

# TECHNICAL MEMORANDUM

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**DATE:** July 5, 2016

**TO:** U.S. Environmental Protection Agency

**FROM:** West Central Wisconsin Regional Planning Commission  
Wisconsin Department of Natural Resources

**RE:** Supplemental explanation of STEPL and SWOT modeling techniques used during the preparation of Health Soil & Health Waters—A Community Strategy for the Eau Claire River Watershed

This technical memorandum is a supplement to *Health Soil & Health Waters—A Community Strategy for the Eau Claire River Watershed*, which was developed in accordance with EPA’s nine-key element planning framework for nonpoint source pollution planning at the watershed level. Due to the technical nature of the information here, it was decided to provide this memorandum as a supplement, rather than including it within the text of the main plan document. This memorandum will also be useful for future reference by local, county, regional, and State staff when evaluating plan progress and updating plan models and goals.

## **Supplement to Section IV.C. STEPL Pollutant Loading Estimates**

The STEPL tool was used during the planning process in two ways:

#1 For each HUC 12 subwatershed, the annual nutrient loading was calculated based on the runoff volume and the pollutant concentrations in the runoff water as influenced by factors such as the land use distribution. The annual sediment load (sheet and rill erosion only; does not include bank erosion) is calculated based on the Universal Soil Loss Equation (USLE) and the sediment delivery ratio. The sediment and pollutant load reductions that result from the implementation of BMPs are computed using the known, typical BMP efficiencies (e.g., how good a BMP is at reducing pollutant loading). West Central Wisconsin Regional Planning Commission and WDNR worked with Olson Environmental Research to fine-tune the land use and model assumptions to local conditions. The STEPL results were then used to create the three maps in Section IV.C.

#2 The STEPL tool was also used to help develop the 10-year phosphorus reduction “goals” (10-year indicators) in Section VIII of the plan using the following process:

- a) The Land Conservation Departments (LCDs) from each of the 5-counties in the watershed estimated the total acreage of current, commonly used best management practices (BMPs) on the landscape by HUC-12 subwatershed and by type of BMP. We do not know specifically where

within each HUC-12 each BMP is occurring. The BMPs were largely taken the BMP list (with definitions) in Appendix E of the plan.

- b) The LCDs also estimated the acreage of potential future BMPs (by HUC-12 and type) based on each LCD’s knowledge of current land uses, resource availability, familiarity with the landowners, and the potential for implementation. The LCDs were asked to be realistic and feasible on what could be accomplished in the next ten years given expected resources. The table with these results is included in Section XIII.C. of the plan and will be used to help guide BMP implementation.
- c) The LCD estimates needed to be further modified to create a potential scenario that accounts for multiple cropland BMPs on the same cropland acreage. Working with WCWRPC, County LCD staff identified three of the most typical BMP combinations.
- d) Since Nutrient Management Planning (NMP) and Reduced Tillage were common to all three levels of combination BMPs, and are frequently used in combination with other BMPs, the maximum total cropland combination BMP acreage in any given HUC-12 would be the highest acreage from one of these two BMPs. Applying these maximums to the total cropland acres, we were able to estimate that, on average across the watershed, 36% of current cropland acreage have two or more BMPs and 51% of future (10-year) cropland acreage could have more than one BMP. These averages, across the watershed, were used to develop an average cropland combination BMP for the scenario; the actual distribution of combination BMPs will vary significantly by HUC-12, but we lacked sufficient data to develop subshed-specific estimates at this time.
- e) Based on County LCD knowledge of farming practices in the watershed, the 36% and 51% were distributed among the three cropland combination BMP levels:

| Combination BMP Assumptions |                                      | % of cropland acres |        |
|-----------------------------|--------------------------------------|---------------------|--------|
|                             |                                      | Current             | Future |
| Level 1:                    | NMP + Contour Farming + Reduced Till | 21.0%               | 19.0%  |
| Level 2:                    | Level 1 + Filter Strips              | 9.0%                | 16.0%  |
| Level 3:                    | Level 2 + Cover Crops                | 6.0%                | 16.0%  |
|                             |                                      | 36.0%               | 51.0%  |

- f) To create our scenario, the above cropland combination BMP percentage assumptions were applied to each HUC-12. The acreages for each cropland BMP for each HUC-12 in the original spreadsheet were then reduced by the corresponding combination acreages. For example, current Reduced Till acreages were reduced by 36% since it is part of all three combination levels, while current Cover Crop acreages were reduced by 6% since it is only part of Level 3. After this adjustment, four HUC-12s still had total cropland BMP acreages in excess of 100%, so their largest, standalone BMP was reduced so that the HUC-12’s total would not exceed 100%. This scenario suggested that in ten years, if we have the resources, 66% of cropland acres could have at least one BMP and 51% could have two or more BMPs.
- g) The results of the above were then used in the STEPL model to estimate potential phosphorus load reductions from primary cropland BMPs for the next ten years. Though current and 10-year acreages for Streambank Stabilization & Fencing were collected, the P reductions were not modeled in STEPL due to varying types of stabilization and fencing projects and the challenges in identifying the acreages impacted by adoption.

- h) Further, Feedlots, Pastureland, and Forest Management BMPs are not specific to cropland, so are potential reductions in addition to the cropland BMPs. While estimated current and 10-year future acreages for these other BMPs were included in the table in Section VIII.C., the P reductions were not modeled in STEPL due to a variety of associated challenges. For example, the phosphorus loading and reductions for Feedlot BMPs were not calculated using STEPL because we did not have watershed-wide estimates for the following as required by the STEPL tool: (i) the acreage of feedlots receiving practices and (ii) an estimate of how many feedlots directly discharge to adjacent waterways.
- i) The Replacement of Failing Septic Systems was also considered as a BMP and addressed separately (or in addition to) the other cropland BMPs using the following approach:
  - i. Since point data for septic systems or structures is not available throughout the watershed, WCWRPC estimated the number of homes with private drainfields within riparian areas by using GIS to identify all parcels that have their centroid within 300 feet of a surface water AND have assessed residential improvements AND are not part of a parcel with agricultural lands. Agricultural lands were excluded given their large parcel sizes resulted in great variation in the centroid.
  - ii. Parcels located in cities and villages were excluded, since it is assumed that most of these are on public sewer.
  - iii. Based on experience, WDNR uses the following equation for estimating septic system failure rates:

$$\text{\# riparian residences} \times .2 \text{ failure rate} \times 0.32\text{-}.16 \text{ lbs/capita/yr} \times \text{\# people per residence} = \text{annual lbs eliminated by replacing failing systems}$$

- iv. It was estimated that 1,377 “riparian area homes” were located in the incorporated towns and on private septic systems. The watershed averages 2.52 persons per household. By applying the above failure rate (20%), this yielded an estimated 275 failing septic systems near surface waters. The numbers from this analysis are included in the table following this section.
- v. Initially, the results of the above analysis was to be provided to WDNR as inputs into the STEPL model to estimate phosphorus load reductions if failing septic systems were replaced. Later, it was decided to use the reduction estimates from the above equation (0.32-16 lbs/capita/year) for the watershed as a whole instead of including specific HUC-12 reduction targets.

The results of the scenario were then reflected in the 10-year reductions by HUC-12 in the first table in Section VIII.C. of the plan, except for reductions related to failing septic systems that are included in the third action plan recommendations in Section VIII.D.

# STEPL Cropland BMP Acreage Assumptions

| STEPL Watershed ID | Name                                      | Area (acres) | Cropland (acres)  |         |                  | Combo Cropland BMPs (scenario) |                   |         |                  |         |                           | Estimated Cropland Non-Combo BMP Acreages by HUC12 watershed |                     |                    |                             |                            |                           | Streambank Stabilization & Fencing (P lbs reduced) not estimated) |                       |                      |               |              |  |   |
|--------------------|---|--------------|-------------------|---------|------------------|--------------------------------|-------------------|---------|------------------|---------|---------------------------|--|---------------------|--------------------|-----------------------------|----------------------------|---------------------------|---|-----------------------|----------------------|---------------|--------------|--|---|
|                    |   |              | Current - Level 1 |         | Future - Level 2 |                                | Current - Level 3 |         | Future - Level 3 |         | Current - Contour Farming | Future - Contour Farming                                     | Current - Diversion | Future - Diversion | Current - Filtered Waterway | Future - Filtered Waterway | Current - Reduced Tillage | Future - Reduced Tillage  | Current - Cover Crops | Future - Cover Crops | Current - NMP | Future - NMP | Current - Streambank Stabilization and Fencing | Future - Streambank Stabilization and Fencing |
|                    |   |              | Level 1           | Level 2 | Level 2          | Level 3                        | Level 3           | Level 2 | Level 3          | Level 3 | Contour Farming           | Contour Farming  | Diversion           | Diversion          | Filtered Waterway           | Filtered Waterway          | Reduced Tillage           | Reduced Tillage   | Cover Crops           | Cover Crops          | NMP           | NMP          | Streambank Stabilization and Fencing           | Streambank Stabilization and Fencing          |
| W1                 | Headwaters North Fork E.C. River          | 22,172       | 2,458             | 2,224   | 1,053            | 1,873                          | 702               | 1,873   | 0                | 0       | 0                         | 0  | 0                   | 0                  | 0                           | 0                          | 0                         | 0   | 0                     | 0                    | 0             | 34           | 34   |   |
| W2                 | Goggle-Eye Creek-North Fork E.C. River    | 18,129       | 2,760             | 2,497   | 1,183            | 2,103                          | 788               | 2,103   | 0                | 0       | 0                         | 0  | 0                   | 0                  | 0                           | 0                          | 0                         | 0   | 0                     | 0                    | 0             | 0            | 0  | 0   |
| W3                 | Sterling Creek-North Fork E.C. River      | 15,058       | 1,584             | 1,434   | 679              | 1,207                          | 453               | 1,207   | 0                | 0       | 0                         | 0  | 0                   | 0                  | 0                           | 0                          | 0                         | 0   | 0                     | 0                    | 0             | 0            | 0  | 0   |
| W4                 | Little Otter Creek-Wolf River             | 23,166       | 3,095             | 2,800   | 1,326            | 2,358                          | 884               | 2,358   | 0                | 0       | 0                         | 0  | 0                   | 0                  | 0                           | 0                          | 0                         | 0   | 0                     | 0                    | 0             | 0            | 0  | 0   |
| W5                 | Wolf River                                | 28,874       | 3,777             | 3,417   | 1,619            | 2,878                          | 1,079             | 2,878   | 0                | 0       | 0                         | 0  | 0                   | 0                  | 0                           | 0                          | 0                         | 0   | 0                     | 0                    | 0             | 0            | 0  | 0   |
| W6                 | Simes Creek-North Fork E.C. River         | 12,607       | 146               | 132     | 62               | 111                            | 42                | 111     | 0                | 0       | 0                         | 0  | 0                   | 0                  | 0                           | 0                          | 0                         | 0   | 0                     | 0                    | 0             | 0            | 0  | 0   |
| W7                 | North Fork E.C. River                     | 12,004       | 211               | 44      | 40               | 19                             | 34                | 13      | 34               | 0       | 0                         | 11   | 11                  | 74                 | 84                          | 0                          | 0                         | 8   | 8                     | 0                    | 0             | 0            | 0  | 106   |
| W8                 | Headwaters South Fork E.C. River          | 14,429       | 2,167             | 1,960   | 929              | 1,651                          | 619               | 1,651   | 0                | 0       | 0                         | 0  | 0                   | 0                  | 0                           | 0                          | 0                         | 0   | 0                     | 0                    | 0             | 0            | 0  | 0   |
| W9                 | St. Hedwig Cemetery-South Fork E.C. River | 18,192       | 2,821             | 2,552   | 1,209            | 2,149                          | 806               | 2,149   | 0                | 0       | 0                         | 0  | 0                   | 0                  | 0                           | 0                          | 0                         | 0   | 0                     | 0                    | 0             | 0            | 0  | 0   |
| W10                | Nowegian Creek-South Fork E.C. River      | 17,761       | 1,399             | 1,266   | 600              | 1,066                          | 400               | 1,066   | 0                | 0       | 0                         | 0  | 0                   | 0                  | 0                           | 0                          | 0                         | 0   | 0                     | 0                    | 0             | 0            | 0  | 0   |
| W11                | Black Creek-South Fork E.C. River         | 9,771        | 1,626             | 341     | 309              | 146                            | 260               | 98      | 260              | 0       | 0                         | 49   | 49                  | 0                  | 0                           | 0                          | 0                         | 0   | 0                     | 0                    | 0             | 0            | 0  | 49  |
| W12                | Head Lake-South Fork E.C. River           | 14,276       | 1,283             | 1,161   | 550              | 978                            | 367               | 978     | 0                | 0       | 0                         | 0  | 0                   | 0                  | 0                           | 0                          | 0                         | 0   | 0                     | 0                    | 0             | 0            | 0  | 0   |
| W13                | Hay Creek-South Fork E.C. River           | 39,227       | 902               | 816     | 387              | 687                            | 258               | 687     | 0                | 0       | 0                         | 0  | 0                   | 0                  | 0                           | 0                          | 0                         | 0   | 0                     | 0                    | 0             | 0            | 0  | 0   |
| W14                | Dickson Creek-South Fork E.C. River       | 12,352       | 186               | 169     | 80               | 142                            | 53                | 142     | 0                | 0       | 0                         | 0  | 0                   | 0                  | 0                           | 0                          | 0                         | 0   | 0                     | 0                    | 0             | 0            | 0  | 0   |
| W15                | South Fork E.C. River                     | 21,459       | 66                | 14      | 13               | 6                              | 11                | 4       | 11               | 0       | 0                         | 0  | 0                   | 0                  | 0                           | 0                          | 0                         | 0   | 0                     | 0                    | 0             | 0            | 0  | 0   |
| W16                | Black Creek-E.C. River                    | 37,672       | 6,348             | 1,333   | 1,206            | 571                            | 1,016             | 381     | 1,016            | 0       | 0                         | 16   | 16                  | 0                  | 0                           | 0                          | 0                         | 0   | 0                     | 0                    | 0             | 0            | 0  | 0   |
| W17                | Muskat Creek                              | 21,655       | 5,657             | 1,188   | 1,075            | 509                            | 905               | 339     | 905              | 0       | 0                         | 0  | 0                   | 0                  | 0                           | 0                          | 0                         | 0   | 0                     | 0                    | 0             | 0            | 0  | 0   |
| W18                | Hay Creek-E.C. River                      | 26,105       | 12,507            | 2,626   | 2,376            | 1,126                          | 2,001             | 750     | 2,001            | 0       | 0                         | 375  | 375                 | 0                  | 0                           | 0                          | 0                         | 0   | 0                     | 0                    | 0             | 0            | 0  | 0   |
| W19                | Lake E.C.-E.C. River                      | 16,917       | 369               | 77      | 70               | 33                             | 59                | 22      | 59               | 0       | 0                         | 0  | 0                   | 0                  | 0                           | 0                          | 0                         | 0   | 0                     | 0                    | 0             | 0            | 0  | 0   |
| W20                | Beaver Creek-Otter Creek                  | 8,288        | 4,710             | 989     | 895              | 424                            | 754               | 283     | 754              | 0       | 0                         | 0  | 0                   | 236                | 0                           | 0                          | 0                         | 0   | 0                     | 0                    | 0             | 0            | 0  | 0   |
| W21                | Otter Creek                               | 34,185       | 2,801             | 2,534   | 1,200            | 2,134                          | 800               | 2,134   | 0                | 0       | 0                         | 0  | 0                   | 0                  | 0                           | 0                          | 0                         | 0   | 0                     | 0                    | 0             | 0            | 0  | 0   |
| W22                | Thompson Valley Creek                     | 8,378        | 4,058             | 852     | 771              | 365                            | 649               | 243     | 649              | 0       | 0                         | 812  | 812                 | 853                | 609                         | 365                        | 0                         | 0   | 0                     | 0                    | 0             | 0            | 0  | 0   |
| W23                | Bridge Creek                              | 37,725       | 9,029             | 1,896   | 1,716            | 813                            | 1,445             | 542     | 1,445            | 0       | 0                         | 0  | 0                   | 0                  | 0                           | 0                          | 0                         | 0   | 0                     | 0                    | 0             | 0            | 0  | 0   |
| W24                | Bears Grass Creek                         | 17,665       | 9,406             | 1,975   | 1,787            | 847                            | 1,505             | 564     | 1,505            | 0       | 0                         | 0  | 0                   | 470                | 0                           | 0                          | 0                         | 0   | 0                     | 0                    | 0             | 0            | 0  | 0   |
| W25                | Fall Creek                                | 11,213       | 5,259             | 1,104   | 999              | 473                            | 841               | 316     | 841              | 0       | 0                         | 0  | 0                   | 789                | 158                         | 473                        | 210                       | 1,787   | 2,210                 | 317                  | 0             | 0            | 0  | 0   |
| W26                | Beaver Creek-E.C. River                   | 11,588       | 3,512             | 738     | 667              | 316                            | 562               | 211     | 562              | 0       | 0                         | 0  | 0                   | 0                  | 0                           | 0                          | 0                         | 0   | 0                     | 0                    | 0             | 0            | 0  | 0   |
| W27                | Sand Creek-E.C. River                     | 17,709       | 4,948             | 1,039   | 940              | 445                            | 792               | 297     | 792              | 0       | 0                         | 0  | 0                   | 0                  | 0                           | 0                          | 0                         | 0   | 0                     | 0                    | 0             | 0            | 0  | 0   |
| W28                | Deinhammer Creek-E.C. River               | 12,460       | 3,653             | 767     | 694              | 329                            | 584               | 219     | 584              | 0       | 0                         | 0  | 0                   | 0                  | 0                           | 0                          | 0                         | 0   | 0                     | 0                    | 0             | 0            | 0  | 0   |
| W29                | Ninemile Creek-E.C. River                 | 11,319       | 3,602             | 756     | 684              | 324                            | 576               | 216     | 576              | 0       | 0                         | 0  | 0                   | 0                  | 0                           | 0                          | 0                         | 0   | 0                     | 0                    | 0             | 0            | 0  | 0   |
| W30                | Altoona Lake-E.C. River                   | 15,272       | 3,135             | 658     | 596              | 282                            | 502               | 188     | 502              | 0       | 0                         | 0  | 0                   | 157                | 0                           | 0                          | 0                         | 0   | 0                     | 0                    | 0             | 0            | 0  | 0   |
| Totals             |   | 565,629      | 41,779            | 37,800  | 17,905           | 31,831                         | 11,937            | 31,831  | 0                | 0       | 0                         | 0  | 0                   | 3,245              | 851                         | 10,969                     | 11,620                    | 9,301   | 10,320                | 2,248                | 5,098         | 26,882       | 29,239   |   |

## STEPL Cropland BMP Scenario Estimates Phosphorus Reductions

| STEPL Watershed ID | Name                                      | Area (acres) | Cropland (acres) | Cropland BMP Scenario Estimated Acreage, Loading, and Reductions<br>(includes cropland combination and non-combo BMPs, but excludes Streambank Stabilization/Fencing) |                                      |                     |                               |                          |                                     |                    |                              |                          |                            |
|--------------------|---|--------------|------------------|---|--------------------------------------|---------------------|-------------------------------|--------------------------|-------------------------------------|--------------------|------------------------------|--------------------------|----------------------------|
|                    |   |              |                  | Current - BMP Total acres   | % of Current Cropland (Current BMPs) | STEPL - Current lbs | STEPL - Current Sediment TONS | Future - BMP Total acres | % of Current Cropland (Future BMPs) | STEPL - Future lbs | STEPL - Future sediment TONS | Cropland P lbs Reduction | % Cropland P lbs Reduction |
| W1                 | Headwaters North Fork E.C. River          | 22,172       | 11,704           | 4,213.4   | 36%                                  | 15,029              | 2,639                         | 5,969.0                  | 51.0%                               | 11,841             | 2,081                        | 3,188                    | 21.2%                      |
| W2                 | Goggle-Eye Creek-North Fork E.C. River    | 18,129       | 13,141           | 9,000.0   | 68%                                  | 13,138              | 3,363                         | 12,298.1                 | 94%                                 | 7,868              | 1,041                        | 5,270                    | 40.1%                      |
| W3                 | Sterling Creek-North Fork E.C. River      | 15,058       | 7,545            | 4,047.0   | 54%                                  | 7,175               | 1,646                         | 7,548.0                  | 100%                                | 5,021              | 1,266                        | 2,154                    | 30.0%                      |
| W4                 | Little Otter Creek-Wolf River             | 23,166       | 14,737           | 5,305.3   | 36%                                  | 19,256              | 3,591                         | 7,515.9                  | 51%                                 | 15,172             | 2,832                        | 4,084                    | 21.2%                      |
| W5                 | Wolf River                                | 28,874       | 17,986           | 8,899.3   | 49%                                  | 21,325              | 3,569                         | 11,899.3                 | 66%                                 | 16,605             | 2,832                        | 4,720                    | 22.1%                      |
| W6                 | Simes Creek-North Fork E.C. River         | 12,607       | 693              | 249.5   | 36%                                  | 595                 | 88                            | 353.4                    | 51%                                 | 469                | 63                           | 126                      | 21.2%                      |
| W7                 | North Fork E.C. River                     | 12,004       | 211              | 168.8   | 80%                                  | 110                 | 18                            | 210.6                    | 100%                                | 59                 | 10                           | 51                       | 46.4%                      |
| W8                 | Headwaters South Fork E.C. River          | 14,429       | 10,318           | 5,412.7   | 52%                                  | 12,242              | 2,323                         | 7,412.7                  | 72%                                 | 8,818              | 1,600                        | 3,424                    | 28.0%                      |
| W9                 | St. Hedwig Cemetery-South Fork E.C. River | 18,192       | 13,431           | 5,689.2   | 42%                                  | 17,750              | 3,503                         | 8,537.2                  | 64%                                 | 13,340             | 2,725                        | 4,410                    | 24.8%                      |
| W10                | Norwegian Creek-South Fork E.C. River     | 17,761       | 6,663            | 2,948.5   | 44%                                  | 6,341               | 1,370                         | 4,368.4                  | 66%                                 | 4,472              | 931                          | 1,869                    | 29.5%                      |
| W11                | Black Creek-South Fork E.C. River         | 9,771        | 1,626            | 634.1   | 39%                                  | 1,441               | 234                           | 878.0                    | 54%                                 | 1,125              | 183                          | 316                      | 21.9%                      |
| W12                | Mead Lake-South Fork E.C. River           | 14,276       | 6,110            | 2,444.0   | 40%                                  | 5,620               | 1,067                         | 3,360.5                  | 55%                                 | 4,388              | 837                          | 1,232                    | 21.9%                      |
| W13                | Hay Creek-South Fork E.C. River           | 39,227       | 4,296            | 1,718.4   | 40%                                  | 3,346               | 259                           | 2,362.8                  | 55%                                 | 2,610              | 202                          | 736                      | 22.0%                      |
| W14                | Dickison Creek-South Fork E.C. River      | 12,352       | 888              | 435.5   | 49%                                  | 685                 | 77                            | 535.5                    | 60%                                 | 547                | 67                           | 138                      | 20.1%                      |
| W15                | South Fork E.C. River                     | 21,459       | 66               | 23.8  | 36%                                  | 53                  | 4                             | 33.7                     | 51%                                 | 42                 | 3                            | 11                       | 20.8%                      |
| W16                | Black Creek-E.C. River                    | 37,672       | 6,348            | 2,555.1   | 40%                                  | 5,486               | 832                           | 3,507.3                  | 55%                                 | 4,318              | 645                          | 1,168                    | 21.3%                      |
| W17                | Muskkrat Creek                            | 21,655       | 5,657            | 2,036.5   | 36%                                  | 5,260               | 982                           | 2,885.1                  | 51%                                 | 4,145              | 775                          | 1,115                    | 21.2%                      |
| W18                | Hay Creek-E.C. River                      | 26,105       | 12,507           | 4,877.7   | 39%                                  | 12,008              | 2,549                         | 6,753.8                  | 54%                                 | 9,378              | 2,001                        | 2,630                    | 21.9%                      |
| W19                | Lake E.C.-E.C. River                      | 16,917       | 369              | 132.8   | 36%                                  | 218                 | 41                            | 188.2                    | 51%                                 | 171                | 32                           | 47                       | 21.6%                      |
| W20                | Beaver Creek-Otter Creek                  | 8,288        | 4,710            | 1,931.1   | 41%                                  | 6,821               | 957                           | 2,402.1                  | 51%                                 | 5,661              | 792                          | 1,160                    | 17.0%                      |
| W21                | Otter Creek                               | 34,185       | 13,338           | 5,468.6   | 41%                                  | 15,975              | 2,632                         | 6,802.4                  | 51%                                 | 13,257             | 2,178                        | 2,718                    | 17.0%                      |
| W22                | Thompson Valley Creek                     | 8,378        | 4,058            | 4,058.8   | 100%                                 | 1,943               | 512                           | 4,058.3                  | 100%                                | 1,506              | 432                          | 437                      | 22.5%                      |
| W23                | Bridge Creek                              | 37,725       | 9,029            | 3,611.6   | 40%                                  | 8,470               | 1,680                         | 4,604.8                  | 51%                                 | 6,733              | 1,331                        | 1,737                    | 20.5%                      |
| W24                | Bears Grass Creek                         | 17,665       | 9,406            | 7,430.7   | 79%                                  | 8,383               | 2,171                         | 8,841.6                  | 94%                                 | 5,721              | 1,548                        | 2,662                    | 31.8%                      |
| W25                | Fall Creek                                | 11,213       | 5,259            | 5,259.1   | 100%                                 | 3,505               | 976                           | 5,260.2                  | 100%                                | 3,126              | 891                          | 379                      | 10.8%                      |
| W26                | Beaver Creek-E.C. River                   | 11,588       | 3,512            | 1,896.5   | 54%                                  | 2,954               | 533                           | 2,107.2                  | 60%                                 | 2,426              | 442                          | 528                      | 17.9%                      |
| W27                | Sand Creek-E.C. River                     | 17,709       | 4,948            | 2,671.9   | 54%                                  | 4,093               | 695                           | 3,711.0                  | 75%                                 | 3,091              | 552                          | 1,002                    | 24.5%                      |
| W28                | Deinhammer Creek-E.C. River               | 12,460       | 3,653            | 1,607.3   | 44%                                  | 3,004               | 421                           | 1,863.03                 | 51%                                 | 2,493              | 351                          | 511                      | 17.0%                      |
| W29                | Ninemile Creek-E.C. River                 | 11,319       | 3,602            | 1,440.8   | 40%                                  | 4,192               | 523                           | 1,837.02                 | 51%                                 | 3,389              | 433                          | 803                      | 19.2%                      |
| W30                | Altoona Lake-E.C. River                   | 13,272       | 3,135            | 2,476.7   | 79%                                  | 2,130               | 334                           | 2,508.0                  | 80%                                 | 1,819              | 288                          | 311                      | 14.6%                      |
| Totals             |   | 565,629      | 198,946          | 98,645  | 49.6%                                | 208,548             |                               | 130,613                  | 65.7%                               | 159,611            | 29,365                       | 48,937                   | 23.5%                      |

## Private Septic System (POWTS) Assumptions

### Improved Residential Parcels within 300ft of Lakes and Rivers (HUC 12)

| HUC 12       | Name                                      | Total Number of Parcels | Parcels in Cities & Villages | Parcels in Towns | Estimated Annual Lbs P from Failing POWTS |
|--------------|---|-------------------------|------------------------------|------------------|---|
| 070500060101 | Headwaters North Fork E.C. River          | 24                      | 3                            | 21               | 3.39                                      |
| 070500060201 | Headwaters South Fork E.C. River          | 13                      | 0                            | 13               | 2.10                                      |
| 070500060102 | Goggle-Eye Creek North Fork E.C. River    | 113                     | 61                           | 52               | 8.39                                      |
| 070500060104 | Little Otter Creek-Wolf River             | 168                     | 103                          | 65               | 10.48                                     |
| 070500060105 | Wolf River                                | 59                      | 0                            | 59               | 9.52                                      |
| 070500060103 | Sterling Creek-North Fork E.C. River      | 34                      | 0                            | 34               | 5.48                                      |
| 070500060202 | St. Hedwig Cemetery-South Fork E.C. River | 27                      | 0                            | 27               | 4.35                                      |
| 070500060203 | Norwegian Creek-South Fork E.C. River     | 20                      | 0                            | 20               | 3.23                                      |
| 070500060204 | Black Creek-South Fork E.C. River         | 11                      | 0                            | 11               | 1.77                                      |
| 070500060106 | Simes Creek-North Fork E.C.               | 5                       | 0                            | 5                | 0.81                                      |
| 070500060207 | Dickison Creek-South Fork E.C. River      | 10                      | 0                            | 10               | 1.61                                      |
| 070500060205 | Mead Lake-South Fork E.C. River           | 157                     | 0                            | 157              | 25.32                                     |
| 070500060206 | Hay Creek-South Fork E.C. River           | 132                     | 0                            | 132              | 21.29                                     |
| 070500060208 | South Fork E.C. River                     | 1                       | 0                            | 1                | 0.16                                      |
| 070500060107 | North Fork E.C. River                     | 0                       | 0                            | 0                | 0.00                                      |
| 070500060302 | Muskrat Creek                             | 29                      | 0                            | 29               | 4.68                                      |
| 070500060303 | Hay Creek-E.C. River                      | 106                     | 48                           | 58               | 9.35                                      |
| 070500060304 | Lake E.C.-E.C. River                      | 198                     | 0                            | 198              | 31.93                                     |
| 070500060301 | Black Creek-E.C. River                    | 33                      | 19                           | 14               | 2.26                                      |
| 070500060502 | Bridge Creek                              | 128                     | 86                           | 42               | 6.77                                      |
| 070500060501 | Thompson Valley Creek                     | 5                       | 0                            | 5                | 0.81                                      |
| 070500060503 | Bears Grass Creek                         | 9                       | 0                            | 9                | 1.45                                      |
| 070500060506 | Sand Creek-E.C. River                     | 7                       | 0                            | 7                | 1.13                                      |
| 070500060505 | Beaver Creek-E.C. River                   | 12                      | 0                            | 12               | 1.94                                      |
| 070500060507 | Deinhammer Creek-E.C. River               | 11                      | 0                            | 11               | 1.77                                      |
| 070500060504 | Fall Creek                                | 22                      | 20                           | 2                | 0.32                                      |
| 070500060508 | Ninemile Creek-E.C. River                 | 34                      | 0                            | 34               | 5.48                                      |
| 070500060401 | Beaver Creek-Otter Creek                  | 20                      | 0                            | 20               | 3.23                                      |
| 070500060402 | Otter Creek                               | 111                     | 53                           | 58               | 9.35                                      |
| 070500060509 | Altoona Lake-E.C. River                   | 342                     | 71                           | 271              | 43.71                                     |
|              | <b>Total</b>                              | <b>1841</b>             | <b>464</b>                   | <b>1377</b>      | <b>222.08</b>                             |

| Parcels in Cities/Villages |            |
|----------------------------|------------|
| City of Stanley            | 103        |
| Village of Boyd            | 48         |
| Village of Lublin          | 3          |
| City of Thorp              | 61         |
| City of Altoona            | 64         |
| City of E.C.               | 60         |
| Village of Fall Creek      | 20         |
| City of Augusta            | 86         |
| Village of Fairchild       | 19         |
| <b>Total</b>               | <b>464</b> |

Methodology: These figures represent all residential improved parcels whose centroid is within 300 feet of a river, lake, or stream. For estimating purposes, parcels located in cities and villages were assumed to be on public sewer and parcels in unincorporated towns were assumed to be on private septic systems (POWTS).

## **Supplement to Section IV.D. WDNR SWAT Phosphorus-Loading Model**

The Soil and Water Assessment Tool (SWAT) model previously developed for the Eau Claire River Watershed (Freihoefer et al. 2009) was used to determine how much phosphorus-loading reduction is needed in each HUC 12 in order to meet Wisconsin's maximum allowable phosphorus concentration standards. The results were used to develop the HUC-12 and overall phosphorous reduction target objectives in Section VIII. of the plan

The SWAT model is a physically based model that simulates stream flow, sediment loss, and nutrient exports (Neitsch et al. 2002). The SWAT model incorporates the effects of weather, surface runoff, evapotranspiration, crop growth, irrigation, groundwater flow, nutrient loading, and water routing for varying land uses. SWAT divides a large watershed into subwatersheds, which are further subdivided into hydrologic response units (HRUs) which are defined as unique combinations of soil, land cover type, and management practices in a subwatershed. The SWAT model has successfully been used to evaluate agriculturally dominant watersheds for sediment and nutrient TMDLs (Cadmus, 2012; Cadmus 2011; USEPA 2004).

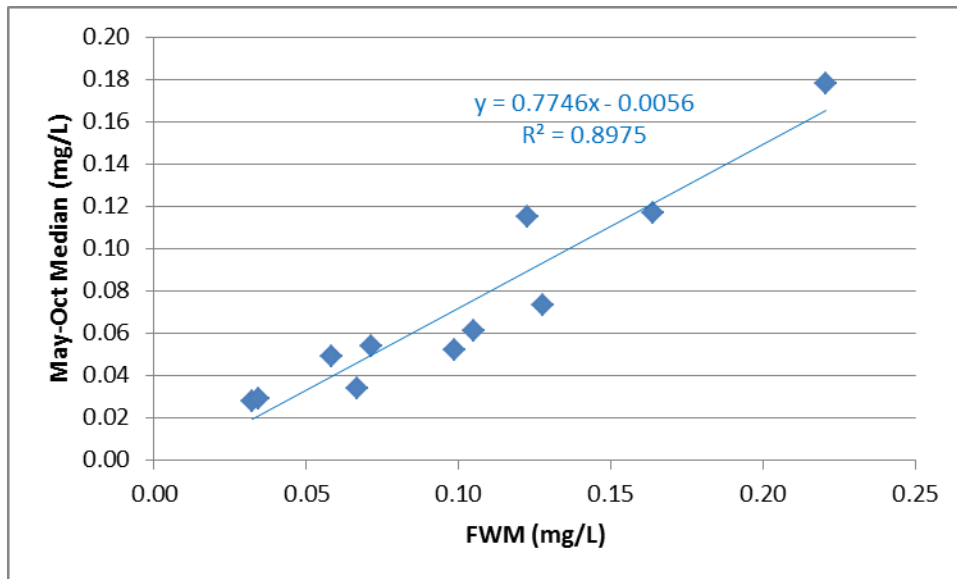
The SWAT model methodology has many elements in common with the EVAAL and STEPL models, the most important of which is that they all share some modification of the Universal Soil Loss Equation as the basis of predicting soil erosion. However, SWAT carries with it the distinctive advantage of being able to be calibrated to account for local phenomena. This calibration process allows the model to accurately predict nutrient transport and to match real world data. In the case of the Eau Claire River Watershed, the SWAT model was calibrated to data from eight phosphorus load monitoring station scattered throughout streams in the watershed.

Due to the manner in which the Eau Claire River Watershed SWAT model was developed, the raw SWAT model outputs needed some adjustment in order to mesh with the EVAAL and STEPL models and plan target objectives. These adjustments primarily relate to the land cover and subwatershed boundaries. The Eau Claire River Watershed SWAT model was developed based on a customized land cover data set based 2001 Clark County land coverage and a modified version of the WDNR 1992 WISCLAND coverage. The STEPL analysis was based on the USGS NLCD 2006 Land Cover data set. The subbasin boundaries in the SWAT model tended not to match up with the Federal HUC12 subwatershed watershed boundaries used in the other modeling efforts.

Because STEPL will be used to estimate and track load reductions at the HUC12 scale during implementation, the SWAT results needed to be translated to this land cover and subbasin scheme. To do this translation, the SWAT model HRU outputs (water and phosphorus yields) were aggregated by SWAT land cover type in each SWAT subbasin to obtain site-specific unit area export coefficients for each land cover type. These export coefficients were then assigned to a corresponding NLCD land cover and HUC12 subwatershed boundary to estimate the long-term average water and phosphorus yield at the HUC12 scale.

Two different tools were used to determine the relationship between watershed phosphorus loading and resultant lake and stream water quality:

- i. For the streams, the goals (or targets) were initially based on meeting the local stream criteria for phosphorus which is a May – October median of 75 µg/L. Many streams in the basin currently exceeded the criteria; however there are a number of streams that are well below the criteria. This latter group of streams generally is in watersheds dominated by forest lands. Recently completed monitoring as part of the development of the Wisconsin River TMDL has demonstrated that a fairly simple regression relationship exists between the annual flow-weighted mean phosphorus concentration (i.e. phosphorus yield ÷ water yield) and the May – October median concentration. This regression equation forms the basis for reductions needed to meet the local stream water quality criteria.



- ii. For the impoundments in the watershed, the goals (or targets) are largely based on summer algal bloom frequencies as measures by chlorophyll-a. The goal is to limit “nuisance algae blooms” (i.e., >20 µg/L chlorophyll-a) to less than of 30% of days during the sampling season. For Lake Altoona, Lake Eau Claire, Coon Fork Lake, Mead Lake, and Rock Dam Lake previously developed Bathtub models (insert references) were used to examine phosphorus loading reduction scenarios. Bathtub is a set of empirical lake response models for predicting total phosphorus, chlorophyll-a, and Secchi transparency (Walker 1996).

Setting the phosphorus reduction target objectives in Section VIII for the watershed was done in a sequential fashion to first ensure that local water quality target were met and then determine if additional reductions were needed to meet downstream water quality targets:

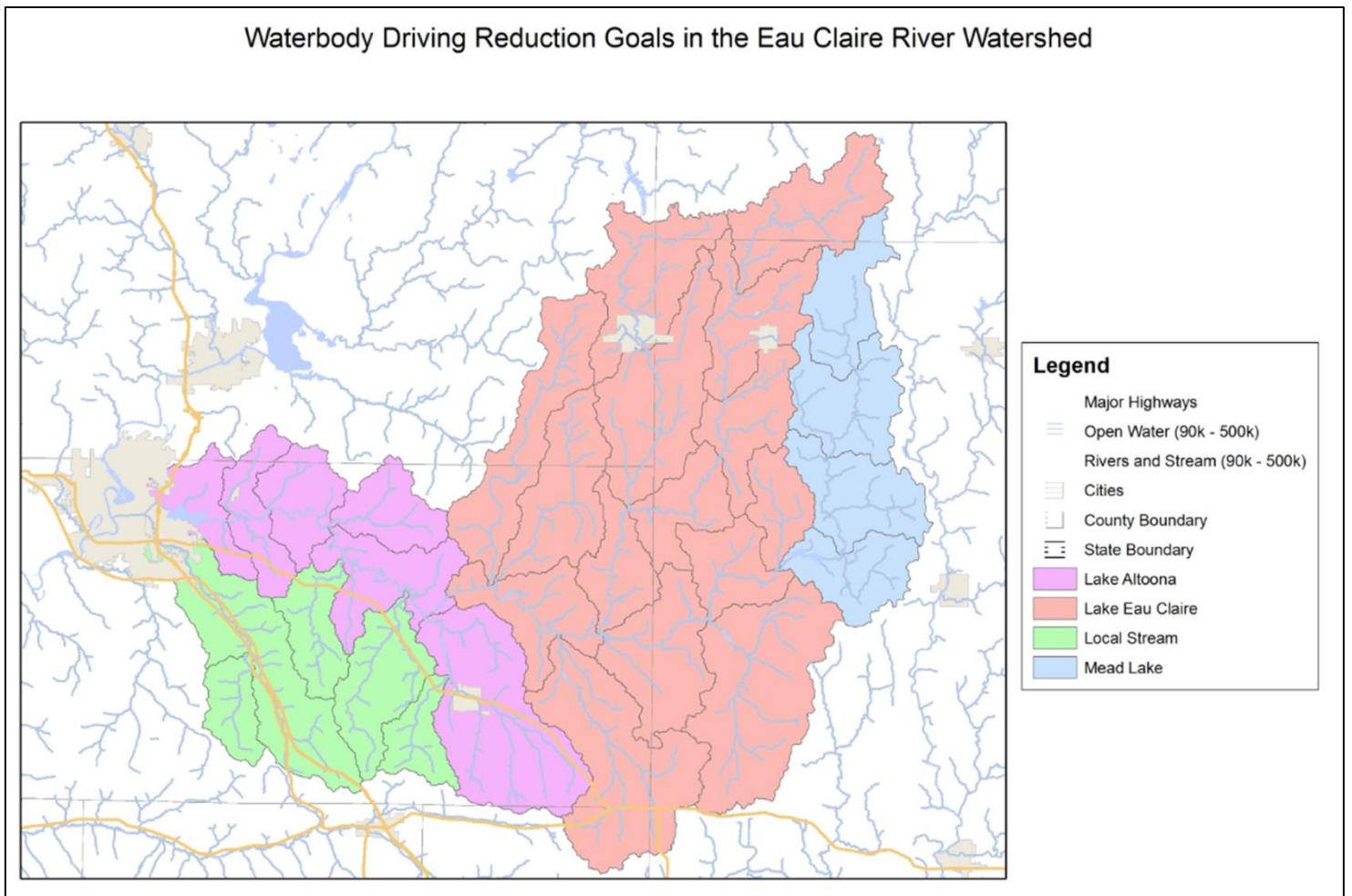
1. By HUC12, calculate the load needed to meet the stream water quality criterion.
2. Where reductions are needed, reduce anthropogenic (i.e. urban and agricultural) sources until load targets are met.
3. Starting at the upstream most impoundment, calculate the load needed to meet the lake water quality targets.
4. Where reductions are needed, reduce anthropogenic (i.e. urban and agricultural) sources until load targets are met. If there are multiple HUC12s above the lake, reduce anthropogenic sources



by the same percentage in each watershed, unless a higher percentage is needed to meet the local stream water load target. This was done by first reducing the estimated average cropland yields in all contributing watershed to that of the lowest in the group and then uniformly reducing all watershed yields until the impoundment goal was met.

5. Repeat process 3 & 4 working sequentially downstream through the watershed to Lake Altoona.
6. Urban phosphorus yields were reduced from 0.6 to 0.4 lbs/ac. Cropland yields were reduced by variable amounts depending on the waterbody needs within the lowest yield being 0.18 lbs/ac.

The results of this analysis is summarized in the table on the following page. The limiting factor for each HUC-12 is also represented in the map below.



## SWAT-Based Phosphorus Loads, Goals, and Reductions by HUC-12

| HUC12        | P Baseline | P Goal | Percent Reduction Total | Percent Reduction Agriculture | W_yield_goal | Ag_yield_goal | W_yield_base | Ag_yield_base | Limit_factor    |
|--------------|------------|--------|-------------------------|-------------------------------|--------------|---------------|--------------|---------------|-----------------|
| 070500060101 | 6997       | 3291   | 53%                     | 63%                           | 0.15         | 0.19          | 0.32         | 0.50          | Lake Eau Claire |
| 070500060102 | 9206       | 3103   | 66%                     | 70%                           | 0.17         | 0.19          | 0.51         | 0.62          | Lake Eau Claire |
| 070500060103 | 5223       | 2028   | 61%                     | 69%                           | 0.13         | 0.19          | 0.35         | 0.59          | Lake Eau Claire |
| 070500060104 | 11232      | 3577   | 68%                     | 73%                           | 0.15         | 0.19          | 0.49         | 0.69          | Lake Eau Claire |
| 070500060105 | 15157      | 4318   | 72%                     | 76%                           | 0.15         | 0.19          | 0.53         | 0.77          | Lake Eau Claire |
| 070500060106 | 1434       | 1048   | 27%                     | 70%                           | 0.08         | 0.19          | 0.11         | 0.63          | Lake Eau Claire |
| 070500060107 | 1070       | 951    | 11%                     | 70%                           | 0.08         | 0.19          | 0.09         | 0.63          | Lake Eau Claire |
| 070500060201 | 6257       | 2190   | 65%                     | 68%                           | 0.15         | 0.18          | 0.43         | 0.56          | Mead Lake       |
| 070500060202 | 9574       | 2927   | 69%                     | 72%                           | 0.16         | 0.18          | 0.53         | 0.64          | Mead Lake       |
| 070500060203 | 5706       | 2204   | 61%                     | 73%                           | 0.12         | 0.18          | 0.32         | 0.66          | Mead Lake       |
| 070500060204 | 1727       | 966    | 44%                     | 69%                           | 0.10         | 0.19          | 0.18         | 0.61          | Lake Eau Claire |
| 070500060205 | 6344       | 2140   | 66%                     | 78%                           | 0.15         | 0.18          | 0.44         | 0.83          | Mead Lake       |
| 070500060206 | 5313       | 3354   | 37%                     | 69%                           | 0.09         | 0.19          | 0.14         | 0.61          | Lake Eau Claire |
| 070500060207 | 1571       | 1081   | 31%                     | 70%                           | 0.09         | 0.19          | 0.13         | 0.63          | Lake Eau Claire |
| 070500060208 | 1707       | 1675   | 2%                      | 70%                           | 0.08         | 0.19          | 0.08         | 0.61          | Lake Eau Claire |
| 070500060301 | 6915       | 3749   | 46%                     | 70%                           | 0.10         | 0.19          | 0.18         | 0.62          | Lake Eau Claire |
| 070500060302 | 5869       | 2327   | 60%                     | 77%                           | 0.11         | 0.19          | 0.27         | 0.80          | Lake Eau Claire |
| 070500060303 | 11964      | 3535   | 70%                     | 78%                           | 0.14         | 0.19          | 0.46         | 0.85          | Lake Eau Claire |
| 070500060304 | 1699       | 1495   | 12%                     | 70%                           | 0.09         | 0.19          | 0.10         | 0.63          | Lake Eau Claire |
| 070500060501 | 5818       | 2436   | 58%                     | 60%                           | 0.29         | 0.35          | 0.70         | 0.86          | Local Stream    |
| 070500060502 | 10891      | 8259   | 24%                     | 29%                           | 0.22         | 0.38          | 0.29         | 0.54          | Lake Altoona    |
| 070500060503 | 11174      | 5174   | 54%                     | 55%                           | 0.29         | 0.36          | 0.63         | 0.81          | Local Stream    |
| 070500060504 | 8149       | 2904   | 64%                     | 66%                           | 0.26         | 0.34          | 0.73         | 0.99          | Local Stream    |
| 070500060505 | 2751       | 1986   | 28%                     | 36%                           | 0.17         | 0.38          | 0.24         | 0.60          | Lake Altoona    |
| 070500060506 | 4363       | 3431   | 21%                     | 30%                           | 0.19         | 0.38          | 0.24         | 0.55          | Lake Altoona    |
| 070500060507 | 2739       | 2052   | 25%                     | 32%                           | 0.16         | 0.38          | 0.22         | 0.57          | Lake Altoona    |
| 070500060508 | 2854       | 2126   | 26%                     | 31%                           | 0.19         | 0.38          | 0.25         | 0.56          | Lake Altoona    |
| 070500060509 | 2958       | 2265   | 23%                     | 31%                           | 0.17         | 0.38          | 0.22         | 0.56          | Lake Altoona    |
| 070500060401 | 6011       | 2302   | 62%                     | 63%                           | 0.28         | 0.35          | 0.73         | 0.93          | Local Stream    |
| 070500060402 | 19003      | 9068   | 52%                     | 55%                           | 0.27         | 0.40          | 0.56         | 0.91          | Local Stream    |
|              | 191676     | 87962  |                         |                               |              |               |              |               |                 |