**Indian River Lagoon Florida Aquatic Preserves (IRLAP)   
Water Quality Metadata Report**

January - December 2005  
Latest Update: 01/10/2019

Note: This is a provisional metadata document; it has not been authenticated as of its download date. Contents of this document are subject to change throughout the QAQC process and it should not be considered a final record of data documentation until that process is complete. Contact the Aquatic Preserve Office ([irene.arpayoglou@dep.state.fl.us](mailto:irene.arpayoglou@dep.state.fl.us)) with any additional questions.

**I. Data Set and Research Descriptors**

1. **Principal investigator & contact persons:**

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1. **Entry verification:**

Data are collected with a YSI Model 6600EDS-S data sonde and uploaded to a laptop computer. Data plots are produced and examined for each deployment period (1 to 2 weeks) and erroneous data are detected using the EcoWatch software from YSI. Graphs for each deployment period are printed and stored with the pre and post deployment files. Notes are made of any unusual data during that deployment (unexplained turbidity spikes, DO anomalies, rain events, etc.).

Files are exported from EcoWatch as a CDF file. The CDF files are opened in Microsoft Excel and converted into a comma-delimited format (CSV). Each CVS file is carefully analyzed, and recorded parameters are verified to ensure they are in the correct order and the pre and post deployment data are removed from the file. This data (pre and post) are recorded at the beginning and end of each data record when the instrument was out of the water and are identified by the sudden change in Specific Conductivity and Depth records. After these data points are deleted the file is saved as an altered comma-delimited format (Altered CSV).

Each Altered CSV file is added to the previous deployment period to create a month-long deployment file for each deployment site and saved as a Monthly CSV file. The anomalous data or outliers (data outside the acceptable range for the sensors) are evaluated to determine whether to flag or delete the suspect data. Data are flagged if the values are: 1) outside the range expected for the site (see Site Location and Character) 2) outside the range of measurements and accuracy established for the sensors or 3) outside the range established for good water quality conditions (e.g., Turbidity >150 NTU, negative turbidity, variable DO or sudden data spikes). Data outside the acceptable range of water quality for a particular site are investigated for validity based on weather data, field observations, QC checks, data printouts, and instrument diagnostics.

Data are rejected if the anomalies are attributed to: 1) sensor malfunction- voltage reading is outside the range established for the sensor or the sensor will not calibrate, 2) exposure of sensors during low tide –identified by unusual Depth, Temperature, and Specific Conductivity data, or 3) fouling of sensors by aquatic organisms, debris or sediment- detected by comparing in situ sensor with post calibration measurements in a standard solutions. Sensor readings that differ significantly (>10%) from standard solutions (Conductivity, pH, Turbidity) suggest that the sensor was fouled during deployment. Mayra Ashton Urrego was responsible for performing the initial QA/QC review.

Beginning in July 2018, data underwent a two-step (primary and secondary) Quality Assurance/Quality Control (QA/QC) procedure as outlined in the NERRS CDMO Data Management Manual Version 6.6 (<http://cdmo.baruch.sc.edu/request-manuals/>).

The primary QA/QC process was performed by the CDMO and involved inserting flag columns into the data files for each water quality parameter, creating a flag record column, and creating an automated process that applied standardized flags to data if the values were outside sensor specifications as determined by YSI, the instrument manufacturer. Yearly data files that completed the primary QA/QC process were returned to FCO staff for secondary QA/QC. Data were evaluated, and standardized flags and codes were applied to individual data points by insertion into the flag columns using the CDMO’s NERRQAQC Excel macro to provide further documentation of the data. Data files were then returned to the CDMO for ingestion into the Florida Aquatic Preserves database as provisional data. For more information on QA/QC flags and codes, see Sections 11 and 12.

1. **Research objectives:**

Four long-term monitoring stations have been established along the three prongs of the St. Sebastian River and its drainage basin in order to collect essential baseline information and improve our understanding of how watershed inputs are affecting water quality and aquatic resources. The St. Sebastian River is the primary freshwater tributary within the Indian River-Malabar to Vero Beach Aquatic Preserve.

The IRLAP (formerly East Central Florida Aquatic Preserves) water quality program collects water quality data for the St. Sebastian River at four permanent stations; the C-54 Canal, the North Prong, the South Prong and the mouth of the river. Recorded data includes temperature (°C), salinity (ppt), conductivity (mS/cm), turbidity (NTU), Dissolved Oxygen (mg/L and %), depth (m) and pH.

The water quality program collects continuous information that helps in determining: 1) short-term variability and long-term changes in brackish water parameters within the different stretches of the river (i.e., localized impacts of seasonal storm events, interannual differences in rainfall, and variability in water quality parameters in association with on-going drainage ditch reconfiguration at the St. Sebastian River Preserve State Park); 2) collection of fundamental baseline data to document conditions after the St. Sebastian River muck removal project eliminates 2 million cubic yards of much form the river; and 3) collection of data to help support the creation and implementation of Total Maximum Daily Load (TMDL) for different reaches of the river.

Certain sections of the St. Sebastian River are considered impaired waters and are part of the TMDL program. The North Prong of the St. Sebastian River is dissolved oxygen (DO) impaired with the causative pollutant identified as high Biochemical Oxygen Demand (BOD) levels. The EPA has completed a DO TMDL but DEP has not adopted it. The C-54 Canal has been identified as impaired due to DO, Iron and Nutrients with Total Nitrogen (TN) identified as the causative pollutant. The EPA has completed the nutrients and DO TMDLs for this section in 2003 but DEP has not adopted it. The Fellsmere Canal is also impaired due to DO with no identified causative pollutant. Data collected helps support the determination that the North Prong and the C-54 are impaired on the basis of low DO values (< 5.0 mg/L).

1. **Research Methods:**

The datasondes are deployed using similar techniques as those used by Guana Tolomato Matanzas National Estuarine Research Reserve with minor variations. A Schedule 40, 4” PVC pipe and two T’s are used to create the housing. The T’s are incorporated into the housing to provide distance between the datasonde and the piling or pipe it is attached to. Providing distance creates greater assurance that the water quality data we receive is not heavily influenced by activity occurring on the piling itself. The housing acts as both security and protection for the sonde. A stainless-steel bolt with a combination “Master Lock” is installed through the body of the housing and the PVC cap. An eyebolt and a stainless-steel plastic-coated cord are attached to the PVC cap and are used to suspend the datasonde. When the datasonde is lowered into the PVC housing the probes rest below the bottom lip, providing maximum amount of flow to the probes. The housing is attached to the piling in 5 places using half inch stainless steel banding called Band-it. This prevents drilling directly into the piling or pipe.

The datasondes are programmed to report the following parameters every 30 minutes: Temperature, turbidity, specific conductivity, DO concentration and percentage, salinity, pH, and depth. Four of the six datasondes East Coast Florida Aquatic Preserves received will be deployed at any given time. Two datasondes will be kept in the office and used as replacements. On a weekly basis two of our four datasondes will be retrieved and brought back to the office for data download and recalibration. This means that each datasonde will be deployed for a total of two weeks. In our initial experimental period, the sondes were deployed for a month and experienced very little drift. We are confident that two weeks is an appropriate deployment time even in months of heavy bioaccumulation and fouling.

1. **Site location and character:**

The Indian River- Malabar to Vero Beach Aquatic Preserve is located on the east coast of Florida in Brevard and Indian River Counties. The preserve’s shoreline contains the incorporated cities of Palm Bay, Malabar, Vero Beach, Orchid, and Indian River shores and the unincorporated cities of Floridana Beach, Melbourne Shores, Grant, Micco, Wabasso, Roseland, and Gifford. Aquatic preserves are bodies of water that were set aside by State Legislation for the purpose of being preserved in an essentially natural or existing condition so that their aesthetic, biological and scientific values may endure for the enjoyment of future generations. Indian River-Malabar to Vero Beach Aquatic Preserve was designated on October 21, 1969 and is approximately 28,000 acres of shallow coastal estuary within the Indian River Lagoon (IRL). The total surface water area of the aquatic preserve is approximately 43.4 square miles (Indian River – Malabar to Vero Beach Aquatic Preserve Management Plan, 1).

The Indian River Lagoon is an Outstanding Florida Water, a SWIM priority waterbody, an Estuary of National Significance, and the most biologically diverse estuary in North America. Over “4,000 plant and animal species make their home in the IRL, of which 50 are threatened or endangered. The commercial and recreational fisheries (based on estuarine-dependent species) in the Indian River are some of Florida’s most important – over 100,000 saltwater anglers are registered in the area,” and about $1 billion are generated a year (Florida Forever Five-Year Plan, 2002). Outstanding Florida Waters (OFW) are defined as waters designated by the Environmental Regulation Commission as worthy of special protection because of their natural attributes. Florida DEP affords the highest protection to these waters. No degradation of water quality, other than that allowed by rule, is to be permitted.

The Sebastian River is the largest tributary within the Indian River-Malabar to Vero Beach Aquatic Preserve. The river’s sub basin contains the largest drainage area in the entire Central Indian River Lagoon region, and comprises approximately 172 square miles (SWIM Plan Update, 5-22). The topography of the Sebastian River area can be viewed as a series of long relict and modern dune systems that parallel the coastline. The barrier islands to the east form the modern dune. The Atlantic Coastal Ridge follows the shoreline of the Indian River Lagoon and makes up the second dune system in the series. The Ten Mile Ridge is the westernmost relict dune system that forms the division between the St. Johns River Basin and the coastal watershed. The Sebastian River has 3 independent drainages and is situated between the Atlantic Coastal Ridge and the Ten Mile Ridge. The three drainages, the north prong, south prong, and west prong (which is now the terminus of the C-54 and Fellsmere canals), converge at the confluence which connects to the Indian River Lagoon at a breech in the Atlantic Coastal Ridge (Mote Marine Lab, 44).

Over the years many hydrological alterations have changed the quality and flow of fresh and salt water. Wetlands in the Sebastian River watershed were diked, and canals dug thus diverting flows to the river itself. The deepest of these penetrated into the artesian and Floridan aquifers, which contributed more freshwater flow to the river. These alterations increased further when the west prong was dredged to create the Canal 54, a waterway connecting the St. Johns basin to the coastal basin. It was built in 1969 by the Army Corps of Engineers to provide flood relief in the upper St. Johns. Additionally, the Fellsmere canal, adjacent to the C-54 and the Sottile Canal, located north of C-54 also contribute a significant amount of water to the Sebastian River (Mote Marine Lab, 47).

Another factor contributing to the dynamic Sebastian River area is the Sebastian inlet, located directly across the Indian River Lagoon. The Sebastian Inlet is an ephemeral inlet that has been open and maintained since 1948. The opening of the inlet has significant effects on the Indian River Lagoon as well as the Sebastian River. The inlet allows oceanic water to cross the lagoon and enter the Sebastian River on a single cycle. “The juxtaposition of these two factors, Sebastian Inlet and Sebastian River, has resulted in a locally dynamic area within a larger and more stable environment of the Indian River Lagoon” (Mote Marine Lab, 49).

Since the Sebastian River makes such a significant contribution to the Indian River Lagoon, the St. Johns Water Management District has several proposed projects for the area. It is estimated that the South Prong and Fellsmere Main Canal contribute roughly 60% of the river’s pollutant loading and annual average discharge to the lagoon. The North Prong constitutes 20-25% and the C-54 contributes the remainder. In the last few years, work in the Upper St. Johns River basin has reduced the flows of the C-54, consequently, the South Prong, the Fellsmere Canal, and the North Prong are receiving more attention for water management. The projects that the water management district have proposed are specific to the Sebastian River WCD (South Prong), the City of Sebastian (South Prong), Vero Lake Estates and Vero Lakes WCD (South Prong), Fellsmere WCD – East (Fellsmere Canal), and the Sotille Canal/North Prong drainage (2002 SWIM Plan Update, 5-23).

The following projects are already underway in the Sebastian River area. In the city of Sebastian, SJRWMD is near completion of a 150-acre stormwater park with recreational facilities to treat drainage within a 1,300-acre residential area. Near the North Prong, the district purchased 496 acres of land on either side of the Sotille canal. Some of the land will be used to treat drainage from development, specifically Barefoot Bay, and the other portion will be used to manage spoil disposal material from the Sebastian River Muck Removal Project. The district plans to dredge the lower to middle reaches of the river. This is intended to remove a majority of organic enriched, oxygen depleting muck and to recreate deeper areas to trap sediment (SWIM Plan Update, 5-24).

The Sebastian River is listed as impaired on the DEP’s List of Impaired Waters for Total Maximum Daily Loads (TMDL’s). The north prong, south prong, drainage basin, Fellsmere Canal, and Canal 54 are all listed for dissolved oxygen and nutrients as parameters of concern and nutrients as a parameter for TMDL development.

**Station description:**

[This section is currently incomplete]

The Fellsmere Canal functions to keep storm water away from the city of Fellsmere. C-54 Canal was created to drain excess water off agricultural lands to the west. The Sebastian River now receives water that would have drained into the St. Johns River. The C-54/Fellsmere Canal datasonde is attached to an abandoned USGS water quality station. This station is accessible by car and kayak.

North Prong datasonde is attached to buffer preserve’s canoe landing and is accessible by ATV.

South Prong/Donald McDonald datasonde is attached to a piling at Donald McDonald Park’s educational overlook. This station is accessible by truck and kayak.

Main Drainage Basis/US1 datasonde is attached to a manatee slow speed zone piling and is accessible by kayak or boat.

**Station timeline:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Station Code** | **Station Name** | **Location** | **Active Dates** | **Reason Decommissioned** | **Notes** |
| IRC54 | C-54 (AKA Fellsmere Canal) | 27.830580°N, -80.534220°W | 9/2003 - 1/2004, 1/2006 - 12/2007 | Office Closure | N/A |
| IRDM | Donald McDonald (AKA South Prong) | 27.818640°N, -80.508380°W | 9/2003 - 2/2004, 12/2004 - 12/2007 | Office Closure | N/A |
| IRNP | North Prong | 27.856130°N, -80.524220°W | 9/2003 - 1/2004, 11/2004 - 12/2008 | Office Closure | N/A |
| IRUS1 | US 1 (AKA Main Drainage Basin) | 27.854620°N, -80.493320°W | 9/2003 - 1/2004, 12/2004 - 12/2008 | Office Closure | N/A |

1. **Data collection period:**

Data collection information is currently unavailable.

1. **Distribution:**

The Principle Investigator (PI) retains the right to be fully credited for having collected and processed the data. Following academic courtesy standards, the PI and Aquatic Preserve (AP) 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. 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. Water quality data and metadata can be obtained from the PI (see section 1).

1. **Associated researchers and projects:**

Associated researchers and projects information are currently unavailable.

**II. Physical Structure Descriptors**

1. **Sensor specifications**:

### Table 2. 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: 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 (specify whether EDS probe or not)

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

Dissolved Oxygen Qualifier: The reliability of the dissolved oxygen (DO) data after 96 hours post-deployment for non-EDS (Extended Deployment System) data sondes may be problematic due to fouling which forms on the DO probe membrane during some deployments (Wenner et al. 2001). Many Aquatic Preserves have upgraded to YSI 6600 EDS data sondes, which increase DO accuracy and longevity by reducing the environmental effects of fouling. The user is therefore advised to consult the metadata and to exercise caution when utilizing the DO data beyond the initial 96-hour time period. However, this potential drift is not always problematic for some uses of the data (e.g., periodicity analysis). It should be noted that the amount of fouling is site specific and that not all data are affected. The Principal Investigator at should be contacted concerning the reliability of the DO data because of the site and seasonal variation in the fouling of the DO sensor.

Depth Qualifier: The water quality 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. Standard calibration protocols for the non-vented sensor use the atmosphere pressure at the time of calibration. Therefore, changes in atmospheric pressure between calibrations appear as changes in water depth. The error is equal to approximately 1.03 cm for every 1millibar change in atmospheric pressure. This error is eliminated for level sensors because they are vented to the atmosphere throughout the deployment time interval. If proper atmospheric pressure data is available, non-vented sensor depth measurements can be corrected for deployments between calibrations. Readings for both vented and non-vented sensors are automatically compensated for water density changes due to variations in temperature and salinity. The Principal Investigator should be contacted in order to obtain information regarding atmospheric pressure data availability. All data sondes used at all 6600 sites in 2006 were non-vented models.

Salinity Units Qualifier: 6600 series sondes report salinity in parts per thousand (ppt) units and the EXO sondes report in practical salinity units (psu). These units are essentially the same and for the AP water quality program purposes are understood to be equivalent, however psu is considered the more appropriate designation. Moving forward the AP program will assign psu salinity units for all data regardless of sonde type.

Turbidity Qualifier: 6600 series sondes report turbidity in nephelometric turbidity units (NTU) and the EXO sondes use formazin nephelometric units (FNU). These units are essentially the same but indicate a difference in sensor methodology, for AP water quality program purposes they will be considered equivalent. Moving forward, the AP program will use FNU/NTU as the designated units for all turbidity data regardless of sonde type. If turbidity units and sensor methodology are of concern, please see the Sensor Specifications portion of the metadata.

1. **Coded variable definitions:**

**Site definitions:**

|  |  |  |
| --- | --- | --- |
| **Sampling Station:** | **Sampling Site Code:** | **Station Code:** |
| C-54 (AKA Fellsmere Canal) | C54 | IRC54 |
| Donald McDonald (AKA South Prong) | DM | IRDM |
| North Prong | NP | IRNP |
| US 1 (AKA Main Drainage Basin) | US1 | IRUS1 |

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 Calculated data: non-vented depth/level sensor correction for changes in barometric pressure

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, but some comment codes (marked with an \* below) can be applied to the entire record in the F\_Record column.

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

Corrected Depth/Level Data Codes

GCC Calculated with data that were corrected during QA/QC

GCM Calculated value could not be determined due to missing data

GCR Calculated value could not be determined due to rejected data

GCS Calculated value suspect due to questionable data

GCU Calculated value could not be determined due to unavailable data

Sensor Errors

SBO Blocked optic

SCF Conductivity sensor failure

SCS Chlorophyll spike

SDF Depth port frozen

SDG Suspect due to sensor diagnostics

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

SQR Data rejected due to QAQC checks

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

CWE\* Significant weather event

1. **Post deployment information:**

Post deployment information is currently unavailable.

1. **Other remarks/notes:**

**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. Any NANs in the dataset stand for “not a number” and are the result of low power, disconnected wires, or out of range readings. If additional information on missing data is needed, contact the Principal Investigator.

**Rejected Data:**

Obvious outliers, data associated with probe malfunction, and/or calibration (both pre and post) problems are rejected as specified below. For more details about rejected data, contact the Principal Investigator.

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

**Anomalous/Suspect data:**

**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 “outliers” (i.e., values that are negative or greater than 1000 NTU for 6600 series sondes and 4000 NTU for EXO series sondes) were not deleted from the monthly records. Readings greater than 1000 NTU for 6600 series sondes and 4000 NTU for EXO series sondes are considered out of range and are 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 %) and, therefore, were not removed from the dataset. They were marked suspect with the CAF code.

**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 mostly the reason is unknown. Data users should exercise caution when interpreting turbidity data that fall within this range.