

Rain Garden Design, Installation and Maintenance

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What is a rain garden?

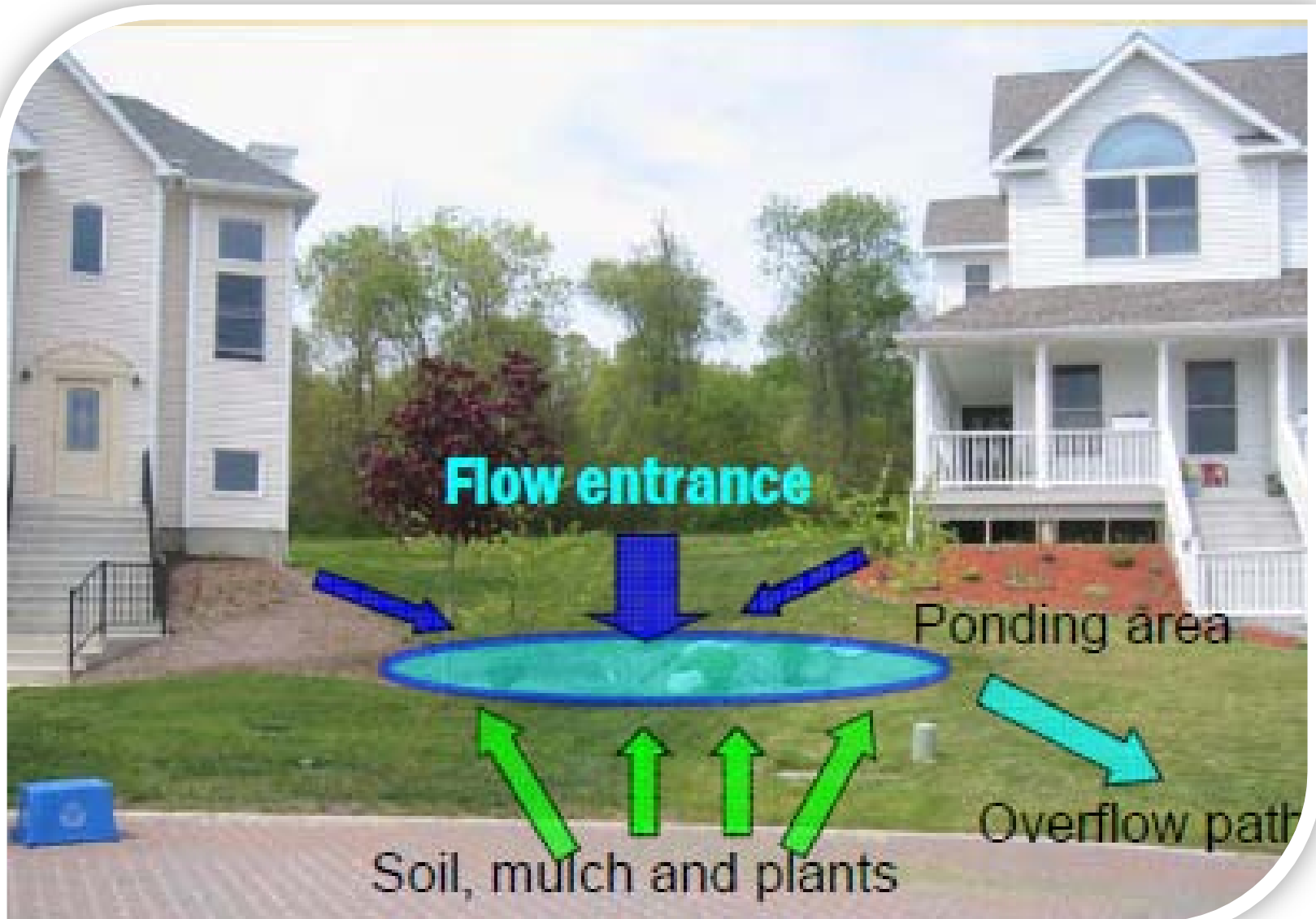
- **A depression in the landscape designed to collect and infiltrate stormwater**
 - Not typically engineered
 - Rely on existing soil
 - Home-scale



What's going on in there?

- **Pollutants retained**
 - Taken up by plants (nitrogen, phosphorus)
 - Absorbed by mulch, soils or organic matter (metals)
 - Broken down by micro-organisms and sunlight (hydrocarbons, bacteria)
 - Converted to gaseous form
- **Reduction in stormwater volume**
 - Infiltration
 - Evapotranspiration
- **Filtration of coarse particles**
 - Sediment
 - Bacteria

Rain Garden Elements



Rain Garden Elements

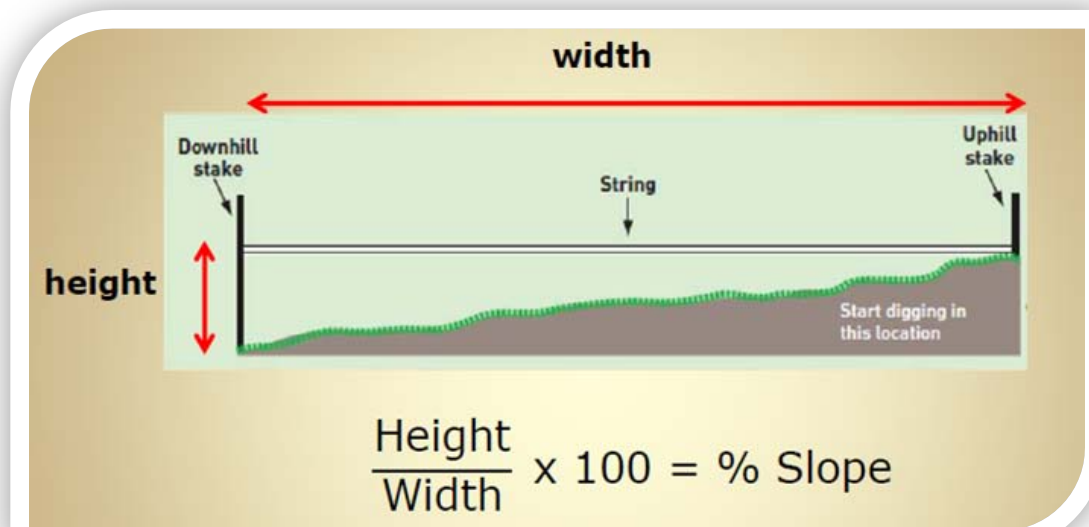
- **Berm**
 - Not necessary on flat slopes
 - Necessary on moderate slopes (3-11%)
- **Depression**
 - Must be flat
- **Ponding Area**
 - Must be flat
 - Ponding is good, but not for more than 24 hours
- **Flow Path / Forebay**
 - Prepared with gravel to slow down inflow of runoff



Rain Garden Design

- **Site Assessment Checklist**

- Avoid placing in wet areas of yard
- Avoid areas with shallow (<3') depth to bedrock
- Avoid areas with seasonal high water table (<2' from bottom)
- Avoid steep slopes (>12%)



Rain Garden Design

- **Site Assessment Checklist**

- What is infiltration capacity of native soils?
- How much sun is available for plants?
- Is overflow needed?
- Is the rain garden site:
 - Chosen to most effectively catch stormwater runoff?
 - At least 10 feet from a foundation with a basement or 10 feet from where the top of the foundation is below ponding level?
 - At least 15' from septic system?
 - At least 25' from private drinking well?

Rain Garden Design

- **Roof runoff capture options**
 1. Intercept gutter downspout leader



2. Drains to lawn area then slopes into rain garden

Rain Garden Design

- **Flow Path / Forebay consideration**
 - Where flow is concentrated or coming out of a pipe, provide something to break up the energy
 - Reduces erosion potential



**Gravel
forebay**

Rain Garden Design

- **Overflow consideration**

- Identify lawn or wooded area adjacent to rain garden to act as overflow when runoff volume exceeds rain garden capacity



Rain Garden Design

- **Percolation Test for Soil Drainage Analysis**

1. Dig a hole 12” deep by 6” in diameter
2. Fill hole with water and let it completely drain
3. Refill the empty hole with water again and measure the water depth with a ruler
4. Check the water depth every hour for 4 hours
5. Calculate how many inches of water drained per hour

~1.5 inches of water per hour draining is ideal...

Rain Garden Design

- **Bal Test for Soil Texture Analysis**

1. Squeeze a moistened ball of soil in your hand

2. If soils:

- Break with pressure = **Sand or sandy loam**
- Stay together but change shape easily = **Sandy loam and silt loam**
- Resist breaking = **Clayey or clayey loam; not suitable**



Rain Garden Design

- **Ribbon Test for Soil Texture Analysis**

1. Squeeze “Tootzie Roll”-size soil mass between your thumb and forefinger
2. Length of ‘ribbon’ that forms dictates predominant soil texture
 - 0-1 inch, gritty = **Sand**
 - 0-1 inch, not gritty = **Loam high in silt content**
 - 1-2 inches, gritty = **Loam**
 - 1-2 inches, not gritty = **Silt; not suitable**
 - 2+ inches = **Clayey; not suitable**



Rain Garden Design

- **Soil Amendments**

- For very sandy soils:

- Amend with compost to slow down infiltration

- For clay soils:

- Make garden larger and shallower, and amend with sand and some compost to encourage infiltration

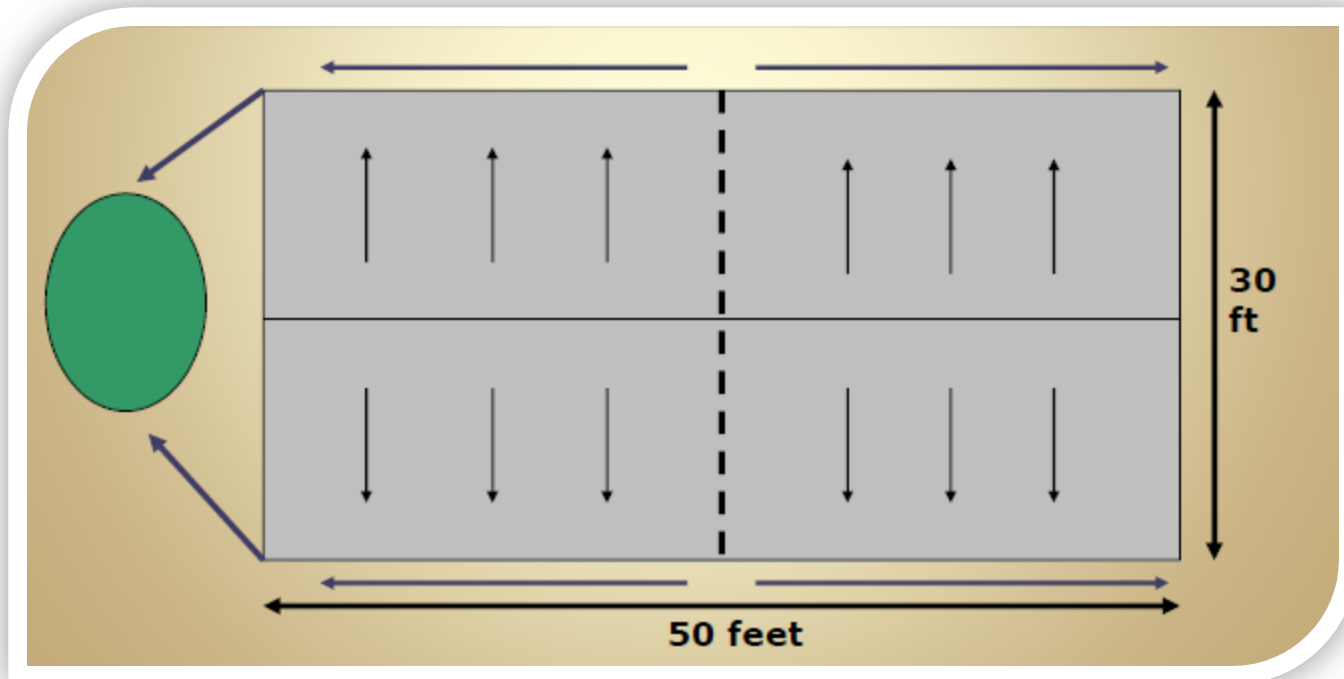
- For compacted soils:

- Loosen up and remove some of the compacted soil, replacing with sand/compost mixture to encourage infiltration

Rain Garden Design

- **Simple Sizing Method**

- Sized to store 1 inch of runoff from 100% of impervious surfaces
- Calculate area of roof feeding the garden



Rain Garden Design

- **Simple Sizing**

- **Method Calculation**

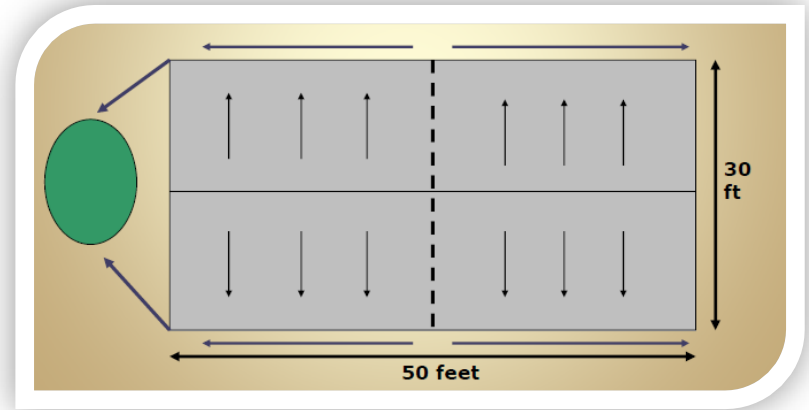
- $50' \times 30' = 1500 \text{ sq ft}$

- $1500 \text{ sq ft} / 2 = 750 \text{ sq ft}$

- Because only $\frac{1}{2}$ the roof contribute to the garden

- $750 \text{ sq ft} / 6 = \underline{\underline{125 \text{ sq ft}}}$

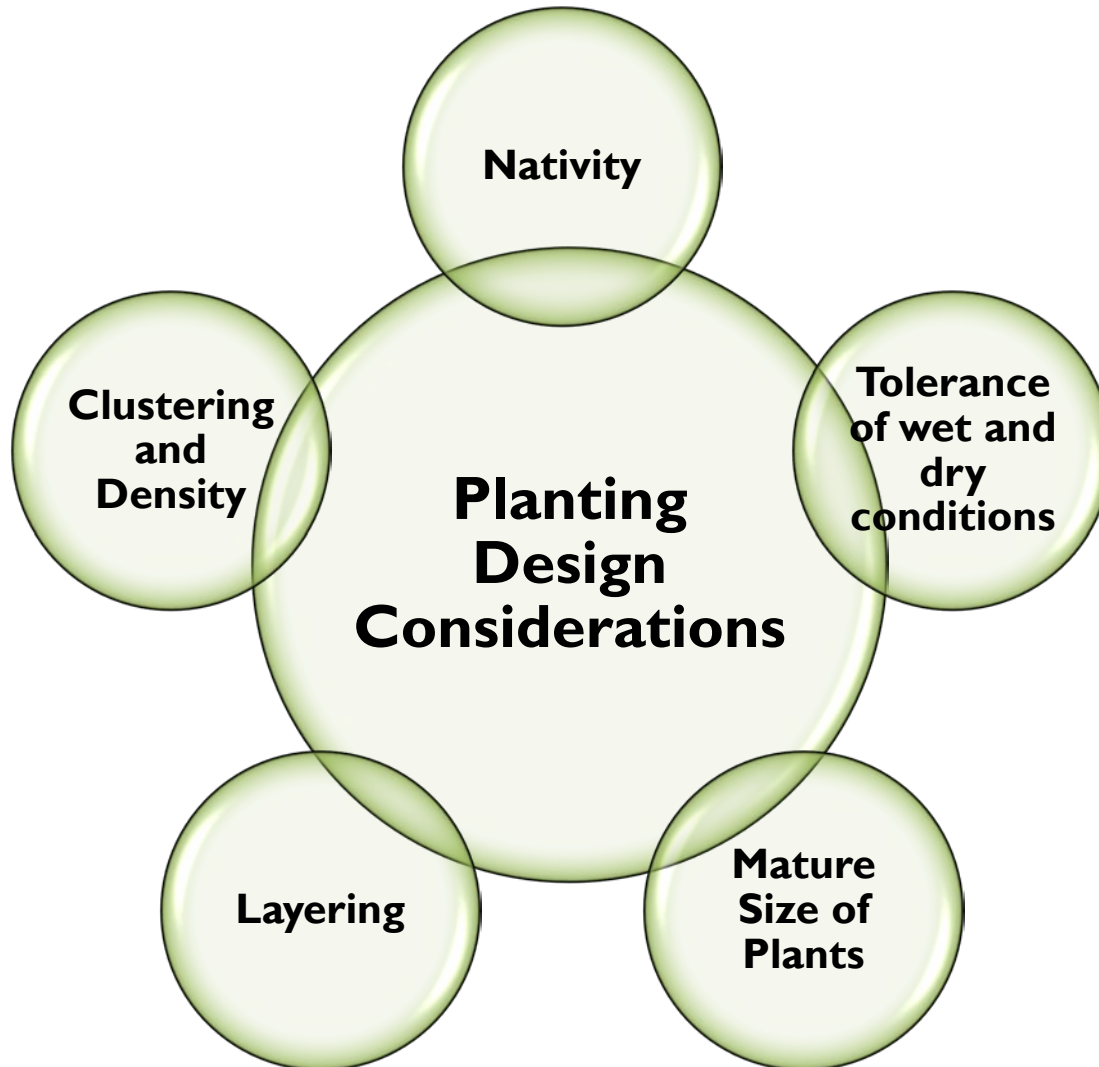
- This sizes the garden to hold 1" of water from the roof in a 6 inch deep rain garden



Why only 1 inch?

- In the East, around 90% of storms are 1" or less

Rain Garden Planting Design



Rain Garden Planting Design

- **What is a native plant?**
 - One that lives naturally in a particular region without direct or indirect human intervention.



Rain Garden Planting Design

• Why Specify Native Plants?

- Adapted to soil and temperature conditions
- Tolerate microclimate conditions
- Tolerate harsh rain garden conditions (sometimes dry, sometimes wet)
- Require less inputs (i.e. fertilizer, water)
- Resistant to most pests and disease
- Attract other natives (i.e. migratory birds, beneficial insects and butterflies)

BOTTOM LINE: They're easy and we need them!

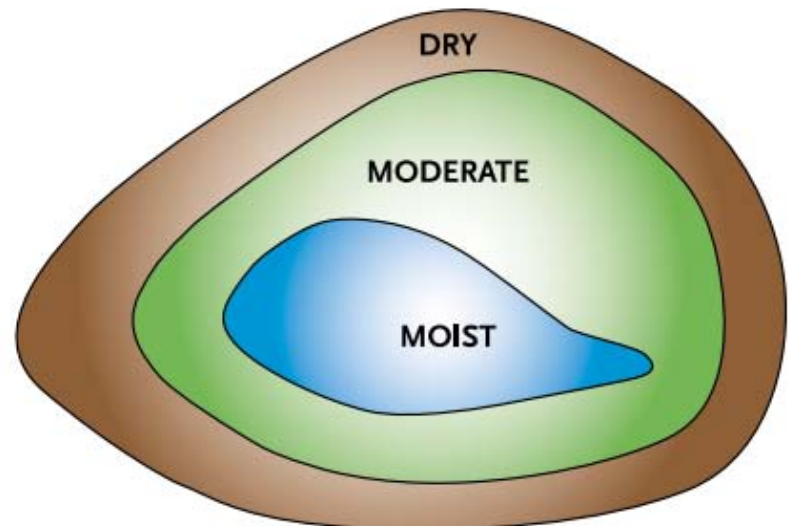
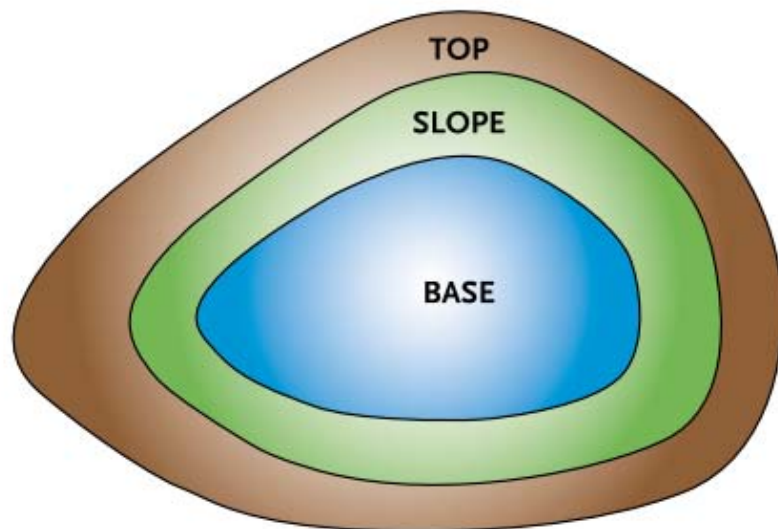
Rain Garden Design

Tolerance of wet and dry conditions

RAIN GARDEN DICTIONARY:

Zones of wet and dry conditions

- **Moist:** plant prefers moist soil and tolerates dry soil other times of the year.
- **Moderate:** plant can tolerate moist and dry soils equally.
- **Dry:** plant tolerates and even thrives in dry soil during most of the year.



Rain Garden Planting Design

Mature Size of Plants



Planting Design Resource

RHODE ISLAND COASTAL PLANT GUIDE

College of the Environment and Life Sciences
 University of Rhode Island
 Cooperative Extension
 Education Center
 ELS
 Education, Experience, Excellence for the 21st Century



50 of 231 Species

Page 1 of 5

Clear Filter

Help | About the Coastal Plant Guide

[Enter all or part of name above to filter list]

[Select from dropdown list to filter plant list by attributes]

Species	Common Name	Zone	Plant Type	Native Status	Full Sun	Shade Tolerant	Drought Tolerant	Wet Sites	Wind Tolerant	Na:Spray Tolerant	Na:Soil Tolerant	Acid Tolerant	pH Adapt	Rain Gardens	Dune Plant	Height	Width	Availability
<i>Abies concolor</i>	White fir	2	Tree	-	+	-	+	-	-	-	-	+	+	-	-	>10'	15-30'	8,10,22,67,74,77,57
<i>Achillea sp.</i>	Yarrow	2	Per.	-	+	-	+	-	+	-	+	-	-	-	-	2-6'	-	28,10,12,22,24,67,74,77,35,51
<i>Aesculus flava (A. octandra)</i>	Yellow Buckeye	2	Tree	-	+	+	-	-	-	-	-	-	-	-	-	>10'	-	10,67
<i>Aesculus glabra</i>	Ohio Buckeye	2	Tree	-	-	-	-	-	-	-	-	-	-	-	-	>10'	20-40'	10,67,74
<i>Aesculus x carnea</i>	Red Horsechestnut	2	Tree	-	-	-	-	-	-	-	-	-	-	-	-	>10'	-	10,67,57
<i>Alnus incana ssp. rugosa</i>	Speckled Alder	1	Shrub	+	+	+	+	+	+	-	+	-	-	-	-	>10'	6-12'	10,74
<i>Alnus serrulata</i>	Common Alder	1	Shrub	+	+	+	+	+	+	-	+	-	-	-	-	>10'	6-12'	
<i>Amelanchier arborea</i>	Serviceberry	1	Tree	+	+	+	+	-	+	+	+	-	+	-	-	>10'	15-25'	10,67,74,57
<i>Amelanchier canadensis !</i>	Shadbush	1	Shrub	+	+	+	+	+	+	+	+	+	+	+	+	>10'	variable	8,10,22,52,74,77,100,57
<i>Amelanchier laevis</i>	Allegheny Serviceberry	1	Tree	+	+	+	+	-	+	+	+	+	+	+	-	>10'	15-25'	8,10,67,74,77,57
<i>Amelanchier stolonifera</i>	Running Serviceberry	1	Shrub	+	+	+	+	+	+	+	+	+	+	-	-	2-6'	variable	22,67
<i>Ammophila breviligulata</i>	American Beach Grass	1	Grass	+	+	-	+	-	+	+	+	-	-	-	+	2-6'	-	10,12,22,35,67,74,77
<i>Andropogon gerardii</i>	Big Bluestem	1	Grass	+	+	-	+	-	+	+	+	-	-	-	-	6-10'	2'	10,12,35,67,74,100
<i>Andropogon glomeratus</i>	Bushy Bluestem	2	Grass	+	+	-	+	+	-	-	-	-	-	-	-	<2'	-	8,10,12,35,67
<i>Andropogon ternarius</i>	Split-beard Bluestem	2	Grass	-	+	-	+	+	-	+	+	+	-	-	-	2-6'	2-3'	67
<i>Andropogon virginicus</i>	Broomsedge	1	Grass	+	+	-	+	-	+	+	+	+	-	-	-	2-6'	1-2'	12,67
<i>Arctostaphylos uva-ursi</i>	Bearberry	1	Shrub	+	+	+	+	-	+	+	+	+	-	+	-	<2'	variable	8,10,22,24,41,52,67,74,77,100
<i>Artemisia stelleriana</i>	Dusty Miller	1	Per.	-	+	-	+	-	-	+	+	-	-	-	-	2-6'	36"	2,8,10,12,22,24,67,74,77
<i>Asclepias tuberosa</i>	Butterfly Milkweed	2	Per.	+	+	-	+	-	-	-	-	-	-	+	-	2-6'	2'	8,10,12,22,24,67,74,77
<i>Astilbe sp.</i>	Astilbe	2	Per.	-	+	+	-	-	-	-	-	-	-	+	-	2-6'	-	2,8,10,12,22,24,67,74,77,35,51
<i>Atriplex sp.</i>	Salt Bush	1	Shrub	+	+	-	+	-	-	+	+	-	-	-	+	<2'	6'	
<i>Baccharis halimifolia</i>	Groundsel-bush	1	Shrub	+	+	-	+	-	+	+	+	+	+	-	-	>10'	5-12'	10,74
<i>Baptisia australis</i>	Blue Wild Indigo	1	Per.	-	+	-	+	-	+	-	-	-	-	-	-	2-6'	3-4'	8,10,12,22,24,67,74,77,100
<i>Baptisia sphaerocarpa</i>	Yellow Wild Indigo	2	Per.	-	+	-	+	-	-	-	-	-	-	-	-	2-6'	3-4'	12,22,67,77
<i>Baptisia tinctoria</i>	False Indigo	1	Per.	+	+	-	+	-	+	+	-	-	-	-	-	2-6'	2-3'	10,22,67,77
<i>Betula populifolia</i>	Gray Birch	2	Tree	+	+	+	+	+	+	-	-	-	+	-	-	>10'	10-20'	10,22,67
<i>Calamagrostis x acutiflora 'Karl Foerster'</i>	Feather Reed Grass	2	Grass	-	+	-	+	+	-	-	-	-	-	-	-	<2'	5-7'	28,10,12,22,24,52,67,74,77

STEP 1: Set 'Native Status' to +

STEP 2: Set 'Rain Garden' to +

Rain Garden Planting Design

- **Layering**

- Mimic natural conditions

TREES



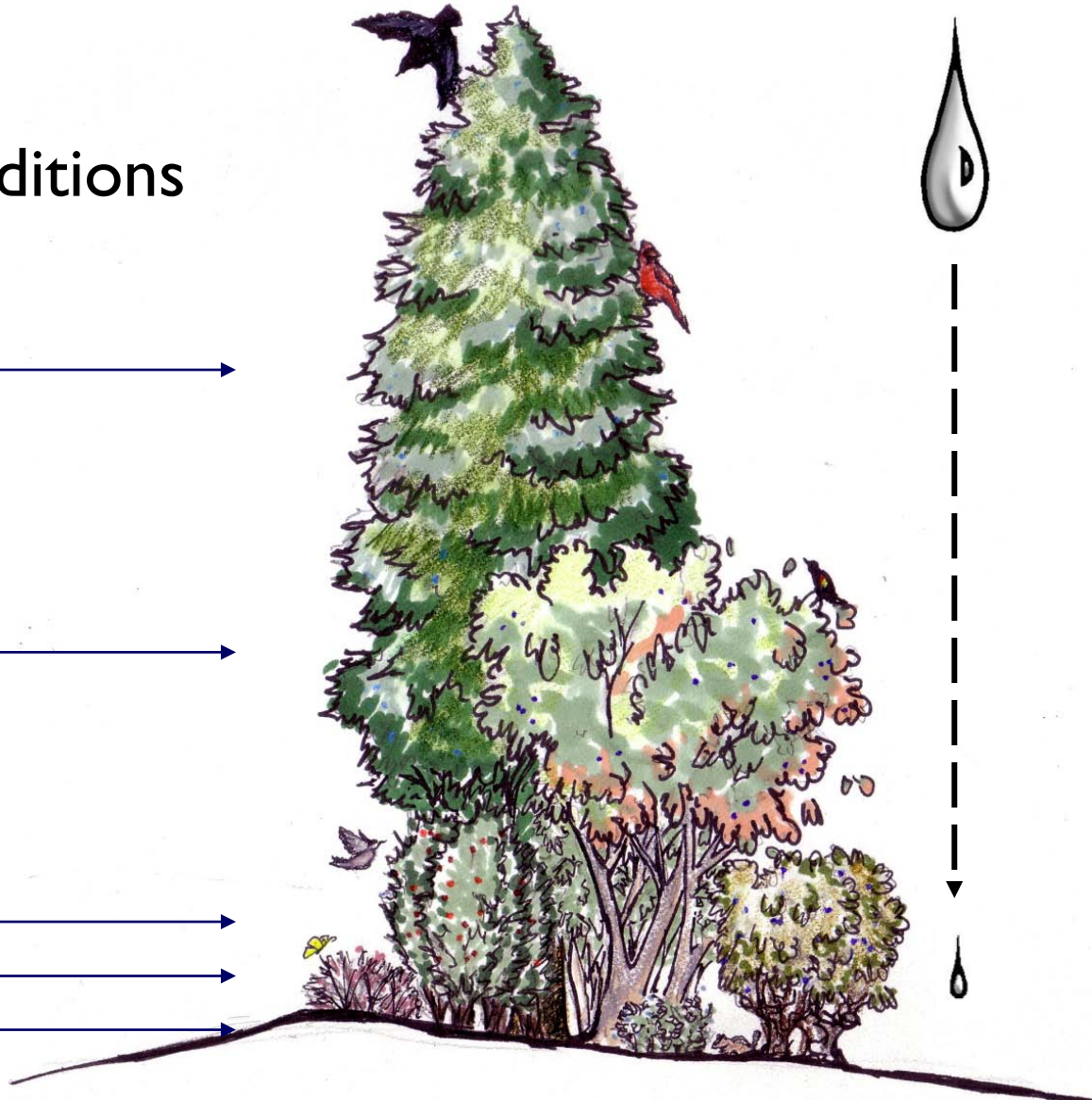
SHRUBS



HERBACEOUS
GROUNDCOVERS

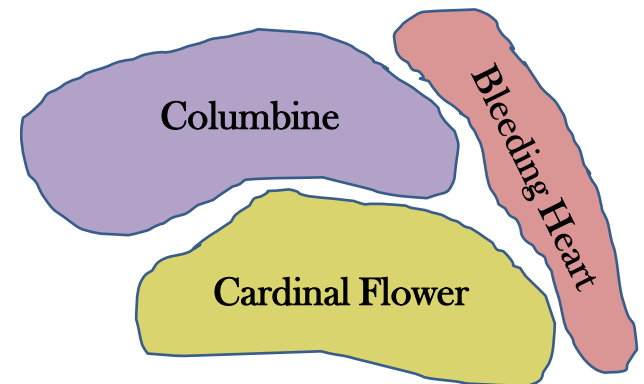
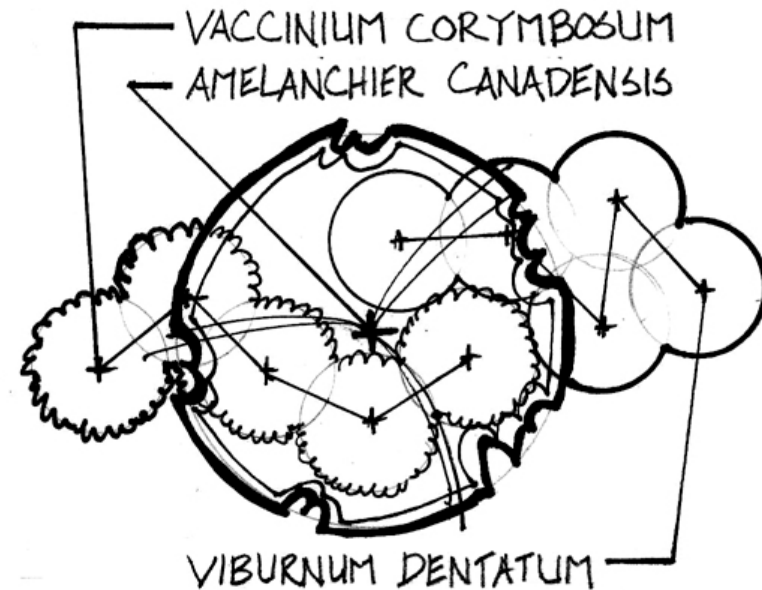


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Rain Garden Planting Design

- **Clustering and Density**
 - Incorporate diverse groups of overlapping native plants of varying heights and shapes
 - Combine evergreen and deciduous trees and shrubs with herbaceous and groundcover species for a variety of layers and age classes of plants
 - Site like species adjacent to each other to create 'swaths'



Rain Garden Installation

- **Step 1: Remove existing grass**

- Delineate rain garden area
- Remove existing grass manually or with machinery

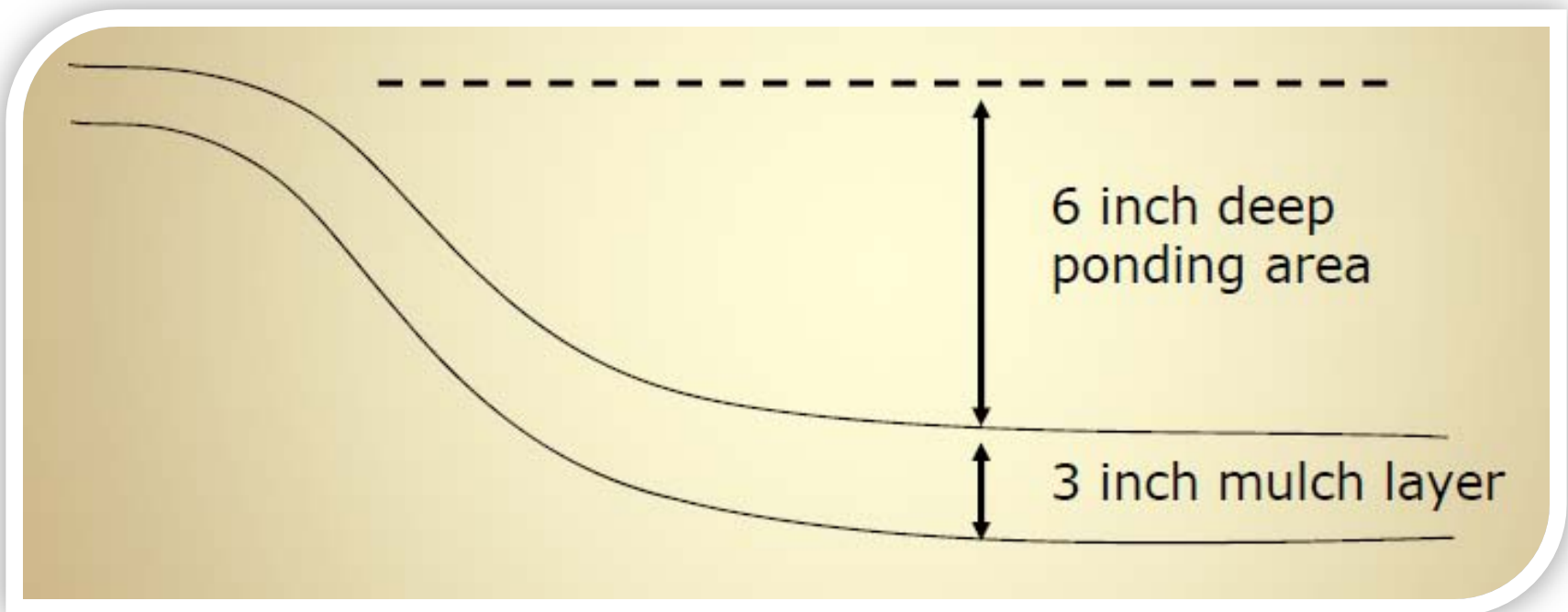
- **Step 2: Excavate to design depth**

- Based on necessary storage and soil amendment requirements



Rain Garden Installation

- **Construction Tip:** Spring-time construction is best (abundant rains allow for plant establishment and easy digging!)



Rain Garden Installation

- **Step 3: Add soil amendments, if needed**
 - Combine amendments with existing soil using shovels and pitchforks
- **Step 4: Prepare the berm, if needed**



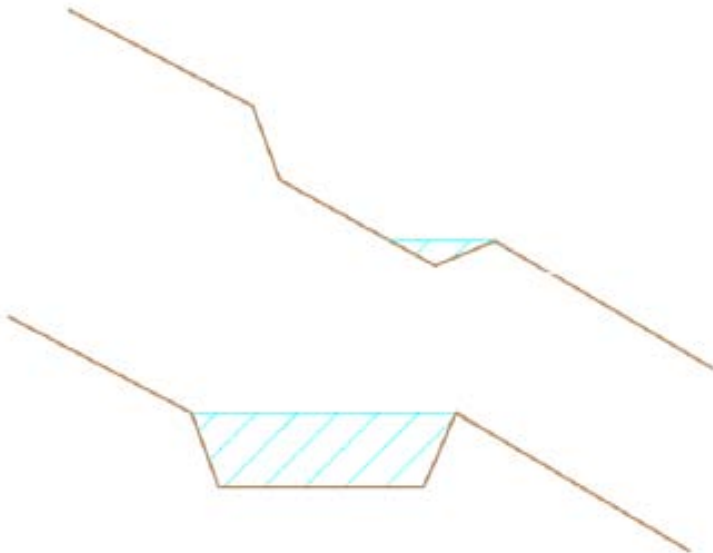
Rain Garden Installation

- **Step 5: Level the rain garden base**



- **Step 6: Plant native species**

- Dig planting hole deep and wide enough to let roots hang vertically to bottom of hole
- For root-bound plants, make several vertical cuts to sides of rootball
- Rootball should be entirely enveloped by soil
- Backfill and water



Rain Garden Installation

- **Step 7: Apply mulch**
 - Triple shredded hardwood, no dyes!
 - 2-3" layer over garden, leave space surrounding plant stems
- **Step 8: Water**
- **Step 9: BREATH!**



Rain Garden Weekly Maintenance

- **Watering**

- Water plants regularly – particularly during the first 1-2 growing seasons
- Be careful that the plants don't get too wet or too dry



Rain Garden Weekly Maintenance

- **Weeding**

- During the first few years, you will need to weed often during the growing season
- You will need to weed less and less as the plants grow and surpass the weeds
- Watch out for aggressive invasive species!



Rain Garden Weekly Maintenance

- **Inspecting**

- Observe the rain garden during rain events and note successes AND problems
- What are you inspecting for?
 - Invasive plants
 - Plant health
 - Excessive sediment
 - Movement of sediment within the rain garden



Problem: Gullying after rain event

Rain Garden Annual Maintenance

- **Mulching**

- Add mulch every spring to maintain a 2” mulch layer

- **Pruning**

- Cut back dead vegetation, flowers and unwieldy herbaceous plants **IN THE SPRING**
- Leave deadheads in winter for wildlife
- Prune woody vegetation to encourage branching density to improve filtering capacity



Rain Garden Annual Maintenance

- **Pruning**

- Prune summer and fall flowering tree and shrubs in the dormant season
- Prune spring flowering trees and shrubs soon after their flower fade
- Avoid pruning plant between June 15th and October 15th, as it stimulates new growth that may not be able to withstand hard frosts in October

Rain Garden Annual Maintenance

- **Removing Sediment**

- Since the rain garden serves the purpose of catchment and filtering runoff, sediment will accumulate within the garden (it would go in a storm drain otherwise)
- Remove sediment with a flat shovel (avoid plants!)
- Core aerate or cultivate bare areas annually if surface becomes clogged with fine sediments



Rain Garden Annual Maintenance

- **Replacing Materials**
 - Add more river rocks if necessary
 - Keep the ground plane covered in the rain garden!
- **Cleaning Gutters**
 - At least once a year, make sure any gutters connected to the rain garden are clear of debris
 - You may have to clean gutters more frequently if they are near large trees





REMEMBER: rain gardens are **LOW** maintenance gardens, not **NO** maintenance gardens!

Acknowledgements

- Michael Dietz, PhD, University of Connecticut
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