

# The Spreadsheet Tool for Estimating Pollutant Load (STEPL)

Introduction to STEPL

March 20, 2018



## Webinar Logistics

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# The Spreadsheet Tool for Estimating Pollutant Loads (STEPL)

Introduction to STEPL

March 20, 2018

## Speakers

- Aileen Molloy, Tetra Tech, Inc.
- Mustafa Faizullahoy, Tetra Tech, Inc.

## Agenda

- Overview of STEPL
- Using the model
  - Navigating worksheets
  - Basic inputs & outputs
- Tools and Calculators
- Adding and Modifying BMPs
- STEPL Updates

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## STEPL OVERVIEW

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## What is STEPL?

- **STEPL**– Spreadsheet Tool for Estimating Pollutant Load - an EPA model
- A customized MS Excel spreadsheet model designed to support planning level decision-making
  - What are the average annual pollutant loadings from the non-point sources?
  - How effective are BMPs in reducing pollutant loadings?

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## What is STEPL?

- Calculates nutrient (N, P, and BOD pollutants) and sediment loads by land use type and aggregated by watershed
- Calculates load reductions as a result of implementing BMPs
- Data driven and highly empirical
- Simple and easy to use
- Formulas and default parameter values can be modified by users (optional) with no programming required

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## Who are STEPL Users?

- Basic understanding of hydrology, erosion, and pollutant loading processes
  - Hydrology -> Curve Number approach
  - Erosion -> USLE and sediment delivery ratio, urban runoff concentration
  - Pollutant load -> runoff concentration
- Knowledge of environmental data (e.g., land use, agricultural statistics, and BMP efficiencies)
- Familiarity with MS Excel and Excel Formulas

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## How is STEPL Used?

- Originally developed to assist State NPS project managers report load reductions to EPA
  - Performance measures for N, P, and Sediment
  - Data entered into the Grant Reporting & Tracking System (GRTS)
- Also used by other federal/state/local partners, environmental consultants, researchers, etc.
  - Primary model used for NPS project planning

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## Progression of STEPL Prior to v.4.4

- First release Oct 2001
- Enhancements over the years
  - BMP calculator
  - Ability to add custom BMPs
  - Groundwater
  - Gullies & streambanks
  - Puerto Rico data
  - LID practices

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## STEPL v.4.4 updates

- Expanded and updated weather data
- Added Manure application for pasture land
- Added tool for calculating average number of months for manure application
- Added reporting function (Export Input/Output Option)
- Expanded agricultural BMPs and updated pollutant efficiencies
- Added flow volume reductions for urban LID and infiltration practices
- Added **Combined BMP Efficiency** worksheet
- Added customized STEPL spreadsheet model for 10 watersheds with ability to determine size of BMP treatment area to meet load reduction target
- Added *E. coli* placeholder for possible future release

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## STEPL Basic Tools

- STEPL
  - Calculates load for different sources at source and watershed level
  - User can specify and update BMP list
  - Urban BMP Tool for stormwater BMPs
- BMP calculator
  - Calculates the “combined efficiency” of multiple BMPs use when more than 1 type of BMP is applied on a single land use type
- Input Data Server
  - Map interface to generate input data for the model at the HUC12 level

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## STEPL Input Data Requirements

- Watershed-level data
  - County & Weather Station
  - Land use distribution
  - Agricultural animal population and number of months manure applied
  - Septic system information
- Land cover specific
  - BMP type and % area applied
  - Urban Land use types for urban BMPs

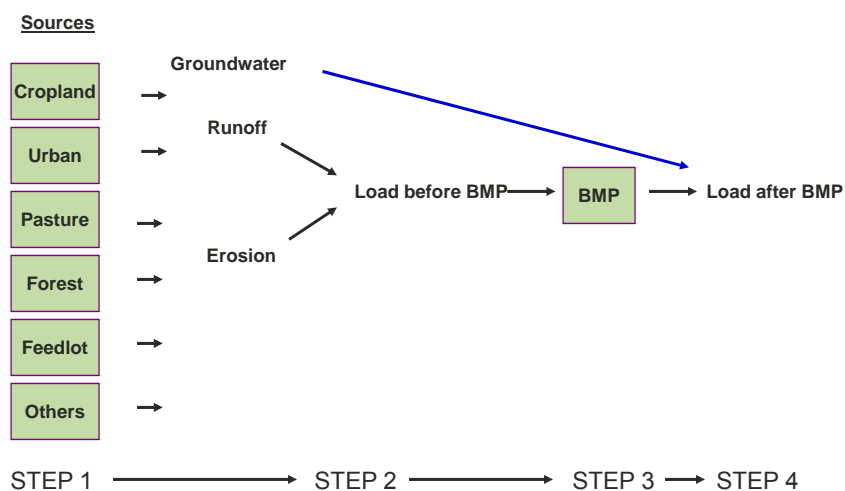
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## STEPL System Defaults

- Derived from user inputs, but can be modified
  - Soil information (based on county)
  - Curve Numbers (land use/soil group)
- Urban land use distribution
- Nutrient concentration in runoff/shallow groundwater

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## STEPL Process Steps



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## System Requirements

- Windows operating system
- MS Excel 2010, 2013 or 2016
  - Not Compatible with Windows 7 operating system and MS Excel 2007 combination
- At least 30 MB hard disk space and memory >8GB RAM preferred

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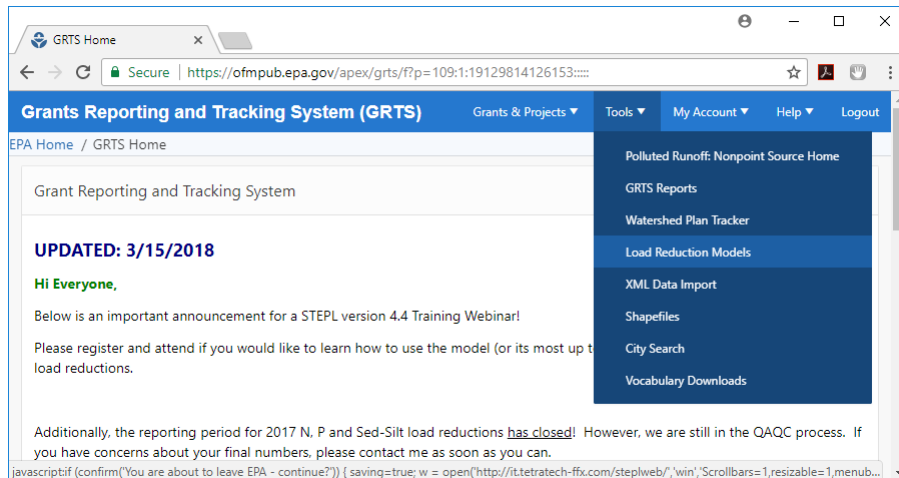
## STEPL Website

The screenshot shows the EPA STEPL website. The left sidebar has a 'Home' link highlighted with a red box. The main content area has a 'Models and Documentation' link highlighted with a red box. The page displays information for STEPL 4.4, including updates and new features, user's guide, spreadsheet model, BMP calculator, and installation package.

Download the latest STEPL program file from: [http://it.tetrattech-ffx.com/steplweb/models\\$docs.htm](http://it.tetrattech-ffx.com/steplweb/models$docs.htm)

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## Alternate STEPL Access




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## STEPL Installation

- Run the *STEPLSetup.exe* to install
  - must have admin rights
  - Important: install STEPL in a folder you have write access to




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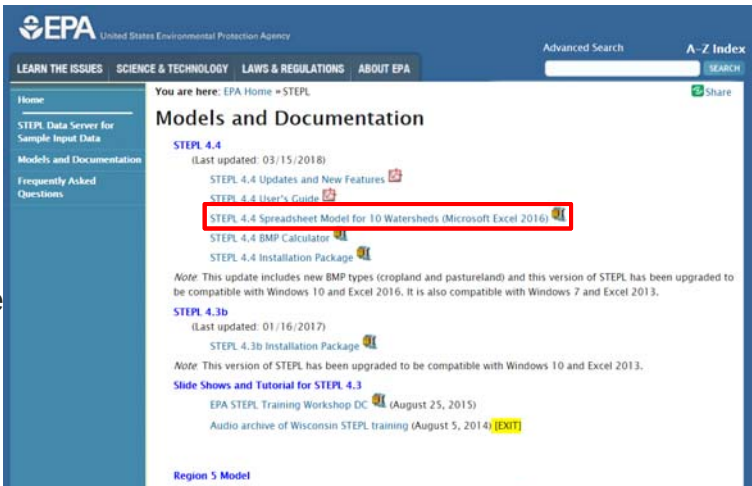


New!


## Customized Spreadsheet Model



- Alternative to STEPLSetup.exe
  - Download *STEPL 4.4 Spreadsheet Model for 10 Watersheds*, which does not require admin rights
- Allows user to start working in STEPL without using installation package
- Provides ability to populate the model with up to 10 watersheds and 100 gullies and streambanks



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## STEPL Resources

- STEPL Installation Package includes:
  - STEPL User Guide
  - BMP Definitions
  - Sample Worksheets
  - Release Notes
  - BMP Calculator Guide
  - Support Worksheets contain input reference data

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## STEPL Resources



- Also on the website:
  - Frequently Asked Questions
  - STEPL Slide Shows & Tutorials
  - Alternative Models Document
  - Region 5 Model and documentation
- STEPL Support:  
[stepl@tetrattech.com](mailto:stepl@tetrattech.com)

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## How to use STEPL

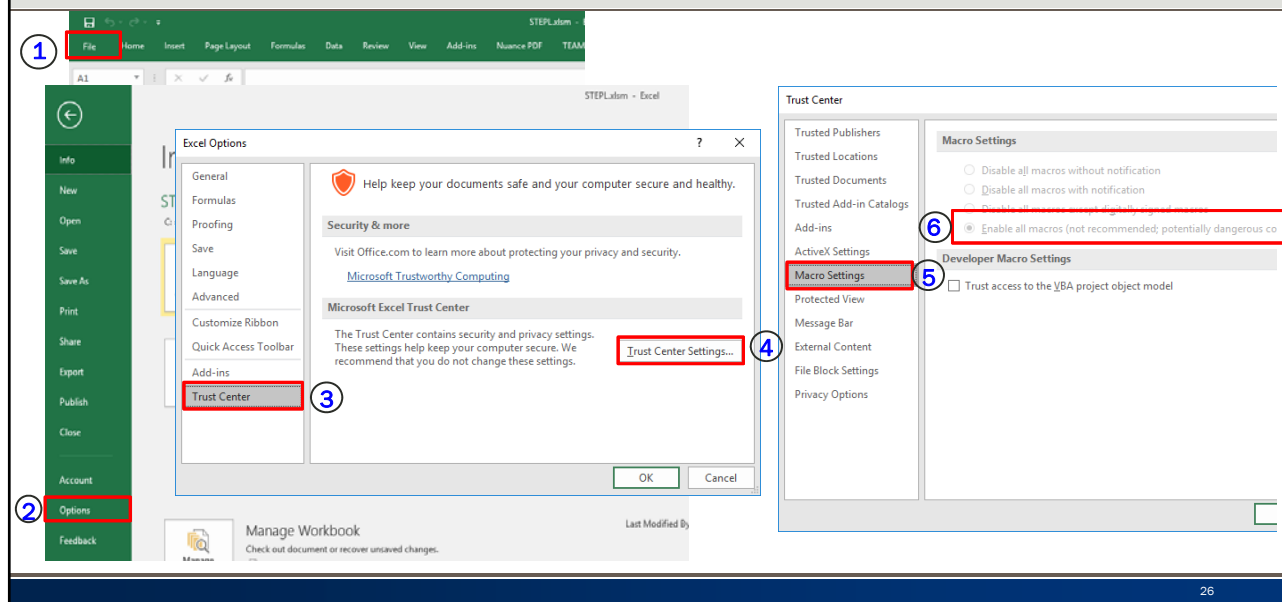
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## Running STEPL

- Know before you begin:
  - Number of watersheds
  - Number of gullies/streambanks
  - Tip: enter more than you need as placeholders
- Enable Macros
  - In Excel 2010, 2013 or 2016, Click on File menu > Options > Trust Center > Trust Center Settings > Macro Settings  
Select “Enable all macros”

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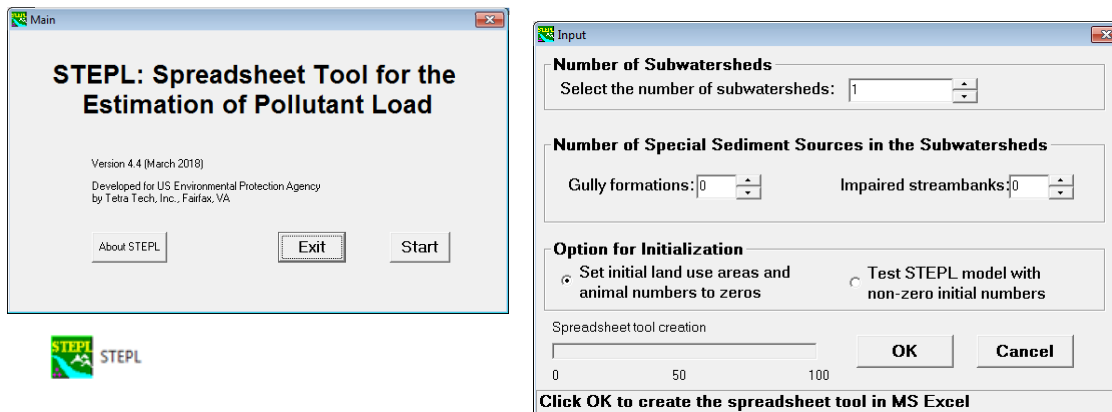
## Macro Settings



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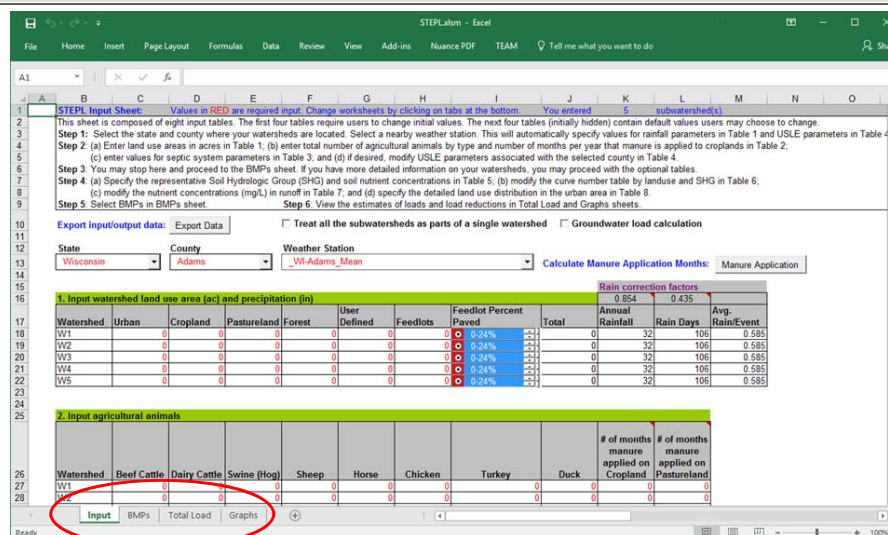
## STEPL Main Program

- Run STEPL executable program *STEPLSetup.exe* to create and customize spreadsheet dynamically



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## STEPL Spreadsheet



Composed of four worksheets

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## Default File Location

The screenshot shows the Microsoft Excel interface with the 'File' menu open. The 'Options' button is highlighted. The 'Excel Options' dialog box is open, and the 'Save' tab is selected. The 'Save workbooks' section is highlighted, showing the 'Default local file location' set to 'C:\STEPL\'. The 'File' menu is circled with a '1', the 'Options' button is circled with a '2', the 'Save' tab in the dialog is circled with a '3', and the 'Default local file location' text box is circled with a '4'.

## Data Input

- Type over **Red** text only
- Do not type in cells with black text

The screenshot shows the STEPL worksheet with three main data input sections. The first section is '1. Input watershed land use area (ac) and precipitation (in)'. The second section is '2. Input agricultural animals'. The third section is '3. Input septic system and illegal direct wastewater discharge data'. Red boxes highlight the input areas for each section.

State	County	Weather Station
Wisconsin	Adams	_W-Adams_Mean

Calculate Manure Application Months:

Watershed	Urban	Cropland	Pastureland	Forest	User Defined	Feedlots	Feedlot Percent Fed	Total	Annual Rainfall	Rain Days
W1	200	200	200	200	0	10	6-24%	818	32	106

Watershed	Beef Cattle	Dairy Cattle	Swine (Hog)	Sheep	Horse	Chicken	Turkey	Duck	# of months manure applied on Cropland	# of months manure applied on Pastureland
W1	100	100	100	100	100	100	100	100	4	4
Total	100	100	100	100	100	100	100	100		

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

## Data Input

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

Watershed	Cropland					Pastureland					Forest				
	R	K	LS	C	P	R	K	LS	C	P	R	K	LS	C	
W1	350,000	0.107	0.203	0.200	1.000	350,000	0.107	0.203	0.040	1.000	350,000	0.107	0.203	0.200	
W2	350,000	0.107	0.203	0.200	1.000	350,000	0.107	0.203	0.040	1.000	350,000	0.107	0.203	0.200	

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. %	Soil E. coli conc. (#/100mg)
W1					B	0.080	0.031	0.150	0.000
W2					B	0.080	0.031	0.150	0.000

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
Transportation	58	58	58	58
Multi-Family	77	85	90	92
Single-Family	57	72	81	86
Urban Cultivat	67	78	85	89
Vacant-Devel	77	85	90	92
Open Space	49	69	79	84

7. Nutrient concentration in runoff (mg/l) and E. coli (MPN/100ml)

Land use	N	P	BOD	E. coli
1. L. Cropland	1.9	0.3	4	0
1a. w/ manure	8.9	2	12.3	0
2. M. Cropland	2.9	0.4	6.1	0
2a. w/ manure	12.2	3	18.5	0
3. H. Cropland	4.4	0.5	9.2	0
3a. w/ manure	18.3	4	24.6	0
4. Pastureland (see Table 10 for default values with manure)	0.2	0.1	0.5	0
5. Forest	0	0	0	0
6. User Defined	0	0	0	0

7a. Nutrient concentration in shallow groundwater (mg/l) and E. coli (MPN/100ml) (may be modified)

Landuse	N	P	BOD	E. coli
Urban	1.5	0.063	0	0
Cropland	1.44	0.063	0	0
Pastureland	1.44	0.063	0	0
Forest	0.11	0.009	0	0
Feedlot	6	0.07	0	0
User-Defined	0	0	0	0

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## Notes on Input Data

- Land use distribution is critical
- Modify inputs with current, local data where available
- Focus on sources being addressed by project
  - For example, agricultural data will not impact results for urban BMPs
  - Will affect total loads but not the load reduction

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## BMPs Worksheet

**Urban BMP Tool**      **Gully and Streambank Erosion**      **Calculate Combined BMP Efficiency**

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

Watershed	Cropland	N	P	BOD	Sediment	E. coli	BMPs	% Area BMP Applied
W1		0.05	0.1374	ND	0.154	ND	Conservation Tillage 2 (equal or more than 50% Resid)	20
W2		0.1125	0.1125	ND	0.1125	ND	Streambank Stabilization and Fencing	15

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

Watershed	Pastureland	N	P	BOD	Sediment	E. coli	BMPs	% Area BMP Applied
W1		0.0665	0.0575	ND	0.0935	ND	Alternative Water Supply	50
W2		0.1075	0.06575	ND	ND	ND	Grazing Land Management (rotational grazing with fe)	25

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

Watershed	Forest	N	P	BOD	Sediment	E. coli	BMPs	% Area BMP Applied
W1		0	0	0	0	0	0 No BMP	0
W2		0	0	0	0	0	0 No BMP	0

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

Watershed	User Defined	N	P	BOD	Sediment	E. coli	BMPs	% Area BMP Applied
W1		0	0	0	0	0	0 No BMP	0
W2		0	0	0	0	0	0 No BMP	0

- Each land use type within each watershed can have one BMP
- % Area BMP Applied: calculate the proportion of acreage treated by the BMP for that land use

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## Total Load Worksheet

**1. Total load by subwatershed(s)**

Watershed	N Load (no BMP)	P Load (no BMP)	BOD Load (no BMP)	Sediment Load (no BMP)	E. coli Load (no BMP)	N Reduction	P Reduction	BOD Reduction	Sediment Reduction	E. coli Reduction	N Load (with BMP)	P Load (with BMP)	BOD (with BMP)	Sediment (with BMP)	E. coli Load (with BMP)	%N Reduction	%P Reduction	%BOD Reduction	%Sed Reduction	%E. coli Reduction
W1	51205.9	7901.6	159749.1	600.7	0.0	1830.5	219.8	259.4	45.0	0.0	49447.4	7081.0	159489.7	641.0	0.0	3.6	2.8	0.2	6.6	0.0
W2	49610.5	7453.3	144180.7	435.0	0.0	3261.1	181.4	42.1	6.6	0.0	46349.4	7271.9	144138.6	428.5	0.0	6.6	2.4	0.0	1.5	0.0
Total	100816.4	15355.0	303929.8	1135.7	0.0	5091.6	401.2	301.5	51.6	0.0	95796.8	14352.9	303628.3	1069.5	0.0	5.1	2.6	0.1	4.1	0.0

**2. Total load by land area (with BMP)**

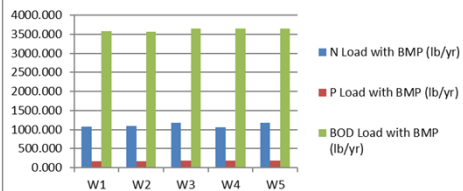
Sources	N Load (lb/yr)	P Load (lb/yr)	BOD Load (lb/yr)	Sediment Load (lb/yr)	E. coli Load (Billion MPN/yr)
Urban	22690.47	3490.20	87132.04	520.92	0.00
Cropland	6448.87	967.74	14579.42	166.45	0.00
Pastureland	46507.46	3084.47	164411.26	279.17	0.00
Forest	8618.51	4271.59	21382.52	192.34	0.00
Feedlots	11273.22	2254.64	15030.97	0.00	0.00
User Defined	0.00	0.00	0.00	0.00	0.00
Septic	267.14	194.63	1990.83	0.00	0.00
Gully	1.90	0.45	2.35	0.03	0.00
Streambank	0.00	0.00	0.00	0.00	0.00
Groundwater	0.00	0.00	0.00	0.00	0.00
Total	95796.84	14953.73	303628.30	1069.51	0.00

Each row of results corresponds to a different watershed or project

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## Graphs Worksheet

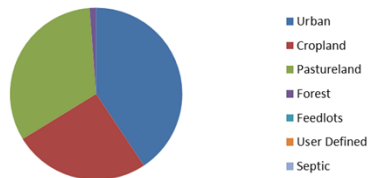
**N, P, and BOD Load by Watersheds with BMP (lb/yr)**



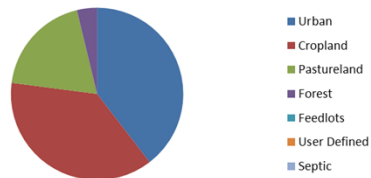
**Sediment Load by Watersheds with BMP (t/yr)**



**Total N Load by Land Uses (with BMP) (lb/yr)**



**Total P Load by Land Uses (with BMP) (lb/yr)**



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## Questions



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# STEPL Input Data Server

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## STEPL Model Input Data Server

The screenshot displays the STEPL Model Input Data Server interface, which includes the EPA website, the STEPL On-line Data Access System, and the Spreadsheet Tool for Estimating Pollutant Load (STEPL) Input Data Server.

**Key features of the STEPL On-line Data Access System include:**

- More stable GIS platform using a simple and modern Web 2.0-style user interface.
- Additional map layers:
  - Street map.
  - Aerial map.
  - Elevation map.
- Boundaries and places.
- State and County boundaries.
- Watershed boundary dataset (HUC12, HUC10, HUC8, HUC6, HUC4, and HUC2).
- NHDplus catchments.
- NHDplus flowlines and waterbodies.
- Updated datasets:
  - 2014 Land use area distribution at the Subwatershed (HUC12) level.
  - 2012 Agricultural animal count at the Subwatershed (HUC12) level.

**Spreadsheet Tool for Estimating Pollutant Load (STEPL) Input Data Server**

The tool includes a **Watershed Search** section with the following steps:

- Step 1: Select a state name from the list below.
- Step 2: Select a county name from the list below.
- Step 3: In order to download data for the entire County, click on the run report button on the right. Otherwise, select one or more subwatershed boundary names from the below list.
- Step 4: Click on run report button when finished to see STEPL input data tables.

**Annotations:**

- Data is available at HUC 12 watershed** (pointing to the Watershed Search section).
- Generate data summaries** (pointing to the Run Report button).

**Click the link below to access the new online data server for STEPL model, or view the User Guide**

[STEPL Model Input Data Server](#)

Last revised: 10/27/2017

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## STEPL Model Input Data Server: Basic Report

- Data is summarized by HUC12 watershed

STEPL Model Input Data Server: Basic Report

Watershed: **Landuse Area**

Watershed Name	HUC12	Urban	Cropland	Pastureland	Forest	User Defined	Feedlots	Water	Others
West Branch Extension-Pigeon	040801030203	1916.682	22636.702	1742.012	1402.961	0.000	1.071	22.229	1179.600

Watershed: **Agricultural Animals Count**

Watershed Name	HUC12	Beef Cattle	Dairy Cattle	Swine	Sheep	Horse	Chicken	Turkey	Duck
West Branch Extension-Pigeon	040801030203	30	742	1005	41	17	0	3	6

Watershed: **Septic System**

Watershed Name	HUC12	Septic Systems	Population per Septic System	% Septic Failure Rate
West Branch Extension-Pigeon River	040801030203	725	2	1.14

Watershed: **Hydrologic Soil Group**

Watershed Name	HUC12	Hydrologic Soil Group
West Branch Extension-Pigeon River	040801030203	C

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New!

## Manure Application

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## Manure Application

- STEPL v4.4 allows application of manure on Pasture land (Table 2)

2. Input agricultural animals										
Watershed	Beef Cattle	Dairy Cattle	Swine (Hog)	Sheep	Horse	Chicken	Turkey	Duck	# of months manure applied on Cropland	# of months manure applied on Pastureland
W1	100	100	100	100	100	100	100	100	9	6
W2	0	0	0	0	0	0	0	0	0	0

- A new table provides EMCs for pastureland based on six groups of livestock density (with and without manure)

- Default values for all six categories are average EMC values from previous version STEPL 4.3
- Will be updated on a later date based on the published literature and after review/approval by EPA

10. Pastureland Nutrient concentration in runoff (mg/l) and E. coli (MPN/100ml)				
Land use	N	P	BOD	E. coli
1. L-Pasture	4	0.3	13	0
1a. w/ manure	4	0.3	13	0
2. M-Pasture	4	0.3	13	0
2a. w/ manure	4	0.3	13	0
3. H-Pasture	4	0.3	13	0
3a. w/ manure	4	0.3	13	0

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## Manure Application

- STEPL v4.4 includes a new worksheet called ManureApplication
- Worksheet is accessed via the Manure Application button next to the weather selection pull down menu in the **Input** worksheet

State Wisconsin	County Adams	Weather Station _WI-Adams_Mean	Calculate Manure Application Months:	Manure Application
--------------------	-----------------	-----------------------------------	--------------------------------------	--------------------

- The worksheet can be used for both cropland and pastureland calculations of months of manure application
- Allows calculation of average number of months for manure application per year

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## Manure Application

- Can specify treatment subareas within a watershed in the **ManureApplication** worksheet
- Each subarea can have a specific number of months where manure is applied
- Calculates an area-weighted number of months when manure is applied across the watershed

Estimate an area-weighted frequency of application based on varying manure application across a watershed

Enter total land use area:  acres

Enter the subarea and its corresponding number of months of manure application below (upto 20 varying frequency of treatment allowed)

Treatment	Area (ac)	# of Months Manure Applied in a Year
1	50.00	9
2	20.00	7
3	30.00	0
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
<b>Total Land Use Area</b>	100.00	<b>6</b>

Total Area check: OK

← Enter the calculated value in Table 2, located in "Input" tab, under the appropriate watershed and landuse (cropland or pastureland under columns K or L)

### 2. Input agricultural animals

Watershed	Beef Cattle	Dairy Cattle	Swine (hog)	Sheep	Horse	Chicken	Turkey	Duck	# of months manure applied on Cropland	# of months manure applied on Pastureland
W1	100	100	100	100	100	100	100	100	6	6
W2	0	0	0	0	0	0	0	0	0	0

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## Urban BMP Tool

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## Urban Land Use Distribution

- STEPL automatically applies a default urban land use distribution to identify the % commercial, % industrial, etc. (Table 8 on “Input” sheet)

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	1760.9	15	10	10	10	10	30	5	5	5	100
W2	836.63	15	10	10	10	10	30	5	5	5	100

- Modify these values with local data when using STEPL to model results of urban BMPs
- The urban land use distribution (acres) will appear in Table 2 of the *Urban* worksheet

2. Urban land use distribution											
Landuse	Commercial	Industrial	Institutional	Transportation	Multi-Family	Single-Family	Urban-Cultivated	Vacant (developed)	Open Space		
W1	264.135	176.09	176.09	176.09	176.09	528.27	88.045	88.045			
W2	125.495	83.663	83.663	83.663	83.663	250.969	41.8315	41.8315			

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## Urban BMP Tool

The screenshot displays the Urban BMP Tool interface, which includes an Excel spreadsheet and a dialog box for setting urban land use distribution.

**Excel Spreadsheet:**

- Sheet 1: Input** - Contains the "Urban BMP Tool" and "Gully and Streambank Erosion" sections. The "Urban BMP Tool" section includes a table for "1. BMPs and efficiencies for different pollutants on CROPLAND, ND-N" and "2. BMPs and efficiencies for different pollutants on PASTURELAND, ND-N".
- Sheet 2: Urban** - Contains the "Urban land use distribution" table, which is the same as the one shown in the previous slide.
- Sheet 3: Total Load** - Contains the "Total Load" table, which is the same as the one shown in the previous slide.
- Sheet 4: Graphs** - Contains the "Graphs" section.

**Urban BMP Tool Dialog Box:**

- Select a Watershed:** A dropdown menu with "W1" selected.
- Select an Urban Land Use:** Radio buttons for Commercial, Industrial, Institutional, Transportation, Multi-Family, Single-Family, Urban-Cultivated, Vacant Developed, and Open Space. "Urban-Cultivated" is selected.
- Select LID/BMP:** A dropdown menu with "0 No BMP" selected.
- Available LID/BMP:** A text box with "264.14" entered.
- BMP Drainage Area (ac):** A text box with "264.14" entered.
- Total Available Area (ac):** A text box with "264.14" entered.
- Buttons:** "Reset All", "Apply LID/BMP", and "Exit".

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## Urban BMP Tool



- Select the watershed
- Select an urban land use to apply the BMP
- Select the BMP
- Enter the drainage area to the BMP

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New!

## Flow Volume Reductions



- STEPL can now estimate flow volume reductions for Urban LID and Infiltration BMP practices
- The user enters the design runoff captured depth, percent imperviousness of the BMP drainage areas and BMP drainage area
- Pre-populated design storage depths for each of the available infiltration BMPs are included in the **BMPList** Worksheet
- Flow volume reductions represented as gallons/year by urban land use type in each watershed

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## Flow Volume Reductions

- **Urban** worksheet showing volume reductions from urban infiltration BMPs (Table 5 of **Urban** worksheet)
- Table 6 provides the BMP surface area of number of units (e.g. rain barrels)
- Urban LID and infiltration practices in STEPL version 4.4 with flow volume reductions

5. Captured Flow Volume (gallon/year)									
Landuse	Commercial	Industrial	Institution	Transport	Multi-Fam	Single-Fam	Urban-Cult	Vacant-De	Open Space
W1	1435371.9	0	0	0	0	49855.14	0	0	0
W2	0	0	0	0	0	0	0	0	0

Land Use	BMP
Urban	Infiltration Basin
Urban	Infiltration Devices
Urban	Infiltration Trench
Urban	LID*/Cistern
Urban	LID*/Cistern+Rain Barrel
Urban	LID*/Rain Barrel
Urban	LID/Bioretenation
Urban	LID/Dry Well
Urban	LID/Infiltration Swale
Urban	LID/Infiltration Trench
Urban	Porous Pavement
Urban	Sand Filter/Infiltration Basin

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## LID\* BMPs

- For LID BMPs marked with an asterisk (\*), STEPL calculates Runoff Volume (ac-ft/yr) reduced by the practice
  - LID\*/Cistern
  - LID\*/Cistern+Rain Barrel
  - LID\*/Rain Barrel
- STEPL calculates the baseline runoff
  - If percentage runoff volume reduction is known, can apply this to determine runoff volume reduction amount
  - Load reduction efficiency = % runoff volume reduced

The screenshot shows the 'Set Urban LID/BMP' dialog box with the following settings:

- Select a Watershed: 1
- Select an Urban Land Use: Single Family (selected)
- Select LID/BMP: LID\*/Cistern (selected)
- Available LID/BMP: LID\*/Cistern
- BMP Drainage Area (ac): 0.1
- Total Available Area (ac): 528.27
- Percent Impervious (%): 100
- Runoff Capture Depth (in): 0.5

Buttons: Reset All, Apply LID/BMP, Exit.

Below the dialog box, two smaller windows are shown:

- LID\*/Cistern**: Input the runoff volume (ac-ft/yr) reduced by the practice (Baseline Runoff = 372.61 ac-ft/yr): 0.044
- Microsoft Excel**:
  - Percent captured volume = 0.01%
  - BMP Storage Capacity = 1357.71 gallons
  - Required Cistern/Rain barrel BMP Units = 14 Units

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# Gullies and Streambanks

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## Gullies and Streambanks

The screenshot shows the 'Gully and Streambank Erosion' tab in the Urban BMP Tool. The interface includes a menu bar (File, Home, Insert, Page Layout, Formulas, Data, Review, View, Developer, Add-ins, Nuance PDF) and a worksheet grid. The 'Gully and Streambank Erosion' tab is active, displaying instructions for inputting gully and streambank dimensions and a table for '1. Gully dimensions in the different watersheds'.

**1. Gully dimensions in the different watersheds**

Watershed	Gully	Top Width (ft)	Bottom Width (ft)	Depth (ft)	Length (ft)	Years to Form	BMP Efficiency (0-1)	Soil Textural Class	Soil Dry Weight (ton/ft)	Nutrient Correction Factor	Annual Load (ton)	Load Reduction (ton)
W1	Gully1	4	2	6	100	5	0.95	Clay	0.035	1.15	12.6000	11.9700

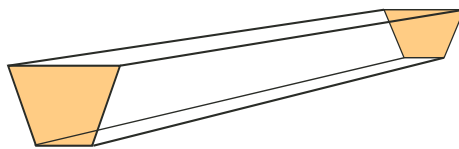
**2. Impaired streambank dimensions in the different watersheds**

Watershed	Strm Bank	Length (ft)	Height (ft)	Lateral Recession Rate (ft/yr)	Rate Range (ft/yr)	BMP Efficiency (0-1)	Soil Textural Class	Soil Dry Weight (ton/ft)	Nutrient Correction Factor	Annual Load (ton)	Load Reduction (ton)
W1	Bank1	0	0	1: Slight	0.01 - 0.05	0.95	Clay	0.035	1.15	0.0000	0.0000
W1	Bank2	0	0	1: Slight	0.01 - 0.05	0.95	Clay	0.035	1.15	0.0000	0.0000

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## STEPL Gully Stabilization

- **Load**
  - Average annual erosion during the life of the gully (ton/yr)  
= Volume x Soil Weight / Years
  - Nutrient load  
= Annual Erosion x Soil Nutrient Conc. x Correction Factor
- **Load reduction after implementing gully stabilization**
  - Specify reduction efficiency (95% efficiency by default)
  - Reduction is equal to annual erosion x user-specified efficiency



$$\text{Volume} = (\text{Top Width} + \text{Bottom Width}) / 2 \times \text{Depth} \times \text{Length}$$

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## Gully Stabilization

- **Nutrient Correction Factor**
  - Smaller soil particles -> larger aggregated surface area -> more nutrients attached

Soil Texture	Nutrient Correction Factor
Clay	1.15
Silt	1.00
Sand	0.85
Peat	1.50

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## Streambank Erosion

- Load (Channel Erosion)  
= Length \* Height \* Lateral Recession rate \* Soil weight
- Load Reduction  
= Load \* Load reduction efficiency

### Determining Lateral Recession Rate by Field Observation

Lateral Recession Rate (ft/yr)	Category	Description
0.01 – 0.05	Slight	Some bare bank, no exposed roots
0.06 – 0.2	Moderate	Bank is mostly bare
0.3 – 0.5	Severe	Bank is bare with exposed roots
0.5+	Very Severe	Bank is bare with fallen trees

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## Questions



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New!

# Combined BMP Efficiency Pasture and Cropland

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## Combined BMP Efficiency – Pasture and Cropland

### Calculate Combined BMP Efficiency

Estimate an area-weighted combined efficiency of multiple BMPs (in parallel) across a watershed

Enter the total land use area (acres)

Enter the subarea treated by each selected BMP type (up to 20 varying frequency of treatment allowed)

Treatment	Area (ac)	Select a BMP Type	N	P	BOD	Sediment	E. coli
1	50.00	Bioreactor	0.453	0.000	0.000	0.000	0.000
2	20.00	Bioreactor	0.150	0.356	0.000	0.493	0.000
3	30.00	Buffer - Forest (50ft wide)	0.154	0.450	0.000	0.000	0.000
4	100.00	Buffer - Grass (50ft wide)	0.120	0.280	0.000	0.000	0.000
5		Combined BMPs-Calculated	0.000	0.000	0.000	0.000	0.000
6		Conservation Tillage 1 (50-50% Residue)	0.000	0.000	0.000	0.000	0.000
7		Conservation Tillage 2 (equal or more than 60% Residue)	0.000	0.000	0.000	0.000	0.000
8		Contour Farming	0.000	0.000	0.000	0.000	0.000
9		Controlled Drainage	0.000	0.000	0.000	0.000	0.000
10		0 No BMP	0.000	0.000	0.000	0.000	0.000
11		0 No BMP	0.000	0.000	0.000	0.000	0.000
12		0 No BMP	0.000	0.000	0.000	0.000	0.000
13		0 No BMP	0.000	0.000	0.000	0.000	0.000
14		0 No BMP	0.000	0.000	0.000	0.000	0.000
15		0 No BMP	0.000	0.000	0.000	0.000	0.000
16		0 No BMP	0.000	0.000	0.000	0.000	0.000
17		0 No BMP	0.000	0.000	0.000	0.000	0.000
18		0 No BMP	0.000	0.000	0.000	0.000	0.000
19		0 No BMP	0.000	0.000	0.000	0.000	0.000
20		0 No BMP	0.000	0.000	0.000	0.000	0.000
Total Land Use Area	200.00	Enter the calculated value in Table 7, located in "BMPs" tab, under the appropriate watershed -->	0.211	0.243	0.000	0.040	0.000
Total Area check:	OK						

- Tool calculates a combined BMP efficiency from multiple types of parallel management practices on the same land use category across the watershed
- The user selects total treated area by land use and BMP types and acreage of treatment for each treatment area in the watershed

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## Combined BMP Efficiency – Pasture and Cropland

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

Watershed	Cropland		BOD	Sediment	E. coli	BMPs	% Area BMP Applied
W1	N	P	0.05	0.1374	ND	0.164 ND	20
W2	0.1125	0.1125	ND	0.1125	ND	Conservation Tillage 2 (equal or more than 60% Resid	15

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

Watershed	Pastureland		BOD	Sediment	E. coli	BMPs	% Area BMP Applied
W1	N	P	0.14295	0.1082	0	0.10005	100
W2	0.1075	0.06575	ND	ND	ND	Combined BMPs-Calculated	25

- The resulting area-weighted values in blue color should be added to Table 7 in the **BMPs** worksheet
- Combined BMPs Calculated should then be used in Tables 1 and 2 on the **BMPs** Worksheet.

7. Combined watershed BMP efficiencies from the BMP calculator

Watershed	Watershed Combined BMP Efficiencies		BOD	Sediment	E. coli	BMPs
W1-Crop	0	0	0	0	0	Combined BMPs
W2-Crop	0	0	0	0	0	Combined BMPs
W1-Pasture	0.14295	0.1082	0	0.10005	0	Combined BMPs
W2-Pasture	0	0	0	0	0	Combined BMPs
W1-Forest	0	0	0	0	0	Combined BMPs
W2-Forest	0	0	0	0	0	Combined BMPs
W1-User	0	0	0	0	0	Combined BMPs
W2-User	0	0	0	0	0	Combined BMPs

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## Saving Combined BMP Scenarios

- The “Copy to Log” allows the user to keep a record of the various combination of the combined BMP efficiencies scenarios that are evaluated
- Creates a Word document (bmplog.docx) in the same location where the STEPL spreadsheet is located

	D	E	F	G	H
	Update BMP List		Copy to Log		
	N	P	BOD	Sediment	E. coli
	0.453	0.000	0.000	0.000	0.000

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# Use the BMP Calculator for Multiple BMPs

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## BMP Calculator

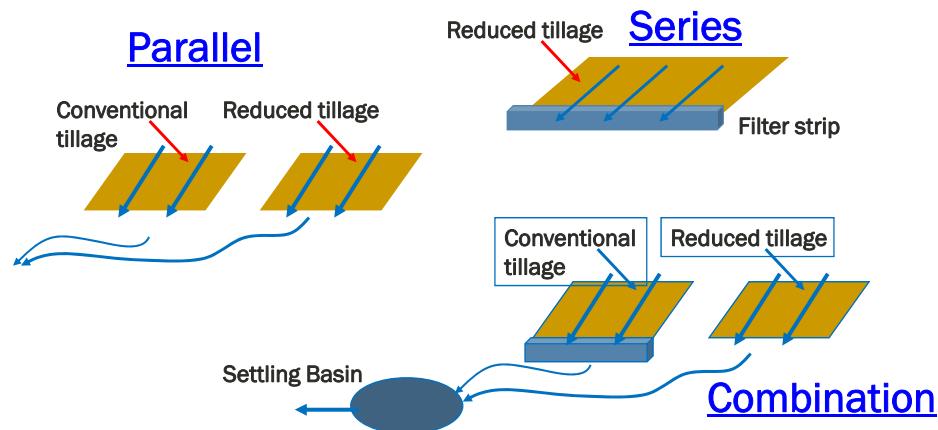
The screenshot shows the BMP Calculator Excel spreadsheet. The STEPL menu is open, highlighting the 'Add-ins' tab. The spreadsheet contains three main sections for different land uses: CROPLAND, PASTURELAND, and FOREST. Each section has a table of BMPs and their efficiencies for various pollutants (N, P, BOD, Sediment, E. coli). The 'Calculate Combined BMP Efficiency' button is visible at the top right of the data area.

Watershed	N	P	BOD	Sediment	E. coli	BMPs	% Area BMP Applied
1. BMPs and efficiencies for different pollutants on CROPLAND, ND-No Data							
W1	0.05	0.1374	ND	0.154	ND	Conservation Tillage 2 (equal or more than 60% Res	20
W2	0.1125	0.1125	ND	0.1125	ND	Streambank Stabilization and Fencing	15
2. BMPs and efficiencies for different pollutants on PASTURELAND, ND-No Data							
W1	0.0665	0.0575	ND	0.0935	ND	Alternative Water Supply	50
W2	0.1075	0.0675	ND	ND	ND	Grazing Land Management (rotational grazing with 6	25
3. BMPs and efficiencies for different pollutants on FOREST, ND-No Data							
W1	0	0	0	0	0	No BMP	0

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## BMP Calculator

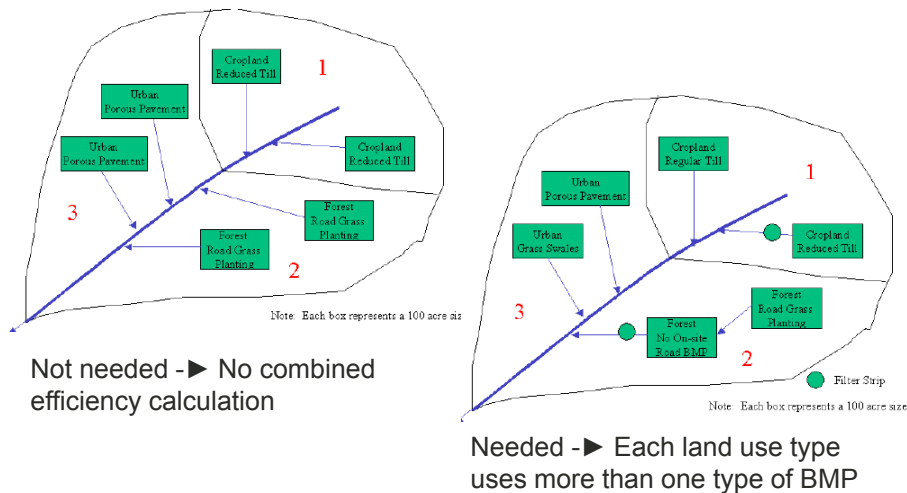
- Calculates combined efficiency of a BMP treatment train for a given land use
- The use of BMP calculator requires the understanding of BMPs and their placement in the watershed



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## BMP Calculator

- When is BMP calculator needed?



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## STEPL BMP Calculator

- Describe schematically the BMP configuration
  - Number and linkages
  - BMP type and efficiency
  - Land use area
- Calculate combined efficiency

Set BMP Parameter Values

Crop/land - Conservation Tillage 1 (30.55% Residue)

Total Pollutant Load or Area: 45

N Removal Efficiency: 0.15

P Removal Efficiency: 0.396

BOD Removal Efficiency: 0

Sediments Removal Efficiency: 0.403

E. Coli Removal Efficiency: 0

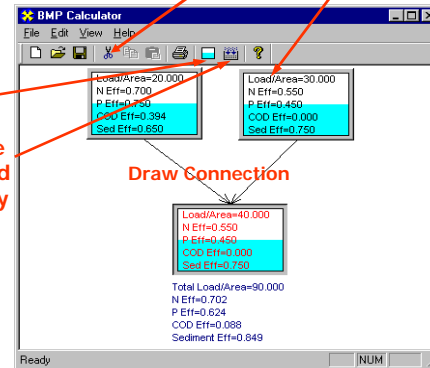
OK Cancel

Add BMP box

Calculate combined efficiency

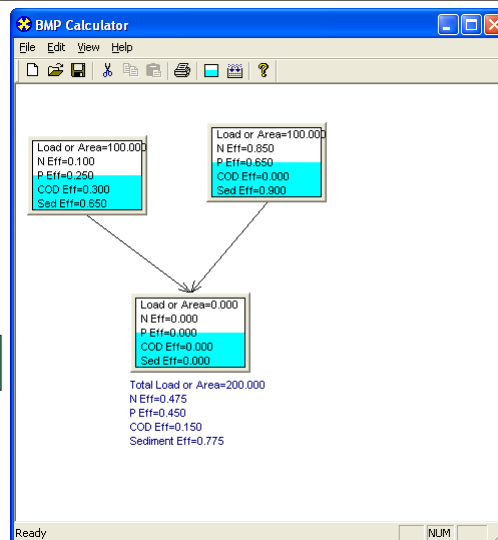
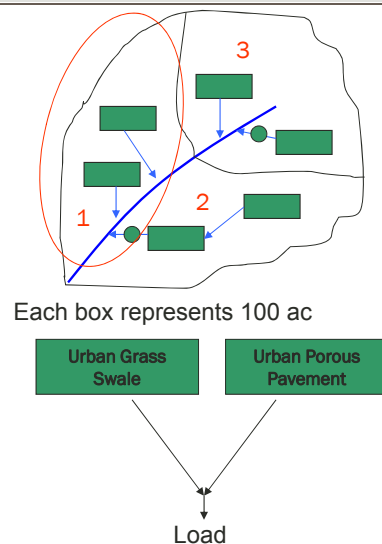
Delete Connection

Use source area or original load as the weighting factor



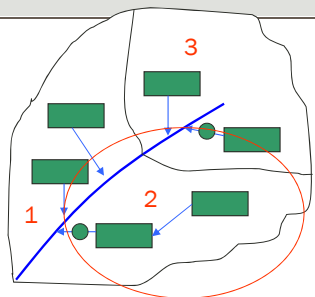
65

## BMP Calculator Example 1



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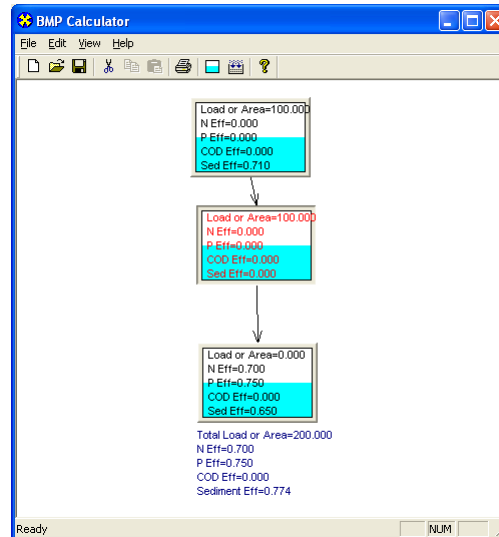
## BMP Calculator Example 2



Forest Road  
Grass Planting

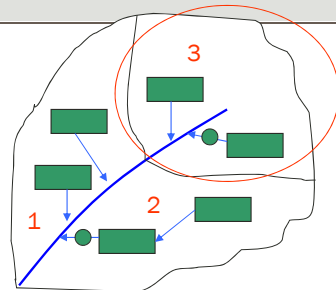
Forest No On-site  
Road BMP

Filter Strip  
Load



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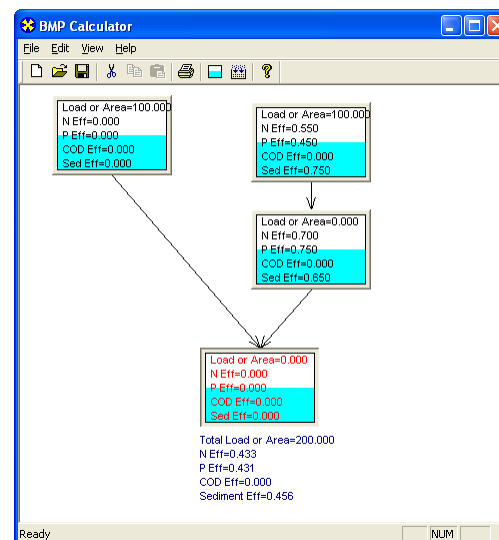
## BMP Calculator Example 3



Crop Regular  
Tillage

Crop Reduced  
Tillage

Filter Strip  
Load



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Tt TETRA TECH

# Questions

 ??

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Tt TETRA TECH

# Adding or Modifying BMPs

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## Ability to Add BMPs

- In STEPL customized menu, click “View/Edit BMP List”
- *BMPList* worksheet is shown, add or delete BMPs

STEPL ▾

- Hide/Unhide Other STEPL Sheets
- Export Model Input/Output Data
- Precipitation/Runoff Data
- USLE Parameters by Land Use
- View/Edit BMP List**
- BMP Calculator
- About

Customized menu

Landuse	BMP & Eff N	P	BOD	Sediment	E. coli
Cropland	0 No BMP	0	0	0	0
Cropland	Combined	0	0	0	0
Cropland	Contour Farming	0.485	0.55	ND	0.405
Cropland	Diversion	0.1	0.3	ND	0.35
Cropland	Filter strip	0.7	0.75	ND	0.65
Cropland	Reduced Tillage	0.55	0.45	ND	0.75
Cropland	Streambank	0.75	0.75	ND	0.75
Cropland	Terrace	0.2	0.7	ND	0.85
Pastureland	0 No BMP	0	0	0	0
Pastureland	Combined	0	0	0	0
Pastureland	User Defin	0.5	0.5	0.5	0.75

Example: New data inserted here

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## Add New Data to BMP List

Microsoft Excel

The BMP data were updated successfully. Click the BMPs worksheet and select BMPs.

Update BMP Data

Save Updates

Update BMP button (BMPList Worksheet)

Instruction:

1. Do not delete the grayed 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.

New BMP added! (BMPs Worksheet)

Landuse	BMP & Efficiency	N	P	BOD	Sediment	E. coli
Cropland	0 No BMP	0	0	0	0	0
Cropland	Bioreactor	0.453	ND	ND	ND	ND
Cropland	Buffer - Forest (100ft wide)					
Cropland	Buffer - Grass (35ft wide)					
Cropland	Combined BMPs-Calculated					
Cropland	Conservation Tillage 1 (30-59% Residue)					
Cropland	Conservation Tillage 2 (60-79% Residue)					
Cropland	Contour Farming					
Cropland	Controlled Drainage					
Cropland	Cover Crop 1 (Group A Tr)					
Cropland	Cover Crop 2 (Group A Tr)					
Cropland	Cover Crop 3 (Group A Tr)					
Cropland	Land Retirement	0.898	0.808	ND	0.95	ND
Cropland	Nutrient Management 1 (Determined Rate)	0.154	0.45	ND	ND	ND
Cropland	Nutrient Management 2 (Determined Rate Plus Addition)	0.247	0.56	ND	ND	ND
Cropland	Streambank Stabilization and Fencing	0.75	0.75	ND	0.75	ND
Cropland	Terrace	0.253	0.308	ND	0.4	ND
Cropland	Two-Stage Ditch	0.12	0.28	ND	ND	ND
Cropland	User Defined	0.5	0.5	0.5	0.5	ND
Pastureland	0 No BMP	0	0	0	0	0
Pastureland	30m Buffer with Optimal Grazing	0.364	0.653	ND	ND	ND
Pastureland	Alternative Water Supply	0.133	0.115	ND	0.187	ND

New BMP added!

Watershed	Cropland	N	P	BOD	Sediment	E. coli	BMPs	% Area BMP Applied
W1	0.279	0.398	ND	0.341	ND		Contour Farming	100
W2	0.15	0.356	ND	0.403	ND		Conservation Tillage 1 (30-59% Residue)	100
W3	0	0	0	0	0		0 No BMP	0
W4	0.485	0.1	0	0	0		Combined BMPs-Calculated	100
W5	0.5	0.5	0.5	0.5	ND		User Defined	100

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## Update BMP List

Landuse	BMP & Efficiency	N	P	BOD	Sediment	E. coli
Cropland	0 No BMP	0	0	0	0	0
Cropland	Bioreactor	0.453	ND	ND	ND	ND
Cropland	Buffer - Forest (100ft wide)	0.478	0.465	ND	0.586	ND
Cropland	Buffer - Grass (35ft wide)	0.338	0.435	ND	0.533	ND
Cropland	Combined BMPs-Calculated	0	0	0	0	0
Cropland	Conservation Tillage 1 (30-59% Residue)	0.15	0.356	ND	0.403	ND
Cropland	Conservation Tillage 2 (equal or more than 60% Residue)					
Cropland	Contour Farming					
Cropland	Controlled Drainage					
Cropland	Cover Crop 1 (Group A Commodity) (High Till only for Se					
Cropland	Cover Crop 2 (Group A Traditional Normal Planting Time)					
Cropland	Cover Crop 3 (Group A Traditional Early Planting Time) (					
Cropland	Land Retirement					
Cropland	Nutrient Management 1 (Determined Rate)					
Cropland	Nutrient Management 2 (Determined Rate Plus Addition					
Cropland	Streambank Stabilization and Fencing					
Cropland	Terrace	0.12	0.28	ND	ND	ND
Cropland	Two-Stage Ditch	0.5	0.5	0.5	0.5	ND
Cropland	User Defined					
Pastureland	0 No BMP	0	0	0	0	0
Pastureland	30m Buffer with Optimal Grazing	0.364	0.653	ND	ND	ND
Pastureland	Alternative Water Supply	0.133	0.115	ND	0.187	ND

<Don't Delete
Update BMP Data
Save Updates

Instruction:

1. Do not delete the grayed 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.

The BMP data were updated successfully. Click the BMPs worksheet and select BMPs.

OK


- Click "Save Updates" to save changes to the BMP List (will be available to any STEPL project)
- You can also modify these spreadsheets manually

C:\Step1\Support\AllBMPstepl.csv

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## New BMPs and Updated Pollutant Efficiencies

- New BMPs for cropland and pastureland have been added to STEPL version 4.4
  - The cropland BMP list has been expanded from 6 BMPs to 17
  - 17 pastureland BMPs added (previous versions of STEPL did not have pastureland BMPs)
- Pollutant efficiency numbers for some existing cropland BMPs have been updated
- All the efficiencies are summarized in the **BMPList** worksheet



New!

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## New BMPs available in STEPL version 4.4 for Cropland and Pastureland

Land Use	BMP
Cropland	Bioreactor
Cropland	Buffer - Forest (100ft wide)
Cropland	Buffer - Grass (35ft wide)
Cropland	Combined BMPs-Calculated
Cropland	Conservation Tillage 1 (30-59% Residue)
Cropland	Conservation Tillage 2 (equal or more than 60% Residue)
Cropland	Contour Farming
Cropland	Controlled Drainage
Cropland	Cover Crop 1 (Group A Commodity) (High Till only for Sediment)
Cropland	Cover Crop 2 (Group A Traditional Normal Planting Time) (High Till only for TP and Sediment)
Cropland	Cover Crop 3 (Group A Traditional Early Planting Time) (High Till only for TP and Sediment)
Cropland	Land Retirement
Cropland	Nutrient Management 1 (Determined Rate)
Cropland	Nutrient Management 2 (Determined Rate Plus Additional Considerations)
Cropland	Streambank Stabilization and Fencing
Cropland	Terrace
Cropland	Two-Stage Ditch
Pastureland	30m Buffer with Optimal Grazing
Pastureland	Alternative Water Supply
Pastureland	Combined BMPs-Calculated
Pastureland	Critical Area Planting
Pastureland	Forest Buffer (minimum 35 feet wide)
Pastureland	Grass Buffer (minimum 35 feet wide)
Pastureland	Grazing Land Management (rotational grazing with fenced areas)
Pastureland	Heavy Use Area Protection
Pastureland	Litter Storage and Management
Pastureland	Livestock Exclusion Fencing
Pastureland	Multiple Practices
Pastureland	Pasture and Hayland Planting (also called Forage Planting)
Pastureland	Prescribed Grazing
Pastureland	Streambank Protection w/o Fencing
Pastureland	Streambank Stabilization and Fencing
Pastureland	Use Exclusion
Pastureland	Winter Feeding Facility

## STEPL Updates

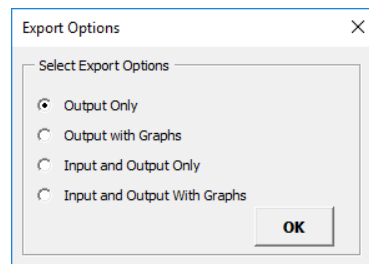


## Export Input/Output Option

- An Export Data button has been added to the *Input* worksheet


Export input/output data: Export Data

- Allows four options to generate summary report into a MS Word Document for Input and/or Outputs



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## Customized Spreadsheet Model Solver

	Target Load Reduction (lb/yr)	625.00	Select a Pollutant:	N	Total Load Reduction (lb/yr)	625.00
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- A simple optimization algorithm (Run Solver) is now included in the customized spreadsheets model
  - Need to activate Excel Solver Add-In (follow instructions in the *BMPs* worksheet to activate Excel Solver Add-In)
  - Optimization is not available in the STEPL installation file version
- Allows the user to identify the extent of treatment areas to meet a load reduction target from the user selected BMP types
- The optimization algorithm only solves for non-urban BMPs
- The optimizer is intended to maximize the load reduction and minimize the treated land use area based on the suite of BMPs provided

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## Customized Spreadsheet Model Solver

- Example land uses with BMPs selected and constraints set

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

Watershed	Cropland						CONSTRAINT		
	N	P	BOD	Sediment	E. coli	BMPs	% Area BMP Applied	Min Area (%)	Max Area (%)
W1	0.24	0.23	ND	0.29	ND	Buffer - Forest (100ft wide)	50.00	0	50
W2	0.03	0.08	ND	0.09	ND	Conservation Tillage 1 (30-59% Residue)	22.25	0	50
W3	0.00	0.00	ND	0.00	ND	Contour Farming	0.00	0	50
W4	0.00	0.00	0.00	0.00	0.00	0 No BMP	0.00	0	0
W5	0.00	0.00	0.00	0.00	0.00	0 No BMP	0.00	0	0
W6	0.00	0.00	0.00	0.00	0.00	0 No BMP	0.00	0	0
W7	0.00	0.00	0.00	0.00	0.00	0 No BMP	0.00	0	0
W8	0.00	0.00	0.00	0.00	0.00	0 No BMP	0.00	0	0
W9	0.00	0.00	0.00	0.00	0.00	0 No BMP	0.00	0	0
W10	0.00	0.00	0.00	0.00	0.00	0 No BMP	0.00	0	0

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

Watershed	Pastureland						CONSTRAINT		
	N	P	BOD	Sediment	E. coli	BMPs	% Area BMP Applied	Min Area (%)	Max Area (%)
W1	0.20	0.30	ND	0.62	ND	Livestock Exclusion Fencing	100.00	0	100
W2	0.00	0.00	ND	0.00	ND	Alternative Water Supply	0.00	0	100
W3	0.00	0.00	ND	0.00	ND	Critical Area Planting	0.00	0	100
W4	0.00	0.00	0.00	0.00	0.00	0 No BMP	0.00	0	0
W5	0.00	0.00	0.00	0.00	0.00	0 No BMP	0.00	0	0
W6	0.00	0.00	0.00	0.00	0.00	0 No BMP	0.00	0	0
W7	0.00	0.00	0.00	0.00	0.00	0 No BMP	0.00	0	0
W8	0.00	0.00	0.00	0.00	0.00	0 No BMP	0.00	0	0
W9	0.00	0.00	0.00	0.00	0.00	0 No BMP	0.00	0	0
W10	0.00	0.00	0.00	0.00	0.00	0 No BMP	0.00	0	0

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## Summary

- STEPL is a simple model for estimating long term average pollutant load reductions to support watershed planning
- Can be applied at various scales from individual farm to large watershed or multiple watersheds
- STEPL is flexible but requires your input and judgment to apply it to your project
  - Easy to add new data and to customize for site specific needs
- Seek assistance from your colleagues
- Questions & suggestions for improvement are always welcome

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## Contact Information



To access STEPL, visit <http://it.tetrattech-ffx.com/steplweb/>  
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