Bioretention Areas:
Lessons Learned for Improved Performance

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San Mateo Countywide Water Pollution Prevention Program

June 18, 2024

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Presentation Overview

- Bioretention area (BRA) overview
- The differences between operation issues & maintenance issues
- Designing with operation and maintenance (O&M) in mind
- Design tips to improve O&M performance
- Construction tips to improve O&M performance

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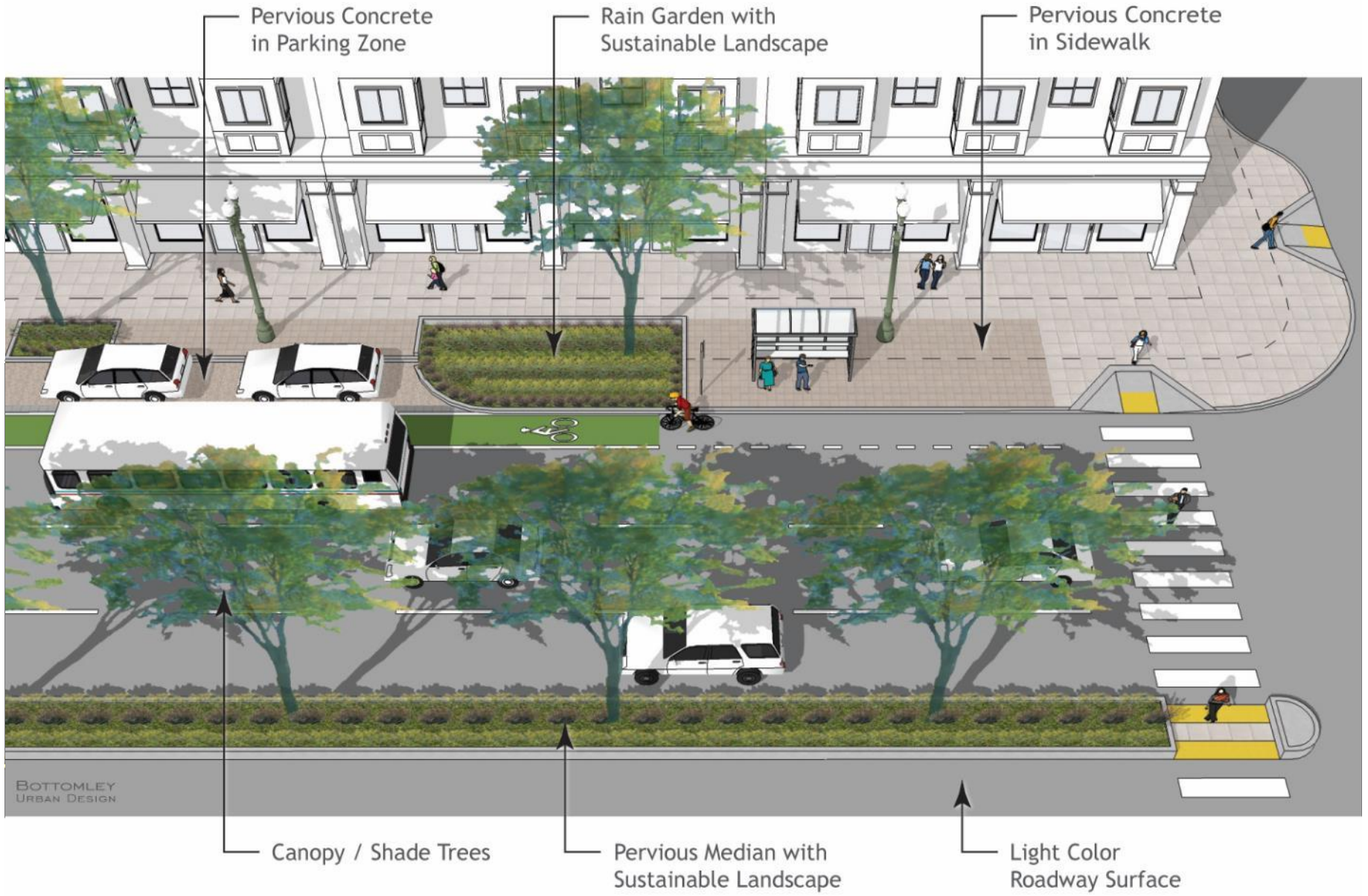
Pervious Concrete
in Parking Zone
Rain Garden with
Sustainable Landscape
Pervious Concrete
in Sidewalk
Bottomley
Urban Design
Canopy / Shade Trees
Pervious Median with
Sustainable Landscape
Light Color
Roadway Surface

Bioretention Design - Overview

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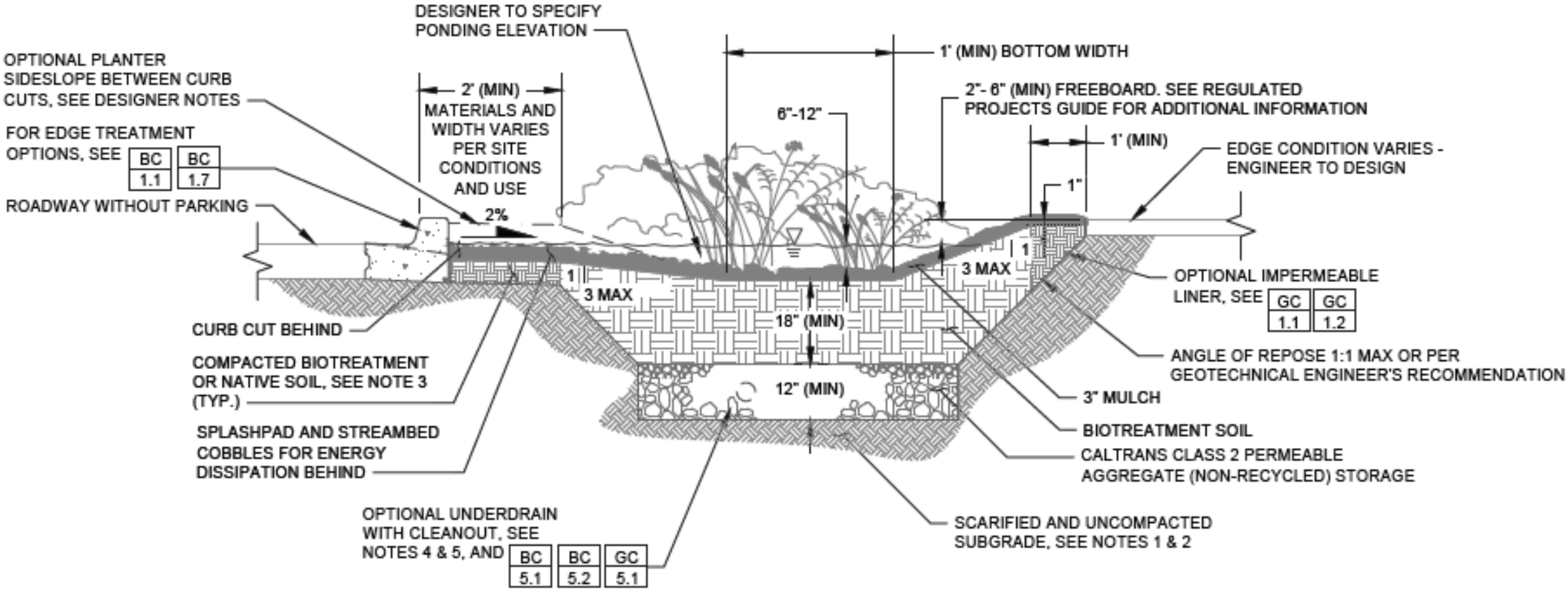
Source:* *Alameda County Clean Water Program

Bioretention Area Overview



From the SMCWPPP GIDG

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Bioretention Area Examples

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Differences Between Operation & Maintenance Issues

- Operation: system is not functioning correctly (design/build error)
- Maintenance: preventing problems and restoring/sustaining functionality
- Example operation issues:
  - Runoff does not enter bioretention area properly (usually for structural reasons):
    - Curb inlet has insufficient drop/slope
    - Cannot enter due to blocked inlet
    - Grading (outside or inside bioretention area)
    - Bypasses system directly to overflow
- Example maintenance issues:
  - Removal of trash
  - Ensuring irrigation system is working

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Designing with Operation and Maintenance In Mind

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Designing with O&M in Mind

- Siting
  - Provide access for maintenance & inspections - not through or on private residential space.
  - Out of sight = out of mind (e.g., underground pumps, media filters, etc.)
- Special equipment
  - Consider equipment needed for maintenance (e.g. sweeper for pervious pavement)

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Designing with O&M in Mind

- Poor planning for pedestrian traffic

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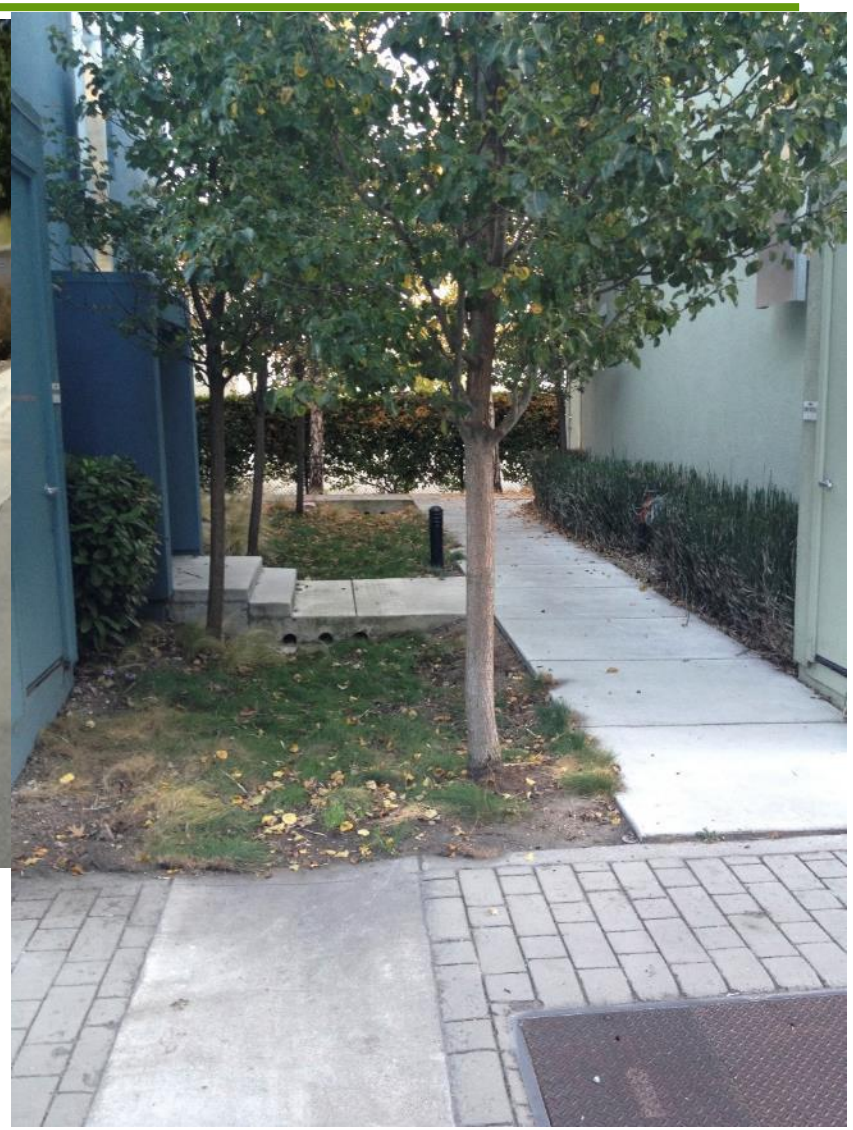
Designing with O&M in Mind

- Consider location of utilities, equipment or design elements that could affect bioretention area performance or surface area space
- Review other parts of the design that may impact stormwater facilities



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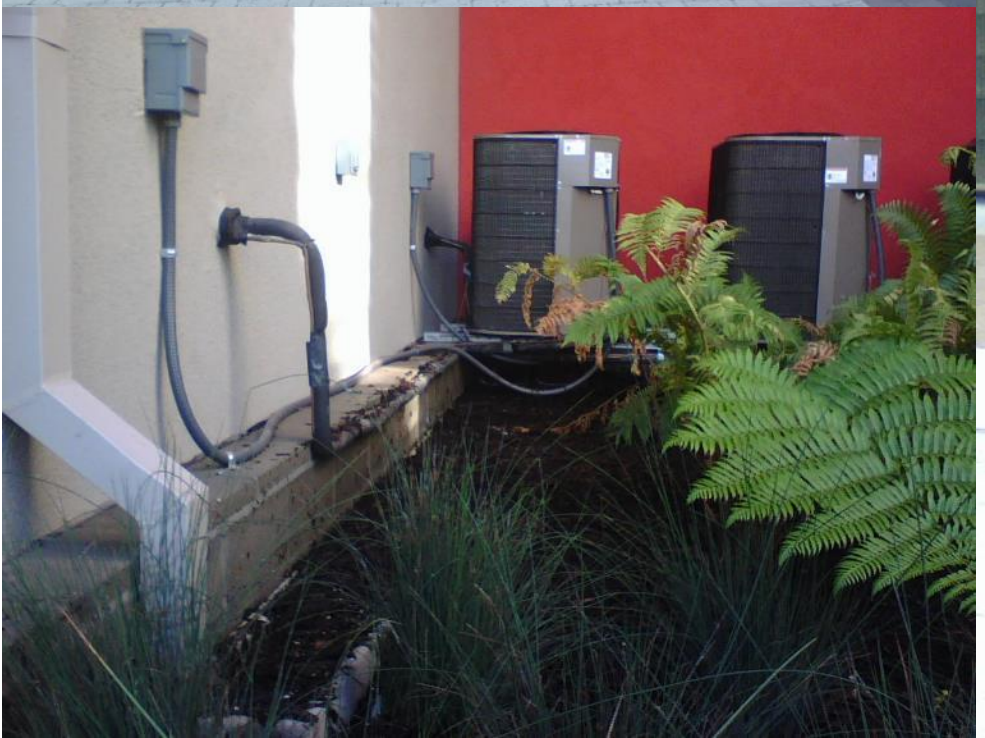

Designing with O&M in Mind

- Consider how design elements will require compaction of soil during construction

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Designing with O&M in Mind

- Cleanout
  - 45º angle or sweep bend - not 90º
  - Smooth interior (not corrugated)
  - Adequate size (4” min)
- Avoid confined space entry (e.g., oversized overflow)
- Removable grates on trench drains for easy access

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Designing with O&M in Mind

- Metal and domed (beehive) grates on overflows prevent mulch blockage, are durable and are easier to find.

Recommended options




Problems - not recommended



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Design Tips
for Improved Performance

Design issues related to flow:

1. **Getting water in – concrete form work and grading**
2. **Spreading the flow**
3. **Erosion**

Design Issue:
1. Getting Water In

- Problem: Blocked inlet

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Design Issue:
Getting the Water In

- Solution: Bioretention area curbs that can be maneuvered by street sweeping vehicles

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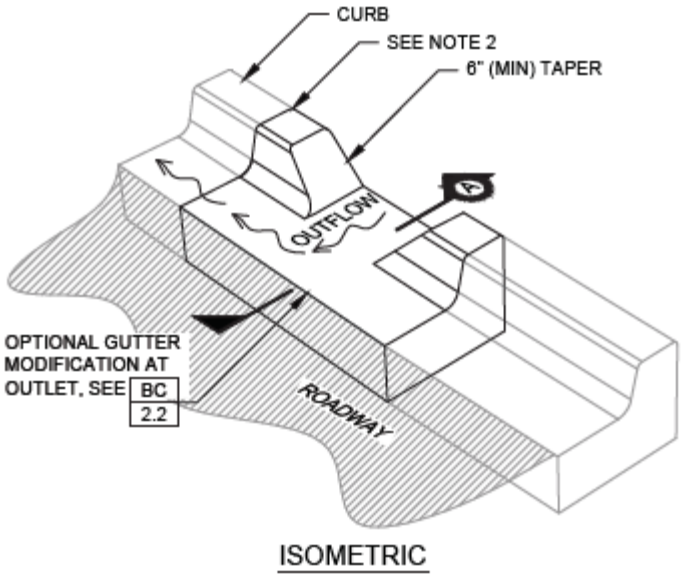
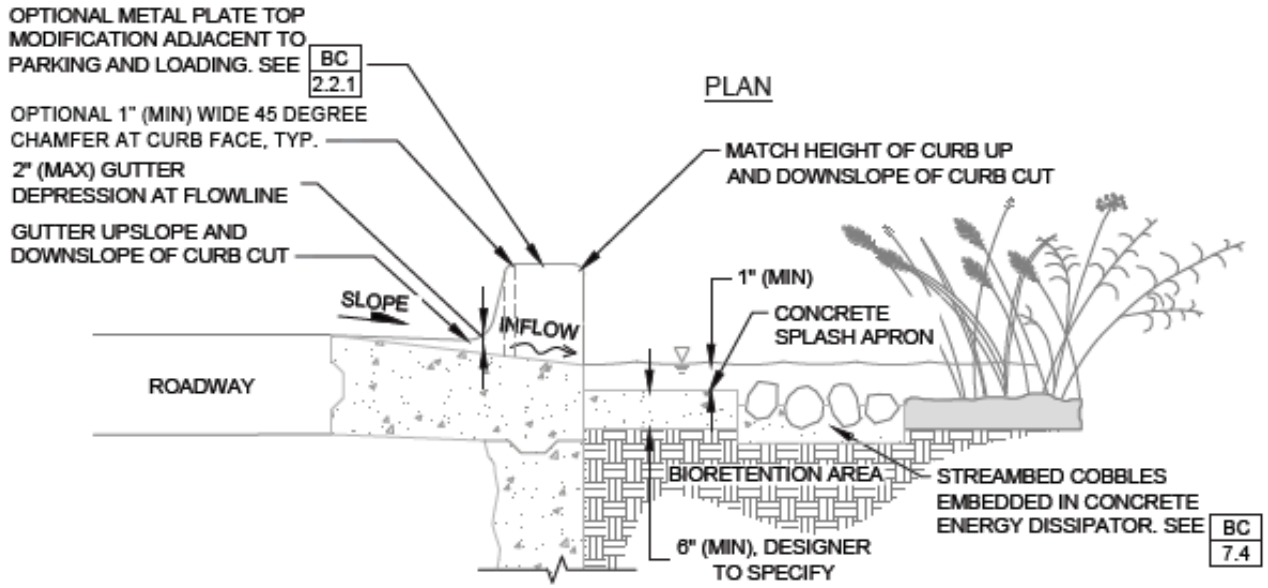
Design Issue:
Getting Water In

Solutions:

- Adequate-sized opening
- Adequate drop
- Adequate slope





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Design Issue:
Getting Water In

Solution: Concrete splash-apron/forebay

Advantages:

- Controls erosion
- Reduces velocity
- Captures sediment and trash
- No weeds
- Sediment can be vacuumed/swept up
- Keeps vegetation from blocking inlet
- Better than cobble!
- Easier maintenance

Disadvantages:

- Less practical when you have many inlets
- Increases impervious surface and reduces treatment area
- Could have standing water for a while
- Increases heat island effect

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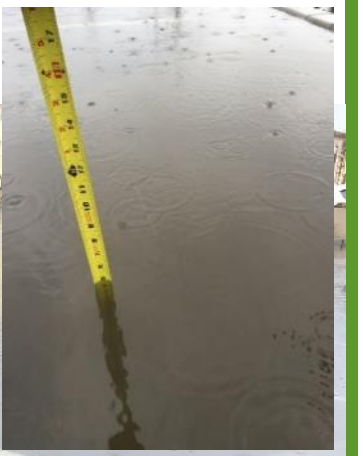
Design Issue:
Getting Water In

- Problem: Pumps



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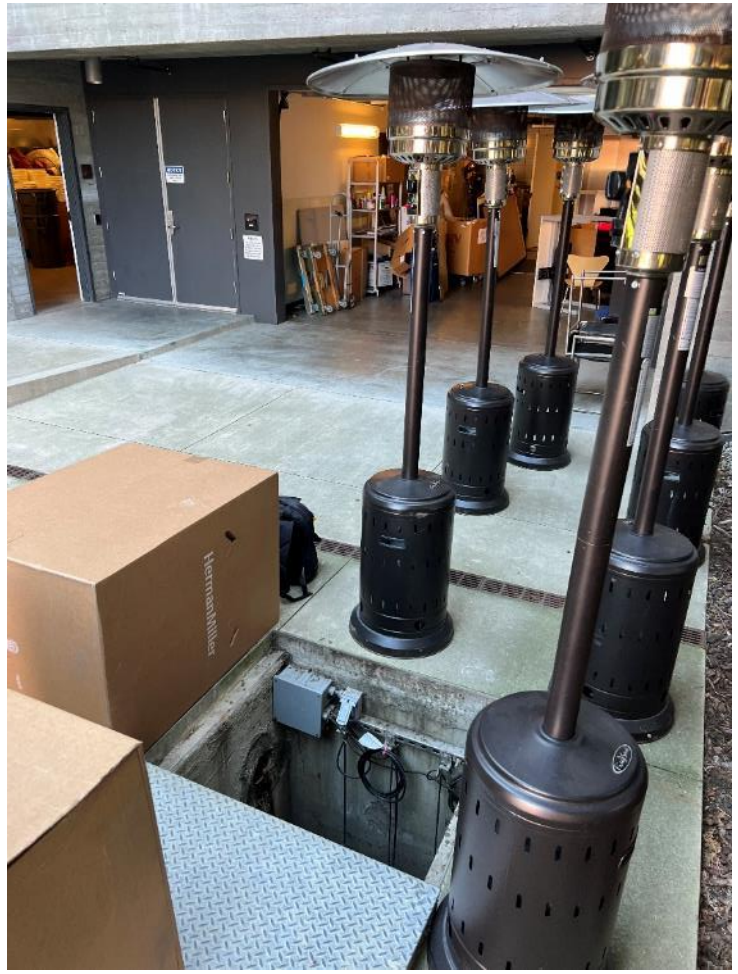
Design Issue:
Getting Water in

- Problem: Erosion at pump outlet



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Design Issue:
Getting Water in

Solutions:

- Don’t use pumps! – design for gravity flow
- If you must use a pump consider requiring:
  - Backup power
  - Alarm (if doesn’t work)
  - Annual testing (in July)
  - Backup pump

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Design Issue
Getting Water in

Solutions:

- Don’t use pumps!
- If using pump review flow rates, pipe size and flow rate/energy
- Consider additional energy dissipation that is hardened and stabilized/staked down

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Design Issue:
2. Spreading the Flow

Problem: Flow doesn't spread out within the BRA

Solution: Flow spreader

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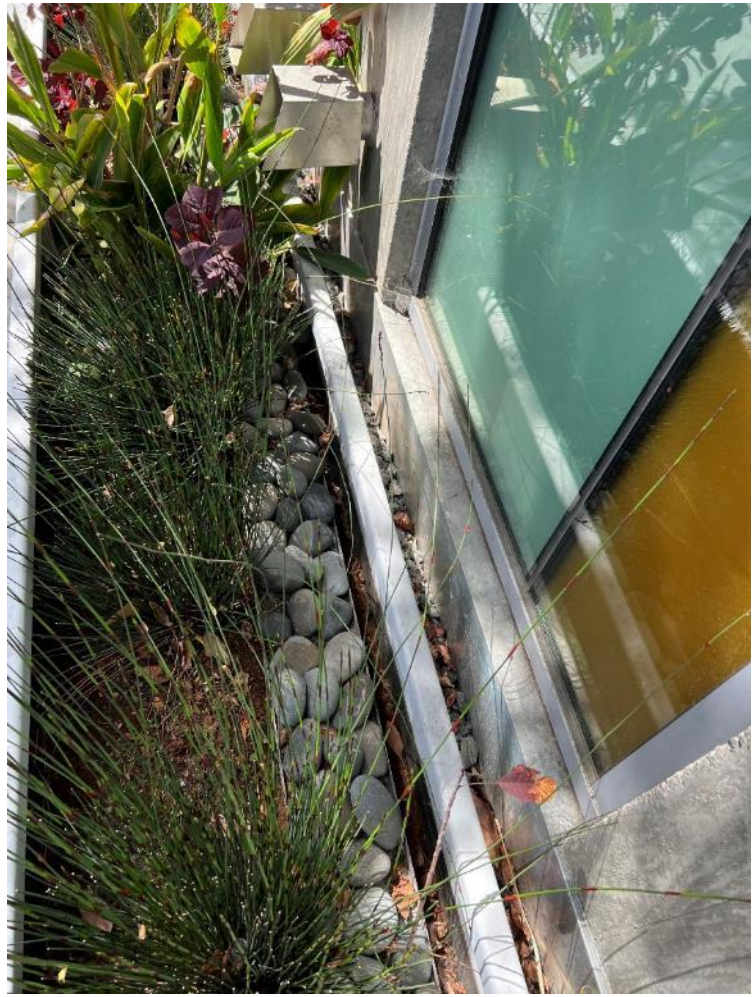
2. Spreading the Flow

Solution: Flow spreader



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Design Issue:
3. Erosion

Problem: Water at inlets causes erosion

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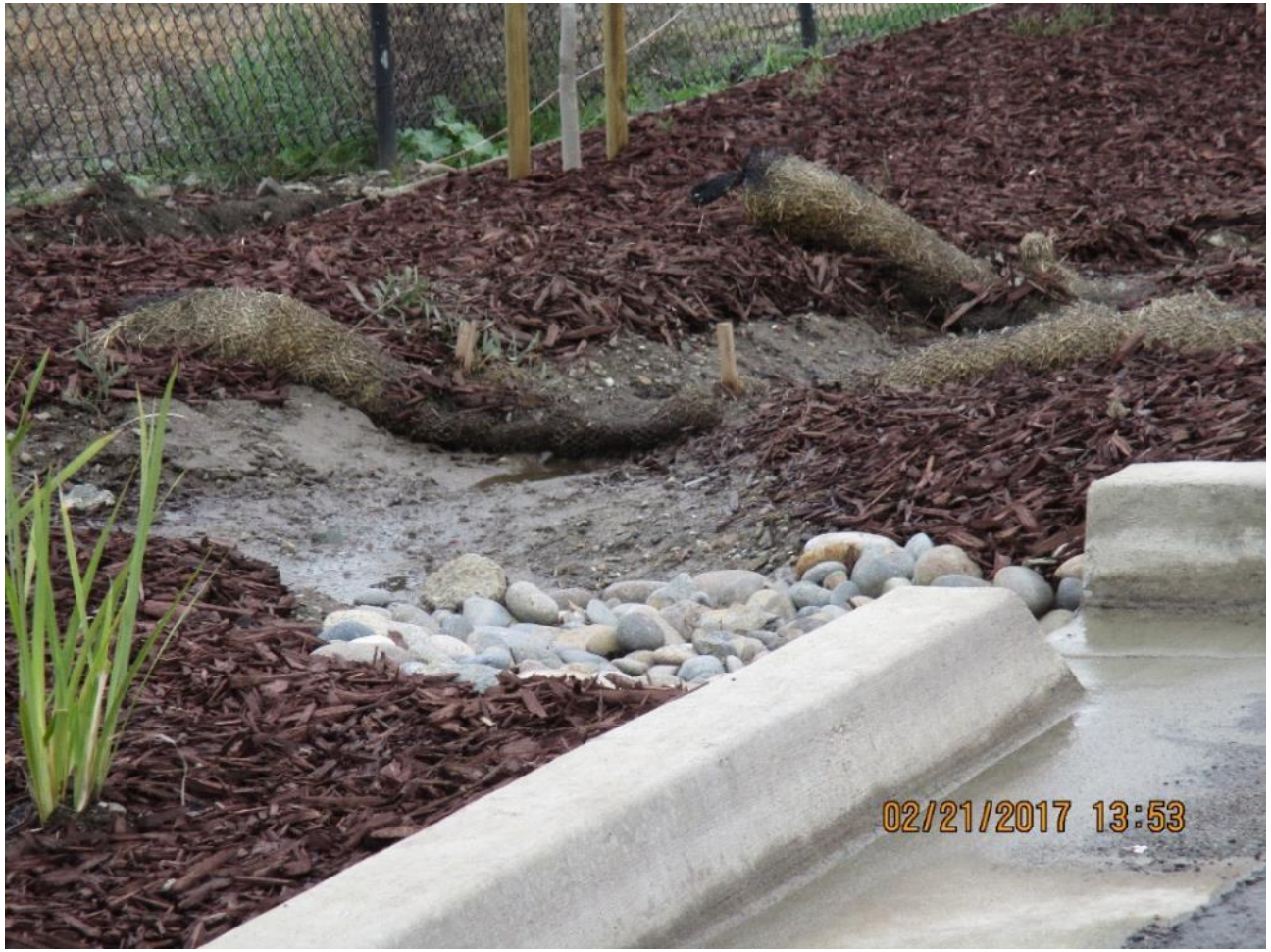
Design Issue:
Erosion

- Problem: Erosion along flow path



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Design Issue: Erosion

Solutions

- Roof leaders
  - Energy dissipation
    - Splash block is best
    - Cobbles – as last resort
  - Flow spreaders
- Curb cuts
  - Energy dissipation
    - Splash apron/forebay is best
    - Cobbles - as last resort

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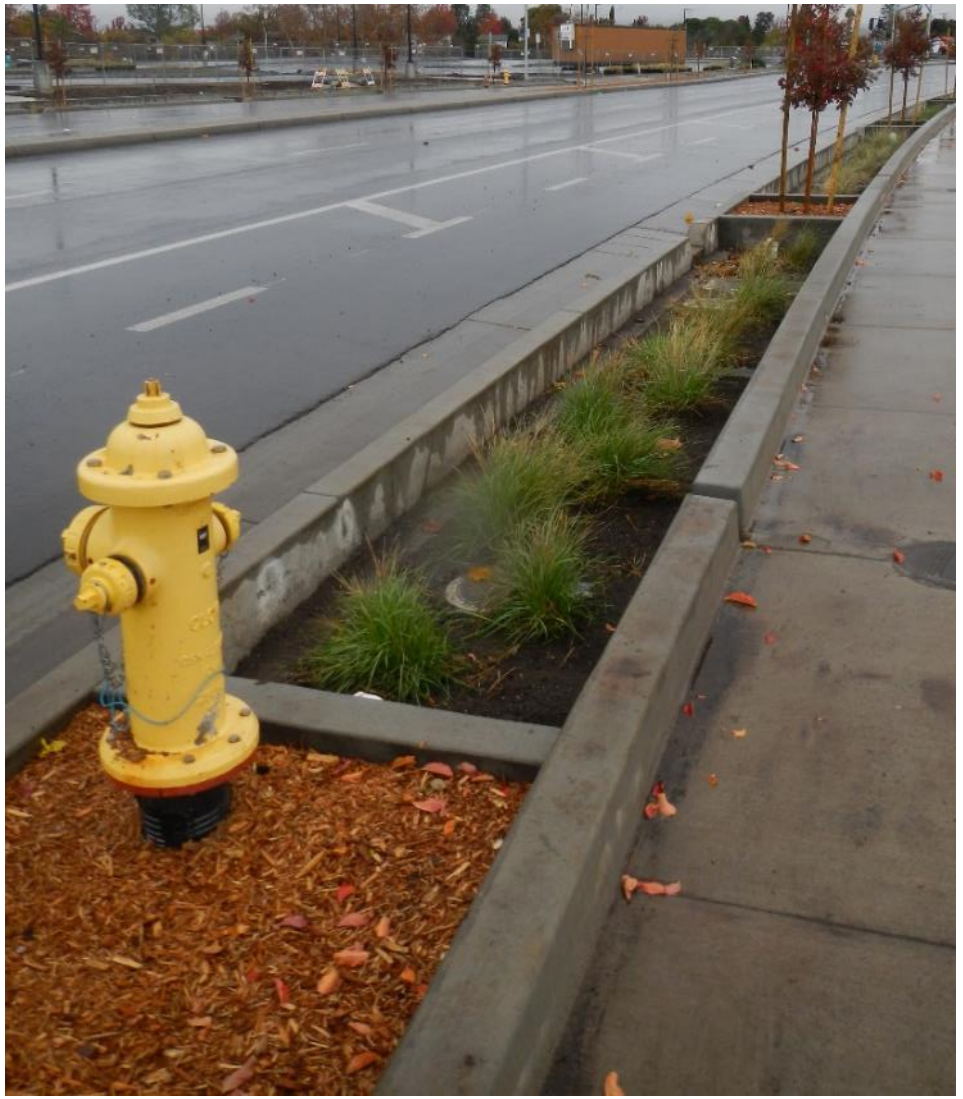
Design Issue:
Erosion

Solution: Vegetation placement/density



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Design Issue:
Erosion

Solutions:

- Grading (spread flow out)
- Multiple/frequent curb cuts
- Vegetation density (no mow turf)

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Construction Tips for Improved Performance

Construction issues:

1. **Grading – inside and outside**
2. **Outlet elevations**
3. **Subsoil and BSM compaction**
4. **Obstructions**

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Construction Issue:
1. Grading - Inside

Problem: Grading inside bioretention area allows only minimal or no treatment

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Construction Issue:
Grading – Inside and Outside

Problem: Grading of pavement to BRA inlet (and inside BRA)

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Construction Issue: Pavement Grading

Solutions (pre-construction – aka prevention):

- Pre-construction meeting with construction contractor?
- Earlier inspection during construction?
- More clear grading information on plans?
- More experienced contractor?
- More experienced inspector?
- Municipal requirement of sign-off before final approval of construction?
- Performance bond for contractor?

Construction Issue: Pavement Grading

Solutions (post-construction):

- Speed bump diverter and BRA regrading
- Trench drain diverter and BRA regrading
- Regrading of BRA with new inlets
- Alternative compliance

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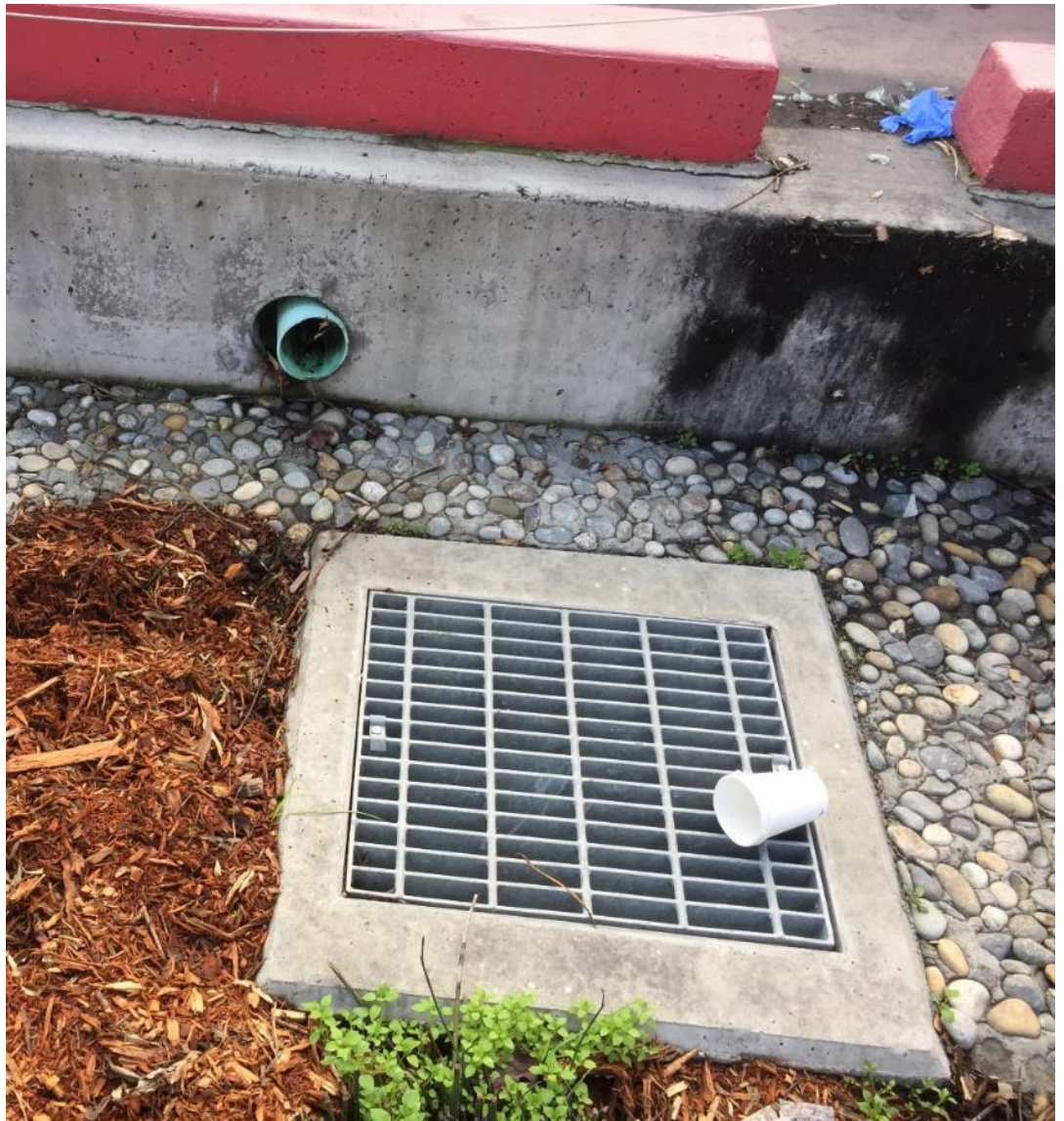
Construction Issue:
2. Outlet Elevation and Location

Problem: Bypass (no treatment)



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Construction Issue: Outlet Elevation

Problem: Overflow not raised to proper height which doesn't allow proper ponding of water

Solution: better coordination between contractor and inspector?

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3. Construction Issue: Compaction

Problem: Mechanical compaction of subgrade in BRA – reduces permeability of subgrade and/or BSM which eliminates infiltration capability and can cause standing water which can cause vector issues.

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Construction Issue: Compaction

Solution:

- Use only boots and water to compact BSM
- Do not smear/glaze subsoil with excavator shovel
- Scarify subgrade prior to filling in BRA with Class 2 perm

4. Construction Issue: Obstructions

Problem: Blocked inlets

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Construction Issue: Obstructions

Solutions:

- Better review of plans?
- Better coordination between contractor and inspector?

Group Exercise

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4X4

- Consider location of utilities/equipment that will require maintenance

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Questions?

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