



In-Progress Construction Inspection of C.3 Measures



Presented by CSG Consultants, Inc.
February 1, 2017



STORMWATER TREATMENT SYSTEM INSPECTIONS

- **Inspection during construction**

- Good practice, but not required by permit
- Avoids costly mistakes which must otherwise be corrected after construction

- **Inspection following construction** (prior to closeout, and release of bonds)

- **Routine Inspections**

- Annual
- Inspect stormwater treatment facilities once every 5 years, or as specified in permit language

COORDINATION

- Coordinate with other inspectors and City staff
 - Public Works
 - Building
 - Stormwater
 - Planning
- Consider attending pre-construction meeting
- Establish Contractor point-of-contact
 - Site Superintendent
 - Project Foreman
 - Project Owner

Always Follow Up On Conversations In Writing!



TOOLS TO BRING



- Personal Protective Equipment (PPE)
- Measuring Tape (30' Minimum Recommended)
- A digital level
- A digital camera
- Copies of the project contract documents
- Clipboard and pen

WHEN TO PERFORM INSPECTIONS

Establish ahead of time at what stages of construction the inspections will be performed

1. Site Grading
2. Subgrade Preparation
3. Placement of any material layers (e.g. filter fabric, subbase, base, pavement/pavers, soil, etc.)
4. Concrete formwork placement
5. Installation of storm drain facilities and structures
6. Installation of planting and irrigation
7. After final landscaping



WHAT TO REVIEW AT THE SITE

- Review Background Information
 - Stormwater Control Plan and Details
 - Other Contract Documents
- Establish scope of your review vs. other inspectors – overlap is better than something being missed
- Anything “C.3 Related”
 - Stormwater Treatment Measures
 - Tributary Areas (“Follow the Water”) and locations of roof downspouts
 - Any associated storm drain piping and appurtenances
 - Dimensions and cross-sections
 - Landscaping and Irrigation of Stormwater Treatment Measures

TYPES OF STORMWATER TREATMENT MEASURES

- **Bioretention Areas***
- **Flow-Through Planters***
- **Permeable Pavements***
- Green Roofs
- Rainwater Harvesting
- Subsurface Infiltration Measures
- Tree Well Filters (limitations apply)
- Media Filters (limitations apply)



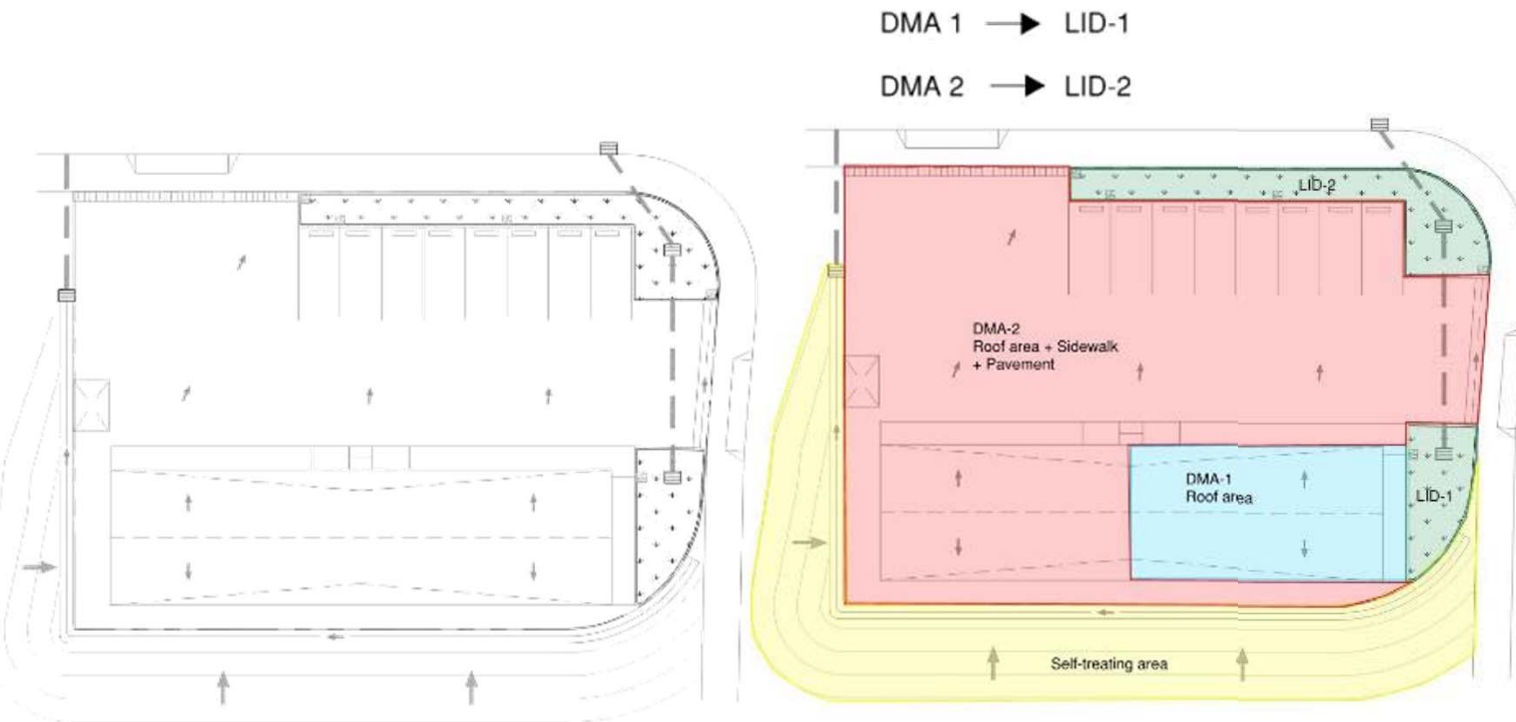
**Most common treatment measures used on projects*

“FOLLOW THE WATER”

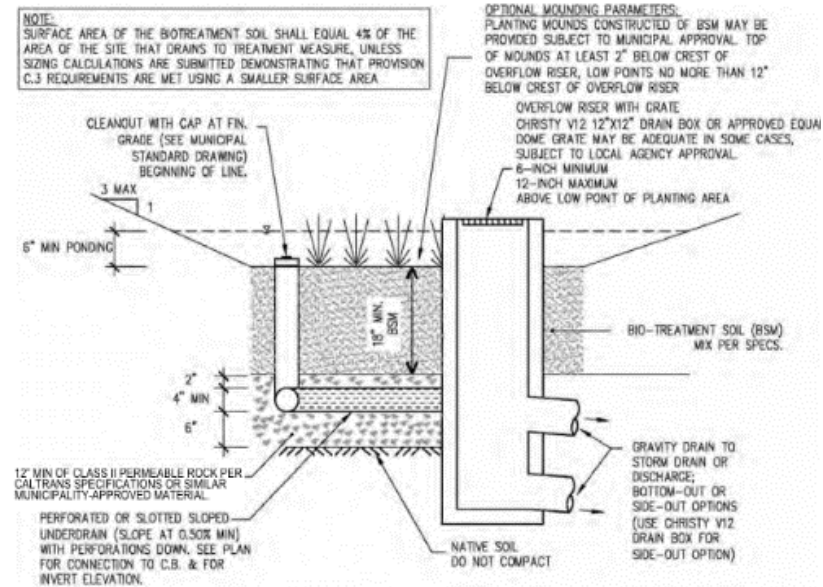
- Examine how water is directed to treatment
 - Trench Drains
 - Pop-Up Emitters or Bubblers
 - Curb Cuts
 - Swales/Valley Gutters
 - Roof Downspouts
- Spot check slopes to ensure tributary areas match the plans
- Make sure that water is not leaving site untreated



TRIBUTARY AREAS



WATER DOES NOT STOP AT THE PROPERTY LINE!



NOT TO SCALE

Figure 6-3: Cross Section, Bioretention Area (side view)

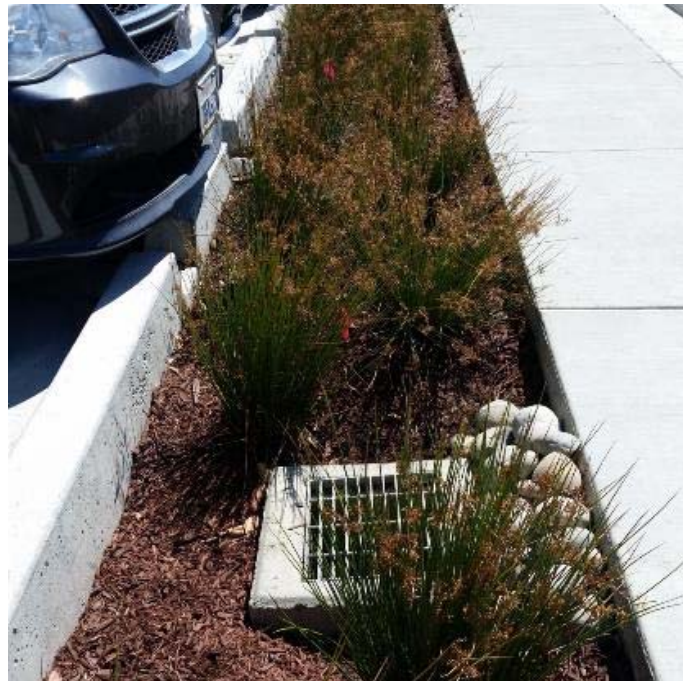
BIOTREATMENT INSPECTION CHECKLIST



- ☐ Review conformance to plans
- ☐ Measure depth to invert of piping
- ☐ Measure treatment area
- ☐ Verify drainage and piping (roof downspouts, area drains, onsite inlets, bubblers, subdrains, etc.)
- ☐ Verify that impermeable liner is installed, if applicable

BIOTREATMENT INSPECTION CHECKLIST

- ☐ Verify freeboard
(2" or per plan) from top of
structure
- ☐ Verify ponding depth
(6" or per plan)



BIOTREATMENT INSPECTION CHECKLIST

- ☐ Verify layer thicknesses
(e.g. 1.5' of bioretention
soil, 1.0' of gravel storage)
- ☐ Review soil submittal

To:
Attn:
Job Ref:

Certificate of Compliance for CCB-3 Biotreatment Soil Mix
for the state wide clean water program.

I hereby certify that the Biotreatment Soil Mix, to be delivered to the project cited above from our company, meets the "Soil Specifications" criteria in sections 1-4 on pages L-1 to L-4 of Attachment L of the San Francisco Bay Regional Water Quality Control Board's Municipal Regional Stormwater Permit (MRP) adopted on November 28, 2011.

Signed: _____

Name: Tom Bonnell

Title: CEO



BIOTREATMENT INSPECTION EXAMPLE



Treatment area dimensions
(inside curb)

Piping depth to invert

Any reduction in volume per approved plan



Verify location of
perforated subdrain versus
plan details

TYPICAL ERRORS SEEN DURING INSPECTIONS

ISSUE	SOLUTION
Treatment facility dimensions are incorrect, and facility is undersized.	Designer must revise sizing calculations to verify that treatment area is still sufficient. If not, reconstruction may be necessary.
Planting is dead, too sparse, or has not matured.	Dead plants should be replaced. Inspector should return later for a follow up inspection, when planting has matured.
Appurtenances are missing (overflow, cleanout, rip-rap, or planting).	Owner should add missing appurtenances.



TYPICAL ERRORS SEEN DURING INSPECTIONS

ISSUE	SOLUTION
Premature erosion of treatment soil mix.	Replacement of eroded soil, leveling of planter, and/or denser installation of cobblestone or mulch.
Standing water is present in treatment measure or inlets (may cause vector control issues).	<p>Perforated pipe – may be plugged or installed incorrectly.</p> <p>Inlets – verify pipe invert elevations; potentially add concrete to slope to drain.</p>



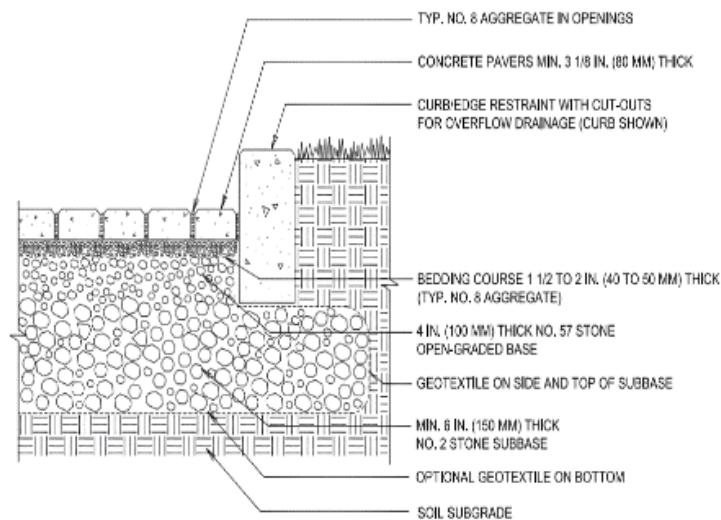
POST-CONSTRUCTION INSPECTION



- ☐ Verify irrigation is present
- ☐ Verify ponding depth (6" or per plan) and freeboard (2" or per plan)
- ☐ Review planting (healthy? good coverage?)
- ☐ Check that energy dissipation (e.g. cobbles) is installed at curb cuts
- ☐ Ensure inlets are marked "No Dumping! Flows to Bay" or equivalent

PERMEABLE PAVEMENT INSPECTION CHECKLIST

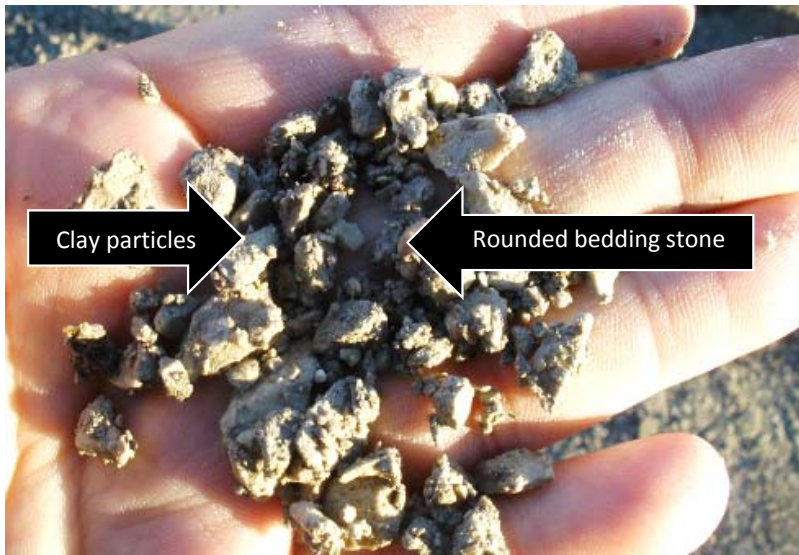
- ☐ Proper subgrade preparation
(either compacted or not,
depending on soils)
- ☐ Proper installation of
underdrains (if required)
- ☐ Properly constructed edge
constraints



NOTES:

1. 2 3/8 IN. (60 MM) THICK PAVERS MAY BE USED IN PEDESTRIAN APPLICATIONS.
2. NO. 2 STONE SUBBASE THICKNESS VARIES WITH DESIGN.
CONSULT ICPI PERMEABLE INTERLOCKING CONCRETE PAVEMENT MANUAL.

PERMEABLE PAVEMENT INSPECTION CHECKLIST



- ☐ Verify aggregates
 - ☐ No fines
 - ☐ Crushed and angular (NOT ROUNDED)
 - ☐ Proper aggregate sizes
 - ☐ Uniform and proper aggregate thickness
- ☐ Prevent contamination of pavers and aggregate with mulch, topsoil, and other materials onsite.

PERMEABLE PAVEMENT INSPECTION CHECKLIST

- ☐ Compaction of the subbase and base course to consolidate materials, but without crushing the aggregate
- ☐ Correct pavers delivered to site (color, thickness, compressive strength, etc.)
- ☐ Tight placement of pavers with minimal small cut pieces and held at least ½" above manholes, edge restraints, etc. (to accommodate settlement)
- ☐ Joint filler placed to top of joints and then replenished after construction is complete once initial filler has settled

PERMEABLE PAVEMENT BUCKET OF WATER TEST



NON-LID TREATMENT

- Proprietary items (e.g. media filters, tree well filters) are generally considered non-low impact development
- Limitations on use - high flow rate filters are typically only allowed on certain high density projects
- Review manufacturer guidelines for inspection requirements



INFILTRATION CHAMBERS



INFILTRATION CHAMBERS



**Geotextile installed over prepared soils and walls
(prevent migration of fines, but not water)**



MAINTENANCE AGREEMENT

- Assigns maintenance responsibility to property owner
- Establishes maintenance frequency, procedures, and inspection checklist template
- Recorded against the property, with the County
- Option 1: Record Prior to Construction
 - Recordation happens concurrently with plan approval, so that the agreement is not forgotten during the time the project is under construction.
 - If any field changes occur, the maintenance agreement must be re-recorded with the County, with the as-built drawings attached.
- Option 2: Record before project close-out and release of bonds, but after construction
 - It may be difficult to time recordation of the agreement to coincide exactly with project sign-off, or the agreement may be forgotten.
 - The agreement will reflect the finished condition of the site, and incorporate project as-built drawings.



MAINTENANCE AGREEMENT COMPONENTS

1. Agreement

2. Legal Description

3. Approved Stormwater Control Plans (Reduced to 8.5"x11")

4. Maintenance Plan

MAINTENANCE AGREEMENT FOR THE ROADS OF THE COUNTY OF
HARRIS AND THE CITY OF SPRINGFIELD, MISSOURI
Effective Date: 12/1/12

REFERENCES

This Shikhar is a Traditional Vietnamese Village and is known as "Thị trấn Cổ" and is located in the district of a village in the City of Hanoi, Vietnam. It is a traditional village of many small "Thị trấn Cổ", a group of small villages, described in the legend.

WHITREAS, On October 14, 2009, the Regional Water Quality Control Board, San Francisco Bay Region, adopted Order 2009-0074, the Municipal Regional Sewerage Permit (MSRP) CWS1200R, and

WHEREAS Programs C-2b of the HRF, and it may be created or revised, require the permittee/polluter agency to provide minimum verification and action to ensure that all future permittees and all future permittees using new HRF permits (1 day) and having only completed a minimum verification, is acceptable for the permittee to have, issue, and hold permits; and

WHIPP 48, Lehigh University, Bethlehem, PA, USA
 Email: whipp48@lehigh.edu (for correspondence) and whipp48@lehigh.edu
 Telephone: +1 610 762 1000

WHEREAS, it is well understood that the "Y" is a key to the Plan and except for a design drawing, the drawings, plans and data are to be located or to be constructed on the Project;

WHEREAS, the Property Owner may lease the lot to:

plants and any macroinvertebrates are on file with the [F]arming, ranch, business, and residential sector used to this Agreement.

the citizens of the City require that the statements be made to be included in the State Police report. The statements must be made in the

[illegible]

THESE FORMS, in duplicate, are to be submitted to the City Supervisor of the State Police, the Property, General Fund, as follows:

SECTION 1: CONSTRUCTION OF TREATMENT MEASURES

The co-ops also must meet minimum accuracy and timeliness of comparable documents shall be constructed by the property

Infiltration Trench Maintenance Plan for



Project Address and Cross Streets: _____

Assessor's Parcel No.: Phone No.:

Designated Contact: _____

Phone No.: _____

Mailing Address: _____

The property contains 1 subsurface infiltration trench, located as described below and as shown in the attached site plan.

- * Infiltration Trench No. 1 is located at within the northeast corner of the parking lot.

1. Routine Maintenance Activities

The principal maintenance objective is to prevent sediment buildup and clogging, which reduces pollutant removal efficiency and may lead to branch failure. Routine maintenance activities, and the frequency at which they will be conducted, are shown in Table 1.

No.	Maintenance Task	Frequency of Task
1	Remove debris, sticks, and trash from infiltration trench and adjacent riparian area.	Monthly, as needed after storm events
2	Inspect trench to ensure that it is between stormwater and vehicle's driving surface. Check every 3rd day after storm to confirm condition.	Monthly, during wet season, or as needed after storm events
3	Monitor trench for blockage (e.g., sediment) as directed during dry season.	Annually, during dry season
4	Remove silt or sediment from trench opening.	As needed
5	Check for bad smells and indicate to the nearest case of spill.	As needed
6	Inspect infiltration trench using the attached inspection checklist.	Monthly, or after large storm events or other unusual circumstances (e.g., construction) associated with the trench.

PROJECT CLOSE-OUT

- ☐ C.3 Measures Constructed Per Plan (or with approved modifications)
- ☐ Final approval letter, summarizing inspections conducted and any field revisions
- ☐ Maintenance Plan and Agreement Recorded, with construction as-builts

FOR FUTHER QUESTIONS, CONTACT:

Mark Lander, P.E.

Principal Engineer
markl@csgengr.com

Katherine Sheehan, P.E., QSD/P

Associate Engineer
katherines@csgengr.com

CSG Consultants, Inc.

550 Pilgrim Drive, Foster City, CA 94404
www.csgengr.com
650.522.2500 *main*

