	10	104
Naples	SW - 2	7/18/13	6.82	43.2	87	29	4	211	93	337	11	8	15	34	1.8	20	5.8	5	<2	<2	9	43.2
Naples	SW - 2	7/29/13	6.99	56.4	118	155	20	177	81	433	29	8	24	61	4.4	24	2.6	5	3	<2	10	58.0
Naples	SW - 2	8/6/13	6.89	43.0	75	3	90	127	28	248	10	2	12	24	1.3	14	7.2	6	3	<2	25	34.4
Naples	SW - 2	8/13/13	7.08	43.0	102	3	129	286	112	530	27	24	32	83	1.4	65	34.0	<5	<2	<2	4	48.0
Naples	SW - 2	8/19/13	6.86	28.6	72	3	105	167	53	328	18	7	26	51	1.4	18	3.8	10	<2	<2	9	161
Naples	SW - 2	8/23/13	6.87	30.0	113	3	445	177	52	677	63	4	24	91	2.5	23	5.8	7	<2	<2	5	36.0
Naples	SW - 2	9/2/13	6.66	36.6	86	29	5	322	47	403	5	4	17	26	0.9	33	3.4	<5	2	<2	4	38.4
Naples	SW - 2	9/6/13	6.64	32.6	74	7	135	55	125	322	14	14	20	48	1.5	21	1.6	11	<2	<2	6	36.4
Naples	SW - 2	9/8/13	6.55	36.4	174	3	266	306	42	617	18	11	25	54	2.6	27	4.0	4	<2	<2	2	84.4
Naples	SW - 2	9/15/13	6.68	27.8	95	3	54	151	154	362	10	58	52	120	1.5	18	2.0	5	<2	<2	4	26.4
Naples	SW - 2	9/24/13	7.32	45.0	96	3	244	94	94	435	23	7	26	56	2.0	22	6.8	10	<2	<2	8	47.6
Naples	SW - 2	10/2/13	6.81	36.0	77	3	122	201	42	368	10	71	40	121	1.3	11	3.4	<5	<2	<2	6	38.0
Naples	SW - 2	11/21/13	7.10	38.6	87	3	204	136	26	369	23	68	39	130	1.5	15	1.6	4	<2	<2	4	40.0
	Minimum Value:		**6.55**	**22.6**	**58**	**3**	**3**	**43**	**26**	**222**	**1**	**1**	**6**	**20**	**0.9**	**11**	**1.4**	**4**	**2**	**<2**	**2**	**22.0**
	Maximum Value:		**7.68**	**78.4**	**494**	**403**	**445**	**691**	**471**	**1,150**	**102**	**88**	**96**	**162**	**5.1**	**65**	**34.0**	**17**	**13**	**<2**	**25**	**161**
	Geometric Mean:		**6.93**	**42.2**	**111**	**8**	**81**	**180**	**86**	**452**	**14**	**12**	**29**	**69**	**2.2**	**24**	**4.9**	**5.1**	**2.1**	**<2**	**5.9**	**43.3**

Characteristics of Stormwater Inflow and Outflow Samples Collected at the Dry Detention and Underdrain Monitoring Sites

Project Location	Site	Collection Date	pH (s.u.)	Alkalinity (mg/L)	Conductivity (µmho/cm)	Ammonia (µg/L)	NOx (µg/L)	Diss.Org. N (µg/L)	Part. N (µg/L)	Total N (µg/L)	SRP (µg/L)	Diss.Org. P (µg/L)	Part. P (µg/L)	Total P (µg/L)	Turbidity (NTU)	Color (Pt-Co)	TSS (mg/L)	Chromium (µg/L)	Copper (µg/L)	Lead (µg/L)	Zinc (µg/L)	Hardness (mg/L)
Naples	SW - 3	5/1/13	7.00	56.4	127	12	100	251	92	455	20	3	16	39	2.9	25	6.5	<5	6	3	5	33.0
Naples	SW - 3	6/12/13	7.04	42.8	95	3	63	106	66	238	14	6	9	29	1.7	23	2.4	5	<2	<2	8	38.4
Naples	SW - 3	6/19/13	6.82	54.6	117	3	3	317	133	456	4	12	7	23	1.1	89	1.6	4	4	<2	4	52.0
Naples	SW - 3	7/1/13	7.12	47.4	102	3	29	281	147	460	6	2	6	14	0.8	33	4.6	6	<2	<2	3	41.6
Naples	SW - 3	7/5/13	6.48	37.4	91	3	32	216	106	357	3	1	23	27	1.6	33	2.9	<5	<2	<2	16	36.8
Naples	SW - 3	7/18/13	6.68	36.0	84	73	26	125	148	372	7	9	25	41	1.6	30	6.0	4	<2	<2	4	38.0
Naples	SW - 3	7/29/13	6.83	32.2	69	65	72	117	31	285	2	15	10	27	1.1	29	1.2	5	2	<2	3	30.0
Naples	SW - 3	8/6/13	6.47	25.2	59	3	118	240	8	369	2	5	22	29	1.3	29	3.8	6	<2	<2	17	28.8
Naples	SW - 3	8/13/13	7.31	29.8	80	6	43	274	96	419	11	13	40	64	6.0	32	11.8	12	<2	<2	5	32.0
Naples	SW - 3	8/19/13	5.85	6.2	14	52	7	202	137	398	2	4	13	19	1.8	10	4.0	5	<2	<2	16	28.0
Naples	SW - 3	8/23/13	7.47	51.4	74	3	5	459	86	553	7	6	50	63	4.7	48	11.0	7	<2	<2	2	52.0
Naples	SW - 3	9/6/13	5.78	6.2	15	20	23	210	32	285	2	4	11	17	1.5	6	2.0	<5	<2	<2	2	47.0
Naples	SW - 3	11/21/13	6.05	9.0	11	3	208	188	7	406	27	2	10	39	2.6	6	4.6	<5	<2	<2	2	32.0
	Minimum Value:		**5.78**	**6.2**	**11**	**3**	**3**	**106**	**7**	**238**	**2**	**1**	**6**	**14**	**0.8**	**6**	**1.2**	**4**	**<2**	**<2**	**2**	**28.0**
	Maximum Value:		**7.47**	**56.4**	**127**	**73**	**208**	**459**	**148**	**553**	**27**	**15**	**50**	**64**	**6.0**	**89**	**11.8**	**12**	**6**	**3**	**17**	**52.0**
	Geometric Mean:		**6.66**	**26.8**	**57**	**8**	**31**	**213**	**59**	**379**	**6**	**5**	**15**	**30**	**1.9**	**24**	**3.9**	**4.4**	**1.3**	**<2**	**4.9**	**36.9**
Naples	SW - 4	3/18/13	7.21	57.6	117	3	47	298	61	409	6	1	30	37	0.8	54	2.2	11	<2	<2	2	58.8
Naples	SW - 4	4/21/13	6.12	12.6	35	2	336	158	279	775	23	9	33	65	2.9	24	11.1	<5	9	<2	18	18.8
Naples	SW - 4	5/1/13	6.74	22.0	57	60	174	227	214	675	34	5	16	55	2.4	27	4.6	6	<2	<2	<2	19.2
Naples	SW - 4	6/4/13	6.84	31.4	67	3	3	213	211	430	18	9	13	40	1.3	35	1.7	5	4	<2	6	22.9
Naples	SW - 4	6/24/13	7.34	76.0	147	3	3	371	171	548	93	15	16	124	2.2	88	1.4	<5	2	<2	5	71.6
Naples	SW - 4	7/1/13	7.23	60.8	136	3	3	194	257	457	10	13	9	32	0.9	61	1.8	8	<2	<2	3	60.0
Naples	SW - 4	7/5/13	7.27	7.6	161	3	3	302	106	414	2	7	13	22	0.8	62	1.2	<5	<2	<2	<2	77.6
Naples	SW - 4	7/18/13	7.45	127	263	3	8	376	226	613	4	4	23	31	2.2	76	5.6	<5	<2	<2	7	130
Naples	SW - 4	7/29/13	6.92	73.0	83	86	23	102	95	306	3	9	13	25	1.5	44	2.0	6	2	<2	<2	38.4
Naples	SW - 4	8/6/13	7.07	48.4	99	3	17	316	46	382	1	7	9	17	0.9	61	1.8	7	2	<2	<2	45.6
Naples	SW - 4	8/13/13	6.78	24.2	67	3	57	236	114	410	8	5	9	22	2.1	35	4.6	12	<2	<2	<2	27.6
Naples	SW - 4	8/23/13	7.16	68.4	156	3	11	235	99	348	2	5	6	13	1.3	50	1.8	8	<2	<2	8	73.2
Naples	SW - 4	9/2/13	7.17	60.8	80	3	100	225	137	465	14	7	5	26	0.6	40	1.4	7	<2	<2	<2	62.4
Naples	SW - 4	9/8/13	6.86	24.4	53	5	30	177	135	347	1	6	19	26	1.8	25	5.4	<5	<2	<2	2	44.4
Naples	SW - 4	9/15/13	6.99	35.0	72	13	47	128	34	222	8	13	9	30	0.7	36	1.0	8	<2	<2	<2	35.2
Naples	SW - 4	9/24/13	6.88	50.6	115	3	58	143	156	360	4	2	16	22	1.2	55	2.6	<5	<2	<2	9	43.2
	Minimum Value:		**6.12**	**7.6**	**35**	**2**	**3**	**102**	**34**	**222**	**1**	**1**	**5**	**13**	**0.6**	**24**	**1.0**	**5**	**<2**	**<2**	**<2**	**18.8**
	Maximum Value:		**7.45**	**127**	**263**	**86**	**336**	**376**	**279**	**775**	**93**	**15**	**33**	**124**	**2.9**	**88**	**11.1**	**12**	**9**	**<2**	**18**	**130**
	Geometric Mean:		**6.99**	**39.4**	**94**	**5**	**22**	**217**	**126**	**428**	**7**	**6**	**13**	**31**	**1.3**	**45**	**2.5**	**5.0**	**1.4**	**<2**	**2.6**	**45.3**

Characteristics of Stormwater Inflow and Outflow Samples Collected at the Dry Detention and Underdrain Monitoring Sites

Project Location	Site	Collection Date	pH (s.u.)	Alkalinity (mg/L)	Conductivity (µmho/cm)	Ammonia (µg/L)	NOx (µg/L)	Diss.Org. N (µg/L)	Part. N (µg/L)	Total N (µg/L)	SRP (µg/L)	Diss.Org. P (µg/L)	Part. P (µg/L)	Total P (µg/L)	Turbidity (NTU)	Color (Pt-Co)	TSS (mg/L)	Chromium (µg/L)	Copper (µg/L)	Lead (µg/L)	Zinc (µg/L)	Hardness (mg/L)
Pembrooke Pines	SW - 1	12/11/12	7.33	75.4	165	3	14	350	166	533	5	6	18	29	9.1	38	62.0	13	11	<2	10	82.8
Pembrooke Pines	SW - 1	2/14/13	7.07	64.4	118	69	13	245	123	450	19	3	20	42	2.5	23	2.6	4	12	<2	15	97.5
Pembrooke Pines	SW - 1	2/27/13	7.39	83.6	185	159	27	469	289	944	25	1	129	155	16.8	39	157	17	3	<2	28	88.2
Pembrooke Pines	SW - 1	4/5/13	7.07	114	274	280	120	651	396	1,447	16	15	70	101	7.1	55	15.5	6	2	<2	83	105
Pembrooke Pines	SW - 1	4/15/13	7.11	64.6	154	116	42	270	504	932	10	20	91	121	7.3	25	38.5	9	11	<2	11	153
Pembrooke Pines	SW - 1	4/22/13	7.18	65.6	151	143	70	296	301	810	17	8	55	80	3.0	24	13.2	5	2	<2	18	56.8
Pembrooke Pines	SW - 1	4/30/13	7.59	66.2	171	77	124	264	125	590	25	35	24	84	3.4	18	14.0	7	3	<2	67	57.6
Pembrooke Pines	SW - 1	5/2/13	7.88	109	273	3	362	253	39	657	27	54	41	122	1.2	21	2.6	<5	4	<2	18	66.6
Pembrooke Pines	SW - 1	5/11/13	8.18	186	430	3	245	582	28	858	15	91	11	117	0.8	18	0.6	<5	3	<2	7	71.1
Pembrooke Pines	SW - 1	5/20/13	6.97	71.0	171	3	381	192	44	620	6	74	33	113	0.7	15	0.9	8	5	<2	31	59.6
Pembrooke Pines	SW - 1	5/29/13	7.15	44.4	122	3	451	101	230	785	37	11	20	68	2.1	16	7.3	5	2	<2	12	48.0
Pembrooke Pines	SW - 1	6/1/13	7.51	94.6	266	3	173	354	21	551	15	57	44	116	0.5	45	1.3	5	4	<2	22	61.6
Pembrooke Pines	SW - 1	6/7/13	7.47	60.6	149	3	184	168	35	390	12	101	6	119	0.5	11	1.4	6	3	<2	18	56.8
Pembrooke Pines	SW - 1	6/19/13	8.08	222	506	3	3	696	124	826	2	45	66	113	6.5	61	16.8	4	2	<2	7	52.0
Pembrooke Pines	SW - 1	6/28/13	7.28	48.6	177	3	151	44	134	332	19	81	21	121	0.9	16	1.2	10	2	<2	12	47.2
Pembrooke Pines	SW - 1	7/9/13	7.67	84.2	222	3	184	52	147	386	11	76	11	98	0.6	17	3.4	<5	<2	<2	26	87.2
Pembrooke Pines	SW - 1	7/14/13	7.39	56.4	156	19	172	39	26	256	11	99	5	115	2.4	12	3.6	<5	<2	<2	13	57.6
Pembrooke Pines	SW - 1	7/27/13	6.71	23.4	52	30	17	93	74	214	2	97	22	121	1.0	11	1.0	<5	<2	<2	12	27.2
Pembrooke Pines	SW - 1	8/3/13	6.73	29.4	69	3	206	236	63	508	2	72	41	115	2.3	19	6.0	6	4	<2	6	34.0
Pembrooke Pines	SW - 1	8/23/13	7.12	57.8	119	61	17	412	52	542	12	13	15	40	4.2	26	18.2	7	2	<2	16	62.4
Pembrooke Pines	SW - 1	9/15/13	7.30	48.0	126	111	64	120	66	361	20	17	19	56	0.8	14	1.2	10	<2	<2	4	48.8
Pembrooke Pines	SW - 1	9/22/13	7.02	42.8	154	3	113	145	40	301	8	70	35	113	0.9	18	1.6	4	<2	<2	11	42.8
Pembrooke Pines	SW - 1	10/2/13	7.52	65.2	175	3	204	218	15	440	8	58	48	114	0.9	17	1.6	16	<2	<2	5	63.2
Pembrooke Pines	SW - 1	10/7/13	7.42	50.4	141	3	193	189	12	397	10	84	29	123	1.3	14	3.2	5	<2	<2	4	53.2
Pembrooke Pines	SW - 1	10/23/13	7.42	61.6	166	3	224	208	15	450	7	71	59	137	0.9	13	1.4	<5	<2	<2	4	58.8
Pembrooke Pines	SW - 1	10/28/13	7.52	98.2	290	50	226	351	72	699	13	49	69	131	1.5	23	2.0	<5	<2	<2	6	124
Pembrooke Pines	SW - 1	11/8/13	6.73	95.2	350	3	319	534	102	958	17	38	86	141	1.3	20	1.6	<5	<2	<2	7	121
Pembrooke Pines	SW - 1	11/15/13	8.03	149	408	3	732	363	222	1,320	41	12	53	106	5.1	25	15.4	4	<2	<2	7	140
Pembrooke Pines	SW - 1	11/21/13	7.26	45.0	118	3	223	179	47	452	23	11	11	45	1.6	15	4.6	<5	<2	<2	6	51.6
Pembrooke Pines	SW - 1	11/26/13	7.04	40.6	114	3	393	98	74	568	19	99	12	130	1.2	14	2.4	<5	<2	<2	7	49.2
	Minimum Value:		**6.71**	**23.4**	**52**	**3**	**3**	**39**	**12**	**214**	**2**	**1**	**5**	**29**	**0.5**	**11**	**0.6**	**4**	**<2**	**<2**	**4**	**27.2**
	Maximum Value:		**8.18**	**222**	**506**	**280**	**732**	**696**	**504**	**1,447**	**41**	**101**	**129**	**155**	**16.8**	**61**	**157**	**17**	**12**	**<2**	**83**	**153**
	Geometric Mean:		**7.33**	**68.2**	**176**	**10**	**112**	**215**	**76**	**559**	**12**	**31**	**29**	**96**	**1.8**	**20**	**4.3**	**5.0**	**2.1**	**<2**	**11.7**	**65.3**

Characteristics of Stormwater Inflow and Outflow Samples Collected at the Dry Detention and Underdrain Monitoring Sites

Project Location	Site	Collection Date	pH (s.u.)	Alkalinity (mg/L)	Conductivity (µmho/cm)	Ammonia (µg/L)	NOx (µg/L)	Diss.Org. N (µg/L)	Part. N (µg/L)	Total N (µg/L)	SRP (µg/L)	Diss.Org. P (µg/L)	Part. P (µg/L)	Total P (µg/L)	Turbidity (NTU)	Color (Pt-Co)	TSS (mg/L)	Chromium (µg/L)	Copper (µg/L)	Lead (µg/L)	Zinc (µg/L)	Hardness (mg/L)
Pembrooke Pines	SW - 2	12/11/12	6.65	32.2	71	27	83	140	66	316	8	52	12	72	2.3	14	6.0	11	3	<2	80	34.4
Pembrooke Pines	SW - 2	1/19/13	7.87	49.2	111	3	3	212	80	298	1	62	17	80	2.7	10	9.4	<5	2	<2	7	48.0
Pembrooke Pines	SW - 2	2/14/13	7.45	40.8	92	3	60	215	33	311	1	75	15	91	1.0	10	3.4	4	2	<2	11	40.4
Pembrooke Pines	SW - 2	2/27/13	7.08	69.6	144	321	57	439	188	1,005	48	7	19	74	3.8	31	9.5	18	9	<2	66	42.0
Pembrooke Pines	SW - 2	4/5/13	7.19	113	261	621	110	515	853	2,099	41	17	107	165	8.8	58	36.7	9	19	<2	127	106
Pembrooke Pines	SW - 2	4/15/13	7.45	73.4	158	263	57	377	147	844	22	11	42	75	5.7	24	28.0	8	10	<2	90	66.8
Pembrooke Pines	SW - 2	4/22/13	7.01	62.4	138	62	166	338	382	948	9	2	52	63	6.7	25	24.9	<5	15	<2	21	52.0
Pembrooke Pines	SW - 2	4/30/13	6.79	28.4	49	14	37	278	239	568	14	34	36	84	1.7	6	7.6	5	3	<2	36	18.8
Pembrooke Pines	SW - 2	5/2/13	7.13	53.4	113	127	53	361	236	777	20	26	33	79	2.3	16	3.9	<5	5	<2	43	22.5
Pembrooke Pines	SW - 2	5/11/13	7.33	68.8	116	364	12	312	108	796	22	7	17	46	2.8	14	3.1	<5	3	<2	42	33.2
Pembrooke Pines	SW - 2	5/20/13	7.12	61.2	207	216	37	215	294	762	290	5	48	343	3.1	31	11.2	13	4	<2	68	56.1
Pembrooke Pines	SW - 2	5/29/13	6.89	43.8	76	3	31	168	160	362	10	68	44	122	0.9	9	0.4	12	6	<2	22	29.9
Pembrooke Pines	SW - 2	6/1/13	7.50	42.8	103	9	3	271	88	371	9	45	71	125	1.8	42	5.3	8	4	<2	34	40.1
Pembrooke Pines	SW - 2	6/7/13	6.53	16.8	48	20	79	77	57	233	3	54	36	93	1.4	9	2.0	<5	<2	<2	62	23.6
Pembrooke Pines	SW - 2	6/19/13	7.04	45.4	95	21	56	261	44	382	32	77	14	123	1.2	13	2.4	10	2	<2	42	41.6
Pembrooke Pines	SW - 2	6/28/13	6.52	15.0	201	3	98	51	147	299	11	39	55	105	1.1	6	1.6	8	3	<2	51	41.6
Pembrooke Pines	SW - 2	7/9/13	6.61	37.8	108	17	82	44	158	301	3	46	82	131	3.0	18	6.2	6	2	<2	43	37.2
Pembrooke Pines	SW - 2	7/14/13	6.75	28.6	73	18	118	36	111	283	11	83	31	125	1.6	11	6.8	<5	<2	<2	28	33.2
Pembrooke Pines	SW - 2	7/27/13	6.56	23.0	52	22	17	123	130	292	1	39	66	106	1.3	11	1.0	<5	3	<2	34	25.2
Pembrooke Pines	SW - 2	8/3/13	6.75	26.2	71	3	302	132	69	506	1	28	61	90	2.6	19	3.8	6	4	<2	67	33.2
Pembrooke Pines	SW - 2	8/23/13	6.95	53.4	137	162	12	320	372	866	1	19	25	45	3.4	36	8.6	6	<2	<2	44	56.8
Pembrooke Pines	SW - 2	8/28/13	6.96	48.4	128	113	94	305	179	691	15	9	12	36	2.4	30	2.6	8	2	<2	56	59.2
Pembrooke Pines	SW - 2	9/8/13	7.32	97.0	249	819	99	714	576	2,208	59	8	115	182	1.4	55	5.5	7	16	<2	95	95.8
Pembrooke Pines	SW - 2	9/15/13	6.86	40.0	83	31	102	122	39	294	1	14	26	41	1.4	16	2.2	8	<2	<2	12	37.2
Pembrooke Pines	SW - 2	9/22/13	6.83	39.8	74	3	105	117	98	323	7	28	6	41	1.0	14	2.8	<5	<2	<2	5	32.4
Pembrooke Pines	SW - 2	10/2/13	6.91	39.4	84	3	109	266	19	397	1	17	13	31	1.4	15	3.0	10	<2	<2	10	39.6
Pembrooke Pines	SW - 2	10/7/13	6.73	31.2	54	3	206	175	100	484	9	54	19	82	2.6	13	10.2	<5	<2	<2	11	28.8
Pembrooke Pines	SW - 2	10/23/13	7.17	56.2	119	94	130	306	197	727	1	13	38	52	2.6	19	12.0	<5	<2	<2	20	54.8
Pembrooke Pines	SW - 2	10/28/13	7.05	56.8	128	228	42	254	189	713	11	6	29	46	2.1	23	6.6	<5	<2	<2	22	60.8
Pembrooke Pines	SW - 2	11/8/13	7.36	72.6	141	138	235	379	87	839	28	12	13	53	1.0	25	3.2	<5	<2	<2	8	60.8
Pembrooke Pines	SW - 2	11/15/13	7.57	75.0	183	3	620	261	205	1,089	16	21	20	57	1.0	30	1.8	<5	<2	<2	7	72.8
Pembrooke Pines	SW - 2	11/21/13	7.02	28.8	85	3	26	185	82	296	6	31	26	63	1.4	13	9.4	<5	<2	<2	21	29.2
Pembrooke Pines	SW - 2	11/26/13	6.92	35.0	85	3	353	184	68	608	4	52	24	80	1.6	9	18.0	6	<2	<2	27	39.6
	Minimum Value:		**6.52**	**15.0**	**48**	**3**	**3**	**36**	**19**	**233**	**1**	**2**	**6**	**31**	**0.9**	**6**	**0.4**	**4**	**<2**	**<2**	**5**	**18.8**
	Maximum Value:		**7.87**	**113**	**261**	**819**	**620**	**714**	**853**	**2,208**	**290**	**83**	**115**	**343**	**8.8**	**58**	**36.7**	**18**	**19**	**<2**	**127**	**106**
	Geometric Mean:		**7.02**	**44.1**	**105**	**26**	**63**	**205**	**127**	**537**	**8**	**23**	**29**	**79**	**2.0**	**17**	**5.1**	**5.2**	**2.5**	**<2**	**29**	**41.8**

Characteristics of Stormwater Inflow and Outflow Samples Collected at the Dry Detention and Underdrain Monitoring Sites

Project Location	Site	Collection Date	pH (s.u.)	Alkalinity (mg/L)	Conductivity (µmho/cm)	Ammonia (µg/L)	NOx (µg/L)	Diss.Org. N (µg/L)	Part. N (µg/L)	Total N (µg/L)	SRP (µg/L)	Diss.Org. P (µg/L)	Part. P (µg/L)	Total P (µg/L)	Turbidity (NTU)	Color (Pt-Co)	TSS (mg/L)	Chromium (µg/L)	Copper (µg/L)	Lead (µg/L)	Zinc (µg/L)	Hardness (mg/L)
Pembrooke Pines	SW - 3	12/11/12	7.43	46.2	105	3	19	129	175	326	6	47	8	61	1.5	34	1.6	10	2	<2	7	47.6
Pembrooke Pines	SW - 3	1/19/13	8.93	69.8	150	3	3	198	177	381	2	94	4	100	1.8	34	3.0	4	<2	<2	2	62.8
Pembrooke Pines	SW - 3	2/14/13	7.51	93.8	258	261	68	636	245	1,210	22	15	105	142	5.3	59	17.8	5	5	<2	23	52.2
Pembrooke Pines	SW - 3	2/27/13	7.30	76.8	180	146	61	284	283	774	26	4	18	48	3.3	63	3.1	18	7	<2	43	66.7
Pembrooke Pines	SW - 3	4/5/13	6.90	118	336	128	418	961	307	1,814	43	15	42	100	1.6	117	6.4	4	11	<2	32	123
Pembrooke Pines	SW - 3	4/15/13	7.37	70.6	147	140	58	328	200	726	18	21	20	59	1.7	31	5.4	6	3	<2	61	57.2
Pembrooke Pines	SW - 3	4/22/13	6.85	69.0	152	22	50	424	121	617	18	12	21	51	1.6	51	2.2	<5	6	<2	23	57.2
Pembrooke Pines	SW - 3	4/30/13	7.56	100	218	3	124	471	116	714	26	14	13	53	1.1	76	3.2	<5	6	<2	36	61.6
Pembrooke Pines	SW - 3	5/2/13	7.26	102	227	3	88	351	229	671	24	59	52	135	1.2	83	4.1	<5	6	<2	36	58.1
Pembrooke Pines	SW - 3	5/11/13	7.59	178	385	3	28	484	236	751	7	43	41	91	1.3	56	0.6	<5	4	3	20	55.6
Pembrooke Pines	SW - 3	5/20/13	9.11	66.8	186	3	3	363	145	514	2	83	3	88	1.8	43	1.4	<5	<2	<2	<2	68.4
Pembrooke Pines	SW - 3	5/29/13	7.64	170	71	3	111	124	38	276	7	15	20	42	1.6	13	9.4	6	3	<2	18	48.0
Pembrooke Pines	SW - 3	6/1/13	7.74	100	250	3	3	362	175	543	9	40	12	61	1.5	71	3.3	8	4	<2	16	49.7
Pembrooke Pines	SW - 3	6/7/13	7.33	56.2	147	3	62	272	55	392	3	59	19	81	1.9	22	2.4	4	2	<2	21	52.8
Pembrooke Pines	SW - 3	6/19/13	7.22	52.0	172	3	174	173	83	433	92	8	25	125	3.0	20	7.6	5	<2	<2	17	45.6
Pembrooke Pines	SW - 3	6/28/13	7.13	62.0	155	3	11	198	102	314	2	103	8	113	1.7	34	2.0	<5	<2	<2	13	57.2
Pembrooke Pines	SW - 3	7/9/13	7.28	64.2	161	3	6	227	44	280	3	44	25	72	1.6	38	1.3	<5	<2	<2	5	68.8
Pembrooke Pines	SW - 3	7/14/13	7.56	87.8	253	10	73	255	166	504	27	14	16	57	1.5	30	4.4	4	<2	<2	21	93.2
Pembrooke Pines	SW - 3	8/3/13	6.92	49.0	123	3	72	255	188	518	2	34	15	51	1.8	35	3.4	6	4	<2	38	54.0
Pembrooke Pines	SW - 3	8/28/13	7.79	65.0	128	3	3	401	148	555	9	53	4	66	1.5	52	3.0	5	<2	<2	2	64.4
Pembrooke Pines	SW - 3	9/15/13	8.53	43.2	210	3	3	248	151	405	12	16	14	42	2.3	40	1.4	8	<2	<2	7	99.2
Pembrooke Pines	SW - 3	9/22/13	7.47	106	113	3	3	383	208	597	10	68	3	81	0.8	50	2.0	10	<2	<2	2	104
Pembrooke Pines	SW - 3	10/2/13	7.59	59.8	134	3	16	165	148	332	2	34	15	51	1.5	43	1.4	9	<2	<2	3	60.8
Pembrooke Pines	SW - 3	10/7/13	7.84	98.6	29	3	3	279	116	401	3	68	11	82	0.9	38	0.8	<5	<2	<2	<2	96.0
Pembrooke Pines	SW - 3	11/8/13	8.12	98.4	251	3	3	635	626	1,267	2	61	9	72	1.0	58	1.8	<5	<2	<2	2	99.2
Pembrooke Pines	SW - 3	11/21/13	8.27	44.8	191	3	30	388	242	663	5	60	6	71	2.3	48	7.0	<5	<2	<2	2	77.2
Pembrooke Pines	SW - 3	11/26/13	7.25	54.4	149	11	188	352	460	1,011	8	4	95	107	8.7	25	19.0	4	2	<2	14	60.8
	Minimum Value:		**6.85**	**43.2**	**29**	**3**	**3**	**124**	**38**	**276**	**2**	**4**	**3**	**42**	**0.8**	**13**	**0.6**	**4**	**<2**	**<2**	**<2**	**45.6**
	Maximum Value:		**9.11**	**178**	**385**	**261**	**418**	**961**	**626**	**1,814**	**92**	**103**	**105**	**142**	**8.7**	**117**	**19.0**	**18**	**11**	**3**	**61**	**123**
	Geometric Mean:		**7.59**	**75.9**	**163**	**6**	**23**	**309**	**160**	**559**	**8**	**29**	**15**	**73**	**1.8**	**42**	**3.0**	**4.4**	**2.1**	**<2**	**9.7**	**65.7**

APPENDIX C

CHARACTERISTICS OF BULK PRECIPITATION SAMPLES COLLECTED AT THE DRY DETENTION AND UNDERDRAIN SITES FROM DECEMBER 2012 – NOVEMBER 2013

Characteristics of Bulk Precipitation Samples Collected at the Dry Detention and Underdrain Monitoring Sites

Project Location	Collection Date	Collected Volume (L)	pH (s.u.)	Alkalinity (mg/L)	Conductivity (µmho/cm)	Ammonia (µg/L)	NOx (µg/L)	Diss.Org. N (µg/L)	Part. N (µg/L)	Total N (µg/L)	SRP (µg/L)	Diss.Org. P (µg/L)	Part. P (µg/L)	Total P (µg/L)	Turbidity (NTU)	Color (Pt-Co)	TSS (mg/L)	Chromium (µg/L)	Copper (µg/L)	Lead (µg/L)	Zinc (µg/L)	Hardness (mg/L)
Bonita Springs	2/18/13	4.557	6.35	6.6	11	48	92	75	86	301	1	8	5	14	1.1	2	1.8	11	3	<2	7	2.0
Bonita Springs	3/21/13	1.912	5.93	7.4	42	88	248	166	54	556	8	2	9	19	1.7	5	2.9	13	<2	<2	40	2.0
Bonita Springs	4/8/13	2.115	5.78	1.0	517	14	82	273	130	499	10	4	19	33	4.2	28	14.7	7	11	<2	94	2
Bonita Springs	4/16/13	1.508	5.85	3.8	23	238	164	698	10	1110	15	10	23	48	1.1	6	1.1	6	3	<2	4	2.0
Bonita Springs	4/22/13	0.902	6.00	7.8	31	448	390	390	1478	2706	11	190	26	227	3.6	11	18.8	<5	4	<2	32	5.6
Bonita Springs	5/6/13	1.446	5.83	3.6	23	198	210	317	47	574	1	7	4	12	1.3	6	2.8	<5	<2	<2	19	1.0
Bonita Springs	5/28/13	4.914	5.96	5.8	29	189	128	369	120	617	24	12	21	57	0.9	12	3.0	7	2	<2	10	4.0
Bonita Springs	6/4/13	6.111	5.42	2.4	6	3	20	131	51	205	1	2	5	8	0.6	7	0.6	9	3	<2	8	2.0
Bonita Springs	6/11/13	4.105	5.19	1.6	15	3	72	64	59	198	1	2	3	6	1.1	4	1.0	6	1	<2	<2	1.0
Bonita Springs	6/19/13	6.313	4.62	0.4	10	3	174	121	155	453	1	6	3	10	1.0	1	1.4	8	4	<2	<2	1.0
Bonita Springs	6/24/13	1.073	5.71	5.0	19	3	90	4	117	214	5	3	4	12	1.9	4	1.4	<5	3	<2	5	1.0
Bonita Springs	7/2/13	11.009	5.79	3.6	8	3	29	181	62	275	1	4	5	10	1.5	4	1.0	<5	3	<2	3	1.0
Bonita Springs	7/8/13	1.116	5.26	1.8	12	90	139	173	13	415	1	2	6	9	3.7	4	2.4	<5	<2	<2	6	1.0
Bonita Springs	7/18/13	7.697	5.12	3.8	11	31	132	92	19	274	1	2	2	5	0.8	6	2.0	6	<2	<2	4	1.8
Bonita Springs	7/31/13	9.066	5.49	3.0	5	61	23	36	127	247	1	1	7	9	1.2	5	2.0	5	<2	<2	2	1.0
Bonita Springs	8/14/13	4.680	5.27	2.0	11	10	135	115	11	271	1	1	7	9	1.1	5	3.0	19	<2	<2	3	3.6
Bonita Springs	8/21/13	4.665	4.78	1.4	8	17	52	32	18	119	1	2	5	8	1.1	7	4.4	5	<2	<2	5	2.2
Bonita Springs	8/28/13	4.634	5.12	1.4	6	6	65	59	42	172	4	1	4	9	1.3	7	1.8	5	<2	<2	2	2.0
Bonita Springs	9/4/13	4.198	4.92	0.8	10	25	107	87	60	279	4	1	4	9	0.7	3	0.8	11	<2	<2	11	1.8
Bonita Springs	9/9/13	8.397	4.80	0.4	4	3	35	120	9	167	1	1	14	16	0.8	3	1.2	7	<2	<2	<2	2.4
Bonita Springs	9/16/13	2.675	5.90	3.6	5	133	73	32	48	286	8	8	18	34	0.8	4	2.6	8	<2	<2	2	4.6
Bonita Springs	9/23/13	3.219	5.69	3.2	10	44	69	84	22	219	3	2	12	17	0.7	10	1.2	<5	<2	<2	2	3.0
Bonita Springs	10/2/13	2.908	5.80	3.0	11	42	98	71	48	259	5	3	4	12	4.6	6	1.0	9	<2	<2	3	2.2
Bonita Springs	10/7/13	2.193	5.89	2.8	6	3	97	36	36	172	2	7	6	15	0.6	2	1.6	<5	<2	<2	<2	1.2
Bonita Springs	12/18/13	1.617	6.12	8.8	5	648	305	540	491	1984	270	24	66	360	0.9	27	2.0	6	<2	4	6	3.2
	Minimum Value:		**4.62**	**0.4**	**4**	**3**	**20**	**4**	**9**	**119**	**1**	**1**	**2**	**5**	**1**	**1**	**1**	**<5**	**<2**	**<2**	**<2**	**1.0**
	Maximum Value:		**6.35**	**8.8**	**517**	**648**	**390**	**698**	**1,478**	**2,706**	**270**	**190**	**66**	**360**	**5**	**28**	**19**	**19**	**11**	**4**	**94**	**5.6**
	Geometric Mean:		**5.52**	**2.6**	**13**	**26**	**94**	**106**	**54**	**350**	**3**	**4**	**8**	**17**	**1**	**5**	**2**	**6.3**	**<2**	**<2**	**4.8**	**1.9**
Orlando	1/8/13		5.54	4.4	40	194	371	53	66	684	1	11	12	24	5.2	4	6.0	28	5	<2	21	6.0
Orlando	2/28/13		7.12	25.6	89	2634	367	794	392	4187	169	87	39	295	2.3	23	7.6	21	5	<2	69	3.6
Orlando	3/21/13		6.23	19.6	77	802	363	81	205	1451	74	58	30	162	3.4	14	17.4	<5	8	<2	98	4.0
Orlando	3/25/13		6.38	9.8	38	340	769	126	107	1342	57	9	29	95	3.8	19	7.8	9	2	<2	92	5.0
Orlando	4/15/13		5.79	5.2	16	332	224	134	133	823	18	8	4	30	1.3	7	4.2	7	2	<2	66	8.0
Orlando	4/22/13		4.99	2.0	10	201	81	34	49	365	40	5	14	59	0.5	5	1.8	8	3	<2	22	1.0
Orlando	5/1/13		5.51	4.8	18	569	163	132	189	1053	61	8	14	83	1.2	6	5.4	6	<2	<2	36	1.8
Orlando	5/3/13		5.33	2.8	2	21	36	5	65	127	14	6	13	33	0.5	3	2.4	<5	<2	<2	23	3.0
Orlando	5/24/13		5.41	5.2	13	98	276	31	42	447	10	1	18	29	1.1	12	3.2	5	<2	<2	53	4.0
Orlando	6/11/13		5.43	3.0	8	25	95	5	111	236	5	3	7	15	1.2	3	1.1	6	3	<2	27	1.0
Orlando	6/19/13		5.18	2.2	15	129	170	37	122	458	15	5	9	29	1.4	2	2.6	3	2	<2	31	1.0
Orlando	6/27/13		5.64	4.6	14	173	226	33	71	503	16	6	3	25	0.7	7	1.5	8	2	<2	25	1.0
Orlando	7/3/13		5.24	3.2	11	37	167	81	102	387	37	24	35	96	1.5	4	2.9	3	<2	<2	27	2.0
Orlando	7/9/13		6.05	4.6	11	31	36	55	13	135	19	11	17	47	1.3	6	1.9	3	<2	<2	32	2.2
Orlando	7/16/13		5.93	4.8	19	102	362	179	4	647	36	4	18	58	1.1	6	4.8	6	<2	<2	22	5.0
Orlando	7/26/13		5.37	2.8	6	44	166	108	73	391	7	2	5	14	0.7	4	0.8	7	<2	<2	18	2.4
Orlando	8/1/13		5.64	3.8	11	183	344	73	82	682	40	4	1	45	1.3	5	2.2	11	2	<2	50	5.4
Orlando	8/5/13		5.29	2.4	7	107	140	27	4	278	4	1	5	10	7.0	3	1.2	13	<2	<2	26	1.8
Orlando	8/20/13		5.84	6.2	16	160	242	131	95	628	2	410	33	445	1.4	4	3.2	5	<2	<2	11	4.0
Orlando	8/27/13		5.49	3.8	10	69	99	124	30	322	2	83	7	92	0.6	3	1.7	5	<2	<2	7	3.8
Orlando	9/3/13		5.92	5.0	41	486	265	164	213	1128	123	184	12	319	1.6	8	6.4	7	<2	<2	6	13.2
Orlando	9/9/13		5.64	4.0	14	104	266	110	29	509	18	109	8	135	0.6	7	3.0	3	2	<2	20	5.0
Orlando	9/26/13		5.27	3.8	11	100	20	58	204	382	18	16	44	78	0.7	8	2.2	10	<2	<2	6	1.4
Orlando	10/8/13		6.20	8.6	12	106	78	116	261	561	61	87	6	154	1.3	10	3.4	4	<2	<2	7	7.8
	Minimum Value:		**4.99**	**2.0**	**2**	**21**	**20**	**5**	**4**	**127**	**1**	**1**	**1**	**10**	**0.5**	**2**	**0.8**	**3**	**2.0**	**<2**	**6**	**1.0**
	Maximum Value:		**7.12**	**25.6**	**89**	**2,634**	**769**	**794**	**392**	**4,187**	**169**	**410**	**44**	**445**	**7.0**	**23**	**17.4**	**28**	**8.0**	**<2**	**98**	**13.2**
	Geometric Mean:		**5.67**	**4.7**	**15**	**141**	**166**	**68**	**70**	**538**	**18**	**13**	**11**	**61**	**1.3**	**6**	**3.0**	**6.2**	**2.9**	**<2**	**25**	**3.0**

Characteristics of Bulk Precipitation Samples Collected at the Dry Detention and Underdrain Monitoring Sites

Project Location	Collection Date	Collected Volume (L)	pH (s.u.)	Alkalinity (mg/L)	Conductivity (μmho/cm)	Ammonia (μg/L)	NOx (μg/L)	Diss.Org. N (μg/L)	Part. N (μg/L)	Total N (μg/L)	SRP (μg/L)	Diss.Org. P (μg/L)	Part. P (μg/L)	Total P (μg/L)	Turbidity (NTU)	Color (Pt-Co)	TSS (mg/L)	Chromium (μg/L)	Copper (μg/L)	Lead (μg/L)	Zinc (μg/L)	Hardness (mg/L)
Naples	2/18/13	2.800	5.63	3.0	13	46	133	304	88	571	1	2	14	17	1.2	2	2.2	23	3	<2	9	4.6
Naples	3/21/13	1.368	6.14	6.6	54	48	221	565	370	1204	2	4	90	96	3.7	74	6.6	10	<2	<2	44	3.8
Naples	4/8/13	2.286	5.75	9.8	32	67	318	44	167	596	1	1	8	10	1.3	5	3.1	6	9	<2	24	3.8
Naples	4/22/13	4.198	5.49	2.0	17	60	222	29	86	397	3	6	12	21	1.3	4	2.8	<5	2	<2	17	1.8
Naples	4/29/13	0.155	5.89	4.8	19	111	148	16	5	280	5	4	14	23	1.0	3	1.4	<5	<2	<2	5	3.8
Naples	5/6/13	1.850	6.48	15.6	54	3	168	54	19	244	1	1	2	4	0.8	4	2.3	<5	<2	2	9	5.0
Naples	6/4/13	8.444	6.41	13.8	53	3	44	114	28	189	1	1	3	5	0.9	9	2.4	<5	3	<2	21	3.0
Naples	6/11/13	1.477	6.27	6.6	26	3	83	77	10	173	1	1	3	5	0.5	3	0.6	<5	<2	<2	29	5.6
Naples	6/19/13	7.231	5.32	2.0	9	51	172	105	59	387	3	1	2	6	1.8	2	0.8	8	2	<2	18	1.0
Naples	6/24/13	6.329	5.58	2.8	47	30	168	74	66	338	8	1	3	12	3.0	5	6.8	6	<2	<2	12	1.0
Naples	7/2/13	7.868	4.67	0.4	15	3	93	104	97	297	1	6	5	12	1.4	4	1.0	7	<2	<2	9	1.0
Naples	7/8/13	3.219	5.81	4.2	14	307	97	369	69	842	25	6	17	48	3.9	6	6.0	<5	<2	<2	6	1.0
Naples	7/18/13	10.356	5.53	3.4	9	123	68	48	68	307	15	4	6	25	1.3	3	1.4	4	<2	<2	12	1.6
Naples	7/31/13	4.914	5.56	2.4	10	181	118	94	46	439	36	2	9	47	3.1	3	4.6	5	2	<2	59	2.2
Naples	8/7/13	3.701	4.81	1.8	11	28	205	122	55	410	13	3	8	24	0.8	3	1.0	6	<2	<2	66	3.2
Naples	8/14/13	2.659	5.55	1.4	13	182	120	128	211	641	77	2	12	91	1.0	4	5.6	12	<2	<2	3	2.6
Naples	8/21/13	9.563	5.48	2.2	6	104	58	122	17	301	5	2	6	13	1.2	8	1.0	5	<2	<2	6	1.4
Naples	8/28/13	5.458	5.06	1.8	7	43	70	95	98	306	8	2	5	15	0.6	6	1.6	5	<2	<2	<2	1.8
Naples	9/4/13	2.224	5.30	1.2	11	156	175	157	48	536	13	2	6	21	1.0	5	2.2	9	<2	<2	2	2.2
Naples	9/9/13	7.075	4.57	0.2	7	27	90	30	61	208	4	2	5	11	0.6	2	2.6	<5	<2	<2	2	3.4
Naples	9/16/13	3.017	5.57	2.0	5	47	64	63	62	236	23	5	28	56	0.7	6	1.0	9	<2	<2	2	4.4
Naples	9/23/13	2.970	5.49	4.4	9	36	61	128	98	323	15	4	3	22	0.9	10	2.4	<5	<2	<2	2	2.6
Naples	10/2/13	3.172	5.97	4.0	17	483	151	187	147	968	51	4	26	81	1.1	7	3.4	9	<2	<2	3	2.2
Naples	10/7/13	1.353	5.74	2.8	6	158	123	109	64	454	28	3	2	33	1.1	3	1.2	<5	<2	<2	9	1.8
Naples	11/25/13	1.912	5.88	3.1	39	390	824	557	317	2088	128	9	44	181	4.0	9	10.8	5	<2	<2	5	7.8
Naples	12/18/13	0.850	5.92	4.2	35	698	738	140	208	1784	78	5	34	117	3.1	7	12.6	<5	<2	<2	4	5.2
	Minimum Value:		**4.57**	**0.2**	**5**	**3**	**44**	**16**	**5**	**173**	**1**	**1**	**2**	**4**	**0.5**	**2**	**0.6**	**4**	**<2**	**<2**	**<2**	**1.0**
	Maximum Value:		**6.48**	**15.6**	**54**	**698**	**824**	**565**	**370**	**2,088**	**128**	**9**	**90**	**181**	**4.0**	**74**	**12.6**	**23**	**9**	**2**	**66**	**7.8**
	Geometric Mean:		**5.59**	**2.8**	**15**	**56**	**136**	**103**	**66**	**440**	**8**	**3**	**8**	**23**	**1.3**	**5**	**2.4**	**4.8**	**<2**	**<2**	**8.1**	**2.6**
Pembrooke Pines	2/18/13	3.359	6.23	10.0	58	198	219	996	200	1613	153	27	69	249	1.6	9	1.6	26	8	<2	24	7.6
Pembrooke Pines	4/8/13	3.949	6.62	7.4	36	117	387	524	58	1086	10	3	10	23	0.9	7	4.5	7	4	<2	101	8.8
Pembrooke Pines	4/16/13	0.746	6.36	11.8	43	337	460	381	55	1233	22	1	30	53	1.3	5	6.4	<5	5	<2	47	21.6
Pembrooke Pines	4/29/13	1.711	6.01	4.6	18	58	242	292	109	701	7	5	5	17	1.1	3	2.5	<5	<2	<2	40	2.6
Pembrooke Pines	5/6/13	3.359	5.71	4.0	13	3	157	101	110	371	1	2	7	10	0.6	3	0.7	<5	<2	3	41	5.0
Pembrooke Pines	5/13/13	0.964	6.03	7.8	15	355	219	176	55	805	7	3	8	18	0.9	3	1.1	<5	<2	3	21	3.7
Pembrooke Pines	5/28/13	0.871	5.92	6.2	12	3	135	45	15	198	2	3	3	8	0.7	5	1.0	8	4	4	16	4.9
Pembrooke Pines	6/4/13	3.421	5.91	7.8	5	3	32	139	49	223	1	5	5	11	0.9	8	0.6	10	<2	3	13	3.3
Pembrooke Pines	6/11/13	4.587	5.41	2.4	8	3	60	74	24	161	1	6	4	11	1.8	2	1.0	6	3	2	17	1.0
Pembrooke Pines	6/24/13	2.472	5.54	3.4	14	3	258	40	55	356	5	2	3	10	2.0	6	1.8	7	<2	<2	25	1.6
Pembrooke Pines	7/2/13	3.188	5.49	4.4	15	3	128	69	177	377	6	4	3	13	1.0	4	2.2	5	4	<2	15	3.0
Pembrooke Pines	7/8/13	1.182	5.72	3.0	20	3	124	73	130	330	1	4	4	9	0.8	4	1.3	<5	<2	<2	18	2.4
Pembrooke Pines	7/18/13	14.943	5.49	2.4	6	3	24	79	39	145	1	4	3	8	0.5	3	1.2	6	3	<2	22	1.0
Pembrooke Pines	7/31/13	1.819	5.55	1.6	8	108	186	7	29	330	1	1	3	5	1.3	3	1.2	8	<2	<2	20	2.8
Pembrooke Pines	8/7/13	1.742	5.26	2.4	11	89	342	105	37	573	1	6	3	10	1.0	4	2.2	5	2	<2	19	3.4
Pembrooke Pines	8/28/13	4.090	5.49	2.2	5	28	160	187	32	407	7	3	4	14	1.2	7	1.0	4	<2	<2	5	7.2
Pembrooke Pines	9/4/13	0.762	5.31	0.8	8	35	242	71	6	354	4	1	1	6	1.0	2	0.8	10	<2	<2	20	2.4
Pembrooke Pines	9/16/13	3.079	5.40	1.0	12	84	153	14	123	374	3	10	26	39	2.4	4	5.2	9	<2	<2	5	2.8
Pembrooke Pines	9/23/13	3.670	5.83	4.2	8	20	187	111	67	385	2	2	8	12	1.2	8	5.0	9	<2	<2	4	4.0
Pembrooke Pines	10/2/13	1.679	5.61	2.2	10	41	105	99	29	274	5	2	2	9	1.0	6	2.6	9	<2	<2	4	4.2
Pembrooke Pines	10/14/13	0.980	5.97	4.2	8	302	109	19	50	480	13	3	10	26	1.1	5	2.6	<5	<2	<2	3	3.0
Pembrooke Pines	11/11/13	1.990	6.41	5.6	43	19	182	138	267	606	22	7	21	50	1.4	5	4.6	<5	<2	<2	8	6.6
Pembrooke Pines	11/20/13	0.482	6.67	5.4	24	3	44	161	36	244	10	2	9	21	1.8	6	3.4	<5	<2	<2	9	5.4
Pembrooke Pines	11/25/13	2.830	5.69	2.2	9	3	57	95	32	187	1	2	8	11	0.7	2	1.2	5	<2	<2	4	2.4
Pembrooke Pines	12/2/13	1.742	5.97	2.4	18	3	28	92	45	168	1	3	6	10	0.9	4	1.0	6	<2	<2	3	4.4
Pembrooke Pines	12/18/13	1.001	6.35	5.4	40	90	144	220	107	561	26	3	12	41	2.3	9	7.0	4	<2	<2	7	7.0
	Minimum Value:		**5.26**	**0.8**	**5**	**3**	**24**	**7**	**6**	**145**	**1**	**1**	**1**	**5**	**0.5**	**2**	**0.6**	**4**	**<2**	**<2**	**3**	**1.0**
	Maximum Value:		**6.67**	**11.8**	**58**	**355**	**460**	**996**	**267**	**1,613**	**153**	**27**	**69**	**249**	**2.4**	**9**	**7.0**	**26**	**8**	**4**	**101**	**21.6**
	Geometric Mean:		**5.83**	**3.6**	**14**	**20**	**131**	**100**	**54**	**393**	**4**	**3**	**6**	**16**	**1.1**	**4**	**1.9**	**5.3**	**<2**	**<2**	**13**	**3.7**

APPENDIX D

CHARACTERISTICS OF SHALLOW GROUNDWATER SAMPLES COLLECTED AT THE DRY DETENTION AND UNDERDRAIN SITES FROM DECEMBER 2012 – NOVEMBER 2013

Chemical Characteristics of Groundwater Monitoring Well Samples Collected at the Dry Detention Monitoring Sites

Project Location	Site	Collection Date	pH (s.u.)	Alkalinity (mg/L)	Cond. (µmho/cm)	Ammonia (µg/L)	NOx (µg/L)	Organic N (µg/L)	Total N (µg/L)	SRP (µg/L)	Organic P (µg/L)	Total P (µg/L)	Color (Pt-Co)	Chromium (µg/L)	Copper (µg/L)	Lead (µg/L)	Zinc (µg/L)	Hardness (mg/L)
Bonita Springs	MW - 1	12/31/12	7.56	185	5,108	36	12	525	573	27	6	33	152	24	7	<2	17	389
Bonita Springs	MW - 1	1/30/13	7.47	203	7,651	340	3	272	615	85	4	89	66	7	5	<2	<2	427
Bonita Springs	MW - 1	2/27/13	7.32	172	4,087	820	3	410	1,233	61	22	83	50	18	6	<2	<2	362
Bonita Springs	MW - 1	3/28/13	7.42	133	2,491	558	9	568	1,135	40	2	42	35	6	3	<2	<2	462
Bonita Springs	MW - 1	4/22/13	7.51	121	2,123	212	3	348	563	34	11	45	46	7	3	<2	<2	211
Bonita Springs	MW - 1	5/21/13	7.54	134	2,431	186	9	894	1,089	17	5	22	67	5	3	<2	<2	282
Bonita Springs	MW - 1	6/24/13	7.40	175	2,204	135	80	495	710	37	39	76	39	11	<2	<2	<2	397
Bonita Springs	MW - 1	7/31/13	7.23	89.8	159	314	3	303	620	68	32	100	37	9	<2	<2	<2	129
Bonita Springs	MW - 1	8/28/13	7.07	111	735	1,447	3	450	1,900	145	16	161	42	3	<2	<2	<2	171
Bonita Springs	MW - 1	9/23/13	7.27	98.2	782	369	3	420	792	83	5	88	36	10	<2	<2	<2	127
Bonita Springs	MW - 1	10/28/13	6.78	139	1,498	973	3	394	1,370	217	14	231	47	4	<2	<2	<2	258
Bonita Springs	MW - 1	11/20/13	7.39	161	3,274	601	17	705	1,323	154	10	164	54	4	<2	<2	<2	520
	Minimum Value:		**6.78**	**89.8**	**159**	**36**	**3**	**272**	**563**	**17**	**2**	**22**	**35**	**3**	**<2**	**<2**	**<2**	**127**
	Maximum Value:		**7.56**	**203**	**7,651**	**1,447**	**80**	**894**	**1,900**	**217**	**39**	**231**	**152**	**24**	**7**	**<2**	**17**	**520**
	Geometric Mean:		**7.33**	**139**	**1,886**	**346**	**6**	**456**	**919**	**62**	**10**	**77**	**51**	**7**	**2.1**	**<2**	**<2**	**281**
Bonita Springs	MW - 2	12/31/12	7.03	116	7,851	25	7	500	532	10	8	18	81	17	25	<2	<2	190
Bonita Springs	MW - 2	1/30/13	6.98	148	8,485	155	142	374	671	13	7	20	104	8	5	<2	<2	242
Bonita Springs	MW - 2	2/27/13	7.09	197	7,654	500	15	579	1,094	29	2	31	129	27	13	<2	<2	322
Bonita Springs	MW - 2	3/28/13	6.99	207	4,441	2,429	13	1,493	3,935	83	9	92	350	8	8	<2	<2	598
Bonita Springs	MW - 2	4/22/13	6.81	89.2	1,226	3,217	3	1,025	4,245	76	57	133	133	8	4	<2	<2	199
Bonita Springs	MW - 2	5/21/13	6.78	133	2,750	51	106	1,067	1,224	13	9	22	102	5	5	<2	4	218
Bonita Springs	MW - 2	6/24/13	7.42	64.0	660	3	3	304	310	21	15	36	96	6	<2	<2	<2	110
Bonita Springs	MW - 2	7/31/13	6.85	60.2	159	51	3	380	434	3	15	18	132	9	<2	<2	<2	51
Bonita Springs	MW - 2	8/28/13	6.89	42.8	195	305	3	284	592	30	7	37	101	5	<2	<2	<2	51
Bonita Springs	MW - 2	9/23/13	6.46	53.4	205	402	3	812	1,217	38	8	46	166	10	<2	<2	<2	82
Bonita Springs	MW - 2	10/28/13	6.69	65.8	492	722	5	600	1,327	56	20	76	150	4	<2	<2	<2	112
Bonita Springs	MW - 2	11/20/13	6.99	138	505	902	7	1,085	1,994	56	12	68	171	2	<2	<2	<2	134
	Minimum Value:		**6.46**	**42.8**	**159**	**3**	**3**	**284**	**310**	**3**	**2**	**18**	**81**	**2**	**<2**	**<2**	**<2**	**51**
	Maximum Value:		**7.42**	**207**	**8,485**	**3,217**	**142**	**1,493**	**4,245**	**83**	**57**	**133**	**350**	**27**	**25**	**<2**	**4**	**598**
	Geometric Mean:		**6.91**	**96.6**	**1,189**	**214**	**9**	**617**	**1,062**	**25**	**10**	**40**	**132**	**7**	**2.8**	**<2**	**<2**	**150**

Chemical Characteristics of Groundwater Monitoring Well Samples Collected at the Dry Detention Monitoring Sites

Project Location	Site	Collection Date	pH (s.u.)	Alkalinity (mg/L)	Cond. (µmho/cm)	Ammonia (µg/L)	NOx (µg/L)	Organic N (µg/L)	Total N (µg/L)	SRP (µg/L)	Organic P (µg/L)	Total P (µg/L)	Color (Pt-Co)	Chromium (µg/L)	Copper (µg/L)	Lead (µg/L)	Zinc (µg/L)	Hardness (mg/L)
Bonita Springs	MW - 3	12/31/12	7.47	161	1,861	75	14	1,412	1,501	18	5	23	175	18	5	<2	<2	214
Bonita Springs	MW - 3	1/30/13	7.40	336	1,830	1,704	3	1,679	3,386	13	12	25	188	5	4	<2	28	446
Bonita Springs	MW - 3	2/27/13	7.27	228	1,852	731	3	808	1,542	40	10	50	174	17	3	<2	<2	303
Bonita Springs	MW - 3	3/28/13	7.29	303	2,724	637	3	1,271	1,911	58	14	72	185	8	9	<2	<2	600
Bonita Springs	MW - 3	4/22/13	7.30	268	1,894	125	8	1,452	1,585	69	10	79	222	10	6	<2	<2	408
Bonita Springs	MW - 3	5/21/13	6.89	280	1,875	3	8	1,356	1,367	15	9	24	140	5	4	<2	2	372
Bonita Springs	MW - 3	6/24/13	7.26	236	926	3	3	1,093	1,099	30	42	72	193	8	<2	<2	<2	304
Bonita Springs	MW - 3	7/31/13	7.24	261	681	57	5	904	966	19	20	39	249	10	<2	<2	<2	258
Bonita Springs	MW - 3	8/28/13	6.92	253	725	186	3	1,080	1,269	38	28	66	106	6	<2	<2	<2	267
Bonita Springs	MW - 3	9/23/13	7.16	322	696	812	3	2,360	3,175	45	41	86	190	11	<2	<2	<2	428
Bonita Springs	MW - 3	10/28/13	6.76	235	1,600	2,694	4	1,481	4,179	26	8	34	177	5	<2	<2	<2	571
Bonita Springs	MW - 3	11/20/13	6.96	385	1,542	1,996	3	3,599	5,598	19	6	25	216	31	<2	<2	10	511
	Minimum Value:		**6.76**	**161**	**681**	**3**	**3**	**808**	**966**	**13**	**5**	**23**	**106**	**5**	**<2**	**<2**	**<2**	**214**
	Maximum Value:		**7.47**	**385**	**2,724**	**2,694**	**14**	**3,599**	**5,598**	**69**	**42**	**86**	**249**	**31**	**9**	**<2**	**28**	**600**
	Geometric Mean:		**7.16**	**266**	**1,380**	**195**	**4**	**1,415**	**1,962**	**28**	**13**	**44**	**181**	**9**	**2.2**	**<2**	**1.7**	**371**
Bonita Springs	MW - 4	12/31/12	6.94	316	7,692	322	7	4,408	4,737	34	8	42	261	24	18	<2	2	584
Bonita Springs	MW - 4	1/30/13	6.93	393	8,517	4,177	3	3,598	7,778	24	12	36	274	28	12	<2	9	213
Bonita Springs	MW - 4	2/27/13	6.87	463	7,125	3,795	4	1,226	5,025	26	26	52	615	19	11	<2	11	856
Bonita Springs	MW - 4	3/28/13	6.94	515	7,187	4,271	3	1,563	5,837	44	11	55	320	9	9	<2	4	1070
Bonita Springs	MW - 4	4/22/13	7.32	393	6,668	2,781	3	4,067	6,851	31	9	40	251	11	5	<2	2	1150
Bonita Springs	MW - 4	5/21/13	7.05	423	6,273	2,068	10	3,121	5,199	18	7	25	301	5	11	<2	7	782
Bonita Springs	MW - 4	6/24/13	7.27	250	3,028	168	12	4,308	4,488	28	32	60	1,466	12	5	<2	2	402
Bonita Springs	MW - 4	7/31/13	7.22	435	1,666	386	45	3,823	4,254	12	47	59	2,336	20	4	<2	2	382
Bonita Springs	MW - 4	8/28/13	7.06	317	1,480	1,107	3	3,125	4,235	42	7	49	1,013	8	<2	<2	2	442
Bonita Springs	MW - 4	9/23/13	6.96	535	1,213	956	3	4,474	5,433	73	25	98	450	12	<2	<2	2	614
Bonita Springs	MW - 4	10/28/13	6.75	253	2,550	3,121	5	5,353	8,479	46	20	66	315	6	<2	<2	2	675
Bonita Springs	MW - 4	11/20/13	6.94	470	4,602	3,087	3	4,625	7,715	35	4	39	420	6	<2	<2	2	983
	Minimum Value:		**6.75**	**250**	**1,213**	**168**	**3**	**1,226**	**4,235**	**12**	**4**	**25**	**251**	**5**	**<2**	**<2**	**<2**	**213**
	Maximum Value:		**7.32**	**535**	**8,517**	**4,271**	**45**	**5,353**	**8,479**	**73**	**47**	**98**	**2,336**	**28**	**18**	**<2**	**11**	**1,150**
	Geometric Mean:		**7.02**	**386**	**3,961**	**1,445**	**5**	**3,377**	**5,671**	**31**	**13**	**49**	**496**	**11**	**8.3**	**<2**	**3.1**	**613**

Chemical Characteristics of Groundwater Monitoring Well Samples Collected at the Dry Detention Monitoring Sites

Project Location	Site	Collection Date	pH (s.u.)	Alkalinity (mg/L)	Cond. (µmho/cm)	Ammonia (µg/L)	NOx (µg/L)	Organic N (µg/L)	Total N (µg/L)	SRP (µg/L)	Organic P (µg/L)	Total P (µg/L)	Color (Pt-Co)	Chromium (µg/L)	Copper (µg/L)	Lead (µg/L)	Zinc (µg/L)	Hardness (mg/L)
Orlando	MW - 1	12/28/12	6.08	53.4	162	277	249	733	1,259	11	6	17	98	27	24	<2	6	72.0
Orlando	MW - 1	1/31/13	6.34	21.8	16	1,041	195	1,095	2,331	8	6	14	110	<5	7	<2	27	41.0
Orlando	MW - 1	2/28/13	5.98	51.2	168	1,834	408	458	2,700	5	7	12	88	23	11	<2	20	70.0
Orlando	MW - 1	3/21/13	6.87	66.2	182	463	367	804	1,634	2	11	13	92	<5	7	<2	7	84.0
Orlando	MW - 1	4/30/13	7.39	72.6	283	79	9	683	771	18	1	19	64	<5	3	<2	14	70.0
Orlando	MW - 1	5/24/13	7.08	85.0	228	394	10	247	651	11	7	18	215	6	<2	<2	10	84.0
Orlando	MW - 1	6/27/13	6.84	120	236	109	27	248	384	25	1	26	166	5	<2	<2	6	119
Orlando	MW - 1	7/16/13	6.96	149	290	3	35	885	923	19	7	26	92	<5	<2	<2	3	153
Orlando	MW - 1	8/20/13	6.94	173	345	37	12	570	619	18	4	22	62	7	3	<2	<2	176
Orlando	MW - 1	9/16/13	6.73	101	201	1,557	3	1,124	2,684	23	18	41	191	10	<2	<2	<2	104
Orlando	MW - 1	10/30/13	6.83	86.6	320	155	3	2,464	2,622	37	6	43	169	4	<2	<2	<2	80.0
Orlando	MW - 1	11/21/13	6.82	92.4	222	220	5	2,198	2,423	11	7	18	159	4	<2	<2	<2	109
	Minimum Value:		**5.98**	**21.8**	**16**	**3**	**3**	**247**	**384**	**2**	**1**	**12**	**62**	**<5**	**<2**	**<2**	**<2**	**41.0**
	Maximum Value:		**7.39**	**173**	**345**	**1,834**	**408**	**2,464**	**2,700**	**37**	**18**	**43**	**215**	**27**	**24**	**<2**	**27**	**176**
	Geometric Mean:		**6.73**	**79.2**	**186**	**203**	**29**	**761**	**1,305**	**12**	**5**	**21**	**116**	**5.5**	**2.6**	**<2**	**4.4**	**90.4**
Orlando	MW - 2	12/28/12	5.94	15.0	65	34	14	322	370	8	53	61	88	25	25	<2	5	12.0
Orlando	MW - 2	1/31/13	6.62	31.2	10	153	122	157	432	8	12	20	84	13	4	6	13	22.0
Orlando	MW - 2	2/28/13	6.61	50.0	133	63	150	241	454	3	27	30	65	18	<2	<2	2	36.0
Orlando	MW - 2	3/21/13	6.70	38.2	187	77	263	357	697	11	25	36	84	<5	6	<2	<2	27.0
Orlando	MW - 2	4/30/13	7.27	53.8	155	287	756	656	1,699	44	14	58	107	6	3	<2	<2	25.0
Orlando	MW - 2	5/24/13	7.07	66.9	213	100	591	209	900	22	19	41	135	8	3	<2	<2	48.0
Orlando	MW - 2	6/27/13	6.68	70.2	167	184	202	415	801	25	9	34	107	10	3	<2	<2	37.0
Orlando	MW - 2	7/16/13	6.36	55.4	138	151	9	298	458	23	15	38	80	<5	<2	<2	<2	61.0
Orlando	MW - 2	8/20/13	6.68	64.2	139	169	17	250	436	20	24	44	103	6	3	<2	<2	47.0
Orlando	MW - 2	9/16/13	6.37	54.0	124	1,225	4	297	1,526	111	86	197	141	10	<2	<2	<2	29.0
Orlando	MW - 2	10/30/13	6.47	50.0	205	899	3	308	1,210	116	15	131	87	5	<2	<2	<2	29.0
Orlando	MW - 2	11/21/13	6.45	30.2	97	3	161	210	374	20	18	38	88	8	<2	<2	<2	32.0
	Minimum Value:		**5.94**	**15.0**	**10**	**3**	**3**	**157**	**370**	**3**	**9**	**20**	**65**	**<5**	**3**	**<2**	**<2**	**12.0**
	Maximum Value:		**7.27**	**70.2**	**213**	**1,225**	**756**	**656**	**1,699**	**116**	**86**	**197**	**141**	**25**	**25**	**6**	**13**	**61.0**
	Geometric Mean:		**6.59**	**44.8**	**112**	**122**	**59**	**290**	**672**	**21**	**21**	**49**	**95**	**7.7**	**2.5**	**<2**	**<2**	**31.3**

Chemical Characteristics of Groundwater Monitoring Well Samples Collected at the Dry Detention Monitoring Sites

Project Location	Site	Collection Date	pH (s.u.)	Alkalinity (mg/L)	Cond. (µmho/cm)	Ammonia (µg/L)	NOx (µg/L)	Organic N (µg/L)	Total N (µg/L)	SRP (µg/L)	Organic P (µg/L)	Total P (µg/L)	Color (Pt-Co)	Chromium (µg/L)	Copper (µg/L)	Lead (µg/L)	Zinc (µg/L)	Hardness (mg/L)
Naples	MW - 1	12/31/12	7.65	276	471	33	71	765	869	22	2	24	85	23	12	<2	<2	262
Naples	MW - 1	1/30/13	7.76	295	1,145	391	5	421	817	29	5	34	65	<5	3	<2	6	279
Naples	MW - 1	2/27/13	7.03	238	473	243	3	505	751	23	8	31	107	20	2	<2	6	226
Naples	MW - 1	3/28/13	7.09	263	665	429	3	1,044	1,476	17	8	25	84	7	3	<2	<2	249
Naples	MW - 1	4/22/13	7.09	244	494	301	50	1,362	1,713	35	5	40	81	12	2	<2	<2	230
Naples	MW - 1	5/21/13	6.96	312	569	420	8	831	1,259	41	16	57	87	6	<2	<2	<2	296
Naples	MW - 1	6/24/13	7.70	277	499	303	3	2,353	2,659	21	27	48	154	<5	<2	<2	<2	251
Naples	MW - 1	7/31/13	7.09	305	556	114	3	951	1,068	8	10	18	166	11	<2	<2	<2	318
Naples	MW - 1	8/28/13	7.13	365	611	231	3	1,157	1,391	22	25	22	242	4	<2	<2	2	324
Naples	MW - 1	9/23/13	7.03	300	623	325	3	1,235	1,563	19	26	45	210	4	<2	<2	<2	271
Naples	MW - 1	10/28/13	7.23	297	574	693	4	778	1,475	23	16	39	72	4	<2	<2	<2	289
Naples	MW - 1	11/20/13	7.21	323	548	326	5	1,105	1,436	10	2	12	82	<5	<2	<2	<2	317
	Minimum Value:		**6.96**	**238**	**471**	**33**	**3**	**421**	**751**	**8**	**2**	**12**	**65**	**<5**	**<2**	**<2**	**<2**	**226**
	Maximum Value:		**7.76**	**365**	**1,145**	**693**	**71**	**2,353**	**2,659**	**41**	**27**	**57**	**242**	**23**	**12**	**<2**	**6**	**324**
	Geometric Mean:		**7.24**	**289**	**584**	**261**	**6**	**948**	**1,295**	**21**	**9**	**30**	**109**	**6.1**	**<2**	**<2**	**<2**	**274**
Naples	MW - 2	12/31/12	7.81	204	396	22	18	590	630	31	4	35	85	22	5	<2	9	206
Naples	MW - 2	1/30/13	7.90	314	724	192	118	310	620	17	2	19	68	7	5	<2	3	316
Naples	MW - 2	2/27/13	7.29	120	272	285	1	253	539	26	20	46	84	20	<2	<2	<2	121
Naples	MW - 2	3/28/13	7.34	116	246	284	3	302	589	32	7	39	43	7	4	<2	<2	100
Naples	MW - 2	4/22/13	7.48	166	407	293	39	827	1,159	27	15	42	126	18	2	<2	5	168
Naples	MW - 2	5/21/13	7.04	177	340	235	6	727	968	36	14	50	81	<5	<2	<2	<2	178
Naples	MW - 2	6/24/13	7.66	353	672	209	3	1,304	1,516	26	15	41	166	<5	<2	<2	<2	361
Naples	MW - 2	7/31/13	7.24	336	658	388	7	553	948	9	6	15	166	12	3	<2	<2	368
Naples	MW - 2	8/28/13	7.25	413	721	457	3	921	1,381	23	8	31	348	7	<2	<2	<2	403
Naples	MW - 2	9/23/13	6.97	492	689	517	1	1,073	1,591	18	22	40	430	5	<2	<2	<2	470
Naples	MW - 2	10/28/13	7.17	276	660	1,047	1	1,287	2,335	19	13	32	135	4	<2	<2	<2	332
Naples	MW - 2	11/20/13	7.39	320	601	280	5	928	1,213	21	7	28	277	<5	<2	<2	<2	300
	Minimum Value:		**6.97**	**116**	**246**	**22**	**1**	**253**	**539**	**9**	**2**	**15**	**43**	**<5**	**<2**	**<2**	**<2**	**100**
	Maximum Value:		**7.90**	**492**	**724**	**1,047**	**118**	**1,304**	**2,335**	**36**	**22**	**50**	**430**	**22**	**5**	**<2**	**9**	**470**
	Geometric Mean:		**7.37**	**249**	**498**	**267**	**5**	**663**	**1,018**	**22**	**9**	**33**	**134**	**6.8**	**<2**	**<2**	**<2**	**250**

Chemical Characteristics of Groundwater Monitoring Well Samples Collected at the Dry Detention Monitoring Sites

Project Location	Site	Collection Date	pH (s.u.)	Alkalinity (mg/L)	Cond. (µmho/cm)	Ammonia (µg/L)	NOx (µg/L)	Organic N (µg/L)	Total N (µg/L)	SRP (µg/L)	Organic P (µg/L)	Total P (µg/L)	Color (Pt-Co)	Chromium (µg/L)	Copper (µg/L)	Lead (µg/L)	Zinc (µg/L)	Hardness (mg/L)
Pembrooke Pines	MW - 1	3/11/13	11.45	474	1,212	123	26	1,583	1,732	9	19	28	113	6	11	<2	8	503
Pembrooke Pines	MW - 1	3/28/13	11.39	509	1,337	115	3	1,700	1,818	11	3	14	135	6	<2	<2	<2	309
Pembrooke Pines	MW - 1	4/16/13	7.65	259	718	3	60	1,853	1,916	24	9	33	183	6	5	<2	8	319
Pembrooke Pines	MW - 1	4/22/13	7.96	323	770	3	57	1,761	1,821	20	8	28	159	12	7	<2	3	328
Pembrooke Pines	MW - 1	5/13/13	7.65	248	537	3	318	1,708	2,029	21	5	26	145	<5	9	2	12	263
Pembrooke Pines	MW - 1	5/28/13	7.57	223	783	3	667	1,608	2,278	22	11	33	160	4	5	<2	8	236
Pembrooke Pines	MW - 1	6/24/13	7.85	260	543	3	104	1,622	1,729	26	18	44	173	<5	6	<2	3	269
Pembrooke Pines	MW - 1	7/8/13	7.66	335	654	3	242	1,214	1,459	10	16	26	125	<5	<2	<2	4	353
Pembrooke Pines	MW - 1	7/31/13	7.62	335	601	3	12	1,363	1,378	32	12	44	155	10	2	<2	2	343
Pembrooke Pines	MW - 1	8/14/13	7.29	324	672	3	70	1,436	1,509	25	19	44	128	12	<2	<2	3	380
Pembrooke Pines	MW - 1	8/28/13	7.51	223	413	3	5	699	707	17	8	25	120	7	<2	<2	2	228
Pembrooke Pines	MW - 1	9/23/13	7.35	238	429	3	86	784	873	4	9	13	90	3	<2	<2	4	252
Pembrooke Pines	MW - 1	10/28/13	7.32	261	398	29	137	1,068	1,234	6	12	18	94	3	<2	<2	3	355
Pembrooke Pines	MW - 1	11/20/13	7.59	297	668	3	44	942	989	13	6	19	91	<5	<2	<2	3	321
	Minimum Value:		**7.29**	**223**	**398**	**3**	**3**	**699**	**707**	**4**	**3**	**13**	**90**	**3**	**<2**	**<2**	**<2**	**228**
	Maximum Value:		**11.45**	**509**	**1,337**	**123**	**667**	**1,853**	**2,278**	**32**	**19**	**44**	**183**	**12**	**11**	**<2**	**12**	**503**
	Geometric Mean:		**8.04**	**298**	**653**	**6**	**56**	**1,325**	**1,460**	**15**	**10**	**26**	**130**	**4.8**	**2.4**	**<2**	**3.7**	**312**
Pembrooke Pines	MW - 2	3/11/13	7.91	402	568	478	14	1,130	1,622	4	16	20	73	7	6	<2	206	375
Pembrooke Pines	MW - 2	3/28/13	7.59	416	634	28	3	1,221	1,252	21	37	58	92	8	3	<2	3	249
Pembrooke Pines	MW - 2	5/13/13	7.35	266	533	1,292	6	1,575	2,873	79	114	193	93	<5	<2	<2	<2	388
Pembrooke Pines	MW - 2	6/24/13	7.86	222	432	635	3	1,305	1,943	43	49	92	71	<5	<2	<2	<2	192
Pembrooke Pines	MW - 2	7/8/13	7.45	310	639	134	4	806	944	53	3	56	162	<5	<2	<2	<2	312
Pembrooke Pines	MW - 2	7/31/13	7.27	294	524	138	3	851	992	50	3	53	96	12	<2	<2	<2	288
Pembrooke Pines	MW - 2	8/14/13	7.32	318	619	5,354	9	2,868	8,231	609	163	772	128	12	<2	<2	<2	307
Pembrooke Pines	MW - 2	8/21/13	7.68	173	610	16	66	1,615	1,697	26	9	35	88	8	4	<2	7	201
Pembrooke Pines	MW - 2	8/28/13	7.50	187	370	46	3	641	690	23	2	25	68	7	<2	<2	2	192
Pembrooke Pines	MW - 2	9/23/13	7.48	252	389	417	61	414	892	8	14	22	82	4	<2	<2	<2	207
Pembrooke Pines	MW - 2	10/28/13	7.23	251	688	236	196	533	965	18	5	23	38	3	<2	<2	<2	217
Pembrooke Pines	MW - 2	11/20/13	7.49	275	606	3	174	580	757	14	6	20	51	3	<2	<2	3	285
	Minimum Value:		**7.23**	**173**	**370**	**3**	**3**	**414**	**690**	**4**	**2**	**20**	**38**	**3**	**<2**	**<2**	**<2**	**192**
	Maximum Value:		**7.91**	**416**	**688**	**5,354**	**196**	**2,868**	**8,231**	**609**	**163**	**772**	**162**	**12**	**6**	**<2**	**206**	**388**
	Geometric Mean:		**7.51**	**272**	**541**	**158**	**13**	**975**	**1,419**	**30**	**14**	**52**	**81**	**5.00**	**<2**	**<2**	**2.3**	**260**

Chemical Characteristics of Groundwater Monitoring Well Samples Collected at the Dry Detention Monitoring Sites

Project Location	Site	Collection Date	pH (s.u.)	Alkalinity (mg/L)	Cond. (µmho/cm)	Ammonia (µg/L)	NOx (µg/L)	Organic N (µg/L)	Total N (µg/L)	SRP (µg/L)	Organic P (µg/L)	Total P (µg/L)	Color (Pt-Co)	Chromium (µg/L)	Copper (µg/L)	Lead (µg/L)	Zinc (µg/L)	Hardness (mg/L)
Pembrooke Pines	MW - 3	3/11/13	7.92	230	688	41	284	963	1,288	14	7	21	69	6	8	<2	9	242
Pembrooke Pines	MW - 3	4/16/13	7.83	266	634	3	397	1,132	1,532	34	19	53	94	<5	7	<2	5	210
Pembrooke Pines	MW - 3	4/22/13	8.07	262	614	3	280	659	942	6	13	19	46	13	2	<2	3	202
Pembrooke Pines	MW - 3	5/13/13	7.45	237	548	3	207	1,032	1,242	8	6	14	55	<5	5	<2	10	249
Pembrooke Pines	MW - 3	6/24/13	7.91	189	553	3	245	563	811	16	4	20	74	<5	2	<2	5	188
Pembrooke Pines	MW - 3	7/8/13	7.87	186	557	3	140	761	904	5	3	8	56	<5	<2	<2	3	206
Pembrooke Pines	MW - 3	7/31/13	7.68	236	615	3	324	798	1,125	5	12	17	64	12	3	<2	<2	240
Pembrooke Pines	MW - 3	8/28/13	7.68	256	749	3	838	1,150	1,991	4	12	16	104	5	2	<2	6	263
Pembrooke Pines	MW - 3	9/16/13	7.32	226	658	3	780	1,075	1,858	19	9	28	118	9	3	<2	2	214
Pembrooke Pines	MW - 3	9/23/13	7.26	243	705	3	542	902	1,447	1	8	9	94	3	3	<2	3	219
Pembrooke Pines	MW - 3	10/28/13	7.49	209	701	48	758	873	1,679	2	8	10	53	3	<2	<2	<2	219
Pembrooke Pines	MW - 3	11/20/13	7.65	278	908	3	1,151	1,257	2,411	7	6	13	93	4	<2	<2	3	285
	Minimum Value:		**7.26**	**186**	**548**	**3**	**140**	**563**	**811**	**1**	**3**	**8**	**46**	**3**	**<2**	**<2**	**<2**	**188**
	Maximum Value:		**8.07**	**278**	**908**	**48**	**1,151**	**1,257**	**2,411**	**34**	**19**	**53**	**118**	**13**	**8**	**<2**	**10**	**285**
	Geometric Mean:		**7.67**	**233**	**654**	**5**	**410**	**907**	**1,363**	**7**	**8**	**17**	**73**	**4.4**	**2.5**	**<2**	**3.4**	**227**

APPENDIX E

MONTHLY CALCULATIONS OF MASS INPUTS AND LOSSES

E.1 Monthly Mean Concentrations for Inflows and Outflows at the Dry Detention and Underdrain Monitoring Sites

E.2 Monthly Mass Loadings for Inflows and Outflows at the Dry Detention and Underdrain Monitoring Sites

E.1 Monthly Mean Concentrations for Inflows and Outflows at the Dry Detention and Underdrain Monitoring Sites

Monthly Geometric Mean Values for Stormwater Inflow and Outflow Samples Collected at the Dry Detention and Underdrain Monitoring Sites

Project Location	Site	Month	pH (s.u.)	Alkalinity (mg/L)	Conductivity (µmho/cm)	Ammonia (µg/L)	NOx (µg/L)	Diss.Org. N (µg/L)	Part. N (µg/L)	Total N (µg/L)	SRP (µg/L)	Diss.Org. P (µg/L)	Part. P (µg/L)	Total P (µg/L)	Turbidity (NTU)	Color (Pt-Co)	TSS (mg/L)	Chromium (µg/L)	Copper (µg/L)	Lead (µg/L)	Zinc (µg/L)	Hardness (mg/L)
Bonita Springs	SW - 1	December	6.81	43.0	531	7	96	203	84	390	19	2	10	31	1.0	23	3.0	6.0	1.0	1.0	2.0	98.8
Bonita Springs	SW - 1	January	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bonita Springs	SW - 1	February	7.58	106	2267	195	34	515	775	1519	9	4	100	113	14.1	29	115	26.0	8.0	1.0	11.0	250
Bonita Springs	SW - 1	March	7.21	74.1	1674	23	10	300	487	999	8	4	78	93	2.2	35	5.6	4.2	8.4	1.0	27.8	175
Bonita Springs	SW - 1	April	7.00	86.1	1229	24	4	640	303	1044	34	48	67	150	3.7	45	7.1	4.5	3.1	1.0	6.5	204
Bonita Springs	SW - 1	May	7.16	79.2	1427	6	36	344	229	1011	19	3	29	101	3.1	43	9.2	2.5	4.3	1.0	4.6	220
Bonita Springs	SW - 1	June	7.17	58.9	1028	16	81	381	199	844	32	7	20	67	1.4	26	4.8	3.5	3.2	1.0	5.5	141
Bonita Springs	SW - 1	July	7.01	46.2	571	11	18	169	77	336	4	11	13	37	1.7	30	4.2	8.3	3.2	1.0	4.2	101
Bonita Springs	SW - 1	August	6.79	44.6	444	5	10	260	49	356	3	9	29	56	1.7	41	7.3	7.6	1.3	1.0	4.8	95.2
Bonita Springs	SW - 1	September	7.09	49.8	586	9	71	163	53	373	20	10	8	42	1.6	25	2.1	4.2	1.3	1.0	2.9	112
Bonita Springs	SW - 1	October	6.69	65.6	557	7	3	419	132	573	11	12	41	81	1.6	59	6.1	5.9	1.0	1.0	2.0	110
Bonita Springs	SW - 1	November	7.48	115	2795	358	1507	551	195	2611	312	24	42	378	1.7	58	3.4	5.0	1.0	1.0	3.0	443
Bonita Springs	SW - 2	December	7.24	39.4	111	52	68	245	19	384	53	4	15	72	1.1	31	1.4	8	1	1	1	46
Bonita Springs	SW - 2	January	7.17	50.2	249	71	28	319	28	461	64	5	15	84	1.2	37	2.0	8	2	1	2	58.9
Bonita Springs	SW - 2	February	7.09	64.0	558	96	12	416	42	555	77	6	14	99	1.3	44	2.7	9	3	1	3	75.5
Bonita Springs	SW - 2	March	6.95	104	2801	178	2	705	94	801	112	9	14	135	1.5	62	5.3	10	8	1	7	124
Bonita Springs	SW - 2	April	6.74	72.5	1057	211	22	462	233	1051	83	9	37	151	2.8	66	11.9	9	6	1	3	86.3
Bonita Springs	SW - 2	May	6.54	50.6	399	249	252	303	576	1380	62	10	98	170	5.4	70	26.8	8	5	1	1	60.0
Bonita Springs	SW - 2	June	7.05	56.4	366	6	78	295	148	671	114	11	23	151	2.3	63	5.0	4	2	1	3	63.9
Bonita Springs	SW - 2	July	7.20	58.9	281	9	108	141	171	509	63	3	16	87	1.7	42	4.0	7	3	1	2	75.1
Bonita Springs	SW - 2	August	7.20	55.6	327	63	16	270	46	408	64	4	11	85	1.2	61	2.7	4	2	1	4	62.8
Bonita Springs	SW - 2	September	7.25	58.9	233	91	24	245	52	423	55	12	16	88	1.1	43	1.8	9	6	1	4	70.1
Bonita Springs	SW - 2	October	7.22	57.8	278	38	35	210	74	445	61	6	14	87	1.3	48	2.7	6	3	1	3	69.1
Bonita Springs	SW - 2	November	7.23	58.3	255	58	29	227	62	434	58	8	15	88	1.2	46	2.2	7	4	1	3	69.6
Bonita Springs	SW - 3	December	6.93	38.0	206	3	22	273	56	354	6	89	4	99	0.9	32	2.6	8	1	1	4	56.0
Bonita Springs	SW - 3	January	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bonita Springs	SW - 3	February	7.38	52.4	776	3	36	338	285	662	22	17	52	91	3.9	27	31.4	25	18	1	4	77.0
Bonita Springs	SW - 3	March	7.53	98.2	280	229	52	342	175	930	32	6	28	67	4.0	33	12.1	5	9	1	3	144
Bonita Springs	SW - 3	April	6.70	32.6	491	110	59	639	116	1186	18	29	57	152	2.9	25	6.0	3	8	1	3	64.9
Bonita Springs	SW - 3	May	6.81	57.3	430	90	30	252	282	986	12	8	48	83	5.9	32	13.8	3	3	1	6	84.3
Bonita Springs	SW - 3	June	7.13	41.8	365	3	140	146	169	529	43	3	9	58	1.6	27	4.0	6	1	1	10	64.9
Bonita Springs	SW - 3	July	6.91	37.4	147	7	40	161	157	524	27	12	15	59	3.1	29	10.2	5	2	1	20	46.1
Bonita Springs	SW - 3	August	6.74	60.7	365	3	3	408	134	571	35	62	35	147	2.9	53	6.5	5	1	1	5	93.0
Bonita Springs	SW - 3	September	6.70	57.6	296	6	17	126	182	404	50	29	22	104	2.5	28	4.5	7	1	1	2	91.4
Bonita Springs	SW - 3	October	6.73	70.9	414	3	3	448	60	530	4	28	27	76	2.6	34	7.9	7	1	1	3	96.2
Bonita Springs	SW - 3	November	6.72	63.9	351	4	7	237	104	463	15	28	24	89	2.5	31	6.0	7	1	1	2	93.8
Bonita Springs	SW - 4	December	6.57	38.4	218	3	19	323	32	377	8	52	3	63	2.2	48	4.4	8	1	1	6	55.6
Bonita Springs	SW - 4	January	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bonita Springs	SW - 4	February	7.06	50.0	820	12	666	231	189	1098	90	39	47	176	12.0	17	138.0	23	4	1	17	136
Bonita Springs	SW - 4	March	7.14	72.8	1602	222	117	332	215	886	23	13	14	50	11.3	35	27.2	10	25	1	80	197
Bonita Springs	SW - 4	April	7.12	52.4	786	171	72	273	125	748	22	5	30	62	3.0	26	7.2	3	10	1	35	130
Bonita Springs	SW - 4	May	6.86	56.5	483	204	40	343	352	1230	7	7	49	70	6.1	44	15.0	5	6	1	43	85.2
Bonita Springs	SW - 4	June	7.02	52.5	401	4	124	200	68	445	32	6	18	63	3.1	28	7.2	7	2	1	29	71.4
Bonita Springs	SW - 4	July	6.92	54.0	362	8	67	146	84	370	10	8	10	50	3.2	28	13.1	7	15	1	19	82.4
Bonita Springs	SW - 4	August	6.75	54.0	296	3	24	227	30	291	10	44	20	76	1.7	39	4.2	19	1	1	5	91.3
Bonita Springs	SW - 4	September	6.68	49.5	268	5	19	210	69	319	3	24	21	57	1.8	27	7.0	6	1	1	8	73.5
Bonita Springs	SW - 4	October	6.68	62.7	376	6	9	303	221	580	3	20	38	69	2.5	31	6.8	4	1	1	3	91.2
Bonita Springs	SW - 4	November	6.68	55.7	318	6	13	252	124	430	3	22	28	62	2.1	29	6.9	5	1	1	4	81.9

Monthly Geometric Mean Values for Stormwater Inflow and Outflow Samples Collected at the Dry Detention and Underdrain Monitoring Sites

Project Location	Site	Month	pH (s.u.)	Alkalinity (mg/L)	Conductivity (µmho/cm)	Ammonia (µg/L)	NOx (µg/L)	Diss.Org. N (µg/L)	Part. N (µg/L)	Total N (µg/L)	SRP (µg/L)	Diss.Org. P (µg/L)	Part. P (µg/L)	Total P (µg/L)	Turbidity (NTU)	Color (Pt-Co)	TSS (mg/L)	Chromium (µg/L)	Copper (µg/L)	Lead (µg/L)	Zinc (µg/L)	Hardness (mg/L)
Bonita Springs	SW - 5	December	6.84	50.4	243	3	9	143	96	251	4	14	10	28	0.7	24	1.0	8	1	1	4	68.8
Bonita Springs	SW - 5	January	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bonita Springs	SW - 5	February	7.27	79.2	3151	422	44	595	89	1150	126	3	21	150	2.5	40	8.3	7	6	1	15	138
Bonita Springs	SW - 5	March	7.07	72.6	1711	225	70	320	122	737	64	14	13	91	1.9	29	8.5	12	9	1	21	159
Bonita Springs	SW - 5	April	6.90	65.3	777	76	40	441	118	856	13	11	29	73	2.3	37	5.5	3	8	1	13	134
Bonita Springs	SW - 5	May	6.98	60.7	570	37	43	327	163	742	12	11	12	46	2.8	36	4.9	7	3	1	9	92.5
Bonita Springs	SW - 5	June	6.84	45.5	353	6	124	116	122	378	40	3	11	57	1.4	34	2.4	4	1	1	6	63.9
Bonita Springs	SW - 5	July	6.96	55.8	329	8	9	119	144	319	2	12	19	40	1.3	34	2.0	5	3	1	2	108
Bonita Springs	SW - 5	August	7.00	53.4	222	3	3	181	51	242	3	3	3	13	1.5	29	2.4	9	1	1	6	67.5
Bonita Springs	SW - 5	September	7.01	72.8	335	5	5	195	81	294	3	26	14	44	1.3	35	1.6	6	2	1	3	96.5
Bonita Springs	SW - 5	October	7.58	80.1	416	32	10	285	50	462	1	25	23	59	1.4	36	2.2	4	1	1	5	101
Bonita Springs	SW - 5	November	7.29	76.3	373	13	7	236	64	369	2	26	18	51	1.4	35	1.8	5	1	1	4	98.8
Orlando	SW - 1	December	6.92	44.6	100	23	259	227	112	621	11	9	41	61	13.9	33	26.1	14	14	1	199	58.7
Orlando	SW - 1	January	6.86	41.7	97	15	270	130	103	572	15	7	35	61	10.0	32	18.8	9	11	1	119	52.0
Orlando	SW - 1	February	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Orlando	SW - 1	March	6.67	34.2	90	5	308	24	79	446	33	4	23	60	3.7	29	7.0	3	5	1	26	36.0
Orlando	SW - 1	April	6.69	30.8	65	11	155	54	80	347	9	37	22	71	2.7	12	14.8	4	7	1	37	45.1
Orlando	SW - 1	May	6.67	14.5	32	17	149	37	104	342	18	19	3	60	2.4	7	5.3	6	3	1	20	12.2
Orlando	SW - 1	June	6.52	16.2	97	15	309	110	79	553	8	12	32	74	4.5	13	5.4	8	5	1	29	31.6
Orlando	SW - 1	July	6.63	27.0	98	52	321	181	64	730	29	33	19	96	5.0	28	11.3	4	7	4	38	44.5
Orlando	SW - 1	August	6.36	20.2	43	16	215	103	79	463	6	25	20	78	3.8	8	10.0	11	2	1	24	20.6
Orlando	SW - 1	September	6.38	17.2	46	11	245	118	101	498	13	56	8	88	2.1	10	9.7	5	1	1	7	16.8
Orlando	SW - 1	October	6.59	19.6	53	27	228	145	127	527	28	24	21	73	3.5	12	15.0	3	1	1	10	20.8
Orlando	SW - 1	November	6.59	19.6	53	27	228	145	127	527	28	24	21	73	3.5	12	15.0	3	1	1	10	20.8
Orlando	SW - 2	December	7.12	42.2	128	6	249	95	88	438	10	2	16	28	6.8	17	7.8	26	10	1	29	35.3
Orlando	SW - 2	January	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Orlando	SW - 2	February	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Orlando	SW - 2	March	7.06	29.2	72	25	687	66	51	829	10	48	57	115	3.2	21	2.6	3	1	1	17	28.4
Orlando	SW - 2	April	6.45	18.8	46	3	113	107	106	329	21	79	37	137	2.1	16	14.2	5	5	1	10	12.4
Orlando	SW - 2	May	6.92	30.7	66	6	83	239	58	419	31	93	19	144	4.2	13	29.5	6	3	1	26	29.6
Orlando	SW - 2	June	6.74	31.1	75	7	221	91	51	454	20	28	13	80	3.9	14	9.4	6	3	2	30	26.0
Orlando	SW - 2	July	6.91	39.2	98	12	136	305	55	534	13	40	10	91	3.5	27	5.4	3	2	2	29	39.5
Orlando	SW - 2	August	6.39	22.3	53	18	96	139	97	400	4	62	18	92	2.2	10	10.8	12	2	1	21	21.3
Orlando	SW - 2	September	6.90	43.6	67	25	83	83	204	400	6	64	15	87	3.0	26	15.0	6	2	1	12	47.7
Orlando	SW - 2	October	6.78	21.2	78	7	165	162	46	380	3	102	25	130	2.9	19	22.4	5	1	1	9	35.2
Orlando	SW - 2	November	6.84	30.4	72	13	117	116	97	390	4	81	19	107	3.0	22	18.3	5	1	1	10	41.0
Orlando	SW - 3	December	6.91	37.4	102	125	923	184	360	1592	130	3	70	203	6.0	36	32.9	13	5	3	33	25.0
Orlando	SW - 3	January	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Orlando	SW - 3	February	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Orlando	SW - 3	March	6.82	28.2	82	75	413	51	62	628	14	12	38	64	11.4	20	43.4	4	8	1	115	25.0
Orlando	SW - 3	April	6.77	21.1	77	79	165	64	48	395	6	28	27	63	5.0	13	23.5	4	5	1	54	18.8
Orlando	SW - 3	May	6.79	20.4	37	17	126	129	20	366	6	67	10	96	3.2	8	17.4	4	1	1	10	12.7
Orlando	SW - 3	June	6.31	17.3	74	12	283	92	54	530	5	85	10	108	2.9	9	11.7	4	3	1	23	19.4
Orlando	SW - 3	July	6.71	21.0	45	28	301	52	180	561	13	92	6	111	1.1	11	21.2	3	1	1	9	24.4
Orlando	SW - 3	August	6.54	21.1	37	52	200	114	46	515	5	122	20	155	1.3	10	10.6	6	1	1	12	20.9
Orlando	SW - 3	September	6.64	23.7	50	65	130	47	28	391	17	31	9	79	3.4	16	22.2	17	2	1	14	23.4
Orlando	SW - 3	October	6.90	38.4	100	29	48	48	131	256	134	12	195	341	6.2	42	19.4	10	3	1	24	40.4
Orlando	SW - 3	November	6.77	30.1	71	44	79	47	61	317	48	19	41	164	4.6	26	20.7	13	2	1	18	30.8

Monthly Geometric Mean Values for Stormwater Inflow and Outflow Samples Collected at the Dry Detention and Underdrain Monitoring Sites

Project Location	Site	Month	pH (s.u.)	Alkalinity (mg/L)	Conductivity (µmho/cm)	Ammonia (µg/L)	NOx (µg/L)	Diss.Org. N (µg/L)	Part. N (µg/L)	Total N (µg/L)	SRP (µg/L)	Diss.Org. P (µg/L)	Part. P (µg/L)	Total P (µg/L)	Turbidity (NTU)	Color (Pt-Co)	TSS (mg/L)	Chromium (µg/L)	Copper (µg/L)	Lead (µg/L)	Zinc (µg/L)	Hardness (mg/L)
Orlando	SW - 4	December	6.72	28.6	77	105	608	139	83	935	55	13	38	106	3.3	20	9.3	12	9	1	34	22.6
Orlando	SW - 4	January	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Orlando	SW - 4	February	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Orlando	SW - 4	March	6.81	39.6	98	47	409	94	38	649	27	5	31	67	7.2	27	20.7	5	4	1	68	33.4
Orlando	SW - 4	April	6.51	20.0	39	79	165	130	106	521	13	6	12	37	3.2	9	19.4	4	7	1	42	12.9
Orlando	SW - 4	May	6.60	22.9	43	5	160	100	67	365	8	12	22	44	1.6	5	9.2	4	3	1	39	14.1
Orlando	SW - 4	June	6.22	15.5	43	3	240	97	159	516	9	11	33	63	1.4	5	9.7	4	4	1	25	10.8
Orlando	SW - 4	July	6.54	21.1	42	8	303	40	159	522	9	19	37	72	2.3	6	15.7	3	2	1	23	16.6
Orlando	SW - 4	August	6.22	13.9	34	39	179	61	133	460	8	31	21	91	1.5	4	12.3	7	1	1	10	14.1
Orlando	SW - 4	September	6.64	21.8	57	43	130	103	31	309	12	101	20	143	1.1	10	9.3	5	2	1	5	22.2
Orlando	SW - 4	October	6.70	38.6	104	165	225	52	86	528	49	14	12	75	6.3	7	8.6	6	1	1	24	39.6
Orlando	SW - 4	November	6.67	29.0	77	84	171	73	52	404	24	38	15	104	2.6	8	9.0	6	1	1	11	29.6
Orlando	SW - 5	December	7.51	110	236	7	450	170	123	750	40	1	17	58	7.6	50	13.3	21	7	3	30	56.2
Orlando	SW - 5	January	7.37	91.4	202	9	454	109	125	726	52	1	17	71	6.2	50	9.0	12	5	2	21	54.7
Orlando	SW - 5	February	7.24	76.0	173	12	458	70	128	703	67	2	17	88	5.1	50	6.1	7	4	2	15	53.2
Orlando	SW - 5	March	6.97	52.5	127	22	466	29	133	659	113	4	17	133	3.4	49	2.8	3	2	1	8	50.3
Orlando	SW - 5	April	7.39	55.6	112	3	170	78	109	391	73	5	12	90	1.9	35	2.5	5	2	1	1	46.6
Orlando	SW - 5	May	7.36	52.5	105	3	84	84	147	328	64	11	6	81	1.7	28	4.0	6	1	1	2	49.4
Orlando	SW - 5	June	7.19	85.6	169	3	172	184	43	430	53	5	12	71	1.8	32	2.8	5	2	1	8	78.9
Orlando	SW - 5	July	7.35	82.5	176	3	128	151	47	394	67	11	9	89	2.0	36	3.9	5	1	1	14	75.5
Orlando	SW - 5	August	7.41	74.1	164	16	205	179	96	540	21	5	19	49	2.4	33	8.1	9	1	1	8	80.5
Orlando	SW - 5	September	6.84	32.3	97	25	223	49	70	385	76	5	6	89	1.0	26	1.4	5	1	1	1	34.8
Orlando	SW - 5	October	7.41	122	258	39	199	41	272	551	67	14	20	101	3.1	34	9.4	5	1	1	3	124
Orlando	SW - 5	November	7.12	62.8	158	31	211	45	138	460	71	9	11	95	1.8	30	3.6	5	1	1	2	65.7
Naples	SW - 1	December	6.96	58.4	156	3	156	211	191	561	8	3	39	50	2.5	22	3.0	3	1	1	5	62.8
Naples	SW - 1	January	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Naples	SW - 1	February	6.98	43.8	93	3	353	372	180	908	38	9	43	90	3.1	37	9.0	4	1	1	1	44.8
Naples	SW - 1	March	6.79	40.8	97	3	3	271	42	319	5	7	11	23	1.2	23	1.8	10	2	1	6	46.4
Naples	SW - 1	April	6.80	61.5	156	15	235	250	155	704	7	10	15	36	5.8	34	6.5	4	6	1	12	63.2
Naples	SW - 1	May	7.22	55.0	114	13	152	166	52	414	14	15	11	41	1.6	17	3.0	4	3	1	15	31.3
Naples	SW - 1	June	7.01	45.7	109	4	109	207	63	398	24	24	5	79	1.7	26	2.3	7	2	1	4	44.5
Naples	SW - 1	July	7.01	49.3	110	25	49	104	126	451	20	9	18	50	1.5	41	3.3	3	1	1	2	51.3
Naples	SW - 1	August	7.02	39.5	119	3	157	211	59	436	15	8	13	40	1.3	32	2.1	8	1	1	2	42.4
Naples	SW - 1	September	6.88	31.5	79	10	106	153	83	388	11	7	17	37	1.5	22	3.8	8	1	1	2	35.1
Naples	SW - 1	October	6.87	43.6	96	3	161	310	24	498	19	3	20	42	1.7	32	2.2	3	1	1	1	42.0
Naples	SW - 1	November	6.72	33.0	86	3	101	239	63	406	20	9	24	53	3.0	18	9.2	6	2	1	9	37.2
Naples	SW - 2	December	7.68	57.2	155	6	3	447	115	571	3	17	57	77	4.8	32	23.0	17	8	1	7	35.3
Naples	SW - 2	January	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Naples	SW - 2	February	7.17	72.2	218	130	166	691	163	1150	63	3	45	111	4.8	51	11.7	12	3	1	5	44.4
Naples	SW - 2	March	7.21	78.4	192	403	61	537	127	1128	102	15	45	162	2.8	52	4.4	7	8	1	11	72.0
Naples	SW - 2	April	6.88	34.5	86	11	125	165	161	496	12	5	44	72	5.0	16	10.2	7	12	1	4	31.0
Naples	SW - 2	May	6.96	61.6	166	5	91	337	170	659	5	9	46	75	3.9	28	6.4	4	5	2	4	30.9
Naples	SW - 2	June	6.88	39.4	101	3	146	110	67	351	12	31	45	104	2.3	25	3.4	5	2	1	6	32.3
Naples	SW - 2	July	6.91	44.6	126	21	36	136	110	382	12	8	14	44	1.9	23	3.7	3	1	1	8	57.2
Naples	SW - 2	August	6.92	35.5	89	3	153	181	54	413	24	6	22	55	1.6	25	8.6	6	1	1	8	55.6
Naples	SW - 2	September	6.76	35.2	100	6	75	150	81	417	12	12	26	54	1.6	24	3.1	6	1	1	4	43.1
Naples	SW - 2	October	6.81	36.0	77	3	122	201	42	368	10	71	40	121	1.3	11	3.4	3	1	1	6	38.0
Naples	SW - 2	November	7.10	38.6	87	3	204	136	26	369	23	68	39	130	1.5	15	1.6	4	1	1	4	40.0

Monthly Geometric Mean Values for Stormwater Inflow and Outflow Samples Collected at the Dry Detention and Underdrain Monitoring Sites

Project Location	Site	Month	pH (s.u.)	Alkalinity (mg/L)	Conductivity (µmho/cm)	Ammonia (µg/L)	NOx (µg/L)	Diss.Org. N (µg/L)	Part. N (µg/L)	Total N (µg/L)	SRP (µg/L)	Diss.Org. P (µg/L)	Part. P (µg/L)	Total P (µg/L)	Turbidity (NTU)	Color (Pt-Co)	TSS (mg/L)	Chromium (µg/L)	Copper (µg/L)	Lead (µg/L)	Zinc (µg/L)	Hardness (mg/L)
Naples	SW - 3	December	6.44	19.2	38	8	44	209	39	368	7	4	13	29	1.9	15	3.6	3	1	1	4	37.6
Naples	SW - 3	January	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Naples	SW - 3	February	6.63	26.9	61	9	30	216	67	367	5	5	14	28	1.8	22	3.5	4	2	1	5	38.6
Naples	SW - 3	March	6.90	46.9	105	8	37	200	93	379	8	5	12	29	1.7	33	3.4	4	2	1	5	37.7
Naples	SW - 3	April	6.95	51.4	115	10	61	224	92	415	13	4	14	34	2.2	29	4.7	3	4	2	5	35.3
Naples	SW - 3	May	7.00	56.4	127	12	100	251	92	455	20	3	16	39	2.9	25	6.5	3	6	3	5	33.0
Naples	SW - 3	June	6.93	48.3	105	3	14	183	94	329	7	8	8	26	1.4	45	2.0	4	2	1	6	44.7
Naples	SW - 3	July	6.77	37.9	85	14	36	173	92	363	4	4	14	25	1.2	31	3.1	4	1	1	5	36.3
Naples	SW - 3	August	6.74	22.1	47	7	21	279	55	429	4	6	28	39	2.9	26	6.7	7	1	1	7	34.0
Naples	SW - 3	September	5.78	6.2	15	20	23	210	32	285	2	4	11	17	1.5	6	2.0	3	1	1	2	47.0
Naples	SW - 3	October	5.91	7.5	13	8	69	199	15	340	7	3	10	26	2.0	6	3.0	3	1	1	2	38.8
Naples	SW - 3	November	6.05	9.0	11	3	208	188	7	406	27	2	10	39	2.6	6	4.6	3	1	1	2	32.0
Naples	SW - 4	December	7.00	39.3	90	6	25	217	123	419	7	6	11	30	1.3	43	2.4	5	1	1	2	41.9
Naples	SW - 4	January	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Naples	SW - 4	February	7.00	38.5	92	7	21	226	138	449	9	7	12	34	1.5	44	2.4	5	1	1	2	40.6
Naples	SW - 4	March	7.21	57.6	117	3	47	298	61	409	6	1	30	37	0.8	54	2.2	11	1	1	2	58.8
Naples	SW - 4	April	6.12	12.6	35	2	336	158	279	775	23	9	33	65	2.9	24	11.1	3	9	1	18	18.8
Naples	SW - 4	May	6.74	22.0	57	60	174	227	214	675	34	5	16	55	2.4	27	4.6	6	1	1	1	19.2
Naples	SW - 4	June	7.09	48.9	99	3	3	281	190	485	41	12	14	70	1.7	55	1.5	4	3	1	5	40.5
Naples	SW - 4	July	7.21	45.5	148	7	6	218	156	434	4	8	14	27	1.2	60	2.2	4	1	1	2	69.4
Naples	SW - 4	August	7.00	43.1	101	3	22	260	80	379	3	6	8	17	1.3	47	2.5	9	1	1	2	45.2
Naples	SW - 4	September	6.97	40.3	77	5	53	164	100	337	5	6	11	26	1.0	38	2.1	4	1	1	2	45.3
Naples	SW - 4	October	6.98	41.0	82	4	43	184	94	347	4	6	10	23	1.1	40	2.2	5	1	1	2	45.3
Naples	SW - 4	November	6.99	41.7	88	4	34	207	89	357	3	6	9	21	1.1	42	2.3	6	1	1	2	45.2
Pembrooke Pines	SW - 1	December	7.33	75.4	165	3	14	350	166	533	5	6	18	29	9.1	38	62.0	13	11	1	10	82.8
Pembrooke Pines	SW - 1	January	7.28	74.4	156	18	16	344	177	589	10	3	30	48	7.7	34	35.4	10	8	1	14	87.6
Pembrooke Pines	SW - 1	February	7.23	73.4	148	105	19	339	189	652	22	2	51	81	6.5	30	20.2	8	6	1	20	92.7
Pembrooke Pines	SW - 1	March	7.23	74.3	164	120	39	341	236	764	19	5	52	88	5.6	29	19.2	7	5	1	26	88.9
Pembrooke Pines	SW - 1	April	7.23	75.2	182	138	81	342	294	896	16	17	54	95	4.8	28	18.2	7	3	1	32	85.1
Pembrooke Pines	SW - 1	May	7.15	44.4	122	3	451	101	230	785	37	11	20	68	2.1	16	7.3	5	2	1	12	48.0
Pembrooke Pines	SW - 1	June	7.58	88.7	244	3	62	207	59	493	9	68	25	117	1.1	26	2.5	6	3	1	14	54.1
Pembrooke Pines	SW - 1	July	7.25	48.1	122	12	81	57	66	277	6	90	11	111	1.1	13	2.3	3	1	1	16	51.5
Pembrooke Pines	SW - 1	August	6.92	41.2	91	14	59	312	57	525	5	31	25	68	3.1	22	10.4	6	3	1	10	46.1
Pembrooke Pines	SW - 1	September	7.16	45.3	139	18	85	132	51	330	13	34	26	80	0.8	16	1.4	6	1	1	7	45.7
Pembrooke Pines	SW - 1	October	7.47	66.8	186	6	211	234	21	484	9	64	49	126	1.1	16	1.9	5	1	1	5	70.4
Pembrooke Pines	SW - 1	November	7.25	71.3	209	3	378	241	94	755	23	27	28	97	1.9	18	4.1	3	1	1	7	81.0
Pembrooke Pines	SW - 2	December	6.65	32.2	71	27	83	140	66	316	8	52	12	72	2.3	14	6.0	11	3	1	80	34.4
Pembrooke Pines	SW - 2	January	7.87	49.2	111	3	3	212	80	298	1	62	17	80	2.7	10	9.4	3	2	1	7	48.0
Pembrooke Pines	SW - 2	February	7.26	53.3	115	31	58	307	79	559	7	23	17	82	1.9	18	5.7	8	4	1	27	41.2
Pembrooke Pines	SW - 2	March	7.18	57.4	122	58	68	336	161	743	11	16	30	86	3.1	19	10.9	7	6	1	38	46.0
Pembrooke Pines	SW - 2	April	7.11	61.9	129	109	79	368	327	988	18	11	54	90	4.9	21	21.0	5	10	1	54	51.3
Pembrooke Pines	SW - 2	May	7.12	56.0	120	74	29	253	186	643	34	16	33	111	2.1	16	2.7	6	4	1	41	33.5
Pembrooke Pines	SW - 2	June	6.89	26.5	99	10	34	129	75	315	10	52	37	111	1.4	13	2.5	6	2	1	46	35.8
Pembrooke Pines	SW - 2	July	6.64	29.2	74	19	55	58	132	292	3	53	55	120	1.8	13	3.5	3	2	1	34	31.5
Pembrooke Pines	SW - 2	August	6.89	40.8	107	38	70	234	166	672	2	17	26	53	2.8	27	4.4	7	2	1	55	48.2
Pembrooke Pines	SW - 2	September	7.00	53.7	115	42	102	217	130	594	7	15	26	67	1.3	23	3.2	5	3	1	18	48.7
Pembrooke Pines	SW - 2	October	6.96	44.5	91	21	105	245	92	562	3	16	23	50	2.1	17	7.0	4	1	1	15	44.2
Pembrooke Pines	SW - 2	November	7.21	48.4	117	8	191	241	100	637	10	25	20	62	1.2	17	5.6	3	1	1	13	47.6

Monthly Geometric Mean Values for Stormwater Inflow and Outflow Samples Collected at the Dry Detention and Underdrain Monitoring Sites

Project Location	Site	Month	pH (s.u.)	Alkalinity (mg/L)	Conductivity (µmho/cm)	Ammonia (µg/L)	NOx (µg/L)	Diss.Org. N (µg/L)	Part. N (µg/L)	Total N (µg/L)	SRP (µg/L)	Diss.Org. P (µg/L)	Part. P (µg/L)	Total P (µg/L)	Turbidity (NTU)	Color (Pt-Co)	TSS (mg/L)	Chromium (µg/L)	Copper (µg/L)	Lead (µg/L)	Zinc (µg/L)	Hardness (mg/L)
Pembrooke Pines	SW - 3	December	7.43	46.2	105	3	19	129	175	326	6	47	8	61	1.5	34	1.6	10	2	1	7	47.6
Pembrooke Pines	SW - 3	January	8.93	69.8	150	3	3	198	177	381	2	94	4	100	1.8	34	3.0	4	1	1	2	62.8
Pembrooke Pines	SW - 3	February	7.40	84.9	215	195	64	425	263	968	24	8	43	83	4.2	61	7.4	9	6	1	31	59.0
Pembrooke Pines	SW - 3	March	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pembrooke Pines	SW - 3	April	7.16	87.1	201	33	111	501	171	873	25	15	22	63	1.5	61	3.9	3	6	1	36	70.6
Pembrooke Pines	SW - 3	May	7.87	120	184	3	30	296	131	517	7	42	19	82	1.5	40	2.4	3	3	1	23	57.1
Pembrooke Pines	SW - 3	June	7.35	65.2	177	3	24	241	95	412	8	37	15	91	2.0	32	3.3	4	2	1	17	51.1
Pembrooke Pines	SW - 3	July	7.42	75.1	202	5	21	241	85	376	9	25	20	64	1.5	34	2.4	3	1	1	10	80.1
Pembrooke Pines	SW - 3	August	7.34	56.4	125	3	15	320	167	536	4	42	8	58	1.6	43	3.2	5	2	1	9	59.0
Pembrooke Pines	SW - 3	September	7.98	67.7	154	3	3	308	177	492	11	33	6	58	1.4	45	1.7	9	1	1	4	102
Pembrooke Pines	SW - 3	October	7.71	76.8	62	3	7	215	131	365	2	48	13	65	1.2	40	1.1	5	1	1	2	76.4
Pembrooke Pines	SW - 3	November	7.87	62.1	193	5	26	443	412	947	4	24	17	82	2.7	41	6.2	3	1	1	4	77.5

E.2 Monthly Mass Loadings for Inflows and Outflows at the Dry Detention and Underdrain Monitoring Sites

Monthly Mass Stormwater Inflows and Measured at the Dry Detention and Underdrain Monitoring Sites

Site	Month	Volume (ac-ft)	Monthly Inflow / Outflow Loadings (g)													
			Ammonia	NOx	Diss.Org. N	Part. N	Total N	SRP	Diss.Org. P	Part. P	Total P	TSS	Chromium	Copper	Lead	Zinc
Bonita Springs Site SW-1	December	0.63	5.4	75	158	65	303	15	1.6	7.8	24	2,331	4.7	0.8	0.8	1.6
	January	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	February	0.37	89	16	235	354	693	4.1	1.8	46	52	52,475	11.9	3.7	0.5	5.0
	March	0.18	5.0	2.1	67	108	222	1.8	0.9	17	21	1,249	0.9	1.9	0.2	6.2
	April	0.38	11	1.8	300	142	489	16	23	31	70	3,331	2.1	1.5	0.5	3.1
	May	0.97	6.8	43	412	274	1,210	22	4.2	35	121	11,038	3.0	5.2	1.2	5.5
	June	2.57	50	255	1,209	632	2,674	102	22	63	212	15,169	11.0	10.3	3.2	17.4
	July	3.09	41	69	645	293	1,282	15	41	50	140	15,932	31.6	12.3	3.8	16.1
	August	1.44	8.6	18	461	87	633	5.1	17	52	100	12,900	13.5	2.3	1.8	8.6
	September	1.51	16	132	304	98	695	37	18	16	78	3,947	7.9	2.3	1.9	5.4
	October	0.43	3.9	1.8	222	70	304	5.9	6.2	22	43	3,210	3.1	0.5	0.5	1.1
	November	0.14	62	260	95	34	451	54	4.1	7.3	65	587	0.9	0.2	0.2	0.5
Totals:		**11.71**	**300**	**874**	**4,108**	**2,157**	**8,955**	**277**	**139**	**346**	**926**	**122,169**	**90.5**	**40.9**	**14.4**	**70.4**
Bonita Springs Site SW-2	December	1.14	73	96	344	27	540	75	5.6	21	101	1,968	11.2	1.4	1.4	1.4
	January	0.03	2.6	1.0	12	1.0	17	2.4	0.2	0.5	3.1	72	0.3	0.1	0.0	0.1
	February	0.57	68	8.2	292	30	390	54	4.2	10	69	1,915	6.3	2.0	0.7	1.9
	March	0.16	35	0	139	19	158	22	1.8	2.8	27	1,046	2.0	1.6	0.2	1.4
	April	0.24	62	6.6	137	69	311	25	2.8	11	45	3,528	2.6	1.9	0.3	0.8
	May	1.24	381	385	463	881	2,110	95	15	150	260	40,984	12.2	7.6	1.5	1.5
	June	4.43	33	428	1,612	807	3,668	625	59	125	823	27,561	22.2	10.2	5.5	13.7
	July	5.42	62	724	940	1,144	3,405	423	23	107	583	27,013	47.6	16.8	6.7	15.3
	August	1.66	129	33	553	94	836	131	8.7	23	173	5,599	7.9	3.5	2.0	8.2
	September	2.77	311	83	837	178	1,445	189	42	54	302	6,111	30.0	21.6	3.4	12.8
	October	0.72	33	31	187	66	395	54	5.0	13	77	2,401	5.5	2.7	0.9	2.9
	November	0.02	1.4	0.7	5.6	1.5	11	1.4	0.2	0.4	2.2	54	0.2	0.1	0.0	0.1
Totals:		**18.40**	**1,191**	**1,797**	**5,522**	**3,317**	**13,286**	**1,696**	**167**	**518**	**2,465**	**118,252**	**148**	**69.5**	**22.7**	**60.0**
Bonita Springs Site SW-3	December	2.43	9.0	66	818	168	1,061	18	267	12	297	7,792	24.0	3.0	3.0	12.0
	January	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	February	1.37	5.1	61	571	482	1,118	37	29	88	154	53,052	42.2	30.4	1.7	6.8
	March	0.66	186	43	279	143	757	26	5.3	23	55	9,813	4.3	7.5	0.8	2.8
	April	1.37	186	100	1,079	196	2,004	30	50	96	256	10,147	4.2	12.8	1.7	5.8
	May	3.68	410	135	1,145	1,281	4,473	57	35	218	375	62,704	11.3	13.8	4.5	29.1
	June	9.84	36	1,697	1,772	2,052	6,418	527	33	112	700	49,143	78.2	12.1	12.1	120
	July	12.00	106	589	2,385	2,326	7,762	396	184	222	878	150,932	75.0	25.3	14.8	292
	August	5.44	20	20	2,737	898	3,829	236	419	233	984	43,933	34.4	6.7	6.7	30.7
	September	5.90	40	125	914	1,326	2,941	365	214	158	756	33,093	50.8	7.3	7.3	16.7
	October	1.66	6.1	6.1	917	122	1,085	9.1	57	55	155	16,198	14.6	2.0	2.0	5.4
	November	0.55	2.8	4.9	161	71	314	10	19	16	60	4,069	4.8	0.7	0.7	1.7
Totals:		**44.90**	**1,009**	**2,846**	**12,777**	**9,064**	**31,763**	**1,712**	**1,311**	**1,233**	**4,670**	**440,877**	**344**	**122**	**55.4**	**523**

Monthly Mass Stormwater Inflows and Measured at the Dry Detention and Underdrain Monitoring Sites

Site	Month	Volume (ac-ft)	Monthly Inflow / Outflow Loadings (g)													
			Ammonia	**NOx**	**Diss.Org. N**	**Part. N**	**Total N**	**SRP**	**Diss.Org. P**	**Part. P**	**Total P**	**TSS**	**Chromium**	**Copper**	**Lead**	**Zinc**
Bonita Springs Site SW-4	December	0.07	0.3	1.6	28	2.8	33	0.7	4.5	0.3	5.4	380	0.7	0.1	0.1	0.5
	January	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	February	0.04	0.6	33	11	9.3	54	4.4	1.9	2.3	8.7	6,808	1.1	0.2	0.0	0.8
	March	0.01	2.7	1.4	4.1	2.7	11	0.3	0.2	0.2	0.6	335	0.1	0.3	0.0	1.0
	April	0.03	6.3	2.7	10	4.6	28	0.8	0.2	1.1	2.3	266	0.1	0.4	0.0	1.3
	May	0.11	28	5.5	47	48	167	1.0	1.0	6.7	9.5	2,039	0.6	0.7	0.1	5.9
	June	0.32	1.6	49	79	27	176	13	2.2	7.1	25	2,857	2.6	0.6	0.4	11
	July	0.54	5.1	45	97	56	246	6.7	5.6	6.9	33	8,722	4.8	9.7	0.7	13
	August	0.11	0.4	3.2	31	4.1	39	1.3	6.0	2.7	10	572	2.6	0.1	0.1	0.6
	September	0.16	1.0	3.7	41	14	63	0.7	4.8	4.2	11	1,383	1.1	0.2	0.2	1.5
	October	0.04	0.3	0.4	15	11	29	0.1	1.0	1.9	3.4	335	0.2	0.1	0.0	0.1
	November	0.01	0.1	0.2	3.1	1.5	5.3	0.0	0.3	0.4	0.8	85	0.1	0.0	0.0	0.1
Totals:		**1.44**	**46**	**145**	**366**	**180**	**850**	**29**	**28**	**34**	**110**	**23,782**	**14**	**12**	**1.8**	**36**
Bonita Springs Site SW-5	December	3.11	12	35	548	368	963	15	54	38	107	3,835	30.7	3.8	3.8	15.3
	January	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	February	1.55	807	84	1,137	170	2,198	241	5.7	40	287	15,866	13.4	11.5	1.9	28.7
	March	0.60	166	52	237	90	545	47	10	10	67	6,290	8.9	6.7	0.7	15.5
	April	1.20	113	60	653	175	1,266	19	17	43	108	8,137	4.7	11.4	1.5	18.7
	May	4.14	190	218	1,671	832	3,790	62	57	60	236	25,134	34.9	16.0	5.1	46.2
	June	11.32	81	1,727	1,616	1,708	5,271	558	41	147	796	34,043	57.2	18.4	14.0	77
	July	12.36	122	138	1,814	2,189	4,861	33	183	283	609	29,890	75.2	50.3	15.2	30
	August	5.03	19	19	1,122	315	1,504	19	19	21	79	15,092	56.5	6.2	6.2	35.6
	September	7.11	45	43	1,709	712	2,578	24	229	119	382	13,788	52.9	13.9	8.8	30.4
	October	1.91	74	24	671	118	1,089	3.4	59	55	139	5,072	9.0	3.0	2.4	11.8
	November	0.36	5.7	3.2	105	28	164	0.9	11	7.9	23	817	2.1	0.6	0.4	1.8
Totals:		**48.69**	**1,634**	**2,402**	**11,284**	**6,706**	**24,229**	**1,022**	**686**	**824**	**2,833**	**157,964**	**346**	**142**	**60.0**	**312**
Orlando Site SW-1	December	0.01	0.3	3.2	2.8	1.4	7.7	0.1	0.1	0.5	0.8	322	0.2	0.2	0.0	2.5
	January	0.01	0.2	3.3	1.6	1.3	7.1	0.2	0.1	0.4	0.8	231	0.1	0.1	0.0	1.5
	February	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	March	0.35	2.0	133	11	34	193	14	1.8	10	26	3,002	1.1	2.2	0.4	11.1
	April	1.87	26	356	124	185	801	21	86	50	165	34,119	8.9	16.0	2.3	84.5
	May	1.38	29	253	64	178	583	31	33	5	102	8,980	11.0	4.8	1.7	33.4
	June	2.35	44	896	319	230	1,602	22	36	91	213	15,743	23.1	14.4	2.9	84
	July	1.15	74	455	257	91	1,035	41	46	27	136	15,978	5.6	9.4	5.0	54
	August	1.04	20	276	132	102	594	7	33	25	100	12,881	14.7	2.5	1.3	31.2
	September	0.98	13	296	142	122	602	16	68	10	106	11,745	6.4	1.7	1.2	8.3
	October	0.15	5.0	42	27	23	97	5.2	4.4	3.9	14	2,775	0.5	0.2	0.2	1.8
	November	0.12	4.0	34	21	19	78	4.1	3.6	3.1	11	2,220	0.4	0.1	0.1	1.5
Totals:		**9.41**	**218**	**2,748**	**1,100**	**986**	**5,600**	**162**	**311**	**226**	**874**	**107,996**	**72**	**52**	**15.2**	**314**

Monthly Mass Stormwater Inflows and Measured at the Dry Detention and Underdrain Monitoring Sites

Site	Month	Volume (ac-ft)	Monthly Inflow / Outflow Loadings (g)													
			Ammonia	NOx	Diss.Org. N	Part. N	Total N	SRP	Diss.Org. P	Part. P	Total P	TSS	Chromium	Copper	Lead	Zinc
Orlando Site SW-2	December	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	January	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	February	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	March	0.09	2.8	76	7.3	5.7	92	1.1	5.3	6.3	13	289	0.3	0.1	0.1	1.9
	April	0.46	1.7	64	61	60	187	12	45	21	78	8,056	2.8	2.8	0.6	5.7
	May	0.34	2.6	35	100	24	176	13	39	8.1	60	12,355	2.7	1.5	0.4	10.8
	June	0.60	4.9	164	67	38	336	15	20	9.3	59	6,979	4.3	2.2	1.3	22
	July	0.30	4.6	50	113	20	197	4.8	15	3.6	34	1,989	0.9	0.8	0.7	11
	August	0.27	5.9	32	46	32	133	1.3	21	6.0	31	3,591	4.1	0.6	0.3	6.9
	September	0.24	7.5	24	25	60	118	1.8	19	4.4	26	4,437	1.7	0.5	0.3	3.4
	October	0.04	0.3	8.1	8.0	2.3	19	0.1	5.0	1.2	6.4	1,105	0.2	0.0	0.0	0.4
	November	0.03	0.5	4.3	4.3	3.6	14	0.2	3.0	0.7	3.9	678	0.2	0.0	0.0	0.4
Totals:		**2.37**	**31**	**458**	**432**	**247**	**1,273**	**49**	**172**	**61**	**311**	**39,478**	**17**	**9**	**3.9**	**63**
Orlando Site SW-3	December	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	January	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	February	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	March	0.08	7.4	41	5.0	6.2	62	1.4	1.2	3.8	6.4	4,285	0.4	0.8	0.1	11.3
	April	0.38	37	78	30	23	185	3.0	13	13	30	11,001	1.8	2.3	0.5	25.2
	May	0.28	6.0	43	45	7.0	127	2.2	23	3.5	33	5,999	1.5	0.3	0.3	3.6
	June	0.50	7.2	174	57	33	327	2.8	53	5.9	67	7,240	2.7	1.8	0.6	14
	July	0.25	8.6	93	16	55	173	4.0	28	1.8	34	6,536	0.8	0.3	0.3	3
	August	0.23	15	57	32	13	146	1.6	35	5.6	44	2,993	1.7	0.4	0.3	3.5
	September	0.20	16	32	12	6.9	97	4.2	7.6	2.2	19	5,465	4.1	0.5	0.2	3.3
	October	0.04	1.4	2.4	2.4	6.5	13	6.6	0.6	10	17	957	0.5	0.1	0.0	1.2
	November	0.03	1.6	2.9	1.8	2.2	12	1.8	0.7	1.5	6.1	767	0.5	0.1	0.0	0.7
Totals:		**1.99**	**100**	**523**	**201**	**153**	**1,141**	**27**	**162**	**46.8**	**256**	**45,244**	**13.9**	**6.6**	**2.5**	**65.7**
Orlando Site SW-4	December	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	January	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	February	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	March	0.07	4.1	35	8.1	3.3	56	2.3	0.4	2.6	5.8	1,789	0.5	0.3	0.1	5.9
	April	0.37	36	75	59	48	238	5.8	2.9	5.6	17	8,868	1.6	3.0	0.5	19.0
	May	0.28	1.7	55	34	23	126	2.7	4.3	7.5	15	3,187	1.4	1.0	0.3	13.4
	June	0.48	1.8	142	58	94	305	5.3	6.6	20	37	5,715	2.6	2.2	0.6	15
	July	0.24	2.4	90	12	47	154	2.6	5.7	11	21	4,638	0.7	0.5	0.3	7
	August	0.22	11	49	16	36	125	2.1	8.4	5.7	25	3,328	2.0	0.3	0.3	2.7
	September	0.20	11	32	26	7.7	76	2.9	25	4.9	35	2,305	1.3	0.4	0.2	1.3
	October	0.03	6.1	8.3	1.9	3.2	20	1.8	0.5	0.4	2.8	318	0.2	0.0	0.0	0.9
	November	0.02	2.1	4.2	1.8	1.3	10	0.6	0.9	0.4	2.6	221	0.1	0.0	0.0	0.3
Totals:		**1.91**	**75**	**491**	**217**	**264**	**1,110**	**26**	**55**	**58**	**161**	**30,370**	**11**	**7.8**	**2.4**	**65.3**

Monthly Mass Stormwater Inflows and Measured at the Dry Detention and Underdrain Monitoring Sites

Site	Month	Volume (ac-ft)	Monthly Inflow / Outflow Loadings (g)													
			Ammonia	NOx	Diss.Org. N	Part. N	Total N	SRP	Diss.Org. P	Part. P	Total P	TSS	Chromium	Copper	Lead	Zinc
Orlando Site SW-5	December	0.02	0.2	11	4.2	3.0	18	1.0	0.0	0.4	1.4	328	0.5	0.2	0.1	0.7
	January	0.02	0.2	11	2.7	3.1	18	1.3	0.0	0.4	1.8	222	0.3	0.1	0.1	0.5
	February	0.01	0.2	5.6	0.9	1.6	8.7	0.8	0.0	0.2	1.1	75	0.1	0.0	0.0	0.2
	March	0.70	19	402	25	115	569	97	3.5	14	115	2,414	2.2	1.7	0.9	6.7
	April	3.83	14	803	369	516	1,846	344	22	56	424	11,723	22.4	9.4	4.7	4.7
	May	2.62	10	272	272	475	1,061	207	35	19	262	13,005	20.9	3.2	3.2	7.2
	June	4.85	18	1,027	1,099	256	2,573	314	29	69	426	16,735	29.6	13.2	6.0	47.4
	July	2.37	10	375	440	137	1,152	195	32	26	261	11,283	14.4	4.2	2.9	41.6
	August	2.11	43	533	466	249	1,405	53	14	49	127	21,024	22.1	3.4	2.6	21.0
	September	1.98	61	544	121	171	939	186	13	14	218	3,384	11.6	3.5	2.4	3.5
	October	0.31	15	76	16	104	211	26	5.4	7.6	39	3,594	1.9	0.4	0.4	1.1
	November	0.23	8.9	60	13	39	131	20	2.4	3.0	27	1,024	1.4	0.3	0.3	0.6
Totals:		**19.05**	**199**	**4,120**	**2,827**	**2,069**	**9,932**	**1,446**	**157**	**260**	**1,902**	**84,811**	**127**	**39.8**	**23.6**	**135**
Naples Site SW-1	December	2.59	9.6	498	674	610	1,792	26	9.6	124.6	160	9,582	8.0	3.2	3.2	16.0
	January	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	February	0.66	2.4	287	303	147	739	31	7.3	35.0	73	7,326	3.3	0.8	0.8	0.8
	March	0.15	0.6	0.6	50	7.8	59	0.9	1.3	2.0	4.3	333	1.8	0.4	0.2	1.1
	April	1.53	28	444	473	292	1,328	13	19	28	69	12,252	7.3	12.2	1.9	21.8
	May	0.96	15	180	197	62	490	17	18	14	49	3,546	4.6	3.6	1.2	17.4
	June	6.37	35	855	1,624	491	3,126	187	185	37	624	18,006	52.4	12.3	7.9	33.2
	July	5.99	188	364	766	934	3,329	147	70	131	373	24,494	25.3	8.5	7.4	12.1
	August	5.89	22	1,139	1,529	431	3,165	113	59	93	290	14,934	58.1	7.3	7.3	12.9
	September	4.57	55	599	863	469	2,188	61	40	97	208	21,356	43.7	5.6	5.6	8.8
	October	0.40	1.5	79	153	12	246	9.4	1.5	10	21	1,085	1.2	0.5	0.5	0.5
	November	0.81	3.0	101	239	63	406	20	9.0	24	53	9,190	6.0	2.0	1.0	9.0
Totals:		**29.92**	**361**	**4,548**	**6,871**	**3,518**	**16,866**	**624**	**419**	**594**	**1,923**	**122,103**	**212**	**56.3**	**36.9**	**134**
Naples Site SW-2	December	1.99	14.7	7	1,097	282	1,401	7	41.7	140	189	56,446	41.7	19.6	2.5	17.2
	January	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	February	0.50	80.2	102	426	101	709	39	1.8	27.7	68	7,215	7.4	1.8	0.6	3.1
	March	0.11	54.7	8.3	73	17	153	14	2.0	6.1	22	597	0.9	1.1	0.1	1.5
	April	1.18	17	182	240	234	722	17	7.4	65	105	14,869	10.1	18.2	1.5	6.5
	May	0.73	4.7	82	303	153	594	4.1	8.5	41	67	5,807	3.2	4.9	1.8	3.6
	June	4.86	18	875	661	402	2,103	71	186	267	621	20,214	32.3	9.4	6.0	33.4
	July	4.58	119	203	769	620	2,157	70	45	80	251	21,065	18.6	8.1	5.6	45.1
	August	4.51	17	849	1,007	302	2,299	131	34	123	307	47,669	31.7	7.3	5.6	45.6
	September	3.49	24	323	647	350	1,795	53	52	111	232	13,431	24.1	4.9	4.3	18.7
	October	0.30	1.1	45	74	16	136	3.7	26	15	45	1,258	0.9	0.4	0.4	2.2
	November	0.62	2.3	156	104	20	282	18	52	30	99	1,223	3.1	0.8	0.8	3.1
Totals:		**22.87**	**352**	**2,832**	**5,402**	**2,496**	**12,351**	**427**	**456**	**905**	**2,006**	**189,794**	**174**	**76.5**	**29.1**	**180**

Monthly Mass Stormwater Inflows and Measured at the Dry Detention and Underdrain Monitoring Sites

Site	Month	Volume (ac-ft)	Monthly Inflow / Outflow Loadings (g)													
			Ammonia	**NOx**	**Diss.Org. N**	**Part. N**	**Total N**	**SRP**	**Diss.Org. P**	**Part. P**	**Total P**	**TSS**	**Chromium**	**Copper**	**Lead**	**Zinc**
Naples Site SW-3	December	2.17	20.9	119	559	105	986	19	10.5	34.1	77	9,559	9.1	3.9	3.1	9.7
	January	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	February	0.56	6.5	21	149	47	254	3.8	3.3	9.6	19	2,423	2.6	1.2	0.9	3.2
	March	0.13	1.3	5.9	32	15	61	1.3	0.8	1.9	4.7	548	0.6	0.4	0.2	0.8
	April	1.32	16	99	364	150	676	21	6.1	23	55	7,671	4.9	6.2	3.4	8.3
	May	0.84	12.4	104	260	95	471	20.7	3.1	17	40	6,734	2.6	6.2	3.1	5.2
	June	5.42	20	92	1,225	626	2,202	50	57	53	173	13,098	29.9	13.4	6.7	37.8
	July	5.04	89	226	1,073	572	2,258	25	25	85	158	19,458	25.9	7.4	6.2	30.5
	August	5.00	45	127	1,723	338	2,648	26	39	170	238	41,097	43.7	6.2	6.2	44.5
	September	3.90	96	111	1,010	154	1,371	10	19	53	82	9,619	12.0	4.8	4.8	9.6
	October	0.36	3.4	31	88	6.6	151	3.3	1.3	4.7	11	1,347	1.1	0.4	0.4	0.9
	November	0.72	2.7	185	167	6.2	361	24	1.8	8.9	35	4,085	2.2	0.9	0.9	1.8
Totals:		**25.46**	**314**	**1,118**	**6,651**	**2,115**	**11,438**	**204**	**167**	**459**	**894**	**115,638**	**135**	**51.0**	**35.9**	**152**
Pembroke Pines SW-1	December	2.44	18.3	75	653	370	1,260	21	19.4	34.2	91	7,098	15.7	3.8	3.0	6.4
	January	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	February	0.27	2.4	6.9	75	46	149	3.0	2.3	4.1	11	803	1.7	0.4	0.3	0.7
	March	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	April	0.61	1.5	253	119	210	583	17	6.8	25	49	8,350	1.9	6.8	0.8	13.5
	May	0.17	12.6	36	48	45	142	7.1	1.0	3	12	964	1.3	0.2	0.2	0.2
	June	2.78	10	10	964	651	1,664	140	40	49	241	5,289	12.1	9.7	3.4	18.8
	July	3.80	33	30	1,020	729	2,034	18	35	64	127	10,393	19.5	5.6	4.7	10.0
	August	3.14	12	85	1,006	311	1,468	10	22	30	66	9,530	33.9	4.9	3.9	7.7
	September	2.32	14	153	470	285	964	13	16	31	74	6,024	12.4	2.9	2.9	5.9
	October	0.08	0.4	4.2	18	9.3	34	0.4	0.6	1.0	2.3	216	0.5	0.1	0.1	0.2
	November	0.14	0.7	5.9	36	15	62	0.6	1.0	1.6	3.6	393	1.1	0.2	0.2	0.4
Totals:		**15.75**	**104**	**659**	**4,408**	**2,672**	**8,360**	**231**	**144**	**244**	**677**	**49,062**	**100**	**34.5**	**19.4**	**63.9**
Pembroke Pines SW-2	December	0.59	2.2	10	255	121	388	3.6	4.4	13.1	21	45,113	9.5	8.0	0.7	7.3
	January	0.13	2.8	2.6	55	28	94	1.7	0.5	4.8	8	5,674	1.7	1.3	0.2	2.3
	February	1.01	130	23	422	235	812	27	2.2	63.3	101	25,166	10.3	7.5	1.2	25.5
	March	0.01	1.5	0.5	4.2	2.9	9.4	0.2	0.1	0.6	1.1	237	0.1	0.1	0.0	0.3
	April	2.48	421	249	1,047	900	2,740	49	52	165	291	55,735	20.2	10.4	3.1	99.1
	May	3.41	13	1,897	425	967	3,301	156	46	84	286	30,700	21.0	8.4	4.2	50.5
	June	4.66	17	354	1,187	340	2,832	52	389	141	674	14,144	33.8	15.1	5.7	77.6
	July	7.92	117	794	560	641	2,701	61	879	104	1,083	22,510	24.4	9.8	9.8	155.8
	August	2.05	34	150	788	145	1,327	12	77	63	171	26,419	16.4	7.2	2.5	24.8
	September	4.53	102	475	737	287	1,842	71	193	144	444	7,741	35.3	5.6	5.6	37.1
	October	1.04	7.8	271	300	27	621	12	82	63	162	2,496	6.1	1.3	1.3	6.0
	November	2.32	8.6	1,082	691	270	2,160	67	76	80	277	11,620	8.0	2.9	2.9	19.3
Totals:		**30.15**	**857**	**5,308**	**6,472**	**3,964**	**18,827**	**513**	**1,802**	**925**	**3,518**	**247,555**	**187**	**77.4**	**37.2**	**505**

Monthly Mass Stormwater Inflows and Measured at the Dry Detention and Underdrain Monitoring Sites

Site	Month	Volume (ac-ft)	Monthly Inflow / Outflow Loadings (g)													
			Ammonia	**NOx**	**Diss.Org. N**	**Part. N**	**Total N**	**SRP**	**Diss.Org. P**	**Part. P**	**Total P**	**TSS**	**Chromium**	**Copper**	**Lead**	**Zinc**
Pembroke Pines SW-3	December	0.15	5.0	15	26	12	58	1.5	9.6	2.2	13	1,110	2.0	0.6	0.2	14.8
	January	0.05	0.2	0	12	5	17	0.1	3.6	1.0	4.6	545	0.1	0.1	0.1	0.4
	February	0.31	12	22	117	30	214	2.6	8.8	6.5	31	2,173	3.2	1.6	0.4	10.3
	March	0.03	2.2	2.5	12.4	5.9	27.5	0.4	0.6	1.1	3.2	404	0.3	0.2	0.0	1.4
	April	0.70	94.2	68.0	317	282	853	15.9	9.2	46.5	77.7	18,129	4.7	8.3	0.9	46.8
	May	0.98	89.4	35.3	305	225	777	40.6	19.1	39.9	134	3,279	6.8	5.3	1.2	49.0
	June	1.25	15.9	52.1	199	116	486	15.2	80.1	57.7	171	3,894	9.7	3.4	1.5	71.1
	July	2.07	48.2	140	148	336	745	8.2	135	141	307	8,885	8.5	4.6	2.6	88.0
	August	0.60	28.1	51.7	173	123	497	1.8	12.5	19.5	39	3,253	4.9	1.5	0.7	40.6
	September	1.31	68.5	165	350	210	960	12.0	23.6	42.3	109	5,228	8.4	4.1	1.6	28.9
	October	0.30	7.8	38.9	90.7	33.9	208	1.2	6.1	8.5	18.4	2,596	1.3	0.4	0.4	5.5
	November	0.66	6.4	156	196	81.3	518	8.3	20.5	16.3	50.8	4,548	2.5	0.8	0.8	10.9
Totals:		**8.41**	**378**	**747**	**1,948**	**1,461**	**5,361**	**108**	**329**	**382**	**959**	**54,042**	**53**	**30.9**	**10.4**	**368**
Pembroke Pines SW-4	December	0.40	1.5	9.4	63.6	86.3	161	3.0	23.2	3.9	30.1	789	4.9	1.0	0.5	3.5
	January	0.11	0.4	0	26.9	24.0	51.7	0.3	12.8	0.5	13.6	407	0.5	0.1	0.1	0.3
	February	0.95	229	75.5	498	309	1,134	28.0	9.1	50.9	96.7	8,703	11.1	6.9	1.2	36.8
	March	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	April	2.34	95.2	320	1,445	494	2,519	70.8	43.8	63.2	182	11,397	10.1	16.9	2.9	103
	May	3.56	13.2	132	1,298	577	2,270	30.6	185	83.0	360	10,473	13.7	12.8	5.8	103
	June	5.17	19.1	156	1,537	606	2,630	53.5	238	93.2	583	21,120	28.5	10.7	6.4	105
	July	8.71	58.8	225	2,584	918	4,035	96.7	267	215	688	25,690	34.0	10.7	10.7	110
	August	2.00	7.4	36.3	789	411	1,323	10.5	105	19.1	143	7,877	13.5	4.9	2.5	21.5
	September	4.34	16.1	16.1	1,650	949	2,632	58.6	177	34.7	312	8,956	47.9	5.4	5.4	20.0
	October	0.93	3.4	7.9	246	150	418	2.8	55.1	14.7	74.2	1,214	5.4	1.1	1.1	2.0
	November	2.30	13.1	72.8	1,256	1,167	2,686	12.2	69.4	48.9	232	17,613	8.3	3.6	2.8	10.9
Totals:		**30.81**	**457**	**1,051**	**11,393**	**5,691**	**19,859**	**367**	**1,184**	**627**	**2,715**	**114,240**	**178**	**74.3**	**39.4**	**516**

APPENDIX F

MONTHLY MASS BALANCE BUDGETS FOR THE DRY DETENTION AND UNDERDRAIN MONITORING SITES

F.1 Bonita Springs Dry Detention

Monthly Mass Balance for Inputs and Losses

Site: Bonita Springs **Parameter: Ammonia**

Month	Mass Inputs (g)						Outfall Losses	Mass Retained	
	SW - 1	SW - 2	SW - 3	SW - 4	Bulk Precip.	Total	(g)	(g)	(%)
December	5.4	73	9.0	0.3	28.1	116	12	104	90
January	0	2.6	0	0	2.3	4.9	0	5	100
February	89	68	5.1	0.6	21.8	184	807	-623	-338
March	5.0	35	186	2.7	17.9	247	166	81	33
April	11	62	186	6.3	56.4	323	113	210	65
May	6.8	381	410	28	170	996	190	806	81
June	50	33	36	1.6	8.3	129	81	48	37
July	41	62	106	5.1	56.7	272	122	150	55
August	8.6	129	20	0.4	15.3	173	19	154	89
September	16	311	40	1.0	57.7	426	45	381	89
October	3.9	33	6.1	0.3	4.1	47.8	74	-27	-56
November	62	1.4	2.8	0.1	81.9	148	5.7	142	96
Totals:	**300**	**1,191**	**1,009**	**46.1**	**521**	**3,066**	**1,634**	**1,432**	**47**

Site: Bonita Springs **Parameter: NOx**

Month	Mass Inputs (g)						Outfall Losses	Mass Retained	
	SW - 1	SW - 2	SW - 3	SW - 4	Bulk Precip.	Total	(g)	(g)	(%)
December	75	96	1.6	66	53.8	292	35	257	88
January	0	1.0	0	0	4.3	5.4	0	5	100
February	16	8.2	33	61	41.7	159	84	75	47
March	2.1	0	1.4	43	50.6	97	52	45	47
April	1.8	6.6	2.7	100	85.8	197	60	137	70
May	43	385	5.5	135	144	713	218	495	69
June	255	428	49	1,697	190	2,619	1,727	892	34
July	69	724	45	589	126	1,553	138	1,415	91
August	18	33	3.2	20	117	191	19	172	90
September	132	83	3.7	125	148	491	43	448	91
October	1.8	31	0.4	6.1	35.3	74.6	24	50	67
November	260	0.7	0.2	4.9	38.6	304	3.2	301	99
Totals:	**874**	**1,797**	**145**	**2,846**	**1,034**	**6,697**	**2,402**	**4,294**	**64**

Site: Bonita Springs **Parameter: Diss. Organic N**

Month	Mass Inputs (g)						Outfall Losses	Mass Retained	
	SW - 1	SW - 2	SW - 3	SW - 4	Bulk Precip.	Total	(g)	(g)	(%)
December	158	344	818	28	43.9	1,392	548	844	61
January	0	12	0	0	3.5	15.3	0	15	100
February	235	292	571	11	34.0	1,144	1,137	6	1
March	67	139	279	4.1	33.9	522	237	286	55
April	300	137	1,079	10	208	1,734	653	1,081	62
May	412	463	1,145	47	301	2,368	1,671	697	29
June	1,209	1,612	1,772	79	124	4,796	1,616	3,180	66
July	645	940	2,385	97	214	4,281	1,814	2,467	58
August	461	553	2,737	31	91.1	3,873	1,122	2,751	71
September	304	837	914	41	163	2,259	1,709	550	24
October	222	187	917	15	18.3	1,358.8	671	688	51
November	95	5.6	161	3.1	68.3	333	105	228	69
Totals:	**4,108**	**5,522**	**12,777**	**366.3**	**1,303**	**24,076**	**11,284**	**12,792**	**53**

Monthly Mass Balance for Inputs and Losses

Site: Bonita Springs **Parameter: Particulate N**

Month	Mass Inputs (g)						Outfall Losses	Mass Retained	
	SW - 1	SW - 2	SW - 3	SW - 4	Bulk Precip.	Total	(g)	(g)	(%)
December	65	27	168	2.8	50.3	313	368	-55	-18
January	0	1.0	0	0	4.1	5.1	0	5	100
February	354	30	482	9.3	39.0	913	170	743	81
March	108	19	143	2.7	11.0	283	90	193	68
April	142	69	196	4.6	61.4	473	175	299	63
May	274	881	1,281	48	66.1	2,550	832	1,717	67
June	632	807	2,052	27	237	3,755	1,708	2,047	55
July	293	1,144	2,326	56	79.2	3,899	2,189	1,709	44
August	87	94	898	4.1	30.7	1,113	315	799	72
September	98	178	1,326	14	61.6	1,678	712	966	58
October	70	66	122	11	15.1	283.7	118	166	58
November	34	1.5	71	1.5	62.1	169	28	141	83
Totals:	**2,157**	**3,317**	**9,064**	**180.1**	**717**	**15,435**	**6,706**	**8,730**	**57**

Site: Bonita Springs **Parameter: Total N**

Month	Mass Inputs (g)						Outfall Losses	Mass Retained	
	SW - 1	SW - 2	SW - 3	SW - 4	Bulk Precip.	Total	(g)	(g)	(%)
December	303	540	1,061	33	176	2,112	963	1,150	54
January	0	17	0	0	14.2	31.3	0	31	100
February	693	390	1,118	54	136	2,392	2,198	194	8
March	222	158	757	11	113	1,261	545	715	57
April	489	311	2,004	28	565	3,397	1,266	2,131	63
May	1,210	2,110	4,473	167	524	8,484	3,790	4,693	55
June	2,674	3,668	6,418	176	690	13,626	5,271	8,354	61
July	1,282	3,405	7,762	246	629	13,324	4,861	8,463	64
August	633	836	3,829	39	268	5,606	1,504	4,102	73
September	695	1,445	2,941	63	521	5,666	2,578	3,088	55
October	304	395	1,085	29	76.5	1,888.6	1,089	800	42
November	451	11	314	5.3	251	1,032	164	868	84
Totals:	**8,955**	**13,286**	**31,763**	**850.2**	**3,965**	**58,819**	**24,229**	**34,590**	**59**

Site: Bonita Springs **Parameter: SRP**

Month	Mass Inputs (g)						Outfall Losses	Mass Retained	
	SW - 1	SW - 2	SW - 3	SW - 4	Bulk Precip.	Total	(g)	(g)	(%)
December	15	75	18	0.7	0.6	109	15	93	86
January	0	2.4	0	0	0.0	2.4	0	2	100
February	4.1	54	37	4.4	0.5	100	241	-141	-140
March	1.8	22	26	0.3	1.6	52	47	4	8
April	16	25	30	0.8	5.8	77	19	58	75
May	22	95	57	1.0	4.3	179	62	117	66
June	102	625	527	13	4.1	1,271	558	713	56
July	15	423	396	6.7	2.1	842	33	810	96
August	5.1	131	236	1.3	2.4	375	19	357	95
September	37	189	365	0.7	7.0	599	24	576	96
October	5.9	54	9.1	0.1	1.1	70.3	3.4	67	95
November	54	1.4	10	0.0	34.1	100	0.9	99	99
Totals:	**277**	**1,696**	**1,712**	**28.6**	**64**	**3,777**	**1,022**	**2,755**	**73**

Monthly Mass Balance for Inputs and Losses

Site: Bonita Springs **Parameter: Diss. Organic P**

Month	Mass Inputs (g)						Outfall Losses	Mass Retained	
	SW - 1	SW - 2	SW - 3	SW - 4	Bulk Precip.	Total	(g)	(g)	(%)
December	1.6	5.6	267	4.5	4.7	283	54	229	81
January	0	0.2	0	0	0.4	0.6	0	1	100
February	1.8	4.2	29	1.9	3.6	40	5.7	35	86
March	0.9	1.8	5.3	0.2	0.4	8	10	-2	-22
April	23	2.8	50	0.2	9.7	85	17	68	80
May	4.2	15	35	1.0	8.1	63	57	6	10
June	22	59	33	2.2	8.0	124	41	83	67
July	41	23	184	5.6	4.2	258	183	75	29
August	17	8.7	419	6.0	1.9	453	19	433	96
September	18	42	214	4.8	4.5	283	229	54	19
October	6.2	5.0	57	1.0	1.7	70.4	59	11	16
November	4.1	0.2	19	0.3	3.0	27	11	16	58
Totals:	**139**	**167**	**1,311**	**27.6**	**50**	**1,695**	**686**	**1,009**	**60**

Site: Bonita Springs **Parameter: Particulate P**

Month	Mass Inputs (g)						Outfall Losses	Mass Retained	
	SW - 1	SW - 2	SW - 3	SW - 4	Bulk Precip.	Total	(g)	(g)	(%)
December	7.8	21	12	0.3	2.9	44	38	6	13
January	0	0.5	0	0	0.2	0.8	0	1	100
February	46	10	88	2.3	2.3	148	40	108	73
March	17	2.8	23	0.2	1.8	45	10	35	78
April	31	11	96	1.1	11.1	151	43	108	71
May	35	150	218	6.7	8.1	418	60	357	86
June	63	125	112	7.1	10.1	317	147	170	54
July	50	107	222	6.9	9.6	396	283	113	29
August	52	23	233	2.7	7.9	319	21	298	93
September	16	54	158	4.2	23.5	255	119	136	53
October	22	13	55	1.9	1.8	93.0	55	38	41
November	7.3	0.4	16	0.4	8.3	33	7.9	25	76
Totals:	**346**	**518**	**1,233**	**33.7**	**88**	**2,219**	**824**	**1,394**	**63**

Site: Bonita Springs **Parameter: Total P**

Month	Mass Inputs (g)						Outfall Losses	Mass Retained	
	SW - 1	SW - 2	SW - 3	SW - 4	Bulk Precip.	Total	(g)	(g)	(%)
December	24	101	297	5.4	8.2	436	107	328	75
January	0	3.1	0	0	0.7	3.8	0	4	100
February	52	69	154	8.7	6.3	290	287	3	1
March	21	27	55	0.6	3.9	106	67	39	37
April	70	45	256	2.3	35.1	409	108	300	73
May	121	260	375	9.5	23.0	788	236	552	70
June	212	823	700	25	24.0	1,783	796	987	55
July	140	583	878	33	16.9	1,652	609	1,043	63
August	100	173	984	10	13.1	1,281	79	1,203	94
September	78	302	756	11	38.1	1,185	382	803	68
October	43	77	155	3.4	4.9	283.4	139	144	51
November	65	2.2	60	0.8	45.5	174	23	151	87
Totals:	**926**	**2,465**	**4,670**	**110.5**	**220**	**8,391**	**2,833**	**5,558**	**66**

Monthly Mass Balance for Inputs and Losses

Site: Bonita Springs **Parameter: TSS**

Month	Mass Inputs (g)						Outfall Losses	Mass Retained	
	SW - 1	SW - 2	SW - 3	SW - 4	Bulk Precip.	Total	(g)	(g)	(%)
December	2,331	1,968	7,792	380	1,053	13,523	3,835	9,688	72
January	0	72	0	0	85	157.2	0	157	100
February	52,475	1,915	53,052	6,808	816	115,066	15,866	99,200	86
March	1,249	1,046	9,813	335	591	13,035	6,290	6,746	52
April	3,331	3,528	10,147	266	3,321	20,593	8,137	12,456	60
May	11,038	40,984	62,704	2,039	2,550	119,314	25,134	94,180	79
June	15,169	27,561	49,143	2,857	2,870	97,600	34,043	63,557	65
July	15,932	27,013	150,932	8,722	3,735	206,334	29,890	176,443	86
August	12,900	5,599	43,933	572	4,356	67,360	15,092	52,268	78
September	3,947	6,111	33,093	1,383	2,951	47,485	13,788	33,697	71
October	3,210	2,401	16,198	335	458	22,602.7	5,072	17,531	78
November	587	54	4,069	85	253	5,048	817	4,231	84
Totals:	**122,169**	**118,252**	**440,877**	**23,781.9**	**23,039**	**728,118**	**157,964**	**570,154**	**78**

Site: Bonita Springs **Parameter: Chromium**

Month	Mass Inputs (g)						Outfall Losses	Mass Retained	
	SW - 1	SW - 2	SW - 3	SW - 4	Bulk Precip.	Total	(g)	(g)	(%)
December	4.7	11.2	24.0	0.7	6.4	47	30.7	16	35
January	0	0.3	0	0	0.5	0.8	0	1	100
February	11.9	6.3	42.2	1.1	5.0	67	13.4	53	80
March	0.9	2.0	4.3	0.1	2.7	10	8.9	1	11
April	2.1	2.6	4.2	0.1	2.3	11	4.7	7	59
May	3.0	12.2	11.3	0.6	3.7	31	34.9	-4	-13
June	11.0	22.2	78.2	2.6	15.8	130	57.2	73	56
July	31.6	47.6	75.0	4.8	7.9	167	75.2	92	55
August	13.5	7.9	34.4	2.6	11.8	70	56.5	14	20
September	7.9	30.0	50.8	1.1	14.1	104	52.9	51	49
October	3.1	5.5	14.6	0.2	1.7	25.1	9.0	16	64
November	0.9	0.2	4.8	0.1	0.8	7	2.1	5	68
Totals:	**91**	**148**	**344**	**14.1**	**73**	**669**	**346**	**324**	**48**

Site: Bonita Springs **Parameter: Copper**

Month	Mass Inputs (g)						Outfall Losses	Mass Retained	
	SW - 1	SW - 2	SW - 3	SW - 4	Bulk Precip.	Total	(g)	(g)	(%)
December	0.8	1.4	3.0	0.1	1.8	7	3.8	3	45
January	0	0.1	0	0	0.1	0.2	0	0	100
February	3.7	2.0	30.4	0.2	1.4	38	11.5	26	70
March	1.9	1.6	7.5	0.3	0.2	11	6.7	5	42
April	1.5	1.9	12.8	0.4	2.5	19	11.4	8	40
May	5.2	7.6	13.8	0.7	1.2	29	16.0	13	44
June	10.3	10.2	12.1	0.6	6.8	40	18.4	22	54
July	12.3	16.8	25.3	9.7	2.8	67	50.3	17	25
August	2.3	3.5	6.7	0.1	1.5	14	6.2	8	56
September	2.3	21.6	7.3	0.2	2.2	34	13.9	20	59
October	0.5	2.7	2.0	0.1	0.4	5.7	3.0	3	48
November	0.2	0.1	0.7	0.0	0.1	1	0.6	0	43
Totals:	**41**	**70**	**122**	**12.4**	**21**	**265**	**142**	**124**	**47**

Monthly Mass Balance for Inputs and Losses

Site: Bonita Springs **Parameter: Lead**

Month	Mass Inputs (g)						Outfall Losses	Mass Retained	
	SW - 1	SW - 2	SW - 3	SW - 4	Bulk Precip.	Total	(g)	(g)	(%)
December	0.8	1.4	3.0	0.1	0.6	6	3.8	2.0	34
January	0	0.0	0	0	0.0	0.1	0	0.1	100
February	0.5	0.7	1.7	0.0	0.5	3	1.9	1.4	43
March	0.2	0.2	0.8	0.0	0.2	1	0.7	0.7	49
April	0.5	0.3	1.7	0.0	0.5	3	1.5	1.5	50
May	1.2	1.5	4.5	0.1	0.9	8	5.1	3.2	38
June	3.2	5.5	12.1	0.4	2.8	24	14.0	10.0	42
July	3.8	6.7	14.8	0.7	2.1	28	15.2	12.8	46
August	1.8	2.0	6.7	0.1	1.5	12	6.2	6.0	49
September	1.9	3.4	7.3	0.2	2.2	15	8.8	6.2	42
October	0.5	0.9	2.0	0.0	0.4	3.9	2.4	1.5	39
November	0.2	0.0	0.7	0.0	0.5	1	0.4	0.9	68
Totals:	**14**	**23**	**55**	**1.8**	**12**	**106**	**60**	**46**	**44**

Site: Bonita Springs **Parameter: Zinc**

Month	Mass Inputs (g)						Outfall Losses	Mass Retained	
	SW - 1	SW - 2	SW - 3	SW - 4	Bulk Precip.	Total	(g)	(g)	(%)
December	1.6	1.4	12.0	0.5	4.1	20	15.3	4	22
January	0	0.1	0	0	0.3	0.4	0	0	100
February	5.0	1.9	6.8	0.8	3.2	18	28.7	-11	-62
March	6.2	1.4	2.8	1.0	8.2	20	15.5	4	20
April	3.1	0.8	5.8	1.3	11.3	22	18.7	3	16
May	5.5	1.5	29.1	5.9	12.1	54	46.2	8	15
June	17.4	13.7	120	11	6.9	170	77	93	55
July	16.1	15.3	292	13	7.4	343	30	312	91
August	8.6	8.2	30.7	0.6	4.7	53	35.6	17	33
September	5.4	12.8	16.7	1.5	5.8	42	30.4	12	28
October	1.1	2.9	5.4	0.1	0.6	10.1	11.8	-2	-17
November	0.5	0.1	1.7	0.1	0.8	3	1.8	1	40
Totals:	**70**	**60**	**523**	**36.0**	**65**	**755**	**312**	**443**	**59**

F.2 Naples Dry Detention

Monthly Mass Balance for Inputs and Losses

Site: Naples **Parameter: Ammonia**

Month	Mass Inputs (g)				Outfall	Mass Retained	
	SW - 1	SW - 2	Bulk Precip.	Total	Losses (g)	(g)	(%)
December	9.6	14.7	741	765	20.9	745	97
January	0	0	11.5	11.5	0	12	100
February	2.4	80.2	17.3	100	6.5	93	93
March	0.6	54.7	7.8	63	1.3	62	98
April	28	17	68.4	113	16	97	86
May	15	4.7	2.1	22	12.4	10	44
June	35	18	36.7	89	20	69	78
July	188	119	186	492	89	403	82
August	22	17	196	235	45	190	81
September	55	24	123	202	96	106	52
October	1.5	1.1	72.5	75.1	3.4	72	95
November	3.0	2.3	168	173	2.7	170	98
Totals:	**361**	**352**	**1,630**	**2,342**	**314**	**2,028**	**87**

Site: Naples **Parameter: NOx**

Month	Mass Inputs (g)				Outfall	Mass Retained	
	SW - 1	SW - 2	Bulk Precip.	Total	Losses (g)	(g)	(%)
December	498	7	784	1,289	119	1,170	91
January	0	0	12.2	12.2	0	12	100
February	287	102	50.0	440	21	419	95
March	0.6	8.3	36.1	45	5.9	39	87
April	444	182	196	821	99	723	88
May	180	82	118	379	104	276	73
June	855	875	344	2,074	92	1,982	96
July	364	203	255	821	226	596	73
August	1,139	849	284	2,272	127	2,145	94
September	599	323	210	1,132	111	1,022	90
October	79	45	35.8	160.3	31	130	81
November	101	156	354	611	185	426	70
Totals:	**4,548**	**2,832**	**2,677**	**10,058**	**1,118**	**8,940**	**89**

Site: Naples **Parameter: Diss. Organic N**

Month	Mass Inputs (g)				Outfall	Mass Retained	
	SW - 1	SW - 2	Bulk Precip.	Total	Losses (g)	(g)	(%)
December	674	1,097	149	1,920	559	1,360	71
January	0	0	2.3	2.3	0	2	100
February	303	426	114	843	149	694	82
March	50	73	92.2	215	32	183	85
April	473	240	24	737	364	373	51
May	197	303	38	538	260	278	52
June	1,624	661	308	2,593	1,225	1,368	53
July	766	769	317	1,852	1,073	779	42
August	1,529	1,007	329	2,866	1,723	1,143	40
September	863	647	186	1,696	1,010	686	40
October	153	74	37.5	264.7	88	177	67
November	239	104	239	582	167	415	71
Totals:	**6,871**	**5,402**	**1,837**	**14,110**	**6,651**	**7,459**	**53**

Monthly Mass Balance for Inputs and Losses

Site: Naples **Parameter: Particulate N**

Month	Mass Inputs (g)				Outfall Losses (g)	Mass Retained	
	SW - 1	SW - 2	Bulk Precip.	Total		(g)	(%)
December	610	282	221	1,113	105	1,008	91
January	0	0	3.4	3.4	0	3	100
February	147	101	33.1	280	47	234	83
March	7.8	17	60.4	85	15	71	83
April	292	234	37.2	563	150	413	73
May	62	153	13.3	228	95	132	58
June	491	402	110	1,003	626	376	38
July	934	620	187	1,740	572	1,169	67
August	431	302	188	921	338	583	63
September	469	350	154	973	154	819	84
October	12	16	25.4	52.8	6.6	46	87
November	63	20	136	219	6.2	213	97
Totals:	**3,518**	**2,496**	**1,169**	**7,182**	**2,115**	**5,067**	**71**

Site: Naples **Parameter: Total N**

Month	Mass Inputs (g)				Outfall Losses (g)	Mass Retained	
	SW - 1	SW - 2	Bulk Precip.	Total		(g)	(%)
December	1,792	1,401	1,894	5,087	986	4,102	81
January	0	0	29.5	29.5	0	29	100
February	739	709	215	1,663	254	1,409	85
March	59	153	196	409	61	348	85
April	1,328	722	362	2,412	676	1,736	72
May	490	594	171	1,254	471	783	62
June	3,126	2,103	867	6,096	2,202	3,894	64
July	3,329	2,157	1,182	6,668	2,258	4,410	66
August	3,165	2,299	1,120	6,584	2,648	3,936	60
September	2,188	1,795	721	4,703	1,371	3,332	71
October	246	136	174	555.7	151	405	73
November	406	282	897	1,585	361	1,224	77
Totals:	**16,866**	**12,351**	**7,830**	**37,046**	**11,438**	**25,608**	**69**

Site: Naples **Parameter: SRP**

Month	Mass Inputs (g)				Outfall Losses (g)	Mass Retained	
	SW - 1	SW - 2	Bulk Precip.	Total		(g)	(%)
December	26	7	82.8	116	19	96	83
January	0	0	1.3	1.3	0	1	100
February	31	39	0.4	70	3.8	66	95
March	0.9	14	0.3	15	1.3	14	91
April	13	17	2.2	32	21	11	35
May	17	4.1	0.7	22	20.7	1	6
June	187	71	7.5	265	50	215	81
July	147	70	29.7	247	25	223	90
August	113	131	40.2	284	26	258	91
September	61	53	27.5	141	10	132	93
October	9.4	3.7	9.9	23.0	3.3	20	86
November	20	18	55.0	93	24	69	74
Totals:	**624**	**427**	**258**	**1,309**	**204**	**1,105**	**84**

Monthly Mass Balance for Inputs and Losses

Site: Naples **Parameter: Diss. Organic P**

Month	Mass Inputs (g)				Outfall Losses (g)	Mass Retained	
	SW - 1	SW - 2	Bulk Precip.	Total		(g)	(%)
December	9.6	41.7	5.3	57	10.5	46	81
January	0	0	0.1	0.1	0	0	100
February	7.3	1.8	0.8	10	3.3	7	66
March	1.3	2.0	0.7	4	0.8	3	81
April	19	7.4	2.6	29	6.1	23	79
May	18	8.5	0.7	27	3.1	24	88
June	185	186	3.4	374	57	317	85
July	70	45	11.4	127	25	101	80
August	59	34	6.3	99	39	60	61
September	40	52	7.1	99	19	80	81
October	1.5	26	0.9	28.7	1.3	27	96
November	9.0	52	3.9	65	1.8	63	97
Totals:	**419**	**456**	**43**	**918**	**167**	**751**	**82**

Site: Naples **Parameter: Particulate P**

Month	Mass Inputs (g)				Outfall Losses (g)	Mass Retained	
	SW - 1	SW - 2	Bulk Precip.	Total		(g)	(%)
December	125	140	36.1	301	34.1	266	89
January	0	0	0.6	0.6	0	1	100
February	35.0	27.7	5.3	68	9.6	58	86
March	2.0	6.1	14.7	23	1.9	21	92
April	28	65	9.9	102	23	80	78
May	14	41	1.4	56	17	40	71
June	37	267	9.2	313	53	260	83
July	131	80	22.7	234	85	149	64
August	93	123	20.8	237	170	67	28
September	97	111	16.8	225	53	172	76
October	10	15	1.9	26.6	4.7	22	82
November	24	30	18.9	73	8.9	64	88
Totals:	**594**	**905**	**158**	**1,658**	**459**	**1,199**	**72**

Site: Naples **Parameter: Total P**

Month	Mass Inputs (g)				Outfall Losses (g)	Mass Retained	
	SW - 1	SW - 2	Bulk Precip.	Total		(g)	(%)
December	160	189	124.2	473	77	396	84
January	0	0	1.9	1.9	0	2	100
February	73	68	6.4	148	19	129	87
March	4.3	22	15.7	42	4.7	37	89
April	69	105	15.1	189	55	134	71
May	49	67	2.8	118	40	78	66
June	624	621	22.1	1,268	173	1,095	86
July	373	251	79.2	703	158	545	78
August	290	307	72.6	669	238	431	64
September	208	232	54.8	495	82	413	83
October	21	45	13.6	79.0	11	68	86
November	53	99	77.8	230	35	195	85
Totals:	**1,923**	**2,006**	**486**	**4,416**	**894**	**3,522**	**80**

Monthly Mass Balance for Inputs and Losses

Site: Naples **Parameter: TSS**

Month	Mass Inputs (g)				Outfall	Mass Retained	
	SW - 1	SW - 2	Bulk Precip.	Total	Losses (g)	(g)	(%)
December	9,582	56,446	13,378	79,407	9,559	69,849	88
January	0	0	208	208	0	208	100
February	7,326	7,215	827	15,367	2,423	12,944	84
March	333	597	1,077	2,007	548	1,459	73
April	12,252	14,869	2,056	29,177	7,671	21,506	74
May	3,546	5,807	1,611	10,963	6,734	4,230	39
June	18,006	20,214	5,675	43,894	13,098	30,795	70
July	24,494	21,065	6,881	52,439	19,458	32,981	63
August	14,934	47,669	4,914	67,517	41,097	26,420	39
September	21,356	13,431	4,569	39,356	9,619	29,737	76
October	1,085	1,258	530	2,873	1,347	1,526	53
November	9,190	1,223	4,640	15,054	4,085	10,970	73
Totals:	**122,103**	**189,794**	**46,366**	**358,264**	**115,638**	**242,626**	**68**

Site: Naples **Parameter: Chromium**

Month	Mass Inputs (g)				Outfall	Mass Retained	
	SW - 1	SW - 2	Bulk Precip.	Total	Losses (g)	(g)	(%)
December	8.0	41.7	2.7	52	9.1	43	83
January	0	0	0.0	0.0	0	0	100
February	3.3	7.4	8.6	19	2.6	17	86
March	1.8	0.9	1.6	4	0.6	4	87
April	7.3	10.1	3.0	20	4.9	16	76
May	4.6	3.2	1.8	10	2.6	7	73
June	52.4	32.3	14.1	99	29.9	69	70
July	25.3	18.6	11.9	56	25.9	30	54
August	58.1	31.7	18.5	108	43.7	65	60
September	43.7	24.1	11.3	79	12.0	67	85
October	1.2	0.9	1.2	3.4	1.1	2	67
November	6.0	3.1	2.1	11	2.2	9	80
Totals:	**212**	**174**	**77**	**463**	**135**	**328**	**71**

Site: Naples **Parameter: Copper**

Month	Mass Inputs (g)				Outfall	Mass Retained	
	SW - 1	SW - 2	Bulk Precip.	Total	Losses (g)	(g)	(%)
December	3.2	19.6	1.1	24	3.9	20	84
January	0	0	0.0	0.0	0	0	100
February	0.8	1.8	1.1	4	1.2	3	69
March	0.4	1.1	0.2	2	0.4	1	76
April	12.2	18.2	2.3	33	6.2	27	81
May	3.6	4.9	0.7	9	6.2	3	32
June	12.3	9.4	5.3	27	13.4	14	50
July	8.5	8.1	3.3	20	7.4	12	63
August	7.3	7.3	2.8	17	6.2	11	65
September	5.6	4.9	2.4	13	4.8	8	63
October	0.5	0.4	0.3	1.1	0.4	1	61
November	2.0	0.8	0.4	3	0.9	2	72
Totals:	**56**	**77**	**20**	**153**	**51**	**102**	**67**

Monthly Mass Balance for Inputs and Losses

Site: Naples **Parameter: Lead**

Month	Mass Inputs (g)				Outfall Losses (g)	Mass Retained	
	SW - 1	SW - 2	Bulk Precip.	Total		(g)	(%)
December	3.2	2.5	1.1	7	3.1	4	53
January	0	0	0.0	0.0	0	0	100
February	0.8	0.6	0.4	2	0.9	1	52
March	0.2	0.1	0.2	0	0.2	0	52
April	1.9	1.5	0.9	4	3.4	1	20
May	1.2	1.8	1.4	4	3.1	1	29
June	7.9	6.0	3.4	17	6.7	11	61
July	7.4	5.6	2.8	16	6.2	10	61
August	7.3	5.6	2.8	16	6.2	9	61
September	5.6	4.3	2.4	12	4.8	8	61
October	0.5	0.4	0.3	1.1	0.4	1	61
November	1.0	0.8	0.4	2	0.9	1	60
Totals:	**37**	**29**	**16**	**82**	**36**	**46**	**56**

Site: Naples **Parameter: Zinc**

Month	Mass Inputs (g)				Outfall Losses (g)	Mass Retained	
	SW - 1	SW - 2	Bulk Precip.	Total		(g)	(%)
December	16.0	17.2	4.2	37	9.7	28	74
January	0	0	0.1	0.1	0	0	100
February	0.8	3.1	3.4	7	3.2	4	57
March	1.1	1.5	7.2	10	0.8	9	92
April	21.8	6.5	11.3	40	8.3	31	79
May	17.4	3.6	6.3	27	5.2	22	81
June	33.2	33.4	64.6	131	37.8	93	71
July	12.1	45.1	38.6	96	30.5	65	68
August	12.9	45.6	16.7	75	44.5	31	41
September	8.8	18.7	4.7	32	9.6	23	70
October	0.5	2.2	1.4	4.1	0.9	3	78
November	9.0	3.1	2.1	14	1.8	12	87
Totals:	**134**	**180**	**161**	**474**	**152**	**322**	**68**

F.3 Pembroke Pines Dry Detention

Monthly Mass Balance for Inputs and Losses

Site: Pembroke Pines **Parameter: Ammonia**

Month	Mass Inputs (g)					Outfall	Mass Retained	
	SW - 1	SW - 2	SW - 3	Bulk Precip.	Total	Losses (g)	(g)	(%)
December	18.3	2.2	5.0	5.6	31	1.5	30	95
January	0	2.8	0.2	1.4	4.4	0.4	4	91
February	2.4	130	12	18.4	163	229	-66	-40
March	0	1.5	2.2	3.2	7	0	7	100
April	1.5	421	94.2	42.4	559	95.2	464	83
May	12.6	13	89.4	5.0	120	13.2	106	89
June	10	17	15.9	1.5	45	19.1	26	57
July	33	117	48.2	6.4	204	58.8	145	71
August	12	34	28.1	10.9	85	7.4	77	91
September	14	102	68.5	20.0	204	16.1	188	92
October	0.4	7.8	7.8	11.4	27.4	3.4	24	87
November	0.7	8.6	6.4	1.5	17	13.1	4	23
Totals:	**104**	**857**		**128**	**1,466**	**457**	**1,009**	**69**

Site: Pembroke Pines **Parameter: NOx**

Month	Mass Inputs (g)					Outfall	Mass Retained	
	SW - 1	SW - 2	SW - 3	Bulk Precip.	Total	Losses (g)	(g)	(%)
December	75	10	15	9.0	109	9.4	100	91
January	0	2.6	0	2.2	5.0	0	5	92
February	6.9	23	22	20.4	73	75.5	-2	-3
March	0	0.5	2.5	5.4	8	0	8	100
April	253	249	68.0	113	682	320	363	53
May	36	1,897	35.3	56.5	2,025	132	1,893	93
June	10	354	52.1	38.6	455	156	299	66
July	30	794	140	80.0	1,044	225	819	78
August	85	150	51.7	62.2	349	36.3	312	90
September	153	475	165	82.5	875	16.1	859	98
October	4.2	271	38.9	11.0	325.2	7.9	317	98
November	5.9	1,082	156	19.0	1,263	72.8	1,190	94
Totals:	**659**	**5,308**		**500**	**7,214**	**1,051**	**6,164**	**85**

Site: Pembroke Pines **Parameter: Diss. Organic N**

Month	Mass Inputs (g)					Outfall	Mass Retained	
	SW - 1	SW - 2	SW - 3	Bulk Precip.	Total	Losses (g)	(g)	(%)
December	653	255	26	13.7	947	63.6	883	93
January	0	55	12	3.4	70.9	26.9	44	62
February	75	422	117	92.6	708	498	210	30
March	0	4.2	12.4	12.2	29	0	29	100
April	119	1,047	317	125	1,608	1,445	163	10
May	48	425	305	31.5	809	1,298	-489	-60
June	964	1,187	199	36.3	2,386	1,537	850	36
July	1,020	560	148	35.6	1,764	2,584	-820	-46
August	1,006	788	173	72.7	2,040	789	1,252	61
September	470	737	350	19.2	1,577	1,650	-73	-5
October	18	300	90.7	4.5	413.7	246	168	41
November	36	691	196	37.5	960	1,256	-295	-31
Totals:	**4,408**	**6,472**		**484**	**13,313**	**11,393**	**1,919**	**14**

Monthly Mass Balance for Inputs and Losses

Site: Pembroke Pines **Parameter: Particulate N**

Month	Mass Inputs (g)					Outfall	Mass Retained	
	SW - 1	SW - 2	SW - 3	Bulk Precip.	Total	Losses (g)	(g)	(%)
December	370	121	12	6.7	510	86.3	424	83
January	0	28	5	1.6	34.6	24.0	11	31
February	46	235	30	18.6	330	309	21	6
March	0	2.9	5.9	2.3	11	0	11	100
April	210	900	282	22.7	1,415	494	921	65
May	45	967	225	15.2	1,252	577	676	54
June	651	340	116	19.6	1,127	606	521	46
July	729	641	336	62.3	1,768	918	850	48
August	311	145	123	12.4	591	411	180	30
September	285	287	210	44.3	826	949	-122	-15
October	9.3	27	33.9	3.9	74.1	150	-76	-103
November	15	270	81.3	19.4	386	2.7	383	99
Totals:	**2,672**	**3,964**		**229**	**8,325**	**4,527**	**3,798**	**46**

Site: Pembroke Pines **Parameter: Total N**

Month	Mass Inputs (g)					Outfall	Mass Retained	
	SW - 1	SW - 2	SW - 3	Bulk Precip.	Total	Losses (g)	(g)	(%)
December	1,260	388	58	35	1,741	161	1,580	91
January	0	94	17	8.6	120.4	51.7	69	57
February	149	812	214	150	1,325	1,134	191	14
March	0	9.4	27.5	24.6	62	0	62	100
April	583	2,740	853	315	4,492	2,519	1,973	44
May	142	3,301	777	132	4,352	2,270	2,081	48
June	1,664	2,832	486	114	5,096	2,630	2,466	48
July	2,034	2,701	745	242	5,723	4,035	1,687	29
August	1,468	1,327	497	158	3,450	1,323	2,127	62
September	964	1,842	960	185	3,951	2,632	1,319	33
October	34	621	208	37.3	900.3	418	482	54
November	62	2,160	518	83.0	2,823	2.7	2,820	100
Totals:	**8,360**	**18,827**		**1,485**	**34,033**	**17,176**	**16,858**	**50**

Site: Pembroke Pines **Parameter: SRP**

Month	Mass Inputs (g)					Outfall	Mass Retained	
	SW - 1	SW - 2	SW - 3	Bulk Precip.	Total	Losses (g)	(g)	(%)
December	21	3.6	1.5	1.6	28	3.0	25	89
January	0	1.7	0.1	0.4	2.1	0.3	2	87
February	3.0	27	2.6	14.2	47	28.0	19	40
March	0	0.2	0.4	0.8	1	0	1	100
April	17	49	15.9	3.7	86	70.8	15	18
May	7.1	156	40.6	0.8	204	30.6	174	85
June	140	52	15.2	0.8	209	53.5	155	74
July	18	61	8.2	1.4	89	96.7	-8	-9
August	10	12	1.8	2.7	27	10.5	16	61
September	13	71	12.0	1.2	97	58.6	38	40
October	0.4	12	1.2	0.8	14.2	2.8	11	80
November	0.6	67	8.3	1.2	77	2.7	75	97
Totals:	**231**	**513**		**30**	**882**	**357**	**524**	**59**

Monthly Mass Balance for Inputs and Losses

Site: Pembroke Pines **Parameter: Diss. Organic P**

Month	Mass Inputs (g)					Outfall	Mass Retained	
	SW - 1	SW - 2	SW - 3	Bulk Precip.	Total	Losses (g)	(g)	(%)
December	19.4	4.4	9.6	0.2	34	23.2	10	31
January	0	0.5	3.6	0.0	4.2	12.8	-9	-207
February	2.3	2.2	8.8	2.5	16	9.1	7	42
March	0	0.1	0.6	0.2	1	0	1	100
April	6.8	52	9.2	0.8	69	43.8	25	36
May	1.0	46	19.1	0.9	67	185	-118	-175
June	40	389	80.1	1.9	511	238	273	53
July	35	879	135	2.5	1,053	267	786	75
August	22	77	12.5	1.2	113	105	8	7
September	16	193	23.6	2.2	235	177	58	25
October	0.6	82	6.1	0.3	89.2	55.1	34	38
November	1.0	76	20.5	1.0	98	2.7	96	97
Totals:	**144**	**1,802**		**14**	**2,289**	**1,118**	**1,171**	**51**

Site: Pembroke Pines **Parameter: Particulate P**

Month	Mass Inputs (g)					Outfall	Mass Retained	
	SW - 1	SW - 2	SW - 3	Bulk Precip.	Total	Losses (g)	(g)	(%)
December	34.2	13.1	2.2	0.7	50	3.9	46	92
January	0	4.8	1.0	0.2	6.0	0.5	5	91
February	4.1	63.3	6.5	6.4	80	50.9	29	36
March	0	0.6	1.1	0.5	2	0	2	100
April	25	165	46.5	3.7	240	63.2	177	74
May	3	84	39.9	1.9	129	83.0	46	36
June	49	141	57.7	1.9	250	93.2	157	63
July	64	104	141	2.8	312	215	97	31
August	30	63	19.5	1.6	114	19.1	95	83
September	31	144	42.3	7.0	224	34.7	190	85
October	1.0	63	8.5	0.5	72.5	14.7	58	80
November	1.6	80	16.3	3.1	101	2.7	98	97
Totals:	**244**	**925**		**30**	**1,582**	**581**	**1,001**	**63**

Site: Pembroke Pines **Parameter: Total P**

Month	Mass Inputs (g)					Outfall	Mass Retained	
	SW - 1	SW - 2	SW - 3	Bulk Precip.	Total	Losses (g)	(g)	(%)
December	91	21	13	2.6	128	30.1	97	76
January	0	8	4.6	0.6	13.0	13.6	-1	-4
February	11	101	31	23.1	166	96.7	70	42
March	0	1.1	3.2	1.6	6	0	6	100
April	49	291	77.7	8.8	427	182	244	57
May	12	286	134	3.8	436	360	75	17
June	241	674	171	5.2	1,091	583	508	47
July	127	1,083	307	7.2	1,525	688	836	55
August	66	171	39	5.4	281	143	138	49
September	74	444	109	10.6	638	312	326	51
October	2.3	162	18.4	1.6	183.8	74.2	110	60
November	3.6	277	50.8	5.9	337	2.7	334	99
Totals:	**677**	**3,518**		**76**	**5,230**	**2,486**	**2,744**	**52**

Monthly Mass Balance for Inputs and Losses

Site: Pembroke Pines **Parameter: TSS**

Month	Mass Inputs (g)					Outfall	Mass Retained	
	SW - 1	SW - 2	SW - 3	Bulk Precip.	Total	Losses (g)	(g)	(%)
December	7,098	45,113	1,110	435	53,756	789	52,967	99
January	0	5,674	545	108	6,326.8	407	5,920	94
February	803	25,166	2,173	149	28,290	8,703	19,587	69
March	0	237	404	50	691	0	691	100
April	8,350	55,735	18,129	1,340	83,555	11,397	72,157	86
May	964	30,700	3,279	311	35,253	10,473	24,781	70
June	5,289	14,144	3,894	500	23,828	21,120	2,708	11
July	10,393	22,510	8,885	1,242	43,031	25,690	17,340	40
August	9,530	26,419	3,253	389	39,591	7,877	31,713	80
September	6,024	7,741	5,228	2,487	21,481	8,956	12,524	58
October	216	2,496	2,596	267	5,574.7	1,214	4,361	78
November	393	11,620	4,548	662	17,222	2.7	17,220	100
Totals:	**49,062**	**247,555**		**7,941**	**358,600**	**96,630**	**261,970**	**73**

Site: Pembroke Pines **Parameter: Chromium**

Month	Mass Inputs (g)					Outfall	Mass Retained	
	SW - 1	SW - 2	SW - 3	Bulk Precip.	Total	Losses (g)	(g)	(%)
December	15.7	9.5	2.0	0.2	27	4.9	23	82
January	0	1.7	0.1	0.1	1.9	0.5	1	71
February	1.7	10.3	3.2	2.4	18	11.1	7	37
March	0	0.1	0.3	0.2	1	0	1	100
April	1.9	20.2	4.7	1.1	28	10.1	18	64
May	1.3	21.0	6.8	1.2	30	13.7	17	55
June	12.1	33.8	9.7	3.7	59	28.5	31	52
July	19.5	24.4	8.5	4.3	57	34.0	23	40
August	33.9	16.4	4.9	1.6	57	13.5	43	76
September	12.4	35.3	8.4	4.4	60	47.9	13	21
October	0.5	6.1	1.3	0.5	8.4	5.4	3	35
November	1.1	8.0	2.5	1.2	13	8.3	5	35
Totals:	**100**	**187**		**21**	**360**	**178**	**182**	**51**

Site: Pembroke Pines **Parameter: Copper**

Month	Mass Inputs (g)					Outfall	Mass Retained	
	SW - 1	SW - 2	SW - 3	Bulk Precip.	Total	Losses (g)	(g)	(%)
December	3.8	8.0	0.6	0.1	12	1.0	11	92
January	0	1.3	0.1	0.0	1.4	0.1	1	91
February	0.4	7.5	1.6	0.7	10	6.9	3	33
March	0	0.1	0.2	0.1	0	0	0	100
April	6.8	10.4	8.3	0.9	26	16.9	9	36
May	0.2	8.4	5.3	0.5	14	12.8	2	11
June	9.7	15.1	3.4	0.7	29	10.7	18	63
July	5.6	9.8	4.6	1.6	22	10.7	11	50
August	4.9	7.2	1.5	0.4	14	4.9	9	65
September	2.9	5.6	4.1	0.5	13	5.4	8	59
October	0.1	1.3	0.4	0.1	1.9	1.1	1	38
November	0.2	2.9	0.8	0.3	4	3.6	1	15
Totals:	**35**	**77**		**6**	**149**	**74**	**74**	**50**

Monthly Mass Balance for Inputs and Losses

Site: Pembroke Pines **Parameter: Lead**

Month	Mass Inputs (g)					Outfall	Mass Retained	
	SW - 1	SW - 2	SW - 3	Bulk Precip.	Total	Losses (g)	(g)	(%)
December	3.0	0.7	0.2	0.1	4	0.5	3	88
January	0	0.2	0.1	0.0	0.2	0.1	0	42
February	0.3	1.2	0.4	0.1	2	1.2	1	43
March	0	0.0	0.0	0.0	0	0	0	100
April	0.8	3.1	0.9	0.3	5	2.9	2	42
May	0.2	4.2	1.2	1.1	7	5.8	1	14
June	3.4	5.7	1.5	0.9	12	6.4	5	45
July	4.7	9.8	2.6	0.9	18	10.7	7	40
August	3.9	2.5	0.7	0.4	8	2.5	5	67
September	2.9	5.6	1.6	0.5	11	5.4	5	49
October	0.1	1.3	0.4	0.1	1.9	1.1	1	38
November	0.2	2.9	0.8	0.3	4	2.8	1	32
Totals:	**19**	**37**		**5**	**72**	**39**	**32**	**45**

Site: Pembroke Pines **Parameter: Zinc**

Month	Mass Inputs (g)					Outfall	Mass Retained	
	SW - 1	SW - 2	SW - 3	Bulk Precip.	Total	Losses (g)	(g)	(%)
December	6.4	7.3	14.8	0.4	29	3.5	25	88
January	0	2.3	0.4	0.1	2.8	0.3	3	90
February	0.7	25.5	10.3	2.2	39	36.8	2	5
March	0	0.3	1.4	0.7	2	0	2	100
April	13.5	99.1	46.8	18.5	178	103	75	42
May	0.2	50.5	49.0	8.1	108	103	5	4
June	18.8	77.6	71.1	8.6	176	105	71	40
July	10.0	155.8	88.0	16.2	270	110	160	59
August	7.7	24.8	40.6	1.9	75	21.5	54	71
September	5.9	37.1	28.9	2.2	74	20.0	54	73
October	0.2	6.0	5.5	0.4	12.0	2.0	10	84
November	0.4	19.3	10.9	1.7	32	10.9	21	66
Totals:	**64**	**505**		**61**	**998**	**516**	**482**	**48**

F.4 Orlando Underdrain

Monthly Mass Balance for Inputs and Losses

Site: Orlando **Parameter: Ammonia**

Month	Mass Inputs (g)						Outfall Losses (g)	Mass Retained	
	SW - 1	SW - 2	SW - 3	SW - 4	Bulk Precip.	Total		(g)	(%)
December	0.3	0	0	0	7.8	8	0.2	8	98
January	0.2	0	0	0	7.4	7.6	0.2	7	97
February	0	0	0	0	70.8	71	0.2	71	100
March	2.0	2.8	7.4	4.1	209	226	19	207	92
April	26	1.7	37	36	473	574	14	560	98
May	29	2.6	6.0	1.7	141	180	10	170	95
June	44	4.9	7.2	1.8	204	262	18	244	93
July	74	4.6	8.6	2.4	64.7	154	10	144	94
August	20	5.9	15	11	147	198	43	155	78
September	13	7.5	16	11	175	222	61	161	72
October	5.0	0.3	1.4	6.1	23.0	35.9	15	21	58
November	4.0	0.5	1.6	2.1	19.2	27	8.9	19	68
Totals:	**218**	**31**	**100**	**75.3**	**1,542**	**1,966**	**199**	**1,767**	**90**

Site: Orlando **Parameter: NOx**

Month	Mass Inputs (g)						Outfall Losses (g)	Mass Retained	
	SW - 1	SW - 2	SW - 3	SW - 4	Bulk Precip.	Total		(g)	(%)
December	3.2	0	0	0	15.0	18	11	7	39
January	3.3	0	0	0	14.1	17.5	11	6	36
February	0	0	0	0	9.9	10	5.6	4	43
March	133	76	41	35	212	497	402	95	19
April	356	64	78	75	247	820	803	17	2
May	253	35	43	55	157	543	272	271	50
June	896	164	174	142	382	1,758	1,027	731	42
July	455	50	93	90	187	875	375	501	57
August	276	32	57	49	223	637	533	104	16
September	296	24	32	32	114	499	544	-46	-9
October	42	8.1	2.4	8.3	17.0	78.0	76	2	2
November	34	4.3	2.9	4.2	14.2	59	60	0	-1
Totals:	**2,748**	**458**	**523**	**491**	**1,592**	**5,812**	**4,120**	**1,691**	**29**

Site: Orlando **Parameter: Diss. Organic N**

Month	Mass Inputs (g)						Outfall Losses (g)	Mass Retained	
	SW - 1	SW - 2	SW - 3	SW - 4	Bulk Precip.	Total		(g)	(%)
December	2.8	0	0	0	2.1	5	0	5	100
January	1.6	0	0	0	2.0	3.6	0	4	100
February	0	0	0	0	21.3	21	0	21	100
March	11	7.3	5.0	8.1	40.5	72	8.1	63	89
April	124	61	30	59	124	397	59	338	85
May	64	100	45	34	36	279	34	245	88
June	319	67	57	58	45	546	58	488	89
July	257	113	16	12	131	528	12	516	98
August	132	46	32	16	91.2	318	16	302	95
September	142	25	12	26	103	307	26	282	92
October	27	8.0	2.4	1.9	25.2	64.3	1.9	62	97
November	21	4.3	1.8	1.8	21.1	50	1.8	49	96
Totals:	**1,100**	**432**	**201**	**217.0**	**643**	**2,592**	**217**	**2,375**	**92**

Monthly Mass Balance for Inputs and Losses

Site: Orlando **Parameter: Particulate N**

Month	Mass Inputs (g)						Outfall Losses (g)	Mass Retained	
	SW - 1	SW - 2	SW - 3	SW - 4	Bulk Precip.	Total		(g)	(%)
December	1.4	0	0	0	2.7	4	3.0	1	25
January	1.3	0	0	0	2.5	3.8	3.1	1	18
February	0	0	0	0	10.5	11	1.6	9	85
March	34	5.7	6.2	3.3	59.4	109	115	-6	-6
April	185	60	23	48	148	464	516	-52	-11
May	178	24	7.0	23	107	339	475	-136	-40
June	230	38	33	94	245	639	256	383	60
July	91	20	55	47	33.9	248	137	110	45
August	102	32	13	36	37.7	221	249	-28	-13
September	122	60	6.9	7.7	110	307	171	137	44
October	23	2.3	6.5	3.2	56.7	92.1	104	-12	-13
November	19	3.6	2.2	1.3	47.4	73	39	34	47
Totals:	**986**	**247**	**153**	**264.3**	**860**	**2,510**	**2,069**	**441**	**18**

Site: Orlando **Parameter: Total N**

Month	Mass Inputs (g)						Outfall Losses (g)	Mass Retained	
	SW - 1	SW - 2	SW - 3	SW - 4	Bulk Precip.	Total		(g)	(%)
December	7.7	0	0	0	28	35	18	17	48
January	7.1	0	0	0	26.1	33.1	18	15	46
February	0	0	0	0	113	113	8.7	104	92
March	193	92	62	56	560	962	569	393	41
April	801	187	185	238	1,003	2,414	1,846	568	24
May	583	176	127	126	521	1,532	1,061	471	31
June	1,602	336	327	305	940	3,509	2,573	937	27
July	1,035	197	173	154	460	2,021	1,152	868	43
August	594	133	146	125	536	1,535	1,405	130	8
September	602	118	97	76	615	1,508	939	569	38
October	97	19	13	20	122	270.3	211	60	22
November	78	14	12	10	102	216	131	85	40
Totals:	**5,600**	**1,273**	**1,141**	**1,109.6**	**5,025**	**14,148**	**9,932**	**4,216**	**30**

Site: Orlando **Parameter: SRP**

Month	Mass Inputs (g)						Outfall Losses (g)	Mass Retained	
	SW - 1	SW - 2	SW - 3	SW - 4	Bulk Precip.	Total		(g)	(%)
December	0.1	0	0	0	0.04	0	1.0	-1	-461
January	0.2	0	0	0	0.04	0.2	1.3	-1	-489
February	0	0	0	0	4.5	5	0.8	4	82
March	14	1.1	1.4	2.3	26.0	45	97	-52	-115
April	21	12	3.0	5.8	49.1	91	344	-253	-278
May	31	13	2.2	2.7	27.2	76	207	-131	-174
June	22	15	2.8	5.3	26.4	72	314	-243	-339
July	41	4.8	4.0	2.6	27.9	80	195	-115	-143
August	7	1.3	1.6	2.1	6.1	18	53	-35	-193
September	16	1.8	4.2	2.9	34.8	59	186	-127	-213
October	5.2	0.1	6.6	1.8	13.3	27.0	26	1	5
November	4.1	0.2	1.8	0.6	11.1	18	20	-3	-14
Totals:	**162**	**49**	**27**	**26.1**	**226**	**491**	**1,446**	**-955**	**-194**

Monthly Mass Balance for Inputs and Losses

Site: Orlando **Parameter: Diss. Organic P**

Month	Mass Inputs (g)						Outfall	Mass Retained	
	SW - 1	SW - 2	SW - 3	SW - 4	Bulk Precip.	Total	Losses (g)	(g)	(%)
December	0.1	0	0	0	0.4	1	0.0	1	96
January	0.1	0	0	0	0.4	0.5	0.0	0	93
February	0	0	0	0	2.3	2	0.0	2	99
March	1.8	5.3	1.2	0.4	9.2	18	3.5	14	81
April	86	45	13	2.9	11.6	159	22	137	86
May	33	39	23	4.3	4.8	104	35	69	66
June	36	20	53	6.6	11.1	126	29	97	77
July	46	15	28	5.7	9.2	105	32	72	69
August	33	21	35	8.4	23.3	119	14	105	88
September	68	19	7.6	25	69.8	189	13	176	93
October	4.4	5.0	0.6	0.5	18.9	29.5	5.4	24	82
November	3.6	3.0	0.7	0.9	15.8	24	2.4	22	90
Totals:	**311**	**172**	**162**	**54.8**	**177**	**877**	**157**	**720**	**82**

Site: Orlando **Parameter: Particulate P**

Month	Mass Inputs (g)						Outfall	Mass Retained	
	SW - 1	SW - 2	SW - 3	SW - 4	Bulk Precip.	Total	Losses (g)	(g)	(%)
December	0.5	0	0	0	0.5	1	0.4	1	58
January	0.4	0	0	0	0.5	0.9	0.4	0	53
February	0	0	0	0	1.0	1	0.2	1	80
March	10	6.3	3.8	2.6	11.8	34	14	20	58
April	50	21	13	5.6	13.7	103	56	46	45
May	5	8.1	3.5	7.5	19.8	44	19	25	57
June	91	9.3	5.9	20	14.2	141	69	71	51
July	27	3.6	1.8	11	20.7	64	26	37	59
August	25	6.0	5.6	5.7	7.1	50	49	1	2
September	10	4.4	2.2	4.9	16.5	38	14	24	63
October	3.9	1.2	10	0.4	1.3	16.5	7.6	9	54
November	3.1	0.7	1.5	0.4	1.1	7	3.0	4	56
Totals:	**226**	**61**	**47**	**57.9**	**108**	**499**	**260**	**239**	**48**

Site: Orlando **Parameter: Total P**

Month	Mass Inputs (g)						Outfall	Mass Retained	
	SW - 1	SW - 2	SW - 3	SW - 4	Bulk Precip.	Total	Losses (g)	(g)	(%)
December	0.8	0	0	0	1.0	2	1.4	0	17
January	0.8	0	0	0	0.9	1.7	1.8	0	-6
February	0	0	0	0	7.9	8	1.1	7	86
March	26	13	6.4	5.8	49.8	101	115	-14	-14
April	165	78	30	17	77.0	366	424	-58	-16
May	102	60	33	15	57.3	268	262	6	2
June	213	59	67	37	54.9	431	426	5	1
July	136	34	34	21	59.4	284	261	23	8
August	100	31	44	25	79.4	278	127	152	55
September	106	26	19	35	153	340	218	122	36
October	14	6.4	17	2.8	33.5	73.0	39	34	47
November	11	3.9	6.1	2.6	27.9	51	27	24	48
Totals:	**874**	**311**	**256**	**161.1**	**602**	**2,204**	**1,902**	**301**	**14**

Monthly Mass Balance for Inputs and Losses

Site: Orlando **Parameter: TSS**

Month	Mass Inputs (g)						Outfall Losses (g)	Mass Retained	
	SW - 1	SW - 2	SW - 3	SW - 4	Bulk Precip.	Total		(g)	(%)
December	322	0	0	0	242	564	328	236	42
January	231	0	0	0	229	459.8	222	238	52
February	0	0	0	0	204	204	75	129	63
March	3,002	289	4,285	1,789	4,672	14,037	2,414	11,623	83
April	34,119	8,056	11,001	8,868	5,033	67,077	11,723	55,354	83
May	8,980	12,355	5,999	3,187	4,614	35,135	13,005	22,130	63
June	15,743	6,979	7,240	5,715	4,030	39,707	16,735	22,972	58
July	15,978	1,989	6,536	4,638	2,912	32,053	11,283	20,770	65
August	12,881	3,591	2,993	3,328	2,360	25,153	21,024	4,129	16
September	11,745	4,437	5,465	2,305	3,550	27,502	3,384	24,119	88
October	2,775	1,105	957	318	739	5,893.9	3,594	2,300	39
November	2,220	678	767	221	617	4,503	1,024	3,479	77
Totals:	**107,996**	**39,478**	**45,244**	**30,370.2**	**29,201**	**252,290**	**84,811**	**167,479**	**66**

Site: Orlando **Parameter: Chromium**

Month	Mass Inputs (g)						Outfall Losses (g)	Mass Retained	
	SW - 1	SW - 2	SW - 3	SW - 4	Bulk Precip.	Total		(g)	(%)
December	0.2	0	0	0	1.1	1	0.5	1	60
January	0.1	0	0	0	1.1	1.2	0.3	1	74
February	0	0	0	0	0.6	1	0.1	0	84
March	1.1	0.3	0.4	0.5	1.9	4	2.2	2	48
April	8.9	2.8	1.8	1.6	13.7	29	22.4	6	22
May	11.0	2.7	1.5	1.4	5.6	22	20.9	1	6
June	23.1	4.3	2.7	2.6	12.2	45	29.6	15	34
July	5.6	0.9	0.8	0.7	5.5	14	14.4	-1	-6
August	14.7	4.1	1.7	2.0	9.4	32	22.1	10	30
September	6.4	1.7	4.1	1.3	5.7	19	11.6	8	40
October	0.5	0.2	0.5	0.2	0.9	2.3	1.9	0	17
November	0.4	0.2	0.5	0.1	0.7	2	1.4	1	28
Totals:	**72**	**17**	**14**	**10.5**	**58**	**172**	**127**	**45**	**26**

Site: Orlando **Parameter: Copper**

Month	Mass Inputs (g)						Outfall Losses (g)	Mass Retained	
	SW - 1	SW - 2	SW - 3	SW - 4	Bulk Precip.	Total		(g)	(%)
December	0.2	0	0	0	0.2	0	0.2	0	54
January	0.1	0	0	0	0.2	0.3	0.1	0	61
February	0	0	0	0	0.1	0	0.0	0	66
March	2.2	0.1	0.8	0.3	1.6	5	1.7	3	66
April	16.0	2.8	2.3	3.0	4.5	29	9.4	19	67
May	4.8	1.5	0.3	1.0	1.3	9	3.2	6	64
June	14.4	2.2	1.8	2.2	5.7	26	13.2	13	50
July	9.4	0.8	0.3	0.5	1.4	12	4.2	8	66
August	2.5	0.6	0.4	0.3	1.4	5	3.4	2	34
September	1.7	0.5	0.5	0.4	1.3	4	3.5	1	23
October	0.2	0.0	0.1	0.0	0.2	0.6	0.4	0	40
November	0.1	0.0	0.1	0.0	0.2	1	0.3	0	33
Totals:	**52**	**9**	**7**	**7.8**	**18**	**93**	**40**	**53**	**57**

Monthly Mass Balance for Inputs and Losses

Site: Orlando **Parameter: Lead**

Month	Mass Inputs (g)						Outfall Losses (g)	Mass Retained	
	SW - 1	SW - 2	SW - 3	SW - 4	Bulk Precip.	Total		(g)	(%)
December	0.0	0	0	0	0.0	0	0.1	0.0	-41
January	0.0	0	0	0	0.0	0.1	0.1	0.0	-12
February	0	0	0	0	0.0	0	0.0	0.0	21
March	0.4	0.1	0.1	0.1	0.4	1	0.9	0.3	24
April	2.3	0.6	0.5	0.5	1.8	6	4.7	0.9	16
May	1.7	0.4	0.3	0.3	1.3	4	3.2	0.9	22
June	2.9	1.3	0.6	0.6	2.5	8	6.0	2.0	25
July	5.0	0.7	0.3	0.3	1.4	8	2.9	4.8	62
August	1.3	0.3	0.3	0.3	1.2	3	2.6	0.8	23
September	1.2	0.3	0.2	0.2	1.0	3	2.4	0.6	19
October	0.2	0.0	0.0	0.0	0.2	0.5	0.4	0.2	29
November	0.1	0.0	0.0	0.0	0.2	0	0.3	0.1	34
Totals:	**15**	**4**	**2**	**2.4**	**10**	**34**	**24**	**10**	**31**

Site: Orlando **Parameter: Zinc**

Month	Mass Inputs (g)						Outfall Losses (g)	Mass Retained	
	SW - 1	SW - 2	SW - 3	SW - 4	Bulk Precip.	Total		(g)	(%)
December	2.5	0	0	0	0.8	3	0.7	3	78
January	1.5	0	0	0	0.8	2.3	0.5	2	77
February	0	0	0	0	1.9	2	0.2	2	90
March	11.1	1.9	11.3	5.9	38.1	68	6.7	62	90
April	84.5	5.7	25.2	19.0	69.7	204	4.7	200	98
May	33.4	10.8	3.6	13.4	47.0	108	7.2	101	93
June	84	22	14	15	68.3	204	47.4	156	77
July	54	11	3	7	32.8	107	41.6	66	61
August	31.2	6.9	3.5	2.7	21.6	66	21.0	45	68
September	8.3	3.4	3.3	1.3	9.1	26	3.5	22	86
October	1.8	0.4	1.2	0.9	1.5	5.9	1.1	5	81
November	1.5	0.4	0.7	0.3	1.3	4	0.6	3	86
Totals:	**314**	**63**	**66**	**65.3**	**293**	**801**	**135**	**665**	**83**