

Old Woman Creek (OWC) NERR Water Quality Metadata

January – December 2022

Latest Update: 11/25/2024

I. Data Set and Research Descriptors

1. Principal investigator & contact person:

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2. Entry verification:

Deployment data were directly uploaded from a YSI EXO sonde to a personal computer with Windows 7 or newer operating system. The data were graphed and visually checked for any obvious outliers. Notes were made of any unusual data or faulty probes. Files are exported from KOR Software in a comma separated file (CSV) 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. Steven and Jacob are responsible for data QAQC at OWC.

3. Research Objectives:

Measurements are taken every 15 minutes over four- to six-week periods at four sites within Old Woman Creek. Three sites are in the estuary proper: one in the upper reaches at Darrow Road (DR); one near the mouth, south of State Route 6 (Wetland Mouth; WM); and the third upstream from the WM site (Lower Estuary; OL). The final site (Berlin Road; BR) is upstream of the first riffle zone above the estuary in Old Woman Creek proper. The purpose of this monitoring program is to document the role of this Great Lakes' estuary in the Lake Erie ecosystem, particularly the estuary's role in mitigating storm flow that passes through it. The role of the OL site is to document the degree of intrusion by lake water during northerly winds and subsequent seiche events.

4. Research methods:

The 2022 water quality monitoring program began on 01/01/2022 at WM, OL, and DR sites and was suspended at these sites on 01/04/2022 due to the threat of ice. Sampling resumed at these 3 sites on 04/26/2022 and continued until 12/12/2023 when sondes were once again removed due to the threat of ice. At BR, 04/26/2022 was the first deployment date. The sonde remained deployed until 11/21/2022 when it was removed due to threat of ice.

YSI EXO sondes (models 2 & 3) were used at all four sites throughout this period. Sondes at BR, DR, and WM are deployed in 10 cm diameter PVC pipes, the first and last of which is clamped to a 2.4 m long metal post that had been driven into the sediment. The logger trap at site DR is not clamped to a 2.4 m metal post, but rather suspended from the north side of the road bridge by metal chain. Each pipe has 4 vertical slits 2 cm wide drilled into it spanning the area of the probe guard on the sonde to ensure that the probes have direct contact with the surrounding waters. The OL sonde is deployed on a deeply embedded steel pipe with a steel trap that has four vertical slits matching in length and width to the EXO sonde guard slits. Additional field readings for dissolved oxygen, pH, temperature, turbidity, and specific conductance were taken using an EXO sonde when the instruments were changed at each site (see the Other Remarks Section). The sondes were cleaned after two to three weeks of deployment to remove fouling and replaced in the field after a calendar month of deployment not to exceed 45 days. The data were retrieved from each sonde and underwent post deployment parameter checks. Each sonde was recalibrated (according to the directions in the YSI Operations Manual) before being returned to the field. Conductivity, turbidity (2-point calibration using distilled water and a YSI standard), and pH (2 point-calibration) were calibrated using commercial standards. These standards were prepared prior to each deployment. Sonde readings were checked against these standards within 24 hours of retrieval. Sondes at all sites have non-vented depth sensors and optical DO sensors. Calibration logs provide sensor information.

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 Old Woman Creek) where that weather station is located significantly above sea level. Please be aware that this protocol was in place starting March 2015, at the start of the sampling season and has been adhered to in subsequent years. Barometric pressure for sonde depth calibration was taken from the owcowmet weather station until November 2020, and with a Kestrel 4000 (not corrected for altitude) from within the lab starting December 2020 until June 2021 due to intermittent data gaps of the weather station. After June 2021,

barometric pressure for sonde depth calibration was taken from the owcowmet weather station.

A Sutron Sat-Link2 transmitter was installed at site OL during October 2006. This system stopped transmitting data in 2017 and was replaced with a WaterLog Storm 3 datalogger in February 2021, which transmits data to the NOAA Goes satellite NESDIS ID# 3B02849A. WaterLog Storm 3 dataloggers have also been used at sites DR and WM since installation in September 2017. These systems transmit data to the NOAA Goes satellites NESDIS ID# 3B0009A8 and 3B001ADE, respectively. The transmissions are scheduled hourly and contain four (4) data sets reflecting fifteen-minute data sampling intervals. Upon receipt by the CDMO, the data undergo 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>.

5. Site Location and Character:

Old Woman Creek National Estuarine Research Reserve is located on the southern shore of Lake Erie, east of the city of Huron, Ohio (Latitude 41° 23'N; Longitude 82° 33'W). Land use in the Old Woman Creek watershed is primarily row crop agriculture. Other than non-point source pollutants coming into the estuary from these agricultural practices and from the town of Berlin Heights, there are no other major pollution sources in the estuary. Salinity in Old Woman Creek is normally 2 psu or less, although it will rise, on occasion, to nearly 4 psu. The tidal range in Lake Erie (and therefore in the estuary) is 4 cm or less. Water levels in the estuary and in the creek are extremely variable, with changes occurring daily, seasonally, and annually due to changing lake levels, seiches on the lake, storm runoff, and the mouth closing and opening through the year. Changes to the status of the mouth (open versus closed) for 2022 are included in the comments section.

The sonde at the State Route 6 (WM) site (Latitude 41° 22' 57" N, Longitude 82° 30' 53" W; Table 1) is approximately 150 m from the mouth of Old Woman Creek. In this portion of the Reserve, the creek is shallow but extends over a large surface area. This site frequently experiences influx of Lake Erie waters. The bottom sediments at this site are silty clay with some cobble. Some rooted aquatic vegetation is now present directly adjacent to the site, along with both emergent and submerged vegetation within 3 m of the site. Historically, the sonde at this site was 0.18 m above the bottom sediments, until 17 August 2016, when the sonde was repositioned due to high water levels. At that time, the height of the sonde was 0.28 m above the sediment. By 2019, the bottom 0.23–0.28 m of the deployment pipe had filled with mud and the bottom 5 cm of the sonde guard frequently filled with mud during deployments. On October 29, 2019, the deployment pipe was replaced with a setup that keeps the pipe well above the bottom to prevent sediment build-up. Sonde depth after this modification was 0.29 m above the bottom, very close to the deployment depth in the previous housing, based on previous measurements. This places the sensors at 0.37 m above the bottom and the depth sensor at 0.52 m (Note: the distance from the bottom end of the sonde guard to the bottom/face of all sensors except the depth sensor is 0.08 m; the distance from the bottom end of the sonde guard to the depth sensor is 0.23 m). The intake tube for associated diel sampling (via Teledyne 5800 refrigerated autosampler) is clamped to the outside of the sonde tube between 0.23 m (bottom of intake guard) and 0.39 m (top of intake guard) from the bottom.

The sonde at site OL (Latitude 41° 22' 55" N, Longitude 82° 30' 51" W; Table 1) is in the lower reaches of the estuary. This site is not visible from the estuary mouth, so northerly winds and resulting seiche activities should be less noticeable at this site, although they do occur. The bottom sediments are silty clay. This site is located about 5 m north of a *Nelumbo lutea* bed, but no plants were immediately adjacent to the sonde. In March 2009, a new logger site was established 5 m north of the original site due to damage of the original site by a winter storm. In 2010, this temporary site became the new OL site. At this site, the base of the logger was 26 cm above the sediment at the time of installation. This site is telemetered to the GOES satellite. On December 1, 2016, the deployment fencepost and PVC trap were replaced with a steel pipe equipped with a steel trap to achieve a more vertically stable deployment platform. The height of the logger above the sediment was 0.42 m off the bottom. In early 2018, the height of the logger changed because the cable on which the trap was suspended slipped through a clamp, causing the trap to descend to where the depth sensor was 0.23 m above the sediment and the other sensors were 0.02 m above the sediment. The trap was re-set on May 23, 2018 at 10:45 EST to position the depth sensor to 0.45 m above the sediment and the other sensors to 0.32 m above the sediment (note: trap length is 0.73 m from top of trap to the top of the trap bottom, where the sonde guard rests; the distance from the bottom end of the sonde guard to the bottom/face of all sensors except the depth sensor is 0.08 m; the distance from the bottom end of the sonde guard to the depth sensor is 0.23 m).

The sonde at site DR (Latitude 41° 21' 54" N, Longitude 82° 30' 17" W; Table 1) is at the southern boundary of the reserve. The logger trap is suspended from the western most of the two center guard rail supports on the north side of the Darrow Road bridge near the deepest part of the creek channel. At this site, the creek is relatively narrow. Although water direction and flow are influenced at this site by changes in Lake Erie water levels, this site does not have direct contact with Lake Erie waters. The bottom sediments at this site are silty clay. No rooted aquatic vegetation is present near or upstream from this site. The trap was repaired and re-deployed in March 2016 and was 0.45 m above the bottom.

The sonde at site BR (Latitude 41° 20' 56" N, Longitude 82° 30' 44" W; Table 1) is located in the lower portion of the creek proper. Just upstream from the sonde, Berlin Road crosses Old Woman Creek. Site BR is upstream of the first riffle above the estuary. Unlike the other three sites, Lake Erie water levels have no impact on the BR site. The bottom of the creek at this site is a combination of rocks interspersed with some clay-silt that has been washed in from upstream. No aquatic macrophytes are present at or near this site. The logger was 18 cm above the bottom at this site when first installed. During winter 2014, the logger distance above bottom was 14 cm above the stream bottom. During summer 2020, the bottom of the sonde guard was 24 cm above the stream bottom (Note: The distance from the bottom end of the sonde guard to the bottom/face of all sensors except the depth sensor is 0.08 m; the distance from the bottom end of the sonde guard to the depth sensor is 0.23 m).

Table 1: Location of water quality stations that are part of the Old Woman Creek System-Wide Monitoring Program (SWMP). Station Code refers to seven-letter site notation used by the CDMO while Station Name is the short-hand name for each site. The Status of all sites is primary (P). The date that monitoring began at each site and, when applicable, the date that the site was decommissioned are listed. If a site has not been decommissioned, not applicable (NA) has been added to the Reason Decommissioned column.

Station Code	SWMP Status	Station Name	Location	Active Dates	Reason Decommissioned	Notes
owcbrwq	P	Berlin Road	Latitude 41° 20' 56" N, Longitude 82° 30' 44" W	03/01/2002 00:00 – current	NA	NA
owcdrwq	P	Darrow Road	Latitude 41° 21' 54" N, Longitude 82° 30' 17" W	08/01/2007 00:00 – current	NA	NA
owcolwq	P	Lower Estuary	Latitude 41° 22' 55" N, Longitude 82° 30' 51" W	04/01/2002 00:00 – current	NA	NA
owcwmwq	P	Route 6	Latitude 41° 22' 57" N, Longitude 82° 30' 53" W	05/01/1995 00:00 – current	NA	NA
owcsuwq	P	Route 2	Latitude 41° 22' 02" N, Longitude 82° 30' 26" W	05/01/1995 00:00 – 08/23/2007 13:15	Bridge repair; could not access site	NA

6. Data collection periods:

Sondes were initially deployed at the beginning of the year at WM, OL, and DR, but were retrieved before freezing conditions were expected. Sondes were redeployed at all sites when freezing conditions were no longer forecasted and left in the estuary through the end of November (BR) or the middle of December (WM, OL, DR; Table 2). Sampling at BR began on 04/26/2022 at 8:00 EST, and data were last downloaded through 11/21/2022 at 14:00 EST. Sampling at DR began on 01/01/2022 at 00:00 EST, was suspended on 01/04/2022 at 13:15 EST, and resumed on 04/26/2022 at 08:30 EST; data were last downloaded through 12/12/2022 at 10:00 EST. Sampling at OL began on 01/01/2022 at 00:00 EST, was suspended on 01/04/2022 at 13:45 EST, and resumed on 04/26/2022 at 09:15 EST; data were last downloaded through 12/12/2022 at 11:00 EST. Sampling at WM began on 01/01/2022 at 00:00 EST, was suspended on 01/04/2022 at 14:00 EST, and resumed on 04/26/2022 at 10:00 EST; data were last downloaded through 12/12/2022 at 11:30 EST.

Table 2: Deployment information for sondes used in 2022 water quality monitoring of Old Woman Creek. Sites are the four monitoring stations Berlin Road (BR), Darrow Road (DR), Lower Estuary (OL), and Wetland Mouth (WM). Deploy Date and Deploy Time indicate when sondes were first set out in the estuary and began recording data. Retrieval Date and Retrieval Time are the last times that data was recorded at each site. Sonde Model and Nickname reflect the type and individual identification for each of the sondes used in 2022 monitoring.

Site	Deploy Date	Deploy Time	Retrieval Date	Retrieval Time	Sonde Model (Nickname)
BR	04/26/2022	08:00	06/01/2022	12:00	EXO 3 (BR11)
BR	06/01/2022	12:15	07/06/2022	08:45	EXO 3 (BR12)
BR	07/06/2022	09:00	07/26/2022	07:30	EXO 3 (BR11)
BR	07/26/2022	07:45	09/07/2022	09:45	EXO 3 (BR12)

BR	09/07/2022	10:00	10/04/2022	07:45	EXO 3 (BR11)
BR	10/04/2022	08:00	11/08/2022	09:30	EXO 3 (BR12)
BR	11/08/2022	09:45	11/21/2022	14:00	EXO3 (BR11)
DR	12/07/2021	10:15	01/04/2022	13:15	EXO 3 (OL12)
DR	04/26/2022	08:30	06/01/2022	12:30	EXO 3(OL11)
DR	06/01/2022	12:45	07/06/2022	9:15	EXO 3 (OL12)
DR	07/06/2022	09:30	07/26/2022	08:00	EXO 3(OL11)
DR	07/26/2022	08:15	09/07/2022	10:15	EXO 3 (OL12)
DR	09/07/2022	10:30	10/04/2022	08:15	EXO 3(OL11)
DR	10/04/2022	08:30	11/08/2022	10:00	EXO 3 (OL12)
DR	11/08/2022	10:15	12/12/2022	10:00	EXO 3(OL11)
OL	12/07/2021	10:45	01/04/2022	13:45	EXO 2 (Nelumbo)
OL	04/26/2022	09:15	06/01/2022	10:45	EXO 2 (Lepomis)
OL	06/01/2022	11:00	07/06/2022	07:30	EXO 2 (Nelumbo)
OL	07/06/2022	08:00	07/26/2022	08:45	EXO 2 (Lepomis)
OL	07/26/2022	09:00	09/07/2022	08:45	EXO 2 (Nelumbo)
OL	09/07/2022	09:15	10/04/2022	10:00	EXO 2 (Lepomis)
OL	10/04/2022	10:15	11/08/2022	10:45	EXO 2 (Nelumbo)
OL	11/08/2022	11:00	12/12/2022	11:00	EXO 2 (Lepomis)
WM	12/07/2021	11:00	01/04/2022	14:00	EXO 2 (WM2)
WM	04/26/2022	10:00	06/01/2022	11:00	EXO 2 (WM1)
WM	06/01/2022	11:15	07/06/2022	08:00	EXO 2 (WM2)
WM	07/06/2022	08:15	07/26/2022	09:00	EXO 2 (WM1)
WM	07/26/2022	09:15	09/07/2022	09:00	EXO 2 (WM2)
WM	09/07/2022	09:15	10/04/2022	10:15	EXO 2 (WM1)
WM	10/04/2022	10:30	11/08/2022	11:15	EXO 2 (WM2)
WM	11/08/2022	11:30	12/12/2022	11:30	EXO 2 (WM1)

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 processed 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:

NOAA National Estuarine Research Reserve System (NERRS). System-wide Monitoring Program. Data accessed from the NOAA NERRS Centralized Data Management Office website: <http://www.nerrsdata.org/>; accessed 12 October 2022.

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. Data are available in comma delimited format.

8. Associated projects:

Two Nile microwave water level sensors are located in Old Woman Creek. One is 34 m northeast of the WM site while the other is 4 m west of the DR site. These water level sensors provide accurate water level data at the southern and northern bounds of the estuary. Water level data are transmitted to each site's respective GOES satellite simultaneously with the sonde data. In addition, a Sontek Acoustic Doppler Current Profiler (ADCP) has been installed to allow for measurement of water velocity at the Route 6 bridge constriction point of the estuary, 27 m northeast of the WM site.

As part of the System-Wide Monitoring Program, Old Woman Creek National Estuarine Research Reserve also collects 15-minute meteorological data and monthly grab and diel samples for nutrient/pigment data which may be correlated with this water quality dataset. Meteorological data has been collected since 2002 at the owcowmet (OW) station, located 60 m east of the OWC visitor center. Beginning 11/18/2022, a secondary meteorological station, owcwrmet (WR) was installed on the Western Reserve Local Schools District Campus, 1.5 km east of the southernmost extent of the Old Woman Creek watershed boundary. All meteorological and nutrient/pigment data are available at [/www.nerrsdata.org](http://www.nerrsdata.org).

II. Physical Structure and Descriptors:

9. Sensor specifications:

The Old Woman Creek National Estuarine Research Reserve deployed eight EXO sondes (YSI Inc., Yellow Springs, OH) through December 2022. A ninth EXO1 sonde was used to collect simultaneous field measurements when sondes were exchanged. EXO3 sondes were deployed at BR and DR sites, while EXO2 sondes were deployed at OL and WM sites.

YSI EXO datalogger

Parameter: Temperature

Units: Celsius (°C)

Sensor Type: CT2 Probe, Thermistor

Model #: 599870 (owcbrwq, owcwmwq)

Range: -5 to 50 °C

Accuracy: -5 to 35 °C: ± 0.01 °C; 35 to 50 °C: ± 0.05 °C

Resolution: 0.01 °C

Model #: 599827 (owcdrwq, owcolwq)

Range: -5 to 50 °C

Accuracy: ± 0.2 °C

Resolution: 0.001 °C

Parameter: Conductivity

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

Sensor Type: CT2 probe, 4-electrode cell with auto-ranging

Model #: 599870 (owcbrwq, owcwmwq)

Range: 0 to 200 mS/cm

Accuracy: 0 to 100 mS/cm: $\pm 0.5\%$ of reading or + 0.001 mS/cm, whichever is greater; 100 to 200 mS/cm: $\pm 1\%$ of reading

Resolution: 0.001 mS/cm to 0.01 mS/cm (range dependent)

Model #: 599827 (owcdrwq, owcolwq)

Range: 0 to 100 mS/cm

Accuracy: $\pm 1\%$ of reading or + 0.002 mS/cm, whichever is greater

Resolution: 0.0001 mS/cm to 0.01 mS/cm (range dependent)

Parameter: Specific Conductance

Units: mS/cm

Sensor Type: CT2 probe; Calculated from conductivity and temperature

Model #: 599870 (owcbrwq, owcwmwq)

Range: 0 to 200 mS/cm

Accuracy: $\pm 0.5\%$ of reading or 0.001 mS/cm, whichever is greatest

Resolution: 0.001, 0.01, 0.1 mS/cm (auto-scaling)

Model #: 599827 (owcdrwq, owcolwq)

Range: 0 to 100 mS/cm

Accuracy: $\pm 1\%$ of reading or + 0.002 mS/cm, whichever is greater

Resolution: 0.0001 mS/cm to 0.01 mS/cm (range dependent)

Parameter: Salinity

Units: practical salinity units (psu)

Sensor Type: 599870 probe (owcbrwq, owcwmwq); Calculated from conductivity and temperature

Range: 0 to 70 psu

Accuracy: $\pm 1\%$ of reading or 0.1 psu, whichever is greater

Resolution: 0.01 psu

Sensor Type: 599827 (owcdrwq, owcolwq)

Range: 0 to 70 psu

Accuracy: $\pm 2\%$ of reading or 0.2 psu, whichever is greater

Resolution: 0.01 psu

Parameter: Dissolved Oxygen % saturation

Units: percent air saturation (%)

Sensor Type: Optical probe w/ mechanical cleaning

Model #: 599100-01 (owcbrwq, owcolwq, owcwmwq, owcdrwq)

Range: 0 to 500% air saturation

Accuracy: 0 to 200% air saturation- $\pm 1\%$ of the reading or 1% air saturation, whichever is greater; 200 to 500% air saturation- $\pm 5\%$ of the reading

Resolution: 0.1% air saturation

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

Units: milligrams per Liter (mg/L)

Sensor Type: Optical probe w/ mechanical cleaning

Model #: 599100-01 (owcbrwq, owcolwq, owcwmwq, owcdrwq)

Range: 0 to 50 mg/L

Accuracy: 0 to 20 mg/L- $\pm 1\%$ of the reading or 0.1 mg/L, whichever is greater; 20 to 50 mg/L- $\pm 5\%$ 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 33 ft (10 m)

Accuracy: ± 0.013 ft (0.004 m)

Resolution: 0.001 ft (0.001 m)

Parameter: pH

Units: pH units

Sensor Type: Glass combination electrode

Model #: 599702 (wiped; owcbrwq, owcolwq, owcwmwq, owcdrwq)

Range: 0 to 14 units

Accuracy: ± 0.1 pH units within ± 10 °C of calibration temp; ± 0.2 pH units for entire temp range

Resolution: 0.01 units

Parameter: Turbidity

Units: formazin nephelometric units (FNU)

Sensor Type: Optical, 90 degree scatter

Model #: 599101-01 (owcbrwq, owcolwq, owcwmwq, owcdrwq)

Range: 0 to 4000 FNU

Accuracy: 0 to 999 FNU: 0.3 FNU or $\pm 2\%$ of reading (whichever is greater); 1000 to 4000 FNU: $\pm 15\%$ of reading

Resolution: 0 to 999 FNU: 0.01 FNU; 1000 to 4000 FNU: 0.1 FNU

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 1.02 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.

NOTE: older Depth data cannot be corrected without verifying that the depth offset was in place and whether a vented or non-vented depth sensor was in use. No SWMP data prior to 2006 can be corrected using this method. The following equation is used for corrected Depth/Level data provided by the CDMO beginning in 2010:

$$((1013-BP)*0.0102)+\text{Depth/Level} = \text{cDepth/cLevel}.$$

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:
State Route 6	WM	owcwmwq
Lower Estuary	OL	owcolwq
Darrow Road	DR	owcdrwq
Berlin Road	BR	owcbrwq

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 different code categories including general, sensor, and comment. General errors document general problems with the deployment or YSI sonde, 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 QAQC checks
GSM	See metadata

Corrected Depth / Level Data Codes

GCC	Calculated with data that were corrected during QAQC
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
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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:

End of Deployment Readings in Standard Solutions

Post deployment information for each sonde is recorded to determine whether sensor drift occurs while the sonde is in the estuary (Table 3). When the sonde is brought back to the lab, it is placed in a bucket of aerated water (i.e. an oxygen saturated environment) for 30 minutes to verify that the dissolved oxygen sensor has not drifted. Specific conductance is checked against a 1.413 mS/cm standard post-deployment. A 2-point calibration is used for pH with 7.00 and 10.00 standards, both of which are corrected for temperature, and both of which are used to verify the pH sensor has not drifted post deployment. Turbidity is also calibrated with a 2-point calibration and is checked against both post deployment. The low turbidity standard is a 0.00 NTU deionized water blank while the high standard is 124.00 NTU. All sondes are unvented. Therefore, the expected depth reading is corrected for changes in barometric pressure.

Table 3: Post-deployment information for each sonde. The location of each Site is Berlin Road (BR), Darrow Road (DR), Lower Estuary (OL) or Wetland Mouth (WM). Deploy Date is the beginning date when sondes were first set out in the estuary. Post-deployment values for specific conductance (Sp. Cond.), pH, and turbidity are listed above the standard value for each parameter which is listed in parentheses. For depth, the top value is the post-deployment value while the bottom value in parentheses is the expected depth offset reading corrected for changes in barometric pressure. Standards for pH were corrected for temperature, and both pH and turbidity are checked against a high and low standard post-deployment because both were originally calibrated using a 2-point calibration. Post deployment dissolved oxygen is checked by placing the sonde in an aerated bucket of water and recording two readings.

Site	Deploy Date	Sp. Cond. (mS/cm)	Dissolved Oxygen 1 (%)	Dissolved Oxygen 2 (%)	pH 7	pH 10	Low Turbidity Standard (NTU)	High Turbidity Standard (NTU)	Depth (m)
BR	04/26/2022	1.418 (1.413)	93.3	93.6	7.13 (7.01)	10.05 (10.03)	0.90 (0.00)	122.60 (124.00)	-0.086 (-0.012)
BR	06/01/2022	1.385 (1.413)	96.6	96.7	7.02 (7.01)	10.02 (10.03)	0.65 (0.00)	120.94 (124.00)	0.020 (0.008)
BR	07/06/2022	1.428 (1.413)	94.5	95.1	7.14 (7.01)	10.14 (10.03)	0.26 (0.00)	120.56 (124.00)	0.035 (0.038)
BR	07/26/2022	1.430 (1.413)	98.0	96.9	7.06 (7.01)	10.05 (10.03)	0.98 (0.00)	120.60 (124.00)	0.048 (0.058)
BR	09/07/2022	1.463 (1.413)	99.2	99.2	7.13 (7.01)	10.12 (10.03)	1.53 (0.00)	124.62 (124.00)	0.090 (0.099)
BR	10/04/2022	1.394 (1.413)	97.9	97.9	7.07 (7.01)	9.84 (10.03)	-0.04 (0.00)	121.07 (124.00)	0.230 (0.263)
BR	11/08/2022	1.399 (1.413)	101.9	102.1	6.99 (7.01)	10.21 (10.03)	0.09 (0.00)	120.67 (124.00)	0.039 (0.058)
DR	12/07/2021	1.417 (1.413)	99.9	100.0	7.03 (7.01)	9.99 (10.03)	0.73 (0.00)	122.93 (124.00)	0.016 (0.069)
DR	04/26/2022	1.422 (1.413)	96.9	96.1	7.12 (7.01)	10.10 (10.03)	1.56 (0.00)	127.58 (124.00)	-0.085 (-0.012)
DR	06/01/2022	1.435 (1.413)	92.9	91.4	6.45 (7.01)	10.15 (10.03)	0.18 (0.00)	119.58 (124.00)	0.027 (0.008)
DR	07/06/2022	1.430 (1.413)	96.4	96.4	7.03 (7.01)	10.06 (10.03)	0.02 (0.00)	120.19 (124.00)	0.006 (0.038)
DR	07/26/2022	1.417 (1.413)	95.1	94.7	7.01 (7.01)	10.05 (10.03)	1.21 (0.00)	121.10 (124.00)	0.027 (0.058)
DR	09/07/2022	1.448 (1.413)	98.8	99.0	7.13 (7.01)	10.05 (10.03)	-0.33 (0.00)	121.20 (124.00)	0.080 (0.099)
DR	10/04/2022	1.447	97.4	97.2	6.98	9.78	0.41	126.64	0.226

		(1.413)			(7.01)	(10.03)	(0.00)	(124.00)	(0.263)
DR	11/08/2022	1.427 (1.413)	97.5	97.6	7.04 (7.01)	10.07 (10.03)	0.04 (0.00)	124.47 (124.00)	0.113 (0.130)
OL	12/07/2021	1.387 (1.413)	99.9	99.9	7.19 (7.01)	10.13 (10.03)	1.52 (0.00)	123.83 (124.00)	-0.002 (0.069)
OL	04/26/2022	1.384 (1.413)	95.2	93.1	7.07 (7.01)	9.98 (10.03)	0.01 (0.00)	124.32 (124.00)	-0.069 (-0.012)
OL	06/01/2022	1.392 (1.413)	95.2	94.9	7.09 (7.01)	10.06 (10.03)	0.01 (0.00)	125.53 (124.00)	0.023 (0.008)
OL	07/06/2022	1.431 (1.413)	95.5	95.5	7.03 (7.01)	10.07 (10.03)	0.03 (0.00)	120.90 (124.00)	0.008 (0.038)
OL	07/26/2022	1.392 (1.413)	91.8	92.8	7.02 (7.01)	10.00 (10.03)	1.54 (0.00)	124.26 (124.00)	0.017 (0.058)
OL	09/07/2022	1.464 (1.413)	99.4	99.1	6.96 (7.01)	9.94 (10.03)	0.78 (0.00)	119.04 (124.00)	0.061 (0.099)
OL	10/04/2022	1.439 (1.413)	98.8	98.3	6.99 (7.01)	9.82 (10.03)	-0.06 (0.00)	122.50 (124.00)	0.216 (0.263)
OL	11/08/2022	1.414 (1.413)	99.2	99.2	6.93 (7.01)	9.96 (10.03)	0.01 (0.00)	123.28 (124.00)	0.095 (0.130)
WM	12/07/2021	1.413 (1.413)	100.1	100.3	7.01 (7.01)	10.05 (10.03)	0.41 (0.00)	122.99 (124.00)	0.000 (0.069)
WM	04/26/2022	1.393 (1.413)	92.1	92.4	7.50 (7.01)	10.36 (10.03)	8.30 (0.00)	143.99 (124.00)	-0.093 (-0.012)
WM	06/01/2022	1.367 (1.413)	97.6	97.3	7.27 (7.01)	10.14 (10.03)	1.70 (0.00)	132.00 (124.00)	0.220 (0.008)
WM	07/06/2022	1.327 (1.413)	97.7	97.5	7.31 (7.01)	10.31 (10.03)	0.60 (0.00)	122.11 (124.00)	0.060 (0.038)
WM	07/26/2022	1.223 (1.413)	95.4	95.3	7.17 (7.01)	10.05 (10.03)	1.21 (0.00)	123.59 (124.00)	-0.001 (0.058)
WM	09/07/2022	1.366 (1.413)	100.5	100.6	7.01 (7.01)	9.99 (10.03)	0.21 (0.00)	123.59 (124.00)	0.077 (0.099)
WM	10/04/2022	1.292 (1.413)	98.0	98.3	7.08 (7.01)	9.98 (10.03)	0.09 (0.00)	119.20 (124.00)	0.220 (0.263)
WM	11/08/2022	1.382 (1.413)	100.2	100.3	7.02 (7.01)	10.03 (10.03)	0.27 (0.00)	124.21 (124.00)	0.107 (0.130)

14. Other Remarks:

All times are Eastern Standard Time (EST; UTC-4). In some instances, 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.

QAQC Flagging notes

Barrier Beach Status and Water Exchange

The water quality of the OL and WM sites at OWC are influenced by whether the barrier beach is breached/open (i.e., surface water exchange is occurring between the estuary and the lake). When the barrier is open, wind-driven surface water exchange usually results in cycles of water inflow from the lake and outflow to the lake that can be detected in water quality data. The change from closed to open can be rapid and dramatic, usually because of precipitation. Sometimes, this can be followed by seiche events, depending on winds during the storm. The transition from open to closed is gradual and usually marked by a gradual increase in water depth and specific conductivity. The opening of the mouth (and sometimes closing) is indicated in the “F_Record” column as “CSM” (see metadata). Mouth status data through December 2022 are below:

Status	Date From	Date To
Open	01/01/2021	03/26/2022
Closed	03/27/2022	04/01/2022
Open	04/02/2022	04/21/2022
Closed	04/22/2022	05/04/2022
Open	05/05/2022	05/11/2022
Closed	05/12/2022	05/16/2022
Open	05/17/2022	05/20/2022
Closed	05/21/2022	05/21/2022
Open	05/22/2022	05/22/2022
Closed	05/23/2022	06/01/2022
Open	06/02/2022	06/12/2022
Closed	06/13/2022	06/17/2022
Open	06/18/2022	06/18/2022
Closed	06/19/2022	07/25/2022
Open	07/26/2022	08/14/2022
Closed	08/15/2022	12/31/2022

Rain and weather events

For rain events that affect water quality parameters, the “F_Record” column is flagged for the entire day(s) that parameters are affected. This is not necessarily when precipitation occurs. For example, rainfall in the watershed is frequently heavier further south of the Old Woman Creek NERRS OW meteorological station. Occasionally, no rain is observed at the OW meteorological station but is observed at the WR weather station. Volunteer rain gauge observers also report precipitation throughout the watershed and region through the [CoCoRaHS website](#). A southernly storm can cause a delay between when parameters are affected at the southern BR site and at the northern WM site. In these instances, a storm

event may be flagged a day later for WM than BR.

Weather events include periods of high wind, which can result in the inflow of water from Lake Erie into the estuary (e.g., true seiche, wind-induced water exchange, waves overtopping the barrier beach into the estuary) or outflow of water from the estuary (e.g., large decrease in water level not associated with a breach of the barrier beach). Lake water inflow events are usually evident at the OL and WM sites and can be most easily detected by plotting both specific conductivity and water depth. The intrusion of lake water into the estuary both increases depth and decreases conductivity. Other parameters may or may not change. These are labeled as a weather event in the “F_Record” column for the duration of the event, in 24-hour periods (i.e., full days are flagged because of difficulty in identifying the exact start and end times of seiche events). Impacted parameter “F_” column(s) may also be flagged, as deemed useful (e.g., if a seiche coincides with retrieval and deployment of sondes, causing the data to look like the retrieved and deployed sondes were not reading similar values). Notable seiche events through December 2022 occurred on 06/03-04 and 06/17-18.

Turbidity

During rain events, there may be several high values that exceed a reasonable range of other values and these are flagged <-3>(STS)(CRE).

Site specific events:

Berlin Road (BR)

During the summer months, dry conditions typically result in low flow at the BR site in which water level falls below the depth sensor and some or all the other sensors. For periods where some but not all sensors are out of water, <-3>(SOW) may be used in conjunction with <1>(CSM) for sensors believed to still be submerged. Periods containing <-3>(GOW) signify that all sensors were out of water.

Sonde field maintenance on 07/20/2022 at 12:15 caused all parameters to be rejected. This timestamp is flagged <-3>[GMC](CSM).

Darrow Road (DR)

Large storm events can cause the sonde to swing up or to swing up and down, alternately, due to high flows. As a result, shallower depths or more variable depths are recorded and flagged as <1>[GSM](CWD) with the F_Record containing the {CRE} code. All other parameters are flagged <0>[GSM](CWD). This may have occurred during the following rain events in 2022, as the result of heavy rain and flow: 05/06/2022 at 12:30 through 05/07/2022 at 02:30, and 05/21/2022 at 23:45 through 05/22/2022 at 05:30.

On occasion, the chain on which the sonde tube is suspended was not fully extended after the monthly infield maintenance or deployment. In these instances, depth was flagged <1>[GSM](CWD) while all other parameters were flagged <0>[GSM](CWD). This occurred between 08:30 and 11:15 on 04/26/2022 and from 07/20/2022 at 12:45 to 07/26/2022 at 8:00.

Lower Estuary (OL)

The sonde was not fully descended in its deployment pipe on 07/06/2022 at 07:45 after deployment. The depth column was flagged <1>[GSM](CWD) and all other parameters were flagged <0>[GSM](CWD) for this timestamp.

A delay in sonde deployment on 09/07/2022 at 9:00, caused all parameters to be rejected. This timestamp is flagged <-2>[GMC].

Wetland Mouth (WM):

Sonde field maintenance on 06/16/2022 at 09:45 caused all parameters to be rejected. This timestamp is flagged <-3>[GSM](CMC).

Turbidity values were abnormally high from 05/06/2022 at 0:00 to 06/01/2022 at 11:00 when sondes were swapped. When infield maintenance occurred during this time on 05/11/2022 at 16:00, it was noted that there was a large amount of mud in the probe guard; therefore, turbidity was flagged <1>[GSM](CMD) from 00:00 on 05/06/2022 to 11:00 on 06/01/2022. Several high values that exceeded a reasonable range of other values during this time period were also flagged <-3>(STS)(CMD).

Field verification

Field data collected at time of sonde retrieval and deployment are reported (Table 4). Data were collected using a field sonde (EXO1) that was deployed simultaneous to the retrieved and newly deployed sondes.

Table 4: Water quality parameters for the field sonde deployed during each sonde swap. Site is the System-Wide Monitoring Program site, including Berlin Road (BR), Darrow Road (DR), Lower Estuary (OL), and Wetland Mouth (WM). Temperature (Temp), specific conductance (SpCond), salinity (Sal), pH, turbidity (Turbid), dissolved oxygen percent saturation (ODOsat), dissolved oxygen concentration (ODO), and depth were all recorded by the field sonde and are reported for the Date and Time the Sonde was deployed into and retrieved from the water.

Site	Sonde	Date (m/d/y)	Time (hh:mm)	Depth (meters)	ODOsat (%)	ODO (mg/L)	Sal (ppt)	SpCond (mS/cm)	Turbid (NTU)	pH	Water Temp (°C)
BR	deployed	4/26/2022	8:01	0.432	90.8	9.75	0.29	0.588	6.51		12.083
BR	retrieved	6/1/2022	13:05	0.169	87.0	7.58	0.29	0.602	8.96	7.79	22.149
BR	deployed	6/1/2022	12:16	0.152	86.0	7.49	0.29	0.601	9.69	7.73	22.136
BR	retrieved	7/6/2022	8:51	0.030	86.6	7.55	0.25	0.520	201.59	7.47	22.070
BR	deployed	7/6/2022	9:01	0.029	87.1	7.59	0.25	0.513	187.32	7.51	22.086
BR	retrieved	7/26/2022	7:36	0.096	86.7	7.77	0.15	0.323	47.09	7.55	20.677
BR	deployed	7/26/2022	7:46	0.094	86.6	7.76	0.15	0.324	46.50	7.55	20.662
BR	retrieved	09/07/2022	9:52	0.060	77.7	7.12	0.28	0.574	17.44	7.56	19.585
BR	deployed	09/07/2022	10:01	0.060	71.4	6.54	0.28	0.575	10.36	7.51	19.584
BR	retrieved	10/04/2022	7:44	0.138	72.9	7.99	0.28	0.573	4.41	7.52	11.169
BR	deployed	10/04/2022	8:01	0.136	72.4	7.94	0.28	0.573	4.47	7.51	11.163
BR	retrieved	11/08/2022	9:29	0.244	30.0	3.40	0.37	0.749	3.93	7.41	9.786
BR	deployed	11/08/2022	9:46	0.246	27.3	3.09	0.37	0.748	3.58	7.41	9.808
BR	retrieved	11/21/2022	13:59	0.100	83.3	11.68	0.40	0.816	2.50	7.45	1.406
DR	retrieved	1/4/2022	13:14	1.162	94.5	13.38	0.27	0.559	25.85	7.59	1.115
DR	deployed	4/26/2022	8:33	0.554	72.6	7.36	0.30	0.617	18.53	9.39	14.680
DR	retrieved	6/1/2022	12:31	1.132	49.6	4.56	0.31	0.637	12.49	7.43	19.353
DR	deployed	6/1/2022	12:46	1.142	50.9	4.68	0.31	0.643	13.01	7.51	19.435
DR	retrieved	7/6/2022	9:15	1.209	51.0	4.35	0.31	0.641	35.42	7.44	23.265
DR	deployed	7/6/2022	9:31	1.244	61.9	5.25	0.31	0.642	28.61	7.54	23.489
DR	retrieved	7/26/2022	8:02	0.621	64.0	5.52	0.11	0.231	105.67	7.23	22.691
DR	deployed	7/26/2022	8:16	0.629	63.3	5.46	0.11	0.232	107.49	7.24	22.692
DR	retrieved	09/07/2022	10:21	1.268	27.8	2.47	0.20	0.410	26.75	7.15	21.056
DR	deployed	09/07/2022	10:37	1.271	23.3	2.07	0.20	0.410	24.66	7.13	21.075
DR	retrieved	10/04/2022	8:14	0.460	53.5	5.60	0.29	0.602	15.68	7.30	13.218

DR	deployed	10/04/2022	8:32	0.470	51.4	5.37	0.29	0.603	16.60	7.32	13.330
DR	retrieved	11/8/2022	9:59	0.680	29.4	3.22	0.28	0.578	7.81	7.22	11.176
DR	deployed	11/8/2022	10:16	0.687	30.1	3.30	0.28	0.576	7.29	7.20	11.101
DR	retrieved	12/12/2022	10:01	0.390	72.3	9.22	0.36	0.740	5.19	7.55	4.951
OL	retrieved	1/4/2022	13:45	0.702	96.5	13.28	0.18	0.382	49.37	7.69	2.147
OL	deployed	4/26/2022	9:16	1.103	81.0	7.87	0.24	0.503	50.02	-3.49	16.681
OL	retrieved	6/1/2022	10:44	1.029	58.2	4.76	0.23	0.479	18.3	7.54	25.422
OL	deployed	6/1/2022	11:01	1.077	4.46	4.46	0.23	0.480	17.79	7.46	25.347
OL	retrieved	7/6/2022	7:39	0.502	37.8	3.05	0.24	0.494	37.34	7.22	26.293
OL	deployed	7/6/2022	7:47	0.528	33.0	2.66	0.24	0.494	41.08	7.22	26.278
OL	retrieved	7/26/2022	8:47	1.732	30.3	2.48	0.23	0.488	178.45	7.15	25.401
OL	deployed	7/26/2022	9:01	0.477	34.4	2.81	0.23	0.489	27.11	7.15	25.459
OL	retrieved	09/07/2022	8:51	1.205	29.9	2.59	0.20	0.415	126.24	7.11	22.345
OL	deployed	09/07/2022	9:01	1.183	22.1	1.92	0.20	0.414	75.61	7.05	22.359
OL	retrieved	10/04/2022	10:00	0.536	109.4	11.34	0.20	0.420	16.50	8.07	13.681
OL	deployed	10/04/2022	10:16	0.548	107.4	11.13	0.20	0.420	16.94	8.07	13.678
OL	retrieved	11/8/2022	10:44	0.621	68.8	7.28	0.24	0.496	21.70	7.5	12.746
OL	deployed	11/8/2022	11:01	0.648	73.2	7.75	0.24	0.497	20.34	7.51	12.733
OL	retrieved	12/12/2022	11:01	0.761	92.4	11.73	0.26	0.539	16.41	7.81	5.180
WM	retrieved	1/4/2022	3:59	0.870	97.8	13.33	0.18	0.368	55.18	7.66	2.513
WM	deployed	4/26/2022	10:01	0.351	77.9	7.51	0.24	0.499	40.34		17.077
WM	retrieved	6/1/2022	11:06	1.218	46.8	3.85	0.23	0.485	19.16	7.39	25.112
WM	deployed	6/1/2022	11:16	1.326	30.6	2.55	0.24	0.493	38.94	7.19	24.450
WM	retrieved	7/6/2022	8:00	0.512	34.1	2.74	0.24	0.496	36.49	7.22	26.362
WM	deployed	7/6/2022	8:15	0.541	37.9	3.05	0.24	0.496	31.37	7.28	26.365
WM	retrieved	7/26/2022	9:04	0.26	37.6	3.07	0.24	0.49	18.61	7.16	25.659
WM	deployed	7/26/2022	9:15	0.975	25.0	2.04	0.24	0.491	18.45	7.15	25.527
WM	retrieved	09/07/2022	9:06	0.556	34.4	2.99	0.20	0.421	22.14	7.05	22.321
WM	deployed	09/07/2022	9:16	0.521	31.2	2.72	0.20	0.417	14.17	7.09	22.245
WM	retrieved	10/04/2022	10:21	0.551	96.6	10.02	0.20	0.417	18.12	7.97	13.637
WM	deployed	10/04/2022	10:31	0.554	94.3	9.78	0.20	0.417	19.42	7.96	13.628
WM	retrieved	11/8/2022	11:14	0.566	63.7	6.76	0.24	0.497	20.06	7.42	12.642
WM	deployed	11/8/2022	11:31	0.564	67.3	7.13	0.24	0.497	18.86	7.46	12.693

WM	retrieved	12/12/2022	11:29	0.855	90.4	11.52	0.26	0.532	12.82	7.77	5.021
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