appendix E

1950s–1990s Chesapeake Bay and Tidal Tributary Chlorophyll *a* Concentrations by Chesapeake Bay Program Segment

HISTORICAL DATA SETS

The earliest water quality data in the Chesapeake Bay Program data base date from the early 1950s. Thus, the historical era referred to here extends from the early 1950s to 1984, when the coordinated baywide Chesapeake Bay Monitoring Program began. Most of the early studies focused on the physical and chemical characterization of tidal waters. Sometimes measurements of phosphorus species, usually orthophosphate, and chlorophyll *a* were taken. The impetus for more nutrient measurements came during the 1960s (possibly exacerbated by the severe drought in that decade) and 1970s with the increasing awareness of the Chesapeake Bay's eutrophication and other signs of degradation. Nitrate measurements were collected more frequently, and measurements of a larger suite of phosphorus and nitrogen species began to be collected. Estimates of total phosphorus and total nitrogen are infrequent in the historical data, however.

Data from the Johns Hopkins University Chesapeake Bay Institute and the U.S. Environmental Protection Agency's Annapolis Field Office constitute the largest contributions to the historical database. Maryland and Virginia state monitoring programs provided data from various state waters. In Virginia, other major contributors to the historical database were the Virginia Institute of Marine Science and the Virginia State Water Control Board slack water surveys. The database also includes many smaller data sets including, among others, data from University of Maryland researchers and from environmental impact studies of electric power generation in Maryland.

Historical to present chlorophyll *a* concentration data are presented by Chesapeake Bay Program segment within decades (1950s-1990s) in Table E-1. Table E-2 presents the same chlorophyll *a* data by Chesapeake Bay Program segment across the same decades.

BENCHMARK CHLOROPHYLL *A* DATA ASSESSMENT

The historical and current monitoring data sets (through 1999) were pooled, and the surface (sampling depth ≤ 1.5 meters) values of the parameters were retained. Each data point was associated with a segment (from the original Chesapeake Bay Program segmentation scheme) and a salinity regime. Salinity regimes were defined as: tidal-fresh 0-0.5 ppt; oligohaline >0.5-5.0 ppt; mesohaline > 5-18 ppt and polyhaline >18 ppt.

If a salinity measurement was associated with the value, then that measurement determined the regime. Otherwise, the regime was assumed from the median salinity of the segment in which the measurement was taken. Values were further identified according to decade (1950s through 1990s) and season. The seasons that were included were: annual (January through December), spring (March, April and May) and summer (June, July, August and September).

The individual data values were assessed using the Chesapeake Bay Program method for calculating relative status (Alden and Perry 1997). The method uses the logistic distribution of values in a reference data set to assess values in a test data set. The procedure yields a score between 0 and 100 for each test value. The reference data, in this case, were Chesapeake Bay Program Water Quality Monitoring data from 1985 through 1990, which includes the largest number of stations and greatest seasonal coverage of the monitoring program's history to date. It thus provided the best available spatial and temporal coverage of the historical record. The time period also represented a relatively wide variety of flow and other climatic conditions, although none was particularly extreme.

The reference and test data sets were similarly partitioned by depth, segment, salinity zone and season. For each reference grouping, the logistic distribution of values was obtained and cutoff points representing the upper, middle and lower thirds of the distribution were determined. For nitrogen, phosphorus, chlorophyll *a* and suspended solids, high values are undesirable, therefore, the cutoff points represented 'poor', 'fair' and 'good' quality conditions, respectively, in this context. The status procedure scored each test value between 0 and 100, based on the distribution of the complementary reference distribution. Then, for each parameter/segment/salinity zone/decade/season, the median score was calculated for each calendar month, from which the median score for the season was obtained. The season median scores were categorized as 'good', 'fair' or 'poor' by using the reference cutoff points and adjusted slightly for the number of observations in the test data.

Each segment/zone/decade/season was then evaluated as representing 'healthy' nutrient and sediment levels. To qualify, none of the critical parameters—total nitrogen, total phosphorus, chlorophyll *a* or total suspended solids—could have a 'poor' assessment; only one parameter could have a 'fair' assessment and one or more parameters had to be 'good'. Benchmark levels for each parameter were then derived from this set of reference locations by extracting the values only from the

reference locations in which the parameter of interest was assessed as 'good'. These values were then pooled by salinity regime and decade and, ultimately, by salinity regime alone.

LITERATURE CITED

Alden, R. W. III and E. S. Perry 1997. *Presenting Measurements of Status: Report to the Chesapeake Bay Program Monitoring Subcommittee's Data Analysis Workgroup.* Chesapeake Bay Program, Annapolis, Maryland.

Table E-1. Chesapeake Bay and tidal tributaries chlorophyll *a* concentrations (μg liter^{-1}) by Chesapeake Bay Program segment within decade: 1950s–1990s.

Decade	Chesapeake Bay Program Segment	Spring Mean	(N)	Summer Mean	(N)	Annual Mean	(N)
1950	Northern Chesapeake Bay	–	–	–	–	1.4	1
	Upper Chesapeake Bay	1.1	1	–	–	2.2	7
	Upper Central Chesapeake Bay	–	–	1.7	1	3.2	10
	Middle Central Chesapeake Bay	3.1	3	2.1	1	4.0	13
	Lower Chesapeake Bay	14.1	3	5.6	1	7.0	16
	Western Lower Chesapeake Bay	–	–	–	–	0.7	8
	Eastern Lower Chesapeake Bay	7.9	3	–	–	4.2	19
	Mouth of the Chesapeake Bay	–	–	–	–	1.6	8
	Outside of Ches. Bay Mouth	–	–	2.0	1	2.2	2
	Northeast River	–	–	–	–	–	–
	Elk/Bohemia Rivers	–	–	–	–	–	–
	Sassafras River	–	–	–	–	–	–
	Chester River	–	–	–	–	–	–
	Eastern Bay	–	–	0.5	1	1.5	3
	Choptank River	2.4	2	3.4	3	2.8	7
	Lower Choptank River	6.9	1	1.7	3	2.6	5
	Nanticoke River	–	–	–	–	–	–
	Wicomico River	–	–	–	–	–	–
	Manokin River	–	–	–	–	–	–
	Big Annemessex River	–	–	–	–	–	–
	Tangier Sound	–	–	11.8	1	4.3	8
	Pocomoke River	–	–	–	–	–	–
	Bush River	–	–	–	–	–	–
	Gunpowder River	–	–	–	–	–	–
	Middle River	–	–	–	–	–	–

Table E-1. Chesapeake Bay and tidal tributaries chlorophyll *a* concentrations (μg liter^{-1}) by Chesapeake Bay Program segment within decade: 1950s–1990s *(continued).*

Decade	Chesapeake Bay Program Segment	Spring Mean	(N)	Summer Mean	(N)	Annual Mean	(N)
1950	Back River	–	–	–	–	–	–
	Patapsco River	–	–	–	–	7.5	1
	Magothy River	–	–	–	–	–	–
	Severn River	–	–	–	–	–	–
	South/Rhode/West Rivers	–	–	–	–	–	–
	Upper Patuxent River	2.6	1	1.7	2	1.7	4
	Middle Patuxent River	–	–	2.1	2	2.9	3
	Lower Patuxent River	5.3	3	3.3	4	2.6	14
	Upper Potomac River	–	–	–	–	–	–
	Middle Potomac River	–	–	26.7	1	26.7	1
	Lower Potomac River	10.8	2	5.0	12	6.1	23
	Upper Rappahannock River	–	–	–	–	–	–
	Middle Rappahannock River	–	–	–	–	3.7	2
	Lower Rappahannock River	8.2	1	–	–	4.3	6
	Upper York River	–	–	–	–	–	–
	Middle York River	–	–	–	–	2.0	1
	Lower York River	4.5	1	–	–	1.8	3
	Mobjack Bay	–	–	–	–	0.6	2
	Upper James River	–	–	–	–	–	–
	Middle James River	–	–	–	–	–	–
	Lower James River	–	–	3.3	19	2.3	28
1960	Northern Chesapeake Bay	6.1	8	18.2	11	12.4	31
	Upper Chesapeake Bay	7.0	10	25.9	15	15.9	42
	Upper Central Chesapeake Bay	6.9	29	18.2	59	11.5	122
	Middle Central Chesapeake Bay	3.9	18	11.1	25	7.4	69
	Lower Chesapeake Bay	2.4	7	10.9	12	9.7	28

Table E-1. Chesapeake Bay and tidal tributaries chlorophyll *a* concentrations (μg liter^{-1}) by Chesapeake Bay Program segment within decade: 1950s–1990s *(continued)*.

Decade	Chesapeake Bay Program Segment	Spring Mean	(N)	Summer Mean	(N)	Annual Mean	(N)
1960	Western Lower Chesapeake Bay	–	–	–	–	–	–
	Eastern Lower Chesapeake Bay	5.5	1	1.2	2	2.0	5
	Mouth of the Chesapeake Bay	–	–	–	–	–	–
	Outside the Ches. Bay Mouth	1.1	2	0.8	4	1.0	8
	Northeast River	–	–	–	–	–	–
	Elk/Bohemia Rivers	–	–	–	–	–	–
	Sassafras River	–	–	18.1	3	20.8	5
	Chester River	5.2	11	8.7	14	5.6	36
	Eastern Bay	5.3	27	9.2	39	6.5	94
	Choptank River	–	–	–	–	–	–
	Lower Choptank River	–	–	–	–	–	–
	Nanticoke River	–	–	–	–	–	–
	Wicomico River	–	–	–	–	–	–
	Manokin River	–	–	–	–	–	–
	Big Annemessex River	–	–	–	–	–	–
	Tangier Sound	–	–	–	–	–	–
	Pocomoke River	–	–	–	–	–	–
	Bush River	–	–	–	–	–	–
	Gunpowder River	–	–	–	–	–	–
	Middle River	–	–	–	–	–	–
	Back River	–	–	7.7	1	30.9	3
	Patapsco River	18.7	17	47.1	41	41.9	64
	Magothy River	8.6	13	12.5	21	11.5	56
	Severn River	7.1	12	15.9	22	10.8	60
	South/Rhode/West Rivers	6.3	17	15.4	38	11.1	73

Table E-1. Chesapeake Bay and tidal tributaries chlorophyll *a* concentrations ($\mu g\ liter^{-1}$) by Chesapeake Bay Program segment within decade: 1950s–1990s *(continued)*.

Decade	Chesapeake Bay Program Segment	Spring Mean	(N)	Summer Mean	(N)	Annual Mean	(N)
1960	Upper Patuxent River	20.1	18	32.0	43	22.5	65
	Middle Patuxent River	15.0	2	24.8	4	21.5	6
	Lower Patuxent River	19.9	2	20.5	4	20.3	6
	Upper Potomac River	24.3	50	59.1	81	38.7	176
	Middle Potomac River	8.1	26	29.3	35	23.6	83
	Lower Potomac River	8.5	24	18.7	33	13.7	76
	Upper Rappahannock River	–	–	–	–	–	–
	Middle Rappahannock River	–	–	–	–	–	–
	Lower Rappahannock River	–	–	–	–	–	–
	Upper York River	–	–	–	–	–	–
	Middle York River	–	–	–	–	–	–
	Lower York River	–	–	–	–	–	–
	Mobjack Bay	–	–	–	–	–	–
	Upper James River	–	–	–	–	–	–
	Middle James River	–	–	–	–	–	–
	Lower James River	12.8	2	–	–	12.8	2
1970	Northern Chesapeake Bay	11.7	28	19.3	66	12.1	116
	Upper Chesapeake Bay	9.6	26	15.4	66	10.6	125
	Upper Central Chesapeake Bay	14.2	156	20.7	266	14.8	589
	Middle Central Chesapeake Bay	11.5	99	10.5	142	9.7	325
	Lower Chesapeake Bay	11.5	29	7.7	35	8.1	94
	Western Lower Chesapeake Bay	–	–	11.0	1	11.0	1
	Eastern Lower Chesapeake Bay	14.7	13	4.8	17	7.3	45
	Mouth of the Chesapeake Bay	14.8	4	7.7	14	8.7	29
	Outside the Ches. Bay Mouth	5.1	7	3.5	8	4.2	31
	Northeast River	40.0	11	54.9	35	49.0	53

Table E-1. Chesapeake Bay and tidal tributaries chlorophyll *a* concentrations (μg liter^{-1}) by Chesapeake Bay Program segment within decade: 1950s–1990s *(continued)*.

Decade	Chesapeake Bay Program Segment	Spring Mean	(N)	Summer Mean	(N)	Annual Mean	(N)
1970	Elk/Bohemia Rivers	27.3	62	28.8	136	25.9	248
	Sassafras River	42.2	26	43.1	61	46.8	106
	Chester River	18.2	42	25.6	84	22.7	159
	Eastern Bay	6.5	84	21.7	89	14.0	226
	Choptank River	18.4	99	17.1	121	18.8	276
	Lower Choptank River	11.1	37	21.5	60	17.2	103
	Nanticoke River	32.5	37	22.9	80	26.7	168
	Wicomico River	36.7	31	41.9	42	31.4	101
	Manokin River	15.5	3	7.2	5	12.2	8
	Big Annemessex River	–	–	18.2	6	18.2	6
	Tangier River	20.3	37	16.6	57	27.6	113
	Pocomoke River	23.1	43	19	63	19.9	146
	Bush River	7.3	4	13.2	12	10.1	25
	Gunpowder River	7.6	24	7.3	39	9.7	94
	Middle River	14.7	8	28.2	8	17.7	19
	Back River	55.7	115	61.5	167	58.3	392
	Patapsco River	14.1	36	40.9	77	23.4	162
	Magothy River	33.8	40	37.8	50	32.7	129
	Severn River	22.2	12	32.1	43	24.8	75
	South/Rhode/West Rivers	25.2	31	29.7	84	29.4	157
	Upper Patuxent River	10.9	37	15.8	68	14.3	147
	Middle Patuxent River	31.3	2	18.1	8	16.8	14
	Lower Patuxent River	10.9	4	15.7	5	11.5	12
	Upper Potomac River	17.9	142	31.0	286	18.0	559
	Middle Potomac River	20.0	78	19.3	142	16.6	288

Table E-1. Chesapeake Bay and tidal tributaries chlorophyll *a* concentrations (μg liter^{-1}) by Chesapeake Bay Program segment within decade: 1950s–1990s *(continued)*.

Decade	Chesapeake Bay Program Segment	Spring Mean	(N)	Summer Mean	(N)	Annual Mean	(N)
1970	Lower Potomac River	8.0	40	8.9	65	11.2	140
	Upper Rappahannock River	2.1	66	9.4	142	5.7	313
	Middle Rappahannock River	6.4	13	6.6	29	5.6	65
	Lower Rappahannock River	6.8	14	8.0	35	7.5	76
	Upper York River	3.9	18	9.8	107	7.2	170
	Middle York River	5.0	24	9.8	109	7.2	167
	Lower York River	7.8	8	5.7	21	5.8	35
	Mobjack Bay	8.3	16	7.4	42	6.5	69
	Upper James River	5.5	55	8.9	187	5.2	345
	Middle James River	7.7	19	4.6	75	4.6	137
	Lower James River	7.6	9	3.8	43	3.6	73
1980	Northern Chesapeake Bay	7.6	20	10.9	28	7.8	68
	Upper Central Chesapeake Bay	8.4	38	10.1	55	7.3	135
	Upper Central Chesapeake Bay	11.5	87	14.7	152	10.7	362
	Middle Central Chesapeake Bay	10.4	155	10.7	225	9.4	590
	Lower Chesapeake Bay	10.3	111	9.0	158	8.6	454
	Western Lower Chesapeake Bay	7.2	60	8.7	80	7.6	236
	Eastern Lower Chesapeake Bay	6.2	140	5.8	187	6.5	543
	Mouth of the Chesapeake Bay	5.8	45	4.9	62	5.5	181
	Outside the Ches. Bay Mouth	6.0	1	2.5	2	4.0	5
	Northeast River	23.7	11	54.3	17	31.9	44
	Elk/Bohemia Rivers	18.1	34	9.9	52	10.1	141
	Sassafras River	34.3	12	70.2	15	47.9	45
	Chester River	8.1	46	16.0	83	10.5	205
	Eastern Bay	4.3	14	10.2	23	6.6	58
	Choptank River	7.0	34	17.4	57	11.2	138

Table E-1. Chesapeake Bay and tidal tributaries chlorophyll *a* concentrations (μg liter^{-1}) by Chesapeake Bay Program segment within decade: 1950s–1990s *(continued)*.

Decade	Chesapeake Bay Program Segment	Spring Mean	(N)	Summer Mean	(N)	Annual Mean	(N)
1980	Lower Choptank River	6.4	26	9.3	44	7.0	107
	Nanticoke River	11.4	23	18.0	32	13.1	90
	Wicomico River	6.6	11	19.6	16	11.3	44
	Manokin River	8.2	12	13.8	16	9.0	43
	Big Annemessex River	5.0	12	10.0	16	6.5	43
	Tangier Sound	9.5	65	10.7	86	8.2	237
	Pocomoke River	4.2	12	11.2	15	8.9	45
	Bush River	17.6	13	42.9	22	25.3	53
	Gunpowder River	22.3	11	20.5	24	17.5	53
	Middle River	14.8	11	24.2	19	19.8	48
	Back River	105.5	13	101.8	38	83.7	87
	Patapsco River	17.5	22	50.3	44	29.3	95
	Magothy River	10.0	13	22.1	19	15.0	51
	Severn River	13.0	10	22.8	18	16.8	47
	South/Rhode/West Rivers	14.9	42	23.8	58	16.5	157
	Upper Patuxent River	4.7	94	18.4	160	9.2	414
	Middle Patuxent River	15.5	13	14.2	26	17.1	65
	Lower Patuxent River	14.7	52	11.4	95	11.4	245
	Upper Potomac River	4.5	95	15.9	121	7.9	336
	Middle Potomac River	7.4	62	7.4	79	5.8	224
	Lower Potomac River	18.2	31	10.3	43	10.7	120
	Upper Rappahannock River	4.1	30	15.2	53	8.4	124
	Middle Rappahannock River	22.1	24	10.8	39	12.5	103
	Lower Rappahannock River	10.9	78	8.9	120	8.3	324
	Upper York River	3.1	24	5.1	40	3.8	102

Table E-1. Chesapeake Bay and tidal tributaries chlorophyll *a* concentrations (μg liter^{-1}) by Chesapeake Bay Program segment within decade: 1950s–1990s *(continued.)*

Decade	Chesapeake Bay Program Segment	Spring Mean	(N)	Summer Mean	(N)	Annual Mean	(N)
1980	Middle York River	5.4	36	11.0	60	7.0	152
	Lower York River	13.5	36	8.3	59	9.7	151
	Mobjack Bay	6.3	60	8.4	80	6.9	236
	Upper James River	10.2	65	20.7	114	11.2	283
	Middle James River	13.8	24	17.3	40	13.7	100
	Lower James River	13.8	88	6.2	140	9.6	349
1990	Northern Chesapeake Bay	6.6	27	8.6	40	5.8	102
	Upper Chesapeake Bay	5.0	58	6.3	79	4.2	220
	Upper Central Chesapeake Bay	7.6	147	14.3	200	9.0	487
	Middle Central Chesapeake Bay	7.5	300	9.9	400	8.1	929
	Lower Chesapeake Bay	9.5	210	8.5	279	8.0	819
	Western Lower Chesapeake Bay	7.1	118	7.5	159	6.7	475
	Eastern Lower Chesapeake Bay	6.6	264	6.8	359	6.5	1059
	Mouth of the Chesapeake Bay	6.3	88	5.6	120	5.8	354
	Outside the Ches. Bay Mouth	–	–	–	–	–	–
	Northeast River	23.0	27	53.5	38	31.4	105
	Elk/Bohemia Rivers	6.9	88	6.5	113	5.9	326
	Sassafras River	39.6	29	66.9	35	46.1	113
	Chester River	10.6	89	20.3	117	13.2	350
	Eastern Bay	8.3	30	12.8	39	9.2	117
	Choptank River	13.3	60	19.9	78	12.8	234
	Lower Choptank River	7.4	60	8.4	78	7.4	229
	Nanticoke River	10.4	60	26.9	74	15.5	226
	Wicomico River	8.1	29	14.3	36	10.6	112
	Manokin River	11.8	30	11.2	36	9.8	111
	Big Annemessex River	7.5	30	9.6	35	7.4	112

Table E-1. Chesapeake Bay and tidal tributaries chlorophyll *a* concentrations (μg liter^{-1}) by Chesapeake Bay Program segment within decade: 1950s–1990s *(continued)*.

Decade	Chesapeake Bay Program Segment	Spring Mean	(N)	Summer Mean	(N)	Annual Mean	(N)
1990	Tangier Sound	10.8	147	10.6	189	9.3	566
	Pocomoke River	2.1	30	7.5	39	4.6	113
	Bush River	26.4	28	50.9	37	31.0	106
	Gunpowder River	21.5	29	18.6	38	17.0	106
	Middle River	20.1	29	12.8	38	13.5	107
	Back River	104.2	29	82.4	38	75.7	107
	Patapsco River	15.5	29	36.1	39	22.3	113
	Magothy River	12.2	29	18.3	37	13.6	110
	Severn River	13.2	30	19.4	35	14.4	109
	South/Rhode/West Rivers	12.4	89	18.4	110	13.0	315
	Upper Patuxent River	5.9	234	15.9	307	8.7	863
	Middle Patuxent River	17.8	30	15.6	39	15.6	118
	Lower Patuxent River	10.7	120	13.0	156	10.4	472
	Upper Potomac River	6.0	174	20.3	233	9.8	655
	Middle Potomac River	5.0	93	8.4	121	5.6	350
	Lower Potomac River	10.8	60	9.4	80	8.7	228
	Upper Rappahannock River	3.6	149	14.1	209	7.3	563
	Middle Rappahannock River	9.0	66	11.0	85	8.5	250
	Lower Rappahannock River	8.2	187	7.9	250	7.1	727
	Upper York River	1.5	64	4.4	79	2.5	240
	Middle York River	3.5	92	13.3	118	7.4	349
	Lower York River	10.3	97	7.6	125	7.6	371
	Mobjack Bay	7.3	125	8.5	167	7.3	502
	Upper James River	6.3	210	16.3	284	8.9	813
	Middle James River	13.3	64	14.1	85	11.1	245
	Lower James River	10.7	331	7.9	447	7.7	1295

Table E-2. Chesapeake Bay and tidal tributaries chlorophyll *a* concentrations (μg liter^{-1}) by segment across decades: 1950s–1990s.

Segment	Decade	Spring Mean	(N)	Summer Mean	(N)	Annual Mean	(N)
CB1	1950	-	-	-	-	1.4	1
CB1	1960	6.1	8	18.2	11	12.4	31
CB1	1970	11.7	28	19.3	66	12.1	116
CB1	1980	7.6	20	10.9	28	7.8	68
CB1	1990	6.6	27	8.6	40	5.8	102
CB2	1950	1.1	1	-	-	2.2	7
CB2	1960	7.0	10	25.9	15	15.9	42
CB2	1970	9.6	26	15.4	66	10.6	125
CB2	1980	8.4	38	10.1	55	7.3	135
CB2	1990	5.0	58	6.3	79	4.2	220
CB3	1950	-	-	1.7	1	3.2	10
CB3	1960	6.9	29	18.2	59	11.5	122
CB3	1970	14.2	156	20.7	266	14.8	589
CB3	1980	11.5	87	14.7	152	10.7	362
CB3	1990	7.6	147	14.3	200	9.0	487
CB4	1950	3.1	3	2.1	1	4.0	13
CB4	1960	3.9	18	11.1	25	7.4	69
CB4	1970	11.5	99	10.5	142	9.7	325
CB4	1980	10.4	155	10.7	225	9.4	590
CB4	1990	7.5	300	9.9	400	8.1	929
CB5	1950	14.1	3	5.6	1	7.0	16
CB5	1960	2.4	7	10.9	12	9.7	28
CB5	1970	11.5	29	7.7	35	8.1	94
CB5	1980	10.3	111	9.0	158	8.6	454
CB5	1990	9.5	210	8.5	279	8.0	819
CB6	1950	-	-	-	-	0.7	8

Table E-2. Chesapeake Bay and tidal tributaries chlorophyll *a* concentrations (μg liter^{-1}) by segment across decades: 1950s–1990s *(continued).*

Segment	Decade	Spring Mean	(N)	Summer Mean	(N)	Annual Mean	(N)
CB6	1960	-	-	-	-	-	-
CB6	1970	-	-	11.0	1	11.0	1
CB6	1980	7.2	60	8.7	80	7.6	236
CB6	1990	7.1	118	7.5	159	6.7	475
CB7	1950	7.9	3	-	-	4.2	19
CB7	1960	5.5	1	1.2	2	2.0	5
CB7	1970	14.7	13	4.8	17	7.3	45
CB7	1980	6.2	140	5.8	187	6.5	543
CB7	1990	6.6	264	6.8	359	6.5	1059
CB8	1950	-	-	-	-	1.6	8
CB8	1960	-	-	-	-	-	
CB8	1970	14.8	4	7.7	14	8.7	29
CB8	1980	5.8	45	4.9	62	5.5	181
CB8	1990	6.3	88	5.6	120	5.8	354
MOUTH	1950	-	-	2.0	1	2.2	2
MOUTH	1960	1.1	2	0.8	4	1.0	8
MOUTH	1970	5.1	7	3.5	8	4.2	31
MOUTH	1980	6.0	1	2.5	2	4.0	5
MOUTH	1990	-	-	-	-	-	-
ET1	1950	-	-	-	-	-	-
ET1	1960	-	-	-	-	-	-
ET1	1970	40.0	11	54.9	35	49.0	53
ET1	1980	23.7	11	54.3	17	31.9	44
ET1	1990	23.0	27	53.5	38	31.4	105
ET2	1950	-	-	-	-	-	-
ET2	1960	-	-	-	-	-	-

Table E-2. Chesapeake Bay and tidal tributaries chlorophyll *a* concentrations (μg liter^{-1}) by segment across decades: 1950s–1990s *(continued).*

Segment	Decade	Spring Mean	(N)	Summer Mean	(N)	Annual Mean	(N)
ET2	1970	27.3	62	28.8	136	25.9	248
ET2	1980	18.1	34	9.9	52	10.1	141
ET2	1990	6.9	88	6.5	113	5.9	326
ET3	1950	-	-	-	-	-	-
ET3	1960	-	-	18.1	3	20.8	5
ET3	1970	42.2	26	43.1	61	46.8	106
ET3	1980	34.3	12	70.2	15	47.9	45
ET3	1990	39.6	29	66.9	35	46.1	113
ET4	1950	-	-	-	-	-	-
ET4	1960	5.2	11	8.7	14	5.6	36
ET4	1970	18.2	42	25.6	84	22.7	159
ET4	1980	8.1	46	16.0	83	10.5	205
ET4	1990	10.6	89	20.3	117	13.2	350
EE1	1950	-	-	0.5	1	1.5	3
EE1	1960	5.3	27	9.2	39	6.5	94
EE1	1970	6.5	84	21.7	89	14.0	226
EE1	1980	4.3	14	10.2	23	6.6	58
EE1	1990	8.3	30	12.8	39	9.2	117
ET5	1950	2.4	2	3.4	3	2.8	7
ET5	1960	-	-	-	-	-	-
ET5	1970	18.4	99	17.1	121	18.8	276
ET5	1980	7.0	34	17.4	57	11.2	138
ET5	1990	13.3	60	19.9	78	12.8	234
EE2	1950	6.9	1	1.7	3	2.6	5
EE2	1960	-	-	-	-	-	-
EE2	1970	11.1	37	21.5	60	17.2	103

Table E-2. Chesapeake Bay and tidal tributaries chlorophyll *a* concentrations (μg liter^{-1}) by segment across decades: 1950s–1990s *(continued)*.

Segment	Decade	Spring Mean	(N)	Summer Mean	(N)	Annual Mean	(N)
EE2	1980	6.4	26	9.3	44	7.0	107
EE2	1990	7.4	60	8.4	78	7.4	229
EE3	1950	-	-	11.8	1	4.3	8
EE3	1960	-	-	-	-	-	-
EE3	1970	20.3	37	16.6	57	27.6	113
EE3	1980	9.5	65	10.7	86	8.2	237
EE3	1990	10.8	147	10.6	189	9.3	566
ET6	1950	-	-	-	-	-	-
ET6	1960	-	-	-	-	-	-
ET6	1970	32.5	37	22.9	80	26.7	168
ET6	1980	11.4	23	18.0	32	13.1	90
ET6	1990	10.4	60	26.9	74	15.5	226
ET7	1950	-	-	-	-	-	-
ET7	1960	-	-	-	-	-	-
ET7	1970	36.7	31	41.9	42	31.4	101
ET7	1980	6.6	11	19.6	16	11.3	44
ET7	1990	8.1	29	14.3	36	10.6	112
ET8	1950	-	-	-	-	-	-
ET8	1960	-	-	-	-	-	-
ET8	1970	15.5	3	7.2	5	12.2	8
ET8	1980	8.2	12	13.8	16	9.0	43
ET8	1990	11.8	30	11.2	36	9.8	111
ET9	1950	-	-	-	-	-	-
ET9	1960	-	-	-	-	-	-
ET9	1970	-	-	18.2	6	18.2	6
ET9	1980	5.0	12	10.0	16	6.5	43

Table E-2. Chesapeake Bay and tidal tributaries chlorophyll *a* concentrations (μg liter^{-1}) by segment across decades: 1950s–1990s *(continued).*

Segment	Decade	Spring Mean	(N)	Summer Mean	(N)	Annual Mean	(N)
ET9	1990	7.5	30	9.6	35	7.4	112
ET10	1950	-	-	-	-	-	-
ET10	1960	-	-	-	-	-	-
ET10	1970	23.1	43	19.0	63	19.9	146
ET10	1980	4.2	12	11.2	15	8.9	45
ET10	1990	2.1	30	7.5	39	4.6	113
WT1	1950	-	-	-	-	-	-
WT1	1960	-	-	-	-	-	-
WT1	1970	7.3	4	13.2	12	10.1	25
WT1	1980	17.6	13	42.9	22	25.3	53
WT1	1990	26.4	28	50.9	37	31.0	106
WT2	1950	-	-	-	-	-	-
WT2	1960	-	-	-	-	-	-
WT2	1970	7.6	24	7.3	39	9.7	94
WT2	1980	22.3	11	20.5	24	17.5	53
WT2	1990	21.5	29	18.6	38	17.0	106
WT3	1950	-	-	-	-	-	-
WT3	1960	-	-	-	-	-	-
WT3	1970	14.7	8	28.2	8	17.7	19
WT3	1980	14.8	11	24.2	19	19.8	48
WT3	1990	20.1	29	12.8	38	13.5	107
WT4	1950	-	-	-	-	-	-
WT4	1960	-	-	7.7	1	30.9	3
WT4	1970	55.7	115	61.5	167	58.3	392
WT4	1980	105.5	13	101.8	38	83.7	87
WT4	1990	104.2	29	82.4	38	75.7	107

Table E-2. Chesapeake Bay and tidal tributaries chlorophyll *a* concentrations (μg liter^{-1}) by segment across decades: 1950s–1990s *(continued)*.

Segment	Decade	Spring Mean	(N)	Summer Mean	(N)	Annual Mean	(N)
WT5	1950	-	-	-	-	7.5	1
WT5	1960	18.7	17	47.1	41	41.9	64
WT5	1970	14.1	36	40.9	77	23.4	162
WT5	1980	17.5	22	50.3	44	29.3	95
WT5	1990	15.5	29	36.1	39	22.3	113
WT6	1950	-	-	-	-	-	-
WT6	1960	8.6	13	12.5	21	11.5	56
WT6	1970	33.8	40	37.8	50	32.7	129
WT6	1980	10.0	13	22.1	19	15.0	51
WT6	1990	12.2	29	18.3	37	13.6	110
WT7	1950	-	-	-	-	-	-
WT7	1960	7.1	12	15.9	22	10.8	60
WT7	1970	22.2	12	32.1	43	24.8	75
WT7	1980	13.0	10	22.8	18	16.8	47
WT7	1990	13.2	30	19.4	35	14.4	109
WT8	1950	-	-	-	-	-	-
WT8	1960	6.3	17	15.4	38	11.1	73
WT8	1970	25.2	31	29.7	84	29.4	157
WT8	1980	14.9	42	23.8	58	16.5	157
WT8	1990	12.4	89	18.4	110	13.0	315
TF1	1950	2.6	1	1.7	2	1.7	4
TF1	1960	20.1	18	32.0	43	22.5	65
TF1	1970	10.9	37	15.8	68	14.3	147
TF1	1980	4.7	94	18.4	160	9.2	414
TF1	1990	5.9	234	15.9	307	8.7	863
RET1	1950	-	-	2.1	2	2.9	3

Table E-2. Chesapeake Bay and tidal tributaries chlorophyll *a* concentrations (μg liter^{-1}) by segment across decades: 1950s–1990s *(continued).*

Segment	Decade	Spring Mean	(N)	Summer Mean	(N)	Annual Mean	(N)
RET1	1960	15.0	2	24.8	4	21.5	6
RET1	1970	31.3	2	18.1	8	16.8	14
RET1	1980	15.5	13	14.2	26	17.1	65
RET1	1990	17.8	30	15.6	39	15.6	118
LE1	1950	5.3	3	3.3	4	2.6	14
LE1	1960	19.9	2	20.5	4	20.3	6
LE1	1970	10.9	4	15.7	5	11.5	12
LE1	1980	14.7	52	11.4	95	11.4	245
LE1	1990	10.7	120	13.0	156	10.4	472
TF2	1950	-	-	-	-	-	-
TF2	1960	24.3	50	59.1	81	38.7	176
TF2	1970	17.9	142	31.0	286	18.0	559
TF2	1980	4.5	95	15.9	121	7.9	336
TF2	1990	6.0	174	20.3	233	9.8	655
RET2	1950	-	-	26.7	1	26.7	1
RET2	1960	8.1	26	29.3	35	23.6	83
RET2	1970	20.0	78	19.3	142	16.6	288
RET2	1980	7.4	62	7.4	79	5.8	224
RET2	1990	5.0	93	8.4	121	5.6	350
LE2	1950	10.8	2	5.0	12	6.1	23
LE2	1960	8.5	24	18.7	33	13.7	76
LE2	1970	8.0	40	8.9	65	11.2	140
LE2	1980	18.2	31	10.3	43	10.7	120
LE2	1990	10.8	60	9.4	80	8.7	228
TF3	1950	-	-	-	-	-	-
TF3	1960	-	-	-	-	-	-

Table E-2. Chesapeake Bay and tidal tributaries chlorophyll *a* concentrations (μg liter^{-1}) by segment across decades: 1950s–1990s *(continued)*.

Segment	Decade	Spring Mean	(N)	Summer Mean	(N)	Annual Mean	(N)
TF3	1970	2.1	66	9.4	142	5.7	313
TF3	1980	4.1	30	15.2	53	8.4	124
TF3	1990	3.6	149	14.1	209	7.3	563
RET3	1950	-	-	-	-	3.7	2
RET3	1960	-	-	-	-	-	-
RET3	1970	6.4	13	6.6	29	5.6	65
RET3	1980	22.1	24	10.8	39	12.5	103
RET3	1990	9.0	66	11.0	85	8.5	250
LE3	1950	8.2	1	-	-	4.3	6
LE3	1960	-	-	-	-	-	-
LE3	1970	6.8	14	8.0	35	7.5	76
LE3	1980	10.9	78	8.9	120	8.3	324
LE3	1990	8.2	187	7.9	250	7.1	727
TF4	1950	-	-	-	-	-	-
TF4	1960	-	-	-	-	-	-
TF4	1970	3.9	18	9.8	107	7.2	170
TF4	1980	3.1	24	5.1	40	3.8	102
TF4	1990	1.5	64	4.4	79	2.5	240
RET4	1950	-	-	-	-	2.0	1
RET4	1960	-	-	-	-	-	-
RET4	1970	5.0	24	9.8	109	7.2	167
RET4	1980	5.4	36	11.0	60	7.0	152
RET4	1990	3.5	92	13.3	118	7.4	349
LE4	1950	4.5	1	-	-	1.8	3
LE4	1960	-	-	-	-	-	-
LE4	1970	7.8	8	5.7	21	5.8	35

Table E-2. Chesapeake Bay and tidal tributaries chlorophyll *a* concentrations (μg liter^{-1}) by segment across decades: 1950s–1990s *(continued)*.

Segment	Decade	Spring Mean	(N)	Summer Mean	(N)	Annual Mean	(N)
LE4	1980	13.5	36	8.3	59	9.7	151
LE4	1990	10.3	97	7.6	125	7.6	371
WE4	1950	-	-	-	-	0.6	2
WE4	1960	-	-	-	-	-	-
WE4	1970	8.3	16	7.4	42	6.5	69
WE4	1980	6.3	60	8.4	80	6.9	236
WE4	1990	7.3	125	8.5	167	7.3	502
TF5	1950	-	-	-	-	-	-
TF5	1960	-	-	-	-	-	-
TF5	1970	5.5	55	8.9	187	5.2	345
TF5	1980	10.2	65	20.7	114	11.2	283
TF5	1990	6.3	210	16.3	284	8.9	813
RET5	1950	-	-	-	-	-	-
RET5	1960	-	-	-	-	-	-
RET5	1970	7.7	19	4.6	75	4.6	137
RET5	1980	13.8	24	17.3	40	13.7	100
RET5	1990	13.3	64	14.1	85	11.1	245
LE5	1950	-	-	3.3	19	2.3	28
LE5	1960	12.8	2	-	-	12.8	2
LE5	1970	7.6	9	3.8	43	3.6	73
LE5	1980	13.8	88	6.2	140	9.6	349
LE5	1990	10.7	331	7.9	447	7.7	1295