FPL-014A

Turkey Point Plant

Comprehensive Pre-Uprate Monitoring Report

Units 3 & 4 Uprate Project

October 31, 2012





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ACRONYMS AND ABBREVIATIONS

%	percent
≥	greater than or equal to
°C	degrees Celsius
µg/L	micrograms per liter
µm	micrometer
µmho/cm	micromhos per centimeter
µmols/m^2/sec	micromole per square meter per second
µS/cm	micro Siemens per centimeter
‰	parts per mille
1x1	1-meter by 1-meter (subplot)
20x20	20-meter by 20-meter (plot)
5x5	5-meter by 5-meter (subplot)
ADaPT	Automated Data Processing Tool
ADCP	Acoustic Doppler Current Profiler
ADFM	acoustic Doppler flow meter
ADVM	acoustic Doppler velocity meter
AFDW	ash-free dry weight
AEI	area of ecological interest
Agencies	South Florida Water Management District, the Florida Department of Environmental Protection, and Miami-Dade County Department of Environmental Resources Management
ANPP	Annual Net Primary Productivity
ANOVA	analysis of variance
Annual Monitoring Report	Florida Power & Light Company Turkey Point Plant Annual Monitoring Report for the Units 3 and 4 Uprate Project
AT100	Aqua TROLL® 100 (probe)

AT200	Aqua TROLL® 200 (probe)
B	bottom
Ba	Barium
BAS	Biscayne Aquifer/Surficial Aquifer System
BBCA	Braun-Blanquet Cover Abundance
BBSW	Biscayne Bay Surface Water
BNP	Biscayne National Park
BSL	below sea level
BTOC	below top of casing
C	carbon
$CaCO_3$	calcium carbonate
cc	cubic centimeter
CCS	cooling canal system
CCV	continuing calibration verification
cdb	culm diameter at the plant base
CL	carapace length
cm	centimeter(s)
CO_2	carbon dioxide
CPUE	catch per unit effort
CRM	certified reference material
CRP	continuous resistivity profiling
CW	carapace width
CWP	circulating water pump
D	deep
DERM	(Miami-Dade County) Department of Environmental Resources Management
df	degrees of freedom
D_f	freshwater density
DFA	discriminant function analysis
DIC	dissolved inorganic carbon
DMA	dimethylamine
DO	dissolved oxygen

DQO	data quality objective
DTS	distributed temperature sensing
DUS	Data Usability Summary
E & E	Ecology and Environment, Inc.
EB	equipment blank
EDMS	Electronic Data Management System
e.g.	for example
EPA	(United States) Environmental Protection Agency
f/s	foot/feet per second
F.A.C.	Florida Administrative Code
FAS	Floridan Aquifer System
FCEB	field cleaned equipment blank
FD	field duplicate
FDEP	Florida Department of Environmental Protection
FDOH/BRC	Florida Department of Health, Bureau of Radiation Control
Fe	Iron
FIU-WQM	Florida International University Water Quality Monitoring
FPL	Florida Power & Light Company
FPL database	Florida Power and Light Electronic Data Management System database
ft	foot/feet
ft/d	foot/feet per day
ft^3/s	cubic foot/feet per second
FTT	faunal throw trap
gal	gallon
g/cm^3	grams per cubic centimeter
g/m^2	grams per square meter
GIS	geographic information system
g/L	grams per liter
gpm	gallon(s) per minute
GPS	Global Positioning System
GW	groundwater

^{3}H	tritium
H_f	freshwater equivalent groundwater elevation
HCl	hydrocholoric acid
HCM	hydrological conceptual model
HSD	honestly significant difference
H_w	groundwater elevation
i.e.	that is
I	intermediate (well depth)
IC	initial calibration
ICV	initial calibration verification
ICWP	intake cooling water pump
ID	Interceptor Ditch
IR	initial read
K	potassium
km	kilometer
km/hr	kilometer(s) per hour
lb	pound
LCS	laboratory control sample
Li	Lithium
LL	live loss
LNWR	Loxahatchee National Wildlife Refuge
LSC	live standing crop
LT500	Level TROLL® 500 (probe)
m	meter(s)
M	Intermediate
MDL	method detection limit
MGD	million gallons per day
mg/kg	milligrams per kilogram
mg/L	milligram(s) per liter
mL	milliliter(s)
MLC	maximum likelihood classification

Monitoring Plan	Groundwater, Surface Water, and Ecological Monitoring Plan for the Florida Power & Light Company Turkey Point Nuclear Power Plant (2009)
M_P	measured pressure (psi)
ms	meters per second
MS	Matrix Spike
MS	Microsoft
mS/cm	milliSiemens per centimeter
MSL	mean sea level
mV	millivolt(s)
MW	megawatt(s)
NAVD 88	North American Vertical Datum of 1988
ND	Not Detected
NE	Northeast
NELAC	National Environmental Laboratory Accreditation Conference
NEXRAD	next generation weather radar
NGVD 29	National Geodetic Vertical Datum of 1929
NH_3	Ammonia
NIST	National Institute of Standards and Technology
NO_x	nitrate/nitrite
NRC	Nuclear Regulatory Commission
NTU	nephelometric turbidity unit(s)
NW	Northwest
OBI	optical borehole image
OCWP	open cooling water pump
OP	orthophosphate
ORP	oxidation reduction potential
PAR	photosynthetically active radiation
pCi/L	picocuries per liter
PDS	post digestion spike
PERA	(Miami-Dade County) Permitting, Environment and

	Regulatory Affairs (formerly DERM; now RER)
PPF	photosynthetic photon flux
ppt	parts per thousand
PQL	practical quantitation limits
PSS-78	Practical Salinity Scale of 1978
PSU	practical salinity unit(s)
QA	quality assurance
QAPP	Quality Assurance Project Plan
R_L	reference water level
R_P	reference pressure (psi)
RER	(Miami-Dade County) Department of Regulatory and Economic Resources (formerly PERA)
RPD	relative percent difference
RTK	Real Time Kinematic
S	shallow (well)
SAV	submerged aquatic vegetation
S.C.	specific conductance
SD	serial dilution
SDG	sample delivery group
SE	southeast
SFWMD	South Florida Water Management District
SG	specific gravity
SL	standard length
SL500	Sontek Argonaut® Side Looker 500
Std Dev	Standard Deviation
SW	surface water; *also* southwest
S_w	well screen midpoint elevation
SWI	Shannon-Wiener Index (of Diversity)
T	top
TDS	total dissolved solids
TestAmerica	TestAmerica Laboratories, Inc.
TKN	total Kjeldahl nitrogen

TL	total length
TN	total nitrogen
TP	total phosphorus
TPGW	Turkey Point Groundwater
TPM-1	Turkey Point Meteorological Station
TPRF	Turkey Point Rain Fall
TPSWC	Turkey Point Surface Water Canal
TPSWCCS	Turkey Point Surface Water Cooling Canal System
TPSWID	Turkey Point Surface Water Interceptor Ditch
USGS	United States Geological Survey
W_L	water level (feet NAVD 88)

EXECUTIVE SUMMARY

Florida Power & Light Company (FPL) has prepared this Comprehensive Pre-Uprate Monitoring Report pursuant to Conditions of Certification IX and X of its Power Plant Site Certification for the FPL Turkey Point Units 3 and 4 Nuclear Power Plant and Unit 5 Combined Cycle Plant (PA 03-45A2). The Monitoring Plan was developed with input from the Florida Department of Environmental Protection (FDEP), the South Florida Water Management District (SFWMD), and Miami-Dade County's Department of Environmental Resources Management (DERM), (collectively, the Agencies), and FPL. The Monitoring Plan requires the collection of groundwater, surface water, meteorological, flow, and ecological data in and around the plant to establish pre-Uprate baseline conditions and determine the horizontal and vertical effects and extent, if any, of the cooling canal system (CCS) water.

FPL has prepared this Comprehensive Pre-Uprate report to document its efforts to establish a pre-Uprate baseline conditions for the required two year pre-Uprate period. The purpose of this report is to summarize and provide analysis of the data collected. This report incorporates information presented in the previous semi-annual reports (FPL 2011a, FPL 2012a) and first annual report (FPL 2011b). It includes data from June 2010 through June 2012.

In accordance with the Monitoring Plan, FPL installed an extensive monitoring network of 47 groundwater wells and 20 surface water stations, a meteorological station, rainfall gauges, and flow meters in the CCS and surrounding area. The groundwater and surface water stations measure and record specific conductance, salinity, water levels, and temperature at 15-minute intervals. Groundwater and surface water samples are collected across the vast network of stations every three months and analyzed for a broad suite of parameters. FPL conducted extensive ecological monitoring and studied flora and fauna in Biscayne Bay, marshes, and mangroves. Initially, FPL collected water samples from the shallow soils (referred to as porewater) at hundreds of locations that covered a 75 square mile area in the vicinity of the CCS and analyzed for a broad suite of parameters.

As required by the Monitoring Plan, FPL has developed a water budget. This analysis calculates components of water and salt inflow and outflow from the CCS on a daily basis. The water budget helps explain the dynamics of CCS hydraulics and may be used to assess the effect of climatic or operational changes on the CCS water levels and salinities.

The Agencies and their experts considered and analyzed the previous data collected and have selected tritium as the tracer. FPL disagrees with the low tritium threshold that the Agencies selected when evaluating potential movement of the CCS. Tritium is a by-product of the nuclear fission process and is unique to and present in and around the CCS. It is important to note that tritium is being measured only as a chemical tracer in order to determine the potential movement of CCS water. At the levels being measured, the tritium is not a public health concern. Tritium is routinely monitored in the CCS by the Florida Department of Health, Bureau of Radiation Control and there have never been results detected near the drinking water standard (20,000 picoCuries per liter).

The results of the two years of pre-Uprate data analysis are summarized below.

Biscayne Bay groundwater results support the conclusion that there is little or no influence from the CCS in the area fronting the northern half of the CCS. However, there is evidence of CCS water under Biscayne Bay in close proximity to the southern tip of the CCS. Over the two year monitoring period, the results indicate that the salt constituents and tracer have remained consistent for all wells. This is indicative of the groundwater maintaining a relatively stable condition during this time period.

Groundwater results immediately adjacent to the CCS indicate the presence of CCS water. Further west from the CCS, there is some influence of CCS water in decreasing concentrations at depth out approximately three miles. The outermost wells approximately six miles to the west are fresh at all depths. Similar to the wells in the bay, the results indicate the salt constituents and tracer have remained consistent for all wells. This is indicative of the groundwater maintaining a relatively stable condition during this time period. A shallow fresher water lens still exists west of the CCS and is supported by the induction logging conducted for this project and the continuous specific conductance profiling done in several historical wells for the interceptor ditch (ID) monitoring. This lens is 10 to 20 feet deep from the surface and generally thickens towards the west.

In most surface water stations, there is no influence of CCS water via groundwater pathway. There are two locations in the surface water canal stations immediately adjacent to the south end of the CCS where there appears to be some CCS water present.

FPL concludes the CCS does not have any ecological impact on the surrounding areas. FPL further concludes there is no evidence of CCS water in the surrounding ecosystems from a groundwater pathway.

FPL concluded that atmospheric deposition of the tracer can affect the surface water, porewater, and very shallow groundwater results as indicated by measured concentrations of tritium and must be considered when evaluating CCS surface water and porewater results. These tritium values are more concentrated immediately adjacent to the CCS and diminish with distance from the CCS.

It is important to understand the historical context of saltwater in the region and to the west of the CCS. Saltwater intrusion pre-dates the construction of the CCS and extended far inland in the 1940s (Klein 1957). Based on historical data, much of the groundwater in the vicinity of the CCS was non-potable. The extent of saltwater intrusion, as defined by the U.S. Geological Survey, varies from year to year but the landward extent of the saltwater intrusion today is still similar to that reported in the 1950s.

FPL and the Agencies conducted a joint study separate from the Monitoring Plan to determine the landward extent of the saltwater orientation in the region prior to construction of the CCS. In August 2011, FPL and the Agencies reached agreement on the conclusions as documented in a report “Saltwater Orientation in the Biscayne Aquifer in the Turkey Point Plant Vicinity Prior to Installation of the Cooling Canal System.” Based on data from the Monitoring Plan, as compared to this report, the western historical extent of saltwater has not changed appreciably since the construction of the CCS in 1972. In fact, all the well clusters furthest to the west contained freshwater historically and still do today. Directly beneath and adjacent to the CCS, the saltwater wedge is closer to the land surface than it was prior to the CCS installation.

In conclusion, FPL has completed two years of pre-Uprate baseline monitoring. Many factors can cause saltwater intrusion, including groundwater withdrawals, agricultural uses, mining, government water management practices, etc. The impact of CCS water at a particular location, the relevancy of its presence, and how the water reached that location, must be considered when assessing the results and determining how to proceed.

FPL has recommended some changes to the monitoring, particularly in the interim period until 2013 when the Uprates of both Turkey Point nuclear units will be completed and those units returned to service at the Uprated power levels. Lastly, FPL makes recommendations in this report that some of the analytical parameters be eliminated.

Going forward, FPL will continue to comply with the Monitoring Plan for the required two year post-Uprate monitoring period. Since increases in temperature and salinity are expected to be minimal after the Uprate Project is implemented, there should be no presumption that the Project will cause any impact to the surrounding environment. The post-Uprate monitoring will help determine if there are any measurable impacts.

1. INTRODUCTION

Florida Power & Light Company (FPL) submits this Comprehensive Pre-Uprate Monitoring Report dated October 2012 for the Units 3 and 4 Uprate Project. This monitoring report has been prepared in accordance with the FPL Turkey Point Power Plant (Turkey Point) Groundwater, Surface Water, and Ecological Monitoring Plan, referred to herein as the Monitoring Plan (South Florida Water Management District [SFWMD] 2009a). The Monitoring Plan requires the collection of groundwater, surface water, meteorological, flow, and ecological data in and around the plant to establish pre-Uprate baseline conditions and determine the horizontal and vertical effects and extent, if any, of the cooling canal system (CCS) water. For further details, refer to the Monitoring Plan (SFWMD 2009a) and Fifth Supplemental Agreement (SFWMD 2009b). The purpose of this Comprehensive Pre-Uprate Monitoring Report is to summarize the pre-Uprate monitoring efforts, to present and summarize the data, and to discuss results. This report incorporates information presented in the previous semi-annual reports (FPL 2011a, FPL 2012a) and annual report (FPL 2011b) and includes data from June 2010 through June 2012.

Data were collected in accordance with the FPL Quality Assurance Project Plan (QAPP) that was available at the time of sample collection (FPL 2010 and 2011c) as well as changes to the QAPP that the SFWMD, the Florida Department of Environmental Protection (FDEP), and the Miami-Dade County Department of Regulatory and Economic Resources (RER, formerly known as Department of Environmental Resource Management [DERM]) (collectively described herein as the Agencies) provided to FPL in June 2011 and the suggested revisions that FPL provided to the agencies in August 2011 and March 2012. FPL's suggested revisions more accurately reflect data collection practices being performed in the field. Any notable deviations are discussed herein and/or are found in the field and laboratory audits (SFWMD 2011, 2012a, and 2012b; FPL 2012b and 2012c).

1.1 Brief Overview of Automated Monitoring Network

FPL installed an extensive automated monitoring network to collect groundwater, surface water, meteorological, and hydrologic data at 15-minute intervals over a broad area surrounding Turkey Point. Table 1.1-1 provides a summary of monitoring efforts and includes information on when the automated monitoring was initiated. A brief overview of each monitoring network is provided below, and further discussion regarding the instrumentation, data collection, and results for the network is included in Section 2 of this report. Photographs of the automated stations are included in Appendix A.

1.1.1 Groundwater

From February through June 2010, FPL installed 42 wells in 14 well clusters (TPGW-1 to TPGW-14) at and around Turkey Point (Figure 1.1-1). Coordinates of each station are provided in Appendix A. The locations were determined based on site conditions and extensive coordination among FPL and the Agencies. The placement of station locations in Biscayne Bay also was coordinated with Biscayne National Park (BNP).

Three separate wells were installed at each location: a shallow well (S); an intermediate depth well (M); and a deep well (D). The borehole for the deep well was drilled first, and down-hole geophysical methods were used to help determine high flow zones and other subsurface characteristics. Based on a collaborative effort among FPL, JLA Geoscience, Inc., and the SFWMD, screen depths were established with screen lengths varying from 2 to 5 feet (ft) based on site conditions. Table 1.1-2 provides a brief summary of the well construction information, and further details are provided in the JLA Geosciences, Inc. (2010) Geology and Hydrogeology Report.

Following well completion, the top of each well casing was surveyed and infrastructure (probes, telemetry, solar panels, and other elements) was installed to facilitate the collection of automated groundwater quality and stage data at 15-minute intervals. Most of the locations were re-surveyed in June 2011 to confirm the elevations. The measured water quality parameters include actual conductance and temperature. Specific conductance, salinity, density, and total dissolved solids (TDS) are calculated by the instrumentation based on the measured parameters. Groundwater data are remotely transmitted via telemetry each day and uploaded to FPL's Electronic Data Management System (EDMS).

1.1.2 Surface Water

Per the Monitoring Plan and as shown on Figure 1.1-2, automated surface water stations were installed at the following locations:

- Seven stations in the CCS;
- Five stations in adjacent canals;
- Three stations in the Interceptor Ditch (ID); and
- Five stations in Biscayne Bay.

In addition, two non-automated stations were installed:

- One station in the CCS (TPSWCCS-8); and
- One station in the Card Sound Road Canal (TPSWC-6).

The locations of the monitoring stations were jointly determined with the Agencies and provide broad coverage of the key water bodies in the project area. Two additional stations (TPBBSW-10 and -14) were added at a later date to record conditions in Biscayne Bay; these stations are co-located with TPGW-10 and -14. Coordinates of each station are provided in Appendix A.

The automated surface water stations record the same water quality data parameters as the groundwater stations. Stage data are recorded at all locations except four stations in Biscayne Bay that do not have the infrastructure to support stage recorders or a telemetry system

(TPBBSW-1, TPBBSW-2, TPBBSW-4, and TPBBSW-5). The data at these four Biscayne Bay locations are retrieved manually at approximately six-week intervals and downloaded into the FPL EDMS. Data from the other stations are transmitted via telemetry daily onto a secure server system and automatically uploaded into the FPL database.

1.1.3 Meteorological

One meteorological station that includes instrumentation to measure solar radiation, wind speed, wind direction, air temperature, relative humidity, and rainfall was installed near the center of the CCS (TPM-1). Four additional rainfall gauging stations were installed around the CCS. Data are collected at 15-minute intervals. Data from the meteorological station are uploaded daily into the FPL database, while the rainfall gauges are manually downloaded during routine site visits. Seven rainfall collectors were installed around the CCS. Additionally, five evaporation pans have been installed at various locations. Figure 1.1-3 illustrates the locations of the above-mentioned stations. Coordinates of each station are provided in Appendix A.

1.1.4 Hydrological

Three acoustic Doppler velocity meters (ADVMs), otherwise known as index-velocity meters or flow meters, were originally set up to determine flow in the CCS at the following three locations: near the power plant discharge into the CCS; the southern end of the CCS before the water enters the return canal of the CCS; and near the intake into the plant from the CCS (Figure 1.1-4). All three units failed within the first two years of deployment due to the harsh conditions within the CCS; two units have subsequently been re-installed and are currently operational. Data are transmitted by telemetry and automatically uploaded to the FPL EDMS.

1.2 Quarterly Sampling for Laboratory Analysis

The aforementioned monitoring network for groundwater and surface water supports the collection of water samples for laboratory analysis. The Monitoring Plan specifies samples must be collected from the 42 new groundwater wells and the 20 surface water stations previously discussed. Samples also must be collected on a quarterly basis from one additional location on the Card Sound Road Canal. In addition, a sample must be collected one time at a localized location within the CCS, identified by the Agencies as potentially having cooler water than the rest of the CCS, based on thermal imagery. The timing of the quarterly sampling efforts is shown on Table 1.1-1. The samples are analyzed for a variety of parameters including CCS Tracer Suite constituents, ions, trace elements, nutrients, and TDS, along with field parameters, depending on the locations and whether the effort was a quarterly or semi-annual event.

Further discussion of the analytical parameters, sample collection methods, and results is provided in Section 3 of this report. The analytical data include sampling events conducted in June/July 2010, September 2010, December 2010, March 2011, June 2011, September 2011, December 2011, March 2012, and June 2012.

Samples were also collected at five existing historical wells as part of FPL's routine sampling for the ID operation. Samples were collected from historical wells L-3, L-5, G-21, G-28, and G-35 in October 2010 and January 2011. Initially, the timing of these sampling events was offset from the Monitoring Plan sampling events but, based on discussions with the Agencies following the January 2011 sampling effort, FPL changed the ID operation sampling to occur in the same month as the Monitoring Plan sampling. Results from the March 2011, June 2011, September 2011, December 2011, March 2012, and June 2012 sampling events, as well as the October 2010 and January 2011 events, are included in this report.

1.3 Ecological Monitoring

The Monitoring Plan and QAPP outline an ecological monitoring program. Biotic components of interest include marsh vegetation in adjacent wetlands, mangroves, submersed aquatic vegetation, and benthic fauna in and adjacent to Biscayne Bay. Table 1.1-1 provides a summary of the ecological monitoring efforts conducted. More detailed information on the transect plot setups, sampling methods and materials, laboratory results, findings, and conclusions are included in Section 4 of this report.

1.3.1 Marsh and Mangroves

Plant community characteristics (composition, cover, canopy, height, productivity), leaf characteristics, nutrient content in the leaves and soil/sediment, and porewater quality are being assessed in 12 transects in marsh and mangrove areas around the CCS (Figure 1.3-1). Two (one each in the marsh and mangrove) of those transects are in reference areas. Ecological monitoring efforts were initiated in October 2010 and completed by December 2010. Additional monitoring in the marsh and mangrove areas was conducted on a quarterly basis in February 2011, May 2011, August 2011, November 2011, February 2012, and May 2012.

1.3.2 Biscayne Bay

Submerged aquatic vegetation (SAV), coral and sponge community composition and cover, fish and invertebrate species composition and abundance, nutrient content in seagrass leaves and sediment, light attenuation, and porewater quality are being assessed in 20 transects that parallel the shoreline (Figure 1.3-1). The monitoring in Biscayne Bay is conducted twice a year. Originally, the plan was to conduct monitoring in May and October; however, during the setup of transects in October 2010, FPL noted that the seagrasses had already senesced by the time sampling was initiated. With concurrence from the Agencies, the subsequent ecological monitoring in Biscayne Bay was changed to April and September with the subsequent monitoring efforts conducted in April 2011, September 2011, and April 2012.

1.3.3 Broad-Scale Porewater Survey

In accordance with the Monitoring Plan and through coordination with the Agencies, an initial broad-scale survey of porewater temperature and specific conductance was conducted in March/April 2010 (dry season) at over 200 locations in adjacent wetlands and Biscayne Bay

(Figure 1.3-2). A second porewater temperature and specific conductance survey was conducted in August 2010 (wet season) at 100 locations in Biscayne Bay (Figure 1.3-3). Based on the initial temperature and specific conductance measurements, locations were established for the porewater samples that would be collected for Tracer Suite laboratory analysis. The wet season Tracer Suite sampling effort took place in October 2010 and the dry season sampling event was conducted in April 2011. While details of this effort are in the report titled "Turkey Point Plant Initial Ecological Characterization Report" (FPL 2012d), summaries of the approach and the findings are provided herein. The results, when used in conjunction with the other data, increase understanding of baseline porewater conditions across the broader landscape.

1.4 Hydrogeologic Assessment

1.4.1 CCS Water Budget

FPL has worked closely with the Agencies to develop an acceptable methodology for the CCS water budget. This methodology has evolved and is included in Section 5 of this report. Estimated monthly water budgets and salt loads from September 2010 through June 2012 are included in Section 5.

1.4.2 Regional Assessment and Extent of CCS Water

With the aid of data collected as part of the well installation efforts, automated data and analytical results, United States Geological Survey (USGS) induction logs, and other supporting documentation, FPL has conducted an initial assessment of the hydrogeologic conditions in the area surrounding Turkey Point and the CCS, which provides some insights into how the groundwater system responds to different environmental conditions and operation of the CCS. The rate of migration and extent of CCS water in the groundwater are discussed in Section 5 of this report.

1.4.3 Biscayne Bay Continuous Resistivity Profile Survey

The USGS conducted a pilot study in Biscayne Bay to assess the feasibility of using continuous resistivity profiling to determine the extent of CCS water both laterally and vertically in the subsurface. The survey in the Bay was conducted on May 25 and 26, 2011, with an additional transect surveyed in the CCS in July 2011. Following the processing and interpretation of the data, the USGS gave a PowerPoint presentation to FPL and the Agencies on August 29, 2012. No report was generated to provide the information to the Agencies. The USGS indicated that preparation and publication of a report would take approximately one year due to their extensive quality assurance/quality control (QA/QC) process. Alternatively, FPL provides a brief summary of the USGS's effort and FPL's overall interpretation of the preliminary findings in Section 5 of this report.

1.5 Interceptor Ditch Operation

The Interceptor Ditch (ID) is located immediately west of the CCS and is designed to prevent seasonal inland movement of saltwater from the CCS into the potable portion of the Biscayne Aquifer. Shallow saline groundwater is intercepted by the ID and pumped back to the CCS during the dry season or other times when the natural gradients are low and the potential for saltwater intrusion exists. Details of the ID operation are found in the 1983 Agreement (the Agreement) between the SFWMD and FPL. On October 14, 2009, the Agreement was modified to expand the monitoring program as part of the Turkey Point Units 3 and 4 Uprate Project and added well G-35 as part of the historical monitoring network. FPL submitted a revised operations plan to the SFWMD in 2011 and comments on that plan are pending.

Since 1972, FPL has been collecting groundwater data west of the CCS and recording ID pumping as part of the ID operation. Results of these efforts have been included in reports that are submitted on a quarterly and annual basis. Based on discussions between FPL and the SFWMD, reporting of the ID operations for the last year (June 2011 through May 2012) is integrated into Section 6 this report.

1.6 Data Quality Objectives and Acceptance Criteria

Data quality objectives (DQOs), along with acceptance criteria, are identified in the project QAPP. The DQOs include the following:

- Precision
- Accuracy
- Analytical Sensitivity
- Completeness
- Representativeness
- Comparability
- Availability
- Reliability
- Maintainability
- Timeliness

Quality guidelines have been established for some of the DQO which reflect quantifiable goals. A summary of performance in meeting the DQOs is described below.

Precision

Precision is a measure of mutual agreement between duplicate or co-located measurements of the same analyte. The closer the numerical values of the measurements are to each other, the more precise the measurement.

Precision for laboratory samples is established by the evaluation of field and laboratory duplicate samples. If the relative percent difference (RPD) between the sample and the duplicate result differ by more than 20%, the results for that analyte in both samples are qualified as questionable. While a small percentage of sample data has been qualified due to high duplicate RPDs, overall, the analytical results are comparable to duplicate samples for those samples using the same method. These precision results indicate the sampling and analytical procedures are consistently performed and repeatable. Details are provided in the Data Usability Summary (DUS) Reports issued for each event.

To assess precision of the probes being used to collect time series water quality and water level data, field measurements are taken during cleaning and calibration events to verify the results. This is discussed further in Section 2 of this report. If the specific conductance value reported by the field verification measurement is more than 30% higher or lower than the automated probe reading, the automated probe data are qualified as questionable (?) back to the previous cleaning and calibration event or, at minimum, back to an interim point where there is an unexplained shift in the data. While most of the data do not need to be qualified, the numerical degree of variability is greater in the high saline locations.

Similarly, if a temperature verification measurement is more than 0.5 degrees Celsius (°C) different than the automated probe reading, the data are qualified in the same manner. Rarely has the water quality data been qualified for not meeting a field instrument verification reading.

For verification of water level precision, refinements were made during the monitoring program. These refinements included the collection of water level measurements with a water level indicator at different times during the cleaning and calibration event. These refinements allowed the determination of the water level before pulling the probes for cleaning and after placement of the probes to verify correct reference level settings. If the difference between the verification water level reading (before the probe is pulled for cleaning) is greater than 0.1 ft from the automated probe reading, the data are qualified as estimated (J) back to the previous cleaning and calibration event or, at minimum, back to an interim point where there is an unexplained shift in the data. The precision has improved over time; however, the biggest challenge has been associated with the surface water stations in Biscayne Bay and the CCS. Sometimes wave action at these larger surface water body locations affects the water level indicator readings, making verification of the automated reading more difficult. Only a limited amount of water level data is qualified as questionable due to verification readings.

Accuracy

Accuracy is the measure of bias in a measurement system. The closer the value of a measurement agrees with the true value, the more accurate the measurement.

For the analytical results, accuracy is evaluated using percent recoveries of analytes added, termed “spiked,” to samples (matrix spikes [MSs]) or reagents (laboratory control samples [LCSs]) and carried through the extraction and analysis procedure. Laboratory-established acceptance criteria (within method requirements) are used for LCS and MS percent recoveries.

LCS percent recoveries have consistently passed acceptance criteria for all analyses indicating the laboratories extraction and analysis procedures and materials met method requirements.

In contrast, some MS recoveries have been qualified as estimated (J) or unusable (?) due to poor recoveries. Results with MS recoveries outside laboratory-established limits are qualified as "J" and recoveries less than 10% are qualified as "?" as the low recovery indicates a significant possibility of error associated with the sample result due to the matrix effects. Results were qualified as "?" in two total phosphorus, one chloride, one sulfate, and one fluoride result in saline water samples. Results were qualified as "J" in many of the samples analyzed for matrix spikes, especially with regards to nutrients. This trend will be followed during future events as it could indicate a possible error associated with the accuracy of the results due to matrix interferences.

In addition to recoveries, accuracy is evaluated using technical comparison checks, including cation and anion charge balance; cations, anions, and TDS compared to the specific conductance; total ammonia less than total Kjeldahl nitrogen (TKN); and orthophosphate (OP) less than total phosphorus (TP). Many cation and anion results, particularly in the high salinity samples, have been qualified as either "J" or "?" due to ion charge and conductance comparisons. TDS/specific conductance and ammonia/TKN comparisons were acceptable.

TP and OP were first sampled in events from June 2010 to February 2011 and the OP had higher results than the TP. In March 2011, the OP analytical method was modified based on a FDEP Laboratory SOP (NU-070-1.8). The sample is analyzed without the color reagent to establish a background concentration. The sample is then analyzed per the method and the background concentration is subtracted from the analytical result. Since the method modification, the OP/TP comparisons have been within the criteria.

The laboratory is considering switching to saline reagent waters to better simulate the sample matrix and reduce matrix-induced interference effects. In addition, certified reference materials (CRMs) for nutrients in saline waters are being analyzed to evaluate the validity of the laboratory results for these methods.

To further evaluate laboratory accuracy, field split samples were collected by RER in the March 2012 semi-annual sampling event and analyzed by the RER laboratory. Samples were collected from select deep wells into separate containers, shipped to TestAmerica Laboratories, Inc. (TestAmerica) and the RER laboratory, and analyzed for ammonia, nitrate/nitrite, TKN, TP, and OP. While the number of data pairs compared (four) is too small to draw major conclusions, there are some significant differences (RPD>50%) among the results for ammonia, TKN, and OP. The two laboratories follow essentially the same methods; however, even minor differences in procedures or materials can affect the analytical results. At this point, it is unclear which set of results is more accurate of the actual groundwater conditions at the time of sampling. It should be noted that the RER results have ammonia consistently greater than TKN, which is not possible; TKN is the sum of ammonia, ammonium, and organic nitrogen. FPL/TestAmerica is reviewing the RER SOPs and is performing analysis of CRMs to aid in the evaluation of the overall sample results.

The instrumentation for all the automated station instruments and field equipment meets the requirements for accuracy per the QAPP. All stations were surveyed with vertical control established to second order closure (accuracy within hundredths of a foot) with the exception of three groundwater cluster stations in Biscayne Bay. The top of the groundwater wells and surface water stilling wells at these Biscayne Bay stations were surveyed with GPS instruments to an accuracy of 0.1 ft.

Analytical Sensitivity

For data validation, qualification and reporting purposes, analytical sensitivity is expressed by method detection limits (MDLs). MDLs are set such that the minimum concentration of an analyte is reported within 99% confidence that the analyte is greater than zero.

Project-required MDLs are listed in Table 3.2-1 of the QAPP. The MDLs are based on applicable criteria, MDLs listed in the Automated Data Processing Tool (ADaPT), Florida Administrative Code (F.A.C.) 62-4.246(3), and stated laboratory capabilities. While the majority of analytical detection limits have met the QAPP requirements, a few have been difficult to achieve due to the saline nature of the samples. This is particularly an issue with the trace metals and fluoride. The laboratory has had to dilute the saline samples to keep instruments from being overloaded with the major ion constituents (i.e., chloride, sodium). This has resulted in some data reported as Not Detected (U) but with detection limits above the QAPP requirements. In addition, these dilutions increase the uncertainty, or error, associated with a result. The laboratory is working to expand or tailor calibration ranges, within method requirements, to fit project samples and reduce the frequency of dilutions needed.

To achieve the required MDLs, the laboratory will be adding preparatory EPA Method 1638 (Determination of Trace Elements in Ambient Waters by Inductively Coupled Plasma Mass Spectrometry) for manganese and molybdenum and EPA Method 1640 (Determination of Trace Metals by Pre-concentration and ICP-MS) for the other trace metals listed above starting in September 2012. The added step will selectively concentrate certain metals prior to analysis to improve detection limits. For fluoride, the laboratory has modified the instrument performing the anion analysis (Method 6010) to allow for lower required dilutions and achieve the QAPP-required MDL. In addition, a fluoride selective probe method is being reviewed as a possible analytical alternative for fluoride only.

Completeness

Completeness is expressed as the percentage of valid or usable measurement to planned measurements. The higher the percentage, the more complete the measurement process. The number of planned measurements is based on when the infrastructure is in place and functional. Per the QAPP, the completeness goal for water quality measurements is 95% and 90% for all other data.

All planned groundwater, surface water, and porewater measurements have been made with a few exceptions. The well clusters at TPGW-10, TPGW-11, and TPGW-14 were not sampled during the June 2010 event as they had not been completed at that time. Some data have been qualified as unusable and, in a few instances, the sample was lost by the lab prior to analysis.

For the nine groundwater and surface water events (four quarterly and five semi-annual) since the start of the project, approximately 31,000 groundwater and surface water analytical data points were scheduled to be reported. Of those, fifteen results were qualified as unusable and thirty results (all isotopes) were not reported due to laboratory errors. For the seven porewater sampling efforts conducted at the ecological transects since the start of the project through May 2012, a total of approximately 10,600 porewater analytical data points were scheduled to be reported. Of those, four (all OP) were reported as unusable and twelve results (isotopes and ions) were not reported due to loss of the sample by the laboratory. This results in a completion rate of greater than 99% in meeting the project objectives. It should be noted that some isotope results have not been received at the time of this assessment and as such, the totals reported above are based on available data.

All the planned ecological measurements have been made with the exception of eliminating the collection of some data in the tree islands due to health concerns about excessive poison ivy on the islands. Any changes in sampling have been agreed to by the Agencies.

The automated water quality data are calculated to be 89% complete. This percentage is lowered as a result of specific conductance oscillations related to probe or cable malfunctions or radio frequency wave interferences, most notably in well clusters TPGW-1 and TPGW-13. FPL and the probe manufacturer have conducted numerous efforts to fix the problem; oscillations still occur, but less frequently.

Meteorological data at TPM-1 are 99% complete. Rainfall data at other stations and CCS flow meter data are less complete. Some of the other rain gauges have had various problems including wiring issues, malfunctioning equipment, or excessive battery drain which have resulted in data gaps. Most of the rain gauge problems have been resolved but since they are not on telemetry, the potential for data gaps of one to two months can still exist if a gauge fails. Gaps in the rain data can be addressed by interpolating results from other stations or using Next Generation Weather Radar (NEXTRAD) data from the SFWMD. Data from the CCS flow meters are less than 50% complete due in part to a number of equipment related issues. These meters are located in a harsh environment and have been removed for various reasons due to hardware components rusting and breaking or instrument failure. The flow meters were going to be used by FPL as a check to the water budget, however, based on findings discussed by FPL in Section 5, it is doubtful if the flow meter data will be used as originally envisioned.

Representativeness

Representativeness is a qualitative parameter that expresses the degree to which data accurately and precisely represent the environmental condition. The sampling locations and techniques as outlined in the Monitoring Plan and QAPP provide data that are representative of conditions in the CCS and the surrounding environment.

Groundwater wells are placed in discrete high flow zones and are spatially distributed to reflect changes in groundwater levels and quality across the landscape. Automated data are collected at 15-minute intervals, an adequate duration to reflect temporal changes in water levels, water quality, water flow, and various meteorological parameters.

Comparability

Comparability is a qualitative parameter expressing the confidence with which one set of data can be compared to another. Nearly all the data, unless qualified as "?" or unusable for other reasons, are comparable. Methods of data collection and analysis have remained primarily consistent over the two years of sampling. Some refinements in data collection have helped improve efficiency or verify precision, but have not necessarily improved precision.

The most notable data that may not be directly comparable are some of the nutrient results. As noted in the "Accuracy" section above, the method of analysis for OP was modified beginning with the collection of data in the March 2011 sampling event; OP data collected prior to March 2011 using the original method are not directly comparable to data collected during and after the March 2011 event. The data prior to the March 2011 event are believed to be biased high due to background fluorescence levels interfering with the analysis.

Nitrate/nitrite samples collected in March 2012 were filtered in the field, as will be done in subsequent events. Previously, the samples were distilled in the lab and not filtered in the field. It is expected that the results are similar. Rarely does one find insoluble forms unless they are large particulates which would not be analyzed in any case; they would have to be removed as they would interfere with the analysis. This was further demonstrated by the March 2012 PERA split samples. The samples were analyzed as filtered and unfiltered for ammonia and nitrate/nitrite with essentially identical results. Therefore, the ammonia and nitrate/nitrite results from both method variations are considered comparable.

Availability

Availability is the percentage of time that a system or function is available for service according to established criteria and the probability that the system is operating satisfactorily at any point in time, excluding times when the system is under repair. This DQO applies primarily to the automated systems.

While FPL has not calculated percentages, the stations that report automated water level and water quality collectively have a high degree of availability. These systems operate round the clock, the probes have been reliable, and spare probes and cables are on-hand to fix a problem station. The meteorological station has been reliable with no down time, thus has a high degree of available data for solar radiation, wind speed and direction, air temperature, relative humidity, and rainfall. The other rain gauges and CCS flow meters appear to record good data when operational, but some of the instruments have failed for extended periods of time. Since the individual rain gauges are not on telemetry, whether the system is operating satisfactorily or not is unknown until the site is visited monthly or bi-monthly and data are downloaded and reviewed. The CCS flow meters are more difficult to maintain.

Reliability

Reliability is the probability of a system performing a specified function without failure for a specified period of time. A "failure" occurs when a measurement or control action does not comply with established accuracy, completeness, or timeliness standards. This DQO applies primarily to the automated systems.

Collectively, the stations that report automated water level and water quality are reliable in the context of data usability. The associated probes that measure and record the data meet the accuracy requirements and exhibit high percent completeness. As previously indicated, some stations have reoccurring issues with oscillating specific conductance data and the precision at some of the higher saline sites is reduced; however, only a small percentage of the data are qualified "?". Reporting of the automated data from the stations on telemetry has typically been on a daily basis. However, a number of transmission/signal issues have occurred when the data have not been consistently reported within 24 hours for all stations. Still, in most instances, the data are stored internally on the probe and eventually downloaded when a phone connection is made or the data are manually downloaded into the system. The quality guideline for reliability, as stated in the QAPP, is difficult to judge since it reflects a mean time between failures of 18 to 24 months depending on the system. While there have been "failures" in less than 18 months, the majority of the data are usable and no decisions are being made on the raw data that is being transmitted via telemetry.

The meteorological station at TPM-1 has not failed and reports regularly, thus it maintains a high level of reliability. The rain gauges at the other sites have less complete data and thus have a lower reliability.

Maintainability

Maintainability is the ease with which a component or equipment can be modified to correct faults. The quality guideline per the QAPP for completion of repairs to components or equipment is 72 hours. Given the size of the system, remote locations of some stations, and the occasional need for extended troubleshooting efforts, strict compliance with the guideline is not always possible or even appropriate. The automated groundwater and surface water stations (inshore) are easier to maintain than some of the other systems, however, some of the oscillation and daily reporting issues have required extensive troubleshooting. On at least a weekly basis, FPL checks for any automated groundwater and surface water stations that are on telemetry but are not reporting. Often the lack of reporting is related to low signal strength or loss of telephone connection the previous day and not to an equipment malfunction. Usually, the system will eventually report. Also on a regular basis, FPL looks at time series plots of the data to see if there are any unusual data trends or oscillations requiring troubleshooting and repair efforts.

The CCS flow meters are more difficult to maintain since they are the most sophisticated pieces of equipment and are affected by the harshest conditions. Rarely can the meters or the associated infrastructure be repaired in 72 hours. FPL suggests modifying the maintainability goal in the QAPP to take logistical constraints and other realities more into account.

Timeliness

Timeliness is the promptness of reporting a measurement after it is made, reporting deficiencies, submission of reports or other project documentation, addressing corrective actions, and reporting deviations within the timeframes specified in the QAPP or within the Monitoring Plan or Agreement.

Per the QAPP, the analytical data have been consistently provided to the Agencies within 48 hours following FPL's receipt of the data from the laboratory. While much of the data from the primary laboratory is in ADaPT format, such data has not undergone a full QA/QC review at the time it is submitted to the laboratory. Since the samples are analyzed by various laboratories, the results are received at different times with several of the isotope results (notably strontium and tritium) taking the longest to obtain. Once all sample results are obtained for a sampling event, a full QA/QC check of the data is conducted and FPL generates DUS Reports. The data are also further assessed during the preparation of semi-annual and annual reports; occasionally, suspect results are found and subsequently qualified.

The automated systems are currently set to report values at 15-minute intervals and, for those systems on telemetry, to upload the results daily. As previously discussed, low signal strength or other issues have prevented various telemetry units to consistently report every day. While the raw data can be viewed by the Agencies in FPL's electronic database, the data are not official until FPL has conducted a full QA/QC review.

If additional errors are noted in the data following the QA/QC process, the results are updated in the database or DUS, as applicable, and are included in an errata or the subsequent annual report.

Reports have been submitted to the Agencies per the timeframes outlined in the QAPP or in accordance with revised schedules agreed to by the Agencies.

Once there is concurrence that corrective actions from field and laboratory audits are needed, corrective action is typically implemented immediately or by the next sampling event.

TABLES

Table 1.1-1. Summary of Monitoring Efforts (June 2010 – November 2012)

	2010							2011										2011	
Monitoring Effort	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ecological Mangrove and Marsh Monitoring					Biota Porewater (field and Tracer Suite parameters, and nutrients) Vegetation (nutrients)				Biota Porewater (field and Tracer Suite parameters)			Biota Porewater (field and Tracer Suite parameters, and nutrients) Vegetation (nutrients)			Biota Porewater (field and Tracer Suite parameters)			Biota Porewater (field and Tracer Suite parameters, and nutrients) Vegetation (nutrients)	
Ecological Biscayne Bay Monitoring					Biota Porewater (field and Tracer Suite parameters, and nutrients) Vegetation (nutrients)						Biota Porewater (field and Tracer Suite parameters, and nutrients) Vegetation (nutrients)					Biota Porewater (field and Tracer Suite parameters, and nutrients) Vegetation (nutrients)			
Automated Data Collection	TPGW-2, TPGW-3, TPGW-6, TPGW-9, TPGW-12, TPGW-13 installed between 6/22 and 6/25	Continuous for those 6 stations	All TPSWC, TPSWID, TPSWCCS stations turned on 8/23-9/3	TPGW-10 and BBSW stations (9/2/10), TPGW-11 to TPGW-14, and TPBBSW-10 (9/17/10), and TPBBSW-14 (9/18/10) turned on. TPGW-1, -4, -5, -7, -8 installed (8/31-9/15).	Continuous	Continuous	Continuous	Continuous; TPBBSW-10 and TPBBSW-14 switched from LT500 to AT200	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous
CCS Flow Meters			TPFM-1, TPFM-2 and TPFM-3 turned on	Continuous	Continuous	Continuous	TPFM-3 failed; TPFM-1 and TPFM-2 still continuous	TPFM-1 and TPFM-2 continuous	TPFM-1 and TPFM-2 continuous	TPFM-1 and TPFM-2 continuous	TPFM-1 and TPFM-2 continuous	TPFM-1 and TPFM-2 continuous	TPFM-1 and TPFM-2 continuous	TPFM-1 stopped reporting mid August	TPFM-2 stopped reporting early August				
Meteorological station		TPM-1 turned on 7/26/10	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous
Rainfall stations						TPRF-2, TPRF-4, TPRF-11, and TPRF-12 installed	Continuous data from TPRF-2 and TPRF-11	Continuous data from TPRF-2 and TPRF-11	Continuous data from TPRF-2 and TPRF-11	Continuous data from TPRF-2 and TPRF-11	Continuous data from TPRF-2 and TPRF-11	Continuous data from TPRF-2 and TPRF-11	Continuous data from TPRF-2 and TPRF-11	Continuous data from TPRF-2 and TPRF-11	Continuous data from TPRF-2 and TPRF-11	Continuous data from TPRF-2, TPRF-4, and TPRF-11	Continuous data from TPRF-2, TPRF-4, and TPRF-11	Continuous data from TPRF-2 and TPRF-11	Continuous data from TPRF-2, TPRF-4, and TPRF-11
Groundwater and Surface Water Sampling (New Stations)	Field and Tracer Suite parameters, trace metals, and nutrients with the exceptions of TPGW-10, TPGW-11, and TPGW-14 (as offshore platforms were incomplete)			Field and Tracer Suite parameters			Field and Tracer Suite parameters, TPGW-10 and TPGW-14 for trace metals, and nutrients Resampled TPGW-1 for ammonia			Field and Tracer Suite parameters, trace metals, and nutrients			Field and Tracer Suite parameters			Field and Tracer Suite parameters, trace metals, and nutrients			Field and Tracer Suite parameters
Historic Groundwater Well Sampling					Field and Tracer Suite parameters			Field and Tracer Suite parameters		Field and Tracer Suite parameters			Field and Tracer Suite parameters			Field and Tracer Suite parameters			Field and Tracer Suite parameters
Evaporation Pan Sampling										TPEVP-2, TPEVP-3, TPEVP-5, and TPEVP-12 installed	Monthly tritium	TPEVP-13A (also called TPEVP-GC) installed	Monthly tritium	Monthly tritium	Monthly tritium	Monthly tritium	Monthly tritium	Monthly tritium	Monthly tritium
Rainfall Collector Sampling												TPRF-2 through TPRF-5, TPRF-7, TPRF-8, and TPRF-12 deployed		Quarterly tritium, except for TPRF-5 (stolen)		Quarterly tritium			Quarterly tritium

Notes:
Automated data collection includes groundwater and surface water quality and stage, flow, rainfall, and meteorological glow and rainfall data at several stations are limited.
Refer to Table 30-2 for field and Tracer Suite parameters and nutrients.

Key:
TPBBSW = Turkey Point Biscayne Bay Surface Water.
TPEVP = Turkey Point Evaporation Pan(s).
TPFM = Turkey Point Flow Meter(s).
TPGW = Turkey Point Groundwater.
TPRF = Turkey Point Rainfall gauge.
TPSW = Turkey Point Surface Water.
TPSWID = Turkey Point Surface Water Inteceptor Ditch.

Notes:
Automated data collection includes groundwat
rainfall, and meteorological glow and rainfal
Refer to Table 30-2 for field and Tracer Suite p

Table 1.1-1. Summary of Monitoring Efforts (June 2010 – November 2012)

	2011		2012						
Monitoring Effort	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
Ecological Mangrove and Marsh Monitoring	Biota Porewater (field and Tracer Suite parameters, and nutrients) Vegetation (nutrients)			Biota Porewater (field and Tracer Suite parameters)			Biota Porewater (field and Tracer Suite parameters, and nutrients) Vegetation (nutrients)		
Ecological Biscayne Bay Monitoring						Biota Porewater (field and Tracer Suite parameters, and nutrients) Vegetation (nutrients)			
Automated Data Collection	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous
CCS Flow Meters							TPFM-1 and TPFM-2 reinstalled and turned on.	TPFM-1 and TPFM-2 continuous	TPFM-1 and TPFM-2 continuous
Meteorological station	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous
Rainfall stations	Continuous data from TPRF-2 and TPRF-11	Continuous data from TPRF-2, TPRF-4, and TPRF-11	Continuous data from TPRF-2, TPRF-4, and TPRF-11	Continuous data from TPRF-2, TPRF-4, and TPRF-11	Continuous data from all stations	Continuous data from all stations	Continuous data from all stations	Continuous data from all stations	Continuous data from all stations
Groundwater and Surface Water Sampling (New Stations)		Field and Tracer Suite parameters			Field and Tracer Suite parameters, trace metals, and nutrients			Field and Tracer Suite parameters	
Historic Groundwater Well Sampling		Field and Tracer Suite parameters			Field and Tracer Suite parameters			Field and Tracer Suite parameters	
Evaporation Pan Sampling	Monthly tritium	Monthly tritium	Monthly tritium	Monthly tritium	Monthly tritium	Monthly tritium	Monthly tritium	Monthly tritium	Monthly tritium
Rainfall Collector Sampling		Quarterly tritium			Quarterly tritium, except for TPRF-7 (stolen)			Quarterly tritium	

Notes:
Automated data collection includes groundwater and surface water quality and stage, flow, rainfall, and meteorological glow and rainfall data at several stations are limited.
Refer to Table 30-2 for field and Tracer Suite parameters and nutrients.

Key:
TPBBSW = Turkey Point Biscayne Bay Surface Water.
TPEVP = Turkey Point Evaporation Pan(s).
TPFM = Turkey Point Flow Meter(s).
TPGW = Turkey Point Groundwater.
TPRF = Turkey Point Rainfall gauge.
TPSW = Turkey Point Surface Water.
TPSWID = Turkey Point Surface Water Inteceptor Ditch.

Table 1.1-2. Well Construction Summary

Monitoring Well	Top of Casing Elevation (ft NAVD 88)	Depth to Top of Screen from TOC (ft)	Depth to Bottom of Screen from TOC (ft)	Screen Length (ft)	Top of Screen Elevation (ft NAVD 88)	Bottom of Screen Elevation (ft NAVD 88)	Elevation Screen Midpoint (ft NAVD 88)
TPGW-1S	3.82	32.0	34.0	2	-28.18	-30.18	-29.18
TPGW-1M	3.92	52.1	54.1	2	-48.18	-50.18	-49.18
TPGW-1D	4.20	85.3	89.3	4	-81.10	-85.10	-83.10
TPGW-2S	1.36	24.7	28.7	4	-23.34	-27.34	-25.34
TPGW-2M	1.18	50.5	52.5	2	-49.32	-51.32	-50.32
TPGW-2D	1.14	85.5	87.5	2	-84.36	-86.36	-85.36
TPGW-3S	1.44	27.1	31.1	4	-25.66	-29.66	-27.66
TPGW-3M	1.22	54.7	58.7	4	-53.48	-57.48	-55.48
TPGW-3D	1.10	86.6	88.6	2	-85.50	-87.50	-86.5
TPGW-4S	2.24	23.2	25.2	2	-20.96	-22.96	-21.96
TPGW-4M	1.82	38.1	43.1	5	-36.28	-41.28	-38.78
TPGW-4D	1.92	61.6	65.6	4	-59.68	-63.68	-61.68
TPGW-5S	5.35	28.6	32.6	4	-23.25	-27.25	-25.25
TPGW-5M	5.07	49.3	54.3	5	-44.23	-49.23	-46.73
TPGW-5D	5.22	67.0	72.0	5	-61.78	-66.78	-64.28
TPGW-6S	1.56	22.3	24.3	2	-20.74	-22.74	-21.74
TPGW-6M	1.52	48.7	52.7	4	-47.18	-51.18	-49.18
TPGW-6D	1.59	81.9	85.9	4	-80.31	-84.31	-82.31
TPGW-7S	1.36	21.8	25.8	4	-20.44	-24.44	-22.44
TPGW-7M	1.25	47.7	51.7	4	-46.45	-50.45	-48.45
TPGW-7D	1.19	79.7	83.7	4	-78.51	-82.51	-80.51
TPGW-8S	1.98	16.8	20.8	4	-14.82	-18.82	-16.82
TPGW-8M	2.12	34.9	36.9	2	-32.78	-34.78	-33.78
TPGW-8D	2.01	49.2	53.2	4	-47.19	-51.19	-49.19
TPGW-9S	3.63	14.9	18.9	4	-11.27	-15.27	-13.27
TPGW-9M	3.53	34.3	36.3	2	-30.77	-32.77	-31.77
TPGW-9D	3.52	47.9	49.9	2	-44.38	-46.38	-45.38
TPGW-10S*	8.3	36.4	38.4	2	-28.1	-30.1	-29.1
TPGW-10M*	8.3	60.4	64.4	4	-52.1	-56.1	-54.1

Table 1.1-2. Well Construction Summary

Monitoring Well	Top of Casing Elevation (ft NAVD 88)	Depth to Top of Screen from TOC (ft)	Depth to Bottom of Screen from TOC (ft)	Screen Length (ft)	Top of Screen Elevation (ft NAVD 88)	Bottom of Screen Elevation (ft NAVD 88)	Elevation Screen Midpoint (ft NAVD 88)
TPGW-10D*	8.3	126.5	130.5	4	-118.2	-122.2	-120.1
TPGW-11S*	8.7	39.4	43.4	4	-30.7	-34.7	-32.7
TPGW-11M*	8.7	90.4	94.4	4	-81.7	-85.7	-83.7
TPGW-11D*	8.7	122.4	126.4	4	-113.7	-117.7	-115.7
TPGW-12S	0.52	21.6	23.6	2	-21.08	-23.08	-22.08
TPGW-12M	0.73	55.8	59.8	4	-55.07	-59.07	-57.07
TPGW-12D	0.76	89.8	93.8	4	-89.04	-93.04	-91.04
TPGW-13S	2.19	29.8	33.8	4	-27.61	-31.61	-29.61
TPGW-13M	2.13	56.7	60.7	4	-54.57	-58.57	-56.57
TPGW-13D	2.18	84.9	88.9	4	-82.72	-86.72	-84.72
TPGW-14S*	8.8	32.5	36.5	4	-23.7	-27.7	-25.7
TPGW-14M*	8.8	56.3	60.3	4	-47.5	-51.5	-49.5
TPGW-14D*	8.6	102.2	106.2	4	-93.6	-97.6	-95.6

Note:
* Offshore wells surveyed using GPS are only accurate to 0.1 foot.

Key:
ft = feet.
NAVD 88 = North American Vertical Datum of 1988.
S = Shallow.
M = Intermediate.
D = Deep.
TOC = Top of casing.

FIGURES

Figure 1.1-1. Locations of Groundwater Monitoring Stations.

Figure 1.1-2. Locations of Surface Water Monitoring Stations.

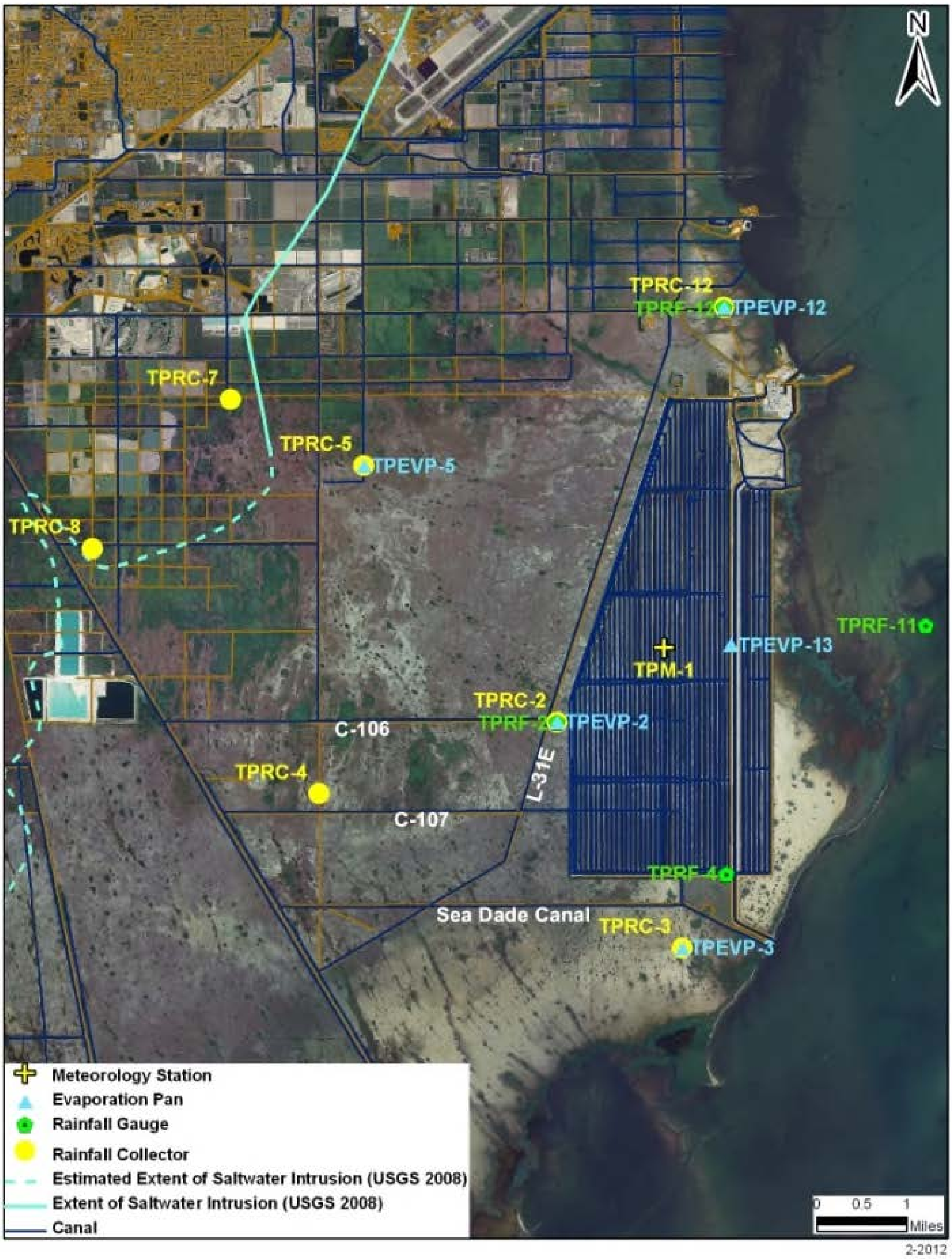


Figure 1.1-3. Locations of the Meteorological Station, Rainfall Gauging Stations, Rainfall Collectors, and Evaporation Pans.

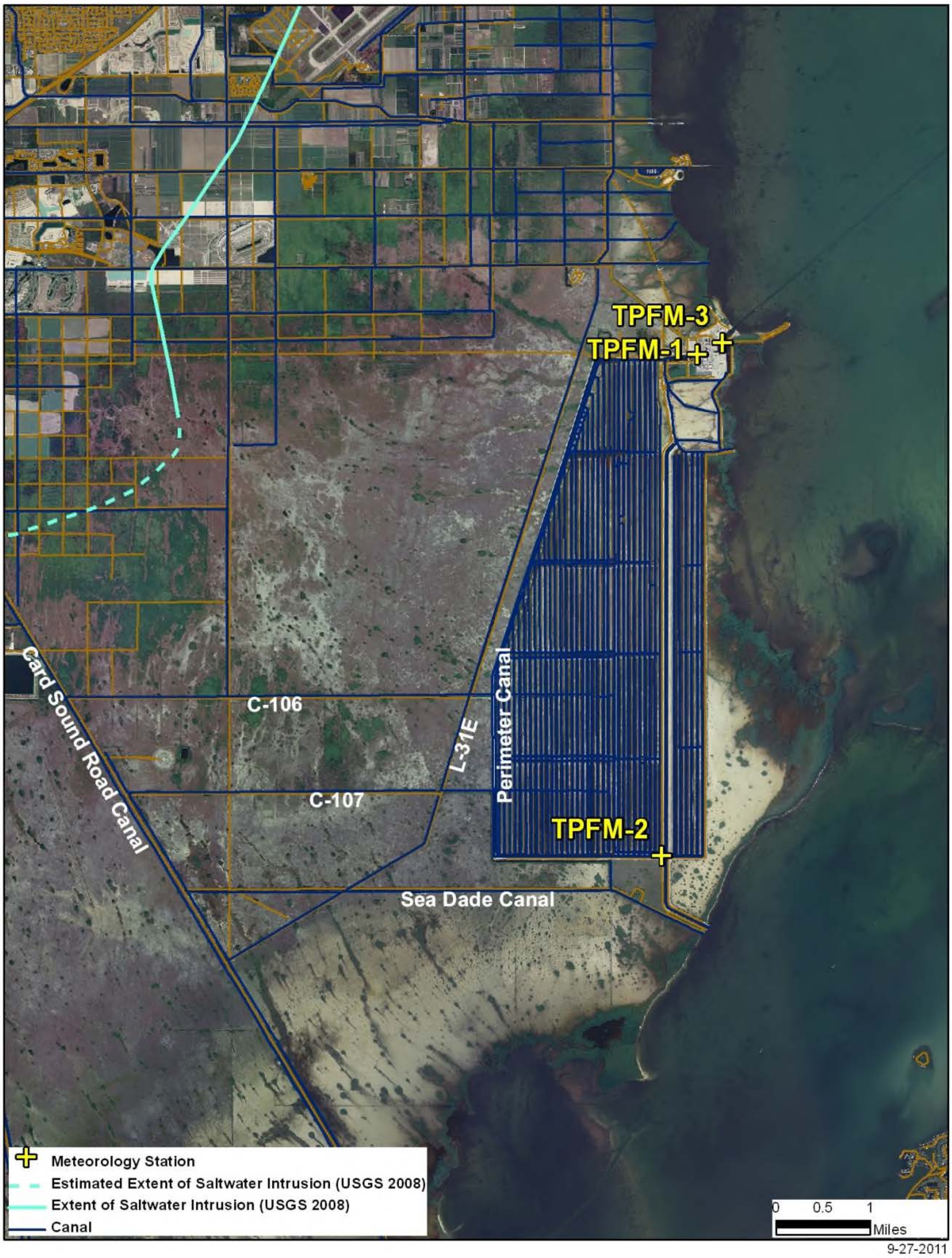


Figure 1.1-4. Flow Meter Locations in the CCS.

Figure 1.3-1. Ecological Transect Locations.

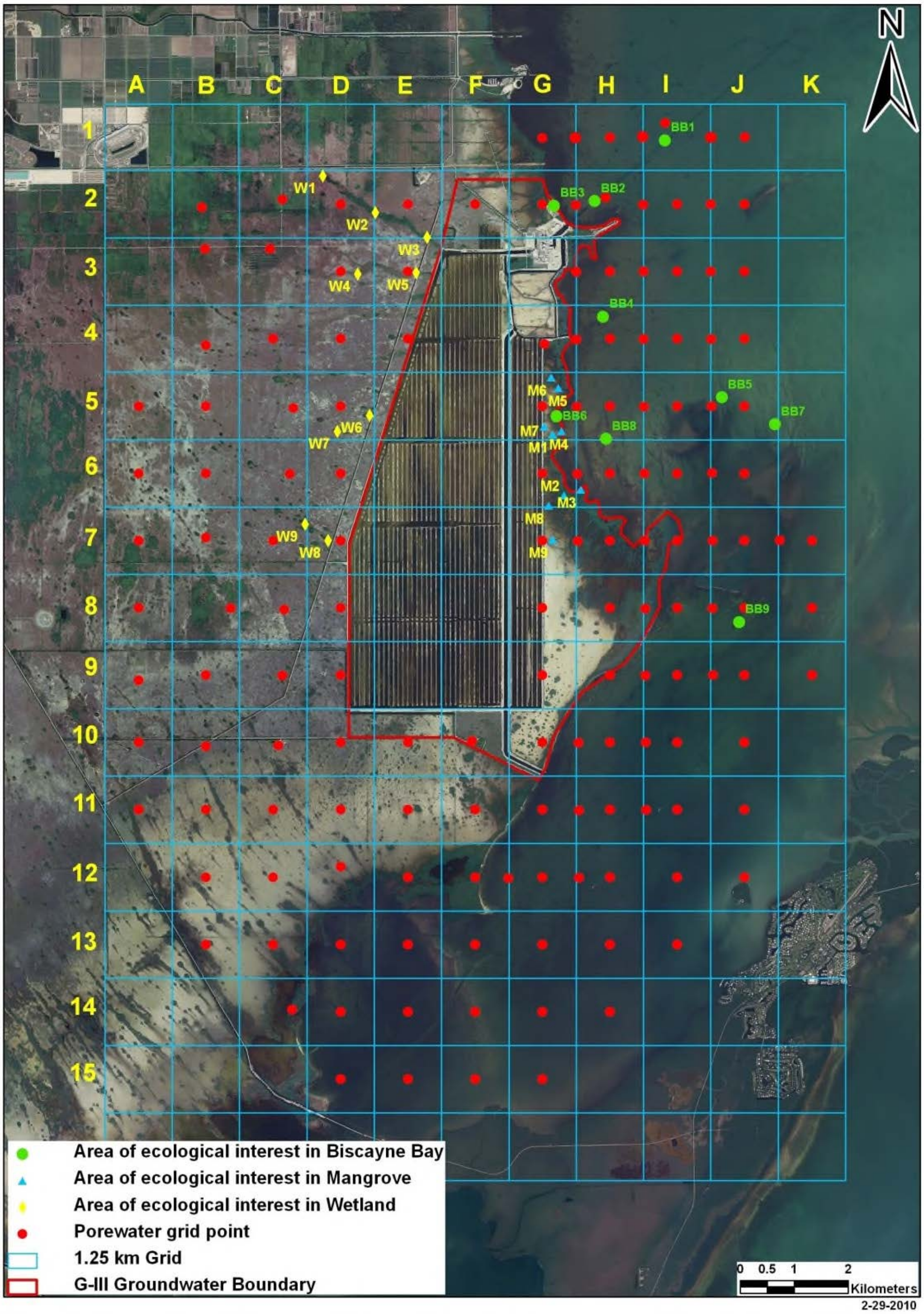


Figure 1.3-2. Initial Broad-Scale Porewater Sample Locations.

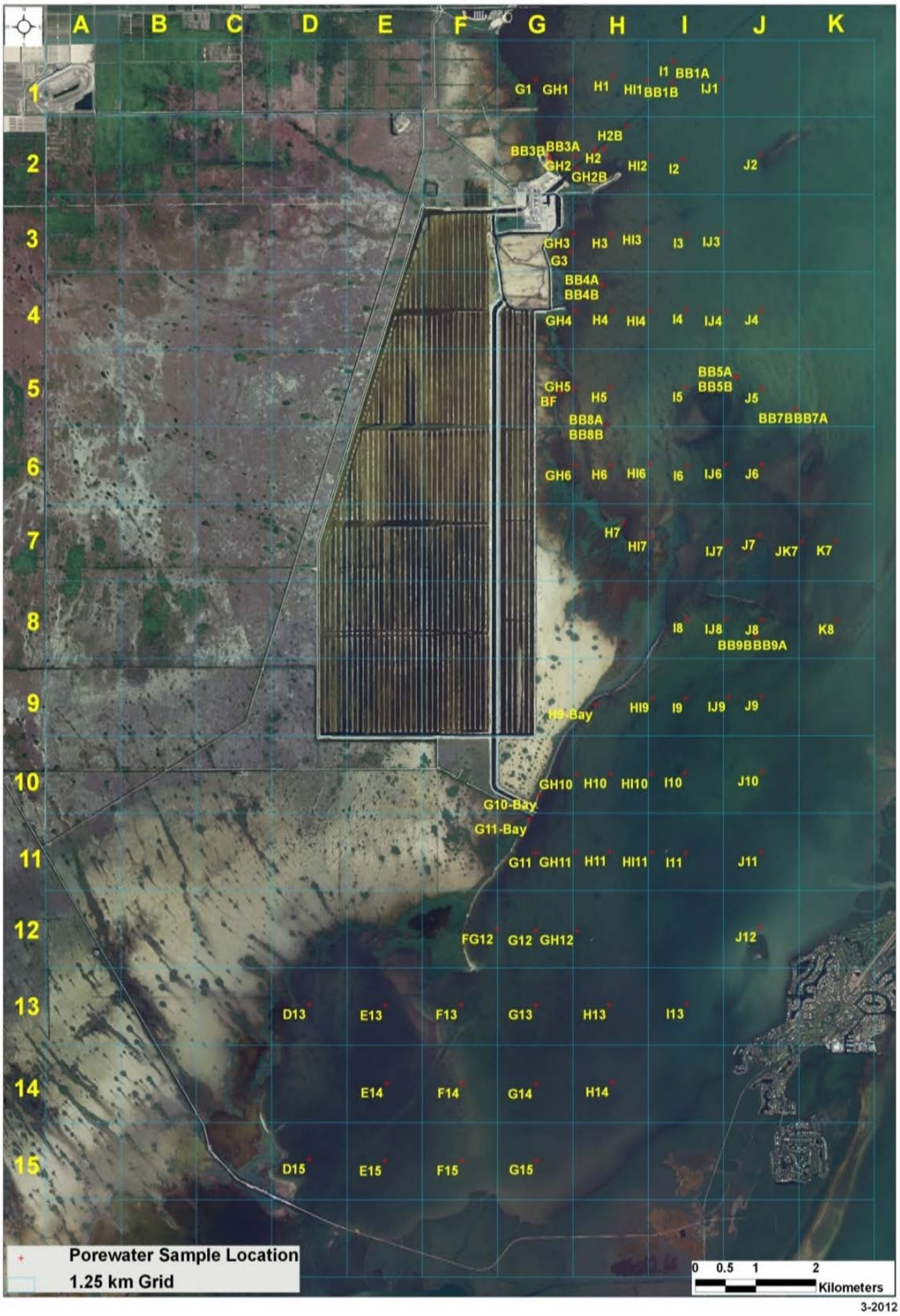


Figure 1.3-3. Wet Season Broad-Scale Porewater Sample Locations.

2. AUTOMATED DATA COLLECTION

2.1 Groundwater Quality

2.1.1 Instrumentation and Data Collection Methods

Automated groundwater monitoring stations were installed at 14 well clusters in a total of 42 wells (three wells per cluster) from February 2010 to August 2010. In each well, two probes manufactured by In-Situ, Inc. (an Aqua TROLL® 100 [AT100] and a Level TROLL® 500 [LT500]) were deployed primarily between June 2010 and September 2010 and were set to record water quality parameters and water levels, respectively, at 15-minute intervals. The probes were connected by cable to a telemetry unit and the data at each of these sites are transmitted remotely by cellular phone service to a central database once per day. The telemetry units are powered with 12-volt batteries that are recharged by solar panels. Figure 2.1-1 shows an automated groundwater station with telemetry.

The focus of this subsection is on the AT100 probe that measures groundwater quality parameters. The AT100 has a titanium body with a completely sealed, internal lithium battery, a real-time clock, a datalogger, and temperature and conductance sensors. At each well, an AT100 is placed in the middle of the screened well interval and measures actual conductance (microSiemens per centimeter [µS/cm]) and temperature (degrees Celsius [°C]). This probe also calculates specific conductance, salinity, TDS, and water density. Salinity values are calculated using actual conductance and temperature and are reported in practical salinity units (per Practical Salinity Scale 1978 [PSS-78]). TDS is based on actual conductance with a manufacturer automated default conversion factor of 0.65, and results are reported in milligrams/liter (mg/L). Water density is calculated using salinity and temperature, and results are reported in grams per cubic centimeter (g/cm^3).

Per the QAPP, the ideal cleaning and calibration schedule for the groundwater probes is approximately every eight weeks, with the Biscayne Bay probes on a rotation of approximately every six weeks. The actual schedule varies depending on field conditions and logistics.

For the cleaning and calibration efforts, probes are pulled from each well and the accuracy of the specific conductance and temperature readings are verified. For specific conductance, each AT100 is placed in a container with a known conductance solution near the expected sample value and Continuing Calibration Verification (CCV) performed. The reading on the probe and the value of the specific conductance solution is recorded. A value within 5% of the standard solution is considered acceptable; if the probe's reading falls outside the 5% range, data from the previous calibration event up to the present reading are qualified as estimated (E) or questionable (?) as discussed later in this section. Following the CCV, the probes are cleaned with analyte-free water and a non-abrasive cloth or sponge. Sensor heads are cleaned using cotton swabs or soft pipe cleaners.

Following the CCV, an initial calibration (IC) and an initial calibration verification (ICV) are conducted with a solution at the high end of the expected sample range. The AT100 and Aqua Troll® 200 (AT200) use a single-point calibration equation. If the specific conductance reading of the probe during the IC and the value of the calibration solution is between 0.98 to 1.02 of each other (referred to as the cell constant), the reading is considered ideal, but a higher range between 0.90 and 1.10 is acceptable. Following cleaning and a successful IC, an ICV and two additional bracketing ICVs are done with standard conductance solutions, with one typically above and another typically below the expected sample value range, to bracket the range of readings. If a probe specific conductivity reading is outside of the acceptable range during any of the steps described above, the probe is replaced.

For temperature, each AT100 is verified during each cleaning and calibration event using a National Institute of Standards and Technology (NIST)-certified thermometer. The temperature reading of the probe is considered acceptable if it is within ±0.5°C of the NIST thermometer reading. If a probe temperature reading is outside the acceptable range, it is replaced with another probe.

During cleaning and calibration, operational parameters involving general system functionality are addressed. The external battery voltage that powers the telemetry system (12:00 a.m. to 1:00 a.m. and 12:00 p.m. to 1:00 p.m. each day) is checked. The 12-volt batteries and solar panels are inspected, as well as fuses and wiring connections. In addition, internal voltage and memory availability of all probes are checked. Desiccants in the system are replaced during every cleaning and calibration event, and overall cleanliness is maintained. Inoperable equipment is repaired or replaced. In the event that equipment is vandalized, it is replaced.

In addition to routine cleaning/calibration, all probes are sent for factory calibration/maintenance checks approximately once every 18 months. This effort was conducted systematically from November 2011 through March 2012. If the cleaning and calibration event occurs when a probe needs to be sent for factory maintenance, the probe undergoes a CCV and high and low ICVs first to determine if it reads within the acceptable 5% range. When a probe is sent back to the factory for recalibration, another probe that has been factory-calibrated within the past 18 months is installed in its place. Since a replacement probe would not have recorded data prior to the current calibration, it would undergo only the IC, ICV, and high and low ICVs.

From June 2010 through June 2012, the most problematic issue with the automated stations continued to be the inconsistent daily reporting by the telemetry units. In nearly all cases, the data were recorded and stored in the instrument but, due to intermittent connectivity to the network, the data were not always transmitted to the FPL database on a daily basis. In a few cases, data were lost due to lightning strikes or probe electronic resets. If the system does not reconnect after these connectivity failures, FPL has to download and manually patch in the data. Data are downloaded from probes every calibration event, typically during cleaning and calibration events. High-gain antennas are now installed at most sites. Also, several issues are causing oscillations in some of the specific conductance values. These issues are discussed in the following subsections.

2.1.2 Results and Discussion

All raw data are made available to the Agencies upon receipt by FPL and are subsequently reviewed for accuracy. Depending upon the results, some of the data are qualified using the qualification codes outlined in the QAPP. The validation and qualification of the data are a substantial undertaking and will continue to be so in the future. For example, each groundwater well (one AT100 and one LT500) generates 576 data points each day. This results in 24,192 data points generated by the groundwater stations (42 wells) each day or approximately 8,830,080 points annually. Both the surface and groundwater stations generate approximately 16.5 million data points per year.

Data validation and qualification is a multi-step process. The first step begins with the plotting of key water quality parameters (salinity, specific conductance, and temperature) over a set validation period as well as the entire period of record. This allows a quick review of the results and identification/flagging of data that are outside expected ranges. Any evident aberrations in the resulting time series plots are then reviewed further based on specific station location, meteorological conditions, and previous results.

As a second step, the data are then compared to validation and calibration logs to ensure that the probes are recording data within the tolerances (5% for specific conductance and 0.5°C for temperature). Data within the accepted levels are deemed valid and data outside that range are qualified. For specific conductance ICVs, most probes have been verified successfully; however, some of the data have been qualified primarily due to CCVs outside acceptable levels. Nine probes have been out of range for temperature and 25 probes have been out of range for specific conductance, resulting in the qualification of data back to the time the probes last passed verification for that parameter. Most of the out-of-range data was qualified as estimated. The calibration and verification logs for the automated station probes are included in Appendix B.

In the final step, each data point for specific conductance, salinity, and temperature is compared to its previous 15-minute value to check for any unusual oscillations that may not have been caught during the calibration and verification events. Salinity differences greater than or equal to (≥) 1 practical salinity unit (per PSS-78) and temperature changes ≥1°C that occur within 15-minute intervals are flagged, and both data rows are highlighted. Data are then manually reviewed for validity. Flagged data are compared against meteorological data and other station data to help determine if they are real or spurious observations beyond normal parameters. There have been instances when a probe has exhibited extreme 15-minute oscillations (e.g., fluctuations up to 80,000 μS/cm) for a period of time before resuming function within normal ranges. Other examples of spurious data include occurrences of specific conductance values dropping drastically and instantaneously and remaining at low levels for days to weeks, or oscillating for one or two time intervals before instantaneously returning to original levels.

Once the above steps are completed and all flagged data are reviewed, the data are qualified as appropriate. The qualifiers used in the data qualification effort are “E” indicating an estimated value, “?” indicating suspect or questionable data, “G” indicating a recalculated value, and “C” indicating a calibration event. Data dependent upon other parameters, (i.e., specific conductance, salinity, density, and TDS) are also qualified for the corresponding period when these parameters are interrelated.

The “E” (estimated) qualifier has been added to data that oscillate, but not more than 5% from what is believed to be the actual value, due to a system electrical/radio frequency issue. Data from the previous cleaning and calibration event up to present are also qualified as “E” when an CCV ranges from 5% to 30%, or when verification or bracketing is not performed. For example, when In-Situ, Inc. deployed probes without performing verification (other than what was done at the factory), these data were qualified with an “E.”

The “?” qualifier has been applied to data that should not be included in any analyses because they may not be an accurate depiction of actual field conditions. These include, but are not limited to, the following:

- Data from any probe with an CCV greater than 30%; however, no data have yet to be qualified as questionable for this reason;
- Specific conductance values that erroneously oscillate between high and low readings at 15-minute intervals due to problems with the automated system; or
- Specific conductance, temperature, and water levels artificially altered when the probe is pulled for cleaning and calibration.

During cleaning and calibration events, both “?” and “C” qualifiers are applied to all applicable parameters. The calibration event begins when a probe starts to be retrieved and ends when it has been set back in place and the temperature reading has stabilized. When air and water temperatures differ greatly, it can take the probe temperature several hours to return to accurate readings of ambient water temperature and, thus, all values are affected.

After a review of the key parameters in their entirety by a second QA/QC person, all qualified data from each station are validated on the EDMS and, subsequently, become available for download by the Agencies.

FPL has made refinements in the data qualification and validation process during the monitoring period and, when necessary, has retroactively applied qualifiers to previous sets of data. For example, in the last Semi-Annual Monitoring Report (FPL 2012a), FPL noted that, during a few short periods, the surface water levels exceeded the top of several groundwater well casings. The groundwater levels were qualified. Also, the water quality readings in several of the wells appeared to be slightly affected during sampling events and the data were qualified. FPL went back through all the previous data to determine whether similar events occurred and qualified the data as appropriate. These changes only affect a small percentage of the data. The information presented in this report reflects the most current data set.

Only a small percentage of the water quality data has been qualified as questionable. The principal reason for using the "?" qualifier is erroneous oscillating specific conductance values (greater than 5% over a 15-minute interval due to obvious system malfunction). An In-Situ, Inc. representative initially stated that these abnormal fluctuations could have been caused by air bubbles on the sensor or by blocked sensor heads. However, gently shaking and tapping the probes have not necessarily alleviated this issue in every instance. FPL subsequently re-grounded some of the sites in hopes of rectifying the problem; however, oscillations were not completely eliminated. In-Situ, Inc. was able to reproduce the oscillation in the laboratory using high-frequency radio waves. These radio waves in the laboratory caused the probe cables to resonate, which caused fluctuating specific conductance readings. In-Situ, Inc. subsequently installed ferrite beads on the probe cables to eliminate cable resonance, but data oscillations still occurred, on occasion. While the oscillations appear to be less frequent than at the project's onset, it is still believed that other factors are contributing to the oscillations; therefore, testing has continued in order to determine the underlying causes of these patterns. One of the latest tests, implemented in January 2012, disconnected external power from several of the probes showing the most frequent oscillations. To date, these probes have been disconnected from the 12-volt battery (but remain connected to the telemetry system) and have been powered by the internal 1.5-volt lithium battery and, for a while, the data appeared stable. FPL has recently run new ground wires at TPGW-1 and TPGW-13, placed ferrite beads on the cables at those sites, and connected an additional grounding rod to TPGW-1, but oscillations in specific conductance still occurs. It appears this may be an ongoing issue; the associated data will continue to be qualified as questionable.

Figures 2.1-2 through 2.1-15 illustrate time series graphs of specific conductance, temperature, and salinity at each well. These graphs depict validated data and exclude suspect data that have been qualified as questionable or that were recorded during a calibration event. Appendix D provides time series graphs of these three parameters, with all reported data including questionable data. The time series graphs show data from the beginning of station reporting in 2010 (June through September 2010 depending on station) through June 2012. To facilitate closer review of the time series results by the Agencies and allow them to adjust graphic scales presented herein and/or focus on a specific time interval, FPL has included the raw time series data in separate Excel files with the report.

Tables 2.1-1, 2.1-2, and 2.1-3 show statistical summaries for time series specific conductance, temperature, and salinity data, respectively. The tables include monthly average values for each monitoring well and the minimum, maximum, average and standard deviation for the entire monitoring period; these summaries were calculated where at least 21 days of data were available for that month. The salinity values are presented since lay people often relate more directly to salinity than specific conductance. Figures 2.1-16, 2.1-17, and 2.1-18 show the average value and standard deviation for specific conductance, temperature, and salinity, respectively, to facilitate a spatial visualization of the average automated groundwater results. Statistical files have been included in separate Excel files with the report.

Overall, the qualified groundwater specific conductance and salinity data indicated consistent readings throughout the entire monitoring period. The salinity results track the specific conductance results since salinity is calculated based on specific conductance and temperature. No observable seasonal changes occurred in any well location. Nearly all the specific conductance time series plots exhibit very little change over time. TPGW-1S was the notable exception where the specific conductance values ranged from approximately 48,000 µS/cm to 64,000 µS/cm.

Similar to what has been previously observed, the wells closest to the CCS and Biscayne Bay had higher specific conductance than the wells located farther away. Outer well clusters TPGW-7, TPGW-8 (excluding TPGW-8S), and TPGW-9 have groundwater that can be characterized as freshwater and do not appear to be affected by salt water intrusion. As discussed further in Section 3, TPGW-8S had specific conductance values that ranged from 2,067 µS/cm to 3,681 µS/cm, but ionic data indicated non-marine influences. Wells TPGW-4S, TPGW-5S, and TPGW-6S had average specific conductance values over the monitoring period of 2,163 µS/cm, 1,298 µS/cm and 1,127 µS/cm, respectively. All other wells are saltier and are influenced by marine water. Monitoring wells TPGW-1M, TPGW-1D, TPGW-2S, TPGW-2M, TPGW-2D, TPGW-3S, TPGW-3M, TPGW-3D, TPGW-12M, TPGW-12D, TPGW-13S, TPGW-13M, and TPGW-13D have the saltiest water, with specific conductance values consistently in excess of 60,000 µS/cm. The specific conductance values in well cluster TPGW-13 were the highest with average values in excess of 80,000 µS/cm.

The majority of the wells that appear to be influenced by marine water had higher specific conductance values with depth; however, the intermediate zone often exhibits values similar to the deep zone. Well cluster TPGW-13 is one of the exceptions where the average values over the monitoring period were slightly higher in the shallow zone, but the values between all zones were within 5% of each other. This is not unexpected at TPGW-13 given the hypersaline conditions in the CCS.

The groundwater temperatures in the intermediate and deep zones exhibited little to no change over the monitoring period and most appear flat-lined on the time series plots. The temperatures in the shallow zone wells were steady, but reflected minor seasonal influences; groundwater temperatures were typically higher near the end/beginning of the year and decreased to their lowest levels when air temperatures were warmer, which is the opposite of what would be expected if there was an immediate response in groundwater temperature to air temperature. This trend may be reflective of a lag in the response of the shallow groundwater (20 to 40 ft below ground surface) to winter and summer air and surface water temperatures. The highest groundwater temperatures occurred in well cluster TPGW-13 with an average value over the monitoring period of 30.0°C. By comparison, the average groundwater temperatures over the monitoring period in TPGW-10S (Biscayne Bay well), TPGW-1S (near CCS), and TPGW-9S (westernmost well) were 26.1, 25.6, and 24.7°C, respectively. The average groundwater temperatures in nearly all the wells were less than the average value of 26.1°C measured at both TPGW10S and TPGW-11S in Biscayne Bay. Wells TPGW-14M and TPGW-14D had slightly higher groundwater temperatures of 26.2 and 26.4°C. Well cluster TPGW-2 had average groundwater temperatures that ranged from 26.5 to 27.4°C, which could suggest some effects of the CCS. Well cluster TPGW-2 did not follow the same general groundwater temperature trends exhibited by the other well clusters, indicating some external influence.

To assess differences between wells over time, Figures 2.1-19 through 2.1-25 show comparisons of specific conductance and temperature in shallow and deep interval wells. Figure 2.1-19 shows that for the wells in Biscayne Bay, TPGW-14 has the highest specific conductance values and the highest temperatures at depth. Figures 2.1-20 through 2.1-23 show changes across the landscape and include wells in Biscayne Bay, the CCS, and wells farther inland. The figures illustrate how much higher the specific conductance and temperature are in CCS well cluster TPGW-13 than the other wells. Also, the figures show how the values generally decrease in wells with distance from the coast. Figure 2.1-24 shows plots of wells in close proximity to the CCS. Figure 2.1-25 compares Biscayne Bay surface water specific conductance values and temperatures with Biscayne Bay groundwater specific conductance values and temperatures. The plots show how much less the groundwater specific conductance values and temperatures fluctuate than the surface water values. This indicates the buffering effects that groundwater has on surface water changes.

2.2 SURFACE WATER QUALITY

2.2.1 Instrumentation and Data Collection Methods

Automated surface water quality stations were located throughout the Turkey Point landscape as determined jointly with the Agencies. All stations record water quality and stage data at 15-minute intervals, with the exception of Biscayne Bay stations TPBBSW-1, TPBBSW-2, TPBBSW-4, and TPBBSW-5 which record only water quality parameters. While most sites that record surface water data have two probes (top and bottom), some have only one probe, depending on surface water depth and other logistical considerations. Stations that are in less than 3 ft of water have only one AT200 probe. Surface water quality stations with two probes have an AT100 at approximately 1 ft above the bottom and an AT200 within 3 ft of the surface. The AT200 is similar to the AT100, except the AT200 also measures water stage. Similar to the AT100, the AT200 has a titanium body with a completely sealed internal lithium battery, real-time clock, data logger, and pressure, temperature, and conductance sensors. The AT200 is also programmed to auto-correct water levels for water density based on readings recorded by the probe. This feature is explained in greater detail in Section 2.3.1.

Similar to the groundwater sites, probe cables are attached to a telemetry system that uploads once a day for most sites (Figure 2.2-1). Table 2.2-1 summarizes the probes used at each surface water station and the parameters measured. Currently, 33 probes (AT100s and AT200s) are deployed throughout the monitoring area, generating up to 6.3 million data points each year.

Four of the automated surface water quality sites in Biscayne Bay (TPBBSW-1, TPBBSW-2, TPBBSW-4, and TPBBSW-5) are not connected to a telemetry system for logistical reasons. Per the Monitoring Plan, these probes are set up similar to the BNP salinity monitoring network stations (Biscayne National Park 2007) equipped with probes that record specific conductance just above the sediment surface. Rather than installing platforms or pilings, the probes are firmly attached to a cement paver/pad and are placed at pre-determined locations on the Bay bottom. Since these probes are designated to measure only water quality parameters, AT100s are deployed at each of these four locations. The probes are swapped out approximately every six weeks, returned to the field office where they are cleaned and calibrated, and the data are manually uploaded into the online database.

All AT100 and AT200 probes are cleaned and calibrated using the same methodology as described for groundwater sites. Appendix B shows the water quality field verification/ calibration logs. Additional verification measurements are conducted for the water level measurements associated with the AT200, as detailed in Section 2.3.1.

2.2.2 Results and Discussion

The automated surface water quality data are qualified and validated in the same manner as the automated groundwater data. Figures 2.2-2 to 2.2-23 show time series graphs of specific conductance, temperature, and salinity at each surface water station. These graphs depict validated data and exclude suspect data that have been qualified as questionable (?), estimated (E), or qualified due to impacts during a calibration (C) event. Appendix C shows what data were qualified, while Appendix D shows time series graphs of the three parameters, but with all reported data including suspect data. The time series graphs show data from the beginning of station reporting in 2010 (August or September 2010, depending on station) through June 2012. Note that the salinity results for all the surface water stations track the specific conductance results since salinity is calculated based on specific conductance and temperature, thus most of the discussion focuses on specific conductance and temperature. To facilitate closer review of the time series results by the Agencies and allow them to adjust graphic scales presented herein and/or focus on a specific time interval, FPL has included the raw time series data files in separate Excel files with the report.

Tables 2.2-1, 2.2-2, and 2.2-3 show statistical summaries of the time series data for specific conductance, temperature, and salinity, respectively. The tables include monthly average values for each monitoring station and the minimum, maximum, average and standard deviation for the entire monitoring period. The salinity values are presented since lay people often relate more directly to salinity than specific conductance. Figures 2.2-24, 2.2-25, and 2.2-26 show the average value and standard deviation for specific conductance, temperature, and salinity, respectively, to facilitate a spatial visualization of the average automated surface water results. Statistical files have been included in separate Excel files with the report.

Compared to the groundwater time series graphs, the surface water time series graphs show greater variability in the data, most of which is related to seasonal and meteorological conditions.

For example, in Biscayne Bay, the highest specific conductance values are near the end of the dry season and the lowest values are near the end of the wet season with minimum and maximum values ranging from 18,922 µS/cm (TPBBSW-10B) to 66,884 µS/cm (TPBBSW-1B). The highest values in Biscayne Bay were recorded near the end of the very dry season in June 2011 at six of the seven Biscayne Bay stations. This equates to salinities throughout the project area in excess of 40 units on the practical salinity units (PSU) scale. Figure 2.2-27 compares surface water specific conductance values at Biscayne Bay stations. Station TPBBSW-14B (measured near the surface) consistently has the lowest water temperatures while TPBBSW-10B (measured near the surface) has the most variability. The specific conductance values in Biscayne Bay are within ranges observed at BBCW10 (SFWMD well located several miles north). In some instances, for example much of June 2011 specific conductance values were higher at BBCW10 than at Turkey Point Biscayne Bay stations.

The specific conductance values in the CCS show less seasonal variability than Biscayne Bay, but do change in response to rainfall events. Following a high rainfall event on October 8, 2011 (6.33 inches measured at TPM-1), the specific conductance values dropped 10% to 20% at all stations. This is similar to what occurred the previous year in September and November 2010 following several heavy rain events (7.34 and 4.36 inches, respectively, at TPM-1). The data show that there was no clear pattern of higher or lower specific conductance among the CCS stations. Variability in the results is often within the acceptable calibration limits of the instrument. Quarterly surface water sampling indicates the specific conductance values at all CCS stations are typically within 5% of each other. Over the entire monitoring period, the minimum and maximum CCS specific conductance values ranged from 50,528 µS/cm (TPSWCCS-4B) to 93,594 µS/cm (TPSWCCS-6B). The average specific conductance values in the CCS were consistently over 70,000 µS/cm in comparison to Biscayne Bay average values ranging between 43,433 µS/cm and 51,006 µS/cm for the monitoring period. Figure 2.2-28 compares time series specific conductance values between the CCS and several Biscayne Bay surface water stations. The specific conductance at TPSWC-5T is consistently higher than the Biscayne stations by over 20,000 µS/cm.

In the L-31E Canal stations, (TPSWC-1, TPSWC-2 and TPSWC-3), the specific conductance values were predominantly reflective of freshwater, however slightly more saline conditions were noted during several periods. The most notable period was near the end of the very dry season in June 2012 when maximum specific conductance values were 9,507 µS/cm (TPSWC-2B) and 22,776 µS/cm (TPSWC-3B). As is discussed in Section 3, there was not an incremental increase in tritium concentrations which might indicate regional Biscayne Bay influences instead of an influence from the CCS. Figure 2.2-29 compares time series specific conductance and temperature values for the different surface water stations in the L-31E Canal. Other spikes in specific conductance values were noted in TPSWC-3B in November 2011 and near the end of the dry season in 2012.

The specific conductance values in the two tidal stations TPSWC-4 and TPSWC-5 were more variable than the L-31E stations. TPSWC-4 is affected by releases from the S-20 structure and can transition from saline to fresh conditions quickly. Station TPSWC-5 reflects marine conditions, but exhibited values in excess of those found in Biscayne Bay at the bottom. The water at TPSWC-5 is over 20 ft deep and is located at the end of this dead-end canal. The deep water depths and restrictions in flushing may contribute to the observed specific conductance values at this station.

The ID specific conductance values are affected by pumping of the ID ditch, which is conducted mostly in the dry season to maintain a seaward gradient between the L-31E Canal and the ID. During non-pumping periods, the water in the ID is slightly saline to brackish, but during periods of heavy pumping, the water becomes saline in the pumped segments. In June 2011, the specific conductance values reached a peak at two ID stations with values in excess of 55,000 μS/cm. The effect was most pronounced at the bottom of TPSWID-2 where specific conductance values remained the highest for the longest duration. Specific conductance values in the ID were always below the values in the CCS and reflect a mixing of CCS water, freshwater, and Biscayne Bay water. Figure 2.2-30 compares time series specific conductance and temperature values for the different surface water stations in the ID. Figures 2.2-31 through 2.2-33 compare time series specific conductance and temperature values for the ID, L-31E, and CCS, at ID operation transect A stations (TPSWID-1, TPSWC-1, and TPSWCCS-1), transect C stations (TPSWID-2, TPSWC-2, and TPSWCCS-7), and transect E stations (TPSWID-3, TPSWC-3, and TPSWCCS-3), respectively. The figures show that CCS specific conductance values are highest in the CCS and lowest in the L-31E. The figures also show the temperature difference between the water bodies as the CCS cools from transect A to transect C. Discussion of the ID operation is included Section 6 of this report.

Water temperatures at all stations are greatly affected by meteorological conditions and reflect seasonal trends as expected. Ambient air temperature changes were quickly reflected in water temperatures and both Biscayne Bay and CCS stations tracked closely the overall ambient trend (Figure 2.2-34). In Biscayne Bay, average monthly water temperatures in January 2011 were around 20°C at all stations. In July 2011, average monthly water temperatures were near 31°C at all Biscayne Bay stations and the highest recorded 15-minute temperature was 35.2°C at TPBBSW-10B.

The water temperatures in the CCS also change with air temperature but are higher than other surface water locations. The CCS water is pumped from the intake side of the plant and routed through condensers to cool the power units. As the water passes through the condensers, it is heated and eventually discharged on the west side of the plant back into the CCS. The water temperatures on the CCS discharge side of the plant at TPSWCCS-1B are 7.5°C warmer on average for the entire monitoring period (June 20110 through June 2012) than at the intake side of the plant at TPSWCCS-6B. The range in temperatures varies monthly and CCS surface water temperatures are warmer in the summer months and cooler in the winter months. For example in September 2011, the average monthly CCS water temperatures ranged from 31.9°C at TPSWCCS-6B to 40.1°C at TPSWCCS-1. In January 2012, the average monthly CCS water temperatures ranged from 23.8°C at TPSWCCS-6B to 33.1°C at TPSWCCS-1B. There did not appear to be any temperature stratification at TPSWCCS-4 and TPSWCCS-6 since the water temperature was consistently the same at the top and bottom. However, at TPSWCCS-5, the surface water temperatures were consistently higher at the top station. Figure 2.2-35 shows time series plots for stations in the CCS and illustrates the differences in temperature between stations on the discharge side of the plant (i.e., TPSWCCS-1B, TPSWCCS-7B) and the intake side of the plant (i.e., TPSWCCS-5 and TPSWCCS-6).

CSS water temperatures are regularly higher than the daily ambient air temperatures (Figure 2.2-34) and are often higher than daily maximum temperatures (Figure 2.2-36). This rarely occurs at other surface water stations. If there are temperature effects on Biscayne Bay from the warmer CCS waters, the effects would most likely be evident during the cooler months. Figure 2.2-36 shows the water temperatures from February to June 2011 for all the Biscayne Bay stations installed for the Uprate monitoring. Surface water temperatures from a SFWMD Biscayne Bay monitoring station several miles north of the site (BBCW-10) are included on Figure 2.2-36. The Turkey Point Biscayne Bay monitoring stations track very closely both with the SFWMD station and the maximum air temperatures recorded at TPM-1.

To help assess whether CCS water temperatures are affecting Biscayne Bay water temperatures, the differences between CCS and Biscayne Bay water temperatures and the differences between ambient air and Biscayne Bay water temperatures were examined (Figure 2.2-37). The results clearly demonstrate that CCS water temperatures, both on the intake and discharges sides, are warmer than Biscayne Bay water temperatures; there is only one instance where the plot exhibits a negative value for the difference between CCS and Biscayne Bay water temperatures (February 13, 2011; TPSWCCS-6 - TPBBSW4). This occurred when there was a major drop in the low ambient air temperature on February 13, and it appears the CCS water temperature responded more quickly to the daily low temperature. When compared to ambient air temperatures, Biscayne Bay water temperatures oscillate between being higher and lower than ambient air temperatures, particularly during the cooler months. This is to be expected as cold fronts move through and air temperatures both drop and recover more quickly, and to a greater degree, than water temperatures. Later in the year, mean ambient temperatures are almost exclusively lower than Biscayne Bay water temperatures. More importantly however, differences between the northern SFWMD surface water station (BBCW10) and both the ambient air temperatures and the CCS water temperatures follow the same pattern and are of the same magnitude as the FPL Biscayne Bay stations. These results suggest that air temperatures are driving water temperatures in Biscayne Bay and do not indicate any readily evident CCS water temperature effects in Biscayne Bay.

Water temperatures in the L-31E Canal (Figure 2.2-29) are on average cooler than those in Biscayne Bay. There is some temperature stratification in L-31 in part due to the canal depths and typically limited flow. The near surface water temperatures are almost always warmer than the bottom temperatures and the surface temperature exhibits more daily variability in response to air temperature changes. Near the end of the 2011 dry season, the bottom temperatures in TPSWC-3B were similar to the near surface water temperatures at that location and the timing coincides with the increase in specific conductance discussed above.

The time series plots (Figure 2.2-30) show that there were periods when the bottom water temperatures in the ID were greater than the surface water temperatures and those periods often corresponded with pumping of the ID and reflect some influence from the CCS. As a result, the average temperatures in the ID stations are higher than at the L-31E stations based on the entire monitoring period.

The water temperatures in the two tidal canal stations (TPSWC-4 and TPSWC-5) were also affected by air temperatures, but TPSWC-4 was also affected by discharges from S-20. Generally the surface water temperatures at TPSWC-4 were higher than or similar to the bottom water temperatures; the effects of the CCS, if any, were hard to differentiate due to the variables that could affect water temperature. At TPSWC-5, the bottom water temperature was higher than the surface water temperature for months at a time.

2.3 WATER LEVELS

2.3.1 Instrumentation and Data Collection Methods

Water levels provide insight into groundwater hydrology and groundwater and surface water interactions; levels are collected at all groundwater and most surface water stations for the Uprate Project monitoring effort. Only four water quality stations in Biscayne Bay do not have stage recorders. Per the Monitoring Plan, automated surface water quality monitoring stations co-located with groundwater monitoring well clusters in Biscayne Bay were to have surface water stage recorders. During the siting of the wells and surface water stations in Biscayne Bay, only one surface water quality station (TPBBSW-3) was co-located with a well cluster (TPGW-11); thus, one stage recorder was initially installed in Biscayne Bay. FPL later opted to install two additional stage recorders in Biscayne Bay (one each at the platforms associated with TPGW-10 and TPGW-14) to better assess groundwater and surface water interactions and tidal differences across the landscape.

Water pressures are measured at 15-minute intervals, and water levels are calculated from the pressure data. The results are typically transmitted on a regular basis via telemetry. LT500 and AT200 probes are used to record water pressure/levels. The LT500 only measures water pressure and temperature. This probe model is used in all automated groundwater well sites and is co-located with AT100 water quality units, but is placed near the surface to increase the accuracy of the pressure readings. At all automated surface water stations, AT200 probes are used for water levels since the probes measure both water pressure and water quality parameters. Both types of data are needed for surface water stations, and probes can typically be placed within 3 ft of the surface. Both probe models that measure water pressure have been deployed using a vented cable. The vented cable contains a tube that applies atmospheric pressure to the back of the pressure gauge. The instrument is programmed to automatically subtract this value from the measured pressure, reflected in the following formula:

$$P_{gauge} = P_{absolute} - P_{atmosphere}$$

Aside from being able to measure water quality parameters, the biggest difference between the AT200 probe and the LT500 probe is how specific gravity (SG) is handled. In the AT200 probe, an option exists to program a fixed density value or to auto-adjust water levels based on actual measured density. In the LT500 probe, only a fixed density value can be entered based on the water type (freshwater, brackish water, or saltwater). All LT500 probes are individually set to the fixed density value that best characterizes the water in the well. The AT200 probes are programed to automatically adjust water levels based on the measured density.

Both probes are programmed to record water levels based on a depth-to-water level setting. Water levels are calculated in the instruments from the measured pressure based on the following formula:

$$W_L = R_L + (2.31 * (R_P - M_P)/SG)$$

where:
W_L – water level (measured in feet based on the North American Vertical Datum of 1988 (ft NAVD 88)
R_L – reference water level (ft NAVD 88)
R_P – reference pressure (pounds per square inch [psi])
M_P – measured pressure (psi)
SG – specific gravity (unitless)

The SG in the above formula is the same as the density reading; thus, the values come directly from the instrument.

The reference level (R_L) is a key component and is established in the field by using a water level indicator to measure the depth to water from the top of the well casing. Since the top of casing has been surveyed to an established datum (both NAVD 88 and National Geodetic Vertical Datum of 1929 [NGVD 29]), an elevation of the water is quickly determined by subtracting the depth to water from the top of casing. The resulting water level elevation is then entered into the probe as the reference level. The probe then automatically calculates the related pressure value, referred to as the reference pressure (R_P). Subsequent pressure measurements recorded by the probe are relative to the reference pressure and its associated elevation.

The AT200 probes are cleaned in the same manner as described for the AT100 probes in the previous sections. The LT500 probes are wiped down with analyte-free water, with care not to damage the pressure transducer. The same care is used on the AT200 probes. While the pressure sensor cannot be calibrated, the resulting stage readings are verified. FPL has refined their approach over the course of the monitoring effort to improve the accuracy of the data. Currently, water level measurements are taken with a water level indicator prior to the removal of the LT500/AT200 probes for cleaning. An instantaneous reading from the probe is taken and compared to the water level indicator. Readings differing less than 0.1 ft are considered acceptable. The probe is then removed for cleaning, placed back in the well, and a similar comparison is made with the water level indicator and pressure reading. If needed, the reference level is reset so the probe reading matches the water level reading to within 0.03 ft, which is the accuracy of the pressure sensor.

Similar to the AT100 probes, all LT500 and AT200 probes are factory-calibrated every 12 to 18 months. This effort was conducted systematically during regularly scheduled cleaning and calibration events between November 2011 and March 2012.

2.3.2 Results and Discussion

2.3.2.1 Groundwater

As part of the validation process, water levels and pressures were plotted for the entire time period for each station. Sudden changes in water level were identified and checked against stage changes at other stations and against rainfall measurements. Time series plots of water levels in similar media and areas such as the CCS or in Biscayne Bay surface water were overlain and compared to one another to help identify potential problems with water level results. In addition, plots in groundwater and nearby or an overlying surface water body were overlain for similar comparisons. Careful attention was paid to periods when cleaning and calibration events occurred and for any activity that could alter the probe placement. Where stage data were available from a water level indicator or stage gauge readings, those values were compared to the reported water level measurements.

If water levels reported by the probe and field-measured values were off by more than 0.1 ft, the data were flagged for closer inspection. Also, shifts in data immediately following a calibration event or activity that could have impacted the probe placement were flagged if they were greater than 0.1 ft. The flagged data were reviewed further and, in some instances, it was clear there was an issue with an incorrect reference level and the data were corrected. In some instances, the cause for a discrepancy greater than 0.1 ft could not be established and the data were qualified as estimated; in other cases, the results were highly suspect in consideration of historical and surrounding station results, and the data were qualified as questionable. For difference of less than 0.1 ft, no correction or qualification of the data was applied.

It should be mentioned that the accuracy of the land-based station survey is better than 0.1 ft (typically within hundredths of a foot), but well locations in the Bay may have a lower level of accuracy since those stations could only be surveyed with GPS units. Thus, the survey accuracy limits should be taken into account when interpreting the results to hundredths of a foot or, in the case of the Biscayne Bay wells, to several tenths of a foot.

Figures 2.3-1 through 2.3-14 show time series graphs at all automated groundwater stations. These graphs are based on refined validated data and exclude data that are questionable or recorded during a calibration event. Stage data were typically not qualified if the density values were suspect since the differences in the instrument-calculated density had little effect on the pressure reading/stage results, given the shallow depth of probe placement. All time-series graphs are based on actual measured levels, with the probes set to a representative density setting. The values do not reflect freshwater head equivalents. In order to facilitate closer review of the time series results by the Agencies and allow them to adjust graphic scales presented herein and/or focus on a specific time interval, FPL has included the raw time series data files in separate files in Excel with the report.

Some of the water level data reported in the first Semi-Annual Report (FPL 2011a) were revised based on a resurvey of the top of casing of groundwater wells. This updated information was included in an Errata to the 2011 Semi-Annual Report and changes were reflected in subsequent reports. Also for the first reporting period, FPL initially conducted a post-correction calculation to adjust the LT500 readings from a fixed density value to a measured value using the density from the AT100 located in the same well at depth. This post-correction used the above formula and was calculated similar to how an AT200 is programmed to calculate water levels. FPL subsequently determined (with SFWMD concurrence) that this procedure was unnecessary as the LT500 water levels readings were only affected by a few thousandths of a foot given the shallow placement of the LT500 probes. All water level data reported in the first Semi-Annual Report (FPL 2011a) were slightly readjusted based on a set density representative of that well. These adjustments have been reflected in subsequent reports.

A summary of the data collected and the patterns observed follows:

- Water levels change very quickly in response to rainfall events. This is most evident in stations not significantly influenced by tides (TPGW-1, TPGW-2, TPGW-4 through TPGW-9, and TPGW-13). Typically, wherever there is a spike in water levels on the time series graphs, there is a corresponding rainfall event. Refer to Figures 2.3-1, 2.3-2, and 2.3-4 through 2.3-9 and 2.3-13.
- At each well cluster, fluctuations in stage for all three depth intervals track closely, indicating a good hydrologic connection between intervals.
- Water levels at stations in or immediately adjacent to Biscayne Bay (TPGW-3, TPGW-10, TPGW-11, TPGW-12, and TPGW-14) exhibited tidal influence at all three depths (Figures 2.3-3, 2.3-10, 2.3-11, 2.3-12 and 2.3-14). The amplitude of the tidal changes decreases across the landscape from north to south, similar to the decrease in surface water tidal amplitude discussed below. Thus, TPGW-10 has a higher range of water levels than TPGW-14.
- Stations furthest from the coast (TPGW-7, TPGW-8, and TPGW-9) exhibit few water level differences among the shallow, intermediate, and deep wells (Figures 2.3-7, 2.3-8 and 2.3-9). These wells are all fresh per FDEP standards.
- Wells located between the westerly most wells and the CCS, such as TPGW-4 and TPGW-5, have brackish water in the intermediate and deep zones overlain by much fresher water in the shallow zone. The shallow zone water elevations in these wells are always higher than the deep zone (Figures 2.3-4 and 2.3-5).
- Closer to Biscayne Bay and the CCS, several well clusters have deep or intermediate zones with the highest elevation, such as TPGW-2. At this cluster, the deep and intermediate interval water levels alternate between having higher water levels (Figure 2.3-2).

- At TPGW-13, the shallow and intermediate zones have nearly identical water levels and the deep zone is up to 0.4 ft lower.

For the land-based stations (tidal and non-tidal), the groundwater levels ranged up to 3 ft over the monitoring period. The non-tidal inland stations had the greatest seasonal range since they are affected more by drought and rainfall conditions. The lowest groundwater elevations at all the land-based stations, with the exception of well cluster TPGW-13, were reported in late May and early June 2011. This was near the end of an extended very dry season. The lowest groundwater elevations at well cluster TPGW-13 were recorded about a month earlier. The previous semi-annual report noted that the water levels at TPGW-2 were the lowest in early May 2011, but further review of the data indicates that the groundwater levels were lowest at this cluster in late May/early June 2011.

To provide insight into the differences in groundwater water levels over the landscape, time series plots from select stations are illustrated on Figures 2.3-15 to 2.3-18. Each figure represents a transect of well clusters. Many of these figures are self-explanatory and support the discussion above. Note that the water elevations of the non-tidal stations in Figures 2.3-15 and 2.3-16 are higher than the tidal stations, with the notable exception towards the end of the very dry season between April and mid-June 2011. Also note that TPGW-13S groundwater elevations on Figures 2.3-17 and 2.3-18 typically follow along the upper range of the tidal stations. Care should be used in drawing conclusions about groundwater flow directions based solely on the transect water levels since density effects have to be considered. Basically, denser water has more driving head than freshwater, and groundwater flow is influenced by these density differences. All the times series data that are reported reflect actual measured water levels and have not been converted to freshwater head equivalents.

To provide some initial insight into the groundwater and surface water interactions, Figures 2.3-19 through 2.3-21 illustrate the differences between surface water levels and groundwater levels in a nearby or co-located well(s) and where the densities in most wells and surface water stations are somewhat similar. Figure 2.3-19 shows a time series plot of surface water stage at TPSWCCS-2 and TPGW-13S and TPGW-13M. The results indicate that the water elevations at TPGW-13S are higher more often than at the corresponding surface water station in the CCS (TPSWCCS-2). However, there was at least one extended period during the dry season of 2011 when the CCS surface water levels were higher.

Figure 2.3-20 shows surface water levels in the CCS and groundwater levels in several wells immediately to the west. Figure 2.3-21 shows daily average surface water levels in TPBBSW-3 and TPGW-11, which is in Biscayne Bay. The daily average eliminates the hourly tidal fluctuations and facilitates a visual comparison between these stations. The plot illustrates that the groundwater levels in the Bay stations are directly influenced by surface water stage and the groundwater elevation at TPGW-11S is always higher than the co-located surface water station.

Further discussion of the groundwater elevations and implications is provided in Section 5 of this report.

2.3.2.2 Surface Water

Figures 2.3-22 through 2.3-39 show time series graphs at all surface water stations where data from automated stage recorders are available. These graphs are based on validated data and exclude data that are questionable or recorded during a calibration event when the log was running. All the time series graphs are based on actual levels and do not reflect freshwater head equivalents. In order to facilitate closer review of the time series results by the Agencies and allow them to adjust graphic scales presented herein and/or focus on a specific time interval, FPL has included the raw time series data files in separate files in Excel with the report.

The precision and accuracy of the surface water levels, particularly associated with stations affected by wave activity, may be slightly lower than for groundwater stations. While wave activity is dampened in stilling wells, some oscillation occurs that can affect the ability to consistently get precise verification readings with a water level indicator. Some data end up being qualified as estimated since a verification reading is off by more than 0.1 ft when in reality it may not need to be qualified. Also, the setting of the reference levels is affected by waves and can cause readings to be off.

As expected, diurnal water level variations were observed at all tidal-influenced stations, including those located in Biscayne Bay (north to south: TPBBSW-10, TPBBSW-3, and TPBBSW-14), as well as tidal canal stations (TPSWC-4 and TPSWC-5). The tidal range declines across the landscape from north to south (Figure 2.3-40). At TPBBSW-10, tide ranges during spring tide and neap tides can be over 2.0 ft and less than 0.5 ft, respectively.

The effect of rainfall is masked in most tidal stations; however, its effect is evident at TPSWC-4 since this station is downstream of S-20 discharges. Rainfall effects are also evident on all onshore stations where water level increases up to 1 ft have been observed following significant rainfall events in L-31E, the CCS, and the ID.

Water levels in the CCS vary spatially depending upon whether the station is located on the discharge or intake side of the canal. Water levels on the plant discharge side have lower ranges in variability (<1 ft at TPSWCCS-1) than stations on the discharge side (up to 4 ft at TPSWCCS-6). Also, water levels on the discharge side of the CCS are typically at least 1 ft higher than those on the CCS plant intake side (Figure 2.3-41). The difference in stage between the discharge and intake side increased during the 2011 and 2012 dry seasons and decreased during the wet season. It was noted that the water levels at all stations were very similar in late September and October 2010, October 2011 and February 2012 following a heavy rainfall event.

Water levels in the CCS and L-31E exhibit little response to tidal influences in Biscayne Bay surface water. Figure 2.3-42 provides a representative time series plot for spring tides on December 24, 2011, and March 9, 2012, which shows the lack of tidal response in the CCS and L-31E. This suggests the hydrogeologic connection with Biscayne Bay is limited or not as direct.

Figure 2.3-43 illustrates a transect of surface water levels, over the entire time period, that includes Biscayne Bay, the CCS, and the L-31E Canal. Care should be used in drawing conclusions about gradients solely based on the transect water levels since density effects have to be considered. Basically, denser water has more driving head than freshwater, and groundwater flow is influenced by these density differences. All the times series data that are reported reflect actual measured water levels and have not been converted to freshwater head equivalents.

To facilitate closer review of the time series results by the Agencies and allow them to adjust graphic scales and/or focus on a specific time interval, FPL has included the raw time series data files in Excel with the report. Further discussion of the surface water elevations and implications is provided in Section 5 of this report.

2.4 METEOROLOGICAL DATA

One of the key parameters of interest is the amount of precipitation in the CCS and surrounding areas. Rainfall timing, duration, and amounts provide some insight into the area's hydrology. Additionally, meteorological data such as barometric pressure, wind speed, and light levels (i.e., photosynthetically active radiation [PAR]) are useful in determining water losses and gains in the CCS and in establishing a water budget.

A meteorological station (TPM-1) was set up in the middle of the CCS, co-located with TPGW-13 and TPSWCCS-2. Four additional rainfall gauges were set up in the vicinity of the plant to determine the spatial and temporal variability in rainfall on and offshore Turkey Point Plant. Locations of the rainfall and the meteorological stations are shown on Figure 2.4-1 and photos are included in Figure 2.4-2.

2.4.1 Instrumentation and Data Collection Methods

Meteorological station TPM-1 consists of a weather transmitter (WXT520, Vaisala Inc., Helsinki, Finland) and a quantum sensor (190SA, Li-Cor Inc., Lincoln, Nebraska) attached to a datalogger (CR1000, Campbell Scientific Ltd., Logan, Utah) and telemetry system, mounted 15 ft above the ground surface; the range of parameters measured is listed in Table 2.4-1. Technical specifications on the instrumentation are provided in Appendix I of the QAPP (approved 12/2/2011, FPL 2011).

The four rainfall-only stations (TPRF-2, TPRF-4, TPRF-11, and TPRF-12) consist of tipping bucket rainfall gauges (TB-3, Hydrological Services Inc., Liverpool, NSW, Australia) connected to waterproof pendant dataloggers (#UA-004-64, Onset Computer Corporation, Bourne, Massachusetts). Data are manually downloaded from these stations at approximately bi-monthly intervals. Rainfall data from the gauges are event-based. The tipping buckets fill at 0.10 inch and the time of each tip of the bucket is recorded.

Additional rainfall data for this report were also provided by a previously existing FPL meteorological station located south of the CCS by the Sea Dade Canal (LU-South) and from an existing rainfall station in the northern portion of the CCS (LU-NEast). The FPL meteorological station (LU-South) is similarly instrumented with a weather station (Climatronics Corp., Bohemia, New York), while the rainfall collector (LU-NEast) is a tipping bucket gauge.

Monitoring at TPM-1 was initiated on July 26, 2010, while the rainfall gauges were installed on November 12, 2010. At TPM-1, data are set to record at 15-minute intervals, although a reconfiguration of the initial setup by the manufacturer resulted in 30-minute data recording until March 7, 2011; although no data were lost, the data logger was then reset to record at 15-minute intervals after March 7, 2011. Data collected at this station are uploaded via telemetry to the FPL database on a daily basis.

In the past, issues with TPRF-12 not recording data occurred, but the unit has since been rewired and is now functional. Additionally, several of the other stations ran out of memory and did not record a full time period of data. These issues have been resolved, but gaps in data from the rainfall gauges remain.

2.4.2 Results and Discussion

Rainfall and temperature (Figure 2.4-3), relative humidity and barometric pressure (Figure 2.4-3), wind speed and wind direction (Figure 2.4-4), and PAR (Figure 2.4-5) for TPM-1 are shown for the entire period.

Over the 704 days of continuous recordkeeping, (July 27, 2010, to June 30, 2012), 121 inches of rain were observed at TPM-1 (Table 2.4-2). The greatest monthly rainfall totals were observed in September 2010 (13.5 inches), followed by October 2011 (13.3 inches), and April 2012 (12 inches) (Figure 2.4-6 and Table 2.4-3). There were a total of 430 rainfall days with 39 days having recorded totals in excess of 1 inch in a calendar day (Table 2.4-4). The number of rain-days and the amount of rainfall was generally greatest during the wet season (May to November), with the driest months from December to February. The least amounts of rain in a month were observed in February 2011 (0.2 inches), November 2011 (0.3 inches) and December 2010 (0.5 inches).

During the first 11 months of monitoring, a severe drought was observed across Florida in the early half of 2011, as evidenced by the limited precipitation (6.1 inches total) from February to May 2011. The second year of monitoring (July 2011 to June 2012) was less dry, as evidenced by the higher amount of rainfall (81 7 inches). These inter-annual differences in precipitation between years (3.8 inches per month from August 2010 to June 2011 water year versus 6.8 inches per month from July 2011 to June 2012) underscore how rainfall variability can potentially influence the hydrology and ecology in coastal South Florida.

Rainfall frequency and periodicity is tied to the seasonal patterns of low pressure over South Florida during the wet season and is a consequence of cold front passage during the winter months. For example, the highest daily precipitation amounts were observed on September 29, 2010 (7.3 inches), and October 8, 2011 (6.3 inches). Both these events are tied to the passage of low pressure systems over South Florida. The passage of cold fronts is usually evidenced by a drop in barometric pressure during the early winter days. Typically, the passage of a cold front is accompanied by higher wind speeds and decreased relative humidity following the rain event. An example of this is shown in late 2010 by the first significant cold front of that season which occurred from November 3 to 5, resulting in a significant decrease in temperature (about 10°C), relative humidity, and pressure.

Table 2.4-3 shows monthly rainfall totals from other rainfall stations around TPM-1. Although there was some variability among stations, the monthly rainfall totals in Biscayne Bay are consistently less than those on land while the totals at TPM-1 are higher than at most stations for most of the period of record. Nonetheless, the patterns at all stations are generally consistent across the months at the stations measured.

Air temperatures (at 15 ft above ground) in the middle of the CCS at TPM-1 ranged from 2.8°C to 33.8°C for the period of record, with an average of 25.5°C. The minimum temperature was observed on December 14, 2010, during the morning hours of a cold front passing through the area. The warmest temperature was observed on July 11, 2011, as July through September (monthly average > 29°C) are usually the warmest months of the year. Comparatively, the winter months of 2010/2011 (November to February) were colder than the similar time period of the following year (Figure 2.4-3).

Relative humidity at TPM-1 was an average of 71% during the period of recordkeeping. The patterns, however, were more variable in the winter months compared to the warmer months of April through June. Diurnal humidity patterns were influenced by broader seasonal patterns; for example, continued rainfall over several days in late September 2010 resulted in a few days (September 28 to 30) of 90% humidity while the passage of cold fronts (e.g., December 15, 2010) resulted in a humidity drop from 75% to 21% in 3.5 hours.

The prevailing wind directions from July 2010 through June 2012 were from the east and east-southeast, i.e., predominantly onshore (Figure 2.4-7). Average wind speed for the whole period, at 5 meters above ground, was 10 miles per hour (mph). The lull wind speeds averaged 6 mph, but several instances of strong wind gusts were observed, some in excess of 60 mph. The highest wind speed recorded at TPM-1 was observed during the passage of a frontal boundary on October 13, 2011, when a 134 mph wind gust was recorded. Similarly, wind speeds > 60 mph were seen on July 13, 2011, and April 26, 2012, with the approach of storm fronts. Forty-four percent of the time, the winds were between 7 to 11 meters per second (Figure 2.4-8).

Light levels show seasonal amplitude, with maximum light levels during the summer months and decreased light levels during the wintertime. Despite these overall trends, there were smaller patterns of decreased light levels as a consequence of cold front events (e.g., October 6 to 20, 2010) where several days of continuous cloudiness resulted in lowered light levels (Figure 2.4-5).

2.5 CCS FLOW METER DATA

2.5.1 Instrumentation and Data Collection Methods

As previously discussed in the August 2011 Annual Report (FPL 2011b), automated Acoustic Doppler Flow Meters (ADFMs) were initially installed at three constrained-flow locations in the CCS and are referred to as the outflow, southerly, and inflow stations. The outflow station (TPFM-1) was set up to measure outflow of water from the plant entering the CCS; due to the canal setup, the station was located in the discharge feeder canal approximately 0.4 mile downstream of the plant, but prior to the flow dispersing into the CCS (Figure 1.1-4). The southerly station (TPFM-2) is located on the southern end of the CCS (south collector) where all water passes as it transitions from southerly to northerly flow (Figure 1.1-4). The inflow station was originally located about 0.4 mile from the intake back into the plant. The purpose of the flow meters was to help assess losses and gains in CCS water volume and flows as part of the water budget.

Each of the stations was equipped with a side-looking ADFM (Argonaut-SL 500, Sontek/YSI, Yellow Springs, Ohio) that emits three acoustic beams in a characteristic pattern (i.e., two horizontal beams separated by 50 degrees and one vertical beam) (Figure 2.5-1). Each station is powered using a solar-charged lead acid battery. All data are stored in a datalogger (CR800, Campbell Scientific, Logan, Utah) and remotely transferred to a permanent database daily via telemetry. The data loggers are programmed to record indexed velocity and flow every 15 minutes.

Platforms to support these ADFMs were constructed in the summer of 2010. The meters were subsequently installed by YSI following industry standard protocol (i.e., mount the sensor plumb ±2 degrees, no obstructions above or in front of the sensor, etc.). Stream gauging and indexing efforts were conducted with the final installation indexing efforts completed in November 2010. Results of the initial indexing effort were provided in the August 2011 Annual Report (FPL 2011b).

Significant turbulence at TPFM-3 yielded poor data quality, and subsequent equipment failure resulted in removal of the flow meter in December 2010. This flow meter was repaired, but has not been reinstalled at TPFM-3 primarily due to issues with data quality, limitations in alternative inflow locations, and concerns of short-circuiting in the CCS. The issue of short-circuiting has been discussed with the Agencies. This issue limits the usefulness of the flow meters as originally envisioned. FPL collected temperature data to help confirm if short-circuiting of water from the discharge canals into the Grand Canal and return canals is occurring under the berms in the CCS. The greatest potential for underflow is the berm that separates the return Grand Canal and the discharge canal immediately adjacent to the Grand Canal, since the head differential between these two canals is the greatest. Results from this effort were presented to the Agencies on March 21, 2012, and indicated that some underflow may be occurring due to higher temperatures in the Grand Canal in comparison to the adjacent return canal to the east; however, the amount of underflow could not be determined.

The other two meters recorded data through July/August 2011, but became inoperable and were pulled for troubleshooting in the field. TPFM-1 was not operating in June 2011, and FPL replaced that flow meter with the one that had been previously pulled and repaired from TPFM-3. This flow meter recorded data for approximately one week (late June/early July 2011) before malfunctioning. At TPFM-2, data were collected until the mounting bracket broke in early August 2011. All flow meters were sent to YSI for diagnostics. These two meters were subsequently repaired, the mounting brackets were repaired, and the flow meters were reinstalled on May 29, 2012. Indexing was conducted during this reinstallation effort (on May 31) and the information is presented in Appendix F.

2.5.2 Results and Discussion

This report includes data that has been recorded by all flow meters since initial installation on July 27, 2010. As the Agencies have expressed interest in these data, it has been post-corrected based on the initial indexing efforts and the results are included with the entire data set for the monitoring period. Figure 2.5-2 shows the available velocity and flow meter data that were collected during the pre-Uprate period.

The results show the variations in flow over time, with the most notable changes directly associated with major plant outages at the nuclear units. Velocity in the CCS ranges from 0.33 foot per second (ft/s) to 2.4 ft/s, with generally higher values observed at TPFM-2 relative to TPFM-1 (Figure 2.5-2). Average velocity is 0.89 ± 0.19 ft/s (average ± standard deviation) at TPFM-1 and 1.62 ± 0.36 ft/s at TPFM-2. The channel is narrower at TPFM-2, hence resulting in greater velocities.

Flow rates of 1,032 cubic feet per second (ft^3/s) to 4,367 ft^3/s were observed in the CCS during the period of record. Average flow rates were 3,810 ± 613 ft^3/s at TPFM-1 and 2,507 ± 520 ft^3/s at TPFM-2. There was a significant positive correlation between the flow at both sites ($Flow_{TPFM-2} = 0.8113(Flow_{TPFM-1}) + 134.27$; $R^2 = 0.8708$), as shown on Figure 2.5-3. Flow was higher at TPFM-1 relative to TPFM-2 (Figures 2.5-3 and 2.5-4) for 92.6% of the time although this pattern was sometimes reversed. Lower flow at TPFM-1 when simultaneously compared to TPFM-2 may in part be caused by plant operations when pumps are turned on and off or varying rainfall distribution over the CCS which can affect flow in different reaches of the CCS.

During an outage, less water is typically needed for cooling and thus less water is pumped through the plant. While the pumpage rates vary, depending on factors such as the specific reason for the outage and length of time, there are some typical considerations for the plant's operating/shutdown conditions. Each nuclear unit has four circulating water pumps (CWPs; about 156,250 gallons per minute [gpm] each) and three intake cooling water pumps (ICWPs; about 16,000 gpm each). CCS water is pumped through the nuclear units for cooling. The nuclear units typically operate at full power with four CWPs and two ICWPs during operation. During a planned nuclear plant refueling shutdown (every 18 months), the CWPs are turned off and the shutdown unit uses one or two ICWPs for plant cooling purposes. The CWPs are returned to service when the unit is ready to restart. During the major scheduled Unit 3 Uprate outage that started in March 2012, the CWPs were turned off. Figure 2.5-2 shows the drop in flow in late September 2010 through late October 2010 and again in mid-March 2011 through early May 2011 during refueling outages.

The two fossil units each have two CWPs (about 137,000 gpm each) and two open cooling water pumps (OCWPs; about 6,000 gpm each). Typically, during operation a fossil unit will use both CWPs and one or two OCWPs depending on cooling requirements. CCS water is pumped through the fossil units for cooling. Pumps in Unit 1 are periodically turned on to maintain its operational readiness as this unit is online during peak seasonal demand periods. However, Unit 2 is currently being used as a synchronous generator and is not producing megawatts (MWs; or steam heat). Unit 2 is typically using the OCWPs for cooling. The complete outage reports for this pre-Uprate period are in Appendix F.

Figures 2.5-5 and 2.5-6 illustrate representative flows over two separate weeks compared to tidal fluxes at TPBBSW-3 in Biscayne Bay. The graphs show daily patterns with a week. These flows are representative of values observed during a week of normal Turkey Point Nuclear Plant operations (January 23 through 30, 2011) and during the outage of Unit 4 (March 23 through 30, 2011). As Units 3 and 4 are the primary drivers of flow within the CCS, flows during the Unit 4 outage were approximately half of normal plant operations in March 2011 (Figure 2.5-2). When flow rates are compared against the tidal fluctuations in Biscayne Bay, there appears to be no relationship between the tidal conditions and the flow rates in the CCS.

TABLES

Table 2.1-1. Statistical Summary of Automated Groundwater Specific Conductance (µS/cm) Data

	2010 Avg Monthly Value						2011 Avg Monthly Value												2012 Avg Monthly Value						Monitoring Period			
Well	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Min	Max	Avg	Std Dev
TPGW-1S				58295	57280	54664	55610	55568	55706	59141	59450		62844	58163	54260	54062	53788	53242			62103	62319	62343	59995	47861	64171	57646	3629
TPGW-1M				72522								70281	70448		70657									72454	66640	75485	71212	1187
TPGW-1D					70950	70592	70655	70754	70789				71327	71818	71886	71369	71230		71471	71737	71801	71693	70645	70639	69525	72580	71194	552
TPGW-2S		71302	71240	71981	71574	71890	72086	71235	72629	74309	76122	76689	74842	73573	73415	73485		73543	74756	74045	73360	74381	72185	71802	68360	77088	73254	1557
TPGW-2M	74790	74155	74241	74178	75427	75845	75435	74531	75052	75499	76489		76172	75348	75262	75110	75101	74946	75785		75610	75848	75309	75206	73143	77386	75304	720
TPGW-2D	75484	75140	75100	75384	75352	75174	75487	75808	75781	75023	74922	74561	75255	75560	76250	75940	75691	75758	76014	76114	76009	76034	75214	75449	72128	77116	75529	468
TPGW-3S			63753	63720	63474	63386	62965	62654	62721	63928	63564	63526	63728	63632	63819	63741	63090	63219	63082	64647	62309	62157	63115	63891	60266	65491	63369	719
TPGW-3M			68451	68882	68976	68760	69290	69698	69416	68993	68892	68775	68519	68521	68617	68712		67852	68499	69095	67858	67749	67735	67905	66779	70236	68617	591
TPGW-3D			67200	67328	68456	68929	68824	68759	68937	68789	69262	69768	69678	69581	69575	69003	68499	68340	68968	69601	68994	69007	68889	68797	66628	70014	68861	694
TPGW-4S			1794	1992	2084	2209	2311	2110	2581	2498			2565	2193	2137	1839	1858	2014	2148	2219	2235	2360	1623	1312	1105	3867	2163	428
TPGW-4M			37773	37796	37025	36833	37360	37778	37742	37172	37074	37302	37655	37470	37583	37435	37751	37949	38303	38551	37853	37873	37529	37501	35988	38785	37602	435
TPGW-4D										43093			42474			42337		42689	43137	43814	43374	43277	42494	42489	41327	44005	42899	504
TPGW-5S				1519	1424	1449			1168	1165	1244	1231			1351		1083	1057	1216	1304	1244	1497	1327		724	1947	1298	195
TPGW-5M				30943		30646	30351	29897	29942	30647	30881	30667	30663	31300	31410	31110	31180	31442	32215	32359	32158	32100	32097	32201	29580	32469	31184	757
TPGW-5D				33701	33449	33290	33132	33125	33059	32306	31815	32490	32805	33799	33872	33632	33275	33242	33732	33818	33683	33669	34021	34248	31234	34377	33357	611
TPGW-6S	1236	1240	1234	1178	1156	1176	1175	1173	1159	1128	1115	1162	1138	1120	1136	1123	1088	1063	1052	1050	1044	1040	1019	1021	496	1258	1127	70
TPGW-6M	22897	22961	22968	23037	22654	22723	22765	22483	22659	22405	22427	22465	22401	22362	22424	22253	21979	22665	22710	22660	22691	22514	22220	22297	21669	23108	22574	271
TPGW-6D	23739	23738	23693	23638	23641	23753	23954	24093	23954	23478	23529	23551	23399	23249	23403	23366	23463	23842	23729	23674	23651	23599	23475	23421	22465	24697	23623	233
TPGW-7S				578	542	551	568	579	580	586	577	562	561	562	559		578	557	578	581	575	556	569	567	421	906	568	32
TPGW-7M				592		614	607	608	606			580	628	687	654			595				559	702	716	551	826	624	53
TPGW-7D				569	599	597	610	607	603	599	596	592	586	582	580	581	578	577	595	606	590	569	596	585	418	679	591	19
TPGW-8S				3430	3352	3320	3019	3219	3116	2918	2898	2750	2622	2349	2589	2439	2595	2621	2706	2703	2731	2599	2290	2423	2067	3681	2808	355
TPGW-8M				652	646	646	646	649	651	647	644	640	642	641	641	640	638	636	629	629	629	630	621	620	618	655	639	9
TPGW-8D				693	685	678	690	684	690	683	686	694	678	675	675	666	667	659	675	677	678	672	674	665	237	714	679	21
TPGW-9S			618	604	592	598	572	582	627	653	647	647	637	595	549	552	535	547	603	554	602	611	597	592	444	949	595	39
TPGW-9M			685	689		661	659	670	665	652	666	653	637	625	642	647	645	635	623	617	631	635	612		598	752	646	23
TPGW-9D			650	649		649	642	640	644	648	641	633	638	639	630	628	629	629	632	635	635		611	611	610	655	635	11
TPGW-10S			51822	52009	51410	50492	50344	50139	50430	50599	50478	50887	51797	51822	52115	52396	52214	52266	52803	52090	52165	52308	52594	52874	50000	53163	51639	890
TPGW-10M			55559	55279	55375	55035	54712	54076	54277	54372	54687	54881	54788	54808	54664	54323	54187	54131	54887	53993	54731	55261	55074	54895	53629	55812	54724	484
TPGW-10D				56127	55927	55568	55369	55003	54882	54795	54877	54899	55020	55498	55192	54415	54648	54676	55362	54102	54785	55273	56922	58960	53918	59934	55362	1049

Table 2.1-1. Statistical Summary of Automated Groundwater Specific Conductance (µS/cm) Data

	2010 Avg Monthly Value						2011 Avg Monthly Value												2012 Avg Monthly Value						Monitoring Period			
Well	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Min	Max	Avg	Std Dev
TPGW-11S				55476	55401	55317	55176	54860	54015	53710	54476	54541	54759	53639	53670	53710	55559		54173	54359	54454	54810	55867	54876	53281	56001	54681	732
TPGW-11M				57571	57071	56515	56166	55460	55803	55982	55793	55798	55818			56114			56258	55777	55788	55985	56601	56406	54895	57774	56200	569
TPGW-11D				58622	58515	58269	57974	57382	57455	57472	57307	57994	58080	57807	57672	57731	58859	58333	58022	58574	58632	58746	59408	59570	55275	59845	58217	696
TPGW-12S	40844	40496	40108	40344	40749	40908	40901	40531	40433	40235	40877	43061	42492	41745	41417			43049	42199	41991	42225	42646	42769	42628	38736	45533	41514	1023
TPGW-12M	64272	64305	63809	64066	64360	64241	64346	64732	64636	64281	62715		61438	62491	62812	63919	63831		63251	62882	63057	62447	63178	64288	58312	65338	63507	1108
TPGW-12D	63914	63947	63515	63452	64093	64231	64246	64273	64281	63554	64428	64509	63983	63634	63611	64324	64304		64099	64019	63332	61686	63531	64169	61509	65028	63886	686
TPGW-13S	83728	83690	84012	84762	85901	86254	85863	85691	85235	84865	84225	83291	82935	82966	82793				83078	83238	83230	83486		83154	81985	86909	84024	1140
TPGW-13M	82710							82346	80681	80066	80678	80840		79975					79642	79716	79884		79145	78646	77609	83273	80393	1155
TPGW-13D				82730		83693	83427	82430	82329	82307	82633	83566	82834	82501	81739	80932	81229		81662	81646				80605	79595	84564	82251	965
TPGW-14S				59043	59505	59259	59079	58563	58158	57756	57804	57327	57459	58813		58774	57234			57607	57100	56694	57236	57263	56335	59860	58055	881
TPGW-14M				64847	64354	63528	63631	63276	63497	63119	62310	62088	63650	65194	64573	63601	63241			62884	61970	61735		63327	60718	67002	63391	1080
TPGW-14D				74692	74283	73885	73909	73790	73678	73676	73934	73988	73924	75385	74206	72895	73346			73855	73165	72871	73494	74008	72358	75797	73820	731

Key:
µs/cm = Micro Siemens per centimeter.
Avg = Average.
Max = Maximum.
Min = Minimum.
Std Dev = Standard Deviation.

Table 2.1-2. Statistical Summary of Automated Groundwater Water Temperature (°C) Data

	2010 Avg Monthly Value						2011 Avg Monthly Value												2012 Avg Monthly Value						Monitoring Period			
Well	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Min	Max	Avg	Std Dev
TPGW-1S				25.4	25.5	25.6	25.6	25.6	25.6	25.6	25.6		25.7	25.6	25.5	25.5	25.6	25.7	25.7		25.8	25.8	25.8	25.7	25.4	25.8	25.6	0.1
TPGW-1M				26.0	26.0	26.0	26.0	26.0	25.9	25.9	25.9	26.0	26.0	26.0	26.0	25.9	25.9	25.9	25.9	25.9	25.9	25.9	26.0	25.9	25.9	26.0	25.9	0.0
TPGW-1D				26.2	26.2	26.2	26.1	26.1	26.1	26.1	26.1	26.1	26.1	26.1	26.1	26.1	26.1	26.1	26.1	26.1	26.1	26.0	26.0	26.0	26.0	26.2	26.1	0.0
TPGW-2S	25.9	26.3	26.5	26.5	26.6	26.6	26.6	26.1	26.2	26.4	27.0	27.4	27.0	26.5	26.5	26.4	26.5	26.6	26.8	26.9	26.7	26.8	26.5	26.1	25.6	27.5	26.5	0.4
TPGW-2M	27.1	27.0	27.0	27.0	27.0	27.0	27.0	27.0	27.0	27.0	27.2	27.4	27.4	27.4	27.3	27.2	27.1	27.1	27.1		27.1	27.1	27.1	27.1	26.9	27.4	27.1	0.1
TPGW-2D	27.6	27.6	27.5	27.5	27.5	27.5	27.4	27.4	27.4	27.4	27.4	27.4	27.4	27.4	27.4	27.4	27.4	27.4	27.4	27.4	27.4	27.4	27.3	27.3	27.3	27.6	27.4	0.1
TPGW-3S			25.9	26.0	26.1	26.2	26.1	26.1	25.9	25.8	25.6	25.6	25.6	25.7	25.8	26.0	26.1	26.2	26.2	26.1	26.0	25.9	25.8	25.9	25.6	26.2	25.9	0.2
TPGW-3M			25.9	25.9	25.9	25.9	25.9	25.9	25.9	25.9	25.9	25.9	25.9	25.9	25.9	25.9	25.9	25.9	25.9	25.9	25.9	25.9	25.9	25.9	25.9	26.0	25.9	0.0
TPGW-3D			25.7	25.7	25.8	25.8	25.8	25.8	25.8	25.8	25.8	25.8	25.8	25.8	25.8	25.8	25.8	25.8	25.8	25.8	25.8	25.7	25.7	25.7	25.7	25.8	25.8	0.0
TPGW-4S			24.4	24.8	25.1	25.2	25.2	25.1	24.9	24.7			24.4	24.2	24.4	24.7	24.9	25.0	25.1	25.0	24.9	24.8	24.6	24.5	24.2	25.3	24.8	0.3
TPGW-4M			24.4	24.4	24.4	24.4	24.5	24.5	24.5	24.6	24.6	24.6	24.5	24.5	24.5	24.4	24.4	24.5	24.5	24.5	24.6	24.6	24.6	24.6	24.4	24.6	24.5	0.1
TPGW-4D			24.4	24.4		24.4	24.4	24.4	24.4	24.4	24.4	24.4	24.4		24.4	24.3	24.3	24.3	24.4	24.4	24.4	24.4	24.4	24.4	24.3	24.5	24.4	0.0
TPGW-5S				23.4	23.5	23.7	23.8	23.8	23.6	23.5	23.4	23.4	23.4	23.3	23.3		23.5	23.6	23.7	23.7	23.7	23.6	23.6		23.3	23.8	23.5	0.2
TPGW-5M				23.5	23.5	23.5	23.5	23.6	23.6	23.6	23.6	23.6	23.5	23.5	23.5	23.5	23.5	23.5	23.5	23.5	23.6	23.6	23.6	23.6	23.5	23.6	23.5	0.0
TPGW-5D				23.7	23.7	23.7	23.7	23.7	23.7	23.7	23.7	23.7	23.7	23.7	23.7	23.7	23.7	23.7	23.6	23.6	23.6	23.6	23.6	23.6	23.6	23.7	23.7	0.0
TPGW-6S	23.1	23.2	23.3	23.4	23.5	23.6	23.6	23.4	23.3	23.3	23.3	23.4	23.3	23.2	23.3	23.4	23.5	23.6	23.7	23.7	23.6	23.6	23.4	23.2	23.0	23.7	23.4	0.2
TPGW-6M	23.6	23.6	23.6	23.6	23.6	23.6	23.6	23.6	23.6	23.6	23.6	23.6	23.6	23.6	23.6	23.6	23.6	23.6	23.6	23.6	23.6	23.6	23.6	23.6	23.5	23.7	23.6	0.0
TPGW-6D	23.5	23.5	23.5	23.5	23.5	23.5	23.5	23.5	23.5	23.5	23.5	23.5	23.5	23.5	23.5	23.5	23.5	23.5	23.5	23.5	23.5	23.5	23.5	23.5	23.5	23.6	23.5	0.0
TPGW-7S				23.9	23.9	24.0	24.0	24.0	23.9	23.8	23.7	23.7	23.7	23.6	23.6		23.7	23.8	23.8	23.8	23.8	23.8	23.7	23.7	23.6	24.0	23.8	0.1
TPGW-7M				23.9		23.8	23.8	23.8	23.9		23.9	23.9	23.9	23.8	23.8		23.7	23.7	23.7			23.8	23.8	23.8	23.7	24.2	23.8	0.1
TPGW-7D				23.9	23.9	23.9	23.9	23.9	23.9	23.9	23.9	23.9	23.9	23.9	23.9	23.9	23.9	23.9	23.9	23.9	23.8	23.8	23.8	23.8	23.8	23.9	23.9	0.0
TPGW-8S				23.8	24.0	24.1	24.0	23.7	23.4	23.3	23.3	23.3	23.5	23.5	23.6	23.8	23.9	24.0	24.0	23.9	23.7	23.5	23.5	23.5	23.3	24.1	23.7	0.3
TPGW-8M				23.7	23.7	23.8	23.8	23.8	23.8	23.7	23.6	23.6	23.6	23.6	23.6	23.7	23.7	23.7	23.7	23.7	23.7	23.7	23.7	23.7	23.6	23.8	23.7	0.1
TPGW-8D				23.7	23.7	23.7	23.7	23.7	23.7	23.7	23.7	23.7	23.7	23.7	23.7	23.7	23.7	23.7	23.7	23.7	23.7	23.7	23.7	23.7	23.5	23.8	23.7	0.0
TPGW-9S	24.4	24.4	24.6	24.8	25.1	25.3	25.1	24.8	24.5	24.4	24.3	24.4	24.4	24.3	24.5	24.8	25.2	25.3	25.2	24.9	24.6	24.5	24.4	24.4	24.2	25.3	24.7	0.3
TPGW-9M	23.7	23.6	23.8	24.0		24.1	24.1	24.2	24.1	24.1	24.0	23.9	23.8	23.8	23.9	24.0	24.0	24.0	24.0	24.1	24.1	24.0	24.0		23.6	24.2	24.0	0.1
TPGW-9D	24.1	24.0	24.0	24.0		24.1	24.1	24.1	24.1	24.1	24.1	24.1	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.1	24.1	24.1	24.0	24.1	24.0	0.0
TPGW-10S			25.8	26.1	26.3	26.3	26.3	26.1	25.9	25.7	25.5	25.5	25.7	25.9	26.1	26.3	26.5	26.6	26.6	26.5	26.3	26.2	26.0	25.9	25.5	26.6	26.1	0.3
TPGW-10M			25.8	25.8	25.8	25.8	25.8	25.9	25.9	25.9	25.9	25.8	25.8	25.8	25.8	25.8	25.8	25.8	25.9	25.9	25.9	26.0	26.0	26.0	25.8	26.0	25.9	0.1
TPGW-10D			25.7	25.7	25.7	25.7	25.7	25.7	25.7	25.7	25.7	25.7	25.7	25.7	25.7	25.7	25.7	25.7	25.7	25.7	25.7	25.7	25.7	25.7	25.6	25.7	25.7	0.0

Table 2.1-2. Statistical Summary of Automated Groundwater Water Temperature (°C) Data

	2010 Avg Monthly Value						2011 Avg Monthly Value												2012 Avg Monthly Value						Monitoring Period			
Well	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Min**	**Max**	**Avg**	**Std Dev**
TPGW-11S				25.3	25.4	25.5	25.5	25.4	25.2	25.1	25.1	25.1	25.1	25.1	25.2	25.3	25.4	25.5	25.5	25.4	25.3	25.3	25.2	25.2	25.0	25.5	25.3	0.2
TPGW-11M				25.4	25.4	25.4	25.4	25.3	25.3	25.3	25.3	25.3	25.3			25.4			25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.4	25.3	0.0
TPGW-11D				25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3	0.0
TPGW-12S	26.0	26.0	26.0	25.9	26.0	26.1	26.1	26.1	26.1	26.0	25.9	25.8	25.9	25.9	25.9			26.0	26.1	26.1	26.0	26.0	26.0	25.9	25.8	26.5	26.0	0.1
TPGW-12M	26.2	26.2	26.1	26.1	26.1	26.1	26.1	26.1	26.1	26.1	26.1	26.1	26.1	26.1	26.1	26.1	26.0	26.1	26.1	26.1	26.1	26.1	26.1	26.1	26.0	26.2	26.1	0.0
TPGW-12D	26.2	26.2	26.2	26.2	26.2	26.2	26.1	26.1	26.1	26.1	26.1	26.1	26.1	26.1	26.1	26.1	26.1	26.1	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.2	26.1	0.1
TPGW-13S	29.4	29.3	29.4	29.6	30.0	30.3	30.5	30.5	30.4	30.2	29.9	29.8	29.8	29.8	29.8			30.1	30.2	30.3	30.3	30.3	30.2	30.1	29.3	30.5	30.0	0.4
TPGW-13M	29.6	29.5	29.5	29.5	29.5	29.4	29.4	29.4	29.5	29.5	29.5	29.6	29.6	29.5	29.5			29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.4	29.6	29.5	0.0
TPGW-13D	29.5	29.5	29.5	29.5	29.5	29.4	29.4	29.4	29.4	29.4	29.4	29.4	29.4	29.4	29.4	29.4	29.4	29.4	29.4	29.4	29.4	29.3	29.3	29.3	29.3	29.5	29.4	0.1
TPGW-14S				26.1	26.2	26.3	26.3	26.1	25.9	25.7	25.5	25.5	25.7	25.9		26.2	26.3			26.2	26.0	25.9	25.9	25.9	25.5	26.4	26.0	0.2
TPGW-14M				26.2	26.2	26.2	26.2	26.2	26.2	26.2	26.2	26.2	26.1	26.1	26.1	26.1	26.1			26.1	26.2	26.2	26.2	26.2	26.0	26.3	26.2	0.0
TPGW-14D				26.3	26.4	26.4	26.4	26.4	26.4	26.4	26.4	26.4	26.4	26.4	26.4	26.3	26.3			26.3	26.3	26.3	26.3	26.3	26.3	26.4	26.4	0.0

Key:
°C = Degrees Celsius.
Avg = Average.
Max = Maximum.
Min = Minimum.
Std Dev = Standard Deviation.

Table 2.1-3. Statistical Summary of Automated Groundwater Water Salinity (PSS-78) Data

	2010 Avg Monthly Value						2011 Avg Monthly Value												2012 Avg Monthly Value						Monitoring Period			
Well	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Min**	**Max**	**Avg**	**Std Dev**
TPGW-1S				39.4	38.7	36.8	37.5	37.5	37.6	40.2	40.5		43.1	39.5	36.5	36.3	36.1	35.7			42.5	42.7	42.7	40.9	31.7	44.1	39.1	2.8
TPGW-1M				50.8								49.0	49.1		49.3									50.7	46.1	53.2	49.7	1.0
TPGW-1D					49.5	49.2	49.3	49.4	49.4				49.8	50.2	50.3	49.9	49.8		49.9	50.2	50.2	50.1	49.3	49.3	48.4	50.8	49.7	0.4
TPGW-2S		49.8	49.8	49.9	50.0	50.3	50.5	49.8	50.9	52.3	53.8	54.2	52.7	51.7	51.5	51.6		51.6	52.6	52.1	51.5	52.3	50.5	50.2	47.5	54.6	51.4	1.3
TPGW-2M	52.7	52.2	52.2	52.2	53.2	53.5	53.2	52.5	52.9	53.3	54.1		53.8	53.1	53.1	52.9	52.9	52.8	53.5		53.3	53.5	53.1	53.0	51.3	54.8	53.1	0.6
TPGW-2D	53.3	53.0	53.0	52.9	53.1	53.0	53.3	53.5	53.5	52.9	52.8	52.5	53.1	53.3	53.9	53.6	53.4	53.5	53.7	53.8	53.7	53.7	53.0	53.2	50.5	54.6	53.3	0.4
TPGW-3S			43.8	43.8	43.6	43.5	43.2	43.0	43.0	43.9	43.7	43.6	43.8	43.7	43.9	43.8	43.3	43.4	43.3	44.5	42.7	42.6	43.3	43.9	41.1	45.2	43.5	0.6
TPGW-3M			47.5	47.8	47.9	47.8	48.2	48.5	48.3	48.0	47.9	47.8	47.6	47.6	47.7	47.7		47.0	47.6	48.0	47.1	47.0	47.0	47.1	46.2	49.0	47.7	0.5
TPGW-3D			46.5	46.6	47.5	47.9	47.8	47.8	47.9	47.8	48.2	48.6	48.5	48.4	48.4	48.0	47.6	47.4	47.9	48.4	47.9	48.0	47.9	47.8	46.1	48.8	47.8	0.6
TPGW-4S			0.9	1.0	1.1	1.1	1.2	1.1	1.3	1.3			1.3	1.1	1.1	0.9	1.0	1.0	1.1	1.2	1.2	1.2	0.8	0.7	0.6	2.1	1.1	0.2
TPGW-4M			24.3	24.3	23.8	23.7	24.0	24.3	24.3	23.9	23.8	24.0	24.2	24.1	24.2	24.1	24.3	24.4	24.7	24.9	24.4	24.4	24.2	24.1	23.1	25.0	24.2	0.3
TPGW-4D										28.2			27.7			27.6		27.9	28.2	28.7	28.4	28.3	27.7	27.7	26.9	28.8	28.0	0.4
TPGW-5S				0.8	0.7	0.7			0.6	0.6	0.6	0.6			0.7		0.5	0.5	0.6	0.7	0.6	0.8	0.7		0.0	1.0	0.7	0.1
TPGW-5M				19.5		19.3	19.1	18.8	18.8	19.3	19.5	19.3	19.3	19.7	19.8	19.6	19.7	19.8	20.4	20.5	20.3	20.3	20.3	20.4	18.6	20.6	19.7	0.5
TPGW-5D				21.4	21.2	21.1	21.0	21.0	21.0	20.5	20.1	20.6	20.8	21.5	21.5	21.4	21.1	21.1	21.4	21.5	21.4	21.4	21.7	21.8	19.7	21.9	21.2	0.4
TPGW-6S	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.2	0.6	0.6	0.0
TPGW-6M	14.0	14.1	14.1	14.1	13.9	13.9	13.9	13.7	13.9	13.7	13.7	13.7	13.7	13.7	13.7	13.6	13.4	13.9	13.9	13.9	13.9	13.8	13.6	13.6	13.2	14.2	13.8	0.2
TPGW-6D	14.6	14.6	14.6	14.5	14.5	14.6	14.7	14.8	14.7	14.4	14.4	14.5	14.3	14.2	14.4	14.3	14.4	14.7	14.6	14.5	14.5	14.5	14.4	14.4	13.7	15.2	14.5	0.2
TPGW-7S				0.28	0.26	0.27	0.28	0.28	0.28	0.29	0.28	0.27	0.27	0.27	0.27		0.28	0.27	0.28	0.28	0.28	0.27	0.28	0.28	0.20	0.44	0.28	0.02
TPGW-7M				0.29		0.30	0.30	0.30	0.30			0.28	0.30	0.33	0.32			0.29				0.27	0.35	0.35	0.27	0.41	0.31	0.03
TPGW-7D				0.28	0.29	0.29	0.30	0.30	0.30	0.29	0.29	0.29	0.28	0.28	0.28	0.28	0.28	0.28	0.29	0.30	0.29	0.28	0.29	0.29	0.21	0.33	0.29	0.01
TPGW-8S				1.79	1.77	1.76	1.59	1.70	1.65	1.54	1.52	1.44	1.37	1.22	1.35	1.27	1.36	1.37	1.42	1.42	1.43	1.36	1.19	1.26	1.06	1.96	1.47	0.19
TPGW-8M				0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.30	0.30	0.30	0.32	0.31	0.00
TPGW-8D				0.34	0.34	0.33	0.34	0.34	0.34	0.34	0.33	0.34	0.33	0.33	0.33	0.33	0.33	0.32	0.33	0.33	0.33	0.33	0.33	0.33	0.11	0.35	0.33	0.01
TPGW-9S	0.33	0.32	0.30	0.30	0.29	0.29	0.28	0.28	0.31	0.32	0.32	0.32	0.31	0.29	0.27	0.27	0.26	0.27	0.30	0.27	0.29	0.30	0.29	0.29	0.22	0.47	0.29	0.02
TPGW-9M	0.32	0.34	0.34	0.34		0.32	0.32	0.33	0.33	0.32	0.33	0.32	0.31	0.30	0.31	0.32	0.32	0.31	0.31	0.30	0.31	0.31	0.30		0.29	0.37	0.32	0.01
TPGW-9D	0.33	0.32	0.32	0.32		0.32	0.32	0.31	0.32	0.32	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31		0.30	0.30	0.30	0.33	0.31	0.01
TPGW-10S			34.7	34.8	34.3	33.7	33.6	33.4	33.6	33.7	33.6	33.9	34.6	34.6	34.9	35.1	35.0	35.0	35.4	34.9	34.9	35.0	35.2	35.4	33.3	35.7	34.5	0.7
TPGW-10M			37.5	37.3	37.3	37.1	36.8	36.4	36.5	36.6	36.8	37.0	36.9	36.9	36.8	36.5	36.4	36.4	37.0	36.3	36.9	37.3	37.1	37.0	36.0	37.7	36.8	0.4
TPGW-10D				37.9	37.8	37.5	37.3	37.1	37.0	36.9	37.0	37.0	37.1	37.4	37.2	36.6	36.8	36.8	37.3	36.4	36.9	37.3	38.5	40.1	36.2	40.8	37.3	0.8

Table 2.1-3. Statistical Summary of Automated Groundwater Water Salinity (PSS-78) Data

	2010 Avg Monthly Value						2011 Avg Monthly Value												2012 Avg Monthly Value						Monitoring Period			
Well	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Min	Max	Avg	Std Dev
TPGW-11S				37.4	37.3	37.3	37.2	36.9	36.3	36.1	36.6	36.7	36.8	36.0	36.0	36.1	37.5		36.4	36.6	36.6	36.9	37.7	36.9	35.7	37.8	36.8	0.6
TPGW-11M				39.0	38.6	38.2	37.9	37.4	37.7	37.8	37.6	37.6	37.7			37.9			38.0	37.6	37.6	37.8	38.3	38.1	37.0	39.1	38.0	0.4
TPGW-11D				39.8	39.7	39.5	39.3	38.9	38.9	38.9	38.8	39.3	39.4	39.2	39.1	39.1	40.0	39.6	39.3	39.8	39.8	39.9	40.4	40.5	37.2	40.8	39.5	0.5
TPGW-12S	26.6	26.3	26.0	26.2	26.5	26.6	26.6	26.3	26.3	26.1	26.6	28.2	27.7	27.2	27.0			28.2	27.5	27.4	27.6	27.9	28.0	27.8	25.0	30.0	27.0	0.7
TPGW-12M	44.2	44.3	43.9	44.0	44.3	44.2	44.3	44.6	44.5	44.2	43.0		42.0	42.8	43.1	43.9	43.9		43.4	43.1	43.3	42.8	43.4	44.2	39.6	45.1	43.6	0.9
TPGW-12D	44.0	44.0	43.6	43.6	44.1	44.2	44.2	44.2	44.2	43.7	44.3	44.4	44.0	43.7	43.7	44.3	44.3		44.1	44.0	43.5	42.2	43.6	44.1	42.1	44.8	43.9	0.5
TPGW-13S	60.2	60.1	60.4	61.0	62.0	62.3	62.0	61.9	61.5	61.2	60.6	59.8	59.5	59.5	59.4				59.7	59.8	59.8	60.0		59.7	58.7	62.9	60.4	1.0
TPGW-13M	59.3							59.0	57.6	57.1	57.6	57.8		57.0					56.8	56.8	57.0		56.4	55.9	55.1	59.8	57.4	1.0
TPGW-13D				59.3		60.1	59.9	59.1	59.0	59.0	59.3	60.0	59.4	59.1	58.5	57.8	58.1		58.4	58.4				57.6	56.7	60.9	58.9	0.8
TPGW-14S				40.1	40.5	40.3	40.2	39.8	39.5	39.2	39.2	38.8	38.9	40.0		40.0	38.8			39.1	38.7	38.3	38.8	38.8	38.1	40.8	39.4	0.7
TPGW-14M				44.6	44.3	43.6	43.7	43.5	43.6	43.3	42.7	42.5	43.7	45.0	44.5	43.7	43.4			43.1	42.4	42.2		43.5	41.5	46.2	43.5	0.8
TPGW-14D				52.6	52.2	51.9	51.9	51.8	51.7	51.7	52.0	52.0	51.9	53.1	52.2	51.1	51.5			51.9	51.3	51.1	51.6	52.0	50.7	53.5	51.9	0.6

Key:
Avg = Average. Min = Minimum.
Max = Maximum. PSS-78 = Practical Salinity Scale of 1978.
Min = Minimum. Std Dev = Standard Deviation.

Table 2.2-1. Probe Types/Automated Measurements at Surface Water Stations

Surface Water Site	Probe	Parameters Measured
TPSWC-1T	AT200	Water Quality, Stage
TPSWC-1B	AT100	Water Quality
TPSWC-2T	AT200	Water Quality, Stage
TPSWC-2B	AT100	Water Quality
TPSWC-3T	AT200	Water Quality, Stage
TPSWC-3B	AT100	Water Quality
TPSWC-4T	AT200	Water Quality, Stage
TPSWC-4B	AT100	Water Quality
TPSWC-5T	AT200	Water Quality, Stage
TPSWC-5B	AT100	Water Quality
TPSWID-1T	AT200	Water Quality, Stage
TPSWID-1B	AT100	Water Quality
TPSWID-2T	AT200	Water Quality, Stage
TPSWID-3T	AT100	Water Quality
TPSWID-3B	AT200	Water Quality, Stage
TPSWCCS-1T	AT200	Water Quality, Stage
TPSWCCS-2T	AT200	Water Quality, Stage
TPSWCCS-3T	AT200	Water Quality, Stage
TPSWCCS-4T	AT200	Water Quality, Stage
TPSWCCS-4B	AT100	Water Quality
TPSWCCS-5T	AT200	Water Quality, Stage
TPSWCCS-5B	AT100	Water Quality
TPSWCCS-6T	AT200	Water Quality, Stage
TPSWCCS-6B	AT100	Water Quality
TPBBSW-1B	AT100	Water Quality
TPBBSW-2B	AT100	Water Quality
TPBBSW-3B	AT200	Water Quality, Stage
TPBBSW-4B	AT100	Water Quality
TPBBSW-5B	AT100	Water Quality
TPBBSW-10B	AT200[1]	Water Quality, Stage
TPBBSW-14B	AT200[1]	Water Quality, Stage

Note:
[1] Supplemental station and LT500 Probe replaced with AT200.
Key:
AT - Aqua TROLL®. B – Bottom. LT – Level TROLL®.

Table 2.2-2. Statistical Summary of Automated Surface Water Specific Conductance (µS/cm) Data

	2010 Avg Monthly Value				2011 Avg Monthly Value												2012 Avg Monthly Value						Monitoring Period			
Well	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Min	Max	Avg	Std Dev
TPBBSW-1B	45724	42762					53344	57032	59610	64190	58049	56627	52513	45601	36155	39126	44940	44670	50060	54997	50761	44443	22645	66884	49891	7952
TPBBSW-2B	41373	34673				49825	54948	56124	59448	61684	56051	57333	53210	42358	34998	37587	43359	45735	53342	55033	49983	43936	25666	64725	48567	8902
TPBBSW-3B		37956	41461	47113	48759	49422	54943	56069	58152	60703	56291	56106	53736	44183	38483	41464	45711	48065	53951	55522	51617		28789	63371	49860	7091
TPBBSW-4B	47783	40599				49015	53544	54788	57957	59923	56892	57587	54949	47918	41284			50349	52915	54719	49363	45479	36028	61649	51006	5928
TPBBSW-5B	43696	37597				45334	51811	53530	59299	61321	57395	56750	53163	45346	40014	44053	46444	48186	52001	53837	44767	40215	32263	64177	48872	7201
TPBBSW-10B							52544	56924	59322	62340	53790	55413	49749	36961	31778	33398	42807	43319	48915	54618	49431	40699	18922	64623	47922	9482
TPBBSW-14B							42086	43192	45500	47174	45572	46396	44849	41738	36603	36725	38201	40814	48929	51965	47201	40098	35635	54677	43433	4471
TPSWC-1T	489	475	470	570	584	645	729	931	1169	1344	1958	1509	893	489	453	515	545	774	947	1170	774	660	315	3574	827	411
TPSWC-1B	528	571	494	575	603	658	893	1026	1257	1392	2750	1673	1402	763	822	752	704	884	1013	1146	1006	1013	387	3158	1002	508
TPSWC-2T	529	473	513	877	1022	871	1291	1662	3010	5681			691	395	475	630	960	1019	955	1314	808	607	256	6194	1210	1194
TPSWC-2B	533	500	533	933	1047	898	1300	1686	4239	6563			716	411	505	657	1059	1057	961	1370	874	623	267	9507	1408	1593
TPSWC-3T	501	428	554	1188	1285	1099	1873	2495	3645	5251	1526	1024	672	390	606	756	1352	1208	1185	2347	889	648	265	5864	1405	1178
TPSWC-3B	505	431	578	1232	1346	1118	2310	4805	18120	17509	5596	1296	681	397	2771	1249	2024	1946	1816	12202	7338	1271	265	22776	3925	5485
TPSWC-4T	6222	1579	9673	31766	34979	30471	33065	43723	57770	60696			22855	10750	25070	35936	37531	39349	39973	45713	29681	21321	60	74428	31088	18612
TPSWC-4B	11580	3484	15289	38527	39310	36005	42633	49753	58836	61371	55943	39983	28289	13016	30417	39162	42515	45600	45932	49142	33250	24939	388	71422	36348	19188
TPSWC-5T	45137	39444	42306	48519	47488	47466	53389	56334	58480	60138	55469	57205	53548	47156	40068			51476	52962	55028	46580	42868	27741	61200	50193	6382
TPSWC-5B	60767	65681	64616	54765	52674	51298	53684	56107	58353	61156	61160	59509	58870	59042	57888	53838	52940	53196	53288	54244	52912	57393	43281	71282	56991	4298
TPSWCCS-1B	78272	64684	63074	62864	69274	75568	77378		80103	82533	81031		83438	75177	70165	80697	79769	79202	87491	87801	71512	69331	54595	92208	76054	8284
TPSWCCS-2B	86980	85197	79816	77128	77321	77459	83099	84686	79816	82246	83991	84764	79743	79056		78234	80092	84575	83962	83102	80230	80194	64216	87632	81429	3435
TPSWCCS-3B	75329	62665	62207	69578	71060	76063	76070	78122	77061	83209	81928	83603	81700	73593	74209	78496	79288	78169			72288	69004	53565	89920	75523	6823
TPSWCCS-4T	80978	68690	64984	72571	74605	78604	80626	83922	82823	86770	82251	84765	81827	74446	76829	83058	87308	83673	89413	87618	73875	71039	55754	93220	79525	7003
TPSWCCS-4B	77956	64974	63602	71296	74326	78310	80864	84194	82955	87555	83032	84956	81377	74344	77545	84233	87124	83003	88445	87011	74917	70981	50528	91928	79210	7428
TPSWCCS-5T	79719	65959	63929	71314	73373	77613	79995	81547	81406	84909	80613		81806			83420	86283		83720	85306	72073	70535	54602	92006	77986	7080
TPSWCCS-5B	75759		64911	64402									68992		70038						74863	70572	52361	82208	69291	5356
TPSWCCS-6T		67677	64745	72308	74581	76748	78687	82405	81041	84474	80666	83079	81464	75544	77191	83268	86014	82419	89150	88242	74904	70464	59558	92827	78692	6624
TPSWCCS-6B		67578	64549	71643	74391	77834	80615	83419	82126	84906	80299			74567	76503	82411	85716	82040	88737	89230	75688	71767	59570	93594	78702	7005
TPSWCCS-7B	77683	62332	61696	69669	71630	75870	73896	72184									74909	71877			70159	65900	53511	85986	70836	5727
TPSWID-1T	3676	2715	2322	3252	8812	7170	20064	18130	25260	36783	23039	9189	9404	4487	2927	8178	24415	11881	7758	11495	5978	3052	2101	45621	11233	9611
TPSWID-1B	3721	2932	2338	3271	17069	13910	23757	26535	30564	41348	28725	13234	17587	5576	3689	13169	31393	21659	12945	27658	16236	3828	2109	48037	16312	11661
TPSWID-2T	2438	1750	2337	3762	4193	4570	9685	11652	30387	41981	16310	3572	5614	2381	2574	4227	14055	8384	5531	7999	4834	2685	1441	55392	8590	10252
TPSWID-2B	6191	3888	3462	3977	9976	10091	42913	41584	57636	65081	63935	36057	36088	13900	5670	15641	58794	36705	11831	40277	15998	7385	2146	68416	26517	22339
TPSWID-3T	1900	1331	1732	3164	3774	4066	4186	4756		50100	16201	5649	4039	2495	2107	3768	9598	6885	4838	9615	4270	2563	1177	62140	7377	11342
TPSWID-3B	2405	1580	1751	3125	3782	4031	5897	7965	55059	64068	26202	5801	5842	3018	2180	4691	25329	10424	5916	27414	4929	2658	1211	66206	12372	18088

Key:
µS/cm = Micro Siemens per centimeter.
Avg = Average.
Max = Maximum.
Min = Minimum.
Std Dev = Standard Deviation.

Table 2.2-3. Statistical Summary of Automated Surface Water Temperature (°C) Data

	2010 Avg Monthly Value				2011 Avg Monthly Value												2012 Avg Monthly Value						Monitoring Period			
Well	**Sep**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Min**	**Max**	**Avg**	**Std Dev**
TPBBSW-1B	30.1	27.1					23.9	27.3	27.8	29.3	30.7	30.7	30.8	26.6	24.2	22.7	20.4	22.8	24.0	24.9	28.0	29.1	15.9	33.4	26.6	3.4
TPBBSW-2B	29.6	26.7				23.0	24.0	27.7	28.2	29.5	31.1	30.8	30.3	26.1	23.9	22.3	20.6	23.3	24.2	25.2	28.4	29.1	13.4	35.0	26.3	3.7
TPBBSW-3B		26.6	23.2	16.6	19.6	22.7	23.7	27.4	27.9	29.3	30.9	30.7	30.2	26.0	23.9	22.2	20.4	23.0	24.0	24.9	28.1		9.5	34.8	25.2	4.2
TPBBSW-4B	29.6	26.8				22.7	23.7	27.5	28.2	29.3	31.0	30.9	30.4	26.3	24.1	22.5	20.4	23.2	24.1	25.1	28.1	29.1	15.9	33.7	26.3	3.5
TPBBSW-5B	29.8	27.0				23.2	24.1	27.9	28.4	29.5	31.2	30.9	30.4	26.4	24.3	22.5	20.7	23.4	24.4	25.3	28.6	29.3	15.8	34.5	26.5	3.5
TPBBSW-10B							23.9	27.6	28.0	28.9	31.0	30.8	30.5	26.2	24.1	22.5	20.8	23.3	24.3	25.2	28.4	29.2	14.9	35.2	26.3	3.5
TPBBSW-14B							23.8	27.5	28.1	29.3	31.0	30.9	30.4	26.2	24.0	22.4	20.8	23.3	24.2	25.2	28.1	28.9	16.6	33.9	26.4	3.4
TPSWC-1T	29.6	26.9	23.3	18.6	20.1	23.0	24.6	28.3	29.1	30.2	30.6	30.4	29.7	26.4	24.5	22.8	21.0	23.5	25.3	26.1	28.3	29.3	14.5	33.7	26.0	3.8
TPSWC-1B	28.9	26.1	22.7	17.9	18.6	21.0	23.1	26.8	27.7	28.7	29.2	29.7	29.0	25.7	24.1	22.5	20.1	22.2	24.3	25.2	26.1	27.9	14.7	30.6	24.9	3.6
TPSWC-2T	29.9	27.1	23.5	18.3	20.3	23.2	24.7	28.5	29.1	30.4			29.9	26.7	24.5	22.6	20.8	23.7	25.2	26.1	28.8	29.4	14.1	34.8	25.8	3.8
TPSWC-2B	29.1	26.5	23.1	17.6	18.8	21.7	24.0	27.8	29.1	30.0			29.2	25.8	23.8	22.1	20.0	22.4	24.4	25.6	27.2	28.7	14.0	31.8	25.0	3.9
TPSWC-3T	29.8	27.1	23.5	18.7	20.4	22.9	24.9	28.6	29.0	29.7	30.5	30.6	30.5	26.8	24.6	23.2	21.3	23.5	25.6	26.4	28.6	29.4	15.1	33.6	26.2	3.7
TPSWC-3B	29.5	27.0	23.2	18.1	19.3	21.8	24.5	28.5	30.6	30.1	29.7	30.2	29.9	26.6	24.3	22.7	20.5	22.5	25.0	27.0	27.8	28.9	15.0	32.2	25.8	4.0
TPSWC-4T	29.5	27.1	24.4	22.6	24.3	25.3	25.6	29.3	29.4	30.7	29.8	29.3	29.7	26.9	26.2	24.3	22.9	25.5	25.9	27.0	28.3	29.4	18.2	34.4	26.9	2.8
TPSWC-4B	29.7	27.1	24.4	22.2	24.3	25.6	26.2	30.0	29.7	30.9	29.4	29.4	29.9	26.9	26.0	24.5	23.1	25.3	26.0	27.3	28.1	29.5	17.4	34.5	27.1	2.8
TPSWC-5T	30.1	27.2	23.7	18.8	20.2	23.2	24.4	28.2	29.0	30.0	31.2	31.5	30.8	26.7	24.6			23.8	24.9	26.0	28.3	29.5	13.8	34.5	26.5	3.9
TPSWC-5B	33.6	28.7	28.0	22.3	21.9	23.8	24.3	28.0	28.8	29.7	31.3	31.7	31.9	29.1	28.9	26.2	22.4	23.8	24.7	25.9	27.3	29.9	16.4	34.9	27.4	3.5
TPSWCCS-1B	37.3	33.3	31.4	26.7	31.1	33.8	32.7	35.6	35.7	39.7	40.6	39.7	40.1	33.8	33.0	32.3	33.1	33.9	32.3	33.2	35.7	36.3	18.0	43.8	34.4	3.9
TPSWCCS-2B		29.4	27.5	22.8	25.8	28.3	27.5	30.1	31.6	33.3	35.0	35.2	35.0	30.3		28.2	26.8	28.3	27.1	27.9	30.6	31.3	14.5	38.2	29.7	3.8
TPSWCCS-3B	32.6	28.6	26.6	22.3	24.7	26.7	26.6	29.6	30.6	32.5	34.7	35.1	35.1	29.9	28.4	27.4	26.6	28.3	27.1	28.4	31.1	31.7	14.8	39.8	29.3	4.0
TPSWCCS-4T	31.5	28.0	25.6	20.6	23.4	26.1	26.0	29.1	30.1	31.5	33.3	33.2	33.0	28.1	26.4	25.3	24.2	26.2	26.0	26.9	29.8	30.4	12.4	37.8	27.9	4.0
TPSWCCS-4B	31.5	28.0	25.6	20.6	23.4	26.1	26.0	29.0	30.1	31.6	33.4	33.3	33.0	28.2	26.4	25.3	24.3	26.2	26.0	26.8	29.9	30.4	12.3	37.9	28.0	4.0
TPSWCCS-5T	31.4	28.0	25.5	20.5	23.3	26.0	26.0	29.0	29.9	31.3	33.0		32.8	28.1	26.3	25.2	24.1	26.0	26.3	26.8	29.8	30.4	12.8	37.0	27.5	3.7
TPSWCCS-5B	31.0	28.1	26.6	23.1	23.6	25.7	25.9		27.9	29.6	31.6		32.3	28.3	26.8	25.4	24.5	26.0		26.8	29.6	30.3	18.9	33.8	27.5	2.8
TPSWCCS-6T		27.7	25.1	20.1	22.8	25.6	25.8	28.9	29.8	31.0	32.7	32.7	32.4	27.8	26.0	24.7	23.8	25.5	26.4	26.8	29.4	30.1	12.5	35.7	27.4	3.8
TPSWCCS-6B		27.7	25.1	20.1	22.8	25.6	25.8	28.9	29.8	31.0	32.6			27.8	26.0	24.8	23.8	25.6	25.8	26.7	29.3	30.0	12.4	35.7	26.9	3.5
TPSWCCS-7B	34.6	30.6	28.9	24.4	27.9	30.2	29.2	32.0	32.8	35.6	37.3	37.4	37.2	31.5	30.3	29.5	29.2	30.6	29.0	30.2	32.8	33.5	15.7	42.6	31.6	4.0
TPSWID-1T	30.2	27.1	24.3	20.0	22.4	24.1	26.3	28.6	28.3	30.1	31.9	31.5	30.4	27.0	24.9	23.9	24.1	24.7	25.6	26.5	28.9	30.0	16.8	36.3	26.9	3.4
TPSWID-1B	29.7	26.6	23.8	19.6	25.2	25.5	26.8	27.9	28.1	29.5	31.4	32.1	30.2	26.3	24.3	25.3	26.0	25.6	26.0	29.3	30.4	29.4	16.8	33.9	27.3	3.1
TPSWID-2T	29.5	27.0	24.6	21.5	23.4	24.5	25.2	28.0	28.8	30.2	31.2	30.6	29.8	26.7	25.1	24.3	24.0	24.7	25.5	26.3	28.3	29.3	18.8	33.6	26.8	2.9
TPSWID-2B	27.5	26.8	24.6	21.3	25.3	25.8	26.7	27.4	29.1	29.9	31.0	31.7	30.2	28.6	25.6	26.6	28.2	27.5	25.9	28.2	28.1	28.2	18.8	32.5	27.5	2.4
TPSWID-3T	29.8	27.3	24.7	21.5	22.8	24.7	25.2	28.1	28.8	30.7	31.7	30.8	30.2	26.9	25.3	23.8	22.6	24.5	25.8	26.4	28.5	29.6	17.0	34.4	26.8	3.1
TPSWID-3B	28.2	26.6	24.3	21.0	22.3	24.2	25.0	27.5	28.0	29.5	31.4	30.2	29.3	26.5	24.9	23.7	25.3	24.5	25.5	27.3	27.7	28.9	18.1	33.8	26.5	2.8

Key:
°C = Degrees Celsius.
Avg = Average.
Max = Maximum.
Min = Minimum.
Std Dev = Standard Deviation.

Table 2.2-4. Statistical Summary of Automated Surface Water Salinity (PSS-78) Data

	2010 Avg Monthly Value				2011 Avg Monthly Value												2012 Avg Monthly Value						Monitoring Period			
Well	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Min	Max	Avg	Std Dev
TPBBSW-1B	30.2	28.0					35.7	38.6	40.6	44.3	39.5	38.4	35.3	30.1	23.2	25.3	29.4	29.3	33.3	37.0	33.9	29.2	13.9	46.4	33.3	6.0
TPBBSW-2B	27.1	22.2				33.1	37.0	38.0	40.5	42.3	38.0	39.0	35.8	27.7	22.4	24.2	28.2	30.1	35.7	37.1	33.3	28.8	15.9	44.8	32.3	6.6
TPBBSW-3B		24.5	27.0	30.8	32.1	32.8	36.9	37.9	39.5	41.5	38.1	38.0	36.2	29.0	24.8	26.9	29.9	31.8	36.2	37.4	34.6		18.0	43.7	33.2	5.3
TPBBSW-4B	31.7	26.4				32.5	35.9	36.9	39.4	40.9	38.6	39.1	37.1	31.8	26.8			33.5	35.4	36.8	32.9	30.0	23.1	42.3	34.1	4.5
TPBBSW-5B	28.7	24.2				29.8	34.6	36.0	40.4	42.0	39.0	38.5	35.8	29.9	25.9	28.8	30.5	31.9	34.8	36.2	29.5	26.2	20.4	44.3	32.5	5.4
TPBBSW-10B							35.1	38.6	40.4	42.8	36.2	37.5	33.2	23.8	20.1	21.2	27.8	28.3	32.5	36.8	32.9	26.5	11.4	44.5	31.9	7.0
TPBBSW-14B							27.4	28.3	30.0	31.2	30.1	30.7	29.5	27.2	23.5	23.5	24.5	26.5	32.5	34.7	31.2	26.0	22.8	36.8	28.5	3.3
TPSWC-1T	0.2	0.2	0.2	0.3	0.3	0.3	0.4	0.5	0.6	0.7	1.0	0.8	0.4	0.2	0.2	0.3	0.3	0.4	0.5	0.6	0.4	0.3	0.2	1.9	0.4	0.2
TPSWC-1B	0.3	0.3	0.2	0.3	0.3	0.3	0.4	0.5	0.6	0.7	1.4	0.9	0.7	0.4	0.4	0.4	0.3	0.4	0.5	0.6	0.5	0.5	0.2	1.7	0.5	0.3
TPSWC-2T	0.3	0.2	0.3	0.4	0.5	0.4	0.7	0.8	1.6	3.1			0.3	0.2	0.2	0.3	0.5	0.5	0.5	0.7	0.4	0.3	0.1	3.4	0.6	0.7
TPSWC-2B	0.3	0.2	0.3	0.5	0.5	0.4	0.7	0.9	2.3	3.6			0.3	0.2	0.2	0.3	0.5	0.5	0.5	0.7	0.4	0.3	0.1	5.4	0.7	0.9
TPSWC-3T	0.2	0.2	0.3	0.6	0.6	0.6	1.0	1.3	1.9	2.9	0.8	0.5	0.3	0.2	0.3	0.4	0.7	0.6	0.6	1.2	0.4	0.3	0.1	3.2	0.7	0.6
TPSWC-3B	0.2	0.2	0.3	0.6	0.7	0.6	1.2	2.6	10.9	10.5	3.1	0.7	0.3	0.2	1.5	0.6	1.1	1.0	0.9	7.1	4.2	0.6	0.1	14.0	2.2	3.3
TPSWC-4T	3.7	0.8	5.6	20.1	22.4	19.3	21.1	28.8	39.3	41.6	36.9		14.6	6.9	15.8	23.0	24.2	25.5	25.9	30.2	19.2	13.4	0.0	51.8	20.2	12.6
TPSWC-4B	7.2	1.8	9.1	24.8	25.5	23.1	27.9	33.2	40.1	42.1	37.9	26.7	18.4	8.5	19.5	25.4	27.7	30.0	30.3	32.7	21.8	16.0	0.2	50.0	23.9	13.1
TPSWC-5T	29.8	25.6	27.6	31.9	31.2	31.3	35.8	38.1	39.8	41.1	37.5	38.9	36.0	31.2	26.0			34.3	35.5	37.1	30.8	28.1	17.5	42.0	33.5	4.8
TPSWC-5B	41.6	45.4	44.5	36.7	35.2	34.2	36.0	38.0	39.7	41.9	41.9	40.6	40.1	40.2	39.3	36.2	35.4	35.6	35.7	36.5	35.5	39.0	28.2	49.1	38.6	3.4
TPSWCCS-1B	55.8	45.0	43.7	43.1	48.3	53.5	55.0		57.3	59.4	58.1		60.2	53.2	49.2	57.7	57.0	56.5	63.5	63.8	50.2	48.5	36.9	67.7	54.0	6.8
TPSWCCS-2B		61.47	56.83	54.30	54.69	54.92	59.55	61.00	56.97	59.05	60.56	61.22	57.02	56.30		55.54	57.00	60.83	60.25	59.57	57.29	57.28	44.24	63.69	58.25	2.91
TPSWCCS-3B	53.32	43.00	42.61	48.20	49.54	53.70	53.72	55.54	54.67	59.87	58.82	60.24	58.63	51.82	52.25	55.72	56.35	55.50			50.78	48.14	36.72	65.19	53.40	5.62
TPSWCCS-4T	57.97	47.79	44.76	50.44	52.31	55.74	57.40	60.32	59.43	62.83	59.06	61.18	58.69	52.46	54.31	59.38	62.86	59.97	64.79	63.36	52.05	49.75	37.65	68.25	56.63	5.81
TPSWCCS-4B	55.46	45.11	43.94	49.43	52.08	55.50	57.60	60.55	59.55	63.50	59.72	61.34	58.32	52.38	54.90	60.37	62.70	59.40	63.97	62.84	52.89	49.70	36.32	67.20	56.41	6.08
TPSWCCS-5T	56.92	45.81	44.16	49.44	51.31	54.92	56.88	58.33	58.25	61.24	57.69		58.67			59.71	61.98		60.00	61.40	50.57	49.34	39.25	67.19	55.38	5.78
TPSWCCS-5B	53.63		44.79	44.20									48.15		48.82						52.86	49.37	35.08	58.98	48.30	4.35
TPSWCCS-6T		47.17	44.58	50.19	52.26	54.19	55.80	59.04	57.94	60.86	57.72	59.74	58.38	53.34	54.59	59.52	61.73	58.88	64.61	63.88	52.87	49.28	40.57	67.77	55.93	5.46
TPSWCCS-6B		47.11	44.43	49.67	52.10	55.08	57.39	59.89	58.85	61.23	57.41			52.55	54.03	58.81	61.48	58.57	64.22	64.71	53.51	50.33	40.58	68.60	55.92	5.77
TPSWCCS-7B	55.28	42.99	42.49	48.40	50.14	53.68	52.04	50.72									52.89	50.43			49.10	45.69	35.99	62.09	49.64	4.58
TPSWID-1T	1.96	1.43	1.21	1.72	5.04	4.00	12.18	10.90	15.67	23.69	14.20	5.23	5.42	2.43	1.54	4.65	15.09	6.94	4.35	6.67	3.30	1.61	1.10	30.08	6.70	6.19
TPSWID-1B	2.0	1.5	1.2	1.7	10.3	8.2	14.6	16.5	19.3	27.0	18.0	7.7	10.6	3.1	2.0	7.8	19.9	13.3	7.6	17.3	9.7	2.0	1.1	31.9	10.0	7.6
TPSWID-2T	1.3	0.9	1.2	2.0	2.3	2.5	5.5	6.8	19.2	27.5	9.9	1.9	3.1	1.2	1.3	2.3	8.4	4.7	3.0	4.5	2.6	1.4	0.7	37.4	5.1	6.7
TPSWID-2B	3.4	2.1	1.9	2.1	5.7	5.8	28.2	27.2	39.2	45.0	44.1	23.4	23.5	8.2	3.1	9.4	40.1	24.0	7.0	26.4	9.6	4.1	1.1	47.6	17.3	15.6
TPSWID-3T	1.0	0.7	0.9	1.7	2.0	2.2	2.3	2.6	19.5	33.5	9.9	3.1	2.2	1.3	1.1	2.0	5.6	3.8	2.6	5.5	2.3	1.3	0.6	42.7	4.4	7.6
TPSWID-3B	1.3	0.8	0.9	1.7	2.0	2.2	3.3	4.6	37.3	44.2	16.9	3.2	3.2	1.6	1.1	2.6	16.0	6.1	3.3	17.4	2.7	1.4	0.6	45.9	7.8	12.5

Key:
Avg = Average. Min = Minimum.
Max = Maximum. PSS-78 = Practical Salinity Scale of 1978.
Min = Minimum. Std Dev = Standard Deviation.

Table 2.4-1. Parameters Collected at 15-Minute Intervals Reported by the Meteorological Station at TPM-1

Parameter	Units	Accuracy	Resolution
Rainfall – Amount	inches	Better than 5%, weather dependent	0.001
Relative Humidity	%	± 3	0.1
Temperature	°Celsius	± 0.3	± 0.1
Barometric Pressure	mmHg	0.5	0.5
Wind Speed- Average	mph	1 ft/sec	0.3 ft/sec
Wind Speed- Gusts and Lull	mph	1 ft/sec	0.3 ft/sec
Wind Direction	degrees	± 3	1
Light Level	μmol m^{-2} s^{-1}	5-10 μA/100 μmol m^{-2} s^{-1}	NA
Hail	Hits	1	1

Key:
ft/sec = Feet per second.
mmHg = Millimeters of mercury.
mph = Miles per hour.
NA = Not applicable.
μmol m^{-2} s^{-1} = Micromoles per meter square per second.

Table 2.4-2. Rainfall Recorded at the Meteorological Station TPM-1

Month	Day	Year	Rain (in)
7	27	2010	0.001
7	30	2010	0.001
8	3	2010	0.341
8	5	2010	0.13
8	8	2010	0.984
8	9	2010	3.075
8	10	2010	1.215
8	11	2010	0.001
8	15	2010	0.007
8	16	2010	0.214
8	17	2010	0.007
8	20	2010	0.16
8	21	2010	0.06
8	22	2010	0.217
8	23	2010	0.375
8	24	2010	0.02
8	26	2010	0.019
8	27	2010	0.351
8	28	2010	0.213
8	29	2010	0.084
8	30	2010	1.46
8	31	2010	0.014
9	1	2010	0.098
9	3	2010	0.479
9	4	2010	0.002
9	5	2010	0.168
9	6	2010	1.569
9	7	2010	0.114
9	8	2010	1.38
9	9	2010	0.005
9	10	2010	0.002
9	14	2010	0.004
9	15	2010	0.006
9	16	2010	0.119
9	17	2010	0.117
9	18	2010	0.041
9	19	2010	0.036
9	22	2010	0.016

Month	Day	Year	Rain (in)
9	23	2010	1.354
9	24	2010	0.019
9	25	2010	0.017
9	26	2010	0.112
9	27	2010	0.113
9	28	2010	0.363
9	29	2010	7.344
9	30	2010	0.008
10	6	2010	0.004
10	12	2010	0.57
10	13	2010	0.198
10	14	2010	0.063
10	17	2010	0.003
10	23	2010	0.303
10	24	2010	0.027
10	25	2010	0.088
10	26	2010	0.001
10	27	2010	0.140
10	28	2010	0.022
10	29	2010	0.898
10	31	2010	0.006
11	1	2010	0.053
11	3	2010	4.358
11	4	2010	0.854
11	5	2010	0.005
11	11	2010	0.002
11	12	2010	0.001
11	18	2010	0.079
11	22	2010	0.019
11	23	2010	0.021
11	24	2010	0.102
11	27	2010	0.008
11	29	2010	0.001
12	1	2010	0.008
12	5	2010	0.005
12	9	2010	0.075
12	12	2010	0.045
12	18	2010	0.221

Table 2.4-2. Rainfall Recorded at the Meteorological Station TPM-1

Month	Day	Year	Rain (in)
12	26	2010	0.182
1	3	2011	0.002
1	6	2011	0.061
1	8	2011	0.002
1	17	2011	2.829
1	19	2011	0.028
1	21	2011	0.005
1	24	2011	0.016
1	26	2011	0.584
2	11	2011	0.063
2	12	2011	0.131
2	14	2011	0.001
2	17	2011	0.034
2	24	2011	0.001
2	25	2011	0.006
3	2	2011	0.155
3	4	2011	0.004
3	5	2011	0.152
3	10	2011	0.329
3	18	2011	0.002
3	19	2011	0.002
3	20	2011	0.001
3	21	2011	0.111
3	22	2011	0.037
3	28	2011	0.55
3	29	2011	0.3
4	1	2011	0.449
4	5	2011	0.138
4	7	2011	0.001
4	13	2011	1.184
4	17	2011	0.069
4	25	2011	0.001
4	29	2011	0.001
4	30	2011	0.005
5	1	2011	0.01
5	3	2011	0.001
5	6	2011	0.151
5	7	2011	0.001

Month	Day	Year	Rain (in)
5	8	2011	0.019
5	10	2011	0.001
5	11	2011	0.037
5	12	2011	0.018
5	13	2011	0.074
5	14	2011	0.022
5	15	2011	0.298
5	16	2011	0.009
5	17	2011	0.024
5	18	2011	0.858
5	19	2011	0.02
5	20	2011	0.004
5	21	2011	0.005
5	22	2011	0.006
5	23	2011	0.001
5	24	2011	0.003
5	25	2011	0.001
5	26	2011	0.045
5	27	2011	0.073
5	28	2011	0.131
5	29	2011	0.124
5	30	2011	0.266
5	31	2011	0.201
6	1	2011	0.008
6	2	2011	0.141
6	3	2011	0.007
6	5	2011	0.001
6	6	2011	0.019
6	16	2011	0.055
6	17	2011	0.055
6	18	2011	0.085
6	19	2011	0.003
6	20	2011	0.164
6	21	2011	0.082
6	22	2011	0.012
6	23	2011	0.001
6	24	2011	0.006
6	25	2011	0.102

Table 2.4-2. Rainfall Recorded at the Meteorological Station TPM-1

Month	Day	Year	Rain (in)
6	26	2011	0.055
6	27	2011	0.100
6	28	2011	0.028
6	29	2011	0.605
6	30	2011	0.050
7	1	2011	0.064
7	2	2011	0.530
7	3	2011	0.048
7	4	2011	0.004
7	5	2011	0.330
7	6	2011	1.520
7	7	2011	3.874
7	8	2011	0.001
7	9	2011	0.008
7	10	2011	0.001
7	11	2011	0.394
7	12	2011	0.003
7	13	2011	0.380
7	15	2011	0.002
7	16	2011	0.002
7	17	2011	0.248
7	18	2011	1.343
7	19	2011	0.905
7	20	2011	0.140
7	21	2011	0.308
7	22	2011	0.047
7	23	2011	0.003
7	24	2011	0.103
7	25	2011	0.015
7	26	2011	0.001
7	27	2011	0.038
7	28	2011	0.146
7	29	2011	0.183
8	1	2011	0.003
8	2	2011	0.026
8	3	2011	0.255
8	5	2011	0.001
8	6	2011	1.472

Month	Day	Year	Rain (in)
8	7	2011	0.627
8	8	2011	0.968
8	9	2011	0.009
8	10	2011	0.028
8	11	2011	0.058
8	12	2011	0.070
8	13	2011	0.080
8	14	2011	0.599
8	15	2011	0.550
8	16	2011	0.116
8	17	2011	0.001
8	18	2011	0.033
8	19	2011	0.452
8	20	2011	0.098
8	21	2011	0.010
8	22	2011	0.170
8	23	2011	0.004
8	24	2011	0.007
8	25	2011	0.301
8	26	2011	0.301
8	27	2011	0.224
8	29	2011	0.684
8	30	2011	2.080
9	1	2011	0.017
9	2	2011	1.758
9	3	2011	0.003
9	8	2011	0.206
9	9	2011	0.022
9	10	2011	0.001
9	12	2011	0.359
9	13	2011	0.339
9	14	2011	0.006
9	16	2011	0.003
9	18	2011	0.057
9	19	2011	0.199
9	20	2011	0.004
9	21	2011	0.127
9	22	2011	1.472

Table 2.4-2. Rainfall Recorded at the Meteorological Station TPM-1

Month	Day	Year	Rain (in)
9	23	2011	0.684
9	25	2011	1.182
9	26	2011	0.148
9	27	2011	0.196
9	29	2011	0.006
9	30	2011	0.144
10	6	2011	0.008
10	7	2011	0.460
10	8	2011	6.333
10	9	2011	0.073
10	10	2011	0.016
10	11	2011	0.010
10	12	2011	0.010
10	13	2011	0.019
10	15	2011	1.053
10	16	2011	1.633
10	17	2011	0.382
10	18	2011	0.350
10	19	2011	1.330
10	22	2011	0.002
10	23	2011	0.003
10	28	2011	0.619
10	29	2011	0.139
10	30	2011	0.007
11	1	2011	0.021
11	2	2011	0.010
11	4	2011	0.004
11	5	2011	0.117
11	6	2011	0.032
11	7	2011	0.004
11	8	2011	0.002
11	9	2011	0.006
11	13	2011	0.003
11	15	2011	0.001
11	17	2011	0.014
11	18	2011	0.052
11	19	2011	0.013
11	20	2011	0.037

Month	Day	Year	Rain (in)
11	29	2011	0.001
12	1	11	0.001
12	2	11	0.003
12	4	11	0.035
12	5	11	0.043
12	7	11	0.043
12	9	11	0.061
12	10	11	0.164
12	12	11	0.001
12	13	11	0.164
12	14	11	0.013
12	16	11	0.001
12	17	11	0.007
12	18	11	0.016
12	21	11	0.003
12	22	11	0.002
12	23	11	0.001
12	27	11	0.001
12	31	11	0.001
1	2	12	0.001
1	4	12	0.022
1	5	12	0.001
1	7	12	0.004
1	10	12	0.005
1	11	12	0.009
1	12	12	0.067
1	13	12	0.283
1	14	12	0.001
1	17	12	0.006
1	18	12	0.012
1	19	12	0.013
1	21	12	0.005
1	22	12	0.001
1	23	12	0.004
1	25	12	0.001
1	26	12	0.001
1	28	12	0.017
1	29	12	0.996

Table 2.4-2. Rainfall Recorded at the Meteorological Station TPM-1

Month	Day	Year	Rain (in)
1	30	12	0.004
2	1	12	0.001
2	2	12	0.009
2	3	12	0.003
2	4	12	0.001
2	5	12	0.140
2	6	12	1.861
2	7	12	0.443
2	9	12	1.007
2	10	12	1.789
2	11	12	0.475
2	13	12	0.003
2	15	12	0.002
2	20	12	0.001
2	22	12	0.003
2	24	12	0.001
2	25	12	0.168
2	26	12	0.001
2	28	12	0.017
2	29	12	0.012
3	1	12	0.003
3	3	12	0.005
3	4	12	0.167
3	5	12	0.007
3	7	12	0.088
3	8	12	0.078
3	9	12	0.002
3	10	12	0.005
3	11	12	0.069
3	12	12	0.074
3	14	12	0.026
3	15	12	0.120
3	16	12	0.009
3	17	12	0.001
3	18	12	0.004
3	19	12	0.212
3	21	12	0.003
3	22	12	0.001

Month	Day	Year	Rain (in)
3	23	12	0.003
3	25	12	0.002
3	26	12	0.002
3	27	12	0.087
3	28	12	0.001
3	30	12	0.012
3	31	12	0.002
4	1	12	0.008
4	2	12	0.002
4	5	12	0.734
4	6	12	0.002
4	7	12	0.004
4	9	12	0.001
4	10	12	0.003
4	13	12	0.001
4	14	12	2.235
4	15	12	0.004
4	16	12	0.015
4	17	12	0.026
4	18	12	0.002
4	19	12	0.003
4	21	12	3.482
4	22	12	0.405
4	23	12	0.002
4	24	12	0.015
4	25	12	0.012
4	26	12	0.004
4	27	12	0.009
4	28	12	1.185
4	29	12	1.889
4	30	12	2.444
5	1	12	0.004
5	4	12	0.003
5	6	12	0.010
5	7	12	0.012
5	8	12	0.425
5	10	12	0.003
5	11	12	0.013

Table 2.4-2. Rainfall Recorded at the Meteorological Station TPM-1

Month	Day	Year	Rain (in)
5	12	12	0.005
5	13	12	0.003
5	15	12	0.005
5	16	12	0.081
5	17	12	2.308
5	18	12	0.119
5	19	12	0.611
5	20	12	0.688
5	21	12	0.007
5	22	12	0.904
5	23	12	0.186
5	24	12	2.896
5	25	12	0.045
5	26	12	0.026
5	27	12	0.052
5	28	12	0.104
5	29	12	0.171
5	30	12	0.138
5	31	12	0.594
6	1	2012	1.298
6	2	2012	0.209
6	3	2012	0.182
6	4	2012	0.264
6	5	2012	0.167
6	6	2012	0.096
6	7	2012	0.226
6	8	2012	0.161
6	9	2012	0.28
6	10	2012	0.164
6	11	2012	0.083
6	12	2012	0.097
6	13	2012	0.079
6	14	2012	0.315
6	15	2012	0.28
6	16	2012	0.051
6	17	2012	0.001
6	18	2012	0.004
6	19	2012	0.066
6	20	2012	2.167
6	21	2012	0.785
6	22	2012	0.573
6	23	2012	1.035
6	24	2012	0.006
6	25	2012	0.001
6	26	2012	0.001
6	27	2012	0.022
6	28	2012	0.174
6	29	2012	0.113
6	30	2012	0.001

Table 2.4-3. Total Rain Days and Rainfall Amounts Recorded Monthly at Each Station

Month	TPM-1		TPRF-2		TPRF-11		TPRF-4		TPRF-12		LU-South		LU-NEast	
	# of Rain Days	Amount	# of Rain Days	Amount	# of Rain Days	Amount	# of Rain Days	Amount	# of Rain Days	Amount	# of Rain Days	Amount	# of Rain Days	Amount
Aug-10	20	8.95	NA	NA	NA	NA			NA	NA	NA	NA	25	6.85
Sep-10	24	13.49	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	14	12.05
Oct-10	13	2.32	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	26	6.92
Nov-10	12	5.50	5	0.25	4	0.13	NA	NA	NA	NA	6	6.12	24	2.47
Dec-10	6	0.54	3	0.42	0	0.00	NA	NA	NA	NA	6	1.00	7	1.27
Jan-11	8	3.53	4	4.01	3	0.46	NA	NA	NA	NA	4	2.81	3	3.19
Feb-11	6	0.24	3	0.16	3	0.15	NA	NA	NA	NA	3	0.11	5	1.09
Mar-11	11	1.64	6	2.07	6	1.40	NA	NA	NA	NA	4	1.13	6	2.62
Apr-11	8	1.85	6	2.83	6	1.39	NA	NA	NA	NA	1	0.06	2	0.26
May-11	27	2.40	8	0.91	6	1.06	NA	NA	NA	NA	5	0.37	7	1.37
Jun-11	20	1.58	12	2.75	9	1.93	NA	NA	NA	NA	6	0.42	10	2.86
Jul-11	29	10.64	15	10.69	15	6.99	NA	NA	NA	NA	19	8.47	18	5.79
Aug-11	29	9.24	NA	NA	20	5.44	NA	NA	NA	NA	23	6.32	23	7.96
Sep-11	21	6.93	NA	NA	15	4.44	19	4.77	NA	NA	15	4.95	12	1.89
Oct-11	19	13.25	NA	NA	14	7.07	6	6.44	NA	NA	12	14.5	12	3.60
Nov-11	18	0.32	NA	NA	5	0.23	NA	NA	NA	NA	5	0.61	6	0.27
Dec-11	18	0.56	4	0.13	7	0.68	8	0.84	NA	NA	8	1.32	7	1.52
Jan-12	20	1.45	5	0.70	NA	NA	3	0.66	NA	NA	6	0.92	3	0.11
Feb-12	19	5.94	11	0.19	NA	NA	8	7.28	NA	NA	8	5.42	9	3.81
Mar-12	25	0.98	8	0.79	NA	NA	8	0.94	8	1.95	7	1.25	10	1.31

Table 2.4-3. Total Rain Days and Rainfall Amounts Recorded Monthly at Each Station

Month	TPM-1		TPRF-2		TPRF-11		TPRF-4		TPRF-12		LU-South		LU-NEast	
	# of Rain Days	Amount	# of Rain Days	Amount	# of Rain Days	Amount	# of Rain Days	Amount	# of Rain Days	Amount	# of Rain Days	Amount	# of Rain Days	Amount
Apr-12	24	12.49	16	1.83	NA	NA	7	11.45	8	8.43	9	11.69	8	10.89
May-12	26	9.41	21	0.62	NA	NA	7	3.94 *	12	7.14	12	4.39	15	9.00
Jun-12	30	8.90	19	4.12	NA	NA	NA	NA	18	4.63	NA	NA	NA	NA

Note: * Data available 5/1/2012 through 5/21/2012.

Table 2.4-4. Dates of Daily Rainfall Greater Than 1" in a 24-Hour Period for All Stations

Month	Date	Year	TPM-1	TPRF-2	TPRF-11	TPRF-12	TPRF-4	LU-South	LU-NEast
8	9	2010	3.08	NA	NA	NA	NA	NA	1.47
8	10	2010	1.22	NA	NA	NA	NA	NA	0.11
8	30	2010	1.46	NA	NA	NA	NA	NA	0.81
9	6	2010	1.57	NA	NA	NA	NA	0.89	1.19
9	8	2010	1.38	NA	NA	NA	NA	1.29	0.51
9	23	2010	1.35	NA	NA	NA	NA	NA	0.38
9	29	2010	7.34	NA	NA	NA	NA	NA	4.53
11	3	2010	4.36	NA	NA	NA	NA	5.39	0.83
1	17	2011	2.83	3.29	0.00	NA	NA	2.48	3.15
4	13	2011	1.18	0.32	1.01	NA	NA	NA	0.75
6	29	2011	0.61	1.96	0.47	NA	NA	0.00	0.00
7	6	2011	1.52	2.50	0.89	NA	NA	2.27	0.35
7	7	2011	3.87	3.39	3.89	NA	NA	2.95	2.83
7	18	2011	1.34	2.51	0.20	NA	NA	1.26	0.31
8	6	2011	1.47	0.39	0.28	NA	NA	0.23	1.37
8	8	2011	0.97	1.55	0.40	NA	NA	0.63	1.27
8	15	2011	0.55	0.01	0.41	NA	NA	1.30	0.05
8	30	2011	2.08	NA	1.48	NA	NA	1.01	0.21
9	9	2011	1.76	NA	0.35	NA	NA	1.27	0.16
9	22	2011	1.47	NA	0.17	NA	0.79	0.00	0.00
9	25	2011	1.18	NA	1.05	NA	1.04	0.00	0.00
10	8	2011	6.33	NA	2.44	NA	3.86	8.05	1.37

Table 2.4-4. Dates of Daily Rainfall Greater Than 1" in a 24-Hour Period for All Stations

Month	Date	Year	TPM-1	TPRF-2	TPRF-11	TPRF-12	TPRF-4	LU-South	LU-NEast
10	15	2011	1.05	NA	0.45	NA	1.20	1.25	0.38
10	16	2011	1.63	NA	1.06	NA	1.23	1.27	0.53
10	19	2011	1.33	NA	0.92	NA	NA	0.90	0.24
10	31	2011	0.00	NA	0.53	NA	NA	1.27	1.06
3	6	2012	1.86	NA	0.00	0.00	0.00	0.00	0.35
3	9	2012	1.01	NA	0.03	0.00	0.00	0.03	0.00
3	10	2012	1.79	NA	NA	0.00	0.00	0.00	0.00
4	14	2012	2.24	0.56	NA	0.62	1.35	1.92	1.58
4	21	2012	3.48	0.33	NA	3.15	2.61	2.89	2.95
4	28	2012	1.19	0.01	NA	0.94	1.58	1.07	0.90
4	29	2012	1.89	0.02	NA	1.85	2.57	2.70	1.84
4	30	2012	2.44	0.04	NA	1.42	2.57	2.25	3.04
5	17	2012	2.31	0.00	NA	1.60	1.66	1.95	1.96
5	24	2012	2.90	0.16	NA	1.85	NA	0.34	2.43
6	1	2012	1.30	0.01	NA	1.02	NA	NA	NA
6	20	2012	2.17	1.89	NA	2.28	NA	NA	NA
6	23	2012	1.04	0.75	NA	NA	NA	NA	NA

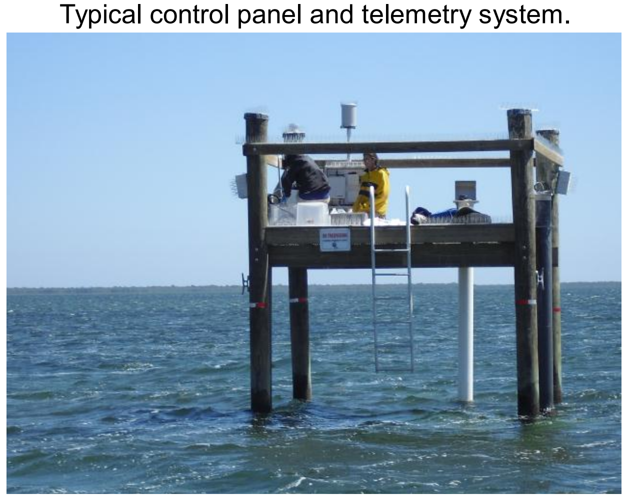
Key:
LU = Land Use.
NA = Not Available.
TPM1 = Turkey Point Meteorological Station.
TPRF = Turkey Point Rainfall Gauge.

FIGURES

Land-based station.

Typical control panel and telemetry system.

Typical automated probe and cable.



Biscayne Bay station.

Figure 2.1-1. Automated Groundwater Stations.

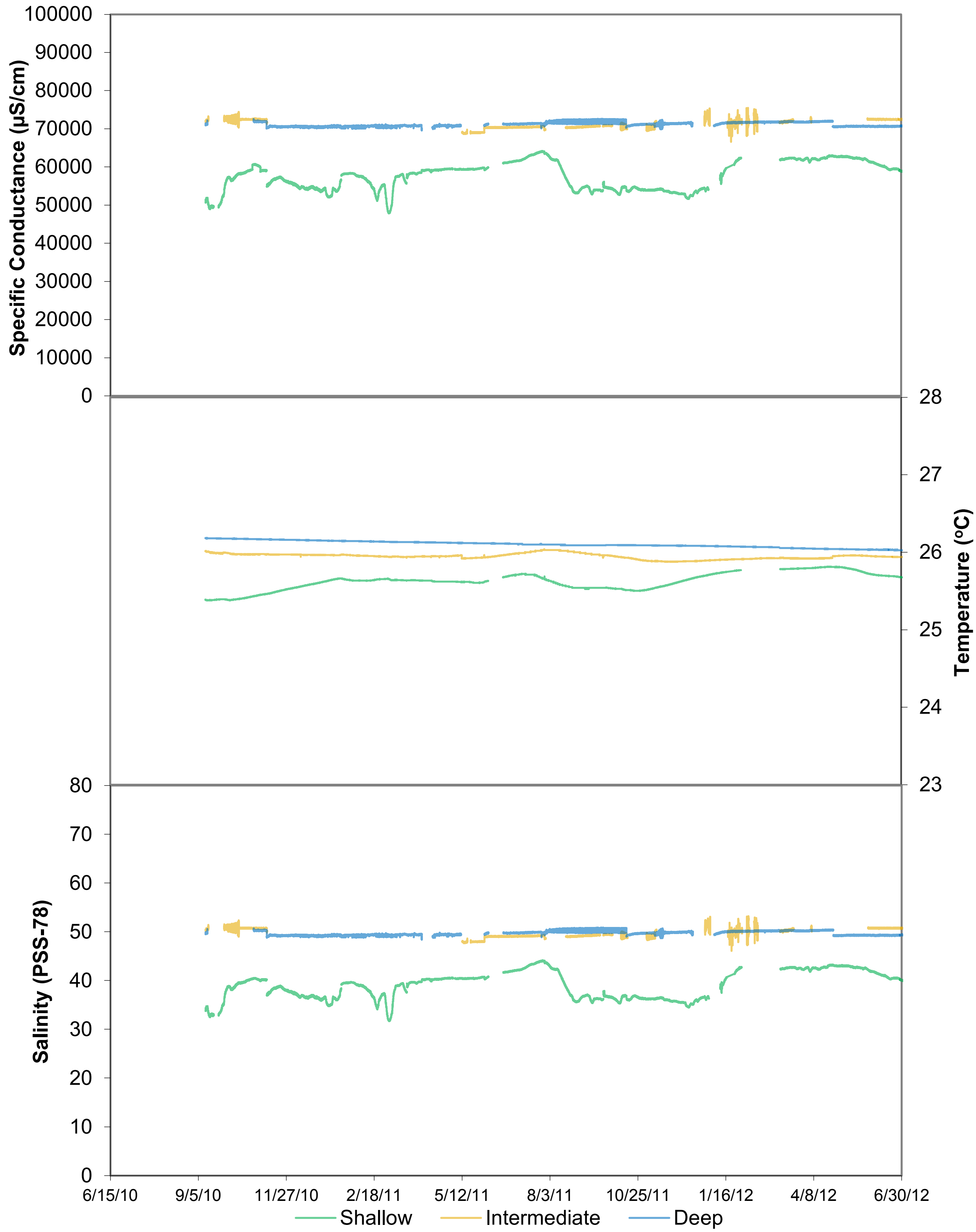


Figure 2.1-2. TPGW-1 Specific Conductance, Temperature, and Salinity.

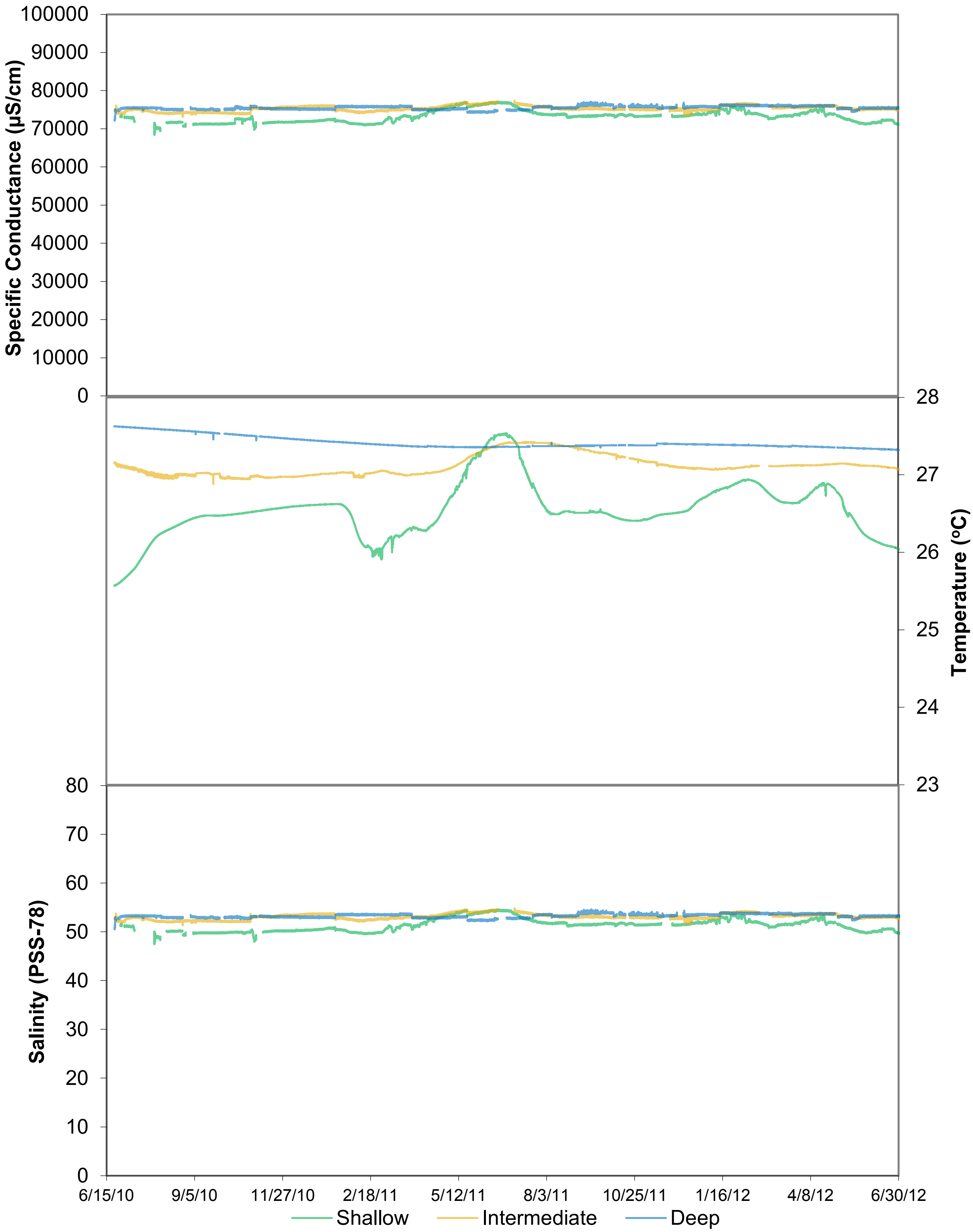


Figure 2.1-3. TPGW-2 Specific Conductance, Temperature, and Salinity.

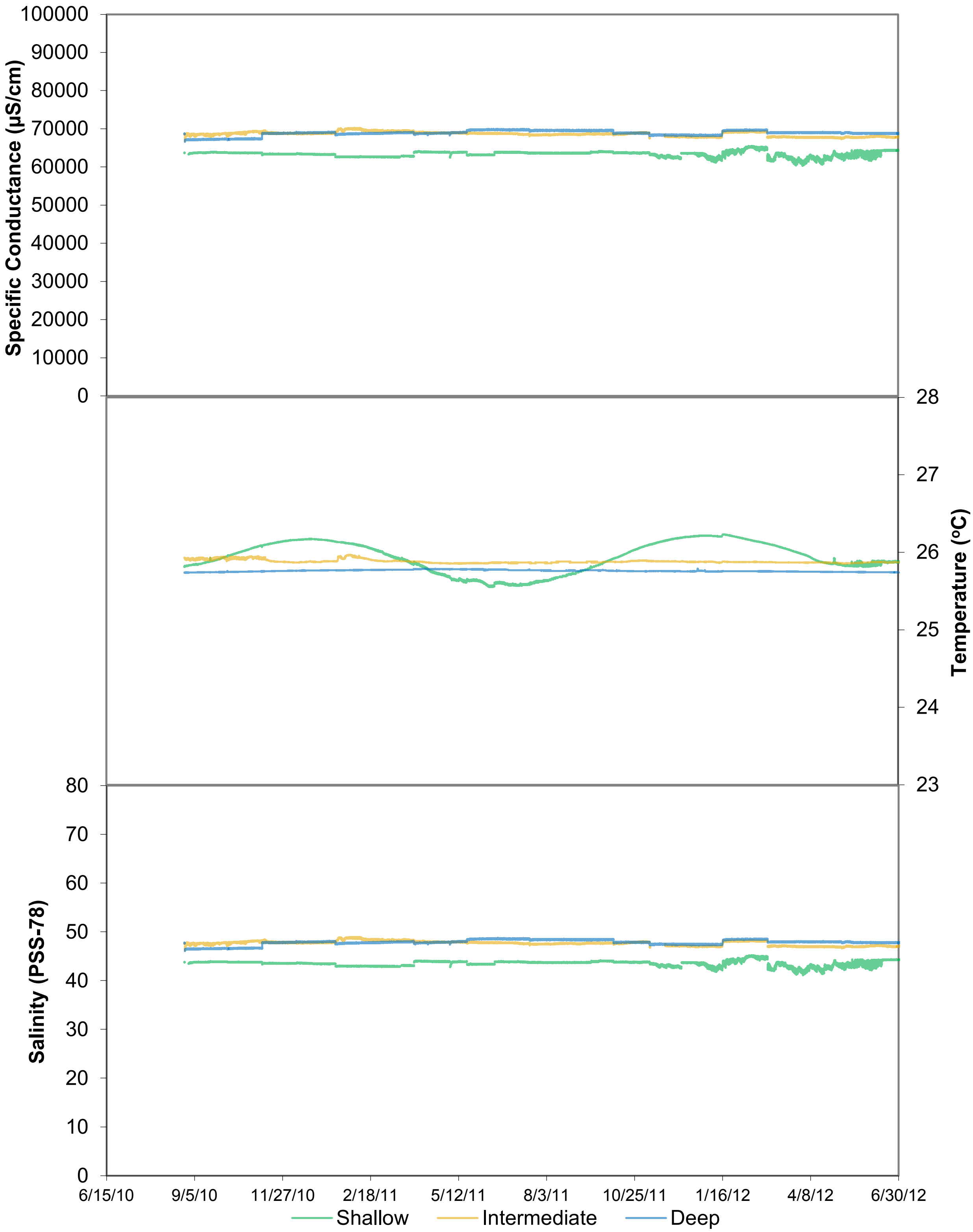


Figure 2.1-4. TPGW-3 Specific Conductance, Temperature, and Salinity.

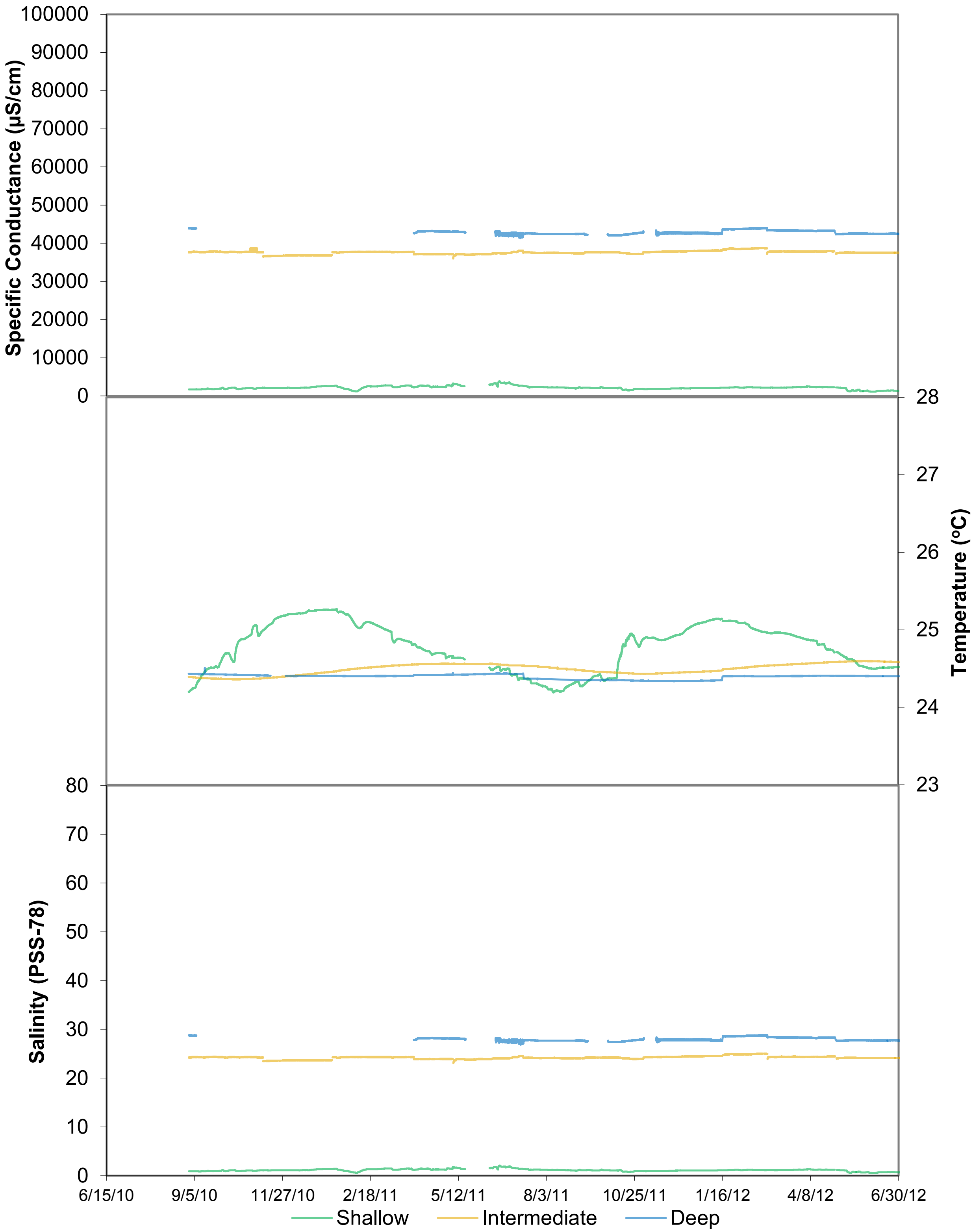


Figure 2.1-5. TPGW-4 Specific Conductance, Temperature, and Salinity.

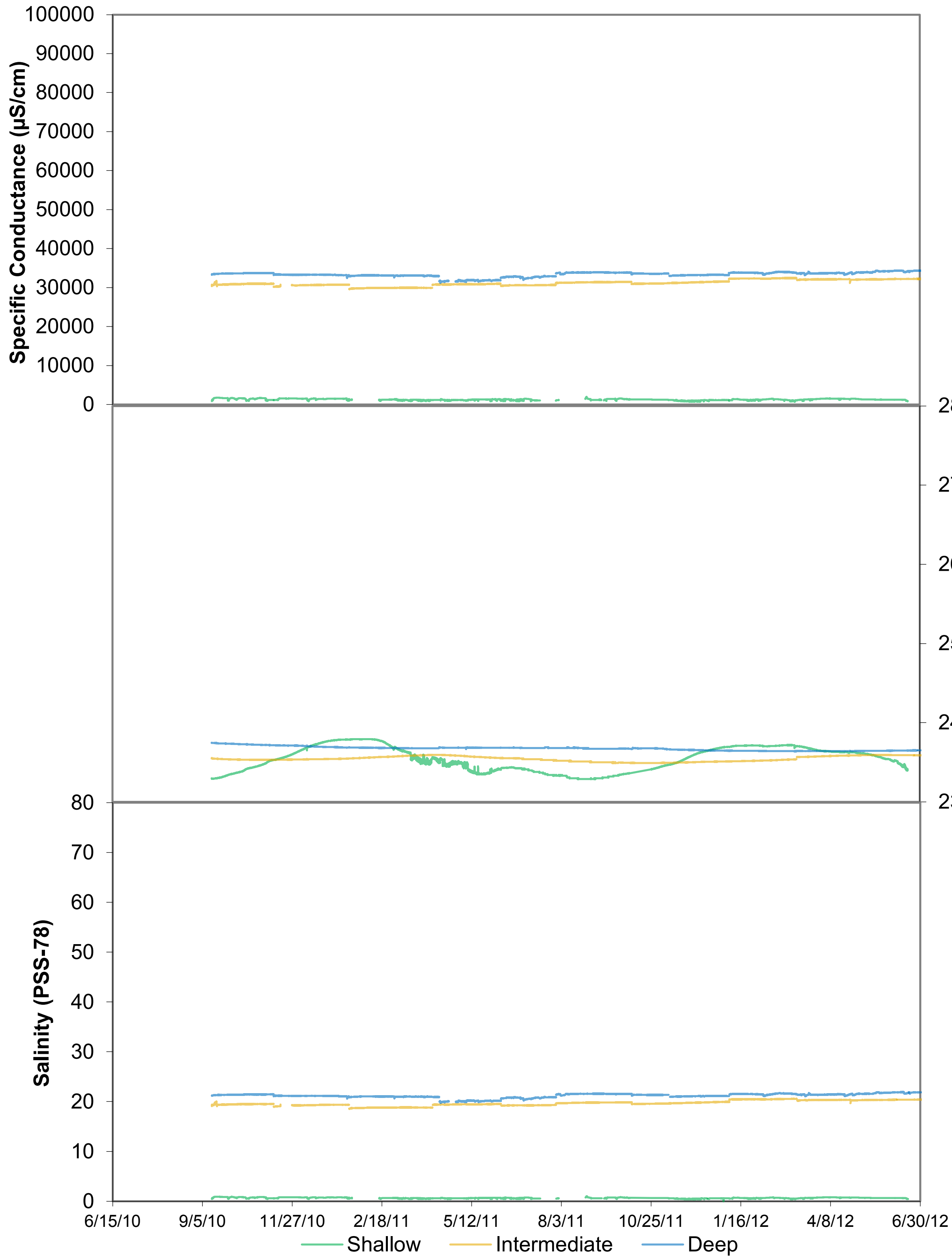


Figure 2.1-6. TPGW-5 Specific Conductance, Temperature, and Salinity.

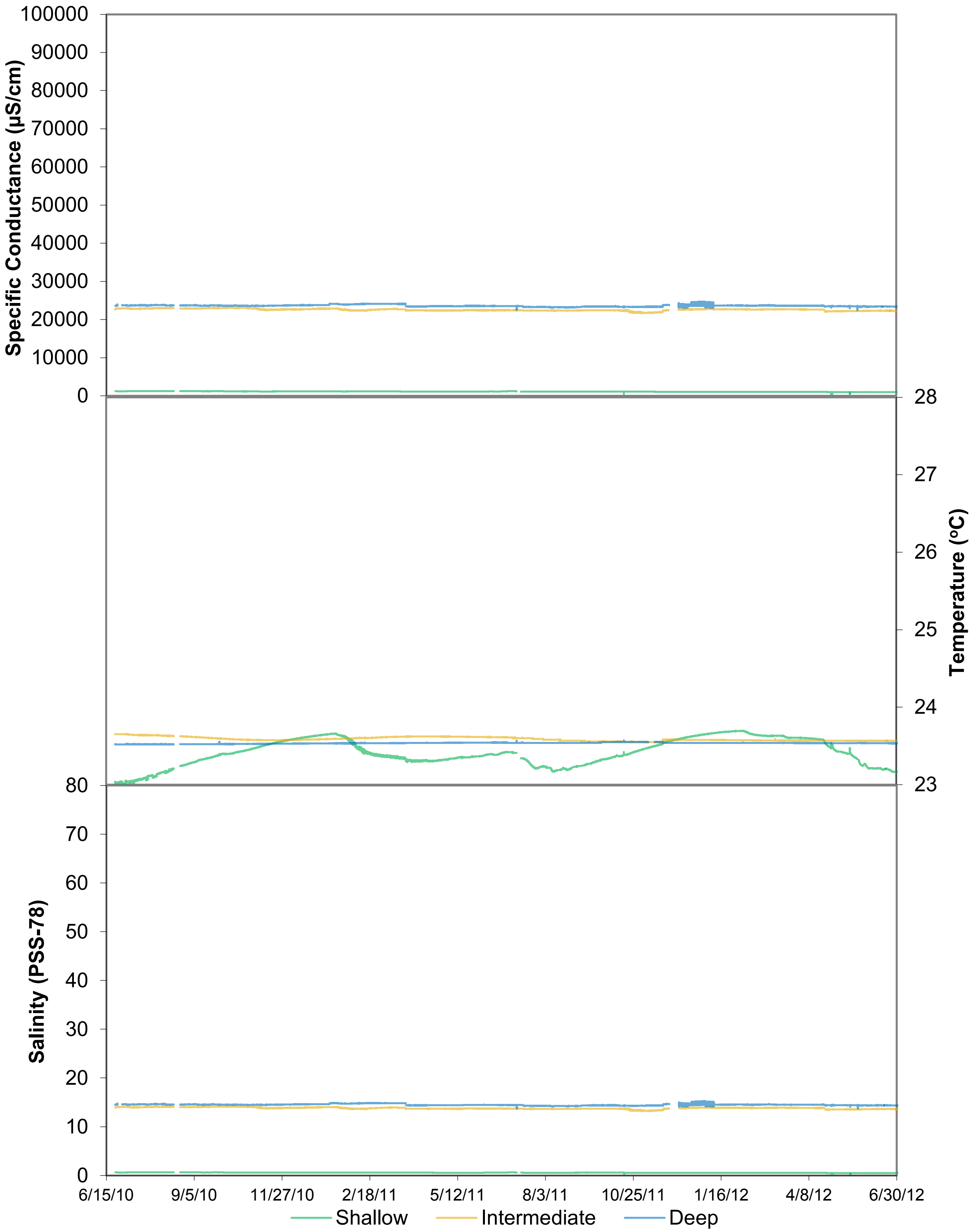


Figure 2.1-7. TPGW-6 Specific Conductance, Temperature, and Salinity.

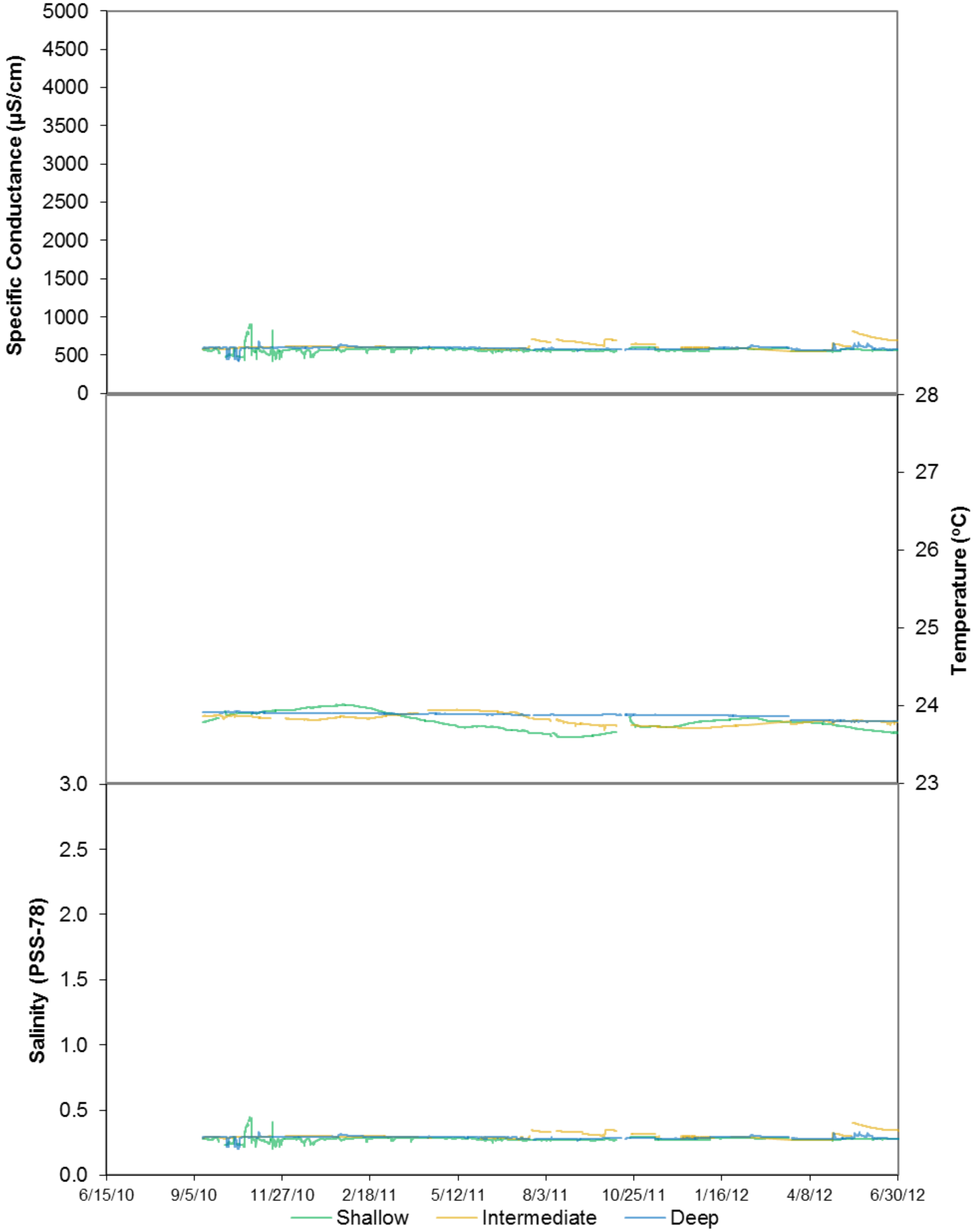


Figure 2.1-8. TPGW-7 Specific Conductance, Temperature, and Salinity.

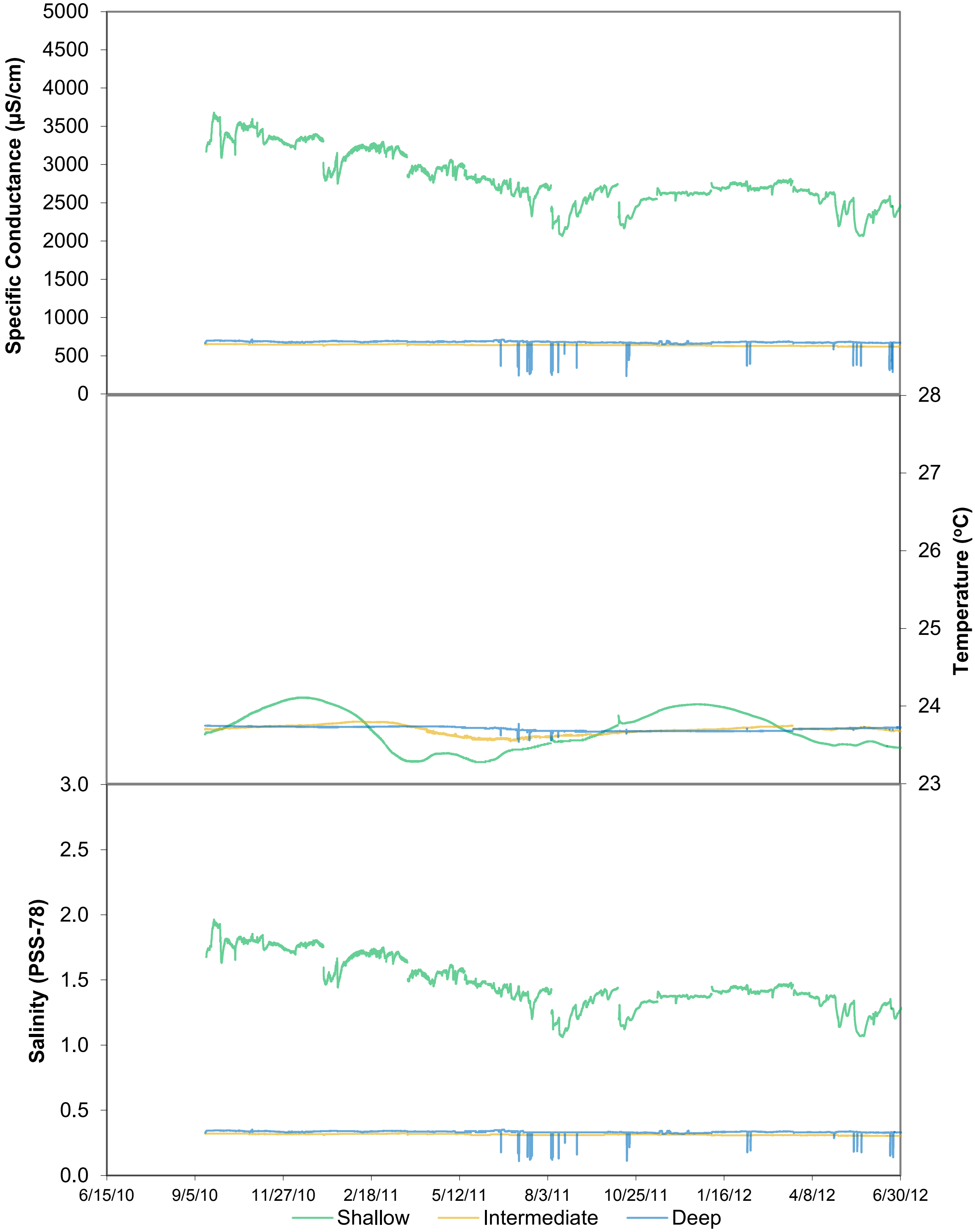


Figure 2.1-9. TPGW-8 Specific Conductance, Temperature, and Salinity.

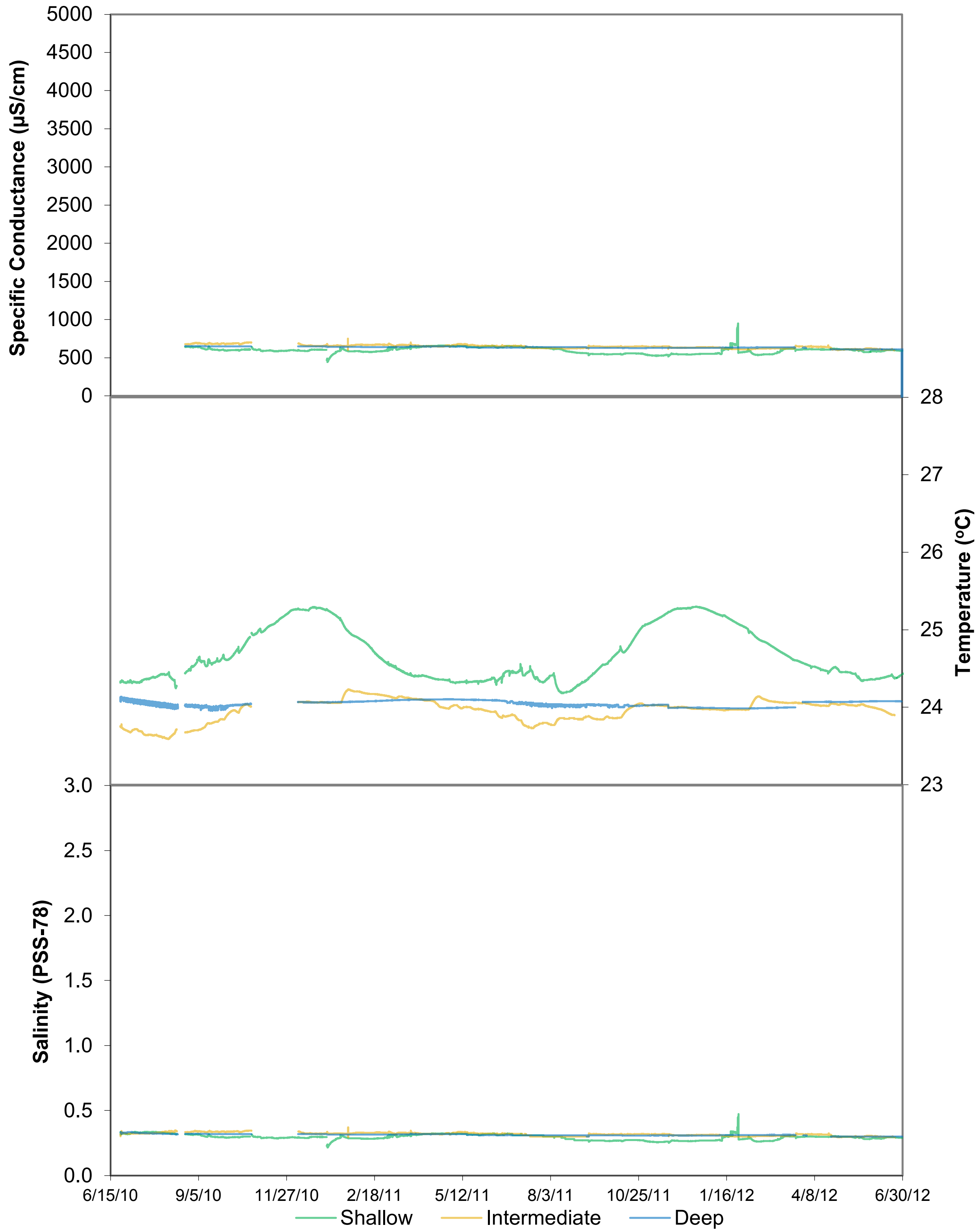


Figure 2.1-10. TPGW-9 Specific Conductance, Temperature, and Salinity.

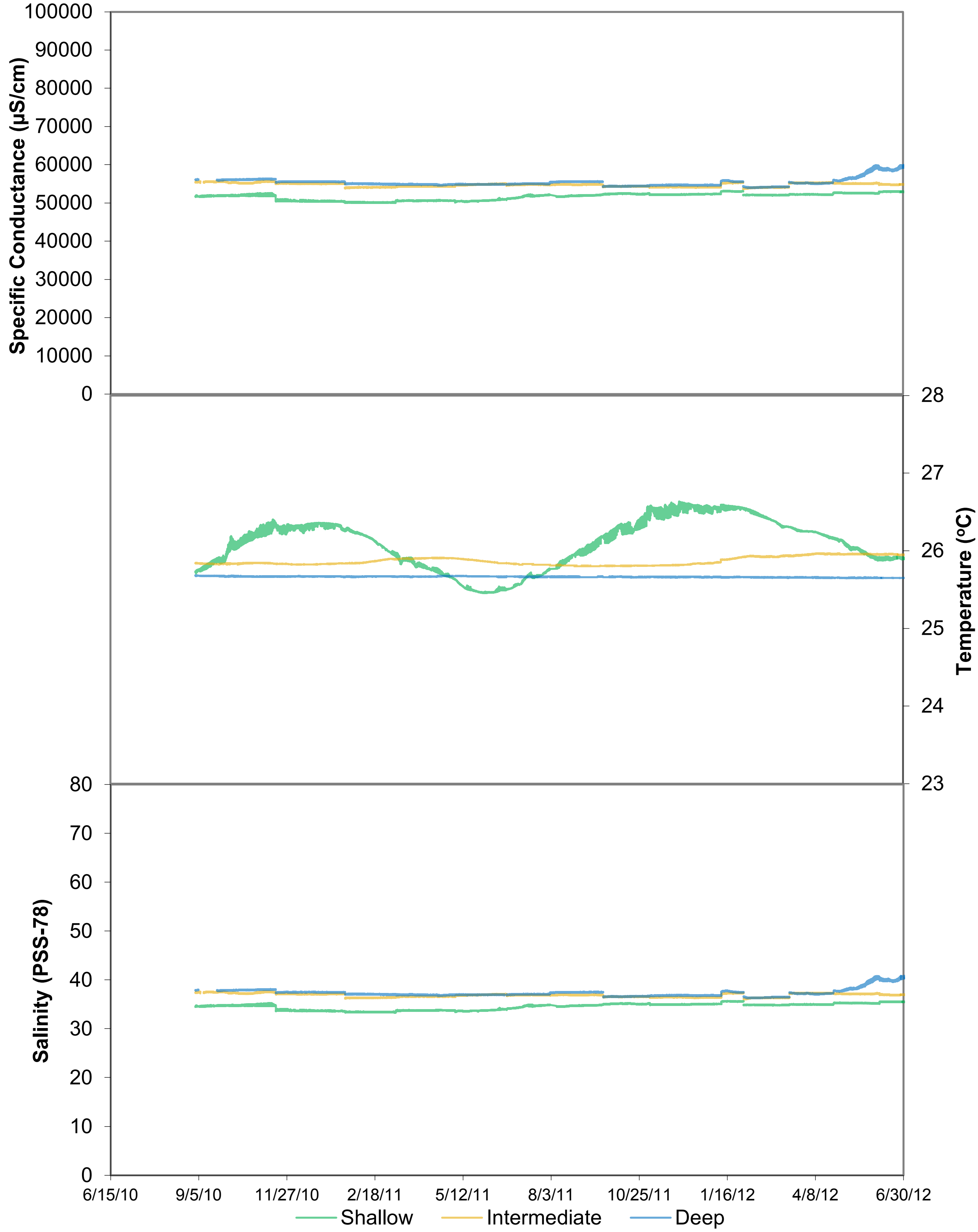


Figure 2.1-11. TPGW-10 Specific Conductance, Temperature, and Salinity.

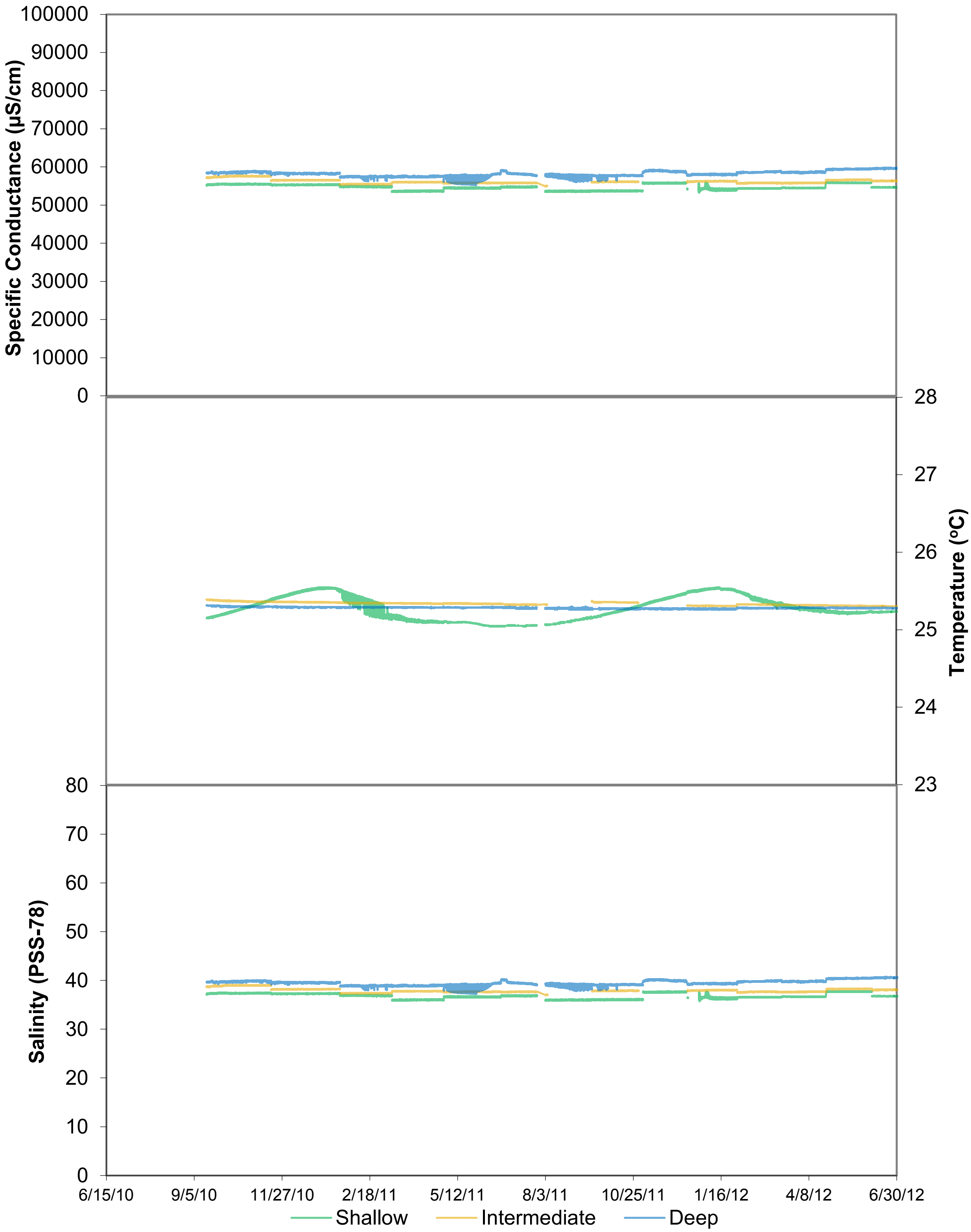


Figure 2.1-12. TPGW-11 Specific Conductance, Temperature, and Salinity.

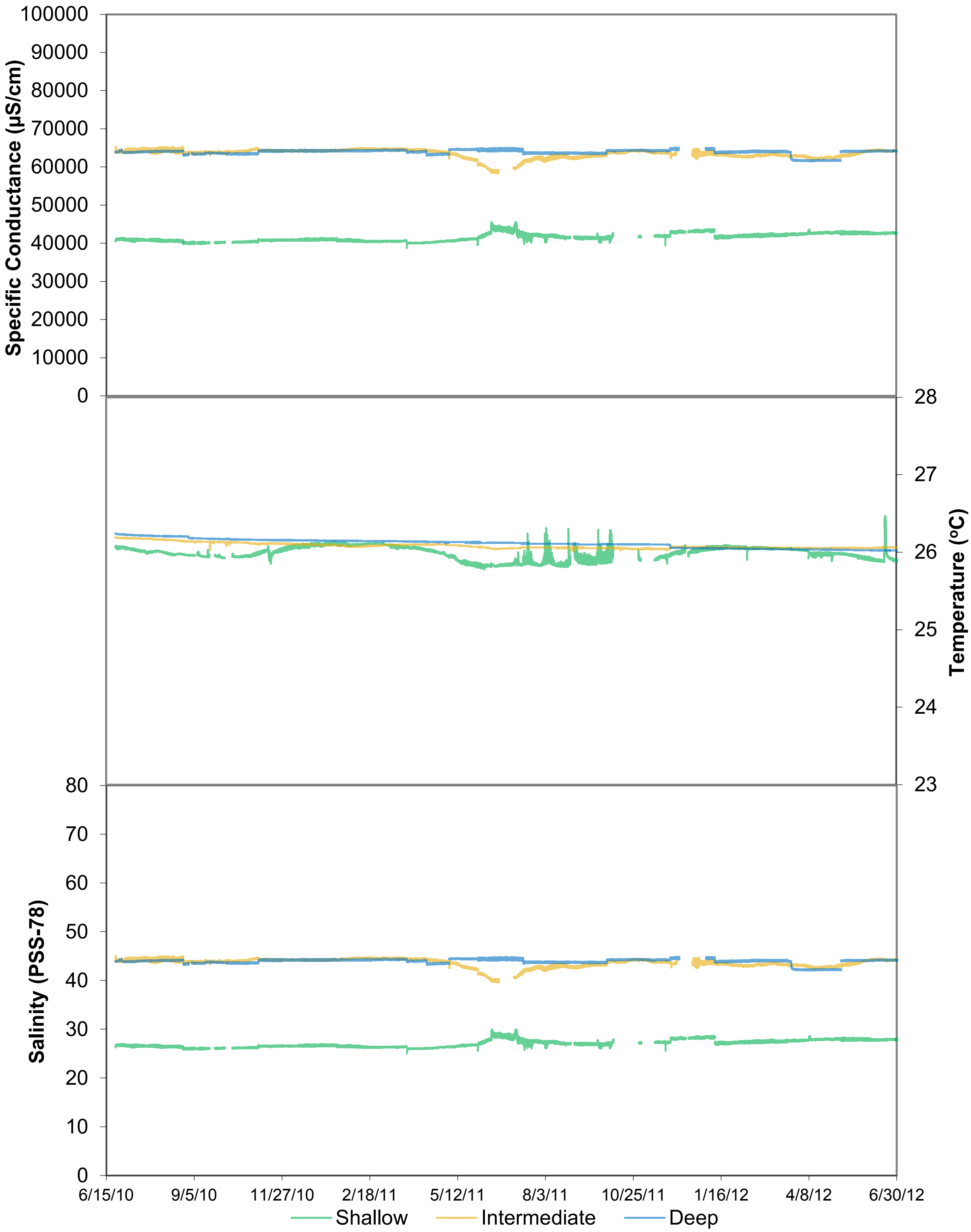


Figure 2.1-13. TPGW-12 Specific Conductance, Temperature, and Salinity.

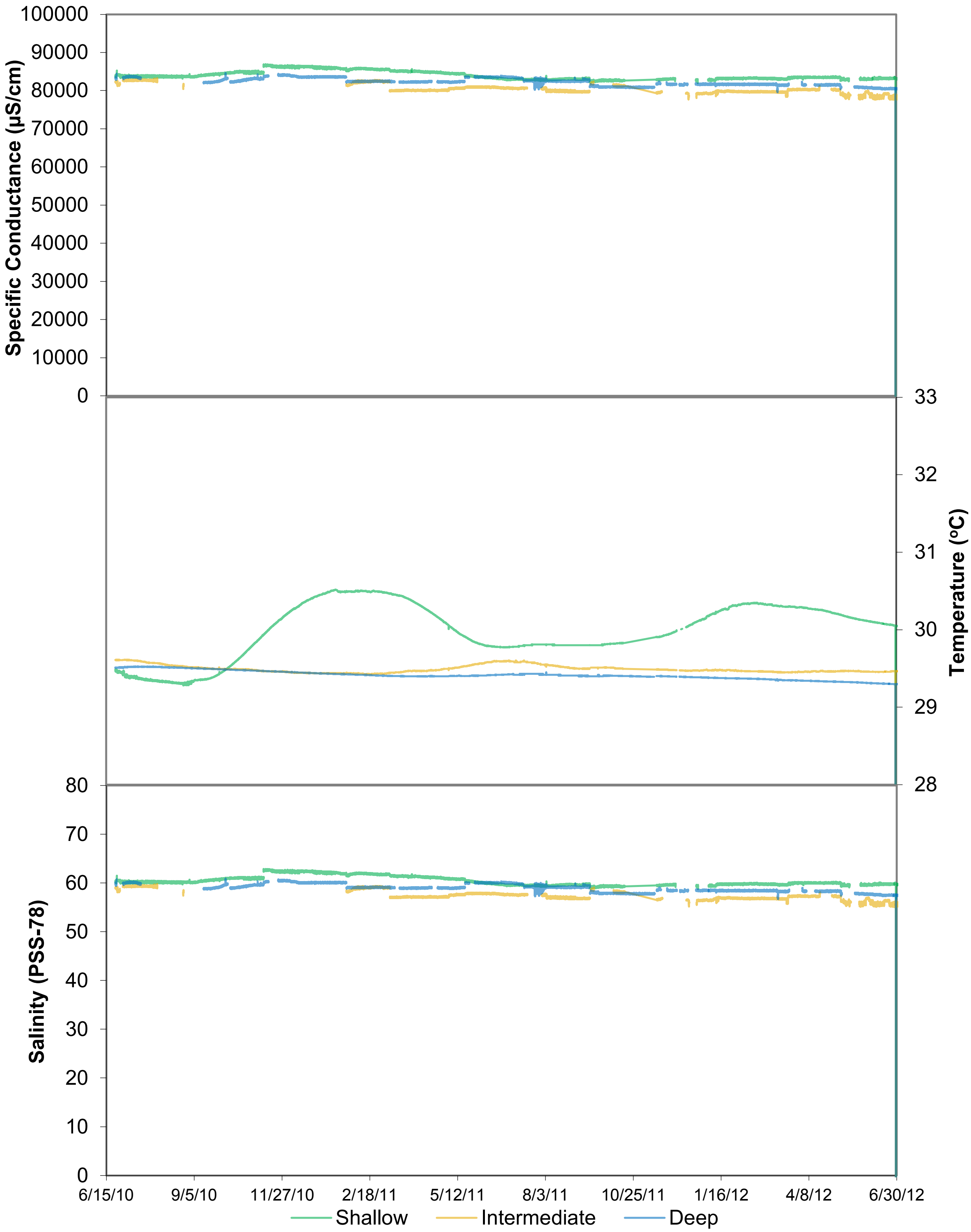


Figure 2.1-14. TPGW-13 Specific Conductance, Temperature, and Salinity.

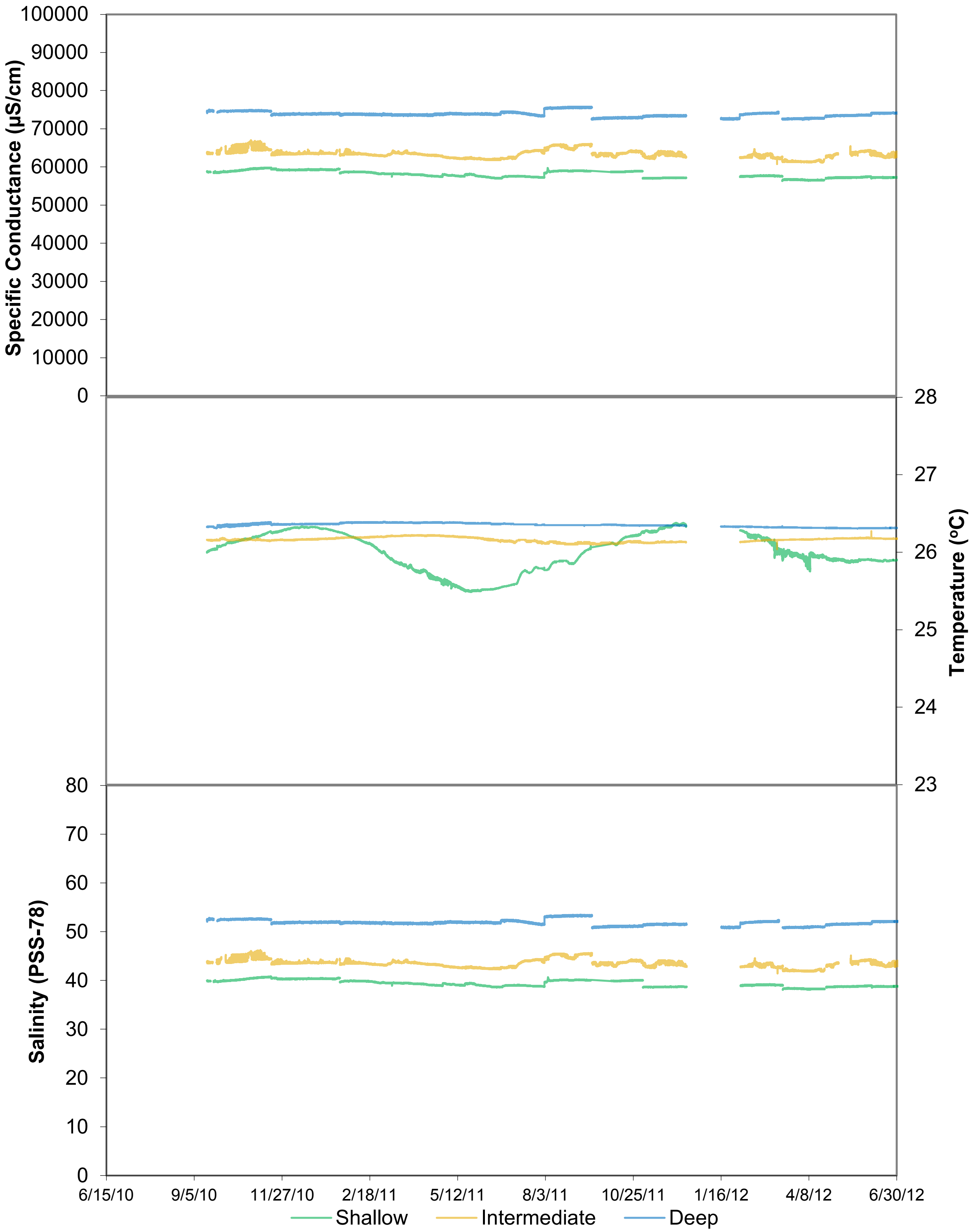


Figure 2.1-15. TPGW-14 Specific Conductance, Temperature, and Salinity.

9-2012

Note: 1) Ave = Average: Jun/Sep 2010 through Jun 2012;
2) Std Dev = Standard Deviation;
3) NA: Not Available;
4) Samples Collected at 3 Depths (S: shallow; M: intermediate; D: deep)

Figure 2.1-16. Average and Standard Deviation of Specific Conductance Values (in μS/cm) for Groundwater Stations.

9-2012

Note: 1) Ave = Average: Jun/Sep 2010 through Jun 2012;
2) Std Dev = Standard Deviation;
3) NA: Not Available;
4) Samples Collected at 3 Depths (S: shallow; M: intermediate; D: deep)

Figure 2.1-17. Average and Standard Deviation of Temperature (in °Celcius) for Groundwater Stations.

Note: 1) Ave = Average: Jun/Sep 2010 through Jun 2012;
2) Std Dev = Standard Deviation;
3) NA: Not Available;
4) Samples Collected at 3 Depths (S: shallow; M: intermediate; D: deep)

9-2012

Figure 2.1-18. Average and Standard Deviation of Salinity (in PSS-78) for Groundwater Stations.