Using Data to Support Watershed Protection and Restoration Decisions

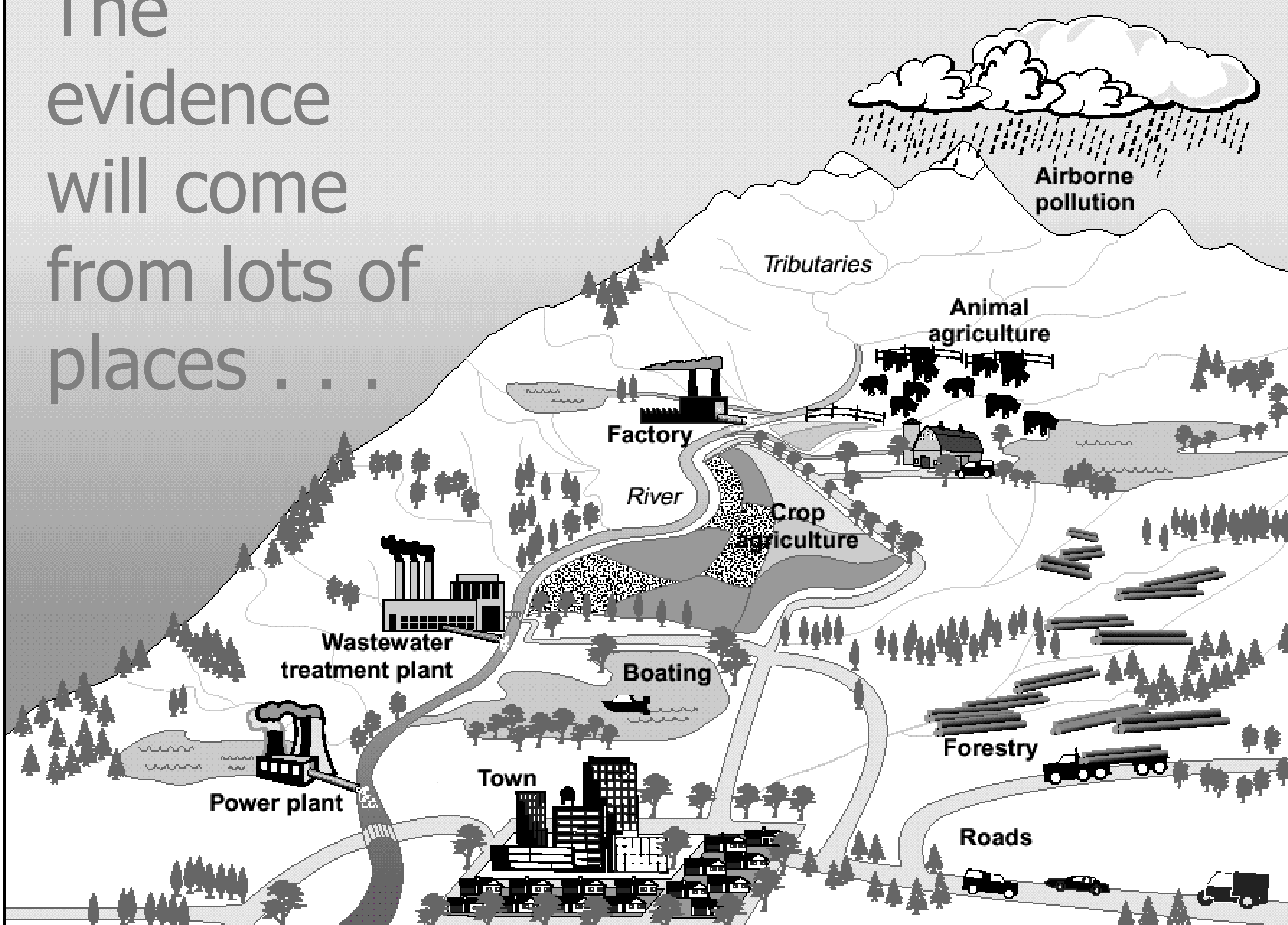
CSI Watershed

You found the (water) body.

There were signs of a struggle.

What happened?

The evidence will come from lots of places . . .



Indiana Watershed Planning Process

- Watershed community
- Watershed inventory
- ID problems & causes
- ID sources, calculate loads
- Set goals, ID critical areas
- Select goals/indicators
- Choose BMPs/measures
- Action register & schedule
- Tracking effectiveness

IDEM Watershed Management Plan (WMP) Checklist (2009)

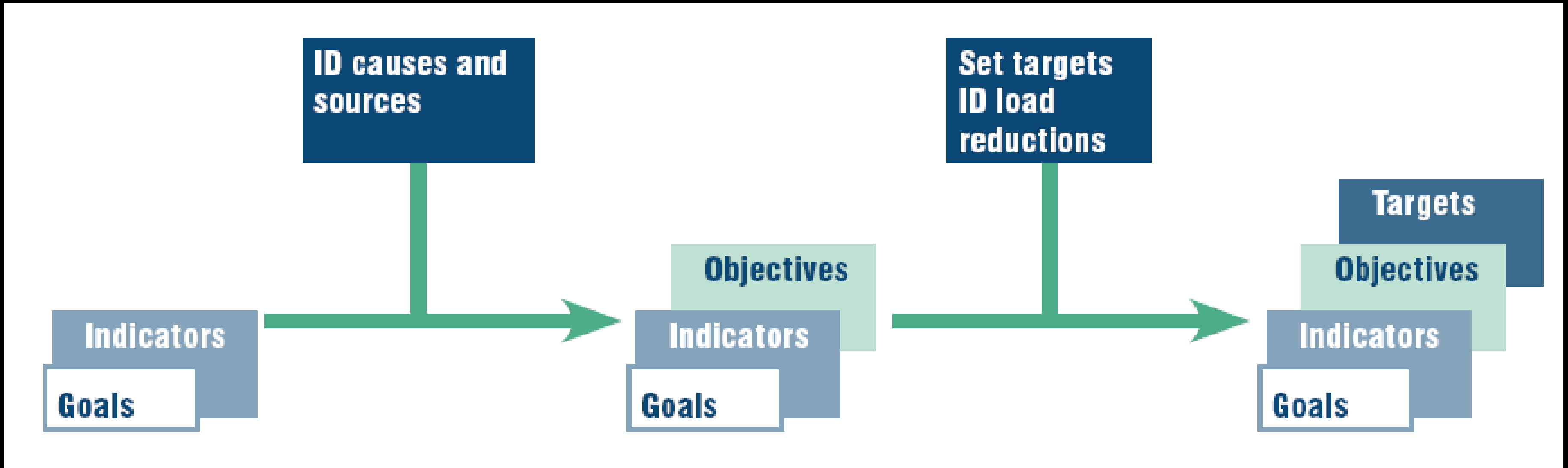
Name of Project:		
WMP Draft Date:		
IDEM Reviewers:		WMP Review Date:
1.	2.	3.

Instructions: The numbered elements (1-33) make up the IDEM WMP Checklist (2009). The items with boxes are the requirements needed to meet the numbered elements. These items come directly from the WMP Checklist instructions. The WMP cannot be approved until all numbered elements are complete.

Page(s) #	Required Content
	WATERSHED COMMUNITY INITIATIVE
	1. The reasons the community decided to initiate this watershed project. ☐ Explain the concerns that led leaders to initiate the project ☐ Explain who the local leaders are ☐ Explain how/why they decided to work together *Comments:*
	2. A description of the steering committee and who they represent. ☐ Explain how stakeholder involvement was generated ☐ Explain how additional stakeholder concerns were gathered ☐ In a figure include: ☐ Title ☐ Number ☐ Title and Number in Table of Contents ☐ Figure is legible ☐ A list of the steering committee members and their affiliation ☐ Describe any outreach efforts used to generate stakeholder involvement *Comments:*
	3. A list of stakeholder concerns. ☐ In a figure include: ☐ Title ☐ Number ☐ Title and Number in Table of Contents ☐ Figure is legible ☐ A list of concerns from the steering committee and the stakeholders *Comments:*
	WATERSHED INVENTORY
	Part One of the Watershed Inventory: 4. A description of the geology/topography as it pertains to the watershed. ☐ Explain karst magnitude and general distribution ☐ Not applicable ☐ Explain the topographic features that define the watershed's drainage patterns *Comments:*
	5. A brief overview of the hydrology as it pertains to the watershed. ☐ Map(s) of project area showing: ☐ Labeled Streams ☐ Lakes ☐ Watershed names and boundaries ☐ HUCs ☐ Legal drains ☐ Wetlands ☐ Labeled Population centers ☐ Labeled Major roads ☐ Not applicable ☐ Not applicable

Identify problems (impairments & threats), causes (pollutants/conditions), & sources

- How does water quality compare to WQ criteria?
  - What are the problem pollutants?
- What & where are the sources?
  - We need to map locations & estimate magnitude . . .



Causes:

pollutants or poor conditions

Cause/Stressor	Miles
Cause unknown	
Impaired Biotic Communities	2,469
Pesticides	
Atrazine	7
Toxic Organics	
PAHs	22
Dioxins	154
Bioaccumulative Chemicals of Concern	
PCBs in Fish Tissue	3,194
Mercury in Fish Tissue	1,703
Other	
Total dissolved solids	341
Nutrient/Eutrophication Indicators	749
Organic Enrichment (Sewage) Indicators	36
pH	81
Oxygen Depletion	702
Temperature	15
Siltation	118
Flow alteration	57
Other habitat alterations	89
Pathogens (*E. coli* indicator)	8,322
Oil and grease	11
Algal Growth	123

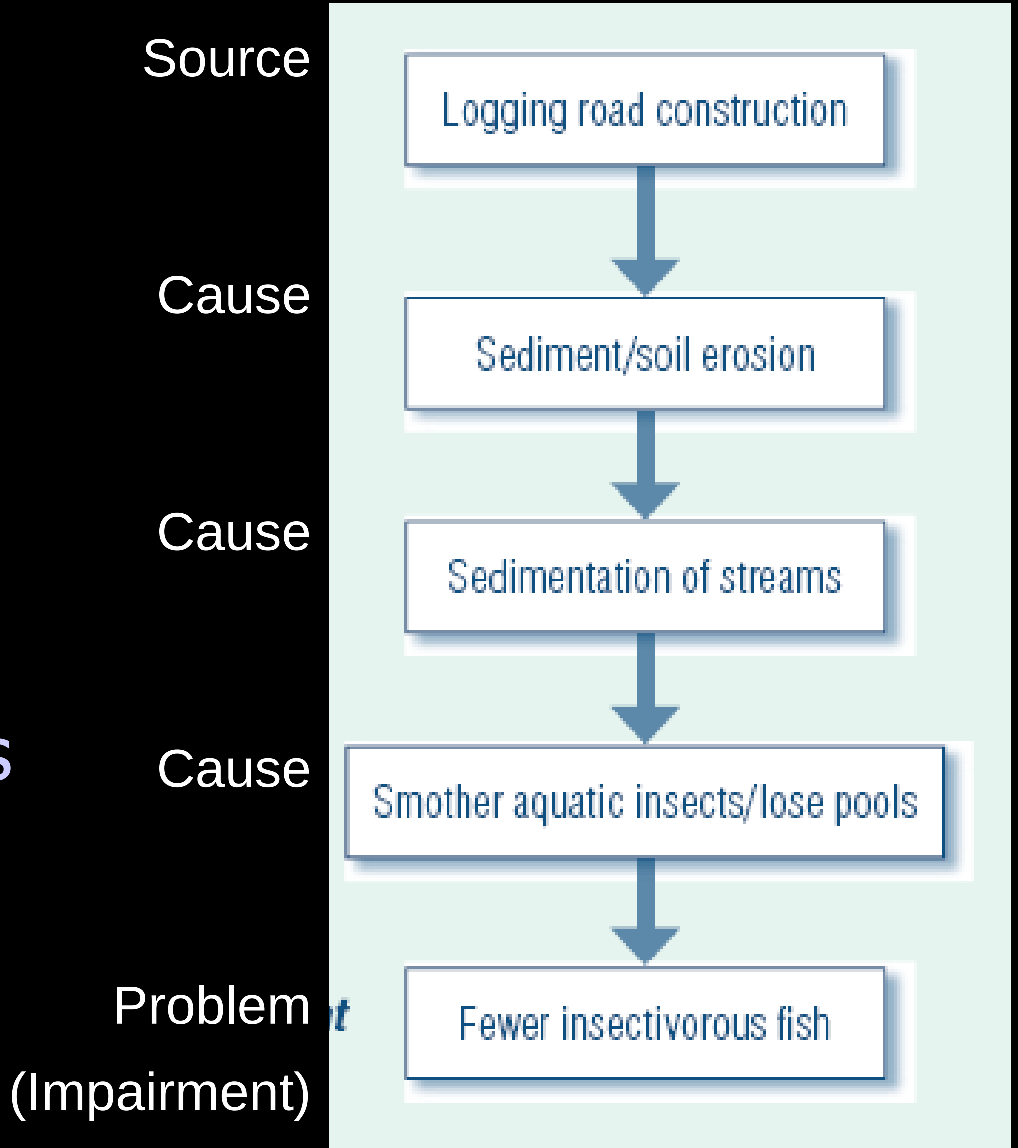
Sources:

origin(s) of the pollutants or problem conditions

Source	Miles
Point Sources	
Package plants (small flows)	901
Combined Sewer Overflow	402
Collection System Failure	4
Industrial Point Sources	333
Agriculture	
Grazing Related Sources	1,465
Animal Feeding Operations (NPS)	1,191
Crop Production	1,473
Land Application/Waste Disposal	
Landfills	7
Illegal Dumps or Other Inappropriate Waste Disposal	45
Onsite Wastewater Treatment Systems (septic systems)	768
Hazardous waste	3
Hydromodification	
Channelization	179
Dam Construction	16
Flow Regulation/Modification	383
Habitat Alterations (not directly related to hydromodification)	
Loss of Riparian Habitat	549
Bank or shoreline modification/destabilization	312
Other	
Contaminated Sediments	165
Debris and Bottom deposits	18
Natural sources	132
Urban Runoff/Stormwater	430
Resource Extraction (Mining)	182

Building Conceptual Models

- Summarize hypotheses of perceived linkages between stressors and impacts
- Provide template for determining potential indicator measurements and management practices



Problem sources: sediment

- High upland erosion potential:
  - Watershed slopes > 15%, row crops, active clearing/grading, erodible soils, few or no BMPs
- High stream channel erosion potential:
  - Impervious area > 15-25%, overgrazed pastures (compacted soil), little or no stream vegetated buffer, active new development, few or no BMPs

Problem sources: nutrients

- High nutrient <u>runoff</u> potential:
  - Animal feeding operations, overfertilized crops and lawns, high density septic system installations near streams,
- High nutrient <u>point source</u> potential:
  - Concentrated animal feeding operations, wastewater treatment plants, municipal separate storm sewer systems (MS4s)

Problem sources: bacteria

- High priority bacteria sources:
  - Poorly operated wastewater treatment plants, combined sewer overflows, high density septic systems near waterways, concentrated animal feeding operations near waterways
- Lower priority bacteria sources:
  - Wildlife, pets in low concentrations, pastured livestock in upland areas, grasslands (no livestock)

Calculating loads: what is a "load?"

- A way to quantify our problems
- Usually measured by weight
  - Kilograms per day
  - Pounds per week
  - Tons per month
- Other quantification schemes:
  - Concentration-based expression of the "load" (e.g., milligrams per liter)
  - # of miles of streambank needing stabilization or vegetation
  - # of AFOs requiring nutrient plans

Data-driven Approaches

- Estimate source loads using:
  - Monitoring data
    - Periodic water quality concentrations and flow gauging data
    - Facility discharge monitoring reports
  - Literature
    - Loading rates, often by land use (e.g., lbs/acre/year)
    - Typical facility concentrations and flow

Is a Data-Driven Approach Appropriate?

- Monitoring data
  - Does it represent most conditions that occur (low flow, storms, etc.)?
  - Are spatial and source variability well-represented?
  - Have all parameters of interest been monitored?
  - Is there a clear path to a management strategy?

Load Estimates – Monitoring Data

- In simplest terms…

  load = flow x concentration
- Load duration curves
  - Flow-based presentation
- Statistical techniques
  - Relationships between flow and concentration to "fill in the blanks" when data aren't available
  - Examples include:
    - Regression approach
    - FLUX

IDEM's load calculation tool

B21 fx =(B14-B16)/B14*100

	A	B	C	D	E
1	Load Calculation Tool	* User needs to input values in gray boxes			
2					
3	mass based pollutants			E. coli	
4	input				
5	TSS, N, P etc (mg/l)	105		cfu/100 ml	2220
6	Flow (cfs)	146		Flow	20
7					
8	Target Concentration			Target Concentration	
9	(mg/l)	80		cfu/100 ml	235
10					
11					
12	output				
13	Current Load (lb/day)	82,636.00		Current Load (cfu/day)	1.09E+12
14	Current Load (ton/year)	15,081.07		Current Load (cfu/year)	3.96E+14
15	Target Load (lb/day)	62,960.76		Target Load (cfu/day)	1.15E+11
16	Target Load (ton/year)	11,490.34		Target Load (cfu/year)	4.19E+13
17					
18					
19	load reduction needed				
20	(ton/year)	3,590.73		(cfu/year)	3.54E+14
21	% reduction	23.8		% reduction	89.4
22					

- *Need pollutant concentration averages & flow*

Load Estimates – Literature

- Land use-specific loading rates (typically annual)
- Multiply loading rate by area:

  $load_{all} = (area_{lu1} \times loading\ rate_{lu1}) + (area_{lu2} \times loading\ rate_{lu2}) + \ldots$

- Generally for land use or watershed-wide analysis
- Many sources: Lin (2004); Beaulac and Reckhow (1982), etc.
- Use with caution (need correct representation for your local watershed)
  - Pollution sources, climate, soils

Example Load Estimation Based on Literature Values

Example of Pollutant Bdget Estimation Using Export Coefficient Model

Land Use	Area (ha)	Nitrogen Export Coefficient (kg/ha/yr)	Total Nitrogen Load (kg/yr)	Percent of Nitrogen Load	Phosphorous Export Coefficient (kg/ha/yr)	Total Phosphorous Load (kg/yr)	Percent of Phosphorous Load
Forest	100	1.8	180	0.91	0.11	11	0.52
Corn	200	11.1	2220	11.24	2	400	18.95
Cotton	100	10	1000	5.6	4.3	430	20.37
Soybeans	20	12.5	250	1.27	4.6	92	4.36
Small Grain	50	5.3	265	1.34	1.5	75	3.55
Pasture	300	3.1	930	4.71	0.1	30	1.42
Feedlot or Dairy	5	2,900	14,500	73.39	220	1,100	52.11
Idle	30	3.4	102	0.52	0.1	3	0.14
Residential	20	7.5	150	0.76	1.2	24	1.14
Business	10	13.8	138	0.7	3	30	1.42
Industrial	5	4.4	22	0.11	3.8	19	0.9
Total	840	-	19,757	1	-	2,111	100

Note: Agricultural coefficients are from Reckhow et al. (1980), and urban coefficients are from Athayde et al. (1983).

Table 9. Unit loads of pollutants (kg/ha/yr) from different land uses*

Pollutant	Central business district	Other commercial	Industrial	Single family res.	Multi-family res.	Cropland	Pasture	Forest	Open
TSS	1080	840	56	17	440	450	340	85	7
COD	1070	1020	63	28	330	n.a.	n.a.	n.a.	2.0
Pb	7.1	3.0	2.0 - 7.1	0.1	0.7	0.005 - 0.006	0.003 - 0.015	0.01 - 0.03	n.a.
Zn	3.0	3.3	3.5 - 12	0.22	0.33	0.03 - 0.08	0.02 - 0.17	0.01 - 0.03	n.a.
Cu	2.1	n.a.	0.33 - 1.1	0.03	0.33	0.01 - 0.06	0.02 - 0.04	0.02 - 0.03	n.a.
NO_3+$N0_2$-N	4.5	0.67	0.45	0.33	3.8	7.9	0.33	0.56	0.33
TKN	15	15	2.2 - 15	1.1 - 5.6	3.4 - 4.5	1.7	0.67	2.9	1.7
TP	2.8	2.7	0.9 - 4.0	0.2 - 1.5	1.3 - 1.6	0.1 - 3.0	0.07 - 3.0	0.02 - 0.45	0.06

* Exact values are given where available; otherwise ranges are reported.

Adapted from Horner et al. (1986)

Limitations of Data-Driven Approaches

- Monitoring data
  - Reflect current/historical conditions (limited use for future predictions)
  - Insight limited by extent of data (usually water quality data)
    - Often not source-specific
    - May reflect a small range of flow conditions
- Literature
  - Not reflective of local conditions
  - Wide variation among literature
  - Often a “static” value (e.g., annual)

Example of Simple Model Application

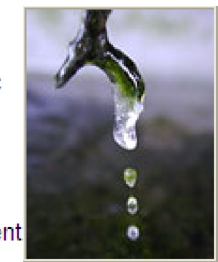
- Spreadsheet Tool for Estimating Pollutant Load (STEPL)
  - Employs simple algorithms to calculate nutrient and sediment loads from different land uses
  - Also includes estimates of load reductions that would result from the implementation of various BMPs
  - Data driven and highly empirical
  - A customized MS Excel spreadsheet model
  - Simple and easy to use

http://it.tetratech-ffx.com/stepl/default.htm

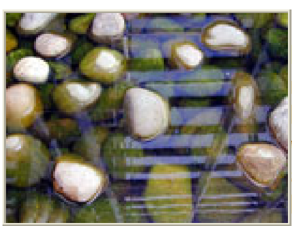
U.S. Environmental Protection Agency

STEPL - Spreadsheet Tool for Estimating Pollutant Load
Region 5 Load Estimation Model

Welcome to STEPL and Region 5 Model



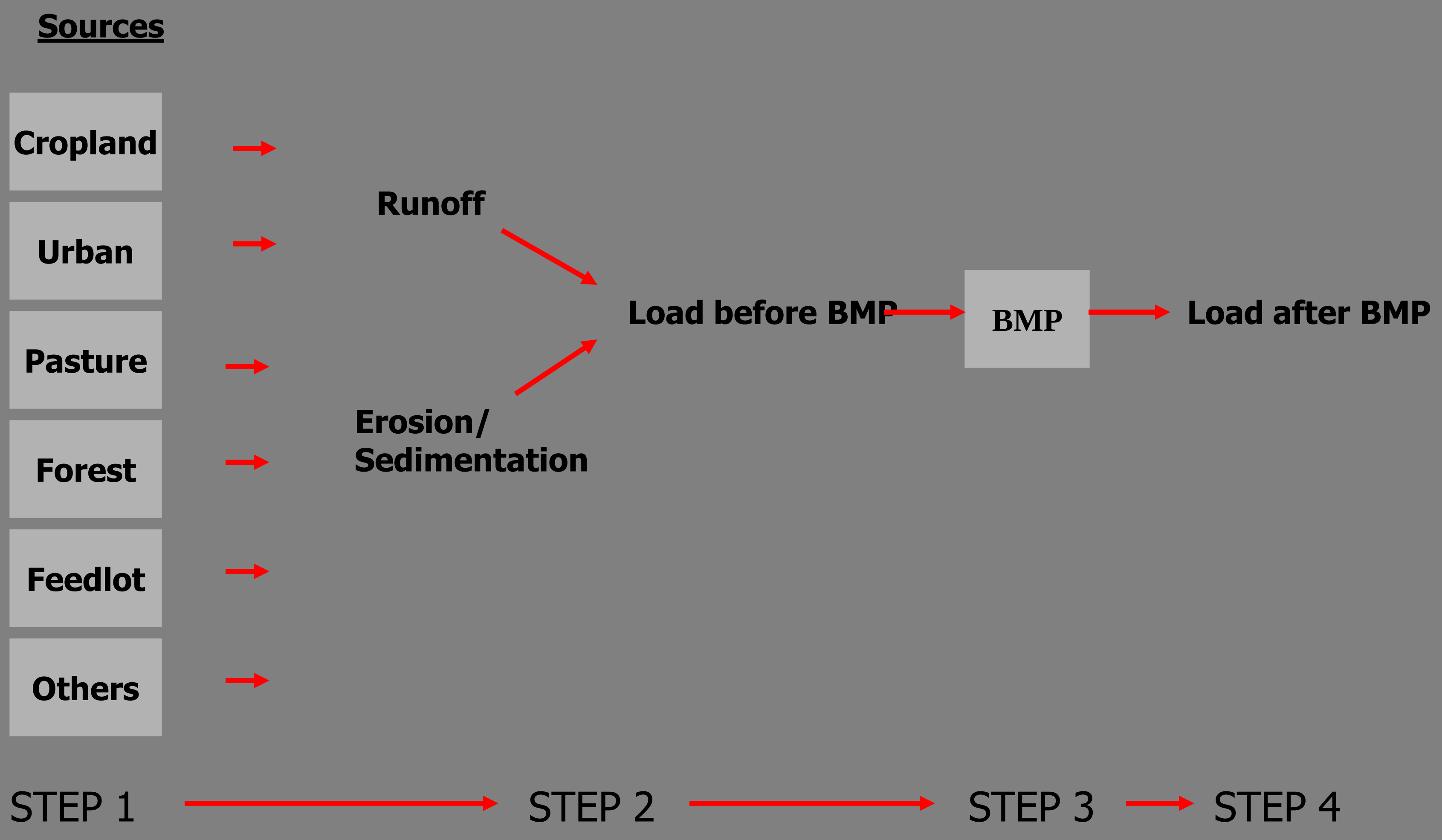
Spreadsheet Tool for Estimating Pollutant Load (STEPL) employs simple algorithms to calculate nutrient and sediment loads from different land uses and the load reductions that would result from the implementation of various best management practices (BMPs).STEPL provides a user-friendly Visual Basic (VB) interface to create a customized spreadsheet-based model in Microsoft (MS) Excel. It computes watershed surface runoff; nutrient loads, including nitrogen, phosphorus, and 5-day biological oxygen demand (BOD5); and sediment delivery based on various land uses and management practices. 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 (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.

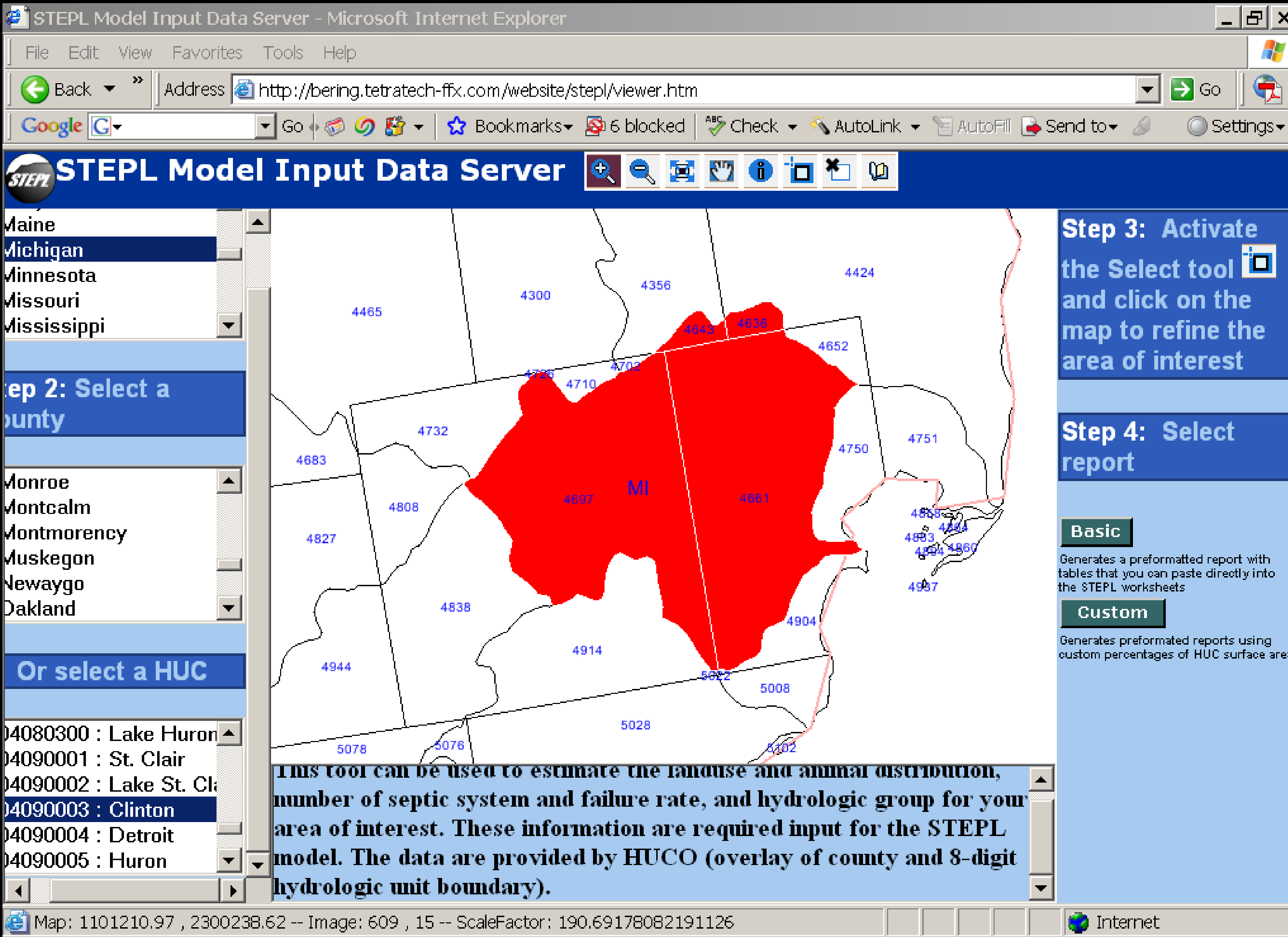


Region 5 Model is an Excel workbook that provides a gross estimate of sediment and nutrient load reductions from the implementation of agricultural and urban BMPs. The algorithms for non-urban BMPs are based on the "Pollutants controlled: Calculation and documentation for Section 319 watersheds training manual" (Michigan Department of Environmental Quality, June 1999). The algorithms for urban BMPs are based on the data and calculations developed by Illinois EPA. Region 5 Model does not estimate pollutant load reductions for dissolved constituents.

Questions? Please contact:

STEPL Process





STEPL Model Input Data Server - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back
Address http://bering.tetratech-ffx.com/website/stepl/viewer.htm
Go
Google Go Bookmarks 6 blocked Check AutoLink AutoFill Send to Settings
STEPL Model Input Data Server
Maine
Michigan
Minnesota
Missouri
Mississippi
tep 2: Select a
ounty
Monroe
Montcalm
Montmorency
Muskegon
Newaygo
Oakland
Or select a HUC
04080300 : Lake Huron
04090001 : St. Clair
04090002 : Lake St. Cla
04090003 : Clinton
04090004 : Detroit
04090005 : Huron
MI
4465
4300
4356
4424
4643
4636
4652
4726
4710
4702
4732
4683
4751
4750
4808
4697
4661
4827
4838
4904
4914
4944
5022
5008
5028
5078
5076
5102
Step 3: Activate the Select tool and click on the map to refine the area of interest
Step 4: Select report
Basic
Generates a preformatted report with tables that you can paste directly into the STEPL worksheets
Custom
Generates preformated reports using custom percentages of HUC surface area
This tool can be used to estimate the landuse and animal distribution, number of septic system and failure rate, and hydrologic group for your area of interest. These information are required input for the STEPL model. The data are provided by HUCO (overlay of county and 8-digit hydrologic unit boundary).
Map: 1101210.97 , 2300238.62 -- Image: 609 , 15 -- ScaleFactor: 190.69178082191126
Internet

Selected watershed(s) information

Polygon ID	County Name	State	HUC	HUC NAME	Area (acre)	% in County	% in HUC
1535	HOUGHTON	MI	4020104	Sturgeon	221349.20	33.96%	48.98%
1612	BARAGA	MI	4020104	Sturgeon	203770.31	34.77%	45.09%
1738	ONTONAGON	MI	4020104	Sturgeon	6822.40	0.80%	1.51%
2063	IRON	MI	4020104	Sturgeon	19931.45	2.58%	4.41%

1. Landuse area (acre)

Polygon ID	Urban/Transportation	Cropland	Pasture/Rangeland	Forest	User Defined	Feedlots	Water	Others
1535	800.00	13600.00	0.00	139800.00	0.00	0.26	3600.00	64800.00
1612	1500.00	9700.00	5300.00	168900.00	0.00	0.14	4800.00	46700.00
1738	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
2063	100.00	0.00	0.00	17600.00	0.00	0.02	1600.00	9000.00
Total	2400.00	23300.00	5300.00	326300.00	0.00	0.42	10000.00	120500.00

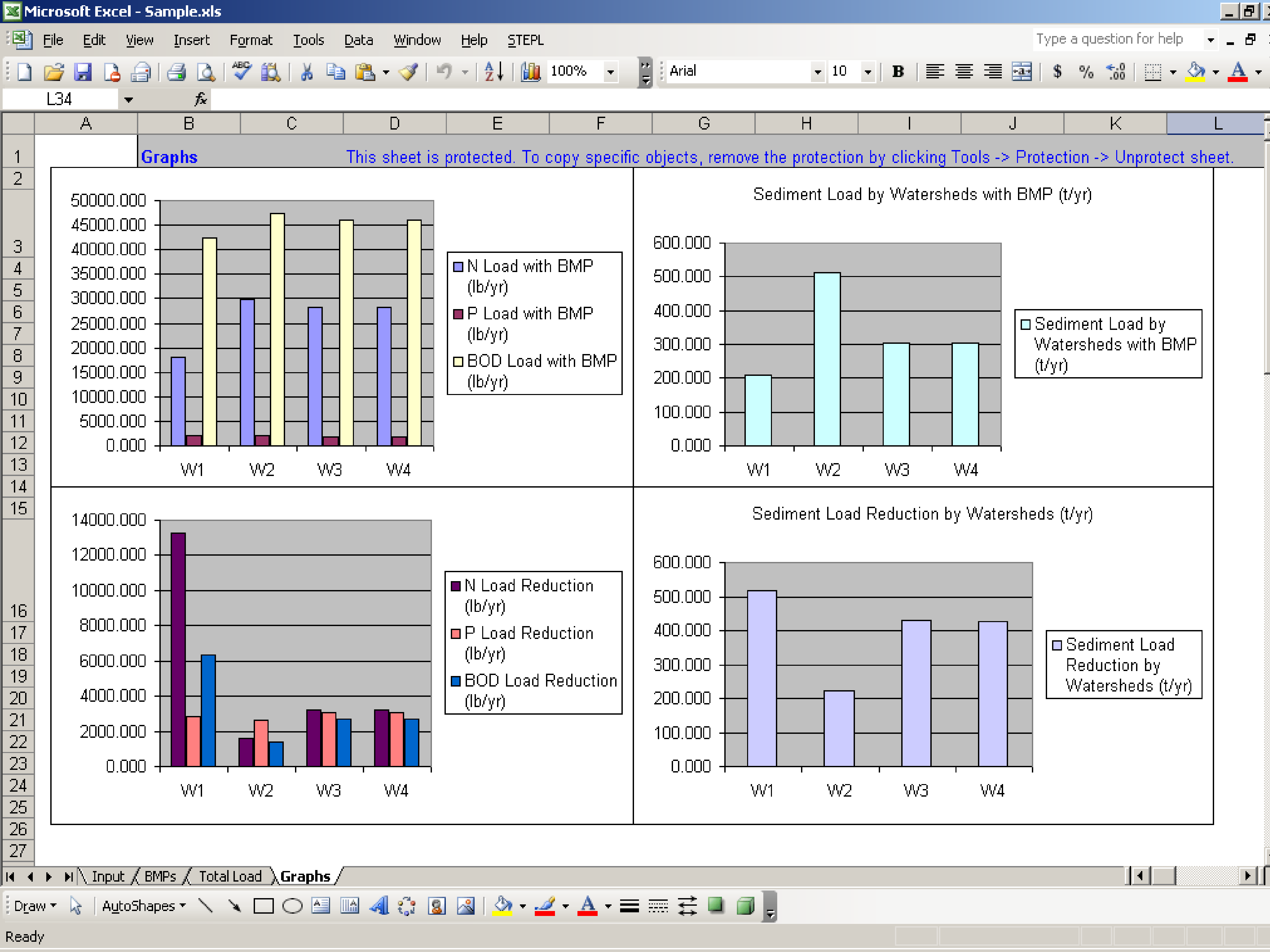
Source: USDA Natural Resources Conservation Service 1997 National Resources Inventory

Feedlot area is estimated based on the minimum space requirement by animmals

2. Agricultural animals

Polygon ID	Beef Cattle	Dairy Cattle	Swine(Hog)	Sheep	Horse	Chicken	Turkey	Duck
1535	141	161	16	118	0	83	10	3
1612	188	33	D	D	0	82	D	0
1738	6	4	D	D	0	0	0	0
2063	23	1	0	4	0	12	0	0
Total	358	199	16	122	0	177	10	3

Source: USDA Census of Agriculture, 2002


Microsoft Excel - Sample.xls
File Edit View Insert Format Tools Data Window Help STEPL
Type a question for help
100%
Arial
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A B C D E F G H I J K L
Graphs
This sheet is protected. To copy specific objects, remove the protection by clicking Tools -> Protection -> Unprotect sheet.
50000.000
45000.000
40000.000
35000.000
30000.000
25000.000
20000.000
15000.000
10000.000
5000.000
0.000
W1 W2 W3 W4
N Load with BMP (lb/yr)
P Load with BMP (lb/yr)
BOD Load with BMP (lb/yr)
Sediment Load by Watersheds with BMP (t/yr)
600.000
500.000
400.000
300.000
200.000
100.000
0.000
W1 W2 W3 W4
Sediment Load by Watersheds with BMP (t/yr)
14000.000
12000.000
10000.000
8000.000
6000.000
4000.000
2000.000
0.000
W1 W2 W3 W4
N Load Reduction (lb/yr)
P Load Reduction (lb/yr)
BOD Load Reduction (lb/yr)
Sediment Load Reduction by Watersheds (t/yr)
600.000
500.000
400.000
300.000
200.000
100.000
0.000
W1 W2 W3 W4
Sediment Load Reduction by Watersheds (t/yr)
Input BMPs Total Load Graphs
Draw AutoShapes
Ready

Input parameters for the STEPL pollutant load estimate spreadsheet.

STEPL Input Parameter	Input Value	Notes
Number of Watersheds	1	Entire Hancock Creek watershed is treated as one drainage area
Urban Land (acres)	774	Includes all developed land – residential, commercial, industrial
Crop Land (acres)	509	Row crop land only
Pasture Land (acres)	6575	Pasture land only
Forest Land (acres)	355	Forest land only
Beef Cattle (# animals)	1500	Original estimate of 1725 lowered to 1500 based on local input
Chickens, Ducks, Turkeys, Hogs, Sheep (# animals)	0	Based on local input
Horses (# animals)	7	Based on local input
Annual Rainfall (inches)	45	Lexington airport – STEPL data server
Septic Systems (total #)	125	Estimated from aerial photos
Septic System Failure Rate (percent)	5	Estimated from local input
Streambank Erosion (total ft)	21120	Estimated from aerial photographs and visual windshield survey
Streambank Erosion (lateral recession ft/yr)	0.03	Used "slight" default setting, based on personal observation and clayey soil type
Streambank Erosion (height of eroded area, ft)	1.5	Based on personal observation – average throughout watershed; most occurring along tributaries to Hancock Creek
USLE Parameters	Default Values	From STEPL data server info for Clark County KY

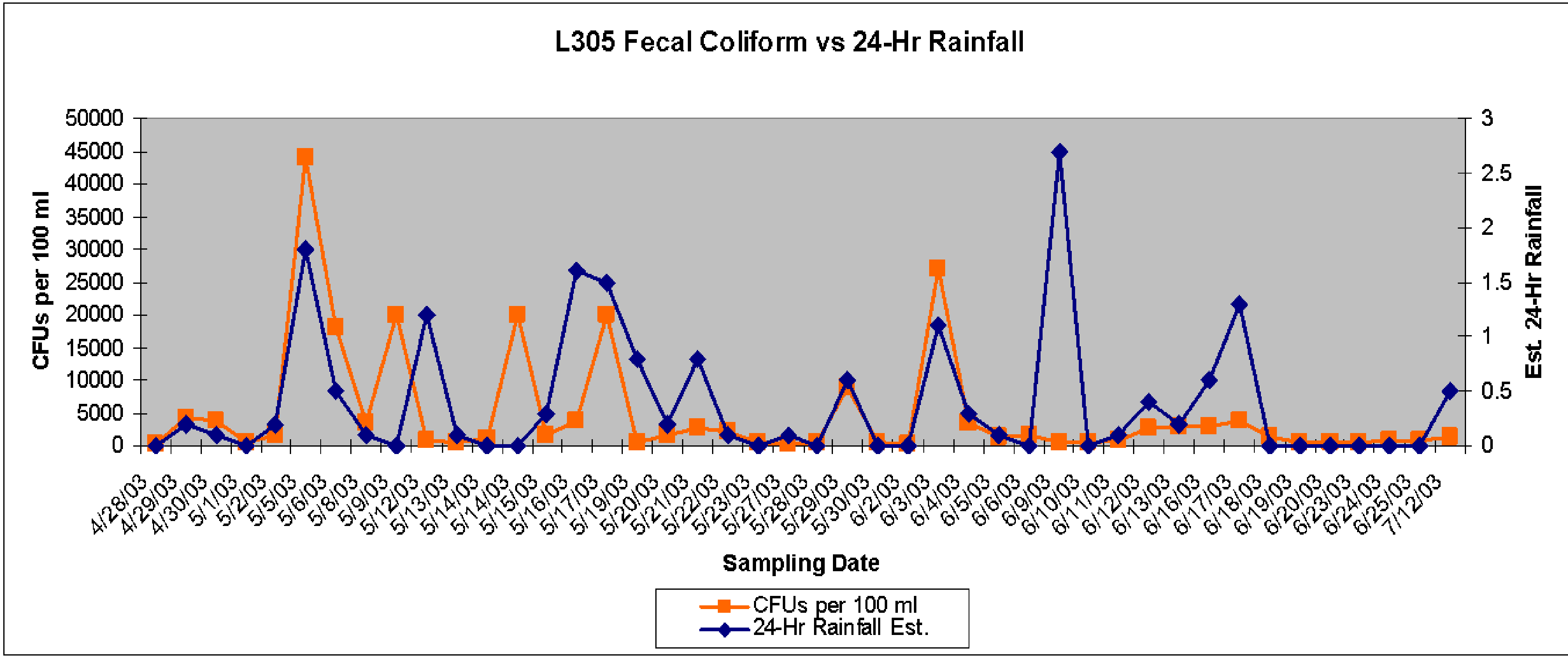
Input Parameters Sources: Clark County GIS, Hancock Creek Watershed Team, Tetra Tech

Draft STEPL model pollutant loads for Hancock Creek.

Sources	N Load (lb/yr)	P Load (lb/yr)	BOD Load (lb/yr)	Sediment Load (t/yr)
Urban	5994.25	922.70	23122.58	137.56
Cropland	10211.38	2532.38	20891.44	1579.98
Pastureland	55451.82	8335.71	163376.37	4210.51
Forest	135.59	61.52	311.69	17.05
Feedlots	0.00	0.00	0.00	0.00
User Defined	0.00	0.00	0.00	0.00
Septic	194.30	76.10	793.40	0.00
Gully	0.00	0.00	0.00	0.00
Streambank	1.51	0.58	3.01	0.82
Groundwater	0.00	0.00	0.00	0.00
Total	71988.84	11928.99	208498.49	5945.92

Johnson Creek
627
64
60
Total P Load by Land Uses (with BMP) (lb/yr)
Urban
Cropland
Pastureland
Forest
Feedlots
User Defined
Septic
Gully
Streambank
Groundwater
Total Sediment Load by Land Uses (with BMP) (t/yr)
Urban
Cropland
Pastureland
Forest
Feedlots
User Defined
Septic
Gully
Streambank
Groundwater
Total N Load by Land Uses (with BMP) (lb/yr)
Urban
Cropland
Pastureland
Forest
Feedlots
User Defined
Septic
Gully
Streambank
Groundwater

Stream flow vs pollutants: always interesting . . . .



CFUs = Colony Forming Unites

E. Br. Coon Creek at Armada Center Rd.

Load Duration Curve *(2004 Monitoring Data)*

Site: EBC2

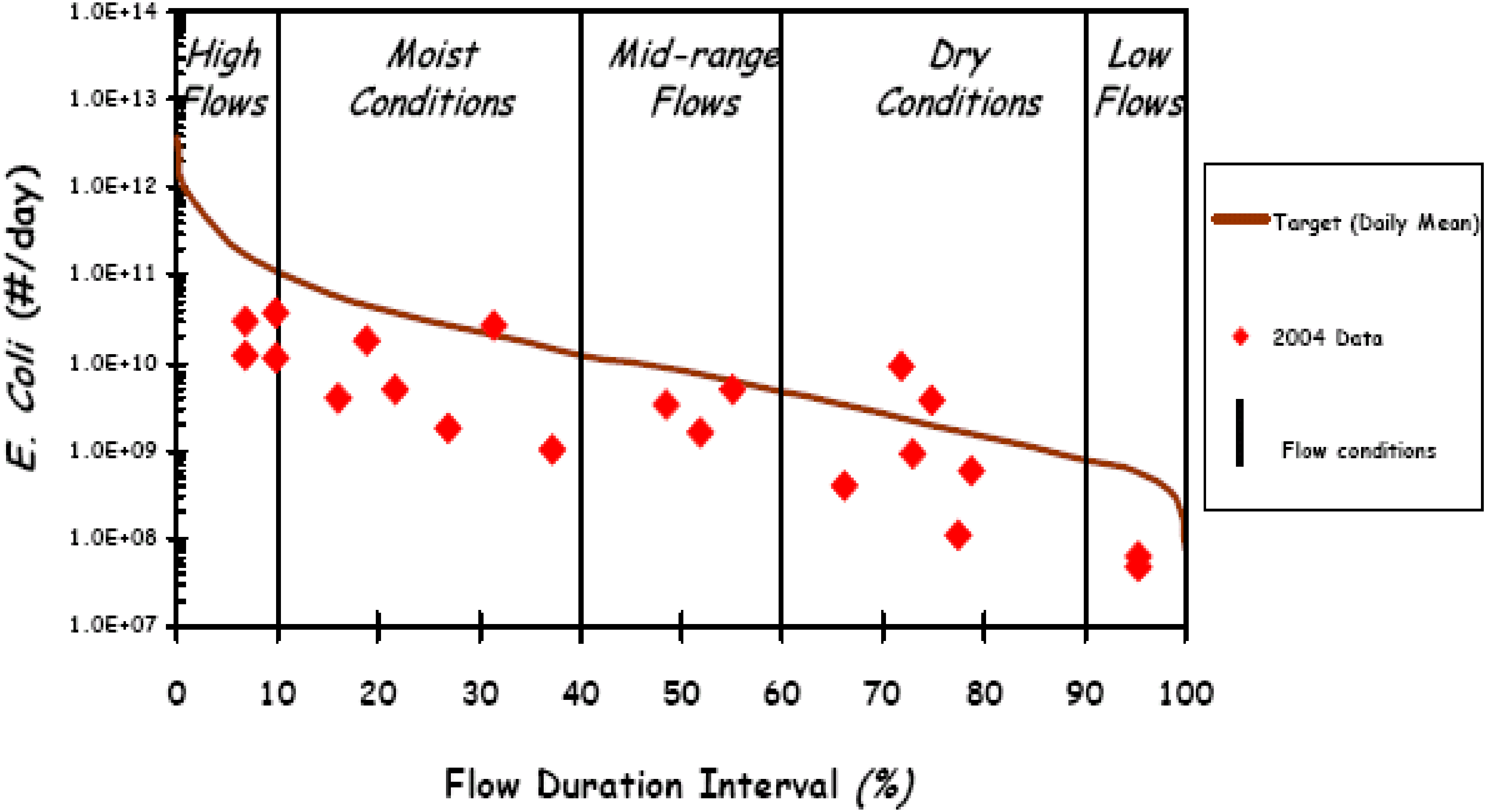
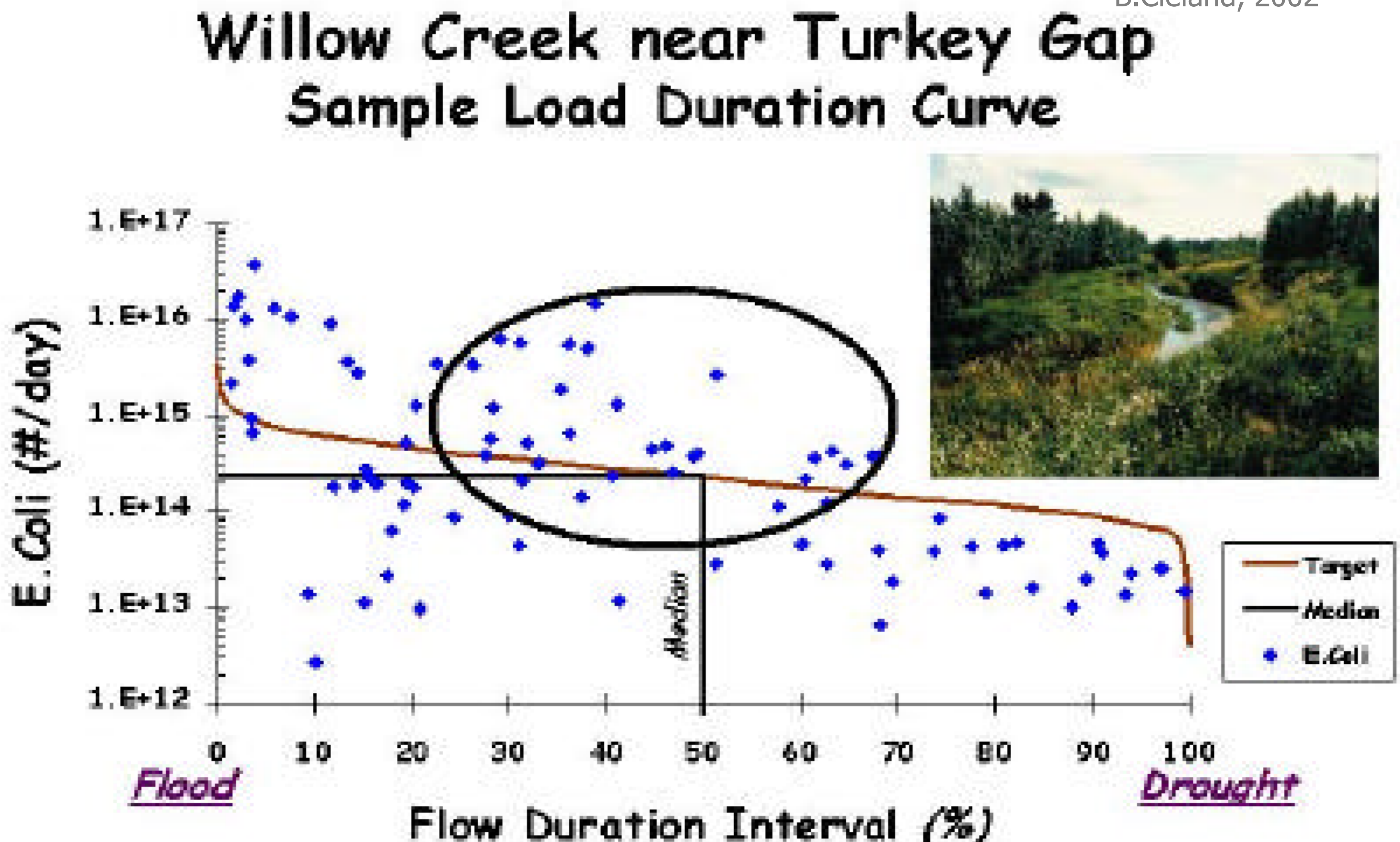


Figure 2. Duration Curve with Contributing Area Focus

T.C. Stiles, 2001;
B.Cleland, 2002



TARGETED Programs: *Riparian Buffers (e.g. CRP, CREP)*

But do your data measure up?

- What are the data quality objectives?
- Do you have a comprehensive picture?
- How old are your sampling results?
- Can you move forward with what you have?

Data quality objectives

- Quantify or qualify how good data must be to achieve the goals of monitoring / assessment
- Described in terms of:
  - precision
  - accuracy
  - representativeness
  - comparability
  - completeness

Data Quality Objectives for Water Chemistry Parameters -- HACH Kit

Parameter	Completeness	Precision	Accuracy[1]	Measurement Range
Fecal Coliform/E. *coli*			High[1]	> or < 200 colonies/100 ml
Dissolved Oxygen (high range test)			+/- 1 mg/L	0-17 mg/L
Dissolved Oxygen (low range test)			+/- 0.02 mg/L	0.2-0.4 mg/L
BOD_5 (high range test)			+/- 1 mg/L	0-17 mg/L
BOD_5 (low range test)			+/- 0.02 mg/L	0.2-0.4 mg/L
pH			+/- 0.2 pH units	0-14 pH units
Total Phosphate (low range test)			+/- 10%	0-1 mg/L
Total Phosphate (medium range test)			+/- 10%	0-5 mg/L
Total Phosphate (high range test)			+/- 10%	0-50 mg/L
Orthophosphate (low range test)			+/- 10%	0-1 mg/L
Orthophosphate (medium range test)			+/- 10%	0-5 mg/L
Orthophosphate (high range test)			+/- 10%	0-50 mg/L
Nitrates (low range test)			+/- 10%	0-1 mg/L
Nitrates (medium range test)			+/- 10%	0-10 mg/L
Nitrates (high range test)			+/- 10%	0-50 mg/L
Turbidity			+/- 10 NTU (+/- 10 JTU)	0 - ≥100 NTU (JTU)
Total Solids[2]			+/- 0.0001 g	
Temperature Change[2]			+/- 1 degree	

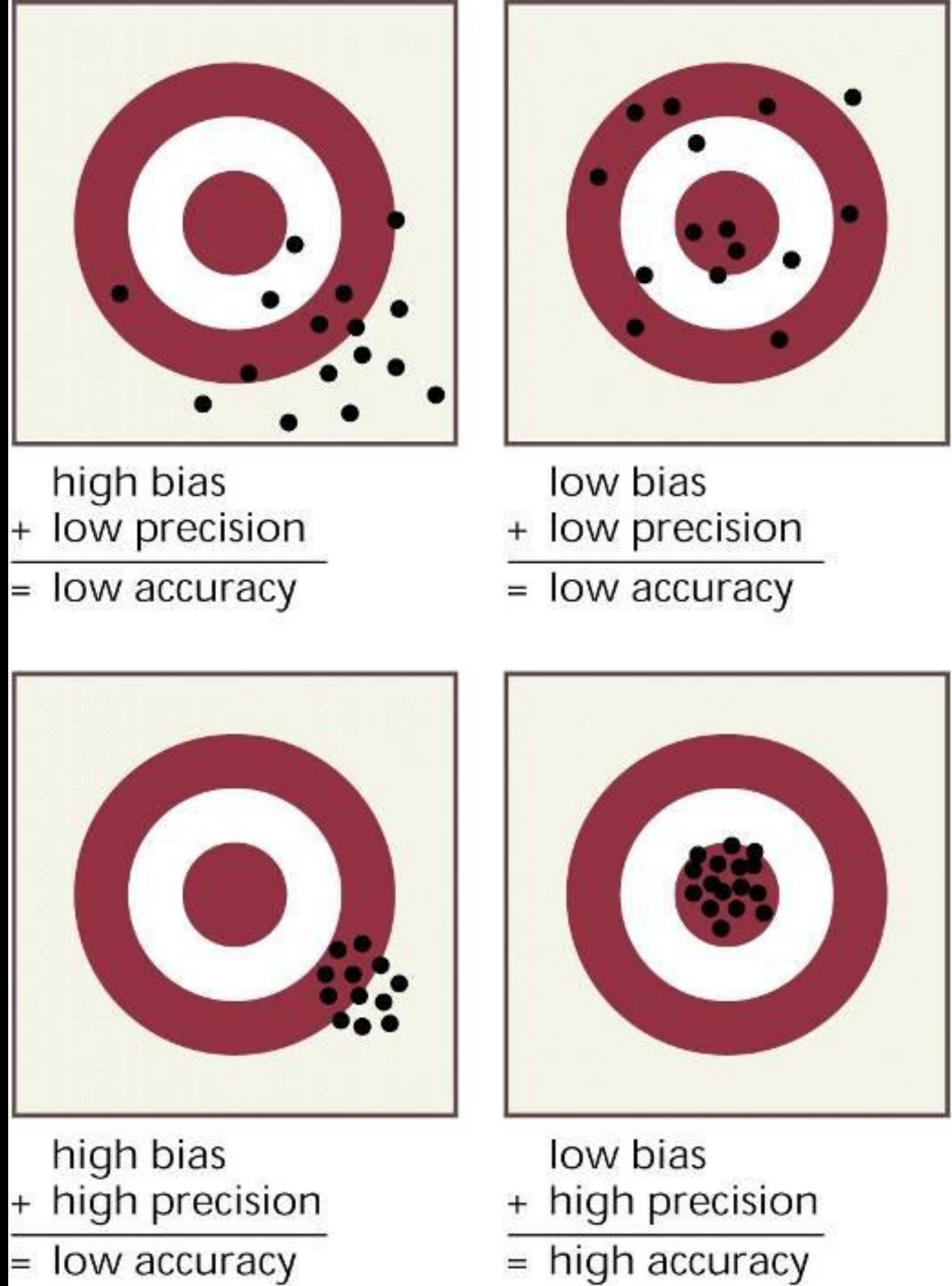
[1] Accuracies reported as percentages are for parameters measured with the HACH colorimeter and, according to the manufacturer, are typical of accuracies achieved with this device. Accuracy of E. *coli* counts are expected to be high given that results are reported as > or < 200 colonies/100ml.

[2] The measurement range for Total Solids depends on the analytical scale you will use (consult the manufacturer's literature). For Temperature Change, state the range of the thermometer used and indicate the units of measurement (i.e. Celsius or Farenheit).

Note that accuracy in colorimeter results vary according to individual color perception. Replicate values may be averaged to obtain more accurate results and to identify obvious outliers. If replicates are averaged to ensure accuracy, at least one additional set of averaged readings will be necessary for the purposes of calculating precision (i.e. RPD or RSD). Indicate in Section 3 of the QAPP if individual measurements will be taken or if, for the purposes of enhancing the accuracy of your data, two or more measurements will be taken instead and averaged into one result.

Accuracy & precision

- Both needed to reflect true water body condition
- Can be biased away from target
- Addressed by following protocols, using field blanks, spiked samples in lab



Completeness, representativeness, and comparability

- Collecting all samples planned
- Collecting samples that represent "true condition" of the water body
  - During various seasons, flows?
  - Following sampling protocols?
- Confidence in comparing different data sets
  - Use similar data quality objectives
  - Avoids differences in methods, accuracy, precision

Comprehensiveness

- Do you have a clear picture of the problems?
  - Land use, cover, and watershed activities indicate likely pollutants
  - Biological assessments provide excellent screening info
- DO, pH, temp are primary parameters
- Conductivity, pesticides, herbicides, metals, and bacteria help to refine & focus results

Age and applicability

- Data age considerations
  - Stable land use & cover make older data (5-7 yrs) more useful
  - Developing watersheds require newer data (2-4 years old)
  - Rapidly developing watersheds may be difficult to characterize (apply LID & BMPs)
  - Note new or altered NPDES discharger info

Volunteer derived data

- Credibility is improved when:
  - Volunteers are trained by professionals
  - Sampling and analytical procedures match accepted protocols
  - Sampling is conducted under a Quality Assurance Project Plan

Volunteer vs agency data (1989 - 2005)

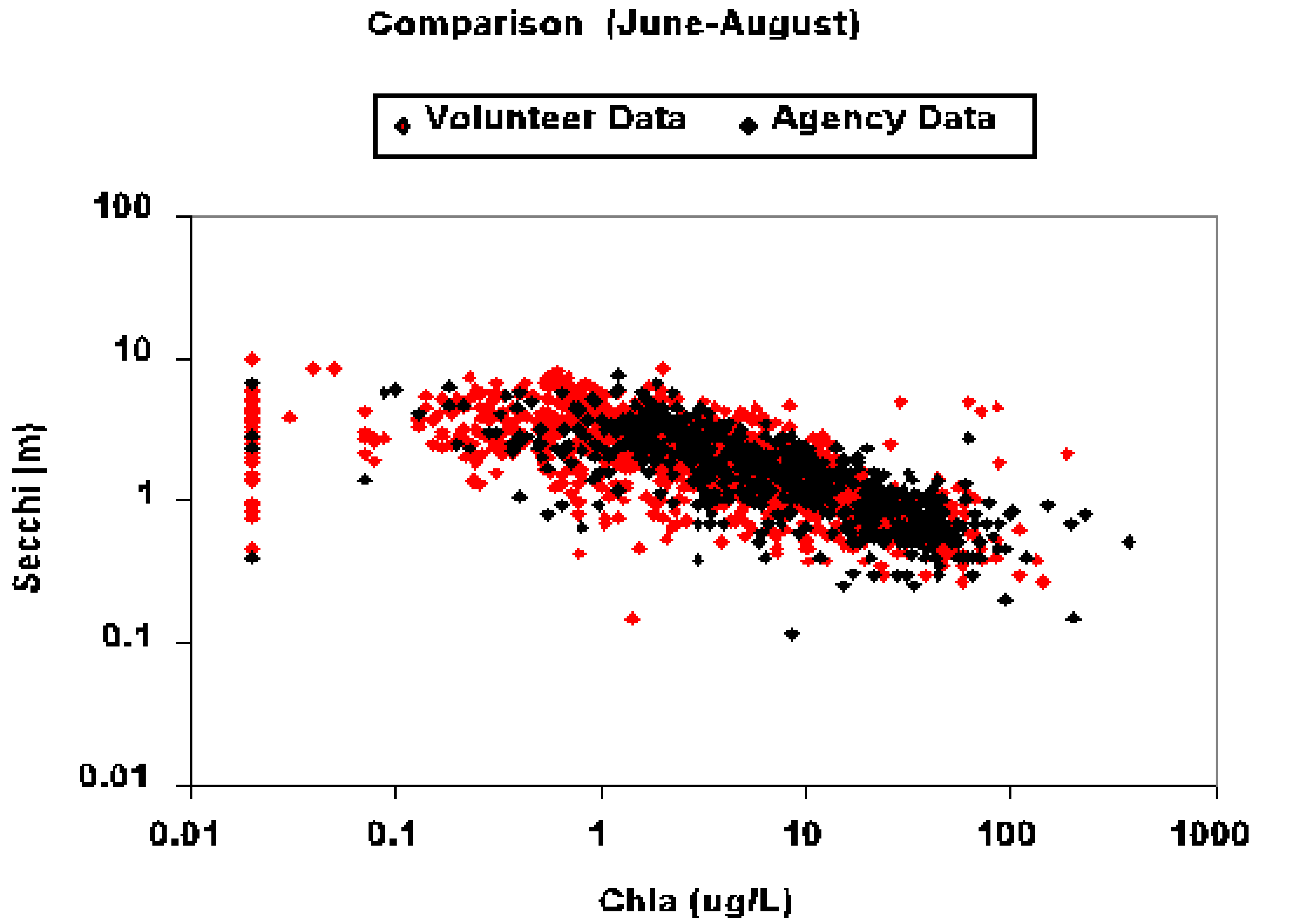


Table 8: Summarized Criteria for Use Support Assessment.

<table>
<tr><th colspan="3">Aquatic Life Use Support - Rivers and Streams</th></tr>
<tr><td rowspan="3">Conventional inorganics</td><td colspan="2">Dissolved oxygen, pH, sulfates, chlorides were evaluated for the exceedance(s) of Indiana's WQS. For any one pollutant, the following assessment criteria are applied to data sets consisting of three or more measurements.</td></tr>
<tr><th>Fully Supporting</th><th>Not Supporting</th></tr>
<tr><td>For dissolved oxygen, one/more samples may be <4mg/L, but no more than 10% of all measurements are <5mg/L. For other conventional inorganics, criteria are exceeded in <10% of measurements.</td><td>For dissolved oxygen, one/more samples <4mg/L and more than 10% of all measurements are <5mg/L. For other conventional inorganics, criteria are exceeded in >10% of measurements.</td></tr>
<tr><td>Nutrients</td><td colspan="2">Nutrient conditions were evaluated on a site by site basis using the benchmarks described below. In most cases, two or more of these conditions must be met on the same date in order to classify a waterbody as impaired. This methodology assumes a minimum of three sampling events.
• Total Phosphorus: One/more measurements >0.3 mg/l
• Nitrogen (measured as $NO_3 + NO_2$) -- One/more measurements >10.0 mg/l
• Dissolved Oxygen (DO) -- Measurements below the water quality standard of 4.0 mg/l or measurements that are consistently at/close to the standard, in the range of 4.0-5.0 mg/l or values >12.0 mg/l
• pH measurements -- Measurements above the water quality standard of 9.0 or measurements that are consistently at/close to the standard, in the range of 8.7- 9.0
• Algal Conditions -- Algae are described as "excessive" based on field observations by trained staff.</td></tr>
<tr><td rowspan="2">Benthic aquatic macroinvertebrate Index of Biotic Integrity (mIBI) Scores (Range of possible scores is 0-8)</td><th>Fully Supporting</th><th>Not Supporting</th></tr>
<tr><td>• mIBI ≥1.8 (for samples collected with an artificial substrate sampler)
• mIBI ≥2.2 (for samples collected using kick methods)</td><td>• mIBI <1.8 (for samples collected with an artificial substrate sampler)
• mIBI <2.2 (for samples collected using kick methods)</td></tr>
<tr><td>Qualitative habitat use evaluation (QHEI) (Range of possible scores is 0-100)</td><td colspan="2">The Qualitative Habitat Evaluation Index (QHEI) is used in conjunction with mIBI and/or IBI data to evaluate the role that habitat plays in waterbodies where impaired biotic communities (IBC) have been identified. QHEI scores are calculated using six metrics: substrate, instream cover, channel morphology, riparian zone, pool/riffle quality, and gradient. QHEI scores are evaluated to determine if habitat is the primary stressor on the aquatic communities or if there may be other stressors/pollutants causing the IBC.</td></tr>
</table>

Table 1: Summary of Use Support - Assessed and Reported 1998 through 2007.

Designated Use	Support	Threatened[1]	Non Support	Assessed	Not Assessed
Rivers (miles)					
Aquatic Life Use	13, 913	--	3,622	17,535	14,606
Fishable Uses	1,044	--	3,402	4,435	27,705
Drinking Water Supply[2]	--	--	1	1	101
Recreational Use (Human Health)	3,700	--	8,374	12,073	20,100
Great Lakes Shoreline (miles)					
Aquatic Life Use	59	--		59	--
Fishable Uses	--	--	59	59	--
Drinking Water Supply[2]	33	--		33	--
Recreational Use (Human Health)	--	--	59	59	--
Lake Michigan (acres)					
Fishable Uses	--	--	154,176	154,176	--
Lakes and Reservoirs (acres)					
Aquatic Life Use	3,690	--	6,625	10,315	21,826
Fishable Uses	7,820	--	63,663	71,483	5,084
Drinking Water Supply[2]	230	--	16,385	22,905	12,926
Recreational Use (Human Health)	21,922	--	983	22,905	104,662
Recreational Use (Aesthetics)	29,035	--	8,006	37,041	90,526

Source: IDEM's Assessment Database