U.S. Environmental Protection Agency
Chesapeake Bay Program Office
Most Effective Basins Funding

In the U.S. Environmental Protection Agency's (EPA) Fiscal Year (FY) 2020 Appropriations Conference Report, an increase to the Chesapeake Bay Program (CBP) Budget was provided in the amount of $6 million for "state-based implementation in the most effective basins." This document describes the methodology EPA followed to establish the most effective use of these funds and the best locations for these practices to be implemented to make the greatest progress toward achieving water quality standards in the Chesapeake Bay.

The most effective basins to reduce the effects of excess nutrient loading to the Bay were determined considering two factors: cost effectiveness and load effectiveness. Cost effectiveness was considered as a factor to assure these additional funds result in state-based implementation of practices that achieve the greatest benefit to water quality overall. It was evaluated by looking at what the jurisdictions have reported in their Phase III Watershed Implementation Plans (WIPs) as the focus of their upcoming efforts, and by looking at the average cost per pound of reduction for BMP implementation by sector.

Past analyses of cost per pound of reduction have shown that reducing nitrogen is less costly by far than reducing phosphorus[1]. Based on that fact, EPA determined that the focus of this evaluation would be to target nitrogen reductions in the watershed. Evaluating the load reduction targets in all the jurisdictions' Phase III WIPs shows that the agricultural sector is targeted for 86 percent of the overall reductions identified to meet the 2025 targets collectively set by the jurisdictions. This means that most of the BMPs to be implemented in the watershed in the coming years are focused on the agricultural sector.

On average, BMPs placed in the agricultural sector have been identified as the most cost effective BMPs. Data collected on BMP cost efficiency show the average cost per pound of nitrogen reduction for agricultural BMPs is approximately $24. This is much more cost-effective than the practices of stream restoration, shoreline erosion and sedimentation control that have been shown to cost about $354 per pound. Comparatively, the average cost of urban BMPs is roughly $2,259 per pound of nitrogen reduction, nearly 100 times that for agriculture. Based on this information, agricultural BMPs for reduction of nitrogen are the most cost effective to implement.

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[1] The information, largely collected over a 15-year period by the Chesapeake Bay Program Office for use in the Partnership's Watershed Models, includes 1) the cost per unit of Best Management Practice(BMP), for over 200 BMPs, from contracted economists, and 2) the effectiveness of each BMP (the lbs. of nutrients and sediment reduced per unit of BMP), mostly from "Expert Panels" made up of academics, agronomists, and practitioners working in the source sectors, including agriculture. The estimates of nutrient loads reduced to the Chesapeake Bay are from the 6th-generation Chesapeake Bay Program Watershed Model [Chesapeake Bay Program, 2017. Chesapeake Assessment and Scenario Tool (CAST) Version 2017d. Chesapeake Bay Program Office, last accessed April 2020].

Load effectiveness[2] is a measure of the ability of management practices implemented in a given area (basin) to have a positive effect on dissolved oxygen in the Bay. Load effectiveness is the combination of three factors: land to water, delivery, and dissolved oxygen response. Each of these factors is described below.

The land to water factor represents how nitrogen applied to the land moves through the soil and is transported to the water. It is a measure of the natural propensity of the landscape to deliver nitrogen to waterways. In the phase 6 model, this factor considers groundwater recharge rates, average available water capacity, and the fraction of land in the piedmont carbonate hydrogeomorphological region by basin to determine the average nitrogen load expected to reach the local streams and rivers. An area with a land-to-water factor of 1 will deliver twice as much nitrogen as an area with a land-to-water factor of 0.5, all else being equal. The land to water factor does not consider land management, which is a separate analysis of available reductions.

The delivery factor is an estimate of the fraction of load reaching a stream, in a given basin, that will eventually make it to tidal waters. In the phase 6 model, it is calculated as a combination of stream and river factors. Stream factors generally apply to streams and reservoirs included in the National Hydrography Dataset that have an average annual flow less than 100 cubic feet per second and are calculated empirically using the USGS's SPARROW (SPAtially Referenced Regression On Watershed attributes) model. River factors apply to rivers and reservoirs with an annual flow greater than 100 cubic feet per second and are simulated by the CBP's Phase 6 dynamic model using HSPF (Hydrologic Simulation Program - Fortran).

The final factor is a measure of the Bay's dissolved oxygen response to nutrient loads from different areas of the watershed. It is based on estuarine circulation patterns and biogeochemical transformations. In the 2017 estuarine Water Quality and Sediment Transport Model (this is the official title of the model used to evaluate dissolved oxygen response to nutrient input throughout the Bay), the oxygen response factor is calculated as the impact of a unit nitrogen load reduction on the critical segments or segments of the Bay. The critical segments were defined in the 2010 TMDL as the set of segments where, if dissolved oxygen criteria are met, the remaining segments of the Bay will all meet their dissolved oxygen goals. These critical segments are the estuarine monitoring segments CB3MH, CB4MH, CB5MH, and POTMH for deep water and CB3MH, CB4MH, and CB5MH for deep channel. Each area of the watershed (basins) has a different effect on these critical segments. As an example, the Susquehanna River, located at the northern end of the Bay, has a greater effect on the dissolved oxygen in the deep water/deep channel area of the Bay than the James River, which is in the lower portion of the Bay. Nitrogen from the Susquehanna has a relatively long residence time in the Bay and must pass through the critical monitoring segments, while much of the nitrogen from the James passes out to the ocean through the Bay mouth.

In order to evaluate the load effectiveness for a given basin, the phase 6 modeling suite was used to simulate the effect of nitrogen loading from agricultural lands in each identified basin. This evaluation included both the watershed model and the estuarine model. Through this evaluation a value of load effectiveness was assigned to each basin. This information was then used to

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[2] Load effectiveness is the same measure known as relative effectiveness used to calculate allocations as described in Section 6.3 of the 2010 TMDL. It was also used to calculate Phase WIP III nitrogen planning targets in 2017.

determine which basins are the most effective at reducing the impact of nitrogen to the critical Bay segments identified in the previous paragraph.

Funding Allocation Methodology

EPA will provide the most effective basins funding for nitrogen reduction from the most cost-effective BMPs in the agricultural sector to the Chesapeake Bay watershed jurisdictions that have committed to reducing the agricultural contribution of nitrogen in their Phase III Watershed Implementation Plans (WIPs), i.e. Delaware, Maryland, New York, Pennsylvania, Virginia, and West Virginia. The District of Columbia does not have an agricultural commitment through 2025. Using the state Phase III WIPs, each identified nitrogen reduction commitment between now and 2025. The total load of these obligations to reduce nitrogen from Agriculture was added and then a percentage for each of those jurisdictions was determined. The $6 million MEB money will be allocated using the individual percentages for those jurisdictions to complete implementation work in the most effective basins identified within their boundaries. Table 1 shows, by jurisdiction, the percentage of agricultural sector implementation proposed in each WIP and the resulting Most Effective Basins (MEB) funding allocation.

Table 1 - Percentage of Agricultural Sector Implementation Proposed in Each WIP and the Resulting MEB Funding Allocation

Jurisdiction	Phase III WIP Ag Nitrogen Commitment (million pounds)	Percent of Total Nitrogen Commitment Proposed	MEB Funding Allocations ($)
DC	0.0	0.00%	-
DE	2.2	6.08%	$ 364,540
MD	4.2	11.60%	$ 695,940
NY	0.5	1.33%	$ 79,536
PA	22.3	61.59%	$ 3,695,112
VA	6.7	18.50%	$ 1,110,191
WV	0.3	0.91%	$ 54,681
Totals	36.2	100.00%	$ 6,000,000

Determining the best locations for use of the additional funding for Most Effective Basins (MEB) comes from the rigorous evaluation that has been explained above. The charge given by Congress was to spend this money in the most effective basins. The questions to be answered are, what size basins provide the best and most targeted use of these funds to get the maximum load reduction possible? Where are the most effective basins located?

Basins can be delineated in many shapes and sizes. For this evaluation, three different shape/size combinations were evaluated: Minor Basins, Hydrologic Unit Code [3](HUC) size 8 (HUC8), and River Segments. Two additional hybrid options, one from the Minor Basins, and one from the River Segments were created to place jurisdictional boundary lines over top of the Minor Basins and River Segments.

There are 25 Minor Basins in the watershed, typically ranging in size from 680 square miles to 3,280 square miles. The basin sizes resulting from this method of segmentation vary greatly. An example of a Minor Basin is the Lower Potomac which covers approximately 2,580 square miles. These are very large tracts of land and may represent extremely varied land uses.

At the HUC 8 scale, there are 53 basins that typically range in size from 810 square miles to 1,580 square miles. The basins are much more homogenous in size compared to the Minor Basin scale mentioned above. Although this segmentation is more homogenous, it still represents extremely varied land use within a basin.

The third option is to divide the watershed by River Segments. The Phase 6 CBP Watershed Model divides the Chesapeake Bay watershed into 979 land-river segments, typically ranging from 10 to 100 square miles. These land-river segments were provided with attributes, including the name of the river. Segments with the same river name were combined to form 311 named rivers with a typical range of 70 to 250 square miles. Most named rivers are nested within river basins of different sizes. For example, Bobs Creek (170 square miles) is also part of the Juniata River (3,400 square miles) and Susquehanna River (27,500 square miles) but for this analysis carries the name attribute for Bobs Creek only. Segments designated as ‘Juniata’ are just the 770 square miles of river basin that are not part of any smaller system. This provides a much finer resolution scale and will have less varied land use in a basin.

Finally, there are two different options to account for jurisdiction boundaries. These hybrid options were developed to overlay those boundaries over the Minor Basins and River Segments identified above. The 26 Minor Basins, divided further by jurisdictional boundaries, result in 43 State Minor Basin Segments, with a typical size of 270 square miles to 1600 square miles. Using the example of the Lower Potomac, there are now four divisions of this minor basin when segmenting by jurisdiction. These are the DC Lower Potomac – 60 square miles, MD Lower Potomac – 1040 square miles, and VA Lower Potomac – 1480 square miles. The 311 named River Segments, divided further by jurisdictional boundaries, result in 383 State-River Segments, with a typical size-range of 50 to 200 square miles. Each State-River Segment may be comprised of several land-river segments. This further division of the State River Basins is the same as described with the State Minor Basins.

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[3] Hydrologic Unit Code: The United States is divided and sub-divided into successively smaller hydrologic units. These hydrologic units are also known as watersheds. Each hydrologic unit is identified by a unique hydrologic unit code (HUC) consisting of two to twelve digits. The two-digit HUCs represent very large watersheds and each additional set of digits added decreases the size of the watershed. This division of watersheds is created using the National Hydrography Dataset. The NHD represents the nation’s drainage networks and related features, including rivers, streams, canals, lakes, ponds, glaciers, coastlines, dams, and stream gages.

Based on our analysis, EPA has determined that the most appropriate scale or segmentation to be used in this allocation is the hybrid State-River segment scale. All the segmentation options were evaluated. The smaller scale provided much more focus than the larger scale segmentation which dampened the effectiveness of the smaller areas. This scale provides focus for the funds to be used in the most effective areas of the watershed. Each basin identified as being the most effective in each jurisdiction (except DC) has agricultural loading available to be reduced. This scale provides direction to the jurisdictions on where to target the funds they receive to most accurately reflect the intent of Congress in allocating this funding.

Table 2 shows the effect of nitrogen to the critical Bay segments as a ratio of pounds delivered to dissolved oxygen response for each of the 383 river segment basins identified. The basins are shown in order of load effectiveness. The table also shows the amount of nitrogen reduced in that basin to date based on reporting by jurisdictions, remaining nitrogen load to be reduced in those basins (from modeling runs), and the size of the basin. At an average cost of $24 per pound of reduction of nitrogen, $6 million for implementation of BMPs in the MEBs should result in approximately 250,000 pounds of nitrogen reduction overall.

Table 2. State-River Basins Total Nitrogen Reduction Effectiveness

Rank	Jurisdiction	State-Rivers	TN Effectiveness	TN Reductions Made to Date	TN Load Remaining to Reduce	Watershed Size (sq. mi.)
1	PA	York Indian Rock Dam	23.68	61,902	146,262	21
2	PA	Black Creek	18.97	25,791	35,771	62
3	PA	Safe Harbor Dam	18.83	204,305	588,214	114
4	PA	Codorus Creek	18.27	93,500	128,727	66
5	PA	Little Swatara Creek	17.67	48,278	958,873	99
6	PA	Chiques Creek	17.08	577,976	1,677,039	126
7	PA	Conestoga Creek	16.74	1,211,181	2,398,215	278
8	PA	Pequea Creek	16.09	532,383	1,566,291	155
9	PA	Deer Creek	15.55	51,332	174,706	25
10	PA	Catawissa Creek	15.42	26,410	225,173	153
11	PA	Mill Creek	15.30	257,922	567,029	56
12	PA	Shamokin Creek	15.26	46,045	207,612	137
13	PA	Codorus Creek West Branch	15.16	62,477	231,494	50
14	PA	Mahanoy Creek	15.12	27,464	268,063	157
15	PA	Nescopeck Creek	15.04	81,446	133,673	112
16	MD	Jones Falls	14.95	36,437	14,306	58
17	PA	Swatara Creek	14.89	338,065	1,175,692	396
18	PA	Roaring Creek	14.88	45,104	273,458	88
19	PA	Mahantango Creek	14.74	158,208	667,328	165
20	MD	Little Pipe Creek	14.74	376,138	373,636	83
21	PA	Octoraro Creek	14.72	380,549	1,695,306	176
22	WV	Stony River	14.51	2,871	7,492	10
23	MD	Deer Creek	14.46	365,240	318,288	146
24	PA	Alvin R. Bush Dam	14.28	0	8,445	95
25	PA	Sinnemahoning Creek	14.18	3,481	3,730	72

26	PA	Middle Creek	14.12	88,346	531,795	177
27	PA	Cocalico Creek	14.04	396,640	863,378	140
28	PA	East Licking Creek	13.96	16,688	53,902	46
29	PA	Buffalo Creek	13.95	100,621	646,554	207
30	PA	Tuscarora Creek	13.93	69,253	462,526	224
31	WV	Mt. Storm Power Station Dam/StoRiver Dam	13.92	26,735	29,033	49
32	PA	Larrys Creek	13.91	31,081	60,953	89
33	PA	Wiconisco Creek	13.87	198,475	279,375	116
34	MD	Bloomington/Jennings Randolph	13.67	16,613	13,577	63
35	PA	Codorus Creek South Branch	13.63	110,728	557,735	117
36	PA	Wills Creek	13.31	60,261	182,765	193
37	PA	Fishing Creek	13.31	110,550	524,137	271
38	PA	Juniata River	13.28	273,870	1,515,659	767
39	MD	Tonoloway Creek	13.17	889	1,586	2
40	MD	Savage River Dam	13.10	16,899	13,120	56
41	PA	Susquehanna River	13.00	1,779,003	3,192,843	2262
42	VA	Lower Eastern Shore Tidal Drainage	12.94	39,615	1,061,219	219
43	PA	Sherman Creek	12.93	25,590	555,339	276
44	PA	Beech Creek	12.85	13,207	30,993	171
45	MD	Susquehanna River	12.84	31,675	22,694	28
46	MD	Octoraro Creek	12.81	67,668	74,899	35
47	MD	Potomac River North Branch	12.79	65,442	56,592	157
48	PA	Penns Creek	12.74	230,978	818,304	377
49	PA	Aughwick Creek	12.71	6,121	77,659	47
50	PA	Muncy Creek	12.61	123,379	236,792	204
51	PA	Bald Eagle Creek	12.57	158,173	466,129	383
52	PA	White Deer Creek	12.50	3,296	9,020	45
53	PA	Susquehanna River West Branch	12.47	530,919	1,344,251	1745
54	MD	Muddy Creek	12.42	2,459	2,015	2
55	PA	Moshannon Creek	12.30	41,630	52,173	274
56	MD	Lingamore Creek	12.25	303,530	253,128	89
57	PA	Chillisquaque Creek	12.21	146,452	421,101	112
58	PA	George B. Stevenson Dam	12.15	1,412	450	27
59	MD	Conowingo Dam	12.15	17,437	23,123	23
60	WV	Potomac River North Branch	12.09	41,441	69,784	162
61	WV	Bloomington/Jennings Randolph	11.99	11,194	40,474	81
62	MD	Monocacy River	11.98	1,416,466	994,573	448
63	PA	Muddy Creek	11.96	106,078	722,807	137
64	PA	Blacklog Creek	11.90	1,443	58,257	73
65	PA	Warrior Ridge Dam	11.80	2,986	112,785	78
66	PA	Broad Creek	11.76	432	2,004	1

67	VA	Pocomoke River	11.73	2,511	90,393	24
68	PA	Cush Creek	11.69	92,351	503,905	191
69	MD	Broad Creek	11.68	104,482	74,690	40
70	MD	Big Pipe Creek	11.66	367,135	343,324	109
71	PA	Holtwood Dam	11.57	21,654	200,609	50
72	PA	Huntington Creek	11.55	46,641	104,308	114
73	PA	Bennette Branch	11.53	26,423	23,825	377
74	PA	Big Elk Creek	11.49	193,113	221,542	42
75	PA	Cayuta Creek	11.47	1,525	915	2
76	MD	Wills Creek	11.33	12,976	12,429	61
77	PA	Foster Joseph Sayers Dam	11.30	48,056	75,597	73
78	PA	Conococheague Creek West Branch	11.20	76,906	897,472	198
79	PA	Conogoguinet Creek	11.20	314,470	1,661,064	458
80	MD	Savage River	11.04	23,441	18,192	60
81	PA	Meshoppen Creek	10.99	126,155	90,982	115
82	PA	Little Juniatta River	10.92	43,333	627,090	343
83	DE	Lower Eastern Shore Tidal Drainage	10.90	120,069	1,755,470	232
84	PA	Wallis Run	10.85	6,158	11,906	37
85	PA	Yellow Breeches Creek	10.81	154,045	433,301	220
86	NY	Owego Creek	10.71	17,060	9,993	13
87	PA	Quittapahilla Creek	10.67	13,113	560,798	77
88	DE	Nanticoke River	10.66	148,268	855,359	91
89	PA	Texas Creek	10.66	56,953	68,235	180
90	PA	Conowingo Dam	10.53	129,767	740,186	102
91	PA	Driftwood Branch	10.50	27,606	5,531	95
92	PA	Sideling Hill Crek	10.48	30,320	275,089	284
93	PA	Bowman Creek	10.39	47,809	36,603	120
94	PA	Branch Creek	10.37	51,737	142,557	46
95	PA	Conococheague Creek	10.32	314,392	1,389,674	304
96	PA	Wyalusing Creek	10.29	217,107	176,504	220
97	PA	Loyalsock Creek	10.20	51,432	129,436	377
98	MD	Middle Western Shore Tidal Drainage	10.17	10,183	4,162	118
99	PA	Tonoloway Creek	10.16	50,029	166,599	112
100	MD	Little Conococheague Creek	10.15	28,452	39,835	17
101	MD	Big Elk Creek	10.13	8,036	7,113	11
102	PA	Curwensville Dam	10.13	13,911	12,193	53
103	VA	Great Wicomico River	10.11	40,220	319,215	128
104	MD	Potomac River	10.05	449,440	408,844	373
105	PA	Kettle Creek	10.02	8,585	24,465	152
106	MD	Licking Creek	10.00	10,841	17,510	27
107	PA	Conewago Creek	9.97	571,578	1,249,196	510
108	WV	Back Creek	9.88	28,321	37,982	106
109	WV	Sleepy Creek	9.86	36,140	35,480	125
110	PA	Lycoming Creek	9.83	77,022	104,254	273
111	MD	Winters Run	9.82	107,637	40,685	58
112	MD	Great Seneca Creek	9.72	218,779	74,265	102

113	MD	Conococheague Creek	9.70	140,601	185,077	66
114	PA	Sinnemahoning Creek First Fork	9.70	15,003	30,041	240
115	MD	Antietam Creek East Branch	9.68	9,399	16,033	8
116	PA	Juniata River Frankstown Branch	9.60	0	765,109	396
117	MD	Nanticoke River	9.60	54,749	98,337	20
118	DE	Middle Eastern Shore Tidal Drainage	9.59	46,949	84,606	19
119	PA	Chest Creek	9.51	50,485	100,395	129
120	PA	Licking Creek	9.45	61,719	273,960	186
121	NY	Tioughnioga Creek	9.44	219,652	194,575	193
122	PA	Potomac River	9.36	3,427	9,037	3
123	MD	Upper Western Shore Tidal Drainage	9.33	117,073	63,446	141
124	PA	Spring Creek	9.27	168,028	233,048	146
125	NY	Tioughnioga River West Branch	9.26	194,940	122,231	104
126	MD	Middle Eastern Shore Tidal Drainage	9.17	727,899	1,360,534	348
127	MD	Lower Western Shore Tidal Drainage	9.13	109,064	95,831	275
128	VA	Lower Potomac Tidal Drainage	9.01	115,946	245,811	470
129	NY	Catatonk Creek	8.89	124,130	65,134	151
130	MD	Marsh Creek	8.89	26,282	30,147	11
131	MD	Antietam Creek	8.88	344,576	396,687	178
132	PA	Little Northeast Creek	8.81	12,302	52,465	8
133	WV	North River	8.80	40,673	107,511	206
134	DE	Deep Creek	8.79	22,043	201,441	30
135	PA	Raystown Dam	8.65	8,739	117,186	209
136	NY	Owego Creek East Branch	8.62	97,338	50,981	101
137	WV	Cacapon river	8.59	9,067	6,527	61
138	NY	Tioughnioga River	8.57	255,073	143,779	208
139	VA	Sleepy Creek	8.51	2,275	7,081	20
140	PA	Pine Creek	8.50	72,883	108,600	599
141	MD	Georges Creek	8.41	16,542	14,853	75
142	MD	Middle Patuxent River	8.36	147,889	63,635	58
143	MD	Lower Patuxent Tidal Drainage	8.35	161,360	249,545	300
144	NY	Nanticoke Creek	8.35	83,706	49,825	114
145	PA	Clearfield Creek	8.31	109,822	123,735	393
146	WV	Potomac River South Branch	8.28	133,491	354,159	543
147	PA	MehoopaCreek	8.27	26,792	26,281	123
148	MD	Seneca Creek	8.27	53,747	45,260	27
149	PA	Little Loyalsock Creek	8.25	18,817	71,286	82
150	MD	Marsh Run	8.21	35,243	50,360	21
151	PA	Little Tonoloway Creek	8.21	1,163	6,753	10

152	MD	Little Northeast Creek	8.20	74,378	114,128	48
153	MD	Lower Potomac Tidal Drainage	8.14	175,353	322,409	428
154	NY	Owego Creek West Branch	8.14	55,094	35,692	77
155	WV	Opequon Creek	8.14	238,367	181,072	192
156	VA	South Branch Potomac	8.06	4,536	52,405	59
157	WV	Potomac River	8.05	203,834	195,032	320
158	MD	Evitts Creek	8.01	5,679	5,001	31
159	MD	Choptank River	8.01	169,481	419,663	108
160	NY	Chenango River	8.00	615,303	397,355	614
161	NY	Susquehanna River	7.99	707,343	391,978	890
162	PA	Bobs Creek	7.98	60,716	199,671	172
163	VA	Potomac River	7.98	136,273	51,586	351
164	PA	Marsh Creek	7.97	161,156	336,360	161
165	MD	Hunting Creek	7.95	12,255	22,809	26
166	PA	Antietam Creek East Branch	7.94	69,242	293,867	86
167	VA	Potomac River South Branch North Fork	7.89	673	4,032	38
168	MD	Conococheague Creek West Branch	7.83	15	19	0
169	MD	Marshyhope Creek	7.80	245,367	456,117	119
170	MD	Gunpowder Falls	7.79	174,116	170,752	175
171	PA	Lackawanna River	7.78	96,580	38,490	348
172	MD	Loch Raven Dam	7.78	6,006	3,112	31
173	PA	Seeley Creek	7.65	69,814	70,691	88
174	PA	Dunning Creek	7.61	6,721	25,772	25
175	PA	Little Conococheague Creek	7.60	0	182	1
176	PA	Antietam Creek	7.56	20,184	119,322	20
177	MD	Little Tonoloway Creek	7.52	5,695	9,651	15
178	PA	Sugar Creek	7.47	195,384	187,338	190
179	PA	Fifteen Mile Creek	7.47	1,554	4,487	12
180	NY	Seeley Creek	7.46	19,713	34,360	58
181	NY	Tuscarora Creek North Branch	7.45	45,757	155,057	128
182	NY	Cayuta Creek	7.45	30,769	46,594	140
183	MD	Nassawango Creek	7.44	134,258	88,841	68
184	MD	Catoctin Creek	7.41	223,108	195,936	120
185	WV	Lost River	7.40	55,371	169,673	414
186	PA	Monocacy River	7.38	39,819	63,745	67
187	WV	Reeds Creek	7.36	5,984	10,202	65
188	MD	Gwynns Falls	7.33	10,313	1,663	65
189	MD	Lower Eastern Shore Tidal Drainage	7.29	1,005,871	1,029,449	454
190	MD	Chester River	7.29	88,059	123,150	35
191	VA	Shenandoah River South Fork	7.29	159,004	808,416	618
192	MD	North East Branch Annacostia River	7.25	18,708	4,184	75

193	MD	Fifteen Mile Creek	7.25	2,848	2,712	50
194	PA	Babb Creek	7.21	56,918	51,916	130
195	MD	Town Creek	7.21	9,572	13,485	68
196	MD	Sideling Hill Crek	7.20	5,034	6,397	24
197	MD	Western Run	7.14	129,304	156,357	118
198	MD	Patapsco River	7.06	186,374	99,619	204
199	VA	Opequon Creek	7.06	99,599	112,996	151
200	PA	Pine Creek West Branch	7.02	1,416	5,914	72
201	NY	Wylie Creek	7.01	16,178	9,451	25
202	NY	Sangerfield River	7.01	61,100	53,664	62
203	MD	Upper Eastern Shore Tidal Drainage	7.00	1,399,789	2,141,323	748
204	DE	Upper Eastern Shore Tidal Drainage	6.98	85,776	116,003	36
205	MD	Annacostia River	6.97	8,354	563	70
206	WV	Potomac River South Branch North Fork	6.96	31,722	64,493	212
207	PA	West Creek	6.92	37,797	12,340	150
208	VA	North River	6.91	53,152	147,644	53
209	DE	Nanticoke River Gravelly fork	6.91	24,161	237,596	42
210	WV	South Branch Potomac	6.90	66,072	117,770	208
211	WV	Shenandoah River North Fork	6.84	1,722	6,648	17
212	PA	Towanda Creek	6.84	157,063	150,744	195
213	NY	Canasawacta Creek	6.81	40,346	21,045	62
214	VA	Catoctin Creek South Fork	6.78	87,306	63,189	93
215	MD	Clark Run	6.75	6,137	7,061	15
216	VA	Shenandoah River North Fork	6.73	258,286	1,163,759	860
217	WV	Shenandoah River	6.73	37,213	21,016	103
218	PA	Yellow Creek	6.72	63,528	193,642	96
219	PA	Juniata River Raystown Branch	6.70	103,288	343,802	461
220	VA	Shenandoah River	6.70	0	0	249
221	PA	Town Creek	6.66	10,673	33,252	89
222	MD	Tuckahoe River	6.60	264,453	516,118	150
223	MD	Chester River Unicorn Branch	6.59	34,564	60,501	20
224	PA	Chemung River	6.55	59,853	55,949	92
225	VA	Lower Rappahannock Tidal Drainage	6.54	176,465	642,853	493
226	PA	Upper Eastern Shore Tidal Drainage	6.53	22,614	40,371	12
227	NY	Kelsie Creek	6.49	35,766	19,487	42
228	PA	Tunkhannock Creek	6.44	209,173	126,568	343
229	WV	Seneca Creek	6.43	5,731	10,708	68
230	VA	Accotink Creek	6.38	2,700	1,571	90
231	MD	Nanjemoy Creek	6.37	4,954	8,607	21
232	NY	Otego Creek	6.28	64,220	50,096	109

233	NY	Genegantslet Creek	6.25	49,924	24,629	105
234	MD	Bynum Run	6.14	39,297	8,226	23
235	MD	Pocomoke River	6.13	811,132	666,824	301
236	MD	St Marys River	6.11	3,794	4,070	25
237	WV	Patterson Creek	6.09	41,686	102,374	282
238	PA	Sinnemahoning Portage Creek	6.03	6,570	2,884	73
239	PA	Tunkhannock Creek East Branch	5.93	38,169	24,229	70
240	VA	Cat Point Creek	5.91	18,377	108,635	72
241	NY	Bennettes Creek	5.91	14,328	56,888	96
242	MD	Rock Creek	5.90	15,261	1,163	61
243	NY	Charlotte Creek	5.89	115,113	43,073	176
244	NY	Otselic River	5.87	96,873	58,767	147
245	NY	Canisteo River	5.86	72,638	247,156	328
246	VA	Piscataway Creek	5.78	17,797	63,157	53
247	NY	Chemung River	5.75	90,000	125,524	369
248	MD	Little Patuxent River	5.75	58,447	15,975	102
249	NY	Whitney Point Dam	5.73	89,059	47,047	110
250	WV	Potomac River South Branch South Fork	5.68	37,894	84,644	278
251	MD	Piscataway Creek	5.63	27,542	4,947	62
252	NY	Scheneuus Creek	5.62	54,143	42,881	119
253	VA	Cedar Creek	5.59	24,179	67,255	157
254	VA	Potomac River South Branch South Fork	5.53	163	1,912	11
255	MD	Conewago Creek	5.52	4,001	6,035	5
256	MD	Zekiah Swamp Run	5.50	29,360	32,784	93
257	MD	Chicamwicomico River	5.42	84,008	226,226	86
258	VA	Back Creek	5.41	28,699	60,176	309
259	MD	St Clement Creek	5.34	12,538	13,543	18
260	VA	Goose Creek	5.26	222,037	193,078	386
261	NY	Tioga River	5.23	15,510	38,517	76
262	VA	Rapidian River	5.22	395,824	487,262	499
263	MD	Dividing Creek	5.20	60,364	70,695	60
264	PA	Tioga River	5.17	83,819	76,410	252
265	NY	Cherry Valley Creek	5.11	34,917	27,203	92
266	MD	McIntosh Run	5.09	8,622	11,027	29
267	NY	Butternut Creek	5.03	64,406	53,186	130
268	DE	Chester River Andover Branch	4.98	34,804	52,123	41
269	PA	Hammond Dam	4.97	42,875	42,272	107
270	VA	Rappahannock River	4.96	513,157	767,606	965
271	NY	Cohocton River	4.92	137,217	500,995	604
272	NY	East Sidney Dam	4.86	1,034	246	4
273	MD	Patuxent River	4.84	119,157	91,986	176
274	VA	Middle River	4.83	165,210	470,018	399
275	PA	Gunpowder Falls	4.81	3,531	10,762	4
276	VA	Blacks Run	4.80	51,962	99,658	44
277	PA	Cowanesque River	4.79	71,186	83,537	200

278	MD	Chester River Andover Branch	4.76	77,191	109,083	56
279	NY	Ouleout Creek	4.75	66,663	18,015	106
280	DE	Choptank River	4.68	52,775	128,072	82
281	NY	Unadilla River	4.58	198,601	165,509	338
282	VA	Dry River	4.56	86,162	341,750	323
283	PA	Evitts Creek	4.54	6,582	20,681	63
284	NY	Cowanesque River	4.34	16,511	56,810	82
285	MD	Patuxent River Western Branch	4.34	53,669	10,109	111
286	DE	Marshyhope Creek	4.25	55,691	248,603	97
287	MD	Gilbert Swamp Run	4.24	15,505	22,582	43
288	MD	Mattawoman Creek	4.22	14,348	6,568	56
289	PA	Schrader Creek	4.22	3,207	3,270	83
290	VA	Quantico Creek	4.18	197	162	27
291	NY	Cowanesque Dam	4.10	388	1,642	2
292	PA	Cowanesque Dam	4.10	3,641	2,946	16
293	VA	Hazel River	4.00	81,882	87,769	194
294	MD	Wicomico River	3.99	75,213	40,944	36
295	VA	South River	3.92	87,999	198,399	353
296	VA	Bull Run	3.92	51,025	13,427	195
297	VA	Robinson River	3.88	89,756	135,110	194
298	VA	Lower York Tidal Drainage	3.80	113,591	240,717	433
299	NY	Wharton Creek	3.76	43,836	40,104	93
300	PA	Tioga Dam	3.71	28,496	26,447	96
301	NY	Oaks Creek	3.70	41,934	42,426	102
302	DE	Wicomico River	3.67	927	3,707	2
303	DE	Pocomoke River	3.50	10,411	86,207	35
304	VA	Occoquan Main Dam	3.49	383	278	35
305	VA	Broad Run	3.44	28,641	15,228	64
306	MD	Herring Run	3.35	11	12	30
307	PA	Lake Murburg Dam	3.34	7,767	18,106	24
308	VA	Mattaponi Tidal Drainage	3.26	40,827	108,793	91
309	VA	Pamunkey Tidal Drainage	3.26	40,101	68,316	85
310	MD	Marumsco Creek	3.25	6,348	30,663	13
311	MD	Nanajemoy Creek	3.24	956	1,131	15
312	VA	Pamunkey River	3.13	92	39,653	261
313	VA	Owens Creek	3.12	8,696	26,558	58
314	VA	Cedar Run	3.09	57,223	90,662	225
315	VA	Holmes Run	3.08	2	1	44
316	VA	Thornton River	2.96	33,633	41,349	157
317	PA	Prettyboy Dam	2.89	996	8,644	7
318	MD	Lake Murburg Dam	2.86	94	109	0
319	VA	Little Creek Reservoir	2.46	0	0	4
320	MD	Whitemarsh Run	2.32	1,223	225	16
321	MD	Rocky Gorge Dam	2.23	25,127	12,450	54
322	VA	T. Nelson Elliott Dam	2.19	13,201	15,106	74
323	MD	Prettyboy Dam	2.17	31,929	32,156	73

324	VA	Mattaponi River	2.07	2,481	55,167	402
325	NY	Otsego Lake Dam	2.06	22,722	23,316	93
326	VA	Totoponomoy Creek	1.96	6,774	18,348	30
327	VA	Aquia Creek	1.86	1,750	1,004	56
328	VA	Piankatank River	1.69	12,942	68,110	137
329	MD	Cabin John Creek	1.53	572	32	26
330	VA	James Tidal Tidal Drainage	1.51	344,723	408,361	845
331	VA	Wreck Island Creek	1.38	5,168	39,609	58
332	VA	South Anna River	1.36	88,028	138,723	466
333	MD	Brighton Dam	1.35	18,556	10,555	44
334	VA	North Anna River	1.34	15,346	32,538	134
335	VA	Piney River	1.32	8,041	30,449	92
336	VA	Marracossic Creek	1.31	0	58,324	137
337	VA	Hardware River	1.23	36,617	45,252	138
338	VA	Rockfish River	1.19	8,091	21,173	155
339	VA	Rivanna River South Fork	1.19	22,515	21,039	120
340	VA	South Rivanna Dam	1.17	14,784	14,970	52
341	VA	Rivanna River	1.17	59,887	65,142	324
342	VA	James River	1.14	257,702	606,166	2232
343	VA	Rivanna River North Fork	1.12	46,800	36,965	177
344	VA	Cowpasture River	1.09	14,852	30,125	354
345	VA	Tye River	1.06	6,323	26,423	106
346	VA	Bullpasture River	0.99	6,528	24,566	110
347	VA	Rockfish River North Fork	0.99	4,337	14,218	93
348	VA	Buffalo River	0.98	16,719	53,474	219
349	WV	Dunlap Creek	0.98	4,038	6,309	30
350	VA	Buffalo Creek	0.97	14,313	52,097	134
351	VA	Catawba Creek	0.94	9,466	34,399	115
352	VA	Craig Creek	0.94	8,163	29,760	267
353	VA	Dunlap Creek	0.93	0	7,022	138
354	VA	Willis River	0.90	34,916	86,287	278
355	VA	Maury River	0.88	36,789	149,859	444
356	VA	Deep Creek	0.84	19,942	12,904	81
357	VA	Mechums River	0.83	23,180	16,701	95
358	VA	Chicahominy River Reservoir	0.81	0	0	47
359	VA	Flat Creek	0.81	36,007	79,897	141
360	VA	Chicahominy River	0.75	56,644	60,875	341
361	VA	Little River	0.73	9,711	18,699	118
362	VA	George F. Brasfield Dam	0.73	5,912	37,023	193
363	VA	Potts Creek	0.69	1,109	7,994	129
364	VA	Slate River	0.67	0	40,129	245
365	VA	Appomatox River	0.66	94,654	161,949	718
366	VA	Bushy River	0.60	15,588	12,848	155
367	VA	Johns Creek	0.59	1,574	4,142	105
368	VA	Po river	0.57	11,616	19,262	256
369	VA	Calfpasture River	0.57	3,164	12,698	141

370	WV	Potts Creek	0.55	2,572	251	44
371	VA	Jackson River	0.53	4,320	24,662	267
372	VA	West Creek	0.51	11,326	66,521	205
373	VA	Diascund Creek Reservoir	0.49	3,006	1,027	44
374	VA	Gathright Dam	0.49	16	106	46
375	VA	North Anna Dam	0.47	28,809	32,696	342
376	VA	Swift Creek	0.44	7,804	7,728	181
377	VA	Western Branch Dam	0.40	18,447	23,515	64
378	VA	Lake Mead Dam	0.37	12,270	19,892	64
379	DC	Annacostia River	0.00	0	0	18
380	DC	Bull Run	0.00	0	0	20
381	DC	Potomac River	0.00	0	0	14
382	DC	Rock Creek	0.00	0	0	10
383	MD	Liberty Dam	0.00	0	6,471	164