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

Introduction

What is a rain garden?

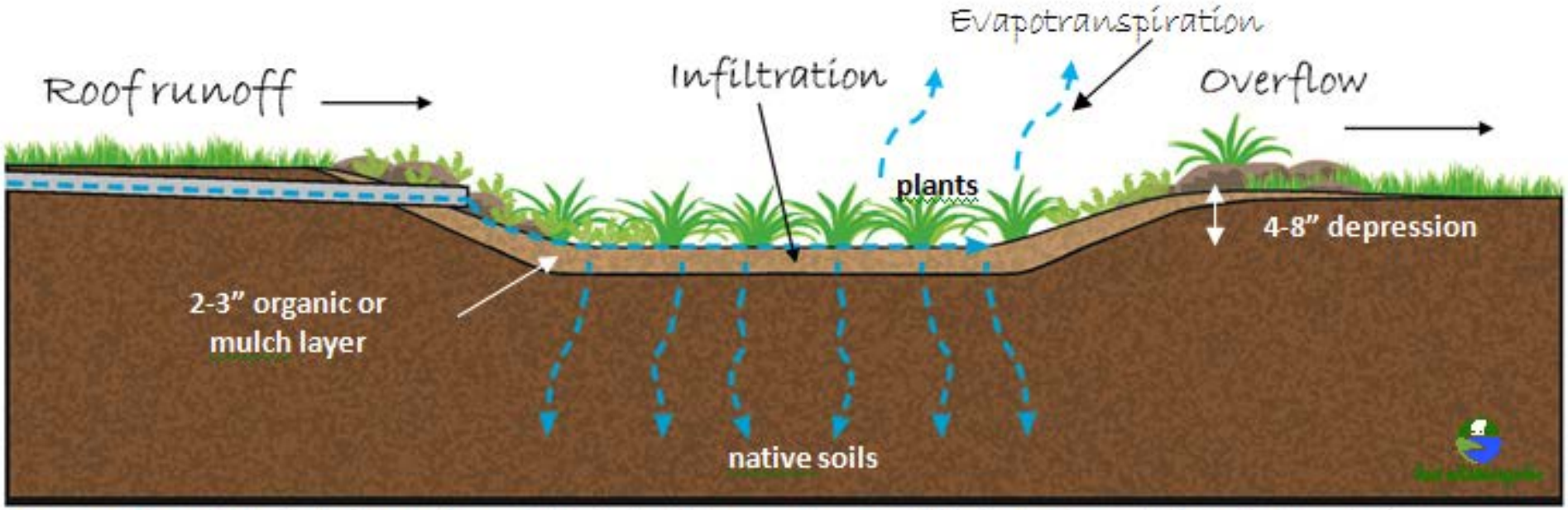
- Basics
- Function
- Examples

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

The Rain Garden Continuum

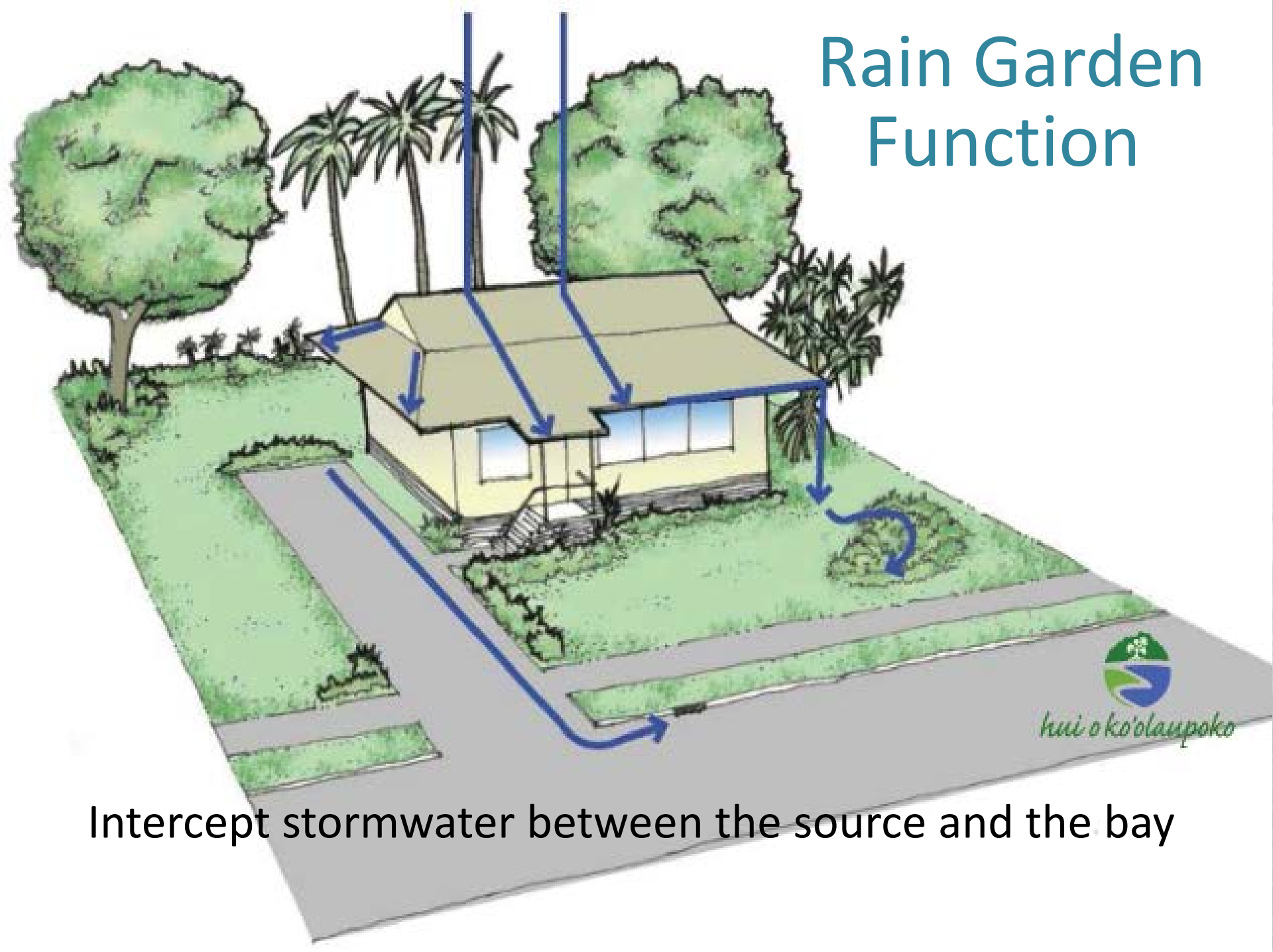
Rain Garden:

- 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

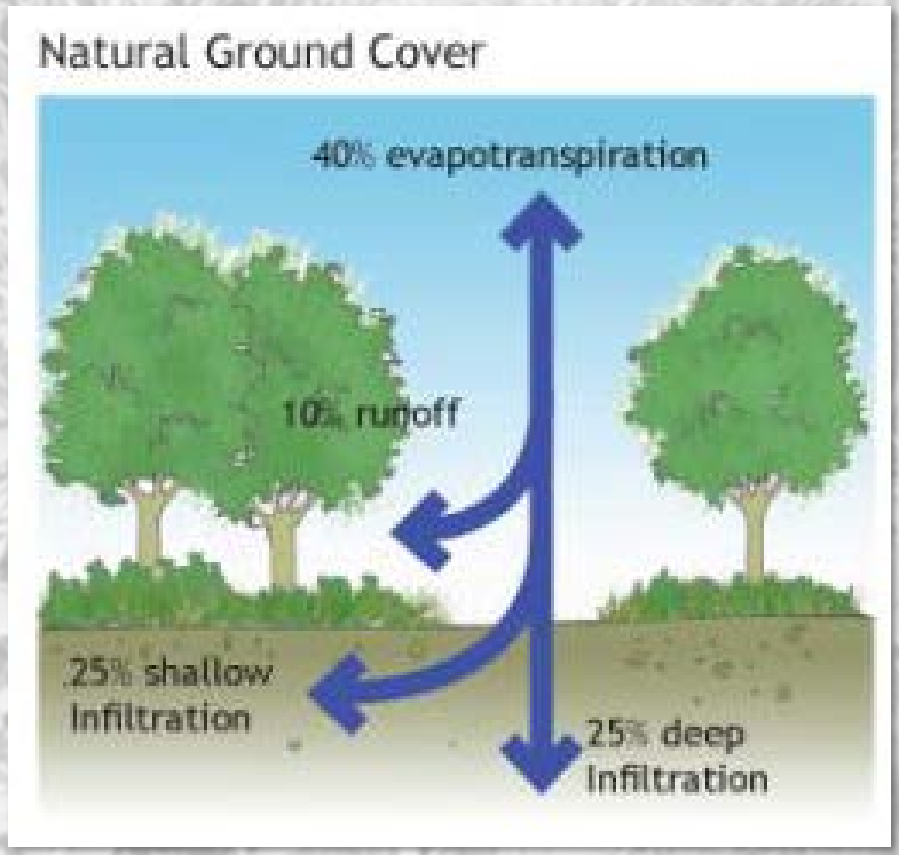
Rain Garden Function

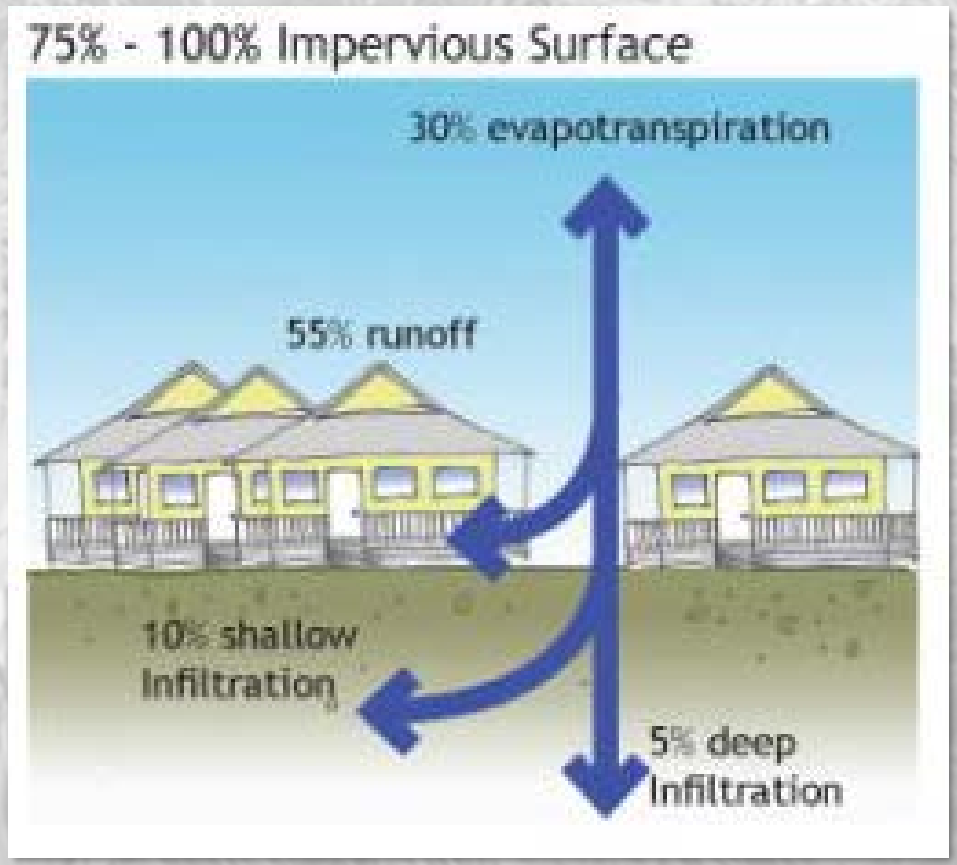


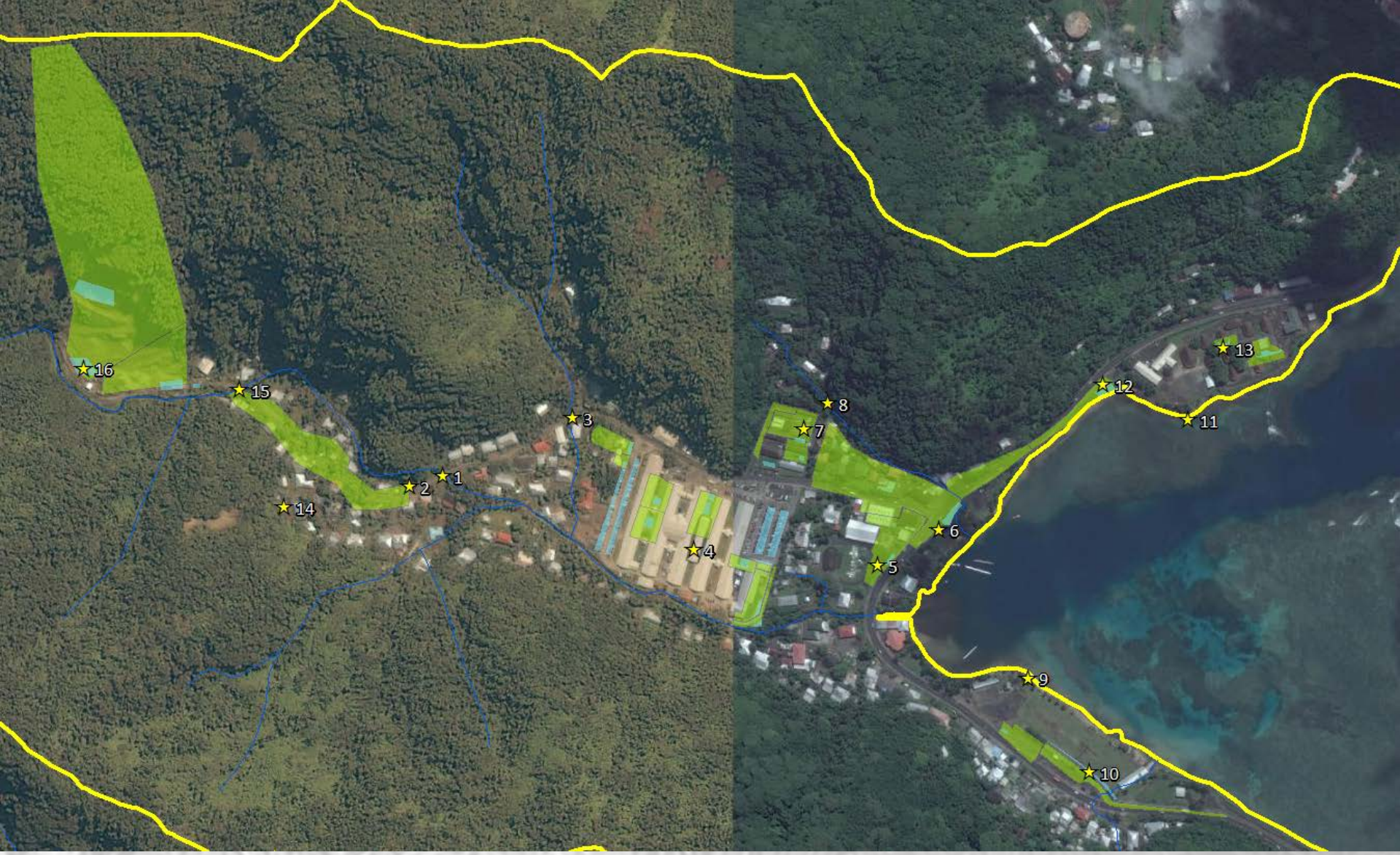
Intercept stormwater between the source and the bay

Why build a Rain Garden?

- Nutrients
- Phosphorus
- Heavy Metals
- Groundwater recharge
- Runoff reduction
- Aesthetics
- Education






16
15
3
1
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6
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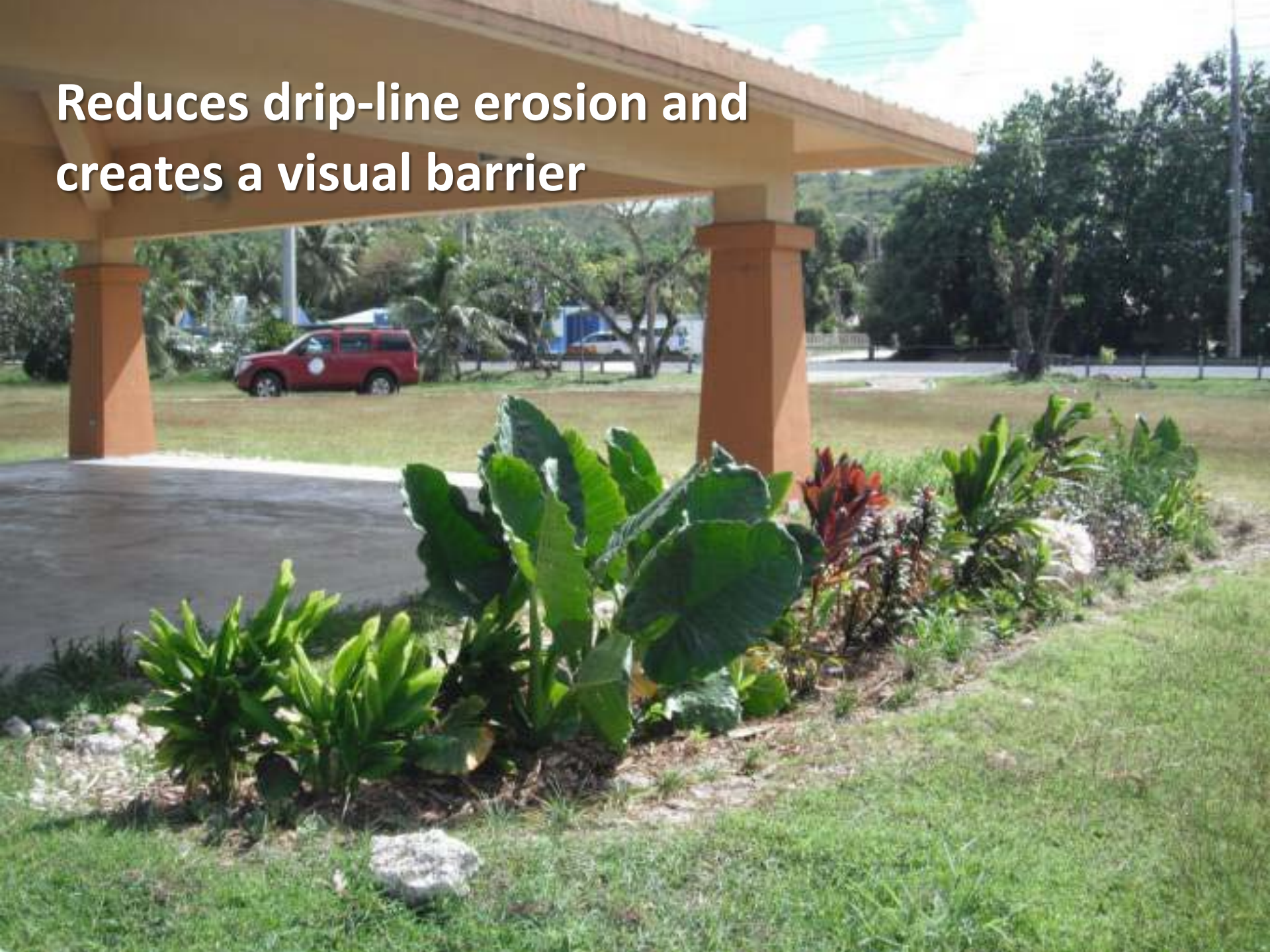
10


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


PLANT
A TREE

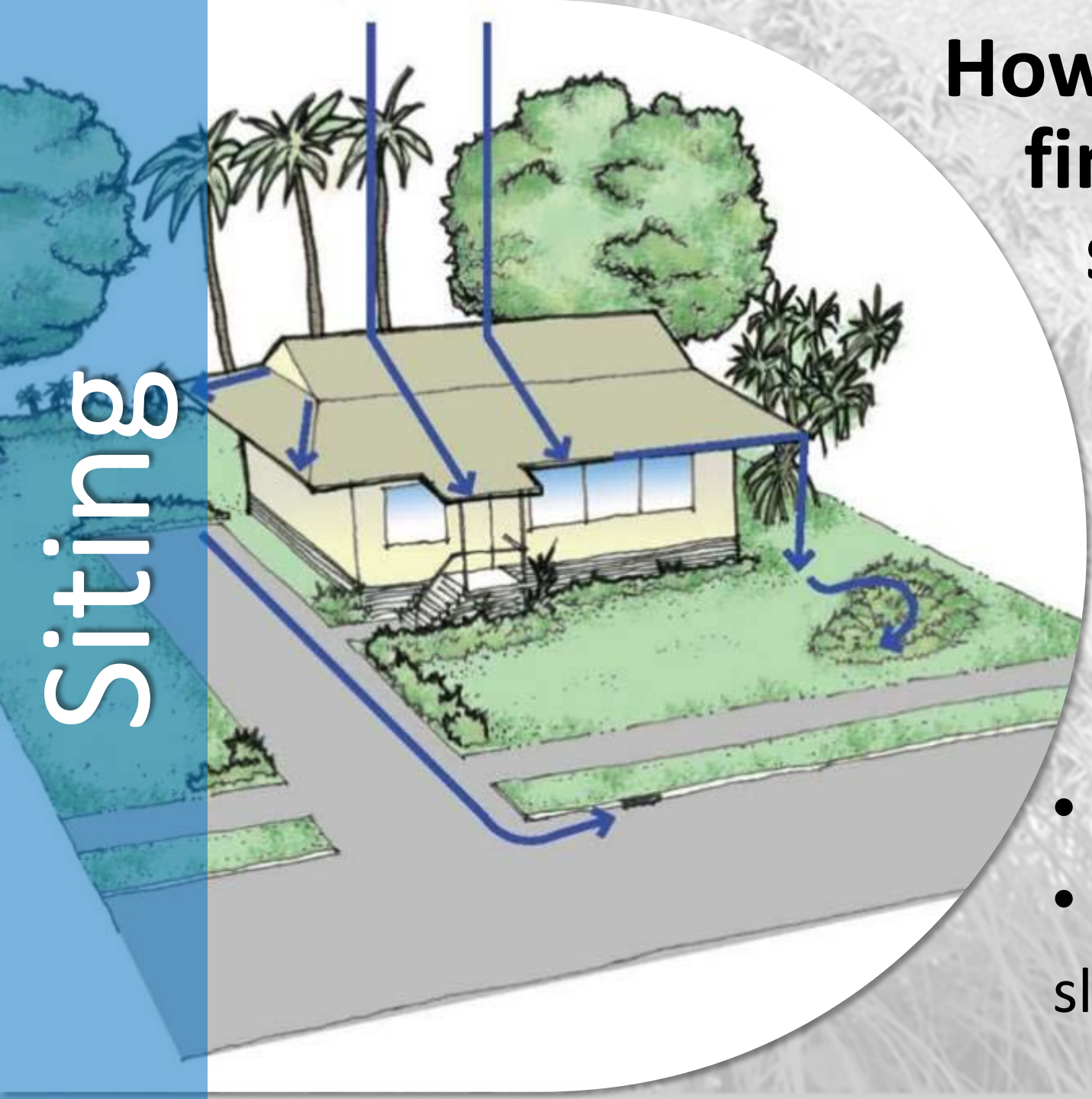

Intercepts direct shower
discharge to ocean


Anyone seen this one?


The road to Vatia…


How about this one?

Siting



How do you find a good spot?

- Walk the site
- Pick a spot
- Estimate DA
- Evaluate slope, & soils

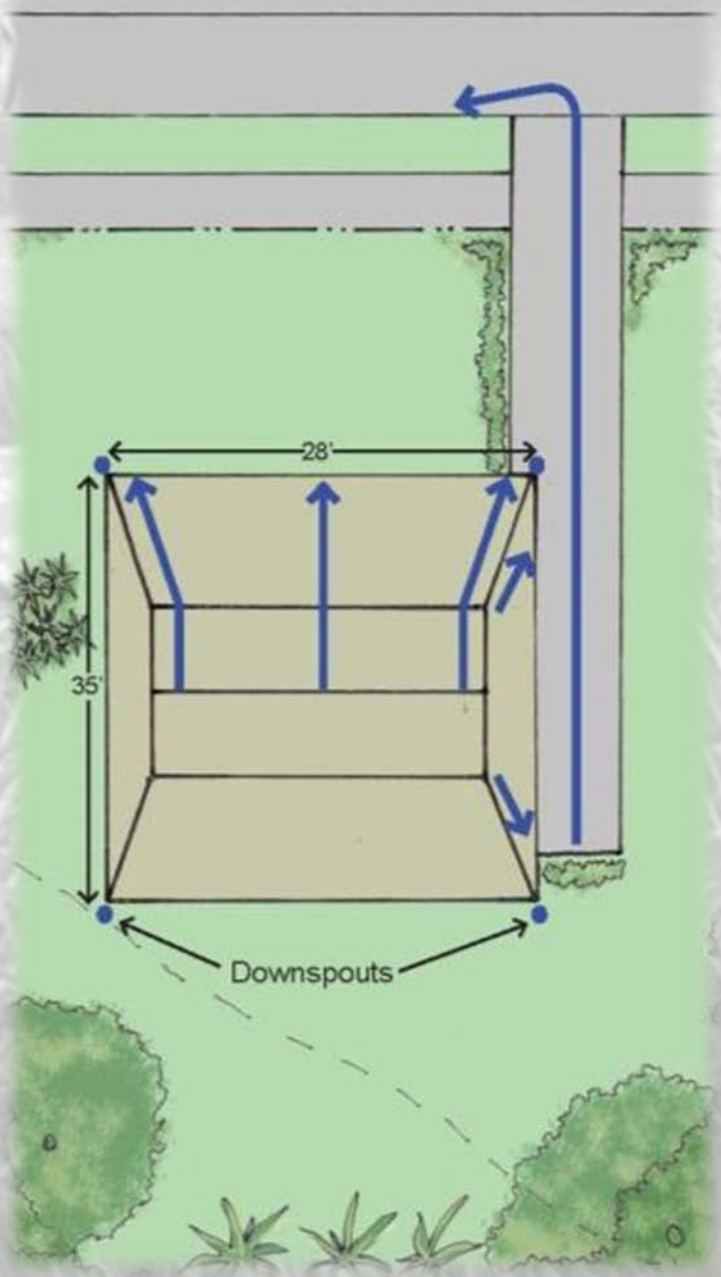
What do you need to know?

1. Drainage Area
2. Soils
3. Slope
4. Conveyance

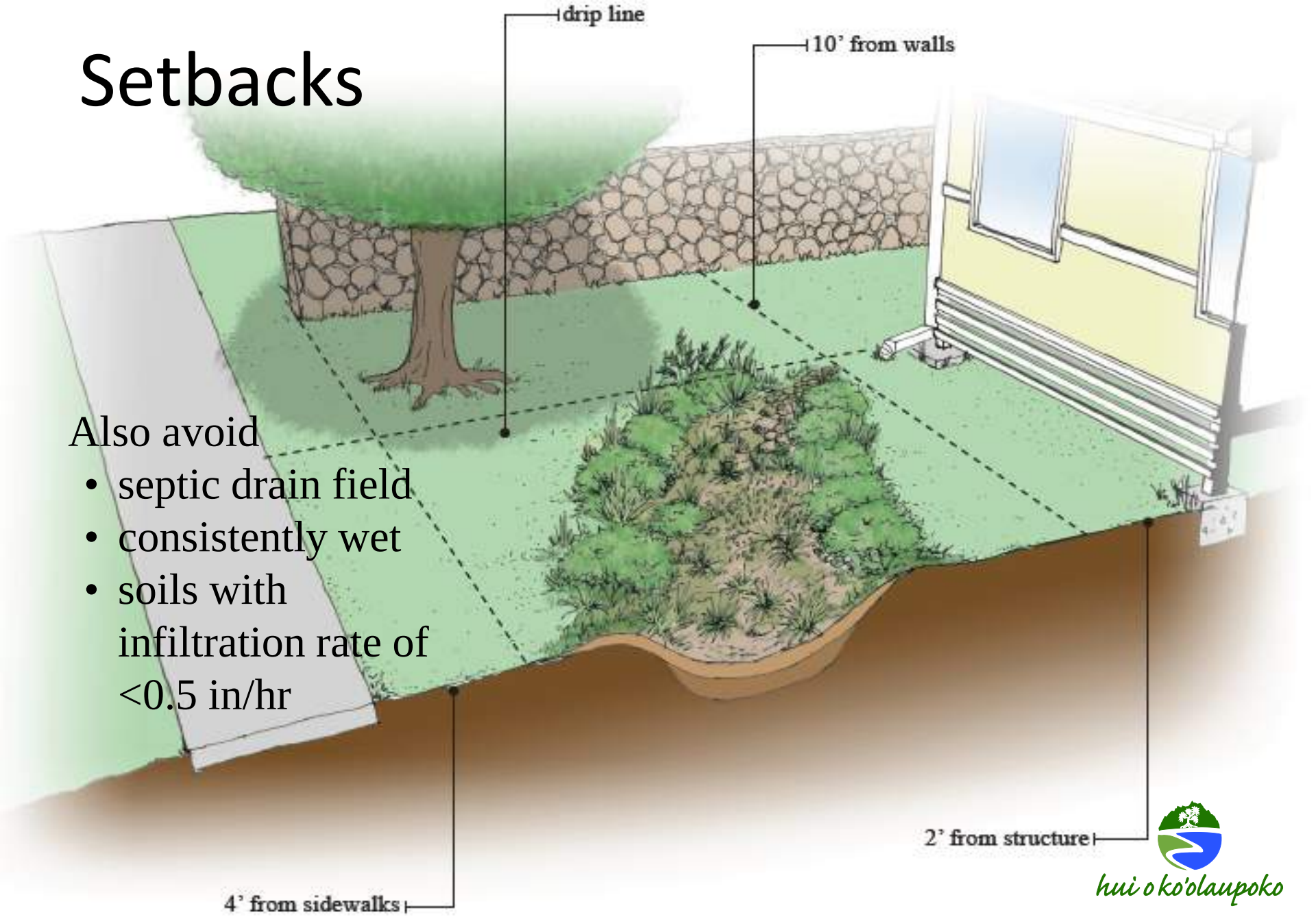
- Drainage pathways
- Rooftop gutters/downspouts (if any)
  - Do they discharge above ground?
  - Are they directly connected to something?
- Existing drainage infrastructure
  - Curb/gutter in parking lot or driveway
  - Catch basins and storm sewers
  - Open swales/ditches
- Topography – flat vs. sloped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

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

hui o ko'olaupoko

Use of area

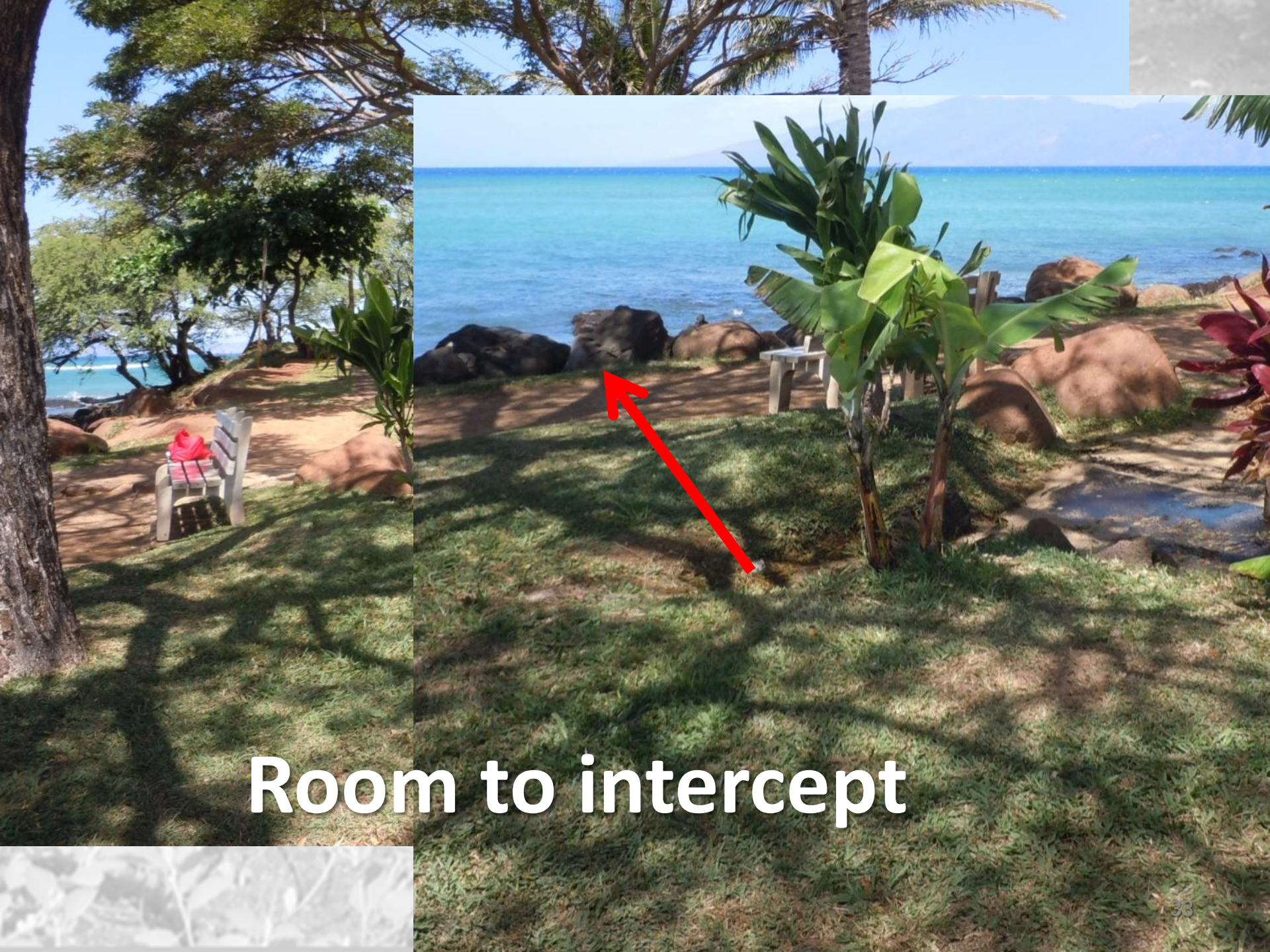

Use of area

Check slope

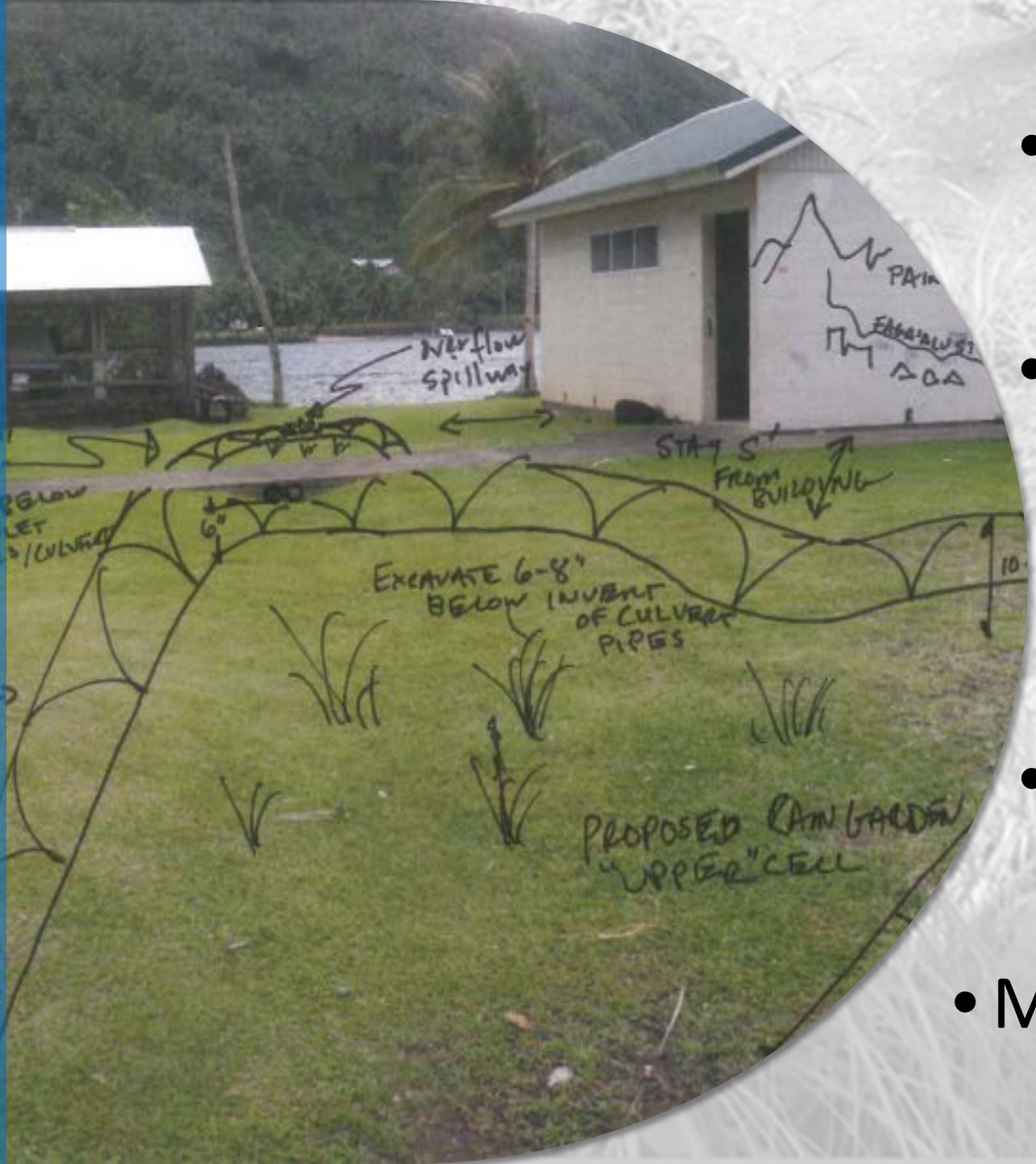
Is this a good spot or not?

Easy curb cut


High spot

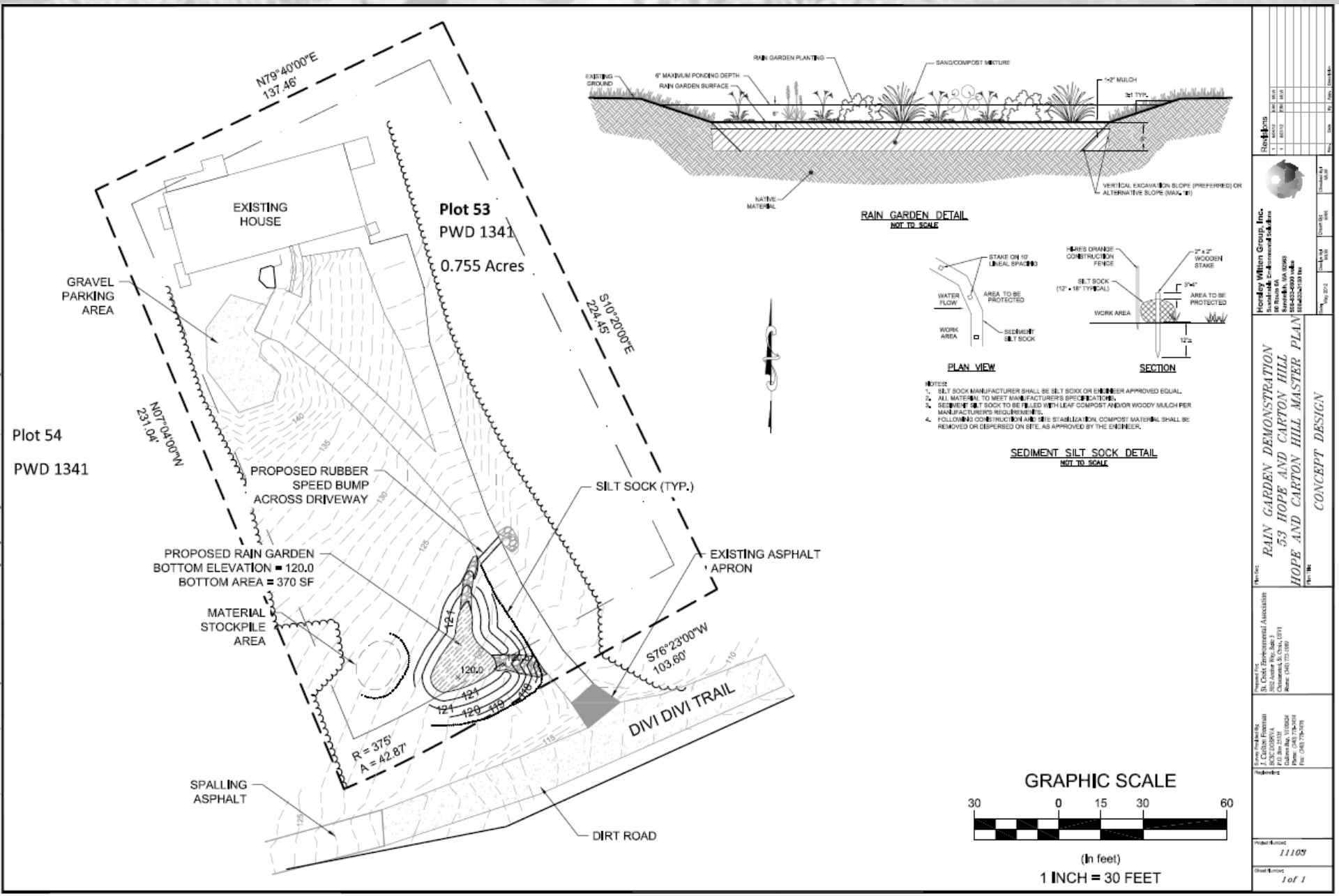

Room to intercept

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 ft^2.


Why 1.6” target?

Table 2. Approximate Rain Garden Size (ft^2) to meet AS rainfall target of 1.6" (0.13 ft)

Impervious Drainage Area	Ponding Depth		
	3" (.25 ft)	6" (.50 ft)	8" (.67 ft)
500 ft^2	260	130	100
750 ft^2	390	195	150
1000 ft^2	520	260	195
1500 ft^2	780	390	290
2000 ft^2	1040	520	390

Simple formula

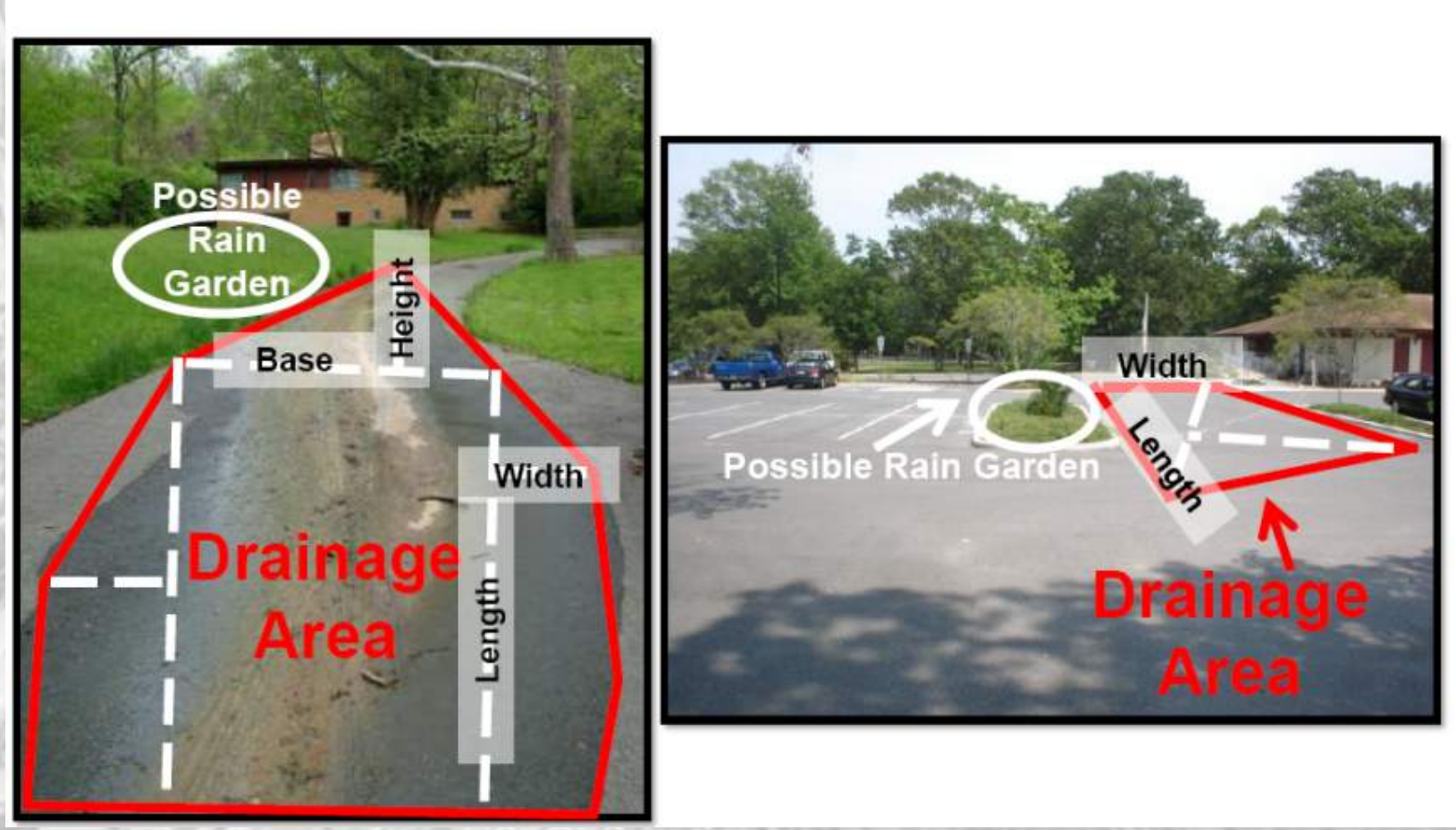
Rain garden surface area (ft^2) =

$$\frac{\text{Impervious DA } (ft^2) \text{ X AS target rainfall depth (ft)}}{\text{Ponding Depth (ft)}}$$


© 2013 Google
Image USGS
Google earth
Imagery Date: 1/1/2008
2001
21°22'49.56" N 157°46'57.24" W elev 338 ft
Eye alt 540 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 3rd filling, record the depth of water and drain time.
- This 3rd 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 = ½ = 0.5 inches/hr

Table 1. Results from Infiltration Tests

Drainage Rate	Recommendation
< ½inch/hour	May want to seek professional assistance; rain garden likely needs perforated drain pipe in or under the soil layer.
½ - 1 inch/hour	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.
1 - 1 ½ inches/hour	Adequate infiltration for a rain garden. Plan for sufficient overflow during high-rainfall storms.
1 ½ - 2 inches/hour	
> 2 inches/hour	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.

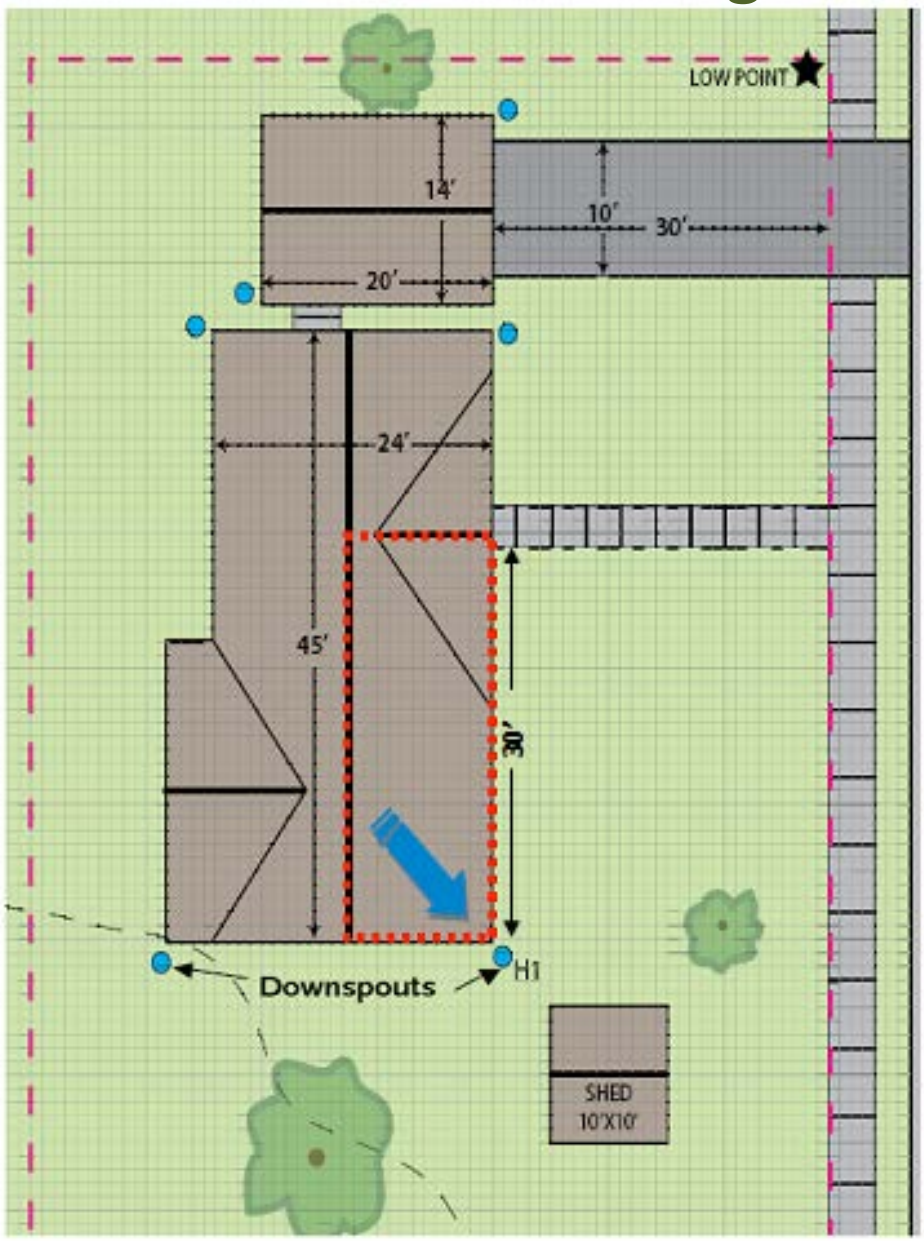
Source: OSU, Sea Grant: The Oregon Rain Garden Guide

Determine Soil Amendments, if necessary

Soil Amendment	Amount for 100 sq ft Rain Garden
Coarse Sand (Bank Run Sand)	1 cubic yard
Compost	1 cubic yard

Size of garden = Impervious DA (ft^2) X rainfall depth (ft)

rain garden depth (ft)



Roof Drainage Area=

12'x30'= 360 ft^2

Rainfall Target=

1.6inches= 0.13 ft

Depth= 6 inches =

0.5 ft

$$\text{RG size} = \frac{360\ ft^2 \times .13\ ft}{0.5\ ft}$$

$$= 94\ ft^2$$


Cell 2 =200 sq ft
Impervious cover =
10,700 sq ft
Cell 1 =500 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) =

$$\frac{10{,}700 \text{ sf impervious} \times 0.13 \text{ ft rainfall target}}{0.5 \text{ ft ponding depth}} = 2782 \text{ sf needed}$$

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

Gloucester County 4-H Fairgrounds

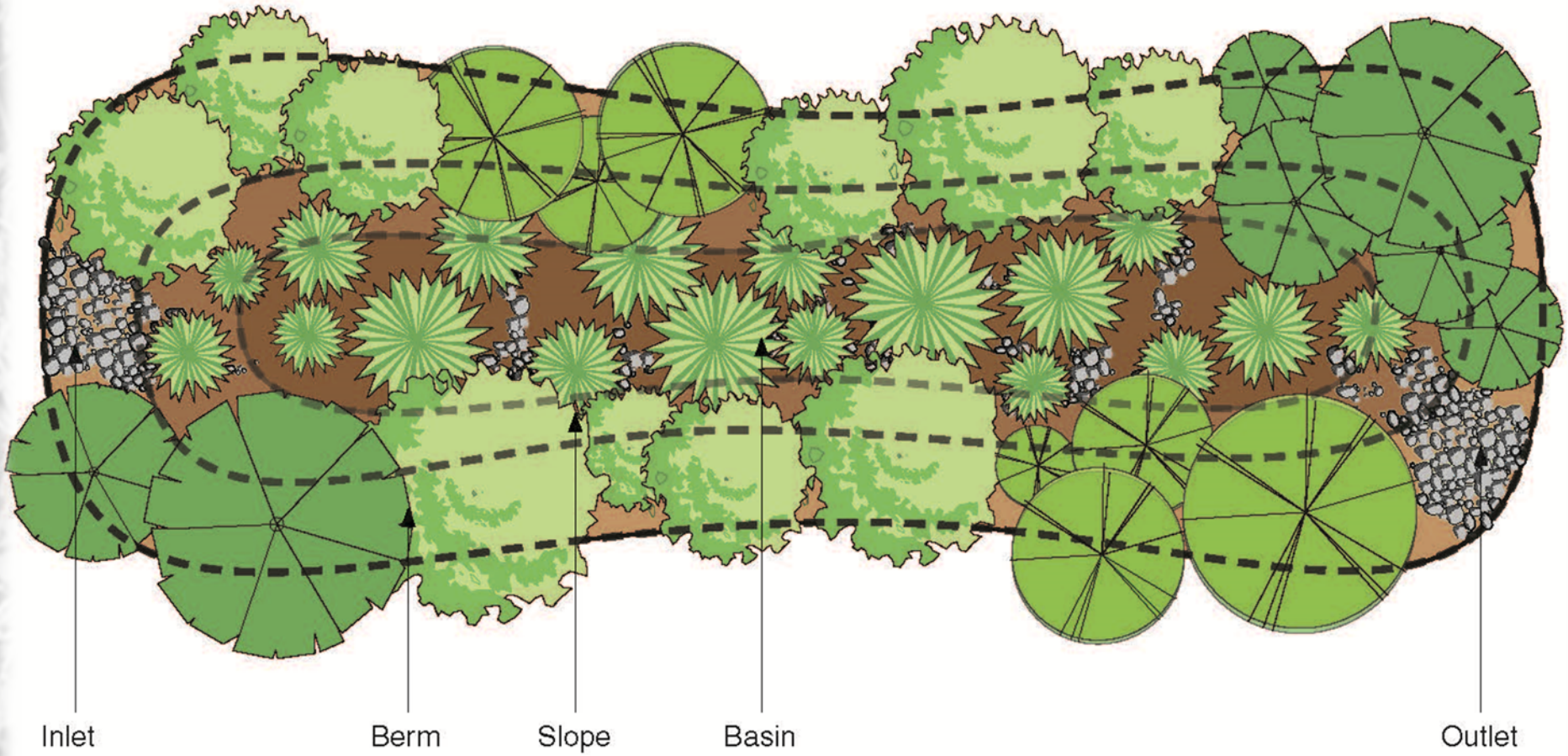
Determine Erosion Potential

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)


Inlet
Berm
Slope
Basin
Outlet

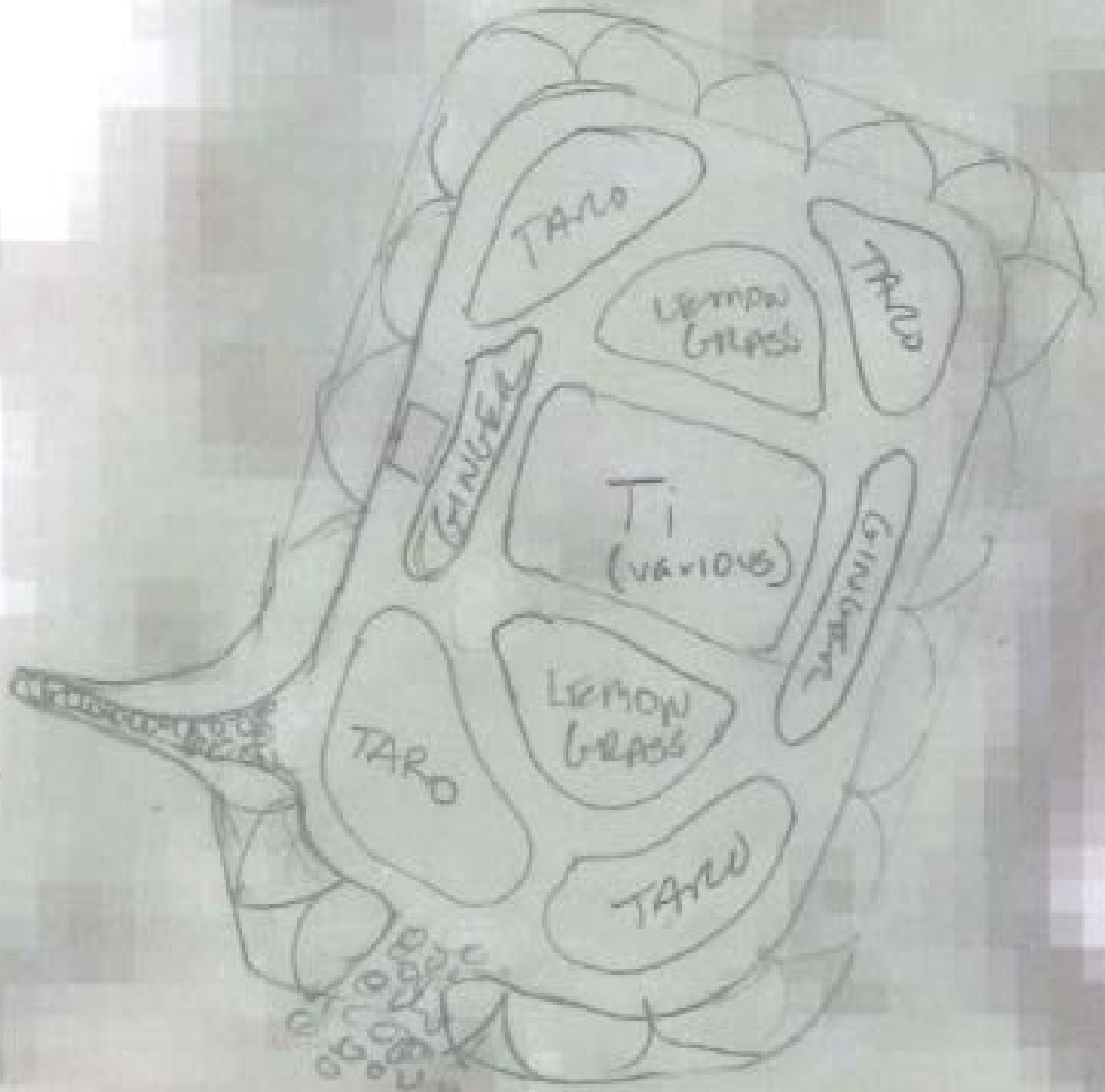
Determine Plant Quantity

Approximate # of Plants Based on Size at Maturity

Size of Rain Garden	Approximate Amount of Plants
100 square feet	1 Small Tree (Optional) 7 Shrubs 24 Herbaceous Species
200 square feet	1 Small Tree (Optional) 14 Shrubs 48 Herbaceous Species

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


TARO
LEMON GRASS
TARO
GINGER
Ti
(VARIOUS)
GINGER
TARO
LEMON GRASS
TARO

SKETCH ADDENDUM

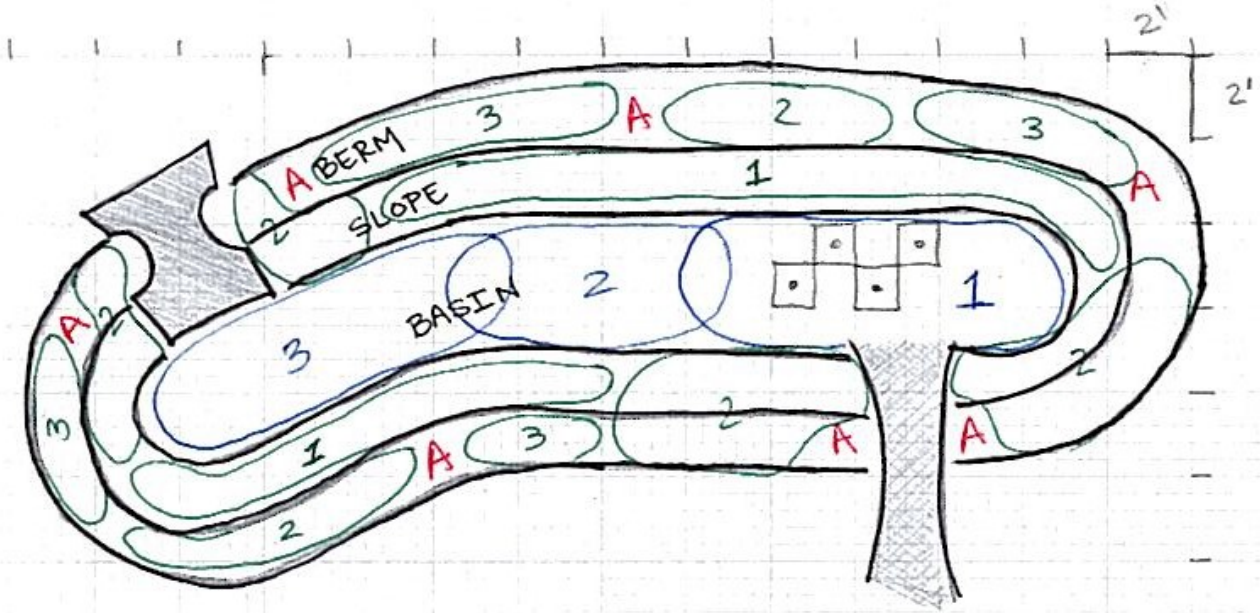
Maui: Wahikuli R.G.

~300 sq ft

~25' x 12'

Substitute plants:

Location in R.G	Plant
A accent	Ohai / Hinahina ewa
(1) basin	'ae'ae
(#) slope/berm	Pa'ohiiaka / ulei / pohinahina

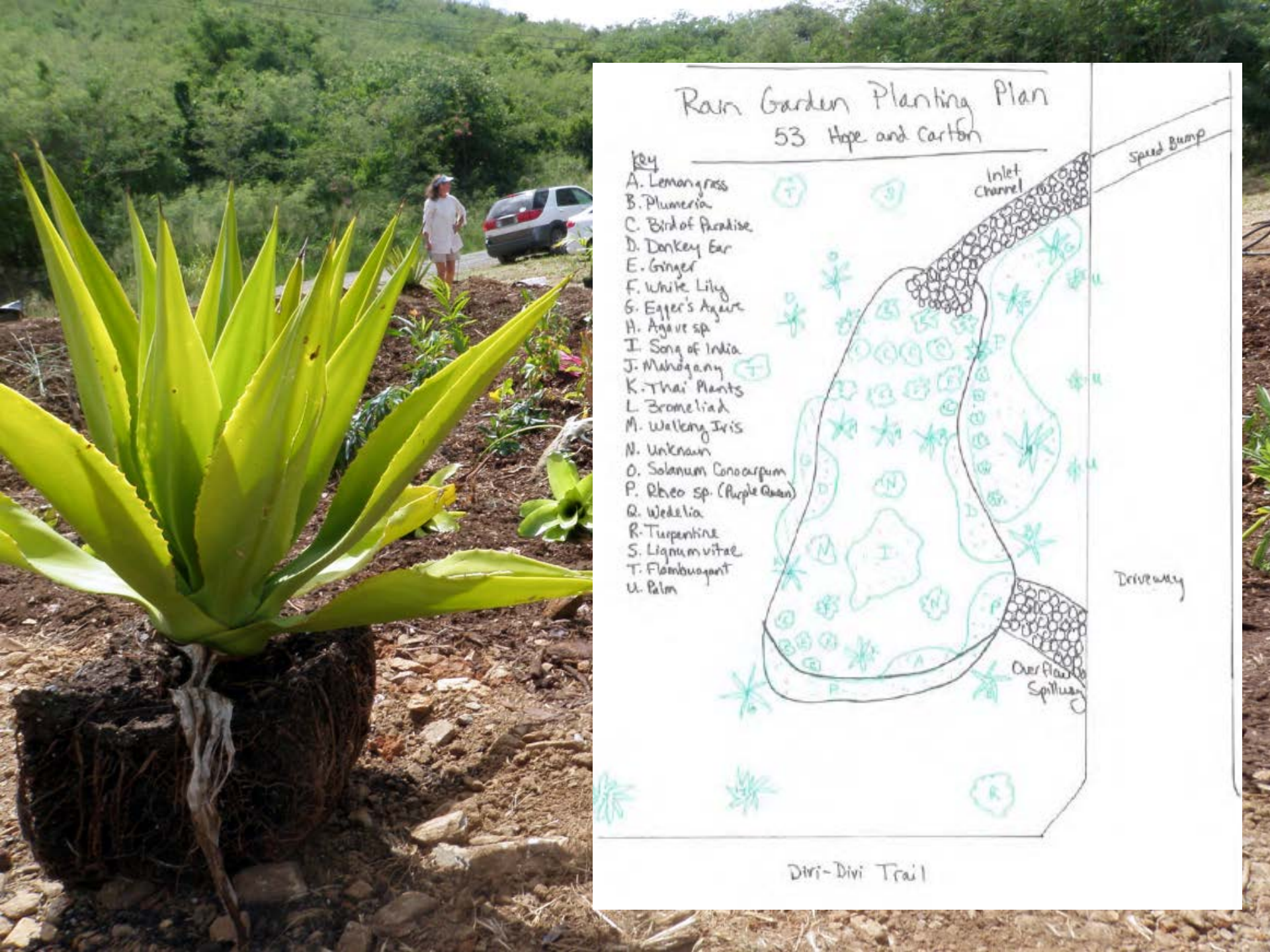


Basin
(1) – at inlet: 'ae'ae/Akulikuli
(2) – mid basin: dwarf naupaka
(3) – end basin: ohelo kai

Slope/Berm
(1) – Pohuehue
(2) – Ilima papa
(3) – Naio

Accent
A – Akia

– Hui o Ko'olaupoko


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. Walking Iris
N. Unknown
O. Solanum Conocarpum
P. Rheo sp. (Purple Queen)
Q. Wedelia
R. Turpentine
S. Lignum vitae
T. Flamboyant
U. Palm
Inlet Channel
Speed Bump
Driveway
Overflow Spillway
Diri-Divi Trail

Planting the Rain Garden

Wet Climate Plants

Hawaiian Name	*Scientific Name*	*Placement*	*Growth*
ʻAeʻae	*Bacopa mannieri*	Inlet	ground cover
Aʻkaʻakai	*Schoenoplectella tabernae-montani*	Basin	tall rush
ʻAlaʻala wai nui	*Plectranthus parviflorus*	Slope/berm	herb
Alaheʻe	*Psydrax odoratum*	Accent	tree
Hapuʻu	*Cibotium sp.*	Basin	tall fern
Ihiʻihilauakea	*Marsillia villosa*	Inlet	ground cover
ʻIliahi	*Santalum freycinetianum*	Accent, Basin	tree
Loulu	*Pritchardia sp.*	Basin	tree
Makaloa	*Cyperus laevigatus*	Basin	tall sedge
Māmake	*Pipturus albidus*	Accent, Basin	tree
Mauʻu ʻakiʻaki	*Fimbristylis cymosa*	Basin	bunching grass
Nehe	*Melanthera integrifola*	Basin	ground cover
Puʻukaʻa	*Cyperus trachysanthos*	Basin	sedge
Uki	*Machaerina angustifolia*	Basin	sedge
ʻUkiʻuki	*Dianella sandwicensis*	Basin	sedge

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

Determine Mulch Quantity

- Triple-shredded mulch with no dye
- 2-3” depth
- Availability? Alternatives? Problems?

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

Size of Rain Garden	Approximate Amount of Mulch
25 square feet	0.25 cubic yard
50 square feet	0.50 cubic yard
100 square feet	1.0 cubic yard
200 square feet	2.0 cubic yards


DEERE

Is stone an alternative?

Construction

- Plan
- Dig
- Inlets & outlets
- Amend Soils
- Mulch & Plants

Planning & Construction Sequence

Construction timeline

Three recommended native plants for rain gardens are, from top, 'Ae'ae, Ilima and 'Akia.

See more in Section 8.

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

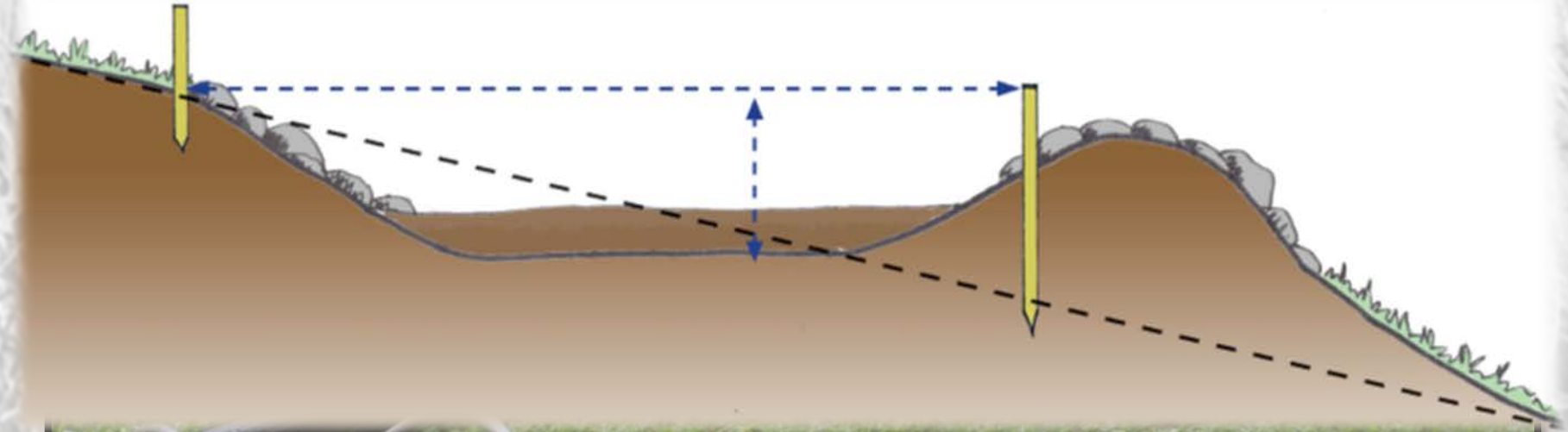
One Week Before Build
- Call utilities before you dig
- Purchase plants
- Purchase mulch
- Purchase compost

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

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

Measuring Slope

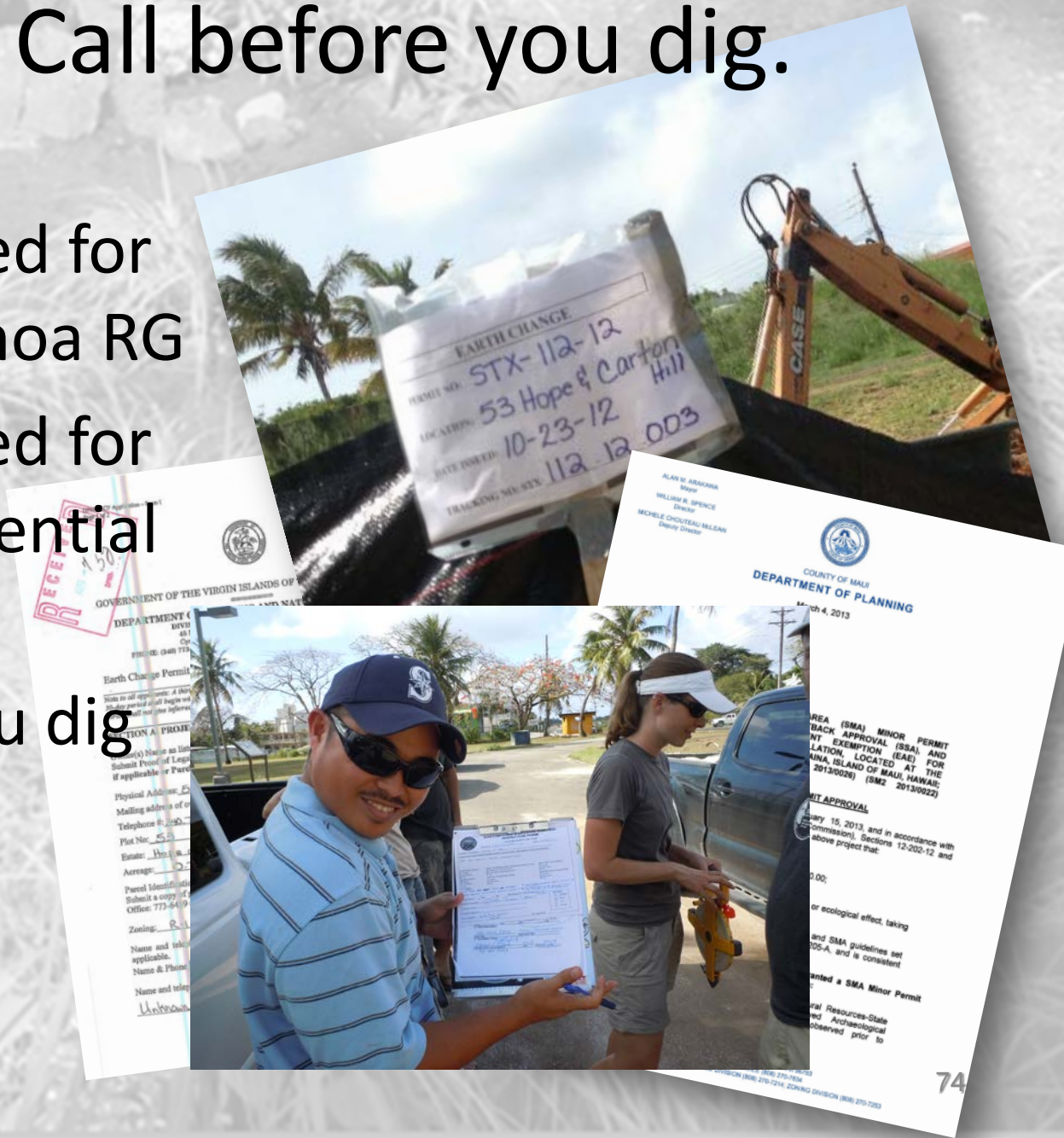
To calculate slope you will need the following tools:




Gift
Shop

Permit, Call before you dig.

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



Compaction

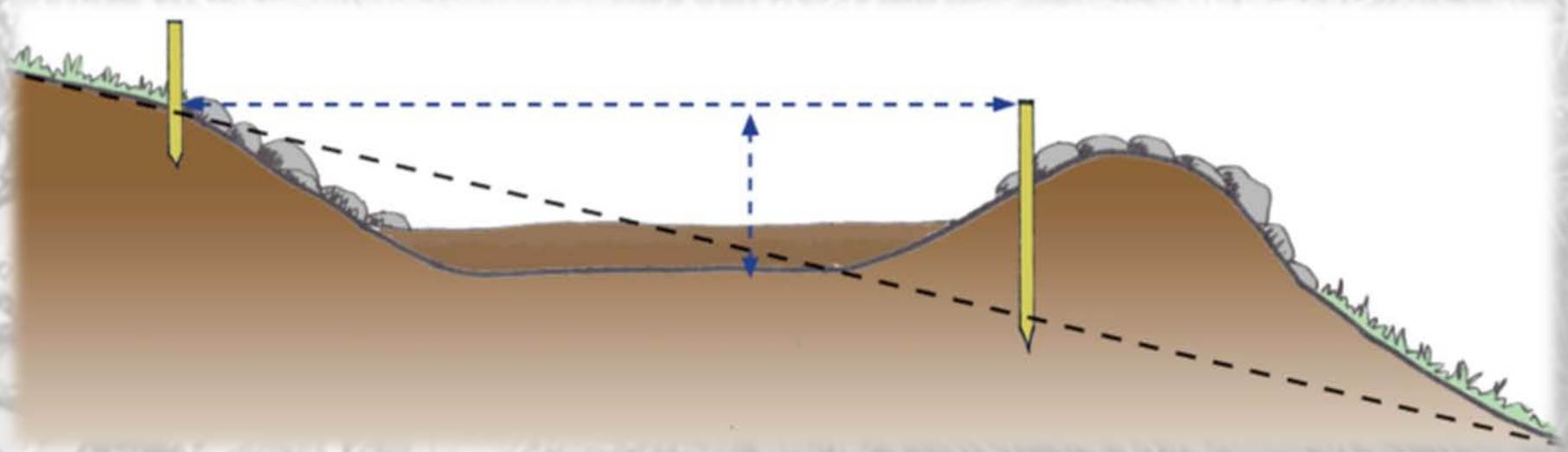
- B
  s
- D
  a

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



ool Rain Garden

Windward Community College

Video of a RG build on Oahu

http://vimeo.com/24896137

Cost

Sample Rain Garden Budget ~ 100 sq. ft.

Item	*Unit*	*Price/unit*	*Total*
Hand excavation			
Compost	cubic yard	$55 - $70	$55 - $70
Mulch	cubic yard	$0 - $35	$0 - $35
Plants	30 - 50	$3 - $5	$90 - $250
Pipe	10 feet	$40	$40
Rock	cubic feet	$4 - $8	$25-$50
Miscellaneous pipe connectors	variable	variable	$25
Miscellaneous tools	variable	variable	$0 - $75
Sub Total			**$235 - $545**
Optional Equipment			
Excavator	day	$175	$175
Excavator operator (4 hr min.)	4 hours	$50	$200
Excavator (delivery/pickup)	roundtrip	$250	$250
Rototiller	day	$60	$60
Optional Sub Total			**$685**
Estimated Total			**$920 - $1230**

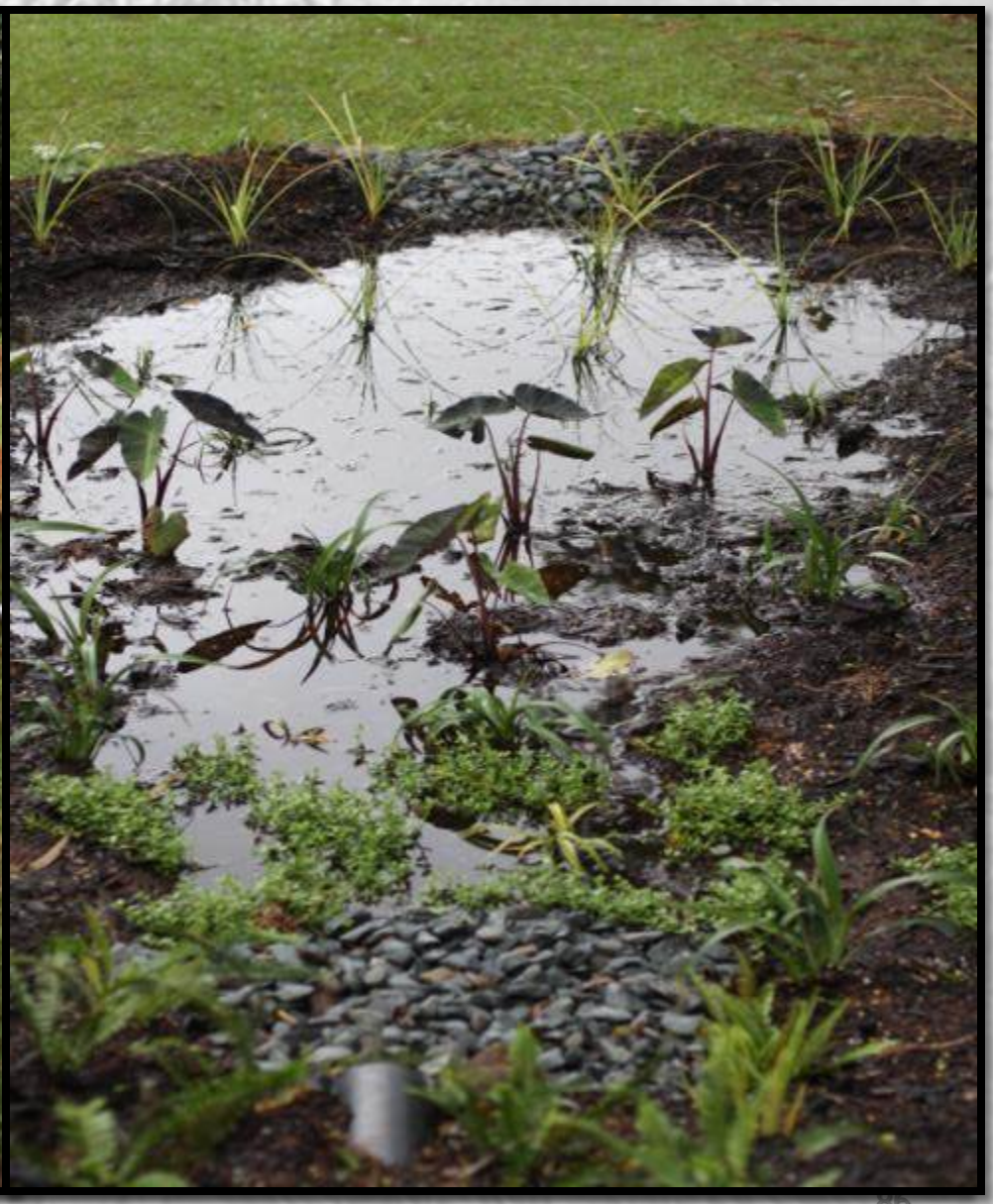
Rain Garden at He'eia State Park

- 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



Maintenance

- 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 Maintenance Activities for a Rain Garden

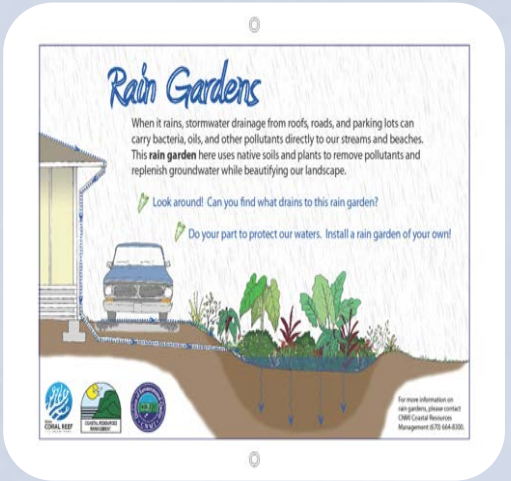
Task	Frequency*
General Site Maintenance	
Keep foot and vehicular traffic out of rain garden; install signage	Immediately after installation
Site Area Cleanup	Immediately after installation, ensure that all trash is picked up and disturbed areas are stabilized with seed or erosion control matting
Trash Removal	Inspect minimum monthly and after major storm events; remove trash as needed
Inlet Locations	
Sediment removal	Inspect minimum once per year and after major storm events; Ensure sediment does not block inlet and cause flow to bypass the rain garden
Stabilize erosion	Inspect minimum once per year and after major storm events; stabilize as needed
Repair/replace inlet materials (e.g., downspout, curb cuts, stone)	Inspect minimum once per year; repair/replace as needed
Plant Maintenance	
Plant Cutting/Thinning	Annually
Weeding	Monthly at first, then at least twice a year (more may be necessary if invasive species are present)
Watering	Immediately after installation; during dry periods the first 1 - 2 years
Plant Replacement	Add reinforcement plantings during the first 6 months to a year to maintain desired vegetation density and aesthetics; then, as needed
Fertilizing	Should not be required
Mulch Maintenance	
Replace or supplement existing mulch	Once every 1-2 years as required to maintain desired depth
Re-mulch bare areas	After major storm events as needed
Filter Bed Maintenance	
Sediment removal	Inspect minimum once per year and after major storm events; remove sediment if buildup of >1 inch is observed. If you frequently observe a lot of sediment in your rain garden, check that the contributing drainage area is stabilized.
Stabilize erosion gullies on side slopes and in the bed itself	Inspect minimum once per year and after major storm events; stabilize as needed
Tilling/soil amendments to improve drainage	If standing water does not drain after 48 hours
Add underdrain	If standing water does not drain after 48 hours after tilling and/or soil amendments have been added
Outlet Locations	
Stabilize erosion	Inspect minimum once per year and after major storm events; stabilize as needed
Adjust height	If standing water is a problem in your rain garden, adjust height of outlet to let more water out.

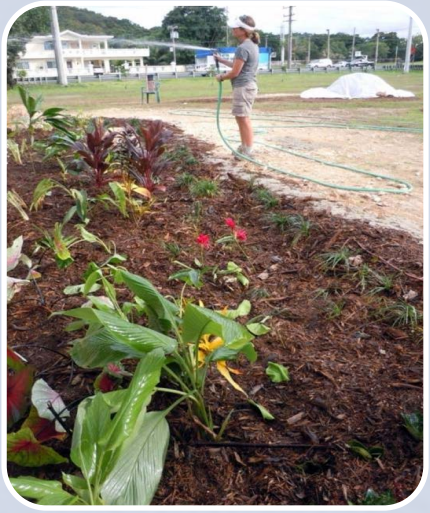
*Adjust frequency as needed, particularly if there are chronic issues or unique features requiring special attention.

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.

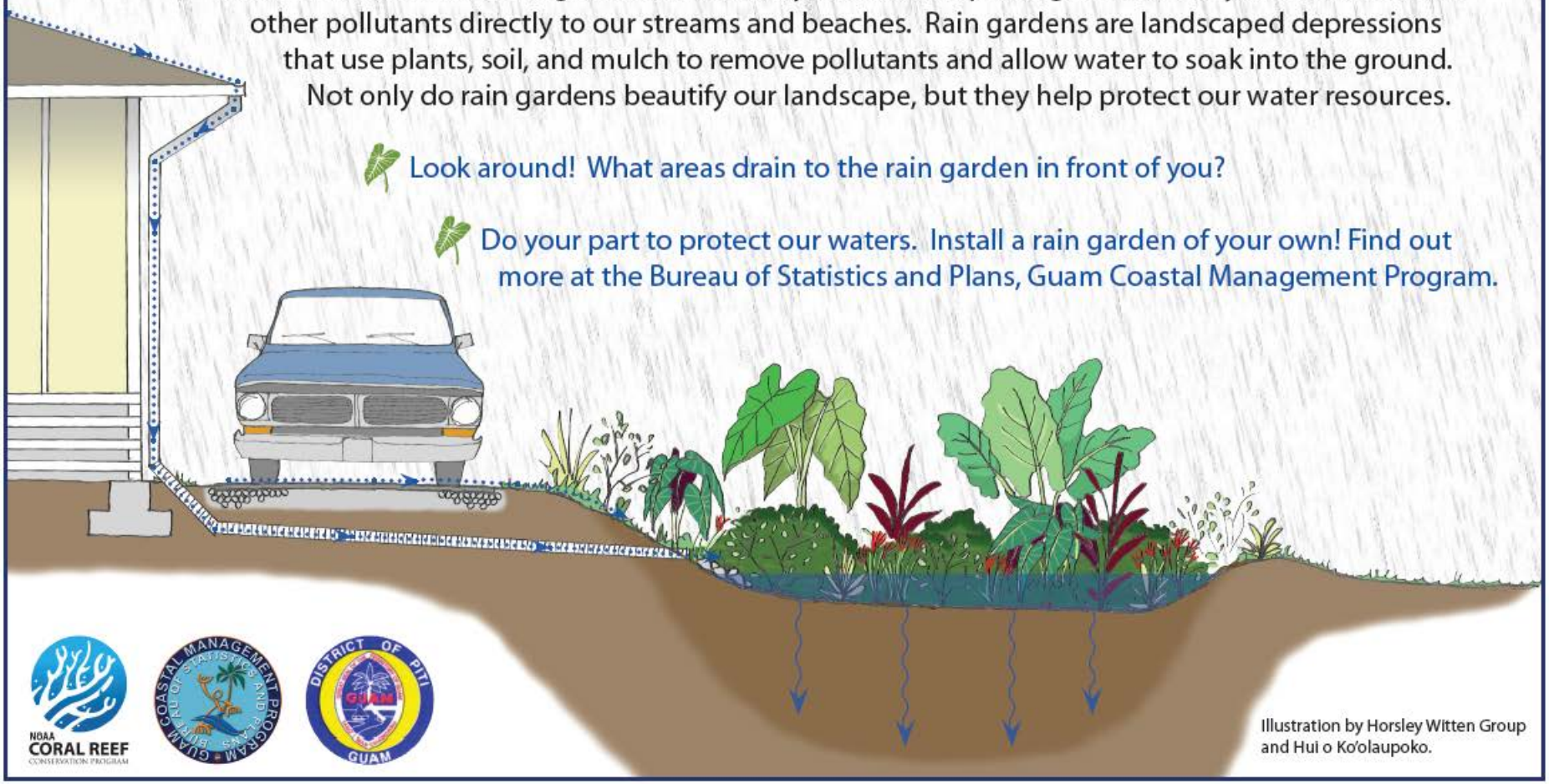
- Signage to help keep people from disturbing the site.
- Plus it helps bring SW awareness.

- 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.



NOAA CORAL REEF CONSERVATION PROGRAM

GUAM COASTAL MANAGEMENT PROGRAM · BUREAU OF STATISTICS AND PLANS

DISTRICT OF PITI · GUAM

Illustration by Horsley Witten Group and Hui o Ko'olaupoko.

During First Two Years

- First 6 months check your RG (at least) after <u>two</u> 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?

RESOURCES


Guam Coastal Management Presents
THE RAIN GARDEN TRAINING WORKSHOP
Landscaping for Clean Water and Healthy Streams.
Instructors are from the Horsley Witten Group and the Center for Watershed Protection. Funding for the rain garden design, materials and installation provided by Guam Coastal Management Program and the NOAA Coral Reef Conservation Program.
MORE
DON'
Hawai'i Residential
Rain Garden Manual
Hui o Ko'olaupoko
USDA NRCS
Date: October 27, 2012
Rain Garden Plants
USDA-NRCS,
St. Croix Environmental Association (SEA) & Horsley Witten Group, Inc.
AT&T
9:28 AM
82%
about
Home
tools
Basics
Basic information about rain gardens.
Design
How to pick a site and size your garden.
Choose Plants
How to select plants for your garden.
Install
How to install, plant and maintain your garden.
My Rain Gardens
How to save information about the rain gardens you have installed.
Plant Catalog
Search
Serviceberry
Amelanchier arborea
Shadbush
Amelanchier canadensis
Allegheny Serv
Amelanchier laevis
Bearberry
Arctostaphylos uva-ursi
Swamp Milkwe
Asclepias incarnata
Butterfly Milkw
Asclepias tuberosa
Astilbe
Astilbe sp.
Bluejoint
Calamagrostis canaden

Tomorrow's Agenda

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

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