



Suspended Pavement Systems for Stormwater Treatment

Rainwater and stormwater runoff enter the suspended pavement system through a permeable surface or alternate drainage systems.



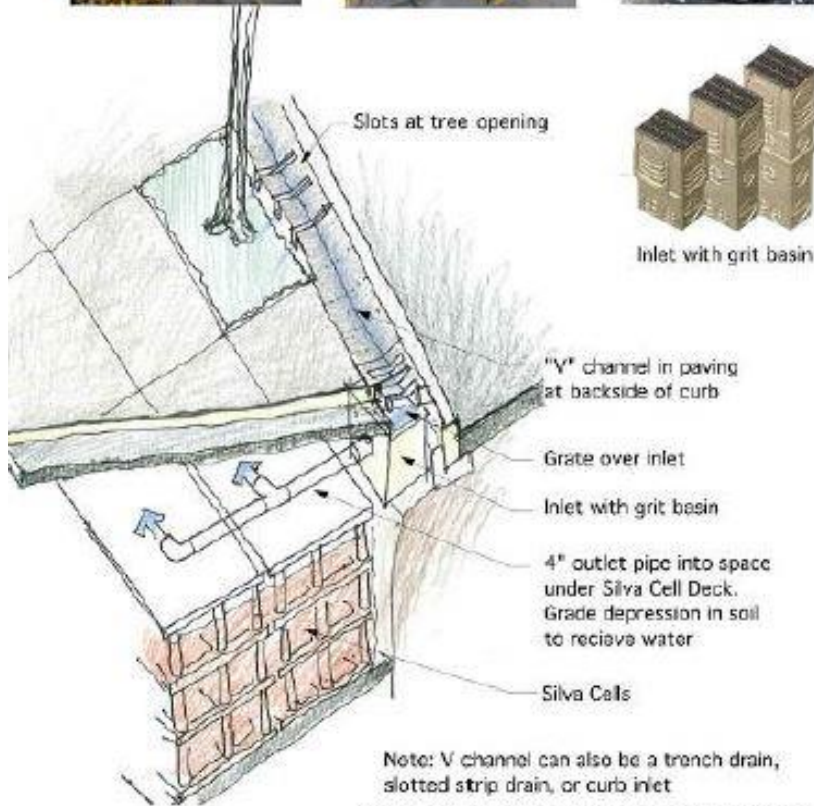
Pervious pavers



Pervious pavers



Pervious pavers and slot drain through paving



Note: V channel can also be a trench drain, slotted strip drain, or curb inlet

Silva Cell Water Harvesting Options



Inlet with grit basin



Trench drain



Trench drain



Slot drain



Curb inlet



Open jointed paver water interception into a planted area

Silva Cell Water Harvesting Options

Collection pipe or flow out
underdrains to existing drainage
network



Solid pipe from catch basin transitions to a perforated distribution pipe to transport water from the catch basin through the Silva Cell system and soil media



Catch Basin



Tree spaces here

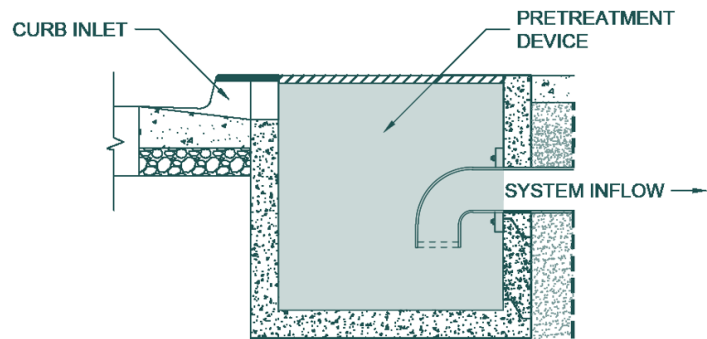


Cleanout

Distribution pipe

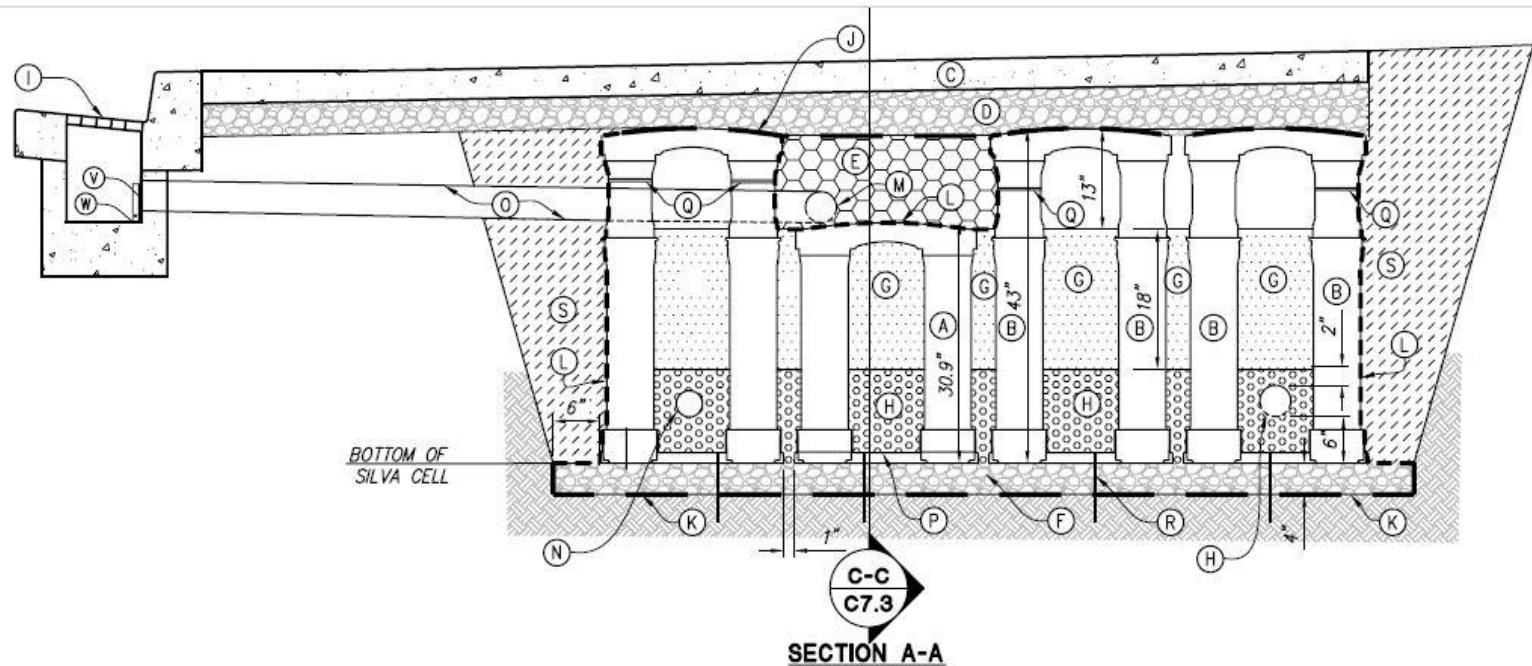


PRETREATMENT

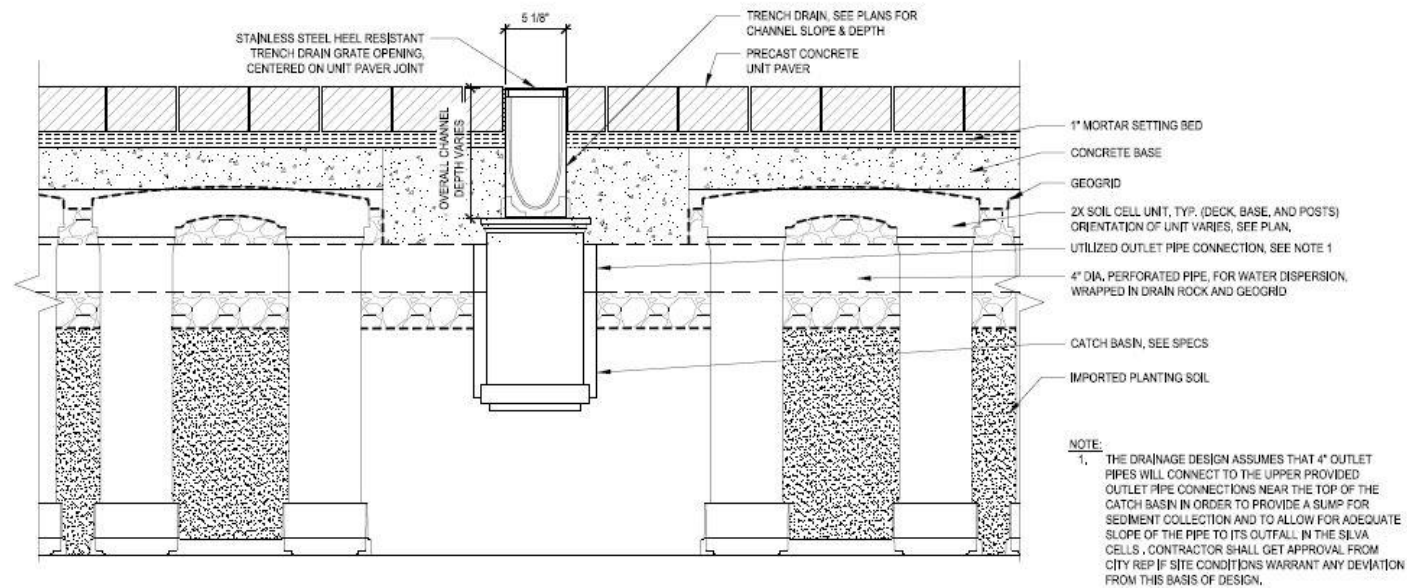
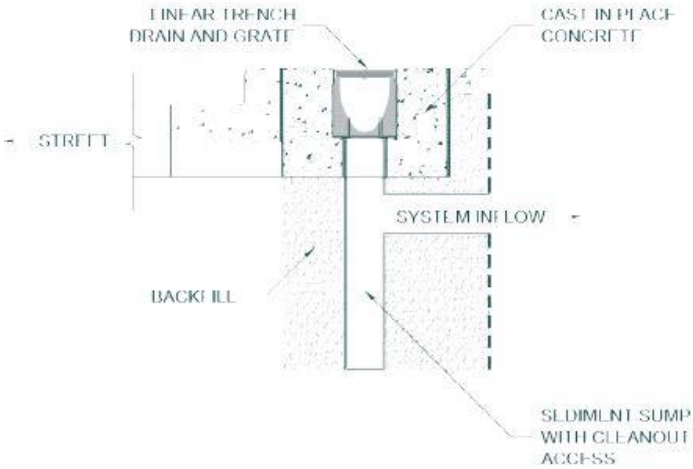


-STREET

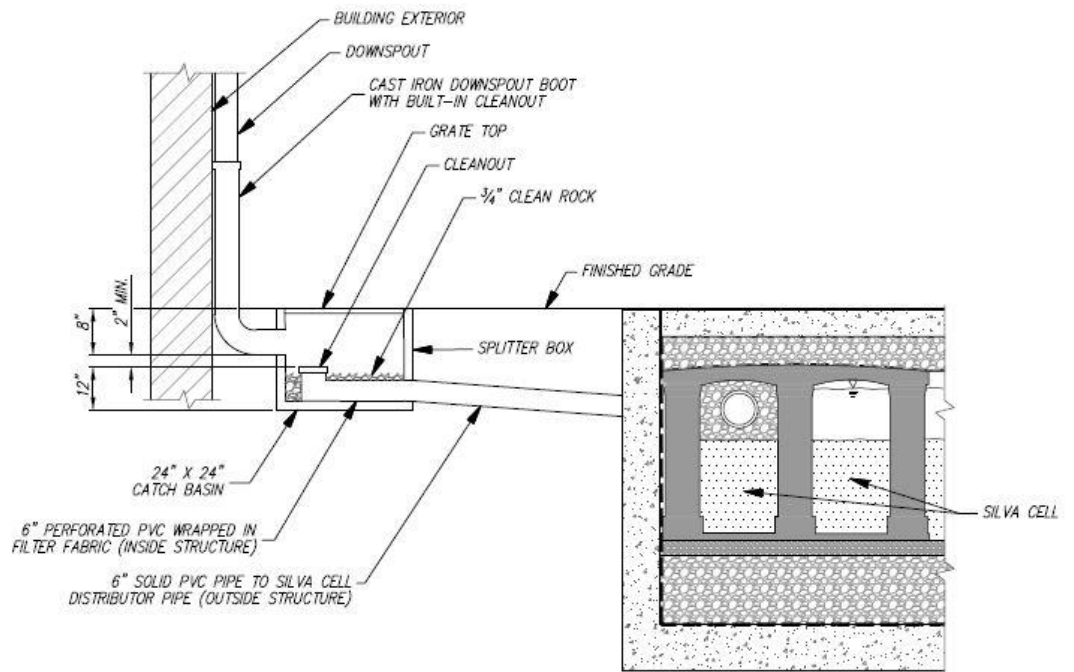
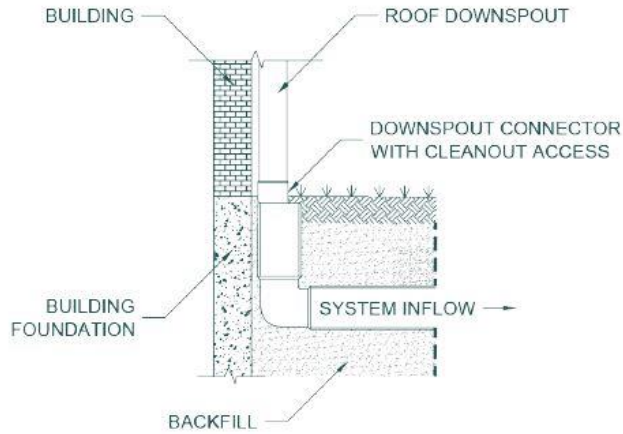
NOTE: PRETREATMENT DEVICE INSTALLED PER
MANUFACTURER RECOMMENDATIONS
OPTIONS INCLUDE HYDRODYNAMIC SEPARATORS,
FILTRATION DEVICES, AND FLOW REGULATORS.



TRENCH DRAIN



ROOF LEADER



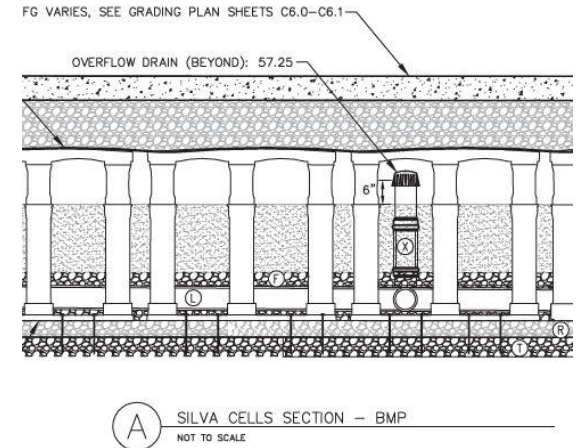
SIZING METHOD:
COMBO
FLOW-VOLUME

A couple of notes on maintenance.....

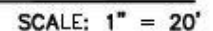
- Sediment, trash, leaf litter and other woody debris can be removed from catch basins, pre-treatment devices and overflow/distribution pipes with a vac-truck
- Soil profile and drainage rates can be monitored and assessed via inspection ports and/or pressure transducers
- Assuming proper pre-treatment is used and the contributing drainage area is and remains stable, soil media in the soil cell system should not require maintenance.

A couple of notes on design considerations...

- Be sure to account for bypass / overflow as part of the inlet system
- Provide horizontal separation between the distribution pipe and the underdrain / collection pipe (do not vertically stack)
- Upturned elbow attached to the underdrain where it discharges from the system (effectively holding back a portion of the storage volume to infiltrate over time)



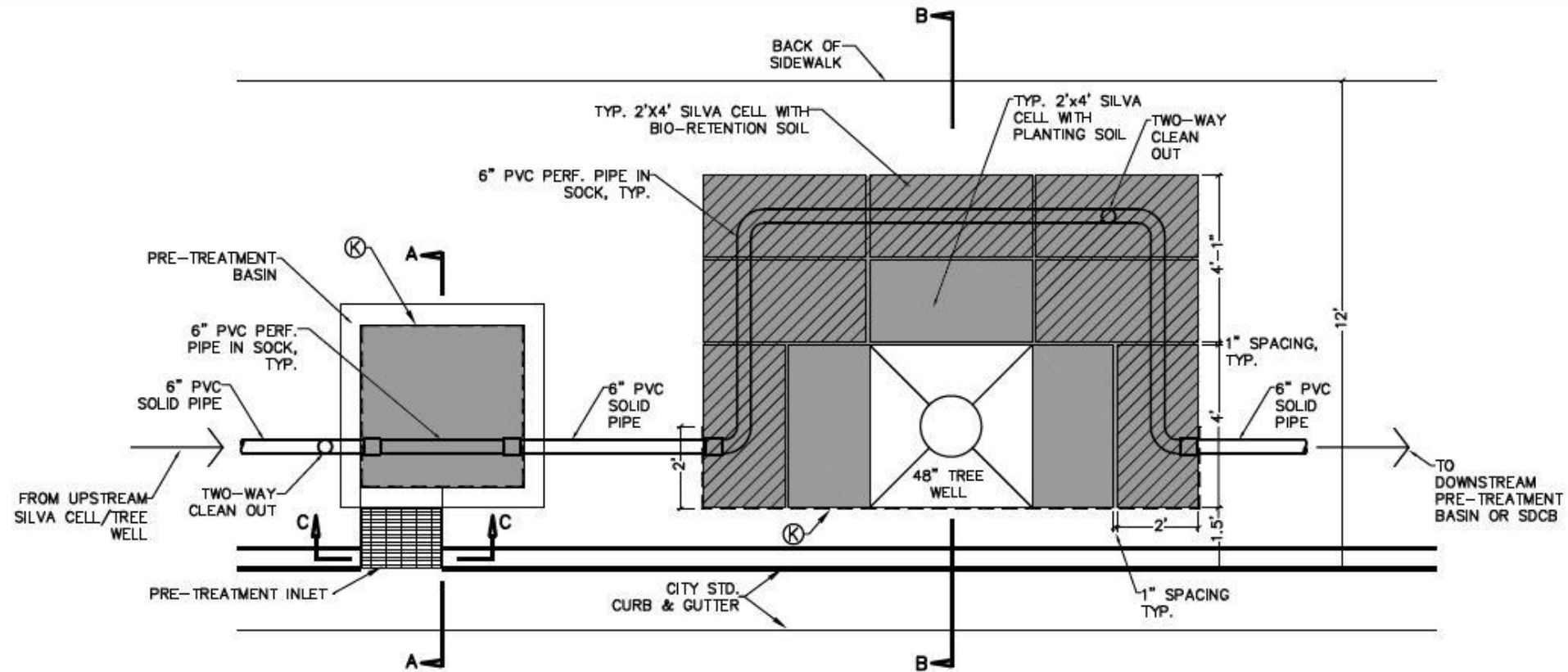
2020



North River Apartments – Public Improvements

Petaluma, CA

2020



15 TYPICAL SILVA CELL INSTALLATION DETAIL

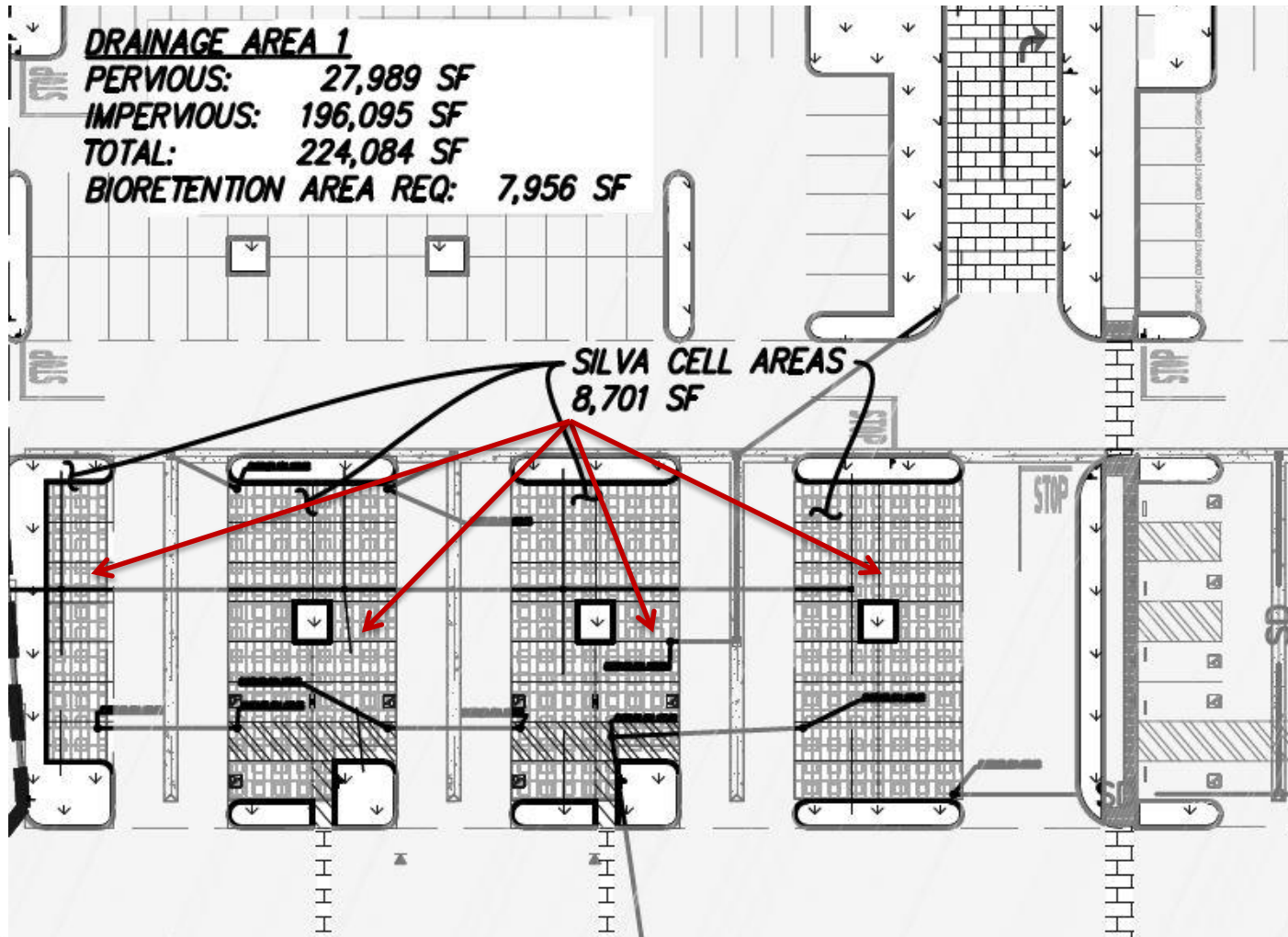
North River Apartments – Public Improvements



Lincoln Landing

Hayward, CA

2021



Lincoln Landing

Lincoln Landing Hayward, CA US-18-1910

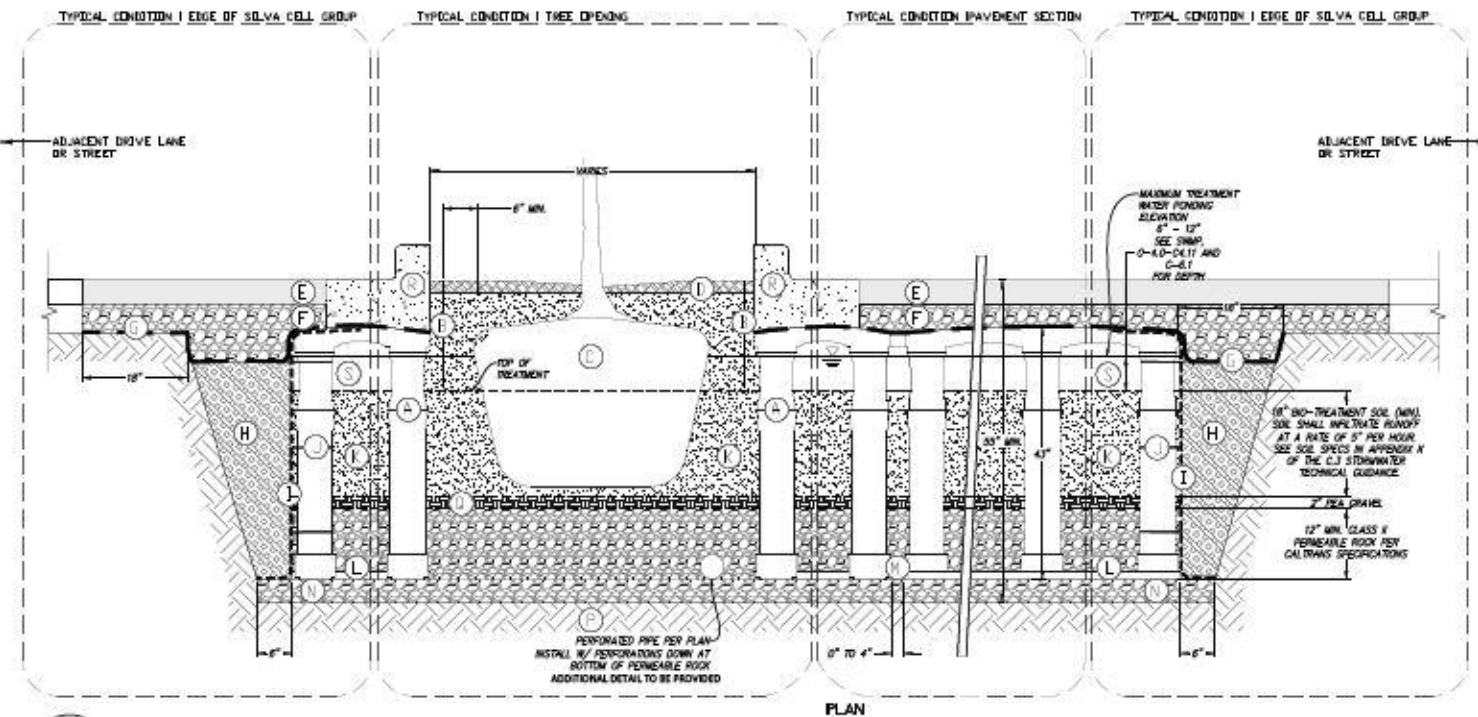
February 24, 2020

SILVA CELL LAYOUT (820) 3x Silva Cells

DISCLAIMER:
 Silva Cell 2 layouts are preliminary,
 and are based on the accuracy of
 the provided base information.
 Layouts use 6" spacing by default.
 Spacing between Silva Cells can
 vary between 1'-6". Field adjustment
 may be required.



Lincoln Landing



KEY PLAN

1. SILVA CELL SYSTEM (DECK, BASE, AND POSTS)
2. DEEPROOT LIGULUS ROOT BARRIER, INSTALL IMMEDIATELY ADJACENT TO CONCRETE EDGE RESTRAINT
3. TREE ROOT PACKAGE, SIZE VARIES
4. 1-2" MULCH, PLACED IN TREE OPENING
5. ASPHALT CONCRETE
6. AGGREGATE BASE COURSE, 12" MINIMUM THICKNESS ABOVE SILVA CELLS
7. GEOTEXTILE TO EDGE OF EXCAVATION
8. BACKFILL, TO WITHIN 4-6" BELOW TOP OF SILVA CELL DECKS, INSTALL IN 8" LIFTS, EACH COMPACTED TO 95% PROCTOR
9. GEOTEXTILE TO LINE PERIMETER OF SYSTEM WITH 6" TOE (OUTWARD FROM BASE) AND 12" EXCESS (OVER TOP OF DECK)
10. 3/16"x1/4" ZIP TIES, SECURING GEOTEXTILE TO SILVA CELLS
11. 18" BIO-TREATMENT SOIL (MIN.) SOIL SHALL INFILTRATE RUNOFF AT A RATE OF 1" PER HOUR, SEE SOIL SPECS IN APPENDIX K OF THE C.J. STORMWATER TECHNICAL GUIDANCE
12. SILVA CELL BASE SLOPE, SEE MAX
13. 0" TO 4" SPACING BETWEEN SILVA CELLS AT BASE
14. 4" MIN. AGGREGATE SUB BASE COMPACTED TO 95% PROCTOR
15. BACKFILL COMPACTED TO 95% PROCTOR
16. SUBGRADE COMPACTED TO 95% PROCTOR
17. 2" OF PER GRAVEL PER C.J. STORMWATER TECHNICAL GUIDANCE
18. 8" CONCRETE CURB
19. 8"-12" PONDING DEPTH PER SWMP C6.1

NOTES

1. INSTALLATION TO BE COMPLETED IN ACCORDANCE WITH MANUFACTURER'S SPECIFICATIONS
2. DO NOT SCALE DRAWINGS
3. PROVIDE SUPPLEMENTAL IRRIGATION FOR SEASONAL DROUGHT SUPPORT OF TREES & SOIL
4. TREE AND PLANTING INSTALLED IN BIO-TREATMENT SOIL ARE TO CONFORM AND COMPLY TO APPENDIX D OF THE C.J. STORMWATER HANDBOOK

1

PARKING APPLICATION | CONCRETE.3x | 3x SILVA CELL SYSTEM FOR CONCRETE PAVING ON AGGREGATE BASE

NOT TO SCALE

Lincoln Landing



Lincoln Landing



Lincoln Landing





LIVING with Soil Cells in the Public Realm











Electric

**Underdrain
(wrapped in fabric)**

Irrigation



**Existing street
lighting
conduits**



Existing gas service



Copper service

**2"
Watermain**





Light pole base





Soil Cells as an Underground Utility

Register Silva Cells as an underground facility with the local one-call agency and make it a permanent part of the notification system

Mark utilities for ease of future locating



Caution tape marks
utility corridor

Use Locating Equipment

Locating equipment can still be used to locate utility lines once Silva Cells have been installed

Electromagnetic style locators have been used successfully to locate utilities running through Silva Cells

Ground-penetrating radar can also detect the limits of the Silva Cell system.



An aerial photograph of an industrial facility, likely a refinery or chemical plant. The image shows a dense arrangement of large, cylindrical storage tanks, interconnected by a complex network of pipes and structural steel frameworks. The ground is covered in gravel or crushed stone. The text "Long Term Maintenance Needs Repair & Restoration" is overlaid in the center of the image.

Long Term Maintenance Needs
Repair & Restoration

Repair: Simulated Emergency Water Main (Toronto, Ontario)

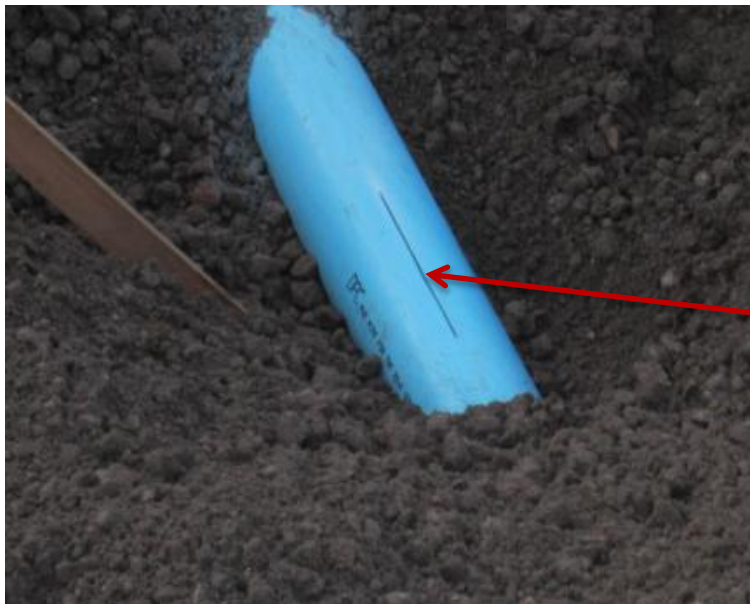
DeepRoot, along with the City of Toronto and Toronto Water
Participated in a demonstration project that simulated an
emergency water main repair scenario.

Repair: Simulated Emergency Water Main

Prior to constructing the Silva Cells, a PVC pipe was buried below the level of the Silva Cells to act as a watermain



A saw cut was made into the pipe to act like a break in the pipe



Repair: Simulated Emergency Water Main

A typical Silva Cell system is constructed over the buried pipe



Repair: Simulated Emergency Water Main

The planned “break” occurred on a bitterly cold day in January

**Silva Cell system with
concrete pavement
now over the top**

**Riser pipe and hose
connection to the
pipe buried under
the Silva Cells**



Repair: Simulated Emergency Water Main

A fire hose from a nearby hydrant was connected to the buried pipe via the riser pipe. When the hydrant was turned on, it flooded the area with water

***Due to the soil in the Silva Cells being loosely compacted, the water came to the surface very near to the location of the break rather than traveling underground**



Repair: Simulated Emergency Water Main

The pavement over the repair area was sawcut into panels and removed with a backhoe



Repair: Simulated Emergency Water Main

The aggregate base was removed and the geotextile fabric over the Silva Cells cut out of the way, exposing the top of the Silva Cells



Repair: Simulated Emergency Water Main

At this point, an effort could be made to salvage the Silva Cells for re-use. However, since this simulated an emergency repair, time is of the essence. Therefore, the crew doesn't stop and just digs right through the Silva Cells



Repair: Simulated Emergency Water Main

Remember, Silva Cells are designed with a 1" to 6" gap between the frames and do not interlock horizontally. Therefore, the adjacent stacks of Silva Cells were not disturbed during the excavation.

Adjacent Silva Cells



Repair: Simulated Emergency Water Main

The pipe was exposed and ready to be repaired in essentially the same time as it would be during a traditional repair.

***Note that the lightly compacted soil in the Silva Cells generally puts less downward pressure on the sides of the excavation than traditionally compacted soil which helps the excavation stay open better**



Restoration Options

There are two ways to approach restoring that area depending on the time frame in which the work must be completed and the available materials:

1. Restore the area temporarily at the time of the repair and do the permanent restoration at a later date.
2. Restore the area permanently at the time of the repair using one of three permanent restoration options.

Restoration Options

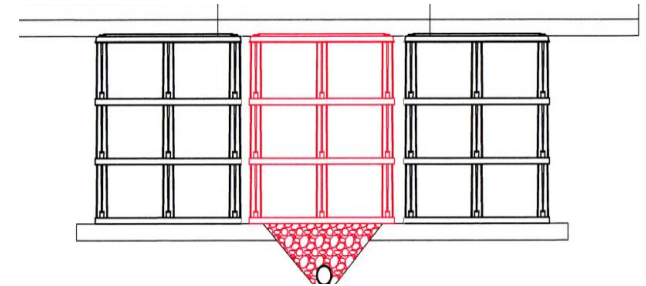
When time is limited, the area can be quickly restored by backfilling the excavation with a lean concrete mix like U-fill or compacted aggregate and temporarily patching the pavement ...

Then at a later date the area can be re-excavated and restored permanently using one of three permanent restoration options.

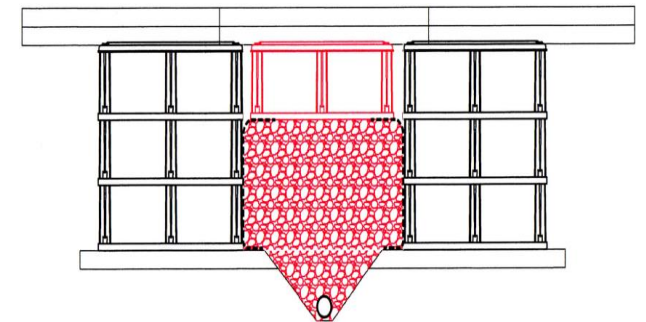


Restoration Options

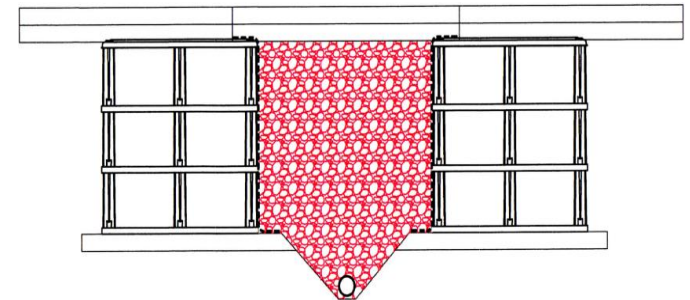
Option 1 – fill/compact the excavation to the bottom of the Silva Cells and re install new or salvaged frames and decks



Option 2 – fill/compact the excavation up to the bottom of the uppermost layer of Silva Cells and re install a single layer of frames and decks



Option 3 – fill/compact the excavation to the bottom of the Silva Cells, install geogrid around the perimeter of the remaining opening and fill with compacted soil, clear stone or flowable fill/U-fill (in the case of flowable fill, try to establish some link between adjacent soil volumes)



Last but not least, re-build the permanent pavement



Recommended Protocol For Utility Repairs and New Utility Installations

1. Locate

- Call Local One-Call Agency

2. Excavate

- Excavate to level of geotextile
- Expose geotextile fabric, cut and fold back, then remove decks
- Use a Hydro-Vac or hand dig out soil from area of excavation

3. Repair or add service (lateral)

4. Replace Silva Cells

- To replace Silva Cells follow Operations Manual procedures

5. Replace permanent surfacing

- Replace or patch paving

for further details, see www.deeproot.com or call 415-781-9700



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