**Lake Superior (lks) NERR Water Quality Metadata**

**June to December 2012**

**January 13, 2015**

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 CDMO ([cdmosupport@belle.baruch.sc.edu](mailto:cdmosupport@belle.baruch.sc.edu)) or Reserve with any additional questions.

**I. Data Set and Research Descriptors**

**1) Principal investigator(s) and contact persons**

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**SWMP Technicians – Joseph Ripley, Seth Bliss, Jesse Carlson**

**2) 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.

Monitoring Coordinator, Tracey Ledder, is responsible for data management.

**3) Research objectives –**

The LSNERR is situated on the freshwater estuary at the confluence of the St. Louis River and Lake Superior, the largest and most pristine of the Great Lakes. The Reserve is a diverse, 16,697-acre complex that contains a variety of representative terrestrial and aquatic habitats allowing for the extensive research and educational opportunities. The Reserve will provide opportunities for research and monitoring, experiential learning, and training while continuing to contribute to the protection of the ecological health of the St. Louis River Freshwater Estuary and Lake Superior coastal habitats.

The Lake Superior NERR will implement the NERR System-Wide Monitoring Program (SWMP). This will include four continuous water quality monitoring stations with monthly nutrient and chlorophyll sampling, a meteorological station, and monthly sampling at one site consisting of 12 nutrient and chlorophyll samples collected over a 24-hour period. Data will be archived at the Centralized Data Management Office (CDMO) as per established protocols. In 2012, three continuous stations with monthly nutrient and chlorophyll sampling were operational.

In addition we have sought funding to become a NOAA Sentinel Site. This will include installing surface elevation tables, establishing permanent vegetation transects, installing water level monitoring wells, and establishing a geodetic framework for all instruments.

To promote information access by the public in a timely manner the Lake Superior NERR will seek to provide real-time water quality and meteorological information using telemetry systems (satellite and cellular). This information will be used in the Coastal Training Program (CTP) and Education programs and made available to the public online and in the Lake Superior NERR Science and Interpretive Center.

**4) Research methods**

This is the first year in which regular sonde deployment was instituted; no units were real-time during 2012. All sondes deployed in 2012 were YSI 6600-series; four 6600-V2s purchased in 2011, and two cooperator-loaned 6600-EDS sondes (Large Lakes Observatory, UMN-Duluth). Data were collected in 15-minute intervals from July through December, 2012.

The sondes have not been painted or otherwise protected from fouling and biological growth. The NERR is a freshwater estuary on Lake Superior, we have not seen major fouling problems in this first monitoring year.

All sondes were calibrated prior to deployment using the following commercial standard solutions

pH – Fisher Scientific Buffer solutions, 7.0 and 10.0

Turbidity – calibrated to 0 in laboratory reagent water and to YSI Turbidity Standard, 126 NTU

Conductivity – YSI Conductivity Standard, 1.00 mS/cm

Temperature – factory calibration

Dissolved Oxygen – air saturated water, DO% calibrated to barometric pressure

Depth – calibrated to barometric pressure by way of depth offset

Chlorophyll a – fluorescence, calibrated to zero; laboratory samples have been taken with nutrient

sampling and results will be compared between the two events

YSI has developed the YSI 6025 chlorophyll sensor for determination of chlorophyll in spot sampling and continuous monitoring applications. It is based on an alternative method for the measurement of chlorophyll which overcomes the disadvantages of the time consuming laboratory analysis, albeit with the potential loss of accuracy. In this procedure, chlorophyll is determined *in vivo*, i.e., without disrupting the cells as in the extractive laboratory analysis. The YSI 6025 chlorophyll sensor is designed for these *in vivo* applications and its use allows the facile collection of large quantities of chlorophyll data in either spot sampling or continuous monitoring applications. It is important to remember, however, that the results of *in vivo* analysis will not be as accurate as those from the certified extractive analysis procedure.

A YSI 650 data logger, or a Microsoft PC, were utilized to set-up logging and data files and calibrate each sonde prior to deployment and to complete post-deployment calibration checks. Data was collected at fifteen-minute intervals, generally for a period of two weeks, at each site.

**5) Site location and character –** The Lake Superior NERR is located within the estuary of the St. Louis River. The St. Louis River Watershed covers approximately 3,634 square miles in northeast Minnesota and 263 square miles in northwest Wisconsin. In the upper watershed the river flows through lake clays and glacial deposits for approximately 100 miles. Near the city of Thomson the channel narrows and the river flows through a rocky rapid-filled gorge. Approximately 23 river miles upstream from Lake Superior is the Fond du Lac dam, the lowest of several dams. Below the gorge and dams the river begins to take on the characteristics of a fresh water estuary. At the mouth of the river is the largest working harbor on the Great Lakes.

Lake Superior does not produce a “tide” as on the ocean coasts, however, seiches, which occur when wind or atmospheric pressure causes oscillations in the water of Lake Superior, are common. For example, the USGS Sontek at the Duluth entry has measured streamflow at between 4.0 cfs and -3.5 cfs. There tends to be a larger seiche period of about eight hours, while smaller seiches can be seen at approximately two hours. The change in water level as a result of the seiche is usually less than a foot, however a strong seiche can reverse the direction of the river’s flow as far upstream as Fond du Lac. The USGS stream gage on the St. Louis River at Scanlon (upstream of the Fond du Lac dam) recorded a yearly median discharge of 2278 cfs for the period of record (1909 to present).

*Oliver Bridge site* (ol)

a) -92.20166, 46.65685

b) This site is located on the downstream side of a bridge piling at Oliver, Wisconsin. The site is 11 miles upstream of Lake Superior and upstream of the majority of the estuary, receives the downstream river flow below the Fond du Lac dam, but may be influenced to some extent by Lake seiche

c) salinity range 0.08 – 0.2 PPT

d) freshwater estuary site, receives flow of the St. Louis River (relatively undeveloped area)

e) approximately 8m depth, 126 meters wide

f) bottom habitat or type currently undocumented (suspected sand or soft sediment)

g) Approximately 12 miles downstream of the Fond du Lac dam

h) This site is the furthest upstream site monitored in the St. Louis River Estuary, approximately 11 miles from the mouth at Lake Superior. This site may experience some influence due to seiche.

*Bong Bridge site* (bo) – initially thought to be a sonde location, but only a nutrient site in 2012

a) -92.14257, 46.73169

b) This site is located at the Bong Bridge in the lower estuary and therefore is influenced to some extent by Lake seiche

c) salinity range thought to be similar, 0.08 – 0.2 PPT

d) freshwater estuary site, receives flow of the St. Louis River and tributaries to the estuary (urban)

e) water approximately 7 m depth, 1286 meters wide

f) bottom habitat or type (soft sediment, grass bed, oyster bar, etc)

g) Site is located within the urban area of Superior, WI/Duluth, MN.

h) This site is within the St. Louis River Estuary

*Blatnick Bridge site* (bl)

a) -92.10027, 46.748649

b) This site is located on the downstream side of a middle river piling off of Rice’s Point, and therefore is influenced by Lake seiche

c) salinity range 0.1 to 0.25 PPT

d) freshwater estuary site, receives flow of the St. Louis River and tributaries to the estuary (urban)

e) water depth approximately 7 m, approximately 360 meters wide

f) bottom habitat or type currently undocumented (suspected sand)

g) Site is located within the urban area of Superior, WI/Duluth, MN. Site is immediately downstream of the

Western Lake Superior Sanitary District WWTP discharge

h) This site is within the lower estuary, in the industrial harbor. The site is influenced by seiche activity.

*Barkers Island site* (ba, formerly ls)

a) -92.06352, 46.721772

b) This site is located on the northwest end of Barkers Island, upstream of the Superior entry to the estuary, and therefore is influenced by Lake seiche

c) salinity range 0.08 to 0.2 PPT

d) freshwater estuary, receives flow from the St. Louis River and tributaries (urban)

e) water depth approximately 2 m, approximately 1207 meters across Superior Bay at this point

f) bottom habitat or type undocumented (suspect sand or soft sediment)

g) Site is downstream of the Superior WWTP and the WLSSD WWTP

h) This site is the furthest downstream site monitored in the St. Louis River Estuary, also within the lower industrial harbor. The Nemadji River (433 square mile watershed) also enters the St. Louis River estuary near the Superior Entry.

**6) Data collection period**

|  |  |  |  |
| --- | --- | --- | --- |
| SITE | START | END | SONDE |
| Oliver Bridge | 07/03/12 10:45 | 07/10/12 9:15 | #3 |
| July to November | 07/10/12 9:30 | 07/23/12 12:45 | #4 |
|  | 07/23/12 13:00 | 08/06/12 10:15 | #1 |
|  | 08/06/12 10:45 | 08/21/12 9:15 | #4 |
|  | 08/21/12 9:30 | 09/04/12 12:15 | #1 (no data) |
|  | 09/04/12 12:30 | 09/18/12 13:30 | #2 |
|  | 9/18/12 13:45 | 09/18/12 20:30 | #3 (data skipping) |
|  | 10/02/12 10:00 | 10/09/12 17:00 | #4 (data skipping) |
|  | 11/07/12 10:15 | 11/19/12 12:00 | #4 (data skipping) |
|  |  |  |  |
| Blatnick Bridge | 07/03/12 11:30 | 07/10/12 11:15 | #1 |
| July to October | 07/10/12 11:30 | 07/23/12 14:00 | #2 |
|  | 07/23/12 14:15 | 08/06/12 9:00 | #3 |
|  | 08/06/12 9:15 | 8/21/12 8:30 | #2 |
|  | 08/21/12 9:00 | 09/04/12 11:15 | #3 |
|  | 09/04/12 11:30 | 09/18/12 13:00 | #4 (no data) |
|  | 09/18/12 13:15 | 10/02/12 9:00 | #1 |
|  | 10/02/12 10:00 | 10/22/12 9:30 | #2 |
|  |  |  |  |
| Barkers Island | 06/15/12 16:00 | 06/26/12 9:30 | #2 (data skipping) |
| June to December | 07/03/12 10:30 | 07/12/12 10:30 | #1 (data skipping) |
|  | 07/12/12 13:15 | 08/03/12 16:00 | #1 (data skipping) |
|  | 08/03/12 16:15 | 08/16/12 9:15 | LLO 02 |
|  | 08/16/12 16:30 | 09/06/12 9:30 | LLO 02 |
|  | 09/06/12 14:45 | 09/18/12 8:30 | LLO 02 |
|  | 09/18/12 8:45 | 10/10/12 15:15 | LLO 02 (no data) |
|  | 10/12/12 15:30 | 12/11/12 11:45 | LLO 02 |
|  | 10/02/12 10:00 | 10/09/12 17:00 | #4 (data skipping) |

**7) Distribution**

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: <http://cdmo.baruch.sc.edu/>; *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 [http://cdmo.baruch.sc.edu/](http://cfcdmo.baruch.sc.edu/).  Data are available in comma delimited format.

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 [http://cdmo.baruch.sc.edu/](http://cfcdmo.baruch.sc.edu/). Data are available in text tab-delimited format.

**8) Associated researchers and projects**

Samples were taken monthly at these four sites (ol, bo, bl, ba) for nutrient and chlorophyll *a* analyses from May through November, 2012. Chlorophyll *a* laboratory analyses results will be compared to sonde readings at the same site and time in order to better understand the limitations and use of the sonde Chlorophyll *a* fluorescence data.

The LSNERR cooperates with researchers at University of Wisconsin and University of Minnesota studying the biogeochemical processes in the estuary. Researchers are looking at the spatial and seasonal patterns of nutrient and organic matter processing. One outcome will be the identification of the role of anthropogenic stressors. The results will enhance our ability to interpret data from water quality monitoring in the estuary to inform management strategies.

Other research in which LSNERR participated in 2012 included the biological control of purple loosestrife, a study of the microbial communities related to mercury methylation in sediment, geospatial analyses of stressor gradients and stakeholder participation patterns in the estuary.

Other agencies working in the St. Louis River estuary include the Wisconsin and Minnesota Departments of Natural Resources, the United States Environmental Protection Agency Mid-Continent Ecological Lab, United Stated Fish and Wildlife Service and the United States Geological Survey. The LSNERR participates with partnerships in the area with these agencies as well as with the City of Superior, Douglas County and several non-profits.

**II. Physical Structure Descriptors**

**9) Sensor specifications**

In 2012, LS NERR deployed mainly 6600-V2 data sondes and utilized two 6600 EDS data sondes loaned by a cooperating partner in the St. Louis River.

YSI 6600-V2 – Sondes #1, 2, 3 and 4

YSI 6600EDS – Sonde LLO 02 (no depth, no chlorophyll *a*)

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: pH – bulb probe or EDS flat glass probe

Units: pH units

Sensor Type: Glass combination electrode

Model#: 6589FR

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:

Oliver Bridge OL lksolwq

Blatnick Bridge BL lksblwq

Barkers Island BA lksbawq

**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** – The following tables include available post-calibration check information for each site.

**Oliver Bridge**



**Blatnick Bridge**



**Barkers Island**



**14) Other remarks/notes**

The Monitoring Coordinator during 2012 was an interim position, and we appreciate the help of Kim Duernberger in this capacity during the initiation of the LSNERR SWMP program. A complete set of complementary sondes for each of four SWMP sites was not available in 2012. Two sets of EXOs were purchased late 2012 and early 2013 for future deployment of a complete SWMP set.

Data was collected beginning in summer 2012 at the LKS NERR. Data was not originally collected following SWMP protocols. WQ field logs were not collected and while calibrations logs were collected, post calibration logs were not. This limited the ability of staff and the qc process to accurately depict potential sensor and sonde issues. In 2013 all data was collected following SWMP protocols.

No WQ field logs were produced in 2012, notes during water column readings at the monthly nutrient sample collection were utilized to complete some of the meta data records, such as site descriptors of water depth, where possible.

Not all calibration logs were filled out completely due to this being the first year of sonde deployment, but the use of documentation sheets increased during the field season as the 2012 crew learned more about the SWMP program.

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.

“CSM” from data sets – Skipped data during deployment in 2012 is suspected to be caused by water intrusion into the battery casing causing periodic electrical problems. For those files in which the majority of data collection was skipped, the existing data collected was thought to be unreliable. One of the 6600-V2 sondes (#2) experienced an RTC battery failure causing loss of that deployment data set.

All sondes were pulled out of the water for the winter due to ice conditions in northern Wisconsin. Ice thickness during March 2013 averages 60 cm in several tributary bays and at their mouths on the St. Louis River. Future planning will include options for winter data collection as we learn more about winter conditions as relates to sonde deployment.

June 2012 FLOOD – The western Lake Superior area experienced an extreme flood event in late June of 2012. Up to 8 inches of rain in one day were reported from several places in the Duluth/Superior area. The USGS stream gage on the St. Louis River at Scanlon (upstream of the estuary) documented a river flow of 40,000 cfs in late June, whereas the average was approximately 500 cfs in September and October (long-term yearly median is 2278 cfs). This rain event caused heavy flooding in the Duluth and Superior areas, with road and dam failures, river bank slumping and changes in upper estuary bathimetry.

The LL02 sonde used at BA had no depth transducer and therefore no depth data was collected during the following deployments:

8/3

8/16

9/6

10/12

During the 7/ deployment at OL 40 NTU turbidity standard was used instead of the normal 126 NTU turbidity standard. This should not have impacted data.

The St. Louis River at the BA SWMP site is a large river, approximately 1200 meters across, with a navigation channel dredged to approximately 7 meters for large lake and ocean-going vessels that enter the Superior/Duluth industrial harbor.  Depth at BA is approximately 2 meters. Much of the riparian area is developed industrial, commercial or residential. Most of this section of the river has been stabilized with rip-rap.  There are some areas of submergent vegetation but very little compared to the pre-industrial setting.  This site also experiences frequent seiches, with Lake Superior water moving upriver well past this point.  Therefore, dissolved oxygen fluctuations from 60-100% are common summer occurrences. Missing calibration and field documentation for 2012 makes the data above 100% uncertain, please use them with caution.

Update March 13, 2014

CDMO determined that the 2012 depth data from 6600s at Oliver Bridge, Barkers Island and Blatknik Bridge must be flagged as “rejected” due to the fact that these sondes are vented however, they were deployed with vent caps on the vented cable to the telemetry box.

Based on communication with YSI representative Mike Lizotte these data are suspect. Non-vented depth sensors have the back side of the depth transducer sealed in a vacuum, this ensures that any changes in the temperature of the instrument housing will not affect or counter the forces on the transducers pressure plate. The vented depth sensor allows the back side of the pressure plate to see surface atmospheric pressure, this means that any changes in the barometric pressure will apply equal force to both sides of the pressure plate thus cancelling out the barometric pressure changes.  If you block the vent the air that is sealed in the vent tubing will now be able to expand and contract with temperature which will apply counter forces to the depth sensors pressure plate. There is no way to know how much the expansion and contraction of this trapped air volume will affect the data without doing some pretty extensive testing. Therefore, we can’t say with certainty that these depth data are accurate or how off they are. Please use these data with caution.

In October 2014 the Data Management Committee determined that barometric pressure readings used for producing the depth offset during water quality data sonde calibration should be taken from the same weather station where barometric pressure is used to correct depth/level for the cDepth/cLevel parameters.  This is a requirement for NERRS Reserves (like Lake Superior) where that weather station is located significantly above sea level.  Please be aware that this protocol was not followed in 2012 due to the fact that the meteorological station was not functional at the time.