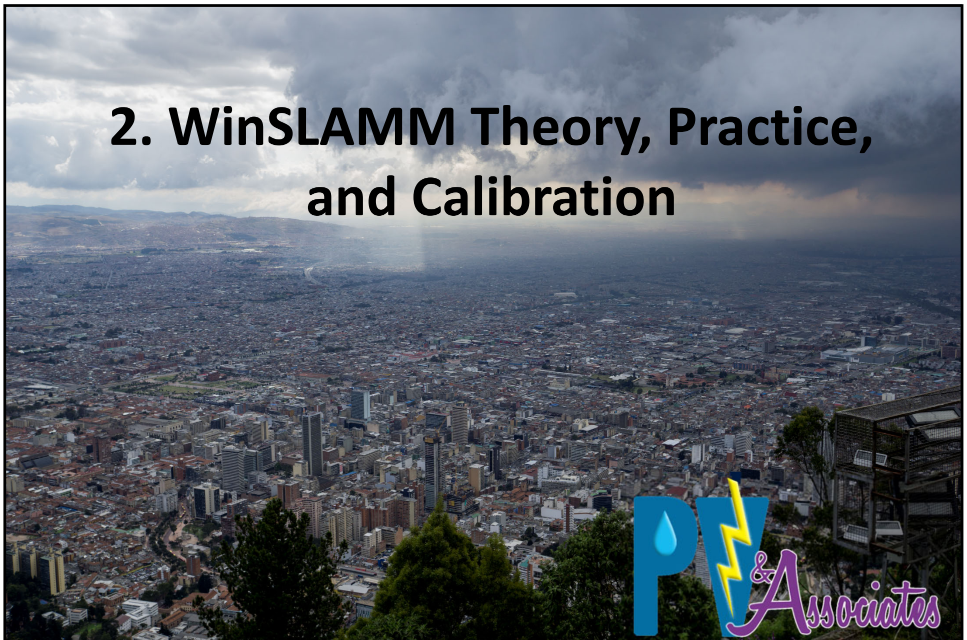
2. WinSLAMM Theory, Practice, and Calibration



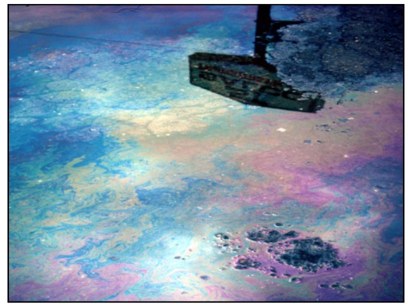
Bogota getting washed… Universidad de los Andes completed stormwater planning and demonstrations using WinSLAMM 1

WinSLAMM – What is it?

- Source Loading And Management Model for Windows
- Calculates Urban Stormwater Pollutant Loads and Quantifies their Reductions through the application of Stormwater Control Practices
- Applicable to:
  - Specific Control Practice Design
  - Site Development Analysis
  - Drainage Basin/MS4 Planning and Design
  - TMDL Reduction Determination

We will cover . . .

- WinSLAMM Purpose, History and Unique Features
- Model Applications
- Small Storm Hydrology
- Basic Program Structure and Operation
- Model Calibration
- Treatment Practices
- Model Input/Output



3

WinSLAMM Can Answer These Types of Policy Questions . . .

- What are the base level pollutant loadings for different land uses with no controls?
- What flow and pollutant levels result from different development scenarios?
- What are the critical sources of flows and pollutants?
- How effective and cost effective are treatment practices in controlling pollutants and reducing flows?
- What combinations of stormwater controls will best meet regulatory requirements?

4

Background & History

- **Development Began in mid-1970's**
  - Early EPA street cleaning and receiving water projects (San Jose and Coyote Creek, CA)
  - Castro Valley (CA), Bellevue (WA), Milwaukee (WI) and other NURP projects
- **Mid-1980's - Model used in Agency Programs:**
  - Ottawa bacteria stormwater management program
  - Toronto Area Watershed Management Strategy
  - Wis. Dept. of Natural Resources: Priority Watershed Program
- **Intensive data collection started in WI in early 1990s.**
- **First Windows version developed in 1995.**
- **Current graphical interface released, after three years of work, in 2012.**
- **Continuously being updated based on user needs and new research results.**

5

Unique Features of WinSLAMM and Why it was Developed

- WinSLAMM based on actual monitoring results at many scales and conditions.
- Early research project monitoring results in the 1970s did not conform to typical stormwater assumptions about rainfall-runoff relationships and sources of pollutants.
- Initial versions of the model therefore focused on site hydrology and particulate sources and transport, and on public works practices.
- Other control practices added as data becomes available.

6

We will cover . . .

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7

Model Applications

Model Can Be Applied on Multiple Scales –

- Large Scale, MS4/TS4 Analysis
- Site Development Analysis (Apartment Complex, Shopping Center, Hospital Complex, Residential Development, Highway Interchange)
- Analysis of Single Practice

Model Applications

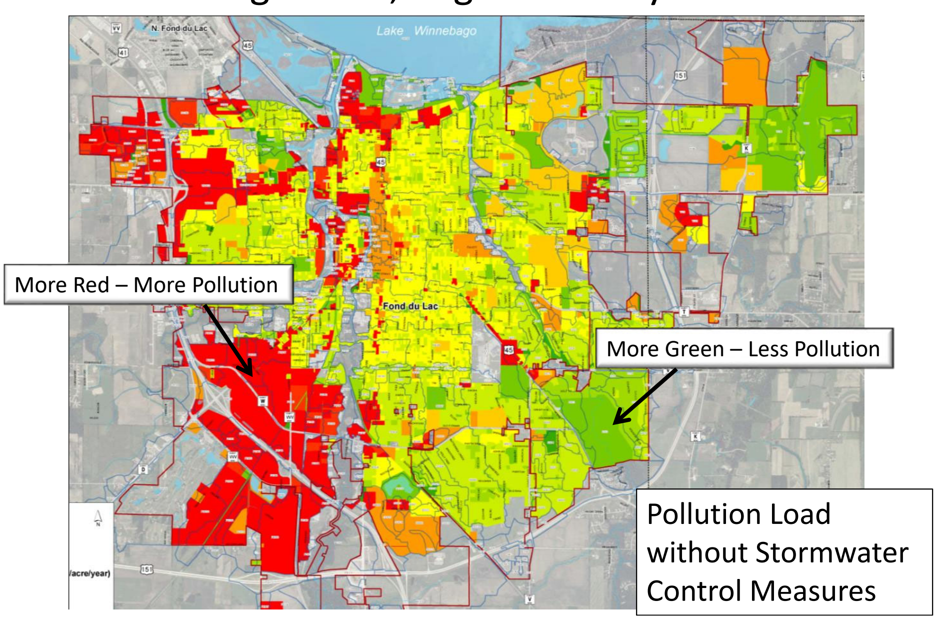
Large Scale, City-wide Analysis

Analysis Procedure -

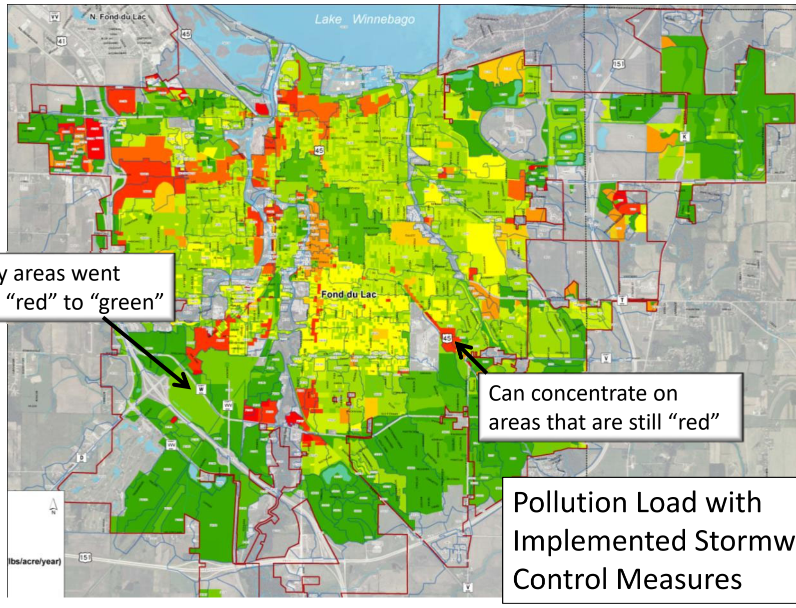
- Inventory drainage basins and land uses
- Evaluate existing pollutant loads and runoff volumes (base condition).
- Adjust base condition with existing stormwater control practices.
- Evaluate additional practices to cost-effectively achieve pollutant reduction goals.

Model Applications

Large Scale, Regional Analysis



Model Applications
Large Scale, Regional Analysis



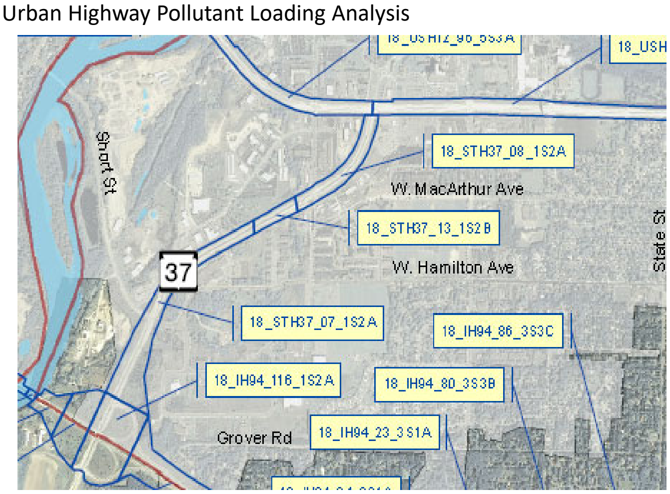
Many areas went from "red" to "green"

Can concentrate on areas that are still "red"

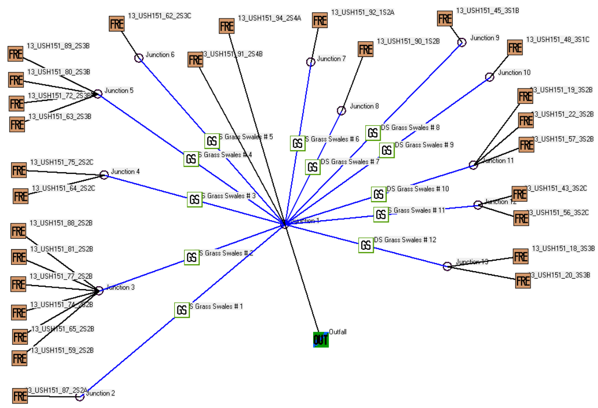
Pollution Load with Implemented Stormwater Control Measures

Large Scale/TS4 (transportation) Stormwater Planning

Statewide Urban Highway Pollutant Loading Analysis



Large Scale/TS4 Stormwater Planning



Outfall Output Summary

	Runoff Volume (cu. ft.)	Percent Runoff Reduction	Runoff Coefficient (Rv)	Particulate Solids Conc. (mg/L)	Particulate Solids Yield (lbs)	Percent Particulate Solids Reduction
Total of All Land Uses without Controls	803607		0.20	221.8	11128	
Outfall Total with Controls	136773	82.98 %	0.03	191.5	1635	85.31 %
Current File Output: Annualized Total After Outfall Controls	138673	Years in Model Run:	0.99		1658	

Pollutant	Concen-tration - No Controls	Concen-tration - With Controls	Concen-tration Units	Pollutant Yield - No Controls	Pollutant Yield - With Controls	Pollutant Yield Units	Percent Yield Reduction
Particulate Solids	221.8	191.5	mg/L	11128	1635	lbs	85.31 %
Particulate Phosphorus	0.9233	0.8337	mg/L	46.32	7.118	lbs	84.63 %
Filterable Phosphorus	0.5422	0.5715	mg/L	27.20	4.880	lbs	82.06 %

Model Applications

Site Development Analysis

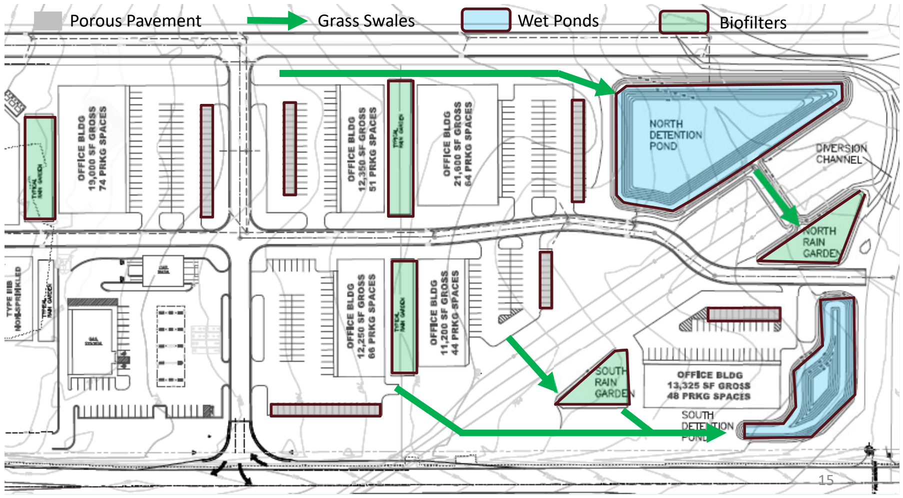
Analysis Procedure -

- Inventory site characteristics (soil type, percent imperviousness, etc.)
- Locate selected stormwater controls throughout the site
- Determine volume and pollutant reduction achieved with selected stormwater control practices.

Enter all the practices for a site and link them to determine the overall runoff and pollutant reductions

Model Applications

Site Development Analysis



Model Applications

Single Practice Analysis

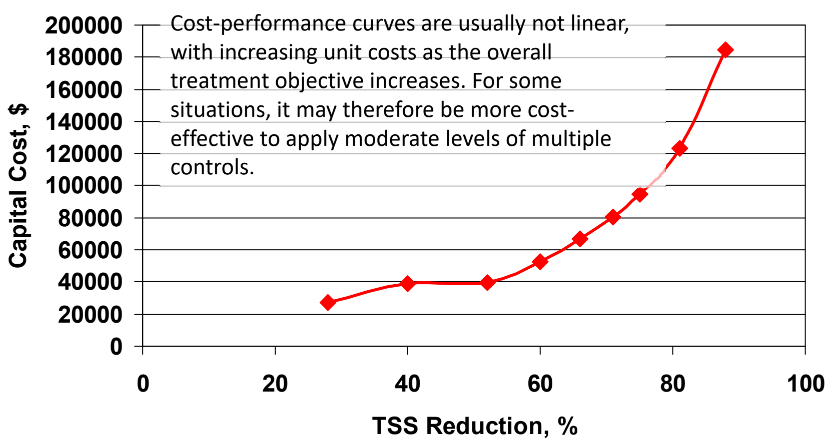
Wet Detention Pond – Analyze the performance of a specific pond for a specific site

Volume and Pollutant Reduction for Biofilters – bioretention, rain gardens, infiltration basins

Model Applications

Cost Analyses

Capital Cost of Pond Achieving Different TSS Reductions at 100 Acre Mix of 40% Shopping Center and 60% Medium Residential



WinSLAMM can also calculate life-cycle costs that include land costs, capital costs, and operational and maintenance costs, all adjusted for financing costs and inflation factors, and expected life of project.

We will cover . . .

- WinSLAMM Purpose, History and Unique Features
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18

Small Storm Hydrology – Runoff Volume

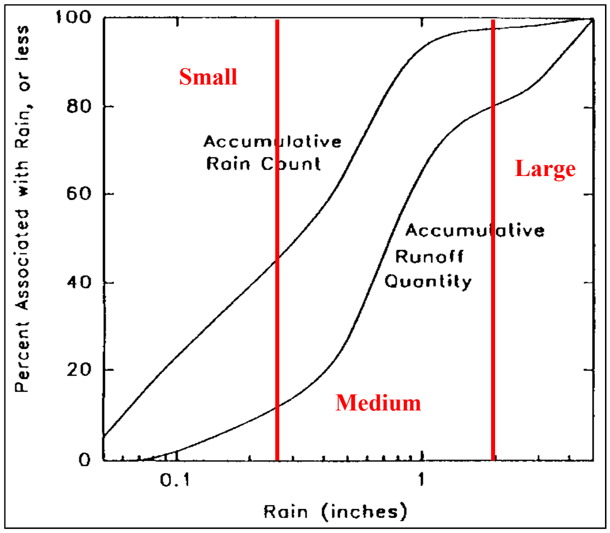
Most of the pollutants in stormwater runoff come from small and moderate size storms . . .

. . .in contrast to design storms, because the smaller storms are much more frequent and account for the majority of runoff water and pollutants

Knowing the Runoff Volume is the Key to Estimating Pollutant Mass

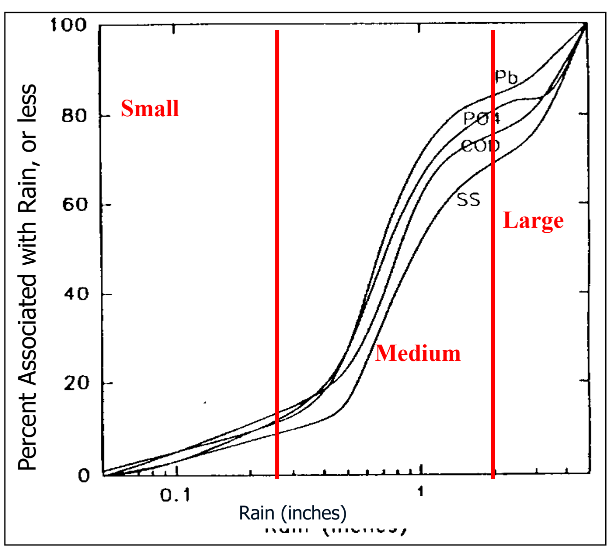
- There is usually a simple relationship between rain depth and runoff depth in urban systems.
- Changes in rain depth affects the relative contributions of runoff and pollutant mass discharges:
  - Directly connected impervious areas contribute most of the flows during relatively small rains
  - Disturbed urban soils may dominate during larger rains

Monitored Milwaukee Rainfall and Runoff Distributions



21

Monitored Milwaukee Pollutant Distribution



22

Rainfall Sorts into Three Distinct Categories

- Small Rains – Accounts for most events, by number
  - Typically can be easily captured for infiltration or on-site beneficial uses
  - Relatively low pollutant loadings, but frequent discharges
  - Key rains associated with water quality violations, e.g. bacteria and total recoverable heavy metals
  - "Every" time it rains, some numeric discharge concentration objectives may be exceeded. Therefore, try to eliminate the small events

23

Rainfall Sorts into Three Distinct Categories

- Medium Rains – Responsible for most pollutant mass discharges
  - Smaller events in this category can be easily captured and infiltrated or re-used
  - Larger events in this category need to be treated.
  - Typically responsible for about 75% of pollutant discharges

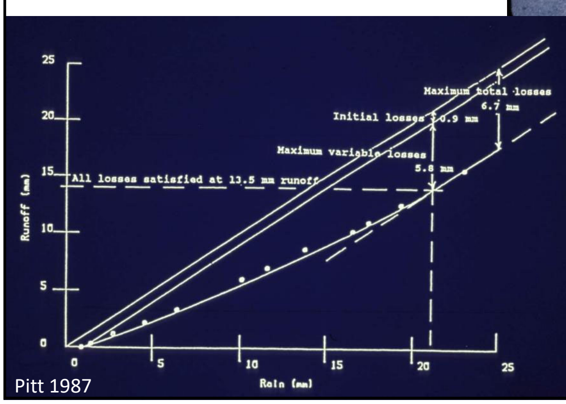
24

Rainfall Sorts into Three Distinct Categories

- Large Rains – Infrequent Large Events
  - Not cost effective to treat all runoff
  - Typically cause flooding and significant erosion
  - Treatment practices designed for smaller storms will mitigate impacts of larger events to some extent

25

Controlled tests in small areas were used in conjunction with long-term rainfall/runoff monitoring at larger parking lot areas to develop actual hydrological relationships for paved areas, the most significant source of runoff for most urban areas during small to intermediate-sized rains.



This is an example of a rainfall-runoff plot from one of many controlled street washoff and runoff tests. About 1/3 of the rainfall is infiltrated through the street pavement for many of these events (up to 20 mm rains in this plot). No further infiltration was observed for larger events, resulting in classical pavement Rv values of 0.8 to 0.95 for large rains of interest for drainage design.

Tree Interception of Rainfall over Directly Connected Paved Areas

Mature Trees Over Paved Parking Areas for Significant Interception

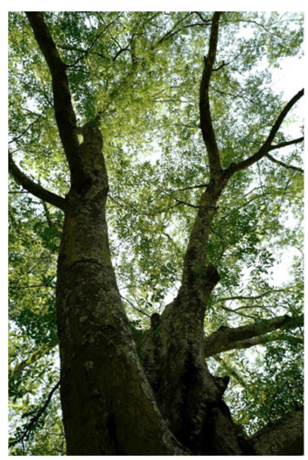

Newly Planted Trees will Require Many Years before Significant Interception


Photos from misc. Internet sources

27

Several years of monitoring of rainfall interception under large and small urban trees with data incorporated into WinSLAMM

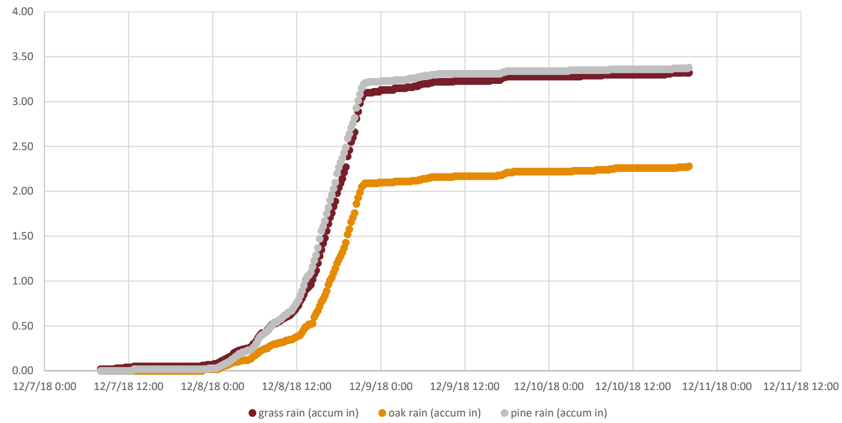
Rain gage under deciduous Water Oak:

28

Cumulative rain plots (3.32 inches, December 7 to 11, 2018)

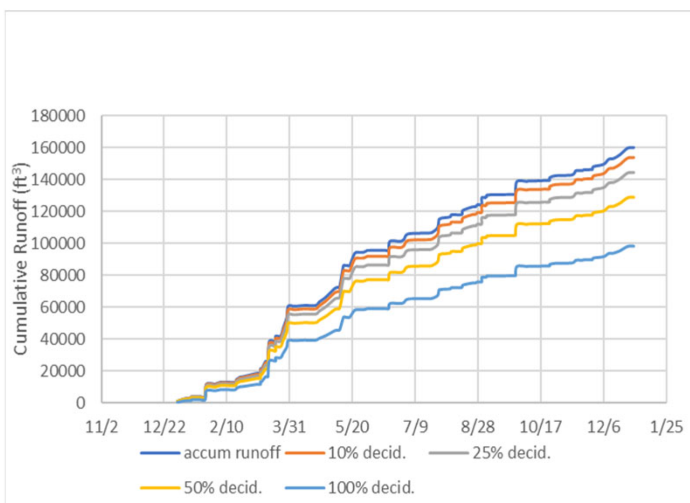
The following plot is the cumulative rainfall at the background location (surrounded by grass) vs. the cumulative throughfall measured under the large pine and oak trees:



It is obvious that the throughfall under the pines were little different compared to the background rainfall, while the oak had substantial throughfall reductions.

29

WinSLAMM calculated throughfall production functions for varying amounts of large deciduous tree cover over directly connected paved parking area.



Maximum 100% deciduous tree cover resulted in about 40% runoff reduction from the paved area

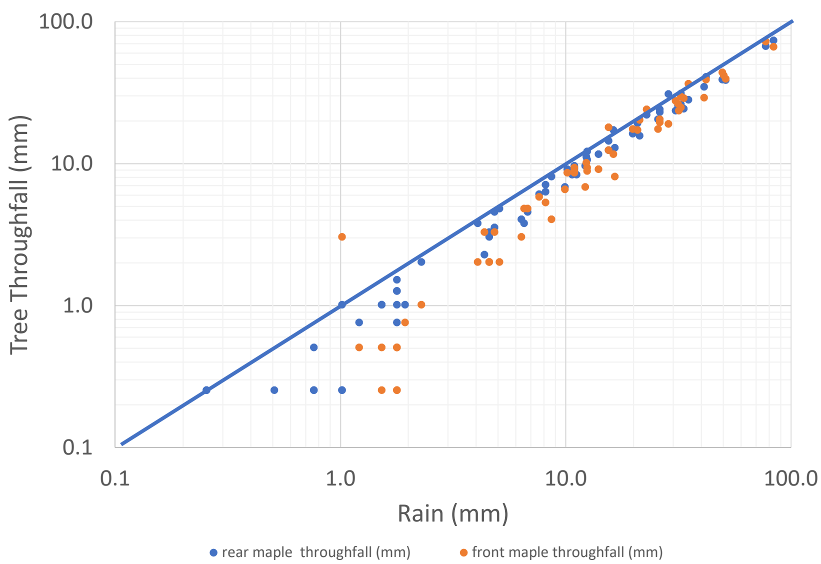
30

Tree Canopies of Smaller Japanese Maples for Different Seasons

Spring (March) canopies | Summer (July) canopies | Fall (October) canopies | Winter (December) canopies

31

Scatterplot of Tree Throughfall vs. Rain Depths for Japanese Maples



32

Tree Interception Conclusions

- Urban trees add substantially to the standard of living of residents and are highly desirable.
- Urban trees have been recommended as a solution for urban drainage and flooding problems.
- Few data are available quantifying these benefits under actual field conditions, especially under a wide range of rain conditions for different tree species and seasons.
- Literature describing urban tree interception at many international locations indicate that canopy interception benefits are limited.
- During the measurements described above, tree specie type and rainfall had the greatest effect on throughfall; the large deciduous tree (even with few leaves during winter conditions) intercepted much more rainfall than the large conifer tree, likely due to the massive branch structure.
- Small and/or immature trees have much smaller interception benefits.

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Basic Program Structure

WinSLAMM Calculation Process

Calculate Runoff Volumes and Particulate Loadings for each Source Area

↓

Apply Appropriate Source Area Treatment Practices

↓

Sum Resulting Source Area Outputs

↓

Route Totals to the Drainage System

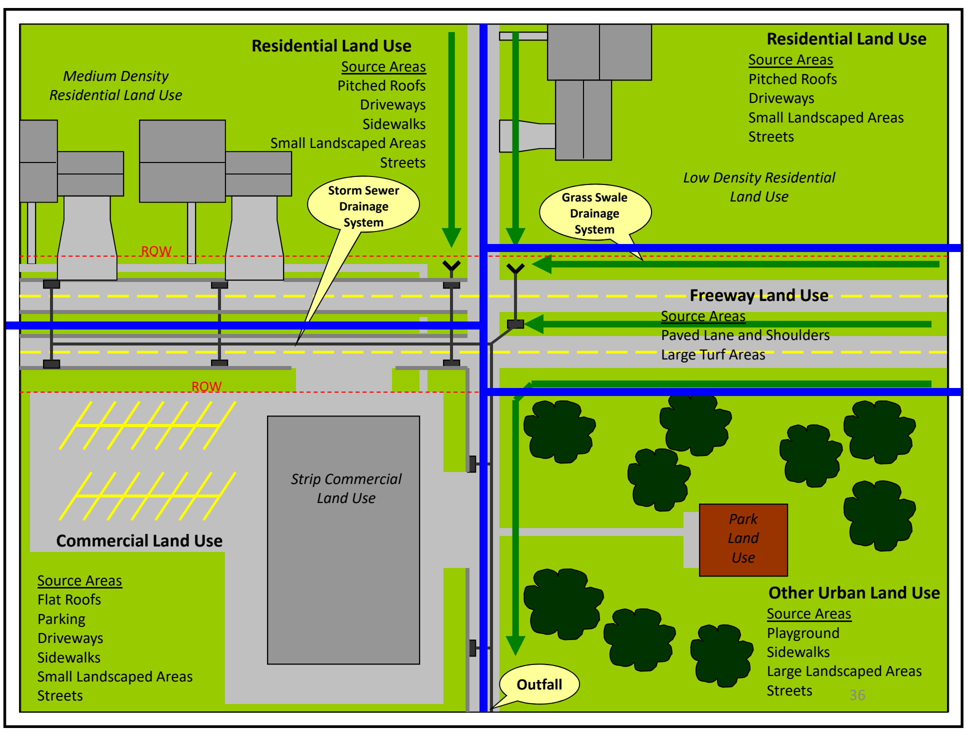
→

Apply Appropriate Drainage System Treatment Practices

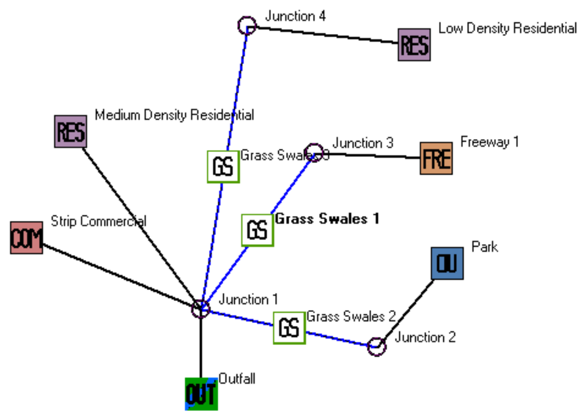
↓

Route Totals to the Outfall for Volume and Pollutant Discharge to Receiving Waters

35



Modeled Drainage System from Previous Slide



37

The Basic Program Structure Information is Entered in the Land Development Characteristic (.mdb) database file:

1. Appropriate Parameter Files
2. Land Use type and area
3. Size of all Source Areas
4. Source Area parameters and characteristics (soil type, connected imperviousness, street texture, etc.)
5. Control Practice designs

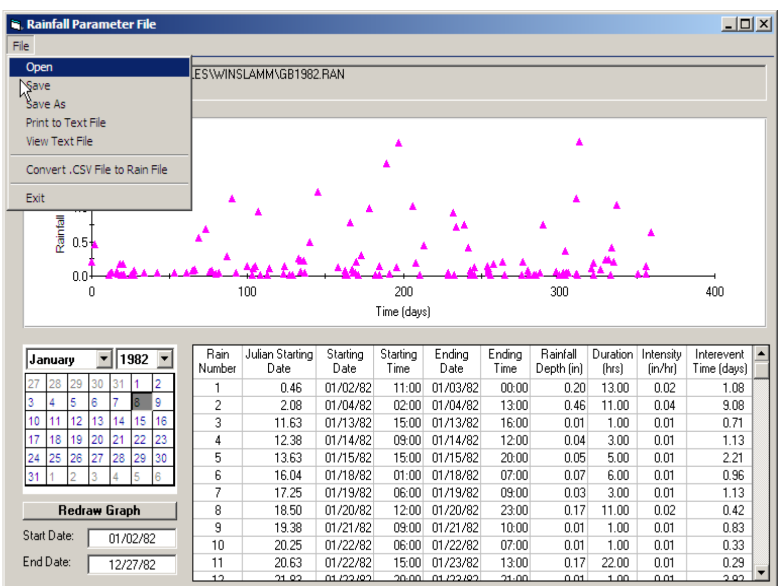
38

The model is driven through the use of data files and calibrated parameter files:

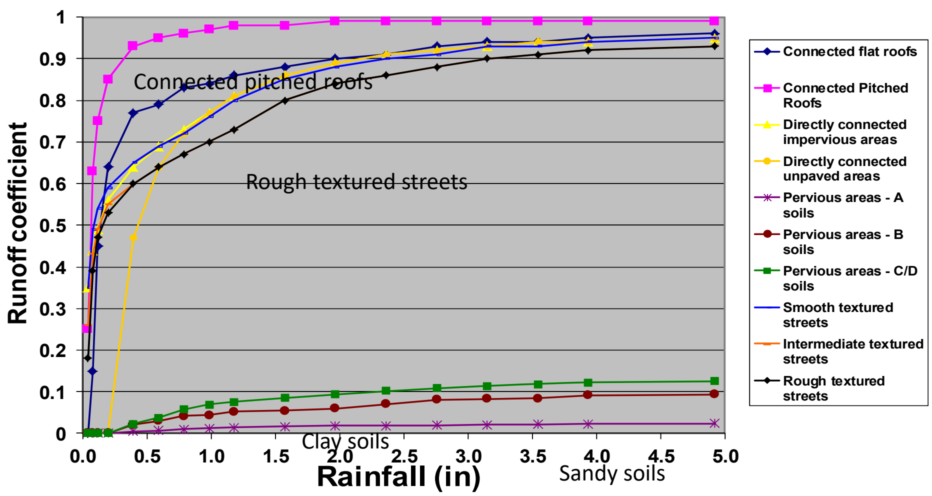
- Rainfall File (*.ran)
- Runoff Coefficient File (v10*.rsv)
- Particulate Solids Concentration File (*.pscx)
- Pollutant Probability Distribution File (*.ppdx)
- Particle Size Parameter File (*.cpz)

39

Rainfall Parameter File – Can Include Many Years/Decades of Rainfall Information



SLAMM runoff coefficient file - .rsv

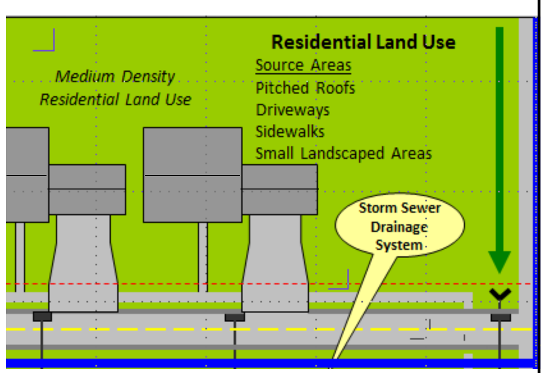


Not much difference between the different "impervious" source areas for the large, drainage design storms, but much larger differences for the small and intermediate-sized rains.

41

Runoff Volume

Runoff Volume (cf) = Rainfall Depth (in) * Source Area (ac) * R_v Coefficient * Unit Conversion



Rainfall Depth (in) ==>		0.26		0.71		0.41	
Source Area	Area (ac)	Rv	Runoff (cf)	Rv	Runoff (cf)	Rv	Runoff (cf)
Residential Land Use							
Roof - Connected	0.15	0.876	124	0.957	370	0.932	208
Roof - Disconnected	0.20	0.005	1	0.037	19	0.020	6
Driveway	0.15	0.692	98	0.903	349	0.761	170
Sidewalk	0.04	0.689	26	0.902	93	0.756	45
Small Landscape Area	1.25	0.007	8	0.037	120	0.022	40
Street	0.30	0.696	197	0.903	698	0.761	340
Total	2.09		454		1649		809

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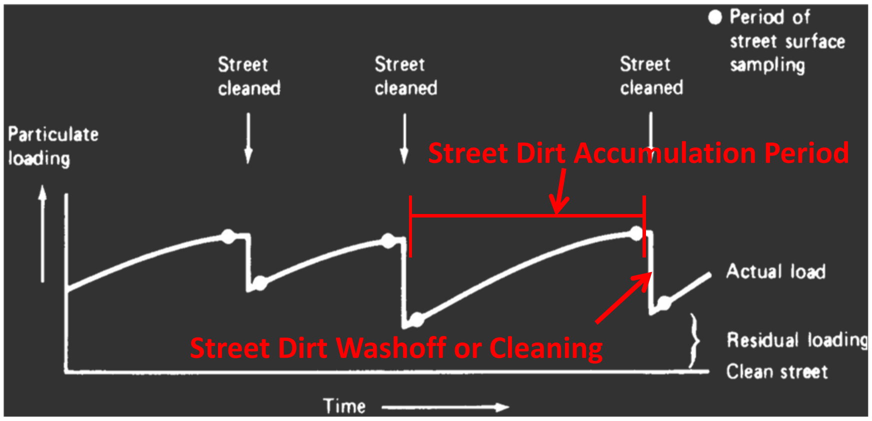
Street Dirt Washoff and Accumulation

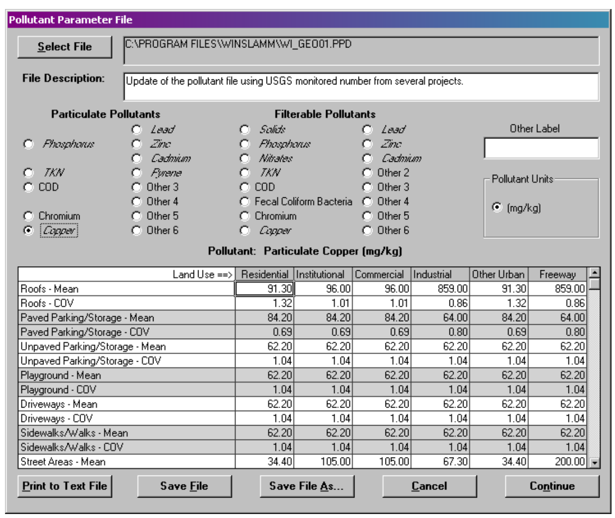
Sawtooth Pattern Associated with Deposition and Removal of Particulates on Urban Street



Pitt 1979

Pollutant File

- Depicts the pollutant concentrations (and variability) for source areas and land uses.
- Regionally calibrated files available, or may be user-defined based on local data.
- File extension: *.ppdx



Land Use ==>	Residential	Institutional	Commercial	Industrial	Other Urban	Freeway
Roofs - Mean	91.30	96.00	96.00	859.00	91.30	859.00
Roofs - COV	1.32	1.01	1.01	0.86	1.32	0.86
Paved Parking/Storage - Mean	84.20	84.20	84.20	64.00	84.20	64.00
Paved Parking/Storage - COV	0.69	0.69	0.69	0.80	0.69	0.80
Unpaved Parking/Storage - Mean	62.20	62.20	62.20	62.20	62.20	62.20
Unpaved Parking/Storage - COV	1.04	1.04	1.04	1.04	1.04	1.04
Playground - Mean	62.20	62.20	62.20	62.20	62.20	62.20
Playground - COV	1.04	1.04	1.04	1.04	1.04	1.04
Driveways - Mean	62.20	62.20	62.20	62.20	62.20	62.20
Driveways - COV	1.04	1.04	1.04	1.04	1.04	1.04
Sidewalks/Walks - Mean	62.20	62.20	62.20	62.20	62.20	62.20
Sidewalks/Walks - COV	1.04	1.04	1.04	1.04	1.04	1.04
Street Areas - Mean	34.40	105.00	105.00	67.30	34.40	200.00

44

Pollutant Loading:

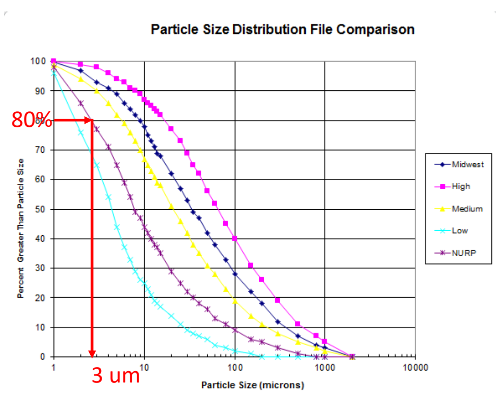
Particulate Pollutant Loading (lbs) = Particulate Solids Loading (lbs) * PPD Coefficient (mg/kg) * Unit Conversion

Dissolved Pollutant Loading (lbs) = Runoff Volume (ft^3) * PPD Coefficient (mg/L) * Unit Conversion

Note: the PPDX file (containing the pollutant particulate strengths and filterable pollutant concentrations) has an optional Monte Carlo component to account for observed stormwater concentration variations.

Critical Particle Size Files

Used for devices using sedimentation such as wet detention ponds, catchbasins, hydrodynamic devices, biofilters, grass swales, grass filters, media filters, etc.

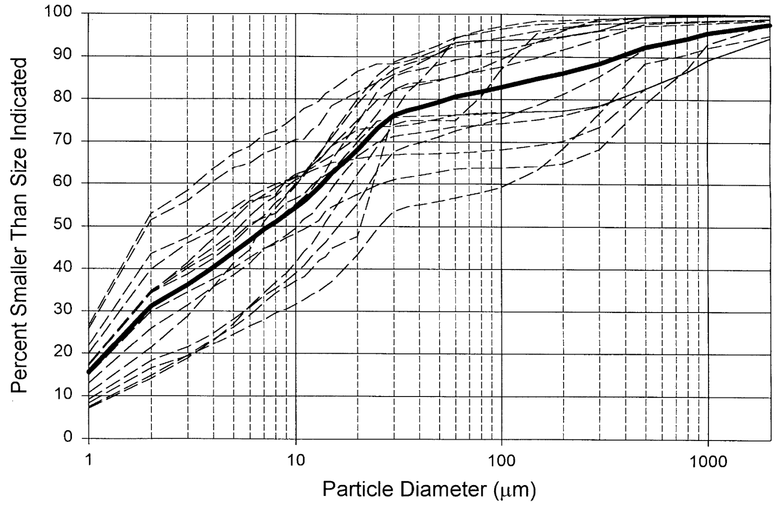


- A number of .cpz files are included with the program, or can be created using locally available psd data

For 80% reduction, the particle size for control is 3 um

46

Measured Particle Sizes, Including Bed Load Component, at influent to the Monroe St. Detention Pond, Madison, WI



Very few of the large particles that enter the drainage systems are transported to the outfalls in typical urban drainage systems. Most (about 85% in this typical example) of the outfall particulates discharged are less than 100 μm in size.

47

Mass balance measurements in the drainage system and at the outfall used to determine the fate and transport of the urban particulates. Much of the larger particulates that are not washed off are lost from the paved surfaces by fugitive dust by winds and traffic turbulence.

Measured fugitive dust losses from traffic (San Jose, Pitt 1979)

Keyes, good asphalt	**0.33 grams/vehicle-mi**
Keyes, oil and screens asphalt	**18 grams/vehicle-mi**
Tropicana, good asphalt	**2.5 grams/vehicle-mi**

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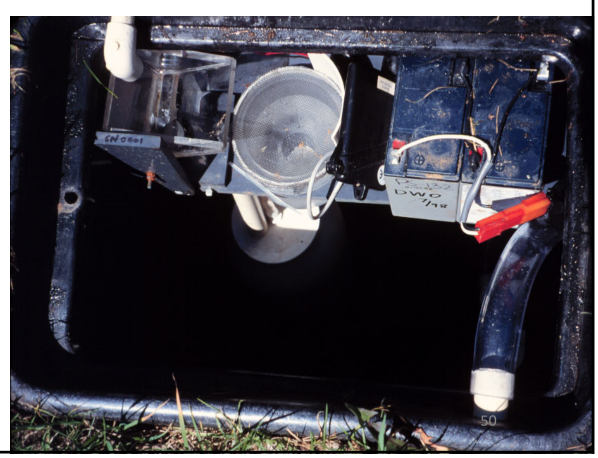
Model Strength – Based on Extensive Field Monitoring Data:

- **Source Areas – Roofs, Streets, etc.**
- **End of Pipe – Many Land uses**
- **Stormwater Control Practices**

Lawn Sheet Flow Sampler: Tipping Bucket for Flow and Cone Splitter for Water Sample

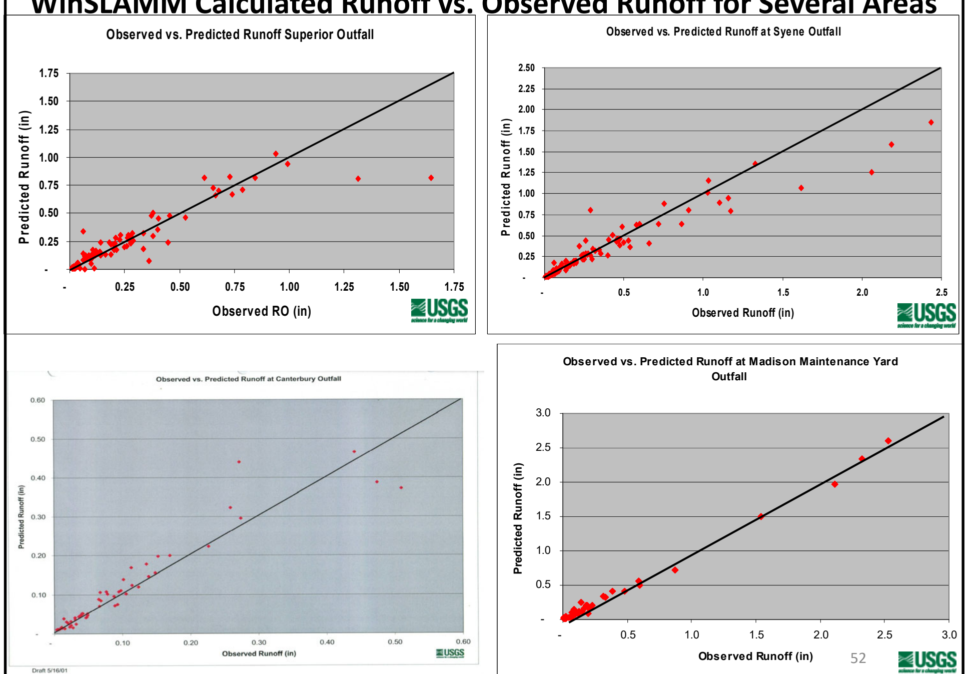


50

End of Pipe Monitoring: Mass Balance

51

WinSLAMM Calculated Runoff vs. Observed Runoff for Several Areas



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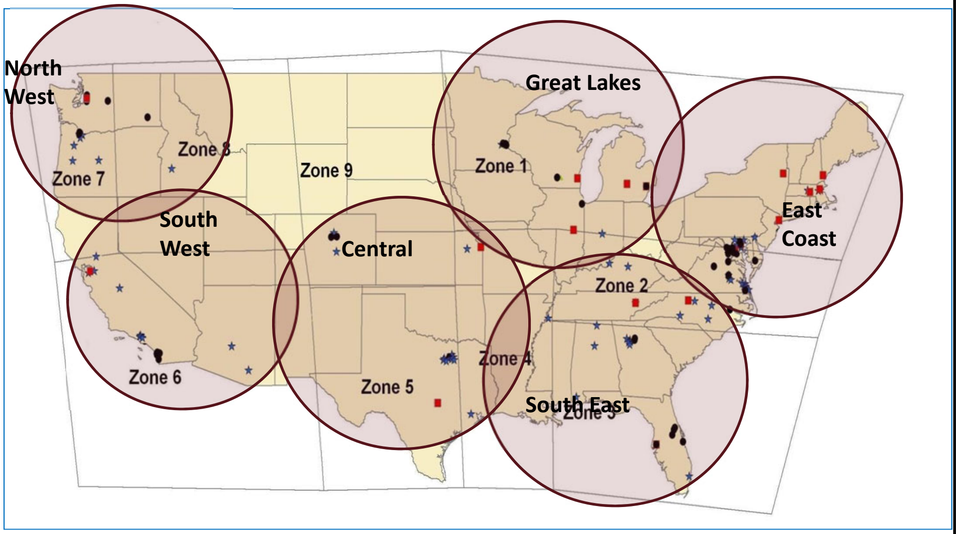
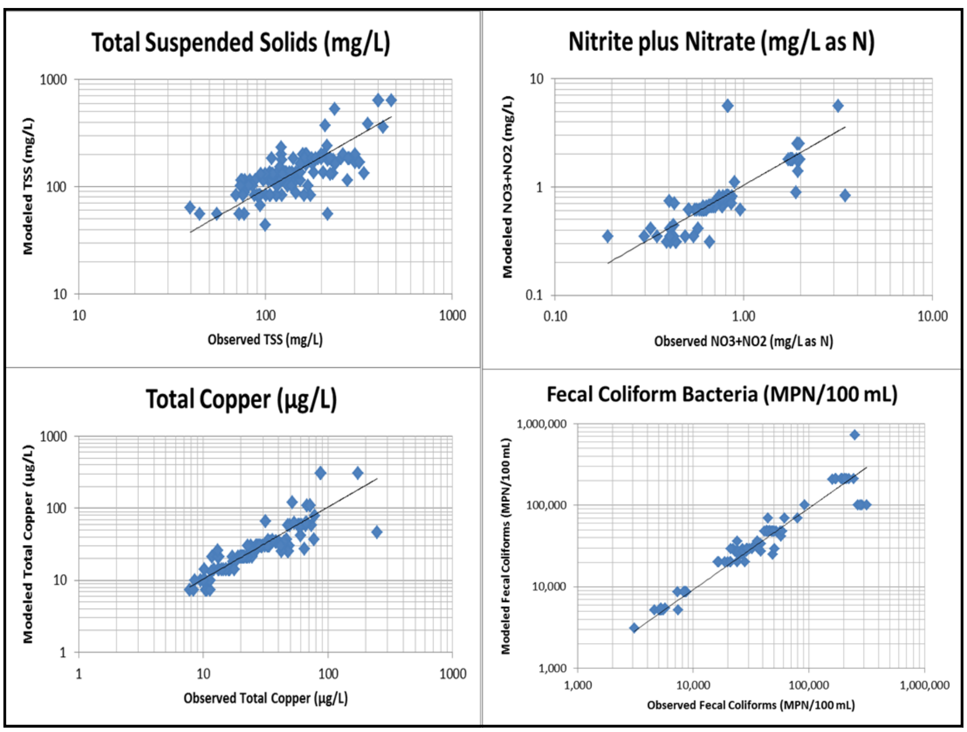
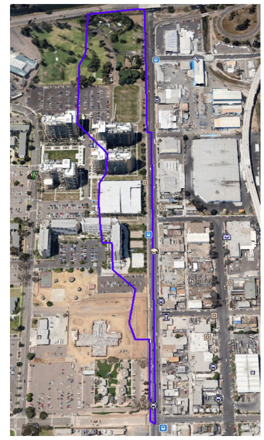
National Stormwater Quality Database Information used to Prepare Regional Calibrations with WinSLAMM

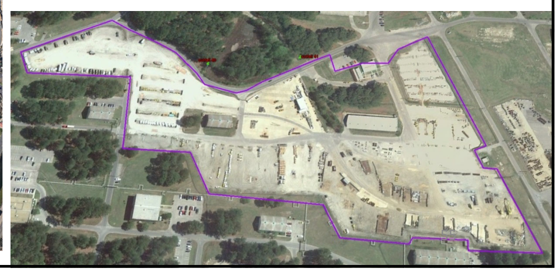


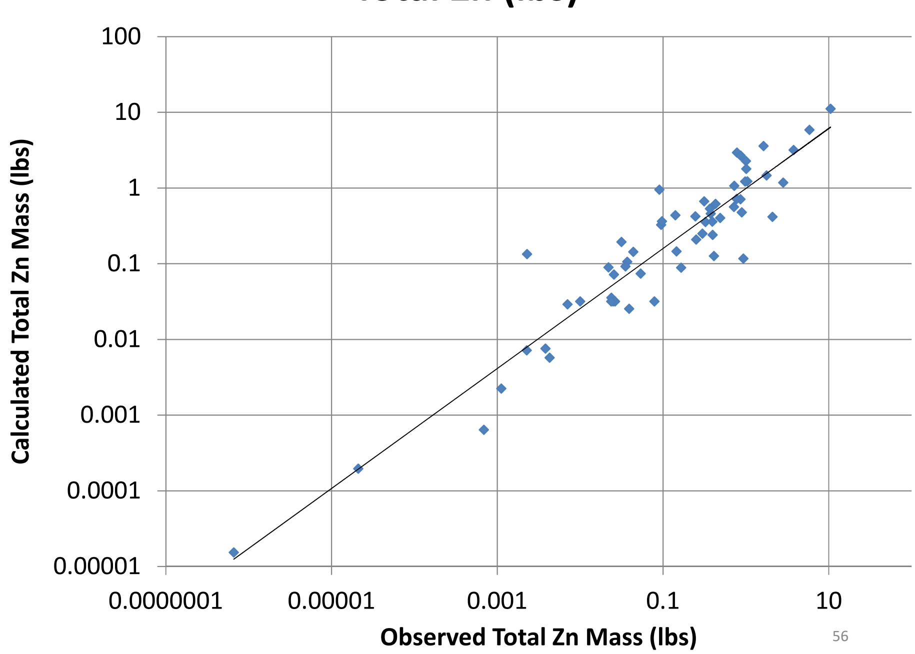
All models require calibration and verification. The NSQD data is a good place to start, but additional locally collected information is necessary for the greatest reliability. 53



Calibrated and Set-up WinSLAMM for US Naval Facilities (15 San Diego, Norfolk, and Puget Sound Bases)







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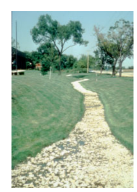
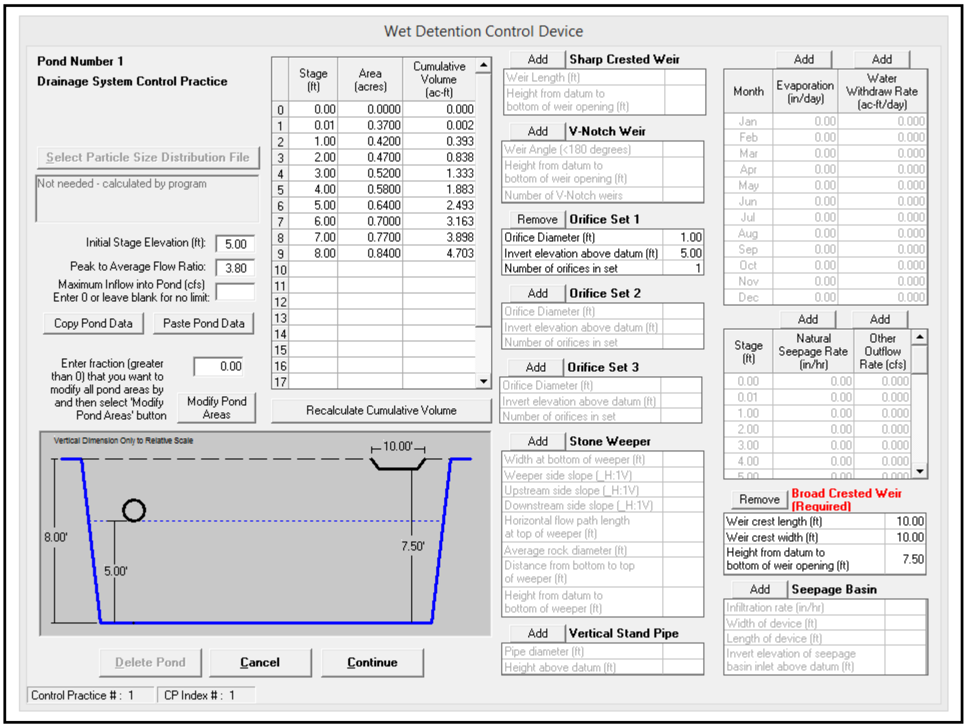
Basic Program Structure
Control Devices

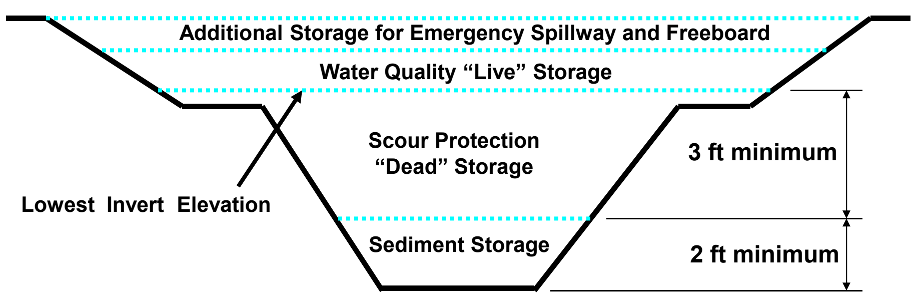


- Wet Detention Ponds
- Porous Pavement
- Street Cleaning
- Catchbasin and HD Cleaning
- Grass Swales and Grass Filters

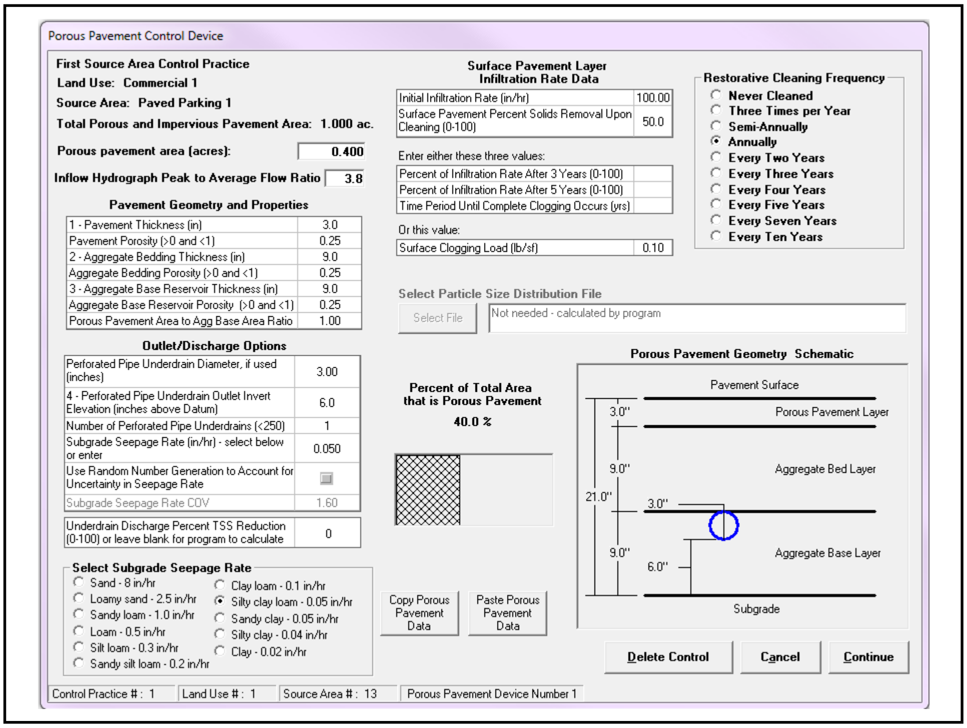
- Biofiltration/bioretention
- Green Roofs
- Proprietary Controls (media filters and hydrodynamic devices)
- Beneficial Uses



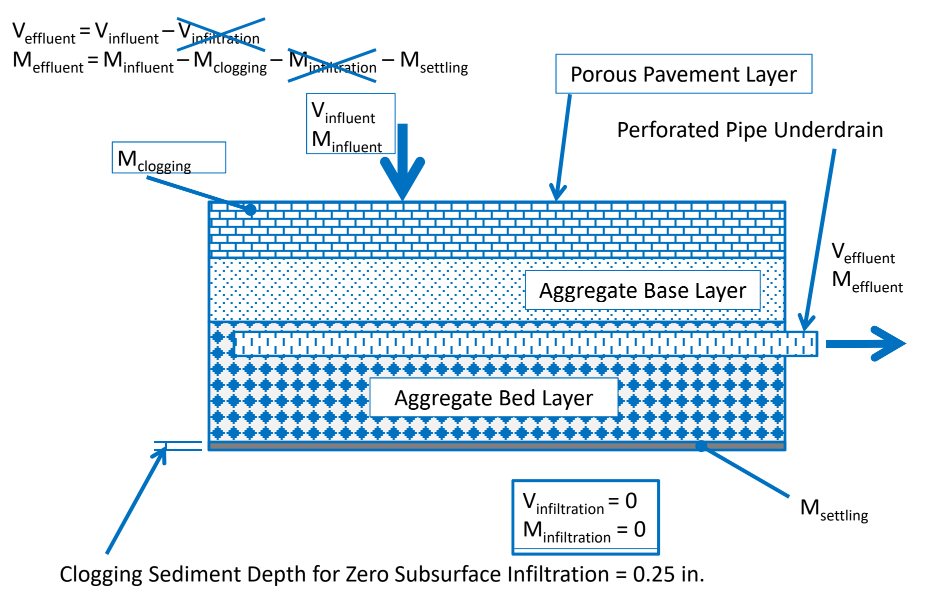
Conceptual Issues – Pond Geometry and Scour



The "dead" storage is needed to prevent scour of previously deposited material and should be at least 3 ft. deep over the sediment. Sediment storage volume is also needed and can be estimated using the program, or should be at least 2 ft. deep.

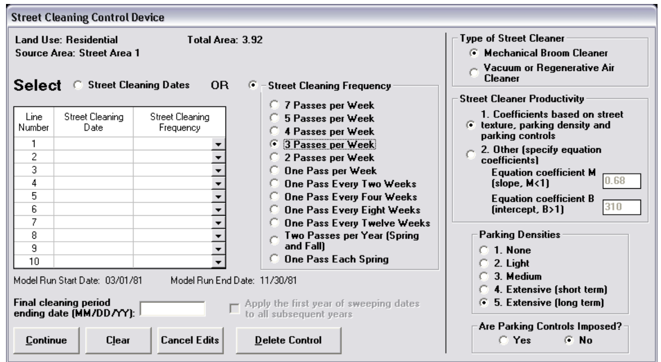


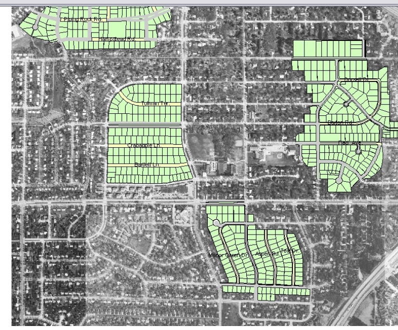
TSS Removal Processes – Subsurface Clogged



Street Cleaning

Full-scale street cleaning tests using conventional and high-energy street cleaners (street dirt loading and washoff monitoring and outfall water quality monitoring)





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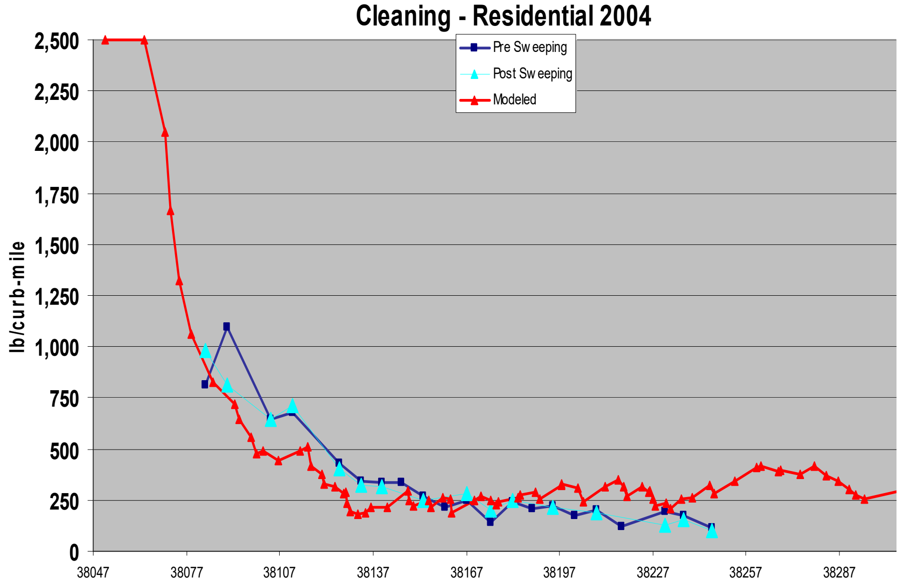
Measured Versus Modeled Street Loads With Mechnical Broom Street Cleaning - Residential 2004



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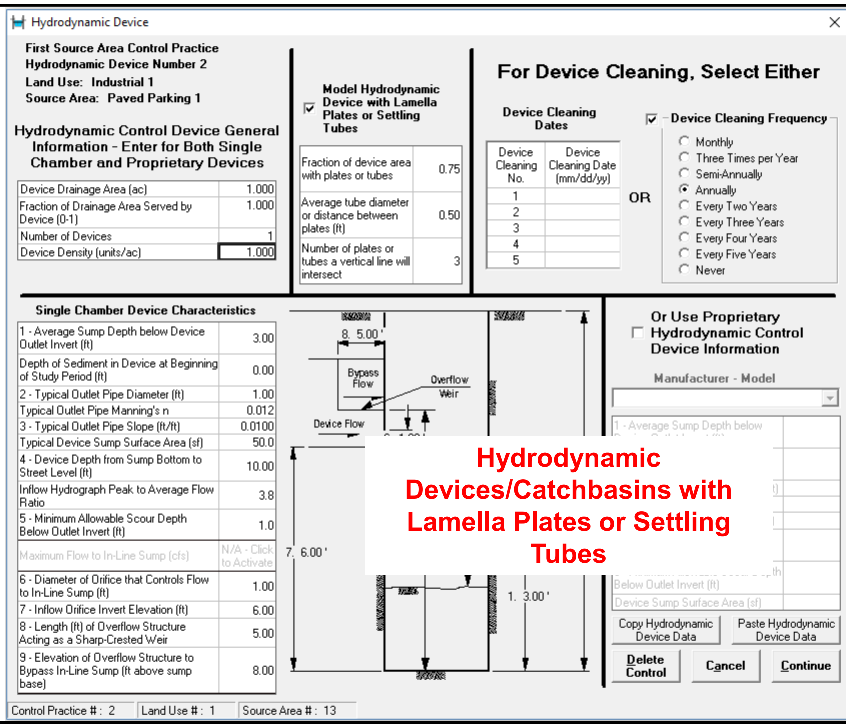
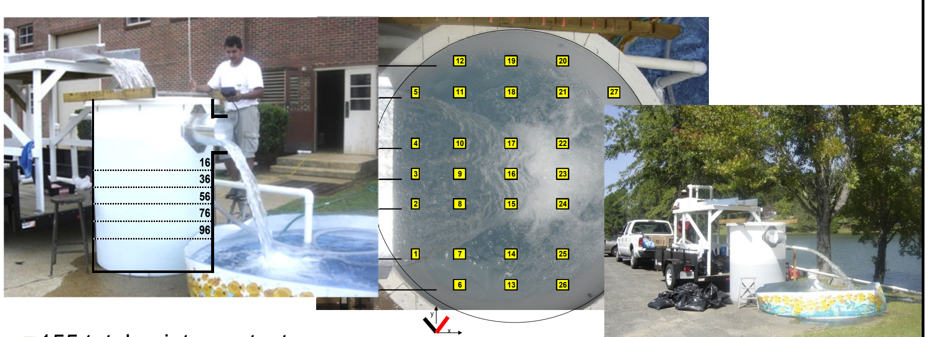


Scour of Captured Sediment in Storm Drain Catchbasin Inlets

- Three flow rates: 10, 5, and 2.5 LPS (160, 80, and 40 GPM)
- Velocity measurements (Vx, Vy, and Vz)
- Five overlying water depths above the sediment: 16, 36, 56, 76, and 96 cm



- 155 total points per test
- 30 velocity measurements at each point

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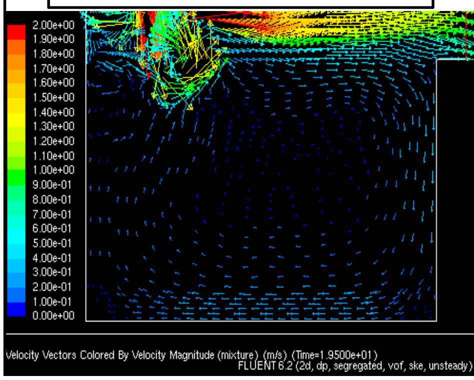
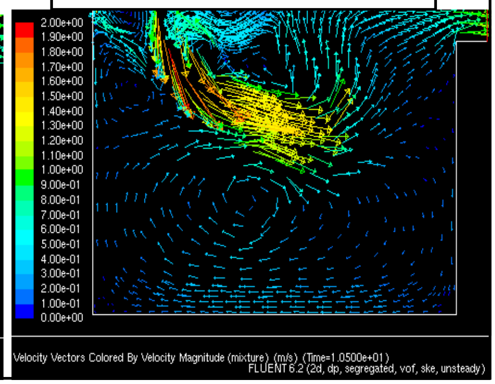
CFD Modeling to Calculate Scour/Design Variations

- Used CFD (Fluent 6.2 and Flow 3D) to determine scour from stormwater controls; results being used to expand WinSLAMM analyses after verification with full-scale physical model
- This is an example of the effects of the way that water enters a sump on the depth of the water jet and resulting scour

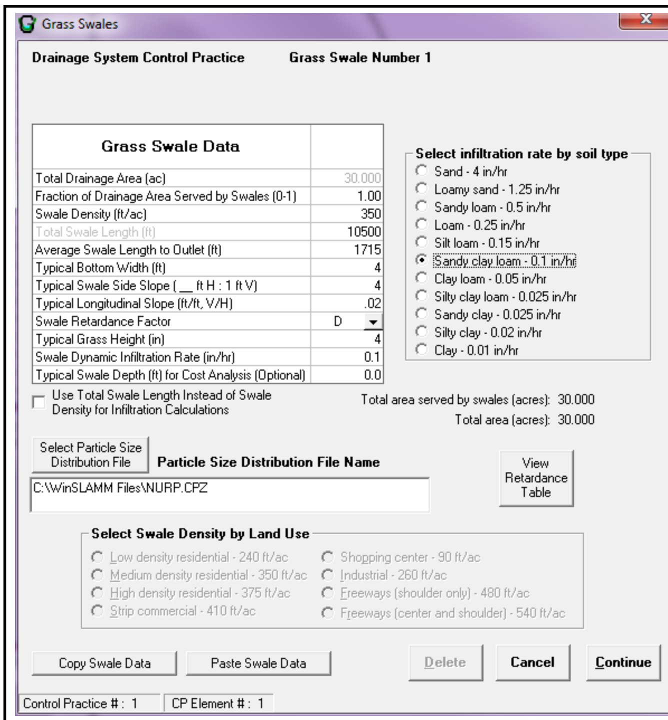
Calibrated CFD Model with Air Entrainment



Uncalibrated CFD Model without Air Entrainment



Grass Swale Data Entry Form



Grass Swales

Drainage System Control Practice — Grass Swale Number 1

Grass Swale Data	
Total Drainage Area (ac)	30.000
Fraction of Drainage Area Served by Swales (0-1)	1.00
Swale Density (ft/ac)	350
Total Swale Length (ft)	10500
Average Swale Length to Outlet (ft)	1715
Typical Bottom Width (ft)	4
Typical Swale Side Slope (__ ft H : 1 ft V)	4
Typical Longitudinal Slope (ft/ft, V/H)	.02
Swale Retardance Factor	D
Typical Grass Height (in)	4
Swale Dynamic Infiltration Rate (in/hr)	0.1
Typical Swale Depth (ft) for Cost Analysis (Optional)	0.0

Select infiltration rate by soil type
- Sand - 4 in/hr
- Loamy sand - 1.25 in/hr
- Sandy loam - 0.5 in/hr
- Loam - 0.25 in/hr
- Silt loam - 0.15 in/hr
- Sandy clay loam - 0.1 in/hr (selected)
- Clay loam - 0.05 in/hr
- Silty clay loam - 0.025 in/hr
- Sandy clay - 0.025 in/hr
- Silty clay - 0.02 in/hr
- Clay - 0.01 in/hr

Use Total Swale Length Instead of Swale Density for Infiltration Calculations

Total area served by swales (acres): 30.000
Total area (acres): 30.000

Select Particle Size Distribution File — Particle Size Distribution File Name — View Retardance Table

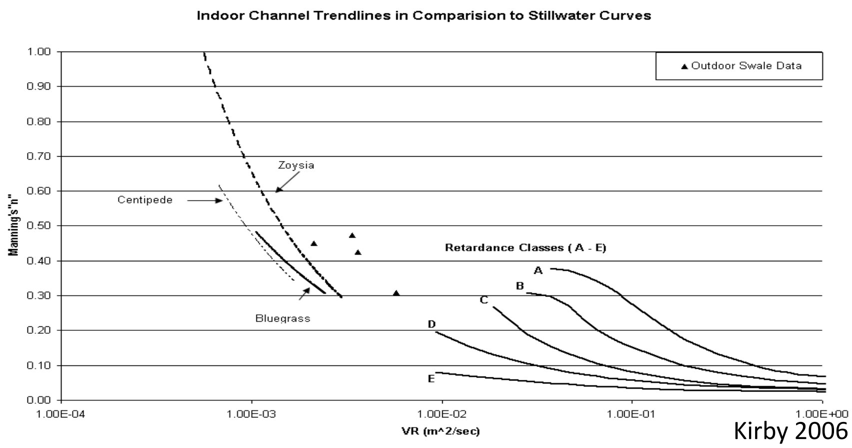
C:\WinSLAMM Files\NURP.CPZ

Select Swale Density by Land Use
- Low density residential - 240 ft/ac
- Medium density residential - 350 ft/ac
- High density residential - 375 ft/ac
- Strip commercial - 410 ft/ac
- Shopping center - 90 ft/ac
- Industrial - 260 ft/ac
- Freeways (shoulder only) - 480 ft/ac
- Freeways (center and shoulder) - 540 ft/ac

Copy Swale Data | Paste Swale Data | Delete | Cancel | Continue

Control Practice # : 1 | CP Element # : 1

Low Flow vs. Historical Stillwater, OK, Retardance Curves (can't use conventional VR-n curves for small urban swales)



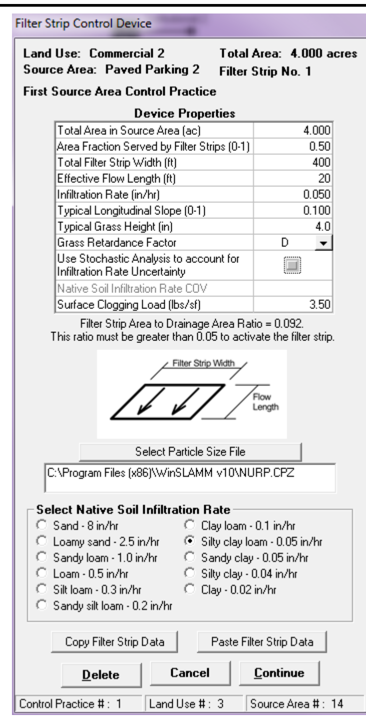
Kirby 2006

Swale and grass filter hydraulic characteristics can be predicted on the basis of flow rate, cross sectional geometry, slope, and vegetation type.

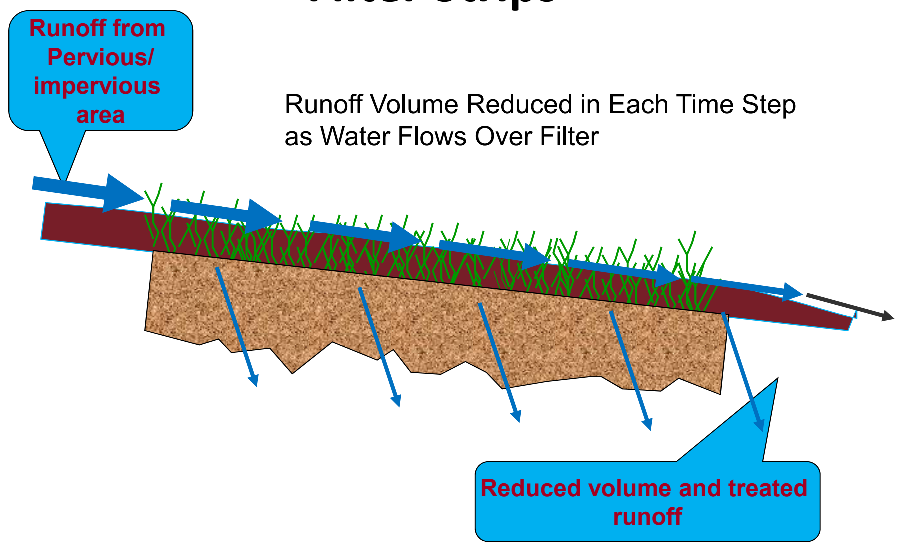
Grass Filter Strips

Assumptions:

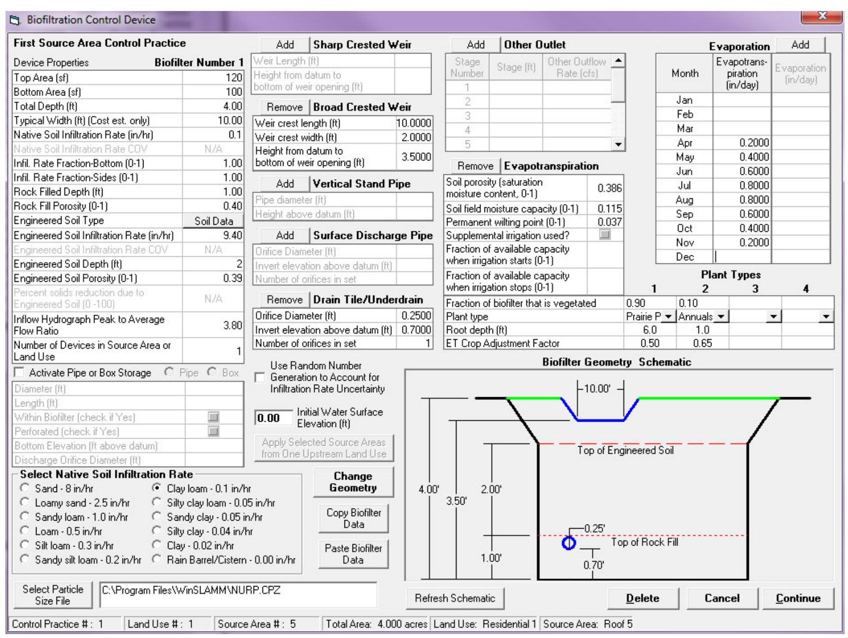
- Flow over surface modeled as sheet flow
- All particle sizes are treated
- Effective treatment length reduced based upon slope
  - <0.02 ft/ft – 3 ft reduction
  - >0.05 ft/ft – 10 ft reduction
  - else – 6 ft reduction
- Irreducible concentration a function of particle size



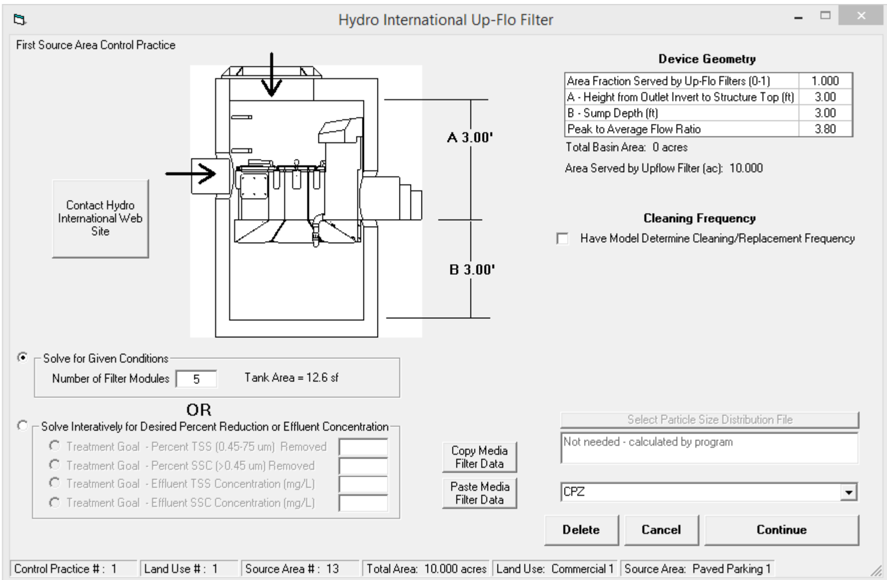
Runoff Volume Reduction in Filter Strips



Biofilter Data Entry Form



Up-flo® Filter Incorporated into WinSLAMM Based on Lab and Field Tests



Monitored Full-Scale Setup in Tuscaloosa, AL

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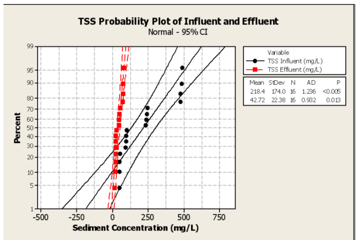
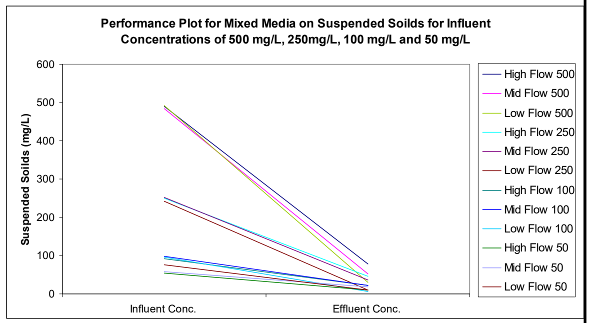
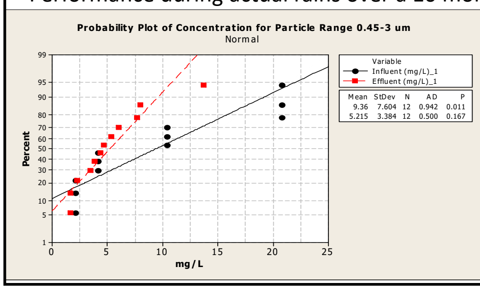
Pilot-Scale Tests, Controlled Tests and Three Years of Actual Runoff Events

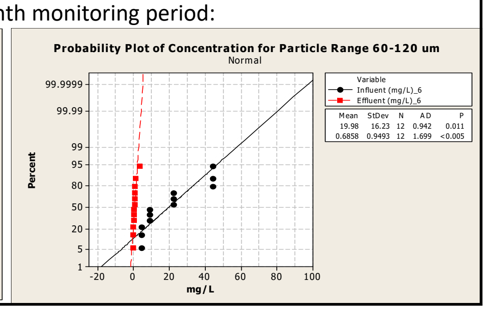
Flow rate has only a small effect on effluent quality. Effluent quality is relatively constant over broad range of influent concentrations and flows.



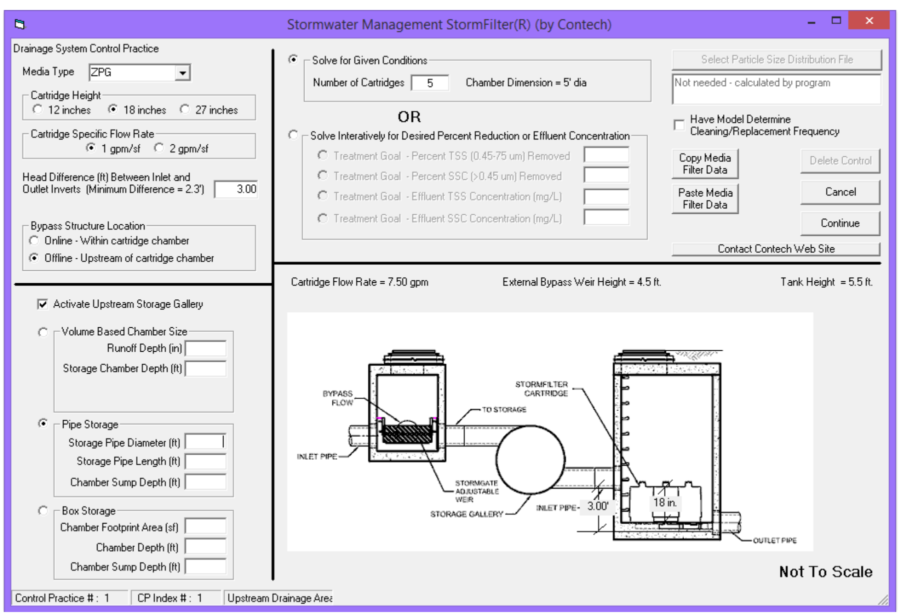


Performance during actual rains over a 10 month monitoring period:

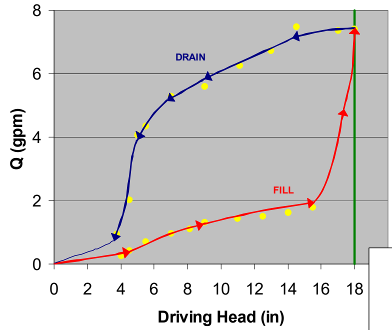


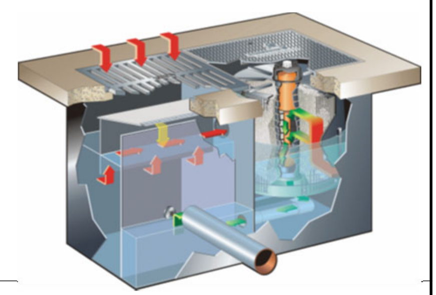


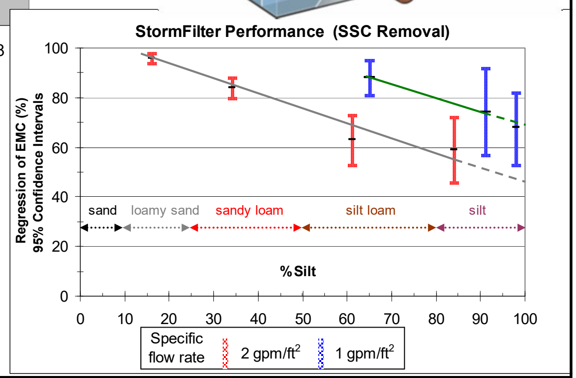
The Contech StormFilter is Incorporated into WinSLAMM based on Field and Lab Data



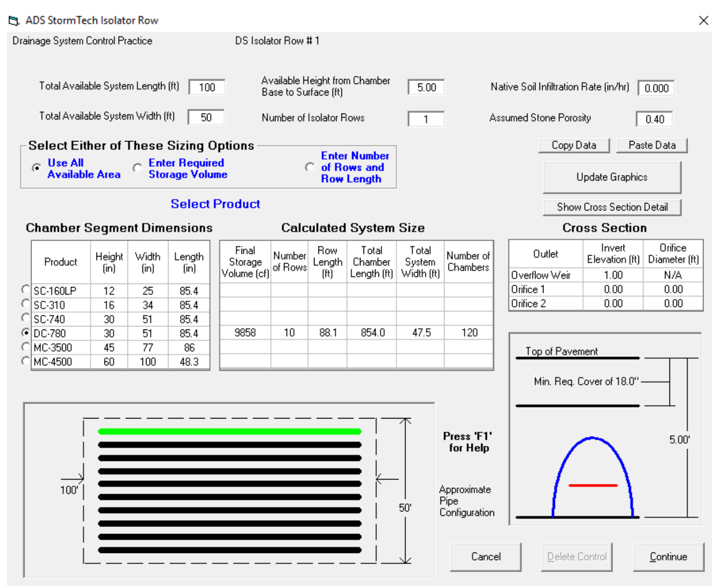
Contech StormFilter Performance Data







The ADS StormTech Isolator Row System is Incorporated into WinSLAMM based on Field and Lab Data



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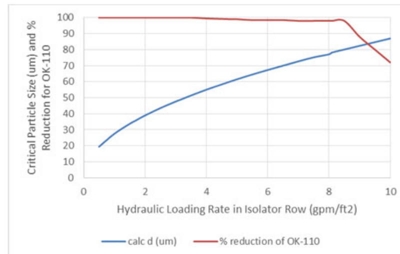
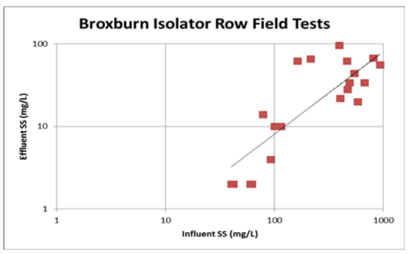
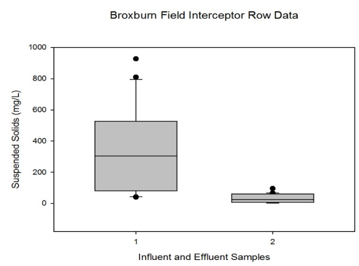
ADS Isolator Row Performance Data



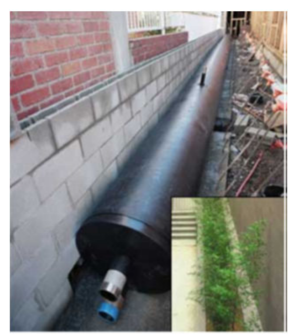


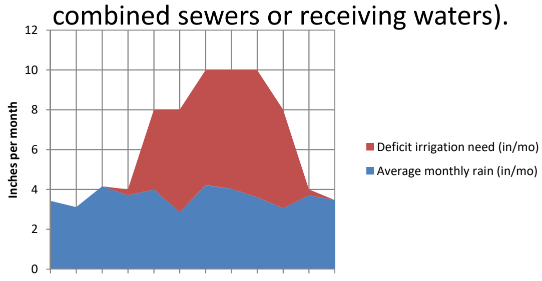


Cisterns and Beneficial Uses in WinSLAMM

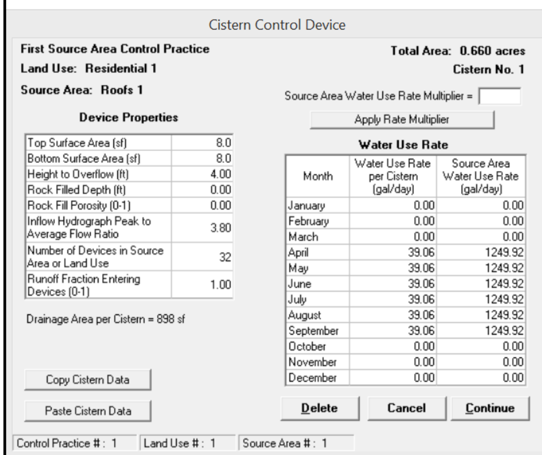
Main Features of Cisterns/Water Tank Storage and Beneficial Use Calculations in WinSLAMM:

- Mass balance calculations using long-term rainfall data.
- Calculations for different tank volumes and source areas.
- Geographical location affects water needs (conservation approach to meet evapotranspiration (ET) requirements or maximum use to minimize discharges to combined sewers or receiving waters).





Cistern Data Entry Form and Example Modeled Production Function



Cistern Control Device

First Source Area Control Practice — **Total Area: 0.660 acres**
Land Use: Residential 1 — **Cistern No. 1**
Source Area: Roofs 1

Source Area Water Use Rate Multiplier =

Apply Rate Multiplier

Device Properties

Top Surface Area (sf)	8.0
Bottom Surface Area (sf)	8.0
Height to Overflow (ft)	4.00
Rock Filled Depth (ft)	0.00
Rock Fill Porosity (0-1)	0.00
Inflow Hydrograph Peak to Average Flow Ratio	3.80
Number of Devices in Source Area or Land Use	32
Runoff Fraction Entering Devices (0-1)	1.00

Drainage Area per Cistern = 898 sf

Water Use Rate

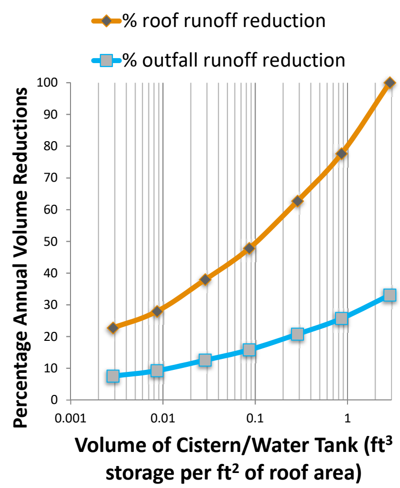
Month	Water Use Rate per Cistern (gal/day)	Source Area Water Use Rate (gal/day)
January	0.00	0.00
February	0.00	0.00
March	0.00	0.00
April	39.06	1249.92
May	39.06	1249.92
June	39.06	1249.92
July	39.06	1249.92
August	39.06	1249.92
September	39.06	1249.92
October	0.00	0.00
November	0.00	0.00
December	0.00	0.00

Copy Cistern Data

Paste Cistern Data

Delete — Cancel — Continue

Control Practice # : 1 — Land Use # : 1 — Source Area # : 1



One of the Most Important WinSLAMM Features is its' Ability to Route Hydrographs and Particle Size Distributions through Successive Control Practices

- Upgradient hydrograph modifications usually improve the performance of downgradient controls mostly due to decreased peak treatment flow rates.
- Particle size distribution routing through control practices provides more accurate overall performance calculations (e.g., errors associated with double counting due to removal of larger particles removed by preceding controls).
- These enhancements result in an improved ability to accurately model treatment trains and to select and size complementary control practices throughout an area.

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We will cover . . .

- WinSLAMM Purpose, History and Unique Features
- Model Applications
- Small Storm Hydrology
- Basic Program Structure and Operation
- Model Calibration
- Treatment Practices
- Model Output

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Model Output

1. Output Summary
2. Receiving Water Impacts
3. Land Uses and Source Area Detail
4. Control Device Detail
5. Analyzed as a single file or in batch mode
6. Many output options
   i. Control Device Detailed Output
   ii. Hydrograph and Particle Size Distribution at each Control Practice, Land Use and Junction

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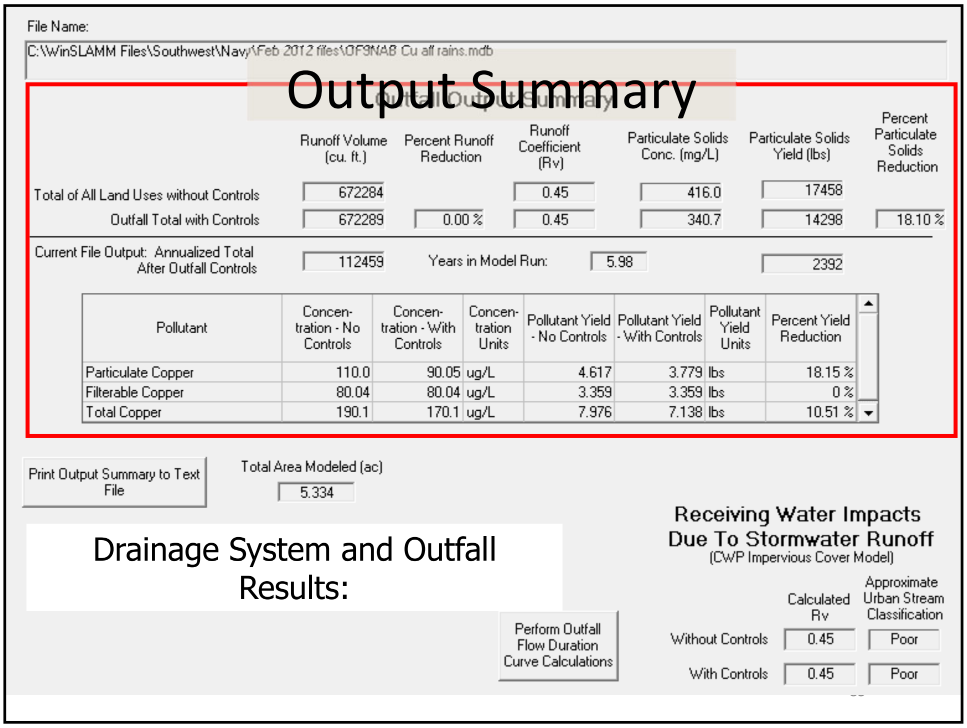
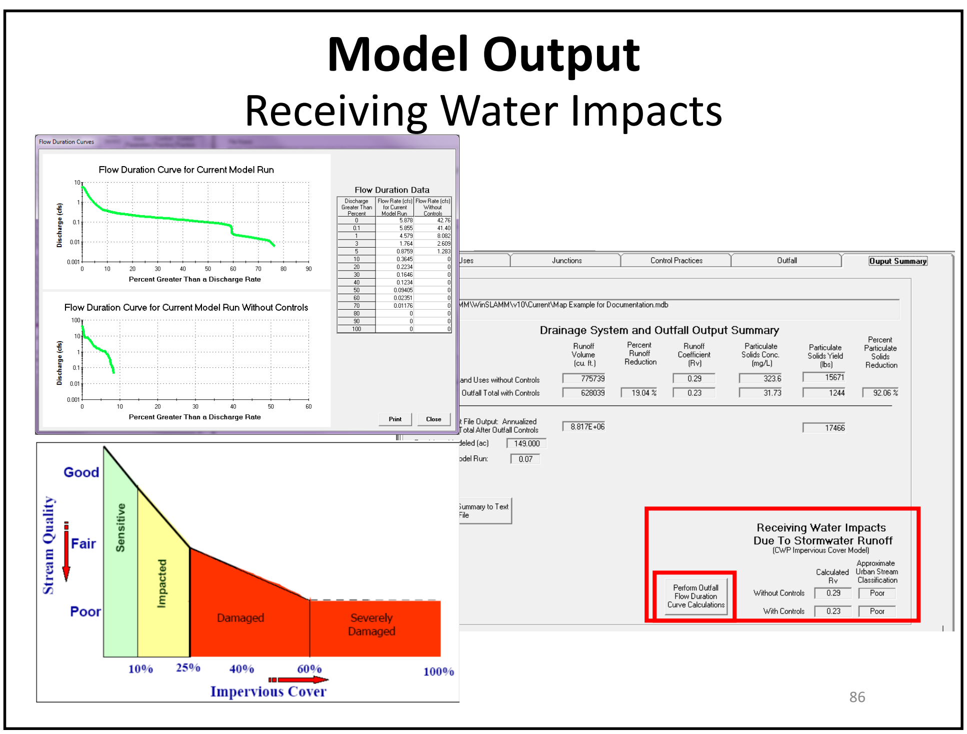
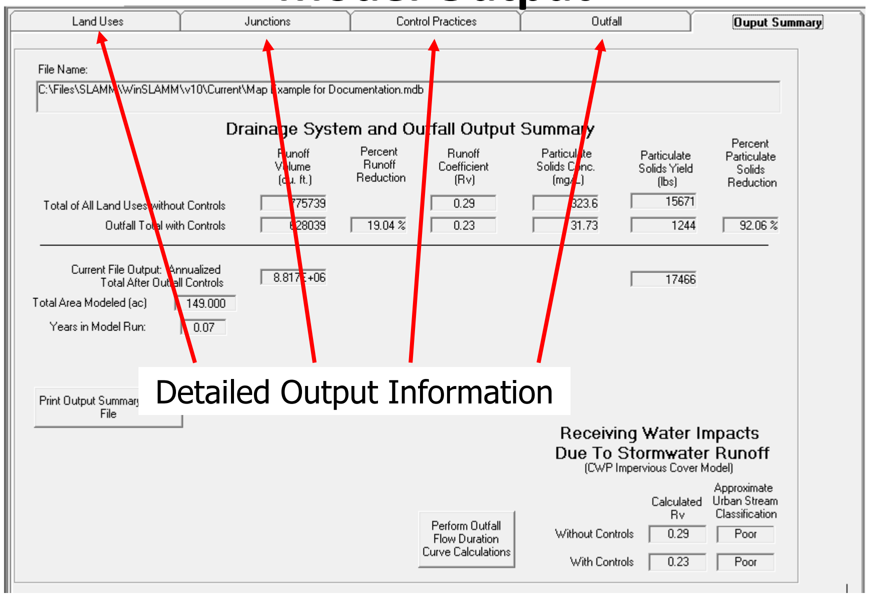
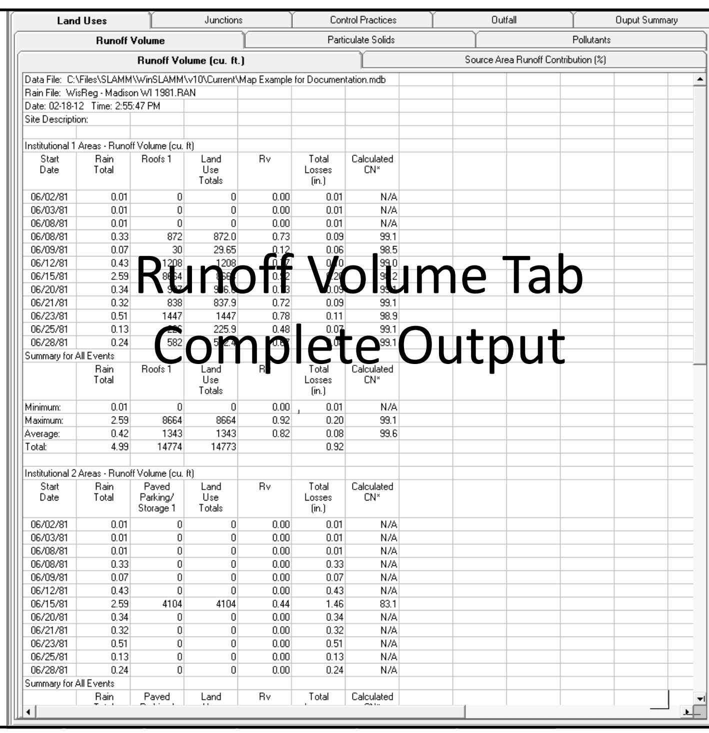

File Name:
C:\WinSLAMM Files\Southwest\Navy\Feb 2012 files\OF9NA8 Cu all rains.mdb
Output Summary
Outfall Output Summary
Runoff Volume (cu. ft.)
Percent Runoff Reduction
Runoff Coefficient (Rv)
Particulate Solids Conc. (mg/L)
Particulate Solids Yield (lbs)
Percent Particulate Solids Reduction
Total of All Land Uses without Controls 672284 0.45 416.0 17458
Outfall Total with Controls 672289 0.00 % 0.45 340.7 14298 18.10 %
Current File Output: Annualized Total After Outfall Controls 112459 Years in Model Run: 5.98 2392
Pollutant | Concen-tration - No Controls | Concen-tration - With Controls | Concen-tration Units | Pollutant Yield - No Controls | Pollutant Yield - With Controls | Pollutant Yield Units | Percent Yield Reduction
Particulate Copper 110.0 90.05 ug/L 4.617 3.779 lbs 18.15 %
Filterable Copper 80.04 80.04 ug/L 3.359 3.359 lbs 0 %
Total Copper 190.1 170.1 ug/L 7.976 7.138 lbs 10.51 %
Print Output Summary to Text File
Total Area Modeled (ac) 5.334
Drainage System and Outfall Results:
Receiving Water Impacts Due To Stormwater Runoff
(CWP Impervious Cover Model)
Calculated Rv
Approximate Urban Stream Classification
Without Controls 0.45 Poor
With Controls 0.45 Poor
Perform Outfall Flow Duration Curve Calculations


Model Output
Receiving Water Impacts
Flow Duration Curve for Current Model Run
Percent Greater Than a Discharge Rate
Flow Duration Curve for Current Model Run Without Controls
Flow Duration Data
Print
Close
Junctions
Control Practices
Outfall
Ouput Summary
Drainage System and Outfall Output Summary
Receiving Water Impacts Due To Stormwater Runoff
(CWP Impervious Cover Model)
Perform Outfall Flow Duration Curve Calculations
Without Controls 0.29 Poor
With Controls 0.23 Poor
Good
Fair
Poor
Stream Quality
Sensitive
Impacted
Damaged
Severely Damaged
10%
25%
40%
60%
100%
Impervious Cover
86

Model Output



87



Data File: C:\Files\SLAMM\WinSLAMM\v10\Current\Map Example for Documentation.mdb
Rain File: WisReg - Madison WI 1981.RAN
Date: 02-18-12 Time: 2:55:47 PM
Site Description:

Institutional 1 Areas - Runoff Volume (cu. ft)

Start Date	Rain Total	Roofs 1	Land Use Totals	Rv	Total Losses (in.)	Calculated CN*
06/02/81	0.01	0	0	0.00	0.01	N/A
06/03/81	0.01	0	0	0.00	0.01	N/A
06/08/81	0.01	0	0	0.00	0.01	N/A
06/08/81	0.33	872	872.0	0.73	0.09	99.1
06/09/81	0.07	30	29.65	0.12	0.06	98.5
06/12/81	0.43	1208	1208	[illegible]	[illegible]	99.0
06/15/81	2.59	8664	[illegible]	[illegible]	[illegible]	[illegible]
06/20/81	0.34	[illegible]	[illegible]	[illegible]	0.09	[illegible]
06/21/81	0.32	838	837.9	0.72	0.09	99.1
06/23/81	0.51	1447	1447	0.78	0.11	98.9
06/25/81	0.13	[illegible]	225.9	0.48	0.07	99.1
06/28/81	0.24	582	[illegible]	[illegible]	[illegible]	99.1

Summary for All Events

	Rain Total	Roofs 1	Land Use Totals	Rv	Total Losses (in.)	Calculated CN*
Minimum:	0.01	0	0	0.00	0.01	N/A
Maximum:	2.59	8664	8664	0.92	0.20	99.1
Average:	0.42	1343	1343	0.82	0.08	99.6
Total:	4.99	14774	14773		0.92	

Institutional 2 Areas - Runoff Volume (cu. ft)

Start Date	Rain Total	Paved Parking/ Storage 1	Land Use Totals	Rv	Total Losses (in.)	Calculated CN*
06/02/81	0.01	0	0	0.00	0.01	N/A
06/03/81	0.01	0	0	0.00	0.01	N/A
06/08/81	0.01	0	0	0.00	0.01	N/A
06/08/81	0.33	0	0	0.00	0.33	N/A
06/09/81	0.07	0	0	0.00	0.07	N/A
06/12/81	0.43	0	0	0.00	0.43	N/A
06/15/81	2.59	4104	4104	0.44	1.46	83.1
06/20/81	0.34	0	0	0.00	0.34	N/A
06/21/81	0.32	0	0	0.00	0.32	N/A
06/23/81	0.51	0	0	0.00	0.51	N/A
06/25/81	0.13	0	0	0.00	0.13	N/A
06/28/81	0.24	0	0	0.00	0.24	N/A

Summary for All Events

	Rain	Paved	Land	Rv	Total	Calculated

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Control Practice Summary Table

Land Uses | Junctions | **Control Practices** | Outfall | Ouput Summary

Runoff Volume | Part. Solids Yield (lbs) | Part. Solids Conc. (mg/L) | **Summary Table**

Data File: C:\Files\SLAMM\WinSLAMM\v10\Current\Map Example for Documentation.mdb
Rain File: WisReg - Madison WI 1981.RAN
Date: 02-18-12 Time: 2:39:53 PM
Site Description:

Control Practice No.	Control Practice Type	Control Practice Name or Location	Total Inflow Volume (cf)	Total Outflow Volume (cf)	Percent Volume Reduction	Total Influent Load (lbs)	Total Effluent Load (lbs)	Percent Load Reduction	Flow Weighted Influent Conc (mg/L)
1	Catchbasin Cleaning	Catchbasins 1	4.834E+06	4.834E+06	0	6428	5798	9.792	21.30
2	Catchbasin Cleaning	SA Device, LU# 1 ,SA# 13	71678	71678	0	1119	936.3	16.31	250.0
3	Street Cleaning	SA Device, LU# 1 ,SA# 37	820200	820200	0	12895	5491	57.42	251.8
4	Wet Detention Pond	Wet Pond 1	5.878E+06	5.878E+06	0	25335	14548	42.58	69.04
5	Grass Swales	Grass Swales 1	4.834E+06	3.273E+06	32.29	5798	3727	35.72	19.21
6	Biofilter	Biofilters 1	2.631E+06	2.605E+06	0.9872	21825	21609	0.9916	132.9
7	Porous Pavement	SA Device, LU# 3 ,SA# 13	71678	0	100.0	581.7	0	100.0	130.0
8	Street Cleaning	SA Device, LU# 4 ,SA# 38	1.383E+06	1.383E+06	0	16912	13988	17.29	195.8
9	Catchbasin Cleaning	SA Device, LU# 4 ,SA# 38	1.383E+06	1.383E+06	0	13988	13522	3.332	162.0
10	Filter Strips	SA Device, LU# 4 ,SA# 25	163944	163944	0	1576	1576	0	154.0

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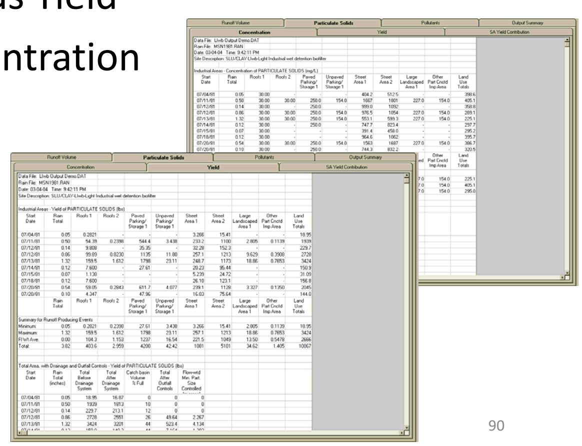
Model Output

Similar Output for -

- Particulate Solids Concentration
- Particulate Solids Yield
- Pollutant Concentration
- Pollutant Yield



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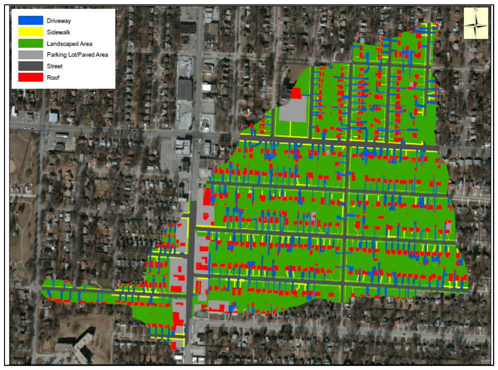

For additional model information, go to www.winslamm.com

Remember to Press the “F1” to access the Help File

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