Macatawa Watershed Critical Area Analysis for Restoration

Prepared for the Macatawa Area Coordinating Council

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Introduction:

Fishbeck, Thompson, Carr & Huber, Inc. (FTC&H) was retained to perform a critical area analysis for restoration for use in the Macatawa Watershed Management Plan (WMP). The Macatawa Area Coordinating Council (MACC) has collected many valuable mapping datasets on the watershed through its past and current watershed planning efforts. Much of this data is available in Geographic Information Systems (GIS) digital format and has been referenced to a common geographic base map. For this critical area analysis, these documented GIS datasets have been compiled and further processed in order to identify and prioritize critical urban and agricultural areas for restoration in the Watershed. The results will be used by the MACC to propose areas for urban and agricultural Best Management Practices in the WMP.

The Watershed was delineated into 55 subbasins by MDEQ for use in MACC Hydrologic Study. This analysis uses the subbasins as its unit of comparison to rank and prioritze critical areas for restoration. ESRI ArView geoprocessing tools were used to intersect data layers and calculate subbasin Priority Score (PS) values representing the various analysis criteria.

A set of rating criteria was evaluated for the entire Watershed using GIS data layers obtained from previous studies and segments of the WMP. Rating criteria include land use, soils, location of watercourses, road-stream crossings, surface runoff, pollutant loading, soil suitability for septic systems, and wetland loss. Some criteria were used in either the agricultural or urban critical analysis while others were used in both sets of analysis. In addition, several criteria were considered to have a greater influence on identifying the need for restoration. These criteria were “double weighted”, their scores were given twice the weight as the remaining criteria in calculating the total PS for a subwatershed.

Priority Score Criteria:

The following figures illustrate the subbasin characteristics and break down of classifications used to assign PS values for each set of rating criteria. Abbreviations noted within parenthesis, for example (PCT_AGR), represent attribute table field names used in the map layer ESRI shapefile. Refer to Tables 1, 2 and 3 for PS values assigned to each classification.

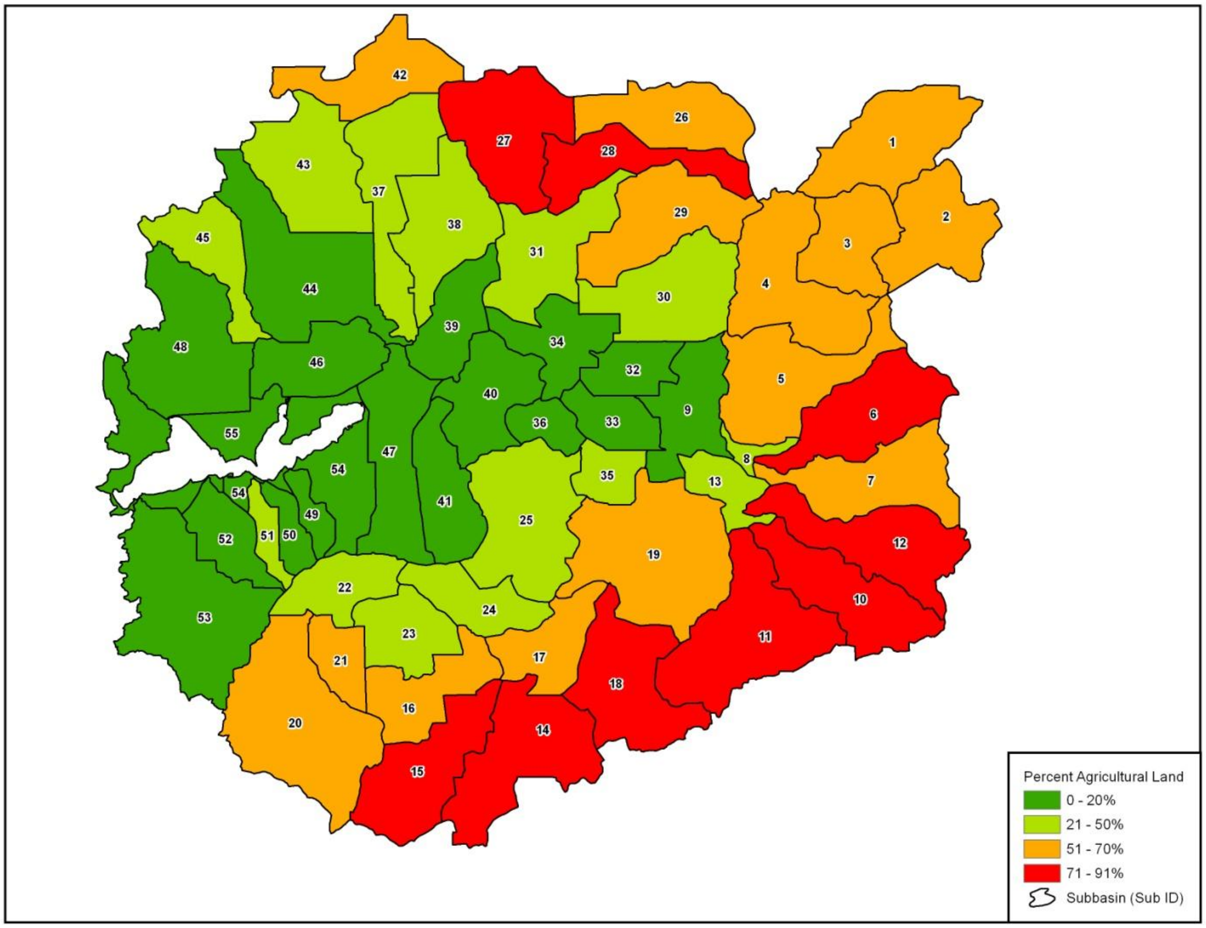

Figure 1 - Percent Agricultural Land
Used in Agricultural Critical Area Analysis

Data Source: 2009 Land Use/Land Cover for the MACC.
Process:

Selection of Level 1 Description = Agricultural.
Intersect agricultural land with subbasins.
Create field and calculate area of agricultural land for each subbasin.
Calculate percent agricultural land by subbasin (PCT_AGR).
Assign priority score for percent agricultural land by subbasin (AGR_PS).

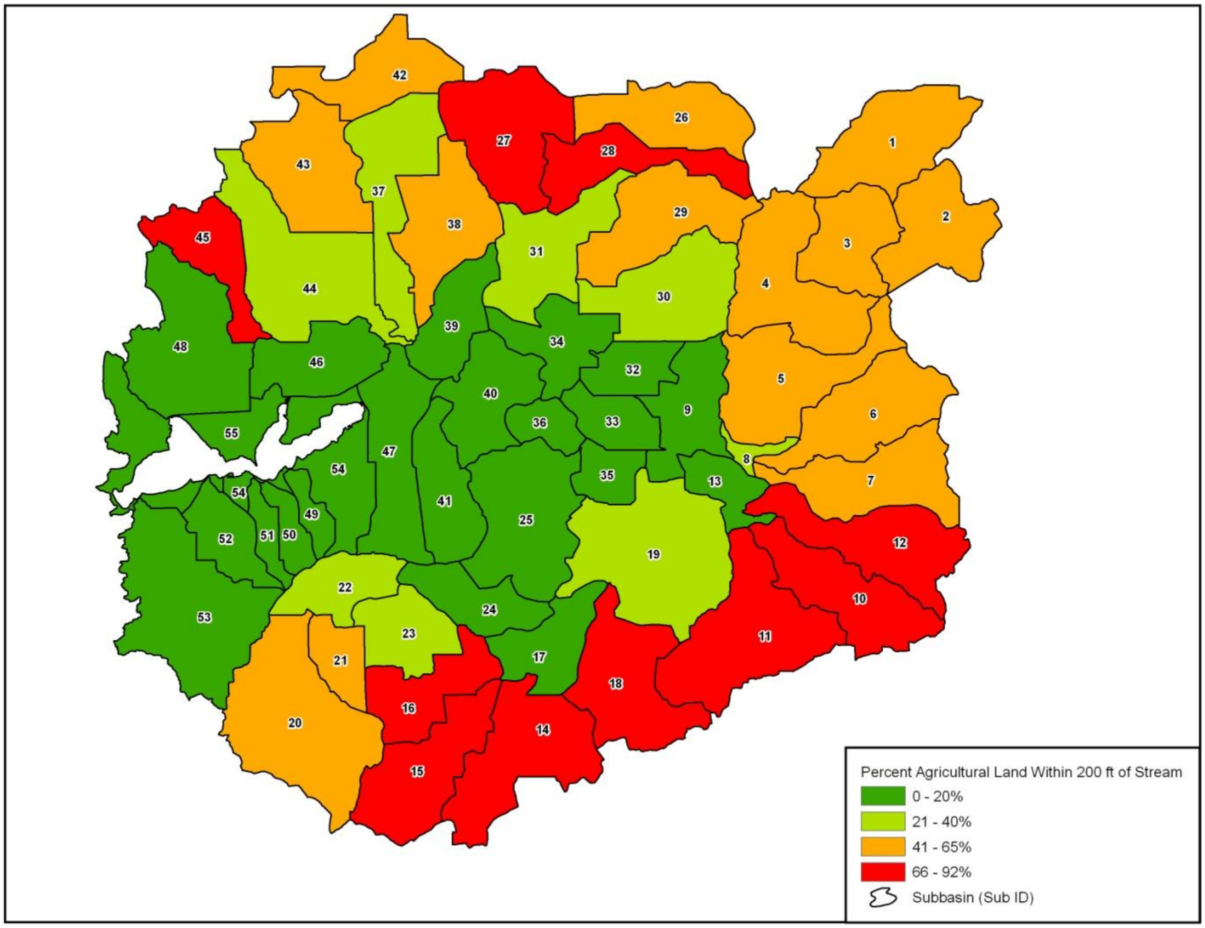

Figure 2 - Percent Agricultural Land Within 200 ft of Stream
Used in Agricultural Critical Area Analysis

Data Source: 2009 Land Use/Land Cover for the MACC and State of Michigan Framework Hydrography.
Process:

Selection of Level 1 Description = Agricultural.
Intersect agricultural land with subbasins.
Buffer streams represented by hydrography line layer 200 ft each side.
Intersect agricultural land with stream buffer.
Create field and calculate area of 200 ft buffer for each subbasin.
Create field and calculate area of agricultural land within 200 ft buffer for each subbasin.
Calculate percent agricultural land within 200 ft buffer by subbasin (PCT_AGR200).
Assign priority score for percent agricultural land within 200 ft buffer by subbasin (AGR200_PS).

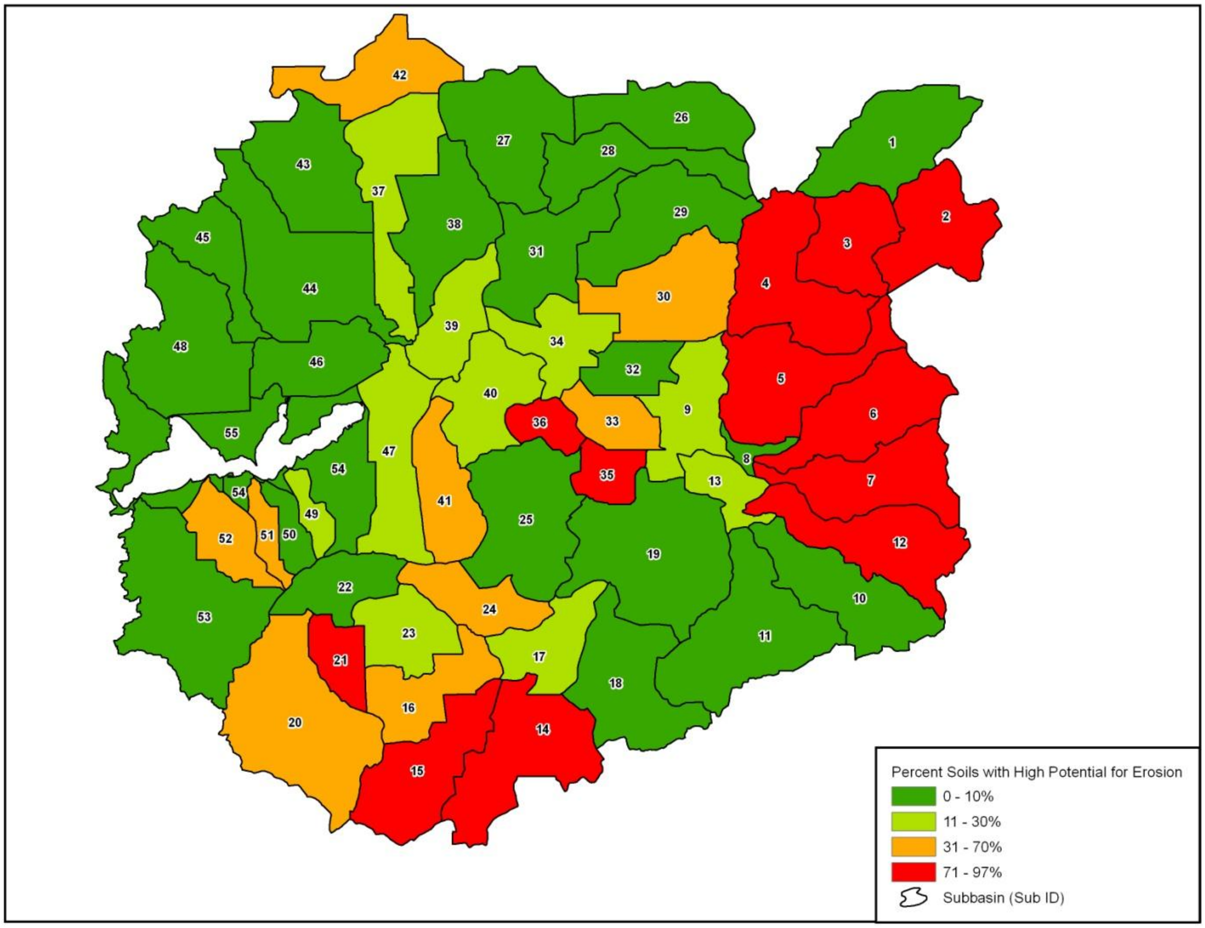

Figure 3 – Percent Soils with High Potential for Erosion
Used in Agricultural Critical Area Analysis

Data Source: USDA Natural Resources Conservation Service SSURGO Soil Survey
Process:

Selection of highly erodible soils per NRCS, kffact >= 0.20.
Intersect erodible soils with subbasins.
Create field and calculate area of erodible soils for each subbasin.
Calculate percent soils with high potential for erosion by subbasin (PCT_EROD).
Assign priority score for percent soils with high potential for erosion by subbasin (EROD_PS).

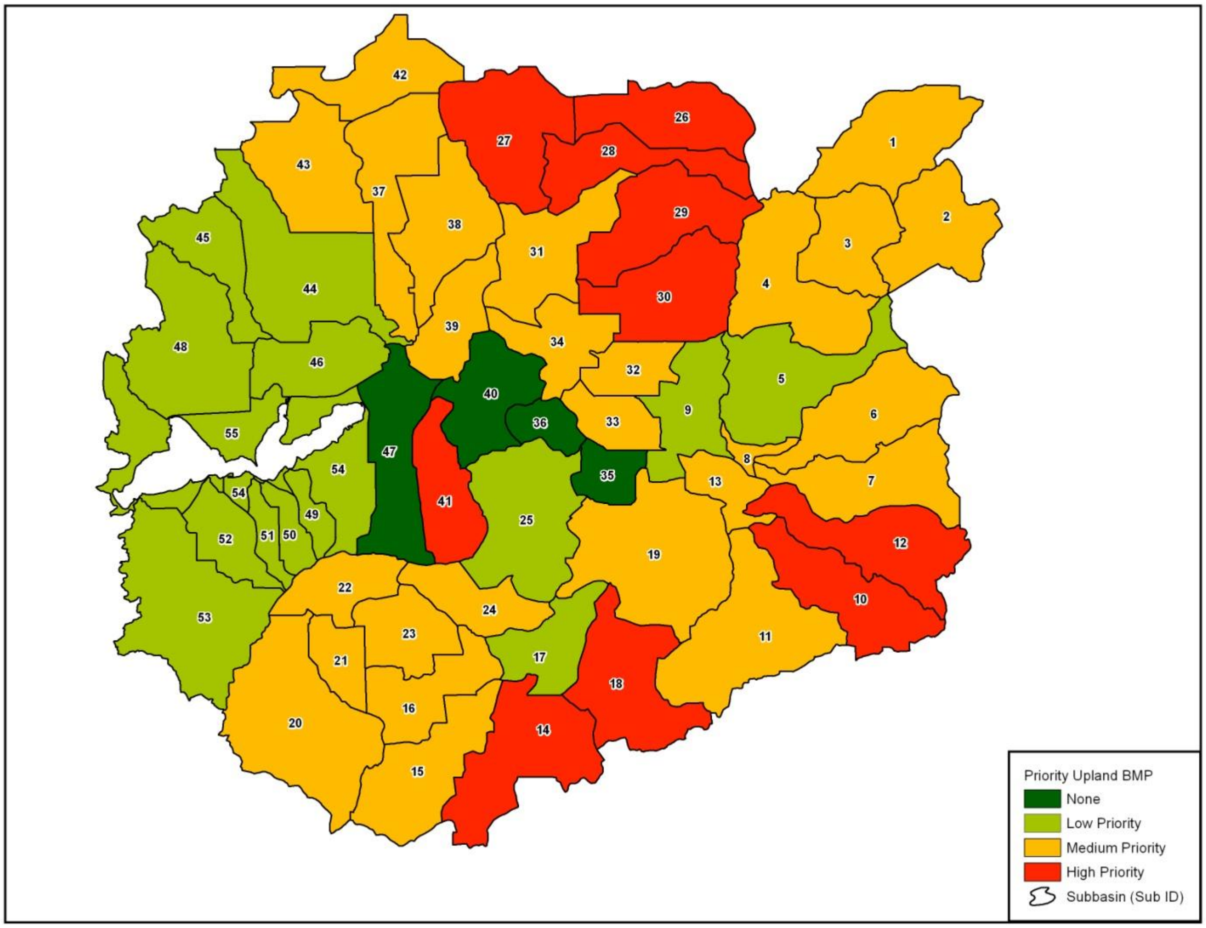

Figure 4- Priority Upland BMP
Used in Agricultural Critical Area Analysis

Data Source: MACC Geomorphology Report 2011.
Process:

Import priority upland BMP stream classification from Geomorphology Report.

Create field and populate for upland BMP based on classification determined for majority of stream length within each subbasin (UPLAND_BMP).

Assign priority score for upland BMP based on stream classifications (UPBMP_PS).

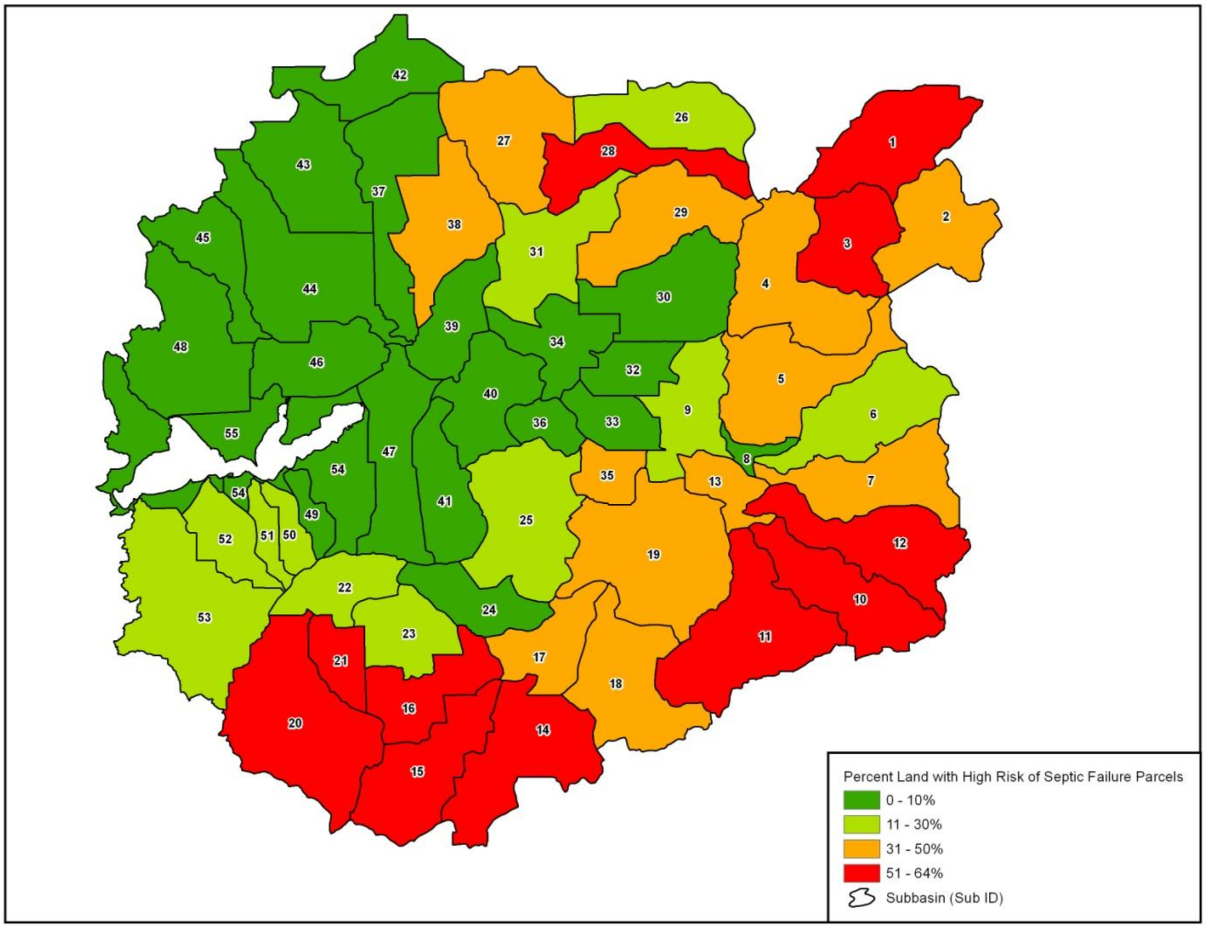

Figure 5 - Percent Land with High Risk of Septic Failure Parcels
Used in Agricultural Critical Area Analysis

Data Source: MACC Septic Priority Inventory Project to indentify parcels in high risk soils areas within 30 meters of watercourses.
Process:

Intersect high risk of septic failure parcels with subbasins.
Create field and calculate area of high risk of septic failure parcels for each subbasin.
Calculate percent high risk of septic failure parcels by subbasin (PCT_SEPRSK).
Assign priority score for percent high risk of septic failure parcels by subbasin (SEPRSK_PS).

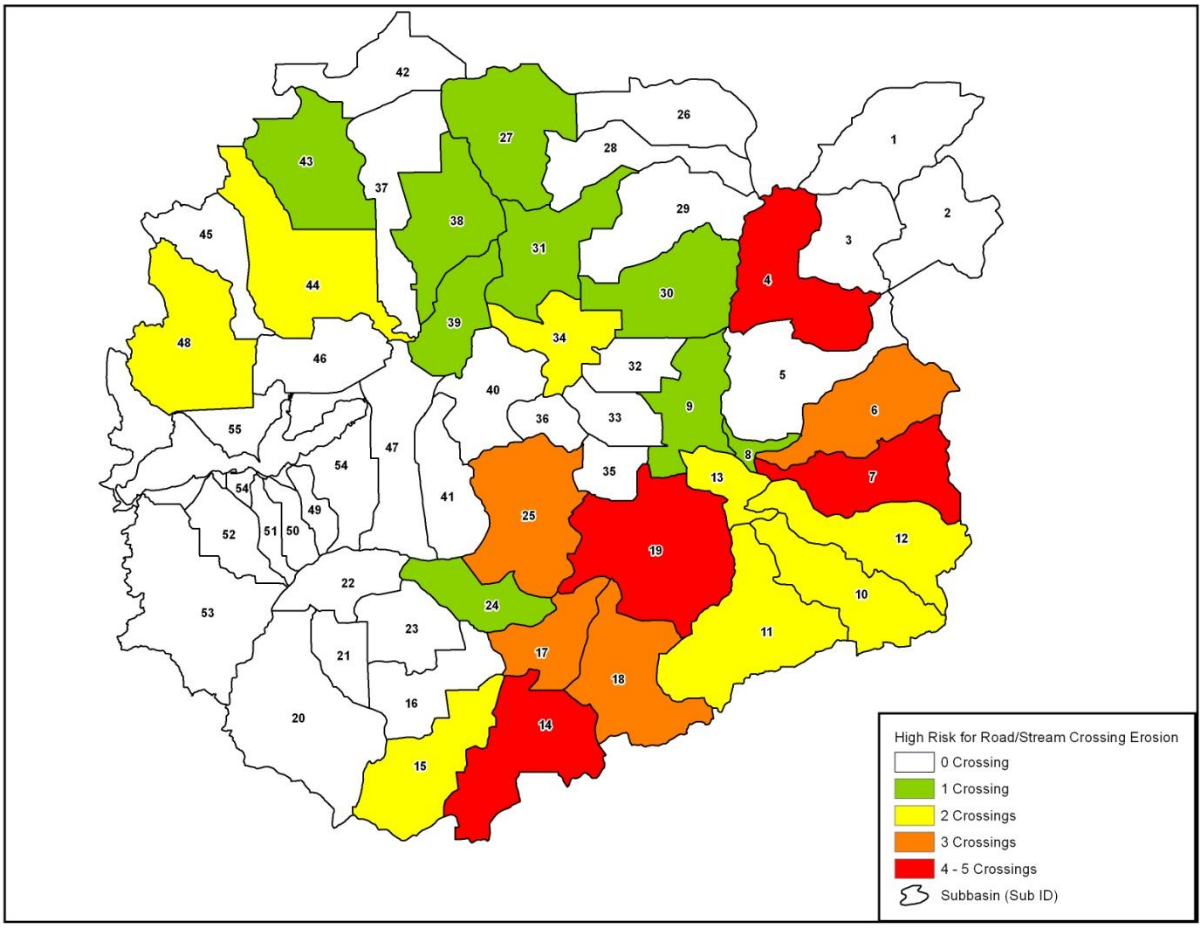

Figure 6 - High Risk for Road/Stream Crossing Erosion
Used in Agricultural and Urban Critical Area Analysis

Data Source: MACC Road and Stream Crossings 2009. To identify stream bank erosion risk from BEHI survey locations.
Process:

Intersect Michigan Framework roads and stream hydrography layer to create point layer for road stream crossings within the Watershed .

Create field and populate with BEHI erosion risk classifications Low, Medium and High, or N/A for crossings that were not evaluated.

Create field for number of crossings located within subbasin that are identified as either Medium or High risk for erosion (XING_EROS).

Assign priority score based on number of high risk erosion road crossings by subbasin (XING_PS).

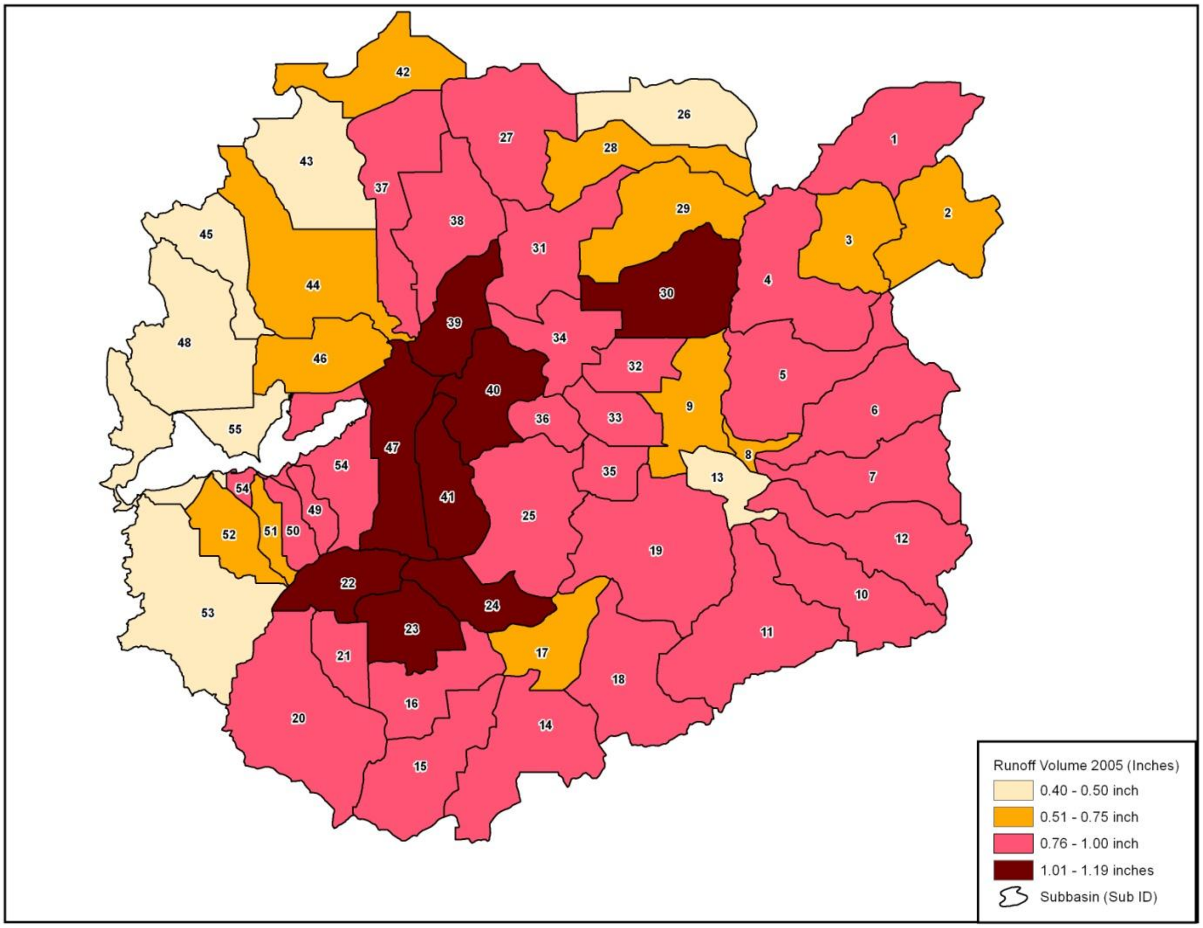

Figure 7 - Runoff Volume
Used in Agricultural and Urban Critical Area Analysis

Data Source: MACC Hydrology Report 2010- MDEQ
Process:

Create field for runoff volume and populate with data from Hydrology Report (RUNOFF_IN).
Assign priority score based on classifications of runoff volume by subbasin provided in Hydrology Report (RUNOFF_PS).

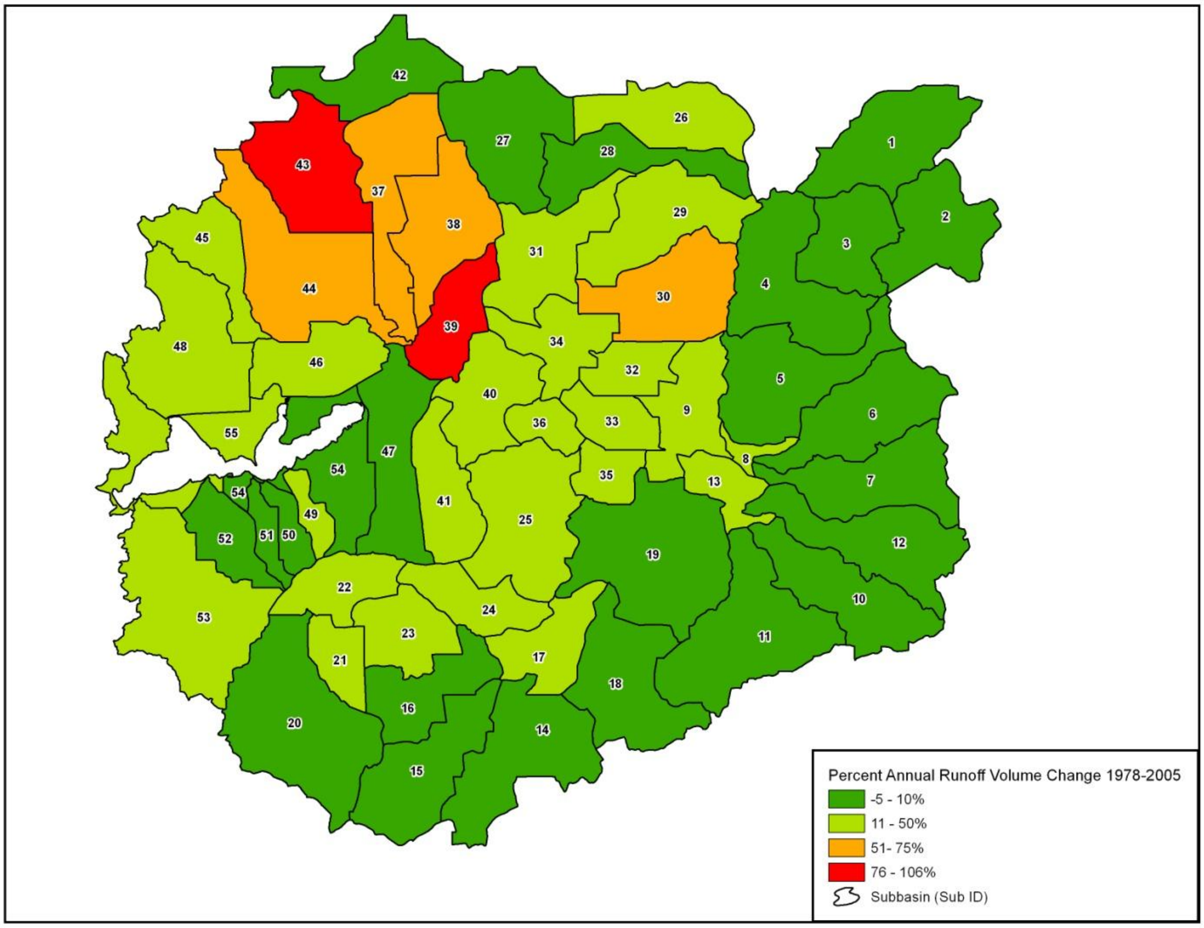

Figure 8 – Percent Runoff Volume Change 1978-2005
Used in Agricultural and Urban Critical Area Analysis

Data Source: Macatawa Watershed Modeled Pollutant Loads 2009 - MDEQ
Process:

> Create field for change in runoff volume from 1978 to 2005 based on land cover and populate with data from Pollutant Loading Report (ROIN_78_05).
> Assign priority score based on classifications of increase in runoff volume by subbasin provided in Pollutant Loading Report (RO7805_PS).

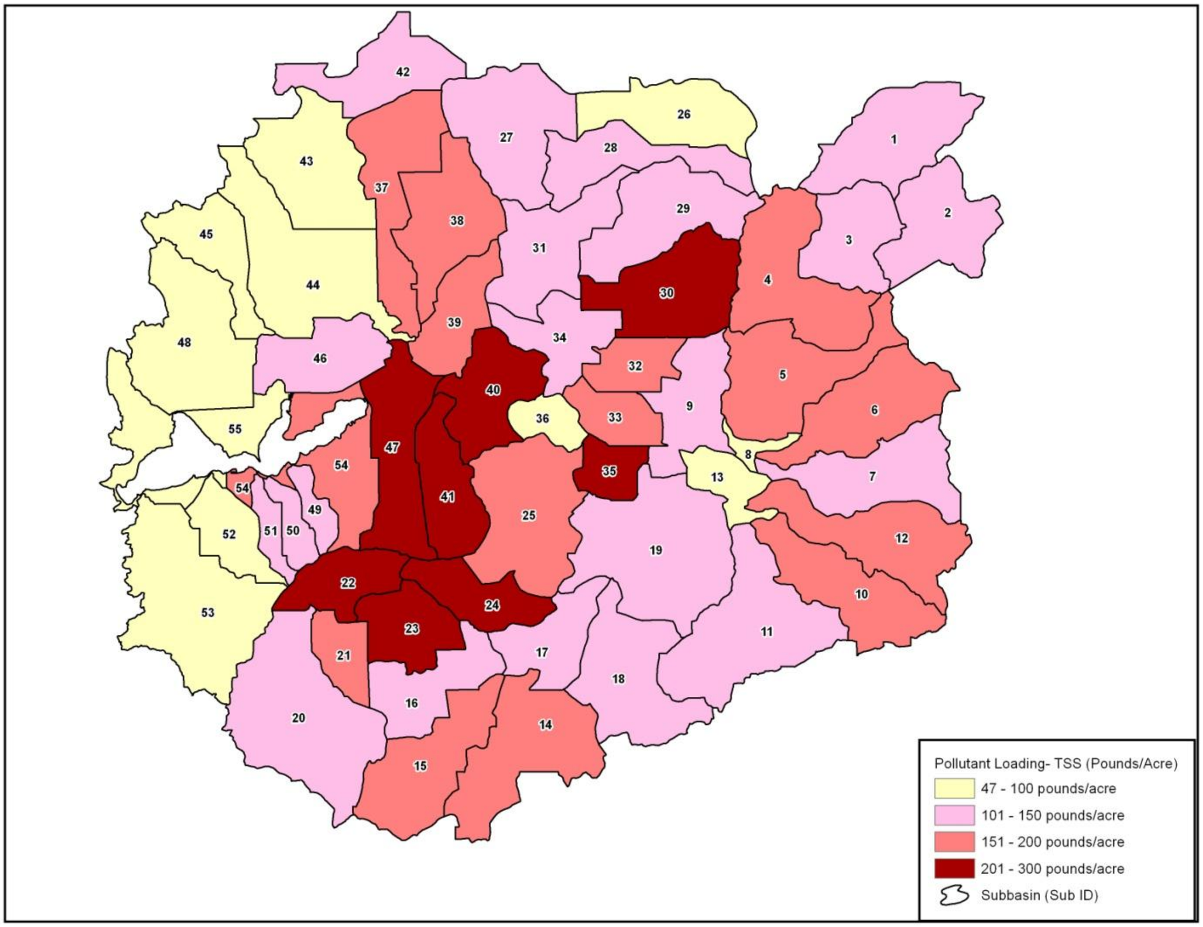

Figure 9 - Pollutant Loading- Total Suspended Solids (TSS)
Used in Agricultural and Urban Critical Area Analysis

Data Source: MACC Hydrology Report 2010- MDEQ
Process:

Create field for pollutant load and populate with data from Hydrology Report (TSS_PPACRE).
Assign priority score based on classifications of TSS loading by subbasin provided in Hydrology Report (TSS_PS).

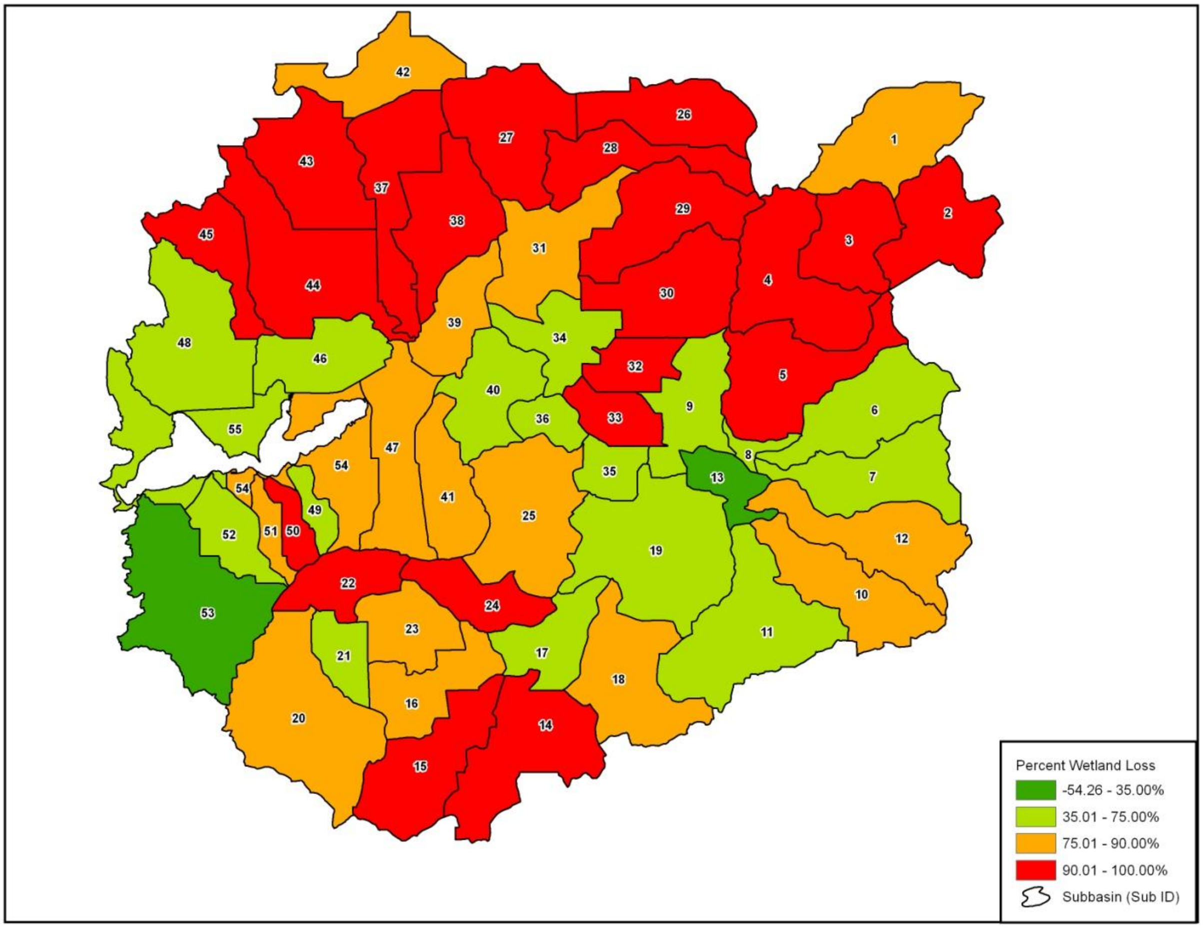

Figure 10 - Percent Wetland Loss
Used in Agricultural and Urban Critical Area Analysis

Data Source: MDNRE Wetland Loss map layer. Indicates the loss of wetland land cover from Presettlement Vegetation circa. 1800 to existing land cover 2005.
Process:

Create field for percent wetland loss and populate with data from MDNRE Wetland Loss map layer (PCT_WLOSS).

*Subbasin ID 47 from MDNRE wetland loss data file was modified from wetland gain of 54.26% to wetland loss of 85% based on similar urbanized conditions of neighboring subwatersheds 41 and 54.

Assign priority score based on classifications of wetland loss by subbasin (WLOSS_PS).

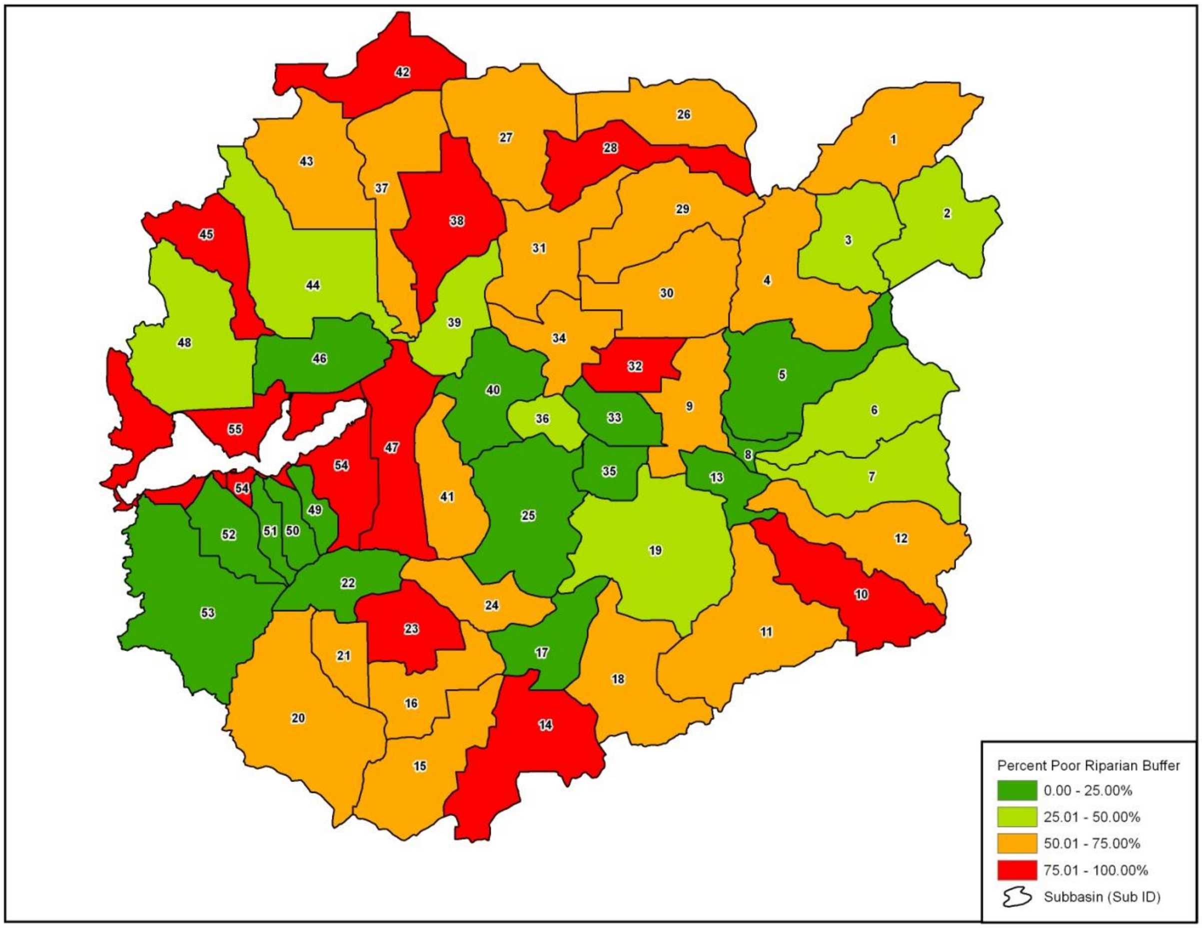

Figure 11 - Percent Poor Riparian Buffer
Used in Agricultural and Urban Critical Area Analysis

Data Source: MACC Geomorphology Report 2011.
Process:

Import stream map layer and poor riparian buffer stream classification from Geomorphology Report.
Summarize streams by subbasin ID and join buffer condition to subbasin layer.
Create field and populate for percent stream length with poor riparian buffer within each subbasin (PCT_POORB).
Assign priority score for poor riparian buffer based on stream classifications (POORB_PS).

*Subbasins ID 47 and 54 are located within a highly urban area with enclosed storm sewer system and no open drainage courses. As they no longer contain riparian buffer, they have been revised manually to assign a rating of 100% poor riparian buffer so as not to imply that they have good riparian buffer.

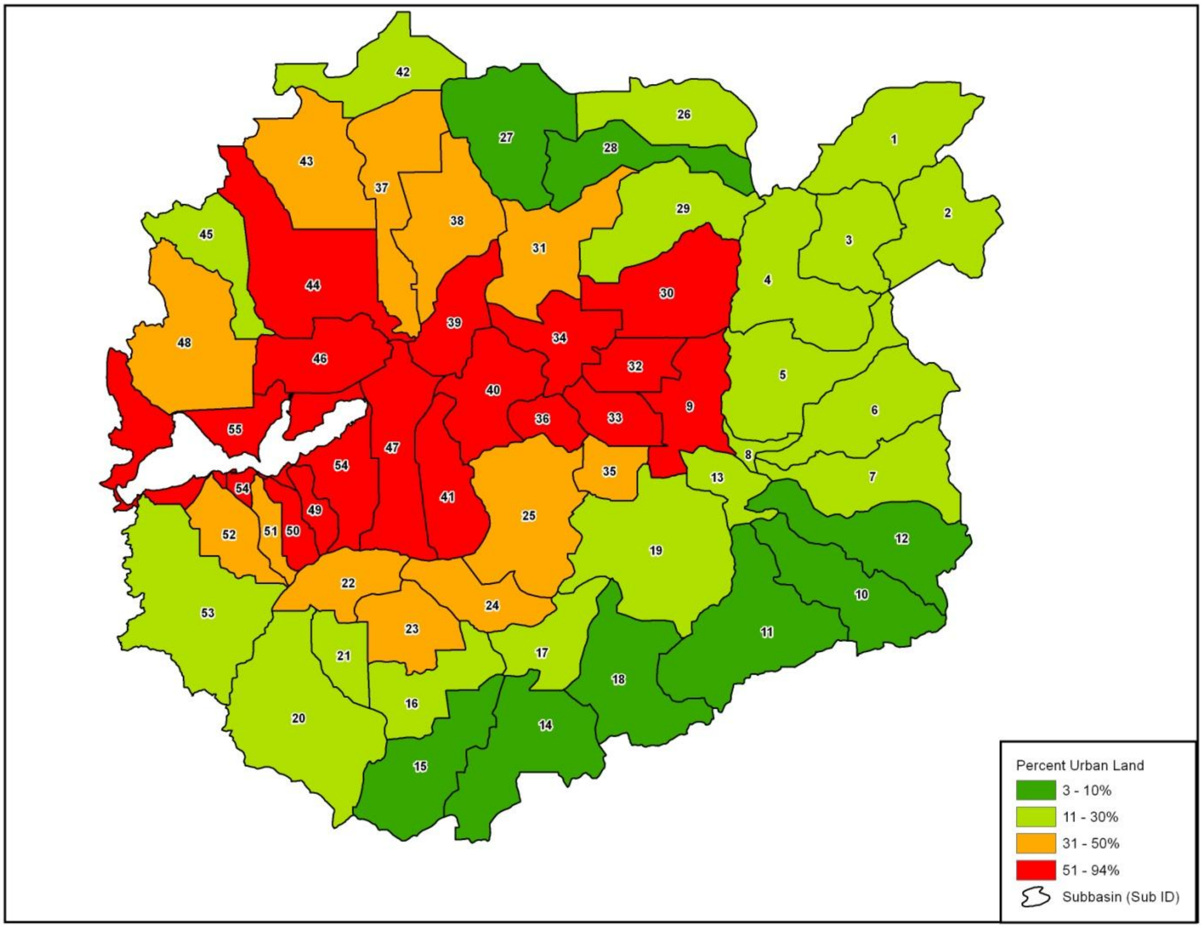

Figure 12 - Percent Urban Land
Used in Urban Critical Area Analysis

Data Source: 2009 Land Use/Land Cover for the MACC.
Process:

Selection of Level 1 Description = Urban/Built-up Land.
Intersect urban land with subbasins.
Create field and calculate area of urban land for each subbasin.
Calculate percent urban land by subbasin (PCT_URB).
Assign priority score for percent urban land by subbasin (URB_PS).

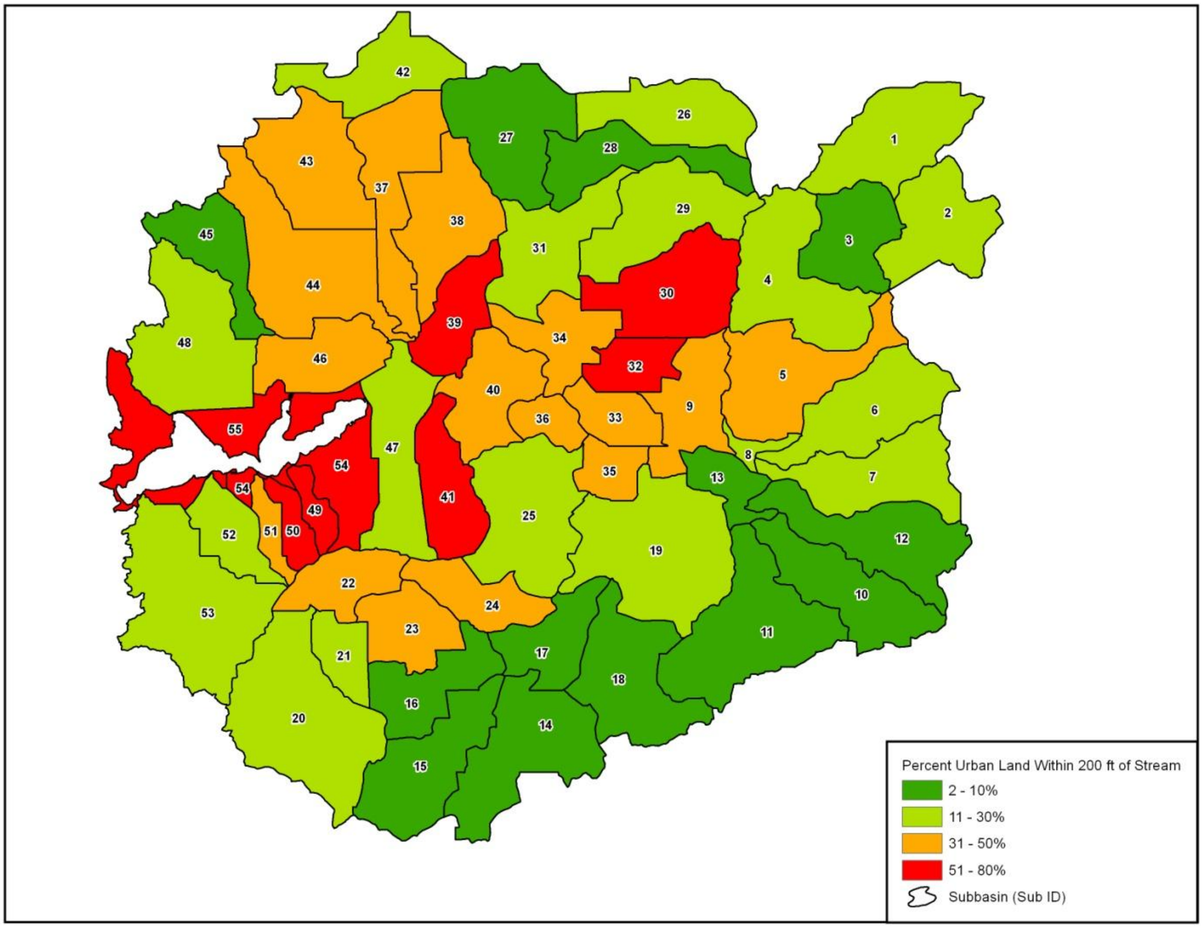

Figure 13 - Percent Urban Land Within 200 ft of Stream
Used in Urban Critical Area Analysis

Data Source: 2009 Land Use/Land Cover for the MACC and State of Michigan Framework Hydrography.
Process:

Selection of Level 1 Description = Urban/Built-up Land.
Intersect urban land with subbasins.
Buffer streams represented by hydrography line layer 200 ft each side.
Intersect urban land with stream buffer.
Create field and calculate area of 200 ft buffer for each subbasin.
Create field and calculate area of urban land within 200 ft buffer for each subbasin.
Calculate percent urban land within 200 ft buffer by subbasin (PCT_URB200).
Assign priority score for percent urban land within 200 ft buffer by subbasin (URB200_PS).

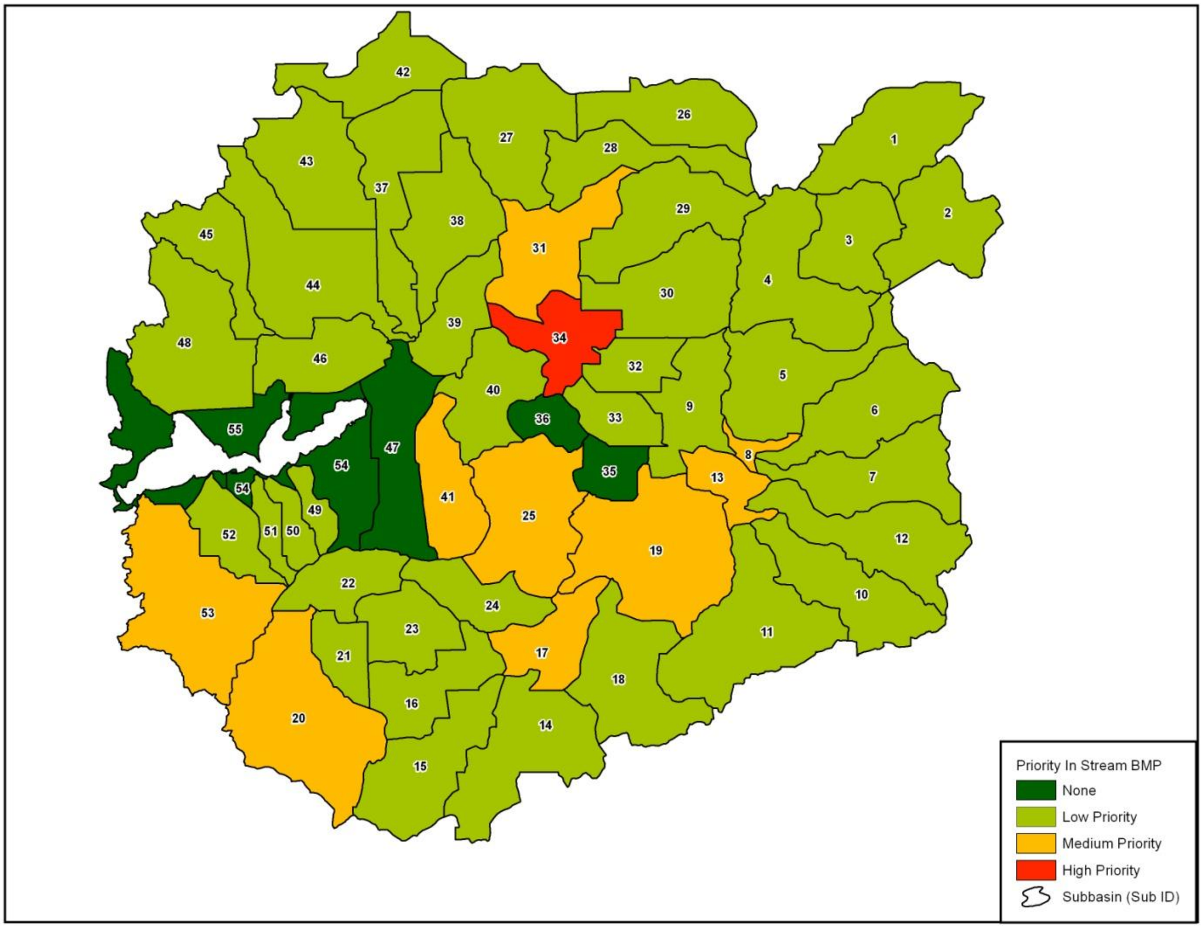

Figure 14 - Priority In Stream BMP
Used in Urban Critical Area Analysis

Data Source: MACC Geomorphology Report 2011.
Process:

Import priority in stream BMP stream classification from Geomorphology Report.

Create field and populate for in stream BMP based on classification determined for majority of stream length within each subbasin (INSTRM_BMP).

Assign priority score for in stream BMP based on stream classifications (INSTBMP_PS).

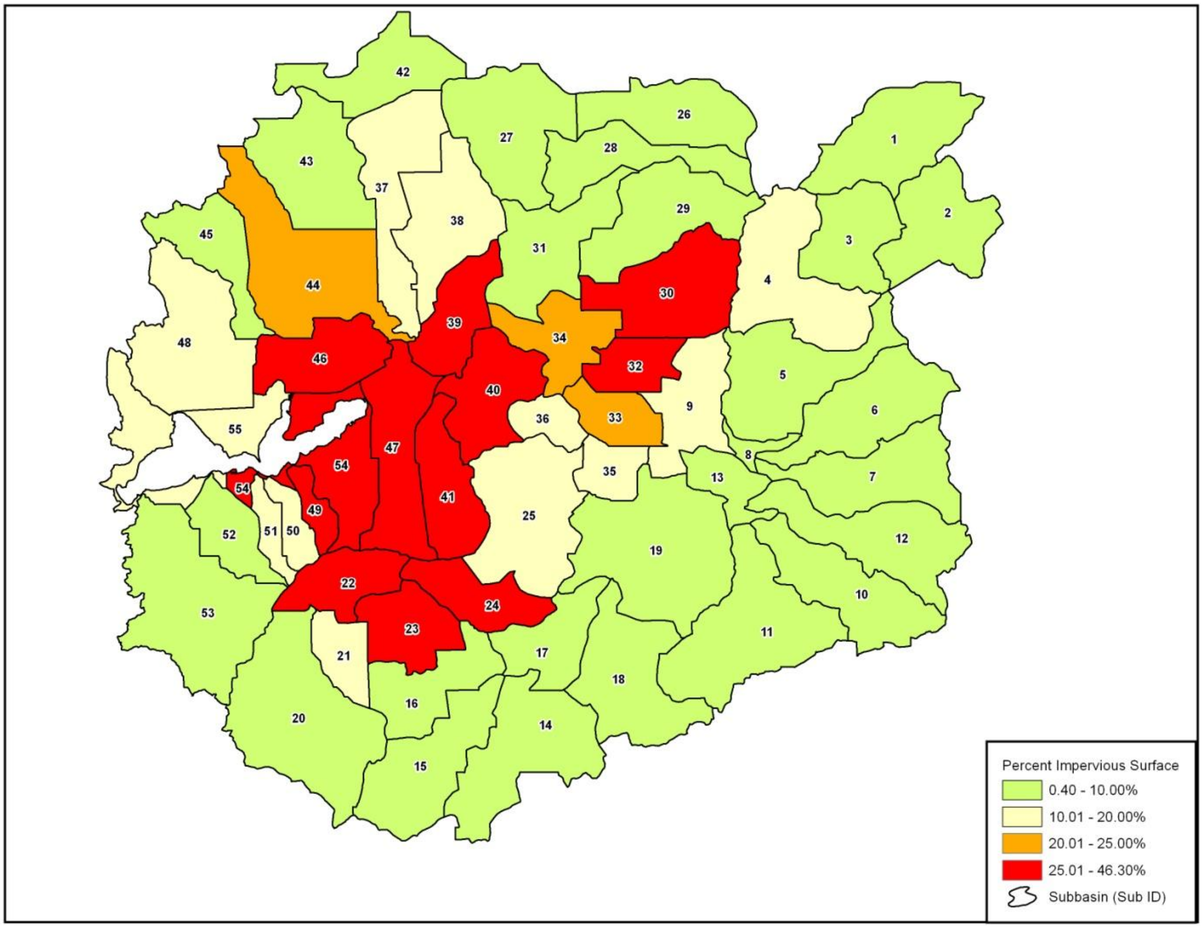

Figure 15 - Percent Impervious Surface
Used in Critical Area Analysis

Data Source: MACC Hydrology Report 2010- MDEQ
Process:

Create field for percent impervious surface and populate with data from Hydrology Report (PCT_IMPERV).

Assign priority score based on classifications of percent impervious by subbasin provided in Hydrology Report (IMPERV_PS).

Results:

Agricultural Critical Analysis Priority Scores

Summaries of the selection criteria and corresponding scores for the agricultural analysis are shown in Table 1. Criteria with "double weight" scores are doubled when added to remaining criteria to calculate subbasin total priority score.

Agricultural Critical Analysis Criteria	Criteria Field	Classification	Score Field	Priority Score
Percent Agricultural Land 2009	PCT_AGR	0-20%	AGR_PS	0
(single weight)		21-50%		1
		51-70%		2
		71-100%		3
Percent Agricultural Land	PCT_AGR200	0-20%	AGR200_PS	0
Within 200 ft of Stream		21-40%		1
(double weight)		41-65%		2
		66-100%		3
Percent Soils with	PCT_EROD	0-10%	EROD_PS	0
High Potential for Erosion		11-30%		1
(double weight)		31-70%		2
		71-100%		3
Number High Risk Road Crossings	XING_EROS	0-1	XING_PS	0
(single weight)		2		1
		3		2
		4-5		3
Runoff Volume- Inches	RUNOFF_IN	0-0.50 in	RUNOFF_PS	0
(single weight)		0.51-0.75 in		1
		0.76-1.00 in		2
		1.01-1.19 in		3
Percent Increase in Runoff Volume	ROIN_78_05	-5-10%	RO7805_PS	0
(1978 - 2005)		11-50%		1
(single weight)		51-75%		2
		76-106%		3
Amount Pollutant Loading	TSS_PPACRE	0-100 lbs/ac	TSS_PS	0
Total Supsended Solids (TSS)		101-150 lbs/ac		1
Pounds per Acre		151-200 lbs/ac		2
(single weight)		201-300 lbs/ac		3
Percent Land with High Risk	PCT_SEPRSK	0-10%	SEPRSK_PS	0
of Septic Failure Parcels		11-30%		1
(double weight)		31-50%		2
		51-100%		3
Percent Wetland Loss	PCT_WLOSS	0-35%	WLOSS_PS	0
(1800 - 2005)		36-75%		1
(single weight)		76-90%		2
		91-100%		3
Percent Poor Riparian Buffer	PCT_POORB	0-25%	POORB_PS	0
(double weight)		26-50%		1
		51-75%		2
		76-100%		3
Priority Upland BMP	UPLAND_BMP	NONE	UPBMP_PS	0
(double weight)		LOW		1
		MEDIUM		2
		HIGH		3

Table 1 – Criteria Used for Agricultural Analysis with Priority Score

The following Visual Basic expression was used to calculate the total priority score for agricultural rating criteria:

TOTAL_PS = [AGR_PS] + ([EROD_PS]*2) + ([AGR200_PS]*2) + [XING_PS] + [RUNOFF_PS] + [RO7805_PS] + [TSS_PS] + ([SEPRSK_PS]*2) + [WLOSS_PS] + ([POORB_PS]*2) + ([UPBMP_PS]*2)

Total PS scores for each subbasin are shown in Table 2. A summary of the number of subbasins and land area by critical area ranking category is shown in Table 3. Figure 16 is a map of the final results for agricultural criteria ranking by subwatershed.

SUB	AGR_PS	EROD_PS	AGR200_PS	XING_PS	RUNOFF_PS	RO7805_PS	TSS_PS	SEPRSK_PS	WLOSS_PS	POORB_PS	UPBMP_PS	TOTAL_PS
1	2	0	2	0	2	0	1	3	2	2	2	**25**
2	2	3	2	0	1	0	1	2	3	1	2	**27**
3	2	3	2	0	1	0	1	3	3	1	2	**29**
4	2	3	2	3	2	0	2	2	3	2	2	**34**
5	2	3	2	0	2	0	2	2	3	0	1	**25**
6	3	3	2	2	2	0	2	1	1	1	2	**28**
7	2	3	2	3	2	0	1	2	1	1	2	**29**
8	1	0	1	0	1	1	0	0	1	0	2	**10**
9	0	1	0	0	1	1	1	1	1	2	1	**14**
10	3	0	3	1	2	0	2	3	2	3	3	**34**
11	3	0	3	1	2	0	1	3	1	2	2	**28**
12	3	3	3	1	2	0	2	3	2	2	3	**38**
13	1	1	0	1	0	1	0	2	0	0	2	**13**
14	3	3	3	3	2	0	2	3	3	3	3	**43**
15	3	3	3	1	2	0	2	3	3	2	2	**37**
16	2	2	3	0	2	0	1	3	2	2	2	**31**
17	2	1	0	2	1	1	1	2	1	0	1	**16**
18	3	0	3	2	2	0	1	2	2	2	3	**30**
19	2	0	1	3	2	0	1	2	1	1	2	**21**
20	2	2	2	0	2	0	1	3	2	2	2	**29**
21	2	3	2	0	2	1	2	3	1	2	2	**32**
22	1	0	1	0	3	1	3	1	3	0	2	**19**
23	1	1	1	0	3	1	3	1	2	3	2	**26**
24	1	2	0	0	3	1	3	0	3	2	2	**23**
25	1	0	0	2	2	1	2	1	2	0	1	**14**
26	2	0	2	0	0	1	0	1	3	2	3	**22**
27	3	0	3	0	2	0	1	2	3	2	3	**29**
28	3	0	3	0	1	0	1	3	3	3	3	**32**
29	2	0	2	0	1	1	1	2	3	2	3	**26**
30	1	2	1	0	3	2	3	0	3	2	3	**28**
31	1	0	1	0	2	1	1	1	2	2	2	**19**
32	0	0	0	0	2	1	2	0	3	3	2	**18**
33	0	2	0	0	2	1	2	0	3	0	2	**16**
34	0	1	0	1	2	1	1	0	1	2	2	**16**
35	1	3	0	0	2	1	3	2	1	0	0	**18**
36	0	3	0	0	2	1	0	0	1	1	0	**12**
37	1	1	1	0	2	2	2	0	3	1	2	**20**
38	1	0	2	0	2	2	2	2	3	3	2	**28**
39	0	1	0	0	3	3	2	0	2	1	2	**18**
40	0	1	0	0	3	1	3	0	1	0	0	**10**
41	0	2	0	0	3	1	3	0	2	2	3	**23**
42	2	2	2	0	1	0	1	0	2	3	2	**24**
43	1	0	2	0	0	3	0	0	3	2	2	**19**
44	0	0	1	1	1	2	0	0	3	1	1	**13**
45	1	0	3	0	0	1	0	0	3	3	1	**19**
46	0	0	0	0	1	1	1	0	1	0	1	**6**
47	0	1	0	0	3	0	3	0	2	3	0	**16**
48	0	0	0	1	0	1	0	0	1	1	1	**7**
49	0	1	0	0	2	1	1	0	1	0	1	**9**
50	0	0	0	0	2	0	1	1	3	0	1	**10**
51	1	2	0	0	1	0	1	1	2	0	1	**13**
52	0	2	0	0	1	0	0	1	1	0	1	**10**
53	0	0	0	0	0	1	0	1	0	0	1	**5**
54	0	0	0	0	2	0	2	0	2	3	1	**14**
55	0	0	0	0	0	1	0	0	1	3	1	**10**

Table 2 – Subbasin Agricultural Critical Area Priority Scores. PS values are highlighted with colors to correspond Figure 16.

Subbasins and Land Area in Agricultural Critical Area Analysis			
Ranking	**Priority Score**	**Number of Subbasins**	**Land Area (Acres)**
Low Priority	5 - 18 PS	24	38,981
Moderate Priority	19 - 28 PS	18	40,052
High Priority	29 - 43 PS	13	30,681
Total		**55**	**109,715**

Table 3 – Summary of Subbasins and Land Area in Agricultural Critical Area Analysis

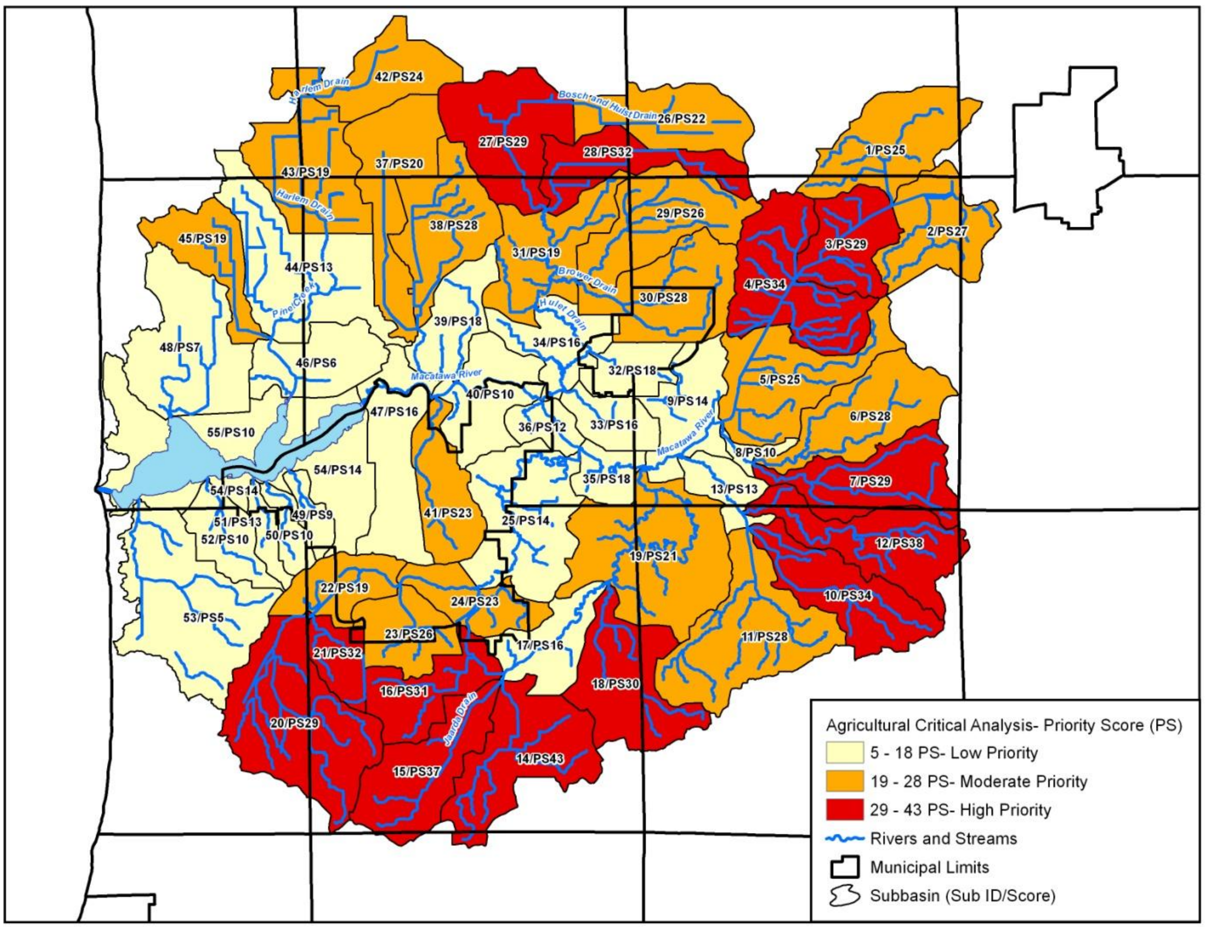

Figure 16 – Agricultural Critical Area Analysis Priority Score (PS)

The results of the critical area analysis can also be compared to historic water quality monitoring data provided by the Michigan Department of Environmental Quality. Digital images of maps representing Total Phosphorus Concentrations and Total Suspended Solids Concentrations were georeferenced to the Watershed boundary in GIS to provide a visual comparison of monitoring values and subbasin priority results. These visual comparisons can be seen in Figures 17 and 18.

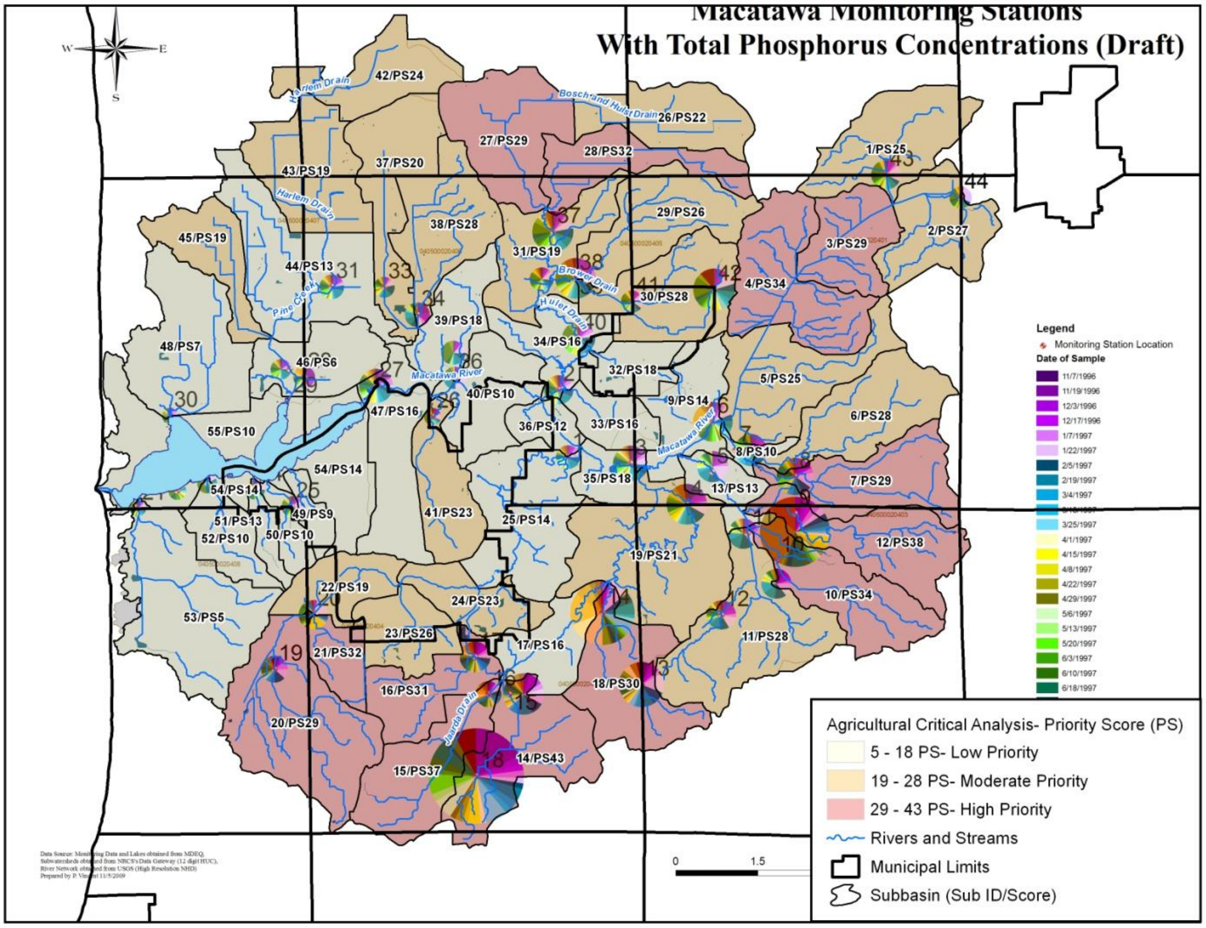

Figure 17 – Agricultural Critical Area Analysis Priority Score and MDEQ Macatawa Monitoring Stations with Total Phosphorus Concentrations.

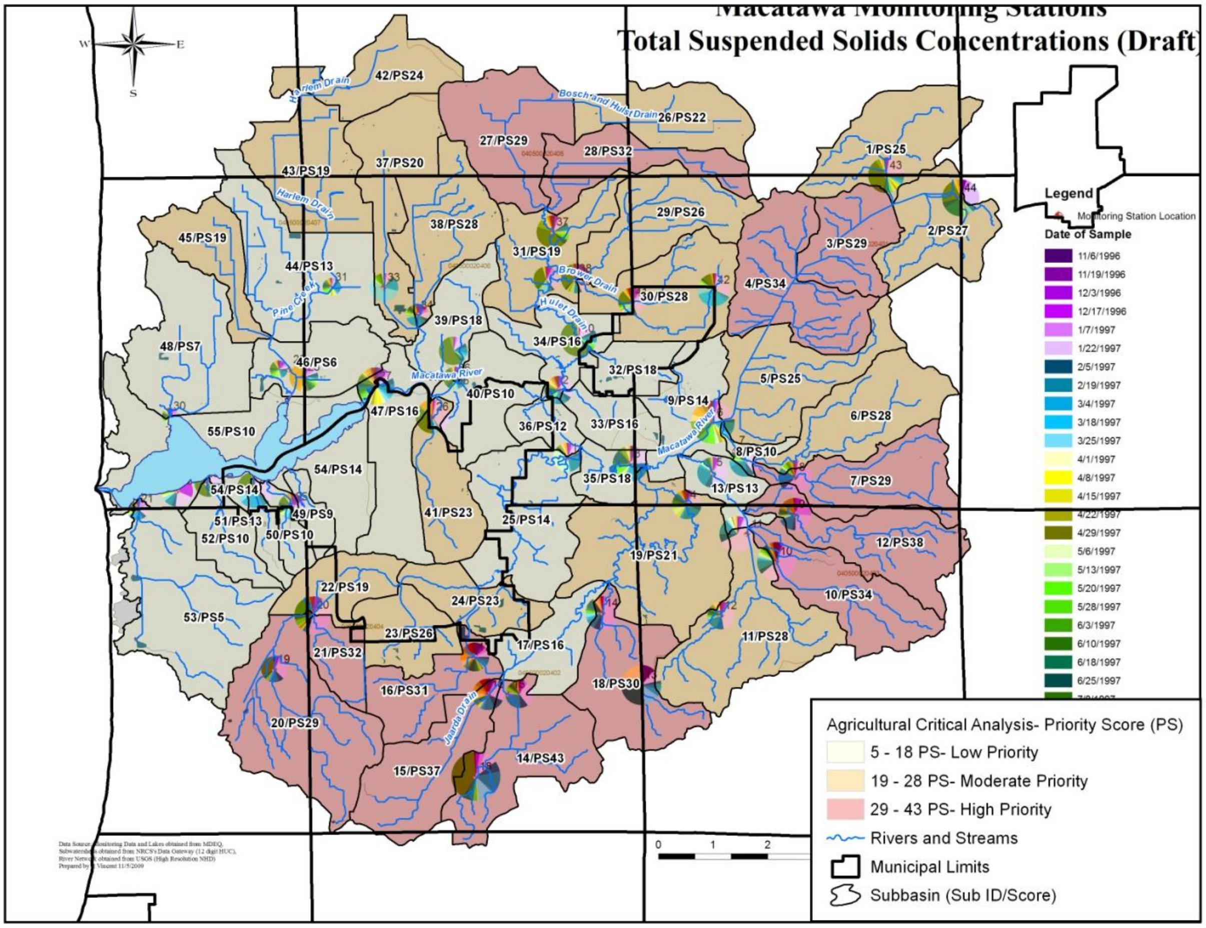

Figure 18 – Agricultural Critical Area Analysis Priority Score and MDEQ Macatawa Monitoring Stations With Total Suspended Solids Concentrations.

Urban Critical Area Analysis Subbasin Scores

Summaries of the selection criteria and corresponding scores for the urban analysis are shown in Table 4. Criteria with “double weight” scores are doubled when added to remaining criteria to calculate subbasin total priority score.

Urban Critical Analysis Criteria	**Criteria Field**	**Classification**	**Score Field**	**Priority Score**
Percent Urban Land 2009	PCT_URB	0-10%	URB_PS	0
(single weight)		11-30%		1
		31-50%		2
		51-100%		3
Percent Urban Land	PCT_URB200	0-10%	URB200_PS	0
Within 200 ft of Stream		11-30%		1
(single weight)		31-50%		2
		51-100%		3
Percent Impervious Surface (2005)	PCT_IMPERV	0-10%	IMPERV_PS	0
(double weight)		11-20%		1
		21-25%		2
		26-100%		3
Priority In Stream BMP	INSTRM_BMP	NONE	INSTBMP_PS	0
(single weight)		LOW		1
		MEDIUM		2
		HIGH		3
Runoff Volume- Inches	RUNOFF_IN	0-0.50 in	RUNOFF_PS	0
(double weight)		0.51-0.75 in		1
		0.76-1.00 in		2
		1.01-1.19 in		3
Percent Increase in Runoff Volume	ROIN_78_05	-5-10%	RO7805_PS	0
(1978 - 2005)		11-50%		1
(single weight)		51-75%		2
		76-106%		3
Number High Risk Road Crossings	XING_EROS	0-1	XING_PS	0
(single weight)		2		1
		3		2
		4-5		3
Amount Pollutant Loading	TSS_PPACRE	0-100 lbs/ac	TSS_PS	0
Total Supsended Solids (TSS)		101-150 lbs/ac		1
Pounds per Acre		151-200 lbs/ac		2
(single weight)		201-300 lbs/ac		3
Percent Wetland Loss	PCT_WLOSS	0-35%	WLOSS_PS	0
(1800 - 2005)		36-75%		1
(double weight)		76-90%		2
		91-100%		3
Percent Poor Riparian Buffer	PCT_POORB	0-25%	POORB_PS	0
(single weight)		26-50%		1
		51-75%		2
		76-100%		3

Table 4 – Criteria Used for Urban Analysis with Priority Score

The following Visual Basic expression was used to calculate the total priority score for urban rating criteria:

TOTAL _PS = [URB_PS] + [URB200_PS] +([IMPERV_PS]*2) +[INSTBMP_PS] +([RUNOFF_PS]*2) + [RO7805_PS] + [XING_PS] + [TSS_PS] +([WLOSS_PS]*2) + [POORB_PS]

Total PS scores for each subbasin are shown in Table 5. A summary of the number of subbasins and land area by critical area ranking category is shown in Table 6. Figure 19 is a map of the final results for urban criteria ranking by subwatershed.

SUB	URB_PS	URB200_PS	IMPERV_PS	INSTBMP_PS	RUNOFF_PS	RO7805_PS	XING_PS	TSS_PS	WLOSS_PS	POORB_PS	TOTAL_PS
1	1	1	0	1	2	0	0	1	2	2	**14**
2	1	1	0	1	1	0	0	1	3	1	**13**
3	1	0	0	1	1	0	0	1	3	1	**12**
4	1	1	1	1	2	0	3	2	3	2	**22**
5	1	2	0	1	2	0	0	2	3	0	**16**
6	1	1	0	1	2	0	2	2	1	1	**14**
7	1	1	0	1	2	0	3	1	1	1	**14**
8	1	1	0	2	1	1	0	0	1	0	**9**
9	3	2	1	1	1	1	0	1	1	2	**16**
10	0	0	0	1	2	0	1	2	2	3	**15**
11	0	0	0	1	2	0	1	1	1	2	**11**
12	0	0	0	1	2	0	1	2	2	2	**14**
13	1	0	0	2	0	1	1	0	0	0	**5**
14	0	0	0	1	2	0	3	2	3	3	**19**
15	0	0	0	1	2	0	1	2	3	2	**16**
16	1	0	0	1	2	0	0	1	2	2	**13**
17	1	0	0	2	1	1	2	1	1	0	**11**
18	0	0	0	1	2	0	2	1	2	2	**14**
19	1	1	0	2	2	0	3	1	1	1	**15**
20	1	1	0	2	2	0	0	1	2	2	**15**
21	1	1	1	1	2	1	0	2	1	2	**16**
22	2	2	3	1	3	1	0	3	3	0	**27**
23	2	2	3	1	3	1	0	3	2	3	**28**
24	2	2	3	1	3	1	0	3	3	2	**29**
25	2	1	1	2	2	1	2	2	2	0	**20**
26	1	1	0	1	0	1	0	0	3	2	**12**
27	0	0	0	1	2	0	0	1	3	2	**14**
28	0	0	0	1	1	0	0	1	3	3	**13**
29	1	1	0	1	1	1	0	1	3	2	**15**
30	3	3	3	1	3	2	0	3	3	2	**32**
31	2	1	0	2	2	1	0	1	2	2	**17**
32	3	3	3	1	2	1	0	2	3	3	**29**
33	3	2	2	1	2	1	0	2	3	0	**23**
34	3	2	2	3	2	1	1	1	1	2	**23**
35	2	2	1	0	2	1	0	3	1	0	**16**
36	3	2	1	0	2	1	0	0	1	1	**15**
37	2	2	1	1	2	2	0	2	3	2	**23**
38	2	2	1	1	2	2	0	2	3	3	**24**
39	3	3	3	1	3	3	0	2	2	1	**29**
40	3	2	3	1	3	1	0	3	1	0	**24**
41	3	3	3	2	3	1	0	3	2	2	**30**
42	1	1	0	1	1	0	0	1	2	3	**13**
43	2	2	0	1	0	3	0	0	3	2	**16**
44	3	2	2	1	1	2	1	0	3	1	**22**
45	1	0	0	1	0	1	0	0	3	3	**12**
46	3	2	3	1	1	1	0	1	1	0	**18**
47	3	1	3	0	3	0	0	3	2	3	**26**
48	2	1	1	1	0	1	1	0	1	1	**11**
49	3	3	3	1	2	1	0	1	1	0	**21**
50	3	3	1	1	2	0	0	1	3	0	**20**
51	2	2	1	1	1	0	0	1	2	0	**14**
52	2	1	0	1	1	0	0	0	1	0	**8**
53	1	1	0	2	0	1	0	0	0	0	**5**
54	3	3	3	0	2	0	0	2	2	3	**25**
55	3	3	1	0	0	1	0	0	1	3	**14**

Table 5 – Subbasin Urban Critical Area Priority Scores. PS values are highlighted with colors to correspond Figure 19.

Subbasins and Land Area in Urban Critical Area Analysis			
Ranking	**Priority Score**	**Number of Subbasins**	**Land Area (Acres)**
Low Priority	5 - 19 PS	36	75,532
Moderate Priority	20 - 23 PS	8	15,337
High Priority	24 - 32 PS	11	18,846
Total		**55**	**109,715**

Table 6 - Summary of Subbasins and Land Area in Urban Critical Area Analysis

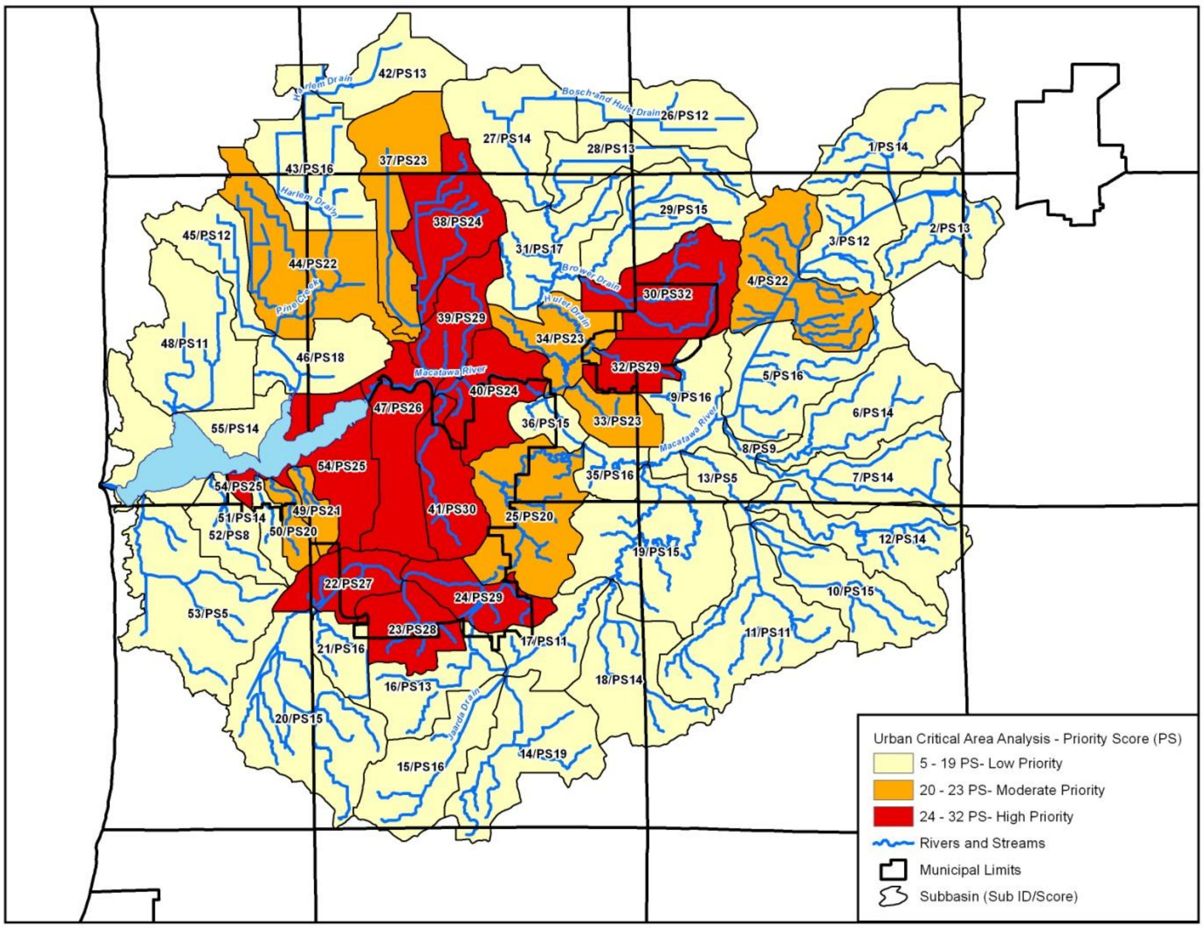

Figure 19 – Urban Critical Area Analysis Priority Score (PS)

The results of the critical area analysis can also be compared to historic water quality monitoring data provided by the Michigan Department of Environmental Quality. Digital images of maps representing Total Phosphorus Concentrations and Total Suspended Solids Concentrations were georeferenced to the Watershed boundary in GIS to provide a visual comparison of monitoring values and subbasin priority results. These visual comparisons can be seen in Figures 20 and 21.

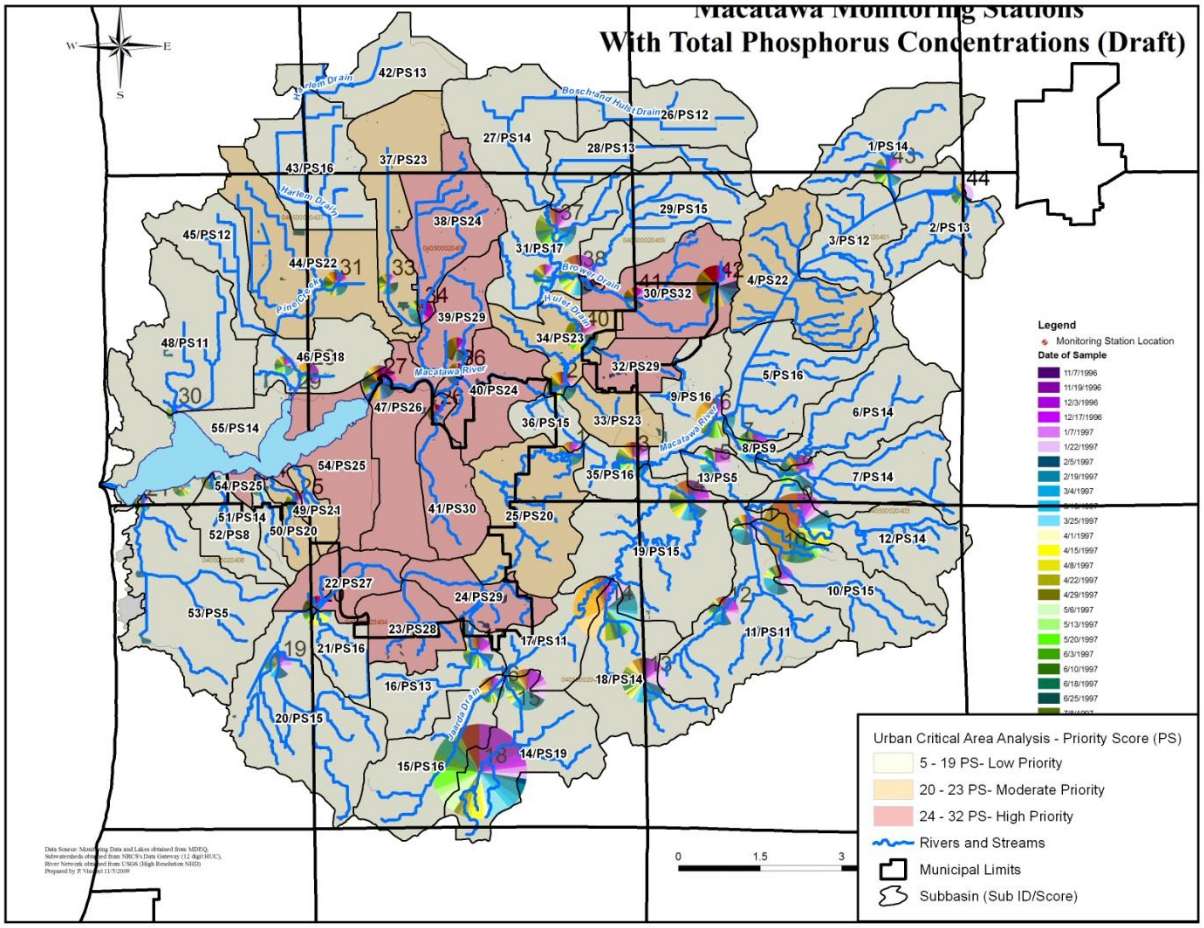

Figure 20 – Urban Critical Area Analysis Priority Score and MDEQ Macatawa Monitoring Stations with Total Phosphorus Concentrations.

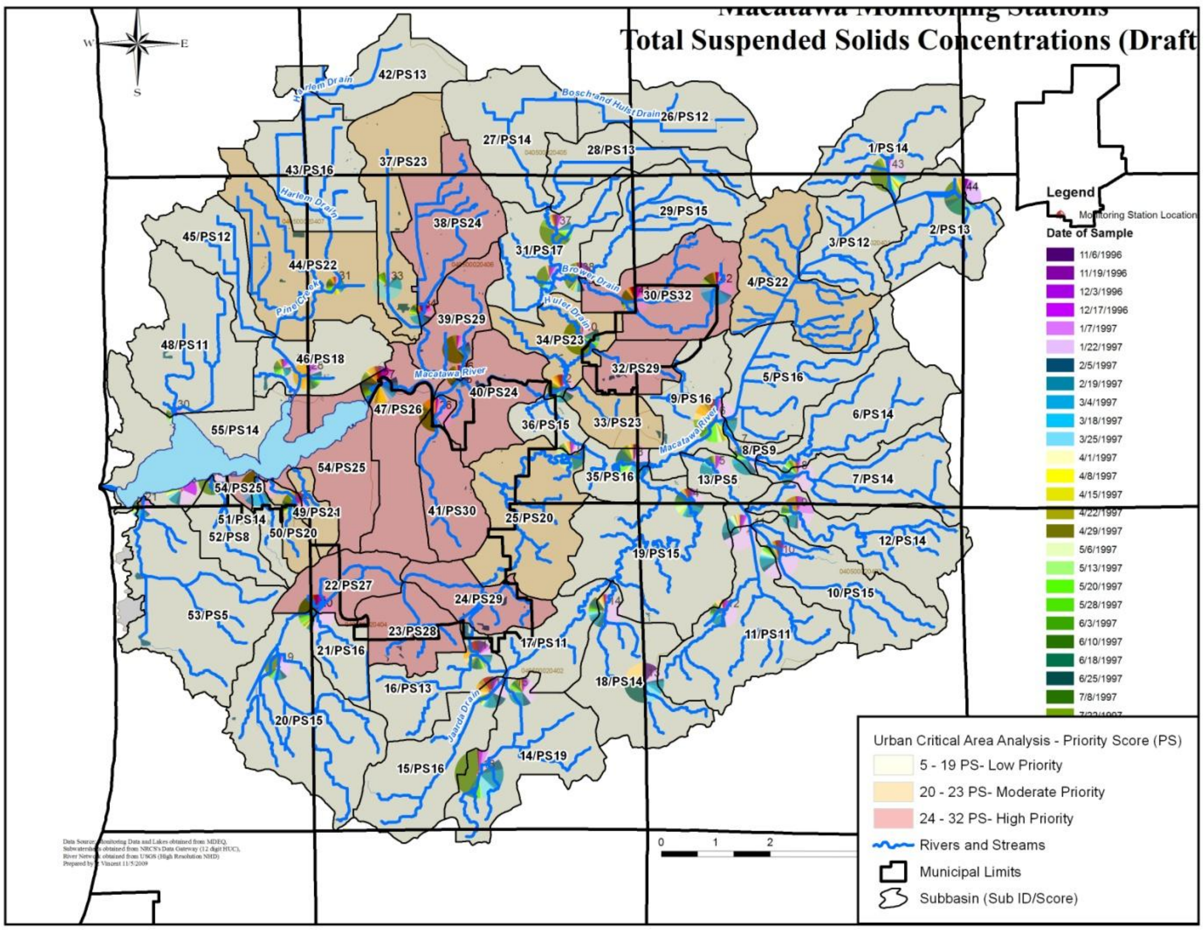

Figure 21 – Urban Critical Area Analysis Priority Score and MDEQ Macatawa Monitoring Stations With Total Suspended Solids Concentrations.