BOSTON GROUNDWATER TRUST (BGwT)
BOARD MEETING
November 16th, 2017

The Board of Trustees of the Boston Groundwater Trust met in the Heritage Room at the Lenox Hotel located at 710 Boylston Street, Boston, MA. The Executive Director electronically distributed the meeting notice and agenda to the City Clerk at Boston City Hall in accordance with the provisions of the Commonwealth of Massachusetts' Open Meeting Law. Mr. Mitchell, co-chair, called the meeting to order at 4:08 pm. The following trustees were present:

Mr. Tim Mitchell, Neighborhood Association of the Back Bay
Mr. Andre Jones, Fenway Community Development Corporation
Mr. John Hemenway, Beacon Hill Civic Association
Ms. Janine Commerford, Greater Boston Real Estate Board
Mr. Austin Blackmon, City of Boston, Office of Environment, Energy, & Open Space
Ms. Angie Liou, Asian Community Development Corporation
Mr. Peter Shilland, Ellis Neighborhood Association

Also present:
Mr. Christian Simonelli, Executive Director; Mr. William Christopher, Commissioner of Inspectional Services Department (ISD); Mrs. Kim Thai-Durrigan, ISD Assistant Commissioner of Plans and Zoning, Director of Policy; Ms. Kathryn Bell, Neighborhood Liaison at the Office of Boston City Councilor Josh Zakim (departed at 4:50pm); Mr. Rory Cuddyer, Chief of Staff, City of Boston, Office of Environment, Energy, & Open Space; Mr. James Lambrechts, Professor at Wentworth Institute of Technology; Mr. Vincent Umipig, Civil Engineer at Wentworth Institute of Technology; Mr. John Schmid, Nitsch Engineering; Mr. Ryan Gordon, Nitsch Engineering; Mr. Maxim Willwerth, The Lagasse Group

1. Adoption of the minutes of the September 26th, 2017 Meeting

Minutes were previously emailed to Board members for review. Discussion followed. Mr. Blackmon, Trustee, moved to adopt the minutes. Mr. Shilland, Trustee, seconded the motion.

Voted: To accept the minutes of the September 26th, 2017 meeting.

2. 2018 Meeting Dates

Mr. Simonelli reviewed the meeting dates for the 2018 Board meetings. He noted that all meeting dates have been confirmed by the Lenox Hotel. Discussion followed.

3. Financial Reports

Mr. Hemenway reviewed the BGwT's financial reports. Discussion followed. Mr. Simonelli noted he distributed the annual report from Raphael & Raphael to the Trustees and that the Trust's form 990 tax return had been filed. Discussion followed.

4. Update on Underpinning Video Project

Mr. Simonelli updated the Board on the underpinning video project. Mr. Simonelli stated that he and Mike Atwood of Haley and Aldrich were interviewed by Don Schechter of Charles River Media Group (CRMG) on the groundwater issue and the underpinning process. He also noted that CRMG documented the underpinning process over the course of about week. Mr. Simonelli is working with CRMG on a second draft of the approximately 11-minute video; he expects the 3rd draft to be available for viewing at the January Board meeting. Discussion followed.

5. Presentation on recharge systems by John Schmid and Ryan Gordon of Nitsch Engineering

Mr. Schmid and Mr. Gordon gave a presentation on groundwater recharge systems focusing on their purpose and methods. They presented the following information to the Trustees:

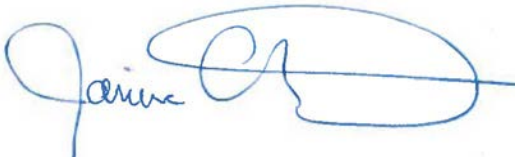
- Overview of urbanization's effects on the water cycle
- Reasons for and requirements of the Groundwater Conservation Overlay District
- Boston Water and Sewer Commission review process and its additional regulatory requirements
- Benefits of groundwater recharge
- Review of design considerations and how site limitations can affect the type of recharge systems that are installed
- Description of groundwater mounding analysis conducted to protect abutters and the environment
- Examples of the various types of recharges systems that have been installed
- Process for submitting plans for approval to the City's Public Improvements Commission when recharge needs to be installed in or under public sidewalks

Mr. Schmid and Mr. Gordon took questions during and after the presentation. Refer to the attached presentation for additional details.

The meeting adjourned at 5:20 p.m.

NEXT MEETING: January 11th, 2018 @ 4:00 pm at the Lenox Hotel.
Notes submitted by Christian Simonelli, BGwT Executive Director, on 11/17/2017.

Approved 3 January 2018



J Commerford, Secretary

Nitsch Engineering

Groundwater Recharge: Purpose & Methods

Presented by:

John M. Schmid, PE, LEED AP
Vice President, Principal

Ryan M. Gordon, EIT, ENV SP, LEED Green Associate
Senior Project Designer

November 16, 2017

@nitscheng

Building better communities with you

Overview

- Urbanization’s effects on water cycle
- Formation of the Groundwater Conservation Overlay District (GCOD)
- Article 32 requirements
- BWSC review and recharge requirements
- Benefits of groundwater recharge
- Groundwater recharge design considerations
- Examples of constructed systems

Urbanization's Effects on the Water Cycle

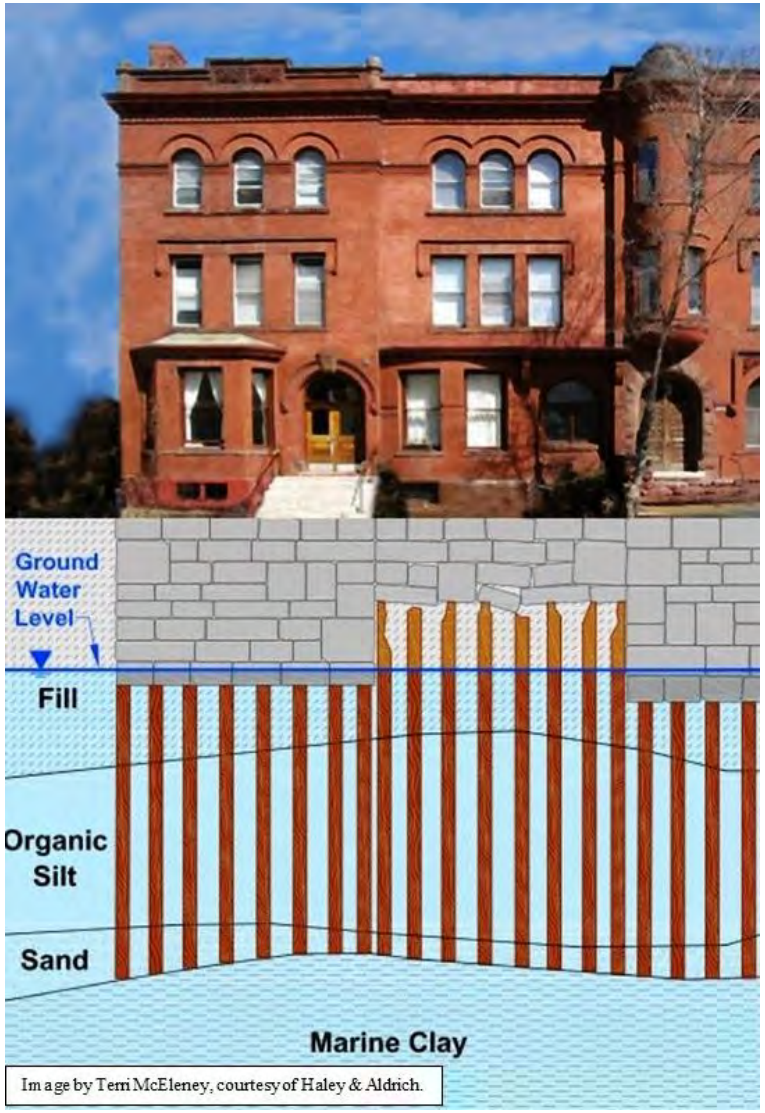
As cities urbanize:

- Impervious area increases (pavement, building roof)
- Urbanization disrupts natural water cycle
- Water is directed to water bodies via engineered infrastructure (e.g. catch basins, roof leaders, pipes, etc.)
- Less stormwater infiltration
- Results in lower groundwater levels

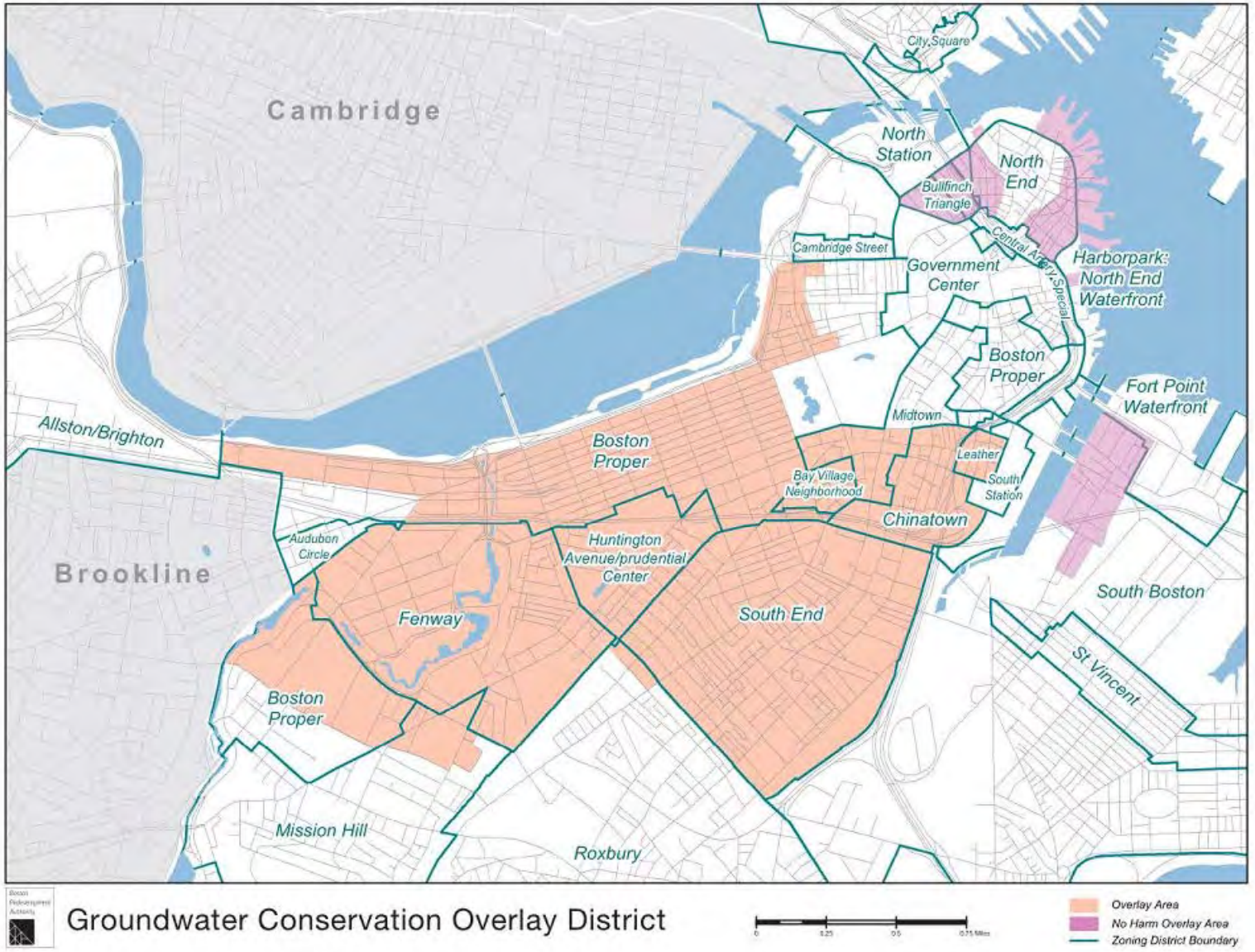
Formation of the GCOD

- Buildings built on fill with wooden piles
- As groundwater levels decrease, wooden piles become exposed to air and rot occurs
- Rotting piles cause damage to foundations
- **Article 32** zoning (GCOD) established in 2006
  - **Prevent** lowering and **promote** restoration of groundwater levels
  - **Protect** city's structures
  - **Reduce** surface water runoff and water pollution
  - **Maintain** public safety

Source: www.bostongroundwater.org



Boston GCOD Map

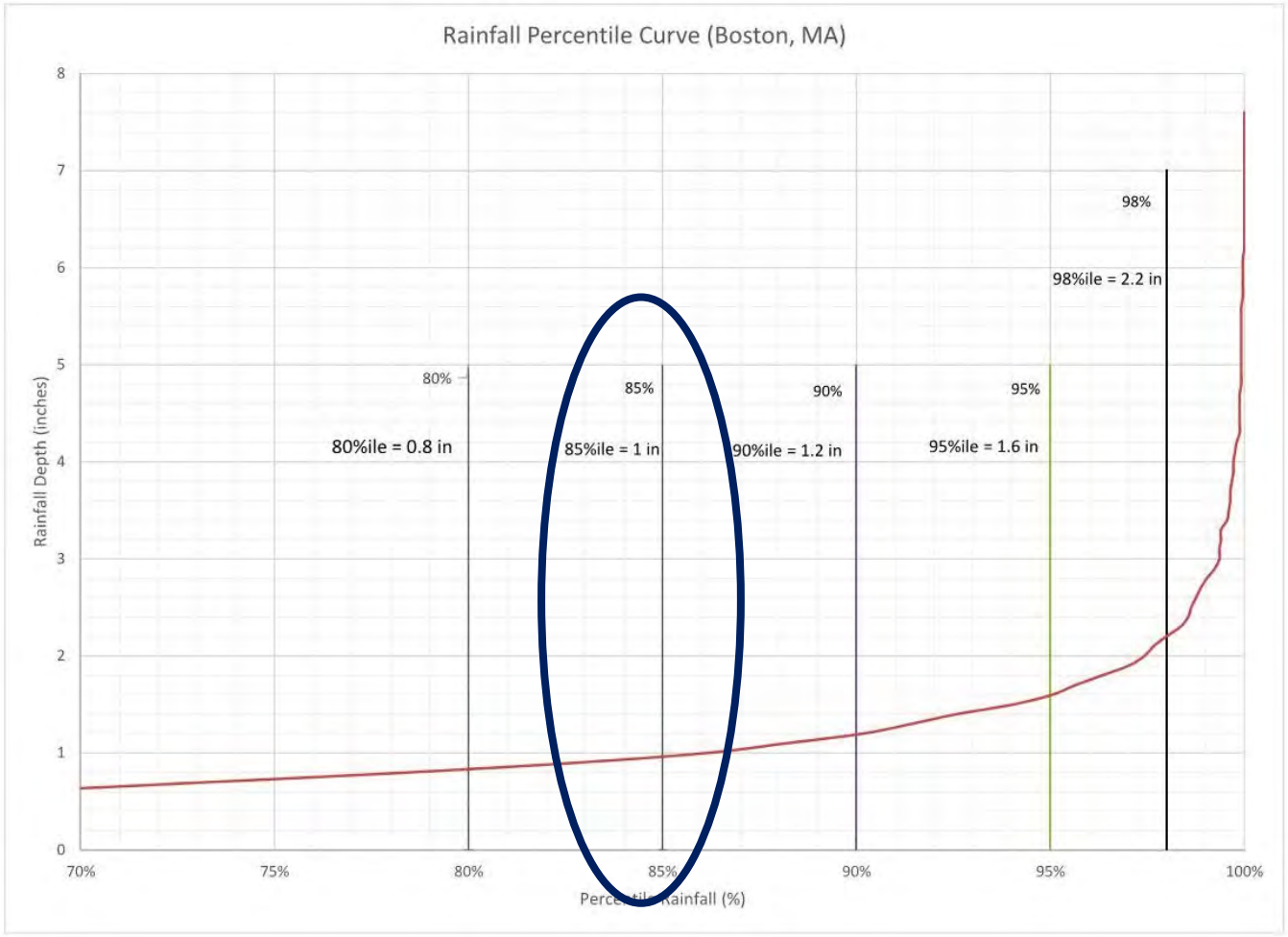


Article 32 Zoning

- Projects in GCOD subject to Article 32 zoning:
  - Erection or extension of structure more than 50 s.f.
  - Below grade excavation to a depth below equal to or below elevation 7 feet (BCB datum)
  - Substantial building rehabilitation/renovation
  - Paving or resurfacing of lot
- Requires hearing before the Zoning Board of Appeals for Conditional Use Permit
- Engineer provides “No Harm” letter
- Requires Site Plan Approval from Boston Water and Sewer Commission

BWSC Review and Recharge Requirements

- Must provide storage for minimum 1” rainfall volume over impervious area
- Nitsch worked with BWSC to determine 1” storage requirement:
  - 85% Boston storms are 1” rainfall or less
- BWSC Site Plan Applications must show:
  - required recharge volume
  - provided recharge volume
  - recharge system design
  - overflow connection to BWSC mains



Other Regulatory Requirements

- Public Improvement Commission
  - License Required for Recharge Systems in Public Ways
  - Public Notification and Hearing Process

- DEP Bureau of Resource Protection
  - Underground Injection Control Regulations (310 CMR 27.00)
  - Injection Well Permit Registration Filing

- Inspectional Services/ Building Code
  - Material Restrictions for Underslab Systems

Benefits of Groundwater Recharge

Recharge systems provide several benefits:

- Promotes groundwater recharge, mimicking natural hydrological processes
- Replenishes groundwater
- Provides stormwater storage
- Reduces volume of stormwater directed to BWSC infrastructure
- Reduces rates of stormwater flows directed to BWSC infrastructure
- Reduces stormwater in combined sewers
- Improves water quality by filtering out excess nutrients (e.g. phosphorus), suspended solids, and contaminants; cleaner water is directed waterways

Groundwater Recharge Design Considerations

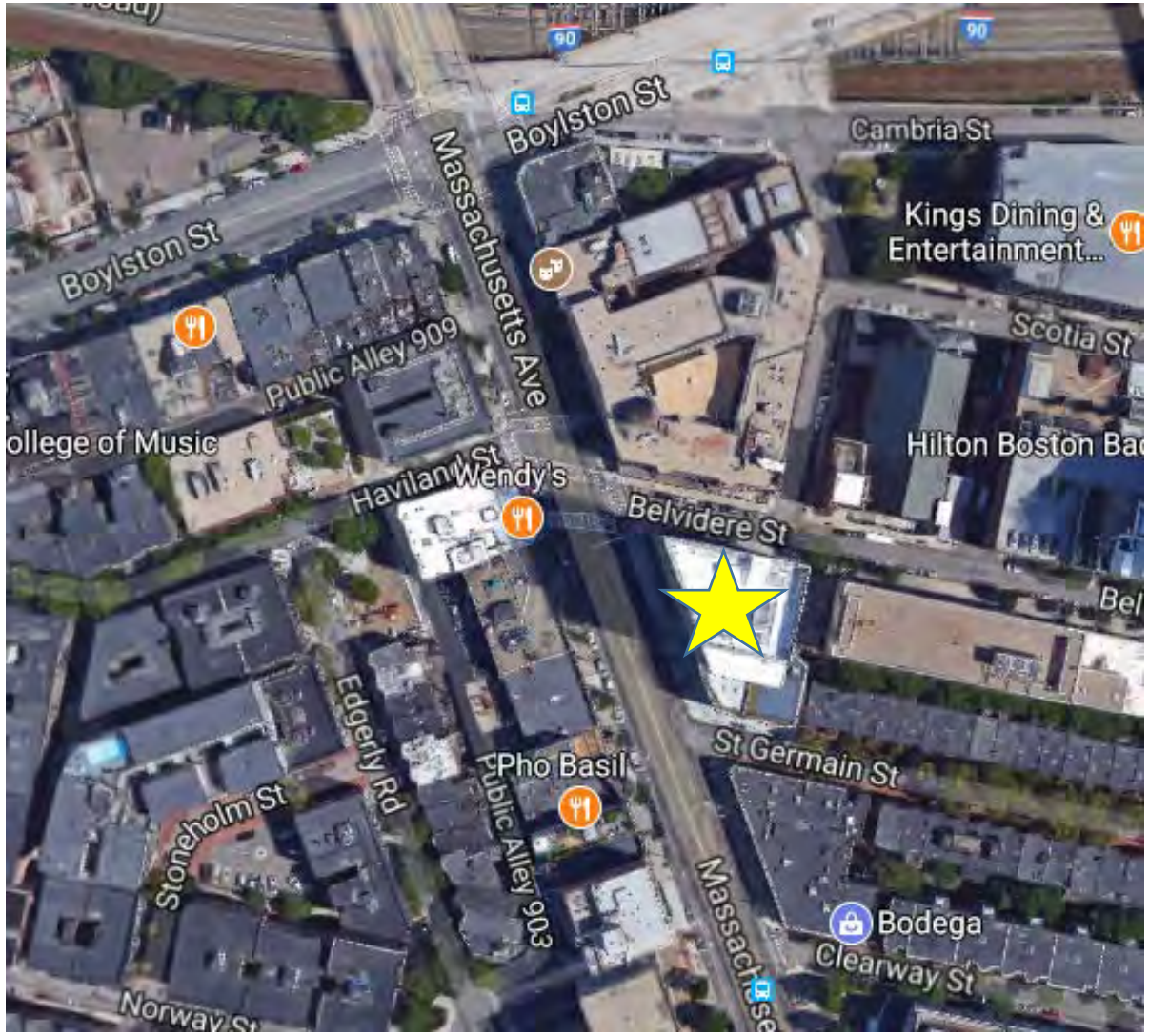
- Systems Limited by:
  - Available site – building vs. parking/landscape areas
  - Underground utilities – below grade conflicts
  - Adjacent buildings- proximity and foundation types/ elevations
  - Mounding Impacts – impacts to abutters
  - Groundwater Table – clearance between finish grade and groundwater
  - Existing Soil Contamination – potential migration concerns
  - Ledge – unlikely but must consider

Types of Recharge Systems

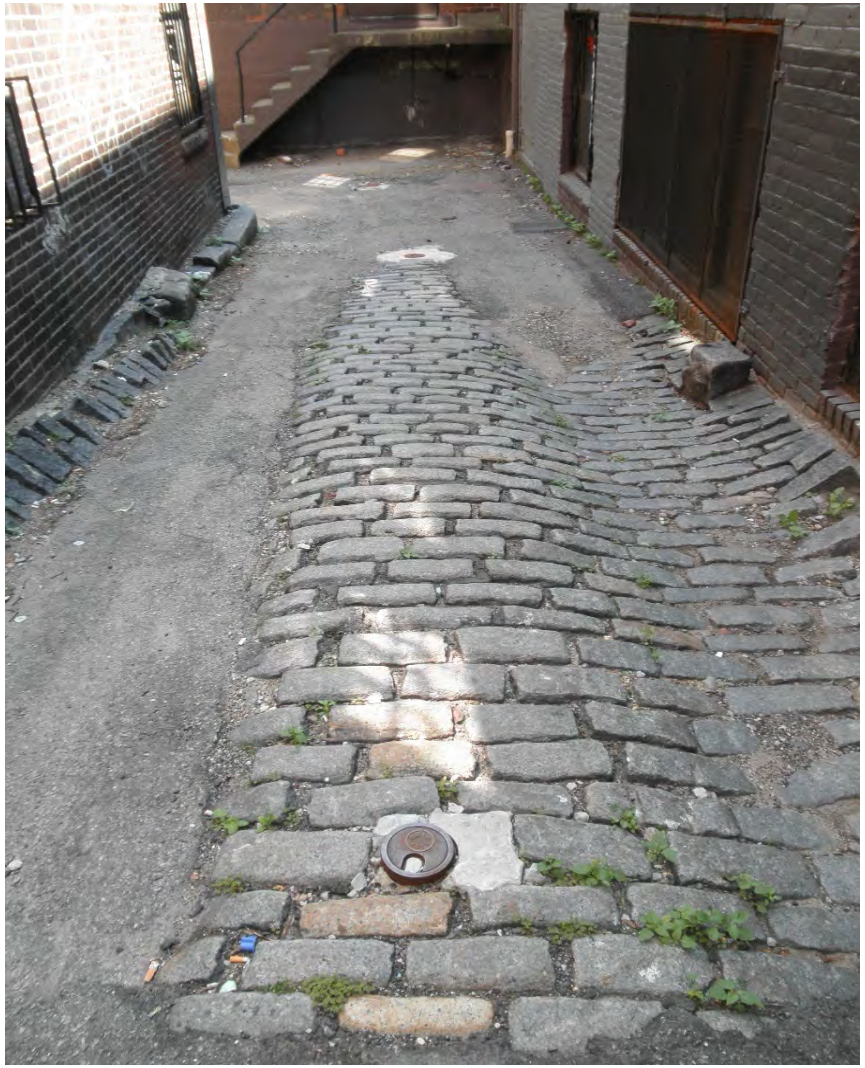
- Types of Systems:
  - Passive Below Grade Exterior Structure System
  - Underslab Passive Structure System
  - Interior tank with groundwater recharge wells

Passive Below Grade Structure System

- Berklee College of Music (160 Massachusetts Avenue)
  - Located in Back Bay/Fenway
  - 369 bed residence hall
  - 400 seat cafeteria
  - 1,600 s.f. academic space
  - 100 seat restaurant
- Recharge system consists of: perforated pipe surrounded by crushed stone and wrapped in filter fabric
- Located under paved alley behind the building



Passive Below Grade Structure System



Passive Below Grade Structure System

RECHARGE CALCULATIONS:

Article 32 requires groundwater recharge in the volume equal to 1" of storage over the impervious area of the site. Berklee is providing extra storage to meet Article 32 requirements for potential future improvements to their 11 Belvidere property.

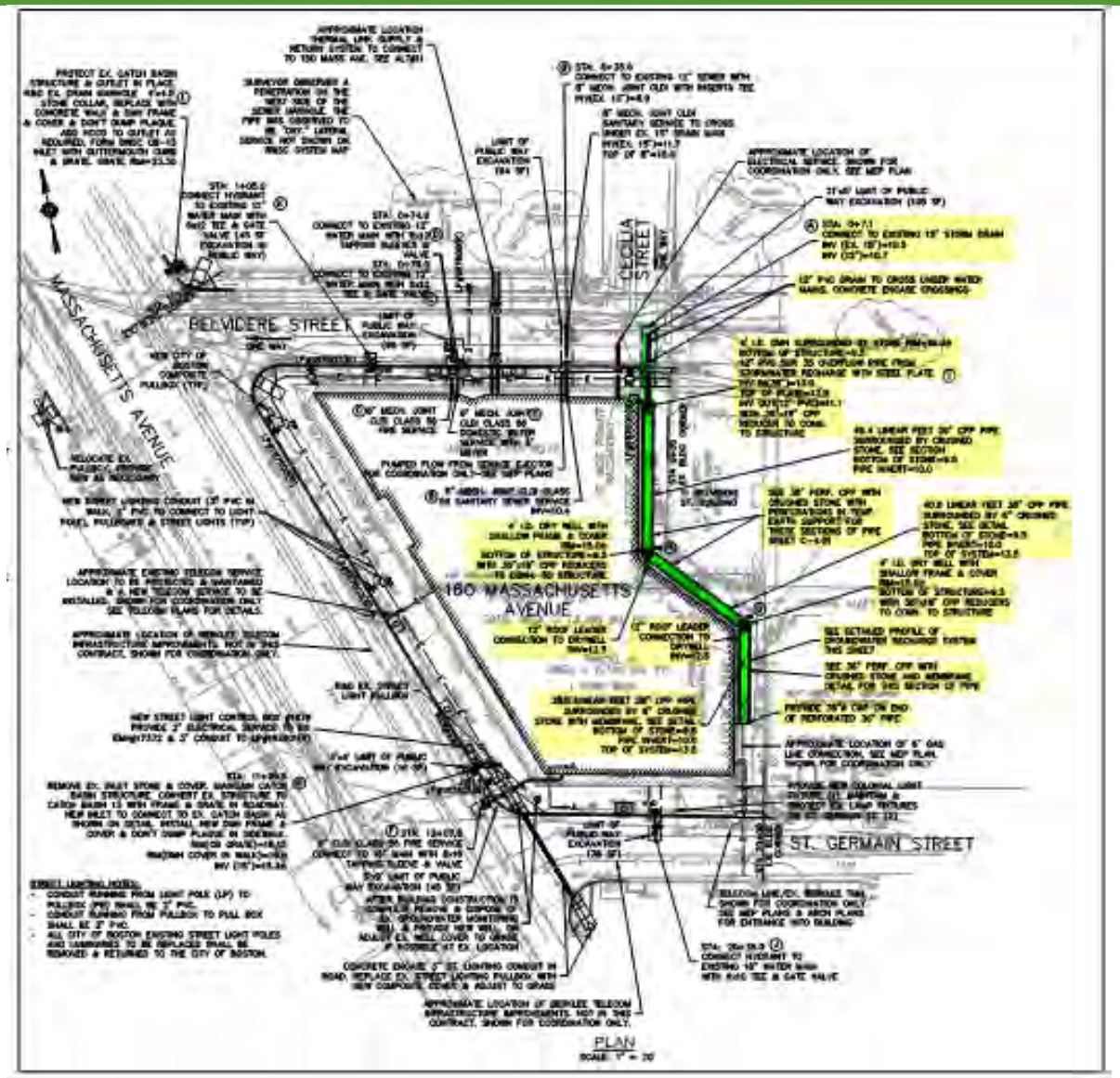
Required Storage Volume:

The 160 Massachusetts Avenue site = 14,142 sf
Banked storage for future improvements at 11 Belvidere St. = 1,778 sf
Total impervious area = 15,920 sf
Required Storage = 1" of runoff (0.083 ft) over the site = 0.083' x 15,920 sf = 1,326 cf of storage ◀

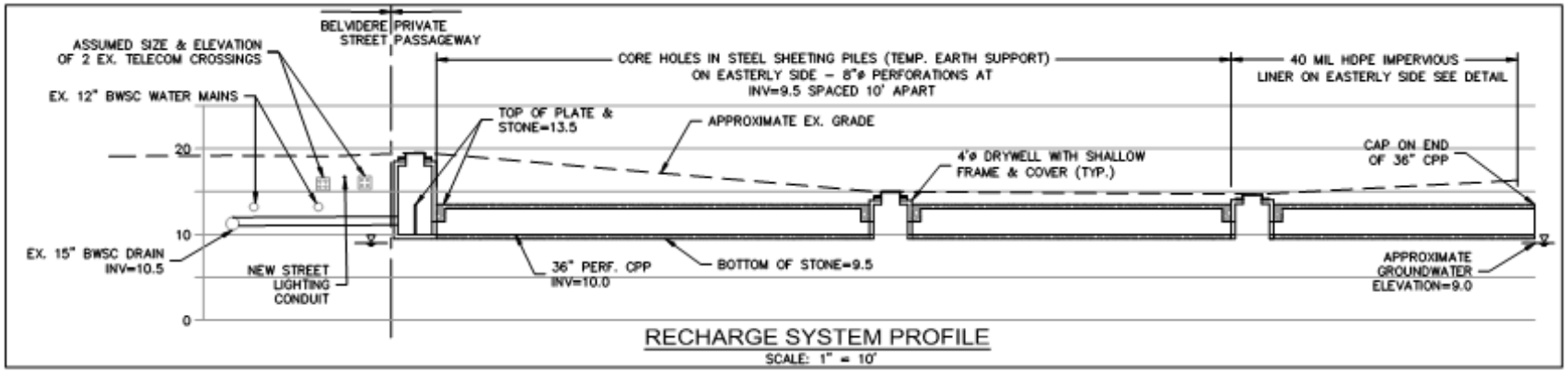
Storage Volume Provided:

The Mini Dry Wells provides storage = 25.1 cf + 50.2 cf + 50.2 cf = 125.5 cf
The 123.5 lf of 36" CPP pipe provides storage = length of pipe x area of pipe=
123.5 x (3.14 x (3/2)x(3/2)) = 872.5 cf
The 123.5 lf of stone provides storage =
((length stone x h x w) - (storage area of pipe)) x 30% =
((123.5 x 4.0 x 4.0) - (872.5)) x .3 = 331.1 cf
Total Storage Provided = 125.5 cf + 872.5 cf + 331.1 cf = 1,329 cf of storage ◀

Required Storage = 1,326 cf of storage < 1,329 cf of storage = Total Storage Provided ◀

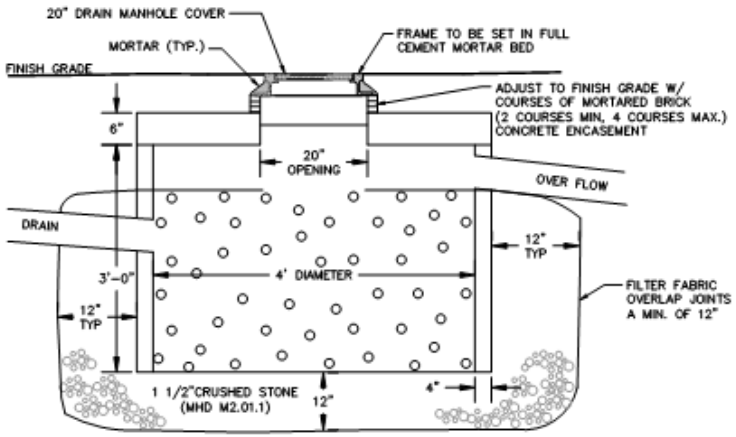


Passive Below Grade Structure System



RECHARGE SYSTEM PROFILE

SCALE: 1" = 10'

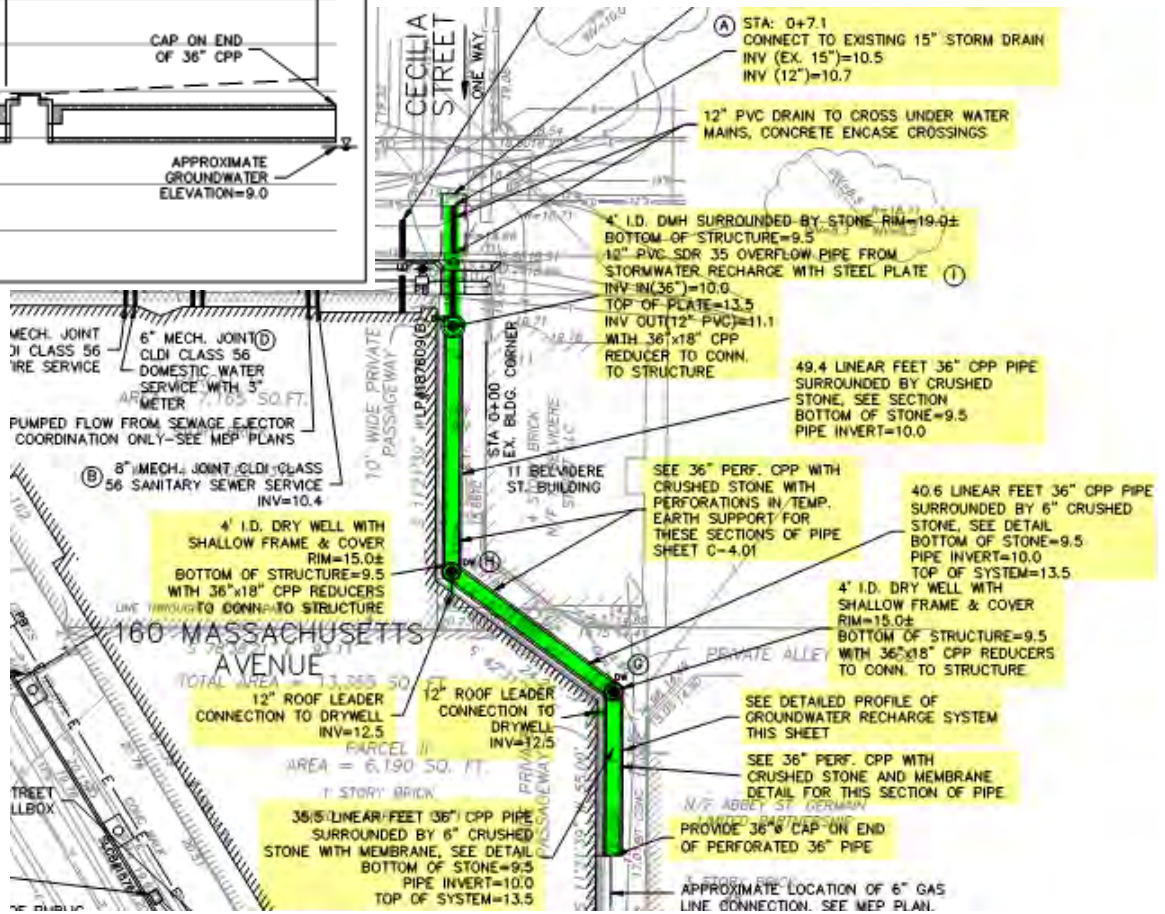


NOTES:

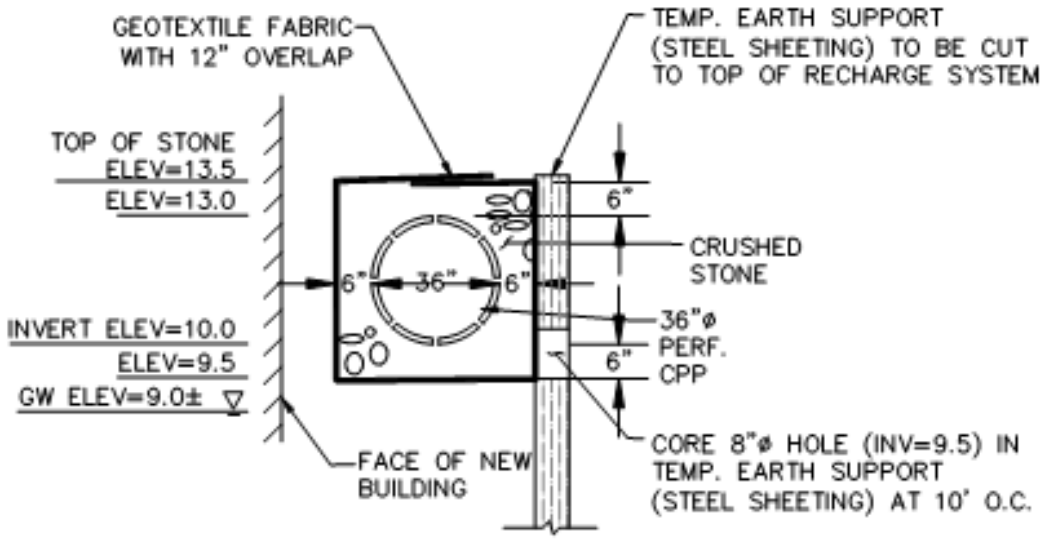
1. NO BOTTOM, UNLESS OTHERWISE INDICATED ON THE PLANS.
2. SEE UTILITY PLAN FOR INLET & OUTLET SIZES & INVERTS.
3. CONCRETE MINIMUM STRENGTH: 4,000 P.S.I. @ 28 DAYS
4. STEEL REINFORCEMENT: ASTM A-615, A-185, OR A-497, 1" MIN. COVER
5. DESIGN LOADING: AASHTO HS20-44

4' INSIDE DIAMETER DRY WELL

NOT TO SCALE

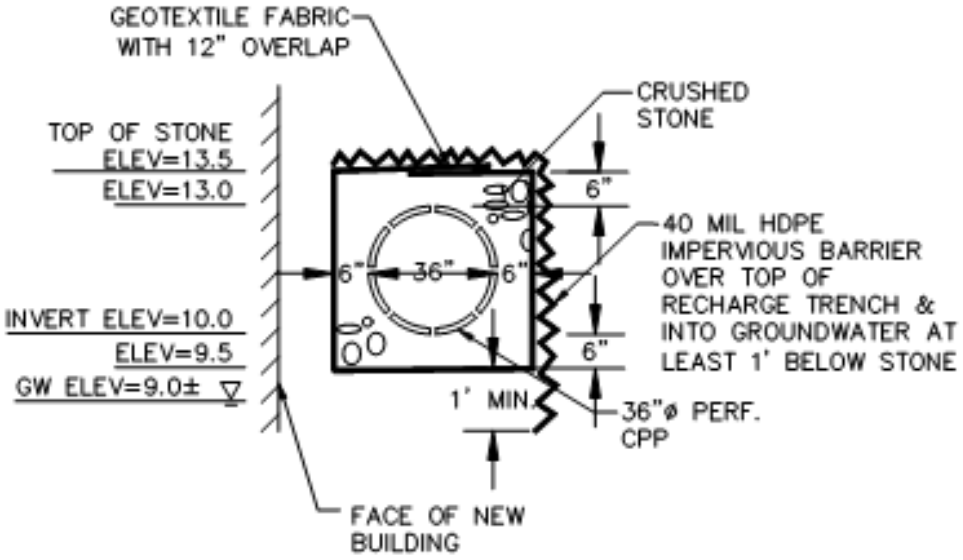


Passive Below Grade Structure System



36" PERFORATED CPP SURROUNDED BY CRUSHED STONE

NOT TO SCALE



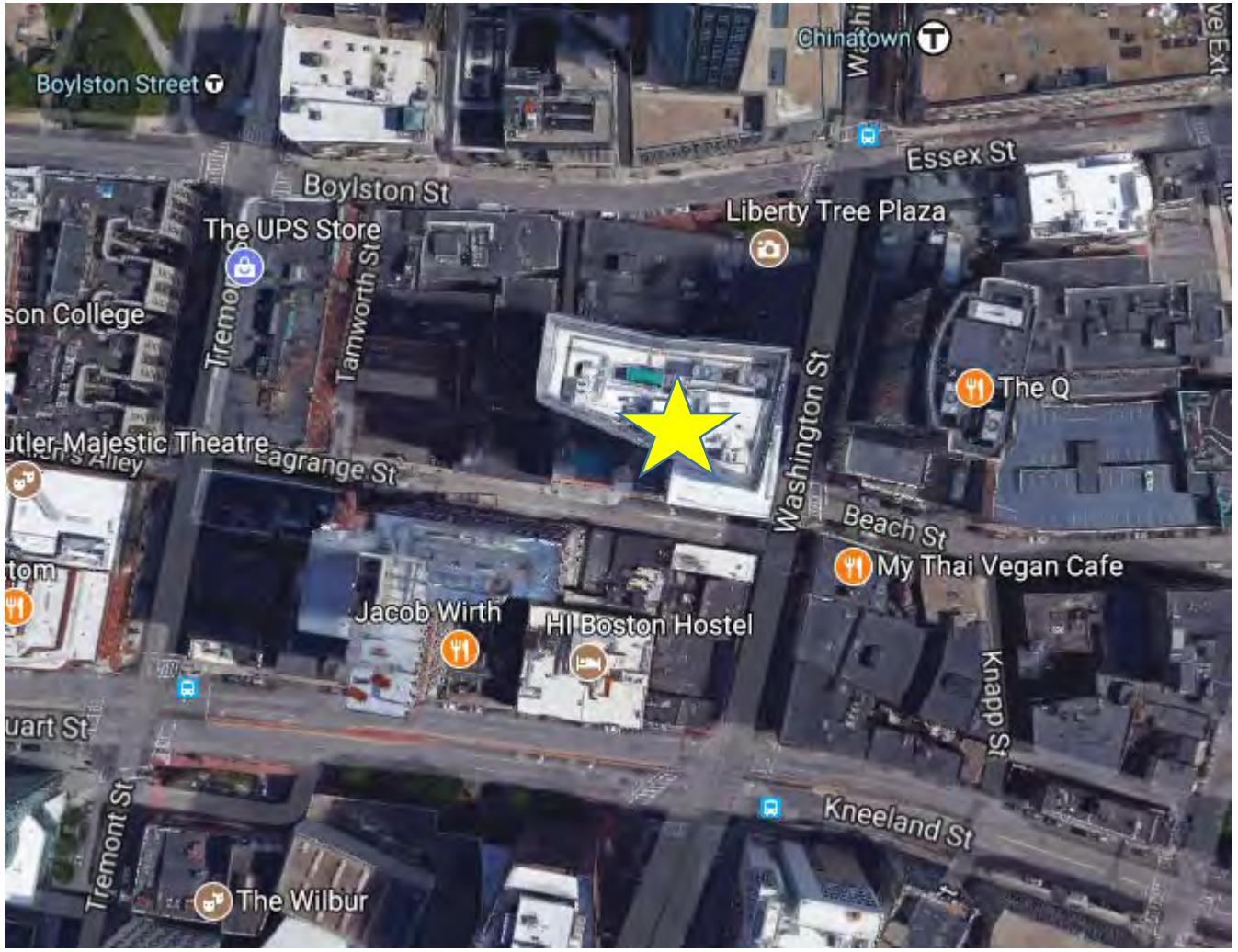
36" PERFORATED CPP SURROUNDED BY CRUSHED STONE WITH MEMBRANE

NOT TO SCALE

Passive Below Grade Structure System

Underslab Recharge System

- The Kensington Apartments (665 Washington Street)
  - Chinatown
  - 371 apartments units
  - 3,000 s.f. restaurant/retail
- Recharge system provides 1.5” storage to meet LEED requirements
- Recharge system is located under the building slab due to limited space



Underslab Recharge System

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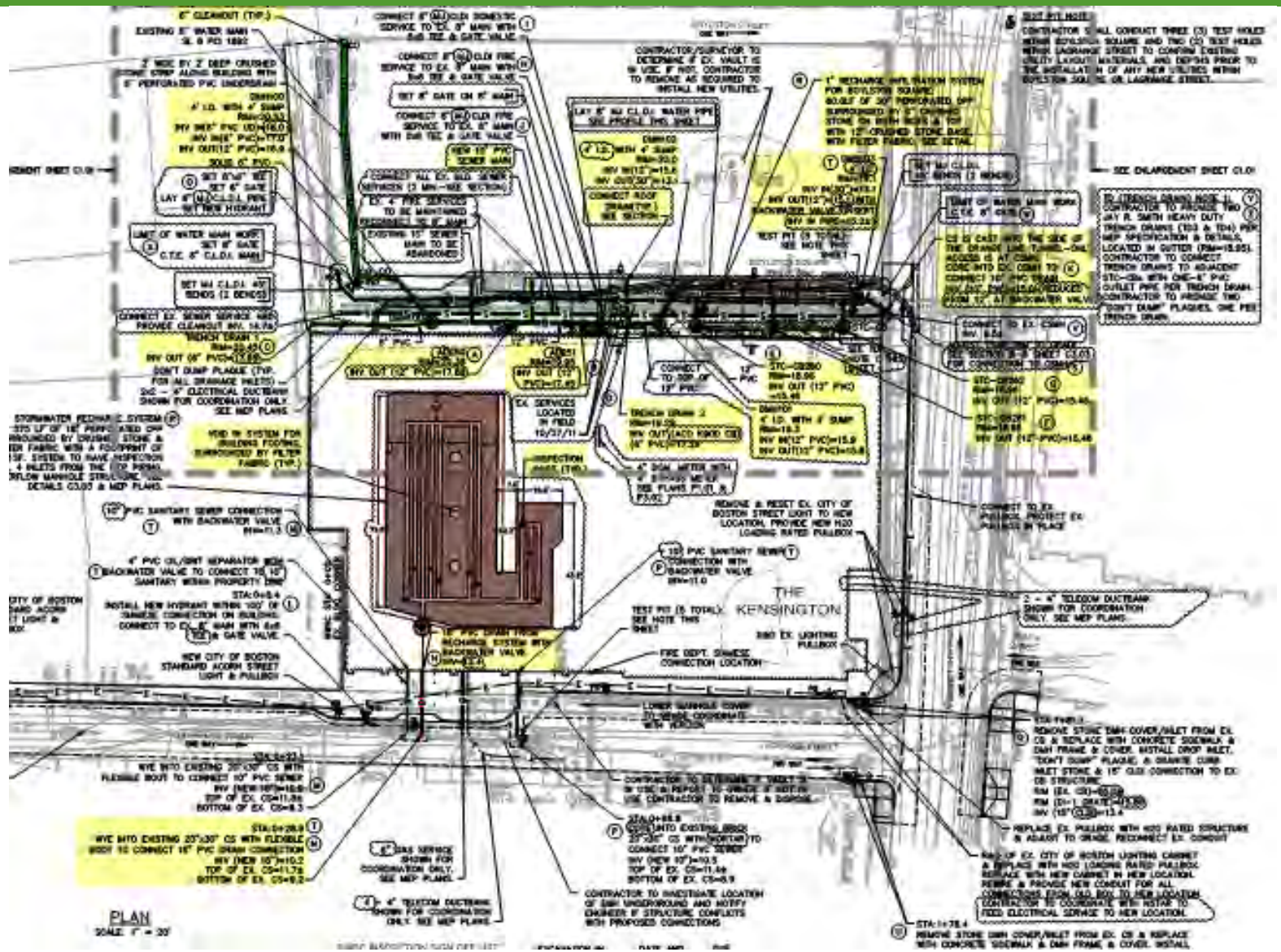


Underslab Recharge System

RECHARGE CALCULATIONS:

Article 32 requires groundwater recharge in the volume equal to 1" of storage over the impervious area of the site. The project will also achieve the City of Boston Article 37 extra LEED Credit by recharging 1.5" of runoff.

Required Storage Volume:

The impervious site = 24,470 sf

1.0" of runoff (0.083 ft) over the site = 0.08' x 24,470 sf = 2,039 cf of storage ◀

1.5" of runoff (0.13 ft) over the site = 0.13' x 24,470 sf = 3,059 cf of storage

Storage Volume Provided:

The 575 lf of 18" CPP provides storage = length of pipe x area of pipe=

575 lf x (3.14 x (1.5/2)x(1.5/2)) = 1,018 cf

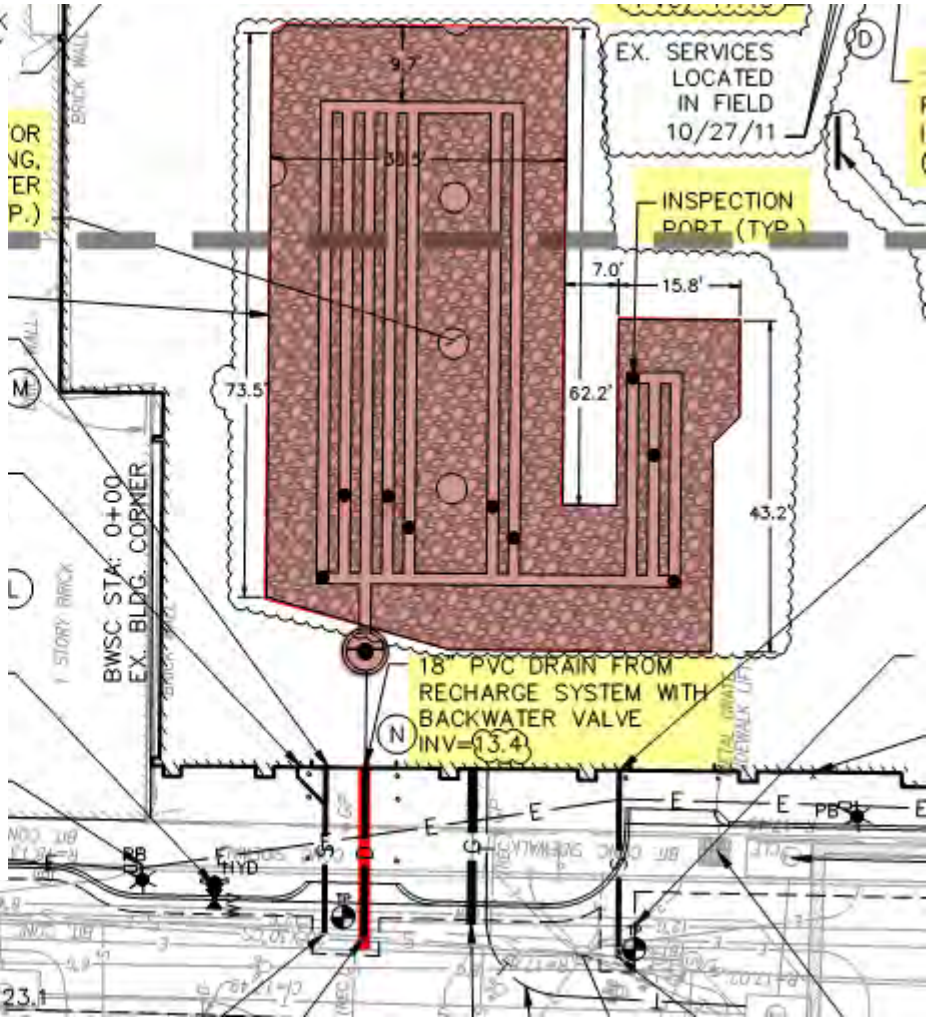
The 3,725 sf of stone provides storage =

((area stone x depth of storage) - (storage area of pipe)) x 30% =

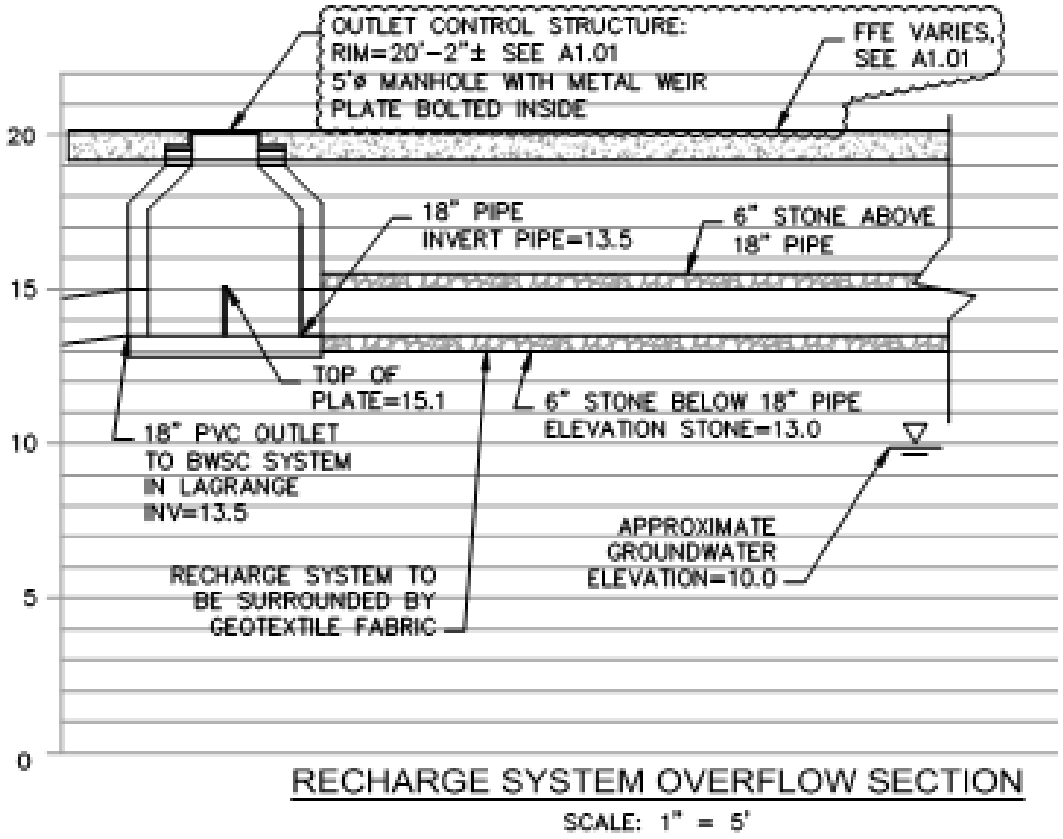
(3,763 sf - 38 sf footings) x 2.1 ft) - (1,018cf)) x .3 = 2,042 cf

Total Storage Provided = 1,018 cf + 2,042 cf = 3,060 cf of storage ◀

Required Storage = 1,709 cf < 3,060 cf = Storage Provided ◀

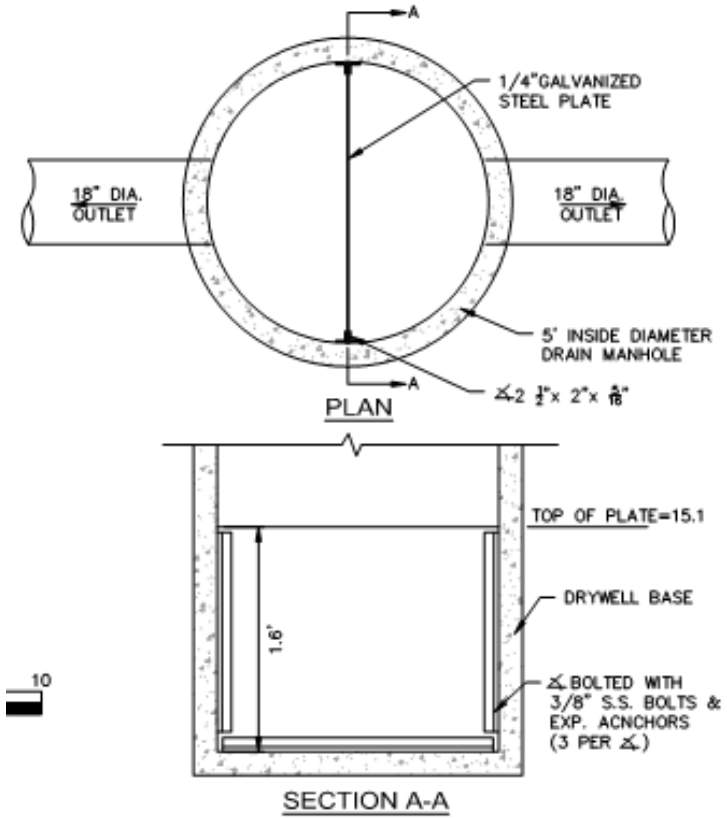


Underslab Recharge System



RECHARGE SYSTEM OVERFLOW SECTION

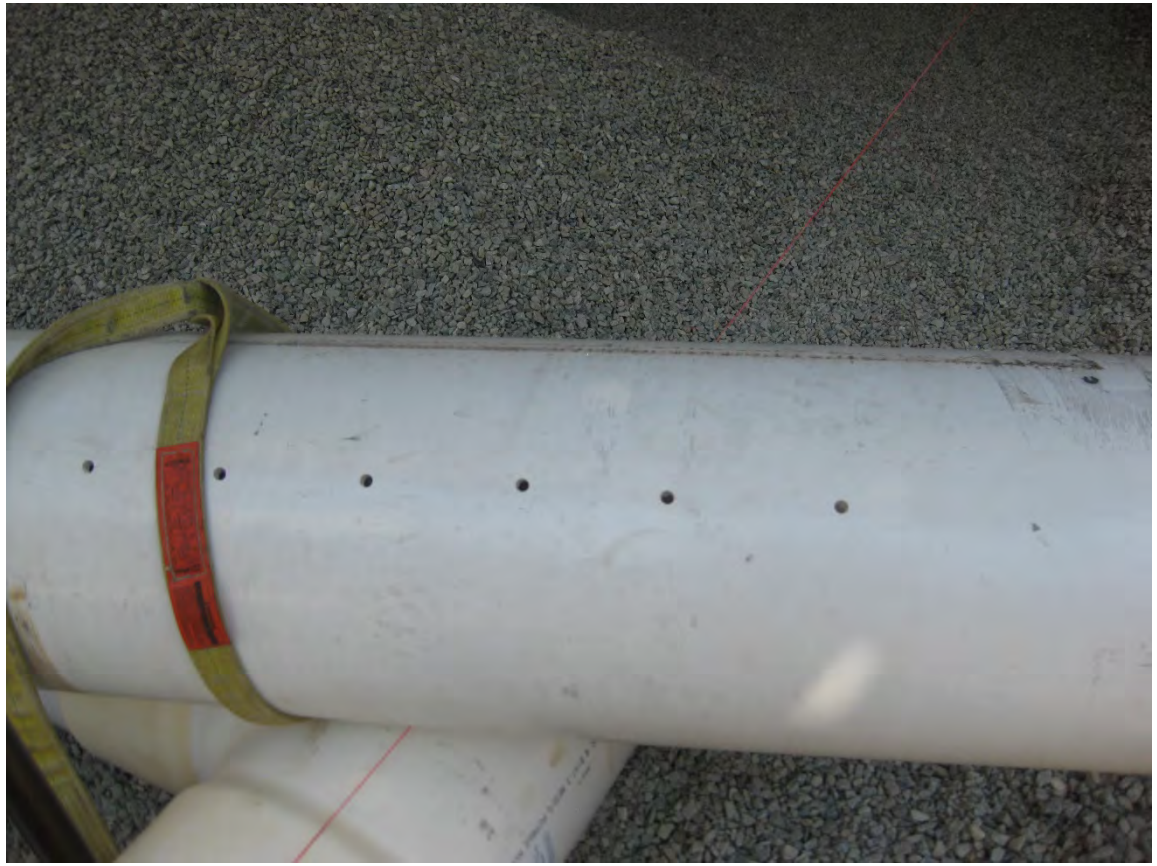
SCALE: 1" = 5'



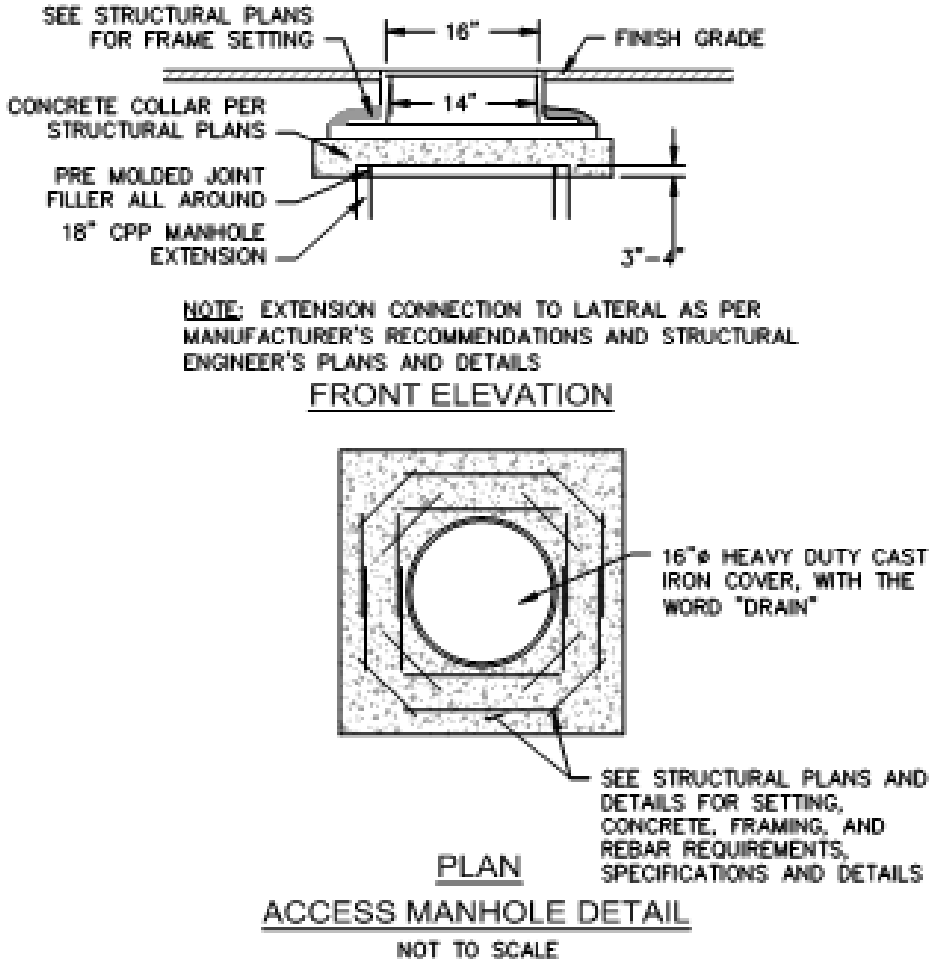
METAL PLATE IN OUTLET CONTROL STRUCTURE
FOR RECHARGE SYSTEM OVERFLOW

NOT TO SCALE

Underslab Recharge System

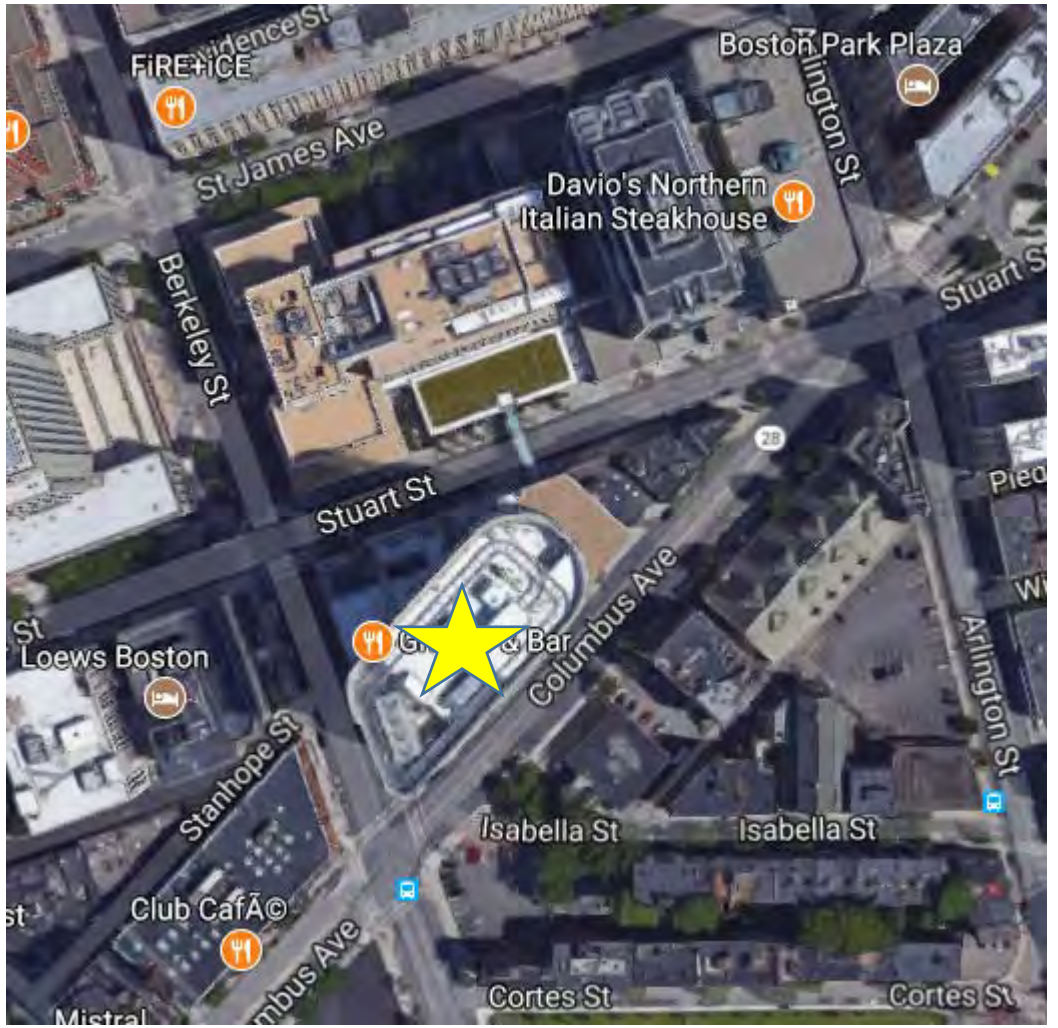


Underslab Recharge System



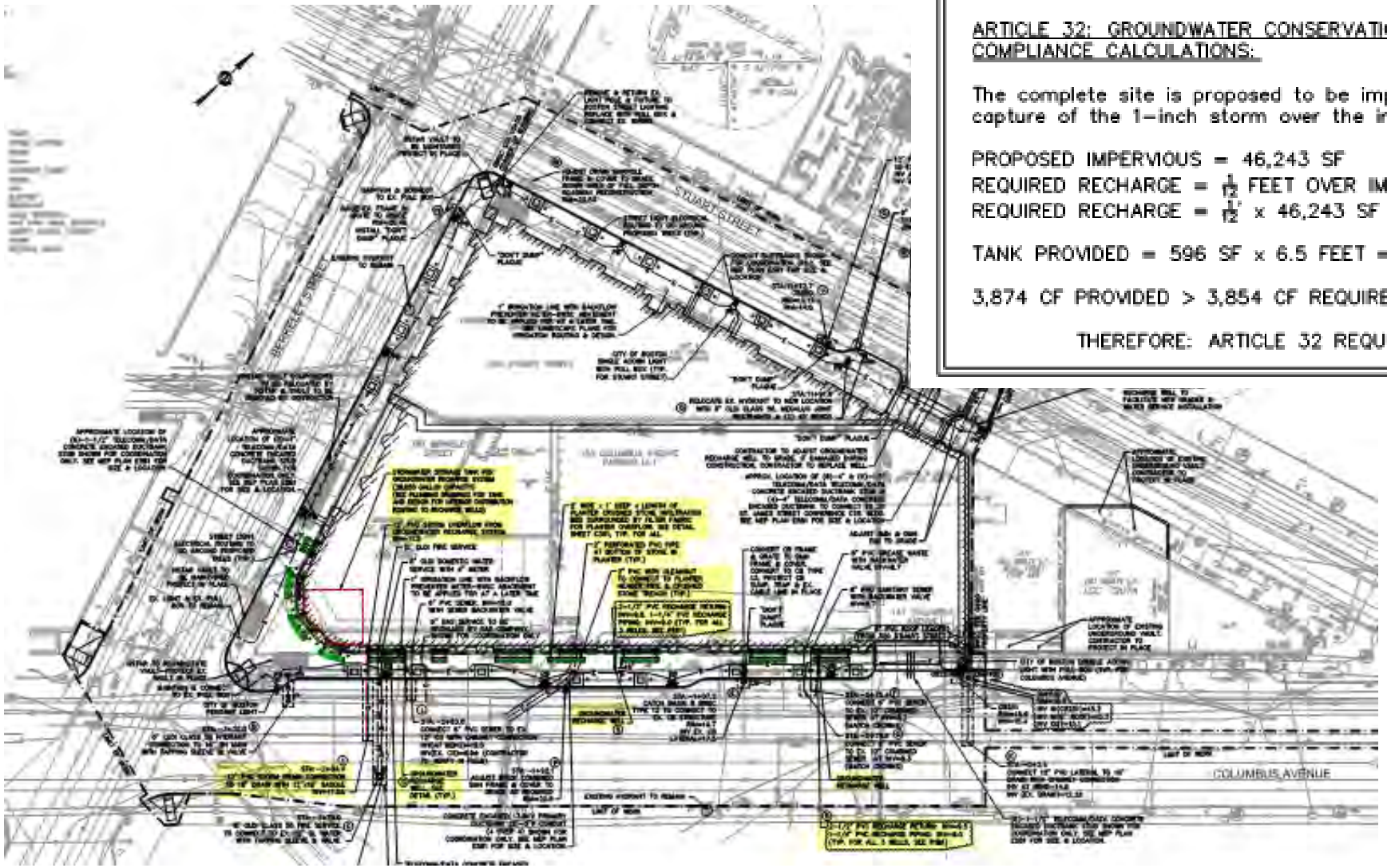
Interior Storage Tank with Recharge Wells

- Liberty Mutual
  - 157 Berkeley Street (Back Bay)
  - 600,000 s.f. office
  - 700 seat cafeteria
  - Stormwater system meets Article 32 using:
    - For 1” Storage: Stormwater storage tank inside building
    - For Recharge: Injection wells in Columbus Ave sidewalk



Interior Storage Tank with Recharge Wells

Interior Storage Tank with Recharge Wells



ARTICLE 32: GROUNDWATER CONSERVATION OVERLAY DISTRICT COMPLIANCE CALCULATIONS:

The complete site is proposed to be impervious. Article 32 requires the capture of the 1-inch storm over the impervious area of the site.

PROPOSED IMPERVIOUS = 46,243 SF

REQUIRED RECHARGE = $\frac{1}{12}$ FEET OVER IMPERVIOUS

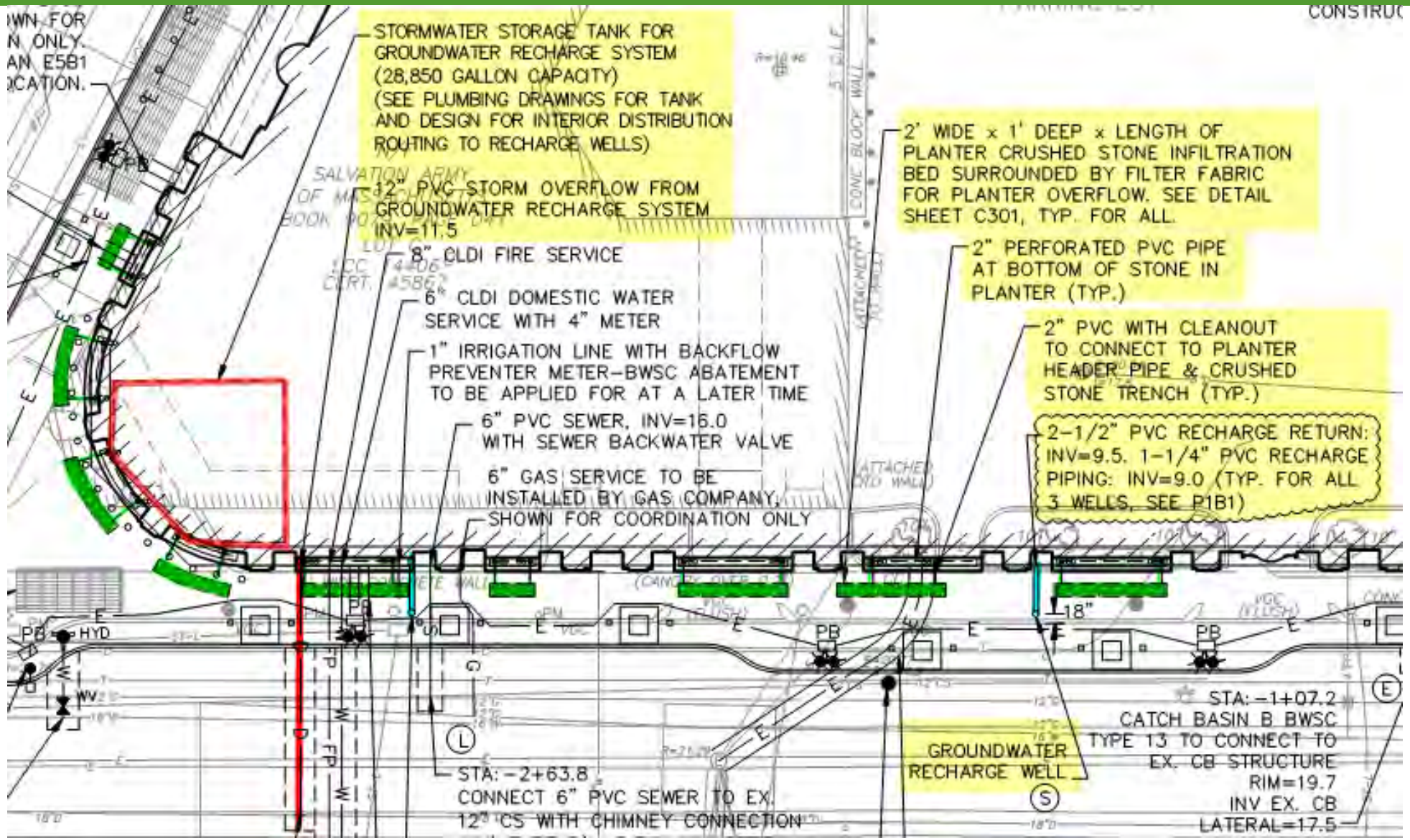
REQUIRED RECHARGE = $\frac{1}{12}'$ x 46,243 SF = 3,854 CF REQUIRED

TANK PROVIDED = 596 SF x 6.5 FEET = 3,874 CF PROVIDED

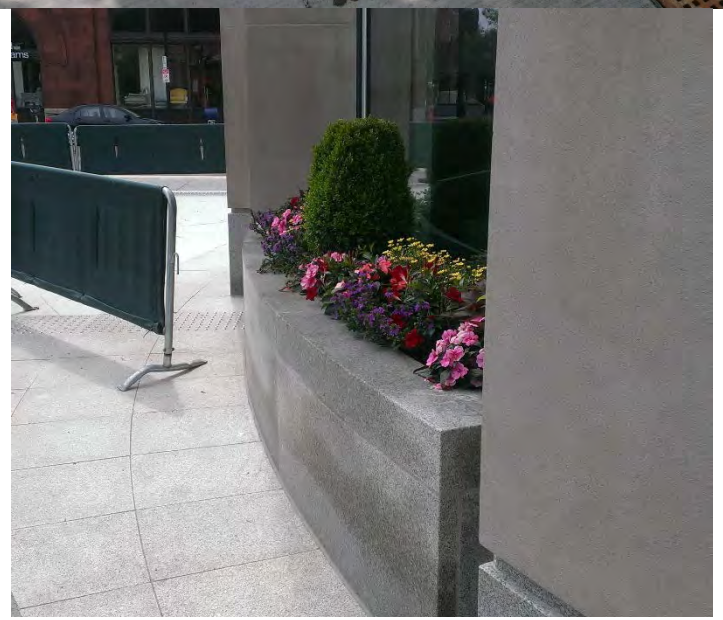
3,874 CF PROVIDED > 3,854 CF REQUIRED

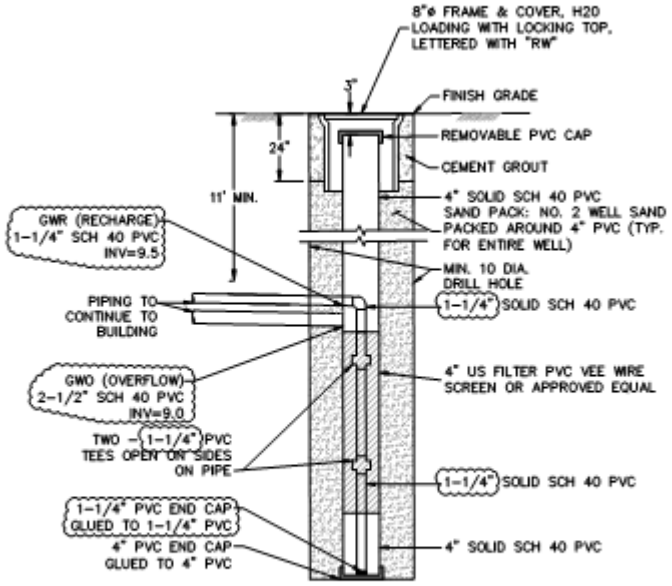
THEREFORE: ARTICLE 32 REQUIREMENTS ARE MET

Interior Storage Tank with Recharge Wells



Interior Storage Tank with Recharge Wells





GROUNDWATER RECHARGE WELL

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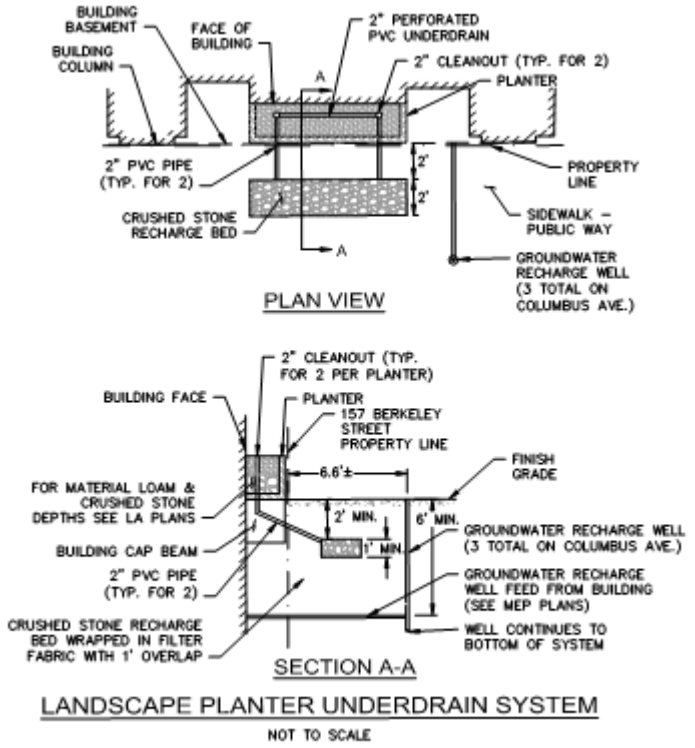

LANDSCAPE PLANTER UNDERDRAIN SYSTEM

NOT TO SCALE

Summary

- There are a variety of methods to collect, store, and recharge the groundwater
- Requires early planning in the design
- Requires multiple design disciplines: civil engineer, geotechnical engineer, plumbing engineer, structural engineer, & architect
- Recharge systems are now standard practice and provides greater benefits than just recharging the groundwater

Questions?

Ryan M. Gordon, EIT, LEED Green Associate, ENV SP | Senior Project Designer

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