Methods for Completing Quality Assurance & Quality Control of Prioritize, Target and Measure Application (PTMApp) Products

Several Geographic Information System (GIS) inputs are required and outputs created from the Prioritize, Target and Measure Application Desktop (PTMApp-Desktop) toolbar. Ensuring quality products can be challenging and requires time to manually and visually evaluate the inputs and output products. Completing some level of quality assurance and quality control (QA/QC) review is therefore necessary. This document provides guidance on recommended values for inputs and outputs generated in the State of Minnesota. Often, a QA/QC review consists of plotting or charting histograms or generating descriptive statistics of raster or feature class attribute values. These can be summarized and the minimum and maximum values evaluated to determine whether there are outliers.

The Clip Watershed tool now has internal checks to ensure input raster data meets PTMApp-Desktop's formatting requirements, as well as fits within the expected values for data in the State of Minnesota. The Clip Watershed tool will create a text file when the input data does not meet the requirements as listed in the table below.

PTMApp-Desktop Input Data Name	Suggested Check	Clip Watershed Tool - Input Check
curve_num	Most values generally > 50. Reasonable range is 30-100. Refer to SCS Curve Number tables for more detail.	Values 0-100
ds_tt	Values will vary depending upon the size of the study area. Furthest upstream areas should contain the highest values	Pixel type = 32 bit floating point
rusle_c	Recommend using LULC lookup table in PTMApp documentation unless better local knowledge exists	Pixel type = 32 bit floating point Values between 0-0.20
rusle_kw	Based upon SSURGO data, typically between 0 and 0.43 but can be as high as 0.60	Pixel type = 32 bit floating point Values between 0-0.43
rusle_m	Values typically set to 1. Can be adjusted based upon local knowledge	Values between 0-1

PTMApp-Desktop Input Data Name	Suggested Check	Clip Watershed Tool - Input Check
rusle_p	Values typically set to 1. Can be adjusted based upon local knowledge	Values between 0-1
rusle_r	Values should range from 50 to 150.	Pixel type = 32 bit floating point
		Values between 50-150
ssurgo_cpi	Values should range from 0 to 100	Values between 0-100
ssurgo_dtgw	Values should range from 0 to > 200	Values between 0-300
ssurgo_hs	Values should be 1 or 0 with 1s representing areas on the landscape with a hydric soil rating	Values 0 or 1
tt_grid	Values should range from > 0 to < 149	Pixel type = 32 bit floating point
		Values between 0-149
us_tt	Values will vary depending on the size of the study area. Largest values should be at the furthest downstream point	Pixel type = 32 bit floating point

Listed in the table below are the recommended checks for PTMApp outputs. Many of these have been coded into the tools, such that a text file will be printed alerting the user when the data range or average value of the dataset does not meet the expected values. These checks are in their testing phase, and may not be operational in all cases. The internal checks currently coded into PTMApp should not replace a thorough review of data generated by the PTMApp modeler.

Outputs Data Name	Suggested Checks
adj_catchment	• catch_id in adj_catchment attribute table should match catch_id of catchment attribute table for the catchment contained within the adjoint catchment's furthest downstream point.

Outputs Data Name	Suggested Checks
bmp_biofilt	• A value of 1 indicates a biofiltration BMP is suitable for the area based on the criteria. Check to see that areas with a value of 1 seem reasonable for a potential BMP and that areas with a value of 0 do not miss opportunities for potential BMPs.
bmp_filtration	• A value of 1 indicates a filtration BMP is suitable for the area based on the criteria. Check to see that areas with a value of 1 seem reasonable for a potential BMP and that areas with a value of 0 do not miss opportunities for potential BMPs.
bmp_infiltration	• A value of 1 indicates an infiltration BMP is suitable for the area based on the criteria. Check to see that areas with a value of 1 seem reasonable for a potential BMP and that areas with a value of 0 do not miss opportunities for potential BMPs.
bmp_prot	• A value of 1 indicates a protection BMP is suitable for the area based on the criteriaCheck to see that areas with a value of 1 seem reasonable for a potential BMP and that areas with a value of 0 do not miss opportunities for potential BMPs.
bmp_sred	• A value of 1 indicates a source reduction BMP is suitable for the area based on the criteria. Check to see that areas with a value of 1 seem reasonable for a potential BMP and that areas with a value of 0 do not miss opportunities for potential BMPs.
bmp_storage	• A value of 1 indicates a storage BMP is suitable for the area based on the criteria. Check to see that areas with a value of 1 seem reasonable for a potential BMP and that areas with a value of 0 do not miss opportunities for potential BMPs.
bmp_user	• A value of 1 indicates the potential for a BMP. Check to see that areas with a value of 1 seem reasonable for a potential BMP and that areas with a value of 0 do not miss opportunities for potential BMPs.
catchment	• Catchments should be 40 acres in area on average • A few in-channel catchments maybe > 200 acres • The entire extent of your study area should be covered by catchments, unless fac_surf and fdr_surf files were ingested.

Outputs Data Name	Suggested Checks
catchmentraster	• Raster values should match the catch_id field in the catchment attribute table • Catchment boundaries should match the boundaries between different cell values.
cti	• Depressional areas on the landscape should have the highest values.
ds_fl	• Values will vary depending upon the size of the study area. Furthest upstream areas should contain the highest values. The change in value between cells should correlate to the cell size dimension or the square root of the sum of the squares ($\sqrt{x^2 + y^2}$).
filtration	• Polygons should overlap locations in bmp_filtration that contained a value of 1 and be located portions of the landscape suitable for filtration BMPs based on the criteria.
ls_factor	• Should be from 0.03 to 52.7 and larger along steeper slopes.
overland_sdr	• Values should be between 0-1 and larger near catchment outlets.
p_res_catchment	• Check to see that each point feature in the p_res_pts layer has an upstream contributing area delineated in this file.
p_res_snap	• Check to see that the cells in this file are aligned with the cells from the input hyd_dem and are snapped to a major flowline.
PeakQ_10yr	• Check to see that 10 year peak is reasonable relative to gage data
PeakQ_2yr	• Check to see that 2 year peak is reasonable relative to gage data
RO_vol_10yr	• Multiplying the value in the runoff_depth_10yr raster by the upstream contributing area should match the raster cell values in this output
RO_vol_2yr	• Multiplying the value in the runoff_depth_2yr raster by the upstream contributing area should match the raster cell values in this output
runoff_depth_10	• All values should be < than the depth of the input precipitation depth which is listed in the processing results. Values can be verified using the SCS runoff depth equation.
runoff_depth_2	• All values should be < than the depth of the input precipitation depth which is listed in the processing results. Values can be verified using the SCS runoff depth equation.

Outputs Data Name	Suggested Checks
sed_mass	• Flat areas should generally have values < 5 tons/acre with most values falling below <2 tons/acre • Should notice increase in value as slope and flow length increase. • Values should generally stay under <50 tons/acre • Will be some exceptions (Values > 500 tons/acre) due to outliers in LS factor
sed_mass_fl	• Values should be reduced relative to sed_mass by the overland_sdr value
sed_mass_fl_acc	• Values should steadily increase as you move downstream.
sed_mass_fl_rank	• Values should be between 0 to 1 with higher values in sed_mass_fl receiving higher ranks
sed_mass_raw	• This should only differ from the sed_mass raster if a calibration factor was used
spi	• Areas with high slopes and large contributing areas should have the highest values. Those areas receiving highest values are relative to the study area
spi_ranks	• Values should be between 0 and 1. Areas with the highest spi values should have the highest spi_ranks
table_adj_catchment	• Find the furthest downstream points of an adjoint catchment near a water quality monitoring gage and compare sediment_sum, tn_sum, and tp_sum estimates to the monitoring data or comparable literature yield values. Estimates should be reasonable approximates of the monitoring data.
table_adj_catchment_route	• A catchment might contribute to multiple downstream adjoint catchments. Loads for downstream adjoint catchments should be < loads delivered to the catchment outlet. Loads from a catchment delivered to a further downstream adjoint catchment should be lower that loads delivered to an adjoint catchment further upstream. • The 'delta_tt' field should increase for catchments further upstream in an adjoint catchment. • The '_delivery_ratio' fields should decrease for catchments further upstream in an adjoint catchment.
table_ba_bmp_all	• Check to see that values are reasonable in the attribute table.
	• R_10yr24hr and R_2yr24hr should be between 0-1.

Outputs Data Name	Suggested Checks
	• SQ2, PQ2, NQ2, etc… should be between 0-1.
	• C_SQ2_10 should be > C_SQ2_02. Same for other similar attributes. Mass reductions should make sense.
table_BA_BMP_All_Catchment	• There should not be more than 1 treatment group record per catchment. Each catchment containing an opportunity for a BMP should have load reduction estimates to all downstream priority resource points.
table_ba_load_red	• Each record should have load reduction estimates to all downstream priority resource points. Load reduction estimates should not be > load reduction estimates to the catchment outlet.
table_ca_bmp_costeff	• Missing qa/qc description
table_catchment	• The tn_mass_lbs, tp_mass_lbs, and sed_mass_lbs fields should contain should contain summed values from the corresponding 'mass' rasters. • The tn_mass_fl_lbs, tp_mass_fl_lbs, and sed_mass_fl_lbs fields should all contain values similar to those found in the corresponding 'fl' raster data • The '_acres' fields are yields/acre and should reflect the values used to develop the tn, tp, and sed 'mass' rasters. • 'depth' and 'RO_vol' field values should correspond to the rainfall depth and RO_vol rasters. • The PeakQ fields should correspond to the calculated maximum peak discharge in the PeakQ rasters.
table_p_res_catchment	• Find the furthest downstream points of a priority resource catchment near a water quality monitoring gage and compared sediment_sum, tn_sum, and tp_sum estimates to the monitoring data. Estimates should be reasonable approximates of the monitoring data
table_p_res_catchment_route	• A catchment might contribute to multiple downstream priority resources. Loads for downstream priority resources should be < loads delivered to the catchment outlet. Loads from a catchment delivered to a further downstream priority resource should be lower than loads delivered to a priority catchment further upstream.
table_r_catchment	• Rank values should be between 0 and 1. Ideally the distribution of the ranks will approximately fit a bell curve.

Outputs Data Name	Suggested Checks
table_r_p_res_catchment	• Each catchment should have rank values for all downstream priority resource points. Ranks should be between 0 and 1. Ideally the distribution of the ranks will approximately fit a bell curve.
table_scaled_load	• All catchments within the drainage area of the scaled load point or model polygon should have a record in this table with a revised loading value that sums to the inputted scale load.
table_treat	• Each treatment group should have a record in this table and data for sediment, TN, and TP. Values can be edited if users have better data on BMP efficiencies.
table_treat_train_catch	• Table should contain median load reductions to the catchment outlet for 2 year and 10 year events for all catchments where BMP opportunities were present. These load reductions should not be > the load deliveries in table_catchment
table_treat_train_p_res	• Table should contain median load reductions to the all downstream priority resource points for each catchment for 2 year and 10 year events for all catchments where BMP opportunities were present. These load reductions should not be > the load deliveries in table_catchment
TN_mass	• Values should be TN_mass > TN_mass_fl and range from just of 1 to just over 16 lbs/acre
TN_mass_fl	• Values should be TN_mass > TN_mass_fl. Values should be within a reasonable range of observed yields in your study area.
TN_mass_fl_acc	• Values should increase towards the outlet of each catchment
TP_mass	• Values should be TP_mass > TP_mass_fl and should range from 0 to just over 1.3 lbs/acre
TP_mass_fl	• Values should be TP_mass > TP_mass_fl. Values should be within a reasonable range of observed yields in your study area.
TP_mass_fl_acc	• Values should increase towards the outlet of each catchment
tt_overland	• Values generally range from 0 to < 25 hrs and decrease towards the catchment outlet
us_fl	• Values will vary depending on the size of the study area. Largest values should be at the furthest downstream point
WQI_mass_fl_rank	• Values should range between 0 to 1. Areas with the highest TP, TN, and sediment values for delivery to flowline, should have the highest ranks.

Outputs Data Name	Suggested Checks
WQI_mass_rank	• Values should range between 0 to 1. Areas with the highest TP, TN, and sediment yields (not delivered downstream), should have the highest ranks.