Bioretention Landscaped Practices

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ASCE LID Conference

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CASQA CALIFORNIA STORMWATER QUALITY ASSOCIATION

Overview

- Bioretention Overview
- Design Guidelines
- Lessons Learned
- Sustainable Landscaping Practices
- BMP Performance
- CASQA handbook

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Bioretention Facilities

- Soil and plant-based retention or filtration device
- Removal Mechanism
  - physical
  - biological
  - chemical
  - Straining
- Have two types of designs that have emerged:
  - Classic retention design
  - Flow through filter

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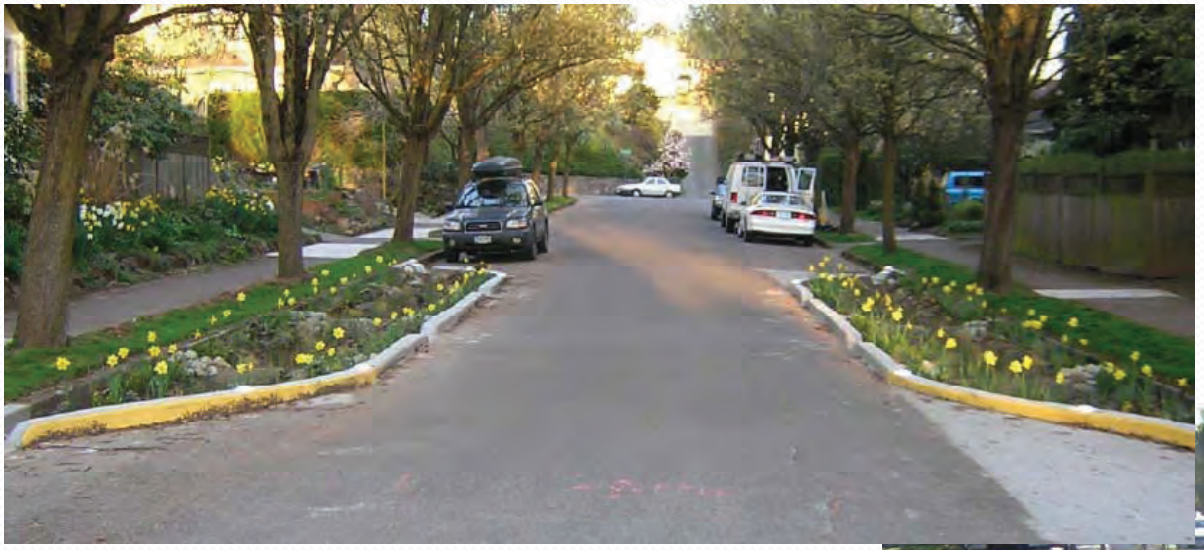
Bioretention along Streets



Flow Through Planters

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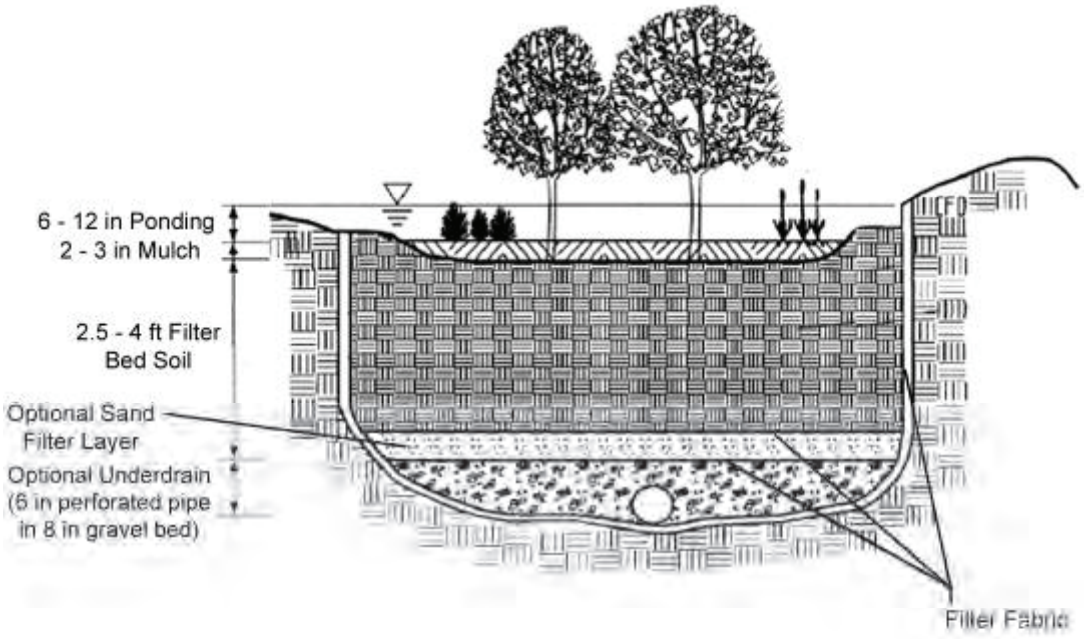
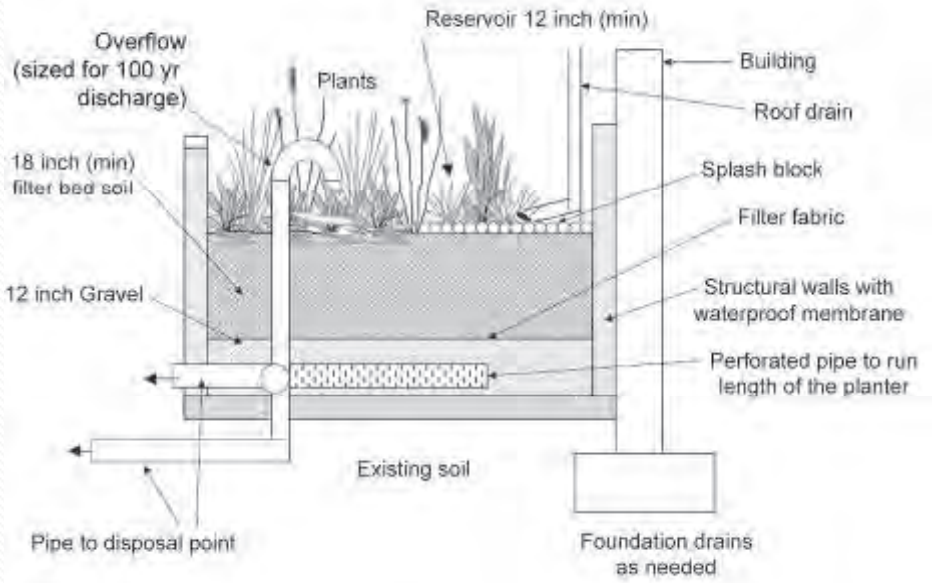


Bioretention facility

Flow Through Planter Box



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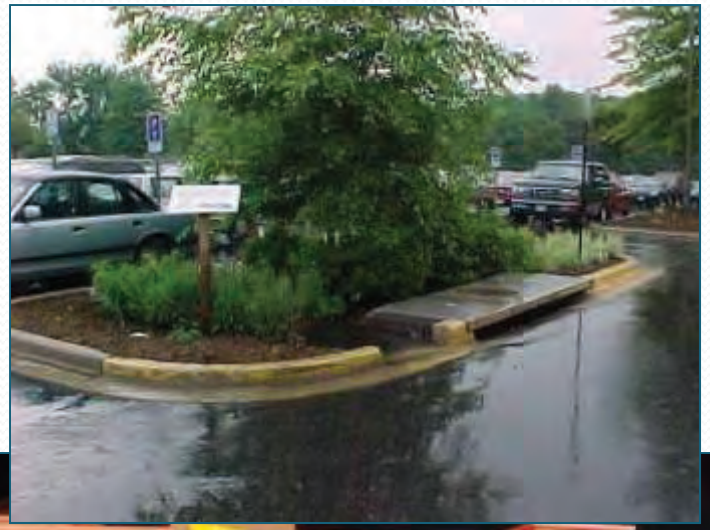
Commercial Examples



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How much space do I need?

$$A = \frac{WQV}{h_f}$$

- A = Bioretention cell area, ft^2
- WQV = Water quality volume, ft^3
- h_f = Average design ponding depth, ft (traditionally a maximum 1 ft of ponding, 0.5 ft preferred)

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Design Guidelines

- Design storage area to accommodate the WQV with a maximum of 1 ft of ponding
- Offline design is preferred (flow by-pass after unit is 'full')
- Soil Matrix: 50% sand (ASTM C-33), 20% compost, 30% site soil (max 5% clay content, porosity 0.25, 1.5 to 3% organic matter)
- Depth to GW: 2' with underdrain, 10' without
- Depth of soil matrix: 2.5 to 4 feet – based on root depth of plantings and volume needed for storage

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Design Guidelines (Con't)

- Storage area below the underdrain is required for nitrate removal (1 foot deep min).
- Can add dead storage below the underdrain to accommodate hydromodification or other mitigation requirements
- Underdrain – 4" PVC perforated pipe (Sch 40), two should be used that join at a 6" dia pipe – slope 0.5% or greater.
- Use a graded gravel filter bed: perforated pipe surrounded by a pea gravel diaphragm (1/4" to ½" dia, 6" thick) surrounded by stone ½" to 1.5" in diameter.

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Design Guidelines (Con't)

- Traditional design accomodates storage above ground, however:
- Volume within the soil matrix and gravel area may be computed and used to reduce the facility surface storage area/depth.
- Use 30% void area in soil and rock for volume calculation
- Note the design will have a lesser factor of safety or will be less 'robust' since the net effect will be a reduced surface area and higher surface loading rate
- Flow-through designs gaining popularity
- MRP limits the surface loading rate – Performance for this type of design not well documented.

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Plant Materials (Northern CA)

Trees	
Cornus nuttallii	Pacific Dogwood
Platanus racemosa	California Sycamore
Shrubs	
*Arctostaphylos, various	Manzanita
*Baccharis pilularis	Dwarf Coyote Brush
*Mahonia pinnata	California Holly Grape
Spiraea, several	Spiraea
Strelitzia reginae	Bird of Paradise
Ground covers, Perennials	
*Achillea millefolium	Yarrow
Agapanthus africanus	Lily of the Nile
*Aquilegia hybrids	Columbine
Campanula, various	Bellflower
Dietes bicolor	African Iris
Fragaria chiloensis	Ornamental Strawberry
Hemerocallis hybrids	Daylily
Vinca minor	Periwinkle
Grasses and Grass like Plants	
*Achnatherum hymenoides	Indian Rice Grass
*Carex barberae	Santa Barbara Sedge
Distichlis spicata	Saltgrass
Festuca, various (except Tall)	Fescue Grass
Liriope, various	Lily Turf

*California Native

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Operation

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Residential

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Overflow Outlet

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Bioretention
Lessons learned and challenges

- Retrofit more complex/costly than new construction
- Not originally a flow-through BMP
- Room to improve BMP design and construction
- Limited scientific information (seek assistance from academia and research)
- Adjust to climate and environment
- Significant External Factors:
  - Vectors
  - Endangered species
  - Regulatory Agencies
  - Aesthetics

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Sustainable Landscaping

Practices that enhance the quality and reduce the quantity of stormwater runoff using landscaping features.

Important to consider site conditions and select correct vegetation.

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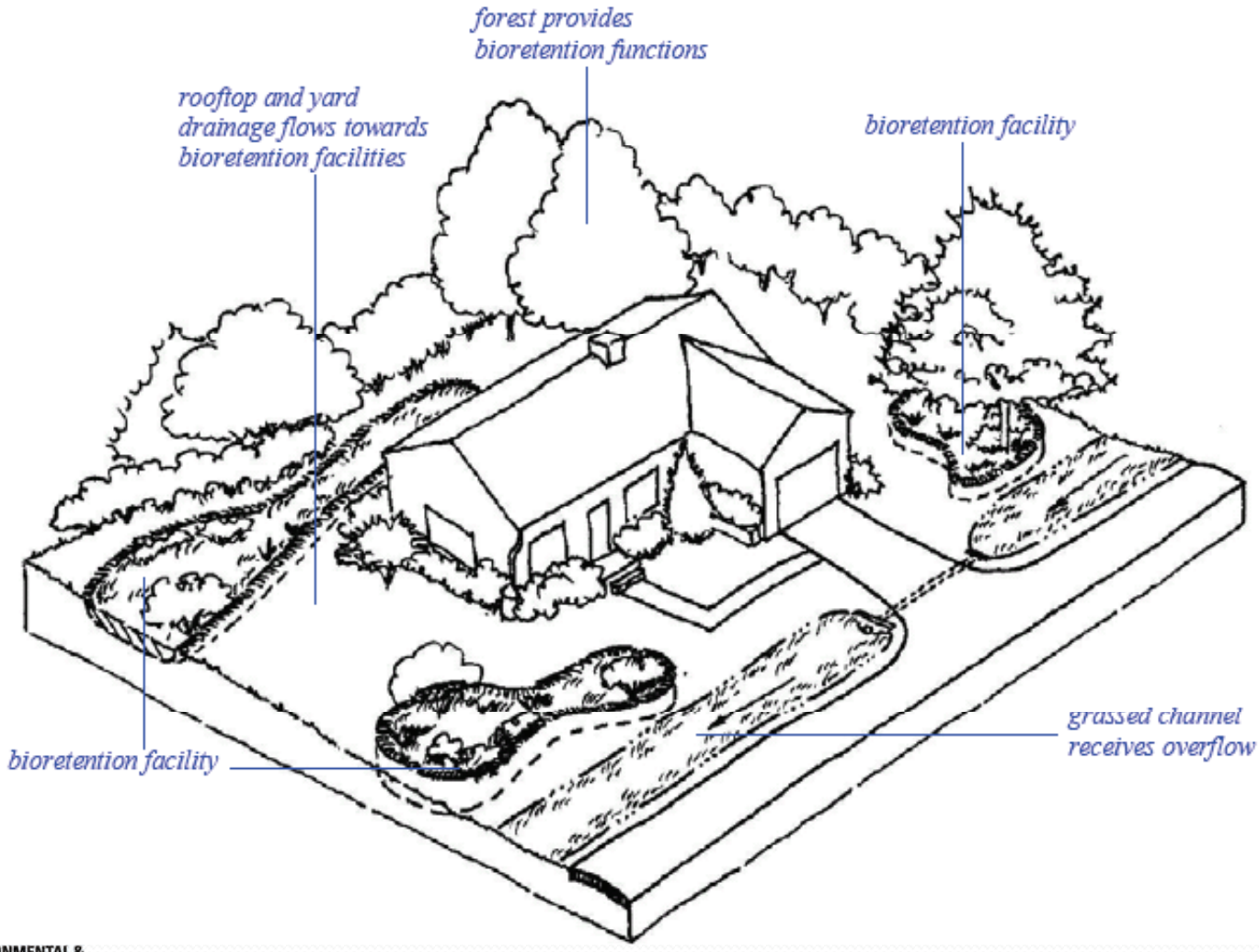
Landscaping



Bioretention

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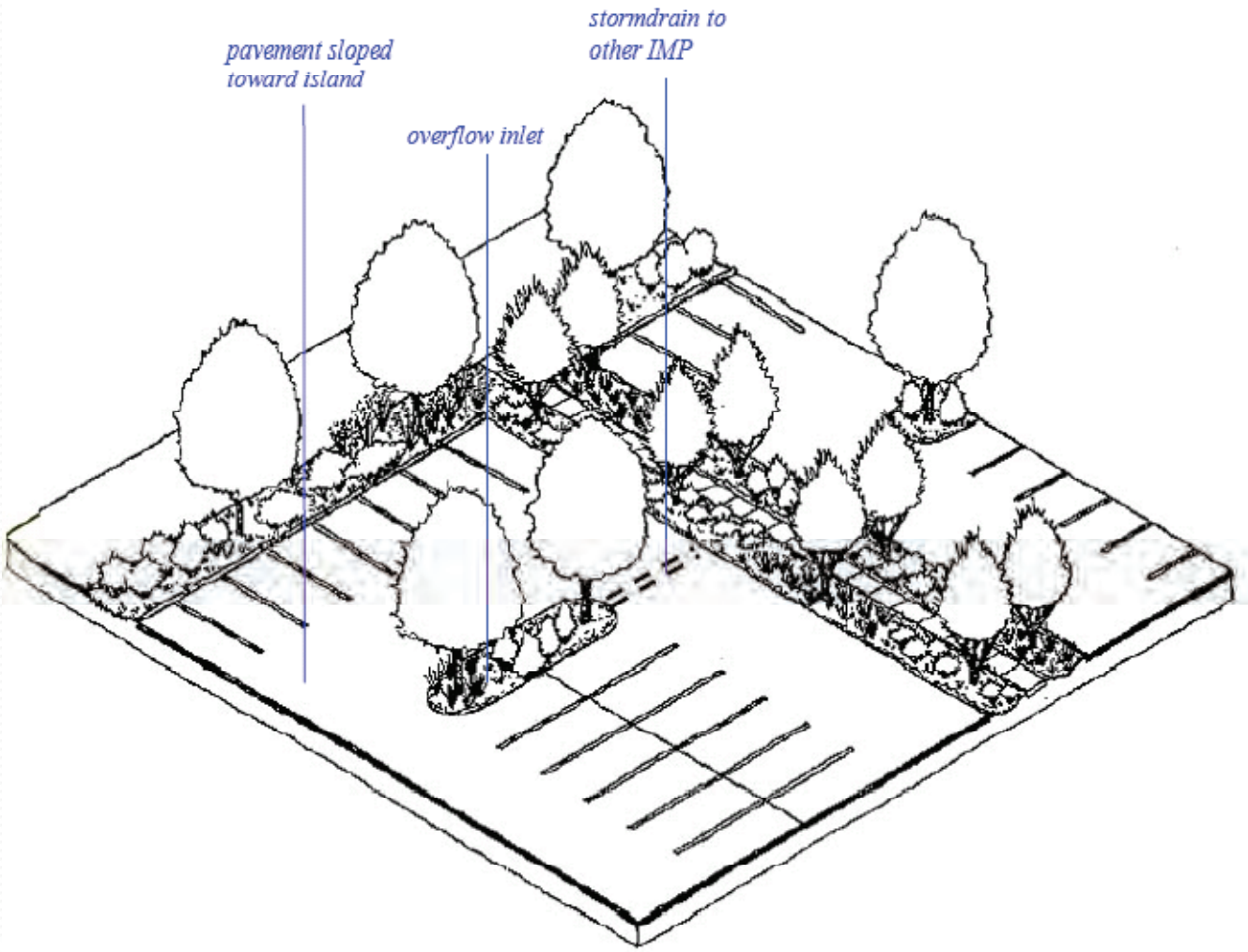
Landscaping



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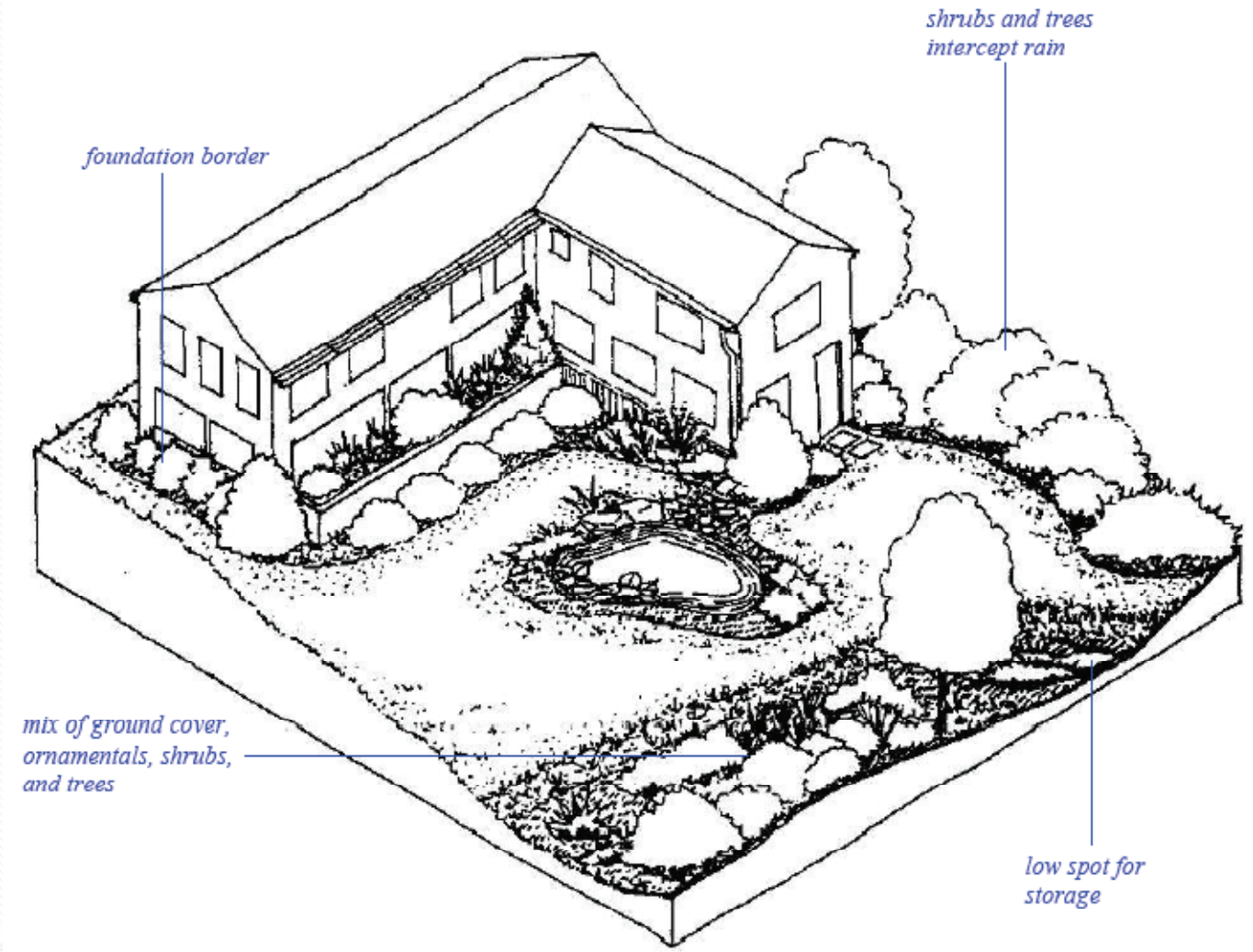
Landscaping



Rain Gardens

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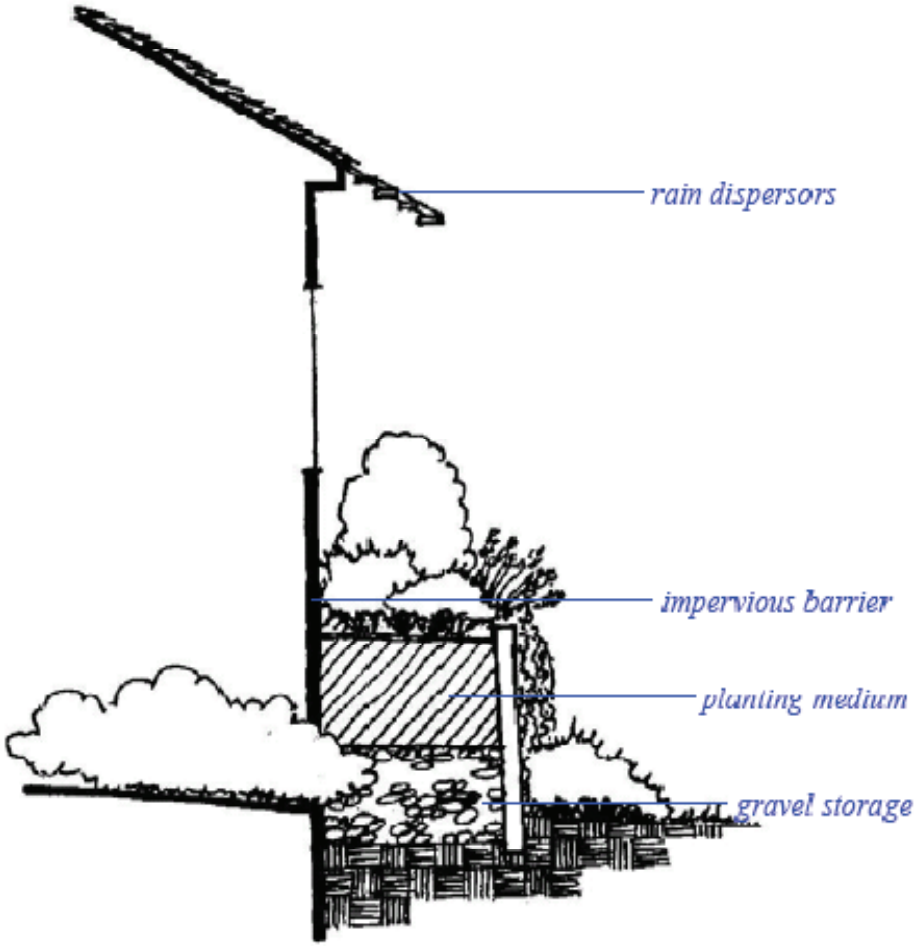
Landscaping



Rain Gardens

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Performance

Device	Phosphorus	TKN	Metals	Sediment
Infiltration Trench	100%	100%	100%	100%
Infiltration Basin	100%	100%	100%	100%
Rain Barrel	100%	100%	100%	100%
Porous Pavement	100%	100%	100%	100%
Bioretention	70-85%	55-65%	90-95%	90-95%
Green Roof	Ukn	Ukn	90-95%	90-95%
Media Filter	40-50%	50-60%	70-80%	80-90%
Wet Pond	0-50%	40-50%	60-90%	20-90%
Swale	Input	60-70%	80-90%	70-80%
EDB	30-40%	10-20%	60-70%	70-80%
Wet Vault	30-40%	10-20%	60-70%	70-80%
Vegetated Strip	Input	Input	70-80%	60-70%
Vortex Separator	Minimal	Minimal	Minimal	60% of 50 micron

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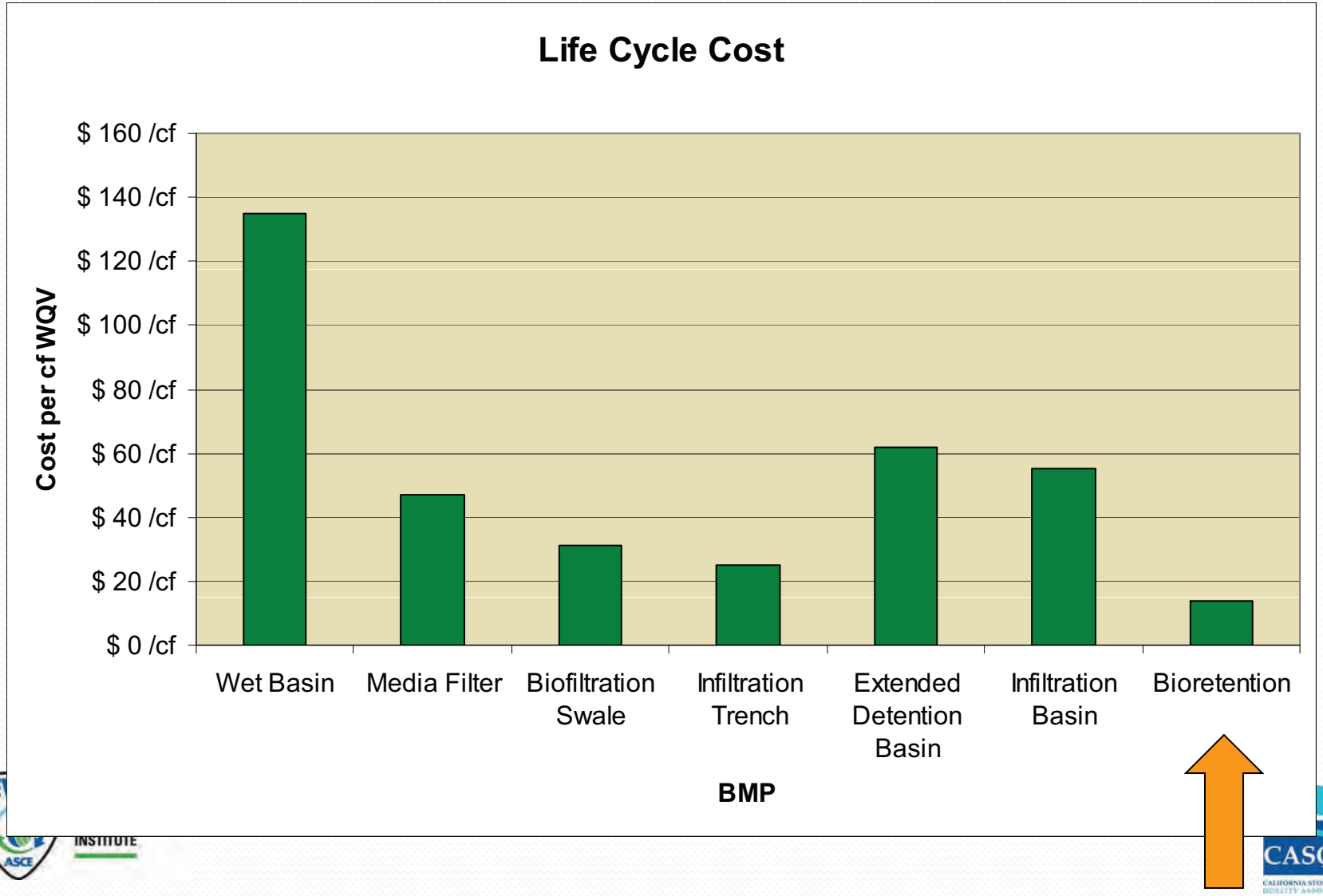
Life Cycle Cost



Issues with Bioretention/Landscape Practices

- Loss of Land to Buffers
- Long-term Sustainability
- Need for research
- Property owner education
- Regional variability
- Ponding in yards (vectors, other issues)
- Difficult to evaluate efficiency

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Credits/References

- Low Impact Development IMP Guide – Prince George's County
- Start at the Source – Design Guidance Manual for Stormwater Quality Protection – BASMAA
- CASQA BMP Handbooks www.casqa.org
- Low Impact Development Center www.lid.org
- Caltrans Stormwater Program
- EPA http://epa.gov/nps/lid/

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California Stormwater Quality Association (CASQA) Handbooks

- www.casqa.org or www.cabmphandbooks.com

Questions?

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