Catching Rain:

Low Impact Development & Green Stormwater Strategies *for* Real Estate Professionals

Spring 2013

Presented by:

Funding from:

LID/Green Stormwater Infrastructure Overview

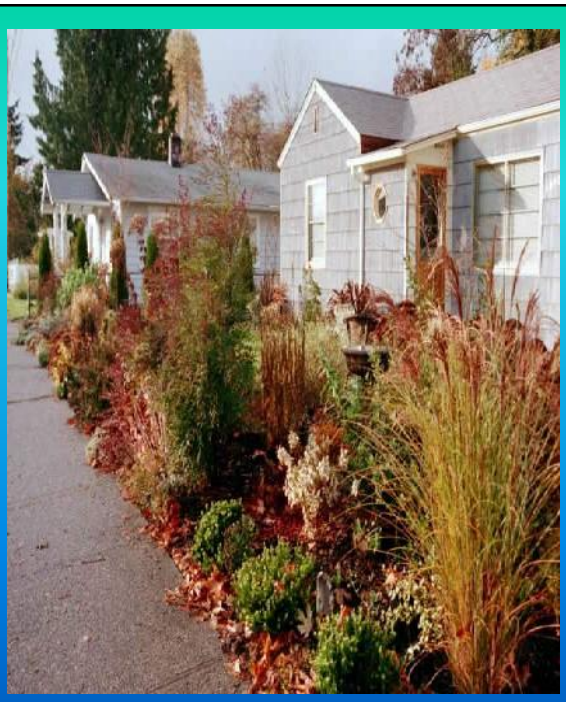
Erica Guttman,WSU Extension
Water Resources Program

SURVEY OF LANDSCAPING PREFERENCES

AMONG RECENT HOMEBUYERS

FALL 2001

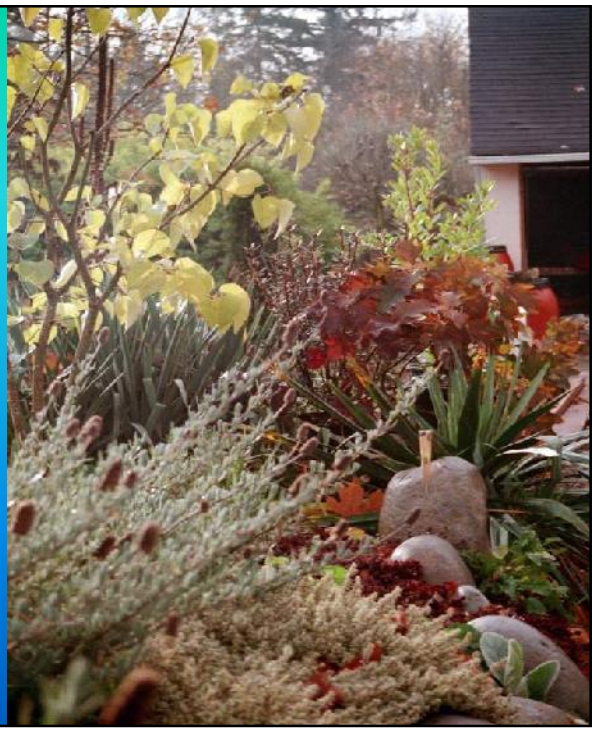
Summary of Results



§ Those with the least amount of mature vegetation — "bare dirt," or just a few shrubs — were more likely to have been "somewhat" or "very dissatisfied" with their landscaping upon moving into their house.

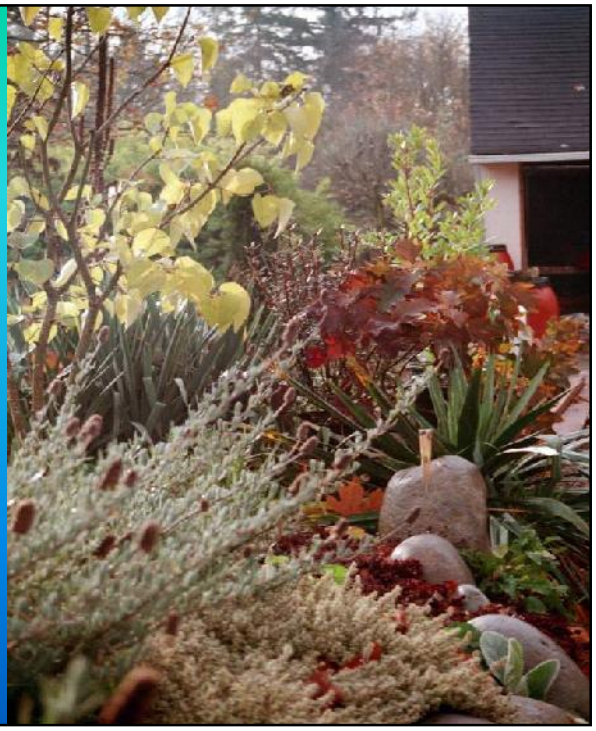
§ Strong interest in **mature** landscapes, with **value** placed on landscapes that are:

- **"natural"**
- **"attract wildlife"**



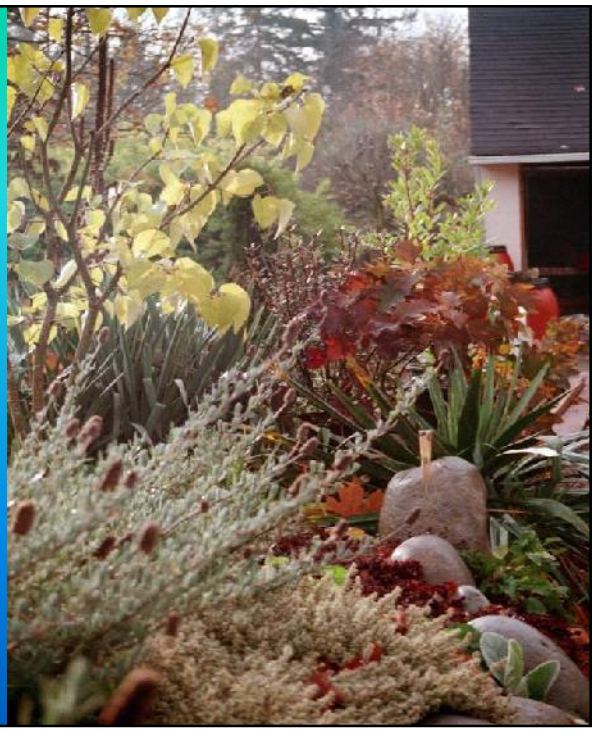
§ Strong interest in **mature** landscapes, with **value** placed on landscapes that are:

- "natural"
- "attract wildlife"
- **"provide privacy and noise screen"**
- **offer a mix of trees, shrubs**



§ Strong interest in **mature** landscapes, with **value** placed on landscapes that are:

- "natural"
- "attract wildlife"
- "provide privacy and noise screen"
- offer a mix of trees, shrubs
- **minimal lawn**
- **with "very low maintenance."**



§ Dissatisfied group **much more likely** to have home over $**250,000 [2000-01]**

§ Much **more likely to have been willing to pay extra** in the purchase price for their preferred landscaping upon moving in.

§ Dissatisfied group more likely to have purchased a newly constructed home, vs. an existing, previously occupied home.

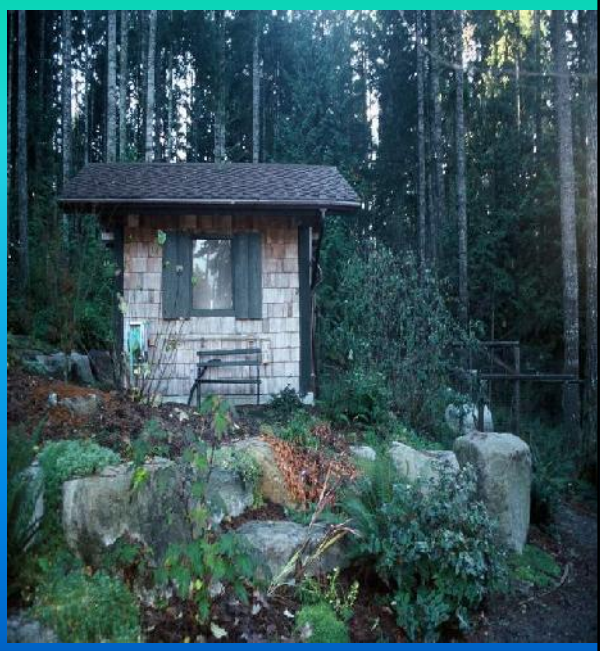
§ Dissatisfied group much more likely to have planted trees, shrubs and native plants since moving in than those in the "satisfied" group.

§ "**Landscaping**" or "**landscaping potential**" rate **higher** as factors in purchase decision than location's relationship to schools, view, privacy, convenience to recreation, and rank almost as high as location's convenience to work.

Literature Search Conducted by

WSU Center for Real Estate Research

Summary of Key Added Values for Homes with Mature, Native Landscaping



- Home sellers report more rapid sales
- More favorable public relations to developers
- Increasing energy efficiency: more cooling in summer & wind barriers
- Reduction of utility bills by up to 30%
- Avoided costs for landscaping installation & maintenance
- Value of privacy screen & noise buffer
- Avoided costs for stormwater management
- Slope-stabilization benefits
- Conserves water
- Mature landscaping may add 3 to 7 percent to home value

What our clients tell us …

- Low maintenance:
- ✓ Less time with power equipment
- ✓ Less water

What our clients tell us …

- **Weeds manageable**
- **Avoid pesticides – Concern for families & pets**

What our clients tell us …

- Potential for food crops: veggies, berries, fruit trees
- Concern about exposure to pollutants

What our clients tell us …

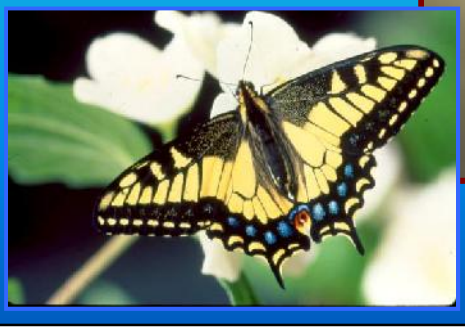
- Good soils

What our clients tell us …

- Drainage safely managed
- LID techniques for on-site management

What our clients tell us …

- Attractive to birds & butterflies
- "Sanctuary"

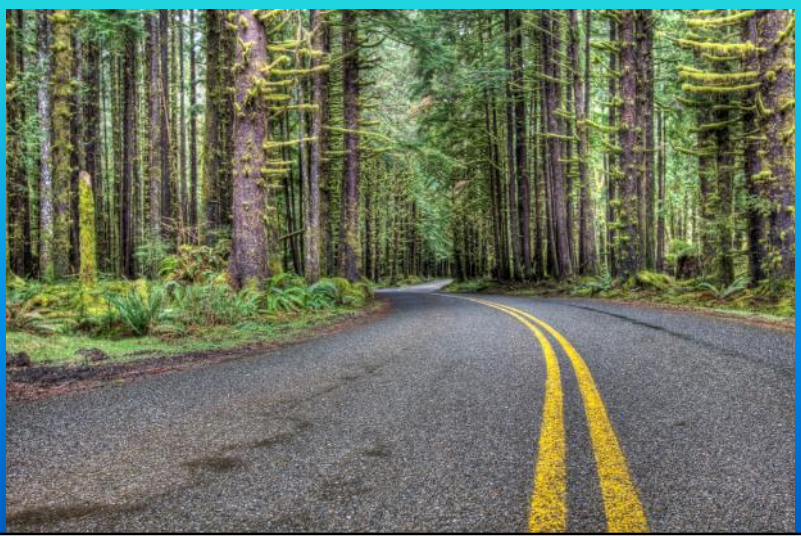


What our clients tell us …

- Trees & mature landscaping

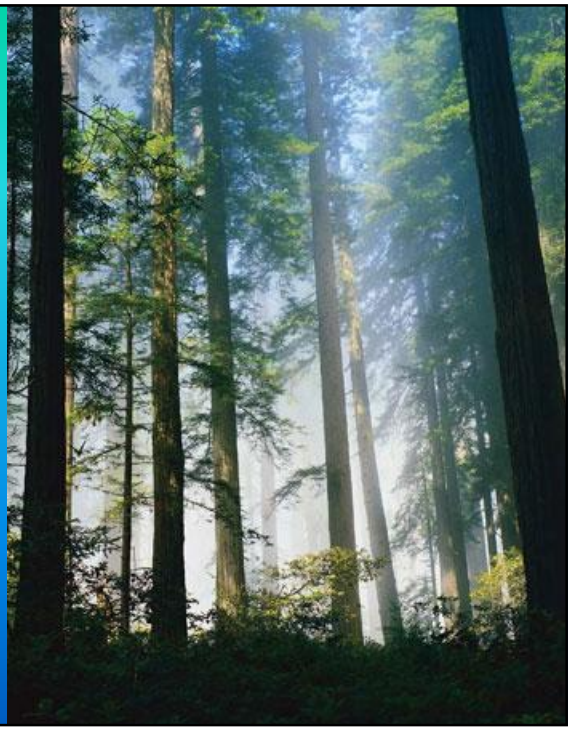
How does it all add up?

Prevention:
Key Preservation Principles

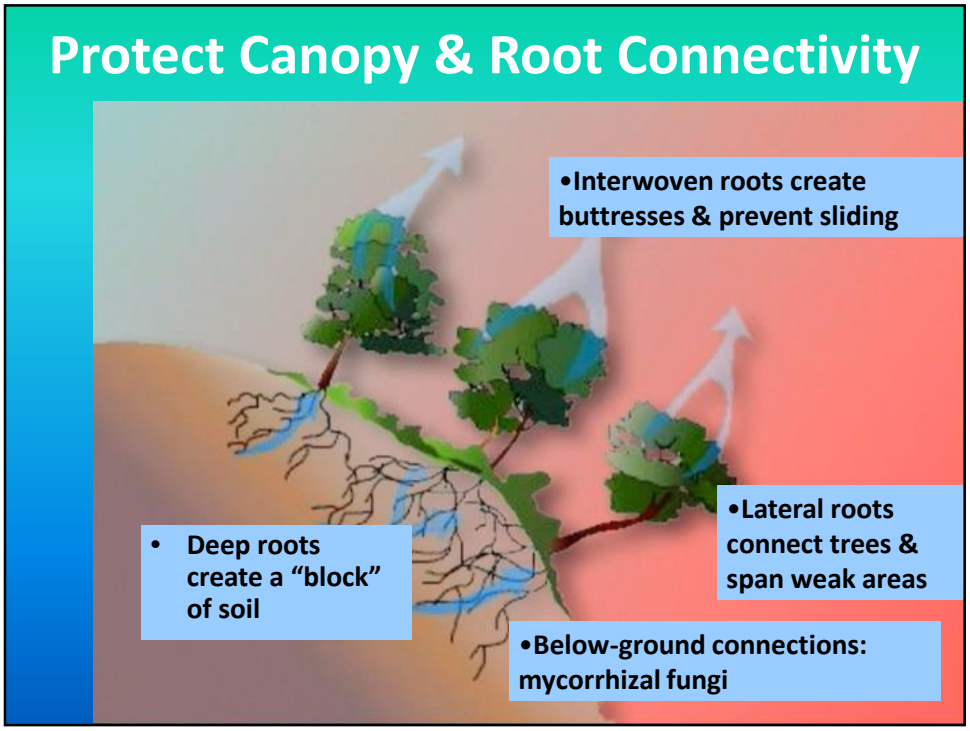


Prevention BMPs

- Preserve larger trees
- Preserve evergreen trees



Preserve Healthy Trees
Photo: Curtis Hinman, WSU


Protect Canopy & Root Connectivity
•Interwoven roots create buttresses & prevent sliding
•Lateral roots connect trees & span weak areas
• Deep roots create a "block" of soil
•Below-ground connections: mycorrhizal fungi

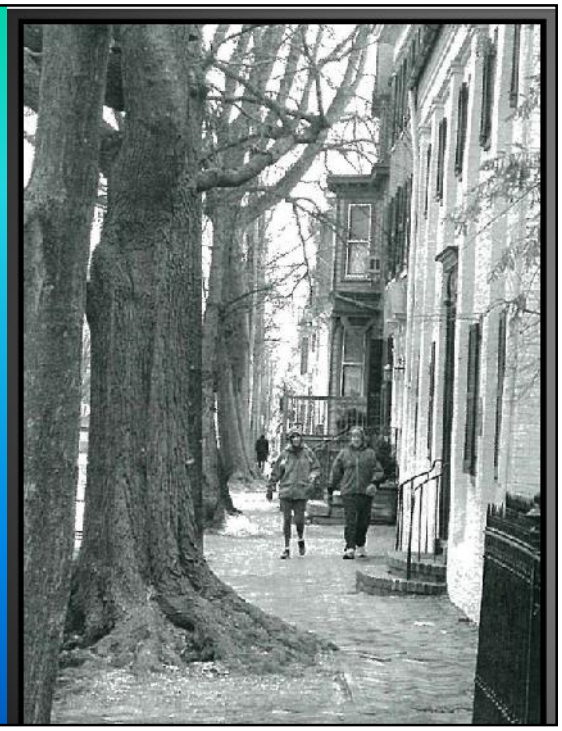
Protect from Equipment

Protect All Roots

Caution with Soils & Mulch

Key Restoration Principles

- Design for mature size
- Consider trunk flare



Key Restoration Principles

- Use permeable pavements when needed near roots: water & air

Prevention BMPs

"… reducing the development envelope and increasing vegetation and soil conservation areas are the most effective techniques to reduce storm flows (AHBL 2002)."

-- Curtis Hinman, *LID Technical Guidance Manual*, 2012

Prevention BMPs

- "… native vegetation and soils are also the most cost-effective and efficient tools for managing stormwater quantity and quality."

-- Curtis Hinman, *LID Technical Guidance Manual*, 2012

Example: 24 acres, 103 home sites

	Detention Storage Reduced (cubic feet)	Detention Storage Required (cubic feet)
Conventional Development	0	270,070
LID Design		
Reduce development envelope (24' wide road)	149,019	
Bioretention swales/cells	40,061	
Minimal excavation foundations	7,432	
20' pervious pavement road	29,988	
Total reduction	226,500	43,570

Source: LID Technical Guidance Manual, 2012

Prevention:
Sediment & Erosion Control

Prevention: Sediment & Erosion Control

- Storm drain inlet
- Compost sock

Prevention: Protection of LID Features

Kathy Gwilym, SvR Design Company

Construction Sequencing

- BMPs = procedures, not products
- Prioritize process over physical controls

Courtesy of Curtis Hinman, WSU

Sustainable Landscaping

- **Building healthy soils: compost, mulch**

Photos: Erica Guttman, Linda Andrews

Lawn and landscaped areas:

- Soil Quality and Depth (T5.13)

Glacial till: high in runoff and poor turf quality

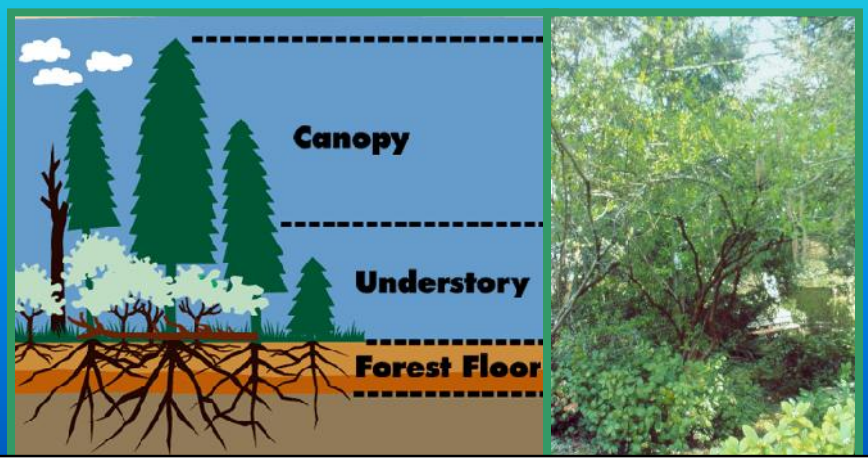
Same soil with 30% compost added. Up to 50% less runoff. Turf still healthy 4 years later

Photos: UW Test Plots

Courtesy of Ed O'Brien, Dept. of Ecology

Sustainable Landscaping

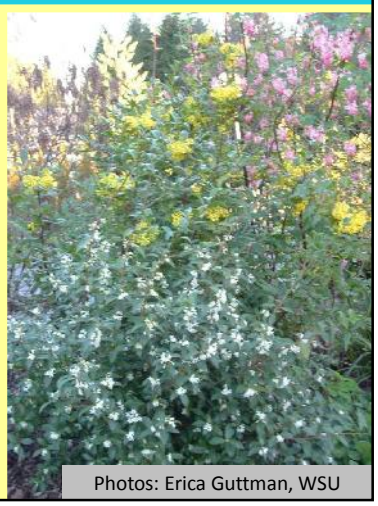
- Building healthy soils: compost, mulch
- **Planting in layers—like the forest**



Linda Andrews, Patterns in Nature

Sustainable Landscaping

- Building healthy soils: compost, mulch
- Planting in layers—like the forest
- **Water-wise plant choices**



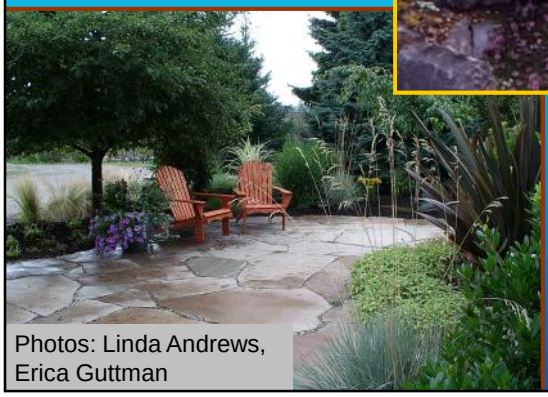
Photos: Erica Guttman, WSU

Sustainable Landscaping

- Building healthy soils: compost, mulch
- Planting in layers—like the forest
- Water-wise plant choices
- **Safe alternatives to pesticides & fertilizers**

Sustainable Landscaping

- **Free-draining walkways & patios**

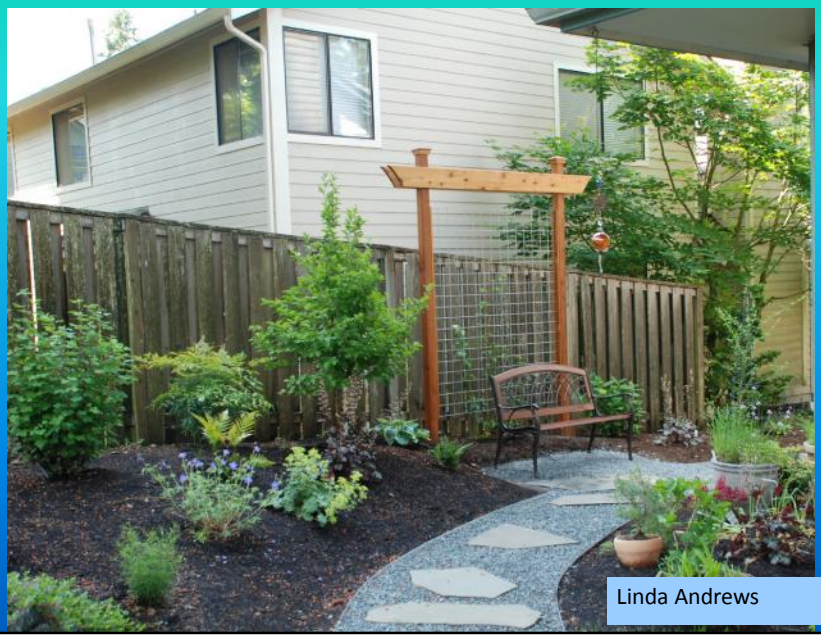


Photos: Linda Andrews, Erica Guttman

green joints, mixed materials with stone, urbanite

Crushed Stone
Linda Andrews

Crushed stone with flagstone accents



Linda Andrews

Radial paver patios with gravel accents

Linda Andrews

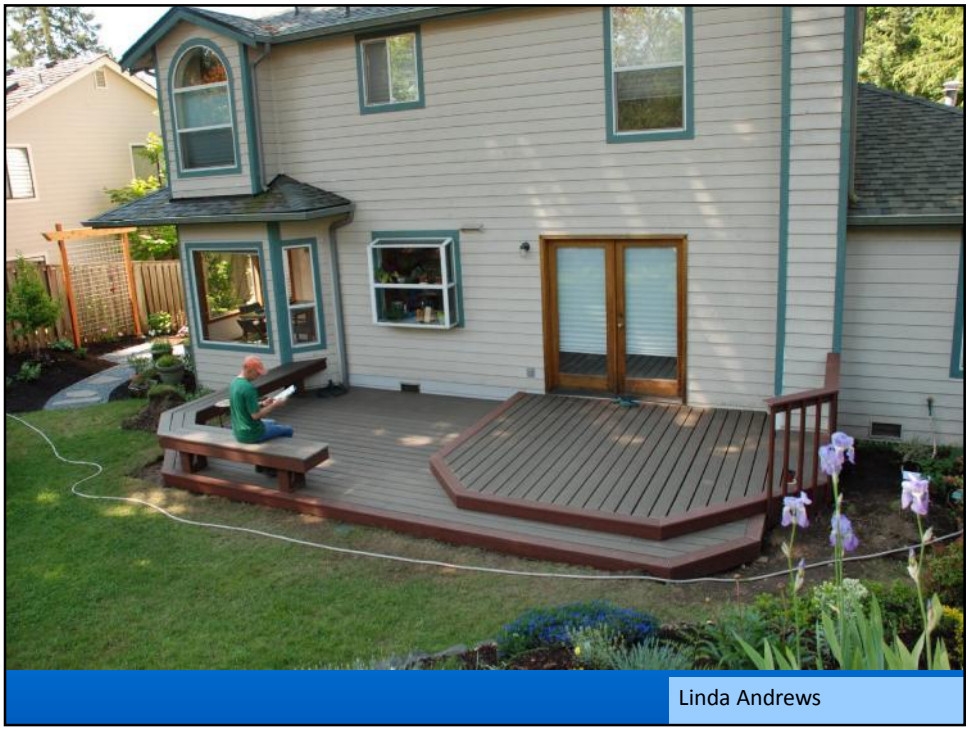
Recycled Materials

Linda Andrews

Decking

Linda Andrews

Composite decks
Linda Andrews


Linda Andrews

Free-Draining Pavements

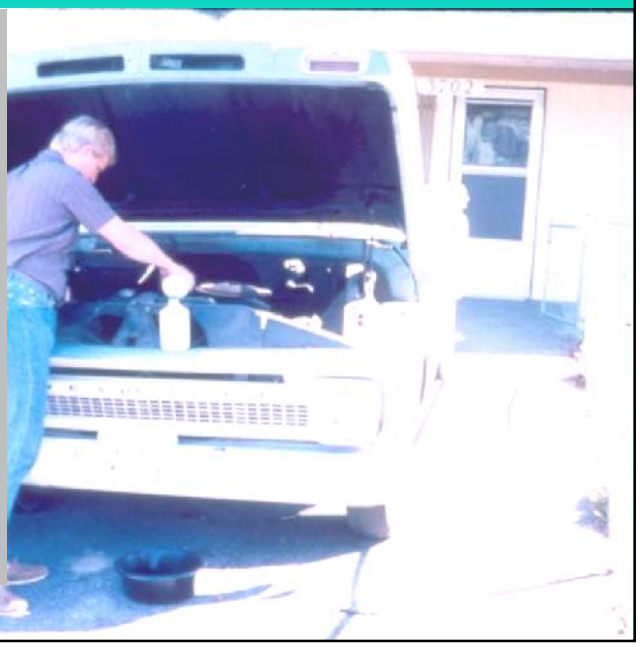
Share your stories

Pavement Pollution

Pollutants & Heavy Metals

Sources:

- Leaking fluids, spills
- Gradual wear of metal parts
- Washing/repairing cars, mowers, etc.
- Animal wastes

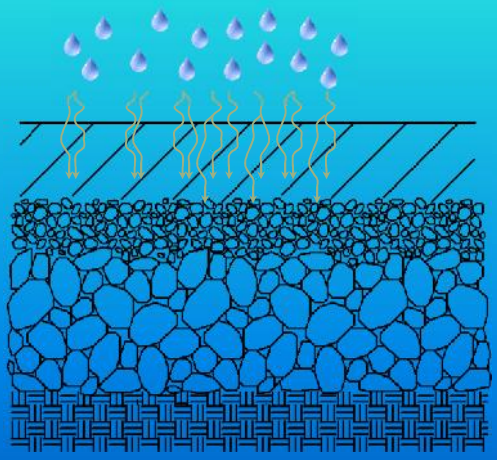


Driveway Design Options:

- Grade and pitch: rain garden or bioswale
- Reduce length & width
- Share access with neighbors

Shared Access

Pollutant Removal Mechanisms in Permeable Pavements



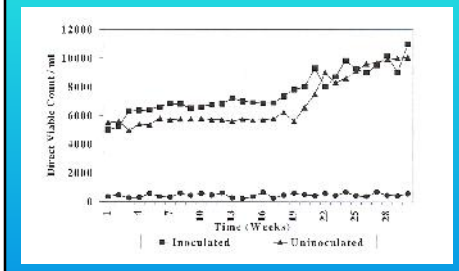
- Biological degradation
- Filtration
- Adsorption
- Volatilization

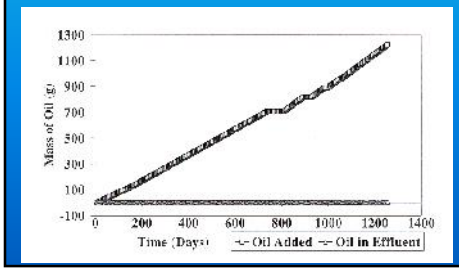
Curtis Hinman, WSU

Pollutant Removal Mechanisms in Permeable Pavements

- Reduced spray on &vehicle wash off

Permeable pavements: highly effective for hydrocarbon biodegradation





- Diversity of microbes (flagelates, amoeba, rotifers) colonize permeable paving immediately
- 97-99% removal capability
- Geotextile primary substrate for microbes

Curtis Hinman, WSU

High initial infiltration rates in permeable paving will diminish over time, but still effective

Infiltration Rates Over Time

- Permeable asphalt hwy: 1986 100 in/hr.; 1990 28 in/hr.
- Florida permeable concrete field evaluation: 6.5 yrs old: 240 in/hr, 8 yrs old: 42 in/hr.
- Borgwardt: reports a long-term infiltration rate for permeable pavers of 4.25 in/hr.
- Worst case: 1,096 cm/hr reduced to 3.32 cm/hr observed. 105 cm/hr after cleaning! (Hinman, 2009)

Courtesy of Curtis Hinman, WSU

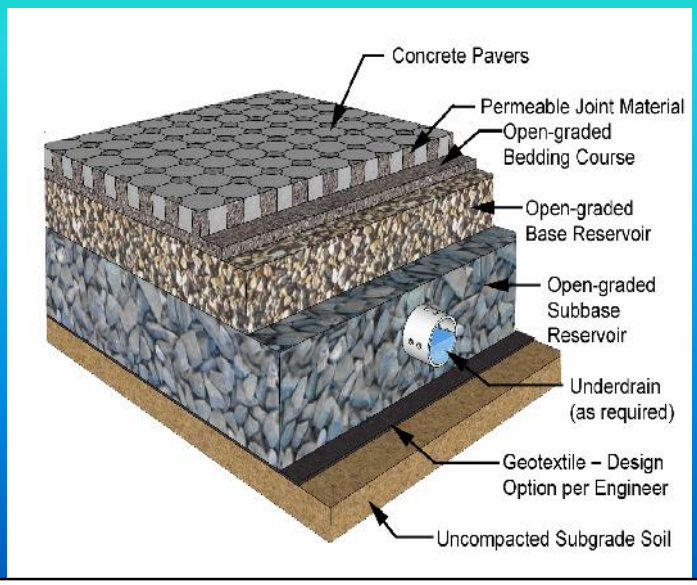
Advantages: LID-Designed Pavements

- **Filter pollution & manage runoff**
- **Allow water to reach plants' roots**
- **Attractive**
- **Durable**

Permeable Pavers

- Pre-cast concrete
- Immediately ready for traffic
- Handle heavy loads at low speed
- Range of colors
- Offer design flexibility

Permeable Interlocking Concrete Pavement *(PICP)*



Typical Paver Shapes for PICP

Drainage joints

Pervious Concrete Paver

RESCUE EMS
Geotextile Optional

Spreading Base Material

Screeding No. 8 stone over No. 57 base

Mechanical placement

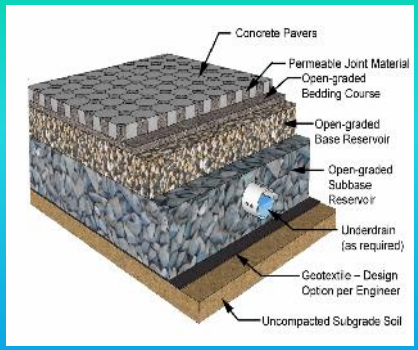
Compact before sweeping in aggregate

Keeping sediment away from the pavers!

PICP Maintenance & Inspection Checklist

Vacuum surface	1 to 2 times annually, adjust for sediment loading
Replenish aggregate in joints	As needed
Inspect vegetation around PICP perimeter for cover & stability	Annually, repair/replant as needed

PICP Maintenance



Cost

Furnished and Installed: $5.00 to $12.00 per sq ft

Includes:

-Pavers placed, cut, compacted, & swept

-2” of ASTM #8 Bedding Aggregate

-4” of ASTM #57 Base Aggregate

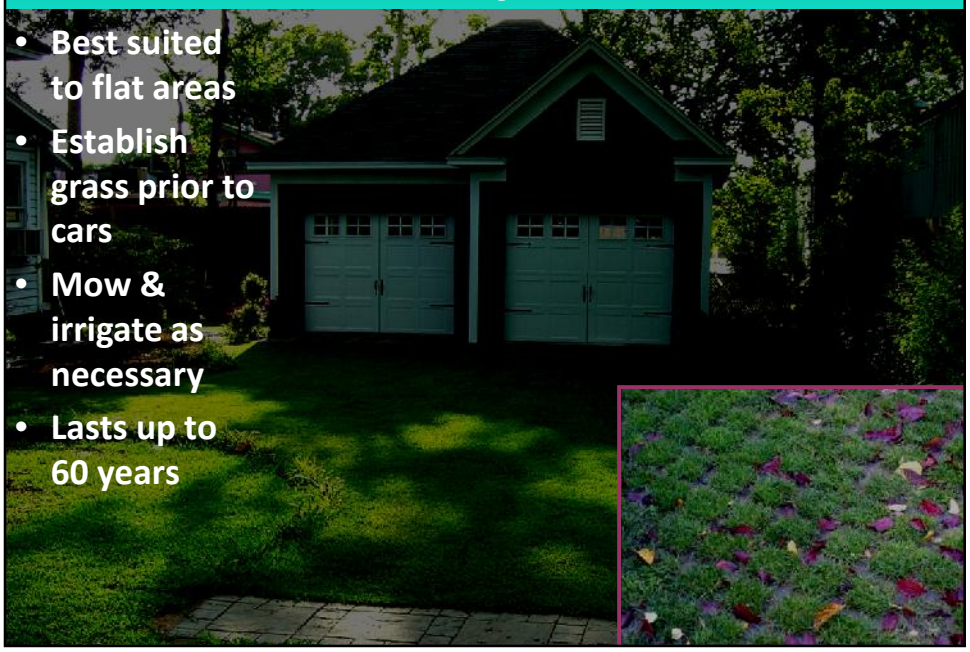
Grid/Porous Aggregate Containment

- Interlocking grid contains small aggregate
- High-strength plastic, concrete, non-corrosive metal
- Easy installation

Grid/Porous Aggregate Containment

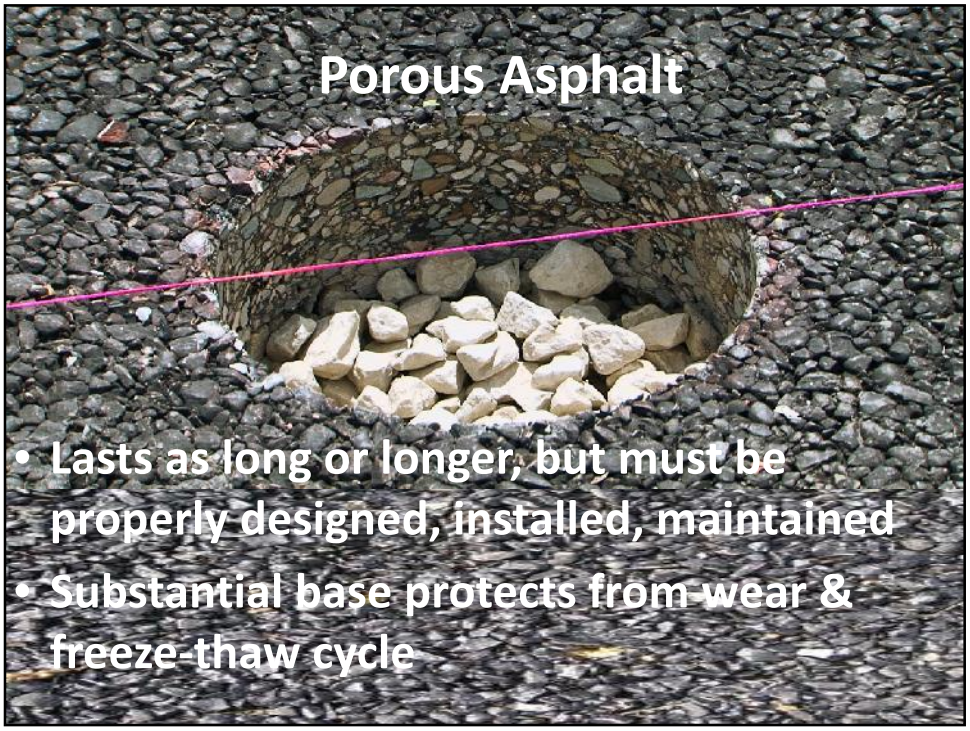
- Price: Comparable to traditional concrete; 10-15% more than asphalt
- Lasts 15-20 years; no repaving expenses

Reinforced Turf Systems

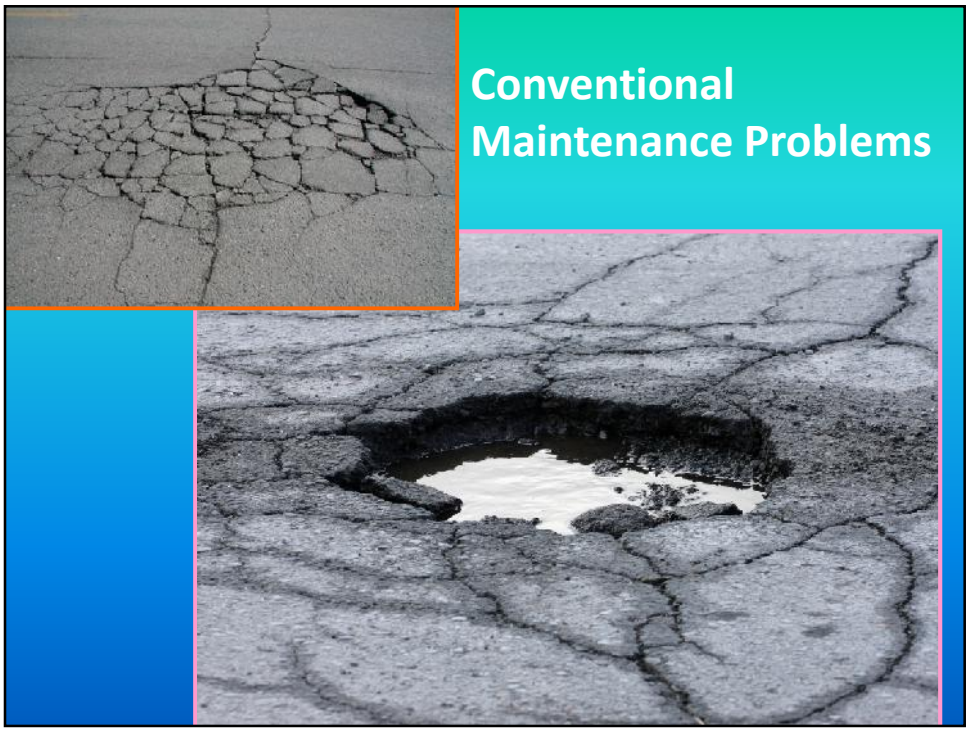


- Best suited to flat areas
- Establish grass prior to cars
- Mow & irrigate as necessary
- Lasts up to 60 years

Porous Asphalt



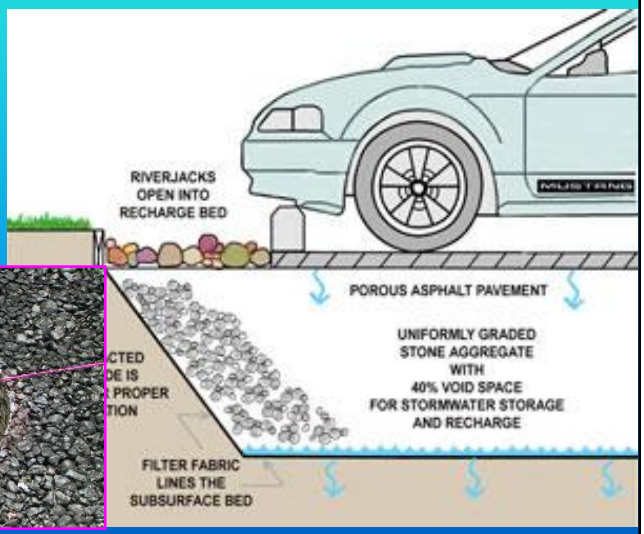
- Lasts as long or longer, but must be properly designed, installed, maintained
- Substantial base protects from wear & freeze-thaw cycle


Conventional
Maintenance Problems

Avoided Maintenance Costs
• No Chip Seal
• No Overlays

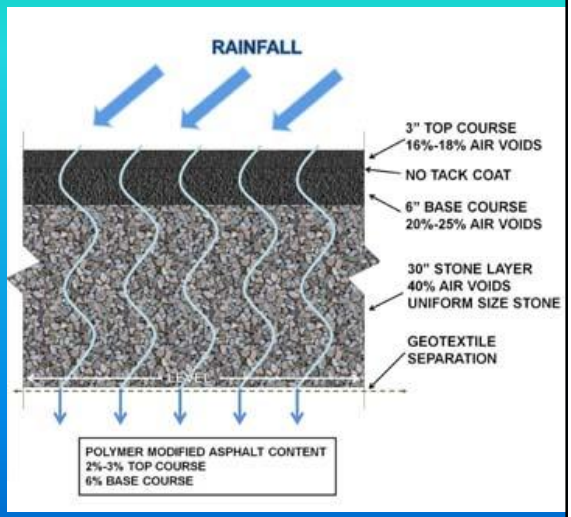
Porous Asphalt

- Coarse stone aggregate & asphalt binder
- Very little fine aggregate = more voids



Porous Asphalt

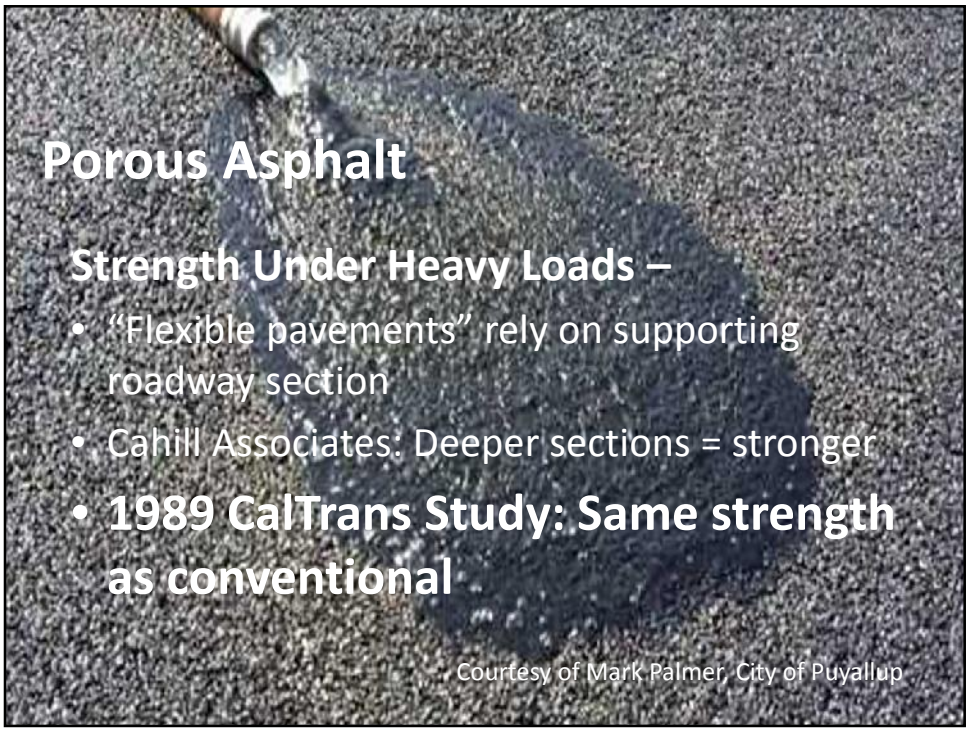
- Pollution abatement – studies find removal via:
  - Geotextile
  - adsorption of metals in pavement matrix



Courtesy of Mark Palmer, City of Puyallup

Porous Asphalt
Strength Under Heavy Loads –
• "Flexible pavements" rely on supporting roadway section
Courtesy of Mark Palmer, City of Puyallup

Porous Asphalt
Strength Under Heavy Loads –
• "Flexible pavements" rely on supporting roadway section
• Cahill Associates: Deeper sections = stronger
Courtesy of Mark Palmer, City of Puyallup


Porous Asphalt
Strength Under Heavy Loads –
• "Flexible pavements" rely on supporting roadway section
• Cahill Associates: Deeper sections = stronger
• 1989 CalTrans Study: Same strength as conventional
Courtesy of Mark Palmer, City of Puyallup

Porous Asphalt

Concerns/Issues

- Protection of pavement during building construction

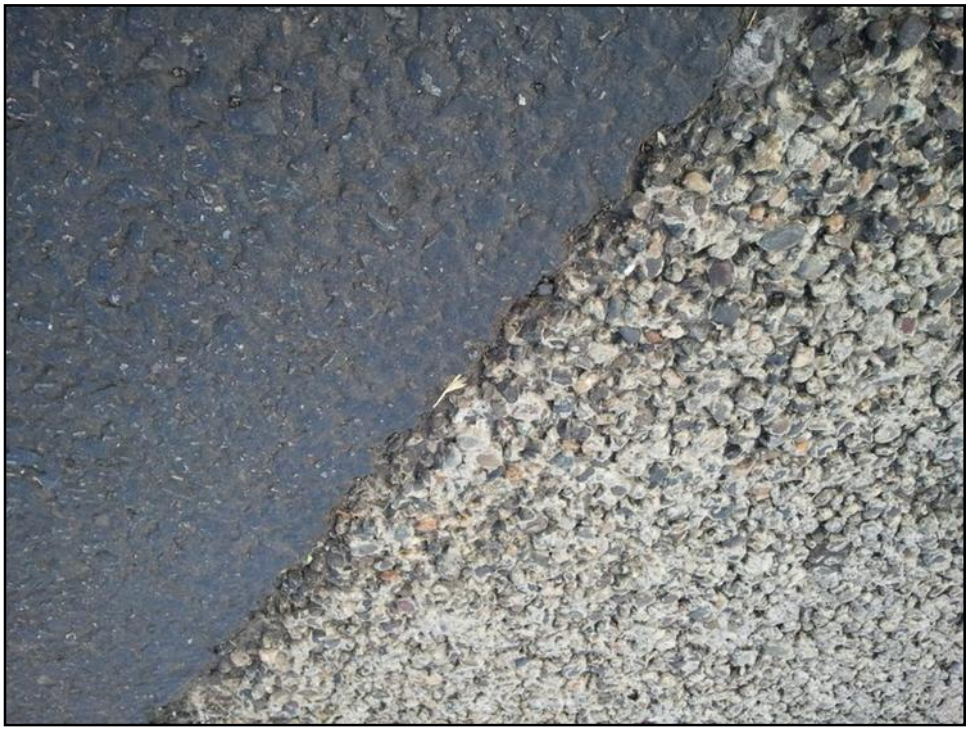
- Design
- Spec
- Communication
- Penalties

Porous Asphalt

Concerns/Issues

- Homeowner/ end user care of pavement
- Education of maintenance personnel
- Design interface with conventional

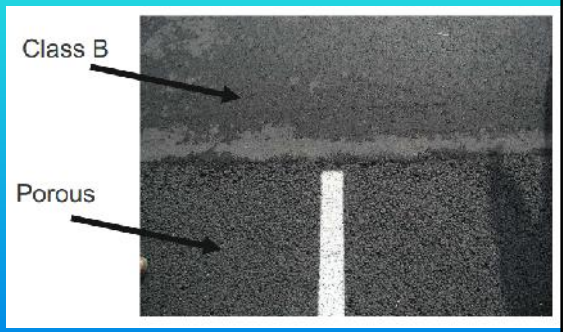
Photo: Bob Simmons, WSU
Porous Asphalt with Run On
from Conventional



Porous Asphalt

Concerns

- Utility installations and roadway repairs
- 5-10% can be conventional



Pervious Concrete

- Filtering & biological removal of pollutants
- Base layer provides storage
- Durable, resists freeze-thaw cycles

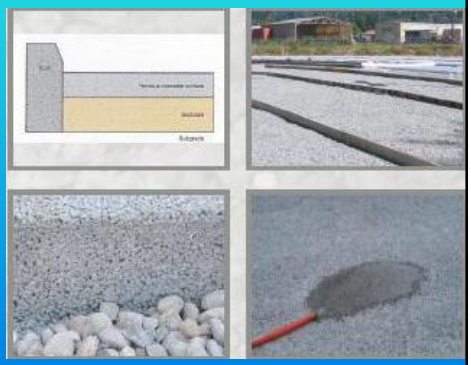
Pervious Concrete

- High strength
- Rigid pavement – not dependent on soil support value

SeaTac Fire Station Headquarters.
Courtesy of Washington Aggregate & Concrete Assn.

Pervious Concrete

- Cement, coarse aggregate & water
- Little to no fine aggregates
- Void content of 15-25% (5-7% conventional)



Commercial lot during rainstorm,
adjacent conventional asphalt

Whidbey Island, WA

Pervious Concrete

Craig Tosomeen, City of Olympia

Precautions

- Qualified, experienced contractors generally required

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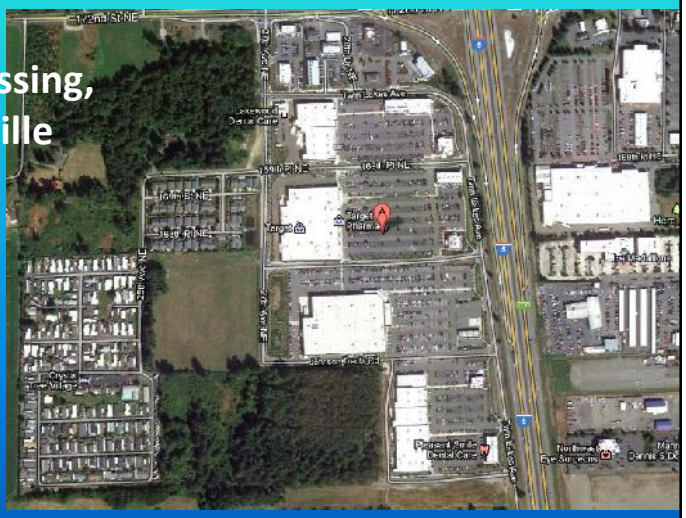
- Follow recommended maintenance (sweeping, vacuuming, etc.)
- Plan for weeds—flame torch, vinegar, intentional plantings

How does this pencil out?

Case study:
Lakewood Crossing,
City of Marysville

476,000 sq. ft.
Mall



LID Options

- Pervious pavement
- Curb cuts to bioretention swales

Photo Credit: NAPA - HotMix.org

Conventional Alternatives …

- Buy more property – off-site pond
- Discharge into ditch that flows to salmon-bearing stream
- Would require raising site 8 ft. – $1M/ft.

Photo: Washington Dept. of Ecology

Resources

- Interlocking Concrete Pavement Institute
- Ecostone Pavers
- Invisible Structures ("Grasspave" "Gravelpave")
- TerraFirm EcoGrid
- Concrete Council
- Asphalt Pavement Alliance

Gary's driveway rain interceptor
AKA: "DryWel Tredbed™"

Captures runoff of driveway and roof
Breaks up monotony of asphalt

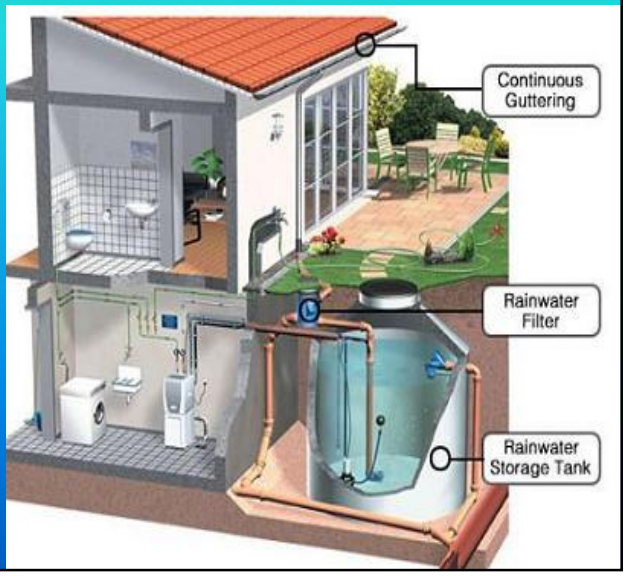
BOXER

Managing Roof Runoff – Rainwater Harvest

Fiona Douglas-Hamilton

Managing Roof Runoff – Rainwater Harvest

- Cisterns provide stored water for many uses



Mike Brioli, Living Systems Design

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Mike Brioli, Living Systems Design

Mike Brioli, Living Systems Design

Tacoma's Pacific Plaza: 150,000 gpy storage

Regional Resources

Michael Brioli
Living Systems Design
Harvestrain.net
mike@harvestrain.net

Department of Ecology

Rooftops

- Zinc
- Lead
- Chromium
- Arsenic
- Polycyclic aromatic hydrocarbons

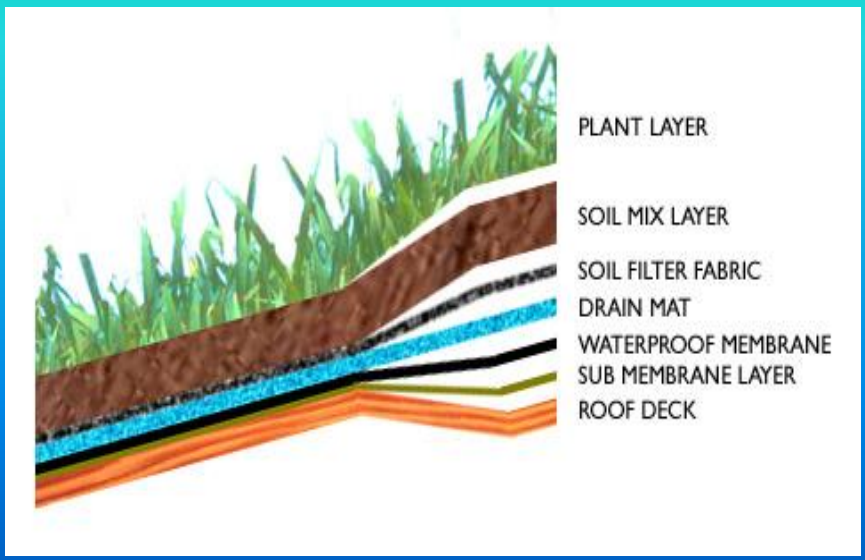
Thanks to:

- Patrick Carey, Hadj Design
- Tom Liptan, City of Portland
- Brian Taylor, formerly Magnusson Klemencic Associates

What are Green Roofs?

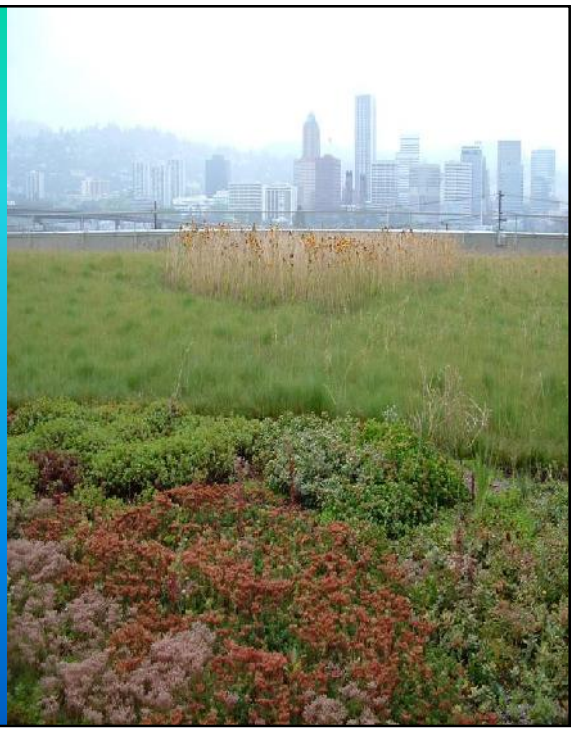
- Also called: eco-roofs, vegetated roofs, living roofs, roof gardens
- Plants = top layer of a composite assembly

Components



Overall Benefits

- Stormwater treatment
- Stormwater reductions
- Aesthetic improvements
- Noise reduction
- Heating/cooling cost savings
- Longer-lasting roofs
- Increased property values



Economic Benefits for Landowner

- Potential increase in real estate values of about 20%.
- Potential to reduce the size of HVAC equipment on new or retrofitted buildings.
- Potential to reduce the amount of standard insulation used.

Long Roof Life & Resource Conservative

- Extended roof life – 50 yrs +
- Reduced thermal expansion/ contraction of membrane
- No UV radiation degradation

Green Roof Applications

- **Poor soils**
- **Limited land availability**
- **Other attributes**

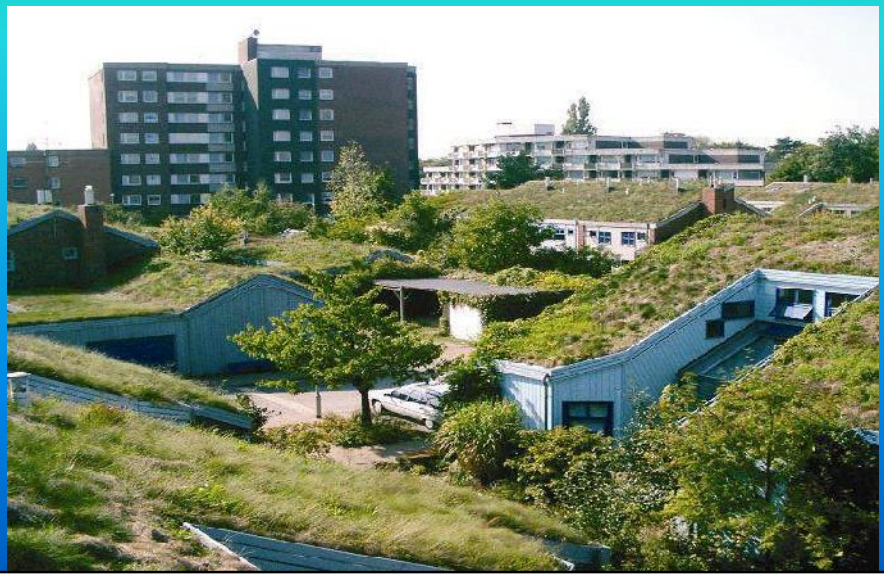
Green Roof Types

- "Intensive": soil or growth medium base of 6 inches to as deep as 3 feet or more.
- "Extensive": soil or growth medium base of sometimes less than 2 inches to as deep as 6 inches.

Built in 1834 and still functioning

Rockefeller Center

Berlin neighborhood 2001



German residence, 1984

Ford's Dearborn Plant, 3.8 acres of green roof

Residential vs. Commercial Roof Surfaces

6-8 times more residential than commercial in cities

Increases more in suburban & rural areas

Photo: Janet Jensen, Tacoma News Tribune

Source: Hadj Design/City of Seattle

"Phyte Club" Action

Stormwater Benefits

What Happens to the Rain?

1. **Some intercepted by vegetation -- evaporates**

Stormwater Benefits

What Happens to the Rain?

1. Evaporation

2. **Portions are absorbed in the substrate—benefit from soil micro-organisms, soil friction/bonding;**

Stormwater Benefits

What Happens to the Rain?

1. Evaporation

2. Portions are absorbed in the substrate—benefit from soil micro-organisms, soil friction/bonding;

3. **Portions in the substrate are taken into the vegetation and then transpire;**

Stormwater Benefits

What Happens to the Rain?

1. Portions of it are intercepted by vegetation and then evaporate;

2. Portions are absorbed in the substrate—benefit from soil micro-organisms, soil friction/bonding;

3. Portions in the substrate are taken into the vegetation and then transpire;

4. **Some water evaporates from the substrate;** and

Stormwater Benefits

What Happens to the Rain?

1. Portions of it are intercepted by vegetation and then evaporate;

2. Portions are absorbed in the substrate—benefit from soil micro-organisms, soil friction/bonding;

3. Portions in the substrate are taken into the vegetation and then transpire;

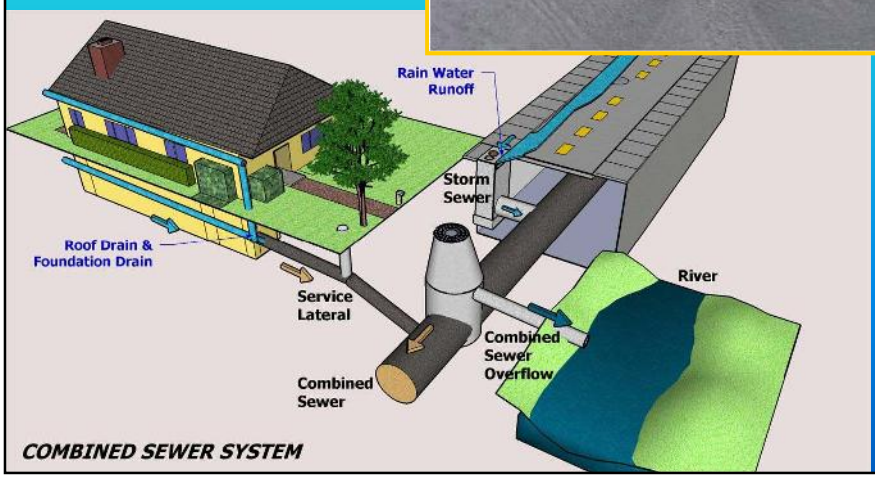
4. Some water evaporates from the substrate; and

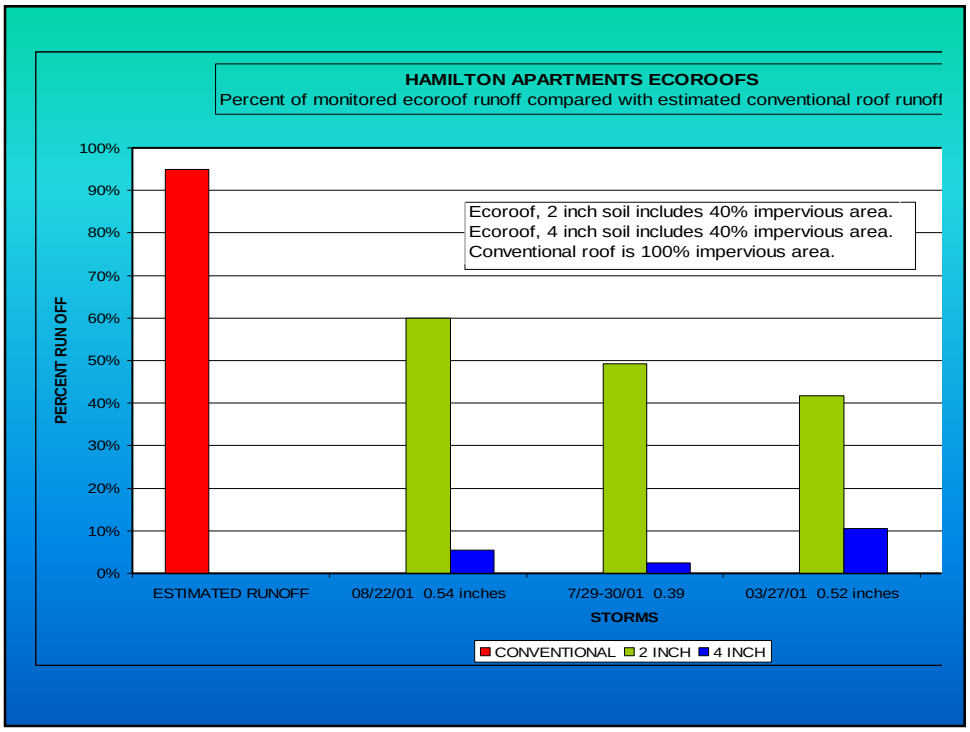
5. **Excess amounts flow through the substrate and become runoff.**

Magnusson Klemencic Research

- **2005-2007**
- **Runoff rates reduced 65-94%**
- **Even during extreme storms, up to 76%**
- **Best success with engineered soils 4-6 inches**

Peak Flow Reduction





Stormwater Interception

Influencing Factors:

- Vegetation maturity
- Substrate maturity
- Rainfall distribution (best at handling intermittent—even heavy—storm events)

Stormwater Interception

- Runoff negligible from events of 0.6" or less

Portland Roof, with 4 to 4.5-inch substrate:
- Retained 20% January to March 2002
- Retained 59% January to March 2003

- More even rainfall distribution in 2002
- More dry periods between storms in 2003

Water Filtration Benefits

- Roof runoff treatment
- Delay of flow
- 95% cadmium, copper, lead, 16% zinc reductions
- Clearer of organic matter and debris

Compatible with Solar

Habitat

- Stepping stones or Islands
- Mimic endangered habitats
- Inherent protections
- Birds
- Insects
- No slugs

Habitat Roof

Patrick Carey, Hadj

Building Structure

- Must hold 10-25 psf saturated weight

Building Structure

- Must hold 10-25 psf saturated weight
- **Typical ballast can hold 10-12 psf ecoroof**

Building Structure

- Must hold 10-25 psf saturated weight
- Typical ballast can hold 10-12 psf ecoroof
- **Retrofit remedies – many options**

Building Structure

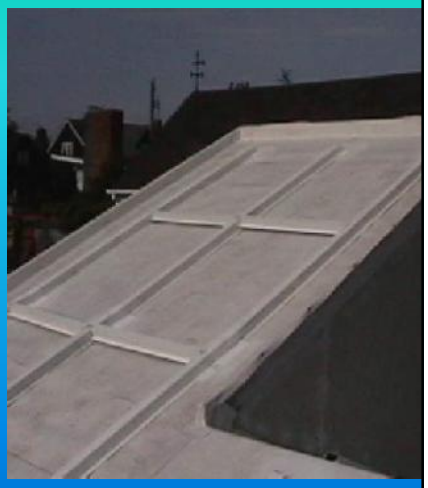
- Must hold 10-25 psf saturated weight
- Typical ballast can hold 10-12 psf ecoroof
- Retrofit remedies
- **Current energy code encourages deeper roof joists for insulation; also creates stronger roofs**

Building Structure

- Must hold 10-25 psf saturated weight
- Typical ballast can hold 10-12 psf ecoroof
- Retrofit remedies
- Current energy code encourages deeper roof joists for insulation; also creates stronger roofs
- **Similar in weight to tile or slate**

Sub-Membrane

- Provides a cushion for the membrane.
- Back-up membrane & temporary protection for the deck before the membrane is installed.



Waterproof Membrane

- Commercial-grade waterproofing layer

Waterproof Membrane

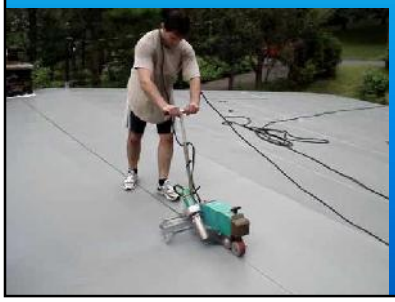
- Many varieties: modified rubber (EPDM), modified plastic (TPO), modified bitumen, PVC, hybrids
- Many forms: Mop down, liquid applied, single-ply, spray

Waterproof Membrane

Seams waterproofed by:

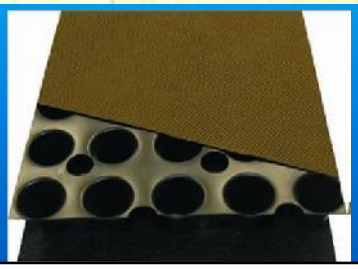
- heat welding
- chemical adhesive
- hot applied bitumen

(depending on membrane material)



Capillary Mat & Drain Mat

- Prevent growth media from draining off roof
- Various designs



Growth Medium ("Engineered Soil Mix"): Structure

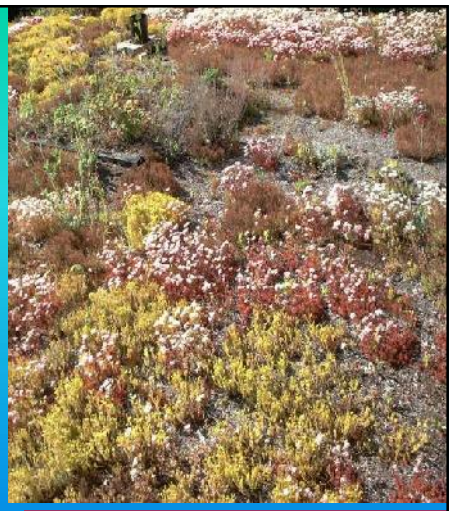
- Can't blow away
- Can't grind to dust
- Porous for water storage
- Allows air flow

Growth Medium ("Engineered Soil Mix"): Nutrition

- **Trace minerals**
- **Organics – nutrition**
- **pH**

Plants

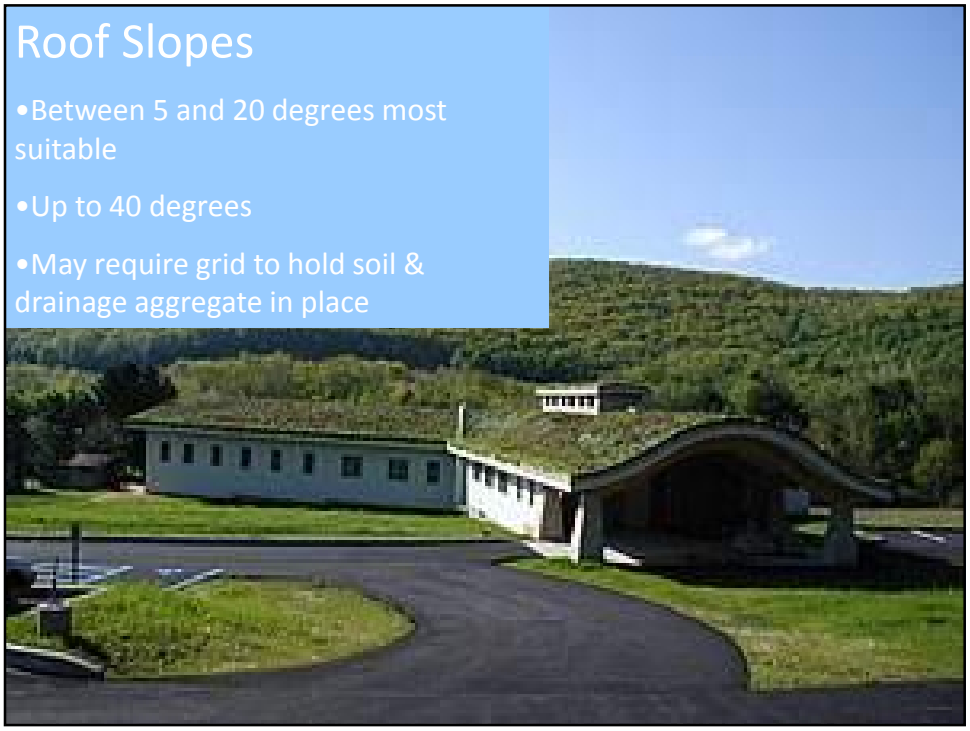
- Fast coverage
- Low maintenance
- Drought tolerant
- Wind and sun tolerant
- Fire resistant
- Attractive



***Examples**: Sedums, hens & chicks, hardy ice plant, creeping herbs, pussytoes, seathrift, bunchgrasses*

Roof Slopes

- Between 5 and 20 degrees most suitable
- Up to 40 degrees
- May require grid to hold soil & drainage aggregate in place



Challenges
• Still a new concept in U.S.

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• Engineers, code officials, contractors, and home loan institutions need more education

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- **Local jurisdictions need to create incentives to reap substantial public benefits**

Challenges

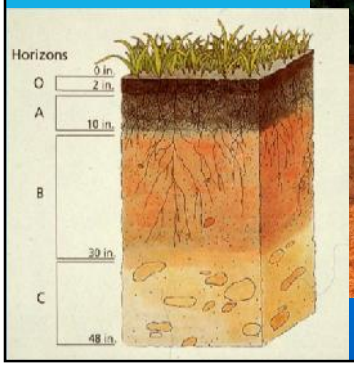
- Still a new concept in U.S.
- Engineers, code officials, contractors, and home loan institutions need more education
- Local jurisdictions need to create incentives to reap substantial public benefits
- **Lending institutions should start life-cycle-cost evaluations in loans**

Minimal Excavation Foundations

- Minimal footprint
- No or minimal equipment
- No or minimal disturbance
- Soils & vegetation in tact

"Typical strip, transfer, pound."

-- Rick Gagliano, PIN Foundations Inc.



Thanks to Rick Gagliano

Typical Foundation

- Heavy equipment
- Site pours
- Disturbance

Thanks to Rick Gagliano

Minimal Excavation Foundations

- Natural Hydrology

Thanks to Rick Gagliano

Diamond Pier

- 2- to 3-person crew depending on size

Thanks to Rick Gagliano

Diamond Pier Foundations

- Installation take 20-30 minutes per pier

Thanks to Rick Gagliano

Pin Construction

Thanks to Rick Gagliano

Why Rain Gardens?

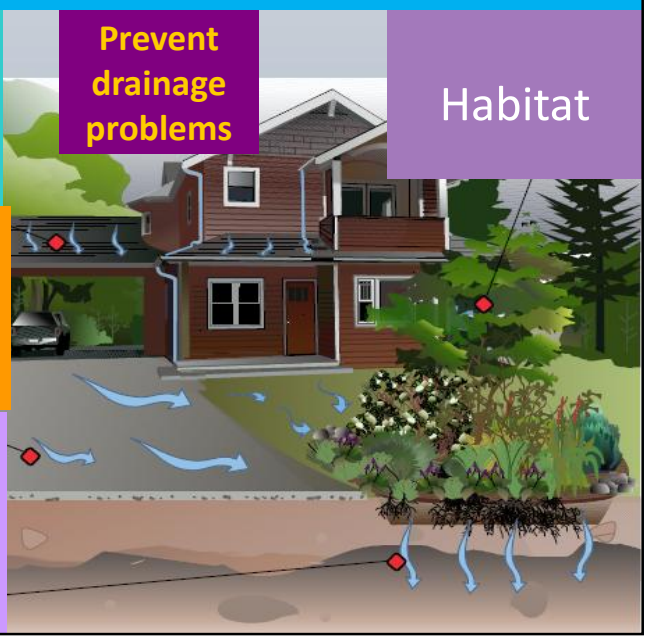
Protect Streams & Waterways

Prevent drainage problems

Habitat

Filter pollution before storm drains & groundwater

Recharge Groundwater



Volume I – Section 2.3 Definitions

Bioretention vs. Rain Garden

Bioretention

- Engineered Soil Mixture
- LID Performance Standard
- Use For Projects Triggering Minimum Requirements #1-9

Retain & Pass Stormwater through a soil mixture

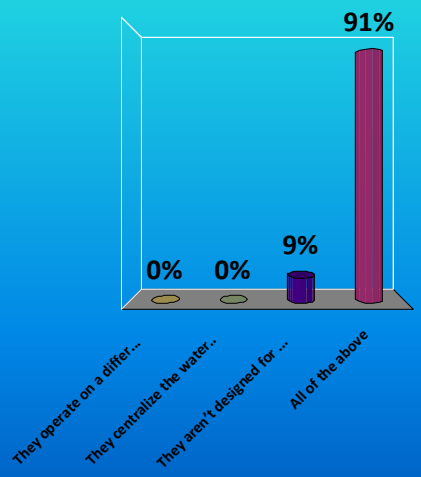
Rain Garden

- Use For Projects Triggering Minimum Requirements #1-5

Courtesy Ed O'Brien, Dept. of Ecology

Why can't stormwater ponds be converted to rain gardens?

A. They operate on a different principle
B. They centralize the water & concentrate pollutants
C. They aren't designed for plants & specialized soils
D. All of the above



What rain gardens aren't …

Root Structure & Soil Structure

"Bio-geo-chemical" process

Graphic: Stacey Gianas

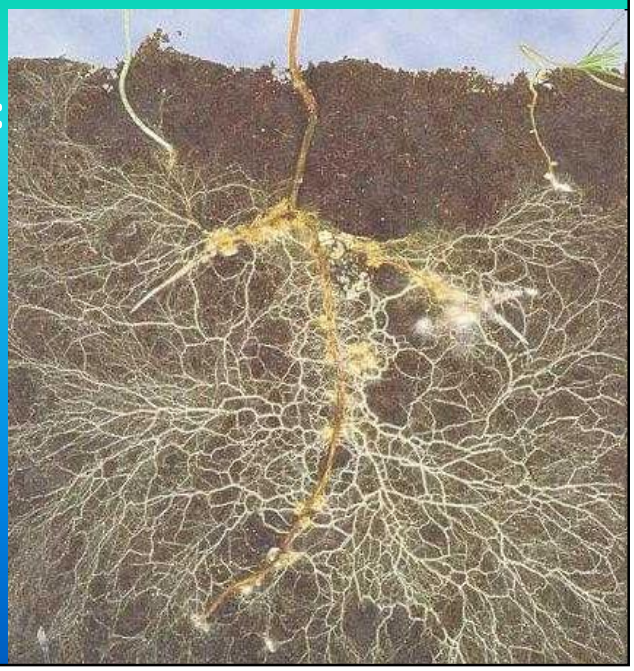
Pollutant Removal Rates

Pollutant	Removal Rate
Total Phosphorous	70-83%
Metals (Cu, Zn, Pb)	93-98%
Total Kjeldahl Nitrogen	68-80%
Total Suspended Solids	90%
Organics (pesticides)	90%
Bacteria	90%

Source: Davis et al. 1998

Treatment mechanisms:

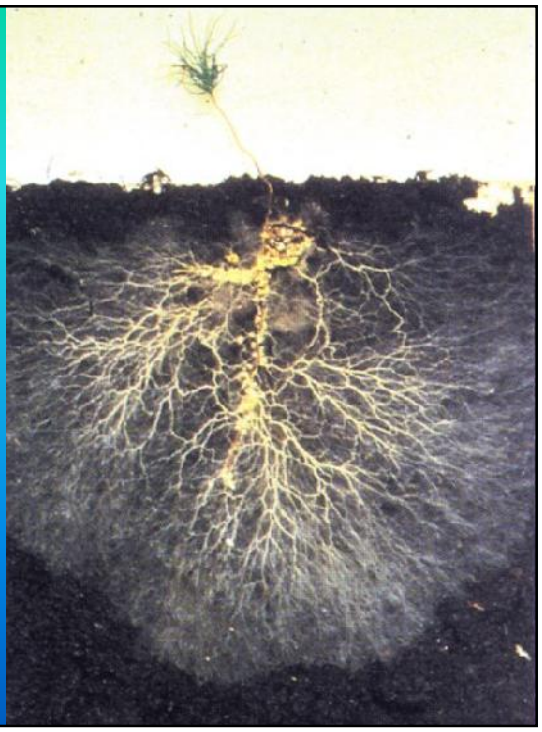
Direct Pathways:
* Nutrient uptake
* Metal uptake
* Uptake, volatilization, transformation of pesticides

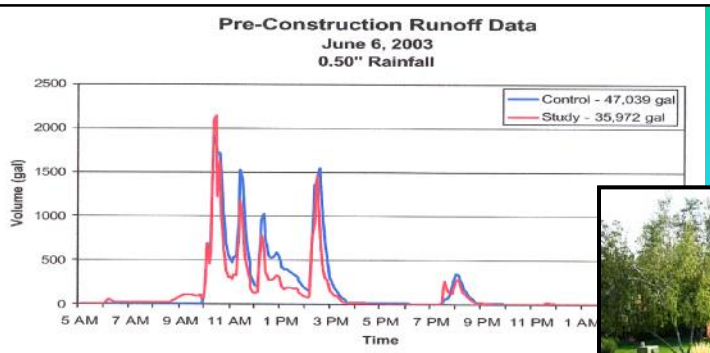


Plants & Water Quality

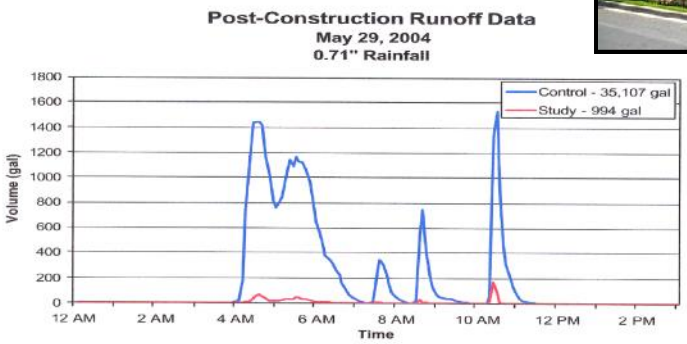
*Soil biota

*Myccorhizal fungi





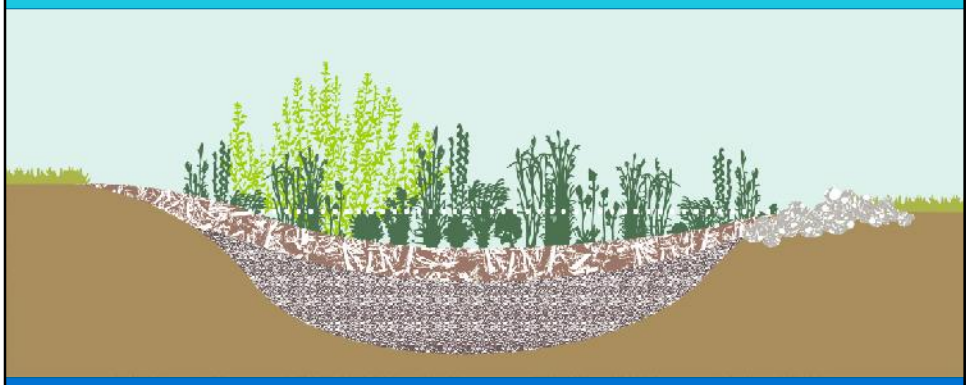
Burnsville, MN



Mulch also plays a role

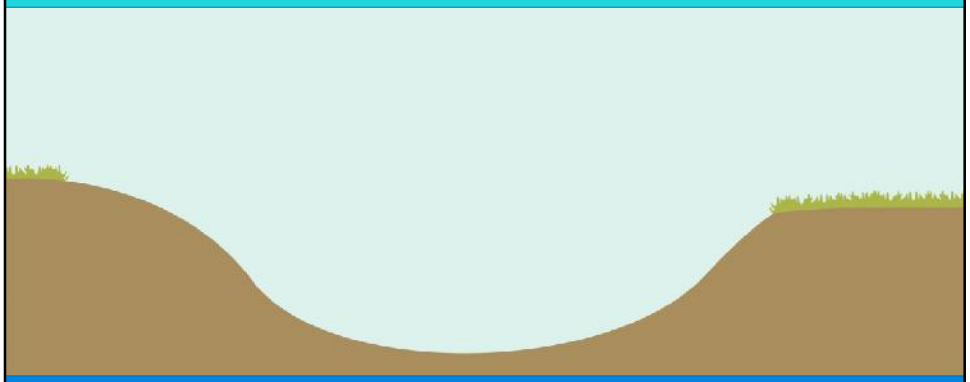
Anatomy of a rain garden

"Inflow" "Ponding depth" "Overflow"



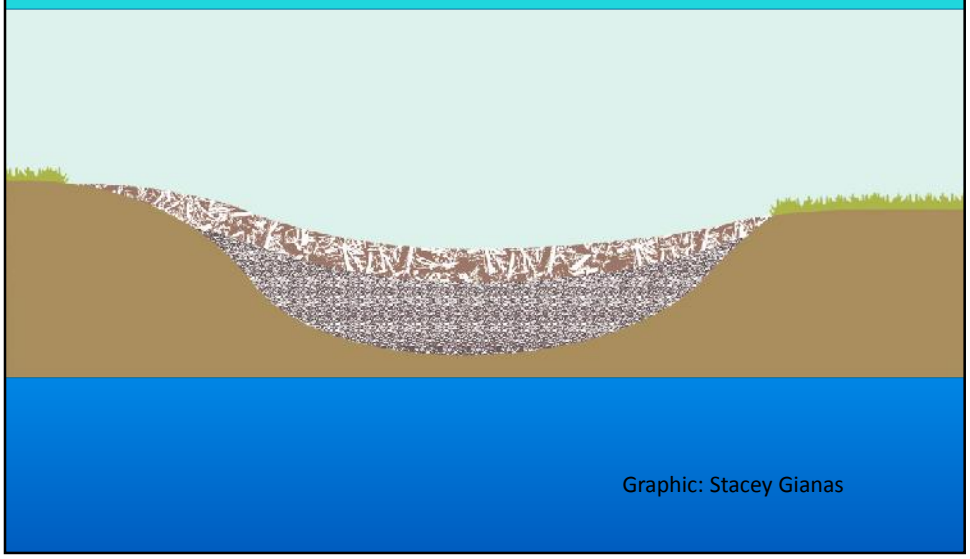
Graphic: Stacey Gianas

Excavation



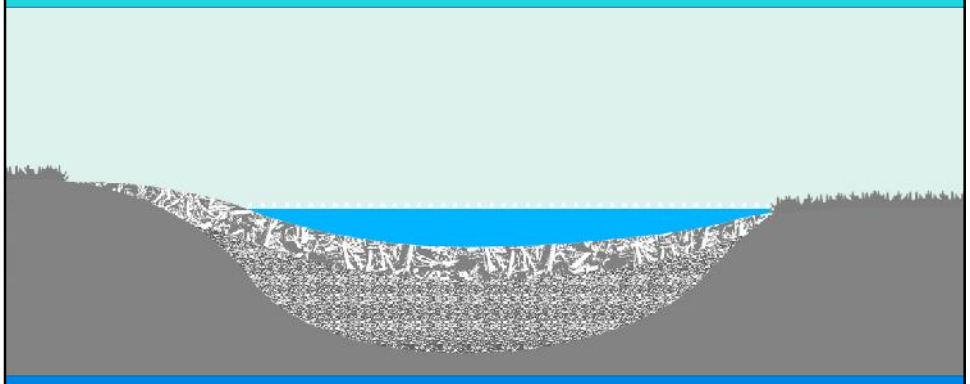
Graphic: Stacey Gianas

Rain garden mix and mulch layer



Graphic: Stacey Gianas

Ponding depth



Graphic: Stacey Gianas

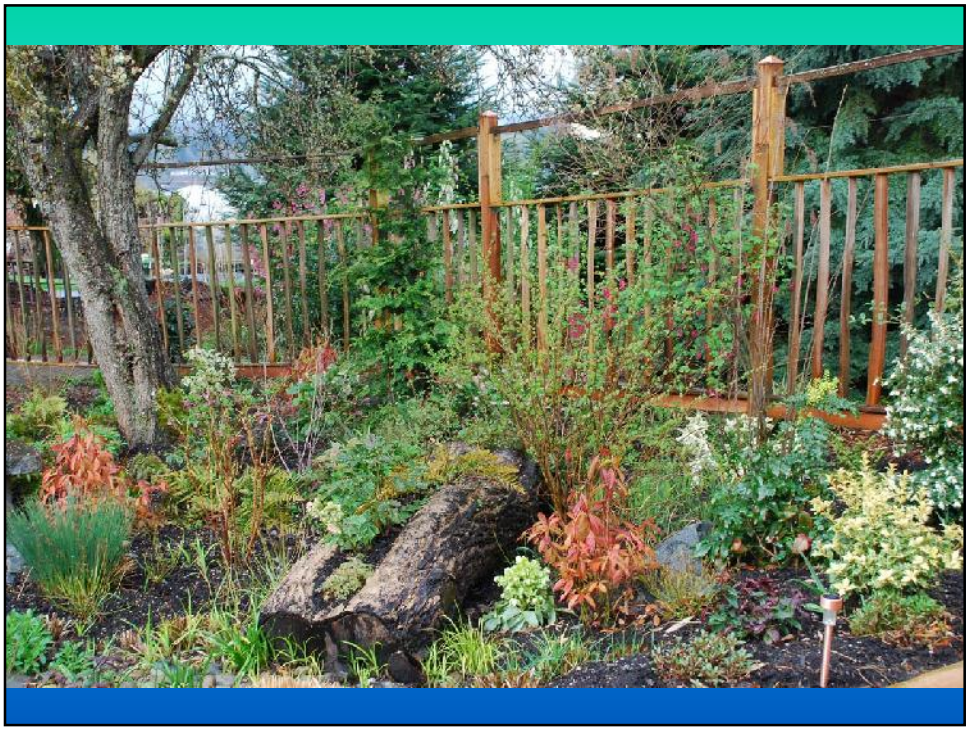
Inflow

Graphic: Stacey Gianas

Overflow

Graphic: Stacey Gianas

Linda Andrews Landscape & Design



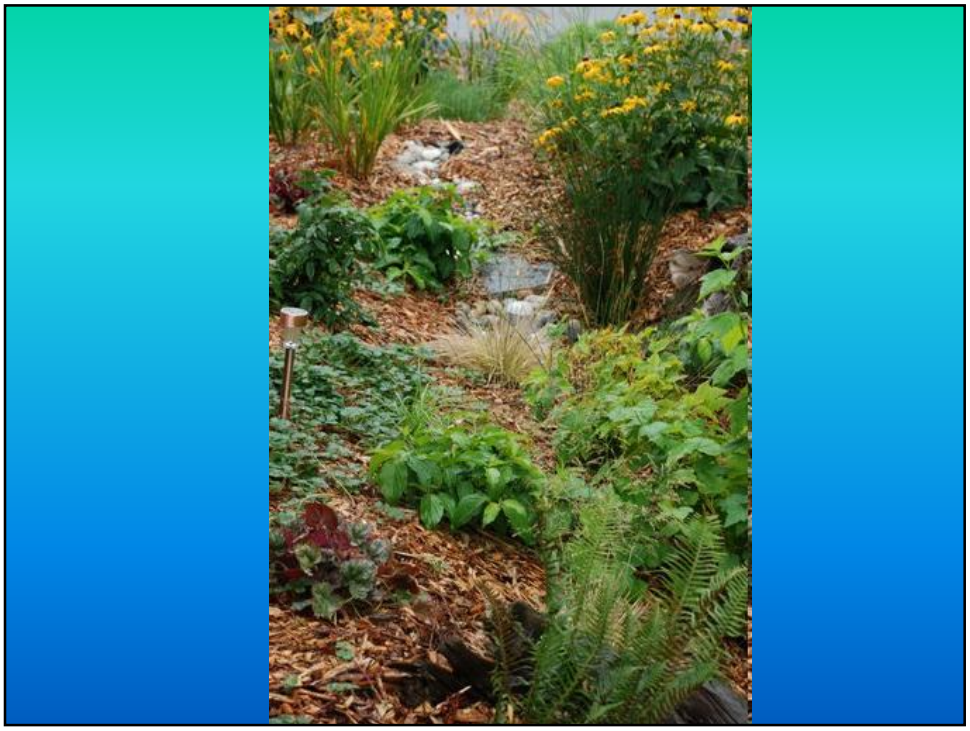
June 26, 2011

July 25, 2011

Photo: Erica Guttman, WSU

Photos: Erica Guttman, WSU

June 26, 2012



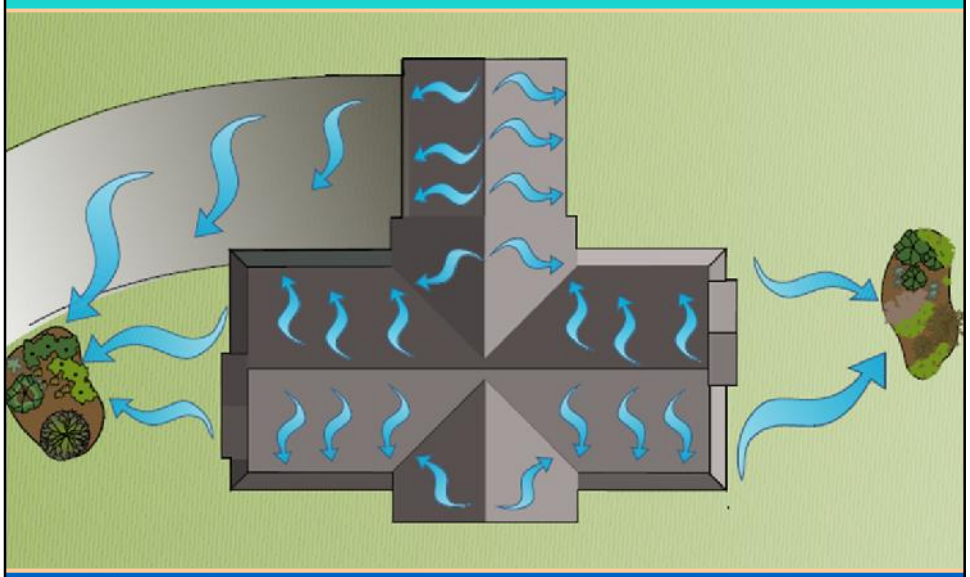
Yelm High School
Photos: David Hymel

David Hymel

Rain garden basics: sizing and locating

Determine Available Space/Sites

Maybe more than one!



Calculate Drainage Rate: 2 ft. pit test

Inches divided by hours = inches/hour

Example:

12” drains in 8 hours = 1.5”/hour

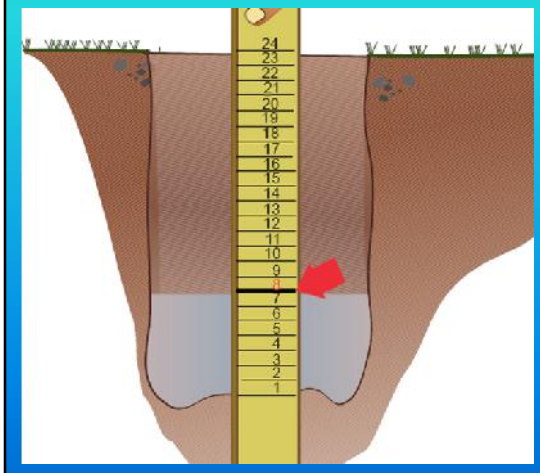
12” drains in 20 hours = 0.6”/hour

12” drains in 30 hours = 0.4”/hour

More than 0.5”/hr. = well draining

Less than 0.5”/hr. = poorly draining

Drainage Rate



Poorly draining soils may be OK, but standing water will be present longer;

0.1” or worse: Find different location

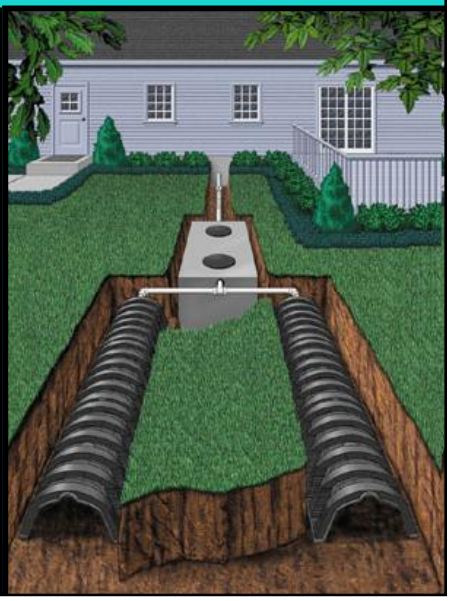
Location

- At least 10 feet from the house or other structures.

Photo: David Hymel, *Rain Dog Designs*

Location

- Not over a septic system.
- Not over perched groundwater



Location

- Stay well back from steep slopes or get professional advice.

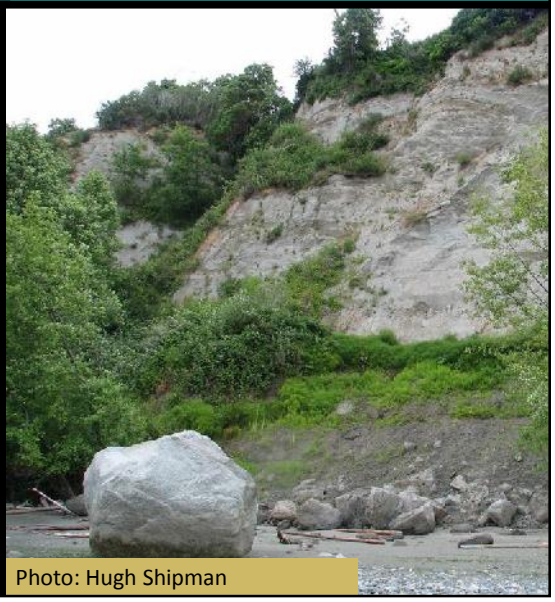
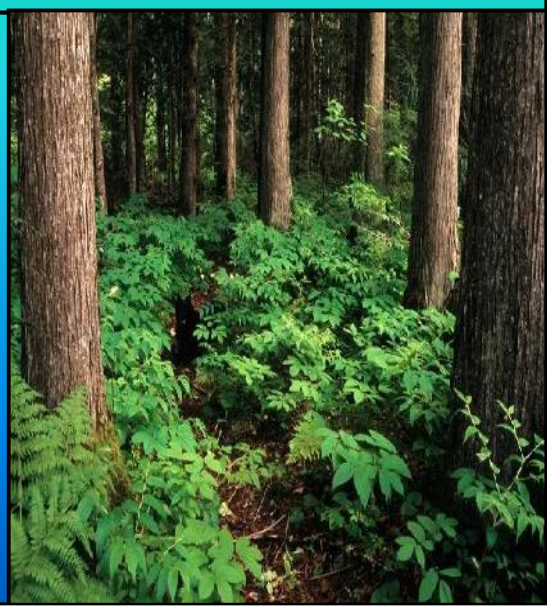


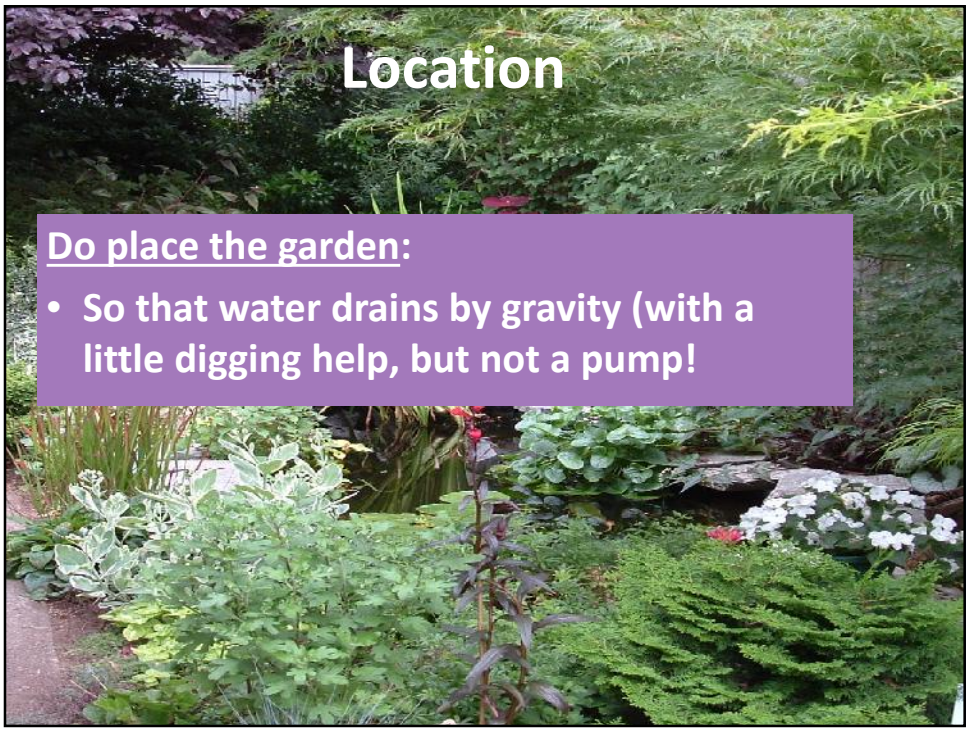
Photo: Hugh Shipman

More native plants at top instead!

Location

- Not in areas with mature vegetation
- Avoid large tree roots—seek a consultation from an arborist when in doubt.

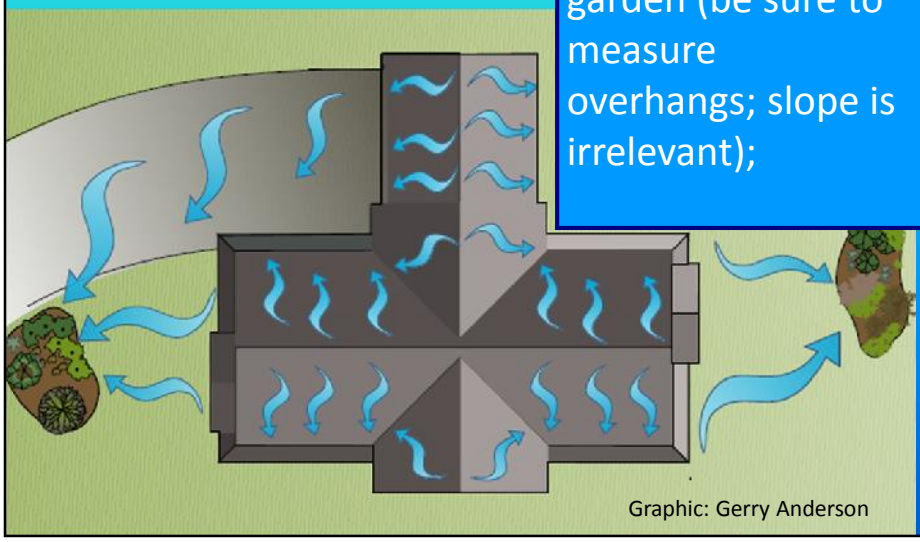



Location
Do place the garden:
• So that water drains by gravity (with a little digging help, but not a pump!

Determine Contributing Area
• Measure portion of driveway/walkways flowing to garden;
• Measure any lawn that sheet flows to garden.

Contributing Area

- Measure roof portions flowing to garden (be sure to measure overhangs; slope is irrelevant);



Graphic: Gerry Anderson

Determine How Much Drainage Your Rain Garden Space Will Hold

Size of Garden (As % impervious Area in sq. ft.)	Annual Volume of Water Held in Garden	
	(1) Poorly-Draining	(2) Well-Draining
10%	70%	99%
20%	90%	100%

(At 12" depth with 6" ponding depth)

• Free-draining soils: Excavate 18 to 30”
• Poorly draining soils: Excavate more

• Free-draining soils: Set soil aside
• Poorly draining soils: Will order in special bioretention soil mix

"Bathtub"

- Poor execution & installation

• Refill to desired depth with 60-65% native soil, 40-35% yard waste compost (by volume)
• Poorly draining soils & bioretention: 60% screened sand, 40% compost

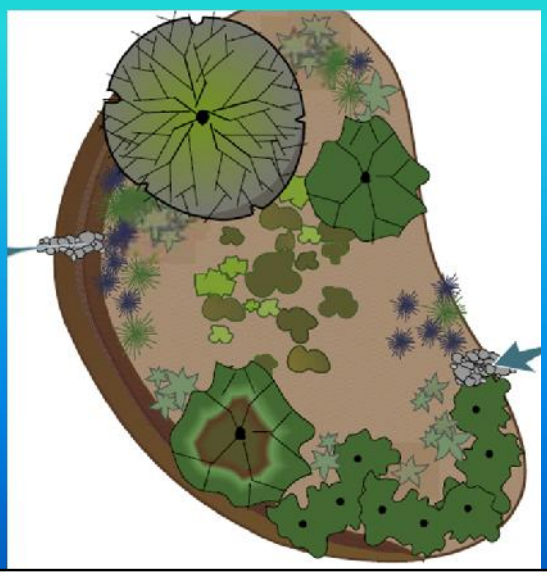
• Leave 6-12” minimum ponding depth

Exceptionally Free-Draining Soil

If 1" or more/hour drainage, sandy soils:

- Excavate to at least 9"
- Add 3" compost
- Till in to about 5"
- Leaves 6" ponding;
- Excavate more for more ponding

Inflow & Overflow

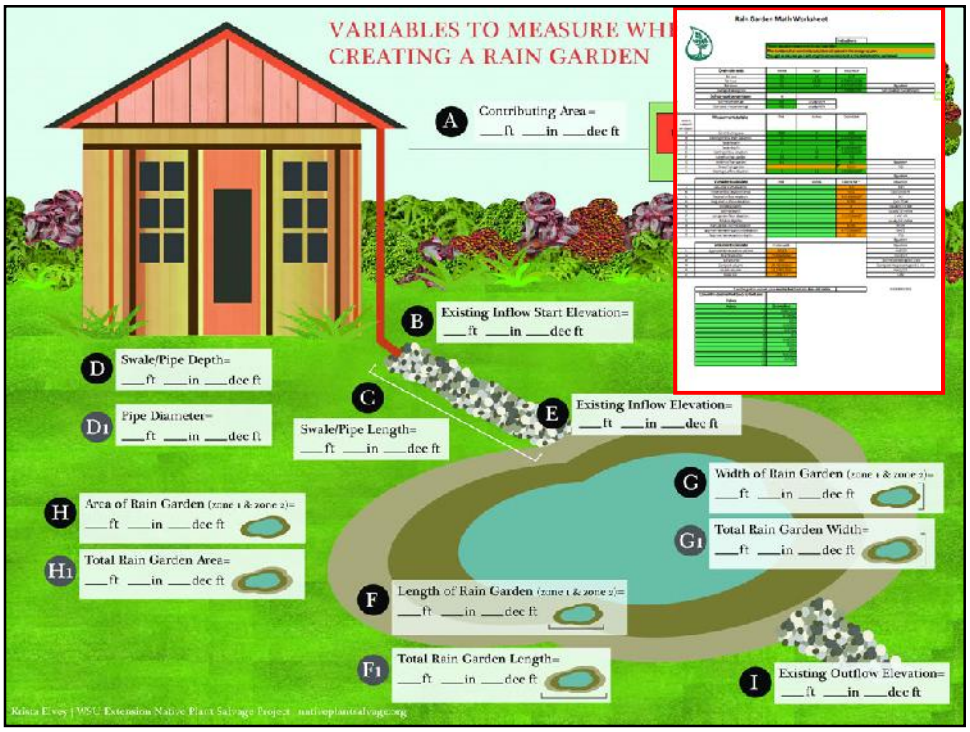


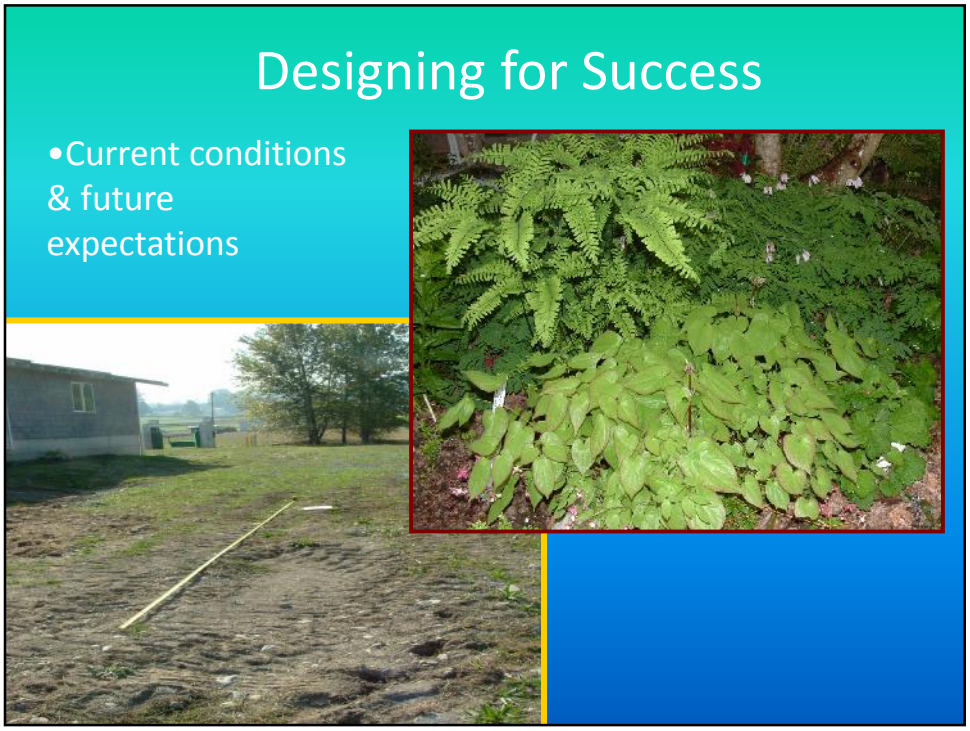
Swale Inflow

Managing Overflow

Dry creek connects to rain garden

Linda Andrews Landscape & Design


VARIABLES TO MEASURE WH
CREATING A RAIN GARDEN
A Contributing Area =
___ft ___in ___dec ft
B Existing Inflow Start Elevation=
___ft ___in ___dec ft
D Swale/Pipe Depth=
___ft ___in ___dec ft
D1 Pipe Diameter=
___ft ___in ___dec ft
C Swale/Pipe Length=
___ft ___in ___dec ft
E Existing Inflow Elevation=
___ft ___in ___dec ft
G Width of Rain Garden (zone 1 & zone 2)=
___ft ___in ___dec ft
G1 Total Rain Garden Width=
___ft ___in ___dec ft
H Area of Rain Garden (zone 1 & zone 2)=
___ft ___in ___dec ft
H1 Total Rain Garden Area=
___ft ___in ___dec ft
F Length of Rain Garden (zone 1 & zone 2)=
___ft ___in ___dec ft
F1 Total Rain Garden Length=
___ft ___in ___dec ft
I Existing Outflow Elevation=
___ft ___in ___dec ft
Kristin Elvey | MSU Extension Native Plant Salvage Project nativeplantsalvage.org

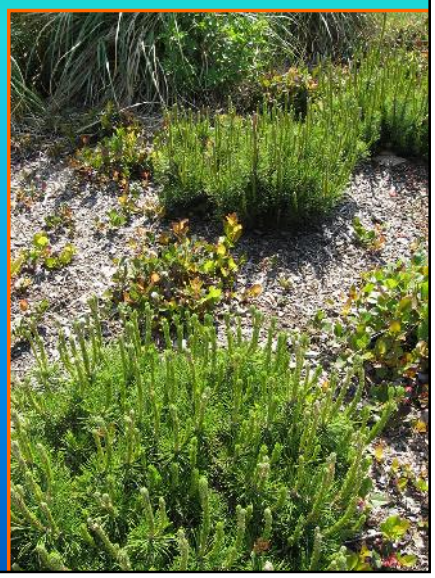

Designing for Success
•Current conditions & future expectations

Right Plant, Right Place

- Soils

Right Plant, Right Place

- Sun



Right Plant, Right Place

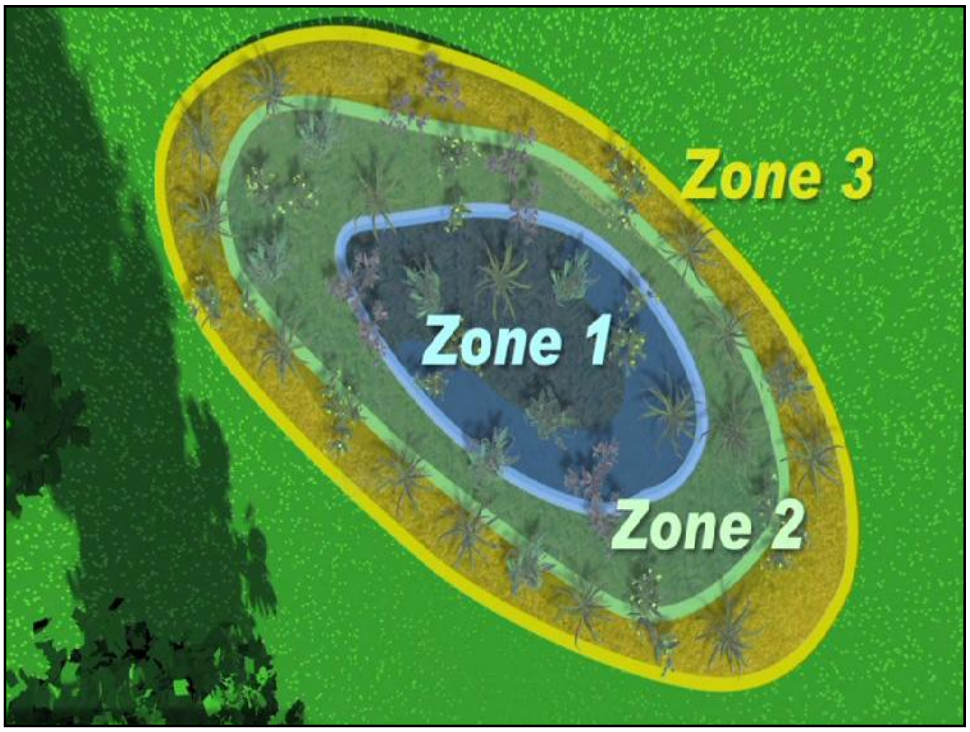
- Plan for survival & maintenance conditions

Right Plant, Right Place

- Microclimate

Right Plant, Right Place

- Zonation



Planting Zones

1. Best at bottom level – Saturation & drought
2. Edge of ponding & supporting slope
3. Top - Blends into existing landscape

Right Plant, Right Place
• Size in scale
• Prevent plants from blocking sight distances
• Swap out if necessary

Plan for Four Seasons of Interest

Turf Interfaces?

Maintenance

- **Prevention!**

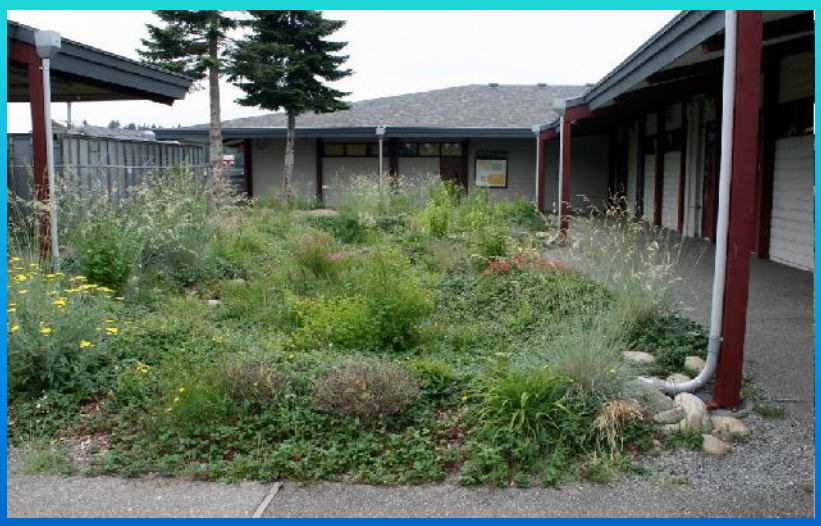
Hand Cultivation Only

Early & Often

Maintenance:
Mulching with
Coarse
Wood Chips

Photo: Stacey Gianas, Stewardship Partners

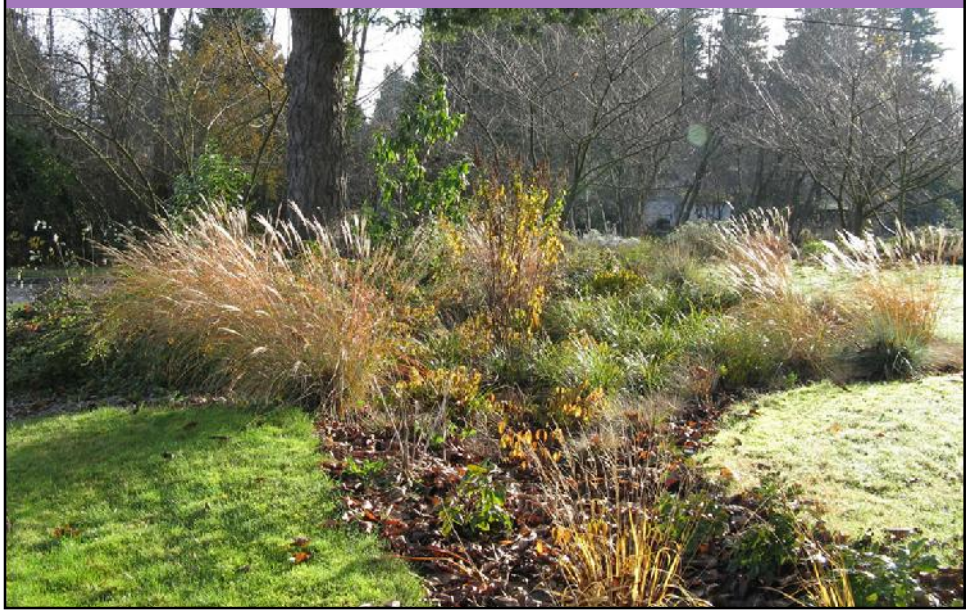
Maintenance:
Maintain healthy plant cover



David Hymel photo

Maintenance:
Maintain protective drain rock

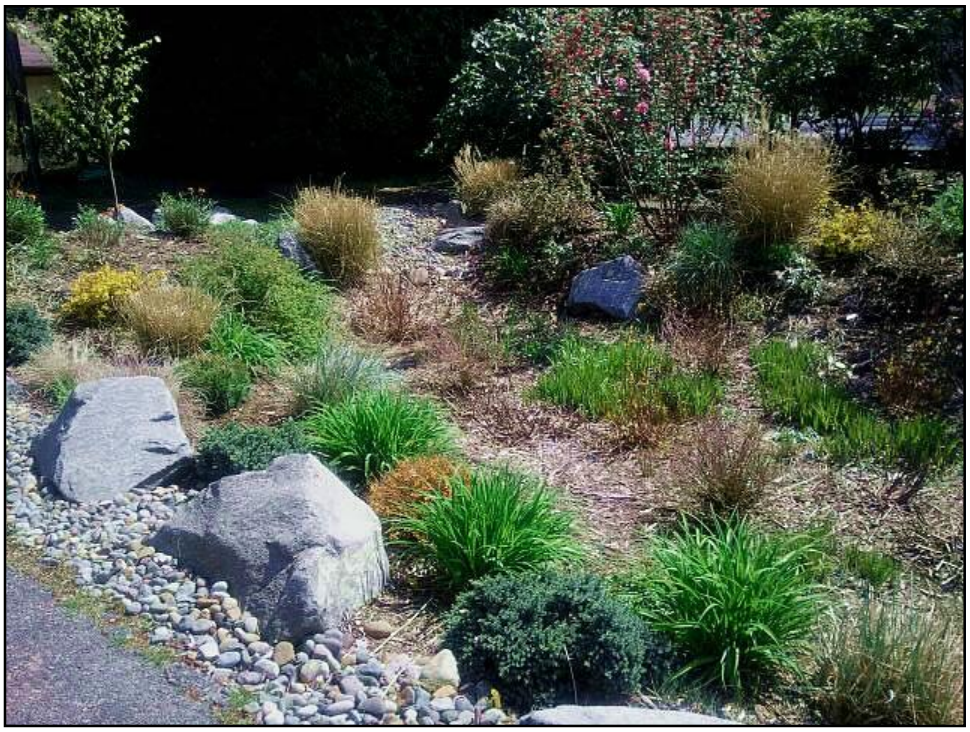
Maintain edging with turf border



Water wisely

- Water regularly until plants are established: deeply but infrequently
- Wean plants from supplemental water
- Water early or late
- Use soaker hoses or spot water with shower wand

Cut Back & Clean Up On Time



Monitor & Correct

- Erosion
- Sediment inflow
- Plants

Common Errors in New Construction

- Poor training & communication
- Compaction of soils

Common Errors in New Construction

- Landscape designers & installers not involved early
- Hiring firms with poor knowledge of plants & bioretention

Common Errors in New Construction

- Soils work done wrong – weeds

Common Errors in New Construction

- Proper construction sequencing not followed

Rain Garden Cost Considerations

- Soils
- Proximity to materials' suppliers
- Local hauling costs
- Labor costs: Self vs. contractor
- Plants: Big or small, how procured
- Digging: Machine or by hand
- Size of garden
- Drainage systems

How to reduce costs for retrofits?

- 250 sq. foot garden professionally designed/installed = $4,000-$5,500
- Do-it-yourselfers: $500+

Reduce Costs

- **Collaborate with neighbors**
- **Excavator = +/- $300/day, $1,000/week**
- **Sod cutter = +/- $40-$70**
- **Hauling costs can be shared for materials**

Reduce Costs: Many hands …

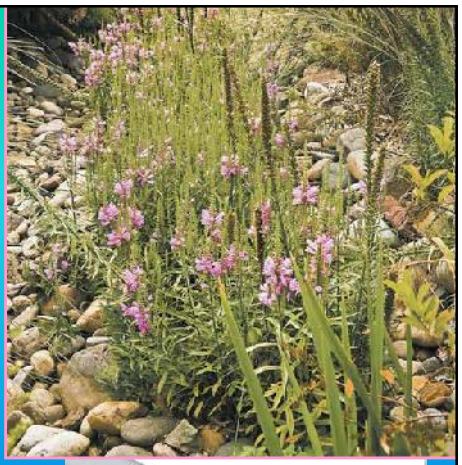
Reduce Costs

- Make smart plant choices

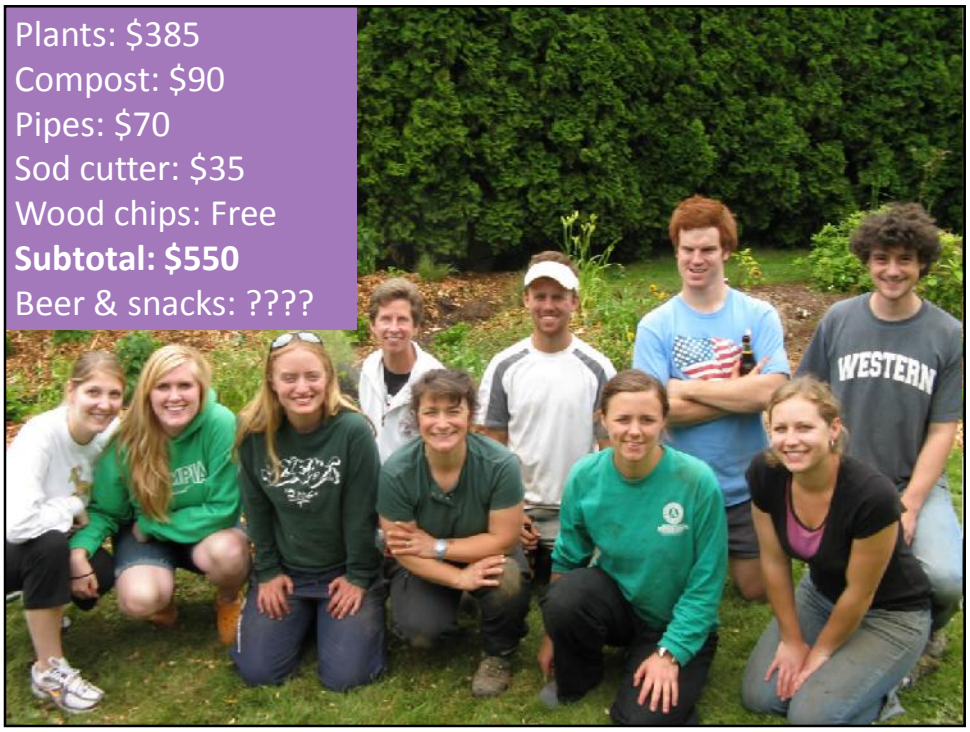
Photos: Sound Native Plants, Inc.

Reduce Costs

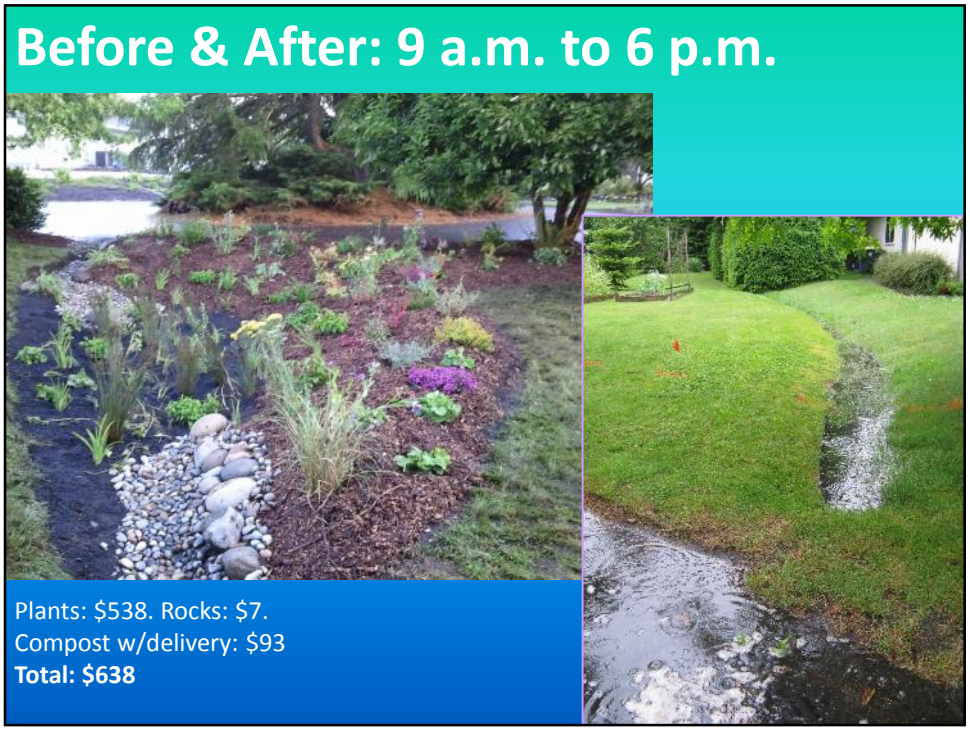
- Simplify drainage systems
- More swales
- Design to avoid need for expensive pipes



Plants: $385
Compost: $90
Pipes: $70
Sod cutter: $35
Wood chips: Free
Subtotal: $550
Beer & snacks: ????



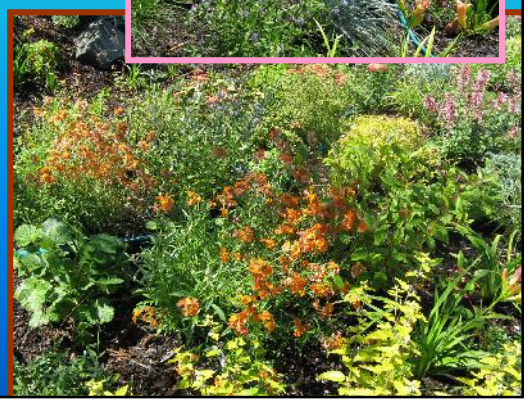
Costs: Tom's Rain Garden (2006)
600 sq. ft + 140 sq. ft swale
Equipment
Sod Cutter: $40
Excavator: $350
Materials
Compost, w/delivery: $100
Rock: $15 (+ delivery)
Drainpipe: $100
Plants (277): $750
(Wholesale cost)
Labor: 115 hours
Total: $1,355


Before & After: 9 a.m. to 6 p.m.
Plants: $538. Rocks: $7.
Compost w/delivery: $93
Total: $638

Plant costs: $389
Sod cutter: $40
Rock: $7
Compost (no delivery): $78
Total: $514

Before & After
9 a.m. – 6 p.m.

Thurston Co. Fair (850 sq. ft.)

- Plants (452) = $2,100
- Excavator = $400
- Compost, drain rock, mulch = $700

Total = $3,200