Wind Point Watershed Restoration Plan

ADDENDUM ONE

July 21, 2017

Restoring, Protecting and Sustaining the Root-Pike Basin Watersheds

ADDENDUM SUMMARY

ELEMENT **A** CLARIFICATIONS

1) **Additional water quality clarifications and data collection results were added.**
   - Table 1: Comparison of Beach Monitoring Data: 2013 Plan vs. New Data Collected
   - Table 2: Summer 2016 Weekly Bacteria Counts (MPN/100 mL) by Sampling Location

2) **Pollutant reduction goals were revised to better reflect MS4 treatment practices.**
   - Figure 1: Urban Storm Water Pollutant Load Adjustment for Existing Treatment Practices
   - Table 3: Original and Updated TSS Results based on MS4 Reduction Efficiencies

ELEMENT **B** CLARIFICATIONS

3) **Revisions were made to reflect additional water quality sampling data and new interpretations were made with regard to the plan's original load reduction estimates.**
   - Table 4: Revised eColi Data from Wind Point Watershed Beach Monitoring Sites
   - Table 5: Revised Wind Point Watershed Agricultural Parcels and Estimated Acres Farmed
   - Table 6: Estimated Unidentified Farmland Still in Production, Out of Production and Totals
   - Table 7: STEPL Report 1 - Reduced Pollutant Loads from Less Ag Acres in Watershed (rev. 07-2017), Total Load by Subwatershed(s)
   - Table 8: STEPL Report 1 - Reduced Agricultural Acres and Pollutant Loads (rev. 07-2017), Total Load by Land Uses (with BMP)
   - Table 9: STEPL Report 2 - Reduced Ag Acres and Pollutant Loads (rev. 07-2017), Total Load by Subwatershed(s)
   - Table 10: STEPL Report 2 - Reduced Ag Acres and Pollutant Loads (rev. 07-2017), Total Load by Land Uses (w/ BMP)
   - Figure 2: Root-Pike WIN's Nine Element Plan Recommendations Database

ELEMENT **C** CLARIFICATIONS

4) **Updates were made as to municipal involvement, plan adoption, site specific management measures, and Racine county land conservation and NRCS on-going involvement.**
   - Table 11: Wind Point Plan Projects in Planning, Design or Implementation as of July 2017

ELEMENT **H** CLARIFICATIONS

5) **The EPA Technical Memo on BMP Depreciation is included for future reference and guidance.**

ELEMENT **A** CLARIFICATIONS

1. **<u>WDNR/EPA Comments 1:</u> Page 239 of plan describes the City of Racine Health Department WQ assessments were completed in 2013, which was a relatively dry year and then recommends completing an additional year of WQ monitoring to establish a more representative baseline of water quality and understanding of the watershed's pollutant inputs to Lake Michigan. We contacted City of Racine Health Department and Dr. Julie Kinzelman to confirm what additional WQ sampling has been completed since 2013. They explained some WQ sampling has been completed, but not at the scope/frequency completed in 2013 for this watershed plan. Please explain how/when plan will be revised to reflect the additional WQ sampling data since 2013. Specifically, what does the additional WQ data indicate and explain if the plan's load reduction estimates (Element B) and number/extent of practices (Element C) need to be revised (increase, decrease or remain the same)?**

   i) Additional water quality data, similar in effort, scale and location to the data collected by Julie Kinzleman of the City of Racine, beyond 2013, has not been collected for the completed version of Wind Point Watershed Restoration Plan. While we fully support the concept of on-going water quality data collection and analysis, Root-Pike WIN did not, and does not, have the designated resources or funding to collect and analyze significant additional data beyond 2013. Root-Pike WIN has built into our implementation strategy the means to collect data with each project recommendation that is funded. In other words, we will build water quality monitoring into the design and implementation budget at the site specific level to gauge before and after success. Furthermore, it is our hope that the DNR and/or EPA will provide Root-Pike WIN with the necessary funding to implement a multi-year, basin-wide monitoring program. Since no additional data has been collected in the same locations and at the same frequency for TN, TP and TSS, as was done in the completed plan (2013), Root-Pike WIN cannot comment on how the load estimates and extent of practices should be revised. Some additional E.coli monitoring by the City of Racine has occurred in six beaches in the Wind Point watershed, and the analysis of that new data is provided in the additional responses to follow.

   ii) Led by Julie Kinzleman, on-going E.coli water quality monitoring has been collected by the City of Racine's Health Department for the beaches along Lake Michigan in the Wind Point watershed. The E.coli data was compiled for five of the six beaches from October 2013 through December 2016. The E.coli number listed represents the average of all of the individual test dates. Table 1 below shows how those new results compare to the data that exists in the existing Wind Point Watershed Restoration Plan and found on page 136. Bender Park, Parkway Beach and North Beach saw significant drops in the E.coli average from the 2013 data. Zoo Beach now exceeds the DNR's criteria and North Beach still exceeds the criteria despite the 54% drop in the average.

Table 1: Wind Point Watershed Beach Monitoring Data: Complete Plan and New Data

BEACH	Bender Park	Light House	Shoop Park	Parkway Beach	Zoo Beach	North Beach
eColi (plan)***	200 AVG	95	106	68	172	522
eColi (new)	93 AVG	91	116	44	306	238
% change	-53%	-4	+9%	-35%	+78%	-54%
New samples taken	96	46	29	46	574	768

*** <235 MPN/100mL WI DNR NR 102.12 (1); (Clayton et al. 2012)

iii) In addition to the new data collected by the City of Racine's Health Department, additional data from the Wind Point area beaches was also collected by The Great Lakes Community Conservation Corps (Great Lakes CCC). Great Lakes CCC conducted six bacteria and water quality monitoring events at five locations in Wind Point along the shoreline between the Wind Point Lighthouse and Cliffside Park. Corps members are part of a national network of more than 20,000 young people at 150 service and conservation corps around the country.

Beachgoers and water recreation enthusiasts are frequently swimming in Lake Michigan at areas of Wind Point that are not regularly monitored for E.coli and other harmful bacteria. These informal beaches were identified as the public right-of-way at 5 ½ Mile Road, the shoreline at Olympia Brown School, and the beach frontage at the Siena Center. With longshore currents generally flow from North to South, the results in Table 2 below may directly impact residences along the entire stretch of Wind Point shoreline where sampling has been done by both Great Lakes CCC and the City of Racine. Since the monitoring only occurred over six weeks, we suggest that more monitoring at these sites occur before any bacteria proclamations are made about these areas.

Table 2: Summer 2016 Weekly Bacteria Counts (MPN/100 mL) by Sampling Location

	5 ½ Mile Road	Outfall South of 5 ½ Mile	Olympia Brown	Siena Center	Siena Ravine
Week 1	272	695	292	332	763
Week 2	10	706	98	10	1,723
Week 3	10	552	10	10	836
Week 4	213	3,652	63	279	145
Week 5	10	24,192	10	10	262
Week 6	31	12,997	20	31	1,309
Week 7	109	1,723	41	97	12,033
AVG	**94**	**6,360**	**76**	**110**	**2,439**

Great Lakes CCC data (2016)

iv) The State of Wisconsin uses a threshold of 235 MPN/mL to evaluate beaches and other surface water bodies. Table 2 indicates the water flowing into Lake Michigan from the outfall located south of the beach at 5½ Mile Road has consistently exceeded the threshold value. Great Lakes CCC found that the highest levels of bacteria were occurring during dry weather durations when minimal rain had fallen. The Siena Center Ravine flowing into Lake Michigan at the north end of the Siena Center parcel has also frequently exceeded the threshold. The most recent sampling event in 2016 that identified a significantly high bacteria count occurred after a heavy rainfall. In a January 23, 2017 trip to the area, Root-Pike WIN noted that adjacent neighborhoods have numerous swale and culvert drainage systems that lead directly into Lake Michigan. Targeted Respect Our Waters campaigns regarding source issues in these neighborhoods could reduce these E.coli hot spots over time. Other green infrastructure projects prescribed in the plans would also help.

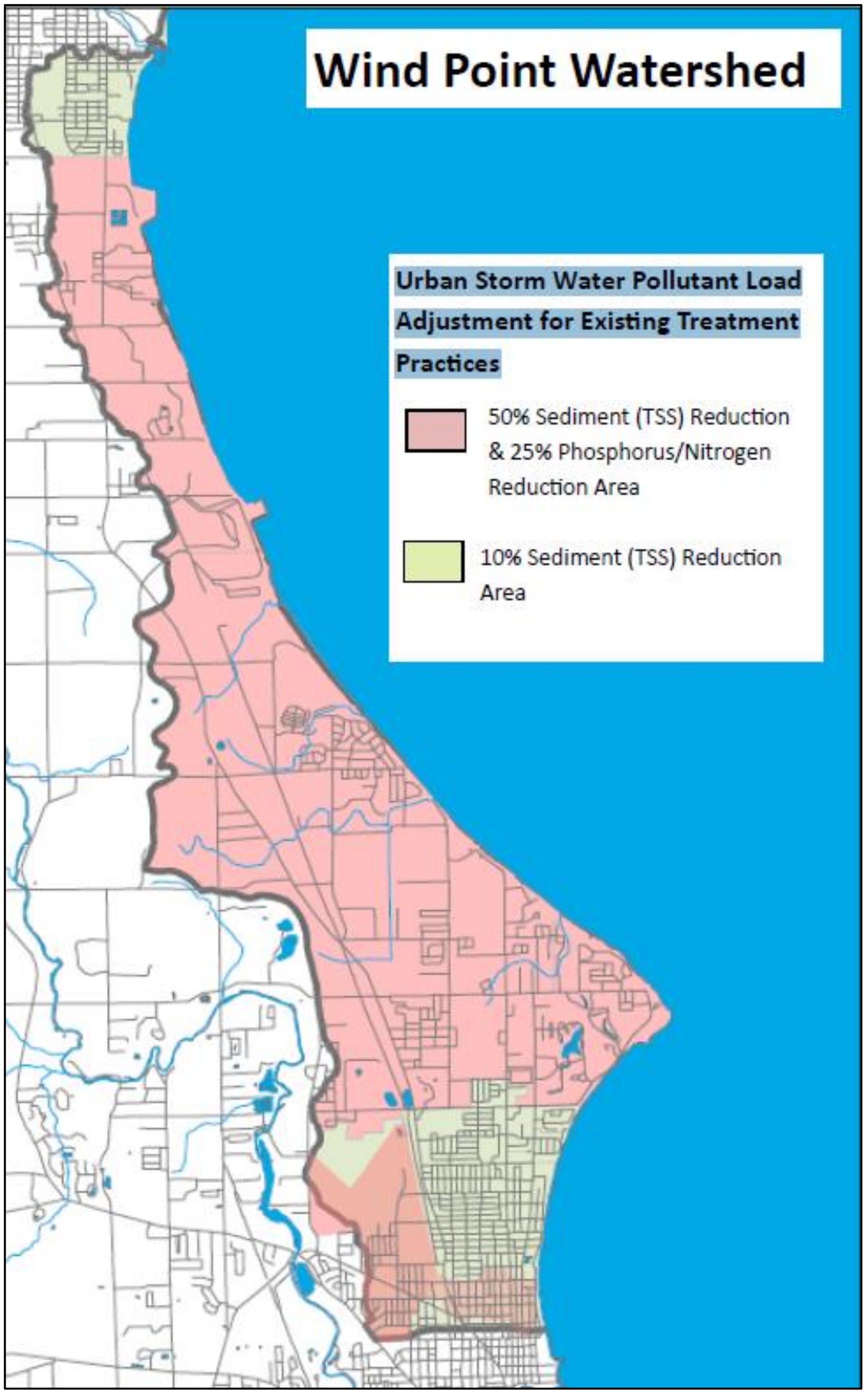
v) One final consideration that is not reflected in the Nine Element process is the degree of likelihood of a project moving forward. Root-Pike WIN has learned this through the implementation of the Pike and Root River Watershed Restoration Plans. The landowner priority isn't necessarily the priority designated in the plan and driven by the pollutant load reduction estimates. The major determining factor as to whether or not the project moves forward is the approval of the landowner to conduct a restoration effort. The pollutant load reduction estimates help that conversation, but the landowner's propensity to want to see improvement from a personal and often symbolic level, is what moves these recommendation into action. If a recommendation moves from a low-priority to a medium priority for instance, we believe the result would have very little effect on the landowner's decision-making about the project.

2) <u>WDNR/EPA Comments 2:</u> **In addition, we consulted with Pete Wood, DNR Stormwater Specialist, during our review of this plan to evaluate the WINSLAAM modeling results, which identify some of the plans causes and sources of pollutants. Pete provided the following comments. We request you provide a response to the questions posed re: existing MS4 treatment practices and municipal-wide MS4 TSS removal efficiencies. Specifically, does the plan's pollutant reduction goals need to be revised to reflect this new information on the existing MS4 treatment practices?**

> *From Pete Wood:*
>
> *The WINSLAAM pollutant loading numbers seem reasonable. However, I think the issue is that the effectiveness of existing MS4 treatment practices doesn't appear to be considered. SMU 23 is a good example. Attached is the actual City of Racine storm sewer system map for this general area. 167 of the assumed 274 acres for SMU 23 drains to a large regional treatment facility near the Lake. This facility provides 50% TSS reduction for the 167 acre contributing drainage area and this reduction would likely impact the "Hot Spot" ranking for SMU 23. There are other existing MS4 treatment practices within the Wind Point Watershed that may have similar circumstances.*
>
> *Here are the municipal-wide MS4 TSS removal efficiencies reported by the municipalities in the Wind Point watershed: Racine = 20%, Wind Point = 50%, Caledonia = 75%, Oak Creek = 35%, South Milwaukee = 20%*
>
> *For Wind Point, Caledonia and Oak Creek, the swale conveyance systems (road ditches) are a major factor in the pollutant reduction. The actual MS4 TSS removals in the Wind Point Watershed could be more or less than these overall values.*

i) The following map (Fig. 1) entitled "Urban Storm Water Pollutant Load Adjustment for Existing Treatment Practices" provides the WINSLAM correction factor/equation for dry year. This map was supplied by Pete Wood, P.E. at the Department of Natural Resources and should be referenced when using the modeled pollutant load reduction estimates in the Section 8 Recommendations.

Figure 1 - Urban Storm Water Pollutant Load Adjustment for Existing Treatment Practices



(Pete Wood, P.E., Department of Natural Resources, 2017)

ii) In January 2017, Root-Pike WIN re-analyzed the original monitoring results and recalculated them based on the MS4 TSS removal efficiencies that Pete Wood referenced. 17 of the TSS sites that exceeded criteria in the completed plan would be reduced to 10 using the removal efficiencies. Four of the 23 SMUs, with new aggregated TSS data from the adjusted sites, could now be considered below criteria for TSS. These SMU's were considered "hot spots" in the plan (Fig. 50) and were also adjusted for this change, but all of the SMU's can still be considered "hot spots" as the TP data still exceeded criteria. These results are shown in Table 3 and summarized by SMU below. It should be noted that SMU 16 was listed as exceeding the TSS criteria for sediment, but based on the data from site RHD-17, this SMU is below the average for TSS. SMU-16 is still a "hot spot" for TP.

(1) SMU-10: TSS is now below criteria, but TP still exceeds criteria

(2) SMU-11: TSS is now below criteria

(3) SMU-12: TSS: 3 of 5 sites are now below criteria for TSS, However, RHD-12 still has a TSS average of 523, which exceeds the criteria by almost 10 times, so this SMU could still be considered a TSS hotspot. In addition, the SMU has TP averages that exceed criteria

(4) SMU-17: TSS is now below criteria, but TP still exceed criteria

Table 3 – Original and Updated TSS Results based on MS4 Reduction Efficiencies

Site	Municipality	SMU	Old TSS	MS4 Factor	New TSS	Conclusion
RHD-1	South Milwaukee	1	9.7	0.8	7.76	still below
RHD-2	South Milwaukee	2	692.1	0.8	553.68	Still hot
RHD-A	Oak Creek	3	38.7	0.65	25.155	Still hot
RHD-3	Oak Creek	6	0	0.65	0	still below
RHD-3s	Oak Creek		0	0.65	0	still below
RHD-B	Oak Creek		229.3	0.65	149.045	Still hot
RHD-C	Oak Creek	7	0	0.65	0	still below
DNR-4	Wind Point	8	185	0.5	92.5	Still hot
RHD-4	Oak Creek		997.3	0.65	648.245	Still hot
DNR-5	Wind Point	10	17	0.5	8.5	still below
DNR-6	Wind Point		10	0.5	5	still below
RHD-5	Caledonia		54.1	0.25	13.525	Now below
RHD-6	Caledonia		0	0.25	0	still below
RHD-7	Caledonia	11	26.1	0.25	6.525	Now below
RHD-7s	Caledonia		0	0.25	0	still below
DNR-1	Caledonia	12	10	0.25	2.5	still below
RHD-10	Caledonia		73.6	0.25	18.4	Now below
RHD-11	Caledonia		121.2	0.25	30.3	Still hot
RHD-12	Caledonia		2180.4	0.25	545.1	Still hot
RHD-13	Caledonia		20	0.25	5	Now below
RHD-8	Caledonia		13.4	0.25	3.35	still below
RHD-9	Caledonia		69.7	0.25	17.425	Now below
RHD-D	Caledonia		3.8	0.25	0.95	still below
DNR-2	Caledonia	13	10	0.25	2.5	still below
RHD-14	Caledonia		80.1	0.25	20.025	Still hot
DNR-3	Caledonia	14	10	0.25	2.5	still below
RHD-15	Caledonia		78	0.25	19.5	Still hot
RHD-16	Wind Point	15	20.6	0.5	10.3	Now below
RHD-17	Wind Point	16	11.5	0.5	5.75	still below
RHD-E	Wind Point	17	26.1	0.5	13.05	Now below
RHD-18	Racine	19	267.3	0.8	213.84	Still hot
RHD-19	Racine		17	0.8	13.6	still below
RHD-F	Racine		0	0.8	0	still below
RHD-G	Racine	21	0	0.8	0	still below
RHD-H	Racine	22	17.7	0.8	14.16	still below
RHD-I	Racine		0	0.8	0	still below
RHD-J	Racine	23	10.1	0.8	8.08	still below
RHD-K	Racine		2.3	0.8	1.84	still below

ELEMENT **B** CLARIFICATIONS

3) **<u>WDNR/EPA Comments 3:</u> While we concur with many of the plans critical area management measures/project, we do not concur with the plan's load reduction estimates for reasons described below; additional information is required for consistency with element B.**

   a) **The plan's pollutant load reduction estimates are based upon City of Racine Health Department WQ assessments completed in 2013. Page 152 describes an important assumption with the estimates are the percent decrease in sample concentration (mg/L) from the 2013 baseline data needed to meet state or federal WQ standards, correlates to the percent reduction in annual pollutant load reduction targets. As stated above, the plan describes 2013 was a relatively dry year and then recommends completing an additional year of WQ monitoring to establish a more representative baseline of water quality and understanding of the watershed's pollutant inputs to Lake Michigan. We contacted City of Racine Health Department and Dr. Julie Kinzleman to confirm what additional WQ sampling has been completed since 2013. Since additional samples have been collected, please explain how/when plan will be revised to reflect additional WQ sampling data. Specifically, what does the additional WQ data indicate and does the plan's load reduction estimates (Element B) and number/extent of practices (Element C) need to increase, decrease or remain the same?**

      i) Additional samples were collected by Julie Kinzleman for the six beaches listed in the plan. The samples were collected from October 2013 to December 2016. The sampling effort did not test for TSS, TP or TN – only E.coli. Based on the fact the sampling did not occur at a majority of the sampling sites, just for the beaches, we don't believe this data would indicate any major shifts in watershed-wide pollutant loading and therefore changes in the plan's recommendations. There are some changes that may affect assumptions about a particular outfall or runoff area adjacent to the beaches. For example, the data for Bender Park suggests a significant decrease in the E.coli, and a shift in E.coli loading in the areas around Zoo Beach and North Beach. The following is a summary of the results:

Table 4 – Revised eColi Data from Wind Point Watershed Beach Monitoring Sites

BEACH	Bender Park	Light House	Shoop Park	Parkway Beach	Zoo Beach	North Beach
eColi (plan)***	200 AVG	95	106	68	172	522
eColi (new)	93 AVG	91	116	44	306	238
% change	-53%	-4	+9%	-35%	+78%	-54%
New samples taken	96	46	29	46	574	768

*** <235 MPN/100mL WI DNR NR 102.12 (1); (Clayton et al. 2012)

b) Please see comments related comments above re: re: existing MS4 treatment practices and municipal-wide MS4 TSS removal efficiencies, as they related to the plan's load reduction estimates.

i) There is no new additional data regarding TSS (or TN and TP) as the cost and time needed to conduct additional sampling exceeded the capabilities of our organization and essential support from the funding community. Root-Pike WIN would welcome additional support and funding from our partners to conduct additional sampling. Adjustments to MS4 TSS removal efficiencies would not affect the new E.coli data shown below with regard to the six beaches if the MS4 treatment practices have no effect on E.coli reduction.

c) The pollutant reduction estimates for management practices (i.e., conservation tillage and filter strips– section 6.1.13) for the 7 critical agricultural areas, derived using USEPA's region 5 model, are modeled incorrectly and overestimate N, P and Sediment reductions. After review of Appendix E, the contributing area used for each agricultural critical area is the total acreage of a field. This is unlikely. Typically only a percentage of a field contributes runoff towards a stream, due to topography and other factors. Revision/reduction of the contributing area values is necessary to reflect the actual contributing area of each field (and may be accomplished using topographic maps and/or on site evaluation of contributing area). Also two of agricultural area modeled calculations do not contain any values, they are set at zero. Please revise these files with field specific information.

i) In the spring of 2017, Andrew Craig of the Department of Natural resources and Dave Giordano of Root-Pike WIN reanalyzed a majority of agricultural parcels listed in the completed Wind Point Plan from 2013. Root-Pike WIN used Racine and Milwaukee GIS sites and Google Maps when imagery was dated after 2013, to recalculate the estimated number and size of the agricultural parcels. These websites were used to clarify whether or not the agricultural parcels were still in production. Since 2013, it was also determined other areas of the identified parcels contained a percentage of trees, wetlands, and other non-agricultural features, which reduced the total number of acres being farmed.

Root-Pike WIN estimated that that of the 1,311 total acres of agricultural land defined in the Plan submitted for review in 2016, 845 were actually still being farmed. The Department of Natural Resources also determined not all agriculture acres modeled in STEPL were or have remained in agricultural production and, accordingly the STEPL model results in the plan completed in 2013 overestimated baseline agricultural loading in watershed. It is clear that from 2013 to 2017 there are fewer agricultural acres in production in the watershed, and therefore the STEPL pollutant baseline loads and load reductions estimates are less than what is currently shown in Wind Point Watershed Restoration Plan.

Consequently, Root-Pike WIN and the WDNR have determined that the acres now farmed and types of crops farmed have changed from what is described in the completed plan from 2013. Based on the data from 2014-2017, visual observations of the parcels from the aforementioned websites in 2017, and the new modeling data and analysis from the Department of Natural Resources, new analysis has been provided in this addendum. Root-Pike WIN will continue to evaluate the status of the agricultural acres in watershed every two years – because some agricultural acres could go back into production or fall out of production. As expected, these changes will impact the plan's pollutant load reduction goals for agriculture and restoration project pursuits.

The results from Root-Pike WIN's and the Department of Natural Resources' findings can be found in Table 5 (Farmed Acres), Table 6 (Acres in Production) and Table 7 on the following pages:

Table 5 – Revised Wind Point Watershed Agricultural Parcels and Estimated Acres Farmed

Parcel	County	Total Acres	% Farmed*	Acres Farmed*	2017 Est. Acres Farmed	2015*	Type*
9139993000	Milwaukee	14.53	70.00%	10.17	10.17	Yes	Unknown
9129930000	Milwaukee	5.34	70.00%	3.73	3.73	Yes	Unknown
9129929000	Milwaukee	3.96	50.00%	1.98	1.98	Yes	Unknown
104042317077000	Racine	14.83	90.00%	13.35	13.35	Yes	Row & Tree
104042317081000	Racine	12.57	90.00%	11.31	11.31	Yes	Row & Tree
104042318204000	Racine	5.77	40.00%	2.31	2.31	Yes	Row & Tree
104042307027000	Racine	10.39	60.00%	6.23	6.23	Yes	Row & Cover
104042317082000	Racine	28.81	90.00%	25.93	25.93	Yes	Row
104042320123000	Racine	23.95	90.00%	21.56	21.56	Yes	Row
104042320132000	Racine	9.30	80.00%	7.44	7.44	Yes	Row
104042307024000	Racine	7.74	90.00%	6.97	6.97	Yes	Row
104042320033000	Racine	4.47	80.00%	3.58	3.58	Yes	Row
104042328074000	Racine	59.12	80.00%	47.30	47.30	Yes	Row
9139999001	Milwaukee	124.29	30.00%	37.29	37.29	Yes	Row
104042307013000	Racine	35.91	70.00%	25.14	25.14	Yes	Row
104042201057005	Racine	28.40	70.00%	19.88	19.88	Yes	Row
104042317072000	Racine	50.18	30.00%	15.05	15.05	Yes	Row
104042307018010	Racine	29.84	50.00%	14.92	14.92	yes	Row
104042318192000	Racine	20.32	70.00%	14.22	14.22	Yes	Row
104042328071000	Racine	14.69	90.00%	13.22	13.22	Yes	Row
104042329193000	Racine	14.25	80.00%	11.40	11.40	Yes	Row
104042201046000	Racine	11.60	90.00%	10.44	10.44	Yes	Row
104042316015010	Racine	14.71	60.00%	8.83	8.83	Yes	Row
104042328009000	Racine	8.01	90.00%	7.21	7.21	Yes	Row
104042307024000	Racine	7.74	90.00%	6.97	6.97	Yes	Row
104042318300111	Racine	9.97	60.00%	5.98	5.98	Yes	Row
104042321098000	Racine	5.80	90.00%	5.22	5.22	Yes	Row
104042318008000	Racine	4.98	60.00%	2.99	2.99	Yes	Row
104042307004090	Racine	5.94	50.00%	2.97	2.97	Yes	Row
104042307004070	Racine	5.94	20.00%	1.19	1.19	Yes	Row
104042307009000	Racine	39.73	60.00%	23.84	23.84	Yes	Cover & Row
104042307007000	Racine	37.77	40.00%	15.11	15.11	Yes	Cover & Row
104042318008000	Racine	13.22	50.00%	6.61	6.61	Yes	Cover & Row
104042201048000	Racine	31.33	80.00%	25.06	25.06	Yes	Cover
104042317043000	Racine	13.91	70.00%	9.74	9.74	Yes	Cover
104042307032000	Racine	8.61	90.00%	7.75	7.75	Yes	Cover
104042317084000	Racine	13.51	30.00%	4.05	4.05	Yes	Cover
104042307008000	Racine	9.07	40.00%	3.63	3.63	Yes	Cover
104042317085000	Racine	11.47	30.00%	3.44	3.44	Yes	Cover
9629995001	Milwaukee	10.52	20.00%	2.10	2.10	Yes	Cover
		782.49 total	**64.75%** farmed	**466.09** adjusted			

Table 6 – Estimated Unidentified Farmland Still in Production, Out of Production and Totals*

Estimated Unidentified Farmland Still in Production*						
Parcel	**County**	**Total Acres**	**% Farmed***	**Acres Farmed***	**2017 Est.- Total Acres Farmed**	**2015***
Based on the original plan total (1,310.95) and adjusted for the percent used based on the 64.75 average above						
1,310.95 - 782.49 - 299.96		**228.50** total	**64.75%** farmed	**147.96** adjusted		

Farmland that Appears to be Out of Production after 2013*						
Parcel	**County**	**Total Acres**	**% Farmed***	**Acres Farmed***	**2017 Est.- Total Acres Farmed**	**2015***
104042307004010	Racine	5.94	90.00%	5.35	0.00	No
104042306007000	Racine	31.88	50.00%	15.94	0.00	No
104042306008000	Racine	29.09	50.00%	14.55	0.00	No
104042306003050	Racine	33.14	60.00%	19.88	0.00	No
104042306006000	Racine	46.43	70.00%	32.50	0.00	No
104042307014000	Racine	67.16	80.00%	53.73	0.00	No
104042213042000	Racine	39.58	90.00%	35.62	0.00	No
9179999001	Milwaukee	40.08	60.00%	24.05	0.00	No
09558060	Milwaukee	6.66	90.00%	5.99	0.00	No
		299.96 total	**71.11%** farmed	**207.61** adjusted		

TOTAL FROM 2013 PLAN		**1,310.95** total	**65.92%** farmed	**824.51** adjusted
TOTAL STILL IN PRODUCTION*		**1,010.99** total	**64.75%** farmed	**614.05** adjusted

** These values are estimates taken after 2013 from the GIS sites for Racine and Milwaukee and Google Maps/Streetview.*

Andrew Craig, the Nonpoint Source Planning Coordinator and NMP Specialist from the Department of Natural Resources, has provided revised STEPL modeled data for the Wind Point Plan. Table 7 represents the STEPL report with the WDNR revision of Soil P Concentration to 0.066 % for sub-watersheds 6, 10, 11, 12, 13, 15 and 17 and reflects 1,301 total agricultural acres in the watershed.

Table 7 –STEPL Report 1 - Reduced Pollutant Loads from Less Ag Acres in Watershed (rev. 07-2017): Total Load by Subwatershed(s)

Watershed	N Load (no BMP)	P Load (no BMP)	BOD Load (no BMP)	Sediment Load (no BMP)	N Reduction	P Reduction	BOD Reduction	Sediment Reduction	N Load (with BMP)	P Load (with BMP)	BOD (with BMP)	Sediment Load (w/BMP)	%N Reduction	%P Reduction	%BOD Reduction	%Sed Reduction
	lb/yr	lb/yr	lb/yr	lb/yr	lb/yr	lb/yr	lb/yr	lb/yr	lb/yr	lb/yr	lb/yr	lb/yr	%	%	%	%
W1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
W2	42.4	16.3	84.9	26.5	0.0	0.0	0.0	0.0	42.4	16.3	84.9	26.5	0.0	0.0	0.0	0.0
W3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
W4	309.8	36.7	940.1	12.4	0.0	0.0	0.0	0.0	309.8	36.7	940.1	12.4	0.0	0.0	0.0	0.0
W5	72.5	7.6	227.1	2.1	0.0	0.0	0.0	0.0	72.5	7.6	227.1	2.1	0.0	0.0	0.0	0.0
W6	509.9	233.5	1166.6	103.4	0.0	0.0	0.0	0.0	509.9	233.5	1166.6	103.4	0.0	0.0	0.0	0.0
W7	10.3	4.0	20.7	6.5	0.0	0.0	0.0	0.0	10.3	4.0	20.7	6.5	0.0	0.0	0.0	0.0
W8	375.0	144.4	750.1	234.4	0.0	0.0	0.0	0.0	375.0	144.4	750.1	234.4	0.0	0.0	0.0	0.0
W9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
W10	8168.0	5699.9	16682.1	3765.5	0.0	0.0	0.0	0.0	8168.0	5699.9	16682.1	3765.5	0.0	0.0	0.0	0.0
W11	2419.8	1310.1	5105.5	705.1	0.0	0.0	0.0	0.0	2419.8	1310.1	5105.5	705.1	0.0	0.0	0.0	0.0
W12	5891.6	3323.8	12634.8	1805.5	0.0	0.0	0.0	0.0	5891.6	3323.8	12634.8	1805.5	0.0	0.0	0.0	0.0
W13	649.2	282.2	1360.3	90.7	0.0	0.0	0.0	0.0	649.2	282.2	1360.3	90.7	0.0	0.0	0.0	0.0
W14	471.7	125.4	1035.9	86.7	0.0	0.0	0.0	0.0	471.7	125.4	1035.9	86.7	0.0	0.0	0.0	0.0
W15	346.7	151.4	818.4	74.6	0.0	0.0	0.0	0.0	346.7	151.4	818.4	74.6	0.0	0.0	0.0	0.0
W16	8.5	2.4	17.3	1.4	0.0	0.0	0.0	0.0	8.5	2.4	17.3	1.4	0.0	0.0	0.0	0.0
W17	756.4	356.6	1569.5	120.0	0.0	0.0	0.0	0.0	756.4	356.6	1569.5	120.0	0.0	0.0	0.0	0.0
W18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
W19	20.2	7.8	40.4	14.8	0.0	0.0	0.0	0.0	20.2	7.8	40.4	14.8	0.0	0.0	0.0	0.0
W20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
W21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
W22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
W23	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
W24	1.5	0.4	3.2	0.3	0.0	0.0	0.0	0.0	1.5	0.4	3.2	0.3	0.0	0.0	0.0	0.0
Total	**20053.7**	**11702.5**	**42456.9**	**7049.8**	**0.0**	**0.0**	**0.0**	**0.0**	**20053.7**	**11702.5**	**42456.9**	**7049.8**	**0.0**	**0.0**	**0.0**	**0.0**

Table 8 below is Andrew Craig's revised STEPL report that reflects the revision of the reduced ag acres and total load from land uses with BMP from 1,310 to 614 acres and adoption of reduced tillage and filter strips on 75% of cropland acres within sub-watersheds 6, 10, 11, 12, 13, 15 and 17.

Table 8 – STEPL Report 2 - Reduced Agricultural Acres and Pollutant Loads (rev. 07-2017)
Total Load by Land Uses (with BMP)

Sources	N Load (lb/yr)	P Load (lb/yr)	BOD Load (lb/yr)	Sediment Load (tons/yr)
Urban	0.00	0.00	0.00	0.00
Cropland	9,603.42	4,396.24	19,750.98	1,385.68
Pastureland	1,593.72	214.52	4,992.75	46.71
Forest	0.00	0.00	0.00	0.00
Feedlots	0.00	0.00	0.00	0.00
User Defined	0.00	0.00	0.00	0.00
Septic	0.00	0.00	0.00	0.00
Gully	0.00	0.00	0.00	0.00
Streambank	8,856.60	7,091.78	1,7713.21	5,617.43
Groundwater	0.00	0.00	0.00	0.00
Total	20,053.75	11,702.53	4,2456.94	7,049.82

2015 Total Cropland Acres in Watershed = 1,301				
Load /acre/year	7.38	3.38	15.18	1.07
2017 Cropland Acres in Watershed = 614				
2017 Crop Load	4,532.28	2,074.78		653.96
2017 Reduction (after less ag acres)	5,071.14	2,321.46		731.72
2015 Cropland Reduction Goal	**0**	**2,442**	**0**	**1573**
Remaining Reduction Need	**0**	**120.54**	**0**	**841.28**

Table 9 below is Andrew Craig's revised STEPL report that reflects the WDNR revision of total load by subwatershed from 1,310 to 614 acres and adoption of reduced tillage and filter strips on 75% of cropland acres within sub-watersheds 6, 10, 11, 12, 13, 15 and 17.

Table 9 – STEPL Report 2 - Reduced Ag Acres and Pollutant Loads (rev. 07-2017):
<u>Total Load by Subwatershed(s)</u>

Watershed	N Load (no BMP)	P Load (no BMP)	BOD Load (no BMP)	Sediment Load (no BMP)	N Reduction	P Reduction	BOD Reduction	Sediment Reduction	N Load (with BMP)	P Load (with BMP)	BOD (with BMP)	Sediment Load (w/ BMP)	%N Reduction	%P Reduction	%BOD Reduction	%Sed Reduction
	lb/year	lb/year	lb/year	t/year	lb/year	lb/year	lb/year	t/year	lb/year	lb/year	lb/year	t/year	%	%	%	%
W1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
W2	42.4	16.4	84.9	26.5	0.0	0.0	0.0	0.0	42.4	16.4	84.9	26.5	0.0	0.0	0.0	0.0
W3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
W4	313.7	38.4	948.0	13.6	0.0	0.0	0.0	0.0	313.7	38.4	948.0	13.6	0.0	0.0	0.0	0.0
W5	73.2	7.8	228.5	2.3	0.0	0.0	0.0	0.0	73.2	7.8	228.5	2.3	0.0	0.0	0.0	0.0
W6	662.0	312.3	1478.2	129.1	303.7	149.8	305.4	47.7	358.3	162.5	1172.8	81.4	45.9	48.0	20.7	37.0
W7	10.3	4.0	20.7	6.5	0.0	0.0	0.0	0.0	10.3	4.0	20.7	6.5	0.0	0.0	0.0	0.0
W8	375.0	145.3	750.1	234.4	0.0	0.0	0.0	0.0	375.0	145.3	750.1	234.4	0.0	0.0	0.0	0.0
W9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
W10	6854.7	5105.6	13978.3	3584.2	833.7	411.3	838.3	131.0	6021.0	4694.4	13140.0	3453.2	12.2	8.1	6.0	3.7
W11	1832.7	1052.3	3895.6	627.7	690.8	340.8	694.6	108.5	1141.9	711.5	3201.0	519.2	37.7	32.4	17.8	17.3
W12	4428.3	2667.8	9621.3	1606.5	1131.5	558.1	1137.7	177.8	3296.9	2109.7	8483.6	1428.7	25.6	20.9	11.8	11.1
W13	492.3	221.2	1035.6	73.7	299.5	137.2	269.5	42.1	192.8	84.1	766.2	31.6	60.8	62.0	26.0	57.1
W14	277.9	69.7	636.9	59.9	0.0	0.0	0.0	0.0	277.9	69.7	636.9	59.9	0.0	0.0	0.0	0.0
W15	252.8	109.2	624.9	61.8	59.6	29.4	59.9	9.4	193.2	79.8	565.0	52.4	23.6	26.9	9.6	15.1
W16	8.9	2.6	18.3	1.6	0.0	0.0	0.0	0.0	8.9	2.6	18.3	1.6	0.0	0.0	0.0	0.0
W17	402.1	196.6	840.1	71.2	244.2	120.4	245.5	38.4	158.0	76.2	594.5	32.9	60.7	61.3	29.2	53.9
W18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
W19	20.2	7.8	40.4	14.8	0.0	0.0	0.0	0.0	20.2	7.8	40.4	14.8	0.0	0.0	0.0	0.0
W20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
W21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
W22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
W23	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
W24	1.6	0.5	3.3	0.3	0.0	0.0	0.0	0.0	1.6	0.5	3.3	0.3	0.0	0.0	0.0	0.0
Total	**16048.4**	**9957.6**	**34205.0**	**6514.1**	**3562.9**	**1747.0**	**3550.9**	**554.8**	**12485.5**	**8210.6**	**30654.1**	**5959.3**	**22.2**	**17.5**	**10.4**	**8.5**

Table 10 below is Andrew Craig's revised STEPL report that reflects the WDNR revision of total agricultural acres in watershed from 1,310 to 614 acres and adoption of reduced tillage and filter strips on 75% of cropland acres within sub-watersheds 6, 10, 11, 12, 13, 15 and 17.

Table 10 – STEPL Report 2 - Reduced Ag Acres and Pollutant Loads (rev. 07-2017):
<u>Total Load by Land Uses (with BMP)</u>

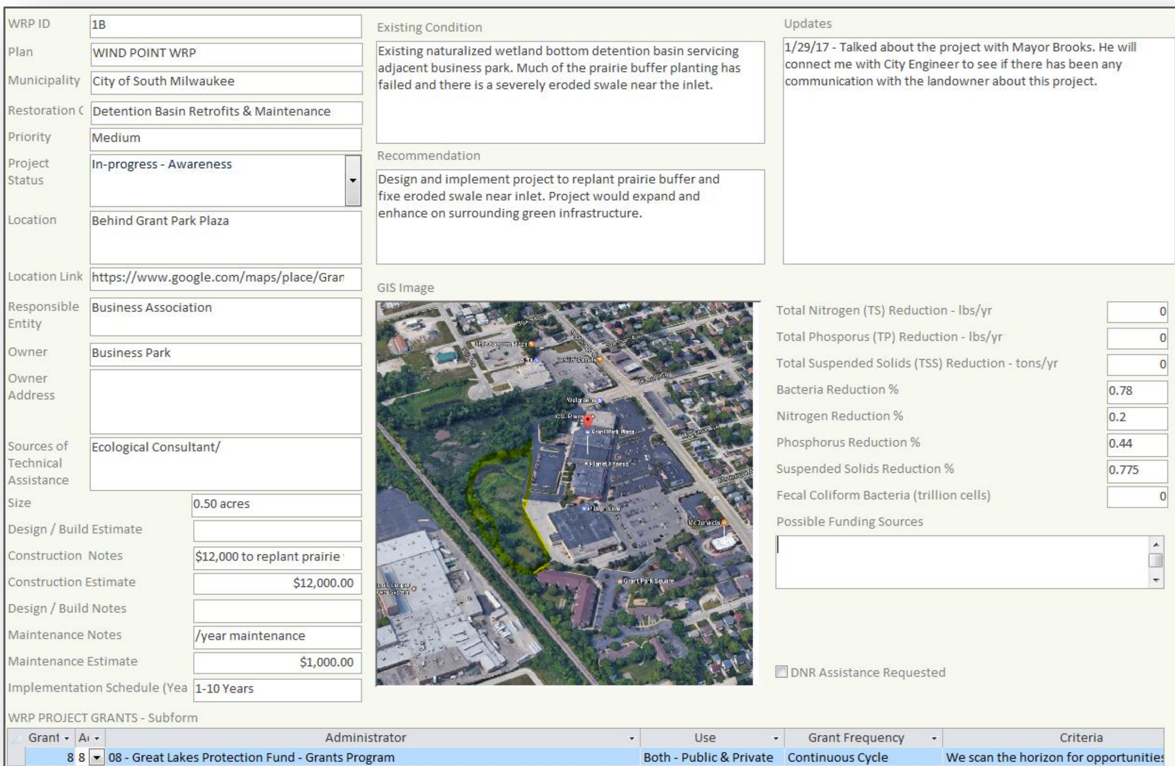
Sources	N Load (lb/yr)	P Load (lb/yr)	BOD Load (lb/yr)	Sediment Load (tons/yr)
Urban	0.00	0.00	0.00	0.00
Cropland	2,020.26	893.80	7,918.38	290.52
Pastureland	1,608.60	225.02	5,022.52	51.36
Forest	0.00	0.00	0.00	0.00
Feedlots	0.00	0.00	0.00	0.00
User Defined	0.00	0.00	0.00	0.00
Septic	0.00	0.00	0.00	0.00
Gully	0.00	0.00	0.00	0.00
Streambank	8,856.60	7,091.79	1,7713.21	5,617.43
Groundwater	0.00	0.00	0.00	0.00
Total	**12,485.47**	**8,210.61**	**3,0654.11**	**5,959.31**

2015 Ag Acres = 1301 **2015-2017 Reduced Ag Acres = 687** **2017 Total Cropland Acres in Watershed = 614**			
2015 Watershed Baseline Cropland Load	4,396.00		1,385.68
2017 Cropland Load = 614 Acres	**2,640.78**		**845.35**
Reduction from No Till and Filter Strips on 75% Cropland Acres	1,746.98		554.83
Reduction from 687 Less Ag Acres	2,321.46		731.72
TOTAL REDUCTION	4,068.44		1,286.55
Wind Point Plan Reduction GOAL For Agriculture Land	**2242**		**1,573**
Remaining Reduction Need	**-1,826.44**		**286.45**

Additional cropland or pasture BMPs or reduced cropland/pasture acres are needed to meet the original (2015) Wind Point Plan's agriculture sediment goal.

Root-Pike WIN has built an Access database of all the Wind Point Watershed Restoration Plan's project recommendations, which includes the pollution reduction estimates (see Fig. 1 below). The adjusted values will be populated into the database and will continue to be the system of record for all basin projects.

Figure 2 – A Screen Root-Pike WIN's Nine Element Plan Recommendations Database


WRP ID: 1B
Plan: WIND POINT WRP
Municipality: City of South Milwaukee
Restoration C: Detention Basin Retrofits & Maintenance
Priority: Medium
Project Status: In-progress - Awareness
Location: Behind Grant Park Plaza
Location Link: https://www.google.com/maps/place/Gran
Responsible Entity: Business Association
Owner: Business Park
Owner Address:
Sources of Technical Assistance: Ecological Consultant/
Size: 0.50 acres
Design / Build Estimate:
Construction Notes: $12,000 to replant prairie
Construction Estimate: $12,000.00
Design / Build Notes:
Maintenance Notes: /year maintenance
Maintenance Estimate: $1,000.00
Implementation Schedule (Yea: 1-10 Years

Existing Condition: Existing naturalized wetland bottom detention basin servicing adjacent business park. Much of the prairie buffer planting has failed and there is a severely eroded swale near the inlet.

Recommendation: Design and implement project to replant prairie buffer and fixe eroded swale near inlet. Project would expand and enhance on surrounding green infrastructure.

Updates: 1/29/17 - Talked about the project with Mayor Brooks. He will connect me with City Engineer to see if there has been any communication with the landowner about this project.

GIS Image

Total Nitrogen (TS) Reduction - lbs/yr: 0
Total Phospurus (TP) Reduction - lbs/yr: 0
Total Suspended Solids (TSS) Reduction - tons/yr: 0
Bacteria Reduction %: 0.78
Nitrogen Reduction %: 0.2
Phosphorus Reduction %: 0.44
Suspended Solids Reduction %: 0.775
Fecal Coliform Bacteria (trillion cells): 0
Possible Funding Sources:
DNR Assistance Requested

WRP PROJECT GRANTS - Subform

Grant	A	Administrator	Use	Grant Frequency	Criteria
8	8	08 - Great Lakes Protection Fund - Grants Program	Both - Public & Private	Continuous Cycle	We scan the horizon for opportunities

Finally, it is rare that stakeholders will use the physical copies of the Nine Element plans, so the electronic files and associated reports with these adjusted reductions can still revised, updated in the database and printed off for various communication uses. While the pollution reduction estimates are good "proof points" for project outcomes, the vast majority of stakeholders look to other determining factors such as habitat improvement or visual enhancements as the reason to proceed with a project.

d) The predicted ag practice reductions for TP and TSS (90%) in the plan significantly exceed the pollutant reduction efficiencies used with EPA STEPL model (65-75%) or SnapPlus model (www.snapplus.net) (60-70%). Please explain how the agricultural practice reductions were calculated (were they a cumulative estimated or individually calculated and then averaged?); what source(s) of information was used to derive the pollutant reduction efficiencies and were the reductions derived from soil data relevant to Wisconsin or another state? To obtain a more accurate estimate of pollutant reduction from the agricultural practices, we recommend the plan's agricultural reduction estimates be revised and calculated using EPA STEPL model or SnapPlus model (www.snapplus.net).

i) Please refer to Table 7, 8, 9, and 10 in the previous section (Element B-3 Clarifications). These tables contain recalculated pollutant load reduction numbers based on Andrew Craig's (WDNR) July 2017 EPA STEPL modeling. This new modeled data was produced with new information on the agricultural parcels in the watershed. Specifically, the 2015 agricultural parcels were reanalyzed in 2017 by Root-Pike WIN to see which were still in production and what percentage of the parcel was actually being farmed. Root-Pike WIN, to the best of their ability and with mapping imagery from 2014-2017, compiled a new list and assessment of all of the current agricultural parcels in the watershed. This updated information can be found on Table 5 and 6 referenced in Element B-3 Clarifications.

e) EPA's STEPL model was used to calculate baseline pollutant loading for each SMU in plan. The soil P concentration used within the STEPL model was set at 0.03 (default value). This is not correct soil P concentration for the soils within this watershed. The correct value is 0.066 (determined using STEPL P concentration map average 0.15 x 0.44 = 0.066). Amending the soil P concentration within STEPL nearly doubles the baseline P loading for all watersheds. This difference in soil P concentration is critical for determining agricultural pollutant P reductions within SMU 6, 7, 12,13,14,15 and 17. These SMU's correspond to the 7 critical agricultural areas in plan.

i) Please refer to Table 7, 8, 9, and 10 in the previous section (Element B-3 Clarifications). These tables contain recalculated pollutant load reduction numbers based on Andrew Craig's (WDNR) July 2017 EPA STEPL modeling. This new modeled data was produced with new information on the agricultural parcels in the watershed. Specifically, the 2015 agricultural parcels were reanalyzed in 2017 by Root-Pike WIN to see which were still in production and what percentage of the parcel was actually being farmed. Root-Pike WIN, to the best of their ability and with mapping imagery from 2014-2017, compiled a new list and assessment of all of the current agricultural parcels in the watershed. This updated information can be found on Table 5 and 6 referenced in Element B-3 Clarifications.

f) We are not sure why the plan uses STEPL to calculate baseline pollutant loading for each SMU and Region 5 model was used to determine agricultural pollutant reductions by SMU. Region 5 model is site/field specific and STEPL model calculates pollutant reductions at a watershed scale. Given the different scale of each model, it may not be accurate to compare their outputs to one another. Using one model, STEPL to calculate pollutant reductions, is recommended.

i) Please refer to Table 7, 8, 9, and 10 in the previous section (Element B-3 Clarifications). These tables contain recalculated pollutant load reduction numbers based on Andrew Craig's (WDNR) July 2017 EPA STEPL modeling. This new modeled data was produced with new information on the agricultural parcels in the watershed. Specifically, the 2015 agricultural parcels were reanalyzed in 2017 by Root-Pike WIN to see which were still in production and what percentage of the parcel was actually being farmed. Root-Pike WIN, to the best of their ability and with mapping imagery from 2014-2017, compiled a new list and assessment of all of the current agricultural parcels in the watershed. This updated information can be found on Table 5 and 6 referenced in Element B-3 Clarifications.

g) We question the plans modeled pollutant load estimates for streambank erosion, calculated using STEPL, because the 2012 stream/ravine inventory results, summarized in figure 38, do not match up with predicted areas of high sediment and pollutant loads (e.g., SMU's 10, 11 and 12; only SMU 8 has some streambank inventory observations that match up with the STEPL model prediction of significant streambank erosion). Figure 38 shows a substantial majority of areas with high to moderate streambank erosion correspond to the ravine/bluff areas, which the plan identifies as critical areas, because they are actively contributing sediment loads to Lake Michigan The upland stream sections, however, show very little or no streambank erosion. It's a bit unclear as to how the Bluffs are considered a critical area if it's not currently known how much of the erosion is due to natural causes versus runoff from impervious surfaces and/or channelized stormwater. Can the plan be revised to reflect the loading from natural versus impervious stormwater runoff caused erosion? Furthermore, it may be a stronger approach to use the proposed funds to implement some of the more low cost methods utilized at Bender Park then to simply conduct a feasibility study for bluff restoration. We agree with the plan's holistic approach to increase detention time within the entire watershed as well as reduce streambank stabilization (where necessary) to reduce sediment and nutrient loads.

i) Root-Pike WIN cannot speak for all of the ravines in the watershed, but we can speak to four of the major ones leading into and within Cliffside Park. These are listed as steams TRF-1, 2, 3 and 4. We have had four site visits to Cliffside Park with various engineers and experts, and it clear there are three, possibly four distinct issues with this particular part of the watershed (SMU-11).

The first erosion issue is the natural decay of the clay seepage bluffs right along the shoreline of Lake Michigan and along some sections of the ravines in proximity to the shoreline. It would take a significant amount of time and effort, certainly beyond the budget and scope of this plan, to determine how significant the natural processes of the eroding bluffs are having on the pollutant loading. However, the North ravine, or TRF-3, overlaps our theory of two distinct issues and warrants more attention. TRF-4 flows South into the main ravine approximately 300' feet from the mouth. One visit followed the waterway back almost to the upland area – now a recovering wetland. At one point the stream came very close to the Lake Michigan bank, which was roughly 30-40 feet, at which point the eroded Lake Michigan back dropped approximately 50' to the lake shore. It was clear, that with higher lake levels that we are seeing again on Lake Michigan, one large event could erode enough of the bank to disconnect TRF-4 from TRF-3 and start discharging directly down the slope. This would be an erosion issue that would dump hundreds of tons of newly eroded soil directly into Lake Michigan as it erodes down the bank shoreline.

ii) The second issue in this SMU is urban runoff from various sources in and around the park. Many different factors are combining, which aggregate along various points within the upper and middle reaches of the eroding ravine. The drainage area demonstrated numerous immediate erosion issues as well as the long term geomorphology of an incising stream. Still, it is probably the most feature-rich streams in the Wind Point watershed. Here are some specific contributing factors and observations associated with the main ravine (TRF-2 and 3). We are confident that the overall situation here is repeated in a number of locations up and down the Lake Michigan shoreline.

(1) Concrete lined swales in the neighborhoods to the South of the park feed into TRF-2

(2) Turf in and around the park drains directly into TRF-2

(3) Paved drives and lots in the park slope toward TRF-2 with very little buffer to the ravine

(4) Turf and paved lots at St. Mary's Church (South of the park) are causing smaller ravines to erode

(5) Turf from an unused field to the South of the park slopes toward the park adding more volume

(6) Two arrested headcuts, anchored by willows, are stopping significant erosion from moving upstream. The willows are dying and therefore the headcut is very fragile. When it moves, the stable banks upstream will become incised and hundreds of tons of sediment will flush out.

(7) The middle portion of the ravine is severely eroded up to this headcut, but recovered from the mouth where the headcut has been moving back over the last 50 years (local report)

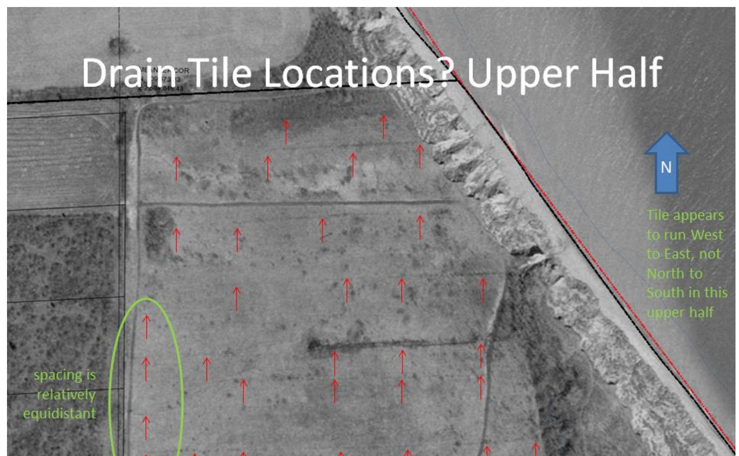
(8) Salmon, brown trout, steelhead and even a sturgeon have been sighted in the ravine up to where TRF-3 flows into TRF-4 near the mouth, but cannot make it past the first headcut.

(9) The overall health and stability of the stream seemed pretty good. Yes, there was bank erosion (minor), bluff sloughing (minor), head cutting (moderate to significant, but not throughout), and terrestrial invasive species issues. The good news is that there are opportunities to do improvements, but they would be generally at individual spot locations and would likely to be within a project scope and expense that make them very feasible (swales, RSCs and BMPs).

(10) There is also a vegetation issue as the ravine is highly invaded with Tatarian honeysuckle and buckthorn. If the invasives could open up the understory, this would allow for the re-establishment of vegetation that could help fight the erosion and sloughing issues. This is likely in other ravine areas and should be considered in the overall strategy for management.

(11) Root-Pike WIN has already begun discussions with Racine County and their Parks Department to begin pursuing grants to address these issues in and around Cliffside Park. Our plan includes the restoration near the headcut in TRF-2, Green Infrastructure in and around the park, and restored wetlands to the West and North of TRF-4 to buffer the ravine from more runoff.

iii) The third issue may involve the drain tile that once drained the farmland that predominately filled the parcel prior to the County's purchase decades ago. Two landowners who own parcels to the West of the park, and once owned the majority of the land that is now Cliffside Park, have come forward and have provided significant information about the area. The family farmed the majority of the land for three generations. In a recent site survey with Root-Pike WIN, they helped identify the drain tile locations and pointed out that much of that tile from pre-1950 is now failing. Visual inspection of these claims where proven to be true and can be seen in the image below, which resides in the wetland/prairie area of the Western half of the parcel.



Pictured left is one of many failing drain tile lines identified by the former Cliffside Park landowners. In the lower half of the wetland prairie, the lines generally flow from North to South into the main ravine (TRF-2). In the upper half, the lines appear to flow from West to East into the Bluff and ravine (TRF-1).

iv) The fourth issue may involve the Oak Creek power plant to the North of Cliffside Park. They also gave accounts of how much of the 11 acre farmland that was present pre-1960 and directly adjacent to the bluffs has eroded into the lake. Finally, they also commented that additions and improvements to the Oak Creek power plant shoreline infrastructure brought the most noticeable changes to the littoral shift, which may be creating an eddy that enhances the erosion to the Cliffside Park shoreline. None of these observations have been scientifically researched or challenged to date.

ELEMENT **C** CLARIFICATIONS

4) **WDNR/EPA Comments 4: We concur with these findings. However, please respond to the following management measures comments:**

   a) **Section 6.1 of plan describes several programmatic management measures that are applicable throughout the watershed. The top priority of the described measures is for the Watershed partners adopt the plan and incorporate the plans goals, objectives and recommended actions into comprehensive plans and ordinances. Have any of the municipalities described in plan (i.e., Caledonia, North Bay, Oak Creek, Racine, South Milwaukee and Wind Point) discussed and adopted sections of the plan. Specifically have any municipalities incorporated the plan's site specific management measures for Streambank, Ravine and Channel Restoration and Agricultural Management Practices which correspond to (as shown in Table 40 in plan) the management measure categories that address 90% of the watersheds estimated TSS and TP loads?**

      i) The Village of Wind Point has proactively adopted the plan in mid-2016 and is cooperative in exploring the implementation of a handful of recommendations. None of the other municipalities have been approached by Root-Pike WIN regarding the adoption of the Wind Point Plan as we are awaiting approval from the DNR and EPA. To our knowledge, none of the municipalities have adopted the site specific management measures like the ones shown in Table 40. We believe approval of the plan will expedite that process of moving these management measures forward.

      ii) Consequently, starting in 2017, Pete Wood and Root-Pike WIN will been working together more to meld the goals and requirements of the Southeastern Wisconsin Clean Water Network (SWCWN) with the recommendations contained within the Nine Element Plans – including the Wind Point Plan. There are three four different ways we intend to incorporate them into the SWCWN and Respect Our Waters campaign education and public outreach.
         (1) We will begin meeting with each municipal representative from SWCWN to bring awareness, plan and implement plan recommendations to include. Many don't know these plans even exist.
         (2) We will continue to hold quarterly events with SWCWN members where we bring awareness to best management practices and successful projects that involve on-site installations and expert presentations of many of the management measure categories.
         (3) We are exploring the use of the Respect Our Waters campaign to better target pollutant hot spots in each of the municipalities, which include those in the Wind Point Plan.

b) The critical areas for agricultural management practices described in plan (i.e., section 6.1.13 - conservation tillage and filter strips) nearly all reside with the town of Caledonia Municipality and Racine County. The plan describes federal (USDA and NRCS) agricultural programs can help farmers implement these measures. The plan, however, fails to describe the Racine County Land and Water Conservation Department - http://racinecounty.com/government/public-works-and-development-services/land-conservation can also help to implement the agricultural measures. The Land Conservation Division implements and administers County and State Soil and Water Conservation Program and provides technical assistance regarding soil erosion, animal waste management, and water quality. The July-Sept 2016 issue of the Racine County Land and Water Conservation Newsletter http://racinecounty.com/home/showdocument?id=5993 – describes cost sharing @ $3,000/acre for implementation of grassed buffers along waterways, via grant from Fund for Lake Michigan, and 28$/acre for NM plans. Have any of the agricultural practices with the plan's high priority agricultural critical areas (as shown in figure 73) been implemented by the agricultural landowners? Have the landowners been contacted by Racine County Land Conservation or NRCS staff about their interest in switching to the new agricultural practices?

i) From an overall perspective, it should be noted that Root-Pike WIN is working closely with Chad Sampson, Racine County Conservationist to advance project recommendations within the Wind Point Plan as well as with the Root and Pike River Plans. On a monthly basis, we are coordinating efforts and sharing information on a variety of priority parcels and involved landowners. Root-Pike WIN has built a database of the Plans' recommendations and we use often to coordinate efforts with Racine County (and all of the other municipalities). Only a few agricultural practices defined in the plan have been implemented as the effort to start implementing the Wind Point Plan did not begin until late 2016.

ii) As of January 15, 2017, Racine County Land Conservation staff has not used any of the Fund for Lake Michigan grassed waterways grant, referenced in the comments above, to address the agricultural issues in the Wind Point watershed.

iii) As of January 15, 2017, Racine County reports a few agricultural practices within the plan's high priority agricultural critical areas (as shown in figure 73) have been implemented by the agricultural landowners. They include the following actions:
   (1) Abandoned old farm wells, or old unused wells at:
      (a) 8200 Botting Rd
      (b) 42xx 3 Mile Rd
      (c) 6205 Hwy 31
      (d) 4503 N Main St
      (e) 1913 5 Mile Rd
   (2) Installed grassed waterways at:
      (a) 7425 Botting Road (500 linear feet)
      (b) 5915 – 7 Mile Road (250 linear feet and 475 linear feet)
   (3) Conservation Reserve Program native prairie planting and pond at:
      (a) 7500 Hwy 31 (67 acres on west side of Hwy 31)
   (4) As of January 15, 2017, it can be reported that landowners have not been contacted by Racine County Land Conservation about their interest in switching to the new agricultural practices. We have not heard back from NRCS about any contact they have made with landowners in this area. Racine County Land Conservation staff is familiar with some of the key parcels and have some knowledge of the existing practices and landowner preferences. Root-Pike WIN has yet to contact any landowners, but it is our goal to begin contacting landowners, as much as possible, in priority parcels in 2017. Again, some of these efforts will be advanced through the Southeastern Wisconsin Clean Water Network.

iv) In summary, Root-Pike WIN will begin contacting landowners in critical areas in 2018 with the help of Racine County Land Conservation Staff and NRCS. Our cooperative efforts will use the information in Figure 73 of the Plan to initiate and prioritize our coordinated efforts with regard to targeting agricultural issues in the watershed.

v) It should be also noted that Root-Pike WIN has advanced the following projects through our own efforts and in collaboration with other partners. Table 11 that follows represents the projects Root-Pike WIN has already begun planning and designing:

Table 11 – Wind Point Plan Projects in Planning, Design or Implementation as of July 2017

Status	Restoration Category	Priority	Updates	ID	Owner
Planning	Wetland Restoration	High: Critical Area	5/1/17 - applied for WDNR Wetland In-lieu Fee program, walked site with Joshua and Sally	22	Racine County
Planning	Streambank & Channel Restoration	High: Critical Area	7/1/17 - Toured site with Fund for Lake Michigan, and tour planned with USACE 8/15/17	TRF 4	Racine County
Planning	Wetland Restoration	Medium	3/23/17: Met with Phil at Oak Creek. This parcel is under City control and is being restored to become a park. RPW could possibly help with grants here.	24	DuPont (private)
Planning	Priority Green Infrastructure Protection Areas	High: Critical Area	3/23/17: Met with Phil at Oak Creek. This parcel is under City control and is being restored to become a park. RPW could possibly help with grants here. Some work has been done on the South side of the shoreline bluffs. Eroding bluffs to the North still need to get done. This will be millions of dollars	GI3	City of Oak Creek
Planning	Detention Basin Retrofits & Maintenance	High: Critical Area	3/29/17: Met with Julie K. and Mark Y. At CoR. RPW and CoR agreed to work together on grants for design phase work. Need to talk to Mark to see if a stormwater plan is already in place here.	39B	City of Racine
Implementation	Priority Green Infrastructure Protection Areas	High: Critical Area	3/20/17: Met with Chad at the City and there is a natural space plan for this area. Work has already begun on an ADA ramp. Future plans include a natural area and ravine restoration. 1/30/17 - Met with Mayor Brooks regarding the project and he is interested. He is going to connect me with the City Engineer to see what might be next. There is a plan that calls for more public green space vs. Private development. Lots of options here to be explored per the Mayor.	GI1	City of South Milwaukee
Planning	Other Management Measures	Medium	1/30/17 - Met with Mayor Brooks regarding the project and he is interested. RPW to help coordinate with South Milwaukee on a cleanup with citizen groups.	1	City of South Milwaukee

ELEMENT **H** CLARIFICATIONS

5) WDNR/EPA: We concur with these findings. However, we recommend the plan include the following EPA Technical Memo on BMP depreciation. Pollutant reduction efficiencies associated with some management practices do not remain constant; in general they decline over time, unless appropriate O&M is completed. The plan partially addresses O&M of practices, via retrofitting of detention basins.

i) The following pages contain the EPA's Technical Memo on BMP Depreciation.

United States
Environmental Protection
Agency

This Technical Memorandum is one of a series of publications designed to assist watershed projects, particularly those addressing nonpoint sources of pollution. Many of the lessons learned from the Clean Water Act Section 319 National Nonpoint Source Monitoring Program are incorporated in these publications.

October 2015

Donald W. Meals and Steven A. Dressing. 2015. Technical Memorandum #1: Adjusting for Depreciation of Land Treatment When Planning Watershed Projects, October 2015. Developed for U.S. Environmental Protection Agency by Tetra Tech, Inc., Fairfax, VA, 16 p.
Available online at *www.epa.gov/xxx/tech_memos.htm*.

Technical Memorandum #1

Adjusting for Depreciation of Land Treatment When Planning Watershed Projects

Introduction

Watershed-based planning helps address water quality problems in a holistic manner by fully assessing the potential contributing causes and sources of pollution, then prioritizing restoration and protection strategies to address the problems (USEPA 2013). The U.S. Environmental Protection Agency (EPA) requires that watershed projects funded directly under section 319 of the Clean Water Act implement a watershed-based plan (WBP) addressing the nine key elements identified in EPA's *Handbook for Developing Watershed Plans to Restore and Protect our Waters (USEPA 2008)*. EPA further recommends that all other watershed plans intended to address water quality impairments also include the nine elements. The first element calls for the identification of causes and sources of impairment that must be controlled to achieve needed load reductions. Related elements include a description of the nonpoint source (NPS) management measures—or best management practices (BMPs)—needed to achieve required pollutant load reductions, a description of the critical areas in which the BMPs should be implemented, and an estimate of the load reductions expected from the BMPs.

Fields near Seneca Lake, New York.

Once the causes and sources of water resource impairment are assessed, identifying the appropriate BMPs to address the identified problems, the best locations for additional BMPs, and the pollutant load reductions likely to be achieved with the BMPs depends on accurate information on the performance levels of both BMPs already in place and BMPs to be implemented as part of the watershed project. All too often, watershed managers and Agency staff have assumed that, once certified as installed or adopted according to specifications, a BMP continues to perform its pollutant reduction function at the same efficiency (percent pollutant reduction) throughout its design or contract life, sometimes longer. An important corollary to this assumption is that BMPs in place during project planning are performing as originally intended. Experience in NPS watershed projects across the nation, however, shows that, without diligent operation and maintenance, BMPs and their effects probably will depreciate over time, resulting in less efficient pollution reduction. Recognition of this fact is important at the project planning phase, for both existing and planned BMPs.

Knowledge of land treatment depreciation is important to ensure project success through the adaptive management process (USEPA 2008). BMPs credited during the planning phase of a watershed project will be expected to achieve specific load reductions or other water quality benefits as part of the overall plan to protect or restore a water body. Verification that BMPs are still performing their functions at anticipated levels is essential to keeping a project on track to achieve its overall goals. Through adaptive management, verification results can be used to inform decisions about needs for additional BMPs or maintenance or repair of existing BMPs. In a watershed project that includes short-term (3–5 years) monitoring, subtle changes in BMP performance level might not be detectable or critical, but planners must account for catastrophic failures, BMP removal or discontinuation, and major maintenance shortcomings. Over the longer term, however, gradual changes in BMP performance level can be significant in terms of BMP-specific pollutant control or the role of single BMPs within a BMP system or train. The weakest link in a BMP train can be the driving force in overall BMP performance.

> Application of and methods for BMP tracking in NPS watershed projects are described in detail in *Tech Notes 11* (Meals et al. 2014).

This technical memorandum addresses the major causes of land treatment depreciation, ways to assess the extent of depreciation, and options for adjusting for depreciation. While depreciation occurs throughout the life of a watershed project, the emphasis is on the planning phase and the short term (i.e., 3–5 years).

Causes of Depreciation

Depreciation of land treatment function occurs as a result of many factors and processes. Three of the primary causes are natural variability, lack of proper maintenance, and unforeseen consequences.

Natural Variability

Climate and soil variations across the nation influence how BMPs perform. Tiessen et al. (2010), for example, reported that management practices designed to improve water quality by reducing sediment and sediment-bound nutrient export from agricultural fields can be less effective in cold, dry regions where nutrient export is primarily snowmelt driven and in the dissolved form, compared to similar practices in warm, humid regions. Performance levels of vegetation-based BMPs in both agricultural and urban settings can vary significantly through the year due to seasonal dormancy. In a single locale, year-to-year variation in precipitation affects both agricultural management and BMP performance levels. Drought, for example, can suppress crop yields, reduce nutrient uptake, and result in nutrient surpluses left in the soil after harvest where they are vulnerable to runoff or leaching loss despite careful nutrient management. Increasing incidence of extreme weather and intense storms can overwhelm otherwise well-designed stormwater management facilities in urban areas.

Lack of Proper Maintenance

Most BMPs—both structural and management—must be operated and maintained properly to continue to function as designed. Otherwise, treatment effectiveness can depreciate over time. For example, in a properly functioning detention pond, sediment typically accumulates in the forebay. Without proper maintenance to remove accumulated sediment, the capacity of the BMP to contain and treat stormwater is diminished. Similarly, a nutrient management plan is only as effective as its implementation. Failure to adhere to phosphorus (P) application limits, for example, can result in soil P buildup and increased surface and subsurface losses of P rather than the loss reductions anticipated.

Jackson-Smith et al. (2010) reported that over 20 percent of implemented BMPs in a Utah watershed project appeared to be no longer maintained or in use when evaluated just 5 years after project completion. BMPs related to crop production enterprises and irrigation systems had the lowest rate of continued use and maintenance (~75 percent of implemented BMPs were still in use), followed by pasture and grazing planting and management BMPs (81 percent of implemented BMPs were still in use). Management practices (e.g., nutrient management) were found to be particularly susceptible to failure.

Practices are sometimes simply abandoned as a result of changes in landowner circumstances or attitudes. In a Kansas watershed project, farmers abandoned a nutrient management program because of perceived restrictive reporting requirements (Osmond et al. 2012).

Abandoned waste storage structure.

In the urban arena, a study of more than 250 stormwater facilities in Maryland found that nearly one-third of stormwater BMPs were not functioning as designed and that most needed maintenance (Lindsey et al. 1992). Sedimentation was a major problem and had occurred at nearly half of the facilities; those problems could have been prevented with timely maintenance.

Hunt and Lord (2006) describe basic maintenance requirements for bioretention practices and the consequences of failing to perform those tasks. For example, they indicate that mulch should be removed every 1–2 years to both maintain available water storage volume and increase the surface infiltration rate of fill soil. In addition, biological films might need to be removed every 2–3 years because they can cause the bioretention cell to clog.

In plot studies, Dillaha et al. (1986) observed that vegetative filter strip-effectiveness for sediment removal appeared to decrease with time as sediment accumulated within the filter strips. One set of the filters was almost totally inundated with sediment during the cropland experiments and filter effectiveness dropped 30–60 percent between the first and second experiments. Dosskey et al. (2002) reported that up to 99 percent of sediment was removed from cropland runoff when uniformly distributed over a buffer area, but as concentrated flow paths developed over time (due to lack of maintenance), sediment removal dropped to 15–45 percent. In the end, most structural BMPs have a design life (i.e., the length of time the item is expected to work within its specified parameters). This period is measured from when the BMP is placed into service until the end of its full pollutant reduction function.

Unforeseen Consequences

The effects of a BMP can change directly or indirectly due to unexpected interactions with site conditions or other activities. Incorporating manure into cropland soils to reduce nutrient runoff, for example, can increase erosion and soil loss due to soil disturbance, especially in comparison to reduced tillage. On the other hand, conservation tillage can result in accumulation of fertilizer nutrients at the soil surface, increasing their availability for loss in runoff (Rhoton et al. 1993). Long-term reduction in tillage also can promote the formation of soil macropores, enhancing leaching of soluble nutrients and agrichemicals into ground water (Shipitalo et al. 2000). Stutter et al. (2009) reported that establishment of vegetated buffers between cropland and a watercourse led to enhanced rates of soil P cycling within the buffer, increasing soil P solubility and the potential for leaching to watercourses.

Despite widespread adoption of conservation tillage and observed reductions in particulate P loads, a marked increase in loads of dissolved bioavailable P in agricultural tributaries to Lake Erie has been documented since the mid-1990s. This shift has been attributed to changes in application rates, methods, and timing of P fertilizers on cropland in conservation tillage not subject to annual tillage (Baker 2010; Joosse and Baker 2011). Further complicating matters, recent research on fields in the St. Joseph River watershed in northeast Indiana has demonstrated that about half of both soluble P and total P losses from research fields occurred via tile discharge, indicating a need to address both surface and subsurface loads to reach the goal of 41 percent reduction in P loading for the Lake Erie Basin (Smith et al. 2015).

Several important project planning lessons were learned from the White Clay Lake, Wisconsin, demonstration projects in the 1970s, including the need to accurately assess pollutant inputs and the performance levels of BMPs (NRC 1999). Regarding unforeseen consequences, the project learned through monitoring that a manure storage pit built according to prevailing specifications actually caused ground water contamination that threatened a farmer's well water. This illustrates the importance of monitoring implemented practices over time to ensure that they function properly and provide the intended benefits.

Control of urban stormwater runoff (e.g., through detention) has been widely implemented to reduce peak flows from large storms in order to prevent stream channel erosion. Research has shown, however, that although large peak flows might be controlled effectively by detention storage, stormflow conditions are extended over a longer period of time. Duration of erosive and bankfull flows are increased, constituting channel-forming events. Urbonas and Wulliman (2007) reported that, when captured runoff from a number of individual detention basins in a stream system is released over time, the flows accumulate as they travel downstream, actually increasing peak flows along the receiving waters. This situation can diminish the collective effectiveness of detention basins as a watershed management strategy.

Assessment of Depreciation

The first—and possibly most important—step in adjusting for depreciation of implemented BMPs is to determine its extent and magnitude through BMP verification.

BMP Verification

At its core, BMP verification confirms that a BMP is in place and functioning properly as expected based on contract, permit, or other implementation evidence. A BMP verification process that documents the presence and function of BMPs over time should be included in all NPS watershed projects.

At the project planning phase, verification is important both to ensure accurate assessment of existing BMP performance levels and to determine additional BMP and maintenance needs. Verification over time is necessary to determine if BMPs are maintained and operated during the period of interest.

Documenting the presence of a BMP is generally simpler than determining how well it functions, but both elements of verification must be considered to determine if land treatment goals are being met and whether BMP performance is depreciating. Although land treatment goals might not be highly specific in many watershed projects, it is important to document what treatment is implemented. Verification is described in detail in *Tech Notes 11* (Meals et al. 2014). This technical memorandum focuses on specific approaches to assessing depreciation within the context of an overall verification process.

Methods for Assessing BMP Presence and Performance Level

Whether a complete enumeration or a statistical sampling approach is used, methods for tracking BMPs generally include direct measurements (e.g., soil tests, onsite inspections, remote sensing) and indirect methods (e.g., landowner self-reporting or third-party surveys). Several of these methods are discussed in *Tech Notes 11* (Meals et al. 2014). Two general factors must be considered when verifying a BMP: the presence of the BMP and its pollutant removal efficiency. Different types of BMPs require different verification methods, and no single approach is likely to provide all the information needed in planning a watershed project.

Certification

The first step in the process is to determine whether BMPs have been designed and installed/adopted according to appropriate standards and specifications. Certification can either be the final step in a contract between a landowner and a funding agency or be a component of a permit requirement.

Certification provides assurance that a BMP is fully functional for its setting at a particular time. For example, a stormwater detention pond or water and sediment control basin must be properly sized for its contributing area and designed for a specific retention-and-release performance level. A nutrient management plan must account for all sources of nutrients, consider current soil nutrient levels, and support a reasonable yield goal. A cover crop must be planted in a particular time window to provide erosion control and/or nutrient uptake during a critical time of year. Some jurisdictions might apply different nutrient reduction efficiency credits for cover crops based on planting date. Some structural BMPs like parallel tile outlet terraces require up to 2 years to fully settle and achieve full efficiency; in those cases, certification is delayed until full stability is reached. Knowledge that a BMP has been applied according to a specific standard supports an assumption that the BMP will perform at a certain level of pollutant reduction efficiency, providing a baseline against which future depreciation can be compared. Practices voluntarily implemented by landowners without any technical or financial assistance could require special efforts to determine compliance with applicable specifications (or functional equivalence). Pollution reduction by practices not meeting specifications might need to be discounted or not counted at all even when first installed.

Depreciation assessment indicators

Ideally, assessment of BMP depreciation would be based on actual measurement of each BMP's performance level (e.g., monitoring of input and output pollutant loads for each practice). Except in very rare circumstances, this type of monitoring is impractical. Rather, a watershed project generally must depend on the use of indicators to assess BMP performance level.

The most useful indicators for assessing depreciation are determined primarily by the type of BMP and pollutants controlled, but indicators might be limited by the general verification approach used. For example, inflow and outflow measurements of pollutant load can be used to determine the effectiveness of constructed wetlands, but a verification effort that uses only visual observations will not provide that data or other information about wetland functionality. A central challenge, therefore, is to identify meaningful indicators of BMP performance level that can be tracked under different verification schemes. This technical memorandum provides examples of how to accomplish that end.

Nonvegetative structural practices

Performance levels of nonvegetative structural practices—such as animal waste lagoons, digesters, terraces, irrigation tailwater management, stormwater detention ponds, and pervious pavement—can be assessed using the following types of indicators:

- Measured on-site performance data (e.g., infiltration capacity of pervious pavement),
- Structural integrity (e.g., condition of berms or other containment structures), and
- Water volume capacity (e.g., existing pond volume vs. design) and mass or volume of captured material removed (e.g., sediment removed from stormwater pond forebay at cleanout).

In some cases, useful indicators can be identified directly from practice standards. For example, the Natural Resources Conservation Service lists operation and maintenance elements for a water and sediment control basin (WASCoB) (*USDA-NRCS 2008*) that include:

- Maintenance of basin ridge height and outlet elevations,
- Removal of sediment that has accumulated in the basin to maintain capacity and grade,
- Removal of sediment around inlets to ensure that the inlet remains the lowest spot in the basin, and
- Regular mowing and control of trees and brush.

These elements suggest that ridge and outlet elevations, sediment accumulation, inlet integrity, and vegetation control would be important indicators of WASCoB performance level.

Required maintenance checklists contained in stormwater permits also can suggest useful indicators. For example, the *Virginia Stormwater Management Handbook* (VA DCR 1999) provides an extensive checklist for annual operation and maintenance inspection of wet ponds. The list includes many elements that could serve as BMP performance level indicators:

- Excessive sediment, debris, or trash accumulated at inlet,
- Clogging of outlet structures,

- Cracking, erosion, or animal burrows in berms, and
- More than 1 foot of sediment accumulated in permanent pool.

Assessment of these and other indicators would require on-site inspection and/or measurement by landowners, permit-holders, or oversight agencies.

Vegetative structural practices

Performance levels of vegetative structural practices—such as constructed wetlands, swales, rain gardens, riparian buffers, and filter strips—can be assessed using the following types of indicators:

- Extent and health of vegetation (e.g., measurements of soil cover or plant density),
- Quality of overland flow filtering (e.g., evidence of short-circuiting by concentrated flow or gullies through buffers or filter strips),
- On-site capacity testing of rain gardens using infiltrometers or similar devices, and
- Visual observations (e.g., presence of water in swales and rain gardens).

Parking lot rain garden.

As for non-vegetative structural practices, assessment of these indicators would require on-site inspection and/or measurement by landowners, permit-holders, or oversight agencies.

Nonstructural vegetative practices

Performance levels of nonstructural vegetative practices—such as cover crops, reforestation of logged tracts, and construction site seeding—can be assessed using the following types of indicators:

- Density of cover crop planting (e.g., plant count),
- Percent of area covered by cover crop, and
- Extent and vitality of tree seedlings.

These indicators could be assessed by on-site inspection or, in some cases, by remote sensing, either from satellite imagery or aerial photography.

Management practices

Performance levels of management practices—such as nutrient management, conservation tillage, pesticide management, and street sweeping—can be assessed using the following types of indicators:

- Records of street sweeping frequency and mass of material collected,
- Area or percent of cropland under conservation tillage,

- Extent of crop residue coverage on conservation tillage cropland, and
- Fertilizer and/or manure application rates and schedules, crop yields, soil test data, plant tissue test results, and fall residual nitrate tests.

Illustration of line-transect method for residue.

Assessment of these indicators would generally require reporting by private landowners or municipalities, reporting that is required under some regulatory programs. Visual observation of indicators such as residue cover, however, can also be made by on-site inspection or windshield survey.

Data analysis

Data on indicators can be expressed and analyzed in several ways, depending on the nature of the indicators used. Indicators reporting continuous numerical data—such as acres of cover crop or conservation tillage, manure application rates, miles of street sweeping, mass of material removed from catch basins or detention ponds, or acres of logging roads/landings revegetated—can be expressed either in the raw form (e.g., acres with 30 percent or more residue cover) or as a percentage of the design or target quantity (e.g., percent of contracted acres achieving 30 percent or more of residue cover). These metrics can be tracked year to year as a measure of BMP depreciation (or achievement). During the planning phase of a watershed project, it might be appropriate to collect indicator data for multiple years prior to project startup to enable calculation of averages or ranges to better estimate BMP performance levels over crop rotation cycles or variable weather conditions.

Indicators reporting categorical data—such as maintenance of detention basin ridge height and outlet elevations, condition of berms or terraces, or observations of water accumulation and flow—are more difficult to express quantitatively. It might be necessary to establish an ordinal scale (e.g., condition rated on a scale of 1–10) or a binary yes/no condition, then use best professional judgment to assess influence on BMP performance.

In some cases, it might be possible to use modeling or other quantitative analysis to estimate individual or watershed-level BMP performance levels based on verification data. In an analysis of stormwater BMP performance levels, Tetra Tech (2010) presented a series of BMP performance curves based on monitoring and modeling data that relate pollutant removal efficiency to depth of runoff treated (Figure 1). Where depreciation indicators track changes in depth of runoff treated as the capacity of a BMP decreases (e.g., from sedimentation), resulting changes in pollutant removal could be determined from a performance curve. This type of information can be particularly useful during the planning phase of a watershed project to estimate realistic performance levels for existing BMPs that have been in place for a substantial portion of their expected lifespans.

The performance levels of structural agricultural BMPs in varying condition can be estimated by altering input parameters in the *Soil and Water Assessment Tool* (SWAT) model (Texas A&M University 2015a); other models such as the *Agricultural Policy/Environmental eXtender* (APEX) model (Texas A&M

University 2015b) also can be used in this way (including application to some urban BMPs). For urban stormwater, engineering models like *HydroCAD* (HydroCAD Software Solutions 2011) can be used to simulate hydrologic response to stormwater BMPs with different physical characteristics (e.g., to compare performance levels under actual vs. design conditions). Even simple spreadsheet models such as the Spreadsheet Tool for Estimating Pollutant Load (*STEPL*) (USEPA 2015) can be used to quantify the effects of BMP depreciation by varying the effectiveness coefficients in the model.

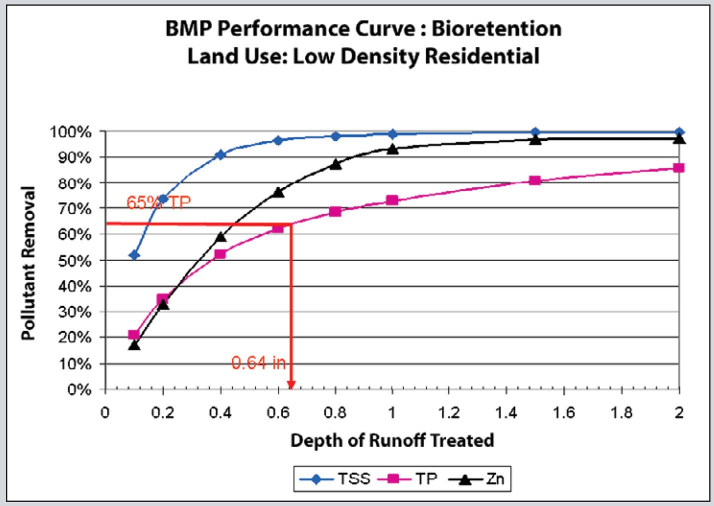


Figure 1. BMP Performance Curve for Bioretention BMP (Tetra Tech 2010).

Data from verification efforts and analysis of the effects of depreciation on BMP performance levels must be qualified based on data confidence. "Confidence" refers mainly to a quantitative assessment of the accuracy of a verification result. For example, the number of acres of cover crops or the continuity of streamside buffers on logging sites determined from aerial photography could be determined by ground-truthing to be within +10 percent of the true value at the 95 percent confidence level. Confidence also can refer to the level of trust that BMPs previously implemented continue to function (e.g., the proportion of BMPs still in place and meeting performance standards). For example, reporting that 75 percent of planned BMPs have been verified is a measure of confidence that the desired level of treatment has been applied.

While specific methods to evaluate data confidence are beyond the scope of this memo, it is essential to be able to express some degree of confidence in verification results—both during the planning phase and over time as the project is implemented. For example, an assessment of relative uncertainty of BMP performance during the planning phase can be used as direct follow-up to verification efforts to those practices for which greater quantification of performance level is needed. In addition, plans to implement new BMPs also can be developed with full consideration of the reliability of BMPs already in place.

Adjusting for Depreciation

Information on BMP depreciation can be used to improve both project management and project evaluation.

Project Planning and Management

Establishing baseline conditions

Baseline conditions of pollutant loading include not only pollutant source activity but also the influence of BMPs already in place at the start of the project. Adjustments based on knowledge of BMP depreciation can provide a more realistic estimate of baseline pollutant loads than assuming that existing land treatment has reduced NPS pollutant loads by some standard efficiency value.

Establishing an accurate starting point will make load reduction targets—and, therefore, land treatment design—more accurate. Selecting appropriate BMPs, identifying critical source areas, and prioritizing land treatment sites will all benefit from an accurate assessment of baseline conditions. Knowledge of depreciation of existing BMPs can be factored into models used for project planning (e.g., by adjusting pollutant removal efficiencies), resulting in improved understanding of overall baseline NPS loads and their sources.

While not a depreciation issue per se, when a BMP is first installed—especially a vegetative BMP like a buffer or filter strip—it usually takes a certain amount of time before its pollutant reduction capacity is fully realized. For example, Dosskey et al. (2007) reported that the nutrient reduction performance of newly established vegetated filter strips increased over the first 3 years as dense stands of vegetation grew in and soil infiltration improved; thereafter, performance level was stable over a decade. When planning a watershed project, vegetative practices should be examined to determine the proper level of effectiveness to assume based on growth stage. Also, because of weather or management conditions, some practices (e.g., trees) might take longer to reach their full effectiveness or might never reach it. The Stroud Preserve, Pennsylvania, section 319 National Nonpoint Source Monitoring Program (NNPSMP) project (1992–2007) found that slow tree growth in a newly established riparian forest buffer delayed significant NO_3–N (nitrate) removal from ground water until about 10 years after the trees were planted (Newbold et al. 2008).

The performance of practices can change in multiple ways over time. For example, excessive deposition in a detention pond that is not properly maintained could reduce overall percent removal of sediment because of reduced capacity as illustrated in Figure 1. The relative and absolute removal efficiencies for various particle size fractions (and associated pollutants) also can change due to reduced hydraulic retention time. Fine particles generally require longer settling times than larger particles, so removal efficiency of fine particles (e.g., silt, clay) can be disproportionally reduced as a detention pond or similar BMP fills with sediment and retention time deteriorates. Expert assessment of the condition and likely current performance level of existing BMPs, particularly those for which a significant amount of pollutant removal is assumed, is essential to establishing an accurate baseline for project planning.

Adaptive watershed management

Watershed planning and management is an iterative process; project goals might not all be fully met during the first project cycle and management efforts usually need to be adjusted in light of ongoing changes. In many cases, several cycles—including mid-course corrections—might be needed for a project to achieve its goals. Consequently, EPA recommends that watershed projects pursue a dynamic and adaptive approach so that implementation of a watershed plan can proceed and be modified as new information becomes available (USEPA 2008). Measures of BMP implementation commonly used as part of progress assessment should be augmented with indicators of BMP depreciation. Combining this information with other relevant project data can provide reliable progress assessments that will indicate gaps and weaknesses that need to be addressed to achieve project goals.

BMP design and delivery system

Patterns in BMP depreciation might yield information on systematic failures in BMP design or management that can be addressed through changes to standards and specifications, contract terms, or permit requirements. This information could be particularly helpful during the project planning phase when both the BMPs and their implementation mechanisms are being considered. For example, a cost-sharing schedule that has traditionally provided all or most funding upon initial installation of a BMP could be adjusted to distribute a portion of the funds over time if operation and maintenance are determined to be a significant issue based on pre-project information. Some BMP components, on the other hand, might need to be dropped or changed to make them more appealing to or easier to manage by landowners. Within the context of a permit program, for example, corrective actions reports might indicate specific changes that should be made to BMPs to ensure their proper performance.

Project Evaluation

Monitoring

Although short-term (3–5 year) NPS watershed projects will not usually have a sufficiently long data record to evaluate incremental project effects, data on BMP depreciation might still improve interpretation of collected water quality data. Even in the short term, water quality monitoring data might reflect cases in which BMPs have suffered catastrophic failures (e.g., an animal waste lagoon breach), been abandoned, or been maintained poorly. Meals (2001), for example, was able to interpret unexpected spikes in stream P and suspended sediment concentrations by walking the watershed and discovering that a landowner had over-applied manure and plowed soil directly into the stream.

Longer-term efforts (e.g., total maximum daily loads[1]) might engage in sustained monitoring beyond individual watershed project lifetime(s). The extended monitoring period will generally allow detection of more subtle water quality impacts for which interpretation could be enhanced with information on BMP depreciation. While not designed as BMP depreciation studies, the following two examples illustrate how changes in BMP performance can be related to water quality.

In a New York dairy watershed treated with multiple BMPs, Lewis and Makarewicz (2009) reported that the suspension of a ban on winter manure application 3 years into the monitoring study led to dramatic increases in stream nitrogen and phosphorus concentrations. First and foremost, knowledge of that suspension provided a reasonable explanation for the observed increase in nutrient levels. Secondly, the study was able to use data from the documented depreciation of land treatment to determine that the winter spreading ban had yielded 60–75 percent reductions in average stream nutrient concentrations.

The Walnut Creek, Iowa, Section 319 NNPSMP project promoted conversion of row crop land to native prairie to reduce stream NO_3-N levels and used simple linear regression to show association of two monitored variables: tracked conversion of row crop land to restored prairie vegetation and stream NO_3-N concentrations (Schilling and Spooner 2006). Because some of the restored prairie was plowed back into cropland during the project period—and because that change was

[1] "Total maximum daily loads" as defined in §303(d) of the Clean Water Act.

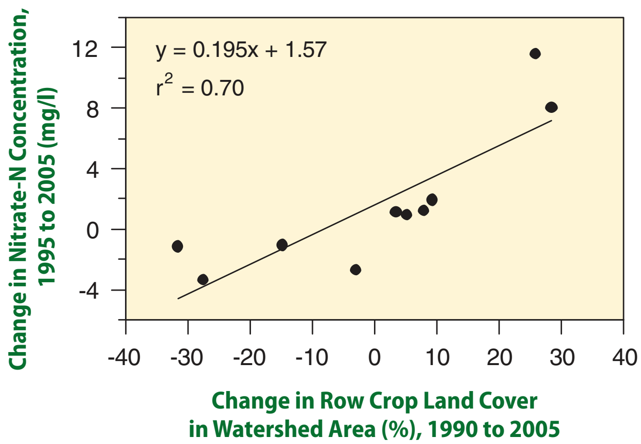


Figure 2. Relating Changes in Stream Nitrate Concentrations to Changes in Row Crop Land Cover in Walnut Creek, Iowa (Schilling and Spooner 2006)).

documented—the project was able to show not only that converting crop land to prairie reduced stream NO_3-N concentrations but also that increasing row crop land led to increased NO_3-N levels (Figure 2).

Modeling

When watershed management projects are guided or supported by modeling, knowledge of BMP depreciation should be part of model inputs and parameterization.

The magnitude of implementation (e.g., acres of treatment) and the spatial distribution of both annual and structural BMPs should be part of model input and should not be static parameters. Where BMPs are represented by pollutant reduction efficiencies, those percentages can be adjusted based on verification of land treatment performance levels in the watershed. Incorporating BMP depreciation factors into models might require setting up a tiered approach for BMP efficiencies (e.g., different efficiency values for BMPs determined to be in fair, good, or excellent condition) rather than the currently common practice of setting a single efficiency value for a practice assumed to exist. This approach could be particularly important for management practices such as agricultural nutrient management or street sweeping, in which degree of treatment is highly variable. For structural practices, a depreciation schedule could be incorporated into the project, similar to depreciating business assets. In the planning phase of a watershed project, multiple scenarios could be modeled to reflect the potential range of performance levels for BMPs already in place.

Recommendations

The importance of having accurate information on BMP depreciation varies across projects and during the timeline of a single project. During the project planning phase, when plans for the achievement of pollutant reduction targets rely heavily on existing BMPs, it is essential to obtain good information on the level of performance of the BMPs to ensure that plan development is properly informed. If existing BMPs are a trivial part of the overall watershed plan, knowledge of BMP depreciation might not be critical during planning. As projects move forward, however, the types of BMPs implemented, their relative costs and contributions to achievement of project pollutant reduction goals, and the likelihood that BMP depreciation will occur during the period of interest will largely determine the type and extent of BMP verification required over time. The following recommendations should be considered within this context:

- For improved characterization of overall baseline NPS loads, better identification of critical source areas, and more effective prioritization of new land treatment during project planning, collect accurate and complete information about:
    - Land use,

  - Land management, and
  - The implementation and operation of existing BMPs. This information should include:
    - Original BMP installation dates,
    - Design specifications of individual BMPs,
    - Data on BMP performance levels if available, and
    - The spatial distribution of BMPs across the watershed.
- Track the factors that influence BMP depreciation in the watershed, including:
  - Variations in weather that influence BMP performance levels,
  - Changes in land use, land ownership, and land management,
  - Inspection and enforcement activities on permitted practices, and
  - Operation, maintenance, and management of implemented practices.
- Develop and use observable indicators of BMP status/performance that:
  - Are tailored to the set of BMPs implemented in the watershed and practical within the scope of the watershed project's resources,
  - Can be quantified or scaled to document the extent and magnitude of treatment depreciation, and
  - Are able to be paired with water quality monitoring data.
- After the implementation phase of the NPS project, conduct verification activities to document the continued existence and function of implemented practices to assess the magnitude of depreciation and provide a basis for corrective action. The verification program should:
  - Identify and locate all BMPs of interest, including cost-shared, non-cost-shared, required, and voluntary practices;
  - Capture information on structural, annual, and management BMPs;
  - Obtain data on BMP operation and maintenance activities; and
  - Include assessment of data accuracy and confidence.
- To adjust for depreciation of land treatment, apply verification data to watershed project management and evaluation by:
  - Applying results directly to permit compliance programs,
  - Relating documented changes in land treatment performance levels to observed water quality,
  - Incorporating measures of depreciated BMP effectiveness into modeling efforts, and
  - Using knowledge of treatment depreciation to correct problems and target additional practices as necessary to meet project goals in an adaptive watershed management approach.

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