User's Guide

Spreadsheet Tool for the Estimation of Pollutant Load (STEPL)

Version 3.0

Developed for U.S. Environmental Protection Agency

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Contents

Quick Guide

Note: You may access the STEPL Web site (http://it.tetratech-ffx.com/stepl) for the latest information and an online STEPL input data server (Appendix D). Optionally, you may obtain the initial model input from the STEPL input data server. However, it is the **user's responsibility** to check and refine the initial data for study areas.

Step 1. After the installation, run the STEPL program by selecting its menu shortcut from the Start >Programs menu bar or double-clicking the STEPL.exe file in the STEPL folder.

Step 2. Once the STEPL Excel sheet is created, named, and saved, begin to enter the necessary parameter values (displayed in red) in the STEPL input sheet.

The *STEPL input sheet* is composed of ten input tables. The first four tables require that you change the initial values. The next six tables (initially hidden) contain default values that you may choose to change.

Step 3. Select the state and county where your watersheds are located. Select a nearby weather station. This will automatically specify values for rainfall parameters in Table 1 and USLE parameters in Table 4.

Step 4

- Enter land use areas in acres in Table 1.
- Enter total number of agricultural animals by type and number of months per year that manure is applied to croplands in Table 2.
- Enter values for septic system parameters in Table 3.
- If desired, modify USLE parameters associated with the selected county in Table 4.

Step 5. You may stop here and proceed to Step 7. If you have more detailed information on your watersheds, click ***Yes*** in row 10 to display optional input tables.

Step 6. Specify optional parameter values for tables 5, 6a, 7, 8, and 9:

- Specify the representative Soil Hydrologic Group (SHG) and soil nutrient concentrations in Table 5.
- Modify the curve number table in Table 6 and Table 6a.
- Modify the nutrient concentrations (mg/L) in runoff in Table 7.
- Specify the detailed land use distribution in the urban area in Table 8.
- Specify cropland irrigation information in Table 9.

Step 7. Navigate to the BMP sheet by clicking on the BMP tab at the bottom of the spreadsheet. From the pull-down list, select the best management practices (BMPs) for different *non-urban* land uses in each subwatershed. For *urban* land uses, click the ***Urban BMP Tool*** button on the top-right corner of the worksheet to specify urban BMPs.

Step 8. View the estimates of loads and load reductions in the Total Load and Graphs sheets.

User's Guide: Spreadsheet Tool for the Estimation of Pollutant Load (STEPL)[1]

1. Introduction

This document is a concise user's guide to the Spreadsheet Tool for the Estimation of Pollutant Load (STEPL, Version 3.0). STEPL provides a user-friendly Visual Basic (VB) interface to create a customized spreadsheet-based model in Microsoft (MS) Excel. It employs simple algorithms to calculate nutrient and sediment loads from different land uses and the load reductions that would result from the implementation of various best management practices (BMPs), including Low Impact Development practices (LIDs) for urban areas. It computes surface runoff; nutrient loads, including nitrogen, phosphorus, and 5-day biological oxygen demand (BOD_5); and sediment delivery based on various land uses and management practices. The land uses considered are urban land, cropland, pastureland, feedlot, forest, and a user-defined type. The pollutant sources include major nonpoint sources such as cropland, pastureland, farm animals, feedlots, urban runoff, and failing septic systems. The types of animals considered in the calculation are beef cattle, dairy cattle, swine, horses, sheep, chickens, turkeys, and ducks. For each watershed, the annual nutrient loading is calculated based on the runoff volume and the pollutant concentrations in the runoff water as influenced by factors such as the land use distribution and management practices. The annual sediment load (from sheet and rill erosion only) 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 BMP efficiencies.

2. Program Flow and Spreadsheet Tool Structure

STEPL uses a VB interface to generate the spreadsheet model in MS Excel (Figure 1). The VB interface allows users to customize the generated spreadsheet in terms of the number of watersheds to include in the analysis. Depending on users' choices, the generated spreadsheet can have the zero initial input values (e.g. zero land use areas and animal counts), or the non-zero sample input values for testing or learning purposes. Users are encouraged to collect their local land use, animal, population, and soil data to obtain good estimates of watershed loads and load reductions for their specific watersheds. The spreadsheet presents the results in both tabular and graphic formats.

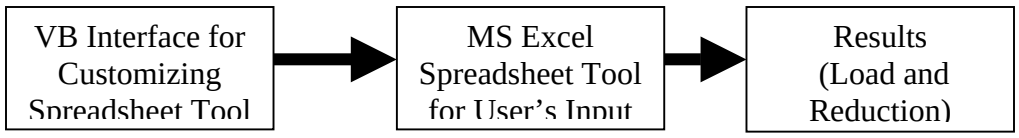


Figure 1. Program flow.

[1] STEPL is designed for the Grants Reporting and Tracking System of the U.S. Environmental Protection Agency (EPA). EPA Work Assignment Manager: Romell Nandi. Tetra Tech developers: Ting Dai, Xingwen Chen, Jian Ouyang, Mira Chokshi, and Henry Manguerra. Special thanks to Wesley Stone of Indiana DEM and Qiu Lu of Tetra Tech Technical Services for their assistance.

Figure 2 shows the overall spreadsheet structure of STEPL. It is composed of worksheets for input and output interaction with the user as well as hidden worksheets to handle intermediate calculations. The input data include state name, county name, weather station, land use areas, agricultural animal numbers, manure application months, population using septic tanks, septic tank failure rate, direct wastewater discharges, irrigation amount/frequency, and BMPs for simulated watersheds. When local data are available, users may choose to modify the default values for USLE parameters, soil hydrologic group, nutrient concentrations in soil and runoff, runoff curve numbers, and detailed urban land use distribution. Pollutant loads and load reductions are automatically calculated for total nitrogen, total phosphorus, BOD_5, and sediment.

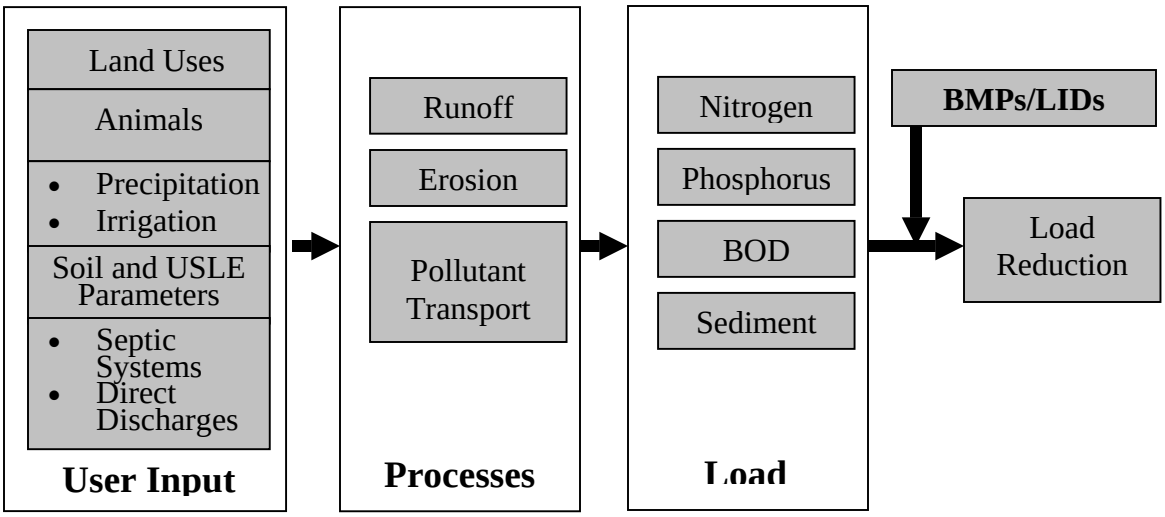


Figure 2. Spreadsheet structure.

3. Installation

3.1 System Requirements

- Windows 95, 98, NT, or 2000.
- MS Excel 2000 is recommended.
- 40 MB hard disk space.

3.2 Installing STEPL

- STEPL can be downloaded as a zipped file (http://it.tetratech-ffx.com/stepl). If you downloaded the STEPL*xxx*.zip (*xxx* stands for version number) file, unzip it to a temporary directory and then run the *setup.exe* program. It is recommended that you install STEPL in the default STEPL folder on the target drive.

- Reboot your computer (not required but recommended).

3.3 System and Data Files

Installation of STEPL will copy the following system files and data files into the target drive:

STEPL.exe	Main program used to generate a customized STEPL model in MS Excel.
BMPcalculator.exe	Calculator for computing combined BMP efficiencies if multiple BMPs have been implemented in a watershed. (See Appendix A.)
BMPcalculator_Help.pdf	Help document and examples for using the BMP calculator.
NutrTplt.xls	Excel template that stores macros for STEPL's customized Excel menus and internal data manipulation.
AllBMPstepl.csv	File that contains BMP and efficiency data that will be loaded into STEPL. You can edit the file through STEPL's STEPL > View/Edit BMP List menu. The installation also puts a backup copy of the same file named as AllBMPstepl_original.csv on your hard drive.
AllBMPs.csv	File that contains BMP and efficiency data that are same as the AllBMPstepl.csv data except the feedlot BMPs. This file is used by the BMP calculator only. The installation also puts a backup copy of the same file named as AllBMPs_original.csv on your hard drive.
BMPDefinition.doc	Reference file that contains BMP descriptions.
PrecRunoff.xls	File that provides a summary of precipitation, number of days with measurable precipitation, and USGS observed runoff for all the US counties except those in Alaska and Hawaii.
USLEbyLU.xls	File that provides a summary of USLE parameters based on the1992 National Resources Inventory (NRI) database. USLE parameter values are estimated by county and land use.
RainCoFactor.xls	File that contains correction factors for precipitation, as well as number of days with measurable precipitation for representative climate stations across the United States.
STEPLGuide.pdf	User's guide in Adobe Acrobat PDF format that is installed along with STEPL.
Sample.xls	Sample STEPL spreadsheet created using STEPL.exe and Excel 2000.
Sample97.xls	Sample STEPL spreadsheet created using STEPL.exe and Excel 97.

SoilNP.xls	File that contains US soil nitrogen and phosphate concentration maps (images).
Release.txt	File that contains release notes, last-minute changes, tips, and other miscellaneous information.

3.4 Directory Structure on Your Hard Drive

If you have installed STEPL on C: drive, you will have the following directory structure:

C:\STEPL
- STEPL.exe
- BMPCalculator.exe
- BMPdefinition.doc
- STEPLGuide.pdf
- Sample.xls
- Sample97.xls
- Release.txt
- \SUPPORT folder
  - AllBMPs.csv
  - AllBMPs_original.csv
  - AllBMPstepl.csv
  - AllBMPstepl_original.csv
  - BMPcalculator_help.pdf
  - NutrTplt.xls
  - PrecRunoff.xls
  - RainCoFactor.xls
  - SoilNP.xls
  - USLEbyLU.xls

3.5 Creating a Customized STEPL Model

Follow these key steps to create a user-customized spreadsheet tool:

- Run the STEPL program by selecting its menu shortcut from the Start-> Programs menu bar or double-clicking the STEPL.exe file in the STEPL folder.
- Click Start in the main interface window (Figure 3).

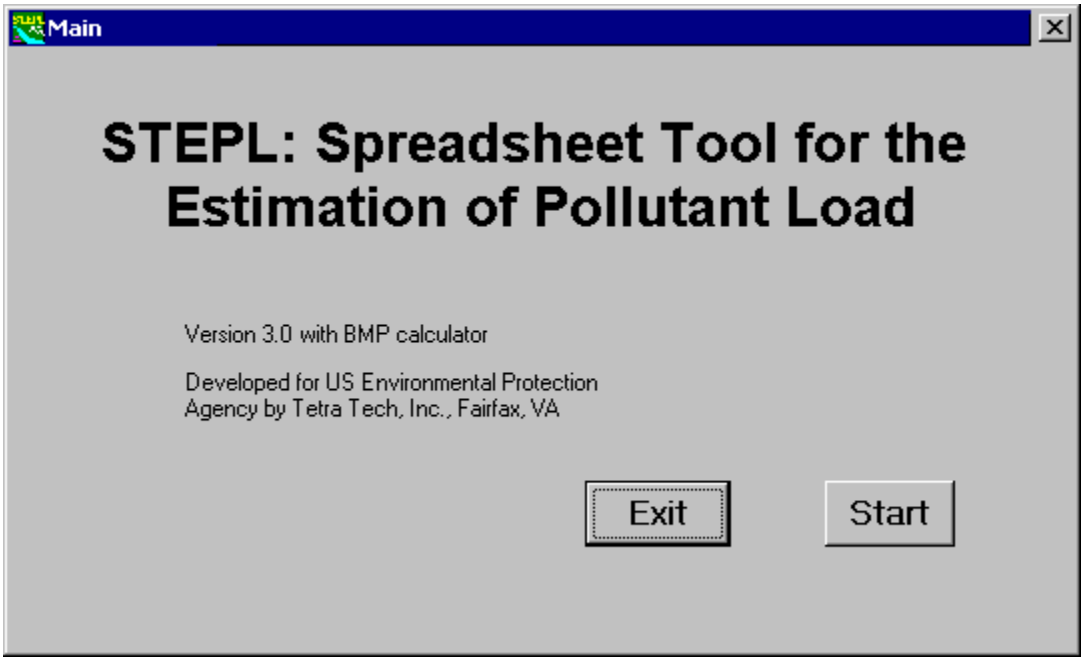


Figure 3. Main program.

- Select the number of watersheds in the study area (Figure 4).

- Select an option to create the STEPL model with zero initial input or non-zero sample input for land use areas and animal counts.
  Note: *Four types of pollutants — total nitrogen, total phosphorus, BOD_5, and sediment; five types of land uses — cropland, pastureland, forest, feedlots, urban, and a user-defined type; and eight types of animals — beef cattle, dairy cattle, swine, sheep, horse, chicken, turkey, and duck, are simulated in STEPL.*

- Click OK to begin creating the STEPL model. A progress bar indicates the progress for the creation of the spreadsheet tool.

- A message box will ask you to save the file and set your Excel security level to medium once the system completes the spreadsheet tool (Figure 5).

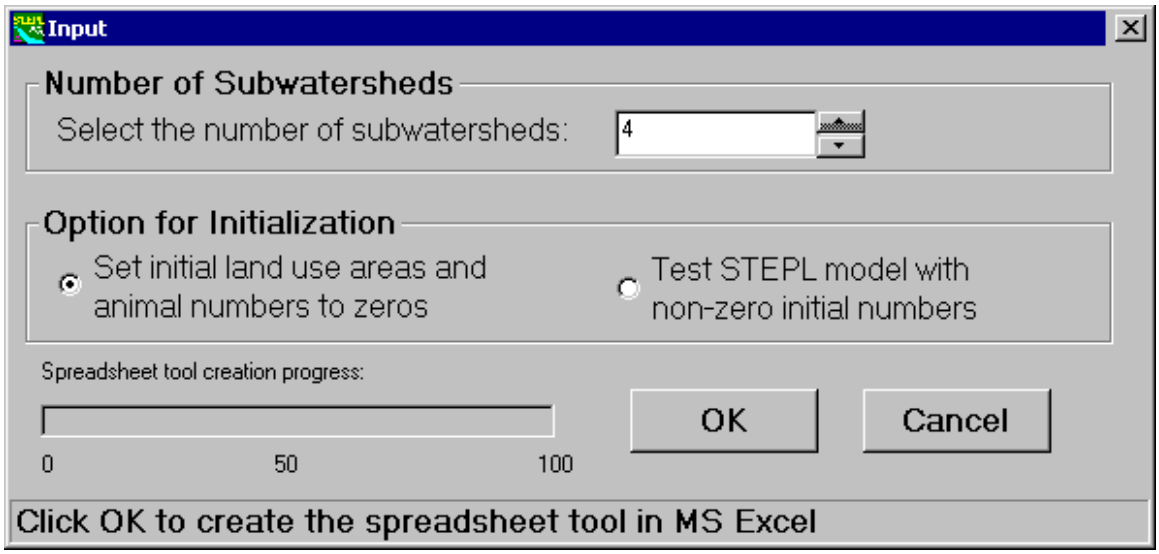


Figure 4. Interface for initial user input to customize the spreadsheet tool.

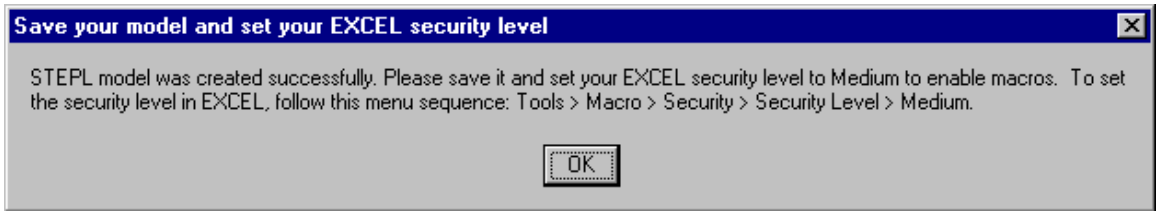


Figure 5. Message box shown after creation of the spreadsheet tool. Follow the instruction to save the newly created STEPL model and to set proper security level for EXCEL application.

4. Using the STEPL Model

STEPL is primarily composed of four worksheets—*Input*, *BMPs*, *Total Load*, and *Graphs*—all designed for user interaction. STEPL also includes 10 other worksheets that are hidden by default. To display all worksheets, click the STEPL > Hide/Unhide Other STEPL Sheets menu. Data entries in the worksheets are in different colors. The hidden worksheets contain detailed data and intermediate calculations.

- Red entries designate values or controls that should be specified (e.g., cropland area in acres) by the user.

- Blue entries provide useful information and assumptions to help users understand the spreadsheet tool.

- Black entries are information calculated by the spreadsheet and should not be changed.

The four worksheets and a *BMPList* worksheet primarily intended for input and output interaction with the user are described below. The nine intermediate (hidden) worksheets are described in Appendix B. A complete summary of all the STEPL worksheets is documented in Appendix C.

4.1 *STEPL* Menu

The spreadsheet tool provides customized MS Excel menus under "STEPL" on the menu bar (Figure 6) to assist you in evaluating and obtaining appropriate parameter values. Under the STEPL menu are the following menu items (Figure 6):

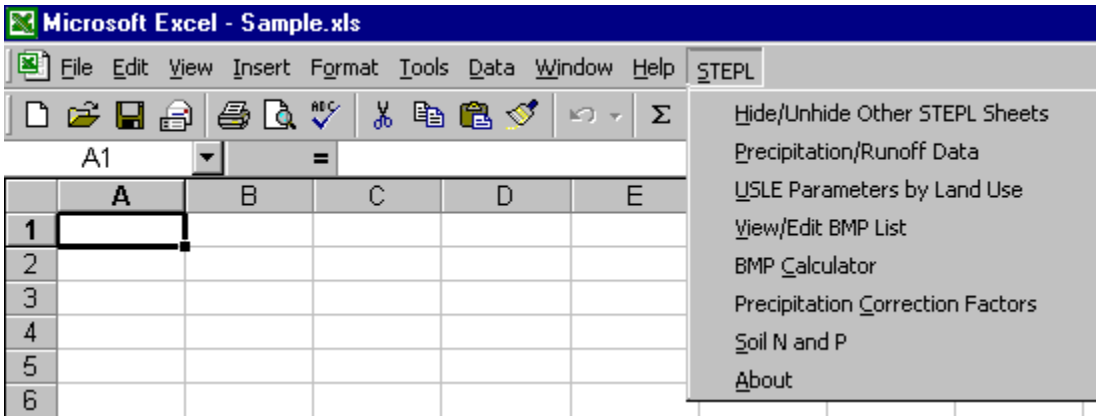


Figure 6. Customized EXCEL menu—the STEPL menu.

Hide/Unhide Other STEPL Sheets – Click this menu to display or hide the STEPL intermediate worksheets.

Precipitation/Runoff Data – Click this menu to open PrecRunoff.xls, which contains summary information on precipitation, rain days, and observed runoff for each state. (See section 3.3.)

USLE Parameters by Land Use – Click this menu to open USLEbyLU.xls, which contains USLE parameter values by land use and county. (See section 3.3.)

View/Edit BMP List – Click this menu to view the *BMPList* worksheet and edit (change, add, or delete) the BMP database, which contains the BMP name and efficiency data. (See sections 3.3, 4.3, and 4.6.)

BMP Calculator – Click this menu to open the BMP calculator to calculate combined BMP efficiencies for a watershed. (See Appendix A.)

Precipitation Correction Data – Click this menu to open RainCoFactor.xls, which contains correction factors for precipitation and number of rain days (see section 3.3). The precipitation correction factor is the percentage of annual precipitation (> = 0.5 cm) that generates runoff. The rain day correction factor is the percentage of rain days that have significant rainfall (> = 0.5 cm).

Soil N and P – Click this menu to open SoilNP.xls. SoilNP.xls provides two national soil maps (Haith et al. 1992) for estimating soil nitrogen and phosphate (P_2O_5) concentrations. You will need to convert the P_2O_5 concentration to a P concentration by multiplying the P_2O_5 concentration by 0.44. (P content in P_2O_5 is 44 percent.)

About – Click this menu to view contact and developer information for STEPL.

4.2 *Input* Worksheet

This worksheet contains your input to the model. It is composed of ten input tables. The first four tables require you to change initial input values (Figure 7). The next six tables (initially hidden) contain default values that you may choose to change (Figure 8). You can obtain pollutant loads and reductions by following these steps:

Step 1: Select the state and county where your watersheds of interest are located. Select a nearby weather station. This will automatically specify values for rainfall parameters in Table 1 and USLE parameters in Table 4 (Figure 7).

Step 2: (a) Enter land use areas in acres in Table 1; (b) enter total number of agricultural animals by type and number of months per year that manure is applied to croplands in Table 2; (c) enter values for septic system parameters, population counts that discharge wastewater directly, and reduction percentages on direct wastewater discharge in Table 3; and (d) optionally modify USLE parameters associated with the selected county in Table 4.

Step 3: You may stop here and proceed to the BMP worksheet. If you have more detailed information on your watersheds, click ***Yes*** in row 10 to display optional input tables.

Step 4: (a) Specify the representative Soil Hydrologic Group (SHG) [2] and soil nutrient concentrations in Table 5; (b) modify curve number table by land use and SHG in Table 6 and Table 6a; (c) modify the default nutrient concentrations (mg/L) in runoff in Table 7[3]; (d) specify detailed land use distribution in the urban area in Table 8; and (e) enter irrigation information (acreage/amount/frequency) in Table 9.

Step 5: Once you have entered and modified the tables in the *Input* worksheet, proceed to the BMP worksheet (section 4.3) to select appropriate BMPs for your watersheds. Pollutant loads and reductions will be calculated and shown on the *Total Load* and *Graphs* sheets. (See sections 4.4 and 4.5.)

Show optional input tables? Yes No

State: Georgia | County: Oconee | Weather Station (for rain correction factors): GA ATHENS MUNI AP

Rain correction factors: 0.917 0.515

1. Input watershed land use area (ac) and precipitation (in)

Watershed	Urban	Cropland	Pasture land	Forest	User Defined	Feedlots	Feedlot Percent Paved	Total	Annual Rainfall	Rain Days	Avg. Rain/Eve
W1	200	200	200	200	0	10	0-24%	810	48.09	97.8	0.876
W2	200	200	200	200	0	10	0-24%	810	48.09	97.8	0.876
W3	200	200	200	200	0	10	0-24%	810	48.09	97.8	0.876
W4	200	200	200	200	0	10	0-24%	810	48.09	97.8	0.876

2. Input agricultural animals

Watershed	Beef Cattle	Dairy Cattle	Swine (Hog)	Sheep	Horse	Chicken	Turkey	Duck	# of months manure
W1	100	100	100	100	100	100	100	100	4
W2	100	100	100	100	100	100	100	100	4
W3	100	100	100	100	100	100	100	100	4
W4	100	100	100	100	100	100	100	100	4
Total	400	400	400	400	400	400	400	400	

3. Input septic system and illegal direct wastewater discharge data

Watershed	No. of Septic Systems	Population per Septic System	Septic Failure Rate, %	Wastewater Direct Discharge, # of People	Direct Discharge Reducti
W1	600	2.43	2	0	0
W2	600	2.43	2	0	0
W3	600	2.43	2	0	0
W4	600	2.43	2	0	0

4. Modify the Universal Soil Loss Equation (USLE) parameters

Watershed	Cropland					Pastureland					Forest
	R	K	LS	C	P	R	K	LS	C	P	R
W1	273.046	0.255	1.017	0.200	0.944	273.046	0.255	1.017	0.040	1.000	273.046
W2	273.046	0.255	1.017	0.200	0.944	273.046	0.255	1.017	0.040	1.000	273.046
W3	273.046	0.255	1.017	0.200	0.944	273.046	0.255	1.017	0.040	1.000	273.046
W4	273.046	0.255	1.017	0.200	0.944	273.046	0.255	1.017	0.040	1.000	273.046

Figure 7. *Input* worksheet, which contains user's input to the model.

[2] SHG A: Low runoff potential and high infiltration rates even when thoroughly wetted. Chiefly deep, well to excessively drained sands or gravels. High rate of water transmission (< 75 cm/hr).

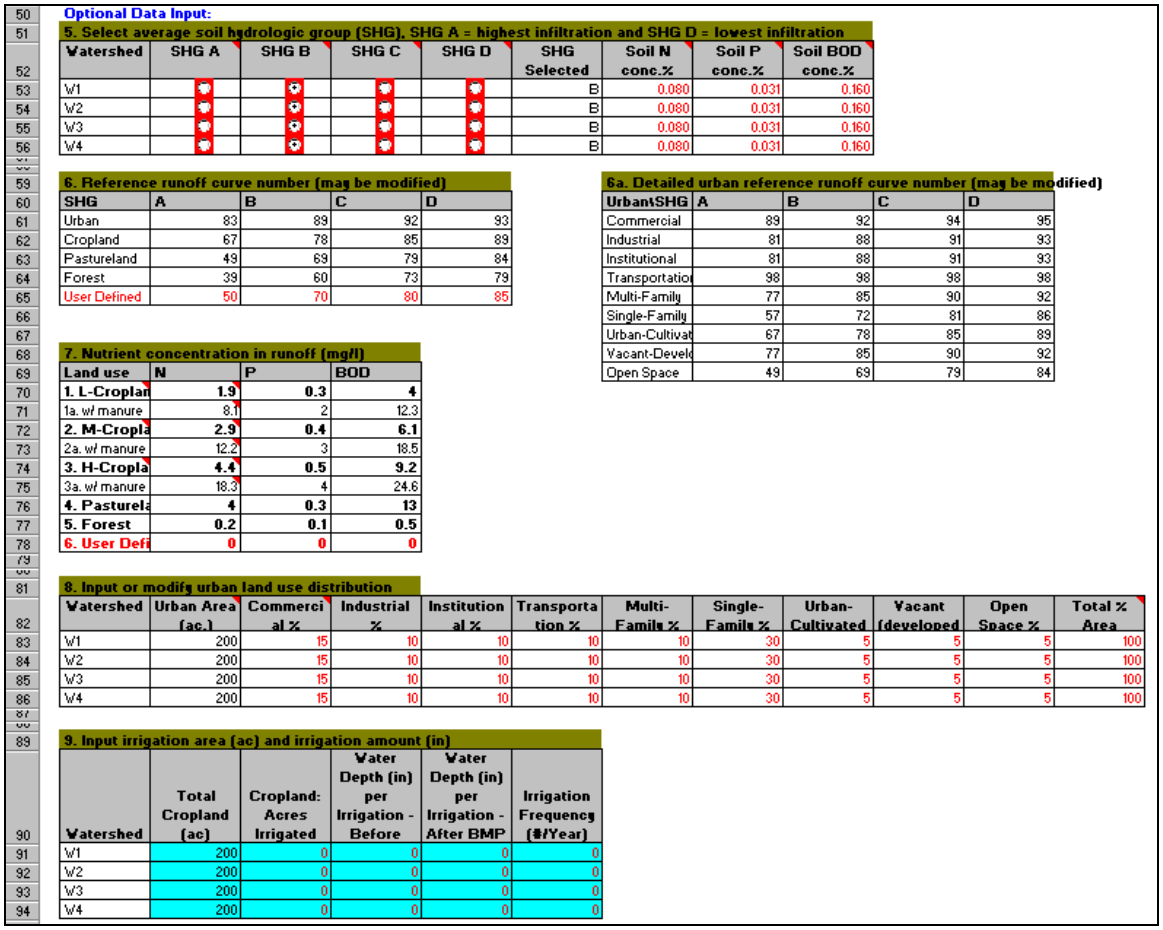
SHG B: Moderate infiltration rates when thoroughly wetted. Chiefly moderately deep to deep, moderately well to well-drained soils with moderately fine to moderately coarse textures. Moderate rate of water transmission (0.4 to 0.75 cm/hr).

SHG C: Low infiltration rates when thoroughly wetted. Chiefly soils with a layer that impedes downward movement of water, or soils with moderately fine to fine texture. Low rate of water transmission (0.15 to 0.40 cm/hr).

SHG D: High runoff potential. Very low infiltration rates when thoroughly wetted. Chiefly clay soils with a high swelling potential, soils with a permanent high water table, soils with a clay pan or clay layer at or near the surface, or shallow soils over nearly impervious material. Very low rate of water transmission (0 to 0.15 cm/hr).

[3] See footnote on next page.

All the table values are directly linked to other worksheets (including hidden worksheets) in STEPL for calculating pollutant loads. Table 1 is linked to the *Land&Rain* and *Feedlots* sheets, which calculate surface runoff. Table 2 is linked to the *Animal* and *Feedlots* sheets, which calculate pollutant loads from agricultural animals. Table 3 is linked to the *Septic* worksheet, which calculates nutrient load from human populations that use septic systems or discharge wastewater directly. Table 4 is linked to the *Sediment* worksheet, which calculates soil erosion and sediment delivery from watersheds. Table 5 is linked to the *Land&Rain* and *Sediment* sheets for determining runoff curve numbers and sediment nutrient concentrations. Table 6 and Table 6a provide reference curve numbers for the *Land&Rain* worksheet. Table 7 [4] provides nutrient concentrations in runoff for calculating pollutant loads in the *Total Load* worksheet. Table 8 provides detailed urban land use distribution for the *Urban* worksheet. Table 9 provides irrigation management information for the *Land&Rain* worksheet.



Optional Data Input:

5. Select average soil hydrologic group (SHG). SHG A = highest infiltration and SHG D = lowest infiltration

Watershed	SHG A	SHG B	SHG C	SHG D	SHG Selected	Soil N conc.%	Soil P conc.%	Soil BOD conc.%
W1					B	0.080	0.031	0.160
W2					B	0.080	0.031	0.160
W3					B	0.080	0.031	0.160
W4					B	0.080	0.031	0.160

6. Reference runoff curve number (may be modified)

SHG	A	B	C	D
Urban	83	89	92	93
Cropland	67	78	85	89
Pastureland	49	69	79	84
Forest	39	60	73	79
User Defined	50	70	80	85

6a. Detailed urban reference runoff curve number (may be modified)

Urban\SHG	A	B	C	D
Commercial	89	92	94	95
Industrial	81	88	91	93
Institutional	81	88	91	93
Transportatio	98	98	98	98
Multi-Family	77	85	90	92
Single-Family	57	72	81	86
Urban-Cultivat	67	78	85	89
Vacant-Develc	77	85	90	92
Open Space	49	69	79	84

7. Nutrient concentration in runoff (mg/l)

Land use	N	P	BOD
1. L-Croplan	**1.9**	**0.3**	**4**
1a. w/ manure	8.1	2	12.3
2. M-Cropla	**2.9**	**0.4**	**6.1**
2a. w/ manure	12.2	3	18.5
3. H-Cropla	**4.4**	**0.5**	**9.2**
3a. w/ manure	18.3	4	24.6
4. Pasturela	**4**	**0.3**	**13**
5. Forest	**0.2**	**0.1**	**0.5**
6. User Defi	**0**	**0**	**0**

8. Input or modify urban land use distribution

Watershed	Urban Area (ac.)	Commercial %	Industrial %	Institutional %	Transportation %	Multi-Family %	Single-Family %	Urban-Cultivated	Vacant (developed	Open Space %	Total % Area
W1	200	15	10	10	10	10	30	5	5	5	100
W2	200	15	10	10	10	10	30	5	5	5	100
W3	200	15	10	10	10	10	30	5	5	5	100
W4	200	15	10	10	10	10	30	5	5	5	100

9. Input irrigation area (ac) and irrigation amount (in)

Watershed	Total Cropland (ac)	Cropland: Acres Irrigated	Water Depth (in) per Irrigation - Before	Water Depth (in) per Irrigation - After BMP	Irrigation Frequency (#/Year)
W1	200	0	0	0	0
W2	200	0	0	0	0
W3	200	0	0	0	0
W4	200	0	0	0	0

Figure 8. Tables 5, 6, 6a, 7, 8, and 9, which are initially hidden in the *Input* worksheet, contain default values that users may choose to change.

[4] Note: Table 7 contains pollutants concentrations in runoff for croplands and other land uses. Based on the density of agricultural animals in the study area (STEPL calculates animal density automatically), croplands are divided into three categories, *i.e.* cropland in a low animal density area, cropland in a medium animal density area, and cropland in a high animal density area. There are six rows of data for croplands in Table 7. The first two rows contain the concentrations during the non-manure application months and the manure application months, respectively, for croplands in the low animal density areas. The third and forth rows contain the data for croplands the medium animal density area. And the fifth and sixth rows contain the data for croplands in the high animal density area.

4.3 *BMPs* Worksheet

The *BMPs* worksheet contains BMP tables for cropland, pastureland, forest, user-defined land use type, and feedlot, respectively, as well as a tool button for specifying BMPs or LIDs for urban land uses (Figure 9).

For each non-urban land use, you need to click to select a BMP from a list for each watershed. If no BMP is used, select "0 No BMP" from the lists. Once you have selected a BMP for a watershed, the pollutant removal efficiencies will be displayed. The efficiencies in the BMP tables are linked to other worksheets for the calculation of pollutant load reductions.

You can add, delete, or edit BMPs in the *BMPList* worksheet, which can be shown by clicking the STEPL > View/Edit BMP List menu. (See section 4.6.)

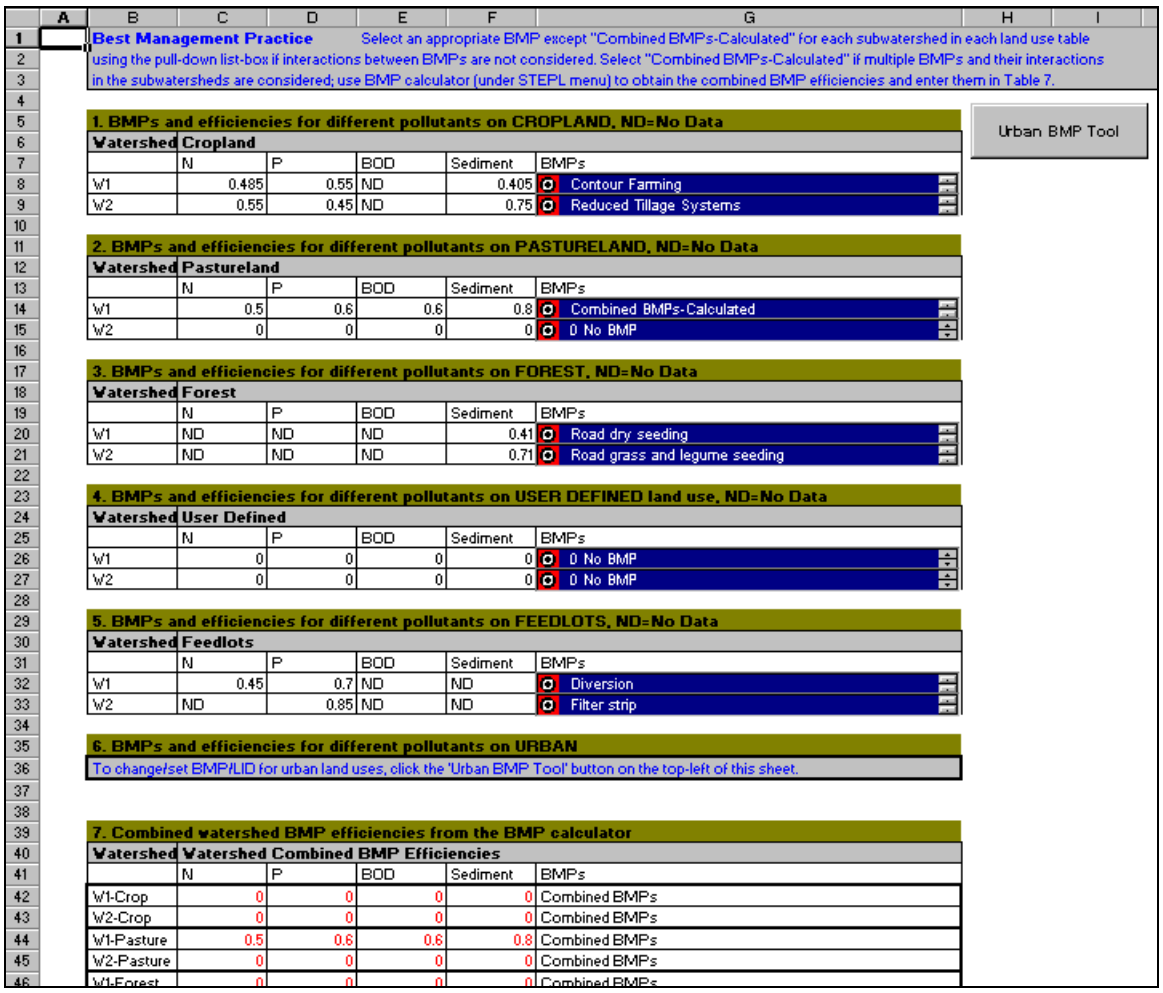
You can also add, delete, or edit BMPs by changing the comma-delimited text file called AllBMPstepl.csv in the \Support directory. For example, if you want to add new BMP data for the cropland, you might append line "Cropland, NewBMP, 0.500, ND, 0.300, 0.800" in the cropland section as illustrated below (in *italic*):

```
Landuse,BMP & Efficiency,N,P,BOD,Sediment
Cropland,,,,,
Cropland,0 No BMP,0,0,0,0
Cropland,Contour Farming,0.485,0.550,ND,0.405
Cropland,Diversion,0.100,0.300,ND,0.350
Cropland,Filter strip,0.700,0.750,0.394,0.650
Cropland,Reduced Tillage Systems,0.550,0.450,ND,0.750
Cropland,Streambank stabilization and fencing,0.750,0.750,ND,0.750
Cropland,Terrace,0.200,0.700,ND,0.850
Cropland,NewBMP,0.500,ND,0.300,0.800
```

Use "ND" for no data and numbers for pollutant removal efficiencies for nitrogen, phosphorus, BOD, and sediment. The removal efficiency **must be less than one**!

In the BMP pull-down list boxes, there are items called "Combined BMPs-Calculated". Select "Combined BMPs-Calculated" if you have detailed information on multiple BMPs and their interactions in the subwatersheds. If you have selected "Combined BMPs-Calculated", you need to use the BMP calculator to obtain the watershed-wide combined BMP efficiencies for calculating pollutant reductions. The combined BMP efficiencies can be calculated if you know the locations, removal efficiencies, and spatial relationships of BMPs that have been or will be implemented in your watersheds. You can find detailed instructions for using the BMP calculator in Appendix A of this manual. The BMP calculator can be accessed by clicking the "BMP calculator" menu under the STEPL menu (Figure 6). Once you have obtained combined BMP efficiencies for your watersheds, enter them in Table 7 of the worksheet (Figure 9). The combined BMP efficiencies will **not** be used in Table 5 (the feedlot BMP table) because STEPL treats feedlots as special high-loading point sources for which feedlot-specific BMPs must be individually selected.

Tip: If you *do not* have detailed information on the locations and spatial relationships of BMPs implemented in a watershed, you need only select an appropriate BMP from the pull-down list box for each non-urban land use in each subwatershed.



Best Management Practice Select an appropriate BMP except "Combined BMPs-Calculated" for each subwatershed in each land use table using the pull-down list-box if interactions between BMPs are not considered. Select "Combined BMPs-Calculated" if multiple BMPs and their interactions in the subwatersheds are considered; use BMP calculator (under STEPL menu) to obtain the combined BMP efficiencies and enter them in Table 7.

Urban BMP Tool

1. BMPs and efficiencies for different pollutants on CROPLAND, ND=No Data

Watershed	Cropland				
	N	P	BOD	Sediment	BMPs
W1	0.485	0.55	ND	0.405	Contour Farming
W2	0.55	0.45	ND	0.75	Reduced Tillage Systems

2. BMPs and efficiencies for different pollutants on PASTURELAND, ND=No Data

Watershed	Pastureland				
	N	P	BOD	Sediment	BMPs
W1	0.5	0.6	0.6	0.8	Combined BMPs-Calculated
W2	0	0	0	0	0 No BMP

3. BMPs and efficiencies for different pollutants on FOREST, ND=No Data

Watershed	Forest				
	N	P	BOD	Sediment	BMPs
W1	ND	ND	ND	0.41	Road dry seeding
W2	ND	ND	ND	0.71	Road grass and legume seeding

4. BMPs and efficiencies for different pollutants on USER DEFINED land use, ND=No Data

Watershed	User Defined				
	N	P	BOD	Sediment	BMPs
W1	0	0	0	0	0 No BMP
W2	0	0	0	0	0 No BMP

5. BMPs and efficiencies for different pollutants on FEEDLOTS, ND=No Data

Watershed	Feedlots				
	N	P	BOD	Sediment	BMPs
W1	0.45	0.7	ND	ND	Diversion
W2	ND	0.85	ND	ND	Filter strip

6. BMPs and efficiencies for different pollutants on URBAN

To change/set BMP/LID for urban land uses, click the 'Urban BMP Tool' button on the top-left of this sheet.

7. Combined watershed BMP efficiencies from the BMP calculator

Watershed	Watershed Combined BMP Efficiencies				
	N	P	BOD	Sediment	BMPs
W1-Crop	0	0	0	0	Combined BMPs
W2-Crop	0	0	0	0	Combined BMPs
W1-Pasture	0.5	0.6	0.6	0.8	Combined BMPs
W2-Pasture	0	0	0	0	Combined BMPs
W1-Forest	0	0	0	0	Combined BMPs

Figure 9. The *BMPs* worksheet, which lets you select BMPs for different land uses. Note that for this example, no BMPs are specified for user-defined land uses. You need to use the BMP calculator to calculate combined BMP efficiencies and enter them in Table 7 if you select "Combined BMPs-Calculated" from any of the BMP pull-down list boxes. For example, "Combined BMPs-Calculated" was selected for pastureland in watershed W1 in this figure.

4.3.1 *Urban BMP Tool*

On the top-right corner of *BMPs* worksheet, there is a tool button—***Urban BMP Tool*** (Figure 9). The ***Urban BMP Tool*** is used for select LIDs or BMPs for different urban land uses. Click ***Urban BMP Tool*** will bring forward a form "Set Urban LID/BMP" on the *Urban* worksheet (Figure 10). You can select or change a LID or BMP for a particular urban land use following the following three steps:

1. Select a watershed; e.g. the watershed number 1 (Figure 1).
2. Select a type of urban land use; e.g. commercial use.
3. Select a LID or BMP by clicking the pull-down list box; e.g. dry detention pond.

4. Specify the area that the selected practice applies; e.g. 1000 acres from a total of 16875 acres available area are controlled by the selected practice.
5. Click ***Apply LID/BMP*** button to set the selected management practice for the selected urban land use; e.g. apply the dry detention pond for the 1000 acres of commercial land in the watershed number 1.

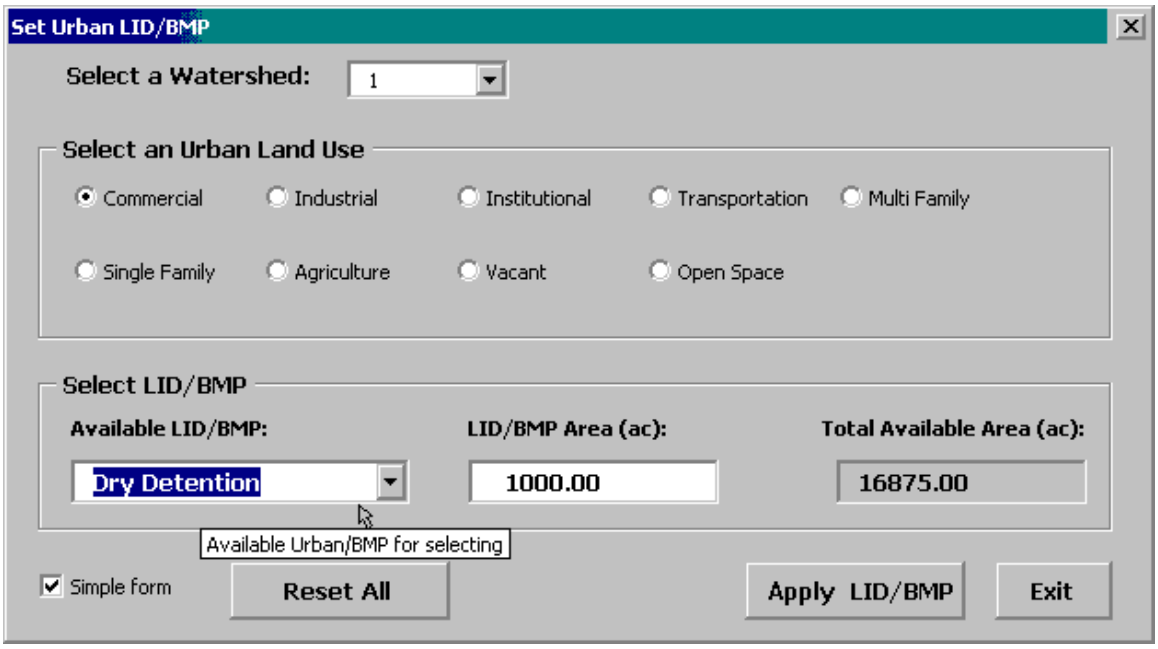


Figure 10. The form for selecting and applying LIDs/BMPs for urban land uses.

On the "Set Urban LID/BMP" form (Figure 10), in addition to ***Apply LID/BMP*** button, there are three other controls:

- ***Reset All*** button: Resets all the urban LIDs or BMPs to 'No BMP' and BMP application areas equal to the total available areas.
- ***Exit*** button: Closes the form.
- ***Simple form*** check box: Uncheck the box will expand the form showing pollutant load information for the selected urban land use and an additional button—***Next Land Use***, which is for navigating land use from the current selection to the next land use type.

In the available LID/BMP drop-down box, if you select "Combined BMPs-Calculated" or any item with an asterisk (*) following 'LID' in its name (e.g. "LID*/Cistern") and click ***Apply LID/BMP*** button, the system will display special forms (Figure 11 and Figure 12) for you to enter required parameter values before it can determine the pollutant load reduction efficiencies.

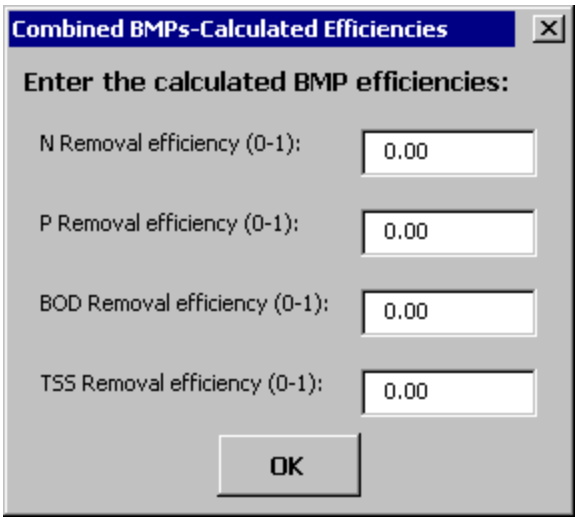


Figure 11. If the "Combined BMP-Calculated" is selected for an urban area, you must specify the BMP efficiencies calculated using the BMP calculator in the form shown above.

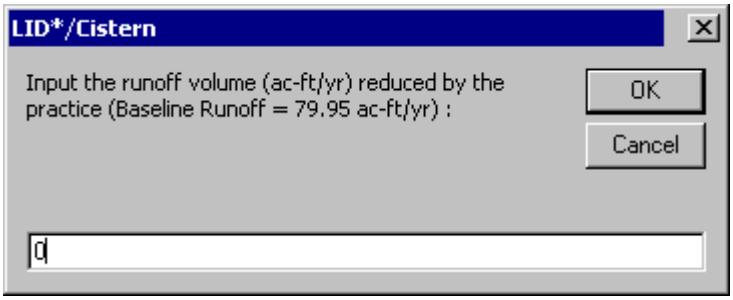


Figure 12. If the "LID*/Cistern", "LID*/Rain Barrel", or "LID*/Cistern/Rain Barrel" is selected for an urban area, you must specify the annual rainfall volume being trapped by the rainfall capture devices.

4.4 *Total Load* Worksheet

The *Total Load* worksheet shows the final results of the calculations in terms of watershed pollutant loads and load reduction (Figure 13). This worksheet has two visible tables. Table 1 shows the total nutrient and sediment loads (before and after BMPs), load reduction, and reduction percentages resulting from the BMPs that you selected on the *BMPs* worksheet. Table 2 summarizes the load from the various sources (urban, cropland, pastureland, forest, and feedlots). This worksheet is *protected* for editing initially, but you may unprotect it if you want to change it. Load summaries in this worksheet are used in the *Graphs* worksheet for plotting.

Total Load This is the summary of annual nutrient and sediment load for each subwatershed. This sheet is initially protected.

1. Total load by subwatershed(s)

Watershed	N Load (no BMP)	P Load (no BMP)	BOD Load (no BMP)	Sediment Load (no BMP)	N Reduction	P Reduction	BOD Reduction	Sediment Reduction	N Load (with BMP)	P Load (with BMP)	BO
	lb/year	lb/year	lb/year	t/year	lb/year	lb/year	lb/year	t/year	lb/year	lb/year	lb/ye
W1	9404.3	1800.0	26237.3	340.7	2342.5	534.7	1124.2	175.7	7061.7	1265.4	
W2	9404.3	1800.0	26237.3	340.7	2753.1	718.0	974.3	152.2	6651.1	1082.0	
W3	9404.3	1800.0	26237.3	340.7	586.0	313.2	524.6	82.0	8818.2	1486.9	
W4	9404.3	1800.0	26237.3	340.7	1284.5	740.4	1274.1	199.1	8119.8	1059.7	
Total	37617.0	7200.2	104949.4	1362.9	6966.2	2306.2	3897.3	609.0	30650.8	4894.0	

2. Total load by land uses (with BMP)

Sources	N Load (lb/yr)	P Load (lb/yr)	BOD Load (lb/yr)	Sediment Load (t/yr)
Urban	9671.3	1492.6	37704.3	221.7
Cropland	8980.2	1677.1	24187.0	327.9
Pastureland	10110.5	946.9	32098.9	190.1
Forest	396.5	193.0	968.5	14.3
Feedlots	0.0	0.0	0.0	0.0
User Defined	0.0	0.0	0.0	0.0
Septic	1492.2	584.5	6093.3	0.0
Total	30650.8	4894.0	101052.0	754.0

Figure 13. *Total Load* worksheet, which summarizes nutrient and sediment loads from all the sources considered in the model.

4.5 *Graphs* Worksheet

The *Graphs* worksheet (Figure 14) shows the pollutant loads and reductions in graphical format. It contains the following graphs:

- Comparison of nutrient loads among the watersheds
- Comparison of sediment loads among the watersheds
- Comparison of nutrient reductions among the watersheds
- Comparison of sediment reductions among the watersheds
- Total nitrogen load (lb/yr) by land uses
- Total phosphorus load (lb/yr) by land uses
- Total BOD load (lb/yr) by land uses
- Total sediment load (t/yr) by land uses

This worksheet is *protected* initially, but you may unprotect this worksheet and modify the graphs.

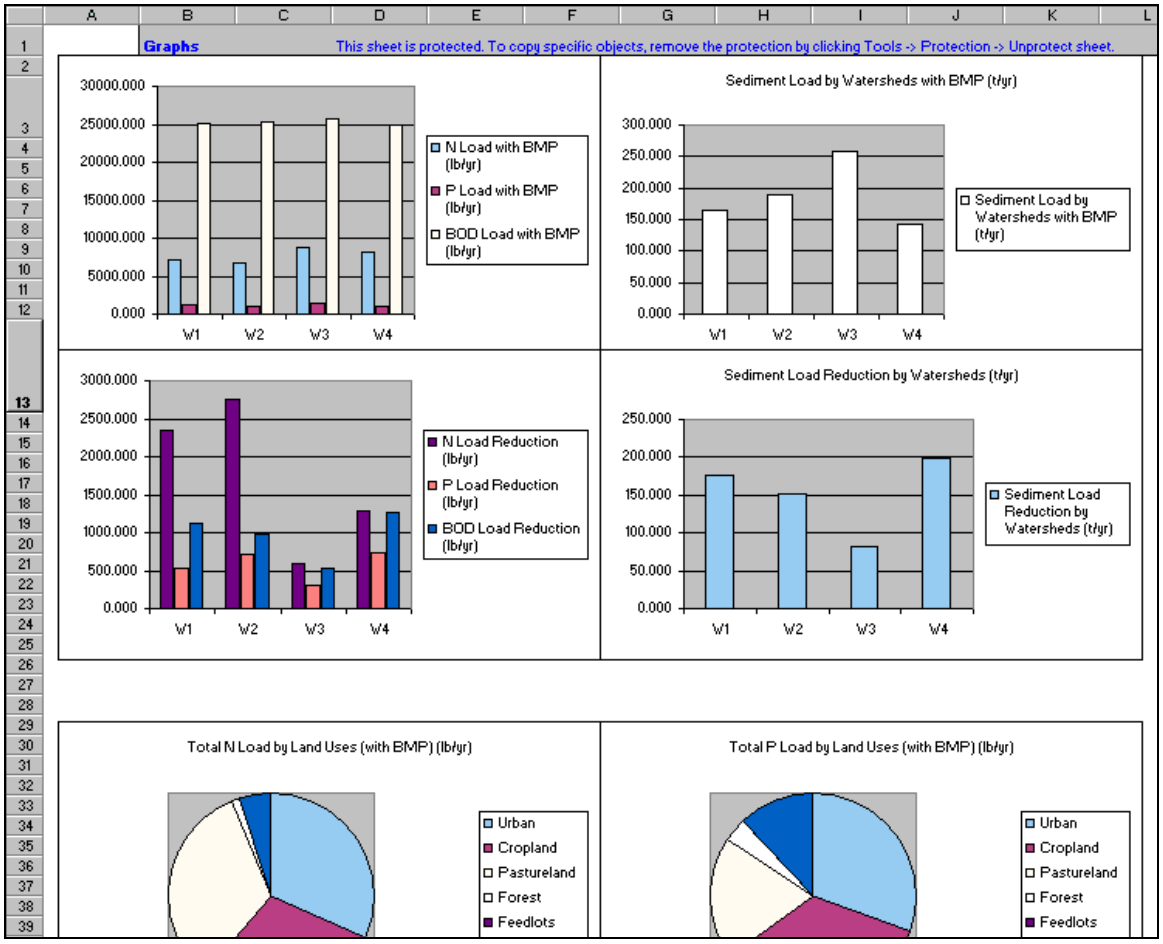


Figure 14. *Graphs* worksheet, which shows the watershed pollutant loads and load reductions in graphic format.

4.6 *BMPList* Worksheet

The *BMPList* worksheet (Figure 15) becomes visible when the STEPL > View/Edit BMP List menu is clicked. The worksheet contains a list of BMP names and efficiencies for different land uses and pollutant types. The *BMPList* worksheet allows you to update BMP data in the *BMPs* worksheet and the two external text files (AllBMPstepl.csv and AllBMPs.csv; see section 3.3).

You can add new BMP records for the six predefined land use categories (Cropland, Pastureland, Forest, User-defined, Feedlots, and Urban). If you insert a row for a new BMP record, you must specify the land use, BMP name, and pollutant removal efficiencies. Pollutant removal efficiencies should be always be less than or equal to 1.0, and you must type "ND" for no data.

Each BMP record in the BMP list can be changed and deleted, but **do not** change or delete the greyed (shaded) rows.

The *BMPList* worksheet has two command buttons: ***Update BMP Data*** and ***Save Updates***. The ***Update BMP Data*** button is used to update the lists in selection boxes in the *BMPs* worksheet. The ***Save Updates*** button is used to save the BMP list to external text files (AllBMPstepl.csv and AllBMPs.csv) in the STEPL/Support folder.

	A	B	C	D	E	F	G	H	I	J	K
1	**Landuse**	**BMP & Efficiency**	**N**	**P**	**BOD**	**Sediment**					
2	**Cropland**						<Don't Delete				
3	**Cropland**	0 No BMP	0	0	0	0	<Don't Delete				
4	**Cropland**	Combined BMPs-Calculated	0	0	0	0					
5	**Cropland**	Contour Farming	0.485	0.55	ND	0.405					
6	**Cropland**	Diversion	0.1	0.3	ND	0.35					
7	**Cropland**	Filter strip	0.7	0.75	ND	0.65					
8	**Cropland**	Reduced Tillage Systems	0.55	0.45	ND	0.75					
9	**Cropland**	Streambank stabilization and fencing	0.75	0.75	ND	0.75					
10	**Cropland**	Terrace	0.2	0.7	ND	0.85					
11	**Pastureland**						<Don't Delete				
12	**Pastureland**	0 No BMP	0	0	0	0	<Don't Delete				
13	**Pastureland**	Combined BMPs-Calculated	0	0	0	0					
14	**Forest**						<Don't Delete				
15	**Forest**	0 No BMP	0	0	0	0	<Don't Delete				
16	**Forest**	Combined BMPs-Calculated	0	0	0	0					
17	**Forest**	Road dry seeding	ND	ND	ND	0.41					
18	**Forest**	Road grass and legume seeding	ND	ND	ND	0.71					
19	**Forest**	Road hydro mulch	ND	ND	ND	0.41					
20	**Forest**	Road straw mulch	ND	ND	ND	0.41					
21	**Forest**	Road tree planting	ND	ND	ND	0.5					
22	**Forest**	Site preparation/hydro mulch/seed/fertilizer	ND	ND	ND	0.71					
23	**Forest**	Site preparation/hydro mulch/seed/fertilizer/transplants	ND	ND	ND	0.69					

Instruction:
1. Do not delete the greyed rows.
2. BMP efficiencies should be <=1.
3. If you add a row for a new BMP, you must specify landuse, BMP name, and pollutant removal efficiencies.
4. Type "ND" for no data.
5. Click "Update BMP Data" to update selection boxes on the BMPs sheet.
6. Click "Save Updates" to save the BMP list to external text files in the STEPL/Support folder.

Update BMP Data

Save Updates

Figure 15. *BMPList* worksheet. BMP records can be viewed, changed, added, or deleted. The changes can be saved to the *BMPs* worksheet or to external text files.

5. References

(References include those cited in appendices.)

ASAE (American Society of Agricultural Engineers). 1998. *ASAE standards: Standards, engineering practice, and data*. 45th ed. American Society of Agricultural Engineers, St. Joseph, Michigan.

Evans, B.M., S. A. Sheeder, K. J. Corradini, and W. S. Brown. 2001. *AVGWLF version 3.2, users guide*. Environmental Resources Research Institute, Pennsylvania State University, University Park, Pennsylvania.

Haith, D.A., R. Mandal, and R.S. Wu. 1992. *GWLF: General watershed loading functions, user's manual, version 2.0.* Cornell University, Ithaca, New York.

MDEQ (Michigan Department of Environmental Quality). 1999. Pollutants controlled: Calculation and documentation for section 319 watersheds training manual. Michigan Department of Environmental Quality, Lansing, Michigan.

USDA-NRCS (U.S. Department of Agriculture, Natural Resources Conservation Service). 1983. Sediment sources, yields, and delivery ratios. In *National Engineering Handbook*, Chapter 6, Section 3, Sedimentation.

In the *Reference* sheet of STEPL model, there are additional 28 references listed for the default parameter values used in the model.

Appendix A: BMP Calculator User Guide and Formulas

If BMP locations, implementation areas, and efficiencies in a watershed are known, the combined pollutant removal efficiencies can be calculated using the BMP Calculator that is included in STEPL. The combined efficiencies can be entered in Table 7 of the *BMPs* worksheet (see section 4.3).

The following sections describe Step-by-Step procedures and examples to use the BMP Calculator as well as the mathematic formulas that BMP Calculator is based on.

A1. Step-by-Step Instructions for Using the BMP Calculator

1. Click the "BMP calculator" menu on the STEPL menu bar or double-click the BMPcalculator.exe file in the STEPL directory to start the calculator.

2. Click the  button to add a new BMP (represented by a box with a default area and BMP efficiencies) to the program window. You may add as many boxes as you wish by clicking the button. **Initially, all the default values in the BMP boxes are set to zero**. To assign values to the parameters in the BMP boxes, see step 4.

   Arrange the BMP boxes to approximate BMP locations in your watershed. To move a BMP box, click and drag it using the left mouse button. Three configuration examples are shown in Figures A1, A2, and A3.

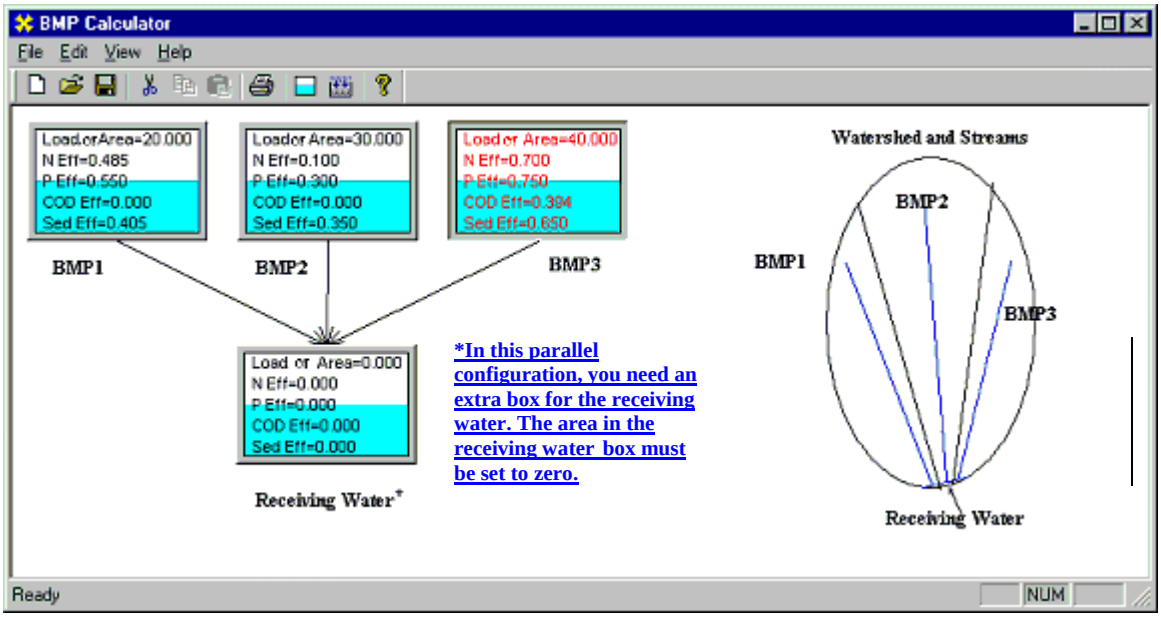


Figure A1. Comparison of parallel BMP configuration in the calculator window with BMP locations in a watershed. The diagram at the right shows three parallel BMP implementations in a watershed. In the calculator window at the left, three BMP boxes are connected to a fourth box, which represents the receiving stream. The area of the receiving stream box must be set to zero.

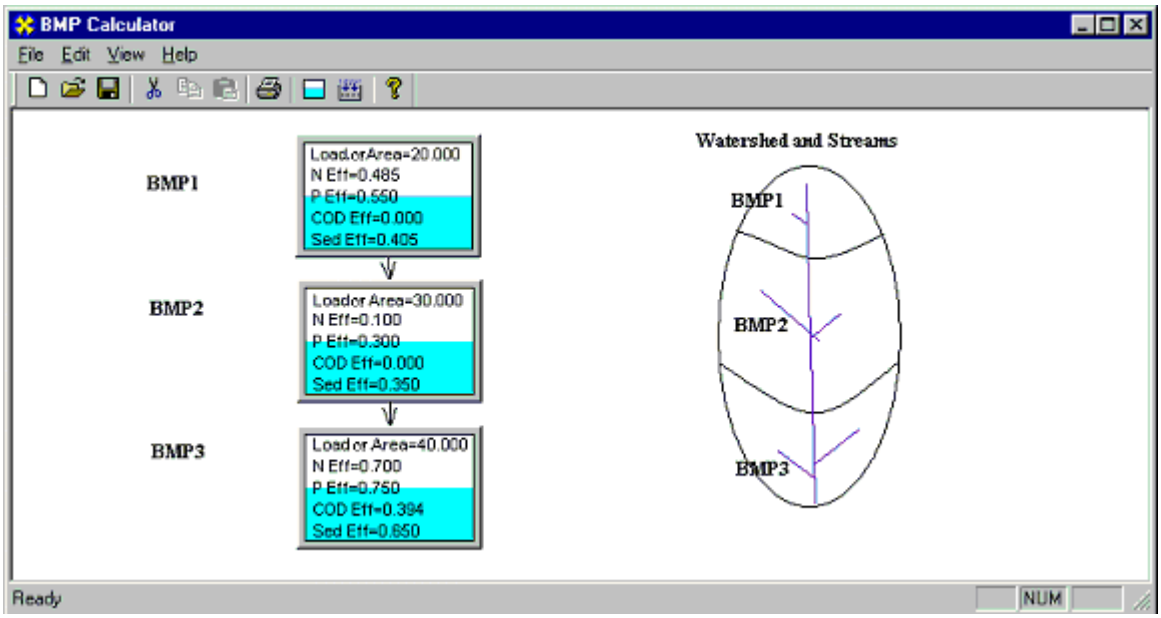


Figure A2. Comparison of serial BMP configuration in the calculator window with BMP locations in a watershed. The diagram at the right shows three serial BMP implementations in the watershed. In the calculator window at the left, three BMP boxes are connected one after another.

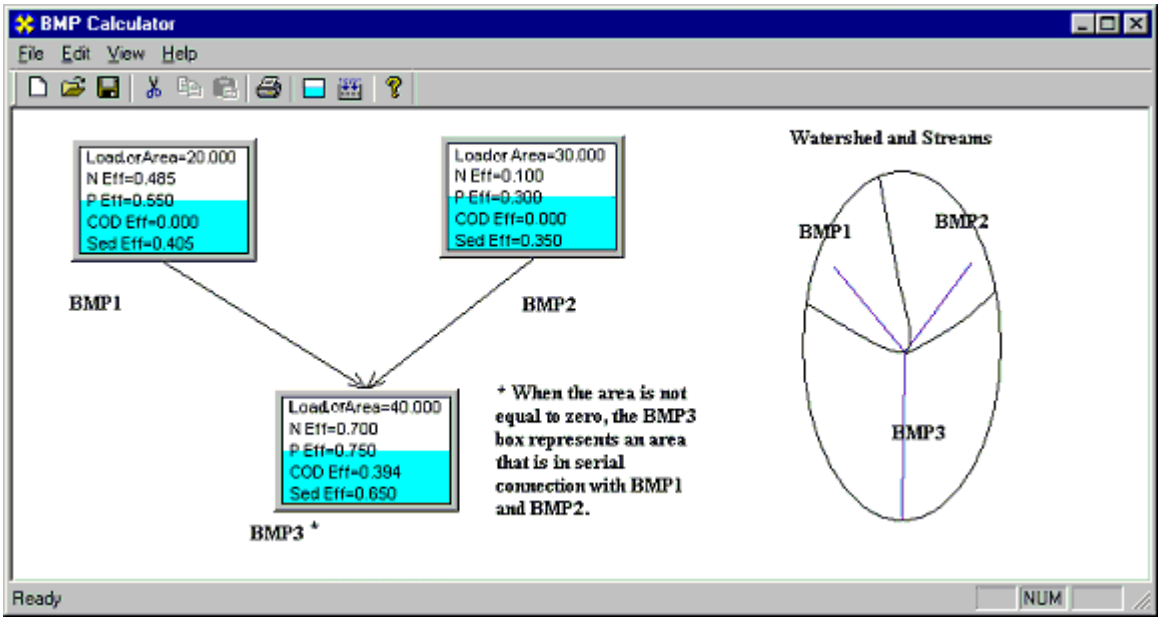


Figure A3. Comparison of mixed BMP configuration in the calculator window with BMP locations in a watershed. The diagram at the right shows two parallel BMPs in series with a third BMP in the watershed. In the calculator window at the left, two BMP boxes are connected to a third BMP box.

3. Drag your mouse from one box to another to add links (lines with arrowheads) between BMP boxes. **Caution**: **When you drag your mouse between two boxes, you must touch both boxes to make the line.** Only one link can originate from a BMP box; however, a BMP box can receive many incoming links.

Tip: To delete a BMP box, click it and press the DEL key. (If the BMP box is selected, the text in the box is displayed in red.) To delete a link between two BMPs, click the connection to select it and press the DEL key.

4. Once you finish adding BMP boxes and links as shown in Figures A1, A2, and A3, you can double-click each box to set the parameter values. The dialog box that appears lets you select a type of BMP from a list (Figure A4). After you select a BMP from the list, pollutant removal efficiencies will appear automatically in the appropriate text boxes in the dialog box. You need to specify the BMP area or total pre-BMP load (in any units, as long as you are consistent throughout the calculation) for each BMP selected. You may also choose to modify the BMP efficiencies in the dialog box.

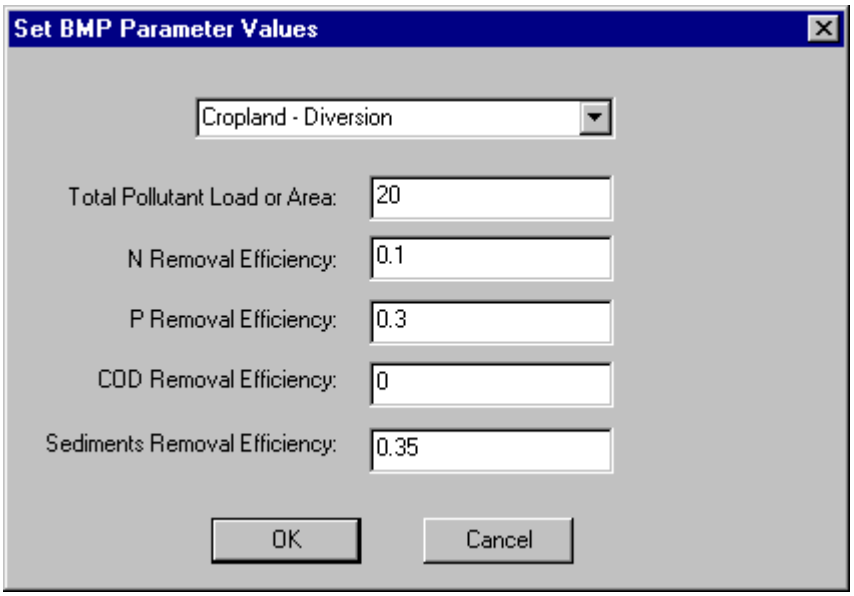


Figure A4. Editing BMP parameter values.

Note: The combined BMP efficiencies are calculated using the pollutant load (before BMP implementation) or the area of a subwatershed as the weighting factor. If the subwatersheds or subareas associated with different BMPs have the same or similar land use types, you can use the area as the weighting factor. However, if the combined BMP efficiencies are to be calculated for subwatersheds or areas that have different land use types, the pre-BMP pollutant load of each land use type should be used as the weighting factor.

5. On the tool bar, click the  button to calculate the combined BMP efficiencies (Figures A5, A6, and A7.)

Tip: You may use the "Save as" and "Open" submenus under the File menu to save and open your BMP configurations.

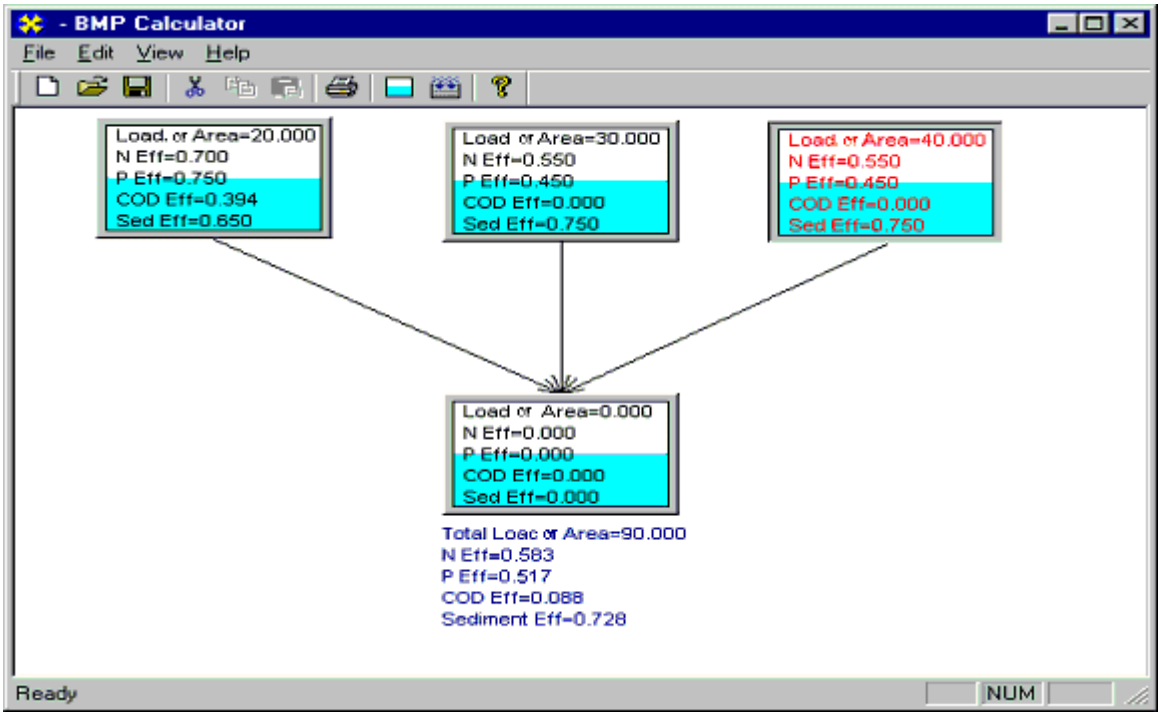


Figure A5. Calculated combined BMP efficiencies for three parallel BMP implementations in a watershed.

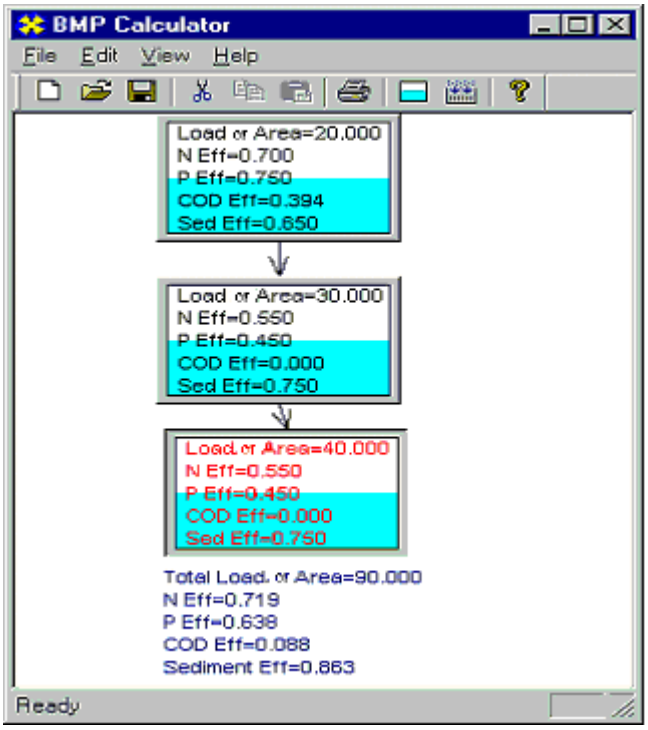


Figure A6. Calculated combined BMP efficiencies for three serial BMP implementations in a watershed.

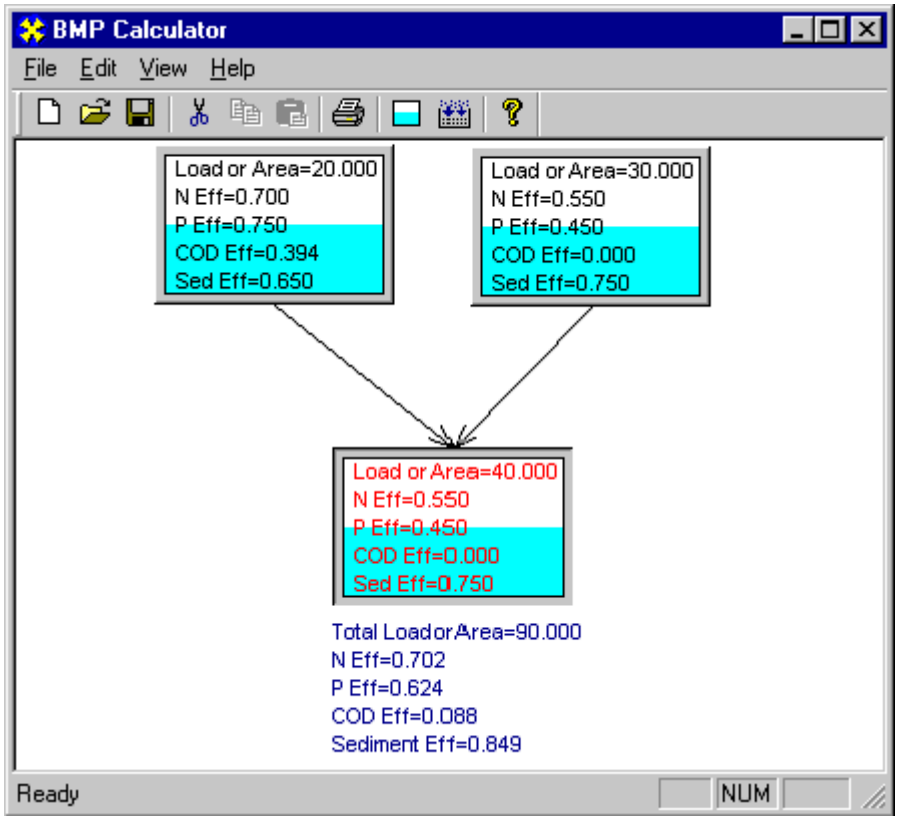


Figure A7. Calculated combined BMP efficiencies for two parallel BMPs in series with a third BMP in a watershed.

6. Enter the combined efficiencies in Table 7 of the *BMPs* worksheet (see section 4.3). You can right-click your mouse button on the result text in BMP Calculator window and you will see a small pop-up window with a copy command. Select the copy command to copy the calculated combined BMP efficiency and paste the copied value to the STEPL worksheet.

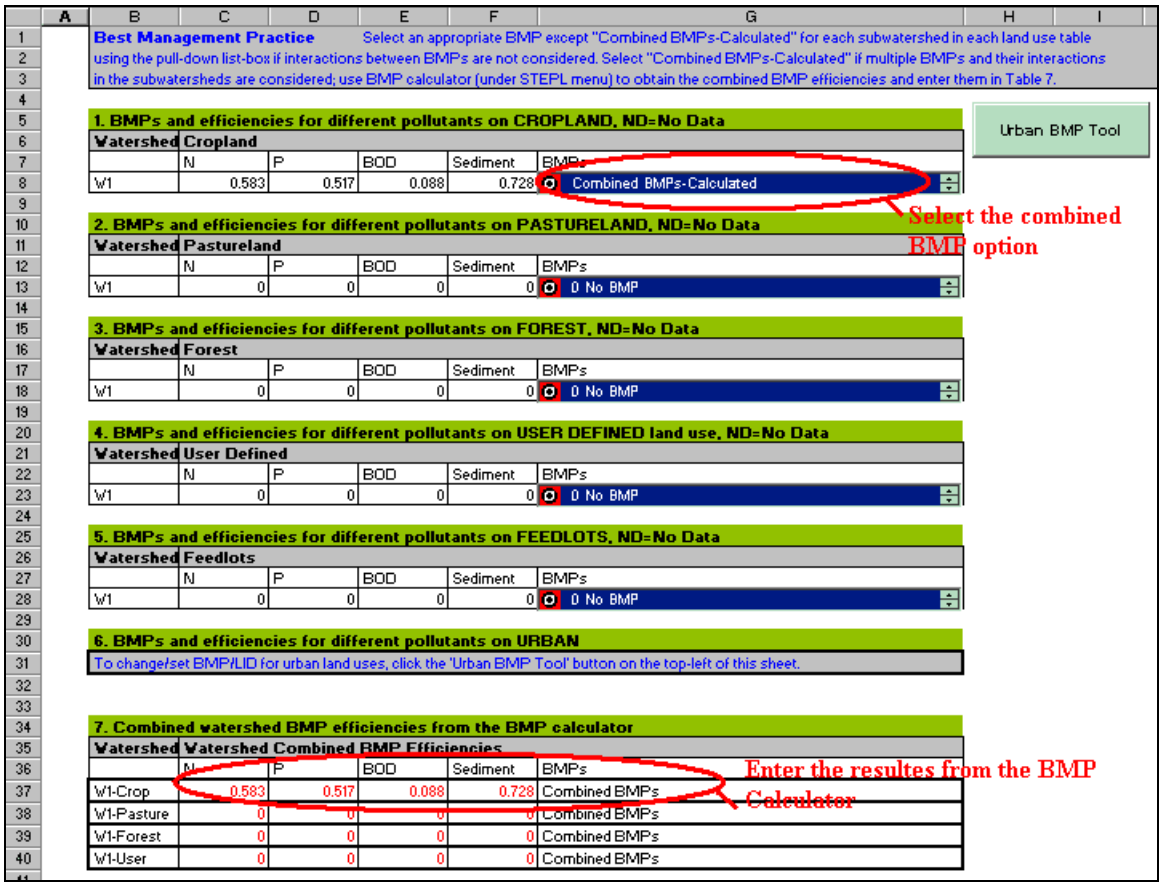


Figure A8. The *BMP* worksheet of the STEPL model, which lets you select BMPs for different land uses. If you select "Combined BMPs-Calculated" from any of the BMP pull-down list boxes, you need to use the BMP Calculator to calculate combined BMP efficiencies and then enter them in Table 7.

A2. Advanced Examples

Consider the following information before you attempt advanced calculations.

- Combined BMP efficiencies are calculated by using area as the weighting factor when all the BMPs are located in the same land use type. Combined BMP efficiencies can also be calculated using the original or pre-BMP load as the weighting factor when the BMPs are located in different land use types with varying pollutant loading rates. Refer to the BMP calculator formulas for details. This document shows only examples using area to calculate the combined BMP efficiencies.

- The area weighting factor in the BMP Calculator refers more specifically to a source area treated by an on-site BMP or a source area treated by an off-site BMP. In many cases, an off-site BMP (e.g., filter strips to intercept pollutants from an upslope cropland) can be separated from its source and represented in the BMP Calculator as an individual box. The source area for the individual off-site BMP should be zero because the BMP itself is not the source area.

- Beyond the original design objectives of the BMP Calculator for two or three BMPs, the BMP Calculator can be used to calculate the combined efficiencies of very complicated BMP arrangements (three or more BMPs arranged in mixed configurations in a watershed), providing that you fully understand the calculator's mathematical formulas and the properties of the BMPs being implemented.

Four example cases are shown in Figures A9 through A12.

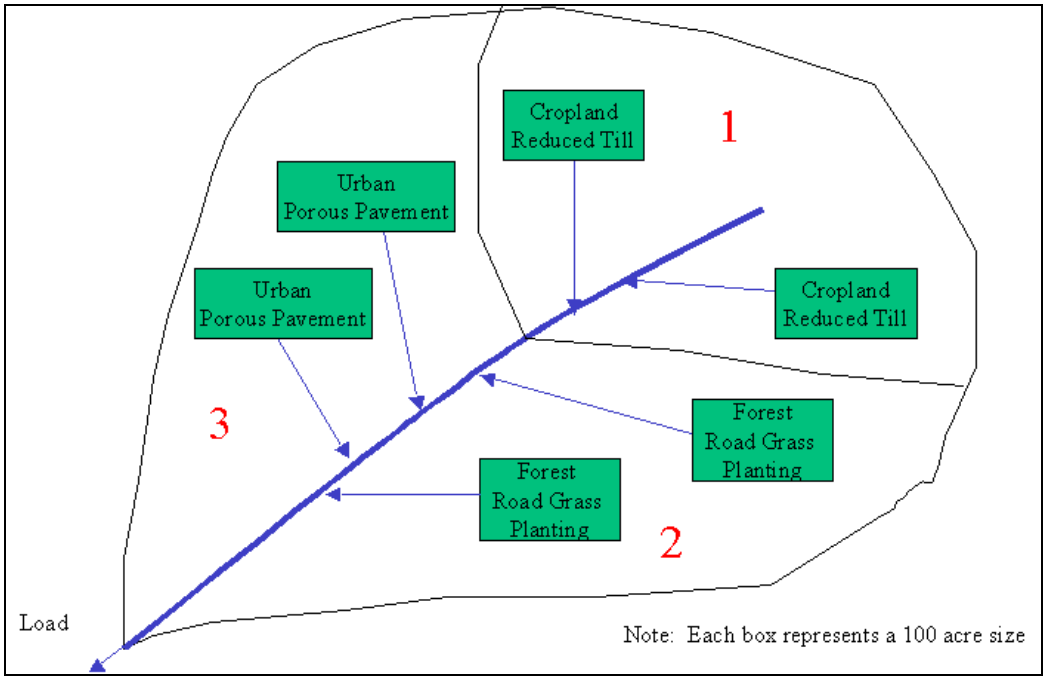


Figure A9. A case that does not need the BMP Calculator. You do not need to calculate the combined BMP efficiency because each land use type uses the same BMP practice (e.g., reduced till for all croplands) regardless of BMP locations in the subwatersheds.

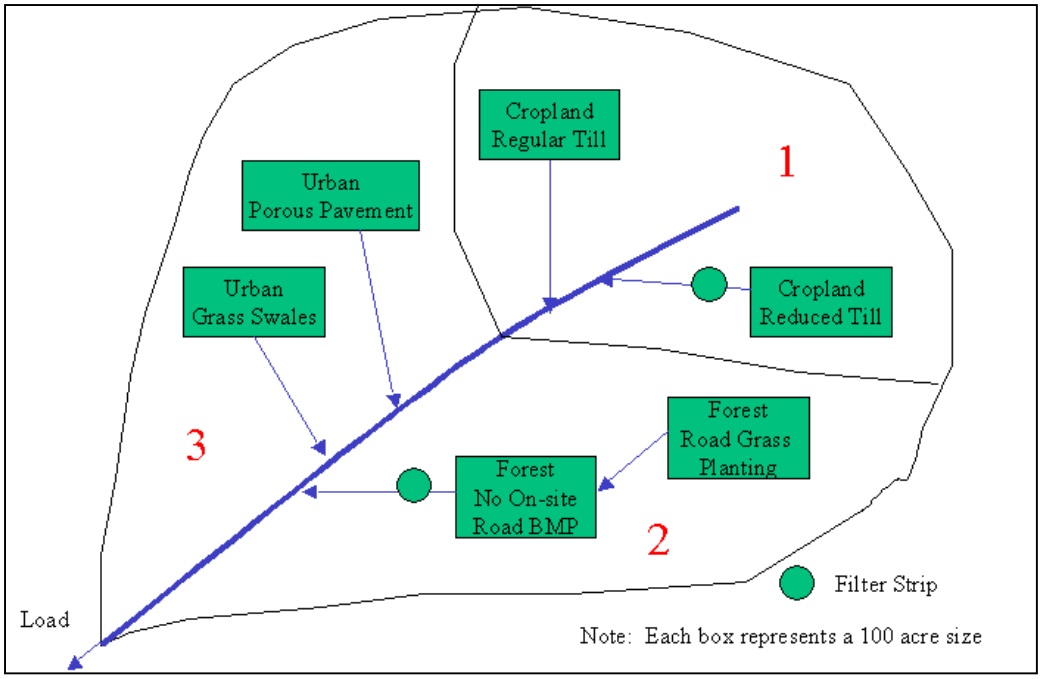


Figure A10. Case that needs the BMP Calculator. You need to calculate the combined BMP efficiency because each land use type uses more than one practice (e.g., regular till and reduced till combined with filter strips for cropland). In this example, you need to calculate a combined efficiency for each land use type or subwatershed.

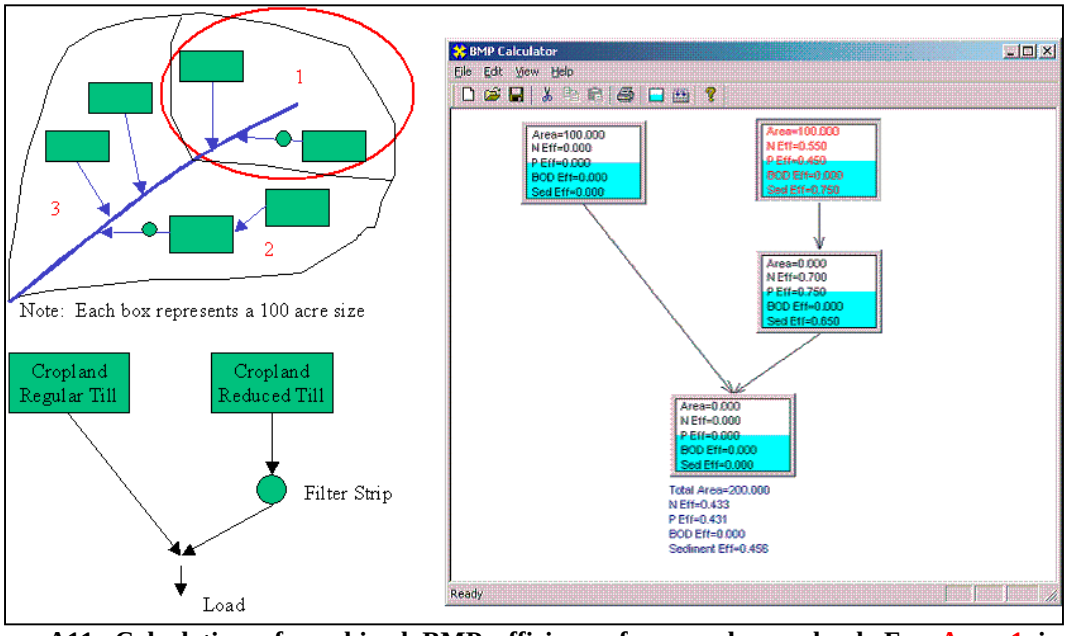


Figure A11. Calculation of combined BMP efficiency for sample cropland. For Area 1 in the watershed, one-half of the cropland uses no BMPs and the other half uses reduced tillage practice and a filter strip in a serial configuration. The two halves of the cropland are arranged in a parallel configuration. Because the filter strip is represented in the BMP Calculator as a box that is separated from the filter strip's treatment area, the source area for the filter strip itself equals zero.

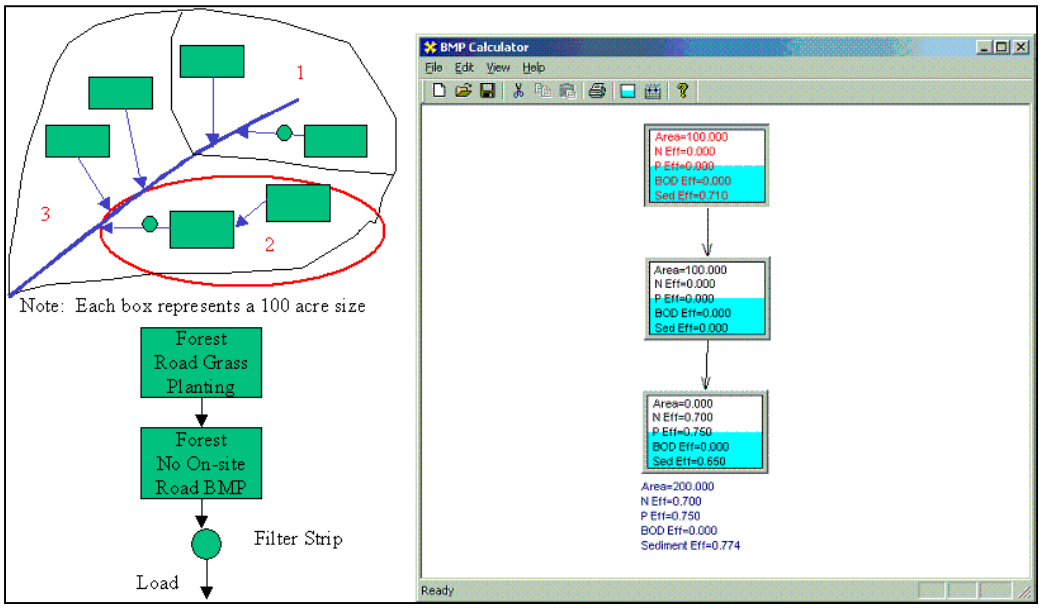


Figure A12. Calculation of combined BMP efficiency for sample forestland. For Area 2 in the watershed, one-half of the forest uses road grass planting and the other half uses no BMPs but has a filter strip between it and the receiving stream. The two halves of the forest are arranged in a serial configuration. Because the filter strip is represented in the BMP Calculator as a box that is separated from the filter strip's treatment area, the source area for the filter strip itself equals zero.

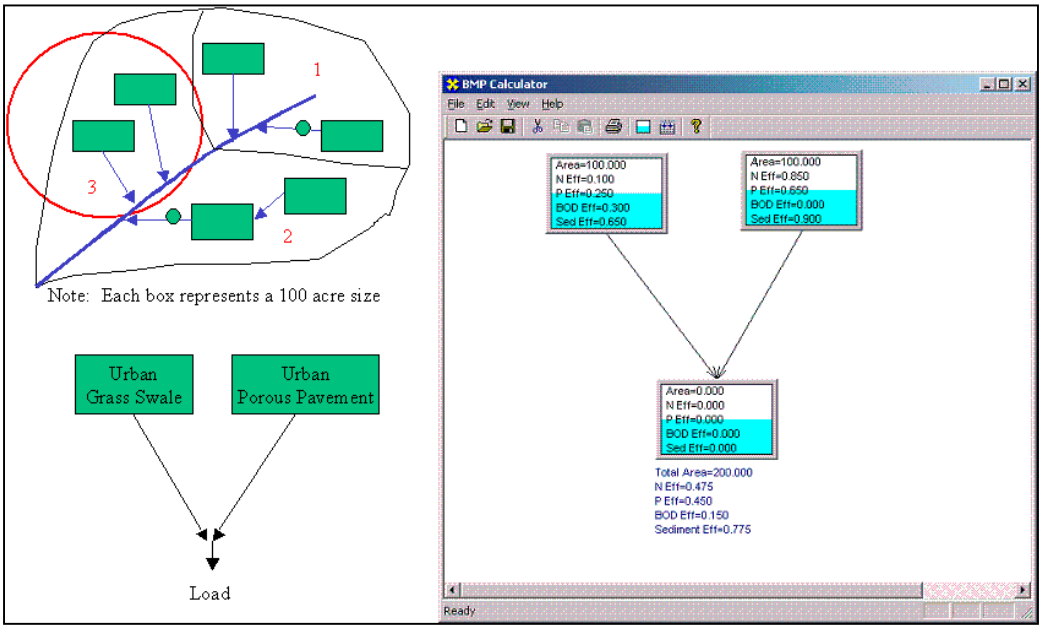


Figure A13. Calculation of combined BMP efficiency for sample urban land. For Area 3 in the watershed, one-half of the urban land is treated with grass swales and the other half is treated with porous pavement. The two halves of the urban land are arranged in a parallel configuration. The configuration is connected through a common box in the BMP Calculator, representing a receiving stream.

A3. BMP Calculator Formulas

Define e_1, e_2, …, and e_n as BMP pollutant removal efficiencies for area A_1, area A_2, …., and area A_n, which have corresponding pollutant loads of T_1, T_2, and T_n. (1-e_1), (1-e_2), …, and (1-e_n) represent pollutant-retaining efficiencies.

For a parallel BMP configuration, the combined efficiency is equal to

$$1-\frac{T_1*(1-e_1)+T_2*(1-e_2)}{T_1+T_2} \text{ or } 1-\frac{\sum_{i=1}^{n} T_i*(1-e_i)}{\sum_{i=1}^{n} T_i}.$$

For a serial BMP configuration, the combined efficiency is equal to

$$1-\frac{T_1*(1-e_1)*(1-e_2)+T_2*(1-e_2)}{T_1+T_2} \text{ or } 1-\frac{\sum_{i=1}^{n} T_i*(1-e_i)*(1-e_{i+1})*...(1-e_n)}{\sum_{i=1}^{n} T_i}.$$

For a single area,

$T_2 = 0$ and $e_2 = 0$, and both of the above formulas are reduced to 1- (1-e_1) = e_1.

If all the subareas have similar pollutant loading rates ($t = T/A$), the T in the above two formulas can be replaced by A for approximation.

Appendix B: Description of the Intermediate STEPL Worksheets

B.1 General Input Data Worksheet

This worksheet is hidden from users by default. To display the worksheet, click the STEPL > Hide/Unhide Other STEPL Sheets menu.

This worksheet summarizes your initial input for the creation of the customized spreadsheet tool (Figure B1).

This Excel file was created dynamically by STEPL VB interface on/at 10/9/01 12:24:05 PM
BLUE text found throughout the spreadsheet presents relevant information and assumptions.
RED text designates values that should be specified by the user.
BLACK text generally presents information that is calculated by the spreadsheet or that should not be changed.

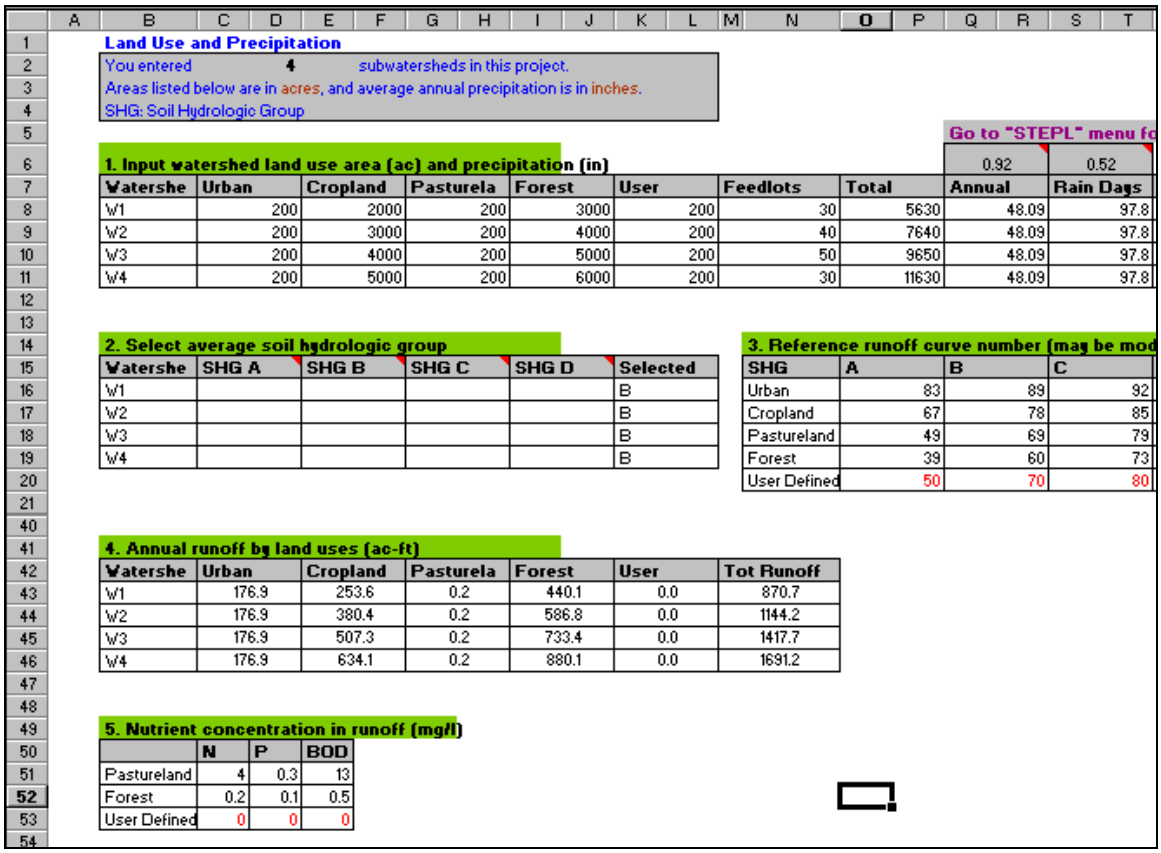
There are 4 subwatersheds in this study.

Land Uses		Animals		Pollutants	
Urban	1	Beef Cattle	1	Nitrogen	1
Cropland	1	Dairy Cattle	1	Phosphorus	1
Pastureland	1	Swine (Hogs)	1	BOD	1
Forest	1	Chicken	1	Sediment	1
User Defined	1	Horse	1		
		Sheep	1		
		Turkey	1		
		Duck	1		
Total	5		8		4

Figure B1. The *General Input Data* worksheet, which displays a summary of your initial input.

B.2 *Land&Rain* Worksheet

This worksheet is hidden from users by default. When displayed, there are five visible tables in this worksheet (Figure B2). The values in Tables 1, 2, 3, and 5 are linked to tables in the *Input* worksheets.



Land Use and Precipitation

You entered 4 subwatersheds in this project.
Areas listed below are in acres, and average annual precipitation is in inches.
SHG: Soil Hydrologic Group

Go to "STEPL" menu fo

1. Input watershed land use area (ac) and precipitation (in)

								0.92	0.52
Watershe	Urban	Cropland	Pasturela	Forest	User	Feedlots	Total	Annual	Rain Days
W1	200	2000	200	3000	200	30	5630	48.09	97.8
W2	200	3000	200	4000	200	40	7640	48.09	97.8
W3	200	4000	200	5000	200	50	9650	48.09	97.8
W4	200	5000	200	6000	200	30	11630	48.09	97.8

2. Select average soil hydrologic group

Watershe	SHG A	SHG B	SHG C	SHG D	Selected
W1					B
W2					B
W3					B
W4					B

3. Reference runoff curve number (may be mod

SHG	A	B	C
Urban	83	89	92
Cropland	67	78	85
Pastureland	49	69	79
Forest	39	60	73
User Defined	50	70	80

4. Annual runoff by land uses (ac-ft)

Watershe	Urban	Cropland	Pasturela	Forest	User	Tot Runoff
W1	176.9	253.6	0.2	440.1	0.0	870.7
W2	176.9	380.4	0.2	586.8	0.0	1144.2
W3	176.9	507.3	0.2	733.4	0.0	1417.7
W4	176.9	634.1	0.2	880.1	0.0	1691.2

5. Nutrient concentration in runoff (mg/l)

	N	P	BOD
Pastureland	4	0.3	13
Forest	0.2	0.1	0.5
User Defined	0	0	0

Figure B2. The *Land&Rain* worksheet, which calculates average annual runoff based on precipitation, soil hydrologic group, and soil curve number.

Table 1 contains model input on land use area in acres, annual precipitation in inches, number of days with measurable precipitation, and correction factors for each watershed. There are three correction factors in row 6: (1) Rainfall correction factor, (2) number of rain day correction factor, and (3) rainfall initial abstraction factor. Rainfall initial abstraction factor determines initial rainfall retention on the land surface, ranges from 0 to 0.2. The default is set to zero. Table 2 contains the soil hydrological group (SHG) information for each watershed. Table 3 shows the default curve numbers by SHG for each land use type.

Once STEPL has the land use area, precipitation data, and soil hydrological group for each watershed, the worksheet calculates the runoff for each type of land use automatically. The results are shown in Table 4, "Annual runoff by land uses (ac-ft)."

Table 5 shows default nutrient concentrations in runoff (mg/L) for pastureland, forest, and the user-defined type. The concentration values are used in the *Total Load* worksheet to calculate the nutrient load from runoff. (Nutrient concentrations from cropland are determined based on the default nutrient concentrations and animal density and manure application in the study area in *Input* and *Animal* worksheet.)

The *Land&Rain* worksheet also calculates the runoff and runoff reduction due to the irrigation practice (hidden Table 2.3) as well as runoff for the detailed urban land uses (hidden tables in Excel Column X to Column AH). Runoff for urban land uses is used to calculate the pollutant loads for *Urban* worksheet.

B.3 *Animal* Worksheet

This worksheet is hidden from users by default. Table 1 in the *Animal* worksheet (Figure B3) links to the *Input* worksheet for the number of farm animals and number of months that manure is applied on cropland in each watershed. The worksheet calculates each animal equivalent unit (AEU, i.e., 1000 lb animal weight per acre) based on number of animals and standard animal weight. The nutrient concentrations in cropland runoff are adjusted with the AEU. The higher the AUE, the higher the nutrient concentrations in the cropland runoff. A step function is used to represent the relationship between the nutrient concentrations and AEU, and nutrient concentrations reach the maximum when the AEU is equal to or greater than 2.5 (Evans et al. 2001).

Animal

The number of animals in the 4 subwatersheds is shown below.

Nutrient contributions from these animals are used to derive loading estimates for all land uses except for urban.

Manure is assumed to be collected and applied to cropland.

Wildlife densities are required input for cropland.

1. Agricultural animals

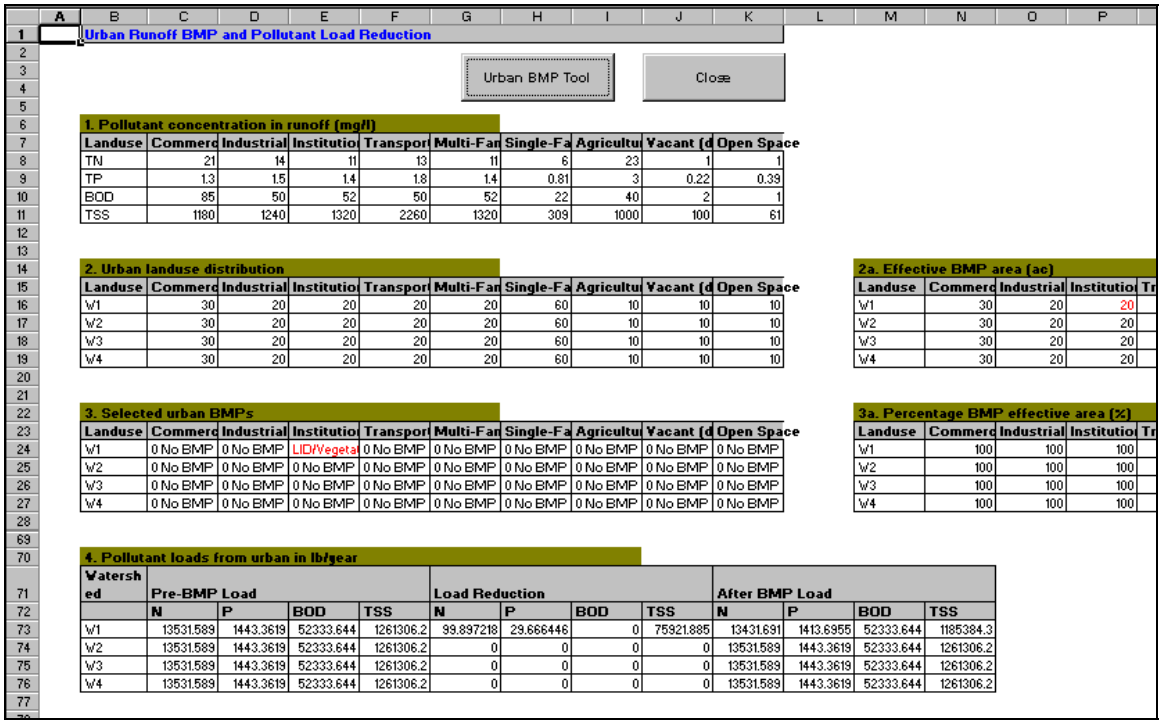
Watershed	Beef Cattle	Dairy Cattle	Swine (Hog)	Sheep	Horse	Chicken	Turkey	Duck	AEU	# of months manure applied
W1	1000	500	100	100	100	100	100	100	0.9159	4
W2	1200	600	100	100	100	100	100	100	0.72393333	4
W3	1400	700	100	100	100	100	100	100	0.62795	4
W4	1600	800	100	100	100	100	100	100	0.57036	4
Total	5200	2600	400	400	400	400	400	400		

Figure B3. The *Animal* worksheet, which contains information on agricultural animal numbers and number of months that manure is applied to cropland.

B.4 *Urban* worksheet

The *Urban* worksheet is created for calculating urban pollutant load and load reduction due to the application of management practices. This worksheet is hidden from users by default. It will be displayed if the user clicks the ***Urban BMP Tool*** button on the *BMPs* worksheet. When displayed, two tool buttons and six tables are visible in this worksheet (Figure B4). The ***Urban BMP Tool*** will allow you to set/select/change a LID/BMP for each urban land use (see detailed description in section 4.3.1). Click the ***Close*** button will hide the *Urban* worksheet. Table 1 contains pollutant concentrations (mg/L) for each urban land use category including: Commercial, Industrial, Institutional, Transportation, Multi-family, Single-family, Urban-cultivated, Vacant (developed), and Open Space. Table 2 contains urban land use distribution by area. Table 2a has the LID/BMP application area (or effective area). Table 3 displays LID or BMP selected for each urban land use. In addition, the percentages of the LID/BMP effective area (100 x effective area / total available area) are calculated in Table 3a.

Once the system has the urban area distribution data (*Input* worksheet) and the LID or BMP application areas, the estimated urban pollutant loads are displayed in Table 4 (Figure B4). The load reductions are calculated by multiplying the total loads by the efficiencies of selected LIDs/BMPs shown in Table 3.



Urban Runoff BMP and Pollutant Load Reduction

Urban BMP Tool | Close

1. Pollutant concentration in runoff (mg/l)

Landuse	Commerc	Industrial	Institutio	Transpor	Multi-Fan	Single-Fa	Agricultu	Vacant (d	Open Space
TN	21	14	11	13	11	6	23	1	1
TP	1.3	1.5	1.4	1.8	1.4	0.81	3	0.22	0.39
BOD	85	50	52	50	52	22	40	2	1
TSS	1180	1240	1320	2260	1320	309	1000	100	61

2. Urban landuse distribution

Landuse	Commerc	Industrial	Institutio	Transpor	Multi-Fan	Single-Fa	Agricultu	Vacant (d	Open Space
W1	30	20	20	20	20	60	10	10	10
W2	30	20	20	20	20	60	10	10	10
W3	30	20	20	20	20	60	10	10	10
W4	30	20	20	20	20	60	10	10	10

2a. Effective BMP area (ac)

Landuse	Commerc	Industrial	Institutio	Tr
W1	30	20	20	
W2	30	20	20	
W3	30	20	20	
W4	30	20	20	

3. Selected urban BMPs

Landuse	Commerc	Industrial	Institutio	Transpor	Multi-Fan	Single-Fa	Agricultu	Vacant (d	Open Space
W1	0 No BMP	0 No BMP	LID/Vegeta	0 No BMP	0 No BMP	0 No BMP	0 No BMP	0 No BMP	0 No BMP
W2	0 No BMP	0 No BMP	0 No BMP	0 No BMP	0 No BMP	0 No BMP	0 No BMP	0 No BMP	0 No BMP
W3	0 No BMP	0 No BMP	0 No BMP	0 No BMP	0 No BMP	0 No BMP	0 No BMP	0 No BMP	0 No BMP
W4	0 No BMP	0 No BMP	0 No BMP	0 No BMP	0 No BMP	0 No BMP	0 No BMP	0 No BMP	0 No BMP

3a. Percentage BMP effective area (%)

Landuse	Commerc	Industrial	Institutio	Tr
W1	100	100	100	
W2	100	100	100	
W3	100	100	100	
W4	100	100	100	

4. Pollutant loads from urban in lb/year

Watersh ed	Pre-BMP Load				Load Reduction				After BMP Load			
	N	P	BOD	TSS	N	P	BOD	TSS	N	P	BOD	TSS
W1	13531.589	1443.3619	52333.644	1261306.2	99.897218	29.666446	0	75921.885	13431.691	1413.6955	52333.644	1185384.3
W2	13531.589	1443.3619	52333.644	1261306.2	0	0	0	0	13531.589	1443.3619	52333.644	1261306.2
W3	13531.589	1443.3619	52333.644	1261306.2	0	0	0	0	13531.589	1443.3619	52333.644	1261306.2
W4	13531.589	1443.3619	52333.644	1261306.2	0	0	0	0	13531.589	1443.3619	52333.644	1261306.2

Figure B4. The *Urban* worksheet, which calculates pollutant loads from urbanized areas.

B.5 *Feedlots* Worksheet

The *Feedlots* worksheet is modified from a model developed by EPA Region 5 (MDEQ 1999). The worksheet is hidden from users by default. When displayed, three tables are visible in this worksheet (Figure B5). Table 1 contains information on size, percentage of imperviousness (paved area), average rainfall, and BMP efficiencies for the feedlots in each watershed. In Table 2, you may enter detailed information on young beef, young dairy stock, and feeder pigs in addition to the animal numbers in the *Animal* worksheet.

The nutrient loads from feedlots are calculated based on animal numbers, feedlot runoff, and default nutrient concentrations in the runoff. They are shown in Table 3 (Figure B5).

Feedlot Pollution

Notes: An animal lot refers to an open lot or combination of open lots intended for confined feeding, breeding, raising or holding animals.
It is specifically designed as a confinement area in which manure accumulates or where the concentration of animals is such that vegetation cannot be maintained.
The purpose of these calculations is to represent nitrogen (N), phosphorus (P), and Biological Oxygen Demand (BOD) reductions after an animal waste BMP is installed.
This method has two assumptions: 1) the feedlot is adjacent to a receiving hydrological system without any buffering areas; and 2) installing the
animal waste BMP will reduce pollutants from the lot from reaching the hydrologic system.
Feedlots that cannot show impact to the hydrologic system being protected should not be evaluated with this computation.

1. Select a range of paved percentage for feedlots

Watershed	Contributing area (ac.)	Percent paved	Average event rainfall (inch)	Feedlot BMP efficiency on N	Feedlot BMP efficiency on P	Feedlot BMP efficiency on BOD
W1	30	0-24%	0.870	0.45	0.7	0
W2	40	25-49%	0.870	0	0.85	0.24
W3	50	50-74%	0.870	0	0.825	0
W4	30	75-100%	0.870	0.35	0.31	0.535

2. Agricultural animals

Animal	Beef Cattle (Slaughter	Young Beef	Dairy Cattle	Young Dairy Stock	Swine	Feeder Pig	Sheep
Design Weight (lbs)	1000	500	1400	500	200	50	100
W1	1000	0	500	0	100	0	100
W2	1200	0	600	0	100	0	100
W3	1400	0	700	0	100	0	100
W4	1600	0	800	0	100	0	100

3. Load from feedlot (lb/yr) (1 ac x in x mg/l = 0.227 lb)

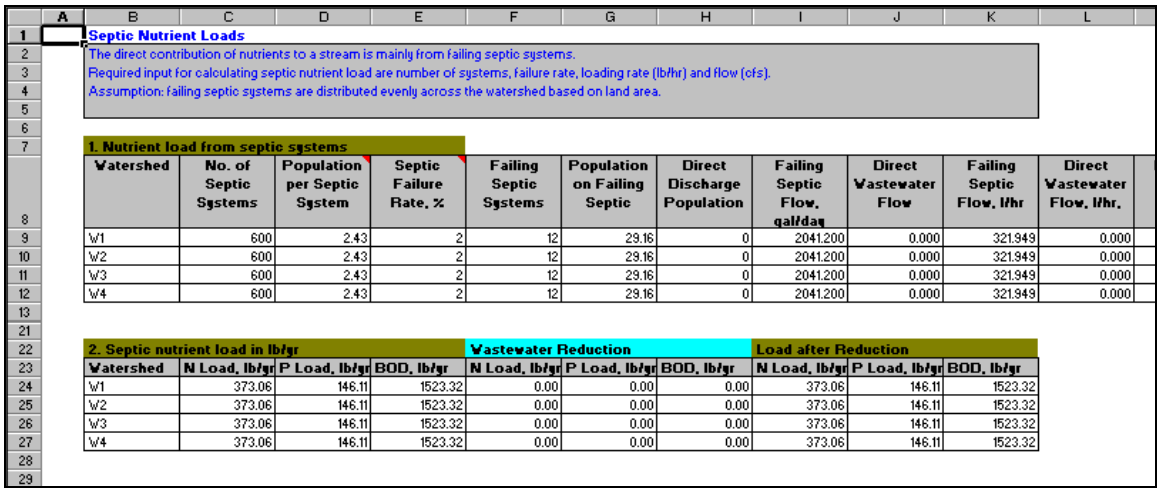
Watershed	N load	P Load	BOD load	N Reduction	P Reduction	BOD Reduction
W1	97127.50	4109.97	116536.04	43707.37	2876.98	0.00
W2	131158.01	5562.98	156886.62	0.00	4728.53	37652.79
W3	172472.58	7327.76	205846.05	0.00	6045.40	0.00
W4	207335.93	9461.89	265002.97	72567.58	2933.19	141776.59

Figure B5. The *Feedlots* worksheet, which calculates pollutant loads from animal feedlots.

B.6 *Septic* Worksheet

The *Septic* worksheet is hidden from users by default. When displayed, there are two visible tables on this worksheet (Figure B6). Table 1 contains information on the number of septic systems (tanks), the failure rates (percentage), the ratio of persons per septic system, and calculated direct wastewater discharge flow for each watershed. The default ratio of persons per septic system is based on the number of people per U.S. home in 1990. Table 2 shows the calculated septic load together with the direct discharge load in pounds per year.

(*Tip: You can reveal the section between the two tables using Excel's unhide function to change the default per capita septic flow rate and nutrient concentrations.*)



Septic Nutrient Loads

The direct contribution of nutrients to a stream is mainly from failing septic systems.
Required input for calculating septic nutrient load are number of systems, failure rate, loading rate (lb/hr) and flow (cfs).
Assumption: failing septic systems are distributed evenly across the watershed based on land area.

1. Nutrient load from septic systems

Watershed	No. of Septic Systems	Population per Septic System	Septic Failure Rate, %	Failing Septic Systems	Population on Failing Septic	Direct Discharge Population	Failing Septic Flow, gal/day	Direct Wastewater Flow	Failing Septic Flow, l/hr	Direct Wastewater Flow, l/hr.
W1	600	2.43	2	12	29.16	0	2041.200	0.000	321.949	0.000
W2	600	2.43	2	12	29.16	0	2041.200	0.000	321.949	0.000
W3	600	2.43	2	12	29.16	0	2041.200	0.000	321.949	0.000
W4	600	2.43	2	12	29.16	0	2041.200	0.000	321.949	0.000

2. Septic nutrient load in lb/yr

				Wastewater Reduction			Load after Reduction		
Watershed	N Load, lb/yr	P Load, lb/yr	BOD, lb/yr	N Load, lb/yr	P Load, lb/yr	BOD, lb/yr	N Load, lb/yr	P Load, lb/yr	BOD, lb/yr
W1	373.06	146.11	1523.32	0.00	0.00	0.00	373.06	146.11	1523.32
W2	373.06	146.11	1523.32	0.00	0.00	0.00	373.06	146.11	1523.32
W3	373.06	146.11	1523.32	0.00	0.00	0.00	373.06	146.11	1523.32
W4	373.06	146.11	1523.32	0.00	0.00	0.00	373.06	146.11	1523.32

Figure B6. The *Septic* worksheet, which estimates pollutant loads from failed septic systems and direct wastewater discharge.

B.7 *Sediment* worksheet

The *Sediment* worksheet is hidden from users by default. When displayed, there are four visible tables (Figure B7) in the worksheet. Table 1 links to the *Input* worksheet for the USLE parameter values (R, the rainfall erosivity index; K, the soil erodibility factor; LS, the topographic factor; C, the cropping factor; and P, the conservation practice factor) for different types of rural land uses. STEPL does not account for gully erosion and stream bank erosion because USLE calculates sheet and rill erosion only. You can obtain soil erosion parameter values from your local Natural Resources Conservation Service office or from the National Resources Inventory (NRI) database (http://www.nhq.nrcs.usda.gov/NRI/1997/). Click STEPL's USLE Parameters by Land Use menu to open a summary NRI table for major land uses in each U.S. county. The worksheet calculates annual erosion in tons per acre for all the watersheds (Table 2). The sediment delivery ratio is calculated based on watershed area (USDA-NRCS 1983). The sediment output is calculated by multiplying soil erosion by the sediment delivery ratio.

Nutrient concentrations in the soil and a default enrichment ratio of 2 are used to estimate the nutrient load carried by sediment (Table 3).

Using the BMPs selected on the *BMPs* worksheet, the nutrient reduction carried by sediment is calculated in Table 4.

Sediment Load

Sediment load is calculated based on USLE equation and delivery ratio. Users need to input USLE parameters.
Sediment delivery ratio (DR) is calculated using: DR=0.42^A-0.125 if A<200 acres, and DR=0.417662A^-0.134958 - 0.127097 if A>=200 acres.
Where A is the watershed area (mi²).

1. Input USLE parameters

Watershe	Cropland					Pastureland					Forest					User Defined					
	R	K	LS	C	P	R	K	LS	C	P	R	K	LS	C	P	R	K	LS	C	P	DR
W1	273	0.255	1.017	0.2	0.944	273	0.255	1.017	0.04	1	273	0.255	1.017	0.003	1	273	0.255	1.017	0.129	1	0.184
W2	273	0.255	1.017	0.2	0.944	273	0.255	1.017	0.04	1	273	0.255	1.017	0.003	1	273	0.255	1.017	0.129	1	0.172
W3	273	0.255	1.017	0.2	0.944	273	0.255	1.017	0.04	1	273	0.255	1.017	0.003	1	273	0.255	1.017	0.129	1	0.163
W4	273	0.255	1.017	0.2	0.944	273	0.255	1.017	0.04	1	273	0.255	1.017	0.003	1	273	0.255	1.017	0.129	1	0.155

2. Erosion and sediment delivery (ton/year)

Watershe	Cropland	Pasturela	Forest	User	Erosion	Sediment	Sed.	%Reductio
W1	26762.000	567.210	638.111	1830.387	29797.708	5493.125	2046.298	37.3
W2	40143.000	567.210	850.815	1830.387	43391.412	7453.609	2517.230	33.8
W3	53524.001	567.210	1063.519	1830.387	56985.116	9260.215	5724.412	61.8
W4	66905.001	567.210	1276.223	1830.387	70578.820	10960.836	7873.982	71.8

3. Nutrient load from sediment (ton/year)

4. Nutrient load reduction (ton/year)

Watershe	N conc.%	P conc.%	BOD	N Load	P Load	BOD Load	N	P	BOD
W1	0.080	0.031	0.160	8.789	3.384	17.578	3.274	1.261	6.548
W2	0.080	0.031	0.160	11.926	4.591	23.852	4.028	1.551	8.055
W3	0.080	0.031	0.160	14.816	5.704	29.633	9.159	3.526	18.318
W4	0.080	0.031	0.160	17.537	6.752	35.075	12.598	4.850	25.197

Go to the "STEPL" menu for soil nutrient concentration map.

Figure B7. The *Sediment* worksheet, which uses USLE and the sediment delivery ratio to calculate sediment load from various land uses.

B.8 *Reference* and *CountyData* worksheets

The *Reference* and *CountyData* worksheets are hidden from users by default. The reference worksheet contains a standard animal weight table modified from the ASAE standard handbook (ASAE 1998). Animal weight data are used to calculate the animal equivalent unit in the *Animal* worksheet. The reference sheet also contains all the references that STEPL uses for estimating the default input parameter values.

The *CountyData* worksheet has a collection of state and county names, precipitation data, and an USLE parameter value summary by U.S. county (Figure B8). The data on this worksheet are used as default values for many tables in the *Input* worksheet after you select a state name and a county name.

	F	G	H	I	O	P	Q	R	S
1	State_name-Name	Rainfall (inches	RainDays	Runoff	Rmean	Kmean	LSavg	Cavg	Pavg
2	Alabama-Autauga	60	87.3	19	374.7	0.20	0.29	0.14	0.99
3	Alabama-Baldwin	60	104.4	25.875	550.0	0.21	0.18	0.20	0.99
4	Alabama-Barbour	60	89.2	18	376.7	0.19	0.56	0.15	0.94
5	Alabama-Bibb	60	97.8	21	375.0	0.25	1.09	0.05	0.99
6	Alabama-Blount	60	95.5	24	325.0	0.26	0.77	0.10	0.96
7	Alabama-Bullock	60	97.2	18	375.0	0.25	0.36	0.05	0.96
8	Alabama-Butler	60	97.8	18	425.0	0.24	0.43	0.10	0.95
9	Alabama-Calhoun	60	97.8	23	325.0	0.27	0.36	0.15	1.00
10	Alabama-Chambers	60	97.8	20	346.8	0.21	0.85	0.02	1.00
11	Alabama-Cherokee	60	100.8	22.75	300.0	0.29	0.56	0.20	0.85
12	Alabama-Chilton	60	90.4	20	374.9	0.24	0.44	0.10	0.94
13	Alabama-Choctaw	60	96.3	22	425.0	0.27	0.52	0.03	0.97
14	Alabama-Clarke	60	98.4	19	450.0	0.27	0.30	0.08	1.00
15	Alabama-Clay	60	98.3	26.333	350.0	0.20	0.62	0.02	1.00
16	Alabama-Cleburne	60	97.3	21.333	325.0	0.30	0.55	0.06	0.96
17	Alabama-Coffee	60	99.7	20	450.0	0.18	0.38	0.14	0.84
18	Alabama-Colbert	60	97.8	24.5	300.0	0.29	0.33	0.23	0.99
19	Alabama-Conecuh	60	93.3	20	449.8	0.21	0.30	0.14	0.91
20	Alabama-Coosa	60	97.8	24	350.3	0.20	0.54	0.03	0.99
21	Alabama-Covington	60	100	21	474.7	0.20	0.36	0.09	0.93
22	Alabama-Crenshaw	60	97.8	18	425.0	0.19	0.36	0.15	0.90
23	Alabama-Cullman	60	101.7	24	325.0	0.25	0.65	0.06	0.96
24	Alabama-Dale	60	97.8	20	424.9	0.17	0.42	0.19	0.86
25	Alabama-Dallas	60	96.4	18	399.9	0.25	0.21	0.12	1.00
26	Alabama-De Kalb	60	115	26.333	300.0	0.24	0.62	0.15	0.91
27	Alabama-Elmore	60	97.8	19	375.0	0.23	0.29	0.18	0.93
28	Alabama-Escambia	60	93.3	23	525.0	0.20	0.22	0.19	0.90
29	Alabama-Etowah	60	96.9	24	325.0	0.27	0.37	0.09	0.96
30	Alabama-Fayette	60	98.5	22	350.0	0.29	0.60	0.11	0.95
31	Alabama-Franklin	60	97.8	24	323.4	0.22	0.43	0.07	0.98
32	Alabama-Geneva	60	98.2	21.333	450.0	0.19	0.37	0.19	0.88
33	Alabama-Greene	60	97.5	20	373.8	0.29	0.23	0.04	1.00
34	Alabama-Hale	60	97.2	20	372.3	0.27	0.26	0.04	0.98
35	Alabama-Henry	60	89	18	400.0	0.17	0.42	0.22	0.90
36	Alabama-Houston	60	97.8	20	424.8	0.18	0.27	0.21	0.90
37	Alabama-Jackson	60	108.8	28	275.0	0.24	0.24	0.15	0.98
38	Alabama-Jefferson	60	98.3	27	350.0	0.28	0.67	0.02	1.00

Figure B8. *CountyData* worksheet, which contains county data on precipitation, runoff, and USLE parameter values by U.S. county.

Appendix C: STEPL Worksheets Summary

1. *Input* Worksheet

Function:

This worksheet collects input for STEPL. Average annual precipitation, number of days with measurable precipitation, correction factors for precipitation and number of days with precipitation, and USLE soil erosion parameter values are automatically entered once the user selects a state name, a county name, and a weather station name.

User input:

Required: State name, county name, weather station name, land use areas, percent of pavement in feedlots, agriculture animals, number of months that manure is applied to croplands, number of septic systems in each watershed, and septic system failure rates

Optional: Number of people that discharge wastewater directly, reduction percentage of direct wastewater discharge, soil hydrologic group, reference runoff curve numbers, nutrient concentrations in runoff and soils, urban land use distribution, and area/amount/frequency/reduction of cropland irrigation

Visible tables:

Input watershed land use area (ac) and precipitation (in)
Input agricultural animals
Input septic system and illegal direct wastewater discharge data
Modify the Universal Soil Loss Equation (USLE) parameters
Select average soil hydrologic group (SHG)
Reference runoff curve number (may be modified)
Detailed urban reference runoff curve number (may be modified)
Nutrient concentration in runoff (mg/L)
Input or modify urban land use distribution
Input irrigation area (ac) and irrigation amount (in)

Hidden tables:

None

2. *General Input Data* Worksheet

Function:

This is the first worksheet generated by the main program, STEPL.exe. It shows the number of watersheds, land uses, pollutants, and animal types the user specified in the VB interface. Users may use it to verify general input information. Note that it also contains the date and time the worksheet was generated.

User input:

None

Visible tables:

Summary of initial user's input

Hidden tables:
None

3. *Land&Rain* Worksheet

Function:
Calculates surface runoff (inches) and runoff volume (acre-feet) for land uses in each watershed using the Soil Conservation Service (SCS, now Natural Resources Conservation Service or NRCS) curve number method.
User input:
Rainfall initial abstraction factor (default = 0, range 0 to 0.2)
Visible tables
- Input watershed land use area (ac) and precipitation (in)
- Select average soil hydrologic group
- Reference runoff curve number (may be modified)
- Annual runoff by land uses (ac-ft)
- Nutrient concentration in runoff (mg/L)

Hidden tables:
- Curve number CN
- Calculated runoff (in)
- Detailed urban land use area (ac)
- Urban runoff curve number
- Runoff by urban land use (in)
- Urban annual runoff (ac-ft)
- Irrigation runoff (in)
- Runoff reduction by land uses (ac-ft) (for irrigation reduction in cropland)

Notes:
- Tables for precipitation, number of days with precipitation, and runoff are provided through a menu under the customized menu bar "STEPL."
- A reference table for correction factors for precipitation and number of days with precipitation is provided through a menu under the customized menu bar "STEPL."

4. *Animal* Worksheet

Function:
Inputs animal-related information for each land use in each watershed.
User input:
Wild animal densities in agricultural areas (default to zeros)
Visible table:
Agricultural animals
Hidden tables:
- Wildlife density in cropland
- Estimated wildlife and AEU in watersheds
- Total animal equivalent units and nutrient concentrations
- AEU and nutrient in runoff (mg/l)

5. *BMPs* Worksheet

Function:

Allows users to select best management practices (BMPs) for cropland, pastureland, forest, user-defined land, feedlot, and urban.

User input:

- Select appropriate BMPs for different land uses
- Use the ***Urban BMP Tool*** for setting and changing LIDs/BMPs for urban land uses
- Optional: Enter the watershed-wide combined BMP efficiencies

Visible tables

- BMPs and efficiencies for different pollutants on cropland
- BMPs and efficiencies for different pollutants on pastureland
- BMPs and efficiencies for different pollutants on forest
- BMPs and efficiencies for different pollutants on user-defined land use
- BMPs and efficiencies for different pollutants on feedlot
- BMPs and efficiencies for different pollutants on urban
- Combined watershed BMP efficiencies from the BMP calculator.

6. *Urban* Worksheet

Function:

Calculates pollutant load from urban runoff and potential load reductions from various BMPs using the runoff volume x concentration approach.

User input:

Urban BMP Tool: Select urban LID/BMPs and the application areas for the selected urban land uses.

Visible tables:

- (Urban) pollutant concentration in runoff (mg/l)
- Urban land use distribution
- Effective BMP application area
- Selected urban BMPs
- Percentage of BMP effective area (%)
- Pollutant loads from urban in lb/yr

Hidden tables:

- Urban runoff (ac-ft)
- Total urban N load (kg)
- Selected urban N reduction efficiency
- Urban N reduction (kg)
- Total urban P load (kg)
- Selected urban P reduction efficiency
- Urban P reduction (kg)
- Total urban BOD load (kg)
- Selected urban BOD reduction efficiency
- Urban BOD reduction (kg)

- Total urban TSS load (kg)
- Selected urban TSS reduction efficiency
- Urban TSS reduction (kg)

7. *Feedlots* Worksheet

Function:

Calculates pollutant load from feedlots based on animal types, weight, and average rainfall.

User input:

Input young animal numbers if available

Visible tables:

- Select a range of paved percentage for feedlots
- Agricultural animals
- Load from feedlot (lb/yr)

Hidden tables:

- Feedlot load calculation
- Ratio of nutrients produced by animals relative to 1000 lb. of slaughter steer

8. *Septic* Worksheet

Function:

Computes pollutant (nitrogen, phosphorus, and BOD) load from failing septic systems and illegal direct discharges.

User input:

None

Visible tables:

- Nutrient load from septic systems (lb/hr)
- Septic nutrient load in lb/yr

Hidden tables:

Assumed average flow rate and concentrations reaching the stream (from overcharge of the failed septic systems and direct wastewater discharge)

9. *Sediment* Worksheet

Function:

- Calculates erosion and sediment load from land and watersheds using USLE.
- Calculates load reduction in sediment and nutrients from BMPs.

User input:

None

Visible tables:

- Input USLE parameters
- Erosion and sediment delivery (ton/year)
- Nutrient load from sediment (ton/year)

- Nutrient load reduction (ton/year)

Hidden tables:

- BMPs and efficiencies
- Erosion and sediment delivery after BMPs (ton/year)
- Sediment and sediment nutrients by land uses (tons/year)

10. *Total Load* Worksheet

Function:

Summarizes pollutant loads from different worksheets by watersheds and land uses.

User input:

None

Visible tables:

- Total load by watershed(s)
- Total load by land uses (with BMP)

Hidden tables:

- Nutrient load from runoff (lb/year) without BMPs
- Nutrient load reduction in runoff with BMPs (lb/yr)
- Nutrient and sediment load by land uses with BMPs (lb/yr)

11. *Graphs* Worksheet

Function:

Plots the pollutant and sediment load by land use and watersheds.

User input:

None

Visible charts:

- Comparison of nutrient loads among the watersheds
- Comparison of sediment loads among the watersheds
- Comparison of nutrient reductions among the watersheds
- Comparison of sediment reductions among the watersheds
- Total nitrogen load by land uses (with BMP) (lb/yr)
- Total phosphorus load by land uses (with BMP) (lb/yr)
- Total BOD load by land uses (with BMP) (lb/yr)
- Total sediment load by land uses (with BMP) (t/yr)

Hidden tables (copied from the *Total Load* worksheet):

- Copy of total load by land uses (with BMP)
- Copy of total load by watersheds

12. *BMPList* Worksheet

Function:

Displays BMP efficiency data and provides users the ability to add, change, or delete the data.

User input:

None or new BMP names and pollutant removal efficiencies.

Visible tables:

List of BMP names and pollutant removal efficiencies for cropland, pastureland, forest, user-defined land, feedlots, and urban land.

Hidden tables:

None

13. *Reference* Worksheet

Function:

Provides necessary reference data or parameter values used for the calculations in other sheets, including typical animal weight.

User input:

None

Visible tables:

Standard animal weight table modified from ASAE standard handbook (ASAE 1998)

Hidden tables:

None

14. *CountyData* Worksheet

Function:

Provides necessary default county data or parameter values used for the calculations in other sheets.

User input:

None

Visible tables:

State names, precipitation, number of rain days and runoff by U.S. counties, and 1992 USLE parameters by U.S. counties.

Hidden tables:

None

Appendix D. Guide for Using STEPL On-line Data Access System

The STEPL on-line data access system is an ArcIMS based system and can be accessed through http://it.tetratech-ffx.com/stepl. The *STEPL Model Input Data Server* interface (Figure D1) has five panels:

- Top panel: Map manipulation and help tools (Figure D2).
- Mid panel: A US state map is shown initially. When the map is zoomed to a state or a county level, a HUCO map will be seen. The HUCO map shows the overlay results of 8-digit USGS hydrologic unit (HU) and county (CO) boundaries. Your watershed might be located in a single HUCO unit (polygon) or across several units.
- Left panel: Simple steps to obtain information for HUCO polygons by selecting a state and a county or a hydrologic unit.
- Right panel: More steps to refine selected HUCO polygons and obtain a report using reporting tools (Figure D2).
- Bottom panel: Displays the server message or the information for the selected polygons.

Note: The HUCO polygons do not always precisely represent your specific watersheds, but they can be used to approximate your specific watersheds.

D1. Steps for using the STEPL on-line data access system

Step 1. On the left panel, select a state from the state list (Figure D1). The system will zoom to the state you have selected.

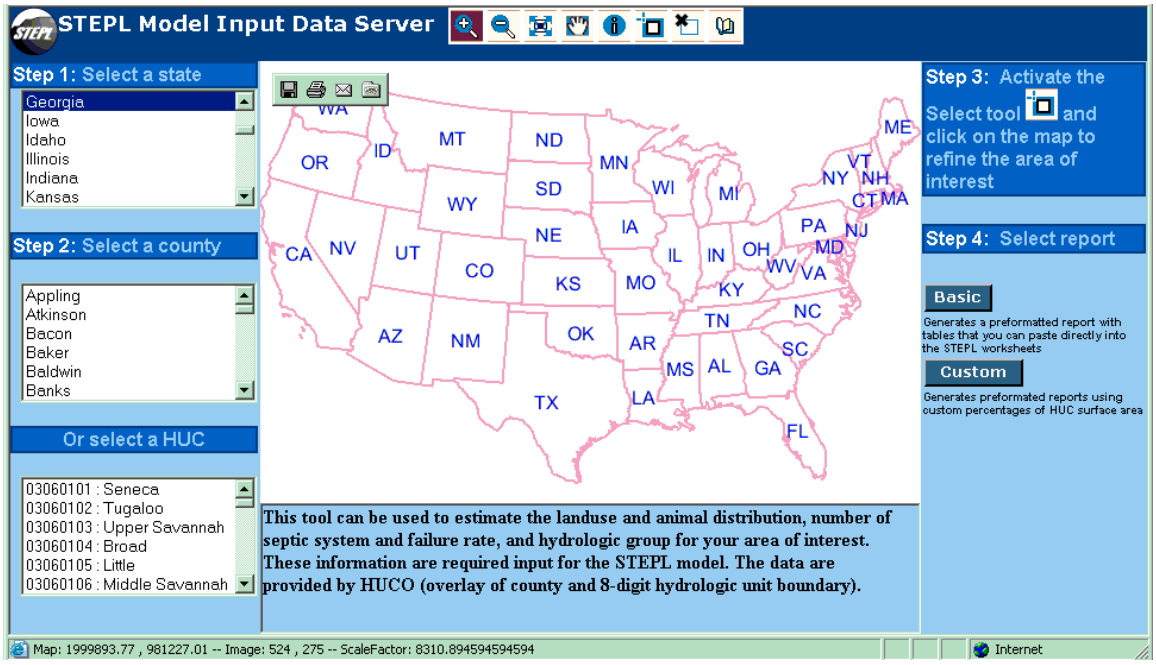


Figure D1. STEPL on-line data access system: ArcIMS interface

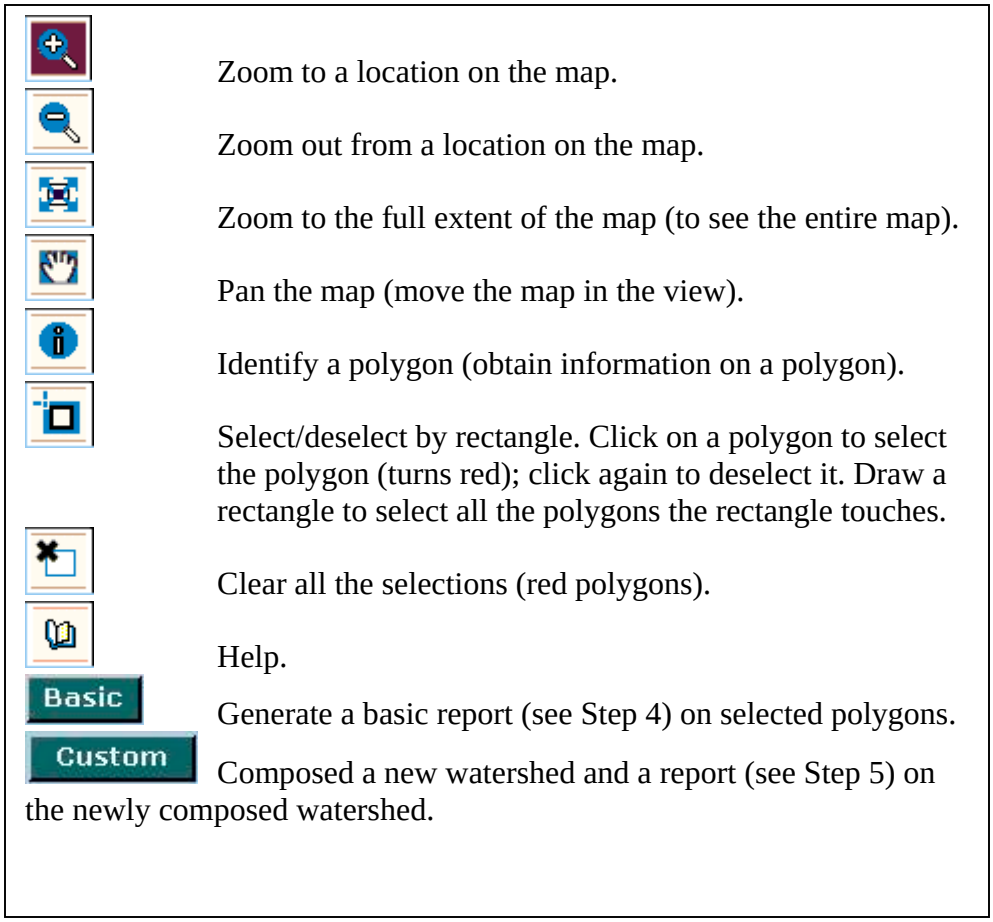


Figure D2. Functions of map manipulation and help tools and reporting command buttons in the *STEPL input data server* interface.

Step 2. Select a county from the county list or select a hydrologic unit from the hydrologic unit code (HUC) list. The system will zoom to the county or the HU you have selected.

Step 3. Using the "select/deselect by rectangle" tool in the top panel, select or deselect areas (polygons) of interest for your watershed.

Each polygon in the map is a portion of an 8-digit HU and a county.
The polygons you have selected are in red, and information on the selected polygons is displayed in the bottom panel.

Tip: To see the HUCO IDs of the map, keep zooming in until the IDs are displayed.

Step 4. Click the "Basic (report) " tool to obtain a report in a new page. The data included in the "Basic" report corresponds to the entire area of each selected polygon (e.g., total number of horses in polygon HUCO ##).

The new page will provide the following tables for the polygons you have selected:

- Information for selected polygon(s) including total area of each polygon
- Landuse area (in acres) (based on NRI database, 1997)
- Agricultural animals (based on USDA Census of Agriculture, 1997)
- Septic system data (based on septic system surveys by National Small Flows Clearinghouse in 1992 and 1998)
- Hydrological group (based on STATSGO database)

With the exception of the first table, the formats of the tables are based on those of the tables in STEPL.

Landuse areas include feedlots. Feedlot areas are estimated based on the following minimum space requirement by farm animals:

- Beef cow: 25 ft^2
- Dairy cow: 40 ft^2
- Swine: 15 ft^2
- Chicken: 1 ft^2
- Horse: 45 ft^2
- Sheep: 8 ft^2
- Turkey: 6 ft^2
- Duck: 3 ft^2

Step 5. Compose a new watershed using "Custom (report)."

The "Custom" report is used to extract data for watersheds or study areas that do not equal the given HUCO polygons located on the map. A watershed or study area could be any one of the following:

- An exact combination of several HUCO polygons
- An area that spans multiple HUCO polygons, but does not exactly follow HUCO boundaries
- A small area that is contained completely within a single HUCO

To utilize the "Custom" report feature, the user must define the Watershed Percent Area (WPA) of each HUCO polygon that lies within the watershed or study area. Note that when the watershed or study area is exactly composed of one or more HUCO polygons, the percent area of each HUCO polygon that is within the watershed is equal to 100%. When the watershed or study area does not exactly follow HUCO boundaries, or is completely contained within a single HUCO polygon, then the WPA of each HUCO would be less than 100%. Additionally, the WPA sums of polygons comprising the watershed or study area do not have to equal 100 percent.

After you enter WPAs for the HUCO polygons that comprise your watershed and click *Submit*, the system recalculates the STEPL input values for a single watershed based on the five tables generated in Step 4.

Example:

- Select a state: Georgia
- Select a HUC: 03060105 (Figure D3)
- If polygon IDs are not displayed, zoom to the selected area so that the polygon IDs can be seen
- Click "Basic" button and the system will generate a report that contains the data for each of the 8 selected HUCO polygons that constitute the HUC 03060105

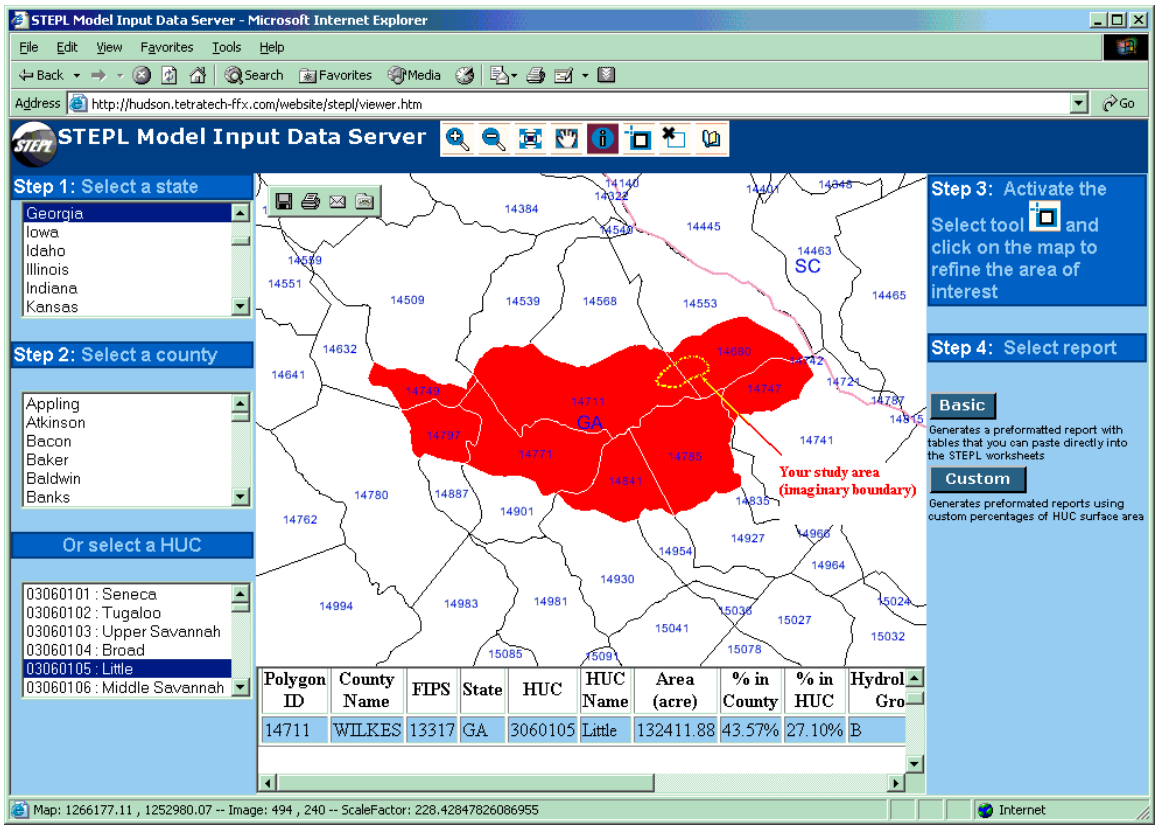


Figure D3. Select a hydrological unit.

- Go back to the map interface, click "Custom" and a new page will ask you to compose a new watershed based on the selected HUCO polygons. You compose the watershed by entering the WPA of each HUCO that is contained within your watershed. For example, if your new watershed has a total area of 10,000 acres (i.e., 5,000 acres is in Polygon 14680, and another 5,000 acres is in Polygon 14711, *imagine a boundary* in Figure D3 and Figure D4), and the total area of Polygon 14680 is 55,280 acres, and that of Polygon 14711 is 132,411 acres (Figure D5), then your percent areas will be the following:

Watershed Percent Area for Polygon 14680 = 5000/55280 x 100 = 9.0 %
Watershed Percent Area for Polygon 14711 = 5000/132411 x 100 = 3.8 %

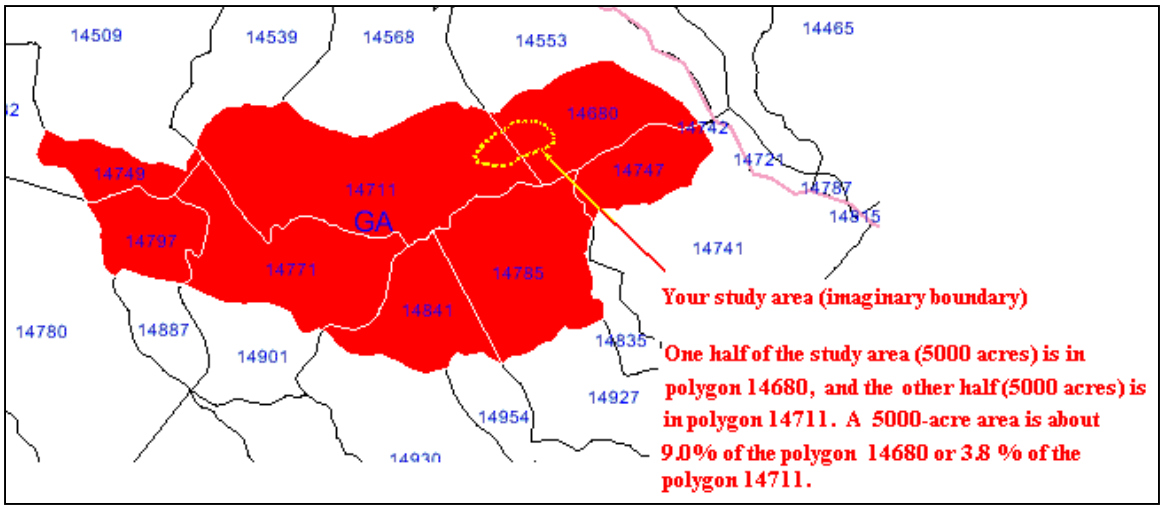


Figure D4. Example of a 10,000-acre study area across two HUCOs.

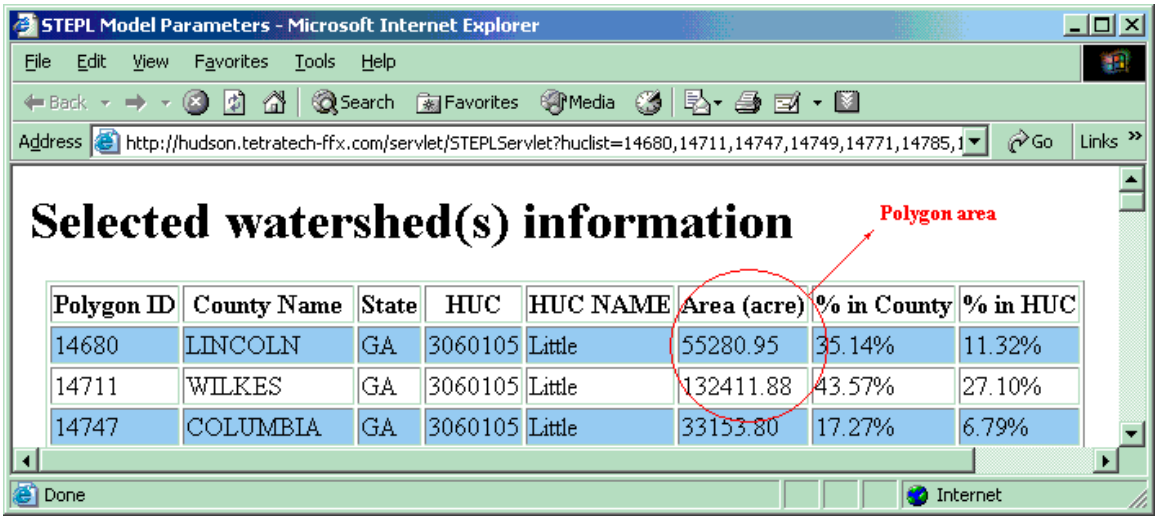


Figure D5. After clicking "Basic (report)" tool, polygon areas can be obtained from the "Selected watershed(s) information" table.

The percent areas will be entered in the STEPL interface similar to below:

Polygon 14680:	9
Polygon 14711:	3.8
Polygon 14747:	0
Polygon 14749:	0
Polygon 14771:	0
Polygon 14785:	0
Polygon 14797:	0
Polygon 14841:	0

The sum of the percent areas does not have to equal 100 percent.

Tip: You can obtain the total area of each HUCO polygon from the first table of the "Basic" report.

- After you complete entering the WPAs, click *Submit* button. The system will compose a new watershed based on your input and generate a report on land use areas, agriculture animal, septic system data, and soil hydrologic group for the subject watershed.

Step 6. Copy the results from the report tables (basic or custom) to your STEPL Excel sheet for use in estimating of pollutant loads.