Northeast Neighborhood Phosphorus Run-off Models

Concerns have been raised about the impact of development for the Northeast Neighborhood on water quality for nearby creeks and Lake Waubesa. In particular, the amount of phosphorus going into the watershed has been discussed as a concern. Phosphorus is generally recognized as one of the primary limiting nutrients contributing to algae growth and potential eutrophication in water bodies.

As a part of the Northeast Neighborhood Conceptual Storm Water Management Plan, Ruekert/Mielke used the Source Loading and Management Model (SLAMM) to determine projected pollutant levels, including phosphorus, in stormwater runoff modeled both with and without controls. The results of the model runs can be seen in Figures 1-6 (pages 50-54) of the Draft Northeast Neighborhood Conceptual Storm Water Management Plan.

During public hearings for the NE Neighborhood, Plan Commission members had indicated an interest in being able to compare these post-development phosphorus loading results with the phosphorus that is currently coming off the agricultural lands within the planning area. City of Fitchburg staff reviewed various models for calculating phosphorus loading coming from agricultural lands (SLAMM, SWAT, SNAP-PLUS, P-Index, RUSLE2, etc.)

While SLAMM is one of the preferred tools to model urbanized lands; it was found to not be intended for modeling agricultural or undeveloped lands. Further information on background and assumptions of this model can be found at: http://wi.water.usgs.gov/slamm/.

After literature research and talking with experts John Panuska and Laura Good in the agricultural runoff field, it was determined that Wisconsin P-Index, a model that incorporates both Snap-Plus and RUSLE2 methodologies was the preferred model to utilize. Further information on background and assumptions of this model can be found at: http://wpindex.soils.wisc.edu/pi.php.

In a pre-development state the main influence in phosphorus runoff is the crop being grown. There is significant variation in phosphorus output from soybean to corn or wheat. In a post development state the phosphorus output is consistent over the years with slight variations being caused by the amount of rainfall in a given year. Dependent on the crop planted the output is either slightly higher or lower than phosphorus output in an agricultural land use. In an average 3 year period the phosphorus output in a post development state will be lower than in a pre-development state as outlined in the Model Results Comparison.

Model Results Comparison

SLAMM's phosphorous reports are in pounds per year for the model area. For the purpose of this study, the total phosphorous output (dissolved and filterable) is being used. SLAMM's results are converted to pounds per acre per year, to match the output from Snap-Plus.

Six sub-watersheds were identified in the NE Neighborhood planning area and labeled as Basins 1 through 6. The map showing these basins can be seen in Exhibit 3 of the Draft Northeast Neighborhood Conceptual Storm Water Management Plan. Since the land use in Basins 1 and 3 is primarily agricultural, we looked at those basins for running the Wisconsin P-Index model. Jon Baldock , who is leasing and farming a large portion of Basins 1 and 3, was kind enough to share soil test results, fertilizer rates, and crop rotations in order to run Snap-Plus. For this study, all lands in the basins were modeled as agricultural and soil test results, fertilizer rates, and crop rotation from Baldock's lands were applied as an average across the entirety of both basins.

Basin 1 covers 274.27 acres and is roughly 85% agricultural lands, with the remaining 15% as single family residences and roadways. The agricultural phosphorus runoff results from Wisconsin P-Index/Snap-Plus is summarized in Table 1. Post-developed urban runoff as designed with stormwater controls is summarized in Table 2. Figure 1 shows the screen output for Snap-Plus and Figure 2 shows the screen output for SLAMM.

Table 1 – Basin 1 Agricultural Phosphorus Run-off

Year	Crop	Total P (lbs/ac/yr)
1	Corn	0.3
2	Soy Beans	1.7
3	Wheat	0.5
Mean	3 year rotation	**0.83**

Table 2 – Basin 1 Urban Phosphorus Run-off (w/ controls)

Total P (lbs/ac/yr)
0.39

Figure 1 – Basin 1 Snap-Plus Screen Output

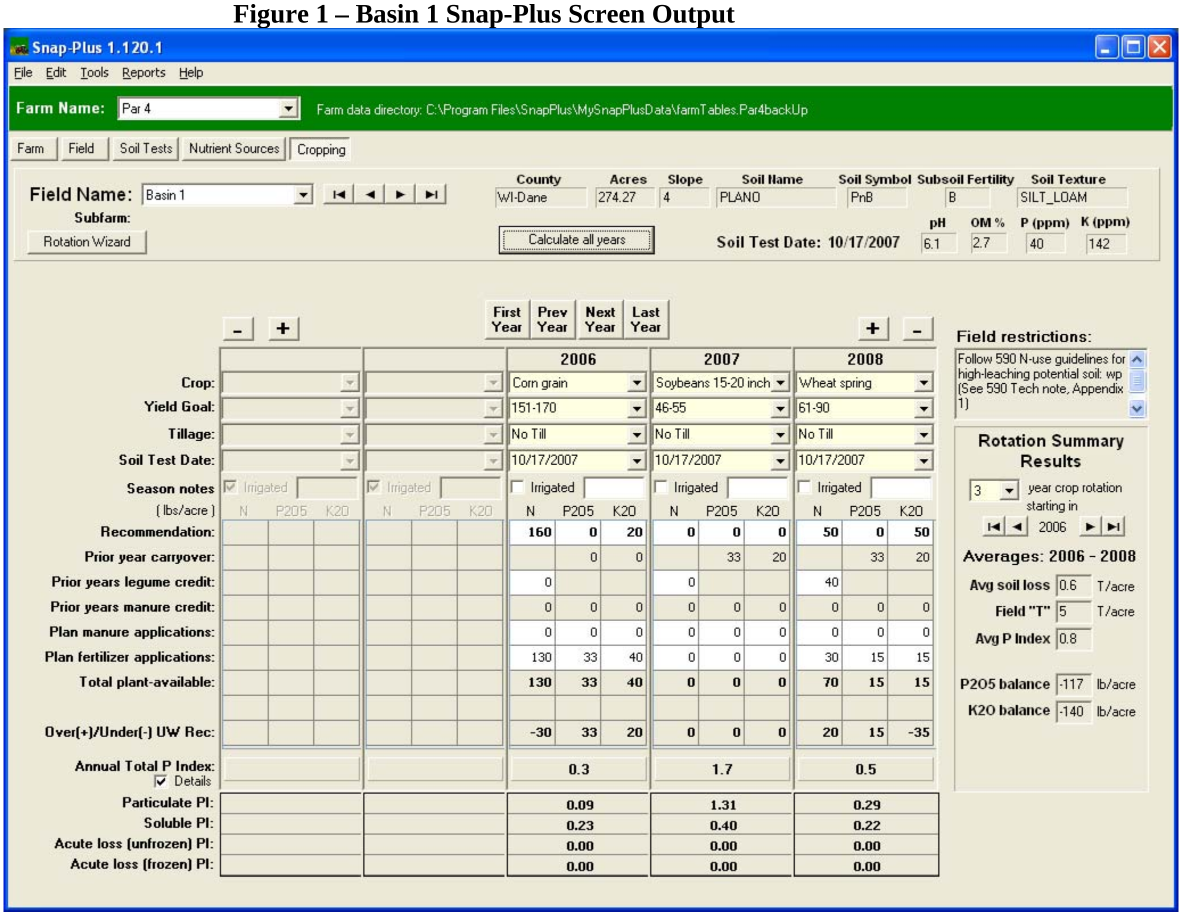
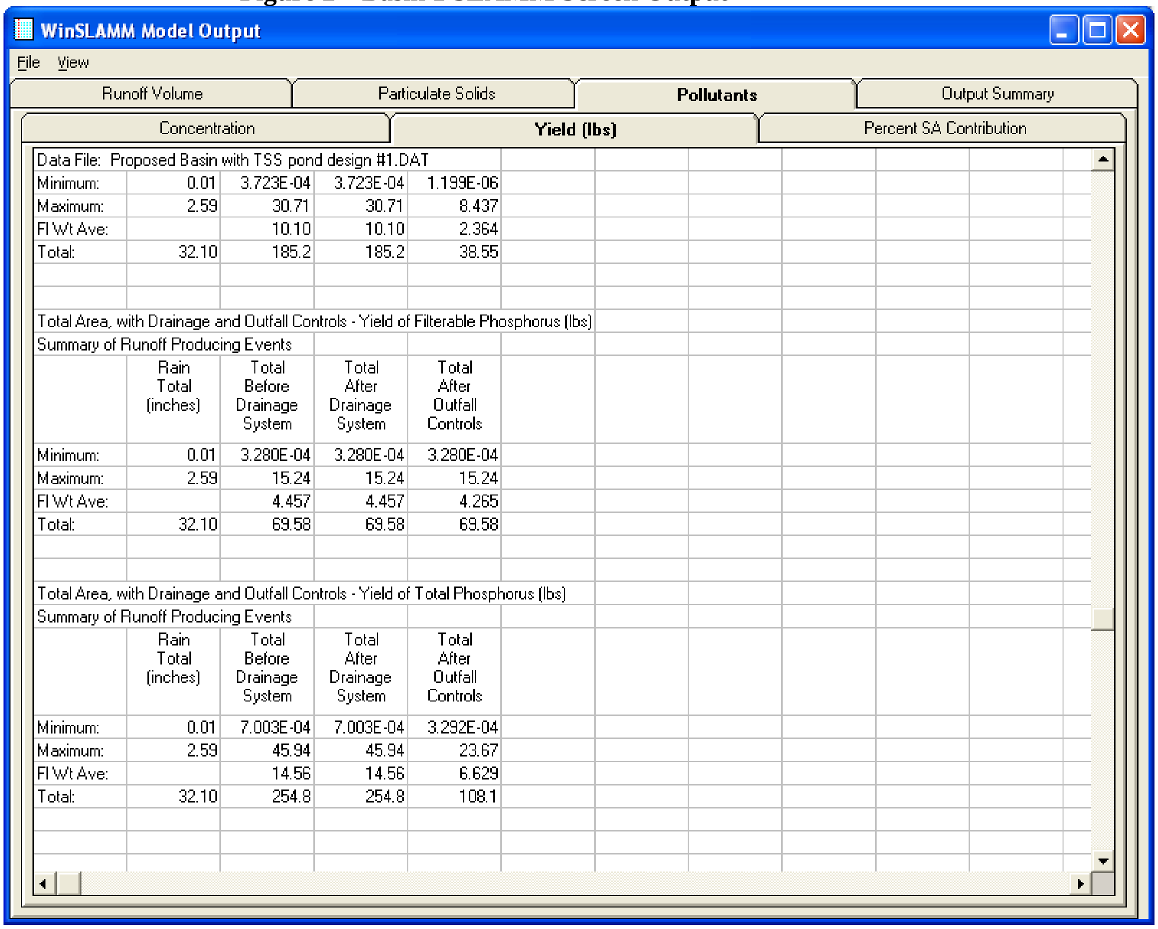


Figure 2 – Basin 1 SLAMM Screen Output



Data File: Proposed Basin with TSS pond design #1.DAT				
Minimum:	0.01	3.723E-04	3.723E-04	1.199E-06
Maximum:	2.59	30.71	30.71	8.437
Fl Wt Ave:		10.10	10.10	2.364
Total:	32.10	185.2	185.2	38.55
Total Area, with Drainage and Outfall Controls - Yield of Filterable Phosphorus (lbs)				
Summary of Runoff Producing Events				
	Rain Total (inches)	Total Before Drainage System	Total After Drainage System	Total After Outfall Controls
Minimum:	0.01	3.280E-04	3.280E-04	3.280E-04
Maximum:	2.59	15.24	15.24	15.24
Fl Wt Ave:		4.457	4.457	4.265
Total:	32.10	69.58	69.58	69.58
Total Area, with Drainage and Outfall Controls - Yield of Total Phosphorus (lbs)				
Summary of Runoff Producing Events				
	Rain Total (inches)	Total Before Drainage System	Total After Drainage System	Total After Outfall Controls
Minimum:	0.01	7.003E-04	7.003E-04	3.292E-04
Maximum:	2.59	45.94	45.94	23.67
Fl Wt Ave:		14.56	14.56	6.629
Total:	32.10	254.8	254.8	108.1

Basin 3 covers 181.54 acres and is nearly all agricultural land use. The agricultural phosphorus runoff is summarized in Table 3. Post-developed urban runoff as designed with stormwater controls is summarized in Table 4. Figure 3 shows the screen output for Snap-Plus and Figure 4 shows the screen output for SLAMM

Table 3 - Basin 3 Agricultural Run-off

Year	Crop	Total P (lbs/ac/yr)
1	Corn	0.3
2	Soy Beans	1.9
3	Wheat	0.5
Mean	3 year rotation	**0.9**

Table 4 - Basin 3 Urban Run-off (w/ Controls)

Total P (lbs/ac/yr)
0.44

Figure 3 - Basin 3 Snap-Plus Screen Output

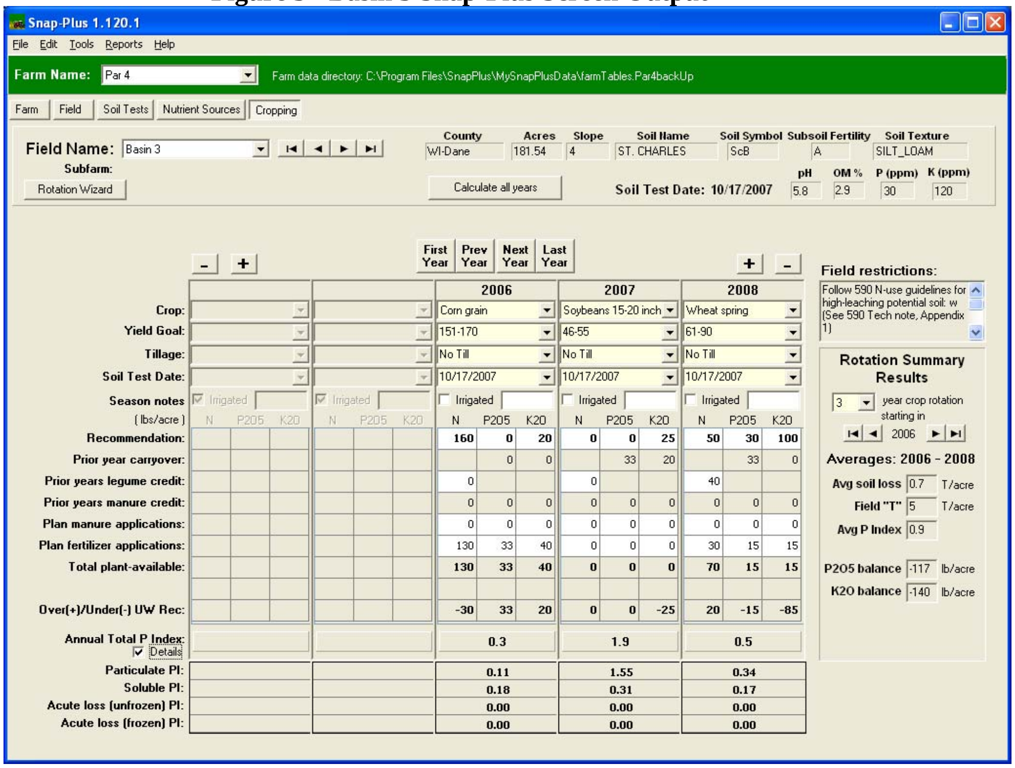


Figure 4 - Basin 3 SLAMM Screen Output