Technical Memorandum

To: Matt Drewitz
            Board of Water and Soil Resources

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            Houston Engineering, Inc.

Subject: PTMApp-Desktop BMP Suitability Enhancement

Date: February 8, 2018

Project: PTMApp Technical Support and Development (HEI ID 7775-010 Phase 013)
            SWIFT Contract No. 121193

BACKGROUND AND PURPOSE

On February 27, 2017, The State of Minnesota Commissioner of the Office of MN.IT (herein 'MN.IT') through the Board of Water and Soil Resources (BWSR) entered into an agreement with Houston Engineering, Inc. (HEI) to "provide enhancements to the software development (Prioritize, Target and Measure Application - PTMApp) in order to meet the needs of BWSR and local governments to coordinate conservation planning at Minnesota watershed scale." This contract was extended on June 30, 2017 with an expiration date of February 28, 2018. Revision 3, Clause 2, Item F of the June 30, 2017 extended contract stipulates HEI will complete tasks for the BWSR including "Enhancements to BMP suitability algorithms to incorporate Field Office Technical Guide criteria from USDA NRCS".

As partial fulfilment of this obligation, HEI developed this Technical Memorandum (TM) to summarize the technical changes made to the BMP Suitability module of PTMApp-Desktop and to provide application users with a guidance document to better understand the inherent functionality of the BMP Suitability module.

The BMP Suitability module develops geospatial products identifying potential locations on the landscape for the placement of Best Management Practices (BMPs). Technical changes made to this module were primarily related to the geospatial criteria used to identify where BMPs are technically feasible on the landscape. These criteria are applied to Geographic Information System (GIS) rasters and feature classes, which are either created as inputs by the user before running PTMApp-Desktop or are generated within the toolbar during its use. These rasters and feature classes include a raw digital elevation model (DEM) and its hydro-conditioned products (e.g. flow accumulation raster), land cover grid, and Soil Survey Geographic Database (SSURGO) soil inputs.

A literature review was conducted to determine applicability of existing BMP suitability criteria and to determine whether additional criteria were available to improve the identification of potential BMP locations. These changes were incorporated into the tool and the results are summarized in this TM and in changes to other supporting documentation, which can be found on the PTMApp-Desktop website's Documentation page: http://ptmapp.rrbdin.org/User/Documentation.

PTMAPP-DESKTOP BMP SUITABILITY REVIEW AND RESULTS

During the original development of PTMApp-Desktop, BMP suitability criteria were created to identify where within a watershed BMPs were considered technically feasible. This work was based on available data, primarily from the Natural Resource Conservation Service (NRCS) Field Office Technical Guide (FOTG) and other regional data sources. In the years since the original criteria were drafted, additional guidance materials have been developed, including (but certainly not limited to) the Minnesota Department of Agriculture's Agricultural BMP Handbook for Minnesota (Miller et al. 2012), the Minnesota Stormwater Manual (Minnesota Stormwater Manual Contributors 2017), and various publications from Iowa State's University's Ag Water Management Research Group (e.g. (Christianson et al. 2013)) regarding denitrifying bioreactors. In addition, NRCS have updated and/or refined many of their technical standards in their FOTG (e.g. denitrifying bioreactors standard, developed in 2015 ((Natural Resources Conservation Service 2015)).

Because of these changes, a review of existing literature regarding BMP suitability was necessary to determine: (1) if the existing criteria were still considered a technical standard for BMP implementation; and (2) whether additional criteria have been developed. New technical standards were scrutinized and, where their use could be substantiated, were incorporated as criteria into the BMP suitability module.

Table 1 shows the existing organization of BMPs in PTMApp-Desktop. For computational efficiency, BMPs are grouped based on the bio-physical process by which they provide treatment to remove sediment, total nitrogen (TN), total phosphorus (TP), and reduce peak discharge. Previously, BMP suitability provided only the treatment group feature class and underlying raster used to develop the feature class. The BMP raster (e.g. 'bmp_storage') is an amalgamation of individual BMP rasters (i.e., BMP types), developed based on a set of suitability criteria. Beginning with version 2.2.83 of the PTMApp-Desktop toolbar, users will have access to each of these individual BMP rasters (Table 1). These rasters are valuable to the local water quality practitioner because, for example, they can be used to identify a specific type of storage practice and are tied to the NRCS Practice Codes.

To help users better understand the changes to BMP Suitability, and to provide them with a pathway for comparing results generated on a previous version of the toolbar, the full list of current BMP suitability criteria, the BMP they are applied to, and whether they are included in previous versions of the toolbar is listed in Table 2.

Table 1: Prioritize, Target, and Measure Application for Desktop (PTMApp-Desktop) best management practice (BMP) treatment group feature classes and rasters generated during the BMP suitability module and exported to the output geodatabase.

Treatment Group Feature Classes and Rasters				Individual BMP Rasters	
Name	Group Code	Feature Class	Raster	BMP Type (NRCS Practice Code)	PTMApp Raster Name
Storage	1	storage	bmp_storage	WASCOB (638)	wascob_bin
				Drainage Water Management/Controlled Drainage (554)	drain_bin
				Farm pond/wetland (378, 657, 658, 659)	pond_bin
				Regional Pond/Wetland (656)	reg_wet_bin
				Regional Nutrient Reduction Wetland (656)	Nutr_wet_bin
Filtration	2	filtration	bmp_filtration	Grassed Waterway (412)	Gwater_bin
				Filter Strip (393)	filst_bin
Biofiltration	3	biofiltration	bmp_biofilt	Denitrifying Bioreactor (605)	Denit_bin
				Saturated Buffer (604)	SatBuff_bin
Infiltration	4	infiltration	bmp_infiltration	Multi-stage Ditch (N/A)	ditch2s_bin
				Infiltration Trench or Small Basin (N/A)	InfTrench_bin
Protection	5	protection	bmp_prot	Grade Stabilization (410)	protect_bin
				Grassed Waterway (412)	Gwater_bin
				Critical Planting Areas (342)	crit_plant_bin
				Shoreline Restoration/Protection (580)	shore_bin
Source Reduction	6	sourcereduction	bmp_sred	Cover Crops (340)	CovCrop_bin
				Perennial Crops (327)	peren_bin
				Nutrient Management of Groundwater for Nitrate (590)	NO3_bin

Table 2: Selection criteria applied in the Prioritize, Target, and Measure Application for Desktop's (PTMApp-Desktop) best management practice (BMP) suitability module for identifying BMP opportunities on the landscape. Specific criteria applied to PTMApp rasters and feature classes in toolbar versions 2.1.38 and earlier are listed in the 'Previous Geospatial Selection Criteria' column. A layman description of what these criteria mean is listed in the 'Selection Criteria Description' column. Similarly, when criteria were changed ('Selection Criteria Status' column = M) or new criteria were developed (Selection Criteria Status; column = N) in version 2.2.83 and later, the 'Changes to Geospatial Selection Criteria' column describes the specific criteria applied to each raster or feature class, while the 'Description of Changes to Selection Criteria' column describes in layman's terms what the criteria mean. Please note that not all the rasters or feature classes used in the BMP Suitability criteria are printed to the geodatabases in the output folder as they are intermediate products and are deleted once processing has completed.

PTMApp Treatment Group	BMP Name (NRCS practice code)	Previous BMP Suitability (v. 2.1.38 and earlier)		Current BMP Suitability (v. 2.2.83 and later)			Individual BMP Raster**
		Previous Geospatial Selection Criteria	Selection Criteria Description	Selection Criteria Status (Y/M/N)*	Changes to Geospatial Selection Criteria	Description of Changes to Selection Criteria	
Storage (Group Code = 1)	WASCOB (638)	sed_mass_fl_rk > 0.75	Accumulated sed. delivered to flowline percentile rank > 0.75	Y			wascob_bin
		fac_acres < 40	Contributing drainage area < 40 acres	Y			
		NLCD Value 82 = 1; all other values = 0	NLCD land cover must be Cultivated Crops	Y			
				N	SPI_ranks > 0.80	SPI percentile rank >0.80	
				N	V_hfacre_f3_n > 4356	Must have greater than 4,356 ft3 (0.1 ac-ft) upstream storage per WASCOB	
	Drainage Water Management/Controlled Drainage (554)	NLCD Value 82 = 1; all other values = 0	NLCD land cover must be Cultivated Crops	Y			drain_bin
		hyd_dem slope <= 1	Slope <= 1%	Y			
		ssurgo_hs = 1	Hydric soil	M	ssurgo_hs = 0	Non-hydric soil	
				N	ssurgo_dtgw >= 3	Depth to groundwater must be greater than or equal to 3 ft	
	Farm pond/wetland (378, 657, 658, 659)	Depressions = FillAll - Raw	Depressions determined from difference of FillAll and Raw DEMs	Y			pond_bin
		Con(max_depth > 'minfilldepth', dpr_1, 0))	User assigns value ('minfilldepth') for minimum depresional depth; In GIS this means any selected depression must have maximum fill depth of at least that number; PTMApp default = 0.5 ft. (0.15 m)	Y			
		Con(Lookup(dpr_grp, COUNT) > 'mindepthsurfacearea', 1, 0)	User assigns value ('mindepthsurfacearea') for minimum depresion surface area; PTMApp default = 1 acre	Y			

PTMApp Treatment Group	BMP Name (NRCS practice code)	Previous BMP Suitability (v. 2.1.38 and earlier)		Current BMP Suitability (v. 2.2.83 and later)			Individual BMP Raster**
		Previous Geospatial Selection Criteria	Selection Criteria Description	Selection Criteria Status (Y/M/N)*	Changes to Geospatial Selection Criteria	Description of Changes to Selection Criteria	
		SetNull (drp_nwi0, 1, 'Value=0')	If an NWI Wetland exists, null out any storage practice	Y			
				N	fac_acres < 500	Drainage area to depression less than 500 acres	
				N	Rat_10V_DeprV < 1	Depressional volume greater than 10yr 24hr design storm volume delivered to depression	
				N	Rat_Depr_DA >= 0.01	Depression's surface area must be larger than or equal to 1% of the drainage area to the depression	
	Regional Pond/Wetland (656)			N	Depressions = FillAll - Raw	Depressions determined from difference of FillAll and Raw DEMs	reg_wet_bin
				N	Con(max_depth > 'minfilldepth', dpr_1, 0))	User assigns value ('minfilldepth') for minimum depressional depth; In GIS this means any selected depression must have maximum fill depth of at least that number; PTMApp default = 0.5 ft. (0.15 m)	
				N	Con(Lookup(dpr_grp, COUNT) > 'mindepthsurfacearea', 1, 0)	User assigns value ('mindepthsurfacearea') for minimum depression surface area; PTMApp default = 1 acre	
				N	SetNull (drp_nwi0, 1, 'Value=0')	If an NWI Wetland exists, null out any storage practice	
				N	fac_acres > 500	Drainage area to depression greater than or equal to 500 acres	
				N	Rat_10V_DeprV < 1	Depressional volume greater than 10yr 24hr design storm volume delivered to depression	
				N	Rat_Depr_DA >= 0.01	Depression's surface area must be larger than or equal to 1% of the drainage area to the depression	
				N	Depressions = FillAll - Raw	Depressions determined from difference of FillAll and Raw DEMs	
	Regional Nutrient Reduction Wetland (656)			N	Con(max_depth > 'minfilldepth', dpr_1, 0))	User assigns value ('minfilldepth') for minimum depressional depth; In GIS this means any selected depression must have maximum fill depth of at least that number; PTMApp default = 0.5 ft. (0.15 m)	Nutr_wet_bin
				N	Con(Lookup(dpr_grp, COUNT) > 'mindepthsurfacearea', 1, 0)	User assigns value ('mindepthsurfacearea') for minimum depresion surface area; PTMApp default = 1 acre	
				N	SetNull (drp_nwi0, 1, 'Value=0')	If an NWI Wetland exists, null out any storage practice	
				N	P_less3ft >= 0.75	Standard #1: no more than 25% of the depressional pool area can have a depth greater than 0.9 m (0.75 ft)	
				N	Rat_Depr_DA >= 0.005 AND Rat_Depr_DA <= 0.02	Standard #2: depressional surface area must be between 0.5-2% of the drainage area to the depression	

| PTMApp Treatment Group | BMP Name (NRCS practice code) | Previous BMP Suitability (v. 2.1.38 and earlier) | | Current BMP Suitability (v. 2.2.83 and later) | | | Individual BMP Raster** |
		Previous Geospatial Selection Criteria	Selection Criteria Description	Selection Criteria Status (Y/M/N)*	Changes to Geospatial Selection Criteria	Description of Changes to Selection Criteria	
				N	fac_acres >= 494	Standard #3: drainage area to the depression must be larger than 200 hectares (494 acres)	
Filtration (Group Code = 2)	Grassed Waterway (412)	NLCD Value 82 = 1; all other values = 0	NLCD land cover must be Cultivated Crops	Y			Gwater_bin
		3% < slope < 12%	Slope of the individual raster cell must be between 3-12%	Y			
		Int expand for fac_acres VALUE > 1000	Using the Expand tool, if any cells within 50 m cells has drainage area > 1000 acres, remove cell from inclusion	Y			
		fac_acres < 7	Contributing drainage area < 7 acres	M	5 < fac_acres < 100	flow accumulation, or drainage area, to the cell must be between 5-100 acres	
				N	Apply Expand to 15 m	Apply Expand tool to make minimum width 15 m (100 ft; meeting typical installed width plus small buffer)	
				N	grp_code = 2	Grassed waterway BMP raster generated in both filtration (grp_code = 2) and protection (grp_code = 5) groups. User has the option to summarize results for this BMP in either group.	
	Filter Strip (393)	fac_acres < 124	Contributing drainage area < 124 acres	Y			filtst_bin
		NLCD Value 82 = 1; all other values = 0	NLCD land cover must be Cultivated Crops	Y			
		Sed_mass_fl_acc < 8.1	Sediment mass accumulated at the catchment outlet < 8.1 tons/year	Y			
		str_exp = 0 within 100 m of NHD Flow line OR fac_acres > 124	Exclude areas within 100 m of a channelized flowline (represented by NHD flowline)	M	str_exp = 1 within 33 m (108 ft) of fac_acres > 124	Changed to INCLUDE areas within 33 m of flowline where flowline defined as drainage area greater than 124 acres	
				N	slope > 1	slope greater than 1%	
Biofiltration (Group Code = 3)	Denitrifying Bioreactor (605)	NLCD Value 82 = 1; all other values = 0	NLCD land cover must be Cultivated Crops	Y			denit_bin
		slope < 1%	Slope of the individual raster cell must be less than 1%	M	Resample slope to 30m cell size AND apply Con(slope_cs_DB <= 1, 1, 0)	Used Resample operation to get average slope of cells in nearest 30 m; average must still be less than or equal to 1 for BMP consideration	

PTMApp Treatment Group	BMP Name (NRCS practice code)	Previous BMP Suitability (v. 2.1.38 and earlier)		Current BMP Suitability (v. 2.2.83 and later)			Individual BMP Raster**
		Previous Geospatial Selection Criteria	Selection Criteria Description	Selection Criteria Status (Y/M/N)*	Changes to Geospatial Selection Criteria	Description of Changes to Selection Criteria	
		hydric = 1	Must have hydric soil below BMP	M	(1) Con(IsNull(ssurgo_hs), 0, ssurgo_hs) AND (2) ssurgo_hs = 1	(1) When no hydric quality is available in the soil data, assume soil is non-hydric AND (2) only consider a bioreactor when soils are non-hydric	
				N	15 <= fac_acres <= 100	Drainage area to the bioreactor must be between 15 and 100 acres	
				N	Apply Expand to 15 m	Apply Expand tool to reach typical surface area of 0.25 acres	
	Saturated Buffer (604)	fac_acres > 124	Contributing drainage area > 124 acres	M	15 <= fac_acres <= 100	Drainage area to the practice must be between 15 and 100 acres	SatBuff_bin
		NLCD Value 82 = 1; all other values = 0	Must have Land Cover = Cultivated Crops	M	NLCD Value 11, 90, and 95 = 0; all other values = 1	Buffers can be placed on any land cover types with exception to open water and wetlands; oftentimes adjacent to fields on fallow ground	
		wtd_dpth_ft < 2	Depth to groundwater < 2 ft	M	(1) Con(IsNull(ssurgo_dtgw), 0, ssurgo_dtgw) AND (2) ssurgo_dtgw = 1	(1) When groundwater depth is unavailable in the soil data, assume depth is 0 AND (2) only consider a buffer when the depth to groundwater is less than or equal to 2 ft	
		dnr_str1 = 1 within 100 ft of NHD Flow line	Only want areas within 100 m of a channelized flowline (represented by NHD flowline)	M	str_exp_SB = 1 within 30 m (~100 ft) of fac_acres > 1000	Used flow accumulation grid instead of NDH flow network to define flowlines, assumed buffer would be within 30 m of perennial flowline (based on drainage area greater than 1000 acres)	
				N	1% < slope < 10%	Slope of the individual raster cell must be between 1-10%	
				N	grp_code = 3	Saturated buffer BMPs moved from the filtration group (grp_code = 2) to the biofiltration group (grp_code = 3)	
Infiltration (Group Code = 4)	Multi-stage Ditch (N/A)	NLCD Value 11, 90, 95 = 0; all other values = 1	Exclude open water and wetlands from consideration	Y			ditch2s_bin
		facgr1000_exp > 449667	Applies Expand tool to consider practice within 100 m of flowline	M	Apply Expand to 18 m on facgr1000ac	Apply Expand to within 18 m (~60 ft) of perennial flowline (defined by the flow accumulation grid (fac_total or fac_surf)	
		TwoStage_Rng < 3	Over 100 cell neighborhood, if range of DEM values is > 3, then exclude cell from analysis (i.e. if banks >10 ft., exclude from analysis)	M	Apply Expand to 18 m on facgr1000ac	100 cell neighborhood focal statistics calculation now only occurs within 18 m (~60 ft) of a perennial flowline (defined by fac_acres > 1000)	
				N	Null NWI raster (converted from polygon in base.gdb)	Exclude Multi-stage ditch placement over existing NWI wetlands	

PTMApp Treatment Group	BMP Name (NRCS practice code)	Previous BMP Suitability (v. 2.1.38 and earlier)		Current BMP Suitability (v. 2.2.83 and later)			Individual BMP Raster**
		Previous Geospatial Selection Criteria	Selection Criteria Description	Selection Criteria Status (Y/M/N)*	Changes to Geospatial Selection Criteria	Description of Changes to Selection Criteria	
	Infiltration Trench or Small Basin (N/A)			N	Resample slope to 10m cell size AND apply Con(slope_cs <= 1, 1, 0)	Used Resample operation to get average slope of cells in nearest 10 m; average must still be less than or equal to 1 for BMP consideration	InfTrench_bin
				N	(1) Con(IsNull(ssurgo_hsg), 0, ssurgo_hsg) AND (2) ssurgo_hsg <= 2	(1) When the hydrologic soil group is unavailable in the soil data, assume the soil is A (VALUE = 1) or B (Value = 2) AND (2) only consider a BMP when soils are soil groups A or B	
				N	NLCD Values 81 and 82 = 1; all other values = 0	NLCD land cover must be Cultivated Crops or Pasture	
				N	(1) Con(IsNull(ssurgo_dtgw), 1000, ssurgo_dtgw) AND (2) ssurgo_dtgw >= 3	(1) When groundwater depth is unavailable in the soil data, assume depth is 1000 AND (2) only consider a buffer when the depth to groundwater is greater than or equal to 3 ft	
				N	5 < fac_acres < 50	Drainage area to the BMP must be between 5 and 50 acres	
Protection (Group Code = 5)	Grade Stabilization (410)	NLCD Value 82 = 1; all other values = 0	NLCD land cover must be Cultivated Crops	Y			protect_bin
		SPI_ranks >= 0.50	SPI percentile rank must be greater than or equal to 0.50	Y			
				N	40 < fac_acres < 250	Drainage area to the BMP must be between 40 and 250 acres	
				N	slope >= 4	Slope of the individual raster cell must be greater than or equal to 4%	
				N	Mannings_Vel >= 4	Velocity of flow (estimated using Manning's equation) at the cell generated from the 2yr 24hr storm event must be greater than or equal to 4 ft/sec	
	Grassed Waterway (412)	NLCD Value 82 = 1; all other values = 0	NLCD land cover must be Cultivated Crops	Y	Rat_Depr_DA >= 0.005 AND Rat_Depr_DA <= 0.02	CREP Standard #2: depressional surface area must be between 0.5-2% of the drainage area to the depression	Gwater_bin
		3% < slope < 12%	Slope of the individual raster cell must be between 3-12%	Y	fac_acres >= 494	CREP Standard #3: drainage area to the depression must be larger than 200 hectares (494 acres)	
		Int expand for fac_acres VALUE > 1000	Using the Expand tool, if any cells within 50 m cells has drainage area > 1000 acres, remove cell from inclusion	Y			
		fac_acres < 7	Contributing drainage area < 7 acres	M	5 < fac_acres < 100	flow accumulation, or drainage area, to the cell must be between 5-100 acres	
				N	Apply Expand to 15 m	Apply Expand tool to make minimum width 15 m (100 ft; meeting typical installed width plus small buffer)	

PTMApp Treatment Group	BMP Name (NRCS practice code)	Previous BMP Suitability (v. 2.1.38 and earlier)		Current BMP Suitability (v. 2.2.83 and later)			Individual BMP Raster**
		Previous Geospatial Selection Criteria	Selection Criteria Description	Selection Criteria Status (Y/M/N)*	Changes to Geospatial Selection Criteria	Description of Changes to Selection Criteria	
				N	grp_code = 5	Grassed waterway BMP raster generated in both filtration (grp_code = 2) and protection (grp_code = 5) groups. User has the option to summarize results for this BMP in either group.	
	Critical Planting Areas (342)			N	NLCD Value 82 = 1; all other values = 0	NLCD land cover must be Cultivated Crops	crit_plant_bin
				N	SPI_ranks >= 0.50	SPI percentile rank must be greater than or equal to 0.50	
				N	5 < fac_acres < 100	flow accumulation, or drainage area, to the cell must be between 5-100 acres	
				N	Apply Expand to 10 m	Apply Expand 10 m (33 ft) to include typical buffer around planting area	
	Shoreline Restoration/Protection (580)			N	Apply Expand to 5 m of facgr1000ac AND TwoStage_Rng > 1.524	BMPS considered within 5 m of areas where bank heights are greater than 1.524 m (5 ft) on a perennial flowline (defined as drainage area of 1000 acres or more)	shore_bin
				N	Number of geoprocessing steps	BMPs considered within 100 ft of lakes (in lakes_route) and wetlands (from NWI in base.gdb)	
				N	NLCD Value 11, 90, and 95 = 0; all other values = 1	BMPs can be placed on any land cover types with exception to open water and wetlands; oftentimes adjacent to fields on fallow ground	
				N	SPI_ranks >= 0.80	SPI percentile rank must be greater than or equal to 0.80	
				N	Apply Expand to 5 m	Apply Expand 5 m (16 ft) to include typical buffer around planting area	
Source Reduction (Group Code = 6)	Cover Crops (340)	NLCD Value 82 = 1; all other values = 0	NLCD land cover must be Cultivated Crops	Y			CovCrop_bin
				N	fac_acres <= 640	No drainage pathways witihin practice larger then 640 acres (1 square-mile)	
	Perennial Crops (327)	NLCD Value 82 = 1; all other values = 0	NLCD land cover must be Cultivated Crops	Y			peren_bin
		ssurgo_cpi <= 61	crop productivity index must be below or equal to 61	M	(1) Con(IsNull(ssurgo_cpi), 0, ssurgo_cpi) AND (2) ssurgo_cpi <= 0.61	(1) When the crop productivity index is unavailable in the soil data, assume the index value is 0 AND (2) only consider a BMP when the index is equal to or below 0.61	
				N	fac_acres <= 640	No drainage pathways witihin practice larger then 640 acres (1 square-mile)	
				N	NLCD Value 82 = 1; all other values = 0	NLCD land cover must be Cultivated Crops	NO3_bin

PTMApp Treatment Group	BMP Name (NRCS practice code)	Previous BMP Suitability (v. 2.1.38 and earlier)		Current BMP Suitability (v. 2.2.83 and later)			Individual BMP Raster**
		Previous Geospatial Selection Criteria	Selection Criteria Description	Selection Criteria Status (Y/M/N)*	Changes to Geospatial Selection Criteria	Description of Changes to Selection Criteria	
	Nutrient Management of Groundwater for Nitrate (590)			N	fac_acres <= 640	No drainage pathways witihin practice larger then 640 acres (1 square-mile)	
				N	(1) Con(IsNull(ssurgo_dtgw), 1000, ssurgo_dtgw) AND (2) ssurgo_dtgw >= 10	(1) When groundwater depth is unavailable in the soil data, assume depth is 1000 AND (2) only consider a BMP when the depth to groundwater is greater than or equal to 10 ft	

* Y = Selection criteria continued to current toolbar version unchanged from previous versions; M = Modification made to previous criteria in current toolbar version; N = New criteria applied to current toolbar version which was not applied in previous versions

** Individual BMP rasters are now printed to the output tables processing geodatabase

The BMP Suitability criteria shown in **Table 2** are used to generate the individual BMP rasters, which are then combined to create the treatment group raster (e.g. bmp_storage). This raster is then converted to a polygon, dissolved, and with the use of the final screening criteria in **Table 3**, used to generate the final treatment group feature classes (e.g. storage). The screening criteria shown in **Table 3** are applied because many of the polygons created from the final raster are very small and not feasible for implementation.

Table 3: Final screening criteria used to create Prioritize, Target, and Measure Application for Desktop (PTMApp-Desktop) best management practice (BMP) treatment groups feature classes.

Treatment Group		Final Screening Criteria	
Name	Group Code	BMP Surface Area (acres)	BMP Drainage Area (acres)
Storage	1	>= 0.10	>= 1.00
Filtration	2	>= 0.33	>= 1.00
Biofiltration	3	>= 0.25	>= 1.00
Infiltration	4	>= 0.011	>= 1.00
Protection	5	>= 0.25	>= 1.00 AND <= 250.00
Source Reduction	6	>= 5.00	<= 640.00

PRACTICAL IMPLICATIONS

There are several practical implications of improving the BMP suitability module. One of the practical implications is that the potential locations identified by PTMApp–Desktop should better align with specific NRCS (and other) technical design criteria. Therefore, the number of BMPs inappropriately identified (i.e., false positives) should be reduced, providing greater confidence during use by local water quality practitioners. A second implication is related to the business needs of water quality practitioners. Decisions and communication surrounding the types of BMPs to implement are normally by NRCS practice code. Specific BMPs corresponding to these practice codes will now be available for use and can be displayed in maps. (Note: these data are not presently planned for display within PTMApp–Web, which will require use of ArcGIS software). The individual rasters for each BMP type will be saved within a file geodatabase. However, the benefits analysis will still be performed for each treatment group. Functionally, this means that all BMP types within a treatment

group will be combined and benefits results reported by treatment group. There will likely be future demand to complete benefits analysis by BMP type.

Users should expect significant differences in where BMP opportunities are located on the landscape when compared to previous analyses. BMP suitability criteria changes are summarized in **Table 2**. Examples are shown in **Figures 1** and **2** below for storage and protection practices, respectively, on a random field. These are the treatment groups that likely saw the greatest changes to their individual selection criteria. For storage, the routine to identify water and sediment control basins (WASCOBs) was completely rewritten and additional criteria were added to better identify depressions on the landscape for potential ponds and wetland restorations. This is evident in **Figure 1B**, where the depression was more accurately identified as compared to **Figure 1A,** and where WASCOB opportunities were identified on the flowline (fac_total) on the southern portion of the field. Similarly, a number of additional BMPs were added to the protection group, including critical area plantings and shoreline restorations. Existing BMP routines within the group were also refined to better characterize potential practice drainage area and width. **Figure 1B**, as compared to **Figure 1A**, demonstrates this difference, with implementable practice width better reflected and with a number of smaller, superfluous practices removed which were too small to actually be installed.

Lastly, it should be noted that the ability of PTMApp-Desktop to identify practical locations for BMP opportunities on the landscape is only as good as the quality of the input data used by the toolbar. These inputs, including land cover, SSURGO soils, and raw elevation data and its hydro-conditioned products (e.g. flow accumulation and slope), are what the BMP suitability criteria use to determine when a practice is feasible and what its potential location and extent may be. Errors in these data will likely be reflected in outputs from the PTMApp-Desktop toolbar. The user may need to consider improving or replacing these input data if they wish to better refine BMP suitability results.
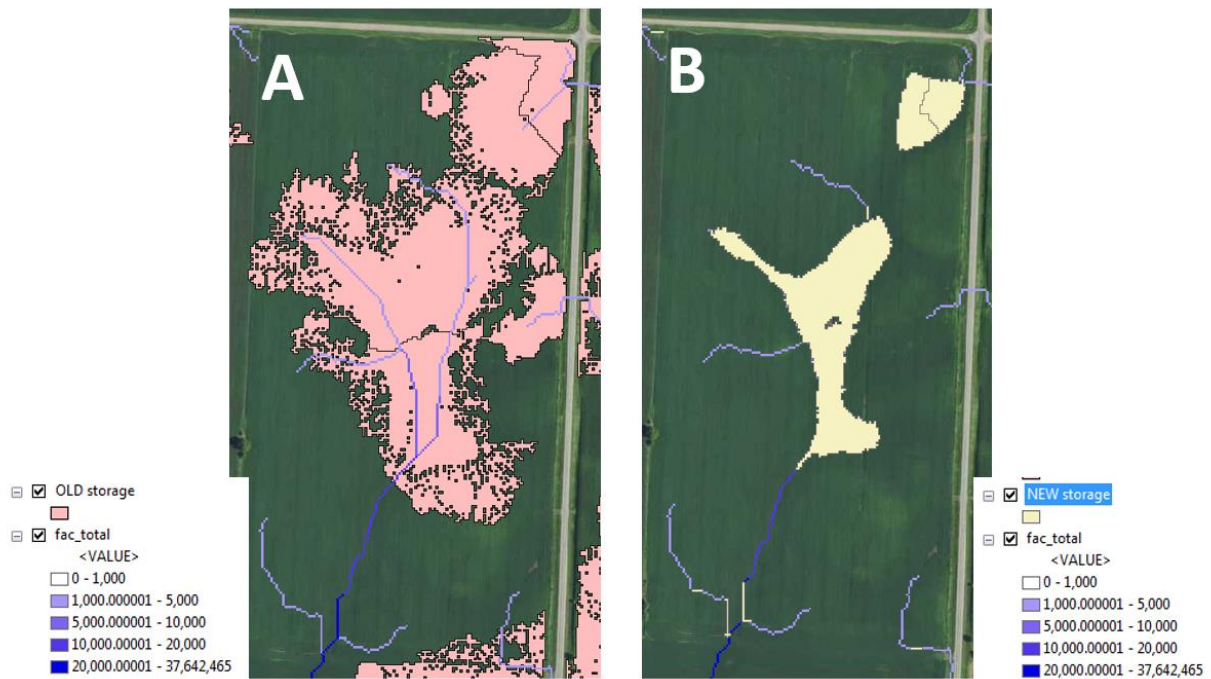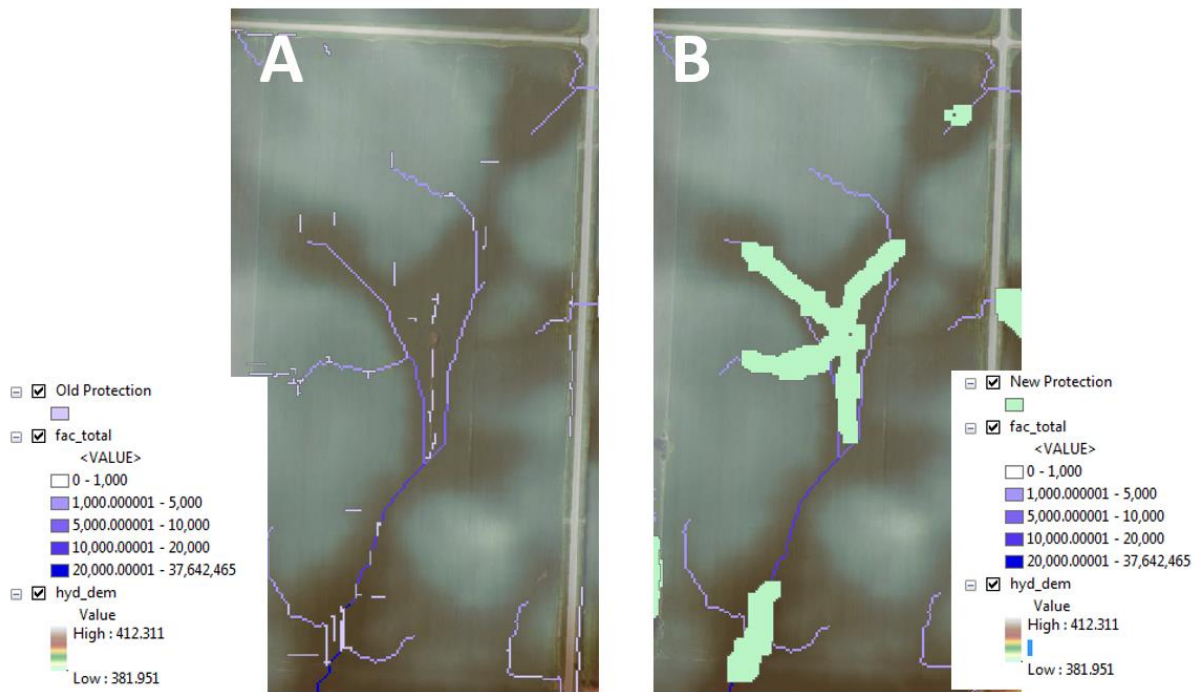
Figure 1: Illustration of changes to the Prioritize, Target, and Measure Application for Desktop (PTMApp-Desktop) Best Management Practice (BMP) suitability criteria for storage practices. The image on the left (A) shows the storage BMPs in red using the previous BMP suitability module, while the image on the right (B) shows the storage BMPs in beige using the new BMP suitability module. The fac_total raster displays the flow accumulation grid in each image.

Figure 2: Illustration of changes to the Prioritize, Target, and Measure Application for Desktop (PTMApp-Desktop) Best Management Practice (BMP) suitability criteria for protection practices. The image on the left (A) shows the protection BMPs in purple using the previous BMP suitability module, while the image on the right (B) shows the protection BMPs in green using the new BMP suitability module. The fac_total raster displays the flow accumulation grid in each image. Hyd_dem shows the hydro-modified digital elevation model (DEM) in meters.

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