PROJECT NARRATIVE & DRAINAGE REPORT TO ACCOMPANY COMPREHENSIVE PERMIT APPLICATION

Multi-Family Development
1486 Main Street Waltham, MA

Prepared: January 20, 2022

Site Locus

CLIENT:
Limited Dividend Affiliate of
WP East Acquisitions, LLC
91 Hartwell Avenue
Lexington, MA 02421

PREPARED BY:
Allen & Major Associates, Inc.
10 Main Street
Lakeville, Massachusetts 02347

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ISSUED:
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REVISED:
-

A&M PROJECT NO.:
1670-14

COMMONWEALTH OF MASSACHUSETTS
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The information presented herein this report has been a collaborative effort from the various members/personnel of the Project Team.	

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1.1 INTRODUCTION

The applicant, a Limited Dividend Affiliate of WP East Acquisitions LLC, is submitting a comprehensive permit application in accordance with Massachusetts General Law chapter 40B, Sections 20-23 for construction of a multi-family residential development located at 1486 Main Street in the City of Waltham, Massachusetts consisting of a total of 192 residential units on approximately 2.15 acres as shown on the Site Development Drawings. The proposed project will include the construction of a four (4) story residential building with two (2) story parking garage located underneath. The parking garage will have two (2) separate entrances, one off Main Street servicing the lower level and the other off an existing access road servicing the second floor. The clubhouse/amenity area will be located within the lower level of the building and an exterior courtyard with a pool will be located in the central core of the building. Construction will also include an access road, parking areas, amenities and all supporting site features and infrastructure required to support the proposed development. The project will be serviced by municipal water and sewer, and private underground utilities consisting of gas services, electrical service and underground tele-communication/cable services from various utility companies.

The purpose of this project narrative and drainage report is to provide a detailed review of the locus, potential project impacts and stormwater as it pertains to the existing conditions and proposed redevelopment. The report will show by means of narrative, calculations and exhibits that appropriate best management practices have been used to mitigate the impacts from the proposed development. The report will demonstrate that the proposed site development reduces the peak stormwater discharge rates and the overall site runoff volume during all storm events at the existing design points. Further, the report will show that the proposed stormwater management system complies with the ten (10) stormwater standards as presented in the Massachusetts Department of Environmental Protection (MassDEP) Stormwater Management Regulations and MA MS4 General Permit regulations in total, whereas a redevelopment project is required to meet only to the extent practicable.

1.2 SITE CATEGORIZATION FOR STORMWATER REGULATIONS

The proposed project is considered a mix of redevelopment and new development under the MassDEP Stormwater Management Standards. A majority of the site was previously developed in 2005 for a garage and parking areas for vehicles. These areas will be considered redevelopment and are required to meet the Stormwater Management Standards to the maximum extent practicable and provide an improvement over existing conditions.

The proposed development will improve the stormwater quality, because the project will minimize exterior parking areas which are subject to pollutants. The proposed building will encompass a majority of the property, therefore clean roof runoff from the building will be collected and piped into a subsurface infiltration system located underneath the parking garage. Stormwater associated with the front parking area will be directed to a water quality structure and into a subsurface infiltration system located within the parking area. Stormwater associated with the easterly access road will continue to drain either into an existing leaching catch basin or onto Main Street. The subsurface infiltration system will consist of Retain-it concrete chambers. The larger subsurface infiltration system located underneath the parking garage will utilize the existing outlet control structures along the westerly property line. The smaller subsurface infiltration system located within the parking lot will be designed for 100% containment and will infiltrate the stormwater. The entire drainage system has been designed to meet or be less than pre-development conditions.

SECTION 2.0
EXISTING CONDITIONS

2.1 SITE LOCATION AND ACCESS

The subject property (the "Property") is located at 1486 Main Street in the City of Waltham which is located in eastern Massachusetts in Middlesex County. Waltham is located approximately 11 miles northwesterly of downtown Boston and approximately 3 miles northwest of Boston's Brighton neighborhood. The property is located in the southwesterly corner of Waltham, near the Town line of Weston and westerly of Interstate Route 95. The Property has legal frontage on the south side of Main Street (Route 117). Main Street run east/west and merges with Route 20 to the east beyond Route 95. Refer to Figure 1, which shows the entire Property, outlined in red.

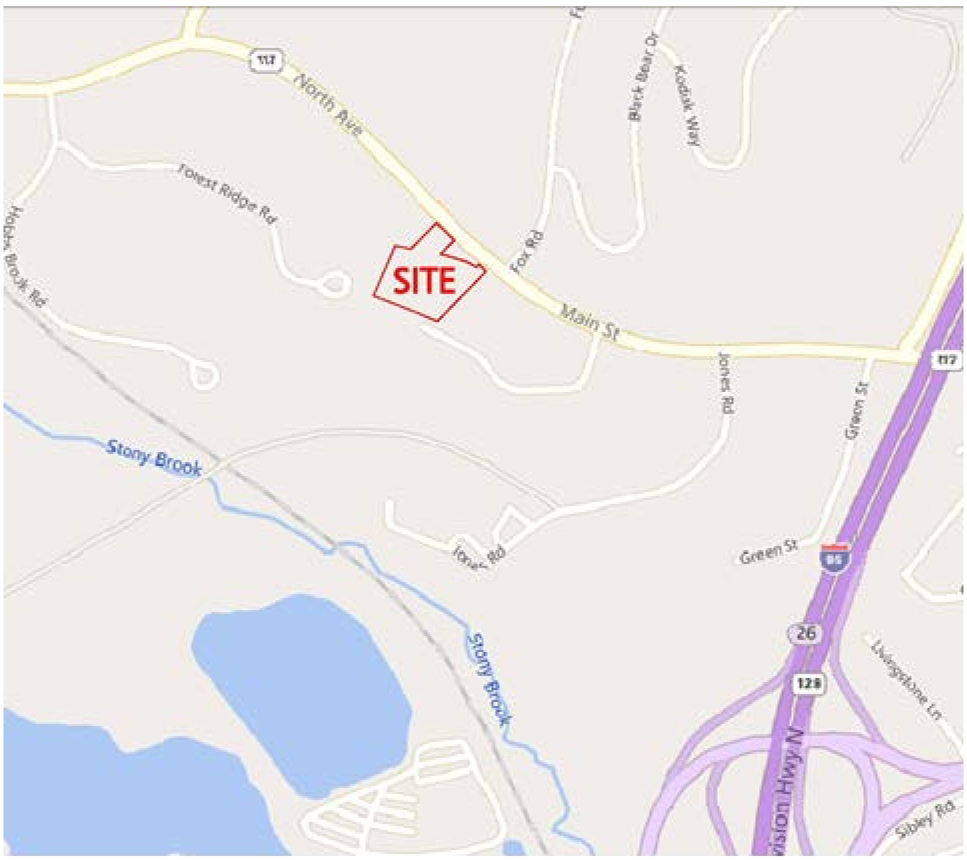


Figure 1 – Locus Map (Bing Map)

Directly in front of the site the paved road is approximately 33 feet wide with a lane in each direction. Just beyond the existing entrance, the southerly lane splits into two lanes, with one dedicated to left turns into the existing residential development on the northerly side of Main Street.

The City of Waltham Assessor's office identifies the property as Parcel ID: R056 002 0005 with a known address of 1486 Main Street and is approximately 2.15 acres in size. The current ownership is titled to TSA Properties, LLC recorded in Middlesex County deed book 56729 page 296. The Property is situated in the Commercial (C) Zoning District with Residence A2 (RA2) and Residence C (RC) Zoning Districts located on the northerly side of Main Street with an Industrial (I) Zoning District located further southerly.

2.2 EXISTING SITE CONDITIONS

The Property is approximately 2.15 acres in size with the majority currently developed, refer to Figure 2 below, which shows the entire property, outlined in red. The property is being used as an automotive maintenance/service garage, storage of vehicles and parts. The 1-story garage is approximately 9,075 sf in footprint area, having an exterior consisting of metal siding/roof and was built in 2005. The parking area and access roads are currently paved and totals approximately 56,202 sf of impervious surfaces. The total lot coverage of impervious surface is approximately 65,277 sf or 69.7%.

Figure 2 - Locus Map (MassGIS Aerial)

The site is located on the Concord USGS Quadrangle map. The site topography is fairly to moderately sloped, adjacent to the existing garage, but elevated around the perimeter with various retaining walls. The topography ranges from a low elevation of 149± at the northerly corner at Main Street as well as the southwesterly corner to a high elevation of 176± at the southerly corner along the top of the retaining walls. Please refer to the site plans for site specific elevations and details.

2.3 WATERSHED

The property falls within the Charles River Watershed with a drainage area of approximately 308 square miles. The Charles River Watershed is comprised of thirty-five (35) communities with Waltham being located in the northerly portion. There are over 80 brooks and streams, 33 lakes and ponds and several major aquifers that feed the Charles River. The Charles River is approximately 80 miles long, meanders through 23 communities and eventually discharges to the sea.

2.4 EXISTING SOIL CONDITIONS

The underlying soils have been mapped by the U.S. Department of Agriculture, Natural Resource Conservation Service (NRCS) and consist of the following:

- 251B Haven silt loam, 3 to 8% slopes;
- 420B Canton fine sandy loam, 3 to 8% slopes;
- 424D Canton fine sandy loam, 15 to 25% slopes, extremely bouldery;
- 656 Udorthents-Urban land complex.

Figure 3 – Soil's Map

Haven and Canton soils are associated with the Hydrologic Soil Group (HSG) designation of A & B. Both soils are well drained with a depth to the water table greater than 80 inches. Udorthents are lands that have been altered/developed.

Test pits and borings have been performed on-site by Haley Aldrich and Vertex in June 2021. Test pits and borings were done for various portions of the project which include foundation and footing design. Soils consist of fill and very dense silty sand with gravels. The water table ranges in depth from 6.2 to 13.7 feet below existing grade. A copy of the soil mapping from the NRCS website and the preliminary geotechnical report are included in the Appendix D.

2.5 FEMA FLOODPLAIN

The Flood Insurance Rate Map (FIRM) (Map Number 25017C0394E) for the City of Waltham dated June 4, 2010 indicates the entire property lies within a FEMA Zone X, refer to Figure 7 below. The FEMA Zone X which is defined as "areas determined to be outside the 0.2% annual chance floodplain".

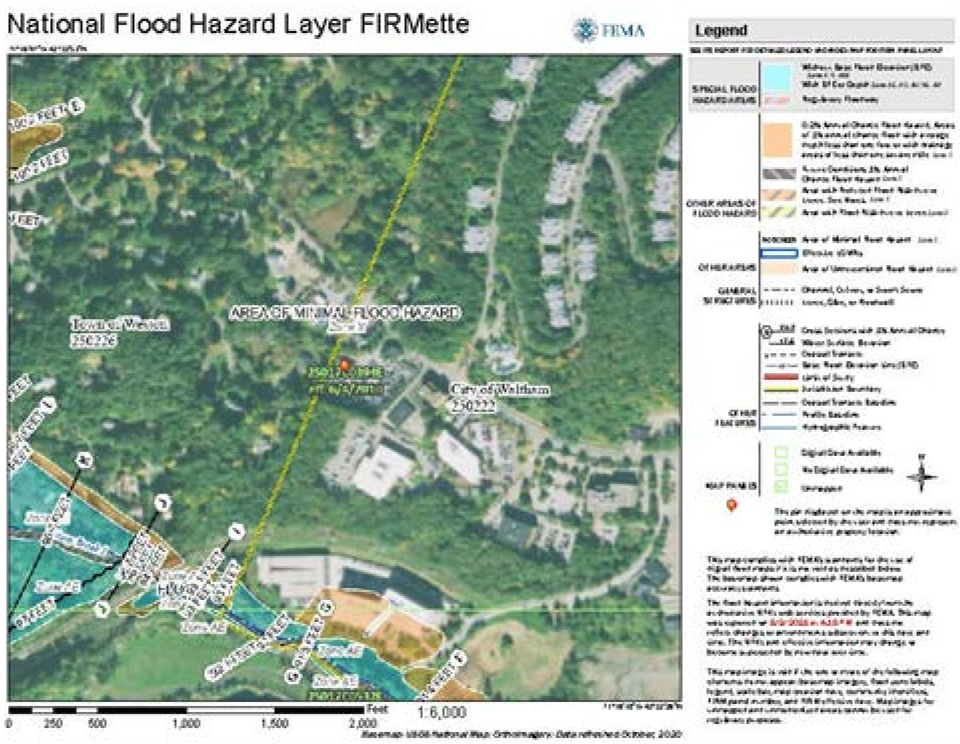


Figure 4 – FEMA FIRMette (Map 25017C0394E)

2.6 ENVIRONMENTALLY SENSITIVE ZONES

The Commonwealth of Massachusetts asserts control over numerous protected and regulated areas including: Areas of Critical Environmental Concern (ACEC); Outstanding Resource Waters (ORWs); areas protected under the Wetlands Protection Act and the Rivers Protection Act, as well as Natural Heritage & Endangered Species Program (NHESP) Priority and Protected Habitat for rare and endangered species.

According to the MassDEP OLIVER website, the property is located within an Outstanding Resource Water (ORW) to a public water supply watershed to Stony Brook Reservoir in the Charles Watershed Basin, located in a Surface Water Protection Area Zone C to Stony Brook Reservoir, and located in an Interim Wellhead Protection Area (IWPA) Kendall Green Tub. Wells (Weston Water Department PWS ID 3333000-01G)(Radius=2640-ft).

There are no wetland resource areas, no riverfront areas and no priority and protected habitat for rare and endangered species on the Property.

2.7 EXISTING STORMWATER PATTERNS

In order to compare the difference between pre- and post-development peak flows and run-off volumes, A&M is relying on the Stormwater Analysis submitted during the permitting of the existing facility as prepared by Brassard Design & Engineering, Inc. dated April 26, 2005 to establish the pre-development conditions prior to development. A&M will also be utilizing the 2005 post-development conditions to establish the baseline. The design points for existing watersheds were established as the outer limits of the property to ensure proper analysis from pre- and post-development conditions.

Stormwater drains from the east-south to the west-north portion of the site. A majority of the stormwater from the existing development is currently being collected in a series of catch basins and piped into a sub-surface infiltration system located adjacent to the garage. Based on record files, the sub-surface infiltration system consist of 36" perforated pipe and has been designed with an outlet control structure which discharges treated stormwater to the southwesterly corner of the site. Stormwater from the main access road is collected by a catch basin and discharges into a drywell. A portion of the stormwater from the secondary access drive is collected by a leaching catch basin and the remaining portion flows into Main Street.

See Appendix E for a copy of the Stormwater Analysis and the rear of this report for a copy of the Existing Watershed Plan (EWS-1).

2.8 EXISTING SITE UTILITIES

The existing garage is currently being serviced by serval utilities which include municipal water and sewer, underground electrical/communication services and gas service. There are two (2) water mains, an eight (8) inch and a twelve (12) inch main, located on the southerly side of Main Street within the travelled way. According to record plans, there are two water lines servicing the garage/facility, one for fire protection and the other for domestic use.

The closest sewer manhole is currently located at the intersection of the secondary drive and Main Street. Due to the location and grade changes, the existing garage discharges into the municipal system via a two (2) inch force main, approximately 350-ft away. The floor drains in the garage are connected to a gas trap and connected to the pump chamber. Sanitary waste is also connected to the pump chamber located on the northerly side of the building.

Utility poles and overhead wires are located on the southerly side of Main Street. Eversource Electric is the electrical service provider for the City of Waltham. Verizon, Comcast, RCN and AT&T supply the City with communication lines that can be either through overhead cables or underground conduits. A gas main is located on the northerly side of Main Street within the travelled way. National Grid Gas is the gas provider for the City of Waltham.

The secondary drive on the easterly side of the property also has several utilities located within the right of way which include municipal water and sewer, overhead utilities and gas service. Based on record plans, these utilities are servicing the existing development at 1474 Main Street, the Keane Fire and Safety Building.

SECTION 3.0
PROPOSED CONDITIONS

3.1 PROPOSED OVERVIEW

The applicant, a Limited Dividend Affiliate of WP East Acquisitions LLC, is submitting a comprehensive permit application in accordance with Massachusetts General Law chapter 40B, Sections 20-23 for construction of a multi-family residential development located at 1486 Main Street in the City of Waltham, Massachusetts consisting of a total of 192 residential units on approximately 2.15 acres as shown on the Site Development Drawings. The proposed project will include the construction of a four (4) story residential building with two (2) story parking garage located underneath. The parking garage will have two (2) separate entrances, one off Main Street servicing the lower level and the other off an existing access road servicing the second floor. The clubhouse/amenity area will be located within the lower level of the building and an exterior courtyard with a pool will be located in the central core of the building. Construction will also include an access road, parking areas, amenities and all supporting site features and infrastructure required to support the proposed development.

Figure 5 – Aerial Map with Proposed Overlay

Parking spaces are dispersed throughout the 2-story parking garage and some exterior spaces are provided adjacent to the clubhouse entrance. 273 total parking spaces are provided comprised of 8 exterior spaces and 265 spaces within the parking garage, or

1.42 spaces per unit. Standard parking spaces are designed at 9′ by 18′. Parking spaces in compliance with the Americans with Disabilities Act (ADA) and the Massachusetts Architectural Access Board (MAAB) are distributed throughout the site adjacent to accessible entrances or amenities. Drive aisles shall be provided at a minimum width of 24 feet to accommodate two way traffic patterns. Accessibly compliant ramps are provided along the intended accessible site path to provide full accommodations for pedestrians. Connectivity to parking fields and across roadways are marked with pedestrian crosswalks in conformance with the Manual on Uniform Traffic Control Devices (MUTCD). A trash and recycling room will be provided on the second floor of the parking garage. Direction signage will be included for internal navigation of the site.

Other site improvements include landscape areas, underground utilities, municipal sewer and water and new stormwater management systems. The proposed stormwater management plan calls for the use of appropriate best management practices, including a water quality structure, and two (2) subsurface infiltration systems. The subsurface infiltration systems will consist of ReTain-It concrete chambers with varying heights. The system has been designed with infiltration and an outlet control structures. The outlet control structures have been designed to match pre-development conditions for peak discharge rates and runoff volumes. The combination of these BMP's will remove greater than 80% of Total Suspended Solids from anticipated stormwater runoff.

3.2 PROPOSED STORMWATER PATTERNS

The drainage patterns under proposed conditions will maintain the same design points and designations under existing conditions with a sub-watershed breakdown including a total of five (5) drainage areas. Some of the existing watershed areas have been modified due to grading of the proposed development. The study concluded that the proposed rates of runoff and runoff volumes at the design points are less than the existing conditions analysis. The breakdown is as follows:

- Watershed P-1 is associated with the proposed building/courtyard and is 62,767 sf in size. Watershed P-1 will consist of grass/landscape area with good groundcover and impervious surfaces (building, pool, patio/sidewalk). Since the central courtyard is located directly above the second floor of the parking garage, A&M has assumed a conservative approach and calculated the entire footprint as impervious. Stormwater will be collected via roof drains and directed into Subsurface Infiltration System No. 1. Subsurface Infiltration System No. 1 will be equipped with an outlet control structure, directing treated runoff into the existing drywell located at the southwesterly corner of the property as originally designed in 2005;
- Watershed P-2 is located on the northerly portion of the site, associated with the exterior parking area and landscape areas adjacent to the building and is 11,337 sf

in size. Watershed P-2 consists of grass/landscape area with good groundcover and impervious surfaces (parking, sidewalks). Stormwater will be directed to a deep sump hooded catch basins (water quality structure) and into Subsurface Infiltration System No. 2. Subsurface Infiltration System No. 2 has been designed to infiltrate all storm events up to and including the 100-year event;

- Watershed P-3 is located on the easterly side, associated with the access drive and is 11,206 sf in size. Watershed P-3 consists of grass/landscape area with good groundcover and impervious surfaces (driveway, sidewalks). Stormwater will continue to drain by overland flow to either the existing leaching catch basin or into Main Street as it currently exists;
- Watershed P-4 is associated with the southerly and westerly edges of the property and is 11,497 sf in size. Watershed P-4 consists of grass/landscape area with good groundcover and impervious surfaces (sidewalk). Stormwater will continue to drain by overland flow to the westerly property line;
- Watershed P-5 is associated with the northerly edge of the property and is 170 sf in size. Watershed P-5 consists of grass/landscape area with good groundcover. Stormwater will continue to drain by overland flow to Main Street;

See the rear of this report for a copy of the Proposed Watershed Plan (PWS-1).

Design Point #1 – Westerly Property Line

Table 3.2.A – Design Point 1 Existing vs Proposed peak rate of runoff to Westerly Property Line

Design Storm	2005 Existing (cfs)	2005 Proposed (cfs)	2022 Proposed (cfs)
2-year	1.2	1.1	0.07
10-year	3.0	2.6	0.34
25-year	4.7	3.6	0.62
100-year	8.0	7.9	1.29

Note: 2005 Existing and 2005 Proposed values are taken from the Stormwater Analysis submitted during the permitting of the existing facility as prepared by Brassard Design & Engineering, Inc. dated April 26, 2005 and reviewed and approved by the City of Waltham. The 2022 proposed peak rate of runoff are less than existing conditions.

Design Point #2 – Main Street

Table 3.2.B – Design Point 2 Existing vs Proposed peak rate of runoff to Main Street

Design Storm	2005 Existing (cfs)	2005 Proposed (cfs)	2022 Proposed (cfs)
2-year	0.9	0.6	0.67
10-year	1.7	1.2	1.09
25-year	2.3	1.7	1.42
100-year	3.5	2.7	2.08

Note: 2005 Existing and 2005 Proposed values are taken from the Stormwater Analysis submitted during the permitting of the existing facility as prepared by Brassard Design & Engineering, Inc. dated April 26, 2005 and reviewed and approved by the City of Waltham. The 2022 proposed peak rate of runoff are less than existing conditions.

3.3 DRAINAGE ANALYSIS METHODOLOGY

The peak rate of runoff was determined using techniques and data found in the following:

1. Urban Hydrology for Small Watersheds – Technical Release 55 by the United States Department of Agriculture Soils Conservation Service, June 1986. Runoff curve numbers and 24-hour precipitation values were obtained from this reference.

2. HydroCAD© Stormwater Modeling System by HydroCAD Software Solutions LLC, version 10.10. The HydroCAD program was used to generate the runoff hydrographs for the watershed areas, to determine discharge/stage/storage characteristics for the infiltration systems, to perform drainage routing and to combine the results of the runoff hydrographs.

3. Soil Survey of Middlesex County, Massachusetts by United States Department of Agriculture, National Resource Conservation Service. Soil types and boundaries were obtained from this reference.

4. Rainfall Data for each of the storm events was based on data published by the Northeast Regional Climate Center Atlas of Precipitation Extremes for the Northeastern United States and Southeastern Canada (Cornell Atlas). The extreme precipitation estimates for Waltham are shown in the following table:

Table 3.3.1 – Rainfall (Cornell Atlas)

2-year	10-year	25-year	100-year
3.16 inches	4.77 inches	6.03 inches	8.61 inches

3.4 CLOSED DRAINAGE SYSTEM COMPUTATIONAL METHODS

The closed drainage system calculations determine the rate of runoff, the time of concentration and the rainfall intensity for the drainage basin. The calculations were performed for a 25-year storm event. The closed drainage system has also been analyzed for the 100-year event. The following standards were used:

1. The Rational Formula (Q =CIA) was used to determine the flow to each structure.
   Q = Flow cubic feet per second (CFS)
   C = Runoff coefficients
   I = Rainfall Intensity (inches per hour)
   A = Drainage Area (acres)

2. The runoff coefficients used are as follows:
   Impervious (pavement and roofs) = 0.9
   Grassed = 0.30
   Bare Ground and gravel = 0.50
   Landscape = 0.3
   Wooded = 0.2

3. The intensity for each area was determined by the Steel Formula for a 25-year frequency storm. The Steel Formula is:
   I = k/(t+b)
   I = Intensity
   k = 230 (25 yr)
   t = Time of Concentration
   b = 30 (25 yr)

4. The times of concentration were calculated using a nomograph provided in "Design, Volume 1," by Seelye, 1960. A minimum time of concentration of six (6) minutes was utilized.

5. The Manning's formula was utilized to calculate the capacity of the individual pipes in the closed drainage system. The Manning's formula is:
   Q = (Ap) (1.486/n) ($s^{1/2}$) ($h^{2/3}$)
   Q = Flow in CFS
   Ap = Cross-sectional area of the pipe (square feet)
   n = Roughness coefficient
   s = slope of the pipe (ft/ft)
   h = hydraulic radius

The closed drainage system, as designed, is capable of handling the design flow as calculated, as well as maintaining a design velocity of between 2.0 feet per second (fps) (cleansing velocity at pipe half full conditions) and 12.0 fps (potential scour conditions).

3.5 EROSION AND SEDIMENT CONTROL

The site will be enclosed with a straw wattle and/or fiber roll barrier to prevent incidental conveyance of sediment from disturbed areas off-site or into the existing drainage system during construction. All existing drainage inlets within the public right of way adjacent to the site that are to remain shall have silt sacks installed prior to any construction activities. Stabilized construction entrances shall be installed as part of the construction and will be maintained until the site has been stabilized. Due to the nature of the site and access, the construction entrance location may require modification throughout the project as building construction commences. The erosion control measures will remain in place until all construction activities are complete and all disturbed areas have been stabilized. The contractor will be required to inspect all controls regularly to ensure that they are working properly and to see if they need to be cleaned and/or replaced on an as-needed basis. The proposed project will disturb greater than one (1) acre of land, therefore the project will require the filing of a National Pollutant Discharge Elimination System (NPDES) Stormwater Construction General Permit. A stormwater Pollution Prevention Plan (SWPPP) will be prepared prior to any construction activity. The SWPPP will prescribe in detail the performance standards the contractor will be required to implement, as needed, during construction. The SWPPP will be maintained at the construction trailer on-site throughout the duration of construction. The SWPPP shall outline acceptable temporary stabilization measures to prevent incidental transport of sediment to off-site areas.

3.6 SITE UTILITIES

Sanitary Sewer System
The project site is located in an area that is serviced by municipal sewer. An existing sewer manhole is located at the intersection of Main Street and the secondary access drive. This sewer manhole is identified as manhole number 3420 on the City of Waltham's GIS system. The manhole is the upgradient (first) manhole in Main Street, receiving flow from 1474, 1481 and 1486 Main Street. The manhole is approximately 8.3-ft deep, with three (3) inlets pipes and one (1) outlet pipe. The inlet pipes are a two (2) inch force main from 1486 Main Street, a four (4) inch gravity line from 1474 Main Street and an eight (8) inch from 1481 Main Street. The outlet pipe is an eight (8) inch diameter, which flows in a southeasterly direction. The proposed project proposes a new oil/gas separator for the floor drains from the parking garage and a separate line

for sanitary waste from the clubhouse/amenity space located on the lower level. The discharge line and sizing of the oil/gas separator shall be coordinated with the plumbing engineers as the project progresses. The sewage flows will be combined in a new lift pump station and pumped into the proposed sewer manhole being constructed over the existing four (4) inch main within the secondary access way. Since the residential units are located on the upper levels, the sewage from the residential units will be via gravity to the new sewer manhole in the access drive. The existing four (4) inch main will be replaced with an eight (8) inch main from the new manhole to the existing manhole in Main Street.

The proposed residential development is anticipated to have 113 one-bedroom units, 59 two-bedroom units, and 20 three-bedroom units; totaling 291 bedrooms. The proposed sewer flows are estimated to be 32,210 gallons per day based on 314 CMR 7.00 and 310 CMR 15.00. The sewage flows were calculated as follows:

Calculated Sewage Flows per The State Environmental Code, Title V (Proposed Development)

Type of Establishment	Min. Flow	Size	Calculated Flow	Design Flow
Residential	110 gpd/bedroom	291 bedrooms	32,010 gpd	32,010 gpd
Office (Clubhouse)	75 gpd/1000 sf min of 200 gpd	2,218 sf	166.3 gpd	200 gpd[1]
Total Flow				**32,210 gpd**

The applicant will seek approval of the municipal sewer connection as shown on the permit application drawings as part of the Comprehensive Permit process through the Zoning Board of Appeals in conformance with the statutes.

Water

The project site is located in an area that is serviced by municipal water system, provided by the Massachusetts Water Resource Authority (MWRA). There are two (2) water mains, an eight (8) inch and a twelve (12) inch main, located on the southerly side of Main Street within the travel way. On May 13, 2021 A&M conducted a hydrant flow test to determine the static and residual pressure for the eight (8) inch main in Main Street. Refer to the Appendix for the hydrant flow test results.

A new eight (8) inch main is being proposed within the secondary access drive as well as the installation of three (3) new hydrants. The new main will provide separate service connections to the building for domestic and fire protection. The proposed project water consumption is calculated at 35,431 gpd based on average sewage flow noted above plus 10%.

Other Utilities

The proposed development will connect to the existing utility poles with a new riser pole and underground conduits will be installed along the westerly side of the property. Transformers and underground conduit locations are shown on the proposed site plan, but the final location will be coordinated with Eversource Electric and determined by the various utility providers.

A new gas main will be provided off the existing gas main within Main Street and the access drive. The new main will be installed around the perimeter of the building to various location of gas meter banks located along the face of the building. Final locations will be coordinated with the Architect, MEP, and National Grid Gas.

3.7 TRANSPORTATION

Vannesse Associates, Inc. is the traffic engineer of record for the project and has prepared as a Traffic and Impact Assessment Study (TIAS) in accordance with standard engineering practice. The TIAS report is included as Appendix B.

3.8 ARCHITECTURAL

The Architectural Team is the architect of record for the project and has prepared an Architectural Design Narrative as included in Appendix C.

SECTION 4.0
STORMWATER MANAGEMENT

4.1 MASSDEP STORMWATER PERFORMANCE STANDARDS

The MassDEP Stormwater Management Policy was developed to improve water quality by implementing performance standards for storm water management. The following section outlines how the proposed Stormwater Management System meets the standards set forth by the Policy.

BMP's implemented in the design include –

- Water Quality Structures/Hydrodynamic separators
- Subsurface Infiltration Systems (ReTain-It Concrete Chambers)
- Specific maintenance schedule

Stormwater Best Management Practices have been incorporated into the design of the project to mitigate the anticipated pollutant loading. An Operations and Maintenance Plan has been developed for the project, which addresses the long-term maintenance requirements of the proposed system.

Temporary erosion and sedimentation controls will be incorporated into the construction phase of the project. These temporary controls may include straw wattles and/or silt fence barriers, inlet sediment traps, slope stabilization, and stabilized construction entrances.

The Massachusetts Department of Environmental Protection has established ten (10) Stormwater Management Standards. A project that meets or exceeds the standards is presumed to satisfy the regulatory requirements regarding stormwater management. The proposed development is considered a mix of redevelopment and new development under the MassDEP Stormwater Management Standards.

The Standards are enumerated below as well as descriptions and supporting calculations as to how the Project will comply with the Standards:

Standard 1

No new stormwater conveyances (e.g. outfalls) may discharge untreated stormwater directly to or cause erosion in wetlands or waters of the Commonwealth.

The proposed development will not introduce any new stormwater conveyances (e.g. outfalls) that discharge untreated stormwater directly to or cause erosion in wetlands or waters of the Commonwealth. The proposed stormwater management system will consists of a water quality structure and subsurface infiltration. The project will utilize the existing outlet control structure as designed and approved in 2005. All discharges from impervious surfaces (parking and drive aisles) will be treated prior to discharging. Where applicable, clean runoff from building roofs will be routed directly to the infiltration system.

Standard 2

Stormwater management systems shall be designed so that post-development peak discharge rates do not exceed pre-development peak discharge rates. This Standard may be waived for discharges to land subject to coastal storm flowage as defined in 310 CMR 10.04.

The proposed development has been designed so that the post-development peak discharge rates do not exceed the pre-development condition. Calculations have been provided to show that the proposed development will not cause an increase in peak discharge rates. Refer to the HydroCAD calculations provided within Appendix E of this report for detailed breakdowns.

Standard 3

Loss of annual recharge to groundwater shall be eliminated or minimized through the use of infiltration measures including environmentally sensitive site design, low impact development techniques, stormwater best management practices, and good operation and maintenance. At a minimum, the annual recharge from the post-development site shall approximate the annual recharge from pre-development conditions based on soil type. This Standard is met when the stormwater management system is designed to infiltrate the required recharge volume as determined in accordance with the Massachusetts Stormwater Handbook.

The existing annual recharge for the site will be exceeded in the post-development condition. Subsurface infiltration chambers will be designed to meet this requirement. All Infiltration Systems were designed using the "Static" Method per the MassDEP Stormwater Management Standards, Volume 3, Chapter 1.

The USDA Soil Survey of Middlesex County was used to determine soil types on site for purposes of recharge.

The required recharge rates for each soil classification are as follows:

Table 4.1 – Recharge Volume per Hydrologic Soil Group (HSG)

	HSG A	HSG B	HSG C	HSG D
Required Recharge	0.60 inches	0.35 inches	0.25 inches	0.10 inches

Table 4.2 – Proposed Impervious Surface

Site	Total Area	HSG A	HSG B	HSG C	HSG D
Building Roof	62,767 sf	656 sf-	62,111 sf	-	-
Pavement/sidewalk	15,340 sf	544-sf	14,796 sf-	-	-
Total New Impervious Area	78,107 sf	1200 sf	76,907 sf	-	-

The project is considered a mix of redevelopment and new development. Under existing conditions, there is approximately 65,145 sf of existing impervious surfaces (pavement/roof). Under proposed conditions, the project will have a total of 78,107 sf of impervious surface area, therefore a net increase of 12,962 sf. Per the Massachusetts Stormwater Handbook, the project is only required to recharge the increase in impervious surface above existing conditions. The required recharge volume is given by the following equation:

R_v = F x IA (Equation 1 Stormwater Handbook Volume 3)

where R_v = Required Recharge Volume, ft^3
F = Target Depth factor
IA = Impervious drainage area
R_v = F x IA
= (0.60 inches)(1 foot/12 inches)(1,200 sf) + (0.35 inches)(1 foot/12 inches)(76,907 sf)
=2,303 cubic feet

The infiltration BMP has been sized using the "Static" Method. The volume within the subsurface infiltration systems is approximately 30,587 cubic feet which exceeds the required volume of 2,303 cubic feet.

MA MS4 General Permit requires the project to retain and infiltrate the volume of one (1) inch over the post-developed new impervious surface, and 0.8 inches for redevelopment, therefore the required V= (1")(1'/12")(12,962 sf) + (0.8")(1'/12")(65,145 sf) = 5,423 cf.

The volume within the subsurface infiltration systems is approximately 30,587 cubic feet which exceeds the required volume of 5,423 cubic feet.

The basin drawdown time is defined as:
$Time_{drawdown}$ = R_v / (K)(bottom area)
where R_v = Required Recharge Volume, ft3
K = Saturated Hydraulic Conductivity (from MassDEP Rawls Table)
Bottom area = Bottom area of recharge structure

Table 4.3 – Drawdown Calculation

System	R_v	K	Bottom Area	$Time_{drawdown}$
Sub-surface Sys 1	26,327 cf	1.02 in/hr	8,048 sf	38.5 hrs
Sub-surface Sys 2	4,260 cf	1.02 in/hr	1,300 sf	38.6 hrs

Note: Volume for drawdown is based on the volume from HydroCAD below the lowest outlet.

Standard 4

Stormwater management systems shall be designed to remove 80% of the average annual post-construction load of Total Suspended Solids (TSS). This standard is met when:

- *Suitable practices for source control and pollution prevention are identified in a long-term pollution prevention plan, and thereafter are implemented and maintained;*
- *Structural stormwater best management practices are sized to capture the required water quality volume determined in accordance with the Massachusetts Stormwater Handbook; and*
- *Pretreatment is provided in accordance with the Massachusetts Stormwater Handbook.*

The proposed stormwater management systems are designed so that the 80% TSS removal standard will be met for each drainage area. Standard #4 is met when structural stormwater best management practices are sized to capture and treat the required water quality volume and pretreatment is provided in accordance with the Massachusetts Stormwater Handbook. Standard #4 also requires that suitable source control measures are identified in the Long Term Pollution Prevention Plan. The 80% TSS removal standard will be met using some combination of the following: street sweeping, water quality structure and several subsurface infiltration systems consisting of ReTain-It concrete chambers.

The water quality volume for the site development will be captured and treated using a proprietary separator. All systems will be sized to meet the water quality flow rate for the 1" storm event.

TSS Removal Credits for Street Sweeping (Massachusetts Stormwater Handbook Volume 2 Chapter 1)

TSS Removal Rate	High Efficiency Vacuum Sweeper – Frequency of Sweeping	Regenerative Air Sweeper – Frequency of Sweeping	Mechanical Sweeper (Rotary Broom)
5%	Quarterly Average, with sweeping scheduled primarily in spring and fall.	Quarterly Average, with sweeping scheduled primarily in spring and fall.	Monthly Average, with sweeping scheduled primarily in spring and fall.

TSS Removal Calculation Worksheet – Clean Roof Runoff				
A	B	C	D	E
BMP	TSS Removal Rate	Starting TSS Load	Amount Removed (B*C)	Remaining Load (C-D)
Subsurface Infiltration	80%	1.00	0.80	0.20
			Total TSS Removal	**80.0%**

TSS Removal Calculation Worksheet – Sub-Surface Infiltration System 2 Prior to Infiltration				
A	B	C	D	E
BMP	TSS Removal Rate	Starting TSS Load	Amount Removed (B*C)	Remaining Load (C-D)
Proprietary Separator	50%*	1.00	0.50	0.50
			Total TSS Removal prior to infiltration	**50.0%* (44% Required)****

*Proprietary TSS removal rates have been capped at 50% though manufacturer studies report more effectiveness.
**A 44% TTS Pre-treatment removal rate is required prior to infiltration.

TSS Removal Calculation Worksheet – Sub-Surface Infiltration System 2				
A	B	C	D	E
BMP	TSS Removal Rate	Starting TSS Load	Amount Removed (B*C)	Remaining Load (C-D)
Subsurface Infiltration	80%	1.00	0.80	0.20
			Total TSS Removal	**80.0%**

Standard 5

For land uses with higher potential pollutant loads, source control and pollution prevention shall be implemented in accordance with the Massachusetts Stormwater Handbook to eliminate or reduce the discharge of stormwater runoff from such land uses to the maximum extent practicable. If through source control and/or pollution prevention all land uses with higher potential pollutant loads cannot be completely protected from exposure to rain, *snow, snow melt, and stormwater runoff, the proponent shall use the specific structural stormwater BMPs determined by the Department to be suitable for such uses as provided in the Massachusetts Stormwater Handbook. Stormwater discharges from land uses with higher potential pollutant loads shall also comply with the requirements of the Massachusetts Clean Waters Act, M.G.L. c. 21, §§ 26-53 and the regulations promulgated thereunder at 314 CMR 3.00, 314 CMR 4.00 and 314 CMR 5.00.*

The proposed development is considered a source of higher potential pollutant loads because the proposed parking area is considered a high-intensity parking area (over 1,000 vehicle trips per day). Pre-treatment and source reduction are provided to the maximum extent practicable. The drainage system will be designed to treat 1" water quality volume and provide a minimum 44% TSS removal prior to discharge to an infiltration device. The SMS will be designed with hydrodynamic separators to provide the 44% TSS removal prior to recharge.

Standard 6

Stormwater discharges within the Zone II or Interim Wellhead Protection Area of a public water supply, and stormwater discharges near or to any other critical area, require the use of the specific source control and pollution prevention measures and the specific structural stormwater best management practices determined by the Department to be suitable for managing discharges to such areas, as provided in the Massachusetts Stormwater Handbook. A discharge is near a critical area if there is a strong likelihood of a significant impact occurring to said area, taking into account site-specific factors. Stormwater discharges to Outstanding Resource Waters and Special Resource Waters shall be removed and set back from the receiving water or wetland and receive the highest and best practical method of treatment. A "storm water discharge" as defined in 314 CMR 3.04(2)(a)1 or (b) to an Outstanding Resource Water or Special Resource Water shall comply with 314 CMR 3.00 and 314 CMR 4.00. Stormwater discharges to a Zone I or Zone A are prohibited unless essential to the operation of a public water supply.

According to the MassDEP OLIVER website, the property is located within an Outstanding Resource Water (ORW) to a public water supply watershed to Stony Brook Reservoir in the Charles Watershed Basin, located in a Surface Water Protection Area Zone C to Stony Brook Reservoir, and located in an Interim Wellhead Protection Area (IWPA) Kendall Green Tub. Wells (Weston Water Department PWS ID 3333000-01G)(Radius=2640-ft).

The drainage system will be designed to treat 1" water quality volume and provide a minimum 44% TSS removal prior to discharge to an infiltration device. The SMS will be designed with hydrodynamic separators to provide the 44% TSS removal prior to recharge.

Standard 7

A redevelopment project is required to meet the following Stormwater Management Standards only to the maximum extent practicable: Standard 2, Standard 3, and the pretreatment and structural best management practice requirements of Standards 4, 5, and 6. Existing stormwater discharges shall comply with Standard 1 only to the maximum extent practicable. A redevelopment project shall also comply with all other requirements of the Stormwater Management Standards and improve existing conditions.

The project is considered a mix of redevelopment and new development. Under existing conditions, there is approximately 65,145 sf of existing impervious surfaces (pavement/roof). Under proposed conditions, the project will have a total of 78,107 sf of impervious surface area, therefore a net increase of 12,962 sf. Per the Massachusetts Stormwater Handbook, the project is only required to recharge the increase in impervious surface above existing conditions.

The proposed development will improve the stormwater quality, because the project will minimize exterior parking areas which are subject to pollutants. The proposed building will encompass a majority of the property, therefore clean roof runoff from the building will be collected and piped into a subsurface infiltration system located underneath the parking garage. Stormwater associated with the front parking lot will be directed to a water quality structure and into a subsurface infiltration system located within the parking area. Stormwater associated with the easterly access road will continue to drain either into an existing leaching catch basin or onto Main Street. The subsurface infiltration system will consist of Retain-it concrete chambers. The larger subsurface infiltration system located underneath the parking garage will utilize the existing outlet control structures along the westerly property line. The smaller subsurface infiltration system located within the parking lot will be designed for 100% containment and will infiltrate the stormwater. The entire drainage system has been designed to meet or be less than pre-development conditions.

Standard 8

A plan to control construction-related impacts including erosion, sedimentation and other pollutant sources during construction and land disturbance activities (construction period erosion, sedimentation, and pollution prevention plan) shall be developed and implemented.

A plan to control construction-related impacts, including erosion, sedimentation and other pollutant sources during construction and land disturbance activities will be developed. The proponent will prepare and submit a Stormwater Pollution Prevention Plan (SWPPP) prior to commencement of construction activities.

Standard 9

A long-term operation and maintenance plan shall be developed and implemented to ensure that stormwater management systems function as designed.

A Long-Term Operation & Maintenance (O&M) Plan has been developed for the proposed stormwater management system and is included within this document. See Appendix G of this report.

Standard 10

All illicit discharges to the stormwater management system are prohibited.

There are no expected illicit discharges to the stormwater management system. The applicant will submit the Illicit Discharge Compliance Statement prior to the discharge of stormwater runoff to the post-construction stormwater best management practices and prior to the issuance of a Certificate of Compliance.

See the next page for the MassDEP Stormwater Checklist.

MassDEP Stormwater Checklist

SECTION 5.0
WAIVERS

5.1 WAIVERS

Application for a Comprehensive Permit through the Zoning Board of Appeals Article V of the Zoning Board of Appeals Rules and Regulations requires an Applicant to comply with all local requirements and regulations including local codes, ordinances, Bylaws or regulations unless an exemption or variance is requested and listed in the application or modification to the application. This will include, but not limited to:

- City of Waltham's Code;
- Rules & Regulations of the Zoning Board of Appeals; and
- Land Rules and Regulations of the Board of Survey and Planning;

The Applicant's requested waivers are based on the Plans entitled "1486 Main Street Waltham, MA" dated January 14, 2022 prepared by Allen & Major Associates, Inc. and the design team ("Site Development Plans"). The applicant requests waivers from all local bylaws necessary to permit the project as shown on the Site Development Plans including the following:

Chapter 25 – STORMWATER

- Article I, Stormwater Management §25-3, Applicability
    - Required: Requires a Stormwater Management Permit for land disturbance over one an acre from the Stormwater Enforcement Agent.
    - Proposed: A waiver is being requested not to obtain an individual Stormwater Management Permit from the Stormwater Enforcement Agent. The applicant request the permit be reviewed and issued through the ZBA during the Comprehensive Permit process.
- Article I, Stormwater Management §25-7, Performance Guarantee
    - Required: The Stormwater Enforcement Agent shall require from the developer a surety or cash bond or other means of security acceptable to the City Treasurer, prior to the issuance of any building permit.
    - Proposed: A waiver is being requested not to post a surety, cash bond or other security acceptable to the City Treasurer.

Chapter Z – ZONING CODE

- Article III, Establishment of Districts, §3.4, Table of Use
    - Allowed: Multi-family is not an allowed use in the Commercial Zoning District.
    - Proposed: A waiver is being requested to allow Multi-family apartments as shown on the Site Development Plans in the Commercial Zoning District.
- Article III, Establishment of Districts, §3.5, Special Permits

- Required: §3.537 For special permits increasing the intensity of use, requires the provision of 15% open space with an increase directly proportional to Floor to Area Ratio.
- Proposed: 32.4% open space is proposed.

- Article III, Establishment of Districts, §3.5, Special Permits
    - Required: §3.539 Traffic Safety and Infrastructure Maintenance Fund, for special permits for increasing intensity of use, a contribution of $1 per square foot of gross floor area for that part of Floor to Area Ratio in excess of what is allowed by right.
    - Proposed: No contribution to the Traffic Safety and Infrastructure Maintenance Fund is being proposed.
- Article VI, Dimensional Requirements, §4.1 General Provisions, §4.11, Table of Dimensional Regulations
    - Allowed: Minimum Building Setback Side – 33.6 feet (1/2 building height)
    - Proposed: 14.7 feet to foundation and 13.6 feet to overhang.
- Article VI, Dimensional Requirements, §4.1 General Provisions, §4.11, Table of Dimensional Regulations
    - Allowed: Minimum Building Setback Rear – 33.6 feet (1/2 building height)
    - Proposed: 14.7 feet to foundation and 13.2 feet to overhang.
- Article VI, Dimensional Requirements, §4.1 General Provisions, §4.11, Table of Dimensional Regulations
    - Allowed: 0.40 FAR by right, 2.0 FAR by Special Permit
    - Proposed: 217,941 s.f./93,645 s.f. = 2.32 FAR.
- Article V, Parking Requirements, §5.2 Off-street parking requirement, §5.21, Table of Off-Street Parking Requirements
    - Required: Multi-family dwelling, 2 spaces per dwelling units (192 x 2 = 384 spaces)
    - Proposed: 273 spaces / 192 units = 1.42 spaces per dwelling unit.
- Article V, Parking Requirements, §5.4 Design of parking areas for more than five cars
    - Required: §5.42, No paved area, excluding entrances and exits, shall extend within five (5) feet of any lot or street line, nor into any front yard.
    - Proposed: The proposed parking area will be located in the front yard and 4.2 feet off the street line.
- Article V, Parking Requirements, §5.4 Design of parking areas for more than five cars
    - Required: §5.43, Trees with a minimum size of 3 1/2 inches in diameter (measured six inches from ground level) shall be provided at the rate of one for every 10 cars. (271 spaces/10 would require 27.1 trees).

  - Proposed: The project is proposing a parking garage, appropriate landscape will be provided.
- Article VI, Special Provisions Relating to Signs, §6.6 Regulations Governing Particular Types of Signs
  - Required: §6.63(b), No ground sign shall be located within 12 feet of an adjacent business establishment activity or property, and further, ground signs shall be set back at least six feet from the street line.
  - Proposed: A monument sign is being proposed at the main entrance, in the vicinity of the existing sign and approximately two (2) feet off the right-of-way line.
- Article IX, Affordable Housing, §9.1 Affordable housing provisions
  - Required: Provisions of either a specific number of dwelling units at certain reduced prices, a fee in lieu of affordable dwelling units, or the purchase or construction of off-site dwelling units.
  - Proposed: The proposed project will create 48 rental units affordable to households earning 80% of Area Median Income, comprising 25% of the units in the overall development.

Land Rules and Regulations of the Board of Survey and Planning

The application does not constitute a subdivision of land, therefore, the Applicant requests a waiver from the entirety of the Land Rules and Regulations with specificity to the sections outlined below as may be applicable to site design elements:

- Section 4 Design Standards
- Section 5 Required Improvements
  - J(2)(a) Catch basins shall be placed before intersections;
  - J(2)(j) Storm drains shall be designed to have 2.5 feet minimum cover over the pipe.

The Applicant reserves the right to amend or modify the list of requested waivers as the project moves through review with the Zoning Board of Appeals and may request such waivers from any additional local bylaws or regulations in order to build the Project as shown on the Site Development Plans.

APPENDIX A

SUPPORT DOCUMENTS TO COMPREHENSIVE PERMIT APPLICATION

APPLICATION FOR HEARING

The City of Waltham

ZONING BOARD OF APPEALS

APPLICATION PACKET

FOR THE

ZONING BOARD OF APPEALS

APPLICATION FOR SPECIAL PERMIT
PETITION/APPLICATION FOR VARIANCE
APPEALS FROM DECISION OF INSPECTOR of BUILDINGS

119 School Street • Waltham, MA 02451
Telephone: 781-314-3330 • Fax: 781-314-3341
pdoucette@city.waltham.ma.us

CHECKLIST

Complete file shall include:

- ☑ Completed original Application/Petition- Signed by Petitioner or Agent; stamped and signed by Inspector of Buildings and date-time stamped by City Clerk.
- ☑ Six (6) copies of all plans- all plans must be appropriately stamped and signed by certified professionals and stamped by Building Department. 15 provided for comprehensive permit
- ☑ Abutters List, Certified by City Assessor - (certification is required for any abutters outside of Waltham by the appropriate town/city)
- ☐ Legal notice To be coordinated post submission with ZBA
- ☑ 2 sets of Mailing labels, to include all abutters (certified by assessors department), owners, petitioners and attorney and other municipal entities within 300 foot radius (i.e., Mass Highway, Cambridge Water, Town of Weston, Lexington, etc.)
- ☑ Tax Status Report – showing all taxes are current MLC Attached
- ☑ Proof of Standing of Petitioner- showing the petitioner's relationship to locus- (Lease, Deed, Purchase and Sale, Letter from Owner)
- ☐ If appealing Inspector of Buildings' decision- (Submit letter of Denial/Zoning Violations by Inspector of buildings)
- ☑ Filing fee

FILING PETITIONS/APPLICATIONS

Please carefully read all of the following requirements. All requirements must be complied with. If after review, by the Chair, a member of the Board or Person designated by the Board finds that the application, appeal or petition does not comply with the requirements of the Board, does not comply with the requirements of Chapter 40A, is incomplete or is improperly filed, the Petitioner will be notified and given opportunity to bring the petition into compliance. If the application is not brought into compliance the Board at the hearing shall deny the application for failure to file a complete application.

Reminder: Before filing an application with the ZBA, all taxes, fees, assessments, betterments or any other municipal charges due the City of Waltham must be paid in accordance with G.L.M. chapter 40 §57. Petitioner can obtain a receipt of such payment from the Treasurer's Office, located in City Hall, 610 Main Street, Waltham, MA.

Building Department Stamp

ZBA Date Stamp

City Clerk Date/Time Stamp

Initials: _____

City of Waltham

Zoning Board of Appeals

Application/ Petition Form

PARCEL ID: MAP 056 BLOCK 002 LOT 0005

PETITIONER: Limited Dividend Affiliate of WP East Acquisitions, LLC

MAILING ADDRESS: 91 Hartwell Avenue, Suite 300
Lexington MA 02421

OWNER: TSA Properties, LLC

MAILING ADDRESS: 96 Beacon Street
Chestnut Hill, MA 02467

NATURE OF APPLICATION/PETITION:

_____ Application for Variance - TYPE: _____

_____ Application for Special Permit- TYPE: _____

_____ Sign Variance

X Other- please specify Comprehensive Permit Application under M.G.L. c. 40B.

SUBJECT MATTER: The Petitioner, a limited dividend affiliate of WP East Acquisitions, LLC herby applies to the Zoning Board of Appeals, pursuant to Massachusetts General Laws, Chapter 40B, for the issuance of a Comprehensive Permit authorizing applicant to construct, use, and maintain 192 rental units (of which 48 will be made affordable to those with incomes up to 80% of the area median income) on land located at 1486 Main Street, Waltham, MA.

The proposed development is more particularly described in the materials submitted simultaneously herewith, including waiver list, all of which are incorporated herein by reference and constitute the documents required under the regulations for filing a Comprehensive Permit under M.G.L c. 40B and the regulations of the Massachusetts Department of Housing and Community Development (760 CMR 56.00)

LOCATION: 1486 Main Street, Waltham, MA

ZONING DISTRICT: Commercial

PROVISIONS OF ZONING ORDINANCE INVOLVED:

Application pursuant to M.G.L Chapter 40B, for the issuance of a Comprehensive Permit, See attached Waivers List

SPECIFIC RELIEF SOUGHT: (Attach additional sheets as needed)

Application pursuant to M.G.L Chapter 40B, for the issuance of a Comprehensive Permit, See attached Waivers List

DETAILED HISTORY OF VARIANCES/NON-CONFORMING USES/SPECIAL PERMITS ON LOCUS (Attach additional sheets as needed- include all dates, measurements, etc.)

Date: ________________

Signature of Petitioner(s) ______________________________

Signature of Owner(s) ______________________________

Name and Address of Attorney: **Nutter McClennen & Fish LLP**
155 Seaport Blvd
Boston, MA 02210

Contact Information : **James Ward**
617-439-2818

Email: **jward@nutter.com**

To be completed by Building Department:

____________ Check if a permit to proceed with proposed subject matter has been refused by the Inspector of Buildings.

Date of Refusal: ____________________

Reason for Denial: ____

Signature of Inspector of Buildings: ____

For Assessor's Use:

List of Abutters to be Notified of Hearing and Decision

Name and Mailing Address of Petitioner

Name and Mailing Address of Owner

Name and Mailing Address of Attorney

Location of Property Map Block Lot

LOCATION OF PROPERTY (map, block and lot numbers)			NAME OF OWNER	Mailing ADDRESS OF OWNER
Number and Street				
Map	*Block*	*Lot*		

LOCATION OF PROPERTY (map, block and lot numbers)			NAME OF OWNER	Mailing ADDRESS OF OWNER
Number and Street				
Map	*Block*	*Lot*		

use as many additional sheets as needed

Legal Notices

Due to the costs of advertising, Legal Notices should be kept as **brief** as possible but must contain the following information:

1. Date, time and place of the public hearing;
2. Name of the petitioners;
3. Nature of Appeal (Variance, Special Permit, Appeal of Building Inspector's Decision)
4. Subject Matter
5. Location of Property (Street address, if any or other adequate identification of the location) and Zoning District;
6. Provisions of Zoning Ordinance involved;
7. Specific Relief sought

Legal Notice must be filed with the petition. If possible, please also, submit by email to pdoucette@city.waltham.ma.us, prior to filing or immediately after filing. Once the Legal Notice is sent to the News Tribune for the publication, the Petitioner/Attorney will be advised of the advertising fees, which should be paid as promptly as possible, (made payable to the "City of Waltham").

INSTRUCTIONS AND PROCEDURES

I. Plans

Have all required plans prepared- please make sure all plans are **signed** and **stamped** by the appropriate professional(s). (i.e., abutter plans, plot plans, topographical- by registered engineer or surveyor; building plans- registered architect for buildings larger than 2 family).

Conceptual Plans and unsigned plans will not be accepted or looked at in the decision process.

Six (6) Copies of all plans shall be submitted to the Board with the petition (other departments may also require copies, please make sure you have enough copies- i.e., Building Department requires one)

A. Abutters Plans and Plot Plans –

1. Plans must be dated within **six (6) months** of filing, signed, and bearing the seal of a registered surveyor or engineer.
2. The **preferred** size of the plan is **11″ by 17″**. The size of the plan should be **no larger** than 2′ (24 inches) by 3′ (36 inches).
3. It ***shall*** have a north point; names of **all** streets; and zoning legend
4. Names and mailing address of the current owners of property, to include:
   a. those who own the Locus;
   b. those who directly abut the applicants locus;
   c. those who are directly opposite on any public or private street or way;
   d. and those who are within a 300 foot radius of the locus property lines.
5. The location of the building or use of the property where a variance is requested and distance from adjacent buildings and property lines shall be verified in the field and shown on the plan. The dimensions of the lot and the percentages of the lot covered by the principle and accessory buildings and any other special requirements parking, landscaping, etc., and the required parking spaces, shall be shown. Entrances, exits,

driveways, etc., that are pertinent to grant the variance shall be shown**.** **All proposed data should be shown in red**.

6. The Locus should be highlighted or designated in such a way as to be easily located.
7. Any **topographical features** of the parcel of land relied upon for a variance, such as ledge, rock, peat or natural conditions of water, brook or river, should be *clearly* shown.
8. The **dimensions** of all of the lots within the 300 foot radius, should be *clearly* shown.
9. All **map**, **block** and **lot** numbers should be *clearly* shown or designated on the map.
10. Each Lot should also *clearly* show **street numbers**.
11. The Plot Plan may be superimposed on a corner of the Abutters Plan if space allows. May be on an 8 ½" by 11 sheet (6 copies).

Abutters' List - The information required to be shown on the ABUTTERS plan, relative to the names and current mailing address of property owners, required to be notified, ***shall*** be compiled on a separate sheet of paper.

Please use form attached, in descending order by map-lot-block numbers. Make sure to include the street number and atlas block number of the property, as well as full name and current mailing address of owner(s) for each lot touching or within the 300 foot radius (300 feet out from each corner of the lot). ANY LOT OUTSIDE OF WALTHAM MUST BE CERTIFIED BY THE APPROPRIATE CITY OR TOWN.

B. Building Plans - If any building is to be constructed, renovated, remodeled or changed in any way, six (6) copies of the following described plan shall be submitted, to the Board**:**

1. A floor plan of each floor on which work is to be done.
2. A floor plan showing the stairways, halls, doors, openings into hallways, and exits, of each floor or floors.
3. An elevation of the parts of the building where outside stairways or fire escapes are to be located.
4. The plans and elevations shall show all existing work, including all existing outside stairways and/or fire escapes.
5. **The proposed work shall be shown in red**.

6. The size of each plan shall be no larger than 24 inches by 36 inches, (preferred size is 11 inches by 17 inches).

****It shall be the obligation of the applicant to have the building plans reviewed and signed by the Fire Inspector and the Building Inspector, make arrangements with them to have the locus inspected and submit to the Clerk of the Board any written safety recommendations made by them.**

II. APPLICATION FORM

A. No petition shall be eligible for either legal publishing or ready for presentation at a formal hearing until it complies with the following requirements:

1. Bears the Signature of the Applicant, or of such agent or attorney as may represent the applicant;
2. Describes the subject matter of the application or petition (e.g. “the construction and maintenance of and addition to an existing single-family dwelling”);
3. Sets forth the provision or provisions of the Zoning Code from which a variance or special permit is needed;
4. Sets forth the specific manner in which the subject matter, for which the variance or permit is requested, varies from the present zoning code. (e.g., “the resulting easterly side yard will be 10 feet”);
5. Sets forth a history of the property to include all previous variances, permits, orders, etc., from all city departments and boards/commissions;
6. Includes a title reference if Real Property is involved and the street name and number when available, owner and owner’s mailing address must be included, if not petitioner;
7. Includes any such additional information the Board may from time to time request.

III. FILING

A. **First - BUILDING DEPARTMENT-** Bring Petition (and copies, if needed) and 7 copies of each plan, (Building Department will require a copy) to the Building Department, located at 119 School Street, Ground Floor, for review and to be stamped and signed (all copies of the plans must be stamped and signed by the Building Inspector).

B. **Second - CITY CLERK-** Bring stamped Petition (and copies), Abutters List, Stamped Plans and filing fee, (currently the fee to file is $20.00 - payable to the "City of Waltham") to the City Clerk's Office, second floor of City Hall at 610 Main Street. File a **copy** of the petition with the City Clerk and have the Original Petition date-time stamped.

C. **Third - ZBA OFFICE-** The **original** petition (date-time stamped by the City Clerk and stamped by the Building Department), Abutter's list, and 6 copies of plans (stamped by the building department) will be filed with the Zoning Board of Appeals' Office, at 119 School Street, third floor, Waltham, MA.

D. **A COMPLETE FILING** with the Zoning Board of Appeals, will include:

1. Completed **original** Application/Petition, stamped and signed by Inspector of Buildings, and date-time stamped by the City Clerk
2. Six (6) copies of all plans (Stamped by Building Department), all plans must be appropriately stamped and signed by certified professionals.
3. Abutters' List- (certification is required for any abutters outside of Waltham, by the appropriate town/city)
4. Filing Fee (see Attached) and Mailing Fee (may be paid with the advertising fee). Mailing Fee is based on current mailing prices.
5. Legal notice
6. 2 sets of Mailing labels, to include all abutters, owners, petitioners and attorney and other municipal entities within 300 foot radius (i.e., Mass Highway, Town of Weston, Lexington, etc.)
7. Tax Status Report – showing all taxes are current
8. Proof of Standing of Petitioner- showing the petitioner's relationship to locus- (Lease, Deed, Purchase and Sale, Letter from Owner)
9. If appealing Inspector of Buildings' decision- (Submit letter of Denial by Inspector of buildings/ Cease and Desist orders)

E. With everything in order and properly stamped, you will be given a DOCKET NUMBER. The BOARD may assign a tentative HEARING DATE at the time of filing or may let Petitioner know at a later time.

IV. 14 DAYS PRIOR TO HEARING- To be filed 14 days prior to the scheduled hearing – may be submitted by email or may prepare 10 packets with postage for mailing.

A. **Findings of Fact and Proposed Decision-** Be prepared to bring exhibits to prove each fact at the hearing. Show detailed history of the Property, (e.g., if any Variances, Special Permits or non-conforming uses were previously applied for and whether it was granted, denied, or withdrawn; when and for what, to include the dimensions, etc.). Also, in Proposed Decision make sure all statutory requirements are satisfied and any conditions or plans are included.

B. **Memorandum of Law-** A memorandum of fact and law will be required at least 14 days prior to the hearing. Memorandum should give a history of the property and should be sufficient in law to meet the requirements of Chapter 40A of the General Laws of Massachusetts.

C. **Advertising Fees-** should be made payable to the City of Waltham. (Cost of advertising will be calculated by the News Tribune and the cost will be forwarded to the Attorney/Petitioner.)

V. HEARING - At the hearing, be prepared to present the case and bring any materials, which may facilitate the Board, (pictures, letters, etc.) providing a copy of each for every Board Member (5) and (1) for the file.

VI. DECISION - If Petitioner is able to do so, on the day following the decision, the Petitioner should e-mail the Proposed Decision and Proposed Findings of Fact with any changes or conditions required by the Board to the following email address; pdoucette@city.waltham.ma.us. If Petitioner is unable to e-mail then the above-mentioned documents should be copied to a disk and submitted.

Reminder: When the appeal period on a granted petition has run, Petitioner/Attorney must secure a certified copy of the decision from the City Clerk's office. A certified copy of the decision must be recorded with the Middlesex South District Registry of Deeds. This must be completed in order to obtain a permit, a copy of the recorded document will go to the building department and a copy should be sent to the ZBA office. (It is highly suggested that plans stated in the decision be recorded as well).

Fee Schedule

Advertising* On case by case basis, at current rate of publishing- (to be paid prior to hearing)

Mailings* Petitioner shall cover the cost of mailings at current rates- (to be paid prior to hearing)

Variances

1-2 Family Homes-	$ 100.00 for all variances presented in one application.
Other Residential (up to 10 units)-	$ 100.00 per Variance
All Other-	$ 500.00 per Variance
Signs-	$ 250.00 per sign

Extension of Time $ 100.00 for commencement or completion of construction

Appeals from Decisions of the Building Inspector $ 250.00

Special Permits- (based on use and per Special Permit)

Residential	$ 200.00
Commercial/Industrial	$ 500.00
Other	$ 200.00

Comprehensive Permits

1-6 units	$ 3,000.00
7-25 units	$ 5,000.00
26-50 units	$ 7,500.00
51-75 units	$10,000.00
76 plus units	$15,000.00

*Please call Zoning Board of Appeals Office for Current Rates

REGULATIONS AND PROCEDURES REGARDING VARIANCES FROM FLOOD PLAIN DISTRICT OF THE ZONING BY-LAW

1. The Zoning Board of Appeals may issue a variance after the following facts have been established.

   (a) Evidence presented must show a good and sufficient cause.

   (b) Evidence that failure to grant the variance would result in exceptional hardship to the applicant.

   (c) The Zoning Board of Appeals shall make the following Finding of Facts:

      (i) That the granting of variance will not result in foreseeable flood height increases.
      (ii) The variance would pose minimal additional threat to the public safety.
      (iii) The variance would not be the cause of extra ordinary public expenses, cause fraud or victimization of the public.
      (iv) The variance shall not substantially conflict with existing local ordinance.
      (v) Evidence must show that the variance requested is the minimum necessary to achieve relief due to the existing flood hazards.

2. Variances may be granted from structures to be erected on a lot of one half acre or less in size, if otherwise permitted by law, contiguous to and surrounded by lots with existing structures constructed below the base flood level.

3. A variance shall not be granted within any designated regulatory floodway if any foreseeable increase in flood levels during the base flood discharge would result.

4. Whenever a variance is granted under this Flood Plain District procedure, the Zoning Board of Appeals shall notify the applicant in writing over their signature that:

   (a) The issuance of such variance to construct a structure below the base flood elevation most likely will result in increased premium rates for flood insurance.

   (b) Such construction below base flood levels will increase risks to life and property.

5. The Zoning Board of Appeals shall maintain a record of all variance actions, including justification for the issuance and report such variances granted in the Annual Report submitted to the Federal Insurance Administration.

6. Variance may be granted for the reconstruction, rehabilitation or restoration of structures listed on the National Register of Historic Places or on a State Inventory of Historic Places, without regard to procedures set forth above.

NOTE: The granting of a variance from the regulations set forth in the Floodplain section of the Zoning Ordinance does not excuse the recipient of such a variance from compliance with the requirements of the Massachusetts General Laws relating to floodplain districts.

PROJECT ELIGIBILITY LETTER

MASSHOUSING

Massachusetts Housing Finance Agency
One Beacon Street, Boston, MA 02108

TEL: 617.854.1000
FAX: 617.854.1091 www.masshousing.com

Videophone: 857.366.4157 or Relay: 711

May 11, 2021

WP East Acquisitions, LLC
91 Hartwell Avenue
3rd Floor
Lexington, MA 02421
Attention: Jim Lambert

Re: 1486 Main Street
Project Eligibility/Site Approval
MassHousing ID No. 1103

Dear Mr. Lambert:

This letter is in response to your application as "Applicant" for a determination of Project Eligibility ("Site Approval") pursuant to Massachusetts General Laws Chapter 40B ("Chapter 40B"), 760 CMR 56.00 (the "Regulations") and the Comprehensive Permit Guidelines issued by the Department of Housing and Community Development ("DHCD") (the "Guidelines" and, collectively with Chapter 40B and the Regulations, the "Comprehensive Permit Rules"), under the New England Fund ("NEF") Program ("the Program") of the Federal Home Loan Bank of Boston ("FHLBank Boston").

WP East Acquisitions, LLC has submitted an application with MassHousing pursuant to Chapter 40B. You have proposed to build 192 units of rental housing (the "Project") on 2.15 acres of land located at 1486 Main Street (the "Site") in Waltham (the "Municipality").

In accordance with the Comprehensive Permit Rules, this letter is intended to be a written determination of Project Eligibility by MassHousing acting as Subsidizing Agency under the Guidelines, including Part V thereof, "Housing Programs In Which Funding Is Provided By Other Than A State Agency."

MassHousing has performed an on-site inspection of the Site and has reviewed the pertinent information for the Project submitted by the Applicant and others in accordance with the Comprehensive Permit Rules.

Municipal Comments

Pursuant to the Regulations, the Municipality was given a thirty (30) day period in which to review the Site Approval application and submit comments to MassHousing. The Municipality did not provide any comments for MassHousing staff to review.

MassHousing Determination and Recommendation

MassHousing staff has determined that the Project appears generally eligible under the requirements of the Program, subject to final review of eligibility and to Final Approval.[1] As a result of our review, we have made the findings as required pursuant to 760 CMR 56.04(1) and (4). Each such finding, with supporting reasoning, is set forth in further detail on Attachment 1 hereto. It is important to note that Comprehensive Permit Rules limit MassHousing to these specific findings in order to determine Project Eligibility. If, as here, MassHousing issues a determination of Project Eligibility, the Applicant may apply to the Zoning Board of Appeals ("ZBA") for a comprehensive permit. At that time local boards, officials and members of the public are provided the opportunity to further review the Project to ensure compliance with applicable state and local standards and regulations.

Based on MassHousing's site and design review, the following issues should be addressed in the application to the ZBA, and the Applicant should be prepared to explore them more fully during the public hearing process:

- Development of this Site will require compliance with all state and federal environmental laws, regulations, and standards applicable to existing conditions and to the proposed use related to building construction, stormwater management, wastewater collection and treatment and hazardous waste safety. The Applicant should expect that the Municipality will require evidence of such compliance prior to the issuance of a building permit for the Project.

MassHousing has also reviewed the application for compliance within the requirements of 760 CMR 56.04(2) relative to Application requirements and has determined that the material provided by the Applicant is sufficient to show compliance.

This Site Approval is expressly limited to the development of no more than 192 rental units under the terms of the Program, of which not less than 48 of such units shall be restricted as affordable for low- or moderate-income persons or families as required under the terms of the Guidelines. It is not a commitment or guarantee of financing and does not constitute a site plan or building design approval. Should you consider, prior to obtaining a comprehensive permit, the use of any other housing subsidy program, the construction of additional units or a reduction in the size of the Site, you may be required to submit a new Site Approval application for review by MassHousing. Should you consider a change in tenure type or a change in building type or height, you may be required to submit a new site approval application for review by MassHousing.

For guidance on the comprehensive permit review process, you are advised to consult the Guidelines. Further, we urge you to review carefully with legal counsel the M.G.L. c.40B Comprehensive Permit Regulations at 760 CMR 56.00.

This approval will be effective for a period of two (2) years from the date of this letter. Should the Applicant not apply for a comprehensive permit within this period this letter shall be considered to be expired and no longer in effect unless MassHousing extends the effective period of this letter in writing. In addition, the Applicant is required to notify MassHousing at the following times throughout this two-year period: (1) when the Applicant applies to the local ZBA for a Comprehensive Permit, (2) when the ZBA issues a decision and (3) if applicable, when any appeals are filed.

[1] MassHousing has relied on the Applicant to provide truthful and complete information with respect to this approval. If at any point prior to the issuance of a comprehensive permit MassHousing determines that the Applicant has failed to disclose any information pertinent to the findings set forth in 760 CMR 56.04 or information requested in the Certification and Acknowledgment of the Application, MassHousing retains the right to rescind this Site Approval letter.

Should a comprehensive permit be issued, please note that prior to (i) commencement of construction of the Project or (ii) issuance of a building permit, the Applicant is required to submit to MassHousing a request for Final Approval of the Project (as it may have been amended) in accordance with the Comprehensive Permit Rules (see especially 760 CMR 56.04(07) and the Guidelines including, without limitation, Part III thereof concerning Affirmative Fair Housing Marketing and Resident Selection). Final Approval will not be issued unless MassHousing is able to make the same findings at the time of issuing Final Approval as required at Site Approval.

Please note that MassHousing may not issue Final Approval if the Comprehensive Permit contains any conditions that are inconsistent with the regulatory requirements of the New England Fund Program of the FHLBank Boston, for which MassHousing serves as Subsidizing Agency, as reflected in the applicable regulatory documents. In the interest of providing for an efficient review process and in order to avoid the potential lapse of certain appeal rights, the Applicant may wish to submit a "final draft" of the Comprehensive Permit to MassHousing for review. Applicants who avail themselves of this opportunity may avoid significant procedural delays that can result from the need to seek modification of the Comprehensive Permit after its initial issuance.

If you have any questions concerning this letter, please contact Michael Busby at (617) 854-1219.

Sincerely,

Colin M. McNiece
General Counsel

cc: Jennifer Maddox, Undersecretary, DHCD
The Honorable Jeanette McCarthy
The Honorable Michael J. Barrett
The Honorable Thomas M. Stanley
The Honorable John J. Lawn, Jr.

Attachment 1

760 CMR 56.04 Project Eligibility: Other Responsibilities of Subsidizing Agency
Section (4) Findings and Determinations

1486 Main Street, MA #1103

MassHousing hereby makes the following findings, based upon its review of the application, and taking into account information received during the site visit and from written comments:

(a) that the proposed Project appears generally eligible under the requirements of the housing subsidy program, subject to final approval under 760 CMR 56.04(7);

The Project is eligible under the NEF housing subsidy program and at least 25% of the units will be available to households earning at or below 80% of the Area Median Income, adjusted for household size, as published by the U.S. Department of Housing and Urban Development ("HUD"). The most recent HUD income limits indicate that 80% of the current median income for a four-person household in Waltham is $101,050.

Proposed rent levels $1,611 for a one-bedroom affordable unit, $1,914 for a two-bedroom affordable unit and $2,188 for a three-bedroom affordable unit accurately reflect current affordable rent levels for the Boston-Cambridge-Quincy HMFA under the NEF Program, less utility allowances of $194, $252 and $314.

The Applicant submitted a letter of financial interest from Cambridge Savings Bank, a member bank of the FHLBank Boston under the NEF Program.

(b) that the site of the proposed Project is generally appropriate for residential development, taking into consideration information provided by the Municipality or other parties regarding municipal actions previously taken to meet affordable housing needs, such as inclusionary zoning, multifamily districts adopted under c.40A, and overlay districts adopted under c.40R, (such finding, with supporting reasoning, to be set forth in reasonable detail);

Based on a site inspection by MassHousing staff, internal discussions, and a thorough review of the application, MassHousing finds that the Site is suitable for residential use and development and that such use would be compatible with surrounding uses and would address the local need for housing.

According to DHCD's Chapter 40B Subsidized Housing Inventory (SHI), updated through December 21, 2020, Waltham has 1,819 Subsidized Housing Inventory (SHI) units (7.3% of its housing inventory), which is 661 units short of the statutory minima requirement of 10%.

In summary, based on evaluation of the site plan using the following criteria, MassHousing finds that the proposed conceptual Project design is generally appropriate for the Site. The following plan review findings are made in response to the conceptual plan, submitted to MassHousing:

(c) that the conceptual project design is generally appropriate for the site on which it is located, taking into consideration factors that may include proposed use, conceptual site plan and building massing, topography, environmental resources, and integration into existing development patterns (such finding, with supporting reasoning, to be set forth in reasonable detail);

Relationship to Adjacent Building Typology (Including building massing, site arrangement, and architectural details):
The Applicant intends to construct a six (6) story building with 192 residential units. The two (2) lower floors will be dedicated to parking and will have a footprint area of approximately 62,600 sf. The four (4) upper floors will be for the residential units. The main lobby and leasing office will be located on the first floor and the main amenity space will be located on the third floor. An amenity courtyard with a pool will be located off the amenity space.

The materials selection and detailing of the proposed building seeks to provide a thoughtful transition from the existing commercial uses to the residential surroundings through the use of high-quality cladding materials including cement fiber profiles; horizontal clapboard, flush reveal panel, and vertical panel finished with different colors and profiles. Double-hung style window selections reflect the residential occupancy of the structure while drawing cues from the residential neighborhood to the west. Detailing is kept clean and straightforward providing a refined the transitional nature of the overall building structure. The complex will provide a total of 273 parking spaces of which 265 spaces will be located within the garage and 8 spaces on the outside parking area by the front door.

Relationship to adjacent streets/Integration into existing development patterns
The Site lies at the westerly end of a series of local office and flex uses along Main Street between the redeveloped former Polaroid Campus east of I-95 / Route 128 and the Waltham /Weston line, which is nearly the Site's westerly bound. The uses similar to the Site along with hotel, flex, self-storage uses continue on Second Avenue to the north of the subject to Winter Street where larger retail uses (Costco and Home Depot), mix in with medical office, office, and larger hotel uses. Directly north of the Site is a late 1990's developed apartment community; Avalon Bear Hill, which was of the first gated apartment communities in Greater Boston. The area to the west of the Site is within the Town of Weston with Route 117 (Main Street in Waltham, North Avenue in Weston) being generally single-family residential, with some small commercial uses.

Density
The Applicant proposes to build 192 rental units on approximately 2.15 acres, all of which are buildable. The resulting density is 89.30 units per buildable acre, which is acceptable given the proposed housing type.

Conceptual Site Plan
The Site will be accessed by two (2) curb-cuts off of Main Street. The primary driveway will be dedicated solely to the development and is proposed to be modified to match the required site geometry. The second entrance will be maintained through the existing curb cut and provide access to the development as well as 1466 and 1474 Main Street. Due to the grade differences, the primary Main Street entrance will provide access to the first-floor parking garage and residential lobby. Access to the second-floor entrance will be located on the easterly side of the building off the secondary driveway. All access drives are proposed to be twenty-four (24) feet wide and all standard parking stalls will be nine (9) feet wide by eighteen (18) feet long. Accessible parking spaces will be provided in accordance with Americans with Disabilities Act (ADA). Other site improvements include landscape areas,

underground utilities, municipal water and sewer and a new stormwater management system. A dedicated trash and recycling center has been proposed on the second floor of the parking garage.

Environmental Resources

The property does not contain any area of critical concern or areas of estimated or priority habitat of rare species, wildlife, or vernal pools.

Topography

The topography is fairly to moderately sloped, adjacent to the existing garage, but elevated around the perimeter with various types of retaining walls. The topography ranges from a low elevation of 149± at the northerly corner at Main Street as well as the southwesterly corner to a high elevation of 176± at the perimeter (southerly corner) along the top of the retaining walls. The topographic features of the Site have been considered in relationship to the proposed development plans and do not constitute an impediment to development of the Site.

(d) that the proposed Project appears financially feasible within the housing market in which it will be situated (based on comparable rentals or sales figures);

According to the appraisal report for the Site, Waltham's residential market appears stable and strong. MassHousing's Appraisal and Marketing team (A&M) performed a Competitive Market Analysis and found that proposed market rents for each unit type fall within the range of adjusted comparable market rents.

(e) that an initial pro forma has been reviewed, including a land valuation determination consistent with the Department's Guidelines, and the Project appears financially feasible and consistent with the Department's Guidelines for Cost Examination and Limitations on Profits and Distributions (if applicable) on the basis of estimated development costs;

MassHousing has commissioned an as "As-Is" appraisal which indicates a land valuation of $2,800,000. Based on a proposed investment of $76,010,084 in equity and permanent financing the development pro forma appears to be financially feasible and within the limitations on profits and distributions.

(f) that the Applicant is a public agency, a non-profit organization, or a Limited Dividend Organization, and it meets the general eligibility standards of the housing program; and

MassHousing finds that the Applicant must be organized as a Limited Dividend Organization. MassHousing sees no reason this requirement could not be met given information reviewed to date. The Applicant meets the general eligibility standards of the NEF housing subsidy program and has executed an Acknowledgment of Obligations to restrict their profits in accordance with the applicable limited dividend provisions.

(g) that the Applicant controls the site, based on evidence that the Applicant or a related entity owns the site, or holds an option or contract to acquire such interest in the site, or has such other interest in the site as is deemed by the Subsidizing Agency to be sufficient to control the site.

The Applicant controls the entire Site by virtue of a Purchase and Sale Agreement dated October 5, 2020, between TSA Properties, LLC (Seller) and WP East Acquisitions, LLC (Buyer) with an expiration date of December 12, 2022.

EVIDENCE OF SITE CONTROL

AGREEMENT FOR PURCHASE AND SALE OF PROPERTY

This AGREEMENT FOR PURCHASE AND SALE OF PROPERTY (this "**Agreement**") is made and entered into as of this 5th day of October, 2020, by and between TSA PROPERTIES, LLC, a Massachusetts limited liability company ("**Seller**"), and WP EAST ACQUISITIONS, L.L.C., a Georgia limited liability company ("**Buyer**").

W I T N E S S E T H T H A T :

WHEREAS, Buyer wishes to purchase, and Seller wishes to sell, the Property (as hereinafter defined), upon the terms and conditions hereinafter set forth.

NOW, THEREFORE, in consideration of Ten Dollars ($10.00), the mutual covenants and agreements contained herein and other good and valuable consideration, the receipt and sufficiency of which are hereby acknowledged, the parties hereto do hereby agree as follows:

1. Definitions and Exhibits.

1.1 Definitions. For purposes of this Agreement, each of the following terms, when used herein with an initial capital letter, shall have the meaning ascribed to it as follows:

"**Broker**" shall mean Aho Properties, LLC, a Massachusetts limited liability company.

"**Business Day**" shall mean a day other than a Saturday, Sunday or legal or bank holiday in either the Commonwealth where the Land is located or of the Federal Government.

"**Closing**" shall mean the closing and consummation of the purchase and sale of the Property pursuant hereto.

"**Closing Date**" shall mean the date on which the Closing occurs as provided in Section 9.1 hereof.

"**Closing Extension**" shall have that meaning set forth in Section 9.1 hereof.

"**Contract Date**" shall mean the date upon which this Agreement shall be deemed effective, which shall be the date first above written.

"**Comprehensive Permit**" shall have that meaning set forth in Section 7.6 hereof.

"**DA Submissions**" shall have that meaning set forth in Section 7.6 hereof.

"**Development Approvals**" shall mean all federal, state, county, and municipal government permits, approvals, and modifications that are necessary for the Intended Use which are acceptable to Buyer in its sole discretion and do not impose upon Buyer or the Land any conditions to or limitations on the acquisition, development or use of the Land which are unacceptable to Buyer in its sole discretion. The Development Approvals shall include, but not be limited to, (i) any rezoning or zoning modifications required to allow for the Intended Use, (ii) any subdivision, re-subdivision, lot consolidation or parcel maps, plats or plans or other similar legal subdivisions, re-subdivisions, partitions, consolidations or recombinations of the Real Property, portions thereof or larger parcels which include the Real Property which may be required in connection with the Intended Use, (iii) site plan approvals, (iv) confirmation of availability of all utilities (including easements necessary for delivery of services to the Property) required for the Intended Use, (v) all approvals and permits (or modifications thereto) by or from the municipal governing body or other agencies or boards of the Intended Use (including, but not limited to, land disturbance and erosion control permits); (vii) a building permit to allow for the vertical construction of the Project, (viii) the Comprehensive Permit, and (ix) the Project Eligibility Letter. A Development Approval shall not be considered to have been received by Buyer for purposes of this Agreement until the expiration of applicable statutory periods of appeal of the issuance of the Development Approval without an appeal being filed or, if the Development Approval has been issued by the duly authorized governmental body or agency but the issuance of the Development Approval has been appealed, when an appeal of an Development Approval has been resolved in Buyer's favor such that the Development Approval is issued either by court decision that cannot be further appealed or by settlement.

"**Earnest Money**" shall have that meaning set forth in Section 3.1 hereof.

"**Entitlements Date**" shall have the meaning set forth in Section 7.6 hereof.

"**Entitlements Failure**" shall have the meaning set forth in Section 7.6 hereof.

"**Environmental Reports**" shall mean all existing environmental site assessments, remediation reports, tank removal reports and other reports (including, but not limited to, any soils and groundwater assessments and reports) for the Property.

"**Escrow Agent**" shall mean First American Title Insurance Company acting as Escrow Agent pursuant to the terms and conditions of the Escrow Agreement and Section 3 hereof.

"**Existing Lease**" shall mean the lease or occupancy agreement described on EXHIBIT I attached hereto and made a part hereof.

"**Existing Lease Estoppel**" shall mean an estoppel statement from the Existing Tenant confirming that its lease terminates prior to the Closing Date and that, as to such Existing Tenant and such Existing Tenant's Existing Lease, the Tenant Vacancy Condition will be satisfied by the Closing Date. The form of any Existing Lease Estoppel shall be subject to Buyer's approval, not to be unreasonably withheld, conditioned or delayed.

"**Existing Tenant**" shall mean European Auto Solutions, LLC, a Massachusetts limited liability company, with a principal place of business at 1486 Main Street, Route 117, Waltham, Massachusetts 02451.

"**Escrow Agreement**" shall mean that certain Escrow Agreement of even date herewith among Seller, Buyer and Escrow Agent referred to in Section 3 hereof and attached hereto as EXHIBIT D and by this reference made a part hereof.

"**Extension Deposit**" shall have that meaning set forth in Section 9.1 hereof.

"**General Assignment**" shall mean an Assignment of Service Contracts, Warranties and Other Intangible Property in the form attached hereto as EXHIBIT E.

"**Hazardous Substances**" shall mean any and all hazardous, extremely hazardous, or toxic substances or wastes or constituents as those terms are defined by any applicable Hazardous Substance Law (including, without limitation, CERCLA and RCRA) and petroleum, petroleum products, asbestos or any asbestos-containing materials, the group of organic compounds known as polychlorinated biphenyls (PCBs), flammables, explosives, radioactive materials, and chemicals known to cause cancer or reproductive toxicity.

"**Hazardous Substance Law**" shall mean any and all federal, state, or local laws, rules, regulations, ordinances, agency or judicial orders and decrees, and agency agreements now and hereafter enacted or promulgated or otherwise in effect, relating to the protection of the environment, including, without limitation, the Resource Conservation and Recovery Act of 1976 ("**RCRA**"), 42 U.S.C. §§6901 et seq., the Comprehensive Environmental Response, Compensation and Liability Act of 1980 ("**CERCLA**"), 42 U.S.C. §§9601 et seq., as amended by the Superfund Amendments and Reauthorization Act of 1986 ("SARA"), the Hazardous Materials Transportation Act, 49 U.S.C. §6901, et seq., the Federal Water Pollution Control Act, 33 U.S.C. §§1251 et seq., the Clean Air Act, 42 U.S.C. §§7401 et seq., the Toxic Substances Control Act, 15 U.S.C. §§2601 et seq., and the Safe Drinking Water Act, 42 U.S.C. §§300f et seq., and all amendments, regulations, orders and decrees promulgated thereunder or pursuant thereto.

"**Improvements**" shall collectively mean any buildings, structures and improvements located on the Land.

"**Initial Entitlements Date**" shall have the meaning set forth in Section 7.6 hereof.

"**Inspection Date**" shall mean the Inspection Date set forth in Section 7.3 hereof.

"**Intangible Personal Property**" shall collectively mean, to the extent assignable, all intangible personal property, if any, owned by Seller and related exclusively to the Real Property, including, without limitation: (i) any trade names associated with the Real Property; (ii) any plans and specifications and other architectural and engineering drawings for the Improvements or any other improvements contemplated in connection with the development or potential development of the Property; (iii) any warranties; (iv) any Service Contracts and other contract rights related to the Property (but only to the extent Seller's obligations thereunder are expressly assumed by Buyer pursuant to the General Assignment); and (v) any governmental permits, approvals and licenses (including any pending applications), including without limitation, the Development Approvals.

"**Intended Use**" (also sometimes referred to herein as the "**Project**") shall mean a multi-family or mixed-use development project containing at least 150 multi-family residential units (or such lesser number as Buyer shall approve in its sole discretion), together with certain amenities, common areas and other ancillary improvements for such development.

"**Land**" shall mean that certain real property located in Middlesex County, Massachusetts with a street address of 1486 Main Street, Waltham, MA, being more particularly described in EXHIBIT A attached hereto and made a part hereof.

"**Material Condemnation**" shall mean a condemnation or threatened condemnation pursuant to which (i) any portion of the Property with a value equal to or greater than $50,000 is taken or threatened to be taken; (ii) causes or would cause a material reduction in size of the Real Property or materially interferes with or increases the cost of the development, use or operation of the Real Property; (iii) results or would result in the Property being in violation of any applicable law, ordinance or regulation; (iv) results or would result in access to the Property being materially impaired, as reasonably determined by Buyer; or (v) otherwise has or would have a material, adverse effect on the Intended Use, which may include, without limitation, a condemnation or threatened condemnation which materially, adversely affects or would materially, adversely affect Buyer's ability to construct and/or develop the Project.

"M.G.L. 40B" shall have the meaning set forth in Section 7.6 hereof.

"**NR EM Portion**" shall have the meaning set forth in Section 7.6 hereof.

"**OFAC**" shall mean the Office of Foreign Assets Control, Department of the Treasury.

"Outside Closing Date" shall have that meaning set forth in Section 9.1 hereof.

"Outside Entitlements Date" shall have that meaning set forth in Section 7.6 hereof.

"**Permitted Title Exceptions**" shall mean those matters affecting title to the Land identified on EXHIBIT B attached hereto and by this reference made a part hereof.

"**Person**" shall mean any individual, sole proprietorship, partnership, joint venture, trust, unincorporated organization, association, corporation, institution, entity, party or government (whether national, Federal, state, county, city, municipal or otherwise, including, without limitation, any instrumentality, division, agency, body or department thereof).

"**PEL Issuance Date**" shall mean Buyer shall have been issued a Project Eligibility Letter by the appropriate governmental agency pursuant to M.G.L. 40B, and such letter provides that the Project is suitable for development of at least 150 multi-family residential units under a Comprehensive Permit, subject to receipt of applicable Development Approvals related thereto.

"**Project Eligibility Letter**" shall have that meaning set forth in Section 7.6 hereof.

"**Property**" shall collectively mean:

(i) the Real Property; and

(ii) all of Seller's right, title and interest in and to the Intangible Personal Property.

There is no tangible personal property included in the sale and therefore the definition of "Property" specifically excludes any tangible personal property unless expressly identified herein to the contrary. Accordingly, any such tangible personal property located on the Real Property after the Closing shall be deemed abandoned by Seller.

"**Proration Date**" shall mean the effective date of the prorations provided in Section 4.2 hereof, which is 11:59 p.m. on the eve of the Closing Date.

"**<u>Purchase Price</u>**" shall mean the purchase price for the Property described in <u>Section 4.1</u> hereof.

"**<u>Real Property</u>**" shall collectively mean the Land, together with:

(i) the Improvements;

(ii) all rights, benefits, privileges, easements, tenements, hereditaments, rights-of-way and other appurtenances thereon or in any way appertaining thereto, including all mineral rights, development rights, air and water rights; and

(iii) all strips and gores and any land lying in the bed of any street, road or alley, open or proposed, adjoining such Land.

"**<u>Second Deposit</u>**" shall have the meaning set forth in <u>Section 3.1</u> hereof.

"**<u>Service Contracts</u>**" shall collectively mean all contracts pertaining to the operation of the Property, including all management, leasing, service and maintenance agreements, and equipment leases.

"**<u>Survey</u>**" shall have that meaning set forth in in <u>Section 6</u> hereof.

"**<u>Taxes</u>**" shall have the meaning set forth in <u>Section 4.2</u> hereof.

"**<u>Tenant Vacancy Condition</u>**" means that all existing leases and occupancy agreements affecting the Property, including the Existing Lease, has terminated by their terms, and all tenants, subtenants or occupants of the Property, including the Existing Tenant, whether permitted pursuant to this Agreement or resulting from a breach hereof, have (i) fully vacated the Property and removed all personal property and effects therefrom, and (ii) otherwise surrendered their respective premises in accordance with the terms and conditions set forth in the Existing Lease and any other applicable leases or occupancy agreements.

"**<u>Title Insurer</u>**" shall mean First American Title Insurance Company, or any other national title insurance company reasonably acceptable to Buyer.

1.2 <u>Exhibits; Schedules</u>. All exhibits, schedules and other attachments hereto form an integral part of this Agreement, all of which are incorporated into this Agreement as fully as if the contents thereof were set out in full herein at each point of reference thereto.

2. <u>Purchase and Sale</u>. Subject to the provisions hereof, Seller agrees to sell, assign and convey the Property to Buyer, and Buyer agrees to purchase the Property from Seller.

3. <u>Earnest Money</u>.

3.1 Earnest Money. Within 3 Business Days after the Contract Date, Buyer shall deposit with Escrow Agent the sum of $50,000.00 (the "**First Deposit**") as earnest money hereunder. Provided this Agreement is then in full force and effect, Buyer shall deposit with Escrow Agent the additional sum of $150,000.00 (the "**Second Deposit**") as additional earnest money hereunder by the date that is 3 Business Days after the Inspection Date (the First Deposit, the Second Deposit and interest or other income earned thereon is collectively referred to as the "**Earnest Money**"). The Earnest Money shall be held, invested and disbursed pursuant to the respective terms and provisions hereof and of the Escrow Agreement.

3.2 Cooperation. Whenever the Earnest Money is by the terms hereof to be disbursed by Escrow Agent, Seller and Buyer agree promptly to execute and deliver such notices as necessary or, in the opinion of Escrow Agent, appropriate to authorize Escrow Agent to make such disbursement.

4. Purchase Price and Prorations.

4.1 Purchase Price.

a. Purchase Price. The purchase price (the "**Purchase Price**") for the Property shall equal the greater of (i) $[redacted]; and (ii) [redacted] multiplied by the total number of residential units that Buyer is permitted to construct within the Project pursuant to the Development Approvals.

b. Payment Mechanics. The Purchase Price, as adjusted by the prorations provided in Section 4.2 hereof and as reduced by the Earnest Money (which, unless otherwise disbursed hereunder, shall be disbursed by Escrow Agent at the Closing to Seller as a portion of the Purchase Price) shall be paid by Buyer to Seller (via Escrow Agent or otherwise) at the Closing in United States dollars, by Federal Reserve System wire transfer or other immediately available funds acceptable to Seller.

4.2 Prorations.

a. Proration Items. The following items shall be prorated between Seller and Buyer as of the Proration Date, and prorations favoring Buyer, to the extent determinable as of the Proration Date, shall reduce the Purchase Price payable by Buyer at the Closing, and such prorations favoring Seller, to the extent determinable as of the Proration Date, shall increase the Purchase Price payable by Buyer at the Closing:

i. Taxes: The state, county, city or other ad valorem property taxes and assessments for the tax period in which the Closing occurs (the "**Taxes**").

1. Assumed Tax Amount: If the actual tax bills for the tax period of Closing have not been issued, then such proration shall be based on such taxes for the prior tax period.

2. True Up Upon Receipt of Tax Bill. After the actual tax bills for the tax period of Closing are received by either Buyer or Seller, Buyer and Seller shall adjust such proration, and any amount then owing shall be paid within 20 days of demand by the party entitled thereto.

3. Not Separate Tax Parcel: If the Land is taxed as a portion of a larger parcel, the parties agree to pay their pro rata share of the Taxes covering the tax period of Closing (and any previous periods) for the entire parcel to taxing authorities at the Closing, or, if the tax bill is not available, pay into escrow the estimated amount of said bill for payment by the Escrow Agent directly to the taxing authorities when the tax bill becomes available and shall execute and deliver such documentation before and after Closing as may be necessary to cause the Land to be assessed as a separate parcel.

4. Rollback Taxes Ascertainable by Closing. If the Land has been designated or valued as agricultural, open space or other special category such that its sale or change of use would trigger the imposition of any "rollback", "agricultural rollback", "catch up" or similar taxes, including penalties and interest thereon (collectively, the "**Rollback Taxes**"), or if any Rollback Taxes are imposed on the Land by the Closing Date in connection with the Intended Use or the conveyance of the Property, Seller shall be responsible for paying any such Rollback Taxes in full at the Closing.

5. Rollback Taxes Not Ascertainable by Closing. If Rollback Taxes are not ascertainable at Closing, Seller shall escrow the amount thereof as estimated by Buyer's tax consultant with Escrow Agent pursuant to an escrow agreement to be executed at Closing between Buyer, Seller and Escrow Agent which shall require Escrow Agent to apply the escrowed funds toward payment of such Rollback Taxes as soon as same have been determined and are due and payable, and shall obligate Seller to pay any deficiency between the actual amount of the Rollback Taxes and the amount of the escrowed funds.

ii. Assessment Liens: Assessment liens which have been certified as of the Closing Date, pending liens where the improvements have been substantially completed, and special assessments or other similar governmental assessments or charges on the Property that have been billed and are pending prior to the Closing, shall be satisfied by Seller, in full, at Closing.

iii. Utility and Sewer Charges: Seller will take all action necessary to ensure that the utilities servicing the property are closed out by Closing, and there will accordingly be no proration with respect to utilities. All utility security deposits, if any, will be retained by Seller.

iv. Service Contracts: Charges or payments due under any Service Contracts which are assumed by Buyer pursuant to the terms hereof.

b. Proration Errors. If the parties make any errors or omissions in the closing prorations or if they subsequently determine any dollar amount prorated to be incorrect, each agrees, upon notice from the other no later than twelve (12) months after the Closing, to make any adjustment necessary to correct the error, including payment of any amount to the other then determined to be owing.

c. Payment of Prorations. Buyer and Seller shall promptly pay to the other party any amount due to the other party as a result of any proration required under this Section 4.2.

d. Interest. Any amounts due hereunder not paid within 20 days after demand by the payee shall bear interest at a rate equal to 15% per annum until such time as all such amounts are paid in full.

5. Title.

5.1 Fee Simple Conveyance at Closing. Seller shall convey good, marketable and insurable fee simple title to the Land to Buyer free and clear of all liens and encumbrances, subject only to the Permitted Title Exceptions and any other matters of title to which Buyer shall expressly consent in writing pursuant hereto.

5.2 Review of Title Commitment. Buyer shall have until the Inspection Date by which to examine title to the Property, to obtain a title insurance commitment (the "**Title Commitment**"), and to give written notice to Seller of any objections. Buyer shall cause to be made, at Buyer's expense, an examination of title to the Property and Buyer shall provide Seller's counsel a copy of the title report issued by Buyer's title examiner on or before the Inspection Date.

a. Failure of Buyer to Object. If Buyer fails to give any notice to Seller by such date, Buyer shall be deemed to have waived such right to object to any title exceptions or defects disclosed in the Title Commitment (except for any Monetary Liens, which must be removed by Seller in accordance with Section 5.5).

b. Buyer Provides Objections. If Buyer timely notifies Seller of Buyer's objection(s) to any title exceptions or defects, Seller may, by delivering written notice thereof to Buyer within 10 days of receipt of such objection(s), elect (x) not to take any action to cure such objection(s), or (y) to cure or satisfy such objection(s) (and, to the extent Seller fails to provide a response to Buyer's objection(s) within such 10 day period, Seller shall be deemed to have elected not to cure such Buyer's objection(s)). Seller's election to cure shall include a reasonable description of the actions Seller will take and the estimated time therefor.

i. Seller Fails to Cure Objection. If Seller elects (A) not to cure such objections (except that Seller must cure Monetary Liens as required by Section 5.5), or (B) to cure such objections and such objections are not reasonably cured or satisfied within 10 days after such election to cure is made, then Buyer may, within 7 days after the election is made in clause (A) or within 7 days after the end of such 10 day cure period in clause (B), as applicable, elect, by written notice to Seller, either:

1. Terminate: to terminate this Agreement, in which case the Earnest Money, less $100 to be paid to Seller, shall be returned to Buyer by Escrow Agent, and the parties shall have no further rights or obligations hereunder, except for those which expressly survive any such termination, or

2. Waive: to waive its objections hereunder and proceed with the transaction pursuant to the remaining terms and conditions of this Agreement.

If Buyer fails to give Seller notice of its election by such time, it shall be deemed to have elected the option contained in Section 5.2(b)(i)(2). For avoidance of doubt, if Seller elects to cure only some of such objections, then (i) Buyer shall have the rights set forth in Section 5.2(b)(i) above as if Seller elected not to cure any of Buyer's objections, and (ii) Seller is obligated to cure any such objections in the manner set forth in this Section 5.2 (and otherwise subject to any applicable rights of Buyer set forth herein with respect thereto).

ii. Seller Cures Objection. If Seller reasonably cures or satisfies all such objection(s) within 10 days after its election to do the same, then this Agreement shall continue in full force and effect.

iii. Waiver. Buyer shall have the right at any time to waive any objections that it may have made and, thereby, to preserve this Agreement in full force and effect.

5.3 Further Encumbrances. Seller agrees not to further alter or encumber in any way Seller's title to the Property after the Contract Date without Buyer's prior written consent.

5.4 Changes In Title. Buyer shall have the right to object to any new title exception or defect disclosed in any update to the Title Commitment, and if (i) Seller elects to cure such objection and Seller cannot cure or satisfy any such objection (or any objection which Seller has previously undertaken to cure or satisfy) within 10 days after such election, or (ii) Seller does not notify Buyer that it will cure such objection within 5 days after receipt of notice thereof, Buyer may exercise the option set forth in clause 5.2(b)(i)(1) or 5.2(b)(i)(2) above. The foregoing election is not intended to be in derogation of, but shall be in addition to, Buyer's remedies for Seller's default hereunder, and does not negate, modify or amend the representations, warranties and covenants of Seller contained herein.

5.5 Monetary Liens. Seller shall remove any monetary liens against the Land (collectively, "**Monetary Liens**") at or before the Closing, including, without limitation, any such liens created by, through or under any tenants of the Property. To the extent that any Monetary Liens have not been removed at or prior to the Closing, Buyer may (without any obligation to do so) cause any such Monetary Liens to be removed at the Closing and apply the cost thereof (including, but not limited to, any out-of-pocket costs incurred in connection with such removal) against the Purchase Price.

5.6 Time Periods. The Closing Date shall be automatically extended to allow all time periods in this Section 5 to run fully.

6. Survey.

6.1 Survey. Buyer, at its sole cost and expense, may obtain a survey of the Property (the "**Survey**").

6.2 Buyer Objections. Any matters shown on such Survey (or any update thereto) and objected to by Buyer by the Inspection Date shall be additional title objections, as to which the obligations and rights of Buyer and Seller shall be the same as provided in Section 5 above. Furthermore, Buyer shall have the right to object to any new matters disclosed on updates to the Survey in the manner set forth in Section 5.4 above.

6.3 Legal Description. The Deed shall contain the legal description of the Land contained in EXHIBIT A hereto.

6.4 Quitclaim Deed. If Buyer obtains a Survey of the Property which results in a legal description different from any legal description on EXHIBIT A hereto, Seller also will convey the Land to Buyer pursuant to the new survey legal description of the Land by quitclaim deed.

7. Buyer's Inspection.

7.1 Physical Inspection.

a. Inspection Right. Buyer and its agents, employees, representatives and independent contractors may enter upon the Property for the purpose of making such surveys, soil tests, borings, percolation tests, inspections, examinations, and studies (collectively, "**Inspections**") as are reasonably necessary to evaluate and study the Property as contemplated herein. During Buyer's Inspections of the Property, Buyer will use commercially reasonable efforts not to disturb or otherwise interfere with the business being conducted at the Premises or Seller's use and enjoyment of the Premises. Seller agrees that Buyer shall have until the Closing Date in which to conduct all such Inspections, but that Buyer's right to terminate this Agreement based thereon shall be limited as provided in Section 7.3 and Section 7.4 below. Buyer agrees to give Seller and the Existing Tenant at least 24 hours prior notice of such on-site Inspections by emailing Seller at [redacted] and the tenant at [redacted].

b. Inspection Indemnity. Any entry onto the Premises by the Buyer or its agents, employees or other consultants for the purposes stated in this Section shall be at their sole risk. Buyer shall (i) be responsible for restoring the Property to substantially the same condition as existed prior to such Inspections and (ii) indemnify, defend and hold Seller harmless from any and all claims, liabilities, costs or expenses, including reasonable attorney's fees actually incurred ("**Claims**") arising out of such Inspections of and entries onto the Property, including, but not limited to, liability for personal injury (including death) and property damage to the extent caused by Buyer, its agents, employees and consultants. In conducting Inspections and testing, Buyer shall comply with all commercially reasonable rules and regulations established by Seller for any Inspections conducted on the Premises.

c. Carveout to Inspection Indemnity. Notwithstanding the foregoing, in no event shall Buyer be liable to restore the Property, or be obligated to indemnify Seller under Section 7.1(b) for (i) the mere discovery of pre-existing conditions at the Property or (ii) any claims, liabilities, costs or expenses arising out of the negligence or willful misconduct of Seller or any agents, employees, consultants or contractors thereof.

d. Certain Agreements Regarding Third-Party Due Diligence and Development Materials upon Termination. In the event Buyer terminates this Agreement pursuant to Section 7.3 or this Agreement terminates for any other reason other than a Seller default: (i) Buyer shall deliver and assign to Seller (without recourse, representation or warranty of any kind) copies of all third-party physical inspection reports, surveys, title work, geotechnical and environmental studies and reports regarding the Property prepared for or on behalf of Buyer; and (ii) upon Seller's written notice to Buyer, to be delivered no later than 30 days after such termination, and subject to Seller's payment to Buyer of all verified third-party costs incurred by Buyer in connection with same, Buyer shall deliver and assign to Seller (without recourse, representation or warranty of any kind, and only to the extent assignable), all third-party architectural and engineering plans regarding the Project prepared for or on behalf of Buyer.

7.2 Document Inspection. Seller covenants that on or before the date that is five (5) days after the Contract Date, Seller will deliver to Buyer true, correct and complete copies of each of the documents or materials listed on EXHIBIT C attached hereto to the extent in Seller's possession or reasonable control.

7.3 Inspection Period.

a. Inspection Date; Termination Right. Notwithstanding Buyer's right of inspection contained in Section 7.1, Buyer shall have until 5:00 p.m. Eastern time on the date that is the earlier of: (i) the 90th day after the PEL Issuance Date; and (ii) the 180th day after the Contract Date (such earlier date, the "**Inspection Date**") to investigate the Property and all matters relevant to its acquisition, ownership and development thereof; including, without limitation, the right to have made, at Buyer's expense, any studies or inspections of the Property that Buyer may deem necessary or appropriate, and to terminate this Agreement, by written notice to Seller, to be received on or before the Inspection Date, if Buyer is not, for any reason or for no reason, satisfied with the Property in its sole and absolute discretion, in which case the Earnest Money, less $100 to be paid to Seller, shall be returned to Buyer by Escrow Agent, and the parties shall have no further rights or obligations hereunder, except for those which expressly survive any such termination.

b. Seller Cooperation. Seller agrees to cooperate reasonably with any such investigations, inspections or studies made by or at Buyer's direction.

c. Failure to Exercise Termination Right. If, on or before the Inspection Date, Buyer does not exercise its termination right pursuant to this Section 7.3, then this Agreement shall remain in full force and effect in accordance with its terms.

d. Second Deposit. If Buyer waives its right to terminate this Agreement pursuant to this Section 7.3, Buyer shall deposit the Second Deposit with Escrow Agent in accordance with Section 3.1.

7.4 Conditions Precedent. In addition to other conditions set forth in this Agreement, Buyer's obligation to purchase the Property shall be subject to and contingent upon the following conditions precedent, any or all of which Buyer may waive by written notice only:

a. Adverse Conditions. There shall be no material adverse change in the condition of or affecting the Property not caused by Buyer between the time of Buyer's inspection of the Property prior to the Inspection Date and the Closing Date, including, but not limited to, (i) environmental contamination, (ii) access, and (iii) any moratorium in place or threatened which would restrict or prevent Buyer from starting and continuing construction on Buyer's proposed Project within 30 days after the Closing Date;

b. Title Insurance. The willingness of Title Insurer to issue, on the Closing Date, upon the sole condition of the payment of an amount no greater than its regularly scheduled premium, its standard extended ALTA form owner's policy of title insurance, insuring in the amount of the fair market value of the Property that title to the Property is vested of record in Buyer on the Closing Date, subject only to the Permitted Title Exceptions, with affirmative coverage over any mechanic's, materialman's and subcontractor's liens and with full extended coverage over all general exceptions, and containing the following endorsements to the extent the same are available in the Commonwealth of Massachusetts: comprehensive, zoning, covenants and restrictions, survey, contiguity and access;

c. Representations and Warranties. Seller's representations and warranties contained herein shall be true and correct in all material respects as of the Contract Date and the Closing Date. For purposes herein, a representation shall be false if the factual matter that is the subject of the representation is false notwithstanding any lack of knowledge or notice to the party making the representation.

d. Compliance with Agreement. Seller must have materially performed all obligations and complied with all covenants required in this Agreement to be performed or complied with by it prior to or at Closing.

e. Tenant Vacancy Condition. The Tenant Vacancy Condition shall be satisfied.

7.5 Failure of Conditions Precedent. If any of the conditions precedent set forth in Section 7.4 are not satisfied or waived in writing by Buyer by 12:00p.m. Eastern time on the Closing Date, Buyer may, but shall not be obligated to, elect, at its option, by notice to Seller, either to: (a) terminate this Agreement, in which event the Earnest Money shall be returned to Buyer, and the parties hereto shall have no further rights or obligations hereunder, except for those which expressly survive such termination; or (b) close without regard to the failure of such condition. The foregoing election is not intended to be in derogation of, but shall be in addition to, Buyer's remedies for Seller's default hereunder, and does not negate, modify or amend the representations, warranties or post-closing covenants of Seller contained herein, which representations, warranties and post-closing covenants shall survive the Closing as herein provided.

7.6 Development Approvals; DA Submission Milestone; Comprehensive Permit. Buyer covenants and agrees as follows as it concerns the Development Approvals:

a. Pursuit of Development Approvals. Buyer agrees to diligently and in good faith pursue the Development Approvals to obtain such approvals during the pendency of this Agreement, subject to Buyer's rights hereunder. For so long as Buyer makes submissions to appropriate governmental authorities, timely responds to inquiries from such authorities, and otherwise engages in diligent efforts to obtain the Development Approvals, Buyer shall be deemed to be diligently and in good faith pursing the Development Approvals.

Buyer hereby acknowledges that Buyer shall be solely responsible for obtaining any and all Development Approvals to enable Buyer to develop the Project. However, Seller, at no material cost and expense to Seller, shall cooperate with Buyer and join with Buyer in the signing of any documents necessary to obtain such approvals.

i. Initial Entitlements Date Termination Right. Notwithstanding anything contained in this Agreement, if at any time on or prior to the date that is 24 calendar months after the Inspection Date (the "**Initial Entitlements Date**"), (i) the Development Approvals and/or any condition, restriction or contribution required by applicable governing authorities prevents or unreasonably restricts Buyer's intended development of the Property, including, but not limited to, (A) any condition or restriction that inhibits Buyer from constructing the Project, including any imposition of berms, buffers and/or setbacks that adversely affect the minimum unit count or parking requirements of the Project, (B) any conditions, restrictions or contributions that collectively increase the cost of the Project by more than [redacted], (C) the failure of Buyer to obtain a Project Eligibility Letter, or (D) [redacted]; or (ii) Buyer, in its reasonable judgment, believes that it will not be able to obtain the Development Approvals (in any case, an "**Entitlements Failure**") on or before the Initial Entitlements Date, then Buyer shall have the right, by providing notice to Seller no later than 3 Business Days after the Initial Entitlements Date, to (1) terminate this Agreement, in which event the Earnest Money shall be returned to Buyer, and the parties hereto shall have no further rights or obligations hereunder, except for those which expressly survive such termination; or (2) continue to pursue obtaining the Development Approvals, in which event one-half of the Earnest Money shall be deemed non-refundable (the "**NR EM Portion**") if Buyer elects to terminate this Agreement pursuant to subsection (ii) below but such NR EM Portion will otherwise continue to be deemed Earnest Money for all purposes hereunder.

ii. Entitlements Date Termination Right. If at any time following the Initial Entitlements Date but on or prior to the date that is 30 calendar months after the Inspection Date (the "**Entitlements Date**"), Buyer, in its reasonable judgment, determines that an Entitlements Failure has occurred, then Buyer shall have the right, by providing notice to Seller no later than 3 Business Days after the Entitlements Date, to (1) terminate this Agreement, in which event one-half of the Earnest Money shall be returned to Buyer and the NR EM Portion shall be delivered to Seller, and the parties hereto shall have no further rights or obligations hereunder, except for those which expressly survive such termination; or (2) continue to pursue obtaining the Development Approvals for up to an additional 24 calendar months, provided Buyer continues to diligently and in good faith pursue the Development Approvals (the "**Outside Entitlements Date**"), in which event the Earnest Money shall be deemed non-refundable for all purposes under this Section 7.6 but will otherwise be deemed to constitute Earnest Money for all purposes under this Agreement.

If at any time following the Entitlements Date but on or prior to the Outside Entitlements Date, Buyer, in its reasonable judgment, determines that an Entitlements Failure has occurred, then Buyer shall have the right, by providing notice to Seller no later than 3 Business Days after the Outside Entitlements Date, to (1) terminate this Agreement, in which event the remaining one-half of the Earnest Money shall be delivered to Seller, and the parties hereto shall have no further rights or obligations hereunder, except for those which expressly survive such termination; or (2) proceed to Closing without regard to the Entitlements Contingency Failure.

iii. Failure to Deliver Termination Notices. If Buyer does not timely deliver the notices referenced in option (1) of either subsection (i) or (ii) above, it shall be deemed to have elected option (2) in each instance, as applicable.

b. Copies of Formal Submissions. Buyer shall provide Seller a copy of all formal Development Approval submissions ("**DA Submissions**") by Buyer to governmental authorities within 7 days of such submission. Electronic copies of such submissions shall be sufficient for the purposes hereunder.

c. Appeals. Notwithstanding anything contained in this Agreement to the contrary, in the event Buyer receives written confirmation that the Waltham Zoning Board of Appeals has rendered an adverse decision with respect to any Development Approval(s), then Buyer may elect either to: (a) terminate this Agreement, in which event the Earnest Money shall be returned to Buyer or, if the Initial Entitlements Date or Entitlements Date has passed, to Seller, as applicable and to the extent set forth this Section 7.6, in accordance with the terms of this Agreement, and the parties hereto shall have no further rights or obligations hereunder, except for those which expressly survive such termination; or (b) timely file an appeal of such decision with the Housing Appeals Committee (or other appropriate governmental agency), subject in any event to Buyer's rights under this Section 7.6 .

d. DA Submission Milestone. If Buyer elects to submit an application pursuant to Massachusetts General Laws (M.G.L.) Chapter 40B ("**M.G.L. 40B**") for a letter of project eligibility (the "**Project Eligibility Letter**"), as opposed to pursuing a rezoning of the Land in connection with the Intended Use, Buyer shall use good faith efforts to file such M.G.L 40B application with the appropriate governmental agency on or before February 1, 2021, subject to force majeure delays beyond Buyer's reasonable control (including COVID-19 Delay (as defined in Section 30)).

e. Suitability of Comprehensive Permit. To Buyer's actual knowledge, and based solely on initial discussions with Buyer's land use counsel and without any duty of further inquiry, Buyer's preliminary due diligence suggests that the Property is suitable for development of at least 100 residential units under a "Comprehensive Permit" issued pursuant to M.G.L. 40B (the "**Comprehensive Permit**"), subject to receipt of applicable Development Approvals related thereto, and provided that the foregoing in no way constitutes any representation, warranty, guaranty or assurances that Buyer will pursue a Comprehensive Permit or be able to obtain same or the balance of the Development Approvals for the Project.

8. Representations and Warranties.

8.1 Representations and Warranties. Seller hereby represents and warrants to Buyer as follows:

a. No Litigation. Seller is not aware of, and has not received any notice of, any actual, pending or threatened violation, action or proceeding by any organization, person, individual or governmental agency against Seller with respect to the Property or against the Property (or any portion thereof), and, to the best of Seller's knowledge, there is no current threat of any litigation or other legal action being filed against Seller or the Property which would affect the Property or Seller's ability to perform its obligations hereunder.

b. Boundary Lines of Property. There is no pending litigation or dispute, and Seller has received no notice of any disputes, concerning the location of the lines and corners of the Property, and Seller has not been served with any legal action concerning the location of the lines and corners of the Property.

c. Authority.

i. Organization. Seller is a Massachusetts limited liability company duly formed, validly existing and in good standing under the laws of the Commonwealth of Massachusetts, and qualified to do business in the Commonwealth in which the Property is located.

ii. Authorization: Seller has obtained all requisite authorizations and consents to enter into this Agreement with Buyer and to consummate the transactions contemplated hereby and the execution, delivery and performance of this Agreement and the other agreements and instruments referred to herein and the consummation of the transactions contemplated hereby by Seller will not violate, nor constitute a default under, Seller's operating agreement or any order or ruling of any governmental authority or court or any document, instrument or agreement by which Seller or the Property may be bound.

iii. Legally Binding: This Agreement is the valid and legally binding obligation of Seller, enforceable against Seller in accordance with its terms.

iv. Legal Power: The entities and individuals executing this Agreement and the other documents and instruments referenced herein or otherwise executed and delivered in connection herewith on behalf of Seller have the legal power, right and authority to bind Seller under the terms and conditions stated herein.

d. Title. Seller has now, and will have, at the Closing, good, insurable and marketable fee simple title to the Property, free and clear of all liens and encumbrances, other than the Permitted Title Exceptions and none of the Property will be subject to any prior conveyance or assignment to, or any superior possessory rights in, any third party. Seller does not own or control any real property that is contiguous to the Land.

e. Undisclosed Agreements and Liabilities. Other than as expressly set forth in this Agreement or otherwise disclosed in writing to Buyer pursuant to this Agreement, there are no undisclosed liabilities or agreements affecting the Property or Seller, in its capacity as owner of the Property.

f. Taxes and Assessments.

i. No Special Assessments: The Property is not subject to or affected by any special assessment for public improvements or otherwise, whether or not presently a lien upon the Property.

ii. No Commitments: Seller has made no commitment to any governmental authority, utility company, school board, church or other religious body, homeowner or homeowner's association or any other organization, group or individual relating to the Property which would impose an obligation upon Seller or its successors or assigns to make any contributions or dedications of money or land, or to construct, install or maintain any improvements of a public or private nature as part of the Property or upon separate lands.

iii. No Special Fees or Contributions: No governmental authority has imposed any requirement that Seller pay, directly or indirectly, any special fees or contributions or incur any expenses or obligations in connection with the development of the Property or any portion thereof, other than any regular and nondiscriminatory local real estate or school taxes assessed against the Property.

iv. Separately Assessed: The Property is separately assessed for real property tax assessment purposes and is not combined with any other real property for tax assessment purposes.

v. No Reassessment: Seller has received no notice of any contemplated or actual reassessment of the Property or any portion thereof for general real estate tax purposes.

vi. Taxes and Assessments Paid: As of the date hereof, all due and payable taxes, assessments, water charges and sewer charges affecting the Property or any portion thereof have been paid.

g. No Rights to Purchase. No Person, other than Buyer, has any right, agreement, commitment, option, right of first refusal or any other agreement, whether oral or written, with respect to the purchase, assignment or transfer of all or any portion of the Property.

h. Environmental Matters.

i. No Hazardous Substances: Hazardous Substances have not been used, generated, transported, treated, stored, released, discharged or disposed of in, onto, under or from the Property by Seller or, to the best of Seller's knowledge, by any predecessor-in-title or agent of Seller or by any other Person at any time.

ii. No Violations: To Seller's knowledge, the Property is not in violation of any Hazardous Substance Laws.

iii. No Claims or Actions: Seller has received no written or oral notice or other communication of pending or threatened claims, actions, suits, proceedings or investigations against Seller, the Property or any occupant of the Property related to alleged or actual violations of Hazardous Substance Laws.

iv. No Notifications: No notification of release of a Hazardous Substance has been filed as to the Property, nor, to the best of Seller's knowledge, is the Property or any property in the immediate vicinity of the Property listed or formally proposed for listing on the National Priority List promulgated pursuant to CERCLA or on any other Federal or state list of Hazardous Substance sites requiring investigation or cleanup.

v. No Storage Tanks: To the best of Seller's knowledge, there are no above-ground or underground tanks or any other underground storage facilities located on the Property.

i. Subdivision. The Land constitutes a separately subdivided, legally distinct parcel of land and Seller has complied with all applicable laws, ordinances, regulations, statutes, rules and restrictions pertaining to and affecting the Property which relate to such subdivision.

j. No Condemnation. There is no pending or, to the best of Seller's knowledge, threatened condemnation, expropriation, eminent domain, change in grade of public street or similar proceeding affecting all or any portion of the Property; Seller has received no written or oral notice of the same; and Seller has no knowledge that any such proceeding is contemplated.

k Covenants, Conditions, Restrictions or Easements. There is no default or breach by Seller nor, to the best of Seller's knowledge, any other party thereto, under any covenants, conditions, restrictions or easements which may affect the Property or any portion or portions thereof which are to be performed or complied with by the owner of the Property, and no condition or circumstance exists which, with the giving of notice or the passage of time, or both, would constitute a default or breach by Seller nor, to the best of Seller's knowledge, any other party thereto, under any such covenants, conditions, restrictions, rights-of-way or easements.

l. No Bankruptcy. Neither Seller, nor its general partner[s] (if Seller is a partnership), is party to any voluntary or involuntary proceedings in bankruptcy, reorganization or similar proceedings under the Federal bankruptcy laws or under any state laws relating to the protection of debtors, or subject to any general assignment for the benefit of the creditors, and, to the best of Seller's knowledge, no such action has been threatened.

m. Existing Lease. Except for the Existing Tenant under the Existing Lease, there are no tenants of the Property and no person or entity now has, or at the time of Closing will have, any possessory interest in the Property, under a lease or otherwise, except for Seller whose total interest in the Property will be transferred to Buyer at Closing. Seller has delivered to Buyer a true, correct and complete copy of the Existing Lease. To Seller's actual knowledge, (i) the information regarding the Existing Lease shown on EXHIBIT I is factually accurate and (ii) there are no material defaults or breaches on the part of the landlord under any Existing Lease.

n. Non-Foreign Status; Withholding. Seller is not a "foreign person" as that term is defined in the Internal Revenue Code of 1986, as amended and the Regulations promulgated pursuant thereto. Seller's sale of the Property is not subject to any Federal, state or local withholding obligation of Buyer under the tax laws applicable to Seller or the Property.

o. Restrictive Covenants: The Property is not part of a development that is subject to restrictive covenants or governed by a declarant or owner's association.

p. Service Contracts. Other than as set forth on EXHIBIT F, there are no Service Contracts affecting the Property. All Service Contracts at the Property are, or by

Closing will be, terminable upon thirty (30) or fewer days prior written notice to the service providers under the Service Contracts.

q. OFAC. Neither Seller nor, to Seller's actual knowledge, any individual having a beneficial interest in Seller is a Person described by Section 1 of the Executive Order (No. 13224) Blocking Property and Prohibiting Transactions with Persons Who Commit, Threaten to Commit, or Support Terrorism, 66 Fed. Reg. 49079 (September 25, 2001), and does not engage in any dealings or transactions, and is not otherwise associated with any such Persons.

r. Tax Appeals. There is no ongoing appeal with respect to taxes or special assessments on the Real Property for any year, and any consultants engaged to perform work with respect to appeals of taxes or special assessments on the Real Property have been paid in full.

s. Employees. Seller has no employees.

8.2 Survival. The foregoing representations are true, correct and complete, and the foregoing warranties are in full force and effect and binding on Seller, as of the date hereof, and shall be true and correct and in full force and effect, as the case may be, and deemed to have been reaffirmed and restated by Seller as of the date and time of the Closing, shall survive the Closing and shall not be deemed merged into any instrument of conveyance delivered at the Closing, and shall inure to the benefit of and be enforceable by Buyer, its successors and assigns.

9. Closing.

9.1 Closing Mechanics.

a. Time and Place. Provided that all of the conditions set forth in this Agreement are theretofore fully satisfied or performed, the Closing shall be conducted by escrow through the Title Insurer on the earlier of: (i) the date that is [redacted] days after the date upon which Buyer receives all Development Approvals or otherwise waives any Development Approvals yet to be obtained (the "**Outside Closing Date**"), or (ii) any date prior to the Outside Closing Date chosen by Buyer and set forth in a written notice from Buyer to Seller at least 7 days prior thereto (as applicable, the "**Closing Date**"), unless the Closing Date is postponed pursuant to the express terms of this Agreement or as otherwise agreed by Seller and Buyer in writing.

b. Closing Extensions. Notwithstanding the foregoing, Buyer shall have the right to extend the Outside Closing Date for up to 2 periods of [redacted] days each (each, a "**Closing Extension**"), by delivering the following on or before the then-current Closing Date: (i) notice to Seller of the Closing Extension; and (ii) an additional deposit to the Escrow Agent in the amount of $25,000.00 (each, an "**Extension Deposit**"). Each Extension Deposit shall be deemed part of the Earnest Money for all purposes hereunder.

9.2 Closing Deliverables. For and in consideration of, and as a condition precedent to Buyer's delivery to Seller of the Purchase Price, Seller shall obtain and deliver to Buyer at the Closing the following documents (all of which shall be duly executed, acknowledged, and witnessed, as applicable), which documents in Buyer agrees to execute where required:

a. Deed: a special warranty deed (the "**Deed**") conveying to Buyer all of Seller's right, title and interest in and to the Property, subject only to the Permitted Title Exceptions and such other matters as are permitted by Section 5 hereof;

b. General Assignment. The General Assignment;

c. Non-Foreign Certificate: a Certificate and Affidavit of Non-Foreign Status, in the form attached as EXHIBIT G hereto and by this reference made a part hereof;

d. Affidavit of Title: an affidavit of title, subject to any modifications required by the Title Insurer in order to issue its extended coverage owner's policy of title insurance without exception for mechanic's, materialmen's or other statutory liens, unrecorded easements or other rights of parties in possession;

e. Authority: such evidence as Title Insurer shall reasonably require as to the authority of the parties acting on behalf of Seller to enter into this Agreement and to discharge the obligations of Seller pursuant hereto;

f. Transfer Tax: a properly completed property transfer tax return or affidavit, if any, in form and substance appropriate to the jurisdiction in which the Property is located;

g. Reaffirmation of Representations and Warranties: a certificate of Seller, dated as of the Closing Date, reaffirming that all representations and warranties of Seller under this Agreement are true, correct and complete as of the Closing Date and that there has occurred no default or breach, nor any event which, with the giving of notice or the passage of time, or both, would constitute a default or breach by Seller under this Agreement;

h. Closing Statement: a closing statement setting forth the prorations, credits, debits, and disbursements to be made at the Closing in accordance with this Agreement; and

i. Further Documentation: such further instructions, documents and information as Buyer or Title Insurer may reasonably request as necessary to consummate the purchase and sale contemplated by this Agreement.

9.3 Costs. At the Closing:

a. Transfer Taxes: Seller shall pay any and all transfer taxes incident to the conveyance of title to the Property to Buyer;

b. Recording Costs: Buyer shall pay the cost of recording the Deed;

c. Title Exam and Premium: Buyer shall pay the costs of examination of title to the Property and owner's title insurance therefor;

d. Financing Costs: Buyer shall pay any mortgage recording or intangibles tax and all other taxes, costs, fees or expenses relating to Buyer's financing of the Property;

e. Survey: Buyer shall pay the cost of the Survey.

f. Escrow/Closing Fees: Any escrow/closing fees charged by the Title Insurer shall be shared equally by Seller and Buyer; and

g. Other Costs: Seller and Buyer shall pay their own respective costs incurred with respect to the consummation of the purchase and sale of the Property as contemplated herein, including, without limitation, attorneys' fees.

10. Default and Remedies.

10.1 Buyer's Default. If the Closing does not occur as a result of a default by Buyer under the terms of this Agreement, the Earnest Money shall be paid to Seller, and Seller shall be entitled, as its sole and exclusive remedy hereunder, to retain the Earnest Money as full liquidated damages for such default of Buyer, whereupon this Agreement shall terminate and the parties shall have no further rights or obligations hereunder, except for those which expressly survive any such termination. It is hereby agreed that Seller's damages in the event of a default by Buyer hereunder are uncertain and difficult to ascertain, and that the Earnest Money constitutes a reasonable liquidation of such damages and is intended not as a penalty, but as full liquidated damages. Seller hereby waives and covenants not to bring any action or suit, whether legal or equitable, against Buyer for damages or other redress in the event of Buyer's default hereunder.

10.2 Seller's Default. In the event of a default by Seller under the terms of this Agreement which is first discovered by Buyer prior to the Closing and is not cured by Seller as provided hereunder, Buyer's remedies hereunder shall be either to (a) terminate this Agreement, receive a refund of the Earnest Money, and seek any other remedies available to Buyer at law or in equity, or (b) seek specific performance of Seller's obligations under this Agreement.

10.3 Seller's Misrepresentation or Breach of Warranty. In the event that Buyer first discovers after the Closing that any representation, warranty or covenant contained herein was untrue or breached, as the case may be, as of the Closing

Date, or if Buyer chooses to enforce any surviving indemnification set forth herein, Buyer shall be entitled to all remedies provided for herein or otherwise available to Buyer at law or in equity.

11. Maintenance of Improvements and Operation of Property.

(a) Insurance. Seller agrees to keep its customary property insurance covering the Property in effect until the Closing (provided, however, that the terms of any such coverage maintained in blanket form may be modified as Seller deems necessary).

(b) Maintenance. Seller shall maintain all Improvements substantially in their present condition (ordinary wear and tear, casualty and condemnation excepted).

(c) Operation. Seller shall operate and manage the Property in a manner consistent with Seller's practices in effect prior to the Effective Date.

(d) Service Contracts.

(i) Notice of Assumption. No later than the Inspection Date, Buyer may advise Seller in writing which Service Contracts Buyer elects to assume, and Seller shall, at its sole cost and expense, terminate effective as of or prior to Closing all Service Contracts that Buyer does not so elect to assume.

(ii) Failure to Provide Notice. Buyer's failure to so advise Seller in writing shall be deemed to constitute Buyer's election to not assume any such Service Contracts.

(iii) Notices. Seller shall deliver at Closing notices of termination of all Service Contracts that are not so assumed and Seller shall be responsible for any charges applicable to periods commencing with the Closing.

(iv) Existing Management and Leasing Agreements. Seller shall terminate, effective as of or prior to Closing, all existing management and leasing agreements with respect to the Property.

(e) No New Encumbrances. From and after the Contract Date until the date and time of the Closing, Seller shall not convey any portion of the Property or any rights therein, or enter into any conveyance, security document, easement or other agreement, or amend any existing agreement, granting to any Person (other than Buyer) any rights with respect to the Property or any part thereof or any interest whatsoever therein, without Buyer's prior written consent.

(f) Existing Tenant Vacancy.

(i) Tenant Vacancy Condition. Seller covenants and agrees to cause the Tenant Vacancy Condition to be satisfied by the Closing Date, and will be responsible for all fees and costs (including any early termination fees payable to the Existing Tenant) in order to effectuate same.

(ii) Status of Tenant Vacancy Condition; Existing Tenant Estoppel. Seller will keep the Buyer reasonably apprised of the status of the Tenant Vacancy Condition upon Buyer's request. No later than 60 days prior to the Closing Date, and again no later than 30 days prior to the Closing Date, Seller shall deliver to Buyer an Existing Tenant Estoppel from the Existing Tenant confirming either that (i) the Tenant Vacancy Condition as to such Existing Tenant has been satisfied or (ii) the Tenant Vacancy Condition as to such Existing Tenant will be satisfied prior to the Closing Date.

(g) Removal of Items. Seller shall remove (or cause the removal of) all waste, trash, and tangible personal property (including, but not limited to, containers, dumpsters, and other equipment and materials related to current operations at the Property) from the Property prior to the Closing.

12. Casualty/Condemnation.

12.1. Casualty. In the event that prior to the Closing there is any damage to the Property, or any part thereof, Buyer shall accept the Property in its then condition, and proceed with the transaction contemplated by this Agreement and Buyer shall be entitled to an assignment of all of Seller's rights to any insurance proceeds payable by reason of such damage or destruction; provided that, to the extent that as a result of such casualty, a material health or safety issue results such that the applicable governmental authority requires commencement of repair prior to Closing, Seller shall commence such repairs (and the amount of insurance proceeds payable to Buyer shall be reduced by Seller's costs of such repairs). Seller shall not compromise, settle or adjust any claims to such proceeds without Buyer's prior written consent.

12.2 Material Condemnation. In the event of a Material Condemnation, Buyer may, at its option to be exercised within 5 Business Days after receipt of notice of the occurrence of the damage or the actual or threatened commencement of condemnation proceedings, either terminate this Agreement or consummate the purchase for the full Purchase Price as required by the terms hereof.

(a) Buyer Elects to Terminate. If Buyer elects to terminate this Agreement by delivering written notice thereof to Seller, then this Agreement shall terminate, the Earnest Money shall be returned to Buyer and neither party shall have any further rights or obligations hereunder, except for those which expressly survive any such termination.

(b) Buyer Does Not Elect to Terminate. If Buyer elects to proceed with the purchase or fails to give Seller notice within such 5 Business Day period that Buyer elects to terminate this Agreement, or Buyer is not entitled to terminate this Agreement because the condemnation or taking is not a Material Condemnation, then this Agreement shall remain in full force and effect.

12.3 Awards and Proceeds.

(a) Credit. Upon the Closing, if Buyer is not entitled to or elects not to terminate this Agreement pursuant to Section 12.1 and Section 12.2 above, there shall be a credit against the Purchase Price due hereunder equal to the amount of any insurance proceeds or condemnation awards collected by Seller as a result of any such damage or condemnation, plus the amount of any insurance deductible, less any reasonable sums expended by Seller toward the collection of such proceeds or awards or to restoration or repair of the Property (the nature of which restoration or repairs, but not the right of Seller to effect such restoration or repairs, shall be subject to the approval of Buyer, which approval shall not be unreasonably withheld, conditioned or delayed).

(b) Assignment. If the proceeds or awards have not been collected as of the Closing, then such proceeds or awards shall be assigned to Buyer, except to the extent needed to reimburse Seller for any reasonable sums expended to collect such proceeds or awards or to repair or restore the Property.

13. Assignment.

13.1 Assignment by Buyer. Buyer may assign any of Buyer's rights hereunder or any part thereof to any person, firm, partnership, corporation or other entity.

13.2 Assignment by Seller. From and after the Contract Date, Seller shall not, without the prior written consent of Buyer, which consent Buyer may withhold in its sole discretion, assign, transfer, convey, hypothecate or otherwise dispose of all or any part of its right, title and interest in the Property.

14. Buyer's Representation and Warranty. Buyer does hereby represent and warrant to Seller that (a) it is duly organized, validly existing and in good standing under the laws of the State of its formation; (b) it has all requisite authorizations to enter into this Agreement with Seller and to consummate the transactions contemplated hereby; (c) the parties executing this Agreement on behalf of Buyer are duly authorized to so do; and (d) neither Buyer nor, to Buyer's actual knowledge, any individual having a beneficial interest in Buyer is a Person described by Section 1 of the Executive Order (No. 13224) Blocking Property and Prohibiting Transactions with Persons Who Commit, Threaten to Commit, or Support Terrorism, 66 Fed. Reg. 49079 (September 25, 2001), and does not engage in any dealings or transactions, and is not otherwise associated with any such Persons.

15. Broker and Broker's Commission.

15.1 Commission. Seller shall pay to Broker a commission for this transaction pursuant to a separate commission agreement. Broker shall only be entitled to such commission if and when the transaction contemplated herein actually closes. Buyer shall have no responsibility for payment of any such commissions.

15.2 Indemnity. Buyer and Seller each warrant and represent to the other that, with the exception of Broker, such party has not and will not employ a real estate broker or agent in connection with the transaction contemplated hereby. Each party agrees to indemnify and hold the other harmless from any loss or cost suffered or incurred by it as a result of the other's representation herein being untrue.

16. Notices.

16.1 Form of Notice. Wherever any notice or other communication is required or permitted hereunder, such notice or other communication shall be in writing and shall be delivered by (a) hand, (b) nationally-recognized overnight express delivery service, or (c) e-mail of a letter in "pdf" format (provided that if the receiving Party has not acknowledged receipt thereof within one (1) Business Day after such delivery (which acknowledgement may be given by such party or its counsel via a "read receipt" or response via electronic mail), then the delivering party shall send a copy of such notice via method (a) or (b) above) to the addresses set out below or at such other addresses as are specified by written notice delivered in accordance herewith:

SELLER:

TSA Properties, LLC
96 Beacon Street
Chestnut Hill, MA 02467
[redacted]

With a copy to:

Marc Kornitsky, Esq.
Pabian & Russell LLC
One International Place, 8th Floor
Boston, MA 02108
[redacted]

BUYER:

c/o Wood Partners
91 Hartwell Avenue
Lexington, Massachusetts 02421
Attention: Jim Lambert
Phone No.: (781) 541-5822

Email: Jim.Lambert@woodpartners.com

With copies to:

c/o Wood Partners
636 W. Yale Street
Orlando, Florida 32804
Attention: Sean Reynolds
Telephone: (407) 982-2517
E-mail: sean.reynolds@woodpartners.com

And

Alston & Bird LLP
One Atlantic Center
1201 W. Peachtree Street
Atlanta, Georgia 30309
Attention: Drew Allen
Telephone: (404) 881-4522
E-mail: drew.allen@alston.com

16.2 Notice Received. Any notice or other communication sent as hereinabove provided shall be deemed received: (a) on the date of delivery, if delivered by hand or overnight express delivery service; (b) on the date indicated on the return receipt if mailed; or (c) on the date of transmission, if sent by electronic transfer device (provided that if the receiving Party did not acknowledge receipt thereof within one (1) Business Day after such delivery, then the delivering Party sent a copy of such notice via method (a) or (b) described in Section 16.1 above).

17. Governing Law. This Agreement shall be construed and interpreted under the laws of the Commonwealth in which the Land is located, without regard to any conflict of law principles that may call for the application of the laws of any other jurisdiction.

18. Construction. The parties agree that this Agreement is the result of negotiation by the parties, each of whom was represented by counsel, and thus, this Agreement shall not be construed against the maker thereof.

19. No Waiver. Neither the failure of either party to exercise any power given such party hereunder or to insist upon strict compliance by the other party with its obligations hereunder, nor any custom or practice of the parties at variance with the terms hereof shall constitute a waiver of either party's right to demand exact compliance with the terms hereof.

20. Entire Agreement. This Agreement and the documents incorporated herein by reference contain the entire agreement of the parties hereto with respect to the Property, and no representations, inducements, promises or agreements, oral or otherwise, between the

parties not embodied herein or incorporated herein by reference shall be of any force or effect.

21. Binding Effect. Subject to Section 13, this Agreement shall be binding upon and shall inure to the benefit of the parties hereto and their respective heirs, executors, administrators, legal representatives, successors and assigns.

22. Amendments. No amendment to this Agreement shall be binding on any of the parties hereto unless such amendment is in writing and is executed by the party against whom enforcement of such amendment is sought.

23. Possession. Possession of the Property shall be granted by Seller to Buyer no later than the Closing Date, subject to the Permitted Title Exceptions.

24. Date For Performance. If the time period or date by which any right, option or election provided under this Agreement must be exercised, or by which any act required hereunder must be performed, or by which the Closing must be held, expires on any day other than a Business Day, then such time period shall be automatically extended through 5:00 p.m. Boston, MA time on the next Business Day. To the extent the statute of frauds or any other legal doctrine requires that the consummation of the transactions contemplated under this Agreement occur within a certain time period, the parties agree that their respective obligations to consummate the Closing under this Agreement will terminate and be of no further force or effect on the date which is 5 years after the Inspection Date.

25. Recording. Seller and Buyer agree that they will not record this Agreement. Simultaneously with the execution of this Agreement, Seller shall execute and deliver to Buyer a short form memorandum of this Agreement in the form attached hereto as Exhibit H ("**Memorandum of Contract**"), which Buyer may countersign and record at any time thereafter.

26. Counterparts. This Agreement may be executed in any number of counterparts, each of which shall be deemed to be an original, but all of which, when taken together, shall constitute but one and the same instrument. This Agreement may be executed electronically (e.g., via DocuSign) and delivered by electronic mail transmission (via .pdf or similar format). An executed copy of this Agreement delivered by electronic mail transmission (via a .pdf or similar format) shall be deemed to be an original counterpart hereof for all purposes.

27. Severability. If any term or provision of this Agreement or the application thereof to any person or circumstance shall for any reason and to any extent be held to be invalid or unenforceable, then such term or provision shall be ignored, and to the maximum extent possible, this Agreement shall continue in full force and effect, but without giving effect to such term or provision.

28. Listings and Other Offers. During the pendency of this Agreement, Seller shall not list the Property with any broker or otherwise solicit or make or accept any offers to sell the Property, engage in any discussions or negotiations with any third party with respect to the sale or other disposition of the Property, or enter into any contracts or agreements (whether binding or not) regarding any disposition of the Property.

29. Survival. No representations, warranties, covenants or agreements of Seller or Buyer contained herein shall survive the Closing or the earlier termination of this Agreement, except as expressly provided in this Agreement. The representations, warranties, covenants and/or agreements of Seller and Buyer, as applicable, contained in following Sections or provisions shall survive (i) the Closing indefinitely unless a limited period of survival is established therefor: Section 4.2, Section 8.1, Section 14; Sections 16-23; and Sections 26-27; (ii) the earlier termination of this Agreement for a period of 1 year: Section 7.1(b); and (iii) the Closing or, as applicable, the earlier termination of this Agreement, indefinitely: Section 15.2.

30. COVID-19. Notwithstanding anything in this Agreement to the contrary, the deadlines specified this Agreement (including, without limitation, the Closing Date) shall be extended (subject to the terms and conditions of this Section) as is reasonably necessary, in the event either party hereto is prevented from, or delayed in, performing any material obligation hereunder as a direct result of any event occurring beyond the reasonable control of such party related to the coronavirus disease (COVID-19) ("**COVID-19**"), including, without limitation, an epidemic, a pandemic, the spread of COVID-19 or any related illness, any state of emergency, any governmental restrictions (including the suspension of postal or other services), and any delays in obtaining any necessary governmental approvals or permits beyond normal process times, regardless of whether the same was known by the party asserting such delay on or before the Contract Date (each a "**COVID-19 Delay**"). For purposes of clarity, COVID-19 Delays shall include delays caused by third parties (including, without limitation, Escrow Agent and government agencies), but do not include changes in economic or market conditions (including, without limitation, the unavailability of debt or equity). Without limiting the generality of the foregoing, the following circumstances shall constitute COVID-19 Delays: (i) the inability of Buyer, Escrow Agent, Buyer's lender(s) (if any), or Buyer's equity partner(s) (if any) to initiate or receive wire transfers, (ii) the closure of the clerk of county courts or other agencies necessary to record any closing documents (unless e-recording remains available), and (iii) the Title Insurer's unwillingness to issue a title insurance policy for the Property at the Closing that meets the requirements set forth in Section 7.4(b) (including, insuring over any "gap period") for any reason other than Buyer's failure to pay the title insurance premium.

In the event either party hereto asserts a COVID-19 Delay, such party shall provide written notice thereof (each a "**COVID-19 Notice**") to the other, which notice shall include a reasonable description and, if possible, estimated duration of the asserted COVID-19 Delay. Upon delivery of a COVID-19 Notice, all future deadlines for performance under this Agreement (the "**Tolled Deadlines**") shall be tolled until the party asserting such COVID-19 Delay delivers a Resumption Notice (defined below) (any such period being a "**Tolling Period**"). After providing a COVID-19 Notice, the notifying party shall throughout the pendency of such COVID-19 Delay, (i) utilize good faith efforts to minimize the impact and delays caused by such COVID-19 Delay, and (ii) keep the other party hereto reasonably apprised of the status of the COVID-19 Delay specified in the COVID-19 Notice, including, without limitation, updates regarding when the notifying party anticipates that it will be able to perform the obligations delayed by the COVID-19 Delay and a final notice to the other party promptly after the asserted COVID-19 Delay has ended (the "**Resumption Notice**"). Upon delivery of such a Resumption Notice, the Tolled Deadlines shall no longer be tolled, and the parties hereto shall perform their respective obligations under this Agreement, as the deadline(s) for such performance are extended by any applicable Tolling Period. By way of example and for informational purposes only, if the Closing Date is April 15, 2021, and Buyer delivers a COVID-19 Notice on March 20, 2021, with a corresponding Resumption Notice on March 30, 2021, then the Closing Date would automatically be extended to April 25, 2021.

If a party hereto asserts a COVID-19 Delay in a COVID-19 Notice, and such party does not deliver a Resumption Notice by the date that is one hundred and eighty (180) days after delivery of such COVID-19 Notice, the other party hereto may, at any time thereafter until receipt of such a Resumption Notice, terminate this Agreement by providing ten (10) days prior written notice thereof to the party that asserted such COVID-19 Delay, in which case, at the end of such ten (10) day period, (i) this Agreement shall terminate, (ii) the Earnest Money shall be immediately returned to Buyer, and (iii) neither party hereto shall have any further obligations or liabilities to the other party hereto, except to the extent the same expressly survive a termination of this Agreement; provided, however, that if the asserting party provides a Resumption Notice within such ten (10) day period, then such termination by the non-asserting party shall be deemed null and void, and the parties hereto shall perform their respective obligations under this Agreement, as the deadline(s) for such performance are extended by any applicable Tolling Period.

Notwithstanding the foregoing to the contrary, in no event may Seller claim or assert a COVID-19 Delay or be entitled to deliver a COVID-19 Notice with respect to its obligation to cause the Tenant Vacancy Condition to occur by Closing.

31. Attorney's fees. The prevailing party in any legal action brought to enforce the terms of this Agreement shall be entitled to court costs and reasonable attorney's fees from the non-prevailing party.

32. TAX FREE EXCHANGE. Seller and Buyer each shall have the option to structure the transaction as a "Tax Free Exchange" under Internal Revenue Code Section 1031. Each party agrees to cooperate with the other in connection with such tax free exchange, which shall be accomplished without expense or liability to the other party. Seller shall be responsible for the payment of all of Seller's income taxes, interest and penalties, if any, arising out of such tax free exchange. In addition, in no event shall such exchanging party's consummation of the Tax Free Exchange constitute a condition precedent to the exchanging party's obligations under this Agreement, and exchanging party's failure or

inability to consummate such Tax Free Exchange shall not be deemed to excuse or release the exchanging party from its obligations under this Agreement.

[signatures on following page]

IN WITNESS WHEREOF, each of the parties hereto has caused this Agreement to be executed by its authorized signatory, effective as of Contract Date.

SELLER:

TSA Properties, LLC, a Massachusetts limited liability company

Name: Timothy S. Allen
Title: Managing Member

BUYER:

WP EAST ACQUISITIONS, L.L.C., a Georgia limited liability company

____
Name: ______________________
Title: ______________________

IN WITNESS WHEREOF, each of the parties hereto has caused this Agreement to be executed by its authorized signatory, effective as of Contract Date.

SELLER:

TSA Properties, LLC, a Massachusetts limited liability company

____
Name: ________________________
Title: ________________________

BUYER:

WP EAST ACQUISITIONS, L.L.C., a Georgia limited liability company

____
Name: James Lambert
Title: Vice President

EXHIBIT A

DESCRIPTION OF LAND

That certain parcel of land with the improvements located thereon, situated at 1480 and 1490 Main Street, in the City of Waltham, County of Middlesex (South), and Commonwealth of Massachusetts and is more particularly described as follows:

Beginning at the most easterly corner of the premises at the southerly line of said Main Street at a nail found, thence;

S44°22'26"W, 283.63' by Two/Ten International Footwear Foundation and Charles and Andrea Bergeron to a stake and nail found, thence;

N66°44'49"W, 83.60' by Robinson/1432 Main Street Limited Partnership, thence;

N68°29'19"W, 194.13' by Robinson/1432 Main Street Limited Partnership to a drill hole found, thence;

N23°23'11"E, 220.07' by the centerline of a stonewall to a drill hole found, thence;

S78°14'49"E, 58.35' by Hayes Nominee Trust, thence;

S8I° 53'09"E, 6.88' by Hayes Nominee Trust, thence;

N44°22'26"E, 148.15' by Hayes Nominee Trust to the southerly sideline of Main Street, thence;

S45°37'43"E, 100.00' by the southerly sideline of Main Street, thence;

S44°22'26"W, 78.62' by Edward and Leslie Corris, thence;

S74°51'59"E, 47.65' by Edward and Leslie Corris, thence;

S72°28'09"E, 62.61' by Edward and Leslie Corris, thence;

S61°06'59"E, 45.19' by Edward and Leslie Corris, thence;

N44°22'26"E, 15.00' by Edward and Leslie Corris to an iron pipe found along the southerly sideline of Main Street, thence;

S45°37'43"E, 36.30' by the southerly sideline of Main Street, thence;

By a curve to the left with a radius of four hundred forty-nine and 50/100 (449.50), with a length of three and 70/100 (3.70) feet to the point of beginning.

Said Parcel contains a total of 93,645 square feet+/- (2.15 Acres+/-) and is shown as "New Lot 2A" on plan entitled Plan of Land by R.E. Cameron Associates, Scale: I" = 20', dated August 13, 2004 and recorded on Sept. 22, 2004 with the Middlesex County Registry of Deeds as Plan No. 1123 of 2004.

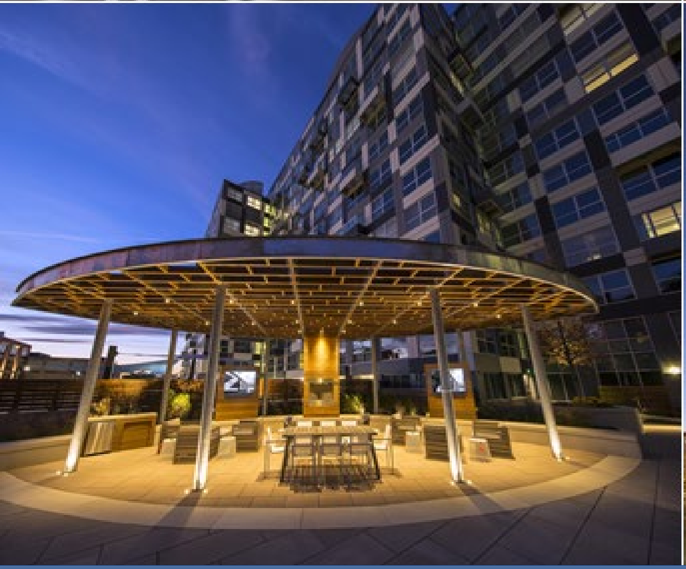
Subject to the following:

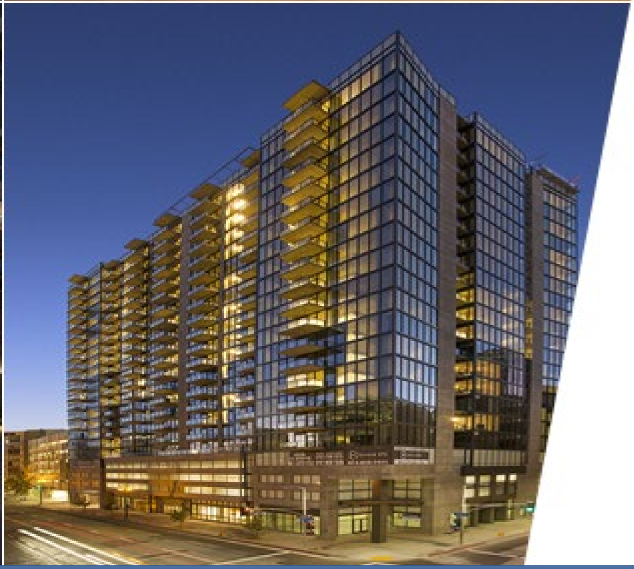
1. Easement to maintain water pipes set forth in deed dated Nov. 23, 1932, recorded in Book 5692, Page 204.

2. Rights of others in and to Lots C and D as shown on plan recorded in Plan Book 386, Plan 44 on Plan No. 238 of 1955.

BEING the same premises conveyed to TSA Properties, LLC by deed dated April 13, 2011 recorded with the Middlesex County South Registry of Deeds respectively in Book 56729, Page 296.

PROJECT TEAM





WOOD
PARTNERS

WOOD PARTNERS OVERVIEW

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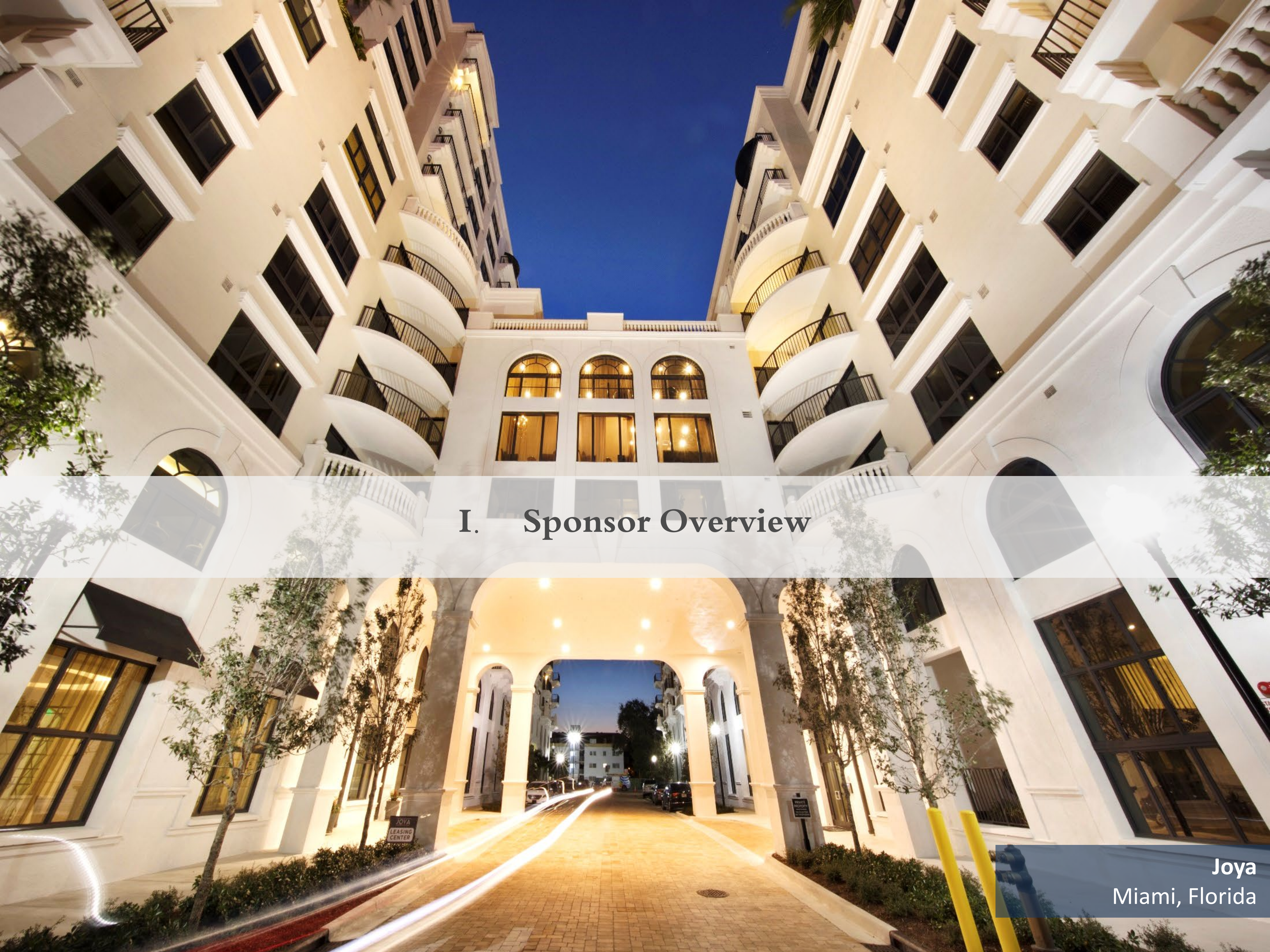
I. Sponsor Overview



Joya
Miami, Florida

Premier National Multifamily Operator/Developer Platform

$11.6B Total gross development of market rate multifamily since 1998	**$7.0B** Total gross development of market rate multifamily realized since 1998	**28% IRR** Realized gross aggregate IRR since 1998(1),(2),(3),(4)	**2.0x** Realized gross equity multiple since 1998(1),(2),(3),(4)	**63.8%** Average leverage since 1998(2),(3),(4) **59.9% since 2010**
680 Employees	**30+** Senior investment professionals	**18** Offices across the U.S.	**21** Year track record of multifamily investing and developing	**70,000+** Total market rate multifamily units acquired or developed since 1998

Note: Past performance is not indicative of future results

(1) Gross Returns are before investment management fees and promote but net of capitalized development and construction fees. Net Returns are available upon request
(2) Includes investments sold through September 30, 2019
(3) Nine projects developed before 2010 were capitalized with 100% construction loan and equity take out; return metrics assume a 25% equity investment at closing for these projects
(4) Metrics are for market rate multifamily developments only, and exclude for-sale, affordable, senior, or student housing investments

Established, Institutional U.S. Multifamily U.S. Operator

Local Expertise

- Localized "cradle-to-grave" approach
- Over 680 professionals in 18 offices operating in 19 states
- 32 partners with an average tenure of over 17 years in the industry and 8.6 years with Wood Partners

Proven Track Record

- 70,000+ market rate multifamily units with total capitalization of $12.6 billion developed and acquired nationwide
- Realized 148 market rate development rental investments totaling 41,000+ units generating a weighted average gross levered IRR and equity multiple of 28% and 2.0x, respectively(1),(2),(3),(4)

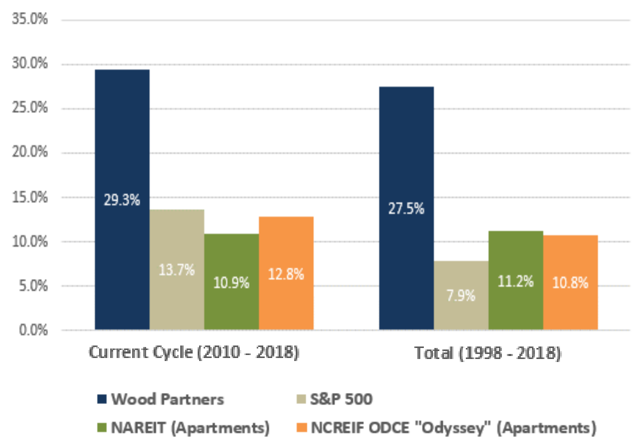
Vertical Integration

- Senior in-house construction team organized at local and regional levels with ability to operate as general contractor or construction manager
- Property and asset management teams focused on providing best-in-class service and execution

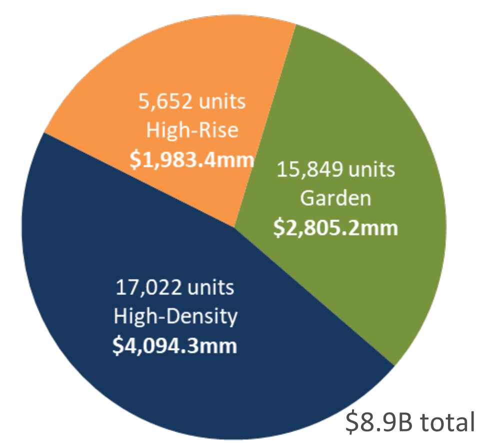
Market Rate Multifamily Since 1998

	Units	$Ms
Central (AZ, CO, IL, NV, TX, UT)	23,409	3,980.1
East (NC, SC, VA)	10,492	1,206.1
Mid-Atlantic (DC, MD, PA)	4,369	932.5
Northeast (CT, MA)	2,755	779.8
South (FL, GA, TN)	15,689	2,543.0
West (CA, OR, WA)	5,981	2,155.5
Acquisitions	7,552	966.6
Total	**70,247**	**$12,563.7**

Weighted Average Return (Gross Leveraged IRR)



Development by Product Type 2010 - 2018



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(4) Metrics are for market rate multifamily developments only, and exclude for-sale, affordable, senior, or student housing investments

History Of Smart Growth

- Wood Partners, founded in 1998 as an unaffiliated spin-out from Trammell Crow Residential, is a national multifamily company with a proven track record, industry-leading pipeline, and entrepreneurial culture
- Wood Partners develops, constructs and manages high-rise, high-density and garden style residential communities, striving to embody its mission of "Improving People's Lives by Creating Better Communities"
- From its initial three offices in Atlanta, Charlotte and Raleigh, the Company has steadily expanded to 18 offices, including 32 Partners with an average tenure with the Company of over 8.6 years
- Wood Partners is majority owned by its Directors with an LP investment from Fayez Sarofim and Co. ("Sarofim")

1998
Wood Partners Founded

2001
Expanded into Texas

2005
Expanded into West Coast

2008
Expanded into Northeast;
CBRE GI Makes Entity Level Investment

2010
Launched Property Management Business

2012
Top Ranked Multifamily Builder by MFE[1]

2014
Top Ranked Multifamily Development Company by CPE[2]

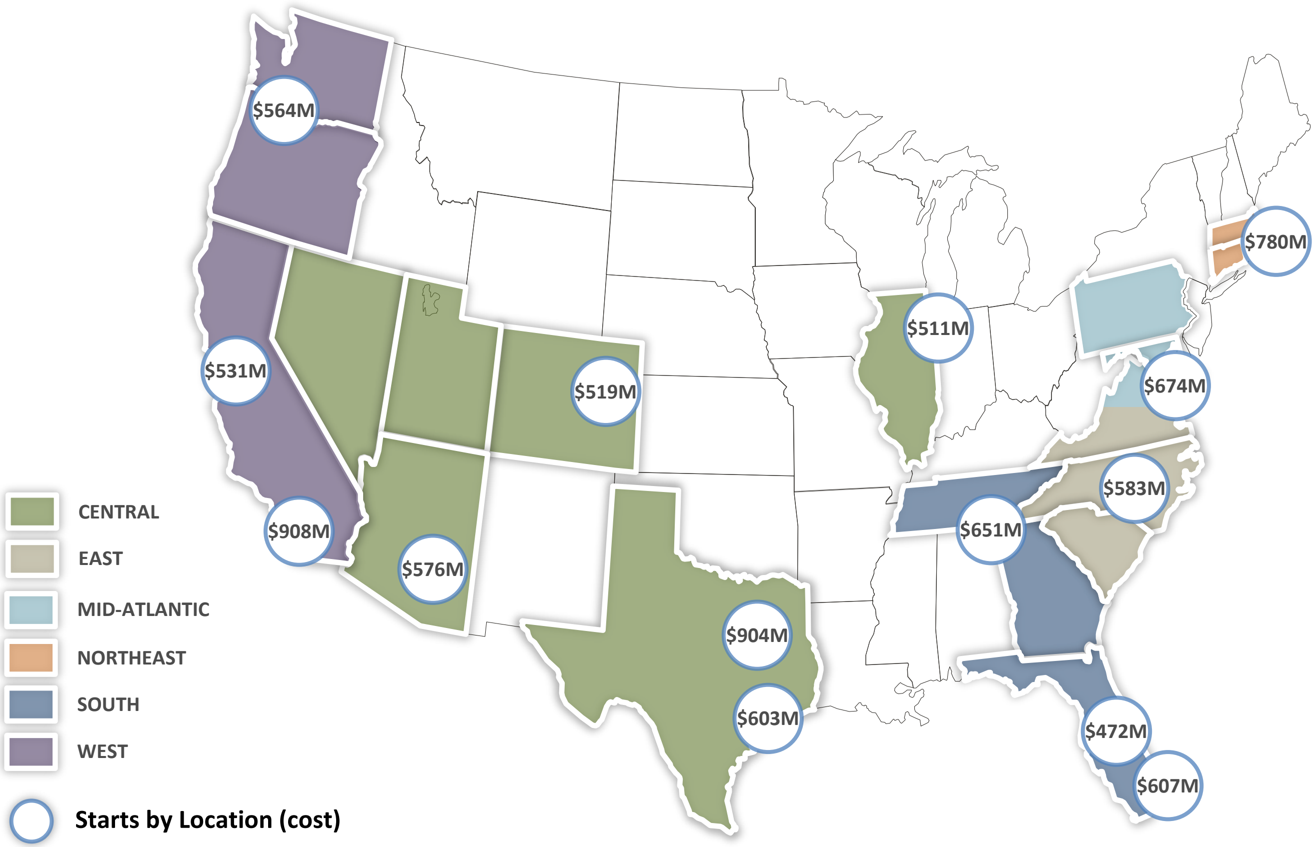
2017
Wood Partners Management Buys Back CBREGI Interest with Investment from Sarofim

2018
18th Office Opened in Nashville

(1) Multifamily Executive
(2) Commercial Property Executive

Current Cycle Industry–Leading Productivity (cont'd)

Wood Partners Has Started $8.9B Of New Development Nationwide Since 2010



Senior development and construction executives domiciled in every major US market

Current cycle, profitable round-trip (start, completion, lease-up and sale) experience in over 20 US markets

Physical, operational and realized economic scale is unmatched in multifamily development industry

Note: Seattle/Portland, Austin/Houston, Charlotte/Raleigh and Atlanta/Nashville offices combined for purposes of illustration

Vertically Integrated For Seamless, Local Execution

Development

- 38,000+ units and $8.9B in total development since 2010
- National footprint spanning 18 offices with "cradle to grave" localized development responsibility
- 49 development team members including 5 senior regional development directors supported by 17 local partners with 13 years average industry experience

Investment Management

- Dedicated asset management team maximizes results of on-site management teams
- In-house legal counsel and asset management team provide efficient best-in-class execution of dispositions
- Institutional quality accounting with approximately 20 CPAs and Big 4 audited financial statements annually since 2008 (with public company quality audit results)

Property Management

- Formed in 2010, Wood Residential Services ("WRS") and its team of 340 dedicated professionals now manages approximately 50 properties and 13,500+ units across the country
- Strong alignment and performance relative to third party options and extensive lease-up experience

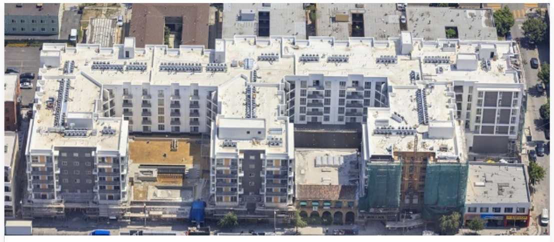
Construction

- Dedicated in-house general contractor and 3rd party construction management capabilities with flexibility to develop garden, high-density and high-rise product types
- Senior in-house team organized at local and regional levels managing over 220 construction professionals

Deep And Broad Multifamily Construction Expertise

Wood Partners Focuses Exclusively On Multifamily Development With Expertise In All Construction Types

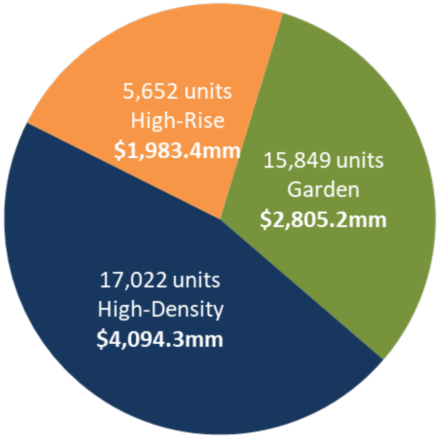
218 Units; Self-Perform; Surface Parked



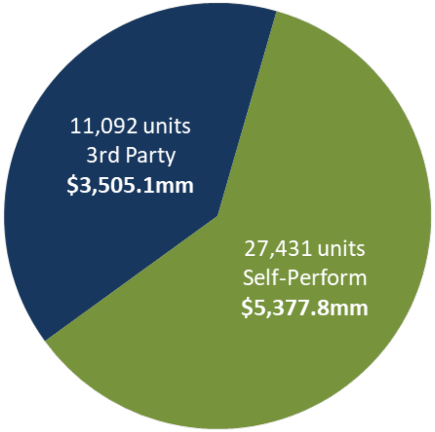
280 Units; Self-Perform; High-Density (Podium)

480 Units; 3rd Party; High-Rise

Development by Product Type 2010 - 2018



Construction Management 2010 - 2018



Owner–Operator Model Ensures Alignment

Owner-Operator model provides high degree of alignment third party options cannot match

Extensive boots-on-the-ground network in all active Wood markets

Wood property management frequently retained by institutional investors following sale of Wood's interest: PGIM, USAA, AIG, Crow Holdings

13,500+ Units under management	**70** New lease-ups managed during the last five years	**31%, 2.0x** Average IRR and MOC of 63 realized lease-ups since 2010
95% Properties managed that are owned and/or developed by Wood Partners	**3.9** Properties managed per regional manager [8-10 is typical for industry]	**25+** Average years experience of Wood Residential Services' senior executives

A Disciplined Approach To Risk Management

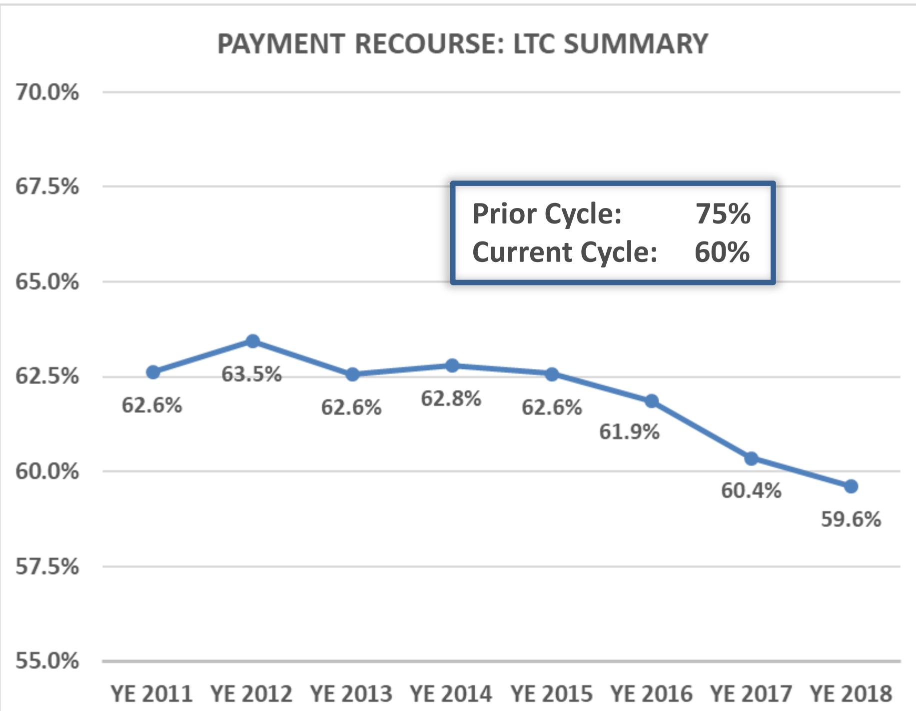
Wood Partners' Tremendous Growth Since 2010 Is Grounded In Discipline Shaped By the Great Recession

Challenge Faced	Wood Policy Change(s)	Impact
▪ Inability to recapitalize projects due to excessive leverage	▪ All recourse construction loans must size to a minimum 10% untrended yield on debt ▪ No recourse land loans	▪ Average loan-to-cost of 60% today vs. 75% in 2008
▪ Inability to recover invested pursuit in a changing market resulting in significant write-offs	▪ Bi-weekly institutional quality IC process primarily focused on managing pursuit risk and limiting spending based on financing and entitlement status	▪ Average outstanding pursuit balance of \$14M since 2014 while starting >\$1B per year ▪ Write-offs since 2011 <10% of pursuit spending
▪ Construction overruns resulting from "scope creep" or incomplete drawings and insufficient contingency	▪ 80% complete drawings per standardized checklist required prior to providing any cost guaranty	▪ Overruns limited to <1.0% of total costs since 2010
▪ Growth extending beyond areas of expertise	▪ Wood only pursues market-rate multifamily for rent opportunities	▪ Additional emphasis on best-in-class execution of core business
▪ Losing best-in-class talent as result of right-sizing overhead in downturn	▪ Retain working capital balance (cash + booked fees) >2.5x annual OH run-rate	▪ Sustained working capital balance of 2.5-3.0x even as company has grown

As A Result, Wood Partners Is Positioned To Be Opportunistic In All Market Conditions

An Industry–Leading Balance Sheet

Wood Partners sizes its recourse construction loans to a downside scenario, with a minimum pro forma debt yield of 10%, to maximize optionality at the end of the development period if in a declining market. The result is a best-in-class balance sheet for a private developer with a weighted-average loan-to-cost of approximately 60% on its loans with payment recourse.



<u>Where does the 10% debt yield come from?</u>

- Major multifamily research firms have reached a consensus of approximately a 10% peak to trough revenue loss across markets, this implies a loss of approximately 16% in NOI[1]
- A 10% debt yield allows for a permanent financing exit assuming a 15% decline in in-place pro-forma NOI sized with a 1.25 DSCR using a 5.5% interest rate and 30 year amortization

NOI Error Margin	Interest Rate	DSCR	Yield on Debt
15.00%	5.50%	1.25	10.02%

In-Place Yield	6.50%	6.25%	6.00%	5.75%	5.50%
Max LTC	64.9%	62.4%	59.9%	57.4%	54.9%

1) assuming a 38% expense ratio

II. Track Record

Belgard
Washington, DC

We Are Proud Of Our Blue–Chip List Of Capital Partners

Wood Partners finances its development production with project level capital from a number of institutional equity and lending relationships.

Since 2010, Wood Partners has raised over $4.0 billion in equity from a combination of high net worth, foreign, and institutional capital partners. In addition to its numerous equity partners, Wood Partners maintains active relationships with many banks and lending institutions across the country. Wood Partners has raised in excess of $6.5 billion of construction debt since 2010.

Equity	Debt
PGIM	JPMorgan
Goldman Sachs	PNC
The Carlyle Group	HSBC The world's local bank
MetLife	Comerica
Principal Real Estate Investors	Bank of America
Sumitomo	Santander
G I D	TD Bank
Northwestern Mutual	BMO Harris Bank
Eagle Realty Group A member of Western & Southern Financial Group	Fifth Third Bank
Diamond Realty Investments, Inc.	Citizens Bank

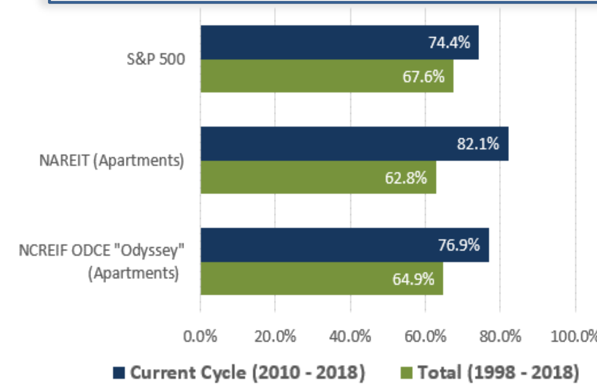
Impressive Track Record Of Outperformance

Proven Performance Exceeding Major Stock Market And Real Estate Industry Indices

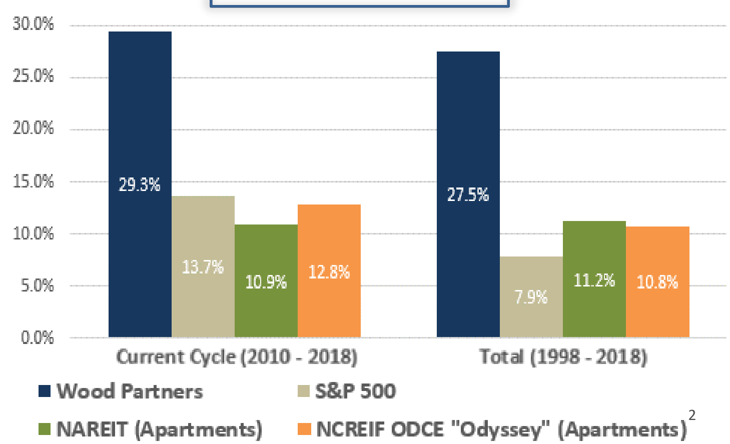
Realized Development Market Rate Transactions

- Current Cycle (2010 – 2018)
  - 78 projects, 20,000+ units, $5.8B sale volume
  - 29.3% gross leveraged IRR, 2.1x gross leveraged MOC, 11.1% value CAGR[1]
- Total (1998 – 2018)
  - 148 projects, 41,000+ units, $8.6B sale volume
  - 28% gross leveraged IRR, 2.0x gross leveraged MOC, 6.8% value CAGR[1]

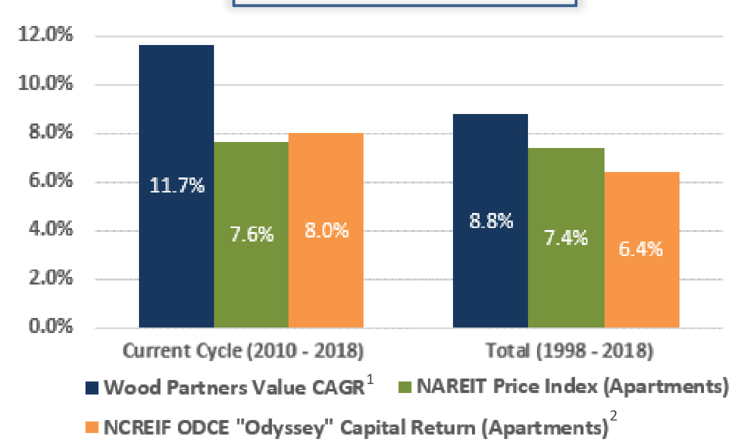
% of WP Deals that Outperformed Index by ≥ 500bps
(gross leveraged IRR)



Weighted Average Return
(gross leveraged IRR)



Investment Appreciation
(unleveraged, excludes cash flow)



(1) Value Compounded Annual Growth Rate (CAGR): Average annual growth rate of investment value. CAGR = (Sale Price/Cost)^(1/# of years) – 1
(2) NCREIF Open-End Diversified Core Equity (ODCE) Index tracks the historical and current performance of over 30 commingled institutionally-held funds (gross of fees)

III. Senior Leadership

Senior Management

Joe Keough

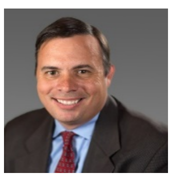
CEO and
Board Member

- Joined Wood Partners in 2008 as CFO, assuming role as CEO in January 2015
- Joe previously served as the COO of Fuqua Capital, with operational and strategic responsibility for the family office's investment strategy across asset classes with a focus on real estate and private equity
- Other previous roles include: SVP (Development and Investment Strategy) at Cousins Properties, a publicly traded REIT; Principal at The Boston Consulting Group
- Joe earned his MBA from Harvard Business School and received his bachelor's degree in finance and economics from Babson College

Patrick Trask

President and
Board Member

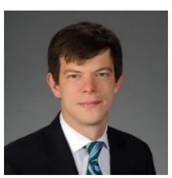
- As President, Patrick is currently responsible for overseeing the company's development and construction divisions and for developing new equity and debt capital relationships
- Prior to his role as President, Patrick served as Regional Development Director for Wood Partners' Central Region, which consists of Texas, Colorado, Arizona, Nevada and Chicago
- Patrick received an MBA degree at UNC's Kenan-Flagler Business School and earned a bachelor's degree in history from Davidson College



Sean Reynolds

COO and
General Counsel

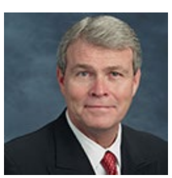
- As COO and General Counsel, Sean is responsible for overseeing the legal, risk management, HR and accounting functions of the company
- Prior to joining Wood Partners, as a partner with Alston & Bird, LLP and Morris, Manning and Martin, LLP previously, Sean represented Wood Partners in various capacities since the company's formation in 1998
- Sean received his JD and bachelor's degrees from the University of Georgia and his MBA from the University of Florida



Matt Trammell

CFO

- As CFO, Matt is responsible for overseeing the project and corporate finance functions as well as the company's asset management platform
- Before joining Wood Partners in 2008, Matt was a senior analyst with Novare Group
- Matt received his bachelor's degree in finance from Washington University in St. Louis and is a CFA Charterholder



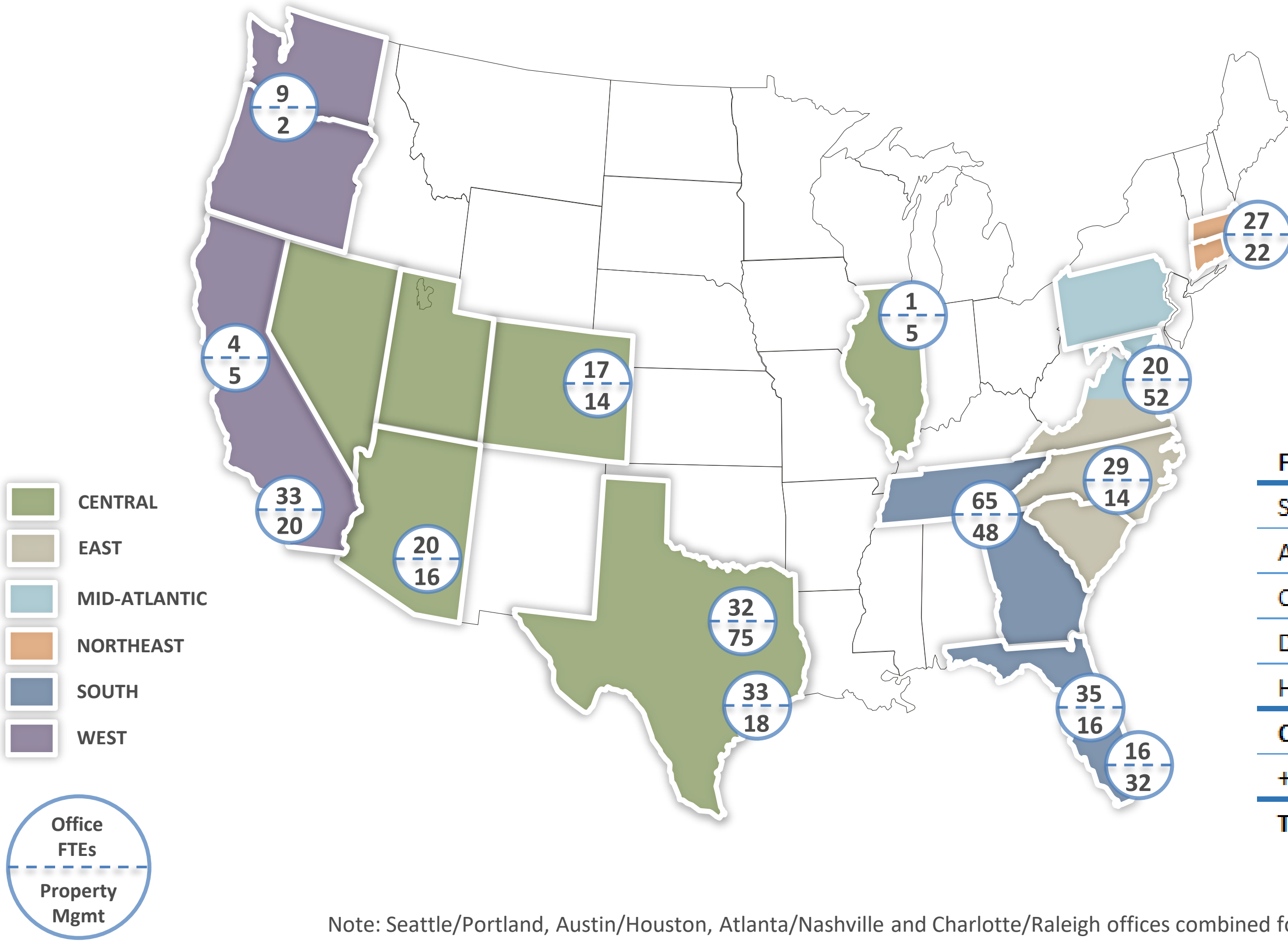
Steve Hallsey

Executive VP, WRS

- Joined Wood Partners in 2016 to oversee Wood Residential Services ("WRS"), Wood's property management platform with over 14,000 units under management
- Steve has over 30 years industry experience, including most recently serving as CEO of AMLI Management Company, a subsidiary of AMLI, from 2003 to 2016
- Steve is a graduate of and former defensive coordinator for the University of Utah

Industry–Leading National Scale

The Wood Team Spans 18 Offices And 680 Professionals



Function	Employees
Senior Management	5
Asset Management	6
Construction	227
Development	49
HR/IT/Acct/Admin	54
Office Staff Subtotal	**341**
+Property Management	339
Total Employees	**680**

Note: Seattle/Portland, Austin/Houston, Atlanta/Nashville and Charlotte/Raleigh offices combined for purposes of illustration

Jonquil
Smyrna, GA

V. Appendix

The Belgard
Washington D.C.

Sample Recent Transactions: New Business

Alta Union House

Product Type:	5-story wrap
Location:	Framingham, MA
Units:	196
Year Started:	2018
In Place Yield on Cost:	7.0%
Market Cap Rate:	4.5%
Leverage:	64%

Alta Purl

Product Type:	5-story wrap
Location:	Charlotte, NC
Units:	341
Year Started:	2018
In Place Yield on Cost:	6.4%
Market Cap Rate:	5.0%
Leverage:	60%

Alta Green Mountain

Product Type:	3-story garden
Location:	Lakewood, CO
Units:	360
Year Started:	2018
In Place Yield on Cost:	6.3%
Market Cap Rate:	4.8%
Leverage:	62%

Alta Woodson

Product Type:	7-story podium
Location:	Oakland, CA
Units:	140
Year Started:	2018
In Place Yield on Cost:	5.8%
Market Cap Rate:	4.3%
Leverage:	55%

Lake House by Alta

Product Type:	5-story wrap
Location:	Orlando, FL
Units:	299
Year Started:	2018
In Place Yield on Cost:	6.3%
Market Cap Rate:	4.8%
Leverage:	60%

Alta Brewer's Hill

Product Type:	8-story wrap
Location:	Baltimore, MD
Units:	371
Year Started:	2018
In Place Yield on Cost:	6.4%
Market Cap Rate:	4.8%
Leverage:	60%

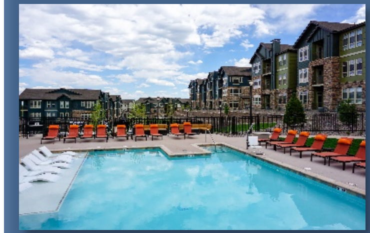
Sample Recent Transactions: Sold Properties

James River Loft at Stony Point

Product Type:	4-story garden
Location:	Richmond, VA
Units:	280
Year Started/Sold:	2016/2018
Total Cost:	$44.1mm
Sale Price:	$62mm
Leverage:	70%
Gross Levered IRR:	43%
Equity Multiple:	2.4x

Alta at Jonquil

Product Type:	5-story wrap
Location:	Atlanta, GA
Units:	266
Year Started/Sold:	2016/2018
Total Cost:	$50.9mm
Sale Price:	$64mm
Leverage:	63%
Gross Levered IRR:	30%
Equity Multiple:	1.7x



Alta Pinehurst

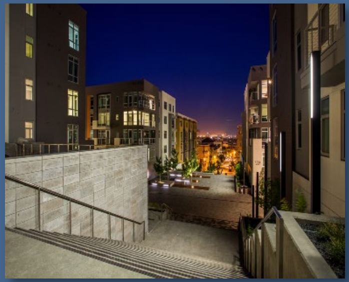
Product Type:	3-story garden
Location:	Lakewood, CO
Units:	350
Year Started/Sold:	2016/2018
Total Cost:	$76.5mm
Sale Price:	$105mm
Leverage:	65%
Gross Levered IRR:	31%
Equity Multiple:	2.0x

The Washingtons

Product Type:	4-story wrap
Location:	Boston, MA
Units:	182 (94 & 88)
Year Started/Sold:	2014-2015/2017
Total Cost:	$55.9mm
Sale Price:	$75mm
Leverage:	65%
Gross Levered IRR:	34%
Equity Multiple:	2.1x

Alta Steelyard Lofts

Product Type:	4-story garden
Location:	Phoenix, AZ
Units:	301
Year Started/Sold:	2014/2018
Total Cost:	$43.9mm
Sale Price:	$69.3mm
Leverage:	65%
Gross Levered IRR:	37%
Equity Multiple:	2.9x



Alchemy by Alta

Product Type:	6-story podium
Location:	San Francisco, CA
Units:	330
Year Started/Sold:	2013/2018
Total Cost:	$152.3mm
Sale Price:	$268mm
Leverage:	60%
Gross Levered IRR:	25%
Equity Multiple:	2.4x

Summary of Qualifications
Multi-Family/Residential

allenmajor.com

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FIRM QUALIFICATIONS

About A&M

Allen & Major Associates, Inc. (A&M) is a multi-disciplinary firm specializing in civil engineering, land surveying, environmental consulting, and landscape architecture. Established in 1973, A&M has three offices that provide services throughout the Northeast. The firm is overseen by Principals, Timothy J. Williams, PE, and Robert P. Clarke, PLA, ASLA.

The A&M team has extensive knowledge in planning, designing, and permitting throughout New England. We understand the need to have projects completed on time and on budget, while still maintaining a high level of quality to our clients. With over 40 dedicated engineers, landscape architects, land surveyors, and support specialists, our team brings a wide range of expertise that comes from decades of service and experience within the following industries:

- **Academic & Student Housing**
- **Commercial & Industrial**
- **Healthcare**
- **Hospitality & Entertainment**
- **Master Planning & Landscape Architecture**
- **Multi-Family Residential**
- **Public, Municipal & Government**
- **Retail & Mixed-Use**
- **Senior Housing & Assisted Living**
- **Sports & Recreation**

Our goal with each project is to provide you with technically sound advice and practical design solutions that go beyond your expectations without exceeding your budget. It is our commitment of offering consistent, responsive, and reliable service that has kept A&M in business for nearly five decades.

Civil Engineering

Allen & Major Associates, Inc. (A&M) offers civil engineering design and project management for site development and infrastructure projects within both the public and private sectors. We offer services for the built environment from conceptual design, to design development, through construction completion. At A&M, our goal is to provide our clients with a single source for all of their project design and development needs.

A&M's Civil Engineering Services include:

- **Construction Consultation**
- **Due Diligence & Feasibility Studies**
- **Federal, State & Local Permitting**
- **Grading & Drainage Design**
- **Master Planning**
- **Peer Review Services**
- **Parking & Roadway Design**
- **Septic Design**
- **Site Development & Re-Development**
- **Soil Evaluations**
- **Utility Design Services**

A&M's professional engineering team has the experience and capability to help our clients see their visions come to life. A&M strives to provide innovative and technically sound development solutions while preserving our role as environmental stewards. We are proud members of the U.S. Green Building Council and support sustainable construction, Best Management Practices, and renovation initiatives.

Environmental Consulting

Environmental services are crucial for the successful development of a project, while at the same time protecting our human and natural environment. A&M knows that environmental compliance can be the biggest challenge to any project and having a thorough and complete understanding of the ever changing regulations and requirements is the most valuable tool to a successful project. A&M applies an interdisciplinary team approach to the design of a project while stressing the avoidance and minimization of adverse impacts to the environment. This approach has allowed A&M to establish and maintain excellent working relationships with resource and permitting agencies, while also saving our clients critical time and money.

A&M's Environmental Consulting Services include:

- **Chapter 91 Applications**
- **FEMA Elevation Certificates and Letter of Map Amendments**
- **Local, State, and Federal Permitting**
- **Massachusetts Endangered Species Act (MESA) Filings**
- **Massachusetts Environmental Policy Act (MEPA) Filings**
- **Massachusetts Natural Heritage & Endangered Species (NHESP) Review**
- **National Pollutant Discharge Elimination Systems (NPDES) Filings**
- **Stormwater Pollution Prevention Plans (SWPPP)**
- **Wetland Replication Design**
- **Wetland Delineation**

Land Surveying

Allen & Major Associates, Inc. (A&M)'s Land Surveying Division offers comprehensive land surveying services to meet the needs of our various clients. With Land Surveyors licensed in Connecticut, Massachusetts, New Hampshire, and Rhode Island, five survey field crews, and in-house project managers and support specialists, our team has the resources available to effectively provide land surveying and consulting services to our clients for a successful project completion.

Our hands on approach to each project is what drives the success of A&M's Land Surveying Division and gives our clients the reassurance and guidance necessary to successfully begin their construction project, obtain project financing, or simply understand their property boundaries. We can assist you at each stage in the process, providing the following services to meet various project needs:

- **ALTA/NSPS Land Title Surveys**
- **As-Built Surveys**
- **AutoCAD Services**
- **Construction Layout**
- **Existing Conditions & Topographic Surveys**
- **FEMA Flood Certification**
- **Interior Building Survey for Fit-up or Expansion**
- **Property Line Surveys**
- **Roadway & Right-of-Way Surveys**
- **Site Planning**
- **Subdivision & Condominium Surveys**
- **Utility Location Surveys & Layout**
- **Zoning Board & Variance Support**

Landscape Architecture

Landscape architecture encompasses all elements of the design, restoration, and preservation of outdoor spaces. Our projects range from small urban parcels to large scale projects within both the public and private sectors. A&M integrates the power of the aesthetic with our civil engineering sensibilities giving us the ability to shape and reshape the physical environment to meet the ever changing needs of the communities in which we live.

While many projects that we undertake are strictly about landscape design, A&M's landscape architecture team applies its artistic and technical design standards to enhance almost all of the designs that A&M produces. By partnering our landscape architecture division with our civil engineering division we are able to provide planning, design, preservation, and rehabilitation of the natural and built environments within both urban and rural settings. Through our team approach, all of our projects are not only technically sound, but aesthetically beautiful.

A&M's Landscape Architecture Services include:

- **Accessible Design**
- **Athletic Field Design**
- **Healing Gardens**
- **Multi-Modal Transportation**
- **Native Plant Landscapes**
- **Neighborhood Development & Planning**
- **Pedestrian Connectivity**
- **Rain Gardens & Bioretention**
- **Site Planning**
- **Streetscape Design**
- **Sustainable/Native Landscape Design**
- **Wetland Replication & Mitigation**

Why A&M?

Why choose the A&M team for your next project?

With nearly five decades of industry experience throughout New England, A&M employs a team of professionals with a proven level of expertise that our clients can trust. This is demonstrated through the number of high-profile clients, public agencies, and small businesses that have repeatedly entrusted the A&M team to handle their project needs.

Commitment to Quality

We understand that each project is unique. That's why we approach every site knowing that one design does not fit all. With each project we will provide technical expertise, creative planning, and innovative design solutions to meet your specific needs. We pride ourselves in our ability to take your vision and bring it to life with a design that goes beyond your expectations.

Exceptional Service

We focus on the details, both large and small, so that you don't have to. Whether we are the lead engineer or providing consultant services, our team of professionals is here to assist in the overall success of your project. What does that mean for you? We will coordinate directly with the development team, regulatory agencies, and others as necessary to ensure all design elements remain on-track for the approval and completion of your project; taking the guess work out of the next steps in the process.

REPRESENTATIVE PROJECTS

Project Profile

PROJECT STATS

Wood Partners

Multi-Family Residential

261 Units/SF

Completed in 2020

ALTA Clara at the Fells

Stoneham, MA

Allen & Major Associates, Inc. provided land survey, civil engineering and landscape architecture design and construction support for this multi-family development located adjacent to the Middlesex Fells Reservation. The project included the following:

- Three (3) buildings, 261 total units, a club house, and 6 garages.
- All runoff from the site is captured and treated by structural Best Management Practices (BMPs) including two (2) underground infiltration systems with a combined storage capacity of 63k c.f.
- Permitting began back in 2010 but did not move forward until 2016. The project was sold and value engineered over the following 2 years until a shovel was finally put in the ground around May of 2018 and completed in the fall of 2020.
- Landscape elements included:
  - » Zero entrance pool, with associated cabana outbuilding featuring gas grills, outdoor kitchen area & restrooms
  - » Extensive hardscape including undulating stacked stone walls, stamped and stained concrete, and pavers for visual texture
  - » Firepit lounge area for extending the seasons
  - » Full variety of site furnishings
  - » Dog park area for pet friendly community
  - » Extensive plantings including trees, evergreens, and native perennials, raised planters, and earthen berms for noise reduction
  - » Walking paths including connection to hiking trails in the Middlesex Fells Reservation

Project Profile

PROJECT STATS

Fairfield Residential

Multi-Family/Residential

298 Units
65,609 SF

Completed in 2018

Mave Apartments

Stoneham, Massachusetts

Allen & Major Associates, Inc. in partnership with Fairfield Residential has provided full site design, engineering, land survey, local permitting, and construction services for this multi-family residential project in both Stoneham and Winchester, Massachusetts.

- Known as the former A.W. Chesterton site, the 16 acre parcel consisted of wooded uplands, wooded wetland pockets, ledge outcrops, crumbling pavement areas, and a vacant 65,609± SF building.
- The site redevelopment consists of two 4-story residential buildings containing a total of 298 housing units, a four-level parking garage providing approximately 337 parking spaces, at-grade site parking for approximately 206 spaces, and a planted earthen berm for buffering to the adjacent neighborhood.
- A&M designed a stormwater management system which was an enhancement over the limited stormwater systems in place which allowed unmitigated stormwater to discharge to the existing woods and wetlands.
- The proposed stormwater systems reduced peak flows, promote stormwater infiltration, and provided improved treatment of stormwater quality that is a benefit to the site and adjacent wetland resources. Additional site improvements include the creation of additional wetland resource areas on-site. Through a coordinated team approach, the project is an example of how thoughtful site design and planning can allow for productive re-use of a site.

Project Profile

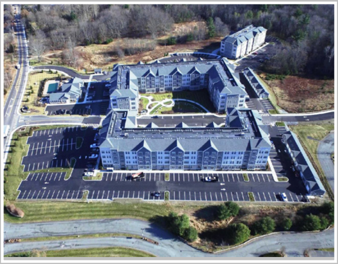
PROJECT STATS

Wood Partners

Multi-Family/Residential
40B Development

20 Acres
280 Units

Completed in 2018



The Westerly at Forge Park

Franklin, Massachusetts

In partnership with Wood Partners and CUBE 3 Studio, Allen & Major Associates, Inc. provided land surveying and civil engineering services for this 280-unit multi-family development situated in Franklin, Massachusetts The overall project consists of three 4-story buildings with 457 parking spaces, two parking garages, a bus shelter, a clubhouse, and a children's play area.

- Stormwater solutions consisted of eight separate underground infiltration chamber systems, porous pavement sections, grass pavers and porous concrete pavers. The hardscape also served as an aesthetic feature within the landscape.
- Permits successfully acquired for this project include a Comprehensive Permit by the Zoning Board of Appeals, Notice of Intent by the Conservation Commission, MassDOT Access Permit, and a General Construction Permit.
- A&M worked with the Franklin Historical commission to provide an assessment of an on-site deteriorated structures relative to the rich history of Franklin and its place in the life of Benjamin Franklin. While the structure could not be salvaged, the design team worked with the Town to provide a historical monument and granite bounded landscaping that will continue to identify the significance of the property in the history of the Town. The marker is a collaborative design exercise between the Historical Commission, the Building Inspector, the owner and the project team.

Project Profile

PROJECT STATS

Wood Partners

Multi-Family/Residential

182 Units

Completed in 2016

The Washingtons (2 & 37/47)

Melrose, Massachusetts

Allen & Major Associates, Inc., in partnership with Wood Partners, provided land surveying, engineering design, and permitting services for the luxury apartment community featuring one-, two- and three-bedroom residences across two new buildings located steps from the Oak Grove MBTA Orange Line station in Melrose, Massachusetts.

- 2 Washington Street was completed in 2015, is comprised of 94 residences, and features ground-floor retail space home to a physical therapy facility. Across the street at 37/47 Washington Street, completed in 2016, are 88 residences.
- A total of 17 residences at The Washingtons are designated affordable, including nine at 2 Washington Street and eight at 37/47 Washington Street.
- Amenities include a 24-hour fitness center, a communal roof deck with sweeping views, a club room featuring a genius bar, outdoor grills, a fire pit, a pool and on-site parking.
- The Washingtons is located just three train stations from Assembly Row and six stations from Downtown Boston, as well as a short drive from Interstate 93, Downtown Boston, Cambridge and Burlington.

Project Profile

PROJECT STATS

Fulcrum Associates, Inc.

Multi-Family/Residential

210 Units

Completed in 2016

Tidewater at Salisbury

Salisbury, Massachusetts

Allen & Major Associates, Inc., in partnership with Fulcrum Associates, Inc., provided land surveying, civil engineering, and structural engineering services for the Tidewater at Salisbury development, situated on an abandoned go-cart track in Salisbury, MA.

- The development features 4-residential buildings with a total of 210-units, a clubhouse, and an in-ground pool.
- Each building consists of 3-wood framed floors supported by a steel and concrete framed first floor "podium" over a below-grade parking garage.
- The foundations for the buildings, pool, and site structures feature conventional reinforced concrete elements supported by grouted and ungrouted ram aggregate piers drilled through the unsuitable soils.
- Civil site design and permitting included a Fill Permit Application with the Salisbury Board of Selectman, MassDOT State Highway Access Permit Application, and a National Pollution Discharge Elimination Systems Construction General Permit.
- A&M provided construction administration services throughout the duration of the project.

Project Profile

PROJECT STATS

Greystar

Multi-Family
& Mixed-Use

282 Units
5.29 Acres

Completed in 2019

Elan Union Market

Watertown, Massachusetts

Allen & Major Associates, Inc., in partnership with Greystar, provided land surveying, environmental consulting, and civil engineering services for Elan Union Market, a mixed-use development situated at the corner of Arsenal and Irving Streets in Watertown, MA.

- Elan Union Market continues the redevelopment of the Arsenal Street corridor and brings increased housing types and affordable housing to Watertown.
- The site features 282 apartment units, 11,000 SF of resident amenity space, 11,000 SF of retail space, and 465 parking spaces. The two buildings on-site are attached by an elegant, elevated glass walkway.
- Site amenities include clubrooms, a pool, gym, and plenty of open space throughout the site. Running along the complex is a new sidewalk and a 10-foot wide bicycle path, helping to link the Community Path to Watertown Square.
- Vehicle access into the site is provided via two drive aisles on Arsenal street, one of which is a signalized access drive, as well as access from Irving Street, which serves the west garage only.

Project Profile

PROJECT STATS

Wood Partners

Multi-Family/Residential

5.3 Acres
186 Units

Completed in 2014

Everly Apartments
Wakefield, Massachusetts

Allen & Major Associates, Inc., in partnership with Wood Partners and CUBE 3 Studio, providing land surveying, environmental consulting, civil engineering, and landscape architectural services for the redevelopment of a former industrial site into a 186-unit, multi-family development situated just off Exit 42 of I-95/Route 128 in Wakefield, Massachusetts.

- Site constraints included substantial wetland resource areas which profoundly minimized the development area. In order to meet the client's vision and avoid major impacts to the resource areas and the floodplain, the site was graded to elevate the building area using segmental block retaining walls. This allowed the wetlands, which surrounded the development area, to remain unaltered. While this approach allowed for creative wetland mitigation, it did not allow any room for stormwater detention, which was solved by instalingl a subsurface infiltration system below the ground level of the parking garage.
- The limited development area also restricted snow storage options. The problem was solved by installing a snow melt system below the access driveways to the parking garage. This technology, though seldom used for this type of project, was an ideal solution.
- The combination of this project's unique and innovative site design, coupled with its modern architecture and inviting landscape features, makes this project a welcome addition to the community.

Project Profile

PROJECT STATS

JPI

Multi-Family/Residential

244 Units

Completed in 2017

Paddock Estates at Boxborough

Boxborough, Massachusetts

Allen & Major Associates, Inc., in partnership with JPI and Sheskey Architects, provided civil engineering and landscape architectural services for Paddock Estates at Boxborough, formerly known as the Jefferson at Beaver Brook, in Boxborough, Massachusetts.

- The project features 11 buildings with 244 multi-family units, a clubhouse, pool, and numerous site amenities for residents, with on-site surface and covered parking.
- A&M's civil engineering division provided the design services for all site improvements, grading and drainage, and stormwater management. The design also features a fire pump house and pond, an on-site wastewater treatment plant, and a water treatment plant for on-site wells.
- Landscape architectural design amenities around the clubhouse include a heated pool, cabana with outdoor showers, and an outdoor bar. Nearby are a barbeque and dining area with a wooden pergola. Active recreational amenities include a basketball court, multiple fire pits, children's playground, winding walking paths connecting the campus, a dog park, and bocce court.
- Plantings throughout the site were carefully selected and placed to enhance the setting.

Project Profile

PROJECT STATS

Simpson Housing, LLLP
Heitman, LLC

Urban Revitalization
Multi-Family & Mixed-Use

286-Units with 17,000 SF of Retail on Ground Level

Completed in 2014

The Victor by Windsor

Boston, Massachusetts

Allen & Major Associates, Inc. (A&M) provided land surveying and civil engineering services as part of an urban revitalization project within the Bulfinch Triangle area of Boston, Massachusetts.

- Located on Beverly Street, The Victor boasts 286 apartments, including 56 penthouse apartments and 17,000 SF of retail space.
- The parcel was formerly occupied by the elevated portion of the Central Artery (I-93).
    - As part of the Boston Big Dig Project, the Central Artery was relocated into a tunnel under the subject parcel and runs parallel with the existing tunnel of the MBTA Green Line, with The Victor straddling both tunnels.
- A&M's Civil Division coordinated the relocation of a 30-inch water main operated by the Boston Water & Sewer Commission, which served as part of the main transmission system for portions of Boston.
- Design components included sidewalk and lighting improvements and site infrastructure engineering for ADA accessibility, sewer collection systems, and telecommunications layout.
- Land survey services included the preparation of existing conditions and easement plans to allow the proposed building to bear on the newly constructed Central Artery Tunnel, as well as layout for footings and foundation walls of the proposed building, and layout for site utilities, as well as the preparation of final as-built plans.

TEAM BIOS

ALLEN & MAJOR ASSOCIATES, INC.

Timothy J. Williams, PE

Principal

100 Commerce Way
Woburn, MA 01801

(781) 305-9416

(781) 589-0363

twilliams@allenmajor.com

EXPERIENCE

A&M - 15 Years
Overall - 30 Years

EDUCATION

1993, B.S., Civil Engineering, Central Connectict State University

REGISTRATIONS

Professional Engineer —
CT (PEN.0021386)
ME (PE14158)
MA (43119)
NH (12916)

Team Role: Principal-in-Charge

Tim Williams serves as a Principal at Allen & Major Associates, Inc. With over 30 years of experience, his extensive background includes planning, design, permitting, and construction document preparation for numerous public and private sector projects. His background also includes specification writing, quantity cost estimation, field studies and investigations, and analysis, as well as construction oversight services. Recognized for his expertise and ability, Tim has managed the design efforts for some of the largest and most significant projects within the firm's history. Throughout the duration of each project, Tim will be responsible for the overall delivery of professional service provided by Allen & Major Associates, Inc. He will provide support to the A&M team, oversee quality control on all deliverables to the development team, and will represent the project team at any meetings as requested.

PROJECT EXPERIENCE

Residential

- Everly Apartments - Wakefield, MA
- Mave Apartments - Stoneham, MA
- Residences on the Charles - Watertown, MA

Commercial

- Legacy Place - Dedham, MA
- Woburn Foreign Motors - Woburn, MA
- Woburn Landing - Woburn, MA

Institutional

- Brightview at Canton - Canton, MA
- Lahey Hospital & Medical Center - Burlington, MA
- Winchester Hospital - Winchester, MA

Public/Municipal

- Boston Planning & Development Agency
- Cambridge Housing Authority
- Department of Conservation & Recreation
- Department of Housing & Community Development

Specialty

- Logan ConRAC - Boston, MA
- MGM Springfield - Springfield, MA

10 Main Street
Lakeville, MA 02347

(508) 923-1010 Ext. 3730

(508) 509-5222

pcordeiro@allenmajor.com

EXPERIENCE

A&M - 19 Years
Overall - 19 Years

EDUCATION

2000, B.S., Civil Engineering, University of Massachusetts, Dartmouth

REGISTRATIONS

Professional Engineer —
CT (PEN.0026532)
MA (47083)
PA (PE083852)
RI (PE.0008972)

Certifications —
MA Soil Evaluator (SE2786)
MA Title 5 System Inspector (SI4419)

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Philip L. Cordeiro, PE

Lakeville Branch Manager

Team Role: Project Manager

Philip (Phil) Cordeiro serves as a Senior Civil Project Manager at Allen & Major Associates, Inc. He has a wide range of project experience in municipal, residential, corporate, industrial, and retail development. Phil's diverse background in civil engineering includes site engineering, drainage design, hydrology and hydraulic analysis, water resources, stormwater and sewer design. This provides a full range of civil engineering knowledge and expertise within the design process. Phil has indispensable hands on field experience, having managed construction administration tasks for many projects to date and because of this is able to anticipate and work through site challenges.

PROJECT EXPERIENCE

Residential

- Ashland Rail Transit Residential Development - Ashland, MA
- Blueberry Estates - Lakeville, MA
- Fruit Sever Apartments - Worcester, MA
- Noquochoke Village - Westport, MA
- Residences at the Hendries Building - Milton, MA
- The Oasis at Plymouth - Plymouth, MA
- The Westerly at Village Forge - Franklin, MA

Commercial/Mixed-Use

- BJ's Regional Distribution Center - Uxbridge, MA
- The Center at Innovation Drive - Tewksbury, MA
- The Chocolate Factory - Mansfield, MA
- The Point - Littleton, MA

Senior Living/Healthcare

- All American Assisted Living - Wareham, MA
- Oak Point - Middleborough, MA

Public/Municipal

- Office of the Massachusetts Attorney General - Various Locations
- Peer Review Services - East & West Bridgewater, MA

Specialty

- AbbVie Bioresearch Center - Worcester, MA
- Thayer Sports Center - Braintree, MA
- Wellesley Country Club - Wellesley, MA
- Wellesley Sports Center - Wellesley, MA

10 Main Street
Lakeville, MA 02347

(508) 923-1010 Ext. 3735

(781) 457-7987

pmatos@allenmajor.com

EXPERIENCE

A&M - 5 Years
Overall - 23 Years

EDUCATION

1996, B.S., Civil Engineering, University of Massachusetts, Dartmouth

2018, Professional Land Surveying Certificate Program, Wentworth Institute of Technology

REGISTRATIONS

Professional Engineer —

MA (52850)
NH (15103)
RI (PE.0011939)

Professional Land Surveyor

MA (55454)

Certifications —

MA Soil Evaluator (SE1511)
MA Title 5 System Inspector (SI3733)

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ALLEN & MAJOR ASSOCIATES, INC.

Paul G. Matos, PE, PLS

Project Manager

Team Role: Project Manager

Paul Matos serves as a Project Manager within the Civil Engineering Division at Allen & Major Associates, Inc. Paul's extensive experience includes conducting zoning analysis and preparation of site development plans to include layout, erosion control, drainage, grading, and utilities. Paul's sustainable approach to drainage analysis, and the subsequent design of stormwater management systems, makes him a valuable member of the development team. Additionally, Paul provides construction administration services, which includes shop drawing approvals, pay requisitions, and preparation of responses to RFI's. He conducts site inspections to observe and verify conformance with the approved plans and specifications. Paul is responsible for preparing various reports, such as feasibility, drainage, impact statements, and SWPPP, applications, letters, construction documents, specifications, cost estimates, quantity takeoffs, and client proposals.

PROJECT EXPERIENCE

Residential

- Alta Union House - Framingham, MA
- Noquochoke Village - Westport, MA
- The Oasis at Plymouth - Plymouth, MA
- The Westerly at Village Forge - Franklin, MA

Commercial/Mixed-Use

- Fairfield Inn - Plymouth, MA
- Homewood Suites - Needham, MA
- Smithfield Plaza - Smithfield, RI
- Southcoast Market Place - Fall River, MA
- The Chocolate Factory - Mansfield, MA

Senior Living/Healthcare

- All American Assisted Living - Wareham, MA

Public/Municipal

- Herring Cove Beach - Provincetown, MA
- Muddy Brook Wildlife Management Area - Hardwick, MA

Specialty

- BASF Facility - Plainville, MA
- Boston Scientific - Conventry, RI
- Thayer Sports Center - Braintree, MA
- Wellesley Sports Center - Wellesley, MA

Additional Experience

Allen & Major Associates, Inc. (A&M)'s recent multi-family and residential experience also includes:

• 135 Wells Avenue – Newton, MA	300 Units
• 35 Rosebrook – Wareham, MA	65 Units
• 75 Armory Avenue – Jamaica Plain, MA	39 Units
• Broadstone Bare Cove – Hingham, MA	244 Units
• Cranberry Manor – Wareham, MA	64 Units
• Cushing Village – Belmont, MA	142 Units
• Elan Union Market Apartments – Watertown, MA	146 Units
• Everly Apartments – Wakefield, MA	186 Units
• Granite Knoll Condominiums – Wakefield, MA	34 Units
• Harvard Mills – Wakefield, MA	184 Units
• Independence Place – Cranston, RI	196 Units
• Jack Flats – Melrose, MA	273 Units
• Jackson Gardens – Cambridge, MA	45 Units
• L.B. Johnson Apartments – Cambridge, MA	117 Units
• Langwood Commons – Stoneham, MA	550 Units
• Lincoln Way – Cambridge, MA	59 Units
• Lumiere Apartments – Medford, MA	163 Units
• Mallory Ridge Apartment Homes – Bloomfield, CT	78 Units
• Modera Natick Center – Natick, MA	150 Units
• Noquochoke Village – Westport, MA	50 Units
• Princeton at Westford – Westford, MA	250 Units
• Quinn 35 – Shrewsbury, MA	250 Units
• Riverbend on the Charles – Watertown, MA	170 Units

Additional Experience

Rolling Green – Andover, MA	224 Units
Rumney Flats – Revere, MA	147 Units
Salem Place Condominium – Woburn, MA	100 Units
Shadowbrook Condominium – Milford, MA	360 Units
Sphere Luxury Apartments – Medford, MA	42 Units
Stonegate Condominium – Stoneham, MA	11 Units
Summit Village – Reading, MA	132 Units
Talia Apartments – Marlborough, MA	225 Units
Taj Estates – Stoughton, MA	180 Units
The Aberdeen – Brighton, MA	40 Units
The Commons at Walpole Station – Walpole, MA	192 Units
The Chocolate Factory – Mansfield, MA	130 Units
The Exchange Street Apartments – Malden, MA	210 Units
The Meadows at Marlborough – Marlborough, MA	290 Units
The Melnea Residences Apartments – Roxbury, MA	50 Units
The Residences at Great Pond – Randolph, MA	234 Units
The Slate at Andover Apartments – Andover, MA	198 Units
The Washingtons – Melrose, MA	364 Units
The Westerly at Forge Park – Franklin, MA	280 Units
Traders Village – Salem, MA	212 Units
Villas at Old Concord – Billerica, MA	324 Units
Washington Crossing – Woburn, MA	205 Units
Windsor Station Apartments – Windsor, CT	130 Units
Woburn Heights – Woburn, MA	168 Units
Woodview at Legacy Farms – Hopkinton, MA	240 Units

tat

LEADERSHIP

Robert J. Verrier FAIA NCARB
Founder

Michael E. Liu AIA NCARB
Senior Partner + Design Principal

Michael D. Binette AIA NCARB
Senior Partner + Managing Principal

SERVICES

Architecture

Interior Design

Master Planning

Moderate Rehabilitation

PROJECT TYPES

Academic | Athletic + Community Centers

Assisted Living

Commercial

Healthcare | Science + Technology

Historic Preservation | Restoration + Adaptive Reuse

Hospitality + Mixed-use

Multifamily

New Construction

Senior Living

Waterfront

Trusted Advisors.

Since 1971, the masterplanning, architecture and interior design firm, The Architectural Team, Inc. (TAT), has been recognized for its thought leadership and diverse portfolio of acclaimed design solutions. The 95+ person firm has earned more than 100 awards for design excellence across a broad range of building types and programs, including: new construction of large-scale urban mixed use developments, multifamily, commercial, waterfront and hospitality developments, assisted and senior living facilities, and community centers.

TAT holds a national reputation in the areas of historic preservation, rehabilitation and adaptive reuse that has transformed neighborhoods across the United States, artfully restoring and reimagining neglected buildings for new uses while simultaneously preserving history.

The firm's insightful and pragmatic design solutions reflect our respect for site, context and sustainability. We believe that inspired and responsive design doesn't happen in isolation. It's the result of a committed partnership between the client and the design team; where regard for the character and quality of the natural and built environment is fundamental.

While our work has been honored with many awards, we are most proud of our lasting client relationships, and our part in their success.

Trusted advisors and active listeners, The Architectural Team is dedicated to creating positive and lasting transformation in the communities we serve.

The Architectural Team, Inc. 50 Commandant's Way at Admiral's Hill Chelsea, MA 02150 617.889.4402 architecturalteam.com

Michael D. Binette

AIA NCARB | Senior Partner + Managing Principal

Mike is a registered architect with more than 30 years of experience in coordinating and managing teams on complex projects in the multifamily, mixed-use, senior and commercial markets. As senior partner, he has a value-based approach to design that seeks first to understand the client's goals and then to identify strategic opportunities for greater return. Mike is a hands-on leader, and is involved in all facets of design – from master planning, space programming and design to construction administration. His multidisciplinary team management and organizational skills, combine with an extensive understanding of the construction process, ensuring delivery of projects efficiently and with high levels of client satisfaction. Mike's award-winning work includes Arlington 360 and Uphams Crossing, having earned recognition from the Boston Society of Architects and the National Housing and Rehabilitation Association.

JOINED THE ARCHITECTURAL TEAM

1982

EDUCATION

Wentworth Institute of Technology
Bachelor of Science in Architectural Engineering

PROFESSIONAL AFFILIATIONS

American Institute of Architects
Boston Society of Architects
The National Trust for Historic Preservation
National Fire Protection Association
National Council of Architectural Registration Boards
UrbanLand Institute
U.S. Green Building Council

PUBLIC AND PROFESSIONAL SERVICE

CURRENT

Chelsea Neighborhood Developers Committee
Committee Member
Federal Home Loan Bank of Boston's Affordable Housing Development Competition
Design Mentor
Boston Society of Architects
Housing Committee Member

FORMER

Masconomet Regional School Building Committee
Committee Member
Boston Society of Architects Housing Committee
Committee Chairman

AWARDS

Urban Land Institute
Jack Kemp Excellence in Affordable and Workforce Housing

PUBLICATIONS

McKnights Senior Living
Minding the 'Gap'
Eco Structure; by R. Verrier + M. Binette
Bridging the Gap
Architects + Artisans
In Boston, Re-knitting the Fabric
EDC; by R. Verrier + M. Binette
Old Mills New Lives
Boston Globe
Groundbreaking for Long-Sought Fenway Center
Complex Takes on Air of a Celebration

REGISTRATIONS

Alabama, Arizona, Arkansas, Colorado, Connecticut, District of Columbia, Florida, Georgia, Illinois, Indiana, Kentucky, Maine, Maryland, Massachusetts, Michigan, Minnesota, Missouri, New Hampshire, New Jersey, New York, North Carolina, Ohio, Pennsylvania, Rhode Island, South Carolina, Texas, Virginia, West Virginia

BOWER, BOSTON, MA

The design of a new mixed-use 1.3M square feet air-rights development located adjacent to Kenmore Square and Fenway Park to include five buildings consisting of 550 luxury rental units, 140,000 square feet of office space, 60,000 square feet of commercial and retail space, and public and private parking to accommodate 950 vehicles.

SIBLEY SQUARE, ROCHESTER, NY

The historic adaptive reuse of a former 1.1M square foot department store into a mixed-use development to include retail, office space, and multifamily residential and senior rental apartments.

★ **ARLINGTON 360, ARLINGTON, MA**

A new market-rate multifamily community located on the 18-acre former Symmes hospital campus offering 200 units in a mix of for-sale and townhomes and midrise buildings, with ample resident amenities, garage and surface parking.

★ **UPHAMS CROSSING, DORCHESTER, MA**

The redevelopment and design of the former St. Kevin's site involving the new construction of 80 mixed-income multifamily units comprised of two midrise buildings and townhomes, and the adaptive reuse of an existing school building to accommodate resident amenities and services.

THE ARCHER RESIDENCES, BOSTON, MA

Located in historic Beacon Hill, The Archer is the reimagining of two existing academic buildings to form 71 units of luxury condominiums. Work includes the addition of a 172,000 square foot penthouse level with roofdeck, and underground parking accessed via car elevator.

★ **HARBOR PLACE I + II, HAVERHILL, MA**

The design of a new mixed-use waterfront development. The phased program consists of two new midrise buildings, a five-story building to provide office and retail space and a six-story mixed-use building to provide 80 mixed-income residential units, ground level retail and commercial space.

Michael D. Binette AIA NCARB | Vice President, Principal

AVALONBAY COMMUNITIES, VARIOUS LOCATIONS, USA
With the successful completion of over 2,500 multifamily units, TAT proudly continues a long-standing relationship of providing insightful and pragmatic architectural and interior design solutions for Avalon properties nationwide.

ALTA UNION HOUSE, FRAMINGHAM, MA
New construction of a 196 unit apartment community in an urban setting. This TOD property offers residents an alternative to living in Boston and features a fitness center, swimming pool, resident lounge, community kitchen, pet spa, and structured parking.

MODERA NEEDHAM, NEEDHAM, MA
Construction of a new 136 unit apartment community situated in a bustling Boston suburb. The units are a mixture of market-rate and fixed-income units incorporated into 52 townhomes within 10 buildings, and 84 flat-style units within a five-story podium building.

★ TREADMARK, BOSTON, MA
New construction of a 83 unit six-story sustainable TOD structure that maintains a strong visual connection to the former Ashmont Tire shop it replaced. The $45M mixed income building is enveloped in grey ironspot brickwork interspersed with clean, vertical aluminum panels that give it a modern feel.

ALEXAN 3 NORTH, BILLERICA, MA
Design of a new amenity rich 178 unit multifamily community offering a mix of market rate and affordable apartment homes. The overall design of the community divides the property into three separate mid-rise buildings whose massing and architectural style complement the surrounding neighborhood.

ONE CHESTNUT PLACE, QUINCY, MA
Making use of an innovate prefabricated structure, One Chestnut Place will become Quincy’s tallest building once complete. Taking cues from current trends in the market, the design of this TOD community calls for sophisticated resident amenities within close proximity to public transportation.

Andrew N. Stebbins

LEED AP | Senior Project Manager

Andrew is an experienced project manager with the ability to unveil the unique aspects of every development he undertakes. He creates enlivened spaces that positively impact the end user and works collaborating with clients to realize their goals. With more than 20 years of project management expertise and a member of the firm's leadership team, Andrew's enthusiastic approach focuses on proactive communication and presenting thoughtful design solutions. His involvement includes all phases of design from the first sketch and schematics through to permitting and occupancy. Andrew is well-versed in both new construction and adaptive reuse and his aptitude spans a wide range of project types, including multifamily, mixed-use, senior living facilities and resilient waterfront design.

JOINED THE ARCHITECTURAL TEAM
1997

EDUCATION
Syracuse University School of Architecture
Bachelor of Architecture

PROFESSIONAL AFFILIATIONS
U.S. Green Building Council
Boston Society of Architects

SPEAKING ENGAGEMENTS
AIA Conference on Architecture 2019
Waterfront Resiliency: Architecture + Site Strategies
ABX Boston
Rising Sea Levels: Design Strategies for Waterfront Projects

PUBLICATIONS
Commercial Building Products
Senior Living Comes of Age
Education & Healthcare Construction Review + Real Estate & Construction Review
Thought Leadership Contributions
High Profile Monthly
For Smaller Massachusetts Cities, Architects Spur Downtown Transformations
Professional Builder
The New Wave of Senior Housing
WIRED
Designing the Coastal City of the Future

★ **CLIPPERSHIP WHARF, EAST BOSTON, MA**
New construction of a resilient waterfront mixed-use community offering 478 multifamily units, retail space, and below-ground parking over a 12-acre site along the Boston Inner Harbor. All four buildings are designed to achieve LEED Gold Certification, and are situated to take advantage of expansive views of Boston skyline while offering an inviting public access to the waterfront.

★ **ONE WINGATE WAY, NEEDHAM, MA**
A luxury senior living facility consisting of 52 independent living units, 42 units of assisted living, 37 units of memory care, and 12 units of supportive independent living. The complex offers living and dining rooms, bistros, library, theater, demonstration kitchen, full-service salon, fitness room, and an aquatic and wellness center.

★ **WINGATE AT NEEDHAM, NEEDHAM, MA**
A 82,786 square foot facility providing 42 units of assisted living, 12 units of supportive independent living and 37 units of memory care comprised in two wings. Resident amenities include open kitchen concept, dining room, bistro lounge, library, fitness area, health care, spa/salon and four outdoor landscaped patios.

★ **VOKE LOFTS, WORCESTER, MA**
The historic adaptive reuse of the Worcester Boys Trade School into 84 flat and loft style units with resident amenities including a common area lounge, fitness center, art gallery and outdoor recreation spaces.

★ **BOURNE MILL APARTMENTS, TIVERTON, RI**
The historic preservation and adaptive reuse of eight mill buildings into a new 165 unit mixed-income residential community with resident lounge/common areas, billiard room/kitchen, fitness center and laundry room. The project achieved LEED Silver certification.

★ **FELTON LOFTS, STEELTON, PA**
The adaptive reuse of a historic elementary school into 83 units of affordable housing. The school's auditorium and gymnasium were converted into a new community center and indoor garage parking.

Alta Union House

Framingham, MA

SERVICE
Architecture

TYPE
Multifamily
New Construction
Hospitality + Mixed-use

CLIENT
Wood Partners

SIZE
210,000 sf

Alta XMBLY
Somerville, MA

SERVICE
Architecture

TYPE
Multifamily
Hospitality + Mixed-use
New Construction

CLIENT
Wood Partners

SIZE
339,999 sf

Elan Union Market
Watertown, MA

SERVICE
Architecture
Interior Design
Master Planning

TYPE
Multifamily
New Construction
Hospitality + Mixed-use

CLIENT
Greystar

SIZE
236,254 sf

Treadmark
Dorchester, MA

SERVICE
Architecture

TYPE
Commerical
Hospitality + Mixed-use
Multifamily

CLIENT
Trinity Financial

SIZE
99,385 sf

Avalon Saugus

Saugus, MA

SERVICE

Architecture
Interior Design
Master Planning

TYPE

Multifamily
New Construction

CLIENT

AvalonBay Communities

SIZE

330,000 sf

Alexan 3 North
Billerica, MA

SERVICE
Architecture
Interior Design

TYPE
Multifamily
New Construction

CLIENT
Trammell Crow Residential

SIZE
223,000 sf

Arlington 360
Arlington, MA

SERVICE
Architecture
Master Planning

TYPE
Multifamily
New Construction

CLIENT
Jefferson Apartment Group
Upton + Partners

SIZE
337,341 sf

Modera Needham

Needham, MA

SERVICE
Architecture
Master Planning

TYPE
Multifamily
New Construction

CLIENT
Mill Creek Residential

SIZE
279,540 sf

Clippership Wharf

East Boston, MA

SERVICE
Architecture
Interior Design
Master Planning

TYPE
Commercial
Hospitality + Mixed-use
Multifamily
Waterfront
New Construction

CLIENT
Lendlease

SIZE
550,000 sf

Avalon Quincy

Quincy, MA

SERVICE
Architecture
Master Planning

TYPE
Multifamily
New Construction

CLIENT
AvalonBay Communities

SIZE
490,000 sf

A.O. Flats
Jamaica Plain, MA

SERVICE
Architecture
Interior Design

TYPE
Hospitality + Mixed-use
Multifamily
New Construction

CLIENT
The Community Builders

SIZE
102,000 sf

MULTIFAMILY | MIXED-INCOME

A.O. FLATS, Jamaica Plain, MA
Program: 126 unit development with ground floor retail
Construction Type: New construction

ALEXAN 3 NORTH, Billerica, MA
Program: 178 unit multifamily development consisting of three buildings
Construction Type: New construction

ALEXAN WRENTHAM, Wrentham, MA
Program: 240 unit multifamily development consisting of three buildings
Construction Type: New construction

ALTA AT RIVER'S EDGE, Wayland, MA
Program: 218 unit mixed-income multifamily community
Construction Type: New construction

ALTA XMBLY, Somerville, MA
Program: 329 unit multifamily TOD community
Construction Type: New construction

ARLINGTON 360, Arlington, MA
Program: Multifamily community with 176 units comprised of townhome units, club room, media room, fitness center, outdoor pool, and garage and surface parking
Construction Type: New construction

ATLAS LOFTS, Chelsea, MA
Program: 53 one-bedroom, mixed-income lofts including community room and fitness center
Construction Type: Renovation and adaptive reuse of a former historic mill located in the Chelsea Box District

AVALON AT LEXINGTON HILLS, Lexington, MA
Program: New 387 unit market-rate multifamily community with resident amenities
Construction Type: Historic adaptive reuse and new construction

AVALON DANVERS, Danvers, MA
Program: 433 unit market rate multifamily community with resident amenities
Construction Type: Historic adaptive reuse and new construction

AVALON EASTON, Easton, MA
Program: Mixed-income 40B community with 246 apartments, 44 townhouse units, clubhouse, and amenity space
Construction Type: New construction

AYER LOFTS, Lowell, MA
Program: 51 loft-style units
Construction Type: Adaptive reuse of a former factory

BATTLE ROAD FARM, Lincoln, MA
Program: 120 multifamily units in 34 buildings
Construction Type: New construction

BELL WATERTOWN, Watertown, MA
Program: 155 units of mixed-income housing
Construction Type: New construction

BOURNE MILL APARTMENTS, Tiverton, RI
Program: A mixed-income, LEED Silver certified, residential community with 165 units, common areas, fitness center, laundry, courtyards; and commercial space
Construction Type: Historic adaptive reuse of former mill complex

CANAL LOFTS, Worcester, MA
Program: A mixed-use development comprised of 64 units of mixed-income with community space, and surface parking
Construction Type: New construction and historic adaptive reuse of a former factory

CHESTNUT PARK APARTMENTS, Holyoke, MA
Program: 54 units of affordable housing
Construction Type: Adaptive reuse of the former Holyoke Catholic Campus

CLOCKTOWER, Nashua, NH
Program: 183 units
Construction Type: Historic adaptive reuse of a mill

COSTELLO HOMES CONDOMINIUMS, Boston, MA
Program: 15 unit condominium development
Construction Type: New construction

COUNTING HOUSE 71, Lowell, MA
Program: 75 unit multifamily development
Construction Type: Renovation and adaptive reuse of a historic mill

NOTE: THIS REPRESENTS A PARTIAL LISTING OF THE FIRM'S PROJECTS.

CURTAIN LOFTS, Fall River, MA
Program: 97 mixed-income LEED certifiable residential community for 55+ population
Construction Type: Renovation and adaptive reuse of a historic textile mill

GATEWAY NORTH APARTMENTS, Lynn, MA
Program: 71 unit mixed-income, mixed-use development that includes affordable and workforce housing units
Construction Type: New construction

HARBOR PLACE, Haverhill, MA
Program: Phased construction of 58,000 sf commercial building and 118,000 sf mixed-use building with 80 units of multifamily housing
Construction Type: New construction

KEEN STUDIOS, Chelsea, MA
Program: 23 mixed-income artist live-work lofts
Construction Type: Historic conversion of the Mary C. Burke Elementary School

KENNEDY BISCUIT LOFTS, Cambridge, MA
Program: 132 units
Construction Type: Adaptive reuse of a historic cookie factory

MARY ELLEN MCCORMACK, South Boston, MA
Program: Redevelopment of 27-acre site into a vibrant community including 3,000 mixed-income units, along with retail, commercial, and community space
Construction Type: New construction

MASON SQUARE, Springfield, MA
Program: Conversion of the historic Indian Motorcycle factory into a 60 unit multifamily community
Construction Type: Historic adaptive reuse

MILLHOUSE OF ADAMS, Adams, MA
Program: 117 units
Construction Type: Adaptive reuse of a certified historic mill

MINER STREET, Boston, MA
Program: New six-story, luxury condominium development with 61 mixed-income units
Construction Type: New construction

MODERA MARSHFIELD, Marshfield, MA
Program: 40B multifamily community consisting of 248 units across 15 buildings
Construction Type: New construction

MODERA NEEDHAM, Needham, MA
Program: New multifamily development with 300 units
Construction Type: New construction

MORAN SQUARE, Fitchburg, MA
Program: Mixed-use, mixed-income multifamily community
Construction Type: Adaptive reuse and new construction

OGDEN MILLS, Cohoes, NY
Program: 120 multifamily units and commercial space
Construction Type: Rehabilitation of an early 19th century five-story certified historic mill

OLIVER LOFTS, Roxbury, MA
Program: Mixed-income, 62 unit LEED Silver certifiable development including private courtyards and three artists work-live units
Construction Type: Historic adaptive reuse of factory buildings

OLYMPIA TOWERS, New Bedford, MA
Program: 130 multifamily housing units
Construction Type: New construction added to an existing certified historic stone building

OVERLOOK APARTMENTS, Gardner, MA
Program: 137 multifamily rental units
Construction Type: New construction

REPTON PLACE, Watertown, MA
Program: Phase one of a two-phase development providing 179 units
Construction Type: New construction

RESIDENCES AT BRIGHTON MARINE, BOSTON, MA
Program: 102 mixed-income apartment homes for veterans
Construction Type: Historic adaptive reuse and new construction

NOTE: THIS REPRESENTS A PARTIAL LISTING OF THE FIRM'S PROJECTS.

RICE SILK MILL, Pittsfield, MA
Program: 45 units of mixed-income multifamily housing
Construction Type: Historic adaptive reuse of mill buildings

ROYAL MILLS AT RIVERPOINT, West Warwick, RI
Program: Mixed-use multifamily community on 14-acres; 244 apartments, and commercial and retail space
Construction Type: Conversion of a historic mill complex and new construction

SAUGUS RIDGE, Saugus, MA
Program: 300 unit multifamily community meeting 40B requirements
Construction Type: New construction

STATE HULETT, Schenectady, NY
Program: 105 units
Construction Type: Adaptive reuse of a historic warehouse

THE CARRUTH, Dorchester, MA
Program: A new mixed-use, TOD development with 116 apartments and condominiums, parking, and a 10,000 sf retail space
Construction Type: New construction

THE CENTRAL BUILDING, Worcester, MA
Program: 55 mixed-income units and retail
Construction Type: Adaptive reuse of an office building

THE CORDOVAN, Haverhill, MA
Program: 146 mixed-income live-work units
Construction Type: Adaptive reuse of a shoe factory

THE GREENHOUSE, Chelsea, MA
Program: A seven-story, 72 unit mixed-income apartment building
Construction Type: Adaptive reuse of a parking garage combined with new construction

THE HAYES AT RAILROAD SQUARE, Haverhill, MA
Program: A mixed-use, mixed-income TOD community with 57 units
Construction Type: Adaptive reuse of a shoe packing facility

THE LOFTS AT LOOMWORKS, Worcester, MA
Program: 94 mixed-income units with fitness room, laundry room and surface parking
Construction Type: Adaptive reuse of historic mill

THE METROPOLITAN, Boston, MA
Program: A 23-story mixed-use building with 118 condominiums, 133 apartments, retail and community space, and an underground parking garage
Construction Type: New construction

THE SLATE AT ANDVOER, Andover, MA
Program: 224 unit multifamily development with resident community building
Construction Type: New construction

TREADMARK, Dorchester, MA
Program: 83 unit mixed-income, mixed-use TOD development
Construction Type: New construction

TURTLE CROSSING, Braintree, MA
Program: 201 condominiums, a community center, swimming pool, and fitness room
Construction Type: New construction

UPHAMS CROSSING, Dorchester, MA
Program: 60 units of workforce housing and an additional 20 units of permanent affordable housing
Construction Type: Adaptive reuse and new construction

VOKE LOFTS, Worcester, MA
Program: 84 mixed-income units
Construction Type: Conversion of a vocational technical school

WATERTOWN MEWS, Watertown, MA
Program: 206 mixed-income units, fitness room, community center, outdoor pool, and parking
Construction Type: New construction

WATERWAY APARTMENTS, Leominster, MA
Program: 80 unit apartment complex
Construction Type: Preservation and restoration of a certified historic shirt factory combined with new construction

WEST END PLACE, Boston, MA
Program: 10-story apartment building with 183 units, retail space, and an underground parking garage
Construction Type: New construction

NOTE: THIS REPRESENTS A PARTIAL LISTING OF THE FIRM'S PROJECTS.

WESTLAND AVENUE, Boston, MA
Program: 97 units of subsidized and market rate housing
Construction Type: Rehabilitation of seven townhouses as part of a neighborhood revitalization project

WHITTIER STREET REDEVELOPMENT, Boston, MA
Program: Phased mixed-use development with 316 multifamily units, 8,000 sf commercial space, and structured parking
Construction Type: New construction

WORCESTER COUNTY COURTHOUSE, Worcester, MA
Program: 114 mixed-income units
Construction Type: Adaptive reuse of a courthouse residential housing

YARN WORKS, Fitchburg, MA
Program: 96 mixed-income units
Construction Type: Adaptive reuse and renovation of the historic Nockege River Mill building

NOTE: THIS REPRESENTS A PARTIAL LISTING OF THE FIRM'S PROJECTS.

MULTIFAMILY | PODIUM CONSTRUCTION

480 MAIN, Malden, MA
Program: 195 unit, five-story multifamily development
Construction Type: New construction

A.O. FLATS, Jamaica Plain, MA
Program: 126 unit development with ground floor retail
Construction Type: New construction

ALEXAN 3 NORTH, Billerica, MA
Program: 178 unit multifamily development consisting of three buildings
Construction Type: New construction

ALTA UNION HOUSE, Framingham, MA
Program: 196 unit multifamily TOD community
Construction type: New construction

ALTA XMBLY, Somerville, MA
Program: 329 unit multifamily TOD community
Construction type: New construction

ARLINGTON 360, Arlington, MA
Program: Master planned multifamily community with 176 units
Construction Type: New construction

AVALON PISCATAWAY, Piscataway, NJ
Program: 360 unit multifamily community
Construction Type: New construction

AVALON QUINCY, Quincy, MA
Program: 398 unit multifamily community
Construction Type: New construction

AVALON RESIDENCES AT THE HINGHAM SHIPYARD, Hingham, MA
Program: Five-story, 190 unit market rate multifamily community with 266 podium garage parking spots
Construction Type: New Construction

AVALON SAUGUS, Saugus, MA
Program: Mixed-use development at the former Hilltop Steakhouse site that includes 280 multifamily units, and 24,000 sf of retail space
Construction Type: New construction

BELL WATERTOWN, Watertown, MA
Program: 155 units of mixed-income housing
Construction Type: New construction

BROOKSIDE SQUARE, West Concord, MA
Program: 74 unit, three-story market rate multifamily housing, with 36,000 sf of retail space.
Construction Type: New construction

CHESTNUT COMMONS, Providence, RI
Program: 94 unit luxury multifamily community
Construction Type: New construction

CLIPPERSHIP WHARF, East Boston, MA
Program: Four buildings, with a combined 397 apartments and 80 condominiums, retail space and waterfront pedestrian access
Construction Type: New construction

ELAN UNION MARKET, Watertown, MA
Program: 282 unit multifamily community and mixed-use development with 11,000 sf of amenity space and 10,000 sf of retail
Construction Type: New construction

GATEWAY NORTH APARTMENTS, Lynn, MA
Program: 71 unit mixed-income, mixed-use development with affordable and workforce units
Construction Type: New construction

HARBOR PLACE, Haverhill, MA
Program: Phased construction of 58,000 sf commercial building and 118,000 sf mixed use building with 80 units
Construction Type: New construction

JEFFERSON AT ADMIRAL'S HILL, Chelsea, MA
Program: Waterfront apartment community with 160 units
Construction Type: New construction

KASANOF HOMES + THOMAS I. ATKINS APARTMENTS, Roxbury, MA
Program: A midrise, townhome duplex including 16 affordable homeownership units and 48 multifamily affordable housing units, creating a new neighborhood street grid
Construction Type: New construction

MODERA FRAMINGHAM, Framingham, MA
Program: New multifamily development with 270 units
Construction Type: New construction

NOTE: THIS ONLY REPRESENTS A PARTIAL LISTING OF THE FIRM'S MULTIFAMILY PODIUM CONSTRUCTION PROJECTS.

MODERA NEEDHAM, Needham, MA
Program: Multifamily development with 300 units
Construction Type: New construction

NEPONSET LANDING, Quincy, MA
Program: A new 12-story apartment building with 280 units and a two-story above-grade parking garage
Construction Type: New construction

RESIDENCE AT READVILLE STATION, Boston, MA
Program: Multifamily TOD development with 305 units
Construction Type: New construction

THE CARRUTH, Dorchester, MA
Program: Mixed-use, TOD development with 116 units, parking, and a 10,000 sf retail space
Construction Type: New construction

THE POINT AT 180, Malden, MA
Program: Five-story apartment building with 86 units
Construction Type: New construction

THE SLATE AT ANDVOER, Andover, MA
Program: 224 unit multifamily development
Construction Type: New construction

TREADMARK, Dorchester, MA
Program: 83 unit mixed-income, mixed-use TOD development
Construction Type: New construction

UPHAMS CROSSING, Dorchester, MA
Program: 60 units of workforce housing and an additional 20 units of permanent affordable housing
Construction: Adaptive reuse and new construction

WATERTOWN MEWS, Watertown, MA
Program: 206 unit mixed-income community
Construction Type: New construction

NOTE: THIS ONLY REPRESENTS A PARTIAL LISTING OF THE FIRM'S MULTIFAMILY PODIUM CONSTRUCTION PROJECTS.

CLIENT REFERENCES

While our work has been honored with many awards, we are most proud of our clients' successes and our many long-standing relationships that account for nearly 85 percent of our repeat business. Our ability to understand and draw inspiration from our clients' goals has resulted in a national reputation as a design leader. We encourage you to speak with any of our references.

332 Main Street Associates
340 Main Street
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Ajax Investment Partners, Inc.
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Lexington, MA 02421
Contact: Robert Easton | Principal, Karel Steiner | Owner
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AvalonBay Communities, Inc.
58 South Service Road, Suite 303
Melville, NY 11747
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AvalonBay Communities, Inc.
101 Old Short Hills Road, PH1
West Orange, NJ 07052
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Phone: 732.404.4827

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Contact: Bill McLaughlin | Vice President,
Michael Roberts | Senior Vice President
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Beacon Communities Development, LLC
2 Center Plaza, Suite 700
Boston, MA 02108
Contact: Howard Cohen | Chairman, Dara Kovel | CEO
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B'nai B'rith Housing New England *
34 Washington Street
Brighton, MA 02135
Contact: Susan Gittelman | Executive Director
Phone: 617.731.5291

Boys & Girls Clubs of Boston *
200 High Street, 3rd Floor
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Contact: Josh Kraft | CEO
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Brookfield Properties
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Contact: Matt Booma | President
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Conifer Realty, LLC
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Phone: 617.825.2580

Curry College
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Milton, MA 02186
Contact: Kenneth K. Quigley, Jr. | President
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Diversified Funding, Inc.
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Boston, MA 02110
Contact: Richard Bendetson | President
Phone: 617.227.0893

*** Non-Profit Developers***

EA Fish Development
60 William Street, Suite 220
Wellesley, MA 02481
Contact: Matt Mittelstadt | Managing Director
Phone: 781.380.1600

Evergreen Partners
560 NE 44th Street
Oakland Park, FL 33334
Contact: Brian Poulin | President
Phone: 954.332.1436

Federal Realty Investment Trust
5 Middlesex Avenue, Floor 4
Somerville, MA 02145
Contact: Patrick McMahon | Senior Vice President
Phone: 617.684.1516

Fox Development
220 Boylston Street, Unit 1020
Boston, MA 02116
Contact: Robert Fox | President
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Greystar
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Hart Development
37 Bay State Road, Apt. 7
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Contact: Daniel Hart | President
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Hearth, Inc. *
1640 Washington Street
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Contact: Mark Hinderlie | President and CEO
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3 Edgewater Drive
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Ed San Clemente | Vice President of Property Development
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Contact: Mahmood Malihi | Co-President
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***** **Non-Profit Developers***

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20 City Square, 2nd Floor
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Lincoln Property Company
53 State Street, 8th Floor
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Contact: John Cappellano | Senior Vice President
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MassHousing
One Beacon Street
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Mill Creek Residential Trust
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Boston, MA 02109
Contact: Robb Hewitt | Vice President of Development
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NAI Hunneman
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Noannet Group
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Todd Nordblom | Business Development Manager
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Pennrose Properties, LLC.
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Planning Office for Urban Affairs *
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Boston, MA 02109
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Preservation of Affordable Housing, Inc. *
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Boston, MA 02108
Contact: Rodger Brown | Managing Director of Real Estate
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Saunders Hotel Group
715 Boylston Street, Suite 310
Boston, MA 02116
Contact: Gary Saunders | Chairman
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Silver Street Development Corp.
33 Silver Street, Suite 200
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Contact: Michael Wilson | Vice President, Anup Misra | Senior Vice President
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The Community Builders *
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The HYM Investment Group, LLC
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The Kraft Group
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CERTIFIED ABUTTER'S LIST

PARCELID	LOCATION	OWNER NAME	OWNER ADDRESS	OWNER CITY	OWNER STATE	OWNER ZIP
R047 001 0006	1449 MAIN ST	ASN-MASSACHUSETTS HOLDINGS / PROPERTY TAX C/O AVALONBAY	671N. GLEBE RD.,STE-800	ARLINGTON	VA	22203
R047 001 0007	1489 MAIN ST	GRAZIOSI, JOHN M. & / THERESA M.	1489 MAIN ST. /	WALTHAM	MA	02451-1625
R047 001 0008	1489 AF MAIN ST	MIRON, JOSHUA & STEPHANIE / LALLET- MIRON	1 NORTH AVENUE /	WESTON	MA	02493
R056 001 0001	1485 MAIN ST	SCHILDKRAUT, E. ROBERT & / DIANE	1485 MAIN STREET /	WALTHAM	MA	02451-1625
R056 001 0002	1481 MAIN ST	CAMPOBASSO-PAZZANO FAM TR; / ANN M.CAMPOBASSO TR.	1481 MAIN ST.	WALTHAM	MA	02451-1625
R056 002 0002	1500 MAIN ST	B.O.P.-WALTHAM, LLC	1500 MAIN STREET	WALTHAM	MA	02451
R056 002 0004	1484 MAIN ST	CORRIS, EDWARD A. & / LESLIE	29 MONTCLAIR ROAD /	WABAN	MA	02468
R056 002 0005	1486 MAIN ST	TSA PROPERTIES, LLC.	96 BEACON ST	CHESTNUT HILL	MA	02467
R056 002 0006	1500 R MAIN ST	COLATOSTI, NANCY N. /	56 FOREST RIDGE ROAD /	WESTON	MA	02493
R056 002 0008	1474 MAIN ST	DONATO A. MAZZOLA REV. TR; / DONATO A. MAZZOLA TR.	77 LONGFELLOW RD. /	WATERTOWN	MA	02472
R056 002 0009	1466 MAIN ST	LEGACY SQUARED, LLC.	107 AUDOBON RD. #2-301 /	WAKEFIELD	MA	01880
R056 002 0011	1460 MAIN ST	FALTER REALTY TRUST, / JAMES T. & EDNA F.	1460 MAIN STREET /	WALTHAM	MA	02451-1623
R056 002 0012	1440 MAIN ST	1440 MAIN LLC	1600 PROVIDENCE HIGHWAY /	WALPOLE	MA	02081
R056 002 0013	1432 MAIN ST	FD SPECIAL OPPORTUNITIES II-A / LLC.C/O CBRE,INC.	177 HUNTINGTON AVE /	BOSTON	MA	02115

VERIFICATION OF INFORMATION PROVIDED

Bernadette Dozier

APPROVED BY THE WALTHAM BOARD OF ASSESSORS

DATE 1-14-2022

1486 MAIN STREET
PARCEL ABUTTERS
CITY OF WALTHAM
MASSACHUSETTS

DISCLAIMER:
This map is for reference and planning purposes only. It is prepared for the inventory of real property within the City of Waltham and is compiled from tax maps, recorded deeds and plats. Users of this tax map are hereby notified that the aforementioned public primary information sources should be consulted for the verification of the information contained on this map. The City of Waltham and its mapping contractors assume no legal responsibility for the information contained herein.

DATA SOURCE:
The digital planimetric base map data were developed by Chas H Sells, Inc. and are updated using spring 2021 1"= 40' scale color orthophotographs. The parcel data and are current as of January 2022. Map prepared by City of Waltham GIS.

Legend

- 300 Foot Radius
- Edge of Pavement
- Unpaved Road
- Fence
- Guard Rail
- Retaining Wall
- Stone Wall
- Rail Lines
- Stream
- Tax Map Grid
- Parcel Lines
- Walkway/Sidewalk
- Swimming Pools
- Building Footprint
- Deck
- Paved Area
- Wetland Area
- Vegetated Area

R022 015 0001 — Parcel Number
19 — Address Number

N E S W

1 inch = 100 feet

0 50 100 200 Feet

	1	2	3						
	4	5	6	7	8				
9	10	11	12	13	14	15	16	17	
18	19	20	21	22	23	24	25	26	27
28	29	30	31	32	33	34	35	36	37
	38	39	40	41	42	43	44	45	46
	47	48	49	50	51	52	53	54	55
	56	57	58	59	60	61	62	63	64
	65	66	67	68	69	70	71	72	
	73	74	75	76	77	78			
		79	80	81					

Map No.:
56

Date: 1/13/2022

Document Path: G:\Maps\Abutter Maps\1486 Main Street - Parcel Abutters.mxd

APPENDIX B TRAFFIC IMPACT ASSESSMENT

APPENDIX C
ARCHITECTURAL

12/4/2020

Alta Waltham
1486 Main Street
Waltham, MA

Architectural Narrative
Project Eligibility Submission

Alta-Waltham is a proposed 189-Unit development located at 1486 Main Street in Waltham. The existing roughly 2-acre site has been entirely and previously developed and is fully covered by either building and/or paved area. It is currently occupied by an automobile repair operation and is situated within a myriad of conditions surrounding the proposed site. The western property line abuts single family homes actually located in the Town of Weston. The property to the south is currently occupied by an existing two-story office building which sits on land that is generally in excess of 10 feet higher in elevation than our property's existing grade. The eastern property is lined with yet another office building that is four stories in height, sitting on land that again is generally in excess of 10-15 feet in elevation higher than our existing parking area.

The existing mature trees that line the western (Weston) property line form a relatively dense existing landscape buffer that will be protected and preserved while the proposed building itself serves to screen the existing residential neighborhood from the somewhat dated commercial uses to the west and south.

The proposed building consists of two levels of "podium"-level parking located beneath the four levels of residential apartments. The proposed building massing and design responds to these varied existing site pressures with consideration given to the immediate surroundings as well as being responsive and mindful to how one approaches the building from its Main Street entrance. The proposed structure utilizes the existing topography to "nestle" the parking levels into the existing higher grades of the adjacent properties along the southern and eastern sides of our site and minimize the visual impact of the structured parking from the public realm.

Along this most public face from Main Street, the building's main entrance is situated within a "gatehouse" scaled module that extends forward from the main building mass that greets you upon arrival to the site. The proposed for-over-two building massing is visually buffered behind the existing lower-scale buildings lining Main Street.

The materials selection and detailing of the proposed building seeks to provide a thoughtful transition from the existing commercial uses to the residential surroundings through the use of very residentially-minded, high-quality cladding materials including cement fiber profiles; horizontal clapboard, flush reveal panel, and vertical panel finished with different colors and profiles. Double-hung style window selections reflect the residential occupancy of the structure while drawing cues from the residential neighborhood to the west. Detailing is kept clean and straightforward providing a refined the transitional nature of the overall building structure.

APPENDIX D

GEOTECHNICAL REPORT

www.haleyaldrich.com

FINAL PRELIMINARY GEOTECHNICAL REPORT
1486 MAIN STREET
WALTHAM, MASSACHUSETTS

by
Haley & Aldrich, Inc.
Boston, Massachusetts

for
WP East Acquisitions, LLC
Lexington, Massachusetts

File No. 0200959
November 2021

HALEY & ALDRICH, INC.
465 Medford St.
Suite 2200
Boston, MA 02129
617.886.7400

19 November 2021
File No. 0200959-000

WP East Acquisitions, LLC
c/o Wood Partners
91 Hartwell Avenue
Lexington, MA 02421

Attention: Michael Tulipani

Subject: Final Preliminary Geotechnical Report
1486 Main Street
Waltham, Massachusetts

Ladies and Gentlemen:

This report summarizes the results of a preliminary geotechnical investigation of a proposed development site located at 1486 Main Street in Waltham, Massachusetts. The investigation was conducted in accordance with our 9 October 2020 proposal, and your subsequent authorization.

The information presented in this report is intended for initial project planning and preliminary cost estimating purposes only. Final design recommendations and associated construction requirements will be developed during the final design phase of the project upon completion of final design explorations.

Introduction

SITE CONDITIONS

WP East Acquisitions, LLC is considering acquisition of the property located at 1486 Main Street in Waltham, Massachusetts for development of a new 6-story building consisting of four-levels of wood frame residential over two-levels of steel podium parking, as wells as bituminous paved parking areas, utilities, and other infrastructure. Our understanding of the proposed development configuration is based on the concept Layout and Materials Plan prepared by Allen & Major Associates, Inc. dated 15 December 2020. The general location of the site is shown on Figure 1, Project Locus.

The approximately 2.2-acre site is currently occupied by an approximately 9,000 SF garage and auto storage facility and bituminous paved parking areas. Site grades are relatively level across the majority of the project site, generally ranging from approximately El. 153 (towards Main Street) to about El. 157[1] along the south side of the site. The exception is along the eastern limits of the site where there is a two-tier concrete block retaining wall; the first wall supports an approximately 7-ft raise-in-grade (up to

[1] Elevations are in feet and reference the North American Vertical Datum of 1988 (NAVD88)

about El. 164) and the second tier (set back approximately 15 to 25 from the first tier) supports an additional approximately 4-to-12-foot raise-in-grade to match grades with the abutting access road (up to approximately El. 165 to El. 175). The eastern access road is located within the property limits but is part of a City Right of Way Easement.

PROPOSED CONSTRUCTION

The proposed building will be a six-story building the lowest two levels consisting of steel podium construction for parking and then four levels of wood frame residential construction above. The building footprint is approximately 62,000 SF footprint area, configured as shown on Figure 2 – Site and Subsurface Exploration Location Plan. The lowest parking level will roughly match existing grades coming off Main Street at El. 152 and slope up to El. 157. The parking will ramp up to the second level at El. 168, matching site grades along the eastern access road. The new building is planned to be built up to the limits of the access road such that the podium parking is “benched into” the existing perimeter grades, with separate garage entrances off Main Street (to Level 1) and off the access road (to Level 2). The proposed development will also consist of new site utilities and improvements, including stormwater infiltration systems positioned outside the building footprint along Main Street and below the lowest level parking slab.

Subsurface Exploration Program

SUBSURFACE SOIL CONDITIONS

Our understanding of the subsurface soil and groundwater conditions is based on six test borings (designated HA-01 through HA-06) conducted by Haley & Aldrich between 3 and 7 June 2021, and seven test boring explorations conducted by Vertex (designated VTX-101 to VTX-107) between 2 and 4 June 2021. The designations and approximate locations of test borings are shown on Figure 2 and a summary of the Haley & Aldrich test boring information is provided in Table I. Copies of logs describing conditions encountered in the test borings are provided in Appendix A. Vertex test borings were conducted using auger methods to gather samples for environmental testing and observe area groundwater levels. The boring locations are shown on Figure 2 and the logs are included in Appendix A for information only. The summary of subsurface conditions and geotechnical design recommendations were based on the conditions observed in the referenced Haley & Aldrich borings only. The table below lists the subsurface units encountered at the test borings conducted at the site, in order of increasing depth below ground surface:

Subsurface Unit	Top of Stratum (NAVD88)	Range in Thickness (ft)
Fill	El. 153 to El. 175 (Ground Surface)	0 to 14
Glacial Deposits	El. 159 to El. 143	2 to 5
Bedrock	El. 155 to El. 138	N/A

A generalized description of the soil units is provided below.

- *Fill* was encountered at three of the six Haley & Aldrich boring locations and typically consisted of a medium dense to very dense silty SAND with gravel or poorly graded SAND ranging in thickness from about 6 to 14 ft below existing site grades, where encountered. At one location at the eastern end of the site (HA-05), an approximately 2-ft thick layer of blast rock was noted within the Fill layer. The Fill generally appears to consist of re-worked natural material and is of greatest thickness near the existing site building. Within the center of the site (boring locations HA-03, HA-04, and HA-06), no Fill material was encountered, with the natural, undisturbed Glacial Till deposits identified directly below the 4 to 5-in. thick bituminous parking surface.
- *Glacial Deposits* were encountered at all boring locations, either beneath the Fill (where present) or directly below the bituminous parking surface, at elevations ranging from approximately El. 159 to El. 143. The Glacial Deposits were generally described as very dense silty SAND with Gravel. Where penetrated, the Glacial Deposits were found to range in thickness from about 2 to 5 ft.
- *Bedrock* was encountered beneath the Glacial Deposits at all Haley & Aldrich boring locations, with the exception of boring HA-02. When encountered and cored, the bedrock was observed to consist of very hard to slightly weathered QUARTZITE at depths of approximately 1.4 to 19.5 ft below existing site grades, corresponding to approximately El. 155 to El. 138. The bedrock surface appears to be highest towards the middle portion of the site and drops towards the eastern and western ends of the site.

GEOTECHNICAL LABORATORY TESTING

Four (4) soil samples were collected from the Haley & Aldrich test borings and submitted to our geotechnical laboratory for soil gradation testing. Three of the samples were collected from the Fill and one sample was collected from the Glacial Deposits. The results of the soil gradation test data are included in Appendix B.

GROUNDWATER

Six (6) groundwater observation wells were installed across the site by Vertex. At the completion of the test boring program, water was measured within the observation wells at depths ranging from about 6.2 to 13.7 ft below existing site grades, corresponding to approximately El. 146 to El. 143. Water levels should be expected to vary with location, season, recent precipitation, snowmelt, nearby construction activities, and other factors.

Preliminary Geotechnical Recommendations

The following preliminary geotechnical recommendations are based on the conceptual design of the project and the subsurface conditions encountered in the Haley & Aldrich test borings. These preliminary geotechnical recommendations are in accordance with the 9th Edition of the Massachusetts

State Building Code. The following recommendations are provided to aid with initial planning and preliminary cost estimating and are not intended for project final design.

FOUNDATION DESIGN

Based on the subsurface conditions encountered in the Haley & Aldrich test borings, the proposed structure can be founded on shallow spread footings bearing at conventional foundation depths on either the Glacial Deposits, Bedrock, or on compacted structural fill or lean concrete placed above the natural Glacial Deposits (following the removal of the existing Fill within the zone of influence of the footings). *Note – given the density of the existing Fill material, further investigations may confirm that some portion of the Fill material may be suitable for foundation bearing and forgo the need for its over-excavation/replacement. Additional evaluation will be required during final design.*

For initial planning purposes, we recommend the following:

- We recommend that footings be designed to bear in the Glacial Deposits or on Bedrock using a maximum net allowable bearing pressure of 8.0 kips per square foot (ksf). Unsuitable Fill materials, where present beneath design footing bearing levels, would have to be removed within the zone of influence beneath new foundations.
- The thickness of Fill was noted to be from 6 to 14 ft, with the greatest thickness concentrated in areas near the existing site building. Assuming the building finished floor is located at approximately El. 153, over-excavation of unsuitable soils below normal footing bearing elevations will typically range from none to about ten (10) ft at footing locations. Where over-excavation is required, the existing Fill should be removed within the zone of influence of the new footings and replaced with compacted structural fill or lean concrete[2] with a minimum 1,500 psi compressive strength. Refer to Figure 3 for conceptual over-excavation details. Bearing capacity recommendations should be re-visited during final design once the site grades and building configuration have been established because higher bearing allowable capacities may be possible if footings are to bear directly on bedrock.
- At the recommended allowable bearing pressures, we estimate that settlement of individual footings under static loading conditions, constructed as recommended herein, will not exceed about 1 in., with differential settlements between individual footings, or within a 30-ft distance along a continuous strip footing, not exceeding about ½ in. Actual footing settlements will depend on final building loadings, proper footing subgrade preparation, and placement of structural backfills (if/where required).
- Locate bottoms of footings at least 48 in. below lowest adjacent ground surface exposed to freezing, and a minimum 18 in. below the top of the adjacent ground floor slab at heated interior locations.

[2] Due to their limited thickness and density/composition, excavation/replacement of the unsuitable soils is expected to be the more cost-effective approach to enable footing foundations compared with ground improvement techniques such as aggregate piers.

- Tops of footings should be positioned a minimum of 4 in. beneath the underside of the overlying floor slab.

Based on the conditions encountered in the recent explorations, the existing fill on the western edge of the building appears to consist of re-worked natural glacial materials that are medium to very dense in nature. The existing fil materials may be suitable for support of the new foundations in their current condition and may not require over-excavation and replacement. Further explorations including test pits and test borings will be required during final design to confirm if the existing materials are suitable in their current state.

LOWEST LEVEL SLAB

The lowest level slabs can be designed as conventional soil support slab-on-grade. We recommend that slabs bear on a minimum of eight (8) inches of Structural Fill or ¾ in. crushed stone separated from underlying/adjacent soils using a geotextile filter fabric (6 oz per sy minimum, needle-punched, non-woven).

The existing Fill is relatively dense, predominantly granular, and is considered suitable to leave in place below slabs-on-grade (including slab haunches supporting load bearing walls) following proof compaction with several passes of a large vibratory roller and provided the risk of some slab cracking and/or settlement is tolerable. We anticipate this risk would be low based on the quality of the Fill observed in the test borings. Existing Fill that is observed to be organic in composition (if encountered) should be removed below slabs.

SEISMIC DESIGN CONSIDERATIONS

Based on the preliminary test borings, the Seismic Site Class is considered to be C. The soils at the site are not considered to be susceptible to liquefaction under the Building Code design level earthquake.

LATERAL EARTH PRESSURES

Building foundation walls retaining earth (such as along the eastern perimeter where the garage wall will retain up to approximately 20 ft of soil) should be designed to resist permanent static, seismic and surcharge loadings indicated below. The pressures do not include hydrostatic loads, as such walls will be above anticipated groundwater levels.

- Static: Use an equivalent fluid unit weight of soil equal to 60 pcf.
- Seismic: Calculate in accordance with the Building Code (Article 1610.2) using a total soil unit weight (gt) of 125 pcf.
- Surcharge: Calculate on the basis of a uniform lateral pressure equal to 0.33 times the vertical surface load (psf), acting on the backside of the wall over the full height of the wall.

GROUNDWATER AND PERMANENT FOUNDATION DRAINAGE

The observed groundwater (measured at depths ranging from approximately 6 to 14 ft bgs) level is well below the planned lowest level slab elevation and is not anticipated to be encountered within the planned excavations for the new building; accordingly, underslab drainage is not required for the proposed building. However, where the lowest level slab is finished 2 ft or greater below adjacent exterior finished grade elevations, we recommend the installation of permanent perimeter foundation drains, consisting of the following:

- Waterstops, caulking, or other seals provided at all foundation wall and wall/footing construction joints where the exterior grading immediately adjacent to the building is higher than the interior floor slab of the building;
- A perimeter foundation drainage system consisting of a continuous loop of 4-in. diameter perforated PVC or slotted corrugated polyethylene pipes placed adjacent to the perimeter footings, laid flat or with a slight pitch (if possible) downward toward the ejection/discharge point(s). The pipe should be surrounded by a minimum thickness of 6 in. of ¾-in. crushed stone, which in turn is surrounded by 6-oz. per sq. yd. non-woven geotextile;
- Where perimeter foundation drainage is provided, below-grade walls should be waterproofed and geocomposite drainage board should be placed against the wall, up to 12 in. below ground surface, and hydraulically connected to the perimeter drainage pipe;
- Inverts of perimeter drainage pipes should be positioned above the bearing elevation of adjacent footings and at least 12 inches below the adjacent finished floor elevations;
- All points in the perimeter drainage should have redundant flow paths to the ejection/discharge point(s);
- Discharge from the drainage systems should be directed to at least one reliable gravity outlet. If gravity discharge is not possible, effluent should be directed to a sump system having redundant pumps and emergency backup power.
- The drainage system piping should be provided with cleanouts.

A moisture vapor retarded membrane is recommended directly beneath the ground floor slabs in occupied and finished spaces, or those with moisture sensitive spaces or floor coverings.

RADON MITIGATION SYSTEM

According to the EPA, the project is located in an area of Massachusetts which has an elevated risk of radon concentrations above recommended action levels (i.e., potential for concentrations above 4 pCi/L). The elevated risk is due to the relatively shallow granitic bedrock beneath the building footprint. Accordingly, a radon mitigation system is a recommended beneath ground floor lobby/amenity areas, as well as elevators and stairwells servicing residential floor levels. A radon mitigation system typically consists of an 8-inch-thick layer of ¾ in. crushed stone below a 15 mill Class A vapor barrier under the lowest building slab. Within the ¾ in. crushed stone layer is a network of perforate PVC pipes that are vented to the exterior of the building, typically through the roof. The building design should include routing power to the roof area in the event the system needs to be activated with mechanical fans.

UTILITIES AND OTHER SITE IMPROVEMENTS

We recommend that the following considerations be incorporated into the preliminary design:

- Utilities below soil-supported slabs-on-grade within the building footprint may be earth-supported and installed using conventional methods.
- Site utilities can be supported in the natural Glacial Deposits or Fill soils. Oversized materials, if present at the subgrade level, should be removed to preclude a "hard spot" along the utility bottom that could damage or break the utility. *We recommend that additional investigations be considered in areas of deep manhole structures or other utility corridors to evaluate the presence of shallow bedrock. Where possible, we recommend that consideration be given to relocating these structures away from areas where significant bedrock removal may be required.*
- Stormwater recharge into the naturally deposited Glacial Till soils or Bedrock will be difficult given their low permeabilities. Refer to soil gradation test data included in Appendix B. Test pits and infiltration testing is recommended in planned recharge areas to evaluate permeability assumptions and assist the project's Civil Engineer with stormwater storage/recharge design.

EARTHWORK

Existing site grades within the limits of proposed building generally range from approximately El. 153 to El. 157, which site grades at the eastern site limits (behind the concrete block retaining walls) up to about El. 175. The anticipated bottom of excavation for the footings is generally at about El. 153 while isolated excavations for elevator pits, stormwater recharge system(s) and other utilities could extend to even greater elevations. Accordingly, we anticipate *typical* cuts of about 3 to 4 at footing locations, with some deeper areas of over-excavation where fill thickness extends below design footing elevation. Along the eastern/southeastern site limits, an approximately 7 to 20 ft cut is anticipated as the proposed building benches into the existing site grades. A support of excavation system will be required to facilitate excavations to these depths while mitigating off-property impacts.

Excavations to construct the buildings will extend through the existing Fill and into the Glacial Deposits or Bedrock. Excavated materials will include pavement, soil, existing utilities, cobbles, boulders, bedrock, and possibly miscellaneous debris. Based on prior experience in the Waltham area, we recommend an allowance for screening (remove oversize cobbles and boulders) of site soils to be reused or transported off-site for disposal.

The Fill and Glacial Deposits appear to consist primarily of fine sandy or gravelly material and appear suitable for re-use as Common Fill and potentially as compacted Structural Fill. It will be important to protect these soils during earthwork activities to the extent practical as excessive moisture may render these soils difficult to not possible to reuse as compacted fill. They will also be susceptible to disturbance from construction traffic. Placement of 3-4 inches of crushed stone on prepared foundations subgrades (with geotextile filter fabric separation) is recommended to protect the subgrades from disturbance during placement of re-bar and forms.

Based on available subsurface data and an anticipated bottom of footing at approximately EL. 153, we anticipate that up to approximately 2 ft of rock removal may be required beneath portions of the building footprint. Excavation of *soils* for foundation construction can likely be conducted using normal mechanized earth-moving equipment. Excavation of *rock* for foundation construction will be difficult. Prior to final design and construction, we recommend that test pits be conducted in areas of high bedrock to assess the bedrock quality to determine if the rock can be removed using hoe ram/excavation methods or if blasting or other means will be required. For initial project planning and pricing we recommend that you carry an allowance for bedrock removal and assume 50 % of the footprint will require bedrock removal of 2 feet.

DEWATERING

Building excavations are anticipated to be above normal groundwater levels; accordingly, temporary dewatering to allow for construction in the dry is not anticipated to be required with the exception of that necessary for controlling precipitation that falls on excavations and surface water runoff that collects in excavations. Localized dewatering may be required for locally deeper excavations or on an intermittent basis during periods of moderate to heavy precipitation or snow melt.

TEMPORARY SUPPORT OF EXCAVATION

Temporary earth support consisting of soldier piles and timber lagging is anticipated along the east/southeast perimeter as cuts of up to approximately 7 to 20-ft may be required to construct the lowest parking level. Given the density and composition of the Fill/Glacial soils, and the likely need to embed the soldier piles into the underlying Bedrock, we do *not* anticipate vibratory methods will be feasible for installing the piles. Instead, we recommend that solider piles be installed using drilled methods.

When site cuts (in favorable soil conditions) are less than about 15-ft, temporary excavation system systems can often be cantilevered, assuming that up to about 2 to 4 inches of movement at the top of the system is permissible. Permissible magnitude of excavation support movement will need to consider off-site impacts to adjacent utilities/infrastructure, as well as potential encroachment into alignment of the perimeter foundation wall (particularly if blindside forming/waterproofing is planned based upon Contractor means and methods). For planning purposes, we recommend that solider piles and timber lagging be assumed internally braced using a continuous waler and steel rakers when planned excavation depths are greater than about 15-ft. These conditions will need to be evaluated further during subsequent stages of design.

ADDITIONAL EXPLORATIONS AND TESTING

Based on the observations during this due diligence phase, we recommend that additional explorations consisting of test pits and test borings be conducted to further investigate subsurface conditions and help advance the following evaluations:

- Feasibility of foundation bearing on/within the existing Fill material.
- Final evaluation/design of east perimeter excavation support system.
- Subsurface conditions (and more specifically depth to bedrock and quality of bedrock) within areas of planned building foundations, utility corridors, and deep utility structures.
- Permeability testing and/or textural classification of soils within the plan limits of proposed stormwater recharge system(s).

The types, numbers, and locations of additional explorations will depend on the final development and utility layout, stormwater infiltration locations, and proposed grading.

CONCLUDING COMMENTS

This report provides preliminary information and comments on geotechnical aspects of development of the subject site based on available information. The comments provided herein are not suitable for final design of any structure. Additional subsurface explorations and engineering evaluations will be needed to better define subsurface conditions and for final design and construction of the subject buildings.

Thank you for the opportunity to assist WP East Acquisitions, LLC on this matter. We trust the information provided herein is helpful to your current planning, and we look forward to assisting you with future phases of the project. Please do not hesitate to contact us if you wish to discuss the contents of this report.

Sincerely yours,
HALEY & ALDRICH, INC.

Lee S. Vanzler, P.E. (MA)	Michael J. Weaver, P.E. (MA)
Senior Project Manager	Senior Associate

Attachments:

Table I	Summary of Haley & Aldrich Test Boring Data
Figure 1	Project Locus
Figure 2	Site and Subsurface Exploration Location Plan
Figure 3	Conceptual Over-Excavation Details
Appendix A	Logs of Recent Test Borings
Appendix B	Soil Gradation Testing

TABLES

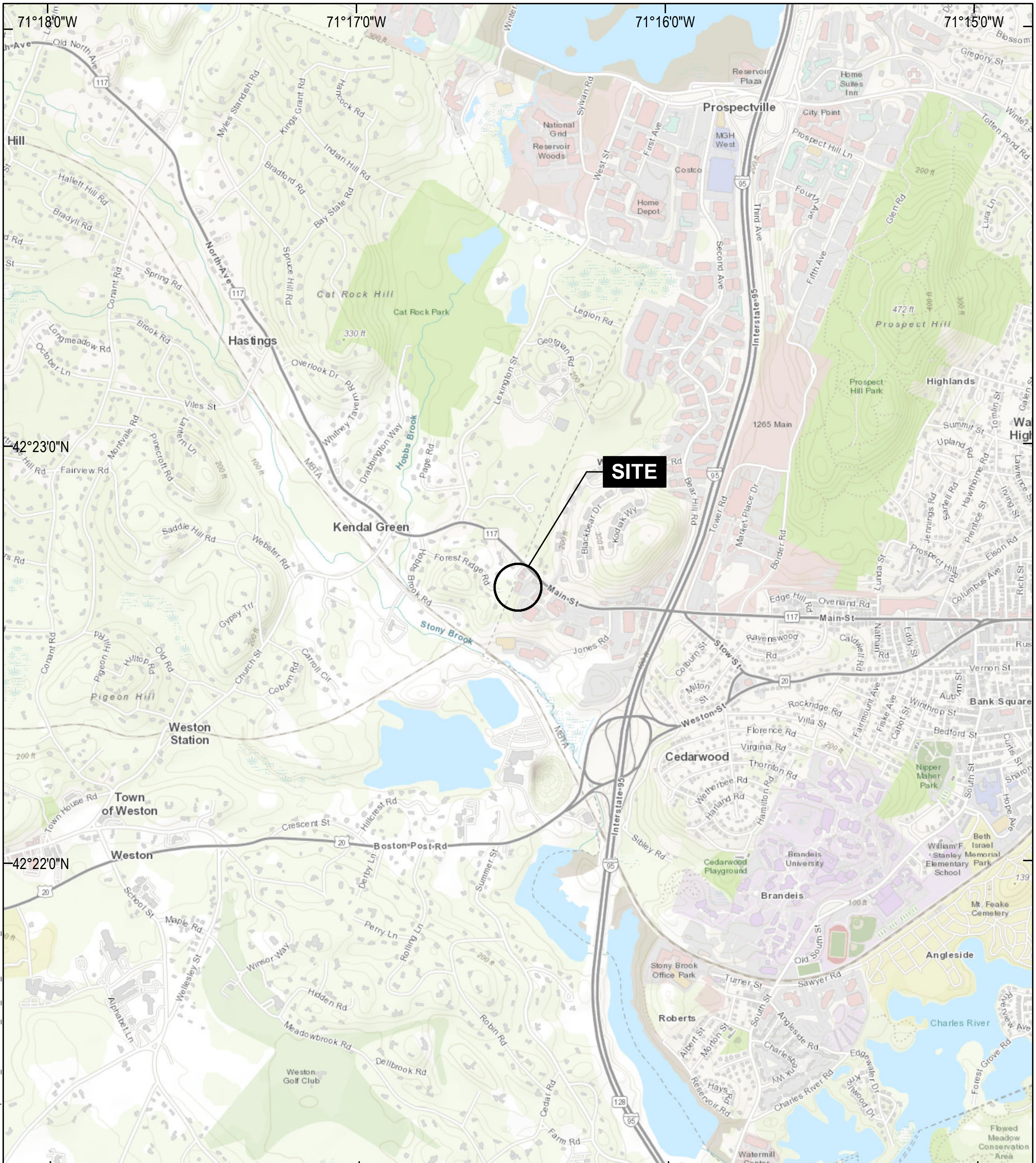
TABLE I - SUMMARY OF HALEY & ALDRICH EXPLORATION DATA
1486 MAIN STREET
WALTHAM, MASSACHUSETTS
FILE NO.: 0200959-001

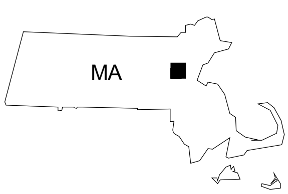
Test Boring ID	Ground Surface Elevation, ft (NAVD88)	Total Exploration Depth (ft)	Fill		Glacial Till		Bedrock
			Top Elevation (ft)	Thickness (ft)	Top Elevation (ft)	Thickness (ft)	Top Elevation (ft)
HA-01	157.0	19.5	157.0	14.0	143.0	5.5	137.5
HA-02	156.0	16.0	156.0	8.0	148.0	BNE	--
HA-03	156.7	11.0	156.7	0.4	156.3	1.2	155.1
HA-04	156.7	5.5	156.7	0.4	156.3	1.3	155.0
HA-05	164.7	19.0	164.7	6.0	158.7	6.0	152.7
HA-06	156.7	6.5	156.7	0.4	156.3	1.0	155.3

NOTES:

1. Elevations are in feet and reference the North Amercian Vertical Datum of 1988 (NAVD88). Surface elevations are estimated based on interpolation of surface grades provided on Existing Conditions Plan.
2. "-" = Not Encountered
3. BNE = Bottom of Soil Layer Not Encountered

FIGURES





N

MAP SOURCE: ESRI
SITE COORDINATES: 42°22'40"N, 71°16'29"W

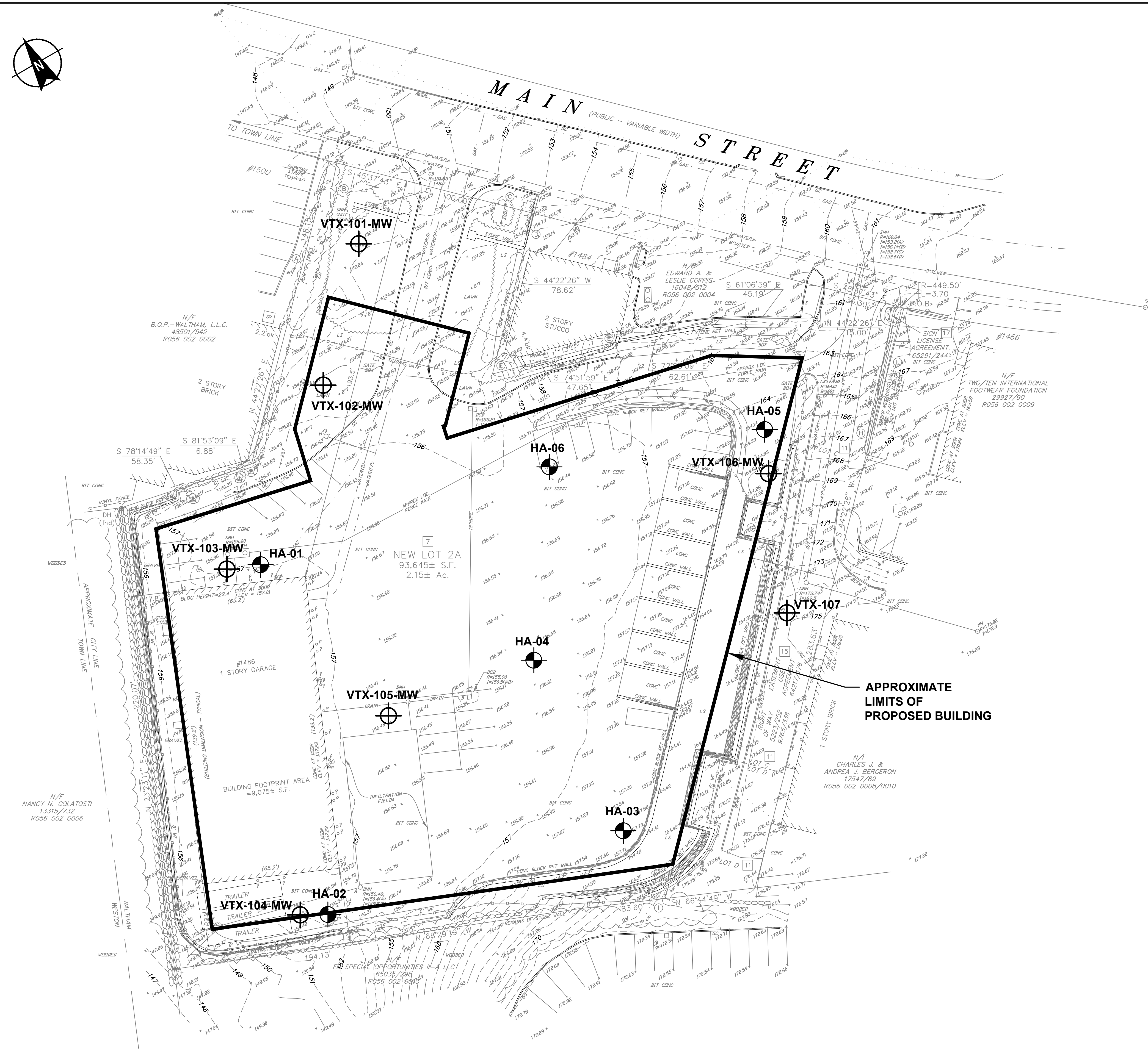
HALEY ALDRICH

1486 MAIN STREET
WALTHAM, MASSACHUSETTS

PROJECT LOCUS

APPROXIMATE SCALE: 1 IN = 2000 FT
NOVEMBER 2021

FIGURE 1



LEGEND

HA-01 — DESIGNATION AND APPROXIMATE LOCATION OF TEST BORING EXPLORATION CONDUCTED BY NEW ENGLAND BORING GEOTECH AND OBSERVED BY HALEY & ALDRICH, INC. BETWEEN 3 AND 7 JUNE 2021

VTX-101-MW — TEST BORING EXPLORATION CONDUCTED BY NEW ENGLAND BORING GEOTECH AND OBSERVED BY VERTEX BETWEEN 2 AND 4 JUNE 2021

(OW) — INDICATES OBSERVATION WELL INSTALLED IN COMPLETED BOREHOLE

NOTES

1. PLAN TAKEN FROM "ALTA/NSPS LAND TITLE SURVEY"PREPARED BY PRECISION LAND SURVEYING, INC. AND DATED 11 NOVEMBER 2020.
2. ELEVATIONS SHOWN ARE IN FEET AND REFERENCE THE NORTH AMERICAN VERTICAL DATUM IN 1988 (NAVD88).
3. PROPOSED LIMITS OF BUILDING TAKEN FROM DRAWING TITLED "LAYOUT & MATERIALS PLAN, C-101" PREPARED BY ALLEN & MAJOR ASSOCIATES, INC. AND DATED 15 DECEMBER 2020.

0 50 100
SCALE IN FEET

HALEY ALDRICH

1486 MAIN STREET
WALTHAM, MASSACHUSETTS

SITE AND SUBSURFACE EXPLORATION LOCATION PLAN

SCALE: AS SHOWN
NOVEMBER 2021

FIGURE 2

Saved by: DTE
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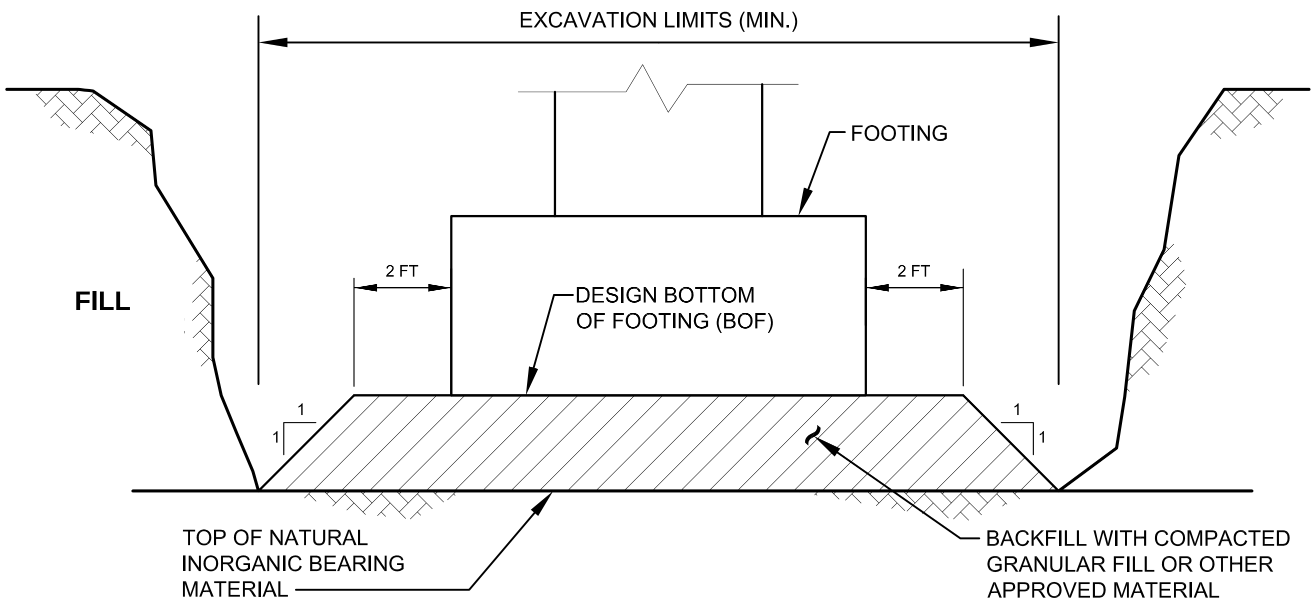
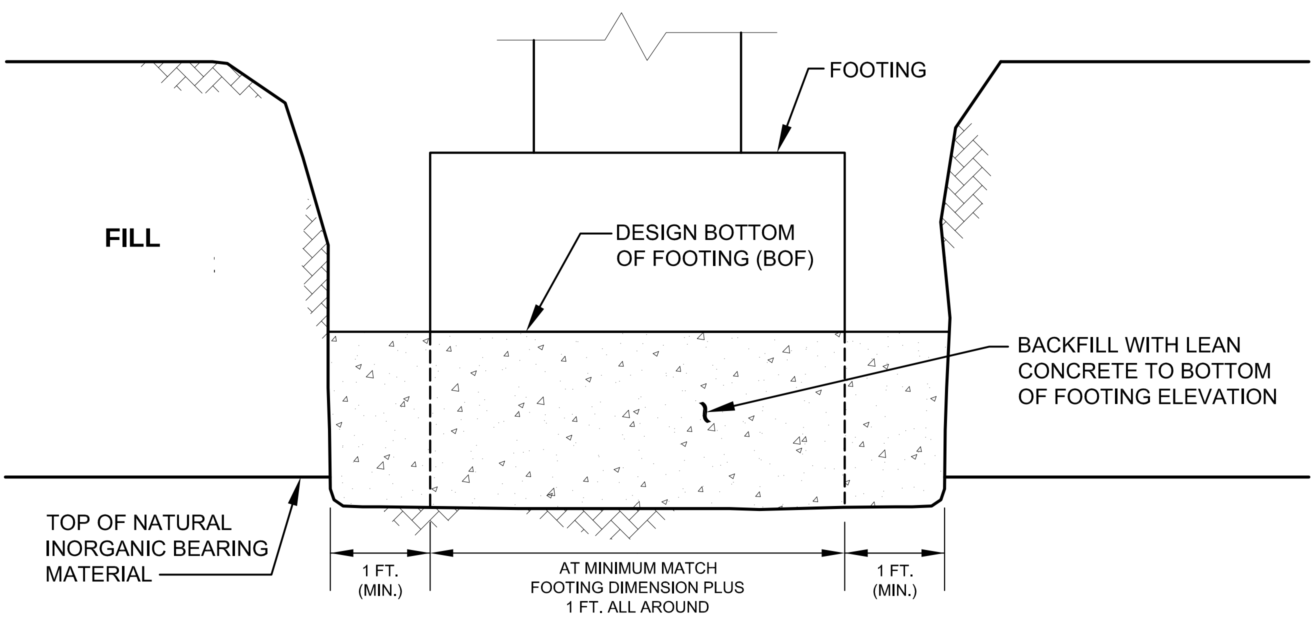


FOOTING BEARING ON GRANULAR FILL
NOT TO SCALE



FOOTING BEARING ON LEAN CONCRETE
NOT TO SCALE

HALEY ALDRICH
1486 MAIN STREET
WALTHAM, MASSACHUSETTS

CONCEPTUAL
OVER - EXCAVATION DETAILS

SCALE: AS SHOWN
NOVEMBER 2021

FIGURE 3

MCELENEY, TERRI Printed: September 3, 2015Layout: A077
Drawing: J:\GRAPHICS\35060\35060-403-A077.DWG

APPENDIX A

Logs of Recent Test Borings

HALEY ALDRICH

TEST BORING REPORT

Boring No. HA-01

Project 1486 MAIN ST, WALTHAM, MA
Client WP EAST ACQUISTIONS, LLC
Contractor NEW ENGLAND BORING CONTRACTORS

File No. 0200959-000
Sheet No. 1 of
Start June 3, 2021
Finish June 3, 2021
Driller K. Smith
H&A Rep. D. Palleiko
Elevation 157.0 (est.)
Datum NAVD88
Location See Plan

	Casing	Sampler	Barrel
Type	HW	S	
Inside Diameter (in.)	4	1.4	
Hammer Weight (lb)	300	140	-
Hammer Fall (in.)	24	30	-

Drilling Equipment and Procedures
Rig Make & Model: GEFCO Strata Star
Bit Type: Roller Bit
Drill Mud: None
Casing: Driven
Hoist/Hammer: Winch / Automatic hammer
PID Make & Model: Not used

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0					156.6 0.4	-ASPHALT ROADWAY-										
	14 12 18	S1 7	0.5 2.0	SP-SM		Medium dense light-brown poorly-graded SAND with silt and gravel (SP-SM), no odor		15		5	70	10				
	11 11 10 20	S2 8	2.0 4.0	SP-SM		Medium dense light-brown poorly-graded SAND with silt (SP-SM), no odor, moist Note: sample collected for soil gradation testing.		29	7	17	30	17				
5	37 22 16 18	S3 7	4.0 6.0	SM		Dense brown silty SAND with gravel (SM), blocky, no odor, moist to wet - TILL FILL -	5	15	5	5	40	30				
	16 16 17 7	S4 5	6.0 8.0	SM		Dense brown silty SAND with gravel (SM), blocky, wet	10	10	5	15	35	25				
	5 5 12 21	S5 4	8.0 10.0	GM		Medium dense gray-brown silty GRAVEL with sand (GM), no odor, wet, limited recovery	60	5		10	10	15				
10	10 14 4 6	S6 3	10.0 12.0	GM		Medium dense gray-brown silty GRAVEL with sand (GM), no odor, wet, limited recovery	60	5		10	10	15				
	8 13 18 40	S7 5	12.0 14.0	GM		Dense gray-brown silty GRAVEL with sand (GM), no odor, wet, limited recovery	60	5		10	10	15				
15	33 51 53 100/4"	S8 14	14.0 15.8	SM	143.0 14.0	Very dense gray-brown silty SAND with gravel (SM), bonded, no odor, moist to wet - GLACIAL TILL -	10	10	20	15	25	20				
	110	S9 5	19.0 19.5	SM	137.5 19.5	Very dense gray-brown silty SAND with gravel (SM), Bonded, no odor, moist to wet. - GLACIAL TILL - BOTTOM OF EXPLORATION 19.5 FT refusal on probable bedrock	10	10	20	15	25	20				

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
					4.0-5.0

Sample ID
O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram
Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary
Overburden (ft) 19.5
Rock Cored (ft) -
Samples S9

Boring No. HA-01

Field Tests:
Dilatancy: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

†**Note: Maximum particle size is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

HALEY ALDRICH

TEST BORING REPORT

Boring No. HA-02

Project	1486 MAIN ST, WALTHAM, MA	File No.	0200959-000
Client	WP EAST ACQUISTIONS, LLC	Sheet No.	1 of
Contractor	NEW ENGLAND BORING CONTRACTORS	Start	June 3, 2021
		Finish	June 3, 2021
		Driller	K. Smith
		H&A Rep.	D. Palleiko
		Elevation	156.0 (est.)
		Datum	NAVD88
		Location	See Plan

	Casing	Sampler	Barrel
Type	HW	S	
Inside Diameter (in.)	4	1.4	
Hammer Weight (lb)	300	140	-
Hammer Fall (in.)	24	30	-

Drilling Equipment and Procedures

Rig Make & Model: GEFCO Strata Star
Bit Type: Roller Bit
Drill Mud: None
Casing: Driven
Hoist/Hammer: Winch / Automatic hammer
PID Make & Model: Not used

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0					155.6 0.4	-ASPHALT ROADWAY-										
	16 20 45	S1 9	0.5 2.0	SM		Very dense brown to light-brown silty SAND with gravel (SM), no odor, moist	10	15	10	20	30	15				
	79 77 26 35	S2 16	2.0 4.0	SM		Very dense brown with gray silty SAND with gravel (SM), moist, trace concrete Note: sample collected for soil gradation testing.		31	11	17	19	22				
5	8 10 20 14	S2 6	4.0 6.0	SM		Medium dense light-brown silty SAND with gravel (SM), blocky, moist to wet - TILL FILL -		33	9	15	21	22				
	8 7 9 16	S4 2	6.0 8.0	SM		Note: sample collected for soil gradation testing. Medium dense light-brown silty SAND with gravel (SM), blocky, no odor, wet	15	15		10	45	15				
	46 48 72 72	S5 12	8.0 10.0	SM	148.0 8.0	Very dense gray-brown silty SAND with gravel (SM), bonded, moist	5	15	5	5	50	20				
10	61 100/4"	S6	10.0 10.8	SM		Very dense gray to gray-brown silty SAND with gravel (SM), cemented, moist - GLACIAL TILL - Rough drilling	5	10		10	60	15				
15	37 79 43 54	S7 12	14.0 16.0	SM		Very dense gray to gray-brown silty SAND with gravel (SM), cemented, moist	5	10		10	60	15				
					140.0 16.0	BOTTOM OF EXPLORATION 16.0 FT										

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
					4.0-5.0

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft) 16.0
Rock Cored (ft) -
Samples S7

Boring No. HA-02

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Plasticity**: N - Nonplastic L - Low M - Medium H - High
Toughness: L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

HALEY ALDRICH — TEST BORING REPORT

Boring No. HA-03

Project	1486 MAIN ST, WALTHAM, MA	File No.	0200959-000
Client	WP EAST ACQUISTIONS, LLC	Sheet No.	1 of 2
Contractor	NEW ENGLAND BORING CONTRACTORS	Start	June 7, 2021
		Finish	June 7, 2021
		Driller	K. Smith
		H&A Rep.	D. Palleiko
		Elevation	156.7 (est.)
		Datum	NAVD88
		Location	See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HW	S	NX	Rig Make & Model: GEFCO Strata Star
Inside Diameter (in.)	4	1.4	2.0	Bit Type: Roller Bit; Drill Mud: None
Hammer Weight (lb)	300	140	-	Casing: Driven; Hoist/Hammer: Winch / Automatic hammer
Hammer Fall (in.)	24	30	-	PID Make & Model: Not used

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0					156.3 0.4	-ASPHALT ROADWAY-										
	10 61 100/1"	S1 8	0.5 1.6	SM		Very dense gray-brown to brown silty SAND with gravel (SM), bonded, no odor, moist	5	15	15	10	30	25				
					155.1 1.6	- GLACIAL TILL - TOP OF BEDROCK 1.6 FT										
						Advanced rollerbit to 3.0 start C1 SEE CORE BORING REPORT FOR ROCK DETAILS										
5																

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water

Sample ID
O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram
Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary
Overburden (ft) 1.6
Rock Cored (ft) 3.4
Samples S1, C1

Boring No. HA-03

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

HALEY ALDRICH

CORE BORING REPORT

Boring No. **HA-03**
File No. 0200959-000
Sheet No. 2 of 2

Depth (ft)	Drilling Rate (min./ft)	Run No.	Run Depth (ft)	Recovery/RQD in.	Recovery/RQD %	Weath-ering	Elev./Depth (ft)	Visual Description and Remarks
								SEE TEST BORING REPORT FOR OVERBURDEN DETAILS
	5 5 5	C1	2.0 5.0	32.0 8.0	89 22	fresh		Very hard, fresh to slightly weathered, gray, aphanitic to medium grained, QUARTZITE. Primary joint set, low angle, close to moderate, smooth, discolored, bed parallel. Secondary joint set, high angle. close, manganese, discolored weathering, iron staining on joint set with halo.
5	5						151.7 5.0	-BEDROCK-
								BOTTOM OF EXPLORATION 5.0 FT
10								
15								
20								
25								
30								
35								

TEST BORING REPORT

Boring No. HA-04

Project	1486 MAIN ST, WALTHAM, MA	File No.	0200959-000
Client	WP EAST ACQUISTIONS, LLC	Sheet No.	1 of 2
Contractor	NEW ENGLAND BORING CONTRACTORS	Start	June 3, 2021
		Finish	June 4, 2021
		Driller	K. Smith
		H&A Rep.	D. Palleiko
		Elevation	156.7 (est.)
		Datum	NAVD88
		Location	See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HW	S	NX	Rig Make & Model: GEFCO Strata Star
Inside Diameter (in.)	4	1.4	2.0	Bit Type: Roller Bit Drill Mud: None
Hammer Weight (lb)	300	140	-	Casing: Driven
Hammer Fall (in.)	24	30	-	Hoist/Hammer: Winch / Automatic hammer PID Make & Model: Not used

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0					156.3 0.4	-ASPHALT ROADWAY-										
	25 54 100/2"	S1	0.5 1.7	SM		Very dense gray-brown to brown silty SAND with gravel (SM), bonded, no odor, moist		40	12	17	12	19				
					155.0 1.7	- GLACIAL TILL - Note: sample collected for soil gradation testing. TOP OF BEDROCK 1.7 FT										
						Advanced rollerbit to 4.0 start C1										
						SEE CORE BORING REPORT FOR ROCK DETAILS										
5																

Water Level Data						Sample ID	Well Diagram	Summary
Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water	O - Open End Rod T - Thin Wall Tube U - Undisturbed Sample S - Split Spoon Sample	Riser Pipe Screen Filter Sand Cuttings Grout Concrete Bentonite Seal	Overburden (ft) 1.7 Rock Cored (ft) 3.8 Samples S1, C1
								Boring No. HA-04

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†**Note: Maximum particle size is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

HALEY ALDRICH

CORE BORING REPORT

Boring No. **HA-04**
File No. 0200959-000
Sheet No. 2 of 2

Depth (ft)	Drilling Rate (min./ft)	Run No.	Run Depth (ft)	Recovery/RQD in.	Recovery/RQD %	Weath-ering	Elev./ Depth (ft)	Visual Description and Remarks
								SEE TEST BORING REPORT FOR OVERBURDEN DETAILS
5		C1	4.0 5.5	17.0 10.0	94 56	fresh	151.2 5.5	Very hard, fresh to slightly weathered, gray, aphanitic to medium grained, QUARTZITE. Primary joint set,low angle, close to moderate, smooth, discolored weathering, bed parallel. Secondary joint set, high angle, close, manganese infilling, discolored weathering, iron staining on joint set with halo. -BEDROCK- BOTTOM OF EXPLORATION 5.5 FT
10								
15								
20								
25								
30								
35								

HALEY ALDRICH — TEST BORING REPORT

Boring No. HA-05

Project	1486 MAIN ST, WALTHAM, MA
Client	WP EAST ACQUISTIONS, LLC
Contractor	NEW ENGLAND BORING CONTRACTORS

	Casing	Sampler	Barrel
Type	HW	S	NX
Inside Diameter (in.)	4	1.4	2.0
Hammer Weight (lb)	300	140	-
Hammer Fall (in.)	24	30	-

Drilling Equipment and Procedures
Rig Make & Model: GEFCO Strata Star
Bit Type: Roller Bit
Drill Mud: None
Casing: Driven
Hoist/Hammer: Winch / Automatic hammer
PID Make & Model: Not used

File No. 0200959-000
Sheet No. 1 of
Start June 3, 2021
Finish June 4, 2021
Driller K. Smith
H&A Rep. D. Palleiko
Elevation 164.7 (est.)
Datum NAVD88
Location See Plan

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0					164.3 0.4	-ASPHALT ROADWAY-										
	48 20 28	S1 9	0.5 2.0	SM		Dense gray-brown to light-brown silty SAND with gravel (SM), no odor, moist	5	15	5	10	40	25				
	31 41 32 46	S2 11	2.0 4.0	SM		Very dense light-brown silty SAND with gravel (SM), no odor, moist - TILL FILL -	5	15	5	15	35	25				
5	30 54 38 49	S3 10	4.0 6.0	GW		Very dense tan to yellow-brown well-graded GRAVEL with sand (GW), no odor, wet, blast rock fill	35	40	10	10	5					
	66 75 70 39	S4 15	6.0 8.0	SM	158.7 6.0	Very dense light-brown silty SAND with gravel (SM), bonded, no odor, moist	5	15	5	10	40	25				
	79 54 123 51	S5 9	8.0 10.0	SM		Very dense gray-brown with brown silty SAND with gravel (SM), bonded, no odor, moist to wet - GLACIAL TILL -	5	15	10	20	30	20				
10	51 42 40 56	S6 9	10.0 12.0	SM		Very dense brown to gray-brown silty SAND with gravel (SM), bonded, no odor, moist	5	15	10	20	30	20				
					152.7 12.0	TOP OF BEDROCK 12.0 FT										
15	20 16 10 7	S7 14	14.0 16.0	SC		Medium dense yellow-brown to yellow clayey SAND with gravel (SC), exhibits relict bedrock structure, no odor, moist - WEATHERED BEDROCK -	5	25	5	15	30	20				
						Hard, Top of sound bedrock at 18.5 ft										
		NA 0	19.0 19.0		145.7 19.0	BOTTOM OF EXPLORATION 19.0 FT										

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
					9.0

Sample ID
O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram
Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary
Overburden (ft) 18.5
Rock Cored (ft) 0.5
Samples S8

Boring No. HA-05

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†**Note: Maximum particle size is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

HALEY ALDRICH

TEST BORING REPORT

Boring No. HA-06

Project	1486 MAIN ST, WALTHAM, MA
Client	WP EAST ACQUISTIONS, LLC
Contractor	NEW ENGLAND BORING CONTRACTORS

File No.	0200959-000
Sheet No.	1 of 2
Start	June 7, 2021
Finish	June 7, 2021
Driller	K. Smith
H&A Rep.	D. Palleiko
Elevation	156.7 (est.)
Datum	NAVD88
Location	See Plan

	Casing	Sampler	Barrel
Type	HW	S	NX
Inside Diameter (in.)	4	1.4	2.0
Hammer Weight (lb)	300	140	-
Hammer Fall (in.)	24	30	-

Drilling Equipment and Procedures

Rig Make & Model: GEFCO Strata Star
Bit Type: Roller Bit
Drill Mud: None
Casing: Driven
Hoist/Hammer: Winch / Automatic hammer
PID Make & Model: Not used

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0					156.3 0.4	-ASPHALT ROADWAY-										
	20 140/5"	S1 9	0.5 1.4	SM	155.3 1.4	Very dense gray-brown to gray silty SAND with gravel (SM), bonded, no odor, moist	5	15	15	10	30	25				
						- TILL FILL - TOP OF BEDROCK 1.4 FT										
						Advanced rollerbit to 3.0 start C1										
						SEE CORE BORING REPORT FOR ROCK DETAILS										
5																

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	1.4
Rock Cored (ft)	7.1
Samples	S1, C1

Boring No. HA-06

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Plasticity**: N - Nonplastic L - Low M - Medium H - High
Toughness: L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†**Note: Maximum particle size is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

HALEY ALDRICH

CORE BORING REPORT

Boring No. **HA-06**
File No. 0200959-000

Depth (ft)	Drilling Rate (min./ft)	Run No.	Run Depth (ft)	Recovery/RQD in.	Recovery/RQD %	Weathering	Elev./Depth (ft)	Visual Description and Remarks
								SEE TEST BORING REPORT FOR OVERBURDEN DETAILS
		C1	3.5 8.5	42.0 7.0	70 12	fresh		Very hard, fresh to slightly weathered, gray, aphanitic to medium grained, QUARTZITE. Primary joint set, low angle, close, moderate, smooth, discolored weathering, bed parallel. Secondary joint, high angle, close, manganese, discolored weathering, iron staining on joint set with halo. -BEDROCK-
5								
							148.2 8.5	BOTTOM OF EXPLORATION 8.5 FT
10								
15								
20								
25								
30								
35								

SOIL BORING/MONITORING WELL CONSTRUCTION LOGS

Project: Wood Partners | City: Waltham | State: MA

VTX-101-MW

VERTEX

BORING INFORMATION		WELL CONSTRUCTION DETAILS		LOCATION	
Start/Completion Date:	06/02/2021 / 06/02/2021	Well Depth (ft):	15.0	Datum:	
Personnel:	Jacob Golden	Welll Diameter (in):		Lat:	
Drilling Co.:	Crawford	Screen Start/End (ft):	7.0 - 15.0	Long:	
Method:	Hollow-Stem Auger	Slot Size (in):	0.010	GS Elev (ft):	
Boring Depth (ft):	15.0	Completion Type:	Crawford	TOC (ft):	
		Casing Diameter (in):			

NOTES DRAFT

Soil were visually classified in general accordance with the Modified Burmister Soil Classification System.
PID screening as follows: Ion Science Tiger PID; 10.6 eV; RF of 1; a DL of 0.1 ppmV; calibration 100 ppmV isobutylene.

Depth (ft)	Penetration (in)	Recovered (in)	Blow Count (6 in) (1,2,3,4)				Strata	Soil Description	Well Construction	Moisture	PID (parts per million by volume)
0	60	vac truck					Fine to Medium Sand	0"-60" Light Brown FINE TO MEDIUM SAND, Trace Gravel, Trace Cobbles, No Odor.		Damp	1.7
5	24	12	4	1	1	1		0"-8" Light Brown FINE TO MEDIUM SAND, Trace Gravel, No Odor.		Moist	1.3
							Sand and Silt	8"-12" Light Brown SILT, Some Brown Fine Sand, Trace Light Brown Gravel, No Odor.		Moist to Wet	1.3
	24	11	7	3	5	5	Fine to Medium Sand	0"-1" Light Brown FINE TO MEDIUM SAND, Trace Gravel, No Odor.		Wet	0.8
							Sand and Silt	1"-5" Reddish Brown SILT, AND FINE SAND, Trace Gravel, No Odor.		Wet	1.5
							Fine Sand	5"-11" Light Brown FINE SAND, Some Silt, Trace Gravel, No Odor.		Wet	1.0
	24	12	11	19	33	41	Fine to Medium Sand	0"-4" Light Brown FINE TO MEDIUM SAND, Little Brown Silt, Trace Gravel, No Odor.		Wet	1.0
10							Sand and Silt	4"-12" Light Brown SILT, AND FINE SAND, Some Gravel, No Odor.		Wet	1.6
	24	14	35	35	37	42	Gravel	0"-1" Light Brown GRAVEL, No Odor.		Wet	
							Sand and Silt	1"-8" Light Brown FINE SAND, Brown SILT, AND Light Brown GRAVEL, No Odor.		Wet	1.3
								8"-14" Light Brown SILT, AND FINE SAND, Some Gravel, No Odor.		Wet	1.4
	24	10	24	17	16	17		0"-10" Light Brown SILT, AND MEDIUM TO COARSE SAND, Some Gravel, Brick, No Odor.		Wet	3.9
15											
20											

06/22/2021

SOIL BORING

Project: Wood Partners City: Waltham State: MA

VTX-102

BORING INFORMATION		LOCATION	
Start/Completion Date:	06/02/2021 / 06/04/2021	Datum:	
Personnel:	Jacob Golden	Lat:	
Drilling Co.:	Crawford	Long:	
Method:	Hollow-Stem Auger	GS Elev (ft):	
Refusal:	REFUSAL AT 8.5 ft.		
Boring Depth (ft):	8.5		

VERTEX®

NOTES DRAFT

PID screening as follows: Ion Science Tiger PID; 10.6 eV; RF of 1; a DL of 0.1 ppmV; calibration 100 ppmV isobutylene.
Soil were visually classified in general accordance with the Modified Burmister Soil Classification System.

Depth (ft)	Penetration (in)	Recovered (in)	Blow Count (6 in) (1,2,3,4)				Strata		Soil Description	Moisture	PID (parts per million by volume)
	60	vac truck						Fine to Medium Sand	0"-60" Light Brown FINE TO MEDIUM SAND, Trace Gravel, Trace Cobbles, No Odor.	Damp	1.8
5	1	0	50					No Recovery	"-" NO RECOVERY.		
	23	0							"-" NO RECOVERY.		
	8	2	63	50				Sand and Silt	0"-2" Brown FINE SAND, AND SILT, Some Gravel, No Odor.	Wet	1.0
	10	0						No Recovery	"-" NO RECOVERY.		
10											
15											
20											

06/22/2021

SOIL BORING/MONITORING WELL CONSTRUCTION LOGS

Project: Wood Partners City: Waltham State: MA

VTX-102A-MW

BORING INFORMATION		WELL CONSTRUCTION DETAILS		VERTEX® LOCATION	
Start/Completion Date:	06/04/2021 / 06/04/2021	Well Depth (ft):	11.0	Datum:	
Personnel:	Jacob Golden	Welll Diameter (in):		Lat:	
Drilling Co.:	Crawford	Screen Start/End (ft):	6.0 - 11.0	Long:	
Method:	Hollow-Stem Auger	Slot Size (in):	0.010	GS Elev (ft):	
Boring Depth (ft):	11.0	Completion Type:	Crawford	TOC (ft):	
		Casing Diameter (in):			

NOTES DRAFT

Soil were visually classified in general accordance with the Modified Burmister Soil Classification System.
PID screening as follows: Ion Science Tiger PID; 10.6 eV; RF of 1; a DL of 0.1 ppmV; calibration 100 ppmV isobutylene.

Depth (ft)	Penetration (in)	Recovered (in)	Blow Count (6 in) (1,2,3,4)				Strata	Soil Description	Well Construction	Moisture	PID (parts per million by volume)
	24	24					Fine to Medium Sand	0"-6" Brown FINE TO MEDIUM SAND, Some Silt, Organics, No Odor.		Dry	0.6
								6"-18" Light Brown FINE TO MEDIUM SAND, Some Gravel, Trace Cobbles, No Odor.		Dry	0.6
							Sand and Gravel	"-" Light Brown FINE TO MEDIUM SAND, AND GRAVEL, No Odor.		Dry	0.6
	12	0					No Recovery	0"-" NO RECOVERY, No Odor.			
	24	6	34	21	14	13	Fine to Medium Sand	0"-6" Brown FINE TO MEDIUM SAND, Some Silt, Some Gravel, No Odor.		Dry	0.3
5	24	18	14	21	37	43	Sand and Silt	0"-7" Brown FINE SAND, AND SILT, Some Gravel, No Odor.		Dry	0.3
							Fine to Medium Sand	7"-12" Light Brown FINE TO MEDIUM SAND, Some Gravel, No Odor.		Dry	0.4
								12"-13" Grayish Brown FINE TO MEDIUM SAND, Some Gravel, No Odor.		Dry	0.4
	18	4	36	17	16	50		13"-18" Light Brown FINE TO MEDIUM SAND, Some Gravel, Trace Silt, No Odor.		Dry	0.4
								0"-4" Light Brown FINE TO MEDIUM SAND, Some Gravel, No Odor.		Damp	0.6
	6	0					No Recovery	0"-" NO RECOVERY.			
	24	18	12	13	11	17	Sand and Silt	0"-6" Brown FINE SAND, AND SILT, Some Gravel, No Odor.		Wet	0.8
10							Fine to Medium Sand	6"-8" Reddish Brown FINE TO MEDIUM SAND, Some Gravel, Little Gravel, No Odor.		Moist	0.7
	2	50					Sand and Silt	0"-2" Brown FINE SAND, AND SILT, Some Gravel, No Odor.		Wet	1.1
15											
20											

06/22/2021

SOIL BORING/MONITORING WELL CONSTRUCTION LOGS

VTX-103-MW

Project: Wood Partners City: Waltham State: MA

VERTEX®

BORING INFORMATION

Start/Completion Date: 06/02/2021 / 06/02/2021

Personnel: Jacob Golden

Drilling Co.: Crawford

Method: Hollow-Stem Auger

Boring Depth (ft): 19.0

WELL CONSTRUCTION DETAILS

Well Depth (ft): 19.0

Welll Diameter (in):

Screen Start/End (ft): 9.0 - 19.0

Slot Size (in): 0.010

Completion Type: Crawford

Casing Diameter (in):

LOCATION

Datum:

Lat:

Long:

GS Elev (ft):

TOC (ft):

NOTES DRAFT

Soil were visually classified in general accordance with the Modified Burmister Soil Classification System.
PID screening as follows: Ion Science Tiger PID; 10.6 eV; RF of 1; a DL of 0.1 ppmV; calibration 100 ppmV isobutylene.

Depth (ft)	Penetration (in)	Recovered (in)	Blow Count (6 in) (1,2,3,4)				Strata	Soil Description	Well Construction	Moisture	PID (parts per million by volume)
	60	vac truck					Asphalt	0"-4" Black ASPHALT (PAVED).		Dry	
							Fine to Medium Sand	4"-60" Light Brown FINE TO MEDIUM SAND, Trace Gravel, No Odor.		Dry	1.4
5	24	5	4	3	9	11		0"-4" Light Brown FINE TO MEDIUM SAND, Trace Gravel, No Odor.		Dry	1.5
							Soil Not Observed	4"-5" Red PREVIOUSLY REPORTED, Brick, No Odor.		Dry	
	24	6	9	7	14	7	Fine to Medium Sand	0"-6" Light Brown FINE TO MEDIUM SAND, Trace Gravel, Trace Silt, Brick, No Odor.		Dry to Damp	1.5
10	24	7	4	4	4	9		0"-7" Brown FINE TO MEDIUM SAND, Trace Silt, Trace Gravel, Brick, No Odor.		Damp	3.3
	24	14	24	46	47	34		0"-2" Brown FINE TO MEDIUM SAND, Little Gravel, Trace Silt, No Odor.		Damp	3.5
							Gravel	2"-3" Brown GRAVEL, No Odor.		Damp	
							Fine to Medium Sand	3"-14" Brown FINE TO MEDIUM SAND, Some Gravel, Trace Silt, No Odor.		Damp	3.2
	18	12	21	27	43			0"-12" Brown FINE TO MEDIUM SAND, Little Gravel, Trace Silt, No Odor.		Moist	0.7
15	7	1	7	40	43		Sand and Silt	0"-1" Brown FINE SAND, SILT, AND GRAVEL, No Odor.		Wet	1.0
	36	0					Soil Not Observed	0"-" NO RECOVERY.			
	2	2	50				Sand and Silt	0"-2" Brown FINE SAND, SILT, AND GRAVEL, No Odor.		Wet	1.7
20	10	0					Soil Not Observed	0"-" NO RECOVERY.			

06/22/2021

SOIL BORING

Project: Wood Partners City: Waltham State: MA

VTX-104

BORING INFORMATION		LOCATION	
Start/Completion Date:	06/03/2021 / 06/03/2021	Datum:	
Personnel:	Jacob Golden	Lat:	
Drilling Co.:	Crawford	Long:	
Method:	Hollow-Stem Auger	GS Elev (ft):	
Refusal:	REFUSAL AT 11.5 ft.		
Boring Depth (ft):	11.5		

VERTEX®

NOTES DRAFT

PID screening as follows: Ion Science Tiger PID; 10.6 eV; RF of 1; a DL of 0.1 ppmV; calibration 100 ppmV isobutylene.
Soil were visually classified in general accordance with the Modified Burmister Soil Classification System.

Depth (ft)	Penetration (in)	Recovered (in)	Blow Count (6 in) (1,2,3,4)				Strata	Soil Description	Moisture	PID (parts per million by volume)
	60	vac truck					Asphalt	0"-4" Black ASPHALT (PAVED).	Dry	
							Fine to Medium Sand	4"-60" Light Brown FINE TO MEDIUM SAND, AND COBBLES, Some Gravel, No Odor.	Dry	0.6
5	24	6	14	19	12	4		0"-6" Brown FINE TO MEDIUM SAND, Some Gravel, No Odor.	Dry	0.3
	24	19	4	9	7	5		0"-14" Light Brown FINE TO MEDIUM SAND, Some Gravel, No Odor.	Dry	0.3
							Sand and Gravel	14"-19" Brown FINE TO MEDIUM SAND, AND GRAVEL, No Odor.	Dry	0.6
10	24	5	12	17	12	9		0"-5" Brown FINE TO MEDIUM SAND, AND GRAVEL, No Odor.	Dry	0.3
	6	1	12				Gravel	0"-1" Brown GRAVEL.		
15										
20										

06/22/2021

SOIL BORING/MONITORING WELL CONSTRUCTION LOGS

Project: Wood Partners City: Waltham State: MA **VTX-105-MW**

BORING INFORMATION		WELL CONSTRUCTION DETAILS		VERTEX LOCATION	
Start/Completion Date:	06/04/2021 / 06/04/2021	Well Depth (ft):	10.0	Datum:	
Personnel:	Jacob Golden	Welll Diameter (in):		Lat:	
Drilling Co.:	Crawford	Screen Start/End (ft):	5.0 - 10.0	Long:	
Method:	Hollow-Stem Auger	Slot Size (in):	0.010	GS Elev (ft):	
Boring Depth (ft):	10.0	Completion Type:	Crawford	TOC (ft):	
		Casing Diameter (in):			

NOTES DRAFT

Soil were visually classified in general accordance with the Modified Burmister Soil Classification System.
PID screening as follows: Ion Science Tiger PID; 10.6 eV; RF of 1; a DL of 0.1 ppmV; calibration 100 ppmV isobutylene.

Depth (ft)	Penetration (in)	Recovered (in)	Blow Count (6 in) (1,2,3,4)				Strata	Soil Description	Well Construction	Moisture	PID (parts per million by volume)
	36	vac truck					Asphalt	0"-4" Black ASPHALT (PAVED).		Dry	
							Fine to Medium Sand	4"-36" Light Brown FINE TO MEDIUM SAND, GRAVEL, AND COBBLES, No odor.		Dry	0.3
	24	5	8	11	21	7		0"-5" Light Brown FINE TO MEDIUM SAND, AND GRAVEL, No odor.		Dry	0.3
5	24	8	9	6	7	17		0"-8" Grayish Brown FINE TO MEDIUM SAND, Some Gravel, No odor.		Dry	0.8
	24	6	7	13	14	17		0"-3" Brown FINE TO MEDIUM SAND, Some Gravel, No odor.		Dry	1.0
								3"-6" Brown FINE TO MEDIUM SAND, Some Gravel, Trace Silt, No odor.		Moist	0.8
	6	2	23				Sand and Silt	0"-2" Brown FINE SAND, SILT, AND GRAVEL, No odor.		Moist to Wet	0.7
10	6	0					No Recovery	0"-" NO RECOVERY, No odor.			
15											
20											

06/22/2021

SOIL BORING

Project: Wood Partners City: Waltham State: MA

VTX-106

BORING INFORMATION		LOCATION	
Start/Completion Date:	06/04/2021 / 06/04/2021	Datum:	
Personnel:	Jacob Golden	Lat:	
Drilling Co.:	Crawford	Long:	
Method:	Hollow-Stem Auger	GS Elev (ft):	
Refusal:	REFUSAL AT 5 ft.		
Boring Depth (ft):	5.0		

VERTEX®

NOTES DRAFT

PID screening as follows: Ion Science Tiger PID; 10.6 eV; RF of 1; a DL of 0.1 ppmV; calibration 100 ppmV isobutylene.
Soil were visually classified in general accordance with the Modified Burmister Soil Classification System.

Depth (ft)	Penetration (in)	Recovered (in)	Blow Count (6 in) (1,2,3,4)				Strata	Soil Description	Moisture	PID (parts per million by volume)
	36	vac truck					Asphalt	0"-4" Black ASPHALT (PAVED).	Dry	
							Fine to Medium Sand	4"-36" Brown FINE TO MEDIUM SAND, Some Gravel, Little Cobbles, No Odor.	Dry	0.5
	24	3	15	12	17	21	Sand and Gravel	0"-3" Light Brown FINE TO MEDIUM SAND, AND GRAVEL, No Odor.	Dry	0.6
5										
10										
15										
20										

06/22/2021

SOIL BORING

Project: Wood Partners City: Waltham State: MA **VTX-107**

BORING INFORMATION	LOCATION
Start/Completion Date: 06/03/2021 / 06/03/2021	Datum:
Personnel: Jacob Golden	Lat:
Drilling Co.: Crawford	Long:
Method: Hollow-Stem Auger	GS Elev (ft):
Refusal: END OF BORING AT 8 REFUSAL NOT ENCOUNTERED.	
Boring Depth (ft): 8.0	

VERTEX®

NOTES DRAFT

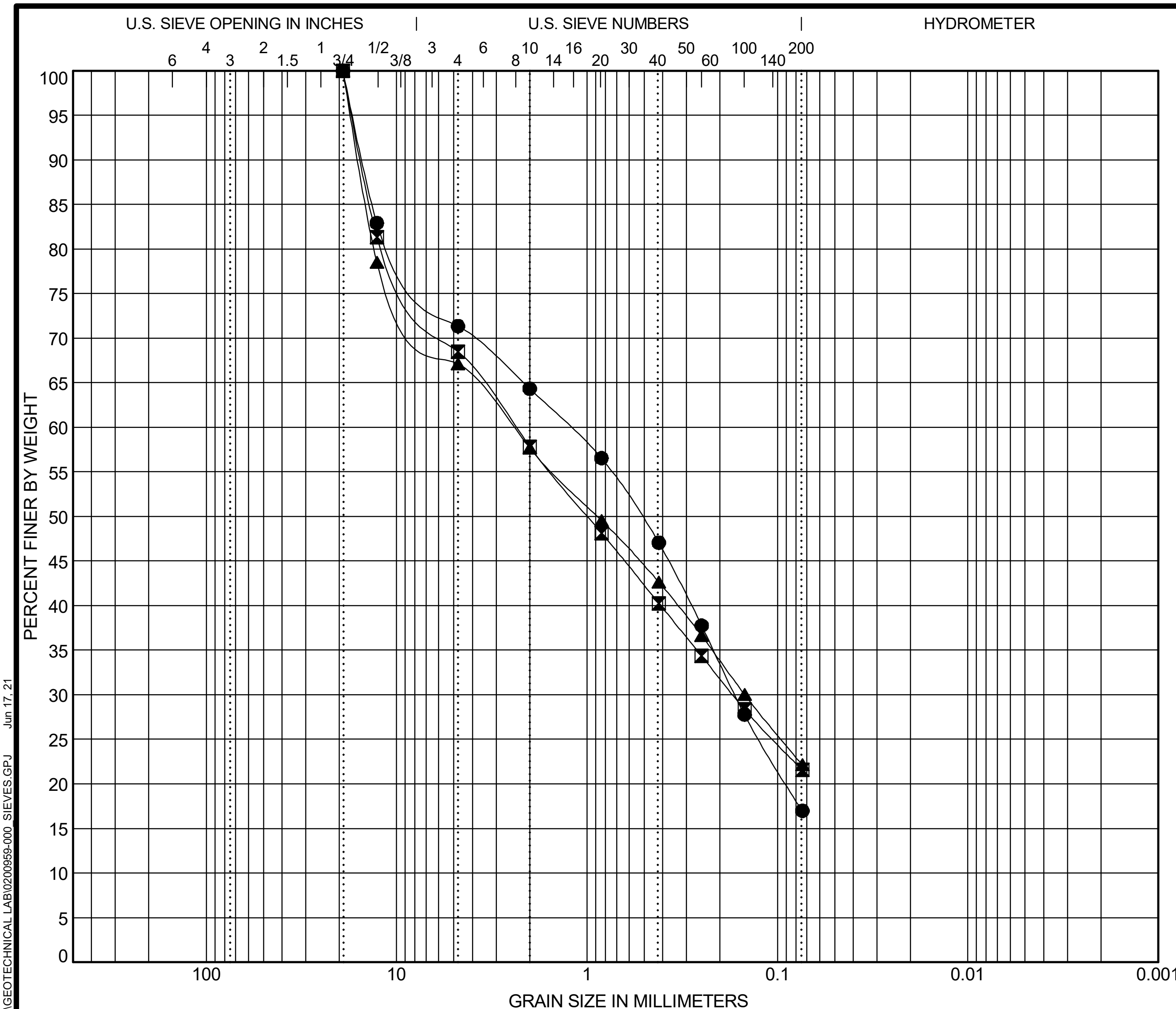
PID screening as follows: Ion Science Tiger PID; 10.6 eV; RF of 1; a DL of 0.1 ppmV; calibration 100 ppmV isobutylene.
Soil were visually classified in general accordance with the Modified Burmister Soil Classification System.

Depth (ft)	Penetration (in)	Recovered (in)	Blow Count (6 in) (1,2,3,4)				Strata	Soil Description	Moisture	PID (parts per million by volume)
	60	vac truck					Fine to Medium Sand	0"-60" Light Brown FINE TO MEDIUM SAND, Some Cobbles, Little Gravel, Asphalt, No odor.	Dry	0.5
5	12	12						0"-12" Brown FINE TO MEDIUM SAND, Some Gravel, Asphalt, No odor.	Dry	0.4
	12	12						0"-12" Brown FINE TO MEDIUM SAND, Some Gravel, No odor.	Dry	0.6
	12	12						0"-12" Brown FINE TO MEDIUM SAND, Trace Gravel, No odor.	Dry	0.3
10										
15										
20										

06/22/2021

APPENDIX B

Soil Gradation Testing



	COBBLES	% GRAVEL		% SAND			% FINES	
		COARSE	FINE	COARSE	MEDIUM	FINE	% SILT	% CLAY
●		**0.0**	**28.6**	**7.0**	**17.3**	**30.1**	**17.0**	
⧗		**0.0**	**31.5**	**10.7**	**17.6**	**18.7**	**21.6**	
▲		**0.0**	**32.9**	**9.4**	**15.0**	**20.5**	**22.1**	

	Expl. No.	Sample No.	Depth (ft.)	LL	PL	PI	Water Content (%)	Cc	Cu
●	**HA-01**	**S2**	**2-4**				**12.2**		
⧗	**HA-02**	**S2**	**2-4**				**12.8**		
▲	**HA-02**	**S3**	**4-6**				**11.7**		

	Sample Description
●	
⧗	
▲	

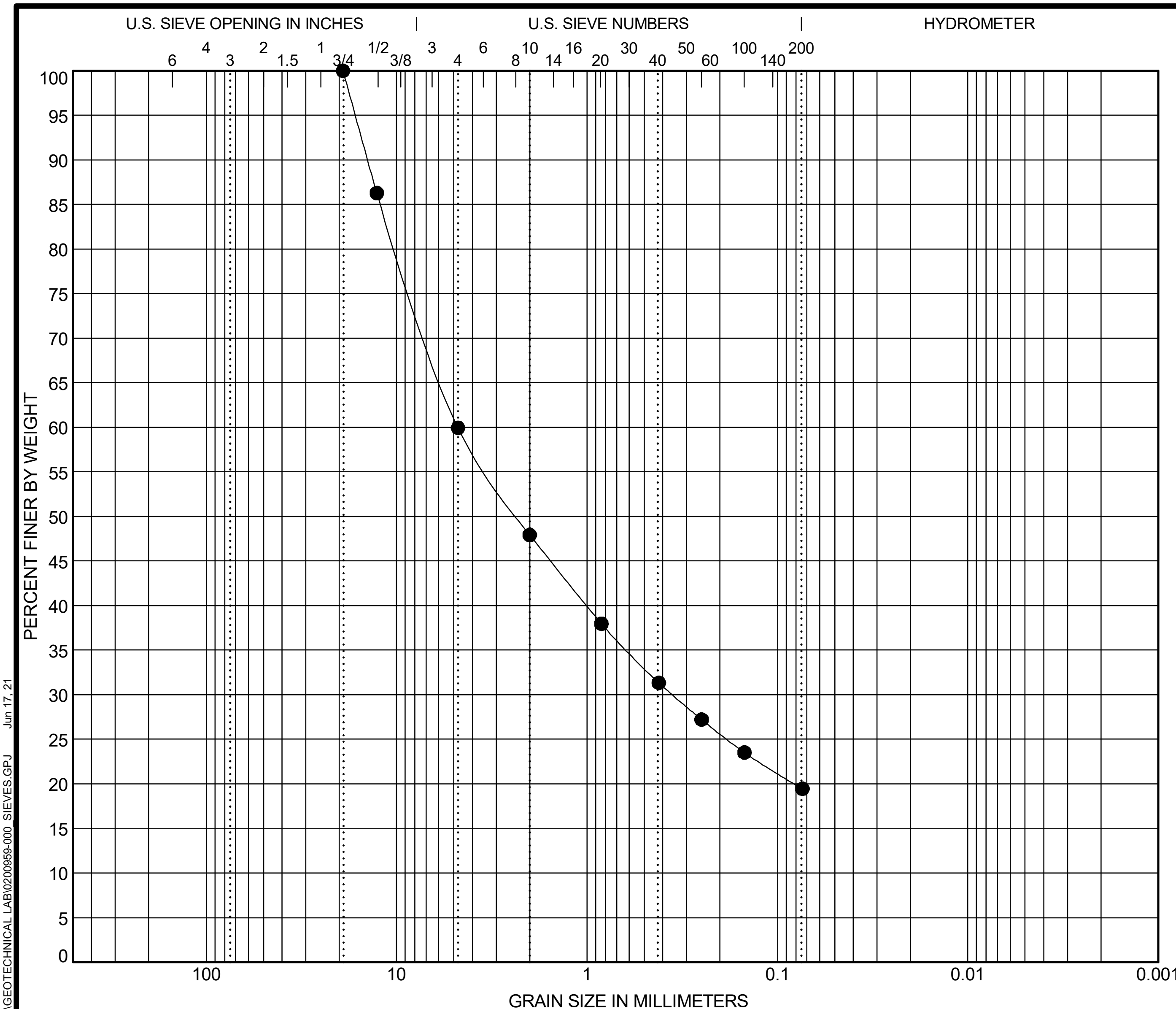
Remarks:

HALEY ALDRICH
Rocky Hill, Connecticut

1486 Main Street
Waltham, MA

GRAIN SIZE DISTRIBUTION

Date: 6/15/2021 File No.: 0200959-000



	COBBLES	% GRAVEL		% SAND			% FINES	
		COARSE	FINE	COARSE	MEDIUM	FINE	% SILT	% CLAY
●		0.0	40.0	12.0	16.6	11.9	19.4	

	Expl. No.	Sample No.	Depth (ft.)	LL	PL	PI	Water Content (%)	Cc	Cu
●	HA-04	S1	0.5-1.7				9.3		

	Sample Description
●	

Remarks:

HALEY ALDRICH
Rocky Hill, Connecticut

1486 Main Street
Waltham, MA

GRAIN SIZE DISTRIBUTION

Date: 6/15/2021 File No.: 0200959-000

H&A SIEVE USCS LABTEMP.GDT \\HALEYALDRICH.COM\SHARE\CF\PROJECTS\134015\001_MILVON TO WEST RIVER\GEOTECHNICAL LAB\0200959-000_SIEVES.GPJ Jun 17, 21

APPENDIX E
HydroCAD

2005 STORMWATER ANALYSIS

BRASSARD DESIGN + ENGINEERING

Storm Water Analysis

Supplemental Documents Accompanying Municipal Review Application

Subject Site: 1490 Main Street
Waltham, Massachusetts

Date: April 26, 2005

Brassard Design & Engineering, Inc. · 91 Prescott Street · Worcester, MA 01605
tel. 508-755-1166 fax 508-755-1945 email: contact@brassarddesign.com

CONTENTS

SITE DESCRIPTION

The 2.2 acre(+/-) project site is located at 1490 Main Street in Waltham, MA and has been generally cleared and used for storage of landscape materials and as a construction staging area. An existing building originally occupied the immediate frontage area on Main Street.

This building area and other open space areas drained overland toward the street; other portions of the site generally drain to the southwestern edge of the property and into a wooded area. Topographic relief across the original site was fairly uniform with a drainage divide running from southeast to northwest across the site as shown on Figure 1.

Based on an on-site soil test as well as visual inspection of exposed natural soil material, the surficial soils would be classified as medium to coarse loamy sand. This well-drained soil would fall under hydrologic soil group B for the purposes of runoff analysis. Brassard Design & Engineering, Inc. witnessed a test pit excavation on April 11, 2005 on the southwest corner of the project site. A test pit was excavated to a depth of 12 feet. The upper 5 feet of material was compacted fill from other parts of the site and was consistent with natural parent material in the remainder of the excavation, which as noted above consists of well graded medium to coarse sandy loam with approximately 40-50% gravel & cobbles. Some 1 – 2-foot diameter boulders were also observed. No groundwater or soil mottling was observed in any part of the excavation. No percolation test was conducted as the naturally occurring parent material was present at a depth that was unsafe for hand excavation.

PROJECT DESCRIPTION / STORM WATER MANAGEMENT

The proposed development includes the construction of a pre-fabricated building and material storage areas, and a paved access drive and maneuvering area. Runoff from the main paved area will be collected in deep-sump hooded catch basins. Runoff collected in the basins and by the roof drain (gutters & downspouts) will be directed into a subsurface storm water detention system for peak flow mitigation. Flow from the subsurface system will be controlled by the outlet structure as detailed on sheet L-03 of the project drawing set.

Reduced flow from the outlet structure will be routed into a small drywell located near the project limits in the southwest corner of the site. The purpose of the drywell is to allow excess water to surcharge and overflow from the drywell grate, promoting sheet discharge from the site in lieu of a typical point source discharge.

Runoff from the entrance drive will be collected in a catch basin that will direct flow to another drywell. Note that because the post-development runoff generated by the area tributary to Main Street is less than that generated under existing conditions, the drywell performance has not been calculated.

Calculation Methodology & Procedure

Calculations were performed to determine pipe sizes and to estimate peak runoff rates using HydroCAD™; a computer aided design program that combines SCS runoff methodology (TR-20) with standard hydraulic calculations. A model of the site's hydrology and hydraulics was developed for pre- and post-development conditions to assess the effects of the proposed development on the project site and surrounding areas.

Conventions used:

- Rainfall depths for all design storms were obtained from the "Atlas of Precipitation Extremes for the Northeastern United States and Southeastern Canada", prepared by the Northeast Regional Climate Research Center, Cornell University, Ithaca, NY; publication No. RR 93-5, September 1993. The rainfall depths listed below were used in the calculations:

Return Period (1-day accum.)	inches	adjusted for 24-hour duration
2-year	2.80	3.16in
10-year	4.20	4.75in
25-year	5.40	6.10in
100-year	7.50	8.48in

- Permeability testing was not conducted as part of the geotechnical investigation, but the soils present indicate that the parent material in the vicinity of the infiltration systems is relatively well-drained. An overall unit exfiltration rate of 0.0007cfs/sec-sf was used in the calculations.
- A minimum time of concentration of 6 minutes was used in the pre and post-development subcatchment descriptions for simplification purposes.

(all figures represent flow in cubic feet per second)

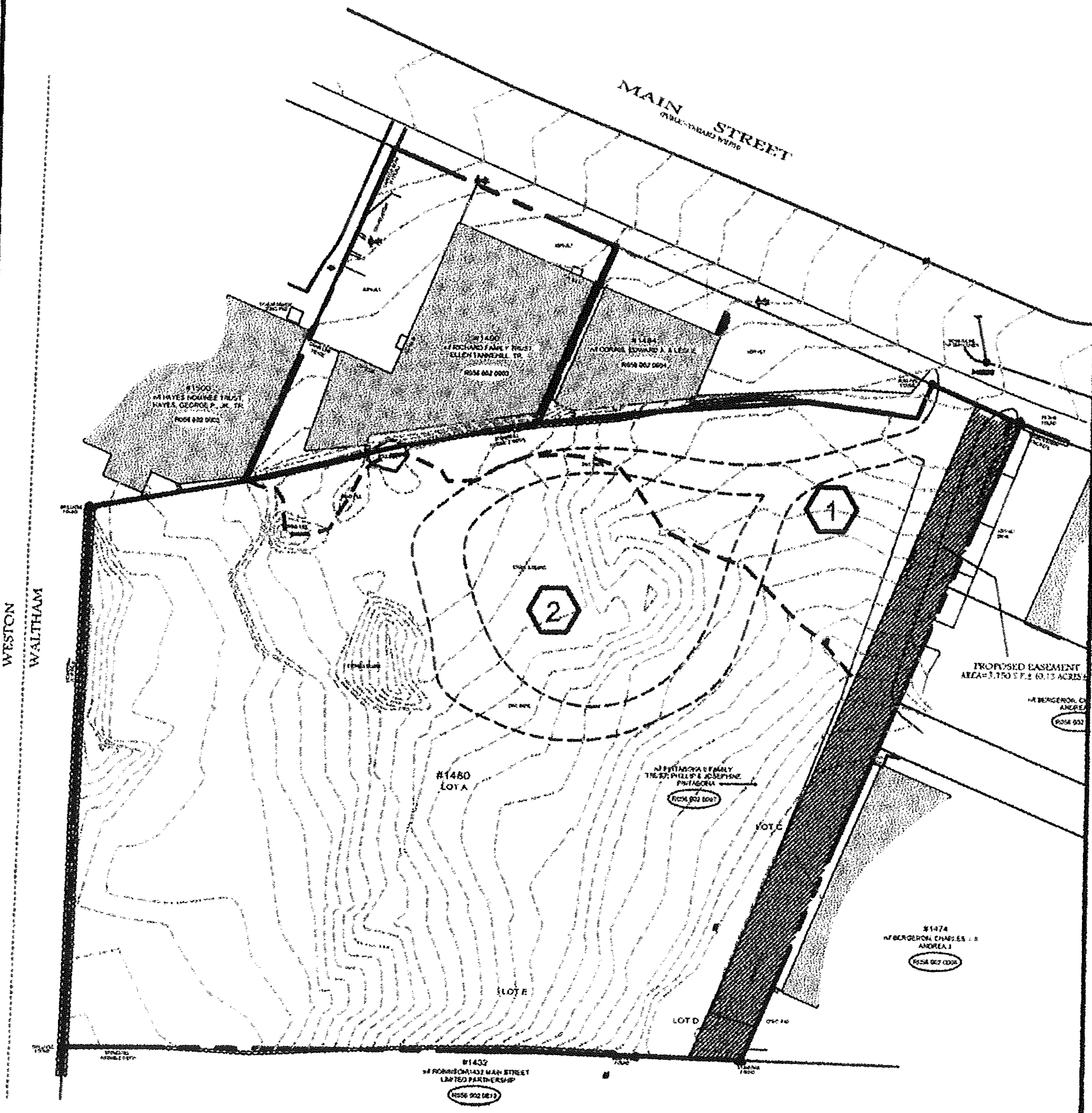
Peak Runoff Summary Table - Runoff toward Main Street				
Storm Event / Condition	2 year storm	10 year storm	25 year storm	100 year storm
Pre-Devel (Subcatch.-1)	0.9	1.7	2.3	3.5
Post-Devel (Subcatch -100)	0.6	1.2	1.7	2.7

(all figures represent flow in cubic feet per second)

Peak Runoff Summary Table - Runoff toward South West				
Storm Event / Condition	2 year storm	10 year storm	25 year storm	100 year storm
Pre-Devel (Subcatch.-2)	1.2	3.0	4.7	8.0
Post-Devel (Reach-200)	1.1	2.6	3.6	7.9

Based on the results of the calculations, the storm water management system should provide adequate peak flow mitigation for the proposed development.

List of Figures



BRASSARD DESIGN ENGINEERING

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Existing Subcatchments

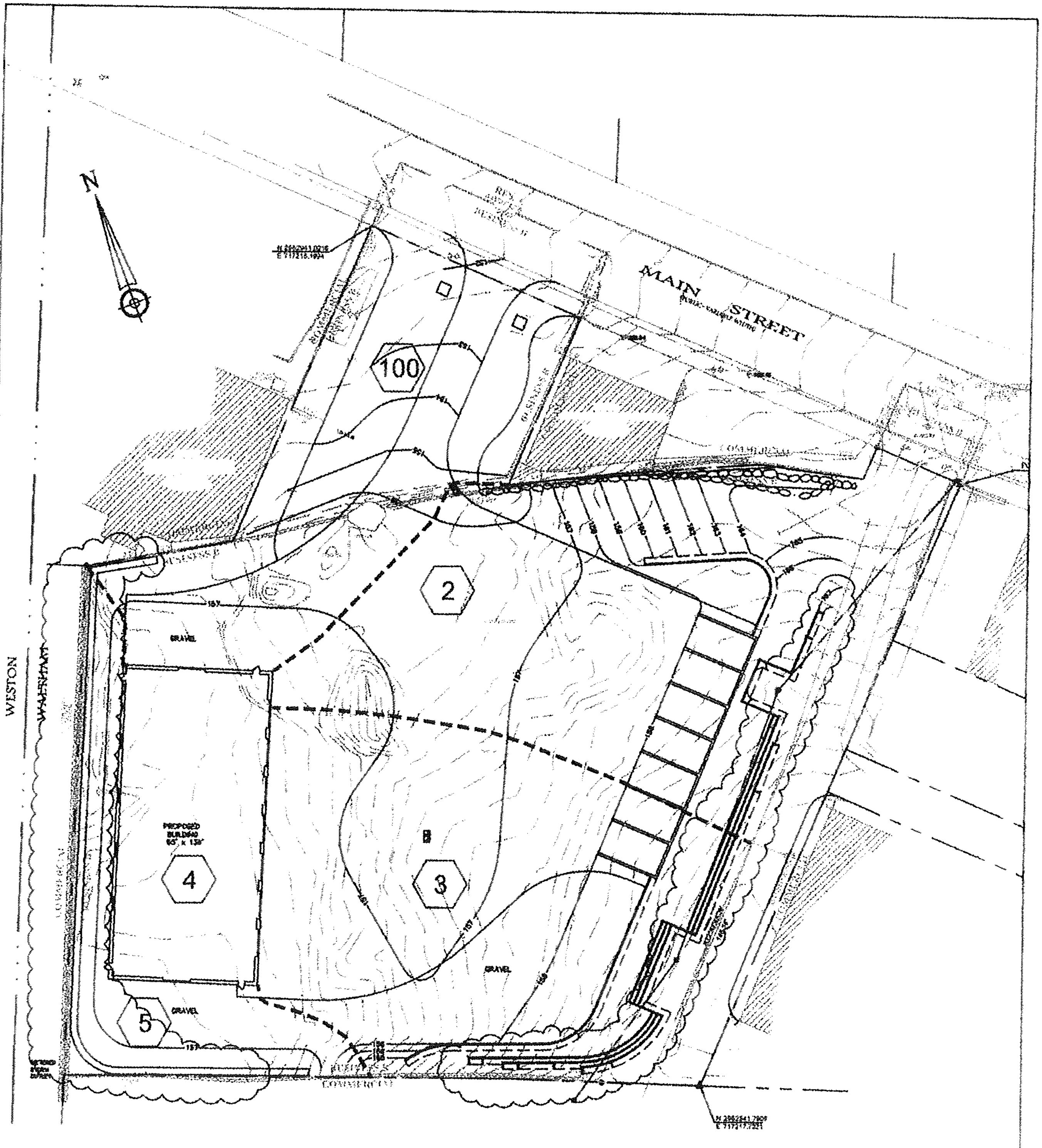
1490 Main Street

Waltham, MA

1" = 60'

4/26/05

1



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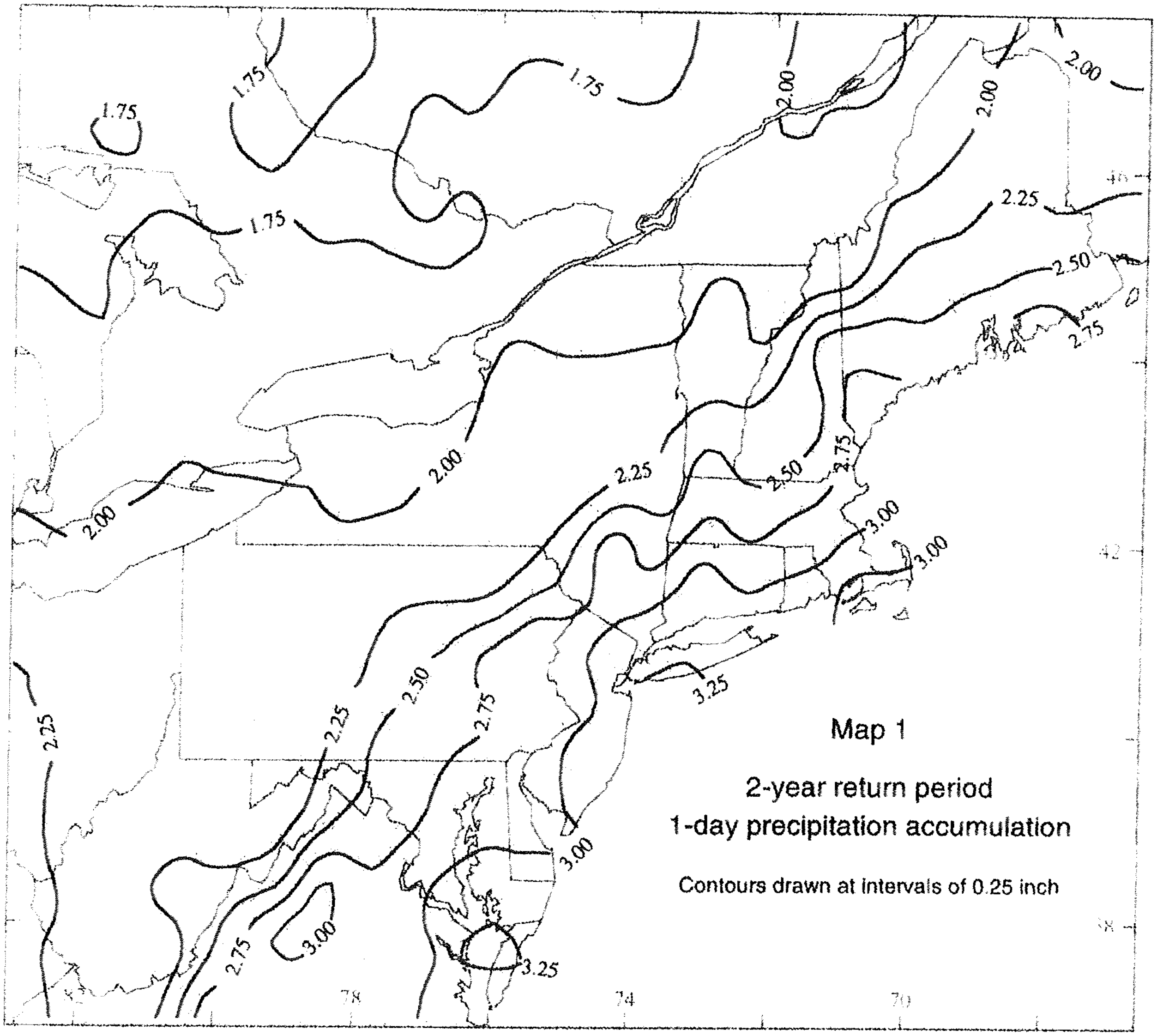
Proposed Subcatchments

1490 Main Street
Waltham, MA

1" = 60'
4/26/05

2


1.75
1.75
1.75
1.75
2.00
2.00
2.00
2.00
2.00
2.00
2.25
2.25
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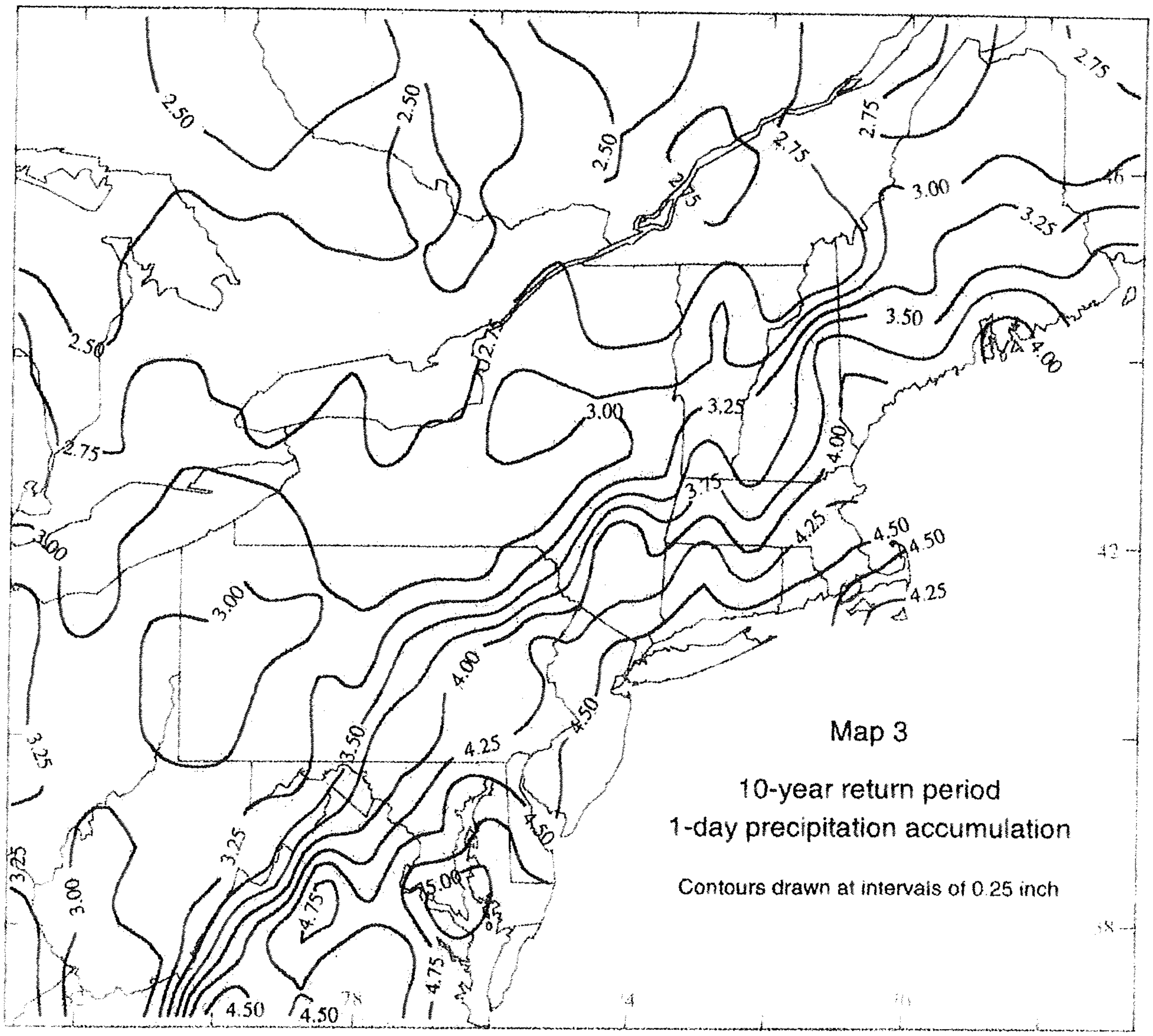
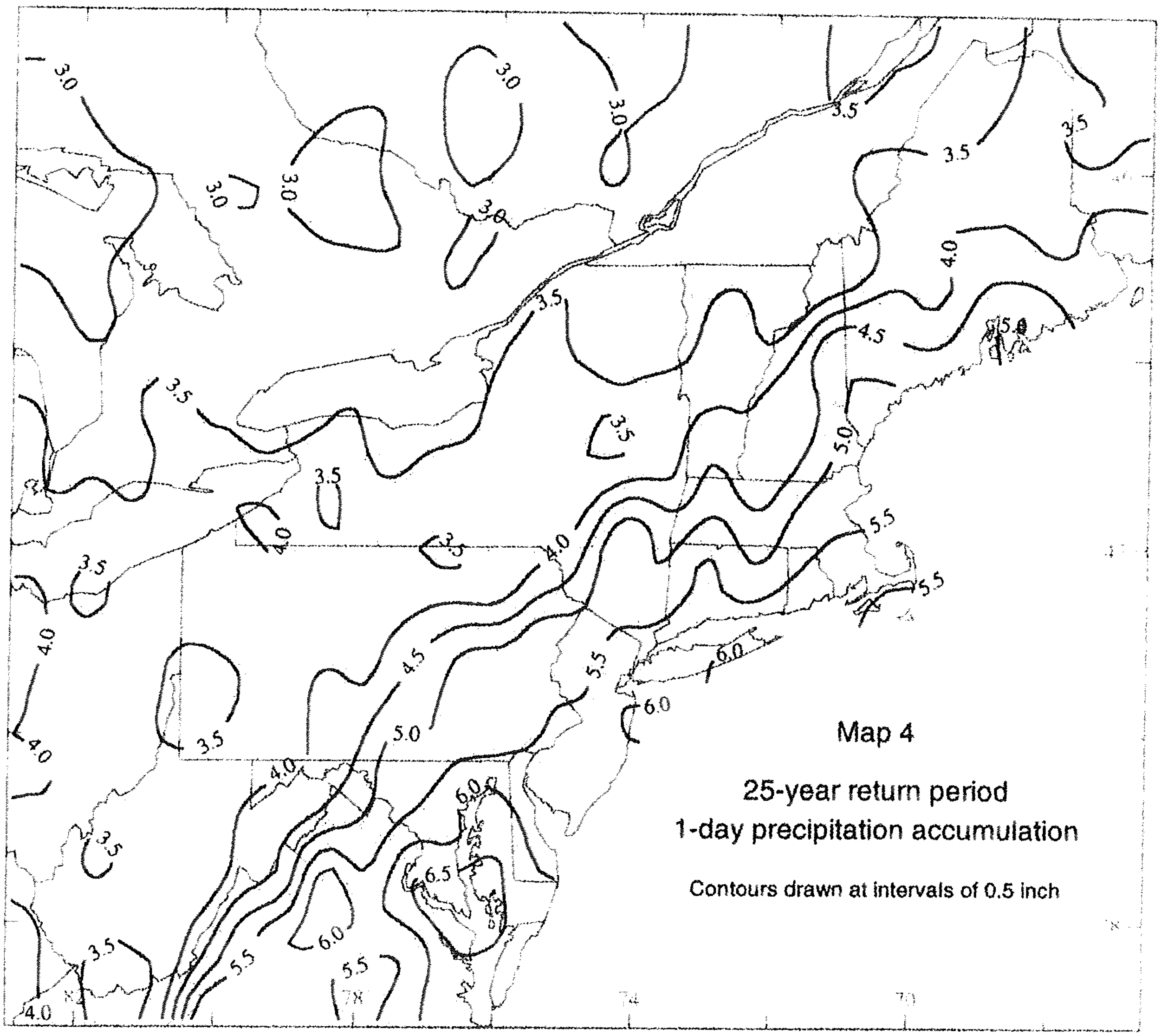
2.25
2.50
2.50
2.50
2.75
2.75
2.75
2.75
3.00
3.00
3.00
3.00
3.25
3.25
78
74
70
42
Map 1
2-year return period
1-day precipitation accumulation
Contours drawn at intervals of 0.25 inch

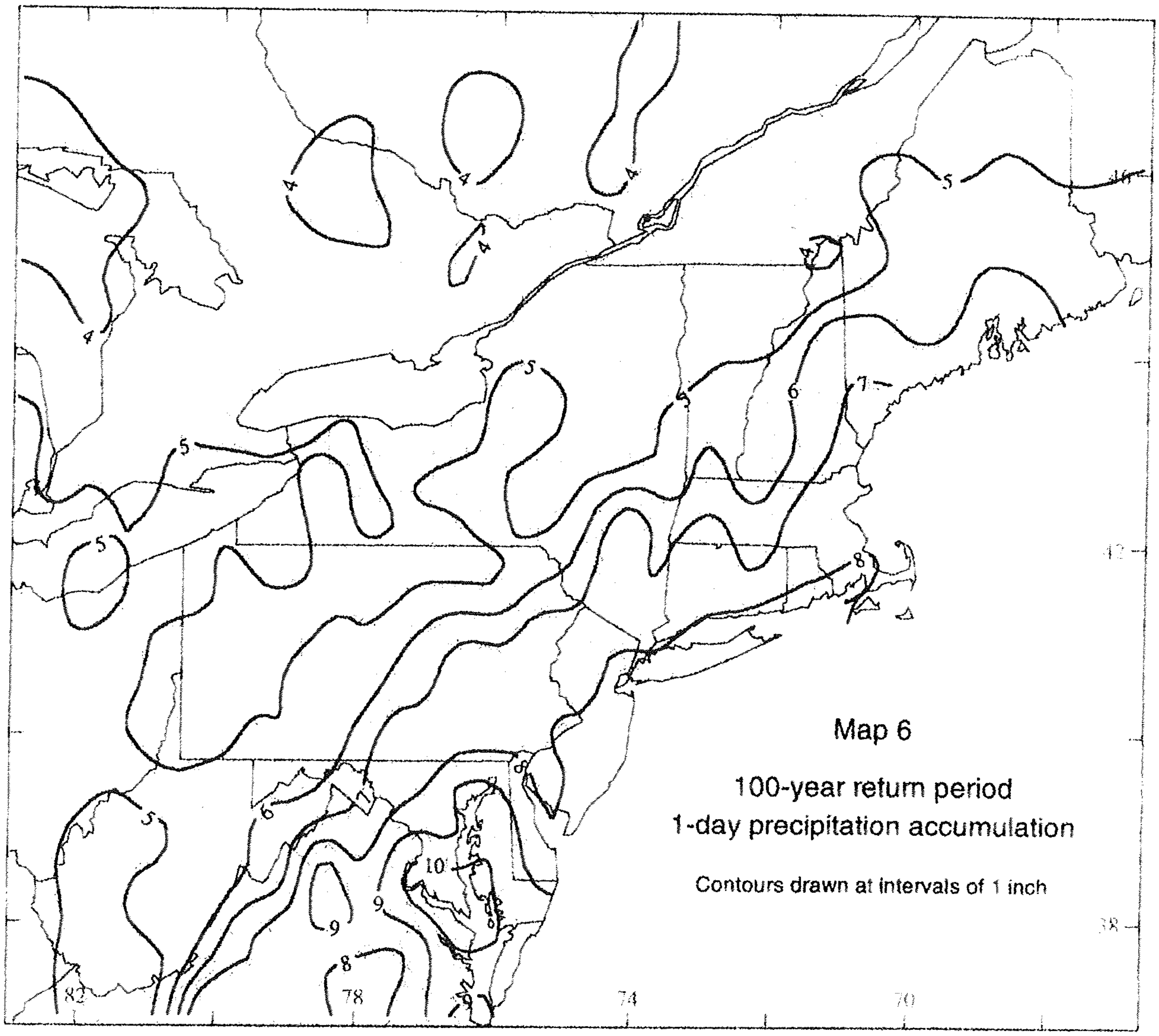

Map 3
10-year return period
1-day precipitation accumulation
Contours drawn at intervals of 0.25 inch



Map 4

25-year return period
1-day precipitation accumulation

Contours drawn at intervals of 0.5 inch


Map 6
100-year return period
1-day precipitation accumulation
Contours drawn at intervals of 1 inch

Technical Appendix

Graduated Pipe Volume Storage Calculations

Pre-Development Calculation Data:

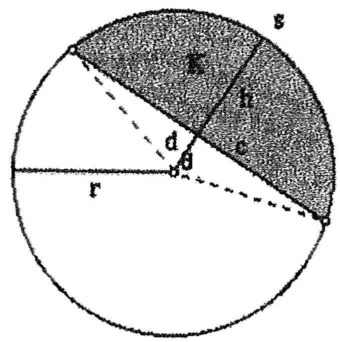
Post-Development Calculation Data:

1490 Main Street
Waltham, MA
date: 04/26/05
Graduated Pipe Cross-sectional Area

Brassard Design + Engineering, Inc.
91 Prescott Street
Worcester, MA 01605

K = Graduated Area

$d = r - h$
$\Theta = 2 \arccos(d/r)$
$c = 2r \sin(\Theta/2)$
$s = r\,\Theta$
$K = r^2[\Theta - \sin\Theta]/2$



pipe diameter = 36 in
pipe diameter = 3 ft
pipe radius = 1.5 ft

refer to diagram

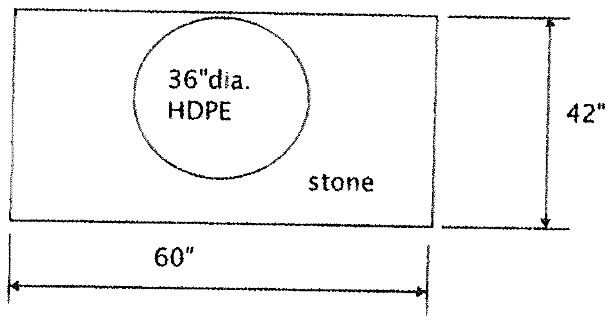
h (ft)	d (ft)	Θ (rad)	c (ft)	s (ft)	K (sf)
0.00	1.50	0.00	0.00	0.00	0.00
0.25	1.25	1.17	1.66	1.76	0.28
0.50	1.00	1.68	2.24	2.52	0.77
0.75	0.75	2.09	2.60	3.14	1.38
1.00	0.50	2.46	2.83	3.69	2.06
1.25	0.25	2.81	2.96	4.21	2.79
1.50	0.00	3.14	3.00	4.71	3.53
1.75	-0.25	3.48	2.96	5.21	4.28
2.00	-0.50	3.82	2.83	5.73	5.01
2.25	-0.75	4.19	2.60	6.28	5.69
2.50	-1.00	4.60	2.24	6.90	6.29
2.75	-1.25	5.11	1.66	7.67	6.79
3.00	-1.50	6.28	0.00	9.42	7.07

1490 Main Street
Waltham, MA
date: 04/26/05

Brassard Design + Engineering, Inc.
91 Prescott Street
Worcester, MA 01605

Segmented Pipe Trench Unit Volume (per unit length of each pipe section)
(Subsurface Detention)

Pipe trench diagram:



Overall Unit Volume Data:

pipe size:	36 in
section width:	60 in
section height:	42 in
stone void ratio:	0.40
unit pipe volume:	7.07 cf/lf
unit stone volume:	10.43 cf/lf
unit stone void volum	4.17 cf/lf
total unit volume:	11.24 cf/lf

H = height from bottom of stone base (ft)
V_p = graduated unit volume of pipe (cf/lf)
V_s = graduated unit volume of stone (cf/lf)
V_{sv} = graduated unit volume of stone voids (cf/lf)
V_t = total graduated unit volume (cf/lf)

H	V_p	V_s	V_{sv}	V_t
0.00	0.00	0.00	0.00	0.00
0.25	0.00	1.25	0.50	0.50
0.50	0.00	2.50	1.00	1.00
0.75	0.28	3.47	1.39	1.67
1.00	0.77	4.23	1.69	2.46
1.25	1.38	4.87	1.95	3.33
1.50	2.06	5.44	2.17	4.24
1.75	2.79	5.96	2.38	5.17
2.00	3.53	6.47	2.59	6.12
2.25	4.28	6.97	2.79	7.07
2.50	5.01	7.49	3.00	8.00
2.75	5.69	8.06	3.23	8.91
3.00	6.29	8.71	3.48	9.78
3.25	6.79	9.46	3.79	10.57
3.50	7.07	10.43	4.17	11.24

1490 Main Street
Waltham, MA

Brassard Design + Engineering, Inc.
91 Prescott Street
Worcester, MA 01605

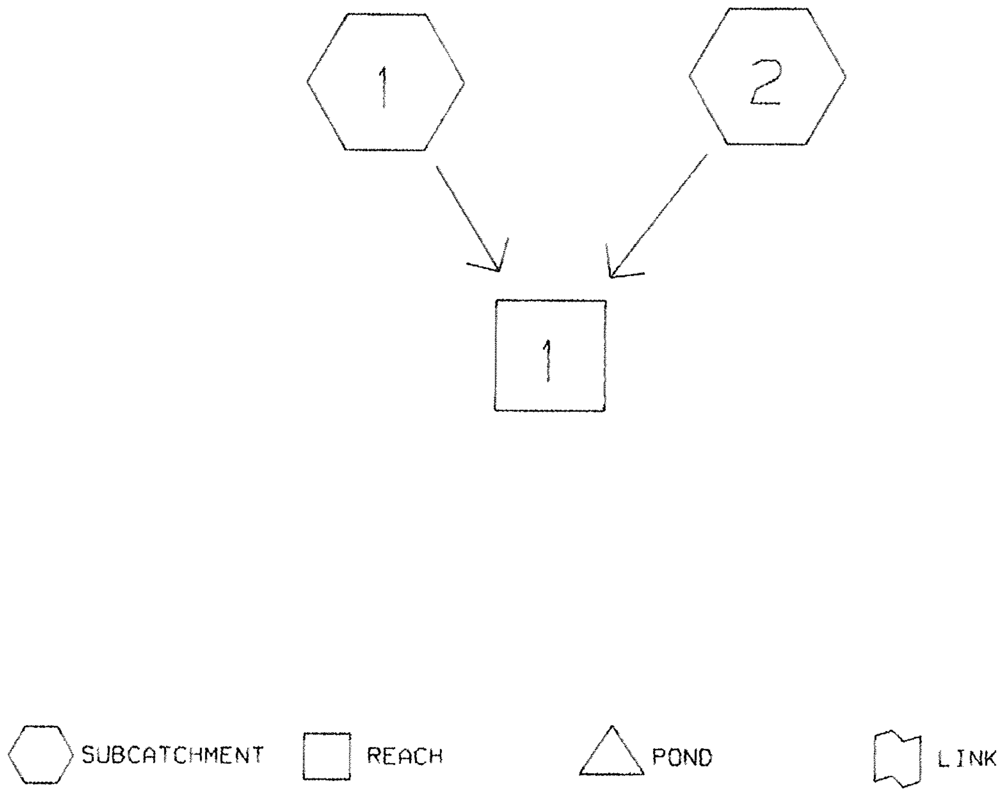
date: 04/26/05

Subsurface Detention System - Graduated Volume (Entire Field)

Number of Rows	7
Length of Rows	70
Total Length of Pipe	490
Field Length	70
Field Width	35
Stone Base Elevation	148.5

Height	Volume
148.45	0
148.70	245
148.95	490
149.20	818
149.70	1631
149.95	2076
150.20	2535
150.45	2999
150.70	3464
150.95	3922
151.20	4367
151.45	4790
151.70	5180
151.95	5508

WATERSHED ROUTING ==



SUBCATCHMENT 1 AREA TRIBUTARY TO MAIN STREET

PEAK= .93 CFS @ 12.06 HRS, VOLUME= .06 AF

ACRES	CN		
.23	98	IMPERVIOUS	SCS TR-20 METHOD
.20	69	OPEN AREA, FAIR CND., HSG B	TYPE III 24-HOUR
.04	85	GRAVEL AREA, FAIR CND., HSG B	RAINFALL= 3.16 IN
.47	85		SPAN= 10-20 HRS, dt=.05 HRS

Method	Comment	Tc (min)
DIRECT ENTRY	MINIMUM Tc	6.0

SUBCATCHMENT 2 AREA TRIBUTARY TO WEST - OFF SITE)

PEAK= 1.15 CFS @ 12.08 HRS, VOLUME= .09 AF

ACRES	CN		
1.31	69	OPEN AREA, FAIR CND., HSG B	SCS TR-20 METHOD
.11	85	GRAVEL AREA, FAIR CND., HSG B	TYPE III 24-HOUR
1.42	70		RAINFALL= 3.16 IN
			SPAN= 10-20 HRS, dt=.05 HRS

Method	Comment	Tc (min)
DIRECT ENTRY	MINIMUM Tc	6.0

REACH 1

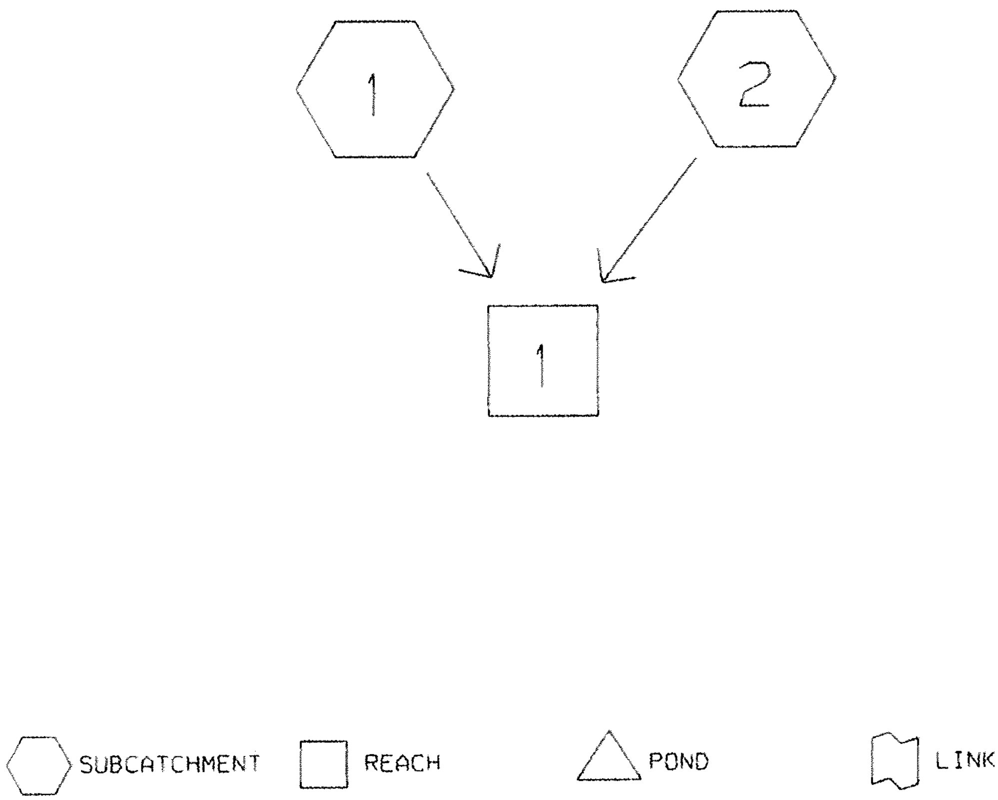
Not described

Qin = 2.10 CFS @ 12.07 HRS, VOLUME= .15 AF
Qout= 2.10 CFS @ 12.07 HRS, VOLUME= .15 AF, ATTEN= 0%, LAG= 0.0 MIN

DEPTH (FT)	END AREA (SQ-FT)	DISCH (CFS)

- METHOD
PEAK DEPTH= 0.00 FT
PEAK VELOCITY= 0.0 FPS
TRAVEL TIME = 0.0 MIN
SPAN= 10-20 HRS, dt=.05 HRS

WATERSHED ROUTING ==



SUBCATCHMENT 1 **AREA TRIBUTARY TO MAIN STREET**

PEAK= 1.69 CFS @ 12.06 HRS, VOLUME= .11 AF

ACRES	CN		
.23	98	IMPERVIOUS	SCS TR-20 METHOD
.20	69	OPEN AREA, FAIR CND., HSG B	TYPE III 24-HOUR
.04	85	GRAVEL AREA, FAIR CND., HSG B	RAINFALL= 4.75 IN
.47	85		SPAN= 10-20 HRS, dt=.05 HRS

Method	Comment	Tc (min)
DIRECT ENTRY	**MINIMUM Tc**	6.0

SUBCATCHMENT 2 **AREA TRIBUTARY TO WEST - OFF SITE)**

PEAK= 2.96 CFS @ 12.07 HRS, VOLUME= .20 AF

ACRES	CN		
1.31	69	OPEN AREA, FAIR CND., HSG B	SCS TR-20 METHOD
.11	85	GRAVEL AREA, FAIR CND., HSG B	TYPE III 24-HOUR
1.42	70		RAINFALL= 4.75 IN
			SPAN= 10-20 HRS, dt=.05 HRS

Method	Comment	Tc (min)
DIRECT ENTRY	**MINIMUM Tc**	6.0

REACH 1

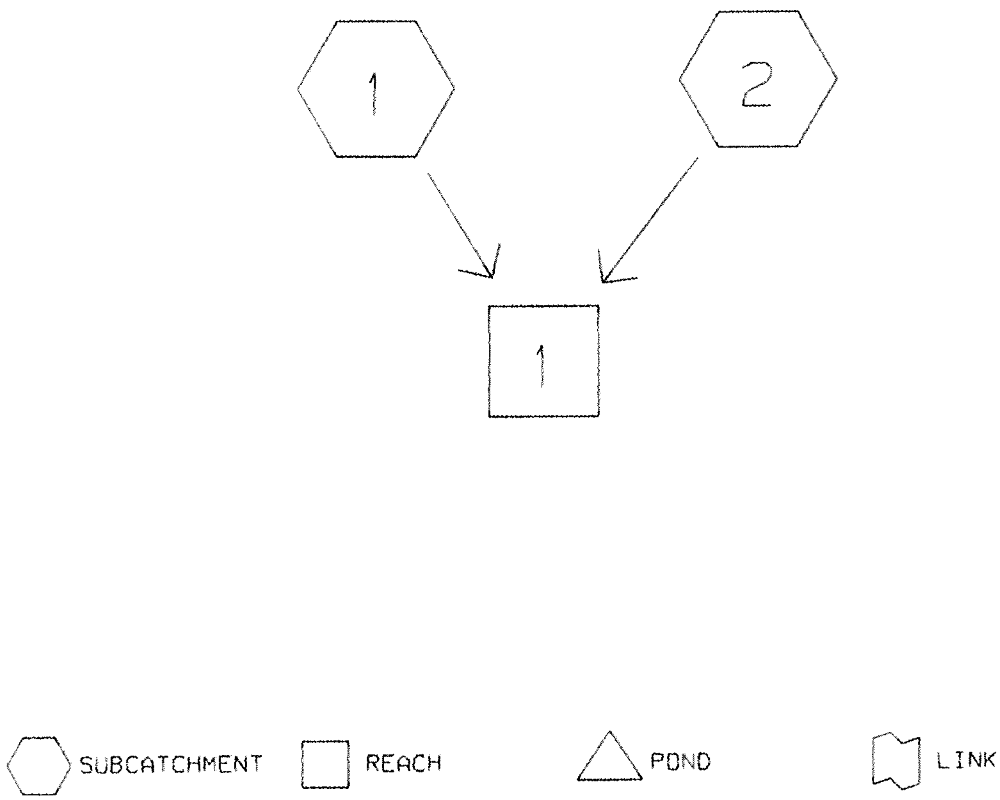
Not described

```
Qin =  4.64 CFS @ 12.07 HRS,  VOLUME=   .31 AF
Qout=  4.64 CFS @ 12.07 HRS,  VOLUME=   .31 AF,  ATTEN=  0%,  LAG=    0.0 MIN
```

DEPTH (FT)	END AREA (SQ-FT)	DISCH (CFS)

```
- METHOD
PEAK DEPTH=     0.00 FT
PEAK VELOCITY=  0.0 FPS
TRAVEL TIME =   0.0 MIN
SPAN= 10-20 HRS, dt=.05 HRS
```

WATERSHED ROUTING ==



SUBCATCHMENT 1 AREA TRIBUTARY TO MAIN STREET

PEAK= 2.34 CFS @ 12.06 HRS, VOLUME= .15 AF

ACRES	CN		
.23	98	IMPERVIOUS	SCS TR-20 METHOD
.20	69	OPEN AREA, FAIR CND., HSG B	TYPE III 24-HOUR
.04	85	GRAVEL AREA, FAIR CND., HSG B	RAINFALL= 6.10 IN
.47	85		SPAN= 10-20 HRS, dt=.05 HRS

Method	Comment	Tc (min)
DIRECT ENTRY	**MINIMUM Tc**	6.0

SUBCATCHMENT 2 AREA TRIBUTARY TO WEST - OFF SITE)

PEAK= 4.70 CFS @ 12.07 HRS, VOLUME= .31 AF

ACRES	CN		
			SCS TR-20 METHOD
1.31	69	OPEN AREA, FAIR CND., HSG B	TYPE III 24-HOUR
.11	85	GRAVEL AREA, FAIR CND., HSG B	RAINFALL= 6.10 IN
1.42	70		SPAN= 10-20 HRS, dt=.05 HRS

Method	Comment	Tc (min)
DIRECT ENTRY	**MINIMUM Tc**	6.0

REACH 1

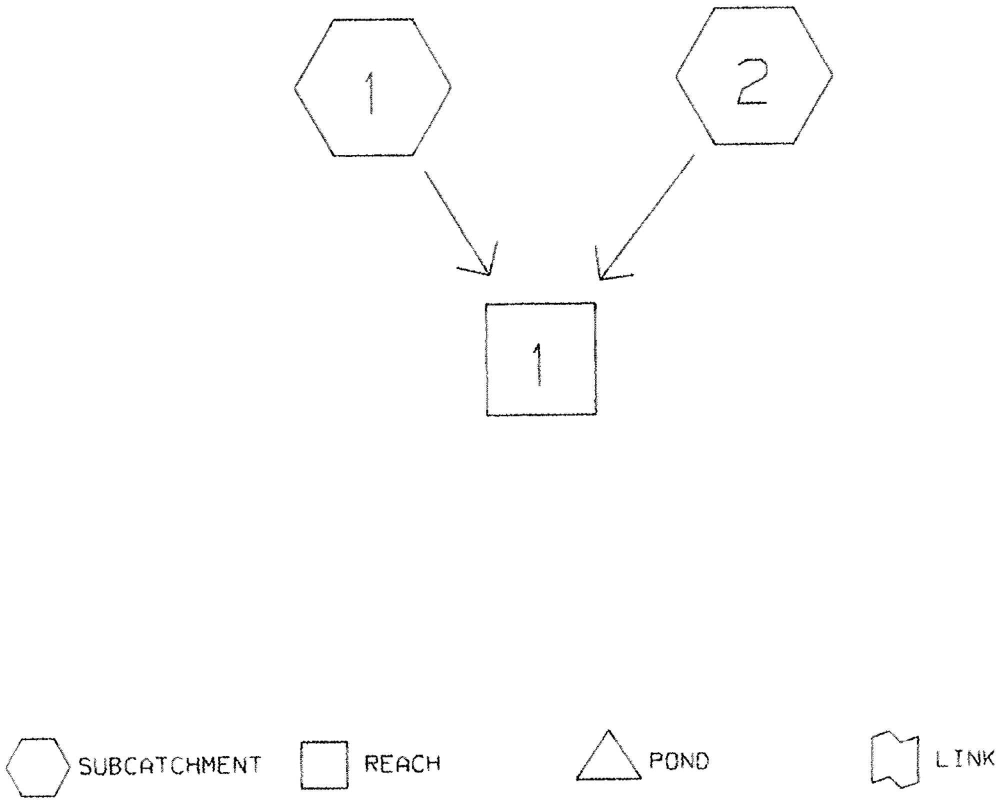
Not described

Qin = 7.03 CFS @ 12.06 HRS, VOLUME= .47 AF
Qout= 7.03 CFS @ 12.06 HRS, VOLUME= .47 AF, ATTEN= 0%, LAG= 0.0 MIN

DEPTH (FT)	END AREA (SQ-FT)	DISCH (CFS)

- METHOD
PEAK DEPTH= 0.00 FT
PEAK VELOCITY= 0.0 FPS
TRAVEL TIME = 0.0 MIN
SPAN= 10-20 HRS, dt=.05 HRS

WATERSHED ROUTING ==



SUBCATCHMENT 1 **AREA TRIBUTARY TO MAIN STREET**

PEAK= 3.48 CFS @ 12.06 HRS, VOLUME= .23 AF

ACRES	CN		
.23	98	IMPERVIOUS	SCS TR-20 METHOD
.20	69	OPEN AREA, FAIR CND., HSG B	TYPE III 24-HOUR
.04	85	GRAVEL AREA, FAIR CND., HSG B	RAINFALL= 8.48 IN
.47	85		SPAN= 10-20 HRS, dt=.05 HRS

Method	Comment	Tc (min)
DIRECT ENTRY	**MINIMUM Tc**	6.0

SUBCATCHMENT 2 **AREA TRIBUTARY TO WEST - OFF SITE)**

PEAK= 7.99 CFS @ 12.06 HRS, VOLUME= .53 AF

ACRES	CN		
1.31	69	OPEN AREA, FAIR CND., HSG B	SCS TR-20 METHOD
.11	85	GRAVEL AREA, FAIR CND., HSG B	TYPE III 24-HOUR
1.42	70		RAINFALL= 8.48 IN
			SPAN= 10-20 HRS, dt=.05 HRS

Method	Comment	Tc (min)
DIRECT ENTRY	**MINIMUM Tc**	6.0

REACH 1

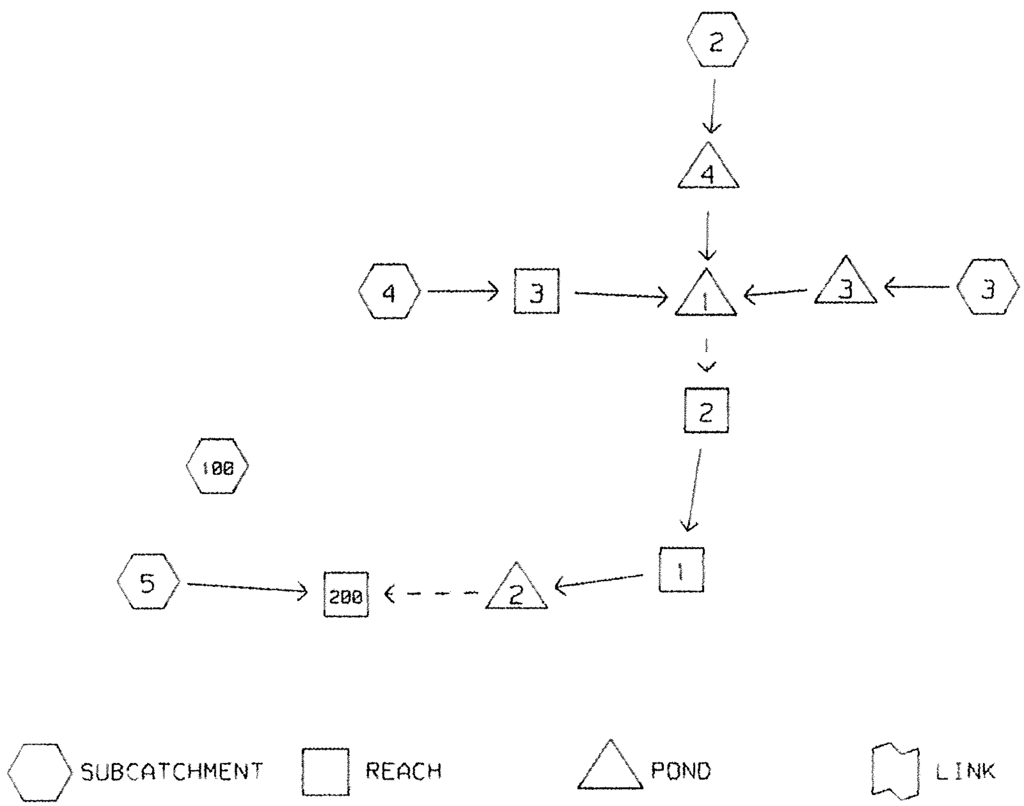
Not described

Qin = 11.46 CFS @ 12.06 HRS, VOLUME= .76 AF
Qout= 11.46 CFS @ 12.06 HRS, VOLUME= .76 AF, ATTEN= 0%, LAG= 0.0 MIN

DEPTH (FT)	END AREA (SQ-FT)	DISCH (CFS)

- METHOD
PEAK DEPTH= 0.00 FT
PEAK VELOCITY= 0.0 FPS
TRAVEL TIME = 0.0 MIN
SPAN= 10-20 HRS, dt=.05 HRS

WATERSHED ROUTING ==



SUBCATCHMENT 2 **AREA TRIBUTARY TO CB-1**

PEAK= 1.04 CFS @ 12.06 HRS, VOLUME= .07 AF

ACRES	CN		
.30	98	IMPERVIOUS AREA	SCS TR-20 METHOD
.18	69	OPEN AREA, FAIR CND., HSG B	TYPE III 24-HOUR
.48	87		RAINFALL= 3.16 IN
			SPAN= 10-20 HRS, dt=.05 HRS

Method	Comment	Tc (min)
DIRECT ENTRY	**MINIMUM Tc**	6.0

SUBCATCHMENT 3 **AREA TRIBUTARY TO CB-2**

PEAK= 1.59 CFS @ 12.06 HRS, VOLUME= .10 AF

ACRES	CN		
.41	98	IMPERVIOUS AREA	SCS TR-20 METHOD
.08	69	OPEN AREA, FAIR CND., HSG B	TYPE III 24-HOUR
.14	85	GRAVEL AREA, FAIR CND., HSG B	RAINFALL= 3.16 IN
.63	91		SPAN= 10-20 HRS, dt=.05 HRS

Method	Comment	Tc (min)
DIRECT ENTRY	**MINIMUM Tc**	6.0

SUBCATCHMENT 4 **BUILDING ROOF RUNOFF**

PEAK= .60 CFS @ 12.06 HRS, VOLUME= .04 AF

ACRES	CN		
.20	98	IMPERVIOUS AREA	SCS TR-20 METHOD
			TYPE III 24-HOUR
			RAINFALL= 3.16 IN
			SPAN= 10-20 HRS, dt=.05 HRS

Method	Comment	Tc (min)
DIRECT ENTRY	**MINIMUM Tc**	6.0

SUBCATCHMENT 5 **AREA TRIBUTARY TO WEST - OFF SITE**

PEAK= .18 CFS @ 12.07 HRS, VOLUME= .01 AF

ACRES	CN		
.13	69	OPEN AREA, FAIR CND., HSG B	SCS TR-20 METHOD
.05	85	GRAVEL AREA, FAIR CND., HSG B	TYPE III 24-HOUR
.18	73		RAINFALL= 3.16 IN
			SPAN= 10-20 HRS, dt=.05 HRS

Method	Comment	Tc (min)
DIRECT ENTRY	**MINIMUM Tc**	6.0

SUBCATCHMENT 100 **AREA TRIBUTARY TO MAIN STREET**

PEAK= .59 CFS @ 12.07 HRS, VOLUME= .04 AF

ACRES	CN	
.12	98	IMPERVIOUS AREA
.24	69	OPEN AREA, FAIR CND., HSG B
.04	85	GRAVEL AREA, FAIR CND., HSG B
.40	79	

SCS TR-20 METHOD
TYPE III 24-HOUR
RAINFALL= 3.16 IN
SPAN= 10-20 HRS, dt=.05 HRS

Method	Comment	Tc (min)
DIRECT ENTRY	**MINIMUM Tc**	6.0

REACH 1 **DMH-3 TO DRYWELL**

Qin = .68 CFS @ 12.29 HRS, VOLUME= .04 AF
Qout= .68 CFS @ 12.30 HRS, VOLUME= .04 AF, ATTEN= 0%, LAG= .1 MIN

DEPTH (FT)	END AREA (SQ-FT)	DISCH (CFS)
0.00	0.00	0.00
.10	.04	.18
.20	.11	.76
.30	.20	1.69
.70	.59	7.23
.80	.67	8.44
.90	.74	9.20
.94	.77	9.28
.97	.78	9.20
1.00	.79	8.63

12" PIPE

n= .012
LENGTH= 16 FT
SLOPE= .05 FT/FT

STOR-IND+TRANS METHOD
PEAK DEPTH= .19 FT
PEAK VELOCITY= 6.6 FPS
TRAVEL TIME = 0.0 MIN
SPAN= 10-20 HRS, dt=.05 HRS

REACH 2 **DMH-2 TO DMH-3**

Qin = .68 CFS @ 12.28 HRS, VOLUME= .04 AF
Qout= .68 CFS @ 12.29 HRS, VOLUME= .04 AF, ATTEN= 0%, LAG= .7 MIN

DEPTH (FT)	END AREA (SQ-FT)	DISCH (CFS)
0.00	0.00	0.00
.10	.04	.18
.20	.11	.74
.30	.20	1.66
.70	.59	7.08
.80	.67	8.27
.90	.74	9.01
.94	.77	9.10
.97	.78	9.01
1.00	.79	8.46

12" PIPE

n= .012
LENGTH= 68 FT
SLOPE= .048 FT/FT

STOR-IND+TRANS METHOD
PEAK DEPTH= .19 FT
PEAK VELOCITY= 6.5 FPS
TRAVEL TIME = .2 MIN
SPAN= 10-20 HRS, dt=.05 HRS

REACH 3 **BUILDING ROOF DRAIN TO DMH-1**

Qin = .60 CFS @ 12.06 HRS, VOLUME= .04 AF
Qout= .60 CFS @ 12.06 HRS, VOLUME= .04 AF, ATTEN= 1%, LAG= .2 MIN

DEPTH (FT)	END AREA (SQ-FT)	DISCH (CFS)
0.00	0.00	0.00
.07	.02	.06
.13	.05	.26
.20	.09	.57
.47	.26	2.45
.53	.30	2.86
.60	.33	3.12
.63	.34	3.15
.65	.35	3.12
.67	.35	2.93

8" PIPE

n= .012
LENGTH= 50 FT
SLOPE= .05 FT/FT

STOR-IND+TRANS METHOD
PEAK DEPTH= .20 FT
PEAK VELOCITY= 6.6 FPS
TRAVEL TIME = .1 MIN
SPAN= 10-20 HRS, dt=.05 HRS

REACH 200

Not described

```
Qin =  1.14 CFS @ 12.25 HRS,  VOLUME=   .04 AF
Qout=  1.14 CFS @ 12.25 HRS,  VOLUME=   .04 AF,  ATTEN= 0%,  LAG=   0.0 MIN
```

DEPTH (FT)	END AREA (SQ-FT)	DISCH (CFS)

- METHOD
PEAK DEPTH= 0.00 FT
PEAK VELOCITY= 0.0 FPS
TRAVEL TIME = 0.0 MIN
SPAN= 10-20 HRS, dt=.05 HRS

POND 1 **INFILTRATION FIELD**

```
Qin =  3.22 CFS @ 12.06 HRS,  VOLUME=   .21 AF
Qout=  1.36 CFS @ 12.28 HRS,  VOLUME=   .21 AF,  ATTEN= 58%,  LAG=  13.2 MIN
Qpri=   .68 CFS @ 12.16 HRS,  VOLUME=   .18 AF
Qsec=   .68 CFS @ 12.28 HRS,  VOLUME=   .04 AF
```

ELEVATION (FT)	CUM.STOR (CF)
148.5	0
148.7	245
149.0	490
149.2	818
149.7	1631
150.0	2076
150.2	2535
150.5	2999
150.7	3464
151.0	3922
151.2	4367
151.5	4790
151.7	5180
152.0	5508

STOR-IND METHOD
PEAK STORAGE = 1798 CF
PEAK ELEVATION= 149.8 FT
FLOOD ELEVATION= 152.0 FT
START ELEVATION= 148.5 FT
SPAN= 10-20 HRS, dt=.05 HRS
Tdet= 10.7 MIN (.21 AF)

#	ROUTE	INVERT	OUTLET DEVICES
1	P	148.5'	**EXFILTRATION**
			Q= .68 CFS at and above 148.6'
2	S	149.0'	**4" CULVERT X 2**
			n=.012 L=1' S=.05'/' Ke=.5 Cc=.9 Cd=.6
3	S	149.8'	**8" CULVERT**
			n=.012 L=1' S=.05'/' Ke=.5 Cc=.9 Cd=.6
4	S	151.2'	**2' SHARP-CRESTED RECTANGULAR WEIR**
			Q=C L H^1.5 C=3.27+.4 H/2.3 L=Length-2(.1 H)

```
Primary Discharge
└──1=Exfiltration

Secondary Discharge
├──2=Culvert
├──3=Culvert
└──4=Sharp-Crested Rectangular Weir
```

POND 2 **DRYWELL**

```
Qin =   .68 CFS @ 12.30 HRS,  VOLUME=   .04 AF
Qout=  1.06 CFS @ 12.25 HRS,  VOLUME=   .04 AF,  ATTEN= 0%,  LAG=   0.0 MIN
Qpri=   .02 CFS @ 12.25 HRS,  VOLUME=   .01 AF
Qsec=  1.04 CFS @ 12.25 HRS,  VOLUME=   .03 AF
```

ELEVATION (FT)	CUM.STOR (CF)
142.8	0
143.8	31
144.8	80
145.8	128
146.8	177
147.8	225
148.8	273
149.8	322
150.0	322

STOR-IND METHOD
PEAK STORAGE = 322 CF
PEAK ELEVATION= 149.9 FT
FLOOD ELEVATION= 150.0 FT
START ELEVATION= 142.8 FT
SPAN= 10-20 HRS, dt=.05 HRS
Tdet= 37.3 MIN (.04 AF)

#	ROUTE	INVERT	OUTLET DEVICES
1	P	142.8'	**EXFILTRATION** Q= .02 CFS at and above 142.9'
2	S	149.8'	**24" HORIZONTAL ORIFICE/GRATE** Q=.6 Area SQR(2gH) (Limited to weir flow @ low head)

Primary Discharge
└─1=Exfiltration

Secondary Discharge
└─2=Orifice/Grate

POND 3 **CB-2 TO DMH-1**

```
Qin =  1.59 CFS @ 12.06 HRS,  VOLUME=   .10 AF
Qout=  1.59 CFS @ 12.06 HRS,  VOLUME=   .10 AF,  ATTEN= 0%,  LAG=   .1 MIN
```

ELEVATION (FT)	AREA (SF)	INC.STOR (CF)	CUM.STOR (CF)
151.7	20	0	0
156.0	20	84	84
157.0	6484	3252	3336

STOR-IND METHOD
PEAK STORAGE = 13 CF
PEAK ELEVATION= 152.4 FT
FLOOD ELEVATION= 157.0 FT
START ELEVATION= 151.7 FT
SPAN= 10-20 HRS, dt=.05 HRS
Tdet= .4 MIN (.1 AF)

#	ROUTE	INVERT	OUTLET DEVICES
1	P	151.7'	**12" CULVERT** n=.012 L=15' S=.05'/' Ke=.5 Cc=.9 Cd=.6

POND 4 **CB1-DMH-1**

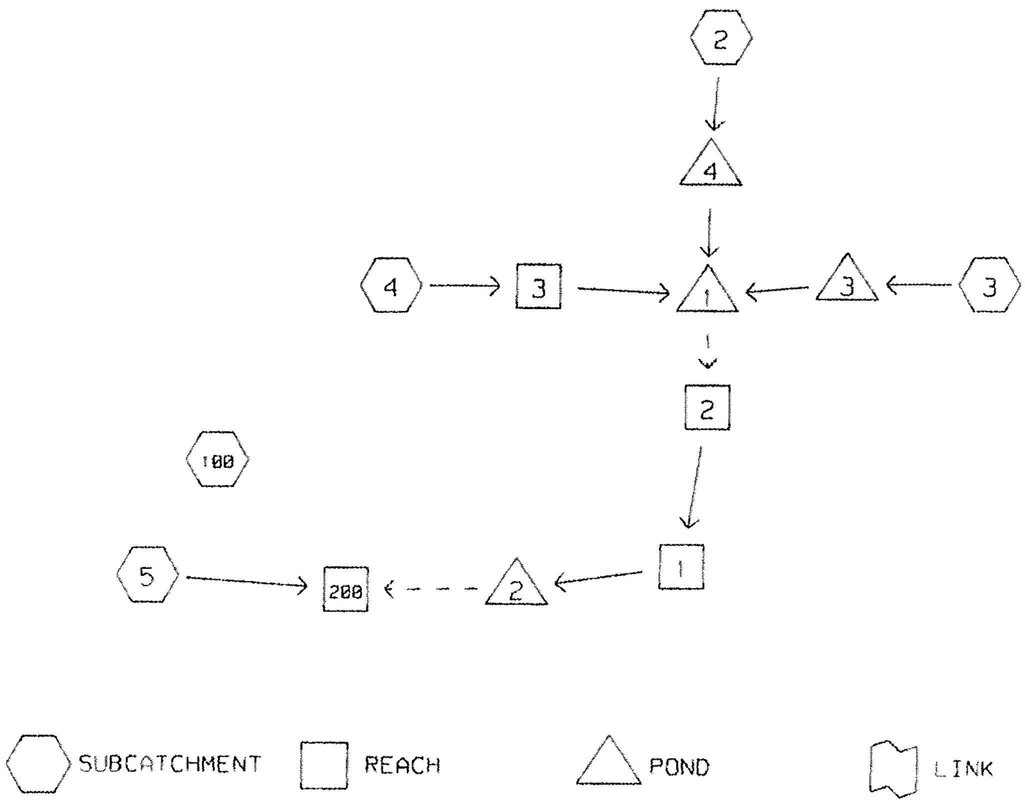
Qin = 1.04 CFS @ 12.06 HRS, VOLUME= .07 AF
Qout= 1.04 CFS @ 12.07 HRS, VOLUME= .07 AF, ATTEN= 0%, LAG= .1 MIN

ELEVATION (FT)	AREA (SF)	INC.STOR (CF)	CUM.STOR (CF)
151.7	20	0	0
155.2	20	69	69
156.0	602	248	317

STOR-IND METHOD
PEAK STORAGE = 11 CF
PEAK ELEVATION= 152.3 FT
FLOOD ELEVATION= 156.0 FT
START ELEVATION= 151.7 FT
SPAN= 10-20 HRS, dt=.05 HRS
Tdet= .5 MIN (.07 AF)

#	ROUTE	INVERT	OUTLET DEVICES
1	P	151.7'	**12" CULVERT** n=.012 L=150' S=.005'/' Ke=.5 Cc=.9 Cd=.6

WATERSHED ROUTING ==



SUBCATCHMENT 2 **AREA TRIBUTARY TO CB-1**

PEAK= 1.82 CFS @ 12.06 HRS, VOLUME= .12 AF

ACRES	CN		
.30	98	IMPERVIOUS AREA	SCS TR-20 METHOD
.18	69	OPEN AREA, FAIR CND., HSG B	TYPE III 24-HOUR
.48	87		RAINFALL= 4.75 IN
			SPAN= 10-20 HRS, dt=.05 HRS

Method	Comment	Tc (min)
DIRECT ENTRY	**MINIMUM Tc**	6.0

SUBCATCHMENT 3 **AREA TRIBUTARY TO CB-2**

PEAK= 2.61 CFS @ 12.06 HRS, VOLUME= .17 AF

ACRES	CN		
.41	98	IMPERVIOUS AREA	SCS TR-20 METHOD
.08	69	OPEN AREA, FAIR CND., HSG B	TYPE III 24-HOUR
.14	85	GRAVEL AREA, FAIR CND., HSG B	RAINFALL= 4.75 IN
.63	91		SPAN= 10-20 HRS, dt=.05 HRS

Method	Comment	Tc (min)
DIRECT ENTRY	**MINIMUM Tc**	6.0

SUBCATCHMENT 4 **BUILDING ROOF RUNOFF**

PEAK= .91 CFS @ 12.06 HRS, VOLUME= .06 AF

ACRES	CN		
.20	98	IMPERVIOUS AREA	SCS TR-20 METHOD
			TYPE III 24-HOUR
			RAINFALL= 4.75 IN
			SPAN= 10-20 HRS, dt=.05 HRS

Method	Comment	Tc (min)
DIRECT ENTRY	**MINIMUM Tc**	6.0

SUBCATCHMENT 5 **AREA TRIBUTARY TO WEST - OFF SITE**

PEAK= .43 CFS @ 12.07 HRS, VOLUME= .03 AF

ACRES	CN		
.13	69	OPEN AREA, FAIR CND., HSG B	SCS TR-20 METHOD
.05	85	GRAVEL AREA, FAIR CND., HSG B	TYPE III 24-HOUR
.18	73		RAINFALL= 4.75 IN
			SPAN= 10-20 HRS, dt=.05 HRS

Method	Comment	Tc (min)
DIRECT ENTRY	**MINIMUM Tc**	6.0

SUBCATCHMENT 100 AREA TRIBUTARY TO MAIN STREET

PEAK= 1.19 CFS @ 12.06 HRS, VOLUME= .08 AF

ACRES	CN		
.12	98	IMPERVIOUS AREA	SCS TR-20 METHOD
.24	69	OPEN AREA, FAIR CND., HSG B	TYPE III 24-HOUR
.04	85	GRAVEL AREA, FAIR CND., HSG B	RAINFALL= 4.75 IN
.40	79		SPAN= 10-20 HRS, dt=.05 HRS

Method	Comment	Tc (min)
DIRECT ENTRY	**MINIMUM Tc**	6.0

REACH 1 **DMH-3 TO DRYWELL**

Qin = 2.01 CFS @ 12.22 HRS, VOLUME= .11 AF
Qout= 2.01 CFS @ 12.22 HRS, VOLUME= .11 AF, ATTEN= 0%, LAG= 0.0 MIN

DEPTH (FT)	END AREA (SQ-FT)	DISCH (CFS)		
			12" PIPE	STOR-IND+TRANS METHOD
0.00	0.00	0.00		PEAK DEPTH= .32 FT
.10	.04	.18	n= .012	PEAK VELOCITY= 9.1 FPS
.20	.11	.76	LENGTH= 16 FT	TRAVEL TIME = 0.0 MIN
.30	.20	1.69	SLOPE= .05 FT/FT	SPAN= 10-20 HRS, dt=.05 HRS
.70	.59	7.23		
.80	.67	8.44		
.90	.74	9.20		
.94	.77	9.28		
.97	.78	9.20		
1.00	.79	8.63		

REACH 2 **DMH-2 TO DMH-3**

Qin = 2.01 CFS @ 12.22 HRS, VOLUME= .11 AF
Qout= 2.01 CFS @ 12.22 HRS, VOLUME= .11 AF, ATTEN= 0%, LAG= .1 MIN

DEPTH (FT)	END AREA (SQ-FT)	DISCH (CFS)		
			12" PIPE	STOR-IND+TRANS METHOD
0.00	0.00	0.00		PEAK DEPTH= .33 FT
.10	.04	.18	n= .012	PEAK VELOCITY= 9.0 FPS
.20	.11	.74	LENGTH= 68 FT	TRAVEL TIME = .1 MIN
.30	.20	1.66	SLOPE= .048 FT/FT	SPAN= 10-20 HRS, dt=.05 HRS
.70	.59	7.08		
.80	.67	8.27		
.90	.74	9.01		
.94	.77	9.10		
.97	.78	9.01		
1.00	.79	8.46		

REACH 3 **BUILDING ROOF DRAIN TO DMH-1**

Qin = .91 CFS @ 12.06 HRS, VOLUME= .06 AF
Qout= .91 CFS @ 12.06 HRS, VOLUME= .06 AF, ATTEN= 1%, LAG= .2 MIN

DEPTH (FT)	END AREA (SQ-FT)	DISCH (CFS)		
			8" PIPE	STOR-IND+TRANS METHOD
0.00	0.00	0.00		PEAK DEPTH= .25 FT
.07	.02	.06	n= .012	PEAK VELOCITY= 7.6 FPS
.13	.05	.26	LENGTH= 50 FT	TRAVEL TIME = .1 MIN
.20	.09	.57	SLOPE= .05 FT/FT	SPAN= 10-20 HRS, dt=.05 HRS
.47	.26	2.45		
.53	.30	2.86		
.60	.33	3.12		
.63	.34	3.15		
.65	.35	3.12		
.67	.35	2.93		

REACH 200

Not described

Qin = 2.62 CFS @ 12.20 HRS, VOLUME= .12 AF
Qout= 2.62 CFS @ 12.20 HRS, VOLUME= .12 AF, ATTEN= 0%, LAG= 0.0 MIN

DEPTH (FT)	END AREA (SQ-FT)	DISCH (CFS)

- METHOD
PEAK DEPTH= 0.00 FT
PEAK VELOCITY= 0.0 FPS
TRAVEL TIME = 0.0 MIN
SPAN= 10-20 HRS, dt=.05 HRS

POND 1 **INFILTRATION FIELD**

```
Qin =  5.33 CFS @ 12.06 HRS,  VOLUME=   .35 AF
Qout=  2.69 CFS @ 12.22 HRS,  VOLUME=   .35 AF,  ATTEN= 49%,  LAG=   9.3 MIN
Qpri=   .68 CFS @ 12.00 HRS,  VOLUME=   .24 AF
Qsec=  2.01 CFS @ 12.22 HRS,  VOLUME=   .11 AF
```

ELEVATION (FT)	CUM.STOR (CF)
148.5	0
148.7	245
149.0	490
149.2	818
149.7	1631
150.0	2076
150.2	2535
150.5	2999
150.7	3464
151.0	3922
151.2	4367
151.5	4790
151.7	5180
152.0	5508

STOR-IND METHOD
PEAK STORAGE = 3151 CF
PEAK ELEVATION= 150.6 FT
FLOOD ELEVATION= 152.0 FT
START ELEVATION= 148.5 FT
SPAN= 10-20 HRS, dt=.05 HRS
Tdet= 12.7 MIN (.35 AF)

#	ROUTE	INVERT	OUTLET DEVICES
1	P	148.5'	**EXFILTRATION**
			Q= .68 CFS at and above 148.6'
2	S	149.0'	**4" CULVERT X 2**
			n=.012 L=1' S=.05'/' Ke=.5 Cc=.9 Cd=.6
3	S	149.8'	**8" CULVERT**
			n=.012 L=1' S=.05'/' Ke=.5 Cc=.9 Cd=.6
4	S	151.2'	**2' SHARP-CRESTED RECTANGULAR WEIR**
			Q=C L H^1.5 C=3.27+.4 H/2.3 L=Length-2(.1 H)

```
Primary Discharge
└—1=Exfiltration

Secondary Discharge
├—2=Culvert
├—3=Culvert
└—4=Sharp-Crested Rectangular Weir
```

POND 2 **DRYWELL**

```
Qin =  2.01 CFS @ 12.22 HRS,  VOLUME=   .11 AF
Qout=  2.39 CFS @ 12.20 HRS,  VOLUME=   .11 AF,  ATTEN=  0%,  LAG=    0.0 MIN
Qpri=   .02 CFS @ 12.10 HRS,  VOLUME=   .01 AF
Qsec=  2.37 CFS @ 12.20 HRS,  VOLUME=   .10 AF
```

ELEVATION (FT)	CUM.STOR (CF)
142.8	0
143.8	31
144.8	80
145.8	128
146.8	177
147.8	225
148.8	273
149.8	322
150.0	322

STOR-IND METHOD
PEAK STORAGE = 322 CF
PEAK ELEVATION= 150.0 FT
FLOOD ELEVATION= 150.0 FT
START ELEVATION= 142.8 FT
SPAN= 10-20 HRS, dt=.05 HRS
Tdet= 15.3 MIN (.11 AF)

#	ROUTE	INVERT	OUTLET DEVICES
1	P	142.8'	**EXFILTRATION** Q= .02 CFS at and above 142.9'
2	S	149.8'	**24" HORIZONTAL ORIFICE/GRATE** Q=.6 Area SQR(2gH) (Limited to weir flow @ low head)

Primary Discharge
└─1=Exfiltration

Secondary Discharge
└─2=Orifice/Grate

POND 3 **CB-2 TO DMH-1**

```
Qin =  2.61 CFS @ 12.06 HRS,  VOLUME=   .17 AF
Qout=  2.60 CFS @ 12.06 HRS,  VOLUME=   .17 AF,  ATTEN=  0%,  LAG=     .1 MIN
```

ELEVATION (FT)	AREA (SF)	INC.STOR (CF)	CUM.STOR (CF)
151.7	20	0	0
156.0	20	84	84
157.0	6484	3252	3336

STOR-IND METHOD
PEAK STORAGE = 19 CF
PEAK ELEVATION= 152.7 FT
FLOOD ELEVATION= 157.0 FT
START ELEVATION= 151.7 FT
SPAN= 10-20 HRS, dt=.05 HRS
Tdet= .3 MIN (.17 AF)

#	ROUTE	INVERT	OUTLET DEVICES
1	P	151.7'	**12" CULVERT** n=.012 L=15' S=.05'/' Ke=.5 Cc=.9 Cd=.6

POND 4 **CB1-DMH-1**

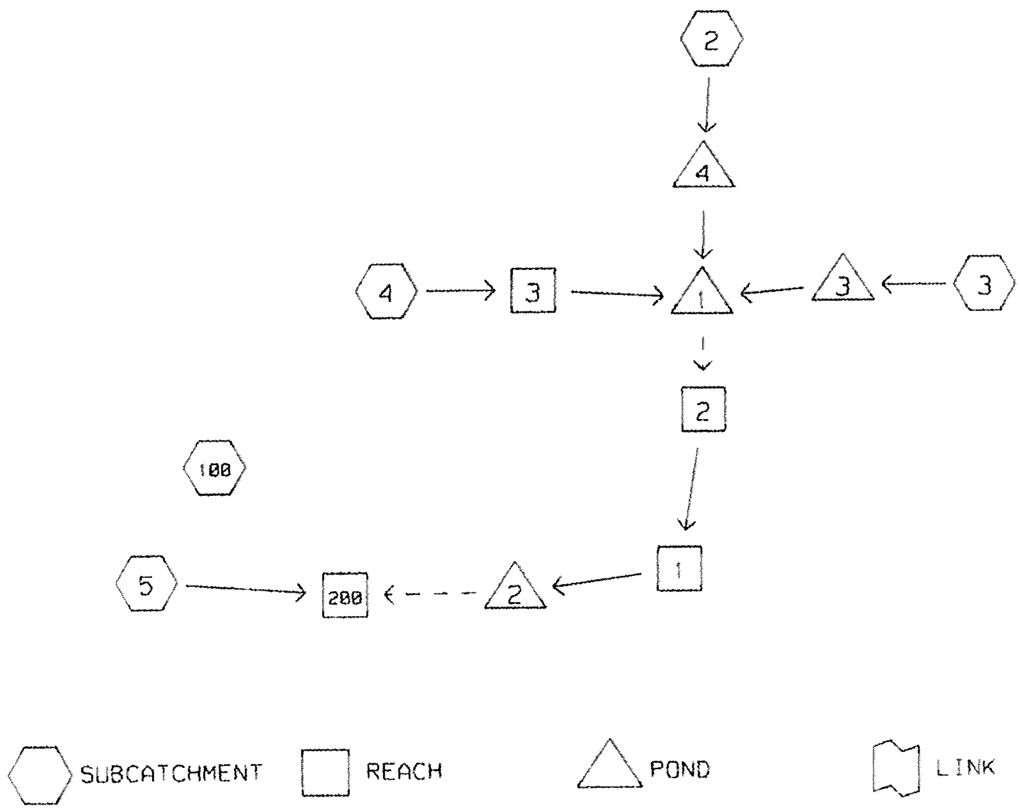
Qin = 1.82 CFS @ 12.06 HRS, VOLUME= .12 AF
Qout= 1.81 CFS @ 12.06 HRS, VOLUME= .12 AF, ATTEN= 0%, LAG= .1 MIN

ELEVATION (FT)	AREA (SF)	INC.STOR (CF)	CUM.STOR (CF)
151.7	20	0	0
155.2	20	69	69
156.0	602	248	317

STOR-IND METHOD
PEAK STORAGE = 16 CF
PEAK ELEVATION= 152.5 FT
FLOOD ELEVATION= 156.0 FT
START ELEVATION= 151.7 FT
SPAN= 10-20 HRS, dt=.05 HRS
Tdet= .4 MIN (.12 AF)

#	ROUTE	INVERT	OUTLET DEVICES
1	P	151.7'	**12" CULVERT** n=.012 L=150' S=.005'/' Ke=.5 Cc=.9 Cd=.6

WATERSHED ROUTING ==



SUBCATCHMENT 2 **AREA TRIBUTARY TO CB-1**

PEAK= 2.48 CFS @ 12.06 HRS, VOLUME= .16 AF

ACRES	CN		
.30	98	IMPERVIOUS AREA	SCS TR-20 METHOD
.18	69	OPEN AREA, FAIR CND., HSG B	TYPE III 24-HOUR
.48	87		RAINFALL= 6.10 IN
			SPAN= 10-20 HRS, dt=.05 HRS

Method	Comment	Tc (min)
DIRECT ENTRY	**MINIMUM Tc**	6.0

SUBCATCHMENT 3 **AREA TRIBUTARY TO CB-2**

PEAK= 3.47 CFS @ 12.06 HRS, VOLUME= .23 AF

ACRES	CN		
.41	98	IMPERVIOUS AREA	SCS TR-20 METHOD
.08	69	OPEN AREA, FAIR CND., HSG B	TYPE III 24-HOUR
.14	85	GRAVEL AREA, FAIR CND., HSG B	RAINFALL= 6.10 IN
.63	91		SPAN= 10-20 HRS, dt=.05 HRS

Method	Comment	Tc (min)
DIRECT ENTRY	**MINIMUM Tc**	6.0

SUBCATCHMENT 4 **BUILDING ROOF RUNOFF**

PEAK= 1.18 CFS @ 12.06 HRS, VOLUME= .08 AF

ACRES	CN		
.20	98	IMPERVIOUS AREA	SCS TR-20 METHOD
			TYPE III 24-HOUR
			RAINFALL= 6.10 IN
			SPAN= 10-20 HRS, dt=.05 HRS

Method	Comment	Tc (min)
DIRECT ENTRY	**MINIMUM Tc**	6.0

SUBCATCHMENT 5 **AREA TRIBUTARY TO WEST - OFF SITE**

PEAK= .66 CFS @ 12.07 HRS, VOLUME= .04 AF

ACRES	CN		
.13	69	OPEN AREA, FAIR CND., HSG B	SCS TR-20 METHOD
.05	85	GRAVEL AREA, FAIR CND., HSG B	TYPE III 24-HOUR
.18	73		RAINFALL= 6.10 IN
			SPAN= 10-20 HRS, dt=.05 HRS

Method	Comment	Tc (min)
DIRECT ENTRY	**MINIMUM Tc**	6.0

SUBCATCHMENT 100 AREA TRIBUTARY TO MAIN STREET

PEAK= 1.73 CFS @ 12.06 HRS, VOLUME= .11 AF

ACRES	CN		
.12	98	IMPERVIOUS AREA	SCS TR-20 METHOD
.24	69	OPEN AREA, FAIR CND., HSG B	TYPE III 24-HOUR
.04	85	GRAVEL AREA, FAIR CND., HSG B	RAINFALL= 6.10 IN
.40	79		SPAN= 10-20 HRS, dt=.05 HRS

Method	Comment	Tc (min)
DIRECT ENTRY	**MINIMUM Tc**	6.0

REACH 1 **DMH-3 TO DRYWELL**

Qin = 2.90 CFS @ 12.22 HRS, VOLUME= .17 AF
Qout= 2.90 CFS @ 12.22 HRS, VOLUME= .17 AF, ATTEN= 0%, LAG= 0.0 MIN

DEPTH (FT)	END AREA (SQ-FT)	DISCH (CFS)		
			12" PIPE	STOR-IND+TRANS METHOD
0.00	0.00	0.00		PEAK DEPTH= .39 FT
.10	.04	.18	n= .012	PEAK VELOCITY= 10.2 FPS
.20	.11	.76	LENGTH= 16 FT	TRAVEL TIME = 0.0 MIN
.30	.20	1.69	SLOPE= .05 FT/FT	SPAN= 10-20 HRS, dt=.05 HRS
.70	.59	7.23		
.80	.67	8.44		
.90	.74	9.20		
.94	.77	9.28		
.97	.78	9.20		
1.00	.79	8.63		

REACH 2 **DMH-2 TO DMH-3**

Qin = 2.90 CFS @ 12.22 HRS, VOLUME= .17 AF
Qout= 2.90 CFS @ 12.22 HRS, VOLUME= .17 AF, ATTEN= 0%, LAG= 0.0 MIN

DEPTH (FT)	END AREA (SQ-FT)	DISCH (CFS)		
			12" PIPE	STOR-IND+TRANS METHOD
0.00	0.00	0.00		PEAK DEPTH= .39 FT
.10	.04	.18	n= .012	PEAK VELOCITY= 10.1 FPS
.20	.11	.74	LENGTH= 68 FT	TRAVEL TIME = .1 MIN
.30	.20	1.66	SLOPE= .048 FT/FT	SPAN= 10-20 HRS, dt=.05 HRS
.70	.59	7.08		
.80	.67	8.27		
.90	.74	9.01		
.94	.77	9.10		
.97	.78	9.01		
1.00	.79	8.46		

REACH 3 **BUILDING ROOF DRAIN TO DMH-1**

Qin = 1.18 CFS @ 12.06 HRS, VOLUME= .08 AF
Qout= 1.17 CFS @ 12.06 HRS, VOLUME= .08 AF, ATTEN= 1%, LAG= .2 MIN

DEPTH (FT)	END AREA (SQ-FT)	DISCH (CFS)		
			8" PIPE	STOR-IND+TRANS METHOD
0.00	0.00	0.00		PEAK DEPTH= .28 FT
.07	.02	.06	n= .012	PEAK VELOCITY= 8.2 FPS
.13	.05	.26	LENGTH= 50 FT	TRAVEL TIME = .1 MIN
.20	.09	.57	SLOPE= .05 FT/FT	SPAN= 10-20 HRS, dt=.05 HRS
.47	.26	2.45		
.53	.30	2.86		
.60	.33	3.12		
.63	.34	3.15		
.65	.35	3.12		
.67	.35	2.93		

REACH 200

Not described

Qin = 3.55 CFS @ 12.15 HRS, VOLUME= .21 AF
Qout= 3.55 CFS @ 12.15 HRS, VOLUME= .21 AF, ATTEN= 0%, LAG= 0.0 MIN

DEPTH (FT)	END AREA (SQ-FT)	DISCH (CFS)

- METHOD
PEAK DEPTH= 0.00 FT
PEAK VELOCITY= 0.0 FPS
TRAVEL TIME = 0.0 MIN
SPAN= 10-20 HRS, dt=.05 HRS

POND 1 **INFILTRATION FIELD**

```
Qin =  7.10 CFS @ 12.06 HRS,  VOLUME=   .47 AF
Qout=  3.58 CFS @ 12.22 HRS,  VOLUME=   .47 AF,  ATTEN= 50%,  LAG=   9.2 MIN
Qpri=   .68 CFS @ 12.00 HRS,  VOLUME=   .29 AF
Qsec=  2.90 CFS @ 12.22 HRS,  VOLUME=   .17 AF
```

ELEVATION (FT)	CUM.STOR (CF)
148.5	0
148.7	245
149.0	490
149.2	818
149.7	1631
150.0	2076
150.2	2535
150.5	2999
150.7	3464
151.0	3922
151.2	4367
151.5	4790
151.7	5180
152.0	5508

STOR-IND METHOD
PEAK STORAGE = 4285 CF
PEAK ELEVATION= 151.2 FT
FLOOD ELEVATION= 152.0 FT
START ELEVATION= 148.5 FT
SPAN= 10-20 HRS, dt=.05 HRS
Tdet= 13.5 MIN (.47 AF)

#	ROUTE	INVERT	OUTLET DEVICES
1	P	148.5'	**EXFILTRATION** Q= .68 CFS at and above 148.6'
2	S	149.0'	**4" CULVERT X 2** n=.012 L=1' S=.05'/' Ke=.5 Cc=.9 Cd=.6
3	S	149.8'	**8" CULVERT** n=.012 L=1' S=.05'/' Ke=.5 Cc=.9 Cd=.6
4	S	151.2'	**2' SHARP-CRESTED RECTANGULAR WEIR** Q=C L H^1.5 C=3.27+.4 H/2.3 L=Length-2(.1 H)

```
Primary Discharge
└──1=Exfiltration

Secondary Discharge
├──2=Culvert
├──3=Culvert
└──4=Sharp-Crested Rectangular Weir
```

POND 2 **DRYWELL**

Qin = 2.90 CFS @ 12.22 HRS, VOLUME= .17 AF
Qout= 3.18 CFS @ 12.25 HRS, VOLUME= .17 AF, ATTEN= 0%, LAG= 2.0 MIN
Qpri= .02 CFS @ 12.05 HRS, VOLUME= .01 AF
Qsec= 3.16 CFS @ 12.25 HRS, VOLUME= .16 AF

ELEVATION (FT)	CUM.STOR (CF)
142.8	0
143.8	31
144.8	80
145.8	128
146.8	177
147.8	225
148.8	273
149.8	322
150.0	322

STOR-IND METHOD
PEAK STORAGE = 322 CF
PEAK ELEVATION= 150.1 FT
FLOOD ELEVATION= 150.0 FT
START ELEVATION= 142.8 FT
SPAN= 10-20 HRS, dt=.05 HRS
Tdet= 9 MIN (.17 AF)

#	ROUTE	INVERT	OUTLET DEVICES
1	P	142.8'	**EXFILTRATION** Q= .02 CFS at and above 142.9'
2	S	149.8'	**24" HORIZONTAL ORIFICE/GRATE** Q=.6 Area SQR(2gH) (Limited to weir flow @ low head)

Primary Discharge
└─1=Exfiltration

Secondary Discharge
└─2=Orifice/Grate

POND 3 **CB-2 TO DMH-1**

Qin = 3.47 CFS @ 12.06 HRS, VOLUME= .23 AF
Qout= 3.45 CFS @ 12.06 HRS, VOLUME= .23 AF, ATTEN= 1%, LAG= .2 MIN

ELEVATION (FT)	AREA (SF)	INC.STOR (CF)	CUM.STOR (CF)
151.7	20	0	0
156.0	20	84	84
157.0	6484	3252	3336

STOR-IND METHOD
PEAK STORAGE = 26 CF
PEAK ELEVATION= 153.0 FT
FLOOD ELEVATION= 157.0 FT
START ELEVATION= 151.7 FT
SPAN= 10-20 HRS, dt=.05 HRS
Tdet= .3 MIN (.23 AF)

#	ROUTE	INVERT	OUTLET DEVICES
1	P	151.7'	**12" CULVERT** n=.012 L=15' S=.05'/' Ke=.5 Cc=.9 Cd=.6

POND 4 **CB1-DMH-1**

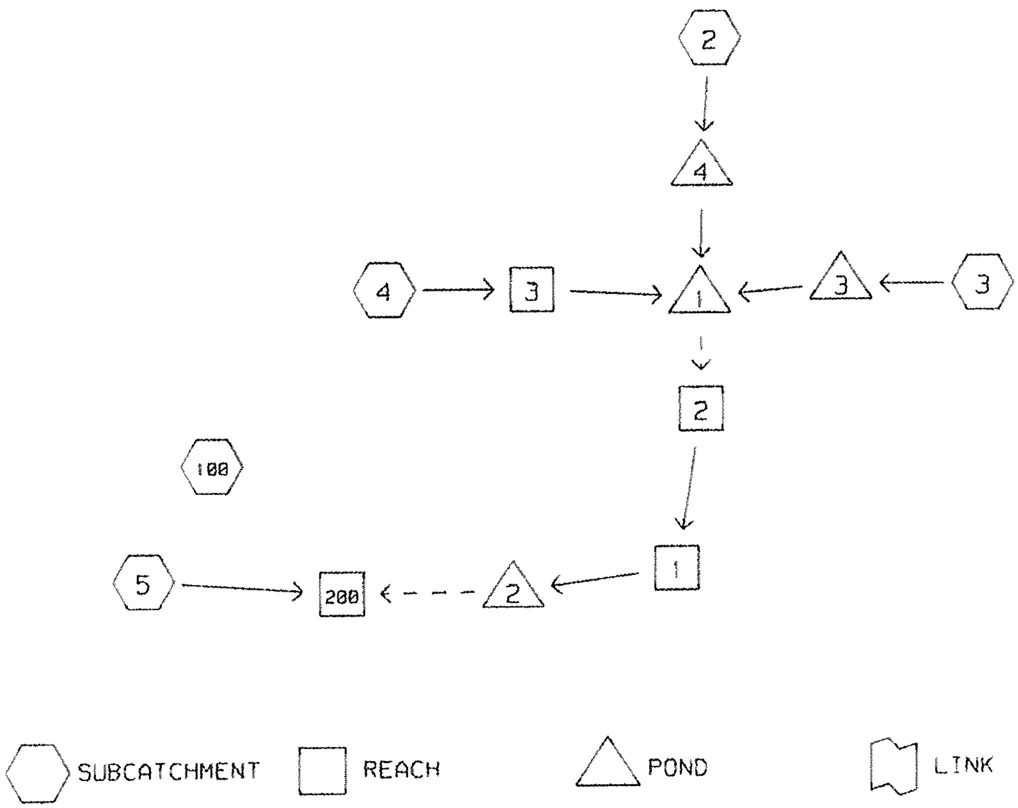
Qin = 2.48 CFS @ 12.06 HRS, VOLUME= .16 AF
Qout= 2.47 CFS @ 12.06 HRS, VOLUME= .16 AF, ATTEN= 0%, LAG= .1 MIN

ELEVATION (FT)	AREA (SF)	INC.STOR (CF)	CUM.STOR (CF)
151.7	20	0	0
155.2	20	69	69
156.0	602	248	317

STOR-IND METHOD
PEAK STORAGE = 20 CF
PEAK ELEVATION= 152.7 FT
FLOOD ELEVATION= 156.0 FT
START ELEVATION= 151.7 FT
SPAN= 10-20 HRS, dt=.05 HRS
Tdet= .3 MIN (.16 AF)

#	ROUTE	INVERT	OUTLET DEVICES
1	P	151.7'	**12" CULVERT** n=.012 L=150' S=.005'/' Ke=.5 Cc=.9 Cd=.6

WATERSHED ROUTING ==



SUBCATCHMENT 2 **AREA TRIBUTARY TO CB-1**

PEAK= 3.64 CFS @ 12.06 HRS, VOLUME= .24 AF

ACRES	CN		
.30	98	IMPERVIOUS AREA	SCS TR-20 METHOD
.18	69	OPEN AREA, FAIR CND., HSG B	TYPE III 24-HOUR
.48	87		RAINFALL= 8.48 IN
			SPAN= 10-20 HRS, dt=.05 HRS

Method	Comment	Tc (min)
DIRECT ENTRY	**MINIMUM Tc**	6.0

SUBCATCHMENT 3 **AREA TRIBUTARY TO CB-2**

PEAK= 4.97 CFS @ 12.06 HRS, VOLUME= .33 AF

ACRES	CN		
.41	98	IMPERVIOUS AREA	SCS TR-20 METHOD
.08	69	OPEN AREA, FAIR CND., HSG B	TYPE III 24-HOUR
.14	85	GRAVEL AREA, FAIR CND., HSG B	RAINFALL= 8.48 IN
.63	91		SPAN= 10-20 HRS, dt=.05 HRS

Method	Comment	Tc (min)
DIRECT ENTRY	**MINIMUM Tc**	6.0

SUBCATCHMENT 4 **BUILDING ROOF RUNOFF**

PEAK= 1.64 CFS @ 12.06 HRS, VOLUME= .11 AF

ACRES	CN		
.20	98	IMPERVIOUS AREA	SCS TR-20 METHOD
			TYPE III 24-HOUR
			RAINFALL= 8.48 IN
			SPAN= 10-20 HRS, dt=.05 HRS

Method	Comment	Tc (min)
DIRECT ENTRY	**MINIMUM Tc**	6.0

SUBCATCHMENT 5 **AREA TRIBUTARY TO WEST - OFF SITE**

PEAK= 1.08 CFS @ 12.06 HRS, VOLUME= .07 AF

ACRES	CN		
.13	69	OPEN AREA, FAIR CND., HSG B	SCS TR-20 METHOD
.05	85	GRAVEL AREA, FAIR CND., HSG B	TYPE III 24-HOUR
.18	73		RAINFALL= 8.48 IN
			SPAN= 10-20 HRS, dt=.05 HRS

Method	Comment	Tc (min)
DIRECT ENTRY	**MINIMUM Tc**	6.0

SUBCATCHMENT 100 AREA TRIBUTARY TO MAIN STREET

PEAK= 2.70 CFS @ 12.06 HRS, VOLUME= .18 AF

ACRES	CN		
.12	98	IMPERVIOUS AREA	SCS TR-20 METHOD
.24	69	OPEN AREA, FAIR CND., HSG B	TYPE III 24-HOUR
.04	85	GRAVEL AREA, FAIR CND., HSG B	RAINFALL= 8.48 IN
.40	79		SPAN= 10-20 HRS, dt=.05 HRS

Method	Comment	Tc (min)
DIRECT ENTRY	**MINIMUM Tc**	6.0

REACH 1 DMH-3 TO DRYWELL

Qin = 7.38 CFS @ 12.14 HRS, VOLUME= .31 AF
Qout= 7.38 CFS @ 12.15 HRS, VOLUME= .31 AF, ATTEN= 0%, LAG= 0.0 MIN

DEPTH (FT)	END AREA (SQ-FT)	DISCH (CFS)
0.00	0.00	0.00
.10	.04	.18
.20	.11	.76
.30	.20	1.69
.70	.59	7.23
.80	.67	8.44
.90	.74	9.20
.94	.77	9.28
.97	.78	9.20
1.00	.79	8.63

12" PIPE

n= .012
LENGTH= 16 FT
SLOPE= .05 FT/FT

STOR-IND+TRANS METHOD
PEAK DEPTH= .71 FT
PEAK VELOCITY= 12.3 FPS
TRAVEL TIME = 0.0 MIN
SPAN= 10-20 HRS, dt=.05 HRS

REACH 2 DMH-2 TO DMH-3

Qin = 7.37 CFS @ 12.14 HRS, VOLUME= .31 AF
Qout= 7.38 CFS @ 12.14 HRS, VOLUME= .31 AF, ATTEN= 0%, LAG= .2 MIN

DEPTH (FT)	END AREA (SQ-FT)	DISCH (CFS)
0.00	0.00	0.00
.10	.04	.18
.20	.11	.74
.30	.20	1.66
.70	.59	7.08
.80	.67	8.27
.90	.74	9.01
.94	.77	9.10
.97	.78	9.01
1.00	.79	8.46

12" PIPE

n= .012
LENGTH= 68 FT
SLOPE= .048 FT/FT

STOR-IND+TRANS METHOD
PEAK DEPTH= .73 FT
PEAK VELOCITY= 12.1 FPS
TRAVEL TIME = .1 MIN
SPAN= 10-20 HRS, dt=.05 HRS

REACH 3 BUILDING ROOF DRAIN TO DMH-1

Qin = 1.64 CFS @ 12.06 HRS, VOLUME= .11 AF
Qout= 1.63 CFS @ 12.06 HRS, VOLUME= .11 AF, ATTEN= 1%, LAG= .2 MIN

DEPTH (FT)	END AREA (SQ-FT)	DISCH (CFS)
0.00	0.00	0.00
.07	.02	.06
.13	.05	.26
.20	.09	.57
.47	.26	2.45
.53	.30	2.86
.60	.33	3.12
.63	.34	3.15
.65	.35	3.12
.67	.35	2.93

8" PIPE

n= .012
LENGTH= 50 FT
SLOPE= .05 FT/FT

STOR-IND+TRANS METHOD
PEAK DEPTH= .35 FT
PEAK VELOCITY= 8.8 FPS
TRAVEL TIME = .1 MIN
SPAN= 10-20 HRS, dt=.05 HRS

REACH 200

Not described

Qin = 7.85 CFS @ 12.13 HRS, VOLUME= .37 AF
Qout= 7.85 CFS @ 12.13 HRS, VOLUME= .37 AF, ATTEN= 0%, LAG= 0.0 MIN

DEPTH (FT)	END AREA (SQ-FT)	DISCH (CFS)

- METHOD
PEAK DEPTH= 0.00 FT
PEAK VELOCITY= 0.0 FPS
TRAVEL TIME = 0.0 MIN
SPAN= 10-20 HRS, dt=.05 HRS

POND 1 **INFILTRATION FIELD**

```
Qin = 10.13 CFS @ 12.06 HRS,  VOLUME=   .68 AF
Qout=  8.05 CFS @ 12.14 HRS,  VOLUME=   .67 AF,  ATTEN= 21%,  LAG=   4.6 MIN
Qpri=   .68 CFS @ 11.80 HRS,  VOLUME=   .36 AF
Qsec=  7.37 CFS @ 12.14 HRS,  VOLUME=   .31 AF
```

ELEVATION (FT)	CUM.STOR (CF)
148.5	0
148.7	245
149.0	490
149.2	818
149.7	1631
150.0	2076
150.2	2535
150.5	2999
150.7	3464
151.0	3922
151.2	4367
151.5	4790
151.7	5180
152.0	5508

STOR-IND METHOD
PEAK STORAGE = 5400 CF
PEAK ELEVATION= 151.9 FT
FLOOD ELEVATION= 152.0 FT
START ELEVATION= 148.5 FT
SPAN= 10-20 HRS, dt=.05 HRS
Tdet= 13.4 MIN (.67 AF)

#	ROUTE	INVERT	OUTLET DEVICES
1	P	148.5'	**EXFILTRATION** Q= .68 CFS at and above 148.6'
2	S	149.0'	**4" CULVERT X 2** n=.012 L=1' S=.05'/' Ke=.5 Cc=.9 Cd=.6
3	S	149.8'	**8" CULVERT** n=.012 L=1' S=.05'/' Ke=.5 Cc=.9 Cd=.6
4	S	151.2'	**2' SHARP-CRESTED RECTANGULAR WEIR** Q=C L H^1.5 C=3.27+.4 H/2.3 L=Length-2(.1 H)

```
Primary Discharge
└──1=Exfiltration

Secondary Discharge
├──2=Culvert
├──3=Culvert
└──4=Sharp-Crested Rectangular Weir
```

POND 2 **DRYWELL**

```
Qin =  7.38 CFS @ 12.15 HRS,  VOLUME=   .31 AF
Qout=  7.06 CFS @ 12.14 HRS,  VOLUME=   .31 AF,  ATTEN=  4%,  LAG=   0.0 MIN
Qpri=   .02 CFS @ 12.10 HRS,  VOLUME=   .01 AF
Qsec=  7.04 CFS @ 12.14 HRS,  VOLUME=   .30 AF
```

ELEVATION (FT)	CUM.STOR (CF)
142.8	0
143.8	31
144.8	80
145.8	128
146.8	177
147.8	225
148.8	273
149.8	322
150.0	322

STOR-IND METHOD
PEAK STORAGE = 323 CF
PEAK ELEVATION= 150.4 FT
FLOOD ELEVATION= 150.0 FT
START ELEVATION= 142.8 FT
SPAN= 10-20 HRS, dt=.05 HRS
Tdet= 5.4 MIN (.31 AF)

#	ROUTE	INVERT	OUTLET DEVICES
1	P	142.8'	**EXFILTRATION** Q= .02 CFS at and above 142.9'
2	S	149.8'	**24" HORIZONTAL ORIFICE/GRATE** Q=.6 Area SQR(2gH) (Limited to weir flow @ low head)

Primary Discharge
└─1=Exfiltration

Secondary Discharge
└─2=Orifice/Grate

POND 3 **CB-2 TO DMH-1**

```
Qin =  4.97 CFS @ 12.06 HRS,  VOLUME=   .33 AF
Qout=  4.94 CFS @ 12.06 HRS,  VOLUME=   .33 AF,  ATTEN=  1%,  LAG=    .3 MIN
```

ELEVATION (FT)	AREA (SF)	INC.STOR (CF)	CUM.STOR (CF)
151.7	20	0	0
156.0	20	84	84
157.0	6484	3252	3336

STOR-IND METHOD
PEAK STORAGE = 43 CF
PEAK ELEVATION= 153.9 FT
FLOOD ELEVATION= 157.0 FT
START ELEVATION= 151.7 FT
SPAN= 10-20 HRS, dt=.05 HRS
Tdet= .2 MIN (.33 AF)

#	ROUTE	INVERT	OUTLET DEVICES
1	P	151.7'	**12" CULVERT** n=.012 L=15' S=.05'/' Ke=.5 Cc=.9 Cd=.6

POND 4 **CB1-DMH-1**

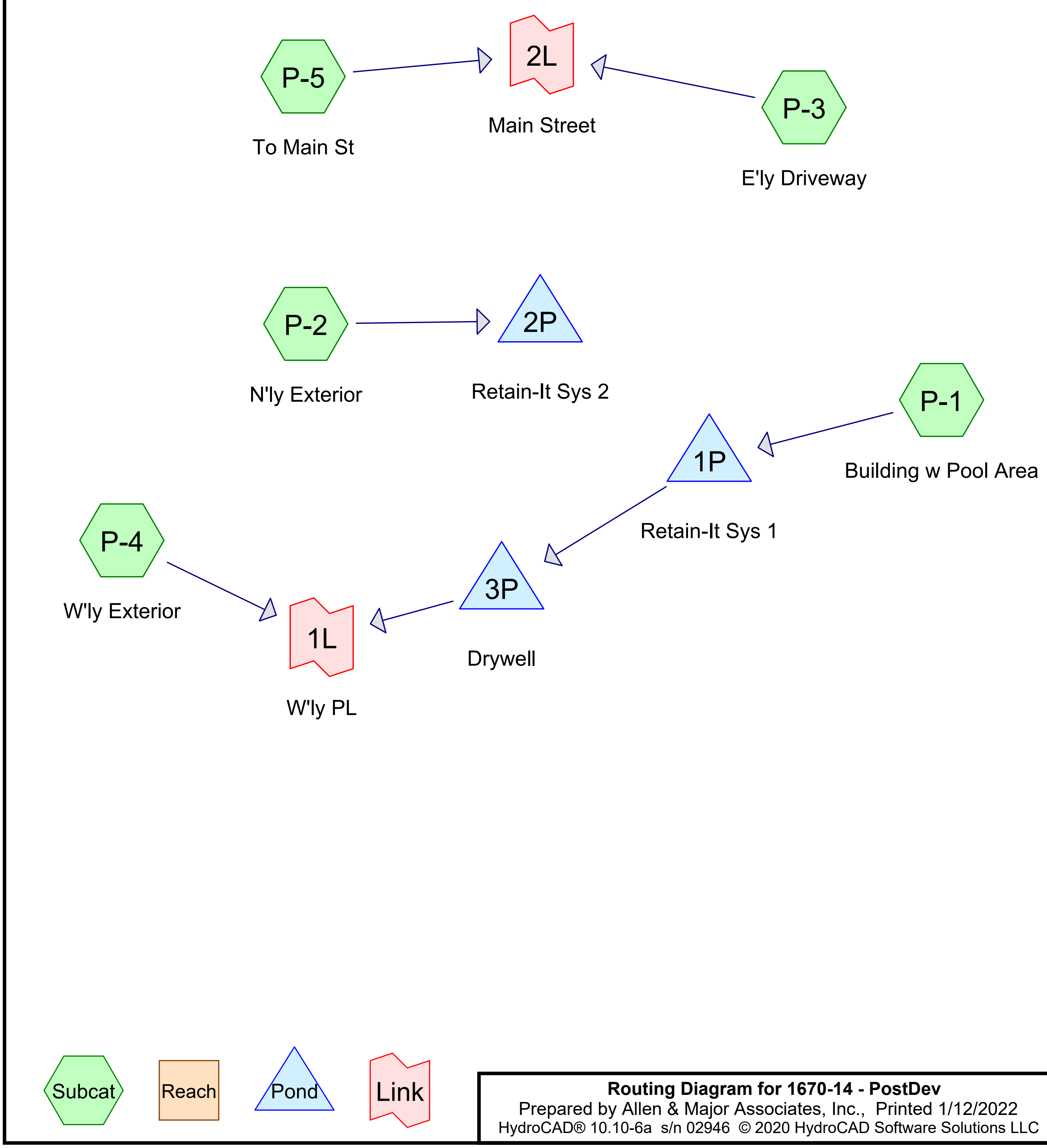
Qin = 3.64 CFS @ 12.06 HRS, VOLUME= .24 AF
Qout= 3.56 CFS @ 12.07 HRS, VOLUME= .24 AF, ATTEN= 2%, LAG= .6 MIN

ELEVATION (FT)	AREA (SF)	INC.STOR (CF)	CUM.STOR (CF)
151.7	20	0	0
155.2	20	69	69
156.0	602	248	317

STOR-IND METHOD
PEAK STORAGE = 38 CF
PEAK ELEVATION= 153.6 FT
FLOOD ELEVATION= 156.0 FT
START ELEVATION= 151.7 FT
SPAN= 10-20 HRS, dt=.05 HRS
Tdet= .3 MIN (.24 AF)

#	ROUTE	INVERT	OUTLET DEVICES
1	P	151.7'	**12" CULVERT** n=.012 L=150' S=.005'/' Ke=.5 Cc=.9 Cd=.6

POST-DEVELOPMENT



Routing Diagram for 1670-14 - PostDev
Prepared by Allen & Major Associates, Inc., Printed 1/12/2022
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Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-yr	Type III 24-hr		Default	24.00	1	3.16	2
2	10-yr	Type III 24-hr		Default	24.00	1	4.77	2
3	25-yr	Type III 24-hr		Default	24.00	1	6.03	2
4	100-yr	Type III 24-hr		Default	24.00	1	8.61	2

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.033	39	>75% Grass cover, Good, HSG A (P-4)
0.351	61	>75% Grass cover, Good, HSG B (P-2, P-3, P-4, P-5)
0.316	98	Paved parking, HSG B (P-2, P-3)
0.015	98	Roofs, HSG A (P-1)
1.426	98	Roofs, HSG B (P-1)
0.012	98	Unconnected pavement, HSG A (P-4)
0.023	98	Unconnected pavement, HSG B (P-4)
0.049	55	Woods, Good, HSG B (P-4)
2.226	**90**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.061	HSG A	P-1, P-4
2.165	HSG B	P-1, P-2, P-3, P-4, P-5
0.000	HSG C	
0.000	HSG D	
0.000	Other	
2.226		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.033	0.351	0.000	0.000	0.000	0.384	>75% Grass cover, Good	P-2, P-3, P-4, P-5
0.000	0.316	0.000	0.000	0.000	0.316	Paved parking	P-2, P-3
0.015	1.426	0.000	0.000	0.000	1.441	Roofs	P-1
0.012	0.023	0.000	0.000	0.000	0.036	Unconnected pavement	P-4
0.000	0.049	0.000	0.000	0.000	0.049	Woods, Good	P-4
0.061	**2.165**	**0.000**	**0.000**	**0.000**	**2.226**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)
1	1P	152.80	152.00	16.0	0.0500	0.012	0.0	12.0	0.0

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment P-1: Building w Pool Area Runoff Area=62,767 sf 100.00% Impervious Runoff Depth>2.93"
Tc=6.0 min CN=98 Runoff=4.32 cfs 0.351 af

Subcatchment P-2: N'ly Exterior Runoff Area=11,337 sf 39.98% Impervious Runoff Depth>1.12"
Tc=6.0 min CN=76 Runoff=0.33 cfs 0.024 af

Subcatchment P-3: E'ly Driveway Runoff Area=11,206 sf 82.57% Impervious Runoff Depth>2.31"
Tc=6.0 min CN=92 Runoff=0.67 cfs 0.050 af

Subcatchment P-4: W'ly Exterior Runoff Area=11,497 sf 13.53% Impervious Runoff Depth>0.36"
Tc=0.0 min UI Adjusted CN=59 Runoff=0.07 cfs 0.008 af

Subcatchment P-5: To Main St Runoff Area=170 sf 0.00% Impervious Runoff Depth>0.43"
Tc=6.0 min CN=61 Runoff=0.00 cfs 0.000 af

Pond 1P: Retain-It Sys 1 Peak Elev=150.30' Storage=7,735 cf Inflow=4.32 cfs 0.351 af
Discarded=0.18 cfs 0.253 af Primary=0.00 cfs 0.000 af Outflow=0.18 cfs 0.253 af

Pond 2P: Retain-It Sys 2 Peak Elev=143.80' Storage=415 cf Inflow=0.33 cfs 0.024 af
Outflow=0.03 cfs 0.024 af

Pond 3P: Drywell Peak Elev=142.80' Storage=0 cf Inflow=0.00 cfs 0.000 af
Discarded=0.00 cfs 0.000 af Primary=0.00 cfs 0.000 af Outflow=0.00 cfs 0.000 af

Link 1L: W'ly PL Inflow=0.07 cfs 0.008 af
Primary=0.07 cfs 0.008 af

Link 2L: Main Street Inflow=0.67 cfs 0.050 af
Primary=0.67 cfs 0.050 af

Total Runoff Area = 2.226 ac Runoff Volume = 0.433 af Average Runoff Depth = 2.34"
19.46% Pervious = 0.433 ac 80.54% Impervious = 1.793 ac

Summary for Subcatchment P-1: Building w Pool Area

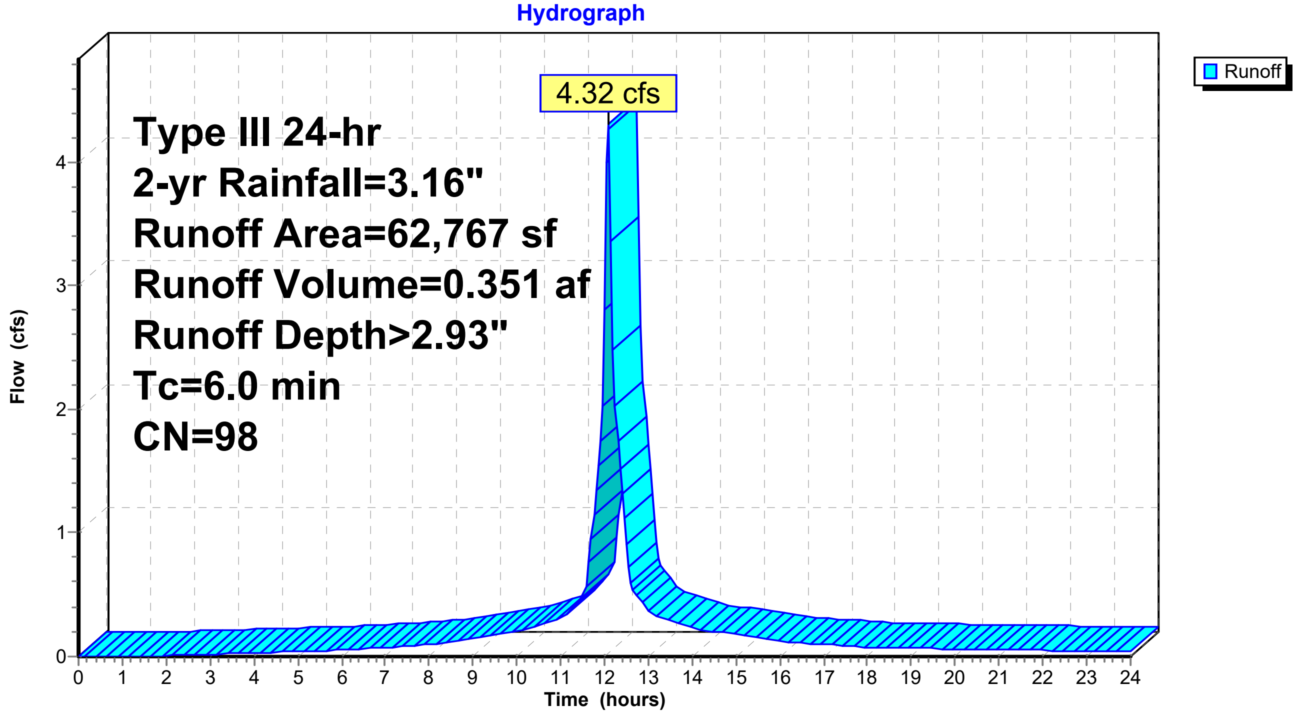
Runoff = 4.32 cfs @ 12.09 hrs, Volume= 0.351 af, Depth> 2.93"
Routed to Pond 1P : Retain-It Sys 1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-yr Rainfall=3.16"

Area (sf)	CN	Description
656	98	Roofs, HSG A
62,111	98	Roofs, HSG B
62,767	98	Weighted Average
62,767		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment P-1: Building w Pool Area



Summary for Subcatchment P-2: N'ly Exterior

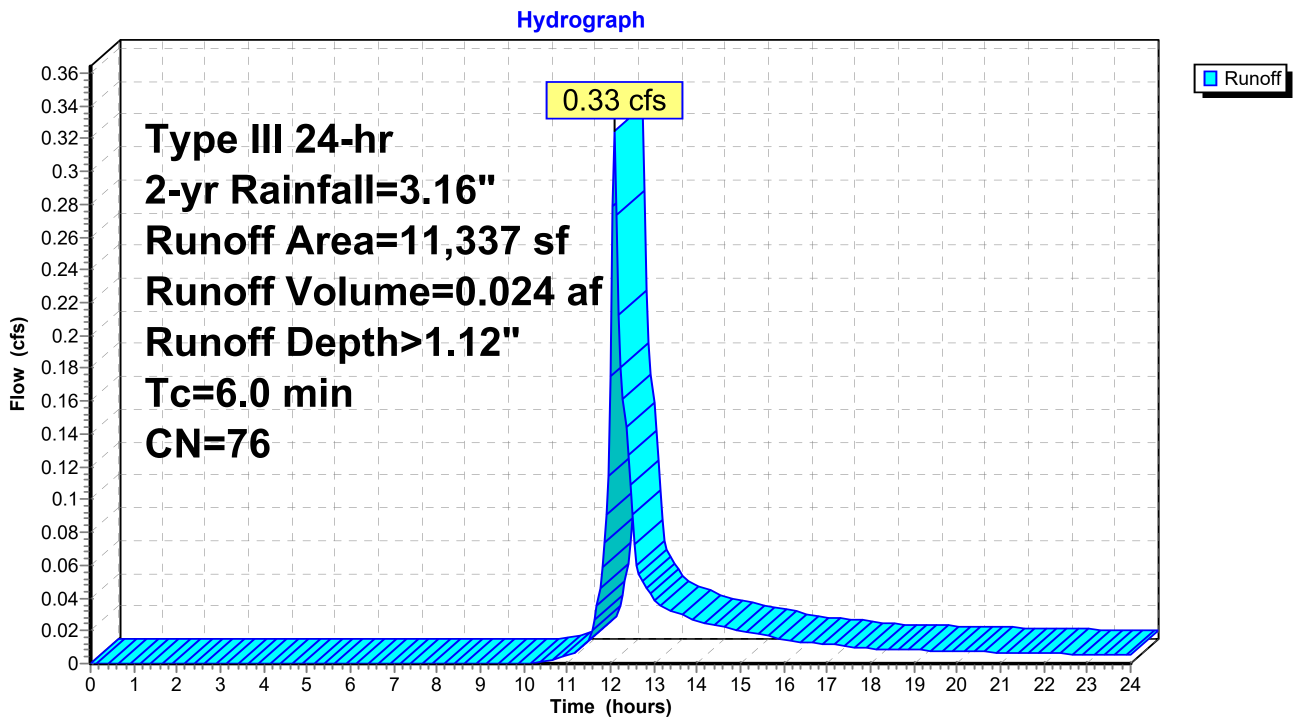
Runoff = 0.33 cfs @ 12.10 hrs, Volume= 0.024 af, Depth> 1.12"
Routed to Pond 2P : Retain-It Sys 2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-yr Rainfall=3.16"

Area (sf)	CN	Description
6,805	61	>75% Grass cover, Good, HSG B
4,532	98	Paved parking, HSG B
11,337	76	Weighted Average
6,805		60.02% Pervious Area
4,532		39.98% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment P-2: N'ly Exterior



Summary for Subcatchment P-3: E'ly Driveway

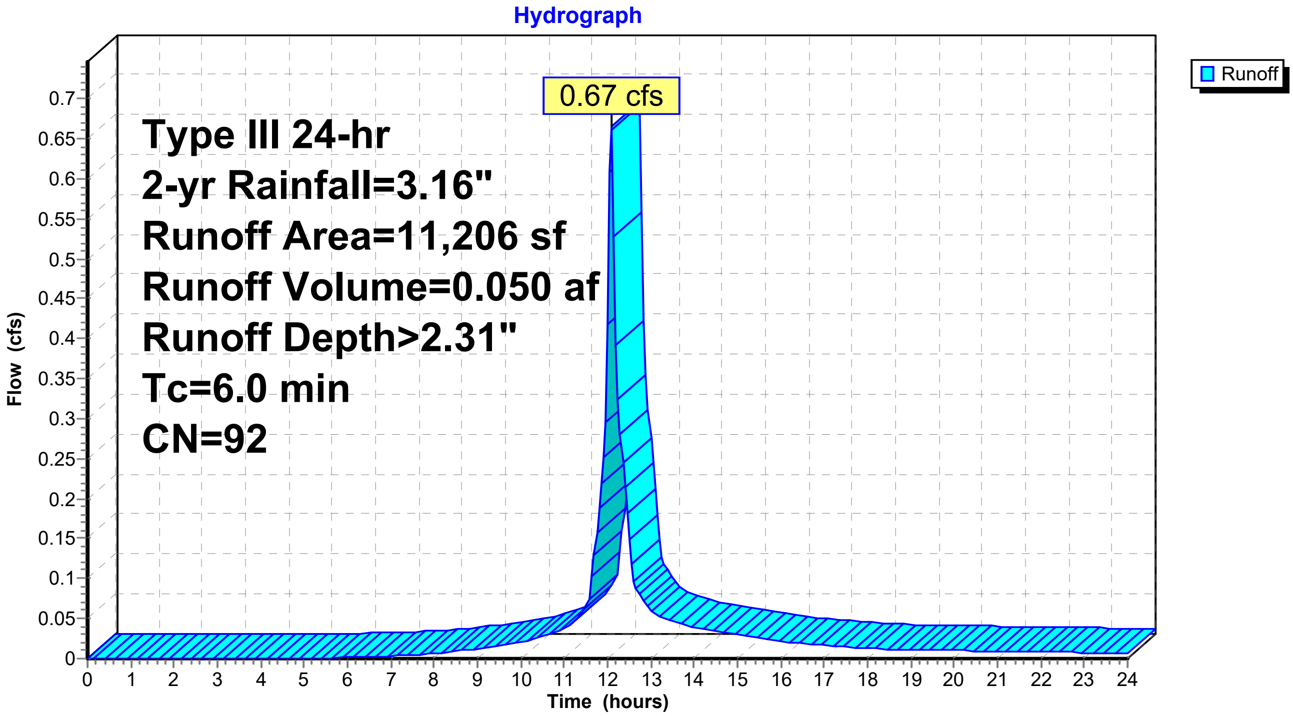
Runoff = 0.67 cfs @ 12.09 hrs, Volume= 0.050 af, Depth> 2.31"
Routed to Link 2L : Main Street

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-yr Rainfall=3.16"

Area (sf)	CN	Description
1,953	61	>75% Grass cover, Good, HSG B
9,253	98	Paved parking, HSG B
11,206	92	Weighted Average
1,953		17.43% Pervious Area
9,253		82.57% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment P-3: E'ly Driveway



Summary for Subcatchment P-4: W'ly Exterior

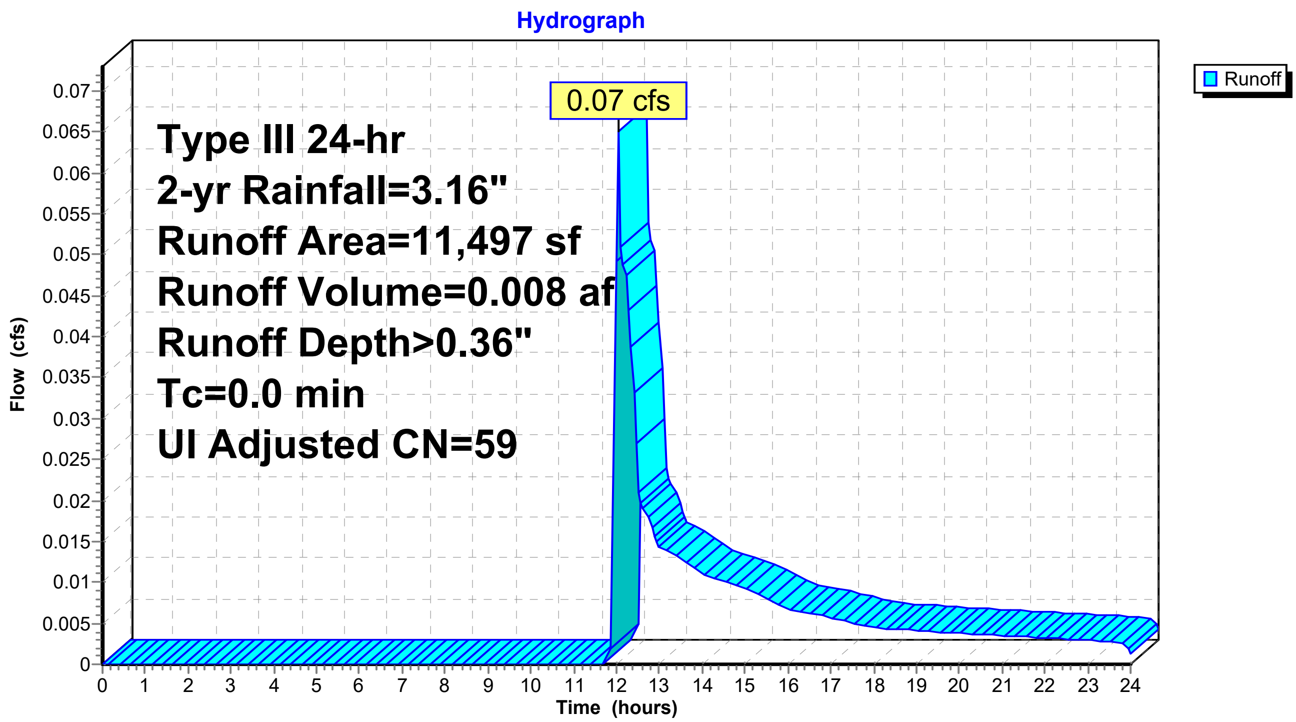
[46] Hint: Tc=0 (Instant runoff peak depends on dt)

Runoff = 0.07 cfs @ 12.05 hrs, Volume= 0.008 af, Depth> 0.36"
Routed to Link 1L : W'ly PL

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-yr Rainfall=3.16"

Area (sf)	CN	Adj	Description
2,135	55		Woods, Good, HSG B
1,459	39		>75% Grass cover, Good, HSG A
6,348	61		>75% Grass cover, Good, HSG B
544	98		Unconnected pavement, HSG A
1,011	98		Unconnected pavement, HSG B
11,497	62	59	Weighted Average, UI Adjusted
9,942			86.47% Pervious Area
1,555			13.53% Impervious Area
1,555			100.00% Unconnected

Subcatchment P-4: W'ly Exterior



Summary for Subcatchment P-5: To Main St

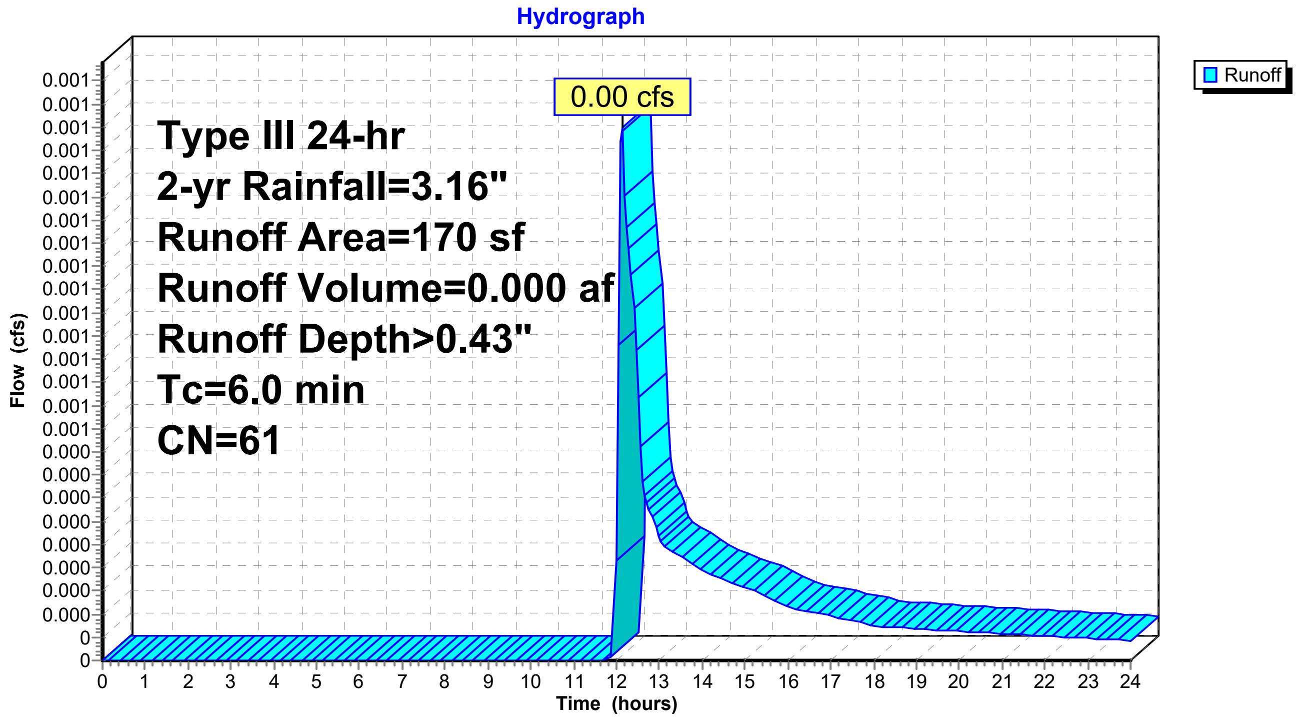
Runoff = 0.00 cfs @ 12.13 hrs, Volume= 0.000 af, Depth> 0.43"
Routed to Link 2L : Main Street

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-yr Rainfall=3.16"

Area (sf)	CN	Description
170	61	>75% Grass cover, Good, HSG B
170		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment P-5: To Main St



Summary for Pond 1P: Retain-It Sys 1

Inflow Area = 1.441 ac,100.00% Impervious, Inflow Depth > 2.93" for 2-yr event
Inflow = 4.32 cfs @ 12.09 hrs, Volume= 0.351 af
Outflow = 0.18 cfs @ 9.95 hrs, Volume= 0.253 af, Atten= 96%, Lag= 0.0 min
Discarded = 0.18 cfs @ 9.95 hrs, Volume= 0.253 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Pond 3P : Drywell

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 150.30' @ 14.89 hrs Surf.Area= 7,700 sf Storage= 7,735 cf

Plug-Flow detention time= 260.3 min calculated for 0.253 af (72% of inflow)
Center-of-Mass det. time= 169.9 min (926.2 - 756.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	148.50'	6,607 cf	**10.00'W x 770.00'L x 6.67'H Field A** 51,333 cf Overall - 34,816 cf Embedded = 16,517 cf x 40.0% Voids
#2A	149.50'	25,947 cf	**retain_it retain_it 5.0'** x 96 Inside #1 Inside= 84.0"W x 60.0"H => 36.41 sf x 8.00'L = 291.3 cf Outside= 96.0"W x 68.0"H => 45.33 sf x 8.00'L = 362.7 cf 1 Rows adjusted for 2,015.7 cf perimeter wall
		32,554 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	148.50'	**1.020 in/hr Exfiltration over Surface area**
#2	Primary	152.80'	**12.0" Round Culvert** L= 16.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 152.80' / 152.00' S= 0.0500 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#3	Device 2	153.50'	**7.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Discarded OutFlow Max=0.18 cfs @ 9.95 hrs HW=148.57' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.18 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=148.50' (Free Discharge)
└─**2=Culvert** (Controls 0.00 cfs)
  └─**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 1P: Retain-It Sys 1 - Chamber Wizard Field A

Chamber Model = retain_it retain_it 5.0' (retain-it®)
Inside= 84.0"W x 60.0"H => 36.41 sf x 8.00'L = 291.3 cf
Outside= 96.0"W x 68.0"H => 45.33 sf x 8.00'L = 362.7 cf
1 Rows adjusted for 2,015.7 cf perimeter wall

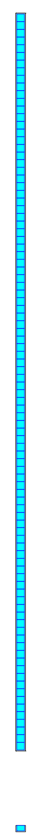
96 Chambers/Row x 8.00' Long = 768.00' Row Length +12.0" End Stone x 2 = 770.00' Base Length
1 Rows x 96.0" Wide + 12.0" Side Stone x 2 = 10.00' Base Width
12.0" Stone Base + 68.0" Chamber Height = 6.67' Field Height

10.4 cf Sidewall x 96 x 2 + 10.4 cf Endwall x 1 x 2 = 2,015.7 cf Perimeter Wall
96 Chambers x 291.3 cf - 2,015.7 cf Perimeter wall = 25,947.2 cf Chamber Storage
96 Chambers x 362.7 cf = 34,816.0 cf Displacement

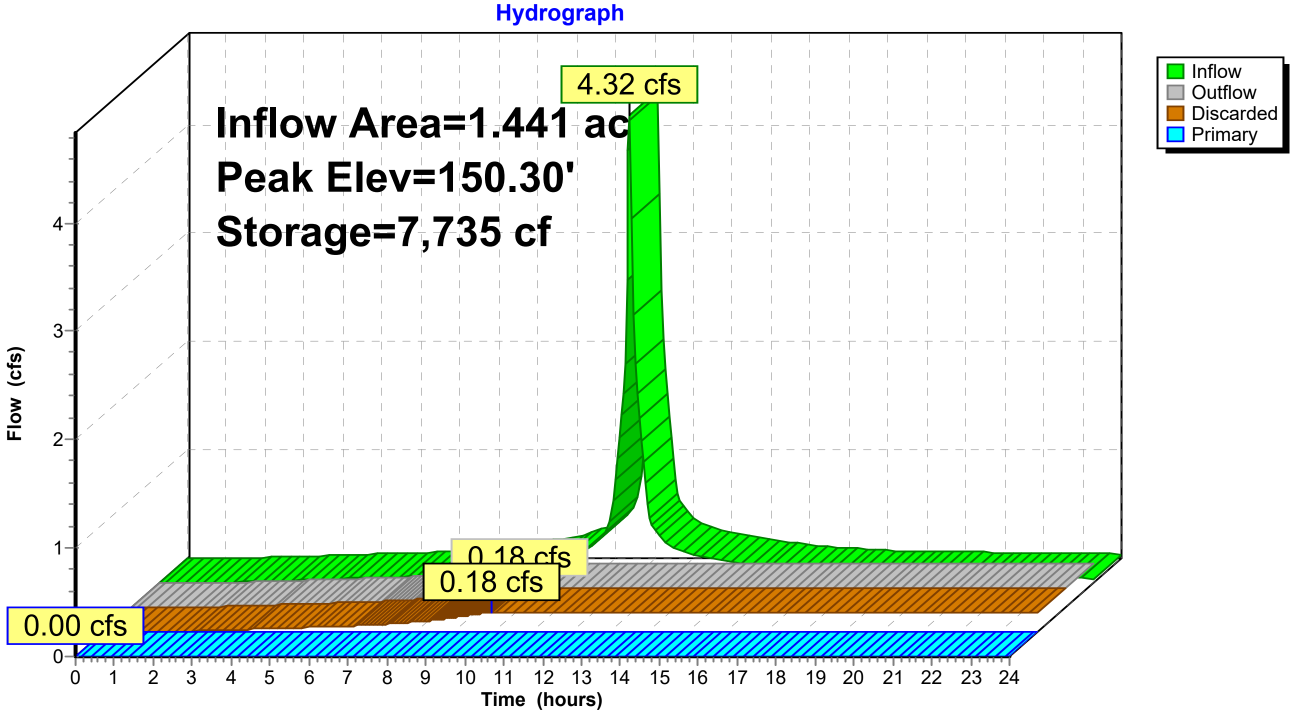
51,333.3 cf Field - 34,816.0 cf Chambers = 16,517.3 cf Stone x 40.0% Voids = 6,606.9 cf Stone Storage

Chamber Storage + Stone Storage = 32,554.2 cf = 0.747 af
Overall Storage Efficiency = 63.4%
Overall System Size = 770.00' x 10.00' x 6.67'

96 Chambers
1,901.2 cy Field
611.8 cy Stone



Pond 1P: Retain-It Sys 1



Summary for Pond 2P: Retain-It Sys 2

Inflow Area = 0.260 ac, 39.98% Impervious, Inflow Depth > 1.12" for 2-yr event
Inflow = 0.33 cfs @ 12.10 hrs, Volume= 0.024 af
Outflow = 0.03 cfs @ 11.85 hrs, Volume= 0.024 af, Atten= 91%, Lag= 0.0 min
Discarded = 0.03 cfs @ 11.85 hrs, Volume= 0.024 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 143.80' @ 13.57 hrs Surf.Area= 1,300 sf Storage= 415 cf

Plug-Flow detention time= 131.9 min calculated for 0.024 af (99% of inflow)
Center-of-Mass det. time= 129.3 min (984.9 - 855.7)

Volume	Invert	Avail.Storage	Storage Description
#1A	143.00'	767 cf	**50.00'W x 26.00'L x 5.17'H Field A** 6,717 cf Overall - 4,800 cf Embedded = 1,917 cf x 40.0% Voids
#2A	144.00'	3,504 cf	**retain_it retain_it 3.5'** x 18 Inside #1 Inside= 84.0"W x 42.0"H => 25.10 sf x 8.00'L = 200.8 cf Outside= 96.0"W x 50.0"H => 33.33 sf x 8.00'L = 266.7 cf 6 Rows adjusted for 110.5 cf perimeter wall
		4,270 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	143.00'	**1.020 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.03 cfs @ 11.85 hrs HW=143.06' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

Pond 2P: Retain-It Sys 2 - Chamber Wizard Field A

Chamber Model = retain_it retain_it 3.5' (retain-it®)
Inside= 84.0"W x 42.0"H => 25.10 sf x 8.00'L = 200.8 cf
Outside= 96.0"W x 50.0"H => 33.33 sf x 8.00'L = 266.7 cf
6 Rows adjusted for 110.5 cf perimeter wall

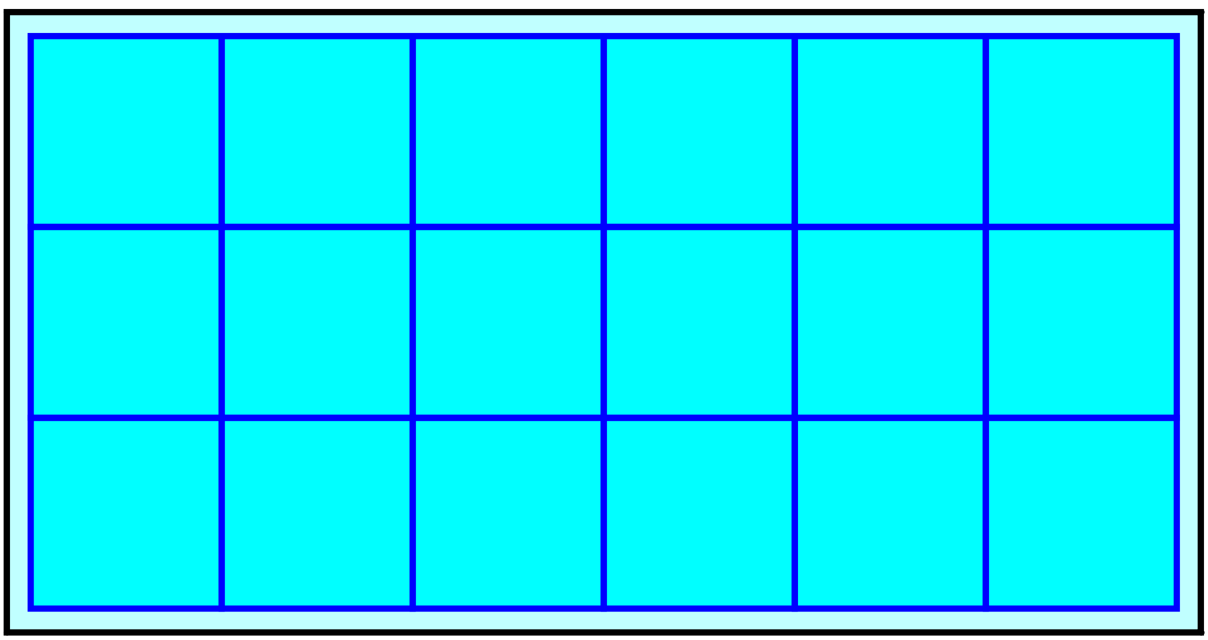
3 Chambers/Row x 8.00' Long = 24.00' Row Length +12.0" End Stone x 2 = 26.00' Base Length
6 Rows x 96.0" Wide + 12.0" Side Stone x 2 = 50.00' Base Width
12.0" Stone Base + 50.0" Chamber Height = 5.17' Field Height

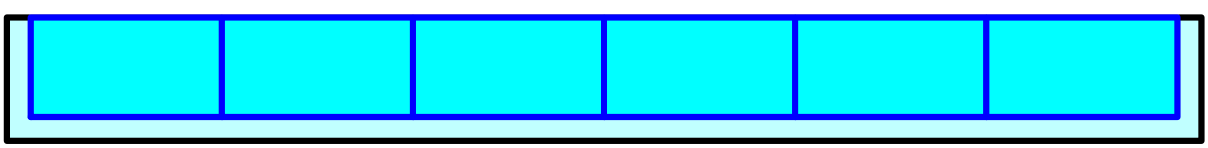
6.1 cf Sidewall x 3 x 2 + 6.1 cf Endwall x 6 x 2 = 110.5 cf Perimeter Wall
18 Chambers x 200.8 cf - 110.5 cf Perimeter wall = 3,503.5 cf Chamber Storage
18 Chambers x 266.7 cf = 4,800.0 cf Displacement

6,716.7 cf Field - 4,800.0 cf Chambers = 1,916.7 cf Stone x 40.0% Voids = 766.7 cf Stone Storage

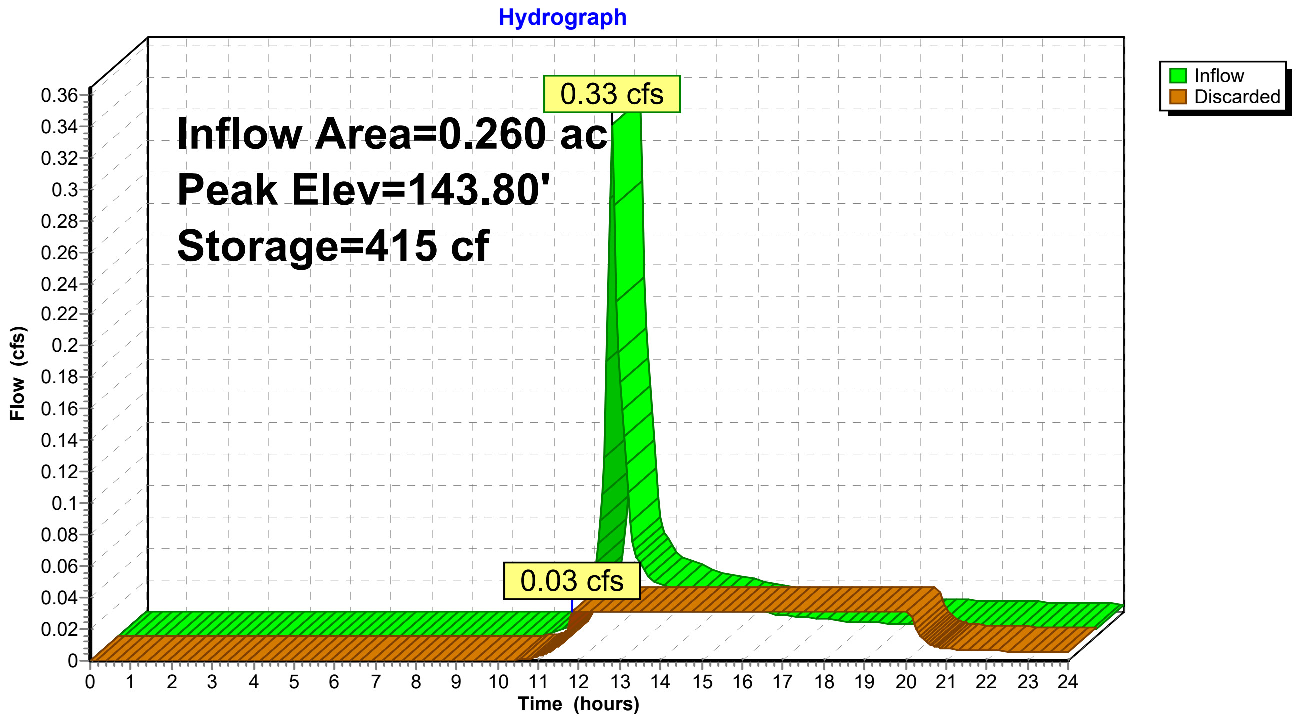
Chamber Storage + Stone Storage = 4,270.2 cf = 0.098 af
Overall Storage Efficiency = 63.6%
Overall System Size = 26.00' x 50.00' x 5.17'

18 Chambers
248.8 cy Field
71.0 cy Stone





Pond 2P: Retain-It Sys 2



Summary for Pond 3P: Drywell

Inflow Area = 1.441 ac,100.00% Impervious, Inflow Depth = 0.00" for 2-yr event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min
Discarded = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Link 1L : W'ly PL

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 142.80' @ 0.00 hrs Storage= 0 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no inflow)

Volume	Invert	Avail.Storage	Storage Description
#1	142.80'	323 cf	**Custom Stage Data** Listed below

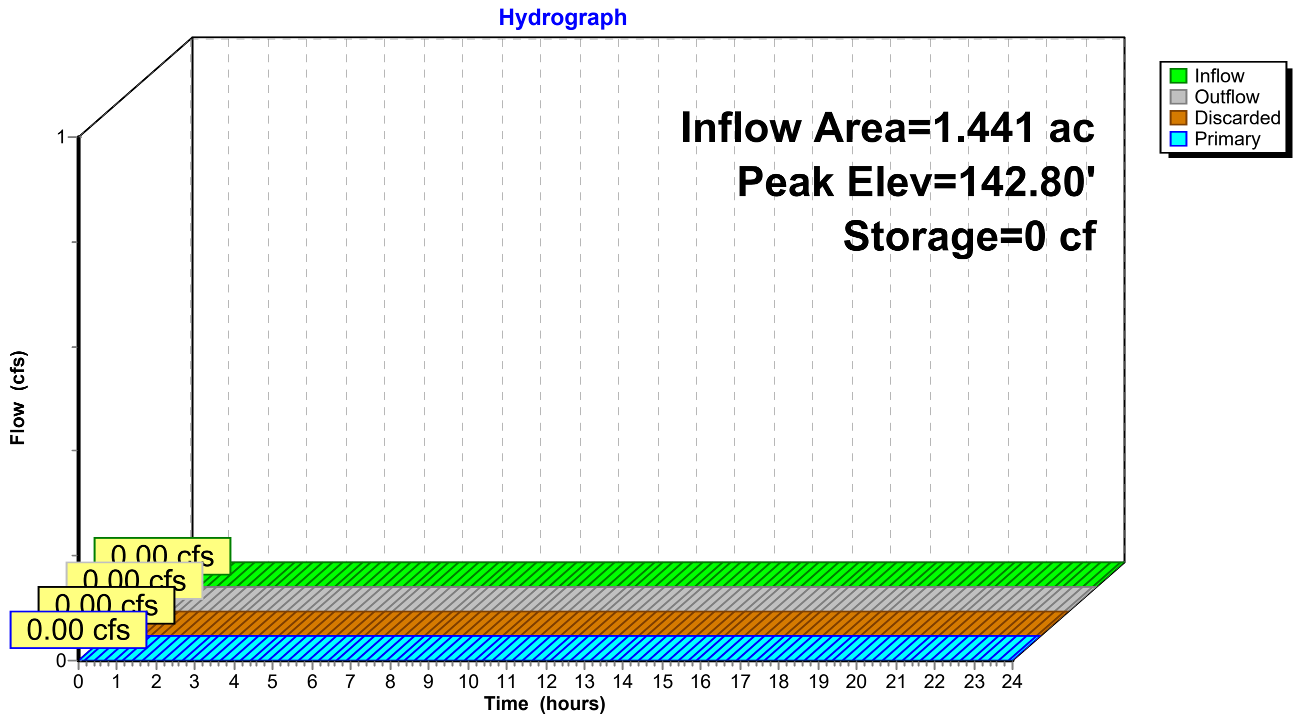
Elevation (feet)	Cum.Store (cubic-feet)
142.80	0
143.80	31
144.80	80
145.80	128
146.80	177
147.80	225
148.80	273
149.90	322
150.00	323

Device	Routing	Invert	Outlet Devices
#1	Discarded	142.80'	**0.02 cfs Exfiltration at all elevations**
#2	Primary	149.80'	**2.0" x 2.0" Horiz. Orifice/Grate X 6.00 columns** X 6 rows C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.00 cfs @ 0.00 hrs HW=142.80' (Free Discharge)
└─**1=Exfiltration** (Passes 0.00 cfs of 0.02 cfs potential flow)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=142.80' (Free Discharge)
└─**2=Orifice/Grate** (Controls 0.00 cfs)

Pond 3P: Drywell

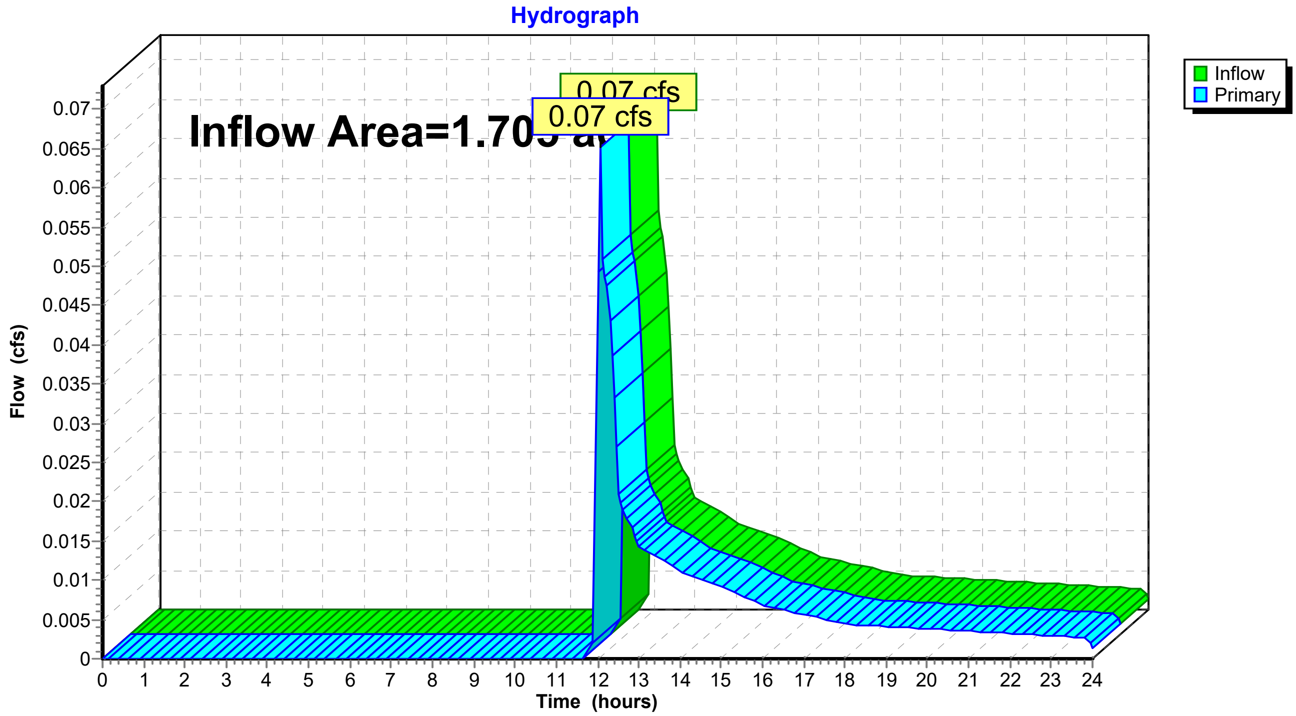


Summary for Link 1L: W'ly PL

Inflow Area = 1.705 ac, 86.61% Impervious, Inflow Depth > 0.06" for 2-yr event
Inflow = 0.07 cfs @ 12.05 hrs, Volume= 0.008 af
Primary = 0.07 cfs @ 12.05 hrs, Volume= 0.008 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

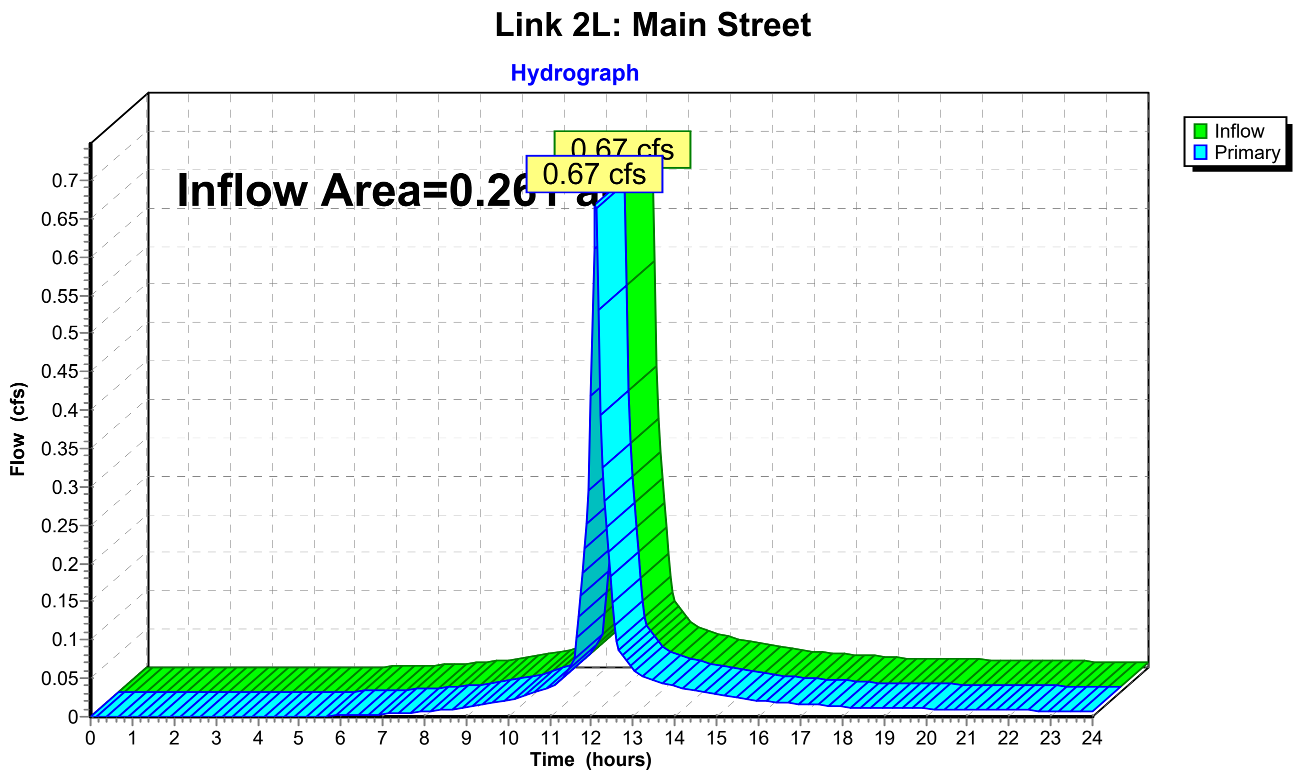
Link 1L: W'ly PL



Summary for Link 2L: Main Street

Inflow Area =	0.261 ac,	81.34% Impervious,	Inflow Depth > 2.28"	for 2-yr event	
Inflow =	0.67 cfs @	12.09 hrs,	Volume=	0.050 af	
Primary =	0.67 cfs @	12.09 hrs,	Volume=	0.050 af,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs



Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment P-1: Building w Pool Area Runoff Area=62,767 sf 100.00% Impervious Runoff Depth>4.53"
Tc=6.0 min CN=98 Runoff=6.56 cfs 0.544 af

Subcatchment P-2: N'ly Exterior Runoff Area=11,337 sf 39.98% Impervious Runoff Depth>2.35"
Tc=6.0 min CN=76 Runoff=0.70 cfs 0.051 af

Subcatchment P-3: E'ly Driveway Runoff Area=11,206 sf 82.57% Impervious Runoff Depth>3.86"
Tc=6.0 min CN=92 Runoff=1.08 cfs 0.083 af

Subcatchment P-4: W'ly Exterior Runoff Area=11,497 sf 13.53% Impervious Runoff Depth>1.11"
Tc=0.0 min UI Adjusted CN=59 Runoff=0.34 cfs 0.024 af

Subcatchment P-5: To Main St Runoff Area=170 sf 0.00% Impervious Runoff Depth>1.23"
Tc=6.0 min CN=61 Runoff=0.00 cfs 0.000 af

Pond 1P: Retain-It Sys 1 Peak Elev=151.37' Storage=13,967 cf Inflow=6.56 cfs 0.544 af
Discarded=0.18 cfs 0.278 af Primary=0.00 cfs 0.000 af Outflow=0.18 cfs 0.278 af

Pond 2P: Retain-It Sys 2 Peak Elev=144.65' Storage=1,204 cf Inflow=0.70 cfs 0.051 af
Outflow=0.03 cfs 0.034 af

Pond 3P: Drywell Peak Elev=142.80' Storage=0 cf Inflow=0.00 cfs 0.000 af
Discarded=0.00 cfs 0.000 af Primary=0.00 cfs 0.000 af Outflow=0.00 cfs 0.000 af

Link 1L: W'ly PL Inflow=0.34 cfs 0.024 af
Primary=0.34 cfs 0.024 af

Link 2L: Main Street Inflow=1.09 cfs 0.083 af
Primary=1.09 cfs 0.083 af

Total Runoff Area = 2.226 ac Runoff Volume = 0.702 af Average Runoff Depth = 3.79"
19.46% Pervious = 0.433 ac 80.54% Impervious = 1.793 ac

Summary for Subcatchment P-1: Building w Pool Area

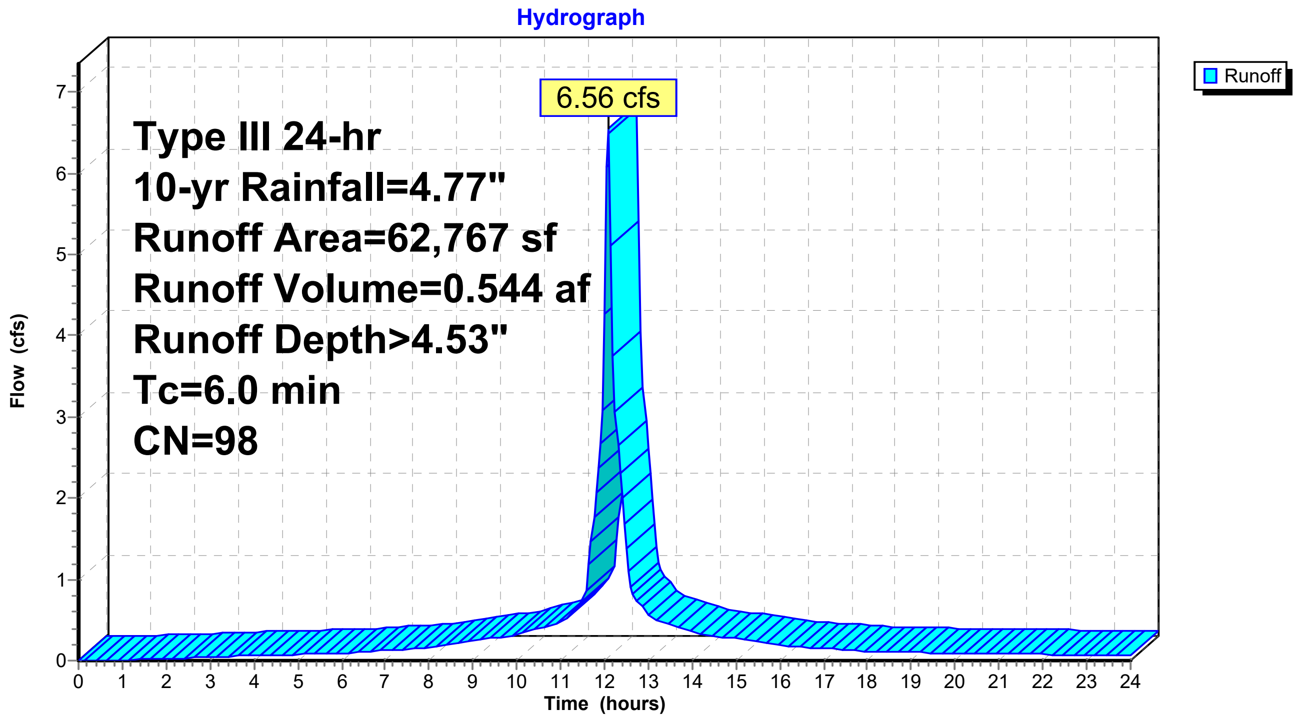
Runoff = 6.56 cfs @ 12.09 hrs, Volume= 0.544 af, Depth> 4.53"
Routed to Pond 1P : Retain-It Sys 1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-yr Rainfall=4.77"

Area (sf)	CN	Description
656	98	Roofs, HSG A
62,111	98	Roofs, HSG B
62,767	98	Weighted Average
62,767		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment P-1: Building w Pool Area



Summary for Subcatchment P-2: N'ly Exterior

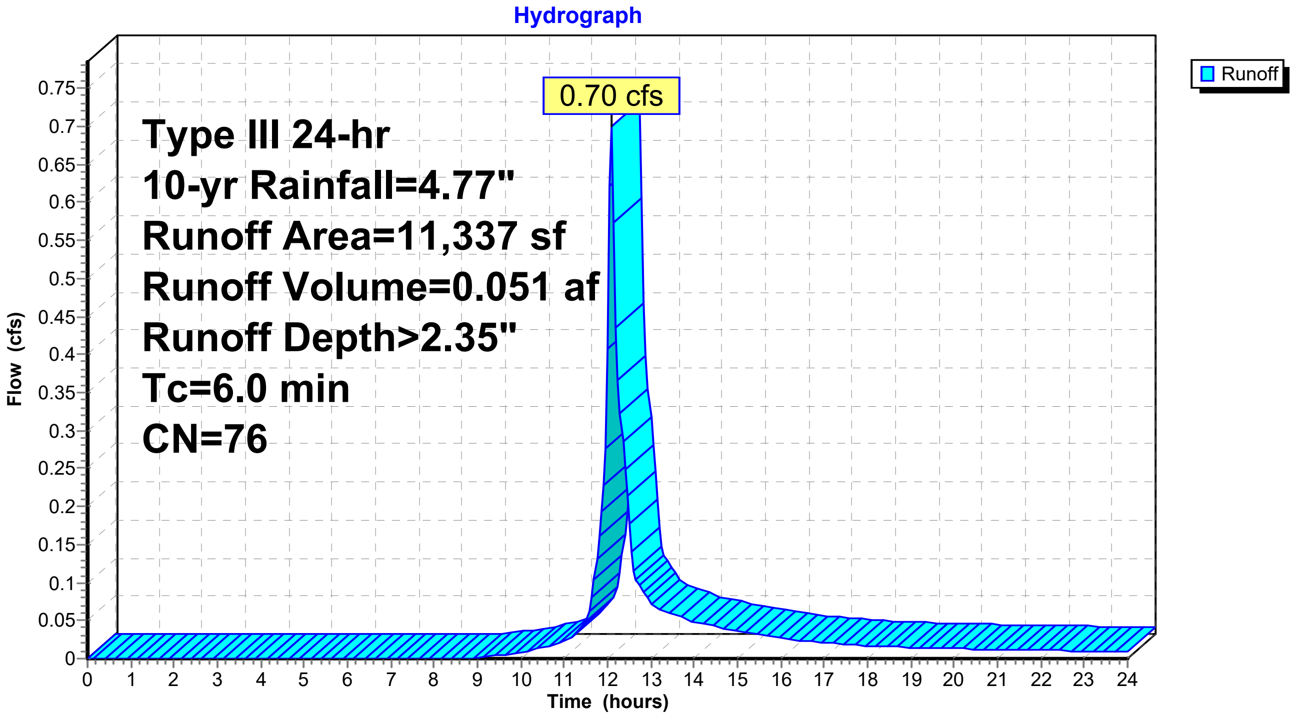
Runoff = 0.70 cfs @ 12.09 hrs, Volume= 0.051 af, Depth> 2.35"
Routed to Pond 2P : Retain-It Sys 2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-yr Rainfall=4.77"

Area (sf)	CN	Description
6,805	61	>75% Grass cover, Good, HSG B
4,532	98	Paved parking, HSG B
11,337	76	Weighted Average
6,805		60.02% Pervious Area
4,532		39.98% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment P-2: N'ly Exterior



Summary for Subcatchment P-3: E'ly Driveway

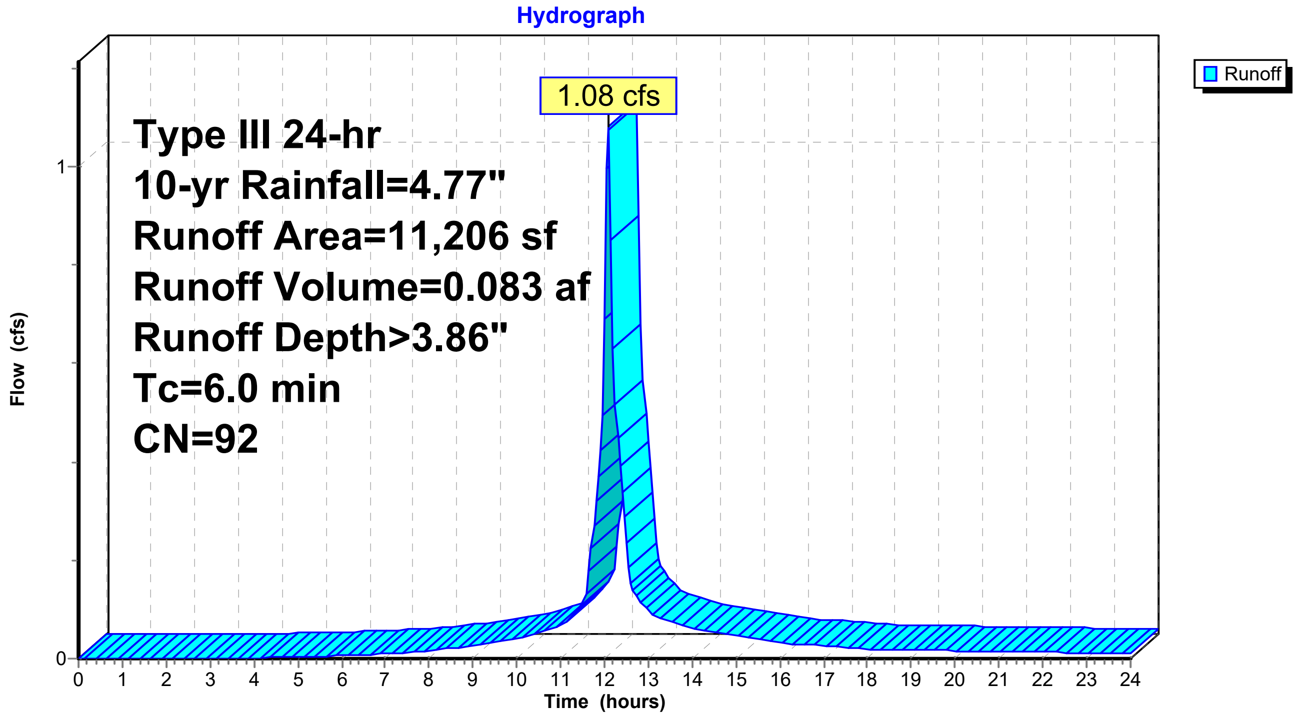
Runoff = 1.08 cfs @ 12.09 hrs, Volume= 0.083 af, Depth> 3.86"
Routed to Link 2L : Main Street

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-yr Rainfall=4.77"

Area (sf)	CN	Description
1,953	61	>75% Grass cover, Good, HSG B
9,253	98	Paved parking, HSG B
11,206	92	Weighted Average
1,953		17.43% Pervious Area
9,253		82.57% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment P-3: E'ly Driveway



Summary for Subcatchment P-4: W'ly Exterior

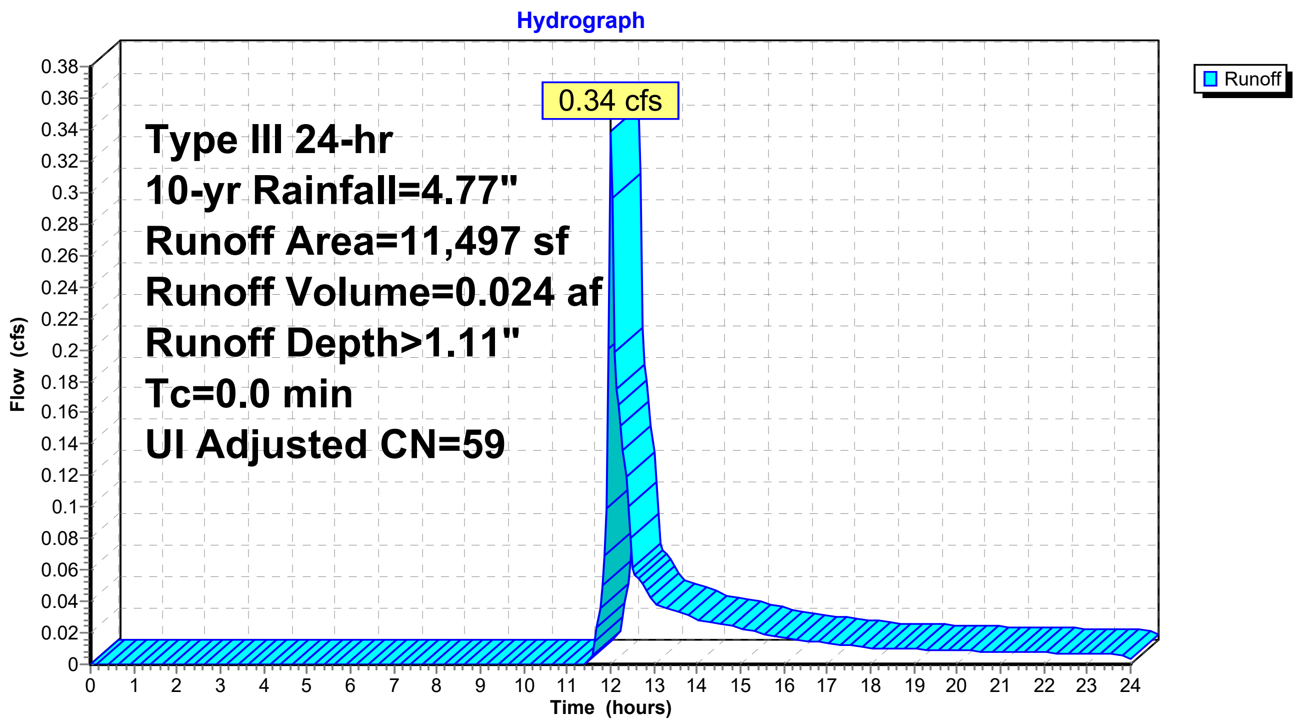
[46] Hint: Tc=0 (Instant runoff peak depends on dt)

Runoff = 0.34 cfs @ 12.01 hrs, Volume= 0.024 af, Depth> 1.11"
Routed to Link 1L : W'ly PL

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-yr Rainfall=4.77"

Area (sf)	CN	Adj	Description
2,135	55		Woods, Good, HSG B
1,459	39		>75% Grass cover, Good, HSG A
6,348	61		>75% Grass cover, Good, HSG B
544	98		Unconnected pavement, HSG A
1,011	98		Unconnected pavement, HSG B
11,497	62	59	Weighted Average, UI Adjusted
9,942			86.47% Pervious Area
1,555			13.53% Impervious Area
1,555			100.00% Unconnected

Subcatchment P-4: W'ly Exterior



Summary for Subcatchment P-5: To Main St

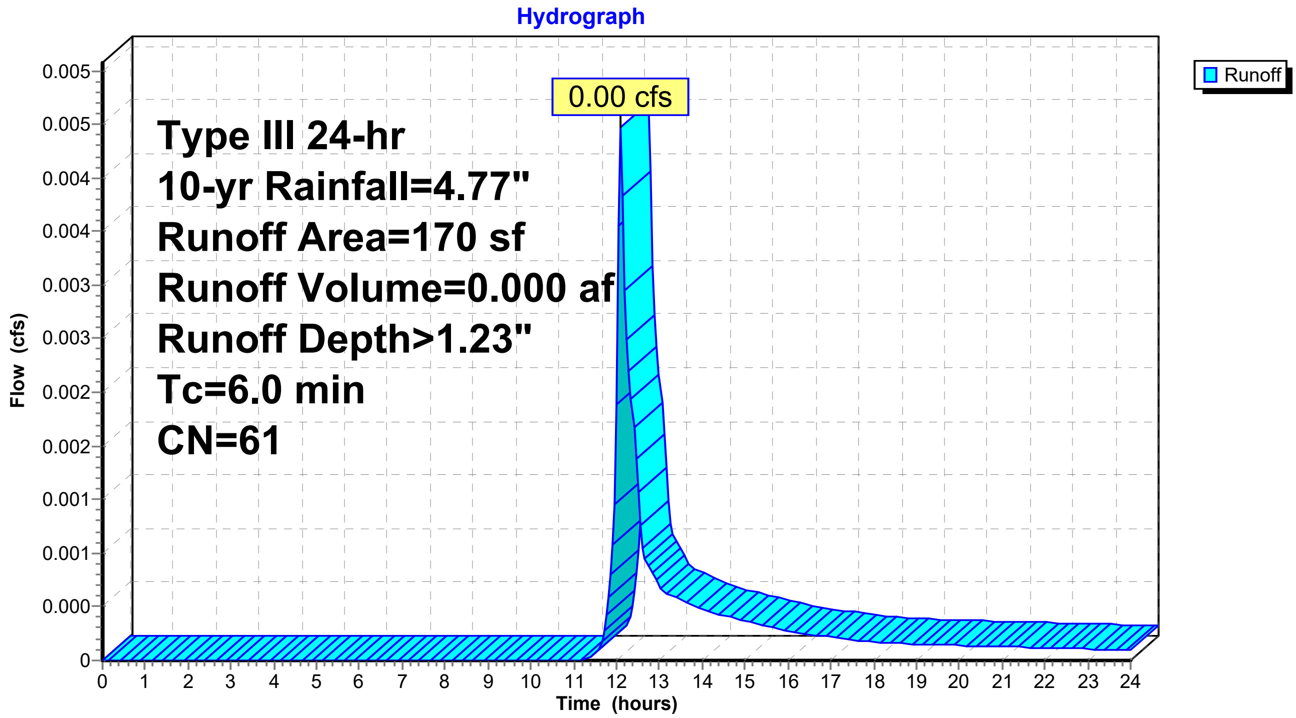
Runoff = 0.00 cfs @ 12.10 hrs, Volume= 0.000 af, Depth> 1.23"
Routed to Link 2L : Main Street

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-yr Rainfall=4.77"

Area (sf)	CN	Description
170	61	>75% Grass cover, Good, HSG B
170		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment P-5: To Main St



Summary for Pond 1P: Retain-It Sys 1

Inflow Area = 1.441 ac,100.00% Impervious, Inflow Depth > 4.53" for 10-yr event
Inflow = 6.56 cfs @ 12.09 hrs, Volume= 0.544 af
Outflow = 0.18 cfs @ 8.60 hrs, Volume= 0.278 af, Atten= 97%, Lag= 0.0 min
Discarded = 0.18 cfs @ 8.60 hrs, Volume= 0.278 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Pond 3P : Drywell

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 151.37' @ 16.07 hrs Surf.Area= 7,700 sf Storage= 13,967 cf

Plug-Flow detention time= 256.3 min calculated for 0.278 af (51% of inflow)
Center-of-Mass det. time= 129.7 min (878.1 - 748.4)

Volume	Invert	Avail.Storage	Storage Description
#1A	148.50'	6,607 cf	**10.00'W x 770.00'L x 6.67'H Field A** 51,333 cf Overall - 34,816 cf Embedded = 16,517 cf x 40.0% Voids
#2A	149.50'	25,947 cf	**retain_it retain_it 5.0'** x 96 Inside #1 Inside= 84.0"W x 60.0"H => 36.41 sf x 8.00'L = 291.3 cf Outside= 96.0"W x 68.0"H => 45.33 sf x 8.00'L = 362.7 cf 1 Rows adjusted for 2,015.7 cf perimeter wall
		32,554 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	148.50'	**1.020 in/hr Exfiltration over Surface area**
#2	Primary	152.80'	**12.0" Round Culvert** L= 16.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 152.80' / 152.00' S= 0.0500 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#3	Device 2	153.50'	**7.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Discarded OutFlow Max=0.18 cfs @ 8.60 hrs HW=148.57' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.18 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=148.50' (Free Discharge)
└─**2=Culvert** (Controls 0.00 cfs)
  └─**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 1P: Retain-It Sys 1 - Chamber Wizard Field A

Chamber Model = retain_it retain_it 5.0' (retain-it®)
Inside= 84.0"W x 60.0"H => 36.41 sf x 8.00'L = 291.3 cf
Outside= 96.0"W x 68.0"H => 45.33 sf x 8.00'L = 362.7 cf
1 Rows adjusted for 2,015.7 cf perimeter wall

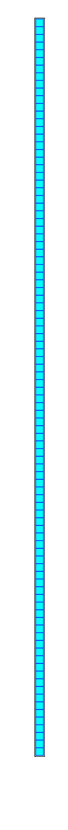
96 Chambers/Row x 8.00' Long = 768.00' Row Length +12.0" End Stone x 2 = 770.00' Base Length
1 Rows x 96.0" Wide + 12.0" Side Stone x 2 = 10.00' Base Width
12.0" Stone Base + 68.0" Chamber Height = 6.67' Field Height

10.4 cf Sidewall x 96 x 2 + 10.4 cf Endwall x 1 x 2 = 2,015.7 cf Perimeter Wall
96 Chambers x 291.3 cf - 2,015.7 cf Perimeter wall = 25,947.2 cf Chamber Storage
96 Chambers x 362.7 cf = 34,816.0 cf Displacement

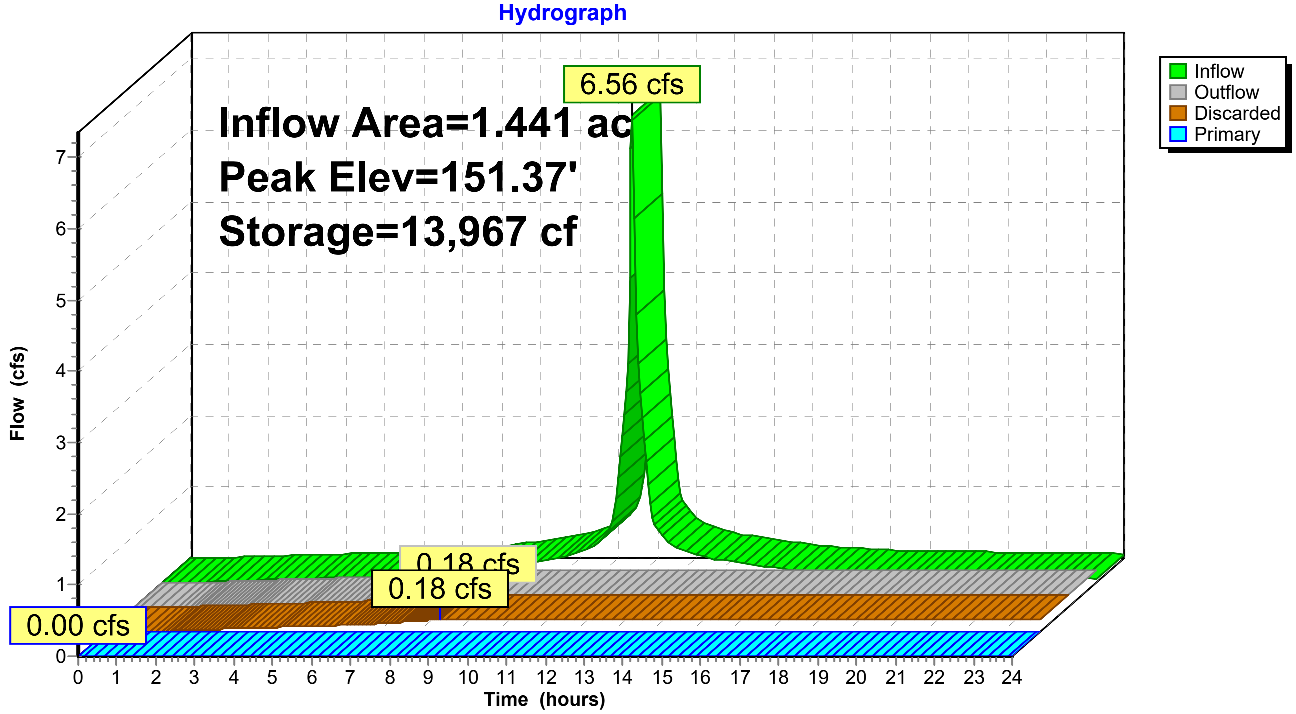
51,333.3 cf Field - 34,816.0 cf Chambers = 16,517.3 cf Stone x 40.0% Voids = 6,606.9 cf Stone Storage

Chamber Storage + Stone Storage = 32,554.2 cf = 0.747 af
Overall Storage Efficiency = 63.4%
Overall System Size = 770.00' x 10.00' x 6.67'

96 Chambers
1,901.2 cy Field
611.8 cy Stone



Pond 1P: Retain-It Sys 1



Summary for Pond 2P: Retain-It Sys 2

Inflow Area = 0.260 ac, 39.98% Impervious, Inflow Depth > 2.35" for 10-yr event
Inflow = 0.70 cfs @ 12.09 hrs, Volume= 0.051 af
Outflow = 0.03 cfs @ 11.40 hrs, Volume= 0.034 af, Atten= 96%, Lag= 0.0 min
Discarded = 0.03 cfs @ 11.40 hrs, Volume= 0.034 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 144.65' @ 15.61 hrs Surf.Area= 1,300 sf Storage= 1,204 cf

Plug-Flow detention time= 305.6 min calculated for 0.034 af (67% of inflow)
Center-of-Mass det. time= 203.4 min (1,037.4 - 834.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	143.00'	767 cf	**50.00'W x 26.00'L x 5.17'H Field A**
			6,717 cf Overall - 4,800 cf Embedded = 1,917 cf x 40.0% Voids
#2A	144.00'	3,504 cf	**retain_it retain_it 3.5'** x 18 Inside #1
			Inside= 84.0"W x 42.0"H => 25.10 sf x 8.00'L = 200.8 cf
			Outside= 96.0"W x 50.0"H => 33.33 sf x 8.00'L = 266.7 cf
			6 Rows adjusted for 110.5 cf perimeter wall
		4,270 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	143.00'	**1.020 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.03 cfs @ 11.40 hrs HW=143.05' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

Pond 2P: Retain-It Sys 2 - Chamber Wizard Field A

Chamber Model = retain_it retain_it 3.5' (retain-it®)
Inside= 84.0"W x 42.0"H => 25.10 sf x 8.00'L = 200.8 cf
Outside= 96.0"W x 50.0"H => 33.33 sf x 8.00'L = 266.7 cf
6 Rows adjusted for 110.5 cf perimeter wall

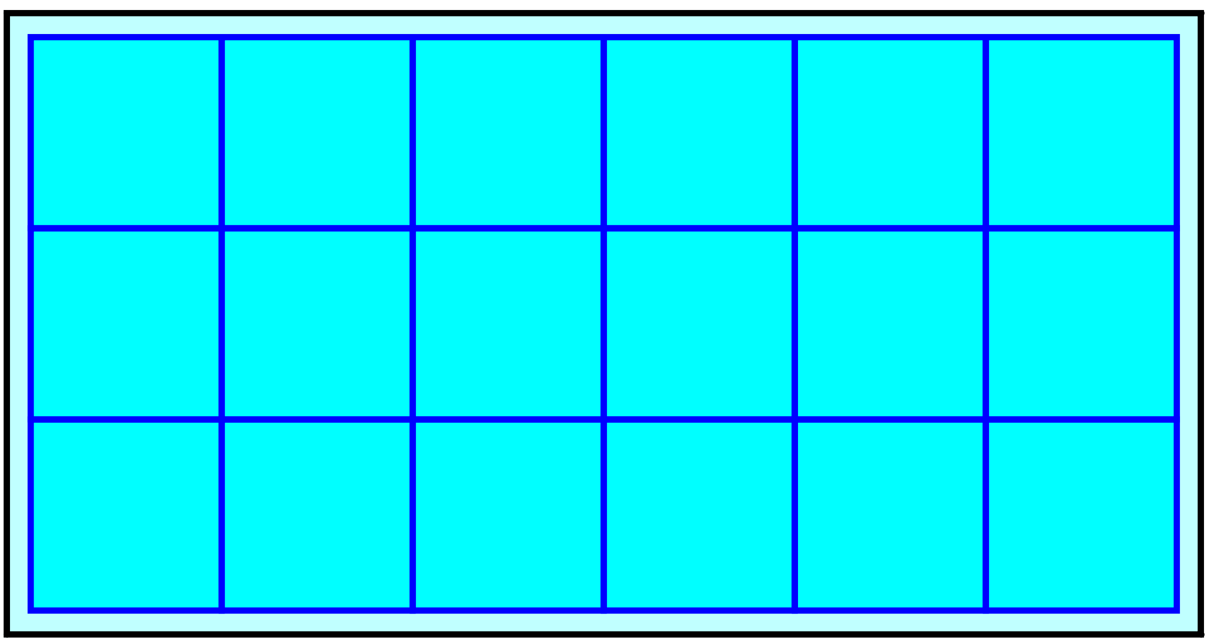
3 Chambers/Row x 8.00' Long = 24.00' Row Length +12.0" End Stone x 2 = 26.00' Base Length
6 Rows x 96.0" Wide + 12.0" Side Stone x 2 = 50.00' Base Width
12.0" Stone Base + 50.0" Chamber Height = 5.17' Field Height

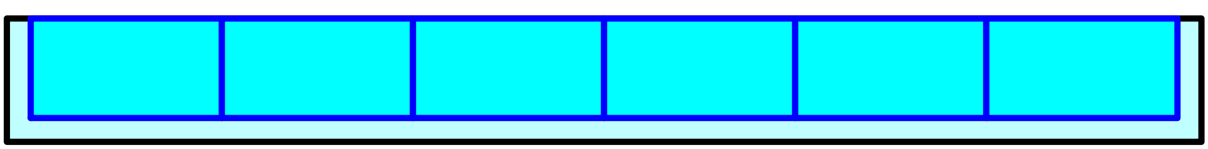
6.1 cf Sidewall x 3 x 2 + 6.1 cf Endwall x 6 x 2 = 110.5 cf Perimeter Wall
18 Chambers x 200.8 cf - 110.5 cf Perimeter wall = 3,503.5 cf Chamber Storage
18 Chambers x 266.7 cf = 4,800.0 cf Displacement

6,716.7 cf Field - 4,800.0 cf Chambers = 1,916.7 cf Stone x 40.0% Voids = 766.7 cf Stone Storage

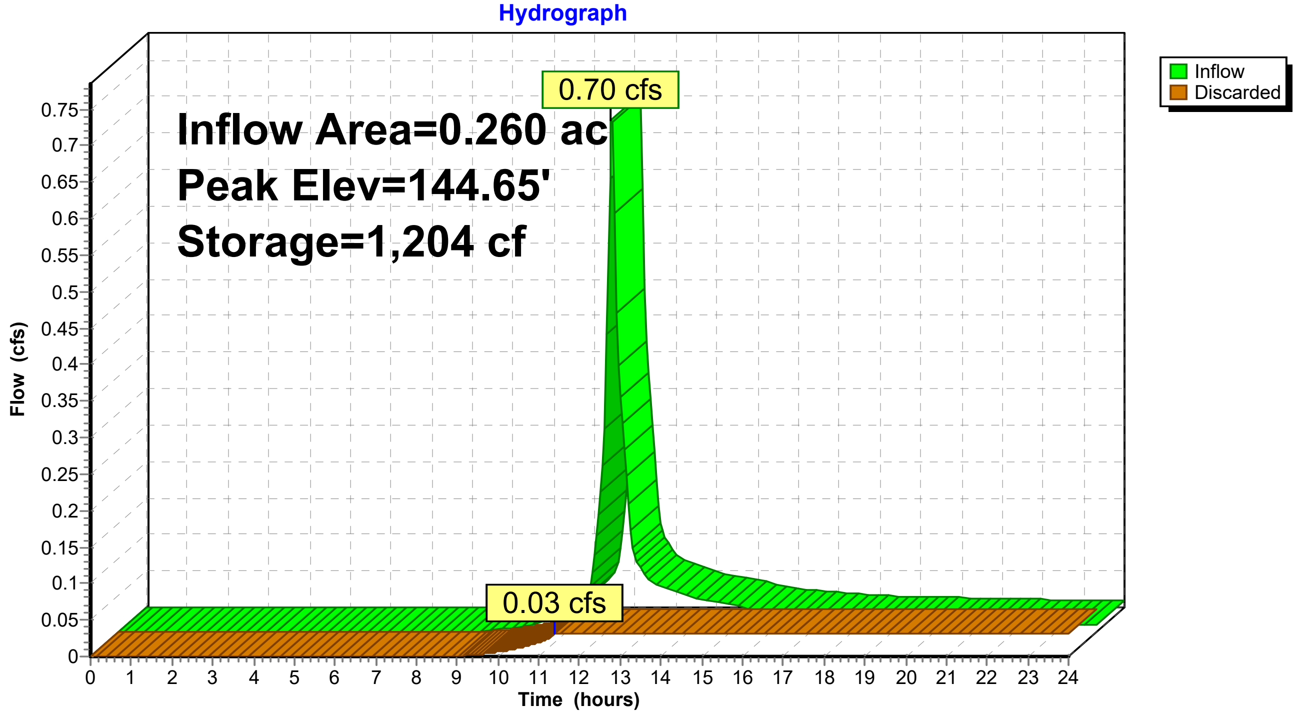
Chamber Storage + Stone Storage = 4,270.2 cf = 0.098 af
Overall Storage Efficiency = 63.6%
Overall System Size = 26.00' x 50.00' x 5.17'

18 Chambers
248.8 cy Field
71.0 cy Stone





Pond 2P: Retain-It Sys 2



Summary for Pond 3P: Drywell

Inflow Area = 1.441 ac,100.00% Impervious, Inflow Depth = 0.00" for 10-yr event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min
Discarded = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Link 1L : W'ly PL

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 142.80' @ 0.00 hrs Storage= 0 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no inflow)

Volume	Invert	Avail.Storage	Storage Description
#1	142.80'	323 cf	**Custom Stage Data** Listed below

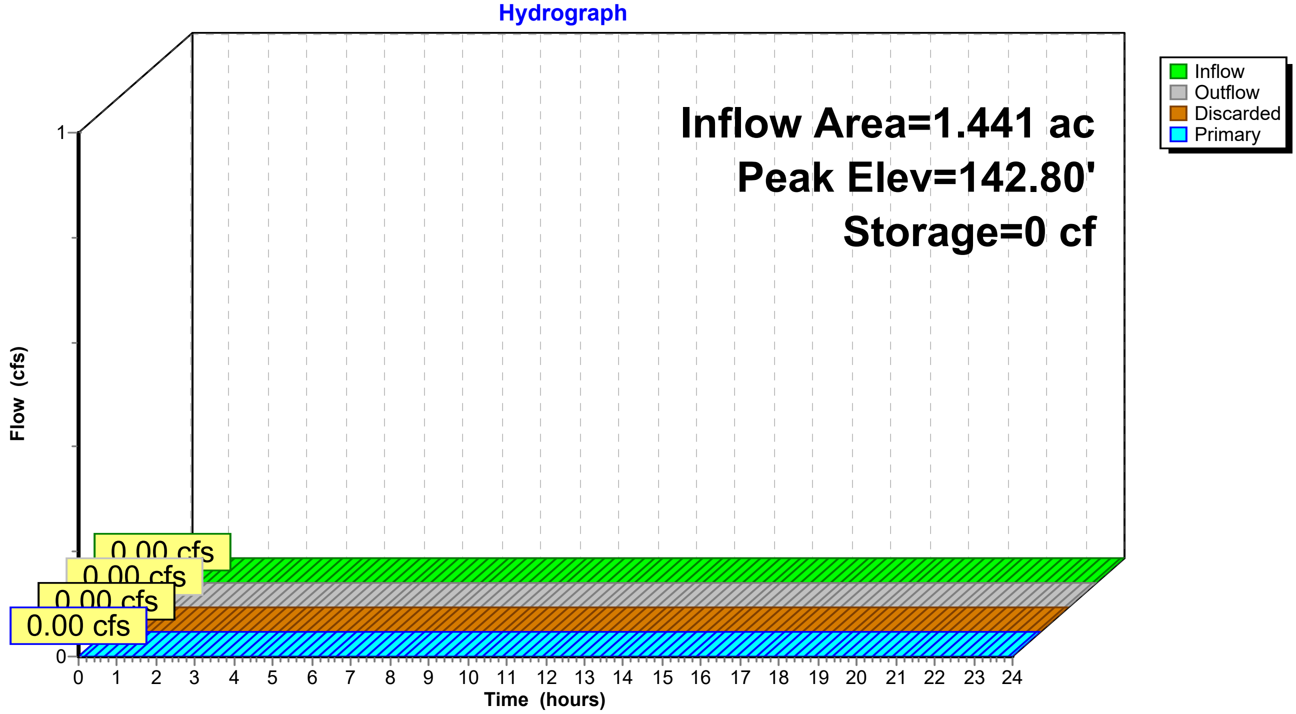
Elevation (feet)	Cum.Store (cubic-feet)
142.80	0
143.80	31
144.80	80
145.80	128
146.80	177
147.80	225
148.80	273
149.90	322
150.00	323

Device	Routing	Invert	Outlet Devices
#1	Discarded	142.80'	**0.02 cfs Exfiltration at all elevations**
#2	Primary	149.80'	**2.0" x 2.0" Horiz. Orifice/Grate X 6.00 columns** X 6 rows C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.00 cfs @ 0.00 hrs HW=142.80' (Free Discharge)
└─**1=Exfiltration** (Passes 0.00 cfs of 0.02 cfs potential flow)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=142.80' (Free Discharge)
└─**2=Orifice/Grate** (Controls 0.00 cfs)

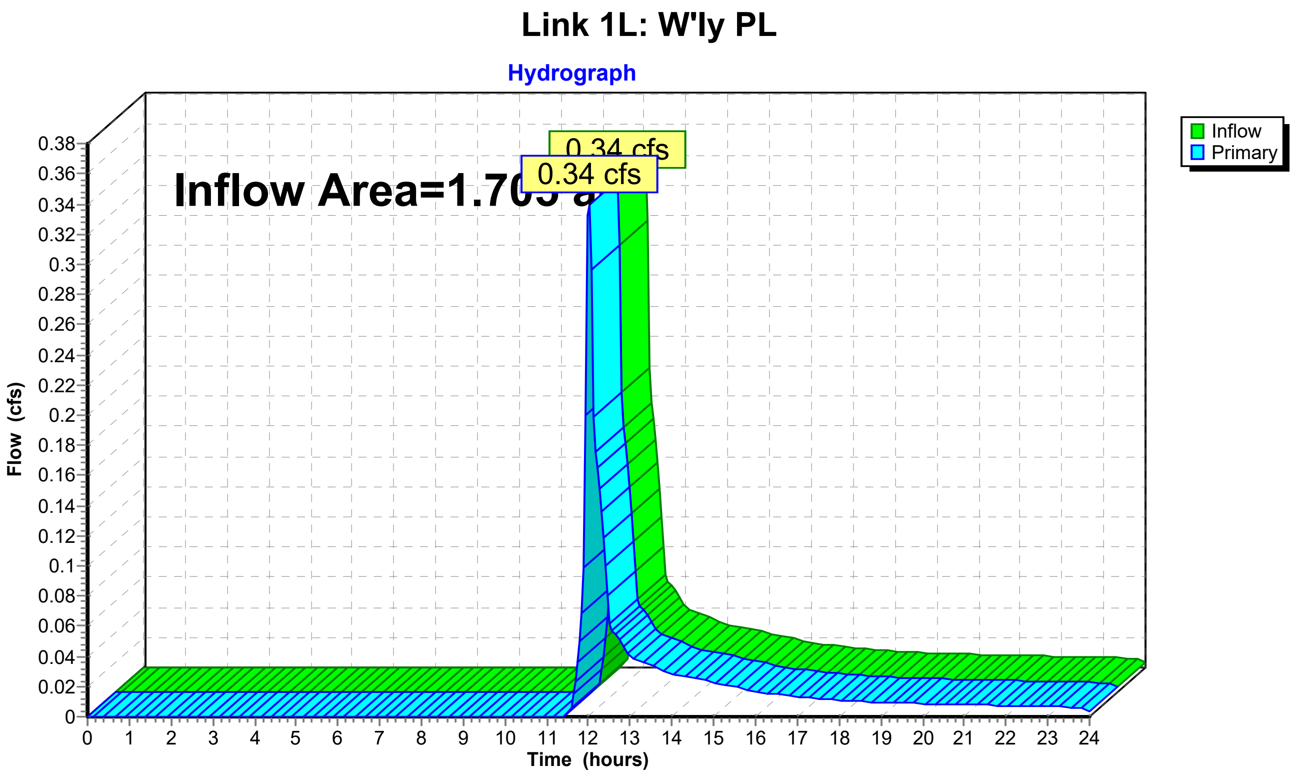
Pond 3P: Drywell



Summary for Link 1L: W'ly PL

Inflow Area = 1.705 ac, 86.61% Impervious, Inflow Depth > 0.17" for 10-yr event
Inflow = 0.34 cfs @ 12.01 hrs, Volume= 0.024 af
Primary = 0.34 cfs @ 12.01 hrs, Volume= 0.024 af, Atten= 0%, Lag= 0.0 min

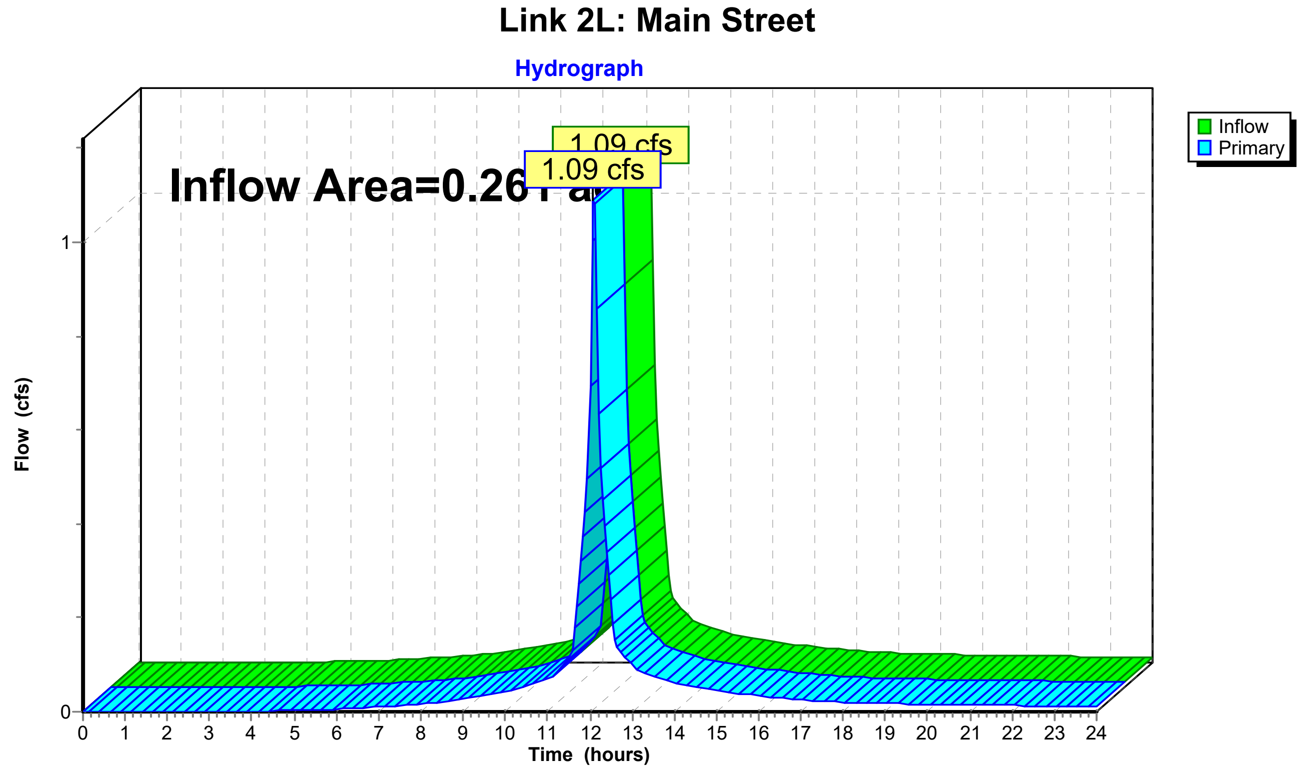
Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs



Summary for Link 2L: Main Street

Inflow Area = 0.261 ac, 81.34% Impervious, Inflow Depth > 3.82" for 10-yr event
Inflow = 1.09 cfs @ 12.09 hrs, Volume= 0.083 af
Primary = 1.09 cfs @ 12.09 hrs, Volume= 0.083 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs



Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment P-1: Building w Pool Area Runoff Area=62,767 sf 100.00% Impervious Runoff Depth>5.79"
Tc=6.0 min CN=98 Runoff=8.32 cfs 0.695 af

Subcatchment P-2: N'ly Exterior Runoff Area=11,337 sf 39.98% Impervious Runoff Depth>3.40"
Tc=6.0 min CN=76 Runoff=1.02 cfs 0.074 af

Subcatchment P-3: E'ly Driveway Runoff Area=11,206 sf 82.57% Impervious Runoff Depth>5.10"
Tc=6.0 min CN=92 Runoff=1.41 cfs 0.109 af

Subcatchment P-4: W'ly Exterior Runoff Area=11,497 sf 13.53% Impervious Runoff Depth>1.86"
Tc=0.0 min UI Adjusted CN=59 Runoff=0.62 cfs 0.041 af

Subcatchment P-5: To Main St Runoff Area=170 sf 0.00% Impervious Runoff Depth>2.02"
Tc=6.0 min CN=61 Runoff=0.01 cfs 0.001 af

Pond 1P: Retain-It Sys 1 Peak Elev=152.28' Storage=19,222 cf Inflow=8.32 cfs 0.695 af
Discarded=0.18 cfs 0.293 af Primary=0.00 cfs 0.000 af Outflow=0.18 cfs 0.293 af

Pond 2P: Retain-It Sys 2 Peak Elev=145.37' Storage=1,973 cf Inflow=1.02 cfs 0.074 af
Outflow=0.03 cfs 0.036 af

Pond 3P: Drywell Peak Elev=142.80' Storage=0 cf Inflow=0.00 cfs 0.000 af
Discarded=0.00 cfs 0.000 af Primary=0.00 cfs 0.000 af Outflow=0.00 cfs 0.000 af

Link 1L: W'ly PL Inflow=0.62 cfs 0.041 af
Primary=0.62 cfs 0.041 af

Link 2L: Main Street Inflow=1.42 cfs 0.110 af
Primary=1.42 cfs 0.110 af

Total Runoff Area = 2.226 ac Runoff Volume = 0.920 af Average Runoff Depth = 4.96"
19.46% Pervious = 0.433 ac 80.54% Impervious = 1.793 ac

Summary for Subcatchment P-1: Building w Pool Area

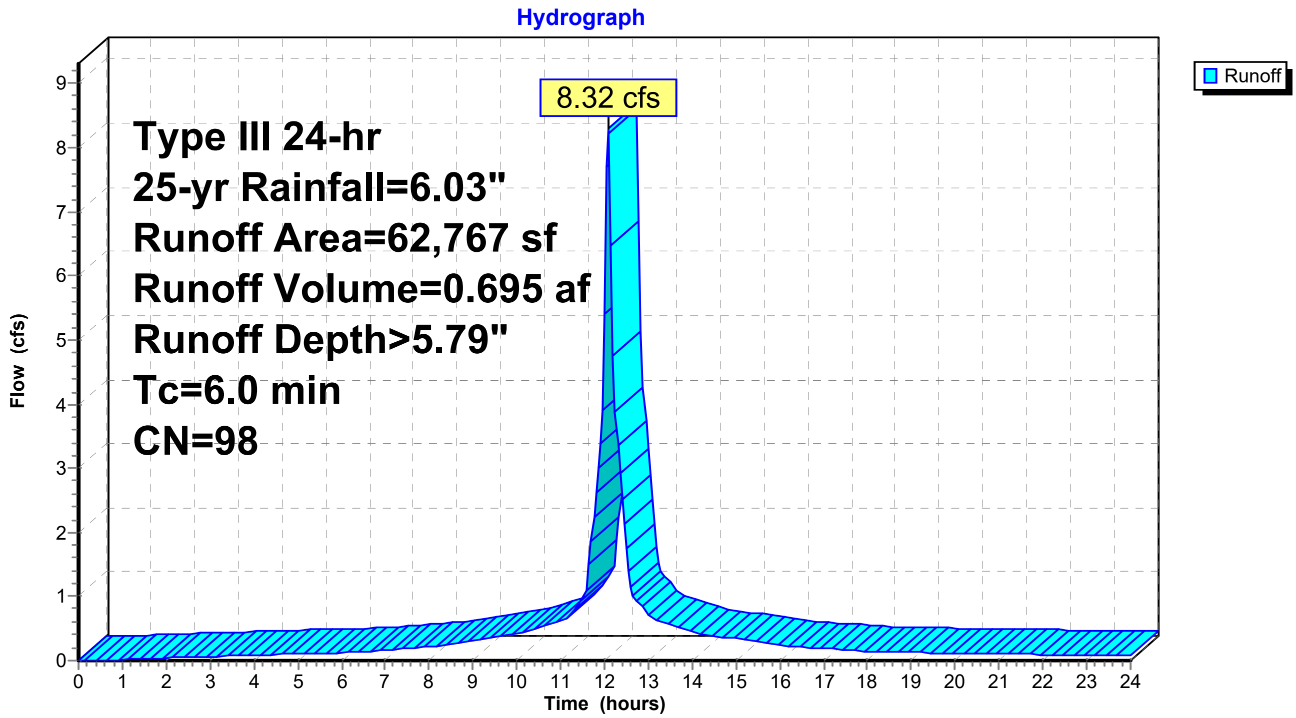
Runoff = 8.32 cfs @ 12.09 hrs, Volume= 0.695 af, Depth> 5.79"
Routed to Pond 1P : Retain-It Sys 1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-yr Rainfall=6.03"

Area (sf)	CN	Description
656	98	Roofs, HSG A
62,111	98	Roofs, HSG B
62,767	98	Weighted Average
62,767		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment P-1: Building w Pool Area



Summary for Subcatchment P-2: N'ly Exterior

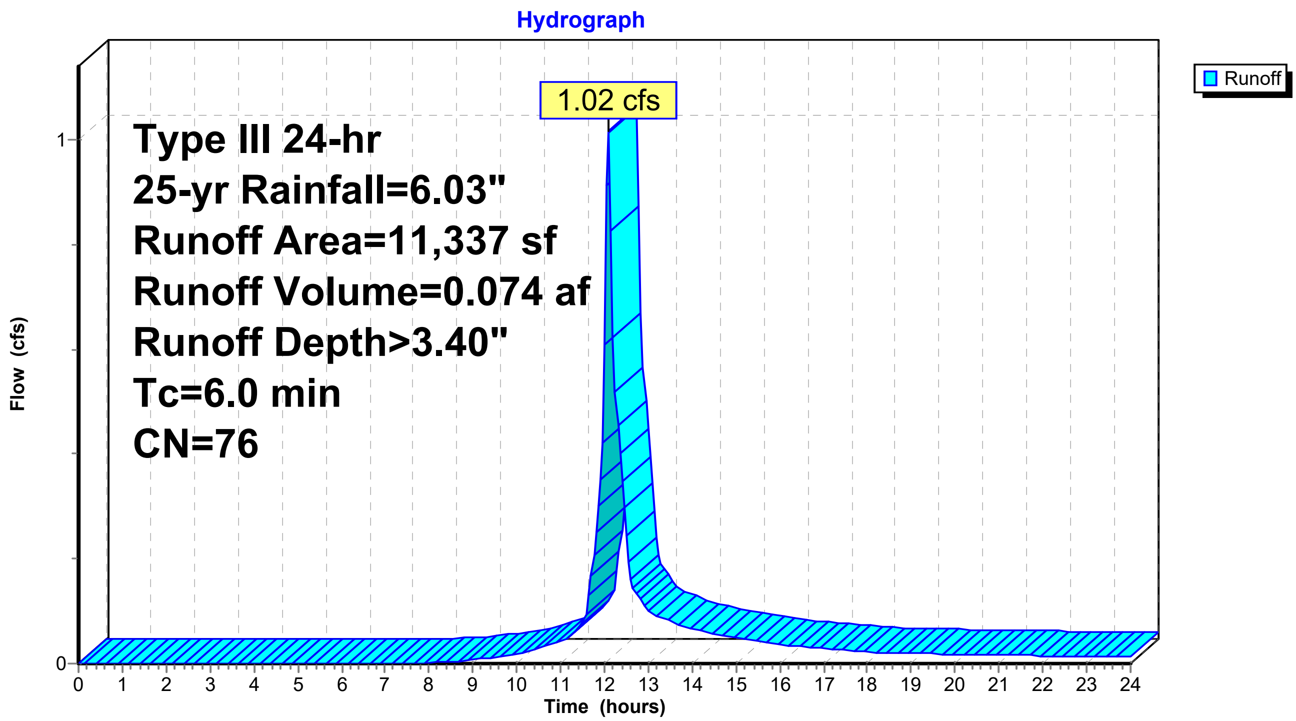
Runoff = 1.02 cfs @ 12.09 hrs, Volume= 0.074 af, Depth> 3.40"
Routed to Pond 2P : Retain-It Sys 2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-yr Rainfall=6.03"

Area (sf)	CN	Description
6,805	61	>75% Grass cover, Good, HSG B
4,532	98	Paved parking, HSG B
11,337	76	Weighted Average
6,805		60.02% Pervious Area
4,532		39.98% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment P-2: N'ly Exterior



Summary for Subcatchment P-3: E'ly Driveway

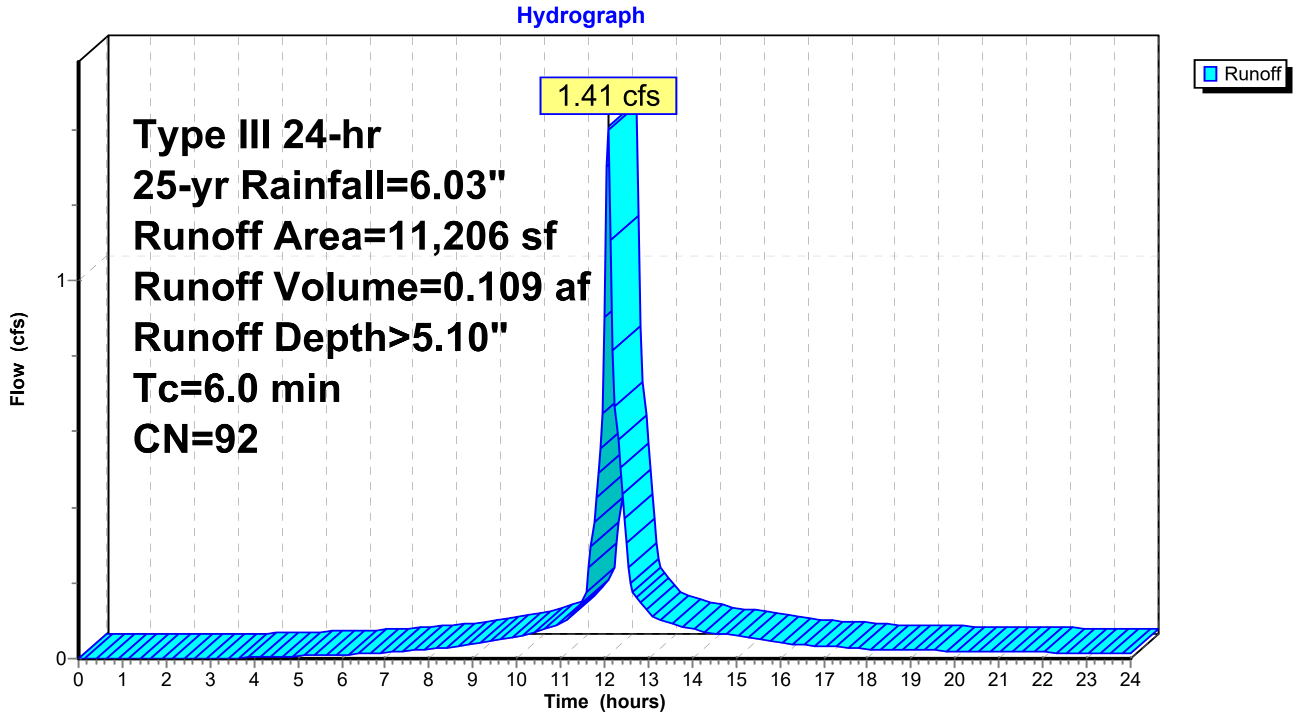
Runoff = 1.41 cfs @ 12.09 hrs, Volume= 0.109 af, Depth> 5.10"
Routed to Link 2L : Main Street

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-yr Rainfall=6.03"

Area (sf)	CN	Description
1,953	61	>75% Grass cover, Good, HSG B
9,253	98	Paved parking, HSG B
11,206	92	Weighted Average
1,953		17.43% Pervious Area
9,253		82.57% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment P-3: E'ly Driveway



Summary for Subcatchment P-4: W'ly Exterior

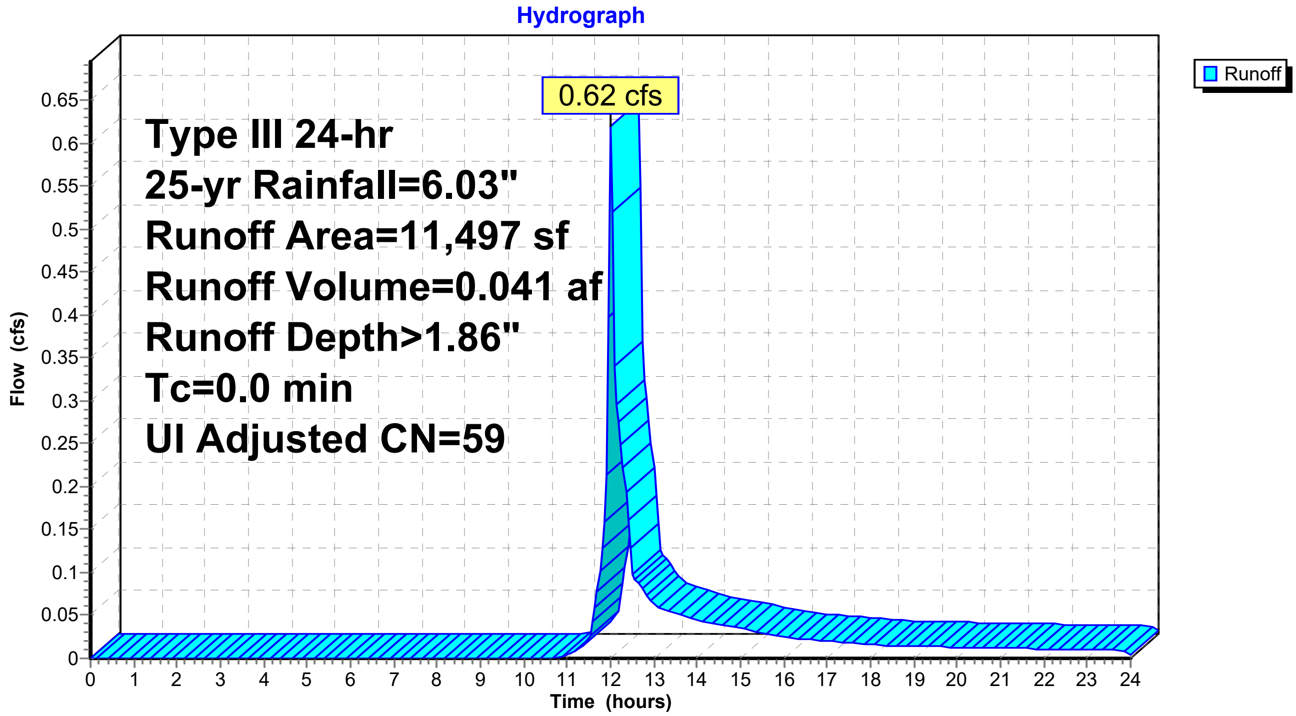
[46] Hint: Tc=0 (Instant runoff peak depends on dt)

Runoff = 0.62 cfs @ 12.01 hrs, Volume= 0.041 af, Depth> 1.86"
Routed to Link 1L : W'ly PL

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-yr Rainfall=6.03"

Area (sf)	CN	Adj	Description
2,135	55		Woods, Good, HSG B
1,459	39		>75% Grass cover, Good, HSG A
6,348	61		>75% Grass cover, Good, HSG B
544	98		Unconnected pavement, HSG A
1,011	98		Unconnected pavement, HSG B
11,497	62	59	Weighted Average, UI Adjusted
9,942			86.47% Pervious Area
1,555			13.53% Impervious Area
1,555			100.00% Unconnected

Subcatchment P-4: W'ly Exterior



Summary for Subcatchment P-5: To Main St

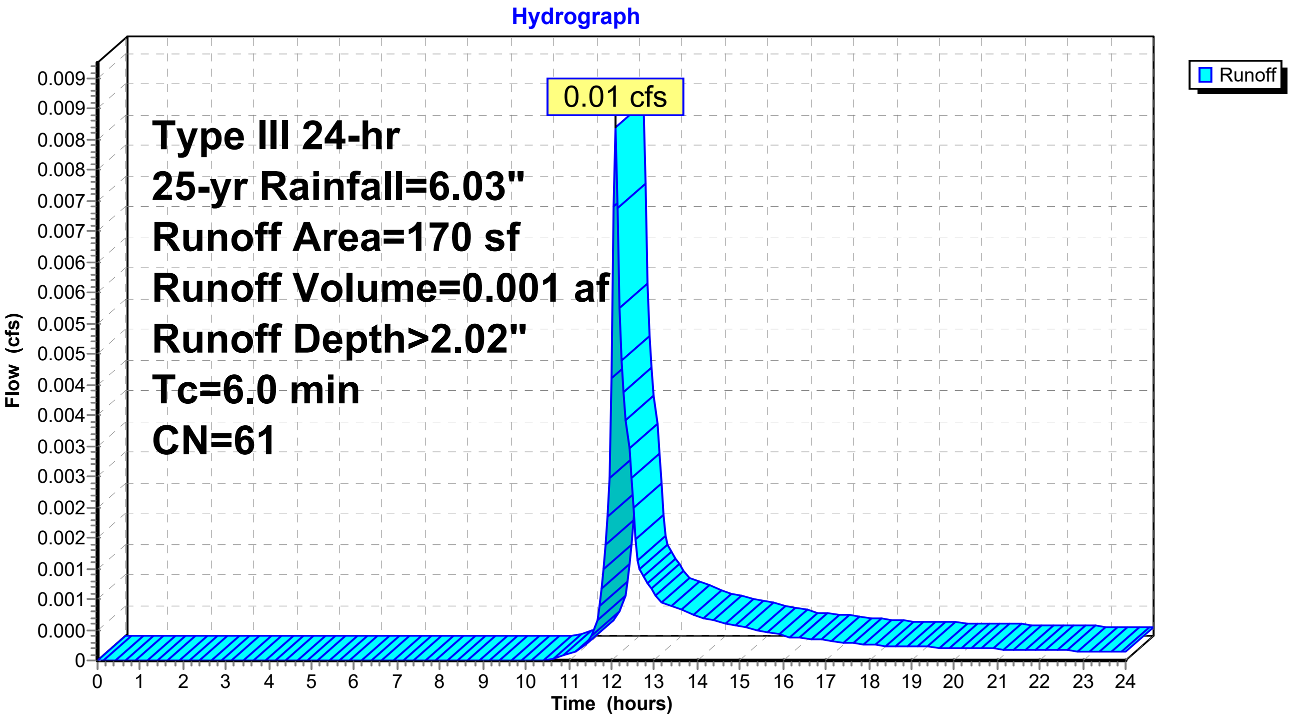
Runoff = 0.01 cfs @ 12.10 hrs, Volume= 0.001 af, Depth> 2.02"
Routed to Link 2L : Main Street

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-yr Rainfall=6.03"

Area (sf)	CN	Description
170	61	>75% Grass cover, Good, HSG B
170		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment P-5: To Main St



Summary for Pond 1P: Retain-It Sys 1

Inflow Area = 1.441 ac,100.00% Impervious, Inflow Depth > 5.79" for 25-yr event
Inflow = 8.32 cfs @ 12.09 hrs, Volume= 0.695 af
Outflow = 0.18 cfs @ 7.70 hrs, Volume= 0.293 af, Atten= 98%, Lag= 0.0 min
Discarded = 0.18 cfs @ 7.70 hrs, Volume= 0.293 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Pond 3P : Drywell

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 152.28' @ 17.14 hrs Surf.Area= 7,700 sf Storage= 19,222 cf

Plug-Flow detention time= 255.5 min calculated for 0.292 af (42% of inflow)
Center-of-Mass det. time= 104.8 min (849.4 - 744.6)

Volume	Invert	Avail.Storage	Storage Description
#1A	148.50'	6,607 cf	**10.00'W x 770.00'L x 6.67'H Field A** 51,333 cf Overall - 34,816 cf Embedded = 16,517 cf x 40.0% Voids
#2A	149.50'	25,947 cf	**retain_it retain_it 5.0'** x 96 Inside #1 Inside= 84.0"W x 60.0"H => 36.41 sf x 8.00'L = 291.3 cf Outside= 96.0"W x 68.0"H => 45.33 sf x 8.00'L = 362.7 cf 1 Rows adjusted for 2,015.7 cf perimeter wall
		32,554 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	148.50'	**1.020 in/hr Exfiltration over Surface area**
#2	Primary	152.80'	**12.0" Round Culvert** L= 16.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 152.80' / 152.00' S= 0.0500 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#3	Device 2	153.50'	**7.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Discarded OutFlow Max=0.18 cfs @ 7.70 hrs HW=148.57' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.18 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=148.50' (Free Discharge)
└─**2=Culvert** (Controls 0.00 cfs)
  └─**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 1P: Retain-It Sys 1 - Chamber Wizard Field A

Chamber Model = retain_it retain_it 5.0' (retain-it®)
Inside= 84.0"W x 60.0"H => 36.41 sf x 8.00'L = 291.3 cf
Outside= 96.0"W x 68.0"H => 45.33 sf x 8.00'L = 362.7 cf
1 Rows adjusted for 2,015.7 cf perimeter wall

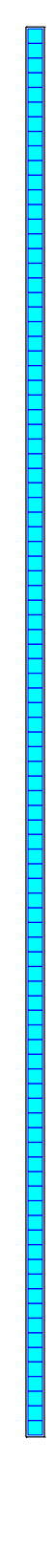
96 Chambers/Row x 8.00' Long = 768.00' Row Length +12.0" End Stone x 2 = 770.00' Base Length
1 Rows x 96.0" Wide + 12.0" Side Stone x 2 = 10.00' Base Width
12.0" Stone Base + 68.0" Chamber Height = 6.67' Field Height

10.4 cf Sidewall x 96 x 2 + 10.4 cf Endwall x 1 x 2 = 2,015.7 cf Perimeter Wall
96 Chambers x 291.3 cf - 2,015.7 cf Perimeter wall = 25,947.2 cf Chamber Storage
96 Chambers x 362.7 cf = 34,816.0 cf Displacement

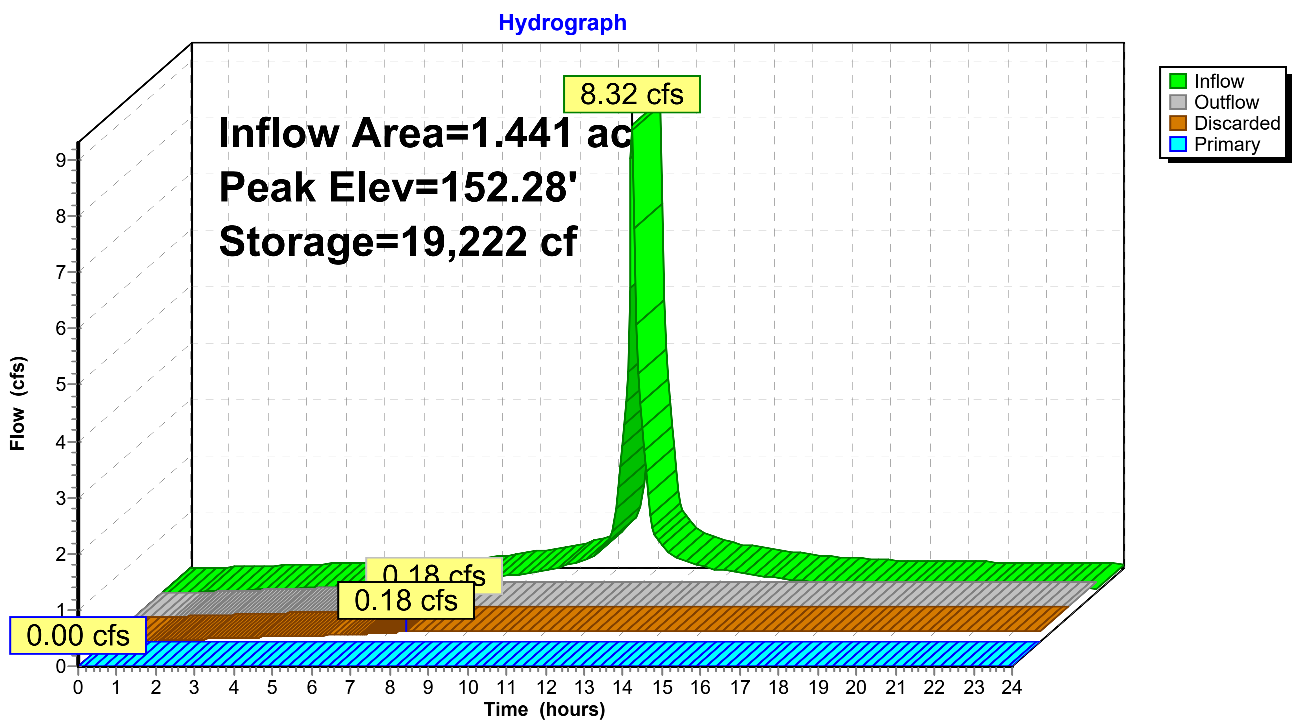
51,333.3 cf Field - 34,816.0 cf Chambers = 16,517.3 cf Stone x 40.0% Voids = 6,606.9 cf Stone Storage

Chamber Storage + Stone Storage = 32,554.2 cf = 0.747 af
Overall Storage Efficiency = 63.4%
Overall System Size = 770.00' x 10.00' x 6.67'

96 Chambers
1,901.2 cy Field
611.8 cy Stone



Pond 1P: Retain-It Sys 1



Summary for Pond 2P: Retain-It Sys 2

Inflow Area = 0.260 ac, 39.98% Impervious, Inflow Depth > 3.40" for 25-yr event
Inflow = 1.02 cfs @ 12.09 hrs, Volume= 0.074 af
Outflow = 0.03 cfs @ 10.85 hrs, Volume= 0.036 af, Atten= 97%, Lag= 0.0 min
Discarded = 0.03 cfs @ 10.85 hrs, Volume= 0.036 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 145.37' @ 16.69 hrs Surf.Area= 1,300 sf Storage= 1,973 cf

Plug-Flow detention time= 305.9 min calculated for 0.036 af (49% of inflow)
Center-of-Mass det. time= 190.2 min (1,013.5 - 823.3)

Volume	Invert	Avail.Storage	Storage Description
#1A	143.00'	767 cf	**50.00'W x 26.00'L x 5.17'H Field A** 6,717 cf Overall - 4,800 cf Embedded = 1,917 cf x 40.0% Voids
#2A	144.00'	3,504 cf	**retain_it retain_it 3.5'** x 18 Inside #1 Inside= 84.0"W x 42.0"H => 25.10 sf x 8.00'L = 200.8 cf Outside= 96.0"W x 50.0"H => 33.33 sf x 8.00'L = 266.7 cf 6 Rows adjusted for 110.5 cf perimeter wall
		4,270 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	143.00'	**1.020 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.03 cfs @ 10.85 hrs HW=143.05' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

Pond 2P: Retain-It Sys 2 - Chamber Wizard Field A

Chamber Model = retain_it retain_it 3.5' (retain-it®)
Inside= 84.0"W x 42.0"H => 25.10 sf x 8.00'L = 200.8 cf
Outside= 96.0"W x 50.0"H => 33.33 sf x 8.00'L = 266.7 cf
6 Rows adjusted for 110.5 cf perimeter wall

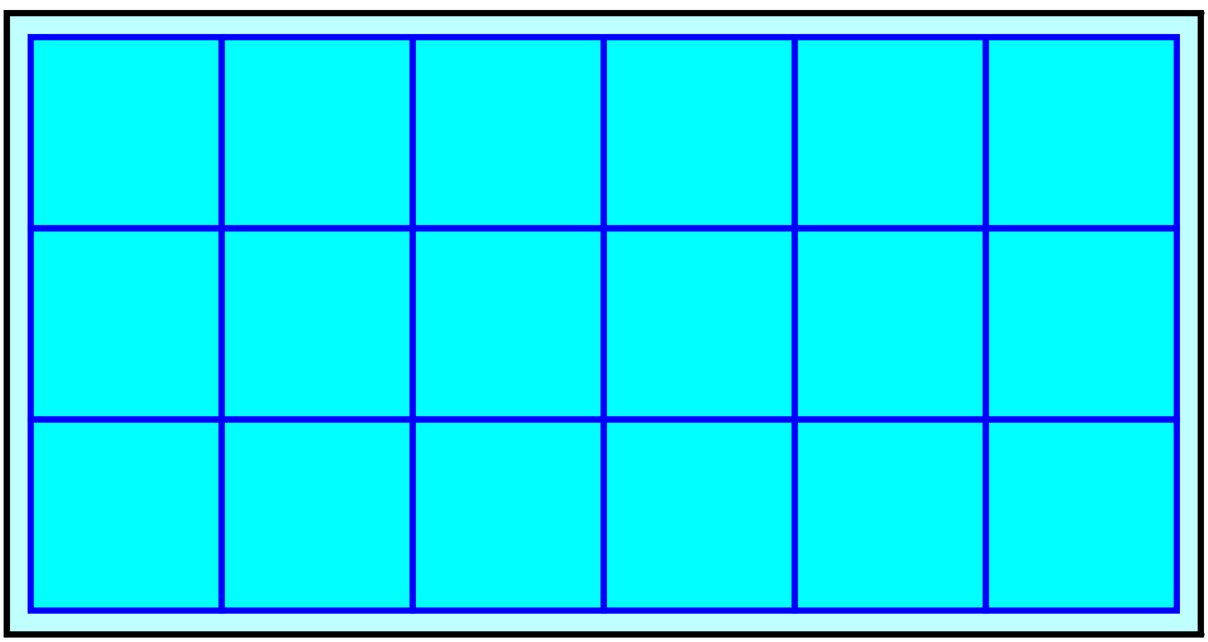
3 Chambers/Row x 8.00' Long = 24.00' Row Length +12.0" End Stone x 2 = 26.00' Base Length
6 Rows x 96.0" Wide + 12.0" Side Stone x 2 = 50.00' Base Width
12.0" Stone Base + 50.0" Chamber Height = 5.17' Field Height

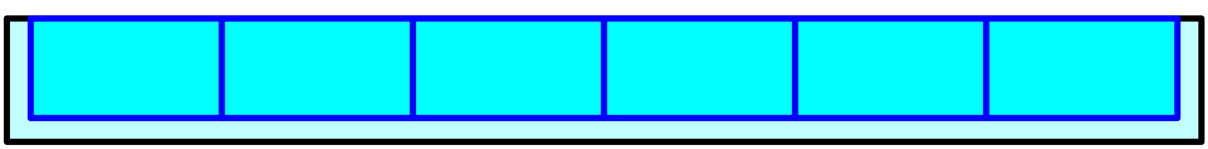
6.1 cf Sidewall x 3 x 2 + 6.1 cf Endwall x 6 x 2 = 110.5 cf Perimeter Wall
18 Chambers x 200.8 cf - 110.5 cf Perimeter wall = 3,503.5 cf Chamber Storage
18 Chambers x 266.7 cf = 4,800.0 cf Displacement

6,716.7 cf Field - 4,800.0 cf Chambers = 1,916.7 cf Stone x 40.0% Voids = 766.7 cf Stone Storage

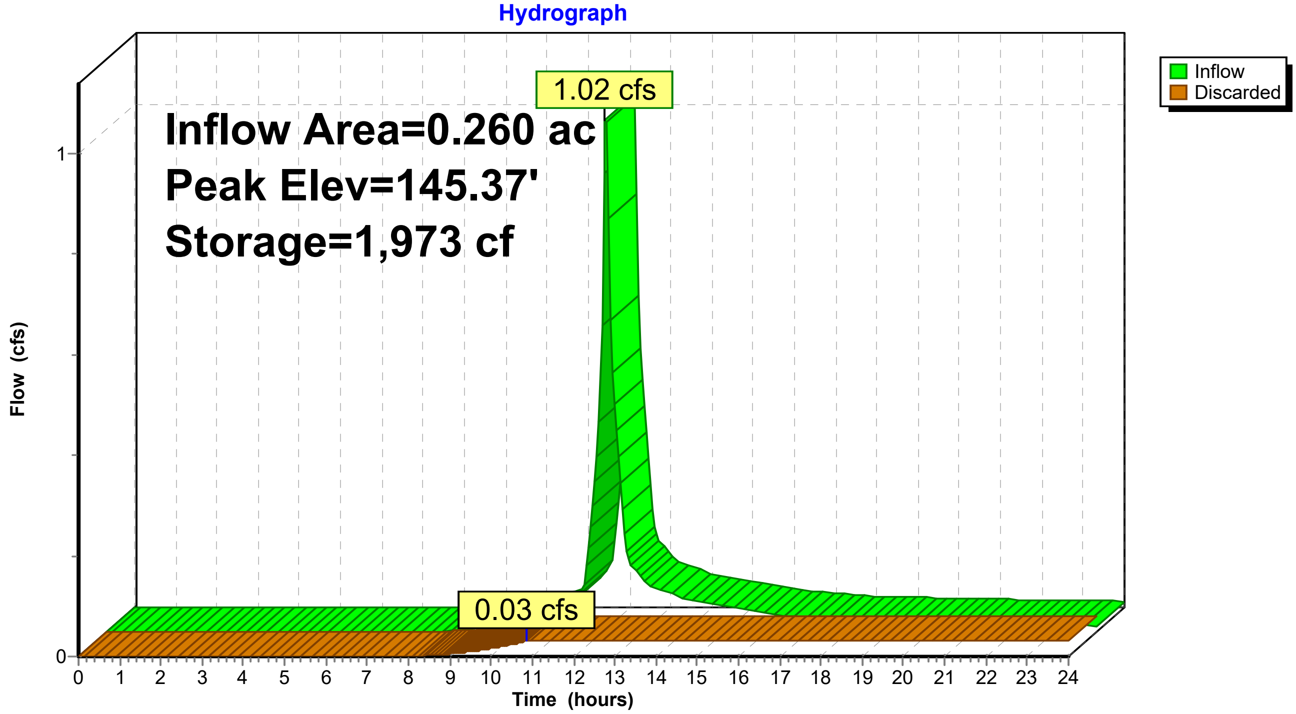
Chamber Storage + Stone Storage = 4,270.2 cf = 0.098 af
Overall Storage Efficiency = 63.6%
Overall System Size = 26.00' x 50.00' x 5.17'

18 Chambers
248.8 cy Field
71.0 cy Stone





Pond 2P: Retain-It Sys 2



Summary for Pond 3P: Drywell

Inflow Area = 1.441 ac,100.00% Impervious, Inflow Depth = 0.00" for 25-yr event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min
Discarded = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Link 1L : W'ly PL

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 142.80' @ 0.00 hrs Storage= 0 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no inflow)

Volume	Invert	Avail.Storage	Storage Description
#1	142.80'	323 cf	**Custom Stage Data** Listed below

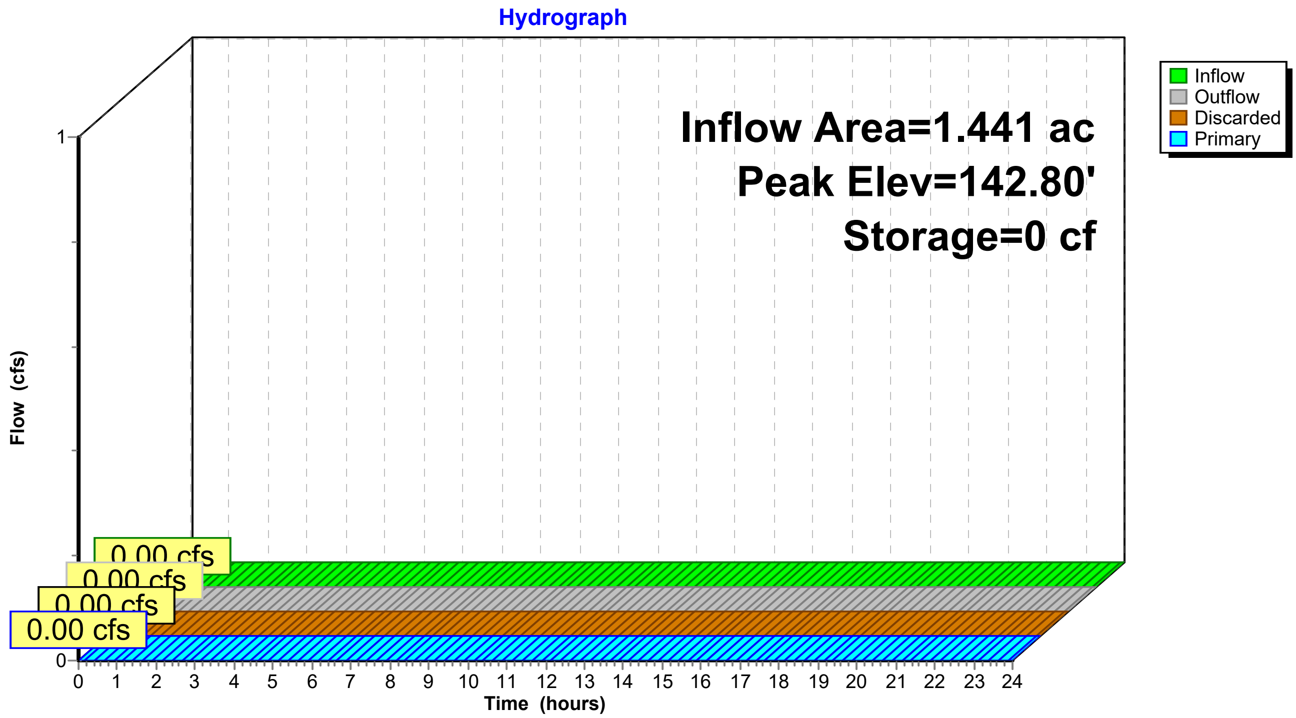
Elevation (feet)	Cum.Store (cubic-feet)
142.80	0
143.80	31
144.80	80
145.80	128
146.80	177
147.80	225
148.80	273
149.90	322
150.00	323

Device	Routing	Invert	Outlet Devices
#1	Discarded	142.80'	**0.02 cfs Exfiltration at all elevations**
#2	Primary	149.80'	**2.0" x 2.0" Horiz. Orifice/Grate X 6.00 columns** X 6 rows C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.00 cfs @ 0.00 hrs HW=142.80' (Free Discharge)
└─**1=Exfiltration** (Passes 0.00 cfs of 0.02 cfs potential flow)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=142.80' (Free Discharge)
└─**2=Orifice/Grate** (Controls 0.00 cfs)

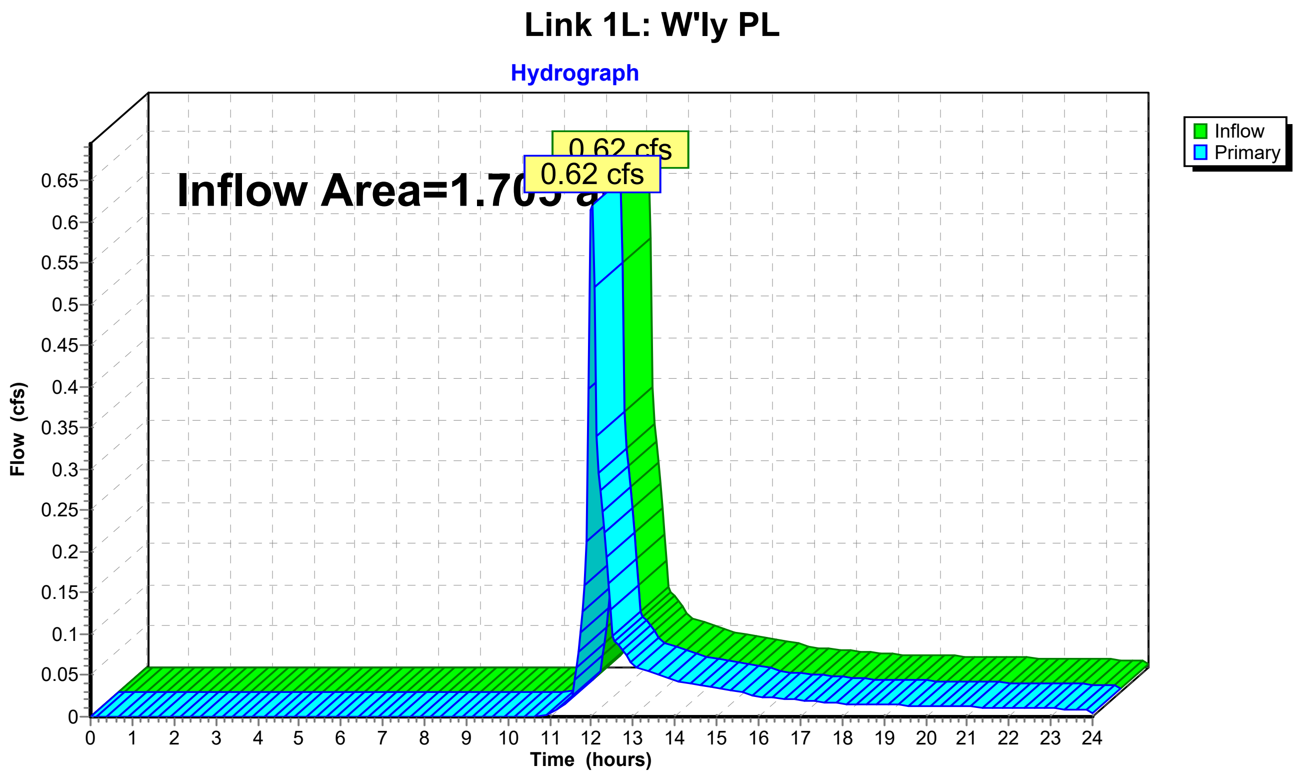
Pond 3P: Drywell



Summary for Link 1L: W'ly PL

Inflow Area = 1.705 ac, 86.61% Impervious, Inflow Depth > 0.29" for 25-yr event
Inflow = 0.62 cfs @ 12.01 hrs, Volume= 0.041 af
Primary = 0.62 cfs @ 12.01 hrs, Volume= 0.041 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

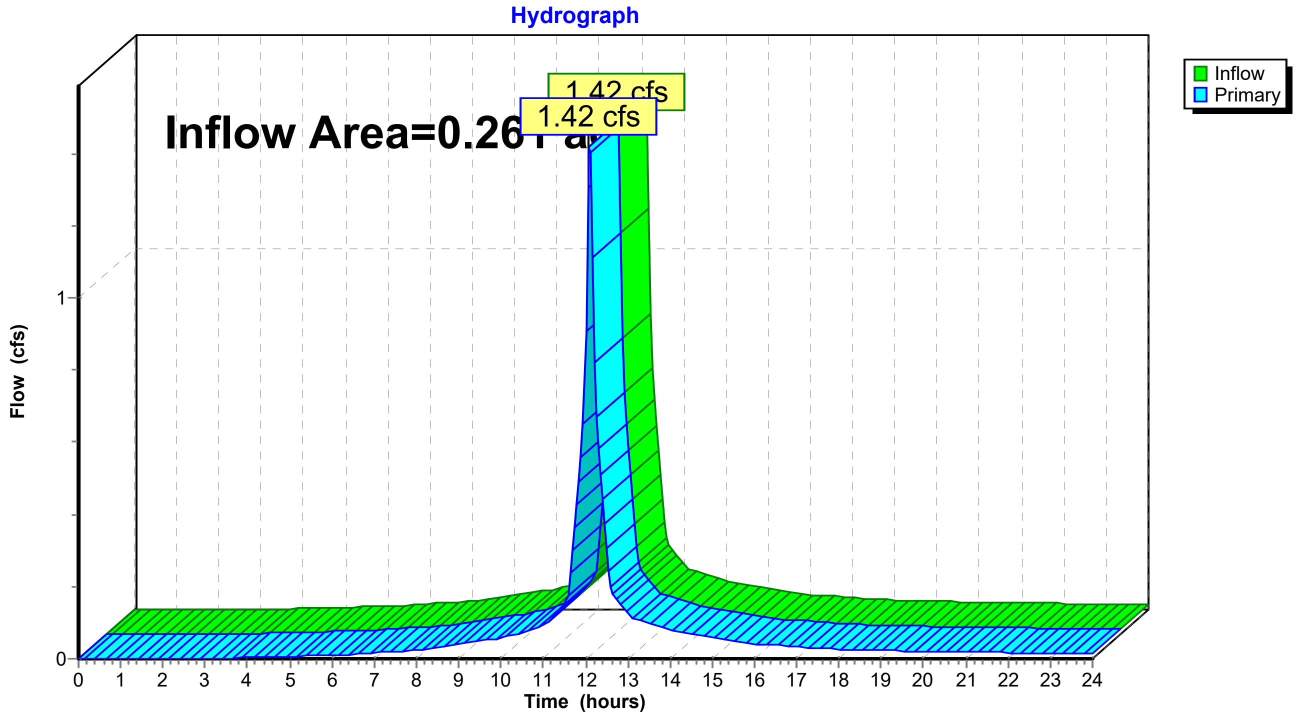


Summary for Link 2L: Main Street

Inflow Area =	0.261 ac,	81.34% Impervious,	Inflow Depth > 5.05"	for 25-yr event
Inflow =	1.42 cfs @	12.09 hrs, Volume=	0.110 af	
Primary =	1.42 cfs @	12.09 hrs, Volume=	0.110 af, Atten= 0%, Lag= 0.0 min	

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 2L: Main Street



Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment P-1: Building w Pool Area Runoff Area=62,767 sf 100.00% Impervious Runoff Depth>8.36"
Tc=6.0 min CN=98 Runoff=11.90 cfs 1.004 af

Subcatchment P-2: N'ly Exterior Runoff Area=11,337 sf 39.98% Impervious Runoff Depth>5.71"
Tc=6.0 min CN=76 Runoff=1.69 cfs 0.124 af

Subcatchment P-3: E'ly Driveway Runoff Area=11,206 sf 82.57% Impervious Runoff Depth>7.64"
Tc=6.0 min CN=92 Runoff=2.06 cfs 0.164 af

Subcatchment P-4: W'ly Exterior Runoff Area=11,497 sf 13.53% Impervious Runoff Depth>3.68"
Tc=0.0 min UI Adjusted CN=59 Runoff=1.29 cfs 0.081 af

Subcatchment P-5: To Main St Runoff Area=170 sf 0.00% Impervious Runoff Depth>3.91"
Tc=6.0 min CN=61 Runoff=0.02 cfs 0.001 af

Pond 1P: Retain-It Sys 1 Peak Elev=153.59' Storage=26,826 cf Inflow=11.90 cfs 1.004 af
Discarded=0.18 cfs 0.316 af Primary=0.51 cfs 0.100 af Outflow=0.70 cfs 0.416 af

Pond 2P: Retain-It Sys 2 Peak Elev=147.10' Storage=3,803 cf Inflow=1.69 cfs 0.124 af
Outflow=0.03 cfs 0.039 af

Pond 3P: Drywell Peak Elev=149.83' Storage=319 cf Inflow=0.51 cfs 0.100 af
Discarded=0.02 cfs 0.017 af Primary=0.62 cfs 0.083 af Outflow=0.64 cfs 0.100 af

Link 1L: W'ly PL Inflow=1.29 cfs 0.164 af
Primary=1.29 cfs 0.164 af

Link 2L: Main Street Inflow=2.08 cfs 0.165 af
Primary=2.08 cfs 0.165 af

Total Runoff Area = 2.226 ac Runoff Volume = 1.374 af Average Runoff Depth = 7.41"
19.46% Pervious = 0.433 ac 80.54% Impervious = 1.793 ac

Summary for Subcatchment P-1: Building w Pool Area

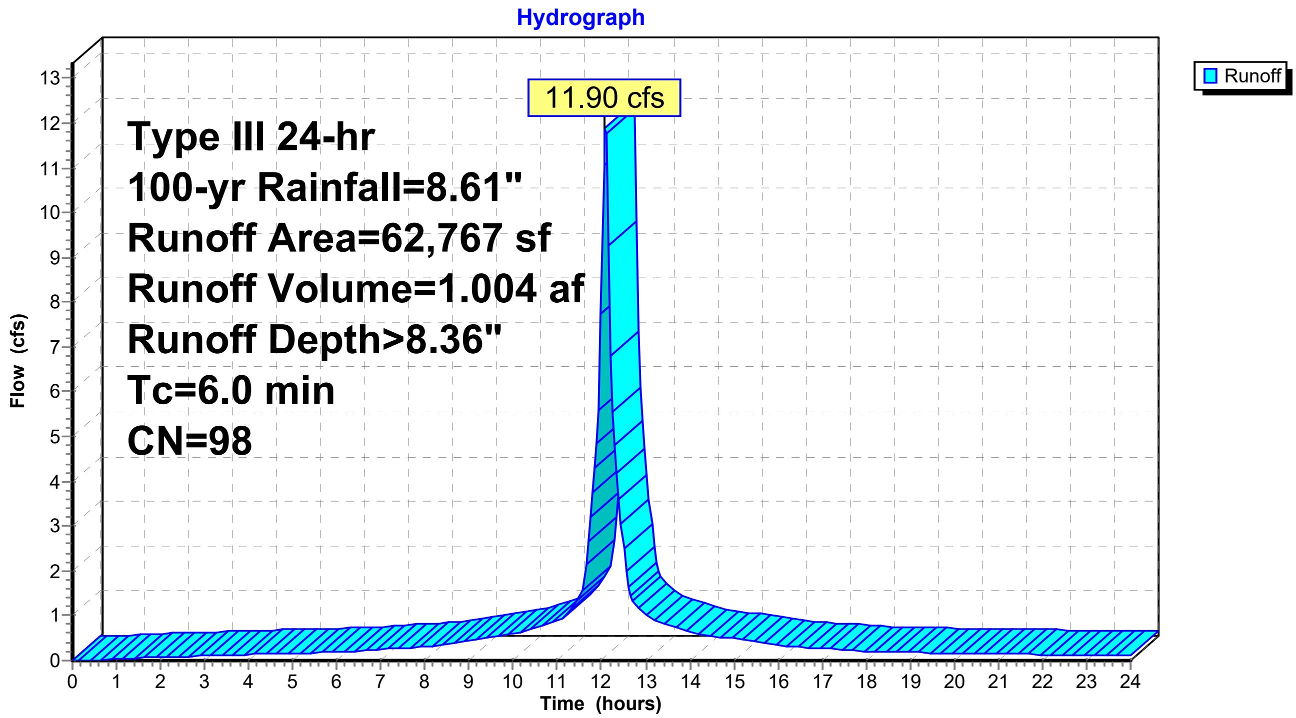
Runoff = 11.90 cfs @ 12.09 hrs, Volume= 1.004 af, Depth> 8.36"
Routed to Pond 1P : Retain-It Sys 1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr Rainfall=8.61"

Area (sf)	CN	Description
656	98	Roofs, HSG A
62,111	98	Roofs, HSG B
62,767	98	Weighted Average
62,767		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment P-1: Building w Pool Area



Summary for Subcatchment P-2: N'ly Exterior

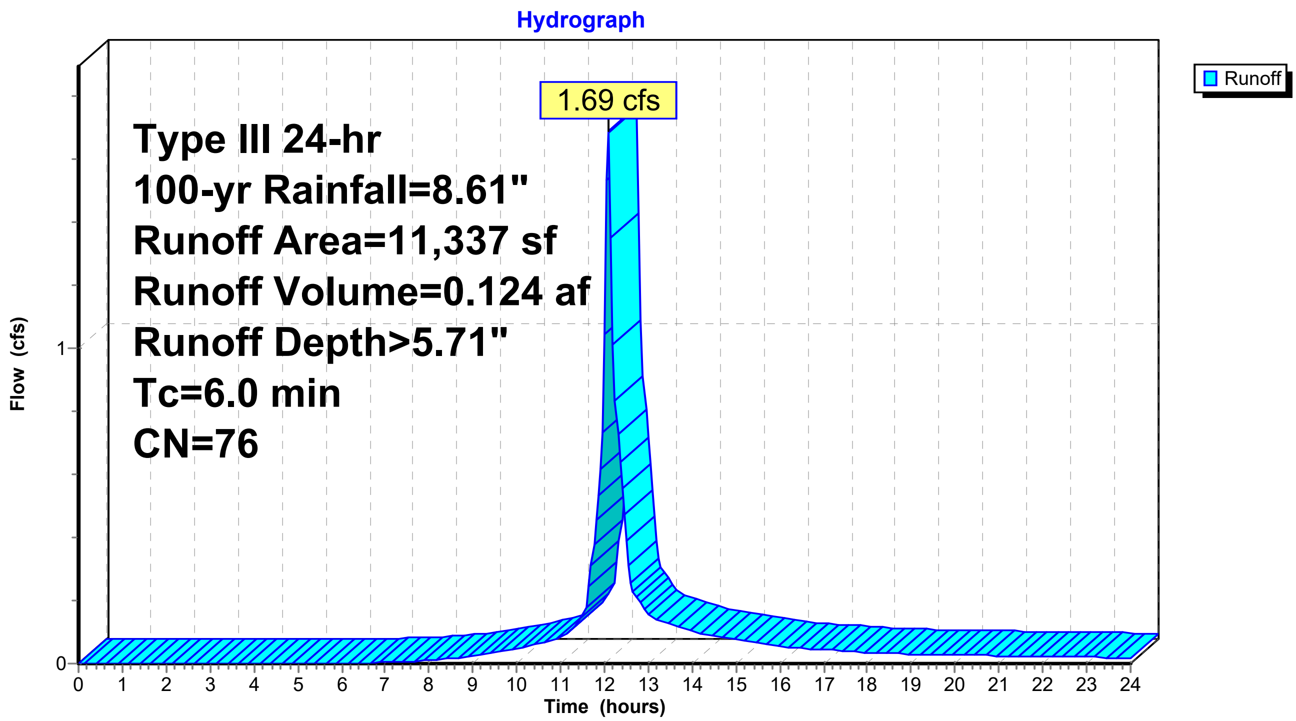
Runoff = 1.69 cfs @ 12.09 hrs, Volume= 0.124 af, Depth> 5.71"
Routed to Pond 2P : Retain-It Sys 2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr Rainfall=8.61"

Area (sf)	CN	Description
6,805	61	>75% Grass cover, Good, HSG B
4,532	98	Paved parking, HSG B
11,337	76	Weighted Average
6,805		60.02% Pervious Area
4,532		39.98% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment P-2: N'ly Exterior



Summary for Subcatchment P-3: E'ly Driveway

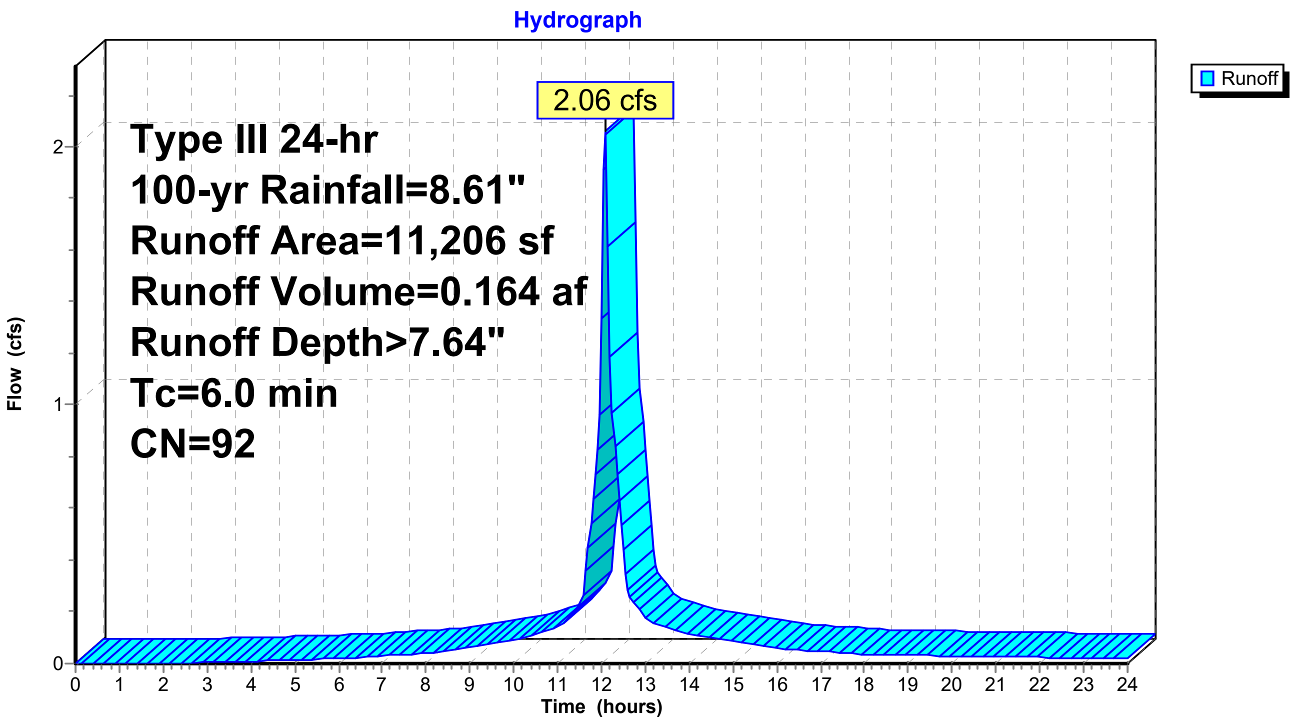
Runoff = 2.06 cfs @ 12.09 hrs, Volume= 0.164 af, Depth> 7.64"
Routed to Link 2L : Main Street

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr Rainfall=8.61"

Area (sf)	CN	Description
1,953	61	>75% Grass cover, Good, HSG B
9,253	98	Paved parking, HSG B
11,206	92	Weighted Average
1,953		17.43% Pervious Area
9,253		82.57% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment P-3: E'ly Driveway



Summary for Subcatchment P-4: W'ly Exterior

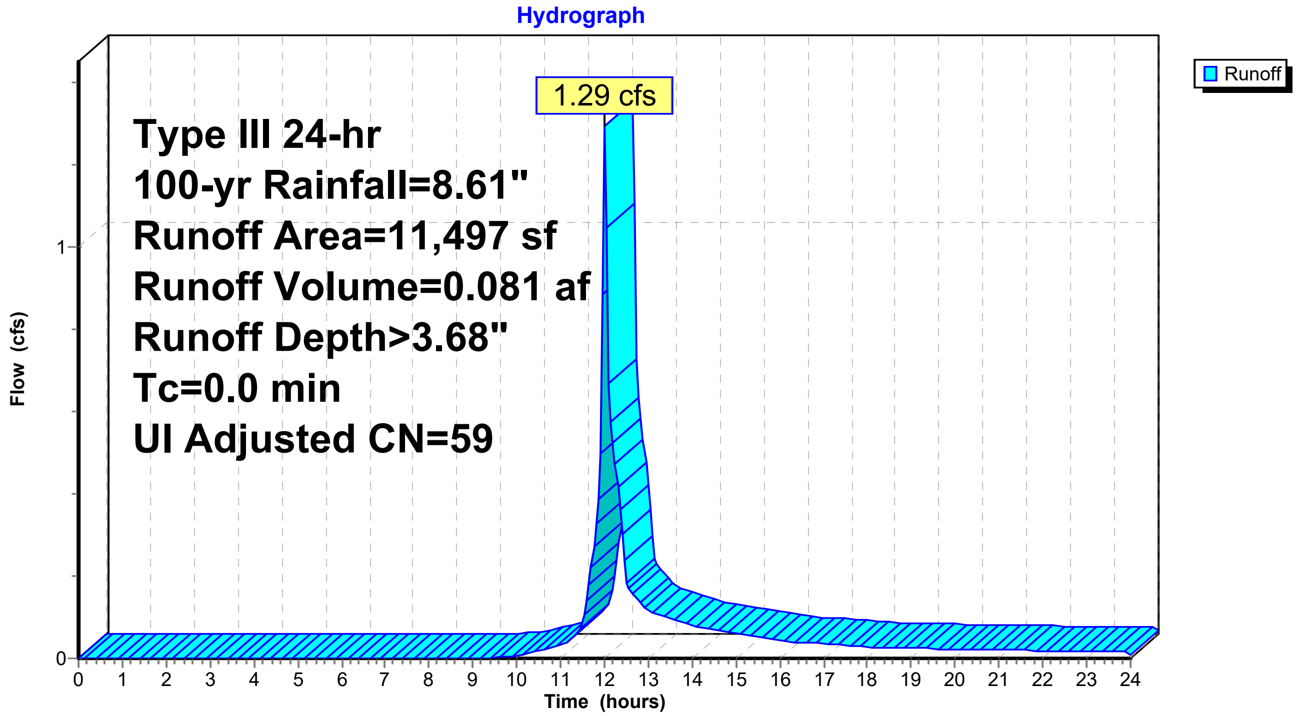
[46] Hint: Tc=0 (Instant runoff peak depends on dt)

Runoff = 1.29 cfs @ 12.01 hrs, Volume= 0.081 af, Depth> 3.68"
Routed to Link 1L : W'ly PL

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr Rainfall=8.61"

Area (sf)	CN	Adj	Description
2,135	55		Woods, Good, HSG B
1,459	39		>75% Grass cover, Good, HSG A
6,348	61		>75% Grass cover, Good, HSG B
544	98		Unconnected pavement, HSG A
1,011	98		Unconnected pavement, HSG B
11,497	62	59	Weighted Average, UI Adjusted
9,942			86.47% Pervious Area
1,555			13.53% Impervious Area
1,555			100.00% Unconnected

Subcatchment P-4: W'ly Exterior



Summary for Subcatchment P-5: To Main St

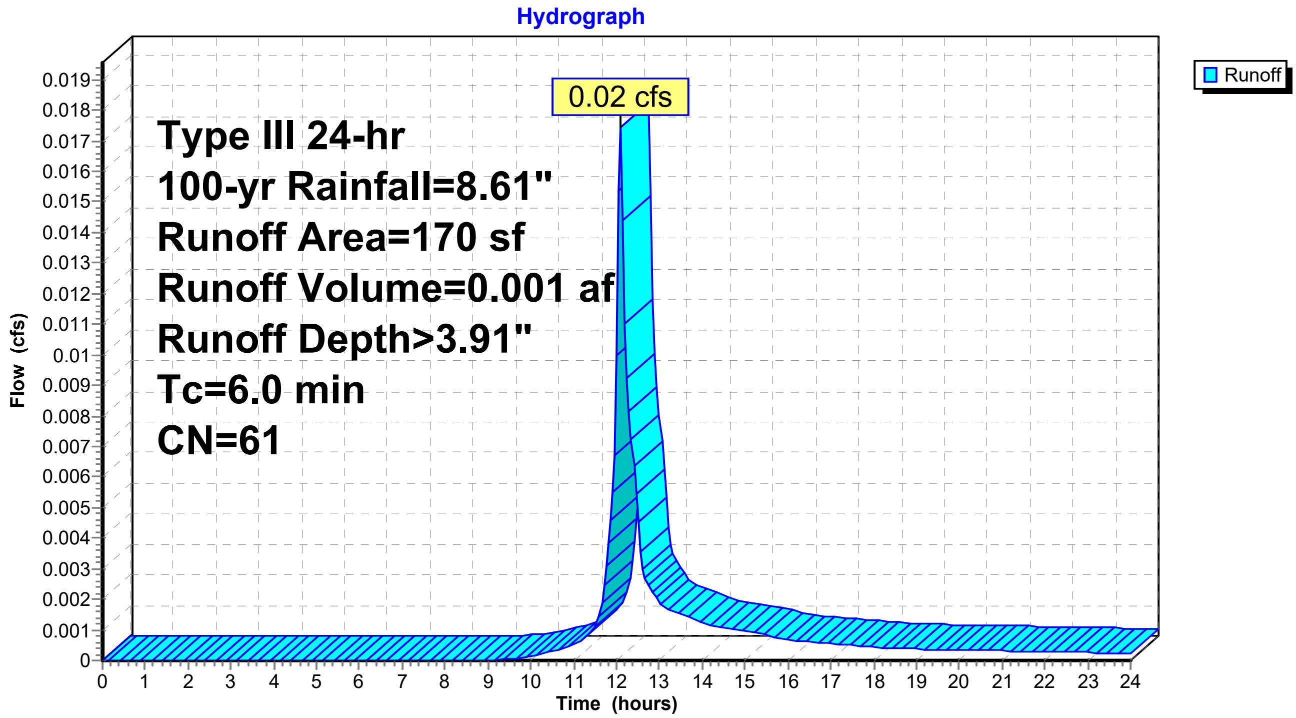
Runoff = 0.02 cfs @ 12.10 hrs, Volume= 0.001 af, Depth> 3.91"
Routed to Link 2L : Main Street

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr Rainfall=8.61"

Area (sf)	CN	Description
170	61	>75% Grass cover, Good, HSG B
170		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment P-5: To Main St



Summary for Pond 1P: Retain-It Sys 1

Inflow Area = 1.441 ac,100.00% Impervious, Inflow Depth > 8.36" for 100-yr event
Inflow = 11.90 cfs @ 12.09 hrs, Volume= 1.004 af
Outflow = 0.70 cfs @ 13.82 hrs, Volume= 0.416 af, Atten= 94%, Lag= 103.7 min
Discarded = 0.18 cfs @ 6.20 hrs, Volume= 0.316 af
Primary = 0.51 cfs @ 13.82 hrs, Volume= 0.100 af
Routed to Pond 3P : Drywell

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 153.59' @ 13.82 hrs Surf.Area= 7,700 sf Storage= 26,826 cf

Plug-Flow detention time= 247.7 min calculated for 0.416 af (41% of inflow)
Center-of-Mass det. time= 89.2 min (829.1 - 739.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	148.50'	6,607 cf	**10.00'W x 770.00'L x 6.67'H Field A** 51,333 cf Overall - 34,816 cf Embedded = 16,517 cf x 40.0% Voids
#2A	149.50'	25,947 cf	**retain_it retain_it 5.0'** x 96 Inside #1 Inside= 84.0"W x 60.0"H => 36.41 sf x 8.00'L = 291.3 cf Outside= 96.0"W x 68.0"H => 45.33 sf x 8.00'L = 362.7 cf 1 Rows adjusted for 2,015.7 cf perimeter wall
		32,554 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	148.50'	**1.020 in/hr Exfiltration over Surface area**
#2	Primary	152.80'	**12.0" Round Culvert** L= 16.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 152.80' / 152.00' S= 0.0500 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#3	Device 2	153.50'	**7.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Discarded OutFlow Max=0.18 cfs @ 6.20 hrs HW=148.57' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.18 cfs)

Primary OutFlow Max=0.49 cfs @ 13.82 hrs HW=153.59' (Free Discharge)
└─**2=Culvert** (Passes 0.49 cfs of 2.00 cfs potential flow)
  └─**3=Broad-Crested Rectangular Weir** (Weir Controls 0.49 cfs @ 0.82 fps)

Pond 1P: Retain-It Sys 1 - Chamber Wizard Field A

Chamber Model = retain_it retain_it 5.0' (retain-it®)
Inside= 84.0"W x 60.0"H => 36.41 sf x 8.00'L = 291.3 cf
Outside= 96.0"W x 68.0"H => 45.33 sf x 8.00'L = 362.7 cf
1 Rows adjusted for 2,015.7 cf perimeter wall

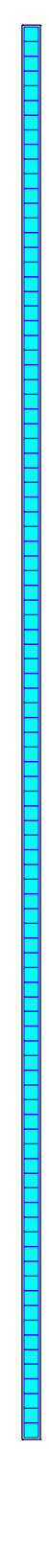
96 Chambers/Row x 8.00' Long = 768.00' Row Length +12.0" End Stone x 2 = 770.00' Base Length
1 Rows x 96.0" Wide + 12.0" Side Stone x 2 = 10.00' Base Width
12.0" Stone Base + 68.0" Chamber Height = 6.67' Field Height

10.4 cf Sidewall x 96 x 2 + 10.4 cf Endwall x 1 x 2 = 2,015.7 cf Perimeter Wall
96 Chambers x 291.3 cf - 2,015.7 cf Perimeter wall = 25,947.2 cf Chamber Storage
96 Chambers x 362.7 cf = 34,816.0 cf Displacement

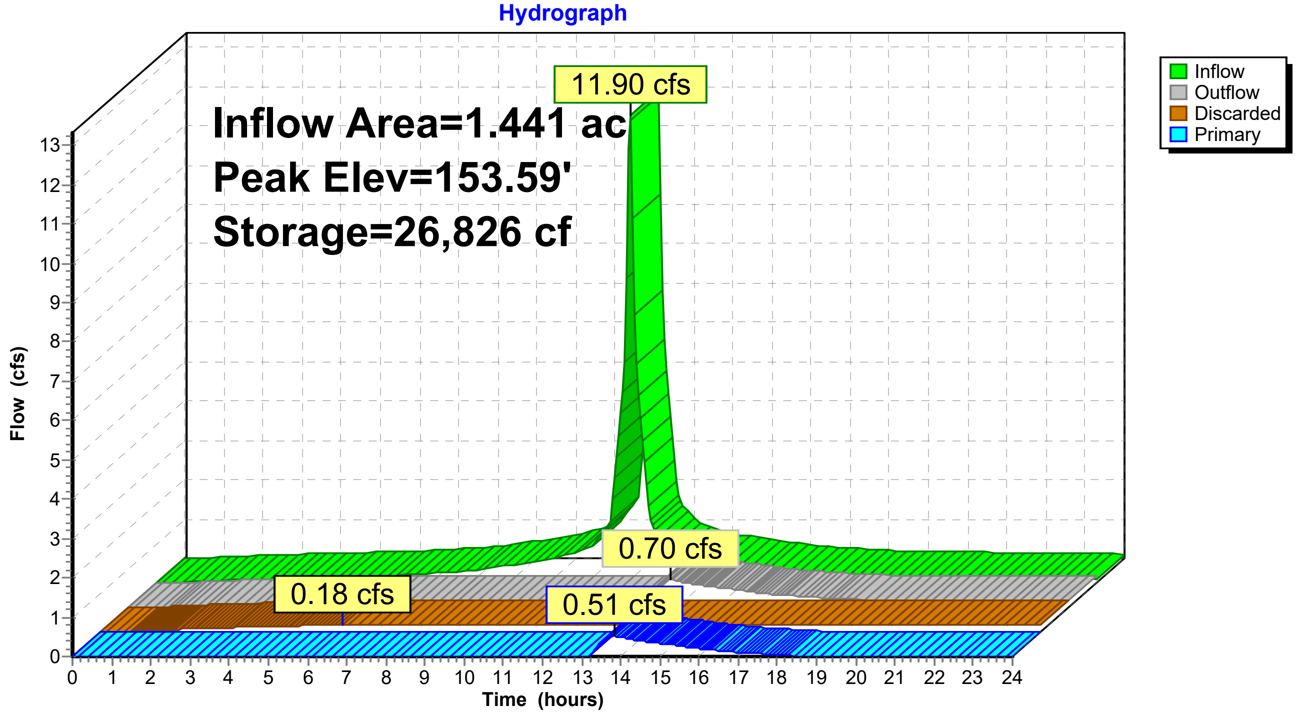
51,333.3 cf Field - 34,816.0 cf Chambers = 16,517.3 cf Stone x 40.0% Voids = 6,606.9 cf Stone Storage

Chamber Storage + Stone Storage = 32,554.2 cf = 0.747 af
Overall Storage Efficiency = 63.4%
Overall System Size = 770.00' x 10.00' x 6.67'

96 Chambers
1,901.2 cy Field
611.8 cy Stone



Pond 1P: Retain-It Sys 1



Summary for Pond 2P: Retain-It Sys 2

Inflow Area = 0.260 ac, 39.98% Impervious, Inflow Depth > 5.71" for 100-yr event
Inflow = 1.69 cfs @ 12.09 hrs, Volume= 0.124 af
Outflow = 0.03 cfs @ 9.60 hrs, Volume= 0.039 af, Atten= 98%, Lag= 0.0 min
Discarded = 0.03 cfs @ 9.60 hrs, Volume= 0.039 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 147.10' @ 18.82 hrs Surf.Area= 1,300 sf Storage= 3,803 cf

Plug-Flow detention time= 296.2 min calculated for 0.039 af (32% of inflow)
Center-of-Mass det. time= 164.7 min (973.2 - 808.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	143.00'	767 cf	**50.00'W x 26.00'L x 5.17'H Field A**
			6,717 cf Overall - 4,800 cf Embedded = 1,917 cf x 40.0% Voids
#2A	144.00'	3,504 cf	**retain_it retain_it 3.5'** x 18 Inside #1
			Inside= 84.0"W x 42.0"H => 25.10 sf x 8.00'L = 200.8 cf
			Outside= 96.0"W x 50.0"H => 33.33 sf x 8.00'L = 266.7 cf
			6 Rows adjusted for 110.5 cf perimeter wall
		4,270 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	143.00'	**1.020 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.03 cfs @ 9.60 hrs HW=143.05' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

Pond 2P: Retain-It Sys 2 - Chamber Wizard Field A

Chamber Model = retain_it retain_it 3.5' (retain-it®)
Inside= 84.0"W x 42.0"H => 25.10 sf x 8.00'L = 200.8 cf
Outside= 96.0"W x 50.0"H => 33.33 sf x 8.00'L = 266.7 cf
6 Rows adjusted for 110.5 cf perimeter wall

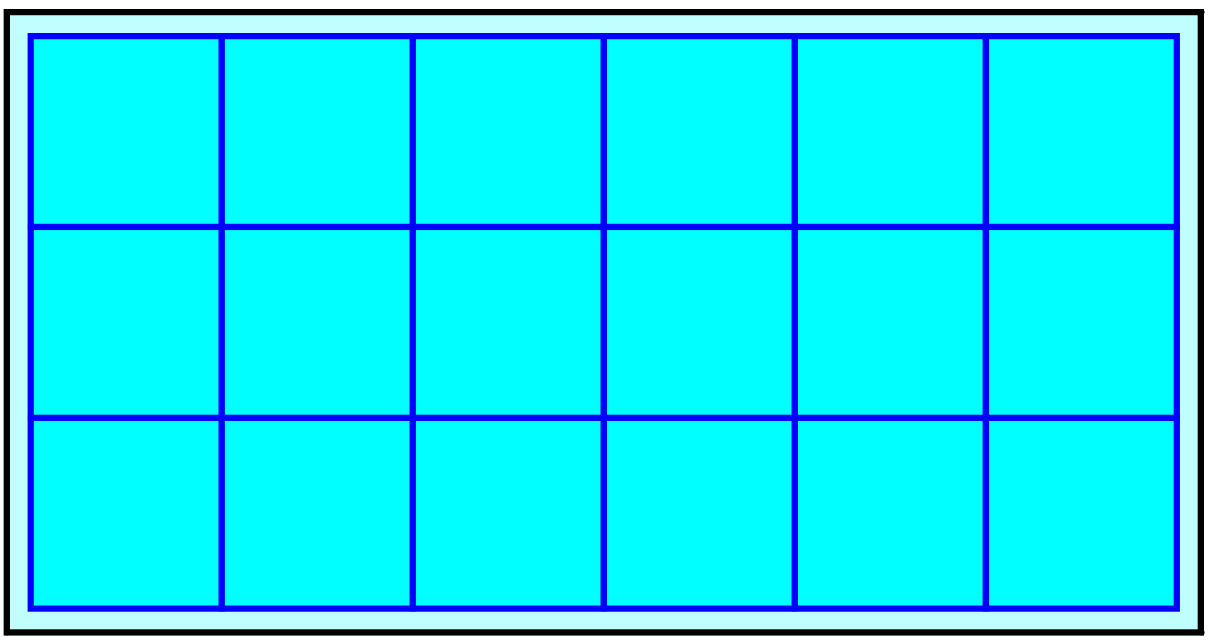
3 Chambers/Row x 8.00' Long = 24.00' Row Length +12.0" End Stone x 2 = 26.00' Base Length
6 Rows x 96.0" Wide + 12.0" Side Stone x 2 = 50.00' Base Width
12.0" Stone Base + 50.0" Chamber Height = 5.17' Field Height

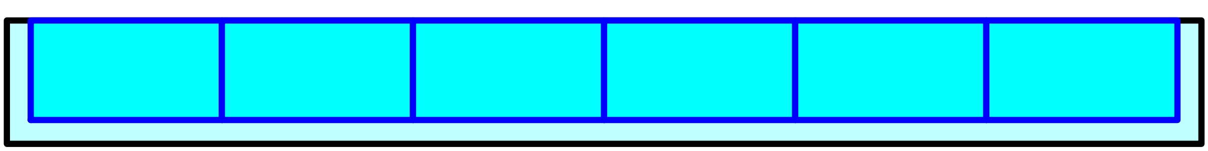
6.1 cf Sidewall x 3 x 2 + 6.1 cf Endwall x 6 x 2 = 110.5 cf Perimeter Wall
18 Chambers x 200.8 cf - 110.5 cf Perimeter wall = 3,503.5 cf Chamber Storage
18 Chambers x 266.7 cf = 4,800.0 cf Displacement

6,716.7 cf Field - 4,800.0 cf Chambers = 1,916.7 cf Stone x 40.0% Voids = 766.7 cf Stone Storage

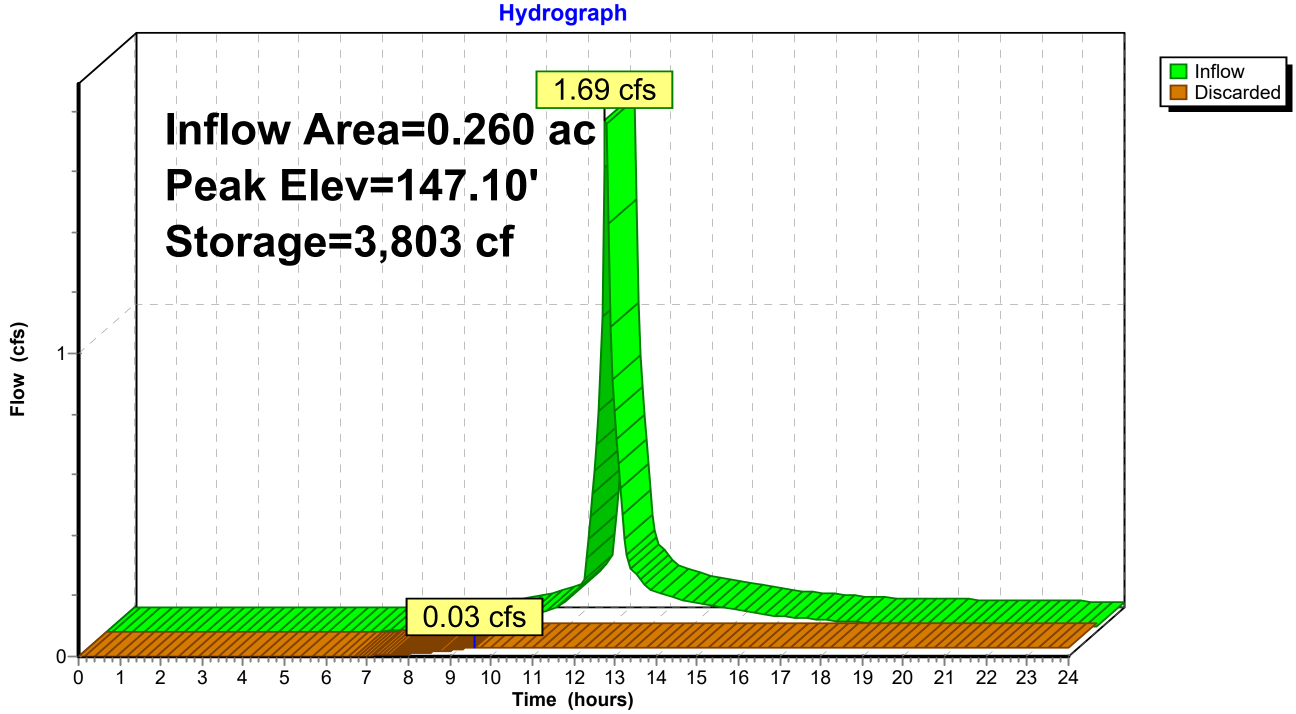
Chamber Storage + Stone Storage = 4,270.2 cf = 0.098 af
Overall Storage Efficiency = 63.6%
Overall System Size = 26.00' x 50.00' x 5.17'

18 Chambers
248.8 cy Field
71.0 cy Stone





Pond 2P: Retain-It Sys 2



Summary for Pond 3P: Drywell

[88] Warning: Qout>Qin may require smaller dt or Finer Routing
[85] Warning: Oscillations may require smaller dt or Finer Routing (severity=34)

Inflow Area = 1.441 ac,100.00% Impervious, Inflow Depth = 0.83" for 100-yr event
Inflow = 0.51 cfs @ 13.82 hrs, Volume= 0.100 af
Outflow = 0.64 cfs @ 13.75 hrs, Volume= 0.100 af, Atten= 0%, Lag= 0.0 min
Discarded = 0.02 cfs @ 13.30 hrs, Volume= 0.017 af
Primary = 0.62 cfs @ 13.75 hrs, Volume= 0.083 af
Routed to Link 1L : W'ly PL

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 149.83' @ 13.75 hrs Storage= 319 cf

Plug-Flow detention time= 33.5 min calculated for 0.100 af (100% of inflow)
Center-of-Mass det. time= 33.5 min (934.2 - 900.8)

Volume	Invert	Avail.Storage	Storage Description
#1	142.80'	323 cf	**Custom Stage Data** Listed below

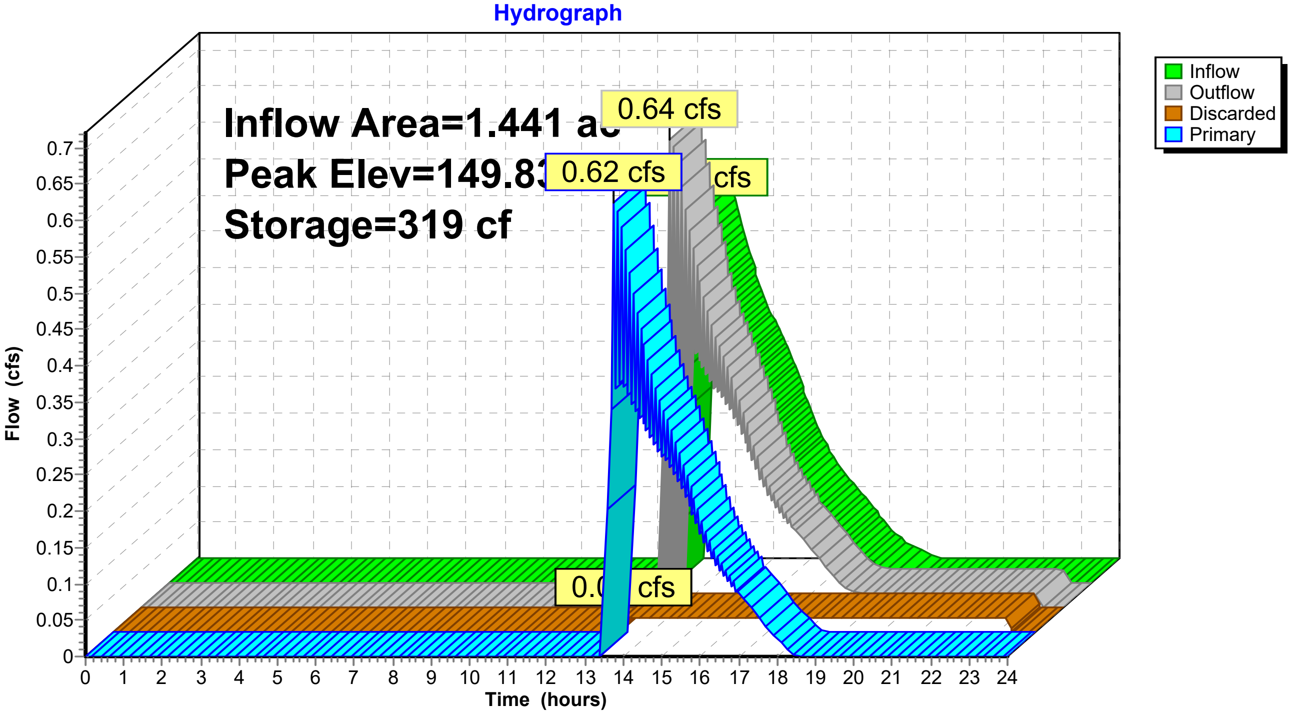
Elevation (feet)	Cum.Store (cubic-feet)
142.80	0
143.80	31
144.80	80
145.80	128
146.80	177
147.80	225
148.80	273
149.90	322
150.00	323

Device	Routing	Invert	Outlet Devices
#1	Discarded	142.80'	**0.02 cfs Exfiltration at all elevations**
#2	Primary	149.80'	**2.0" x 2.0" Horiz. Orifice/Grate X 6.00 columns** X 6 rows C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.02 cfs @ 13.30 hrs HW=142.98' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.02 cfs)

Primary OutFlow Max=0.47 cfs @ 13.75 hrs HW=149.83' (Free Discharge)
└─**2=Orifice/Grate** (Weir Controls 0.47 cfs @ 0.60 fps)

Pond 3P: Drywell

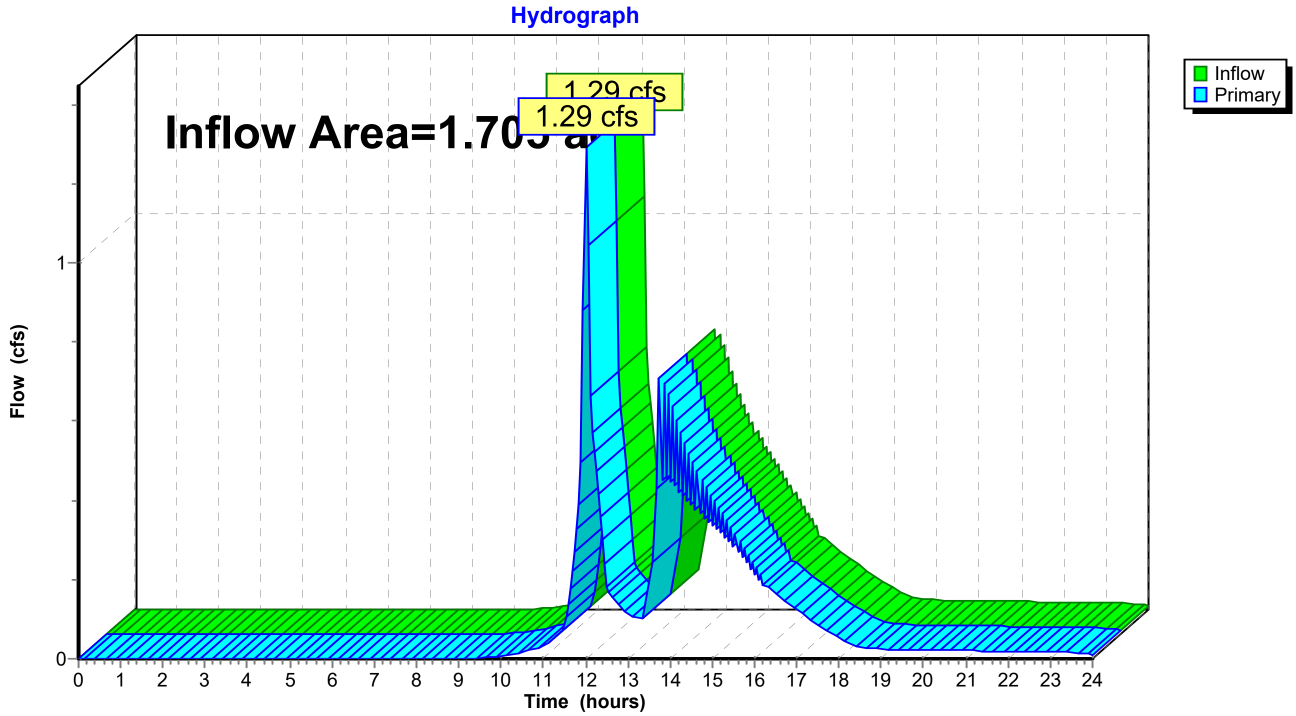


Summary for Link 1L: W'ly PL

Inflow Area = 1.705 ac, 86.61% Impervious, Inflow Depth > 1.16" for 100-yr event
Inflow = 1.29 cfs @ 12.01 hrs, Volume= 0.164 af
Primary = 1.29 cfs @ 12.01 hrs, Volume= 0.164 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 1L: W'ly PL

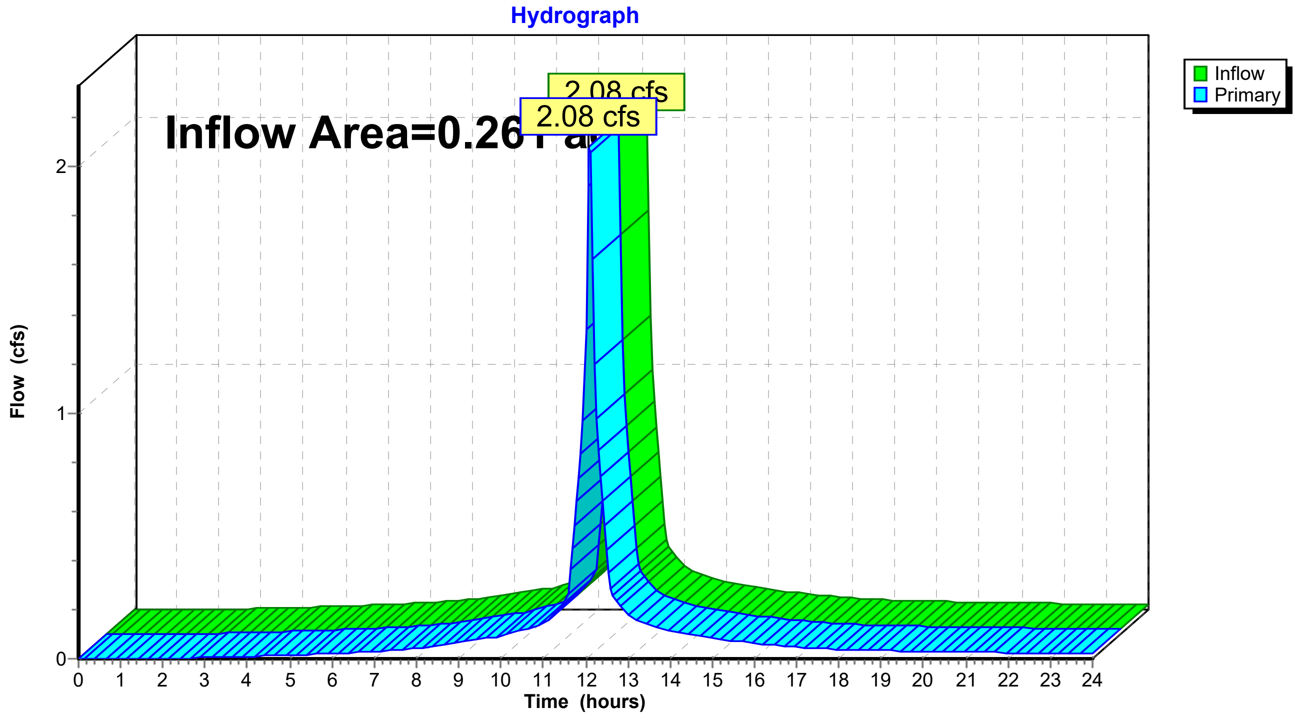


Summary for Link 2L: Main Street

Inflow Area = 0.261 ac, 81.34% Impervious, Inflow Depth > 7.59" for 100-yr event
Inflow = 2.08 cfs @ 12.09 hrs, Volume= 0.165 af
Primary = 2.08 cfs @ 12.09 hrs, Volume= 0.165 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 2L: Main Street



APPENDIX F
SUPPORTING INFORMATION

ILLICIT DISCHARGE STATEMENT

Project: Multi-Family Residential Development
1486 Main Street
Waltham, MA

Date: January 14, 2022

The stormwater management system proposed shall not be connected to the wastewater management system and shall not be contaminated by contact with process wastes, raw materials, toxic pollutants, hazardous substances, oil, or grease per Massachusetts DEP stormwater standard 10.

Engineer:
Allen & Major Associates, Inc.
10 Main Street
Lakeville, MA 02347

Philip Cordeiro, P.E.

Philip L Cordeiro
c=US, o=Allen and Major Associates Inc.,
ou=A01410C00000175798BB4FD00002012, cn=Philip L Cordeiro
2022.01.27 10:57:54 -05'00'

Print Name Signature

Owner:
Limited Dividend Affiliate of
WP East Acquisitions, LLC
91 Hartwell Avenue
Lexington, MA 02421

Print Name Signature

RAINFALL DATA

Extreme Precipitation Tables

Northeast Regional Climate Center

Data represents point estimates calculated from partial duration series. All precipitation amounts are displayed in inches.

Smoothing	Yes
State	Massachusetts
Location	
Longitude	71.275 degrees West
Latitude	42.378 degrees North
Elevation	0 feet
Date/Time	Thu, 23 Dec 2021 13:51:22 -0500

Extreme Precipitation Estimates

	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr	24hr	48hr		1day	2day	4day	7day	10day	
1yr	0.28	0.43	0.54	0.70	0.88	1.11	**1yr**	0.76	1.05	1.28	1.63	2.07	2.64	2.85	**1yr**	2.34	2.74	3.23	3.91	4.57	**1yr**
2yr	0.35	0.54	0.67	0.88	1.11	1.39	**2yr**	0.96	1.28	1.61	2.02	2.53	3.16	3.50	**2yr**	2.80	3.36	3.86	4.60	5.24	**2yr**
5yr	0.42	0.65	0.81	1.09	1.39	1.77	**5yr**	1.20	1.60	2.05	2.57	3.21	3.99	4.45	**5yr**	3.53	4.28	4.90	5.84	6.54	**5yr**
10yr	0.47	0.74	0.93	1.27	1.65	2.11	**10yr**	1.42	1.90	2.46	3.09	3.85	4.77	5.34	**10yr**	4.22	5.14	5.88	6.99	7.73	**10yr**
25yr	0.56	0.89	1.14	1.56	2.07	2.68	**25yr**	1.79	2.38	3.12	3.92	4.88	6.03	6.81	**25yr**	5.33	6.55	7.48	8.89	9.66	**25yr**
50yr	0.63	1.02	1.31	1.83	2.47	3.22	**50yr**	2.13	2.83	3.77	4.73	5.87	7.20	8.19	**50yr**	6.37	7.87	8.98	10.66	11.44	**50yr**
100yr	0.72	1.17	1.52	2.15	2.94	3.86	**100yr**	2.54	3.36	4.53	5.69	7.04	8.61	9.85	**100yr**	7.62	9.47	10.79	12.79	13.55	**100yr**
200yr	0.84	1.37	1.77	2.54	3.50	4.62	**200yr**	3.02	3.99	5.42	6.82	8.43	10.30	11.85	**200yr**	9.12	11.39	12.96	15.35	16.05	**200yr**
500yr	1.02	1.68	2.18	3.17	4.43	5.87	**500yr**	3.82	5.02	6.91	8.69	10.73	13.06	15.14	**500yr**	11.56	14.56	16.53	19.55	20.09	**500yr**

Lower Confidence Limits

	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr	24hr	48hr		1day	2day	4day	7day	10day	
1yr	0.24	0.36	0.45	0.60	0.74	0.83	**1yr**	0.64	0.81	1.10	1.45	1.77	2.26	2.50	**1yr**	2.00	2.40	2.76	3.53	4.04	**1yr**
2yr	0.33	0.51	0.63	0.85	1.05	1.26	**2yr**	0.91	1.23	1.44	1.90	2.44	3.09	3.41	**2yr**	2.73	3.28	3.70	4.49	5.11	**2yr**
5yr	0.39	0.60	0.74	1.02	1.29	1.49	**5yr**	1.12	1.46	1.72	2.24	2.87	3.71	4.12	**5yr**	3.28	3.96	4.52	5.42	6.09	**5yr**
10yr	0.43	0.67	0.82	1.15	1.49	1.70	**10yr**	1.29	1.66	1.90	2.52	3.23	4.24	4.72	**10yr**	3.76	4.54	5.12	6.26	6.93	**10yr**
25yr	0.50	0.76	0.95	1.35	1.78	2.00	**25yr**	1.53	1.96	2.23	2.96	3.78	5.05	5.62	**25yr**	4.47	5.41	5.99	7.54	8.20	**25yr**
50yr	0.55	0.84	1.05	1.51	2.03	2.28	**50yr**	1.75	2.23	2.50	3.35	4.26	5.74	6.42	**50yr**	5.08	6.17	6.67	8.68	9.33	**50yr**
100yr	0.61	0.93	1.16	1.68	2.30	2.59	**100yr**	1.98	2.53	2.81	3.44	4.80	6.54	7.28	**100yr**	5.78	7.00	7.40	9.98	10.61	**100yr**
200yr	0.68	1.03	1.30	1.89	2.63	2.94	**200yr**	2.27	2.87	3.17	3.80	5.42	7.41	8.25	**200yr**	6.56	7.93	8.13	11.48	12.04	**200yr**
500yr	0.79	1.18	1.52	2.20	3.14	3.48	**500yr**	2.71	3.40	3.70	4.35	6.39	8.71	9.67	**500yr**	7.71	9.30	9.03	13.79	14.24	**500yr**

Upper Confidence Limits

	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr	24hr	48hr		1day	2day	4day	7day	10day	
1yr	0.32	0.49	0.59	0.80	0.98	1.16	**1yr**	0.85	1.13	1.35	1.79	2.26	2.83	3.07	**1yr**	2.50	2.95	3.45	4.19	4.89	**1yr**
2yr	0.37	0.57	0.70	0.94	1.16	1.36	**2yr**	1.00	1.33	1.57	2.08	2.67	3.25	3.61	**2yr**	2.88	3.48	4.04	4.73	5.40	**2yr**
5yr	0.45	0.70	0.86	1.19	1.51	1.80	**5yr**	1.30	1.76	2.04	2.64	3.35	4.31	4.83	**5yr**	3.81	4.64	5.31	6.28	6.99	**5yr**
10yr	0.54	0.84	1.04	1.45	1.87	2.22	**10yr**	1.61	2.17	2.57	3.19	4.02	5.36	6.06	**10yr**	4.74	5.83	6.63	7.81	8.57	**10yr**
25yr	0.70	1.07	1.33	1.90	2.50	2.94	**25yr**	2.16	2.87	3.43	4.11	5.11	7.16	8.22	**25yr**	6.33	7.90	8.95	10.43	11.24	**25yr**
50yr	0.85	1.29	1.61	2.31	3.11	3.64	**50yr**	2.68	3.56	4.26	4.99	6.14	8.94	10.35	**50yr**	7.91	9.95	11.23	13.01	13.79	**50yr**
100yr	1.03	1.56	1.96	2.83	3.88	4.50	**100yr**	3.34	4.40	5.30	6.60	7.37	11.20	13.07	**100yr**	9.91	12.57	14.20	16.23	16.93	**100yr**
200yr	1.25	1.89	2.39	3.46	4.83	5.57	**200yr**	4.17	5.44	6.60	8.12	8.84	14.06	16.55	**200yr**	12.44	15.92	18.01	20.28	20.79	**200yr**
500yr	1.63	2.42	3.12	4.53	6.45	7.35	**500yr**	5.56	7.18	8.83	10.69	11.25	19.03	22.66	**500yr**	16.84	21.78	24.76	27.23	27.32	**500yr**

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SOIL INFORMATION

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for
Middlesex County, Massachusetts

November 20, 2020

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

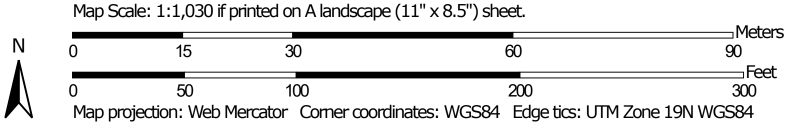
After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map

Map Scale: 1:1,030 if printed on A landscape (11" x 8.5") sheet.



Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 19N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Unit Polygons

Soil Map Unit Lines

Soil Map Unit Points

Special Point Features

Blowout

Borrow Pit

Clay Spot

Closed Depression

Gravel Pit

Gravelly Spot

Landfill

Lava Flow

Marsh or swamp

Mine or Quarry

Miscellaneous Water

Perennial Water

Rock Outcrop

Saline Spot

Sandy Spot

Severely Eroded Spot

Sinkhole

Slide or Slip

Sodic Spot

Spoil Area

Stony Spot

Very Stony Spot

Wet Spot

Other

Special Line Features

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:25,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Middlesex County, Massachusetts
Survey Area Data: Version 20, Jun 9, 2020

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jul 28, 2019—Aug 15, 2019

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
251B	Haven silt loam, 3 to 8 percent slopes	0.1	4.1%
420B	Canton fine sandy loam, 3 to 8 percent slopes	0.1	2.8%
424D	Canton fine sandy loam, 15 to 25 percent slopes, extremely bouldery	0.0	0.1%
656	Udorthents-Urban land complex	2.2	93.0%
Totals for Area of Interest		**2.4**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Middlesex County, Massachusetts

251B—Haven silt loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 990d
Elevation: 30 to 1,000 feet
Mean annual precipitation: 45 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 145 to 240 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Haven and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Haven

Setting

Landform: Plains, terraces
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread, rise
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Friable loamy eolian deposits over loose sandy glaciofluvial deposits

Typical profile

H1 - 0 to 2 inches: silt loam
H2 - 2 to 20 inches: silt loam
H3 - 20 to 32 inches: very fine sandy loam
H4 - 32 to 65 inches: stratified coarse sand to sand to fine sand

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: 18 to 36 inches to strongly contrasting textural stratification
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 4.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: A
Ecological site: F144AY023CT - Well Drained Outwash
Hydric soil rating: No

Minor Components

Merrimac

Percent of map unit: 9 percent
Landform: Plains, terraces
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Tread, rise
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Scio

Percent of map unit: 5 percent
Landform: Terraces, depressions
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: No

Unnamed

Percent of map unit: 1 percent

420B—Canton fine sandy loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2w81b
Elevation: 0 to 1,180 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Canton and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Canton

Setting

Landform: Ridges, moraines, hills
Landform position (two-dimensional): Backslope, summit, shoulder
Landform position (three-dimensional): Side slope, crest, nose slope
Down-slope shape: Convex, linear
Across-slope shape: Convex
Parent material: Coarse-loamy over sandy melt-out till derived from gneiss, granite, and/or schist

Typical profile

Ap - 0 to 7 inches: fine sandy loam
Bw1 - 7 to 15 inches: fine sandy loam
Bw2 - 15 to 26 inches: gravelly fine sandy loam
2C - 26 to 65 inches: gravelly loamy sand

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: 19 to 39 inches to strongly contrasting textural stratification
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.17 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Very low (about 2.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2s
Hydrologic Soil Group: B
Ecological site: F144AY034CT - Well Drained Till Uplands
Hydric soil rating: No

Minor Components

Scituate

Percent of map unit: 10 percent
Landform: Drumlins, hills, ground moraines
Landform position (two-dimensional): Footslope, backslope, summit
Landform position (three-dimensional): Crest, side slope
Down-slope shape: Linear, convex
Across-slope shape: Convex
Hydric soil rating: No

Montauk

Percent of map unit: 5 percent
Landform: Drumlins, hills, ground moraines, moraines
Landform position (two-dimensional): Backslope, shoulder, summit
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Linear, convex
Across-slope shape: Convex
Hydric soil rating: No

Charlton

Percent of map unit: 4 percent
Landform: Hills, ground moraines, ridges
Landform position (two-dimensional): Backslope, shoulder, summit
Landform position (three-dimensional): Crest, side slope
Down-slope shape: Linear, convex
Across-slope shape: Convex
Hydric soil rating: No

Swansea

Percent of map unit: 1 percent

Landform: Kettles, swamps, bogs, depressions, marshes
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

424D—Canton fine sandy loam, 15 to 25 percent slopes, extremely bouldery

Map Unit Setting

National map unit symbol: vqs3
Elevation: 0 to 1,000 feet
Mean annual precipitation: 45 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Canton and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Canton

Setting

Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Friable loamy eolian deposits over friable sandy basal till derived from granite and gneiss

Typical profile

H1 - 0 to 8 inches: fine sandy loam
H2 - 8 to 21 inches: fine sandy loam
H3 - 21 to 65 inches: gravelly loamy sand

Properties and qualities

Slope: 15 to 25 percent
Surface area covered with cobbles, stones or boulders: 9.0 percent
Depth to restrictive feature: 18 to 30 inches to strongly contrasting textural stratification
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Very low (about 2.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: A
Ecological site: F144AY034CT - Well Drained Till Uplands
Hydric soil rating: No

Minor Components

Charlton

Percent of map unit: 10 percent
Landform: Ground moraines, drumlins
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Hinckley

Percent of map unit: 5 percent
Landform: Eskers, ridges, terraces
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex
Hydric soil rating: No

656—Udorthents-Urban land complex

Map Unit Setting

National map unit symbol: 995k
Elevation: 0 to 3,000 feet
Mean annual precipitation: 32 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 110 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Udorthents and similar soils: 45 percent
Urban land: 35 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Udorthents

Setting

Parent material: Loamy alluvium and/or sandy glaciofluvial deposits and/or loamy glaciolacustrine deposits and/or loamy marine deposits and/or loamy basal till and/or loamy lodgment till

Properties and qualities

Slope: 0 to 15 percent
Depth to restrictive feature: More than 80 inches
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None

Description of Urban Land

Setting

Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Excavated and filled land

Minor Components

Canton

Percent of map unit: 10 percent
Landform: Hills
Landform position (two-dimensional): Backslope, toeslope
Landform position (three-dimensional): Side slope, base slope
Down-slope shape: Linear
Across-slope shape: Convex
Hydric soil rating: No

Merrimac

Percent of map unit: 5 percent
Landform: Plains, terraces
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Tread, rise
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Paxton

Percent of map unit: 5 percent
Landform: Hillslopes
Landform position (two-dimensional): Backslope, summit
Landform position (three-dimensional): Head slope, side slope
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

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WATER QUALITY SIZING (CONTECH)

Project: **1486 Main St**
Location: **Waltham, MA**
Prepared For: **Allen & Major / Paul Maros**

CONTECH ENGINEERED SOLUTIONS

Purpose: To calculate the water quality flow rate (WQF) over a given site area. In this situation the WQF is derived from the first 1" of runoff from the contributing impervious surface.

Reference: Massachusetts Dept. of Environmental Protection Wetlands Program / United States Department of Agriculture Natural Resources Conservation Service TR-55 Manual

Procedure: Determine unit peak discharge using Figure 1 or 2. Figure 2 is in tabular form so is preferred. Using the tc, read the unit peak discharge (qu) from Figure 1 or Table in Figure 2. qu is expressed in the following units: cfs/mi^2/watershed inches (csm/in).

Compute Q Rate using the following equation:

Q = (qu) (A) (WQV)

where:

Q = flow rate associated with first 1" of runoff
qu = the unit peak discharge, in csm/in.
A = impervious surface drainage area (in square miles)
WQV = water quality volume in watershed inches (1" in this case)

Structure Name	Impv. (acres)	A (miles^2)	t_c (min)	t_c (hr)	WQV (in)	qu (csm/in.)	Q (cfs)
PCB 1	0.10	0.0001563	6.0	0.100	1.00	774.00	0.12

Brief Stormceptor Sizing Report - PCB 1

Project Information & Location			
Project Name	1486 Main St	**Project Number**	698607
City	Waltham	**State/ Province**	Massachusetts
Country	United States of America	**Date**	1/11/2022
Designer Information		**EOR Information (optional)**	
Name	Jim Lyons	**Name**	Paul Matos
Company	Contech Engineered Solutions	**Company**	Allen & Major Assoc
Phone #	413-246-5151	**Phone #**	413-246-5151
Email	jimlyons413@gmail.com	**Email**	pmatos@allenmajor.com

Stormwater Treatment Recommendation

The recommended Stormceptor Model(s) which achieve or exceed the user defined water quality objective for each site within the project are listed in the below Sizing Summary table.

Site Name	PCB 1
Target TSS Removal (%)	80
TSS Removal (%) Provided	96
Recommended Stormceptor Model	STC 450i

The recommended Stormceptor Model achieves the water quality objectives based on the selected inputs, historical rainfall records and selected particle size distribution.

Stormceptor Sizing Summary	
Stormceptor Model	**% TSS Removal Provided**
STC 450i	96
STC 900	98
STC 1200	98
STC 1800	98
STC 2400	99
STC 3600	99
STC 4800	99
STC 6000	99
STC 7200	99
STC 11000	100
STC 13000	100
STC 16000	100

Stormceptor®

CONTECH ENGINEERED SOLUTIONS

Sizing Details

Drainage Area	
Total Area (acres)	0.26
Imperviousness %	38.0

Water Quality Objective	
TSS Removal (%)	80.0
Runoff Volume Capture (%)	
Oil Spill Capture Volume (Gal)	
Peak Conveyed Flow Rate (CFS)	1.69
Water Quality Flow Rate (CFS)	0.12

Rainfall	
Station Name	BLUE HILL
State/Province	Massachusetts
Station ID #	0736
Years of Records	58
Latitude	42°12'44"N
Longitude	71°6'53"W

Up Stream Storage	
Storage (ac-ft)	Discharge (cfs)
0.000	0.000

Up Stream Flow Diversion	
Max. Flow to Stormceptor (cfs)	

Particle Size Distribution (PSD) The selected PSD defines TSS removal		
OK-110		
Particle Diameter (microns)	Distribution %	Specific Gravity
1.0	0.0	2.65
53.0	3.0	2.65
75.0	15.0	2.65
88.0	25.0	2.65
106.0	41.0	2.65
125.0	15.0	2.65
150.0	1.0	2.65
212.0	0.0	2.65

Notes

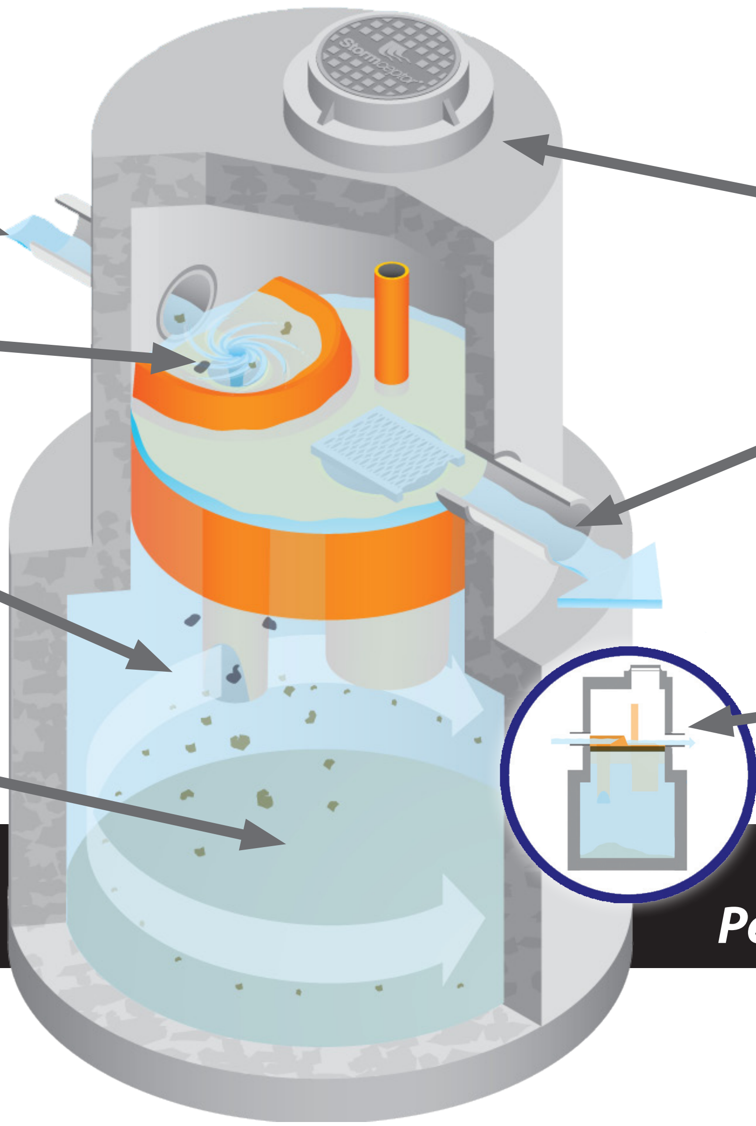
• Stormceptor performance estimates are based on simulations using PCSWMM for Stormceptor, which uses the EPA Rainfall and Runoff modules.
• Design estimates listed are only representative of specific project requirements based on total suspended solids (TSS) removal defined by the selected PSD, and based on stable site conditions only, after construction is completed.
• For submerged applications or sites specific to spill control, please contact your local Stormceptor representative for further design assistance.

For Stormceptor Specifications and Drawings Please Visit:
https://www.conteches.com/technical-guides/search?filter=1WBC0O5EYX

Stormceptor®

Stormwater Treatment Made Simple!

TSS & Oil Removal ■ *Scour Prevention* ■ *Small Footprint*



Design Flexibility

Proven Performance

Environmentally Engineered Stormwater Solutions...
that exceed your client's needs!

A calm treatment environment

CONTECH® ENGINEERED SOLUTIONS

Stormceptor® STC

Stormceptor® is an underground stormwater quality treatment device that is unparalleled in its effectiveness for pollutant capture and retention. With thousands of systems operating worldwide, Stormceptor delivers protection every day in every storm.

With patented technology, optimal treatment occurs by allowing free oil to rise and sediment to settle. The Stormceptor design prohibits scour and release of previously captured pollutants, ensuring superior treatment and protection during even the most extreme storm events.

Stormceptor is very easy to design and provides flexibility under varying site constraints such as tight right-of-ways, zero lot lines and retrofit projects. Design flexibility allows for a cost-effective approach to stormwater treatment. Stormceptor has proven performance backed by the longest record of lab and field verification in the industry.

Tested Performance

- Fine particle capture
- Prevents scour or release
- 95%+ Oil removal

Massachusetts – Water Quality (Q) Flow Rate

Stormceptor STC Model	Inside Diameter (ft)	Typical Depth Below Inlet Pipe Invert [1] (in)	Water Quality Flow Rate Q [2] (cfs)	Peak Conveyance Flow Rate [3] (cfs)	Hydrocarbon Capacity [4] (Gallons)	Maximum Sediment Capacity [4] (ft^3)
STC 450i	4	68	0.40	5.5	86	46
STC 900	6	63	0.89	22	251	89
STC 2400	8	104	1.58	22	840	205
STC 4800	10	140	2.47	22	909	543
STC 7200	12	148	3.56	22	1,059	839
STC 11000	2 x 10	142	4.94	48	2,792	1,086
STC 16000	2 x 12	148	7.12	48	3,055	1,677

[1] Depth Below Pipe Inlet Invert to the Bottom of Base Slab, and Maximum Sediment Capacity can vary to accommodate specific site designs and pollutant loads. Depths can vary to accommodate special designs or site conditions. Contact your local representative for assistance.
[2] Water Quality Flow Rate (Q) is based on 80% annual average TSS removal of the OK110 particle size distribution.
[3] Peak Conveyance Flow Rate is based upon ideal velocity of 3 feet per second and outlet pipe diameters of 18-inch, 36-inch, and 54-inch diameters.
[4] Hydrocarbon & Sediment capacities can be modified to accommodate specific site design requirements, contact your local representative for assistance.

APPENDIX G
OPERATION & MAINTENANCE PLAN

OPERATION & MAINTENANCE PLAN

Multi-Family Development
1486 Main Street Waltham, MA

Prepared: January 14, 2022

Site Locus

CLIENT:
Limited Dividend Affiliate of
WP East Acquisitions, LLC
91 Hartwell Avenue
Lexington, MA 02421

PREPARED BY:
Allen & Major Associates, Inc.
10 Main Street
Lakeville, Massachusetts 02347

allenmajor.com

OPERATION & MAINTENANCE PLAN

Multi-Family Development
1486 Main Street Waltham, MA

PROPONENT:
Limited Dividend Affiliate of
WP East Acquisitions, LLC
91 Hartwell Avenue
Lexington, MA 02421

PREPARED BY:
Allen & Major Associates, Inc.
10 Main Street
Lakeville, Massachusetts 02347

ISSUED:
January 14, 2022

REVISED:
-

A&M PROJECT NO.:
1670-14

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SECTION 1.0
OPERATIONS & MAINTENANCE PLAN

1.1 INTRODUCTION

In accordance with the standards set forth by the Stormwater Management Policy issued by the Massachusetts Department of Environmental Protection (MassDEP), Allen & Major Associates, Inc. has prepared the following Operations & Maintenance (O&M) Plan for the proposed stormwater management system for the Multi-Family Development located at 1486 Main Street in Waltham, MA.

This plan focuses on post construction maintenance of the on-site drainage system. Operation and Maintenance (O&M) practices discussed below are recommendations made by the Design Engineer based on available reference material on Best Management Practices (BMP's) and experience. The property owner is responsible for implementation of the plan, and is encouraged to revise / supplement this plan accordingly based on actual site conditions.

The plan is broken down into two major sections. The first section describes the long-term pollution prevention measures (Long Term Pollution Prevention Plan). The second section is a post-construction operation and maintenance plan designed to address the long-term maintenance needs of the stormwater management system (Long Term Maintenance Plan).

1.2 NOTIFICATION PROCEDURES FOR CHANGE OF RESPONSIBILITY FOR O&M

The Stormwater Management System (SMS) for this project is owned by a Limited Dividend Affiliate of WP East Acquisitions, LLC (owner). The owner shall be legally responsible for the long-term operation and maintenance of this SMS as outlined in this Operation and Maintenance Plan.

The owner shall submit an annual summary report and the completed Operation & Maintenance Schedule & Checklist to the Conservation Commission (via email or print copy), highlighting inspection and maintenance activities including performances of BMPs. Should ownership of the SMS change, the owner will continue to be responsible until the succeeding owner shall notify the Commission that the succeeding owner has assumed such responsibility.

1.3 CONTACT INFORMATION

Stormwater Management System Owner:	Limited Dividend Affiliate of WP East Acquisitions, LLC 91 Hartwell Avenue Lexington, MA 02421 Phone: TBD

Emergency Contact Information:

Limited Dividend Affiliate of WP East Acquisitions, LLC (Owner/Operator)	Phone: TBD
Waltham Engineering Department	Phone: 781-314-3835
Waltham Fire Department (non-emergency line)	Phone: 781-314-3710
MassDEP Emergency Response	Phone: (888) 304-1133
Clean Harbors Inc (24-Hour Line)	Phone: (800) 645-8265

1.4 CONSTRUCTION PERIOD

1. Call Digsafe: 1-888-344-7233
2. Schedule a meeting with the various City Departments, Design Engineer and Owner at least three (3) days prior to start of construction.
3. Install Erosion Control measures (construction entrance, wattles, straw bales, silt fence, silt sac, etc.) as shown on the Plans prepared by A&M. If required, by any special conditions, the City shall review the installation of erosion control measures prior to the start of any site demolition work. Install Construction fencing if determined to be necessary at the commencement of construction.
4. All erosion and sedimentation controls shall be in accordance with MassDEP's Erosion and Sedimentation Control guidelines revised through May 2003 and the USDA SCS Erosion and Sedimentation Control in site development dated September 1983.
5. Site access shall be achieved only from the designated construction entrances.
6. Cut and clear trees in construction areas only (within the limit of work; see plans).
7. Stockpiles of materials subject to erosion shall be stabilized with erosion control matting or temporary seeding whenever practicable, but in no case more than 14 days after the construction activity in that portion of the site has temporarily or permanently ceased.

8. Install silt sacks and straw bales around each drain inlet prior to any demolition and or construction activities.
9. All erosion control measures shall be inspected weekly and after every rainfall event. Records of these inspections shall be kept on-site for review.
10. All erosion control measures shall be maintained, repaired, or replaced as required or at the direction of the owner's engineer or the City's representative.
11. Sediment accumulation up-gradient of the straw bales, silt fence, and stone check dams greater than 6" in depth shall be removed and disposed of in accordance with all applicable regulations.
12. If it appears that sediment is exiting the site, silt sacks shall be installed in all catch basins adjacent to the site. Sediment accumulation on all adjacent catch basin inlets shall be removed and the silt sack replaced if torn or damaged.
13. Install stone check dam on-site during construction as needed. Refer to the erosion control details. Temporary sediment basins combined with stone check damns shall be installed on-site during construction to control and collect runoff from upland areas of this site during demolition and construction activities.
14. The contractor shall comply with the Sedimentation and Erosion Control Notes as shown on the Site Development Plans and Specifications.
15. The stabilized construction entrances shall be inspected weekly and records of inspections kept. The entrances shall be maintained by adding additional clean, angular, durable stone to remove the soil from the construction vehicle's tires when exiting the site. If soil is still leaving the site via the construction vehicle tires, adjacent roadways shall be kept clean by street sweeping.
16. Dust pollution shall be controlled using on-site water trucks and/or an approved soil stabilization product.
17. During demolition and construction activities, Status Reports on compliance with this O&M Document shall be submitted weekly. The report shall document any deficiencies and corrective actions taken by the applicant.
18. No overuse, over-compaction, or storage of materials shall occur within any areas defined as stormwater infiltration to prevent the incidental compaction of soils. The areas are to be constructed as soon as possible and protected from construction traffic. NO CONSTRUCTION WATERS are to be emptied into an infiltration system. An allowance may be accommodated for a temporary excavation of soils within the infiltration basin for collection and handling of construction water, but the entirety of the debris is to be removed in order to achieve the grades as shown on the construction drawings.

19. The entire drainage system, including but not limited to catch basin, manholes, piping, water quality structures and infiltration system should be cleaned prior to turnover to the Owner.

1.5 LONG-TERM POLLUTION PREVENTION PLAN

Standard #4 from the MassDEP Stormwater Management Handbook requires that a Long-Term Pollution Prevention Plan (LTPPP) be prepared and incorporated as part of the Operation and Maintenance Plan of the Stormwater Management System. The purpose of the LTPPP is to identify potential sources of pollution that may affect the quality of stormwater discharges, and to describe the implementation of practices to reduce the pollutants in stormwater discharges. The following items describe the source control and proper procedures of the LTPPP.

- **Housekeeping**
  The existing development has been designed to maintain a high level of water quality treatment for all stormwater discharge to the wetland areas. An Operation and Maintenance (O&M) plan has been prepared and is included in this section of the report. The owner (or its designee) is responsible for adherence to the O&M plan in a strict and complete manner.

- **Storing of Materials & Water Products**
  The trash and waste program for the site includes exterior dumpsters. There is a trash contractor used to pick up the waste material in the dumpsters. The stormwater drainage system has water quality inlets designed to capture trash and debris.

- **Vehicle Washing**
  Outdoor vehicle washing has the potential to result in high loads of nutrients, metals, and hydrocarbons during dry weather conditions, as the detergent-rich water used to wash the grime off the vehicle enters the stormwater drainage system. The existing development does not include any designated vehicle washing areas, nor is it expected that any vehicle washing will take place on-site.

- **Spill Prevention & Response**
  Sources of potential spill hazards include vehicle fluids, liquid fuels, pesticides, paints, solvents, and liquid cleaning products. The majority of the spill hazards would likely occur within the buildings and would not enter the stormwater drainage system. However, there are spill hazards from vehicle fluids or liquid fuels located outside of the buildings. These exterior spill hazards have the potential to enter the stormwater drainage system and are to be addressed as follows:

1. Spill hazards of pesticides, paints, and solvents shall be remediated using the Manufacturers' recommended spill cleanup protocol.
2. Vehicle fluids and liquid fuel spill shall be remediated according to the local and state regulations governing fuel spills.
3. The owner shall have the following equipment and materials on hand to address a spill clean-up: brooms, dust pans, mops, rags, gloves, absorptive material, sand, sawdust, plastic and metal trash containers.
4. All spills shall be cleaned up immediately after discovery.
5. Spills of toxic or hazardous material shall be reported, regardless of size, to the Massachusetts Department of Environmental Protection at (888) 304-1333.
6. Should a spill occur, the pollution prevention plan will be adjusted to include measures to prevent another spill of a similar nature. A description of the spill, along with the causes and cleanup measures will be included in the updated pollution prevention plan.

- **Maintenance of Lawns, Gardens, and Other Landscaped Areas**
  It should be recognized that this is a general guideline towards achieving high quality and well-groomed landscaped areas. The grounds staff/landscape contractor must recognize the shortcomings of a general maintenance plan such as this, and modify and/or augment it based on weekly, monthly, and yearly observations. In order to assure the highest quality conditions, the staff must also recognize and appreciate the need to be aware of the constantly changing conditions of the landscaping and be able to respond to them on a proactive basis. No trees shall be planted over the drain lines or recharge area, and that only shallow rooted plants and shrubs will be allowed.

  - **Fertilizer**

    Maintenance practices should be aimed at reducing environmental, mechanical and pest stresses to promote healthy and vigorous growth. When necessary, pest outbreaks should be treated with the most sensitive control measure available. Synthetic chemical controls should be used only as a last resort to organic and biological control methods. Fertilizer, synthetic chemical controls and pest management applications (when necessary) shall be performed only by licensed applicators in accordance with the manufacturer's label instructions when environmental conditions are conducive to controlled product application.

Only slow-release organic fertilizers should be used in the planting and mulch areas to limit the amount of nutrients that could enter downstream resource areas. Fertilization of the planting and mulch areas will be performed within manufacturers labeling instructions and shall not exceed an NPK ration of 1:1:1 (i.e. Triple 10 fertilizer mix), considered a low nitrogen mixture. Fertilizers approved for the use under this O&M Plan are as follows:

Type: LESCO® 28-0-12 (Lawn Fertilizer)
MERIT® 0.2 Plus Turf Fertilizer
MOMENTUM™ Force Weed & Feed

- **Suggested Aeration Program**

  In-season aeration of lawn areas is good cultural practice, and is recommended whenever feasible. It should be accomplished with a solid thin tine aeration method to reduce disruption to the use of the area. The depth of solid tine aeration is similar to core type, but should be performed when the soil is somewhat drier for a greater overall effect.

  Depending on the intensity of use, it can be expected that all landscaped lawn areas will need aeration to reduce compaction at least once per year. The first operation should occur in late May following the spring season. Methods of reducing compaction will vary based on the nature of the compaction. Compaction on newly established landscaped areas is generally limited to the top 2-3" and can be alleviated using hollow core or thin tine aeration methods.

  The spring aeration should consist of two passes at opposite directions with 1/4" hollow core tines penetrating 3-5" into the soil profile. Aeration should occur when the soil is moist but not saturated. The soil cores should be shattered in place and dragged or swept back into the turf to control thatch. If desired the cores may also be removed and the area top-dressed with sand or sandy loam. If the area drains on average too slowly, the topdressing should contain a higher percentage of sand. If it is draining on average too quickly, the top dressing should contain a higher percentage of soil and organic matter.

- **Landscape Maintenance Program Practices**:

  - **Lawn**

    1. Mow a minimum of once a week in spring, to a height of 2” to 2 1/2” high. Mowing should be frequent enough so that no more than 1/3 of grass blade is removed at each mowing. The top growth supports the roots; the shorter the grass is cute, the less

the roots will grow. Short cutting also dries out the soil and encourages weeds to germinate.

2. Mow approximately once every two weeks from July 1st to August 15th depending on lawn growth.
3. Mow on a ten-day cycle in fall, when growth is stimulated by cooler nights and increased moisture.
4. Do not remove grass clippings after mowing.
5. Keep mower blades sharp to prevent ragged cuts on grass leaves, which cause a brownish appearance and increase the chance for disease to enter a leaf.

- **Shrubs**
  1. Mulch not more than 3″ depth with shredded pine or fir bark.
  2. Hand prune annually, immediately after blooming, to remove 1/3 of the above-ground biomass (older stems). Stem removals are to occur within 6″ of the ground to open up shrub and maintain two-year wood (the blooming wood).
  3. Hand-prune evergreen shrubs only as needed to remove dead and damaged wood and to maintain the naturalistic form of the shrub. Never mechanically shear evergreen shrubs.
- **Trees**
  1. Provide aftercare of new tree plantings for the first three years.
  2. Do not fertilize trees, it artificially stimulates them (unless tree health warrants).
  3. Water once a week for the first year; twice a month for the second; once a month for the third year.
  4. Prune trees on a four-year cycle.
- **Invasive Species**
  1. Inform the Conservation Commission Agent prior to the removal of invasive species proposed either through hand work or through chemical removal.

- **Storage and Use of Herbicides and Pesticides**
  Integrated Pest Management is the combination of all methods (of pest control) which may prevent, reduce, suppress, eliminate, or repel an insect population. The main requirements necessary to support any pest population are food, shelter and

water, and any upset of the balance of these will assist in controlling a pest population. Scientific pest management is the knowledgeable use of all pest control methods (sanitation, mechanical, chemical) to benefit mankind's health, welfare, comfort, property and food. A Pest Management Professional (PMP) should be retained who is licensed with the Commonwealth of Massachusetts Executive Office of Energy and Environmental Affairs, Department of Agricultural Resources.

The site manager will be provided with approved bulletin before entering into or renewing an agreement to apply pesticides for the control of indoor household or structural pests, refer to 333 CMR 13.08.

Before beginning each application, the applicator must post a Department approved notice on all of the entrances to the treated room or area. The applicator must leave such notices posted after the application. The notice will be posted at conspicuous point(s) of access to the area treated. The location and number of signs will be determined by the configuration of the area to be treated based on the applicator’s best judgment. It is intended to give sufficient notice so that no one comes into an area being treated unaware that the applicator is working and pesticides are being applied. However, if the contracting entity does not want the signs posted, he/she may sign a Department approved waiver indicating this.

The applicator or employer will provide to any person upon their request the following information on previously conducted applications:

1. Name and phone number of pest control company;
2. Date and time of the application;
3. Name and license number of the applicator;
4. Target pests; and
5. Name and EPA Registration Number of pesticide products applied.

- **Pet Waste Management**
  The owner’s landscape crew (or designee) shall remove any obvious pet waste that has been left behind by pet owners within the development. The pet waste shall be disposed of in accordance with local and state regulations.

- **Management of Deicing Chemicals and Snow**
  Snow will be stockpiled on site until the accumulated snow becomes a hazard to the daily operations of the site. It will be the responsibility of the snow removal contractor to properly dispose of transported snow according to MassDEP, Bureau of Resource Protection – Snow Disposal Guideline #BRPG01-01, governing the proper disposal of snow. It will be the responsibility of the snow removal contractor to follow these guidelines and all applicable laws and regulations

The owner's maintenance staff (or its designee) will be responsible for the clearing of the sidewalk and building entrances. The owner may be required to use a de-icing agent such as potassium chloride to maintain a safe walking surface. If used, the de-icing agent for the walkways and building entrances will be kept within the storage rooms located within the building. If used, de-icing agents will not be stored outside. The owner's maintenance staff will limit the application of sand.

1.6 LONG-TERM MAINTENANCE PLAN – FACILITIES DESCRIPTION

A maintenance log will be kept (i.e. report) summarizing inspections, maintenance, and any corrective actions taken. The log will include the date on which each inspection or maintenance task was performed, a description of the inspection findings or maintenance completed, and the name of the inspector or maintenance personnel performing the task. If a maintenance task requires the clean-out of any sediments or debris, the location where the sediment and debris was disposed after removal will be indicated. The log will be made accessible to department staff and a copy provided to the department upon request.

The following is a description of the Stormwater Management System for the project site.

- **Stormwater Collection System – On-Site**: The stormwater collection system is comprised of deep sump hooded catch basins, water quality structures, a sub-surface infiltration system consisting of ReTain-It concrete chambers, a closed gravity pipe network an outlet control structure.
  The stormwater runoff from the building rooftops are collected using roof drains. The stormwater is conveyed to the discharge locations using internal building plumbing and external roof leaders. The building rooftop runoff discharges to one of the sub-surface infiltration systems.

1.7 INSPECTION AND MAINTENANCE FREQUENCY AND CORRECTIVE MEASURES

In accordance with MA DEP Stormwater Handbook: Volume 2, Chapter 2; the following areas, facilities, and measures will be inspected and the identified deficiencies will be corrected. Clean-out must include the removal and legal disposal of any accumulated sediments, trash, and debris. In any and all cases, operations, inspections, and maintenance activities shall utilize best practical measures to avoid and minimize impacts to wetland resource areas outside the footprint of the SMS.

Attached is an Operation and Maintenance Plan (OM-1) illustrating the location of the following SMS components that will require continuing inspection as outlined in the document:

- *Street Sweeping*
- *Water Quality Structures*
- *Sub-Surface Infiltration Systems (ReTain-It Concrete Chambers)*

- *Snow Storage (as outlined on plan)*

1.8 STRUCTURAL PRETREATMENT BMPS

Regular maintenance of these BMPs is especially critical because they typically receive the highest concentration of suspended solids during the first flush of a storm event.

Water Quality Structure:

Regular maintenance is essential. Inspect or clean water quality structure at least twice per year (e.g. spring & fall) and snow-removal seasons. Sediments must also be removed whenever the depths of deposits is greater than or equal to one half the depth from the bottom of the invert of the lowest pipe in the basin. Please refer to the Stormceptor STC Operation and Maintenance Guide attached hereafter.

Vacuum trucks are preferable, because they remove more trapped sediment and supernatant than clamshells. Vacuuming is also a speedier process and is less likely to snap the cast iron hood within the deep sump catch basin.

Always consider the safety of the staff cleaning the structure. Cleaning structures within a road with active traffic or even within a parking lot is dangerous, and a police detail may be necessary to safeguard workers.

Although debris often contains concentrations of oil and hazardous materials, such as petroleum hydrocarbons and metals, MassDEP classifies them as solid waste. Unless there is evidence that they have been contaminated by a spill or other means, MassDEP does not routinely require catch basin cleanings to be tested before disposal. Contaminated catch basin cleanings must be evaluated in accordance with the Hazardous Waste Regulations, 310 CMR 30.000, and handled as hazardous waste.

In the absence of evidence of contamination, catch basin cleanings may be taken to a landfill or other facility permitted by MassDEP to accept solid waste, without any prior approval by MassDEP. However, some landfills require catch basin cleanings to be tested before they are accepted.

With prior MassDEP approval, catch basin cleanings may be used as grading and shaping materials at landfills undergoing closure (see Revised Guidelines for Determining Closure Activities at Inactive Unlined Landfill Sites) or as daily cover at active landfills. MassDEP also encourages the beneficial reuse of catch basin cleanings whenever possible. A Beneficial Reuse Determination is required for such use.

MassDEP regulations prohibit landfills from accepting materials that contain free-draining liquids. One way to remove liquids is to use a hydraulic lift truck during cleaning operations so that the material can be decanted at the site. After loading material from several catch basins into a truck, elevate the truck so that any free-draining liquid can flow back into the structure. If there is no free water in the truck, the material may be deemed to be sufficiently dry. Otherwise catch basin cleanings must undergo a Paint Filter Liquids Test. Go to www.Mass.gov/dep/recycle/laws/cafacts.doc for information on all of the MassDEP requirements pertaining to the disposal of catch basin cleanings.

1.9 INFILTRATION BMPS

Subsurface Structures:

Subsurface structures are underground systems that capture runoff, and gradually infiltrate it into the groundwater through rock and gravel.

Because subsurface structures are installed underground, they are extremely difficult to maintain. Inspect inlets at least twice a year. Remove any debris that might clog the system. Include mosquito controls in the Operation and Maintenance Plan.

Inspect outlet from subsurface structures to adjacent resource area for signs of scour and sediment accumulation at least twice annually. Remove sediment accumulation and add rip rap as necessary to prevent scour.

1.10 OTHER BMPS AND ACCESSORIES:

Outlet Control Structures:

Outlets of BMPs are devices that control the flow of stormwater out of the BMP to the conveyance system.

Inspect outlet structures twice per year. Remove any accumulated sediment and debris that could prevent flow at the outlet structure.

Culverts:

Inspect culverts 2 times per year (preferably in Spring and Fall) to ensure that the culverts are working in their intended fashion and that they are free of debris. Remove any obstructions to flow; remove accumulated sediments and debris at the inlet, at the outlet, and within the conduit and repair any erosion damage at the culvert's inlet and outlet.

Rip Rap and Level Spreaders:

Inspect twice per year for erosion, debris accumulation, and unwanted vegetation. Erosion areas shall be stabilized and sediment, debris, and woody vegetation will be removed.

Vegetated Areas:

Inspect slopes and embankments early in the growing season to identify active or potential erosion problems. Replant bare areas or areas with sparse growth. Where rill erosion is evident, armor the area with an appropriate lining or divert the erosive flows to on-site areas able to withstand the concentrated flows.

Roadway and Parking Surfaces:

Clear accumulations of winter sand in parking lots and along roadways at least once a year, preferably in the spring. Accumulations on pavement may be removed by pavement sweeping. Accumulations of sand along road shoulders may be removed by grading excess sand to the pavement edge and removing it manually or by a front-end loader.

Mosquito Control Plan:

MA Stormwater Handbook; Volume 2, Chapter 5 (Attached)

Both above ground and underground stormwater BMPs have the potential to serve as mosquito breeding areas. Good design, proper operation and maintenance, and treatment with larvicides can minimize this potential.

1.11 SUPPLEMENTAL INFORMATION

PROPOSED OPERATIONS AND MAINTENANCE LOG FORM

Based on site specific stormwater management system asset list. At a minimum, fields should be provided for:

- Date of inspection
- Name of inspector
- Condition of each BMP, including components such as:
  - Pretreatment devices
  - Vegetation
  - Other safety devices
  - Control structures
  - Embankments, slopes, and safety benches
  - Inlet and outlet channels and structures
  - Underground drainage
  - Sediment and debris accumulation in storage and forebay areas (including catch basins)
  - Any nonstructural practices
  - Any other item that could affect the proper function of the stormwater management system
- Description of the need for maintenance
- Description of maintenance performed

APPENDIX A
SUPPLEMENT INFORMATION

SNOW DISPOSAL GUIDANCE

Commonwealth of Massachusetts
Executive Office of Energy & Environmental Affairs

Department of Environmental Protection

One Winter Street Boston, MA 02108 • 617-292-5500

Charles D. Baker
Governor

Karyn E. Polito
Lieutenant Governor

Kathleen A. Theoharides
Secretary

Martin Suuberg
Commissioner

Massachusetts Department of Environmental Protection
Bureau of Water Resources
Snow Disposal Guidance

Effective Date: December 23, 2019

Applicability: Applies to all federal, state, regional and local agencies, as well as to private businesses.

Supersedes: Bureau of Resource Protection (BRP) Snow Disposal Guideline No. BRPG97-1 issued December 12, 1997 and BRPG01-01 issued March 8, 2001; Bureau of Water Resources (BWR) snow disposal guidance issued December 21, 2015 and December 12, 2018.

Approved by: Kathleen Baskin, Assistant Commissioner, Bureau of Water Resources

PURPOSE: To provide guidelines to all government agencies and private businesses regarding snow disposal site selection, site preparation and maintenance, and emergency snow disposal options that are protective of wetlands, drinking water, and water bodies, and are acceptable to the Massachusetts Department of Environmental Protection (MassDEP), Bureau of Water Resources.

APPLICABILITY: These Guidelines are issued by MassDEP's Bureau of Water Resources on behalf of all Bureau Programs (including Drinking Water Supply, Wetlands and Waterways, Wastewater Management, and Watershed Planning and Permitting). They apply to all federal agencies, state agencies, state authorities, municipal agencies and private businesses disposing of snow in the Commonwealth of Massachusetts.

INTRODUCTION

Finding a place to dispose of collected snow poses a challenge to municipalities and businesses as they clear roads, parking lots, bridges, and sidewalks. While MassDEP is aware of the threats to public safety caused by snow, collected snow that is contaminated with road salt, sand, litter, and automotive pollutants such as oil also threatens public health and the environment.

As snow melts, road salt, sand, litter, and other pollutants are transported into surface water or through the soil where they may eventually reach the groundwater. Road salt and other pollutants can contaminate water supplies and are toxic to aquatic life at certain levels. Sand washed into waterbodies can create sand bars or fill in wetlands and ponds, impacting aquatic life, causing flooding, and affecting our use of these resources.

There are several steps that communities can take to minimize the impacts of snow disposal on public health and the environment. These steps will help communities avoid the costs of a contaminated water supply, degraded waterbodies, and flooding. Everything that occurs on the land has the potential to impact the Commonwealth's water resources. Given the authority of local government over the use of the land, municipal officials and staff have a critically important role to play in protecting our water resources.

The purpose of these guidelines is to help federal agencies, state agencies, state authorities, municipalities and businesses select, prepare, and maintain appropriate snow disposal sites before the snow begins to accumulate through the winter. Following these guidelines and obtaining the necessary approvals may also help municipalities in cases when seeking reimbursement for snow disposal costs from the Federal Emergency Management Agency is possible.

RECOMMENDED GUIDELINES

These snow disposal guidelines address: (1) site selection; (2) site preparation and maintenance; and (3) emergency snow disposal.

1. SITE SELECTION

The key to selecting effective snow disposal sites is to locate them adjacent to or on pervious surfaces in upland areas or upland locations on impervious surfaces away from water resources and drinking water wells. At these locations, the snow meltwater can filter into the soil, leaving behind sand and debris which can be removed in the spring. The following conditions should be followed:

- Within water supply Zone A and Zone II, avoid storage or disposal of snow and ice containing deicing chemicals that has been collected from streets located outside these zones. Municipalities may have a water supply protection land use control that prohibits the disposal of snow and ice containing deicing chemicals from outside the Zone A and Zone II, subject to the Massachusetts Drinking Water Regulations at 310 CMR 22.20C and 310 CMR 22.21(2).
- Avoid storage or disposal of snow or ice in Interim Wellhead Protection Areas (IWPA) of public water supply wells, and within 75 feet of a private well, where road salt may contaminate water supplies.
- Avoid dumping snow into any waterbody, including rivers, the ocean, reservoirs, ponds, or wetlands. In addition to water quality impacts and flooding, snow disposed of in open water can cause navigational hazards when it freezes into ice blocks.
- Avoid dumping snow on MassDEP-designated high and medium-yield aquifers where it may contaminate groundwater.
- Avoid dumping snow in sanitary landfills and gravel pits. Snow meltwater will create more contaminated leachate in landfills posing a greater risk to groundwater, and in gravel pits, there is little opportunity for pollutants to be filtered out of the meltwater because groundwater is close to the land surface.

- Avoid disposing of snow on top of storm drain catch basins or in stormwater drainage systems including detention basins, swales or ditches. Snow combined with sand and debris may block a stormwater drainage system, causing localized flooding. A high volume of sand, sediment, and litter released from melting snow also may be quickly transported through the system into surface water.

Recommended Site Selection Procedures

It is important that the municipal Department of Public Works or Highway Department, Conservation Commission, and Board of Health work together to select appropriate snow disposal sites. The following steps should be taken:

- Estimate how much snow disposal capacity may be needed for the season so that an adequate number of disposal sites can be selected and prepared.
- Identify sites that could potentially be used for snow disposal, such as municipal open space (e.g., parking lots or parks).
- Select sites located in upland locations that are not likely to impact sensitive environmental resources first.
- If more storage space is still needed, prioritize the sites with the least environmental impact (using the site selection criteria, and local or MassGIS maps as a guide).

Snow Disposal Mapping Assistance

MassDEP has an online mapping tool to assist in identifying possible locations to potentially dispose of snow. MassDEP encourages municipalities to use this tool to identify possible snow disposal options. The tool identifies wetland resource areas, public drinking water supplies and other sensitive locations where snow should not be disposed. The tool may be accessed through the Internet at the following web address:
https://maps.env.state.ma.us/dep/arcgis/js/templates/PSF/.

2. SITE PREPARATION AND MAINTENANCE

In addition to carefully selecting disposal sites before the winter begins, it is important to prepare and maintain these sites to maximize their effectiveness. The following maintenance measures should be undertaken for all snow disposal sites:

- A silt fence or equivalent barrier should be placed securely on the downgradient side of the snow disposal site.
- Wherever possible maintain a 50-foot vegetated buffer between the disposal site and adjacent waterbodies to filter pollutants from the meltwater.
- Clear debris from the site prior to using the site for snow disposal.
- Clear debris from the site and properly dispose of it at the end of the snow season, and no later than May 15.

3. SNOW DISPOSAL APPROVALS

Proper snow disposal may be undertaken through one of the following approval procedures:

- Routine snow disposal – Minimal, if any, administrative review is required in these cases when upland and pervious snow disposal locations or upland locations on impervious surfaces that have functioning and maintained stormwater management systems have been identified, mapped, and used for snow disposal following ordinary snowfalls. Use of upland and pervious snow disposal sites avoids wetland resource areas and allows snow meltwater to recharge groundwater and will help filter pollutants, sand, and other debris. This process will address the majority of snow removal efforts until an entity exhausts all available upland snow disposal sites. The location and mapping of snow disposal sites will help facilitate each entity's routine snow management efforts.
- Emergency Certifications – If an entity demonstrates that there is no remaining capacity at upland snow disposal locations, local conservation commissions may issue an Emergency Certification under the Massachusetts Wetlands Protection regulations to authorize snow disposal in buffer zones to wetlands, certain open water areas, and certain wetland resource areas (i.e. within flood plains). Emergency Certifications can only be issued at the request of a public agency or by order of a public agency for the protection of the health or safety of citizens, and are limited to those activities necessary to abate the emergency. See 310 CMR 10.06(1)-(4). Use the following guidelines in these emergency situations:
    - Dispose of snow in open water with adequate flow and mixing to prevent ice dams from forming.
    - Do not dispose of snow in salt marshes, vegetated wetlands, certified vernal pools, shellfish beds, mudflats, drinking water reservoirs and their tributaries, Zone IIs or IWPAs of public water supply wells, Outstanding Resource Waters, or Areas of Critical Environmental Concern.
    - Do not dispose of snow where trucks may cause shoreline damage or erosion.
    - Consult with the municipal Conservation Commission to ensure that snow disposal in open water complies with local ordinances and bylaws.

- Severe Weather Emergency Declarations – In the event of a large-scale severe weather event, MassDEP may issue a broader Emergency Declaration under the Wetlands Protection Act which allows federal agencies, state agencies, state authorities, municipalities, and businesses greater flexibility in snow disposal practices. Emergency Declarations typically authorize greater snow disposal options while protecting especially sensitive resources such as public drinking water supplies, vernal pools, land containing shellfish, FEMA designated floodways, coastal dunes, and salt marsh. In the event of severe winter storm emergencies, the snow disposal site maps created by municipalities will enable MassDEP and the Massachusetts Emergency Management Agency (MEMA) in helping communities identify appropriate snow disposal locations.

  If upland disposal sites have been exhausted, the Emergency Declaration issued by MassDEP allows for snow disposal near water bodies. In these situations, a buffer of at least 50 feet, preferably vegetated, should still be maintained between the site and the waterbody. Furthermore, it is essential that the other guidelines for preparing and maintaining snow disposal sites be followed to minimize the threat to adjacent waterbodies.

Under extraordinary conditions, when all land-based snow disposal options are exhausted, the Emergency Declaration issued by MassDEP may allow disposal of snow in certain waterbodies under certain conditions. ***A federal agency, state agency, state authority, municipality or business seeking to dispose of snow in a waterbody should take the following steps***:

- Call the emergency contact phone number [(888) 304-1133)] and notify the MEMA of the municipality's intent.
- MEMA will ask for some information about where the requested disposal will take place.
- MEMA will confirm that the disposal is consistent with MassDEP's Severe Weather Emergency Declaration and these guidelines and is therefore approved.

During declared statewide snow emergency events, MassDEP's website will also highlight the emergency contact phone number [(888) 304-1133)] for authorizations and inquiries. For further non-emergency information about this Guidance you may contact your MassDEP Regional Office Service Center:

Northeast Regional Office, Wilmington, 978-694-3246
Southeast Regional Office, Lakeville, 508-946-2714
Central Regional Office, Worcester, 508-792-7650
Western Regional Office, Springfield, 413-755-2114

MOSQUITO CONTROL

Chapter 5
Miscellaneous Stormwater Topics

Mosquito Control in Stormwater Management Practices

Both aboveground and underground stormwater BMPs have the potential to serve as mosquito breeding areas. Good design, proper operation and maintenance and treatment with larvicides can minimize this potential.

EPA recommends that stormwater treatment practices dewater within 3 days (72 hours) to reduce the number of mosquitoes that mature to adults, since the aquatic stage of many mosquito species is 7 to 10 days. Massachusetts has had a 72-hour dewatering rule in its Stormwater Management Standards since 1996. The 2008 technical specifications for BMPs set forth in Volume 2, Chapter 2 of the Massachusetts Stormwater Handbook also concur with this practice by requiring that all stormwater practices designed to drain do so within 72 hours.

Some stormwater practices are designed to include permanent wet pools. These practices – if maintained properly – can limit mosquito breeding by providing habitat for mosquito predators. Additional measures that can be taken to reduce mosquito populations include increasing water circulation, attracting mosquito predators by adding suitable habitat, and applying larvicides.

The Massachusetts State Reclamation and Mosquito Control Board (SRMCB), through the Massachusetts Mosquito Control Districts, can undertake further mosquito control actions specifically for the purpose of mosquito control pursuant to Massachusetts General Law Chapter 252. The Mosquito Control Board, http://www.mass.gov/agr/mosquito/, describes mosquito control methods and is in the process of developing guidance documents that describe Best Management Practices for mosquito control projects.

The SRMCB and Mosquito Control Districts are not responsible for operating and maintaining stormwater BMPs to reduce mosquito populations. The owners of property that construct the stormwater BMPs or municipalities that "accept" them through local subdivision approval are responsible for their maintenance.[1] The SRMCB is composed of officials from MassDEP, Department of Agricultural Resources, and Department of Conservation and Recreation. The nine (9) Mosquito Control Districts overseen by the SRMCB are located throughout Massachusetts, covering 176 municipalities.

Construction Period Best Management Practices for Mosquito Control

To minimize mosquito breeding during construction, it is essential that the following actions be taken to minimize the creation of standing pools by taking the following actions:

- ***Minimize Land Disturbance:*** Minimizing land disturbance reduces the likelihood of mosquito breeding by reducing silt in runoff that will cause construction period controls to clog and retain standing pools of water for more than 72 hours.
- ***Catch Basin inlets:*** Inspect and refresh filter fabric, hay bales, filter socks or stone dams on a regular basis to ensure that any stormwater ponded at the inlet drains within 8 hours after precipitation stops. Shorter periods may be necessary to avoid hydroplaning in roads

[1] MassDEP and MassHighway understand that the numerous stormwater BMPs along state highways pose a unique challenge. To address this challenge, the 2004 MassHighway Stormwater Handbook will provide additional information on appropriate operation and maintenance practices for mosquito control when the Handbook is revised to reflect the 2008 changes to the Stormwater Management Standards..

caused by water ponded at the catch basin inlet. Treat catch basin sumps with larvicides such as *Bacillus sphaericus* (*Bs*) using a licensed pesticide applicator.

- ***Check Dams:*** If temporary check dams are used during the construction period to lag peak rate of runoff or pond runoff for exfiltration, inspect and repair the check dams on a regular basis to ensure that any stormwater ponded behind the check dam drains within 72 hours.
- ***Design construction period sediment traps*** to dewater within 72 hours after precipitation. Because these traps are subject to high silt loads and tend to clog, treat them with the larvicide *Bs* after it rains from June through October, until the first frost occurs.
- ***Construction period open conveyances:*** When temporary manmade ditches are used for channelizing construction period runoff, inspect them on a regular basis to remove any accumulated sediment to restore flow capacity to the temporary ditch.
- ***Revegetating Disturbed Surfaces:*** Revegetating disturbed surfaces reduces sediment in runoff that will cause construction period controls to clog and retain standing pools of water for greater than 72 hours.
- ***Sediment fences/hay bale barriers:*** When inspections find standing pools of water beyond the 24-hour period after a storm, take action to restore barrier to its normal function.

<u>Post-Construction Stormwater Treatment Practices</u>

- Mosquito control begins with the environmentally sensitive site design. Environmentally sensitive site design that minimizes impervious surfaces reduces the amount of stormwater runoff. Disconnecting runoff using the LID Site Design credits outlined in the Massachusetts Stormwater Handbook reduces the amount of stormwater that must be conveyed to a treatment practice. Utilizing green roofs minimizes runoff from smaller storms. Storage media must be designed to dewater within 72 hours after precipitation.
- Mosquito control continues with the selection of structural stormwater BMPs that are unlikely to become breeding grounds for mosquitoes, such as:
  - ***Bioretention Areas/Rain Gardens/Sand Filter:*** These practices tend not to result in mosquito breeding. If any level spreaders, weirs or sediment forebays are used as part of the design, inspect them and correct them as necessary to prevent standing pools of water for more than 72 hours.
  - ***Infiltration Trenches:*** This practice tends not to result in mosquito breeding. If any level spreaders, weirs, or sediment forebays are used as part of the design, inspect them and correct them as necessary to prevent standing pools of water for more than 72 hours.
- Another mosquito control strategy is to select BMPs that can become habitats for mosquito predators, such as:
  - ***Constructed Stormwater Wetlands:*** Habitat features can be incorporated in constructed stormwater wetlands to attract dragonflies, amphibians, turtles, birds, bats, and other natural predators of mosquitoes.
  - ***Wet Basins:*** Wet basins can be designed to incorporate fish habitat features, such as deep pools. Introduce fish in consultation with Massachusetts Division of Fisheries and Wildlife. Vegetation within wet basins designed as fish habitat must be properly managed to ensure that vegetation does not overtake the habitat. Proper design to ensure that no low circulation or "dead" zones are created may reduce the potential for mosquito breeding. Introducing bubblers may increase water circulation in the wet basin.

Effective mosquito controls require proponents to design structural BMPs to prevent ponding and facilitate maintenance and, if necessary, the application of larvicides. Examples of such design practices include the following:

- ***Basins:*** Provide perimeter access around wet basins, extended dry detention basins and dry detention basins for both larviciding and routine maintenance. Control vegetation to ensure that access pathways stay open.
- ***BMPs without a permanent pool of water:*** All structural BMPs that do not rely on a permanent pool of water must drain and completely dewater within 72 hours after precipitation. This includes dry detention basins, extended dry detention basins, infiltration basins, and dry water quality swales. Use underdrains at extended dry detention basins to drain the small pools that form due to accumulation of silts. Wallace indicates that extended dry extended detention basins may breed more mosquitoes than wet basins. It is, therefore, imperative to design outlets from extended dry detention basins to completely dewater within the 72-hour period.
- ***Energy Dissipators and Flow Spreaders:*** Currier and Moeller, 2000 indicate that shallow recesses in energy dissipators and flow spreaders trap water where mosquitoes breed. Set the riprap in grout to reduce the shallow recesses and minimize mosquito breeding.
- ***Outlet control structures:*** Debris trapped in small orifices or on trash racks of outlet control structures such as multiple stage outlet risers may clog the orifices or the trash rack, causing a standing pool of water. Optimize the orifice size or trash rack mesh size to provide required peak rate attenuation/water quality detention/retention time while minimizing clogging.
- ***Rain Barrels and Cisterns:*** Seal lids to reduce the likelihood of mosquitoes laying eggs in standing water. Install mosquito netting over inlets. The cistern system should be designed to ensure that all collected water is drained into it within 72 hours.
- ***Subsurface Structures, Deep Sump Catch Basins, Oil Grit Separators, and Leaching Catch Basins:*** Seal all manhole covers to reduce likelihood of mosquitoes laying eggs in standing water. Install mosquito netting over the outlet (CALTRANS 2004).

The Operation and Maintenance Plan should provide for mosquito prevention and control.

- ***Check dams:*** Inspect permanent check dams on the schedule set forth in the O&M Plan. Inspect check dams 72 hours after storms for standing water ponding behind the dam. Take corrective action if standing water is found.
- ***Cisterns:*** Apply *Bs* larvicide in the cistern if any evidence of mosquitoes is found. The Operation and Maintenance Plan shall specify how often larvicides should be applied to waters in the cistern.
- ***Water quality swales:*** Remove and properly dispose of any accumulated sediment as scheduled in the Operation and Maintenance Plan.
- ***Larvicide Treatment:*** The Operation and Maintenance Plan must include measures to minimize mosquito breeding, including larviciding.
- The party identified in the Operation and Maintenance Plan as responsible for maintenance shall see that larvicides are applied as necessary to the following stormwater treatment practices: catch basins, oil/grit separators, wet basins, wet water quality swales, dry extended detention basins, infiltration basins, and constructed stormwater wetlands. The Operation and Maintenance Plan must ensure that all larvicides are applied by a licensed pesticide applicator and in compliance with all pesticide label requirements.
- The Operation and Maintenance Plan should identify the appropriate larvicide and the time and method of application. For example, *Bacillus sphaericus (Bs*), the preferred

larvicide for stormwater BMPs, should be hand-broadcast.[2] Alternatively, Altosid, a Methopren product, may be used. Because some practices are designed to dewater between storms, such as dry extended detention and infiltration basins, the Operation and Maintenance Plan should provide that larviciding must be conducted during or immediately after wet weather, when the detention or infiltration basin has a standing pool of water, unless a product is used that can withstand extended dry periods.

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[2] *Bacillus thuringienis israelensis* or *Bti* is usually applied by helicopter to wetlands and floodplains

Roads and Stormwater BMPs

In general, the stormwater BMPs used for land development projects can also be used for new roadways and roadway improvement projects. However, for improvement of existing roads, there are often constraints that limit the choice of BMP. These constraints derive from the linear configuration of the road, the limited area within the existing right-of-way, the structural and safety requirements attendant to good roadway design, and the long-term maintainability of the roadway drainage systems. The MassHighway Handbook provides strategies for dealing with the constraints associated with providing stormwater BMPs for roadway redevelopment projects.

Roadway design can minimize impacts caused by stormwater. Reducing roadway width reduces the total and peak volume of runoff. Designing a road with country drainage (no road shoulders or curbs) disconnects roadway runoff. Disconnection of roadway runoff is eligible for the Low Impact Site Design Credit provided the drainage is disconnected in accordance with specifications outlined in Volume 3.

Like other parties, municipalities that work within wetlands jurisdictional areas and adjacent buffer zones must design and implement structural stormwater best management practices in accordance with the Stormwater Management Standards and the Stormwater Management Handbook. In addition, in municipalities and areas where state agencies operate stormwater systems, the DPWs (or other town or state agencies) must meet the “good housekeeping“ requirement of the municipality’s or agency's MS4 permit.

MassHighway has taken stormwater management one step further by working with MassDEP to develop the MassHighway Storm Water Handbook for Highways and Bridges. The purpose of the MassHighway Handbook is to provide guidance for persons involved in the design, permitting, review and implementation of state highway projects, especially those involving existing roadways where physical constraints often limit the stormwater management options available. These constraints, like those common to redevelopment sites, may make it difficult to comply precisely with the requirements of the Stormwater Management Standards and the Massachusetts Stormwater Handbook.[3] In response to these constraints, MassDEP and MHD developed specific design, permitting, review and implementation practices that meet the unique challenges of providing environmental protection for existing state roads. The information in the MassHighway Handbook may also aid in the planning and design of projects to build new highways and to add lanes to existing highways, since they may face similar difficulties in meeting the requirements of the Stormwater Management Standards.

Although it is very useful, the MassHighway Handbook does not allow MassHighway projects to proceed without individual review and approval by the issuing authority when subject to the Wetlands Protection Act Regulations, 310 CMR 10.00, or the 401 Water Quality Certification Regulations, 314 CMR 9.00. For example, MassHighway must provide a Conservation Commission with a project-specific Operation and Maintenance Plan in accordance with Standard 9 that documents how the project’s post-construction BMPs will be operated and maintained.[4]

[3] The 2004 MassHighway Handbook outlines standardized methods for dealing with these constraints as they apply to highway redevelopment projects. MassDEP and MassHighway intend to work together to provide guidance for add a lane projects when the 2004 Handbook is revised to reflect the 2008 changes to the Stormwater Management Standards.

[4] The general permit for municipal separate storm sewer systems (the MS4 Permit) requires MassHighway to develop and implement procedures for the proper operation and maintenance of stormwater BMPs. To

Some municipalities have asked if the MassHighway Handbook governs municipal road projects. The answer is no.[5] The MassHighway Handbook was developed in response to the unique problems and challenges arising out of the management of the state highway system. Like other project proponents, cities and towns planning road or other projects in areas subject to jurisdiction under the Wetlands Protection Act must design and implement LID, non-structural and structural best management practices in accordance with the Stormwater Management Standards and the Massachusetts Stormwater Handbook.

avoid duplication of effort, MassHighway may be able rely on the same procedures to fulfill the operation and maintenance requirements of Standard 9 and the MS 4 Permit.

[5] Although the MassHighway Handbook does not govern municipal road projects, cities and towns may find some of the information presented in the Handbook useful.

OPERATION & MAINTENANCE SUMMARY TABLE

OPERATION AND MAINTENANCE PLAN SCHEDULE **Date:**

ALLEN & MAJOR ASSOCIATES, INC.

Project: Multi-Family Development
Project Address: 1486 Main Street Waltham, MA

Responsible for O&M Plan: WP East Acquisitions, LLC
Address: 91 Hartwell Avenue Lexington, MA 02421
Phone:

All information within table is derived from Massachussetts Stormwater Handbook: Volume 2, Chapter 2

BMP CATEGORY	BMP OR MAINTENANCE ACTIVITY	SCHEDULE/ FREQUENCY	NOTES	ESTIMATED ANNUAL MAINTENANCE COST	INSPECTION PERFORMED	
					DATE:	BY:
STRUCTURAL PRETREATMENT BMPs	PROPRIETARY SEPARATORS	In accordance with manufacturers requirements, but no less than twice a year following installation and once a year thereafter.	Remove sediment and other trapped pollutants at frequency or level specified by manufacturer.	$1,000		
	SUBSURFACE STRUCTURES	Inspect structure inlets at least twice a year. Remove debris that may clog the system as needed.	Because subsurface structures are installed underground, they are extremely difficult to maintain. Remove any debris that might clog the system.	$2,500		
INFILTRATION BMPs	LEVEL SPREADERS	Inspect regularly, especially after large rainfall events.	Inspect level spreaders regularly, especially after large rainfall events. Note and repair any erosion or low spots in the spreader.	$500		
BMP ACCESSORIES	OUTLET STRUCTURES	Periodic cleaning of Outlet Control Structures as needed.	Clear trash and debris as necessary.	$500		
	MISQUITO CONTROL	Inspect BMPs as needed to ensure the system's drainage time is less than the maximum 72 hour period.	Massachusetts stormwater handbook requires all stormwater practices that are designed to drain do so within 72 hours to reduce the number of mosquitos that mature to adults since the aquatic stage of a mosquito is 7-10 days.	$300		
NANCE ACTIVITY	SNOW STORAGE	Clear and remove snow to approved storage locations as necessary to ensure systems are working properly and are protected from meltwater pollutants.	Carefully select snow disposal sites before winter. Avoid dumping removed snow over catch basins, or in detention ponds, sediment forebays, rivers, wetlands, and flood plains. It is also prohibited to dump snow in the bioretention basins or gravel swales.	$500		

OTHER MAINTEI	**STREET SWEEPING**	Clear accumulations of winter sand in parking lots and along roadways at least once a year, preferably in the spring.	Sweep, power broom or vacuum paved areas. Submit information that confirms that all street sweepings have been completed in accordance with state and local requirements	$500		

STORMCEPTOR OPERATION & MAINTENANCE

CDS Guide
Operation, Design, Performance and Maintenance

CDS®

Using patented continuous deflective separation technology, the CDS system screens, separates and traps debris, sediment, and oil and grease from stormwater runoff. The indirect screening capability of the system allows for 100% removal of floatables and neutrally buoyant material without blinding. Flow and screening controls physically separate captured solids, and minimize the re-suspension and release of previously trapped pollutants. Inline units can treat up to 6 cfs, and internally bypass flows in excess of 50 cfs (1416 L/s). Available precast or cast-in-place, offline units can treat flows from 1 to 300 cfs (28.3 to 8495 L/s). The pollutant removal capacity of the CDS system has been proven in lab and field testing.

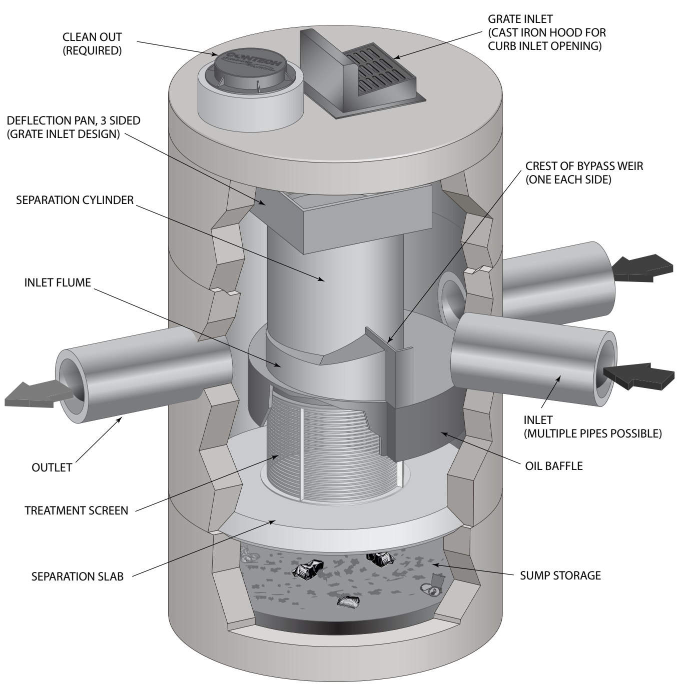
Operation Overview

Stormwater enters the diversion chamber where the diversion weir guides the flow into the unit's separation chamber and pollutants are removed from the flow. All flows up to the system's treatment design capacity enter the separation chamber and are treated.

Swirl concentration and screen deflection force floatables and solids to the center of the separation chamber where 100% of floatables and neutrally buoyant debris larger than the screen apertures are trapped.

Stormwater then moves through the separation screen, under the oil baffle and exits the system. The separation screen remains clog free due to continuous deflection.

During the flow events exceeding the treatment design capacity, the diversion weir bypasses excessive flows around the separation chamber, so captured pollutants are retained in the separation cylinder.



Design Basics

There are three primary methods of sizing a CDS system. The Water Quality Flow Rate Method determines which model size provides the desired removal efficiency at a given flow rate for a defined particle size. The Rational Rainfall Method™ or the and Probabilistic Method is used when a specific removal efficiency of the net annual sediment load is required.

Typically in the Unites States, CDS systems are designed to achieve an 80% annual solids load reduction based on lab generated performance curves for a gradation with an average particle size (d50) of 125 microns (μm). For some regulatory environments, CDS systems can also be designed to achieve an 80% annual solids load reduction based on an average particle size (d50) of 75 microns (μm) or 50 microns (μm).

Water Quality Flow Rate Method

In some cases, regulations require that a specific treatment rate, often referred to as the water quality design flow (WQQ), be treated. This WQQ represents the peak flow rate from either an event with a specific recurrence interval, e.g. the six-month storm, or a water quality depth, e.g. 1/2-inch (13 mm) of rainfall.

The CDS is designed to treat all flows up to the WQQ. At influent rates higher than the WQQ, the diversion weir will direct most flow exceeding the WQQ around the separation chamber. This allows removal efficiency to remain relatively constant in the separation chamber and eliminates the risk of washout during bypass flows regardless of influent flow rates.

Treatment flow rates are defined as the rate at which the CDS will remove a specific gradation of sediment at a specific removal efficiency. Therefore the treatment flow rate is variable, based on the gradation and removal efficiency specified by the design engineer.

Rational Rainfall Method™

Differences in local climate, topography and scale make every site hydraulically unique. It is important to take these factors into consideration when estimating the long-term performance of any stormwater treatment system. The Rational Rainfall Method combines site-specific information with laboratory generated performance data, and local historical precipitation records to estimate removal efficiencies as accurately as possible.

Short duration rain gauge records from across the United States and Canada were analyzed to determine the percent of the total annual rainfall that fell at a range of intensities. US stations' depths were totaled every 15 minutes, or hourly, and recorded in 0.01-inch increments. Depths were recorded hourly with 1-mm resolution at Canadian stations. One trend was consistent at all sites; the vast majority of precipitation fell at low intensities and high intensity storms contributed relatively little to the total annual depth.

These intensities, along with the total drainage area and runoff coefficient for each specific site, are translated into flow rates using the Rational Rainfall Method. Since most sites are relatively small and highly impervious, the Rational Rainfall Method is appropriate. Based on the runoff flow rates calculated for each intensity, operating rates within a proposed CDS system are determined. Performance efficiency curve determined from full scale laboratory tests on defined sediment PSDs is applied to calculate solids removal efficiency. The relative removal efficiency at each operating rate is added to produce a net annual pollutant removal efficiency estimate.

Probabilistic Rational Method

The Probabilistic Rational Method is a sizing program Contech developed to estimate a net annual sediment load reduction for a particular CDS model based on site size, site runoff coefficient, regional rainfall intensity distribution, and anticipated pollutant characteristics.

The Probabilistic Method is an extension of the Rational Method used to estimate peak discharge rates generated by storm events of varying statistical return frequencies (e.g. 2-year storm event). Under the Rational Method, an adjustment factor is used to adjust the runoff coefficient estimated for the 10-year event, correlating a known hydrologic parameter with the target storm event. The rainfall intensities vary depending on the return frequency of the storm event under consideration. In general, these two frequency dependent parameters (rainfall intensity and runoff coefficient) increase as the return frequency increases while the drainage area remains constant.

These intensities, along with the total drainage area and runoff coefficient for each specific site, are translated into flow rates using the Rational Method. Since most sites are relatively small and highly impervious, the Rational Method is appropriate. Based on the runoff flow rates calculated for each intensity, operating rates within a proposed CDS are determined. Performance efficiency curve on defined sediment PSDs is applied to calculate solids removal efficiency. The relative removal efficiency at each operating rate is added to produce a net annual pollutant removal efficiency estimate.

Treatment Flow Rate

The inlet throat area is sized to ensure that the WQQ passes through the separation chamber at a water surface elevation equal to the crest of the diversion weir. The diversion weir bypasses excessive flows around the separation chamber, thus preventing re-suspension or re-entrainment of previously captured particles.

Hydraulic Capacity

The hydraulic capacity of a CDS system is determined by the length and height of the diversion weir and by the maximum allowable head in the system. Typical configurations allow hydraulic capacities of up to ten times the treatment flow rate. The crest of the diversion weir may be lowered and the inlet throat may be widened to increase the capacity of the system at a given water surface elevation. The unit is designed to meet project specific hydraulic requirements.

Performance

Full-Scale Laboratory Test Results

A full-scale CDS system (Model CDS2020-5B) was tested at the facility of University of Florida, Gainesville, FL. This CDS unit was evaluated under controlled laboratory conditions of influent flow rate and addition of sediment.

Two different gradations of silica sand material (UF Sediment & OK-110) were used in the CDS performance evaluation. The particle size distributions (PSDs) of the test materials were analyzed using standard method "Gradation ASTM D-422 "Standard Test Method for Particle-Size Analysis of Soils" by a certified laboratory.

UF Sediment is a mixture of three different products produced by the U.S. Silica Company: "Sil-Co-Sil 106", "#1 DRY" and "20/40 Oil Frac". Particle size distribution analysis shows that the UF Sediment has a very fine gradation (d50 = 20 to 30 μm) covering a wide size range (Coefficient of Uniformity, C averaged at 10.6). In comparison with the hypothetical TSS gradation specified in the NJDEP (New Jersey Department of Environmental Protection) and NJCAT (New Jersey Corporation for Advanced Technology) protocol for lab testing, the UF Sediment covers a similar range of particle size but with a finer d50 (d50 for NJDEP is approximately 50 μm) (NJDEP, 2003).

The OK-110 silica sand is a commercial product of U.S. Silica Sand. The particle size distribution analysis of this material, also included in Figure 1, shows that 99.9% of the OK-110 sand is finer than 250 microns, with a mean particle size (d50) of 106 microns. The PSDs for the test material are shown in Figure 1.

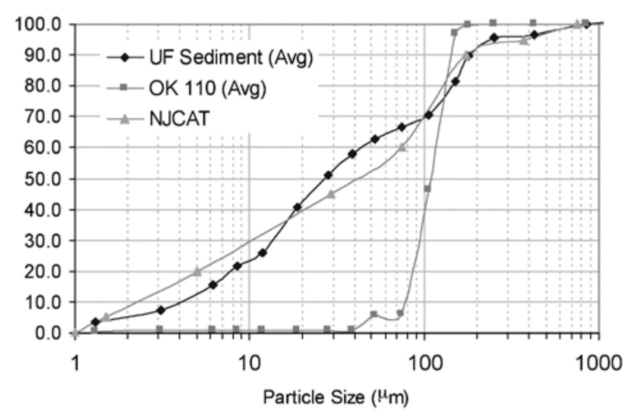


Figure 1. Particle size distributions

Tests were conducted to quantify the performance of a specific CDS unit (1.1 cfs (31.3-L/s) design capacity) at various flow rates, ranging from 1% up to 125% of the treatment design capacity of the unit, using the 2400 micron screen. All tests were conducted with controlled influent concentrations of approximately 200 mg/L. Effluent samples were taken at equal time intervals across the entire duration of each test run. These samples were then processed with a Dekaport Cone sample splitter to obtain representative sub-samples for Suspended Sediment Concentration (SSC) testing using ASTM D3977-97 "Standard Test Methods for Determining Sediment Concentration in Water Samples", and particle size distribution analysis.

Results and Modeling

Based on the data from the University of Florida, a performance model was developed for the CDS system. A regression analysis was used to develop a fitting curve representative of the scattered data points at various design flow rates. This model, which demonstrated good agreement with the laboratory data, can then be used to predict CDS system performance with respect to SSC removal for any particle size gradation, assuming the particles are inorganic sandy-silt. Figure 2 shows CDS predictive performance for two typical particle size gradations (NJCAT gradation and OK-110 sand) as a function of operating rate.

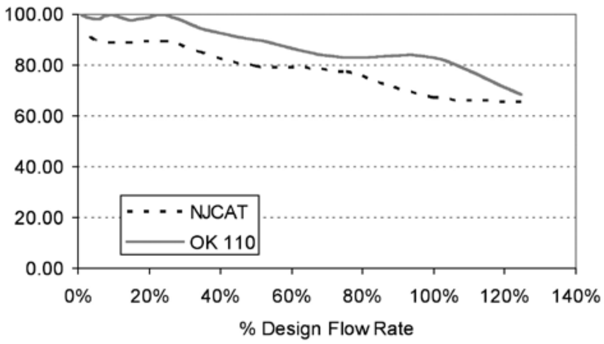


Figure 2. CDS stormwater treatment predictive performance for various particle gradations as a function of operating rate.

Many regulatory jurisdictions set a performance standard for hydrodynamic devices by stating that the devices shall be capable of achieving an 80% removal efficiency for particles having a mean particle size (d50) of 125 microns (e.g. Washington State Department of Ecology — WASDOE - 2008). The model can be used to calculate the expected performance of such a PSD (shown in Figure 3). The model indicates (Figure 4) that the CDS system with 2400 micron screen achieves approximately 80% removal at the design (100%) flow rate, for this particle size distribution (d50 = 125 μm).

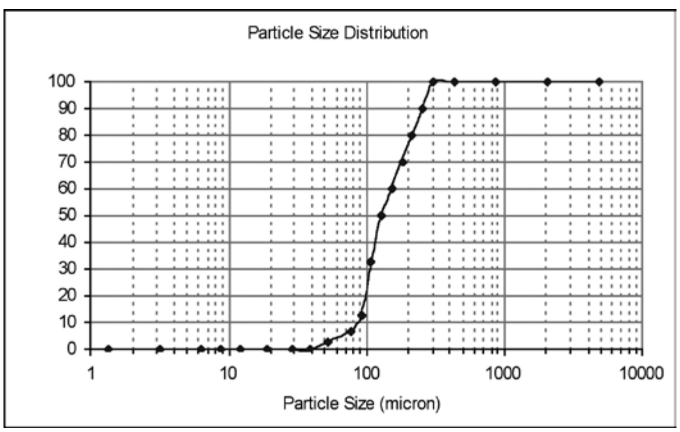


Figure 3. WASDOE PSD

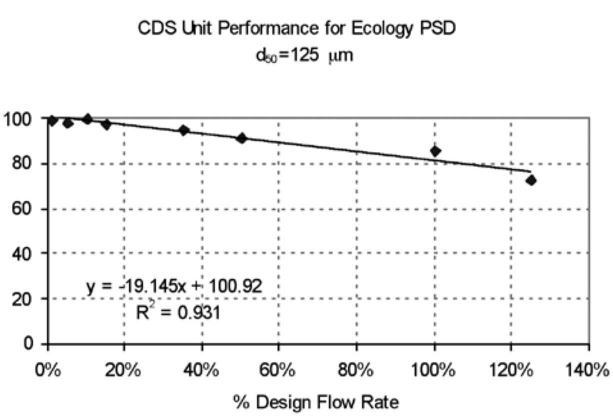


Figure 4. Modeled performance for WASDOE PSD.

Maintenance

The CDS system should be inspected at regular intervals and maintained when necessary to ensure optimum performance. The rate at which the system collects pollutants will depend more heavily on site activities than the size of the unit. For example, unstable soils or heavy winter sanding will cause the grit chamber to fill more quickly but regular sweeping of paved surfaces will slow accumulation.

Inspection

Inspection is the key to effective maintenance and is easily performed. Pollutant transport and deposition may vary from year to year and regular inspections will help ensure that the system is cleaned out at the appropriate time. At a minimum, inspections should be performed twice per year (e.g. spring and fall) however more frequent inspections may be necessary in climates where winter sanding operations may lead to rapid accumulations, or in equipment washdown areas. Installations should also be inspected more frequently where excessive amounts of trash are expected.

The visual inspection should ascertain that the system components are in working order and that there are no blockages or obstructions in the inlet and separation screen. The inspection should also quantify the accumulation of hydrocarbons, trash, and sediment in the system. Measuring pollutant accumulation can be done with a calibrated dipstick, tape measure or other measuring instrument. If absorbent material is used for enhanced removal of hydrocarbons, the level of discoloration of the sorbent material should also be identified

during inspection. It is useful and often required as part of an operating permit to keep a record of each inspection. A simple form for doing so is provided.

Access to the CDS unit is typically achieved through two manhole access covers. One opening allows for inspection and cleanout of the separation chamber (cylinder and screen) and isolated sump. The other allows for inspection and cleanout of sediment captured and retained outside the screen. For deep units, a single manhole access point would allows both sump cleanout and access outside the screen.

The CDS system should be cleaned when the level of sediment has reached 75% of capacity in the isolated sump or when an appreciable level of hydrocarbons and trash has accumulated. If absorbent material is used, it should be replaced when significant discoloration has occurred. Performance will not be impacted until 100% of the sump capacity is exceeded however it is recommended that the system be cleaned prior to that for easier removal of sediment. The level of sediment is easily determined by measuring from finished grade down to the top of the sediment pile. To avoid underestimating the level of sediment in the chamber, the measuring device must be lowered to the top of the sediment pile carefully. Particles at the top of the pile typically offer less resistance to the end of the rod than consolidated particles toward the bottom of the pile. Once this measurement is recorded, it should be compared to the as-built drawing for the unit to determine weather the height of the sediment pile off the bottom of the sump floor exceeds 75% of the total height of isolated sump.

Cleaning

Cleaning of a CDS systems should be done during dry weather conditions when no flow is entering the system. The use of a vacuum truck is generally the most effective and convenient method of removing pollutants from the system. Simply remove the manhole covers and insert the vacuum hose into the sump. The system should be completely drained down and the sump fully evacuated of sediment. The area outside the screen should also be cleaned out if pollutant build-up exists in this area.

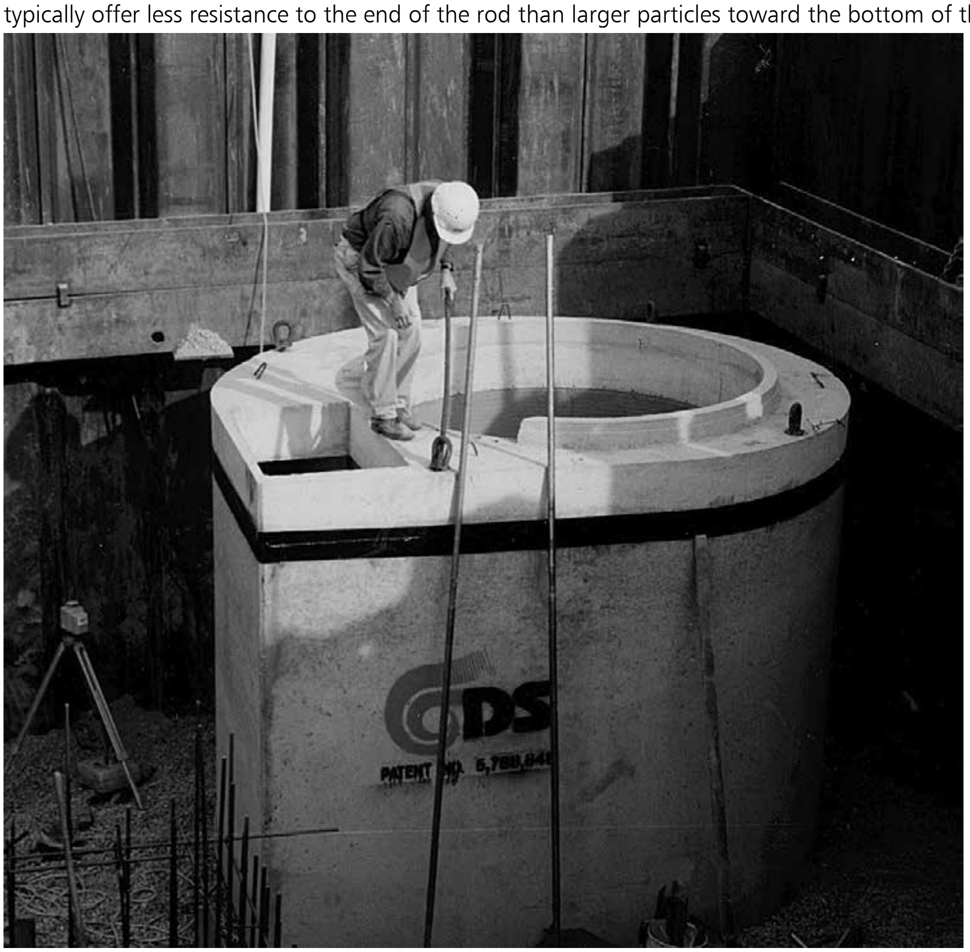
In installations where the risk of petroleum spills is small, liquid contaminants may not accumulate as quickly as sediment. However, the system should be cleaned out immediately in the event of an oil or gasoline spill. Motor oil and other hydrocarbons that accumulate on a more routine basis should be removed when an appreciable layer has been captured. To remove these pollutants, it may be preferable to use absorbent pads since they are usually less expensive to dispose than the oil/water emulsion that may be created by vacuuming the oily layer. Trash and debris can be netted out to separate it from the other pollutants. The screen should be cleaned to ensure it is free of trash and debris.

Manhole covers should be securely seated following cleaning activities to prevent leakage of runoff into the system from above and also to ensure that proper safety precautions have been followed. Confined space entry procedures need to be followed if physical access is required. Disposal of all material removed from the CDS system should be done in accordance with local regulations. In many jurisdictions, disposal of the sediments may be handled in the same manner as the disposal of sediments removed from catch basins or deep sump manholes. Check your local regulations for specific requirements on disposal.

CDS Model	Diameter		Distance from Water Surface to Top of Sediment Pile		Sediment Storage Capacity	
	ft	m	ft	m	y³	m³
CDS1515	3	0.9	3.0	0.9	0.5	0.4
CDS2015	4	1.2	3.0	0.9	0.9	0.7
CDS2015	5	1.5	3.0	0.9	1.3	1.0
CDS2020	5	1.5	3.5	1.1	1.3	1.0
CDS2025	5	1.5	4.0	1.2	1.3	1.0
CDS3020	6	1.8	4.0	1.2	2.1	1.6
CDS3025	6	1.8	4.0	1.2	2.1	1.6
CDS3030	6	1.8	4.6	1.4	2.1	1.6
CDS3035	6	1.8	5.0	1.5	2.1	1.6
CDS4030	8	2.4	4.6	1.4	5.6	4.3
CDS4040	8	2.4	5.7	1.7	5.6	4.3
CDS4045	8	2.4	6.2	1.9	5.6	4.3
CDS5640	10	3.0	6.3	1.9	8.7	6.7
CDS5653	10	3.0	7.7	2.3	8.7	6.7
CDS5668	10	3.0	9.3	2.8	8.7	6.7
CDS5678	10	3.0	10.3	3.1	8.7	6.7

Table 1: CDS Maintenance Indicators and Sediment Storage Capacities

Note: To avoid underestimating the volume of sediment in the chamber, carefully lower the measuring device to the top of the sediment pile. Finer silty particles at the top of the pile may be more difficult to feel with a measuring stick. These finer particles typically offer less resistance to the end of the rod than larger particles toward the bottom of the pile.



CDS Inspection & Maintenance Log

CDS Model: ______________________ Location: ______________________

Date	Water depth to sediment[1]	Floatable Layer Thickness[2]	Describe Maintenance Performed	Maintenance Personnel	Comments

1. The water depth to sediment is determined by taking two measurements with a stadia rod: one measurement from the manhole opening to the top of the sediment pile and the other from the manhole opening to the water surface. If the difference between these measurements is less than the values listed in table 1 the system should be cleaned out. **Note: to avoid underestimating the volume of sediment in the chamber, the measuring device must be carefully lowered to the top of the sediment pile**.

2. For optimum performance, the system should be cleaned out when the floating hydrocarbon layer accumulates to an appreciable thickness. In the event of an oil spill, the system should be cleaned immediately.

SUPPORT

- Drawings and specifications are available at www.ContechES.com.
- Site-specific design support is available from our engineers.

CONTECH® ENGINEERED SOLUTIONS

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The product(s) described may be protected by one or more of the following US patents: 5,322,629; 5,624,576; 5,707,527; 5,759,415; 5,788,848; 5,985,157; 6,027,639; 6,350,374; 6,406,218; 6,641,720; 6,511,595; 6,649,048; 6,991,114; 6,998,038; 7,186,058; 7,296,692; 7,297,266; related foreign patents or other patents pending.

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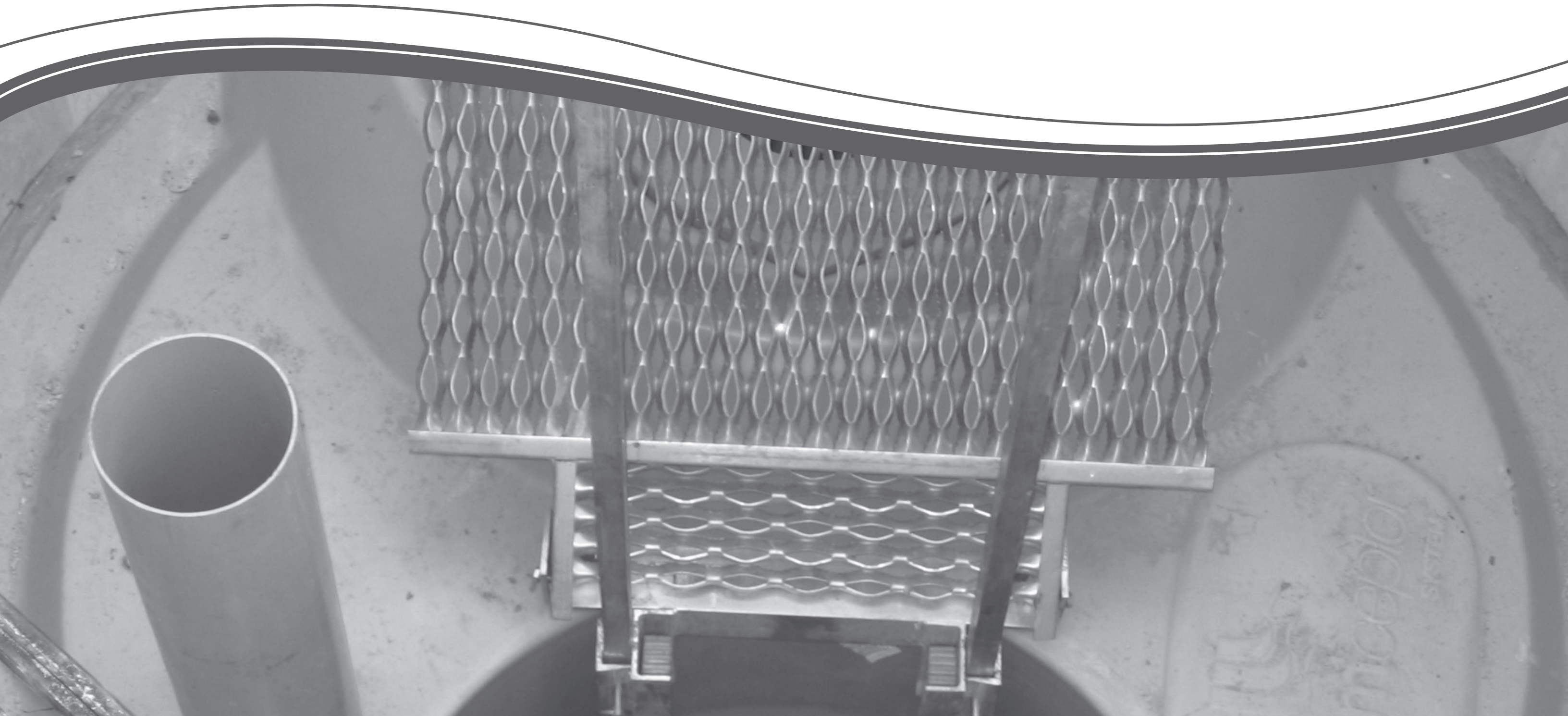
CONTECH®
ENGINEERED SOLUTIONS

Stormceptor® STC
Operation and Maintenance Guide



Stormceptor® STC

Stormceptor Design Notes

- Only the STC 450i is adaptable to function with a catch basin inlet and/or inline pipes.
- Only the Stormceptor models STC 450i to STC 7200 may accommodate multiple inlet pipes.

Inlet and outlet invert elevation differences are as follows:

Inlet and Outlet Pipe Invert Elevations Differences			
Inlet Pipe Configuration	STC 450i	STC 900 to STC 7200	STC 11000 to STC 16000
Single inlet pipe	3 in. (75 mm)	1 in. (25 mm)	3 in. (75 mm)
Multiple inlet pipes	3 in. (75 mm)	3 in. (75 mm)	Only one inlet pipe.

Maximum inlet and outlet pipe diameters:

Inlet/Outlet Configuration	Inlet Unit STC 450i	In-Line Unit STC 900 to STC 7200	Series* STC 11000 to STC 16000
Straight Through	24 inch (600 mm)	42 inch (1050 mm)	60 inch (1500 mm)
Bend (90 degrees)	18 inch (450 mm)	33 inch (825 mm)	33 inch (825 mm)

- The inlet and in-line Stormceptor units can accommodate turns to a maximum of 90 degrees.
- Minimum distance from top of grade to crown is 2 feet (0.6 m)
- Submerged conditions. A unit is submerged when the standing water elevation at the proposed location of the Stormceptor unit is greater than the outlet invert elevation during zero flow conditions. In these cases, please contact your local Stormceptor representative and provide the following information:
- Top of grade elevation
- Stormceptor inlet and outlet pipe diameters and invert elevations
- Standing water elevation
- Stormceptor head loss, K = 1.3 (for submerged condition, K = 4)

Stormceptor® STC

OPERATION AND MAINTENANCE GUIDE
Table of Content

1. About Stormceptor

The Stormceptor® STC (Standard Treatment Cell) was developed by Imbrium™ Systems to address the growing need to remove and isolate pollution from the storm drain system before it enters the environment. The Stormceptor STC targets hydrocarbons and total suspended solids (TSS) in stormwater runoff. It improves water quality by removing contaminants through the gravitational settling of fine sediments and floatation of hydrocarbons while preventing the re-suspension or scour of previously captured pollutants.

The development of the Stormceptor STC revolutionized stormwater treatment, and created an entirely new category of environmental technology. Protecting thousands of waterways around the world, the Stormceptor System has set the standard for effective stormwater treatment.

1.1. Patent Information

The Stormceptor technology is protected by the following patents:

- Australia Patent No. 693,164 • 693,164 • 707,133 • 729,096 • 779401
- Austrian Patent No. 289647
- Canadian Patent No 2,009,208 •2,137,942 • 2,175,277 • 2,180,305 • 2,180,383 • 2,206,338 • 2,327,768 (Pending)
- China Patent No 1168439
- Denmark DK 711879
- German DE 69534021
- Indonesian Patent No 16688
- Japan Patent No 9-11476 (Pending)
- Korea 10-2000-0026101 (Pending)
- Malaysia Patent No PI9701737 (Pending)
- New Zealand Patent No 314646
- United States Patent No 4,985,148 • 5,498,331 • 5,725,760 • 5,753,115 • 5,849,181 • 6,068,765 • 6,371,690
- Stormceptor OSR Patent Pending • Stormceptor LCS Patent Pending

2. Stormceptor Design Overview

2.1. Design Philosophy

The patented Stormceptor System has been designed to focus on the environmental objective of providing long-term pollution control. The unique and innovative Stormceptor design allows for continuous positive treatment of runoff during all rainfall events, while ensuring that all captured pollutants are retained within the system, even during intense storm events.

An integral part of the Stormceptor design is PCSWMM for Stormceptor - sizing software developed in conjunction with Computational Hydraulics Inc. (CHI) and internationally acclaimed expert, Dr. Bill James. Using local historical rainfall data and continuous simulation modeling, this software allows a Stormceptor unit to be designed for each individual site and the corresponding water quality objectives.

By using PCSWMM for Stormceptor, the Stormceptor System can be designed to remove a wide range of particles (typically from 20 to 2,000 microns), and can also be customized to remove a specific particle size distribution (PSD). The specified PSD should accurately reflect what is in the stormwater runoff to ensure the device is achieving the desired water quality objective. Since stormwater runoff contains small particles (less than 75 microns), it is important to design a treatment system to remove smaller particles in addition to coarse particles.

2.2. Benefits

The Stormceptor System removes free oil and suspended solids from stormwater, preventing spills and non-point source pollution from entering downstream lakes and rivers. The key benefits, capabilities and applications of the Stormceptor System are as follows:

- Provides continuous positive treatment during all rainfall events
- Can be designed to remove over 80% of the annual sediment load
- Removes a wide range of particles
- Can be designed to remove a specific particle size distribution (PSD)
- Captures free oil from stormwater
- Prevents scouring or re-suspension of trapped pollutants
- Pre-treatment to reduce maintenance costs for downstream treatment measures (ponds, swales, detention basins, filters)
- Groundwater recharge protection
- Spills capture and mitigation
- Simple to design and specify
- Designed to your local watershed conditions
- Small footprint to allow for easy retrofit installations
- Easy to maintain (vacuum truck)
- Multiple inlets can connect to a single unit
- Suitable as a bend structure
- Pre-engineered for traffic loading (minimum AASHTO HS-20)
- Minimal elevation drop between inlet and outlet pipes
- Small head loss
- Additional protection provided by an 18” (457 mm) fiberglass skirt below the top of the insert, for the containment of hydrocarbons in the event of a spill.

2.3. Environmental Benefit

Freshwater resources are vital to the health and welfare of their surrounding communities. There is increasing public awareness, government regulations and corporate commitment to reducing the pollution entering our waterways. A major source of this pollution originates from stormwater runoff from urban areas. Rainfall runoff carries oils, sediment and other contaminants from roads and parking lots discharging directly into our streams, lakes and coastal waterways.

The Stormceptor System is designed to isolate contaminants from getting into the natural environment. The Stormceptor technology provides protection for the environment from spills that occur at service stations and vehicle accident sites, while also removing contaminated sediment in runoff that washes from roads and parking lots.

3. Key Operation Features

3.1. Scour Prevention

A key feature of the Stormceptor System is its patented scour prevention technology. This innovation ensures pollutants are captured and retained during all rainfall events, even extreme storms. The Stormceptor System provides continuous positive treatment for all rainfall events, including intense storms. Stormceptor slows incoming runoff, controlling and reducing velocities in the lower chamber to create a non-turbulent environment that promotes free oils and floatable debris to rise and sediment to settle.

The patented scour prevention technology, the fiberglass insert, regulates flows into the lower chamber through a combination of a weir and orifice while diverting high energy flows away through the upper chamber to prevent scouring. Laboratory testing demonstrated no scouring when tested up to 125% of the unit's operating rate, with the unit loaded to 100% sediment capacity (NJDEP, 2005). Second, the depth of the lower chamber ensures the sediment storage zone is adequately separated from the path of flow in the lower chamber to prevent scouring.

3.2. Operational Hydraulic Loading Rate

Designers and regulators need to evaluate the treatment capacity and performance of manufactured stormwater treatment systems. A commonly used parameter is the "operational hydraulic loading rate" which originated as a design methodology for wastewater treatment devices.

Operational hydraulic loading rate may be calculated by dividing the flow rate into a device by its settling area. This represents the critical settling velocity that is the prime determinant to quantify the influent particle size and density captured by the device. PCSWMM for Stormceptor uses a similar parameter that is calculated by dividing the hydraulic detention time in the device by the fall distance of the sediment.

$$v_{SC} = \frac{H}{6_H} = \frac{Q}{A_S}$$

Where:

v_{SC} = critical settling velocity, ft/s (m/s)

H = tank depth, ft (m)

$Ø_H$ = hydraulic detention time, ft/s (m/s)

Q = volumetric flow rate, ft3/s (m3/s)

A_S = surface area, ft^2 (m^2)

(Tchobanoglous, G. and Schroeder, E.D. 1987. Water Quality. Addison Wesley.)

Unlike designing typical wastewater devices, stormwater systems are designed for highly variable flow rates including intense peak flows. PCSWMM for Stormceptor incorporates all of the flows into its calculations, ensuring that the operational hydraulic loading rate is considered not only for one flow rate, but for all flows including extreme events.

3.3. Double Wall Containment

The Stormceptor System was conceived as a pollution identifier to assist with identifying illicit discharges. The fiberglass insert has a continuous skirt that lines the concrete barrel wall for a depth of 18 inches (457 mm) that provides double wall containment for hydrocarbons storage. This protective barrier ensures that toxic floatables do not migrate through the concrete wall into the surrounding soils.

4. Stormceptor Product Line

4.1. Stormceptor Models

A summary of Stormceptor models and capacities are listed in Table 1.

Table 1. Stormceptor Models

Stormceptor Model	Total Storage Volume U.S. Gal (L)	Hydrocarbon Storage Capacity U.S. Gal (L)	Maximum Sediment Capacity ft^3 (L)
STC 450i	470 (1,780)	86 (330)	46 (1,302)
STC 900	952 (3,600)	251 (950)	89 (2,520)
STC 1200	1,234 (4,670)	251 (950)	127 (3,596)
STC 1800	1,833 (6,940)	251 (950)	207 (5,861)
STC 2400	2,462 (9,320)	840 (3,180)	205 (5,805)
STC 3600	3,715 (1,406)	840 (3,180)	373 (10,562)
STC 4800	5,059 (1,950)	909 (3,440)	543 (15,376)
STC 6000	6,136 (23,230)	909 (3,440)	687 (19,453)
STC 7200	7,420 (28,090)	1,059 (4,010)	839 (23,757)
STC 11000	11,194 (42,370)	2,797 (10, 590)	1,086 (30,752)
STC 13000	13,348 (50,530)	2,797 (10, 590)	1,374 (38,907)
STC 16000	15,918 (60,260)	3,055 (11, 560)	1,677 (47,487)

NOTE: Storage volumes may vary slightly from region to region. For detailed information, contact your local Stormceptor representative.

4.2. Inline Stormceptor

The Inline Stormceptor, Figure 1, is the standard design for most stormwater treatment applications. The patented Stormceptor design allows the Inline unit to maintain continuous positive treatment of total suspended solids (TSS) year-round, regardless of flow rate. The Inline Stormceptor is composed of a precast concrete tank with a fiberglass insert situated at the invert of the storm sewer pipe, creating an upper chamber above the insert and a lower chamber below the insert.

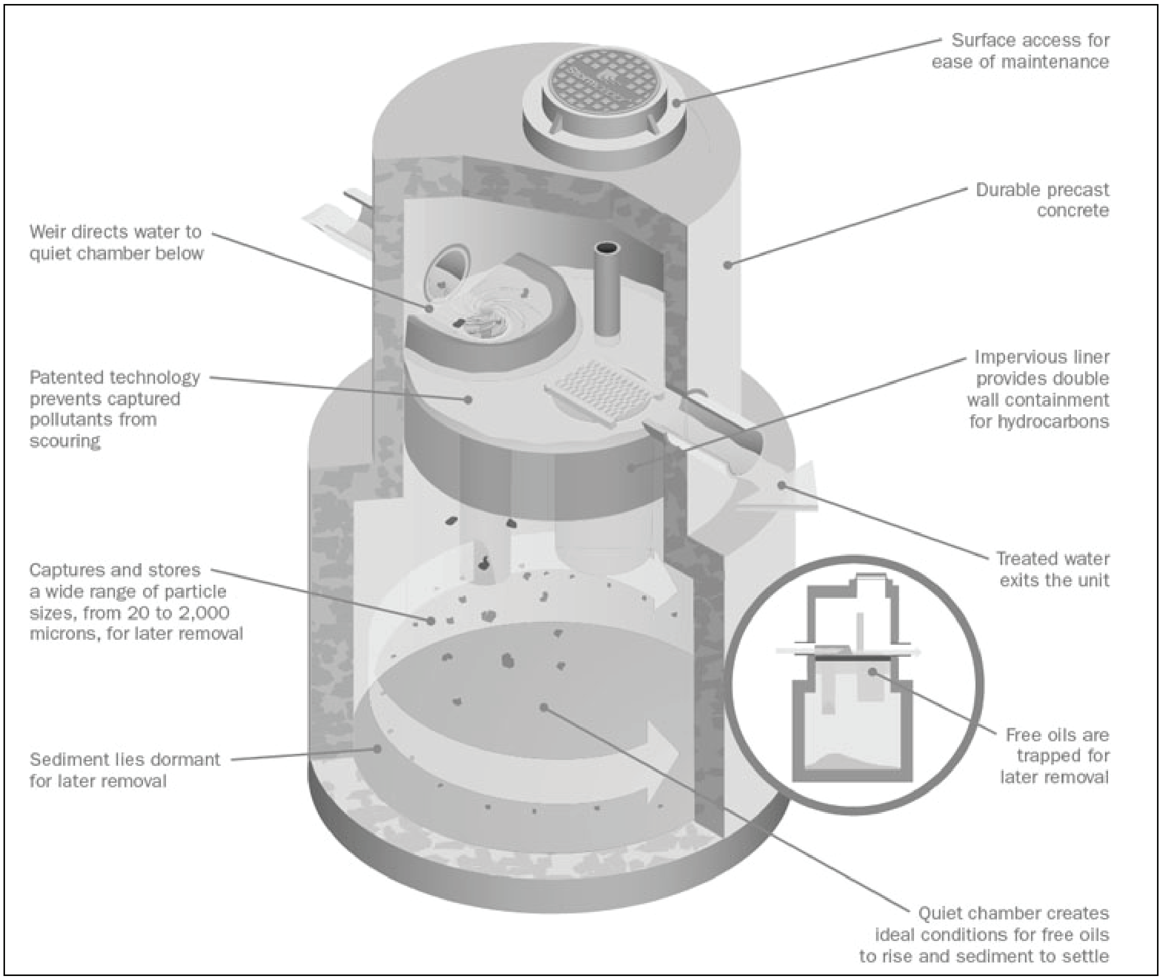


Figure 1. Inline Stormceptor

Operation

As water flows into the Stormceptor unit, it is slowed and directed to the lower chamber by a weir and drop tee. The stormwater enters the lower chamber, a non-turbulent environment, allowing free oils to rise and sediment to settle. The oil is captured underneath the fiberglass insert and shielded from exposure to the concrete walls by a fiberglass skirt. After the pollutants separate, treated water continues up a riser pipe, and exits the lower chamber on the downstream side of the weir before leaving the unit. During high flow events, the Stormceptor System's patented scour prevention technology ensures continuous pollutant removal and prevents re-suspension of previously captured pollutants.

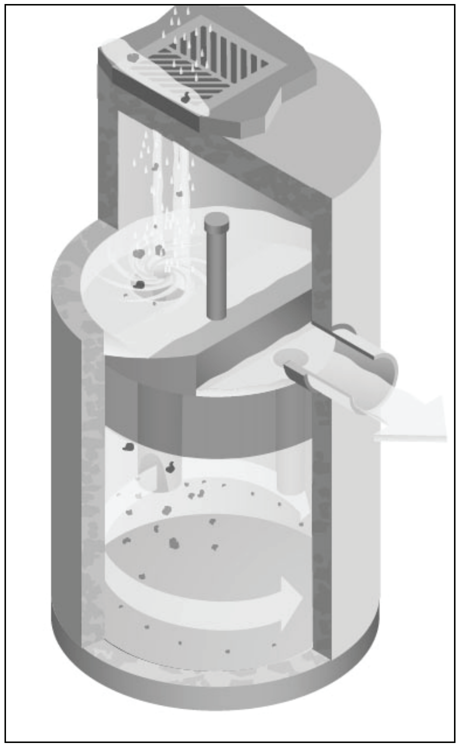


Figure 2. Inlet Stormceptor

4.3. Inlet Stormceptor

The Inlet Stormceptor System, Figure 2, was designed to provide protection for parking lots, loading bays, gas stations and other spill-prone areas. The Inlet Stormceptor is designed to remove sediment from stormwater introduced through a grated inlet, a storm sewer pipe, or both.

The Inlet Stormceptor design operates in the same manner as the Inline unit, providing continuous positive treatment, and ensuring that captured material is not re-suspended.

4.4. Series Stormceptor

Designed to treat larger drainage areas, the Series Stormceptor System, Figure 3, consists of two adjacent Stormceptor models that function in parallel. This design eliminates the need for additional structures and piping to reduce installation costs.

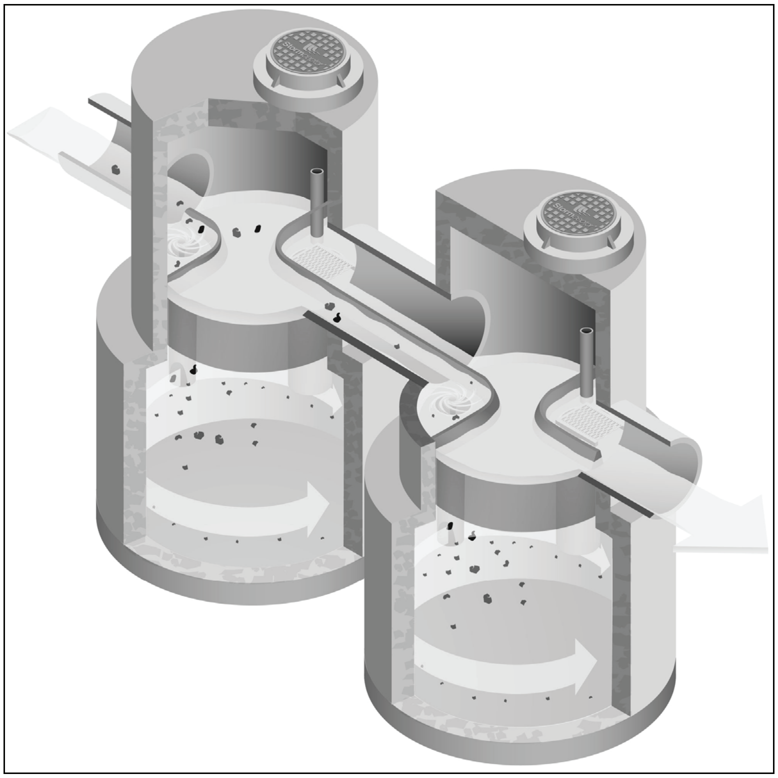


Figure 3. Series System

The Series Stormceptor design operates in the same manner as the Inline unit, providing continuous positive treatment, and ensuring that captured material is not re-suspended.

5. Sizing the Stormceptor System

The Stormceptor System is a versatile product that can be used for many different aspects of water quality improvement. While addressing these needs, there are conditions that the designer needs to be aware of in order to size the Stormceptor model to meet the demands of each individual site in an efficient and cost-effective manner.

PCSWMM for Stormceptor is the support tool used for identifying the appropriate Stormceptor model. In order to size a unit, it is recommended the user follow the seven design steps in the program. The steps are as follows:

STEP 1 – Project Details

The first step prior to sizing the Stormceptor System is to clearly identify the water quality objective for the development. It is recommended that a level of annual sediment (TSS) removal be identified and defined by a particle size distribution.

STEP 2 – Site Details

Identify the site development by the drainage area and the level of imperviousness. It is recommended that imperviousness be calculated based on the actual area of imperviousness based on paved surfaces, sidewalks and rooftops.

STEP 3 – Upstream Attenuation

The Stormceptor System is designed as a water quality device and is sometimes used in conjunction with onsite water quantity control devices such as ponds or underground detention systems. When possible, a greater benefit is typically achieved when installing a Stormceptor unit upstream of a detention facility. By placing the Stormceptor unit upstream of a detention structure, a benefit of less maintenance of the detention facility is realized.

STEP 4 – Particle Size Distribution

It is critical that the PSD be defined as part of the water quality objective. PSD is critical for the design of treatment system for a unit process of gravity settling and governs the size of a treatment system. A range of particle sizes has been provided and it is recommended that clays and silt-sized particles be considered in addition to sand and gravel-sized particles. Options and sample PSDs are provided in PCSWMM for Stormceptor. The default particle size distribution is the Fine Distribution, Table 2, option.

Table 2. Fine Distribution

Particle Size	Distribution	Specific Gravity
20	20%	1.3
60	20%	1.8
150	20%	2.2
400	20%	2.65
2000	20%	2.65

If the objective is the long-term removal of 80% of the total suspended solids on a given site, the PSD should be representative of the expected sediment on the site. For example, a system designed to remove 80% of coarse particles (greater than 75 microns) would provide relatively poor removal efficiency of finer particles that may be naturally prevalent in runoff from the site.

Since the small particle fraction contributes a disproportionately large amount of the total available particle surface area for pollutant adsorption, a system designed primarily for coarse particle capture will compromise water quality objectives.

STEP 5 – Rainfall Records

Local historical rainfall has been acquired from the U.S. National Oceanic and Atmospheric Administration, Environment Canada and regulatory agencies across North America. The rainfall data provided with PCSMM for Stormceptor provides an accurate estimation of small storm hydrology by modeling actual historical storm events including duration, intensities and peaks.

STEP 6 – Summary

At this point, the program may be executed to predict the level of TSS removal from the site. Once the simulation has completed, a table shall be generated identifying the TSS removal of each Stormceptor unit.

STEP 7 – Sizing Summary

Performance estimates of all Stormceptor units for the given site parameters will be displayed in a tabular format. The unit that meets the water quality objective, identified in Step 1, will be highlighted.

5.1. PCSWMM for Stormceptor

The Stormceptor System has been developed in conjunction with PCSWMM for Stormceptor as a technological solution to achieve water quality goals. Together, these two innovations model, simulate, predict and calculate the water quality objectives desired by a design engineer for TSS removal.

PCSWMM for Stormceptor is a proprietary sizing program which uses site specific inputs to a computer model to simulate sediment accumulation, hydrology and long-term total suspended solids removal. The model has been calibrated to field monitoring results from Stormceptor units that have been monitored in North America. The sizing methodology can be described by three processes:

1. Determination of real time hydrology
2. Buildup and wash off of TSS from impervious land areas
3. TSS transport through the Stormceptor (settling and discharge). The use of a calibrated model is the preferred method for sizing stormwater quality structures for the following reasons:
   » The hydrology of the local area is properly and accurately incorporated in the sizing (distribution of flows, flow rate ranges and peaks, back-to-back storms, inter-event times)
   » The distribution of TSS with the hydrology is properly and accurately considered in the sizing
   » Particle size distribution is properly considered in the sizing
   » The sizing can be optimized for TSS removal
   » The cost benefit of alternate TSS removal criteria can be easily assessed
   » The program assesses the performance of all Stormceptor models. Sizing may be selected based on a specific water quality outcome or based on the Maximum Extent Practicable

For more information regarding PCSWMM for Stormceptor, contact your local Stormceptor representative, or visit www.imbriumsystems.com to download a free copy of the program.

5.2. Sediment Loading Characteristics

The way in which sediment is transferred to stormwater can have a considerable effect on which type of system is implemented. On typical impervious surfaces (e.g. parking lots) sediment will build over time and wash off with the next rainfall. When rainfall patterns are examined, a short intense storm will have a higher concentration of sediment than a long slow drizzle. Together with rainfall data representing the site's typical rainfall patterns, sediment loading characteristics play a part in the correct sizing of a stormwater quality device.

Typical Sites

For standard site design of the Stormceptor System, PCSWMM for Stormceptor is utilized to accurately assess the unit's performance. As an integral part of the product's design, the program can be used to meet local requirements for total suspended solid removal. Typical installations of manufactured stormwater treatment devices would occur on areas such as paved parking lots or paved roads. These are considered "stable" surfaces which have non – erodible surfaces.

Unstable Sites

While standard sites consist of stable concrete or asphalt surfaces, sites such as gravel parking lots, or maintenance yards with stockpiles of sediment would be classified as "unstable". These types of sites do not exhibit first flush characteristics, are highly erodible and exhibit atypical sediment loading characteristics and must therefore be sized more carefully. Contact your local Stormceptor representative for assistance in selecting a proper unit sized for such unstable sites.

6. Spill Controls

When considering the removal of total petroleum hydrocarbons (TPH) from a storm sewer system there are two functions of the system: oil removal, and spill capture.

'Oil Removal' describes the capture of the minute volumes of free oil mobilized from impervious surfaces. In this instance relatively low concentrations, volumes and flow rates are considered. While the Stormceptor unit will still provide an appreciable oil removal function during higher flow events and/or with higher TPH concentrations, desired effluent limits may be exceeded under these conditions.

‘Spill Capture’ describes a manner of TPH removal more appropriate to recovery of a relatively high volume of a single phase deleterious liquid that is introduced to the storm sewer system over a relatively short duration. The two design criteria involved when considering this manner of introduction are overall volume and the specific gravity of the material. A standard Stormceptor unit will be able to capture and retain a maximum spill volume and a minimum specific gravity.

For spill characteristics that fall outside these limits, unit modifications are required. Contact your local Stormceptor Representative for more information.

One of the key features of the Stormceptor technology is its ability to capture and retain spills. While the standard Stormceptor System provides excellent protection for spill control, there are additional options to enhance spill protection if desired.

6.1. Oil Level Alarm

The oil level alarm is an electronic monitoring system designed to trigger a visual and audible alarm when a pre-set level of oil is reached within the lower chamber. As a standard, the oil

level alarm is designed to trigger at approximately 85% of the unit’s available depth level for oil capture. The feature acts as a safeguard against spills caused by exceeding the oil storage capacity of the separator and eliminates the need for manual oil level inspection.

The oil level alarm installed on the Stormceptor insert is illustrated in Figure 4.

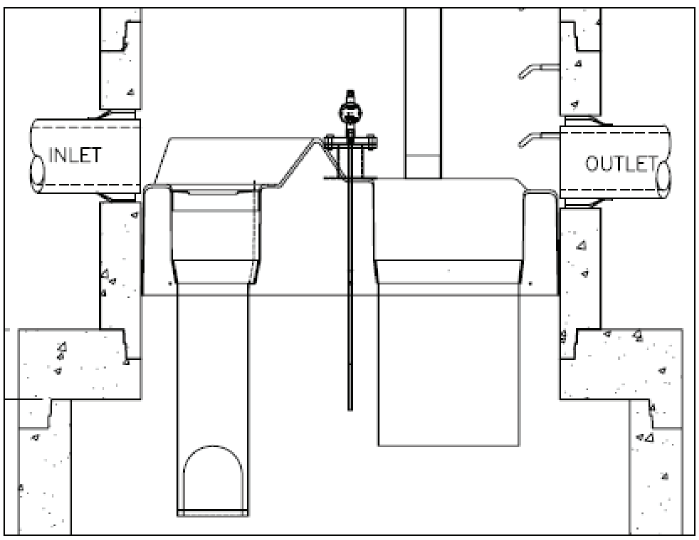


Figure 4. Oil level alarm

6.2. Increased Volume Storage Capacity

The Stormceptor unit may be modified to store a greater spill volume than is typically available. Under such a scenario, instead of installing a larger than required unit, modifications can be made to the recommended Stormceptor model to accommodate larger volumes. Contact your local Stormceptor representative for additional information and assistance for modifications.

7. Stormceptor Options

The Stormceptor System allows flexibility to incorporate to existing and new storm drainage infrastructure. The following section identifies considerations that should be reviewed when installing the system into a drainage network. For conditions that fall outside of the recommendations in this section, please contact your local Stormceptor representative for further guidance.

7.1. Installation Depth Minimum Cover

The minimum distance from the top of grade to the crown of the inlet pipe is 24 inches (600 mm). For situations that have a lower minimum distance, contact your local Stormceptor representative.

7.2. Maximum Inlet and Outlet Pipe Diameters

Maximum inlet and outlet pipe diameters are illustrated in Figure 5. Contact your local Stormceptor representative for larger pipe diameters

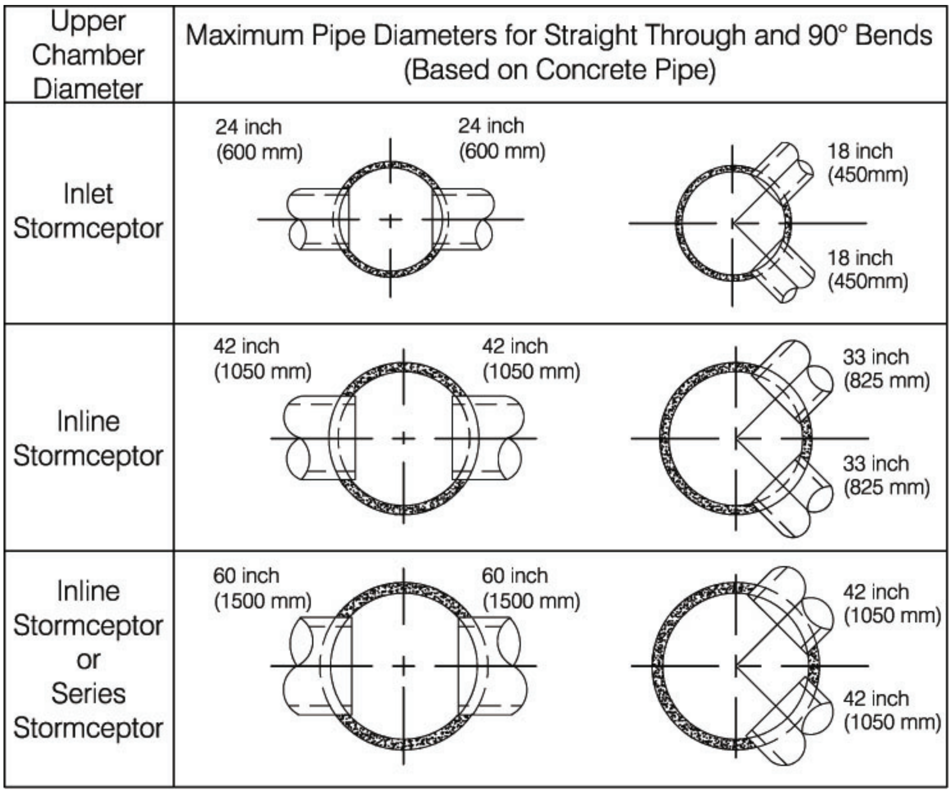


Figure 5. Maximum pipe diameters for straight through and bend applications

*The bend should only be incorporated into the second structure (downstream structure) of the Series Stormceptor System

7.3. Bends

The Stormceptor System can be used to change horizontal alignment in the storm drain network up to a maximum of 90 degrees. Figure 6 illustrates the typical bend situations of the Stormceptor System. Bends should only be applied to the second structure (downstream structure) of the Series Stormceptor System.

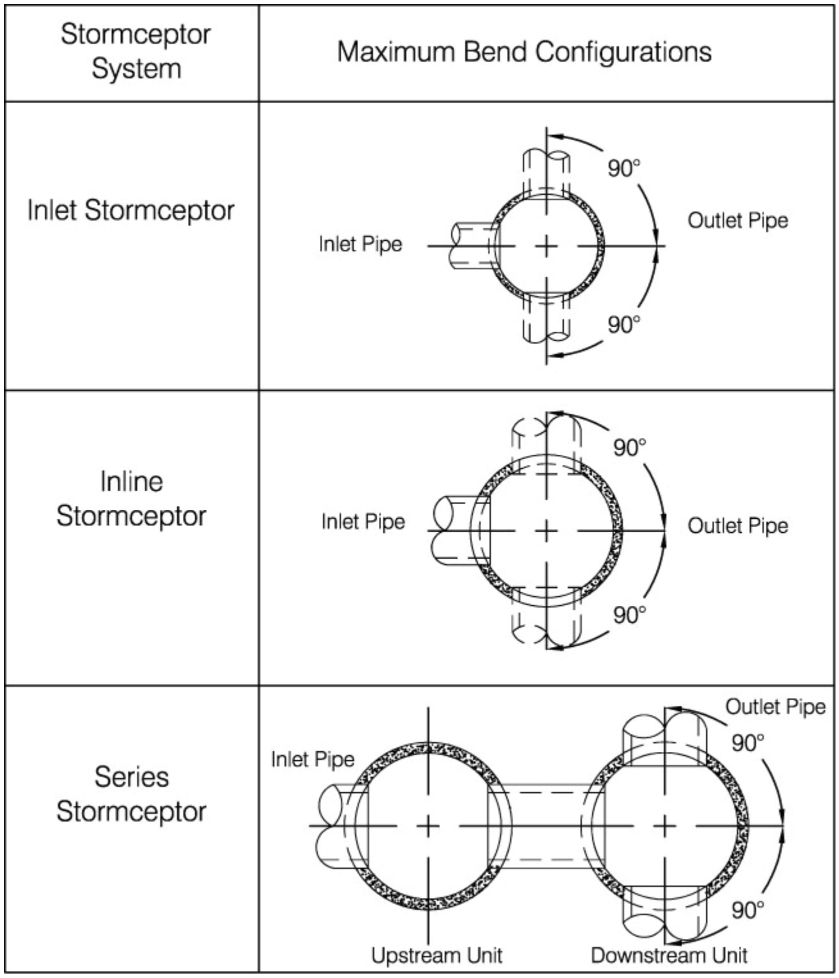


Figure 6. Maximum bend angles

7.4. Multiple Inlet Pipes

The Inlet and Inline Stormceptor System can accommodate two or more inlet pipes. The maximum number of inlet pipes that can be accommodated into a Stormceptor unit is a function of the number, alignment and diameter of the pipes and its effects on the structural integrity of the precast concrete. When multiple inlet pipes are used for new developments, each inlet pipe shall have an invert elevation 3 inches (75 mm) higher than the outlet pipe invert elevation.

7.5. Inlet/Outlet Pipe Invert Elevations

Recommended inlet and outlet pipe invert differences are listed in Table 3.

Table 3. Recommended Drops Between Inlet and Outlet Pipe Inverts

Number of Inlet Pipes	Inlet System	In-Line System	Series System
1	3 inches (75 mm)	1 inch (25 mm)	3 inches (75 mm)
>1	3 inches (75 mm)	3 inches (75 mm)	Not Applicable

7.6. Shallow Stormceptor

In cases where there may be restrictions to the depth of burial of storm sewer systems. In this situation, for selected Stormceptor models, the lower chamber components may be increased in diameter to reduce the overall depth of excavation required.

7.7. Customized Live Load

The Stormceptor system is typically designed for local highway truck loading (AASHTO HS- 20). When the project requires live loads greater than HS-20, the Stormceptor System may be customized structurally for a pre-specified live load. Contact your local Stormceptor representative for customized loading conditions.

7.8. Pre-treatment

The Stormceptor System may be sized to remove sediment and for spills control in conjunction with other stormwater BMPs to meet the water quality objective. For pretreatment applications, the Stormceptor System should be the first unit in a treatment train. The benefits of pre-treatment include the extension of the operational life (extension of maintenance frequency) of large stormwater management facilities, prevention of spills and lower total life- cycle maintenance cost.

7.9. Head loss

The head loss through the Stormceptor System is similar to a 60 degree bend at a manhole. The K value for calculating minor losses is approximately 1.3 (minor loss = k*1.3v2/2g).

However, when a Submerged modification is applied to a Stormceptor unit, the corresponding K value is 4.

7.10. Submerged

The Submerged modification, Figure 7, allows the Stormceptor System to operate in submerged or partially submerged storm sewers. This configuration can be installed on all models of the Stormceptor System by modifying the fiberglass insert. A customized weir height and a secondary drop tee are added.

Submerged instances are defined as standing water in the storm drain system during zero flow conditions. In these instances, the following information is necessary for the proper design and application of submerged modifications:

- Stormceptor top of grade elevation
- Stormceptor outlet pipe invert elevation
- Standing water elevation

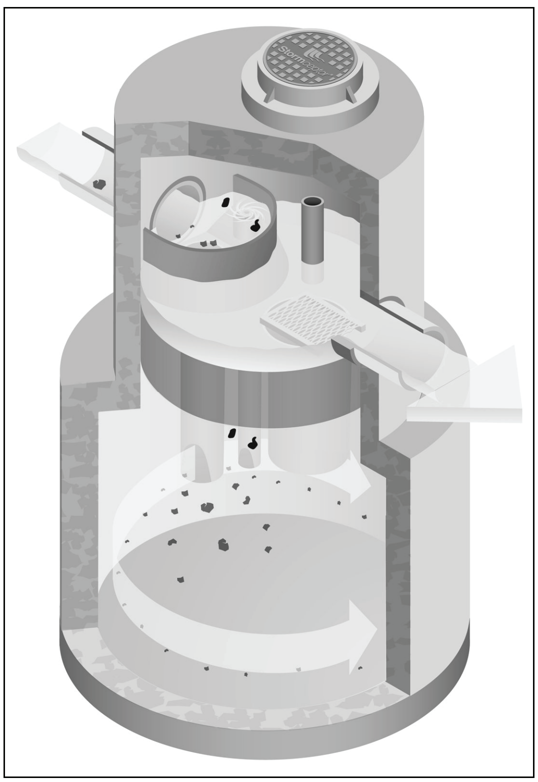


Figure 7. Submerged Stormceptor

8. Comparing Technologies

Designers have many choices available to achieve water quality goals in the treatment of stormwater runoff. Since many alternatives are available for use in stormwater quality treatment it is important to consider how to make an appropriate comparison between “approved alternatives”. The following is a guide to assist with the accurate comparison of differing technologies and performance claims.

8.1. Particle Size Distribution (PSD)

The most sensitive parameter to the design of a stormwater quality device is the selection of the design particle size. While it is recommended that the actual particle size distribution (PSD) for sites be measured prior to sizing, alternative values for particle size should be selected to represent what is likely to occur naturally on the site. A reasonable estimate of a particle size distribution likely to be found on parking lots or other impervious surfaces should consist of a wide range of particles such as 20 microns to 2,000 microns (Ontario MOE, 1994).

There is no absolute right particle size distribution or specific gravity and the user is cautioned to review the site location, characteristics, material handling practices and regulatory requirements when selecting a particle size distribution. When comparing technologies, designs using different PSDs will result in incomparable TSS removal efficiencies. The PSD of the TSS removed needs to be standard between two products to allow for an accurate comparison.

8.2. Scour Prevention

In order to accurately predict the performance of a manufactured treatment device, there must be confidence that it will perform under all conditions. Since rainfall patterns cannot be predicted, stormwater quality devices placed in storm sewer systems must be able to withstand extreme events, and ensure that all pollutants previously captured are retained in the system.

In order to have confidence in a system’s performance under extreme conditions, independent validation of scour prevention is essential when examining different technologies. Lack of independent verification of scour prevention should make a designer wary of accepting any product’s performance claims.

8.3. Hydraulics

Full scale laboratory testing has been used to confirm the hydraulics of the Stormceptor System. Results of lab testing have been used to physically design the Stormceptor System and the sewer pipes entering and leaving the unit. Key benefits of Stormceptor are:

- Low head loss (typical k value of 1.3)
- Minimal inlet/outlet invert elevation drop across the structure
- Use as a bend structure
- Accommodates multiple inlets

The adaptability of the treatment device to the storm sewer design infrastructure can affect the overall performance and cost of the site.

8.4. Hydrology

Stormwater quality treatment technologies need to perform under varying climatic conditions. These can vary from long low intensity rainfall to short duration, high intensity storms. Since a treatment device is expected to perform under all these conditions, it makes sense that any system’s design should accommodate those conditions as well.

Long-term continuous simulation evaluates the performance of a technology under the varying conditions expected in the climate of the subject site. Single, peak event design does not provide this information and is not equivalent to long-term simulation. Designers should request long-term simulation performance to ensure the technology can meet the long-term water quality objective.

9. Testing

The Stormceptor System has been the most widely monitored stormwater treatment technology in the world. Performance verification and monitoring programs are completed to the strictest standards and integrity. Since its introduction in 1990, numerous independent field tests and studies detailing the effectiveness of the Stormceptor System have been completed.

- Coventry University, UK – 97% removal of oil, 83% removal of sand and 73% removal of peat
- National Water Research Institute, Canada, - scaled testing for the development of the Stormceptor System identifying both TSS removal and scour prevention.
- New Jersey TARP Program – full scale testing of an STC 900 demonstrating 75% TSS removal of particles from 1 to 1000 microns. Scour testing completed demonstrated that the system does not scour. The New Jersey Department of Environmental Protection was followed.
- City of Indianapolis – full scale testing of an STC 900 demonstrating over 80% TSS removal of particles from 50 microns to 300 microns at 130% of the unit's operating rate. Scour testing completed demonstrated that the system does not scour.
- Westwood Massachusetts (1997), demonstrated >80% TSS removal
- Como Park (1997), demonstrated 76% TSS removal
- Ontario MOE SWAMP Program – 57% removal of 1 to 25 micron particles
- Laval Quebec – 50% removal of 1 to 25 micron particles

10. Installation

The installation of the concrete Stormceptor should conform in general to state highway, or local specifications for the installation of manholes. Selected sections of a general specification that are applicable are summarized in the following sections.

10.1. Excavation

Excavation for the installation of the Stormceptor should conform to state highway, or local specifications. Topsoil removed during the excavation for the Stormceptor should be stockpiled in designated areas and should not be mixed with subsoil or other materials.

Topsoil stockpiles and the general site preparation for the installation of the Stormceptor should conform to state highway or local specifications.

The Stormceptor should not be installed on frozen ground. Excavation should extend a minimum of 12 inches (300 mm) from the precast concrete surfaces plus an allowance for shoring and bracing where required. If the bottom of the excavation provides an unsuitable foundation additional excavation may be required.

In areas with a high water table, continuous dewatering may be required to ensure that the excavation is stable and free of water.

10.2. Backfilling

Backfill material should conform to state highway or local specifications. Backfill material should be placed in uniform layers not exceeding 12 inches (300mm) in depth and compacted to state highway or local specifications.

11. Stormceptor Construction Sequence

The concrete Stormceptor is installed in sections in the following sequence:

1. Aggregate base
2. Base slab
3. Lower chamber sections
4. Upper chamber section with fiberglass insert
5. Connect inlet and outlet pipes
6. Assembly of fiberglass insert components (drop tee, riser pipe, oil cleanout port and orifice plate
7. Remainder of upper chamber
8. Frame and access cover

The precast base should be placed level at the specified grade. The entire base should be in contact with the underlying compacted granular material. Subsequent sections, complete with joint seals, should be installed in accordance with the precast concrete manufacturer's recommendations.

Adjustment of the Stormceptor can be performed by lifting the upper sections free of the excavated area, re-leveling the base and re-installing the sections. Damaged sections and gaskets should be repaired or replaced as necessary. Once the Stormceptor has been constructed, any lift holes must be plugged with mortar.

12. Maintenance

12.1. Health and Safety

The Stormceptor System has been designed considering safety first. It is recommended that confined space entry protocols be followed if entry to the unit is required. In addition, the fiberglass insert has the following health and safety features:

- Designed to withstand the weight of personnel
- A safety grate is located over the 24 inch (600 mm) riser pipe opening
- Ladder rungs can be provided for entry into the unit, if required

12.2. Maintenance Procedures

Maintenance of the Stormceptor system is performed using vacuum trucks. No entry into the unit is required for maintenance (in most cases). The vacuum service industry is a well- established sector of the service industry that cleans underground tanks, sewers and catch basins. Costs to clean a Stormceptor will vary based on the size of unit and transportation distances.

The need for maintenance can be determined easily by inspecting the unit from the surface. The depth of oil in the unit can be determined by inserting a dipstick in the oil inspection/cleanout port.

Similarly, the depth of sediment can be measured from the surface without entry into the Stormceptor via a dipstick tube equipped with a ball valve. This tube would be inserted through the riser pipe. Maintenance should be performed once the sediment depth exceeds the guideline values provided in the Table 4.

Table 4. Sediment Depths Indicating Required Servicing*

Particle Size	Specific Gravity
Model	Sediment Depth inches (mm)
450i	8 (200)
900	8 (200)
1200	10 (250)
1800	15 (381)
2400	12 (300)
3600	17 (430)
4800	15 (380)
6000	18 (460)
7200	15 (381)
11000	17 (380)
13000	20 (500)
16000	17 (380)
* based on 15% of the Stormceptor unit's total storage	

Although annual servicing is recommended, the frequency of maintenance may need to be increased or reduced based on local conditions (i.e. if the unit is filling up with sediment more quickly than projected, maintenance may be required semi-annually; conversely once the site has stabilized maintenance may only be required every two or three years).

Oil is removed through the oil inspection/cleanout port and sediment is removed through the riser pipe. Alternatively oil could be removed from the 24 inches (600 mm) opening if water is removed from the lower chamber to lower the oil level below the drop pipes.

The following procedures should be taken when cleaning out Stormceptor:

1. Check for oil through the oil cleanout port
2. Remove any oil separately using a small portable pump
3. Decant the water from the unit to the sanitary sewer, if permitted by the local regulating authority, or into a separate containment tank
4. Remove the sludge from the bottom of the unit using the vacuum truck
5. Re-fill Stormceptor with water where required by the local jurisdiction

12.3. Submerged Stormceptor

Careful attention should be paid to maintenance of the Submerged Stormceptor System. In cases where the storm drain system is submerged, there is a requirement to plug both the inlet and outlet pipes to economically clean out the unit.

12.4. Hydrocarbon Spills

The Stormceptor is often installed in areas where the potential for spills is great. The Stormceptor System should be cleaned immediately after a spill occurs by a licensed liquid waste hauler.

12.5. Disposal

Requirements for the disposal of material from the Stormceptor System are similar to that of any other stormwater Best Management Practice (BMP) where permitted. Disposal options for the sediment may range from disposal in a sanitary trunk sewer upstream of a sewage treatment plant, to disposal in a sanitary landfill site. Petroleum waste products collected in the Stormceptor (free oil/chemical/fuel spills) should be removed by a licensed waste management company.

12.6. Oil Sheens

With a steady influx of water with high concentrations of oil, a sheen may be noticeable at the Stormceptor outlet. This may occur because a rainbow or sheen can be seen at very small oil concentrations (<10 mg/L). Stormceptor will remove over 98% of all free oil spills from storm sewer systems for dry weather or frequently occurring runoff events.

The appearance of a sheen at the outlet with high influent oil concentrations does not mean the unit is not working to this level of removal. In addition, if the influent oil is emulsified the Stormceptor will not be able to remove it. The Stormceptor is designed for free oil removal and not emulsified conditions.

SUPPORT

Drawings and specifications are available at www.ContechES.com.
Site-specific design support is available from our engineers.

CONTECH ENGINEERED SOLUTIONS
800-925-5240
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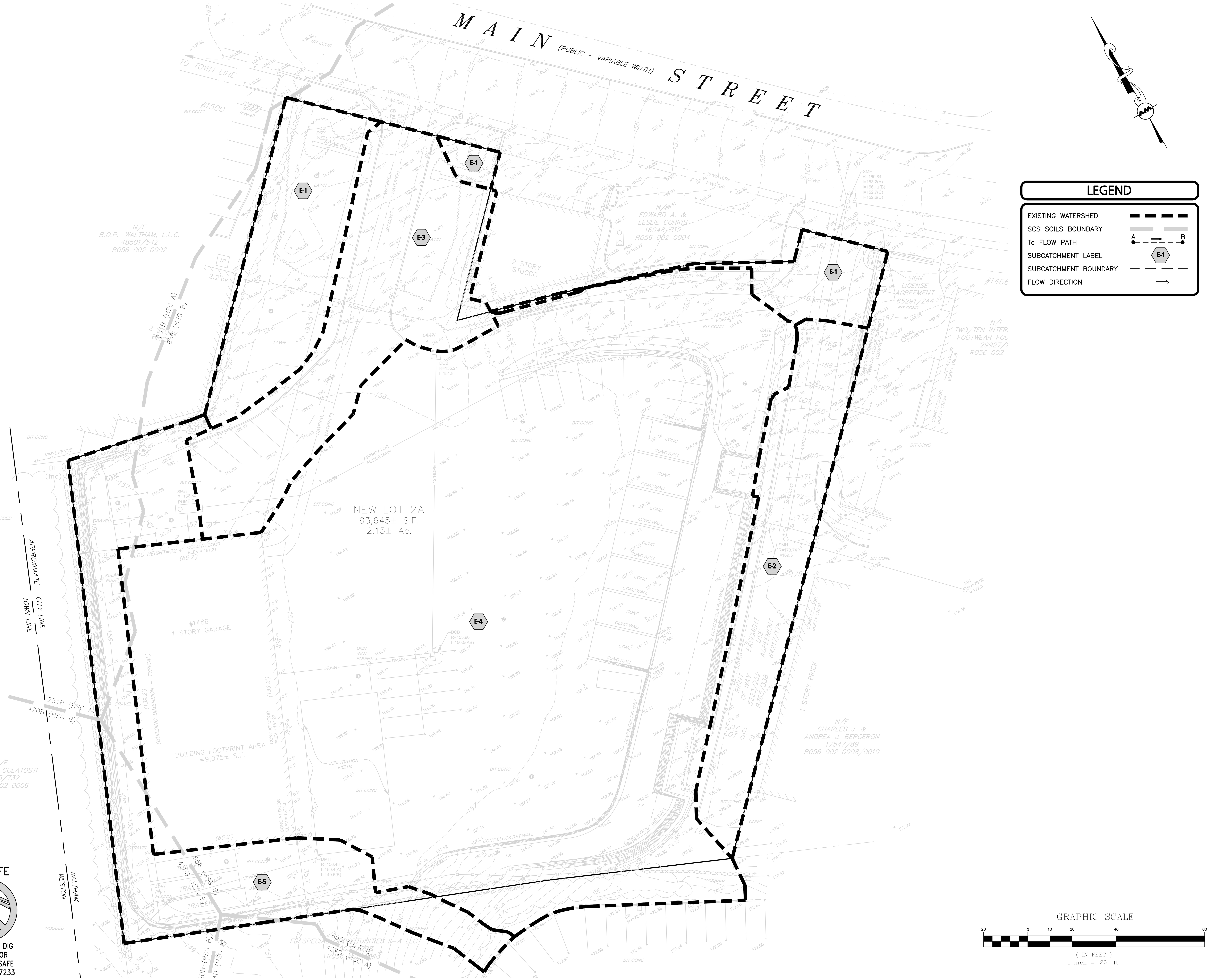
APPENDIX B SITE PLANS

SITE PLAN

APPENDIX H
WATERSHED PLANS

EXISTING WATERSHED PLAN EWS-1



LEGEND

EXISTING WATERSHED	
SCS SOILS BOUNDARY	
Tc FLOW PATH	A — B
SUBCATCHMENT LABEL	E-1
SUBCATCHMENT BOUNDARY	
FLOW DIRECTION	

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JANUARY 20, 2022

COMMONWEALTH OF MASSACHUSETTS
PHILIP L. CORDEIRO
CIVIL
NO. 47083
REGISTERED PROFESSIONAL ENGINEER

Philip L Cordeiro
c=US, o=Allen and Major Associates Inc., ou=A01410C0000017579 8B84FD00002012, cn=Philip L Cordeiro
2022.01.27 10:57:07 -05'00'

PROFESSIONAL ENGINEER FOR ALLEN & MAJOR ASSOCIATES, INC.

REV	DATE	DESCRIPTION

APPLICANT\OWNER:

WP EAST ACQUISITIONS, LLC
91 HARTWELL AVENUE, 3RD FLOOR
LEXINGTON, MA 02421

PROJECT:

1486 MAIN STREET
WALTHAM, MA

PROJECT NO.	1670-14	DATE:	01-20-2022
SCALE:	1" = 20'	DWG. NAME:	C1670-14_
DESIGNED BY:		CHECKED BY:	PLC

PREPARED BY:

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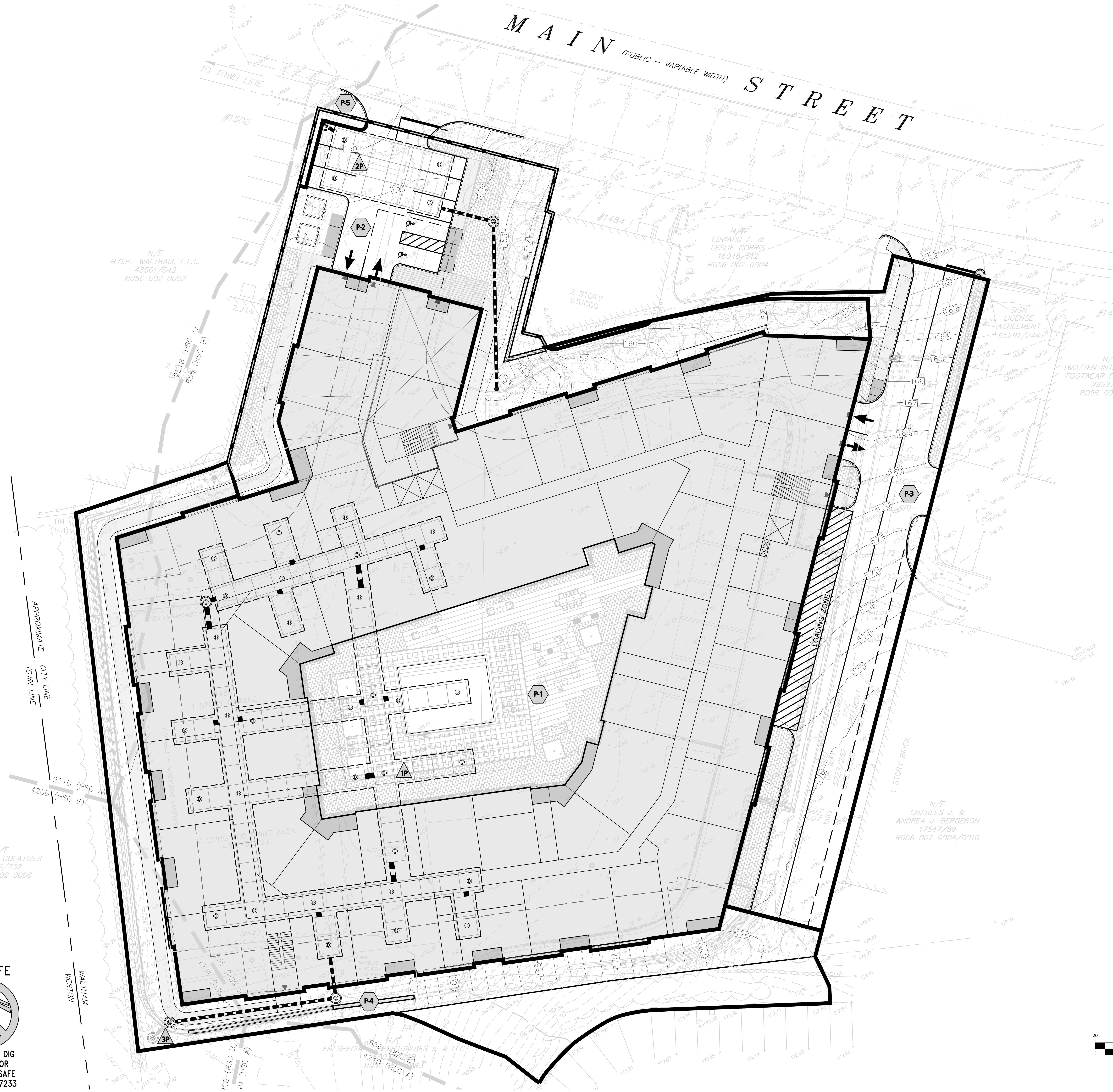
DRAWING TITLE:	SHEET No.
EXISTING WATERSHED PLAN	EWS-1

PROPOSED WATERSHED PLAN – PWS-1



LEGEND

EXISTING WATERSHED	
PROPOSED WATERSHED	
SCS SOILS BOUNDARY	
Tc FLOW PATH	A B
SUBCATCHMENT LABEL	P-1
SUBCATCHMENT BOUNDARY	
FLOW DIRECTION	

DIG SAFE

BEFORE YOU DIG
CALL 811 OR
1-888-DIG-SAFE
1-888-344-7233

GRAPHIC SCALE

20 0 10 20 40 80

(IN FEET)
1 inch = 20 ft.

M:\PROJECTS\1670-14\CIVIL\DRAWINGS\CURRENT\C1670-14_WATERSHED-PROPOSED.DWG

ISSUED FOR COMPREHENSIVE PERMIT
JANUARY 20, 2022

COMMONWEALTH OF MASSACHUSETTS
PHILIP L. CORDEIRO
CIVIL
NO. 47083
REGISTERED
PROFESSIONAL ENGINEER

Philip L Cordeiro
c=US, o=Allen and Major Associates Inc.,
ou=A01410C0000017579 8BB4FD00002012, cn=Philip L Cordeiro
2022.01.27 10:56:21 -05'00'

PROFESSIONAL ENGINEER FOR
ALLEN & MAJOR ASSOCIATES, INC.

REV	DATE	DESCRIPTION

APPLICANT\OWNER:

WP EAST ACQUISITIONS, LLC
91 HARTWELL AVENUE, 3RD FLOOR
LEXINGTON, MA 02421

PROJECT:

1486 MAIN STREET
WALTHAM, MA

PROJECT NO.	1670-14	DATE:	01-20-2022
SCALE:	1" = 20'	DWG. NAME:	C1670-14_
DESIGNED BY:		CHECKED BY:	PLC

PREPARED BY:

ALLEN & MAJOR
ASSOCIATES, INC.
civil engineering ◆ land surveying
environmental consulting ◆ landscape architecture
www.allenmajor.com
10 MAIN STREET
LAKEVILLE MA 02347
TEL: (508) 923-1010
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WOBURN, MA ◆ LAKEVILLE, MA ◆ MANCHESTER, NH

DRAWING TITLE:

PROPOSED WATERSHED PLAN

SHEET No.

PWS-1