Swales and Rain Gardens

Swales and Rain Gardens: Introduction

Mike Faha

GreenWorks

GREEN
from the Ground Up
Seminars for land-savvy developers

Metro

GREENWORKS

CleanWater Services

VERDE

kpff

TRENDS / Sustainable Site & Urban Design

Private →	Public →	Shared
Suburban →	Urban →	Statewide
Scale: Site →	Neighborhood →	Community
Greenfield →	Urban Infill	
Single Objective →	Multi-objective	
New Development →	Retrofitting	
Green Development →	Sustainable Development	

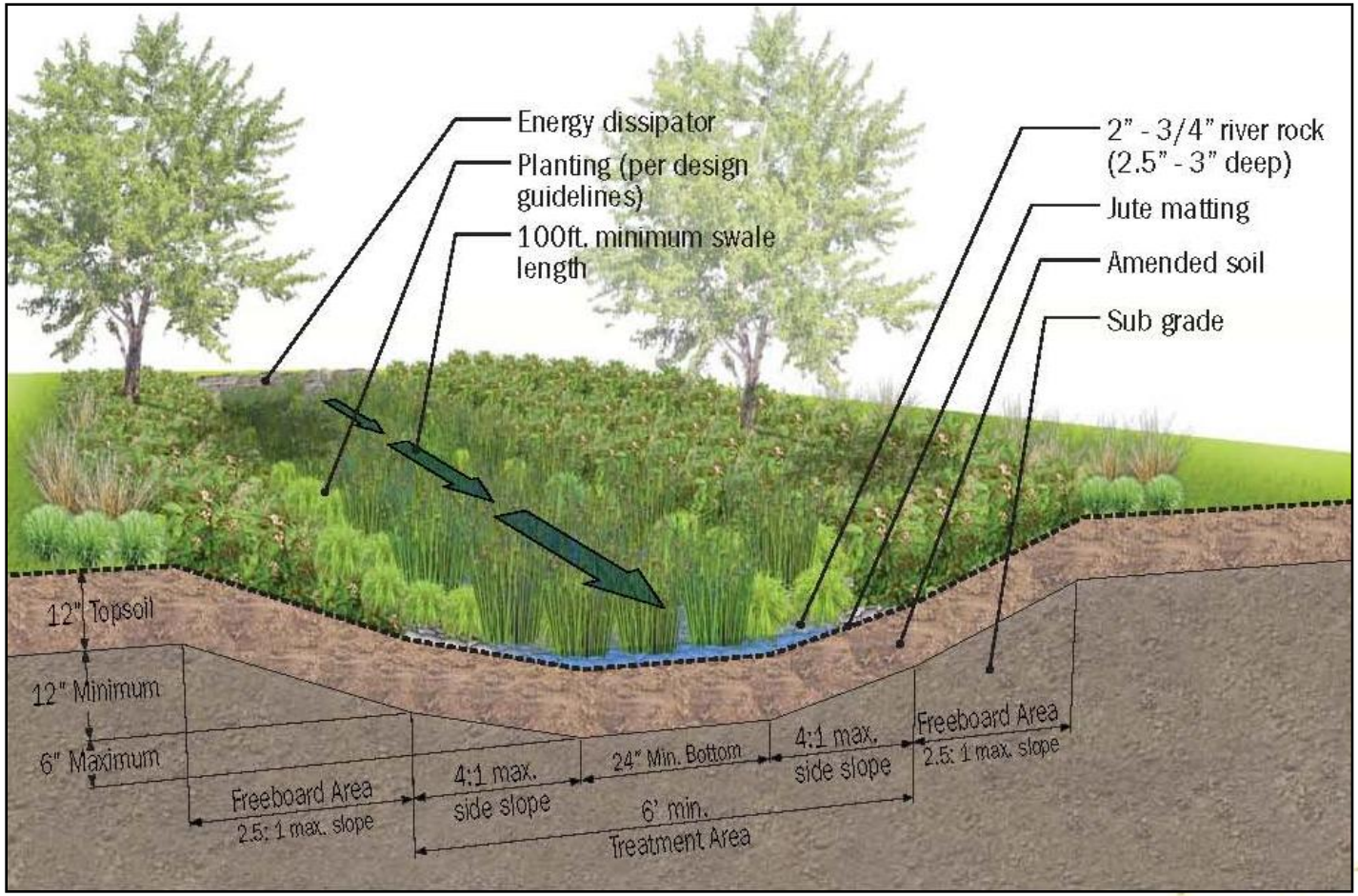
Issues / LIDA Components

- Differences between LIDA Facilities
- Functions (conveyance, infiltration, overflow)
- Benefits
- Siting
- Soils
- Planting
- Access

1991 – Columbia Trailer Swale

Vegetated Swale

Vegetated Swale



1992 – OMSI Parking Lot

Vegetated Swale

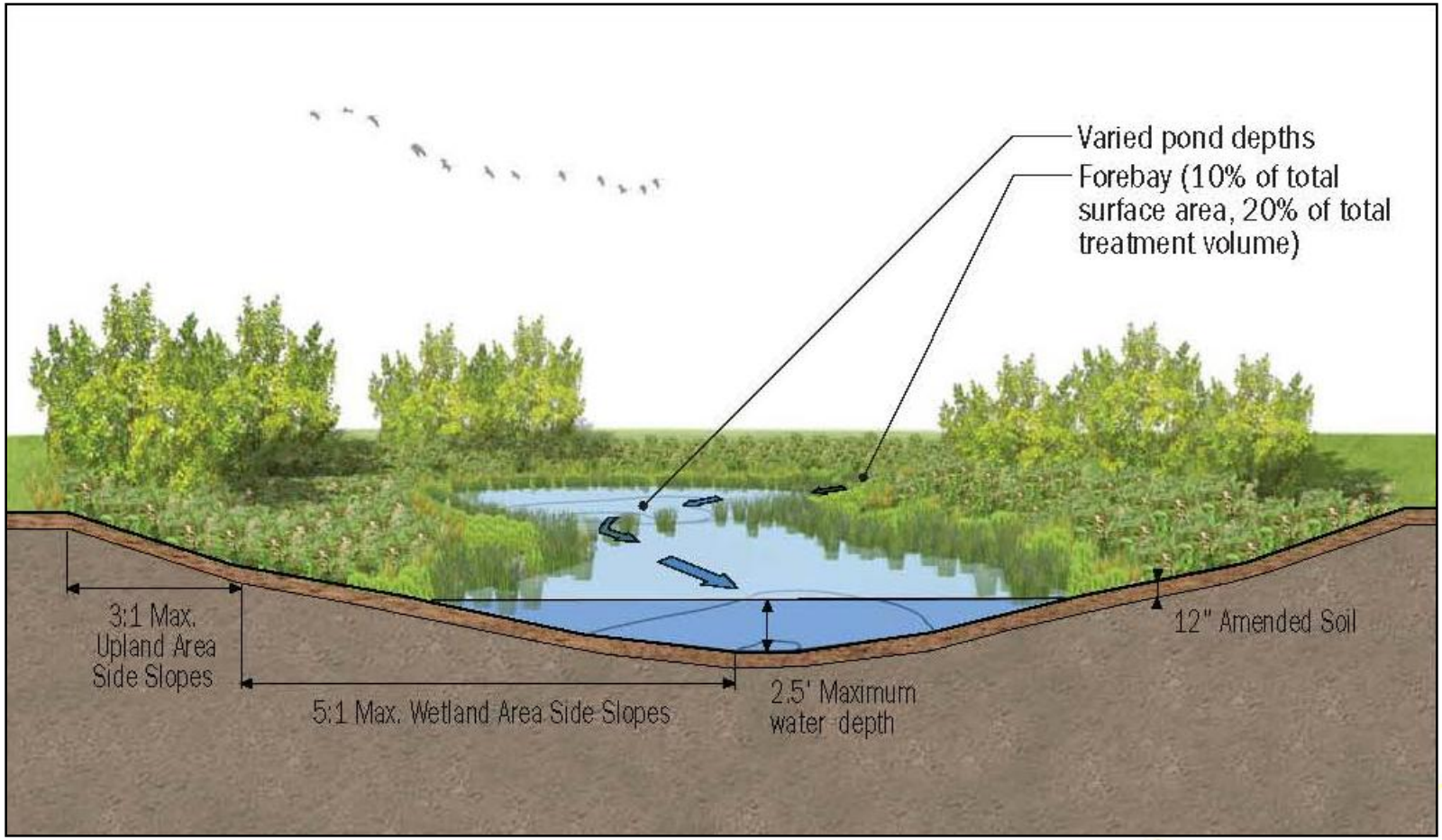
1993 – Gabriel Park

Vegetated Swale

1994 – 107th Ave Wetland Facility

Constructed Water Quality Wetland

Constructed Water Quality Wetland



1997 – Portland B.E.S. Water Quality Laboratory

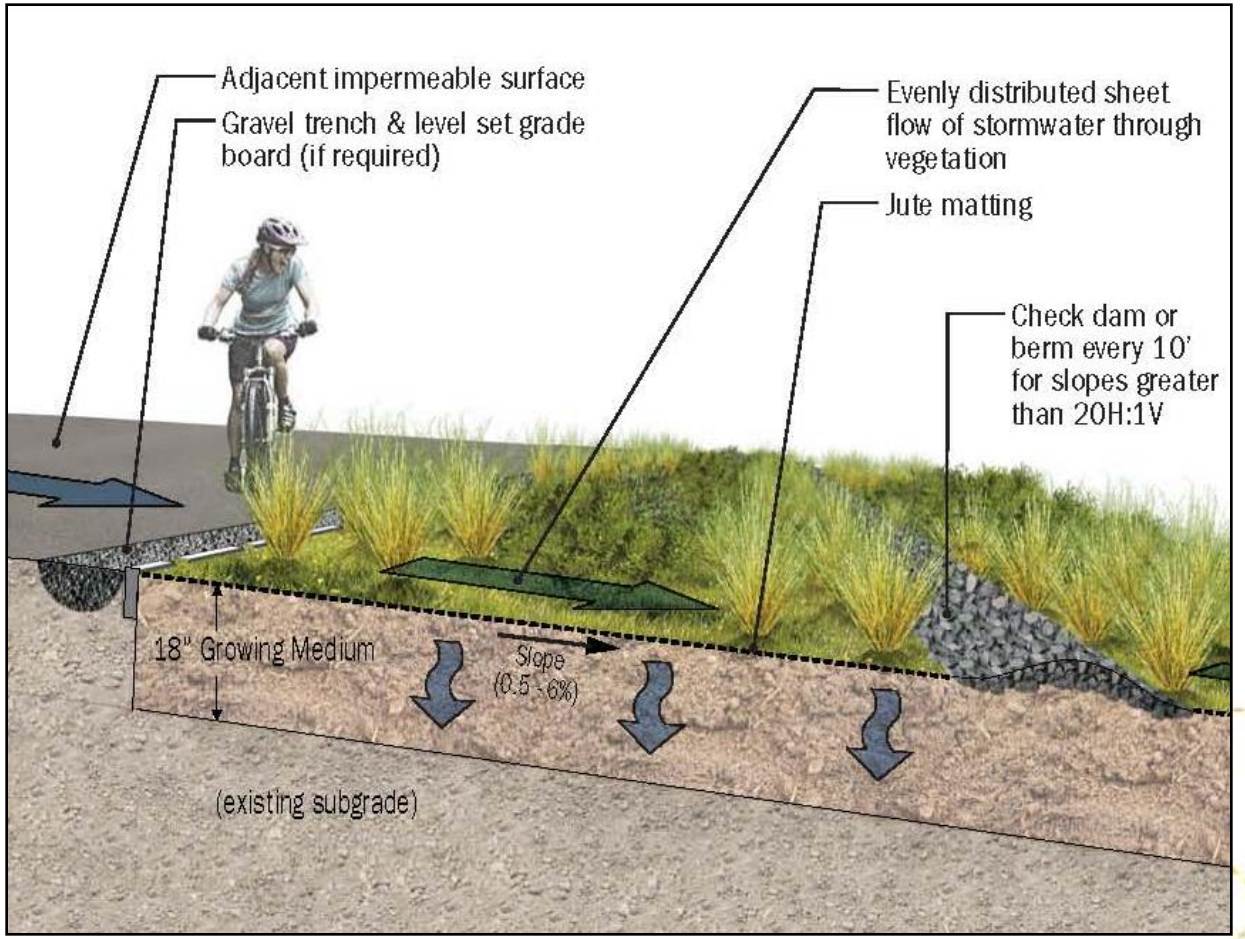
Conveyance/Stormwater Art

Water Quality Pond

1999 – Arata Creek School

Vegetated Filter Strip

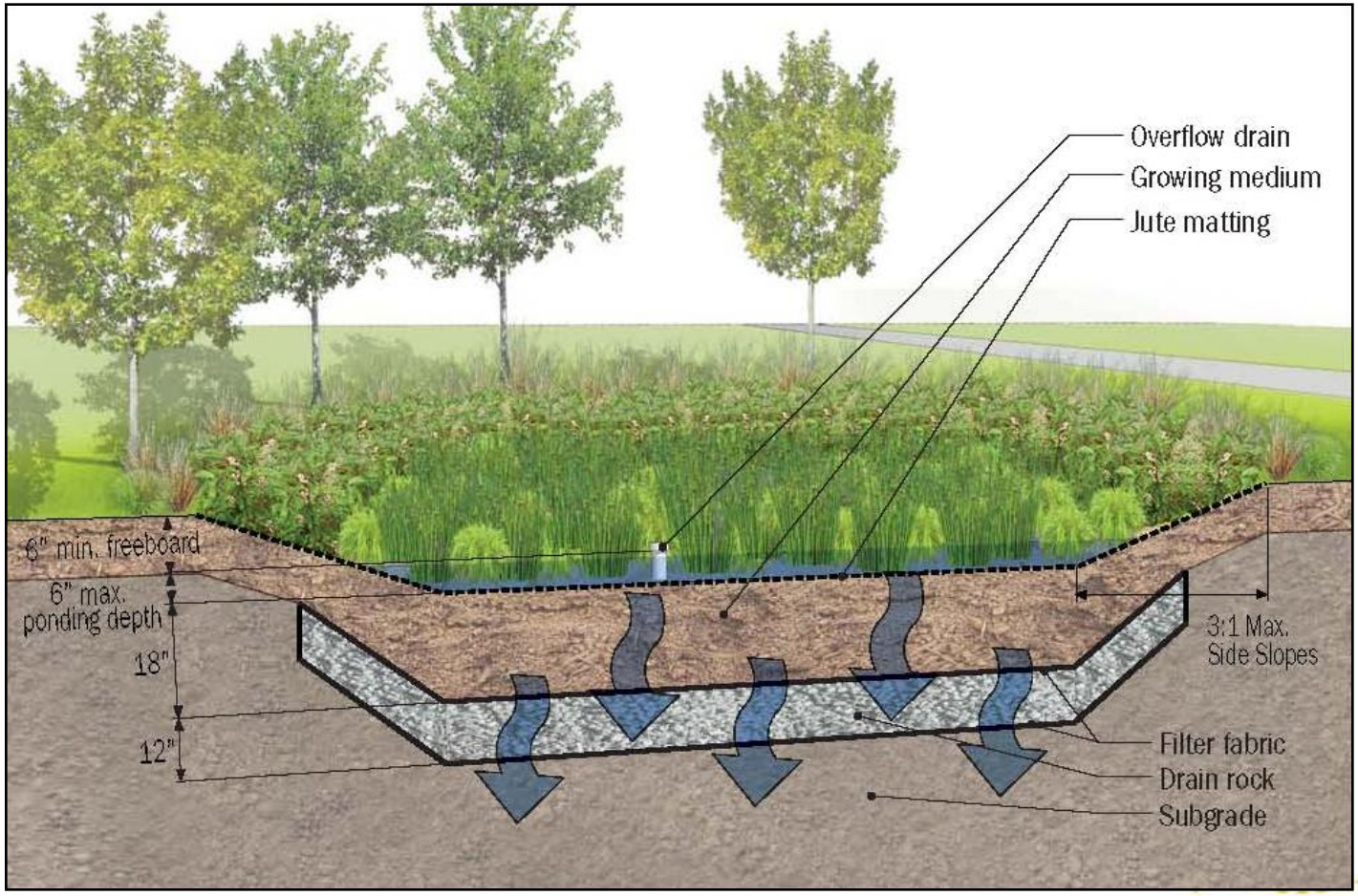
Vegetated Filter Strip



1999– Buckman Heights Apartments

Infiltration Planter

Infiltration Planter/Rain Garden



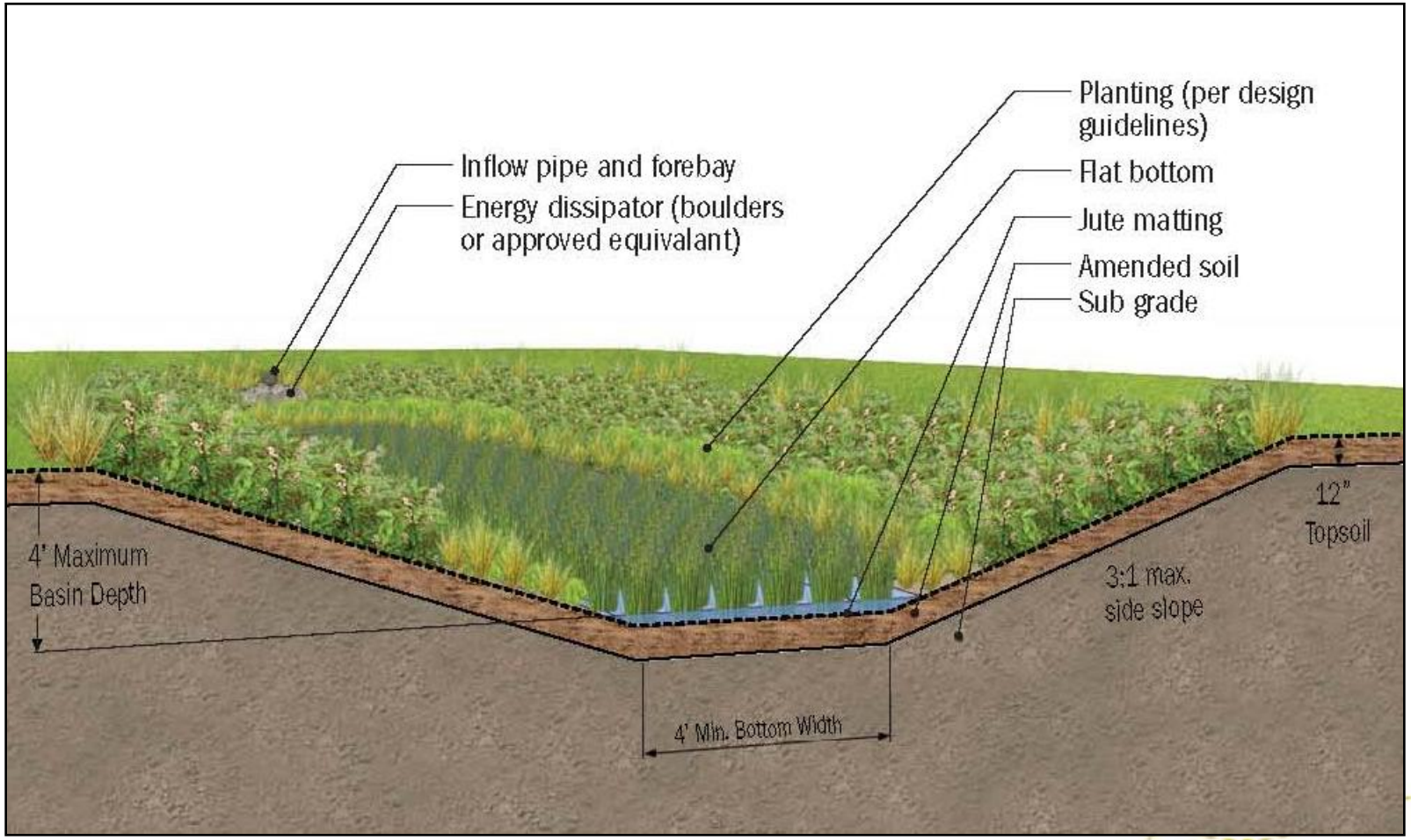
2000 – Tanasbourne Office Building

Vegetated Swale

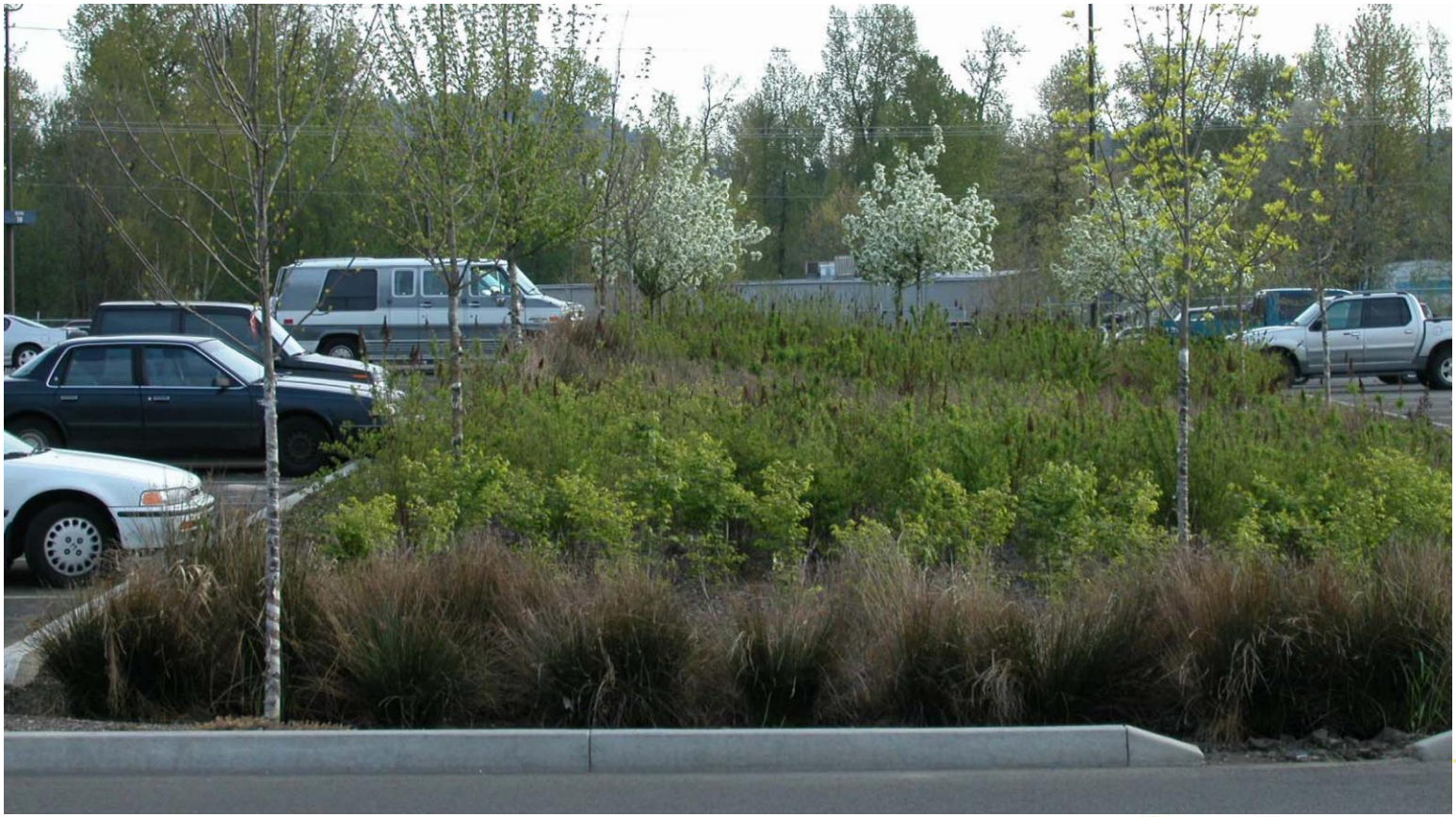
2000 – Novellus

Extended Dry Basin

Extended Dry Basin



2002 – Airport Employee Parking



Vegetated Swale

2002 – Intel Ronler Acres

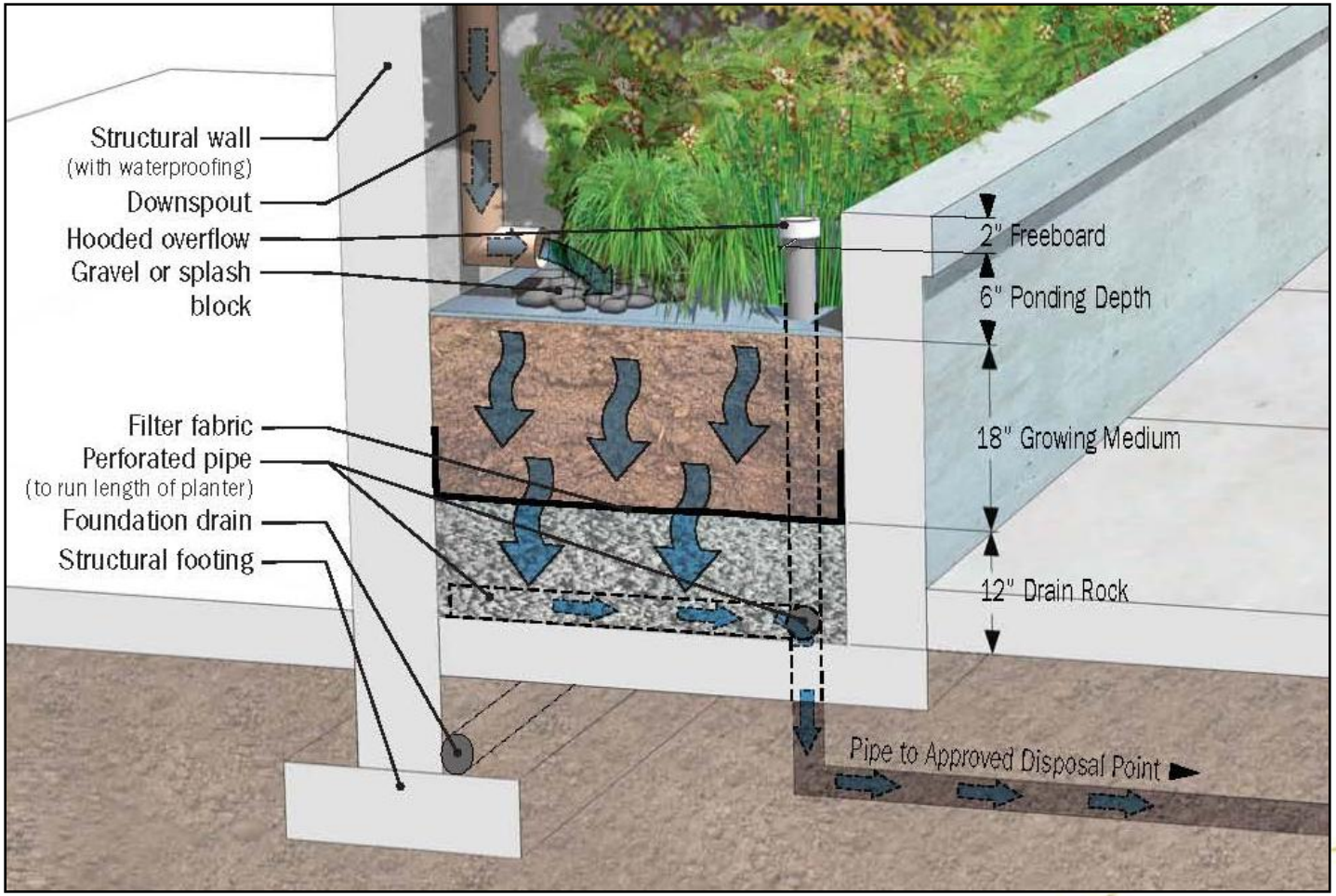
Constructed Water Quality Wetland

2003 – PSU, Epler Hall

Flow Through Planter

Conveyance/Stormwater Art

Flow-Through Planter



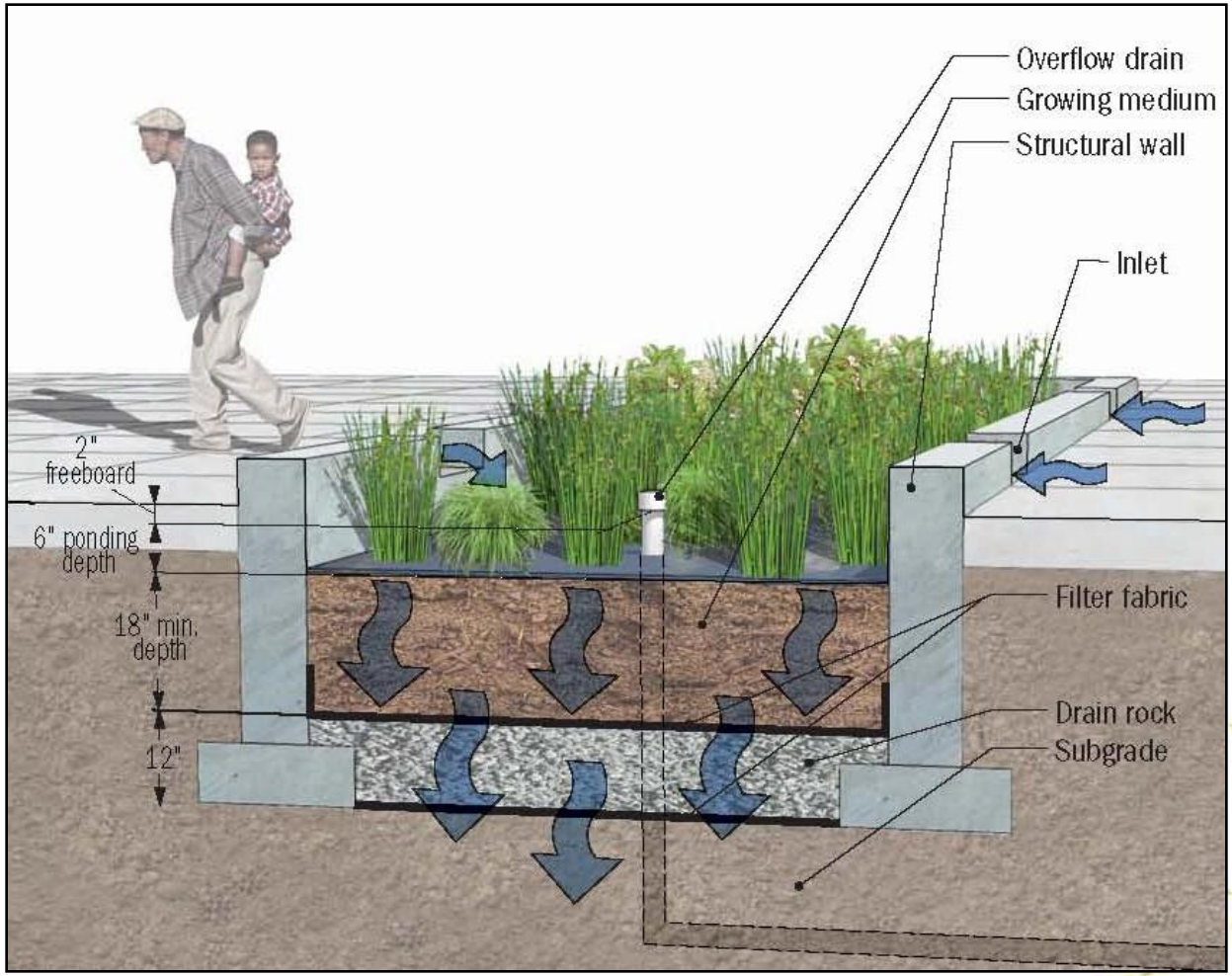
2004 – Oregon Zoo Retrofit

Vegetated Filter Strip

2004 – Mississippi Commons

Infiltration Planter

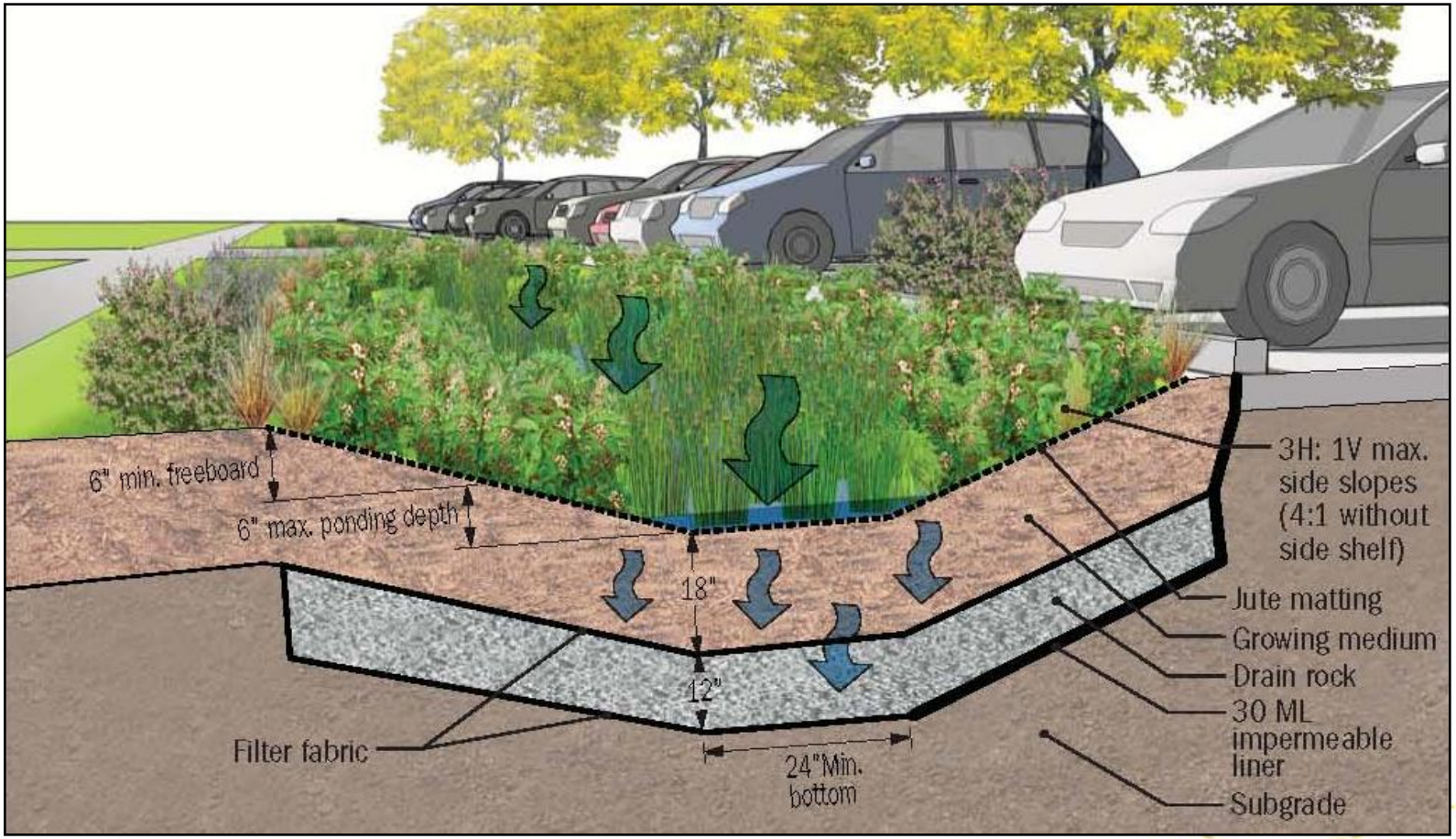
Infiltration Planter/Rain Garden



2005 – NE Siskiyou Street

LIDA Swale

LIDA Swale


6" min. freeboard
6" max. ponding depth
18"
12"
24"Min. bottom
Filter fabric
3H: 1V max. side slopes (4:1 without side shelf)
Jute matting
Growing medium
Drain rock
30 ML impermeable liner
Subgrade

2005 – Estacada Library

Infiltration Planter and Vegetated Swale

2005 – Local 49

Conveyance/Stormwater Art

2006 – Headwaters at Tryon Creek

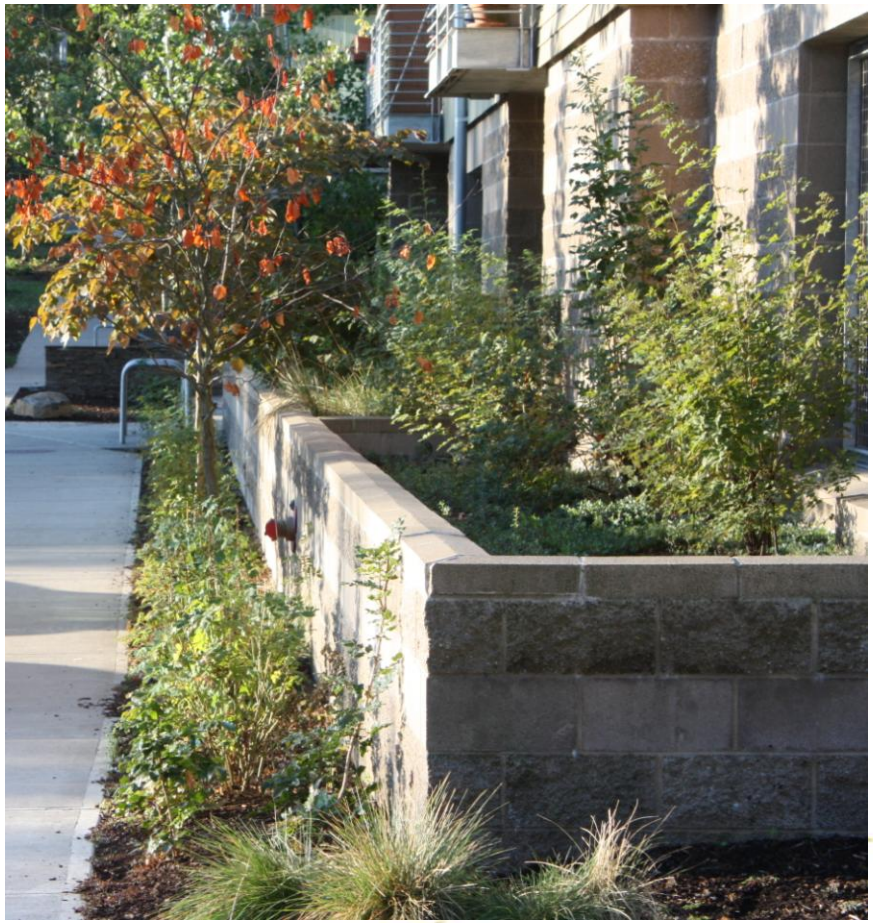
Infiltration Planter

2006 – Headwaters at Tryon Creek

Infiltration Planter

2006 – Headwaters at Tryon Creek

Flow-Through Planter



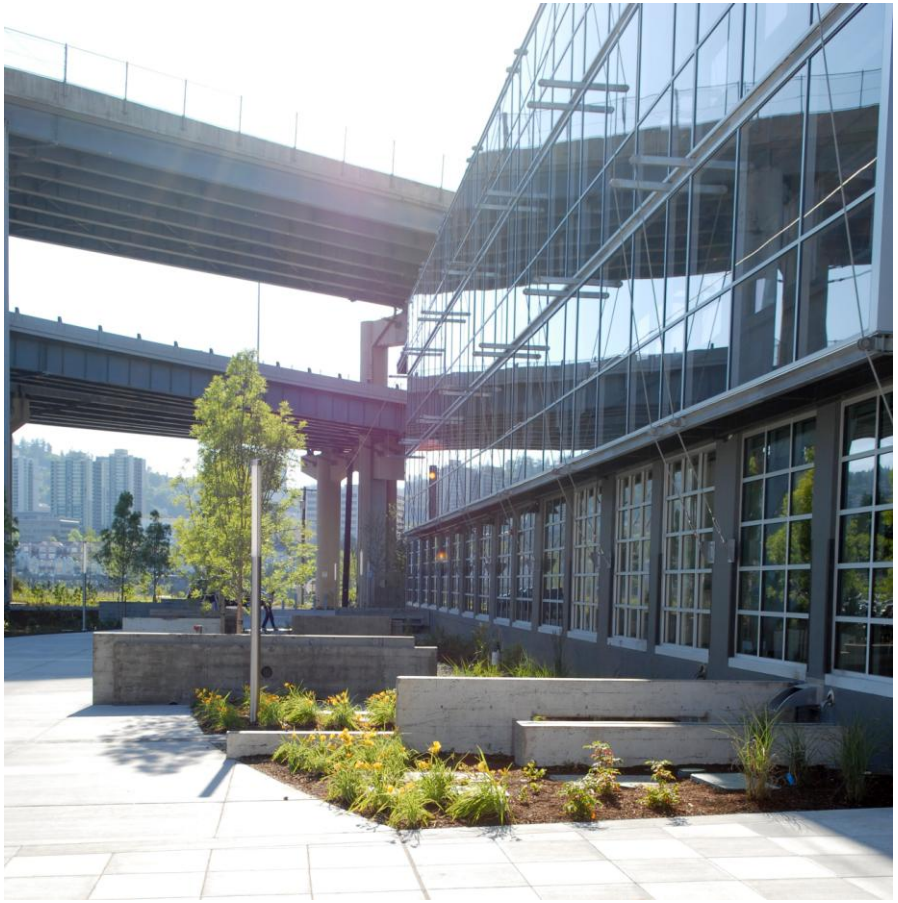
2006 – Mt. Tabor Middle School

Infiltration Planter

2006 – Mt. Tabor Middle School

Infiltration Planter

2007 – RiverEast Center



Flow Through Planter

2007 – RiverEast Center

LIDA Swale

2007 – Team Estrogen

Conveyance/Stormwater Art

2007 – Beaumont Village Lofts

Infiltration Planter

2007 – Washougal Town Center

Conveyance/Stormwater Art

Flow-Through Planter

2007 – Portland Community College, Rock Creek Campus

Vegetated Swale

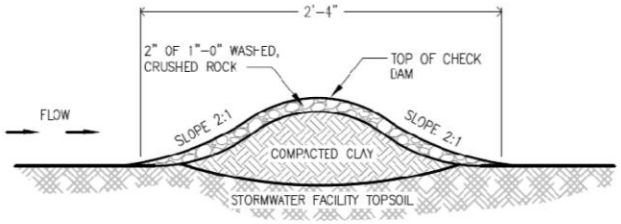
2008 – Beranger Condominiums Greenroof

Flow-Through Planters and Green Roof

2008 – Taralon Community

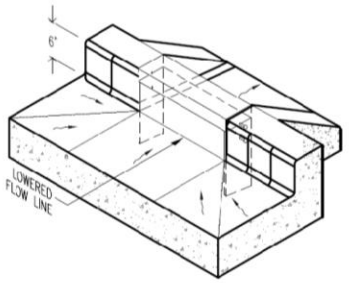
Vegetated Swale

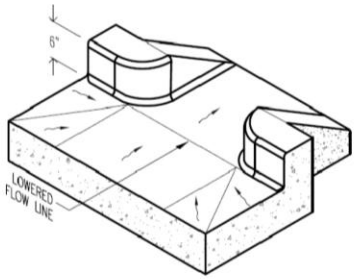
Weirs

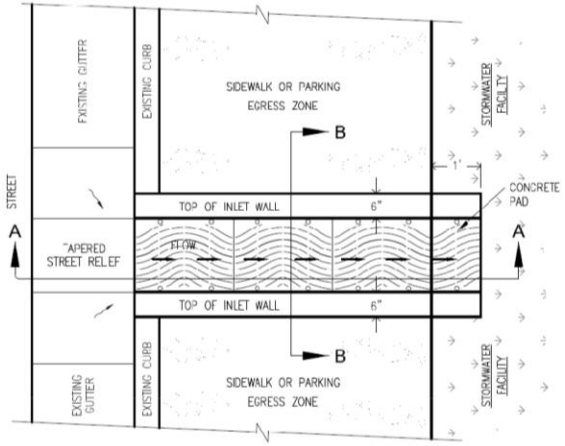


CHECK DAM

Inlets



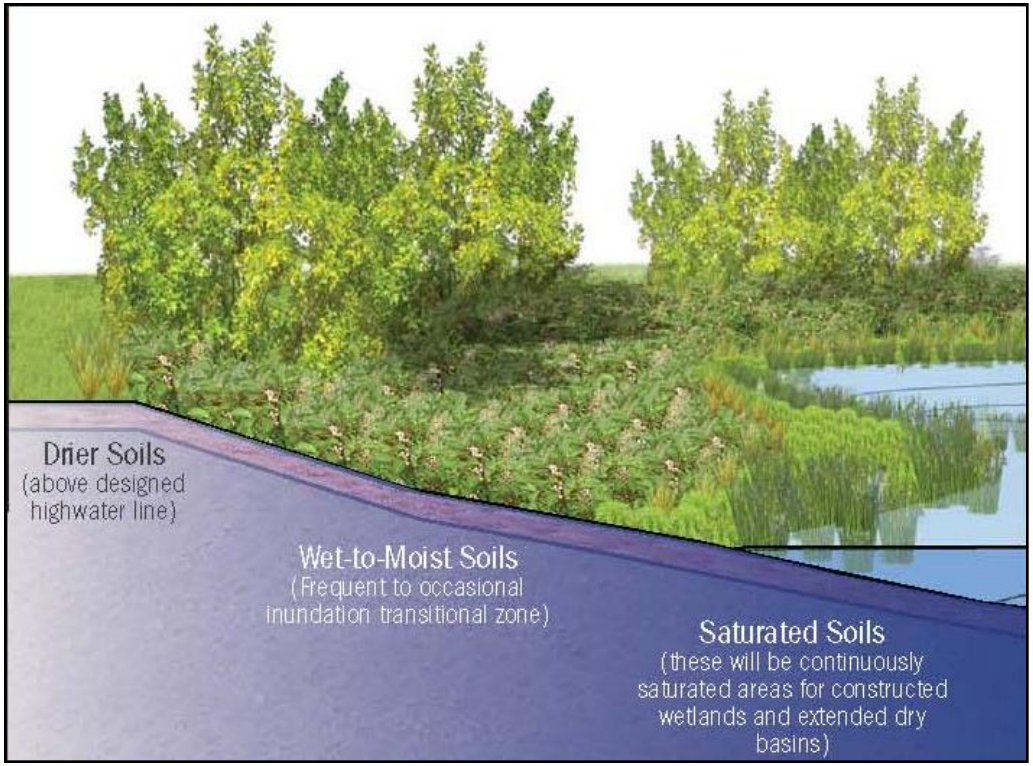


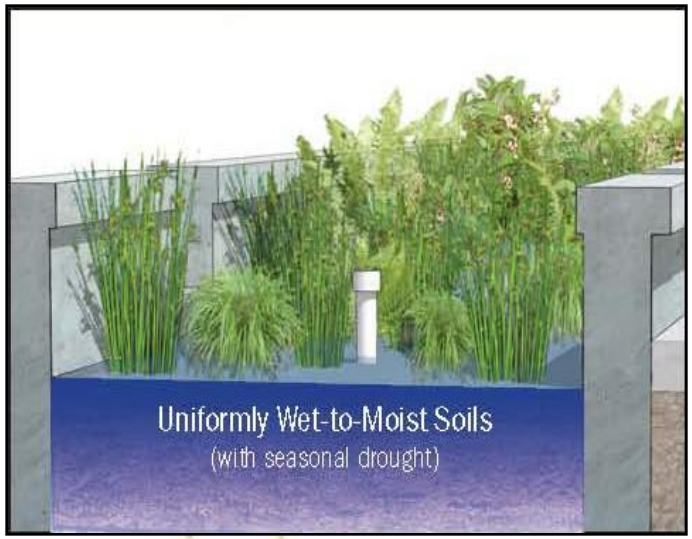


PLAN VIEW

Planting

Planting

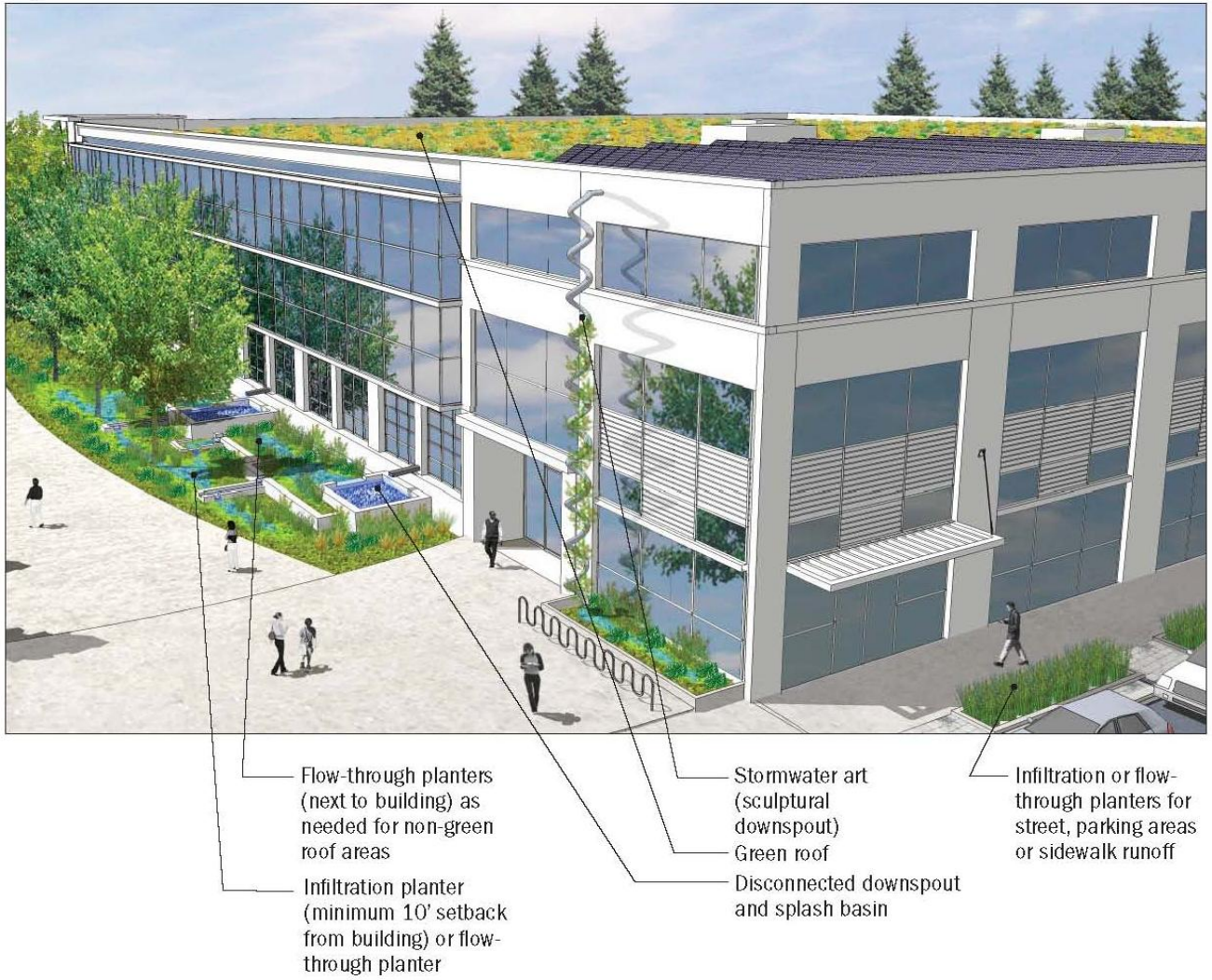

Drier Soils
(above designed highwater line)
Wet-to-Moist Soils
(Frequent to occasional inundation transitional zone)
Saturated Soils
(these will be continuously saturated areas for constructed wetlands and extended dry basins)


Uniformly Wet-to-Moist Soils
(with seasonal drought)

LIDAs In Parking Areas

LIDAs for Streets

LIDAs for Buildings and Adjacent Areas



The Civil Engineer's Perspective

Paul Dedyo, PE, LEED AP

KKPFF Consulting Engineers

GREEN
from the Ground Up
Seminars for land-savvy developers

Metro

GREEN WORKS

VERDE

kpff

Clean Water Services

Overview of Presentation

- Applicability
- Sizing & Design
- Regulatory Permitting (UICs)
- Construction

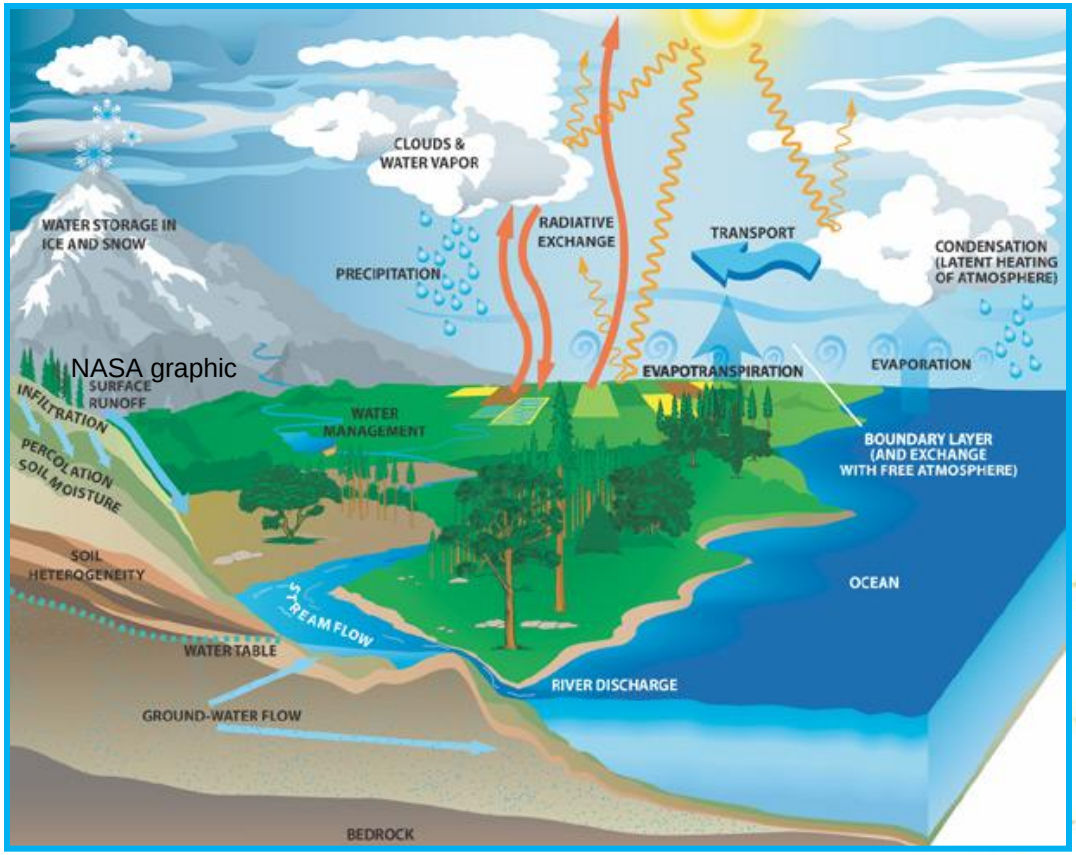
Common Considerations

- Topography
- Overflow Path
- Geotechnical Evaluation
  - Native Infiltration Rates
  - Groundwater or Impermeable Strata
- Slopes
- Structures with Habitable Space
- Code Setback Requirements
- Existing Vegetation

Overview of Presentation

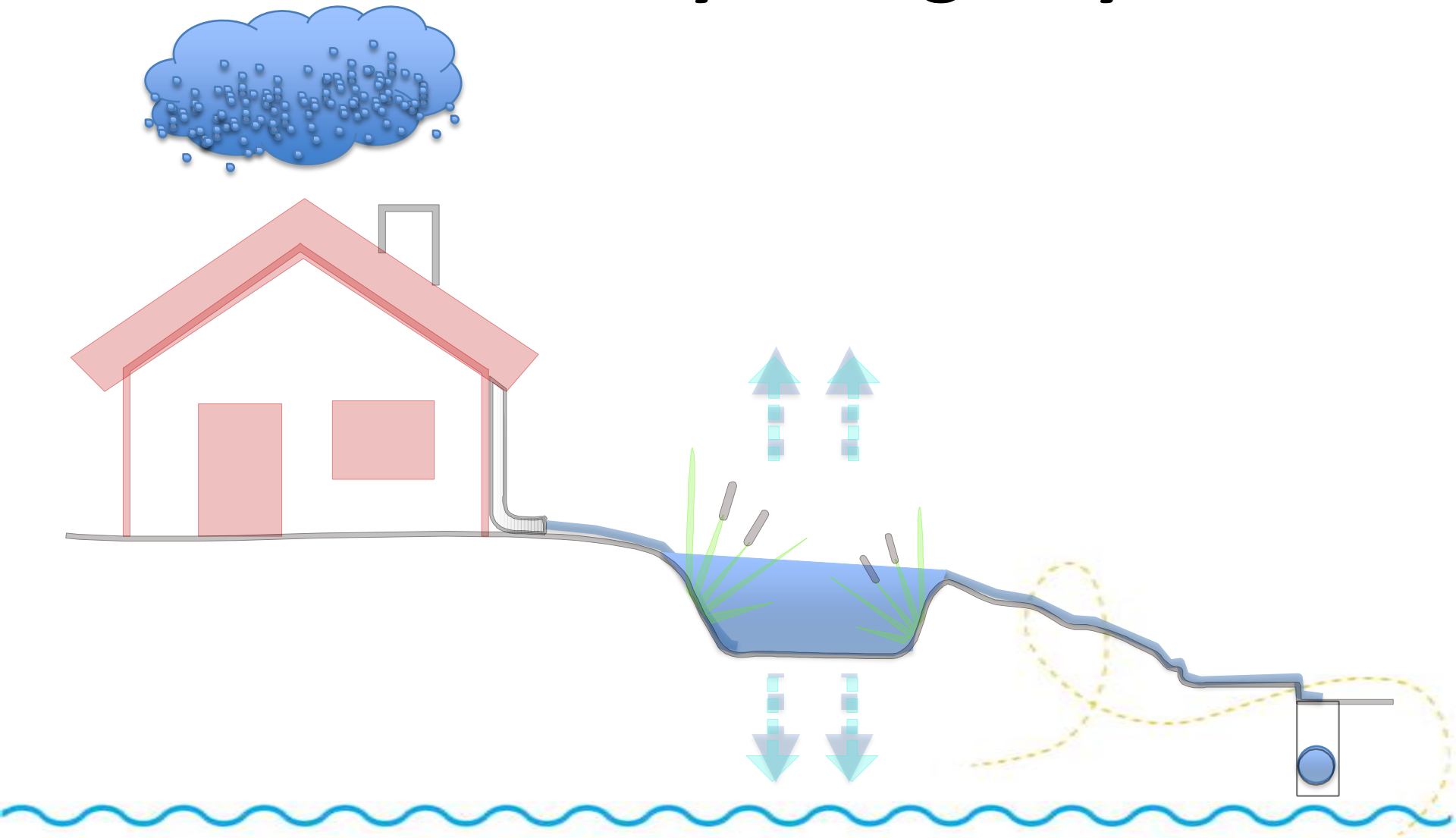
- Applicability
- Sizing & Design
- Regulatory Permitting (UICs)
- Construction

What is it? The Hydrologic Cycle



NASA graphic

Mimic the Hydrologic Cycle



GREEN from the Ground Up

Goals

- Local Regulatory Jurisdiction
- Mitigation
- Mimic the Hydrologic Cycle

Critical Criteria for Sizing

- Storm Catchment Area and Event

Credit: Flickr

- Native Soil Infiltration Rate
- Importing Growing Medium Infiltration Rate
- Facility Type and Size

Sizing for Site Conditions

- Sizing Ratio
- Multiple Smaller Facilities or Combined
- Plumbing/Conveyance
- Maximum Catchment Area

Infiltration Testing

Credit: Earth Engineers

Credit: Flickr

- Type of Tests
- Number of Tests
- Depth of Tests

Falling Head

Credit: University of Sydney

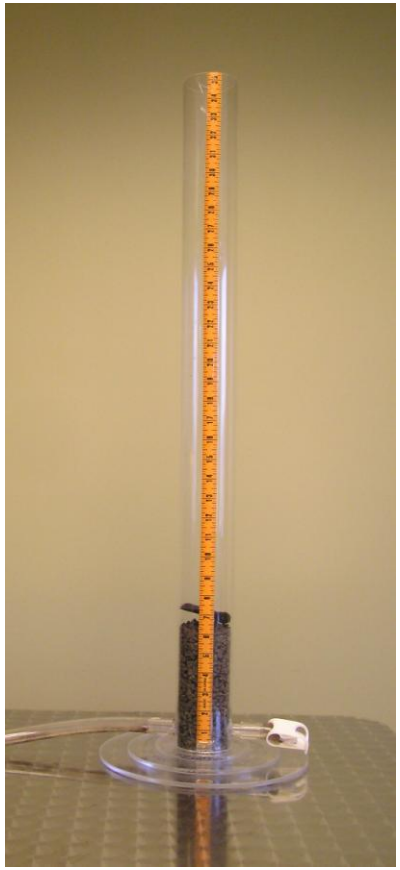
Double Ring Infiltrometer

Growing Medium

Three-part Mix

- Loamy Sand
- Compost
- Sand

Testing of Growing Medium

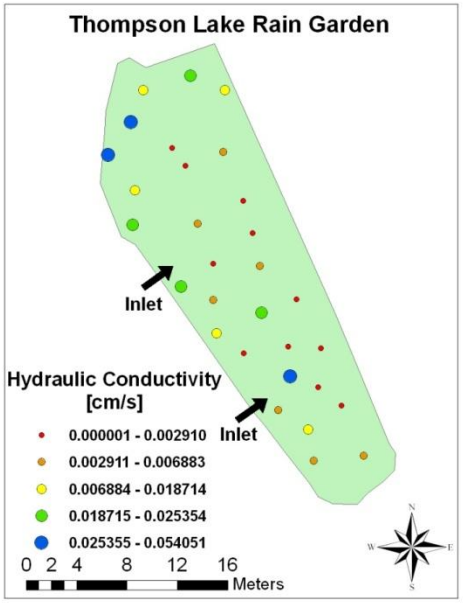


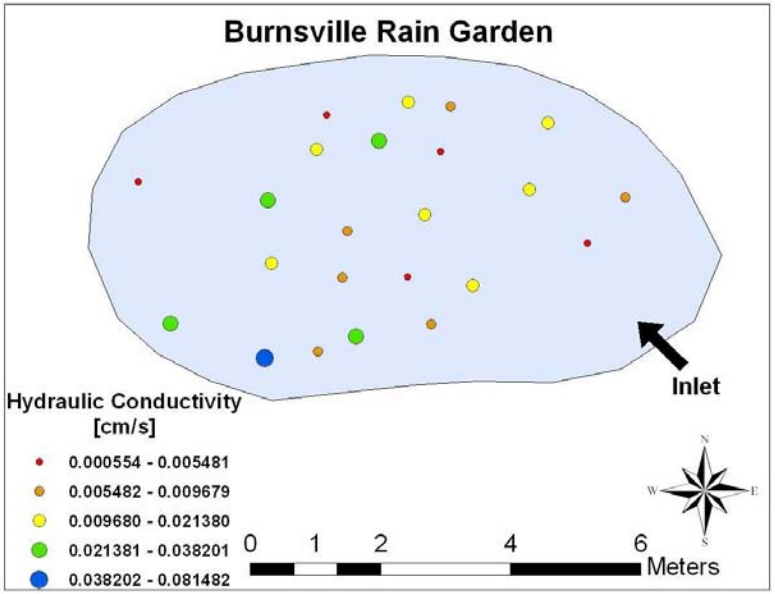
Falling Head Perco-Meter

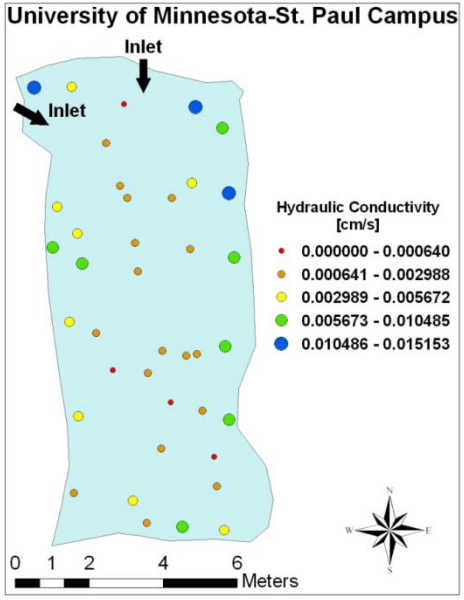
Developing the best blend ratio

- Laboratory ASTM Testing
- Informal Falling Head Testing
- Mock-up Garden Testing

Variable Performance







Credit: University of Minnesota

Facility Type and Size

- Available Space
- Topography

Credit: Flickr

Credit: Vivian Felton, NRCS

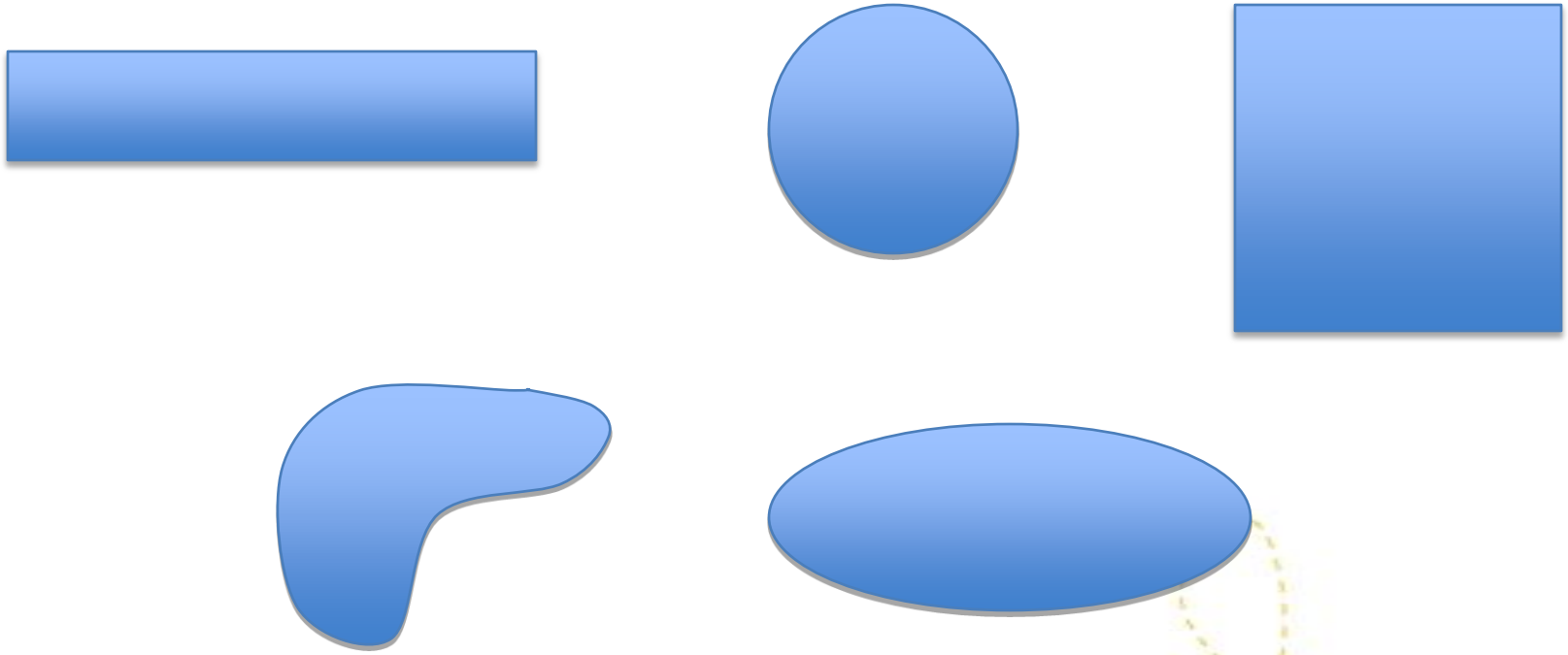
Credit: Rain Gardens of West Michigan

Credit: Virginia Department of Forestry

Credit: Maplewood MN Rain Gardens

Credit: Flickr

Geometry



Overflow Scenarios







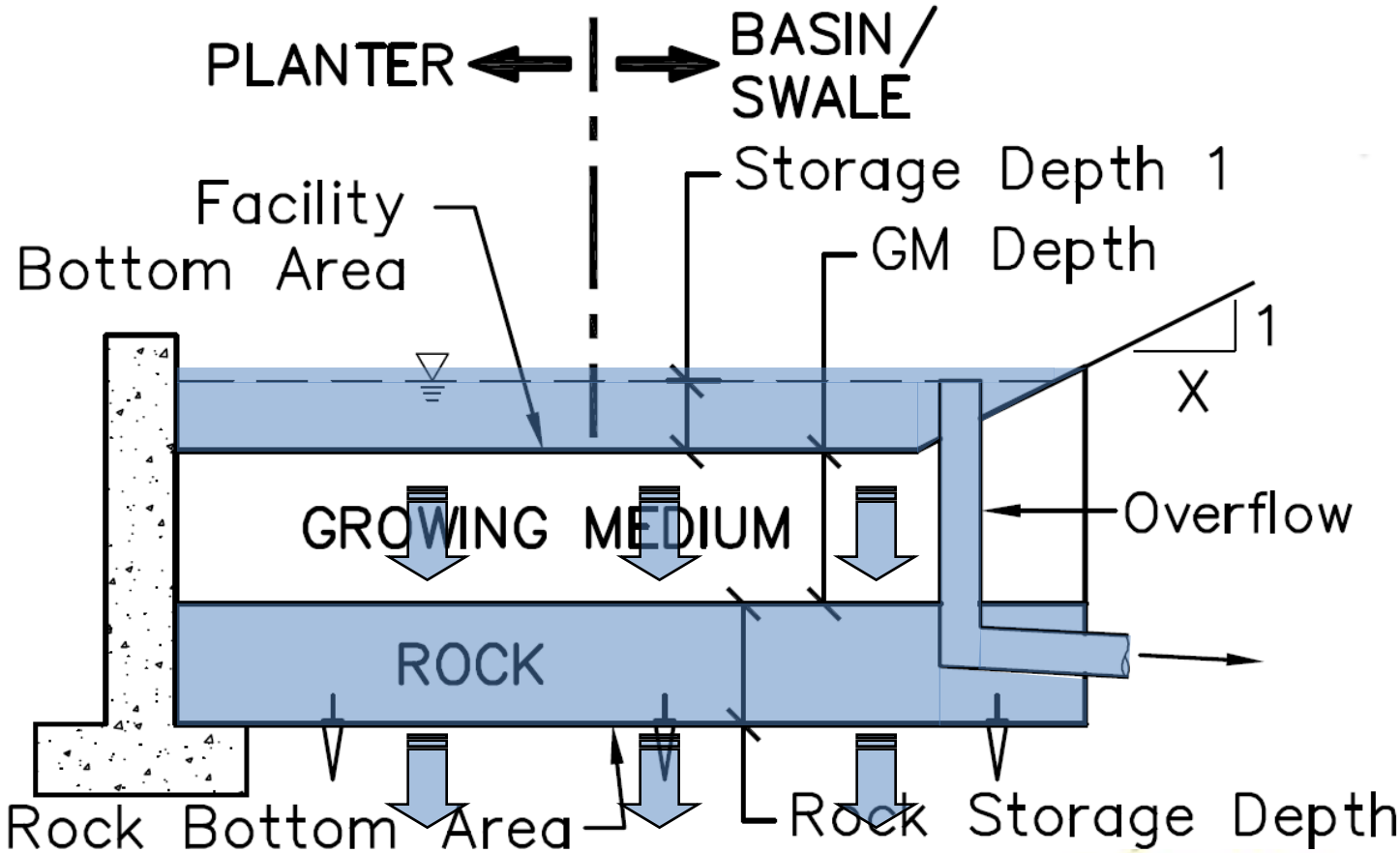


Credit: Flickr

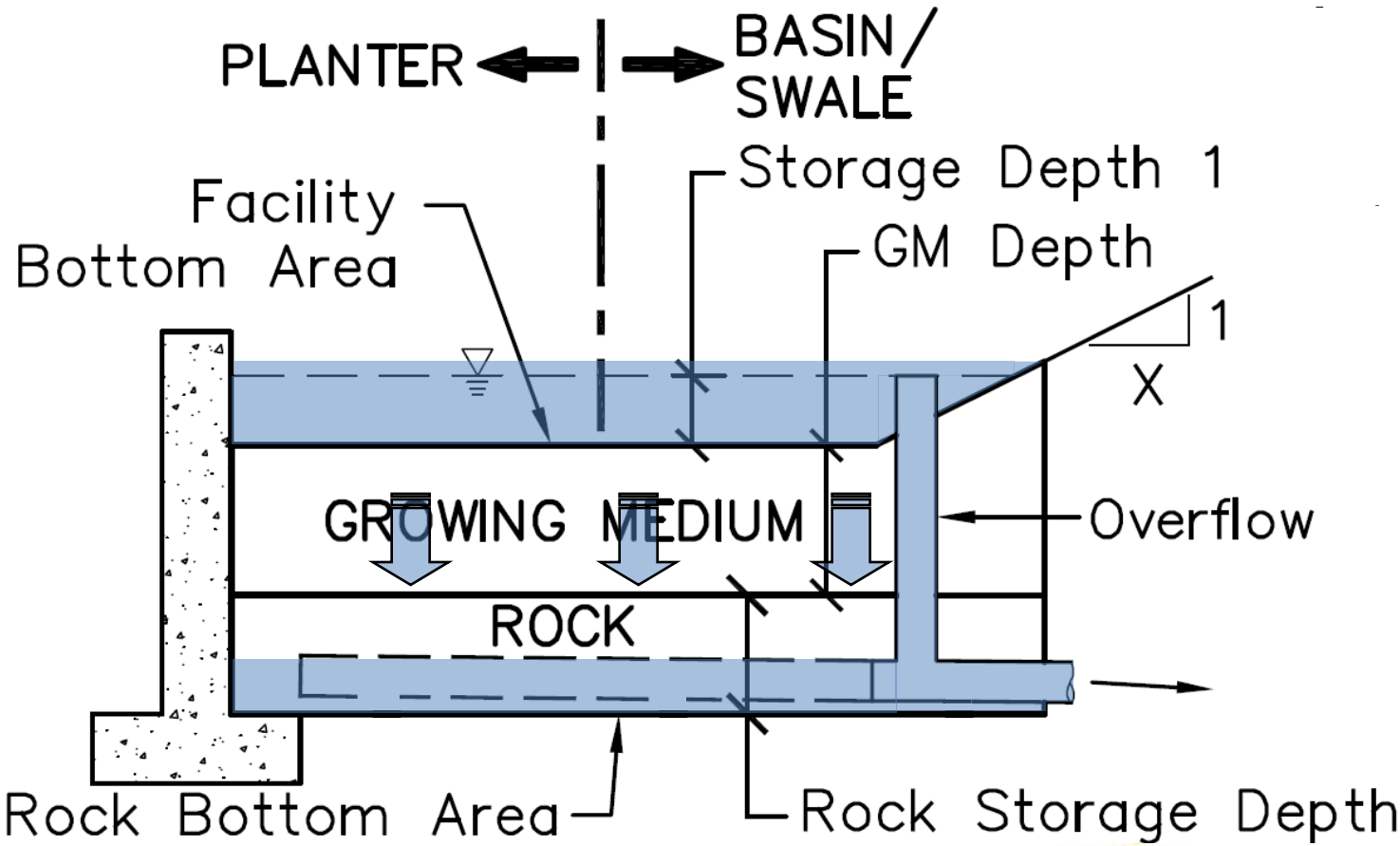
Facility Function

- Surface Infiltration Facility
  - With or Without Gravel Storage Bed
  - No Underdrain Pipe
  - Controlled Overflow
- Flow Through Facility
  - With Underdrain Pipe in Gravel
  - Assumed Little to No Infiltration
  - Controlled Overflow

Infiltration Facility



Flow Through Facility



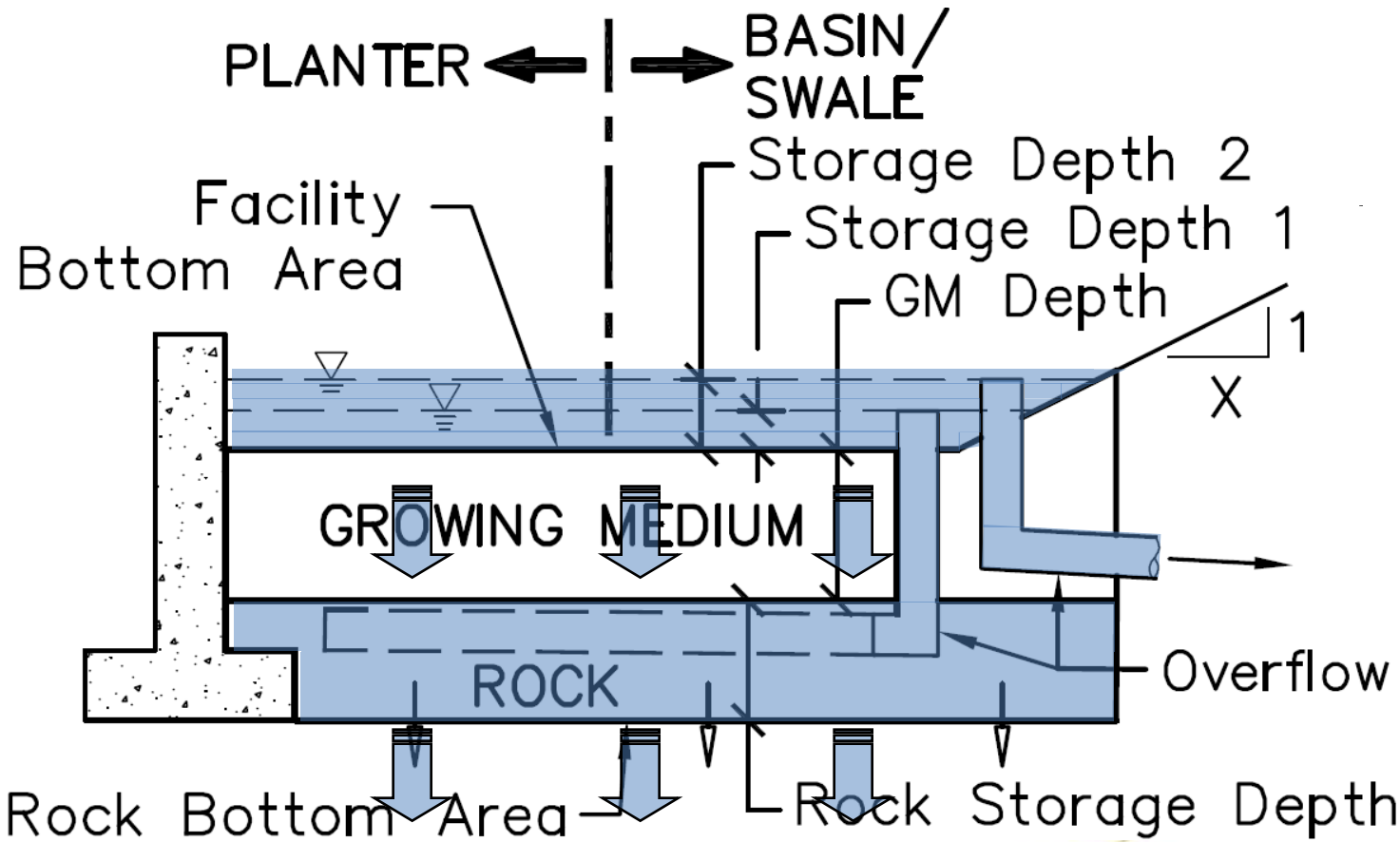
Overview of Presentation

- Applicability
- Sizing & Design
- Regulatory Permitting (UICs)
- Construction

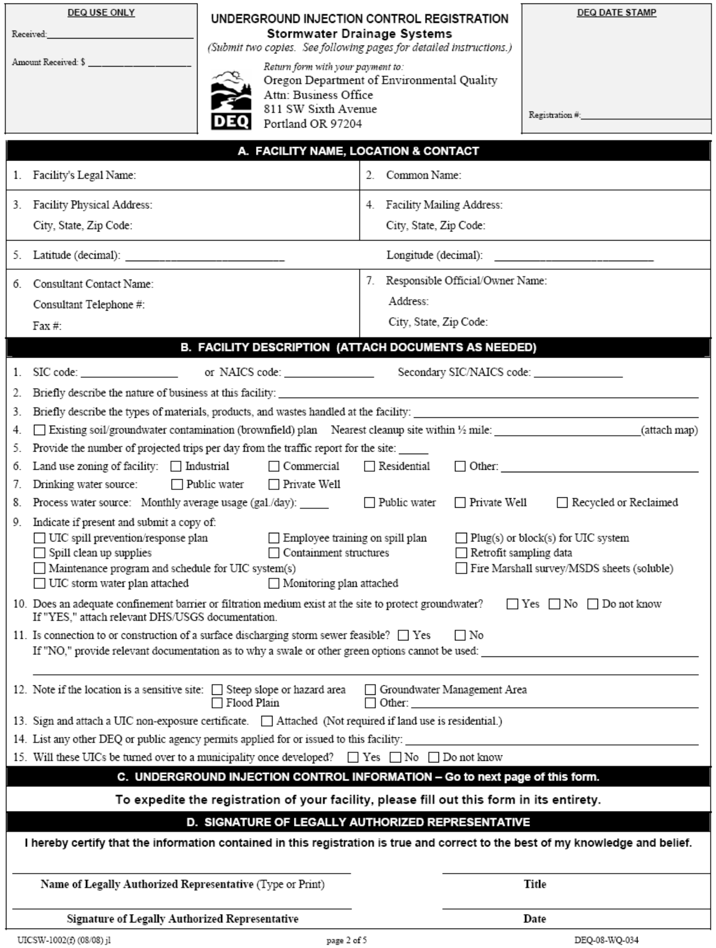
Facility Function

- Surface Infiltration Facility - UIC
  - Direct Connection to Underdrain Pipe in Gravel
  - Controlled Overflow

Underground Injection Control



Oregon DEQ UIC Registration



DEQ USE ONLY

Received: ____________________

Amount Received: $ ____________________

UNDERGROUND INJECTION CONTROL REGISTRATION
Stormwater Drainage Systems
(Submit two copies. See following pages for detailed instructions.)

Return form with your payment to:
Oregon Department of Environmental Quality
Attn: Business Office
811 SW Sixth Avenue
Portland OR 97204

DEQ DATE STAMP

Registration #: ____________________

A. FACILITY NAME, LOCATION & CONTACT

1. Facility's Legal Name:
2. Common Name:
3. Facility Physical Address:
City, State, Zip Code:
4. Facility Mailing Address:
City, State, Zip Code:
5. Latitude (decimal): ____________________ Longitude (decimal): ____________________
6. Consultant Contact Name:
Consultant Telephone #:
Fax #:
7. Responsible Official/Owner Name:
Address:
City, State, Zip Code:

B. FACILITY DESCRIPTION (ATTACH DOCUMENTS AS NEEDED)

1. SIC code: ______________ or NAICS code: ______________ Secondary SIC/NAICS code: ______________
2. Briefly describe the nature of business at this facility: ____________________
3. Briefly describe the types of materials, products, and wastes handled at the facility: ____________________
4. ☐ Existing soil/groundwater contamination (brownfield) plan Nearest cleanup site within ½ mile: ____________________(attach map)
5. Provide the number of projected trips per day from the traffic report for the site: _____
6. Land use zoning of facility: ☐ Industrial ☐ Commercial ☐ Residential ☐ Other: ____________________
7. Drinking water source: ☐ Public water ☐ Private Well
8. Process water source: Monthly average usage (gal./day): _____ ☐ Public water ☐ Private Well ☐ Recycled or Reclaimed
9. Indicate if present and submit a copy of:
☐ UIC spill prevention/response plan ☐ Employee training on spill plan ☐ Plug(s) or block(s) for UIC system
☐ Spill clean up supplies ☐ Containment structures ☐ Retrofit sampling data
☐ Maintenance program and schedule for UIC system(s) ☐ Fire Marshall survey/MSDS sheets (soluble)
☐ UIC storm water plan attached ☐ Monitoring plan attached
10. Does an adequate confinement barrier or filtration medium exist at the site to protect groundwater? ☐ Yes ☐ No ☐ Do not know
If "YES," attach relevant DHS/USGS documentation.
11. Is connection to or construction of a surface discharging storm sewer feasible? ☐ Yes ☐ No
If "NO," provide relevant documentation as to why a swale or other green options cannot be used: ____________________
12. Note if the location is a sensitive site: ☐ Steep slope or hazard area ☐ Groundwater Management Area
☐ Flood Plain ☐ Other: ____________________
13. Sign and attach a UIC non-exposure certificate. ☐ Attached (Not required if land use is residential.)
14. List any other DEQ or public agency permits applied for or issued to this facility: ____________________
15. Will these UICs be turned over to a municipality once developed? ☐ Yes ☐ No ☐ Do not know

C. UNDERGROUND INJECTION CONTROL INFORMATION – Go to next page of this form.

To expedite the registration of your facility, please fill out this form in its entirety.

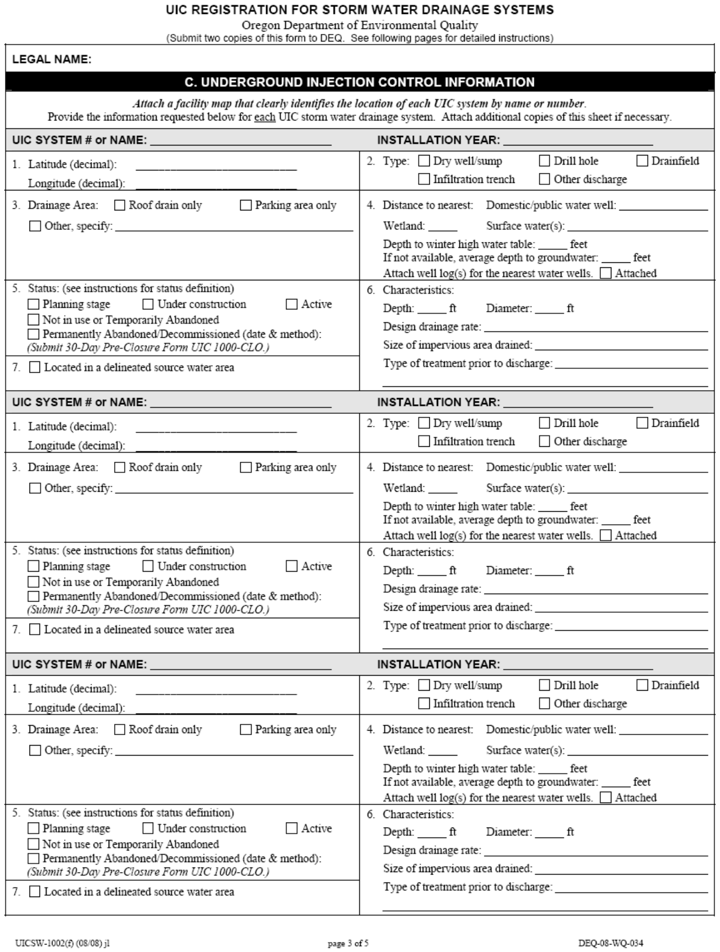
D. SIGNATURE OF LEGALLY AUTHORIZED REPRESENTATIVE

I hereby certify that the information contained in this registration is true and correct to the best of my knowledge and belief.

Name of Legally Authorized Representative (Type or Print) **Title**

Signature of Legally Authorized Representative **Date**

UICSW-1002(f) (08/08) jl page 2 of 5 DEQ-08-WQ-034



UIC REGISTRATION FOR STORM WATER DRAINAGE SYSTEMS
Oregon Department of Environmental Quality
(Submit two copies of this form to DEQ. See following pages for detailed instructions)

LEGAL NAME:

C. UNDERGROUND INJECTION CONTROL INFORMATION

Attach a facility map that clearly identifies the location of each UIC system by name or number.
Provide the information requested below for each UIC storm water drainage system. Attach additional copies of this sheet if necessary.

UIC SYSTEM # or NAME: ____________________ **INSTALLATION YEAR:** ____________________

1. Latitude (decimal): ____________________
Longitude (decimal): ____________________
2. Type: ☐ Dry well/sump ☐ Drill hole ☐ Drainfield
☐ Infiltration trench ☐ Other discharge
3. Drainage Area: ☐ Roof drain only ☐ Parking area only
☐ Other, specify: ____________________
4. Distance to nearest: Domestic/public water well: ______________
Wetland: _____ Surface water(s): ______________
Depth to winter high water table: _____ feet
If not available, average depth to groundwater: _____ feet
Attach well log(s) for the nearest water wells. ☐ Attached
5. Status: (see instructions for status definition)
☐ Planning stage ☐ Under construction ☐ Active
☐ Not in use or Temporarily Abandoned
☐ Permanently Abandoned/Decommissioned (date & method):
(Submit 30-Day Pre-Closure Form UIC 1000-CLO.)
6. Characteristics:
Depth: _____ ft Diameter: _____ ft
Design drainage rate: ______________
Size of impervious area drained: ______________
Type of treatment prior to discharge: ______________
7. ☐ Located in a delineated source water area

UIC SYSTEM # or NAME: ____________________ **INSTALLATION YEAR:** ____________________

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UICSW-1002(f) (08/08) jl page 3 of 5 DEQ-08-WQ-034

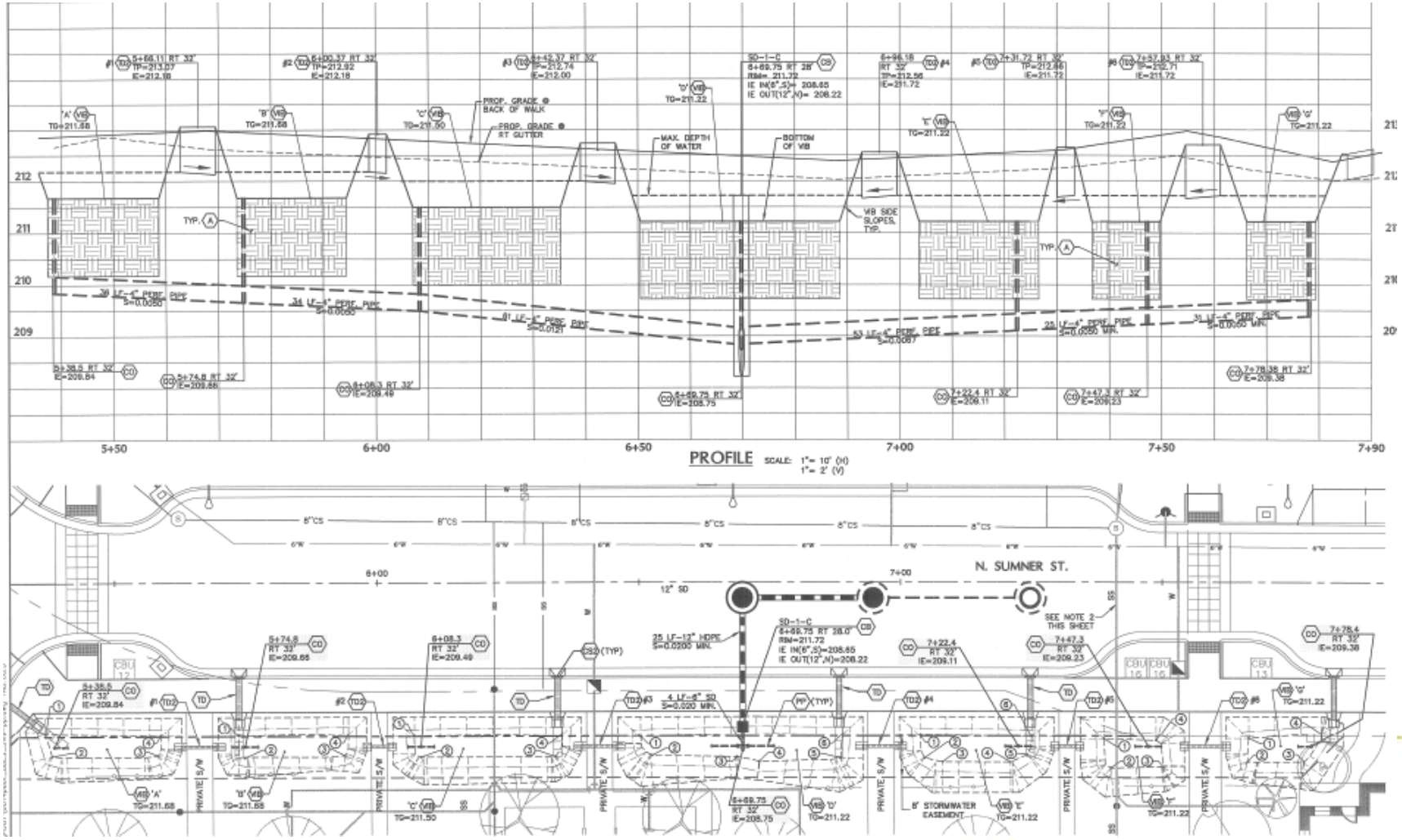
Overview of Presentation

- Applicability
- Sizing & Design
- Regulatory Permitting (UICs)
- Construction

Construction Phasing

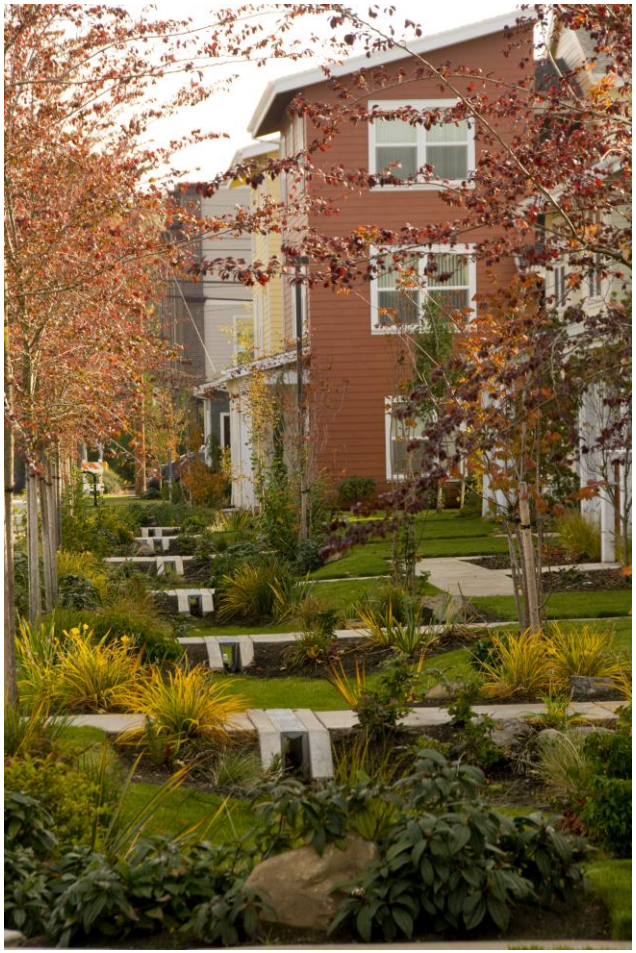
- Pre-Con with Engineer & Jurisdiction
- Many variables vulnerable during construction
- Details and Horizontal Control

Green Streets - Sumner



GREEN from the Ground Up

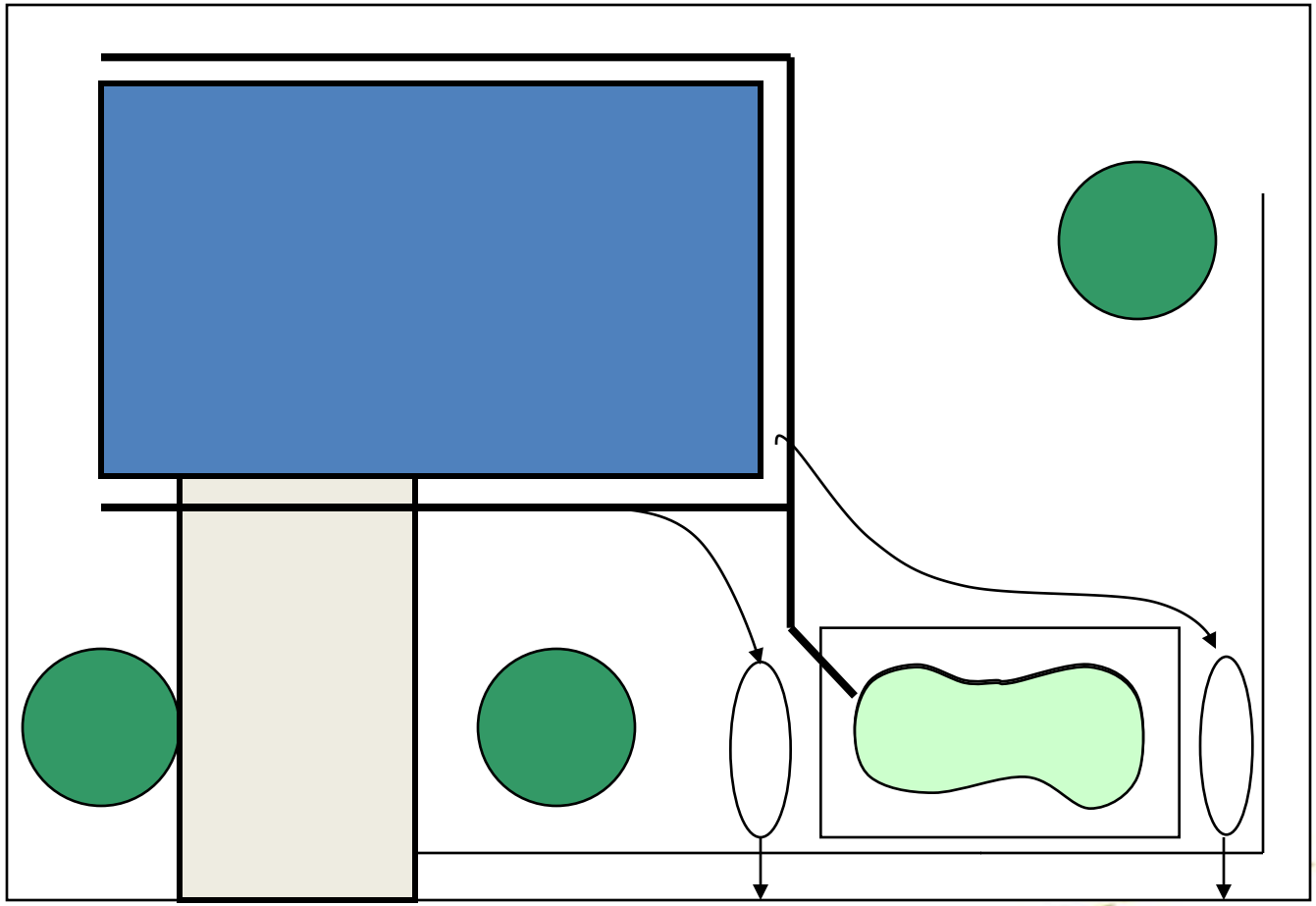
Green Streets - Sumner



Construction Phasing

- Pre-Con with Engineer & Jurisdiction
- Many variables vulnerable during construction
- Details and Horizontal Control
- Installation Sequencing & Erosion Control

Construction Sequence

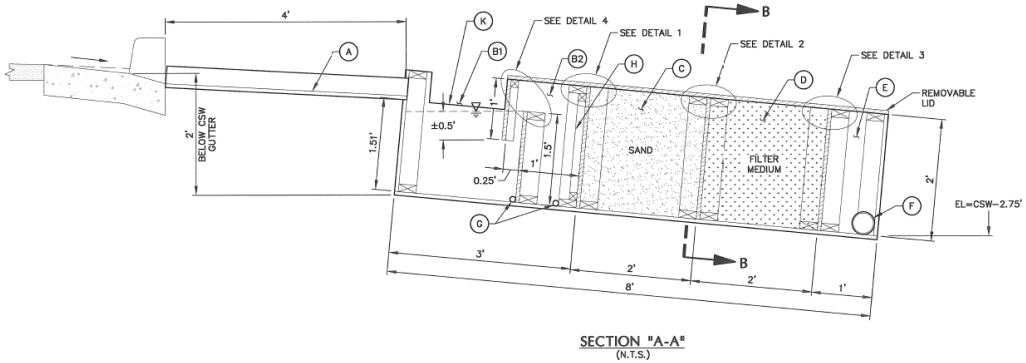


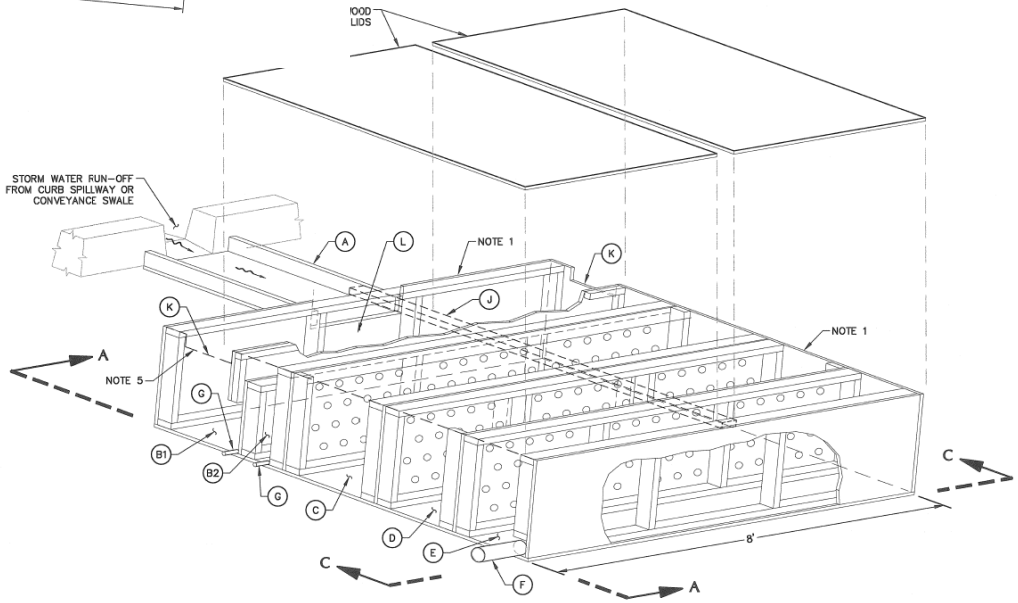
Facility Construction

- Outline area of facility
- Remove existing sod or vegetation
- Strip surface soils to expose suitable subgrade
- Build berm if needed on prepared subgrade
- Set gravel and/or growing medium per plan
- Final grading
- Plantings and finish materials
- Establishment period
- Route drainage to facility

In-Line Erosion Control

Erosion Control – Dual Filter





GREEN from the Ground Up

Construction Phasing

- Pre-Con with Engineer & Jurisdiction
- Many variables vulnerable during construction
- Details and Horizontal Control
- Construction Sequencing & Erosion Control
- Submittals & Testing
- Anticipate Weather Conditions
- Placement and Compaction
- As-Built Verification
- Maintenance

Construction – Gravel Bed with Underdrain

Construction – Initial Landscaping & Jute

Construction – Growing Medium and Rock Channel Bed

Construction – Growing Medium Replaced

Construction – Restored Facility

Summary

- Learn about site conditions and suitability
- Establish goals for facility
- Select facility type
- Facility should be designed by an experienced and knowledgeable Engineer with Detailed Grading Plan
- Permits
- Pre-Con & Construction Sequence
- Submittals & Horizontal Control
- Erosion Control
- As-Built Verification
- Maintenance

Questions?

Paul M. Dedyo, PE, LEED AP

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Presentation Topics

- Verde
- Stormwater Facility Maintenance
- Tenant & Homeowner Education
- Examples & Costs

www.verdenw.org

5135 NE Columbia Blvd, Portland, OR 97218 503.980.5260 (p), 866.279.8719 (f)

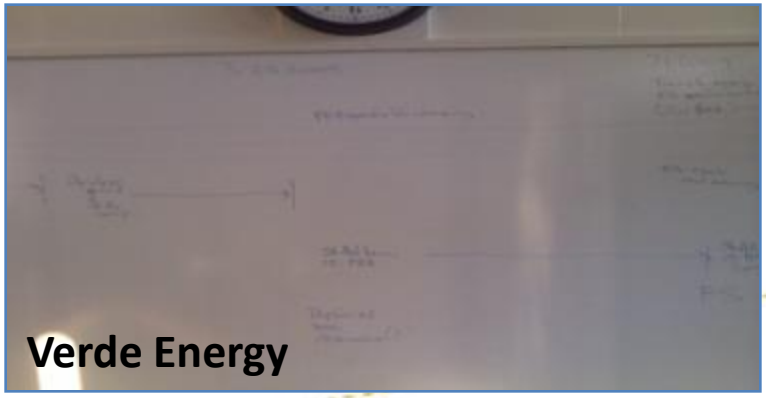
The Mission of Verde, a tax-exempt nonprofit corporation, is to improve the economic health of disadvantaged communities by creating job training, employment, and entrepreneurial opportunities, fostering the connection between economic vitality and environmental protection and restoration.

Activities

Social Enterprise

Outreach & Education

Social Enterprise



Outreach & Education

Friendly Maintenance Fact #1:
A Stormwater Facility is <u>Infrastructure</u>

It's a Lot Like:


A Ceiling/Roof


Plumbing

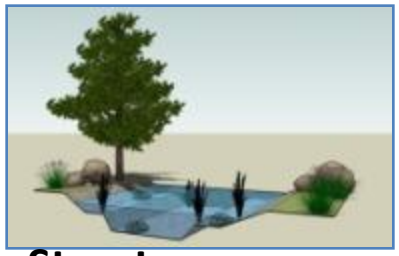
It's Not Like:


A Lawn


Ornamental Landscaping

Friendly Facility Maintenance Fact #2: Follow the O&M Plan

Access

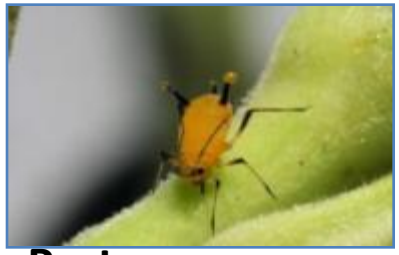


Structure

Water Flow/Infiltration

Vegetation

Erosion

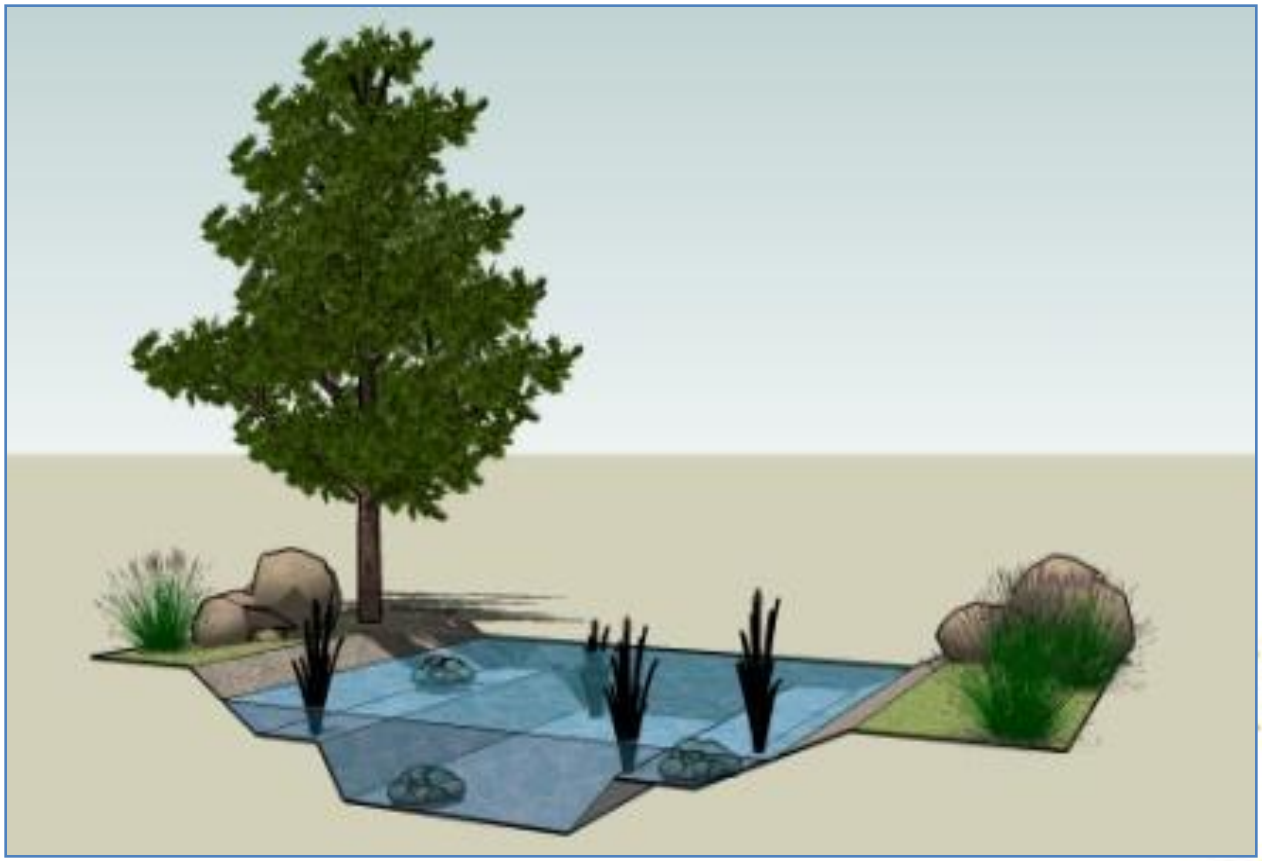


Pests

Pollution/Debris

O&M Plan: Access

O&M Plan: Structure



Missing Part(s)

Broken Part(s)

Not To Design Standards

O&M Plan: Water Flow/Infiltration

Blocked, Capacity Diminished

Uneven ponding or Stagnant-Standing Water

O&M Plan: Vegetation

Strained Vegetation

Insufficient Plant Cover

Remove Invasives, Noxious Weeds

O&M Plan: Erosion

Scouring

Channelization

Slope Failure

O&M Plan: Pests

O&M Plan: Pollution

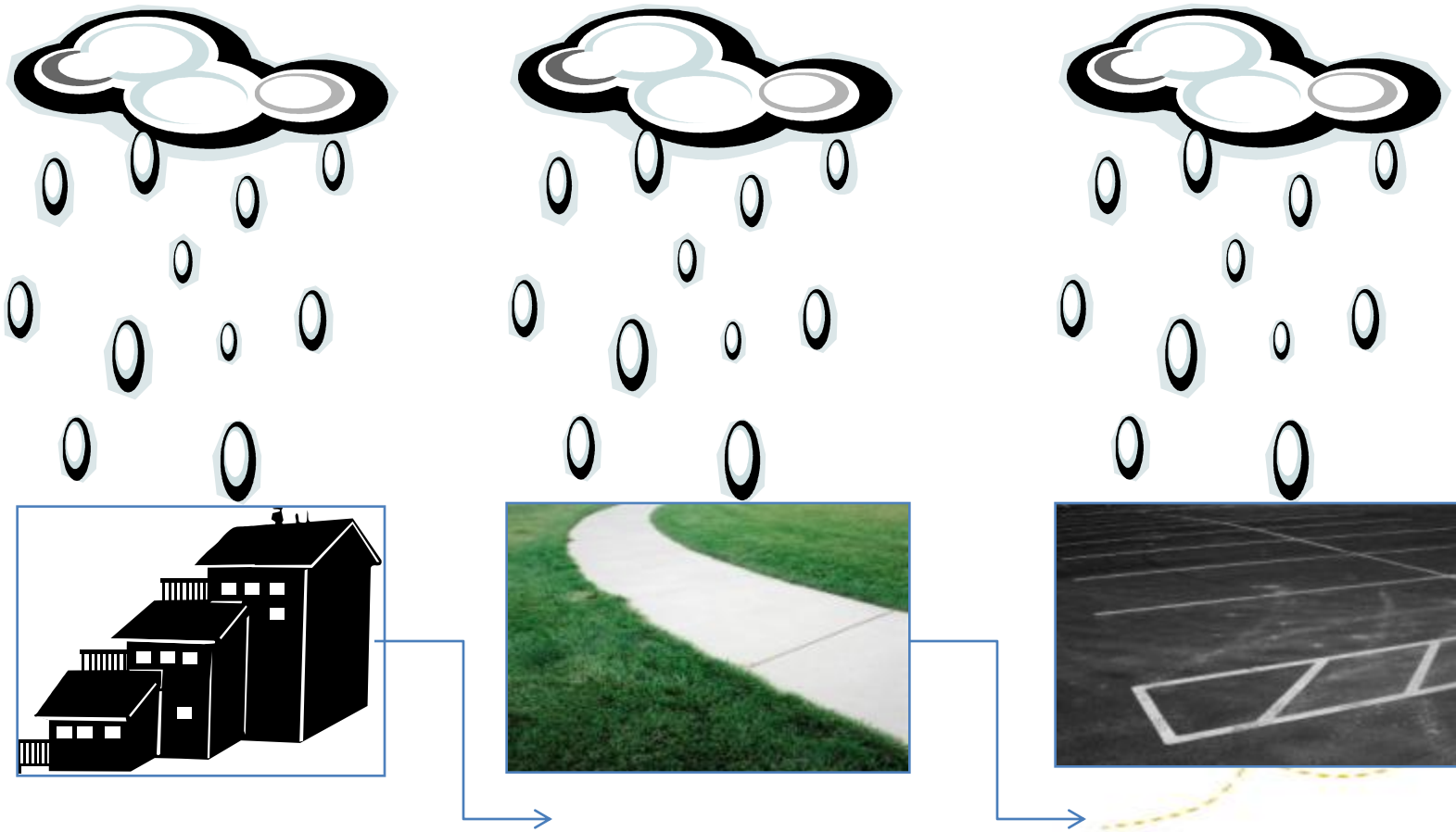
Debris

Off-Color, Odor

Friendly Facility Maintenance Fact #3:

<u>Tenant & Homeowner Education</u> Makes a Big Difference

Tenant Education: Stormwater



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Tenant Education: Stormwater

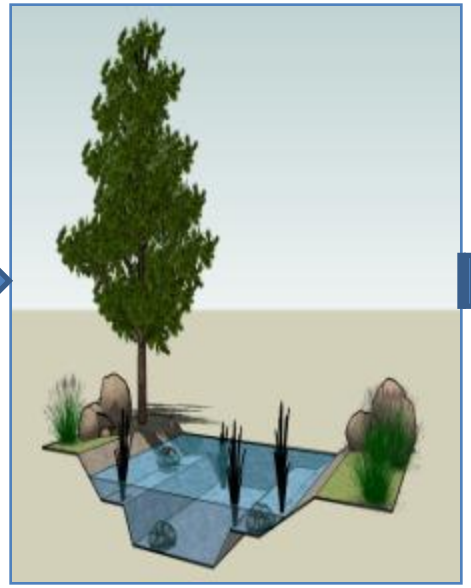
Stormwater Contains Pollution

Stormwater Takes Pollution To:

Tenant Education: Facility Function

Stormwater with Pollution

Stormwater Facility



Stormwater w/o Pollution

Tenant Education: Facility Locations

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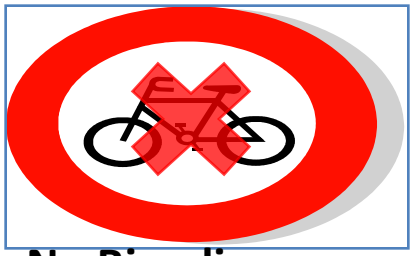
Tenant Education: Plant Health

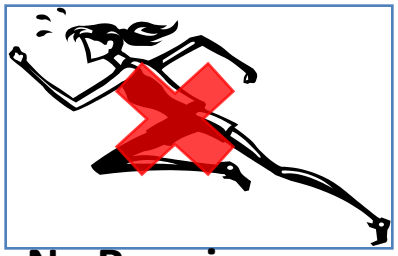
Redtwig Dogwood

- **Function: Habitat, Erosion Control**
- **Warning: Leaf color changes when plant is not receiving enough water**

Tenant Education: Stewardship



No Bicycling

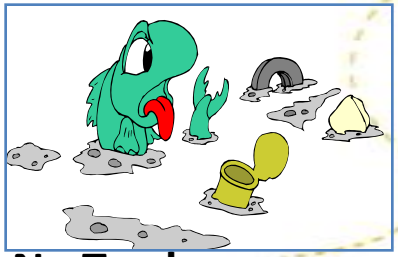


No Running

Rocks

Tree Stakes

Watch for Plant Health



No Trash

Friendly Facility Maintenance Fact #3:
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<u>Tenant & Homeowner Education</u> Makes a Big Difference

Example: Deferred Maintenance

Example: Deferred Maintenance

Example: Deferred Maintenance

Example: Deferred Maintenance

Example: Corrective Action

Example: Corrective Action

Example: Corrective Action

Example: Corrective Action

503.980.5260 www.verdenw.org alan@verdenw.org

GREEN from the Ground Up

Thank you partners!

- Oregon Department of Environmental Quality
- Clean Water Services
- Home Builders Association of Metro Portland
- Green Works
- KPFF Engineering
- Verde

GREEN
from the Ground Up
Seminars for land-savvy developers

Metro

GREEN WORKS

Clean Water Services

VERDE

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