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Low Impact Landscaping for Homeowners

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Geosyntec Consultants, Inc.

Mirror Lake Protective Association

July 20, 2013

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Low Impact Landscaping

- LID Overview
- Raingardens / Bioretention Cells
- Vegetated Buffers
- Other Techniques
- Benefits of LID: Nashoba Brook Watershed Case Study

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Lesson #1:

It's Water…Not Trash.

A pile of water.

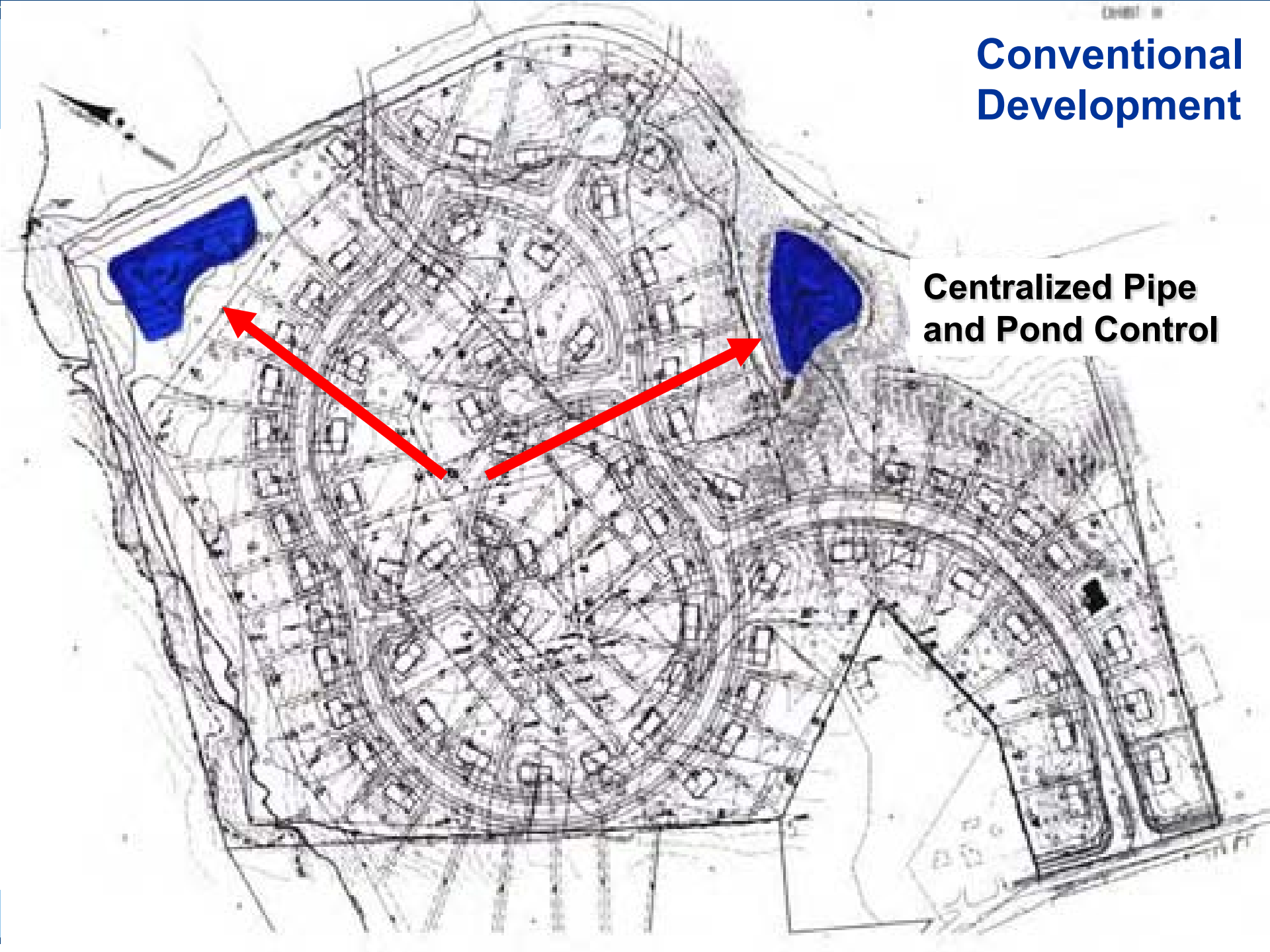
A pile of trash.

Criminal detention center

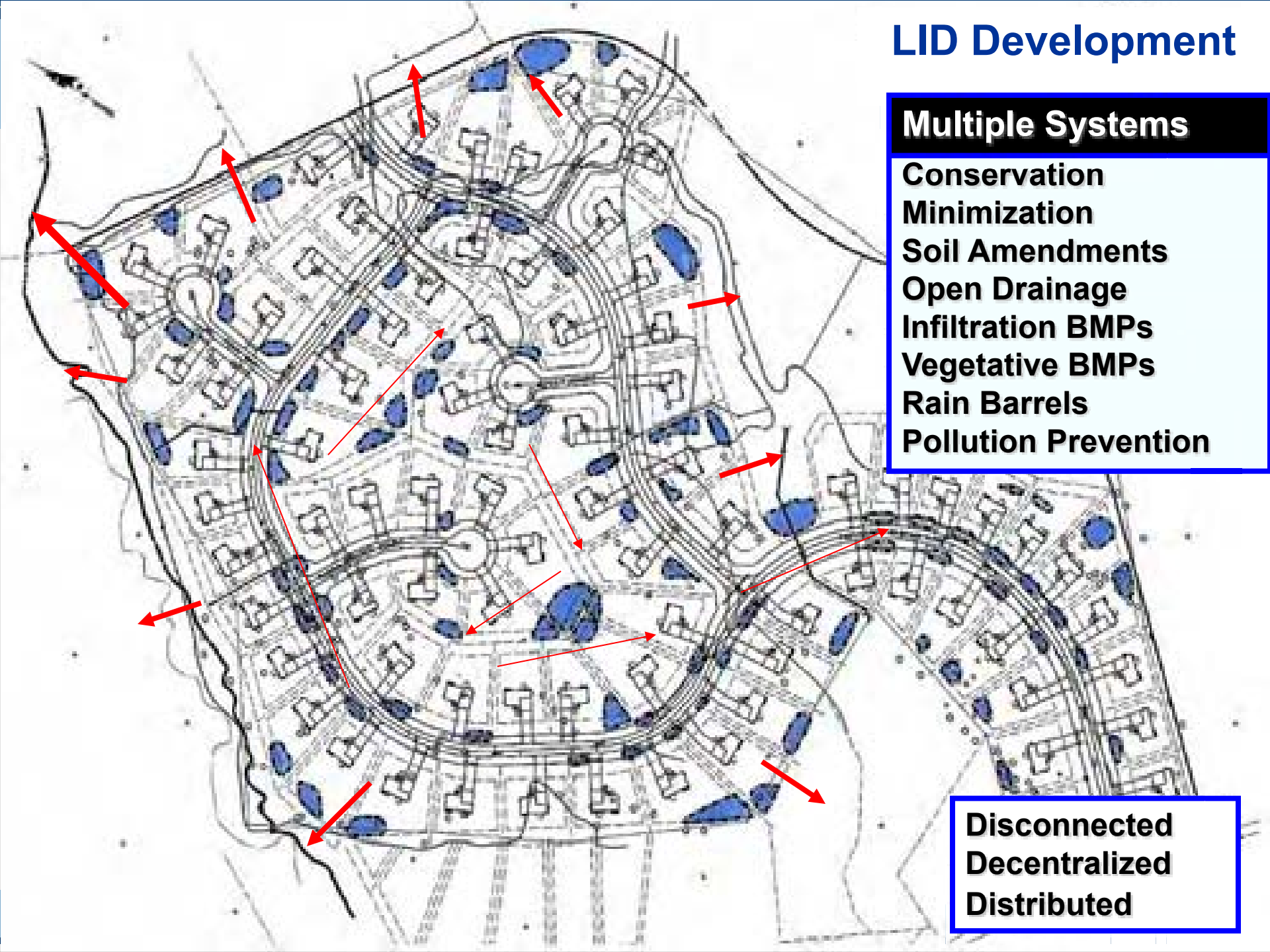
School detention

Detention basin

Conventional Development



LID Development



Multiple Systems

- Conservation
- Minimization
- Soil Amendments
- Open Drainage
- Infiltration BMPs
- Vegetative BMPs
- Rain Barrels
- Pollution Prevention

- Disconnected
- Decentralized
- Distributed

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Lesson #2: Impervious surfaces…

Latin Root:

Im – per – via

Not – through - way

"Not allowing passage into or through something."

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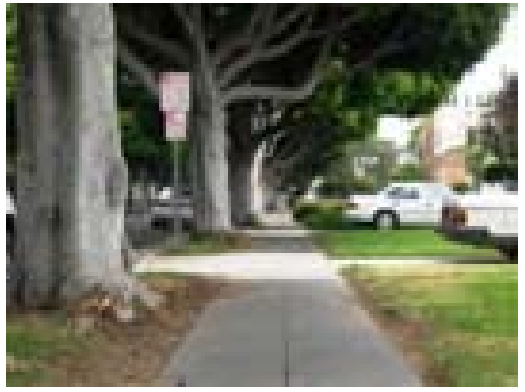
Lesson #2: Impervious surfaces…





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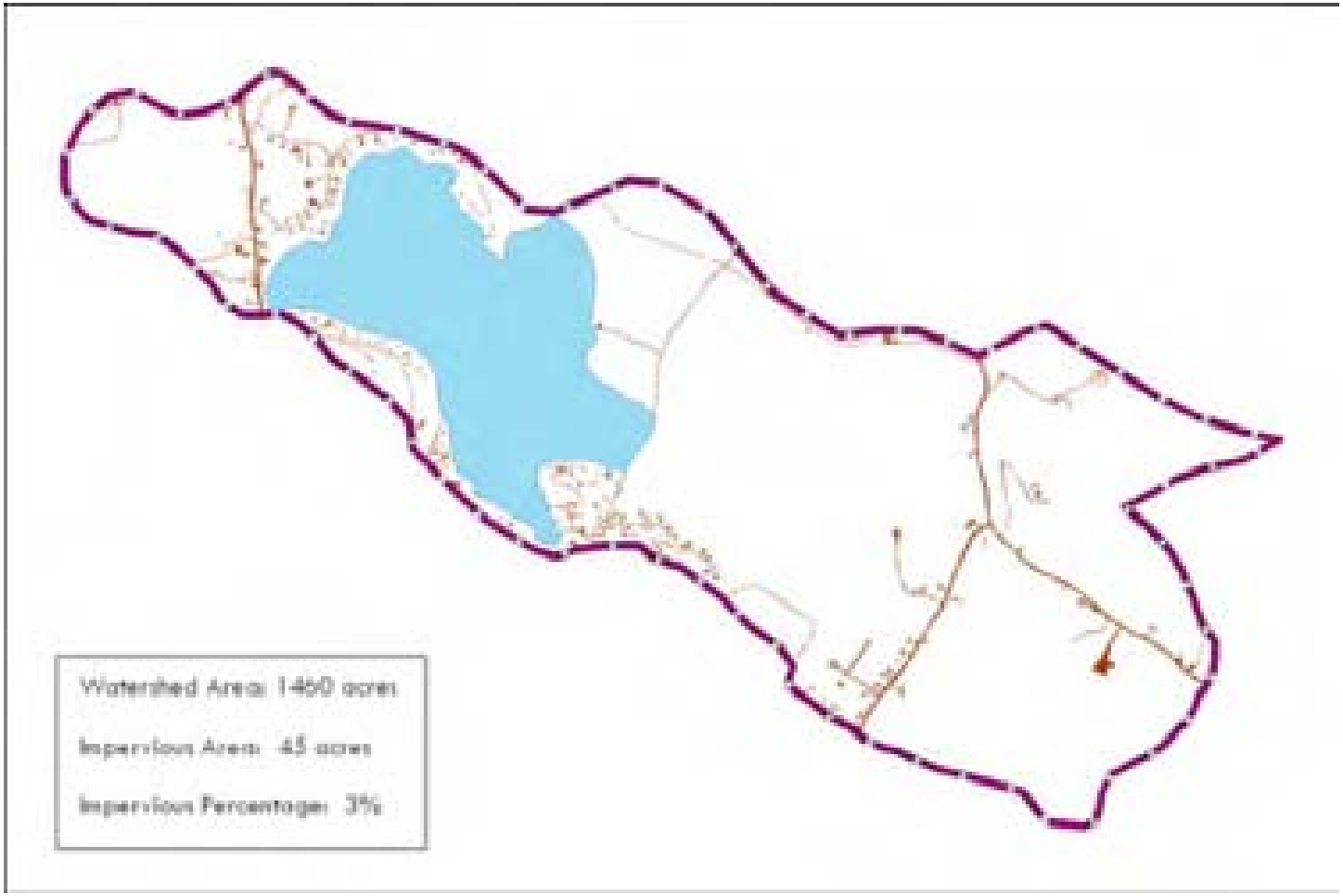
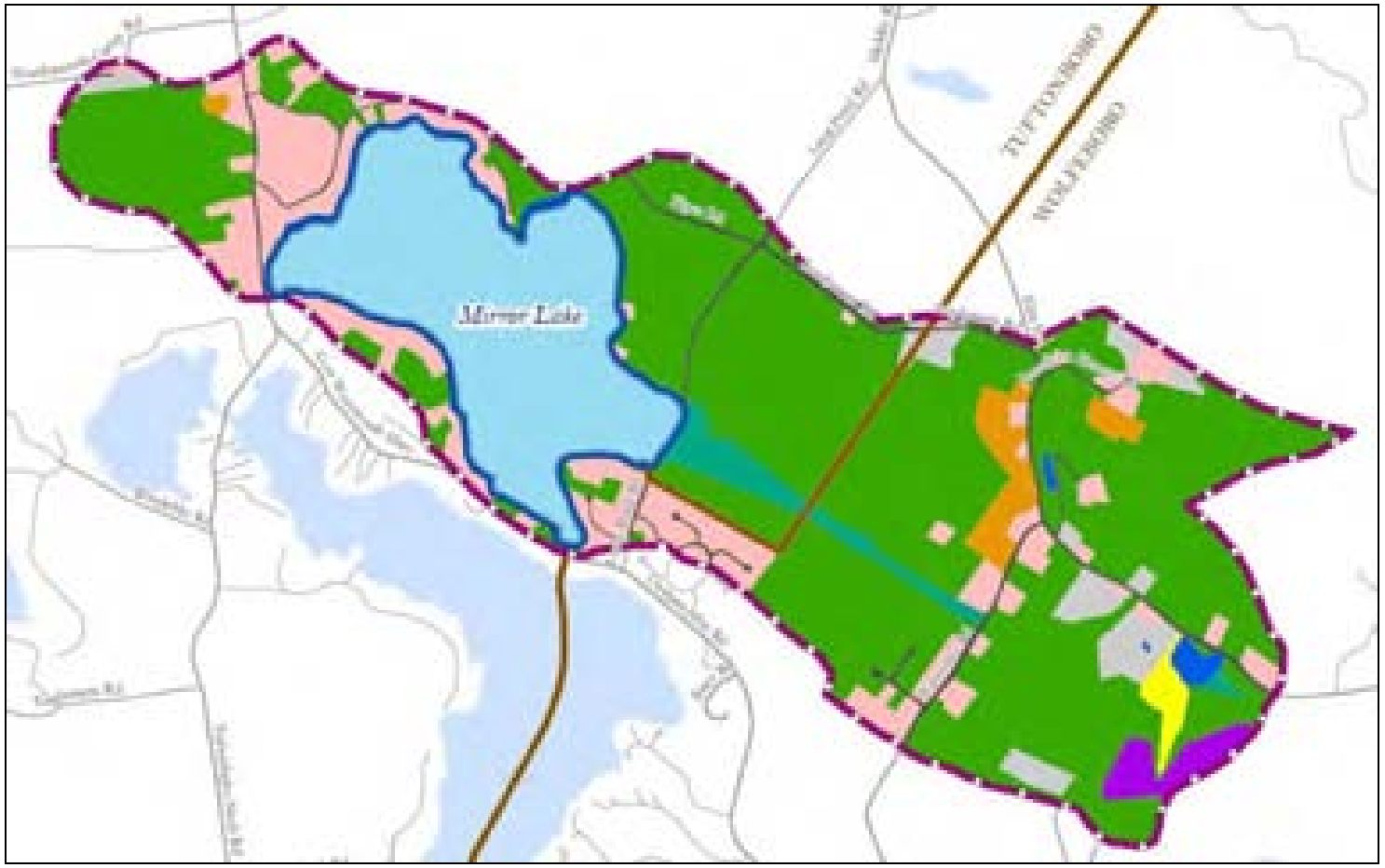
...lead to stormwater problems.

- higher peak flows
- reduced base flows
- higher pollutant loads

Mirror Lake Watershed – Impervious Cover



Land Use Analysis



Land Use

- Forest
- Open
- Pasture
- Recreation
- Residential
- Road
- Spray Field
- Water
- Wetland

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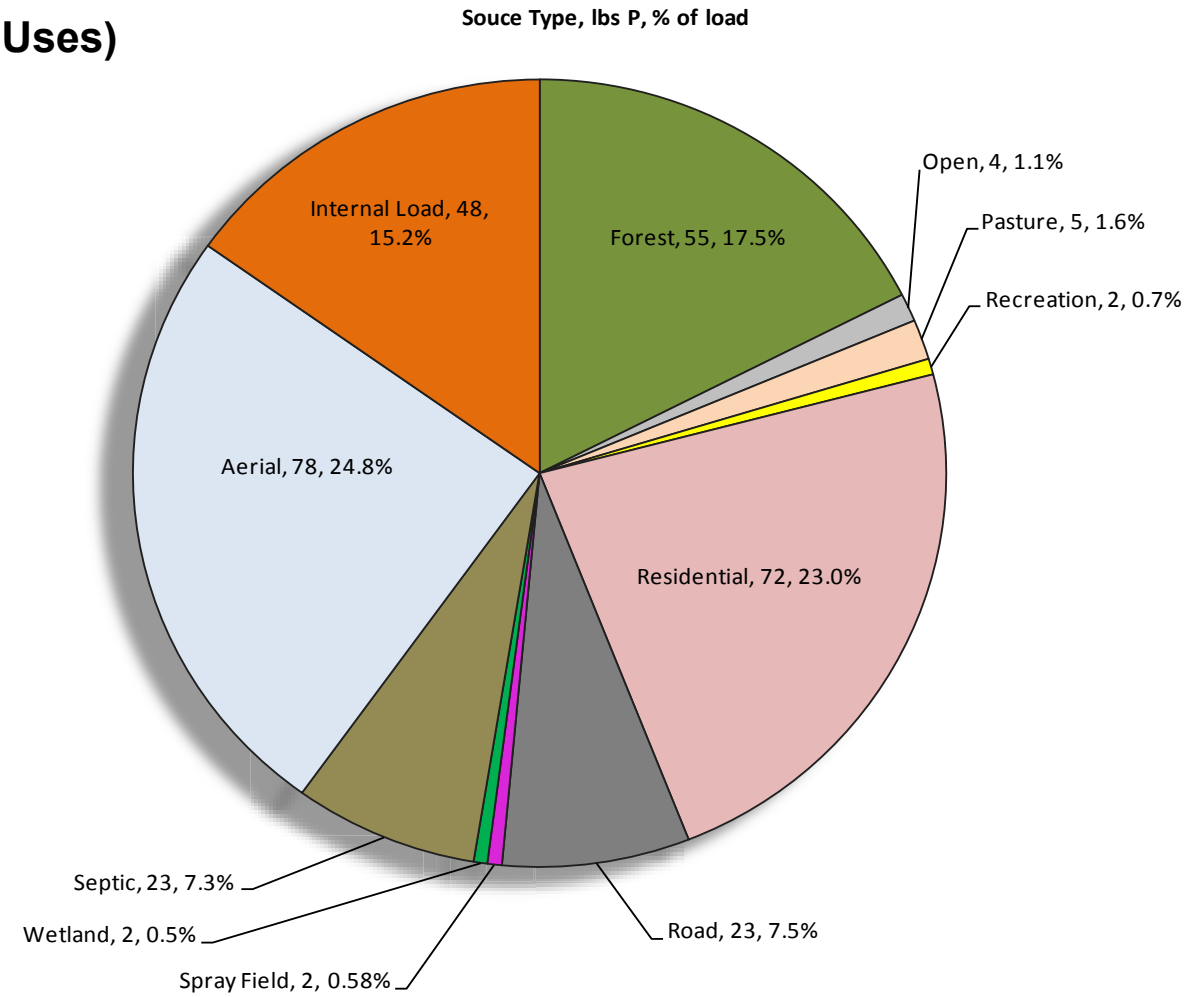
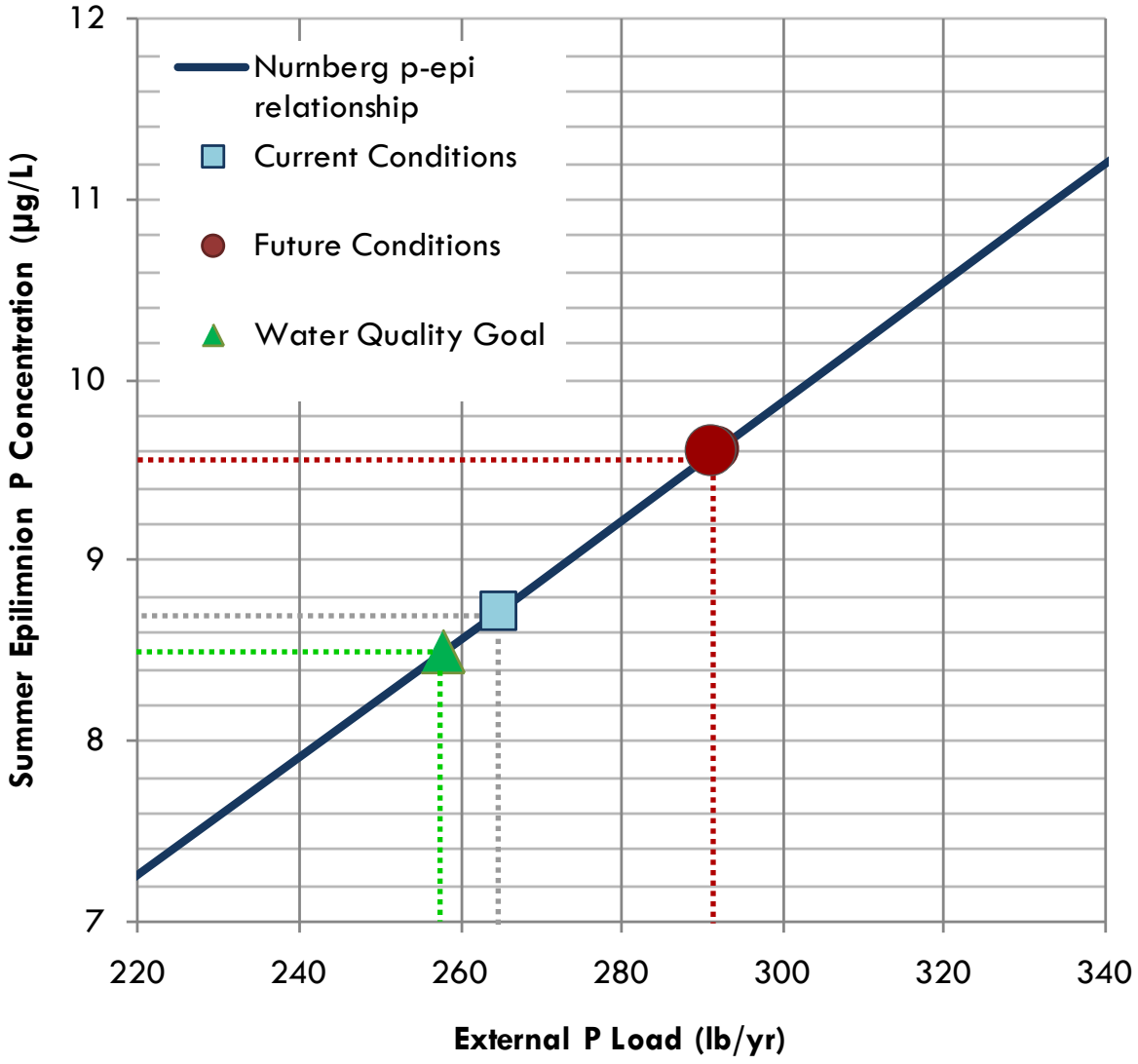
PHOSPHORUS LOADING BUDGET

- Stormwater Runoff (Land Uses)
- Septic Systems
- Aerial Deposition
- Internal Loading



MIRROR LAKE WATER QUALITY GOAL



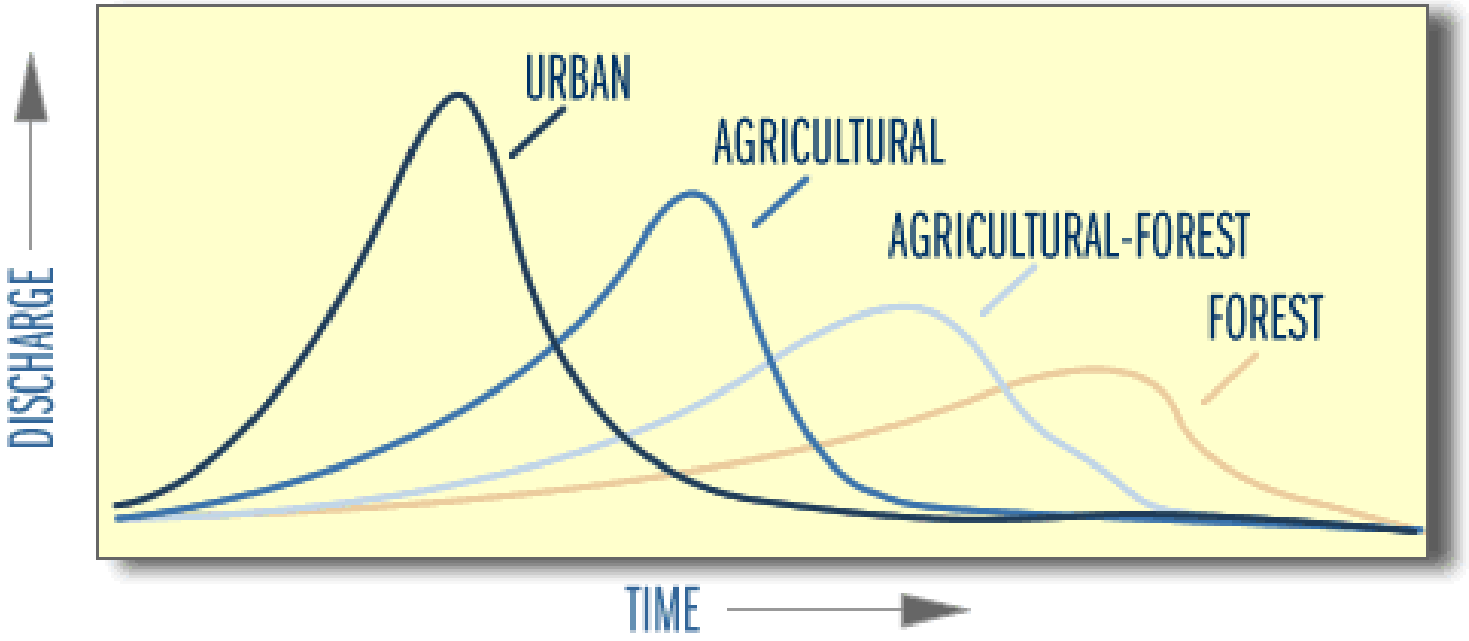
Goal = 8.50 ug/L

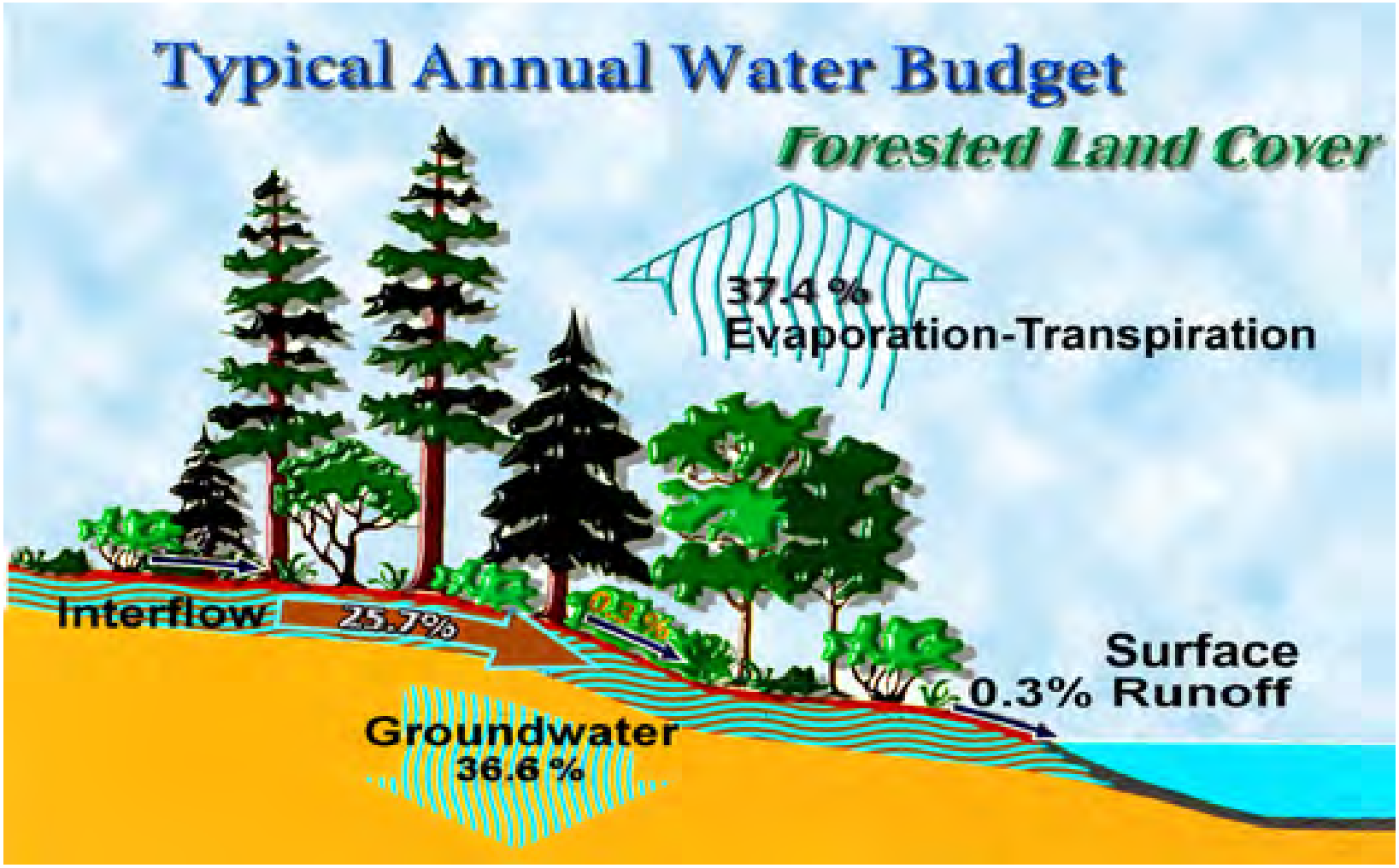
Current = 8.66 ug/L
(+ 7.5 lbs of P)

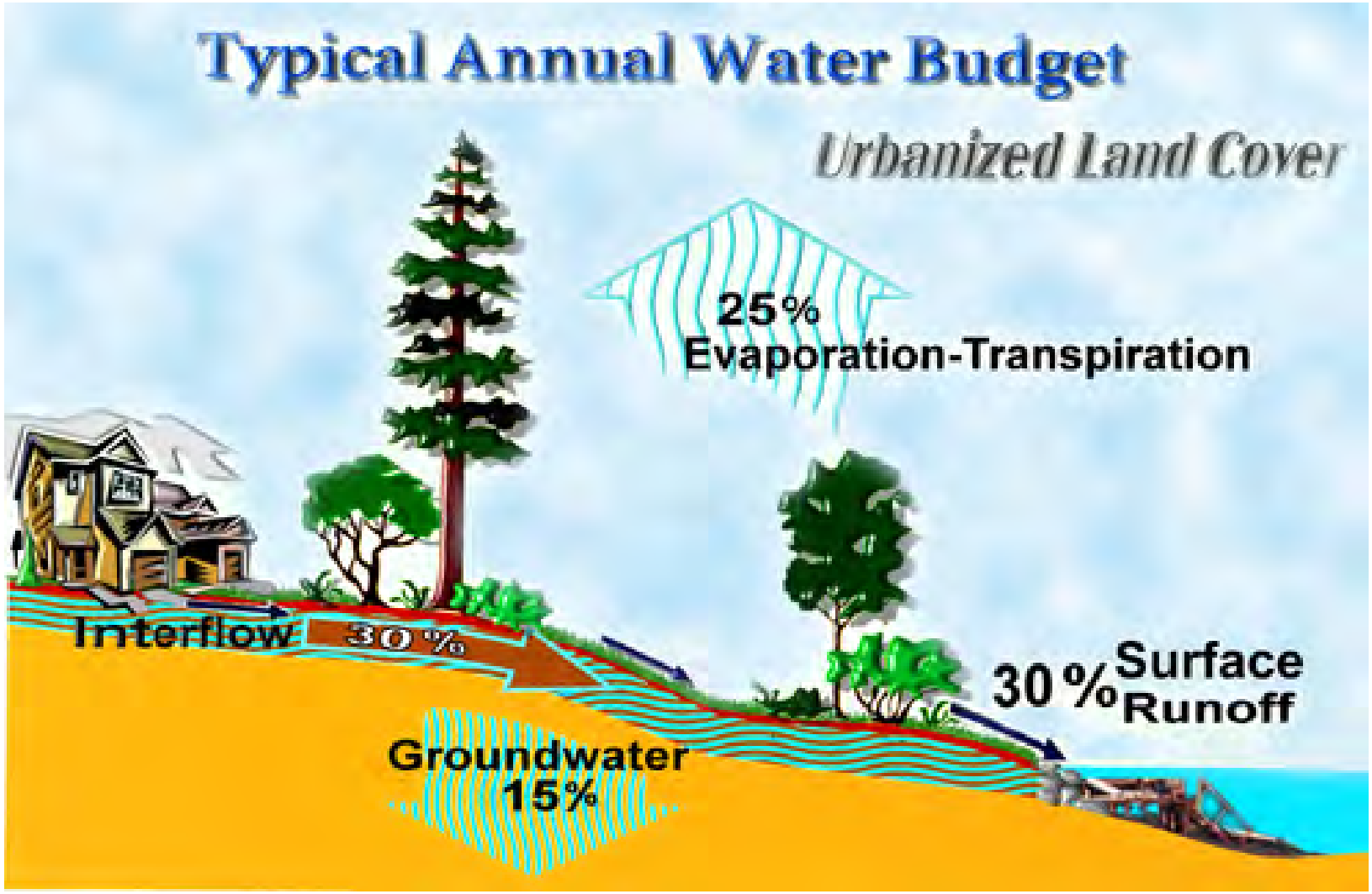
2030 = 9.50 ug/L
(+34 lbs of P)

- **Mirror Lake is Lower Mesotrophic (very good)…but it will take hard work to keep it that way:**
  - **Stormwater Improvements**
  - **Land conservation**
  - **Wise development (zoning , ordinances, etc.)**
- **Small improvements on many sites will add up!**

STORMWATER DISCHARGES FROM VARIOUS LAND COVERS




Typical Annual Water Budget
Forested Land Cover
37.4 %
Evaporation-Transpiration
Interflow
25.7%
0.3%
Surface
Runoff
Groundwater
36.6 %


Typical Annual Water Budget
Urbanized Land Cover
25%
Evaporation-Transpiration
Interflow
30 %
30 %
Surface
Runoff
Groundwater
15%

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Low Impact Development (LID)

An ecosystem-based approach to land development and stormwater management

Goal: Mimic pre-development site hydrology

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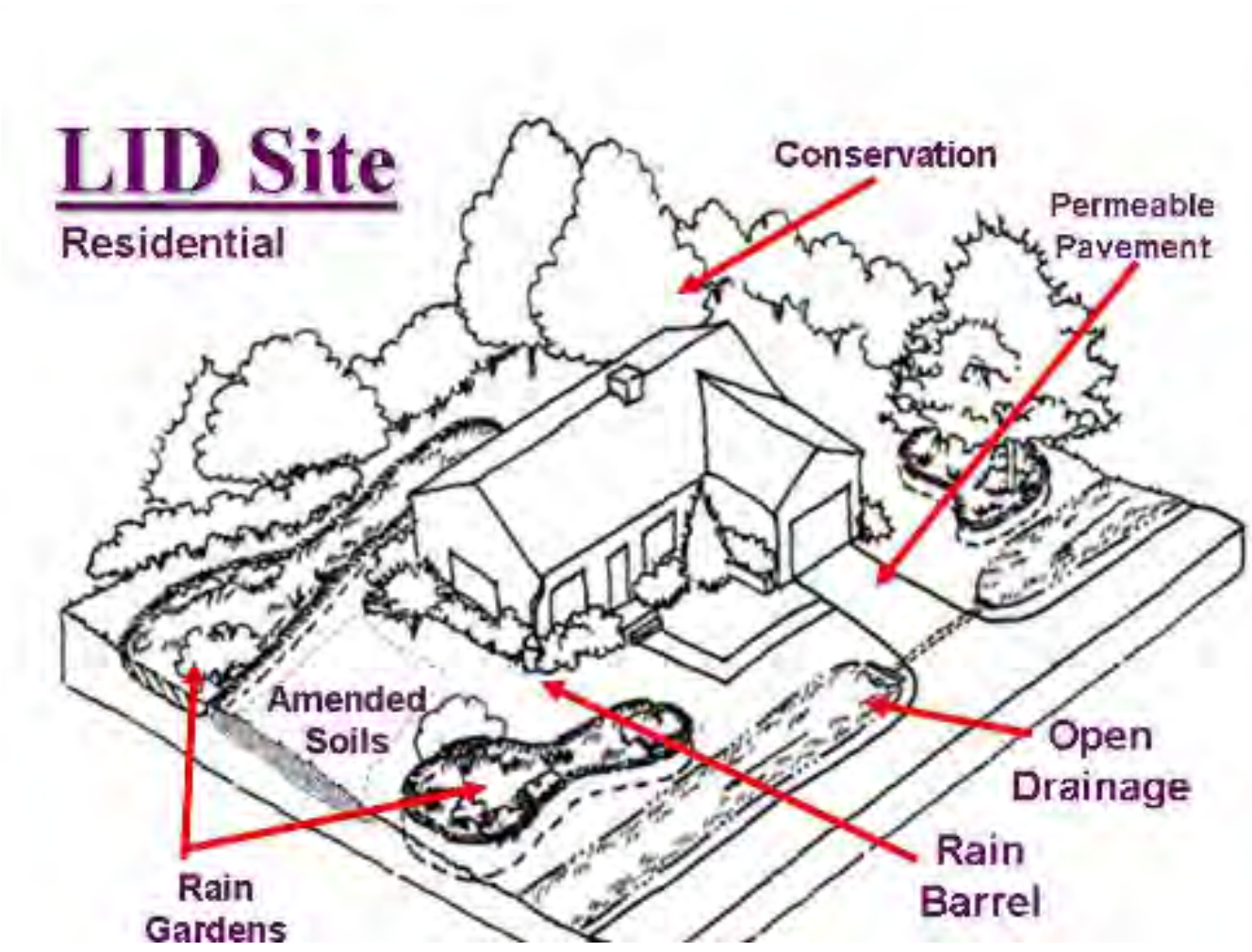
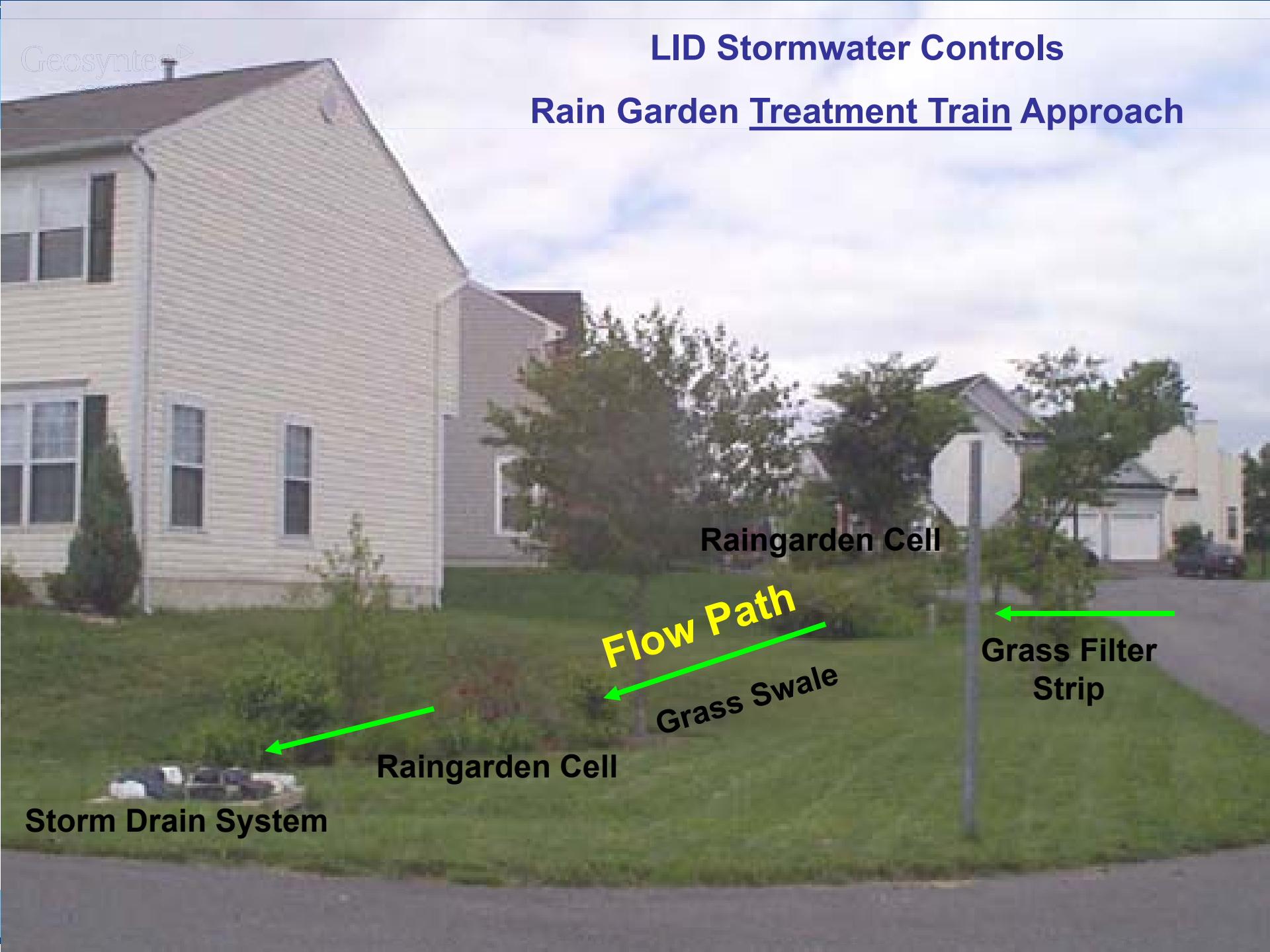


LID Stormwater Controls

Rain Garden Treatment Train Approach



Bioretention

Raingardens/barrels

Low Impact Development Stormwater Controls

Porous surfaces

Bioretention

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Raingardens

A bowl-shaped garden designed to capture and absorb stormwater.

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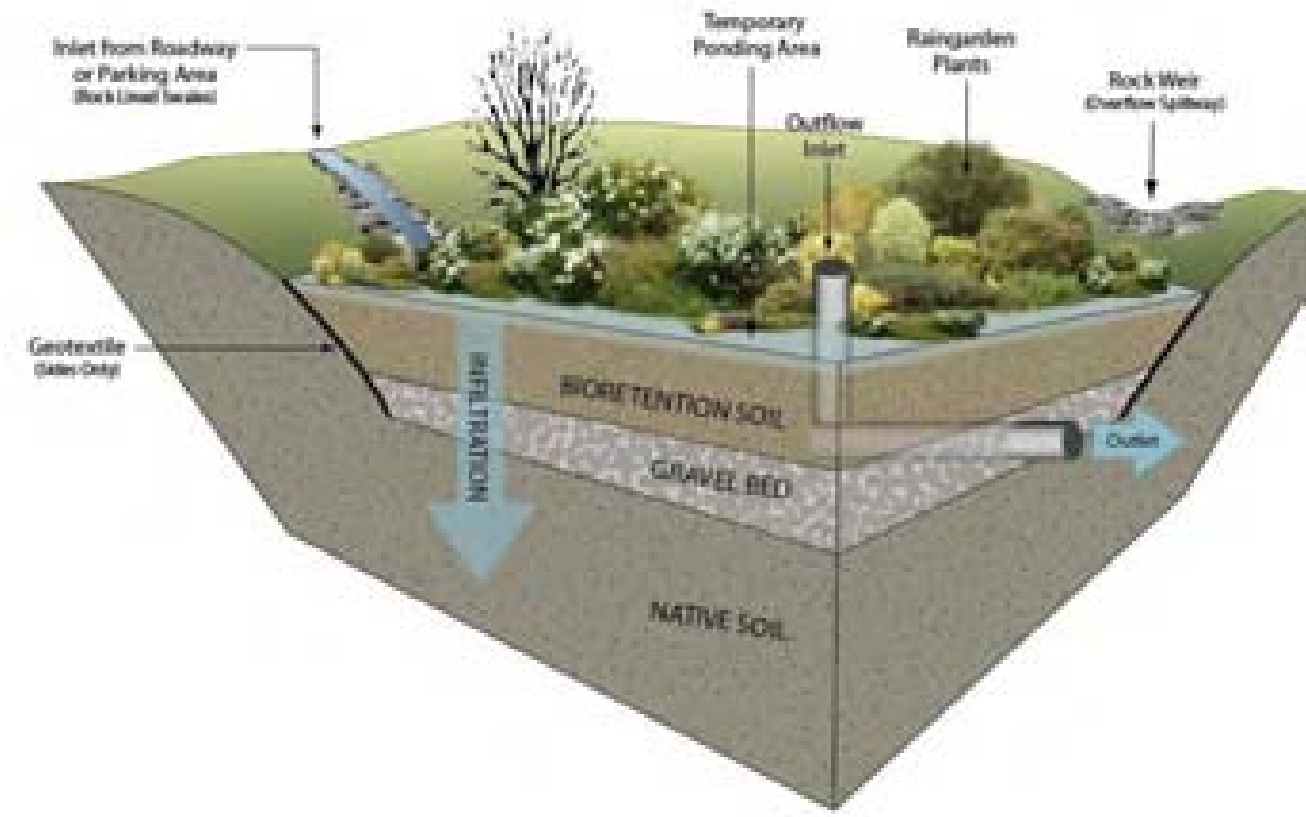
Bioretention Cell

Similar to raingarden, more highly engineered:

- **underdrain/riser pipe**
- **gravel bed**
- **engineered soils**



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Street Edge Alternatives (SEA)

Functional Landscape

Reduced Impervious Area

98% Stormwater volume reduction for 2-year storm

“SEA” Street: Maximized space for filtration, recharge and landscape elements


SEP 14 2005

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How to Build a Raingarden!

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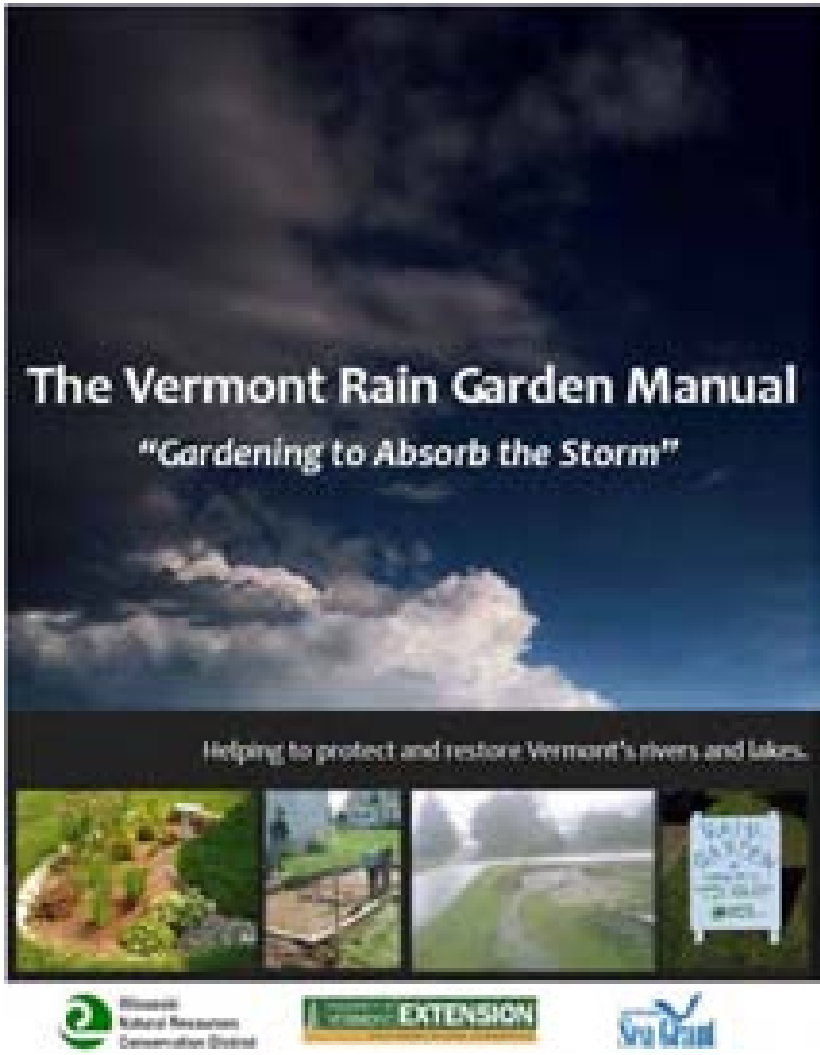
The Vermont Raingarden Manual

http://nsgl.gso.uri.edu/lcsg/lcsgh09001.pdf



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Choosing a Raingarden Location

- For roof runoff, garden should be 10 feet from house to prevent basement seepage
- Select a flat area if possible for easier installation
- Call Dig Safe (1-888-DIG-SAFE) 3 days before digging

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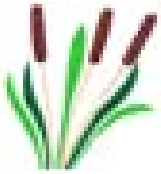
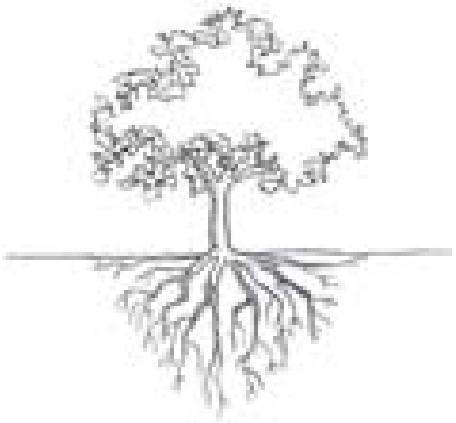
Choosing a Raingarden Location

- Do not place within wetlands or naturally wet areas



- Avoid disturbing tree roots



- Do not place over a septic tank, leach field or drinking water well

Step 1: Calculate Drainage Area

(Length) X (Width) = Drainage Area ft^2

Estimate drainage area from:

- **Roof**
- **Lawn**
- **Road**
- **Other (forested, etc.)**

This can be tricky! May require observation during rain.

Step 2: Evaluate Soil

PIT TEST

- **Dig hole 6” deep, fill with water**
- **Choose new site if water is still standing after 24 hrs**

Step 2: Evaluate Soil

IDENTIFY SOIL TYPE

1. Roll handful of moist soil into ball
2. Work soil upwards between thumb and forefinger to form ¼" ribbon of uniform thickness/width
3. Repeat motion until ribbon breaks under its own weight
4. Measure to determine if sand, silt or clay →

SAND: Soil does not form a ribbon
SILT: Weak ribbon < 1.5" (before breaking)
CLAY: Ribbon > 1.5"

Step 3: Calculate Slope

1. Stake uphill and downhill ends of raingarden
2. Level a string between stakes
3. Measure string length and height of string at downhill stake (inches)
4. (Height / Length) x 100 = Slope
5. Use table for rain garden depth

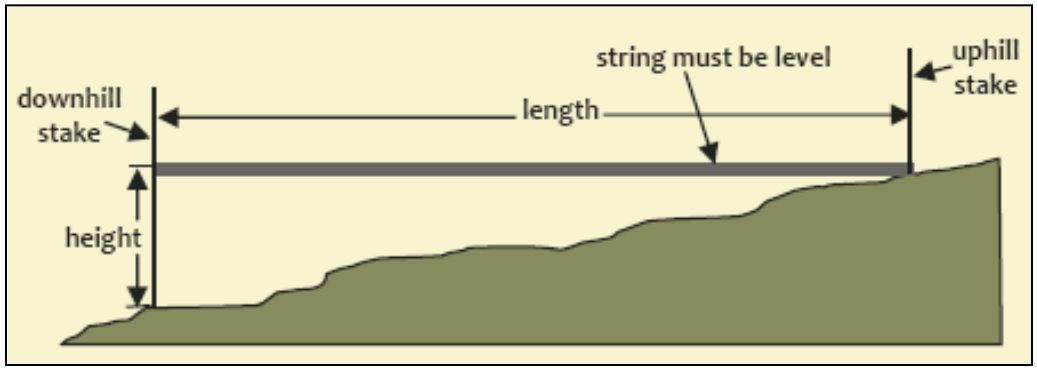


Table 1	
Slope	**Depth**
< 4%	3-5 in
5-7%	6-7 in
8-12%	8 in+

Step 4: Raingarden Sizing

Size Factor X Drainage Area = Rain Garden Area

1. **Use table to determine size factor**
2. **Multiply size factor by drainage area = recommended rain garden size**

Table 2	Depth		
Soil Type	3-5 in	6-7 in	8 in +
Sand	0.19	0.15	0.08
Silt	0.34	0.25	0.16
Clay	0.43	0.32	0.20

Step 5: Raingarden Design

1. Any shape, but must have level bed
2. Water Entrance
   - Stabilize entry point(s) with stone
   - Direct water to raingarden with:
     - downspout extensions
     - grass /rock-lined swale
     - piping
3. Select Plantings

Shrubs

Red Osier Dogwood

Silky Dogwood

Rugosa Rose

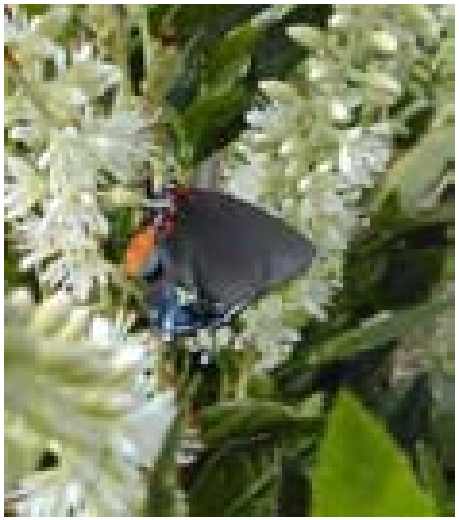
Virginia Rose

Bayberry

Inkberry

Black Chokeberry

Shrubs



Sweet pepperbush

Winterberry holly

Sheep laurel

Highbush blueberry

Mountain laurel

Maple-leaf viburnum

Shrubs

Meadowsweet

Northern Arrowood

Pussy Willow

Serviceberry

Highbush Blueberry

Perennial Flowers

Coneflower

Black-eyed Susan

Purple Joe-Pye Weed

Marsh Blazing Star

Daisies

Helenium/Sneezeweed

Daylilies

Perennial Flowers

New England Aster
White Turtlehead
Boneset

Blue Flag Iris
Cardinal Flower
Wild Bergamot
Foamflower

Groundcovers

Bearberry

Partridgeberry

Virginia Creeper

Lowbush blueberry

Ferns

Cinnamon fern

Royal fern

Christmas fern

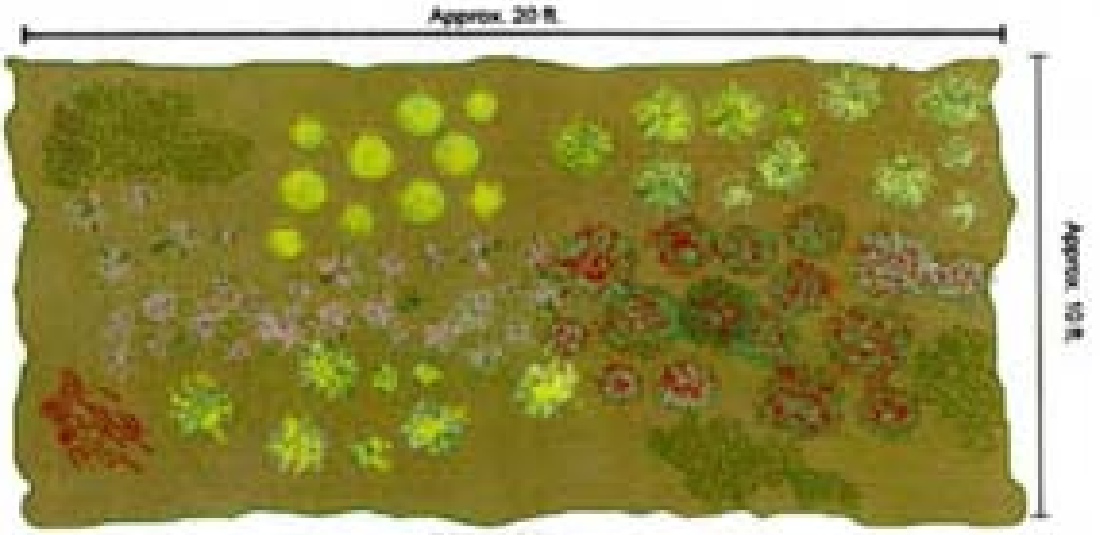
Grasses / Sedges

Canada Bluejoint or Reedgrass

Pennsylvania sedge

Narrow-leaved cat-tail

Perennial Daylily Rain Garden



Plan View

Autumn Joy Sedum
Sedum x 'autumn joy'
Approx. Qty: 150

Hearts Afire Daylily
Hemerocallis 'hearts afire'
Approx. Qty: 10

Cross Section

Hearts Afire Daylily
Hemerocallis 'hearts afire'
Approx. Qty: 18

Catherine Woodbury Daylily
Hemerocallis 'catherine woodbury'
Approx. Qty: 30

Oxeye Sunflower
Heliopsis helianthoides
Approx. Qty: 20

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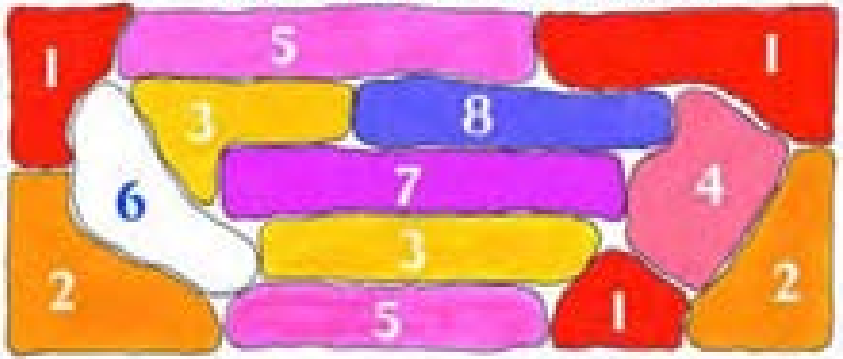
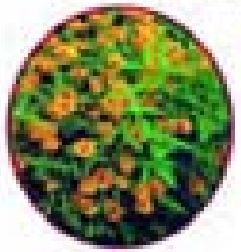
An Easy Daylily Garden Layout



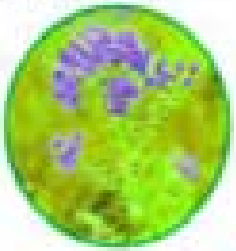
1 Hearts Alive Daylily
(Hemerocallis 'Hearts Alive')
Height: 20inches
Space: 24 inches
Blooms: June - July

2 Happy Returns Daylily
(Hemerocallis 'Happy Returns')
Height: 18 inches
Space: 12 inches
Blooms: June to frost

3 Oseye Sunflower
(Heliopsis helianthoides)
Height: 3-5 feet
Space: 30 inches
Blooms: All Summer



8 New England Aster
(Aster novae-Angliae)
Height: 4-5 feet
Space: 2 feet
Blooms: Midsummer to frost

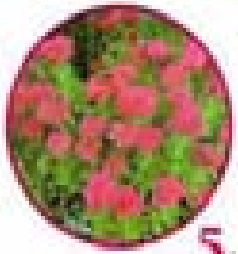


7 Marsh Milkweed
(Asclepias incarnata)
Height: 3-5 feet
Space: 1 foot
Blooms: June through August

4 Catherine Woodbury Daylily
(Hemerocallis 'Catherine Woodbury')
Height: 33 inches
Space: 24 inches
Blooms: June - August

6 Gentle Shepherd Daylily
(Hemerocallis 'Gentle Shepherd')
Height: 28 inches
Space: 24 inches
Blooms: June - July

5 Autumn Joy Sedum
(Sedum x. 'Autumn Joy')
Height: 18-24 inches
Space: 18 inches
Blooms: Late summer to frost



Bonestroo Rosene Anderlik & Associates

MARSHWOOD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The Easy Shrub Garden Layout

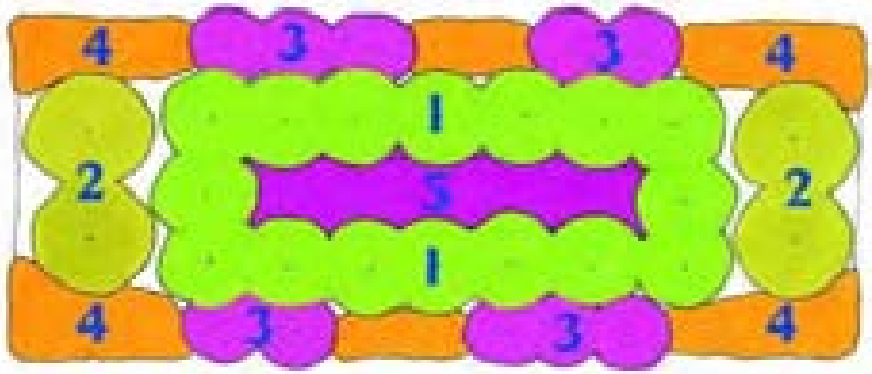
1 Compact American cranberrybush
Viburnum trilobum 'Bailey Compact'
Height: 4-5'
Space: 4' o. c.
Blooms: White flowers in May
Deep red fall foliage; red berries into winter.
Blooms: May

Viburnum trilobum fruit

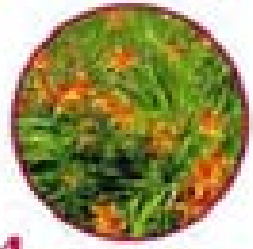
Viburnum trilobum flowers

Viburnum trilobum fall color

5 Marsh milkweed
Asclepias incarnata
Height: 3-5 feet
Space: 1 foot
Blooms: June through August



2 Annabelle hydrangea
Hydrangea arborescens 'Annabelle'
Height: 4-5'
Space: 4' o. c.
Blooms: white flowers
June - July



4 Stella de Oro Daylily
Hemerocallis 'Stella de Oro'
Height: 15 inches
Space: 15 inches
Blooms: May to Frost

3 Anthony Waterer Spirea
Spirea x bumalda 'Anthony Waterer'
Height: 2-3'
Space: 3' o. c.
Blooms: June - July rose-pink flowers Red leaves in fall

The Shady Garden Layout

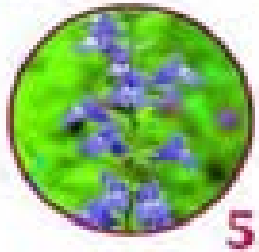
1 Wild Geranium
(Geranium maculatum)
Height: 1-2 Feet
Space: 1 foot
Blooms: May - June

2 August Lily Hosta
(Hosta plantaginea)
Height: 16 inches
Space: 18 inches
Blooms: July - August

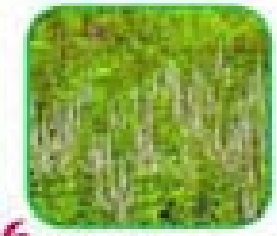
3 Golden-edged Hosta
(Hosta fortunei)
Height: 1-2 feet
Space: 1 foot
Blooms: July - August

4 Pink Astilbe
(Astilbe arendsii 'Rheinland')
Height: 2 feet
Space: 2 feet
Blooms: June - July

5 Great Blue Lobelia
(Lobelia siphilitica)
Height: 2 feet
Space: 1 foot
Blooms: August - September



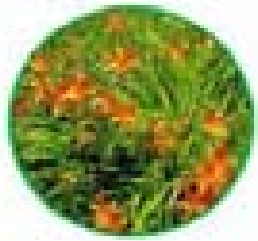
6 Culver's Root
(Veronicastrum virginicum)
Height: 3-4 feet
Space: 2 feet
Blooms: July - August



7 Ostrich Fern
(Matteuccia pennsylvanica)
Height: 3 feet
Space: 3 feet
Blooms: Cool Green Fronds all summer

8 Lady's Mantle
(Alchemilla mollis)
Height: 12-18 inches
Space: 12 inches
Blooms: May - June

9 Stella de Oro Daylily
(Hemerocallis 'Stella de Oro')
Height: 12 inches
Space: 12 inches
Blooms: May to Frost

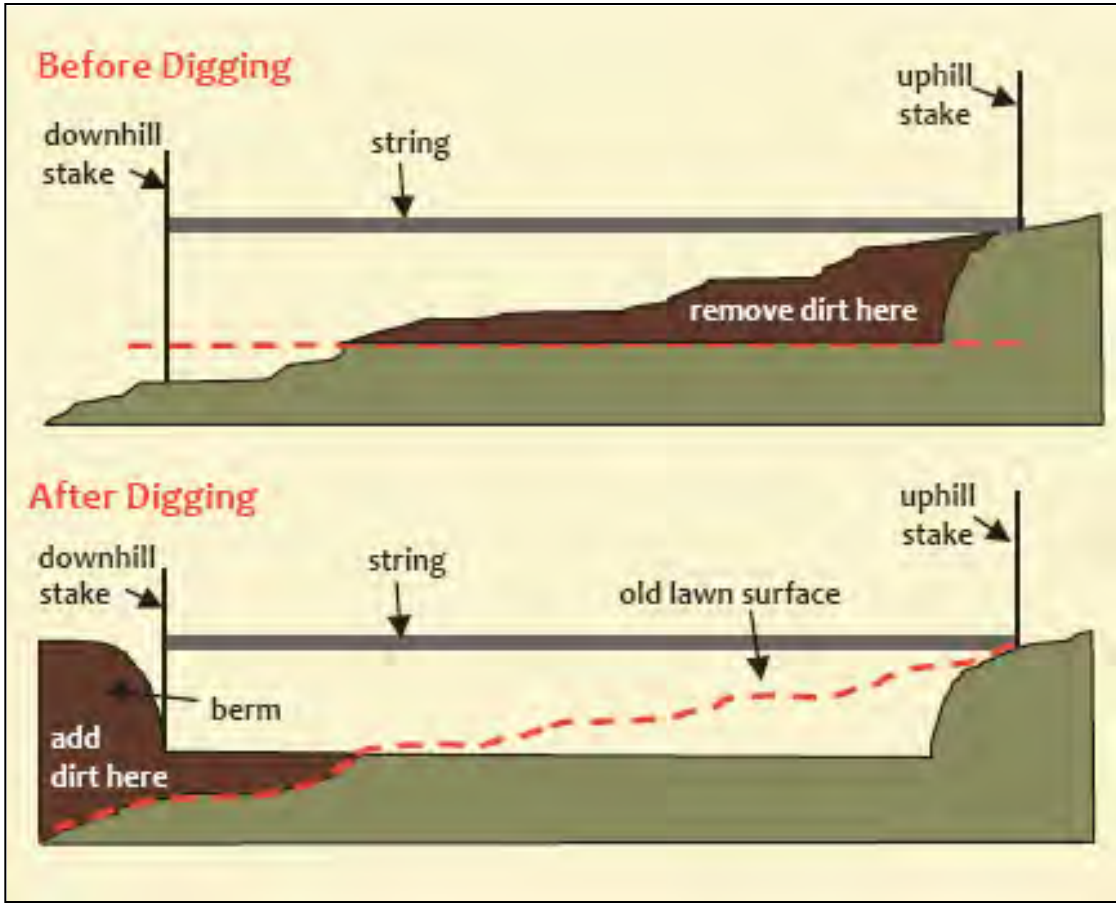


Step 6: Installation

1. Define Borders (string, spray paint)
2. Remove Grass
3. Dig / Level the bed

Step 6: Installation

- When building a raingarden on a slope, create a berm to hold water.
- Level the bed and use the dirt removed to create the berm



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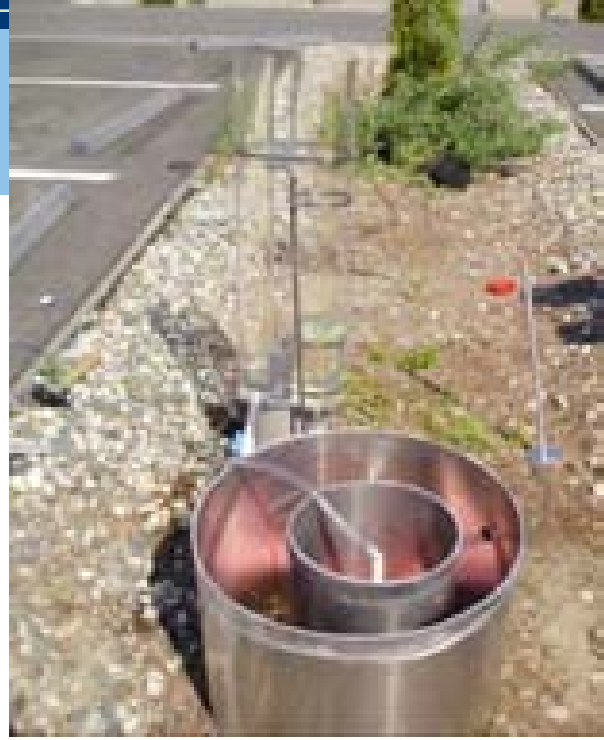

Soils specifications (for bioretention):

Underlying soils should drain >0.25 inches/hr

- **>6 inches soil over 24 hrs**

Bioretention soil:

- **75% sand (ASTM c-33 concrete sand), 25% organic matter (compost)**

Or…

- **50% sand, 30% topsoil (loam), 20% organic matter**
- **Underdrains may be required**


Infiltration rate = 5 inches/hour

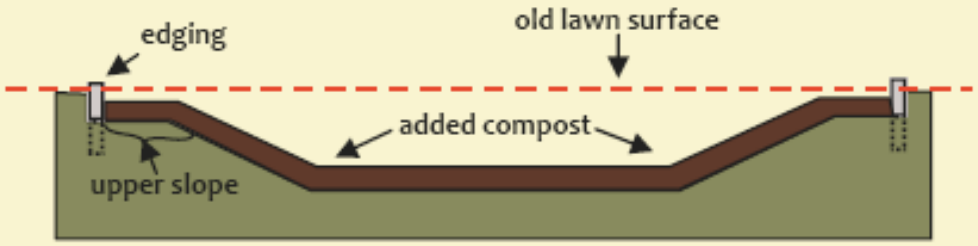

Figure 3: Level bed with sloping edges. This design requires more space. Only plants that can thrive in drier soil conditions can be planted on the upper slope of this type of raingarden; true rain garden plants will not thrive here.

Figure 4: Level bed without sloping edges. Ideal design for tight spaces.

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Before

After

Step 6: Installation

4. Improve the soil ("Soil Amendment")
    - Till 2-4" compost into native soil
5. Plant (shrubs on approx. 3' centers)
    - Water immediately
6. Mulch (2"-3")

Step 7: Maintenance

1. Water new plants regularly until roots are established
2. Weed / replace failed plantings
3. Refresh mulch as needed


Lake Shirley Bioretention Cell


Straw
mulch
“blanket”
Geosyntec
consultants


Lake Shirley Bioretention Cell
Lesson: Small is beautiful!

100 ft Bioretention Cell in Parking Lot


AUG 1 2005

Bioretention cell with overflow

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Vegetated Filter Strips / Buffers

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Vegetated Buffers

- Pollutant Uptake /Filtering
- Habitat / Wildlife Food Source
- Shading
- Aesthetics
- Physical deterrent to geese

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Buffer Design Criteria

- **Aesthetics. Include a diversity of native shrubs, wildflowers and ground cover that will add visual interest and provide year-round color.**
- **Maintain (reasonable) access and views.**
- **Use low-maintenance native plants, beneficial to wildlife.**
- **Maintain a "useable area" between the homes and buffer for picnic tables, chairs, etc.**
- **The wider the better…10'-20' minimum for filtration**


Mirror Lake Rain Gardens


Mirror Lake Rain Gardens


Mirror Lake Rain Gardens


Mirror Lake Rain Gardens


Mirror Lake Rain Gardens


Mirror Lake Rain Gardens


Mirror Lake Rain Gardens

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Staked straw bales to protect the lake from sediment during the buffer installation.

2 days for site preparation and buffer installation .

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Lake Shirley, Lunenburg, MA

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Case Study: Vegetated Buffer

Lake Wyola
Shutesbury, Massachusetts

State Park Beach Area

Persistent problems with beach erosion from road runoff

Pre-Construction Condition

Shrub Buffer Plantings

Silky Dogwood

Red Osier Dogwood

Bayberry

Pussy Willow

Meadowsweet

Northern Arrowood

Sweet Pepperbush

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Installation

Vegetated Buffer

Fully Stabilized Vegetated Buffer

Other Techniques

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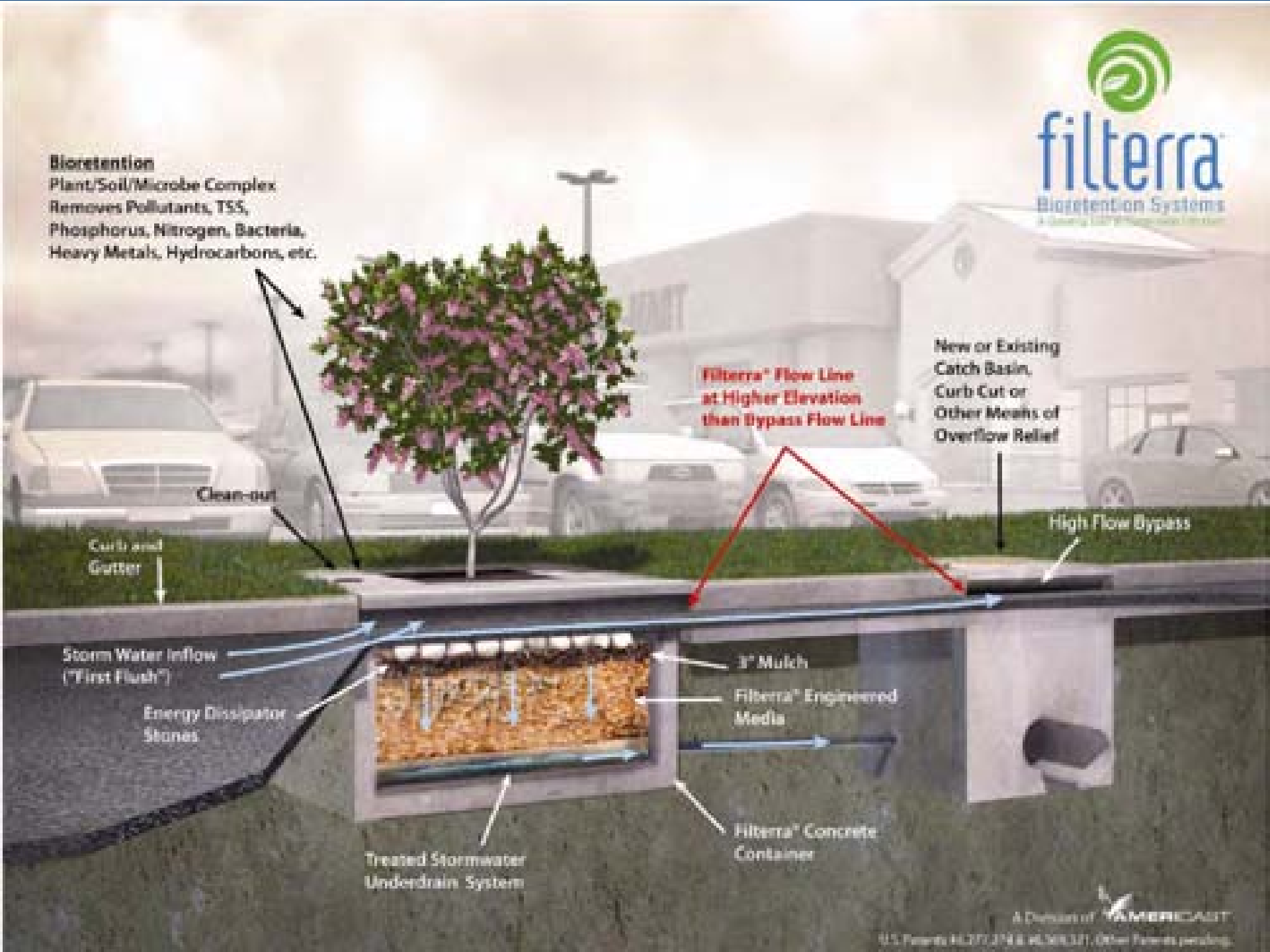
Infiltrating Planter Box for Roof Runoff (Plymouth, MA)


APR 19 2005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Bioretention Systems
Bioretention
Plant/Soil/Microbe Complex
Removes Pollutants, TSS,
Phosphorus, Nitrogen, Bacteria,
Heavy Metals, Hydrocarbons, etc.
Filterra® Flow Line
at Higher Elevation
than Bypass Flow Line
New or Existing
Catch Basin,
Curb Cut or
Other Means of
Overflow Relief
Clean-out
High Flow Bypass
Curb and
Gutter
Storm Water Inflow
("First Flush")
3" Mulch
Filterra® Engineered
Media
Energy Dissipator
Stones
Treated Stormwater
Underdrain System
Filterra® Concrete
Container
A Division of AMERICAST
U.S. Patents #6,277,274 & #6,569,321. Other Patents pending.


3" SHREDDED MULCH
21" ENGINEERED MEDIA
6" UNDERDRAIN STONE

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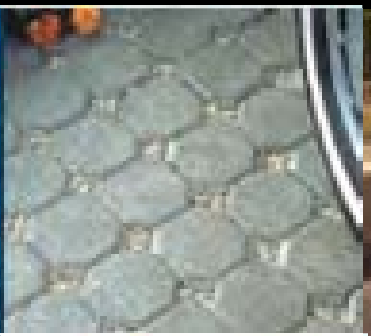
Rain Barrels

- For capture/re-use of roof runoff
- Most barrels average 60 gallons and cost $75 - $125
- Cisterns are much larger systems, often involving pumps and drywell structures.

Porous Pavements (Wilmington MA)

- Interlocking Concrete Pavers
- Porous Asphalt / Concrete
- Flexipave



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GravelPave

Turfstone

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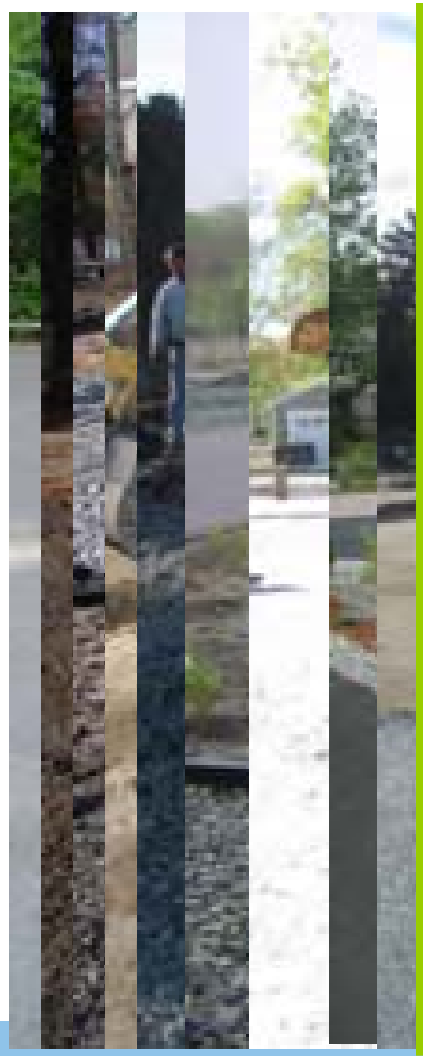
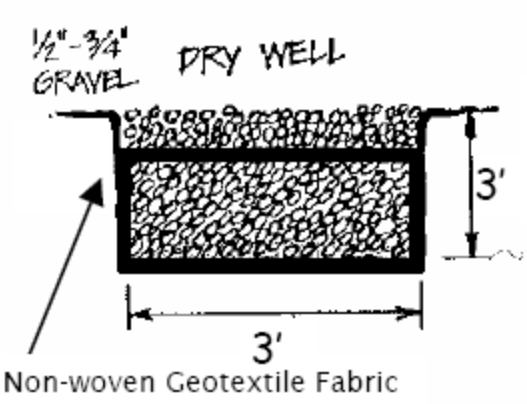
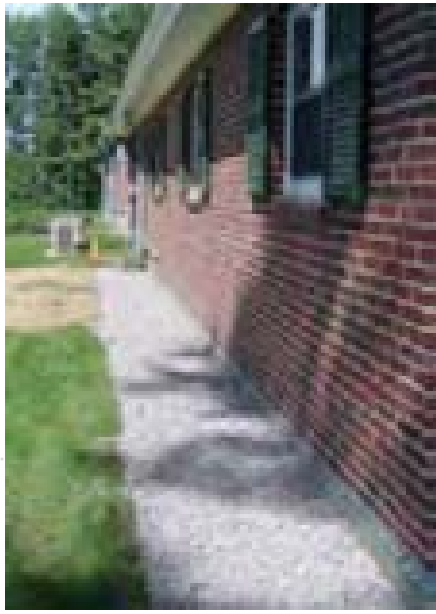


Dry Well / Infiltration Trench

- Dry wells range in size and complexity from a simple gravel-filled pit or trench to large perforated structures fed by drainage pipes.
- Often used to capture runoff from roof downspouts, driveways
- Work best in sand/gravel soils





Soils

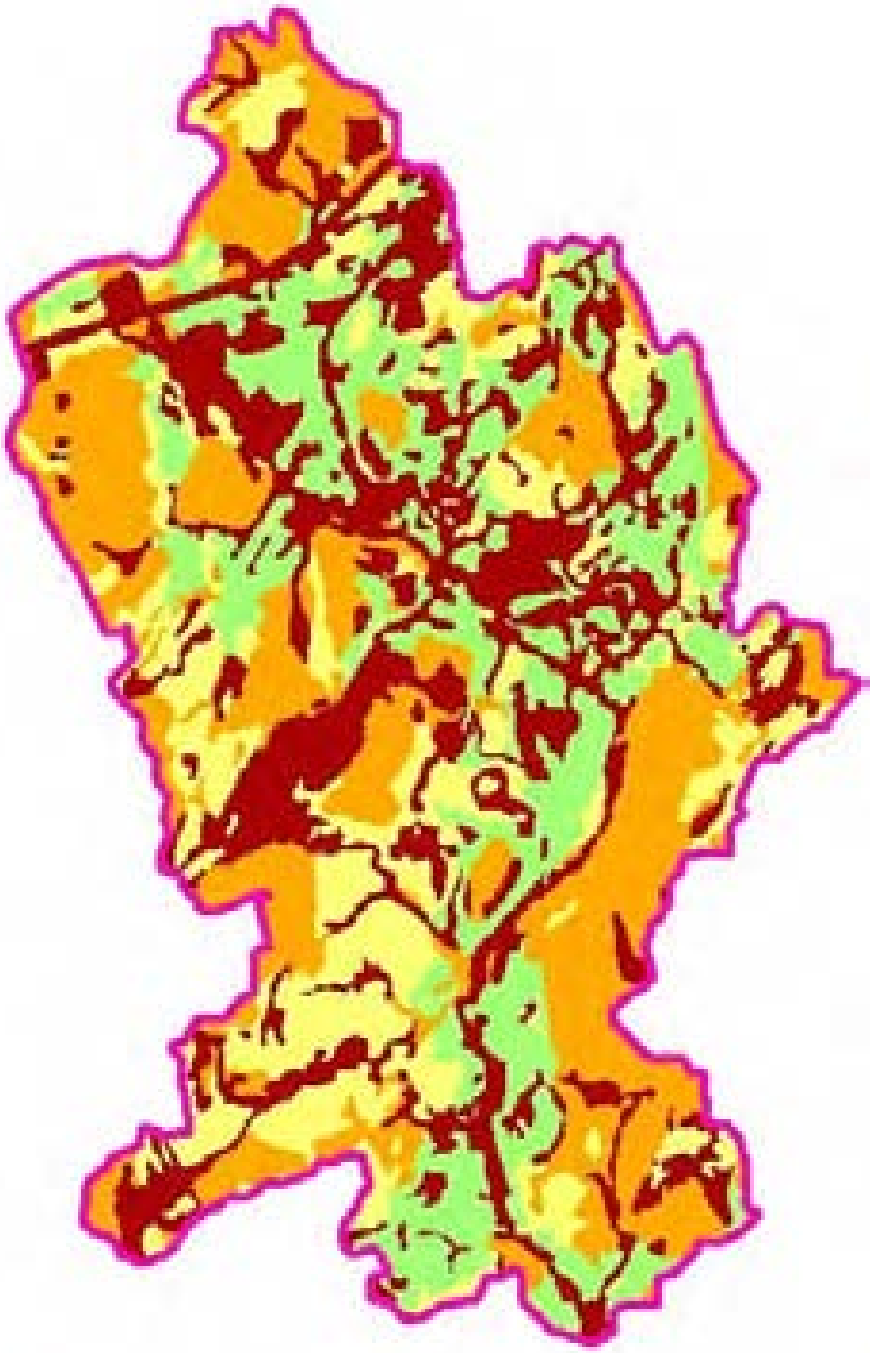
Hydrologic Soil Groups

A: Sand, loamy sand or sandy loam soils. High infiltration rates!

B: Silt loam or loam. Moderate infiltration when fully wetted.

C: Sandy clay loam. Poor infiltration when thoroughly wetted.

D: Clay loam, silty clay loam, sandy clay, silty clay or clay. Highest runoff potential, very low infiltration when fully wetted.



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Water Bars

- Water bars intercept runoff on sloped pathways and divert it to stable vegetated areas
- Install on sloped paths with concentrated flows
- Construct with 6”-8” diameter timbers and ¾” crushed stone
- Install multiple bars with spacing based on table

Table 1. Water Bar Spacing	
% Grade	Spacing Between Water Bars (in feet)
2	250
5	130
10	80
15	50
25+	40

A Shoreland Homeowner’s Guide to Stormwater Management (NHDES)

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Green Roofs

- Can be built almost any flat or low-angle roof.
- Reduce stormwater runoff volume and peak discharge
- Lower heating and cooling costs.
- Cost: $30-$45 per square foot

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Soil Amendment

- Any material added to soil to improve water retention, infiltration and structure.
- Add organic matter and nutrients to the soil, which stimulates plant growth.
- Compost can be tilled or added to the surface as a mulch. This “compost blanket” will retain water and improve water quality.
- Reduces need for fertilizer.
- Cost: $15-25 per cubic yard, depending on whether delivery is needed.

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Boat Ramps

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LID Costs (Installed)

- **Raingarden:**
  - With Stone = $12 sf
  - Without Stone = $10 sf
- **Bioretention Cell:**

  (Unlike raingardens, biocells have piping such as an underdrain to a catch basin)
  - Large (1000+ sf) = $8 sf
  - Medium (500-1000 sf) = $10 sf
  - Small (200-500 sf) = $30 sf
  - Very Small (<200 sf) = $30 sf
- **Porous Pavement:**

  (includes infiltration bed 24” min)
  - Pavers (large area) = $8 sf
  - Pavers (small area) = $12 sf
  - Asphalt (large area) = $7 sf
  - FlexiPave = $8 sf
  - GravelPave = $15 sf
- **Swale:**

  (includes bioretention soil mix)
  - Grass = $8 lf
  - Vegetated/Bioretention = $10 lf
- **Catch Basin Upgrade:**
  - Deep Sump = $3,000 installed
  - Hydrodynamic Separator = $12-15,000 installed
- **Tree Box Filters:**

  (Filterra)
  - $10K per 0.25 ac

Thank you for your time!

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