MARYLAND CHESAPEAKE BAY PROGRAM BENTHIC MONITORING DATA DICTIONARY

(Revised: 28 March, 2023)

ABSTRACT:
The state of Maryland, in cooperation with the USEPA Chesapeake Bay Program has monitored benthic species abundance and biomass in the Maryland Chesapeake Bay mainstem and tributaries since July 1984. This monitoring effort began as an extension of ongoing Power Plant monitoring studies in the state. The current program is designed to give comprehensive spatial and temporal information on benthic conditions in the Chesapeake Bay.   The sampling parameters include water quality and sediment measurements, benthic infauna composition and abundance, and benthic infauna biomass. Sample collection is currently performed once a year, independently from Maryland plankton and water quality monitoring programs.

DATA FILE NAMING CONVENTION:

MDBEyy_EV.TXT	Maryland Benthic Program Sampling Event Record
MDBEyy_SMP.TXT	Maryland Benthic Program Sample Collection Record
MDBEyy_WQ.TXT	Maryland Benthic Program Water Quality Data Record
MDBEyy_SED.TXT	Maryland Benthic Program Sediment Data Record
MDBEyy_TX.TXT	Maryland Benthic Taxonomic and Abundance Data Record
MDBEyy_BM.TXT	Maryland Benthic Biomass Data Record
MDBEyy_IBI.TXT	Maryland Benthic Index of Biotic Integrity Record

Data files are provided in comma delimited ASCII format with header line.

ASSOCIATED DATA FILES:

NEWTAXA.TXT	Species Code Supplement for the data reporting year
MISSDOC.TXT	Missing data for the reporting year
METHODCHANGE.TXT	Changes to methods for the reporting year

NAMES AND DESCRIPTIONS OF ASSOCIATED DATA DICTIONARY FILES:
Chesapeake Bay Water Quality Monitoring Program, Long-Term Benthic Monitoring and Assessment Component Quality Assurance Project Plan (QAPP)

Please see QAPP at http://www.baybenthos.versar.com/data.htm for detailed information on program organization and management, program objectives, program design, station location and identification procedures, field collection procedures, laboratory processing,

data management and analysis, and data quality assurance and control (QA/QC) procedures.

PROJECT TITLE:
Maryland Chesapeake Bay Long-Term Benthic Monitoring and Assessment Program

CURRENT PRINCIPAL INVESTIGATORS:
Program Manager: Tom Parham, Maryland Department of Natural Resources, Tidewater Ecosystem Assessment.
Program Lead Scientist: Dr. Roberto J. Llansó, Versar, Inc.
Data Coordinator: Michael F. Lane, Old Dominion University.

CURRENT FUNDING AGENCIES:
Maryland Department of Natural Resources as match grant to U.S. Environmental Protection Agency Chesapeake Bay Program.

CURRENT QA/QC OFFICER:
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LOCATION OF STUDY:
Chesapeake Bay and tidal tributaries in Maryland, U.S.A.

DATE INTERVALS:

The Maryland Chesapeake Bay Long-Term Benthic Monitoring and Assessment Program was implemented in July 1984. This web site currently serves data from July 15, 1995 through September 2022 (summer only). Data from previous years and spring sampling (see below) can be obtained by contacting the Program Lead Scientist (see above), or from the Chesapeake Bay Program Data Hub:

http://www.chesapeakebay.net/data

STUDY DESIGN:

The sampling design of this survey changed several times to accommodate changes in the State of Maryland's objectives for this program. See the history of the benthic monitoring program at this web site: http://www.baybenthos.versar.com/history.htm.

With the current design (July 1994 to present), two types of sites are sampled: (1) fixed sites sampled to identify temporal trends and (2) spatially random sites sampled to assess bay-wide benthic community status. Although the site selection criteria for random sites has changed since 1994, sample collection and laboratory methods have not changed significantly. Fixed sites were sampled twice a year through 2008, in May and in late August or September. From 2009 onwards, fixed sites are sampled once a year in late August or September. Random sites are sampled once a year in late August or September at a new set of locations every year. Three replicate sediment samples for benthos are collected at each of 27 fixed sites with gear used since 1984. One sample is collected at each randomly selected site using a Young grab with a surface area of 440 cm^2. Twenty five random samples per sampling stratum are collected every year for a total of 150 samples in six strata. Samples are sieved on a 0.5-mm screen and preserved in the field.

Site selection, strata, and the name, position, and physical characteristics of fixed sites can be found in the QAPP at this Data Dictionary web site location:
http://www.baybenthos.versar.com/data.htm

VARIABLE NAMES AND DESCRIPTIONS FOR DATA FILES:

MARYLAND BENTHIC PROGRAM SAMPLING EVENT RECORD
File: MDBE_EV.TXT

Name	Description
STATION	Sampling Station
SAMPLE_DATE	Sampling Date (YYYY-MM-DD)
SAMPLE_TIME	Time of Station Positioning/initial sampling (HH:MM)
STRATUM	Sampling Stratum or Tributary Designation (see below for strata)
LATITUDE	Latitude (decimal degrees)

Name	Description
LONGITUDE	Longitude (negative decimal degrees)
LL_DATUM	North American Datum Code
SITE_TYPE	Sampling Site Type (Fixed, Random)
TOTAL_DEPTH	Bottom Depth of Station (meters)
SOURCE	Data Collection Institution
YEARCODE	Sampling Year Code (YY/YY, years bracketing the funding period, July 1-June 30)
CRUISENO	Sampling Cruise Number (1 =Summer, 2 =Spring)
STAEQ85	Pre-1989 Station Designation
STAEQ89	Post-1989 Station Designation
SAMP_TYPE	Sample Collection Type (F =Fixed, M =Bay-wide Random)

MARYLAND BENTHIC PROGRAM SAMPLE COLLECTION RECORD
File: MDBE_SMP.TXT

Name	Description
STATION	Sampling Station
SAMPLE_DATE	Sampling Date (YYYY-MM-DD)
SAMPLE_NUMBER	Sample Replicate Number
GMETHOD	Gear Method Code (BC-PH =Post-hole digger; BC-WC =Wildco box corer; PP =Petite Ponar; VV-YM =Van Veen-modified Young grab)
NET_MESH	Screen Mesh Opening (millimeter)
PENETR	Sampling Gear Penetration Depth (centimeters)
SER_NUM	Source Sample Serial Number
SOURCE	Data Collection Institution
YEARCODE	Sampling Year Code (YY/YY, years bracketing the funding period, July 1-June 30)
CRUISENO	Sampling Cruise Number (1 =Summer, 2 =Spring)
STAEQ85	Pre-1989 Station Designation
STAEQ89	Post-1989 Station Designation

MARYLAND BENTHIC PROGRAM WATER QUALITY DATA RECORD
File: MDBE_WQ.TXT

Name	Description
STATION	Sampling Station
SAMPLE_DATE	Sampling Date (YYYY-MM-DD)
SAMPLE_NUMBER	Sample Replicate Number
SAMPLE_DEPTH	Sample Collection Water Depth (meters)

PARAMETER	Sampling Parameter (CONDUCT, DO, DO_PSAT, PH, SALINITY, WTEMP, see below)
VALUE	Sampling Parameter Value
UNITS	Reporting Units of Value
SOURCE	Data Collection Institution
YEARCODE	Sampling Year Code (YY/YY, years bracketing the funding period, July 1-June 30)
CRUISENO	Sampling Cruise Number (1 =Summer, 2 =Spring)
STAEQ85	Pre-1989 Station Designation
STAEQ89	Post-1989 Station Designation
SAMP_TYPE	Sample Collection Type (F =Fixed, M =Bay-wide Random)

MARYLAND BENTHIC PROGRAM SEDIMENT DATA RECORD
File: MDBE_SED.TXT

Name	Description
STATION	Sampling Station
SAMPLE_DATE	Sampling Date (YYYY-MM-DD)
SAMPLE_NUMBER	Sample Replicate Number
PARAMETER	Sampling Parameter (MOIST, SAND, SILTCLAY, TC, TIC, TN, TOC, see below)
VALUE	Sampling Parameter Value
UNITS	Reporting Units of Value
SOURCE	Data Collection Institution
YEARCODE	Sampling Year Code (YY/YY, years bracketing the funding period, July 1-June 30)
CRUISENO	Sampling Cruise Number (1 =Summer, 2 =Spring)
STAEQ85	Pre-1989 Station Designation
STAEQ89	Post-1989 Station Designation
SAMP_TYPE	Sample Collection Type (F =Fixed, M =Bay-wide Random)

MARYLAND BENTHIC TAXONOMIC AND ABUNDANCE DATA RECORD
File: MDBE_TX.TXT

Name	Description
STATION	Sampling Station
SAMPLE_DATE	Sampling Date (YYYY-MM-DD)
SAMPLE_NUMBER	Sample Replicate Number
SPEC_CODE	Agency Taxon Code

LBL	Label or Taxon Name
TSN	ITIS Taxon Serial Number
PARAMETER	Sample Parameter (COUNT, see below)
VALUE	Sample Parameter Value
UNITS	Reporting Units of Value
SOURCE	Data Collection Institution
GMETHOD	Gear Method Code (BC-PH =Post-hole digger; BC-WC =Wildco box corer; PP =Petite Ponar; VV-YM =Van Veen-modified Young grab)
NET_MESH	Screen Mesh Opening (millimeter)
SKIP	Skip Species Count Indicator (see below)
YEARCODE	Sampling Year Code (YY/YY, years bracketing the funding period, July 1-June 30)
CRUISENO	Sampling Cruise Number (1 =Summer, 2 =Spring)
STAEQ85	Pre-1989 Station Designation
STAEQ89	Post-1989 Station Designation
SAMP_TYPE	Sample Collection Type (F =Fixed, M =Bay-wide Random)

MARYLAND BENTHIC BIOMASS DATA RECORD
File: MDBE_BM.TXT

Name	Description
STATION	Sampling Station
SAMPLE_DATE	Sampling Date (YYYY-MM-DD)
SAMPLE_NUMBER	Sample Replicate Number
SPEC_CODE	Agency Taxon Code
LBL	Label or Taxon Name
TSN	ITIS Taxon Serial Number
PARAMETER	Sample Parameter (AFDW, see below)
VALUE	Sample Parameter Value
VALUE_TYPE	Actual or Estimated (W =Actual Ash-Free Dry Weight)
UNITS	Reporting Units of Value
SOURCE	Data Collection Institution
GMETHOD	Gear Method Code (BC-PH =Post-hole digger; BC-WC =Wildco box corer; PP =Petite Ponar; VV-YM =Van Veen-modified Young grab)
NET_MESH	Screen Mesh Opening (millimeter)
YEARCODE	Sampling Year Code (YY/YY, years bracketing the funding period, July 1-June 30)
CRUISENO	Sampling Cruise Number (1 =Summer, 2 =Spring)
STAEQ85	Pre-1989 Station Designation

STAEQ89   Post-1989 Station Designation
SAMP_TYPE   Sample Collection Type (F =Fixed, M =Bay-
                                    wide Random)

MARYLAND BENTHIC INDEX OF BIOTIC INTEGRITY RECORD
File: MDBE_IBI.TXT

Name	Description
STATION	Sampling Station
SAMPLE_DATE	Sampling Date (YYYY-MM-DD)
SOURCE	Data Collection Institution
YEARCODE	Sampling Year Code (YY/YY, years bracketing the funding period, July 1-June 30)
SITE_TYPE	Sampling Site Type (Fixed, Random)
IBI_SALZONE	Bottom Salinity Class (TF =Tidal Fresh, O =Oligohaline, LM =Low Mesohaline, HM =High Mesohaline, P =Polyhaline, see below)
IBI_BOTTOM_TYPE	Sediment Type (M =mud, S =sand)
STAEQ85	Pre-1989 Station Designation
STAEQ89	Post-1989 Station Designation
SAMPLE_NUMBER	Sample Replicate Number
IBI_SCORE	Benthic Index of Biotic Integrity Value for Sample
AVE_IBI_SCORE	Fixed Station Replicate Averaged Benthic Index of Biotic Integrity Value
IBI_PARAMETER	Benthic Index of Biotic Integrity Parameter (PCT_CAR_OMN, PCT_DEPO, PCT_PI_ABUND, PCT_PI_BIO, PCT_PI_F_ABUND, PCT_PI_O_ABUND, PCT_PS_ABUND, PCT_PS_BIO, PCT_PS_O_ABUND, PCT_TANYPODINI, SW, TOLERANCE, TOT_ABUND, TOT_BIOMASS, see below)
VALUE	Benthic Index of Biotic Integrity Parameter Value
SCORE	Benthic Restoration Goal Score for Parameter
R_DATE	Benthic Index of Biotic Integrity Run Date

SAMPLING STRATUM OR TRIBUTARY DESIGNATION:
Probability sites are allocated according to a stratified random sampling scheme designed
to produce an annual estimate of area meeting the Restoration Goals for the tidal waters
(>1 m MLLW) of the Maryland Chesapeake Bay as well as estimates for six subdivisions
or strata. Samples are allocated equally among strata. Regions of the Maryland bay
mainstem deeper than 12 m are not included in the sampling strata because these areas

are subjected to summer anoxia and have been found to be azoic. The following are the sampling strata (see QAPP for a map of strata):

MET = Maryland Eastern Tributaries
MMS = Maryland Mainstem
MWT = Maryland Upper Western Tributaries
PMR = Potomac River
PXR = Patuxent River
UPB = Maryland Upper Bay

Fixed stations, which are not part of these strata, are designated as HIS = Historical

LIST OF PARAMETERS AND METHODS:

Parameter: **AFDW** (Taxon ash free dry weight in grams)

Collection Method: Benthic grab (220 cm^2 surface area Wildco box corer, 250 cm^2 Petite Ponar, 440 cm^2 Young grab) or 250 cm^2 surface area post-hole digger. Contents sieved through 0.5-mm screen and preserved in the field.

Sample Preservatives: 10% buffered formalin with Rose Bengal, transferred to 70% ethanol after 5-8 months.

Sample Storage: Plastic bottles until commencement of processing

Laboratory Technique: Since 1994, ash-free dry weight biomass is measured directly for each species (with the exceptions listed below) by drying the organisms to a constant weight at 60°C and ashing in a muffle furnace at 500°C for four hours and re-weighing (ash weight). The difference between dry weight and ash weight is the ash-free weight. Because oligochaetes and chironomids require slide mounting for identification, species-specific biomass for Oligochaeta and Chironomidae is not provided except for *Tubificoides* spp., *Branchiura sowerbyi*, and *Coelotanypus* spp., which do not require slide mounting for identification. Bivalves are crushed to open the shells and expose the animal to drying and ashing (shells included).

Parameter: **COUNT**

Collection Method: Benthic grab (220 cm^2 surface area Wildco box corer, 250 cm^2 Petite Ponar, 440 cm^2 Young grab) or 250 cm^2 surface area post-hole digger. Contents sieved through 0.5-mm screen and preserved in the field. See QAPP for detail on where the various types of benthic samplers are used.

Sample Preservatives: 10% buffered formalin with Rose Bengal transferred to 70% ethanol after sorting.

Sample Storage: Plastic bottles until commencement of processing

Laboratory Technique:	Most organisms are separated from the detritus in gridded petri dishes and sorted into major taxa using binocular dissecting microscopes. After sorting, the organisms are stored in 70% ethanol and subsequently identified to the lowest possible taxonomic level (usually species) and counted. Fragments without heads are eliminated from the counts but included in biomass determinations. Oligochaetes and chironomids are mounted on microscope slides, examined under a compound microscope, and identified to genus and species following procedures based upon currently accepted practices in benthic ecology. If the number of oligochaetes or chironomids in a sample is between 20 and 300 individuals, the sample is split and approximately 50% of the specimens are mounted. The remaining portion is saved and used in biomass determinations. The sample is split by evenly spreading the specimens in a gridded tray and selecting half of the total number of grids at random. If the number of individuals is greater than 300, grids are selected randomly until 150 specimens are mounted. Total taxonomic counts for each oligochaete and chironomid species are adjusted by the proportion of the total number of specimens mounted in the sample.

Parameter:	**CONDUCT** (Conductivity in umho/cm, equivalent to uS/cm)
Collection Method:	Hydrolab DataSonde 4a four graphite electrode cell (open-cell design), or YSI-6600 and YSI EXO2 four nickel electrode cell with automatic temperature compensation.
Sample Preservatives:	N/A
Sample Storage:	N/A
Laboratory Technique:	N/A

Parameter:	**DO** (Dissolved oxygen in ppm., equivalent to mg/l)
	DO_PSAT (Dissolved oxygen percent saturation)
Collection Method:	Hydrolab DataSonde 4a membrane-design DO sensor, YSI 6600 Rapid Pulse, or YSI EXO2 optical sensor with automatic temperature and salinity compensation.
Sample Preservatives:	N/A
Sample Storage:	N/A
Laboratory Technique:	N/A

Parameter:	**MOIST** (Sediment moisture content in percent)
Collection Method:	One sediment sub-sample of approximately 120 ml is taken from the surface of a benthic grab for percent silt-clay, sand, and moisture determination.
Sample Preservatives:	None
Sample Storage:	Frozen until processing
Laboratory Technique:	Weight loss on drying for at least 24 hr at 60° C

Parameter: **PH** (pH of sample)

Collection Method: Hydrolab DataSonde 4a, YSI 6600, or YSI EXO2 combined glass pH and reference sensor automatically compensated for temperature.

Sample Preservatives: N/A

Sample Storage: N/A

Laboratory Technique: N/A

Parameter: **SALINITY** (Salinity in practical salinity units, equivalent to ppt)

Collection Method: Hydrolab DataSonde 4a four graphite electrode cell (open-cell design), or YSI 6600 and YSI EXO2 four nickel electrode cell with automatic temperature compensation

Sample Preservatives: N/A

Sample Storage: N/A

Laboratory Technique: N/A

Parameter: **SAND** (Sand content in percent by weight)

Collection Method: One sediment sub-sample of approximately 120 ml is taken from the surface of a benthic grab for percent silt-clay, sand, and moisture determination.

Sample Preservatives: None

Sample Storage: Frozen until processing

Laboratory Technique: Sand is separated from silt-clay particles (<62.5 um) by wet sieving, and the percent sand fraction is determined by weighing.

Parameter: **SILTCLAY** (Silt-clay content in percent by weight)

Collection Method: One sediment sub-sample of approximately 120 ml is taken from the surface of a benthic grab for percent silt-clay, sand, and moisture determination.

Sample Preservatives: None

Sample Storage: Frozen until processing

Laboratory Technique: Silt-clay is separated from sand by wet sieving through a 62.5 um screen, and the percent silt-clay fraction is determined by pipette analysis and weighing.

Parameter: **TC** (Total carbon content in percent)

Collection Method: One sediment sub-sample (additional to the silt-clay sediment sub-sample) of approximately 120 ml is taken from the surface of a benthic grab for sediment carbon and nitrogen analysis.

Sample Preservatives: None

Sample Storage: Frozen until processing

Laboratory Technique: Combustion at high temperature (975º C) in a carbon analyzer (Exeter Analytical, Inc., CE-440 Elemental Analyzer) and

subsequent measurement of the carbon dioxide produced by thermal conductivity detection. Prior to combustion, each sample is homogenized and oven-dried. No acid is applied.

Parameter:	**TIC** (Total inorganic carbon content in percent)
Collection Method:	One sediment sub-sample (additional to the silt-clay sediment sub-sample) of approximately 120 ml is taken from the surface of a benthic grab for sediment carbon and nitrogen analysis.
Sample Preservatives:	None
Sample Storage:	Frozen until processing
Laboratory Technique:	Ashing in a muffle furnace at a low temperature of 500°C results in the removal of organic carbon. The inorganic carbon remaining in the ash is then injected in a carbon analyzer (Exeter Analytical, Inc., CE-440 Elemental Analyzer) and combusted at high temperature (975°C). The carbon dioxide produced during combustion is measured by thermal conductivity detection. Prior to ashing, each sample is homogenized and oven-dried. No acid is applied.

Parameter:	**TN** (Total nitrogen content in percent)
Collection Method:	One sediment sub-sample (additional to the silt-clay sediment sub-sample) of approximately 120 ml is taken from the surface of a benthic grab for sediment carbon and nitrogen analysis.
Sample Preservatives:	None
Sample Storage:	Frozen until processing
Laboratory Technique:	Combustion at high temperature in a Exeter Analytical, Inc., CE-440 Elemental Analyzer. The nitrogen concentration is measured by thermal conductivity against a reference cell after all the carbon and hydrogen in the combustion chamber is removed.

Parameter:	**TOC** (Total organic carbon content in percent)
Collection Method:	One sediment sub-sample (additional to the silt-clay sediment sub-sample) of approximately 120 ml is taken from the surface of a benthic grab for sediment carbon and nitrogen analysis.
Sample Preservatives:	None
Sample Storage:	Frozen until processing
Laboratory Technique:	TOC is determined by performing separate TC and TIC analyses and subtracting the results.

Parameter:	**WTEMP** (Water temperature in deg. C)
Collection Method:	Thermistor attached to Hydrolab DataSonde 4a, YSI 6600, or YSI EXO2 sonde.
Sample Preservatives:	N/A
Sample Storage:	N/A
Laboratory Technique:	N/A

IBI_PARAMETER	DESCRIPTION
PCT_CAR_OMN	Percent abundance of carnivore and omnivores
PCT_DEPO	Percent abundance of deep-deposit feeders
PCT_PI_ABUND	Percent abundance of pollution-indicative taxa
PCT_PI_BIO	Percent biomass (AFDW) of pollution-indicative taxa
PCT_PI_F_ABUND	Percent abundance of tidal fresh pollution-indicative taxa
PCT_PI_O_ABUND	Percent abundance of oligohaline pollution-indicative taxa
PCT_PS_ABUND	Percent abundance of pollution-sensitive taxa
PCT_PS_BIO	Percent biomass (AFDW) of pollution-sensitive taxa
PCT_PS_O_ABUND	Percent abundance of oligohaline pollution-sensitive taxa
PCT_TANYPODINI	Tanypodinae to Chironomidae percent abundance ratio
SW	Shannon-Wiener species diversity index (log-base =2)
TOLERANCE	Pollution Tolerance Score
TOT_ABUND	Total species abundance (number per meter squared)
TOT_BIOMASS	Total species biomass (grams AFDW per meter squared)

IBI_SALZONE	DESCRIPTION	RANGE (PSU)
TF	Tidal freshwater	0-0.5
O	Oligohaline	≥0.5-5
LM	Low mesohaline	≥5-12
HM	High mesohaline	≥12-18
P	Polyhaline	≥18

IBI_BOTTOM_TYPE	DESCRIPTION	RANGE (% SILT-CLAY)
M	Mud	>40
S	Sand	0-40

THE SKIP VARIABLE OF THE BENTHIC TAXONOMIC AND ABUNDANCE DATA RECORD:

In counting the number of taxa present in a sample, general taxonomic designations at the generic, familial, and higher taxonomic levels are dropped if there is one valid lower-level designation for that group. For example, if both *Leitoscoloplos* sp. and *Leitoscoloplos fragilis* have been identified in one sample, *Leitoscoloplos* sp. is skipped when counting the number of taxa. Skip codes are used to track these general taxonomic designations.

END OF THE DATA DICTIONARY