Design for Maintenance: Lessons Learned from the Field

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Outline of Presentation

- Operation vs Maintenance Issue
- Design with Maintenance in Mind
- Maintenance Issues
  - Design Solutions

Thank you to City of San Jose for providing many of the photos used in this presentation

Operation vs Maintenance

- System not functioning properly
  - Maintenance vs Operation
  - Construction vs Design
- Operational Issues
  - Site may need more time for corrective action
  - Look for creative, less costly ways to achieve compliance
  - Municipality may need to review processes (e.g. approval process)

Operation vs Maintenance

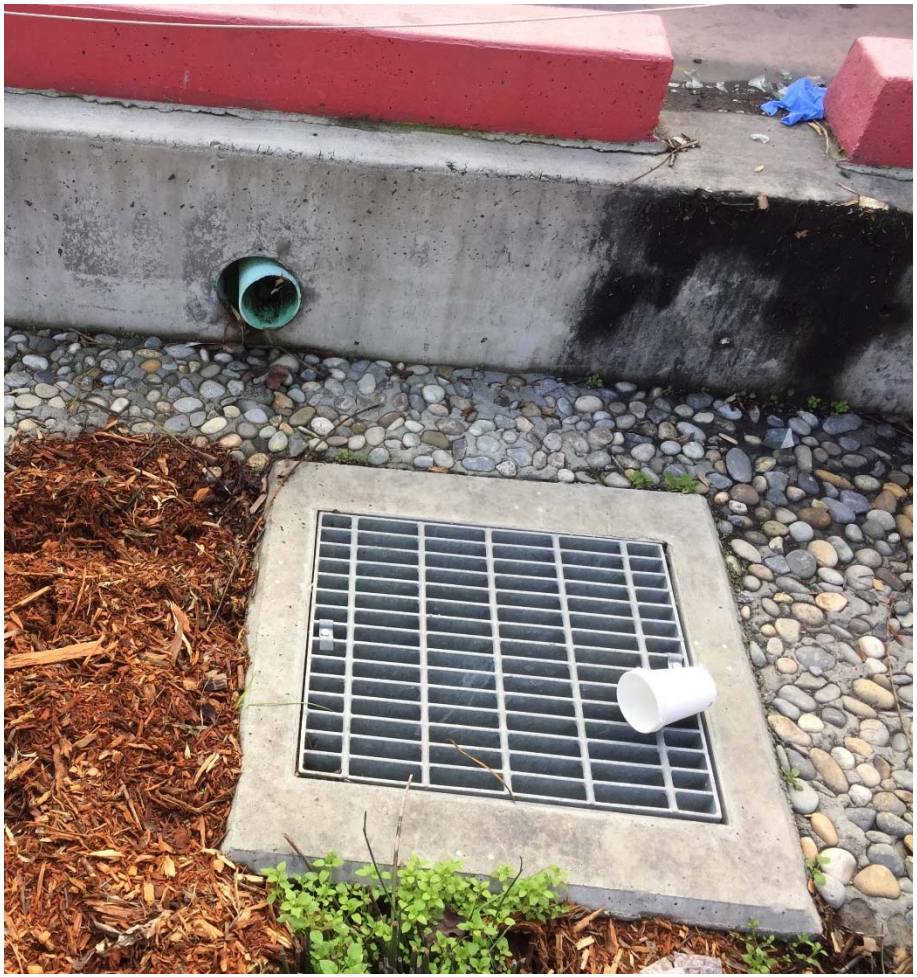
- Example Operational Issues
  - Runoff does not enter bioretention area
    - Bypasses curb inlets
    - Does not flow towards area (due to improper grading)
    - Cannot enter due to blocked inlet
    - Bypasses system directly to overflow

Operation Issue

- Blocked inlet

Operation Issue

- Short-circuiting



Operation Issue

- Overflow not raised to proper height

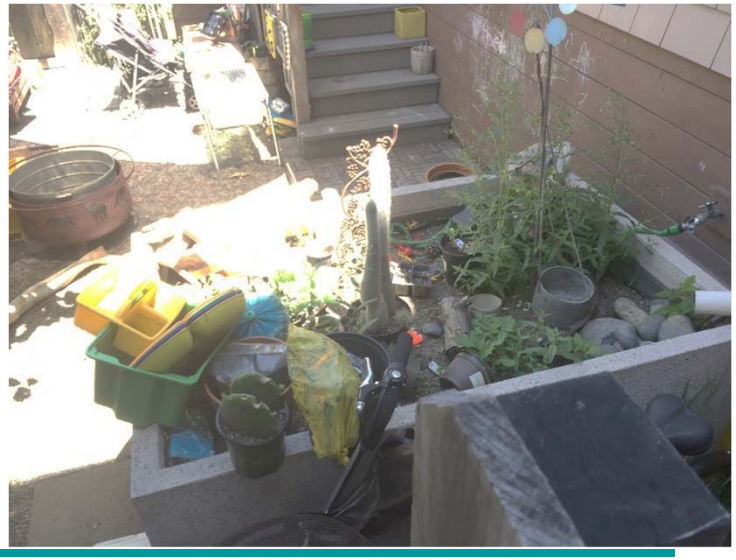
Operation Issue

- Undersized system
- Water does not infiltrate
  - Compacted soil from utility access or pedestrian crossings

Operation Issue

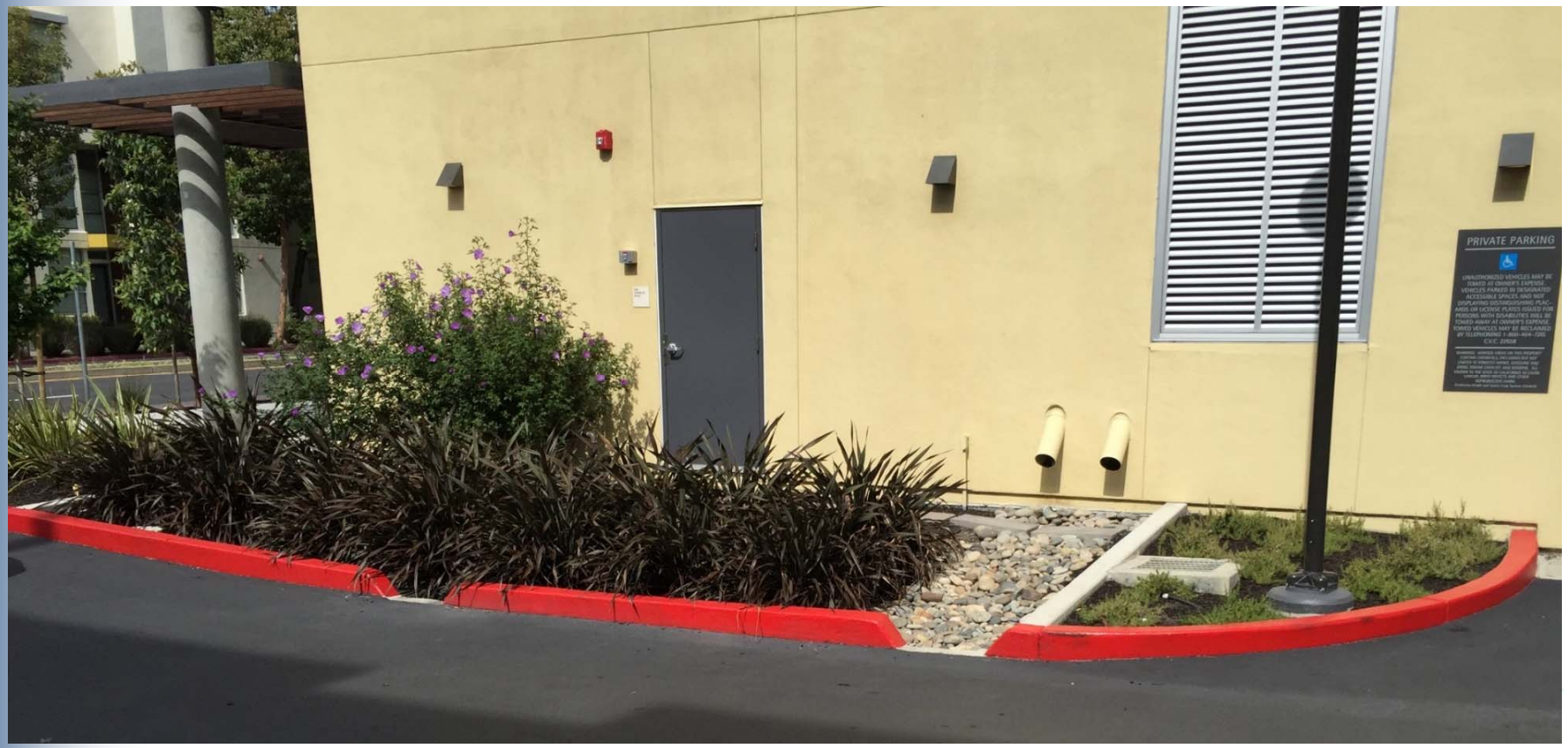
Design with Maintenance in Mind

- Siting
  - Provide access for maintenance & inspections
  - 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)



Design with Maintenance in Mind

- Consider location of utilities/equipment that will require maintenance



Design with Maintenance in Mind

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

Maintenance Issue

- Erosion at inlets – curb cuts and roof leaders

Design Solutions

- Curb cuts
  - Energy dissipation
    - Splash apron (concrete pad) allows for easy removal of sediment and debris
    - Cobbles
  - Off-line vs. in-line systems
- Roof leaders
  - Energy dissipation

Design Solutions

Offline design

Splash Apron and Cobbles

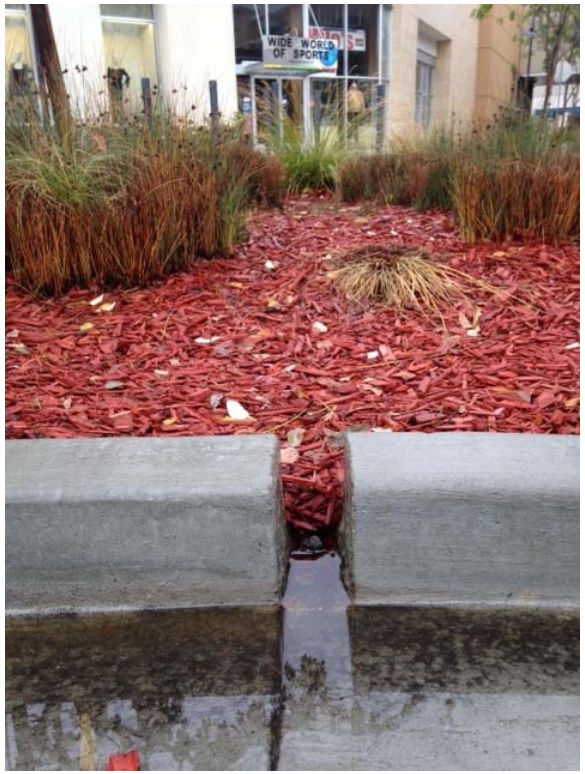
Design Solutions

Splash Block Under Roof Leader

Cobbles Under Roof Leader

Maintenance Issue

- Blocked inlet



Maintenance Issue

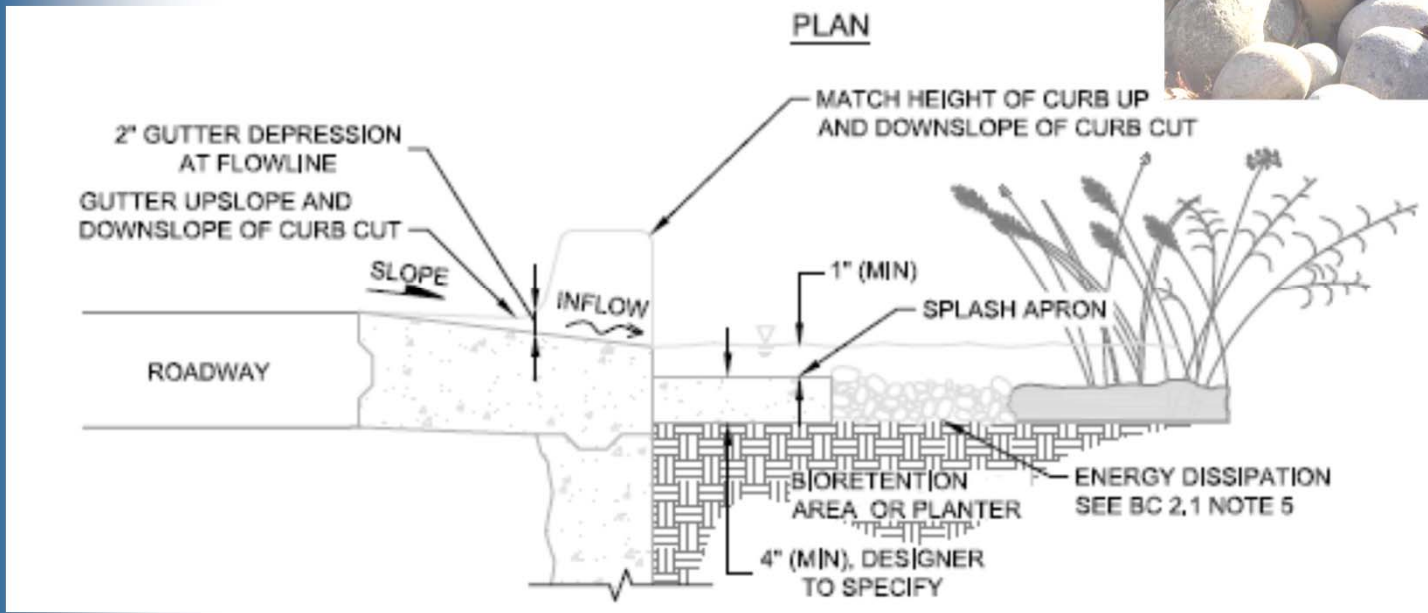
- Blocked inlet

Santa Clara Valley
Urban Runoff
Pollution Prevention Program

EOA inc.

Design Solutions

- Adequate sized opening
- Adequate drop



Design Solutions

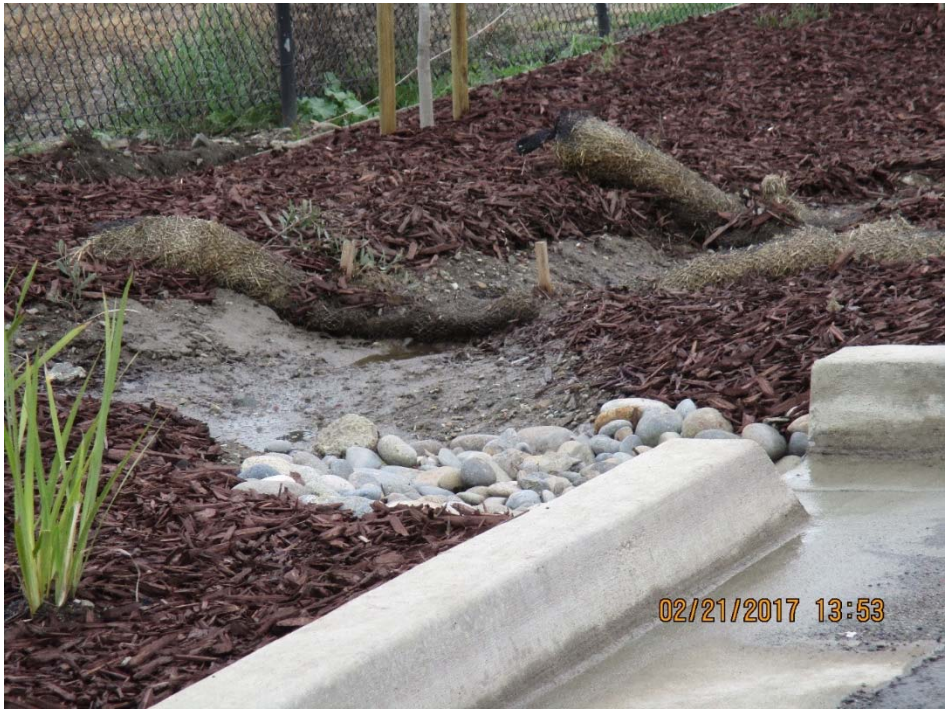
Sediment forebay at inlet

Design Solutions

- Vegetation placement/density

Maintenance Issue

- Erosion along flow path



Design Solutions

- Grading
- Direct flow lines
- Multiple/frequent curb cuts
- Vegetation density

Design Solutions

- Flow Spreader

Maintenance Issue

- Mulch missing or blocking outlets/overflows

Design Solutions

- Right Mulch - Right Place
- Disperse/dissipate flow
- Overflow grate design and placement

Aged arbor mulch

Design Solutions

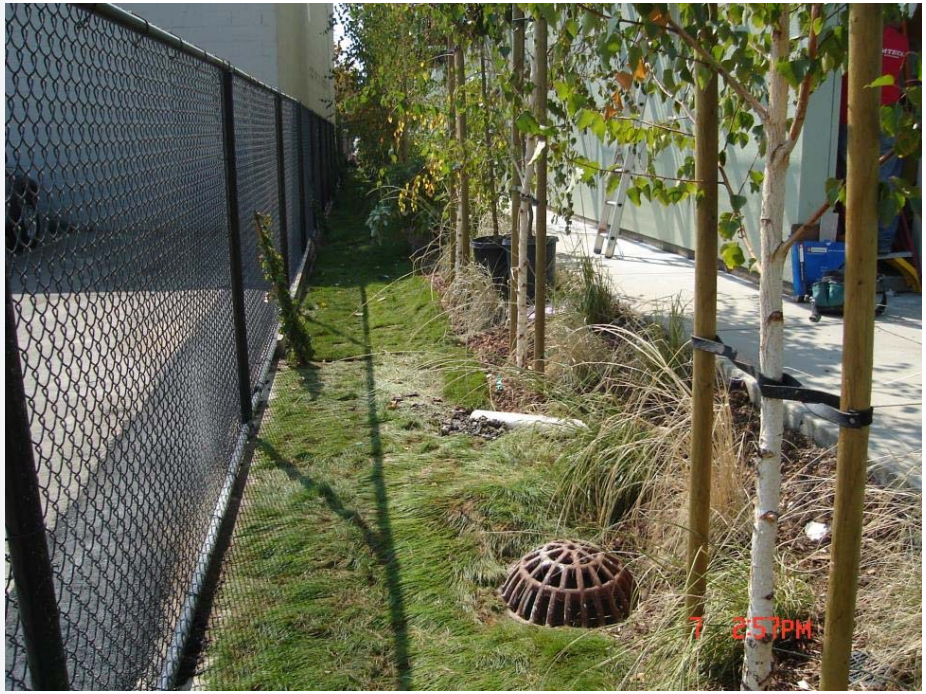
Rock mulch used along flow-line

Maintenance Issue

- Poor vegetative cover

Design Solutions

- Right Plant – Right Place



Design Solutions

- Proper irrigation system
- Alternative BSM specification process
  - http://basmaa.org/Announcements/basmaa-revisions-to-mrp-biotreatment-soil-mix-bsm-spec

VERIFICATION OF ALTERNATIVE BIORETENTION SOIL MIXES

Bioretention soils not meeting the above criteria shall be evaluated on a case by case basis. Alternative bioretention soil shall meet the following specification: "Soils for bioretention facilities shall be sufficiently permeable to infiltrate runoff at a minimum rate of 5 inches per hour during the life of the facility, and provide sufficient retention of moisture and nutrients to support healthy vegetation."

The following steps shall be followed by municipalities to verify that alternative soil mixes meet the specification:

1. General Requirements – Bioretention soil shall achieve a long-term, in-place infiltration rate of at least 5 inches per hour. Bioretention soil shall also support vigorous plant growth. The applicant refers to the entity proposing the soil mixture for approval.
   a. Submittals – The applicant must submit to the municipality for approval:
      (1) A minimum one-gallon size sample of mixed bioretention soil.
      (2) Certification from the soil supplier or an accredited laboratory that the Bioretention Soil meets the requirements of this guideline specification.

Maintenance Issue

- Trash, sediment, and leaf accumulation in corners outside of bioretention area /planter (roadside or parking lot)

Design Solutions

- Bioretention area transitions that can be maneuvered by street sweeping vehicles

Maintenance Issue

- Pump not working

Design Solutions

- Don’t use pumps! – design for gravity flow
- If using pump consider
  - backup power,
  - alarm,
  - testing,
  - backup pump

Maintenance Issue

- Erosion at pump outlet

Design Solutions

- Don’t use pumps!
- If using pump review flow rates
- Consider additional energy dissipation

Maintenance Issue

- Pervious Pavers breaking or uneven

Low severity depression

Medium severity depression

High severity depression

Photos show structural depression most common over utility cuts, catch basins and adjacent to other roadway types. Courtesy of David Smith and the Interlocking Concrete Paver Institute (ICPI)

Design Solutions

- Allow for settling
- Consider possibility of differential settling (e.g., if utility in area protected by hardscape)

LAYOUT REQUIREMENTS:

1. ALL PERVIOUS PAVEMENT DESIGN MUST COMPLY WITH MUNICIPAL STANDARD ACCESSIBILITY/ADA REQUIREMENTS.
2. THE ALLOWABLE CATCHMENT AREA CONTRIBUTING RUN-ON TO A PERVIOUS PAVEMENT FACILITY IS A MAXIMUM OF 2:1 RATIO OF AREA CONTRIBUTING RUN-ON TO PERVIOUS PAVEMENT AREA. THE DESIGNER SHOULD CONSIDER THE INCREASED MAINTENANCE REQUIREMENTS ASSOCIATED WITH HIGHER RUN-ON RATIOS WHEN DESIGNING THE FACILITY.
3. WHEN DESIGNED TO ACCEPT RUN-ON FROM OTHER CATCHMENT AREAS, PERVIOUS PAVEMENT AREAS MUST BE PROTECTED FROM SEDIMENTATION WHICH CAN CAUSE CLOGGING AND DIMINISHED FACILITY PERFORMANCE. THE FOLLOWING REQUIREMENTS APPLY FOR RUN-ON CONTRIBUTIONS:
   - RUN-ON FROM LAWN, LANDSCAPE OR OTHER ERODIBLE SURFACES IS DISCOURAGED. IF MINOR RUN-ON FROM LAWN OR LANDSCAPE AREAS IS UNAVOIDABLE, THOSE ERODIBLE AREAS MUST BE FULLY STABILIZED.
   - CONCENTRATED RUN-ON (E.G., DIRECT DISCHARGE FROM A DOWNSPOUT) SHOULD BE DISPERSED PRIOR TO DISCHARGE TO A PERVIOUS PAVEMENT FACILITY. ACCEPTABLE METHODS INCLUDE SHEET FLOW OR SUBSURFACE DELIVERY TO THE STORAGE RESERVOIR. IF SUBSURFACE DELIVERY IS USED, PRIMARY SETTLING IS REQUIRED (E.G., VIA SAND TRAP) FOLLOWED BY DISTRIBUTION TO STORAGE RESERVOIR (E.G., VIA PERFORATED PIPE).
4. WEARING COURSE FOR PAVERS SHALL BE SET ¼ INCH HIGHER THAN FINAL ELEVATION TO ALLOW FOR SETTLING AFTER CONSTRUCTION.
5. WEARING COURSE SHALL HAVE A MINIMUM SURFACE SLOPE OF 0.5% TO ALLOW FOR SURFACE OVERFLOW AND A MAXIMUM SURFACE SLOPE AS LISTED BELOW:
   a. POROUS ASPHALT SURFACE: = 5 PERCENT SLOPE
   b. PERVIOUS CONCRETE SURFACE: = 10 PERCENT SLOPE
   c. PERMEABLE PAVERS OR PERMEABLE INTERLOCKING PAVERS: = 12 PERCENT SLOPE (PER MANUFACTURER'S RECOMMENDATION)
   d. SLOPES EXCEEDING 2% TYPICALLY REQUIRE SUBSURFACE CHECKDAMS.
6. WHILE THERE IS NO MAXIMUM SLOPE FOR THE SUBGRADE UNDER THE PERVIOUS PAVEMENT COURSES, THERE MAY BE ENGINEERING CHALLENGES ASSOCIATED WITH SUBSURFACE CHECK DAM REQUIREMENTS ON SUBGRADE SLOPES EXCEEDING 5%. SEE SUBSURFACE CHECK DAMS (**PC 2.1** AND **PC 2.2**).

DESIGNER CHECKLIST (MUST SPECIFY, AS APPLICABLE):

- ☐ PERVIOUS PAVEMENT SPECIFICATIONS AND/OR PAVER TYPE AND GAP WIDTH
- ☐ PERVIOUS PAVEMENT WIDTH AND LENGTH
- ☐ ELEVATIONS AND CONTROL POINTS AT EVERY CORNER OR POINT OF TANGENCY
- ☐ THICKNESS OF EACH LAYER IN THE PAVEMENT SECTION
- ☐ JOINT SPACING AND TYPE
- ☐ SUBGRADE SLOPE
- ☐ SUBSURFACE CHECK DAM SPACING, HEIGHT, AND TYPE
- ☐ ELEVATIONS OF EACH PIPE INLET AND OUTLET INVERT
- ☐ TYPE AND DESIGN OF PERVIOUS PAVEMENT COMPONENTS (E.G., EDGE TREATMENTS, OUTLETS, UNDERDRAINS, etc.)

Wearing course for pavers shall be set ½ inch higher than final elevation to allow for settling after construction.

NOTES		KEY MAP	SECTIONS		
PP 1.1	PP 1.2	PP 1.3	PP 2.1	PP 3.1	PP 4.1

Santa Clara Valley Urban Runoff Pollution Prevention Program

GREEN INFRASTRUCTURE TYPICAL DETAILS

DETAIL ADAPTED FROM SAN FRANCISCO PUBLIC UTILITIES COMMISSION PP 1.2

DATE: SEPTEMBER 2019
VERSION: 1.0
REVISED:

PERVIOUS PAVEMENT
DESIGNER NOTES (2 OF 2)

DWG NO. PP 1.2

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