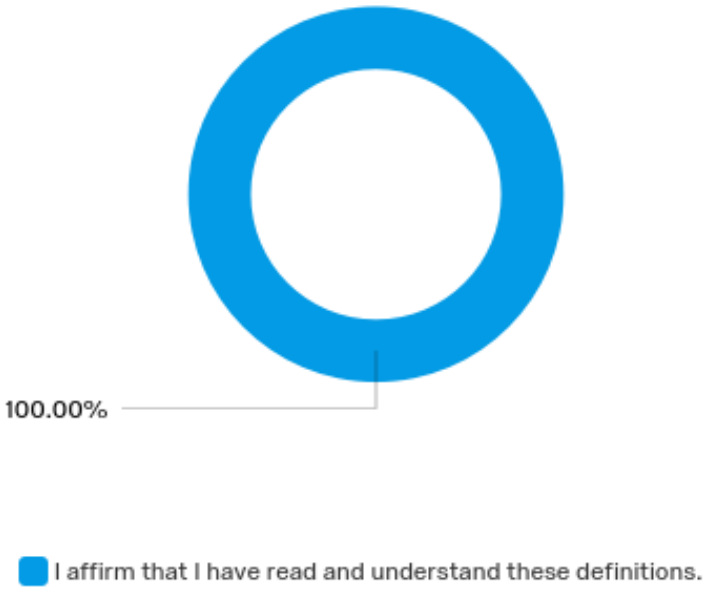
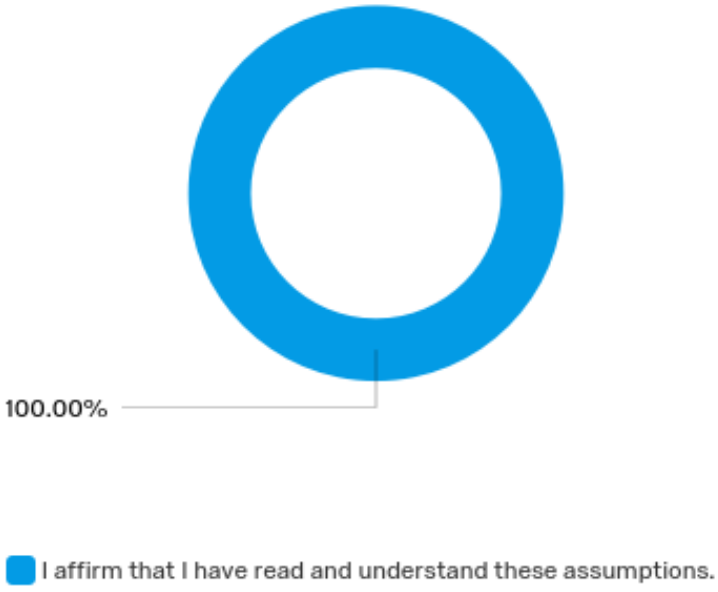
Appendix G.

Expert Elicitation Survey (Round Two) Questions and Results

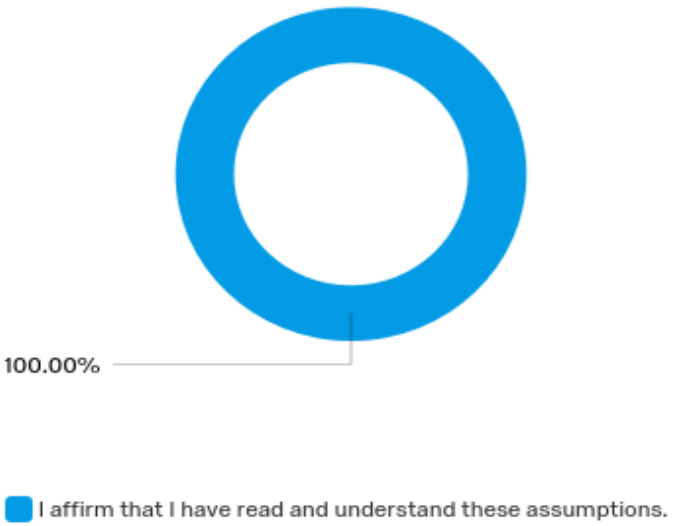
Q1 - For the purposes of this survey, the basic definition of the four wetland BMPs are as follows: Wetland Restoration BMP: The manipulation of the physical, chemical, or biological characteristics of a site with the goal of returning natural/historic functions to a former wetland. Hydric soils are present but a wetland does not exist on the site. Wetland Creation BMP: The manipulation of the physical, chemical, or biological characteristics present to develop a wetland that did not previously exist at a site. Hydric soils are not present. Wetland Rehabilitation BMP: The manipulation of the physical, chemical, or biological characteristics of a site with the goal of repairing natural/historic functions to a degraded wetland. A wetland is physically present but there are multiple conditions within the wetland that are degraded. Wetland Enhancement BMP: The manipulation of the physical, chemical, or biological characteristics of a wetland to heighten, intensify, or improve a specific function(s). A wetland is present and functioning but not in an optimal state. Typically one component of the wetland is addressed.



Q2 - For the purposes of this survey, there are four key assumptions for the panel to understand as you deliberate and provide a response: Wetland BMPs are implemented at sites where a natural wetland is degraded to some degree, existed previously at the site, or in the case of a created wetland, a wetland did not previously exist at the site. The efficiency - i.e., the average effectiveness - is the difference between the 'before' and 'after' condition of the wetland from pre- and post-project implementation. This is expressed as a percent (%) value of the pollutant load in absolute terms. The responses you provide for natural wetlands and the other BMPs may provide context to establish a ranking of wetland BMP pollutant load reduction benefits. For example, if you provide a response for a 60%TSS load reduction of a natural wetland (best guess), and you think an enhancement BMP may not perform as well as a natural wetland, and your response is a 25% TSS load reduction (as a best guess). The 25% is not 25% of the natural wetland, rather based on the performance of the wetland enhancement BMP. Read Attachment E for a more detailed explanation and example. The existing condition of the degraded wetland may affect the performance of a wetland BMP (e.g. the 'before' or baseline condition). You will have an opportunity to characterize and/or explain how your responses considered the baseline condition of the existing, degraded wetland or site without a wetland. The hydrologic, vegetation and soil conditions effect the retention of nitrogen, phosphorus and sediment of a wetland. The degree to which any of these influence a wetland BMP will be determined by the current condition of the wetland (present/absent; what is degraded and to what extent) and techniques implemented. As such, we ask individuals to look at these three components of a wetland and how they may affect water quality as they are implemented individually as a basic approach to improve water quality, or collectively as a more comprehensive approach to improve water quality.



Q3 - Things to consider while formulating your responses Your response values should represent an average, annual performance of the wetlands to retain/reduce the constituent of interest (i.e., TN, TP or TSS). The value is for the (natural, restored/created/rehabilitated/enhanced BMP) wetland alone (i.e., 'edge of field') and not the cumulative effect of the wetland at the watershed scale (i.e., 'edge of stream'). For an undisturbed high-functioning natural wetland, this average annual performance represents the wetland's average annual ability to reduce nutrient or sediment loads as it exists at the site (difference in pollutant load import and export from the wetland). For the four wetland BMPs you are considering the absolute effectiveness of post-treatment conditions to reduce loads. For example, if you think the average pre-treatment wetland would reduce 25% of TN, and after treatment implementation it would reduce TN by 40% then your response would be 40% and not 15% (the difference between the pre- and post-treatment) or 10% (25% of 40%). This may be calculated based on the survey responses if needed, but it is not part of your survey response. See Attachment E for further clarification. From a timescale perspective, it is acknowledged that other time periods may impact the water quality function of wetlands or wetland BMPs such as individual storm events and their characteristics (intensity, frequency, amount of rainfall) or seasonality. However, the value relevant to the Chesapeake Bay watershed modeling tools for TMDL credit is based on the annual timescale. Your entered values may range from negative values up to 100, but remember your upper/lower bounds represent your reasonable bounds on the average, not the upper and lower bounds of the variable population. Please note that we are asking you to provide responses that may allow for a relative ranking of effectiveness for each of the four wetland BMP types (restoration, creation, rehabilitation and enhancement). While there is an existing efficiency assigned to restoration wetland BMPs (TN, TP and TSS load reduction for wetland restoration BMPs of 42%, 40% and 31%, respectively), we are not constraining your responses to relate to these values as the data used to inform these efficiencies were not specific to wetland restoration BMPs. You may choose to use this information to inform your response, or not.



Q5 - Based on the sources of available information and your effort so far, realistically, what is your best guess for the average, annual performance of the pre-treatment site conditions to reduce total nitrogen loads for each BMP? Please adjust the sliders below to provide your responses.

Editor's Note: Question 4 was omitted because it asked the respondent's name [results kept anonymous for the panel, only used for reference by the Chair (Neely), Coordinator (Jeremy) and Deb.

Editor's Note: Q5 and other questions refer to "sliders," which allowed respondents to more efficiently provide their answers for each field concurrently.

Editor's Note: The responses are given as % values (possible responses for efficiency values ranged from -100% to 100%).

#	Field	Minimum	Maximum	Mean	Std Deviation	Count
2	Wetland Creation	-50.00	15.00	-4.30	17.58	10
4	Wetland Enhancement	-10.00	50.00	26.60	15.40	10
3	Wetland Rehabilitation	-12.00	27.00	18.00	10.99	10
1	Wetland Restoration	-5.00	30.00	10.50	10.30	10

Q6 - Based on the sources of available information and your effort so far, realistically, what do you think the lowest plausible, average, annual performance of natural wetlands or the four wetland BMP types to reduce total nitrogen loads entering the natural or post-treatment site? Please adjust the sliders below to provide your responses.

#	Field	Minimum	Maximum	Mean	Std Deviation	Count
1	Natural wetland	-8.00	55.00	29.70	18.08	10
2	Wetland Restoration	-8.00	28.00	15.70	9.76	10
3	Wetland Creation	-8.00	22.00	9.90	8.25	10
4	Wetland Rehabilitation	-8.00	31.00	17.80	11.96	10
5	Wetland Enhancement	-8.00	46.00	23.00	14.95	10

Q7 - Based on the sources of available information and your effort so far, realistically, what do you think the highest plausible, average, annual performance of natural wetlands or the four wetland BMP types to reduce total nitrogen loads entering the natural or post-treatment site? Please adjust the sliders below to provide your responses.

#	Field	Minimum	Maximum	Mean	Std Deviation	Count
1	Natural wetland	43.00	100.00	76.90	17.81	10
2	Wetland Restoration	27.00	80.00	58.80	17.05	10
3	Wetland Creation	20.00	85.00	51.40	17.37	10
4	Wetland Rehabilitation	35.00	80.00	60.40	15.52	10
5	Wetland Enhancement	30.00	85.00	62.40	18.53	10

Q8 - Based on the sources of available information and your effort so far, realistically, what is your best guess of the average, annual performance of natural wetlands or the four wetland BMP types to reduce total nitrogen loads entering the natural or post-treatment site? Please adjust the sliders below to provide your responses.

#	Field	Minimum	Maximum	Mean	Std Deviation	Count
1	Natural wetland	42.00	75.00	56.90	10.46	10
2	Wetland Restoration	30.00	54.00	39.80	6.29	10
3	Wetland Creation	15.00	42.00	29.80	6.66	10
4	Wetland Rehabilitation	33.00	54.00	41.00	6.40	10
5	Wetland Enhancement	25.00	60.00	45.10	10.17	10

Q9 - Please provide any statement or information in support of any of the answers provided above (e.g., were there specific studies or resources you relied on; which specific conceptual model(s) from Attachment A - if any - did you rely on?). Comments should be concise and based on the evidence used to provide your responses. Comments may be shared anonymously with other expert assessors.

Editor's Note: Attachment A is provided with this report as Appendix F. Other Attachments referenced in the survey (Attachments B through E) are provided at the end of this Appendix, without edits/updates aside from page numbers.

TBA
Data from Gebo and Brooks
Estimates based on WEP16 conclusions and evidence from WEP2 discussions/lit review
while we have been asked to base answers on the average and generalized condition, it should be noted that the variability with respect to surface water versus groundwater treatment is very important. In particular groundwater treatment could be expected to be nearly complete in anaerobic conditions and modest treatment for surface flow akin to a retention pond. therefore the cumulative effect would be a combination of the two and based on the degree of surface versus groundwater flow. Furthermore I am a little troubled (but I understand the need) to assess these 4 categories while not addressing the other perhaps equally important factors of soils, hydrology, etc
I used the "Wetland Type Summary" database of N, P, and sediment retention from the literature. I then calculated for "N and TN", "P and TP", and all sediment %retentions the following percentiles: 10, 20, 40, 50, 60, 70, and 80th. For pre-restoration, average %retention is assumed to be: creation=10th, restoration=20th, rehabilatation=40th, enhancement=60th, natural=80th. For post-restoration: created=40th, restoration=50th, rehabilatation=60th, enhancement=70th, natural=80th.
I consulted Table 9 from the 2016 WEP report and Attachment C to derive these values.
Wetland restoration is likely to perform nearly as well as a natural wetland because of the landscape positions in which they typically occur. Rehabilitation is likely to perform well, but the landscape position is much more variable - some will be receive high loads while others will not. Wetland enhancement varies based on what is being done, with some treatments not changing efficiency much and others potentially decreasing efficiency. Creation has the greatest potential for failure and may not be in a good landscape position.
I based my estimate of removal efficiency for natural wetlands on the bar graph provided in appendix C. I used values a little higher than what is represented on the bar graph assuming that not all wetlands used to create the graph were high-quality, natural wetlands. I had no basis to conclude that enhanced wetlands would perform better than natural wetlands, because enhancements may be targeted at achieving objectives other than N removal. I assumed that restored and rehabilitated wetlands would perform comparably, with both falling somewhat below the efficiencies for natural wetlands. Values for created wetlands were lowest and substantially lower than for natural wetlands because of doubts about the overall success rate for wetlands creation.
best prof. judgement
I reviewed all of attachment A and looked carefully through Attachment C before filling out the survey. In addition to the information provided, there is a lot of variability from site to site based on wetland type, wetland condition, landscape position, etc. so I do not have a high degree of confidence in my responses to the survey questions.

Q10 - For each of the above natural or BMP-treated conditions, how confident are you that your interval, from lowest to highest, captures the true average, annual efficiency of the natural or post-treatment wetland sites to reduce TN loads? See Attachment D for guidance on selecting a confidence value.

Editor's Note: Following guidance from Hemming et al (2018), panelists were instructed that their confidence should be >50%. If their confidence was below that level it would imply that they feel the truth is more likely to fall outside their provided interval, which is rarely what the expert actually believes. Therefore, responses for Q10, Q16 and Q22 are provided as % values between 50 and 100.

#	Field	Minimum	Maximum	Mean	Std Deviation	Count
1	Natural wetland	70.00	80.00	76.10	3.73	10
2	Wetland Restoration	60.00	80.00	71.00	6.63	10
3	Wetland Creation	55.00	80.00	68.60	9.62	10
4	Wetland Rehabilitation	55.00	81.00	70.10	8.78	10
5	Wetland Enhancement	55.00	80.00	64.50	8.79	10

Q11 - Based on the sources of available information and your effort so far, realistically, what is your best guess for the average, annual performance of the pre-treatment site conditions to reduce total phosphorus loads for each BMP? Please adjust the sliders below to provide your responses.

#	Field	Minimum	Maximum	Mean	Std Deviation	Count
1	Wetland Restoration	-5.00	40.00	10.60	12.58	10
2	Wetland Creation	-50.00	15.00	-3.90	17.24	10
3	Wetland Rehabilitation	-15.00	30.00	11.50	12.36	10
4	Wetland Enhancement	-10.00	46.00	17.70	16.78	10

Q12 - Based on the sources of available information and your effort so far, realistically, what do you think the lowest plausible, average, annual performance of natural wetlands or the four wetland BMP types to reduce total phosphorus loads entering the natural or post-treatment site? Please adjust the sliders below to provide your responses.

#	Field	Minimum	Maximum	Mean	Std Deviation	Count
1	Natural wetland	-47.00	65.00	21.80	30.56	10
2	Wetland Restoration	-47.00	34.00	4.30	20.46	10
3	Wetland Creation	-47.00	25.00	0.30	18.60	10
4	Wetland Rehabilitation	-47.00	41.00	5.90	22.87	10
5	Wetland Enhancement	-47.00	55.00	12.00	25.96	10

Q13 - Based on the sources of available information and your effort so far, realistically, what do you think the highest plausible, average, annual performance of natural wetlands or the four wetland BMP types to reduce total phosphorus loads entering the natural or post-treatment site? Please adjust the sliders below to provide your responses.

#	Field	Minimum	Maximum	Mean	Std Deviation	Count
1	Natural wetland	22.00	100.00	73.60	22.26	10
2	Wetland Restoration	18.00	78.00	53.20	15.15	10
3	Wetland Creation	23.00	60.00	43.80	12.33	10
4	Wetland Rehabilitation	10.00	78.00	54.10	17.95	10
5	Wetland Enhancement	12.00	85.00	58.70	20.54	10

Q14 - Based on the sources of available information and your effort so far, realistically, what is your best guess of the average, annual performance of natural wetlands or the four wetland BMP types to reduce total phosphorus loads entering the natural or post-treatment site? Please adjust the sliders below to provide your responses.

#	Field	Minimum	Maximum	Mean	Std Deviation	Count
1	Natural wetland	15.00	80.00	52.70	18.88	10
2	Wetland Restoration	10.00	48.00	33.50	11.30	10
3	Wetland Creation	12.00	38.00	27.00	7.73	10
4	Wetland Rehabilitation	10.00	55.00	35.30	13.34	10
5	Wetland Enhancement	11.00	65.00	41.10	16.39	10

Q15 - Please provide any statement or information in support of any of the answers provided above (e.g., were there specific studies or resources you relied on; which specific conceptual model(s) from Attachment A - if any - did you rely on?). Comments should be concise and based on the evidence used to provide your responses. Comments may be shared anonymously with other expert assessors.

tba
Gebo and Brooks
WEP2016 report, combined with WEP2 lit review and discussions
Timescale could be important for development of hydric soils
I used the "Wetland Type Summary" database of N, P, and sediment retention from the literature. I then calculated for "N and TN", "P and TP", and all sediment %retentions the following percentiles: 10, 20, 40, 50, 60, 70, and 80th. For pre-restoration, average %retention is assumed to be: creation=10th, restoration=20th, rehabilatation=40th, enhancement=60th, natural=80th. For post-restoration: created=40th, restoration=50th, rehabilatation=60th, enhancement=70th, natural=80th. With a 10% range around mean
2016 WEP and Attachment C. Enhancement really depends on what function they are enhancing - vegetation enhancement by spraying phragmites can reduce water quality benefits; increased residence time can improve water quality benefits.
As with TN, some types of projects occur more often in good landscape positions to treat TP, while others are more variable, and creation has a greater chance of not being successful.
I based my estimate of removal efficiency for natural wetlands on the bar graph provided in appendix C. I used values a little higher than what is represented on the bar graph assuming that not all wetlands used to create the graph were high-quality, natural wetlands. I had no basis to conclude that enhanced wetlands would perform better than natural wetlands, because enhancements may be targeted at achieving objectives other than P removal. I assumed that restored and rehabilitated wetlands would perform comparably, with both falling

somewhat below the efficiencies for natural wetlands. Values for created wetlands were lowest and substantially lower than for natural wetlands because of doubts about the overall success rate for wetlands creation.

BPJ

I reviewed all of attachment A and looked carefully through Attachment C before filling out the survey. Phosphorus is challenging because it can be a sink and then become a source when there is substantial accumulation. In addition, there is a lot of variability from site to site based on wetland type, wetland condition, landscape position, etc. so I do not have a high degree of confidence in my responses to the survey questions.

Q16 - For each of the above natural or BMP-treated conditions, how confident are you that your interval, from lowest to highest, captures the true average, annual efficiency of the natural or post-treatment wetland sites to reduce TP loads? See Attachment D for guidance on selecting a confidence value.

#	Field	Minimum	Maximum	Mean	Std Deviation	Count
1	Natural wetland	57.00	81.00	71.30	7.73	10
2	Wetland Restoration	60.00	80.00	69.50	6.50	10
3	Wetland Creation	55.00	81.00	65.60	9.85	10
4	Wetland Rehabilitation	55.00	80.00	65.70	8.57	10
5	Wetland Enhancement	55.00	80.00	63.20	8.84	10

Q17 - Based on the sources of available information and your effort so far, realistically, what is your best guess for the average, annual performance of the pre-treatment site conditions to reduce total sediment loads for each BMP? Please adjust the sliders below to provide your responses.

#	Field	Minimum	Maximum	Mean	Std Deviation	Count
1	Wetland Restoration	-5.00	44.00	14.30	16.14	10
2	Wetland Creation	-50.00	32.00	-1.30	20.88	10
3	Wetland Rehabilitation	-35.00	30.00	13.10	18.43	10
4	Wetland Enhancement	-15.00	52.00	22.30	19.37	10

Q18 - Based on the sources of available information and your effort so far, realistically, what do you think the lowest plausible, average, annual performance of natural wetlands or the four wetland BMP types to reduce total sediment loads entering the natural or post-treatment site? Please adjust the sliders below to provide your responses.

#	Field	Minimum	Maximum	Mean	Std Deviation	Count
1	Natural wetland	-30.00	78.00	31.30	30.49	10
2	Wetland Restoration	-30.00	50.00	13.00	22.01	10
3	Wetland Creation	-30.00	45.00	7.90	20.22	10
4	Wetland Rehabilitation	-30.00	55.00	14.90	23.39	10
5	Wetland Enhancement	-30.00	65.00	21.50	26.79	10

Q19 - Based on the sources of available information and your effort so far, realistically, what do you think the highest plausible, average, annual performance of natural wetlands or the four wetland BMP types to reduce total sediment loads entering the natural or post-treatment site? Please adjust the sliders below to provide your responses.

#	Field	Minimum	Maximum	Mean	Std Deviation	Count
1	Natural wetland	48.00	96.00	76.30	17.49	10
2	Wetland Restoration	26.00	91.00	53.50	19.42	10
3	Wetland Creation	14.00	87.00	45.80	19.71	10
4	Wetland Rehabilitation	20.00	93.00	55.40	19.12	10
5	Wetland Enhancement	21.00	95.00	61.60	20.93	10

Q20 - Based on the sources of available information and your effort so far, realistically, what is your best guess of the average, annual performance of natural wetlands or the four wetland BMP types to reduce total sediment loads entering the natural or post-treatment site? Please adjust the sliders below to provide your responses.

#	Field	Minimum	Maximum	Mean	Std Deviation	Count
1	Natural wetland	31.00	85.00	59.40	19.62	10
2	Wetland Restoration	25.00	71.00	39.90	13.95	10
3	Wetland Creation	17.00	64.00	32.60	12.48	10
4	Wetland Rehabilitation	20.00	76.00	39.80	16.15	10
5	Wetland Enhancement	15.00	80.00	44.10	18.81	10

Q21 - Please provide any statement or information in support of any of the answers provided above (e.g., were there specific studies or resources you relied on; which specific conceptual model(s) from Attachment A - if any - did you rely on?). Comments should be concise and based on the evidence used to provide your responses. Comments may be shared anonymously with other expert assessors.

tba
Wardrop dissertation and unpublished data
WEP2016 report, combined with WEP2 lit review and discussions
I would expect that the range of high to low would be less for TSS as it is less complex of a process and does not involve chemical or biological processes
I used the "Wetland Type Summary" database of N, P, and sediment retention from the literature. I then calculated for "N and TN", "P and TP", and all sediment %retentions the following percentiles: 10, 20, 40, 50, 60, 70, and 80th. For pre-restoration, average %retention is assumed to be: creation=10th, restoration=20th, rehabilatation=40th, enhancement=60th, natural=80th. For post-restoration: created=40th, restoration=50th, rehabilatation=60th, enhancement=70th, natural=80th. With a 10% range around mean
same sources as before
As with TN and TP, related to landscape position and difference in locations of various BMPs.
I based my estimate of removal efficiency for natural wetlands on the bar graph provided in appendix C. I used values a little higher than what is represented on the bar graph assuming that not all wetlands used to create the graph were high-quality, natural wetlands. I had no basis to conclude that enhanced wetlands would perform better than natural wetlands, because enhancements may be targeted at achieving objectives other than TSS removal. I assumed that restored and rehabilitated wetlands would perform comparably, with both falling somewhat below the efficiencies for natural wetlands. Values for created wetlands were lowest and substantially lower than for natural wetlands because of doubts about the overall success rate for wetlands creation.

BPJ

I reviewed all of attachment A and looked carefully through Attachment C before filling out the survey. In addition to the information provided, there is a lot of variability from site to site based on wetland type, wetland condition, landscape position, etc. The location and morphology of a wetlands will be particularly important for retention of TSS. So, with all the variables from site to site, I do not have a high degree of confidence in my responses to the survey questions.

Q22 - For each of the above natural or BMP-treated conditions, how confident are you that your interval, from lowest to highest, captures the true average, annual efficiency of the natural or post-treatment wetland sites to reduce sediment loads? See Attachment D for guidance on selecting a confidence value.

#	Field	Minimum	Maximum	Mean	Std Deviation	Count
1	Natural wetland	65.00	85.00	73.00	6.40	10
2	Wetland Restoration	63.00	80.00	70.20	6.00	10
3	Wetland Creation	54.00	80.00	64.70	8.21	10
4	Wetland Rehabilitation	55.00	80.00	67.80	7.59	10
5	Wetland Enhancement	51.00	80.00	63.30	9.47	10

Q24 - Please provide responses to the best of your ability to identify the individual wetland techniques that are commonly associated with the four different wetland BMP types. A technique may apply to one or more of the BMPs, or none at all. Secondly, please identify to the best of your ability if you would classify the technique as 'simple', 'comprehensive', or 'both'. For the purposes of this survey, a simple technique is one that is typically used alone, to address a single wetland condition and/or function while a comprehensive technique is commonly used as part of a suite of techniques to address multiple wetland conditions. The implementation of the simple and/or comprehensive techniques should be evaluated with respect to their impact on a wetland BMP's water quality. Attachment B is provided for guidance. Please select all boxes below that apply, given your individual breadth of knowledge and experience.

Question	Restoration	#	Creation	#	Rehabilitation	#	Enhancement	#
Ditch plugs	32.00%	8	8.00%	2	20.00%	5	8.00%	2
Ditch fills	28.57%	8	10.71%	3	25.00%	7	7.14%	2
Low profile berms	24.14%	7	17.24%	5	17.24%	5	13.79%	4
Shallow excavation	15.38%	4	26.92%	7	11.54%	3	19.23%	5
Levee breach	23.08%	6	7.69%	2	26.92%	7	15.38%	4
Water control structures/weirs	14.81%	4	18.52%	5	25.93%	7	14.81%	4
Poly barrier/slurry wall	9.09%	1	27.27%	3	18.18%	2	0.00%	0
Grading ditch banks	20.00%	5	16.00%	4	24.00%	6	12.00%	3
Fill removal	25.93%	7	14.81%	4	22.22%	6	11.11%	3
Legacy sediment removal	26.09%	6	13.04%	3	21.74%	5	13.04%	3
Tile drainage plugs	29.17%	7	8.33%	2	20.83%	5	12.50%	3
Microtopography	14.29%	4	17.86%	5	21.43%	6	21.43%	6
Phragmites control	12.50%	3	12.50%	3	20.83%	5	25.00%	6
Woody vegetation control - pine removal	9.09%	2	13.64%	3	22.73%	5	22.73%	5
Woody veg. control - maple, gum, alders & invasive species	11.54%	3	11.54%	3	23.08%	6	26.92%	7
Tree and shrub planting	17.86%	5	17.86%	5	21.43%	6	17.86%	5
Grass and forb plantings	18.52%	5	18.52%	5	18.52%	5	18.52%	5
Soil decompaction	23.08%	6	15.38%	4	15.38%	4	15.38%	4

Question	Simple	#	Comprehensive	#	Both (Simple & Comprehensive)	#
Ditch plugs	8.00%	2	0.00%	0	24.00%	6
Ditch fills	3.57%	1	0.00%	0	25.00%	7
Low profile berms	0.00%	0	3.45%	1	24.14%	7
Shallow excavation	3.85%	1	3.85%	1	19.23%	5
Levee breach	7.69%	2	3.85%	1	15.38%	4
Water control structures/weirs	3.70%	1	3.70%	1	18.52%	5
Poly barrier/slurry wall	18.18%	2	9.09%	1	18.18%	2
Grading ditch banks	4.00%	1	8.00%	2	16.00%	4
Fill removal	0.00%	0	3.70%	1	22.22%	6
Legacy sediment removal	0.00%	0	4.35%	1	21.74%	5
Tile drainage plugs	4.17%	1	0.00%	0	25.00%	6
Microtopography	3.57%	1	10.71%	3	10.71%	3
Phragmites control	8.33%	2	8.33%	2	12.50%	3
Woody vegetation control - pine removal	4.55%	1	13.64%	3	13.64%	3
Woody veg. control - maple, gum, alders & invasive species	3.85%	1	3.85%	1	19.23%	5
Tree and shrub planting	3.57%	1	3.57%	1	17.86%	5
Grass and forb plantings	3.70%	1	3.70%	1	18.52%	5
Soil decompaction	7.69%	2	11.54%	3	11.54%	3

Editor's Note: The final question (Q25) asked respondents for their confidence in each of their answers for Q24. The results from that question could not be reasonably summarized here. Q24 and Q25 were optional questions and had less than 10 responses. The responses helped to inform discussions that eventually built Table 13 in the report, but the quantified responses from Q24 and Q25 were not used directly in the way that the responses for TN, TP and TSS were.

Editor's Note: Attachment A is provided in this report with minor updates as Appendix F. Attachments B-E are added on the subsequent pages for documentation/reference, with no updates aside from page numbers.

As part of the survey you will be asked to select which of the BMPs you feel are applicable to a given wetland management technique (you can select more than one if you feel the technique can be used as part of multiple BMPs, as defined for CBP purposes). You are then asked whether you think the technique is best described as "simple" or "comprehensive."

Wetland Restoration BMP: The manipulation of the physical, chemical, or biological characteristics of a site with the goal of returning natural/historic functions to a former wetland. Hydric soils are present but a wetland does not exist on the site.

Wetland Creation BMP: The manipulation of the physical, chemical, or biological characteristics present to develop a wetland that did not previously exist at a site. Hydric soils are not present.

Wetland Rehabilitation BMP: The manipulation of the physical, chemical, or biological characteristics of a site with the goal of repairing natural/historic functions to a degraded wetland. A wetland is physically present but there are multiple conditions within the wetland that are degraded.

Wetland Enhancement BMP: The manipulation of the physical, chemical, or biological characteristics of a wetland to heighten, intensify, or improve a specific function(s). A wetland is present and functioning but not in an optimal state. Typically, one component of the wetland is addressed.

Simple: Basic or 'quick fix' to modify a single wetland component, typically implemented as a stand-alone technique.

Comprehensive: A comprehensive technique that has potential to affect more the one wetland component to return natural/historic wetland functions, and may be used in combination with other techniques.

Note: If a technique can be either Simple or Comprehensive depending on the site context, then select the 'Both (Simple and Comprehensive)' option for that technique in the survey.

Table B.1. List of Commonly Used Techniques to Implement Wetland BMPs (list provided by Expert Panel members Steve Strano, NRCS and Erin McLaughlin, MD DNR; expanded to reflect panel discussion and input)

	Restoration (Re-establish)	Rehab	Enhancement	Creation (establish)	Wetland Function or Process Designed to Improve
HYDROLOGY					
Ditch Plugs	X	X			Hydrology
Ditch Fills	X	X			Hydrology
Low profile berms	X			X	Hydrology
Shallow excavation	X			X	Hydrology - Used to impound water for emergent wetland, or to restore/establish wetland hydrology when blocking drainage is not feasible
Levee breach		X			Hydrology/Floodplain reconnection
Water control structures/weirs	X	X		X	In combination with embankments to control water level or provides safe outlet; or, within ditches to raise water level; or, within channelized streams to restore

					water surface profile, hydrology, floodplain reconnection
Poly barrier/slurry wall	X	X			Hydrology - Installed along tax ditches/large ditches to restore groundwater surface profile
Grading ditch banks	X	X			Hydrology, habitat - Convert steep banked ditch to shallow swale
Fill removal	X				Restore hydric soils and hydrology;
Legacy sediment removal	X				Excavate to historic wetland layer to restore hydric soils and hydrology
Tile drainage plugs	X				Restore hydrology
Microtopography			X		Provide diversity of hydroperiods and vegetation; create pit and mound topography
VEGETATION					
Phragmites control			X		Native vegetation
Woody veg control - pine removal			X		Restore native plant communities in pine plantations
Woody veg control - maple, gum, alders, and invasive species		X			Restore hydrology and vegetation
Tree and shrub plantings			X		Restore native plant communities
Grass and forb plantings	X				Restore native plants for early successional habitat
SOILS					
Soil decompaction					

ATTACHMENT C: TN, TP and TSS Reductions from Updated Database

The following document summarizes data contained in the WEP wetland database and is presented to act as a support tool to panelists as guidance for estimating wetlands performance. To date, five additional studies have been added to the database from the WEP literature review completed this past March, and one study and one data point has been excluded from analyses. The resulting TN, TP and TSS removal rates for all wetlands except constructed wetlands are presented here, along with a more detailed description of the changes to the database and the summaries presented. The database includes studies for both natural wetlands and wetland BMPs and wetlands within and outside of the Chesapeake Bay watershed. The majority of the data entries to estimate the percent efficiency is based on a loads, while there are a few studies that just report concentration for the parameters of interest (nitrogen, phosphorus and sediment). The WEP (2016) report provides a more detailed description of the database (see page 53, Table 9 of the report).

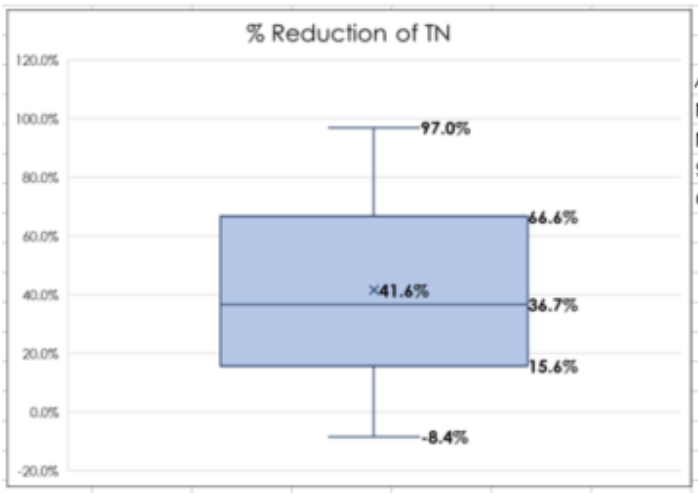
Removal Rates and Basic Statistics

The mean removal rates presented in Table 1 represent all studies in the database that were not identified as Constructed Wetlands, and that calculated some measure of Total Nitrogen, Total Phosphorus, or Total Sediment (or Total Suspended Solids). More detailed summary statistics and Box Plots are included in Figures 1-3 to include the range, median (50th percentile), 25th and 75th percentile efficiencies.

Table 1. Mean Efficiencies for Non-Constructed Wetlands in the Wetland Expert Panel Database

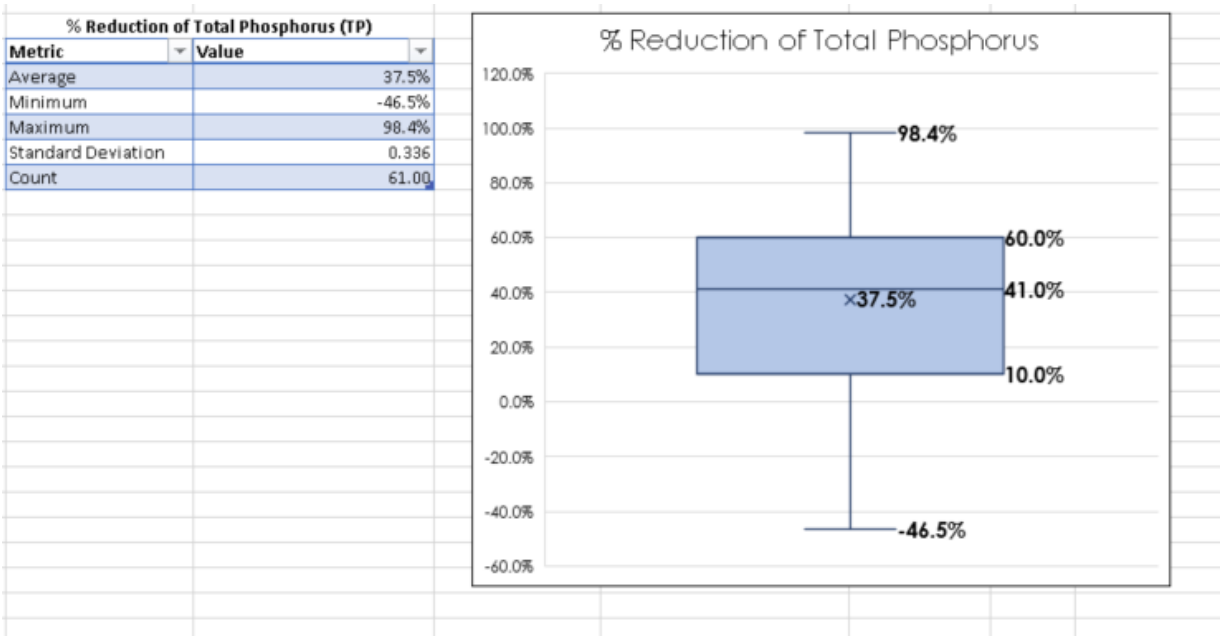
Parameter	Removal Percentage
Nitrogen	41.6%
Phosphorus	37.5%
Sediment	33.8%

Figure 1. Summary Statistics for TN Removal



% Reduction of Total Nitrogen (TN)	
Metric	Value
Average	41.6%
Minimum	-8.4%
Maximum	97.0%
Standard Deviation	0.316
Count	40

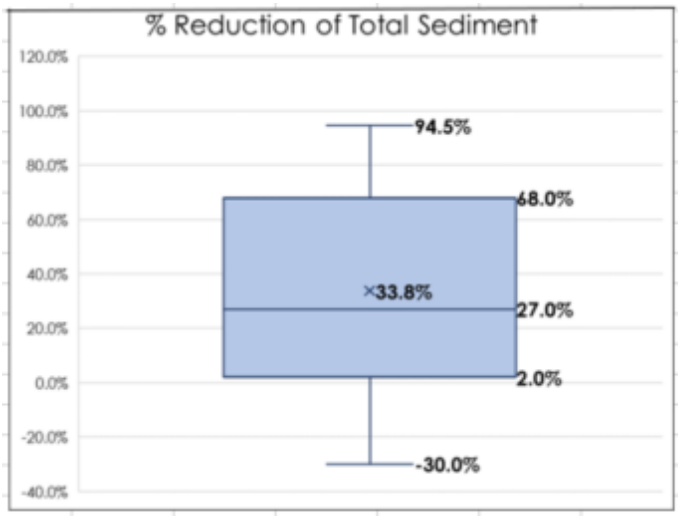
Figure 2. Summary Statistics for TP Removal



% Reduction of Total Phosphorus (TP)

Metric	Value
Average	37.5%
Minimum	-46.5%
Maximum	98.4%
Standard Deviation	0.336
Count	61.00

Figure 3. Summary Statistics for TSS Removal



% Reduction of Total Suspended Sediment (TSS)

Metric	Value
Metric	Value
Average	33.8%
Minimum	-30.0%
Maximum	0.945
Standard Deviation	0.367829567
Count	19

Chemical Constituents included in Summary Data

Data reported in the above plots were restricted to measures of Total Nitrogen, Total Phosphorus or Total Suspended Sediment as certain forms of these parameters have different removal rates. For example, Soluble Reactive Phosphorus (SRP) typically has much lower removal rates than Total Phosphorus. The parameters included in the data in figures 1—3 and Table 1 are summarized in Table 2.

Table 2. Parameters Included in Summary Data

Parameter	Measured or Reported Parameter
Nitrogen	TN, N
Phosphorus	TP, Total PO_4-P, PO_4-P
Sediment	TSS, Suspended Solids, Total Solids, Total Suspended Sediment

Studies Added and Removed

The following studies have been added to the database to date:

Doherty, J. M., J. R. Miller, S. C. Prellwitz, A.M. Thompson, S. P Loheide II, J. B. Zadler. 2014. Hydrologic regimes revealed bundles and tradeoffs among six wetland services. Ecosystems, 17:1026-1039.

Gumiero, B., J. Mant, T. Hein, J. Elso and B. Boz. 2013. Linking the restoration of rivers and riparian zones/wetlands in Europe: sharing knowledge through case studies. Ecological Engineering, 56:36-50.

Kreiling, R. M and W. Richardson. 2014. Wetland management reduces sediment and nutrient loads on the Upper Mississippi.

Land, W., W. Graneli, A. Grimwall, C. Hoffman, W. Mitsch, K. Tondersi and J. Verhoeven. 2016. How effective are created or restored freshwater wetlands for nitrogen and phosphorus removal? A systematic review

Mitsch, W., J. Zhang, E. Waletzko and B. Bernal. 2014. Validation of the ecosystem services of created wetlands: Two decades of plant succession, nutrient retention, and carbon sequestration in experimental riverine marshes.

We removed data from the following reference, which was originally in the database as there was an update to the study provided in Mitsch et al 2014.

Mitsch, W. J., L. Zhang et al 2012. Creating wetlands: Primary succession, water quality changes and self-design over 15 years. BioScience, 62(3); 237-250. DOI: 10.1525/bio.2012.62.3.5

In addition, we removed one data point from the WEP 2016 database taken from the following summary article:

Ardón, M., Morse, J.L., Doyle, M.W., Bernhardt, E.S. 2010. The Water Quality Consquences of Restoring Wetland Hydrology to a Large Agricultural Watershed in the Southeastern Coastal Plain. Ecosystems (2010) 13: 1060. https://doi.org/10.1007/s10021-010-9374-x

The data point removed was for a single wetland in the Everglades, which reported greater than 100% removal for some parameters. On closer examination, it appeared that the methodology used to determine efficiencies in this particular study was highly suspect.

Additional Data

The complete database, divided into separate spreadsheets for Nitrogen, Phosphorus, and Sediment may be made available on October 17, upon request or by downloading it directly from the Sharepoint site. In addition to the summaries presented above, the database includes data for additional forms of N, P and S, as well as queries for different types of wetlands, vegetation, and regions.

Attachment D – Guidance for Assigning Percent Confidence Level

- **50-59%** confident that the interval is about as likely as not to contain the true annual average
- **60-69%** confident that the interval is fairly likely to contain the true annual average
- **70-79%** confident that the interval is likely to contain the true annual average
- **80-89%** confident that the interval is highly likely to contain the true annual average
- **90-95%** confident that the interval is very likely to contain the true annual average
- **96-100%** confident that the interval is virtually certain to contain the true annual average

Attachment E

The Round 2 survey questions will solicit responses about your best guess for the "pre-treatment performance" or baseline to help clarify individual responses on wetland BMP performance. The results in Round 1 did not necessarily reflect a common understanding of how efficiency was interpreted and the relationship between a natural wetland performance and a wetland BMP. For example, responses may have reflected a "net efficiency change" or the "post-treatment performance". Consequently, the results entered in Round 1 would differ as shown in the table below.

For Round 2, we ask you to provide a percent reduction for both "pre-treatment" and "post treatment" that represents the absolute pollutant load reduction given either scenario (yellow and green highlighted cells, respectively).

Example:
What we are asking for in Round 2:
Yellow and green highlighted responses provided by the example respondents are in absolute terms, i.e., the percent reduction based on input and export of pollutant load on an average, annual basis. If desired, we can use survey responses to calculate a net change (pink cells), but you do not provide that information directly as an answer.

What we are <u>not</u> asking for in Round 2:
When formulating your responses, please do not provide responses that are calculated based on a relative measure to another wetland BMP or natural wetland.

Table 1. Example responses for the performance of wetland restoration BMP, pre- and post-treatment (best guess), TN

Survey respondent	Pre-treatment performance	"Best Guess" Post-treatment performance	Net efficiency change
1	20	40	20
2	5	25	20
3	40	60	20

Table 2. Example responses for the performance of a natural wetland (best guess, TN).

Survey respondent	Existing high-functioning natural wetland condition
1	50
2	25
3	40