

Watershed Modeling with the Spreadsheet Tool for Estimating Pollutant Load

Matt Schultz & Dave Menzie

New Mexico Environment Department
Watershed Protection Section

Silver City Field Office



Download STEPL at:

<http://it.tetrattech-ffx.com/stepl>

Why Estimate Pollutant Loads?

- Watershed planning (one of the 9 key elements)
- Target future management efforts
- BMP load reductions
- Required for 319 funded watershed planning and on-the ground implementation

Load Reduction Estimation

- Load estimation techniques
- Using models to estimate loads
- Available models
- Model selection

What Approach to Estimate Loads?

Depends on:

- water quality parameters
- time scale
- data needs
- user experience

“simplest approach that meets your needs”

BUT justify your choice

Spreadsheet Models

- Spreadsheet Tool for Estimating of Pollutant Load (STEPL) model
- Region 5 model
(a simple model **not** just for EPA Region 5)

Website



<http://it.tetrattech-ffx.com/stepl>

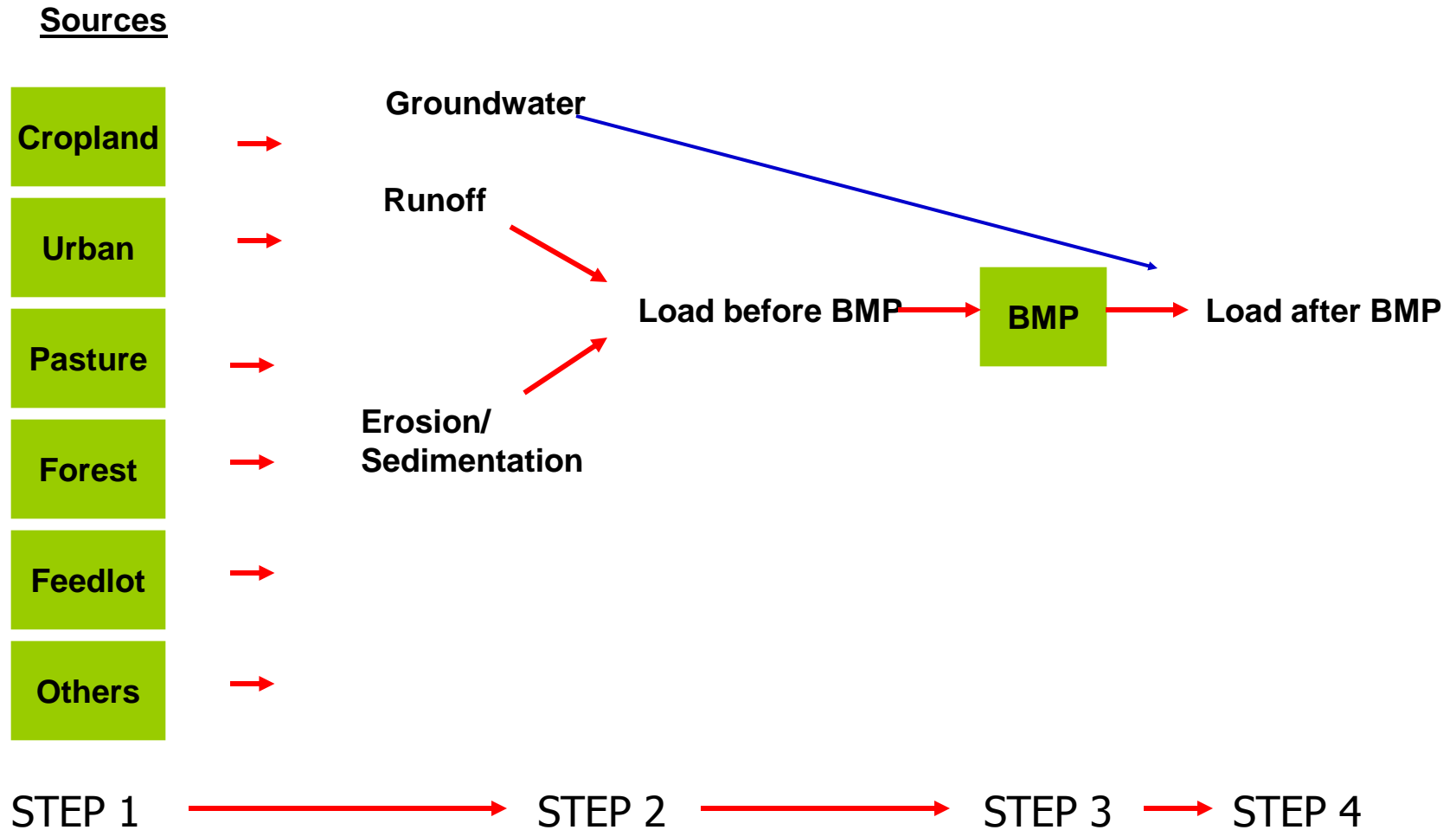
What is STEPL?

- Calculates nutrient and sediment loads by land use type
- Calculates load reductions from Best Management Practice (BMP) implementation
- A customized MS Excel spreadsheet model
 - Simple and easy to use
 - Data driven
 - Formulas and default parameter values can be modified by users with no programming required

Users

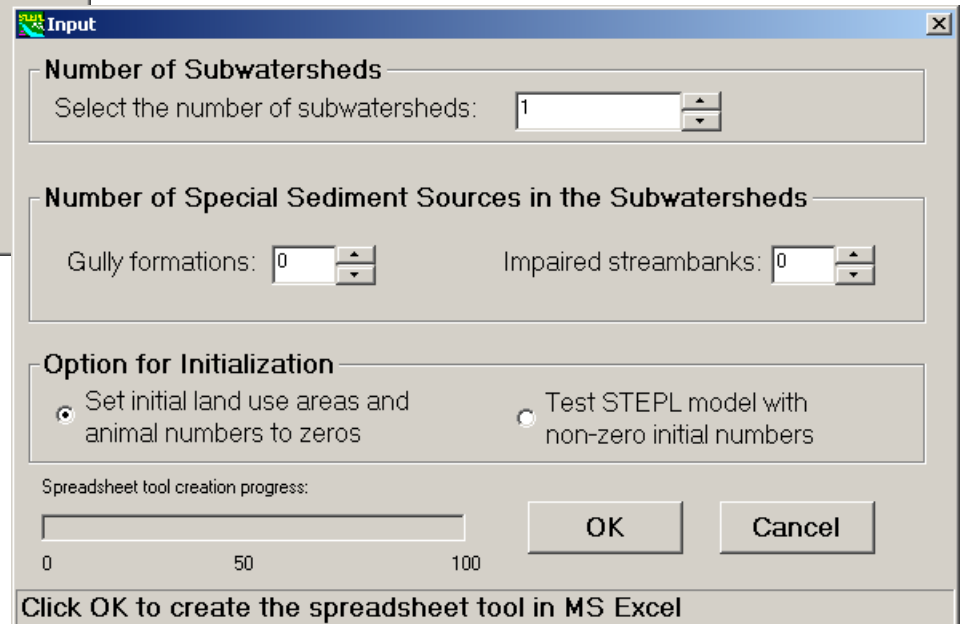
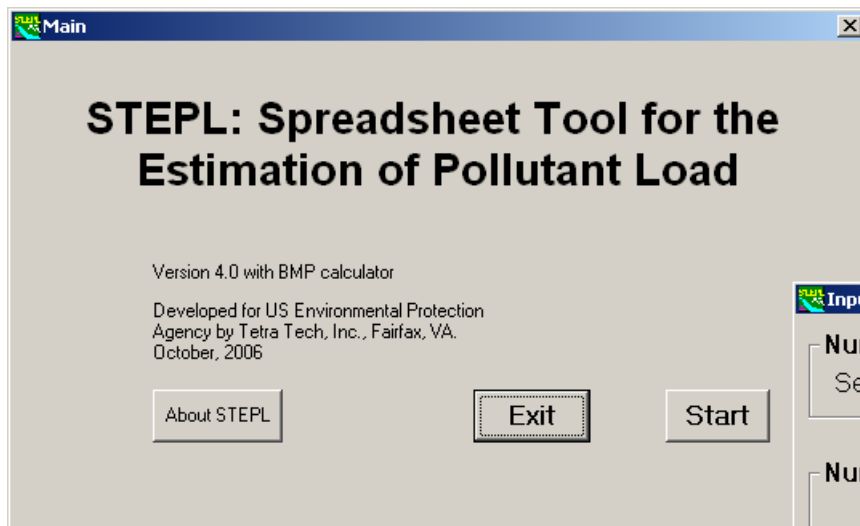
- Basic understanding of hydrology, erosion, and pollutant loading processes
- Environmental data (e.g., land use, agricultural statistics, and BMP efficiencies)
- Familiarity with MS Excel

Process



STEPL Main Program

- Run STEPL executable program to create and customize spreadsheet



STEPL Spreadsheet

Microsoft Excel - TrainingDemo.xls

File Edit View Insert Format Tools Data Window Help STEPL

Type a question for help

85%

Arial 10 B

A1

STEPL Input Sheet: Values in RED are required input. Change worksheets by clicking on tabs at the bottom. You entered

This sheet is composed of eight input tables. The first four tables require users to change initial values. The next four tables (initially hidden) contain instructions for data entry.

Step 1: Select the state and county where your watersheds are located. Select a nearby weather station. This will automatically specify values for rainfall.

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 they are present; (c) enter values for septic system parameters in Table 3; and (d) if desired, modify USLE parameters associated with the selected county.

Step 3: You may stop here and proceed to the BMPs sheet. If you have more detailed information on your watersheds, click the Yes button in the optional input tables section.

Step 4: (a) Specify the representative Soil Hydrologic Group (SHG) and soil nutrient concentrations in Table 5; (b) modify the curve number taken from the NRCS National Engineering Handbook; (c) modify the nutrient concentrations (mg/L) in runoff in Table 7; and (d) specify the detailed land use distribution in the urban area in Table 8.

Step 5: Select BMPs in BMPs sheet. **Step 6:** View the estimates of loads and load reductions in Total Load and Graphs sheets.

Show optional input tables? Yes No ☐ Treat all the subwatersheds as parts of a single watershed ☒ Groundwater

State Alabama **County** Baldwin **Weather Station (for rain correction factors)** 0 Default

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

Watershed	Urban	Cropland	Pastureland	Forest	User Defined	Feedlots	Feedlot Percent Paved	Total	Annual Rainfall
WV1	200	200	200	200	0	10	0-24%	810	
WV2	200	200	200	200	0	10	0-24%	810	
WV3	200	200	200	200	0	10	0-24%	810	

Input BMPs Total Load Graphs







Composed of four worksheets

BMPs Worksheet

Urban BMP Tool

Gully and
Streambank Erosion

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

Watershed	Cropland						
	N	P	BOD	Sediment	BMPs		% Area BMP Applied
W1	0.485	0.55	ND	0.405	 Contour Farming		100
W2	0.1	0.3	ND	0.35	 Diversion		100
W3	0	0	0	0	 0 No BMP		100

Each land use type within each watershed can have a separate BMP or combinations of BMPs.

Can be partial application using the % Area BMP applied.

Can change the initial BMP efficiencies if local data are available.

Gully and Streambank Erosion Calculation Tool

1. Gully dimensions in the different watersheds

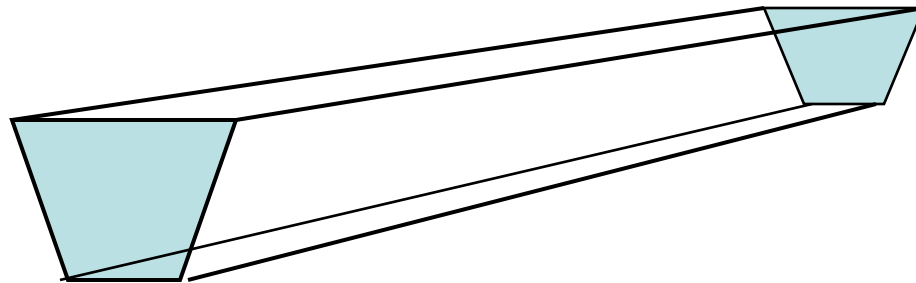
Watershed	Gully	Top Width (ft)	Bottom Width (ft)	Depth (ft)	Length (ft)	Years to Form	BMP Efficiency (0-1)	Soil Textural Class
<input checked="" type="radio"/> W1	Gully1	5	5	5	5	1	0.95	<input checked="" type="radio"/> Clay

2. Impaired streambank dimensions in the different watersheds

Watershed	Strm Bank	Length (ft)	Height (ft)	Lateral Recession	Rate Range (ft/yr)	Rate (ft/yr)	BMP Efficiency (0-1)	Soil Textural Class
<input checked="" type="radio"/> W1	Bank1	5	100	<input checked="" type="radio"/> 1. Slight	0.01 - 0.05	0.03	0.95	<input checked="" type="radio"/> Clay

Gully Stabilization Worksheet

- Load
 - Average annual erosion during the life of the gully (t/y)
= 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 (100% efficiency by default)
 - Reduction is equal to annual erosion x user-specified efficiency



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

Urban BMP Tool

Set Urban LID/BMP [X]

Select a Watershed: 1 [v]

Select an Urban Land Use

☐ Commercial ☐ Industrial ☐ Institutional ☐ Transportation ☐ Multi Family

☐ Single Family ☐ Urban-Cultivated ☐ Vacant-Developed ☒ Open Space

Select LID/BMP

Available LID/BMP:	LID/BMP Area (ac):	Total Available Area (ac):
LID/Bioretenction [v]	5.00	5.00

☒ Simple form **Reset All** **Apply LID/BMP** **Exit**

Add New Data to BMP List

If a certain BMP is not in the selection list, can add your BMP to the database

A	B	C	D	E	F	G	H	I	J	K
Landuse	BMP & Efficiency	N	P	BOD	Sediment					
Cropland	0 No BMP	0	0	0	0	<Don't Delete	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 STEP1/Support folder.			
Cropland	Combined BMPs-Calculated	0	0	0	0	<Don't Delete				
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 Systems	0.55	0.45	ND	0.75					
Cropland	Streambank stabilization and fencing	0.75	0.75	ND	0.75					
Cropland	Terrace	0.2	0.7	ND	0.85					
Pastureland	0 No BMP	0	0	0	0	<Don't Delete				
Pastureland	Combined BMPs-Calculated	0	0	0	0	<Don't Delete				
Pastureland	User Defined	0.5	0.5	0.5	0.75					
Forest						<Don't Delete				
Forest	0 No BMP	0	0	0	0	<Don't Delete	Update BMP Data			

**Update BMP button
(BMPList worksheet)**

**New BMP added!
(BMPs worksheet)**

New BMP added!

2. BMPs and efficiencies for different pollutants on pastureland, ND=No Data					
Watershed	Pastureland				
	N	P	BOD	Sediment	BMPs
W1	0.5	0.5	0.5	0.75	<input checked="" type="radio"/> User Defined

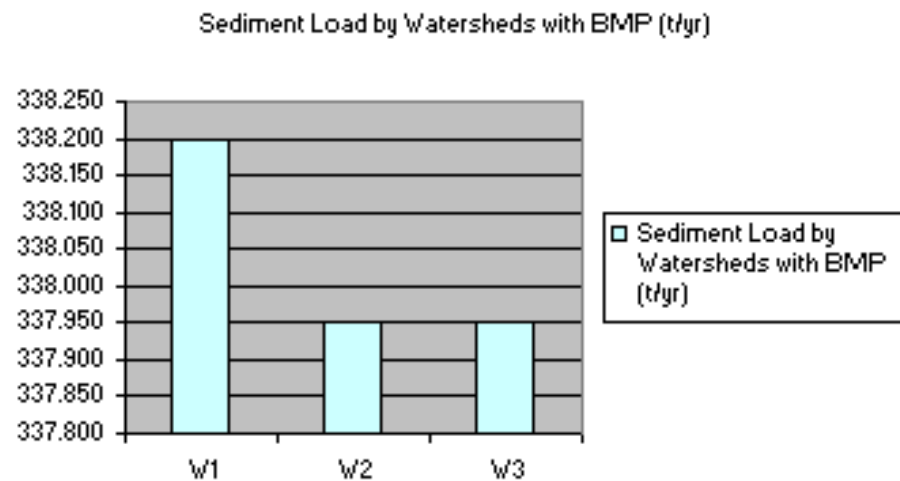
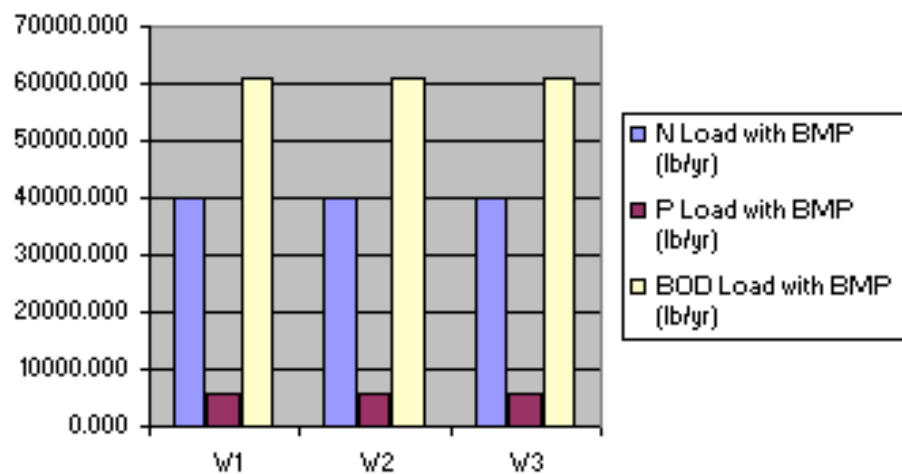
Total Load Worksheet

1. Total load by subwatershed(s)

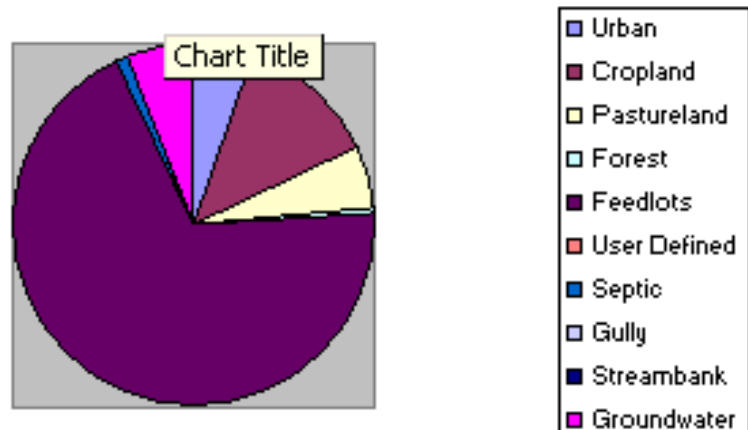
Watershed	N Load (no BMP)	P Load (no BMP)	BOD Load (no BMP)	Sediment Load (no BMP)	N Reduction	P Reduction	BOD Reduction	Sediment Reduction
	lb/year	lb/year	lb/year	t/year	lb/year	lb/year	lb/year	t/year
W1	39888.8	5615.6	60882.3	342.9	8.6	3.3	17.1	4.7
W2	39879.8	5612.2	60864.2	338.0	0.0	0.0	0.0	0.0
W3	39879.8	5612.2	60864.2	338.0	0.0	0.0	0.0	0.0
Total	119648.4	16839.9	182610.8	1018.8	8.6	3.3	17.1	4.7

Each row of results corresponds to a different watershed or project.

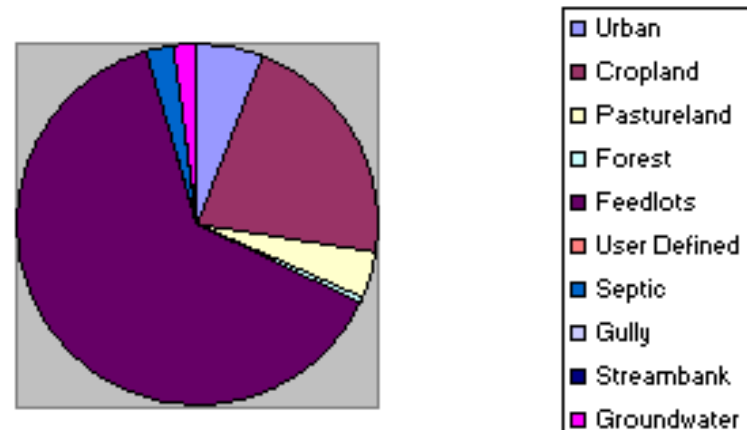
Graphs Worksheet



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

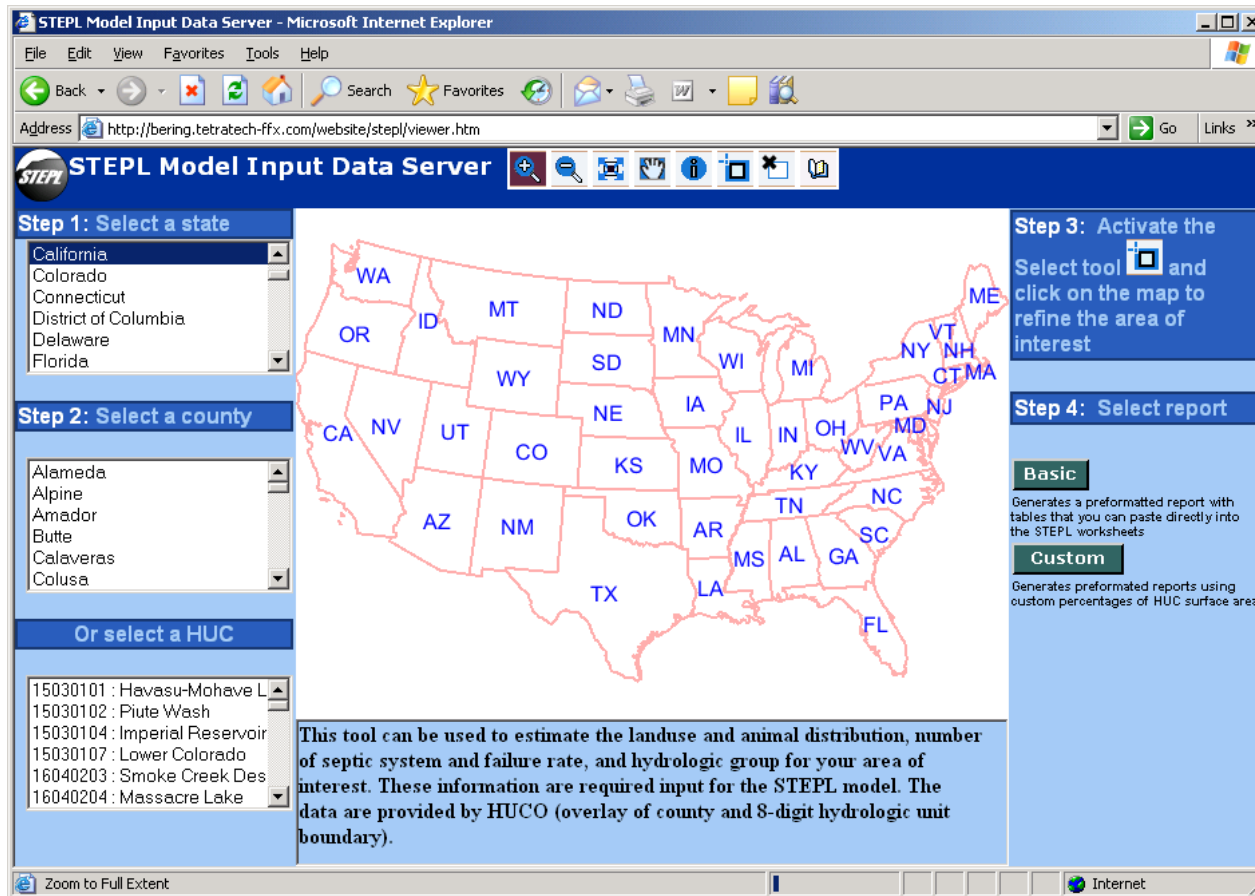


Total P Load by Land Uses (with BMP) (lb/yr)



STEPL Online Input Data Server

<http://bering.tetrattech-ffx.com/website/stepl/viewer.htm>



Or try



United States Department of Agriculture

National Agricultural Statistics Service

<http://www.nass.usda.gov/>

Questions?



www.nmenv.state.nm.us

