Old Woman Creek (OWC) **NERR Water Quality Metadata**
January – December, 2024
Latest Update: 14 April 2025

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@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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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.

3) Research objectives –

Measurements are taken every 15 minutes over four- to six-week periods at five sites within Old Woman Creek. Four sites are in the estuary proper: one in the upper reaches at Darrow Road (DR); one at the point where Old Woman Creek opens up to a wetland (RR); one near the mouth, south of State Route 6 (Wetland Mouth; WM); and the fourth 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 sondes at sites DR, RR, OL, and WM were deployed between 01/01/2024 and 01/02/2024 as part of the previous year's deployment, before being pulled for the winter due to threat of ice, but the 2024 water quality monitoring program began on 03/05/2024 at all sites and continued through the current reporting period. YSI EXO sondes (models 2 & 3) measured each water quality parameter at 15 minute intervals at all five sites throughout this period. Specific conductivity is calibrated to a single 1.413 mS/cm YSI 3160 standard. A one-point calibration is also performed on dissolved oxygen using a bucket of water that had 100% saturation from an airstone running for at least 60 minutes. Depth is calibrated in a humid calibration cup after programing a depth offset into the sonde based on recent barometric pressure from the owcowmet station. A two-point calibration is performed on pH, which uses 7.00 and 10.00 buffered standards (7.01 and 10.03, respectively, when corrected for room temperature) from Fisher Scientific, and on turbidity, which uses 0.00 FNU deionized water for the first calibration point, and 124.00 FNU YSI 6073G standard as the second. Water temperature is not regularly calibrated, but is verified with a NIST traceable thermometer before and after deployment for all sondes. Every 30–45 days, each sonde is replaced with a clean, freshly calibrated sonde. Once during most deployments, especially between June and October when biofouling is greatest, each sonde is inspected and cleaned in the field to ensure robust data collection throughout the deployment.

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 sonde trap at site DR is not clamped to a 2.4 m metal post, but is instead 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 sonde trap at site RR is an aluminum tube with 2.5 cm diameter holes drilled around the bottom 30 cm of the tube to ensure proper water flow around the sonde sensors. The tube is bolted onto the upstream, eastern abutment of an overpassing railroad bridge, extending into the water at a vertical, fixed position. The distance from the tube to the abutment is 10 cm. 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 exceeding 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 began in 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.

Old Woman Creek began reporting *in situ* chlorophyll-*a* at site OL in 2024 using the TAL sensor offered by YSI. Before deployment, a two-point calibration is completed for both the μg/L and RFU channels, with each channel receiving its own calibration. The two the calibration points for each channel are 0 μg/L (deionized water) and 62.5 μg/L (rhodamine WT dye). Temperature and fluorescence are inversely related, so the high standard is corrected for temperature and ranges from 14.0–20.8 RFU and 56.5–83.3 μg/L for temperatures

between 8–30 ºC. Current QA/QC of the chlorophyll-*a* fluorescence parameter includes flagging erroneous, isolated spike values that are substantially higher or lower than the values immediately before and immediately after the spike as -3, CSM, small negative values (0 to -1) with 1, CAF and negative values (<-1) -3, 1 SIC. We do not calibrate the chlorophyll-*a* sensor using a known concentration of phytoplankton from fluorometric analysis or adjust the data with this correction, as suggested by YSI. Water temperature, turbidity, fluorescence from dissolved organic matter, and phytoplankton community composition are known to interfere *in situ* chlorophyll-*a* fluorescence readings. In 2022, Old Woman Creek participated in a NERR study comparing extracted chlorophyll-*a*, measured in the lab, with *in situ* chlorophyll-*a* measured with the TAL sensor. The results from this study, including information on correcting for the aforementioned interferences, can be found in the report resulting from this study (Dix et al. 2022).

Dix, N., H. Ramage, J. Cianci-Gaskill, S. Dunnigan, J.S. Tanner, K. Cressman, S. McMurray, Y. Rii, R. Guy, R. Jeppesen, E. Smith. 2022. Recommendations for the National Estuarine Research Reserve System-Wide Monitoring Program regarding the YSI EXO Total Algae sensor. Technical Report: 35 pp.

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 and at site RR since installation in 2023. These systems transmit data to the NOAA Goes satellites NESDIS ID# 3B0009A8, 3B001ADE, and 3B010B52, 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). Long-term water quality monitoring has occurred at six sites within the stream, one of which has been decommissioned in 2007 (Table 1). 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. 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 2024 are included in the comments section.

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. Site status is either primary (P) or secondary (S). 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
owcrrwq	S	Railroad	Latitude 41° 22' 21" N, Longitude 82° 30' 48 W	06/07/2023 17:00 – 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; site inaccessible	NA

The sonde at the State Route 6 (WM) site (Table 2) 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. Some rooted aquatic vegetation is 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 18 cm 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 28 cm above the sediment. By 2019, the bottom 23–28 cm 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 29 cm above the bottom, very close to the deployment depth in the previous housing, based on previous measurements. This places the sensors at 37 cm above the bottom and the depth sensor at 52 cm (Note: the distance from the bottom end of the sonde guard to the bottom/face of all sensors except the depth sensor is 8 cm; the distance from the bottom end of the sonde guard to the depth sensor is 23 cm). The intake tube for associated diel sampling (via Teledyne 5800 refrigerated autosampler) is clamped to the outside of the sonde tube between 23 cm (bottom of intake guard) and 39 cm (top of intake guard) from the bottom.

Table 2: Site description for site Wetland Mouth (owcwqwm).

Site name	Wetland Mouth or State Route 6 (WM)
Latitude and longitude	Latitude 41° 22' 57" N, Longitude 82° 30' 53" W
Tidal range *(meters)*	The tidal range in Lake Erie (and therefore in the estuary) is 4 cm or less, although water levels may fluctuate by as much as 1.5 m depending on factors like precipitation, Lake Erie water levels, whether the barrier beach is open or closed, and seiches.
Salinity range *(psu)*	≤ 0.4 psu
Type and amount of freshwater input	Old Woman Creek is a freshwater stream that drains an agriculturally dominated landscape. 100% of the input into the stream is freshwater and the specific amount can be determined by looking at discharge data from an upstream USGS stream gauge or by requesting flow data from one of the two Acoustic Current Doppler Profilers (ADCPs) deployed within the estuary.
Water depth (*meters, MLW*)	This is not applicable to Old Woman Creek because this stream does not have tides nor a national tidal datum epoch.
Sonde distance from bottom (*meters*)	This is a fixed distance sonde deployed so that sonde sensor faces are 37 cm above the stream bottom.
Bottom habitat or type	The bottom sediments at this site are silty clay with some cobble
Pollutants in area	Old Woman Creek has been classified as "impaired" according to the U.S. EPA's 303(d) list because of high levels of *e. coli* and suspended sediments. High nutrient concentrations are also a concern.

Description of watershed	Old Woman Creek drains a 69 km² watershed that is dominated by agricultural land use (row crops, orchards, and, to a lesser extent, animal pasture).

The sonde at site OL (Table 3) 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. 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 sonde 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 sonde 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 sonde above the sediment was 42 cm off the bottom. In early 2018, the height of the sonde 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 23 cm above the sediment and the other sensors were 2 cm above the sediment. The trap was re-set on May 23, 2018 at 10:45 EST to position the depth sensor to 45 cm above the sediment and the other sensors to 32 cm above the sediment (note: trap length is 73 cm 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 8 cm; the distance from the bottom end of the sonde guard to the depth sensor is 23 cm).

Table 3: Site description for site Overlook (owcwqwm).

Site name	Overlook or Lower Estuary (OL)
Latitude and longitude	Latitude 41° 22' 55" N, Longitude 82° 30' 51" W
Tidal range *(meters)*	The tidal range in Lake Erie (and therefore in the estuary) is 4 cm or less, although water levels may fluctuate by as much as 1.5 m depending on factors like precipitation, Lake Erie water levels, whether the barrier beach is open or closed, and seiches.
Salinity range *(psu)*	≤ 0.4 psu
Type and amount of freshwater input	Old Woman Creek is a freshwater stream that drains an agriculturally dominated landscape. 100% of the input into the stream is freshwater and the specific amount can be determined by looking at discharge data from an upstream USGS stream gauge or by requesting flow data from one of the two Acoustic Current Doppler Profilers (ADCPs) deployed within the estuary.
Water depth (*meters, MLW*)	This is not applicable to Old Woman Creek because this stream does not have tides nor a national tidal datum epoch.
Sonde distance from bottom (*meters*)	This is a fixed distance sonde deployed so that sonde sensor faces are 32 cm above the stream bottom.
Bottom habitat or type	The bottom sediments are silty clay.
Pollutants in area	Old Woman Creek has been classified as "impaired" according to the U.S. EPA's 303(d) list because of high levels of *e. coli* and suspended sediments. High nutrient concentrations are also a concern.
Description of watershed	Old Woman Creek drains a 69 km² watershed that is dominated by agricultural land use (row crops, orchards, and, to a lesser extent, animal pasture).

The sonde at site RR (Table 4) is located on a railroad bridge that crosses the estuary. The bridge was constructed over Old Woman Creek's thalweg, but the tracks on either side of the bridge were built on top of fill added to raise the tracks above the wetland and make it level with the banks on either side. This "pinch

point" created by the railroad bridge separates the upstream portion of the estuary, where a clearly defined channel is surrounded by small patches of wetland vegetation, and the downstream portion of the estuary, which is dominated by emergent macrophytes (a mix of either American water lotus [*Nelumbo lutea*] and white water lily [*Nymphaea odorata*], or cattail [*Typha latifolia*] and common reed [*Phragmites australis*], depending on water levels in previous years). The sonde trap at site RR is positioned vertically so that the bottom of the sonde guard is 42 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 8 cm; the distance from the bottom end of the sonde guard to the depth sensor is 23 cm). The trap is located right above the steeply sloping side of the abutment and several small ledges contribute to an uneven substrate immediately beneath and surrounding the sonde.

Table 4: Site description for site Railroad (owcwqrr).

Site name	Railroad (RR)
Latitude and longitude	Latitude 41° 22' 21" N, Longitude 82° 30' 47" W
Tidal range *(meters)*	The tidal range in Lake Erie (and therefore in the estuary) is 4 cm or less, although water levels may fluctuate by as much as 1.5 m depending on factors like precipitation, Lake Erie water levels, whether the barrier beach is open or closed, and seiches.
Salinity range *(psu)*	≤ 0.4 psu
Type and amount of freshwater input	Old Woman Creek is a freshwater stream that drains an agriculturally dominated landscape. 100% of the input into the stream is freshwater and the specific amount can be determined by looking at discharge data from an upstream USGS stream gauge or by requesting flow data from one of the two Acoustic Current Doppler Profilers (ADCPs) deployed within the estuary.
Water depth (*meters, MLW*)	This is not applicable to Old Woman Creek because this stream does not have tides nor a national tidal datum epoch.
Sonde distance from bottom (*meters*)	This is a fixed distance sonde deployed so that sonde sensor faces are 42 cm above the stream bottom.
Bottom habitat or type	Substrate beneath the sonde is cobble and concrete from the abutment, but substrate at the middle of the Old Woman Creek channel, located 6 m from the sonde, is mainly gravel.
Pollutants in area	Old Woman Creek has been classified as "impaired" according to the U.S. EPA's 303(d) list because of high levels of *e. coli* and suspended sediments. High nutrient concentrations are also a concern.
Description of watershed	Old Woman Creek drains a 69 km² watershed that is dominated by agricultural land use (row crops, orchards, and, to a lesser extent, animal pasture).

The sonde at site DR (Table 5) is at the southern boundary of the reserve. The sonde 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. No rooted aquatic vegetation is present near or upstream from this site. The trap was repaired and re-deployed in March 2016 and was 45 cm above the bottom. During periods when the sonde is removed due to threat of ice, the sonde tube is also removed. In 2023, the sonde tube was re-deployed at 30 cm above the bottom.

Table 5: Site description for site Darrow Road (owcwqdr).

Site name	Darrow Road (DR)

Latitude and longitude	Latitude 41° 21'54" N, Longitude 82° 30' 17" W
Tidal range *(meters)*	The tidal range in Lake Erie (and therefore in the estuary) is 4 cm or less, although water levels may fluctuate by as much as 1.5 m depending on factors like precipitation, Lake Erie water levels, whether the barrier beach is open or closed, and seiches.
Salinity range *(psu)*	≤ 0.4 psu
Type and amount of freshwater input	Old Woman Creek is a freshwater stream that drains an agriculturally dominated landscape. 100% of the input into the stream is freshwater and the specific amount can be determined by looking at discharge data from an upstream USGS stream gauge or by requesting flow data from one of the two Acoustic Current Doppler Profilers (ADCPs) deployed within the estuary.
Water depth (*meters, MLW*)	This is not applicable to Old Woman Creek because this stream does not have tides nor a national tidal datum epoch.
Sonde distance from bottom (*meters*)	The sonde is suspended from a bridge so that the sensor faces are 30 cm above the stream bottom. During periods of high flow, the sonde may be pushed higher up in the water column. In extreme cases, the distance the sensor faces are above the stream bed may be up to 1.5 m higher than when the sonde is in its normal position.
Bottom habitat or type	Bottom sediments in the thalweg are gravel, but transition to silty clay towards the streambanks.
Pollutants in area	Old Woman Creek has been classified as "impaired" according to the U.S. EPA's 303(d) list because of high levels of *e. coli* and suspended sediments. High nutrient concentrations are also a concern.
Description of watershed	Old Woman Creek drains a 69 km² watershed that is dominated by agricultural land use (row crops, orchards, and, to a lesser extent, animal pasture).

The sonde at site BR (Table 6) is 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. No aquatic macrophytes are present at or near this site. The sonde was 18 cm above the bottom at this site when first installed. During winter 2014, the sonde 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 8 cm; the distance from the bottom end of the sonde guard to the depth sensor is 23 cm).

Table 6: Site description for site Berlin Road (owcwqbr).

Site name	Berlin Road (BR)
Latitude and longitude	Latitude 41° 20'56" N, Longitude 82° 30'44" W
Tidal range *(meters)*	The tidal range in Lake Erie (and therefore in the estuary) is 4 cm or less, although water levels may fluctuate by as much as 1.5 m depending on factors like precipitation, Lake Erie water levels, whether the barrier beach is open or closed, and seiches.
Salinity range *(psu)*	≤ 0.4 psu
Type and amount of freshwater input	Old Woman Creek is a freshwater stream that drains an agriculturally dominated landscape. 100% of the input into the stream is freshwater and the specific amount can be determined by looking at discharge

	data from an upstream USGS stream gauge or by requesting flow data from one of the two Acoustic Current Doppler Profilers (ADCPs) deployed within the estuary.
Water depth (*meters, MLW*)	This is not applicable to Old Woman Creek because this stream does not have tides nor a national tidal datum epoch.
Sonde distance from bottom (*meters*)	This is a fixed distance sonde deployed so that sonde sensor faces are 24 cm above the stream bottom.
Bottom habitat or type	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.
Pollutants in area	Old Woman Creek has been classified as "impaired" according to the U.S. EPA's 303(d) list because of high levels of *e. coli* and suspended sediments. High nutrient concentrations are also a concern.
Description of watershed	Old Woman Creek drains a 69 km² watershed that is dominated by agricultural land use (row crops, orchards, and, to a lesser extent, animal pasture).

6) Data collection period –

For the 2023 deployment, sondes at sites DR, RR, OL, and WM were pulled on 01/02/2024. Sondes were redeployed in 2024 at all sites when freezing conditions were no longer forecasted in the spring and left in the estuary until winter when freezing conditions were again forecasted (Table 7). Sampling at BR began on 03/05/2024 at 11:00 EST and continued until 11/29/2024 at 13:15 EST when the sonde was pulled due to threat of ice. Sampling at DR began on 03/05/2024 at 11:45 EST and continued until 12/03/2024 at 09:00 EST when the sonde was pulled due to threat of ice. Sampling at RR began on 03/05/2024 at 09:15 EST and continued until 12/03/2024 at 10:45 EST when the sonde was pulled due to threat of ice. Sampling at OL began on 03/05/2024 at 10:00 EST continued until 12/03/2024 at 12:00 EST when the sonde was pulled due to threat of ice. Sampling at WM began on 03/05/2024 at 10:15 EST and continued until 12/03/2024 at 12:15 EST when the sonde was pulled due to threat of ice.

Table 7: Deployment information for sondes used in 2024 water quality monitoring of Old Woman Creek. Sites are the five monitoring stations Berlin Road (BR), Darrow Road (DR), Railroad (RR), 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 2024 monitoring.

Site	Deploy Date	Deploy Time	Retrieval Date	Retrieval Time	Sonde Model (Nickname)
BR	03/05/2024	11:00	04/16/2024	10:00	EXO3 (BR-11)
BR	04/16/2024	10:15	05/07/2024	11:45	EXO3 (BR-12)
BR	05/07/2024	12:00	06/04/2024	10:30	EXO3 (BR-11)
BR	06/04/2024	10:45	07/09/2024	12:15	EXO3 (BR-12)
BR	07/09/2024	12:30	08/13/2024	11:15	EXO3 (BR-11)
BR	08/13/2024	11:30	09/10/2024	11:30	EXO3 (BR-12)
BR	09/10/2024	11:45	10/16/2024	07:30	EXO3 (BR-11)
BR	10/16/2024	07:45	11/13/2024	12:00	EXO3 (BR-12)
BR	11/13/2024	12:15	11/29/2024	13:15	EXO3 (BR-11)
DR	01/01/2024	00:00	01/02/2024	14:45	EXO3 (OL-12)
DR	03/05/2024	11:45	04/16/2024	10:30	EXO2 (BR-2)
DR	04/16/2024	10:45	05/07/2024	12:15	EXO3 (OL-12)
DR	05/07/2024	12:30	06/04/2024	11:00	EXO2 (BR-2)
DR	06/04/2024	11:15	07/09/2024	12:45	EXO3 (OL-12)

DR	07/09/2024	13:00	08/13/2024	11:45	EXO2 (BR-2)
DR	08/13/2024	12:00	09/10/2024	12:00	EXO3 (OL-12)
DR	09/10/2024	12:15	10/16/2024	08:00	EXO2 (BR-2)
DR	10/16/2024	08:15	11/13/2024	12:30	EXO3 (OL-12)
DR	11/13/2024	12:45	12/03/2024	09:00	EXO2 (BR-2)
RR	01/01/2024	00:00	01/02/2024	13:15	EXO2 (Haliaeetus)
RR	03/05/2024	09:15	04/16/2024	08:15	EXO2 (BR-1)
RR	04/16/2024	08:30	05/07/2024	08:15	EXO2 (Haliaeetus)
RR	05/07/2024	08:30	06/04/2024	08:15	EXO2 (BR-1)
RR	06/04/2024	08:30	07/09/2024	11:00	EXO2 (Haliaeetus)
RR	07/09/2024	11:15	08/13/2024	11:45	EXO2 (BR-1)
RR	08/13/2024	12:00	09/10/2024	08:30	EXO2 (Haliaeetus)
RR	09/10/2024	08:45	10/16/2024	09:15	EXO2 (BR-1)
RR	10/16/2024	09:30	11/13/2024	09:15	EXO2 (Haliaeetus)
RR	11/13/2024	09:30	12/03/2024	10:45	EXO2 (BR-1)
OL	01/01/2024	00:00	01/02/2024	13:45	EXO2 (Amia)
OL	03/05/2024	10:00	04/16/2024	08:45	EXO2 (Lepomis)
OL	04/16/2024	09:00	05/07/2024	08:45	EXO2 (Amia)
OL	05/07/2024	09:00	06/04/2024	09:00	EXO2 (Lepomis)
OL	06/04/2024	09:15	07/09/2024	10:15	EXO2 (Amia)
OL	07/09/2024	10:30	08/13/2024	10:30	EXO2 (Lepomis)
OL	08/13/2024	10:45	09/10/2024	9:15	EXO2 (Amia)
OL	09/10/2024	09:30	10/16/2024	09:45	EXO2 (Lepomis)
OL	10/16/2024	10:00	11/13/2024	10:00	EXO2 (Amia)
OL	11/13/2024	10:30	12/03/2024	12:00	EXO2 (Lepomis)
WM	01/01/2024	00:00	01/02/2024	14:00	EXO2 (Esox)
WM	03/05/2024	10:15	04/16/2024	09:00	EXO2 (WM-1)
WM	04/16/2024	09:15	05/07/2024	09:15	EXO2 (Esox)
WM	05/07/2024	09:30	06/04/2024	09:30	EXO2 (WM-1)
WM	06/04/2024	09:45	07/09/2024	09:45	EXO2 (Esox)
WM	07/09/2024	10:00	08/13/2024	10:45	EXO2 (WM-1)
WM	08/13/2024	11:00	09/10/2024	09:30	EXO2 (Esox)
WM	09/10/2024	09:45	10/16/2024	10:30	EXO2 (WM-1)
WM	10/16/2024	10:45	12/03/2024	09:45	EXO2 (Esox)

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 and the State of Ohio does not assume liability to the Recipient or third persons, nor will the Federal government nor State of Ohio 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 2024.

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 researchers and projects –

Two Nile microwave water level sensors are 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. Additionally, two Sontek Acoustic Doppler Current Profilers (ADCPs) have been installed to allow for measurement of water flow, velocity, and direction at the Route 6 bridge constriction point of the estuary, 27 m northeast of the WM site, and at the constriction point under the railroad bridge that crosses the estuary, 4 m north of site RR. The EXO sondes at the OL and WM sites are equipped with sensors that measure nonstandard SWMP parameters including in situ chlorophyll-*a* fluorescence, fluorescent dissolved organic matter (fDOM), phycocyanin fluorescence, and nitrate concentrations. Beginning in August, 2022, an EXO sonde was deployed on a buoy located 900 m north of the Old Woman Creek barrier beach in Lake Erie. The buoy, located at 41˚ 23' 32.568" N, 82˚ 30' 44.315" W, is deployed 0.5 m from the water's surface and measures standard SWMP parameters in addition to *in situ* chlorophyll-*a*, fDOM, and phycocyanin fluorescence. Please contact the Reserve's Research Coordinator for any of this data.

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, or by contacting the Reserve's Research Coordinator.

II. Physical Structure Descriptors

9) Sensor specifications –

OWC NERR deployed EXO2 and EXO3 sondes in 2024. Sensors located at each site are specified below, along with the specifications for each sensor.

YSI EXO Sonde:

Parameter: Temperature
Units: Celsius (C)
Sensor Type: CT2 Probe, Thermistor
Model#: 599870 (owcbrwq, owcrrwq [sonde serial number 23D103000], owcwmwq)
Range: -5 to 50 C
Accuracy: -5 to 35: +/- 0.01, 35 to 50: +/- 0.05
Resolution: 0.001 C

Parameter: Temperature
Units: Celsius (C)
Sensor Type: Wiped probe; Thermistor
Model#: 599827 (owcdrwq, owcrrwq [sonde serial number 13L101381], 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 autoranging
Model#: 599870 (owcbrwq, owcrrwq [sonde serial number 23D103000], owcwmwq)
Range: 0 to 200 mS/cm
Accuracy: 0 to 100: +/- 0.5% of reading or 0.001 mS/cm; 100 to 200: +/- 1% of reading
Resolution: 0.001 mS/cm to 0.1 mS/cm (range dependent)

Parameter: Conductivity
Units: milli-Siemens per cm (mS/cm)
Sensor Type: Wiped probe; 4-electrode cell with autoranging
Model#: 599827 (owcdrwq, owcrrwq [sonde serial number 13L101381], owcolwq)
Range: 0 to 100 mS/cm
Accuracy: ±1% of the reading or 0.002 mS/cm, whichever is greater
Resolution: 0.0001 to 0.01 mS/cm (range dependent)

Parameter: Salinity
Units: practical salinity units (psu)/parts per thousand (ppt)
Sensor Type: CT2 probe, Calculated from conductivity and temperature
Model#: 599870 (owcbrwq, owcrrwq [sonde serial number 23D103000], owcwmwq)
Range: 0 to 70 psu
Accuracy: +/- 1.0% of reading pr 0.1 ppt, whichever is greater
Resolution: 0.01 psu

Parameter: Salinity
Units: practical salinity units (psu)/parts per thousand (ppt)
Model#: 599827 (owcdrwq, owcrrwq [sonde serial number 13L101381], owcolwq)
Sensor Type: Wiped probe; Calculated from conductivity and temperature
Range: 0 to 70 ppt
Accuracy: ±2% of the reading or 0.2 ppt, whichever is greater
Resolution: 0.01 psu

Parameter: Dissolved Oxygen % saturation
Sensor Type: Optical probe w/ mechanical cleaning
Model#: 599100-01 (all sites)
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: +/- 5% 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#: 599100-01 (all sites)
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: +/- 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 (all sites)

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#: 577602 (wiped) (owcrrwq, owcolwq [sonde serial# 16J102367])
Model#: 599702 (wiped) (owcbrwq, owcdrwq, owcolwq [sonde serial# 17L101747], owcwmwq)
Range: 0 to 14 units
Accuracy: +/- 0.1 units within +/- 10° of calibration temperature, +/- 0.2 units for entire temperature range
Resolution: 0.01 units

Parameter: Turbidity
Units: formazin nephelometric units (FNU)
Sensor Type: Optical, 90 degree scatter
Model#: 599101-01 (all sites)
Range: 0 to 4000 FNU
Accuracy: 0 to 999 FNU: 0.3 FNU or +/-2% of reading (whichever is greater); 1000 to 4000 FNU +/-5% of reading
Resolution: 0 to 999 FNU: 0.01 FNU, 1000 to 4000 FNU: 0.1 FNU

Parameter: Chlorophyll
Units: micrograms/Liter
Sensor Type: Optical probe
Model#: 599102-01 (owcolwq)
Range: 0 to 400 µg/Liter
Accuracy: Dependent on methodology
Resolution: 0.01 µg/L chl-*a*, 0.1% FS

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)+Depth/Level = 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
Railroad	RR	owcrrwq
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 (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 –

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 8). 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 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 8: Post-deployment information for each sonde. The location of each Site is Berlin Road (BR), Darrow Road (DR), Railroad (RR), Lower Estuary (OL) or Wetland Mouth (WM). Deploy Date is the beginning date when sondes were first set out in the estuary. Sondes at sites DR, RR, OL, and WM were deployed through 01/02/2024, and once again beginning on 03/05/2024. 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. In instances where values were obtained from telemetered data because a SD Card Error caused the sonde to not log internally, "n/a" (not applicable) is used to indicate that no post-deploy dissolved oxygen concentrations were available.

Site	Deploy Date	Dissolved Oxygen 1 (%)	Dissolved Oxygen 2 (%)	Depth (m)	Sp. Cond. (mS/cm)	pH 7	pH 10	Low Turbidity Standard (NTU)	High Turbidity Standard (NTU)
BR	03/05/2024	99.8	99.7	0.031 (0.079)	1.411 (1.413)	7.09 (7.01)	10.03 (10.03)	-0.23 (0.00)	112.65 (124.00)
BR	05/07/2024	96.7	96.6	-0.104 (-0.064)	1.423 (1.413)	7.06 (7.01)	10.01 (10.03)	0.35 (0.00)	100.52 (124.00)
BR	06/04/2024	97.2	96.4	-0.031 (0.004)	1.412 (1.413)	6.93 (7.01)	10.14 (10.03)	0.21 (0.00)	110.16 (124.00)
BR	07/09/2024	94.9	94.9	-0.074 (0.018)	1.404 (1.413)	7.09 (7.01)	10.03 (10.03)	0.29 (0.00)	117.19 (124.00)
BR	08/13/2024	94.3	93.6	0.066 (0.079)	1.427 (1.413)	7.09 (7.01)	9.99 (10.03)	-0.14 (0.00)	119.49 (124.00)
BR	09/10/2024	97.8	97.7	0.062 (0.079)	1.390 (1.413)	7.08 (7.01)	9.99 (10.03)	-0.16 (0.00)	118.94 (124.00)
BR	10/16/2024	98.5	98.6	0.140 (0.131)	1.418 (1.413)	7.03 (7.01)	10.13 (10.03)	-0.06 (0.00)	121.52 (124.00)
BR	11/13/2024	98.0	98.0	0.104 (0.110)	1.446 (1.413)	7.11 (7.01)	9.89 (10.03)	-0.05 (0.00)	122.36 (124.00)
BR	12/03/2024	99.8	n/a	0.104 (0.159)	1.396 (1.413)	7.03 (7.01)	10.07 (10.03)	-0.20 (0.00)	122.12 (124.00)
DR	12/12/2023	100.1	100.1	0.020 (0.038)	1.448 (1.413)	7.09 (7.01)	10.36 (10.03)	0.04 (0.00)	127.88 (124.00)
DR	03/05/2024	96.4	96.4	0.056 (0.079)	1.431 (1.413)	7.05 (7.01)	10.03 (10.03)	0.45 (0.00)	124.62 (124.00)
DR	05/07/2024	96.9	96.7	0.056 (-0.064)	1.420 (1.413)	7.07 (7.01)	10.01 (10.03)	0.24 (0.00)	101.04 (124.00)
DR	06/04/2024	98.0	97.8	-0.093 (0.004)	1.423 (1.413)	7.07 (7.01)	9.90 (10.03)	-0.05 (0.00)	110.16 (124.00)
DR	07/09/2024	93.9	93.8	-0.069 (0.018)	1.412 (1.413)	7.20 (7.01)	9.87 (10.03)	0.02 (0.00)	117.18 (124.00)
DR	08/13/2024	97.3	96.4	0.062 (0.079)	1.436 (1.413)	7.06 (7.01)	9.92 (10.03)	0.28 (0.00)	123.47 (124.00)

DR	09/10/2024	98.3	97.9	0.058 (0.079)	1.398 (1.413)	7.02 (7.01)	10.00 (10.03)	-0.17 (0.00)	122.41 (124.00)
DR	10/16/2024	99.3	99.3	0.132 (0.131)	1.434 (1.413)	6.92 (7.01)	10.05 (10.03)	0.21 (0.00)	116.78 (124.00)
DR	11/13/2024	98.1	97.7	0.095 (0.110)	1.463 (1.413)	7.14 (7.01)	10.04 (10.03)	0.09 (0.00)	120.47 (124.00)
DR	12/03/2024	99.7	99.8	0.110 (0.159)	1.411 (1.413)	6.94 (7.01)	9.98 (10.03)	0.06 (0.00)	122.56 (124.00)
RR	12/12/2023	99.6	99.6	0.006 (0.038)	1.438 (1.413)	6.98 (7.01)	10.03 (10.03)	0.23 (0.00)	129.30 (124.00)
RR	03/05/2024	100.4	n/a	0.043 (0.079)	1.395 (1.413)	7.01 (7.01)	9.96 (10.03)	0.07 (0.00)	106.04 (124.00)
RR	05/07/2024	95.5	95.8	-0.108 (-0.060)	1.419 (1.413)	6.98 (7.01)	9.89 (10.03)	-0.13 (0.00)	113.08 (124.00)
RR	06/04/2024	90.7	86.2	-0.015 (0.004)	1.239 (1.413)	7.10 (7.01)	9.91 (10.03)	0.16 (0.00)	121.12 (124.00)
RR	07/09/2024	89.3	89.8	0.025 (0.018)	1.395 (1.413)	7.01 (7.01)	9.96 (10.03)	0.07 (0.00)	106.04 (124.00)
RR	08/13/2024	97.6	97.5	0.074 (0.079)	1.415 (1.413)	7.07 (7.01)	10.03 (10.03)	-0.03 (0.00)	118.77 (124.00)
RR	09/10/2024	98.3	97.8	0.057 (0.079)	1.364 (1.413)	7.17 (7.01)	10.09 (10.03)	0.3 (0.00)	118.54 (124.00)
RR	10/16/2024	98.8	98.8	0.135 (0.131)	1.431 (1.413)	7.07 (7.01)	10.07 (10.03)	0.14 (0.00)	120.39 (124.00)
RR	11/13/2024	100.0	99.9	0.095 (0.110)	1.385 (1.413)	7.10 (7.01)	10.05 (10.03)	0.44 (0.00)	119.83 (124.00)
RR	12/03/024	99.4	99.5	0.092 (0.159)	1.41 (1.413)	6.93 (7.01)	9.98 (10.03)	0.14 (0.00)	124.95 (124.00)
OL	12/12/2023	98.1	98.1	-0.013 (0.038)	1.446 (1.413)	7.03 (7.01)	10.02 (10.03)	-0.16 (0.00)	125.95 (124.00)
OL	03/05/2024	97.0	96.9	0.066 (0.079)	1.418 (1.413)	7.05 (7.01)	10.05 (10.03)	-0.14 (0.00)	118.30 (124.00)
OL	05/07/2024	95.8	95.8	-0.102 (-0.064)	1.384 (1.413)	7.06 (7.01)	10.06 (10.03)	0.32 (0.00)	108.46 (124.00)
OL	06/04/2024	89.9	90.0	-0.005 (0.004)	1.418 (1.413)	7.07 (7.01)	9.96 (10.03)	0.03 (0.00)	118.66 (124.00)
OL	07/09/2024	87.4	86.8	0.047 (0.018)	1.299 (1.413)	7.06 (7.01)	10.00 (10.03)	0.05 (0.00)	127.09 (124.00)
OL	08/13/2024	96.2	n/a	0.080 (0.079)	1.418 (1.413)	7.03 (7.01)	9.98 (10.03)	0.08 (0.00)	129.09 (124.00)
OL	09/10/2024	94.5	95.0	0.075 (0.079)	1.236 (1.413)	6.91 (7.01)	10.01 (10.03)	0.00 (0.00)	121.36 (124.00)

OL	10/16/2024	100.6	100.5	0.139 (0.131)	1.424 (1.413)	6.95 (7.01)	10.12 (10.03)	-0.03 (0.00)	122.57 (124.00)
OL	11/13/2024	98.3	98.0	0.088 (0.110)	1.413 (1.413)	6.96 (7.01)	9.98 (10.03)	0.08 (0.00)	125.54 (124.00)
OL	12/04/2024	100.3	100.3	-0.060 (-0.038)	1.420 (1.413)	6.97 (7.01)	10.06 (10.03)	0.05 (0.00)	124.59 (124.00)
WM	12/12/2023	99.1	99.1	-0.018 (0.038)	1.449 (1.413)	7.05 (7.01)	10.04 (10.03)	0.39 (0.00)	127.12 (124.00)
WM	03/05/2024	96.7	96.1	0.064 (0.079)	1.379 (1.413)	7.09 (7.01)	9.99 (10.03)	0.34 (0.00)	117.28 (124.00)
WM	05/07/2024	97.2	96.5	-0.124 (-0.064)	1.407 (1.413)	7.02 (7.01)	10.03 (10.03)	0.09 (0.00)	105.31 (124.00)
WM	06/04/2024	84.9	83.9	-0.012 (0.004)	1.414 (1.413)	6.99 (7.01)	9.89 (10.03)	0.00 (0.00)	124.01 (124.00)
WM	07/09/2024	90.6	n/a	0.006 (0.018)	1.301 (1.413)	7.05 (7.01)	10.02 (10.03)	0.05 (0.00)	112.76 (124.00)
WM	08/13/2024	99.4	99.2	0.072 (0.079)	1.107 (1.413)	7.10 (7.01)	9.98 (10.03)	-0.01 (0.00)	128.67 (124.00)
WM	09/10/2024	96.3	96.2	0.065 (0.079)	1.066 (1.413)	7.10 (7.01)	10.02 (10.03)	-0.14 (0.00)	113.60 (124.00)
WM	10/16/2024	99.9	99.0	0.146 (0.131)	1.418 (1.413)	6.91 (7.01)	10.09 (10.03)	0.03 (0.00)	132.19 (124.00)
WM	11/13/2024	100.1	100.1	0.087 (0.110)	1.459 (1.413)	7.08 (7.01)	9.98 (10.03)	0.16 (0.00)	119.24 (124.00)
WM	12/04/2024	101.4	101.5	-0.030 (0.038)	1.416 (1.413)	6.90 (7.01)	9.95 (10.03)	0.31 (0.00)	123.53 (124.00)

14) Other remarks/notes –

All times are Eastern Standard Time (EST; UTC-4). 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 the end of record on December 31, 2024, are below:

Status	Date From	Date To
Open	01/01/2024	02/10/2024
Closed	02/11/2024	02/17/2024
Open	02/18/2024	03/18/2024
Closed	03/19/2024	03/31/2024
Open	04/01/2024	04/25/2024
Closed	04/26/2024	04/29/2024
Open	04/30/2024	05/07/2024
Closed	05/08/2024	05/17/2024
Open	05/18/2024	05/26/2024
Closed	05/27/2024	06/05/2024
Open	06/06/2024	06/07/2024
Closed	06/08/2024	07/07/2024
Open	07/08/2024	07/09/2024
Closed	07/10/2024	12/10/2024
Open	12/11/2024	12/31/2024

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 meteorological 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 specific 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). No notable seiche events occurred while the barrier beach was open through December 2024.

Ice
Periods in which sondes are removed from the estuary due to the threat of ice are flagged <-2>(GIC) and the "F_Record column is flagged {CSM}

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.

A spike in conductivity and salinity occurred between 03/26/2024 12:45 to 03/27/2024 15:30 and was attributed to an unknown cause; conductivity and salinity data for these timestamps were therefore flagged <1>[GSM](CCU).

A nation-wide shortage of turbidity standard required the use of previously used standard for turbidity sensor calibration for the 05/07/2024 deployment of sondes at all sites. New turbidity standard was used for post-deployment checks, which returned values lower than expected. Turbidity data from 05/07/2024 12:00 to 06/04/2024 10:30 were therefore flagged <1>[SIC](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 2023, as the result of heavy rain and flow: From 04/02/2024 at 05:30 to 11:45 on 04/03/2024; between 04/11/2024 at 05:00 to 04/13/2024 at 07:00; on 04/29/2024 from 13:00 to 18:15; on 05/07/2024 from 13:45 to 21:00; from 05/10/2024 23:30 to 05/11/2024 12:00; from 05/26/2024 09:00 to 05/27/2024 05:15; between 13:30 and 22:30 on 07/04/2024; between 11:30 to 18:30 on 08/02/2024.

A spike in conductivity and salinity occurred between 03/27/2024 08:30 to 03/28/2024 02:15 and was attributed to an unknown cause; conductivity and salinity data for these timestamps were therefore flagged <1>[GSM](CCU).

Throughout the 04/16/2024 deployment, a probable wiper malfunction resulted in erroneous conductivity, salinity, and turbidity data. Affected timestamps between 04/16/2024 10:45 to 05/07/2024 12:15 were therefore flagged <1>[GSM](CCU).

A nation-wide shortage of turbidity standard required the use of previously used standard for turbidity sensor calibration for the 05/07/2024 deployment of sondes at all sites. New turbidity standard was used for post-deployment checks, which returned values lower than expected. Turbidity data from 05/07/2024 12:30 to 06/04/2024 11:00 were therefore flagged <1>[SIC](CSM).

At the beginning of a new deployment on 05/07/2024, 12:30, dissolved oxygen, turbidity, pH, and temperature had not yet stabilized and were therefore flagged <1>[GQR](CSM). All other parameters were not affected.

A probable sonde malfunction resulted in the recording of no or erroneous data on 04/21/2024 from 12:15 to 12:45; these datapoints were therefore flagged <-3>[GIM](CSM) for all parameters.

A sensor malfunction resulted in no depth data being collected from 10:30 on 05/03/2024 to 12:15 on 05/07/2024; these timepoints were therefore flagged <-2>[SSM](CSM).

The sonde was not fully descended in its deployment pipe on 11/13/2024 at 15:00 after deployment. The depth column was flagged <1>[GSM](CWD) and all other parameters were flagged <0>[GSM](CWD) from 11/13/2024 at 15:00 to 12/03/2024 at 9:00.

Railroad (RR)

From 04/13/2024 15:00 to 04/16/2024 21:45, the sonde experienced a malfunction and telemetered data transmitted to the CDMO at the time they were measured is reported for those timestamps, which were flagged <1>[GIT](CSM). During this period, between 09:00-9:45 on 04/15/2024, data for the depth and temperature were nonsensical and were thus flagged <-3>[GIT](CSM).

A nation-wide shortage of turbidity standard required the use of previously used standard for turbidity sensor calibration for the 05/07/2024 deployment of sondes at all sites. New turbidity standard was used for post-deployment checks, which returned values lower than expected. Turbidity data from 05/07/2024 08:30 to 06/04/2024 08:15 were therefore flagged <1>[SIC](CSM).

The sonde was not fully descended in its deployment pipe on 11/13/2024 at 09:30 after deployment. The depth column was flagged <1>[GSM](CWD) and all other parameters were flagged <0>[GSM](CWD) from 11/13/2024 at 09:30 to 12/03/2024 at 10:45.

Lower Estuary (OL)

Between 08/03/2024 10:30 to 08/13/2024 10:15, the sonde experienced a malfunction, and no data were available for depth, temperature, and chlorophyll; these timestamps were flagged <-2>[GIM](CSM) for these parameters. For all other parameters, telemetered data transmitted to the CDMO at the time they were measured is reported for these timestamps; these parameters were flagged <1> (GIT)(CSM).

On 03/20/2024 at 18:00, the sonde experienced a malfunction, and no data were available for pH and temperature; this timestamp was flagged <-2>[GIM](CSM) for these parameters. For all other parameters, telemetered data transmitted to the CDMO at the time they were measured is reported for this timestamp; these parameters were flagged <1> (GIT)(CSM).

The cable holding the sonde deployment pipe at a fixed depth broke, and the sonde collected data from an incorrect depth between 01/01/2024 at 00:00 to 01/02/2024 at 13:45. The depth column was flagged <1>[GSM](CWD) and all other parameters were flagged <0>[GSM](CWD) for these time periods.

A nation-wide shortage of turbidity standard required the use of previously used standard for turbidity sensor calibration for the 05/07/2024 deployment of sondes at all sites. New turbidity standard was used for post-deployment checks, which returned values lower than expected. Turbidity data from 05/07/2024 09:00 to 06/04/2024 09:00 were therefore flagged <1>[SIC](CSM).

The sonde was not fully descended in its deployment pipe on 11/13/2024 at 10:30 after deployment. The depth column was flagged <1>[GSM](CWD) and all other parameters were flagged <0>[GSM](CWD) from 11/13/2024 at 10:30 to 12/03/2024 at 12:00.

Wetland Mouth (WM):

On 08/06/2021 14:15, 08/07/2024 09:45, 08/08/2024 10:30 and 11:15, 08/09/2024 09:15 and 21:45, 08/10/2024 22:00, 08/11/2024 06:45, 08/13/2024 08:15, 09/17/2024 22:45-23:45, 09/21/2024 08:30-08:45 and 21:00, 09/22/2024 13:45-17:30, and 09/23/2024 14:30, the sonde experienced malfunctions, and no data were available; these timestamps were therefore flagged <-2>[GIM](CSM).

Between 07/03/2024 at 06:00 and 07/09/2024 at 09:45, the sonde experienced a malfunction and telemetered data transmitted to the CDMO at the time they were measured is reported for those timestamps, which were flagged <1>[GIT](CSM).

On 04/30/2024 at 22:30, 05/01/2022 at 12:15, 05/01/2024 at 13:45, 05/05/2024 at 03:45, 05/05/2024 at 07:00, 06/06/2024 at 22:00, 06/12/2024 at 00:30, 10/30/2024 at 09:00, 11/03/2024 at 06:15, 11/05/2024 at 00:00, and 11/06/2024 at 16:30 the wiper appears to be positioned in a way that disrupted temperature and conductivity sensor, causing erroneous values to be reported. Temperature and specific conductivity were flagged as <-3>[SWM](CSM), along with dissolved oxygen, depth, pH, and salinity because these parameters depend on temperature.

A nation-wide shortage of turbidity standard required the use of previously used standard for turbidity sensor calibration for the 05/07/2024 deployment of sondes at all sites. New turbidity standard was used for post-deployment checks, which returned values lower than expected. Turbidity data from 05/07/2024 09:30 to 06/04/2024 09:30 were therefore flagged <1>[SIC](CSM).

On 10/20/2024 at 11:30, the sonde experienced a malfunction and telemetered data transmitted to the CDMO at the time they were measured is reported for this timestamp, which was flagged <1>[GIT](CSM).

The sonde was not fully descended in its deployment pipe on 11/13/2024 at 10:45 after deployment. The depth column was flagged <1>[GSM](CWD) and all other parameters were flagged <0>[GSM](CWD) from 11/13/2024 at 10:45 to 12/03/2024 at 12:15.

Field verification

Field data collected at time of sonde retrieval and deployment are reported (Table 9). Data were collected using a field sonde (EXO1 or EXO2) that was deployed simultaneous to the retrieved and newly deployed sondes.

Table 9: 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), Railroad (RR), 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. Sondes at sites DR, RR, OL, and WM were deployed through 01/02/2024, and once again beginning on 03/05/2024. Not applicable (n/a) is used to indicate instances where no field sonde data exist.

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	03/05/2024	11:01	0.106	100.0	10.91	0.30	0.620	4.26	8.10	11.404
BR	retrieved	04/16/2024	09:59	0.176	99.6	10.70	0.26	0.526	6.01	7.89	12.087
BR	deployed	04/16/2024	10:16	0.183	101.9	10.91	0.26	0.525	5.95	7.95	12.222
BR	retrieved	05/07/2024	11:44	-0.037	93.7	9.46	0.30	0.609	9.47	7.99	14.853
BR	deployed	05/07/2024	12:01	-0.043	94.1	9.49	0.30	0.609	9.05	8.00	14.953
BR	retrieved	06/04/2024	10:33	0.035	93.3	8.52	0.30	0.615	90.25	8.05	19.726
BR	deployed	06/04/2024	10:46	0.034	88.3	8.06	0.30	0.611	12.90	7.96	19.718
BR	retrieved	07/09/2024	12:28	0.031	89.0	7.59	0.28	0.572	8.97	7.84	23.213
BR	deployed	07/09/2024	12:31	0.031	89.1	7.60	0.28	0.572	8.27	7.84	23.223
BR	retrieved	08/13/2024	11:23	0.070	87.0	7.92	0.26	0.533	20.93	7.82	19.864
BR	deployed	08/13/2024	11:27	0.070	79.2	7.25	0.26	0.530	6.54	7.72	19.579
BR	retrieved	09/10/2024	11:37	0.105	84.1	8.19	0.30	0.606	5.14	7.70	16.554
BR	deployed	09/10/2024	11:41	0.104	79.3	7.74	0.30	0.605	4.61	7.64	16.455
BR	retrieved	10/16/2024	07:29	0.164	88.8	10.03	0.30	0.622	10.45	7.88	9.898
BR	deployed	10/16/2024	07:46	0.162	88.6	10.01	0.30	0.618	11.26	7.92	9.885
BR	retrieved	11/13/2024	11:59	0.133	77.7	9.39	0.35	0.710	3.23	7.81	7.128
BR	deployed	11/13/2024	12:08	0.129	77.4	9.34	0.35	0.710	3.19	7.83	7.156
BR	retrieved	11/29/2024	13:15	n/a	98.4	13.03	n/a	0.654	n/a	8.19	3.600
DR	retrieved	01/02/2024	14:45	0.716	91.6	11.99	0.24	0.502	37.41	8.09	4.024
DR	deployed	03/05/2024	11:46	0.900	93.3	10.50	0.32	0.655	11.48	7.93	10.017
DR	retrieved	04/16/2024	10:29	0.674	80.4	8.30	0.25	0.513	21.09	7.80	13.816
DR	deployed	04/16/2024	10:46	0.695	80.8	8.34	0.25	0.514	19.42	7.79	13.830
DR	retrieved	05/07/2024	12:14	0.438	79.5	7.84	0.30	0.606	23.34	7.85	15.954
DR	deployed	05/07/2024	12:31	0.442	79.1	7.81	0.30	0.607	24.39	7.84	15.952
DR	retrieved	06/04/2024	10:59	0.782	59.5	5.46	0.29	0.604	17.71	7.68	19.413
DR	deployed	06/04/2024	11:16	0.791	59.9	5.50	0.29	0.603	16.82	7.70	19.435
DR	retrieved	07/09/2024	12:38	0.435	54.2	4.57	0.25	0.525	19.18	7.45	23.809
DR	deployed	07/09/2024	13:01	0.438	48.6	4.09	0.25	0.523	17.55	7.49	23.835
DR	retrieved	08/13/2024	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
DR	deployed	08/13/2024	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

DR	retrieved	09/10/2024	11:59	0.565	45.5	4.26	0.25	0.523	8.47	7.45	18.413
DR	deployed	09/10/2024	12:16	0.334	42.5	3.99	0.25	0.523	9.05	7.43	18.448
DR	retrieved	10/16/2024	07:59	0.971	38.1	4.09	0.31	0.637	9.50	7.40	12.034
DR	deployed	10/16/2024	08:17	0.988	37.1	3.98	0.31	0.637	9.58	7.39	12.019
DR	retrieved	11/13/2024	12:29	0.668	31.0	3.50	0.31	0.630	11.08	7.37	9.897
DR	deployed	11/13/2024	12:46	0.666	31.4	3.55	0.31	0.629	11.45	7.37	9.892
DR	retrieved	12/03/2024	08:59	1.179	76.5	9.99	0.33	0.674	4.17	7.72	4.082
RR	retrieved	01/02/2024	13:27	0.734	92.0	12.00	0.24	0.500	49.35	7.97	4.152
RR	deployed	03/05/2024	09:21	0.549	93.2	10.44	0.32	0.661	22.72	7.89	10.219
RR	retrieved	04/16/2024	08:14	0.286	88.2	9.02	0.25	0.516	33.31	7.80	14.329
RR	deployed	04/16/2024	08:31	0.275	87.8	8.95	0.25	0.516	31.64	7.79	14.412
RR	retrieved	05/07/2024	08:14	0.496	78.2	7.55	0.28	0.58	41.53	7.80	16.976
RR	deployed	05/07/2024	08:31	0.523	78.3	7.56	0.28	0.579	41.09	7.81	16.980
RR	retrieved	06/04/2024	08:17	0.349	91.1	7.94	0.26	0.545	20.02	7.66	22.075
RR	deployed	06/04/2024	08:31	0.945	82.3	7.28	0.26	0.547	17.75	7.68	21.357
RR	retrieved	07/09/2024	11:06	0.315	58.0	4.76	0.24	0.504	26.33	7.20	25.249
RR	deployed	07/09/2024	12:15	0.311	68.0	5.57	0.24	0.501	24.75	7.25	25.409
RR	retrieved	08/13/2024	09:44	0.446	36.8	3.16	0.22	0.450	12.48	7.12	22.849
RR	deployed	08/13/2024	10:01	0.419	34.5	2.96	0.22	0.450	12.81	7.10	22.866
RR	retrieved	09/10/2024	08:34	0.959	40.6	3.86	0.23	0.473	14.23	7.24	17.805
RR	deployed	09/10/2024	08:46	1.002	37.8	3.58	0.23	0.474	14.62	7.23	17.894
RR	retrieved	10/16/2024	09:17	0.546	52.3	5.57	0.22	0.450	12.72	7.38	12.432
RR	deployed	10/16/2024	09:31	0.605	43.5	4.64	0.22	0.446	12.59	7.37	12.394
RR	retrieved	11/13/2024	09:14	1.149	68.3	7.94	0.24	0.504	11.94	7.39	8.690
RR	deployed	11/13/2024	09:31	1.243	61.8	7.19	0.24	0.504	12.02	7.33	8.654
RR	retrieved	12/03/2024	10:44	1.091	56.9	7.42	0.30	0.624	8.85	7.39	4.107
OL	retrieved	01/02/2024	13:46	0.649	93.4	12.31	0.24	0.508	52.44	8.07	3.736
OL	deployed	03/05/2024	10:01	0.830	92.0	10.25	0.23	0.467	24.30	7.99	10.474
OL	retrieved	04/16/2024	08:48	0.405	83.9	8.48	0.20	0.417	56.03	7.73	14.874
OL	deployed	04/16/2024	09:01	0.335	74.3	7.54	0.20	0.416	59.54	7.65	14.634
OL	retrieved	05/07/2024	08:46	0.488	112.0	10.58	0.22	0.463	41.31	8.29	18.028
OL	deployed	05/07/2024	09:01	0.427	116.3	10.97	0.22	0.465	44.27	8.27	18.113
OL	retrieved	06/04/2024	08:59	1.600	67.3	5.97	0.26	0.535	91.58	7.63	21.215
OL	deployed	06/04/2024	09:16	0.586	101.2	8.86	0.26	0.533	26.48	7.98	21.868
OL	retrieved	07/09/2024	10:06	0.515	64.4	5.20	0.25	0.514	38.73	7.29	26.164
OL	deployed	07/09/2024	10:31	0.786	50.1	4.05	0.24	0.509	38.52	7.24	26.049
OL	retrieved	08/13/2024	10:16	0.237	85.9	7.26	0.21	0.435	25.12	7.53	23.687
OL	deployed	08/13/2024	10:31	0.420	59.0	5.08	0.21	0.432	26.22	7.37	22.779

OL	retrieved	09/10/2024	09:14	1.024	61.1	5.73	0.22	0.462	29.18	7.43	18.419
OL	deployed	09/10/2024	09:31	1.012	59.8	5.61	0.22	0.462	28.39	7.4	18.379
OL	retrieved	10/16/2024	09:51	0.621	67.3	7.21	0.21	0.443	24.78	7.74	12.194
OL	deployed	10/16/2024	10:01	0.648	65.3	7.00	0.21	0.443	17.42	7.74	12.211
OL	retrieved	11/13/2024	09:59	0.820	68.8	7.85	0.23	0.477	14.83	7.62	9.486
OL	deployed	11/13/2024	10:26	0.778	69.9	7.98	0.23	0.477	14.43	7.68	9.472
OL	retrieved	12/03/2024	11:59	1.210	90.6	12.76	0.24	0.505	5.12	8.18	1.282
WM	retrieved	01/02/2024	14:01	0.248	102.1	13.60	0.23	0.472	65.19	8.22	3.349
WM	deployed	03/05/2024	10:16	0.683	83.5	9.03	0.25	0.506	70.53	7.85	11.777
WM	retrieved	04/16/2024	09:05	0.346	84.0	8.65	0.19	0.393	45.63	7.75	13.981
WM	deployed	04/16/2024	09:16	0.338	75.8	7.80	0.19	0.396	51.83	7.66	14.011
WM	retrieved	05/07/2024	09:14	0.361	124.9	11.80	0.22	0.455	42.22	8.36	18.049
WM	deployed	05/07/2024	09:31	0.429	116.9	11.06	0.22	0.455	45.92	8.20	17.965
WM	retrieved	06/04/2024	09:29	1.149	80.2	7.07	0.26	0.534	23.22	7.80	21.526
WM	deployed	06/04/2024	09:46	0.755	88.3	7.73	0.26	0.535	26.00	7.85	21.816
WM	retrieved	07/09/2024	09:48	0.950	59.0	4.75	0.25	0.521	38.33	7.33	26.368
WM	deployed	07/09/2024	10:01	0.037	59.3	4.78	0.13	0.271	33.44	7.32	26.357
WM	retrieved	08/13/2024	10:35	0.405	72.1	6.17	0.21	0.430	18.61	7.46	23.070
WM	deployed	08/13/2024	10:46	0.457	73.8	6.29	0.21	0.432	19.85	7.50	23.229
WM	retrieved	09/10/2024	09:37	1.048	70.8	6.63	0.22	0.462	19.93	7.54	18.469
WM	deployed	09/10/2024	09:46	1.048	70.0	6.56	0.22	0.462	17.30	7.53	18.441
WM	retrieved	10/16/2024	10:13	1.373	64.3	6.86	0.22	0.445	22.85	7.72	12.408
WM	deployed	10/16/2024	10:31	1.480	61.3	6.53	0.22	0.445	31.26	7.48	12.424
WM	retrieved	11/13/2024	10:31	1.276	74.0	8.43	0.23	0.477	17.86	7.70	9.507
WM	deployed	11/13/2024	10:46	1.310	72.3	8.23	0.23	0.477	32.04	7.71	9.552
WM	retrieved	12/03/2024	12:14	0.836	90.3	12.79	0.24	0.505	5.12	8.13	1.076