

The background of the slide is a dense, close-up photograph of various green leaves, likely from a tropical plant, creating a textured and vibrant green backdrop.

# **Buildings Green Infrastructure**

**Climate Change in the Caribbean Conference:  
Puerto Rico & US Virgin Islands**

Dr. Fernando Abruña, FAIA

Founder and Past President

US Green Building Council, Caribbean Chapter



# USGBC Caribbean



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**USGBC  
Caribbean  
Membership**

**5 in 2004**

**300+**  
**in 2011**

Project Name	City	State	Country	LEED System
<input type="checkbox"/> Y	<input type="checkbox"/> Y	PR Y	<input type="checkbox"/> Y	<input type="checkbox"/> Y
1612 Ponce de Leon	Rio Piedras	PR	US	LEED CS 2.0
609 Central Station Tower	San Juan	PR	US	LEED NC 2.2
7th AVENUE Live Work-Trinity Corporate	Curitiba	PR	BR	LEED-CS v2009
AMS Construction Managers	Caguas	PR	US	LEED-EB:OM v2009
AR 3000 - Cabral Corporate and Offices	Curitiba	PR	BR	LEED-CS v2009
Aicon Mechanics Offices	Mayaguez	PR	US	LEED-CS 2.0
Amgen Manufacturing Limited	Poncos	PR	US	LEED-EB:OM v2009
Bernardo Residence Puerto Rico	Penuelas	PR	US	LEED FOR HOMES (Single Family) 1.0
Beverly Park	Guaynabo	PR	US	LEED for Homes (Single Family) 1.0
CITY CENTRO CIVICO	Curitiba	PR	BR	LEED-CS v2009
Caguas Mechanical Office Bldg.	Gurabo	PR	US	LEED-CS 2.2
Caribe Plaza Office Building	San Juan	PR	US	LEED-CS 2.0
Catuai Cascavel	Cascavel	PR	BR	LEED-CS v2009
Ceiba, PR BRAC AFR Center/OMS/Unh Strg	Roosevelt Roads	PR	US	LEED-CS 2.2
Corozal Early Head Start and Head Start	Corozal	PR	US	LEED-NC v2009
Corporate Jardim Botanico	Curitiba	PR	BR	LEED-CS v2009
EDIFICIO NEO CORPORATE	Curitiba	PR	BR	LEED-CS v2009
EcoHab - G Philippi	San Juan	PR	US	LEED FOR HOMES (Single Family) 1.0
EcoHab - G philippi	San Juan	PR	US	LEED FOR HOMES (Single Family) 1.0
EI BLOK	Esperanza	PR	US	LEED NC 2.2
Enlace Corporation Headquarters	San Juan	PR	US	LEED NC 2.2
Environmental Agencies Building	San Juan	PR	US	LEED-EB:OM v2009
Escuela Dr Hiram Gonzalez	Bayamon	PR	US	LEED FOR SCHOOLS v2009
Ethicon San Lorenzo Offices Building	San Lorenzo	PR	US	LEED-NC v2009
Facilidades Recreativas Ermita	Isabela	PR	US	LEED-NC v2009
Farmacia Sally	Rio Grande	PR	US	LEED NC 2.2
Ft Buchanan Reserve Ctr Addition	Bayamon	PR	US	LEED-NC v2009

+ 83

Registered

Green Buildings

# 9 Certified

Project Name	State	Country	LEED System	Case Study	Owner Organization	Cert Level	
<input type="text"/>	<input type="text"/>	<input type="text" value="PR"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>		
AXON-PR B...abela	PR	US	LEED NC 2.2	<a href="#">Detail</a>	Puerto Rico Industrial Development Compa	Silver	
Ft. Allen PR Center/OMS/Unh Str	Juan Diaz	PR	US	LEED NC 2.2	<a href="#">Detail</a>	Gold	
McNeil Campus I Mfg. Facilities	Las Piedras	PR	US	LEED EB 2.0	<a href="#">Detail</a>	McNeil Healthcare LLC	Certified
Professional Offices Park II	San Juan	PR	US	LEED EB O&M	<a href="#">Detail</a>	Professional Offices Park	Certified
Professional Offices Park V - Tower I	San Juan	PR	US	LEED EB O&M	<a href="#">Detail</a>	Professional Offices Park	Gold
Second Floor Interior Remodeling	Guaynabo	PR	US	LEED CI 2.0	<a href="#">Detail</a>	CLAG, CIYnica las Américas Guaynabo	Silver
Sheraton Puerto Rico Convention Center	San Juan	PR	US	LEED NC 2.2	<a href="#">Detail</a>	Interlink Group of Puerto Rico	Certified
Standard Refrigeration Company Inc.	San Juan	PR	US	LEED NC 2.1	<a href="#">Detail</a>		Platinum
Standard Refrigeration Office Building	San Juan	PR	US	LEED EB O&M	<a href="#">Detail</a>	Standard Properties	Platinum

## Green Buildings

Name	Organization	City	State	Country	Primary Area of Practice	Secondary Area of Practice	Designation
<a href="#">Devora Abreu</a>		Guaynabo	PR	PUERTO RICO	Electrical Engineering		• LEED AP
<a href="#">Janice Adomo</a>	<a href="#">Caribbean Project Management</a>	Guaynabo	PR	PUERTO RICO	Construction Management	Consulting	
<a href="#">Edgar Albandoz</a>		Cabo Rojo	PR	PUERTO RICO	Architecture		• LEED AP • LEED AP BD+C (expires 1/29/2012)
<a href="#">Ernesto A Almeyda</a>		San Juan	PR	PUERTO RICO	Electrical Engineering		• LEED Green Associate (expires 3/4/2012)
<a href="#">Pedro L Anqueira</a>		San Juan	PR	PUERTO RICO	Architecture		• LEED Green Associate (expires 4/18/2013)
<a href="#">Patricia Dolores Aybar-Imbert Rivera</a>		San Juan	PR	PUERTO RICO	Architecture		• LEED Green Associate (expires 12/11/2011)
<a href="#">Carlos I Baez-Dotel</a>	<a href="#">Integra Group</a>	San Juan	PR	PUERTO RICO	Structural Engineering		
<a href="#">Jose R Bernabe</a>	JRb Engineering Consulting	San Juan	PR	PUERTO RICO	Mechanical Engineering	Plumbing Engineering	• LEED Green Associate (expires 6/9/2013)
<a href="#">Jose A Bird-Hernandez</a>	<a href="#">V Architecture</a>	San Juan	PR	PUERTO RICO	Architecture	Specialty Writer	• LEED Green Associate (expires 3/1/2012)
<a href="#">Fernando R Bonnin</a>	<a href="#">Bonnin Orozco Arquitectos csp</a>	Ponce	PR	PUERTO RICO	Architecture	Consulting	• LEED Green Associate (expires 10/28/2012)
<a href="#">Javier Bonnin</a>	Bonnin Orozco Arquitectos	Ponce	PR	PUERTO RICO	Architecture		• LEED AP
<a href="#">Carlos M Bou Santiago</a>		Corozal	PR	PUERTO RICO	Project Management		• LEED Green Associate (expires 1/17/2012)

+

800

LEED AP's  
& Associates

Start Over Reset Search

# ENERGY STAR Labeled Buildings & Plants

Showing ENERGY STAR Labeled Facilities in Puerto Rico

Show as a Map  
Up to 500 Facilities

Show as List

1-10 of 10 Facilities. Labeled Buildings represent 36,007 square feet.



# Labeled Buildings



# Green

Sistema Integrado de Permisos

- Inicio
- Servicios
- Regulación Profesional
- Mi Cuenta
- Búsqueda

[Servicios](#) » [Permisos](#) » [Proyectos Verdes](#)

## Proyectos Verdes

Solicitudes de Permisos Verdes es el área en donde el ciudadano puede realizar los trámites vinculados a permisos relacionados con el medioambiente.

### Pre-Cualificación de Proyecto Verde

Radicación de pre-cualificación de proyecto verde.

[> Acceder](#)

### Permiso de Construcción

Escrito oficial que autoriza el inicio de las obras de edificación.

[> Acceder](#)

### Autorización de Ocupación de Proyecto Verde

Autorización de Ocupación de Proyecto Verde

[> Acceder](#)

### Permiso de Uso

Autorización escrita expedida por la GPe, que concede una dispensa a nuevas actividades a ser establecidas.

# Construction

# Permit

**Wind**

**PR**



**Energy  
Alliance**



Sustainable

**Sites**

**Water**

Efficiency

**Energy &**

Atmosphere

**Materials**

& Resources

**Indoor**

Environmental Quality

# Carbon Neutral

**Zero**  
Energy Home





# Eco-School

Escuela Elemental José de Diego  
AEP-8816  
Dorado  
1ro de agosto de 2011



# Eco-School



**Eco Hab: Affordable Green Homes, San Juan**



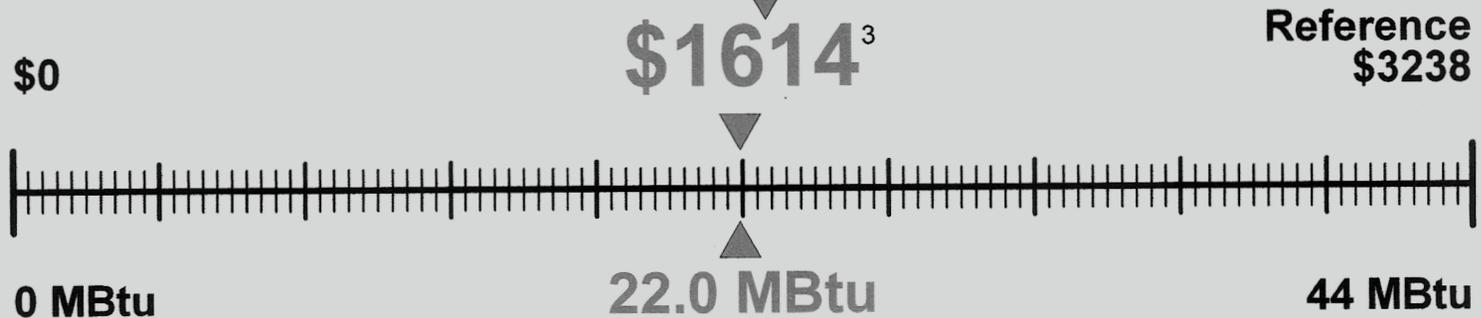
**Eco Hab: Affordable Green Homes, San Juan**

**Projected Rating Based on Plans  
Field Confirmation Required**

Verde Homes  
Gonzalo Philippi 771  
San Juan, PR 00923-

Design: SAN\_JUAN\_L\_M\_MARIN\_INTL\_AP, PR  
Title: Puerto Rico Eco Hab Rectangular (MS) SAN\_JUAN\_L\_M\_MARIN\_INTL\_AP, PR

# BUILDING ENERGY RATING GUIDE



▼ Proposed Home

Savings = \$1624

Cost Basis:  
Puerto Rico  
Florida Average  
Statewide Prices

Electric Rate: \$0.250 /kWh  
Gas Rate: \$2.119 /Therm  
Oil: \$1.10/gal LP Gas: \$4.80/gal

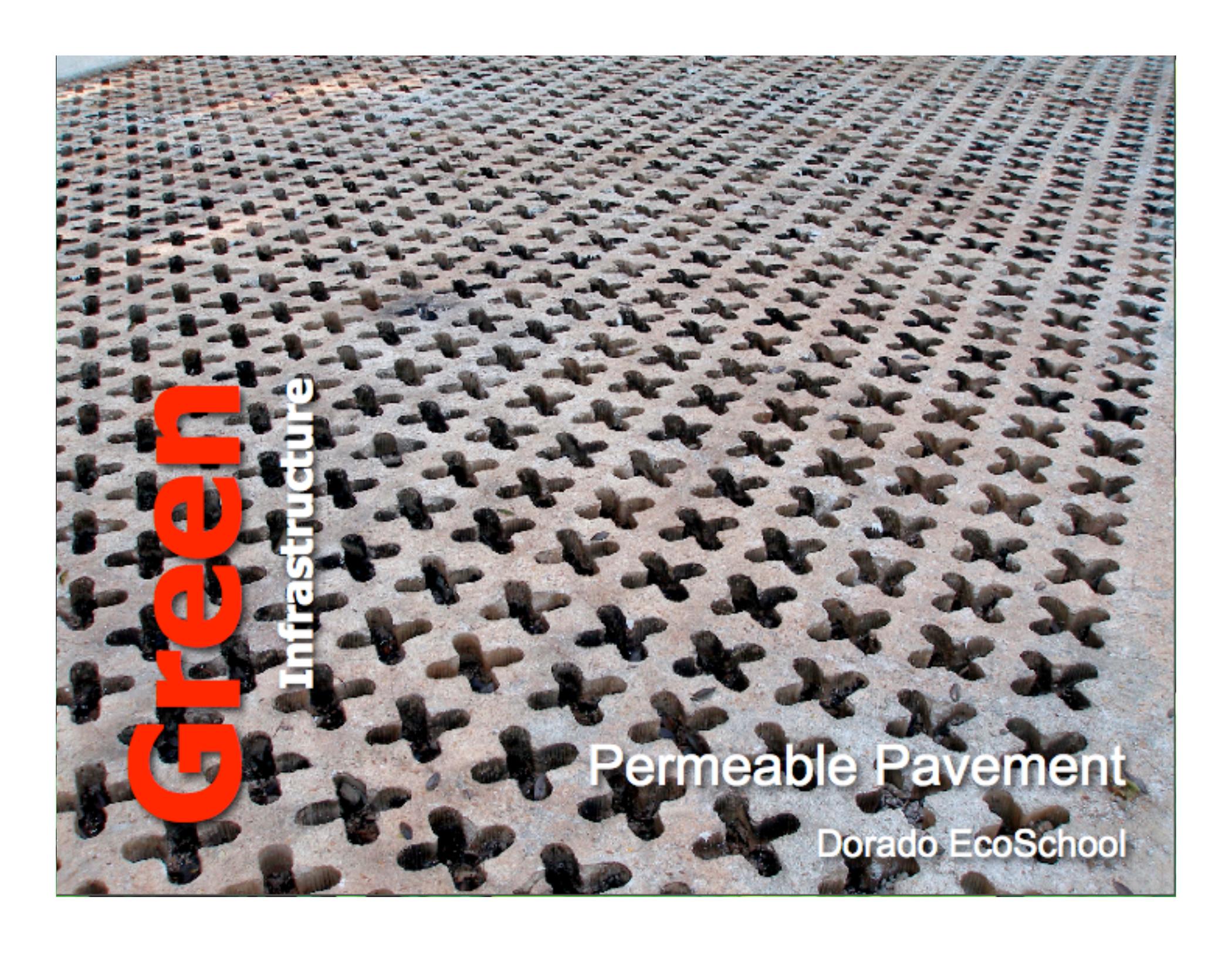
**This Home may Qualify for EPA's Energy Star Label <sup>1</sup>**  
**This Home Qualifies for an Energy Efficient Mortgage (EEM)**

# Eco Hab: Affordable Green Homes, San Juan



**Green**

**Infrastructure**



**Green**

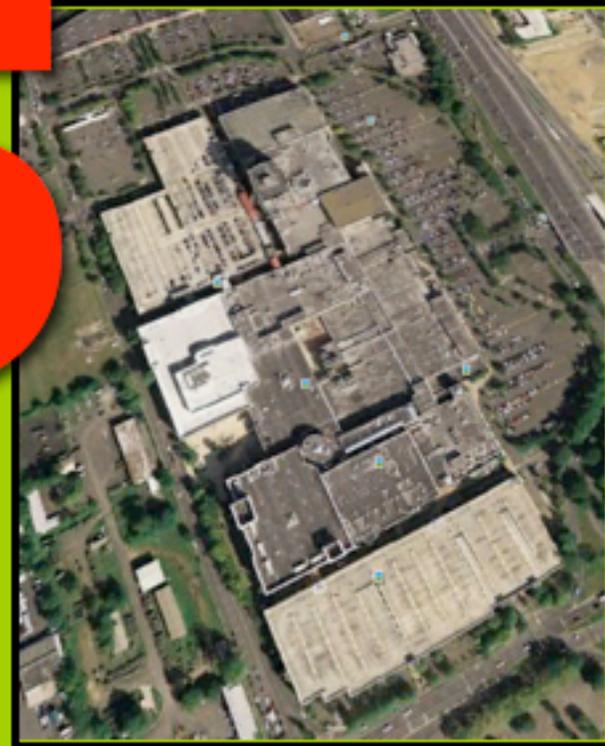
Infrastructure

Permeable Pavement

Dorado EcoSchool

**165**

**Million  
Gallons/year**



**Sustainability Plan for  
Plaza Las Américas**

2008

Abruña & Musgrave, Architects

# Green

## Infrastructure



Green Roof, Ballajá Cultural Center  
San Juan

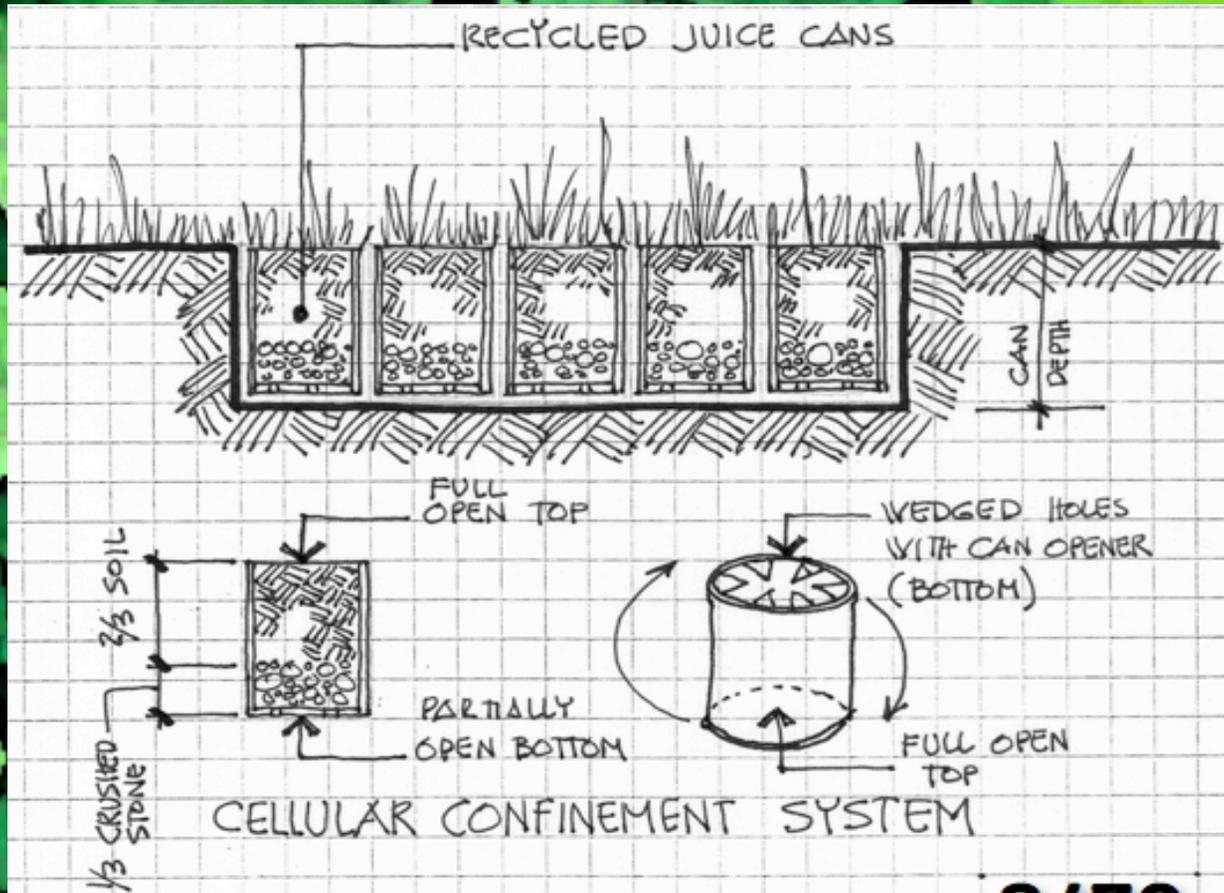


Residential Green Roof

# Simple Things You Can Do

# Green

## Infrastructure



**8/30**

### PERMEABLE NATURAL PAVEMENT

### NOTES

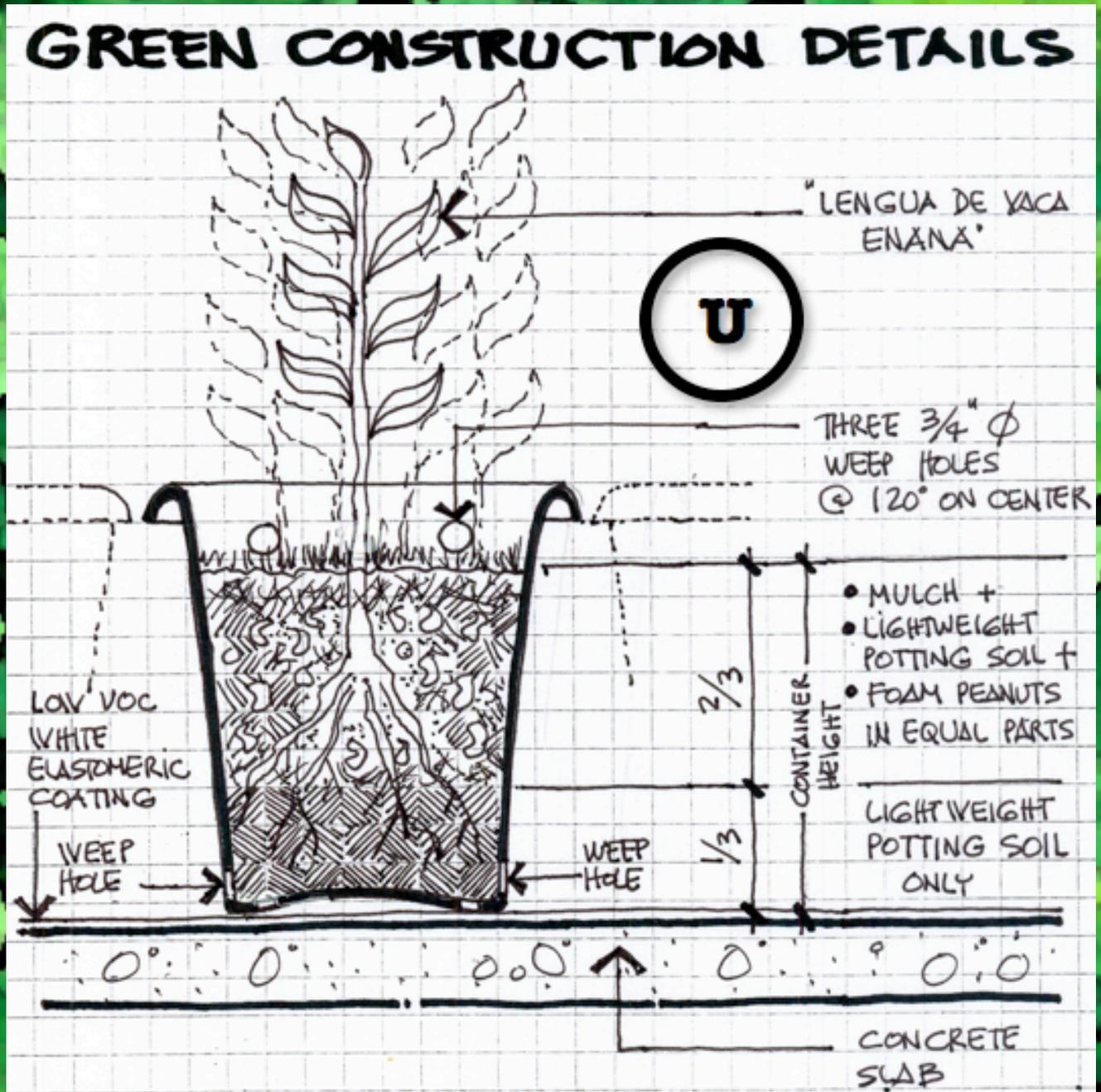
- RECYCLED JUICE CANS ACT AS STRUCTURAL SUBSTRATE FOR TEMPORARY PARKING AREAS
- DEEPER CANS ARE PREFERRED
- NATURAL OXIDATION BRING CANS BACK TO THE SOIL

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Simple Things  
You Can Do

# Green

Infrastructure

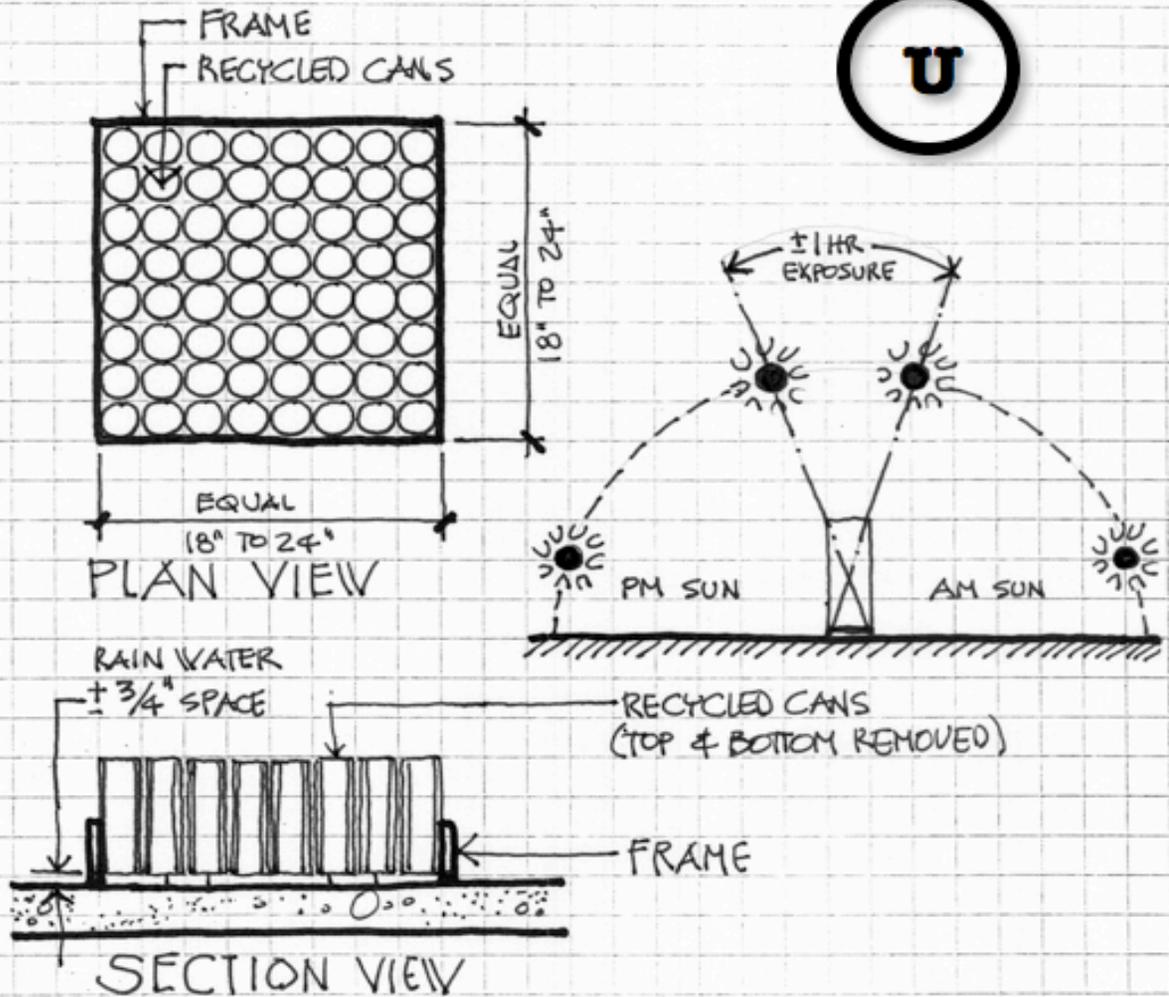


Simple Things  
You Can Do

Green

Infrastructure

# GREEN CONSTRUCTION DETAILS



SHADOW COLLECTOR DETAIL

14/30

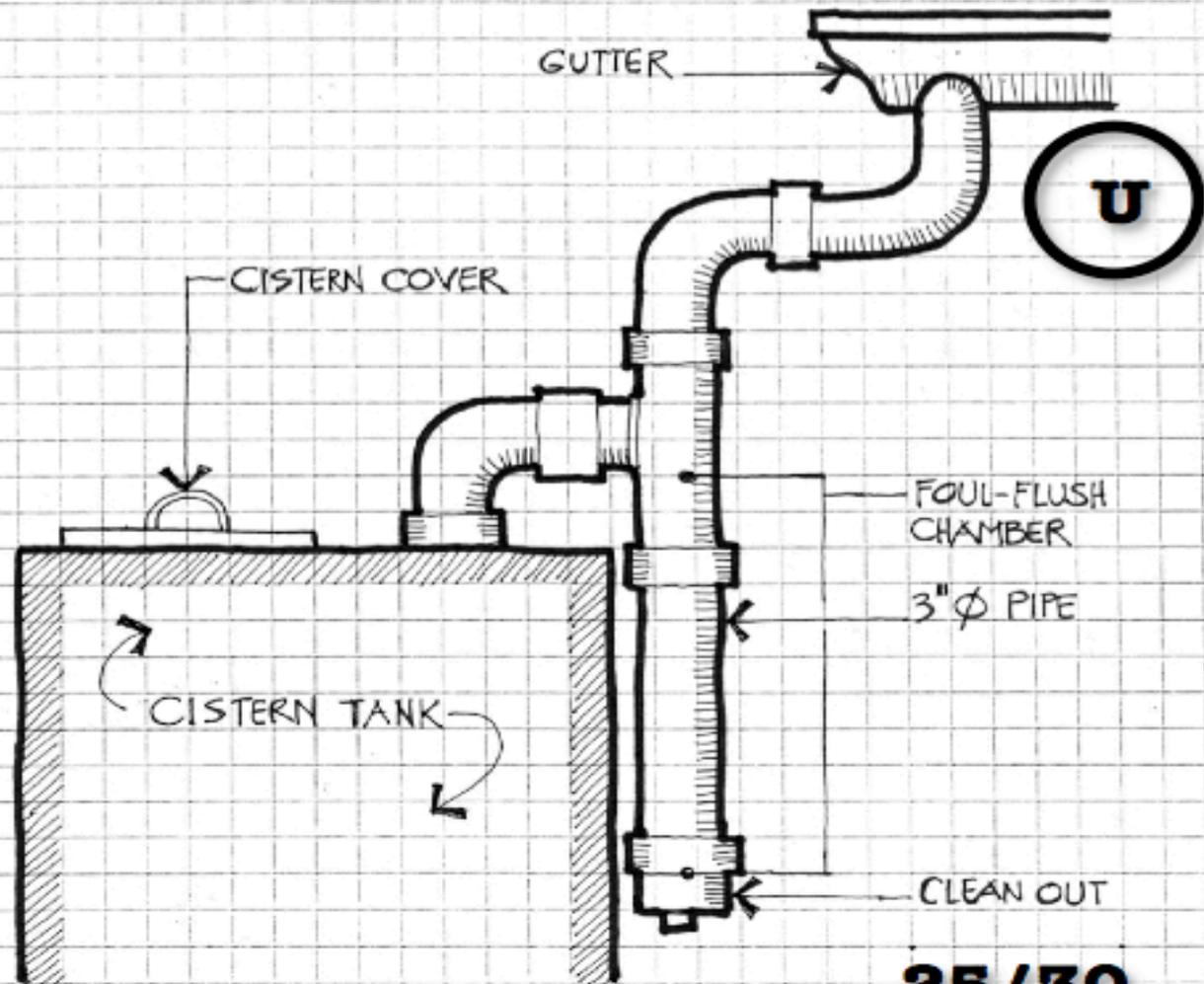
NOTES

Simple Things  
You Can Do

Green

Infrastructure

## GREEN CONSTRUCTION DETAILS



RAINWATER FOUL-FLUSH DEVICE:

25/30

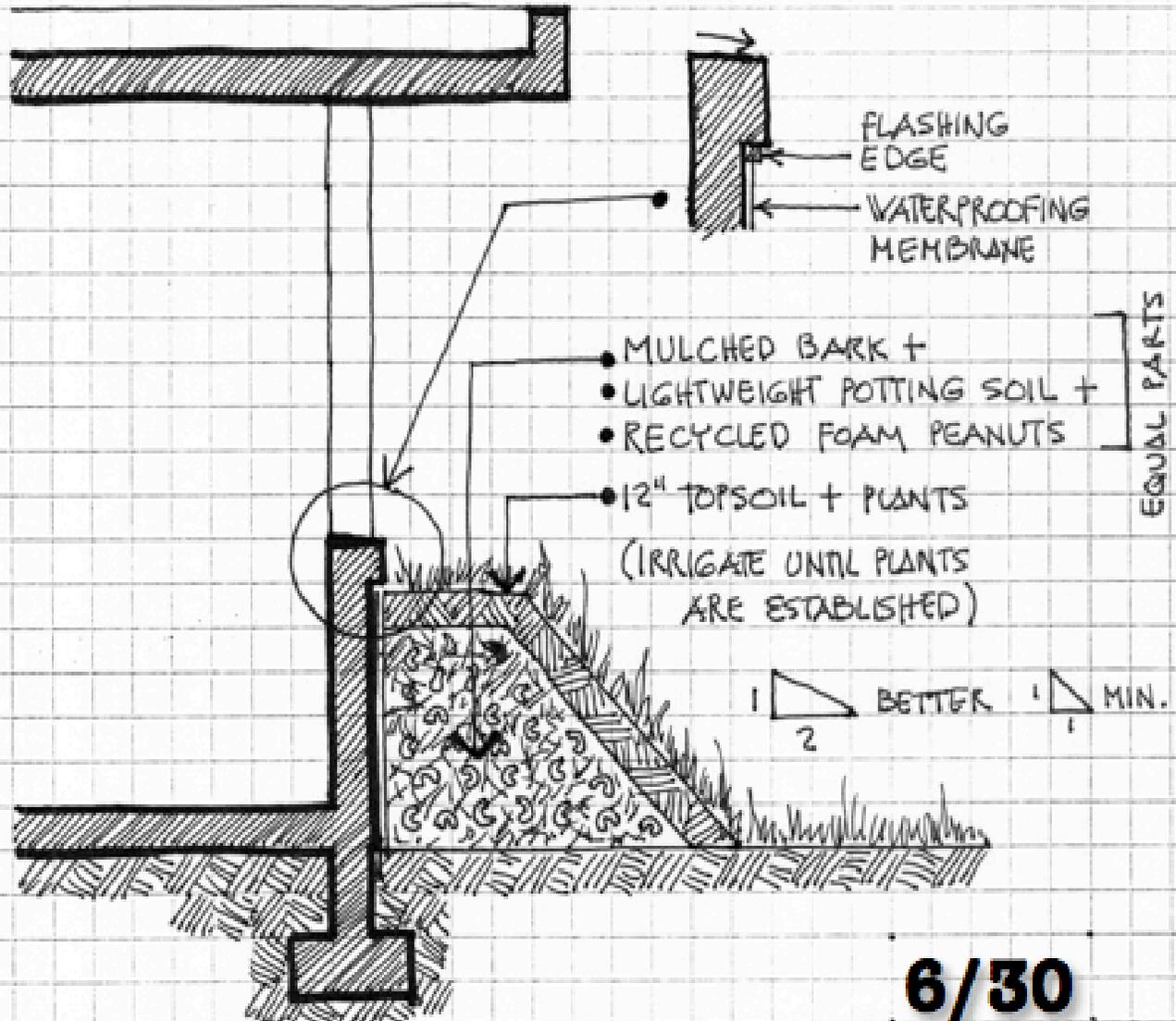
NOTES

- THIS DEVICE REQUIRES PERIODIC CLEANING OF THE FOUL-FLUSH CHAMBER

# Simple Things You Can Do

# Green

## Infrastructure



INSULATIVE BERM DETAIL

6/30

NOTES

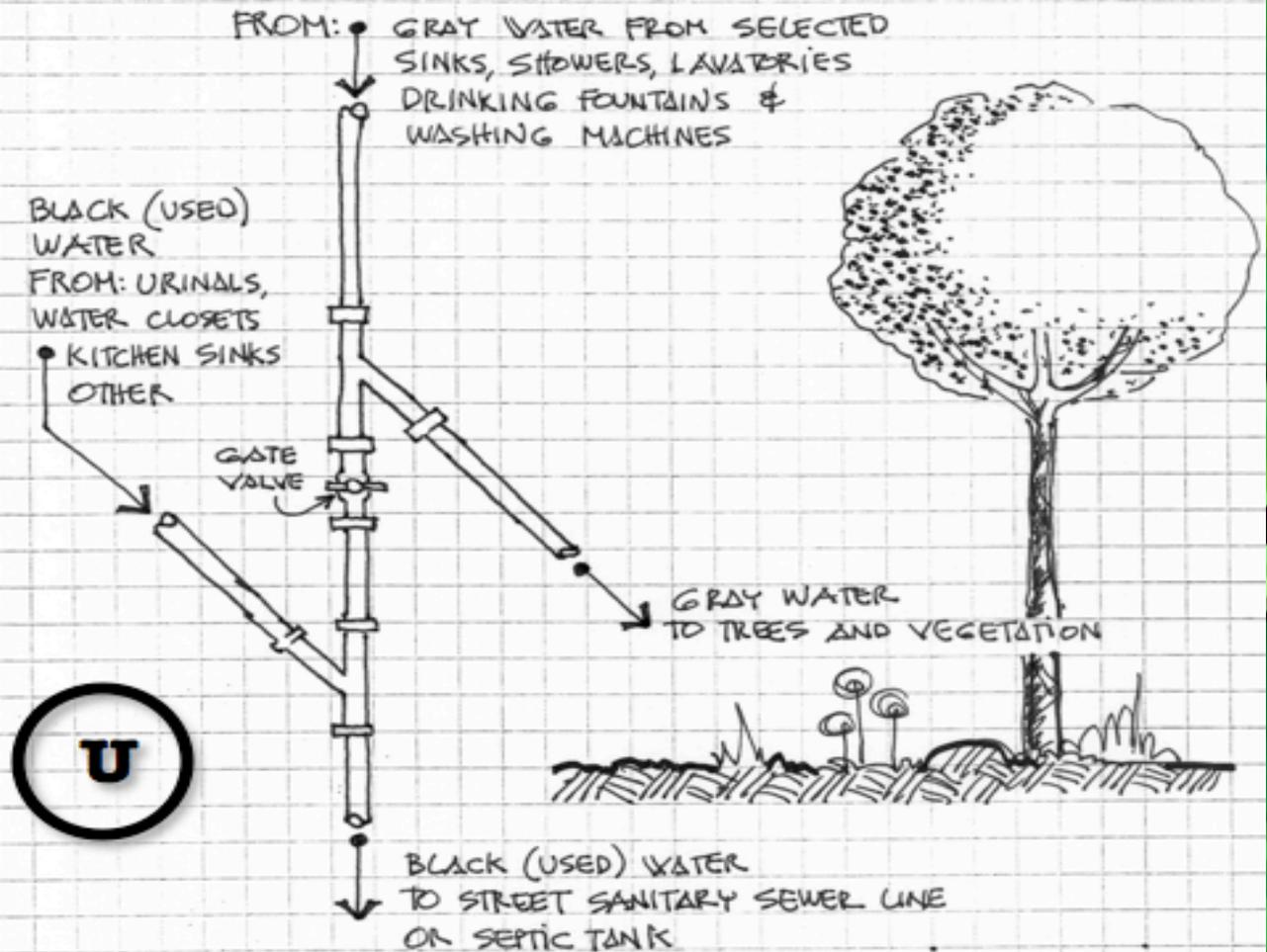
- IRRIGATE UNTIL ROOT SYSTEM IS STABILIZED.

# Simple Things You Can Do

# Green

## Infrastructure

### GREEN CONSTRUCTION DETAILS



21/30

#### GRAY WATER DIVERTING VALVE

NOTES

- DIVERTING VALVE IS USED DEPENDING ON SPECIFIC USE OF SELECTED PLUMBING FIXTURES.

# Simple Things You Can Do

# Green Infrastructure

Pervious Gravel  
Pavement (Very  
Low Cost)

Photovoltaics  
@\$6/watt

Rain Water  
Harvesting  
(low cost)

Outdoor  
Living  
(Free)



# Simple Things You Can Do

Low Cost Green Roof:  
waterproof membrane +  
Plastic Containers @  
\$2.80/sf

**Green**  
Infrastructure



# Simple Things You Can Do

# Green

## Infrastructure

### Approach:

In developed urban areas the permeability of surfaces is greatly reduced. This causes the stormwater runoff to flow into gutters and sewers and finally into the receiving waters. This stormwater contains sediments and other contaminants which deteriorate the water quality. Hence, it is necessary to reduce the impervious areas.

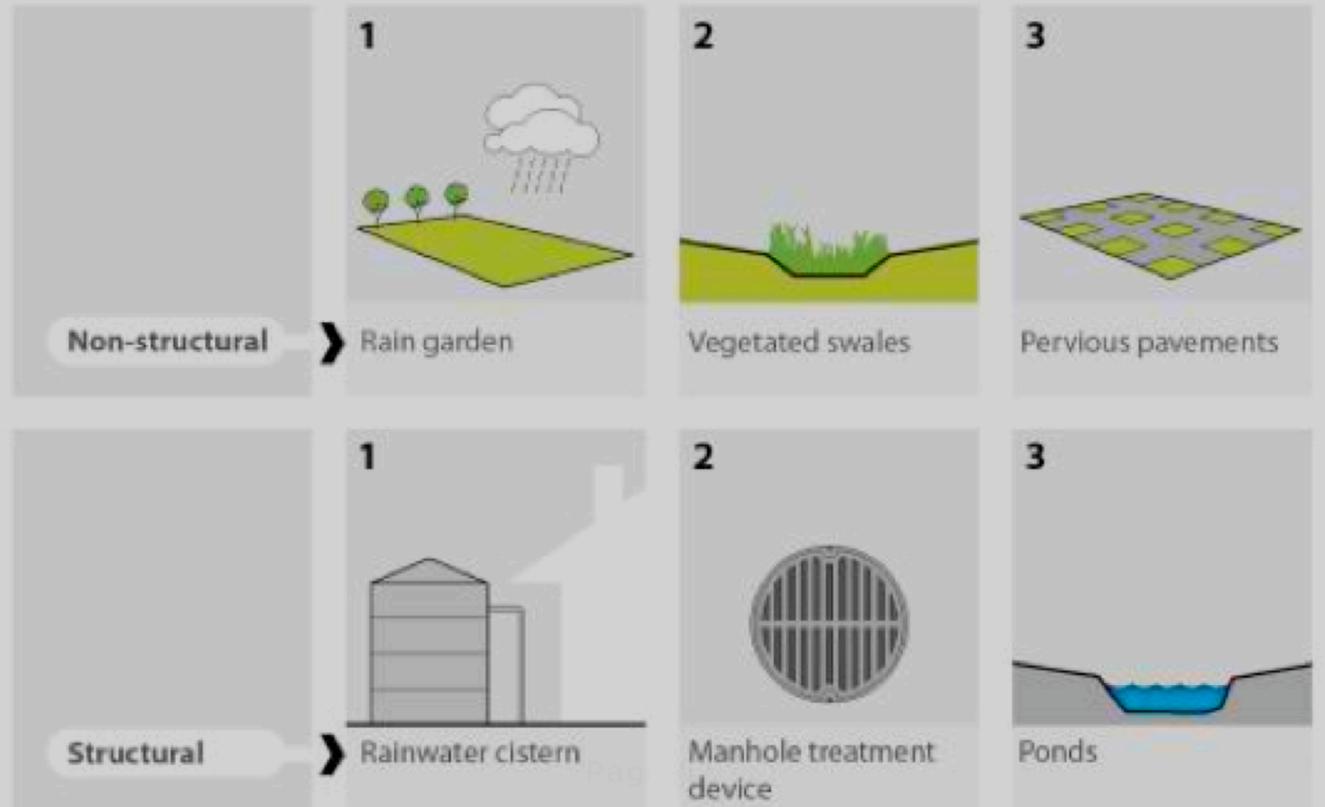
Following are two different storm water management measures, which can be used to minimize impervious areas:

**Non-structural measures:** The stormwater naturally percolates into the soil, gets filtered and most pollutants are broken down by micro-organisms.

- 1) Rain gardens
- 2) Vegetated swales
- 3) Disconnected impervious areas and pervious pavements

### Structural measures:

- 1) Rainwater cistern
- 2) Manhole treatment device
- 3) Ponds



# Simple Things You Can Do

# Green

## Infrastructure

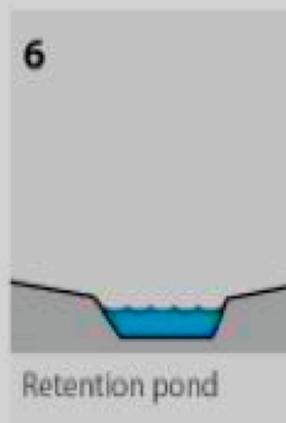
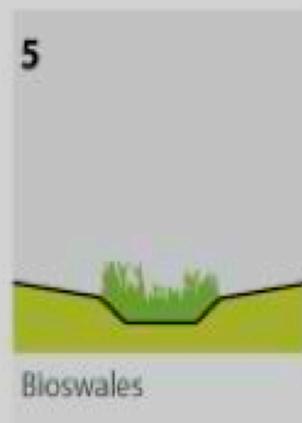
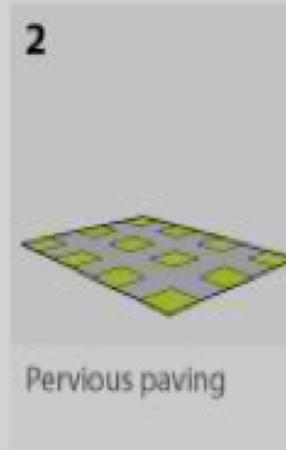
### Approach:

The stormwater runoff is the water from rains and melted snow that flows over surfaces into sewer systems or receiving bodies.

The increase in the quantity of stormwater runoff due to development can cause erosion, widen channels and cause downcutting in streams.

Effective stormwater management practices allows stormwater to infiltrate in the ground thereby reducing its volume.

Following are some of the ways to minimize stormwater runoff volume:



# Simple Things You Can Do

# Green

## Infrastructure

### Approach:

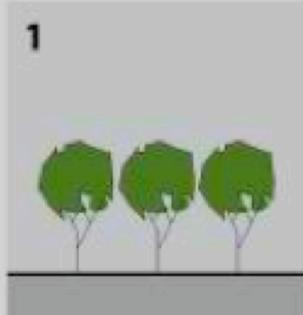
Heat island effect refers to the absorption of heat by hardscapes, such as dark, non-reflective pavement and buildings, and its radiation to surrounding areas. Particularly in urban areas, other sources may include vehicle exhaust, air conditioners, and street equipment; reduced airflow from tall buildings and narrow streets exacerbate the effect.

Due to this effect the ambient temperature in urban areas is about 10°F more than the surrounding undeveloped areas.

LEED recommends following strategies for reducing the heat island effect:

- 1) Providing shade from existing trees, or within 5 years of landscape installation.
- 2) Providing shade with the help of structures covered with solar panels.
- 3) Providing shade with architectural devices having a SRI of at least 29.
- 4) Using hardscape materials with minimum SRI of 29.
- 5) Using open grid pavement system (at least 50% pervious)
- 6) Placing 50% parking under cover.

1



Shade within 5 years

2

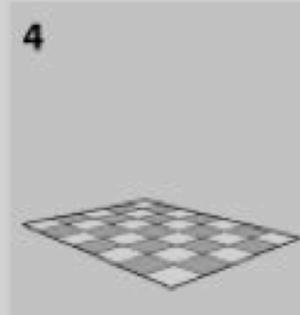


Architectural structures

3

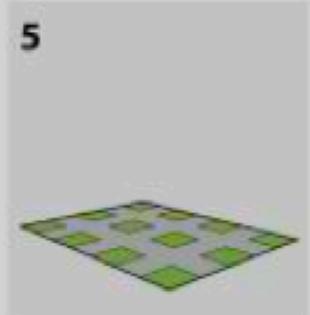


4



Hardscape with SRI ≥ 29

5



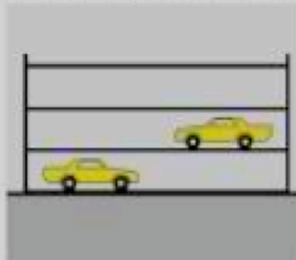
Open grid pavement

6

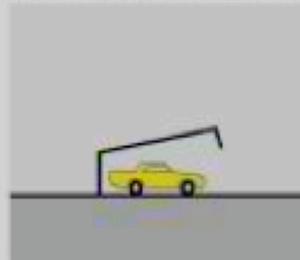
*Roofing OR covered surface material must have at least SRI 29 OR green roof OR covered by solar panel.*



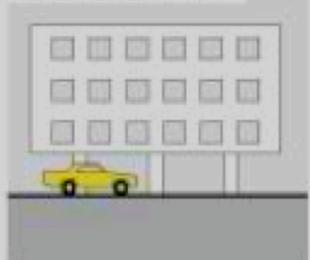
Underground.



Under deck.



Under roof.



Under building.

# Final Thoughts

Design big spaces with small dimensions.

Take efficiency to such an extreme as to be able to do almost everything with almost nothing.

Daylight is more efficient than LED's.

Wants should subsidize needs.

(Kevin Langdon)

The site or environment is the beginning of a building that aspires to be Architecture.

(Frank Lloyd Wright)

# Final Thoughts

Buildings are greener when landscaped.

Locally sourced is green, but...homegrown is greener!

Smaller footprints make greener buildings.

Frugality is another term for the wise use of resources.

Weeds are plants whose virtues we have not yet  
discovered.

(Ralph Waldo Emerson)

Vegetation in the city, brings wildlife to the site.

# Final Thoughts

You have perfected a green design, not when you have nothing more to add, but when you have nothing more to take away.

The best sustainable building is the one we make unnecessary to build through intelligent green design.

Nature has always the last word!



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