Existing Load

MS4 Workshops – Pollutant Reduction and TMDL Plans

Fall 2016

Tom Wolf, Governor

Patrick McDonnell, Acting Secretary

Training Goals

- Calculate existing loads in planning areas using a range of methods
- Familiarize with tools available to calculate loading

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Why Is This Important?

- Permit requires % pollutant reduction from existing load
- Provides insight into pollutant sources
- Needed for prioritizing individual sewersheds and BMP load reduction calculations

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PRP Instructions

- Existing load calculated and reported as of PRP date
- No credit for past non-structural BMPs (street sweeping)
- Existing structural BMPs (with proper O&M) reduce existing load
- Permittees may use any scientifically defensible method to calculate existing load

So it helps lower the starting point.

Wide range of expertise

There are a lot of methods and there and not a lot of ways to game the system.

Pollutant Load Formulas

1. **Load = Concentration * Flow**
   = 0.04 mg/l TP * 3 MGD * 8.34 * 365 days/year
   = 365 lb TP/year
2. **Load =** **Land Use / Cover Based Loading Rate** ✖ **Land Area**
   = 0.5 lb/acre/year TP * 10 acres
   = 5 lb TP/year

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Typical method to calc. from a pipe discharge

Method for land-based loading.

Basic Steps to Calculate Existing Load

1. Select loading rates
2. Determine area of storm sewersheds and % of each land use or land cover, based on your mapping
3. Calculate load using loading rates and land area from previous steps
4. Evaluate existing structural BMPs to reduce existing loading (optional)

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Step 1: Select Loading Rates

Option 1: Chesapeake Bay Program loading rates for broad urban categories

Option 2: Literature or other scientifically valid sources

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Step 1: Select Loading Rates

Option 1: Chesapeake Bay Derived Loading Rates

[illegible] 5/2016
[illegible] Instructions

ATTACHMENT B

DEVELOPED LAND LOADING RATES FOR PA COUNTIES[1,2]

County	Category	Acres	TN lbs/acre/yr	TP lbs/acre/yr	TSS (Sediment) lbs/acre/yr
Adams	impervious developed	10,373.2	33.43	2.1	1,398.77
	pervious developed	44,026.6	22.99	0.8	207.67
Bedford	impervious developed	9,815.2	19.42	1.9	2,034.34

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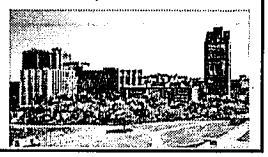
Option 1: CB Loading Rates

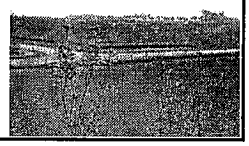
- Developed land cover
  - Counties within the Bay watershed
  - Counties outside the Bay watershed may use composite from within watershed
  - Both divided into impervious & pervious
- Undeveloped land cover



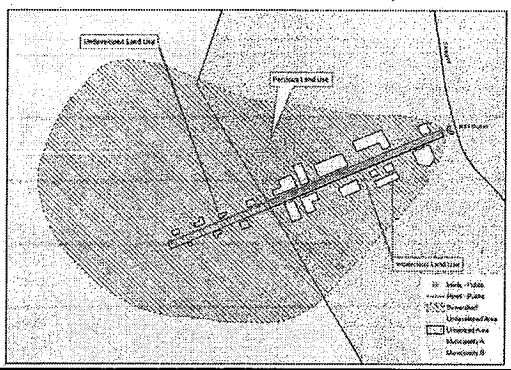
Option 1: CB Loading Rates

For land area outside of the urbanized area, undeveloped land loading rates may be used:

- TN: 10 lbs/acre/yr
- TP: 0.33 lbs/acre/yr
- Sediment: 234.6 lbs/acre/yr

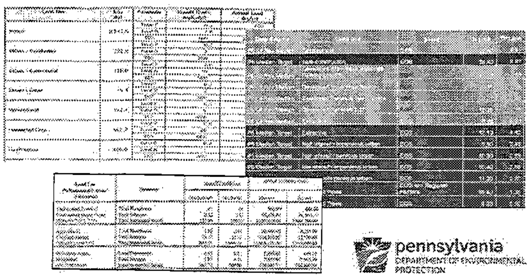


Option 1: CB Loading Rates



Option 2: Literature Loading Rates

Loading Rates, Runoff Coefficients,
Export Coefficients/Rates…



Option 2: Literature Loading Rates

Data Source	Land use	Scale	TN Lb/A	TP Lb/A
P6 Lit Rev Median	Construction	EOS	26.40	8.81
P5 Median Target	bare-construction	EOS	26.40	8.81
P6 Lit Rev Median	Developed Impervious Buildings Parking Lots Etc	EOF	[illegible]	[illegible]
P6 Lit Rev Median	Developed Impervious Roads	EOF	[illegible]	2.19
P6 Lit Rev Median	Developed Pervious Open Space	EOF	[illegible]	0.85
P6 Lit Rev Median	Developed Pervious Turf	EOF	[illegible]	2.19
P6 Lit Rev Median	Extractive	EOS	[illegible]	[illegible]
P5 Median Target	Extractive	EOS	13.10	4.42
P5 Median Target	high intensity impervious urban	EOS	9.90	2.49
P5 Median Target	high intensity pervious urban	EOS	10.90	0.89
P5 Median Target	low intensity impervious urban	EOS	10.40	2.50
P5 Median Target	low intensity pervious urban	EOS	11.20	0.90
P5.3.2	Urban-All Types	EOS w/o Regional Factors	15.40	1.35
Sparrow	Urban-All Types	EOS	9.35	0.50

Will have to do a crosswalk to make these match.

Option 2: Literature Loading Rates

Land Use	Area (ha)	Parameter	Runoff Coeff. (kg/ha/yr)	Annual Load (kg/yr)
Forest		Total P		
Urban - Residential				
Urban - Commercial				
Urban - Other				
Recreational				
Harvested Crop				
Hay/Pasture				

Land Use (%Watershed/# Acres/ # Hectares)	Parameter
Undisturbed Forested, Undisturbed Mixed Forest (59% /19,217/7,777)	Total Phosphorus Total Nitrogen Total Suspended Solids
Agricultural, Cropland-Pasture (35%/11,211/4,537)	Total Phosphorus Total Nitrogen Total Suspended Solids
Developed Areas, Residential (5% /1,601/648)	Total Phosphorus Total Nitrogen Total Suspended Solids

Basic Steps to Calculate Existing Load

1. Select loading rates
2. **Determine area of storm sewersheds and % of each land use or land cover, based on your mapping**
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Step 2: Determine Land Area

Load = [Land Use / Cover Based Loading Rate] X [**Land Area**]

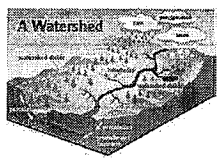
- Land Area is typically mixed land use
- Need land use distribution within defined drainage area

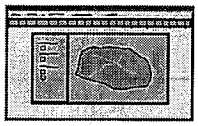
Land Area Determination Tools

Option 1: DEP Simplified Method

Option 2: Stroud watershed tool

Option 3: Modeling (GIS)





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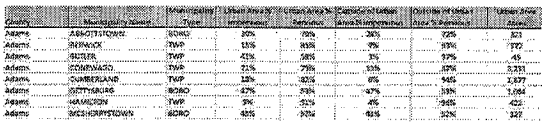
Option 1: DEP Simplified Method

Table of municipal distributions by land cover



- Multiply calculated acreage by corresponding loading rate and sum
- Not appropriate for land use determinations at finer scales (e.g. individual sewershed, BMP treatment area)

Option 1: DEP Simplified Method

Conewago Township, Adams County

Urban Area % Impervious	Urban Area % Pervious	Total UA Area (Acres)
21%	79%	3,233

3,233 acres * 0.21 = 679 acres impervious developed

3,233 acres – 679 acres = 2,554 acres pervious developed

Option 1: DEP Simplified Method

Impervious developed

679 acres ✖ 1,398.77 lbs sediment/ac/yr = 949,242 lbs sediment/yr

✚

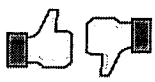
Pervious developed

2,554 acres ✖ 207.67 lbs sediment/ac/yr = 530,389 lbs sediment/yr

Total Developed Load = 1,479,631 lbs sediment/yr

Option 1: DEP Simplified Method

Advantages:



- Easy and inexpensive

Disadvantages:

- Lacks site-specificity
- Limited application beyond UA loading unless homogenous impervious surface distribution

Option 2: Stroud Watershed Tool

WikiWatershed

- Collaborative effort
- Includes modules on modeling, monitoring, field observation (e.g. habitat, aquatic insects)
- May require conversion from land use categories to land covers, unless loading rates are available for these land uses

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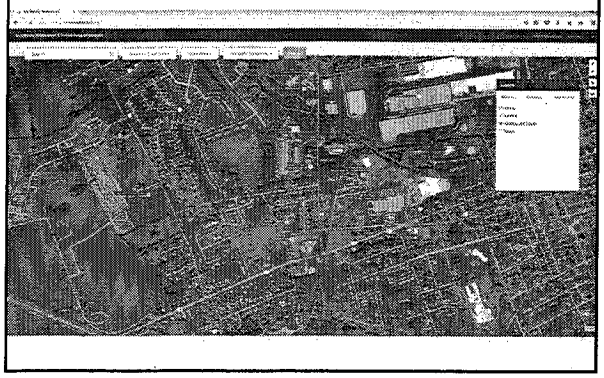
Option 2: Stroud Watershed Tool



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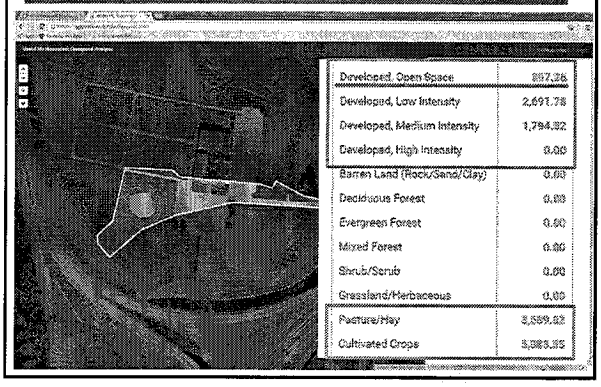

Option 2: Stroud Watershed Tool

National Land Cover Database 2011

www.mrlc.gov

- Developed, Open Space: 19% impervious
- Developed, Low Intensity : 49% impervious
- Developed, Medium Intensity : 79% impervious
- Developed High Intensity : 100% impervious

Option 2: Stroud Watershed Tool

CBP Loading Rate Example

Developed, Open Space = 19% impervious

897.26 m^2 = 0.22 ac total

0.22 ac * 19% = 0.04 ac impervious

0.22 ac – 0.04 ac = 0.18 acres pervious

Type	Area (m^2)
Developed, Open Space	897.26

County	Category	Acres	TSS (Sediment) lbs/acre/yr
York	impervious developed	10,330.7	1,614.15
	pervious developed	40,374.8	220.4

Option 2: Stroud Watershed Tool

Developed, Open Space - impervious

1614.15 lb/ac/yr ✖ 0.04 acres 〓 64.6 lbs sediment/yr

✚

Developed, Open Space - pervious

220.40 lb/ac/yr ✖ 0.18 acres 〓 39.7 lbs sediment/yr

Total DOS Sediment Load 〓 104.3 lbs sediment/yr

Option 2: Stroud Watershed Tool

Impervious

1,614.15 lb/ac/yr ✖ 0.72 acres 〓 1,162 lbs sediment/yr

✚

Pervious

220.40 lb/ac/yr ✖ 2.83 acres 〓 624 lbs sediment/yr

Total Sediment Load 〓 1,786 lbs sediment/yr

Option 2: Stroud Watershed Tool

- Advantages:
  - Easy and publicly available
  - MRLC/NLCD standardized for national use
  - Generate an input file for MapShed Modeling
- Disadvantages:
  - Stroud tool not a full GIS package
    - Cannot import/export shape files
  - Must delineate area of interest

Option 3: Water Quality Modeling

- Loads estimated from mathematical simulation of pollutant generation and hydrologic processes
- Site-specific
- User-friendly with model parameterization data readily available

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Option 3: Water Quality Modeling (MapShed)

- GIS-based environment
- Automated population of required inputs
- Loads split by UA and municipality with option to import sewershed delineations
- BMP scenario module - Expert Panel methods
- Model download and instructional videos available at http://www.mapshed.psu.edu

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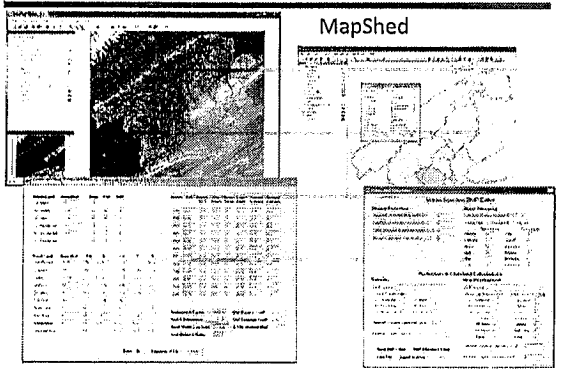
Option 3: Water Quality Modeling (MapShed)



Option 3: Modeling (GIS)

- Advantages:
  - Free, public domain software
  - Site specific
  - Allows for delineation, land cover determination, load calculation and BMP scenarios for any area of interest
- Disadvantages
  - Requires more user understanding of GIS/Modeling

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Step 4: Evaluate Existing BMPs

- MS4s may account for structural BMPs that are currently installed and maintained in existing load estimates.
- Any existing structural BMPs must be identified in Section D of the PRP along with required information in order to claim credit
- Pollutant reduction calculations for existing BMPs will be discussed in BMP Selection session

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Summary

Clarifications?

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