Stormwater Management Report and Environmental Impact Analysis

Needham Mews
692 & 744 Greendale Avenue
Needham, Massachusetts

Submitted to:
Needham Board of Appeals

April 12, 2013

Revised November 8, 2013

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1.0 Introduction

This revised Stormwater Management Report, prepared in accordance with DEP Stormwater Management Standards, is submitted to the Town of Needham on behalf of the applicant, Greendale Avenue Venture LLC, c/o Mill Creek Residential Trust LLC, 15 New England Industrial Park, Burlington, Massachusetts, for a proposed site development known as "Needham Mews". The revised project under Massachusetts General Laws, Chapter 40B is a 268-unit rental apartment community located on a 6.02-acre site at 692 & & 744 Greendale Avenue, Figure 1, *USGS Locus Map*. This report supplements the set of revised plans, dated October 31, 2013, prepared by this office and submitted to the Town of Needham, entitled, "Comprehensive Permit Preliminary Site Plans, Needham Mews, 692 & & 744 Greendale Avenue, Needham, MA".

The site consists of three parcels (Assessors Map 18, Parcels 42, 43 & 44) within the Single Residence A Zoning District. It is bounded by the Route 128/I-95 highway to the northeast, the Greendale Worship Center to the southeast, Greendale Avenue to the southwest, and "Hardy Street" to the northwest. Hardy Street is listed as an ancient town way; portions of it were abandoned by Town Meeting action. It is overgrown with vegetation and passable only by foot. Access to the site is from Greendale Avenue, a public way. There is no access to the site from Route 128.

Two of the site parcels consist of single-family residences: the 1.00 acre property at 692 Greendale Avenue and the 0.58 acre property at 744 Greendale Avenue. The remainder of the site, 4.44 acres, consists of undeveloped woodlands and sloping topography with an elevation differential of approximately 50 feet between high side of the lot at Greendale Avenue and the bottom of slope near Route 128. A 20' wide Town sewer easement with an 8" diameter sewer pipe bisects the undeveloped wooded portion of the site from Greendale Avenue connecting to a manhole and 21" diameter sewer pipe that runs parallel to Route 128.

The proposed development consists of five townhome buildings, each consisting of 4 units (total of 20 townhome units); and two 4-story apartment buildings (total of 248 units), access drives, surface and under-building parking garages, 458 parking spaces (20 townhome garages, 359 structured parking garage spaces and 79 surface spaces), waste/recycle enclosure areas located within the parking garages, sidewalks, site lighting, landscaping, stormwater management system and utility infrastructure. The existing sewer pipe and easement is to remain as is. Sewer, storm drain, water, gas, electric and telecommunication utilities are available in Greendale Avenue. The proposed stormwater management facilities will incorporate water quality and quantity control features, and best management practices (BMP's) in conformance with DEP Stormwater Management Standards.

Runoff Calculations with Future MassDOT Route 128 Improvements

On October 30, 2013, the Town Engineer notified Tetra Tech via email that he had reviewed a set of plans entitled, "MassDOT Highway Division, Plans & Profiles of I-95/93 (Route 128) TIP – Bridge V In The Towns Of Needham – Wellesley Norfolk County, 100% Design Submission April 30, 2013" and commented that the plans show a proposed discharge of stormwater to the

low area of the Needham Mews Site straddling the Route 128 right-of-way and the Needham Mews property line. He concluded his email by stating that accommodations will have to be made for the proposed Route 128 design.

Tetra Tech reviewed the pertinent plan sheets at the Town Engineering Department showing the Route 128 improvements adjacent to the Project Site. The proposed MassDOT drainage improvements show drainage entirely within the State Layout that will not affect the Project. The Route 128 drainage improvements include several proposed catch basins along the gutter line edge of the southbound lanes. In particular, one catch basin collects runoff from an approximately 1/3-acre portion of the highway, where it is then conveyed to a proposed leaching catch basin and infiltrated into the ground. An overflow pipe from the leaching basin discharges to a proposed flared end section with stone. All of these highway improvements are located within the State Highway Layout adjacent to the Project Site.

Tetra Tech has analyzed the potential discharge rates associated with the future MassDOT drainage improvements to see what effect, if any, the new point of discharge within the State Layout may have on the Project Site. Please refer to Appendix C in this report, which includes runoff calculations with future MassDOT improvements. Compared with the existing Route 128 drainage system (without the future improvements), the future Route 128 drainage system abutting the Project Site collects highway runoff from a slightly larger contributing area (from 0.23 acre to 0.36 acre) and therefore results in a slight increase in potential discharge towards the Project Site. This potential slight increase is not significant, because the excessively well-draining A-type soils in the area of the Project Site are highly suitable for promoting infiltration of runoff from the proposed Route 128 and the discharge is entirely within the State Highway Layout. The discharge from Route 128 therefore will not affect the Project.

As noted above, the Project infiltrates its stormwater entirely on the Project Site. Therefore, the only land area contributing runoff to the drainage swale and culvert (located within the State Highway Layout) is the highway and its embankments. To ensure that the MassDOT design will not result in flooding at the 15" diameter culvert, we calculated the culvert depth of flow for the current Route 128 drainage system versus the future Route 128 condition with drainage improvements. Because of the slightly larger contributing area and slight increase in rate of discharge from the highway, the depth during the 100-year storm event in the 15" diameter culvert increases slightly, from 4" to 5". The results of the analysis conclude that there is no impact on the drainage swale or culvert from either the future improvements to Route 128 or from the Project.

1.1 Environmental Impact Analysis

Per Town of Needham Comprehensive Permit Rules of the Board of Appeals, Adopted September 15, 2011, under Article III. Section 1. (b) (i), an "Environmental Impact Analysis" prepared by a qualified environmental scientist, professional wetland scientist (PWS), certified soil scientist, botanist, hydrogeologist and/or scientific professional with demonstrated qualifications is required as part of the submission to the Board of Appeals. It shall assess the impact of the development on the environment within the development and adjacent thereto. Such analysis shall include, but shall not be limited to, an evaluation of pre-development conditions and post-development impacts. Such analysis shall include proposed mitigation of any identified post-development impacts. Mitigation measures requiring continuing or periodic maintenance shall be identified and a proposed maintenance plan shall be included with the Environmental Impact Analysis.

The Environmental Impact Analysis (EIA) prepared by Tetra Tech personnel, and more specifically, by Edward Hutchinson, a Professional Wetland Scientist (PWS) and Glenn Dougherty, a certified soil scientist and Professional Engineer, is included in this Stormwater Management Report and submitted to the Town of Needham as part of the Comprehensive Permit Application filing with the Board of Appeals. All of the information required in the EIA as stated in the above paragraph are found in this Stormwater Management Report, including a hydrologic evaluation of pre-development versus post-development conditions found in Appendix B; proposed stormwater management mitigation measures of the potential post-development impacts in the form of best management practices (BMP's) as described in sections 2.0 and 3.0; and a proposed maintenance plan for the BMP mitigation measures, i.e., the Operations and Maintenance Plan, found in Appendix G.

Ed Hutchinson, Tetra Tech's PWS conducted an initial inspection of the project site for the presence of wetland resource areas on the above referenced site in June, 2011. The site was investigated for the presence of hydrophytic (wetland) vegetation, hydric (wetland) soils, and wetland hydrology. The wooded site is dominated by red oak (*Quercus rubra*) and white pine (*Pinus strobus*) trees and saplings, with the occasional American beech (*Fagus grandifolia*). These species are considered Facultative Upland (FACU), which indicates that they usually occur in non-wetlands, but occasionally can be found in wetlands. The soils on the site did not exhibit hydric soil characteristics and no evidence of wetland hydrology was observed. There was no evidence of standing or ponded water, the soils were not saturated, nor was there any indication of high groundwater. Some low lying areas were observed in portions of the site; however, these areas did not support hydrophytic vegetation, nor did they contain hydric soils or exhibit indicators of wetland hydrology.

Massachusetts Department of Environmental Protection's (DEP) wetlands layer found in the Massachusetts Geographic Information System (MassGIS) data base indicate no wetland resource areas or hydrologic connections at all on the subject site, consistent with our field observations. However, mapping from the Town of Needham GIS data base indicates the presence of three intermittent streams on and adjacent to the project site, which in our professional opinion, appears to be inconsistent with the DEP/MassGIS wetlands data base and with Tetra Tech's findings from the initial site inspection.

Mr. Hutchinson conducted a second site inspection on March 13, 2013 to further investigate the specific areas depicted as intermittent streams on the Needham GIS map. Utilizing a hand auger to check for the presence of hydric soils and a visual inspection of the area for the presence of wetlands species and other indicators did not produce any evidence of two of the three intermittent streams—the two shown on the Needham GIS map as being on the project site and within the State Highway Layout adjacent to the project site. However, one intermittent stream was found during the site inspection. This intermittent stream, as shown on the Needham GIS map, is located on the property of the Greendale Worship Center at the base of the hill adjacent to Route 128. It is important to note that the proposed limits of the Needham Mews development as designed is more than 100 feet from the closest portion of this intermittent stream as shown on the Site Plans. In summary, two of the three intermittent streams shown on the Needham GIS are not jurisdictional under the Massachusetts Wetlands Protection Act because they do not meet the criteria for an intermittent stream and because no resource areas are present; and the one intermittent stream that does exist on an abutting property does not affect the proposed residential development at 692 & 744 Greendale Avenue. A memorandum report summarizing these findings was submitted to Patricia Barry, Conservation Department Director, on March 29, 2013.

Per Ms. Barry's recommendation, on July 11, 2013, an Abbreviated Notice of Resource Area Delineation (ANRAD) was filed by the project proponent with the Needham Conservation Commission. After two public hearings and a site walk by the Commission, the hearing was closed on August 8, 2013 and an approved Order of Resource Area Delineation (ORAD) was issued on August 19, 2013. The ORAD from the Commission has determined that the assumptions made in the previous paragraph are accurate, and that the flagged delineation of the inland bank associated with the intermittent stream located on the adjacent Worship Center property is accurate as shown on the project plans. The proposed development has been designed to be outside the 100-foot buffer zone to the off-site inland bank of the intermittent stream; therefore, no further Conservation Commission filings or review is required as part of this site development project.

FEMA mapping was reviewed to determine if there are any flood zones located on the project site. According to the published FEMA mapping, there are not any portions of the site shown as being within a 100 year flood zone. Along the north side of Route 128, there is an extensive flood zone associated with the Charles River, however this flood zone does not cross to the south side of Route 128 and therefore does not affect the property. Refer to Figure 3, *FEMA Flood Boundaries.*

Natural Heritage and Endangered Species Program (NHESP) mapping was reviewed to determine if there are any areas on or near the site with Areas of Critical Environmental Concern (ACEC) such as vernal pools, estimated habitat for rare wildlife and priority habitat sites for rare species. According to the published NHESP mapping, there are not any portions of the site shown as being within any ACEC's. Refer to Figure 4, *Reserved and Protected Areas.*

The site is not located in or near any public water supply area, surface water protection area or Title V 100' buffer zones. Refer to Figure 5, *Public Water Supplies* and Figure 6, *Title V Buffer Areas.* Municipal water and sewer utilities provide services to the houses at 692 and 744 Greendale Avenue. Therefore, no environmental impacts associated with an on-site wastewater disposal system are applicable with the proposed development.

As described in Section 1.2 *Soils,* on-site evaluations were conducted for stormwater management design purposes by Glenn Dougherty, PE, Tetra Tech's DEP certified soil evaluator. The soil testing, which included several deep pit observations and percolation testing (refer to Appendix H *Soil Evaluation Logs*), resulted in excessively well-draining soils (as characterized in DEP soil evaluation criteria) of sand and gravel, particularly suitable for promoting infiltration of stormwater runoff.

In conformance with MA DEP Stormwater Handbook, best management practices (BMP's) were chosen for the design of the stormwater management system, including subsurface infiltration/recharge areas which provide quantity controls and mitigation measures for potential post-development site impacts that otherwise would result due to increases in impervious surfaces and storm runoff. Based on a hydrologic evaluation of pre-development conditions and potential post-development impacts, the infiltration/recharge areas are designed to provide mitigation for potential post-development impacts during the 2-, 10-, 25- and 100-year storm events in order to meet DEP Standard #2, i.e., post-development peak discharge rates will not exceed pre-development peak discharge rates. In addition, the recharge areas are designed to meet the recharge volume requirements set forth in by Standard #3.

BMP's chosen as mitigation measures for water quality control consist of deep sump/hooded catch basins and water quality treatment units, as well as a pavement sweeping program. The water quality BMP's as designed meet the requirements for Standard #1- no new untreated discharges; and Standard #4- 80% Total Suspended Solids (TSS) Rate of Removal. Mitigation measures requiring continuing or periodic maintenance for all quantity and quality control BMP's are identified in the Operations and Maintenance (O&M) Plan found in Appendix G. The purpose of the O&M Plan is to ensure periodic inspections of the BMP's; proper removal and disposal of accumulated sediments, oils, and debris; and implementation of corrective action and record keeping activities, meeting the requirement of Standard #9- implementation of a long-term Drainage Operations and Maintenance Plan.

In summary, this Environmental Impact Analysis addresses potential environmental impacts associated with the proposed residential development. Site investigations by a Professional Wetlands Scientist conclude that no resource areas exist on the project site or are affected by the project; soil testing by a DEP certified soil evaluator conclude that on-site soils are highly suitable for promoting stormwater infiltration and groundwater recharge; record research concludes that the site is not within or near any Areas of Critical Environment Concern, FEMA Flood Zone, Public Water Supply Area, Surface Water Protection Area or Title V Buffer Zone; and the proposed site stormwater management system was designed based on a hydrologic evaluation of pre-development conditions and post-development impacts, and includes proposed mitigation measures of impacts requiring periodic maintenance as outlined in the Operations and Maintenance Plan.

1.2 Soils

According to the Natural Resources Conservation Service (NRCS) Norfolk County Soil Survey, Dated 1989 the soils on site consist of the following (Refer to Figure 2, *Soils Map*):

- 5 – Saco Silt Loam, 0-3 percent slopes, Hydrologic Soil Group D
- 245B – Hinckley Sandy Loam, 3-8 percent slopes, Hydrologic Soil Group A

- 253D – Hinckley Loamy Sand, 15-35 percent slopes, Hydrologic Soil Group A
- 254B – Merrimac Fine Sandy Loam, 3-8 percent slopes, Hydrologic Group A

On-site soil evaluation testing was conducted on February 26-28, 2013 in the locations of the proposed stormwater management areas. Eight (8) deep observation test pits were excavated as identified on the Site Grading & Drainage Plan and evaluated by a Tetra Tech DEP certified Soils Evaluator (see soil logs, Appendix H).

Soils were evaluated for elevation of estimated seasonal high groundwater and suitability of the underlying soils to provide infiltrative capacity. In each of the deep pits, either very gravelly coarse sand or clean coarse sand were found. Percolation tests produced rapid rates of permeability, characteristic of excessively well-draining soils and categorized in Hydrologic Soil Group A. It has been determined that soils at this site are particularly suitable for subsurface infiltration/recharge systems.

1.3 Ground Cover

The total project site is 6.02 acres. To quantify contributory runoff from off-site areas, the hydrologic study area totals 6.62 acres.

Table 1-1 summarizes the ground cover distribution for the hydrologic study area for existing and proposed conditions. There is an increase of 3.75 acres (4.08 acres proposed - 0.33 acres existing) in impervious area (pavement and roof) associated with the project. The numbers reflected in this report and drainage calculations include the existing single-family house and driveway at 692 Greendale Avenue and the existing single-family house, detached garage and driveway at 744 Greendale Avenue; both are proposed to be removed.

Table 1-1 Ground Cover - Hydrologic Area

Area	Existing (ac)	Proposed (ac)
Pavement/Roofs	0.33	4.08
Grass/Landscape	0.41	1.72
Woods	6.10	1.04
Total	**6.84**	**6.84**

2.0 Stormwater Management

2.1 Existing Stormwater Management

2.1.1 Existing Drainage System

Due to the nature of the existing development on the site (houses that are older than 50 years), there is no formalized drainage system. Stormwater runoff is conveyed through the site via overland flow. There are no stormwater quality features present on the site. A drainage system consisting of catch basins, manholes, and closed drainage pipe exists in Greendale Avenue.

2.1.2 Existing Watershed

For the analysis of existing storm water conditions the project area is divided into six (6) subcatchment areas. Characteristics of each subcatchment area are noted below and shown on Plan A.

There are four (4) points of analysis within the watershed:

- Reach 1R – Overland discharge near the eastern corner of the site.
- Reach 2R – Existing headwall at an existing 15" culvert near the eastern side of the site within the Route 128 right-of-way.
- Reach 3R – Overland discharge at the northern property line at Hardy Street.
- Reach 4R – Existing catch basin on Greendale Avenue

Subcatchment 1S consists of mostly wooded, overland flow that contributes to stormwater runoff to Reach 1R. Containing 0.67 acres, this area contains pervious, undeveloped woodland. The area slopes downward generally to the north, away from Greendale Avenue, towards the Route 128/I-95 right-of-way. Stormwater discharge is currently conveyed via overland flow and discharges near the eastern corner of the site to Reach 1R.

Subcatchment 2Sa consists of mostly wooded, undisturbed overland flow. The upstream area consists of impervious surfaces which include a portion of the single family house and garage at 744 Greendale Ave. and associated paved driveway. Containing 1.30 acres, 2Sa slopes downward to the north into a small depression (1D). 1D is analyzed as a pond with infiltration capabilities and has a natural earthen berm overflow which discharges downstream to Subcatchment 2Sb.

Subcatchment 2Sb consists of wooded, undisturbed overland flow which contains 0.40 acres and slopes downward to the northeast into a small depression (2D). 2D is analyzed as a pond with infiltration capabilities and has a natural earthen berm overflow which discharges downstream to Subcatchment 2Sc.

Subcatchment 2Sc consists of mostly wooded, undisturbed overland flow. The upstream area consists of impervious surfaces which include a portion of the single family house at 692 Greendale Ave. and associated paved driveway. Containing 3.89 acres, 2Sc slopes downward to the east into a large depression (3D). 3D is analyzed as a pond with infiltration capabilities and discharges downstream to Reach 2R.

Subcatchment 3S consists of mostly wooded, undeveloped overland flow. The upstream area consists of roof runoff from a portion of the single family house at 692 Greendale Ave. Containing 0.31 acres, 3S slopes downward to the northeast and discharges overland to Hardy Street and Reach 3R.

Subcatchment 4S consists of a small (0.04 acres) area of pervious, vegetative runoff which discharges into the Greendale Avenue gutter towards an existing catch basin downstream (Reach 4R) that is part of the Greendale Avenue storm drainage system.

2.1.3 Existing Runoff Calculations

In order to determine the peak rate of discharge for existing conditions, runoff hydrographs were generated for the storm events using the SCS TR-20 Method (refer to Appendix B, *HydroCAD® Input/Output*). Under existing conditions, runoff hydrographs were flood routed through the existing stormwater management facilities. Time of Concentration (Tc) calculations were performed which are shown on Plan A and included in the *HydoCAD Input/Output*. A minimum Tc value of 6.0 minutes was used in the *HydroCAD Input/Output* as stated in Chapter 3 of TR-55. The existing stormwater discharge rates are shown in Table 2-1.

Table 2-1 Existing Peak Runoff Rates

Point of Analysis	2-Year Storm (cfs)	10-Year Storm (cfs)	25-Year Storm (cfs)	100-Year Storm (cfs)
1R	0.00	0.00	0.00	0.01
2R	0.00	0.14	0.48	1.02
3R	0.00	0.01	0.04	0.12
4R	0.00	0.01	0.02	0.05

*cfs = cubic feet per second

2.2 Proposed Stormwater Management

2.2.1 Proposed Drainage System

The proposed drainage system consists of area drains, catch basins, manholes, HDPE high-density polyethylene pipes (sized for a 25-year storm), water quality treatment units and subsurface infiltration/recharge systems. Water quality treatment devices include four-foot deep sediment sumps and hoods at the outlets of the catch basins, Stormceptors water quality units, and subsurface infiltration/recharge systems utilizing Cultec Recharger 900HD chamber units. Site runoff from paved areas will be treated by the Stormceptor units prior to discharging to the Cultec chamber recharge areas. An overflow outlet from each of the eleven recharge areas is piped to two separate discharge points located at existing natural low-gradient areas on the site near the northerly lot line by Route 128. The overall site stormwater management system conforms to all applicable DEP Standards, as listed in Section 3.0.

2.2.2 Proposed Watershed

For the analysis of proposed storm water conditions the project area is divided into fifteen (15) subcatchment areas. Characteristics of each subcatchment area is noted below and shown on Plan B.

The same four (4) points of analysis from the existing conditions were used in the proposed conditions. A fifth (Reach 5R) point of analysis was added to analyze the proposed site peak flow rates at the proposed flared end outlet at the northerly property line.

Subcatchments 1S consists of an area at the upper part of the site (closer to Greendale Avenue), including the proposed Clubhouse roof, site drive aisle and landscaped areas. The runoff from this area is collected via roof drains and catch basins into closed drain pipes and conveyed to Infiltration Areas 1 (1P) located beneath the drive aisle pavement in front of the Clubhouse. Infiltration Area 1 consists of sixteen (16) Cultec Recharger 900HD chambers.

Subcatchment 2S consists of roof runoff from the southwest roof area of Building A and collected via roof drains into closed drainage pipes and conveyed to Infiltration Area 2 (2P) located beneath the drive aisle pavement in front of the Clubhouse. Infiltration Area 2 consists of eight (8) Cultec Recharger 900HD chambers.

Subcatchment 3S consists of an area at the upper part of the site adjacent to Greendale Avenue which includes roof runoff from Townhouse 2, the westerly site access drive, drive aisles and landscaped areas. The runoff from this area is collected via roof drains and catch basins into closed drainage pipes and conveyed to Infiltration Area 3 (3P) located beneath the drive aisle pavement in front of Building A. Infiltration Area 3 consists of sixteen (16) Cultec Recharger 900HD chambers.

Subcatchment 4S consists of roof runoff from the southeast roof area of Building A and Townhouse 3 and collected via roof drains into closed drainage pipes and conveyed to Infiltration Area 4 (4P) located beneath the drive aisle pavement in front of Building A. Infiltration Area 4 consists of eighteen (18) Cultec Recharger 900HD chambers.

Subcatchment 5S consists of an area at the upper part of the site adjacent to Greendale Avenue which includes roof runoff from the southwest roof area of Building B and the roof runoff from Townhouse 4, part of the easterly site access drive, drive aisles and landscaped areas. The runoff from this area is collected via roof drains and catch basins into closed drainage pipes and conveyed to Infiltration Area 5 (5P) located beneath the drive aisle pavement in front of Building B. Infiltration Area 5 consists of seventeen (17) Cultec Recharger 900HD chambers.

Subcatchment 6S consists of an area at the upper part of the site adjacent to Greendale Avenue which includes roof runoff from the southeast roof area of Building B, part of the easterly site access drive, drive aisles and landscaped areas. The runoff from this area is collected via roof drains and catch basins into closed drainage pipes and conveyed to Infiltration Area 6 (6P) located beneath the drive aisle pavement in front of Building B. Infiltration Area 6 consists of sixteen (16) Cultec Recharger 900HD chambers.

Subcatchment 7S consists of roof runoff from Townhouse 4 and collected via roof drains into closed drainage pipes and conveyed to Infiltration Area 7 (7P) located beneath the drive aisle pavement in front of Building A. Infiltration Area 7 consists of six (6) Cultec Recharger 900HD chambers.

Due to the grade change along the along the drive aisle, there is an elevation difference between the infiltration areas. The areas are hydraulically connected by a 12" diameter HDPE pipe.

Subsurface Infiltration Areas 1 - 4 help mitigate the post-development runoff from the 2-, 10-, 25- and 100-year design storms to be less than the pre-development flow. Subsurface Infiltration Areas 5 - 7 are also at different elevations and are hydraulically connected by a 12" diameter HDPE pipe and help mitigate the post-development runoff.

Subcatchment 8S consists of an area at the upper part of the site adjacent to Greendale Avenue, including roof runoff from Townhouse 1, the westerly site drive aisle, the proposed Pool Deck and landscaped areas. The runoff from this area is collected via roof drains and catch basins into closed drain pipes and conveyed to Infiltration Areas 8 (8P) located beneath the drive aisle pavement in back of the Building A. Infiltration Area 8 consists of thirty (30) Cultec Recharger 900HD chambers.

Subcatchment 9S consists of roof runoff from the easterly roof area and courtyard of Building A and collected via roof drains into closed drainage pipes and conveyed to Infiltration Area 9 (9P) located beneath the drive aisle pavement in back of Building A. Infiltration Area 9 consists of thirty (30) Cultec Recharger 900HD chambers.

Subcatchment 10S consists of the easterly drive aisle and landscaped areas behind Buildings A and B. The runoff from this area is collected via catch basins into closed drainage pipes and conveyed to Infiltration Area 10 (10P) located beneath the drive aisle pavement in back of Buildings A and B. Infiltration Area 10 consists of twenty-eight (28) Cultec Recharger 900HD chambers.

Subcatchment 11S consists of landscaped area at the upper part of the site adjacent to Greendale Avenue, the easterly site drive aisle and associated landscaping and roof runoff from the easterly roof area and courtyard of Building B. The runoff from this area is collected via roof drains and catch basins into closed drain pipes and conveyed to Infiltration Areas 11 (11P) located beneath the drive aisle pavement in back of the Building B. Infiltration Area 11 consists of thirty-three (33) Cultec Recharger 900HD chambers.

Due to the grade change along the along the drive aisle, there is an elevation difference between the infiltration areas. The areas are hydraulically connected by a 12" diameter HDPE pipe. Subsurface Infiltration Areas 8 - 10 help mitigate the post-development runoff from the 2-, 10-, 25- and 100-year design storms to be less than the pre-development flow. Subsurface Infiltration Areas 10 and 11 are also at different elevations and are hydraulically connected by a 12" diameter HDPE pipe and help mitigate the post-development runoff.

Subcatchment 12S consists of undisturbed and regraded landscape area at the upper part of the site adjacent to Greendale Avenue then slopes downward between Buildings A and B along mostly undisturbed wooded land within an existing sewer easement to the northeast into a small graded detention pond (12P) which has infiltration capabilities.

Subcatchment 13S consists of pervious landscaping at the low side of the proposed retaining wall at the westerly side of the site. Containing 0.05 acres, 13S slopes downward to the northeast and discharges overland to Hardy Street and Reach 3R.

Subcatchment 14S consists of mostly wooded, undisturbed overland flow within the Route 128 right-of-way. 14S slopes downward to the east into a large depression (14P) which was altered by the proposed site. 14P is analyzed as a pond with infiltration capabilities and discharges downstream to Reach 2R.

Subcatchment 15S consists of pervious landscaping and undisturbed woodland at the low side of the proposed retaining wall at the easterly side of the site. Containing 0.16 acres, 15S slopes downward to the north and discharges overland to Reach 1R.

2.2.3 Proposed Runoff Calculations

In order to determine the peak rate of discharge for proposed conditions, runoff hydrographs were generated for the storm events using the SCS TR-20 Method (refer to Appendix B, *HydroCAD® Input/Output*). Under the proposed condition, runoff hydrographs were flood routed through the proposed stormwater management facilities. Time of Concentration (Tc) calculations were performed for each subcatchment and shown on Plan B. A minimum Tc value of 6.0 minutes was used in the *HydroCAD Input/Output* as stated in Chapter 3 of TR-55. The proposed stormwater discharge rates are shown in Table 2-2.

Table 2-2 Proposed Peak Runoff Rates

Point of Analysis	2-Year Storm (cfs)	10-Year Storm (cfs)	25-Year Storm (cfs)	100-Year Storm (cfs)
1R	0.00	0.00	0.00	0.00
2R	0.00	0.14	0.48	1.02
3R	0.00	0.00	0.00	0.00
4R	0.00	0.00	0.00	0.00
5R	0.00	0.00	0.00	0.00

*cfs = cubic feet per second

3.0 Stormwater Management Standards

The proposed stormwater management system complies with the Massachusetts Department of Environmental Protection (MADEP) Stormwater Management Policy. The project as designed will meet or exceed all of the ten (10) standards. The standards are described below.

3.1 Standard #1 – No New Untreated Discharges

No point discharges of untreated stormwater to resource areas are proposed. Stormwater quality control for the project includes street sweeping, deep sump/hooded catch basins, water quality treatment units and subsurface infiltration/recharge systems.

3.2 Standard #2 – Peak Rate Attenuation

Stormwater management controls were developed for the 2-, 10-, 25-, and 100-year 24-hour storm events. Under existing and proposed conditions, hydrologic analyses were performed utilizing the computer program, HydroCAD®. In order to determine the peak rate of discharge for existing and proposed conditions, runoff hydrographs were generated for the storm events using the SCS TR-20

Method (refer to Appendix B, *HydroCAD® Input/Output*). Under the proposed conditions, the post-development runoff hydrographs were flood routed through the proposed drainage collection system and into the proposed stormwater management system.

Table 3-1 summarizes the pre- and post-development peak runoff discharge rates determined in the hydrologic analyses performed for the Project.

Table 3-1 Comparison of Peak Runoff Rates

Point of Analysis	2-Year Storm (cfs)			10-Year Storm (cfs)			25-Year Storm (cfs)			100-Year Storm (cfs)		
	Pre	Post	Δ	Pre	Post	Δ	Pre	Post	Δ	Pre	Post	Δ
1R	0.00	0.00	-0.00	0.00	0.00	-0.00	0.00	0.00	-0.00	0.01	0.00	-0.01
2R	0.00	0.00	-0.00	0.14	0.14	-0.00	0.48	0.48	-0.00	1.02	1.02	-0.00
3R	0.00	0.00	-0.00	0.01	0.00	-0.01	0.04	0.00	-0.04	0.12	0.00	-0.12
4R	0.00	0.00	-0.00	0.01	0.00	-0.01	0.02	0.00	-0.02	0.05	0.00	-0.05
5R	-	0.00	-	-	0.00	-	-	0.00	-	-	0.00	-

*cfs = cubic feet per second

As shown in Table 3-1, proposed peak runoff rates for the project are less than that of existing conditions for each storm event. At 1R, there is no discharge from the proposed development. At 2R, the 1.02 cfs of runoff for the 100-year storm is from the existing area within the Route 128 Right-of-Way. At 3R, there is no discharge from the proposed development onto Hardy Street. At 4R, there is no discharge from the proposed development entering the catch basin on Greendale Avenue. At 5R, there is no discharge from the proposed development. All runoff for all the storms contributing to this point of analysis is attenuated on site. The proposed site development project will not increase runoff rates at all the points of analysis.

3.3 Standard #3 – Recharge

Soils encountered during the site testing conducted on February 26-28, 2013 in the proposed stormwater management areas are extremely well-draining gravelly coarse sand and classified as Hydrologic Soil Group A (refer to Appendix H, *Soil Evaluation Logs*). Utilizing the Mass DEP Volume to Recharge table for Hydrologic Soil Group A (HSG A) soils, the required recharge volume is based on 0.60 inches of runoff times total impervious area.

The total proposed impervious area over the project site is 3.93 acres. Therefore, the required groundwater recharge volume is calculated as the following: [3.93 x (0.60/12)] = 0.197 acre-feet or 8,560 cubic feet. Referring to the Rawl's Table in the DEP Handbook, the infiltration/recharge areas are designed using an infiltration rate of 8.27 inches/hour recommended for HSG A soils. Using the most conservative "static" storage volume method, the recharge areas provide approximately 0.830 acre-feet or 36,151 cubic feet of static stormwater storage volume below the invert elevation of the overflow discharge pipes. All stormwater runoff of all impervious surfaces on site will be infiltrated. The recharge systems will drain in less than 72 hours, and the required recharge volume (Standard #3) is met. Refer to Appendix E, *Groundwater Recharge Calculations,* for calculations.

3.4 Standard #4 – Water Quality

Best Management Practices (BMPs) will be used to provide water quality. The following BMPs will be provided on-site: street sweeping, deep sump hooded catch basins, Stormceptor water quality units, and Cultec subsurface infiltration/recharge systems. These BMPs will provide for greater than the required 80% TSS removal.

3.4.1 Street Sweeping

A comprehensive source reduction program of regular pavement sweeping, litter removal, and maintenance of trash areas will be implemented at the site to protect water quality by reducing the amount of sediment and pollutants entering the stormwater management system. The sweeping program will remove sand and contaminants directly from paved surfaces before they become mobilized during rain events and transported to the drainage system. Paved areas will be cleaned and maintained at least twice per year, typically in April and October and possibly more often as needed. In accordance with MADEP standards, a 10% TSS removal rate is credited for this BMP.

3.4.2 Deep Sump Catch Basins

All proposed catch basins on site will include four-foot deep sumps and provided with hooded outlets, which will serve to trap sediment and floatables before entering the drainage system. Catch basins will be inspected quarterly and cleaned when sediment reaches ½ full-depth to ensure that the catch basins are working in their intended purpose and free of debris. Sediments and hydrocarbons shall be properly handled and disposed of, in accordance with local, state, and federal requirements. A TSS removal credit of 25% is credited for this BMP.

3.4.3 Water Quality Units

The proposed design of the on-site drainage system will incorporate six (6) Stormceptor water quality units to provide treatment of runoff from pavement areas prior to discharging to the subsurface infiltration chambers. In accordance with MADEP standards a 50% TSS removal rate is credited for this BMP.

3.4.4 Subsurface Infiltration/Recharge Systems

There are eleven (11) subsurface infiltration systems which provide groundwater recharge of treated runoff prior to discharge. The systems consist of a series of Cultec Recharger 900HD chambers surrounded with double-washed stone and filter fabric. The systems have been designed to provide storage, infiltration, and additional filtration treatment of stormwater runoff. Runoff is directed through catch basins (with sumps) and Stormceptor water quality units prior to discharging into the infiltration systems. In accordance with MADEP standards an 80% TSS removal rate is credited for this BMP provided they are combined with one or more pretreatment BMPs prior to infiltration.

The incorporation of these BMP's will achieve a cumulative TSS removal rate of 92%, greater than the 80% minimum required by DEP. Refer to Appendix F, *Water Quality Calculations.*

3.5 Standard #5 – Land Uses with Higher Potential Pollutant Loads

The proposed site development project for a residential apartment community is not considered a land use with higher potential pollutant loads.

3.6 Standard #6 – Critical Areas

Critical areas are Outstanding Resource Waters (ORWs), shellfish beds, swimming beaches, cold water fisheries, and recharge areas for public drinking water supplies. No critical areas are located within the project.

3.7 Standard #7 – Redevelopment Standards only to the Maximum Extent Practicable

The proposed development project is not considered a redevelopment of an existing developed site. The stormwater management standards will be met in full for the proposed drainage system serving the site development.

3.8 Standard #8 – Construction Period Erosion and Sedimentation Control

Erosion and sediment control techniques will be employed during construction and earth moving phases of the work. Some of these include installation and maintenance of stabilized anti-tracking construction entrance, fiber roll and silt fence barriers, and catch basin protection with temporary catch basin filters and fiber roll barriers. The contractor will be responsible for implementing and maintaining each of these controls as shown on the Erosion Control Plan.

3.9 Standard #9 – Operations and Maintenance Plan

An Operation and Maintenance Plan for the project site has been prepared in accordance with DEP Stormwater Management Standard No. 9. A copy is presented in Appendix G.

The Stormwater Management System will be the overall responsibility of the Owner. The Owner will retain a Project Manager who will be responsible during construction. The Owner will be responsible for post-construction operation and maintenance.

3.10 Standard #10 – Prohibition of Illicit Discharges

Illicit discharges to the on-site stormwater management system and to the off-site existing municipal drainage system are prohibited. The project does not include any new off-site drainage connections to the existing municipal system. No illicit connections to the local drainage system or discharges to or from the on-site system will be made.

4.0 Site Hydraulics

The proposed drain pipe network is composed of catch basins and manholes that will collect runoff from the roadway, parking, building roof and landscaped areas within the proposed project area and discharge to the on-site infiltration/recharge systems.

The proposed storm drainage collection system has been designed for a 25-year storm frequency utilizing the Rational Method. StormCAD® was used to perform the hydraulic analysis for the storm drainage system (refer to Appendix D, *StormCAD Pipe Design Input/Output*).

The following criteria were used to design the pipe network for the proposed project:

- Pipes are sized to convey the 25-year storm event.
- Drainage pipes are High-Density Polyethelene (HDPE).
- Rainfall intensity of 6.0 inches per hour for 5-minute duration during the 25-year storm frequency.
- Manning's coefficient (n) of 0.013 for HDPE.
- Maximum pipe velocity is 10 feet per second (fps).

5.0 Conclusion

The Stormwater Management System addresses both the quantity control and quality of stormwater runoff from the site and meets or exceeds the requirements of the ten (10) standards outlined by the Massachusetts Department of Environmental Protection (DEP) Stormwater Policy.

TETRA TECH
One Grant Street
Framingham, MA 01701

USGS Map

692 & 744 Greendale Avenue
Needham, Massachusetts

3/27/13

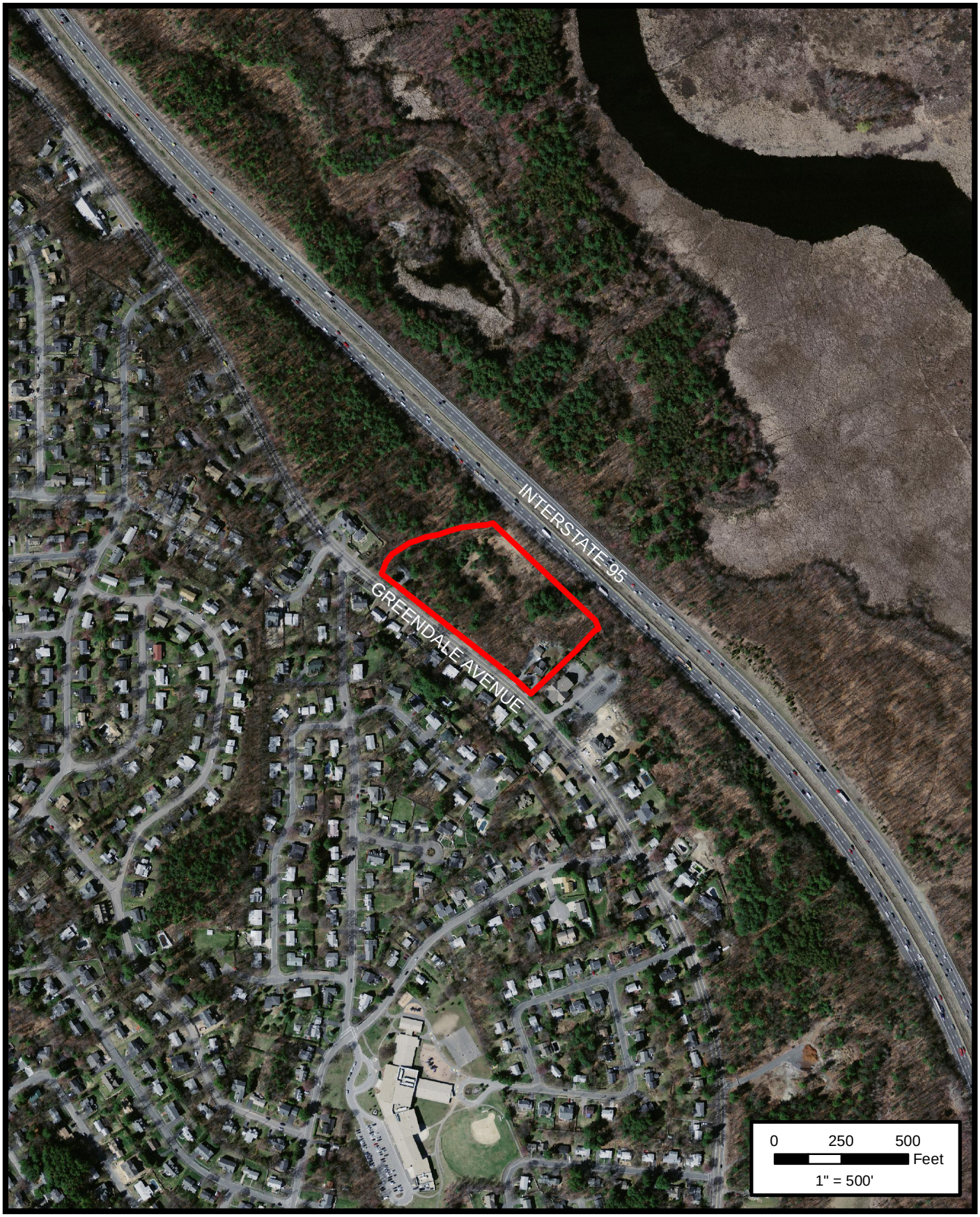
Z

Source: MassGIS, USGS

Figure 1

Created by: JLP

143-82806-13003 USGS.mxd



TETRA TECH
One Grant Street
Framingham, MA 01701

Site Aerial (2008)

692 &744 Greendale Avenue
Needham, Massachusetts

3/27/13

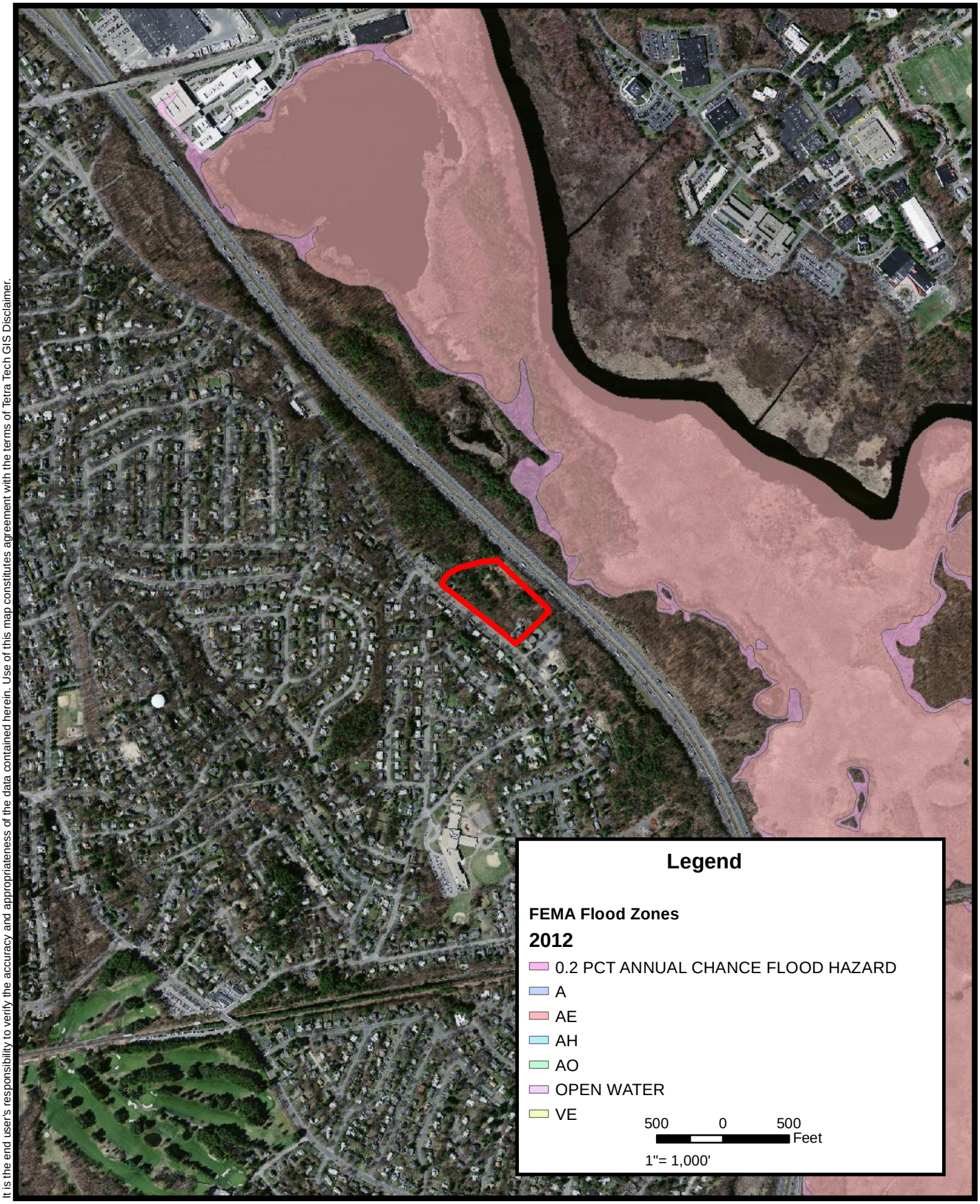
Z

Source: MassGIS

Figure 2

Created by: JLP

143-82806-13003 Aerial.mxd



TETRA TECH

One Grant Street
Framingham, MA 01701

FEMA Flood Boundaries

692 & 744 Greendale Avenue
Needham, Massachusetts

3/27/13

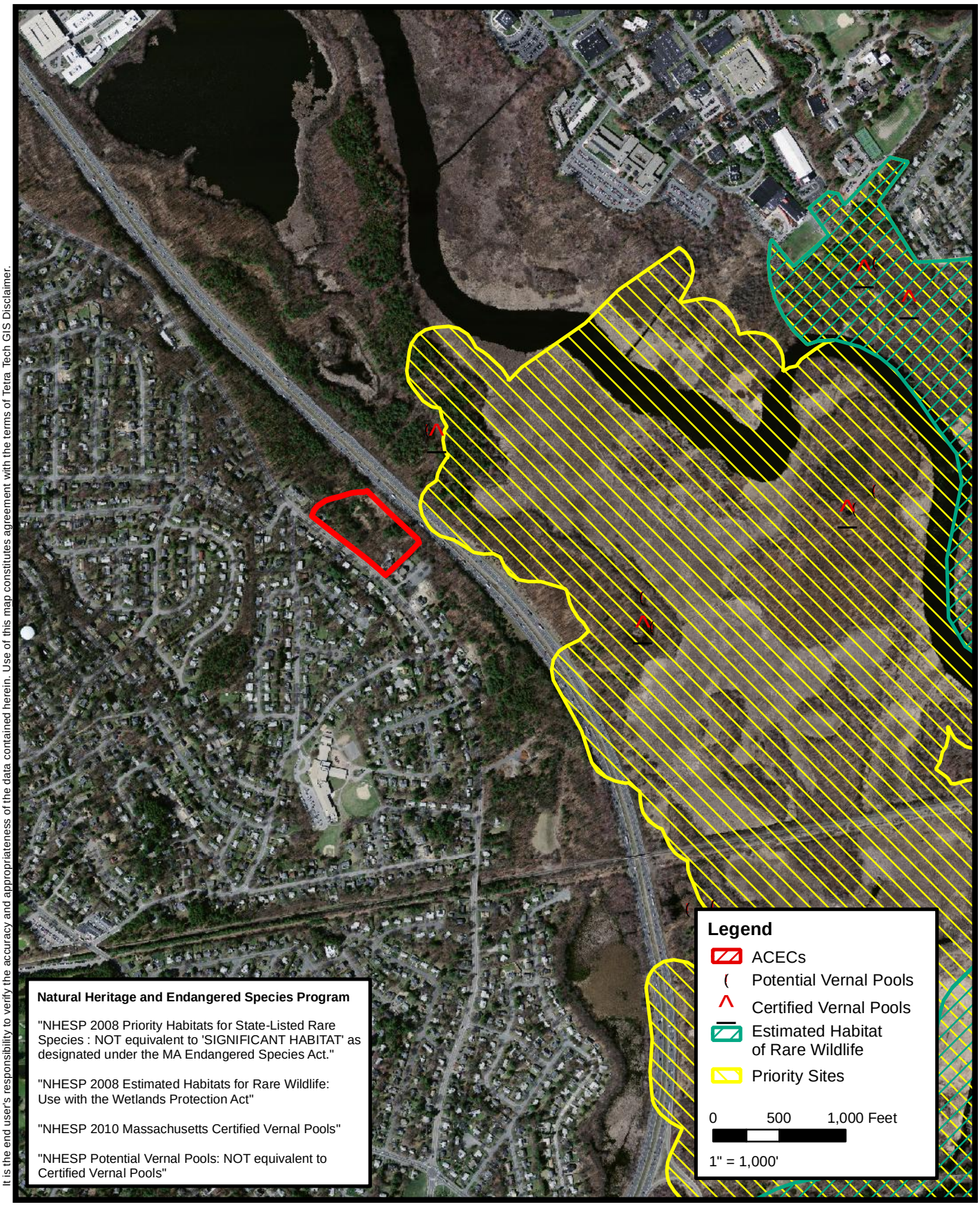
Z

Source: MassGIS, FEMA

Figure 3

Created by: JLP

143-82806-13003 FEMA.mxd



TETRA TECH
One Grant Street
Framingham, MA 01701

Reserved and Protected Areas

692 & 744 Greendale Avenue
Needham, Massachusetts

3/27/13

Z

Source: MassGIS, NHESP

Figure 4

Created by: JLP

143-82806-13003 NHESP.mxd

TETRA TECH
One Grant Street
Framingham, MA 01701

Public Water Supplies

692 & 744 Greendale Avenue
Needham, Massachusetts

3/27/13

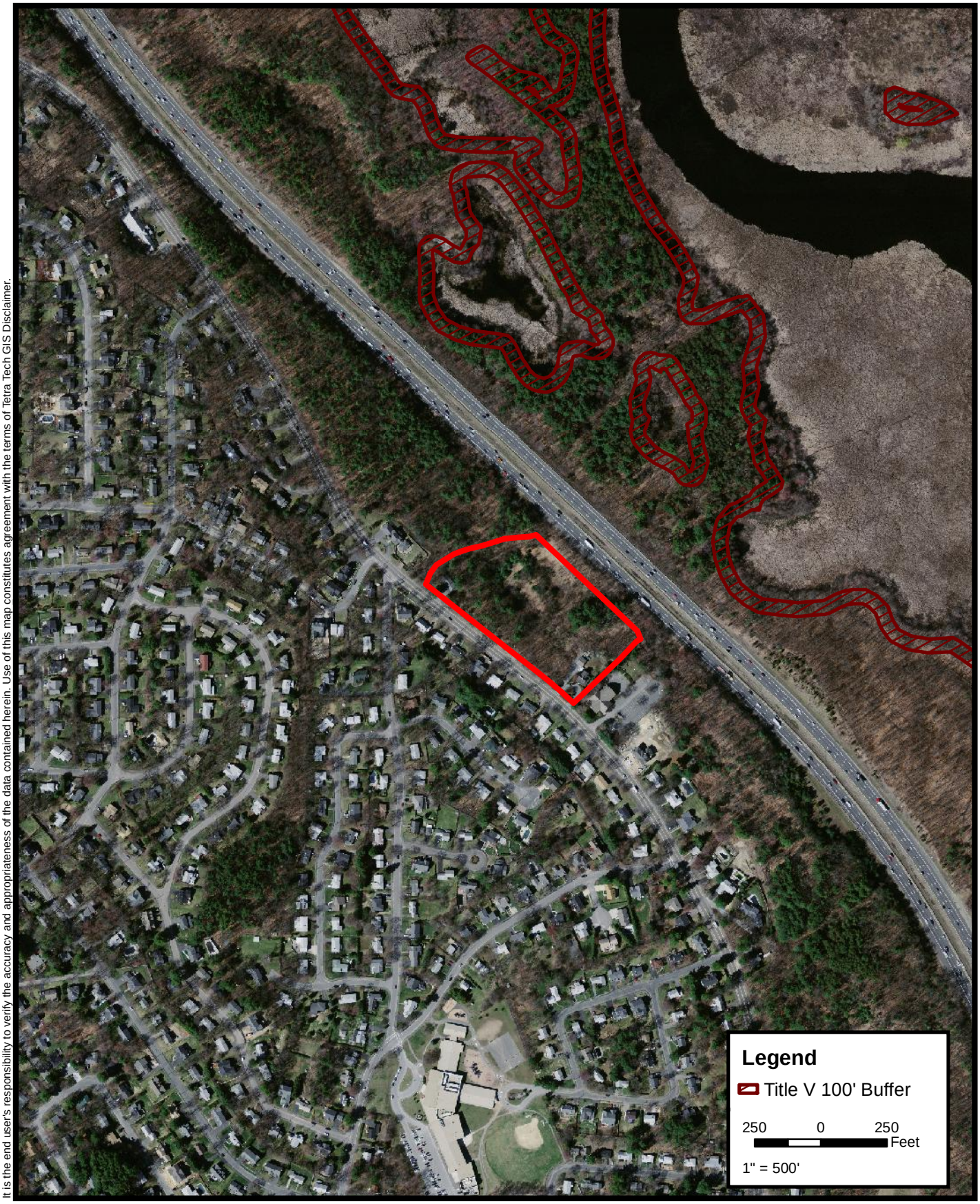
Z

Source: MassGIS, DEP

Figure 5

Created by: JLP

143-82806-13003 PWS.mxd



TETRA TECH
One Grant Street
Framingham, MA 01701

Title V Buffer Areas

692 & 744 Greendale Avenue
Needham, Massachusetts

3/27/13

Z

Source: MassGIS, DEP

Figure 6

Created by: JLP

143-82806-13003 TITLE V.mxd

TETRA TECH

One Grant Street
Framingham, MA 01701

Wetland Resources (DEP 1:12,000)

692 & 744 Greendale Avenue
Needham, Massachusetts

3/27/13

Z

Source: MassGIS, DEP

Figure 7

Created by: JLP

143-82806-13003 wetland.mxd

TETRA TECH
One Grant Street
Framingham, MA 01701

Soils Map

692 & 744 Greendale Avenue
Needham, Massachusetts

3/27/13

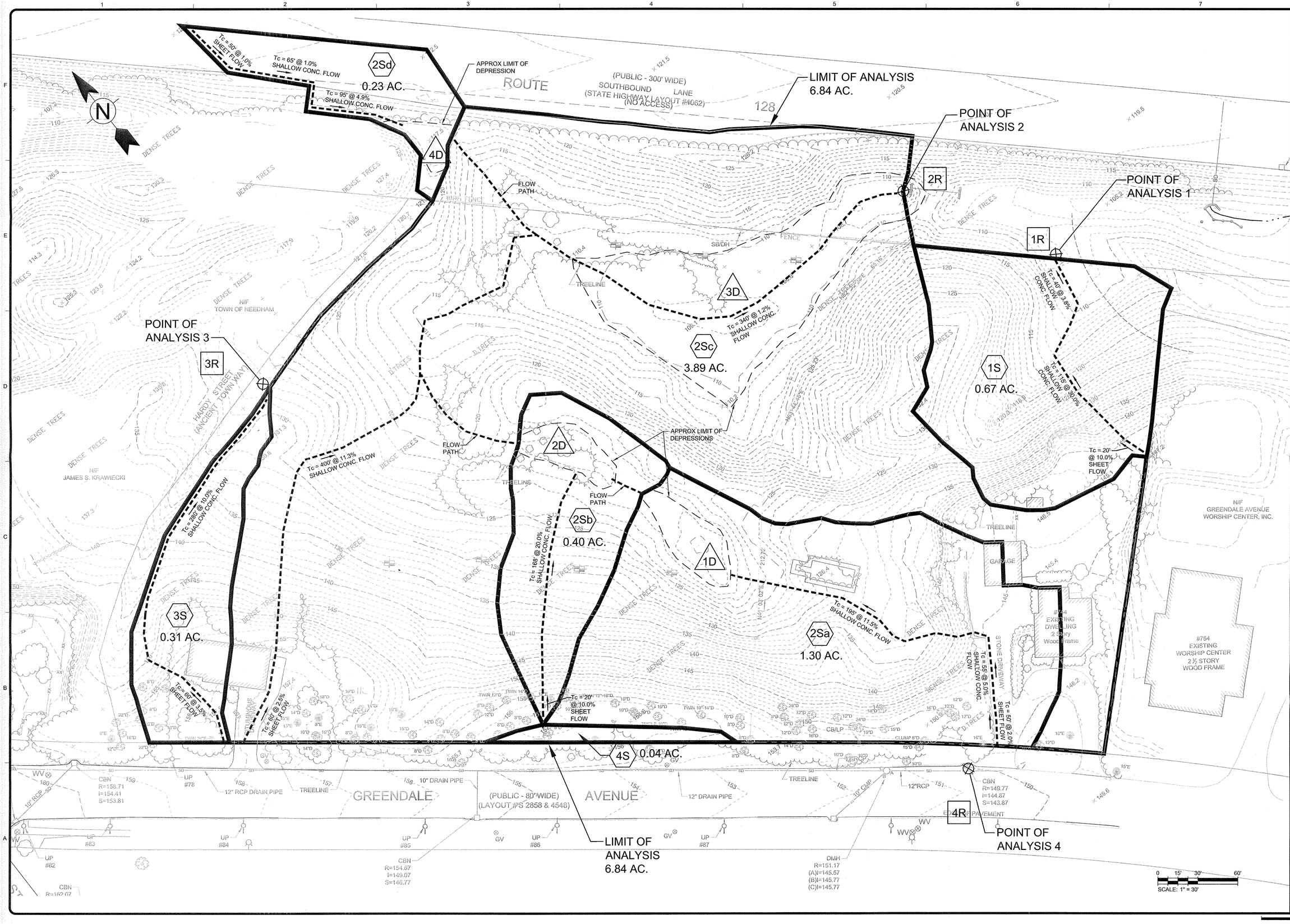
Z

Source: MassGIS

Figure
8

Created by: JLP

143-82806-13003 Aerial.mxd



TETRA TECH

www.tetratech.com
One Grant Street
Framingham, MA 01701
PHONE: (508) 903-2000 FAX: (508) 903-2001

MARK	DATE	DESCRIPTION	BY
1	3/29/13	Site Development Plans	
2	9-30-13	ZBA Submission Full Set	

Client: Greendale Avenue Venture LLC
Proj. Loc.: Needham, Massachusetts

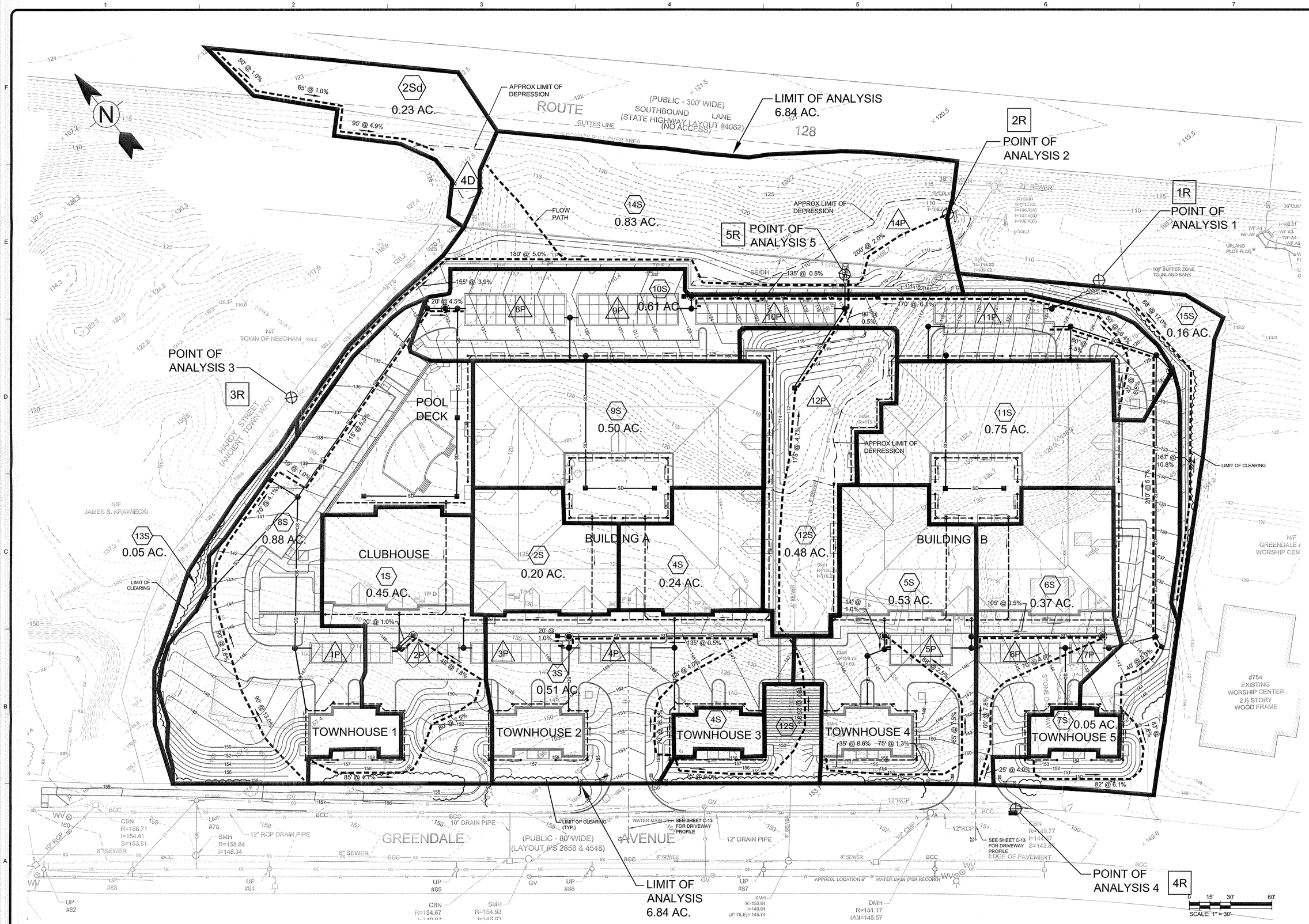
Comprehensive Permit Plans
692 & 744 Greendale Avenue - Needham, Massachusetts

Existing Conditions Watershed Plan

Project No.:	143-82806-13003
Designed By:	CDH
Drawn By:	CDH
Checked By:	GKD

A

Bar Measures 1 inch



Bar Measures 1 inch

TETRA TECH
www.tetratech.com
One Grant Street
Framingham, MA 01701
PHONE: (508) 903-2000 FAX: (508) 903-2001

MARK	DATE	DESCRIPTION	BY
1	3/29/13	Site Development Plans	
2	9-30-13	ZBA submission Full Set	

Client: Greendale Avenue Venture LLC
Proj. Loc.: Needham, Massachusetts

Comprehensive Permit Plans
692 & 744 Greendale Avenue - Needham, Massachusetts

Proposed Conditions Watershed Plan

Project No.:	143-82806-13003
Designed By:	CDH
Drawn By:	CDH
Checked By:	GKD

B

ROUTE 128 (PUBLIC - 300' WIDE)
SOUTHBOUND LANE
(STATE HIGHWAY LAYOUT #4062)
(NO ACCESS)

N

N/F
TOWN OF NEEDHAM

N/F
JAMES S. KRAWIECKI

HARDY STREET
(ANCIENT TOWN WAY)

ROOF A-3
ROOF A-1
ROOF A-2
ROOF B-3
ROOF B-4
ROOF B-1
ROOF B-2
POOL DECK
COURTYARD
CLUBHOUSE

TOWNHOUSE 1
TOWNHOUSE 2
TOWNHOUSE 3
TOWNHOUSE 4
TOWNHOUSE 5

CB-1 CB-2 CB-3 CB-4 CB-5 CB-6 CB-7
STC-1 STC-2 STC-3 STC-4
AD AD-3 AD-4
TP A TP B TP C TP D TP E TP F TP G

ROOF LEADER CONNECTION (TYP)

DESIGNATED SNOW STORAGE AREA 5,000 S.F.

LIMIT OF CLEARING
LIMIT OF CLEARING (TYP.)

100' BUFFER ZONE TO INLAND BANK
UPLAND PLOT FLAG
WF A1 WF A2 WF A3 WF A4 WF A5

N/F
GREENDALE AVE
WORSHIP CENTE

BVA
EXISTING
WORSHIP CENTER
2.5 STORY
WOOD FRAME

SEE SHEET C-13 FOR DRIVEWAY PROFILE

SEE SHEET C-13 FOR DRIVEWAY

EDGE OF PAVEMENT

GREENDALE AVENUE
(PUBLIC - 80' WIDE)
(LAYOUT #'S 2858 & 4548)

0 15' 30' 60
SCALE: 1" = 30'

Bar Measures 1 inch

TETRA TECH
www.tetratech.com
One Grant Street
Framingham, MA 01701
PHONE: (508) 903-2000 FAX: (508) 903-2001

MARK	DATE	DESCRIPTION
1	4/12/13	Site Development Plans
2	5-30-13	ZBA Submission Full Set

Client: Greendale Avenue Venture LLC
Proj. Loc.: Needham, Massachusetts

Comprehensive Permit Plans
692 & 744 Greendale Avenue - Needham, Massachusetts

Proposed Catchment Area Plan

Project No.:	143-82806-13003
Designed By:	CDH
Drawn By:	CDH
Checked By:	GKD

C

Appendix A

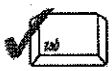
Stormwater Report Checklist

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands Program

Checklist for Stormwater Report

A. Introduction

Important: When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.



A Stormwater Report must be submitted with the Notice of Intent permit application to document compliance with the Stormwater Management Standards. The following checklist is NOT a substitute for the Stormwater Report (which should provide more substantive and detailed information) but is offered here as a tool to help the applicant organize their Stormwater Management documentation for their Report and for the reviewer to assess this information in a consistent format. As noted in the Checklist, the Stormwater Report must contain the engineering computations and supporting information set forth in Volume 3 of the Massachusetts Stormwater Handbook. The Stormwater Report must be prepared and certified by a Registered Professional Engineer (RPE) licensed in the Commonwealth.

The Stormwater Report must include:

- The Stormwater Checklist completed and stamped by a Registered Professional Engineer (see page 2) that certifies that the Stormwater Report contains all required submittals.[1] This Checklist is to be used as the cover for the completed Stormwater Report.
- Applicant/Project Name
- Project Address
- Name of Firm and Registered Professional Engineer that prepared the Report
- Long-Term Pollution Prevention Plan required by Standards 4-6
- Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan required by Standard 8[2]
- Operation and Maintenance Plan required by Standard 9

In addition to all plans and supporting information, the Stormwater Report must include a brief narrative describing stormwater management practices, including environmentally sensitive site design and LID techniques, along with a diagram depicting runoff through the proposed BMP treatment train. Plans are required to show existing and proposed conditions, identify all wetland resource areas, NRCS soil types, critical areas, Land Uses with Higher Potential Pollutant Loads (LUHPPL), and any areas on the site where infiltration rate is greater than 2.4 inches per hour. The Plans shall identify the drainage areas for both existing and proposed conditions at a scale that enables verification of supporting calculations.

As noted in the Checklist, the Stormwater Management Report shall document compliance with each of the Stormwater Management Standards as provided in the Massachusetts Stormwater Handbook. The soils evaluation and calculations shall be done using the methodologies set forth in Volume 3 of the Massachusetts Stormwater Handbook.

To ensure that the Stormwater Report is complete, applicants are required to fill in the Stormwater Report Checklist by checking the box to indicate that the specified information has been included in the Stormwater Report. If any of the information specified in the checklist has not been submitted, the applicant must provide an explanation. The completed Stormwater Report Checklist and Certification must be submitted with the Stormwater Report.

[1] The Stormwater Report may also include the Illicit Discharge Compliance Statement required by Standard 10. If not included in the Stormwater Report, the Illicit Discharge Compliance Statement must be submitted prior to the discharge of stormwater runoff to the post-construction best management practices.

[2] For some complex projects, it may not be possible to include the Construction Period Erosion and Sedimentation Control Plan in the Stormwater Report. In that event, the issuing authority has the discretion to issue an Order of Conditions that approves the project and includes a condition requiring the proponent to submit the Construction Period Erosion and Sedimentation Control Plan before commencing any land disturbance activity on the site.

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands Program

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

The following checklist is intended to serve as a guide for applicants as to the elements that ordinarily need to be addressed in a complete Stormwater Report. The checklist is also intended to provide conservation commissions and other reviewing authorities with a summary of the components necessary for a comprehensive Stormwater Report that addresses the ten Stormwater Standards.

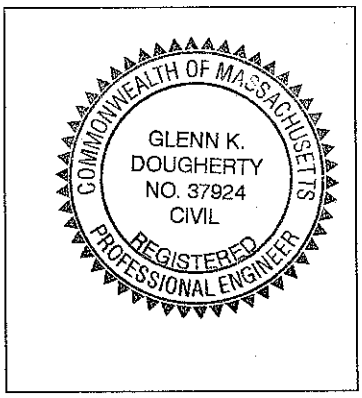
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the item is not applicable (N.A.) and provide the reasons for that determination.

A complete checklist must include the Certification set forth below signed by the Registered Professional Engineer who prepared the Stormwater Report.

Registered Professional Engineer's Certification

I have reviewed the Stormwater Report, including the soil evaluation, computations, Long-term Pollution Prevention Plan, the Construction Period Erosion and Sedimentation Control Plan (if included), the Long-term Post-Construction Operation and Maintenance Plan, the Illicit Discharge Compliance Statement (if included) and the plans showing the stormwater management system, and have determined that they have been prepared in accordance with the requirements of the Stormwater Management Standards as further elaborated by the Massachusetts Stormwater Handbook. I have also determined that the information presented in the Stormwater Checklist is accurate and that the information presented in the Stormwater Report accurately reflects conditions at the site as of the date of this permit application.

Registered Professional Engineer Block and Signature



11-8-2013
Signature and Date

Checklist

Project Type: Is the application for new development, redevelopment, or a mix of new and redevelopment?

☒ New development

☐ Redevelopment

☐ Mix of New Development and Redevelopment

Checklist for Stormwater Report

Checklist (continued)

LID Measures: Stormwater Standards require LID measures to be considered. Document what environmentally sensitive design and LID Techniques were considered during the planning and design of the project:

- ☐ No disturbance to any Wetland Resource Areas
- ☐ Site Design Practices (e.g. clustered development, reduced frontage setbacks)
- ☐ Reduced Impervious Area (Redevelopment Only)
- ☐ Minimizing disturbance to existing trees and shrubs
- ☐ LID Site Design Credit Requested:
  - ☐ Credit 1
  - ☐ Credit 2
  - ☐ Credit 3
- ☐ Use of "country drainage" versus curb and gutter conveyance and pipe
- ☐ Bioretention Cells (includes Rain Gardens)
- ☐ Constructed Stormwater Wetlands (includes Gravel Wetlands designs)
- ☐ Treebox Filter
- ☐ Water Quality Swale
- ☐ Grass Channel
- ☐ Green Roof
- ☐ Other (describe): _____

Standard 1: No New Untreated Discharges

- ☒ No new untreated discharges
- ☐ Outlets have been designed so there is no erosion or scour to wetlands and waters of the Commonwealth
- ☒ Supporting calculations specified in Volume 3 of the Massachusetts Stormwater Handbook included.

Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

☐ Standard 2 waiver requested because the project is located in land subject to coastal storm flowage and stormwater discharge is to a wetland subject to coastal flooding.

☒ Evaluation provided to determine whether off-site flooding increases during the 100-year 24-hour storm.

☒ Calculations provided to show that post-development peak discharge rates do not exceed pre-development rates for the 2-year and 10-year 24-hour storms. If evaluation shows that off-site flooding increases during the 100-year 24-hour storm, calculations are also provided to show that post-development peak discharge rates do not exceed pre-development rates for the 100-year 24-hour storm.

Standard 3: Recharge

☒ Soil Analysis provided.

☒ Required Recharge Volume calculation provided.

☐ Required Recharge volume reduced through use of the LID site Design Credits.

☒ Sizing the infiltration, BMPs is based on the following method: Check the method used.

☒ Static ☐ Simple Dynamic ☐ Dynamic Field[1]

☒ Runoff from all impervious areas at the site discharging to the infiltration BMP.

☐ Runoff from all impervious areas at the site is *not* discharging to the infiltration BMP and calculations are provided showing that the drainage area contributing runoff to the infiltration BMPs is sufficient to generate the required recharge volume.

☒ Recharge BMPs have been sized to infiltrate the Required Recharge Volume.

☐ Recharge BMPs have been sized to infiltrate the Required Recharge Volume *only* to the maximum extent practicable for the following reason:

- ☐ Site is comprised solely of C and D soils and/or bedrock at the land surface
- ☐ M.G.L. c. 21E sites pursuant to 310 CMR 40.0000
- ☐ Solid Waste Landfill pursuant to 310 CMR 19.000
- ☐ Project is otherwise subject to Stormwater Management Standards only to the maximum extent practicable.

☒ Calculations showing that the infiltration BMPs will drain in 72 hours are provided.

☐ Property includes a M.G.L. c. 21E site or a solid waste landfill and a mounding analysis is included.

[1] 80% TSS removal is required prior to discharge to infiltration BMP if Dynamic Field method is used.

Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

☐ The infiltration BMP is used to attenuate peak flows during storms greater than or equal to the 10-year 24-hour storm and separation to seasonal high groundwater is less than 4 feet and a mounding analysis is provided.

☐ Documentation is provided showing that infiltration BMPs do not adversely impact nearby wetland resource areas.

Standard 4: Water Quality

The Long-Term Pollution Prevention Plan typically includes the following:

- Good housekeeping practices;
- Provisions for storing materials and waste products inside or under cover;
- Vehicle washing controls;
- Requirements for routine inspections and maintenance of stormwater BMPs;
- Spill prevention and response plans;
- Provisions for maintenance of lawns, gardens, and other landscaped areas;
- Requirements for storage and use of fertilizers, herbicides, and pesticides;
- Pet waste management provisions;
- Provisions for operation and management of septic systems;
- Provisions for solid waste management;
- Snow disposal and plowing plans relative to Wetland Resource Areas;
- Winter Road Salt and/or Sand Use and Storage restrictions;
- Street sweeping schedules;
- Provisions for prevention of illicit discharges to the stormwater management system;
- Documentation that Stormwater BMPs are designed to provide for shutdown and containment in the event of a spill or discharges to or near critical areas or from LUHPPL;
- Training for staff or personnel involved with implementing Long-Term Pollution Prevention Plan;
- List of Emergency contacts for implementing Long-Term Pollution Prevention Plan.

☐ A Long-Term Pollution Prevention Plan is attached to Stormwater Report and is included as an attachment to the Wetlands Notice of Intent.

☒ Treatment BMPs subject to the 44% TSS removal pretreatment requirement and the one inch rule for calculating the water quality volume are included, and discharge:

- ☐ is within the Zone II or Interim Wellhead Protection Area
- ☐ is near or to other critical areas
- ☒ is within soils with a rapid infiltration rate (greater than 2.4 inches per hour)
- ☐ involves runoff from land uses with higher potential pollutant loads.

☐ The Required Water Quality Volume is reduced through use of the LID site Design Credits.

☒ Calculations documenting that the treatment train meets the 80% TSS removal requirement and, if applicable, the 44% TSS removal pretreatment requirement, are provided.

Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

☒ The BMP is sized (and calculations provided) based on:

- ☒ The ½" or 1" Water Quality Volume or
- ☐ The equivalent flow rate associated with the Water Quality Volume and documentation is provided showing that the BMP treats the required water quality volume.

☒ The applicant proposes to use proprietary BMPs, and documentation supporting use of proprietary BMP and proposed TSS removal rate is provided. This documentation may be in the form of the propriety BMP checklist found in Volume 2, Chapter 4 of the Massachusetts Stormwater Handbook and submitting copies of the TARP Report, STEP Report, and/or other third party studies verifying performance of the proprietary BMPs.

☐ A TMDL exists that indicates a need to reduce pollutants other than TSS and documentation showing that the BMPs selected are consistent with the TMDL is provided.

Standard 5: Land Uses With Higher Potential Pollutant Loads (LUHPPLs)

☐ The NPDES Multi-Sector General Permit covers the land use and the Stormwater Pollution Prevention Plan (SWPPP) has been included with the Stormwater Report.

☐ The NPDES Multi-Sector General Permit covers the land use and the SWPPP will be submitted ***prior to*** the discharge of stormwater to the post-construction stormwater BMPs.

☐ The NPDES Multi-Sector General Permit does ***not*** cover the land use.

☐ LUHPPLs are located at the site and industry specific source control and pollution prevention measures have been proposed to reduce or eliminate the exposure of LUHPPLs to rain, snow, snow melt and runoff, and been included in the long term Pollution Prevention Plan.

☐ All exposure has been eliminated.

☐ All exposure has ***not*** been eliminated and all BMPs selected are on MassDEP LUHPPL list.

☐ The LUHPPL has the potential to generate runoff with moderate to higher concentrations of oil and grease (e.g. all parking lots with >1000 vehicle trips per day) and the treatment train includes an oil grit separator, a filtering bioretention area, a sand filter or equivalent.

Standard 6: Critical Areas

☐ The discharge is near or to a critical area and the treatment train includes only BMPs that MassDEP has approved for stormwater discharges to or near that particular class of critical area.

☐ Critical areas and BMPs are identified in the Stormwater Report.

Checklist for Stormwater Report

Checklist (continued)

Standard 7: Redevelopments and Other Projects Subject to the Standards only to the maximum extent practicable

☐ The project is subject to the Stormwater Management Standards only to the maximum Extent Practicable as a:

- ☐ Limited Project
- ☐ Small Residential Projects: 5-9 single family houses or 5-9 units in a multi-family development provided there is no discharge that may potentially affect a critical area.
- ☐ Small Residential Projects: 2-4 single family houses or 2-4 units in a multi-family development with a discharge to a critical area
- ☐ Marina and/or boatyard provided the hull painting, service and maintenance areas are protected from exposure to rain, snow, snow melt and runoff
- ☐ Bike Path and/or Foot Path
- ☐ Redevelopment Project
- ☐ Redevelopment portion of mix of new and redevelopment.

☐ Certain standards are not fully met (Standard No. 1, 8, 9, and 10 must always be fully met) and an explanation of why these standards are not met is contained in the Stormwater Report.

☐ The project involves redevelopment and a description of all measures that have been taken to improve existing conditions is provided in the Stormwater Report. The redevelopment checklist found in Volume 2 Chapter 3 of the Massachusetts Stormwater Handbook may be used to document that the proposed stormwater management system (a) complies with Standards 2, 3 and the pretreatment and structural BMP requirements of Standards 4-6 to the maximum extent practicable and (b) improves existing conditions.

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control

A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan must include the following information:

- Narrative;
- Construction Period Operation and Maintenance Plan;
- Names of Persons or Entity Responsible for Plan Compliance;
- Construction Period Pollution Prevention Measures;
- Erosion and Sedimentation Control Plan Drawings;
- Detail drawings and specifications for erosion control BMPs, including sizing calculations;
- Vegetation Planning;
- Site Development Plan;
- Construction Sequencing Plan;
- Sequencing of Erosion and Sedimentation Controls;
- Operation and Maintenance of Erosion and Sedimentation Controls;
- Inspection Schedule;
- Maintenance Schedule;
- Inspection and Maintenance Log Form.

☐ A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan containing the information set forth above has been included in the Stormwater Report.

Checklist for Stormwater Report

Checklist (continued)

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control (continued)

☐ The project is highly complex and information is included in the Stormwater Report that explains why it is not possible to submit the Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan with the application. A Construction Period Pollution Prevention and Erosion and Sedimentation Control has ***not*** been included in the Stormwater Report but will be submitted ***before*** land disturbance begins.

☐ The project is ***not*** covered by a NPDES Construction General Permit.

☐ The project is covered by a NPDES Construction General Permit and a copy of the SWPPP is in the Stormwater Report.

☒ The project is covered by a NPDES Construction General Permit but no SWPPP been submitted. The SWPPP will be submitted BEFORE land disturbance begins.

Standard 9: Operation and Maintenance Plan

☒ The Post Construction Operation and Maintenance Plan is included in the Stormwater Report and includes the following information:

- ☒ Name of the stormwater management system owners;
- ☒ Party responsible for operation and maintenance;
- ☒ Schedule for implementation of routine and non-routine maintenance tasks;
- ☒ Plan showing the location of all stormwater BMPs maintenance access areas;
- ☐ Description and delineation of public safety features;
- ☒ Estimated operation and maintenance budget; and
- ☒ Operation and Maintenance Log Form.

☐ The responsible party is ***not*** the owner of the parcel where the BMP is located and the Stormwater Report includes the following submissions:

- ☐ A copy of the legal instrument (deed, homeowner's association, utility trust or other legal entity) that establishes the terms of and legal responsibility for the operation and maintenance of the project site stormwater BMPs;
- ☐ A plan and easement deed that allows site access for the legal entity to operate and maintain BMP functions.

Standard 10: Prohibition of Illicit Discharges

☐ The Long-Term Pollution Prevention Plan includes measures to prevent illicit discharges;

☐ An Illicit Discharge Compliance Statement is attached;

☒ NO Illicit Discharge Compliance Statement is attached but will be submitted ***prior to*** the discharge of any stormwater to post-construction BMPs.

Appendix G

Operations and Maintenance Plan

Operations and Maintenance Plan
Needham Mews
692 & 744 Greendale Avenue
Needham, Massachusetts

Submitted to:
Town of Needham

April 12, 2013

Table of Contents

1.0 Introduction

This long-term Stormwater Management System Operations and Maintenance (O&M) Plan, filed with the Town of Needham, shall be implemented at the Needham Mews residential community development at 692 & 744 Greendale Avenue to ensure that the stormwater management system functions as designed. The Owner possesses the primary responsibility for overseeing and implementing the O&M Plan and assigning a Property Manager who will be responsible for the proper operation and maintenance of the stormwater structures. In case of transfer of property ownership, future property owners shall be notified of the presence of the stormwater management system and the requirements for proper implementation of the O&M Plan. Included in the manual is a log for tracking inspections and maintenance of key components of the stormwater management system.

The stormwater management system protects and enhances the stormwater runoff water quality through the removal of sediment and pollutants, and source control significantly reduces the amount of pollutants entering the system. Preventive maintenance of the system will include a comprehensive source reduction program of regular pavement sweeping and litter removal, prohibitions on the use of pesticides, and maintenance of designated waste and recycling areas.

1.1 Responsibility

The purpose of the Stormwater Operations and Maintenance (O&M) plan is to ensure inspections of the system, removal of accumulated sediments, oils, and debris, and implementation of corrective action and record keeping activities. The ongoing responsibility is the Owner, its successors and assigns. Adequate maintenance is defined in this document as good working condition.

Owner contact information is provided below:

Responsibility for Operations and Maintenance

Name:	Greendale Avenue Venture LLC c/o Mill Creek Residential Trust, LLC
Address:	15 New England Executive Park
City, State:	Burlington, MA 01803
Contact:	Robert D. Hewitt
Telephone:	(781) 685-4698

1.2 Documentation

An Inspection and Maintenance Record Log and Schedule will be kept by the Owner or Property Manager summarizing inspections, maintenance, repairs 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. Inspection & Maintenance Logs will be kept on file at the on-site Property Management office.

The Town of Needham has the right to enter the property at reasonable times and in a reasonable manner for the purpose of inspecting the stormwater management components and to review the Inspection and Maintenance Log.

2.0 Maintenance Program

The Owner, Property Manager and maintenance staff will conduct the Operation and Maintenance program set forth in this document. The Owner or Property Manager will ensure that inspections and record keeping are timely and accurate and that cleaning and maintenance are performed in accordance with the recommended frequency for each stormwater component. The Owner or Property Manager will also maintain all drainage components to function as they were designed to. Inspection & Maintenance Log Forms (provided herein) shall include the date and the amount of the last significant storm event in excess of 1" of rain in a 24-hour period, physical conditions of the structures, depth of sediment in structures, evidence of overtopping or debris blockage and maintenance required of each structure. Estimated annual cost of the Maintenance Program is $3,000 to $5,000.

2.1 Inspection and Maintenance Frequency

The following areas, facilities and measures will be inspected by the Owner or Property Manager and maintained as specified below. Identified deficiencies will be corrected. Accumulated sediments and debris will be properly handled and disposed of off-site, in accordance with local, state, and federal guidelines and regulations.

2.1.1 Yard Drains

Yard drains are incorporated into the stormwater management system to collect runoff from landscape areas. The drains are located in low-gradient areas and tie into the storm drainage piping system. The yard drains should be clear of any obstruction or debris in order to operate properly. Typical observations that would indicate that yard drains are not functioning properly are: sediment/trash accumulation around the inlet, vegetation growth within the yard drain and puddles around the yard drain grates after a storm event.

Yard drains will be inspected twice per year (April and October) to ensure that they are working in their intended fashion and free of debris. Sediments will be properly handled and disposed of off-site. The method of sediment removal will be by manual or vacuum as necessary and disposal must be documented. Any structural damage to drains or to castings must be repaired upon discovery.

2.1.2 Catch Basins

Catch basins with 4-foot deep sumps and hooded outlets will be inspected twice per year (April and October) and cleaned when sediment reaches ½ full depth from the invert of the pipe to ensure that the catch basins are working in their intended fashion and that they are free of debris. The basin outlet equipped with a hood/tee to trap floatable materials should be checked to ensure that the watertight seal is working. Sediments and hydrocarbons will be properly handled and disposed of off-site, in accordance with local, state, and federal guidelines and regulations. The method of sediment removal will be by vacuum and disposal must be documented. Any structural damage to catch basins or to castings must be repaired upon discovery.

2.1.3 Drain Manholes

Drain manholes shall be inspected on twice per year (April and October). Collection of accumulated sediment and hydrocarbons will be accomplished by means of vacuum pumping. Disposal of accumulated sediment and hydrocarbons will be performed in accordance with applicable local, state and federal regulations. Any structural damage to drain manholes or to castings must be repaired upon discovery.

2.1.4 Stormceptor® Water Quality Structures

Stormceptor units will be inspected twice per year (April and October) and cleaned when the sediment depth reaches 15% of storage capacity. Sediments and hydrocarbons will be properly handled and disposed of off-site in accordance with local, state and federal guidelines and regulations. In addition, inspections must be made immediately after an oil, fuel or chemical spill. A licensed waste management company must remove captured petroleum waste products and dispose responsibly in accordance with local, state and federal guidelines and regulations.

2.1.5 Subsurface Infiltration Systems

The Cultec Recharger 900HD subsurface infiltration systems will be inspected twice per year (April and October) by removing the inspection port cover located over the inlet row to provide access to the Cultec chambers below. Through this access port, a stadia rod may be used to measure depth of accumulated sediment. Cleaning is required if the depth of sediment is in excess of 3 inches and is accomplished through an upstream manhole utilizing a high-pressure culvert cleaning nozzle. The inlet row of the Cultec system is placed on a polyethylene liner to facilitate the flushing and prevent scouring of the washed stone beneath this row. The culvert cleaning nozzle is deployed through an upstream manhole and extended to the end of the row. The water is turned on and the inlet row is flushed back into the manhole and removed using a vacuum truck. Sediments and hydrocarbons will be properly handled and disposed of off-site in accordance with local, state and federal guidelines and regulations.

2.1.6 Flared End Outlets

A flared end outlet with rip rap stone is provided at the drainage outfall at the low-gradient end of the site. Typical observations that would indicate that the flared end outlet is not functioning properly are: sediment/trash accumulation around the outlet, erosion, vegetation growth through the rip rap, and dislodged rip rap. Flared end outlets and rip rap will be inspected twice per year (April and October) or as necessary to ensure that they are working in their intended fashion and free of debris. Remove any obstructions to flow; remove accumulated sediments and debris at the outlet and within the conduit and repair any erosion damage.

2.1.7 Vegetated Embankment 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. If erosion is evident, armor the area with an appropriate lining or riprap stone.

2.1.8 Site Access Drive

Accumulations of sand and debris will be cleared from the paved site access drives through mechanical sweeping. The sweeping program is a highly effective source control measure to reduce pollutant loading in stormwater by removing sand and contaminants directly from paved surfaces before they become mobilized during rain events and transported to the drainage system. Pavement sweeping will be conducted twice per year (April and October) or more often as necessary. Sweeping is most important in Spring after winter snowmelt when road sand and other sediments have accumulated.

3.0 Sample Inspection Forms

Inspection and Maintenance Log

INSPECTOR: _____ YEAR: _____

RAINFALL INSPECTION DATE: _____ RAINFALL AMOUNT: _____

Component to be inspected	Frequency	Date Performed	Action to be Taken	Comments
Yard Drains	Inspections Twice per Year	April and October	Remove sediment and debris	
Catch Basins	Inspections Twice per Year	April and October	Remove sediment and debris	
Drain Manholes	Inspections Twice per Year	April and October	Remove sediment and debris	
Stormceptors	Inspections Twice per Year	April and October	Maintenance as necessary-remove sediment and hydrocarbons	
Subsurface Infiltration Cultec Systems	Inspections Twice per Year	April and October	Maintenance as necessary-power flush and remove sediment	
Flared End Outlets	Inspections Twice per Year	April and October	Remove sediment and debris	
Vegetated Areas	Inspections Twice per Year	April and October	Replant bare spots and eroded areas as necessary	
Site Access Drive	Inspections Twice per Year	April and October	Street Sweeping	

YARD DRAIN INSPECTION FORM

Needham Mews
692 & 744 Greendale Avenue
Needham, Massachusetts

Owner: _____

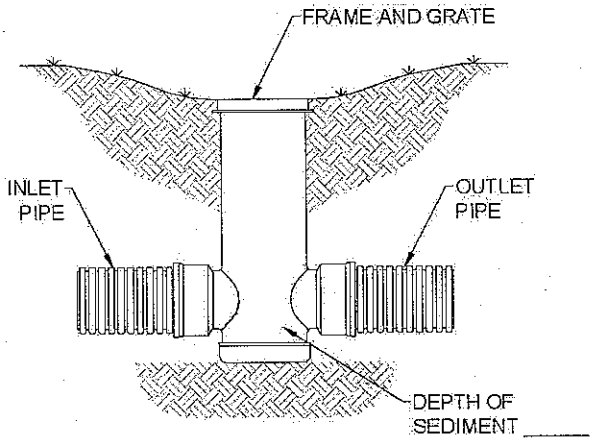
Property Manager: _____

Inspected By: _____

Date of Inspection: _____

Yard Drain Inspected: _____

	Acceptable	Needs Work	Notes



Date of Cleaning: _____ By Whom: _____

Date of Repair: _____ By Whom: _____

Note any discrepancies and suggested corrective actions:

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CATCH BASIN INSPECTION FORM

Needham Mews
692 & 744 Greendale Avenue
Needham, Massachusetts

Owner: _____

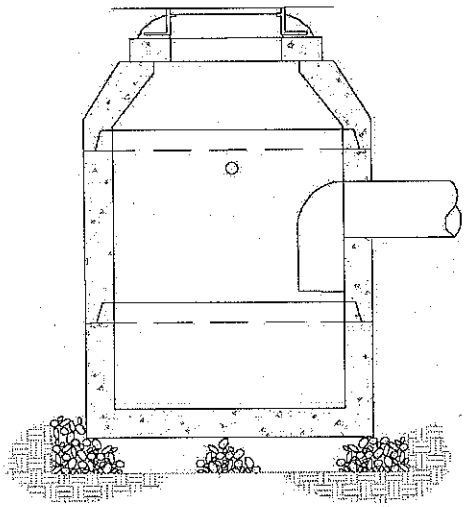
Property Manager: _____

Inspected By: _____

Date of Inspection: _____

Catch Basin Inspected: _____

	Acceptable	Needs Work	Notes



Date of Cleaning: _____ By Whom: _____

Date of Repair: _____ By Whom: _____

Note any discrepancies and suggested corrective actions:

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DRAIN MANHOLE INSPECTION FORM

Needham Mews
692 & 744 Greendale Avenue
Needham, Massachusetts

Owner: _____

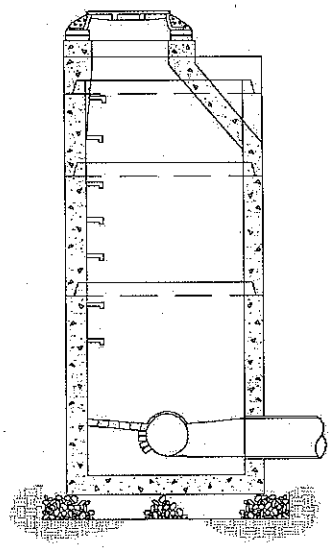
Property Manager: _____

Inspected By: _____

Date of Inspection: _____

Drain Manhole Inspected: _____

	Acceptable	Needs Work	Notes



Date of Cleaning: _____ By Whom: _____

Date of Repair: _____ By Whom: _____

Note any discrepancies and suggested corrective actions:

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STORMCEPTOR INSPECTION FORM

Needham Mews
692 & 744 Greendale Avenue
Needham, Massachusetts

Owner: _____

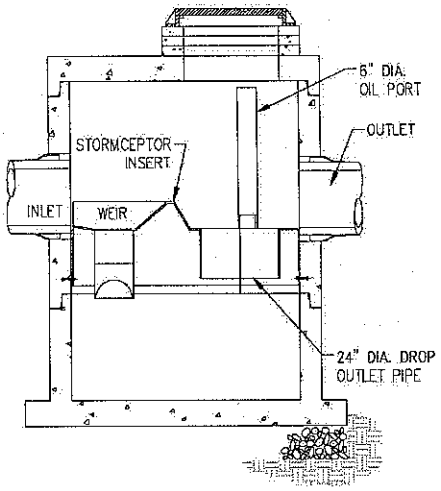
Property Manager: _____

Inspected By: _____

Date of Inspection: _____

Stormceptor Inspected: _____

	Acceptable	Needs Work	Notes



Date of Cleaning: _____ By Whom: _____

Date of Repair: _____ By Whom: _____

Note any discrepancies and suggested corrective actions:

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SUBSURFACE INFILTRATION CULTEC SYSTEM INSPECTION FORM

Needham Mews
692 & 744 Greendale Avenue
Needham, Massachusetts

Owner: _____

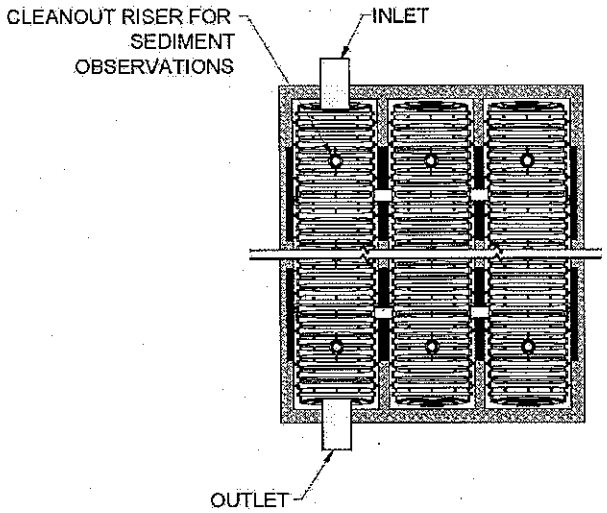
Property Manager: _____

Inspected By: _____

Date of Inspection: _____

System Inspected: _____

	Acceptable	Needs Work	Notes



Date of Cleaning: _____ By Whom: _____

Date of Repair: _____ By Whom: _____

Note any discrepancies and suggested corrective actions:

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FLARED END OUTLET INSPECTION FORM

Needham Mews
692 & 744 Greendale Avenue
Needham, Massachusetts

Owner: _____

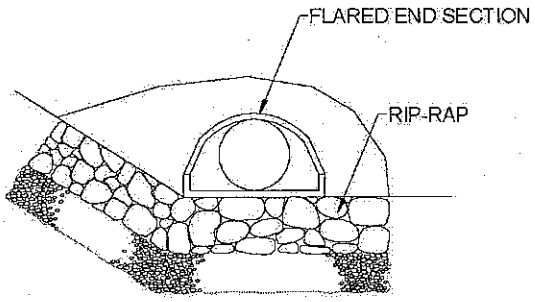
Property Manager: _____

Inspected By: _____

Date of Inspection: _____

Flared End Section Inspected: _____

	Acceptable	Needs Work	Notes



Date of Cleaning: _____ By Whom: _____

Date of Repair: _____ By Whom: _____

Note any discrepancies and suggested corrective actions:

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