**Old Woman Creek** (OWC) **NERR Nutrient Metadata**

**Months and year the documentation covers**

**Latest Update:** 14 June 2024

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](mailto:cdmosupport@baruch.sc.edu)) or reserve with any additional questions.

**I. Data Set and Research Descriptors**

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**2) Research objectives** –

1. Monthly Grab Sampling Program:

Samples for chemical analysis are taken at least monthly at five existing datalogger sites within or near the Old Woman Creek National Estuarine Research Reserve (NERR). 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 (BR) is just upstream of the first riffle zone above the estuary in Old Woman Creek proper. The purpose of this part of the nutrient monitoring program is to document the spatial and temporal distribution of nutrient levels as water moves through this Great Lakes estuary.

1. Diel Sampling Program:

At site WM, samples are collected at 2-hour intervals over a 26-hour period once per month. The purpose of this part of the monitoring program is to examine temporal changes in nutrient levels in the estuary over the course of a diurnal cycle.

**3) Research methods** –

1. Monthly Grab Sampling

In 2023 at BR, DR, OL, and WM, the first sample was collected on 23 January 2023. Sampling at BR ended on 24 November 2023 when the water quality monitoring sonde located at the site was removed due to threat of ice. At DR, OL, and WM, the last sampling date of the year occurred on 12 December 2023. On 07 June 2023, RR was established as a secondary SWMP station. Sampling occurred at this site between 23 July 2023, and 12 December 2023.

Replicate surface water grab samples for chemical and chlorophyll-*a* analysis were collected sequentially at each site. Both replicates were normally collected within 1 minute of each other, except at site DR, where samples were usually collected within a few minutes of each other (Table 1). Samples were collected as grab samples just below the water’s surface, except for at DR, where samples were collected using a 3-L Van Dorn bottle at 0.5 m depth.

Sample bottles (previously washed in a commercial grade dishwasher with phosphate-free detergent and citric acid rinse aid, rinsed six (6) times with deionized water, then allowed to air dry upside down prior to sampling) were rinsed with sample water three times before the sample was collected for analysis. Water temperature, dissolved oxygen, specific conductance, and pH were determined on the samples at time of collection using a field meter (YSI Pro Plus, Yellow Spring Inc, Yellow Springs, OH). Sample turbidity was measured in the lab with a Hach 2100AN Turbidimeter. If samples could not be filtered within an hour after collection, they were stored in a refrigerator (4˚C) or in the dark on ice.

All monthly grab samples collected in 2023 were processed and analyzed on-site at the Old Woman Creek analytical laboratory. A description of the protocols and methods can be found in Part II, Sections 13 and 14 of this document.

**Table 1:** Monthly grab sampling occurred at five sites including BR (owcbrnut), DR (owcdrnut), RR (owcrrnut), OL (owcolnut), and WM (owcwmnut). Two replicates were collected on each sample date. Collection time for each replicate is listed based on a 24:00 clock in Eastern Standard Time (EST).

|  |  |  |  |
| --- | --- | --- | --- |
| **Site** | **Replicate** | **Sample Date (mm/dd/yyyy)** | **Time (EST)** |
| BR | 1 | 01/23/2023 | 09:36 |
| BR | 2 | 01/23/2023 | 09:37 |
| BR | 1 | 03/07/2023 | 08:50 |
| BR | 2 | 03/07/2023 | 08:51 |
| BR | 1 | 04/11/2023 | 07:35 |
| BR | 2 | 04/11/2023 | 07:36 |
| BR | 1 | 05/09/2023 | 07:46 |
| BR | 2 | 05/09/2023 | 07:47 |
| BR | 1 | 06/06/2023 | 12:22 |
| BR | 2 | 06/06/2023 | 12:23 |
| BR | 1 | 07/11/2023 | 09:18 |
| BR | 2 | 07/11/2023 | 09:22 |
| BR | 1 | 08/15/2023 | 11:52 |
| BR | 2 | 08/15/2023 | 11:53 |
| BR | 1 | 09/12/2023 | 11:16 |
| BR | 2 | 09/12/2023 | 11:17 |
| BR | 1 | 10/11/2023 | 10:57 |
| BR | 2 | 10/11/2023 | 10:58 |
| BR | 1 | 11/07/2023 | 11:00 |
| BR | 2 | 11/07/2023 | 11:01 |
| BR | 1 | 11/24/2023 | 11:09 |
| BR | 2 | 11/24/2023 | 11:10 |
| DR | 1 | 01/23/2023 | 09:50 |
| DR | 2 | 01/23/2023 | 09:54 |
| DR | 1 | 03/07/2023 | 09:18 |
| DR | 2 | 03/07/2023 | 09:19 |
| DR | 1 | 04/11/2023 | 08:11 |
| DR | 2 | 04/11/2023 | 08:18 |
| DR | 1 | 05/09/2023 | 08:10 |
| DR | 2 | 05/09/2023 | 08:14 |
| DR | 1 | 06/06/2023 | 12:54 |
| DR | 2 | 06/06/2023 | 12:58 |
| DR | 1 | 07/11/2023 | 09:48 |
| DR | 2 | 07/11/2023 | 09:54 |
| DR | 1 | 08/15/2023 | 12:34 |
| DR | 2 | 08/15/2023 | 12:42 |
| DR | 1 | 09/12/2023 | 11:42 |
| DR | 2 | 09/12/2023 | 11:51 |
| DR | 1 | 10/11/2023 | 11:16 |
| DR | 2 | 10/11/2023 | 11:21 |
| DR | 1 | 11/07/2023 | 11:29 |
| DR | 2 | 11/07/2023 | 11:37 |
| DR | 1 | 12/12/2023 | 12:18 |
| DR | 2 | 12/12/2023 | 12:26 |
| RR | 1 | 07/11/2023 | 11:10 |
| RR | 2 | 07/11/2023 | 11:11 |
| RR | 1 | 08/15/2023 | 10:07 |
| RR | 2 | 08/15/2023 | 10:08 |
| RR | 1 | 09/12/2023 | 09:19 |
| RR | 2 | 09/12/2023 | 09:20 |
| RR | 1 | 10/11/2023 | 08:05 |
| RR | 2 | 10/11/2023 | 08:06 |
| RR | 1 | 11/07/2023 | 11:07 |
| RR | 2 | 11/07/2023 | 11:08 |
| RR | 1 | 12/12/2023 | 09:43 |
| RR | 2 | 12/12/2023 | 09:44 |
| OL | 1 | 01/23/2023 | 10:23 |
| OL | 2 | 01/23/2023 | 10:24 |
| OL | 1 | 03/07/2023 | 10:18 |
| OL | 2 | 03/07/2023 | 10:19 |
| OL | 1 | 04/11/2023 | 09:09 |
| OL | 2 | 04/11/2023 | 09:10 |
| OL | 1 | 05/09/2023 | 08:56 |
| OL | 2 | 05/09/2023 | 08:57 |
| OL | 1 | 06/06/2023 | 10:36 |
| OL | 2 | 06/06/2023 | 10:37 |
| OL | 1 | 07/11/2023 | 11:38 |
| OL | 2 | 07/11/2023 | 11:43 |
| OL | 1 | 08/15/2023 | 09:34 |
| OL | 2 | 08/15/2023 | 09:37 |
| OL | 1 | 09/12/2023 | 09:55 |
| OL | 2 | 09/12/2023 | 09:56 |
| OL | 1 | 10/11/2023 | 08:55 |
| OL | 2 | 10/11/2023 | 08:56 |
| OL | 1 | 11/07/2023 | 09:29 |
| OL | 2 | 11/07/2023 | 09:30 |
| OL | 1 | 12/12/2023 | 10:52 |
| OL | 2 | 12/12/2023 | 10:53 |
| WM | 1 | 01/23/2023 | 10:32 |
| WM | 2 | 01/23/2023 | 10:33 |
| WM | 1 | 03/07/2023 | 10:48 |
| WM | 2 | 03/07/2023 | 11:07 |
| WM | 1 | 04/11/2023 | 09:35 |
| WM | 2 | 04/11/2023 | 09:36 |
| WM | 1 | 05/09/2023 | 09:31 |
| WM | 2 | 05/09/2023 | 09:32 |
| WM | 1 | 06/06/2023 | 11:13 |
| WM | 2 | 06/06/2023 | 11:14 |
| WM | 1 | 07/11/2023 | 12:24 |
| WM | 2 | 07/11/2023 | 12:27 |
| WM | 1 | 08/15/2023 | 09:00 |
| WM | 2 | 08/15/2023 | 09:05 |
| WM | 1 | 09/12/2023 | 10:20 |
| WM | 2 | 09/12/2023 | 10:21 |
| WM | 1 | 10/11/2023 | 09:23 |
| WM | 2 | 10/11/2023 | 09:24 |
| WM | 1 | 11/07/2023 | 10:00 |
| WM | 2 | 11/07/2023 | 10:01 |
| WM | 1 | 12/12/2023 | 11:07 |
| WM | 2 | 12/12/2023 | 11:08 |

1. Diel Sampling

An ISCO Model 5800 refrigerated sampler was used to collect water samples at site WM once a month, from March through December 2023 (Table 2). The sampler collected a single, 600 mL sample at 2-hour intervals over a 26-hour period. The sampler intake was suspended adjacent to the WM data sonde at the same depth as the sonde sensors. Prior to collecting each sample, the ISCO sampler was programmed to rinse the collection line three times. Otherwise, protocols were the same as for the Monthly Grab Sampling Program, including bottle cleaning, processing, and analysis.

All Diel samples collected in 2023 were processed and analyzed on-site at the Old Woman Creek analytical laboratory. A description of the protocols and methods can be found in Part II, Sections 13 and 14 of this document.

**Table 2:** Diel sampling occurred once per month at site WM (owcwmnut). Samples were collected at two-hour intervals beginning at 4:00 AM on the start date and concluding at 6:00 AM on the end date. Collection time for each replicate is listed based on a 24:00 clock in Eastern Standard Time (EST).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Site** | **Start Date (mm/dd/yyyy)** | **Start Time (EST)** | **End Date (mm/dd/yyyy)** | **End Time (EST)** |
| WM | 03/26/2023 | 4:00 | 03/27/2023 | 6:00 |
| WM | 04/02/2023 | 4:00 | 04/03/2023 | 6:00 |
| WM | 04/30/2023 | 4:00 | 05/01/2023 | 6:00 |
| WM | 06/11/2023 | 4:00 | 06/12/2023 | 6:00 |
| WM | 07/23/2023 | 4:00 | 07/24/2023 | 6:00 |
| WM | 08/27/2023 | 4:00 | 08/28/2023 | 6:00 |
| WM | 09/24/2023 | 4:00 | 09/25/2023 | 6:00 |
| WM | 10/22/2023 | 4:00 | 10/23/2023 | 6:00 |
| WM | 11/26/2023 | 4:00 | 11/27/2023 | 6:00 |
| WM | 12/17/2023 | 4:00 | 12/18/2023 | 6:00 |

**4) 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 3). 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 2023 are included in the comments section.

**Table 3:** 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 4) 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 sediment, 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 29 October 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 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 4:** 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 5) 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 01 December 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 5:** 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 6) 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 6:** 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 7) 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 7:** 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 8) 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 8:** 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). |

**5) Coded variable definitions** –

owcnut = Old Woman Creek nutrients

|  |  |
| --- | --- |
| **Sampling Station** | **Sampling Site Code** |
| State Route 6 | owcwmnut |
| Lower Estuary | owcolnut |
| Railroad | owcrrnut |
| Darrow Road | owcdrnut |
| Berlin Road | owcbrnut |

*Coded Project Identifiers Within the Dataset:*

Whether samples were collected as part of the Monthly grab or Diel sampling program are denoted in the “Monitoring Program” column of the dataset using the following numbering scheme.

Monthly grab sample program = 1

Diel grab sample program = 2

**6) Data collection period** –

1. Monthly Sampling

Sampling at BR, DR, OL, and WM began on 23 January 2023 and continued until 23 November 2023 at BR, and until 12 December 2023 at DR, OL, WM. RR was established as a secondary SWMP site on 07 June 2023. Sampling at RR occurred between 11 July 2023 and 12 December 2023.

Specific deployment dates and times (EST) are listed (Table 1). The two grab samples were collected sequentially.

1. Diel Sampling

For the following dates and times (EST; Table 2) in 2023, samples were collected at site WM at two-hour intervals over a 26-hour period.

**7) Associated researchers and projects–**

As part of the long-term System-wide Monitoring Program, the Old Woman Creek NERR also monitors 15-minute meteorological and water quality data which may be correlated with this nutrient/pigment dataset. Water quality data sondes are deployed at each of the nutrient sampling sites. These sondes measure and record water temperature, specific conductivity, dissolved oxygen, pH, turbidity, depth, *in situ* nitrate, *in situ* chlorophyll-*a* fluorescence, *in situ* phycocyanin fluorescence, and *in situ* fluorescent dissolved organic matter (fDOM) at 15-minute intervals throughout the sampling period (approximately March – December). A meteorological tower is located on Reserve property within 1 km of the DR, OL, and WM nutrient collection sites and within 5 km of the BR nutrient collection site. Beginning 18 November 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. Air temperature, relative humidity, barometric pressure, wind speed and direction, precipitation, and photosynthetically active radiation data were collected at 15-minute intervals throughout the year. These data are available at [www.nerrsdata.org](http://www.nerrsdata.org). All meteorological and water quality data are available at [www.nerrsdata.org](http://www.nerrsdata.org).

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 water level measurements at the southern and northern bounds of the estuary at 15-minute intervals, during ice-free conditions. A Sontek Acoustic Doppler Current Profiler (ADCP) has been installed to measure water velocity and flow at 15-minute intervals, 27 m northeast of the WM site at the Route 6 bridge constriction point of the estuary. Water level, velocity, and flow data are transmitted to each site’s respective GOES satellite simultaneously with the sonde data and are available upon request from the Research Coordinator (please see Section I, Part 1).

Since May 2015, ongoing work in the Reserve has been dedicated to quantifying the nutrient processing ability of the Old Woman Creek wetland to understand how storm events influence nutrient loading into Lake Erie. Between May 2015 and June 2019, three samples per day were collected from site BR (owcbrnut) and site WM (owcwmnut) using an autosampler programmed to collect samples at 04:00, 12:00, and 20:00. If a storm event had occurred, 2–3 samples per day were analyzed until the creek had receded to near pre-storm levels, while only 1 sample per day was analyzed if the creek remained at baseflow. Beginning in June 2019, water samples were analyzed on-site at the Old Woman Creek analytical lab and the sampling frequency was modified to the schedule, below:

For storm events (≥10 per year), the following sampling schedule was followed until recession to pre-storm levels:

BR (owcbrnut) ×3 per day at 04:00, 12:00, and 20:00

WM (owcwmnut) ×1 per day at 12:00

During non-storm, baseflow conditions, sampling frequency was as follows:

BR (owcbrnut) ×1 per day at 12:00

WM (owcwmnut) ×1 per week at 12:00 on Mondays

These modifications to sampling frequency were based analysis of the 2015–2018 data showing that baseflow nutrient concentrations were stable over the course of 24 hours at site BR, or from one week to the next at site WM. Throughout this ongoing project, water samples have been analyzed for orthophosphate (PO4F), total phosphorus (TP), nitrite (NO2F), nitrite+nitrate (NO23F), and ammonium (NH4F). Nitrate (NO3F) and dissolved inorganic nitrogen (DIN) were quantified by calculation. Data are available by request from the Reserve’s Research Coordinator (please see Section I, Part 1).

In addition to the nutrient and pigment concentrations presented in this dataset, Old Woman Creek measures several other parameters including alkalinity, total nitrogen, total organic carbon, dissolved nitrogen, dissolved organic carbon, dissolved silica, dissolved sulfate, and dissolved chloride. The collection frequency for these parameters varies and can be provided, along with the data, from the Reserve’s Research Coordinator (please see Section I, Part 1).

**8) 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: www.nerrsdata.org; *accessed* 12 October 2022.

NERR nutrient data and metadata can be obtained from the Research Coordinator at the individual NERR site (please see Principal investigators and contact persons), from the Data Manager at the Centralized Data Management Office (please see personnel directory under the general information link on the CDMO home page) and online at the CDMO home page [www.nerrsdata.org](http://cfcdmo.baruch.sc.edu/). Data are available in comma separated version format.

**II. Physical Structure Descriptors**

**9) Entry verification** –

All field data are recorded by hand on a field datasheet during sample collection. All laboratory chemical analysis data are transcribed by hand on a laboratory datasheet; field measurements of water temperature, pH, specific conductance, and dissolved oxygen are transcribed to that datasheet. Any anomalies observed in the field or in the lab are also recorded on their respective datasheets. Duplicate readings are visually inspected to identify outliers, which would suggest either testing or contamination problems. The datasheets are kept on file at the Old Woman Creek Visitor Center.

Reserve staff enter the data recorded on field datasheets into an Excel workbook designated for that sampling year. Parameters measured in ppb (µg/L) are converted to ppm (mg/L) in the Excel workbook, except for chlorophyll-*a*. Field and laboratory workbooks are saved to the computer associated with the analyzer that measures nutrients, and a central Ohio Department of Natural Resources Office of Coastal Management server, which is regularly backed up through the State of Ohio’s Information Technology Department. The System-wide Monitoring Program Coordinator is responsible for the nutrient analysis QAQC.

Nutrient data are entered into a Microsoft Excel worksheet and processed using the NutrientQAQC Excel macro from the CDMO. The NutrientQAQC macro sets up the data worksheet, metadata worksheets, and method detection limit (MDL) worksheet; adds chosen parameters and facilitates data entry; allows the user to set the number of significant figures to be reported for each parameter and rounds using banker’s rounding rules; allows the user to input MDL values and then automatically flags/codes measured values below MDL and inserts the MDL; calculates parameters chosen by the user and automatically flags/codes for component values below MDL, negative calculated values, and missing data; allows the user to apply QAQC flags and codes to the data; produces summary statistics; graphs selected parameters for review; and exports the resulting data file to the CDMO for tertiary QAQC and assimilation into the CDMO’s authoritative online database.

**10) Parameter titles and variable names by category –**

Nutrient and chlorophyll-*a* concentrations, along with water quality parameters measured from whole water samples (Table 9), are available to download through the Centralized Data Management Office (CDMO) or by request from the Reserve’s Research Coordinator (please see Section I, Part 1).

**Table 9:** Parameters quantified in Old Woman Creek during 2023 Monthly grab and Diel sampling. Centralized Data Management Office (CDMO) parameter name, as listed on the downloaded data, are provided along with the units for each parameter.

**Data Category Parameter Variable Name Units of Measure**

**Phosphorus:** \*Orthophosphate PO4F mg/L as P

(PO4), Filtered

Total Phosphorus TP mg/L as P

**Nitrogen:** \*NO2+3 (Nitrite + Nitrate), Filtered NO23F mg/L as N

\*NO2 (Nitrite), Filtered NO2F mg/L as N

\*NO3 (Nitrate), Filtered NO3F mg/L as N

\*NH4 (Ammonium), Filtered NH4F mg/L as N

Dissolved Inorganic Nitrogen DIN mg/L as N

**Algal Pigments:** \*Chlorophyll-*a* CHLA\_N μg/L

**Field Parameters:** Water Temperature WTEM\_N ºC

pH PH\_N pH

Dissolved Oxygen DO\_N mg/L

Specific Conductivity SCON\_N μS/cm

Turbidity TURB\_N NTU

\*Required NOAA/NERR System-wide Monitoring Program nutrient parameters

**11) Measured or calculated laboratory parameters** –

1. **Parameters measured directly**

Nitrogen species: NH4F, NO2F, NO23F

Phosphorus species: PO4F, TP

Other: CHLA\_N

1. **Calculated parameters**

NO3F NO23F-NO2F

DIN NO23F+NH4F

**12) Limits of detection** –

MDLs, which are the lowest concentration of a parameter that an analytical procedure can reliably detect, have been established by the Old Woman Creek Analytical Laboratory (Table 10). The MDL is determined as 3 times the standard deviation of a minimum of 7 replicates of a single low concentration sample. The 7 replicates are distributed across 3 analytical runs, with the “Date Revisited” representing the date of the final run. MDL are determined annually, except for CHLA\_N, which, prior to 08 September 2023, was last measured in 2019.

**Table 10:** Method detection limits (MDL) for parameters measured at the Old Woman Creek Analytical Lab and reported to the CDMO. Variable name, as it appears when downloaded from the CDMO, is listed in parentheses in the Parameter column. Each time MDLs are assessed, the newly determined MDL replaces the old one. Start and End Dates represent the temporal range over which each MDL is applicable. All dates when the MDL was determined are included here, even if it did not change before or after assessment.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Parameter** | **Start Date (mm/dd/yyyy)** | **End Date (mm/dd/yyyy)** | **MDL** | **Units** | **Date Revisited** |
| NH4 (NH4F) | 01/01/2023 | 11/20/2023 | 0.011 | mg/L | 11/22/2023 |
| 11/22/2023 | 12/31/2023 | 0.004 |
| NO2 (NO2F) | 01/01/2023 | 10/12/2023 | 0.001 | mg/L | 10/13/2023 |
| 10/13/2023 | 12/31/2023 | 0.001 |
| NO2+3 (NO23F) | 01/01/2023 | 10/12/2023 | 0.016 | mg/L | 10/13/2023 |
| 10/13/2023 | 12/31/2023 | 0.041 |
| PO4 (PO4F) | 01/01/2023 | 10/03/2023 | 0.006 | mg/L | 10/04/2023 |
| 10/04/2023 | 12/31/2023 | 0.006 |
| TP | 01/01/2023 | 11/28/2023 | 0.013 | mg/L | 11/29/2023 |
| 11/29/2023 | 12/31/2023 | 0.007 |
| Chlorophyll-*a* (CHLA\_N) | 01/01/2023 | 12/31/2023 | 0.16 | µg/L | 09/08/2023 |

**13) Laboratory methods** –

**Filtration:**

Each water sample is filtered withing 24 hours of collection using vacuum filtration. Due to frequent, high levels of suspended particles, the OWC analytical lab uses a 2-step filtration process. Briefly, whole water samples are first filtered through 0.7 µm glass fiber filters (GFF), and then through pre-soaked 0.45 µm membrane filters within 24 hours of collection. All dissolved parameters, including orthophosphate (PO4F), Nitrate + Nitrite (NO23F), Nitrite (NO2F), and Ammonium (NH4F) are measured from 0.45 µm filtrate. Chlorophyll-*a* concentrations (CHLA\_N) are measured from the material retained on the 0.7 µm GFF.

**Preservation:**

If samples are not able to be processed and analyzed within allowable hold times, they are preserved through freezing at -20˚C. Hold times for samples collected at OWC follow the National Estuarine Research Reserve Standard Operating Procedures (NERR 2021), which generally align with hold times recommended in Standard Methods (APHA 2017). Briefly, samples are stored in the lab at 4˚C and analyzed within 5 days of collection. If analysis within 5 days is not possible, hold times may be extended for an additional 28 days by freezing filtrate at -20˚C. For chlorophyll-*a*, freezing extends hold times by 30 days.

**Nutrients:**

The following parameters are measured with a Seal Analytical AQ300 Discrete Autoanalyzer. All parameters are quantified spectrophotometrically. For each parameter, the OWC analytical lab follows methods developed by Seal Analytical that suggest reagent volumes and masses appropriate for their equipment. However, these methods follow principals outlined in Standard Methods (APHA 2017) and USEPA (1993), which are listed, below.

**a) Total Phosphorus (TP)** – measured on whole water samples

Digestion: Persulfate digestion on a hot plate following Standard Methods 4500-P B.5 (23rd edition, APHA 2017)

Analysis: Ascorbic acid reduction following Standard Methods 4500-P F (23rd edition; APHA 2017)

**b) Orthophosphate (PO4F)**

Method: Ascorbic acid reduction following USEPA 365.1 Rev 2.0 (1993) and Standard Methods 4500-P F (23rd edition; APHA 2017)

Principal: Sample is combined with molybdate and antimony to form an antimony phosphor-molybdate complex. This complex is reduced by ascorbic acid to an intensely blue dye, phosphomolybdenum blue, which is measured at 880 nm.

**c) Nitrate + Nitrite (NO23F)**

Method: USEPA 132 A Rev 1.0 (1993) and Standard Methods 4500-NO3- F (23rd edition; APHA 2017)

Principal: Nitrate is chemically reduced to nitrite by passing the sample water through a cadmium coil. Reduced sample is then mixed with sulfanilamide and phosphoric acid, causing a reaction where nitrite forms a diazonium compound which, when combined with N-(1-naphthyl)-ethylenediamine, forms a pink dye that can be measured spectrophotometrically at 520 nm.

**d) Nitrite (NO2F)**

Method: USEPA 354.1 Rev 2.0 (1993); Standard Methods 4500-NO2-B (23rd edition; APHA 2017)

Principal: The sample is mixed with sulfanilamide and phosphoric acid. This causes a reaction where nitrite forms a diazonium compound which, when combined with N-(1-naphthyl)-ethylenediamine, forms a pink dye that can be measured spectrophotometrically at 520 nm.

**e) Ammonium (NH4F)**

Method:USEPA 350.1 Rev 2.0 (1993); Standard Methods 4500-NH3 H (23rd edition; APHA 2017)

Principal: Ammonia reacts with hypochlorite in an alkaline sample, forming chloramine. The chloramine is combined with salicylate and nitroferricyanide, forming a blue-green dye that is measured at 660 nm.

**Pigments:**

Chlorophyll-*a* is extracted from material retained on 0.7 µm GFF, which are placed in stoppered vials containing 90 % acetone solvent and left to sit for a 2–7 day steeping period at -20 ˚C. Filters are transferred to test tubes and centrifuged (1 minute, 2840 RPM) to separate particulates. Chlorophyll-*a* is then determined fluorometrically from whole water samples using a Turner Design Trilogy model fluorometer following the CHL-NA (“non-acidification”) module. This module follows the Welschmeyer Method (Welschmeyer 1994), where the Trilogy provides a set of very narrow bandpass excitation and emission filters that nearly eliminate the spectral interference caused by the presence of pheophytin-*a* and chlorophyll-*b*, allowing for the direct measurement of chlorophyll-*a* without the need for acidification.

**a) Chlorophyll-*a* (CHLA\_N)**

Method:USEPA Method 445.0 (USEPA 1997); Notable deviations from Method 445.0 include:

* OWC skips the grinding step where the filter is homogenized because filter particles can interfere with fluorometer readings if not properly removed, and overheating during grinding can cause chlorophyll-*a* to degrade.
* OWC places filters in the freezer (-20˚C) instead of the fridge (4˚C), both when filters are placed in vials, and for steeping. Freezing lyses phytoplankton cells and releases chlorophyll-*a*, which is important because OWC does not grind their filters.

Principal: A solvent, in this case 90 % aqueous acetone, is used to extract chlorophyll from phytoplankton cells retained on GFF. Extract is then placed in a fluorometer, which excites electrons in the chlorophyll extract with a lower wavelength light, and then measures their emission at a higher wavelength. With the Welschmeyer Method (Welschmeyer 1994), filters are included in the fluorometer to ensure that measured emission is only from chlorophyll-*a*, and not other phytoplankton pigments nor organic material in the water.

**14) Field and Laboratory QAQC programs** –

1. **Precision**

**Field Variability**- For Monthly grab sampling, two replicate samples are collected at all four sites (i.e., 100 % of samples receive a field replicate). These samples are collected consecutively (within 4 minutes of each other at a maximum, but usually within 1 minute of each other) and represent true replicates. For Diel sampling, only one sample is collected at each time (i.e., 0 % of samples receive a field replicate).

**Lab Variability-** No lab replicates are analyzed for nutrient samples. For chlorophyll-*a* samples, one sample is analyzed as a lab duplicate for each run. This represents 9 % of Monthly grab samples, and 7 % of Diel samples that are run in duplicate for chlorophyll-*a*.

**Inter-organizational Splits-** OWC NERR did not participate in an inter-organizational split program with any other lab in 2022.

1. **Accuracy**

**Sample Spikes**- For Monthly grab sampling, a sample spike is included on every run (i.e., 10 % of samples), for each nutrient parameter. OWC does not include spikes for Diel sampling, nor when analyzing chlorophyll-*a*.

**Cross Calibration Exercises**- Old Woman Creek NERR did not participate in any cross-calibration exercises with other labs during 2022.

**General Laboratory QA/QC-** For each nutrient analysis, a deionized water blank and a known standard are analyzed after every 10 unknown samples, and at the end of every run, to ensure that the analysis maintains accuracy throughout the entire run.

When Nitrate + Nitrite (NO23F) is analyzed, nitrate (NO3-) is reduced to nitrite (NO2-) when sample water passes through a cadmium coil. The reduction efficiency of this process is measured by analyzing known nitrate and known nitrite standards of the same concentration. Theoretically, each standard should return the same value after analysis (i.e., 100 % reduction efficiency), but this is almost never the case due to deterioration of the cadmium coil and interferences within the sample. If the reduction efficiency drops below 85 %, the coil is regenerated, and the entire run is reanalyzed.

Total phosphorus is analyzed by digesting all phosphorus species to orthophosphate, which is then measured directly on the analyzer. During each total phosphorus run, a known standard and deionized water blank are included as samples to verify that the digestion is complete, and that it is not introducing any interferences into the analysis, respectively.

For chlorophyll-*a*, a filter blank (i.e., a sample which had deionized water passed through a 0.7 µm GFF) and a 90 % acetone blank are included at the end of every run to assess whether there was any contamination in the sample, and evaluate any background fluorescence from the extraction solvent, respectively. Furthermore, each chlorophyll-*a* run includes a solid secondary standard at the beginning and end of each run. The Solid Secondary Standard provides a stable fluorescence signal that can be used to check the stability of the fluorometer and track drift over time. As long as the solid secondary standard is within +/- 50 RFU of its originally calibrated value, OWC does not create a new calibration curve for chlorophyll-*a*.

**15) 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\_). QAQC flags are applied to the nutrient data during secondary QAQC to indicate data that are out of sensor range low (-4), rejected due to QAQC checks (-3), missing (-2), optional and were not collected (-1), suspect (1), and that have been corrected (5). All remaining data are flagged as having passed initial QAQC checks (0) when the data are uploaded and assimilated into the CDMO ODIS as provisional plus data. The historical data flag (4) is used to indicate data that were submitted to the CDMO prior to the initiation of secondary QAQC flags and codes (and the use of the automated primary QAQC system for WQ and MET data). This flag is only present in historical data that are exported from the CDMO ODIS.

-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

4 Historical Data: Pre-Auto QAQC

5 Corrected Data

**16) 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 sample or sample collection, sensor errors document common sensor or parameter specific problems, 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. However, a record flag column (F\_Record) in the nutrient data allows multiple comment codes to be applied to the entire data record.

General errors

GCM Calculated value could not be determined due to missing data

GCR Calculated value could not be determined due to rejected data

GDM Data missing or sample never collected

GQD Data rejected due to QA/QC checks

GQS Data suspect due to QA/QC checks

GSM See metadata

Sensor errors

SBL Value below minimum limit of method detection

SCB Calculated value could not be determined due to a below MDL component

SCC Calculation with this component resulted in a negative value

SNV Calculated value is negative

SRD Replicate values differ substantially

SUL Value above upper limit of method detection

Parameter Comments

CAB Algal bloom

CDR Sample diluted and rerun

CHB Sample held beyond specified holding time

CIP Ice present in sample vicinity

CIF Flotsam present in sample vicinity

CLE Sample collected later/earlier than scheduled

CRE Significant rain event

CSM See metadata

CUS Lab analysis from unpreserved sample

Record comments

CAB Algal bloom

CHB Sample held beyond specified holding time

CIP Ice present in sample vicinity

CIF Flotsam present in sample vicinity

CLE Sample collected later/earlier than scheduled

CRE Significant rain event

CSM See metadata

CUS Lab analysis from unpreserved sample

*Cloud cover*

CCL clear (0-10%)

CSP scattered to partly cloudy (10-50%)

CPB partly to broken (50-90%)

COC overcast (>90%)

CFY foggy

CHY hazy

CCC cloud (no percentage)

*Precipitation*

PNP none

PDR drizzle

PLR light rain

PHR heavy rain

PSQ squally

PFQ frozen precipitation (sleet/snow/freezing rain)

PSR mixed rain and snow

*Tide stage*

TSE ebb tide

TSF flood tide

TSH high tide

TSL low tide

*Wave height*

WH0 0 to <0.1 meters

WH1 0.1 to 0.3 meters

WH2 0.3 to 0.6 meters

WH3 0.6 to > 1.0 meters

WH4 1.0 to 1.3 meters

WH5 1.3 or greater meters

*Wind direction*

N from the north

NNE from the north northeast

NE from the northeast

ENE from the east northeast

E from the east

ESE from the east southeast

SE from the southeast

SSE from the south southeast

S from the south

SSW from the south southwest

SW from the southwest

WSW from the west southwest

W from the west

WNW from the west northwest

NW from the northwest

NNW from the north northwest

*Wind speed*

WS0 0 to 1 knot

WS1 > 1 to 10 knots

WS2 > 10 to 20 knots

WS3 > 20 to 30 knots

WS4 > 30 to 40 knots

WS5 > 40 knots

**17) Other remarks/notes –**

Data may be missing due to problems with sample collection or processing. Laboratories in the NERR System submit data that are censored at a lower detection rate limit, called the Method Detection Limit or MDL. MDLs for specific parameters are listed in the Laboratory Methods and Detection Limits Section (Section II, Part 12) of this document. Concentrations that are less than this limit are censored with the use of a QAQC flag and code, and the reported value is the method detection limit itself rather than a measured value. For example, if the measured concentration of NO23F was 0.0005 mg/l as N (MDL=0.0008), the reported value would be 0.0008 and would be flagged as out of sensor range low (-4) and coded SBL. In addition, if any of the components used to calculate a variable are below the MDL, the calculated variable is removed and flagged/coded -4 SCB. If a calculated value is negative, it is rejected and all measured components are marked suspect. If additional information on MDL’s or missing, suspect, or rejected data is needed, contact the Research Coordinator at the reserve submitting the data.

Note: The way below MDL values are handled in the NERRS SWMP dataset was changed in November of 2011. Previously, below MDL data from 2007-2010 were also flagged/coded, but either reported as the measured value or a blank cell. Any 2007-2011 nutrient/pigment data downloaded from the CDMO prior to November of 2011 will reflect this difference.

***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. Mouth status data for the barrier beach in 2023 are below:

|  |  |  |
| --- | --- | --- |
| Status | Date From | Date To |
| Closed | 01/01/2023 | 01/03/2023 |
| Open | 01/04/2023 | 04/20/2023 |
| Closed | 04/21/2022 | 05/02/2023 |
| Open | 05/03/2023 | 05/17/2023 |
| Closed | 05/18/2023 | 06/15/2023 |
| Open | 06/16/2023 | 06/22/2023 |
| Closed | 06/23/2023 | 07/15/2023 |
| Open | 07/16/2023 | 08/22/2023 |
| Closed | 08/23/2023 | 08/23/2023 |
| Open | 08/24/2023 | 09/26/2023 |
| Closed | 09/27/2023 | 10/14/2023 |
| Open | 10/14/2023 | 10/20/2023 |
| Closed | 10/21/2023 | 10/29/2023 |
| Open | 10/30/2023 | 11/11/2023 |
| Closed | 11/12/2023 | 12/01/2023 |
| Open | 11/18/2023 | 12/01/2023 |
| Closed | 12/02/2023 | 12/07/2023 |
| Open | 12/08/2023 | 12/21/2023 |
| Closed | 12/22/2023 | 12/23/2023 |
| Open | 12/24/2023 | 01/02/2024 |

***Site specific flagging:***

Berlin Road (BR)

On 06/06/2023, F\_CHLA\_N replicates differed substantially. Furthermore, both replicates were uncharacteristically high for this site. The highest concentration, replicate 1 (23.19 µg/L) would be the highest chlorophyll-*a* concentration observed at the site over the previous five years, while replicate 2 (12.41 µg/L) would be the third highest concentration. F\_CHLA\_N replicate 1 was rejected and flagged <-3> [SRD](CSM), while F\_CHLA\_N replicate 2 was flagged <1> [SRD](CSM).

Darrow Road (DR)

On 07/11/2023, both replicates of NO2F were uncharacteristically high. The concentrations measured on this date would have been higher than NO2F concentrations measured anywhere within Old Woman Creek within the past 5 years. However, these concentrations are not out of the realm of possibility and replication between samples was robust. Ultimately NO2F and NO3F, which is calculated using NO2F, were flagged as <1> [GQS](CSM).

Wetland Mouth (WM)

On 04/02/2023 at 20:00 for Diel sampling, F\_PO4F was uncharacteristically high. Not only would this have been the highest F\_PO4F concentration measured at this site over the past five years, but it was an order of magnitude greater than any of the other Diel samples collected during the 26-hour sampling on 04/02/2023. Therefore, this data point was flagged <-3> [GQS](CSM).

On 01/23/2023, F\_PO4F replicates differed substantially, but it was replicate 2, the higher concentration of the two replicates, that was likely the sample in error because it was higher than F\_PO4F concentrations at nearby site OL, and higher than concentrations at WM on the next sampling dates (03/07/2023). Replicate 2 was flagged <-3> [SRD](CSM).

***Sample hold times***

Whole water samples were filtered within 24 hours of collection (Table 11). Unless noted otherwise, all water samples (whole water and filtrate) were held at 4 °C, and filters for chlorophyll-*a* analysis were immediately placed in -20 °C for extraction (see Section II, Part 13 for a more detailed description of methods used to quantify chlorophyll-*a*). Nutrient samples were often analyzed within 5 days, which is the maximum hold time for dissolved nutrients at 4 °C allowable by the NERR standard operating procedure (NERR 2021). The hold time for total phosphorus is 6 months at 4 °C, per NERR protocols. In instances when it was not feasible to analyze dissolved nutrients within 5 days, NERR protocols allow nutrient samples to be held for up to 28 days (30 days for chlorophyll-*a*) at -20 °C. Samples held beyond what is allowable by NERR protocols are flagged as suspect and coded CHB in the data set (i.e., <1>(CHB)).

**Table 11:** Nutrient and chlorophyll-*a* sample hold times for 2023. Sampling methods, frequency, and location followed the Monthly grab sampling program (“Grab”) and Diel sampling program (“Diel”). Samples were filtered within 24 hours of the collection date. Parameters include orthophosphate (PO4F), total phosphorus (TP),ammonium (NH4F), nitrite (NO2F), nitrite+nitrate(NO23F), and chlorophyll-*a* (CHLA\_N).

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Collection Date** | **Program** | **Date Analyzed** | | | | | |
| **PO4F** | **TP** | **NH4F** | **NO2F** | **NO23F** | **CHLA\_N** |
| 01/23/2023 | Grab | 01/24/2023 | 01/24/2023 | 01/24/2023 | 01/25/2023 | 01/25/2023 | 01/27/2023 |
| 03/07/2023 | Grab | 03/08/2023 | 03/08/2023 | 03/07/2023 | 03/08/2023 | 03/09/2023 | 03/10/2023 |
| 04/11/2023 | Grab | 04/12/2023 | 04/12/2023 | 04/12/2023 | 04/13/2023 | 04/13/2023 | 04/14/2023 |
| 05/09/2023 | Grab | 05/09/2023 | 05/10/2023 | 05/09/2023 | 05/11/2023 | 05/11/2023 | 05/12/2023 |
| 06/06/2023 | Grab | 06/06/2023 | 06/08/2023 | 06/06/2023 | 06/08/2023 | 06/08/2023 | 06/09/2023 |
| 07/11/2023 | Grab | 07/13/2023 | 07/13/2023 | 07/13/2023 | 07/20/2023\* | 07/20/2023\* | 07/17/2023 |
| 08/15/2023 | Grab | 08/16/2023 | 08/17/2023 | 08/16/2023 | 08/17/2023 | 08/17/2023 | 08/17/2023 |
| 09/12/2023 | Grab | 09/12/2023 | 09/14/2023 | 09/12/2023 | 09/13/2024 | 09/13/2024 | 09/18/2023 |
| 10/11/2023 | Grab | 10/11/2023 | 10/19/2023 | 10/11/2023 | 10/12/2023 | 10/12/2023 | 10/16/2023 |
| 11/07/2023 | Grab | 11/07/2023 | 11/15/2023 | 11/07/2023 | 11/08/2023 | 11/21/2023\*\* | 11/09/2023 |
| 11/24/2023ᵻ | Grab | 12/05/2023ᵻ | 11/28/2023 | 12/04/2023ᵻ | 12/05/2023ᵻ | 12/05/2023ᵻ | 12/01/2023 |
| 12/12/2023 | Grab | 12/12/2023 | 12/13/2023 | 12/12/2023 | 12/14/2023 | 12/14/2023 | 12/15/2023 |
| 03/26-27/2023 | Diel | 03/28/2023 | 03/28/2023 | 03/28/2023 | 03/31/2023 | 03/30/2023 | 03/31/2023 |
| 04/02-03/2023 | Diel | 04/03/2023 | 04/04/2023 | 04/03/2023 | 04/05/2023 | 04/05/2023 | 04/07/2023 |
| 04/30-05/01 /2023 | Diel | 05/02/2023 | 05/02/2023 | 05/02/2023 | 05/03/2023 | 05/03/2023 | 05/05/2023 |
| 06/11-12/2023 | Diel | 06/12/2023 | 06/13/2023 | 06/12/2023 | 06/15/2023 | 06/15/2023 | 06/15/2023 |
| 07/23-24/2023 | Diel | 07/25/2023 | 07/26/2023 | 07/25/2023 | 07/27/2023 | 07/27/2023 | 07/27/2023 |
| 08/27-28/2023 | Diel | 08/28/2023 | 09/06/2023 | 08/28/2023 | 08/29/2023 | 08/29/2023 | 09/01/2023 |
| 09/24-25/2023 | Diel | 09/26/2023 | 09/29/2023 | 09/26/2023 | 09/28/2023 | 09/28/2023 | 09/29/2023 |
| 10/22-23/2023 | Diel | 10/23/2023 | 10/26/2023 | 10/23/2023 | 10/24/2023 | 10/26/2023 | 10/27/2023 |
| 11/26-27/2023 | Diel | 11/27/2023 | 11/28/2023 | 11/27/2023 | 11/30/2023 | 11/30/2023 | 12/01/2023 |
| 12/17-18/2023 | Diel | 12/18/2023 | 12/19/2023 | 12/18/2023 | 12/19/2023 | 12/19/2023 | 12/22/2023 |

\*NO2F and NO23F were analyzed outside of hold times on 07/11/2023 and were flagged suspect <1> and coded (CHB).

\*\*NO23F was froze at -20 °C on 11/09/2023, thawed on 11/13/2023, re-froze on 11/14/2023, and thawed again, this time for analysis of NO23F on 11/21/2023. This sample was flagged as suspect <1> and coded (CHB).

ᵻOnly samples at site owcbr were collected on 11/24/2023 because this is when the water quality data logger at this site was pulled due to threat of ice. All samples from this date were froze on 11/24/2023, and then thawed for analysis on 12/04/2023. This sample did not receive flagging because it was analyzed within allowable hold times.

**References**

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