

Maryland Shallow Water Monitoring Program – 2017 Continuous Monitoring

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator: Maryland Department of Natural Resources, Resource Assessment Service (MD DNR RAS)

Publication_Date: 20180703

Title: MD DNR Continuous Water Quality Monitoring Project 2017

Geospatial_Data_Presentation_Form: Spatial dataset

Description:

Abstract:

Water quality was monitored at thirty-three Maryland shallow water sites located in Chesapeake Bay, Chesapeake Bay tributaries and Maryland Coastal Bay tributaries during 2017. YSI (6600 V2 or EXO2) data loggers sampled seven environmental parameters: water temperature, specific conductance, dissolved oxygen concentration, oxygen percent saturation, pH, turbidity and fluorescence. Water depth was measured at stations where loggers were deployed at fixed depths. Salinity and chlorophyll were derived from specific conductance and fluorescence, respectively. Each parameter was sampled at 15-minute intervals, except at stations XEF3551 and XFG4618. The surface and bottom monitors at station XEF3551 and the monitor at station XFG4618 sampled parameters at 60-minute intervals for the entire deployment. The number of days that data was collected at individual stations ranged from ten to three hundred sixty-five.

Data loggers at most stations were exchanged bi-weekly. At nine stations, data loggers equipped with more advanced monitoring technology that allows for longer deployments were exchanged monthly. Data loggers deployed from November through March were exchanged monthly because less biofouling, which may compromise data integrity, occurs during cold weather months. Data loggers deployed greater than 10m below the surface at station XEF3551 were exchanged monthly. Data loggers deployed in a contained lake at station MZC0016 were exchanged monthly. Loggers were deployed simultaneously at two depths at stations XEF3551, XHH4931, and XIE7136.

When data loggers were exchanged, water samples for pigments, suspended solids, and nutrients from select stations were collected for later analyses. At the same time, Secchi disk depth was measured and a Hydrolab (series 4a or 5) water quality sonde was used to collect discrete water temperature, salinity, dissolved oxygen and pH data. Light attenuation was also measured using a LI-COR instrument.

Purpose:

The Maryland Department of Natural Resources Shallow Water Monitoring program is part of a cooperative effort between the Federal government and State and local governments in the Chesapeake Bay watershed to assess the ambient water quality criteria for dissolved oxygen, chlorophyll and water clarity in shallow water habitats. The Shallow Water Monitoring Program includes two components, the Water Quality Mapping Project and the Continuous Water Quality Monitoring Project.

Continuous Water Quality monitoring data describe the 2017 state of thirty-three shallow water sites on Chesapeake Bay and Maryland Coastal Bay and their tributaries using key water quality indicators.

The information is integrated with data from other Bay water quality stations and living resources monitoring projects and used to understand linkages, temporal variation and long-term trends.

Water quality data are used to refine, calibrate and validate Chesapeake Bay ecological models. The models are used to develop and assess water quality criteria with the goal of removing the Chesapeake Bay and its tidal rivers from the U.S. Environmental Protection Agency 303(d) list of impaired waters.

Supplemental Information:

The target audiences for this information include Resource Managers, Technical/Scientific Users, Government, Educators, Students and General Public.

Data users who desire very detailed information about Water Quality Monitoring data definition, sampling procedures and data processing are encouraged to refer to the documents listed below.

Water Quality Database - Database Design and Data Dictionary Prepared For: U.S. Environmental Protection Agency, Region III, Chesapeake Bay Program Office, January 2004. [http://www.chesapeakebay.net/documents/3676/cbwqdb2004_rb.pdf]

Guide to Using Chesapeake Bay Program Water Quality Monitoring Data, EPA 903-R-12-001, February 2012, CBP/TRS 304-12 [http://www.chesapeakebay.net/documents/3676/wq_data_userguide_10feb12_mod.pdf]

Methods and Quality Assurance for Chesapeake Bay Water Quality Monitoring Programs, May 2017, CBP/TRS-319-17 [<https://www.chesapeakebay.net/documents/CBPMethodsManualMay2017.pdf>]

Quality Assurance Project Plan for the Maryland Department of Natural Resources, Chesapeake Bay Shallow Water Quality Monitoring Program, for the period July 1, 2017 - June 30, 2018 [http://eyesonthebay.dnr.maryland.gov/eyesonthebay/documents/SWM_QAPP_2017_2018_Draft_v6.pdf]

Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 20170101

Ending_Date: 20171231

Currentness_Reference: Ground condition

Status:

Progress: Complete

Maintenance_and_Update_Frequency: As needed

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -79.4938

East_Bounding_Coordinate: -75.0405

North_Bounding_Coordinate: 39.7425

South_Bounding_Coordinate: 37.8713

Keywords:

Theme:

Theme_Keyword_Thesaurus:

Global Change Master Directory (GCMD). 2018. GCMD Keywords, Version 8.6. Greenbelt, MD: Global Change Data Center, Science and Exploration Directorate, Goddard Space Flight Center (GSFC) National Aeronautics and Space Administration (NASA).

URL (GCMD Keyword Forum Page): [<https://earthdata.nasa.gov/gcmd-forum>]

Theme_Keyword: Earth Science > Biosphere > Ecosystems > Marine Ecosystems > Estuary

Theme_Keyword: Earth Science > Biosphere > Ecosystems > Freshwater Ecosystems >

Rivers/Streams

Theme_Keyword: Earth Science > Biosphere > Ecological Dynamics > Ecosystem

Functions > Nutrient Cycling

Theme_Keyword: Earth Science > Biosphere > Ecological Dynamics > Ecosystem

Functions > Primary Production

Theme_Keyword: Earth Science > Terrestrial Hydrosphere > Surface Water > Surface Water Features > Rivers/Streams

Theme_Keyword: Earth Science > Terrestrial Hydrosphere > Surface Water > Surface Water Processes/Measurements > Water Depth

Theme_Keyword: Earth Science > Terrestrial Hydrosphere > Water Quality/Water Chemistry > Water Characteristics > Alkalinity

Theme_Keyword: Earth Science > Terrestrial Hydrosphere > Water Quality/Water Chemistry > Water Characteristics > Chlorophyll Concentrations

Theme_Keyword: Earth Science > Terrestrial Hydrosphere > Water Quality/Water Chemistry > Water Characteristics > Conductivity

Theme_Keyword: Earth Science > Terrestrial Hydrosphere > Water Quality/Water Chemistry > Water Characteristics > Light Transmission

Theme_Keyword: Earth Science > Terrestrial Hydrosphere > Water Quality/Water Chemistry > Water Characteristics > Nitrogen Compounds

Theme_Keyword: Earth Science > Terrestrial Hydrosphere > Water Quality/Water Chemistry > Gases > Dissolved Oxygen

Theme_Keyword: Earth Science > Terrestrial Hydrosphere > Water Quality/Water Chemistry > Water Characteristics > Nutrients

Theme_Keyword: Earth Science > Terrestrial Hydrosphere > Water Quality/Water Chemistry > Water Characteristics > pH

Theme_Keyword: Earth Science > Terrestrial Hydrosphere > Water Quality/Water Chemistry > Water Characteristics > Phosphorous Compounds

Theme_Keyword: Earth Science > Terrestrial Hydrosphere > Water Quality/Water Chemistry > Solids > Suspended Solids

Theme_Keyword: Earth Science > Terrestrial Hydrosphere > Water Quality/Water Chemistry > Water Characteristics > Turbidity

Theme_Keyword: Earth Science > Terrestrial Hydrosphere > Water Quality/Water Chemistry > Water Characteristics > Water Temperature

Theme_Keyword: Earth Science > Terrestrial Hydrosphere > Water Quality/Water Chemistry > Water Characteristics > Saline Concentration

Place:

Place_Keyword_Thesaurus: Producer Defined

Place_Keyword: United States

Place_Keyword: Maryland

Place_Keyword: Chesapeake Bay Watershed

Place_Keyword: Chesapeake Bay

Place_Keyword: Anne Arundel County

Place_Keyword: Baltimore City

Place_Keyword: Baltimore County

Place_Keyword: Calvert County

Place_Keyword: Caroline County

Place_Keyword: Cecil County

Place_Keyword: Dorchester County

Place_Keyword: Harford County

Place_Keyword: Kent County

Place_Keyword: Prince George's County

Place_Keyword: Queen Anne's County

Place_Keyword: Somerset County

Place_Keyword: St. Mary's County

Place_Keyword: Talbot County

Place_Keyword: Worcester County

Place_Keyword: Assawoman Bay

Place_Keyword: Back River

Place_Keyword: Bush River

Place_Keyword: Chincoteague Bay

Place_Keyword: Choptank River

Place_Keyword: Coastal Bays

Place_Keyword: Corsica River

Place_Keyword: Harris Creek

Place_Keyword: Patapsco River

Place_Keyword: Patuxent River

Place_Keyword: Potomac River

Place_Keyword: Sassafra River

Place_Keyword: Susquehanna Flats

Place_Keyword: Susquehanna River

Place_Keyword: Wicomico River

Place_Keyword: Williston Lake

Temporal:

Temporal_Keyword_Thesaurus: None

Temporal_Keyword: 2017

Access_Constraints: None

Use_Constraints: Acknowledgement of the MD Department of Natural Resources, Resource Assessment Service as a data source would be appreciated in products developed from these data. Please use the following citation: Maryland Department of Natural Resources, Resource Assessment Service. Eyes on the Bay. URL: [<http://www.eyesonthebay.net>].

Point_of_Contact:

Contact_Information:

Contact_Person_Primary:

Contact_Person: Mark Trice

Contact_Position: Chief, Water Quality Informatics

Contact_Address:

Address_Type: Mailing Address

Address: MDDNR, 580 Taylor Avenue, D2

City: Annapolis

State_or_Province: MD

Postal_Code: 21401

Contact_Voice_Telephone: 410 260-8630

Contact_Electronic_Mail_Address: Mark.Trice_nospam_@maryland.gov [Remove _nospam_ for valid email address]

Browse_Graphic:

Browse_Graphic_File_Name:

[http://eyesonthebay.dnr.maryland.gov/contmon/stn_map/Cmon_stns_2017.pdf]

Browse_Graphic_File_Description:

Map of thirty-three 2017 Continuous Monitoring Sites.

Browse_Graphic_File_Type: PDF

Data_Set_Credit:

Maryland Department of Natural Resources (MDDNR) Resource Assessment Service (RAS) staff collected the majority of samples and processed the data. The Nutrient Analytical Services Laboratory (NASL) at the Chesapeake Biological Laboratory (University of Maryland Center for Environmental Science) analyzed the nutrient, chlorophyll and suspended solids samples.

The project was made possible with funding provided by The State of Maryland, the United States Environmental Protection Agency Chesapeake Bay Program, the National Oceanic and Atmospheric Administration Chesapeake Bay Office and National Estuarine Research Reserve System program, the Dominion Foundation, the National Fish and Wildlife Foundation, the

Oyster Recovery Partnership, the National Aquarium in Baltimore, and The Nature Conservancy.

Data Quality Information:

Attribute Accuracy:

Attribute Accuracy Report:

Quality Assurance/Quality Control: MDDNR followed specific procedures to ensure that the Shallow Water Quality Monitoring Program project design was properly implemented and managed with sufficient accuracy, precision and detection limits. Accuracy (closeness to the true value) of collected data was controlled and assured by the proper use, calibration and maintenance of both field and laboratory equipment for the measurement of physical and chemical parameters.

The YSI 6600 V2 sondes were configured with the following probes: 6560(conductivity/temperature); 6561(flat glass pH) or 6579(tall pH); 6136(turbidity); 6150(ROX dissolved oxygen); 6025(fluorescence/chlorophyll). Sondes at two sites (MZC0016 and XJI2396) were also configured with 6131 (blue-green phycocyanin) probes.

The YSI EXO2 sondes were configured with the following probes: 599870-01(conductivity/temperature) or 599827 (wiped conductivity/temperature); 599702(unguarded pH); 599101-01(turbidity); 599100-01(optical dissolved oxygen); 599103-01(total algal chlorophyll and phycoerythrin).

Resolution, range and accuracy specifications for the YSI sondes and probes may be obtained from the manufacturer. [<http://www.yei.com/support.php>]

In March 2015 all remaining Series 4a instrument equipped with Standard Clark Polarographic Dissolved Oxygen Sensors were replaced with Series 5 instruments equipped with optical dissolved oxygen sensors (Luminescent Dissolved Oxygen Sensor - LDO). Calibration logs for each instrument list specific replacement dates. Sensors for temperature, specific conductance, pH and depth are identical for Series 4a and 5 instruments.

Procedures used to control and assure the accuracy of field measurements consisted of calibration of field instruments, verification of calibrations, equipment maintenance, and collection of filter blanks. Details of how data acquired with YSI sondes were quality assured and quality controlled may be found in the process description elements in the Lineage portion of this metadata record.

Water quality laboratory analysis results were used to calibrate and cross-check sonde data for accuracy. Daily quality control checks (including the running of blanks and standards) were used to control and assure laboratory accuracy.

Accuracy of Chesapeake Biological Laboratory, Nutrient Analytical Services Laboratory (CBL NASL) laboratory results was also assessed through DNR's participation in the Chesapeake Bay Coordinated Split Sample Program (CSSP), a split sampling program in which five laboratories involved in Chesapeake Bay monitoring analyze the coordinated split samples.

CSSP was initiated in June 1989 to establish a measure of comparability between sampling and analytical operations for water quality monitoring throughout the Chesapeake Bay and its tributaries. DNR followed the protocols in the Chesapeake Bay Coordinated Split Sample Program Implementation Guidelines (EPA 1991) and its revisions. Split samples were collected quarterly. Results were analyzed by appropriate statistical methods to determine if results differed significantly among labs. If a difference occurred, discussions began regarding techniques and potential method changes to resolve discrepancies.

Additionally, CBL NASL participated two times per year in the United States Geologic Survey (USGS) reference sample program.

Logical Consistency Report:

Two of the attributes in the water quality data set are PARAMETER and MEASUREVALUE. In cases where PARAMETER value is "SIGMA_T" and the MEASUREVALUE in the record is a negative number, the number should be considered unreliable. SIGMA_T values are not measured. SIGMA_T values are derived.

During 2017, at all but three stations, water quality monitoring sondes were deployed at a single depth. At three stations: Possum Point (XHH4931), the Gooses (XEF3551), and Aquarium East (XIE7136) sondes were deployed concurrently at two depths: one meter from the surface and 0.3 meters above the bottom.

Values in the 'LAYER' column of sonde data files may be used to determine the depth at which a sonde was deployed. Sonde data from all 2017 sites, except XHH4931, XEF3551, XFG4618, and XIE7136, list a value of 'BS' ('below surface') in the LAYER column. Depth values for stations with a LAYER value of 'BS' will vary depending on the method of sonde deployment at that station. For stations XHH4931, XEF3551, and XIE7136, a LAYER column value of 'B' indicates the sonde was deployed 0.3 meters above the bottom and a LAYER column value of 'S' indicates the sonde was deployed 1 meter below the surface. For station XFG4618, a LAYER column value of 'S' indicates the sonde was deployed 1 meter below the surface.

Beginning in 2013, data collection was discontinued at station XIE4741 (Masonville Cove) and a new station, XIE4742 (Masonville Cove Pier), was deployed approximately 160 meters west of station XIE4741. Also, beginning in 2014, data collection at station XFI9597 (Williston Lake) was discontinued and a new station, MZC0016 (Williston Lake Pier), was deployed approximately 30 meters northeast of station XFI9597.

In the 2017 sonde data, there are numerous instances of turbidity measurements with negative values. The turbidity probe accuracy is plus or minus 5 Nephelometric Turbidity Units/Formazin Nephelometric Units (NTU/FNU). In cases where turbidity probe post-deployment calibration values were within acceptable limits, negative values greater than or equal to -5.0 NTU/FNU are reported.

During 2017, it was not always possible, for logistical reasons, to replace sondes at all sites every two weeks, or every month for stations: XEF3551 (Gooses - Bottom), MZC0016

(Williston Lake Pier), LMN0028 (Little Monie Creek), XIF3760 (Pleasure Island), XBF7904 (St. Georges Creek), XHF0460 (Sandy Point - South Beach), XEE3591 (Dares Beach), XEE3691 (Dares Beach Pier), XGF5025 (Arundel on the Bay), XDG6518 (Taylor's Island), and XFF2293 (Tilghman Island).

The sonde at station XKH0375 was not exchanged on 27-Apr-2017, 25-May-2017, 4-Sep-2017, and 11-Oct-2017.

The sonde at station XFG2810 was not exchanged on 18-Apr-2017, 11-May-2017, 6-Jul-2017, 10-Aug-2017, 26-Sep-2017, and 25-Oct-2017.

The sonde at station XFG6431 was not exchanged on 18-Apr-2017, 11-May-2017, 6-Jul-2017, 10-Aug-2017, and 25-Oct-2017.

The sonde at station WXT0013 was not exchanged on 19-Jul-2017.

The sonde at station PXT0455 was not exchanged on 19-Jul-2017.

The sonde at station LMN0028 was not exchanged on 10-Jun-2017 and 7-Sep-2017.

The sonde at station MTI0015 was not exchanged on 19-Jul-2017.

The sonde at station XJG7035 was not exchanged on 18-Apr-2017, 23-May-2017, and 14-Jun-2017.

The sonde at station XIF7918 was not exchanged on 18-Apr-2017, 23-May-2017, 14-Jun-2017, and 25-Oct-2017.

The sonde at station XBF7904 was not exchanged on 14-May-2017 and 26-Jul-2017.

The sonde at station XHF0460 was not exchanged on 5-May-2017.

The sonde at station XKH2949 was not exchanged on 25-May-2017, 6-Jul-2017, 17-Aug-2017, and 4-Sep-2017.

The bottom sonde at station XIE7136 was not exchanged on 19-Oct-2017.

The surface sonde at station XEF3551 was not exchanged on 23-Mar-2017, 25-Apr-2017, 4-Jul-2017, 17-Aug-2017, 26-Sep-2017, and 9-Dec-2017.

The bottom sonde at station XEF3551 was not exchanged on 25-Feb-2017, 21-May-2017, 2-Jul-2017, 1-Sep-2017, and 21-Oct-2017.

The sonde at station XFG4618 was not exchanged on 18-Apr-2017, 11-May-2017, 6-Jul-2017, 10-Aug-2017, 26-Sep-2017, and 25-Oct-2017.

Completeness_Report:

2017 Data from thirty-three continuous monitoring stations are available on-line.
[<http://eyesonthebay.dnr.maryland.gov/contmon/ContMon.cfm>]

The 2017 Continuous Monitoring project dataset includes twelve months of sonde records from the continuous monitoring stations: WXT0013 (Iron Pot Landing), PXT0455 (Jug Bay), XIE4742 (Masonville Cove Pier), XEF3551 (Gooses – Surface and Bottom), XIE7135 (Aquarium West), and XIE7136 (Aquarium East – Surface and Bottom).

Sondes were deployed eleven months at station: XFG4618 (Harris Creek Profiler - Surface).

Sonde data were collected for ten months at stations: XFG2810 (Harris Creek Downstream) and XFG6431 (Harris Creek Upstream).

Nine month deployments occurred at stations: MTI0015 (Mataponi) and XJG7035 (Otter Point Creek).

Deployments at stations: XIG2853 (Tolchester), LMN0028 (Little Monie Creek), XKH2949 (Havre de Grace), XIF7918 (Riverside), XIF3760 (Pleasure Island), XJI2396 (Budd's Landing), XBF7904 (St Georges Creek), XJH1222 (Camp Tockwogh), XDG6518 (Taylor's Island), and XHF0460 (Sandy Point - South Beach) lasted eight months.

Sondes were deployed seven months at station: XDM4486 (Bishopville Prong), XDN6921 (Grey's Creek), NPC0012 (Newport Creek), XBM8828 (Public Landing), XKH0375 (Susquehanna Flats), XGF5025 (Arundel on the Bay), and XFF2293 (Tilghman Island).

Sonde data were collected for six months at station: MZC0016 (Williston Lake Pier).

Sonde data were collected for five months at station: XEE3591 (Dares Beach).

Sonde data were collected for two months at station: XEE3691 (Dares Beach Pier).

Sondes were deployed for one month at stations: XHH3851 (Sycamore Point) and XHH4931 (Possum Point – Surface and Bottom).

In 2017, the full suite of nutrient samples was collected at stations: XFG2810 (Harris Creek Downstream) and XFG6431 (Harris Creek Upstream). A sub-set of nutrients (Volatile Suspended Solids, Ammonium, Orthophosphate, Nitrite plus Nitrate, Total Dissolved Nitrogen (TDN), and Total Dissolved Phosphorus (TDP)) were collected at stations: XJG7035 (Otter Point Creek), PXT0455 (Jug Bay), MTI0015 (Mataponi), WXT0013 (Iron Pot Landing), and LMN0028 (Little Monie Creek). Alkalinity was measured at stations: XFG2810 (Harris Creek Downstream), XFG6431 (Harris Creek Upstream), and XFG4618 (Harris Creek Profiler - Surface). Total Suspended Solids, chlorophyll, and pheophytin were collected at all stations except stations XIE7135 (Aquarium West) and XIE7136 (Aquarium East - Bottom and Surface). No samples were collected by DNR at these two stations.

The user may discover a few interruptions in sonde datasets. In most cases, these interruptions were related to short-term problems with sonde operation.

Station XEE3591 (Dares Beach) was permanently removed from the Middle Central Mainstem Chesapeake Bay (CB4MH) on 23-Aug-2017 due to logistical issues with deployment at that location. A new station in CB4MH, station XEE3691 (Dares Beach Pier), was deployed on 20-Sep-2017 approximately 200m north of the previous location.

Station XHH3851 (Sycamore Point) was removed from service on 10-Jan-2017 due to cessation of monitoring at that site.

Station XHH4931 (Possum Point - Bottom) was removed from service on 9-Jan-2017 due to cessation of monitoring at that site.

Station XHH4931 (Possum Point - Surface) was removed from service on 24-Jan-2017 due to cessation of monitoring at that site.

Station XFG2810 (Harris Creek Downstream) was not deployed until 8-Mar-2017 due to concerns about ice and low temperatures.

Station XFG6431 (Harris Creek Upstream) was not deployed until 8-Mar-2017 due to concerns about ice and low temperatures.

Station MTI0015 (Mataponi) was not deployed until 12-Apr-2017 due to concerns about ice and low temperature.

Station XJG7035 (Otter Point Creek) was not deployed until 4-Apr-2017 due to concerns about ice and low temperature.

Station MZC0016 (Williston Lake Pier) was not deployed until 25-May-2017 and was removed from service on 4-Oct-2017.

There were gaps in the sonde data for the following reasons.

Station XFG4618 (Harris Creek Profiler - Surface) was not deployed between 5-Jan-2017 and 8-Mar-2017 due to concerns about ice and low temperature. Station XFG4618 is also missing data on 8-Jun-2017 and from 29-Jun-2017 to 1-Jul-2017 due to equipment malfunctions.

Station XIE7136 (Aquarium East - Surface) is missing data from 1-Jan-2017 to 11-Jan-2017 due to equipment malfunction. Station XIE7136 is also missing data from 29-Oct-2017 to 1-Nov-2017 due to a sonde power failure, and from 16-Oct-2017 to 19-Oct-2017 because the sonde was removed during pier construction.

Station XEF3551 (Gooses - Surface) is missing data from 1-Jan-2017 to 25-Jan-2017 due to an equipment malfunction.

Station XIE4742 (Masonville Cove Pier) is missing data from 12-Mar-2017 to 4-Apr-2017, 5-Oct-2017 to 19-Oct-2017, and from 21-Dec-2017 to 31-Dec-2017 due to equipment malfunctions.

Station WXT0013 (Iron Pot Landing) is missing data from 6-Apr-2017 to 12-Apr-2017 due to a sonde power failure.

Station XIF3760 (Pleasure Island) is missing data from 15-Apr-2017 to 25-Apr-2017 and from 5-May-2017 to 9-May-2017 due to sonde power failures. Station XIF3760 is also missing data from 17-Aug-2017 to 29-Aug-2017 due to equipment removed from service for repair.

Station XJG7035 (Otter Point Creek) is missing data from 22-Apr-2017 to 25-Apr-2017, 2-May-2017 to 9-May-2017, 18-Jun-2017 to 21-Jun-2017, and 7-Dec-2017 to 14-Dec-2017 due to sonde power failures.

Station XHF0460 (Sandy Point - South Beach) is missing data from 25-Apr-2017 to 16-May-2017, 20-May-2017 to 13-Jun-2017, 8-Sep-2017 to 14-Sep-2017, and 1-Nov-2017 to 28-Nov-2017 due to sonde power failures.

Station XFG6431 (Harris Creek Upstream) is missing data from 14-May-2017 to 18-May-2017 and from 31-Aug-2017 to 12-Sep-2017 due to sonde power failures. Station XFG6431 is also missing data from 18-May-2017 to 1-Jun-2017 due to a sonde configuration error.

Station XIG2853 (Tolchester) is missing data from 26-May-2017 to 7-Jun-2017 due to a sonde power failure.

Station XKH0375 (Susquehanna Flats) is missing data from 8-Jun-2017 to 17-Jul-2017 because the deployed sonde went missing. Data collection at station XKH0375 ended on 27-Oct-2017 because the deployed sonde again went missing.

Station XIE7136 (Aquarium East – Bottom) is missing data from 9-Jul-2017 to 12-Jul-2017 and from 27-Jul-2017 to 10-Aug-2017 due to equipment malfunctions. Station XIE7136 (Aquarium East – Bottom) is also missing data from 10-Nov-2017 to 16-Nov-2017 and from 3-Dec-2017 to 6-Dec-2017 due to sonde power failures. Lastly, station XIE7136 (Aquarium East – Bottom) is missing data from 16-Oct-2017 to 1-Nov-2017 because the sonde was removed during pier construction.

Station XBF7904 (St. Georges Creek) is missing data from 10-Jul-2017 to 2-Aug-2017 due to an equipment malfunction.

Station XGF5025 (Arundel on the Bay) is missing data from 30-May-2017 to 14-Jun-2017, 19-Jul-2017 to 26-Jul-2017, and from 30-Jul-2017 to 10-Aug-2017 due to sonde power failures.

Station XJI2396 (Budd's Landing) is missing data from 31-Jul-2017 to 2-Aug-2017 due to an equipment malfunction.

Station XIF7918 (Riverside) is missing data from 22-Aug-2017 to 29-Aug-2017 due to a sonde power failure.

Station MZC0016 (Williston Lake Pier) is missing data from 23-Aug-2017 to 30-Aug-2017 due to a sonde power failure.

Station XKH2949 (Havre de Grace) is missing data from 27-Sep-2017 to 12-Oct-2017 due to an equipment malfunction.

Station PXT0455 (Jug Bay) is missing data from 9-Nov-2017 to 15-Nov-2017 and from 7-Dec-2017 to 20-Dec-2017 due to sonde power failures. Station PXT0455 is also missing data from 15-Nov-2017 to 5-Dec-2017 due to an equipment malfunction.

Station XEE3591 (Dares Beach) is missing data from 4-Jun-2017 to 14-Jun-2017 due to a sonde power failure.

Station XEF3551 (Gooses – Surface) is missing data from 11-Apr-2017 to 9-Jun-2017 due to an equipment malfunction.

Station XEF3551 (Gooses – Bottom) is missing data from 21-Sep-2017 to 7-Dec-2017 because sondes were not deployed during repair of equipment.

Station XDN6921 (Grey's Creek) is missing data from 14-May-2017 to 16-May-2017 due to an equipment malfunction.

Station LMN0028 (Little Monie Creek) is missing data from 26-May-2017 to 21-Jun-2017 due to a sonde power failure.

Station NPC0012 (Newport Creek) is missing data from 17-Jun-2017 to 28-Jun-2017 due to a sonde power failure.

Station XDG6518 (Taylor's Island) is missing data from 17-Nov-2017 to 27-Nov-2017 due to a sonde power failure.

Station XFF2293 (Tilghman Island) is missing data from 15-Oct-2017 to 18-Oct-2017 and from 30-Oct-2017 to 28-Oct-2017 due to an equipment malfunction.

On a few occasions, due to extreme low tide conditions, sondes were not submerged. These data are not included in the published dataset.

All other missing sonde attribute values were removed during the quality control process because the data were determined to be unreliable.

Lineage:

Process_Step:

Process_Description:

SONDE CALIBRATION and POST-CALIBRATION

The Yellow Springs Instrument (YSI) 6600 V2 and EXO2 data sondes were maintained and calibrated before and after each deployment in accordance with YSI recommendations. [<http://www.ysi.com/support.php>]

FIELD MEASUREMENTS AND SAMPLING

SONDES:

The continuous monitoring sensors at the sites recorded seven water quality parameters every 15 minutes, except at stations XEF3551 and XFG4618. The surface and bottom monitors at station XEF3551 and the surface monitor at station XFG4618 sampled parameters at 60-minute intervals for all deployments. Data were uploaded to DNR's web site [<http://www.eyesonthebay.net>] shortly after retrieval.

At all sites the seven water quality parameters measured continuously were: water temperature, specific conductance (used to derive salinity values), dissolved oxygen, oxygen percent saturation, turbidity (NTU/FNU), fluorescence (used to estimate chlorophyll a) and pH. Sondes deployed at fixed depths also measured water depth.

Most monitoring stations were equipped with a YSI 6600 V2 sonde. The following eleven stations were equipped with a YSI EXO2 sonde: LMN0028 (Little Monie Creek), XIF3760 (Pleasure Island), XIE7135 (Aquarium West), XIE7136 (Aquarium East – Surface and Bottom), XBF7904 (St. Georges Creek), XHF0460 (Sandy Point - South Beach), XEE3591 (Dares Beach), XEE3691 (Dares Beach Pier), XGF5025 (Arundel on the Bay), XDG6518 (Taylor's Island), and XFF2293 (Tilghman Island). Both types of sonde logged data onto an internal memory, where it was stored until retrieval. Fourteen stations were equipped with cellular telemetry units, which allowed data to be transmitted hourly to a server computer at DNR. Sondes were deployed inside vertically-oriented PVC pipes with several two-inch holes drilled along their length to allow for water exchange. Depending on location, sondes were either suspended from a float 1.0-meters below surface or fixed 0.3-meters, 0.4-meters, or 0.5-meters above bottom resting on a stop bolt.

Sondes at the following stations were deployed at a fixed depth of 0.3 meters above the bottom: LMN0028 (Little Monie Creek), MTI0015 (Mataponi), NPC0012 (Newport Creek), PXT0455 (Jug Bay), WXT0013 (Iron Pot Landing), XBM8828 (Public Landing), XDM4486 (Bishopville Prong), XDN6921 (Grey's Creek), XHH4931 (Possum Point - Bottom), XJG7035 (Otter Point Creek), XKH0375 (Susquehanna Flats), XKH2949 (Havre de Grace), XFG2810 (Harris Creek Downstream), XFG6431 (Harris Creek Upstream), XIF3760 (Pleasure Island), XIE7136 (Aquarium East - Bottom), XEE3591 (Dares Beach), and XEE3691 (Dares Beach Pier).

Sondes at station XEF3551 (Gooses - Bottom) were deployed at a fixed depth of 0.4 meters above the bottom. Sondes at station XBF7904 (St Georges Creek) were deployed at a fixed depth of 0.5 meters above the bottom.

All other sondes were deployed suspended from buoys or floats at a depth of 1.0 meters below the surface.

Note that sondes were deployed concurrently at two depths at stations: XEF3551, XHH4931, and XIE7136.

WATER QUALITY CALIBRATION SAMPLES:

Each time sondes were exchanged at each Continuous Monitoring station, "grab" water quality samples were collected at 1.0 meter depth, or at deployment depth for stations deployed at a fixed depth above the bottom, using a horizontal "Alpha" water sampler. At Station XFG4618, a second (bottom) grab sample was collected at 2.0m depth. Also, at station XEF3551, a second (bottom) grab sample was collected at 11.0m depth. At the time the water was collected, a Hydrolab sonde measurement was taken at 1.0 meter depth. Note that no samples were collected by DNR at stations XIE7135 and XIE7136.

Numbered two-quart bottles were triple-rinsed and filled with water for "whole" and "filtered" nutrient and chlorophyll samples. (As noted previously, full suites of nutrient samples were not collected at all stations).

Nutrient, pigment and suspended-solid water samples were filtered on station or shortly thereafter. Sample waters and filters were placed on ice immediately after filtration.

Particulate samples included: Chlorophyll, Particulate Carbon, Particulate Nitrogen (PN), Particulate Phosphorus (PP), Particulate Inorganic Phosphorous (PIP), Total Suspended Solids (TSS) and Volatile Suspended Solids (VSS).

Filtrate collected from TSS/VSS or PP/PIP filtrations was used for dissolved nutrient samples. Total Dissolved Nitrogen (TDN) and Total Dissolved Phosphorus (TDP), Nitrite plus Nitrate, Nitrite, Ammonium, Orthophosphate, and Dissolved Organic Carbon samples were collected.

HYDROLAB PROFILE:

The first reading of the Hydrolab water column profile at each station was recorded at the same time the water quality "grab" sample was collected. After the 1.0-meter depth record was logged, the sonde was lowered to the bottom. A reading was taken at 0.3-meters above the bottom. The sonde was raised and measurements were recorded at 0.5-meter or 1.0-meter increments until it reached the surface. (In cases where station depth was greater than 3-meters, the sonde was raised in 1-meter increments).

SECCHI DEPTH:

Secchi disk depth was measured each time sondes were exchanged. Readings with the Secchi disk were made in-situ without the aid of sunglasses. The Secchi disk was lowered into the water, on the shady side of the boat or pier. The depth at which the disk was no longer visible was recorded. The time at which the reading was taken was noted. This facilitated later matching of Secchi depth readings with transmissometer and turbidity data.

PAR MEASUREMENT:

Underwater Photosynthetically Active Radiation (PAR, 400-700nm)

When meters were exchanged at a site, down-welling light penetrating the water column (PAR) was measured underwater at several depths to calculate the light attenuation coefficient, K_d . Simultaneous surface and submersed PAR intensity measurements were taken to account for variability in incident surface irradiance due to changes in cloud cover. Data collected from this procedure were used to estimate the depth of the photic zone.

The equipment used was manufactured by LI-COR, Inc. and consisted of a LI-192SA, flat cosine Underwater Quantum Sensor, a LI-190SA air (deck) reference sensor and a Data Logger (LI-1000 or LI-1400).

Surface and underwater readings were recorded simultaneously. Readings were allowed to stabilize before being recorded. If the station depth was less than 3 meters, readings were taken at 0.1 meter and at 0.25-meter intervals until 10% of the 0.1-meter reading was reached. If the station depth was greater than 3 meters, a reading was taken at 0.1-meter and at 0.5-meter intervals until 10% of the 0.1-meter reading was reached.

PAR readings had also been collected at 15-minute intervals during deployment dates at station XBM8828 (Public Landing) between 2005 and 2012. All 2013 readings were considered invalid, however, due to equipment failure and the PAR sensor has not been deployed since 2013.

SONDE DATA CHECKS

At most stations, the continuous monitoring sondes were retrieved, calibrated and replaced bi-weekly during deployment. At nine stations, data loggers equipped with more advanced monitoring technology that allows for longer deployments were exchanged monthly. Data loggers deployed from November to March were exchanged monthly because less biofouling, which may compromise data integrity, occurs during cold weather months. Data loggers deployed greater than 10m below surface at station XEF3551 were exchanged monthly. Data loggers deployed in a contained lake at station MZC0016 were exchanged monthly. At each deployment, sondes were replaced with clean, recalibrated units and data from the data loggers were downloaded to a computer.

In the field, before an instrument was replaced, field staff allowed both the new (freshly calibrated) sonde and the old (deployed) sonde to log two readings (fifteen minutes apart at

most stations) side by side at the same depth. For the surface and bottom sondes at station XEF3551 and the surface monitor at station XFG4618, only one simultaneous reading was taken using the new and old sondes. At all of the stations, for one of the simultaneous readings, data were recorded from a discrete instrument (usually a Hydrolab sonde). This three-way comparison assured that the "new" and "old" sondes were both reading each parameter within a certain tolerance. The Hydrolab reading was used as a "double-check," and since it was a discrete reading, it allowed staff to watch the display and note whether the parameters were fluctuating or stable.

EcoWatch(TM) software (a YSI product) was used to calibrate the YSI 6600 V2 instruments, as well as to upload and view data collected. KOR(TM) software (a YSI product) was used to calibrate the EXO2 instruments, as well as to upload and view data collected. Data downloaded from the sonde were subjected to quality assurance/quality control checks to ensure that values outside the range of possibility were not displayed on the DNR web site.

Data were evaluated using both three-way in-situ comparison results and data from sonde calibrations. The comparison tolerances were as follows - for both pre- and post-calibration and in-situ comparisons: Temperature (deg C) \pm 0.2; Specific Conductance (uM/cm) \pm 5%; Dissolved Oxygen (mg/l) \pm 0.5 mg/l; pH \pm 0.2; Turbidity (NTU/FNU) \pm 5% or 5.0 NTU/FNU (whichever is greater); Chlorophyll (ug/l) \pm 5% or 5.0 ug/l (whichever is greater).

Excessive drift between pre- and post- calibration values of sonde probes, variance from in-situ measurements or probe failures caused data to be flagged. When post-calibration drift exceeded the limits stated above in both the post-calibration and the in-situ comparables, suspect data were masked within the data set with an error code (see QAPP for list of error codes).

SONDE FILE POST-PROCESSING:

Each "raw" .csv file of sonde data was post-processed using an Excel(TM) macro. The file was opened and renamed. Rows of data acquired before and after deployment were deleted. Records (if any) were also deleted if instrument error codes indicated erroneous data. The macro rearranged columns and inserted error-tracking columns and headings. Macro statements flagged negative values, missing values and highlighted values outside each parameter's normal range. The macro also returned a report summarizing range exceedances. Event and instrument information was appended to each record.

Flagged values were evaluated. Common anomalies included spikes in fluorescence and turbidity, dips in specific conductance, and extremely high dissolved oxygen readings. Instrument post-calibration results, in-situ comparisons with Hydrolab, LI-COR readings, historical data from nearby locations, and survey crew remarks were used to determine whether sensor values were acceptable.

In cases where data were determined to be unreliable, the reason(s) were documented with error codes and comments. Unreliable data were masked. No data were discarded. Only data considered reliable were published in reports.

Field biologists and data analysts reviewed continuous monitoring data weekly. If a problem was identified, a field team member was dispatched to replace the instrument as soon as possible.

VERIFICATION AND DATA MANAGEMENT

At the end of the monitoring season, DNR data analysts and field biologists conducted additional data QA/QC procedures. All of the data were plotted, and outliers and anomalous values were thoroughly researched. Staff compared unusual values to historic values from the site and values from nearby sites in the Bay. Weather events were considered, event logs were reviewed, and field staff members were consulted regarding possible legitimate causes for the values. In cases where values were not considered legitimate, error codes were assigned. All data were retained in the archive data set. After field staff and the Quality Assurance Officer reviewed error flags, the values were masked within the published dataset.

Process_Date: Unknown

Process_Contact:

Contact_Information:

Contact_Person_Primary:

Contact_Person: Kristen Heyer

Contact_Position: Program Manager, Water Quality Monitoring, DNR

Contact_Address:

Address_Type: mailing and physical

Address: 1919 Lincoln Drive

City: Annapolis

State_or_Province: Maryland

Postal_Code: 21401

Country: USA

Contact_Voice_Telephone: 410 263-3369

Contact_Electronic_Mail_Address: Kristen.Heyer_nospam_@maryland.gov [Remove _nospam_ for valid email address]

Process_Step:

Process_Description:

LABORATORY ANALYSIS - CBL

University of Maryland Center for Environmental Science's Chesapeake Biological Laboratory (CBL), Nutrient Analytical Services Laboratory analyzed total dissolved nitrogen, particulate nitrogen, nitrite, nitrite + nitrate, ammonium, total dissolved phosphorus, particulate phosphorus, particulate inorganic phosphorus, orthophosphate, dissolved organic carbon, particulate carbon, total suspended solids, volatile suspended solids, chlorophyll, pheophytin, and alkalinity.

Note that in 2017, the full suite of nutrients was only collected at stations: XFG2810 (Harris Creek Downstream) and XFG6431 (Harris Creek Upstream). A subset of nutrients (Volatile Suspended Solids, Ammonium, Orthophosphate, Nitrite plus Nitrate, Total Dissolved Nitrogen, and Total Dissolved Phosphorus) was collected at stations XJG7035 (Otter Point

Creek), PXT0455 (Jug Bay), MTI0015 (Mataponi), WXT0013 (Iron Pot Landing), and LMN0028 (Little Monie Creek). Alkalinity was collected at stations: XFG2810 (Harris Creek Downstream), XFG6431 (Harris Creek Upstream), and XFG4618 (Harris Creek Profiler - Surface). Total Suspended Solids, chlorophyll, and pheophytin were collected at all stations except stations XIE7135 (Aquarium West) and XIE7136 (Aquarium East - Bottom and Surface). No samples were collected by DNR at these two stations.

During the years 2008-2011, Shallow Water Monitoring silicate samples were collected and analyzed at four Maryland Coastal Bays stations: XDM4486 (Bishopville Prong), XDN6921 (Grey's Creek), NPC0012 (Newport Creek) and XBM8828 (Public Landing). Beginning in 2012, silicate samples were no longer collected at these four Coastal Bays stations.

Further information about laboratory analytical procedures may be obtained from the "Process_Contact".

Process_Date: Unknown

Process_Contact:

Contact_Information:

Contact_Person_Primary:

Contact_Person: Jerry Frank

Contact_Position: Manager of Analytical Services/Senior Faculty Research Assistant

Contact_Address:

Address_Type: mailing and physical

Address: Chesapeake Biological Laboratory, 146 Williams St; P.O. Box 38

City: Solomons

State_or_Province: Maryland

Postal_Code: 20688

Country: USA

Contact_Voice_Telephone: 410 326-7252

Contact_Electronic_Mail_Address: frank_nospam_@cbl.umces.edu [Remove _nospam_ for valid email address]

Spatial_Data_Organization_Information:

Indirect_Spatial_Reference: Assawoman Bay, Back River, Bush River, Chesapeake Bay, Chincoteague Bay, Maryland Coastal Bays, Choptank River, Corsica River, Harris Creek, Patapsco River, Patuxent River, Potomac River, Sassafras River, Susquehanna River, Susquehanna Flats, Wicomico River, Williston Lake, Maryland, USA

Direct_Spatial_Reference_Method: Point

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Geographic:

Latitude_Resolution: 0.0001

Longitude_Resolution: 0.0001

Geographic_Coordinate_Units: Decimal degrees

Geodetic_Model:

Horizontal_Datum_Name: North American Datum of 1983
Ellipsoid_Name: Geodetic Reference System 80
Semi-major_Axis: 6378137
Denominator_of_Flattening_Ratio: 298.257

Entity_and_Attribute_Information:

Overview_Description:

Entity_and_Attribute_Overview:

This metadata record is a description of a continuous monitoring project. Project data are an aggregation of data collected at thirty-three Maryland stations during 2017.

The data are contained in six related entities (tables): Station_Information, Monitoring_Event_Data, Water_Quality_Data, Light_Attenuation_Data, Optical_Density_Data, and CMON_DATA. Each table contains attributes (fields).

The entity Station_Information is comprised of the attributes: Station, StationDescription, CBSeg2003, CBSeg2003Description, CBSegmentShed2009, CBSegmentShed2009Description, HUC8, HUC12, FIPS, State, CountyCity, USGSGage, FallLine, Latitude, Longitude, UTMX, UTMY and LLDatum.

The entity Monitoring_Event_Data is comprised of the attributes: MonitoringStation, EventId, Cruise, Program, Project, Agency, Source, Station, SampleDate, SampleTime, TotalDepth, UpperPycnocline, LowerPycnocline, FieldActivityEventType, FieldActivityRemark, WindSpeed, WindDirection, PrecipType, TideStage, WaveHeight, CloudCover, Pressure, GaugeHeight, FlowStage, Details, Latitude, and Longitude.

The entity Water_Quality_Data is comprised of the attributes: MonitoringStation, EventId, Cruise, Program, Project, Agency, Source, Station, SampleDate, SampleTime, TotalDepth, UpperPycnocline, LowerPycnocline, Depth, Layer, SampleType, SampleReplicateType, Parameter, Qualifier, MeasureValue, Unit, Method, Lab, Problem, PrecisionPC, BiasPC, Details, Latitude, and Longitude.

The entity Light_Attenuation_Data is comprised of the attributes: MonitoringStation, EventId, Cruise, Program, Project, Agency, Source, Station, SampleDate, SampleTime, TotalDepth, UpperPycnocline, LowerPycnocline, Depth, Layer, SampleType, SampleReplicateType, Parameter, Qualifier, MeasureValue, Unit, Method, Lab, Problem, PrecisionPC, BiasPC, Details, Latitude, and Longitude.

The entity Optical_Density_Data is comprised of the attributes: MonitoringStation, EventId, Cruise, Program, Project, Agency, Source, Station, SampleDate, SampleTime, TotalDepth, UpperPycnocline, LowerPycnocline, Depth, Layer, SampleType, SampleReplicateType, Parameter, Qualifier, MeasureValue, Unit, Method, Lab, Problem, PrecisionPC, BiasPC, Details, Latitude, and Longitude.

The entity CMON_DATA is comprised of the attributes: Station, StationDesc, Sample_Date, Sample_Time_EST, Layer, Depth_m, Salinity_ppt, Temp_C, DO_mg/L, DO_%Sat, pH, Turbidity_NTU/FNU, and Chl_ug/L.

Entity_and_Attribute_Detail_Citation:

Water Quality Database - Database Design and Data Dictionary Prepared For: U.S. Environmental Protection Agency, Region III, Chesapeake Bay Program Office, January 2004. [http://www.chesapeakebay.net/documents/3676/cbwqdb2004_rb.pdf]

Guide to Using Chesapeake Bay Program Water Quality Monitoring Data, EPA 903-R-12-001, February 2012, CBP/TRS 304-12 [http://www.chesapeakebay.net/documents/3676/wq_data_userguide_10feb12_mod.pdf]

Methods and Quality Assurance for Chesapeake Bay Water Quality Monitoring Programs, May 2017, CBP/TRS-319-17 [<https://www.chesapeakebay.net/documents/CBPMethodsManualMay2017.pdf>]

Quality Assurance Project Plan for the Maryland Department of Natural Resources, Chesapeake Bay Shallow Water Quality Monitoring Program, for the period July 1, 2017 - June 30, 2018. [http://eyesonthebay.dnr.maryland.gov/eyesonthebay/documents/SWM_QAPP_2017_2018_Draft_v6.pdf]

Distribution_Information:

Distributor:

Contact_Information:

Contact_Person_Primary:

Contact_Person: Michael Mallonee

Contact_Position: Water Quality Database Manager

Contact_Address:

Address_Type: mailing

Address: 410 Severn Avenue, Suite 109

City: Annapolis

State_or_Province: Maryland

Postal_Code: 21403

Contact_Voice_Telephone: 410-267-5785

Contact_Electronic_Mail_Address: mmallone@_no_spam_chesapeakebay.net [Remove _no_spam_ for valid email address]

Resource_Description: Downloadable data

Distribution_Liability: None of the Chesapeake Bay Program partners or any of their employees, contractors, or subcontractors makes any warranty, expressed or implied, nor assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information or data contained within the web site. Reference to any specific commercial products, processes, or services or the use of any trade, firm, or corporation name is for the information and convenience of the public and does not constitute endorsement, recommendation or favoring by the Chesapeake Bay Program partners.

Standard_Order_Process:

Digital_Form:

Digital_Transfer_Information:

Format_Name: ASCII file, formatted for text attributes, declared format

Format_Information_Content: Station Information data, Monitoring Event data, Light Attenuation data and Water Quality data

File-Decompression_Technique: No compression applied

Transfer_Size: 2.2

Digital_Transfer_Option:

Online_Option:

Computer_Contact_Information:

Network_Address:

Network_Resource_Name:

[http://www.chesapeakebay.net/data/index.cfm?subjectarea=WATER_QUALITY]

Access_Instructions: Station Information, Monitoring Event, Light Attenuation and Water Quality data are available through the Chesapeake Bay Programs CIMS data hub. Select Water Quality Database (1984-Present). Access the data by following web site (see network resource name) instructions.

Digital_Form:

Digital_Transfer_Information:

Format_Name: ASCII file, formatted for text attributes, declared format

Format_Information_Content: Continuous monitoring sonde data

File-Decompression_Technique: No compression applied

Transfer_Size: 100

Digital_Transfer_Option:

Online_Option:

Computer_Contact_Information:

Network_Address:

Network_Resource_Name:

[<http://eyesonthebay.dnr.maryland.gov/contmon/ContMon.cfm>]

Access_Instructions: CMON data (sonde data) for 2017 are available through the Continuous Monitoring - Archived Results page of the Eyes on the Bay website. Access sonde data by following web site (see network resource name) instructions. Select station and specify dates. Station record counts range from 811 to 35,040. Depending on connection speed, downloads may take a considerable amount of time. Downloading partial record sets will proceed more quickly.

Fees: None

Metadata_Reference_Information:

Metadata_Date: 20180718

Metadata_Contact:

Contact_Information:

Contact_Person_Primary:

Contact_Person: Brian Smith

Contact_Address:

Address_Type: Mailing and physical address

Address: MDDNR, 580 Taylor Ave, D-2

City: Annapolis

State_or_Province: MD

Postal_Code: 21401

Contact_Voice_Telephone: (410) 260-8630

Contact_Electronic_Mail_Address: brianr.smith_nospam_@maryland.gov[Remove
nospam for valid email address]

Metadata_Standard_Name: Content Standards for Digital Geospatial Metadata

Metadata_Standard_Version: FGDC-STD-001-1998