ChesBay ALERT

AMEC Load Estimation and Reduction Tracking

Metropolitan Washington Council of Governments
October 4, 2012
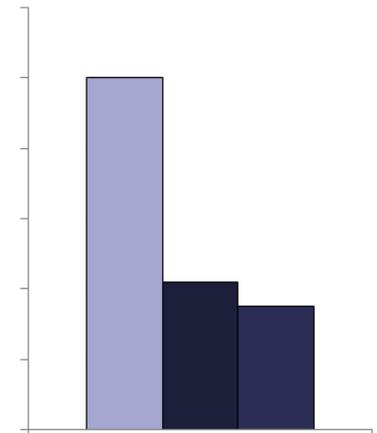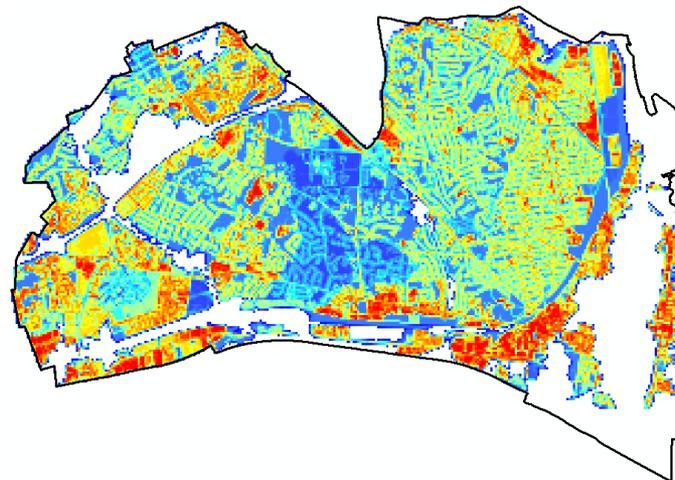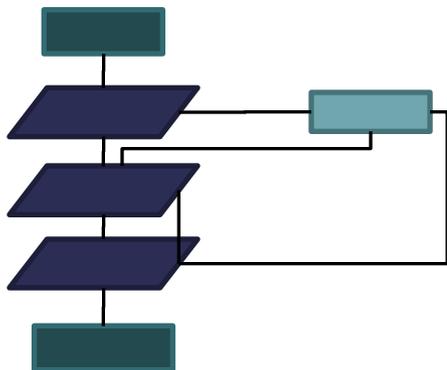
1. Build a GIS-based system to plan and track BMPs for the Chesapeake Bay TMDL.

2. Help MS4-permitted communities estimate the total cost of compliance.

3. Design for maximum flexibility.

ALERT Summary

GIS Component

- Establish regulated MS4 landuse.

- Calculate baseline loads.

- Capture expected redevelopment and Post-2009 BMPs.

- Identify and draw in "real" retrofit projects though a desktop exercise.

- Assign project timing and efficiencies.

- Calculate reductions.

Spreadsheet Component

- Establishes the "gap" between projects captured in GIS and the target loads to meet permit requirements.

- Allows the user to input BMP mixes to meet the remaining compliance gap.

- Automatically calculates initial capital and life cycle costs for BMPs based on user inputs.

ALERT Process Diagram

ALERT GIS Process

Landuse Data → Calculate Baseline Load → Define BMPs → Calculate Reduced Load
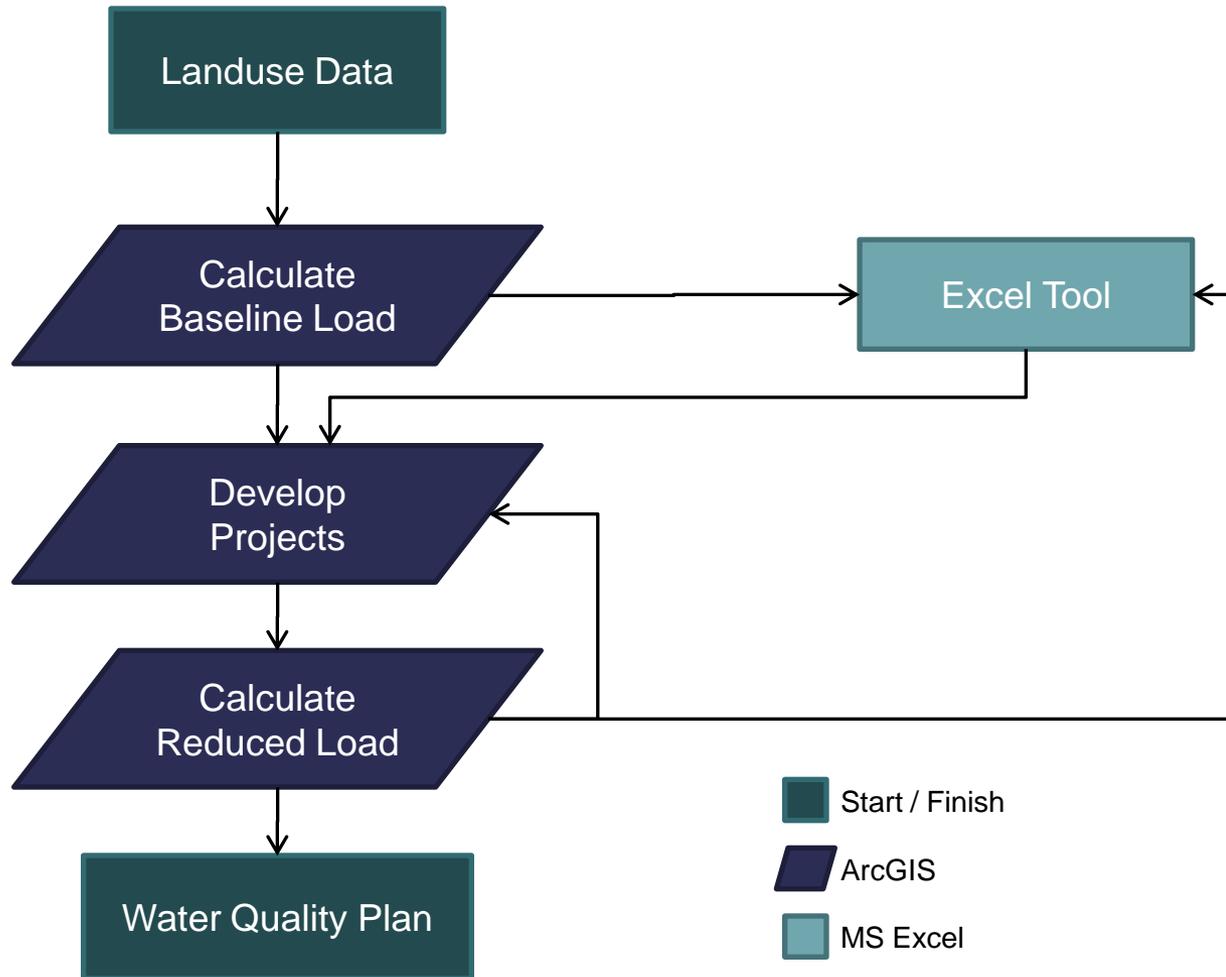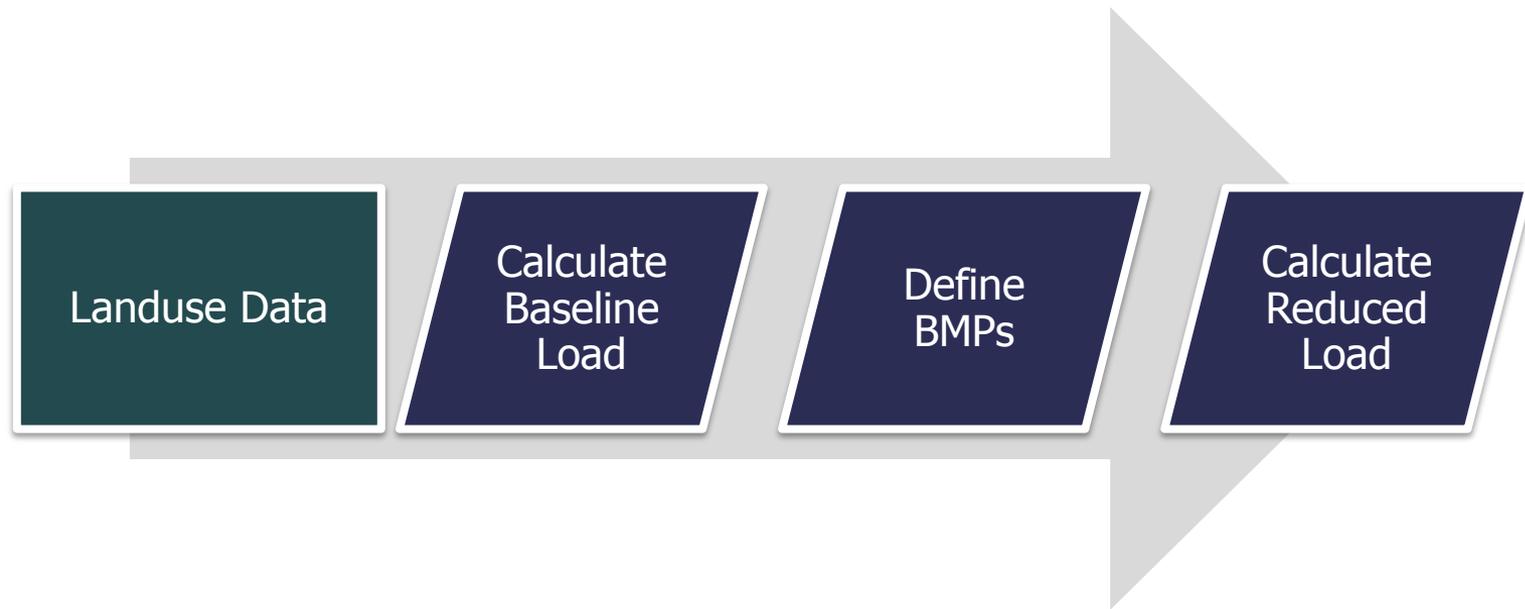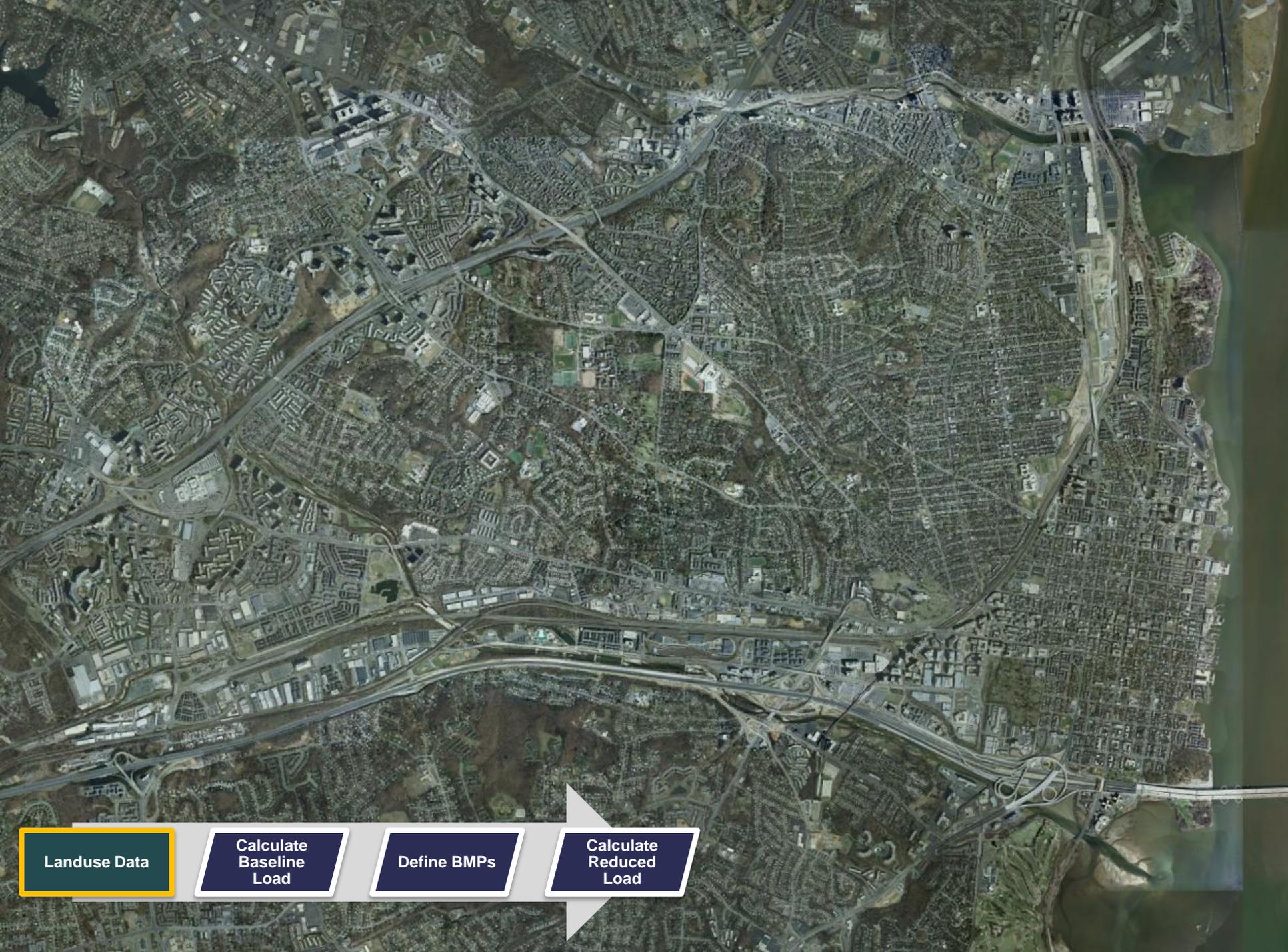
Landuse Data | Calculate Baseline Load | Define BMPs | Calculate Reduced Load

Landuse

Landuse Data → Calculate Baseline Load → Define BMPs → Calculate Reduced Load

MS4 Landuse

Landuse Data — Calculate Baseline Load — Define BMPs — Calculate Reduced Load
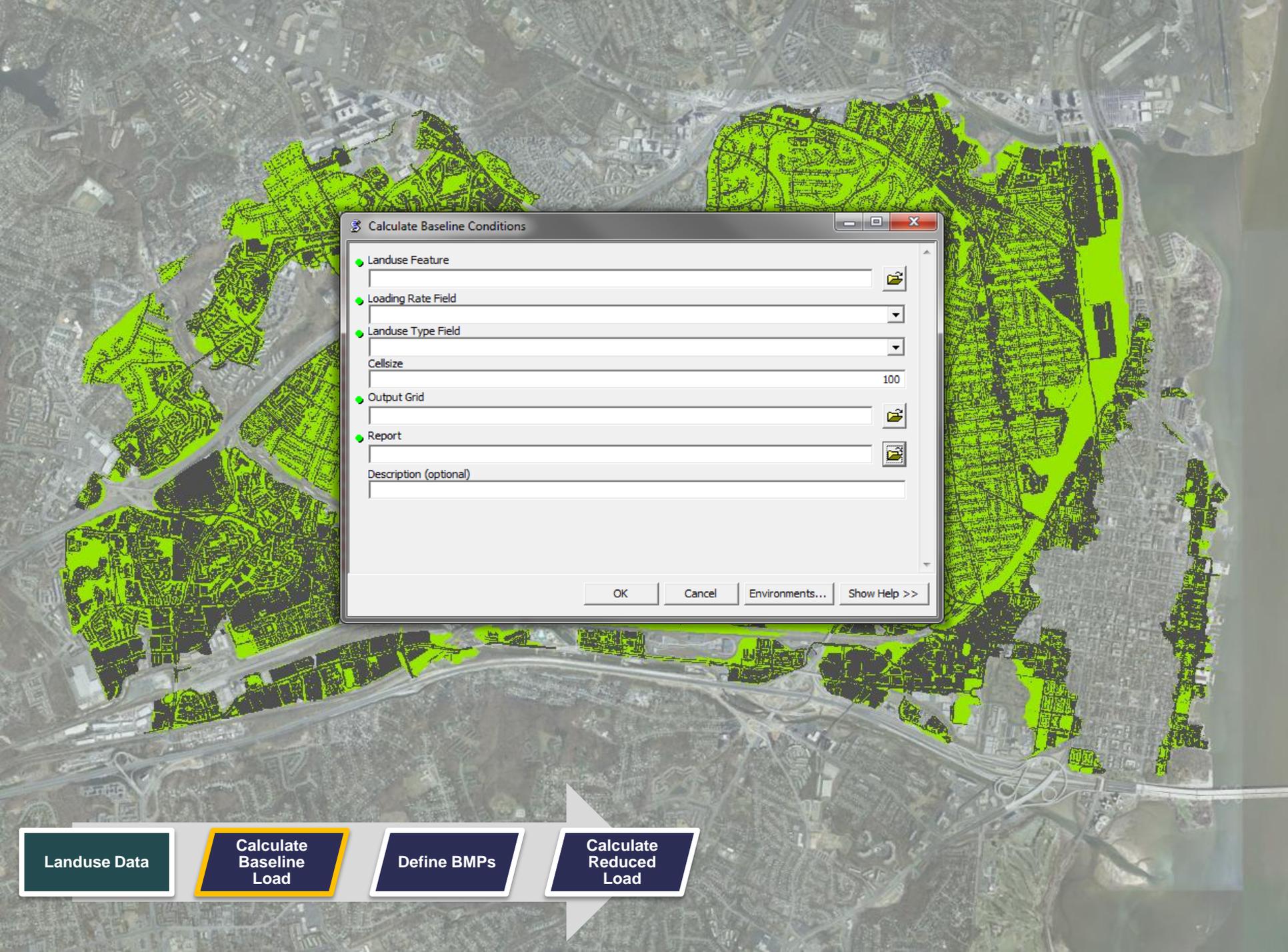
Calculate Baseline Conditions

Landuse Feature

Loading Rate Field

Landuse Type Field

Cellsize
100

Output Grid

Report

Description (optional)

OK   Cancel   Environments...   Show Help >>

Landuse Data   Calculate Baseline Load   Define BMPs   Calculate Reduced Load

Baseline Conditions
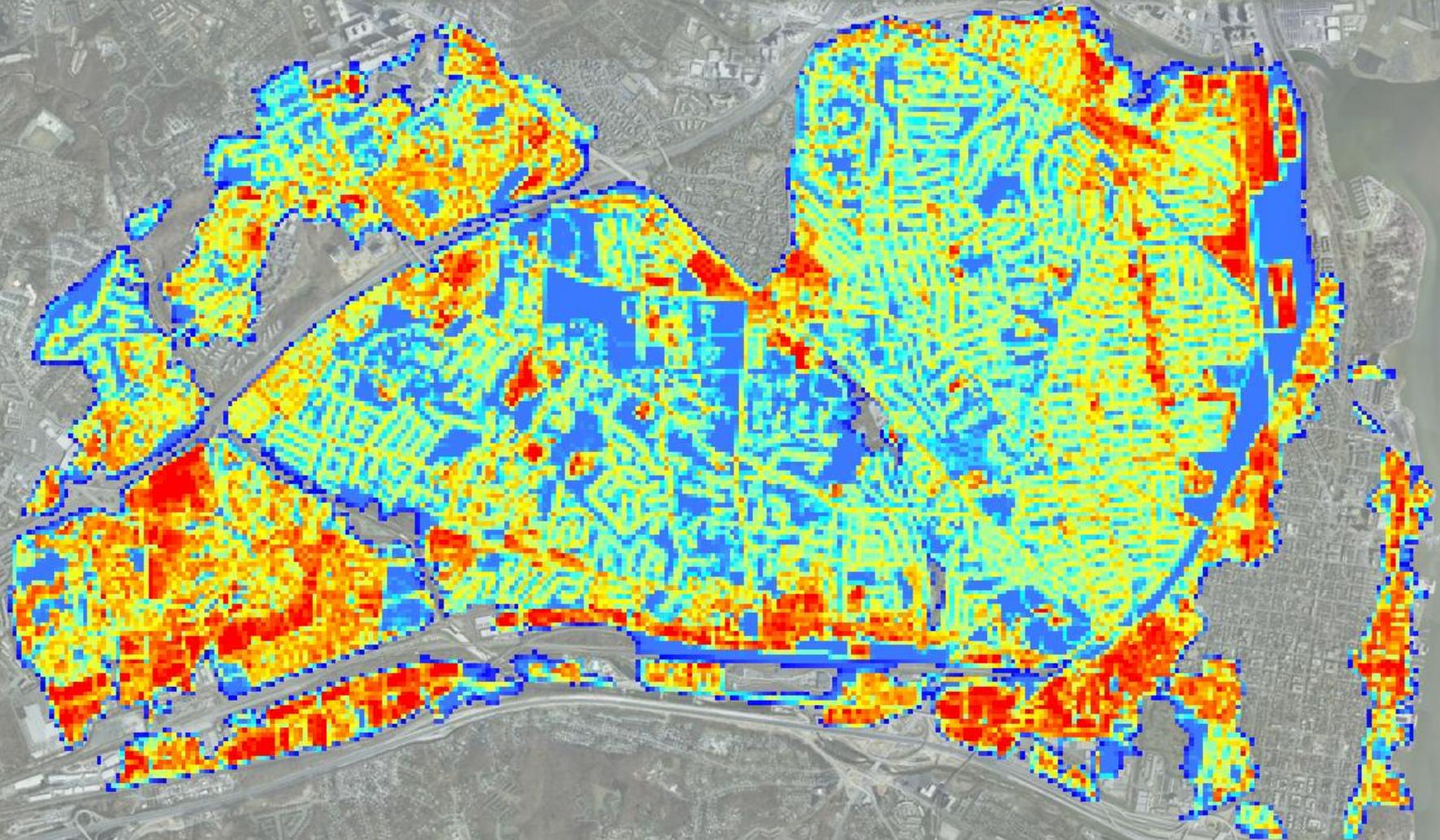
Landuse Data | Calculate Baseline Load | Define BMPs | Calculate Reduced Load

nbase.txt - Notepad

File   Edit   Format   View   Help

AMEC Water Quality Tools
Baseline Conditions Report
Tue Jan 03 12:49:23 2012
_____
DESCRIPTION
City of Alexandria; Nitrogen baseline.
_____
INPUTS
Landuse Feature C:\temp\Alexandria
\AlexMS4_LU_LRsegs_010312.shp
Loading Rate Field   N
Landuse Field   IMP
Cellsize   100
_____
OUTPUTS
Grid   C:\temp\Alexandria\Baseline\nbase
Report   C:\temp\Alexandria\Baseline\nbase.txt
_____
RESULTS
Baseline Load (lbs)   64096.9469768
Area (ac)   7530.20977527
Execution Time (s)   72.4219999313
_____
DETAILED RESULTS (tab-separated)

Landuse Load (lbs)   Area (ac)
Impervious_DC   2430.68180556   241.139068012
Impervious_VA   31968.1647007   3245.49895438
Pervious_DC   2444.16813022   274.00988007
Pervious_VA   27253.9323404   3769.5618728

Landuse Data   Calculate Baseline Load   Define BMPs   Calculate Reduced Load

Defining BMPs in ALERT

- After baseline and target loads for N, P, and S are determined, BMPs can be defined.

- Default BMP types are stored in a table populated by the user.

- To define a BMP, simply draw the treatment area and select a type.

- All BMP data is stored in an ESRI file geodatabase (.gdb)
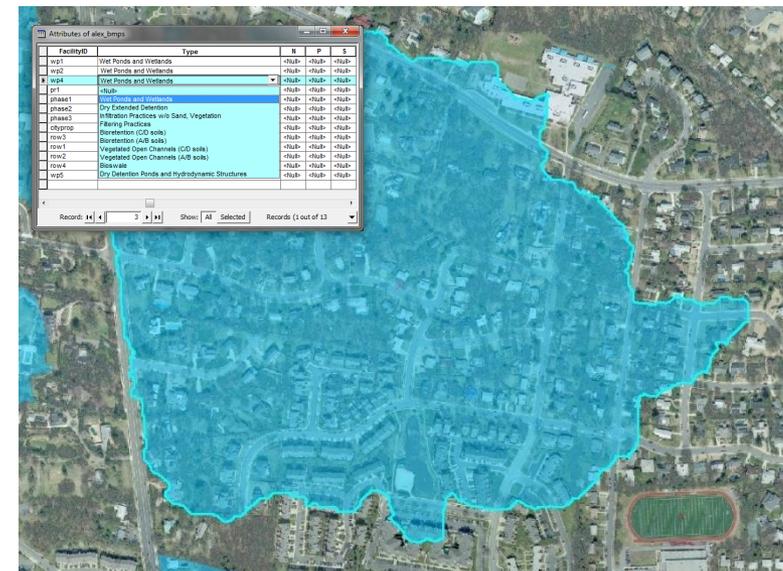
| Landuse Data | Calculate Baseline Load | Define BMPs | Calculate Reduced Load |

Attributes of alex_bmps

FacilityID	Type	N	P	S
wp1	Wet Ponds and Wetlands	<Null>	<Null>	<Null>
wp2	Wet Ponds and Wetlands	<Null>	<Null>	<Null>
wp4	Wet Ponds and Wetlands	<Null>	<Null>	<Null>
pr1	<Null>	<Null>	<Null>	<Null>
phase1	Wet Ponds and Wetlands	<Null>	<Null>	<Null>
phase2	Dry Extended Detention	<Null>	<Null>	<Null>
phase3	Infiltration Practices w/o Sand, Vegetation	<Null>	<Null>	<Null>
cityprop	Filtering Practices	<Null>	<Null>	<Null>
row3	Bioretention (C/D soils)	<Null>	<Null>	<Null>
row1	Bioretention (A/B soils)	<Null>	<Null>	<Null>
row2	Vegetated Open Channels (C/D soils)	<Null>	<Null>	<Null>
row4	Vegetated Open Channels (A/B soils)	<Null>	<Null>	<Null>
wp5	Bioswale	<Null>	<Null>	<Null>
	Dry Detention Ponds and Hydrodynamic Structures	<Null>	<Null>	<Null>

Record: 3   Show: All | Selected   Records (1 out of 13)
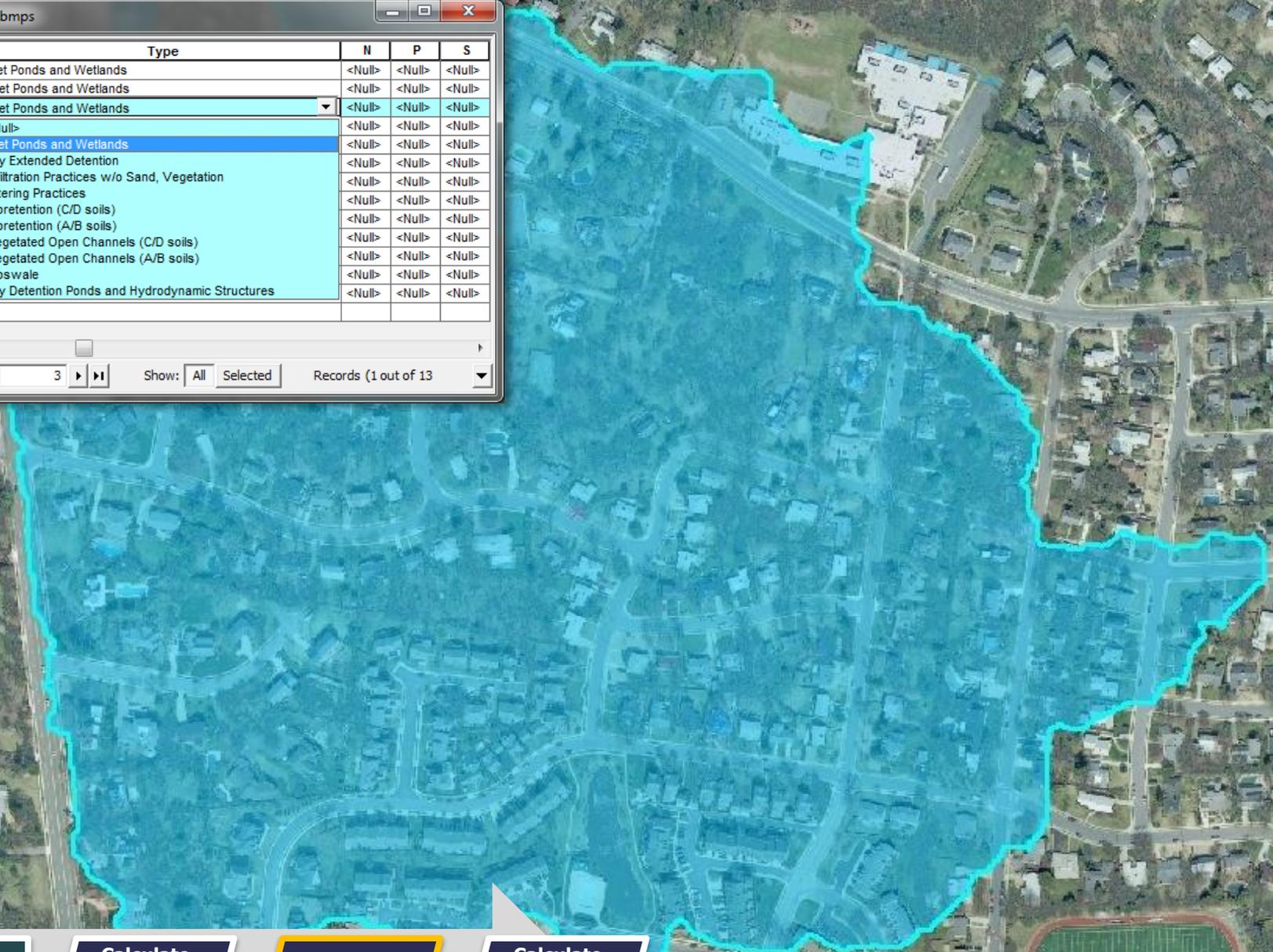
Landuse Data → **Calculate Baseline Load** → **Define BMPs** → **Calculate Reduced Load**

Calculating BMP Reductions

- **Treatment area polygons and BMP efficiencies are used to calculate reductions.**

- **Inputs**
  - Baseline conditions grid
  - BMP treatment area polygons
  - BMP types/efficiencies table

- **Outputs**
  - Grid with reduced conditions (cell values in lbs/yr)
  - Report (.txt file)
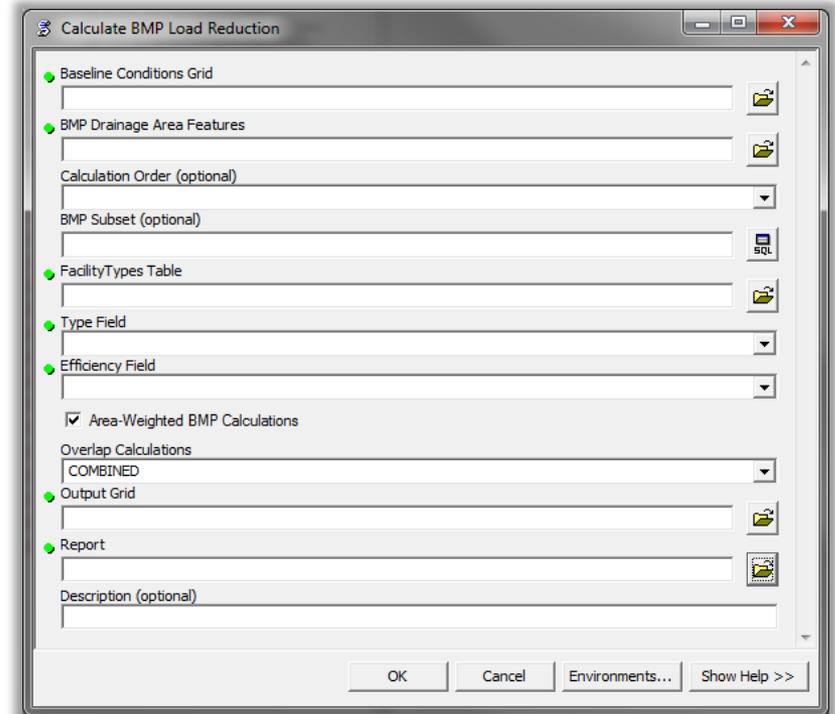
Landuse Data → Calculate Baseline Load → Define BMPs → **Calculate Reduced Load**

Calculating BMP Reductions (continued)

- Additional features:
  - Set custom efficiencies for specific BMPs.
  - Allow treatment trains OR use maximum efficiencies.
  - Evaluate subsets of BMPs using a SQL statement.
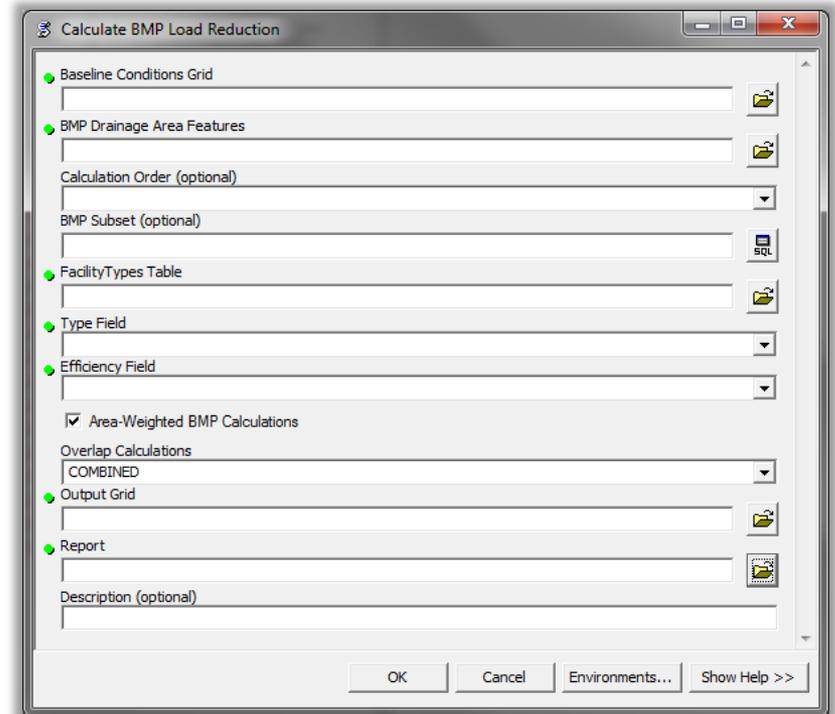
Landuse Data → **Calculate Baseline Load** → **Define BMPs** → **Calculate Reduced Load**

Baseline Conditions

Landuse Data | Calculate Baseline Load | Define BMPs | Calculate Reduced Load
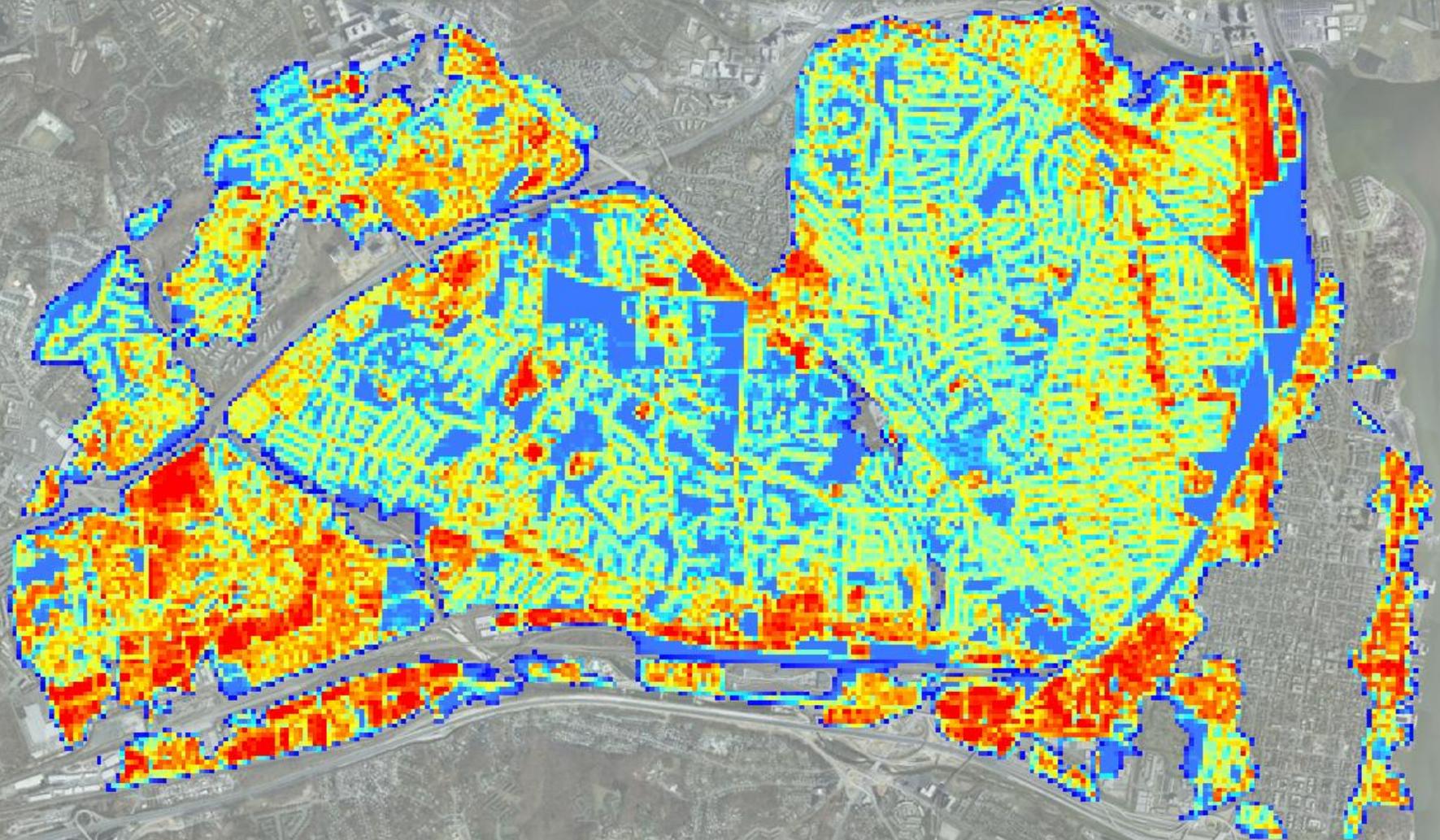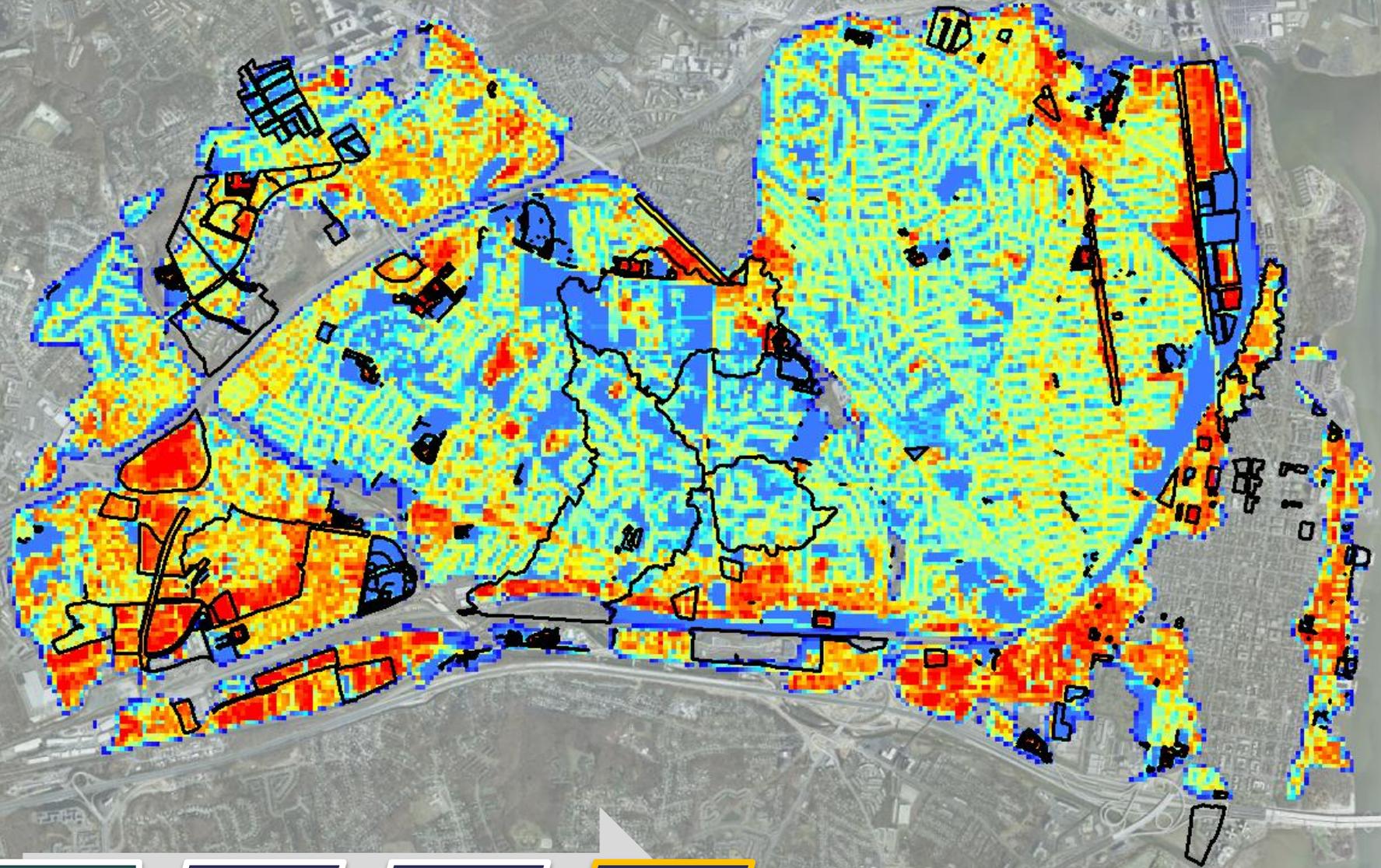
Landuse Data

Calculate Baseline Load

Define BMPs

Calculate Reduced Load

Reduced Conditions BMPs

Landuse Data — Calculate Baseline Load — Define BMPs — Calculate Reduced Load
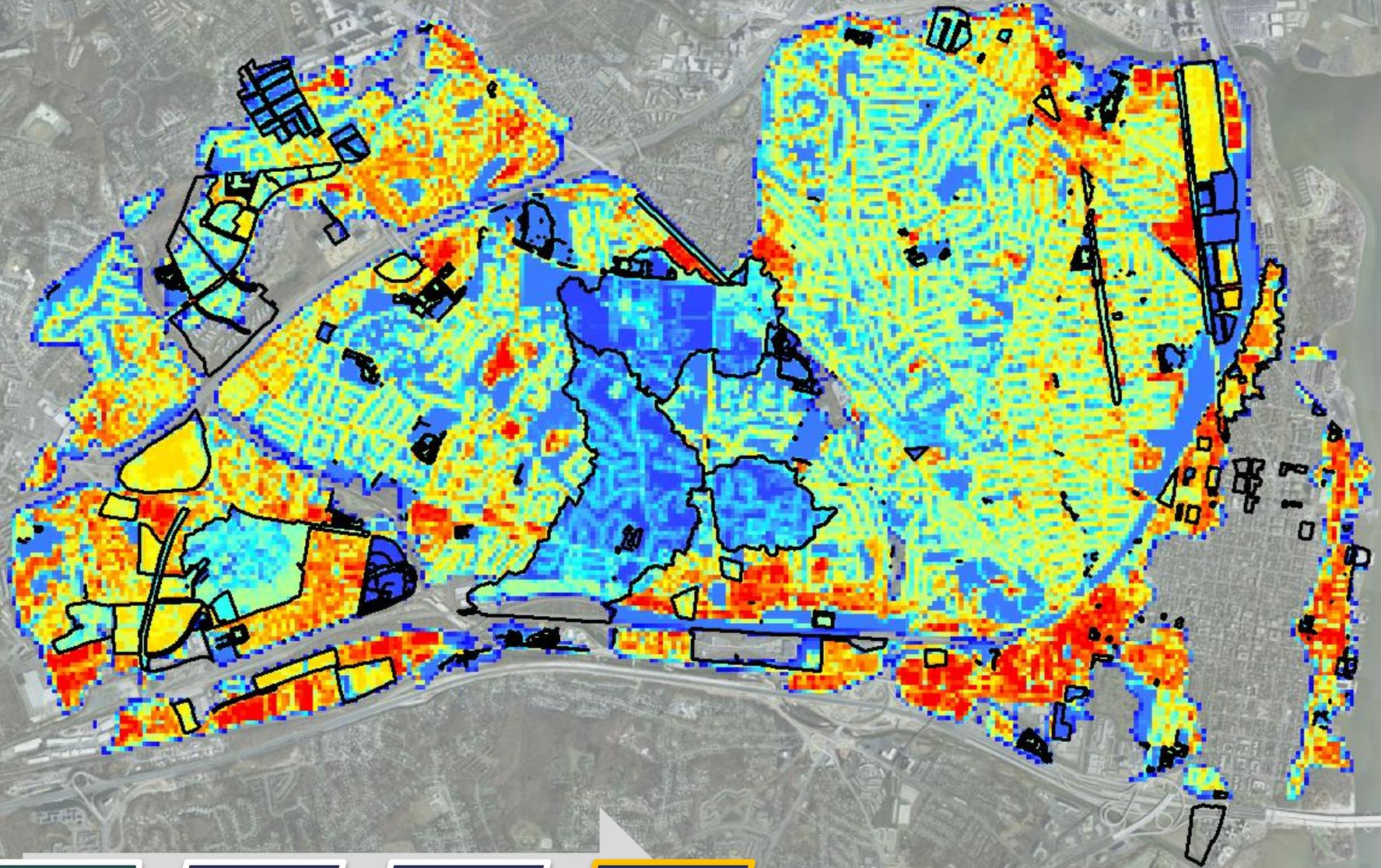
Reduced Conditions
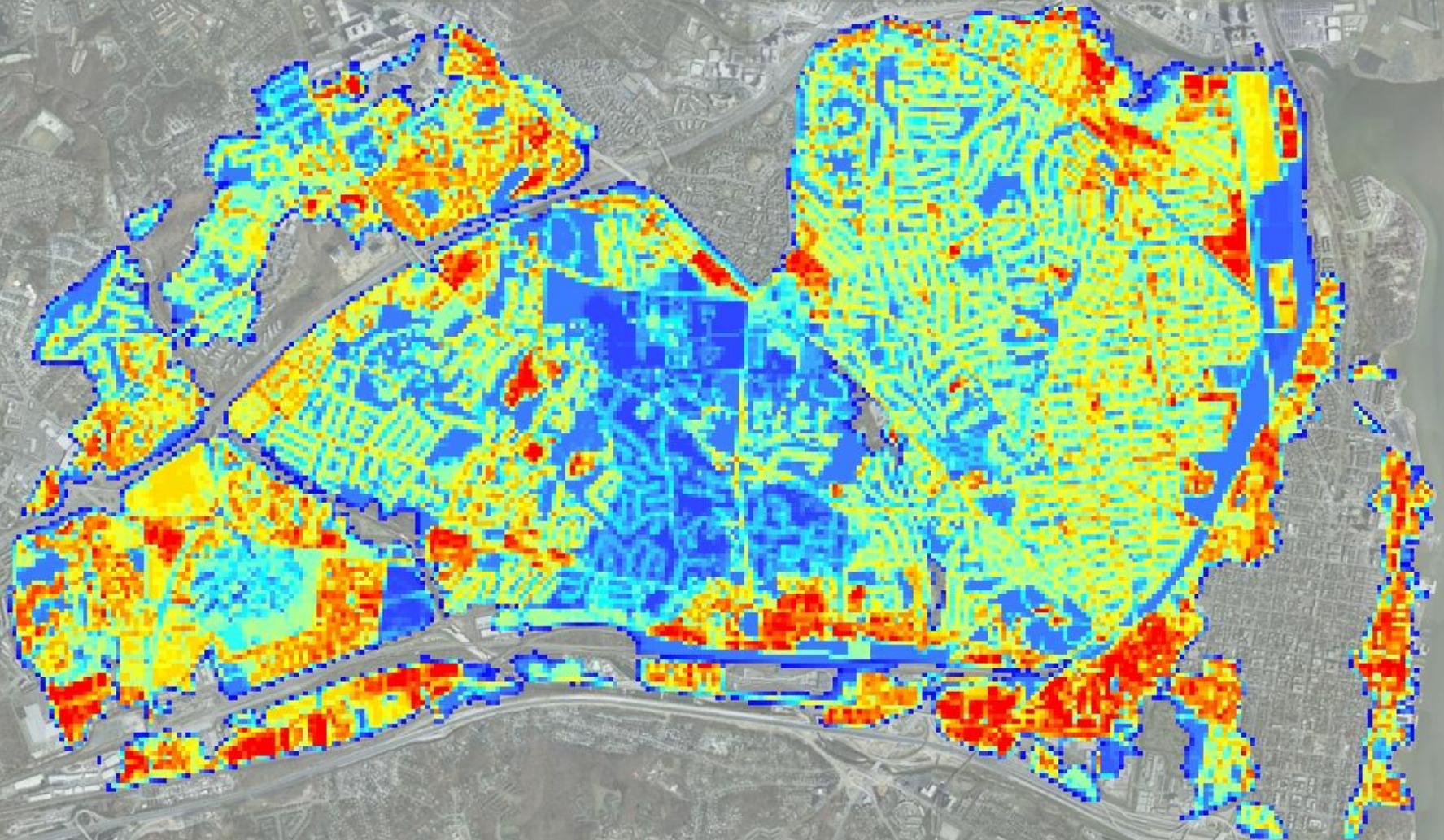
Landuse Data | Calculate Baseline Load | Define BMPs | Calculate Reduced Load

```
AMEC Water Quality Tools
BMP Load Reduction Report
Tue Jan 17 14:58:14 2012
_____
DESCRIPTION
City of Alexandria; Nitrogen, with planned BMPs
_____
INPUTS
Baseline Cond. Grid      \\Chy-gis2\Chantilly\Staff\williams_T\Alexandria
\Calculations\Baseline\nbase
BMP Feature Class        \\Chy-gis2\Chantilly\Staff\williams_T\Alexandria
\Calculations\Results_011712\AMECWQToolTemp5\sqlfacilities.shp
Calculation Order        Phase
BMP Subset
FacilityTypes Table      \\Chy-gis2\Chantilly\Staff\williams_T\Alexandria
\Calculations\BMPs\Alex_BMPs.gdb\CBPtypes
Facility Type Field      Type
Efficiency Field         N
Area-Weighted BMPs       true
Overlap Calcs   COMBINED
_____
OUTPUTS
Grid    \\Chy-gis2\Chantilly\Staff\williams_T\Alexandria\Calculations
\Results_011712\calc2_n
Report  \\Chy-gis2\Chantilly\Staff\williams_T\Alexandria\Calculations
\Results_011712\calc2_n.txt
_____
RESULTS
Baseline Load (lbs)      64096.9475849
Reduced Load (lbs)       61788.4637244
Reduction (lbs) 2308.4838605
Execution Time (s) = 732.776000023
_____
DETAILED RESULTS (tab-separated)
-----------------------------------------------
FacilityID      Reduction (lbs) Efficiency (%)  Efficiency Value
Area (ac)       Type    Overlaps        Phase
phase1  174.966596869   0.15    Default 144.388566149   Redevelopment
cityprop,phase2,phase3,pr1,row1,row2,row3,wp1,wp2       1
wp1     251.105423142   0.2     Default 155.877770298   Wet Ponds and
Wetlands        cityprop,phase1,phase2,phase3   1
phase2  416.881552962   0.15    Default 428.34417355    Redevelopment
cityprop,phase1,phase3,pr1,row1,row2,row4,wp1,wp5       2
```

Landuse Data | Calculate Baseline Load | Define BMPs | Calculate Reduced Load
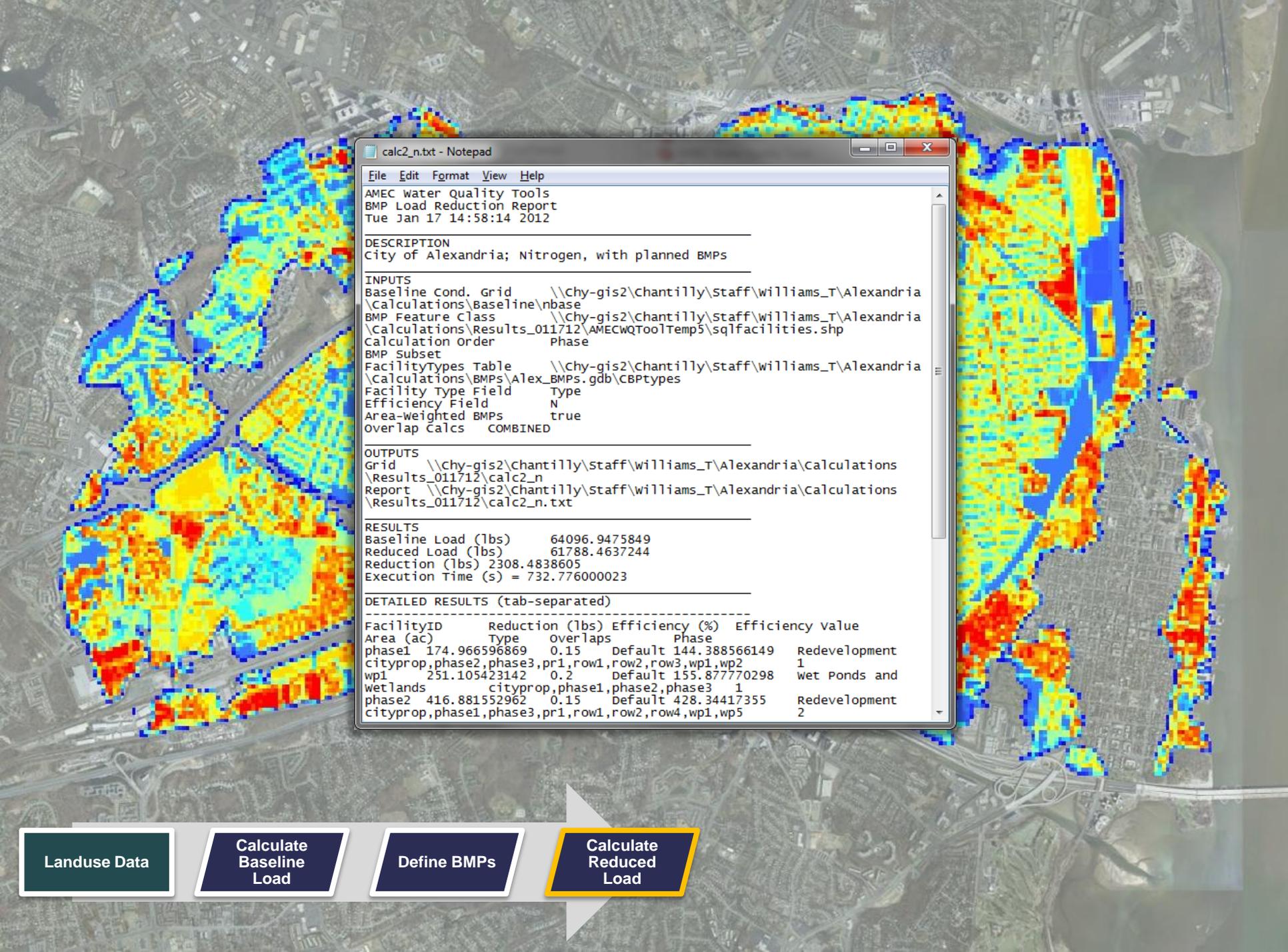
ALERT Spreadsheet
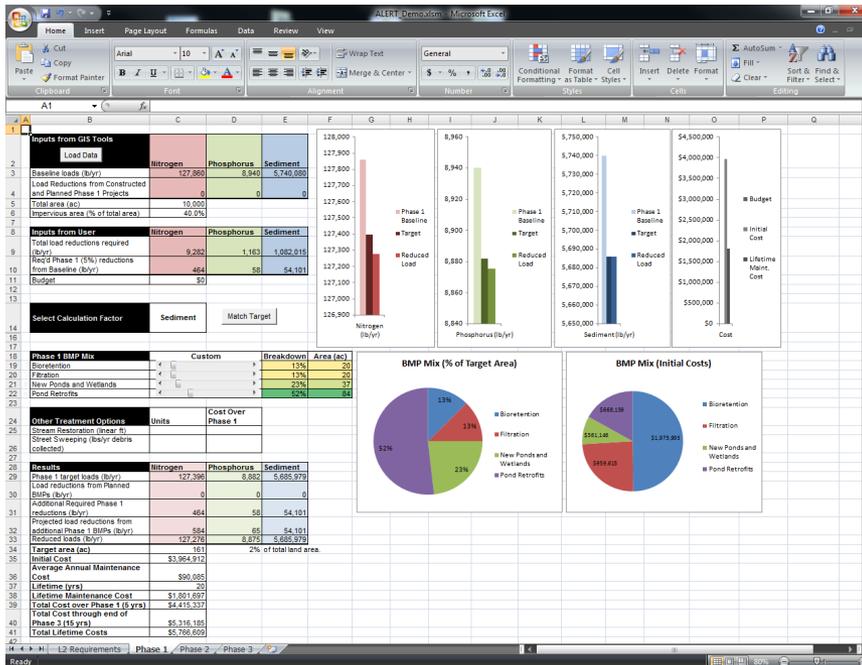
- Helps make high-level predictions about the level of effort needed to achieve compliance.

- Used to inform further planning exercises.

- Estimates the total treated acreage and cost to comply.

ALERT Spreadsheet

- Inputs
  - Baseline loads (lbs/yr)
  - Reductions from planned projects (lbs/yr)
  - Total regulated land area (acres)
  - Impervious fraction (%)
  - Total required reductions (lbs/yr)
- Other user-defined information
  - BMP mix
  - BMP unit costs ($ per impervious acre treated)
- Outputs
  - Total area of treatment required (acres)
  - Cost

- Three main tabs represent the three phases of compliance.
  - Phase I (5% compliance – 2017)
  - Phase II (40% compliance – 2023)
  - Phase III (100% compliance – 2028)

- Results from each phase feed into the next.

- "Match Target" button uses the Goal Seek function to "meet" targets.
  - Total acreage of treatment is automatically adjusted until the target is achieved.

- Many factors can be adjusted to fit the needs of a community.
  - BMP mix
  - BMP unit costs

Inputs from GIS Tools

Load Data

	Nitrogen	Phosphorus	Sediment
Baseline loads (lb/yr)	127,860	8,940	5,740,080
Load Reductions from Constructed and Planned Phase 1 Projects	0	0	0
Total area (ac)	10,000		
Impervious area (% of total area)	40.0%		

Inputs from User

	Nitrogen	Phosphorus	Sediment
Total load reductions required (lb/yr)	9,282	1,163	1,082,015
Req'd Phase 1 (5%) reductions from Baseline (lb/yr)	464	58	54,101
Budget	$0		

Select Calculation Factor — Sediment — Match Target

Phase 1 BMP Mix	Custom	Breakdown	Area (ac)
Bioretention		13%	20
Filtration		13%	20
New Ponds and Wetlands		23%	37
Pond Retrofits		52%	84

Other Treatment Options	Units	Cost Over Phase 1
Stream Restoration (linear ft)		
Street Sweeping (lbs/yr debris collected)		

Results	Nitrogen	Phosphorus	Sediment
Phase 1 target loads (lb/yr)	127,396	8,882	5,685,979
Load reductions from Planned BMPs (lb/yr)	0	0	0
Additional Required Phase 1 reductions (lb/yr)	464	58	54,101
Projected load reductions from additional Phase 1 BMPs (lb/yr)	584	65	54,101
Reduced loads (lb/yr)	127,276	8,875	5,685,979
Target area (ac)	161	2% of total land area.	
Initial Cost	$3,964,912		
Average Annual Maintenance Cost	$90,085		
Lifetime (yrs)	20		
Lifetime Maintenance Cost	$1,801,697		
Total Cost over Phase 1 (5 yrs)	$4,415,337		
Total Cost through end of Phase 3 (15 yrs)	$5,316,185		
Total Lifetime Costs	$5,766,609		
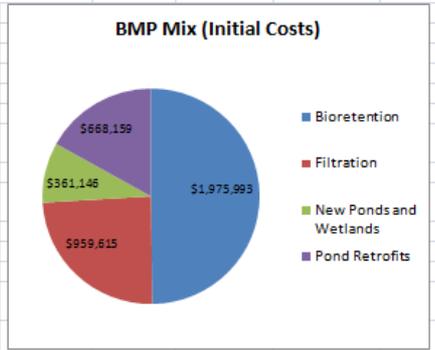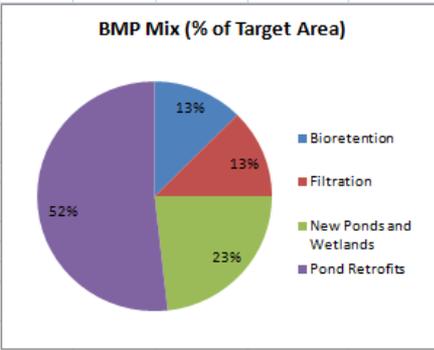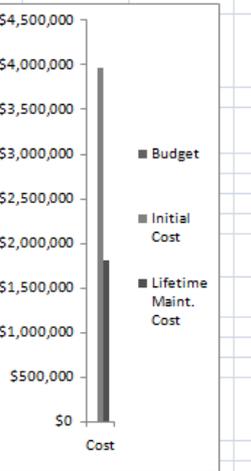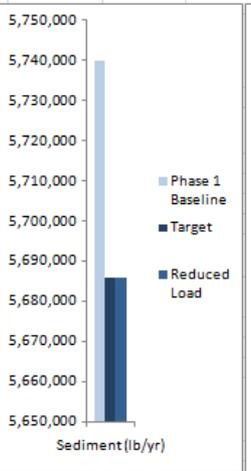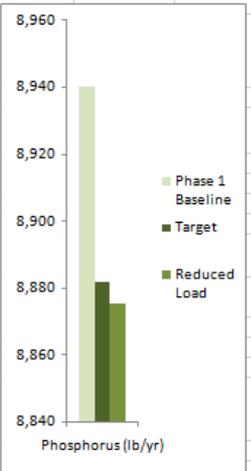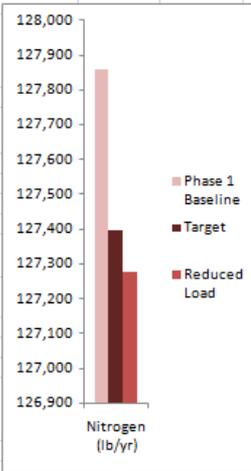
BMP Mix (% of Target Area)

BMP Mix (Initial Costs)

ALERT Spreadsheet

Phase I BMPs	%
Bioretention	10%
Filtration	10%
New Ponds	30%
Pond Retrofits	50%

Calculation Factor	Phosphorus

Phase 1 Results	
Target Area	145 ac.
Initial Cost	$3.5 m
Ann. Maint.	$81,000
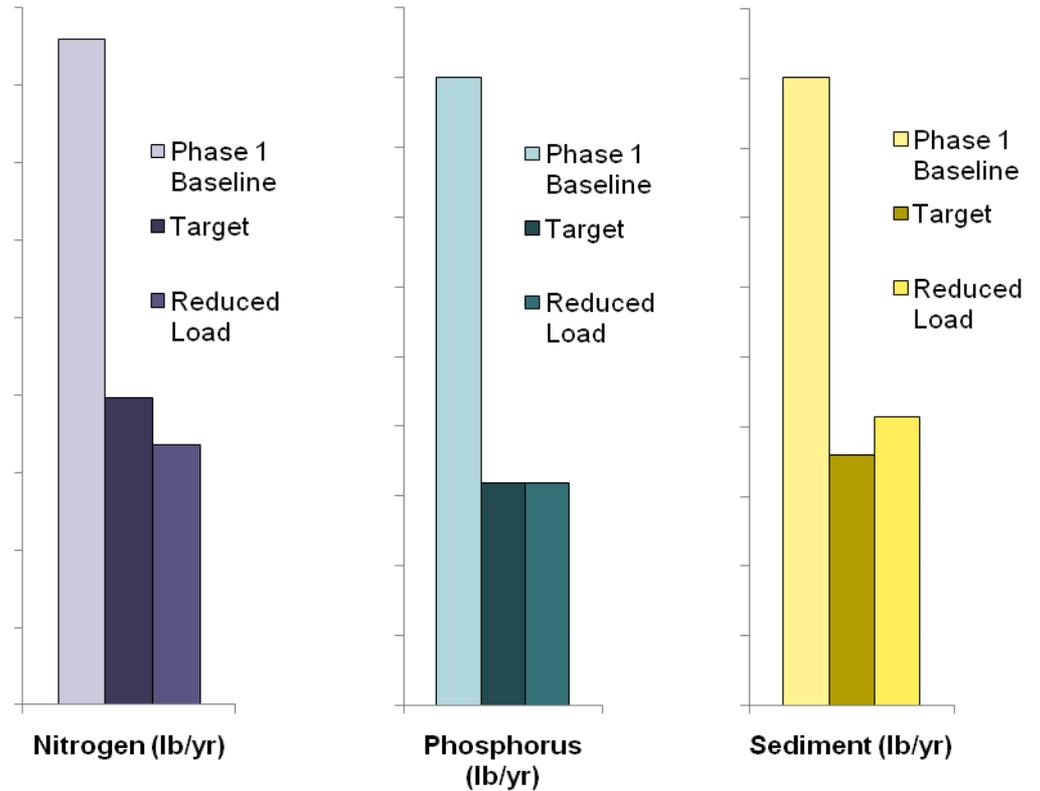
Phosphorus and nitrogen targets are met, but sediment lags behind. Recalculate.

ALERT Spreadsheet

Phase I BMPs	%
Bioretention	10%
Filtration	10%
New Ponds	30%
Pond Retrofits	50%

Calculation Factor	Sediment

Phase 1 Results	
Target Area	161 ac.
Initial Cost	$4.0 m
Ann. Maint.	$90,000
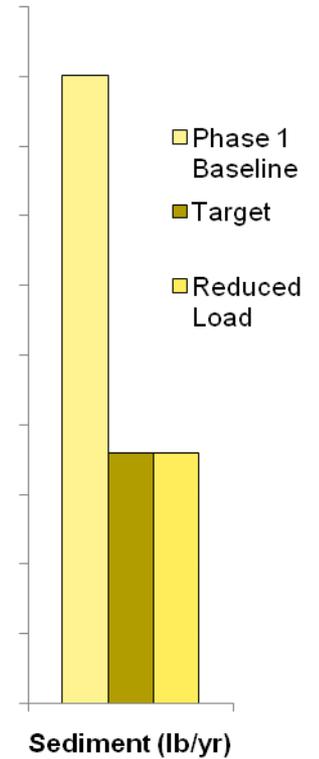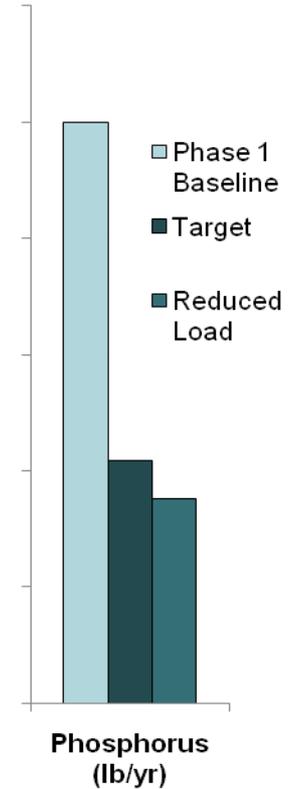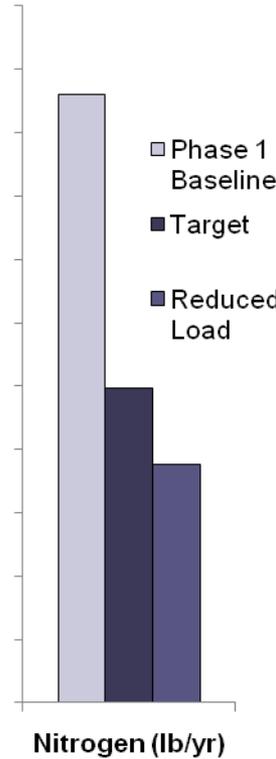
All Phase I targets achieved.

1. **Use GIS.**
   Regardless of the tools used to plan and track BMPs, the ability to integrate a spatial aspect is important to verify that your plans are realistic.

2. **Plan for Efficiency.**
   In a resource constrained environment, the ability to run and assess multiple retrofit scenarios to test for cost-efficiency will be important.

3. **Build in Flexibility.**
   State and federal expectations continue to change. The platform should allow for changes in technical assumptions as well as changing community expectations and targets.

Questions?

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