Condensed Planning & Design Guide for Surface Water Pollution Control Planning and Permanent Best Management Practices

Creating pervious surfaces for new development and redevelopment

From Marin County Storm Water Pollution Prevention Program (MCSTOPPP) and BASMAA's Start at the Source,1999 Edition

ACKNOWLEDGEMENTS

This document was prepared for Marin County Stormwater Pollution Prevention Program (MCSTOPPP) of the DPW Flood Control & Water Conservation District. The following agencies and individuals have contributed to its development.

Agencies:

Bay Area Stormwater Management Agencies Association (BASMAA):
Start at the Source, 1999 Edition design standards and illustrations
MCSTOPPP Agency Staff
Marin County Flood Control & Water Conservation District
Marin County Land Development

Individuals:

John Wooley, PE: Design review
Eric Steger, PE: Design review
Liz Lewis, Wildlife Biologist: Design review
Dave Nicholson, EIT: Design

Version-III, March, 2003

CONTENTS

INTRODUCTION

The way we design and build residential, commercial and industrial structures can have a direct affect on stormwater quality. These structures may create impervious surfaces that direct stormwater flow horizontally, rather than vertically into the ground, often resulting in concentrated runoff that may adversely affect watersheds.

Studies have shown that most rainfall infiltrates into natural pervious ground rather than flowing over the surface resulting in less pollution and erosion damage. When impervious structures are created, any or all of the following may result.[1]

- stream degradation and natural channel erosion acceleration
- groundwater depletion
- increase non-point source pollution in streams
- increase in stream water temperature

The Bay Area Stormwater Management Agencies Association (BASMAA) has developed a manual called Start at the Source (1999 Edition) to help remedy the situation. This manual is intended to be a guide for employing design standards that significantly reduce stormwater runoff. Furthermore, in an attempt to aid architects, developers, and municipal agencies in implementing these design standards, Marin County Flood Control & Water Conservation District has produced the following design matrix.

How to use the Matrices
There are six matrices, each one for a different structure type: pavement, streets, driveways, parking lots, buildings, and landscape. Each matrix rates a design solution for a certain parameter and site condition. First consider the structure type. Then consider site-specific conditions. Finally, determine design method(s) that maximize surface water infiltration while meeting your site-specific needs.

Within the rating system, there are three general ratings; 1) not good, 2) acceptable, and 3) most desired (each rating has a corresponding symbol). Match the site condition with the design method to determine its rating. Subsequent drawings help illustrate the design method. Also, design methods and engineer drawings are referenced to Start at the Source at bottom of each matrix.

Please note that design methods in this matrix are only recommendations for alternative structures that reduce stormwater runoff pollution. This design guide in not intended to be a prescriptive document or to limit solutions to design problems. For more information please refer to the Start at the Source handbook, 1999 Edition. Also, on the internet, refer to the following web pages for more information.

http://www.basmaa.org/
http://mcstoppp.org/

1. *Start at the Source*, BASMAA, 1999, page-5

Condensed Planning & Design Guide for Surface Water Pollution Control Planning and Permanent Best Management Practices

Creating pervious surfaces for new development and redevelopment

STRUCTURE TYPE:

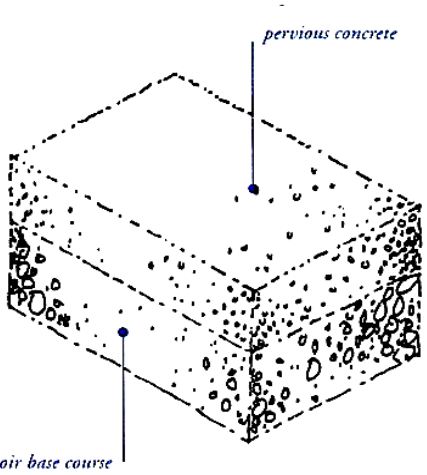
PERMEABLE PAVEMENTS

DESIGN METHOD

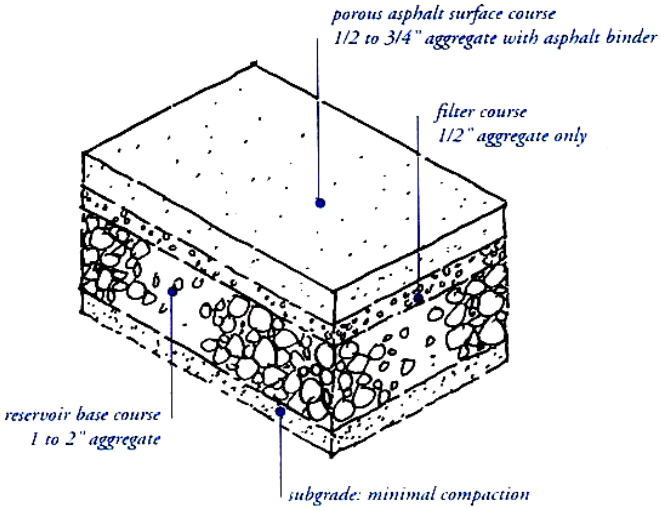
☐ = not good ⊡ = acceptable ■ = most desired

PARAMETER	SITE CONDITION	*Conventional Asphalt/Concrete*	Pervious Concrete	Porous Asphalt	Turf Block	Brick	Natural Stone	Concrete Unit Pavers	Crushed Aggregate	Cobbles
SOIL TYPE	Clay	⊡	☐	☐	⊡	⊡	⊡	⊡	■	■
	Loam	⊡	⊡	⊡	⊡	⊡	⊡	⊡	■	■
	Sandy	⊡	■	■	■	■	■	■	■	■
	Shallow Bedrock	⊡	■	■	■	■	■	■	■	■
SLOPE	0% to 3%	☐	⊡	⊡	■	■	■	■	■	■
	4% to 7%	☐	■	■	■	■	■	⊡	⊡	⊡
	8% to 12%	⊡	■	■	⊡	⊡	⊡	⊡	☐	☐
	>12%	⊡	■	■	☐	☐	☐	⊡	☐	☐
CLIMATE	NE County (Novato area)	⊡	■	⊡	■	⊡	■	■	■	■
	NW County (Tomales area)	⊡	■	⊡	■	⊡	■	■	■	■
	SE County (San Rafael to Sausalito areas)	⊡	■	⊡	■	⊡	■	■	■	■
	SW County (Woodacre to Point Reyes areas)	⊡	■	⊡	■	⊡	■	■	■	■
PROXIMITY TO WATER/ STORMDRAIN	>1,000 ft (usually rural areas)	⊡	■	■	■	■	■	■	■	■
	500 ft to 1,000 ft (usually rural, some urban areas)	⊡	■	■	■	■	■	■	■	■
	100 ft to 500 ft (usually urban, some rural areas)	⊡	⊡	⊡	■	⊡	■	■	■	■
	50 ft to 100 ft (usually urban areas)	☐	⊡	⊡	■	⊡	⊡	■	⊡	⊡
COST H = High M = Moderate L = Low	Initial	M	H	H	M	H	H	H	L	L
	Maintenance	L	H	H	H	M	M	M	M	M
Effectiveness For Reducing Runoff		☐	■	■	■	⊡	⊡	⊡	■	⊡
Durability/Life Span		■	⊡	⊡	⊡	■	■	■	☐	☐
"Start at the Source" 1999 Reference-Book Page Number(s)		N/A	47, 101	48,49 102	50, 104	50, 105	51, 106	51,52 107	52,53 108	53, 109

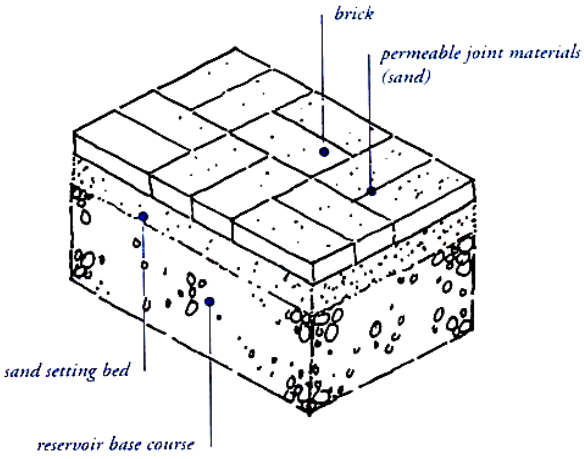
PERMEABLE PAVEMENT DESIGN SAMPLES



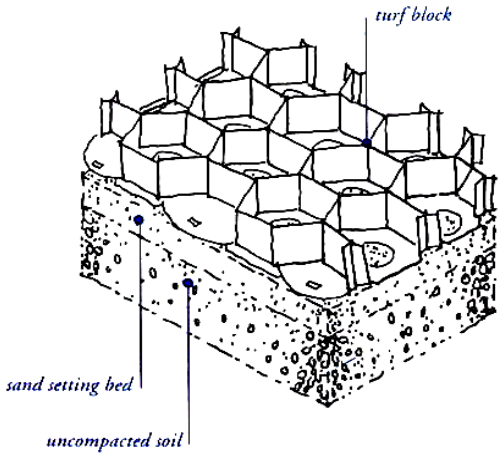
Pervious concrete



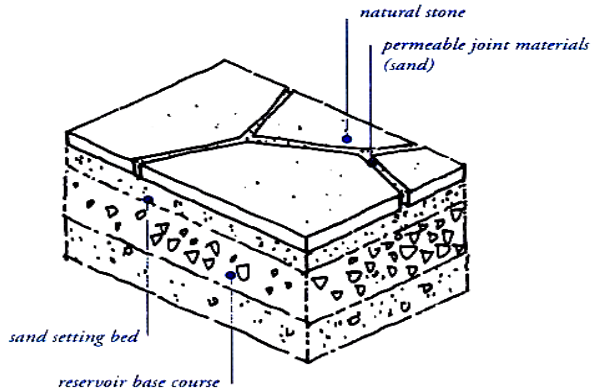
Porous asphalt



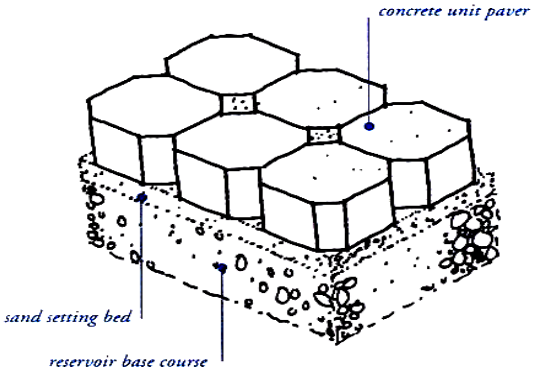
Brick



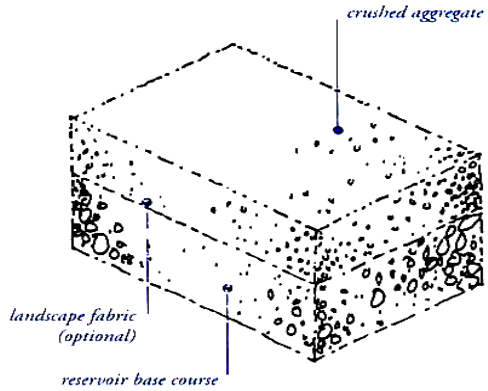
Turf block



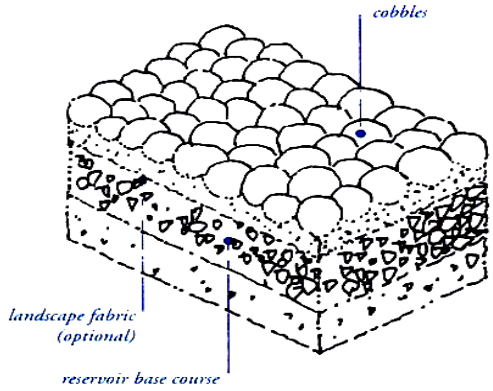
Natural stone



Concrete unit pavers



Crushed aggregate



Cobbles

Condensed Planning & Design Guide for Surface Water Pollution Control Planning and Permanent Best Management Practices

Creating pervious surfaces for new development and redevelopment

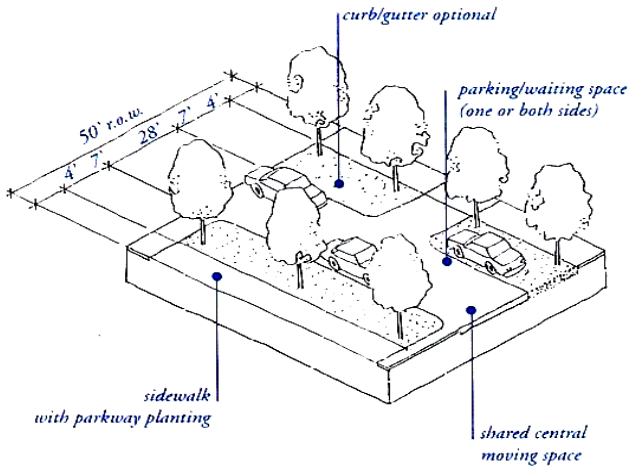
STRUCTURE TYPE: STREETS

DESIGN METHOD

□ = not good ⊡ = acceptable ■ = most desired

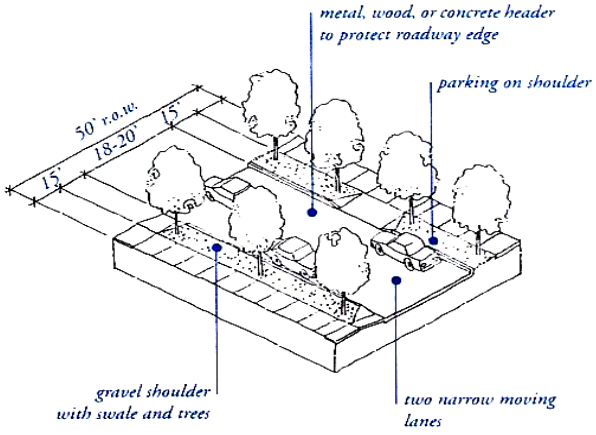
PARAMETER	SITE CONDITION	*Conventional Asphalt/Concrete*	Access Street: Urban Neo-traditional standard	Access Street: Rural Standard	Urban Curb/Swale System	Rural Swale System	Dual Drainage System	Concave Median	Cul-de-sac
SOIL TYPE	Clay	□	■	■	⊡	⊡	■	⊡	⊡
	Loam	□	■	■	■	■	■	■	■
	Sandy	□	■	■	■	■	■	■	■
	Shallow Bedrock	□	■	■	⊡	⊡	⊡	□	□
SLOPE	0% to 3%	⊡	■	■	■	■	■	■	■
	4% to 7%	⊡	■	■	⊡	■	■	■	■
	8% to 12%	⊡	⊡	■	⊡	⊡	⊡	⊡	⊡
	>12%	□	⊡	⊡	□	⊡	□	□	□
CLIMATE	NE County (Novato area)	⊡	⊡	■	■	■	⊡	■	□
	NW County (Tomales area)	□	⊡	■	■	■	□	■	□
	SE County (San Rafael to Sausalito areas)	□	■	■	■	■	⊡	■	⊡
	SW County (Woodacre to Point Reyes areas)	□	■	■	■	■	□	■	□
PROXIMITY TO WATER/ STORMDRAIN	>1,000 ft (usually rural areas)	⊡	■	■	■	■	■	■	■
	500 ft to 1,000 ft (usually rural, some urban areas)	□	⊡	■	■	■	■	■	■
	100 ft to 500 ft (usually urban, some rural areas)	⊡	⊡	■	■	■	■	■	■
	50 ft to 100 ft (usually urban areas)	□	⊡	■	■	■	■	■	■
COST H = High M = Moderate L = Low	Initial	H	L	L	M	L	H	L	L
	Maintenance	L	L	M	M	M	H	L	L
Effectiveness For Reducing Runoff		□	■	■	■	■	■	■	■
Durability/Life Span		■	■	■	■	■	■	■	■
"Start at the Source" 1999 Reference-Book Page Number(s)		N/A	55, 111, 112	55, 113, 114	57, 115	57, 116	58, 117	59, 118	60, 119

STREET DESIGN SAMPLES



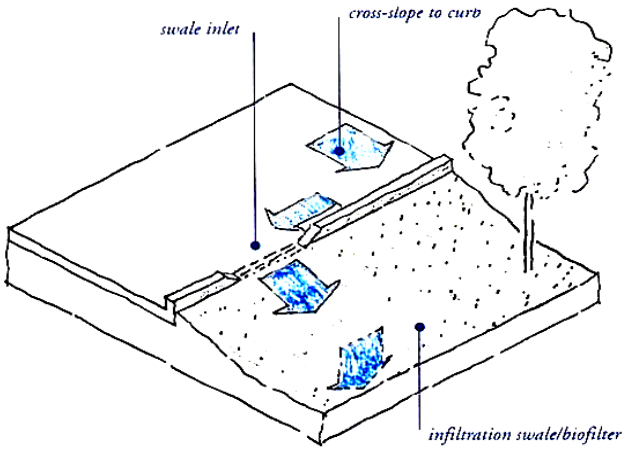
Access street: urban neo-traditional standard

74± % impervious land coverage

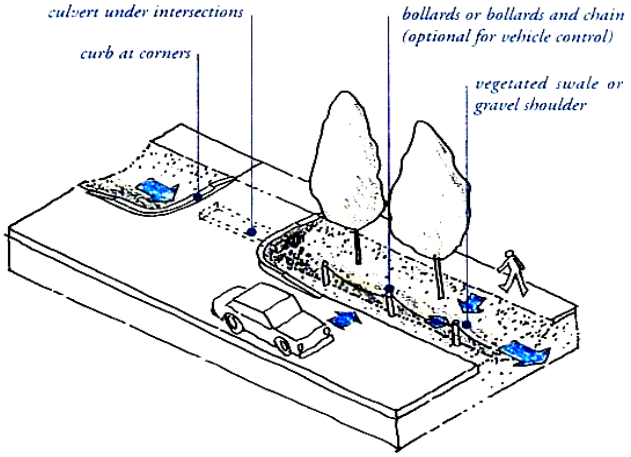


Access street: rural standard

36± % impervious land coverage



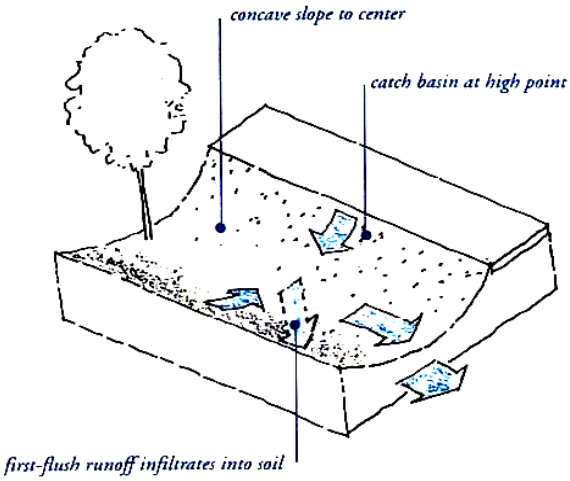
Urban curb/swale system



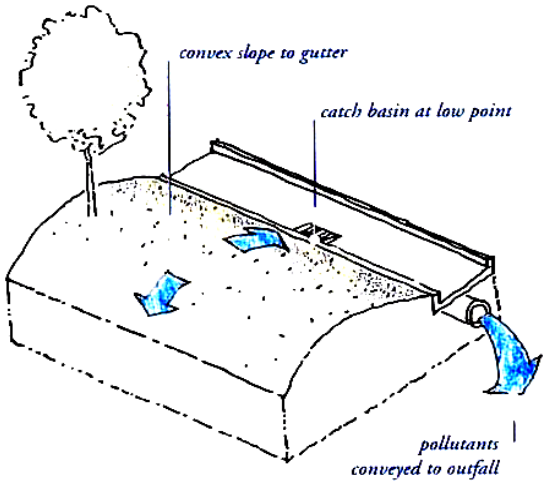
Rural swale system

Inlet detail for urban curb/swale system

Just as a drop inlet collects runoff into an underground pipe system, a swale inlet collects runoff into a surface infiltration system. This swale inlet includes boulders set in soil to dissipate flow velocities and minimize erosion.

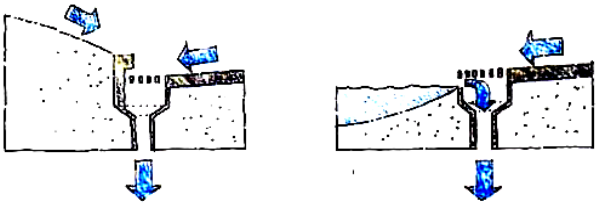


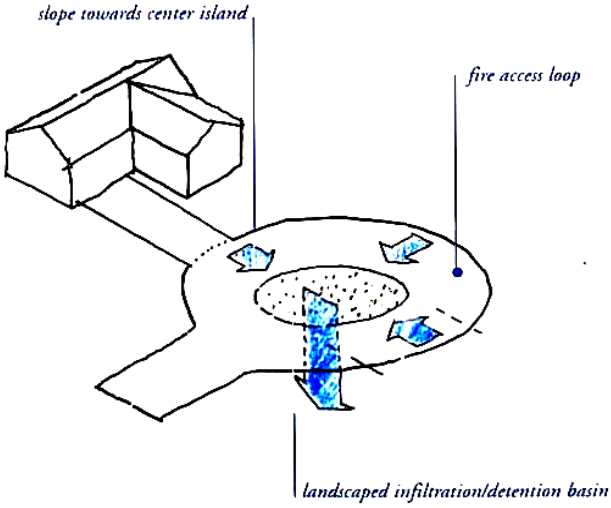
Concave median



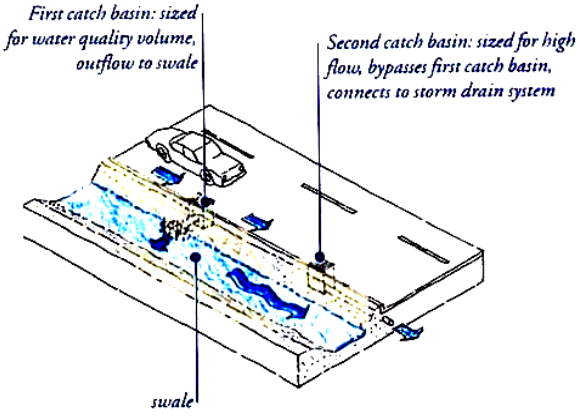
Conventional median design: convex surface

Catch-basin design for medians.





Cul-de-sac



Dual drainage system

Condensed Planning & Design Guide for Surface Water Pollution Control Planning and Permanent Best Management Practices

Creating pervious surfaces for new development and redevelopment

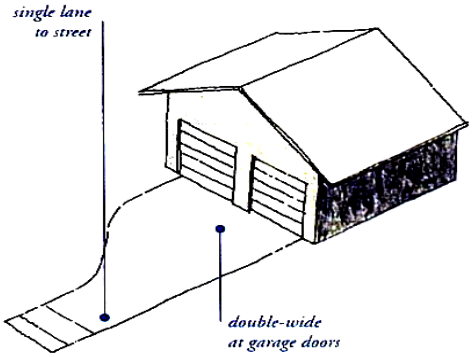
STRUCTURE TYPE: DRIVEWAYS

DESIGN METHOD

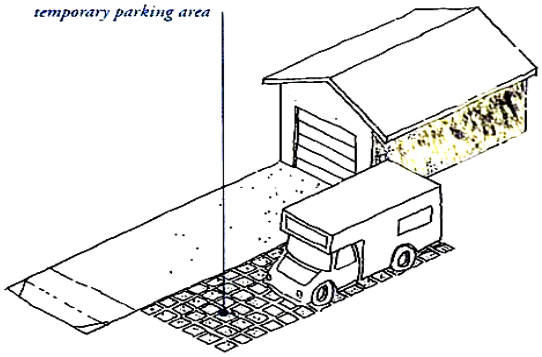
□ = not good ▣ = acceptable ■ = most desired

PARAMETER	SITE CONDITION	*Conventional Driveway*	Not Directly-connected impervious driveway	Crushed Aggregate	Unit Pavers on Sand	Paving Only Under Wheel	Flared Driveways	Temporary Parking
SOIL TYPE	Clay	▣	▣	■	▣	■	■	■
	Loam	▣	■	■	▣	■	■	■
	Sandy	▣	■	■	■	■	■	■
	Shallow Bedrock	▣	▣	▣	▣	■	■	■
SLOPE	0% to 3%	▣	▣	■	■	■	■	■
	4% to 7%	▣	▣	▣	▣	■	■	■
	8% to 12%	□	□	□	□	□	□	□
	>12%	▣	■	□	□	□	■	□
CLIMATE	NE County (Novato area)	▣	■	■	■	■	■	■
	NW County (Tomales area)	▣	■	▣	■	■	■	■
	SE County (San Rafael to Sausalito areas)	▣	■	▣	■	■	■	■
	SW County (Woodacre to Point Reyes areas)	▣	■	▣	■	■	■	■
PROXIMITY TO WATER/ STORMDRAIN	>1,000 ft (usually rural areas)	▣	▣	■	■	■	■	■
	500 ft to 1,000 ft (usually rural, some urban areas)	▣	▣	▣	■	■	▣	■
	100 ft to 500 ft (usually urban, some rural areas)	▣	□	▣	▣	■	▣	▣
	50 ft to 100 ft (usually urban areas)	□	□	□	▣	■	□	▣
COST H = High M = Moderate L = Low	Initial	L	L	L	H	L	L	L
	Maintenance	M	L	M	M	M	L	M
Effectiveness For Reducing Runoff		□	■	■	▣	■	■	■
Durability/Life Span		■	■	▣	▣	■	■	■
"Start at the Source" 1999 Reference-Book Page Number(s)		N/A	64, 127	64, 128	65, 129	65, 130	66, 131	66, 132

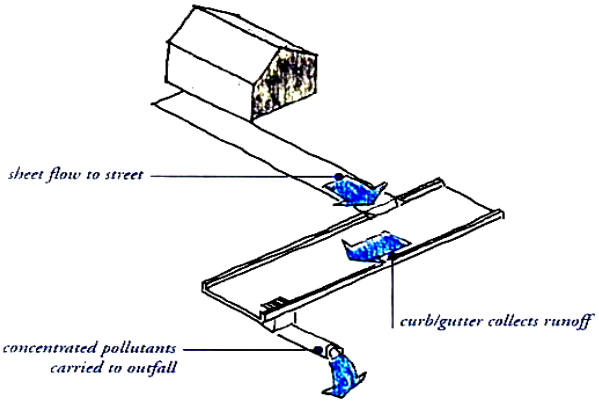
DRIVEWAY DESIGN SAMPLES



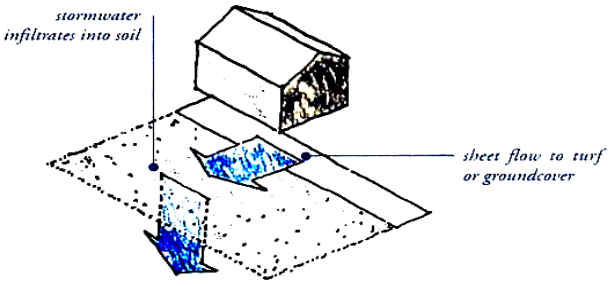
Flared driveways



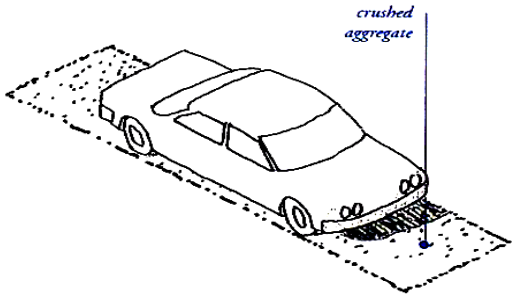
Temporary parking



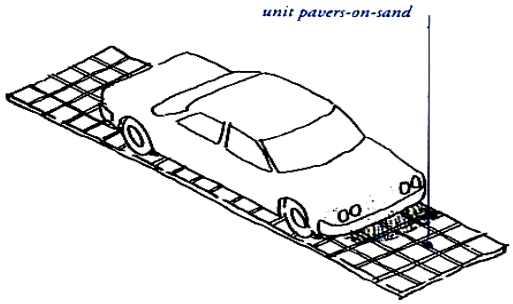
Directly-connected impervious driveway



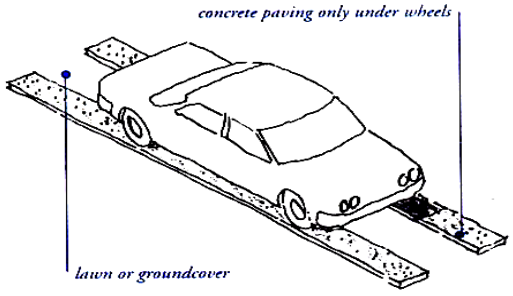
Not directly-connected impervious driveway



Crushed aggregate driveway



Unit pavers on sand



Paving only under wheels

Creating pervious surfaces for new development and redevelopment

STRUCTURE TYPE:
PARKING LOTS

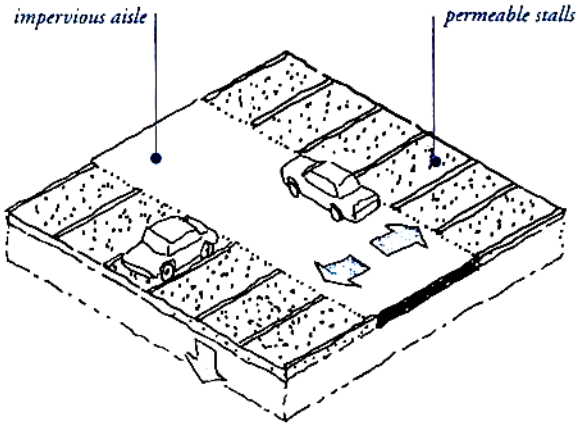
DESIGN METHOD

□ = not good I = acceptable ■ = most desired

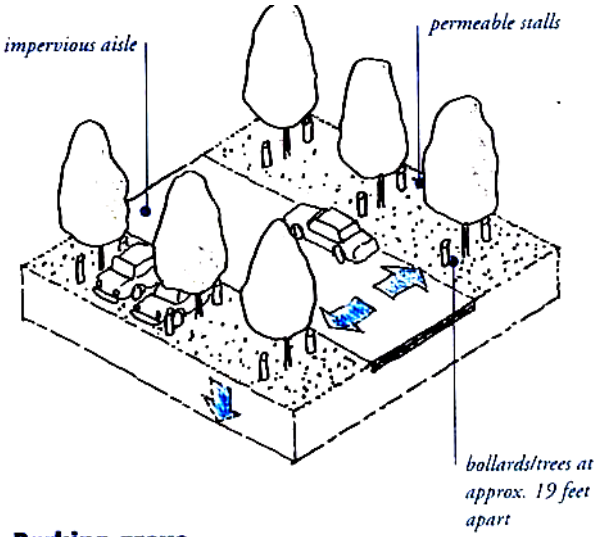
PARAMETER	SITE CONDITION	Hybrid Parking Lot	Parking Grove	Overflow Parking	Porous Pavement Recharge Bed
SOIL TYPE	Clay	■	■	■	■
	Loam	■	■	■	■
	Sandy	⊡	⊡	⊡	■
	Shallow Bedrock	⊡	□	□	⊡
SLOPE*	0% to 3%	■	■	■	■
	4% to 7%	N/A	N/A	N/A	N/A
	8% to 12%	N/A	N/A	N/A	N/A
	>12%	N/A	N/A	N/A	N/A
CLIMATE	NE County (Novato area)	■	■	■	■
	NW County (Tomales area)	■	■	■	■
	SE County (San Rafael to Sausalito areas)	■	■	■	■
	SW County (Woodacre to Point Reyes areas)	■	■	■	■
PROXIMITY TO WATER/ STORMDRAIN	>1,000 ft (usually rural areas)	■	■	⊡	■
	500 ft to 1,000 ft (usually rural, some urban areas)	□	■	⊡	■
	100 ft to 500 ft (usually urban, some rural areas)	⊡	■	⊡	■
	50 ft to 100 ft (usually urban areas)	■	■	■	■
COST H = High M = Moderate L = Low	Initial	L	M	L	H
	Maintenance	M	L	M	H
Effectiveness For Reducing Runoff		■	■	■	■
Durability/Life Span		⊡	⊡	⊡	■
"Start at the Source" 1999 Reference-Book Page Number(s)		61, 121, 122	62, 123	63, 124	63, 125

*Parking lot design typically does not exceed 5% slope

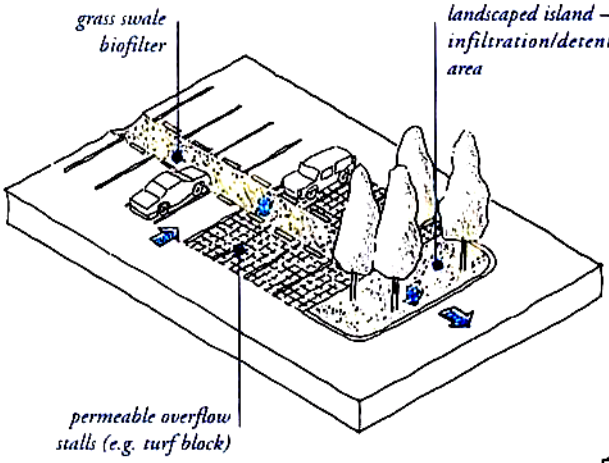
PARKING LOT DESIGN SAMPLES



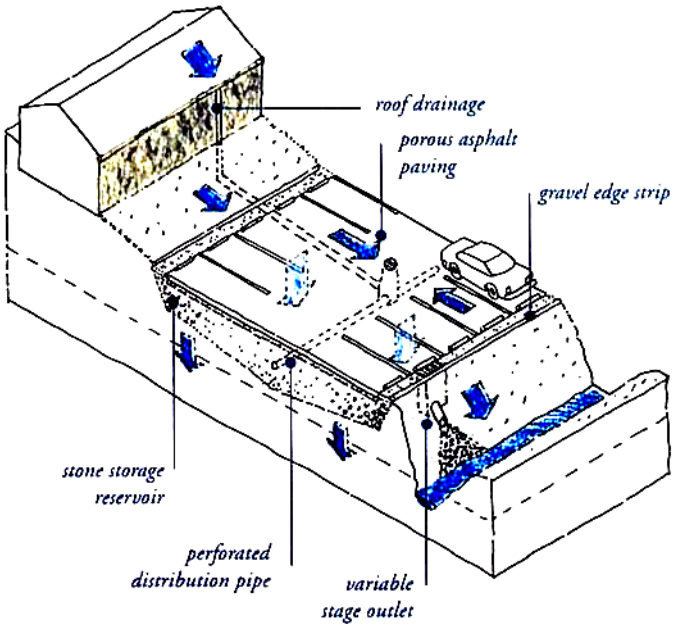
Hybrid parking lot



Parking grove



Overflow parking



Porous pavement recharge bed
(adapted from Prince Georges Co., MD)

Condensed Planning & Design Guide for Surface Water Pollution Control Planning and Permanent Best Management Practices

Creating pervious surfaces for new development and redevelopment

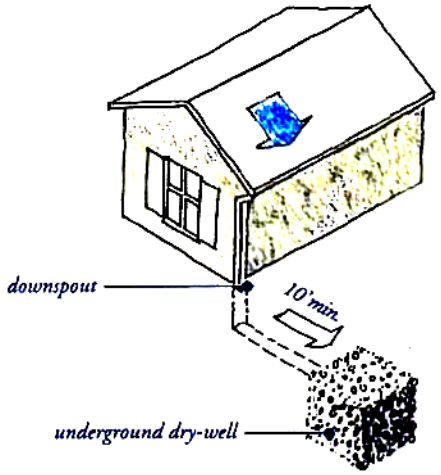
STRUCTURE TYPE: BUILDINGS

DESIGN METHOD

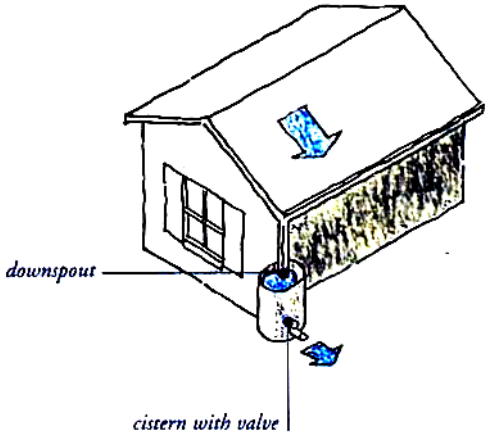
☐ = not good ▣ = acceptable ■ = most desired

PARAMETER	SITE CONDITION	*Conventional Pipe System*	Dry-Well	Cistern	Foundation Planting	Pop-up Emitters	Building Materials*
SOIL TYPE	Clay	▣	▣	■	▣	☐	■
	Loam	▣	■	■	■	▣	■
	Sandy	▣	■	■	▣	■	▣
	Shallow Bedrock	☐	☐	■	☐	☐	▣
SLOPE	0% to 3%	▣	■	■	■	■	■
	4% to 7%	▣	■	■	■	■	■
	8% to 12%	▣	▣	■	▣	▣	▣
	>12%	▣	▣	■	▣	☐	☐
CLIMATE	NE County (Novato area)	▣	■	■	■	■	▣
	NW County (Tomales area)	▣	■	■	■	■	▣
	SE County (San Rafael to Sausalito areas)	▣	■	■	■	■	▣
	SW County (Woodacre to Point Reyes areas)	▣	■	■	■	■	▣
PROXIMITY TO WATER/ STORMDRAIN	>1,000 ft (usually rural areas)	▣	■	■	■	■	▣
	500 ft to 1,000 ft (usually rural, some urban areas)	▣	■	■	■	■	▣
	100 ft to 500 ft (usually urban, some rural areas)	▣	■	■	■	■	☐
	50 ft to 100 ft (usually urban areas)	☐	■	■	▣	■	☐
COST H = High M = Moderate L = Low	Initial	H	L	H	L	L	M
	Maintenance	M	M	M	L	M	M
Effectiveness For Reducing Runoff		☐	■	▣	■	■	■
Durability/Life Span		■	■	▣	■	▣	■
"Start at the Source" 1999 Reference-Book Page Number(s)		N/A	67, 134	67, 135	68, 136	68, 137	69

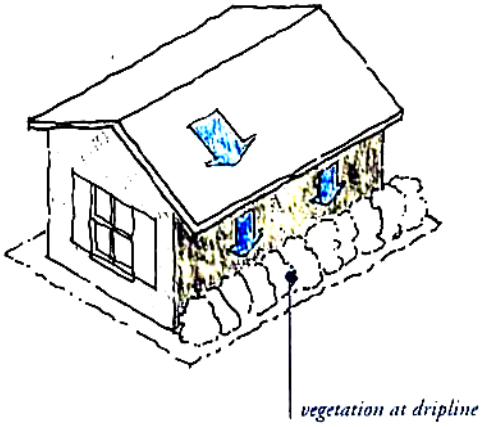
*Based on roofing materials that may contribute to a pollution discharge. See *Start at the Source* for details.



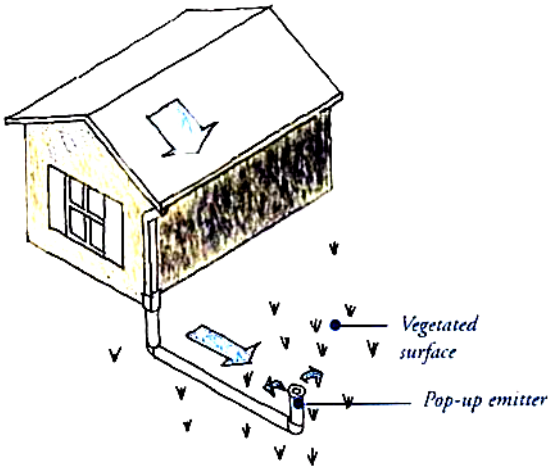
Dry-well



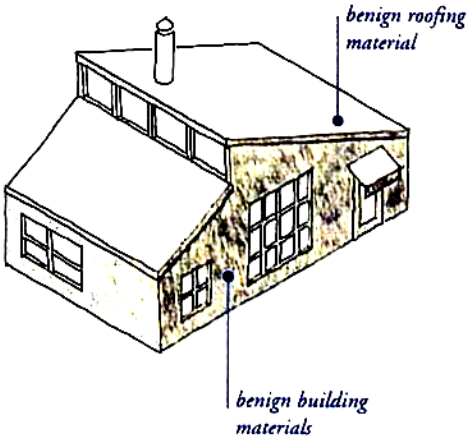
Cistern



Foundation planting



Pop-up drainage emitter



Building materials

Condensed Planning & Design Guide for Surface Water Pollution Control Planning and Permanent Best Management Practices

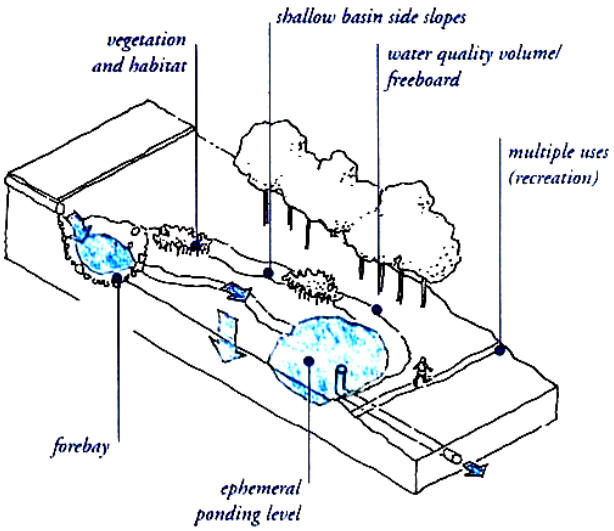
Creating pervious surfaces for new development and redevelopment

STRUCTURE TYPE: LANDSCAPE

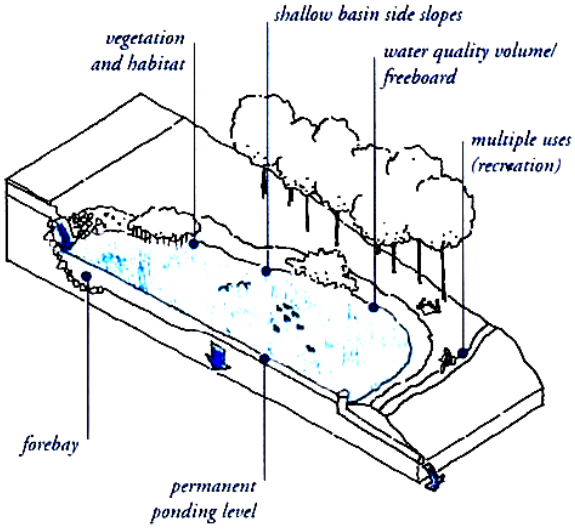
DESIGN METHOD

□ = not good ⊡ = acceptable ■ = most desired

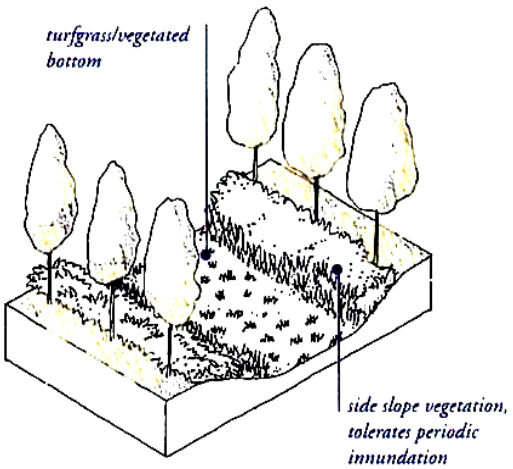
PARAMETER	SITE CONDITION	*Conventional Pipe System*	Grass/Vegetated Swales	Extended Detention (dry) Ponds	Wet Ponds	Plant Species Selection for Infiltration Areas	Landscape Maintenance for Stormwater System
SOIL TYPE	Clay	⊡	■	■	■	■	■
	Loam	⊡	■	⊡	⊡	■	■
	Sandy	⊡	■	□	□	⊡	⊡
	Shallow Bedrock	□	⊡	⊡	⊡	□	□
SLOPE	0% to 3%	⊡	■	■	■	■	■
	4% to 7%	⊡	■	⊡	⊡	■	■
	8% to 12%	⊡	⊡	□	□	⊡	⊡
	>12%	□	□	□	□	⊡	⊡
CLIMATE	NE County (Novato area)	⊡	■	■	■	⊡	■
	NW County (Tomales area)	⊡	■	■	■	■	■
	SE County (San Rafael to Sausalito areas)	⊡	■	■	■	■	■
	SW County (Woodacre to Point Reyes areas)	⊡	■	■	■	■	■
PROXIMITY TO WATER/ STORMDRAIN	>1,000 ft (usually rural areas)	⊡	■	■	■	■	■
	500 ft to 1,000 ft (usually rural, some urban areas)	⊡	■	■	■	■	■
	100 ft to 500 ft (usually urban, some rural areas)	⊡	⊡	■	■	■	■
	50 ft to 100 ft (usually urban areas)	⊡	□	■	■	⊡	■
COST H = High M = Moderate L = Low	Initial	H	L	L	L	L	M
	Maintenance	M	M	M	H	M	M
Effectiveness For Reducing Runoff		□	■	■	■	■	■
Durability/Life Span		⊡	■	■	■	■	■
"Start at the Source" 1999 Reference-Book Page Number(s)		N/A	71, 139, 140, 141	71, 142, 143	71, 144, 145	71, 146, 147	72



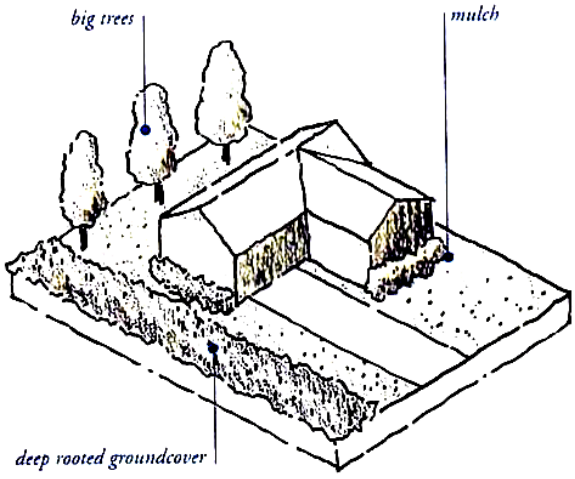
Extended detention (dry) ponds



Wet ponds



Grass/vegetated swales



Plant selection and landscape maintenance