Rain Garden Workshop

Tuesday, August 25, 2015
9:00 am—12:00am
Office of Samoan Affairs Conference Room
Agenda

- Intro
- Siting & Design
- Build & Maintain
- Q&A
What is a rain garden?

- Basics
- Function
- Examples
A rain garden is...

- a constructed depression
- planted with vegetation
- designed to
  - collect storm water
  - promote infiltration
  - increase evapotranspiration

is NOT...

- A pond or water feature
  - should drain within 24 hours
  - not enough time for mosquitoes to breed
- A traditional vegetable “garden”
  - Runoff can contain contaminants

Cross-section of a typical rain garden and the fate of stormwater runoff (adapted from Hui o ko‘olaupoko).
Fight MOSQUITO BORNE ILLNESSES
- Dengue
- Chikungunya
- Zika
by doing the 3D's
- Drain
- Deet
- Dress
The Parts of a Rain Garden

- Berm
- Inlet
- Slope
- Level Ponding Bed
- Slope
- Berm
- Outlet
The Rain Garden Continuum

Rain Garden:
• Some friends with shovels digging a shallow hole;
• A couple beers;
• A few plants.

Bioretention:
• Bigger drainage area;
• Complex sizing calculations;
• Engineered soils;
• Underdrains and sophisticated conveyance devices
Rain Garden

Function

Intercept stormwater between the source and the bay
Why build a Rain Garden?

- Nutrients
- Phosphorus
- Heavy Metals
- Groundwater recharge
- Runoff reduction
- Aesthetics
- Education
Thigh bone is connected to your hip bone, your hip bone is connected to your storm drains are connected to the streams, streams are connected to the ocean, the ocean is connected to us!
Helps drain parking/entrance area
Collects roof runoff for self-watering, campus landscaping
Reduces drip-line erosion and creates a visual barrier
School demonstration project, manages large drainage area
Intercepts direct shower discharge to ocean
Anyone seen this one?
The road to Vatia...
How about this one?
How do you find a good spot?

- Walk the site
- Pick a spot
- Estimate DA
- Evaluate slope, & soils
What do you need to know?

- Drainage pathways
- Rooftop gutters/downspouts (if any)
  - Do they discharge above ground?
  - Are they directly connected to something?
- Existing drainage infrastructure
  - Curb/gutter in parking lot or driveway
  - Catch basins and storm sewers
  - Open swales/ditches
- Topography – flat vs. sloped
- Type of existing vegetation (if any)

1. Drainage Area
2. Soils
3. Slope
4. Conveyance
Walk the Site

- Identify any slopes or low spots
- Identify areas where water might drain from/to adjacent property
- Identify impervious surfaces that generate stormwater
- Identify areas where your rain garden can overflow safely (e.g.; a storm drain)
Setbacks

Also avoid:
- septic drain field
- consistently wet
- soils with infiltration rate of <0.5 in/hr
Use of area
Use of area
Check slope
Is this a good spot or not?
Easy curb cut
Room to intercept
Design

• Sizing
• Moving water in/out
• Plants
• Materials
Do we need a design plan?
Size of the Rain Garden

• The size of the rain garden is a function of volume of runoff to be treated and recharged
  – contributing drainage area
  – rainfall
  – ponding depth
  – soil infiltration rate.

• Typically, a rain garden is sized to handle the Water Quality Volume:
  – 90% of all storms
  – American Samoa - 1.6 inches rainfall depth

• A typical rain garden ranges from 200 to 400 ft².
Why 1.6” target?
Table 2. Approximate Rain Garden Size ($ft^2$) to meet AS rainfall target of 1.6” (0.13 ft)

<table>
<thead>
<tr>
<th>Impervious Drainage Area</th>
<th>Ponding Depth</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3” (0.25 ft)</td>
<td>6” (0.50 ft)</td>
</tr>
<tr>
<td>500 ft$^2$</td>
<td>260</td>
<td>130</td>
</tr>
<tr>
<td>750 ft$^2$</td>
<td>390</td>
<td>195</td>
</tr>
<tr>
<td>1000 ft$^2$</td>
<td>520</td>
<td>260</td>
</tr>
<tr>
<td>1500 ft$^2$</td>
<td>780</td>
<td>390</td>
</tr>
<tr>
<td>2000 ft$^2$</td>
<td>1040</td>
<td>520</td>
</tr>
</tbody>
</table>
Simple formula

Rain garden surface area \( (ft^2) = \)

\[
\text{Impervious DA (ft}^2\text{)} \times \text{AS target rainfall depth (ft)} \\
\text{Ponding Depth (ft)}
\]
Contributing Drainage Area (CDA)

$30 \times 19' = 570 \text{ sq. ft.}$

$15' \times 19' = 285 \text{ sq. ft.}$
Contributing Drainage Area

Driveways and Parking Lots
Soil Infiltration Rates

• Dig a 10” to 15” test hole in the middle of your rain garden location, fill it with the depth of water similar to the ponding depth.
Making Mud

- Fill the hole with water and allow to drain. Do this 3 times.
- On the 3\textsuperscript{rd} filling, record the depth of water and drain time.
- This 3\textsuperscript{rd} test mimics water infiltration rates during rain storms when the soils are saturated.
Math!

• Divide the distance the water dropped by the time it took to drop.

• For example, if it dropped 1 inch in 2 hours, infiltration rate = $\frac{1}{2} = 0.5$ inches/hr.
<table>
<thead>
<tr>
<th>Drainage Rate</th>
<th>Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; ½ inch/hour</td>
<td>May want to seek professional assistance; rain garden likely needs perforated drain pipe in or under the soil layer.</td>
</tr>
<tr>
<td>½ - 1 inch/hour</td>
<td>Low infiltration for a rain garden. Homeowners may want to build a larger or deeper garden, or likewise plan for additional overflow during high-rainfall storms.</td>
</tr>
<tr>
<td>1 - 1 ½ inches/hour</td>
<td>Adequate infiltration for a rain garden. Plan for sufficient overflow during high-rainfall storms.</td>
</tr>
<tr>
<td>1 ½ - 2 inches/hour</td>
<td>Adequate infiltration for a rain garden. Plan for sufficient overflow during high-rainfall storms.</td>
</tr>
<tr>
<td>&gt; 2 inches/hour</td>
<td>High infiltration for a rain garden. Design should feature fewer moisture-loving and more drought-tolerant plants. The rain garden may also be sized to hold smaller amounts of water, have a deeper mulch layer, or have denser plantings.</td>
</tr>
</tbody>
</table>

*Source: OSU, Sea Grant: The Oregon Rain Garden Guide*
Soil Amendment Amount for 100 sq ft Rain Garden

Coarse Sand (Bank Run Sand) 1 cubic yard
Compost 1 cubic yard

Determine Soil Amendments, if necessary
Size of garden = **Impervious DA (ft²) X rainfall depth (ft)**

Rain garden depth (ft)

Roof Drainage Area = 12’ x 30’ = 360 ft²

Rainfall Target = 1.6 inches = 0.13 ft

Depth = 6 inches = 0.5 ft

RG size = 360 ft² x 0.13 ft

0.5 ft

= 94 ft²
Rain Garden Size

- Impervious cover = 10,700 sq ft
- Cell 1 = 500 sq ft
- Cell 2 = 200 sq ft
- Area available (yellow) = 1,600 sq ft

Total drainage area = 18,360 sq ft
Rain garden surface area (ft$^2$) = Impervious DA (ft$^2$) X AS target rainfall depth (ft) Ponding Depth (ft)
Rain garden surface area (ft\(^2\)) = 10,700 sf impervious \times 0.13 ft rainfall target = 2782 sf needed
Rain garden surface area (ft$^2$) =

10,700 sf impervious X 0.13 ft rainfall target
0.5 ft ponding depth

=2782 sf needed
=1600 sf available

It’s OK!
• High infiltration rates
• Already flowing through here
• Meets 1” rainfall target
Moving water in & out

How will the stormwater runoff enter the rain garden?

• Extended downspout/gutter
• Stone or concrete spillway
• Across lawn via a gradual slope
• Vegetated or stone-lined swales
• Diversion berm along the bottom of slope
• Paved surface
Determine Rain Garden Overflow

Where will the excess stormwater runoff go in a heavy storm event?

- Overflow is away from buildings
- Berm higher near building
- Overflow sheets over lawn, garden, driveway or walkway
- Larger applications: berm with level spillway or landscape grate
- Flows onto street - an existing storm drain can be used as an outlet for a rain garden
Determine Erosion Potential

Will the velocity and erosion of the stormwater runoff be a problem?

• No

• Yes, erosion is possible. Address with:
  • Grading
  • Rocks or obstructions to slow flow
  • Rocks to stabilize
  • Erosion control blanket
Planting Plan

• Prefer native species over non-native (some exceptions)

• AVOID USING EDIBLE PLANTS

• Use plants tolerant to wet/dry conditions; Also consider salt, shade, & wind

• Provide for variable heights, color, leaf shape (trees, shrubs, herbaceous materials)
## Determine Plant Quantity

### Approximate # of Plants Based on Size at Maturity

<table>
<thead>
<tr>
<th>Size of Rain Garden</th>
<th>Approximate Amount of Plants</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 square feet</td>
<td>1 Small Tree (Optional)</td>
</tr>
<tr>
<td></td>
<td>7 Shrubs</td>
</tr>
<tr>
<td></td>
<td>24 Herbaceous Species</td>
</tr>
<tr>
<td>200 square feet</td>
<td>1 Small Tree (Optional)</td>
</tr>
<tr>
<td></td>
<td>14 Shrubs</td>
</tr>
<tr>
<td></td>
<td>48 Herbaceous Species</td>
</tr>
</tbody>
</table>

### Plant Spacing Cheat Sheet

- 18” O.C. = multiply sq. ft by .44
- 24” O.C. = multiply sq. ft by .25
- 30” O.C. = multiply sq. ft by .16
- 36” O.C. = multiply sq. ft by .11
Mawi: Wahi Kuli R.G.

Substitute plants:

<table>
<thead>
<tr>
<th>Location in R.G</th>
<th>Plant</th>
</tr>
</thead>
<tbody>
<tr>
<td>A accent</td>
<td>Chai / Hinahina ena</td>
</tr>
<tr>
<td>1 basin</td>
<td>'ae'a'ae</td>
</tr>
<tr>
<td># Slope/term</td>
<td>Pau'ohiia'aka / ilei / pohinahina</td>
</tr>
</tbody>
</table>

Sketch Addendum

Basin
1. at inlet: 'ae'a'ae / Akulikuli
2. mid basin: dwarf naupaka
3. end basin: chele kai

Slope/Berm
1. Pohuehue
2. Ilima papa
3. Naio

Accent
A - Akia

Hui o Ko'aolaupoko

~300 sq ft
~25' x 12'
Rain Garden Planting Plan

53 Hope and Carton

Key
A. Lemongrass
B. Plumeria
C. Bird of Paradise
D. Donkey Ear
E. Ginger
F. White Lily
G. Egger's Agave
H. Agave sp
I. Song of India
J. Mahogany
K. Thai Plants
L. Bromeliad
M. Welling Iris
N. Unknown
O. Solanum Concarpum
P. Rheo sp (Purple Queen)
Q. Worchia
R. Turpentine
S. Lignum Vitræ
T. Planubuapt
U. Balm

Inlet Channel

Speed Bump

Diri-Divi Trail

Driveway

Over Flow Spillway

Outlet Channel
# Planting the Rain Garden

## Wet Climate Plants

<table>
<thead>
<tr>
<th>Hawaiian Name</th>
<th>Scientific Name</th>
<th>Placement</th>
<th>Growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘Ae‘ae</td>
<td>Bacopa mannieri</td>
<td>Inlet</td>
<td>ground cover</td>
</tr>
<tr>
<td>A’ka‘akai</td>
<td>Schoenoplectella tabernae-montani</td>
<td>Basin</td>
<td>tall rush</td>
</tr>
<tr>
<td>‘Ala‘ala wai nui</td>
<td>Plectranthus parviflorus</td>
<td>Slope/berm</td>
<td>herb</td>
</tr>
<tr>
<td>Alahe‘e</td>
<td>Psydrax odoratum</td>
<td>Accent</td>
<td>tree</td>
</tr>
<tr>
<td>Hapu‘u</td>
<td>Cibotium sp.</td>
<td>Basin</td>
<td>tall fern</td>
</tr>
<tr>
<td>Ihilihaliuakea</td>
<td>Marsilia villosa</td>
<td>Inlet</td>
<td>ground cover</td>
</tr>
<tr>
<td>‘Iliahi</td>
<td>Santalum freycinetianum</td>
<td>Accent, Basin</td>
<td>tree</td>
</tr>
<tr>
<td>Loulu</td>
<td>Pritchardia sp.</td>
<td>Basin</td>
<td>tree</td>
</tr>
<tr>
<td>Makaloa</td>
<td>Cyperus laevigatus</td>
<td>Basin</td>
<td>tall sedge</td>
</tr>
<tr>
<td>Māmake</td>
<td>Pipturus albidus</td>
<td>Accent, Basin</td>
<td>tree</td>
</tr>
<tr>
<td>Mau‘u ‘aki ‘aki</td>
<td>Fimbristylis cymosa</td>
<td>Basin</td>
<td>bunching grass</td>
</tr>
<tr>
<td>Nehe</td>
<td>Melanthera integrifola</td>
<td>Basin</td>
<td>ground cover</td>
</tr>
<tr>
<td>Pu‘uka‘a</td>
<td>Cyperus trachysanthos</td>
<td>Basin</td>
<td>sedge</td>
</tr>
<tr>
<td>Uki</td>
<td>Machaerina angustifolia</td>
<td>Basin</td>
<td>sedge</td>
</tr>
<tr>
<td>‘Uki‘uki</td>
<td>Dianella sandwicensis</td>
<td>Basin</td>
<td>sedge</td>
</tr>
</tbody>
</table>
Be Creative!

• Incorporate landscape boulders to add interest
• Mix and match plants
• Pay attention to bloom time and color

• Think about what birds and bugs eat
• Think about maintenance
The benefits of mulch:

- Keeps soil moist, which allows for percolation of rain water.
- Protects plants and makes weeding easier.
- Minimizes erosion of the rain garden soil.

Determine Mulch Quantity

<table>
<thead>
<tr>
<th>Size of Rain Garden</th>
<th>Approximate Amount of Mulch</th>
</tr>
</thead>
<tbody>
<tr>
<td>25 square feet</td>
<td>0.25 cubic yard</td>
</tr>
<tr>
<td>50 square feet</td>
<td>0.50 cubic yard</td>
</tr>
<tr>
<td>100 square feet</td>
<td>1.0 cubic yard</td>
</tr>
<tr>
<td>200 square feet</td>
<td>2.0 cubic yards</td>
</tr>
</tbody>
</table>
Is stone an alternative?
Construction

Plan

Dig

Inlets & outlets

Amend Soils

& Mulch Plants

70
Planning & Construction Sequence

Construction timeline

Construction sequence

It is a good idea to plan ahead and have all supplies, materials, plants, compost and mulch on site before the rain garden is started. Additionally, make sure you have enough volunteers to help you start and finish the project. The following graph will help you plan your construction sequence.

Two Weeks Before Build
- Read Manual
- Map your property
- Determine slope
- Determine size of contributing draining area
- Determine size of rain garden
- Call about permits

One Week Before Build
- Call utilities before you dig
- Purchase plants
- Purchase mulch
- Purchase compost

Week of Build
- Secure volunteers
- Stage equipment and supplies on site

Day of Build
- Review Manual
- Dig, compost, mulch, plant
- Irrigate

Three recommended native plants for rain gardens are:
- Hānalei, ‘œle‘œle
- ‘Ala‘ala

See more in Section 8.
Measuring Slope

To calculate slope, you will need the following tools:
Permit, Call before you dig.

• Permits needed for American Samoa RG
• Permits needed for a typical residential RG
• Call before you dig
Compaction

• Build your rain garden with friends and shovels
• Don't 'double-back' or drive excavator in RG area – Infiltration will decrease
Level bed

- Keep basin of RG level from inlet/outlet
- Water should spread evenly before overflowing via outlet
Ponding Depth

- Manual sizing based on 9” ponding depth
- More digging is needed if building on a slope
Kaiser Highschool Rain Garden
Windward Community College
Video of a RG build on Oahu

http://vimeo.com/24896137
# Sample Rain Garden Budget ~ 100 sq. ft.

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
<th>Price/unit</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hand excavation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compost</td>
<td>cubic yard</td>
<td>$55 - $70</td>
<td>$55 - $70</td>
</tr>
<tr>
<td>Mulch</td>
<td>cubic yard</td>
<td>$0 - $35</td>
<td>$0 - $35</td>
</tr>
<tr>
<td>Plants</td>
<td>30 - 50</td>
<td>$3 - $5</td>
<td>$90 - $250</td>
</tr>
<tr>
<td>Pipe</td>
<td>10 feet</td>
<td>$40</td>
<td>$40</td>
</tr>
<tr>
<td>Rock</td>
<td>cubic feet</td>
<td>$4 - $8</td>
<td>$25-$50</td>
</tr>
<tr>
<td>Miscellaneous pipe connectors</td>
<td>variable</td>
<td>variable</td>
<td>$25</td>
</tr>
<tr>
<td>Miscellaneous tools</td>
<td>variable</td>
<td>variable</td>
<td>$0 - $75</td>
</tr>
<tr>
<td><strong>Sub Total</strong></td>
<td></td>
<td></td>
<td><strong>$235 - $545</strong></td>
</tr>
</tbody>
</table>

## Optional Equipment

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
<th>Price</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excavator</td>
<td>day</td>
<td>$175</td>
<td>$175</td>
</tr>
<tr>
<td>Excavator operator (4 hr min.)</td>
<td>4 hours</td>
<td>$50</td>
<td>$200</td>
</tr>
<tr>
<td>Excavator (delivery/pickup)</td>
<td>roundtrip</td>
<td>$250</td>
<td>$250</td>
</tr>
<tr>
<td>Rototiller</td>
<td>day</td>
<td>$60</td>
<td>$60</td>
</tr>
<tr>
<td><strong>Optional Sub Total</strong></td>
<td></td>
<td></td>
<td><strong>$685</strong></td>
</tr>
<tr>
<td><strong>Estimated Total</strong></td>
<td></td>
<td></td>
<td><strong>$920 - $1230</strong></td>
</tr>
</tbody>
</table>
Rain Garden at He'eia State Park

- University of Hawai‘i Sea Grant
- Oregon State University Sea Grant
- Kama‘āina Kids
- EPA/DOH 319 funded
HPU Rain Garden

• ~160 sq. ft. <9” ponding depth
• ~60 volunteer hours (not everyone worked hard, or at all)
• $367
HPU Rain Garden
• What to expect
• Typical tasks
• Short-term vs long-term
You Mean There Is More?

• Rain gardens need help to flourish and work properly.
• Maintenance need not be time consuming and intensive.
• Proper maintenance can extend rain garden life.
• It gets easier as you go.
What to inspect

• General site
• Inlet locations
• Plants
• Mulch
• Filter bed
• Outlet locations
Typical Tasks

• Weeding
• Watering
• Mulching
• Shoveling
• Trash removal
• Human impacts
• Replace plants
Immediately After Construction

Exposed soil = erosion
Seed & cover disturbed areas around your RG.
Remove any trash on site.

Signage to help keep people from disturbing the site.
Plus it helps bring SW awareness.

Water
Ensure mulch coverage
One time fertilizer maybe
Remove weeds!
Invasives!
Rain Gardens

When it rains, water washing off roofs, driveways, roads, and parking lots can carry bacteria, oils, and other pollutants directly to our streams and beaches. Rain gardens are landscaped depressions that use plants, soil, and mulch to remove pollutants and allow water to soak into the ground. Not only do rain gardens beautify our landscape, but they help protect our water resources.

🌿 Look around! What areas drain to the rain garden in front of you?

🌿 Do your part to protect our waters. Install a rain garden of your own! Find out more at the Bureau of Statistics and Plans, Guam Coastal Management Program.


During First Two Years

What’s Going On?

• Soil Amendments:
  • Standing water?
  • Needs sand.
  • Water draining too fast?
  • Needs organics (compost).

• First 6 months check your RG (at least) after two separate ½ inch storms.

• What is the water doing?
During First Two Years

- Bare spots in the contributing drainage area?
- Bare spots in your RG?
- Landscape rocks to slow the water
- Remove the sediment.

- Extended dry weather? Water!
- Weeds! Pull ‘em out!
- Dead or diseased plants? Remove them.
- Thin! Prune!
Long Term

• Check after heavy storms.
• Blockages?
• Channels?
• Sediment?
• Trash?
• Plant health?
• Plant diversity?
• Upgrade?
Tomorrow’s Agenda

8:30-2:00  Meet at Faga’alu Beach Park

✓ Fine grading
✓ Plumbing rain garden
✓ Amendments
✓ Leveling
✓ Planting
✓ Lunch