Post-construction BMPs

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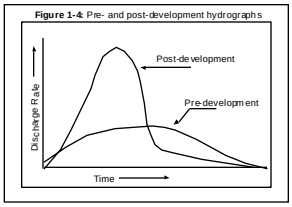
The Urbanization Stormwater Problems:

- Changes to hydrology
- Changes to water quality
- Ultimate impacts to aquatic life and humans



Post-construction BMPs

- Water Quality Impacts from Post-Construction Stormwater Runoff
- What are the requirements?
- Best Management Practices – What Have We Learned About Their Performance
- Setting up a program
- Operation and Maintenance

All in less than 1 hour!

Urbanization – Landscape Changes

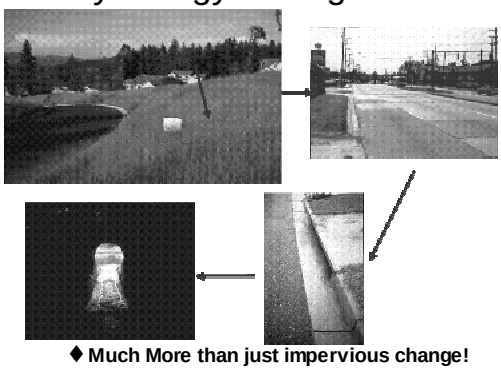
Stormwater More "Sustainable" Strategy for Post-Construction

1. Reduce (less pavement, evapotranspiration, etc.)
2. Reuse (store for irrigation, delayed evapotranspiration)
3. Recycle (infiltration)
4. Treat

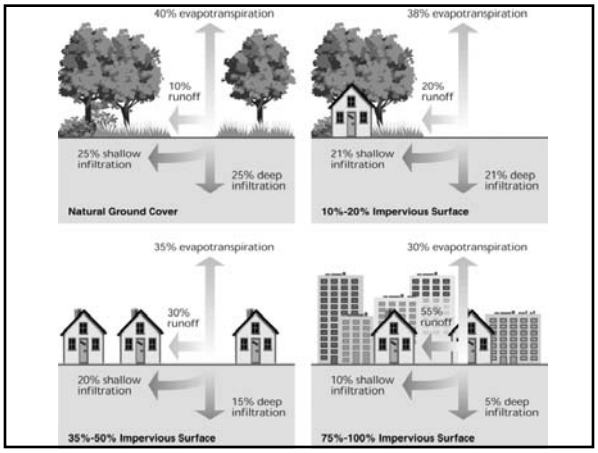
Urban Development Sources of Changes In Runoff Hydrology

- Removal of tree and/or shrub canopy
- Removal or compacting of moisture adsorptive soils
- Creation of landscaping consisting of turfs
- Creation of impervious surfaces
- Connection of these "disturbed surfaces" to the stormwater system

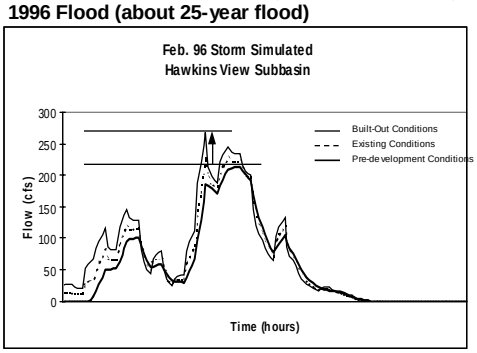
Hydrology Changes



♦ Much More than just impervious change!



Eugene Stormwater Modeling Results - February, 1996 Flood (about 25-year flood)

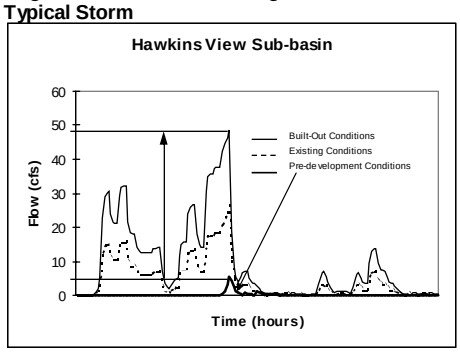


Peak Flows Increased, but not dramatically (25 to 30 percent)

Changes in Streams (perennial and ephemeral)

LT 5% IMP ***5 - 10% IMP*** ***GT 20% IMP***

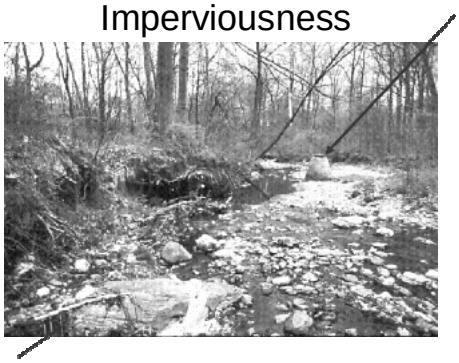
Eugene Stormwater Modeling Results - Smaller Typical Storm



Peak Flows and Volume (Increased Almost 1000 percent)

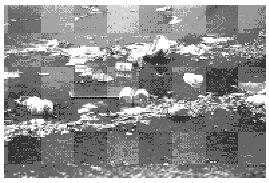
Result = More Energy in Channel

Greater Than 20% Imperviousness



Ballona Channel, Los Angeles Under Construction

Pollution Sources



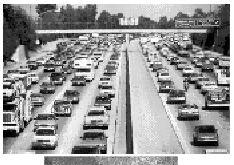
Urban and Industrial Stormwater - Typical Pollutants of Concern

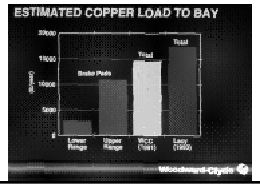
- Suspended solids – fine particulates
- Nutrients - phosphorus and nitrogen
- Metals – copper, lead, and zinc
- Oil and grease
- Bacteria – (Standard of the Month?)
- Pesticides and herbicides (Diazinon)
- Temperature
- Trash and debris

Vehicle/Pavement Washing and Irrigation

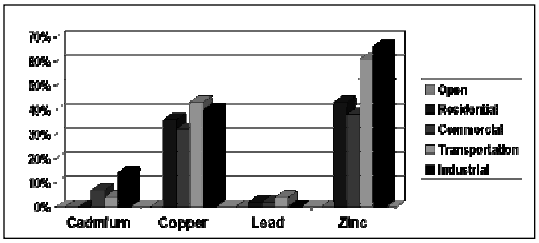
"Urban Slobber"

Pollution Sources





Summary of Oregon Stormwater Samples That Exceeded Receiving Water Water Quality Criteria



Based upon Oregon NPDES Stormwater Monitoring Data
Compiled by ACWA. Developed areas: 27 to 67 storm events; Open space: 9 storm events

Where have all the fish gone?

- Studies in Northwest have shown that in streams with more than 5 to 10 percent impervious cover, coho salmon populations are significantly impacted.
- Both Salmon and Trout species have been listed as endangered under the Federal Endangered Species Act (ESA).
- Southern California has had Trout and Salmon impacts along with other species

Phase II Minimum Control Measure:

Post-construction Stormwater Management in New Development and Redevelopment

RECOMMEND:

- The BMPs chosen should:
  - be appropriate for the local community
  - minimize water quality impacts
  - attempt to maintain pre-development runoff conditions
- Participate in watershed planning efforts
- Assess existing ordinances, policies, and programs that address stormwater runoff quality
- Provide opportunities for public participation

Results

Regulations:

- NPDES – General Requirements to Treat Runoff
- TMDLs – Specific pollutant loading limits
- Potential for new development to be determined as being a "take" under the Endangered Species Act, unless impacts are reduced.

What are the common elements of a post-construction runoff control program?

- Update of General/Comprehensive Plan and Environmental Review Procedures
- Development of Stormwater Design Standards / Ordinance
- Process for Review and Approval of Stormwater Plans for New Development
- Post-construction BMP Maintenance, Tracking and Inspection
- Penalty Provisions for Noncompliance
- Training and Education

Phase II Minimum Control Measure:

Post-construction Stormwater Management in New Development and Redevelopment

MUST:

- Develop a program, using an ordinance or other regulatory means, to address runoff from new development and redevelopment projects that disturb $\geq$ 1 acre
- Implement strategies with a combination of structural and/or non-structural BMPs
- Ensure adequate long-term operation & maintenance (O&M) of BMPs

Update of General/Comprehensive Plan and Environmental Review Procedures

- General/Comprehensive plan amendments:
  - Some cities are required by the State to develop plans to guide in decision-making process for planning (e.g., General Plans or Comprehensive Plans)
  - These plans should include watershed and stormwater quality and quantity policies
- Environmental review procedures
  - Many cities review or screen projects for potential environmental impacts
  - Ensure that the City's review procedures address stormwater quality impacts
  - Should address both construction and post-construction

Development of Stormwater Design Standards / Ordinance

- Stormwater Design Standards are used by both the development community and City engineers
- Sets minimally acceptable BMPs and sizing criteria
- Ordinance should require compliance with stormwater design standards

Estimated BMP Pollutant Removal Performances in BMP Manuals

	TSS	TP	COD	PB	CU	ZN
Stormwater Ponds						
Wet Pond	80	45	40	75	NA	60
Dry Extended Detention	45	25	20	50	NA	20
Wet Extended Detention	80	65	NA	40	NA	20
Stormwater Marsh	-20 to 98	-140 to 98		6 to 94		
Vaults/Tanks	60	30	NA	30	NA	30
Infiltration						
Infiltration Trenches/Dry Well	75	60	65	65	NA	65
Infiltration Basins	75	60	65	65	NA	65
Porous Pavements	90	65	80	100	NA	100
Filtration						
Sand Filter	85	55	55	82	53	76
Vegetated Swale	83	29	NA	63-72	63-72	63-72

Source: City of Portland, OR, Stormwater Quality Facilities: A Design Guidance Handbook

WWE

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ASCE
American Society of Civil Engineers
Urban Water Resources Research Council

EPA
United States Environmental Protection Agency

Best Management Practices – What Have We Learned About Their Performance

The International BMP Database Project

www.bmpdatabase.org

Project Approach - A Scientifically Rigorous BMP Data Collection and Analysis Effort

Products Produced to Date:

- BMP Monitoring and Reporting Protocols
- Database Tool
  - Data Input and Search
  - Available in CD (1700 distributed to-date) and Downloadable Formats
- Web Site (www.bmpdatabase.org)
  - Project Information
  - Searchable Database
  - Project Deliverables Available for Download
  - Analysis Results
  - Flat File Database – Much easier to use
- Monitoring Guidance Manual

The BMP Problems

- Widespread use of BMPs and faulty BMP performance information without sufficient understanding of performance and factors leading to performance
- Inconsistent data reporting methods limit scientific comparison/evaluation of studies
- Differences in monitoring strategies and data evaluation methods result in wide range of reported "effectiveness" (e.g. – to + percent removals)

Results: Faulty descriptions of BMP performance being applied to TMDLs and Stormwater Management Planning

Distribution of Current Studies (Summer/03)

BMP TOTALS BY CATEGORY

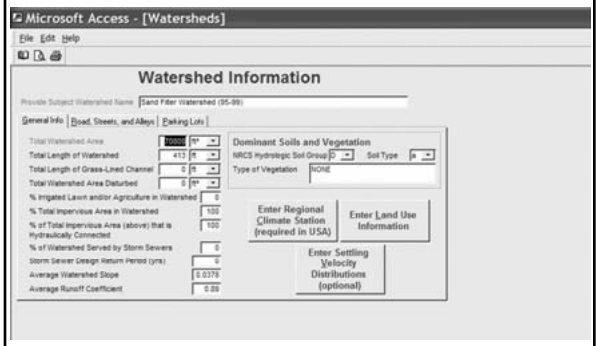
BMP CATEGORY	NUMBER OF BMPS
Structural	
Biofilter (Grass Swales)	32
Detention Basin	24
Hydrodynamic Device	16
Media Filter	30
Percolation Trench/Well	1
Porous Pavement	5
Retention Pond	33
Wetland Basin	15
Wetland Channel	14
Total	**170**
Non-Structural	
Maintenance Practice	28
Total	**28**
Grand Total	**198**

BMP TOTALS BY STATE/COUNTRY

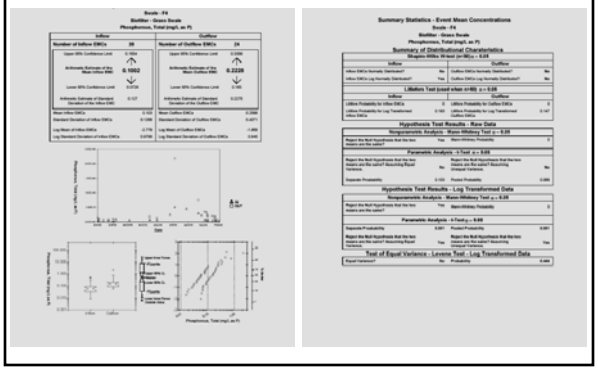
STATE	NUMBER OF BMPS
Domestic	
AL	13
CA	**41**
CO	4
FL	24
GA	2
IL	5
MD	4
MI	5
MN	7
NC	6
NJ	3
OH	1
OR	3
TX	19
VA	29
WA	20
WI	10
International	
Sweden	1
Canada	1

Over 40+ studies waiting be entered (funding)

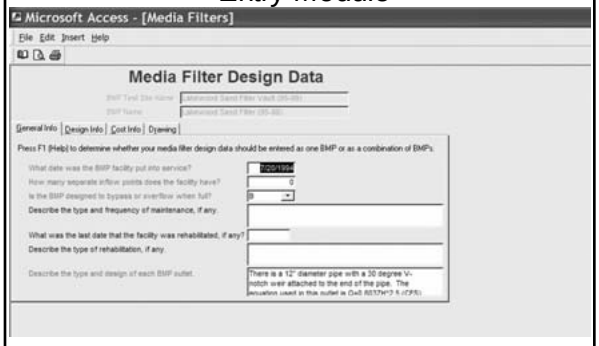
BMP Software: BMP Database Data Entry Module



Updated Statistical Analysis – PDF Documents Water Quality Analysis



BMP Software: BMP Database Data Entry Module



Recommended Measures of BMP Performance

- How much stormwater runoff is prevented? ("hydrological source control")
- How much of the runoff that occurs is treated by the BMP or not ("hydraulic performance")?
- Of the runoff treated, what is the effluent quality? ("concentration characteristics achieved")
- Does the BMP address downstream erosion impacts?

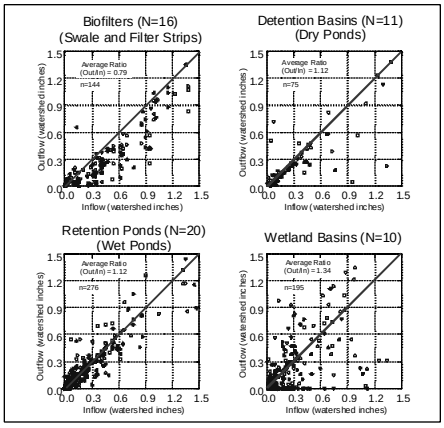
Percent Removal is <u>Very Problematic</u> and NOT RECOMMENDED as a performance measure for BMPs

Protocols in Practice - The Manual

- The manual is available for download: WWW.BMPDATABASE.ORG
- Over 25,000 downloads to date from web site
- Guidance is highly relevant for various levels of BMP monitoring

Runoff Volume Control

- ET losses
- Infiltration



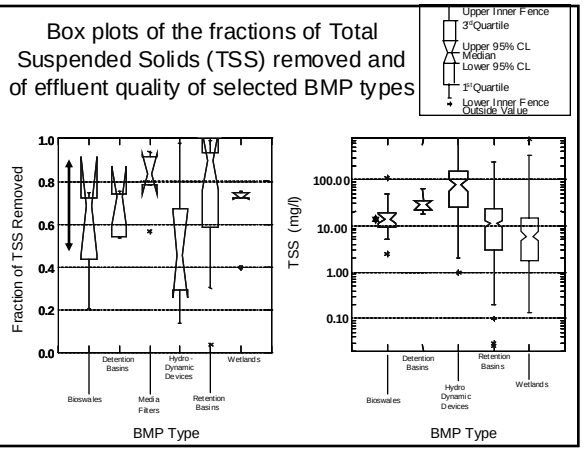
Runoff Volume Control

BMP Type	Mean Monitored Outflow/Mean Monitored Inflow for Events Where Inflow is Greater Than or Equal to 0.2 Watershed Inches
Detention Basins	0.70
Biofilters	0.62
Media Filters	1.00
Hydrodynamic Devices	1.00
Wetland Basins	0.95
Retention Ponds	0.93
Wetland Channels	1.00

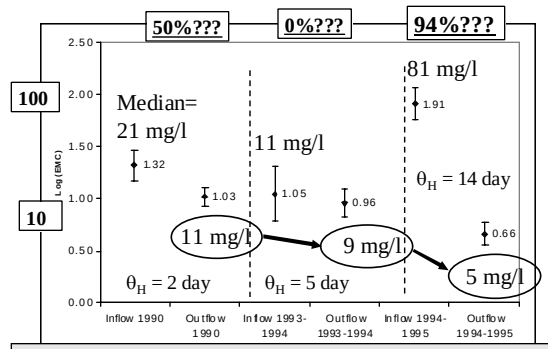
Percent Removal? Example Study -SWFWMD Pond

- Drainage area, 6.5 acres
- Land use (commercial, office)
  - 30% roof tops and parking lots, 6% crushed stone, 64 % grassed
  - Drained by swales to pond
- Five year study with two design modifications
  - 1990 (shallow and vegetated, θ_H = 2 day)
  - 1993 (volume increased, 35% veg, θ_H = 5 day)
  - 1994 (area enlarged, replant littoral zone, θ_H = 14 day)

Box plots of the fractions of Total Suspended Solids (TSS) removed and of effluent quality of selected BMP types

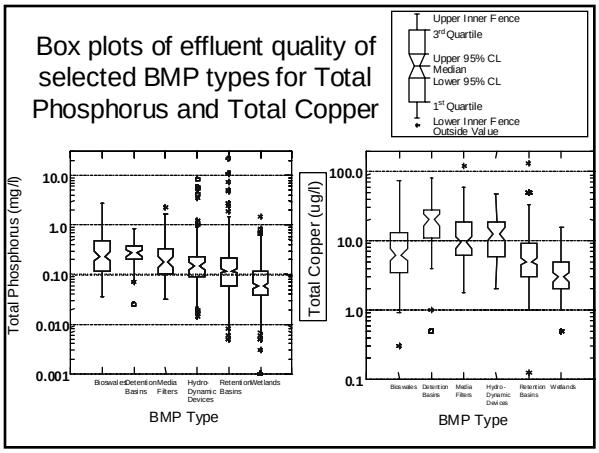


Inflow and Outflow Log Mean TSS Concentrations (mg/l) and 95 Percent Confidence Limits for 3 Different Designs of a Wet Pond Located at SWFWMD Service Office in Tampa, Florida.



Was 7 times larger worth going from about 10 to about 5 mg/l?

Box plots of effluent quality of selected BMP types for Total Phosphorus and Total Copper



BMP "Acceptance"

- A huge issue for communities: Are all "BMPs" acceptable regardless of performance
- Developing acceptance standards that are defensible as well as result in well performing BMPs

Lake George Field Study Evaluation Vortechs model 11000

Runoff	TSSin (mg/L)		TSSout (mg/L)		% Reduction	
Event #	Interpolated	Arithmetic	Interpolated	Arithmetic	Interpolated	Arithmetic
1	987.48	693.52	263.18	205.98	73%	70%
2	128.73	88.57	59.23	59.18	54%	33%
3	1040.04	882.42	337.87	486.75	68%	45%
4	213.73	225.42	359.14	388.08	-68%	-72%
5	1673.57	1217.53	71.39	102.84	96%	92%
6	535.16	603.54	70.14	85.23	87%	86%
7	180.81	132.22	29.76	34.88	84%	74%
8	2491.55	2202.78	35.41	35.47	99%	98%
9	89.99	76.60	31.98	33.14	64%	57%
10	1047.02	2257.46	37.08	31.22	96%	99%
11	439.45	344.86	16.57	13.83	96%	96%
12	445.19	291.58	17.36	14.91	96%	95%
13	1156.16	674.94	44.72	37.91	96%	94%
Averages	802.2215	745.4954	105.6792	117.6477	87%	84%

(Winkler and Guswa 2002)

Is an average of 100+ mg/l TSS effluent acceptable performance?

Analysis Findings

- Results of the analyses of the now expanded database have reinforced the initial finding that BMPs are best described by:
  1. how much they reduce runoff volumes, [Hydrologic Source Control]
  2. how much of the runoff that occurs is treated (and not) by the BMP (e.g., bypass or overflow), [Hydraulic Performance]
  3. and of the runoff treated what effluent quality (concentrations and toxicity potential) is achieved? [Water Quality Performance]

Relating Design to Performance

- One of the primary long-term project objectives
- Multiple regression analyses
- Sub-sample parameter analyses

Analysis Findings Cont.

These Basic BMP performance description elements can be utilized to:

- assess the concentrations that BMPs are able to achieve (concentration TMDLs),
- more accurately assess effects on total loadings (TMDLs) (how much runoff is prevented, treated and more realistic estimates of resulting loads)
- frequency of potential exceedances of water quality criteria or other targets, and
- other desired water quality performance measures.

For the First Time We Can Say
(and back-up with statistics):

"BMP Effluent Quality for different BMP types is different,"

"Big Wet Ponds (in Relationship to Storm Inflow Sizes) Work Better Than Little Wet Ponds,"

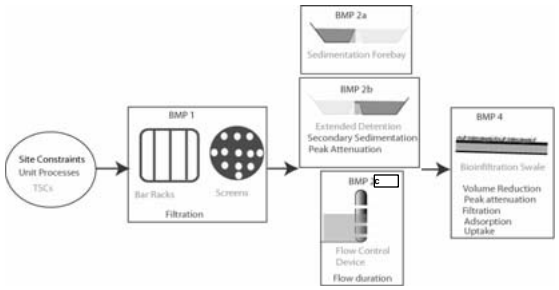
and

"Some BMPs beside infiltration systems appear to provide significant volume reductions that should be accounted for in performance"

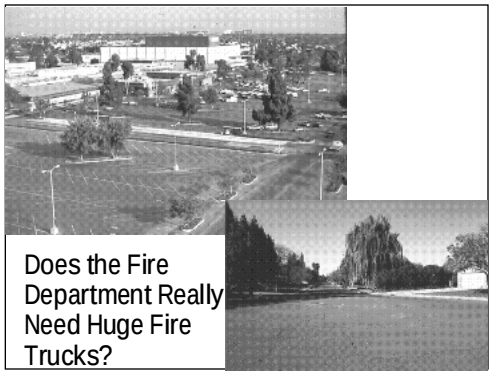
WERF/NCHRP Guidance Manual Outline

1. Introduction
2. Characterize Conditions and Constraints
3. Identify Fundamental Unit Process Categories
4. Integrated Unit Process Design Approach
5. Critically Assess BMP Options
6. Design BMP or BMP Systems
7. Low-Impact Development/Distributed BMP Systems
8. Example Applications of BMP Selection and Design
9. Monitoring and Evaluation
   - BMP Performance and Evaluation
   - Data Needs for improving URC Selection and Design
10. Conclusions and Recommendations

Trash/Debris, TSS and Dissolved Copper – TMDL -Alternative 1



Design for 25 – Year Shopping Event?



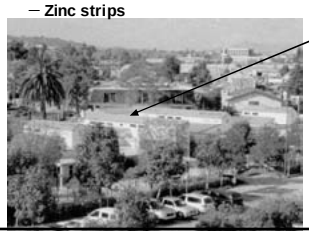
Does the Fire Department Really Need Huge Fire Trucks?

Solving the Problems: BMP Tools

1. **Site Planning:**
   - **Hydrological source control**
   - **Pollution source control**
   - **On-site "lower impact" stormwater management techniques for treatment and flow control**
2. **On-site treatment via end of pipe "structural" facilities**
3. **In-stream stabilization measures**
4. **Regional water quality/flow management facilities**

Inert Building Materials

- **Building Materials with High Pollution Potential**
  - **Copper/Zinc Roofs**
  - **Copper/Zinc Downspouts**
  - **Treated wood**
  - **Asphalts**
  - **Zinc strips**
- **Alternatives:**
  - **Coated Steel Roofs (Copper Color)**
  - **Coated Aluminum downspouts**
  - **Allow moss to grow**



Managing the "Sponge"

- **Typical Urban Development has severely reduced the <u>evapotranspiration</u> and infiltration**
- **To often, we think infiltration could be the answer in areas where pre-development infiltration was minimal, but is eliminated due to soils and/or slope conditions concerns**
- **We need to look at ways of mimicking pre-development evapotranspiration rates**
- **"Sponge" includes:**
  - **Trees, Shrubs and Grasses**
  - **Shallow soils (non compacted)**
  - **EcoRoofs**

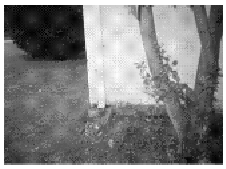
Narrow Streets, No Curb Swale Examples

The Woodlands, Texas

Patrick Condon, UBC

Eugene, OR

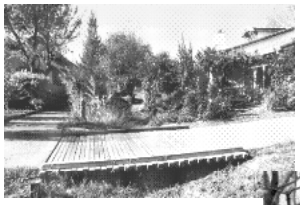
Reduce Runoff – Disconnected Roof Drains, Pervious Pavements, and Reduced Impervious Surfaces




Parking Lot Vegetated Swales


Grass Swale with Trees and a vegetated swale (native plants) with gravel

Drainage Swales Within Development



Tustin Ranch, Tustin, CA

Village Homes, Davis, CA

Infiltration Swale

Village Homes

Village Homes, Davis, CA. Project has no stormwater pipes; most of the runoff infiltrates (in poor soils). Built almost 30 years ago. Saved about $1,000 per lot in 1970s.

BioRetention Facility

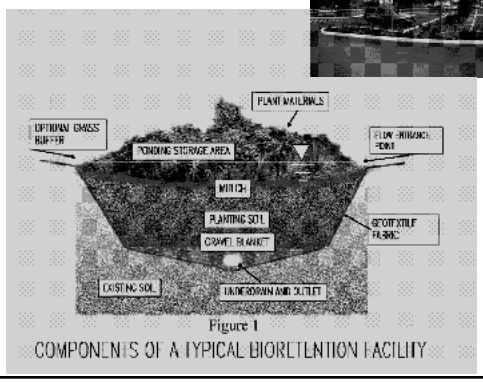
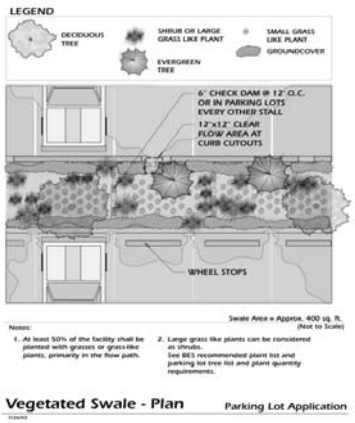
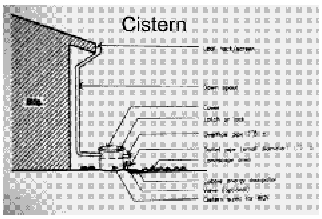


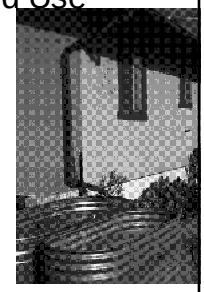
Figure 1
COMPONENTS OF A TYPICAL BIORETENTION FACILITY

City of Portland - Simplified Approach Parking Lot Swales



Rainfall Storage and Use





Cisterns for roof drains – underground or above ground components. Stores rainwater for later use. Reduces runoff.
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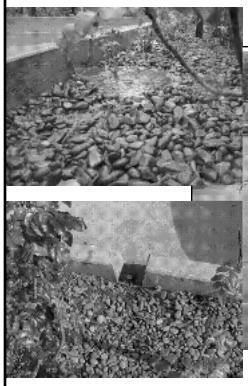
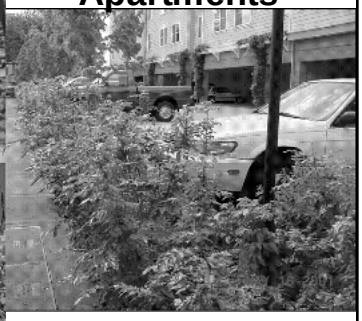
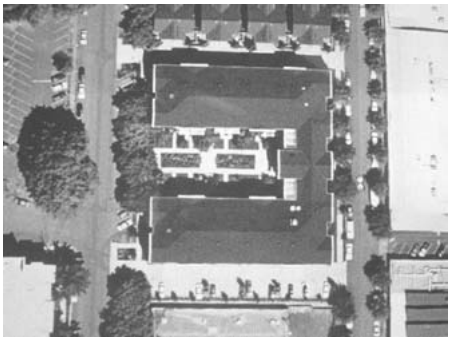
Buckman Heights Apartments

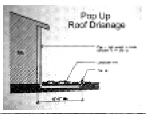




Buckman Heights Apartments



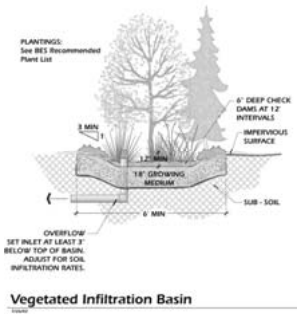
Apartment Courtyard Biofiltration System



Runoff is directed to center planter and either infiltrates or overflows into small inlets

City of Portland **Simplified Approach**

- **Make Using "Green Standards" Easier**



Vegetated Infiltration Basin

Buckman Terrace Apartments- Stormwater Planters

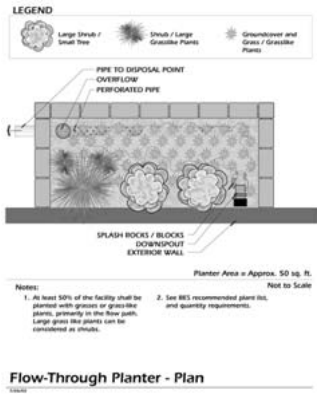
Figure I.6.10

Buckman Heights Apartments

Figure I.6.12

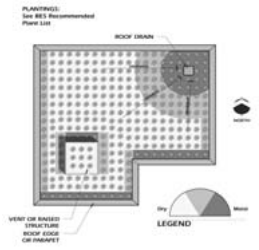
Roofs – Good Looking?

City of Portland – Simplified Method

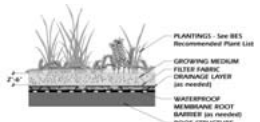


Flow-Through Planter - Plan

City of Portland -Simplified Approach



Ecoroof Evaporation Diagram



SIMPLIFIED APPROACH DESIGN CRITERIA

Eco-roof

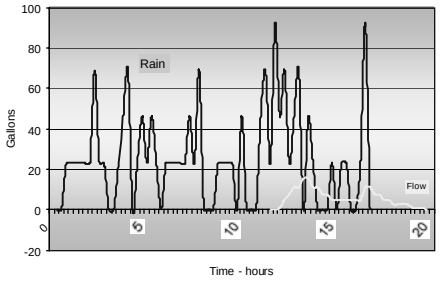
Traditional vs. Integrated Landscape Stormwater Design Approaches

Project	Integrated Approach	Cost: Traditional vs. Integrated Approach	Savings
OMSI (commercial)	"Naturescaped" bioswales in parking lots	$273K vs. $195K	$78,000
Walnut Park Police Station (commercial)	Bioswale and infiltration area in parking lot	$10K vs. $1K	$9,000
Flex Alloy (industrial)	Flow-through grass filters and swale	$79K vs. $68K	$11,000
Canby Village (31-home subdivision, including streets)	Open channel bioswales and soakage trenches	$79K vs. $58K	$21,000

Detention Based BMPs - Ponds

- Wet
- Dry
- Dry Extended Detention
- Wet Extended Detention

Hamilton Ecoroof westside rainfall and runoff
June 28-29, 2002 storm event 0.73"



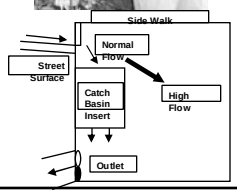
- **If the 239 gallons of rainfall from the impervious surfaces was removed then no runoff would have occurred**
- **Summer flows reduced up to 80 percent, winter 30 to 40%**

Detention Based BMPs - Stormwater Marshes

- Shallow Marsh Systems
- Extended Detention Wetlands
- "Pocket" Wetlands
- Pond/Marsh Systems

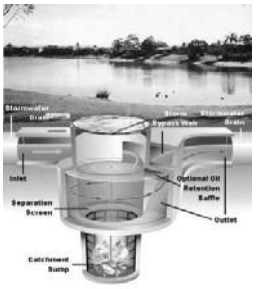
Lake Tahoe Stormwater Wetland

Potential Catchbasin Retrofit Potential for Trash and Debris Removal



Davis, CA Wetland/Pond System

CDS Unit – Hydraulic Particle Separation

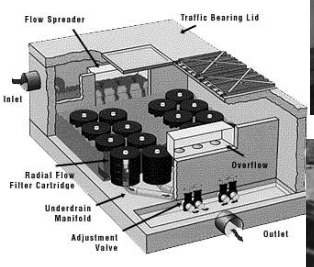


CDS Solids Separation System

Other Treatment BMP Types

- Catch Basin Inserts
- MSDs
- Filters

Underground Filtration – Stormwater Management Inc., StormFilter



Low-impact development

- Smaller-scale, distributed BMPs
- Focused on retention and infiltration
- Multiple benefits in addition to stormwater control

Residential bioretention system

State Stormwater Design Manuals

- Some States have developed statewide stormwater design manuals
  - E.g., Maryland, Georgia, New York, Vermont, Washington, etc.
- If your State has adopted a manual, your Phase II post-construction program will probably need to comply with that manual.

Low Impact Development Resources

EPA references:

- Low Impact Development Design Strategies: An Integrated Design Approach
- Low Impact Development Hydrologic Analysis
- Low Impact Development Literature Review and Fact Sheets

- http://www.epa.gov/nps/lid/
- http://www.lowimpactdevelopment.org/

Questions to Consider When Adopting New Stormwater Design Standards

- What kind of development do you expect in the future?
- What kind of impacts does development cause in your community?
- What kind of rain falls on the community (e.g., intensity, seasonality)?
- How experienced is your community with stormwater management?
- What kind of design standard do you really need?

Incorporating LID into BMP Requirements

- Require that developments consider treatment BMPs in this order:
  1. On-site hydrological source control measures (e.g., LID, infiltration, cisterns, ET losses).
  2. On-site effective treatment controls
  3. Regional treatment systems (however, allow if significant benefit)

Additional Design Standard Tips

- Establish basic rules and engineering criteria
- Provide flexibility in interpretation
- Allow manual or technical guidance to be revised administratively
- Standardize the review process

Early Design Standard Decisions

- What minimum threshold should you set?
  - Minimum site size
  - Waivers and exemptions
  - Review burden

Example: Western Washington Stormwater Manual

- 5 Volumes
  - Volume I - Minimum Technical Requirements and Site Planning
  - Volume II - Construction Stormwater Pollution Prevention
  - Volume III - Hydrologic Analysis and Flow Control Design/BMPs
  - Volume IV - Source Control BMPs
  - Volume V - Runoff Treatment BMPs

Getting your design standards accepted

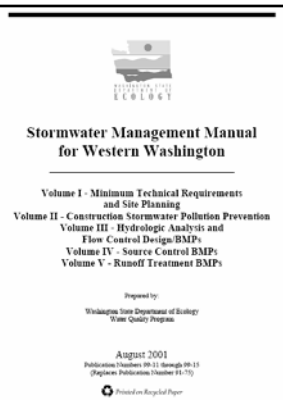
- Review other stormwater manuals and design standards
- Market your design standards/manual to the public, elected officials, developers, engineers
  - Link to local concerns
  - Costs and economic benefits
  - Education, education, education
- Address concerns directly

Western Washington Flow Control/Treatment Standards

- Uses a rainfall-runoff continuous hydrologic simulation model (HSPF)
- Match discharge durations of flows from the developed site to the durations of flows from the pre-developed site for the range of pre-development discharge rates from 50% of the 2-year peak flow up to the full 50-year peak flow.
- Pre-developed condition shall be forested land cover.
- Requires treatment of runoff from pollution-generating impervious and pervious surfaces.

Example Requirements

- EPA's National Urban Management Measures Guidance
- Western Washington Stormwater Manual
- Los Angeles Standard Urban Stormwater Mitigation Plans (SUSMPs)
- Maryland Stormwater Design Manual
- City and County of Honolulu
- City of Portland


Stormwater Management Manual
for Western Washington

Volume I - Minimum Technical Requirements
and Site Planning
Volume II - Construction Stormwater Pollution Prevention
Volume III - Hydrologic Analysis and
Flow Control Design/BMPs
Volume IV - Source Control BMPs
Volume V - Runoff Treatment BMPs

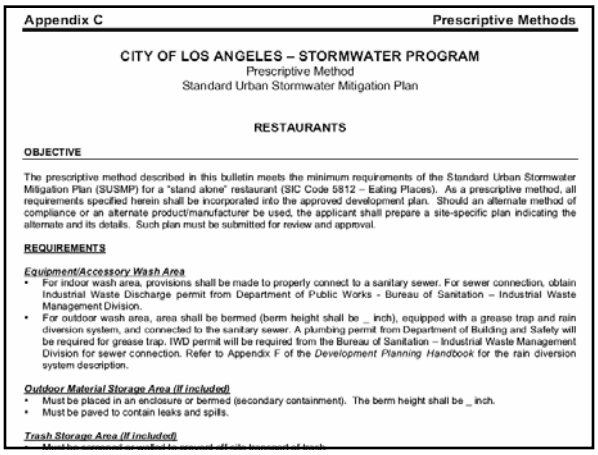
August 2001

http://www.ecy.wa.gov/programs/wq/stormwater/manual.html

Example: Los Angeles Standard Urban Stormwater Mitigation Plans (SUSMPs)

SUSMP Project Categories

- Single-Family Hillside Residences
- 10+ Units Housing Developments
- 1 Acre+ Commercial/Industrial Developments
- Automotive Service Facilities
- Retail Gasoline Outlets
- Restaurants
- Parking Lots 5,000 ft^2 or more or with 25 or more parking spaces
- Projects located in, adjacent to or discharging directly to a designated Environmental Sensitive Area (ESA)



Appendix C — Prescriptive Methods

CITY OF LOS ANGELES – STORMWATER PROGRAM
Prescriptive Method
Standard Urban Stormwater Mitigation Plan

RESTAURANTS

OBJECTIVE

The prescriptive method described in this bulletin meets the minimum requirements of the Standard Urban Stormwater Mitigation Plan (SUSMP) for a "stand alone" restaurant (SIC Code 5812 – Eating Places). As a prescriptive method, all requirements specified herein shall be incorporated into the approved development plan. Should an alternate method of compliance or an alternate product/manufacturer be used, the applicant shall prepare a site-specific plan indicating the alternate and its details. Such plan must be submitted for review and approval.

REQUIREMENTS

Equipment/Accessory Wash Area

- For indoor wash area, provisions shall be made to properly connect to a sanitary sewer. For sewer connection, obtain Industrial Waste Discharge permit from Department of Public Works - Bureau of Sanitation – Industrial Waste Management Division.
- For outdoor wash area, area shall be bermed (berm height shall be _ inch), equipped with a grease trap and rain diversion system, and connected to the sanitary sewer. A plumbing permit from Department of Building and Safety will be required for grease trap. IWD permit will be required from the Bureau of Sanitation – Industrial Waste Management Division for sewer connection. Refer to Appendix F of the *Development Planning Handbook* for the rain diversion system description.

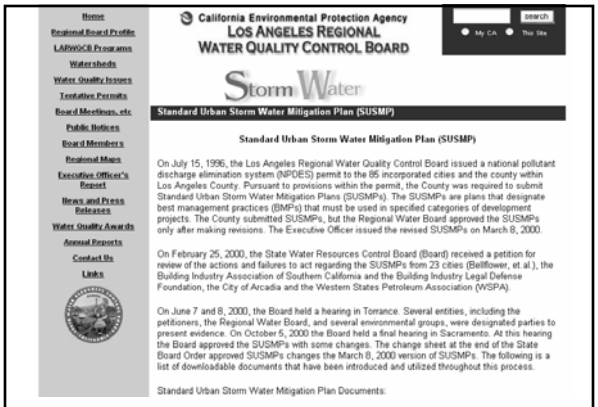
Outdoor Material Storage Area (If included)

- Must be placed in an enclosure or bermed (secondary containment). The berm height shall be _ inch.
- Must be paved to contain leaks and spills.

Trash Storage Area (If included)

SUSMP Numerical Design Standards

- Design standards for volumetric treatment control BMPs:
  - 85th percentile 24-hour rainfall event
  - Volume of runoff to achieve 80% volume treatment
  - 0.75 inch storm event
- Design standards for flow based treatment control BMPs:
  - 0.2 inches/hour intensity
  - Two times the 85th percentile hourly rainfall intensity



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Storm Water

Standard Urban Storm Water Mitigation Plan (SUSMP)

Standard Urban Storm Water Mitigation Plan (SUSMP)

On July 15, 1996, the Los Angeles Regional Water Quality Control Board issued a national pollutant discharge elimination system (NPDES) permit to the 85 incorporated cities and the county within Los Angeles County. Pursuant to provisions within the permit, the County was required to submit Standard Urban Storm Water Mitigation Plans (SUSMPs). The SUSMPs are plans that designate best management practices (BMPs) that must be used in specified categories of development projects. The County submitted SUSMPs, but the Regional Water Board approved the SUSMPs only after making revisions. The Executive Officer issued the revised SUSMPs on March 8, 2000.

On February 25, 2000, the State Water Resources Control Board (Board) received a petition for review of the actions and failures to act regarding the SUSMPs from 23 cities (Bellflower, et al.), the Building Industry Association of Southern California and the Building Industry Legal Defense Foundation, the City of Arcadia and the Western States Petroleum Association (WSPA).

On June 7 and 8, 2000, the Board held a hearing in Torrance. Several entities, including the petitioners, the Regional Water Board, and several environmental groups, were designated parties to present evidence. On October 5, 2000 the Board held a final hearing in Sacramento. At this hearing the Board approved the SUSMPs with some changes. The change sheet at the end of the State Board Order approved SUSMPs changes the March 8, 2000 version of SUSMPs. The following is a list of downloadable documents that have been introduced and utilized throughout this process.

Standard Urban Storm Water Mitigation Plan Documents:

http://www.swrcb.ca.gov/rwqcb4/html/programs/stormwater/susmp/susmp_details.html
http://www.lastormwater.org/Pages/partb.htm

City of Los Angeles – BMP Manual

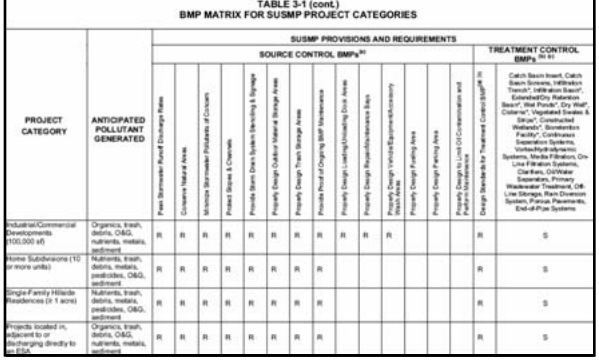

TABLE 3-1 (cont.)
BMP MATRIX FOR SUSMP PROJECT CATEGORIES

PROJECT CATEGORY	ANTICIPATED POLLUTANT GENERATED	SUSMP PROVISIONS AND REQUIREMENTS: SOURCE CONTROL BMPs[a]																TREATMENT CONTROL BMPs [b] [c]
		Peak Stormwater Runoff Discharge Rates	Conserve Natural Areas	Minimize Stormwater Pollutants of Concern	Protect Slopes & Channels	Provide Storm Drain System Stenciling & Signage	Properly Design Outdoor Material Storage Areas	Properly Design Trash Storage Areas	Provide Proof of Ongoing BMP Maintenance	Properly Design Loading/Unloading Dock Areas	Properly Design Repair/Maintenance Bays	Properly Design Vehicle/Equipment Wash Areas	Properly Design Fueling Area	Properly Design Parking Area	Properly Design to Limit Off-Site Conveyance and Pollutant Transportation	Design Standards for Treatment Control BMPs [b] [c]
Industrial/Commercial Developments (100,000 sf)	Organics, trash, debris, O&G, nutrients, metals, sediment	R	R	R	R	R	R	R	R	R	R	R	R				R	S
Home Subdivisions (10 or more units)	Nutrients, trash, debris, metals, pesticides, O&G, sediment	R	R	R	R	R	R	R	R								R	S
Single-Family Hillside Residences (≥ 1 acre)	Nutrients, trash, debris, metals, pesticides, O&G, sediment	R	R	R	R	R	R	R	R								R	S
Projects located in, adjacent to or discharging directly to an ESA	Organics, trash, debris, O&G, nutrients, metals, sediment	R	R	R	R	R	R	R	R								R	S

Catch Basin Insert, Catch Basin Screens, Infiltration Trench*, Infiltration Basin*, Extended/Dry Retention Basin*, Wet Ponds*, Dry Well/ Cisterns*, Vegetated Swales & Strips*, Constructed Wetlands*, Bioretention Facility*, Continuous Separation Systems, Vortex/Hydrodynamic Systems, Media Filtration, On-Line Filtration Systems, Clarifiers, Oil/Water Separators, Primary Wastewater Treatment, Off-Line Storage, Rain Diversion System, Porous Pavements, End-of-Pipe Systems

More Comprehensive Requirements

- Source Controls
  - No zinc or copper roof materials
  - Cover garbage areas
- Site Planning
  - Minimize impervious areas
  - Route runoff to vegetated areas
  - Preserve natural areas
- <u>And</u> Treatment Controls

Post-construction BMP Maintenance, Tracking and Inspection

- Develop a program to address post-construction BMP maintenance, tracking and inspection
  - How will the City ensure maintenance?
  - How will the City track all of the approved treatment control BMPs?
  - How will the City inspect BMPs to ensure they are adequately maintained?
- This is a ½ + day topic by itself

Training and Education

- The City must train it's own staff on the post-construction program
  - Plan review staff
  - Construction inspectors
  - BMP maintenance inspectors
  - Code enforcement, others?
- Local developers and engineers must also be educated so they develop adequate plans.
- Education for property owners on maintenance of BMPs

Inspections to ensure BMPs are adequately installed

Inspections to ensure adequate maintenance

Summary

- International BMP Database has good data on rain event BMP performance:
  - Percent removal is a faulty and misleading description of BMP performance
  - Effluent data on numerous BMPs for rain events and established differences in effluent quality for BMP types
  - Better overall description of performance has been developed
  - "Hydrological source control" of some BMPs demonstrated

Penalty Provisions for Noncompliance

- Can include non-monetary penalties, fines, bonding requirements, permit denial, or denial of occupancy permit.
- Develop an escalating enforcement plan to document steps that will be taken to address non-compliance
- Educate staff on how to use penalty provisions when necessary

Points to Ponder

- It is OK to "Beg, Barrow, and Steal," but one should still think
- BMP performance is an evolving field
- One should focus on solving local problems first and then "meet the requirements"
- Lot's of oxymoron's in this field:
  - e.g., "Six Minimum Measures" to meet the "Maximum Extent Practicable"