

Linking BMP Performance to Receiving Water Quality

Presented to
Barr Lake /Milton Reservoir Association

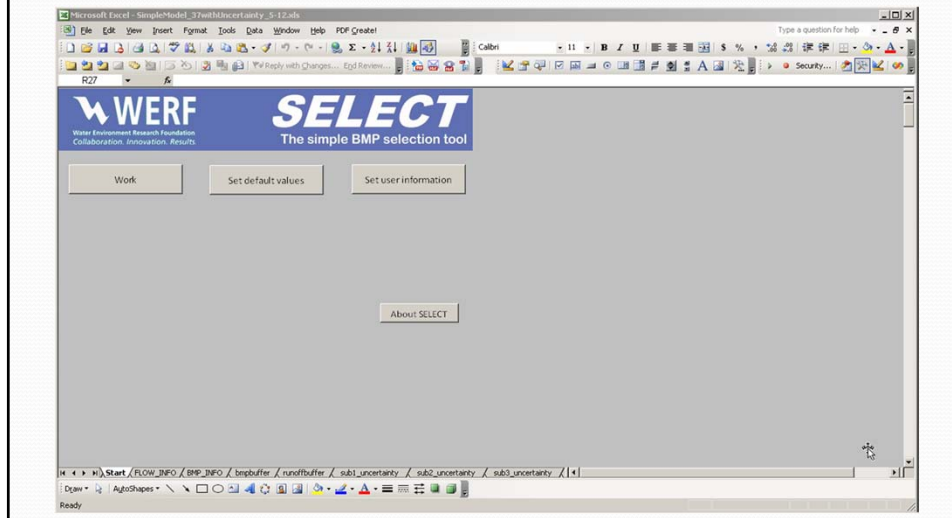
Feb 22, 2011

Larry Roesner
Colorado State University

Challenge Comprises Two Tools

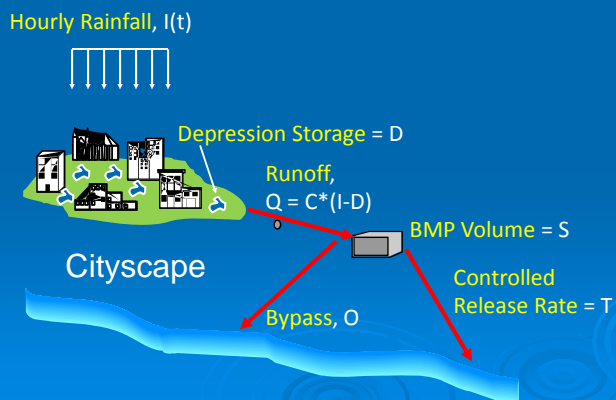
- SELECT – A simple screening model to analyze trade-offs between BMP scenarios in terms of pollutant load to receiving waters TMDL and whole live cost
- FRAMEWORK – A tool for linking Watershed Models to BMP Models to Receiving Water Models for TMDL Analysis

The SIMPLE Model



Conceptual Model of SELECT

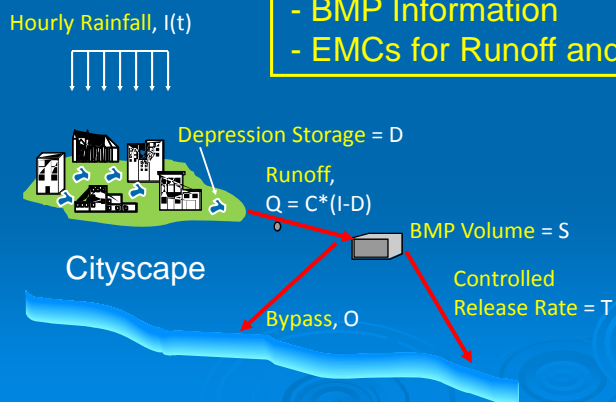
- Accounts for rainfall, runoff, treated flow and untreated flow.



Conceptual Model of SELECT

INPUT DATA

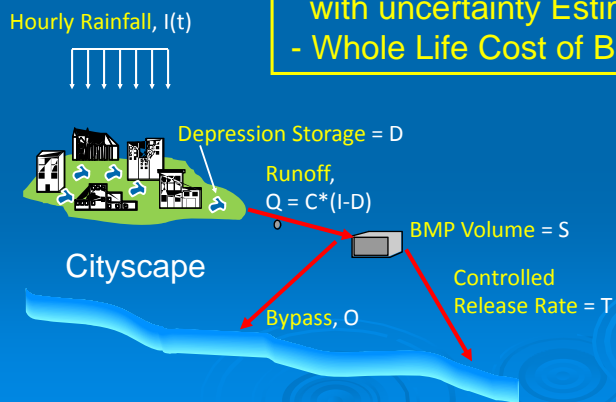
- Long Term Hourly Rainfall
- Land use Data
- BMP Information
- EMCs for Runoff and BMPs



Conceptual Model of SELECT

OUTPUT DATA

- Annual Pollutant Loads
- Pollutant Load Frequency Curves with uncertainty Estimates
- Whole Life Cost of BMPs

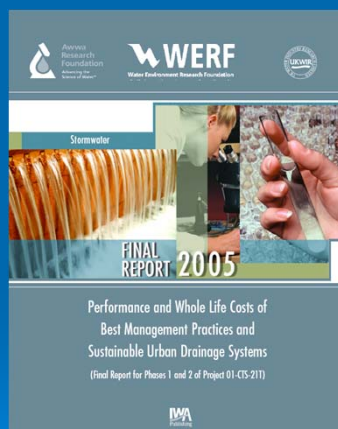


BMPs & Parameters

- Best Management Practices
 - Extended detention
 - Bioretention
 - Wetlands
 - Swales
 - Permeable Pavement
 - Filters
- Water quality parameters
 - TSS
 - Total Nitrogen
 - Total Phosphorus
 - Total Zinc

Whole Life Cost of BMPs

- Capital costs
 - parametric equation
- O&M costs
 - % of capital cost
- Replacement Costs
 - % of capital cost
- Sources:
 - WERF 2005, WERF 2009, Denver UDFCD



Watershed Report

BMP Performance Report										SELECT model version 1.0	
User Name	Name of firm or organization								Report Date	5/29/2009	
User organization	Name of department or work group								Report Time	2:40 PM	
Scenario Name	No name assigned for this scenario										
Scenario Data											
Subwatershed Name	Area (acres)	Land Use	Cv	DS (ins)	BMP	Treated A	WQCV (in)	Drawdown	% Loss	PPV (in)	
Subcatchment a	100	Commercial	0.9	0.1	Permeabl	25				12	
Subcatchment 2	32	Residential	0.23	0.1	Extended	32	0.22	12	0		
Subcatchment 3	13	Residential	0.23	0.1	Wetland E	13	0.17	24	0		
Total Area	145					70					
Scenario BMP Quality Data											
Subwatershed Name	BMP Type	% Loss	TP (mg/l)	TN (mg/l)	TSS (mg/l)	TZn (mg/l)					
Subcatchment a	Permeabl	0	0.14	1.15	18	0.0307					
Subcatchment 2	Extended D	0	0.19	2.72	31	0.0602					
Subcatchment 3	Wetland B	0	0.14	1.15	18	0.0307					
Scenario Land Use Quality Data											
Subwatershed Name	Land Use Name	TP (mg/l)	TN (mg/l)	TSS (mg/l)	TZn (mg/l)						
Subcatchment a	Commercial	0.201	0.572	69	0.226						
Subcatchment 2	Residential	0.383	0.736	101	0.135						
Subcatchment 3	Residential	0.383	0.736	101	0.135						
Rainfall											
Name	Rainfall file 4			To	12/31/95						
From	01/01/90			Total rain (ins)	304.66						
Duration (days)	2191			Event average rainfall (ins)	0.495						
Number of events (ins)	615			Annual average rainfall (ins)	50.61						
Runoff											
	Quantity	TP	TN	TSS	TZn						
Total Over	89635.66	557.82	1494.78	183512.97	548.81						
Annual Av	14691.55	92.67	248.34	30487.78	91.34						
BMPs											
	Quantity	TP	TN	TSS	TZn						
Annual Tr	183.09	6.11	78.42	1061.98	2.26						
Annual Bg	10724.13	65.08	177.34	21683.42	66.61						
Annual To	18893.21	71.19	295.76	22725.40	68.97						
Annual Total Perce	23.19	-2.99	25.46	24.60	24.60	Warning: The chosen EMCs cause an increase.					
Average Concentra	0.21	0.76	67.48	0.20							

The report includes:
 -personal data
 -scenario data
 -results

Watershed Report (top)

BMP Performance Report										SELECT model version 1.0	
User Name	Name of firm or organization								Report Date	#####	
User organization	Name of department or work group								Report Time	2:40 PM	
Scenario Name	No name assigned for this scenario										
Scenario Data											
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Subcatchment 3	Residential	0.383	0.736	101	0.135						

User Info

Scenario data

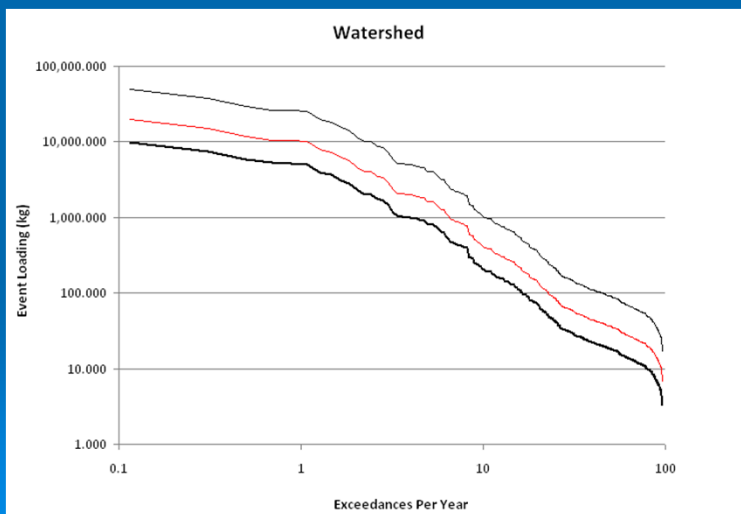
Watershed Report (bottom)

Scenario data

Subcatchment 2	Residential		0.383	0.736	101	0.135
Subcatchment 3	Residential		0.383	0.736	101	0.135
Rainfall						
	Name	Rainfall file 4				
	From	01/01/90			To	12/31/95
	Duration (days)	2191			Total rain (ins)	304.66
	Number of events (ins)	615			Event average rainfall (ins)	0.495
					Annual average rainfall (ins)	50.61
Runoff						
	Quantity	TP	TN	TSS	ZN	
Total Over Period	89635.66	557.82	1494.78	183512.97	549.81	
Annual Average (ins)	14891.55	92.67	248.34	30487.78	91.34	
BMPs						
	Quantity	TP	TN	TSS	ZN	
Annual Treated Discharge	1169.09	6.11	78.42	1061.98	2.26	
Annual Bypassed	10724.13	65.08	177.34	21663.42	66.61	
Annual Total Discharge	11893.21	71.18	255.76	22725.40	68.87	
Annual Total Percent Remove	23.19	-2.99	25.46	24.60	*** Warning: The chosen EMCs cause an increase in loading.	
Average Concentration (mg/l)		0.21	0.76	67.48	0.20	

Results

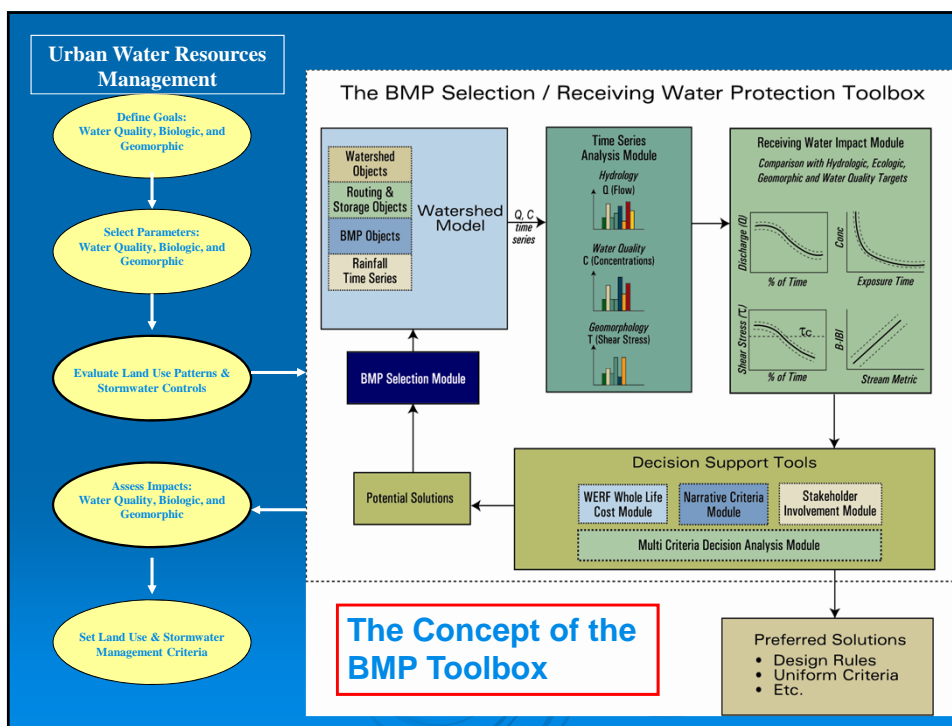
Automated Exceedance Curves with Confidence Limits



Cost Report

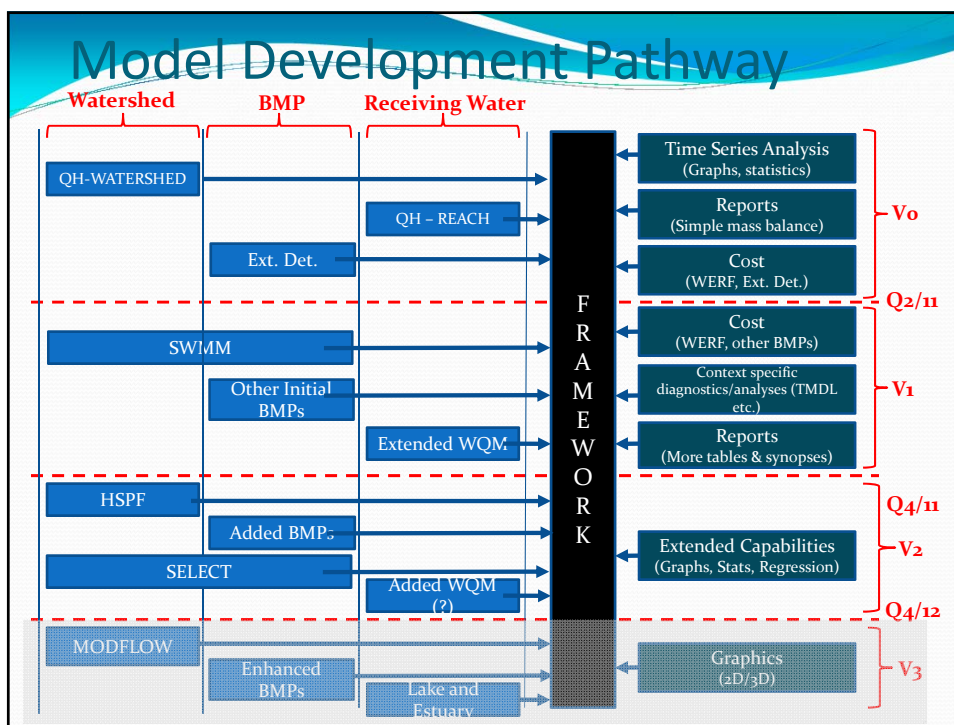
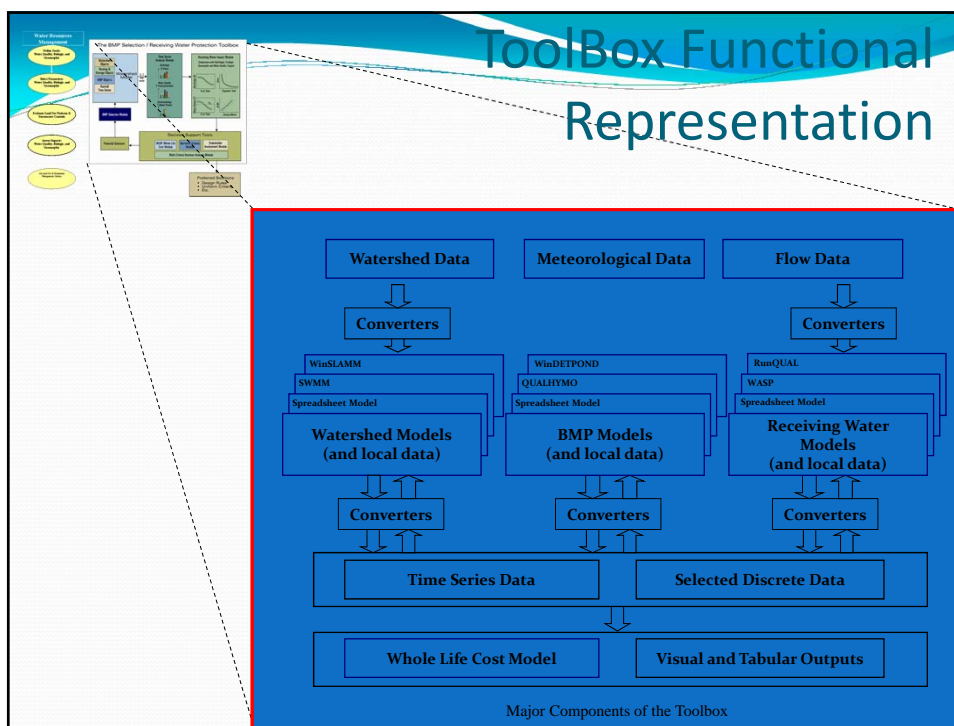
BMP Cost Report		User Info		SELECT model version 1.0				
User Name	Name of firm or organization	Report Date	5/6/2009					
User organization	Name of department or work group	Report Time	11:53 PM					
Scenario Name	No name assigned for this scenario							
Scenario Data								
Subwatershed Name	Area (acres)	BMP	BMP Area					
Subcatchment a	100	Permeabl	25					
Subcatchment 2	32	Etended I	32					
Subcatchment 3	13	Wetland E	13					
Total Area	145		70					
Capital Cost Data								
Subwatershed Name	BMP Area	Esse \$/ac	Adjustme	Cap Cost	EBP	Land	Other	Total
Subcatchment a	25	\$1,000	1.42	\$35,500	\$50,000	\$250,000	50	\$335,500
Subcatchment 2	32	\$3,750	2	\$240,000	50	50	50	\$240,050
Subcatchment 3	13	\$3,750	1.42	\$69,225	50	50	50	\$69,275
Total Capital Costs				\$344,725	\$50,000	\$250,000	50	\$644,725
O&M and Replacement Cost Data								
Subwatershed Name	Discount Rate	Life Span	O&M %	O&M \$	O&M PV	Replacement %	Replacement \$	NPV Replacement \$
Subcatchment a	5.5	20	1	\$3,355	\$40,094	20	\$260,400	\$91,500
Subcatchment 2	5.5	20	2.7	\$6,400	\$77,430	20	\$192,000	\$65,400
Subcatchment 3	5.5	25	1.4	\$969	\$13,000	20	\$55,300	\$14,500
Total Capital O&M and Replacement Costs					\$130,524			\$172,000
Summary Costs								
Subwatershed Name	Total NPV							
Subcatchment a	\$467,582							
Subcatchment 2	\$383,242							
Subcatchment 3	\$96,748							
Grand Total of All Costs	\$947,572							

The Framework Tool



Basic Components of the Framework

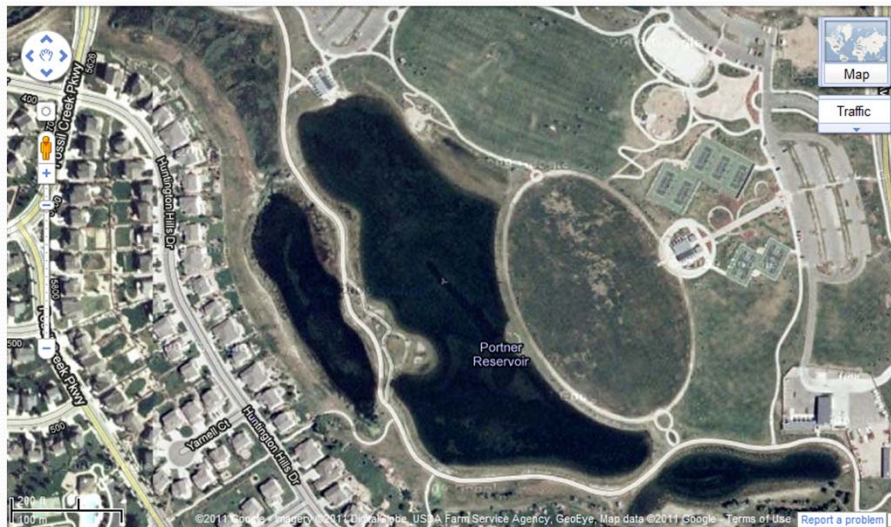
- Improved algorithms for defining BMP performance
- Screening Tools to assist with the development of cost effective BMP strategies
- Drainage System Design Tools for BMP planning to meet WQS and TMDLs
- Stakeholder Communication Tools



Fossil Creek Park Lakes Rehab

- Lake is about 12 acres
 - Average Depth – 6 ft
 - Max Depth – 12 ft
- Overturn in spring and fall cause obnoxious H₂S odors, and killed fish
- Anoxic bottom caused low DO in lake in winter greatly stressing the fishery

Fossil Creek Park Lakes



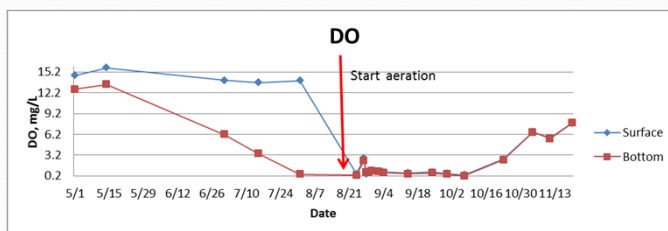
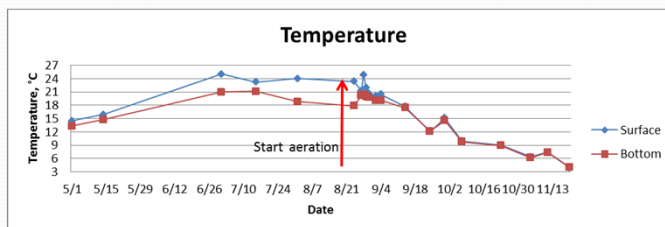




Sampling Locations



Results of Aeration



Results of Aeration (cont)

