**Hudson River** (HUD) **NERR Water Quality Metadata**

**January 1, 2013 – December 31, 2013**

**Latest Update: May 16, 2023**

**I. Data Set and Research Descriptors**

1. **Principal investigator(s) and 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; automated depth/level corrections for changes in barometric pressure (cDepth or cLevel parameters); and become part of the CDMO’s online provisional database. All pre- and post-deployment data are removed from the file prior to upload. During primary QAQC, data are flagged if they are missing or out of sensor range. The edited file is then returned to the Reserve for secondary QAQC 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 summary statistics, and graphs the data for review. It allows the user to apply QAQC flags and codes to the data, remove any overlapping deployment data, append files, and export the resulting data file for upload to the CDMO. Upload after secondary QAQC results in ingestion into the database as provisional plus data, recalculation of cDepth or cLevel parameters, and finally tertiary QAQC by the CDMO 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.

Persons responsible for data verification are the Research Assistant and the Research Coordinator

1. **Research objectives –**

The objective of this study is to monitor surface water quality at the Tivoli Bays component of the Hudson River National Estuarine Research Reserve (NERR). Two tidal freshwater wetlands, Tivoli North Bay and Tivoli South Bay, and their primary upland tributaries, Stony Creek and Saw Kill Creek respectively, are monitored using four dataloggers (YSI 6600 sondes). In Tivoli North Bay and Tivoli South Bay the dataloggers monitor the ebbing and flooding Hudson River water. In Stony Creek and Saw Kill Creek, the dataloggers are deployed above the area of tidal influence and monitor the quality of water entering the Tivoli Bays via stream flow. Thus, the relative importance of stream flow and tidal exchange and the potential impacts of intertidal areas on the water quality of the Tivoli Bays can be determined.

Monitoring the water quality of the tributaries is important because it has previously been determined that urban and residential land use practices are markedly influencing the water chemistry of the tributaries, especially Saw Kill Creek. Since residential coverage continues to increase, we hope that the intensive monitoring of the surface waters in these watersheds will identify trends associated with this rapid development. Examining the influence of tidal exchange allows identification of long-term trends in the water quality of the Hudson River Estuary at this location and the potential inputs to the Estuary from the Tivoli Bays. Finally, the influence of intertidal areas on water quality within the Tivoli Bays is interesting because of the potential impacts of both floating and emergent invasive plant species present in this system.

1. **Research methods –**

Four YSI 6600 dataloggers are deployed at the Tivoli Bays component site of the Hudson River NERR. The instruments in Saw Kill Creek and Tivoli South Bay are deployed 0.5 meters off the bottom in perforated four-inch PVC tubes that are vertically mounted to existing concrete structures. Note: In Saw Kill Creek, the end of the dam to which the equipment was attached was damaged during Tropical Storm Irene on 8/28/11. The station was reconstructed as close to the original location as possible. As of 9/13/11 the deployment tube is affixed to the undamaged end of the dam at a 45 degree angle, retaining the original 0.5 meters off the bottom of the creek. The instrument at Tivoli South Bay uses a depth sensor that is vented to the atmosphere for more precise depth readings. In addition, YSI 6600 V2 sondes are utilized at Tivoli South Bay. (See Note Below) The Saw Kill Creek station has been vulnerable to destruction during flood events, thus a more stable design, where the top of the PVC tube is flush with the top of the concrete structure is now used. However, this design does not allow venting to the atmosphere, non-vented sondes are now deployed at Saw Kill Creek. EDS (EDS instruments differ from the other instruments in that they have a central wiper that wipes the surfaces of all probes to minimize fouling) and non-EDS sondes are rotated at Saw Kill Creek.

Non-vented instruments are also deployed at Stony Creek and Tivoli North Bay. At Stony Creek, instruments are deployed in a perforated four-inch PVC pipe set in approximately 70 pounds of concrete at such angle that when laid in a creek pool, the streambank-end of the pipe matched the grade of the bank for most of its length and the sonde, set in place by a 0.5 inch through-bolt, rests 0.25 meters above the substrate. Along the portion of the PVC in contact with dry bank, several rebar stakes, bent around and lashed through holes in the pipe, hold the deployment in place and discourage vandalism. Additionally, the tube is painted to match surrounding deadfall, the end is capped and locked and contact/project information provided to further discourage tampering. During initial deployment of the Tivoli North sonde, the previously existing deployment tube was determined to have been damaged by ice during the previous winter. During the periods of July 18 – 28, 2011 and August 5-9, 2011 continuous low, hypoxic D.O. concentrations were detected in Stony Creek. However, handheld YSI sampling yielded acceptable D.O. concentrations during this time. No definitive statement can be made as to the actual cause of the hypoxia. Further investigation would be required in order to solely identify the source. It is however likely, based on the limited dataset that the outflow from the water treatment facility, located upstream of the sonde, impacted Stony Creek during this time period (See Section 14 below, for more detailed information).

Dataloggers are deployed from March through December of each year. Initially, data were collected at 30-minute intervals. The interval was changed to 15 minutes on the 8/3/2006 deployment at Tivoli South, and on 8/9/2006 at Stony Creek, Saw Kill Creek, and Tivoli North. A 15 minute interval was maintained through the current data set. Each YSI 6600 datalogger measures depth, dissolved oxygen, temperature, conductivity, salinity, pH, and turbidity. In addition, from 10/7/09, chlorophyll is measured at Tivoli North Site. Prior to deployment, calibration and maintenance are performed on each datalogger following the manufacturer's instructions (YSI Manual, sections 3, 4, and 7 as well as the YSI 6-series operations manual). Calibration standards are utilized for pH, turbidity, and conductivity. These standards are purchased from a scientific supply company.

Individual instrument deployments last from two to four weeks. At the end of each deployment period, the dataloggers are swapped with newly calibrated instruments to avoid breaks in data collection. After instruments are retrieved, calibration is checked against standards and the probes are serviced. The data are uploaded to a desktop computer via cable. Graphs of each parameter are generated and examined immediately in order to identify significant problems or events that may have occurred during deployment. The data are then verified as described previously.

# A Sutron Sat-Link2 transmitter was installed at the Tivoli South station on 11/15/05 and transmits data to the NOAA GOES satellite, NESDIS ID #3B00A782. A second Sutron Sat-Link2 transmitter was also installed at the Tivoli North station on 10/03/06 and transmits data to the NOAA GOES satellite, NESDIS ID #3B03A08C. A Sutron Sat-Link2 transmitter was installed at the Saw Kill station on 06/11/12 and transmits data to the NOAA GOES satellite, NESDIS ID #3B010580. The transmissions are scheduled hourly and contain four (4) data sets reflecting fifteen minute data sampling intervals. Upon receipt by the CDMO, the data undergoes the same automated primary QAQC process detailed in Section 2 above. The “real-time” telemetry data become part of the provisional dataset until undergoing secondary and tertiary QAQC and assimilation in the CDMO’s authoritative online database. Provisional and authoritative data are available at [http://cdmo.baruch.sc.edu](http://cdmo.baruch.sc.edu/).

Note: Due to destruction of telemetry equipment, logistical, and legal issues involving CSX Railroad, both Sat-Links located at the Tivoli Bays site were not in-place since the 2011 sampling season. The resolution has been on-going the entirety of the 2011- 2013 sampling years. As of the date of this metadata, the issues have not yet been resolved, and the equipment has not yet been re-installed. An alternative telemetry plan has been constructed; however, it is awaiting approval from various entities.

1. **Site location and character –**

The Hudson River National Estuarine Research Reserve (HUDNERR) is a multi-component site totaling approximately 5,000 acres. Each component of the reserve is referenced by River Mile (RM) of the Hudson River in New York State proceeding north from the southern tip of Manhattan (RM 0). The reserve includes the following four component sites: Piermont Marsh, Rockland County (RM 24)(41o02'30"N 73o54'15"W), Iona Island, Rockland County (RM 45)(41o18'15"N 73o58'45"W), Tivoli Bays, Dutchess County (RM 98)(42o02'15"N 73o55'10"W), and Stockport Flats, Columbia County (RM 124)(42o02'30"N 73o46'00"W). The four component sites include open water, tidal wetland, and adjacent upland buffer habitats and are representative of the diverse plant and animal communities that occupy the salinity gradient within the Hudson River Estuary. Development within the watersheds of the four component sites ranges from predominantly urban/suburban to forested/agricultural.

The highlighted component for this study is the Tivoli Bays in Annandale, NY. This component includes four monitored sites: Tivoli South Bay (TS), Tivoli North Bay (TN), Saw Kill Creek (SK) and Stony Creek (SC). All four monitored sites are freshwater (0.0 ppt salinity). Tivoli South Bay (latitude 42° 01' 37.336" N, longitude 73° 55' 33.445" W) is a tidal freshwater wetland with intertidal mudflats exposed at low tide. During the growing season (June – September), the subtidal area of Tivoli South Bay is dominated by the invasive floating macrophyte *Trapa natans*. Tivoli South Bay has a tidal range of 1.19 meters and a soft, silt/clay bottom type. The depth at the sampling location ranges from 0.5 to 2.5 meters. The non-tidal freshwater input to Tivoli South Bay includes that of a large upland tributary and a few small perennial streams. Tivoli North Bay (latitude 42° 02' 11.56464" N, longitude 73° 55' 31.16645" W) is a freshwater tidal marsh with emergent marsh vegetation dominated by the cattail *Typha angustifolia*. Tivoli North Bay has a tidal range of 1.19 meters, a soft, silt/clay bottom type, and a depth range from 0.5 to 3.0 meters at the sampling location. The non-tidal freshwater input to Tivoli North Bay includes that of a large upland tributary and a few small perennial streams.

Saw Kill Creek (latitude 42° 01' 01.543" N, longitude 73° 54' 53.589" W) is the main tributary flowing into Tivoli South Bay. The Saw Kill Creek watershed is 26.6 square miles and land use within the watershed includes forested (51.1%), agricultural (25.8%), and urban (16.5%) areas. Characteristics of Saw Kill Creek at the sampling location include a rocky bottom type, a depth range of 0.5 to 2.0 meters, and discharge that can range from 2x10-5 to 1.2 m3/sec. Stony Creek (latitude 42° 02' 46.881" N, longitude 73° 54' 38.984" W) is the main tributary flowing into Tivoli North Bay. The Stony Creek watershed is approximately 23 square miles and is dominated by agricultural land use. Characteristics of Stony Creek at the sampling location include a solid rock bottom and a depth range of 0.5 to 1.5 meters. Stony Creek discharge is currently being determined. Since both Stony Creek and Saw Kill Creek are non-tidal, freshwater input to these tributaries consists of smaller creeks in their watersheds.

The entire Hudson River system south of the Troy Dam is affected by polychlorinated biphenyls (PCBs), and Tivoli North and South Bays have low sedimentary concentrations of PCBs. Nutrient inputs to the Tivoli Bays via the non-tidal tributaries are the main concern in terms of pollutants. High concentrations of nitrate and phosphate have previously been documented in both Saw Kill Creek and Stony Creek. Saw Kill Creek appears to be strongly influenced by residential land use practices. Stony Creek appears to be strongly influenced by a municipal wastewater treatment plant upstream of the sampling site. This highlights the importance of continued monitoring and identification of both non-point and point sources of pollution at these sites.

1. **Data collection period –**

YSI 6-series datalogger sampling at Saw Kill Creek (SK) and Tivoli South Bay (TS) began in May 1995. Sampling at Tivoli North Bay (TN) began in July 1996 but ceased in 1997-1998 due to instrument exposure at low tide. In 1999, an alternate site was established for TN and sampling began again in July of 1999. Sampling began at Stony Creek (SC) in April 2002. Sampling is continuous from April through December but is not conducted from approximately mid-December through the end of March due to winter storms and ice on the Hudson River and the tributaries.

A YSI 6600 Extended Deployment System (EDS) sonde was deployed at Tivoli South Bay starting on 04/08/2003. The EDS differs from the other 6600 instruments in that a large wiper is positioned centrally to the probes and wipes them prior to every sample. This wiper requires that the pH probe not have a guard over the glass bulb, and a new flat pH probe was deployed on the EDS starting 09/25/2003. Otherwise, the EDS sonde is identical to the other 6600 dataloggers. YSI 6600 V2’s been utilized at Tivoli South Bay and Tivoli North Bay since the addition of the Chlorophyll probes on 10/7/09.

Dates and times for site deployments and retrievals for 2013:

Site Deployment Retrieval

TN 03/29/2013 10:45 05/02/2013 13:30

05/02/2013 14:00 05/30/2013 13:15

05/30/2013 13:30 06/28/2013 12:30

06/28/2013 13:15 07/22/2013 08:45

\*07/22/2013 09:00 08/20/2013 08:45

08/20/2013 09:00 09/11/2013 11:15

09/11/2013 11:30 10/23/2013 10:30

10/23/2013 10:45 11/07/2013 10:15

11/07/2013 10:30 12/06/2013 10:45

12/06/2013 11:00 12/12/2013 13:45

Site Deployment Retrieval

TS 03/29/2013 11:30 05/02/2013 14:00

05/02/2013 14:30 05/30/2013 14:00

\*05/30/2013 14:00 06/28/2013 12:30

06/28/2013 12:45 07/22/2013 09:00

07/22/2013 09:15 08/20/2013 09:00

08/20/2013 09:30 09/11/2013 11:45

09/11/2013 12:00 10/23/2013 10:45

10/23/2013 11:15 11/08/2013 10:45

11/08/2013 11:00 12/06/2013 10:15

12/06/2013 10:45 12/12/2013 14:00

Site Deployment Retrieval

SC 03/29/2013 11:45 05/02/2013 14:45

05/02/2013 15:00 05/30/2013 12:45

05/30/2013 13:00 06/28/2013 11:30

06/28/2013 12:00 07/22/2013 09:30

07/22/2013 09:45 08/20/2013 09:30

08/20/2013 10:00 09/11/2013 12:00

09/11/2013 12:30 10/23/2013 10:15

10/23/2013 11:00 11/07/2013 10:45

11/07/2013 11:00 12/06/2013 10:00

12/06/2013 10:15 12/12/2013 13:30

Site Deployment Retrieval

SK 03/29/2013 12:30 05/02/2013 14:15

05/02/2013 14:45 05/30/2013 14:00

05/30/2013 14:45 06/28/2013 13:15

06/28/2013 13:30 07/22/2013 09:45

07/22/2013 10:00 08/20/2013 10:00

08/20/2013 10:15 09/11/2013 12:15

09/11/2013 12:45 10/23/2013 11:15

10/23/2013 11:30 11/07/2013 11:00

11/07/2013 11:30 12/06/2013 11:30

12/06/2013 11:45 12/12/2013 14:45

\*There were sondes deployed during these deployments however they malfunctioned and no data were collected

1. **Distribution –**

Ocean and Coastal Resource Management Data Dissemination Policy for the NERRS System-wide Monitoring Program in the metadata.

NOAA retains the right to analyze, synthesize and publish summaries of the NERRS System-wide Monitoring Program data.  The NERRS retains the right to be fully credited for having collected and process the data.  Following academic courtesy standards, the NERR site where the data were collected should 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.  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.

Requested citation format:

National Estuarine Research Reserve System (NERRS). 2012.  System-wide Monitoring Program. Data accessed from the NOAA NERRS Centralized Data Management Office website: [www.nerrsdata.org](http://www.nerrsdata.org); *accessed* 12 October 2012.

NERR water quality data and metadata can be obtained from the Research Coordinator at the individual NERR site (please see Principal Investigators and Contact Persons), from the Data Manager at the Centralized Data Management Office (please see personnel directory under the general information link on the CDMO home page) and online at the CDMO home page [www.nerrsdata.org](http://www.nerrsdata.org).  Data are available in comma delimited format.

1. **Associated researchers and projects**

As part of the Hudson River NERR water quality monitoring project, physical and chemical constituents of the tributary waters discharging into HUDNERR marshes and marsh waters are measured monthly during ebb tides. Measurements include dissolved oxygen, seston, chlorophyll, alkalinity, pH, temperature, salinity, conductivity and concentrations of ammonium, nitrate, phosphate, sulfate and chloride. In addition, meteorological data including average air temperature, average relative humidity, average barometric pressure, average wind speed, average wind direction, wind direction standard deviation, total precipitation and total PAR is collected every 15 minutes.

Associated researchers working at the Tivoli Bays component site include scientists from the Cary Institute of Ecosystem Studies in Millbrook, NY, Yale School of Forestry and Environmental Studies in New Haven, CT, Cornell University Center for the Environment, Cornell Institute for Resource Systems, Cornell Department of Natural Resources, Ithaca, NY, State University of New York College of Environmental Science and Forestry, Syracuse, NY and Rensselaer Polytechnic Institute in Troy, NY.

**II. Physical Structure Descriptors**

**9) Sensor specifications**

HUDNERR deployed YSI 6600/YSI 6600EDS dataloggers at all sites (see Section 4). All Rapid-pulse DO sensors were replaced by ROX DO sensors for all sites starting with the first deployment in 2007. Additionally, all flat-glass pH probes 6561 probes were replaced by Fast Response 6589 probes at the beginning of the 2010 sampling period.

YSI 6600EDS data sonde:

Parameter: Temperature

Units: Celsius (C)

Sensor Type: Thermistor

Model#: 6560

Range: -5 to 50 C

Accuracy: +/- 0.15

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 dependant)

Parameter: Salinity

Units: parts per thousand (ppt)

Sensor Type: Calculated from conductivity and temperature

Range: 0 to 70 ppt

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

Resolution: 0.01 ppt

Parameter: Dissolved Oxygen % saturation

Units: percent air saturation (%)

Sensor Type: Optical probe w/ 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% or reading

Resolution: 0.1% air saturation

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

Units: milligrams/Liter (mg/L)

Sensor Type: Optical probe w/ mechanical cleaning

Model#: 6150 ROX

Range: 0 to 50 mg/L

Accuracy: 0-20 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: 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 0-10 ft: +/- 0.01 ft (0.003 m)

Accuracy 10-30 ft: +/- 0.06 ft (0.018 m)

Resolution: 0.001 ft (0.001 m)

Parameter: pH – Fast Response

Units: pH units

Sensor Type: Glass Bulb

Model #: 6589 Fast Response

Range: 0 to 14 units

Accuracy: +/- 0.2 units

Resolution: 0.01 units

Parameter: Turbidity

Units: nephelometric turbidity units (NTU)

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

Model#: 6136

Range: 0 to 1000 NTU

Accuracy: +/- 2% of reading or 0.3 NTU (whichever is greater)

Resolution: 0.1 NTU

Parameter: Chlorophyll Fluorescence

Units: micrograms/Liter

Sensor Type: Optical probe w/ mechanical cleaning

Model#: 6025

Range: 0 to 400 ug/Liter

Accuracy: Dependent on methodology

Resolution: 0.1 ug/L chl a, 0.1% FS

**Dissolved Oxygen Qualifier (Rapid Pulse / Clark type sensor):**

The reliability of dissolved oxygen (DO) data collected with the rapid pulse / Clark type sensor 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). Some Reserves utilize the YSI 6600 EDS data sondes, which increase DO accuracy and longevity by reducing the environmental effects of fouling. Optical DO probes have further improved data reliability. The user is therefore advised to consult the metadata for sensor type information and to exercise caution when utilizing rapid pulse / Clark type sensor DO data beyond the initial 96-hour time period. Potential drift is not always problematic for some uses of the data, i.e. periodicity analysis. It should also be noted that the amount of fouling is very site specific and that not all data are affected. If there are concerns about fouling impacts on DO data beyond any information documented in the metadata and/or QAQC flags/codes, please contact the Research Coordinator at the specific NERR site regarding site and seasonal variation in fouling of the DO sensor.

**Depth Qualifier:**

The NERR System-Wide Monitoring Program utilizes YSI data sondes that can be equipped with either vented or non-vented depth/level sensors.  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 vented 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 can be corrected.

In 2010, the CDMO began automatically correcting depth/level data for changes in barometric pressure as measured by the Reserve’s associated meteorological station during data ingestion. These corrected depth/level data are reported as cDepth and cLevel, and are assigned QAQC flags and codes based on QAQC protocols. Please see sections 11 and 12 for QAQC flag and code definitions.

**Salinity Units Qualifier:**

In 2013, EXO sondes were approved for SWMP use and began to be utilized by Reserves. While the 6600 series sondes report salinity in parts per thousand (ppt) units, the EXO sondes report practical salinity units (psu). These units are essentially the same and for SWMP purposes are understood to be equivalent, however psu is considered the more appropriate designation. Moving forward the NERR System will assign psu salinity units for all data regardless of sonde type.

**Turbidity Qualifier:**

In 2013, EXO sondes were approved for SWMP use and began to be utilized by Reserves. While the 6600 series sondes report turbidity in nephelometric turbidity units (NTU), the EXO sondes use formazin nephelometric units (FNU). These units are essentially the same but indicate a difference in sensor methodology, for SWMP purposes they will be considered equivalent. Moving forward, the NERR System 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.

**Chlorophyll Fluorescence Disclaimer:**

YSI chlorophyll sensors (6025 or 599102-01) are designed to serve as a proxy for chlorophyll concentrations in the field for monitoring applications and complement traditional lab extraction methods; therefore, there are accuracy limitations associated with the data that are detailed in the YSI manual including interference from other fluorescent species, differences in calibration method, and effects of cell structure, particle size, organism type, temperature, and light on sensor measurements.

**10) Coded variable definitions**

Sampling station: Sampling site code: Station code:

Tivoli North Bay TN hudtnwq

Tivoli South Bay TS hudtswq

Stony Creek SC hudscwq

Saw Kill Creek SK hudskwq

**11) 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

**12) 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

**13) Post deployment information** –

Deployment DO 100% SpCond 1.0 mS/cm pH 7 Turb 0 NTU

SC 03/29/13 101.9 0.990 6.99 1.2

05/02/13 103.1 0.969 7.15 0.9

05/30/13 98.3 0.992 7.12 8.1

06/28/13 103.9 0.984 7.16 3.2

07/22/13 100.7 0.874 7.06 11.4

08/20/13 99.7 0.962 7.19 1.5

09/11/13 97.1 0.948 7.02 0.0

10/23/13 100.3 0.955 7.14 4.4

11/07/13 103.7 0.946 7.07 0.7

12/06/13 101.2 1.003 7.07 0.3

Deployment DO 100% SpCond 1.0 mS/cm pH 7 Turb 0 NTU

SK 03/29/13 101.5 0.995 7.19 0.3

05/02/13 101.6 1.029 6.89 0.5

05/30/13 100.2 0.996 7.14 12.0

06/28/13 102.4 1.210 7.07 4.9

07/22/13 100.5 0.980 7.05 4.9

08/20/13 99.8 1.005 7.47 1.9

09/11/13 99.8 0.993 7.01 1.2

10/23/13 99.3 1.192 6.98 4.0

11/07/13 107.1 0.986 6.98 1.1

12/06/13 100.0 0.989 7.02 0.8

Deployment DO 100% SpCond 1.0 mS/cm pH 7 Turb 0 NTU

TN 03/29/13 104.5 1.005 7.02 0.5

05/02/13 109.7 0.988 7.07 0.4

05/30/13 94.5 0.981 7.14 -0.2

06/28/13 100.3 0.950 7.13 17.9

07/22/13 97.1 0.948 7.08 2.1

08/20/13 99.5 0.954 7.29 3.6

09/11/13 102.0 1.018 7.07 2.7

10/23/13 99.4 1.005 7.02 4.1

11/07/13 101.9 0.980 7.05 -1.4

12/06/13 102.1 0.990 7.10 0.7

Deployment DO 100% SpCond 1.0 mS/cm pH 7 Turb 0 NTU

TS 03/29/13 103.4 0.985 7.15 -2.4

05/02/13\* 96.1 0.998 7.04 1.7

05/30/13\* 96.2 1.053 7.24 7.4

06/28/13 100.4 1.000 7.22 5.0

07/22/13 100.3 0.950 7.13 17.9

08/20/13 95.1 0.991 6.76 -3.7

09/11/13\* 99.4 0.983 7.11 0.3

10/23/13 100.1 1.011 6.99 1.1

11/07/13 100.4 1.126 7.08 7.6

12/06/13 100.6 0.993 7.02 0.3

**\* Sonde crashed during deployment, post deployment information was obtained after the sonde was examined and tested.**

**14) Other remarks/notes –**

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 Research Coordinator at the reserve submitting the data.

Across the four files, there were some turbidity posts that were low. The data itself matched up well despite the low posts. The deployments impacted and the post values are noted below. We have also included notes on potential reasons why the posts were low.

**SC**:

3/29 1.2/93.2 Unsure of cause

5/2 0.9/85.1 Unsure of cause

5/30 8.1/127.4 Inclined to think the high end is fine, likely dirty DI water used in 0 post

7/22 11.4/116 Was post calibrated with TS, seems to be the same dirty DI water

9/11 0.0/143.8

**SK**:

5/30 12.0/125 Likely dirty DI water

**TN**:

6/28 10.1/97.6 Unsure of cause

7/19 2.1/88.1 Likely contaminated stardard

9/11 2.7/76.6 Likely contaminated stardard

**TS**:

7/22 17.9/115.6 Post calibrated with SC, seems to be the same dirty DI

11/8 7.6/131.3 Slightly high, potentially light fouling

**Data Coded (GOW) Instrument out of Water**

**TN**

<-3> (GOW) [SDF] (CSM)

Suspect data is flagged during the hours of 11/24/2013 @ 23:30 – 11/25/2013 @ 05:30

It appears that during a storm even, a blowout tide occurred combined with cold water temperatures and sub-zero air temperatures. During the time frame it appears the sonde came out of the water or the depth port froze. The remaining probes on the instrument appeared to record strangely either due to absence of water, or frozen conditions.

**TS**

<-3> (GOW) [SDF] (CSM)

Suspect data is flagged during the hours of 11/24/2013 @ 10:45 – 14:00 and 11/24/2013 @ 22:30 – 11/25/2013 @ 02:00

It appears that during a storm even, a blowout tide occurred combined with cold water temperatures and sub-zero air temperatures. During the time frame it appears the sonde came out of the water or the depth port froze. The remaining probes on the instrument appeared to record strangely either due to absence of water, or frozen conditions.

**Data Coded (CCU) Cause Unknown**

**SK**

<1> [GSM] (CCU)

Suspect dissolved oxygen conditions occurred on 6/25/13 @ 05:00, 6/26/13 @ 13:45, and 6/27/13 @ 21:00, 02:30. Causes of these conditions could not be determined.

**Data coded (CDA) DO hypoxia (<3 mg/L)**

**TN**

06/10/13, 6/21/13, 6/23/13, 6/25/13, 6/26, 6/27

During periods of low tide, hypoxic conditions appear intermittently. Hypoxia is likely due to low tide conditions and low water volumes in channel.

**SC**

Various Times from 07/2013 – 10/2013

Low flow and discharge from a waste water treatment facility upstream likely caused these events. The low flow was visibly observed during these months, and is typical of this location from year to year.

**Data Coded (CSM) See Meta Data**

**TN**

11/25/13 23:30 – 05:30

During a blowout tide, it appears that the sonde came out of water. Readings indicate that during the time it was exposed to shallow or no water, the temperatures were low enough to cause freezing of the optical probes and depth sensor. All data for this period is flagged, until the sonde was re-submerged and was warmed to ambient water temperature. After water levels rose, all probes resumed what appears to be normal function.

**TS**

**See (GPF), (GOW)** for additional information

11/08/13 – 12/06/13

Due to damaged equipment, a 2 Optical port probe was needed to be deployed during this sample cycle. The optical Chlorophyll probe was omitted during this deployment, based on the determination of minimal chlorophyll productivity during the freezing temperatures of late fall. It was resumed briefly on 12/06/13 - 12/12/13 before sondes were pulled.

**Data Coded (GPF) General Power Failure**

**TS –**

The Vented sondes were compromised during a storm surge during Hurricane Sandy in 2012, the sondes vent tubes were flooded. Upon doing quality assurance tests the sondes appeared to function normally. During the 2013 deployment season, numerous power issues arose in the sondes including multiple power failures on new deployments despite utilizing brand new functioning batteries. The data during the following times was not sampled and recorded due to the power failure. The missing data were excused by the SWMP Oversight Committee (J. Crooks, 1/21/14). The sondes will be replaced for the 2014 sampling season, or as soon as funding allows.

5/17/13 @ 23:00 – 5/30/13 @ 13:45

Battery drainage occurred; data was not logged during this time period.

5/30/13 @ 14:00 – 6/28/13 @ 12:30

Battery failure in sonde due to equipment malfunction. No data collected during entirety of deployment.

09/16/13 @ 20:00 – 10/24/13 @ 12:00

Battery drainage occurred; data was not logged during this time period

**TN**

7/22/13@ 09:00 – 8/20/13 @ 09:00

A reversal of polarization was noted in a battery cell during this deployment. The reverse cell caused a disruption in the normal operation of the sonde and no data was collected for the deployment.

**Data Coded [GMC]**

**TS**

The sonde was removed at 7/26 10:45 to survey the bolt/instrument height. This reading was taken when the sonde was out of the water. Data are rejected.

**Data Coded (CIP)**

**All sites**

Surface ice was observed beginning to form during the 12/6/13 sonde rotation. Water temperature was hovering around freezing as nighttime temperatures were below 0 (C). Daytime heating was observed to keep ice at a minimum during the day. On 12/10/13 it was observed that significant ice was forming in the SC and SK locations.

Conditions permitting access to these sites were hampered by snowfall and ice formation. Due to safety concerns for crew and equipment all sondes were removed on 12/12/2013

**Removal times**

SK 12/12/13 @ 14:45

SC 12/12/13@ 13:30

TN 12/12/13 @ 13:45

TS 12/12/13 @ 14:01

Sondes will be deployed at the earliest safest time of ice out during the 2014 season.