working for clean rivers

Green Street Challenges and Design Considerations

Watershed Revegetation Program
Bureau of Environmental Services

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ENVIRONMENTAL SERVICES
CITY OF PORTLAND

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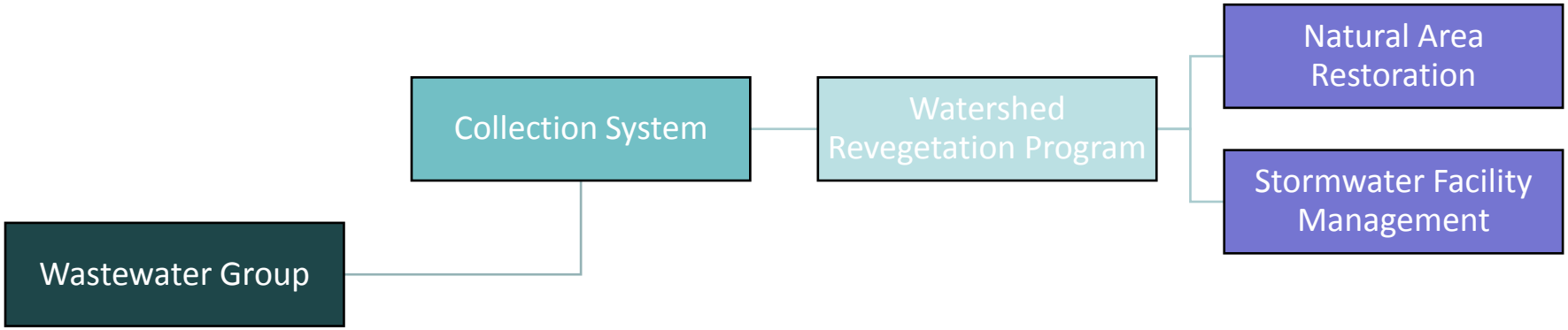
Presentation Outline

Background
Challenges and Considerations
Summary
Questions

Background

Watershed Revegetation Program



- Design and Plan Review
- Facility Inspection
- Planting
- Contractor Management
- Maintenance
- Irrigation
- Tree Pruning

Adopted Bureau Level of Service (LOS)

CATEGORY	(Good Effort)
Vegetation	✓ Plants are mostly healthy ✓ Small quantities of weeds ✓ At least 75% plant survival
Litter	✓ Small quantities of litter present
Soils	✓ Occasional bare spots ✓ Erosion?
Function	✓ Checkdam condition? ✓ Inlets are open no less than 50% of time
Maintenance Effort	✓ WRP staff inspect a minimum of 2 times/year ✓ Maintenance crews visit sites 3-4 times/year ✓ Dead plants are selectively replaced ✓ Checkdams are selectively repaired/rebuilt

Level of Service

- Maintenance Activities
  - Routine (~3-4/year)
    - Inlet cleaning and sediment removal
    - Leaf and trash removal
    - Weeding
  - Periodic (as needed)
    - Tree and shrub pruning
    - Irrigation

Level of Service

- Repair Activities
  - Replanting
    - Plant coverage or health below service level
  - Structural Damage
    - Chipped/cracked curbs
    - Broken check dams, etc.

Pass

INLETS

VEGETATION COVER & HEALTH

SEDIMENT

Fail

Challenges and Design Considerations

Why is this important?

1. Provide lessons learned from field observations and maintenance history
   - Facility Design
   - Facility Siting
2. Improve feedback loop between design and maintenance

Challenges and Design Considerations

Topics Covered

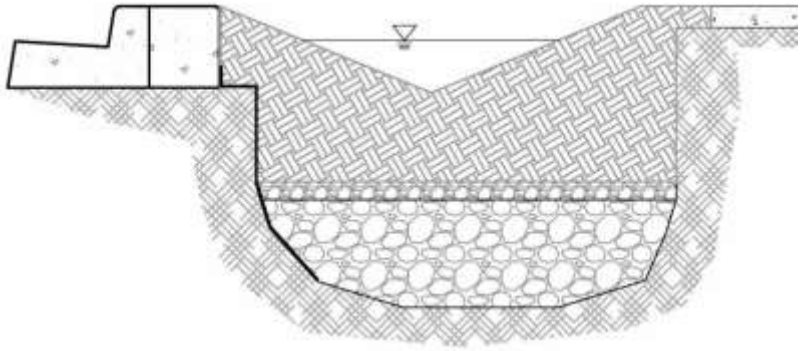
- Planters and Swales
- Inlets
- Splash Pads
- Forebays
- Step-Out Zones
- Check Dams
- Soils
- Rock Galleries

Planters and Swales

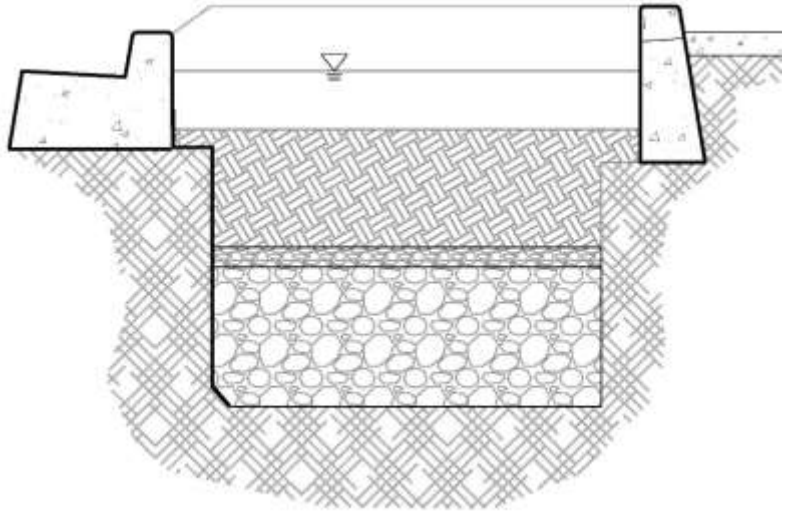
Planters and Swales - Challenges

- Design type affects plant choices, plant health and maintenance costs.

Swale

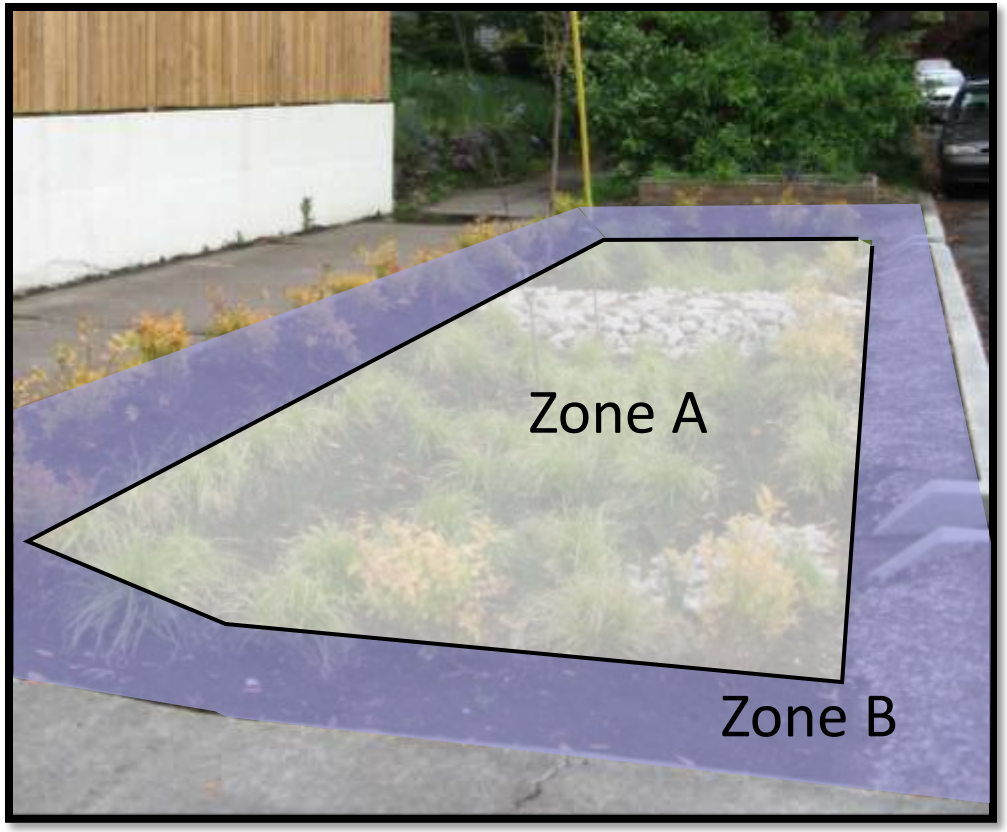


Planter



Planters and Swales – Challenges

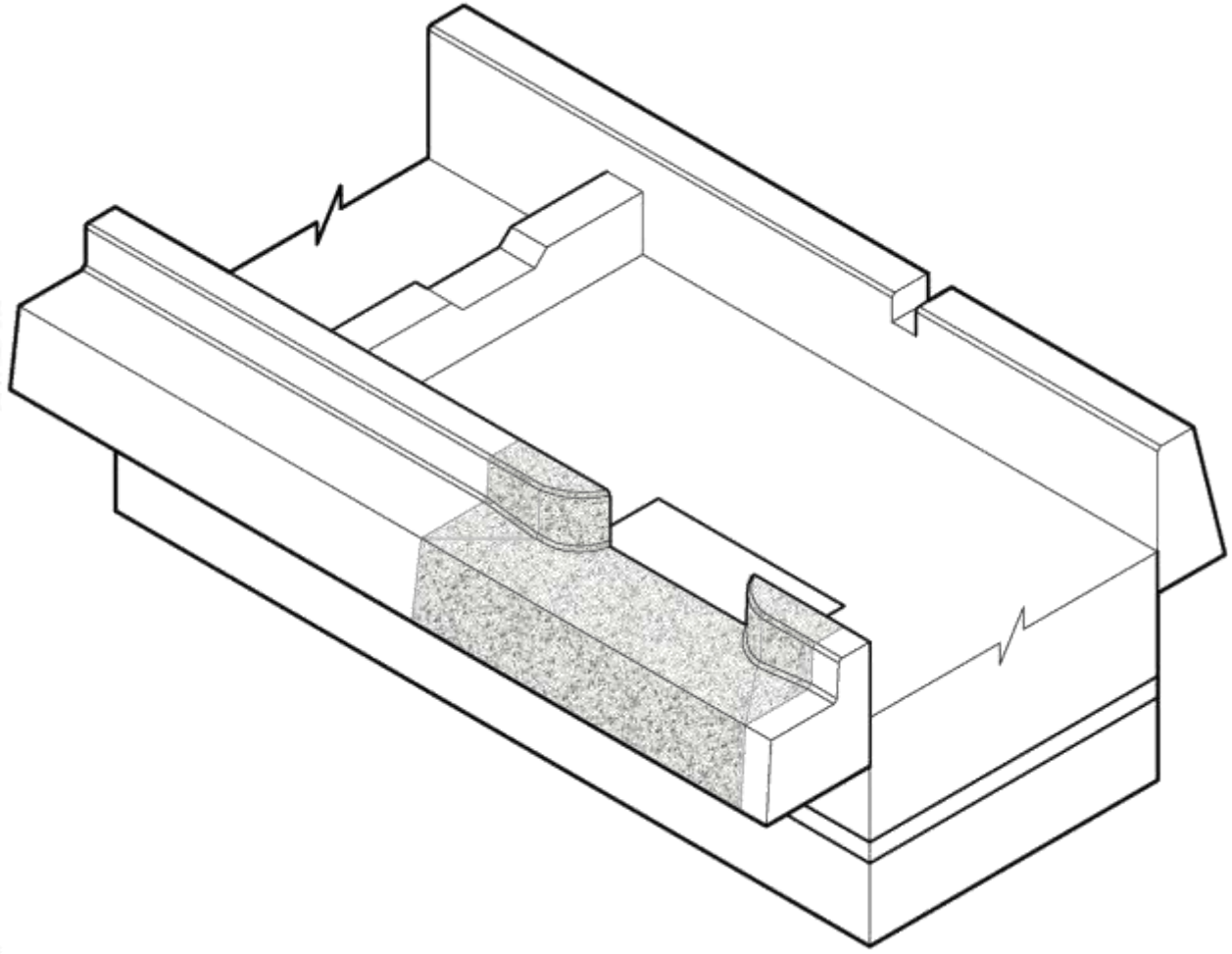
- Swales may cost less to build, but more costly to maintain.
- Zone A
  - Treatment area
- Zone B
  - Irrigation
  - Weed Intrusion
  - Pedestrian Damage



Planters and Swales – Considerations

- Advantages of planters
  - Zone A only
  - Plant installation simpler
  - Less weed intrusion
  - Flood irrigation
  - Fewer external impacts

Inlets



Inlets – Challenges

- Must allow water to enter facility
- Will clog – must be easy to clean
- Allow sediment and leaf debris to enter and be detained
- Trenches further complicate cleaning

Inlets – Considerations

- Wide openings without obstructions work best

Inlets – Considerations

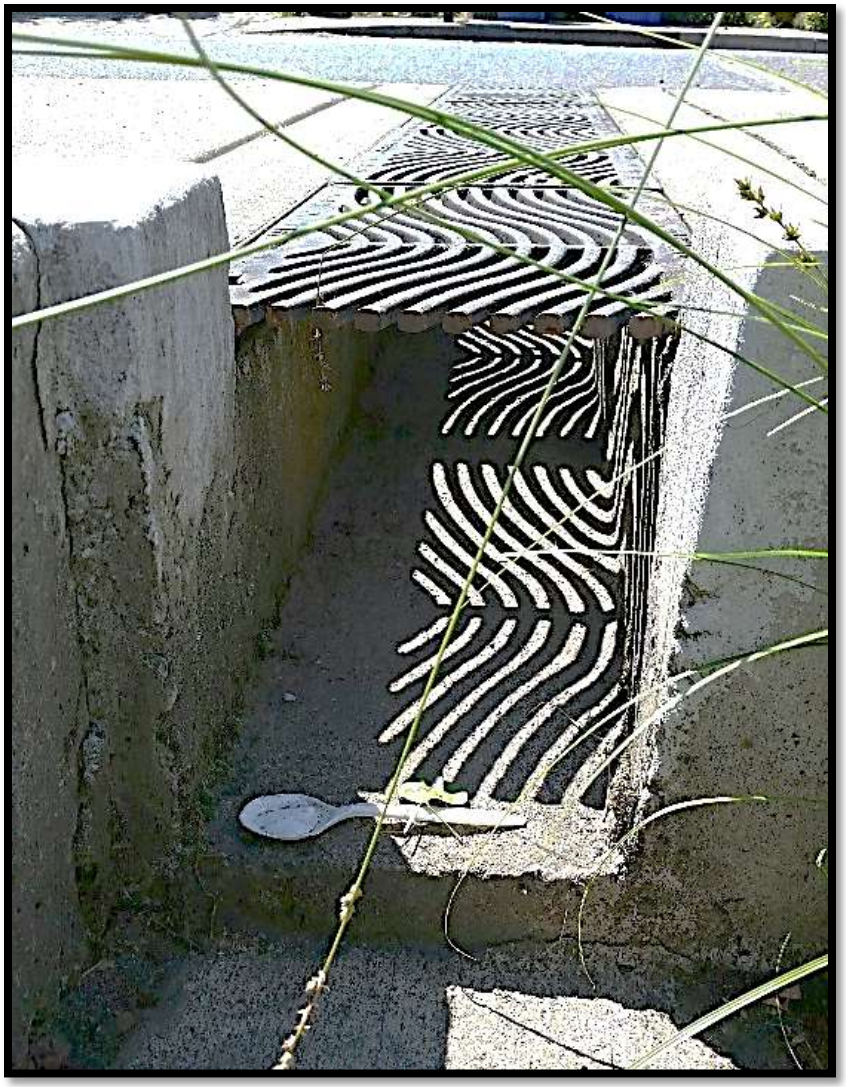
- Trenches longer than an arms-reach require specialized tools
- Narrow facilities & long trenches necessitate working in the street

Inlets – Considerations

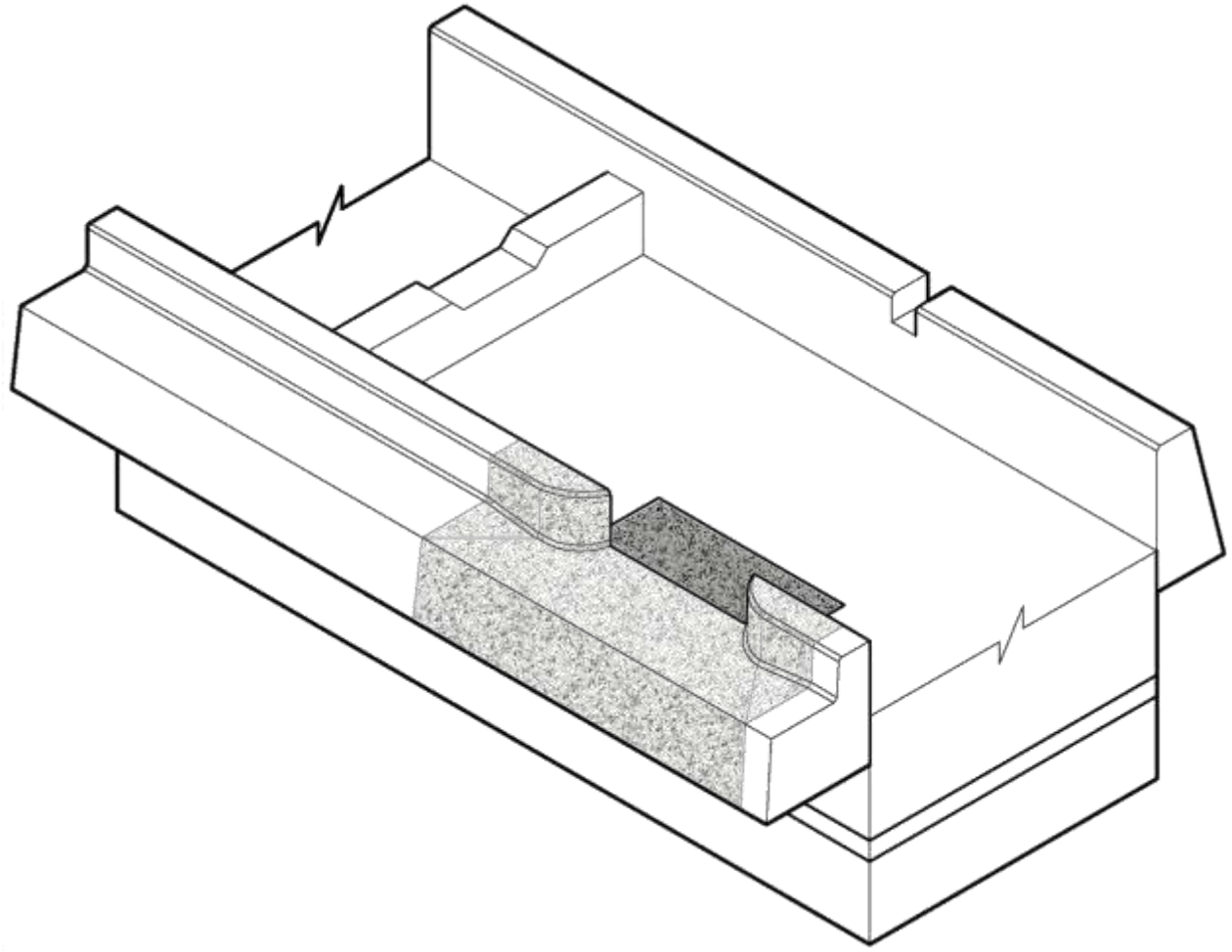
- Grates should be removable
  - Tamper-resistant vs. hex-head bolts
  - Traffic Rated

Inlets – Considerations

- Inlet opening size is very important



Splash Pads



Splash Pads – Challenges

- Must be cleaned quickly
- Need to be set level with soil (+/- 1”)
- Right size for the facility

Splash Pads – Considerations

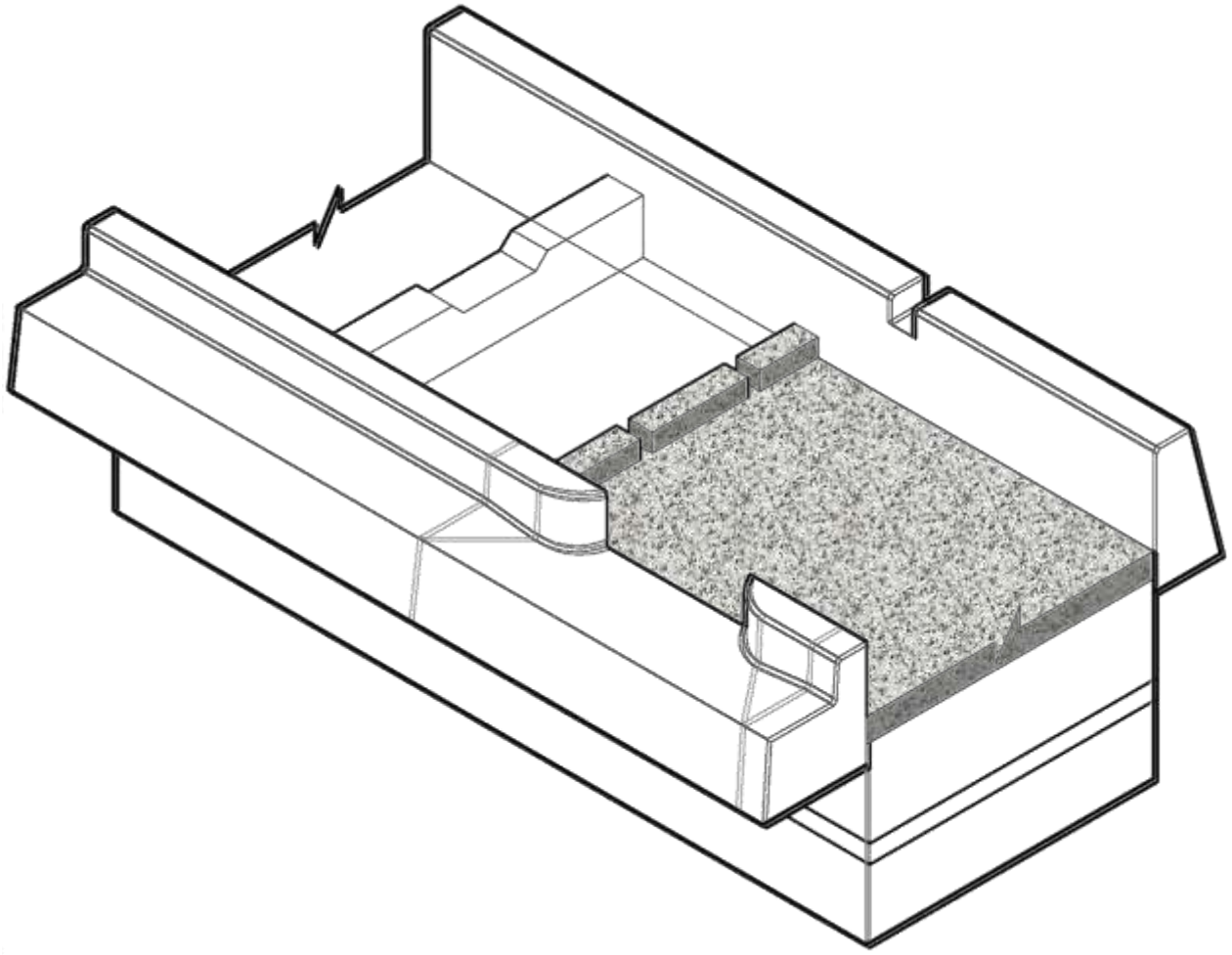
- Rock is time consuming to clean
  - Concrete works best

- Set the pad flush with the soil to reduce erosion

Splash Pads – Considerations

- Eliminate ‘dead’ space
  - Hard for plants to grow in <18” between pad and wall

Forebays



Forebays – Challenges

- Situational
- Need to drain – no standing water
- Accessible and easy to clean (concrete bottoms)

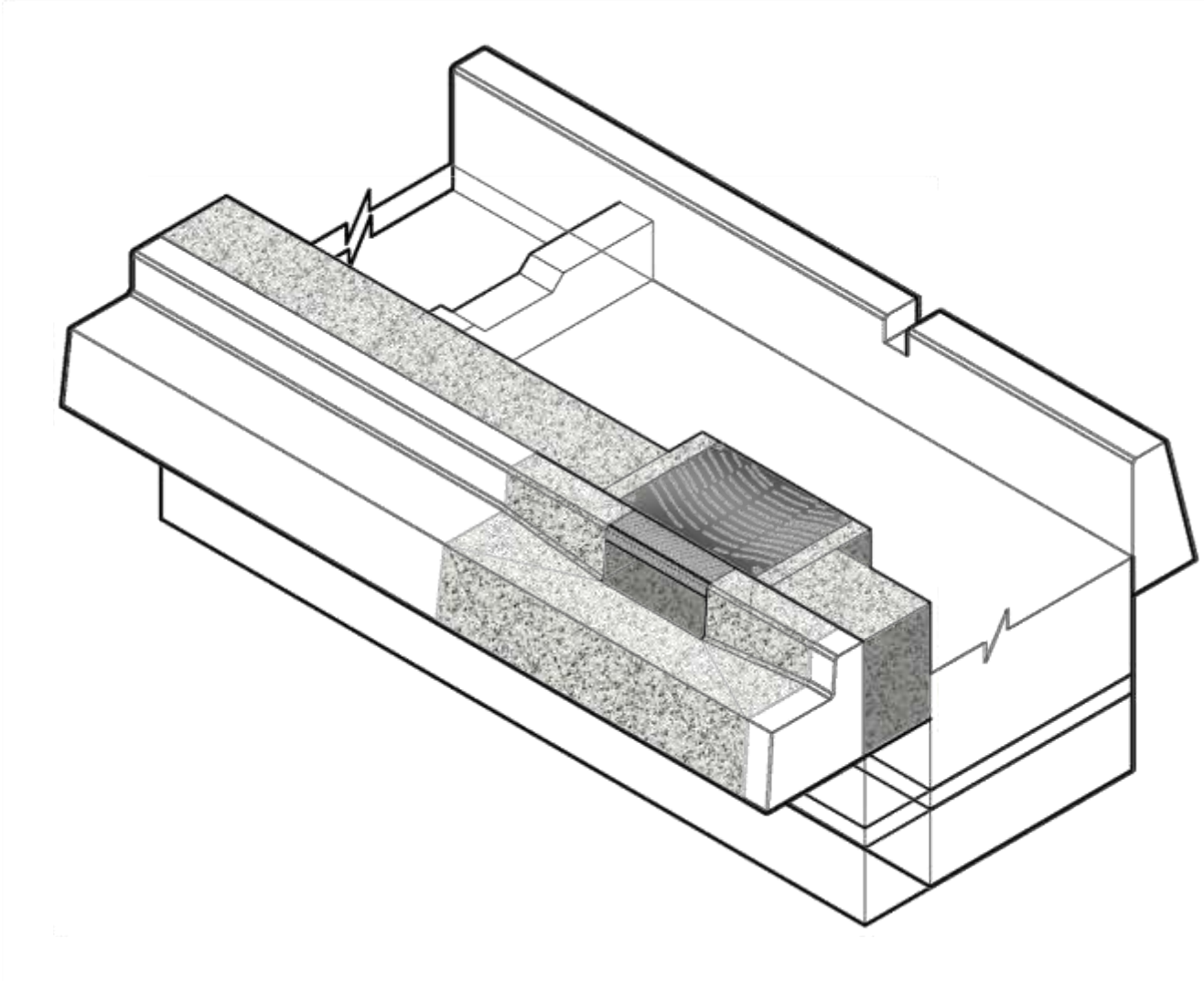
Forebays – Considerations

- Use on high-traffic streets or where there are sediment concerns

Forebays – Considerations

- Weep holes clog
- Vertical slots preferred
  - 1”- 3” wide
  - Multiple slots

Step-out Zone



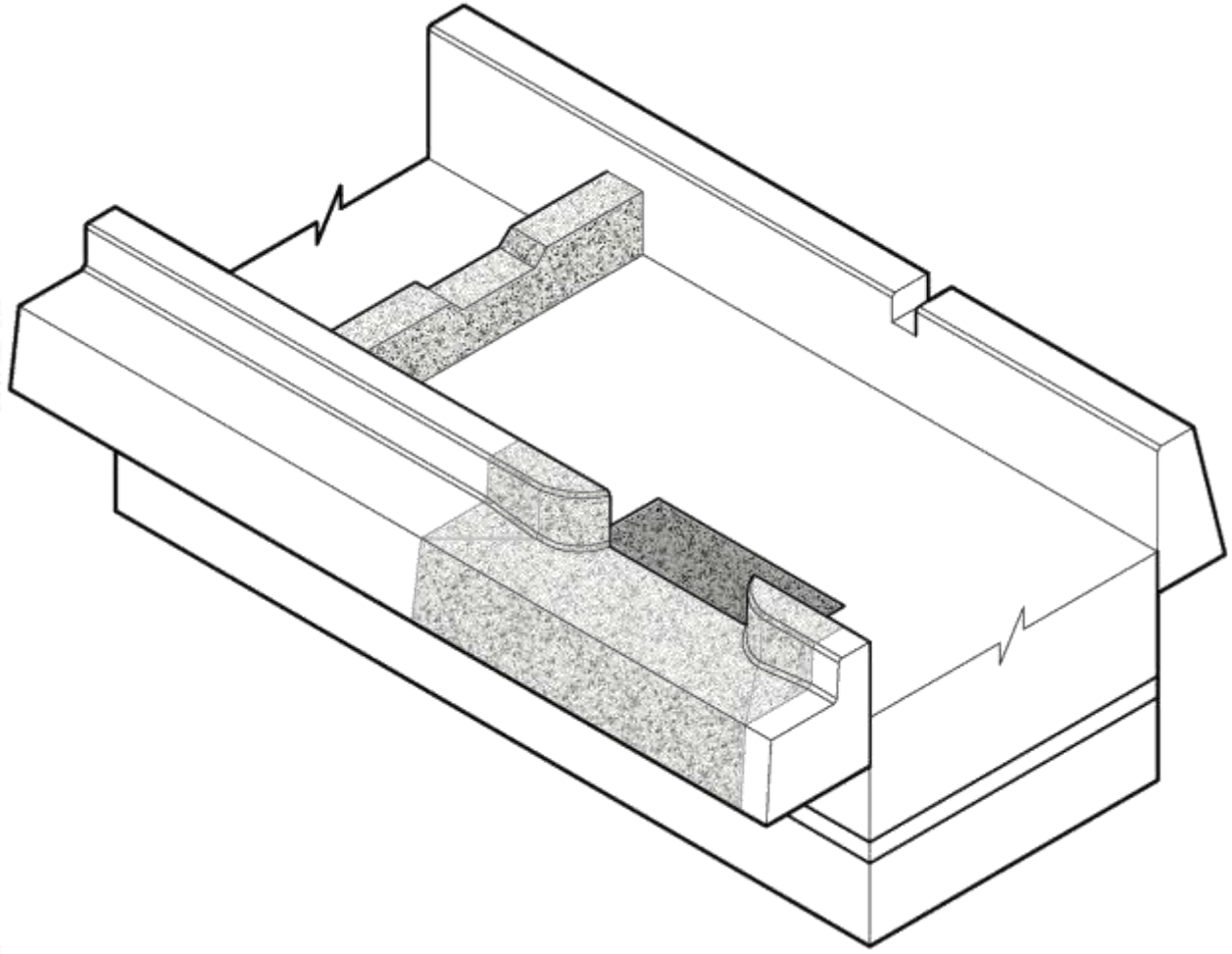
Step-out Zones – Challenges

- If you build it, people will walk there
- Protect people
- Protect the City's infrastructure investment
- Needs to be durable and reduce maintenance

Step-out Zones – Lessons Learned

- Rock step-out zones subside, more maintenance
- 12’ Concrete step-out more durable and low maintenance

Check Dams



Check Dams – Challenges

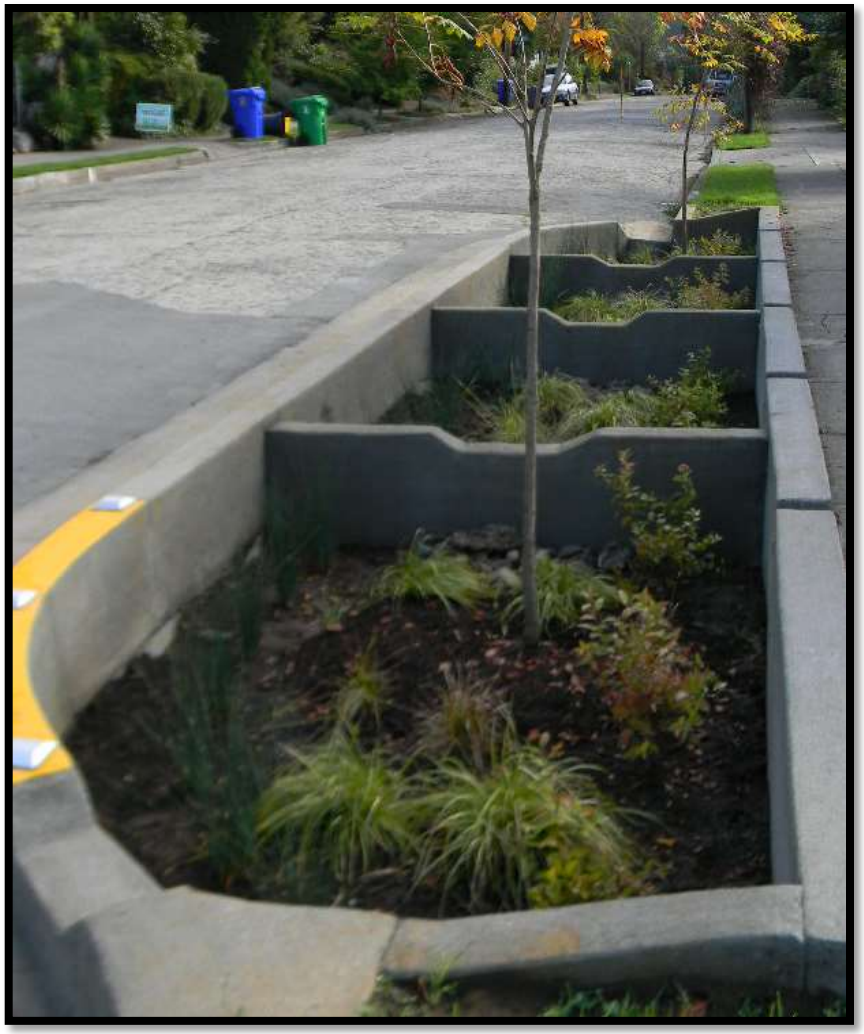
- Multiple options. One size does not fit all. Make the solution fit the problem
- Need to consider life-cycle costs
- Materials used: clay, rock, wood, concrete, plastic, metal

Check Dams – Considerations

- Clay core not durable
  - Clay washes out
  - Dam gets trampled or settles
- Rock dams do not detain water effectively
  - Rocks don’t stay in place

Check Dams – Considerations

- Concrete dams are durable and low-maintenance
  - Makes the most sense where there is a sidewalk wall to connect to
  - Static material; cannot be easily changed



Check Dams – Considerations

- Notches are useful but can cause erosion
- Most important to get the height of the dam correct
  - Elevation must be tied to other facility elements

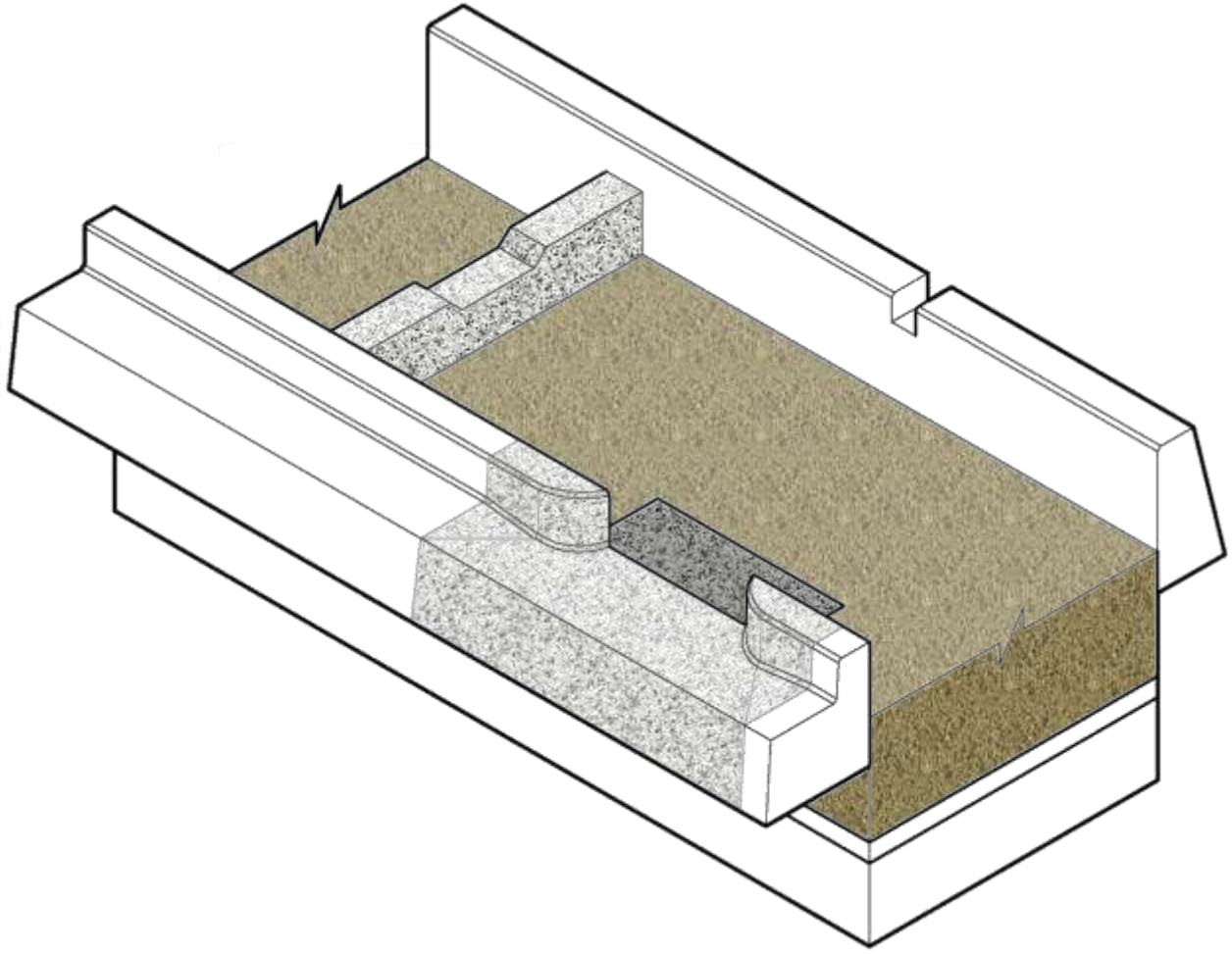
Check Dams – Considerations

- Wood dams best for retrofits, swales, challenging situations
  - Have used Douglas Fir, Cedar, Juniper
  - Juniper is expected to last the longest
    - Limited sizes
  - Chemically treated wood not permitted

Check Dams – Considerations

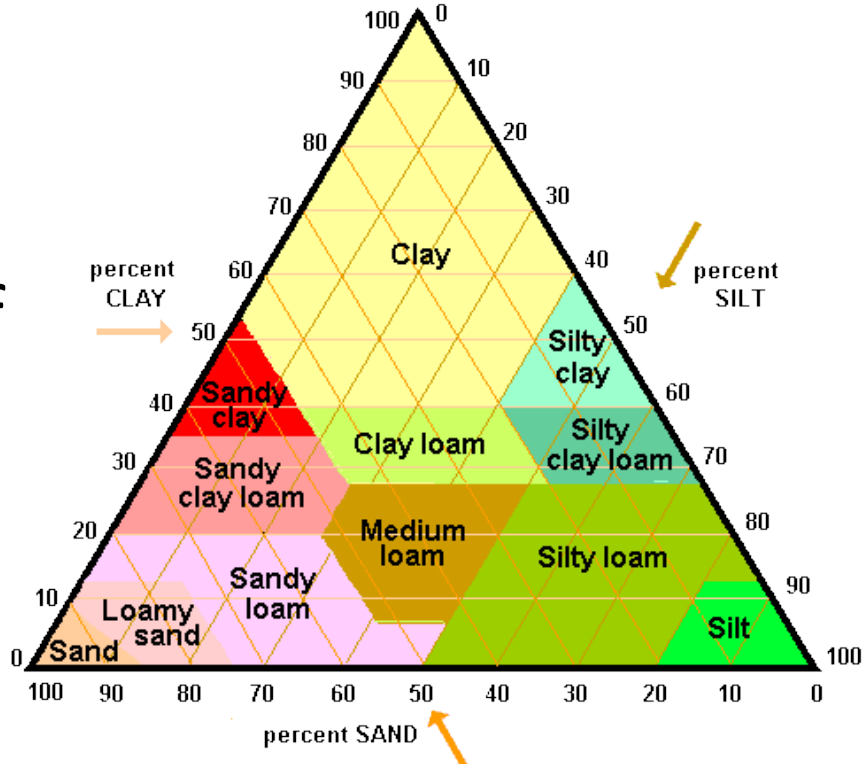
- Wood is a dynamic material and can easily be altered
- Gaps at the ends are problematic
  - Wood must be cut to fit
  - Sealant may be used

Soils



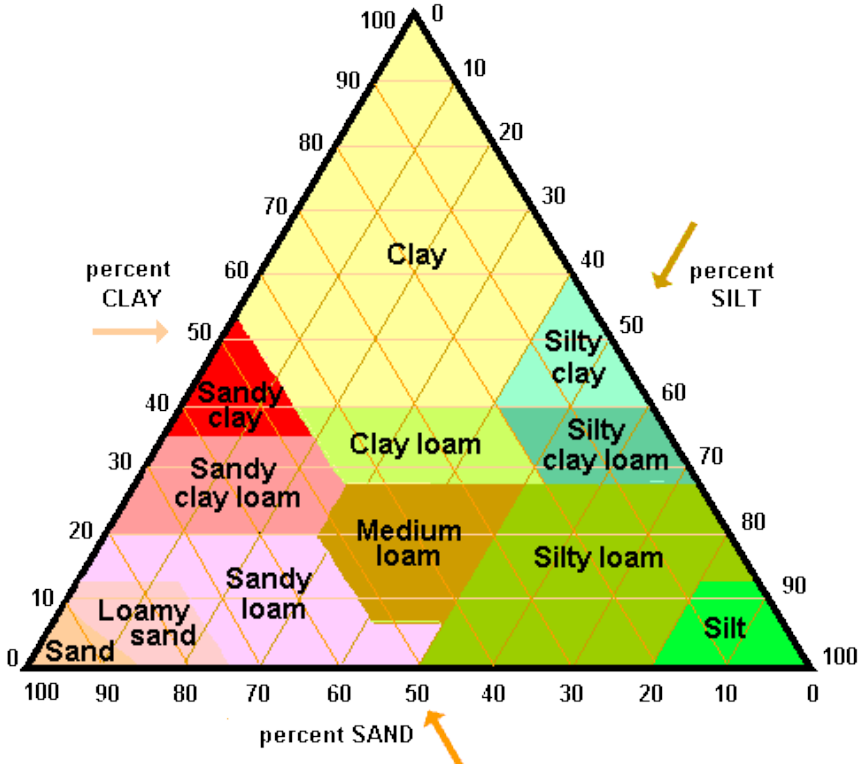
Soils – Challenges

- Filters storm water and sustains plant life
- Must infiltrate rapidly enough to get water off the street
- Current BES req.
  - 40% compost
  - 50%-60% sand
  - <10% fines (200 sieve)



Soils - Considerations

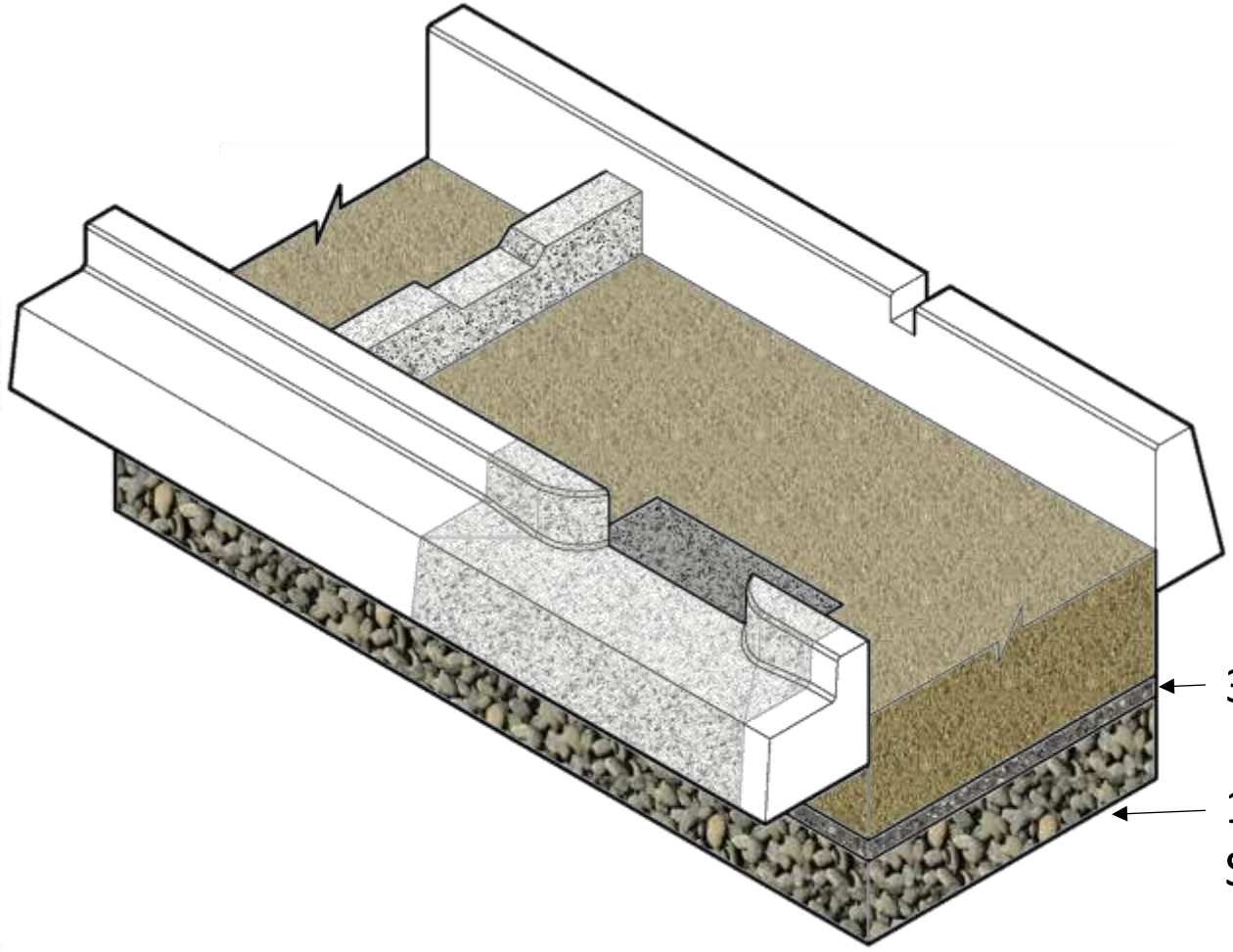
- High-sand soil mixes greatly restrict plant longevity
- Uniform soil mixes retain less water in the summer



Soils - Considerations

- Weed seeds can be imported with the soil
- Compost breaks down over time and can export phosphorus

Rock Galleries

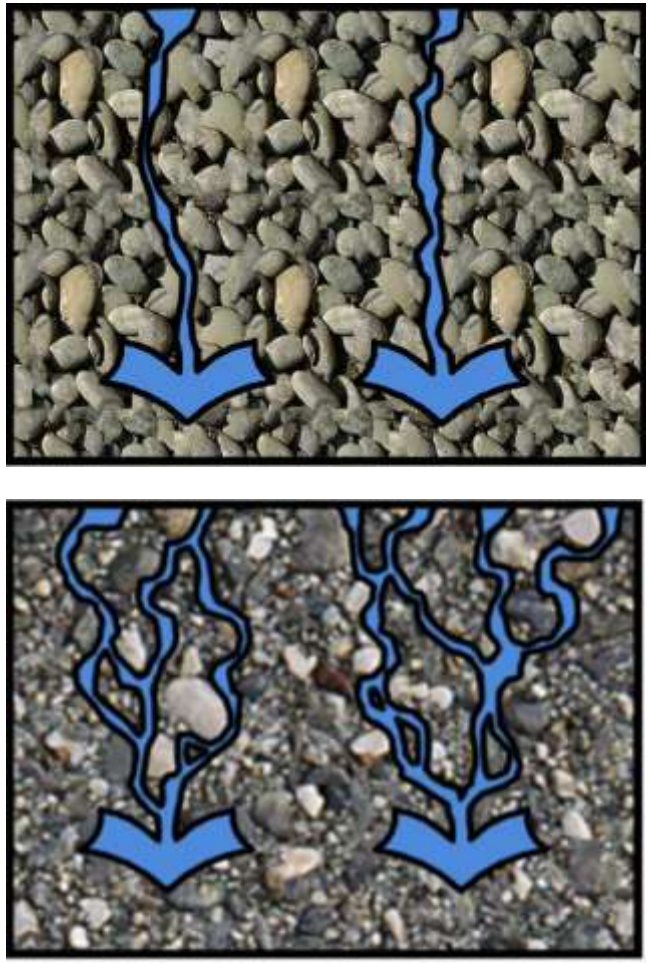


Rock Galleries - Challenges

- Drought-related stress observed in plants in facilities with rock galleries
- Rock Galleries are useful tools, but should not be an assumed part of the facility

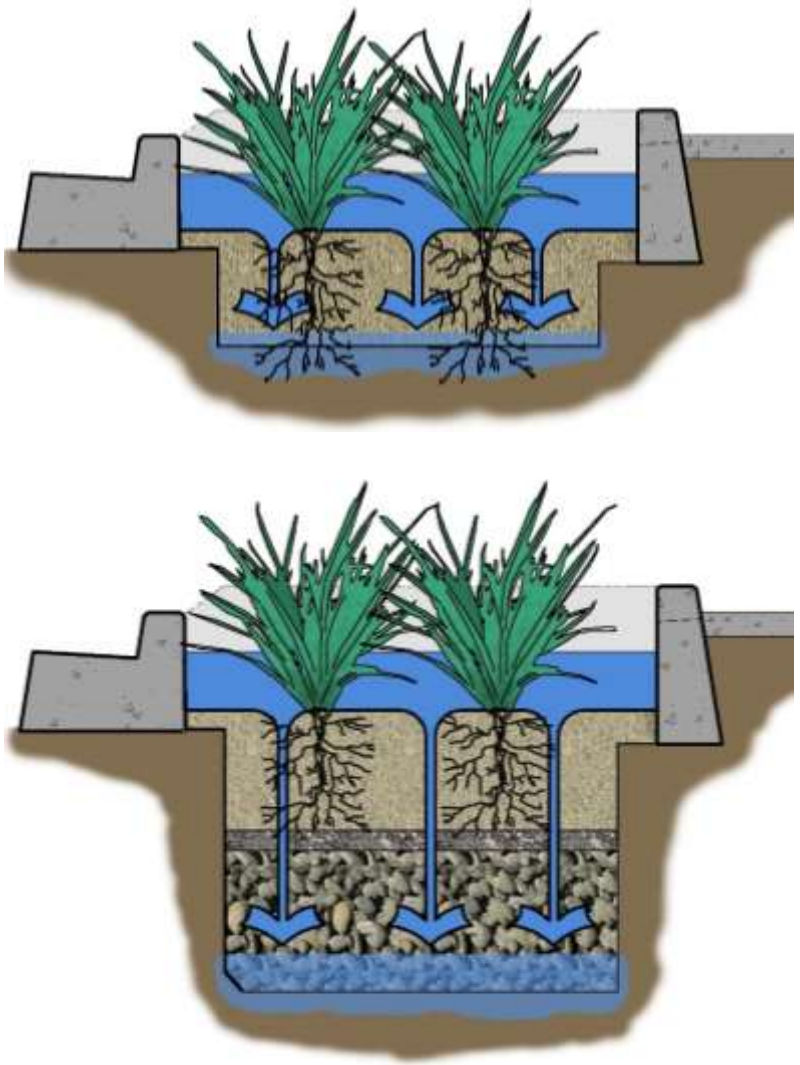
Rock Galleries – Considerations

- Hydraulic Conductivity (*K*)
  - Ratio at which fluids, such as rain water, move through soil, rock, plant roots, etc.
  - Higher *K* means less water suspended in soil and accessible to plant roots



Rock Galleries – Considerations

- Rock Galleries may be contributing to declining plant health
  - water drains quickly through the soil (high *K*) and collects at the bottom of the facility
  - Rock galleries may prevent roots from accessing this water



Summary

Recommendations – Planters and Swales

- Planters are preferred for ease of maintenance, less foot traffic, less structural issues
- Upland planting areas (Zone B) should be minimized
  - Step-out zones should be added next to on-street parking

Recommendations – Inlets

- Wide openings with no obstructions
- Trenches
  - Must accommodate tools: 12” wide and 4-5’ long
  - Removable grates with tamper resistant bolts

Recommendations – Splash Pads

- Concrete, not rock
- Set flush with soil
- If the “plantable” space behind the pad is less than 18” – extend the pad to the wall

Recommendations – Forebays

- Best used on busy, heavily traffic streets
- Larger is better
- Use slots for drainage
  - Slots should be 1”-3” wide

Recommendations – Step-Out Zones

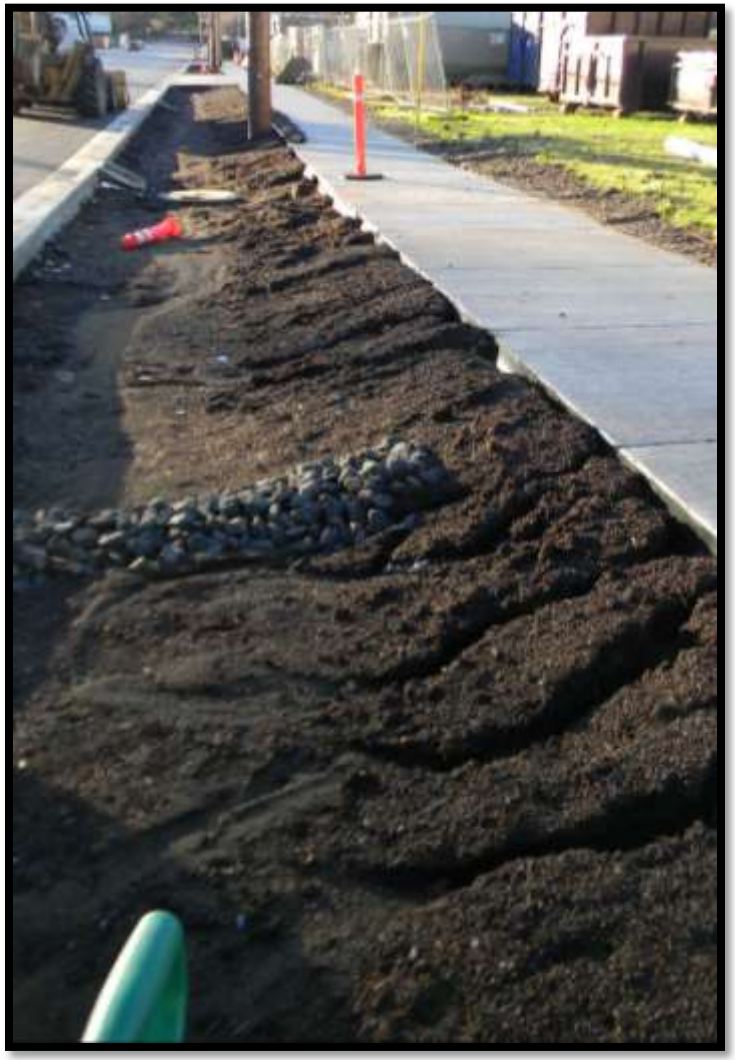
- Identify the need early in the design process
- Use concrete step out zones
- Gravel step-out zones can be retrofitted to concrete

Recommendations – Check Dams

- "Right dam in the right place"
- Concrete is the most durable and low maintenance
- Wood is best for swales and retrofit situations
  - Look for long-lasting woods like Juniper
  - Minimize gaps at the ends of wood dams
- Make sure dam height is correct
- Notches do not need to be in the middle

Recommendations – Soils

- Need to look beyond infiltration rate alone for facility soil needs
- A good soil mix can benefit plant health and lower maintenance costs



Recommendations – Rock Galleries

- Is the rock gallery needed?
- If a tree is required, can the rock gallery be removed, reoriented, or truncated to avoid interaction with tree roots?
- Can the rock gallery be designed such that plant roots can access the native subgrade?

Green Street Program Successes

- Green Street program began with three facilities in 2003
- Grey and Green infrastructure work well together
- Overall, public acceptance of facilities has been positive

Questions

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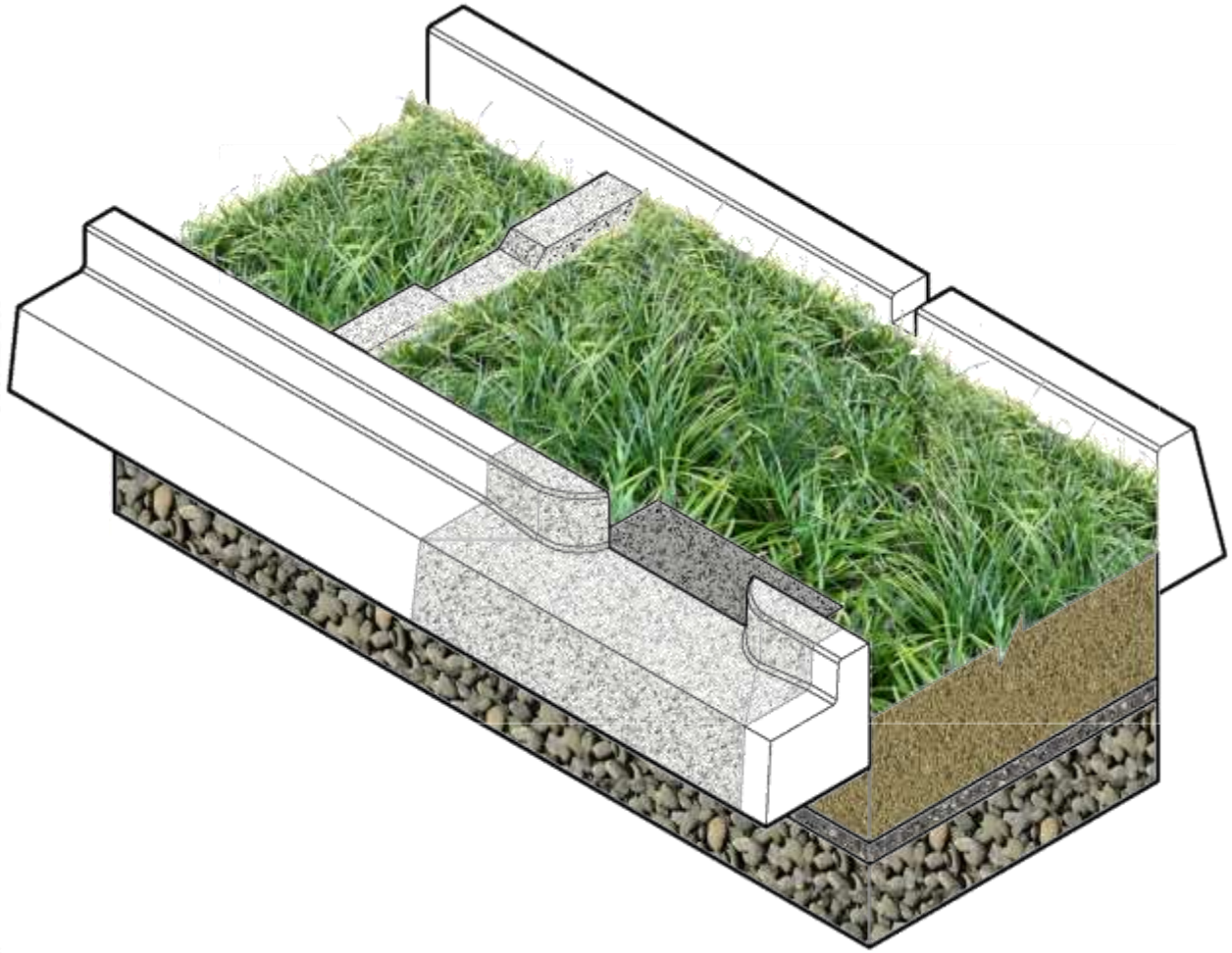
Plants in SMFs



Plants in SMFs – Challenges

- Plants must tolerate a range of conditions
- Slope, aspect, microclimate, upstream issues, heat island and sight lines (30” from top of curb)
- Safety and visibility

Plants in SMFs – Considerations

- Plant selection helps control maintenance costs
- Specify plants that perform well for site conditions
- SWMM Plant List updated based on successes

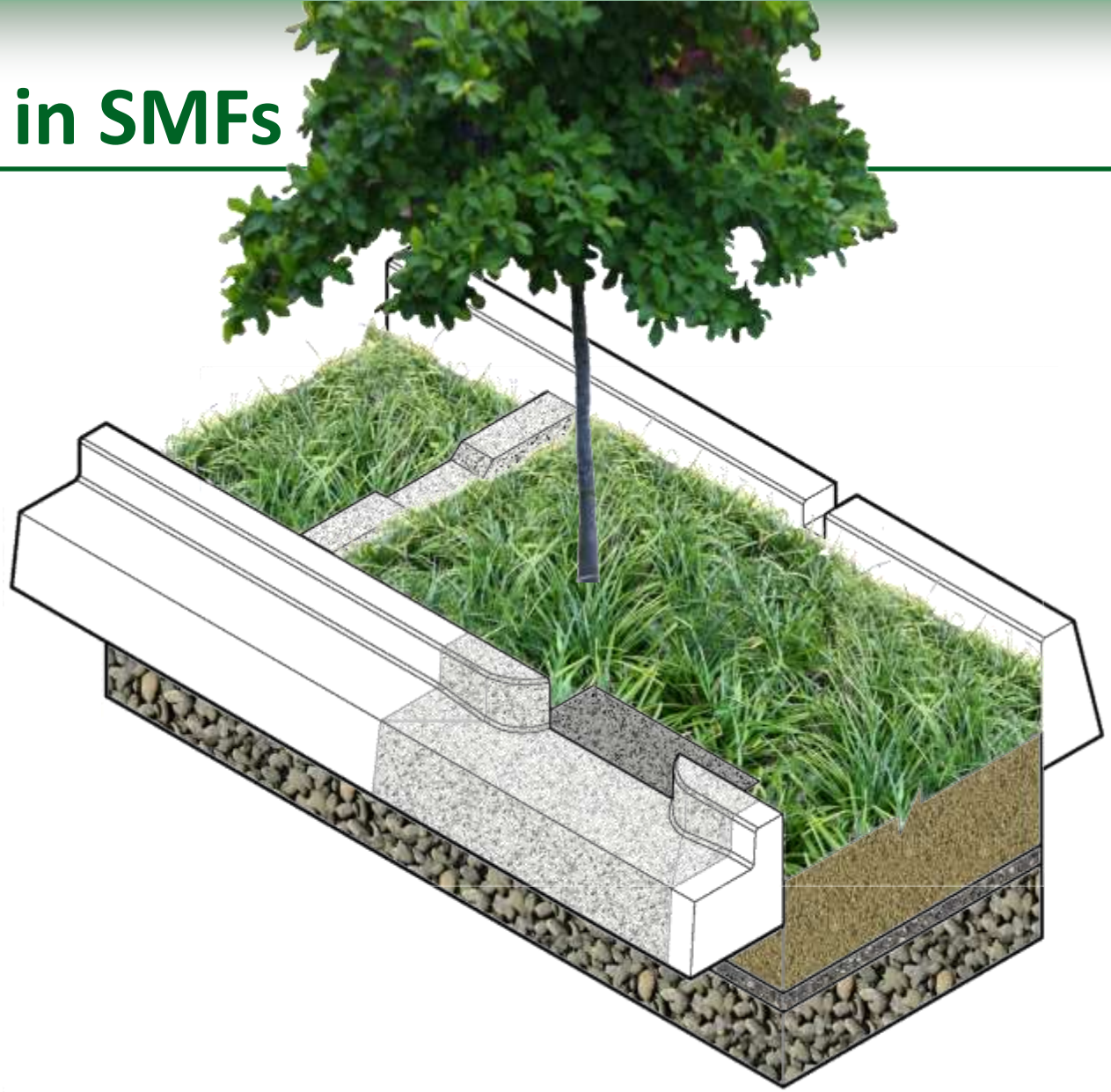
Plants in SMFs – Considerations

- Irrigation (post-establishment) is an ongoing cost
  - FY12 - $32,000
  - FY13 - $53,000
  - FY14 -$50,000
  - FY15 - $70,000
  - FY16 - $73,000
- Lined facilities
  - 21% of our green street irrigation expense for 2015 (~$16K) went toward watering lined facilities (9% of inventory)

Plants in SMFs – Considerations

- Visibility and pedestrian/motorist safety must be considered

Trees in SMFs



Trees in SMFs – Challenges

- Trees, while beneficial, add additional costs to long-term facility management
- Choose the right tree for the right place
  - Could be outside facility

Trees in SMFs – Considerations

- Building new facilities around existing trees creates challenges
  - Construction
  - Added stress to tree
  - BES responsibility for these trees
  - Existing tree roots can disrupt water flow

Trees in SMFs – Considerations

- Additional costs
  - Pruning
  - Seasonal leaf removal
  - Extra irrigation
  - Disease, damage, replacements

Trees in SMFs – Considerations

- Right tree, right place
  - Consider existing canopy and trees
  - Pedestrian walkways
  - Growing space

Trees in SMFs – Considerations

- Right tree, right place
  - Visibility / Signage locations

Recommendations – Plants in SMFs

- Plant selection helps control maintenance costs
- Irrigation may be required in LTM
- Site considerations are important to plant selection – “Right plant, right place”

Recommendations – Trees in SMFs

- Trees important to stormwater management
- “Right tree, right place”
- Criteria for planting a tree in a facility
  - Can the tree be placed outside the facility?