Guana Tolomato Matanzas (GTM) National Estuarine Research Reserve

**Water Quality Metadata Report**

January - December 2007  
Latest Update: 08/29/2011

I. Data set and Research Descriptors

1. Principal investigator & contact persons:

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1. Entry verification:

Deployment data are uploaded from the YSI data logger to a Personal Computer (IBM compatible). Files are exported from EcoWatch in a comma-delimited format (.CDF) and uploaded to the CDMO where they undergo automated primary QAQC and become part of the CDMO’s online provisional database. Excessive pre- and post-deployment data are removed from the file prior to upload with up to 2 hours of pre- and post-deployment data retained to assist in data management. During primary QAQC, data are flagged if they are missing or out of sensor range. The edited file is then returned to the Reserve where it is opened in Microsoft Excel and processed using the CDMO’s NERRQAQC Excel macro. The macro inserts station codes, creates metadata worksheets for flagged data, and graphs the data for review. It allows the user to apply QAQC flags and codes to the data, remove remaining pre- and post-deployment data, append files, and export the resulting data file to the CDMO for tertiary QAQC and assimilation into the CDMO’s authoritative online database. Where deployment overlap occurs between files, the data produced by the newly calibrated sonde is generally accepted as being the most accurate. For more information on QAQC flags and codes, see Sections 11 and 12.

Anomalous data are evaluated to determine whether to flag or delete the suspect values. Data outside the "normal" range of water quality parameters for a particular site were investigated for validity based on weather data, field observations, QC checks, EcoWatch printouts, and instrument diagnostics. Data are rejected if the anomalies are attributed to sensor malfunction and/or excessive fouling. In addition to observations of any physical damage (e.g., a torn DO probe membrane), sensor malfunctions are detected if the voltage reading of the probe is outside the range established for the sensor or the sensor will not calibrate. All raw .cdf files are also sent to the CDMO via FTP for archiving. Katie Petrinec is responsible for these tasks.

1. Research Objectives:

The System-wide Monitoring Program (SWMP) water quality initiative began within the GTMNERR in 2001. There are presently four permanent stations at which YSI 6600 EDS data sondes have been deployed for continuously monitoring a suite of selected abiotic parameters at 15 min intervals (30 minute intervals at Pine Island, San Sebastian and Fort Matanzas monitoring stations for first deployment of 2007). The positions of these stations allow for comparisons between relatively pristine versus more urbanized drainage basins as well as higher versus lower salinity regions of the estuary (see “Station Descriptions” under “Site Location and Character”). Nutrient analyses are also performed on water samples collected monthly at each of these sites. The objective of this effort is to quantify the spatial/temporal variability and trends, both seasonally and as a function of tidal forcing, of selected abiotic and nutrient parameters within the Reserve, and to explore how these are related to concurrently generated meteorological data.

1. Research methods:

YSI 6600 data sondes have been continuously operated at the Pine Island and Fort Matanzas monitoring stations since December 2000 and at the San Sebastian and Pellicer Creek monitoring stations since February 2002. At each site the sonde is contained within a 10 cm (inside diameter) PVC housing pipe mounted vertically on a piling. A steel pin at the bottom of the pipe holds the sonde at a position within 1 meter from the bottom. To facilitate water flow across the sensors, several 2 cm diameter holes were drilled into the submerged portion of the pipe. Hole density is greatest near the base where the sonde sensors are located. As of April 2, 2003 at 16:30:00, deployment of the sonde at the Pine Island station was reconfigured using a PVC housing that does not have drilled holes or a steel pin at the bottom. The sonde is now suspended by a stainless steel chain (attached to the cap of the PVC pipe) such that the sensor portion of the sonde extends beyond the end of the PVC housing at a position within 1 meter from the bottom. As of January 21, 2004, all sondes were upgraded to the 6600 EDS models. These new models incorporate a specially designed wiper apparatus attached to the turbidity probe that reduces the oxygen and pH sensor fouling and thereby improves the quality of data collected.

Sonde exchanges at all sites are made at approximately two week intervals and usually take less than 5 minutes. At the end of a sampling period, sondes are returned to the laboratory where post-deployment readings and reconditioning take place in accordance with the methods outlined in the YSI Operating and Service Manual. The EDS turbidity wiper brush is removed and replaced with a clean wiper to avoid contamination of standards during post-calibration procedures. After a superficial rinse of the sonde in tap water, post deployment readings are recorded for temperature and in standards for pH (Fisher 7.00 buffer solution) and conductivity (Exaxol 50.00 mS/cm standard); a post-deployment turbidity reading in 0.0 NTU standard (DI water) is recorded after a more thorough rinse of the turbidity sensor. The results of these post-deployment readings are used to evaluate the validity of data (See Tables 2-5). Whenever the rapid pulse dissolved oxygen (DO) membrane is replaced, it is allowed to equilibrate for 24 hours before the DO sensor is pre-calibrated in water-saturated air for the following deployment.

A Sutron Sat-Link2 transmitter was installed at the Pellicer Creek monitoring station on June 29, 2006 and transmits data to the NOAA GOES satellite, NESDIS ID #3B02C790. The transmissions are scheduled hourly and contain four (4) datasets reflecting fifteen minute data sampling intervals. The telemetry data is “Provisional” data and not the “Authentic” dataset used for long term monitoring and study. This data can be viewed by going to [http://cdmo.baruch.sc.edu](http://cdmo.baruch.sc.edu/#_blank).

1. Site location and character:

The GTMNERR (North section [NW and SE corners]: 30.1632º N, 81.3447º W and 29.9698º N, 81.2488º W; South section: 29.8295º N, 81.3294º W and 29.6017º N, 81.1936º W), located in the Florida Upper East Coast Drainage Basin, includes over 60,000 acres (24,281 hectares) of publicly owned forested uplands, tidal wetlands, estuarine lagoons and offshore seas. Geographically separated by the greater St. Augustine area, the Reserve is associated with the riverine systems of the Tolomato and Guana River estuaries to the north and the Matanzas River estuary to the south. The Tolomato River Basin is about 18 miles (29 km) in length with a drainage area of approximately 53,802 acres (21,773 hectares); it converges with the Matanzas River and Salt Run from the south before flowing into the Atlantic Ocean at the St. Augustine Inlet. The headwaters of the Guana River originate in the Diego Plains drainage area in Ponte Vedra Beach. This drainage basin encompasses approximately 7,800 acres (3,157 hectares). The Guana River runs parallel to the Tolomato on the seaward side, with the two lagoons joining 7 miles (11.3 km) north of the St. Augustine Inlet. The Matanzas River estuary is approximately 20 miles (32 km) in length and extends 8 miles (13 km) south of the Matanzas Inlet. The Matanzas River sub-basin has a drainage area of approximately 103,615 acres (41,931 hectares) and is bounded to the west by the Atlantic Coastal Ridge, which separates it from the lower St. Johns River basin. Both the St. Augustine and Matanzas Inlets provide oceanic exchange to the system. The Matanzas Inlet, one of the last “natural” inlets on Florida’s east coast, has been unimproved and is suitable only for small watercraft. The natural hydrology of the Guana Tolomato Matanzas system has been somewhat altered by water control structures, including dikes, inland wells, drainage ditches and a dam across a portion of the Guana River. In addition, the Intracoastal Waterway traverses both the Tolomato and Matanzas estuaries.

The climate of northeast Florida is classified as humid subtropical and is characteristic of the Gulf and Atlantic coastal plain of the Southeastern United States. The average annual rainfall is approximately 52 inches (132 cm) per year, with the wet season extending from June through September. Seasonal variation in temperature within the Reserve follows that of rainfall with a summer period of high temperatures between June and September and a cooler period extending from December through March. The annual mean air temperature within the Reserve is approximately 21°C.

Station Descriptions: The **Pine Island (PI)** station is at Channel Marker 25 (30° 03.051´N; 81° 22.048´W) in the Tolomato River. This site is located within the Guana River Marsh Aquatic Preserve in the northern section of the GTMNERR. Channel Marker 25 is adjacent to Pine Island near the mouth of Deep Creek, which provides freshwater drainage from silviculture-dominated uplands in the northwestern portion of the Tolomato River Basin. The average depth at this site is approximately 3.8 m with a tidal range of about 1.6 m; the bottom type is muddy sand. Salinity ranged from 2.5 to 41.4 ppt during 2007. The **Fort Matanzas (FM)** site (in the southern section of the GTMNERR) is located at Channel Marker 75 (29° 44.222´N; 81° 14.757´W) in the Matanzas River. This site is approximately 4 km north of the Matanzas Inlet and near a shoreline on Anastasia Island that is undergoing residential development. The average depth at this site is approximately 3.6 m with a tidal range of about 1.4 m; the bottom type is muddy sand. The salinity ranged from 18.6 to 38.3 ppt during 2007. Both the FM and PI stations are situated within Class II Shellfish Harvesting Waters. The **San Sebastian (SS)** station is at Channel Marker 1 (29° 52.131´N; 81° 18.446´W) located at the confluence of the San Sebastian and Matanzas Rivers, approximately 4 km south of the St. Augustine Inlet. The San Sebastian River drains an urbanized watershed in the western portion of St. Augustine; it is characterized by both residential and commercial development including five marinas. The average depth at this site is approximately 4.4 m with a tidal range of about 1.7 m; the bottom type is muddy sand. The salinity range during 2007 was from 19.6 to 41.1 ppt. The **Pellicer Creek (PC)** station (29° 40.024´N; 81° 15.444´W) is at the end of a recreational dock in Faver Dykes State Park located within the Pellicer Creek Aquatic Preserve in the southern section of the GTM Reserve. Pellicer Creek is tidal and bordered for much of its length by publicly-owned conservation lands. The average depth at this site is approximately 2.3 m with a tidal range of about 0.6 m; the bottom type is muddy sand. The salinity ranged from 0.2 to 36.3 ppt during 2007.

1. Data collection period:

Individual sonde deployment and retrieval dates and times for 2007 data are as follows:

BEGAN ENDED

Pine Island Site

12/19/06, 13:30 01/04/07, 12:00\*

01/04/07, 12:15 01/19/07, 12:15

01/19/07, 12:30 02/02/07, 11:45

02/02/07, 12:00 02/20/07, 11:45

02/20/07, 12:00 03/07/07, 11:30

03/07/07, 11:45 03/21/07, 10:30

03/21/07, 10:45 04/04/07, 11:45

04/04/07, 12:00 04/18/07, 11:00

04/18/07, 11:15 05/02/07, 10:45

05/02/07, 11:00 05/16/07, 10:30

05/16/07, 10:45 05/31/07, 11:00

05/31/07, 11:15 06/13/07, 10:00

06/13/07, 10:15 06/26/07, 10:15

06/26/07, 10:30 07/09/07, 09:45

07/09/07, 10:00 07/26/07, 11:45

07/26/07, 12:00 08/14/07, 08:30

08/14/07, 08:45 08/29/07, 09:15

08/29/07,09:30 09/12/07, 10:00

09/12/07, 10:15 09/26/07, 10:00

09/26/07, 10:15 10/10/07, 08:45

10/10/07, 09:00 10/24/07, 09:15

10/24/07, 09:30 11/14/07, 10:30

11/14/07, 10:45 12/06/07, 11:15

12/06/07, 11:30 12/19/07, 11:00

12/19/07, 11:15 01/08/08, 10:15

San Sebastian Site

12/19/06, 12:30 01/04/07, 13:00

01/04/07, 13:15 01/19/07, 13:15

01/19/07, 13:30 02/02/07, 13:15

02/02/07, 13:30 02/20/07, 14:30

02/20/07, 14:45 03/07/07, 14:45

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05/02/07, 12:15 05/16/07, 11:45

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09/26/07, 11:00 10/10/07, 10:30

10/10/07, 10:45 10/24/07, 10:00

10/24/07, 10:15 11/14/07, 14:00

11/14/07, 14:15 12/06/07, 14:45

12/06/07, 15:00 12/19/07, 12:15

12/19/07, 12:30 01/08/08, 10:15

Fort Matanzas Site

12/20/06, 15:00 01/03/07, 14:45

01/03/07, 15:00 01/18/07, 10:45

01/18/07, 11:00 01/31/07, 09:45

01/31/07, 10:00 02/16/07, 11:30

02/16/07, 11:45 03/07/07, 13:45

03/07/07, 14:00 03/20/07, 08:45

03/20/07, 09:00 04/03/07, 09:45

04/03/07, 10:00 04/18/07, 14:00

04/18/07, 14:15 05/04/07, 09:45

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10/09/07, 09:00 10/23/07, 08:45

10/23/07, 09:00 11/08/07, 12:45

11/08/07, 13:00 11/20/07, 09:45

11/20/07, 10:00 12/06/07, 13:00

12/06/07, 13:15 12/18/07, 09:45

12/18/07, 10:00 01/08/08, 13:30

Pellicer Creek Site

12/20/06, 12:00 01/03/07, 13:15

01/03/07, 13:30 01/18/07, 11:30

01/18/07, 11:45 01/31/07, 11:15

01/31/07, 11:30 01/31/07, 15:45\*\*

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02/16/07, 12:45 03/06/07, 11:15

03/06/07, 11:30 03/20/07, 10:00

03/20/07, 10:15 04/03/07, 11:00

04/03/07, 11:15 04/16/07, 13:15

04/16/07, 13:30 05/04/07, 10:45

05/04/07, 11:00 05/15/07, 14:30

05/15/07, 14:45 05/30/07, 11:15

05/30/07, 11:30 06/12/07, 09:00

06/12/07, 09:15 06/27/07, 09:45

06/27/07, 10:00 07/11/07, 09:00

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09/25/07, 10:15 10/09/07, 11:30

10/09/07, 11:45 10/11/07, 10:00

10/11/07, 10:15 10/23/07, 10:00

10/23/07, 10:15 11/08/07, 10:30

11/08/07, 10:45 11/20/07, 10:45

11/20/07, 11:00 12/05/07, 10:00

12/05/07, 10:15 12/18/07, 10:45

12/18/07, 11:00 01/04/08, 13:15

\* indicates loss of data due to battery failure and/or other internal problems that occurred during deployment.

\*\* See Section 14 Other remarks/notes: Missing Data.

1. Distribution:

According to the Ocean and Coastal Resource Management Data Dissemination Policy for the NERRS System-wide Monitoring Program, NOAA/ERD retains the right to analyze, synthesize and publish summaries of the NERRS System-wide Monitoring Program data. The PI retains the right to be fully credited for having collected and processed the data. Following academic courtesy standards, the PI and NERR site where the data were collected will be contacted and fully acknowledged in any subsequent publications in which any part of the data are used. Manuscripts resulting from the NOAA/OCRM supported research that are produced for publication in open literature, including refereed scientific journals, will acknowledge that the research was conducted under an award from the Estuarine Reserves Division, Office of Ocean and Coastal Resource Management, National Ocean Service, National Oceanic and Atmospheric Administration. The data set enclosed within this package/transmission is only as good as the quality assurance and quality control procedures outlined by the enclosed metadata reporting statement. The user bears all responsibility for its subsequent use/misuse in any further analyses or comparisons. The Federal government does not assume liability to the Recipient or third persons, nor will the Federal government reimburse or indemnify the Recipient for its liability due to any losses resulting in any way from the use of this data.

NERR water quality data and metadata can be obtained from the Research Coordinator at the individual NERR site (see section 1), from the Data Manager at the CDMO (see personnel directory under the general information link at the CDMO website) and online at the CDMO website http://cdmo.baruch.sc.edu. Data are available in text tab-delimited format.

1. Associated researchers and projects:

The GTMNERR has formed partnerships with other agencies and organizations actively involved in resource protection in the GTMNERR watershed. Cooperating managers of lands within the NERR include the: 1) National Park Service (NPS), 2) St. Johns River Water Management District (SJRWMD), 3) Department of Environmental Protection (DEP) Division of Recreation and Parks/Florida Park Service (FPS), 4) DEP Aquatic Preserve Program, 5) Florida Fish and Wildlife Conservation Commission (FWC), 6) Florida Division of Forestry (DOF), and 7) Flagler County.

The SJRWMD Northern Coastal Basin Program, established in 1995, covers the watersheds along the Intracoastal Waterway from Ponce Inlet in Volusia County, north through Flagler and St. Johns Counties, to the Guana River marshes at Ponte Vedra in southern Duval County. This program was developed in response to concerns about the impacts of population growth and development on water quality in the Northern Coastal Basin (NCB). Some of the major research activities conducted within the boundaries of the GTMNERR through the NCB program include: 1) a fisheries monitoring project in conjunction with the United States Geological Survey (USGS); 2) hydrodynamic modeling of the estuarine systems; 3) emergent marsh vegetation and oyster habitat mapping; and 4) water quality monitoring. Many of the water quality monitoring and assessment activities of the NCB program are aimed at pollution source identification and the development of pollution load reduction goals.

Other water quality research and monitoring initiatives within the GTMNERR include: 1) studies of nutrient profiles by the laboratory of Dr. Edward Phlips at the University of Florida [This work includes GTMNERR-contracted nutrient analyses (part of SWMP) as well as separately-funded studies], and 2) regular monitoring of fecal coliform levels in shellfish harvesting waters by the Department of Agriculture and Consumer Services.

GTMNERR-specific research during this period includes graduate research projects to: 1) study the parameters affecting reforestation of spoil islands; 2) examine the details of bluefish winter recruitment in the South Atlantic Bight; 3) assess and model mangrove forest dynamics in eastern Florida; 4) study the ecology of gopher tortoises inhabiting spoil islands; 5) investigate how selected components of estuaries respond to nutrient load; and 6) examine and model the hydrodynamic aspects of estuarine responses to extreme events in the GTM system. Other GTMNERR-specific work includes: 1) a continuing project to monitor the abundance and distribution of non-indigenous crab species; 2) a project to develop a handheld sensor for use in the field that can provide information on the levels of specific microbial contaminants in the estuary (PI: Dr. John Paul, USF); 3) development of a bioreactor to remove nitrogen from septic tank effluent (PI: Dr. Jay Garland, Dynamac Corporation); 4) a cyber-infrastructure demonstration project based on a 3-dimensional hydrodynamic model of the GTMNERR estuary (PI: Dr. Peter Sheng, UF); and 5) study of the population origins and settlement patterns of green mussel (*Perna viridis*) larvae within the GTM system.

As part of the System-wide Monitoring Program (SWMP), the GTMNERR collects abiotic water quality and nutrient data within the Reserve. To complement the water quality data the GTMNERR also operates a weather station (part of SWMP). All SWMP data is available for download through the CDMO.

II. Physical Structure Descriptors

1. Sensor Specifications:

### Table 1. YSI 6600 EDS data sonde

Parameter: Temperature

Units: Celsius (C)

Sensor Type: Thermistor

Model #: 6560

Range: -5 to 45 °C

Accuracy: +/-0.15 °C

Resolution: 0.01 °C

Parameter: Conductivity

Units: milli-Siemens per cm (mS/cm)

Sensor Type: 4-electrode cell with autoranging

Model #: 6560

Range: 0 to 100 mS/cm

Accuracy: +/-0.5% of reading + 0.001 mS/cm

Resolution: 0.001 mS/cm to 0.1 mS/cm (range dependent)

Parameter: Salinity

Units: parts per thousand (ppt)

Sensor Type: Calculated from conductivity and temperature

Range: 0 to 70 ppt

Accuracy: +/- 1.0% of reading or 0.1 ppt, whichever is greater

Resolution: 0.01 ppt

Parameter: Dissolved Oxygen % saturation

Units: percent air saturation (%)

Sensor Type: Rapid Pulse – Clark type, polarographic

Model #: 6562

Range: 0 to 500 % air saturation

Accuracy: 0-200 % air saturation, +/- 2 % of the reading or 2 % air saturation, whichever is greater; 200-500 % air saturation, +/- 6 % of the reading

Resolution: 0.1 % air saturation

Parameter: Dissolved Oxygen mg/L (Calculated from % air saturation, temperature and salinity)

Units: milligrams per Liter (mg/L)

Sensor Type: Rapid Pulse – Clark type, polarographic

Model #: 6562

Range: 0 to 50 mg/L

Accuracy: 0 to 20 mg/L, +/- 2 % of the reading or 0.2 mg/L, whichever is greater; 20 to 50 mg/L, +/- 6 % of the reading

Resolution: 0.01 mg/L

Parameter: Dissolved Oxygen % saturation

Units: percent air saturation (%)

Sensor Type: Optical probe with mechanical cleaning

Model #: 6150 ROX

Range: 0 to 500 % air saturation

Accuracy: 0-200 % air saturation, +/- 1 % of the reading or 1 % air saturation, whichever is greater; 200-500 % air saturation, +/- 15 % of the reading

Resolution: 0.1 % air saturation

Parameter: Dissolved Oxygen mg/L (Calculated from % air saturation, temperature and salinity)

Units: milligrams per Liter (mg/L)

Sensor Type: Optical probe with mechanical cleaning

Model #: 6150 ROX

Range: 0 to 50 mg/L

Accuracy: 0 to 20 mg/L, +/- 0.1 mg/L or 1% of the reading, whichever is greater; 20 to 50 mg/L, +/- 15 % of the reading

Resolution: 0.01 mg/L

Parameter: Non-Vented Level – Shallow (Depth)

Units: feet or meters (ft or m)

Sensor Type: Stainless steel strain gauge

Range: 0 to 30 ft (9.1 m)

Accuracy: +/- 0.06 ft (0.018 m)

Resolution: 0.001 ft (0.001 m)

Parameter: pH

Units: units

Sensor Type: Glass combination electrode

Model #: 6561

Range: 0 to 14 units

Accuracy: +/- 0.2 units

Resolution: 0.01 units

Parameter: Turbidity

Units: nephelometric turbidity units (NTU)

Sensor Type: Optical, 90 ° scatter, with mechanical cleaning

Model #: 6136

Range: 0 to 1000 NTU

Accuracy: +/- 5 % reading or 2 NTU (whichever is greater)

Resolution: 0.1 NTU

Depth Qualifier: The NERR System-Wide Monitoring Program utilizes YSI data sondes that can be equipped with either depth or water level sensors.  Both sensors measure water depth, but by convention, level sensors refer to atmospherically vented measurements and depth refers to non-vented measurements.  Readings for both vented and non-vented sensors are automatically compensated for water density change due to variations in temperature and salinity; but for all non-vented depth measurements, changes in atmospheric pressure between calibrations appear as changes in water depth.  The error is equal to approximately 1.03 cm for every 1 millibar change in atmospheric pressure, and is eliminated for level sensors because they are vented to the atmosphere throughout the deployment time interval.

Beginning in 2006, NERR SWMP standard calibration protocol calls for all non-vented depth sensors to read 0 meters at a (local) barometric pressure of 1013.25 mb (760 mm/hg).  To achieve this, each site calibrates their depth sensor with a depth offset number, which is calculated using the actual atmospheric pressure at the time of calibration and the equation provided in the SWMP calibration sheet or Digital Calibration Log.  This offset procedure standardizes each depth calibration for the entire NERR System.  If accurate atmospheric pressure data are available, non-vented sensor depth measurements at any NERR site can be corrected.  The Research Coordinator at the specific NERR site should be contacted in order to obtain information regarding atmospheric pressure data availability.

1. Coded variable definitions:

|  |  |  |
| --- | --- | --- |
| Sampling Station | Sampling Site Code | Station Code |
| Pine Island | PI | gtmpiwq |
| San Sebastian | SS | gtmsswq |
| Fort Matanzas | FM | gtmfmwq |
| Pellicer Creek | PC | gtmpcwq |

1. QAQC flag definitions

QAQC flags provide documentation of the data and are applied to individual data points by insertion into the parameter’s associated flag column (header preceded by an F\_). During primary automated QAQC (performed by the CDMO), -5, -4, and -2 flags are applied automatically to indicate data that is missing and above or below sensor range. All remaining data are then flagged 0, passing initial QAQC checks. During secondary and tertiary QAQC 1, -3, and 5 flags may be used to note data as suspect, rejected due to QAQC, or corrected.

-5 Outside High Sensor Range

-4 Outside Low Sensor Range

-3 Data Rejected due to QAQC

-2 Missing Data

-1 Optional SWMP Supported Parameter

0 Data Passed Initial QAQC Checks

1 Suspect Data

2 *Open - reserved for later flag*

3 *Open - reserved for later flag*

4 Historical Data: Pre-Auto QAQC

5 Corrected Data

1. QAQC code definitions

QAQC codes are used in conjunction with QAQC flags to provide further documentation of the data and are also applied by insertion into the associated flag column. There are three (3) different code categories, general, sensor, and comment. General errors document general problems with the deployment or YSI datasonde, sensor errors are sensor specific, and comment codes are used to further document conditions or a problem with the data. Only one general or sensor error and one comment code can be applied to a particular data point.

General Errors

GIC No Instrument Deployed Due to Ice

GIM Instrument Malfunction

GIT Instrument Recording Error; Recovered Telemetry Data

GMC No Instrument Deployed Due to Maintenance/Calibration

GNF Deployment Tube Clogged / No Flow

GOW Out of Water Event

GPF Power Failure / Low Battery

GQR Data Rejected Due to QA/QC Checks

GSM See Metadata

Sensor Errors

SBO Blocked Optic

SCF Conductivity Sensor Failure

SDF Depth Port Frozen

SDO DO Suspect

SDP DO Membrane Puncture

SIC Incorrect Calibration / Contaminated Standard

SNV Negative Value

SOW Sensor Out of Water

SPC Post Calibration Out of Range

SSD Sensor Drift

SSM Sensor Malfunction

SSR Sensor Removed / Not Deployed

STF Catastrophic Temperature Sensor Failure

STS Turbidity Spike

SWM Wiper Malfunction / Loss

Comments

CAB Algal Bloom

CAF Acceptable Calibration/Accuracy Error of Sensor

CAP Depth Sensor in Water, Affected by Atmospheric Pressure

CBF Biofouling

CCU Cause Unknown

CDA DO Hypoxia (<3 mg/L)

CDB Disturbed Bottom

CDF Data Appear to Fit Conditions

CFK Fish Kill

CIP Surface Ice Present at Sample Station

CLT Low Tide

CMC In Field Maintenance/Cleaning

CMD Mud in Probe Guard

CND New Deployment Begins

CRE Significant Rain Event

CSM See Metadata

CTS Turbidity Spike

CVT Possible Vandalism/Tampering

CWD Data Collected at Wrong Depth

1. Post deployment information

End of deployment Post-calibration readings in standard solutions prior to probe cleaning. Dates provided are deployment begin times.

**Table 2. Post-deployment readings of all sondes deployed at the Pine Island site during 2007.**

**pH Temp (C) SC (mS/cm) DO % Turbidity (NTU) Depth (m)**

**Date/Std. 7.00 n/a 50.00 100.0 0.0 n/a**

12/19/06 6.94 N/A 50.62 93.1, 93.1 2.9 0.077

01/04/07 7.21 N/A 50.76 103.1, 103.1 1.8 0.064

01/19/07 7.02 N/A 50.58 94.2, 94.4 -0.1 -0.026

02/02/07 7.10 N/A 52.82 105.4, 105.4 0.9 0.057

02/20/07 7.35 N/A 50.83 99.7, 99.6 3.1 0.092

03/07/07 7.30 N/A 48.92 101.3, 101.3 -2.5 0.121

03/21/07 7.07 N/A 48.54 105.0, 101.1 1.0 0.029

04/04/07 7.01 N/A 50.28 98.5, 98.5 6.4 -0.678

04/18/07 7.00 N/A 50.79 99.8, 99.9 0.7 0.057

05/02/07 6.93 N/A 49.58 86.1, 86.0 2.3 0.015

05/16/07 7.26 N/A 51.00 105.4, 104.8 0.7 0.030

05/31/07 7.21 N/A 48.97 75.3, 76.0 -1.7 -0.039

06/13/07 7.08 N/A 49.67 101.9, 98.8 2.2 0.081

06/26/06 7.16 N/A 39.64 100.0, 100.3 -0.5 0.049

07/09/07 7.13 N/A 51.85 101.5, 101.5 0.5 0.019

07/26/07 7.12 N/A 51.03 99.8, 100.0 0.8 0.005

08/14/07 6.97 N/A 49.88 104.4, 104.5 1.3 0.035

08/29/07 7.08 N/A 48.41 107.5, 107.4 0.5 0.062

09/12/07 7.16 N/A 51.14 100.7, 100.8 -6.2 0.002

09/26/07 7.06 N/A 27.90 111.9, 111.8 0.7 -0.033

10/10/07 7.61 N/A 49.79 101.4, 101.3 1.3 -0.041

10/24/07 6.98 N/A 47.58 105.8, 105.8 -0.4 0.002

11/14/07 7.35 N/A 48.73 98.9, 99.4 -0.2 0.132

12/06/07 6.98 N/A 50.90 109.3, 109.4 4.1 0.035

12/19/07 7.02 N/A 50.54 100.0, 100.0 -0.6 0.096

**Table 3. Post-deployment readings of all sondes deployed at the San Sebastian site during 2007.**

**pH Temp (C) SC (mS/cm) DO % sat. Turbidity (NTU) Depth (m)**

**Date/Std. 7.00 n/a 50.00 100.0 0.0 n/a**

12/19/06 7.03 N/A 47.65 100.3, 100.1 2.2 0.063

01/04/07 7.12 N/A 49.44 99.9, 99.8 1.1 0.072

01/19/07 7.14 N/A 51.13 96.7, 96.6 -0.3 -0.026

02/02/07 7.02 N/A 49.64 103.3, 103.2 0.6 0.076

02/20/07 7.27 N/A 52.43 100.9, 100.9 2.3 0.085

03/07/07 7.02 N/A 48.92 99.7, 99.9 0.8 0.124

03/21/07 7.27 N/A 50.44 102.9, 103.6 0.3 0.019

04/04/07 6.88 N/A 50.54 102.0, 102.1 6.0 -0.649

04/18/07 7.17 N/A 51.55 98.2, 98.2 -2.5 0.044

05/02/07 7.08 N/A 50.60 99.9, 99.8 3.2 0.020

05/16/07 7.45 N/A 51.45 107.4, 107.2 0.5 0.035

05/31/07 7.05 N/A 49.82 102.4, 102.3 1.5 0.006

06/13/07 7.14 N/A 50.47 100.4, 100.6 0.1 0.084

06/26/07 7.05 N/A 50.39 102.4, 102.7 0.4 0.063

07/09/07 7.19 N/A 54.45 153.5, -0.0 0.4 0.012

07/26/07 7.09 N/A 51.41 75.9, 76.0 0.6 0.023

08/14/07 7.01 N/A 50.81 99.4, 99.2 0.8 0.026

08/29/07 6.94 N/A 50.04 99.2, 99.1 0.4 0.047

09/12/07 6.88 N/A 50.00 111.2, 109.8 1.8 0.010

09/26/07 7.00 N/A 49.94 106.1, 105.9 0.3 -0.033

10/10/07 7.04 N/A 49.00 89.8, 89.8 2.3 -0.033

10/24/07 7.11 N/A 49.91 102.1, 102.2 -0.9 0.018

11/14/07 7.05 N/A 50.14 102.7, 102.9 0.8 0.138

12/06/07 6.89 N/A 51.74 108.6, 108.5 1.2 0.070

12/19/07 6.97 N/A 50.79 103.3, 103.3 1.1 0.074

**Table 4. Post-deployment readings of all sondes deployed at the Fort Matanzas site during 2007.**

**pH Temp (C) SC (mS/cm) DO % sat. Turbidity (NTU) Depth (m)**

**Date/Std. 7.00 n/a 50.00 100.0 0.0 n/a**

12/20/06 6.98 N/A 49.28 101.9, 101.7 -0.2 0.120

01/03/07 7.14 N/A 50.62 105.3, 105.3 0.9 0.128

01/18/07 7.09 N/A 51.29 105.2, 104.9 -0.7 0.086

01/31/07 7.08 N/A 49.92 106.1, 105.7 1.2 0.028

02/16/07 6.85 N/A 49.93 102.9, 102.7 3.3 0.092

03/07/07 7.09 N/A 50.53 103.4, 103.4 -2.8 0.149

03/20/07 6.98 N/A 49.84 106.9, 106.8 0.3 0.063

04/03/07 7.24 N/A 51.17 87.6, 87.2 5.8 -0.645

04/18/07 6.94 N/A 50.03 88.9, 88.8 2.0 0.036

05/04/07 7.12 N/A 50.45 100.8, 100.8 2.9 0.028

05/18/07 7.01 N/A 50.44 100.7, 100.7 0.3 0.078

05/30/07 6.99 N/A 50.07 106.9, 106.6 1.6 0.008

06/14/07 6.96 N/A 50.40 101.1, 101.2 0.7 0.095

06/27/07 7.20 N/A 50.69 105.1, 105.1 -0.2 0.074

07/09/07 7.01 N/A 50.50 100.9, 101.1 -0.1 -0.008

07/31/07 7.09 N/A 49.20 100.0, 100.2 -0.5 0.009

08/09/07 6.73 N/A 49.90 99.4, 99.8 -0.2 0.061

08/28/07 6.73 N/A 49.74 99.9, 99.5 -0.9 0.025

09/11/07 6.70 N/A 49.59 97.9, 97.9 0.7 0.039

09/25/07 6.83 N/A 50.16 102.6, 102.6 -1.2 0.002

10/09/07 6.98 N/A 49.00 85.4, 85.6 2.1 0.012

10/23/07 7.43 N/A 51.09 104.1, 103.9 -0.3 0.052

11/08/07 6.72 N/A 49.89 101.5, 101.4 -2.2 0.093

11/20/07 7.32 N/A 50.03 109.9, 109.8 1.0 0.133

12/06/07 7.23 N/A 49.73 102.3, 102.3 1.6 0.131

12/18/07 6.67 N/A 50.39 105.3, 105.2 1.4 0.066

**Table 5. Post-deployment readings of all sondes deployed at the Pellicer Creek site during 2007.**

**pH Temp (C) SC (mS/cm) DO % s Turbidity (NTU) Depth (m)**

**Date/Std. 7.00 n/a 50.00 100.0 0.0 n/a**

12/20/06 6.96 N/A 49.73 96.2, 96.2 1.6 0.113

01/03/07 7.00 N/A 49.51 78.1, 78.1 2.4 0.124

01/18/07 7.12 N/A 50.21 89.1, 88.7 -0.8 0.094

01/31/07 7.24 N/A 49.77 102.7, 102.4 1.6 0.037

02/16/07 7.11 N/A 50.30 87.0, 87.0 4.0 0.144

03/06/07 7.11 N/A 49.97 100.0, 100.4 -2.0 0.111

03/20/07 6.90 N/A 49.44 93.4, 93.4 0.7 0.066

04/03/07 6.95 N/A 51.41 107.4, 106.5 6.2 -0.385

04/16/07 6.55 N/A 50.19 91.7, 91.8 2.0 0.039

05/04/07 7.10 N/A 50.16 97.6, 97.4 3.7 0.077

05/15/07 6.84 N/A 49.82 90.7, 90.7 0.4 0.073

05/30/07 6.87 N/A 49.75 102.7, 102.9 3.0 0.026

06/12/07 6.91 N/A 49.97 97.8, 97.9 1.8 0.096

06/27/07 6.88 N/A 50.34 116.6, 120.1 1.5 0.060

07/11/07 6.98 N/A 50.06 95.8, 95.8 1.7 -0.006

07/31/07 6.79 N/A 50.21 107.5, 107.4 0.7 0.016

08/09/07 6.71 N/A 49.95 99.4, 99.2 0.6 0.059

08/28/07 No post deployment data all sensors read negative values. Datasonde was possibly struck by lightening. Sent to YSI for repairs.

09/04/07 6.62 N/A 50.62 98.4, 98.3 -0.3 0.035

09/11/07 7.07 N/A 50.87 101.5, 101.3 -0.3 0.055

09/25/07 6.98 N/A 49.74 99.3, 99.3 0.8 0.004

10/09/07 7.07 N/A 51.27 100.0, 100.2 0.9 -0.011

10/11/07 7.13 N/A 49.83 104.3, 103.8 1.2 0.010

10/23/07 7.32 N/A 51.27 101.9, 101.9 -0.1 0.038

11/08/07 7.11 N/A 50.56 105.8, 108.4 -0.9 0.101

11/20/07 7.12 N/A 50.70 98.8, 98.8 1.1 -0.027

12/05/07 7.12 N/A 50.61 101.5, 100.1 2.0 0.118

12/18/07 7.01 N/A 51.11 102.0, 102.1 0.1 0.215

1. Other remarks/notes:
   1. Calibration of DO was performed on the day of deployment. Two DO values are recorded during the post-calibration process.
   2. Copies of calibration sheets can be obtained through the CDMO.
   3. Daily, Monthly, and Annual Precipitation Totals at the Pellicer Creek Weather (gtmpcmet) station.

**Optical (ODO) Dissolved Oxygen Data**

During 2007, two dissolved oxygen probes the Rapid Pulse and Optical (ODO) were deployed simultaneously for a comparison study at Pine Island, San Sebastian and Fort Matanzas. The Rapid Pulse dissolved oxygen data was uploaded and submitted to the CDMO for all four sites it is the primary dissolved oxygen data with the exception that only ODO data was uploaded and submitted to the CDMO for San Sebastian on 10/10/07 – 10/24/07 and for Pellicer Creek 11/8/07 – 12/31/07. All additional ODO data is available by contacting the Reserve directly or requesting the raw deployment data from the CDMO. This additional dissolved oxygen data is available for the following deployments:

|  |  |  |
| --- | --- | --- |
| Pine Island | San Sebastian | Fort Matanzas |
| 2/20/07 – 3/7/07 | 10/24/07 – 11/14/07 | 3/7/07 – 3/20/07 |
| 3/7/07 – 3/21/07 | 11/14/07 – 12/6/07 | 3/20/07 – 4/3/07 |
| 3/21/07 – 4/4/07 | 12/6/07 – 12/19/07 | 4/3/07 – 4/18/07 |
| 4/4/07 – 4/18/07 | 12/19/07 –1/8/08 | 4/18/07 – 5/4/07 |
| 4/18/07 – 5/2/07 |  | 5/30/07 – 6/14/07 |
| 5/31/07 – 6/13/07 |  | 6/27/07 – 7/9/07 |
| 6/13/07 – 6/26/07 |  | 7/31/07 – 8/9/07 |
| 6/26/07 – 7/9/07 |  | 8/9/07 – 8/28/07 |
| 7/9/07 – 7/26/07 |  | 8/28/07 – 9/11/07 |
| 9/12/07 – 9/26/07 |  | 9/25/07 – 10/9/07 |
| 10/10/07 – 10/24/07 |  | 9/11/07 – 9/25/07 |
| 10/24/07 – 11/1407 |  | 10/9/07 – 10/23/07 |
| 11/14/07 – 12/6/07 |  | 10/23/07 – 11/8/07 |
| 12/6/07 – 12/18/07 |  | 11/8/07 – 11/20/07 |
| 12/18/07 – 1/8/08 |  | 11/20/07 – 12/6/07 |
|  |  | 12/6/07 – 12/18/07 |
|  |  | 12/18/07 -1/8/08 |

**Missing Data**

Data are missing due to equipment or associated specific probes not being deployed, equipment failure, time of maintenance or calibration of equipment, or repair/replacement of a sampling station platform. If additional information on missing data is needed, contact the Research Coordinator at the reserve submitting the data.

**January 1-31, 2007**

**PI**

1. Data was collected intermittently 1/1 00:00 through 1/4 12:00 due to inconsistent battery operation/failure.

**PC**

1. Missing data 1/31 16:00 through 1/31 17:15; datasonde was retrieved to set “sample and hold” and was then redeployed.

**See Metadata “CSM” Notes/Comments from Data Files**

**Note #1:** Slight shifts in data are sometimes correlated with sonde exchanges. These shifts are most noticeable in pH, specific conductivity, salinity, DO% and DO conc, and may be related to sensor drift (e.g., due to fouling) and/or calibration/performance differences between sondes.

**Note #2:** Turbidity readings greater than 1000 NTU are considered out of range and rejected. They have been left in the database to provide users with a complete dataset and to allow true visual representation of the data in graphs. Negative turbidity values occur throughout the year at all four sites. Some of these negative values are within the accuracy range of the sensor (+/- 2.0 NTU) and, therefore, are considered suspect. Larger negative values are rejected

**Note #3**: Turbidity data is subject to single and clusters of spikes that occur in the beginning and middle of deployments. Turbidity values that fall between 500 and 1000 are not specifically indicated as suspect data, but possibly could be interpreted as suspect. Turbidity spikes may be associated with wiper malfunction but the reason is unknown. Data users should exercise caution when interpreting turbidity data that fall within this range.

**Note #4:** Time series profiles of the dissolved oxygen data at all monitoring stations sometimes exhibits brief “spikes” of reduced DO concentrations. These events appear to be coupled with the occurrence of slack tide conditions as well as the level of fouling associated with the sonde.

**January 1-31, 2007**

**SS**

1. From 1/1 00:15 to 1/4 12:45 data flagged/coded <0> (CSM), this is the last of the 2006 data which was collected at 30 minute intervals.
2. Reduced DO concentrations occurring intermittently 1/1 14:00 through 1/10 07:45. (See Note #4).
3. Shifts in Specific Conductivity/Salinity and pH data on 1/19 13:30 associated with sonde exchange. (See Note #1).

**FM**

* 1. From 1/1 00:15 to 1/3 14:45 <0> (CSM), this is the last of the 2006 which was collected at 30 minute intervals.
  2. Shifts in Specific Conductivity/Salinity and pH data on 1/18/07 11:00 and 1/31/07 10:00 associated with sonde exchange. (See Note #1).

**PC**

1. Shift in DO data 1/3 13:30 and 1/18 11:45 associated with sonde exchange. (See Note #1)
2. Shift in depth data 1/17 09:30 through 1/21 15:30attributed to rain and strong northeast winds.

**February 1-28, 2007**

**SS**

1. Shifts in Specific Conductivity/Salinity and pH data on 02/02 13:30 and 2/20 14:45 associated with sonde exchange. (See Note #1).

**PI**

1. Shifts in Specific Conductivity/Salinity, DO and pH data on 02/02 12:00 associated with sonde exchange. (See Note #1).
2. Shift in pH data on 02/20 12:00 associated with sonde exchange. (See Note #1).

**March 1-31, 2007**

**SS**

1. Shift in Specific Conductivity/Salinity on 3/7 15:00 attributed to sonde exchange. (See Note #1).

**FM**

1. Suspect pH data 3/7/ 14:00 through 3/20 08:45 possibly attributed to a calibration error.

**PC**

1. Shift in Specific Conductivity/Salinity, DO and pH data on 3/6 11:30 attributed to sonde exchange. (See Note #1).
2. Suspect turbidity data 3/10 10:15 through 3/20 10:00, several values out of range; reason unknown.

**April 1-30, 2007**

**SS**

1. Shift in Specific Conductivity/Salinity and pH on 4/4 10:45 associated with sonde exchange. (See Note #1).
2. Suspect DO data 4/4 10:45 through 4/18 12:00 possibly attributed to an error in calibration.
3. Suspect depth data 4/4 10:45 through 4/18 12:00 attributed to an error in calibration. A wrong barometric pressure value was used for calibration.
4. Shift in pH on 4/18 12:15 associated with sonde exchange. (See Note #1).

**FM**

1. Suspect DO data 4/1 00:00 through 4/30 23:45 possibly attributed to a DO membrane issue. Additional Optical Dissolved Oxygen (ODO) data can be obtained by contacting the Reserve directly or requesting the raw deployment data from the CDMO.
2. Shift in pH data on 4/3 10:00 and 4/18 14:15 associated with sonde exchange. (See Note #1)
3. Suspect depth data 4/3 10:00 through 4/18 14:00 attributed to an error in calibration. A wrong barometric pressure value was used for calibration.

**PC**

a) Suspect depth data 4/3 11:15 through 4/16 13:15 attributed to an error in calibration.

**PI**

1. Shift in pH data on 4/4 12:00 through 4/4 13:00 associated with sonde exchange. (See Note #1).
2. Suspect depth data 4/4 12:00 through 4/18 11:00 attributed to an error in calibration. A wrong barometric pressure value was used for calibration.

**May 1-31, 2007**

**SS**

1. Shift in Specific Conductivity/Salinity and pH data on 5/16 12:00-12:30 associated with sonde exchange. (See Note #1).
2. Shift in Specific Conductivity/Salinity data on 5/31 12:45 associated with sonde exchange. (See Note #1).

**FM**

1. Suspect DO data 5/1 00:00 through 5/4 09:45 possibly attributed to a DO membrane issue. Additional Optical Dissolved Oxygen (ODO) data can be obtained by contacting the Reserve directly or requesting the raw deployment data from the CDMO.

**PI**

1. Shift in pH data on 5/2 11:00 associated with sonde exchange.
2. Shift in Specific Conductivity/Salinity and pH data on 5/16 10:45 associated with sonde exchange. (See Note #1).
3. Suspect pH data 5/31 11:15 through 5/31 23:45 attributed to an error in calibration.

**June 1-30, 2007**

**SS**

1. Shift in pH data on 6/13 11:15 associated with sonde exchange. (See Note #1).

**PI**

1. Suspect pH data 6/1 00:00 through 6/13 10:00 attributed to an error in calibration.
2. Shift in pH data 6/13 10:15 to 11:15 and 6/26 10:30 to 11:30 associated with sonde exchange. (See Note #1).

**July 1-31, 2007**

**SS**

1. Shift in pH data 5/16 12:00 to 12:30 associated with sonde exchange.
2. Shift in pH data on 7/9 12:15-12:45 associated with sonde exchange. (See Note #1).
3. Reject all data 7/9 12:00 through 7/26 13:00; attributed to turbidity probe failure and cond/temp probe with cell constant out of range (5.555)

**FM**

1. Shift in pH data on 7/9 14:00 associated with sonde exchange. (See Note #1)

**PI**

1. Shift in pH data on 7/26 12:00 associated with sonde exchange. (See Note #1).

b) Depth flagged/coded <1> (CWD), datasonde stuck in tube at retrieval.

**August 1-31, 2007**

**SS**

1. Shift in pH data on 8/29 10:30 associated with sonde exchange. (See Note #1).

**FM**

1. Suspect pH data 8/9 09:00 through 08/28 09:45 possibly attributed to an error in   
   calibration.

**PC**

1. Suspect pH data 8/9 10:45 through 8/28 11:00 possibly attributed to an error in calibration.

**PI**

1. Shift in pH data on 8/29 9:30 associated with sonde exchange. (See Note #1).

b) DO data suspect from 8/14 08:45 to 8/29 12:15, DO is low during deployment. Also fish kill in area of sonde that may have impacted data during this time period.

**September 1-30, 2007**

**PC**

1. Reject all data 9/2 13:30 through 9/4 11:30; attributed to an instrument malfunction. Datasonde was possibly struck by lightening and sent to YSI for repairs. There is no post deployment data available for 8/28 deployment.

**PI**

1. Shift in Specific Conductivity/Salinity and pH data on 9/12 10:15 associated with sonde exchange. (See Note #1).

**October 1-31, 2007**

**FM**

1. Shift in pH data on 10/23 09:00 associated with sonde exchange. (See Note #1).

**PI**

1. Shift in pH data 10/24 9:30 through 10/31 23:45 does not appear to be an error in calibration; reason unknown.

**November 1-30, 2007**

**FM**

1. Shift in pH data 11/8 13:00 through 11/20 09:45suspect error in calibration data flagged/coded suspect.
2. Shifts in pH data on 11/8 13:00 and 11/20 10:00 associated with sonde exchanges. (See Note #1)

**PI**

1. Shift in pH data 11/1 00:00 through 11:30 23:45 does not appear to be an error in calibration; reason unknown.
2. Shift in pH data 11/14 10:45 associated with sonde exchange. (See Note #1).

**December 1-31, 2007**

**PI**

1. Shift in pH data 12/1 00:00 through 12/31 23:45 does not appear to be an error in calibration; reason unknown.
2. Shift in pH data 12/6 11:30 associated with sonde exchange. (See Note #1).

SS

1. DO suspect from 12/6 15:00 to 12/19 12:15. Rapid pulse and ROX probes reading very different from each other and post cals lower than would like to see.

**Daily, Monthly, and Annual Precipitation Totals at the Pellicer Creek Weather (gtmpcmet) station.**

Date Daily Precip. Totals (mm)

01/01/2007 8.9

01/03/2007 2.3

01/06/2007 0.5

01/08/2007 3.6

01/17/2007 5.1

01/18/2007 2.3

01/22/2007 7.1

01/24/2007 0.5

01/25/2007 11.7

01/28/2007 1.0

Monthly Total (mm) 42.9

02/01/2007 16:00 85.6

02/02/2007 142.0

02/18/2007 3.3

02/27/2007 0.8

Monthly Total (mm) 231.6

03/01/2007 3.0

03/02/2007 36.6

03/03/2007 5.3

03/15/2007 8.9

03/16/2007 41.7

03/30/2007 0.8

Monthly Totals (mm) 96.3

04/09/2007 1.0

04/10/2007 4.6

04/14/2007 20.6

04/15/2007 3.0

04/18/2007 0.3

04/20/2007 1.0

04/24/2007 14.0

Monthly Totals (mm) 44.5

05/06/2007 13.0

05/08/2007 0.8

05/09/2007 0.5

05/13/2007 0.3

05/14/2007 0.3

05/24/2007 1.3

05/29/2007 0.3

Monthly Totals (mm) 16.8

06/01/2007 3.0

06/02/2007 84.6

06/06/2007 0.8

06/12/2007 11.2

06/13/2007 1.5

06/14/2007 1.0

06/19/2007 3.6

06/20/2007 0.8

06/30/2007 3.6

Monthly Totals (mm) 110.0

07/01/2007 0.8

07/02/2007 60.5

07/03/2007 9.7

07/04/2007 10.7

07/07/2007 47.2

07/10/2007 3.3

07/11/2007 5.3

07/12/2007 3.0

07/13/2007 0.5

07/14/2007 20.6

07/15/2007 15.7

07/17/2007 1.3

07/20/2007 9.4

07/21/2007 38.6

07/22/2007 3.0

07/24/2007 16.8

07/25/2007 0.3

07/26/2007 0.3

07/28/2007 3.3

07/31/2007 13.5

Monthly Totals (mm) 263.9

08/01/2007 7.9

08/02/2007 7.1

08/25/2007 0.8

08/26/2007 1.3

08/31/2007 20.1

Monthly Totals (mm) 37.1

09/01/2007 11.4

09/02/2007 26.4

09/05/2007 0.8

09/07/2007 2.3

09/08/2007 9.4

09/10/2007 22.1

09/11/2007 9.4

09/12/2007 15.7

09/16/2007 0.3

09/17/2007 18.3

09/18/2007 17.3

09/19/2007 119.6

09/20/2007 7.9

09/23/2007 0.5

09/24/2007 0.3

09/25/2007 0.8

09/26/2007 6.6

09/29/2007 3.0

Monthly Totals (mm) 278.1

10/01/2007 3.3

10/02/2007 21.6

10/03/2007 11.2

10/04/2007 6.1

10/05/2007 5.3

10/06/2007 4.3

10/07/2007 0.5

10/14/2007 0.3

10/20/2007 0.8

10/21/2007 0.5

10/22/2007 0.5

10/25/2007 6.9

10/27/2007 7.4

10/28/2007 15.5

10/29/2007 36.1

10/30/2007 0.3

Monthly Totals (mm) 120.4

11/01/2007 1.5

11/15/2007 5.6

11/22/2007 0.5

11/25/2007 0.8

11/29/2007 4.8

Monthly Totals (mm) 13.2

12/16/2007 41.1

12/21/2007 4.1

12/22/2007 2.0

12/23/2007 0.3

12/30/2007 3.8

Monthly Totals (mm) 51.3

**Annual Total (mm): 1306.07**