Phase 1: Lincoln Street Subwatershed Nutrient Control Strategies

FINAL REPORT - JUNE 2017

Water Integration for Squamscott-Exeter (WISE) Integrated Plan

Prepared for:

Town of Exeter, New Hampshire

Prepared by:

Waterstone Engineering, PLLC

Funded by:

NOAA Office for Coastal Management
NH Coastal Program

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FINAL REPORT

Project:

Water Integration for Squamscott-Exeter (WISE) Integrated Plan

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ACRONYMS

AOC	Administrative Order on Consent
BMP	Best Management Practice
CSO	Combined Sewer Overflows
CIP	Capital Improvement Plans
CWA	Clean Water Act
EPA	United States Environmental Protection Agency
GBNNPSS	Great Bay Nutrient Nonpoint Source Study
GI	Green Infrastructure
HRU	Hydrologic Response Unit
I/I	Inflow and Infiltration
IP	Integrated Planning
LID	Low Impact Development
MEP	Maximum Extent Practicable
MS4	Municipal Separate Storm Sewer System
NHDES	New Hampshire Department of Environmental Services
NLM	Nitrogen Load Model
NPDES	National Pollution Discharge Elimination System
NPS	Nonpoint source pollution
NRCS	Natural Resources Conservation Service
O&M	Operations and Maintenance
ORIWMP	Oyster River Integrated Watershed Management Plan
PREP	Piscataqua Region Estuaries Partnership
PTAPP	Pollution Tracking and Accounting Pilot Program
ROW	Right-of-way
SSO	Sanitary Sewer Overflow
SWMM	EPA Stormwater Management Model
TMDL	Total Maximum Daily Load
TN	Total Nitrgen
UNH	University of New Hampshire
WISE	Water Integration for the Squamscott-Exeter
WLA	Waste Load Allocation
WQRP	Water Quality Response Plan
WWTF	Wastewater Treatment Facility

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EXECUTIVE SUMMARY

What is the Lincoln Street Subwatershed Nutrient Control Strategies Report?

This report presents information from the Lincoln Street Subwatershed Nutrient Control Strategies, Phase 1, Water Integration for Squamscott-Exeter (WISE) Integrated Plan. This project (conducted from 2016-2017) builds upon recommended activities detailed in the Plan which will help satisfy permit requirements for wastewater and stormwater management and increase climate resiliency for municipal drainage infrastructure.

This project provides a plan and design to support the 2017-2018 Lincoln Street Capital Improvement Plan for Utilities and Road Reconstruction. The capital project is based on a complete street approach that balances mobility and safety for all users while creating a healthier place – socially, environmentally, and for the local economy. A complete street approach combines the use of green infrastructure with attractive public spaces for the community and local businesses to help reduce nitrogen and flooding from stormwater runoff. This project conducted watershed planning and designs for green infrastructure strategies in the Town's largest subwatershed for use in future CIP, and grant program applications. The project uses recommendations from the 2015 Integrated Plan and involved priority sites with the highest pollutant load that discharge directly to the Squamscott-Exeter River.

The project has four primary objectives:

1. Increasing municipal capacity to identify and implement feasible and cost effective nutrient control strategies by beginning the implementation of the WISE Integrated Plan through the use of Plan recommendations and best management practice (BMP) sizing tools.

2. Reduce nitrogen load from a series of BMPs throughout the Lincoln Street subwatershed.

3. Increase climate resiliency by reducing flooding through installation of BMPs.

4. Development of construction-ready green infrastructure designs for inclusion in future capital improvement projects in Exeter's largest subwatershed.

Why Nutrient Control Planning?

New Hampshire coastal communities have experienced rising populations resulting in an increase in development in point source and non-point source nitrogen loads. As communities respond to new federal permit requirements for treating and discharging stormwater and wastewater, meeting regulatory requirements requires innovative ways to find effective and affordable means to meet water quality goals. Integrated Planning allows flexibility in permitting of wastewater and stormwater controls to plan for the most cost-effective measures first while still meeting regulatory standards that protect public health and water quality. It encourages the use of green infrastructure which manages stormwater as a resource, and supports other economic and quality of life benefits. Integrated planning is being shown to have great cost-efficiencies through the comprehensive management of wastewater, stormwater and nonpoint sources.

Major Findings

- Four priority locations were identified as feasible retrofits which include 14 individual stormwater best management practices (BMPs).
- Small BMPs designed to treat the first flush provide the greatest cost-effective nitrogen controls with 13 BMPs sized to treat 0.25-0.5" water quality volume.
- Implementation of these BMPs is expected to reduce nitrogen loading by 300 pounds per year and total runoff volume by 24 million gallons per year.
- The total cost for the 14 BMPs is estimated at $309,800 at an average unit cost of $1,040 per pound of nitrogen.

Project Team

The project team included Paul Vlasich, Town Engineer, Jennifer Mates, Assistant Town Engineer, Jay Perkins, Road Agent, Daniel Lewis, Engineering Technician, Jennifer Perry, Public Works Director from the Town of Exeter, Robert Roseen, Project Director, Jake Sahl, Modeler and Analyst from Waterstone Engineering, Sally Soule, Grant Manager, Steve Couture, Supervisor, of the New Hampshire Coastal Program.

Funding was provided by the New Hampshire Coastal Program for a project titled *Phase 1: Lincoln Street Subwatershed Nutrient Control Strategies, Water Integration for Squamscott-Exeter (WISE) Integrated Plan.*

1. INTRODUCTION

This project summary presents information from the Water Integration for Squamscott-Exeter (WISE) Integrated Plan Phase 1: Lincoln Street Subwatershed Nutrient Control Strategies by Waterstone Engineering. The project builds upon recommended activities detailed in the Plan which will satisfy permit requirements for wastewater and stormwater.

The study area is Exeter's largest watershed (S10[1]) totaling 179 acres and comprised of 2 subwatersheds, the upper watershed area to the west (S10 West), and the lower area to the east of the railroad tracks (S10 East) which encompasses Lincoln Street. These areas drain underneath Phillips Exeter Academy to a known area of flooding concern along Tan Lane, the location of which makes upsizing sewer infrastructure very difficult. Management of upstream runoff will reduce flood vulnerability and provide water quality treatment in a more cost-effective manner than simply upgrading pipe size and capacity. Previous studies[2] used a drainage infrastructure model to identify several areas of concern within the watershed based on the likelihood of flooding. The flood risk at these locations (shown in Figure 1) has been confirmed by town staff. Using geospatial data for stormsewer lines, manholes, catch basins, and topography, drainage infrastructure components were categorized based on their watershed area. This allowed the project team to identify several sites where BMP installations would have large drainage areas and thus a significant potential to reduce flooding and improve water quality within the watershed.

This project identified locations and calculated the potential benefits from BMPs for nutrient management and climate resiliency. This report identifies locations of potential BMPs and presents estimates of the nitrogen load and storm volume reduction using BMP performance curves[3]. A suite of 14 priority BMPs were modeled for flood reduction potential and costing and 95% concept designs were completed for each.

[1] Drainage Area Map Package, Town of Exeter, December 29, 2014
[2] Climate Adaptation for Exeter (CAPE) Project, 2016
[3] Water Integration for Squamscott Exeter (WISE, 2015), Draft Integrated Plan

2. BACKGROUND

Like many coastal regions, population growth and development in Exeter has contributed to an increase in impervious cover and has led to increased pollutant loads and stormwater runoff. As more impervious surface is added, flooding risks are elevated and water quality is impacted. Recent documented changes in climate have resulted in higher-intensity precipitation events, increased rainfall depth, and greater variations in storm duration and frequency which increase these risks and impacts.

In 2009, NHDES concluded that many sub-estuaries in the Great Bay Estuary were impaired by nitrogen, and the Great Bay was placed on the Clean Water Act (CWA) Sec. 303(d) list of impaired and threatened waters (NHDES, 2009). New and revised discharge permits in the watershed are now subject to additional nitrogen requirements including the National Pollutant Discharge Elimination System (NPDES) permits for wastewater treatment facilities, and Municipal Separate Storm Sewer Discharge (MS4) permits for stormwater. In 2012 EPA issued a new NPDES wastewater discharge permit to the Town of Exeter with a total nitrogen (TN) effluent limit of 3 mg/l. The Town subsequently negotiated an Administrative Order of Consent (AOC) with the EPA that allows a staged approach to TN reduction, allowing 5 years to construct a facility to treat nitrogen to meet a limit of 8 mg/l TN, followed by continued upgrades and reductions in TN. The AOC requires a *Total Nitrogen Nonpoint and Point Source Stormwater Control Plan* by September 30, 2018. The plan must include a schedule for implementing specific nitrogen control measures. In addition, the new 2017 NH Small MS4, which becomes effective in 2018, includes significant new elements such as a focus on illicit discharge detection and elimination, and nutrient management through BMP retrofits. The town approved funding for a $49.9 million new wastewater plant in March 2017 through the NH Clean Water State Revolving Loan Fund. Construction began in June 2017 and is expected to be completed in 2018.

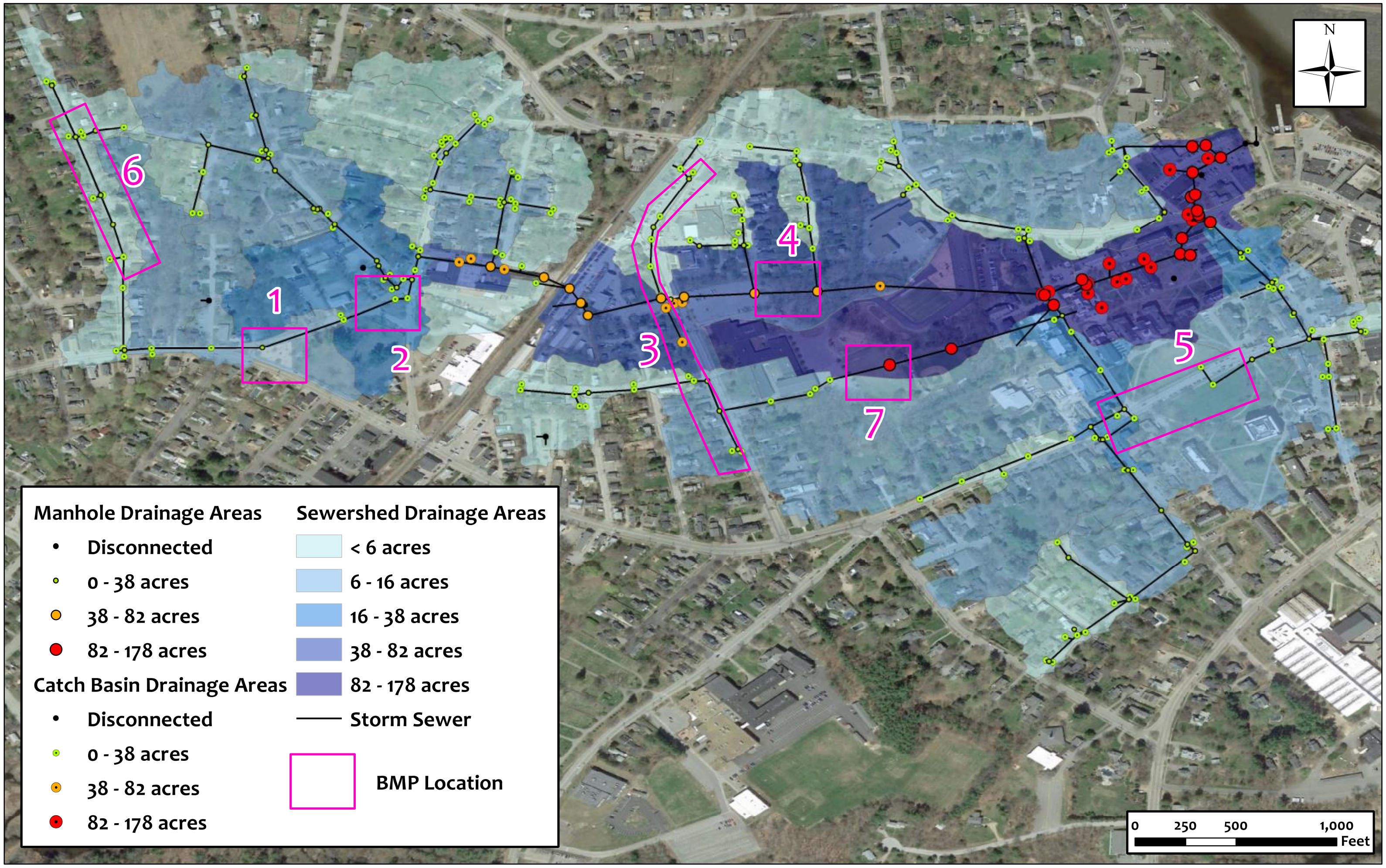


Figure 1: Areas of interest for BMP Retrofit

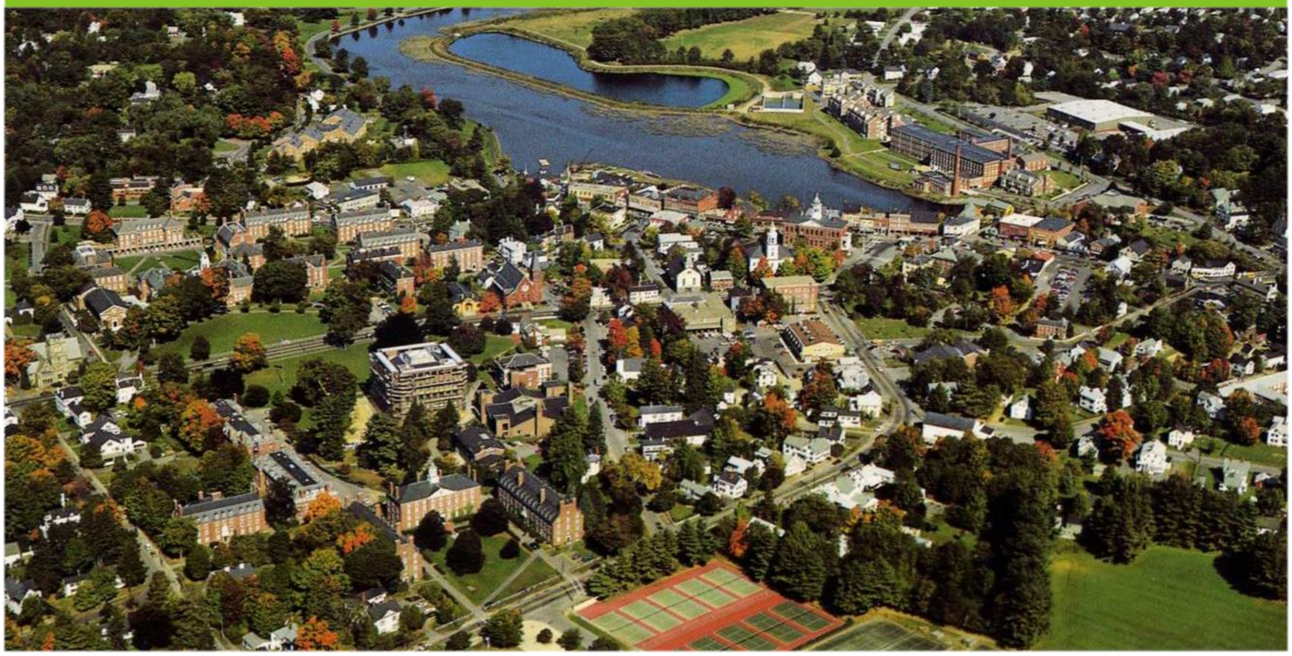
3. STORMWATER MANAGEMENT

In March 2015, the Water Integration for Squamscott-Exeter (WISE) project completed an Integrated Planning framework for three coastal communities including Exeter, Stratham, and Newfields to provide recommendations for affordably managing permits for wastewater and stormwater. A watershed level load model was developed to determine the nitrogen load to the Squamscott-Exeter estuary. The results represent a baseline assessment to quantify the economic and performance advantages of integration of water resource planning both at the municipal and inter-municipal level. This project seeks to build upon the WISE analysis to identify specific green infrastructure (GI) and low impact development (LID) practices that can be installed in Exeter to manage stormwater, reduce nutrient loads, and increase resiliency.

The new 2017 MS4 permit requires management of existing stormwater runoff in impaired watersheds. While new development is required to manage stormwater on-site, existing developments were constructed before stormwater management was required and modern criteria established. Retrofits include new installations or upgrades to existing best management practices (BMPs) in developed areas draining to impaired waters and their tributaries.

BMPs for stormwater management and nitrogen controls include both structural and non-structural practices to reduce runoff volume from stormwater sources such as impervious surfaces (rooftops and parking lots), residential areas, commercial/industrial/institutional properties, roads, outdoor recreational spaces (i.e., parks), agricultural areas, and managed turf (i.e., golf courses, lawn). Common BMPs for nutrient controls include biofiltration (bioretention, raingardens, tree planters), gravel wetlands, infiltration practices (dry wells, and subsurface infiltration), and porous pavements. The Plan lists a range of BMPs that were reviewed and vetted by the towns with respect to land use and practicality. A wealth of BMP sources exists in the literature and locally at the UNH Stormwater Center. A list of practices can be found in the New Hampshire Stormwater Manual on the NHDES website.

4. WATERSHED OVERVIEW



a. Watershed Status and Regulatory Framework

EPA is required to develop criteria (numeric or narrative) based on a determination that there exists a reasonable potential to cause or contribute to an impairment[4]. This determination is based on 'the best available science' at the time, which acknowledges that although our understanding of an ecosystem is necessarily incomplete, further delay in corrective measures will clearly contribute to increasing degradation. Permits may be issued to comply with numeric or narrative criteria. In 2009 NHDES developed draft numeric nutrient criteria for the protection of eelgrass and low dissolved oxygen conditions. In the absence of final numeric criteria EPA asserts the obligation and authority to issue effluent limitations based on narrative criteria and in 2012 EPA issued final WWTF discharge permits in Newmarket and Exeter based on a narrative TN nutrient criteria and a reasonable potential analysis. A 2014 Peer Review was critical of the draft numeric criteria after which the criteria were dropped as part of a 2014 settlement agreement between NHDES and the Municipal Coalition[5]. The standard upon which the Peer Review was tasked to review the draft numeric criteria was in part…" whether the available data support the conclusion that excess nitrogen was the primary factor that caused (1) the decline of eelgrass populations…"[6] This determination as the "primary factor that caused" is a higher standard than a "reasonable potential to cause or contribute". In 2012 the Environmental Appeals Board and, in 2013 the Supreme Court, upheld the basis

[4] Pg. 143, Section 5. Reasonable Potential Analysis and Effluent Limit Derivation, EPA. (2012). "Authorization to Discharge Under the National Pollutant Discharge Elimination System, The Town of Exeter, New Hampshire, Squamscott River." NPDES Permit No. NH0100871, Office of Ecosystem Protection, U.S. Environmental Protection Agency, Region I, Boston, Massachusetts.
[5] April 2014, Settlement Agreement between the Great Bay Municipal Coalition (Portsmouth, Dover, Rochester, NH) and the State of New Hampshire.
[6] Pg 46, section b) from the "Joint Report of Peer Review Panel-Great Bay Estuary", February 13, 2014 Victor J. Bierman, Robert J. Diaz, W. Judson Kenworthy, Kenneth H. Reckhow.

for this finding by EPA in determining effluent limitations[7]. In 2016, the Piscataqua Region Estuaries Partnership reconvened the technical advisory committee to review indicator trends and status. In so doing they convened a panel of experts including Jud Kenworthy, the eelgrass expert from the Peer Review, to review eelgrass stressors. They affirmed the position that nitrogen was indeed a major factor and has a reasonable potential to cause or contribute to the environmental problem.

b. Watershed Land Use and Growth Trends

Exeter has experienced substantial growth during the past 50 years. Understanding and mitigating impacts due to population increase, changes in land use and cover, and imperviousness are an essential element of effective management strategies. Since 1960 Exeter has experienced 98% population growth and a 20 year increase in impervious cover of 108% (Figure 2).

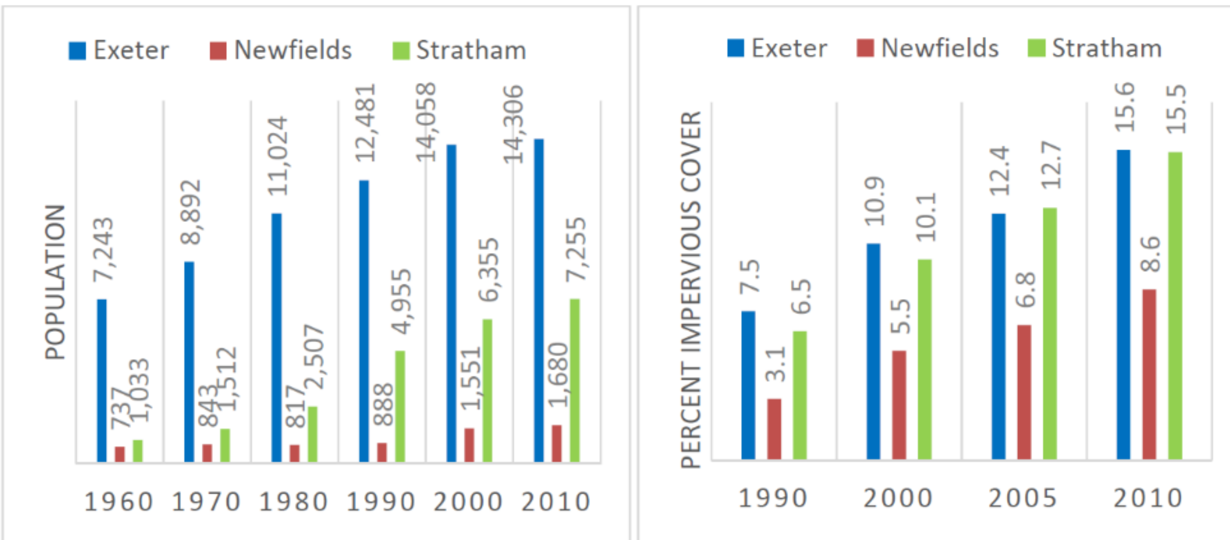


Figure 2 - Population and Impervious Cover changes in the Towns of Exeter, Newfields and Stratham

The study area is comprised of 2 distinct watersheds in terms of drainage infrastructure, the upper watershed area to the west (S10 West), and the lower area to the east of the railroad tracks (S10 East) as displayed in Figure 2. The total watershed is 41% impervious cover, 179 acres, and contributes an estimated 1,265 lbs of nitrogen annually, as shown in Table 1. The watershed land use is predominantly commercial, residential, and roadways. The upper watershed is 57 acres and contributes an estimated 390 lbs of nitrogen annually (Appendix A). The lower watershed, including Lincoln Street, is the larger of the two at 122 acres and contributes an estimated 876 lbs of nitrogen annually (Appendix A). These areas all drain into a 27” storm drain underneath Phillips Exeter Academy to a known area of flooding concern along Tan Lane, the location of which makes upsizing very difficult. Management of upstream runoff will reduce flood vulnerability and provide water quality treatment in a more cost-effective manner than simply upgrading pipe size and capacity. The growth trends in the area will require planning efforts and administrative tools to protect water quality. Communities are all in need of cost-effective strategies from meeting permit requirements to assist in balancing the range of competing municipal demands.

[7] (2012). "Upper Blackstone Water Pollution Dist. v. EPA." F. 3d, Court of Appeals, 1st Circuit, 9.

Table 1: Lincoln Street Total Watershed Characteristics

Land Use Type	Hydrologic Soil Group*	Area (acres)	Annual Nitrogen Export (lbs)**
Agriculture	A	0.04	0.02
	C/D	0.47	1.51
Commercial, Services, and Institutional	A	6.44	3.42
	C/D	15.48	41.48
	IMP	30.72	424.48
Forest	A	3.62	1.01
	C/D	2.69	3.88
	IMP	0.02	0.27
Industrial and Commercial Complexes	C/D	0.00	0.01
	IMP	0.77	10.64
Outdoor and Other Urban and Built-up Land	A	1.83	2.00
	C/D	6.15	34.07
	IMP	0.48	6.62
Residential	A	20.41	10.82
	C/D	47.59	127.53
	IMP	26.26	413.04
Transitional	A	0.09	0.02
	C/D	0.23	0.31
	IMP	0.19	2.68
Transportation, Communications, and Utilities	A	0.16	0.04
	C/D	0.14	0.17
	IMP	16.17	182.87
Totals		**179**	**1,265**

* Hydrologic soil group derived from landform. Watershed area was divided into 3 slope classes, 0-3%, 3-8%, and 8-15%. Dominant soil type for each slope class was assumed for entire slope class. Scitico silt loam for 0-3% slopes, Charlton fine sandy loam for others. **Based on WISE, 2015 PLERs

c. Environmental Impacts from Growth

Monitoring and research conducted by various university, local, state and federal programs and projects have documented stresses in the Great Bay system. Prominent drivers of change include watershed modification and development resulting in increased impervious cover; increased nutrient and pollutant loading from a rapidly growing coastal population; and ecosystem instability and loss of diversity caused by invasive species, habitat destruction, disease, and others. Each stress drives additional physical, chemical, and biological pressures on the Great Bay system that effect the environmental, lifestyle, and economic benefits valued by local communities. Environmental indicators used by the National Estuaries Program to identify and track ecosystem health clearly illustrate an ecosystem in trouble. In the most recent State of Our Estuaries 2013 report (PREP, 2013), 12 of 16 indicators showed a declining or cautionary condition. Impervious cover, an indicator of development, shows a long-term increasing trend which is related to condition indicators including nutrient concentration, eelgrass, dissolved oxygen, and macroalgae that show either no improvement or continued quality decline.

d. NPDES Wastewater Permit and Administrative Order of Consent

EPA Region 1 issues individual facility-specific permits for the discharge of treated domestic and industrial wastewater in the State of New Hampshire. Under these individual permits, the discharges will be limited and monitored by the permittee. Of the three WISE watershed communities, the Towns of Exeter and Newfields operate and discharge treated domestic wastewater.

In 2012 after several years of study and negotiations, EPA issued a new NPDES discharge permit to the Town of Exeter with a total nitrogen (TN) effluent limit of 3 mg/l. The Town subsequently negotiated an Administrative Order on Consent (AOC) with the EPA that allows a staged approach to TN reduction which allows 5 years to construct a facility which will treat nitrogen to meet a limit of 8 mg/l TN, followed by continued upgrades and reductions in TN. The AOC requires tracking and monitoring to ensure that load reductions goals and ecosystem response are on target.

e. Municipal Separate Storm Sewer System (MS4)

Under the MS4 program, towns with urbanized areas as defined by the US Census are required to obtain permit coverage for their stormwater discharges. Exeter is subject to the requirements of EPA’s 2017 NH Small MS4 General Permit for stormwater discharges. EPA released a final permit in 2017 which contained new provisions for the 6 Minimum Measures (MM):

1) Public Education and Outreach
2) Public Participation/Involvement
3) Illicit Discharge Detection and Elimination
4) Construction Site Runoff Control
5) Post-Construction Runoff Control
6) Pollution Prevention/Good Housekeeping

The draft permit also includes new requirements to develop Water Quality Response Plans (WQRPs) for stormwater outfalls that discharge to impaired water bodies. The WQRPs will assess all significant discharges to determine if they could contribute to the waterbody impairment and identify BMPs and a schedule for implementation to address the impairments.

f. EPA Integrated Planning Framework and Watershed Based Planning

The June 2012 EPA memorandum, “Integrated Municipal Stormwater and Wastewater Planning Approach Framework” provides guidance for EPA, States and local governments to develop and implement effective integrated plans that satisfy the CWA. The framework outlines the overarching principles and essential elements of a successful integrated plan which includes:

- Maintaining existing regulatory standards that protect public health and water quality.

- Allowing a municipality to balance CWA requirements in a manner that addresses the most pressing public health and environmental protection issues first.
- The responsibility to develop an integrated plan rests on the municipality that chooses to pursue the approach. EPA and/or the State will determine appropriate actions, which may include developing requirements and schedules in enforceable documents.
- Innovative technologies, including green infrastructure, are important tools that can generate many benefits, and may be fundamental aspects of municipalities' plans for integrated solutions.

The elements in the WISE plan are consistent with guidance issued by EPA to support integrated permit planning, as well as the Agency's nine-element watershed plans.

g. Municipal Regulations

For the Integrated Plan to be effective, future regulations will need to be adopted by Exeter that include: 1) provisions for new and redevelopment projects to require nitrogen controls, and 2) a means for tracking changes in significant land use activities that will impact the nitrogen load to surface waters. Exeter is participating in PTAPP (the Pollution Tracking and Accounting Pilot Program) which in June 2017 developed a draft uniform approach using a web based application that can be used by communities for MS4 and AOC tracking and accounting.

The March 2015 Piscataqua Region Environmental Planning Assessment report (PREPA) recommends Exeter adopt fertilizer application buffers for all surface waters, increase the no vegetation disturbance to 100' on tidal wetlands, and adopt the Southeast Watershed Alliance Model Stormwater Management Regulations.

h. Southeast Watershed Alliance Model Stormwater Management Regulations

The Southeast Watershed Alliance developed model stormwater standards in 2012, and revised in 2017, to provide minimum, consistent, and effective model stormwater management standards for communities in the Great Bay. These standards are intended to address some of the requirements for communities subject to the MS4 permit. The model standards include 7 critical core elements: Applicability Standards, Minimum Thresholds for Applicability, Best Management Practices, Applicability for Redevelopment, Stormwater Management Plan Approval and Recordation, Maintenance Criteria, Inspection of Infrastructure.

i. Impaired Waters

The Clean Water Act requires each state to submit a list of impaired waters to the U.S. Environmental Protection Agency every two years. Listing of impaired waters (303d list) includes surface waters that:

- Are impaired or threatened by a pollutant or pollutant(s),
- Are not expected to meet water quality standards within a reasonable time even after application of best available technology standards for point sources or best management practices for nonpoint sources and,
- Require development and implementation of a comprehensive water quality study (i.e., called a Total Maximum Daily Load or TMDL study) that is designed to meet water quality standards.

As of the final 2008 listing, the impaired waters within the Town of Exeter include: Dudley Brook; Norris Brook; Little River; Squamscott River; Wheelwright Creek- Parkman Brook; Exeter River; Colcord Pond; and Little River – Scamen Brook. Under the MS4, Exeter is required to manage the drainage area and infrastructure to receiving waters and implement controls to reduce sources of impairments.

5. Site Selection and BMP Feasibility

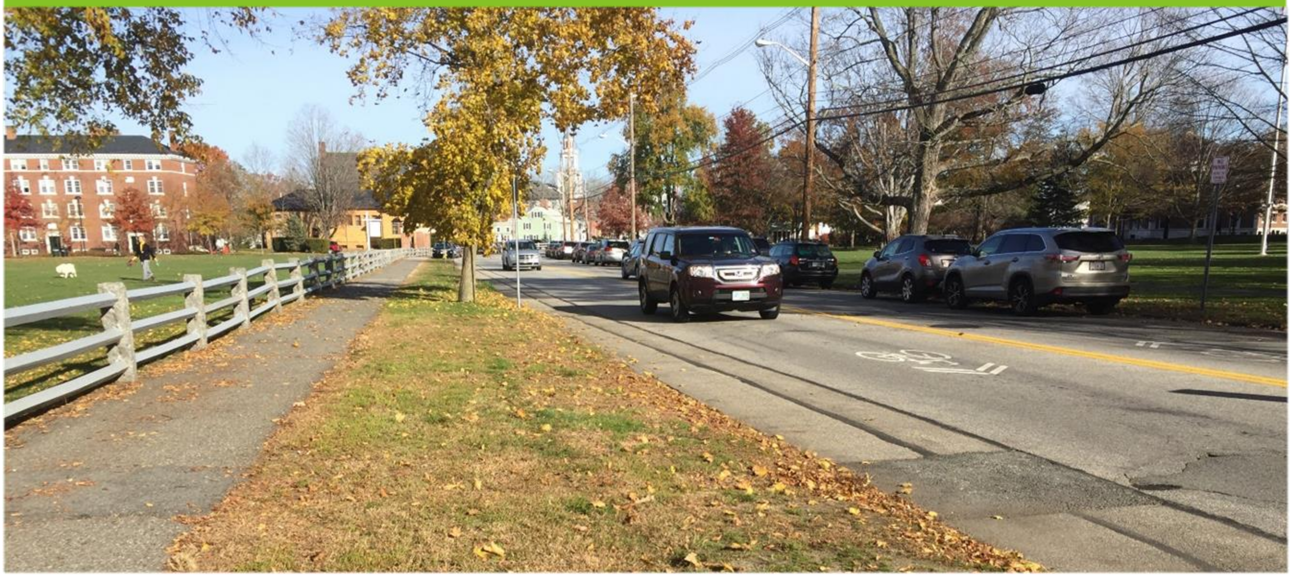
A field assessment was performed at each of the seven locations shown in Figure 1 to determine the soil classification and feasibility for BMP retrofit. Soil coring was conducted on November 28th, and December 6th-7th, 2016. Soils were sampled at six of the seven sites. The seventh site, located behind Lincoln Street Elementary School was too gravelly to be cored and the soil type of that site was assumed to be the same as that of sites 3 and 4 given the geographic proximity and similarity in landform characteristics (e.g. slope).

Soil cores indicated that 5 of the 6 sites are fine sandy loams with lower horizons as fine sands. The dominant soil type (found in sites 1, 2, 3, 4, 5, and also assumed to be found 7) is a 62B: Charlton Fine Sandy Loam[8]. The soil samples from site 6 were more characteristic of a 33A: Scitico Silt Loam[8] with largely clay and silt features below the upper horizon. Appendix B describes each site's soil type, hydrologic soil group, published saturated hydraulic conductivity, and also contains a detailed field soil log.

Based on the physical characteristics of each site, a few suitable BMP types were identified. Subsurface infiltration systems with pre-treatment are applicable in parks or open space locations that have enough available area to house large storage chambers intended to divert flow from within the storm drain network and thereby treat large upstream drainage areas. ROW retrofits are applicable within the roadside right-of-way (ROW) and designed to treat surface runoff from roads and surrounding areas through connection into the existing drainage network. These systems can include tree planters, bioretention, and/or infiltration for stormwater treatment.

[8] NRCS Soil Survey designation number and description

6. Best Management Practice Retrofit Opportunities



For each of the seven locations discussed above, a feasibility analysis was performed based on location, upstream drainage area, and soil characteristics to determine its potential for a BMP retrofit. The location of BMPs focused on the feasibility of utilizing publicly controlled areas such as right-of-ways, parks, and open spaces.

Figure 1 depicts the seven sites within the watershed that were chosen for assessment. Ultimately, a suite of 14 BMPs were chosen for installation at sites, 1, 2, 3, and 5. Table 2 presents the BMP and upstream drainage area characteristics for these 14 BMPs.

a. Example Best Management Practices for Nutrient Control and Climate Resiliency

There are several best management practices that can be used in municipal, commercial, industrial, and residential areas to manage runoff from roof tops, impervious surfaces, and pervious surfaces. These include dry wells, subsurface infiltration systems, gravel wetlands, porous pavements, biofiltration, and high efficiency bioretention.

Figure 3: Tree Planter Combined with Catch Basin

Figure 3 illustrates a tree planter installed as part of road reconstruction and sewer improvements. The tree planter combines a tree well and catchbasin with an engineered soil that provides a growing medium and water quality filter. The planter was designed with an eye towards low maintenance, especially during the winter. Tree planters like these can be cleared easily by snow plow and the sediment and debris removal process is limited to a deep sump and cleaning by vactor truck. With the tree planter grate the sidewalk area is usable for pedestrian travel.

Tree planters, bioretention, and other forms of infiltration or biofiltration can be combined with streetscapes for added functionality. Figure 4 shows a bioretention system located in a parking lot that could be applied in road right-of-way.

Figure 4: Parking Lot Bioretention

Figure 5 - Streetscape with Street Trees Adaptable for Stormwater Management

Figure 5 is an example of a streetscape and tree planter that could easily be combined for stormwater management. The street scape has a combination of pedestrian considerations, space for local business to use the sidewalks, and park benches, all of which could allow for use of some type of planter or infiltration system below ground.

Figure 6 shows a large scale subsurface infiltration system combined with an isolator row for pretreatment. The isolator row is a wrapped chamber that prevents clogging of the stone bed. A subsurface infiltration system such as this combined with a pretreatment design could be used effectively for flood control and nutrient reduction.

Figure 6: Subsurface Infiltration with Stone Reservoir and Isolator Row Pretreatment Chamber

Table 2 - BMP and Drainage Area Characteristics

Location	BMP #	BMP Type	Soil Type	Drainage Area (acres)	Annual TN Load (lbs)	System Size
WINTER STREET	1	Subsurface Infiltration	A	12.88	90.1	1/2" WQV
	2*	Subsurface Infiltration	A	24.56	157.6	1/2" WQV
LINCOLN STREET NORTH	3.1	Tree Planter	A	0.20	2.5	1/2" WQV
	3.2	Tree Planter	A	0.13	1.7	1/2" WQV
	3.3	Tree Planter	A	0.27	3.4	1/2" WQV
	3.4	Tree Planter	A	0.22	2.9	1/2" WQV
	3.5	ROW Infiltration- Grassed	A	0.24	2.4	1/2" WQV
	3.6	ROW Infiltration- Grassed	A	0.78	7.2	1/2" WQV
	3.8	ROW Infiltration- Grassed	A	1.20	9.1	1/2" WQV
	3.9	ROW Infiltration- Grassed	A	0.70	5.6	1/2" WQV
	3.22	ROW Infiltration- Grassed	A	0.20	1.3	1/2" WQV
LINCOLN STREET SOUTH	3.20	ROW Infiltration- Grassed	A	1.60	13.9	1/2" WQV
	3.21	ROW Infiltration- Grassed	A	0.24	1.4	1/2" WQV
FRONT STREET	5	Subsurface Infiltration	A	20.29	138.3	1/4" WQV
Totals	-	-	-	63.5	437.5	-

* Drainage area and Annual TN Load estimates exclude area and load managed by BMP 1

b. BMP 1: Subsurface Infiltration at the Intersection of Winter and Front Street

BMP 1 was chosen for full 95% design and costing. It is located in a public playground at the intersection of Winter Street and Front Street (Figure 7). Soils test pits within this site identified fine sandy loams that are highly suitable for infiltration as they fall in hydrologic soil group A. The project team assessed the impacts of installing a subsurface infiltration treatment system to manage the 13-acre upstream drainage area.

Figure 7: BMP 1 Subsurface Infiltration at the Intersection of Winter and Front Street

Subsurface infiltration systems of several sizes were modeled to compare the costs of construction against the nutrient loading and flood reduction benefits. The three sizes that were considered were a ¼” water quality volume system (big enough to fully capture the 1st ¼” of runoff from the upstream drainage area), a ½” WQV system, and a ‘flood sized’ system big enough to capture runoff from an event slightly smaller than the 2-year storm (this was the maximum potential size based on the proposed site).

Ultimately, it was decided that the ½” WQV system would provide the most benefit relative to the associated costs. This BMP is expected to manage 68.2 lbs of nitrogen annually, leading to a 76% load reduction from the upstream drainage area at a total cost of $45,900. It will also reduce flooding extent and duration downstream during large storm events, including along Railroad Avenue. Figure 8 shows the 95% engineering design for BMP 1.

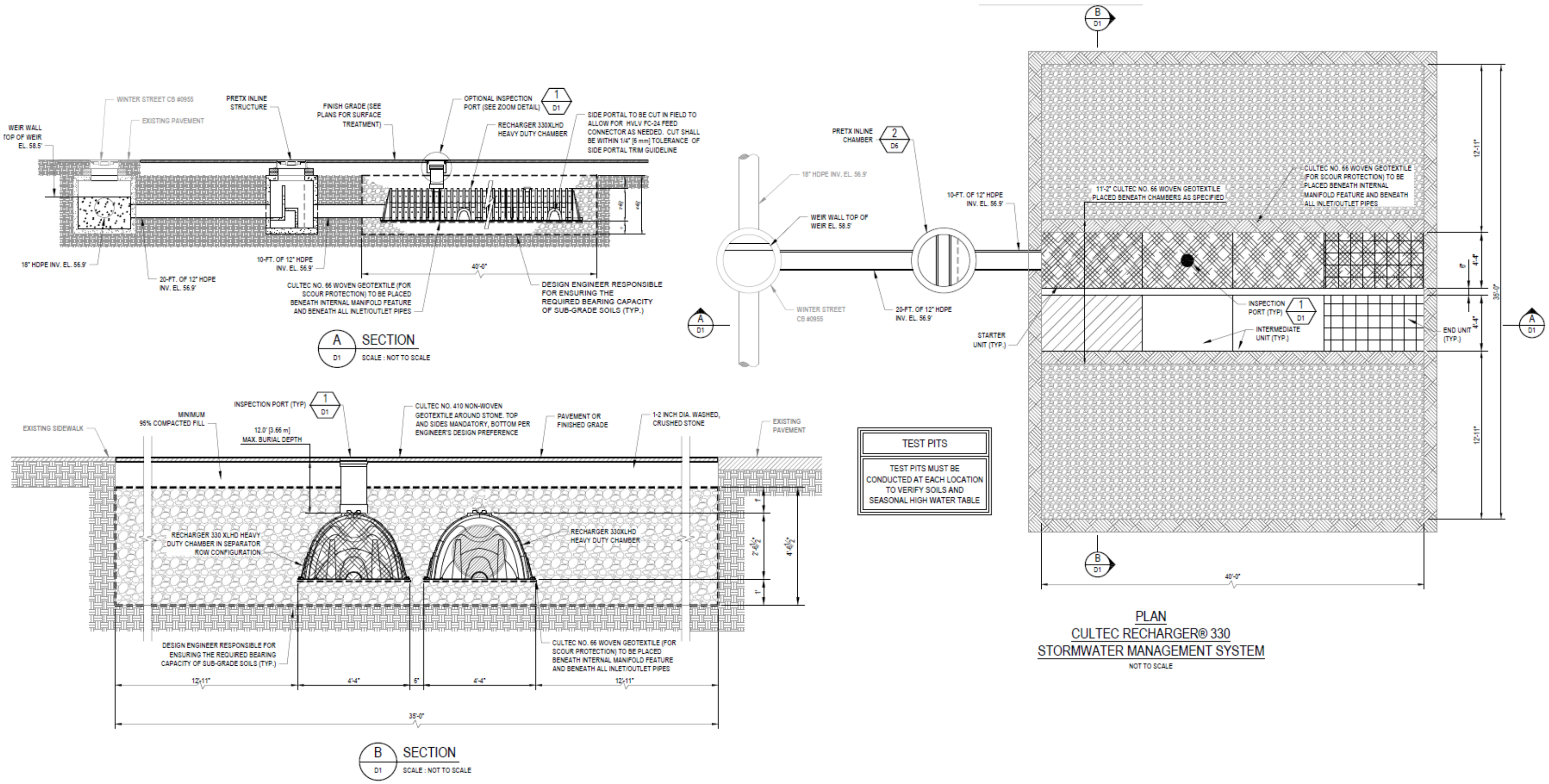


Figure 8: Engineering Detail for Winter Street Subsurface Infiltration BMP 1

c. BMP 2: Subsurface Infiltration at Columbus Ave., Winter St., Railroad Ave. Intersection

BMP 2 was chosen for full 95% design and costing. It is located in a small park at the intersection of Columbus Avenue, Winter Street, and Railroad Avenue (Figure 9). The project team assessed the impacts of installing a subsurface infiltration system to manage the 25-acre upstream drainage area. Soil test pits within this site found fine sandy loams highly suitable for infiltration as they fall in hydrologic soil group A. Some reconfiguration of the drainage infrastructure would be required to divert flows and is described in Appendix A.

Figure 9: BMP 2 Subsurface Infiltration Site at the Intersection of Columbus Ave., Winter St., and Railroad Ave.

Subsurface infiltration systems of several sizes were modeled to compare the costs of construction against the nutrient loading and flood reduction benefits. The three sizes that were considered were a ¼" water quality volume system (big enough to fully capture the 1st ¼" of runoff from the upstream drainage area), a ½" WQV system, and a 'flood sized' system of the maximum potential size based on the proposed site.

Ultimately, it was decided that the ½" WQV system would provide the most benefit relative to the associated costs. This BMP is expected to manage 120.2 lbs of nitrogen annually, leading to a 76% load reduction from the upstream drainage area at a total cost of $79,000. It will also reduce flooding extent and duration downstream during large storm events, including along Railroad Avenue. Figure 10 shows the 95% engineering design for BMP 2.

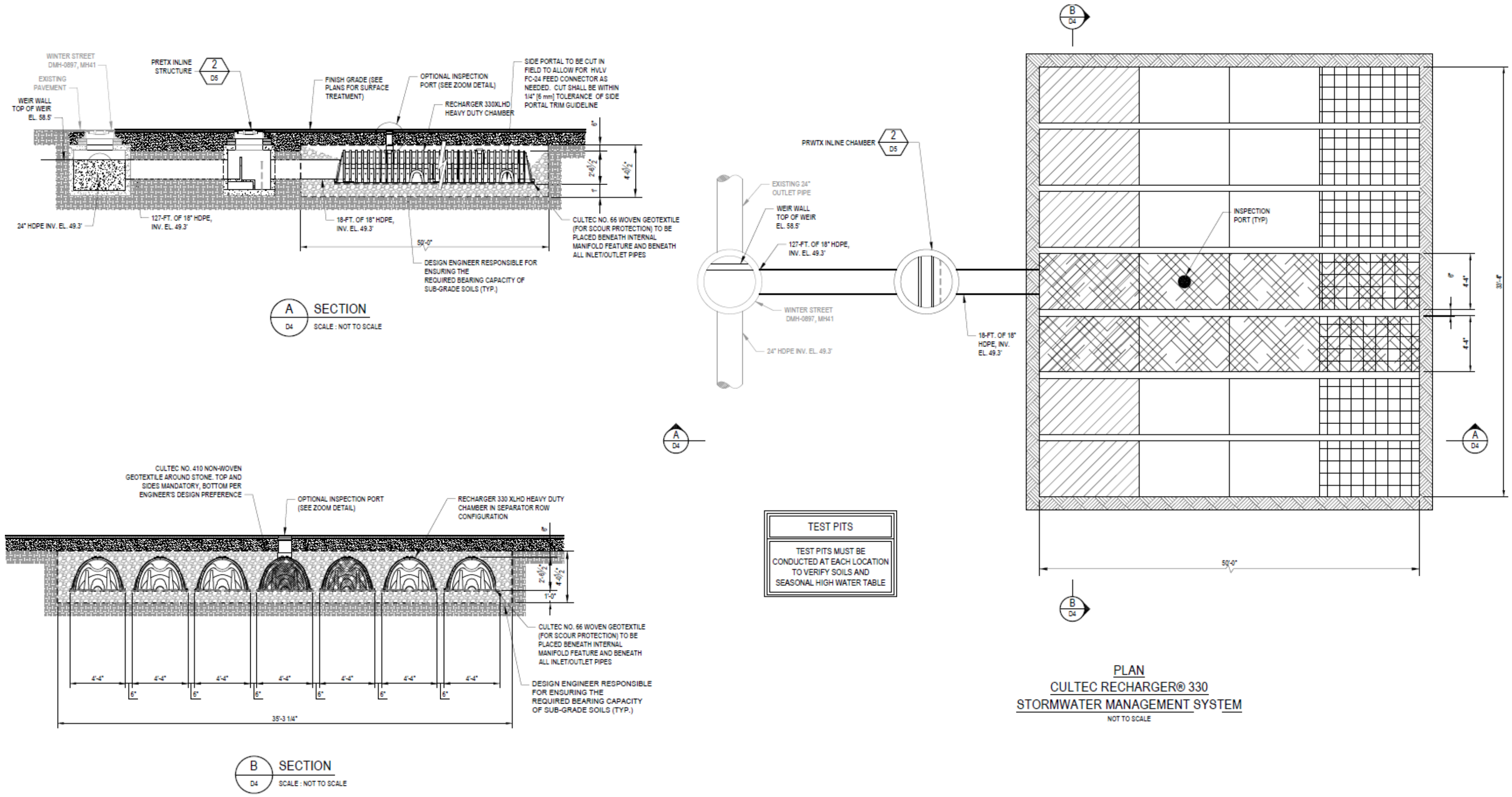


Figure 10: Engineering Detail for Railroad Avenue Subsurface Infiltration BMP 2

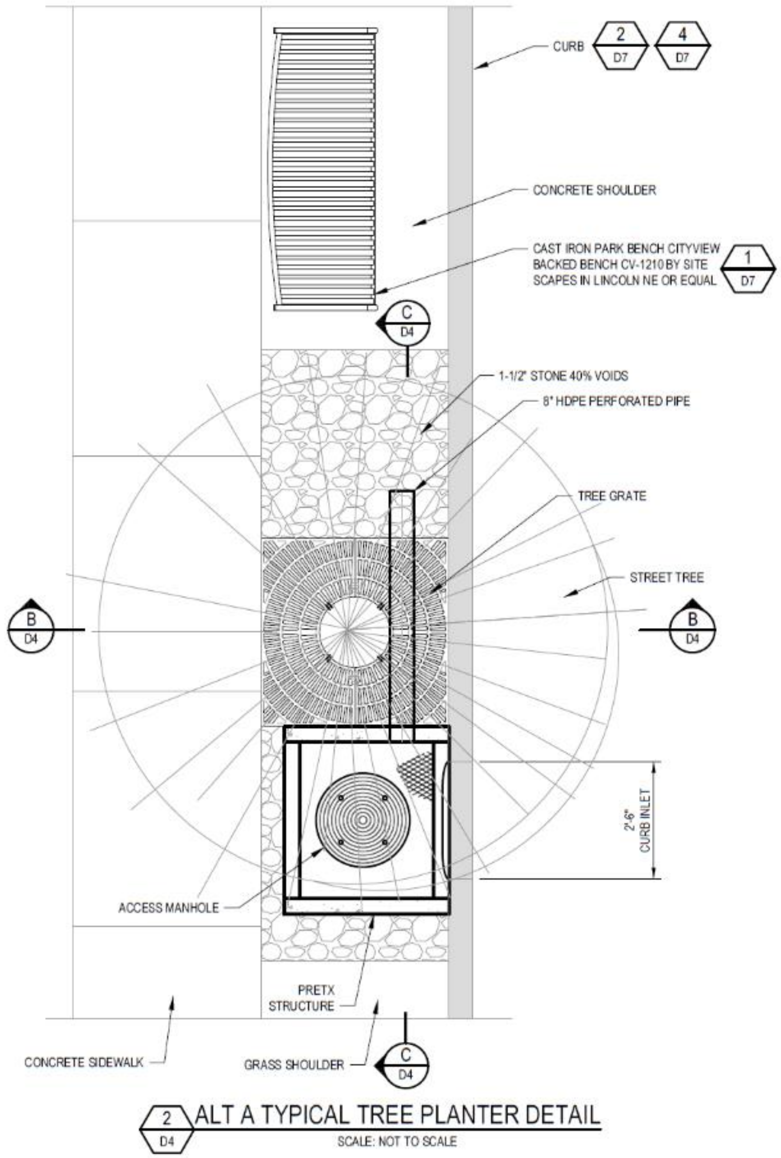
d. BMP 3: ROW Infiltration on Lincoln Street

BMP 3 was chosen for full 95% design and costing. It consists of numerous (11) small systems located in the public right-of-way on Lincoln Street. These BMPs will be a mix of tree planters and right-of-way infiltration systems located in the public right-of-way. These BMPs would manage surface and road runoff from 5.8 acres (Figure 11). Soils within this site are fine sandy loams and are highly suitable for infiltration as they fall in hydrologic soil group A.

Figure 11: BMP 3 ROW Infiltration Site on Lincoln Street

ROW infiltration systems of several sizes were modeled to compare the costs of construction against the nutrient loading and flood reduction benefits. The three sizes that were considered were a ¼" water quality volume system (big enough to fully capture the 1st ¼" of runoff from the upstream drainage area), a ½" WQV system, and a 'flood sized' system of the maximum potential size based on the proposed site.

Ultimately, it was decided that the ½" WQV systems would provide the most benefit relative to the associated costs. These BMPs are expected to manage 39.6 lbs of nitrogen annually, leading to a 77% load reduction from the upstream drainage area at a total cost of $139,700. It will also reduce flooding extent and duration downstream during large storm events. Figure 12 and Figure 13 show the 95% engineering designs for BMPs 3.1-3.22.



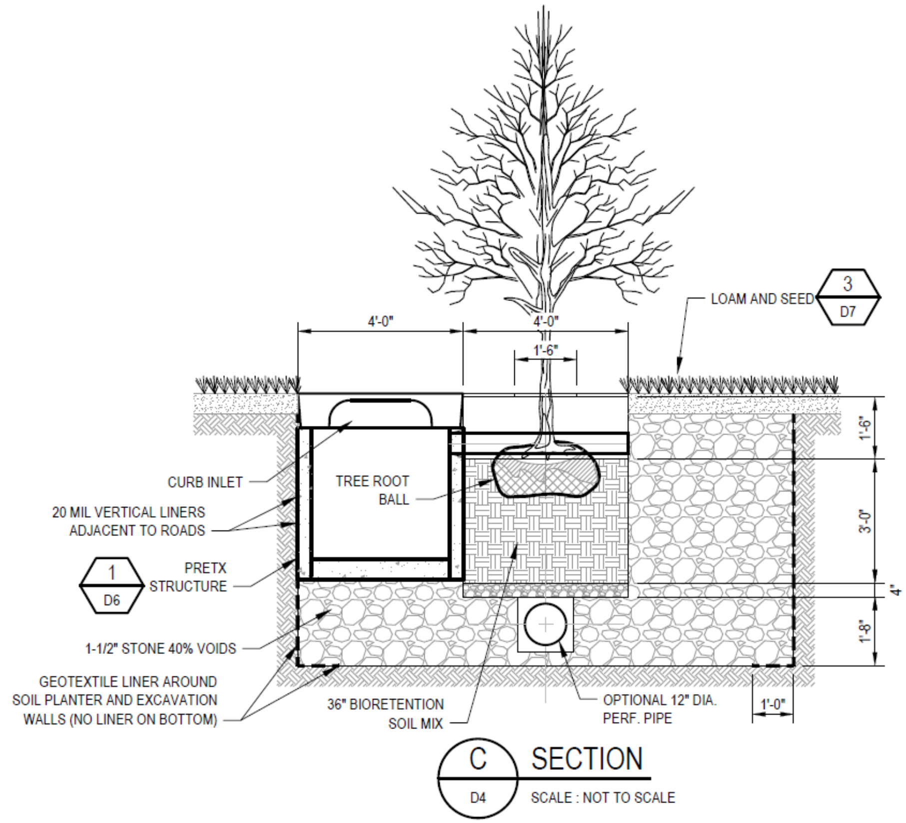


Figure 12: Engineering Detail for Lincoln Street North, Tree Planter BMPs 3.1 -3.4

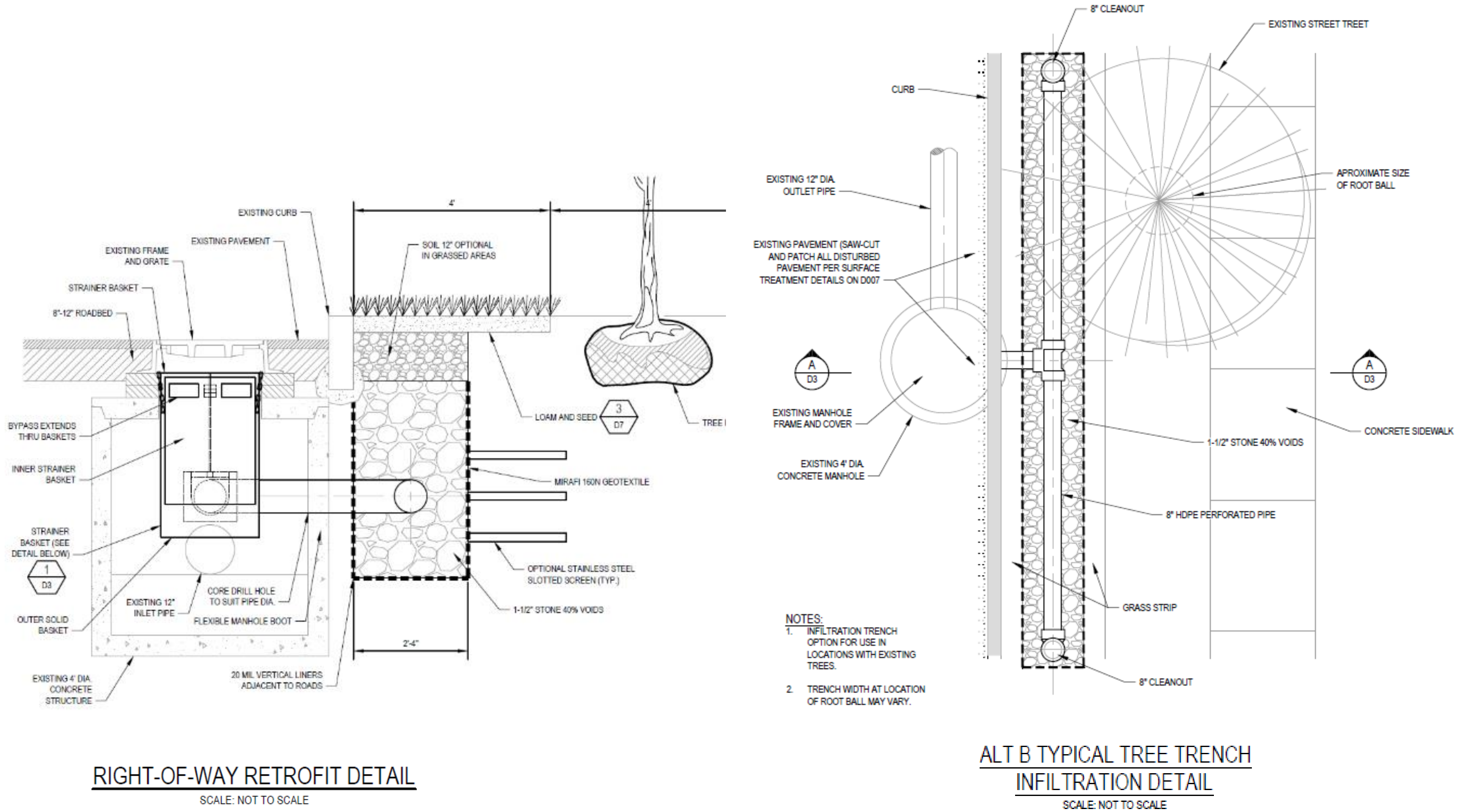


Figure 13: Engineering Detail for Lincoln Street South Right-of-Way Infiltration BMPs 3.5, 3.6, 3.8, 3.9, 3.20, 3.21, 3.22

e. BMP 4: Subsurface Infiltration at Lincoln Street Elementary School Parking Lot

BMP 4 was not chosen for design and costing under this project but will be pursued in a future Phase II analysis. The proposed site for BMP 4 is located behind the Lincoln Street Elementary School parking lot (Figure 14). The entire upstream drainage area is 76 acres, which would be reduced to 33 acres with the installation of BMPs 1, 2, and 3. Soils within this site are fine sandy loams and are suitable for infiltration however there is a shallow depth to groundwater that would need to be further evaluated. Given the size of the usable area, it may be feasible to install a subsurface infiltration treatment system within this site.

Figure 14: BMP 4 Subsurface Infiltration Site at the Lincoln Street Elementary School Parking Lot

f. BMP 5: ROW Infiltration/Filtration on Front Street

BMP 5 was chosen for full 95% design and costing. It is located in the public right-of-way on Front Street in front of Philips Exeter Academy (Figure 15). Soils within this site are fine sandy loams and are highly suitable for infiltration. The project team assessed the impacts of installing a subsurface infiltration treatment system to manage the 20-acre upstream drainage area.

Figure 15: BMP 5 ROW Infiltration/Filtration Site on Front Street

Subsurface infiltration systems of several sizes were modeled to compare the costs of construction against the nutrient loading and flood reduction benefits. The three sizes that were considered were a ¼" water quality volume system (big enough to fully capture the 1^{st} ¼" of runoff from the upstream drainage area), a ½" WQV system, and a 'flood sized' system of the maximum potential size based on the proposed site.

Ultimately, it was decided that the ¼" WQV system would provide the most benefit relative to the associated costs. This BMP is expected to manage 71.7 lbs of nitrogen annually, leading to a 52% load reduction from the upstream drainage area at a total cost of $45,200. It will also reduce flooding extent and duration downstream during large storm events. Figure 16 shows the 95% engineering designs for BMP 5.

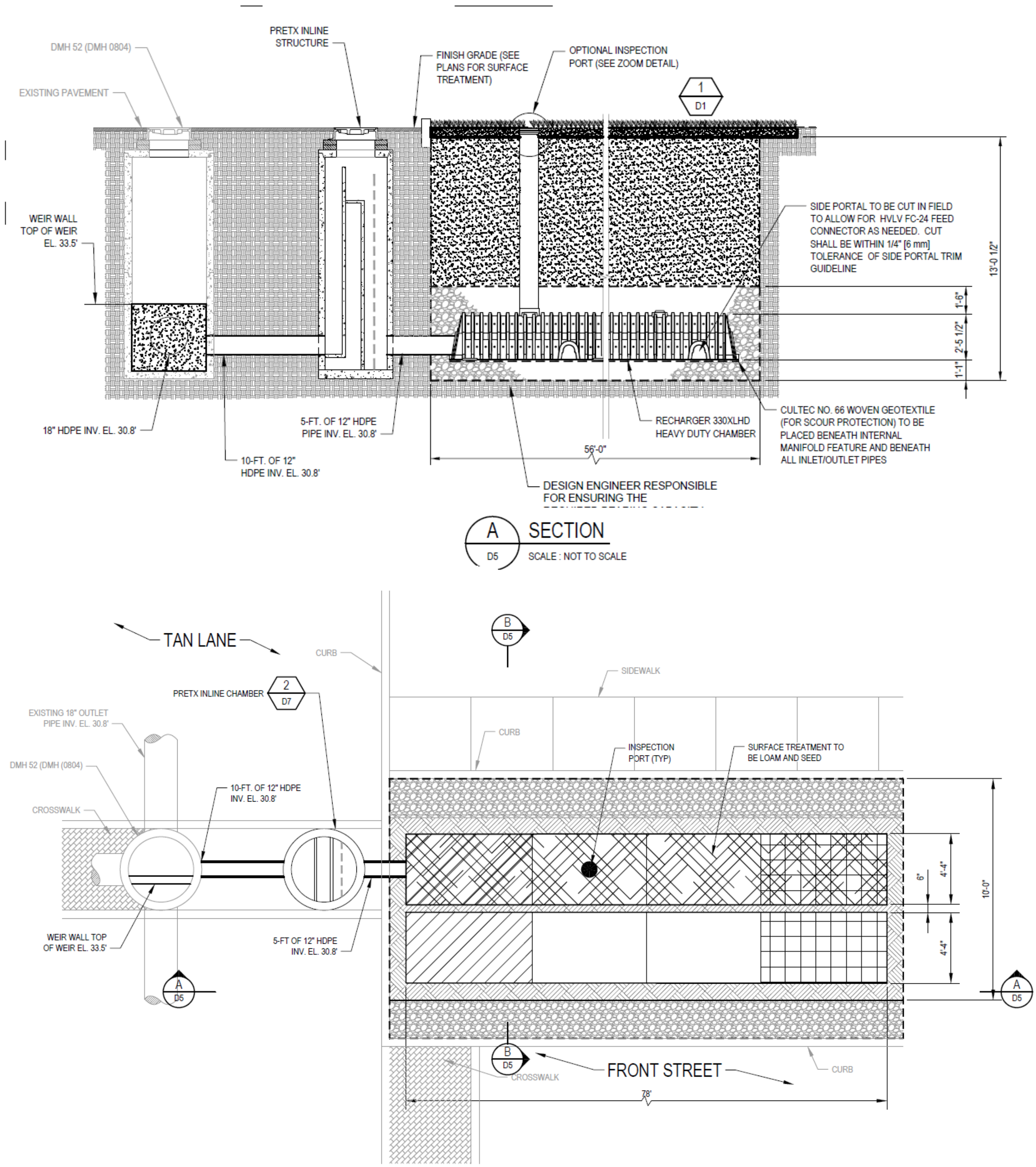


Figure 16: Engineering Detail for Front Street Subsurface Infiltration BMP 5

g. BMP 6: ROW Infiltration/Filtration on Washington Street

BMP 6 was not chosen for design and costing under this project but may be pursued in future phases. The proposed site for BMP 6 is located in the public right- of-way on Washington Street and could manage 1.7 acres of runoff (Figure 17). Soils within this site are silty clays and are not ideal for infiltration as they fall in hydrologic soil group C/D. This site is suitable for ROW infiltration, tree planters, or bioretention. Ultimately, it was decided that this is a low-priority BMP compared to the others considered during this effort. It could be re-examined at a later date in order to reduce the demands on downstream BMPs (primarily 1 and 2).

Figure 17: BMP 6 ROW Infiltration/Filtration Site on Washington Street

h. BMP 7: Subsurface Infiltration in the Lincoln Street Elementary School Fields

BMP 7 was not chosen for design and costing under this project but will be pursued in future a Phase II analysis. The proposed site for BMP 7 is located behind the Lincoln Street Elementary School in a large grassed area (Figure 18). Test pits were not conducted at this site but given the proximity and similarity in landform (e.g. slope), soil conditions are assumed to be similar to sites 3 and 4. Given the size of the usable area, it could be feasible to install a large subsurface infiltration treatment system within this site with 29 acres of upstream drainage area.

Figure 18: BMP 7 Subsurface Infiltration at Lincoln Street Elementary School

i. BMP Optimization and Lowest Cost Option

One of the core elements of integrated planning is the allowance that a permittee can take credit for actions associated with one permit (i.e., wastewater) while simultaneously receiving credit under another (i.e., MS4). For example, installation of green infrastructure (i.e., biofiltration to treat road runoff, or drywells to treat runoff from roof tops) for non-point source management under the WWTF permit would also satisfy requirements for Post Construction Stormwater Management (Minimum Measure 5) in the 2017 NH Small MS4 permit. This has the potential to be more economical than traditional permitting because it satisfies elements of both the MS4 and wastewater permits and it helps manage the uncertainty of environmental response.

Integrated planning also allows for flexibility as to when and what runoff management measures are implemented so long as the goal is the protection of public health and water quality. This approach allows for the use of various sizes (i.e., capture depths) of BMPs to allow for a greater number of smaller systems in replace of fewer systems designed to treat larger volumes.

An optimization model was developed as part of WISE which selects the most cost effective management measures for a range of runoff reduction levels. The optimization model runs iteratively, changing the target volume reduction with each iteration. It evaluates the runoff control strategies based upon user defined constraints including available land for implementation, volume reduction capability based on capture depth of the BMP, and cost to implement the strategy. This is first applied at the system level to develop a series of BMP performance curves. It is next applied at the land use scale to identify the most cost effective options for each particular land use. The optimization is then conducted at the watershed scale for the range of available runoff control measures, given the range of land uses within the wastershed. Appendix E presents BMP optimization and costing examples.

7. WATERSHED ANALYSIS

This section provides a summary of the methodology behind the water quality and hydrologic and hydraulic stormwater runoff model ("Model") for the Town of Exeter storm drainage infrastructure, initially developed as part of the Climate Adaptation Plan for Exeter (CAPE) project and WISE pollutant load model, and updated as part of this effort. A more in-depth description can be found in Appendix D of this document. The Model was created using the US Environmental Protection Agency (USEPA) Storm Water Management Model (SWMM) modeling platform to evaluate water quality and flooding potential of the stormwater infrastructure network under varying storm depths and future buildout conditions. The Model was used to investigate the flooding and surcharging of town storm drainage infrastructure during the 10-yr, 24-hr design storm (event depth of 4.72")[9]. The Model was created for planning purposes and includes some simplifying assumptions; it is not intended to provide design parameters for stormwater infrastructure installation and/or replacement. The preliminary stormwater infrastructure designs prepared for the Town of Exeter included independent detailed hydraulic/hydrologic analysis. Detailed information is provided in Appendix D: Watershed Modeling Methodology.

BMP designs and associated modeling calculations were performed with the HydroCAD (v 9.1) software package. Hydrographs are prepared for each element of the watershed and routed through the dynamic-storage-indication method to produce various time-based results. Runoff results from 0.25" and 0.5" WQV 24-hour design storms were used to develop appropriately sized treatment systems. These designs were then translated to the SWMM model to determine the larger watershed impacts.

Each of the proposed BMPs 1, 2, and 5 requires the addition of a weir in the existing drainage network in order to re-direct flow to the infiltration system. One major concern is to ensure that sufficient velocity exists for scouring sediment within the pipe network and to avoid added maintenance. A hydraulic analysis was conducted to evaluate pipe flow velocities upstream of BMPs 1, 2, and 5 both with and without the proposed weirs. The analysis showed that sufficient flow velocities will be maintained even with the addition of the weirs. The velocities drop near the weir for the water quality design of 0.25-0.5"

[9] Methodology and results are summarized in the memorandum prepared by Geosyntec Consultants, dated 21 October 2016, entitled "Storm Sewer Infrastructure Model Evaluation; 10-yr Design Storm Analysis; Exeter, New Hampshire"

and for greater storms the velocity remains high and pipe scour will occur insuring no issues with sedimentation. A table showing detailed modeling results for this analysis is provided in Appendix A.

8. BMP PERFORMANCE AND POLLUTANT LOAD REDUCTION

For each location and proposed BMP a pollutant loading analysis was performed in order to quantify the potential to reduce total nitrogen loads from the Lincoln Street watershed. Nitrogen removal performance was based on values derived as part of the WISE (2015) study, using pollutant load export rates (PLERs), BMP types, drainage areas, land uses, and soil types. Results were compiled for the final recommended BMPs (1, 2, 3, and 5) and are presented in Table 3.

The greatest potential nitrogen load reductions are expected from BMPs 1, 2, and 5, due to the fact that the drainage areas for each of these BMPs are quite large. All of the BMPs, with the exception of BMP 5, are expected to control roughly ¾ of the total nitrogen load from their respective drainage area. The reason that the portion of total load reduction associated with BMP 5 is much lower than the other systems is because this system was only sized to manage the ¼" water quality volume due to space constraints at the proposed site.

The total annual nitrogen load from the entire Lincoln Street watershed is 1,265 pound. Installation of BMPs 1, 2, 3, and 5 is expected to reduce this load to 300 pounds annually, a 34% reduction.

Table 3: Pollutant Load Reduction and Performance for Priority BMPs 1, 2, 3, and 5 for ½" Water Quality Volume

LOCATION	BMP #	DRAINAGE AREA (ACRES)	ANNUAL TN LOAD (LBS)	ANNUAL TN LOAD REDUCTION (LBS)	% LOAD REDUCTION	$/LBS NITROGEN
WINTER STREET	1	12.88	90.1	68.2	76%	$680
	2*	24.56	157.6	120.2	76%	$660
LINCOLN STREET NORTH	3.1	0.20	2.5	2	80%	$4,000
	3.2	0.13	1.7	1.3	76%	$5,080
	3.3	0.27	3.4	2.6	77%	$4,620
	3.4	0.22	2.9	2.2	77%	$4,500
	3.5	0.24	2.4	1.8	75%	$3,890
	3.6	0.78	7.2	5.7	79%	$3,830
	3.8	1.20	9.1	7.1	78%	$3,100
	3.9	0.70	5.6	4.2	75%	$3,240
	3.22	0.20	1.3	1.0	74%	$3,000
LINCOLN STREET SOUTH	3.20	1.60	13.9	10.7	77%	$3,090
	3.21	0.24	1.4	1.0	72%	$2,800
FRONT STREET	5	20.29	138.3	71.7	52%	$640
Totals	**-**	**63.5**	**437.5**	**299.7**	**69%**	**$1,040**

9. BMP Flood Reduction Benefits

The existing CAPE SWMM model was updated to include the proposed BMPs 1, 2, 3, and 5 in order to analyze the flood reduction benefits associated with the BMPs both from a standpoint of flood duration (using the SWMM 1-D model) and flooding extent (using the PCSWMM 2-D model) during a 10-year, 24-hour storm event. Results from this analysis are presented in Figure 19, Figure 20, and Figure 21.

Although none of the BMPs are designed to manage a 10-year storm (4.72" of runoff; each BMP is designed to handle 0.5" of runoff with BMP 5 designed to manage 0.25"), modeling results indicate that they will have a significant impact on flood duration at 12 major catch basins and manholes, as well as flood extent reductions at many key locations within the Lincoln Street watershed.

Results inidcate a 5 million gallon decrease in total runoff (25% reduction) during the 10-year, 24-hour storm event following installation of the recommended suite of BMPs. This translates to significant flooding extent reduction benefits along railroad avenue (just downstream of BMPs 1 and 2), along Lincoln Street (just downstream of BMPs 3.1-3.22), and along Front Street (just upstream of BMP 5). The flood reduction benefits are expected to be even more significant during smaller, more frequent storm events that are common flooding in the Town of Exeter.

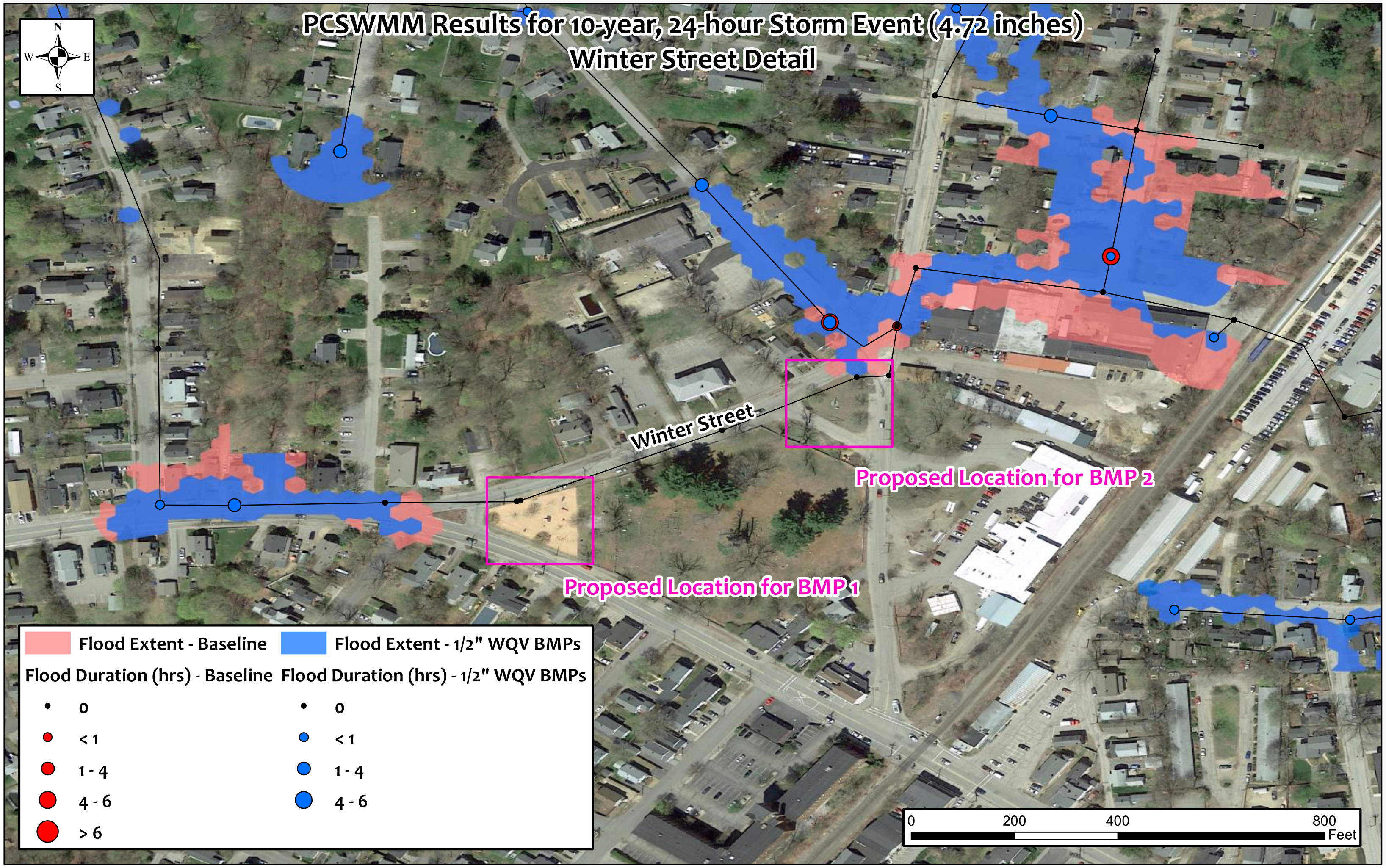


Figure 19: Modeled Flood Reduction Impacts of BMPs 1 and 2 (sized for 1/2" WQV)

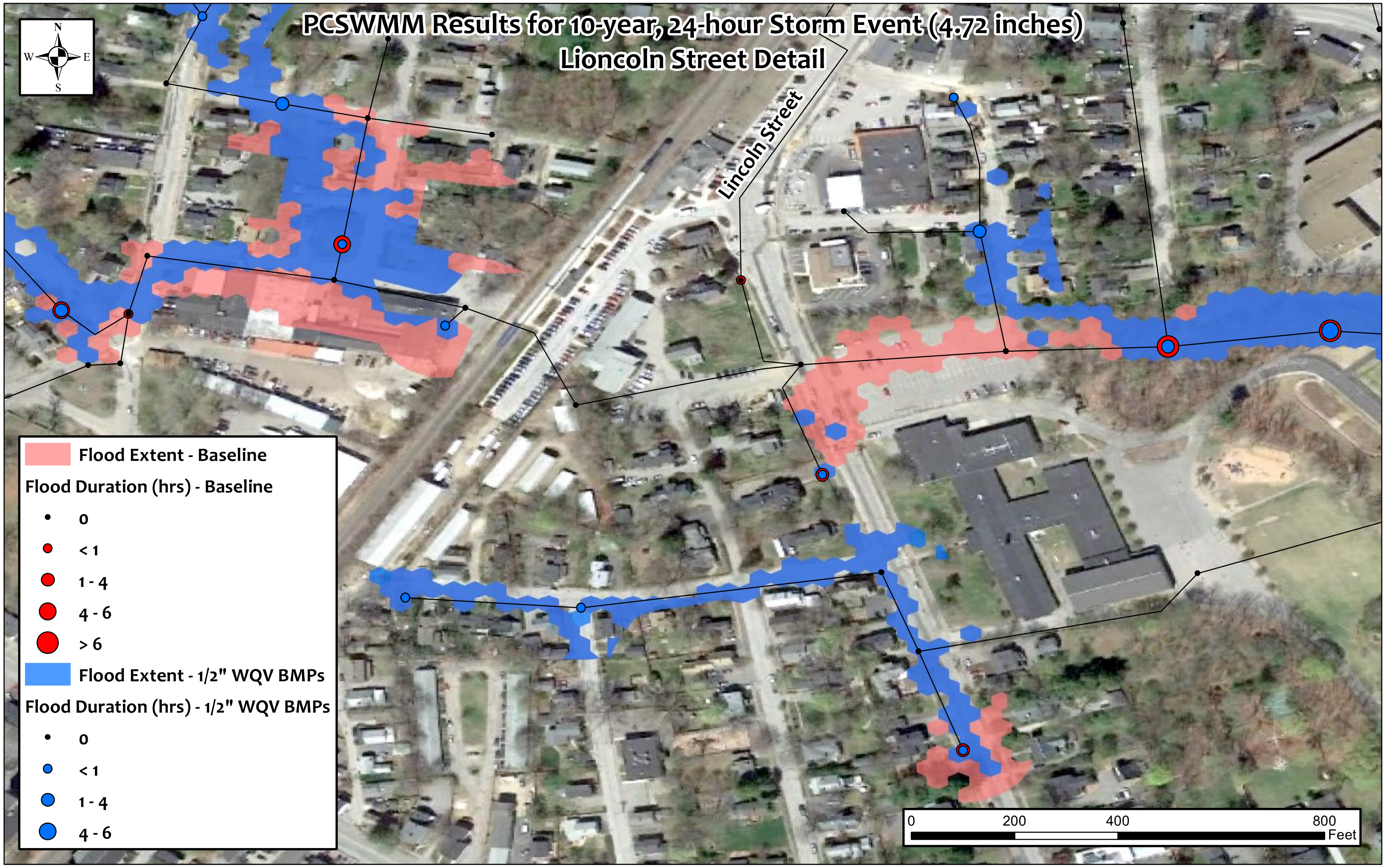


Figure 20: Modeled Flood Reduction Impacts of BMP 3 (sized for 1/2" WQV)

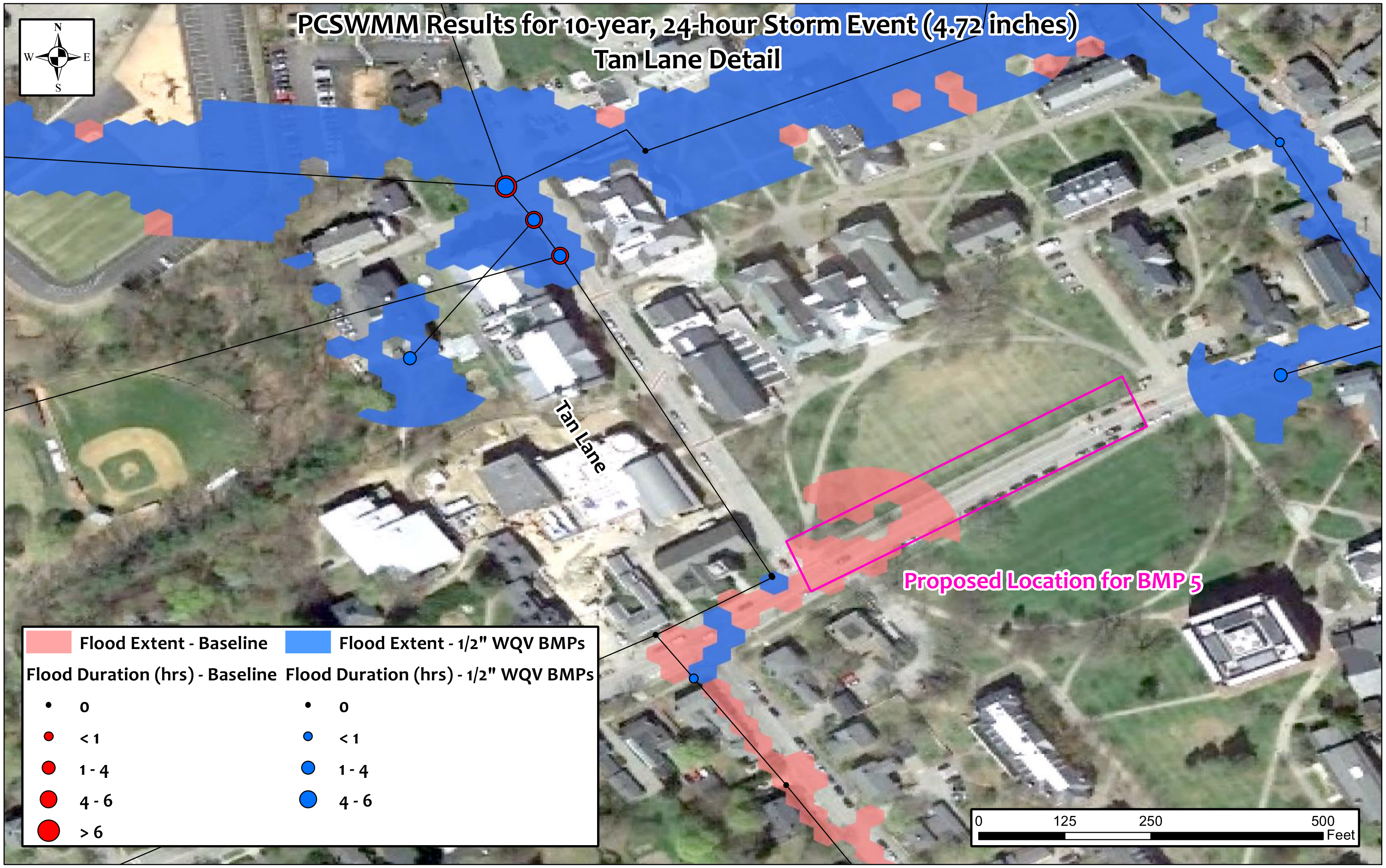


Figure 21: Modeled Flood Reduction Impacts of BMP 5 (sized for 1/4" WQV)

10. ENGINEERING COST ESTIMATES

A costing analysis was performed to quantify the total and unit costs (cost per pound of nitrogen removed) for each BMP. Engineering cost estimates were developed based on materials quantities, labor, and equipment for BMPs 1, 2, 3, and 5 and are shown in Table 4. A more detailed look at the costing analysis is provided in Appendix G: Engineering Cost Estimates.

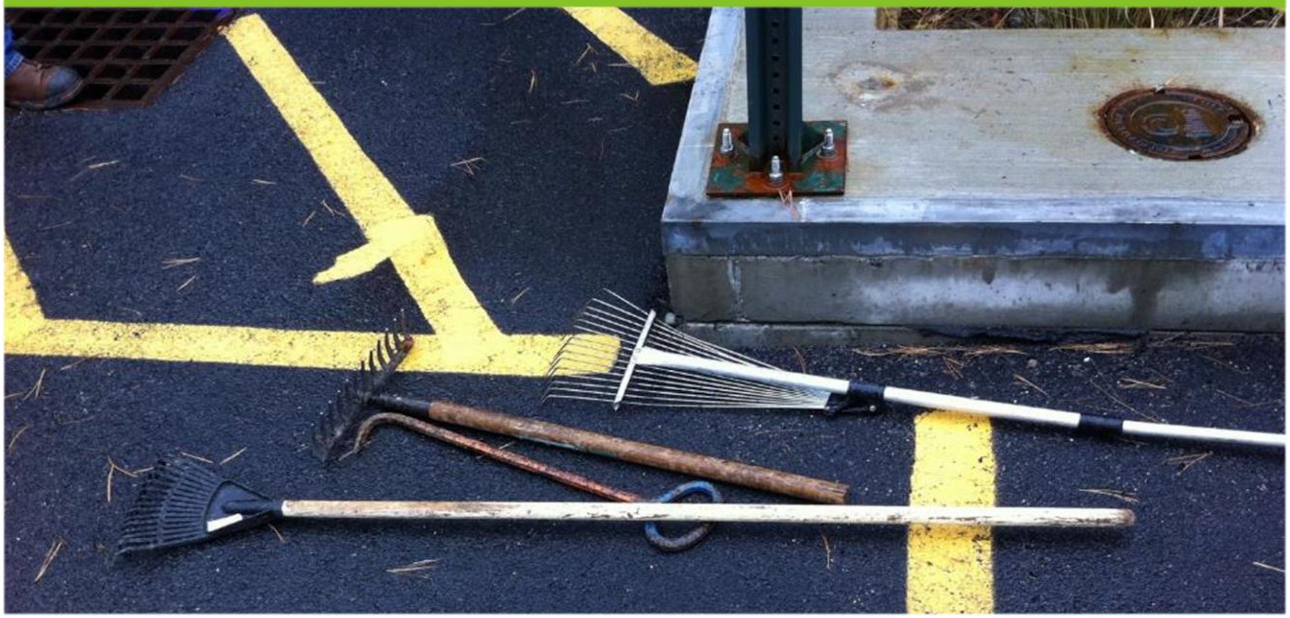
Of particular note is the low unit costs ($ per pound of nitrogen loading reduction) associated with the subsurface infiltration systems (BMPs 1, 2, and 5). For all three of these systems, the unit cost is estimated at well below $1,000, representing an extremely economical option for reducing nitrogen loading in the Lincoln Street watershed. BMPs 1, 2, and 5 all manage runoff from large drainage areas, making it possible to achieve economies of scale not possible for BMPs 3.1-3.22. These ROW infiltration and tree planter systems have relatively small drainage areas (< 2 acres) meaning they will each handle fairly small nitrogen loads. Nevertheless, $3,000-$5,000 (the unit cost per pound of nitrogen loading reduction associated with BMPs 3.1-3.22) is still a worthwhile expenditure, especially given that each of these systems is expected to control around ¾ of the total nitrogen load from their respective drainage areas.

Tremendous cost saving opportunities exist when BMP retrofits are timed with road and utility improvements. For example, a bioretention system designed to treat 1 acre of runoff might cost an estimated $40,000. However, when paired with road improvements the costs may be reduced to $10,000 due to the shared costs of curbs, sidewalks, and roads.

Table 4: Engineering Cost Estimates for BMPs 1, 2, 3, and 5

LOCATION	BMP #	DRAINAGE AREA (ACRES)	ANNUAL TN REDUCTION (LBS)	% LOAD REDUCTION	95% DESIGN COST ESTIMATE	$/LBS NITROGEN
WINTER STREET	1	12.9	68.2	76%	$45,900	$680
	2	24.6	120.2	76%	$79,000	$660
Subtotal	-	**37.4**	**188.4**	**76%**	**$124,900**	-
LINCOLN STREET NORTH	3.1	0.2	2.0	80%	$8,000	$4,000
	3.2	0.1	1.3	76%	$6,600	$5,080
	3.3	0.3	2.6	77%	$12,000	$4,620
	3.4	0.2	2.2	77%	$9,900	$4,500
	3.5	0.2	1.8	75%	$7,000	$3,890
	3.6	0.8	5.7	79%	$21,800	$3,830
	3.8	1.2	7.1	78%	$22,000	$3,100
	3.9	0.7	4.2	75%	$13,600	$3,240
	3.22	0.2	1.0	77%	$3,000	$3,000
Subtotal	-	**3.9**	**27.9**	**77%**	**$103,900**	-
LINCOLN STREET SOUTH	3.20	1.6	10.7	77%	$33,000	$3,090
	3.21	0.2	1.0	72%	$2,800	$2,800
Subtotal	-	**1.8**	**11.7**	**76%**	**$35,800**	-
FRONT STREET	5	20.3	71.7	52%	$45,200	$640
Total	-	**63.5**	**299.7**	**69%**	**$309,800**	-

11. MAINTENANCE CONSIDERATIONS



A detailed Operations and Maintenance Plan has been developed for the proposed BMPs and is provided in Appendix H: Operations and Maintenance Plan. This includes methods, checklists, and annual reporting forms. All BMPs will incorporate low maintenance design elements with an emphasis on pre-treatment to reduce maintenance needs. A series of maintenance fact sheets and recommendations are also provided in Appendix H for tree planters, right-of-way infiltration, and subsurface infiltration. The focus on pre-treatment will provide easy-to-maintain shallow sumps for collection of sediment and trash with standard maintenance procedures using vactor trucks and requires no specialty equipment or training. The location of curb cuts will be spaced to optimize the function of existing drainage infrastructure.

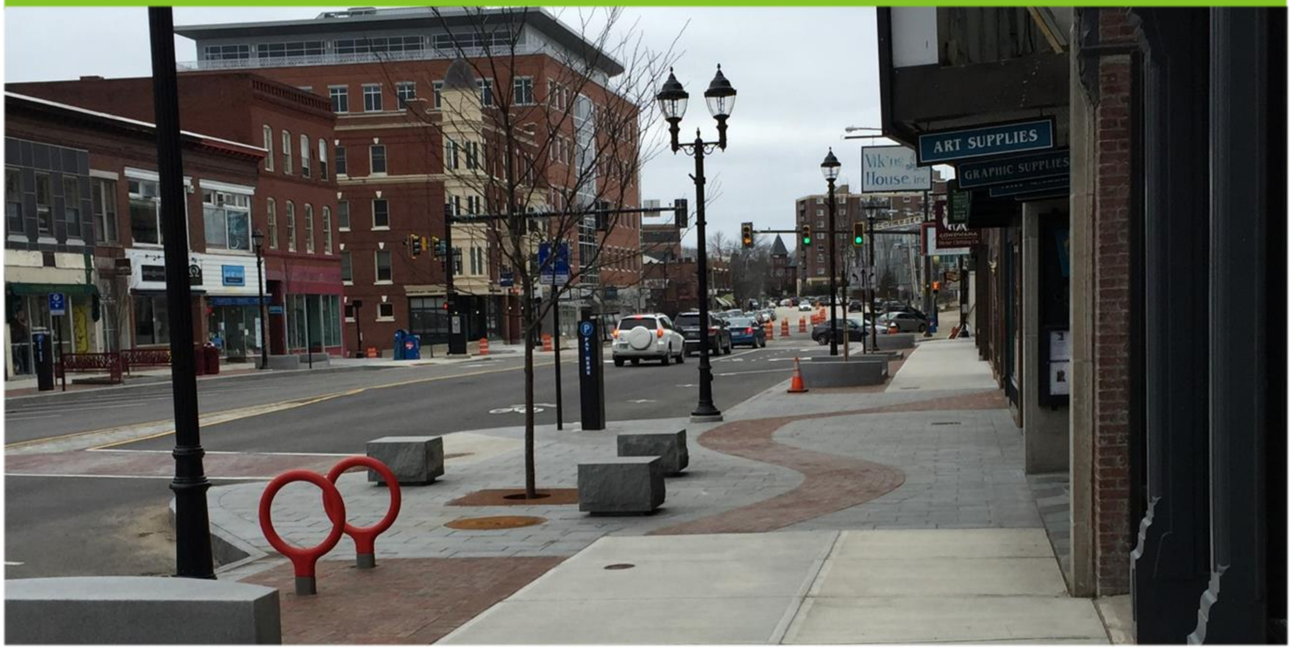
To ensure the effectiveness of BMPs, regular inspections and maintenance is necessary. Generally speaking, inspection and maintenance falls into two categories: expected routine maintenance and non-routine (repair) maintenance. Routine maintenance is performed regularly to maintain both aesthetics and good working order of BMPs. Routine inspection and maintenance helps prevent potential nuisances (odors, mosquitoes, weeds, etc.), reduces the need for repair maintenance, and insures long term performance.

Under MS4 rules, owners and operators are responsible for implementing BMP inspection and maintenance programs and having penalties in place to deter infractions. The rules recommend that all stormwater BMPs should be inspected on a regular basis for continued effectiveness and structural integrity.

12. OUTREACH EFFORTS

Public outreach and education is a critical component of raising awareness and building support for resiliency and water infrastructure management within any community. The project team attended two meetings and presented interim and final project findings to the Conservation Commission. The commission was very supportive of the efforts and an engaging discussion was had regarding the potential benefits and long-term implications. The presentations are available in Appendix F: Outreach Efforts

13. RECOMMENDATIONS



As part of a future Phase II effort, we recommend pursuing further analyses to identify additional potential BMPs to maximize flood reduction along Tan Lane and further reduce nutrient loading. This examination should include the following areas: 1) BMP 4 in the vicinity of Lincoln Street School and Kiminees Brook which has been covered and piped in the ravine area, 2) BMP 7 areas draining the south end of Lincoln Street feeding a major storm drain that joins item #1 and #3, 3) BMP 8 for areas draining Front Street and Elm Street, and 4) BMP 9 for areas draining Main Street and Tan Lane. BMPs installed in these locations would likely have substantial flood reduction and water quality benefits given that they represent most of the major trunklines (including Phase I) within the S10 watershed.

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15. APPENDICES

APPENDIX A: DRAINAGE INFRASTRUCTURE INVENTORY AND LAND USE
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APPENDIX A: DRAINAGE INFRASTRUCTURE INVENTORY AND LAND USE

WATERSTONE ENGINEERING
INNOVATIVE STORMWATER MANAGEMENT

Project Name: Lincoln Street Phase I **Date:** 25-Nov-16
Project Number: 16928
Client: Town of Exeter

Manhole Inspection Results

Entry #	Exeter Drainage Inventory ID	Date / Time	Inspector	DPW ID	Pipe ID	Rim Elevation (ft)	Invert Depth (in)	Invert Elevation (ft)	Pipe Type	Diameter (in)	Total Depth (in)	Notes
1	DMH-0899	11/17/16 11:00 AM	A. Moskal	MH34	Primary Influent	59.5	88	52.2	RCP	18	75	
					Secondary Influent		60	54.5	RCP	12		
					Primary Effluent		95	51.6	RCP	18		
2	DMH-0902	11/17/16 11:00 AM	A. Moskal	MH36	Primary Influent	59.3	75	53.1	RCP	14	60	
					Primary Effluent		78	52.8	RCP	14		
					Secondary Influent		64	54.0	RCP	12		
					Secondary Influent		73	53.2	RCP	12		
3	DMH-0904	11/17/16 11:00 AM	A. Moskal	MH40	Primary Influent	59.8	81	53.05	RCP	14	66	
					Primary Effluent		83	52.9	RCP	14		
4	DMH-0905	11/17/16 11:00 AM	A. Moskal	MH39	Primary Influent	60.6	81	53.85	RCP	14	66	
					Primary Effluent		83	53.7	RCP	14		
5	DMH-0897	11/17/16 11:00 AM	A. Moskal	MH41	Primary Influent	59	115	49.4	RCP	18	96	
					Primary Effluent		121	48.9	RCP	24		
					Secondary Influent		107	50.1	RCP	14		
6	DMH-0895	11/17/16 11:00 AM	A. Moskal	MH43	Primary Influent	59.4	132	48.4	RCP	24	117	
					Primary Effluent		134	48.2	RCP	24		
					Secondary Influent		58	54.6	PVC	12		
7	DMH-0777	11/17/16 11:00 AM	A. Moskal	MH48	Primary Influent	43.3	120	33.3	RCP	14	115	
					Primary Effluent		121	33.2	RCP	14		
					Secondary Influent		61	38.2	RCP	12		
8	DMH-0778	11/17/16 11:00 AM	A. Moskal	MH47	Primary Influent	43.4	121	33.3	RCP	14	116	
					Primary Effluent		122	33.2	RCP	14		
9	DMH-0801	11/17/16 11:00 AM	A. Moskal	MH50	Primary Influent	43.4	129	32.7	RCP	14	124	
					Primary Effluent		131	32.5	RCP	14		
					Secondary Influent		81	36.7	RCP	12		
10	DMH-0804	11/17/16 11:00 AM	A. Moskal	MH52	Primary Influent	42.1	135	30.85	RCP	14	115	
					Primary Effluent		136	30.8	RCP	14		
					Secondary Influent		84	35.1	RCP	12		

INSPECTION KEY: RCP: Reinforced Concrete, PVC: Polyvinyl Chloride

OBSERVATIONS: Total Depth of all structures can be assumed as the invert of the primary effluent; total depth recorded is to the flat base above the bottom pipe

Adam Moskal
Performed By

Reviewed By

11/17/2016
Date

11/25/2016
Date

Project Name: Lincoln Street Phase I
Project Number: 16928
Client: Town of Exeter

Date: 25-Nov-16

Catch Basin Inspection Results

Entry #	Exeter Drainage Inventory ID	Date / Time	Inspector	Exeter DPW ID	Pipe ID	Rim Elevation (ft)	Invert Depth (in)	Invert Elevation (ft)	Pipe Type	Diameter (in)	Total Depth (in)	Notes
1	CB-0959	11/17/16 11:00 AM	A. Moskal	CB31	Primary Influent	59.9	121	49.8	RCP	12	124	
					Primary Effluent		124	49.6	RCP	18		
2	CB-0958	11/17/16 11:00 AM	A. Moskal	CB32	Primary Influent	59.4	102	50.9	RCP	18	104	
					Primary Effluent		104	50.7	RCP	18		
3	CB-0900	11/17/16 11:00 AM	A. Moskal	CB33	Primary Influent	58.8					82	
					Primary Effluent		43	55.2	RCP	12		
4	CB-0898	11/17/16 11:00 AM	A. Moskal	CB38	Primary Influent	58.9	96	50.9	RCP	14	98	
					Primary Effluent		98	50.7	RCP	14		
5	CB-0896	11/17/16 11:00 AM	A. Moskal	CB42	Primary Influent	58.7	117	49.0	RCP	24	118	
					Primary Effluent		118	48.9	RCP	24		
6	CB-0894	11/17/16 11:00 AM	A. Moskal	CB44	Primary Influent	60.565	40	57.2	RCP	12	44	
					Primary Effluent		44	56.9	RCP	12		
7	CB-0956	11/17/16 11:00 AM	A. Moskal	CB30	Primary Influent	61.7	100	53.4	RCP	14	103	
					Primary Effluent		103	53.1	RCP	14		
					Secondary Influent		60	56.7	RCP	12		
8	CB-0776	11/17/16 11:00 AM	A. Moskal	CB49	Primary Effluent	43	38	39.8	RCP	12	78	
9	CB-0802	11/17/16 11:00 AM	A. Moskal	CB46	Primary Effluent	44.4	76	38.1	RCP	12	113	
10	CB-0803	11/17/16 11:00 AM	A. Moskal	CB53	Primary Influent	43.1	69	37.4	RCP	12	70	
					Primary Effluent		70	37.3	RCP	12		
11	CB-0805	11/17/16 11:00 AM	A. Moskal	CB51	Primary Effluent	42.3	44	38.6	RCP	12	86.5	

INSPECTION KEY: RCP: Reinforced Concrete, PVC: Polyvinyl Chloride

OBSERVATIONS: Total Depth of all structures can be assumed as the invert of the primary effluent; total depth recorded is to the base of the flat base above the bottom pipe

Adam Moskal
Performed By

11/17/2016
Date

Reviewed By

11/25/2016
Date

BMP 2

Drainage infrastructure near BMP 2 was evaluated for retrofit feasibility and checked for invert elevations of pipes, direction of flow, and pipe characteristics. Figure 22 displays the location of the drainage infrastructure adjacent to BMP 2 that was assessed during a site visit. Figure 23 shows the drainage infrastructure elevations with the colored rectangles representing each individual structure. This examines the feasibility of rerouting certain storm drains to treatment systems without flooding upstream catch basins or manholes. For BMP 2, this would involve the installation of a weir at the junction of Columbus Ave. and Winter St. (MH41) that would reroute drainage from Columbus Ave to a subsurface infiltration system located at the corner of Railroad Ave and Winter Street in the outlined area. Complete drainage structure inventory records can be found in Appendix A of this document.

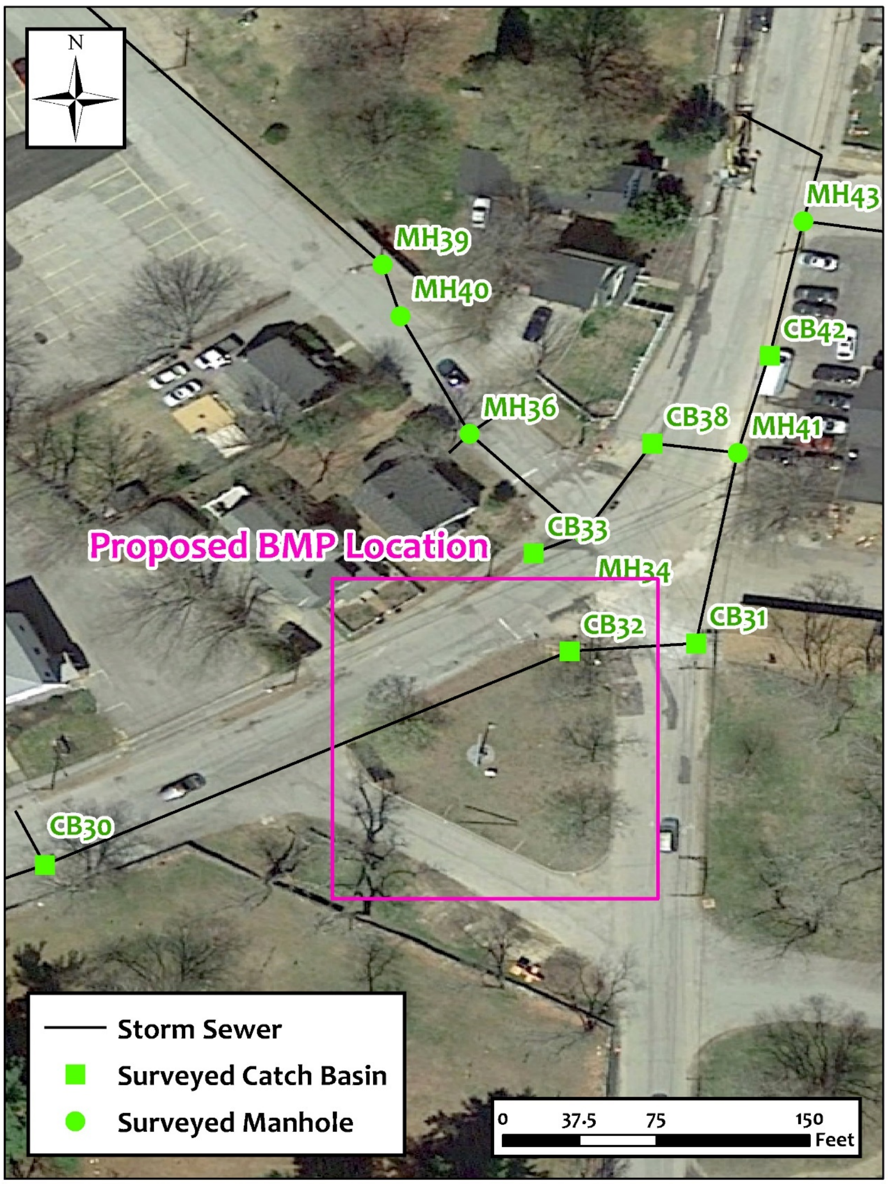


Figure 1: BMP 2 Subsurface Infiltration at Winter Street, Columbus Avenue, and Railroad Avenue

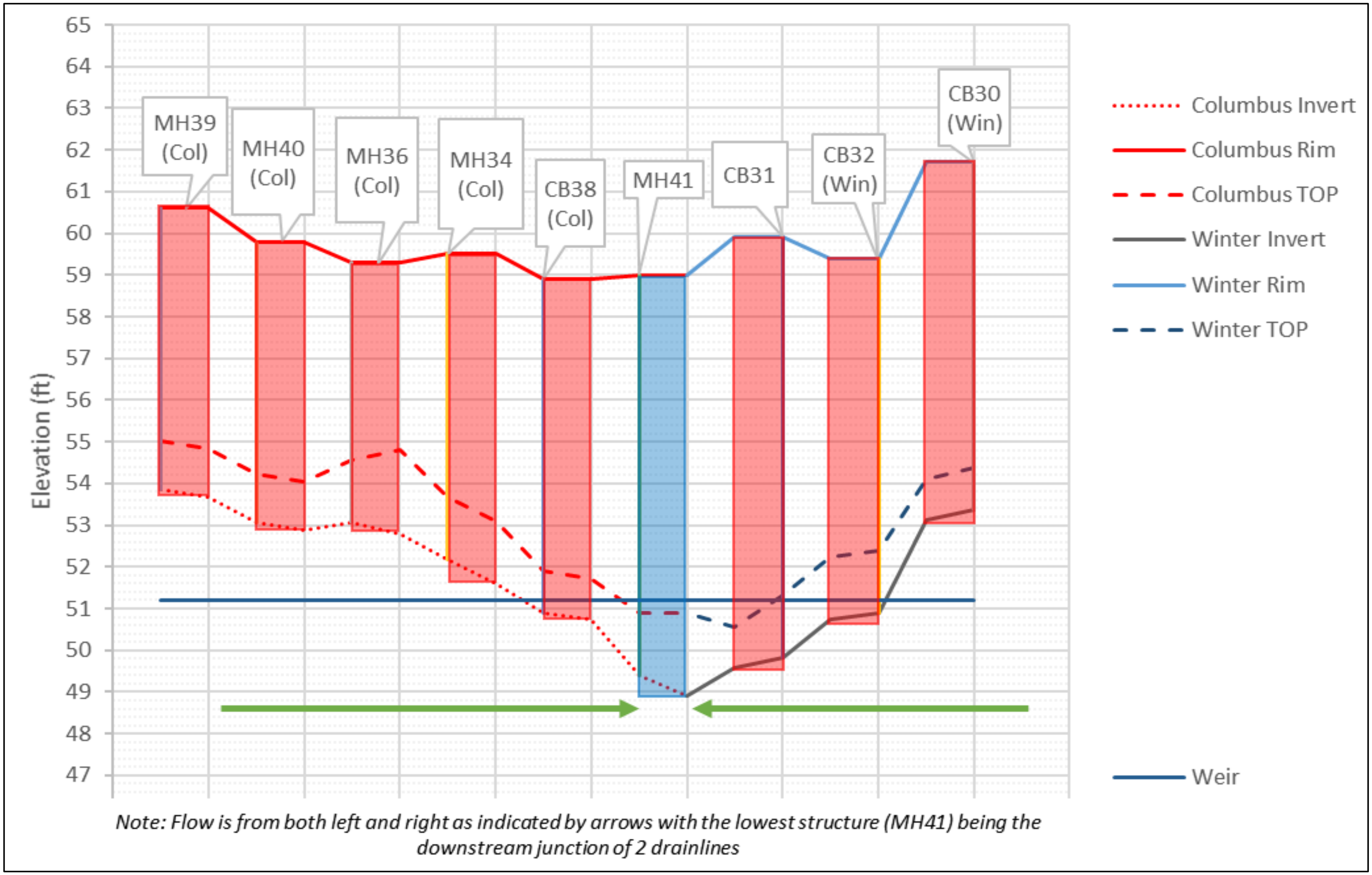


Figure 2: BMP 2 Drainage Elevations

BMP 5

Drainage infrastructure near BMP 5 was evaluated for retrofit feasibility and surveyed for pipe invert elevations, direction of flow, and pipe characteristics. Figure 24 displays the location of the drainage infrastructure adjacent to BMP site 5 that were assessed during a site visit. Figure 25 shows the drainage infrastructure elevations with the colored rectangles representing each individual structure. This examines the feasibility of rerouting certain storm drains to treatment systems without flooding upstream catch basins or manholes. At site 5, a weir would be installed at the junction of Front St. and Tan Ln. (see MH52) that would reroute drainage into a ROW Infiltration/Filtration system located in the outlined area. Complete drainage structure inventory records can be found in Appendix A of this document.

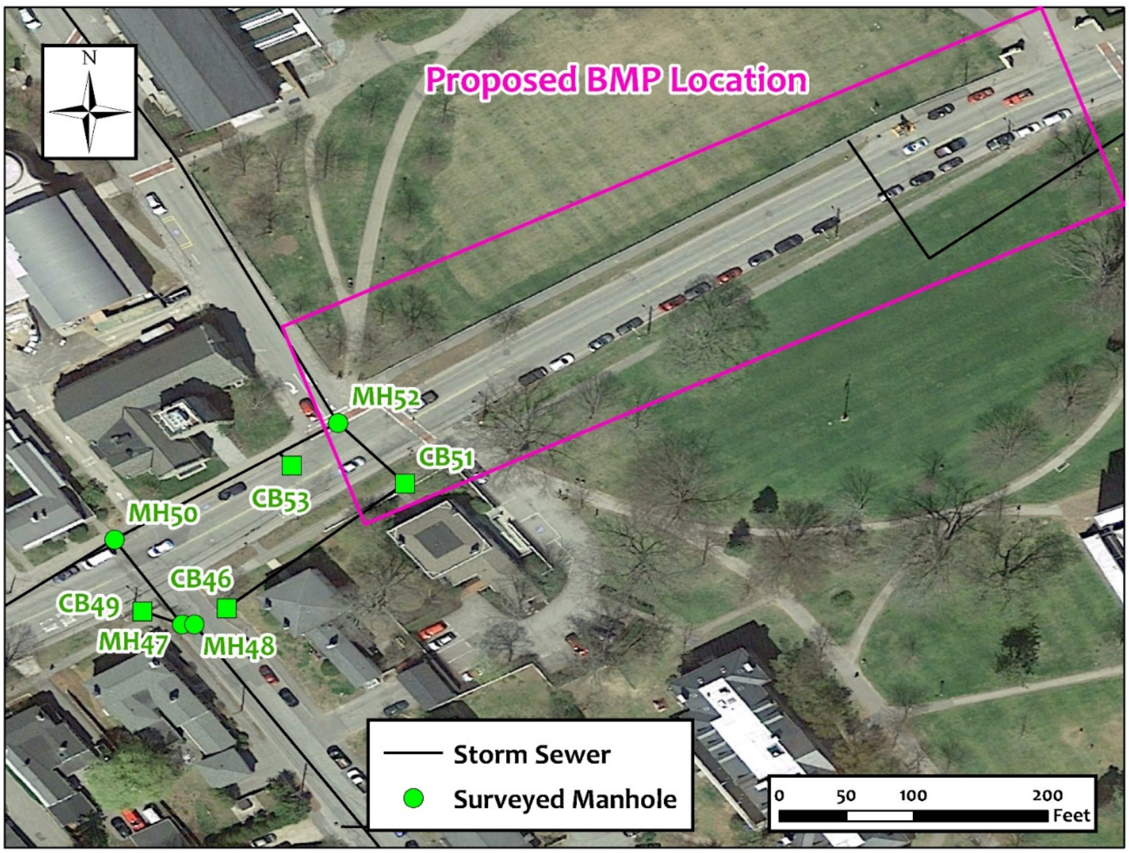


Figure 3: BMP Site 5 at Front Street, Tan Lane, and Elliot Street

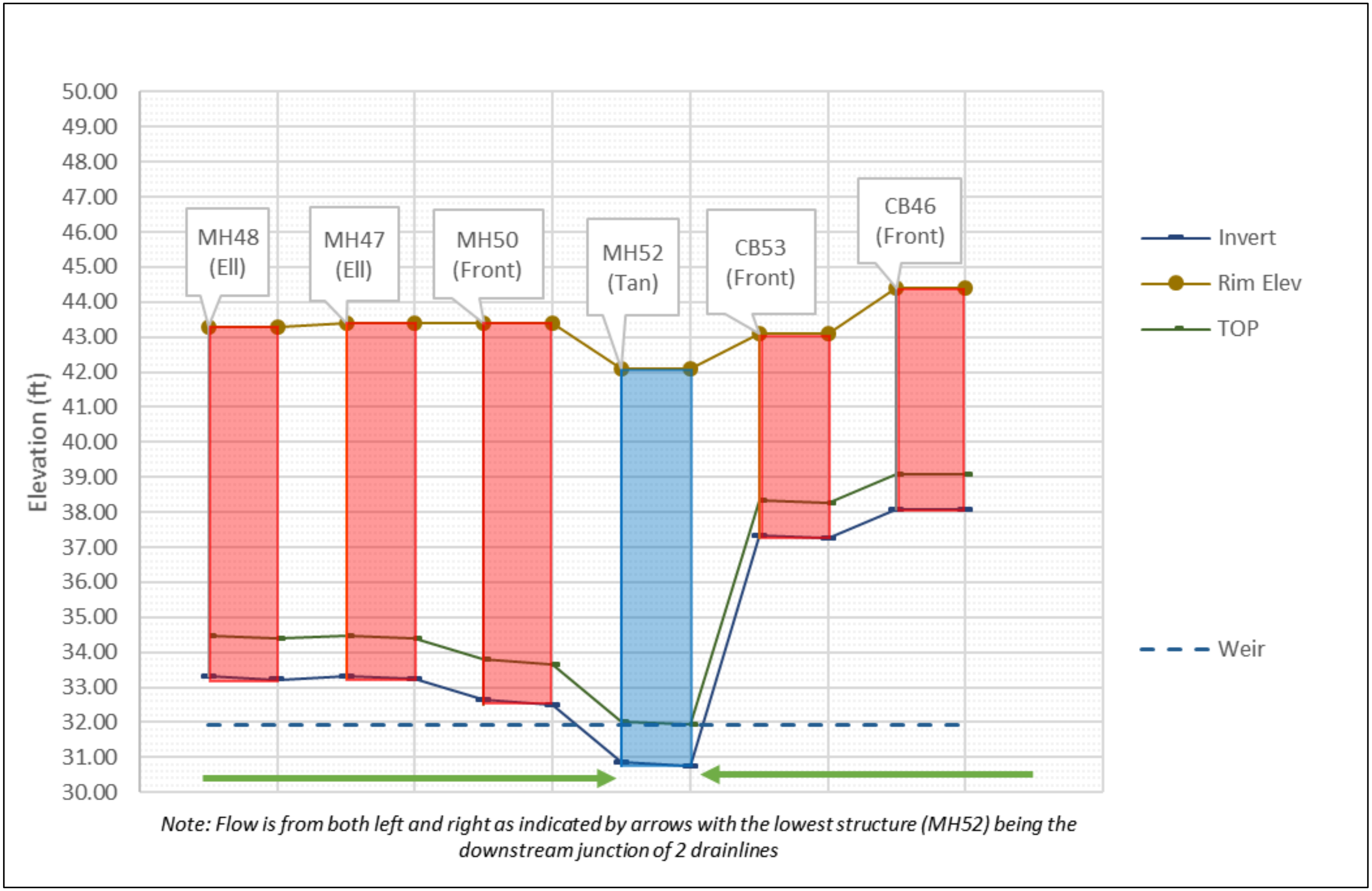


Figure 4: BMP Site 5 Drainage Elevation

Table 1: Lincoln Street Total Land Use Watershed Characteristics

Land Use Type	Hydrologic Soil Group*	Area (acres)	Annual Nitrogen Export (lbs)**
Agriculture	A	0.04	0.02
Agriculture	C/D	0.47	1.51
Commercial, Services, and Institutional	A	6.44	3.42
Commercial, Services, and Institutional	C/D	15.48	41.48
Commercial, Services, and Institutional	IMP	30.72	424.48
Forest	A	3.62	1.01
Forest	C/D	2.69	3.88
Forest	IMP	0.02	0.27
Industrial and Commercial Complexes	C/D	0.00	0.01
Industrial and Commercial Complexes	IMP	0.77	10.64
Outdoor and Other Urban and Built-up Land	A	1.83	2.00
Outdoor and Other Urban and Built-up Land	C/D	6.15	34.07
Outdoor and Other Urban and Built-up Land	IMP	0.48	6.62
Residential	A	20.41	10.82
Residential	C/D	47.59	127.53
Residential	IMP	26.26	413.04
Transitional	A	0.09	0.02
Transitional	C/D	0.23	0.31
Transitional	IMP	0.19	2.68
Transportation, Communications, and Utilities	A	0.16	0.04
Transportation, Communications, and Utilities	C/D	0.14	0.17
Transportation, Communications, and Utilities	IMP	16.17	182.87
Total		**179**	**1265**

* Hydrologic soil group derived from landform. Watershed area was divided into 3 slope classes, 0-3%, 3-8%, and 8-15%. Dominant soil type for each slope class was assumed for entire slope class. Scitico silt loam for 0-3% slopes, Charlton fine sandy loam for others. **Based on WISE, 2015 PLERs

Table 2: Lincoln Street Land Use Upper Watershed Characteristics

Land Use Type	Hydrologic Soil Group*	Area (acres)	Annual Nitrogen Export (lbs)**
Agriculture	A	0.04	0.02
Agriculture	C/D	0.47	1.51
Commercial, Services, and Institutional	A	0.18	0.09
Commercial, Services, and Institutional	C/D	1.91	5.13
Commercial, Services, and Institutional	IMP	5.21	70.87
Outdoor and Other Urban and Built-up Land	A	0.04	0.04
Outdoor and Other Urban and Built-up Land	C/D	2.81	15.59
Outdoor and Other Urban and Built-up Land	IMP	0.39	5.37
Residential	A	5.87	3.11
Residential	C/D	24.97	66.91
Residential	IMP	10.43	164.11
Transportation, Communications, and Utilities	A	0.00	0.00
Transportation, Communications, and Utilities	C/D	0.05	0.06
Transportation, Communications, and Utilities	IMP	5.12	57.91
Total		**57**	**390**

* Hydrologic soil group derived from landform. Watershed area was divided into 3 slope classes, 0-3%, 3-8%, and 8-15%. Dominant soil type for each slope class was assumed for entire slope class. Scitico silt loam for 0-3% slopes, Charlton fine sandy loam for others. **Based on WISE, 2015 PLERs

Table 3: Lincoln Street Land Use Lower Watershed Characteristics

Land Use Type	Hydrologic Soil Group*	Area (acres)	Annual Nitrogen Export (lbs)**
Commercial, Services, and Institutional	A	6.27	3.32
Commercial, Services, and Institutional	C/D	13.56	36.35
Commercial, Services, and Institutional	IMP	25.51	353.61
Forest	A	3.62	1.01
Forest	C/D	2.69	3.88
Forest	IMP	0.02	0.27
Industrial and Commercial Complexes	C/D	0.00	0.01
Industrial and Commercial Complexes	IMP	0.77	10.64
Outdoor and Other Urban and Built-up Land	A	1.80	1.96
Outdoor and Other Urban and Built-up Land	C/D	3.33	18.48
Outdoor and Other Urban and Built-up Land	IMP	0.09	1.25
Residential	A	14.54	7.71
Residential	C/D	22.62	60.62
Residential	IMP	15.82	248.93
Transitional	A	0.09	0.02
Transitional	C/D	0.23	0.31
Transitional	IMP	0.19	2.68
Transportation, Communications, and Utilities	A	0.16	0.04
Transportation, Communications, and Utilities	C/D	0.09	0.11
Transportation, Communications, and Utilities	IMP	11.05	124.96
Total		**122**	**876**

* Hydrologic soil group derived from landform. Watershed area was divided into 3 slope classes, 0-3%, 3-8%, and 8-15%. Dominant soil type for each slope class was assumed for entire slope class. Scitico silt loam for 0-3% slopes, Charlton fine sandy loam for others. **Based on WISE, 2015 PLERs

SCOUR VELOCITY ANALYSIS

The following tables display the pipe velocities in the vicinity of BMPs 1, 2, and 5 under baseline conditions (no weirs or BMPs added) and proposed conditions. Each row of the table represents a reach of pipe between a listed in and out junction. Weir locations are noted in the left-hand columns of each table.

Table 4 - Pipe velocities in vicinity of BMPs 1 and 2

Junction In	Junction Out	Pipe Length	Pipe Diameter	Flow Rate (cfs)	Velocity (fps)	Scenario
Main Sewer Line Entry to BMP 1, BMP 2						
J40	J39	302	15"	2.06	3.12	w/ weir
				2.01	3.32	w/o weir
J39	CB-0952	106	18"	3.19	2.71	w/ weir
				3.3	2.98	w/o weir
CB-0952	DMH-0954	214	18"	3.95	3.06	w/ weir
				4.8	3.37	w/o weir
DMH-0954	**CB-0955 (BMP 1 Weir)**	186	18"	4.62	2.62	w/ weir
				5.47	4.26	w/o weir
CB-0955 (BMP 1 Weir)	CB-0956	325	18"	1.22	4.15	w/ weir
				5.33	6.24	w/o weir
CB-0956	CB-0958	215	18"	1.67	4.32	w/ weir
				5.78	6.01	w/o weir
CB-0958	CB-0959	45	18"	2.42	2.79	w/ weir
				6.23	4.92	w/o weir
CB-0959	**DMH-0897 (BMP 2 Weir)**	94	18"	2.75	1.56	w/ weir
				6.38	3.61	w/o weir
DMH-0897 (BMP 2 Weir)	J33	116	24"	2.13	2.11	w/ weir
				12.63	4.02	w/o weir
North Sewer Line Entry to BMP 2						
J31	J32	322	15"	3.73	4.7	w/ weir
				3.73	4.7	w/o weir
J32	**DMH-0897 (BMP 2 Weir)**	128	15"	7.01	6.33	w/ weir
				7.16	6.35	w/o weir

Table 5 - Pipe velocities in vicinity of BMP 5

Junction In	Junction Out	Pipe Length	Pipe Diameter	Flow Rate (cfs)	Velocity (fps)	Scenario
West Sewer Line Entry to J129						
J130	J129	705	12"	1.24	3.85	w/ weir
				1.56	3.29	w/o weir
J129	J127 (BMP 5 Weir)	150	18"	6.64	3.76	w/ weir
				5.74	4.77	w/o weir
J127 (BMP 5 Weir)	J124	518	18"	5.77	5.79	w/ weir
				8.38	9.13	w/o weir
South Sewer Line Entry to J129						
J132	J131	421	15"	2.1	2.86	w/ weir
				2.09	2.86	w/o weir
J131	J128	184	15"	2.65	3.61	w/ weir
				2.66	3.82	w/o weir
J128	J129	75	15"	5.64	4.59	w/ weir
				4.94	4.7	w/o weir

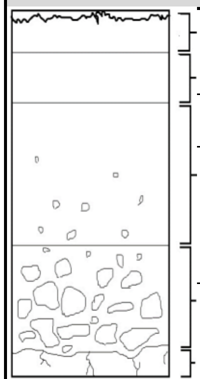
APPENDIX B: SOIL TEST PIT RECORDS

Table 1: Soil Coring Findings

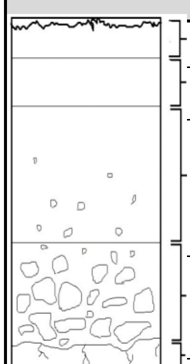
BMP #	Location	Soil Type	Hydrologic Soil Group	Saturated Hydraulic Conductivity (in/hr)	BMP Type
1	Playground on the intersection of Winter St. and Front St.	*62B: Charlton Fine Sandy Loam*	A	0.6-6	Subsurface Infiltration
2	Intersection of Columbus Ave., Winter St., and Railroad Ave.	*62B: Charlton Fine Sandy Loam*	A	0.6-6	Subsurface Infiltration
3	24 Lincoln Street	*62B: Charlton Fine Sandy Loam*	A	0.6-6	ROW Infiltration/Filtration
4	Lincoln Street Elementary School Parking Lot	*62B: Charlton Fine Sandy Loam*	A	0.6-6	Subsurface Infiltration
5	Philips Exeter Academy	*62B: Charlton Fine Sandy Loam*	A	0.6-6	Subsurface Infiltration
6	Intersection of Washington St. and Spruce St.	*33A Scitico Silt Loam*	C/D	0-0.2	ROW Infiltration/Filtration
7	Lincoln Street Elementary School Playground	*62B: Charlton Fine Sandy Loam*	A	0.6-6	Subsurface Infiltration

Soil Test Pit Worksheet

Project Name: Lincoln Street Phase I	**Date: 11/28/2016**
Project Number: 16928	**Technician: A. Moskal, M. Roseen**
Location: TP1 Intersection of Railroad Ave., Winter St., and Columbus Ave.	**Description: Soil Pit by Auger**

Horizons	**Layer**	**TP**					
		Depth (in) inches	**Color**	**Texture Consistency**	**SHWT** yes, no, depth	**Roots** inches	**Notes**
	O – Top layer, “organic” layer	0-4	Black	Organics	No		62B: Charlton Fine Sandy Loam, 3-8% Slopes
	A – Second layer of soil, “top soil”, lots of organic matter mixed, darkly colored.	4-22	2.5y 4/1	Fine Loamy Sand	No		
	B – Subsoil layer. Transition between top soil and subsoil. Striations and repeating floodplain deposition layers	B1: 22-28 B2: 28-42	B1: 2.5y 5/4 B2: 2.5y 6/4	Fine Loamy Sand	No		
	C – This layer usually has lots of large rocks mixed in with deep soil.	C1: 42-54 C2: 54+	C1: 5y 7/2 C2: 5y 8/1	C1: Sandy Loam C2: Sand	No		
	D – Bedrock						

Project Name: Lincoln Street Phase I	**Date: 12/06/2016**
Project Number: 16928	**Technician: A. Moskal, M. Roseen**
Location: TP2 (Playground adjacent to Winter St. and Front St. Intersection)	**Description: Soil Pit by Auger**

Horizons	**Layer**	**TP**					
		Depth (in) inches	**Color**	**Texture Consistency**	**SHWT** yes, no, depth	**Roots** inches	**Notes**
	O – Top layer, “organic” layer	0-3	Black	Heavy Organic	No		62B: Charlton Fine Sandy Loam, 3-8% Slopes
	A – Second layer of soil, “top soil”, lots of organic matter mixed, darkly colored.	3-8	10 yr 4/4	Fine Loamy Gravely Sand	No		
	B – Subsoil layer. Transition between top soil and subsoil. Striations and repeating floodplain deposition layers	B1: 8-22 B2: 22-35	B1: 10y 6/6 B2: 2.5y 7/4	Fine Loamy Sand	No		
	C – This layer usually has lots of large rocks mixed in with deep soil.	41+	2.5y 7/3	Fine Silty Loam	No		
	D – Bedrock						

Soil Test Pit Worksheet

Project Name: Lincoln Street Phase I	Date: 11/28/2016
Project Number: 16928	Technician: A. Moskal, M. Roseen
Location: TP3 (Intersection of Washington and Spruce)	Description: Soil Pit by Auger

Horizons	Layer	TP Depth (in) inches	Color	Texture Consistency	SHWT yes, no, depth	Roots inches	Notes
	O – Top layer, "organic" layer	0-6	Black	Organics	No		33A Scitico Silt Loam 0 to 5 % Slopes
	A – Second layer of soil, "top soil", lots of organic matter mixed, darkly colored.	6-12	5y 4/2	Fine Loamy Sand	No		
	B – Subsoil layer. Transition between top soil and subsoil. Striations and repeating floodplain deposition layers	B1: 12-19 B2: 19+	B1: 5y 5/2 B2: 5y 5/1	B1: Sandy Loam B2: Silty Clay	No		No significant change after 19"
	C – This layer usually has lots of large rocks mixed in with deep soil.	19+	5y 5/1	Silty Clay	No		
	D – Bedrock						

Project Name: Lincoln Street Phase I	Date: 12/06/2016
Project Number: 16928	Technician: A. Moskal, M. Roseen
Location: TP4 (24 Lincoln Street)	Description: Soil Pit by Auger

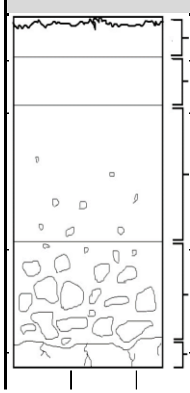
Horizons	Layer	TP Depth (in) inches	Color	Texture Consistency	SHWT yes, no, depth	Roots inches	Notes
	O – Top layer, "organic" layer	0-2	Black	Heavy Organic	No		62B: Charlton Fine Sandy Loam, 3-8% Slopes
	A – Second layer of soil, "top soil", lots of organic matter mixed, darkly colored.	2-14	5y 4/1	Fine Loamy Sand	No		
	B – Subsoil layer. Transition between top soil and subsoil. Striations and repeating floodplain deposition layers	B1: 14-18 B2: 18-32	B1: 5y 4/2 B2: 2.5y 8/1	B1: Sandy Loam B2: Fine Loamy Sand	No		
	C – This layer usually has lots of large rocks mixed in with deep soil.	32+	7.5yr 5/4	Fine Loamy Sand	No		
	D – Bedrock						

Soil Test Pit Worksheet

Project Name: Lincoln Street Phase I	**Date: 12/06/2016**
Project Number: 16928	**Technician: A. Moskal, M. Roseen**
Location: TP5 Valley Bottom behind Lincoln Street Elementary School Parking Lot	**Description: Soil Pit by Auger**

Horizons	Layer	TP					
		Depth (in) inches	Color	Texture Consistency	SHWT yes, no, depth	Roots inches	Notes
	O – Top layer, "organic" layer	0-5	Black	Heavy Organic	No		62B: Charlton Fine Sandy Loam, 3-8% Slopes
	A – Second layer of soil, "top soil", lots of organic matter mixed, darkly colored.	5-14	7.5 yr 4/1	Loamy Sand with Gravel	No		
	B – Subsoil layer. Transition between top soil and subsoil. Striations and repeating floodplain deposition layers	B1: 14-20 B2: 20+	B1: 5y 4/2	Saturated Loamy Sand	Yes: 26 in		Could not sample any deeper
	C – This layer usually has lots of large rocks mixed in with deep soil.						
	D – Bedrock						

Project Name: Lincoln Street Phase I	**Date: 12/07/2016**
Project Number: 16928	**Technician: A. Moskal, M. Roseen**
Location: TP6 (In front of Philips Exeter Academy)	**Description: Soil Pit by Auger**



Horizons	Layer	TP					
		Depth (in) inches	Color	Texture Consistency	SHWT yes, no, depth	Roots inches	Notes
	O – Top layer, "organic" layer	0-2	Black	Heavy Organic	No		62B: Charlton Fine Sandy Loam, 3-8% Slopes
	A – Second layer of soil, "top soil", lots of organic matter mixed, darkly colored.	2-9	10yr 5/3	Loamy Sand with Gravel	No		
	B – Subsoil layer. Transition between top soil and subsoil. Striations and repeating floodplain deposition layers	B1: 9-16 B2: 16-28	B1: 10yr 6/8 B2: 2.5y 8/4	Fine Loamy Sand	No		
	C – This layer usually has lots of large rocks mixed in with deep soil.	28+	10yr 8/4	Fine Loamy Sand	No		
	D – Bedrock						

APPENDIX C: ASSUMPTIONS AND LIMITATIONS

ASSUMPTIONS AND LIMITATIONS

All watershed models seek to represent complex physical processes through the use of simplifying equations and assumptions. The process of parameterizing watershed characteristics to suit a watershed model involves an inherent level of uncertainty. Though it is impossible to avoid this uncertainty, it is important to understand the sources of uncertainties so that they can be quantified and incorporated into the model to create a more robust analysis. The sources of uncertainty in this analysis are described below along with a brief discussion of the main approaches for characterizing the uncertainty of the model input parameters. The sources of uncertainty relating to the model input parameters arise from, but are not limited to, the:

- Representativeness of data from studies conducted in other areas that were used in the analysis (e.g. runoff concentrations).

- General uncertainty in any stormwater data due to measurements, field protocols, data quality, and data accuracy.

- Stormwater volume estimation methods that rely on empirical relationships between annual rainfall and runoff.

- Spatial uncertainty in watershed/site conditions (e.g., imperviousness, soils, runoff parameters), as they relate to the certainty that can be had regarding hydrologic conditions at a given location.

- Model output relates one land use to one nutrient management measure and therefore, cannot be applied to a variety of land uses or multiple consecutive nutrient management measures (i.e., treatment train).

- Model output associated with runoff volume and pollutant load are scaled from 1-acre parcels to the entire watershed area.

- Model does not consider runoff hydraulics after runoff leaves a hydrologic response unit or nutrient management measure.

It is important to note that the model does not seek to describe the temporal variability that is inherent in stormwater pollutant loading. The model is intended to estimate long-term average conditions for the location and project. At this scale, temporal variability (e.g., storm-to-storm, year-to-year) is not relevant. Additionally, the model is not intended to predict conditions for a given storm event or monitoring period.

The previously mentioned assumptions are more or less general to all watershed modeling studies. Some further assumptions of note that are specific to this effort are:

- Design storm rainfall volumes based on data from the NRCC for Exeter, NH.

- Subcatchment runoff characteristics for current conditions are based on 2005 land use data, the most current available data set.

- Infiltration/runoff calculations are based on the least sophisticated method available in PCSWMM (CN vs. CN + Imp. Green-Ampt, or Horton methods).

- The representations of BMPs 1, 2, 3, and 5 in the PCSWMM model mimic the intended *function* of the systems they represent (e.g. storage capacity for 0.5" of runoff depth before bypassing) but many of the more specific *form* details associated with each system were unable to be represented due to limitations in the modeling software. Designs for the BMPs were based primarily on a HydroCAD modeling effort, though the PCSWMM model was used to quantify runoff reduction impacts at the watershed scale.

- Due to the number of catch basins, manholes, pipes and outfalls, Geosyntec developed a methodology under the CAPE project to accurately model the storm sewer infrastructure by reducing the number of nodes within the model to only represent the main trunk lines of the system. Based on this approach, catch basins and manholes in the model were represented at inlets, outlets, and areas where there was a change in pipe diameter. Drainage areas were delineated for the areas which drained to these pipes. This approach provides an accurate representation of the capacity of the system; however, does not include analysis of single catch basins and associated pipes which convey flows to the main trunk line. The modeling approach and analysis provides a conservative estimate of the system and represents the flow in the pipe at its maximum value along the length of the run, rather than gradually increasing flow as each catch basin downstream successively contributes to the system.

- The original CAPE model was not re-calibrated after adding BMPs 1, 2, 3, and 5 as no other major modifications to the original model were made.

APPENDIX D: WATERSHED MODELING METHODOLOGY

FLOOD MODELING

The flood modeling effort for the Lincoln Street Watershed Analysis built on an existing drainage model ("Model") developed as part of the Climate Adaptation Plan for Exeter (CAPE). The CAPE Model was modified to simulate the addition of BMPs 1, 2, 3, and 5 in order to determine the flood reduction impacts associated with these BMPs during the 10-year, 24-hour storm event (for which the CAPE Model was calibrated). The original CAPE Model development methodology is presented below, along with a section describing the modifications made for this assessment. It is important to note that the model was not re-calibrated following the updates to the drainage network made as a part of the Lincoln Street Watershed Analysis.

Original CAPE Model Methodology[1]

The Model was created using the US Environmental Protection Agency (USEPA) Storm Water Management Model (SWMM) modeling platform to evaluate the flooding potential of the stormwater infrastructure network under varying storm depths, tidal storm surge and future buildout conditions. The Model was used to investigate the flooding and surcharging of town storm drainage infrastructure during the 10-yr design storm event under a variety of conditions (such as climate change, land use/buildout changes, coastal storm surges, etc.). The Model was created for planning purposes and includes some simplifying assumptions; it is not intended to provide design parameters for stormwater infrastructure installation and/or replacement. Any preliminary stormwater infrastructure designs prepared by the Town of Exeter or its consultants should include independent detailed hydraulic/hydrologic analysis.

The Model framework consists of several components including: watershed drainage areas (i.e., storm sewered areas and non-sewered areas), storm sewer infrastructure network (i.e., catch basins, manholes, pipes and outfalls), and river segments (i.e., Little River and Exeter/Squamscott River).

Drainage Areas and Infrastructure Network

Two types of drainage areas were delineated for the Model, which included: areas where storm sewer infrastructure is present and areas where storm sewer infrastructure is not present. In the storm sewered areas, the drainage area or "sewershed" represents the areas draining to catch basins, manholes, culverts, pipes and outfalls (Figure 1). Areas where storm sewer infrastructure is not present, represent areas where stormwater follows natural drainage patterns and/or is intercepted by roadside swales and conveyed to receiving waters. These drainage areas were delineated using standard HUC-12 watersheds. In areas where a HUC-12 watershed intersected a delineated sewershed, the HUC-12 watershed was clipped so as to not overlap.

To delineate the drainage areas within the storm sewered area, Geosyntec obtained copies of Exeter Department of Public Works (DPW) storm sewer infrastructure logbooks as well as the current DPW GIS files of stormwater infrastructure. The GIS shapefiles contain location information for catch basins, manholes, culverts, and stormwater pipes, as well as pipe diameters. Rim elevations for catch basins and manholes were interpolated from LiDAR topographic data, with the inverts of any connecting pipes being located at an assumed depth from the rim. To supplement/confirm these assumptions, the DPW logbooks were used to modify pipe invert elevation where data was available. The data were assembled in ArcGIS

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[1] Methodology and results are summarized in the memorandum prepared by Geosyntec Consultants, dated 21 October 2016, entitled "Storm Sewer Infrastructure Model Evaluation; 10-yr Design Storm Analysis; Exeter, New Hampshire"

and critical information (such as depth, invert, material, etc.) was transcribed from the logbooks into the shapefile attribute information.

Due to the number of catch basins, manholes, pipes and outfalls, Geosyntec developed a methodology under the CAPE project to accurately model the storm sewer infrastructure by reducing the number of nodes within the model to only represent the main trunk lines of the system. Based on this approach, catch basins and manholes in the model were represented at inlets, outlets, and areas where there was a change in pipe diameter. Drainage areas were delineated for the areas which drained to these pipes. This approach provides an accurate representation of the capacity of the system; however, does not include analysis of single catch basins and associated pipes which convey flows to the main trunk line. The modeling approach and analysis provides a conservative estimate of the system and represents the flow in the pipe at its maximum value along the length of the run, rather than gradually increasing flow as each catch basin downstream successively contributes to the system.

Geosyntec obtained American Recovery and Reinvestment Act (ARRA) LiDAR Data for the Northeast from the University of New Hampshire GRANIT spatial data distribution site. The primary use of the LiDAR topographic data was to delineate drainage areas and to determine approximate rim elevations of catch basins and manholes, as these were not readily available in the DPW data. Attachment 1 provides a map book of the delineated storm sewersheds.

River Segments

Cross sections of the river networks were modeled to understand the effects of backwater within the storm sewer network caused by water surface elevations in the receiving waters (i.e., Little River and Exeter Squamscott Rivers) related to the tidal cycle and coastal storm surge. To include this effect in the simulations, the two rivers were represented in the Model using "custom conduits". The conduits' cross-sectional geometry and physical parameters (i.e., Manning's n) were imported from the existing Hydrologic Engineering Centers River Analysis System (HECRAS) model of the two rivers developed by University of New Hampshire (UNH) as part of the CAPE project.

Precipitation and Boundary Conditions

To simulate runoff, the Model was run using the 10-yr, 24-hr design storm. The design storm distribution was obtained from Hydrological Simulation Program-Fortran (HSPF), as shown in Figure 2 below. This unitless design storm distribution was scaled up according to the total estimated storm event depth for each scenario. The storm event depths were 4.72", 5.29", and 5.66" for current (2010), 2040, and 2070 scenarios, respectively. The increased storm event depth for 2040 and 2070 is intended to reflect the projected levels of precipitation increase due to climate change. Storm event depths were provided by Dr. Paul Kirshen at UNH as part of the CAPE project.

As part of the CAPE project, a Hydrologic Engineering Center Hydrologic Modeling System (HEC-HMS) model of the entire Exeter-Squamscott watershed was developed by UNH to quantify hydrological conditions for 2010, 2040 and 2070. The 10-yr, 24-hr storm peak flow rates at Pickpocket Dam and Little River, as predicted by the HEC-HMS model, were entered as constant flow rates into the Model at the upstream boundary junctions representing the Pickpocket Dam and the headwaters of Little River.

The downstream boundary is the water surface elevation of the tidal portion of the Squamscott River at its intersection with Wheelwright Creek. Depending on the modelled scenario, this water surface elevation either represented a typical tidal elevation (Mean Higher-High Water), or the 100-year coastal storm surge elevation. In either case, the boundary condition was maintained at a static elevation for the duration of each model run. Table 1 summarizes the precipitation data and boundary conditions for the five model scenarios performed in this analysis.

Model Calibration[2]

The Model was calibrated using flow records for the storm sewered areas and the HEC-HMS model for the non-sewered areas.

For the sewered areas of Exeter, flow records were obtained from a pressure transducer at a catch basin located at the intersection of Park Street and Water Street in Exeter, during June and July of 20131. Observed flows at this catch basin were compared to modeled flows, and this comparison was used for calibration. Sewershed drainage area parameters were adjusted in an iterative process to maximize Nash-Sutcliffe efficiency (E) and minimize the difference in runoff volume during four monitored precipitation events. The final set of calibration parameters caused the model to perform with a Nash-Sutcliffe efficiency E = 0.352 and a runoff volume difference of -5.3%.

For the non-sewered areas, the HEC-HMS model results were used to calibrate the Model. Based on the calibration, the two models appear to be in modest agreement.

Modification of CAPE Model for the Lincoln Street Watershed Analysis

This section describes the modifications made to the existing CAPE Model in order to apply it to the Lincoln Street Watershed Analysis. This analysis focused in on a small portion of the modeled area from the CAPE Model. Consequently, it was necessary to downsize the CAPE Model and also add resolution at certain points within the drainage network. Ultimately, representations of BMPs 1, 2, 3, and 5 were added to the model, along with additional sewer system infrastructure necessary to divert flows at the level desired. Once all of the CAPE Model components were adjusted to a satisfactory degree, PCSWMM was used to run a 2D simulation to determine flooding extent during the 10-year, 24-hour storm event.

Down-sizing of Drainage Network

The CAPE Model covers a much larger area than the focus area for this effort. Consequently, the decision was made to remove all model components outside of the S10 watershed because these features had no impact on the hydrologic or hydraulic dynamics within the Lincoln Street watershed.

Adjustments to the Drainage Network

After downsizing the drainage network to represent only the S10 watershed, it was necessary to add resolution in certain areas and adjust certain model parameters so that the model would suit the analytical needs of this effort. These adjustments were:

- Updating invert elevations for catch basins and manholes in the vicinity of the proposed locations for BMPs 1, 2, 3, and 5.
- Updating pipe diameters in the vicinity of the proposed BMP sites.
- Adding nodes representing catch basins and manholes in areas around the proposed BMP sites.

[2] Methodology and results are summarized in the memorandum prepared by Geosyntec Consultants, dated 31 October 2013, entitled "CAPE: Storm sewershed runoff model calibration."

- Subdivision of Existing Model Subcatchments for BMPs 3.1-3.6, 3.8, 3.9, and 3.20-3.22. A topographic analysis was used to determine the drainage areas for these BMPs, and these drainage areas were re-directed to the BMPs rather than directly into the drainage network.

Addition of BMPs 1, 2, 3, and 5 to CAPE Model

Once the necessary adjustments to the drainage network were made, the final suite of BMPs (1, 2, 3.1-3.6, 3.8, 3.9, 3.20-3.22, and 5) were added to the PCSWMM model. All BMP designs were originally generated using HydroCAD, a modeling package which is more capable of capturing structural details that are integral to the hydraulic function of a BMP. In transferring the BMP designs from HydroCAD to PCSWMM, modifications were made to preserve the HydroCAD-predicted function. The main difference being that PCSWMM is not capable of representing void space in a storage unit, requiring the modeling team to decrease the heights of each BMP by 40% to account for the stone fill. This allowed for the preservation of surface areas which are more important for exfiltration rates and overall BMP function. For BMPs 3.1-3.22, the PCSWMM-modeled surface areas were further adjusted until the desired performance for the ½" sized units was achieved:

Overflow = 0cfs during the 0.5" storm
Overflow > 0cfs during the 0.6" storm

It is important to note that final designs for BMPs 1, 2, 3, and 5 were derived from a HydroCAD modeling effort, not from the use of SWMM. HydroCAD is more capable of capturing the design details of stormwater BMPs. However, the SWMM model was used to determine the hydrologic impacts of the BMPs on the S10 watershed.

PCSWMM 2D Simulation

As a final modeling step, PCSWMM was used to determine the flooding extent during the 10-year, 24-hour storm event with and without the recommended suite of BMPs. This involved tying the 1-D SWMM model in with LiDAR data (LiDAR for the Northeast, 2011), a process which is supported by a PCSWMM 2-D modeling tool.

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Memorandum

Date: 31 October 2013

To: Paul Kirshen, University of New Hampshire

From: Robert Roseen, Geosyntec Consultants
Renee Bourdeau, Geosyntec Consultants
Chad Yaindl, Geosyntec Consultants

Subject: CAPE: Storm sewershed runoff model calibration

SUMMARY

This memorandum describes the methods and results of the model calibration effort for the Exeter storm sewer model. Flow records were obtained from a pressure transducer at catch basin CB534, located at the intersection of Park Street and Water Street, during June and July of 2013. Observed flows at CB534 were compared to modeled flows in conduit C34 (which is the outlet of CB534). Sewershed parameters were adjusted in an iterative process to maximize Nash-Sutcliffe efficiency (E) and minimize the difference in runoff volume during four precipitation events. The final set of calibration parameters caused the model to perform with an efficiency E = 0.352 and a runoff volume difference of -5.3%.

CALCULATION OF MONITORED FLOWRATE

Monitoring data at catch basin CB534 was collected using a pressure transducer to collect a 5-minute time series of absolute pressure and temperature. Barometric pressure and precipitation records were obtained a weather station located in Stratham, New Hampshire. Absolute pressure at CB534 was converted to water depth above the transducer using the barometric pressure record. Using the water depth above the transducer, a water depth above the outlet pipe invert was calculated by subtracting the known offset between the transducer and the pipe invert.

Flow at CB534 was calculated assuming the outlet pipe was inlet controlled and that the water depth measured by the transducer reflected headwater above the pipe invert. To calculate observed flow the following equations were used:

$$\frac{HW}{d} = \frac{E_c}{d} + K\left[\frac{Q}{Ad^{0.5}}\right]^M - 0.5S; (Inlet\ unsubmerged)$$

$$\frac{HW}{d} = c\left[\frac{Q}{Ad^{0.5}}\right]^2 + Y - 0.5S;\ (Inlet\ submerged)$$

where, HW is head above the culvert inlet, E_c is the minimum specific energy, d is the diameter of the pipe, Q is the discharge, A is the full cross-sectional area of the barrel, S is the pipe slope, and K, M, c, and Y are constants reflecting various types of inlet configurations.

CHOICE OF PRECIPITATION EVENTS

During the observed period of record (June through July 2013), the modeled flowrates at conduit C34 were compared to observed flowrates at CB 534. Four precipitation events were chosen for calibration based on a qualitative process. The qualitative process included determining if a precipitation event produced a modeled runoff hydrograph with approximately the same shape and magnitude as the observed hydrograph. In several instances, the model produced a large peak event where no such event was evident in the monitoring record. These discrepancies are most likely due to potential differences in precipitation intensity between location of the CB 534 watershed and the Stratham precipitation gage and less likely a function of watershed parameters.

CALIBRATION OF SUBWATERSHED PARAMETERS

Presented in Table 1, are the subwatershed parameters used in the Exeter storm sewereshed model and whether these parameters are unique to each subcatchment if they were calculated using GIS processes or if an estimated model wide value was used (default).

The subwatershed parameters were considered for calibration, primarily the default values. Using an iterative process, the watershed parameters were adjusted to minimize the difference in runoff volume between the observed and modeled during the four calibration precipitation events. To determine the effectiveness of the calibration, the Nash-Sutcliffe efficiency (E) was used to assess the predictive power of the hydrologic model. The efficiencies range from negative infinity (-∞ to 1), with an efficiency of 1 corresponding to a perfect match between observed and modeled. For each of the four calibration events, Nash-Sutcliffe efficiency and observed and modeled runoff volumes were calculated. The subwatershed model parameters were adjusted to provide the highest efficiency and the lowest percent difference between observed and modeled runoff volumes. Results of the two calibration indicators are presented in Table 2 and hydrographs for the four events presented as Figure 1. The calibration process increased efficiency (E) from 0.291 to 0.352, and reduced difference in runoff volume by approximately 5%. To achieve this, the following subwatershed parameters were adjusted, which are also presented in Table 1:

- Increase of Manning's n for pervious surfaces;
- Increase of storage depth for both impervious and pervious surfaces;
- Routing of pervious surface runoff onto impervious surfaces (i.e. lawn runoff onto driveway/road);
- Increase of calculated curve number by 7%; and
- Decrease in the soil drying time from 4 to 2 days.

Table 1. Subwatershed Parameters Pre- and Post-calibration

Subwatershed Parameter	Unique (calculated) or Default Value [U or D]	Default Value	Post-calibration Value
Area	U	--	--
Width	U	--	--
% Slope	U	--	--
% Impervious	U	--	--
N-Impervious	D	0.01	0.01
N-Pervious	D	0.1	0.15
Dstore Impervious	D	0.05	0.012
Dstore Pervious	D	0.05	0.18
%Zero Impervious	D	25	25
Subarea Routing	D	OUTLET	IMPERVIOUS
Percent Routed	D	100	100
Infiltration Curve Number	U	--	x1.07
Soil Drying Time	D	4 days	2 days

Table 2. Calibration indicators

PRE-CALIBRATION			POST-CALIBRATION		
Event	E	Volume % Diff.	Event	E	Volume % Diff.
6/7/2013 0:00	0.283	60%	6/7/2013 0:00	0.499	10%
6/10/2013 12:00	0.538	-33%	6/10/2013 12:00	-0.072	21%
6/11/2013 18:00	0.037	-63%	6/11/2013 18:00	0.452	-45%
7/1/2013 12:00	0.307	-5%	7/1/2013 12:00	0.528	-7%
Average	0.291	-10%	**Average**	0.352	-5.3%

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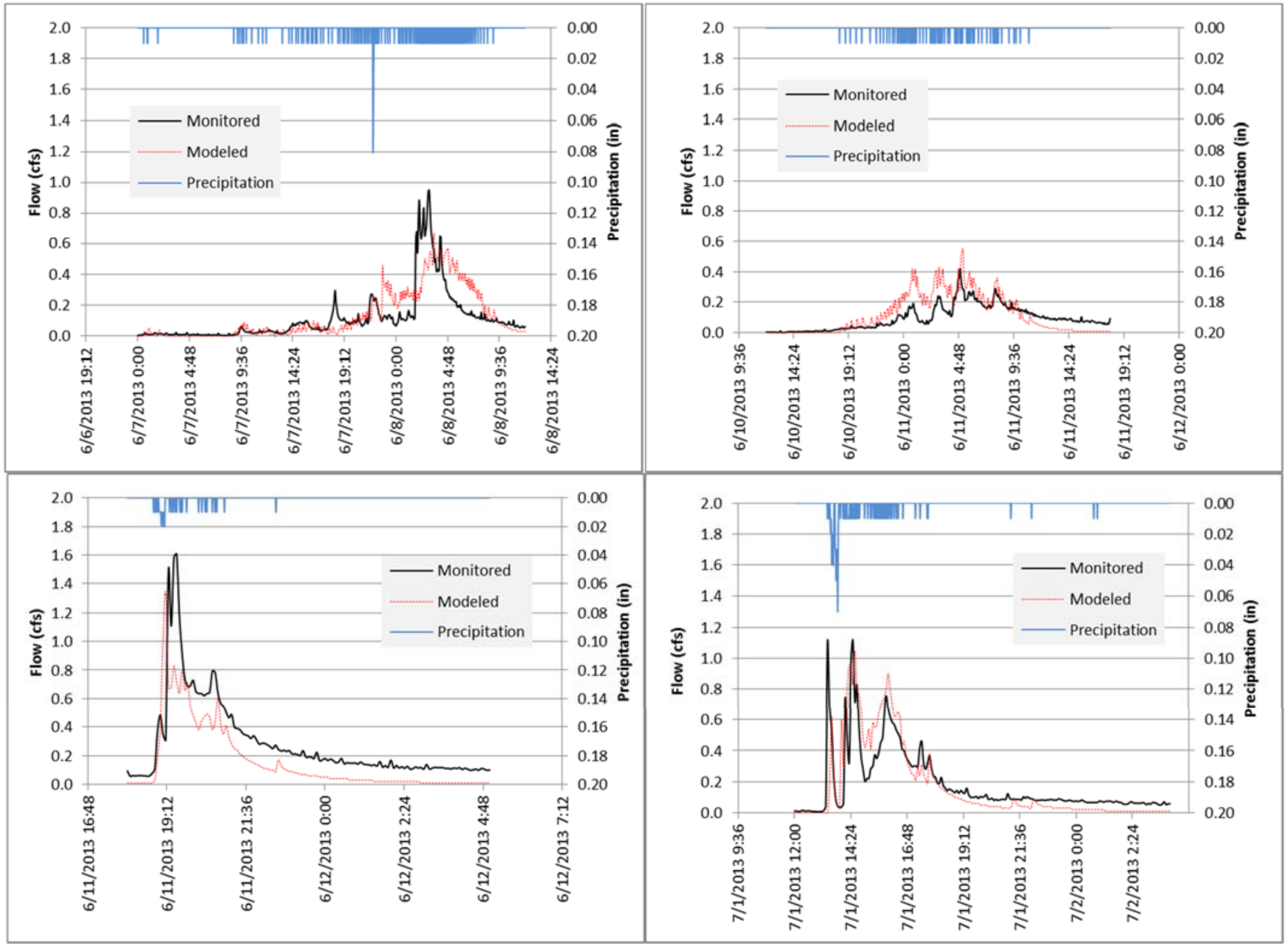


Figure 1. Four calibration events, monitored and modeled flowrates, location CB 534.

APPENDIX E: POLLUTANT LOAD METHODOLOGY

Pollutant Loading and BMP Costing Analysis

A planning level pollutant loading and BMP costing analysis was performed for each of the 7 potential BMPs identified for the Lincoln Street watershed. The soil type, BMP type, and land use type for each BMP is shown in Table 1 - BMP type, soil, and land use summary. These were used in conjunction with performance curves from the WISE, 2015[1] analysis to determine expected runoff and nitrogen load reductions associated with each BMP.

These curves and associated pollutant load reduction estimates are shown in Section C.1, below.

Estimates for the cost per acre of drainage area for each BMP type from the WISE, 2015[1] analysis were used to estimate the total and unit costs associated with the nitrogen load reductions for each BMP. The numbers used for these estimates are shown in Section C.2, below.

Table 1 - BMP type, soil, and land use summary

BMP Location	Soil Type	Proposed BMP Type
1	A	Subsurface Infiltration
2	A	Subsurface Infiltration
3.1	A	Bioretention
3.2	A	Bioretention
3.3 - 3.6	A	Bioretention
4	A	Subsurface infiltration
5	A	Subsurface infiltration
6	C	Bioretention
7	A	Subsurface Infiltration

[1] Roseen, R., Watts, A., Bourdeau, R., Stacey, P., Sinnott, C., Walker, T., Thompson, D., Roberts, E., and Miller, S. (2015). Water Integration for Squamscott Exeter (WISE), Preliminary Integrated Plan, Final Technical Report. Portsmouth, NH, Geosyntec Consultants, University of New Hampshire, Rockingham Planning Commission, Great Bay National Estuarine Research Reserve, Consensus Building Institute.

C.1 Pollutant Loading Analysis

Pollutant Loading Calculation Example

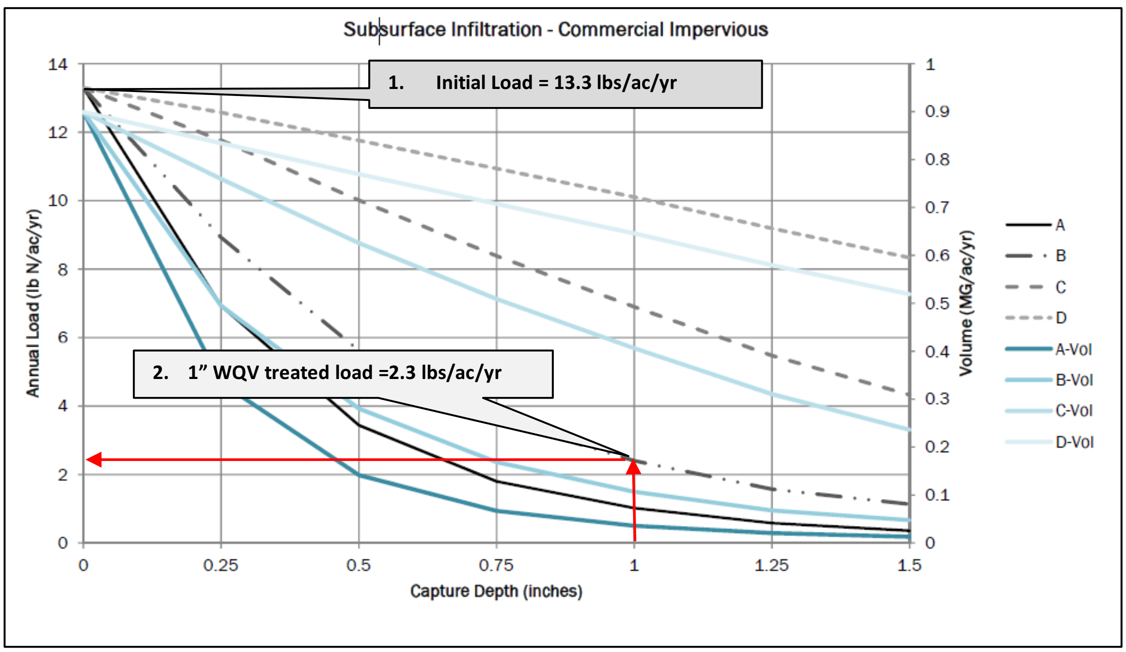
The following example and accompanying figures explain the approach taken for the pollutant loading and volume reduction analysis performed in this study with a BMP of the following characteristics:

- subsurface infiltration system,
- 1" water quality volume,
- type B soil,
- commercial land use,

From the BMP performance curve for a subsurface infiltration system pollutant removal and volume reduction are determined as follows:

1. **Determine initial load.** Where the BMP curve for nitrogen (black curves) crosses the left hand vertical axis (capture depth=0) determine the initial TN load based on commercial land use = 13.3 lbs/ac/yr.
2. **Determine treated load.** Locate performance curve for soil type B for the capture volume. A system treating a 1" water quality volume for 1 acre will have a treated load of 2.3 lbs/ac/yr.

Example 1: BMP optimization for pollutant load with subsurface infiltration at 1" water quality volume

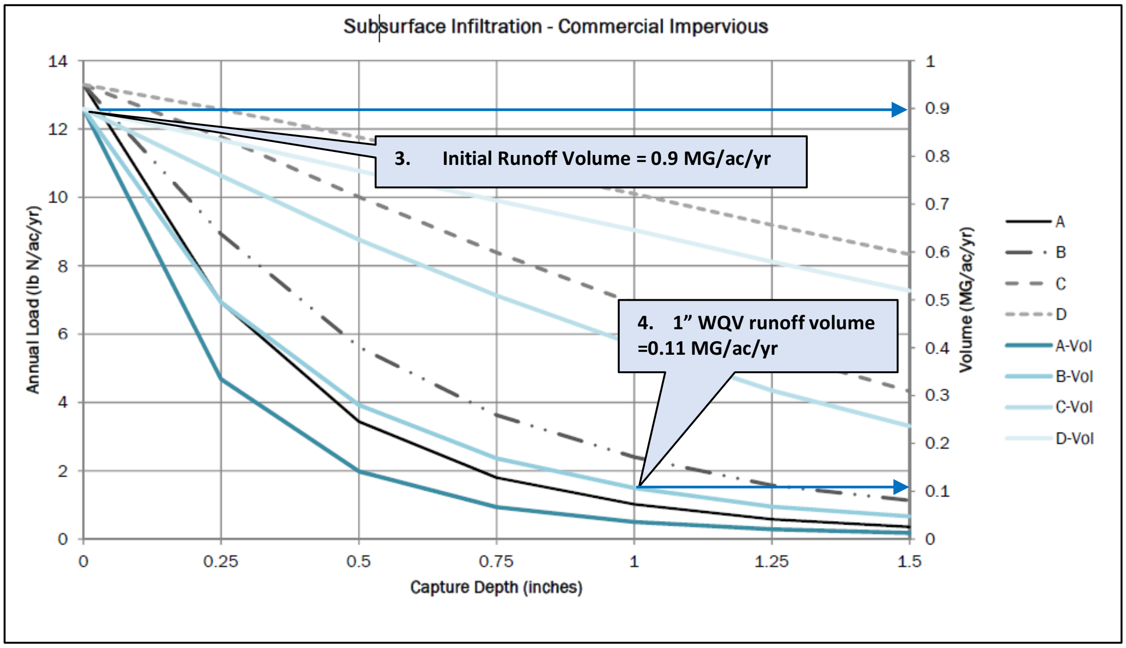


3. **Determine load removed.** An initial load of 13.3 lbs/ac/yr and a treated load of 2.3 lbs/ac/yr removes 11 lbs/ac/yr or 83% annual TN reduction.

$$\frac{\text{Treated Load}}{\text{Initial Load}} = \frac{11}{13.3} = 83\%\ \text{TN reduction annually}$$

4. **Determine initial runoff volume.** Where the BMP curve for volume (blue curves) crosses the left hand vertical axis (capture depth=0) determine the initial runoff volume based on the right hand axis for commercial land use = 0.9 million gallons/ac/yr.
5. **Determine treated runoff volume.** Locate performance curve for soil type B for the capture volume. A system treating a 1" water quality volume for 1 acre will have a runoff volume = 0.11 million gallons/ac/yr.

Example 2: BMP optimization for volume with subsurface infiltration at 1" water quality volume



6. **Determine volume removed.** An initial runoff volume of 0.9 MG/ac/yr and a treated runoff volume of 0.11 MG/ac/yr removes 0.79 MG/ac/yr or 88% annual runoff reduction.

$$\frac{\text{Treated Runoff Volume}}{\text{Initial Runoff Volume}} = \frac{0.11}{0.9} = 88\% \text{ runoff volume reduction annually}$$

The complete methods can be found in the BMP Decision Support System (BMPDSS)(EPA 2010)[2] and WISE Project (Roseen et al 2015)[1]. This approach was developed in cooperation with EPA Region 1 to support an Integrated Planning and Permitting framework for watershed scale nitrogen management for the Exeter-Squamscott Watershed.

[2] EPA and I. Tetra Tech (2010). Stormwater Best Management Practices (BMP) Performance Analysis. United States Environmental Protection Agency – Region 1, Boston, MA.

The following tables display the actual numbers used to calculate pollutant load reductions in this analysis, applying the methodology outlined above in Examples 1 and 2. The associated BMP performance curves can be found in WISE, 2015[1], pages 92-180.

Table 2 - Performance estimates for BMP 6

BMP	Drainage Area (acres)	Annual N Load (lbs)	1/4" Volume Reduction (ft^3)	1/2" Volume Reduction (ft^3)	1/4" N Reduction (lbs)	1/2" N Reduction (lbs)
6	1.73	27.27	1,569	3,138	5	6

Table 3 - Performance estimates for BMP 3

BMP	Drainage Area (acres)	Annual N Load (lbs)	1/4" Volume Reduction (ft^3)	1/2" Volume Reduction (ft^3)	1/4" N Reduction (lbs)	1/2" N Reduction (lbs)
3	12.33	104.64	11,192	22,384	65	84

Table 4 - Performance estimates for BMPs 1, 2, 4, 5, and 7

BMP	Drainage Area (acres)	Annual N Load (lbs)	1/4" Volume Reduction (ft^3)	1/2" Volume Reduction (ft^3)	1/4" N Reduction (lbs)	1/2" N Reduction (lbs)
1	11.15	76.6	10,116	20,232	42	62
2	24.56	157.6	22,291	44,582	84	120
4	38.63	252.2	35,059	70,119	114	174
5	17.85	113.7	16,199	32,397	59	86
7	24.79	152.3	22,498	44,997	77	113

C.2 COSTING ANALYSIS

The WISE, 2015[3] study developed estimates for the cost of sizing a variety of stormwater capture systems to manage different size storm events. Table 5 - BMP cost estimates developed for WISE, 2015 shows the estimated per-acre costs for bioretention and subsurface infiltration systems designed to manage the 0.25" and 0.5" storm events.

In order to calculate the total cost of a BMP using this table, it is necessary to multiply the drainage area by the cost shown in Table 5 - BMP cost estimates developed for WISE, 2015. The unit cost ($ per pound of nutrient load reduction) can then be derived by dividing the total cost by the total expected annual nutrient load reduction.

Table 5 - BMP cost estimates developed for WISE, 2015

Structural Treatment Practice	Capitol Cost Range Based on Capture Depth of 1-acre drainage area ($)					
	0.25 in.			0.5 in.		
	LOW	HIGH	FINAL	LOW	HIGH	FINAL
Bioretention with Underdrain (No Pretreatment)[1]	$2,759	$40,000	$11,400	$5,518	$60,000	$18,300
Subsurface Infiltration	$18,000	$35,000	$18,500	$25,000	$45,000	$28,000

1. Pretreatment not required for direct runoff from impervious surfaces (i.e., roof tops and parking lots).

[3] Roseen, R., Watts, A., Bourdeau, R., Stacey, P., Sinnott, C., Walker, T., Thompson, D., Roberts, E., and Miller, S. (2015). Water Integration for Squamscott Exeter (WISE), Preliminary Integrated Plan, Final Technical Report. Portsmouth, NH, Geosyntec Consultants, University of New Hampshire, Rockingham Planning Commission, Great Bay National Estuarine Research Reserve, Consensus Building Institute.

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BMP Cost Calculation Example

The following example explains the approach taken for the costing analysis performed in this study using BMP 1, which has the the following relevant characteristics:

- subsurface infiltration system,
- 0.25" water quality volume,
- 11.1 acre drainage area
- 42 lbs annual Nitrogen load reduction when sized for 0.25" water quality volume (from Pollutant Loading Analysis)

1. Reference Table 5 to determine the capital cost per-acre for a subsurface infiltration system sized to capture the 0.25" water quality volume. For this analysis, we use the 'Final' estimate rather than the 'High' or 'Low' estimates, yielding a per-acre cost of $18,500.

2. Multiply the per-acre cost by the BMP drainage area. For BMP 1, the drainage area is 11.1 acres:

[11.15 acres] x [$18,500 / acre] = $206,221

3. Divide the total cost from Step 2 by the annual Nitrogen Load reduction potential to derive the unit cost for the BMP:

[$206,206] / [42 lbs N] = $4,905 / lb N

Table 6 – Lincoln Street costing analysis results, shows the results of this analysis applied to the Lincoln Street watershed.

Table 6 – Lincoln Street costing analysis results

		1/4" WQV System		1/2" WQV System	
BMP Location	**Drainage Area (acres)**	**Total Cost**	**Unit Cost ($/lb)**	**Total Cost**	**Unit Cost ($/lb)**
1	11.1	$206,221	$4,900	$312,118	$5,000
2	24.6	$454,414	$5,400	$687,761	$5,700
3.1	6.9	$78,509	$2,200	$126,028	$2,700
3.2	4.2	$47,512	$2,500	$76,270	$3,100
3.3 - 3.6	1.3	$14,569	$1,400	$23,388	$1,800
4	38.6	$714,710	$6,300	$1,081,724	$6,200
5	17.9	$330,222	$5,600	$499,796	$5,800
6	1.7	$19,713	$3,800	$31,644	$5,000
7	24.8	$458,646	$5,900	$694,167	$6,100

APPENDIX F: OUTREACH EFFORTS

PROJECT TEAM

Waterstone Engineering	Town of Exeter	NHDES
Robert Roseen, Project Lead Engineer Jake Sahl, Modeler and Analyst	Paul Vlasich, Town Engineer Jennifer Mates, Assistant Town Engineer Jay Perkins, Road Agent Daniel Lewis, Engineering Technician	Sally Soule, Grant Manager

5/9/2017 May 9, 2017 Con Comm Presentation

REGIONAL CONTEXT

- In 2009, NHDES concluded that many sub-estuaries in the Great Bay Estuary were impaired by nitrogen, and the Great Bay was placed on the Clean Water Act (CWA) Sec. 303(d) list of impaired and threatened waters (NHDES, 2009).
- New and revised discharge permits in the watershed are now subject to additional nitrogen requirements including the National Pollutant Discharge Elimination System (NPDES) permits for wastewater treatment facilities, and Municipal Separate Storm Sewer Discharge (MS4) permits for stormwater.

5/9/2017

WASTEWATER & MS4 BACKGROUND

- In 2012 EPA issued a new wastewater permit with a total nitrogen effluent limit of 3 mg/l.
- Negotiated an Administrative Order on Consent (AOC) to allow a staged approach.
- AOC requires a Nitrogen Control Plan by September 30, 2018 with a schedule for implementing specific nitrogen control measures.
- 2017 NH Small MS4 issued, effective in 2018, includes significant new elements such as a focus on illicit discharge detection and elimination, and nutrient management through BMP retrofits.

PROJECT OVERVIEW

OBJECTIVES

1. Build upon the WISE analysis to identify specific green infrastructure (GI) and low impact development (LID) practices that can be installed in Exeter to manage stormwater, reduce nutrient loads, and increase resiliency.
2. Design green infrastructure (GI) practices within the watershed to help reduce the risk of flooding while reducing pollutant load into the Squamscott River.

OUTCOMES

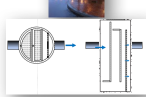
1. Identify a suite of BMPs that will reduce nutrient loading and flooding.
2. Provide performance metrics for BMPs in terms of total costs, unit costs ($/lb N reduced), and flood mapping for volume and the duration.
3. Develop GI concepts and final designs that can be used for bidding and construction for the future Lincoln Street CIP planned for FY18.

TASKS

1. Watershed Modeling

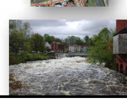
2. Potential Green Infrastructure Retrofit Locations

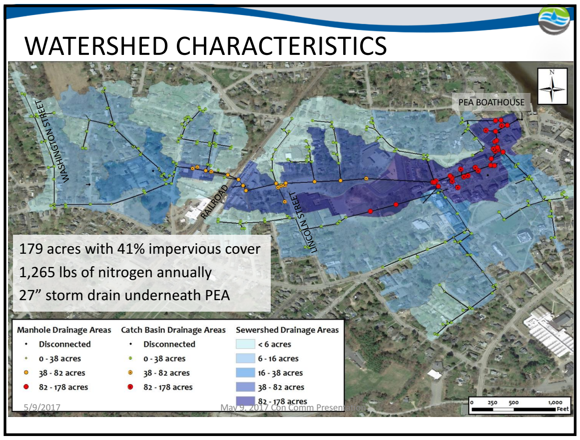
3. Project Design



4. Other Locations for BMPs

5. Nutrient and Flooding Reduction




WATERSHED CHARACTERISTICS
PEA BOATHOUSE
WASHINGTON STREET
RAILROAD
LINCOLN STREET
179 acres with 41% impervious cover
1,265 lbs of nitrogen annually
27" storm drain underneath PEA
Manhole Drainage Areas
Disconnected
0 - 38 acres
38 - 82 acres
82 - 178 acres
Catch Basin Drainage Areas
Disconnected
0 - 38 acres
38 - 82 acres
82 - 178 acres
Sewershed Drainage Areas
< 6 acres
6 - 16 acres
16 - 38 acres
38 - 82 acres
82 - 178 acres
0 250 500 1,000 Feet
5/9/2017


Modeling designs after natural systems
LOW IMPACT DEVELOPMENT
5/9/2017
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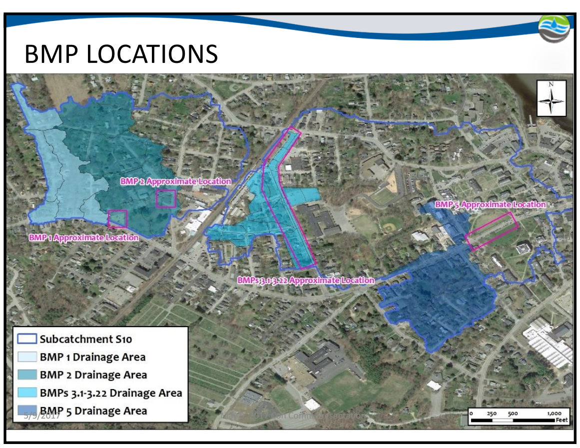
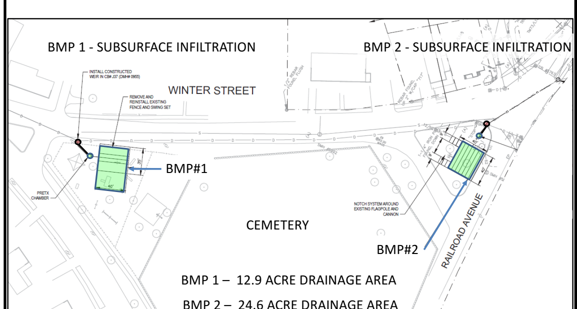

BMP LOCATIONS
BMP 2 Approximate Location
BMP 1 Approximate Location
BMP 5 Approximate Location
BMPs 3.1-3.22 Approximate Location
Subcatchment S10
BMP 1 Drainage Area
BMP 2 Drainage Area
BMPs 3.1-3.22 Drainage Area
BMP 5 Drainage Area
0 250 500 1,000 Feet

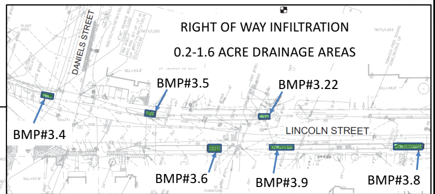
NITROGEN LOADING REDUCTION POTENTIAL

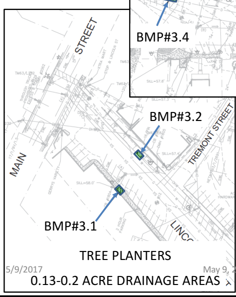
	BMP #	BMP Type	Drainage Area (acres)	Annual TN Load (lbs)	Annual N Load Reduction Potential (lbs)	$/LBS NITROGEN
WINTER STREET	1	Subsurface Infiltration	12.88	90.7	68.2	$675
	2	Subsurface Infiltration	24.56	157.6	120.2	$610
	Total	-	37.44	248.3	188.4	-
LINCOLN STREET NORTH	BMP #	BMP Type	Drainage Area (acres)	Annual TN Load (lbs)	Annual N Load Reduction Potential (lbs)	$/LBS NITROGEN
	3.1	Tree Planter	0.20	2.5	2.0	$3,924
	3.2	Tree Planter	0.13	1.7	1.3	$5,031
	3.3	Tree Planter	0.27	3.4	2.6	$4,276
	3.4	Tree Planter	0.22	2.9	2.2	$4,459
	3.5	ROW Infiltration- Grassed	0.24	2.4	1.8	$3,621
	3.6	ROW Infiltration- Grassed	0.78	7.2	5.7	$3,812
	3.8	ROW Infiltration- Grassed	1.20	9.1	7.1	$3,060
	3.9	ROW Infiltration- Grassed	0.70	5.6	4.2	$3,233
	3.22	ROW Infiltration- Grassed	0.20	1.3	1.0	$2,716
	Total	-	3.94	36.2	27.9	-
LINCOLN STREET SOUTH	BMP #	BMP Type	Drainage Area (acres)	Annual TN Load (lbs)	Annual N Load Reduction Potential (lbs)	$/LBS NITROGEN
	3.20	ROW Infiltration- Grassed	1.60	13.9	10.7	$3,046
	3.21	ROW Infiltration- Grassed	0.24	1.4	1.0	$2,716
	Total	-	1.84	15.3	11.7	-
FRONT STREET	BMP #	BMP Type	Drainage Area (acres)	Annual TN Load (lbs)	Annual N Load Reduction Potential (lbs)	$/LBS NITROGEN
	5	Subsurface Infiltration	20.29	138.3	71.7	$585
TOTAL	-	-	63.51	438	299.7	-

EXISTING FLOOD EXTENT

WINTER STREET AND RAILROAD AVE

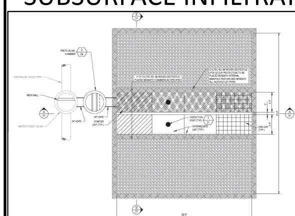


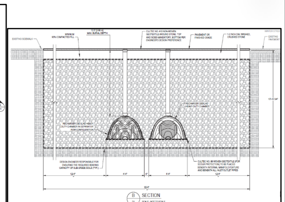




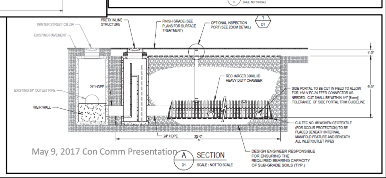
LINCOLN STREET

SUBSURFACE INFILTRATION

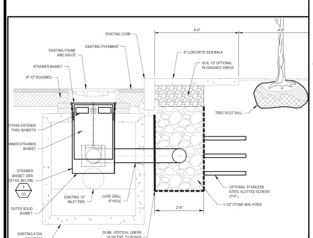


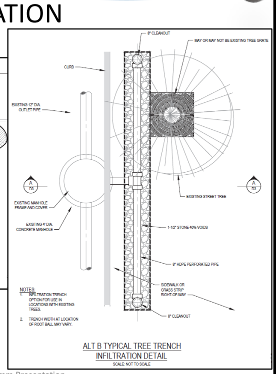


- INLINE SYSTEMS AND PRETREATMENT INSTALLED IN EXISTING CATCH BASINS AND DRAINAGE INFRASTRUCTURE AND INFILTRATION IN RIGHT-OF-WAY
- MAINTENANCE IS BY STANDARD VACTOR TRUCKS WITH NO SPECIAL EQUIPMENT OR TRAINING



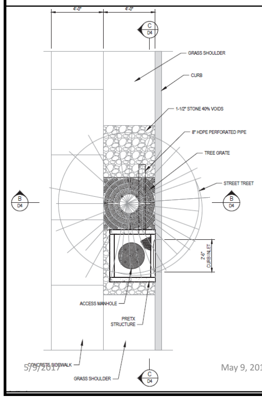
RIGHT-OF-WAY INFILTRATION

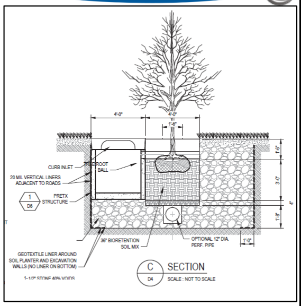




- LOW COST PRETREATMENTINSTALLED IN EXISTING CATCH BASINS AND DRAINAGE INFRASTRUCTURE AND INFILTRATION IN RIGHT-OF-WAY
- MAINTENANCE IS BY STANDARD VACTOR TRUCKS WITH NO SPECIAL EQUIPMENT OR TRAINING

TREE PLANTERS





- LOW COST PRETREATMENTINSTALLED IN EXISTING CATCH BASINS AND DRAINAGE INFRASTRUCTURE AND PLANTERS UNDERNEATH SIDEWALK FOR MAXIMUM PEDESTRIAN USAGE
- MAINTENANCE IS BY STANDARD VACTOR TRUCKS WITH NO SPECIAL EQUIPMENT OR TRAINING

5/9/2017 May 9, 2017 Con Comm Presentation

Thank you for your time

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Town of Exeter

Robert Roseen
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Waterstone Engineering

WATERSTONE ENGINEERING

5/9/2017 May 9, 2017 Con Comm Presentation

Lincoln Street Subwatershed Nutrient Control Strategies

Water Integration for Squamscott-Exeter (WISE) Integrated Plan Phase 1

Paul Vlasich, PE, Town of Exeter Robert Roseen, PE, PHD, Jake Sahl, Waterstone Engineering

Tuesday, June 13, 2017

Funding Source: NH Department of Environmental Services

PROJECT TEAM

Robert Roseen, Project Lead Engineer Jake Sahl, Modeler and Analyst	Paul Vlasich, Town Engineer Jennifer Mates, Assistant Town Engineer Jay Perkins, Highway Superintendent Daniel Lewis, Engineering Technician	Sally Soule, Grant Manager

WASTEWATER & MS4 BACKGROUND

- In 2012 EPA issued a new wastewater permit with a total nitrogen effluent limit of 3 mg/l.
- Negotiated an Administrative Order on Consent (AOC) to allow a staged approach.
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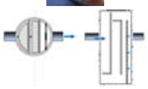
- 2017 NH Small MS4 issued, effective in 2018, includes significant new elements such as a focus on illicit discharge detection and elimination, and nutrient management through BMP retrofits.

TASKS

1. Watershed Modeling

2. Identify Green Infrastructure Retrofit Locations



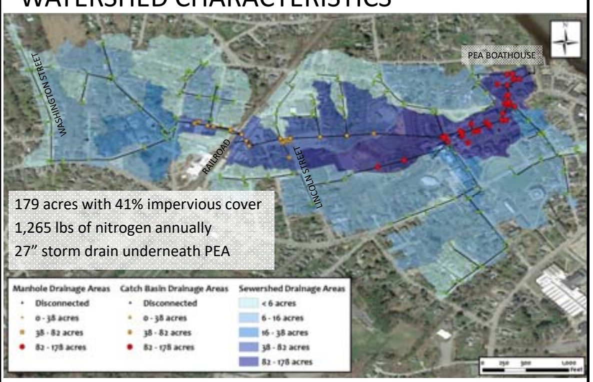
3. Project Design

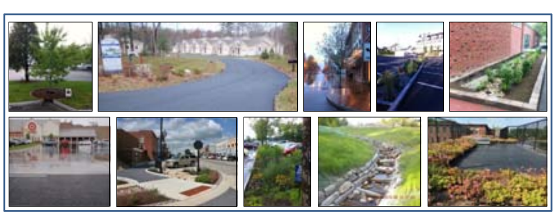
4. Other Locations for BMPs

5. Nutrient and Flooding Reduction

4

WATERSHED CHARACTERISTICS

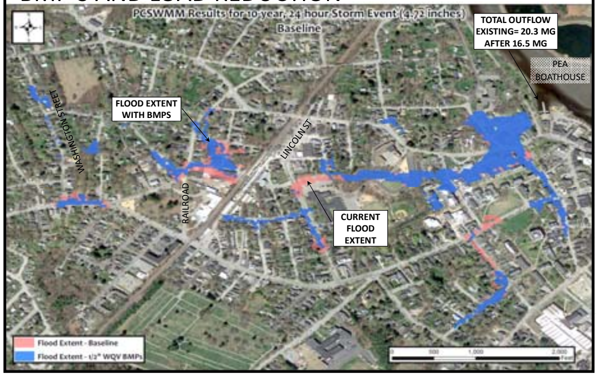




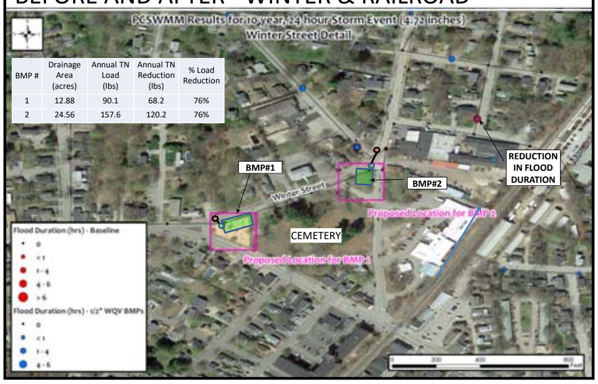
Modeling designs after natural systems

LOW IMPACT DEVELOPMENT

WINTER ST & RAILROAD AVE
BMP'S AND LOAD REDUCTION

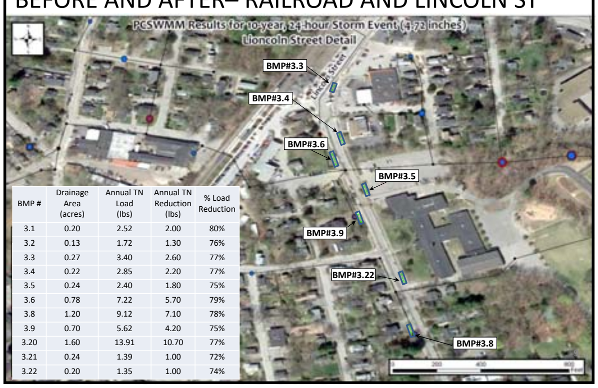


FLOODING EXTENT
BEFORE AND AFTER– WINTER & RAILROAD



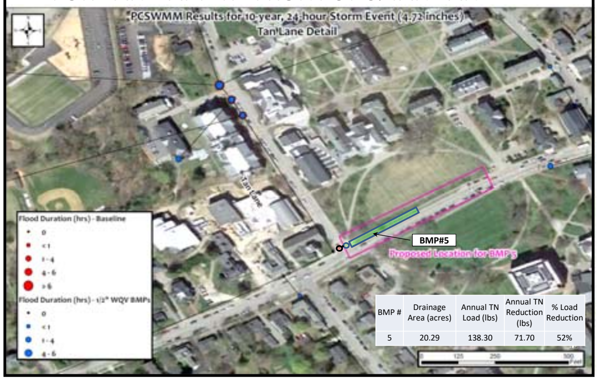
BMP #	Drainage Area (acres)	Annual TN Load (lbs)	Annual TN Reduction (lbs)	% Load Reduction
1	12.88	90.1	68.2	76%
2	24.56	157.6	120.2	76%

FLOODING EXTENT
BEFORE AND AFTER– RAILROAD AND LINCOLN ST



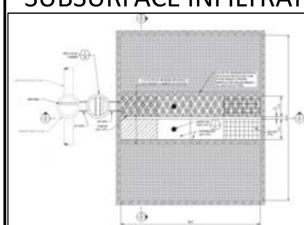
BMP #	Drainage Area (acres)	Annual TN Load (lbs)	Annual TN Reduction (lbs)	% Load Reduction
3.1	0.20	2.52	2.00	80%
3.2	0.13	1.72	1.30	76%
3.3	0.27	3.40	2.60	77%
3.4	0.22	2.85	2.20	77%
3.5	0.24	2.40	1.80	75%
3.6	0.78	7.22	5.70	79%
3.8	1.20	9.12	7.10	78%
3.9	0.70	5.62	4.20	75%
3.20	1.60	13.91	10.70	77%
3.21	0.24	1.39	1.00	72%
3.22	0.20	1.35	1.00	74%

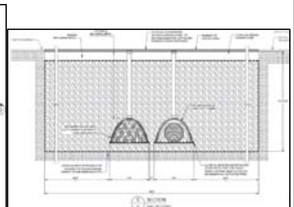
FLOODING EXTENT
BEFORE AND AFTER– FRONT ST & TAN LANE



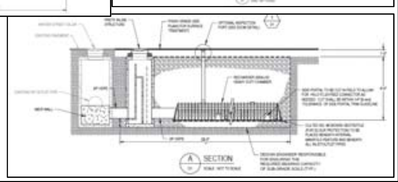
BMP #	Drainage Area (acres)	Annual TN Load (lbs)	Annual TN Reduction (lbs)	% Load Reduction
5	20.29	138.30	71.70	52%

SUBSURFACE INFILTRATION



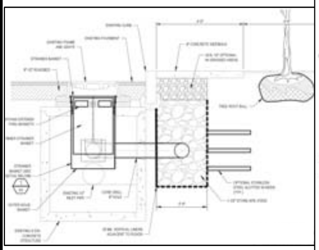


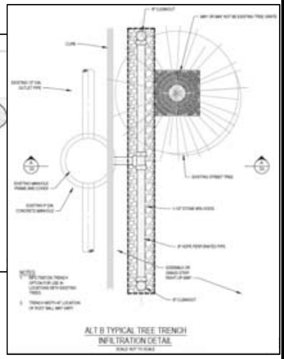
- INLINE SYSTEMS AND PRETREATMENT INSTALLED IN EXISTING CATCH BASINS AND DRAINAGE INFRASTRUCTURE AND INFILTRATION IN RIGHT-OF-WAY
- MAINTENANCE IS BY STANDARD VACTOR TRUCKS WITH NO SPECIAL EQUIPMENT OR TRAINING



SUBSURFACE INFILTRATION

RIGHT-OF-WAY INFILTRATION

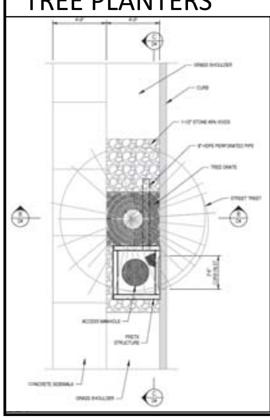


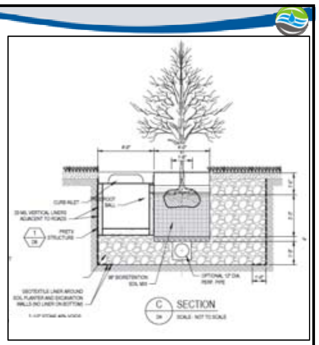


- LOW COST PRETREATMENTINSTALLED IN EXISTING CATCH BASINS AND DRAINAGE INFRASTRUCTURE AND INFILTRATION IN RIGHT-OF-WAY
- MAINTENANCE IS BY STANDARD VACTOR TRUCKS WITH NO SPECIAL EQUIPMENT OR TRAINING

RIGHT-OF-WAY INFILTRATION

TREE PLANTERS





- LOW COST PRETREATMENTINSTALLED IN EXISTING CATCH BASINS AND DRAINAGE INFRASTRUCTURE AND PLANTERS UNDERNEATH SIDEWALK FOR MAXIMUM PEDESTRIAN USAGE
- MAINTENANCE IS BY STANDARD VACTOR TRUCKS WITH NO SPECIAL EQUIPMENT OR TRAINING

TREE PLANTERS





95% COST ESTIMATES

	BMP #	Drainage Area (acres)	Annual TN Reduction (lbs)	% Load Reduction	95% Design Cost Estimate	$/LBS NITROGEN
WINTER STREET	1	12.9	68.2	76%	$45,900	$680
	2	24.6	120.2	76%	$79,000	$660
Subtotal	-	**37.4**	**188.4**	**76%**	**$124,900**	-
LINCOLN STREET NORTH	**BMP #**	**Drainage Area (acres)**	**Annual TN Reduction (lbs)**	**% Load Reduction**	**95% Design Cost Estimate**	**$/LBS NITROGEN**
	3.1	0.2	2.0	80%	$8,000	$4,000
	3.2	0.1	1.3	76%	$6,600	$5,080
	3.3	0.3	2.6	77%	$12,000	$4,620
	3.4	0.2	2.2	77%	$9,900	$4,500
	3.5	0.2	1.8	75%	$7,000	$3,890
	3.6	0.8	5.7	79%	$21,800	$3,830
	3.8	1.2	7.1	78%	$22,000	$3,100
	3.9	0.7	4.2	75%	$13,600	$3,240
	3.22	0.2	1.0	77%	$3,000	$3,000
Subtotal	-	**3.9**	**27.9**	**77%**	**$103,900**	-
LINCOLN STREET SOUTH	**BMP #**	**Drainage Area (acres)**	**Annual TN Reduction (lbs)**	**% Load Reduction**	**95% Design Cost Estimate**	**$/LBS NITROGEN**
	3.20	1.6	10.7	77%	$33,000	$3,090
	3.21	0.2	1.0	72%	$2,800	$2,800
Subtotal	-	**1.8**	**11.7**	**76%**	**$35,800**	-
FRONT STREET	**BMP #**	**Drainage Area (acres)**	**Annual TN Reduction (lbs)**	**% Load Reduction**	**95% Design Cost Estimate**	**$/LBS NITROGEN**
	5	20.3	71.7	52%	$45,200	$640
Total	-	**63.5**	**299.7**	**69%**	**$309,800**	-

Thank you for your time

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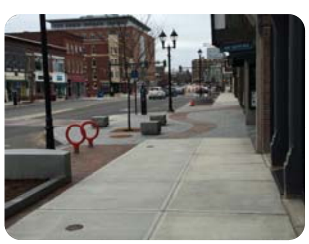

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APPENDIX G: ENGINEERING COST ESTIMATES

ENGINEERING DESIGN COSTS

PHASE 1: LINCOLN STREET SUBWATERSHED NITROGEN CONTROL STRATEGIES

	BMP #	BMP Type	Drainage Area (acres)	Annual TN Load (lbs)	Engineering Cost Estimate	Annual N Load Reduction Potential (lbs)	$/LBS NITROGEN
WINTER STREET	1	Subsurface Infiltration	12.88	90.7	$45,900	68.2	$675
	2	Subsurface Infiltration	24.56	157.6	$78,700	120.2	$656
	Total	-	**37.44**	**248.3**	**$124,600**	**188.4**	-

	BMP #	BMP Type	Drainage Area (acres)	Annual TN Load (lbs)	Engineering Cost Estimate	Annual N Load Reduction Potential (lbs)	$/LBS NITROGEN
LINCOLN STREET NORTH	3.1	Tree Planter	0.20	2.5	$7,848	2.0	$3,924
	3.2	Tree Planter	0.13	1.7	$6,540	1.3	$5,031
	3.3	Tree Planter	0.27	3.4	$11,118	2.6	$4,276
	3.4	Tree Planter	0.22	2.9	$9,810	2.2	$4,459
	3.5	ROW Infiltration- Grassed	0.24	2.4	$6,518	1.8	$3,621
	3.6	ROW Infiltration- Grassed	0.78	7.2	$21,728	5.7	$3,812
	3.8	ROW Infiltration- Grassed	1.20	9.1	$21,728	7.1	$3,060
	3.9	ROW Infiltration- Grassed	0.70	5.6	$13,580	4.2	$3,233
	3.22	ROW Infiltration- Grassed	0.20	1.3	$2,716	1.0	$2,716
	Total	-	**3.94**	**36.2**	**$101,586**	**27.9**	-

	BMP #	BMP Type	Drainage Area (acres)	Annual TN Load (lbs)	Engineering Cost Estimate	Annual N Load Reduction Potential (lbs)	$/LBS NITROGEN
LINCOLN STREET SOUTH	3.20	ROW Infiltration- Grassed	1.60	13.9	$32,591	10.7	$3,046
	3.21	ROW Infiltration- Grassed	0.24	1.4	$2,716	1.0	$2,716
	Total	-	**1.84**	**15.3**	**$35,307**	**11.7**	-

	BMP #	BMP Type	Drainage Area (acres)	Annual TN Load (lbs)	Engineering Cost Estimate	Annual N Load Reduction Potential (lbs)	$/LBS NITROGEN
FRONT STREET	5	Subsurface Infiltration	20.29	138.3	$45,200	71.7	$630.40

TOTAL	-	-	**63.51**	**438**	**$306,694**	**299.7**	-

BMP-1

Costcode	Description	Quantity	Column1	Material	Labor	Other	Total
			Unit	$	$	$	$
General							
01410	TESTING	1.00		0.00	0.00	0.00	0.00
014101100	Aggregate Infiltration test	2.00	Ea	0.00	270.00	262.50	532.50
015004230	Board-up cover, two sheets plywood	1.00	Ea	51.21	100.63	0.00	151.84
01600	EQUIPMENT RENTAL	1.00		0.00	0.00	0.00	0.00
016001080	Backhoe, diesel, crawler, 1 Cy	3.00	Day	0.00	2,760.00	4,181.25	6,941.25
016001360	Core drill, electric, 2-1/2 HP	1.00	Day	0.00	0.00	88.00	88.00
016001720	Edger, lawn, gas	1.00	Day	0.00	0.00	35.00	35.00
016002660	Saw, concrete, gas	1.00	Day	0.00	0.00	110.00	110.00
016002940	Transit tripod set	1.00	Day	0.00	0.00	53.75	53.75
016003020	Truck, dump, tandem, 12 T load	3.00	Day	0.00	0.00	1,530.00	1,530.00
017001100	Final cleanup	1540.00	Sf	0.00	0.00	1,925.00	1,925.00
	Subtotal General			**51.21**	**3,130.63**	**8,185.50**	**11,367.34**
Sitework							
02050	DEMOLITION	1.00		0.00	0.00	0.00	0.00
020502130	Saw cutting, paving	56.00	Lf	0.00	77.84	25.20	103.04
020502140	Saw cutting, concrete	8.00	Lf	0.00	264.53	5.60	270.13
02060	AGGREGATE AND SOILS	1.00		0.00	0.00	0.00	0.00
020601130	Crushed Stone, Drainage, 1/2"	214.00	Cy	5,082.50	0.00	0.00	5,082.50
02070	GEOSYNTHETICS	1.00		0.00	0.00	0.00	0.00
020701110	Geotextiles- Mirafi 160N	675.00	Sf	263.25	0.00	0.00	263.25
02100	SITE PREPARATION	1.00		0.00	0.00	0.00	0.00
021001390	Test Pits	1.00		0.00	0.00	0.00	0.00
02200	EARTHWORK	1.00		0.00	0.00	0.00	0.00
022001010	General excavation	467.00	Cy	0.00	4,315.08	2,685.25	7,000.33
022003330	Area backfill, 7' deep	1400.00	Sf	0.00	700.00	490.00	1,190.00
02370	EROSION AND SEDIMENTATION CONTROL	1.00		0.00	0.00	0.00	0.00
023701020	3' Silt fence and haybales	300.00	Lf	825.00	0.00	0.00	825.00
02500	PAVING AND SURFACING	1.00		0.00	0.00	0.00	0.00
025001110	Grade and compact	18.00	Sy	0.00	82.80	46.80	129.60
025002160	Asphalt paving repair	18.00	Sy	290.70	331.20	189.00	810.90
02600	DRAINAGE	1.00		0.00	0.00	0.00	0.00
026001630	Drainage pipe, HDPE, 12" dia	50.00	Lf	855.00	192.50	37.50	1,085.00
026201210	PRETX-Inline, 5' dia, 8' deep	1.00	Ea.	3,325.00	440.00	0.00	3,765.00
026201310	Subsurface chambers 330XL	10.00	Ea.	3,325.00	880.00	0.00	4,205.00
02900	LANDSCAPING	1.00		0.00	0.00	0.00	0.00
029001210	Area prep for seeding	156.00	Sy	0.00	57.72	4.68	62.40
029001220	Place top soil, by hand	156.00	Sy	0.00	430.56	0.00	430.56
029002110	Seeding	156.00	Sy	15.60	57.72	3.12	76.44
	Subtotal Sitework			**13,982.05**	**7,829.95**	**3,487.15**	**25,299.15**
	Estimate Total			**14,033.26**	**10,960.58**	**11,672.65**	**36,666.49**
	Contingency	25.00	%	3,508.32	2,740.15	2,918.16	9,166.62
	Estimate Total			17,541.58	13,700.73	14,590.81	45,833.11

BMP-2

Costcode	Description	Quantity	Unit	Material	Labor	Other	Total
				$	$	$	$
General							
01410	TESTING	1.00		0.00	0.00	0.00	0.00
014101100	Aggregate Infiltration test	2.00	Ea	0.00	270.00	262.50	532.50
015004230	Board-up cover, two sheets plywood	1.00	Ea	51.21	100.63	0.00	151.84
01600	EQUIPMENT RENTAL	1.00		0.00	0.00	0.00	0.00
016001080	Backhoe, diesel, crawler, 1 Cy	3.00	Day	0.00	2,760.00	4,181.25	6,941.25
016001360	Core drill, electric, 2-1/2 HP	1.00	Day	0.00	0.00	88.00	88.00
016001720	Edger, lawn, gas	1.00	Day	0.00	0.00	35.00	35.00
016002660	Saw, concrete, gas	1.00	Day	0.00	0.00	110.00	110.00
016002940	Transit tripod set	1.00	Day	0.00	0.00	53.75	53.75
016003020	Truck, dump, tandem, 12 T load	3.00	Day	0.00	0.00	1,530.00	1,530.00
017001100	Final cleanup	2200.00	Sf	0.00	0.00	2,750.00	2,750.00
	Subtotal General			**51.21**	**3,130.63**	**9,010.50**	**12,192.34**
Sitework							
02050	DEMOLITION	1.00		0.00	0.00	0.00	0.00
020502130	Saw cutting, paving	56.00	Lf	0.00	77.84	25.20	103.04
020502140	Saw cutting, concrete	8.00	Lf	0.00	264.53	5.60	270.13
02060	AGGREGATE AND SOILS	1.00		0.00	0.00	0.00	0.00
020601130	Crushed Stone, Drainage, 1/2"	202.00	Cy	4,797.50	0.00	0.00	4,797.50
02070	GEOSYNTHETICS	1.00		0.00	0.00	0.00	0.00
020701110	Geotextiles- Mirafi 160N	720.00	Sf	280.80	0.00	0.00	280.80
02100	SITE PREPARATION	1.00		0.00	0.00	0.00	0.00
021001390	Test Pits	1.00		0.00	0.00	0.00	0.00
02200	EARTHWORK	1.00		0.00	0.00	0.00	0.00
022001010	General excavation	1037.00	Cy	0.00	9,581.88	5,962.75	15,544.63
022003330	Area backfill, 7' deep	2000.00	Sf	0.00	1,000.00	700.00	1,700.00
02370	EROSION AND SEDIMENTATION CONTROL	1.00		0.00	0.00	0.00	0.00
023701020	3' Silt fence and haybales	300.00	Lf	825.00	0.00	0.00	825.00
02500	PAVING AND SURFACING	1.00		0.00	0.00	0.00	0.00
025001110	Grade and compact	18.00	Sy	0.00	82.80	46.80	129.60
025002160	Asphalt paving repair	18.00	Sy	290.70	331.20	189.00	810.90
02600	DRAINAGE	1.00		0.00	0.00	0.00	0.00
026001630	Drainage pipe, HDPE, 12" dia	50.00	Lf	855.00	192.50	37.50	1,085.00
026201210	PRETX-Inline, 5' dia, 8' deep	1.00	Ea.	3,325.00	440.00	0.00	3,765.00
026201310	Subsurface chambers 330XL	49.00	Ea.	16,292.50	4,312.00	0.00	20,604.50
02900	LANDSCAPING	1.00		0.00	0.00	0.00	0.00
029001210	Area prep for seeding	222.00	Sy	0.00	82.14	6.66	88.80
029001220	Place top soil, by hand	222.00	Sy	0.00	612.72	0.00	612.72
029002110	Seeding	222.00	Sy	22.20	82.14	4.44	108.78
	Subtotal Sitework			**26,688.70**	**17,059.75**	**6,977.95**	**50,726.40**
	Estimate Total			**26,739.91**	**20,190.38**	**15,988.45**	**62,918.74**
	Contingency	25.00	%	6,684.98	5,047.60	3,997.11	15,729.69
	Estimate Total			**33,424.89**	**25,237.98**	**19,985.56**	**78,648.43**

BMP-3 ROW Infiltration Grassed (Typical)

Costcode	Description	Quantity	Unit	Material	Labor	Other	Total
				$	$	$	$
General							
01410	TESTING	1.00		0.00	0.00	0.00	0.00
014101100	Aggregate Infiltration test	1.00	Ea	0.00	135.00	131.25	266.25
015004230	Board-up cover, two sheets plywood	1.00	Ea	51.21	100.63	0.00	151.84
01600	EQUIPMENT RENTAL	1.00		0.00	0.00	0.00	0.00
016001080	Backhoe, diesel, crawler, 1 Cy	2.00	Day	0.00	1,840.00	2,787.50	4,627.50
016001360	Core drill, electric, 2-1/2 HP	1.00	Day	0.00	0.00	88.00	88.00
016002660	Saw, concrete, gas	1.00	Day	0.00	0.00	110.00	110.00
016002940	Transit tripod set	1.00	Day	0.00	0.00	53.75	53.75
016003020	Truck, dump, tandem, 12 T load	2.00	Day	0.00	0.00	1,275.00	1,275.00
017001100	Final cleanup	110.00	Sf	0.00	0.00	137.50	137.50
	Subtotal General			**51.21**	**2,075.63**	**4,583.00**	**6,709.84**
Sitework							
02050	DEMOLITION	1.00		0.00	0.00	0.00	0.00
020502140	Saw cutting, concrete	8.00	Lf	0.00	264.53	5.60	270.13
02060	AGGREGATE AND SOILS	1.00		0.00	0.00	0.00	0.00
020601130	Crushed Stone, Drainage, 1/2"	26.00	Cy	617.50	0.00	0.00	617.50
020601160	Top soil	3.00	Cy	79.80	0.00	0.00	79.80
02070	GEOSYNTHETICS	1.00		0.00	0.00	0.00	0.00
020701110	Geotextiles- Mirafi 160N	210.00	Sf	81.90	0.00	0.00	81.90
020701130	PVC Liner	140.00	Sf	68.60	0.00	0.00	68.60
02100	SITE PREPARATION	1.00		0.00	0.00	0.00	0.00
021001390	Test Pits	1.00		0.00	0.00	0.00	0.00
02200	EARTHWORK	1.00		0.00	0.00	0.00	0.00
022001010	General excavation	26.00	Cy	0.00	240.24	149.50	389.74
022003330	Area backfill, 7' deep	100.00	Sf	0.00	50.00	35.00	85.00
02370	EROSION AND SEDIMENTATION CONTROL	1.00		0.00	0.00	0.00	0.00
023701020	3' Silt fence and haybales	70.00	Lf	192.50	0.00	0.00	192.50
02600	DRAINAGE	1.00		0.00	0.00	0.00	0.00
026201610	ROW Infiltration catch basin insert	1.00	Ea.	1,995.00	330.00	0.00	2,325.00
02900	LANDSCAPING	1.00		0.00	0.00	0.00	0.00
029001210	Area prep for seeding	12.00	Sy	0.00	4.44	0.36	4.80
029001220	Place top soil, by hand	12.00	Sy	0.00	33.12	0.00	33.12
029002110	Seeding	12.00	Sy	1.20	4.44	0.24	5.88
	Subtotal Sitework			**3,036.50**	**926.77**	**190.70**	**4,153.97**
	Estimate Total			**3,087.71**	**3,002.40**	**4,773.70**	**10,863.81**

BMP-3 Tree Planter (Typical)

Costcode	Description	Quantity	Unit	Material	Labor	Other	Total
				$	$	$	$
General							
01410	TESTING	1.00		0.00	0.00	0.00	0.00
014101100	Aggregate Infiltration test	1.00	Ea	0.00	135.00	131.25	266.25
015004230	Board-up cover, two sheets plywood	1.00	Ea	51.21	100.63	0.00	151.84
01600	EQUIPMENT RENTAL	1.00		0.00	0.00	0.00	0.00
016001080	Backhoe, diesel, crawler, 1 Cy	2.00	Day	0.00	1,840.00	2,787.50	4,627.50
016002660	Saw, concrete, gas	1.00	Day	0.00	0.00	110.00	110.00
016002940	Transit tripod set	1.00	Day	0.00	0.00	53.75	53.75
016003020	Truck, dump, tandem, 12 T load	2.00	Day	0.00	0.00	1,275.00	1,275.00
017001100	Final cleanup	110.00	Sf	0.00	0.00	137.50	137.50
	Subtotal General			**51.21**	**2,075.63**	**4,495.00**	**6,621.84**
Sitework							
02050	DEMOLITION	1.00		0.00	0.00	0.00	0.00
020501320	Flooring demolition, ceramic tile	1.00	Sf	0.00	1.32	0.35	1.67
020502140	Saw cutting, concrete	8.00	Lf	0.00	264.53	5.60	270.13
02060	AGGREGATE AND SOILS	1.00		0.00	0.00	0.00	0.00
020601130	Crushed Stone, Drainage, 1/2"	19.00	Cy	451.25	0.00	0.00	451.25
020601170	Bioretention soil mix	4.00	Cy	171.00	0.00	0.00	171.00
02070	GEOSYNTHETICS	1.00		0.00	0.00	0.00	0.00
020701110	Geotextiles- Mirafi 160N	210.00	Sf	81.90	0.00	0.00	81.90
020701130	PVC Liner	140.00	Sf	68.60	0.00	0.00	68.60
02100	SITE PREPARATION	1.00		0.00	0.00	0.00	0.00
021001390	Test Pits	1.00		0.00	0.00	0.00	0.00
02200	EARTHWORK	1.00		0.00	0.00	0.00	0.00
022001010	General excavation	26.00	Cy	0.00	240.24	149.50	389.74
022003230	Area backfill, 3' deep	40.00	Sf	0.00	9.20	2.80	12.00
022003330	Area backfill, 7' deep	100.00	Sf	0.00	50.00	35.00	85.00
02370	EROSION AND SEDIMENTATION CONTROL	1.00		0.00	0.00	0.00	0.00
023701020	3' Silt fence and haybales	70.00	Lf	192.50	0.00	0.00	192.50
02500	PAVING AND SURFACING	1.00		0.00	0.00	0.00	0.00
025004110	Walkways, concrete, 4 in thick, basic	100.00	Sf	143.00	115.00	5.00	263.00
02600	DRAINAGE	1.00		0.00	0.00	0.00	0.00
026201110	PRETX-Surface, 48" x 48"	1.00	Ea.	2,731.25	0.00	0.00	2,731.25
026201410	Tree, 4" caliper	1.00	Ea.	332.50	220.00	1.00	553.50
026201510	Tree frame and grate, 6' square	1.00	Ea.	855.00	330.00	2.00	1,187.00
02900	LANDSCAPING	1.00		0.00	0.00	0.00	0.00
	Subtotal Sitework			**5,027.00**	**1,230.29**	**201.25**	**6,458.54**
	Estimate Total			**5,078.21**	**3,305.92**	**4,696.25**	**13,080.38**

BMP-5

Costcode	Description	Quantity	Unit	Material	Labor	Other	Total
				$	$	$	$
General							
01410	TESTING	1.00		0.00	0.00	0.00	0.00
014101100	Aggregate Infiltration test	2.00	Ea	0.00	270.00	262.50	532.50
015004230	Board-up cover, two sheets plywood	1.00	Ea	51.21	100.63	0.00	151.84
01600	EQUIPMENT RENTAL	1.00		0.00	0.00	0.00	0.00
016001080	Backhoe, diesel, crawler, 1 Cy	3.00	Day	0.00	2,760.00	4,181.25	6,941.25
016001360	Core drill, electric, 2-1/2 HP	1.00	Day	0.00	0.00	88.00	88.00
016001720	Edger, lawn, gas	1.00	Day	0.00	0.00	35.00	35.00
016002660	Saw, concrete, gas	1.00	Day	0.00	0.00	110.00	110.00
016002940	Transit tripod set	1.00	Day	0.00	0.00	53.75	53.75
016003020	Truck, dump, tandem, 12 T load	3.00	Day	0.00	0.00	1,530.00	1,530.00
017001100	Final cleanup	858.00	Sf	0.00	0.00	1,072.50	1,072.50
	Subtotal General			**51.21**	**3,130.63**	**7,333.00**	**10,514.84**
Sitework							
02050	DEMOLITION	1.00		0.00	0.00	0.00	0.00
020502130	Saw cutting, paving	56.00	Lf	0.00	77.84	25.20	103.04
020502140	Saw cutting, concrete	8.00	Lf	0.00	264.53	5.60	270.13
02060	AGGREGATE AND SOILS	1.00		0.00	0.00	0.00	0.00
020601130	Crushed Stone, Drainage, 1/2"	102.00	Cy	2,422.50	0.00	0.00	2,422.50
02070	GEOSYNTHETICS	1.00		0.00	0.00	0.00	0.00
020701110	Geotextiles- Mirafi 160N	880.00	Sf	343.20	0.00	0.00	343.20
02100	SITE PREPARATION	1.00		0.00	0.00	0.00	0.00
021001390	Test Pits	1.00		0.00	0.00	0.00	0.00
02200	EARTHWORK	1.00		0.00	0.00	0.00	0.00
022001010	General excavation	376.00	Cy	0.00	3,474.24	2,162.00	5,636.24
022003330	Area backfill, 7' deep	780.00	Sf	0.00	390.00	273.00	663.00
02370	EROSION AND SEDIMENTATION CONTROL	1.00		0.00	0.00	0.00	0.00
023701020	3' Silt fence and haybales	300.00	Lf	825.00	0.00	0.00	825.00
02500	PAVING AND SURFACING	1.00		0.00	0.00	0.00	0.00
025001110	Grade and compact	18.00	Sy	0.00	82.80	46.80	129.60
025002160	Asphalt paving repair	18.00	Sy	290.70	331.20	189.00	810.90
02600	DRAINAGE	1.00		0.00	0.00	0.00	0.00
026001630	Drainage pipe, HDPE, 12" dia	50.00	Lf	855.00	192.50	37.50	1,085.00
026201210	PRETX-Inline, 5' dia, 8' deep	1.00	Ea.	3,325.00	440.00	0.00	3,765.00
026201310	Subsurface chambers 330XL	22.00	Ea.	7,315.00	1,936.00	0.00	9,251.00
02900	LANDSCAPING	1.00		0.00	0.00	0.00	0.00
029001210	Area prep for seeding	87.00	Sy	0.00	32.19	2.61	34.80
029001220	Place top soil, by hand	87.00	Sy	0.00	240.12	0.00	240.12
029002110	Seeding	87.00	Sy	8.70	32.19	1.74	42.63
	Subtotal Sitework			**15,385.10**	**7,493.61**	**2,743.45**	**25,622.16**
	Estimate Total			**15,436.31**	**10,624.24**	**10,076.45**	**36,137.00**
	Contingency	25.00	%	3,859.08	2,656.06	2,519.11	9,034.25
	Estimate Total			**19,295.39**	**13,280.30**	**12,595.56**	**45,171.25**

APPENDIX H: OPERATIONS AND MAINTENANCE PLAN

Operations and Maintenance Plan

Project:

Phase 1: Lincoln Street Subwatershed Nutrient Control Strategies
Water Integration for Squamscott-Exeter (WISE) Integrated Plan

Prepared for:

Paul Vlasich, PE
Exeter Public Works
13 Newfields Road
Exeter, NH 038330

Prepared by:

Robert Roseen, PE, PhD, D.WRE, Jake Sahl, MS
Waterstone Engineering, PLLC
2 College Road #1209
Stratham, NH 03885

June 2017

WATERSTONE ENGINEERING
INNOVATIVE STORMWATER MANAGEMENT

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1.0 INTRODUCTION

The New Hampshire Alteration of Terrain (AoT) regulations (Env-Wq 1500) require the long-term maintenance of stormwater practices, and stipulate the establishment of a mechanism to provide for ongoing inspections and maintenance. This plan has been developed in accordance with Env-Wq 1507.08 Long-Term Maintenance. This Stormwater Management System Operations and Maintenance (O&M) Plan is for Phase 1: Lincoln Street Subwatershed Nutrient Control Strategies, Water Integration for Squamscott-Exeter (WISE) Integrated Plan.

This O&M Plan includes information for three types of BMPs and pretreatment systems: Roadside Right-of-Way (ROW) infiltration, Tree Planters, and Subsurface Infiltration. All systems include pretreatment measures for capture of sediment, trash, and debris. All systems have simple manhole access for cleaning by vactor truck or other means for catch basin cleaning.

Inspections and maintenance are necessary to ensure that the stormwater management systems function as designed. 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.

This O&M Plan identifies responsible parties, reviews the stormwater management systems, provides information on the required maintenance and inspection schedule for each stormwater management method used at the property, discusses debris disposal, and outlines source control procedures. In addition, O&M inspection checklists and site plans are provided in Appendix A: Annual Report Form and O&M Inspection Checklists and Appendix B: Site Plans.

1.1 Responsible Parties

The Owner is responsible for implementing the required reporting, inspection, and maintenance activities identified in this O&M Plan. The Responsible Parties possess the primary responsibility for overseeing and implementing the O&M Plan and assigned Designee who will be responsible for the proper operation and maintenance of the stormwater structures.

1.2 Reporting, Tracking, and Enforcement

The stormwater management system shall be inspected and maintained in accordance with the Operations and Maintenance Plan for the project and the conditions of the NHDES Alteration of Terrain Approval. All record keeping shall be maintained by the identified responsible party and be made available to NHDES or EPA upon request. Inspections should be conducted annually. Reports and inspection forms will be reviewed for completeness with the O&M Plan, inspection findings, and corrective measures, with a report issued by a licensed professional engineer. Maintenance guidance and checklists are provided in Appendix A. Electronic copies will be retained by the Owner for up to 10 years to be made available upon request. All record keeping required by the O&M Plan will be maintained by the Responsible Parties.

These records will include an inspection and maintenance log to document each inspection and maintenance activity and a cataloguing of inspection forms herein. The inspection and maintenance 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 spoils will be disposed of offsite in an appropriate manner. Deficiencies found during inspection will be noted and corrective action undertaken by the owner if needed.

Table 1: Schedule for Inspection and Reporting Activities

Inspection and Reporting Activity	Timing
<u>1st Year Post Construction</u> Inspect stormwater management and erosion control; examine for 72 hour drawdown.	Every six months and after major storms
<u>2nd Year and Later Post Construction</u> Routine annual inspections per BMP requirements	Annually

2.0 STORMWATER MANAGEMENT

This O&M Plan includes information for three types of BMPs and pretreatment systems:

1. Roadside Right-of-Way (ROW) infiltration
2. Tree Planters
3. Subsurface Infiltration

All systems include pretreatment measures for capture of sediment, trash, and debris. All systems have simple manhole access for cleaning by vactor truck or other means for catch basin cleaning. Detailed checklists for inspection and maintenance are provided in Appendix A.

2.2 Tree Planters and Biofilters

The following maintenance items are required for the tree planters, in accordance with Chapter 4-3.4c of the NH Stormwater Manual, Volume 2 (2008). During the six months immediately after construction, the tree planters should be inspected after precipitation events greater than 0.25 inches to ensure that the system is functioning properly. The following activities will be conducted during the first six months after construction and, thereafter, inspections will be conducted on an annual basis:

- Inspections during the first 6 months:
  - Closed pipe system;
  - Curb inlet pretreatment
  - Rip rap apron for inlet and outlet;
  - Filter media
  - Repair/re-vegetate as deficiencies are identified.

- Systems should be inspected annually, and following any rainfall event exceeding 0.5 inches in a 24-hour period during the first year, with maintenance or rehabilitation conducted as warranted by such inspection.
- Pretreatment measures should be inspected annually, and cleaned of accumulated sediment as warranted by inspection.
- Trash and debris should be removed at each inspection
- Vegetation should be inspected annually, and maintained in healthy condition, including pruning, removal and replacement of dead or diseased vegetation, and removal of invasive species.

A checklist for inspection and maintenance is provided in Appendix A.

2.3 Right- of-Way Infiltration Trenches

The following maintenance items are required for the ROW infiltration, in accordance with Chapter 4-3.4c of the NH Stormwater Manual, Volume 2 (2008). During the six months immediately after construction, the tree planters should be inspected after precipitation events greater than 0.25 inches to ensure that the system is functioning properly. The following activities will be conducted during the first six months after construction and, thereafter, inspections will be conducted on an annual basis:

- Inspections during the first 6 months:
  - Closed pipe system;
  - Drop inlet pretreatment basket for trash and debris;
  - Drop inlet piping connection;
  - Infiltration trench monitoring well for drawdown within 72 hrs

- Drop inlet pretreatment basket should be inspected annually, and cleaned of accumulated sediment as warranted by inspection.

- Inspect infiltration trench monitoring well annually after a major storm to ensure it is draining within 72 hours. Corrective action will be taken if drawdown is not evident.

- Inspect for erosion, leakage in liners, and signs of differential settlement.

- Inspect for catch basin pretreatment insert including pipe connections, flexible boot from hanging basket to infiltration trench, and suspension from catch basin frame.

A checklist for inspection and maintenance is provided in Appendix A.

2.4 Subsurface Infiltration

The following maintenance items are required as needed for dry wells at the Site, in accordance with Chapter 4-3.3d of the NH Stormwater Manual, Volume 2 (2008). The following activities will be conducted during the first six months after construction and, thereafter, inspections will be conducted on an annual basis:

- Inspections during the first 6 months:

- Diversion structure;
- Pretreatment chamber;
- Closed pipe system;
- Cultec Chambers Inspection Ports;

- Removal of debris from inlet control structures
- Removal of debris from pretreatment structure
- Inspection of accumulated sediment in Cultec Recharger Inspection Ports
- Removal of accumulated sediment
- Inspection and repair of outlet structures and appurtenances
- Inspection of infiltration components shall occur if a system does not drain within 72-hours following a rainfall event. Then a qualified professional should assess the condition of the facility to determine measures required to restore infiltration function, including but not limited to removal of accumulated sediments or reconstruction of the infiltration trench.

A checklist for inspection and maintenance of subsurface infiltration is provided in Appendix A.

3.0 Stormwater Debris and Sediment Disposal

Debris and sediment removed during maintenance must be disposed of properly, not left in a location vulnerable to runoff again. Catch basin spoils are not hazardous and should not require contaminated sediment disposal. These materials are commonly used as daily landfill cover if sufficient materials exist. Sediment pollutant concentrations should be below thresholds for categorization as hazardous waste. Vactor liquid could be discharged to a local sanitary sewer or a settling basin.

4.0 Personnel Training

All personnel retained for work will be given a copy of this Plan and will receive training in applicable practices for maintenance of the stormwater systems and activities covered in this O&M Plan. The training will include the complete elements of the O&M plan including inspection, corrective measures, and annual reporting.

APPENDIX A: ANNUAL REPORT FORM AND O&M INSPECTION CHECKLISTS

A.1 ANNUAL REPORTING FORM

A.2 TREE PLANTER INSPECTION GUIDANCE AND CHECKLIST

A.3 RIGHT-OF-WAY INFILTRATION GUIDANCE AND CHECKLIST

A.4 SUBSURFACE INFILTRATION GUIDANCE AND CHECKLIST

ANNUAL REPORT
OPERATIONS AND MAINTENANCE (O&M)

TOWN OF EXETER, NEW HAMPSHIRE
STORMWATER MANAGEMENT BMPS

RESPONSIBLE PARTY OR DESIGNEE:	
REVIEWING ENGINEER:	
ENGINEER SIGNATURE:	**DATE:**
DATE SUBMITTED TO TOWN:	
REPORT SUMMARY	

INSPECTION AND REPORTING REQUIREMENTS

This report documents BMP Operations and Maintenance for the Town of Exeter, New Hampshire. All personnel retained for work will be given a copy of this Plan and will receive training for applicable practices for maintenance of the stormwater systems and activities covered in this O&M Plan.

Inspections will be reported annually. Reports and inspection forms will be reviewed for completeness with the O&M Plan, inspection findings, and corrective measures by a professional engineer. An annual report form is provided in Appendix A of the O&M Plan. Electronic copies will be sent to the Town Engineer. Electronic copies will be retained by the Town for such a period as may be required by permits and be made available to appropriate parties upon request. All record keeping required by the O&M Plan will be maintained by the Responsible Parties.

Records will include an inspection and maintenance log to document each inspection and maintenance activity and a cataloguing of inspection forms herein. The inspection and maintenance 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. Any deficiencies found during inspection will be noted and corrective action undertaken either by the Town as appropriate.

TOWN CONTACTS FOR SUBMITTAL	COMPLETE
Paul Vlasich, Town Engineer:	☐

REQUIRED ANNUAL REPORTING ELEMENTS	INSPECTION COMPLETE	COMMENTS/ CORRECTIVE ACTION
1. Tree Planter Maintenance Checklist	☐	
2. Right-of-Way Infiltration Inspection and Maintenance Checklist	☐	
3. Subsurface Infiltration Inspection and Maintenance Checklist	☐	

INSPECTION AND MAINTENANCE GUIDANCE FOR TREE PLANTERS

Maintenance of tree planters can typically be performed as part of standard landscaping. Regular inspection and maintenance is critical to the effective operation of tree planters to insure they remain clear of leaves and debris and free draining. This page provides guidance on maintenance activities that are typically required for these systems, along with the suggested frequency for each activity. Individual systems may have more, or less, frequent maintenance needs, depending on a variety of factors including the occurrence of large storm events, overly wet or dry (i.e., drought), regional hydrologic conditions, and the upstream land use.

INSPECTION ACTIVITIES

The most common maintenance activity is the removal of leaves, trash and debris from the pretreatment system. Visual inspections are routine for system maintenance. This includes looking for standing water, accumulated leaves, holes in the soil media, signs of plant distress, and debris and sediment accumulation in the pretreatment system. Tree health is integral to the performance of the system, including infiltration rate and nutrient uptake. Tree care is important to system productivity and health.

ACTIVITY	FREQUENCY
A record should be kept of the time for the system to drain completely after a storm event. The system should drain completely within 72 hours.	After every major storm in the first few months, then annually
Check to insure the filter surface remains well draining after storm events. **Remedy**: If filter bed is clogged, draining poorly, or standing water covers more than 15% of the surface 48 hours after a precipitation event, then remove top few inches of discolored material. Till or rake remaining material as needed.	
Check pretreatment inlet and outlet for sediment, leaves and debris. **Remedy**: Vactor truck for removal trash and debris from pretreatment device. Access by removal of manhole. Maintenance with the tree planter should rarely be necessary. If needed, rake in and around the system to clear it of debris.	
Check for animal burrows and short circuiting in the system. **Remedy:** Soil erosion from short circuiting or animal boroughs should be repaired when they occur. The holes should be filled and lightly compacted	
Check to insure the filter bed does not contain more than 2 inches accumulated material **Remedy:** Remove sediment as necessary. If 2 inches or more of filter bed has been removed, replace media with either mulch or a (50% sand, 20% woodchips, 20% compost, 10% soil) mixture.	
During extended periods without rainfall, inspect tree planter for signs of distress. **Remedy:** tree planter should be watered until established (typical only for first few months) or as needed thereafter.	
Inspect inlets and outlets to ensure good condition and no evidence of deterioration. Check to see if high-flow bypass is functioning. **Remedy:** Repair or replace any damaged structural parts, inlets, outlets, sidewalls.	Annually
Check for robust tree health within the system. **Remedy:** If tree is not established after 1 year, replacement should be considered. Dying branches should be pruned and removed as necessary.	

CHECKLIST FOR INSPECTION OF TREE PLANTERS

Location: Inspector:

Date: Time: Site Conditions:

Date Since Last Rain Event:

Inspection Items	Satisfactory (S) or Unsatisfactory (U)	Comments/Corrective Action
1. Initial Inspection After Planting		
Tree is stable, roots not exposed	**S U**	
Surface is at design level, typically 4” below overflow	**S U**	
Overflow bypass / inlet (if available) is functional	**S U**	
2. Trash, Debris, and Sediment Removal (1 time a year)		
Litter, leaves, and trash removed from the pretreatment prefilter	**S U**	
Sediment accumulation within filter bed less than 2”	**S U**	
3. Standing Water (1 time a year & after large storm events during first year)		
No evidence of standing water after 48 hours	**S U**	
4. Short Circuiting & Erosion (1 time a year)		
No evidence of animal burrows or other holes	**S U**	
No evidence of erosion	**S U**	
5. Drought Conditions (as needed)		
Water tree planter as needed	**S U**	
Dead or dying tree	**S U**	
6. Overflow Bypass / Inlet Inspection (1 time a year & after large storm events during first year)		
No evidence of blockage or accumulated leaves	**S U**	
Good condition, no need for repair	**S U**	
7. Tree Health (1 time a year)		
Tree health established by first year	**S U**	
Robust growth by year 2 or later	**S U**	
Prune dying branches	**S U**	

Corrective Action Needed	Due Date
1.	
2.	
3.	

INSPECTION AND MAINTENANCE GUIDANCE FOR RIGHT-OF-WAY INFILTRATION

Maintenance of right-of-way infiltration can typically be performed as part of standard landscaping. Regular inspection and maintenance is critical to the effective operation of infiltration systems to insure they remain clear of sediment, trash and debris and are free draining. This page provides guidance on maintenance activities that are typically required for these systems, along with the suggested frequency for each activity. Individual systems may have more, or less, frequent maintenance needs, depending on a variety of factors including the occurrence of large storm events, overly wet or dry (i.e., drought), regional hydrologic conditions, and the upstream land use.

INSPECTION ACTIVITIES

The most common maintenance activity is the removal of leaves, trash and debris from the pretreatment system and visual inspections of the monitoring well within the trench to check for proper drain time.

<table>
<tr><th>ACTIVITY</th><th>FREQUENCY</th></tr>
<tr><td>A record should be kept of the time for the system to drain completely after a storm event. The system should drain completely within 72 hours.</td><td rowspan="5">After every major storm in the first few months, then annually</td></tr>
<tr><td>Check drop inlet pretreatment within catch basin for sediment and debris.
Remedy: Vactor truck for removal trash and debris from pretreatment device. Access by removal of manhole. Maintenance within the infiltration trench component should rarely if ever be necessary.</td></tr>
<tr><td>Check infiltration trench monitoring well annually after a major storm to ensure it is draining within 72 hours.
Remedy: Examine inlet to infiltration trench for proper function, monitor the time to drain nearly completely, if the trench fails to drain and remains full, assessment by a qualified engineer is recommended.</td></tr>
<tr><td>Check for erosion, leakage in liners, and signs of differential settlement.
Remedy: Monitor issue and address settlement by surface fill. If the issue persists assessment by a qualified engineer is recommended.</td></tr>
<tr><td>Check catch basin insert pre-filter basket and strainer, pipe connections, flexible boot from hanging basket to infiltration trench, and suspension from catch basin frame.
Remedy: Repair or replace parts as necessary.</td></tr>
<tr><td>Inspect inlets and outlets to ensure good condition and no evidence of deterioration. Check to see if high-flow bypass is functioning.
Remedy: Repair or replace any damaged structural parts, inlets, outlets, sidewalls.</td><td>Annually</td></tr>
</table>

CHECKLIST FOR INSPECTION OF RIGHT-OF-WAY INFILTRATION

Location: Inspector:
Date: Time: Site Conditions:
Date Since Last Rain Event:

Inspection Items	Satisfactory (S) or Unsatisfactory (U)		Comments/Corrective Action
1. Initial Inspection After Installation			
Pretreatment system is functional including filter basket	**S**	**U**	
Primary outlet with flexible boot to infiltration trench is fastened and not leaking	**S**	**U**	
Overflow bypass / inlet (if available) is functional	**S**	**U**	
2. Drop Inlet Pretreatment (1 time a year)			
Trash, sediment and debris removed from the prefilter system	**S**	**U**	
3. Infiltration Trench Monitoring Well (1 time a year & after large storm events during first year)			
No standing water after 72 hours	**S**	**U**	
4. Erosion, Leakage In Liners, and Signs Of Differential Settlement (1 time a year)			
No evidence of leakage from liners or other holes around trench	**S**	**U**	
No evidence of differential sediment above infiltration trench			
No evidence of erosion	**S**	**U**	
5. Pretreatment Catch Basin Insert Parts (1 time a year)			
Pretreatment pre-filter basket and strainer, pipe connections, flexible boot from hanging basket to infiltration trench, and suspension from catch basin frame.	**S**	**U**	
6. Overflow Bypass / Inlet Inspection (1 time a year & after large storm events during first year)			
No evidence of blockage or accumulated leaves	**S**	**U**	
Good condition, no need for repair	**S**	**U**	

Corrective Action Needed	Due Date
1.	
2.	
3.	

INSPECTION AND MAINTENANCE GUIDANCE FOR CULTEC INFILTRATION SYTEMS: RECHARGE CHAMBERS AND SEPARATOR ROW	
Regular inspection and maintenance is necessary for the effective operation of infiltration systems. The following guidance is provided for corrective action and maintenance should an infiltration system function inadequately. The Responsible Parties must maintain the infiltration systems in accordance with the minimum design standards. This page provides guidance on maintenance activities that are typically required for infiltration systems, along with a suggested frequency for each activity. Individual infiltration systems may have more, or less, frequent maintenance needs, depending upon a variety of factors including: the occurrence of large storm events; overly wet or dry (i.e., drought) regional hydrologic conditions; and any changes or redevelopment in the upstream land use.	
Activity	**Frequency**
Check to insure the infiltration systems does not clog after storm events	As needed for corrective action
Check inlets and outlets for debris and high efficiency	
Check to see that the infiltration systems are draining completely within 72 hours after a rain event in Cultec Recharger Inspection Port #1	
Check to see that the infiltration systems are draining completely within 72 hours after a rain event in Cultec Separator Row Port #2	
Check to see that the infiltration bed well does not contain more than 6 inches accumulated material in Cultec Recharger Inspection Port #1	
Check to see that the infiltration bed well does not contain more than 6 inches accumulated material in Cultec Separator Row Port #2	
Check to see that the diversion structure is not full of trash, debris, and floatables	
Inspect inlets and outlets to ensure good condition and no evidence of deterioration	
Repair or replace any damaged structural parts, inlets, outlets, valves	

CHECKLIST FOR INSPECTION OF FOR CULTEC INFILTRATION SYTEMS: RECHARGE CHAMBERS AND SEPARATOR ROW

Regular inspection and maintenance is necessary for the effective operation of infiltration system. The following guidance is provided for corrective action and maintenance should an infiltration system function inadequately.

Location:

Inspector:

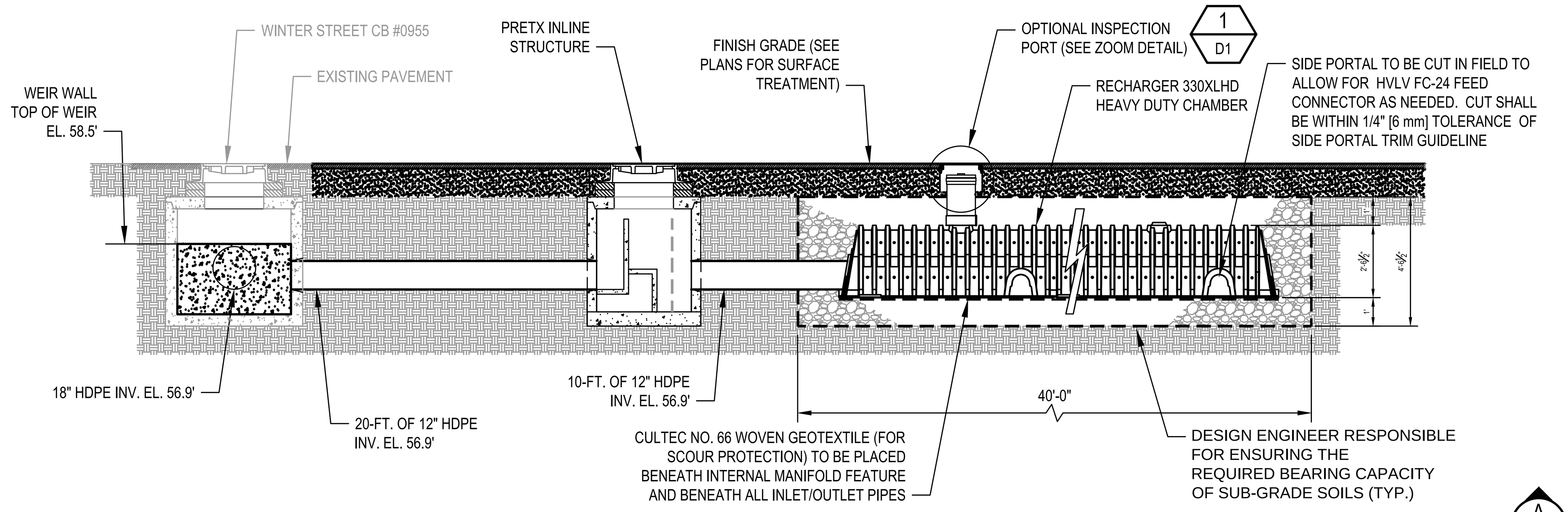
Date: Time: Site Conditions:

Date Since Last Rain Event:

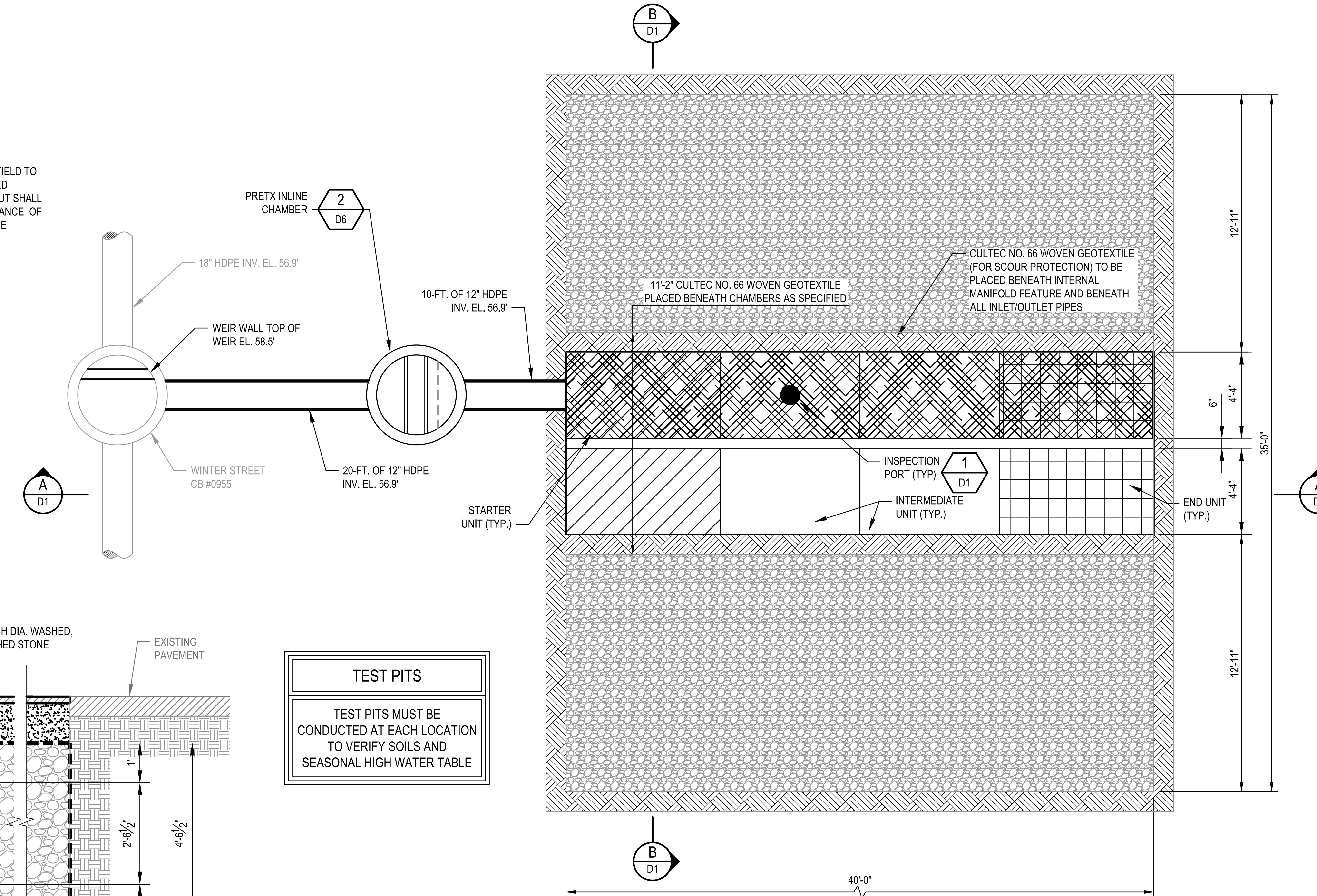
Inspection Items	Satisfactory (S) or Unsatisfactory (U)	Comments/Corrective Action
1. Complete drainage of Cultec Recharger within 72 hours after rain event observed through access port #1	S U	
2. Complete drainage of Cultec Separator Row within 72 hours after rain event observed through access port #2	S U	
3. Sediment accumulation of Cultec Recharger, 6” or less observed through access port #1	S U	
4. Sediment accumulation of Cultec Separator Row, 6” or less observed through access port #2	S U	
5. Clogging of Cultec Recharger observed through access port #1	S U	
6. Clogging of Cultec Separator Row observed through access port #2	S U	
7. Cultec Recharger clear of debris observed through access port #1	S U	
8. Cultec Separator Row clear of debris observed through access port #2	S U	
9. Diversion structures empty of trash, debris, and floatables observed through manhole	S U	
10. Clogging of inlet/outlet structures	S U	
11. Cracking, spalling, or deterioration of concrete	S U	
12. Animal burrows	S U	
13. Undesirable vegetation	S U	
14. Undesirable odors	S U	
15. Complaints from residents	S U	
16. Public hazards noted	S U	

Corrective Action Needed	Due Date
1.	
2.	
3.	

APPENDIX B: SITE PLANS

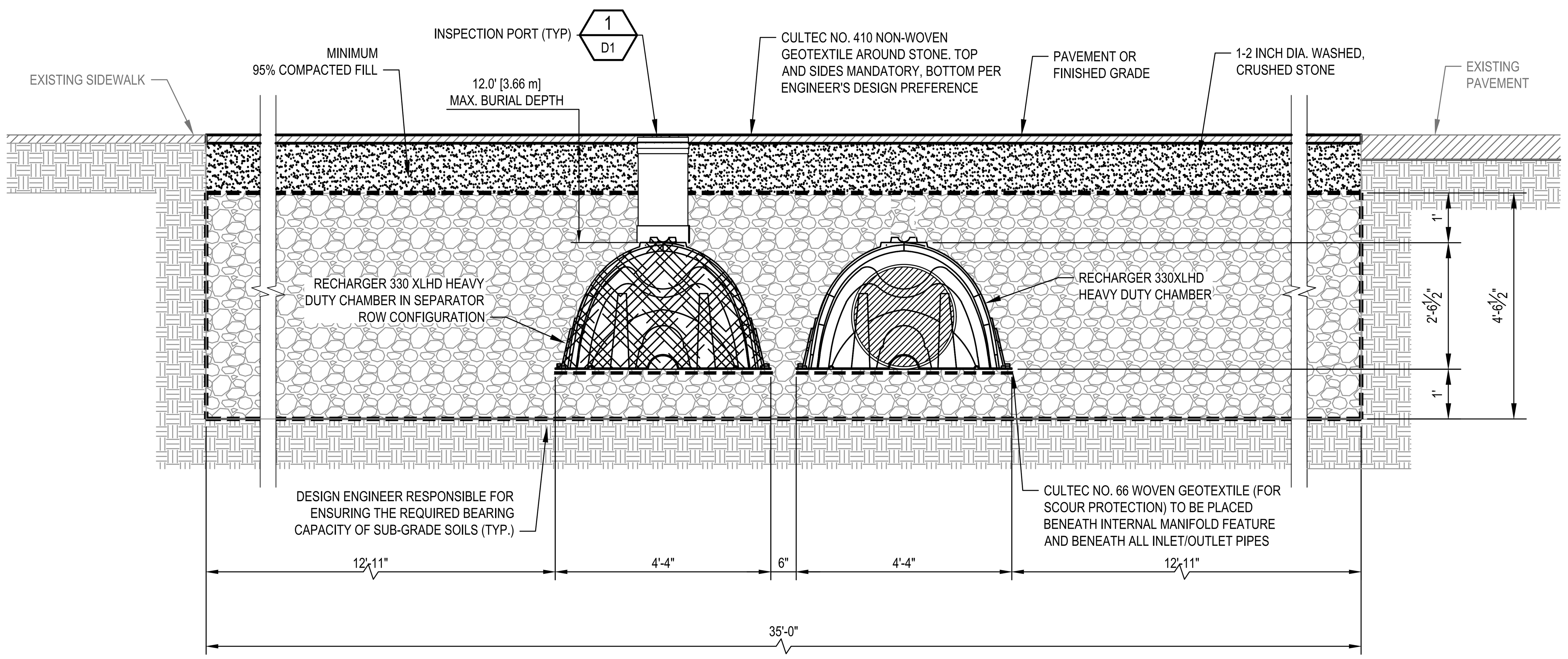


A SECTION
D1 SCALE : NOT TO SCALE



PLAN
CULTEC RECHARGER® 330
STORMWATER MANAGEMENT SYSTEM
NOT TO SCALE

TEST PITS
TEST PITS MUST BE CONDUCTED AT EACH LOCATION TO VERIFY SOILS AND SEASONAL HIGH WATER TABLE

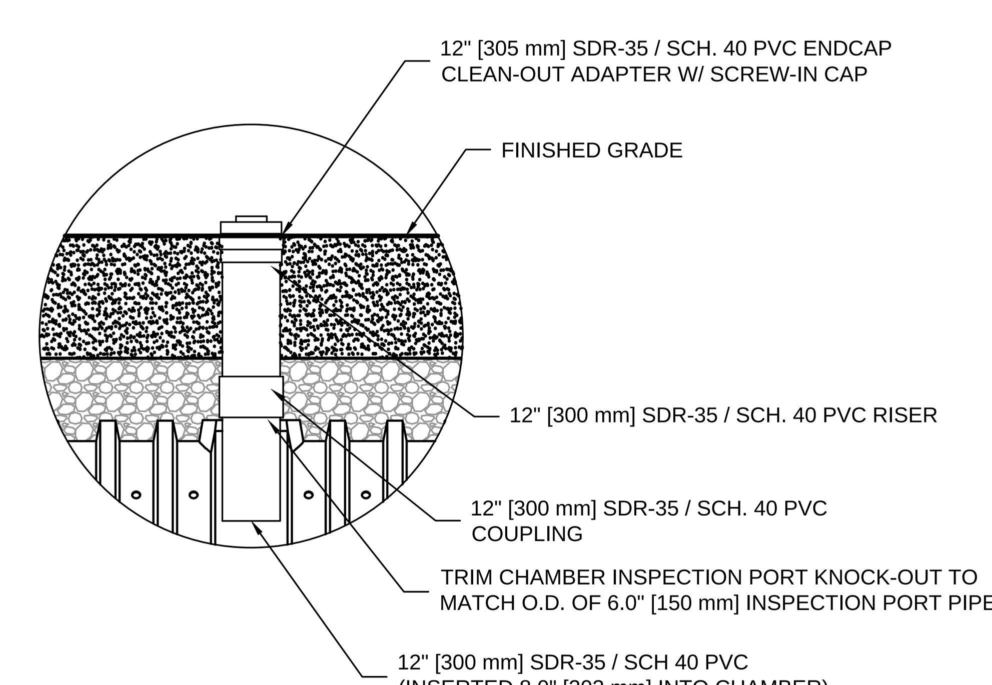


B SECTION
D1 SCALE : NOT TO SCALE

MATERIALS LIST		
(SEE COVER SHEET FOR COMBINED PROJECT MATERIALS LIST)		
RECHARGER 330XLSHD STARTER	2	PIECES
RECHARGER 330XLIHD INTERMEDIATE	4	PIECES
RECHARGER 330XLEHD END	2	PIECES
CULTEC NO. 66 WOVEN GEOTEXTILE 7.5' x 300'	10	LINEAL FEET
SEPARATOR ROW MATERIALS LIST		
CULTEC NO. 410 NON-WOVEN GEOTEXTILE 7.5' x 300' (TO WRAP SEPARATOR ROW)	14.22	SQ. YDS
CULTEC NO. 66 WOVEN GEOTEXTILE 7.5' x 300' (BENEATH SEPARATOR ROW)	0.20	ROLLS

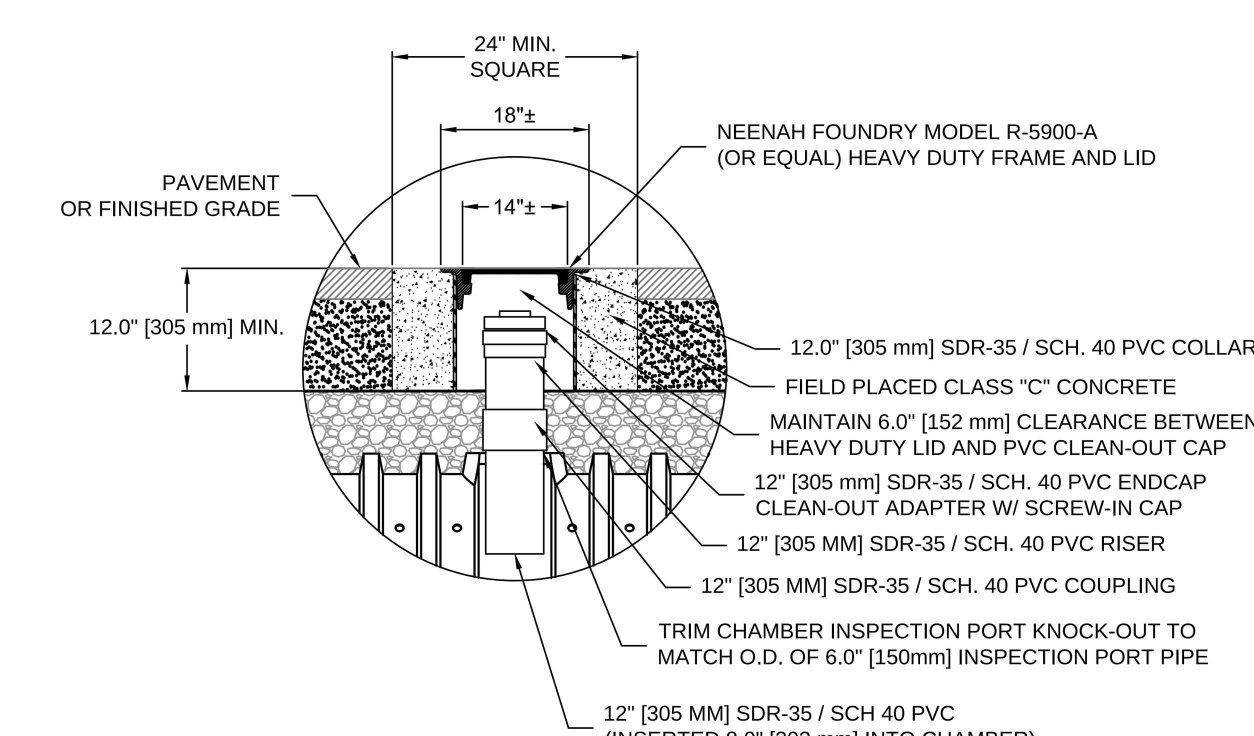
CULTEC RECHARGER® 330 XLHD LEGEND

RECHARGER 330XLSHD STARTER
RECHARGER 330XLIHD INTERMEDIATE
RECHARGER 330XLEHD END
CULTEC NO. 66 WOVEN GEOTEXTILE
CULTEC NO. 410 NON-WOVEN GEOTEXTILE



BEYOND PAVED SURFACES

1 DETAIL
D1 SCALE : 3/4" = 1'-0"



WITHIN PAVED SURFACES

2 DETAIL
D1 SCALE : 3/4" = 1'-0"

NOTE:
ALL ELECTRIC, GAS, TEL. WATER, SEWER AND DRAIN SERVICES ARE SHOWN IN SCHEMATIC FASHION. THEIR LOCATIONS ARE NOT PRECISE OR NECESSARILY ACCURATE. NO WORK WHATSOEVER SHALL BE UNDERTAKEN ON THIS SITE USING THIS PLAN TO LOCATE THE ABOVE SERVICES. CONSULT WITH THE PROPER AUTHORITIES CONCERNED WITH THE SUBJECT SERVICE LOCATIONS FOR INFORMATION REGARDING SUCH. CALL DIG-SAFE AT 811.

This Drawing shall not be used for Construction unless Signed and Sealed For Construction.

NO	DATE	DESCRIPTION	CKD
1	4/9/17	35% REVIEW	RR
2	6/4/17	95% REVIEW	RR

WATERSTONE ENGINEERING
INNOVATIVE STORMWATER MANAGEMENT
9 GRETA'S WAY
STRATHAM, NH 03885
(p) 603.686.2488

95% DESIGN FOR WATER INTEGRATION FOR SQUAMSCOTT - EXETER (WISE) INTEGRATED PLAN (IP) PHASE 1

LINCOLN STREET SUBWATERSHED NUTRIENT CONTROL STRATEGIES

PREPARED FOR:
TOWN OF EXETER
DEPT. OF PUBLIC WORKS
11 NEWFIELDS ROAD

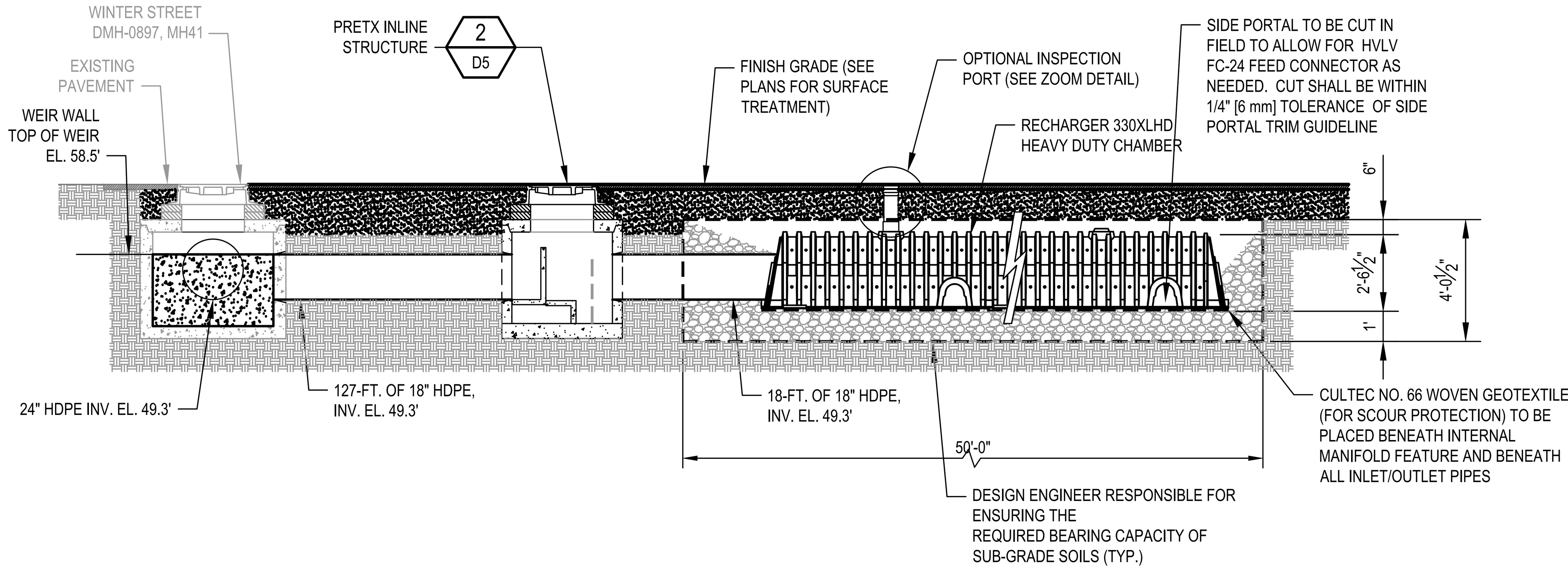
DESIGNED BY:	RR
DRAFTED BY:	CDS
CHECKED BY:	RR

STATE OF NEW HAMPSHIRE ROBERT M. ROSEEN No. 12215 LICENSED PROFESSIONAL ENGINEER

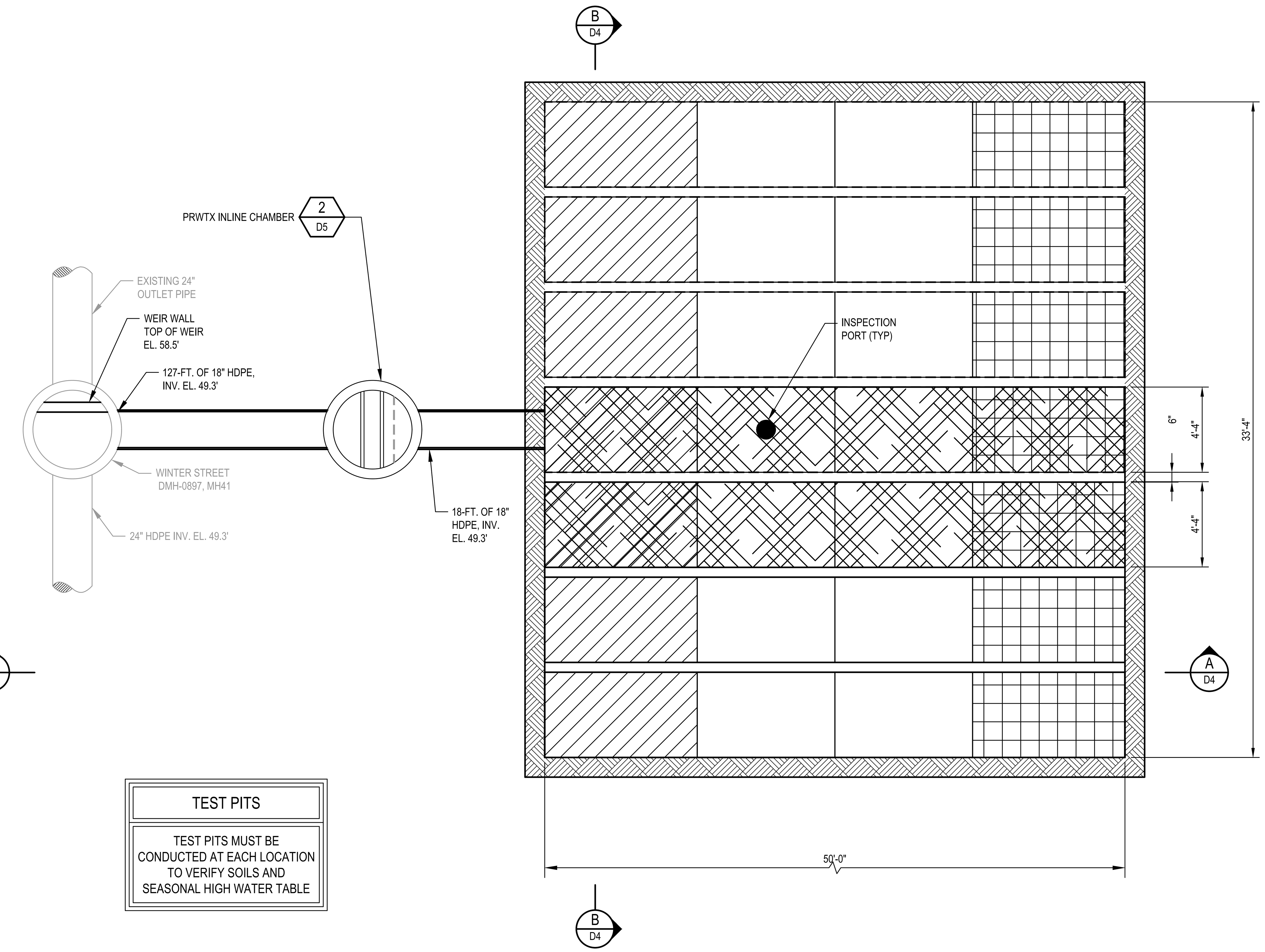
SUBSURFACE INFILTRATION BMP-1 DETAILS

JOB #:	16928
SCALE:	AS SHOWN
CONTRCT #:	N/A

D1

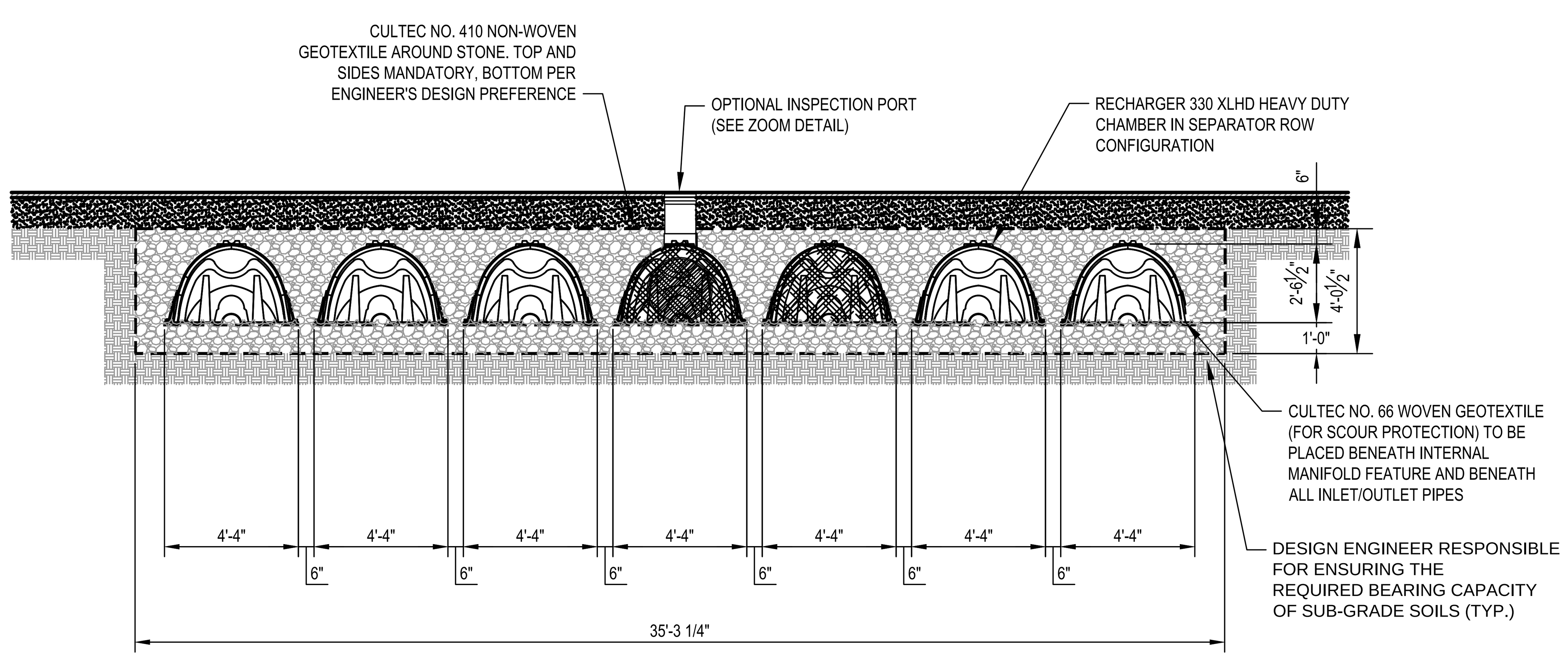


A SECTION
D4
SCALE : NOT TO SCALE



TEST PITS
TEST PITS MUST BE CONDUCTED AT EACH LOCATION TO VERIFY SOILS AND SEASONAL HIGH WATER TABLE

PLAN
CULTEC RECHARGER® 330
STORMWATER MANAGEMENT SYSTEM
NOT TO SCALE



B SECTION
D4
SCALE : NOT TO SCALE

MATERIALS LIST		
(SEE COVER SHEET FOR COMBINED PROJECT MATERIALS LIST)		
RECHARGER 330XLSHD STARTER	2	PIECES
RECHARGER 330XLIHD INTERMEDIATE	4	PIECES
RECHARGER 330XLEHD END	2	PIECES
CULTEC NO. 66 WOVEN GEOTEXTILE 7.5' x 300'	10	LINEAL FEET
SEPARATOR ROW MATERIALS LIST		
CULTEC NO. 410 NON-WOVEN GEOTEXTILE 7.5' x 300' (TO WRAP SEPARATOR ROW)	14.22	SQ. YDS
CULTEC NO. 66 WOVEN GEOTEXTILE 7.5' x 300' (BENEATH SEPARATOR ROW)	0.20	ROLLS

CULTEC RECHARGER® 330 XLHD LEGEND

- RECHARGER 330XLSHD STARTER
- RECHARGER 330XLIHD INTERMEDIATE
- RECHARGER 330XLEHD END
- CULTEC NO. 66 WOVEN GEOTEXTILE
- CULTEC NO. 410 NON-WOVEN GEOTEXTILE

NOTE:
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NO	DATE	DESCRIPTION	CKD
1	4/9/17	35% REVIEW	RR
2	6/4/17	95% REVIEW	RR

WATERSTONE ENGINEERING
INNOVATIVE STORMWATER MANAGEMENT
9 GRETA'S WAY
STRATHAM, NH 03885
(p) 603.686.2488

95% DESIGN FOR WATER INTEGRATION FOR SQUAMSCOTT - EXETER (WISE) INTEGRATED PLAN (IP) PHASE 1
LINCOLN STREET SUBWATERSHED
NUTRIENT CONTROL STRATEGIES

PREPARED FOR:
TOWN OF EXETER
DEPT. OF PUBLIC WORKS
11 NEWFIELDS ROAD

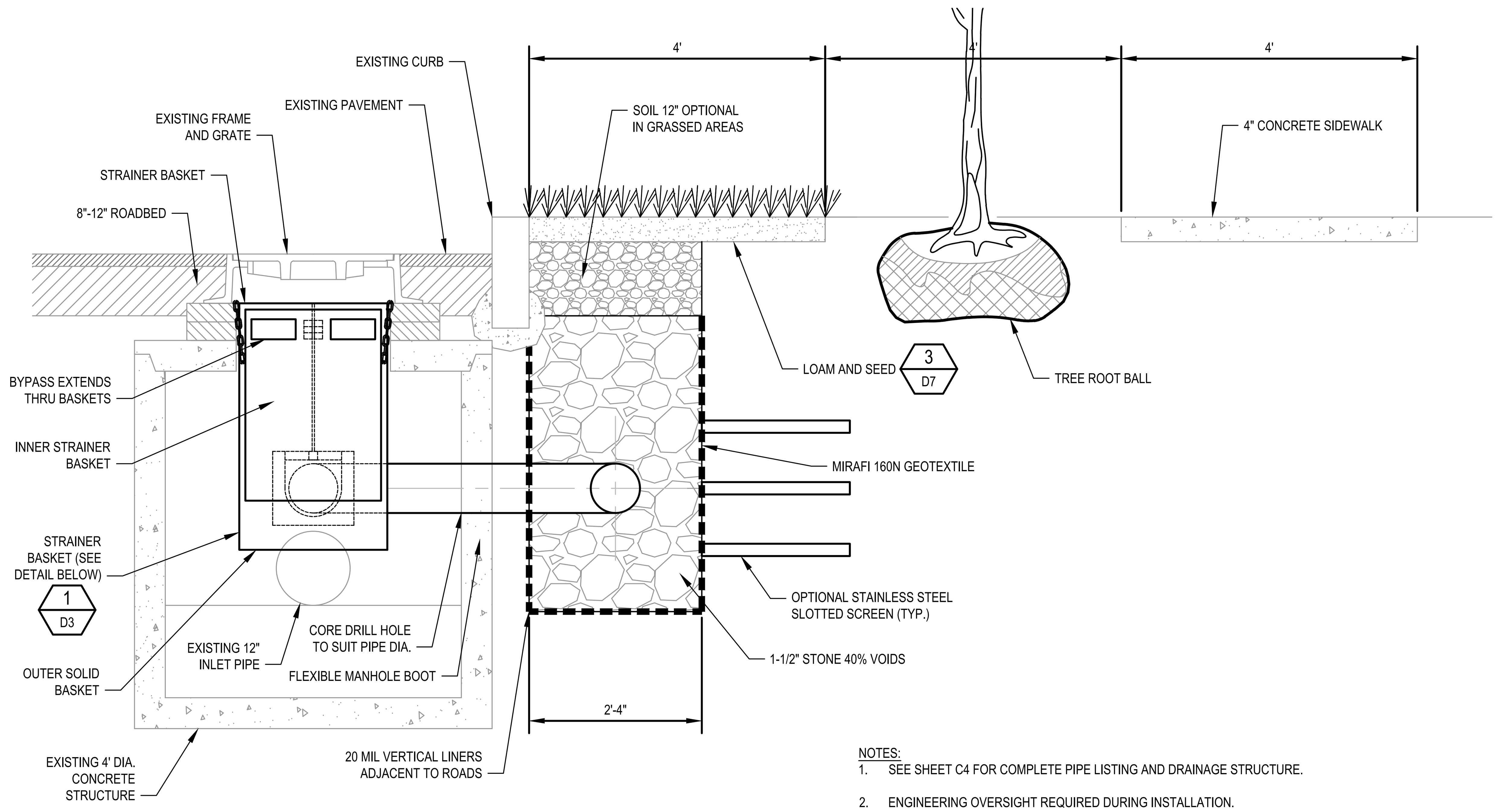
DESIGNED BY:	RR
DRAFTED BY:	CDS
CHECKED BY:	RR

STATE OF NEW HAMPSHIRE
ROBERT M. ROSEEN
No. 12215
LICENSED
PROFESSIONAL ENGINEER

BIOFILTER
BMP-2
DETAILS

JOB #:	16928
SCALE:	AS SHOWN
CONTRCT #:	N/A

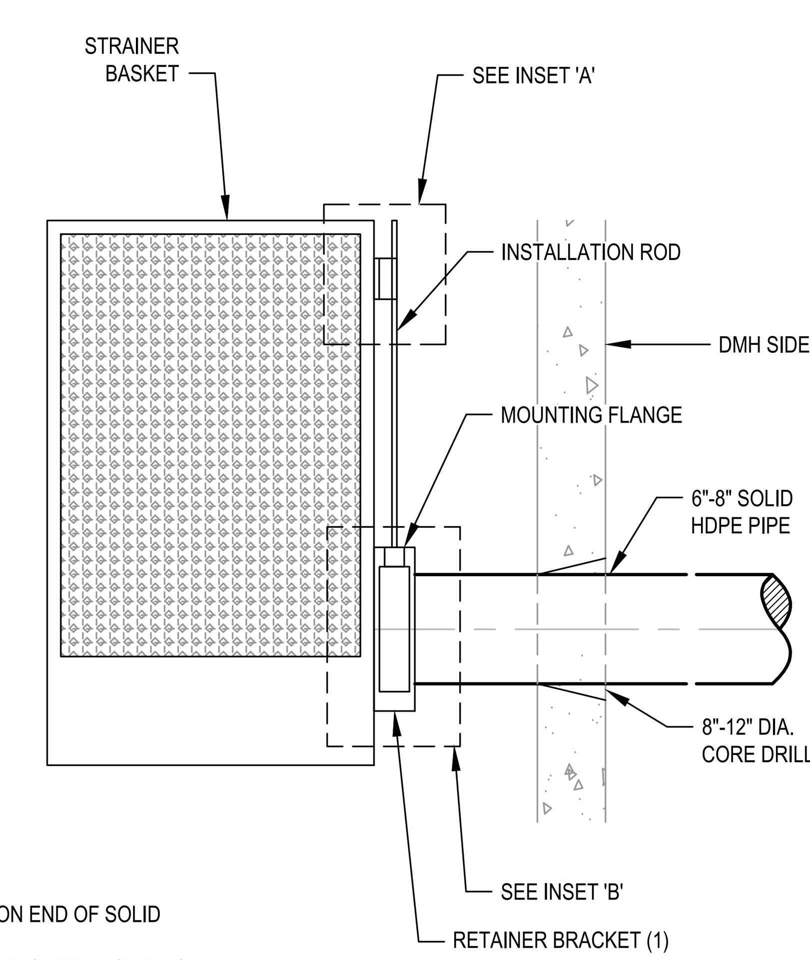
D2



NOTES:
1. RIGHT OF WAY (ROW) INFILTRATION RETROFIT IS IDEAL FOR LOW COST RETROFITS OF EXISTING DRAINAGE INFRASTRUCTURE WHERE ROW EXIST.
2. ROW INFILTRATION RETROFIT INSTALL WITHIN EXISTING CATCH BASIN WITH CHAINS AND CLIPS TO HANG BELOW GRATE AND STRAIN AND REMOVE SOLIDS AND DEBRIS PRIOR TO INFILTRATION.
3. SOLIDS AND DEBRIS RETAINED IN INNER AND OUTER BASKETS.

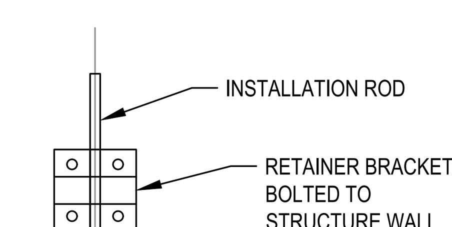
NOTES:
1. SEE SHEET C4 FOR COMPLETE PIPE LISTING AND DRAINAGE STRUCTURE.
2. ENGINEERING OVERSIGHT REQUIRED DURING INSTALLATION.
3. PRESERVE EXISTING SIDEWALK, ROAD, CURB, CATCH BASIN AND TREES.
4. SYSTEMS DO NOT TIE INTO EXISTING DRAINAGE UNLESS LOW COST CONDUCTIVITY SOILS ARE PRESNET IN WHICH CASE PERFORATED UNDERDRAINS TIE INTO EXISTING CATCH BASINS AT BMP OUTLET.
5. ALL SYSTEMS INCLUDEACF PRETX PRETREATMENT SYSTEM FOR REMOVAL OF SEDIMENT, TRASH AND DEBRIS AND FOCUSED EASE OF MAINTENANCE AT MANHOLE BY VACTOR TRUCK.
6. ALL BYPASS IS BACK INTO ROAD AND GUTTERLINE AND INTO EXISTING STORM DRAINAGE INFRASTRUCTURE.
7. PVC LINER ON VERTICAL WALL AND AGAINST ROADBASE, ALL OTHER FACES GEOTEXTILE LINER.
8. STONE DEPTH AND WIDTH VARIES BASED ON AVAILABLE MEDIAN SIZE AND EXISTING INVERTS.

RIGHT-OF-WAY RETROFIT DETAIL
SCALE: NOT TO SCALE

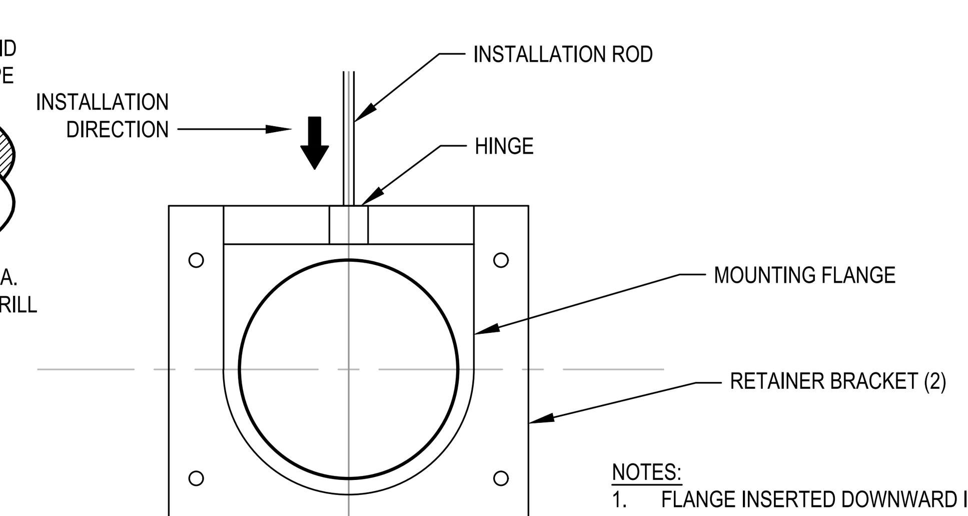


INSTALLATION PROCESS:
1. MOUNTING FLANGE INSTALLED ON END OF SOLID PIPE.
2. PIPE CONNECTED TO STRAINER BASKET BY SLIDING FLANGE INTO RETAINER BRACKET(1) WITH INSTALLATION ROD.
3. INSTALLATION ROD FIXED INTO PLACE BY RETAINER BRACKET (2).
4. REMOVAL IS REVERSE PROCEDURE.
5. HDPE BSKET AND STRAINER WITH 3/8" OPENINGS.

1
D3
STRAINER BASKET CONNECTION DETAIL
SCALE: NOT TO SCALE

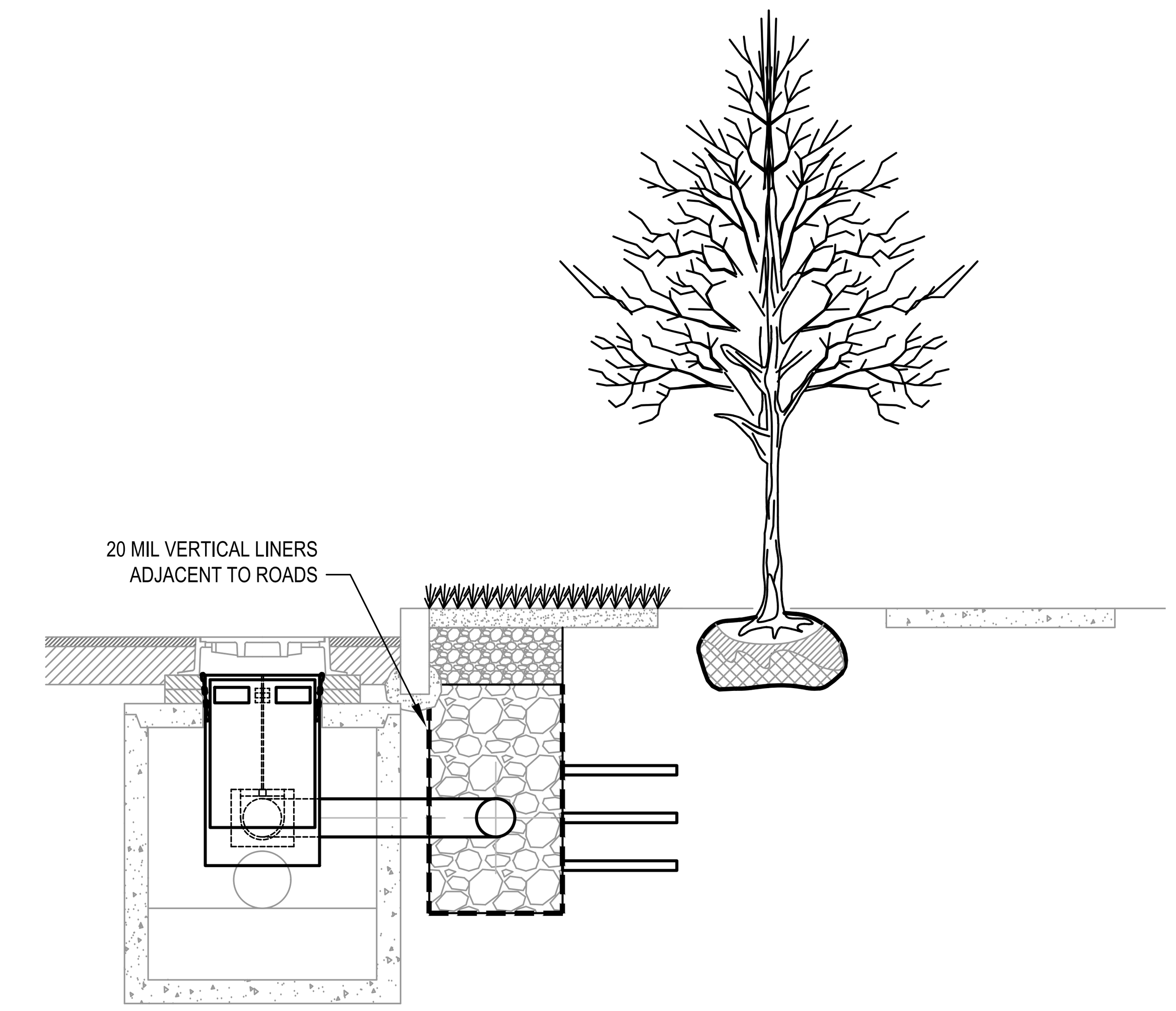


INSET DETAIL 'A'
SCALE: NOT TO SCALE

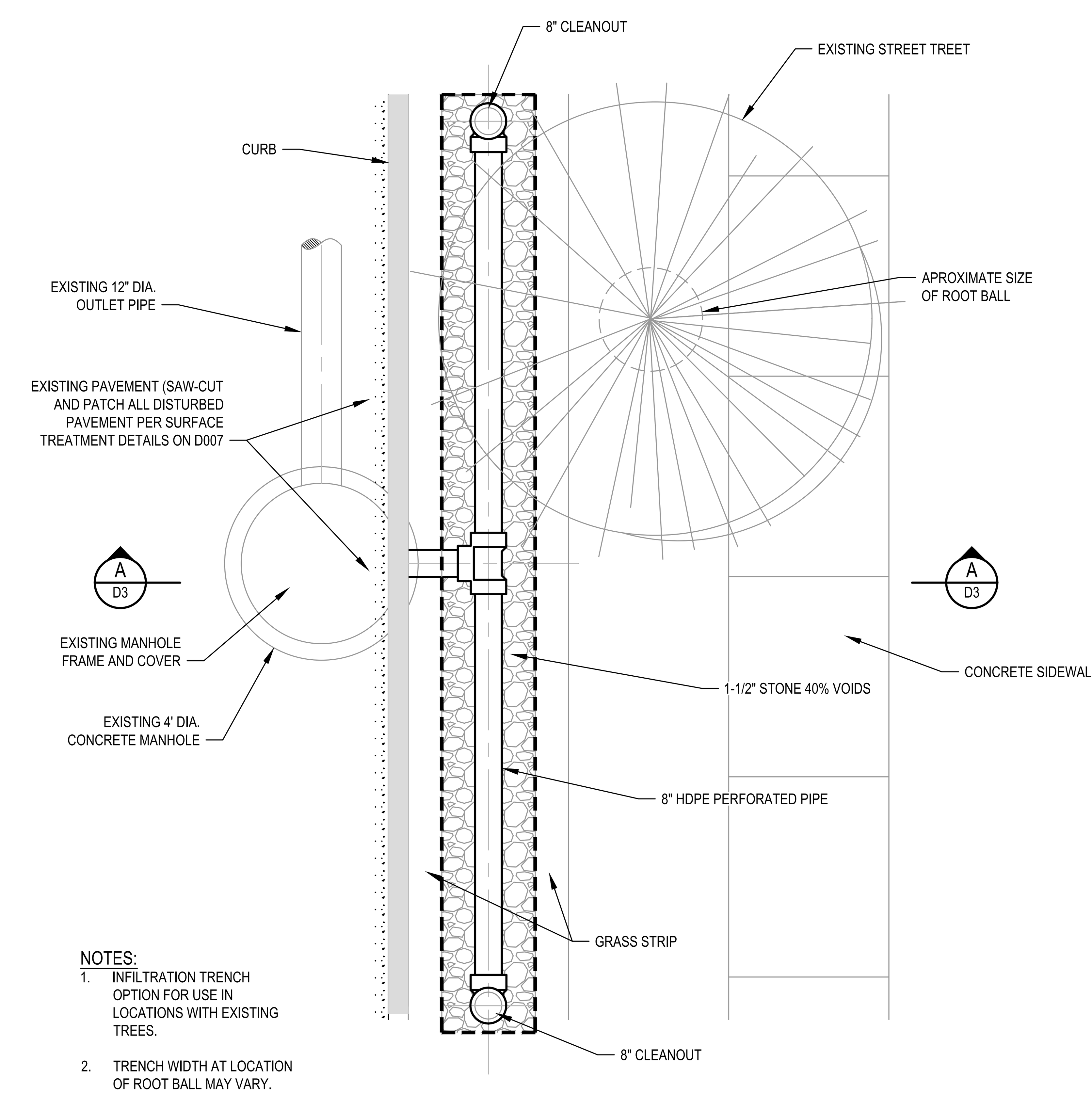


NOTES:
1. FLANGE INSERTED DOWNWARD INTO BRACKET (1)
2. ROD FIXED IN PLACE WITH BRACKET (2)

INSET DETAIL 'B'
SCALE: NOT TO SCALE



A
D3
SECTION
SCALE : NOT TO SCALE



NOTES:
1. INFILTRATION TRENCH OPTION FOR USE IN LOCATIONS WITH EXISTING TREES.
2. TRENCH WIDTH AT LOCATION OF ROOT BALL MAY VARY.

ALT B TYPICAL TREE TRENCH INFILTRATION DETAIL
SCALE: NOT TO SCALE

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NO	DATE	DESCRIPTION	CKD
1	4/9/17	35% REVIEW	RR
2	6/4/17	95% REVIEW	RR

WATERSTONE ENGINEERING
INNOVATIVE STORMWATER MANAGEMENT
9 GRETA'S WAY
STRATHAM, NH 03885
(p) 603.686.2488

95% DESIGN FOR WATER INTEGRATION FOR SQUAMSCOTT - EXETER (WISE) INTEGRATED PLAN (IP) PHASE 1
LINCOLN STREET SUBWATERSHED NUTRIENT CONTROL STRATEGIES

PREPARED FOR:
TOWN OF EXETER
DEPT. OF PUBLIC WORKS
11 NEWFIELDS ROAD

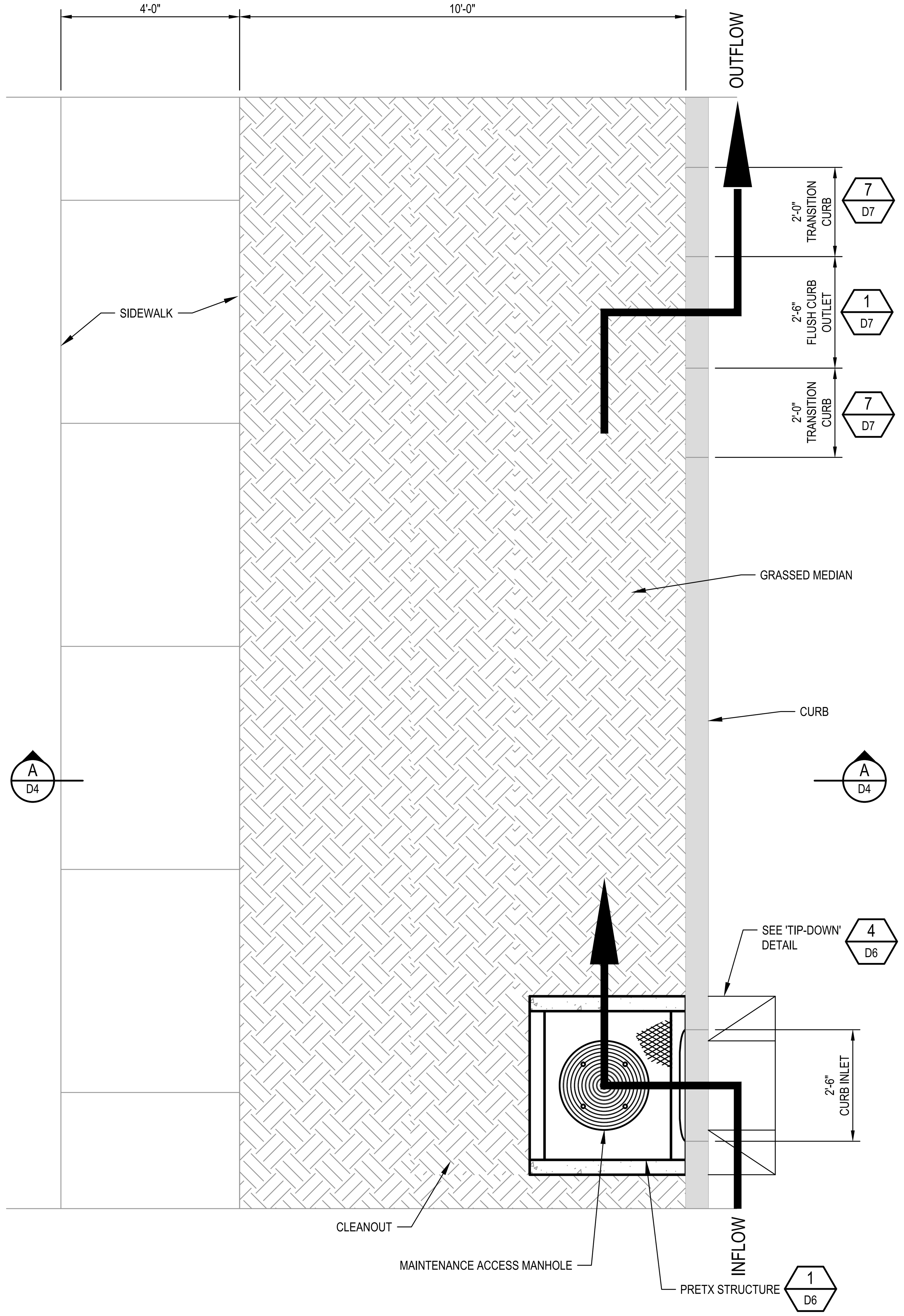
DESIGNED BY:	RR
DRAFTED BY:	CDS
CHECKED BY:	RR

STATE OF NEW HAMPSHIRE
ROBERT M. ROSEEN
No. 12211
LICENSED PROFESSIONAL ENGINEER

RIGHT-OF-WAY INFILTRATION DETAILS

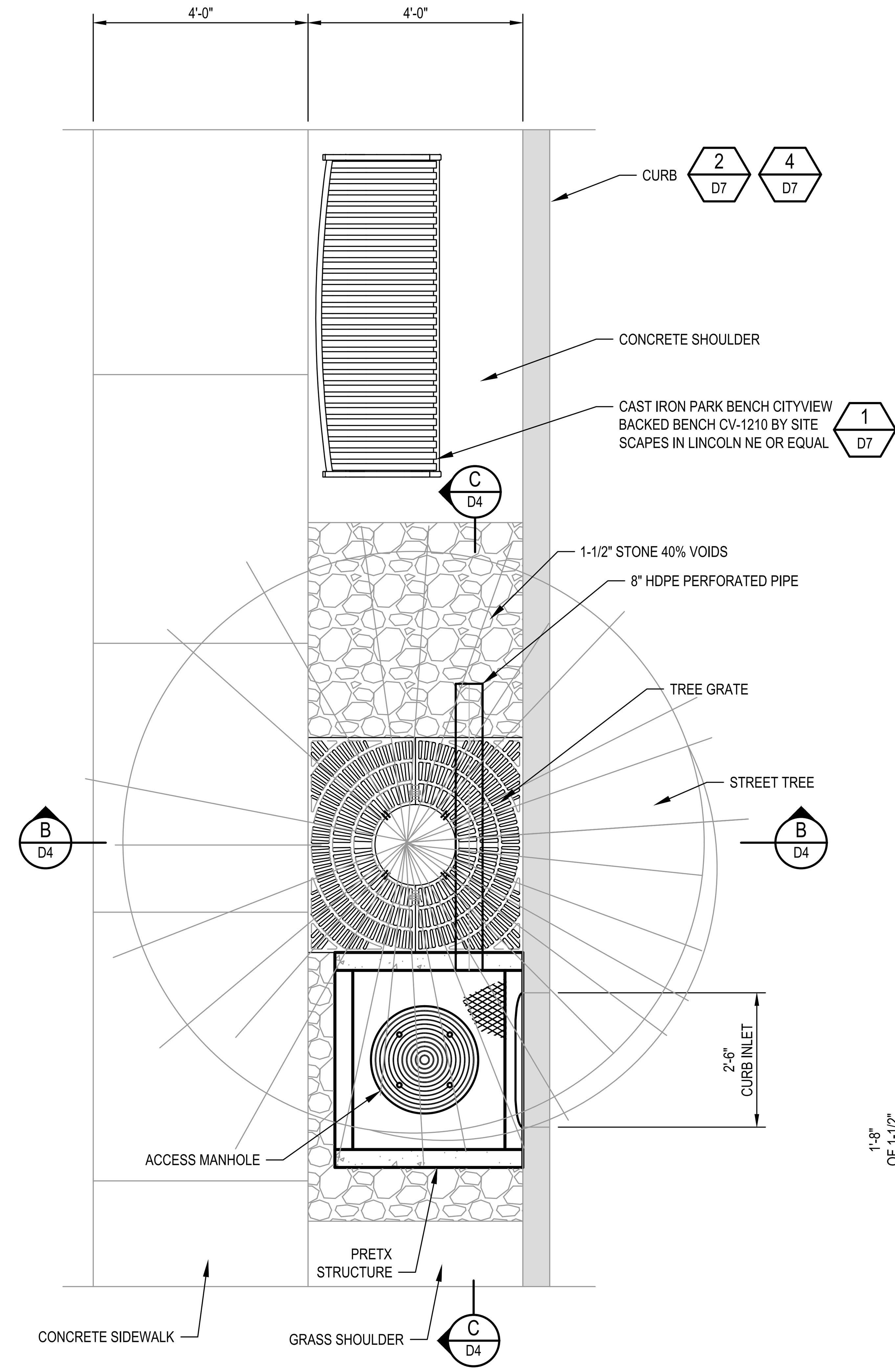
JOB #:	16928
SCALE:	AS SHOWN
CONTRCT #:	N/A

D3



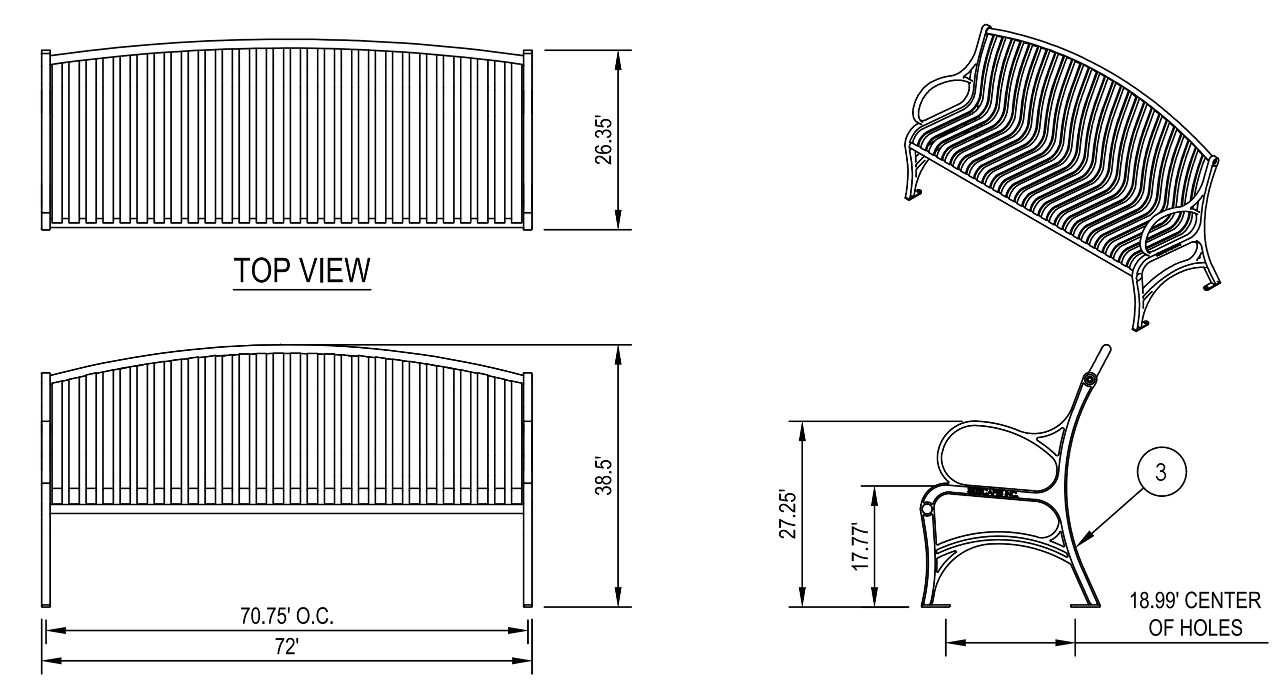
1 D4 TYPICAL GRASSED BIOSWALE DETAIL

SCALE: NOT TO SCALE



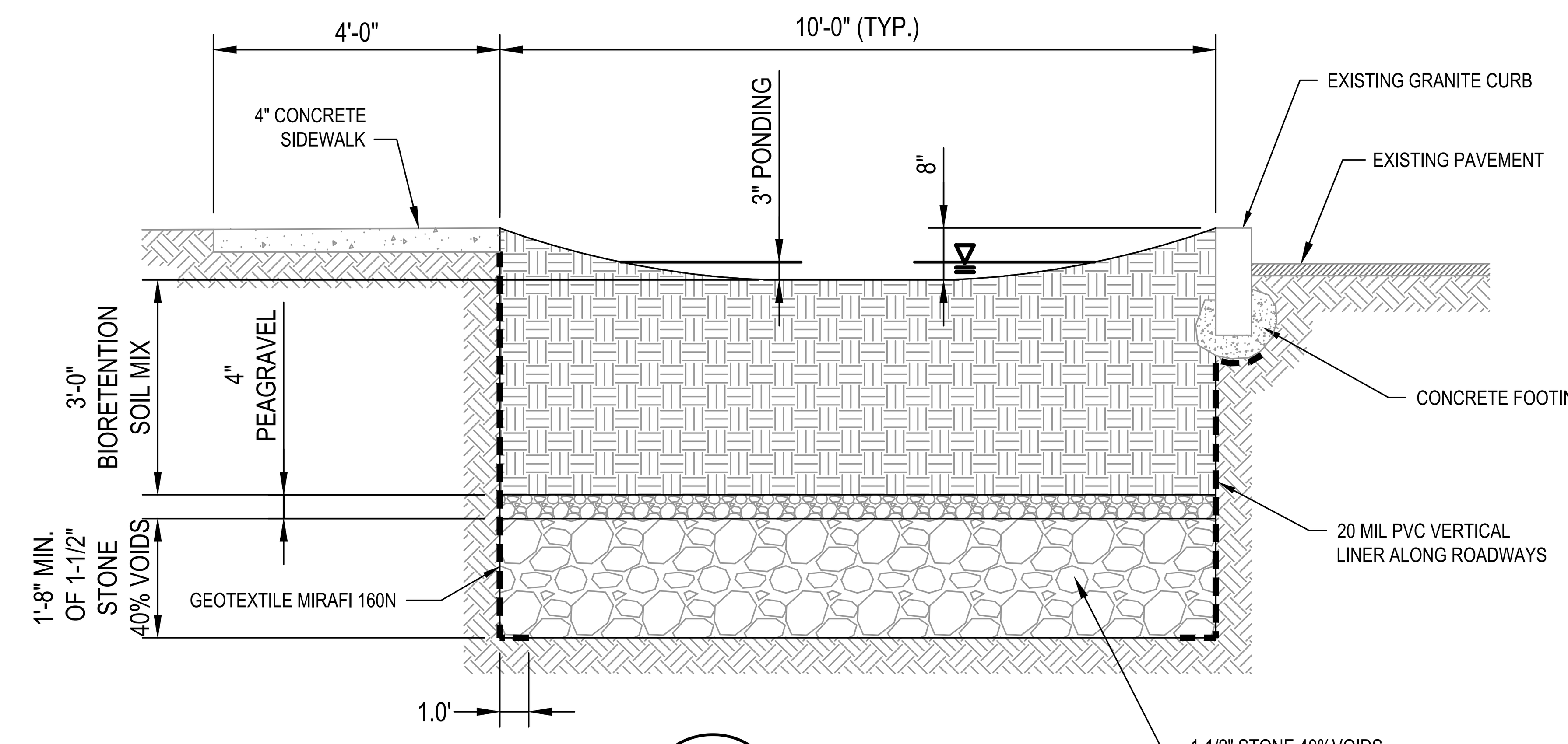
2 D4 ALT A TYPICAL TREE PLANTER DETAIL

SCALE: NOT TO SCALE



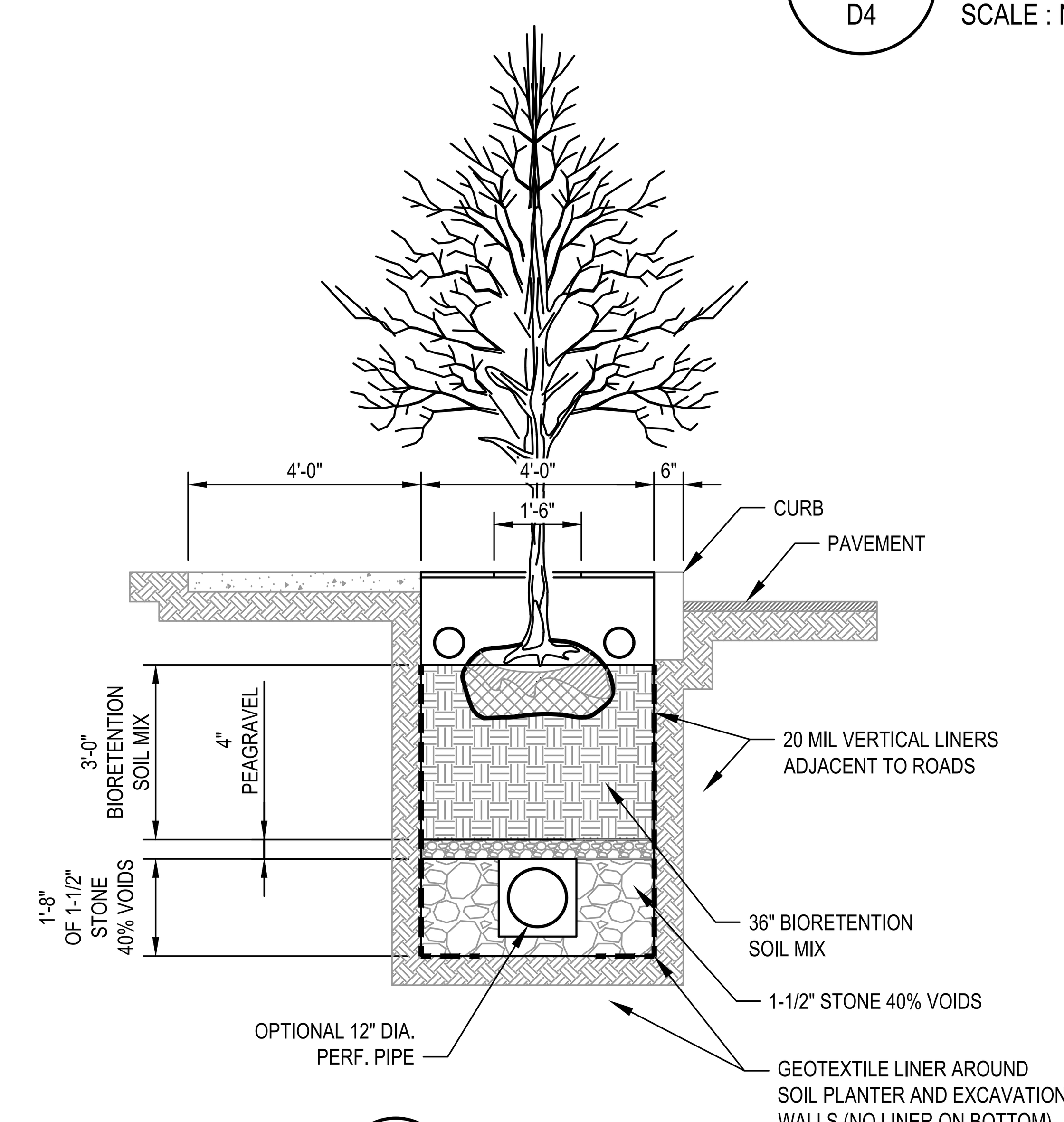
3 D4 PARK BENCH DETAIL

SCALE: NOT TO SCALE



A D4 SECTION

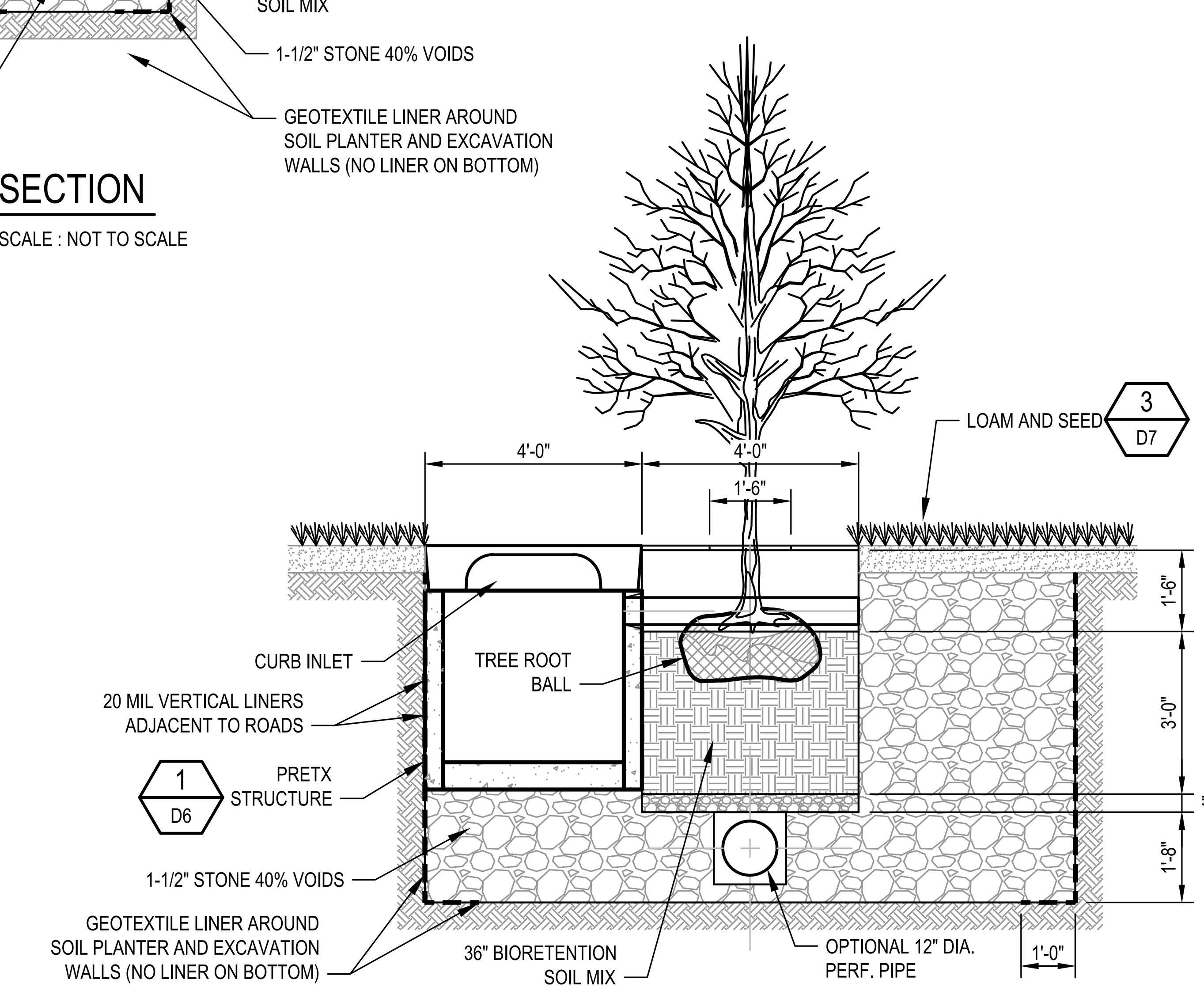
SCALE : NOT TO SCALE



B D4 SECTION

SCALE : NOT TO SCALE

TEST PITS
TEST PITS MUST BE CONDUCTED AT EACH LOCATION TO VERIFY SOILS AND SEASONAL HIGH WATER TABLE



C D4 SECTION

SCALE : NOT TO SCALE

NOTES:

1. SEE SHEET C4 FOR COMPLETE PIPE LISTING AND DRAINAGE STRUCTURE.
2. ENGINEERING OVERSIGHT REQUIRED DURING INSTALLATION.
3. PRESERVE EXISTING SIDEWALK, ROAD, CURB, CATCH BASIN AND TREES.
4. SYSTEMS DO NOT TIE INTO EXISTING DRAINAGE UNLESS LOW COST CONDUCTIVITY SOILS ARE PRESNET IN WHICH CASE PERFORATED UNDERDRAINS TIE INTO EXISTING CATCH BASINS AT BMP OUTLET.
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6. ALL BYPASS IS BACK INTO ROAD AND GUTTERLINE AND INTO EXISTING STORM DRAINAGE INFRASTRUCTURE.
7. PVC LINER ON VERTICAL WALL AND AGAINST ROADBASE, ALL OTHER FACES GEOTEXTILE LINER.
8. STONE DEPTH AND WIDTH VARIES BASED ON AVAILABLE MEDIAN SIZE AND EXISTING INVERTS.

NOTES:

1. BIORETENTION SOIL MIX SHALL CONSIST OF 30% LOAM, 5% WATER TREATMENT RESIDUALS, 65% SAND.
2. DO NOT COMPACT SUBGRADE AT BOTTOM OF EXCAVATION.
3. NO BIORETENTION SOIL MIX SHALL BE PLACED UNTIL AFTER ENGINEERING APPROVAL AND INSPECTION OF SUBGRADE.
4. SEE DRAINAGE PLAN FOR STRUCTURE ELEVATION AND INVERTS, PIPE TYPE, LENGTH AND SLOPE, AND BIORETENTION AREA DIMENSIONS.
5. GRAVEL DEPTH MAY VARY FOR STORAGE.

This Drawing shall not be used for Construction unless Signed and Sealed For Construction.

NO	DATE	DESCRIPTION	CKD
1	4/9/17	35% REVIEW	RR
2	6/4/17	95% REVIEW	RR

WATERSTONE ENGINEERING
INNOVATIVE STORMWATER MANAGEMENT
9 GRETAS WAY
STRATHAM, NH 03885
(p) 603.686.2488

95% DESIGN FOR WATER INTEGRATION FOR SQUAMSCOTT - EXETER (WISE) INTEGRATED PLAN (IP) PHASE 1

LINCOLN STREET SUBWATERSHED NUTRIENT CONTROL STRATEGIES

PREPARED FOR:
TOWN OF EXETER
DEPT. OF PUBLIC WORKS
11 NEWFIELDS ROAD

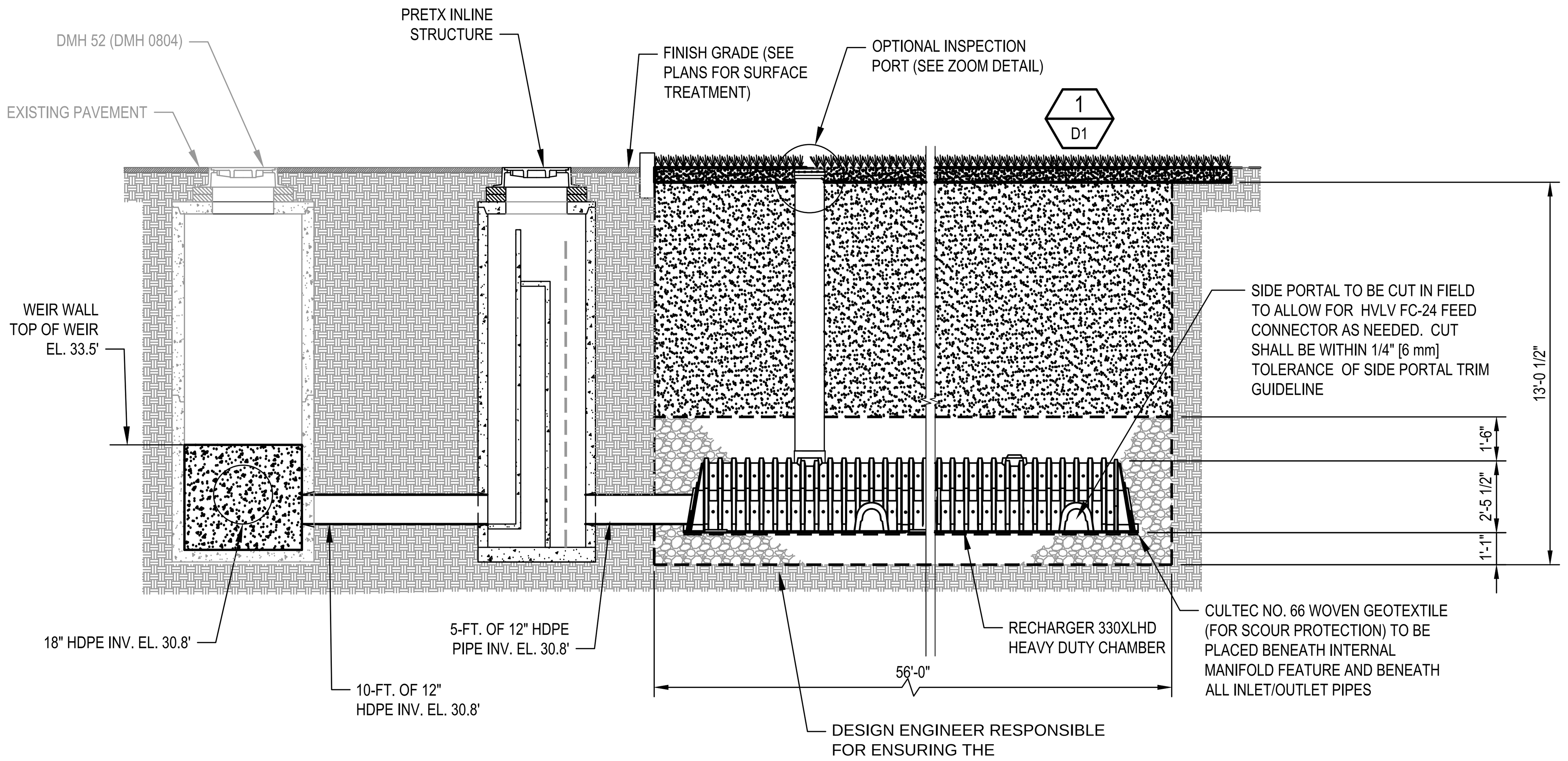
DESIGNED BY:	RR
DRAFTED BY:	CDS
CHECKED BY:	RR

STATE OF NEW HAMPSHIRE ROBERT M. ROSEEN No. 12214 LICENSED PROFESSIONAL ENGINEER

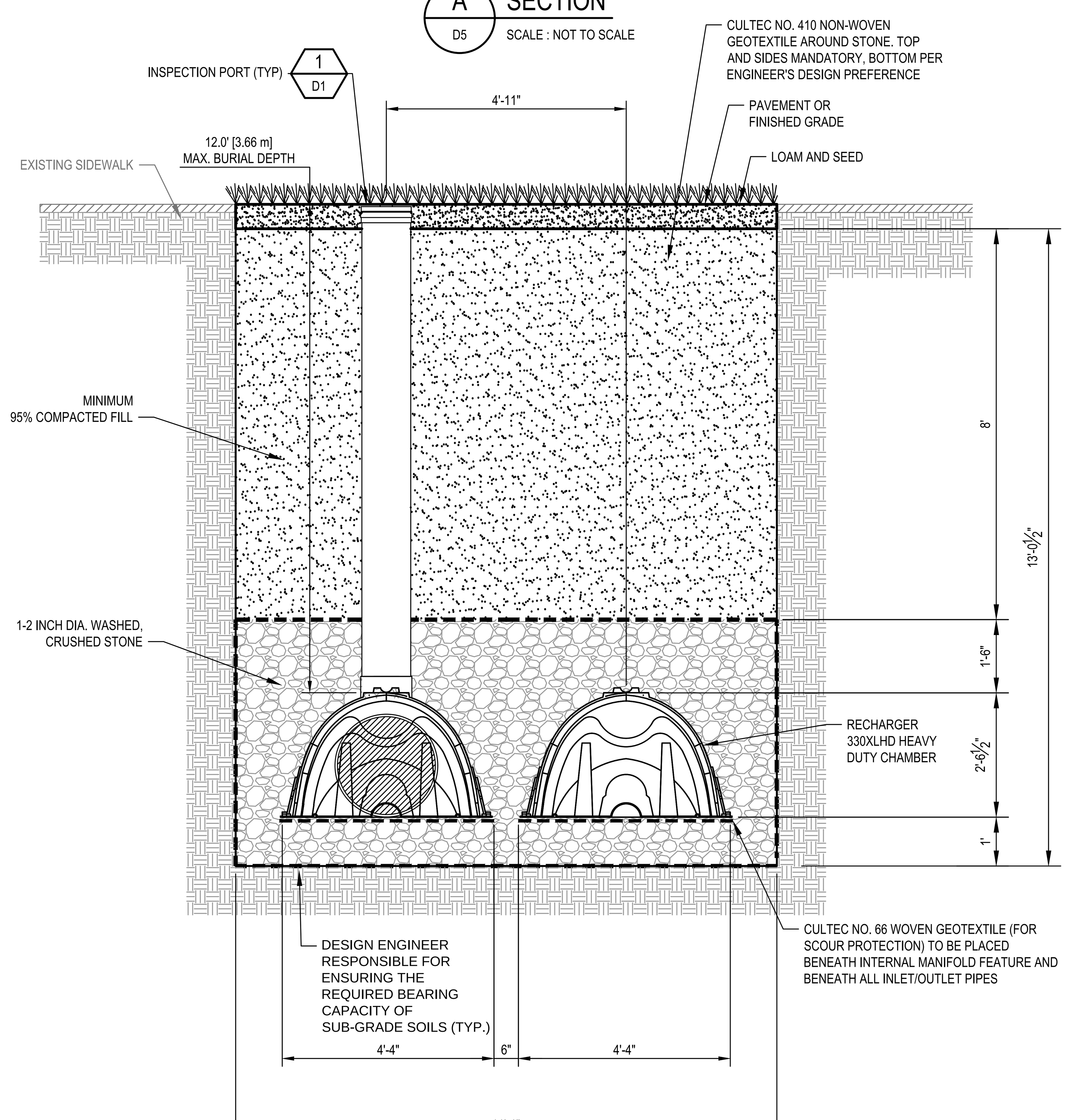
TREE PLANTER AND BIOSWALE DETAILS

JOB #:	16928
SCALE:	AS SHOWN
CONTRCT #:	N/A

D4

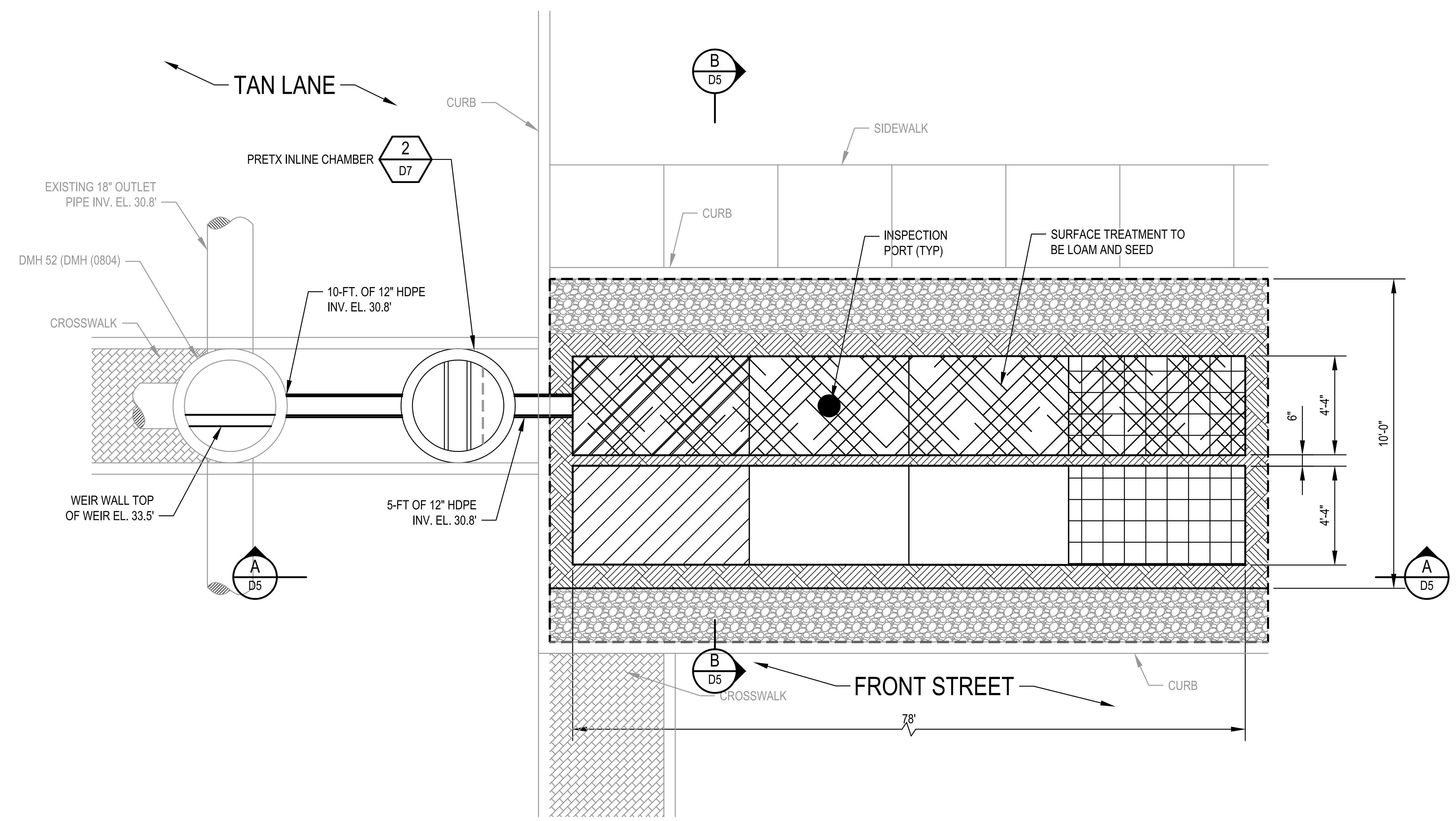


A SECTION
D5
SCALE : NOT TO SCALE



NOTES:
1. ALL ELECTRIC, GAS, TEL. WATER, SEWER AND DRAIN SERVICES ARE SHOWN IN SCHEMATIC FASHION, THEIR LOCATIONS ARE NOT PRECISE OR NECESSARILY ACCURATE. NO WORK WHATSOEVER SHALL BE UNDERTAKEN ON THIS SITE USING THIS PLAN TO LOCATE THE ABOVE SERVICES. CONSULT WITH THE PROPER AUTHORITIES CONCERNED WITH THE SUBJECT SERVICE LOCATIONS FOR INFORMATION REGARDING SUCH. CALL DIG-SAFE AT 811.
2. UNDERGROUND UTILITIES SHOWN ARE APPROXIMATE. EXACT LOCATIONS OF EXISTING UNDERGROUND UTILITIES SHALL BE DETERMINED BY THE CONTRACTOR IN THE FIELD PRIOR TO CONSTRUCTION.

B SECTION
D5
SCALE : NOT TO SCALE



PLAN
CULTEC RECHARGER® 330
STORMWATER MANAGEMENT SYSTEM
NOT TO SCALE

TEST PITS
TEST PITS MUST BE CONDUCTED AT EACH LOCATION TO VERIFY SOILS AND SEASONAL HIGH WATER TABLE

MATERIALS LIST		
(SEE COVER SHEET FOR COMBINED PROJECT MATERIALS LIST)		
RECHARGER 330XLSHD STARTER	2	PIECES
RECHARGER 330XLIHD INTERMEDIATE	4	PIECES
RECHARGER 330XLEHD END	2	PIECES
CULTEC NO. 66 WOVEN GEOTEXTILE 7.5' x 300'	10	LINEAL FEET
SEPARATOR ROW MATERIALS LIST		
CULTEC NO. 410 NON-WOVEN GEOTEXTILE 7.5' x 300' (TO WRAP SEPARATOR ROW)	14.22	SQ. YDS
CULTEC NO. 66 WOVEN GEOTEXTILE 7.5' x 300' (BENEATH SEPARATOR ROW)	0.20	ROLLS

CULTEC RECHARGER® 330 XLHD LEGEND

- RECHARGER 330XLSHD STARTER
- RECHARGER 330XLIHD INTERMEDIATE
- RECHARGER 330XLEHD END
- CULTEC NO. 66 WOVEN GEOTEXTILE
- CULTEC NO. 410 NON-WOVEN GEOTEXTILE

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NO	DATE	DESCRIPTION	CKD
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2	6/4/17	95% REVIEW	RR

WATERSTONE ENGINEERING
INNOVATIVE STORMWATER MANAGEMENT
9 GRETA'S WAY
STRATHAM, NH 03885
(p) 603.686.2488

95% DESIGN FOR WATER INTEGRATION FOR SQUAMSCOTT - EXETER (WISE) INTEGRATED PLAN (IP) PHASE 1

LINCOLN STREET SUBWATERSHED NUTRIENT CONTROL STRATEGIES

PREPARED FOR:
TOWN OF EXETER
DEPT. OF PUBLIC WORKS
11 NEWFIELDS ROAD

DESIGNED BY:	RR
DRAFTED BY:	CDS
CHECKED BY:	RR

STATE OF NEW HAMPSHIRE ROBERT M. ROSEEN No. 12215 LICENSED PROFESSIONAL ENGINEER

BIOFILTER
BMP-5
DETAILS

JOB #:	16928
SCALE:	AS SHOWN
CONTRCT #:	N/A

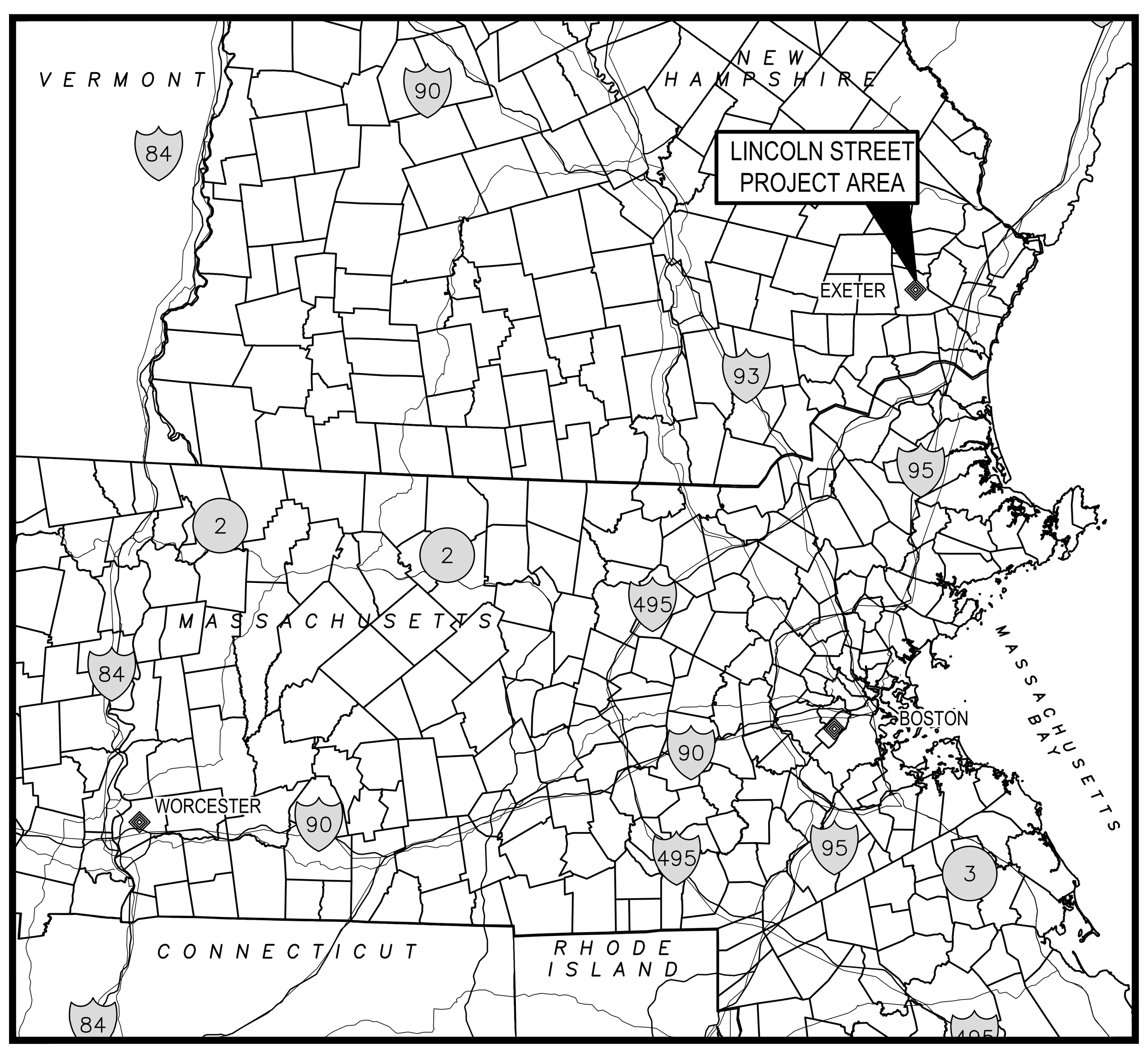
D5

Appendix I: 95% BMP Design Package

95% DESIGN
FOR
WATER INTEGRATION FOR SQUAMSCOTT - EXETER (WISE) INTEGRATED PLAN (IP)

PHASE 1: LINCOLN STREET SUBWATERSHED
NUTRIENT CONTROL STRATEGIES

PREPARED FOR
TOWN OF EXETER, NEW HAMPSHIRE



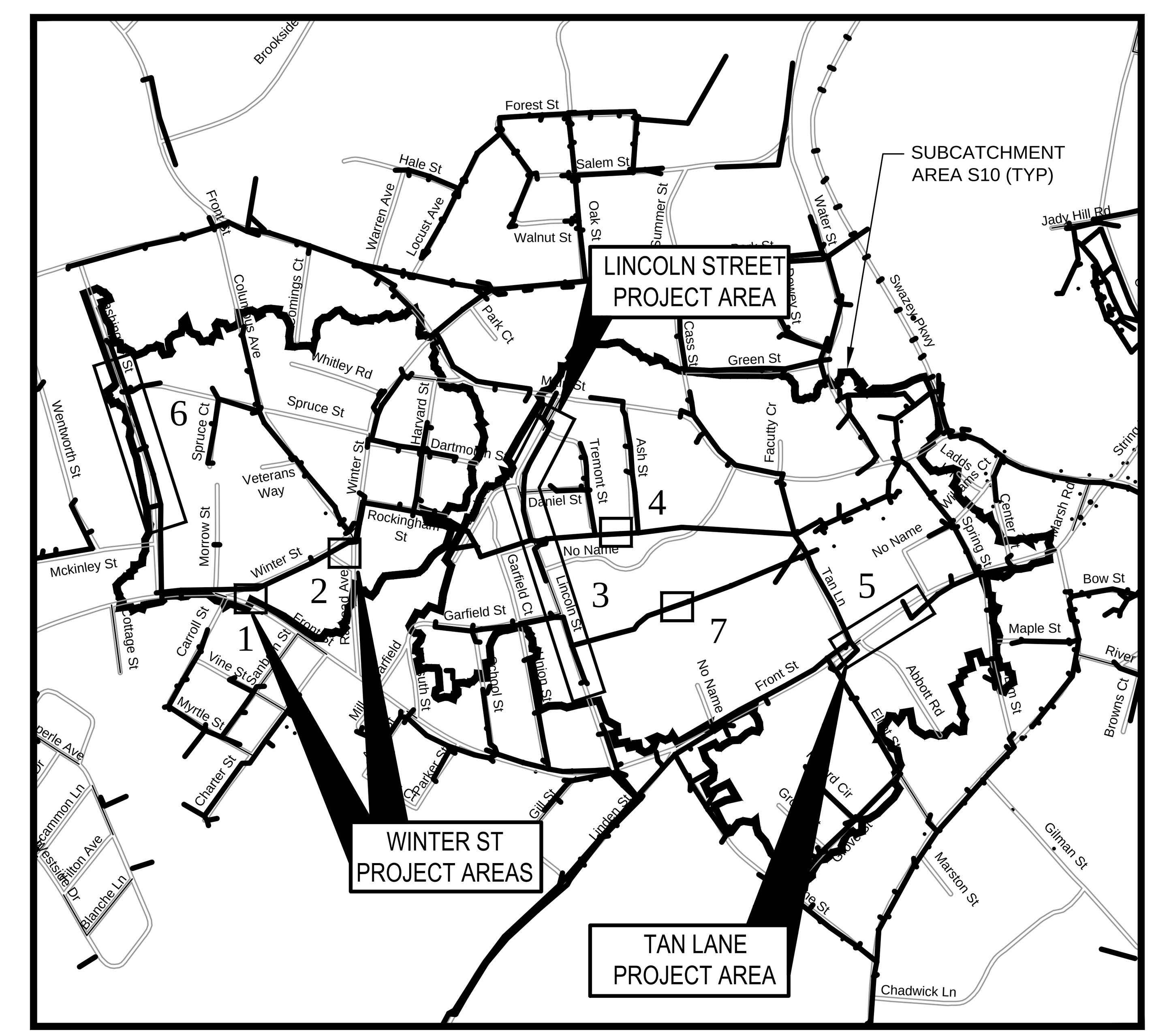
VICINITY MAP
NOT TO SCALE

OWNER:
TOWN OF EXETER
PAUL VLASICH
TOWN ENGINEER
11 NEWFIELDS ROAD

GRANT MANAGER:
SALLY SOULE
NH DEPARTMENT OF ENVIRONMENTAL SERVICES
PORTSMOUTH, NH 03881

FUNDED BY:
NH DEPARTMENT OF ENVIRONMENTAL SERVICES
COASTAL PROGRAM

DIG SAFE:
CONTACT DIG SAFE AT 811
HOURS PRIOR TO ANY CONSTRUCTION.



LOCATION MAP
NOT TO SCALE

NOTES: UNDERGROUND FACILITIES, STRUCTURES, AND UTILITIES HAVE BEEN PLOTTED FROM AVAILABLE SURVEYS AND RECORDS, AND THEREFORE THEIR LOCATIONS MUST BE CONSIDERED APPROXIMATE ONLY. THERE MAY BE OTHERS, THE EXISTENCE OF WHICH IS PRESENTLY NOT KNOWN. ANYONE USING UTILITY INFORMATION AND DATA PROVIDED HEREIN SHALL CALL DIG SAFE AT 811 SEVENTY TWO (72) HOURS, 3 BUSINESS DAYS IN ADVANCE TO VERIFY THE LOCATION OF UTILITIES PRIOR TO START OF CONSTRUCTION.

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NO	DATE	DESCRIPTION	CKD
1	4/9/17	35% REVIEW	RR
2	6/4/17	95% REVIEW	RR

WATERSTONE ENGINEERING
INNOVATIVE STORMWATER MANAGEMENT
9 GRETA'S WAY
STRATHAM, NH 03885
(p) 603.686.2488

95% DESIGN FOR WATER INTEGRATION FOR SQUAMSCOTT - EXETER (WISE) INTEGRATED PLAN (IP) PHASE 1
LINCOLN STREET SUBWATERSHED NUTRIENT CONTROL STRATEGIES

PREPARED FOR:
TOWN OF EXETER
DEPT. OF PUBLIC WORKS
11 NEWFIELDS ROAD

DESIGNED BY:	RR
DRAFTED BY:	CDS
CHECKED BY:	RR

STATE OF NEW HAMPSHIRE
ROBERT M. ROSEEN
No. 12215
LICENSED PROFESSIONAL ENGINEER

COVER SHEET AND VICINITY MAPS

JOB #:	16928
SCALE:	AS SHOWN
CONTRCT #:	N/A

G1

LEGEND - EXISTING

(EXISTING - PHASE 1)

SMH	SEWER MANHOLE
DMH	DRAINAGE MANHOLE
	GRATED INLET
CB	CATCH BASIN
CBCI	CATCH BASIN WITH CURB INLET
TMH	TELEPHONE MANHOLE
	TELEPHONE POLE
	UTILITY POLE
	LIGHT POLE
	SPOT LIGHT
EMH	ELECTRIC MANHOLE
	SURVEY MONUMENT
	PULL BOX
	WHEELCHAIR RAMP (WCR)
	BOLLARD
	SIGN
	VERTICAL BENCHMARK
	SHRUB
	TREE
	CURB STOP
SG	SEWER GATE
	FIRE HYDRANT
WMH	WATER MANHOLE
WG	WATER GATE

	CONTOUR MAJOR
	CONTOUR MINOR
W	WATER LINE
G	GAS MAIN
T	UNDERGROUND TELEPHONE OR ELECTRIC
D	STORM DRAINAGE PIPE
	OVERHEAD ELECTRIC
	FENCE
	TREE LINE
	PROPERTY LINE OR RIGHT-OF-WAY
VS	SANITARY VACUUM SEWER
S	SANITARY GRAVITY SEWER
FM	SANITARY SEWER FORCE MAIN
	STONE WALL
	RETAINING WALL
GC	GRANITE CURB
VP1 OR VP2	VALVE PIT TYPE 1 OR TYPE2
SBT OR DBT	SINGLE OR DUAL BUFFER TANK

LEGEND - EXISTING

(EXISTING - SURVEYED AREAS)

	ABUTTERS LINE (PER TOWN OF EXETER GIS)
	STOCKADE FENCE
V	PICKET FENCE
<>	POST & RAIL FENCE
	CHAIN LINK FENCE
OHW	OVERHEAD WIRES
S	SEWER LINE
D	DRAIN LINE
G	GAS LINE
W	WATER LINE
100	MAJOR CONTOUR LINE
98	MINOR CONTOUR LINE
	TREE LINE
	SHRUB LINE
	UTILITY POLE
	UTILITY POLE & GUY WIRE
	SIGN
	GRANITE BOUND FOUND
	IRON PIPE/ROD FOUND
	POST
HYD	FIRE HYDRANT
WV	WATER GATE VALVE
WSO	WATER SHUTOFF VALVE
GV	GAS GATE VALVE
GSO	GAS SHUTOFF VALVE
GM	GAS METER
	MAIL BOX
	CATCH BASIN (ROUND)
	CATCH BASIN
	DRAIN MANHOLE
	MANHOLE
	ELECTRIC MANHOLE
	TELEPHONE MANHOLE
	WATER MANHOLE
	SEWER MANHOLE
	BOULDER

	TREE STUMP
	CONIFEROUS TREE
	DECIDUOUS TREE
	CONIFEROUS SHRUB
	DECIDUOUS BUSH
	BORING
	PEDESTRIAN MAT
	CONCRETE
	LANDSCAPED AREA
	CRUSHED STONE
	BRICK
TYP.	TYPICAL
EP	EDGE OF PAVEMENT
SWL	SINGLE WHITE LINE
SYL	SINGLE YELLOW LINE
DYL	DOUBLE YELLOW LINE
CONC.	CONCRETE
VGC	VERTICAL GRANITE CURB
SGC	SLOPED GRANITE CURB
CC	CONCRETE CURB
BB	BITUMINOUS BERM
TM63/L19	TAX MAP & LOT NUMBER

MATERIAL LEGEND

- INFILTRATION CHAMBER
- BRICK SIDEWALK WITH PATTERN TO MATCH EXISTING
- CONCRETE SIDEWALK
- CONCRETE PAVING
- GRASS
- STANDARD "HMA" PAVEMENT
- BIORETENTION SWALE
- TREE PLANTER
- ROW - INFILTRATION GRASSED
- ROW INFILTRATION - TREE TRENCH

DRAWING LIST (CONT)

DRG No.	DRAWING TITLE
GENERAL	
16928-G1	COVERSHEET , VICINITY AND LOCATION MAPS
16928-G2	LEGENDS, NOTES AND DRAWING INDEX
16928-G3	ABBREVIATIONS AND LEGENDS
16928-G4	NOTES, ABUTTERS LISTS AND DRAINAGE STRUCTURE TABLES
EROSION AND SEDIMENTATION CONTROL	
16298-ES1	EROSION AND SEDIMENTATION CONTROL DETAILS AND NOTES
CIVIL	
16928-C1	EXISTING CONDITIONS PLAN WITH PROPOSED - PLAN 1 LINCOLN STREET NORTH
16928-C2	EXISTING CONDITIONS PLAN WITH PROPOSED - PLAN 2 LINCOLN STREET SOUTH
16928-C3	EXISTING CONDITIONS PLAN WITH PROPOSED - PLAN 3 WINTER STREET
16928-C4	EXISTING CONDITIONS PLAN WITH PROPOSED - PLAN 4 FRONT STREET
DETAILS	
16928-D1	BIOFILTER BMP-1 AND DETAILS
16928-D2	BIOFILTER BMP-2 AND DETAILS
16928-D3	RIGHT-OF-WAY INFILTRATION DETAILS
16928-D4	TREE PLANTER AND BIOSWALE DETAILS
16928-D5	BIOFILTER BMP-5 AND DETAILS
16928-D6	MISCELLANEOUS DETAILS-1
16928-D7	MISCELLANEOUS DETAILS-2
16928-D8	CULTEC DETAILS

LEGEND - PROPOSED

(ALL PHASES)

1+00	ROADWAY BASELINE
	EDGE OF POROUS PAVEMENT
	GRANITE CURBING
	CAPE COD BERM
	LIMIT OF STONE RESERVOIR TRENCH
	EDGE TRANSITION DETAIL
S	REMOVE AND RESET PARKING METER
D	REMOVE AND RESET PARKING METER
D	HDPE DRAIN PIPE
	HDPE CAP
	CATCH BASIN
	CATCH BASIN WITH TIP DOWN DETAIL
	DRAIN MANHOLE

UTILITY OPERATING AUTHORITIES	
DRAIN/SEWER/WATER	TOWN OF EXETER
TELEPHONE	VERIZON
ELECTRIC	UNITIL

DRAINAGE NOTES:

1. ALL DRAINAGE PIPING SHALL BE 12" INSIDE DIAMETER CORRUGATED HDPE TYPE N-12 PIPE MANUFACTURED BY ADS OR EQUAL SUITABLE FOR H-20 LOADING AT MINIMUM BURIED DEPTH OF 24" UNLESS OTHERWISE NOTED. PIPE SHALL BE SUPPLIED IN 20 FT LENGTHS. JOINTS SHALL BE SOIL TIGHT PUSH ON JOINTS.
2. FINAL LOCATION OF ALL DRAINAGE STRUCTURES TO BE COORDINATED WITH RESIDENT PROJECT REPRESENTATIVE PRIOR TO STARTING WORK.
3. PIPE SHALL BE SLOPED AT A MINIMUM OF 1.0% UNLESS OTHERWISE NOTED.
4. CONTRACTOR IS RESPONSIBLE FOR VERIFYING ALL UTILITIES PRIOR TO EXCAVATION, INCLUDING UTILITIES NOT MARKED BY DIG-SAFE (811), NOT SHOWN ON THE SURVEY, OR NOT MARKED BY THE TOWN. CONTRACTOR IS RESPONSIBLE FOR ANY AND ALL DAMAGES IF AN UNDERGROUND UTILITY IS DAMAGED DURING THE COURSE OF CONSTRUCTION.
5. IN THE EVENT THAT ANY UTILITY, UNDERGROUND OR OVERHEAD, IS DAMAGED DURING CONSTRUCTION, CONTRACTOR SHALL IMMEDIATELY NOTIFY ENGINEER AND THE APPROPRIATE UTILITY COMPANY.
6. ALL CONNECTIONS BETWEEN PRECAST CONCRETE SECTIONS SHALL BE SEALED WITH NON-SHRINK GROUT.
7. CATCH BASINS, INLETS & INFILTRATION BEDS SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE STATE DEPARTMENT OF TRANSPORTATION AND ENVIRONMENTAL SERVICES UNLESS OTHERWISE NOTED.
8. ALL PRECAST CONCRETE STRUCTURES SHALL BE RATED FOR AASHTO/H-20 LOADING.
9. ALL MATERIALS USED AND CONSTRUCTION METHODS EMPLOYED ARE TO BE IN ACCORDANCE WITH THE LATEST FEDERAL, STATE AND TOWN REGULATIONS.
10. CONTRACTOR IS RESPONSIBLE FOR DETERMINING DEPTH OF GROUNDWATER AND FOR ALL COSTS ASSOCIATED WITH DEWATERING NECESSARY TO INSTALL STRUCTURES OR PIPING.
11. 13. ANY UNSUITABLE MATERIAL ENCOUNTERED DURING EXCAVATION (ORGANICS, PEAT, ETC.) FOR DRAINAGE STRUCTURES SHALL BE DISPOSED OF BY THE CONTRACTOR AT THEIR EXPENSE. CONTRACTOR IS RESPONSIBLE FOR PROVIDING SUITABLE CLEAN BACKFILL FOR BACKFILL AND COMPACTION.
12. 14. ALL GATE BOXES, PULL BOXES, CATCH BASIN GRATES AND OTHER UTILITY COVERS SHALL BE RAISED AS NEEDED TO BE FLUSH WITH THE TEMPORARY AND FINAL PAVING IF APPLICABLE.

GENERAL NOTES:

1. THIS PROJECT HAS BEEN FINANCED BY A DES COASTAL PROGRAM PLANNING GRANT.
2. THE LOCATIONS OF THE BUILDINGS AND PROPERTY LINES WERE TAKEN FROM TOWN SUPPLIED GIS FILES AND SUPPLEMENTED BY THE FIELD SURVEY, REFERENCED BELOW, PERFORMED BY DOUCET LAND SURVEYORS, INC.
3. THE CONTRACTOR SHALL BE RESPONSIBLE FOR DETERMINING FINAL LOCATION AND DEPTH OF ALL UTILITIES.
4. THE CONTRACTOR SHALL CONTACT UTILITY COMPANIES WHEN EXCAVATING IN THE VICINITY OF EXISTING UTILITIES. CONTRACTOR SHALL BE RESPONSIBLE FOR THE REPAIR OF ANY EXISTING UTILITIES DAMAGED DUE TO HIS OPERATION.
5. THE CONTRACTOR SHALL STRUCTURALLY SUPPORT AND/OR PROTECT WATER MAIN, GAS, STORM SEWER, SANITARY SEWER OR ANY OTHER EXISTING UTILITIES WHERE NECESSARY IN ACCORDANCE WITH UTILITY OWNER'S REQUIREMENT WHEN EXCAVATING ADJACENT TO OR CROSSING THAT UTILITY.
6. CONTRACTOR SHALL NOTIFY ENGINEER IMMEDIATELY OF ANY INTERFERENCE WITH EXISTING UTILITIES AND THE NEW UTILITIES. IF NEW WORK NEEDS TO BE MOVED OR RELOCATED DUE TO A FIELD CHANGE (EXISTING UTILITIES, TREES, OWNER REQUEST, ETC.) COST FOR RELOCATION SHALL BE INCLUDED IN THE INDIVIDUAL BID ITEM BASED ON THE QUANTITY OF ACTUAL MATERIAL INSTALLED.
7. CONTRACTOR SHALL BE RESPONSIBLE FOR SUPPORT OF ALL EXCAVATIONS, AS REQUIRED, INCLUDING SHEETING OR BRACING, OR OTHER METHOD APPROVED BY ENGINEER.
8. ALL EXISTING ITEMS, INCLUDING BUT NOT LIMITED TO LANDSCAPING, CURBING AND SIDEWALKS DAMAGED BY THE CONTRACTOR SHALL BE RESTORED TO ORIGINAL CONDITIONS AT THE CONTRACTORS EXPENSE.
9. WHEN THE CONTRACTOR DISTURBS AN AREA WITHIN 5' OF A UTILITY POLE, THE CONTRACTOR SHALL SUPPORT THAT POLE IN ACCORDANCE WITH UTILITY OWNER'S REQUIREMENTS AT NO ADDITIONAL COST TO THE OWNER.
10. LIMIT OF WORK SHALL BE WITHIN THE PUBLIC RIGHT OF WAY OR AS SHOWN ON THE DRAWINGS.
11. PROPOSED CONDITIONS SHOWN HEAVY. EXISTING CONDITIONS SHOWN LIGHT.
12. ALL PAVEMENT TO BE SAW-CUT.
13. NOT ALL OVERHEAD WIRES AND POWER LINES ARE SHOWN ON THE DRAWINGS. THE CONTRACTOR SHALL FIELD VERIFY LOCATIONS BEFORE CONSTRUCTION COMMENCES.
14. FOR CLARITY PROFILES DO NOT SHOW UTILITIES.
15. PRIOR TO SUBMITTING HIS/HER BID THE CONTRACTOR SHALL VISIT THE SITE TO IDENTIFY AND DOCUMENT WHAT EXISTING CONDITIONS ARE PRESENT ALONG THE STREETSCAPE CORRIDOR AS THESE WILL BE IMPORTANT FOR THE SATISFACTORY COMPLETION OF THE PROJECT.
16. NEW SITE GRADES AND ELEVATIONS SHALL BE ESTABLISHED FROM THE ACTUAL EXISTING ELEVATIONS THAT BORDER EACH SECTION OF THE WORK ZONE. THESE ELEVATIONS MAY BE AT STEP BASES, WALK SURFACES, AND EXISTING EARTH AND GARDEN AREAS.
17. THE RECONSTRUCTED STREET PAVEMENT SHALL BE GRADED SO THAT SURFACE DRAINAGE PITCHES TO THE NEW DRAINS. INLETS TO BE SET AT A DESIRED GRADE OF 2 PERCENT, WITH A MINIMUM GRADE OF 1 PERCENT. IN SOME AREAS THE SURFACE GRADE OF THE STREET MAY EXCEED 2 PERCENT BUT SHALL NOT EXCEED 3 PERCENT ON A CROSS PITCH ACROSS THE STREET PAVEMENT.
18. NEW DRAIN INLETS SHALL HAVE THEIR RIM ELEVATIONS SET TO WORK WITH THE REBUILT STREET GRADES.
19. AT ALL TIMES THE CONTRACTOR SHALL MAINTAIN A SMOOTH CURB LINE THAT FUNCTIONS WITH THE SIDEWALK AND STREET GRADES AND IS WITHOUT SHARP BREAKS, HUMMOCKS, AND HOLLOWS. THE FINAL SURFACE OF THE SIDEWALK SHALL HAVE AN EVEN GRADIENT ALONG THE LINE OF THE STREETSCAPE AS WELL AS FROM SIDE TO SIDE AND SHALL FUNCTION WITH A STREET PAVEMENT THAT HAS THE SAME CHARACTER.

This Drawing shall not be used for Construction unless Signed and Sealed For Construction.

NO	DATE	DESCRIPTION	CKD
1	4/9/17	35% REVIEW	RR
2	6/4/17	95% REVIEW	RR

WATERSTONE ENGINEERING
INNOVATIVE STORMWATER MANAGEMENT
9 GRETA'S WAY
STRATHAM, NH 03885
(p) 603.686.2488

95% DESIGN FOR WATER INTEGRATION FOR SQUAMSCOTT - EXETER (WISE) INTEGRATED PLAN (IP) PHASE 1

LINCOLN STREET SUBWATERSHED NUTRIENT CONTROL STRATEGIES

PREPARED FOR:
TOWN OF EXETER
DEPT. OF PUBLIC WORKS
11 NEWFIELDS ROAD

DESIGNED BY: RR
DRAFTED BY: CDS
CHECKED BY: RR

STATE OF NEW HAMPSHIRE - ROBERT M. ROSEEN No. 12215 LICENSED PROFESSIONAL ENGINEER

LEGENDS, NOTES AND DRAWING INDEX

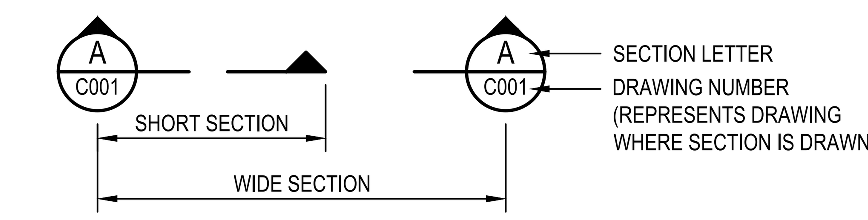
JOB #: 16928
SCALE: AS SHOWN
CONTRCT #: N/A

G 2

LIST OF ABBREVIATIONS - PROPOSED

AB	ANCHOR BOLT
AC	ASBESTOS CEMENT
ACOUS	ACOUSTICAL (SOUND DEADENING)
ACTL	ACOUSTIC TILE
ADD'L	ADDITIONAL
ADJ	ADJUSTABLE
AFF	ABOVE FINISHED FLOOR
AGGR	AGGREGATE
ALLOW	ALLOWANCE
ALT	ALTERNATE
ALUM	ALUMINUM
APPROX	APPROXIMATE
ARCH	ARCHITECT OR ARCHITECTURAL
AS	AUTOMATED SAMPLER
ASB	ASBESTOS
ASPH	ASPHALT
ASSY	ASSEMBLY
AST	ASPHALT TILE
ATPB	ASPHALT TREATED PERMEABLE BASE
BCV	BUTTERFLY CONTROL VALVE
BF	BLIND FLANGE
BIT	BITUMINOUS
BL or ℄	BUILDING LINE
BLDG	BUILDING
BLK	BLOCK
BM	BENCH MARK\ BEAM
BO	BOARD
BOF	BOTTOM OF FOOTING
BOT or B	BOTTOM
BP	BASE PLATE
BRG	BEARING
BRK	BRICK
BRZ	BRONZE
BTW	BETWEEN
BU	BUILT UP
CABN	CABINET
CB	CATCH BASIN
CC	CENTER TO CENTER
CEM	CEMENT
CER	CERAMIC
CF	CUBIC FEET
CFM	CUBIC FEET PER MINUTE
CI	CAST IRON
CIP	CAST IRON PIPE
CIRC	CIRCLE, CIRCULAR or CIRCUMFERENCE
℄	CENTER LINE
CL2	CHLORINE
CL or CLR	CLEAR
CLG	CEILING
CLKG	CAULKING
CLF	CHAIN LINK FENCE
CL JT	CONTROL JOINT
CMH	CHEMICAL MANHOLE
CMP	CORRUGATED METAL PIPE
CMU	CONCRETE MASONRY UNIT
CS JT	CONSTRUCTION JOINT
CO	CLEANOUT
COL	COLUMN, COLOR
COMBN	COMBINATION
CONC	CONCRETE
CONN	CONNECTION
CONST	CONSTRUCTION
CONT	CONTINUOUS
CONTR	CONTRACTOR
COND	CONDUIT
COR	CORRIDOR
COORD	COORDINATE
CP	CONCRETE PLANK
CPLG	COUPLING
CPVC	CHLORINATED POLYVINYL CHLORIDE
CRF	CHEMICAL RESISTANT FINISH
CRS	COURSE
CT	CERAMIC TILE
CTR	CONTRACT
CTRD	CENTERED
CTS	COPPER TUBE SIZE
CU	COPPER
CU IN	CUBIC INCH
CV	CHECK VALVE
CW	COLD WATER/ CIRCULAR WASHER
CY	CUBIC YARD
DJ	DOUBLE JOINT
DL	DEAD LOAD
DET	DETAIL
DIA, Ø	DIAMETER
DIAG	DIAGONAL
DEFL	DEFLECTION
DIM	DIMENSION
DIST	DISTRIBUTION, DISTANCE
DI	DUCTILE IRON
DOZ	DOZEN
DN	DOWN
DR	DOOR
DWG	DRAWING
DWL	DOWEL
DH	DECK HYDRANT
DMH	DRAINAGE MANHOLE
E	EAST
EA	EACH
EF	EACH FACE
EJ	EXPANSION JOINT
EW	EACH WAY
ECC	ECCENTRIC
EFF	EFFLUENT
EL or ELEV	ELEVATION
ELB	ELBOW
ELEC	ELECTRIC
ENAM	ENAMEL
ENG	ENGINE
ENGR	ENGINEER
ENT	ENTRANCE
EQUIP	EQUIPMENT
EQ or EQUIV	EQUAL or EQUIVALENT
EX, EXIST	EXISTING
EXC	EXCAVATE
EXH	EXHAUST
EXP	EXPANSION
EXT	EXTERIOR
EXTEND OPER	EXTENDED OPERATOR
EXTR	EXTRUDE
FA	FLANGE ADAPTER
FC	FOOT CANDLE/ FLUSHING CONNECTION
FD	FLOOR DRAIN/ FIRE DOOR
FE	FIRE EXTINGUISHER
FF	FAR FACE/ FINISHED FLOOR
FG	FIBERGLASS
FAB	FABRICATE
FND	FOUNDATION
FIN	FINISH
FIN RAD	FIN RADIATOR
FITG	FITTING
FIX	FIXTURE
FL	FLASHING/ FLANGE
FLX CON	FLEXIBLE CONTAINMENT TUBE
FLG	FLOORING
FLR	FLOOR
FLOUR	FLUORESCENT
FOC	FACE OR COLUMN
FPRF	FIREPROOF
FRP	FIBERGLASS REINFORCED PLASTIC
FS	FOOTING STEP
FST	FINAL SETTLING TANK
FT	FEET
FTG	FOOTING
FURR	FURRING/ FURRED
F&C	FRAME AND COVER
F&G	FRAME AND GRATING
GC	GENERAL CONTRACTOR
GI	GALVANIZED IRON
GPM	GALLONS PER MINUTE
GV	GATE VALVE
GWF	GLAZED WALL FINISH
GA	GAUGE
GAL	GALLON
GALV	GALVANIZED
GEN	GENERATOR
GL	GLASS
GR	GRADE
GRAN	GRANITE
GRTG	GRATING
GYP	GYPSUM
GYP BD	GYPSUM BOARD
GMU	GLAZED MASONRY UNIT
HVAC	HEATING and VENTILATION
HD	HEAVY DUTY
HDPE	HIGH DENSITY POLYETHYLENE
HDBD	HARDBOARD
H EXCH	HEAT EXCHANGER
HWL	HIGH WATER LEVEL
HDWR	HARDWARE
HGT or HT	HEIGHT
HM	HOLLOW METAL
HMA	HOT MIX ASPHALT
H or HORIZ	HORIZONTAL
HP	HORSEPOWER
H PT	HIGH POINT
HTR	HEATER
HSC	HYDRAULIC SYSTEM CENTER
HYD	HYDRANT
I	IRON
'I'	INLET
IF	INSIDE FACE
ID	INSIDE DIAMETER
INCIN	INCINERATOR
INCL	INCLUDE
INSUL	INSULATION
INT	INTERIOR
INV	INVERT
IPS	INTERNAL PIPE SIZE
ISO	ISOLATION
I/O	INPUT/ OUTPUT
JCT	JUNCTION
JST	JOIST
JT	JOINT
JAN CLO	JANITOR'S CLOSET
K	1,000 POUNDS (1 KIP)
KC	KEENE'S CEMENT
KGF	KNIFE GATE VALVE
L	ANGLE
LE	LEFT END
LF	LINEAR FEET
LL	LIVE LOAD
LLV/ (H)	LONG LEG VERT./ (HOR.)
LWL	LOW WATER LEVEL
LAM	LAMINATE
LAV	LAVATORY
LT WT	LIGHTWEIGHT
LG	LENGTH/ LONG
L PT	LOW POINT
LT	LIGHT
LV	LOUVER
M	MOTOR
MCC	MOTOR CONTROL CENTER
MGD	MILLION GALLONS PER DAY
MH	MANHOLE
MJ	MECHANICAL JOINT
MO	MASONRY OPENING
MAS	MASONRY
MATL	MATERIAL
MAX	MAXIMUM
MECH	MECHANICAL
MEMB	MEMBRANE
MTL	METAL
MEZZ	MEZZANINE
MFR	MANUFACTURER
MIN	MINIMUM
MIR	MIRROR
MISC	MISCELLANEOUS
MMH	METHANOL MANHOLE
MTD	MOUNTING
MULT	MULTIPLE
N	NORTH
NF	NEAR FACE
NIC	NOT IN CONTRACT
NPT	NATIONAL PIPE THREAD
NTS	NOT TO SCALE
No. or #	NUMBER
NOM	NOMINAL
NAT	NATURAL
NS	NO SMOKING
OF	OVERFLOW STRUCTURE
OC	ON CENTER
OD	OUTSIDE DIAMETER
OF	OUTSIDE FACE
OT	OPEN TRUSS
OPNG	OPENING
OPP	OPPOSITE
ORIG	ORIGINAL
OPER	OPERABLE
P&ID	PROCESS INSTRUMENTATION DIAGRAM
PCF	POUNDS PER CUBIC FOOT
PRV	PRESSURE RELIEF VALVE
PSF	POUNDS PER SQUARE FOOT
PV	PLUG VALVE
PSI	POUNDS PER SQUARE INCH
POLY, PE	POLYETHYLENE
PAR	PARALLEL
PARTN	PARTITION
PAT	PATTERN
PAVT	PAVEMENT
PC	PIECE
PDC	POWER DISTRIBUTION CENTER
PERF	PERFORATED
PERP	PERPENDICULAR
PIV	PINCH VALVE
℘	PLATE/ PROPERTY LINE
PLAST	PLASTER
PLAS LAM	PLACTIS LAMINATE
PLBG	PLUMBING
PLE	PLANT EFFLUENT
PLR	PILASTER
PLYWD	PLYWOOD
PNL	PANEL
POR	PORCELAIN
PR	PAIR
PREFAB	PREFABRICATED
PROP	PROPOSED
PT	POINT/ PAINT
PVC	POLYVINYL CHLORIDE
QT	QUARRY TILE
QTY	QUANTITY
R	RISER, REACTION, RADIUS
RD	ROOF DRAIN\ ROAD
RO	ROUGH OPENING
ROB	RUN OF BANK
RAD	RADIUS/ RADIATOR
RE	RIGHT END
REC	RECESS/ RECORD
RECIR	RECIRCULATION
RED	REDUCER
REF	REFERENCE/ REFRIGERATOR
RCP	REINFORCED CONCRETE PIPE
REG	REGISTER
REINF	REINFORCING
REM	REMOVE
REP	REPAIR
REQ'D	REQUIRED
REV	REIVISE
RF	ROOF
RFG	ROOFING
RL	ROOF LEADER
RM	ROOM
RUBB	RUBBER
RES FLR	RESILIENT FLOORING
S	SOUTH
'S'	SUCTION
SCC	SYSTEM CONTROL CENTER
SF	SQUARE FOOR
SJ	STEEL JOINT
SP	STOP PLATE
SS	STAINLESS STEEL
SWD	SIDE WATER DEPTH
SADL	SADDLE
SCH	SCHEDULE
SECT	SECTION
SEL	SELECTION
SH	SHEET
SIM	SIMILAR
SMP	SUMP PUMP
SOI	SPRAYED ON INSULATION
SPEC	SPECIFICATION
SQ	SQUARE
ST	STREET
STAT	STATION
STL	STEEL
STL JST	STEEL JOIST
STOR	STORAGE
STD	STANDARD
STIRR	STIRRUPS
STRUC	STRUCTURAL or STRUCTURE
SUR	SURFACE
SUS	SUSPENDED/ SUSPENSION
SYM	SYMMETRICAL
SYP	SOUTHERN YELLOW PINE
SCP	STRUCTURAL CLAY PIPE
SV	SOLENOID VALVE
T	TILE, TREAD or TOP
TDH	TOTAL DYNAMIC HEAD
T/B	TOP OF BERM
T/D	TOP OF DECK
T/FTG	TOP OF FOOTING
T/G	TOP OF GROUT
T/GRTG	TOP OF GRATING
T/MAS	TOP OF MASONARY
T/S	TOP OF SLAB
T/STL	TOP OF STEEL
T/W	TOP OF WALL
THK	THICK
T&B	TOP AND BOTTOM
T&G	TONGUE AND GROOVE
TEL	TELEPHONE
TEMP	TEMPERATURE
TR	TOILET ROOM
TOL	TOLERANCE
TRANS	TRANSFORMER
TK	TANK
TYP	TYPICAL
UNO	UNLESS NOTED OTHERWISE
UR	URINAL
UV	ULTRAVIOLET
V	VINYL or VERTICAL
VAT	VINYL ASBESTOS TILE
VT	VITRIFIED TILE
VERT	VERTICAL
VS	VACUUM SEWER
W	WATER
W/	WITH
WAS	WAS LINE
WI	WROUGHT IRON
WG	WEIR GATE
WL	WATER LEVEL
WO	WINDOW OPENING
W/O	WITHOUT
WS	WATER SURFACE
WWF	WELDED WIRE FABRIC
WC	WATER CLOSET
WD	WOOD
WP	WORKING POINT
WS	WATERSTOP
WT	WEIGHT
W ST	WELDED STEEL PIPE
WV	WATER VALVE
WH	WALL HYDRANT
WP	WORKING POINT

TYPICAL SECTION MARKS (FOR PLANS)



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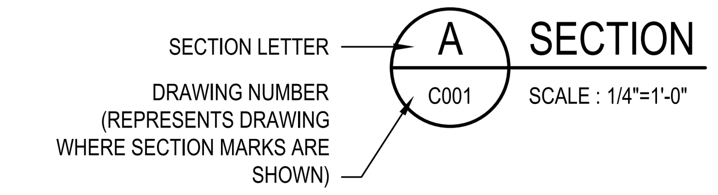
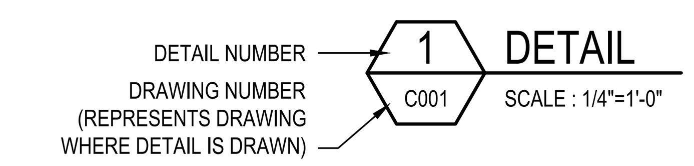


TYPICAL DETAIL MARKS



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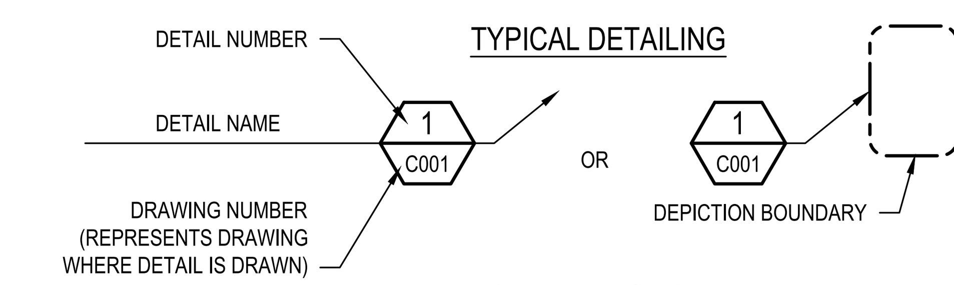


NORTH ARROWS

CIVIL DRAWINGS ONLY SHOW SURVEY NORTH

ALL DRAWINGS SHOW PROJECT/SURVEY NORTH

PROPOSED LEGEND

PROPOSED GRAPHICS; EQUIPMENT, STRUCTURES, ETC., ARE SHOWN AS BOLD LINEWORK AND IN THIS TEXT FORMAT.

EXISTING GRAPHICS; EQUIPMENT, CONDITIONS STRUCTURES, ETC. ARE SHOWN AS LIGHT LINEWORK AND IN THIS TEXT FORMAT.

This Drawing shall not be used for Construction unless Signed and Sealed For Construction.

NO	DATE	DESCRIPTION	CKD
1	4/9/17	35% REVIEW	RR
2	6/4/17	95% REVIEW	RR

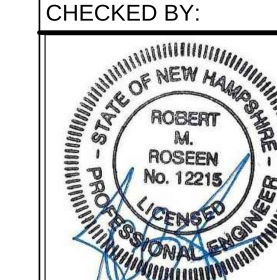
WATERSTONE ENGINEERING
INNOVATIVE STORMWATER MANAGEMENT
9 GRETA'S WAY
STRATHAM, NH 03885
(p) 603.686.2488

95% DESIGN FOR WATER INTEGRATION FOR SQUAMSCOTT - EXETER (WISE) INTEGRATED PLAN (IP) PHASE 1

LINCOLN STREET SUBWATERSHED NUTRIENT CONTROL STRATEGIES

PREPARED FOR:
TOWN OF EXETER
DEPT. OF PUBLIC WORKS
11 NEWFIELDS ROAD

DESIGNED BY: RR
DRAFTED BY: CDS
CHECKED BY: RR



ABBREVIATIONS AND LEGENDS

JOB #: 16928
SCALE: AS SHOWN
CONTRCT #: N/A

G3

STAGING AREA NOTES

1. FINAL STAGING AREA LOCATION TO BE DETERMINED WITH THE OWNER PRIOR TO CONSTRUCTION. THE CONTRACTOR IS RESPONSIBLE FOR SECURITY OF ALL MATERIALS AND EQUIPMENT.
2. ANY EXISTING PAVEMENT OR OTHER LANDSCAPED AREA DISTURBED DURING CONSTRUCTION SHALL BE RESTORED TO EQUAL OR BETTER CONDITION AT NO ADDITIONAL COST TO THE OWNER.

EROSION & SEDIMENTATION CONTROL NOTES

1. CONTRACTOR SHALL COMPLY WITH ALL LOCAL AND STATE REGULATIONS AS APPLICABLE FOR ROAD RECONSTRUCTION.
2. ALL EROSION AND SEDIMENTATION CONTROL MEASURES SHALL BE INSPECTED BY THE CONTRACTOR DAILY AND IMMEDIATELY AFTER PERIODS OF RAINFALL. REPAIR AND/OR MAINTENANCE OF SEDIMENTATION AND EROSION CONTROL MEASURES SHALL BE MADE PER THE ENGINEER'S REQUEST AND AS NEEDED. THE CONTRACTOR IS RESPONSIBLE FOR THE IMPLEMENTATION AND MAINTENANCE OF ALL CONTROL MEASURES ON THIS SITE.
3. FINAL LOCATION OF ALL SEDIMENTATION CONTROL MEASURES SHALL BE COORDINATED WITH THE TOWN CONSERVATION OFFICE PRIOR TO CONSTRUCTION.
4. LAND DISTURBANCE SHALL BE KEPT TO A MINIMUM. RESTABILIZATION WILL BE SCHEDULED IMMEDIATELY AFTER ANY DISTURBANCE.
5. SILT FENCES SHALL BE INSTALLED ALONG ANY GRASS ISLAND, WITHIN THE R.O.W., NOT PROTECTED BY CURBING.
6. ALL CATCH BASINS IN THE PROJECT AREA SHALL BE PROTECTED WITH FILTER BAG INSERTS THROUGHOUT THE CONSTRUCTION PERIOD AND UNTIL ALL DISTURBED AREAS ARE STABILIZED.
7. EROSION AND SEDIMENTATION CONTROL MEASURES SHALL BE INSTALLED PRIOR TO ANY CONSTRUCTION ACTIVITY.
8. COVER AND ANCHOR ALL TOPSOIL STOCK PILES WITH STRAW MULCH AND RING WITH SILT FENCE, OR HAY BALE BARRIER.
9. DURING CONSTRUCTION, ALL EXPOSED SLOPES THAT WILL NOT RECEIVE PERMANENT SURFACE TREATMENT IMMEDIATELY, AND ALL SOIL STOCKPILES SHALL BE TEMPORARILY SEEDED WITH A MIXTURE OF PERENNIAL RYEGRASS, ANNUAL RYEGRASS AND WINTER GRASS.
10. SEDIMENT REMOVAL FROM CONTROL STRUCTURES SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR. SEDIMENT SHALL BE DISPOSED OF IN A MANNER WHICH DOES NOT RESULT IN ADDITIONAL EROSION AND WHICH IS CONSISTENT WITH THE CONTRACT DOCUMENTS AND REGULATORY REQUIREMENTS. ALL SEDIMENT SHALL BE DISPOSED OF AT THE CONTRACTORS EXPENSE.
11. THE EROSION AND SEDIMENTATION CONTROL MEASURES DESCRIBED HEREIN ARE INTENDED AS A GENERAL GUIDE FOR THE CONTRACTOR. IT IS THE CONTRACTOR'S RESPONSIBILITY TO PROVIDE ANY AND ALL WORK NECESSARY TO PREVENT EROSION OF SOIL FROM THE CONSTRUCTION SITE. TO PREVENT EROSION, THE CONTRACTOR SHALL PROVIDE SILT FENCES OR OTHER CONTROL MEASURES AS THE NEED ARISES DURING CONSTRUCTION AT NO ADDITIONAL COST TO THE OWNER.
12. PAVED ROADWAYS SHALL BE KEPT CLEAN AT ALL TIMES.
13. A TEMPORARY CRUSHED STONE PAD OR ROADWAY SHALL BE CONSTRUCTED AT ALL NON-PAVED PARKING AREAS, HEAVY USE AREAS, OR ROADWAYS WHERE THERE IS NO EXISTING PAVEMENT, OR WHERE PAVEMENT HAS BEEN REMOVED.
14. CATCH BASINS NOT SHOWN ON SURVEY WITHIN THE CONTRACTOR'S STAGING AREA SHALL BE SUBJECT TO EROSION AND SEDIMENTATION CONTROL MEASURES.

CONSTRUCTION NOTES

1. ALL MATERIALS USED AND CONSTRUCTION METHODS EMPLOYED ARE TO BE IN ACCORDANCE WITH THE LATEST FEDERAL, STATE AND TOWN REGULATIONS.
2. NOT ALL EXISTING ITEMS (INCLUDING TREES, PLANTERS, HEDGES, SIDEWALKS, FENCE, GUIDE LINES, ETC.) ARE SHOWN ON DRAWINGS. HOWEVER THE CONTRACTOR SHALL BE RESPONSIBLE FOR ANY DAMAGE TO EXISTING ITEMS, INCLUDING BUT NOT LIMITED TO LANDSCAPING, CURBING AND SIDEWALKS. ALL DAMAGED ITEMS SHALL BE RESTORED TO THEIR EXISTING CONDITION OR BETTER AND AT NO ADDITIONAL COST TO THE OWNER.
3. THE CONTRACTOR SHALL REMOVE AND REPLACE ANY TREES DAMAGED BY HIS CONSTRUCTION OPERATIONS.
4. THE CONTRACTOR IS RESPONSIBLE FOR DETERMINING DEPTH OF GROUNDWATER AND FOR ALL COSTS ASSOCIATED WITH DEWATERING NECESSARY TO INSTALL PIPING.
5. THE CONTRACTOR SHALL LOCATE, MARK, SAFEGUARD AND PRESERVE ALL SURVEY CONTROL, R.O.W. MONUMENTS, AND INDIVIDUAL PROPERTY CORNER PINS/MONUMENTS IN THE AREA OF CONSTRUCTION. IF DAMAGED, THE CONTRACTOR SHALL REPLACE, AT NO ADDITIONAL COST TO OWNER, INCLUDING SURVEYED CERTIFICATION.
6. ALL OPEN TRENCH EXCAVATIONS TO BE PROTECTED BY TRENCH BOX, SHEET PILING OR OTHER METHOD APPROVED BY THE ENGINEER.
7. ALL PAVING SHALL BE MAINTAINED BY THE CONTRACTOR, AS-NEEDED THROUGHOUT CONSTRUCTION AND FOR ONE CALENDAR YEAR AFTER CONTRACT COMPLETION. ANY IMPERFECTIONS IN THE PAVEMENT, AS DETERMINED BY THE TOWN OF PROVINCETOWN OR THE ENGINEER, DURING THE GUARANTEE PERIOD SHALL BE RESTORED BY THE CONTRACTOR AT NO ADDITIONAL COST TO THE OWNER.

SURVEY NOTES

1. REFERENCE: LINCOLN STREET AREA EXETER, NH
2. FIELD SURVEY PERFORMED BY J.M.L. & L.P.S. OF DOUCET SURVEYING DURING 06/15 USING A TRIMBLE 5603 DR 200 PLUS TOTAL STATION WITH A TDS RANGER DATA COLLECTOR AND A SOKKIA B21 AUTO LEVEL TRAVERSE ADJUSTMENT BASED ON LEAST SQUARE ANALYSIS.
3. HORIZONTAL DATUM BASED ON NEW HAMPSHIRE STATE PLANE(2800) NAD83(2011) DERIVED FROM REDUNDANT GPS OBSERVATIONS UTILIZING THE KEYNETGPS VRS NETWORK.
4. VERTICAL DATUM IS BASED ON NGVD29 PER DISK B14 1934 ELEV.=37.67'.
5. THE ACCURACY OF MEASURED UTILITY INVERTS AND PIPE SIZES/TYPES IS SUBJECT TO NUMEROUS FIELD CONDITIONS, INCLUDING; THE ABILITY TO MAKE VISUAL OBSERVATIONS, DIRECT ACCESS TO THE VARIOUS ELEMENTS, MANHOLE CONFIGURATION, ETC.
6. UNDERGROUND UTILITIES MARKED BY TMD SERVICES AND THE TOWN OF EXETER DEPARTMENT OF PUBLIC WORKS.
7. EDGE OF SURVEY LIMIT LISTED WHERE LOCATIONS ARE APPROXIMATE AND BASED ON STATE AND TOWN GIS.

SEWER & DRAINAGE STRUCTURE TABLE

CB #1026
RIM ELEV.=47.7'
10" PVC INV.=43.1'

SMH #1028
RIM ELEV.=48.5'
(A) 8" CLAY INV.=43.9'
(B) NKN. INV.=44.0'
(#1084) 8" CLAY INV.=44.0'

CB #1072
RIM ELEV.=48.6'
12" PVC INV.=44.2'

SMH #1084
RIM ELEV.=49.0'
(A) 12" CLAY INV.=42.8'
(B) 8" CLAY INV.=42.8'
(C) 8" ASBESTOS INV.=44.5'
(#1028) 8" CLAY INV.=42.7'

DMH #1086
RIM ELEV.=49.0'
(A) 12" RCP INV.=41.9'
(B) 12" RCP INV.=41.8'
(C) 12" RCP INV.=41.9'

DMH #1091
RIM ELEV.=49.6'
(A) 12" RCP INV.=41.7'
(#1092) 12" RCP INV.=41.8'

CB #1092
RIM ELEV.=48.6'
(#1091) 12" RCP INV.=42.1'
(#1099) 12" RCP INV.=41.9'

CB #1099
RIM ELEV.=47.7'
(#1026) 10" PVC INV.=41.7'
(#1092) 12" RCP INV.=41.7'

CB #1114
RIM ELEV.=48.5'
12" RCP INV.=44.6'

DMH #1142
RIM ELEV.=48.9'
(#1033) 12" RCP INV.=44.7'
(#1144) 12" PVC INV.=41.7'
(#1224) 12" RCP INV.=41.6'

SMH #1143
RIM ELEV.=49.0'
(A) 8" CLAY INV.=45.8'
(B) 8" CLAY INV.=42.7'
(#1145) 10" PVC INV.=42.2'
(#1251) 12" CLAY INV.=42.2'

SMH #1145
RIM ELEV.=49.1'
(A) 10" PVC INV.=42.4'
(#1143) 10" PVC INV.=42.4'

CB #1154
RIM ELEV.=48.6'
6" CIP INV.=44.7'

DMH #1144
RIM ELEV.=49.0'
(A) 15" RCP INV.=41.5'
(#1114) 12" RCP INV.=43.9'
(#1142) 12" PVC INV.=41.6'
(#1159) 15" RCP INV.=41.6'

DMH #1159
RIM ELEV.=48.8'
(#1144) 21" RCP INV.=43.8'
(#1163) 21" RCP INV.=44.0'

CB #1163
RIM ELEV.=48.3'
(A) 21" RCP INV.=44.0'
(#1159) 21" RCP INV.=44.0'

CB #1199
RIM ELEV.=46.8'
(#1199) 12" CMP INV.=44.2'

CB #1219
RIM ELEV.=46.4'
(#1224) 12" RCP INV.=42.7'

DMH #1224
RIM ELEV.=46.7'
(A) 8" PVC INV.=41.8'
(#1143) 12" RCP INV.=43.2'
(#1199) 12" RCP INV.=43.2'
(#1219) 12" RCP INV.=41.9'

SMH #1251
RIM ELEV.=46.3'
(#1143) 12" CLAY INV.=40.9'
(#1317) 12" CLAY INV.=40.9'

SMH #1317
RIM ELEV.=45.8'
(UNABLE TO OPEN)

CB #1318
RIM ELEV.=45.3'
(#1323) 12" RCP INV.=42.2'

DMH #1323
RIM ELEV.=46.1'
(#1401) 12" RCP INV.=41.7'
(#1318) 12" RCP INV.=41.8'
(#1324) 12" RCP INV.=41.8'

CB #1324
RIM ELEV.=45.7'
(#1323) 12" PVC INV.=42.2'

SMH #1400
RIM ELEV.=47.7'
(#1317) 12" PVC INV.=38.8'
(#1427) UNKN. INV.=37.0'
(#1447) UNKN. INV.=36.9'

DMH #1401
RIM ELEV.=47.9'
(A) 15" RCP INV.=40.5'
(#1323) 12" RCP INV.=40.7'
(#1421) 12" RCP INV.=40.9'

MH #1402
RIM ELEV.=48.4'
WATER=42.6'
SUMP=38.1'

SMH #1416
RIM ELEV.=49.6'
(A) 12" PVC INV.=37.6'
(B) 10" PVC INV.=44.8'
(C) UNKN. INV.=38.0'
(#1427) 15" PVC INV.=37.5'

SMH #1419
RIM ELEV.=49.5'
(UNABLE TO OPEN)

SMH #1420
RIM ELEV.=49.5'
NO VISIBLE PIPES
SUMP=40.0'

DMH #1421
RIM ELEV.=49.3'
(A) 12" RCP INV.=42.1'
(#1401) 12" RCP INV.=41.9'

SMH #1427
RIM ELEV.=47.9'
(#1400) UNKN. INV.=37.3'
(#1416) 15" PVC INV.=37.3'

SMH #1447
RIM ELEV.=47.1'
(A) 15" PVC INV.=36.4'
(B) 20" RCP INV.=35.9'
(#1400) 20" RCP INV.=36.1'

CB #1468
RIM ELEV.=49.7'
(A) 12" RCP INV.=43.9'
(#1421) 12" RCP INV.=42.7'
(#1468) 12" RCP INV.=41.0'

CB #1469
RIM ELEV.=50.7'
(#1468) 12" PVC INV.=45.5'

CB #1493
RIM ELEV.=47.9'
15" RCP INV.=44.0'

CB #1552
RIM ELEV.=46.5'
(A) 15" RCP INV.=42.3'
(#1493) 15" RCP INV.=42.4'
(#1565) 15" RCP INV.=42.2'

DMH #1563
RIM ELEV.=46.2'
(A) 24" RCP INV.=34.1'
(#1564) UNKN. INV.=34.0'
(PIPE BLOCKED)
(#1568) 24" RCP INV.=39.3'

CB #1564
RIM ELEV.=45.7'
(#1563) 15" RCP INV.=36.9'
(#1565) 15" RCP INV.=38.1'

CB #1565
RIM ELEV.=46.4'
(#1552) 15" RCP INV.=41.4'
(#1564) 15" RCP INV.=41.4'

MH #1566
RIM ELEV.=47.1'
(A) 8" CLAY INV.=40.0'
(B) 12" UNKN. INV.=40.5'

SMH #1567
RIM ELEV.=47.3'
NO VISIBLE PIPES
SUMP=41.8'

DMH #1568
RIM ELEV.=47.1'
(#1570) 24" RCP INV.=41.0'
(#1563) 24" RCP INV.=40.9'
(#1626) 12" RCP INV.=41.6'

SMH #1569
RIM ELEV.=47.6'
(A) 8" PVC INV.=42.3'
(DROP INLET)
(B) 8" PVC INV.=39.3'
(#1571) 15" PVC INV.=38.5'

DMH #1570
RIM ELEV.=47.2'
(A) 24" RCP INV.=42.1'
(#1572) 12" PVC INV.=42.8'
(#1568) 24" RCP INV.=42.1'

SMH #1571
RIM ELEV.=47.7'
(A) 12" PVC INV.=39.4'
(B) 15" PVC INV.=38.5'
(#1569) 15" PVC INV.=38.6'

CB #1572
RIM ELEV.=47.2'
(#1570) 15" RCP INV.=43.0'

CB #1626
RIM ELEV.=50.2'
(#1568) 12" RCP INV.=42.1'
(#1687) 12" RCP INV.=42.1'

SMH #1680
RIM ELEV.=54.7'
(A) 6" CLAY INV.=45.9'
(B) 8" CLAY INV.=44.8'
(C) 6" CLAY INV.=44.9'

CB #1687
RIM ELEV.=53.8'
(#1823) 12" RCP INV.=45.6'
(#1626) 12" RCP INV.=45.4'

SMH #1724
RIM ELEV.=49.9'
6" UNKN. INV.=47.8'

CB #1743
RIM ELEV.=49.9'
(#1763) 12" RCP INV.=45.7'
(#4427) 12" RCP INV.=45.7'

CB #1763
RIM ELEV.=44.8'
(#1743) 12" RCP INV.=42.3'

CB #1803
RIM ELEV.=56.6'
12" RCP INV.=51.5'

CB #1804
RIM ELEV.=56.3'
(A) 12" RCP INV.=50.1'
(B) 8" PVC INV.=51.7'
(#1805) 12" RCP INV.=47.6'

DMH #1805
RIM ELEV.=56.7'
(#1803) 12" RCP INV.=49.9'
(#1804) 12" RCP INV.=47.6'
(#1828) 12" RCP INV.=47.6'

DMH #1823
RIM ELEV.=56.1'
(#1828) 12" RCP INV.=46.8'
(#1687) 12" RCP INV.=46.9'

CB #1828
RIM ELEV.=56.3'
(#1828) 12" RCP INV.=47.1'
(#1823) 12" RCP INV.=47.2'

SMH #1898
RIM ELEV.=57.5'
(A) 8" CLAY INV.=51.4'
(B) FILLED W/SILT

CB #2029
RIM ELEV.=57.3'
12" RCP INV.=53.1'

SMH #2062
RIM ELEV.=57.1'
(A) 12" UNKN. INV.=48.5'
(B) 12" UNKN. INV.=48.5'
(C) 8" PVC INV.=48.6'

CB #2252
RIM ELEV.=52.0'
8" HDPE INV.=47.7'

CB #2373
RIM ELEV.=49.5'
12" RCP INV.=45.9'

SMH #2418
RIM ELEV.=51.0'
(A) 4" UNKN. INV.=47.2'
(B) 4" UNKN. INV.=47.2'
(#2457) 8" CLAY INV.=46.9'

CB #2454
RIM ELEV.=48.6'
(#2573) 12" RCP INV.=44.8'
(#2574) 12" PVC INV.=44.8'
(#2644) 12" RCP INV.=44.7'

SMH #2457
BURIED UNDER PAVEMENT
LOCATION PER MARKING

CB #2574
RIM ELEV.=49.0'
12" PVC INV.=44.9'

CB #2644
RIM ELEV.=48.3'
(#2434) 12" RCP INV.=44.2'
(#4243) 12" RCP INV.=43.9'

CB #4211
RIM ELEV.=47.5'
12" RCP INV.=44.0'

SMH #4241
RIM ELEV.=47.6'
(#1742) 8" PVC INV.=42.4'
(#2457) 8" PVC INV.=42.4'
(#4242) 8" PVC INV.=42.2'

SMH #4242
RIM ELEV.=47.3'
(A) 8" PVC INV.=41.0'
(#4241) 8" PVC INV.=41.1'

CB #4243
RIM ELEV.=46.9'
(#2644) 12" RCP INV.=43.5'
(#4244) 12" RCP INV.=42.3'

DMH #4244
RIM ELEV.=47.3'
(A) 15" RCP INV.=41.8'
(#4243) 12" RCP INV.=42.7'
(#4427) 12" RCP INV.=42.0'

CB #4427
RIM ELEV.=47.3'
(#1743) 12" RCP INV.=44.2'
(#4244) 12" RCP INV.=43.0'
(#4462) 12" RCP INV.=43.5'

CB #4462
RIM ELEV.=47.4'
(#4427) 12" RCP INV.=44.5'

LINCOLN STREET ABUTTERS

MAP 63 LOT 7
NANCY SUTHERLAND IRREV TRUST
NANCY SUTHERLAND - TRUSTEE
134 STAGE RD
NOTTINGHAM, NH 03290

MAP 63 LOT 8
AMERICAN LEGION CLUB
85 LINCOLN ST
EXETER, NH 03833-0506

MAP 63 LOT 9
TREMONT ST APARTMENTS
30 BIRCH RD
DEERFIELD, NH 03037

MAP 63 LOT 252
MCM REALTY TRUST
STUART R. PEEKE TRUSTEE
PO BOX 1986
EXETER, NH 03833

MAP 73 LOT 1
HAY CREEK EXETER PARTNERS I LLC
ATTEN: LEO FICTEAU
90 FRONT ST
EXETER, NH 0383

MAP 73 LOT 6
TOWN OF EXETER
10 FRONT STREET
EXETER, NH 03833

MAP 73 LOT 7
BARBARA A. PASTER
100 FRONT ST
EXETER, NH 03833

MAP 73 LOT 8
TODD M. & CHRISTINE T. PICANSO
102 FRONT ST - APT #2
EXETER, NH 03833

MAP 73 LOT 260
KILIMANJARO LIMITED PARTNERSHIP
PO BOX 1986
EXETER, NH 03833

MAP 73 LOT 261
BURTON G. MACARTHUR TRUST
MARIE MACARTHUR TRUST
8 LINCOLN ST
EXETER, NH 03833

MAP 73 LOT 262
MARGARET C. GAGE
12 LINCOLN ST
EXETER, NH 03833

MAP 73 LOT 263
LORI D. & JEFFREY L. WARRINER
266 FREMONT RD
CHESTER, NH 03036

MAP 73 LOT 264
JOHN P. & ANDREA M. RICHARDS
24 LINCOLN ST
EXETER, NH 03833

MAP 73 LOT 265
KILIMANJARO LIMITED PARTNERSHIP
PO BOX 1986
EXETER, NH 03833

MAP 73 LOT 266
KATHERINE WOOLHOUSE
34 LINCOLN ST
EXETER, NH 03833

MAP 73 LOT 268
JAMES E. CONLEY JR
36 LINCOLN ST
EXETER, NH 03833

MAP 73 LOT 269
CHRISTOPHER J. CLARKE & SUSAN K. DAVIS
40 LINCOLN STREET
EXETER, NH 03833

MAP 73 LOT 270
FREDERICK R. AMEY
42 LINCOLN ST
EXETER, NH 03833

MAP 73 LOT 271
ANDREW ROCKWELL
25 GALE DR
HAMPTON, NH 03842-1013

MAP 73 LOT 271-1
ANDREW KENT ROCKWELL (65.31%)
JANE KENT ROCKWELL REV LIV TRUST (34.69%)
25 GALE ROAD
HAMPTON, NH 03842

MAP 73 LOT 272
52 LINCOLN ST LLC
157 COURT ST
EXETER, NH 03833

MAP 73 LOT 273
TERRY EUSTIS & MARTIN STOLLAR
157 COURT ST
EXETER, NH 03833

MAP 73 LOT 274
JAMES BATTLES-TRUSTEE
JAMES BATTLES IRREVOCABLE LIVING TRUST
56 LINCOLN ST
EXETER, NH 03833

MAP 73 LOT 275
TOWN OF EXETER
10 FRONT STREET
EXETER, NH 03833

MAP 73 LOT 276
ROLAND H. GOUPIL REV. LIVING TRUST
LAURIE HUNT GOUPIL REV. LIVING TRUST
37 BELL AVE
EXETER, NH 03833

MAP 73 LOT 277
BURNHAM AND PFISTER REALTY TRUST
76 LINCOLN ST
EXETER, NH 03833

MAP 73 LOT 278
JOHN S. & ROBI G. JACKSON
1313 LENOX GREENS DR
SUN CITY CENTER, FL 33573

MAP 73 LOT 279
MARY E. PERRY
18 DANIEL ST
EXETER, NH 03833

MAP 73 LOT 280
EDWARD D. & CATHERINE A. MILLER
14 TREMONT ST
EXETER, NH 03833

MAP 73 LOT 281
BAILLARGEON ARTHUR V
16 TREMONT ST
EXETER, NH 03833

MAP 73 LOT 282
CHRISTINE D. LOWE
18 TREMONT ST
EXETER, NH 03833

MAP 73 LOT 283
ROBERT T. JOHNSTONE
PO BOX 141
EXETER, NH 03833

MAP 73 LOT 284
STEVEN M. & KATHERINE H. SEGAL
21 TREMONT ST
EXETER, NH 03833

MAP 73 LOT 285
ELIJAH P. GOULD
19 TREMONT ST
EXETER, NH 03833

MAP 73 LOT 286
KERI MARSHALL
47 DEPOT ROAD
E.KINGSTON, NH 03827

MAP 73 LOT 287
JOSEPH P. & KIMBERLY C. PHILBRICK
MATT & ELIZABETH FOX JACOBS
4 CORTLAND DR
GREENLAND, NH 03840

MAP 73 LOT 290
WILLIAM B. & BONNIE L. DEMANCHE
19 DANIEL ST
EXETER, NH 03833

MAP 73 LOT 291
JOSEPH R. MIKULSKY & MARY E. CONNOLLY
8 PARKER ST
EXETER, NH 03833

MAP 73 LOT 292
SOCIETY OF ST VINCENT DE PAUL - EXETER CHAPT
PO BOX 176
EXETER, NH 03833

MAP 73 LOT 293
EXETER SCHOOL DISTRICT
30 LINDEN ST
EXETER, NH 03833

MAP 73 LOT 294
LINCOLN ST CONDO ASSOC.
23 LINCOLN ST
EXETER, NH 03833

MAP 73 LOT 295
PHILIP M. & CHRISTINE S. UTTER
17 LINCOLN ST
EXETER, NH 03833

MAP 73 LOT 296
MICHAEL J. FARRELL FAMILY TRUST 1992
15 LINCOLN ST
EXETER, NH 03833

MAP 73 LOT 297
GREGG & VICKI JEAN WILLETT
13 LINCOLN ST
EXETER, NH 03833

MAP 73 LOT 298
CARY R. EINAUS & JAMES W. MILLS
11 LINCOLN ST
EXETER, NH 03833

MAP 73 LOT 299
SAINT MICHAEL CATHOLIC CHURCH
9 LINCOLN ST
EXETER, NH 03833

MAP 73 LOT 300
ROMAN CATHOLIC BISHOP OF MANCHESTER
9 LINCOLN ST
EXETER, NH 03833

MAP 73 LOT 301
GEOFFREY ANDREW VON KUHN
89 FRONT ST
EXETER, NH 03833

This Drawing shall not be used for Construction unless Signed and Sealed For Construction.

NO	DATE	DESCRIPTION	CKD
1	4/9/17	35% REVIEW	RR
2	6/4/17	95% REVIEW	RR

WATERSTONE ENGINEERING
INNOVATIVE STORMWATER MANAGEMENT
9 GRETA'S WAY
STRATHAM, NH 03885
(p) 603.686.2488

95% DESIGN FOR WATER INTEGRATION FOR SQUAMSCOTT - EXETER (WISE) INTEGRATED PLAN (IP) PHASE 1

LINCOLN STREET SUBWATERSHED NUTRIENT CONTROL STRATEGIES

PREPARED FOR:
TOWN OF EXETER
DEPT. OF PUBLIC WORKS
11 NEWFIELDS ROAD

DESIGNED BY: RR
DRAFTED BY: CDS
CHECKED BY: RR

NOTES, ABUTTERS LIST AND TABLE

JOB #: 16928
SCALE: AS SHOWN
CONTRCT #: N/A

G 4

EROSION CONTROL NOTES

GENERAL NOTES:

1. EROSION CONTROL MEASURES SHALL BE INSTALLED AS SHOWN ON THE PLANS.

2. SILT FENCES AND HAY BALE BARRIERS ARE TO BE MAINTAINED AND CLEANED UNTIL ALL SLOPES HAVE BEEN ADEQUATELY STABILIZED.

3. ALL DISTURBED AREAS WHERE TEMPORARY OR FINAL LOAM AND SEED REQUIRED SHALL HAVE A MINIMUM OF 4 INCHES OF LOAM PLACED BEFORE BEING SEEDED AND MULCHED.

4. FILL MATERIAL SHALL BE FREE FROM STUMPS, WOOD, ROOTS, ETC.

5. THE BOTTOM OF ANY SEDIMENT BASINS SHALL BE PERIODICALLY CLEANED, WITH THE SEDIMENT REMOVED TO A SECURE LOCATION SO AS TO PREVENT SILTATION OF NATURAL WATER WAYS AND WETLANDS.

6. AFTER ALL DISTURBED AREAS HAVE BEEN STABILIZED, THE TEMPORARY EROSION CONTROL MEASURES ARE TO BE REMOVED AND ACCUMULATED SEDIMENT DISPOSED IN A SECURE LOCATION.

7. EARTH STOCKPILES ARE TO BE SEEDED AND MULCHED AND HAVE A SILT FENCE INSTALLED ON THE DOWNSLOPE SIDE AS SHOWN ON THE PLANS.

8. EROSION CONTROL MEASURES SHALL BE INSPECTED WEEKLY DURING THE LIFE OF THE PROJECT AND AFTER 0.5" OF RAINFALL. ALL DAMAGED SILT FENCES SHALL BE REPAIRED. SEDIMENT DEPOSITS SHALL PERIODICALLY BE REMOVED AND DISPOSED OF AT AN APPROVED LOCATION.

9. EROSION CONTROL MEASURES SHALL BE REMOVED WHEN THE DISTURBED AREA IS STABILIZED. DISTURBED AREA RESULTING FROM THE SILT FENCE REMOVAL OPERATION SHALL BE PERMANENTLY SEEDED.

10. AN AREA AREA SHALL BE CONSIDERED STABALIZED IF ONE OF THE FOLLOWING HAS OCCURED:
- BASE COURSE GRAVELS HAVE BEEN INSTALLED IN AREAS TO BE PAVED;
- A MINIMUM OF 85% VEGETATED GROWTH HAS BEEN ESTABLISHED;
- A MINIMUM OF 3" OF NON-EROSIVE MATERIAL SUCH AS STONE OR RIP RAP HAS BEEN INSTALLED; OR
- EROSION CONTROL BLANKETS HAVE BEEN PROPERLY INSTALLED.

11. ALL AREAS SHALL BE STABILIZED WITHIN 45 DAYS OF INITIAL DISTURBANCE UNLESS OTHERWISE NOTED.

WINTER NOTES:

1. ALL PROPOSED VEGETATED AREAS WHICH DO NOT EXHIBIT A MINIMUM OF 85% VEGETATIVE GROWTH BY OCTOBER 15TH, OR WHICH ARE DISTURBED AFTER OCTOBER 15TH, SHALL BE STABILIZED BY SEEDING AND INSTALLING EROSION CONTROL BLANKETS ON SLOPES GREATER THAN 3:1, AND SEEDING AND PLACING 3 TO 4 TONS OF MULCH PER ACRE, SECURED WITH ANCHORED NETTING, ELSEWHERE. THE INSTALLATION OF EROSION CONTROL BLANKETS OR MULCH AND NETTING SHALL NOT OCCUR OVER ACCUMULATED SNOW OR ON FROZEN GROUND AND SHALL BE COMPLETED IN ADVANCE OF THAW OR SPRING MELT EVENTS.

2. ALL DITCHES OR SWALES WHICH DO NOT EXHIBIT A MINIMUM OF 85% VEGETATIVE GROWTH BY OCTOBER 15TH, OR WHICH ARE DISTURBED AFTER OCTOBER 15TH, SHALL BE STABILIZED TEMPORARILY WITH STONE OR EROSION CONTROL BLANKETS APPROPRIATE FOR THE DESIGN FLOW CONDITIONS.

3. AFTER NOVEMBER 15TH, INCOMPLETE ROAD OR PARKING SURFACES, WHERE WORK HAS STOPPED FOR THE WINTER SEASON, SHALL BE PROTECTED WITH A MINIMUM OF 3 INCHES OF CRUSHED GRAVEL PER NHDOT ITEM 304.3.

SEQUENCE OF CONSTRUCTION

STANDARD STABILIZATION NOTE: FOLLOWING INITIAL SOIL DISTURBANCE OR REDISTURBANCE, PERMANENT OR TEMPORARY STABILIZATION SHALL BE COMPLETED WITHIN SEVEN (7) CALENDAR DAYS AS TO THE SURFACE OF ALL PERIMETER CONTROLS, DIKES, SWALES, DITCHES, PERIMETER SLOPES, AND ALL SLOPES GREATER THAN 3 HORIZONTAL TO 1 VERTICAL (3:1), AND FOURTEEN (14) DAYS AS TO ALL OTHER DISTURBED OR GRADED AREAS ON THE PROJECT SITE.

1. CONTRACTOR/DEVELOPER SHALL NOTIFY NEW HAMPSHIRE DEPARTMENT OF ENVIRONMENTAL SERVICES (NHDES) AND TOWN OF RINDGE 2 WEEKS PRIOR TO START OF CONSTRUCTION.

2. SCHEDULE PRE CONSTRUCTION MEETING. REVIEW AND BECOME FAMILIAR WITH ALL PERMITS.

3. A SOURCE OF OFFSITE FILL MATERIAL SHALL BE IDENTIFIED AND APPROVED BY THE OWNER/INSPECTOR/ENGINEER.

4. INSTALL STABILIZED CONSTRUCTION ENTRANCE (1 DAY).

5. INSTALL STANDARD INLET PROTECTION DEVICES ON EXISTING STORM DRAIN AND CATCH BASIN INLETS (2 DAYS).

6. CLEAR AND ROUGH GRADE (ONLY WHERE NECESSARY) FOR THE INSTALLATION OF PERIMETER SILT FENCE (3 DAYS).

7. INSTALL REMAINDER OF SILT FENCE ON EXISTING WWTP AND EFFLUENT DISPOSAL SITE (1 DAY).

8. CUT AND CLEAR TREES.

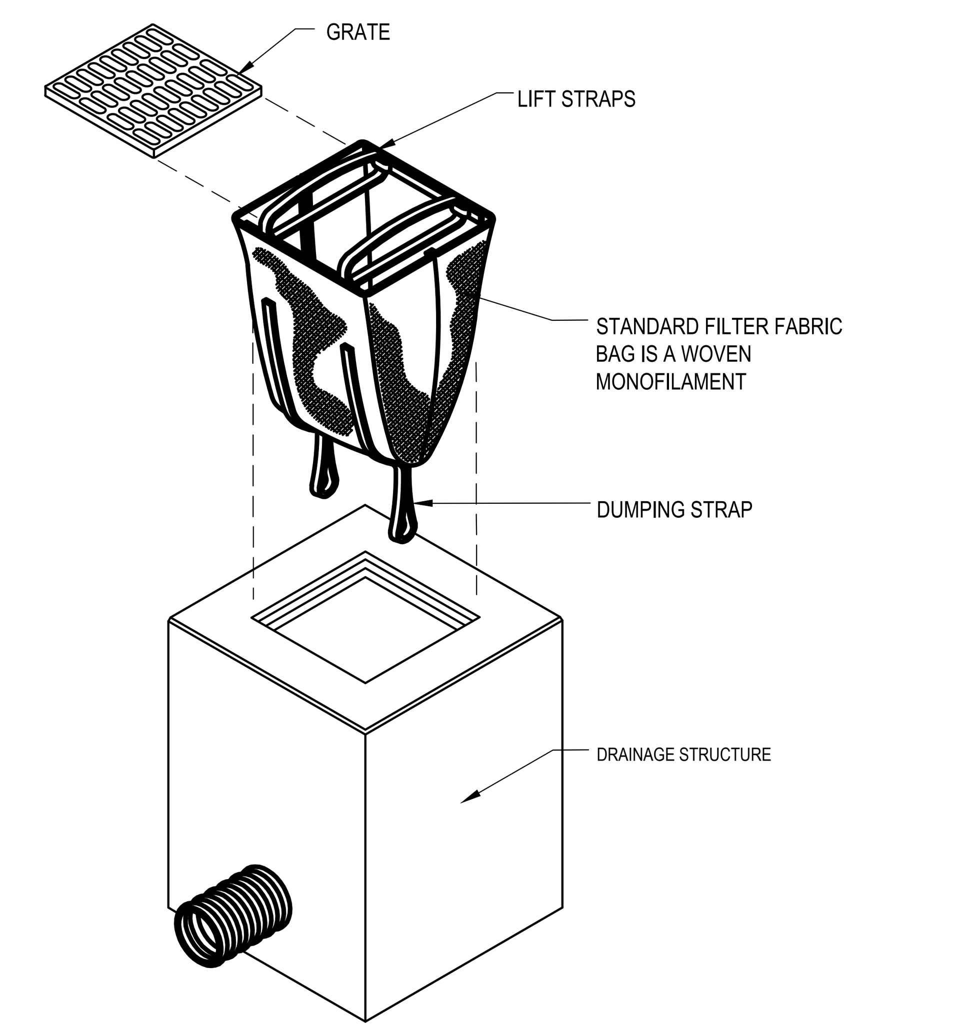
9. CLEAR AND DISPOSE OF DEBRIS.

10. GRADE AND GRAVEL ROADWAYS AND PARKING AREAS -ALL ROADS AND PARKING AREAS SHALL BE STABILIZED IMMEDIATELY AFTER GRADING.

11. CONTRACTOR TO CONSTRUCT ONLY ONE SAND BED AT A TIME TO MINIMIZE SITE DISTURBANCE.

12. BEGIN PERMANENT AND TEMPORARY SEEDING AND MULCHING. ALL CUT AND FILL SLOPES SHALL BE SEEDED AND MULCHED WITHIN 72 HOURS OF THEIR CONSTRUCTION.

13. DAILY, OR AS REQUIRED, CONSTRUCTED TEMPORARY BERMS, DRAINS, DITCHES, SILT FENCES, SEDIMENT TRAPS, ETC., MULCH AND SEED AS REQUIRED.



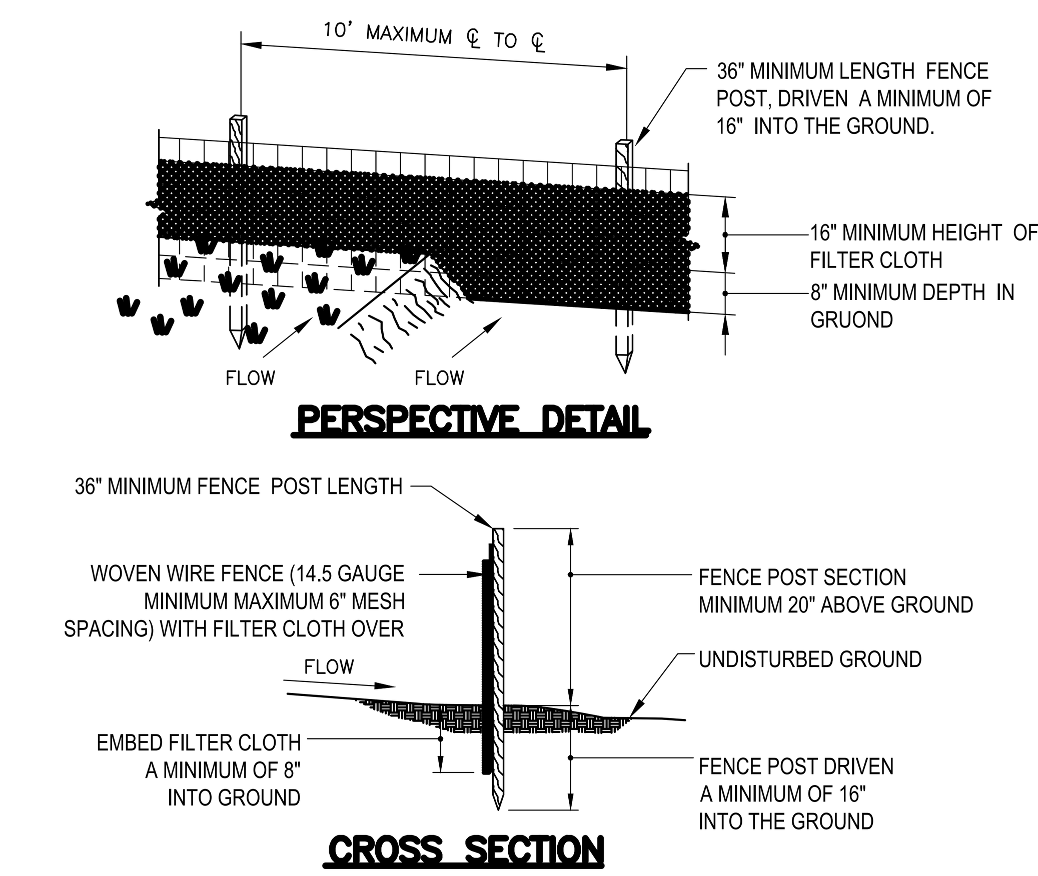
NOTES:

1. ALTERNATIVE TO GRAVEL AND STONE WIRE MESH DROP INLET SEDIMENT FILTER.

2. CONTRACTOR TO INSPECT IN ACCORDANCE WITH THE EROSION CONTROL NOTES.

SEDIMENTATION CONTROL AT CATCH BASIN

NOT TO SCALE



CONSTRUCTION NOTES FOR FABRICATED SILT FENCE

1. WOVEN WIRE FENCE TO BE FASTENED SECURELY TO FENCE POSTS WITH WIRE TIES OR STAPLES.

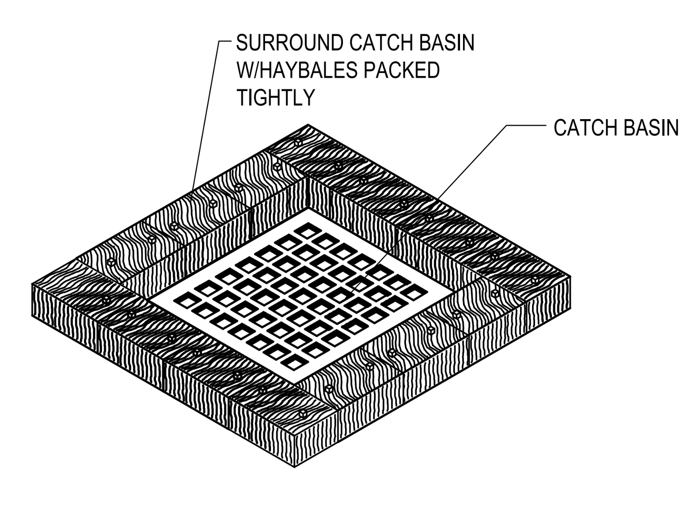
2. FILTER CLOTH TO BE FASTENED SECURELY TO WOVEN WIRE FENCE WITH TIES SPACED EVERY 24" AT TOP, MID SECTION AND BOTTOM.

3. WHEN TWO SECTIONS OF FILTER CLOTH ADJOIN EACH OTHER THEY SHALL BE OVERLAPPED BY SIX INCHES, FOLDED AND STAPLED.

4. MAINTENANCE SHALL BE PERFORMED AS NEEDED AND MATERIAL REMOVED WHEN "BULGES" DEVELOP IN THE SILT FENCE.

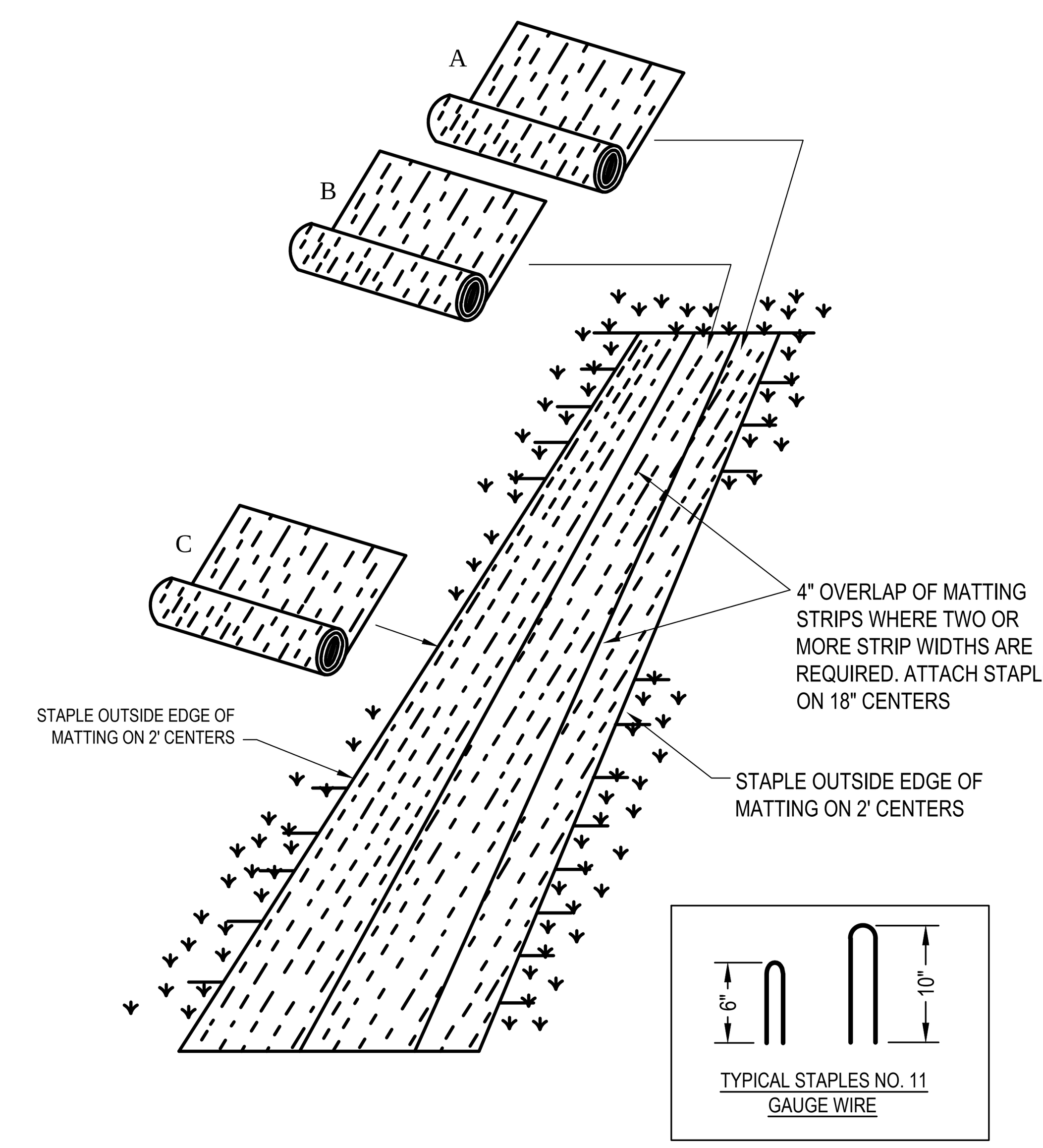
SILT FENCE DETAIL

NOT TO SCALE



HAYBALE RING DETAIL

NOT TO SCALE



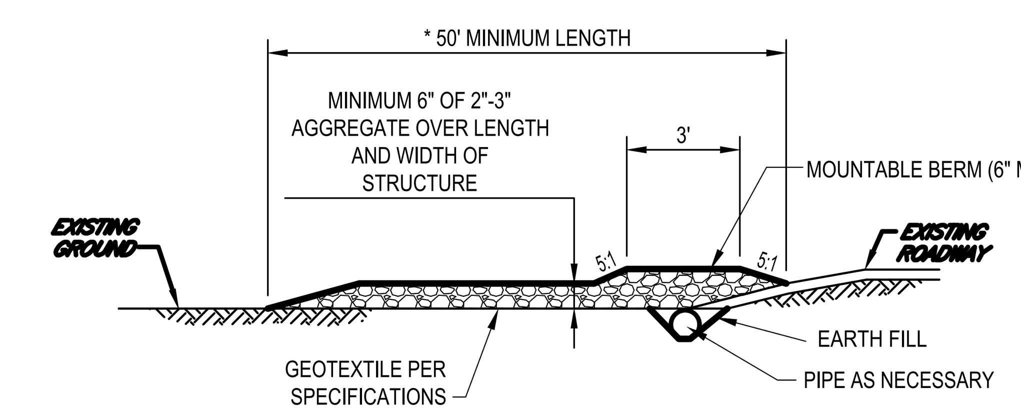
EROSION CONTROL MATTING

NOT TO SCALE

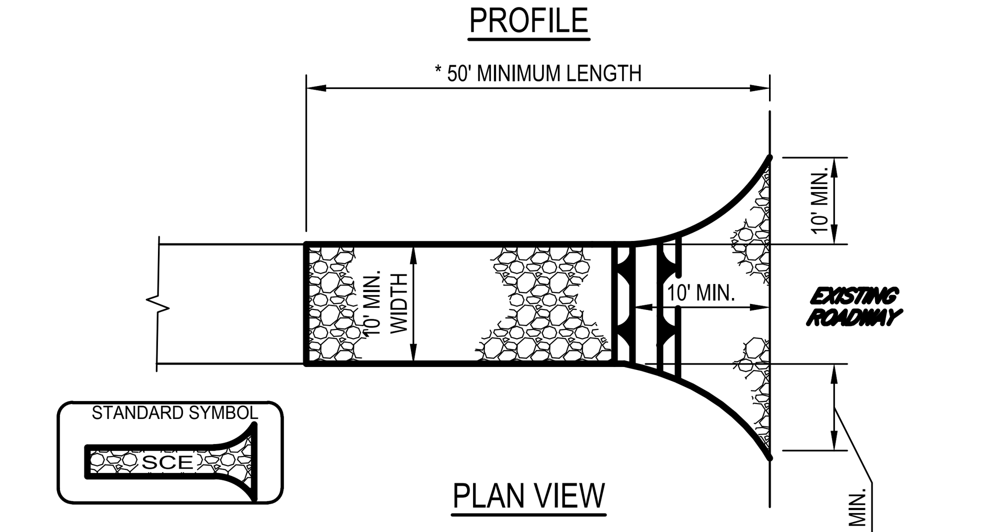
NOTES:

1. EROSION CONTROL MATS MANUFACTURED BY NORTH AMERICAN GREEN'S, MODEL S150 & SC150 AND INSTALLED PER MANUFACTURERS RECOMMENDATIONS.

2. USE S150 EROSION CONTROL MATS ON 3:1 TO 2:1 SLOPES. USE SC150 EROSION CONTROL MATS ON 2:1 TO 1:1 SLOPES.



PROFILE



PLAN VIEW

CONSTRUCTION SPECIFICATION

1. LENGTH - MINIMUM OF 50'.

2. WIDTH - 10' MINIMUM, SHOULD BE FLARED AT THE EXISTING ROAD TO PROVIDE A TURNING RADIUS.

3. GEOTEXTILE FABRIC (MIRAFI 180N OR EQUAL) SHALL BE PLACED OVER THE EXISTING GROUND PRIOR TO PLACING STONE.

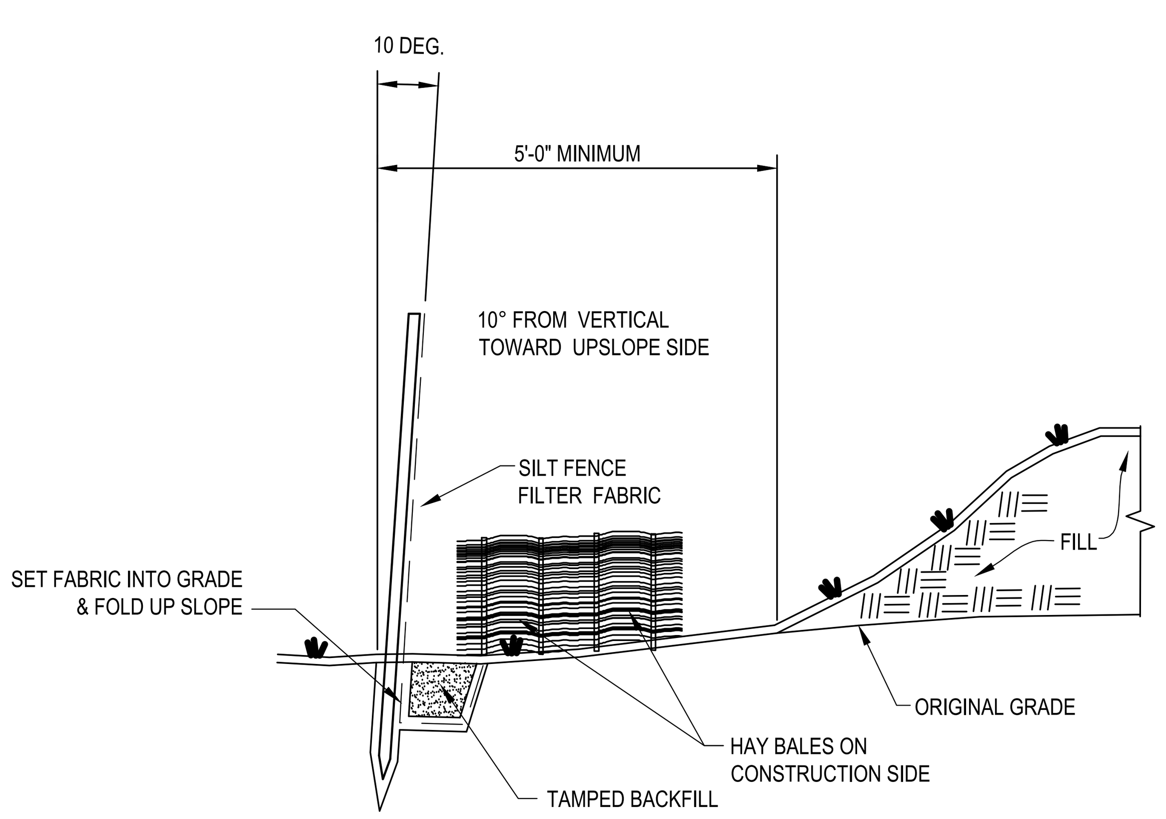
4. STONE - CRUSHED AGGREGATE (2" TO 3") OR RECLAIMED OR RECYCLED CONCRETE EQUIVALENT SHALL BE PLACED AT LEAST 6" DEEP OVER THE LENGTH AND WIDTH OF THE ENTRANCE.

5. SURFACE WATER - ALL SURFACE WATER FLOWING TO OR DIVERTED TOWARD CONSTRUCTION ENTRANCES SHALL BE PIPED THROUGH THE ENTRANCE, MAINTAINING POSITIVE DRAINAGE. PIPE INSTALLED THROUGH THE STABILIZED CONSTRUCTION ENTRANCE SHALL BE PROTECTED WITH A MOUNTABLE BERM WITH 5:1 SLOPES AND A MINIMUM OF 6" OF STONE OVER THE PIPE. PIPE HAS TO BE SIZED ACCORDING TO THE DRAINAGE. WHEN THE SCE IS LOCATED AT A HIGH SPOT AND HAS NO DRAINAGE TO CONVEY A PIPE WILL NOT BE NECESSARY. PIPE SHOULD BE SIZED ACCORDING TO THE AMOUNT OF RUNOFF TO BE CONVEYED. A 6" MINIMUM WILL BE REQUIRED.

6. LOCATION - A STABILIZED CONSTRUCTION ENTRANCE SHALL BE LOCATED AT EVERY POINT WHERE CONSTRUCTION TRAFFIC ENTERS OR LEAVES A CONSTRUCTION SITE. VEHICLES LEAVING THE SITE MUST TRAVEL OVER THE ENTIRE LENGTH OF THE STABILIZED CONSTRUCTION ENTRANCE.

STABILIZED CONSTRUCTION ENTRANCE

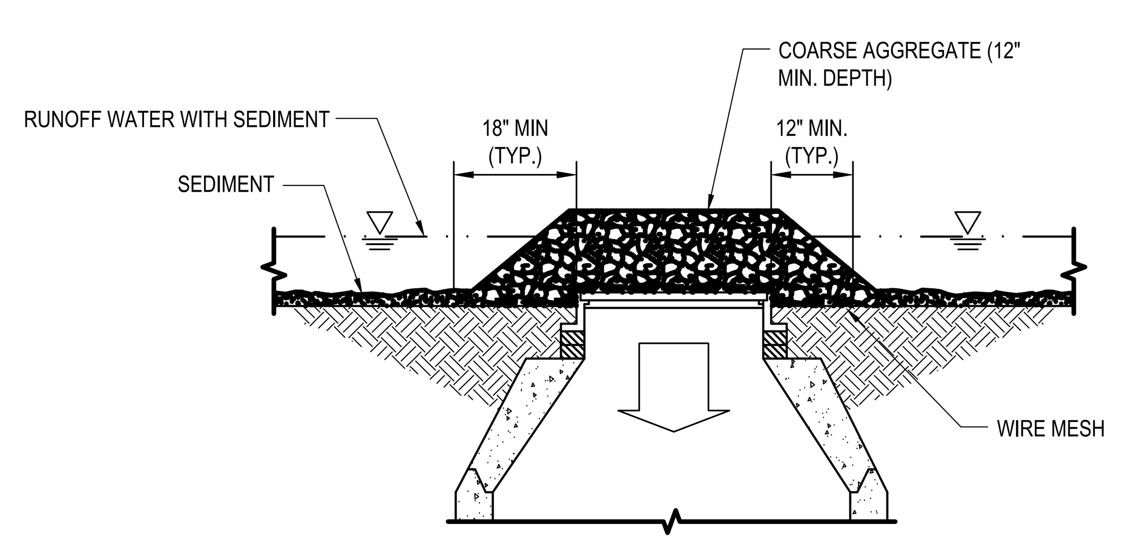
NOT TO SCALE



NOTE:
SILT FENCE AND POSTS FROM APPROVED MANUFACTURER/SUPPLIER. SET TO MANUFACTURERS DIRECTIONS AND IN ACCORDANCE WITH PLANS AND SPECIFICATIONS.

SILT FENCE INSTALLATION SCHEMATIC

NOT TO SCALE



GRAVEL AND WIRE MESH DROP INLET SEDIMENT FILTER

NOT TO SCALE

NOTES:

1. A WIRE MESH SHOULD BE PLACED OVER THE DROP INLET OR CURB OPENING SO THAT THE ENTIRE OPENING AND A MINIMUM OF 12" OF THE OPENING ARE COVERED BY THE MESH. THE MESH MAY BE ORDINARY HARDWARE CLOTH OR WIRE MESH WITH OPENINGS UP TO 1/2".

2. THE WIRE MESH SHOULD BE COVERED WITH CLEAN COARSE AGGREGATE SUCH AS SEWER STONE FOR A MINIMUM DEPTH OF 12".

3. THE COARSE AGGREGATE SHOULD EXTEND AT LEAST 18" ON ALL SIDES OF THE DRAIN OPENING.

NOTE:
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This Drawing shall not be used for Construction unless Signed and Sealed For Construction.

NO	DATE	DESCRIPTION	CKD
1	4/9/17	35% REVIEW	RR
2	6/4/17	95% REVIEW	RR

WATERSTONE ENGINEERING
INNOVATIVE STORMWATER MANAGEMENT
9 GRETA'S WAY
STRATHAM, NH 03885
(p) 603.686.2488

95% DESIGN FOR WATER INTEGRATION FOR SQUAMSCOTT - EXETER (WISE) INTEGRATED PLAN (IP) PHASE 1

LINCOLN STREET SUBWATERSHED NUTRIENT CONTROL STRATEGIES

PREPARED FOR:
TOWN OF EXETER
DEPT. OF PUBLIC WORKS
11 NEWFIELDS ROAD

DESIGNED BY:	RR
DRAFTED BY:	CDS
CHECKED BY:	RR

STATE OF NEW HAMPSHIRE
ROBERT M. ROSEEN No. 12215
LICENSED PROFESSIONAL ENGINEER

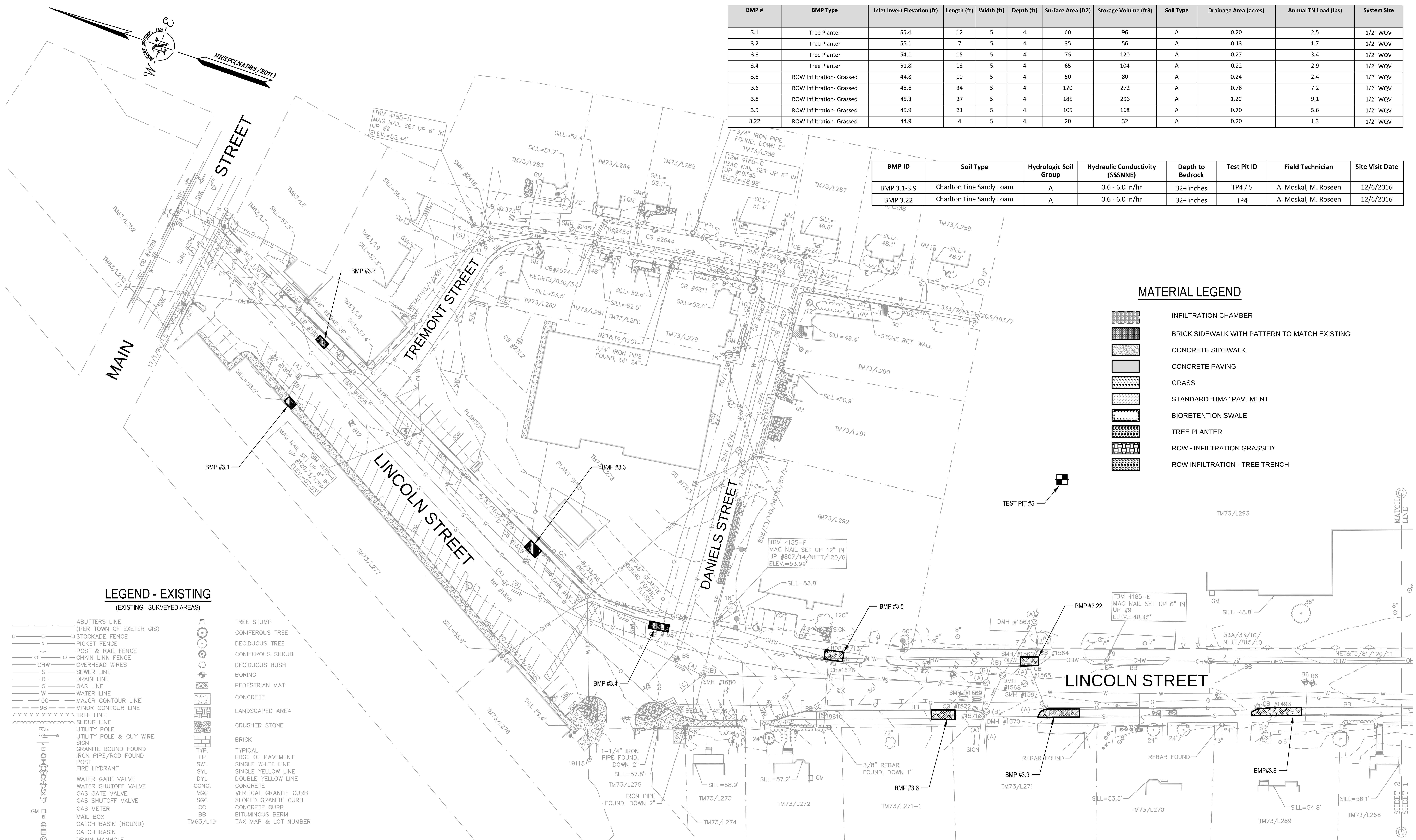
EROSION AND SEDIMENTATION CONTROL

JOB #:	16928
SCALE:	AS SHOWN
CONTRCT #:	N/A

ES1

BMP #	BMP Type	Inlet Invert Elevation (ft)	Length (ft)	Width (ft)	Depth (ft)	Surface Area (ft2)	Storage Volume (ft3)	Soil Type	Drainage Area (acres)	Annual TN Load (lbs)	System Size
3.1	Tree Planter	55.4	12	5	4	60	96	A	0.20	2.5	1/2" WQV
3.2	Tree Planter	55.1	7	5	4	35	56	A	0.13	1.7	1/2" WQV
3.3	Tree Planter	54.1	15	5	4	75	120	A	0.27	3.4	1/2" WQV
3.4	Tree Planter	51.8	13	5	4	65	104	A	0.22	2.9	1/2" WQV
3.5	ROW Infiltration- Grassed	44.8	10	5	4	50	80	A	0.24	2.4	1/2" WQV
3.6	ROW Infiltration- Grassed	45.6	34	5	4	170	272	A	0.78	7.2	1/2" WQV
3.8	ROW Infiltration- Grassed	45.3	37	5	4	185	296	A	1.20	9.1	1/2" WQV
3.9	ROW Infiltration- Grassed	45.9	21	5	4	105	168	A	0.70	5.6	1/2" WQV
3.22	ROW Infiltration- Grassed	44.9	4	5	4	20	32	A	0.20	1.3	1/2" WQV

BMP ID	Soil Type	Hydrologic Soil Group	Hydraulic Conductivity (SSSNNE)	Depth to Bedrock	Test Pit ID	Field Technician	Site Visit Date
BMP 3.1-3.9	Charlton Fine Sandy Loam	A	0.6 - 6.0 in/hr	32+ inches	TP4 / 5	A. Moskal, M. Roseen	12/6/2016
BMP 3.22	Charlton Fine Sandy Loam	A	0.6 - 6.0 in/hr	32+ inches	TP4	A. Moskal, M. Roseen	12/6/2016



EXISTING AND PROPOSED CONDITIONS PLAN - 1 LINCOLN STREET NORTH

SCALE: 1" = 40'

SCALE 1"=40' AT ORIGINAL SIZE

NOTE:
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WATERSTONE ENGINEERING
INNOVATIVE STORMWATER MANAGEMENT
9 GRETA'S WAY
STRATHAM, NH 03885
(p) 603.686.2488

95% DESIGN FOR WATER INTEGRATION FOR SQUAMSCOTT - EXETER (WISE) INTEGRATED PLAN (IP) PHASE 1
LINCOLN STREET SUBWATERSHED NUTRIENT CONTROL STRATEGIES

PREPARED FOR:
TOWN OF EXETER
DEPT. OF PUBLIC WORKS
11 NEWFIELDS ROAD

DESIGNED BY: RR
DRAFTED BY: CDS
CHECKED BY: RR

STATE OF NEW HAMPSHIRE
ROBERT M. ROSEEN
No. 12218
LICENSED PROFESSIONAL ENGINEER

EXISTING & PROPOSED CONDITIONS PLAN - 1

JOB #: 16928
SCALE: AS SHOWN
CONTRCT #: N/A

C1

LEGEND - EXISTING

(EXISTING - SURVEYED AREAS)

ABUTTERS LINE (PER TOWN OF EXETER GIS)
STOCKADE FENCE
PICKET FENCE
POST & RAIL FENCE
CHAIN LINK FENCE
OVERHEAD WIRES
SEWER LINE
DRAIN LINE
GAS LINE
WATER LINE
MAJOR CONTOUR LINE
MINOR CONTOUR LINE
TREE LINE
SHRUB LINE
UTILITY POLE
UTILITY POLE & GUY WIRE
SIGN
GRANITE BOUND FOUND
IRON PIPE/ROD FOUND
POST
FIRE HYDRANT
WATER GATE VALVE
WATER SHUTOFF VALVE
GAS GATE VALVE
GAS SHUTOFF VALVE
GAS METER
MAIL BOX
CATCH BASIN (ROUND)
CATCH BASIN
DRAIN MANHOLE
MANHOLE
ELECTRIC MANHOLE
TELEPHONE MANHOLE
WATER MANHOLE
SEWER MANHOLE
BOULDER

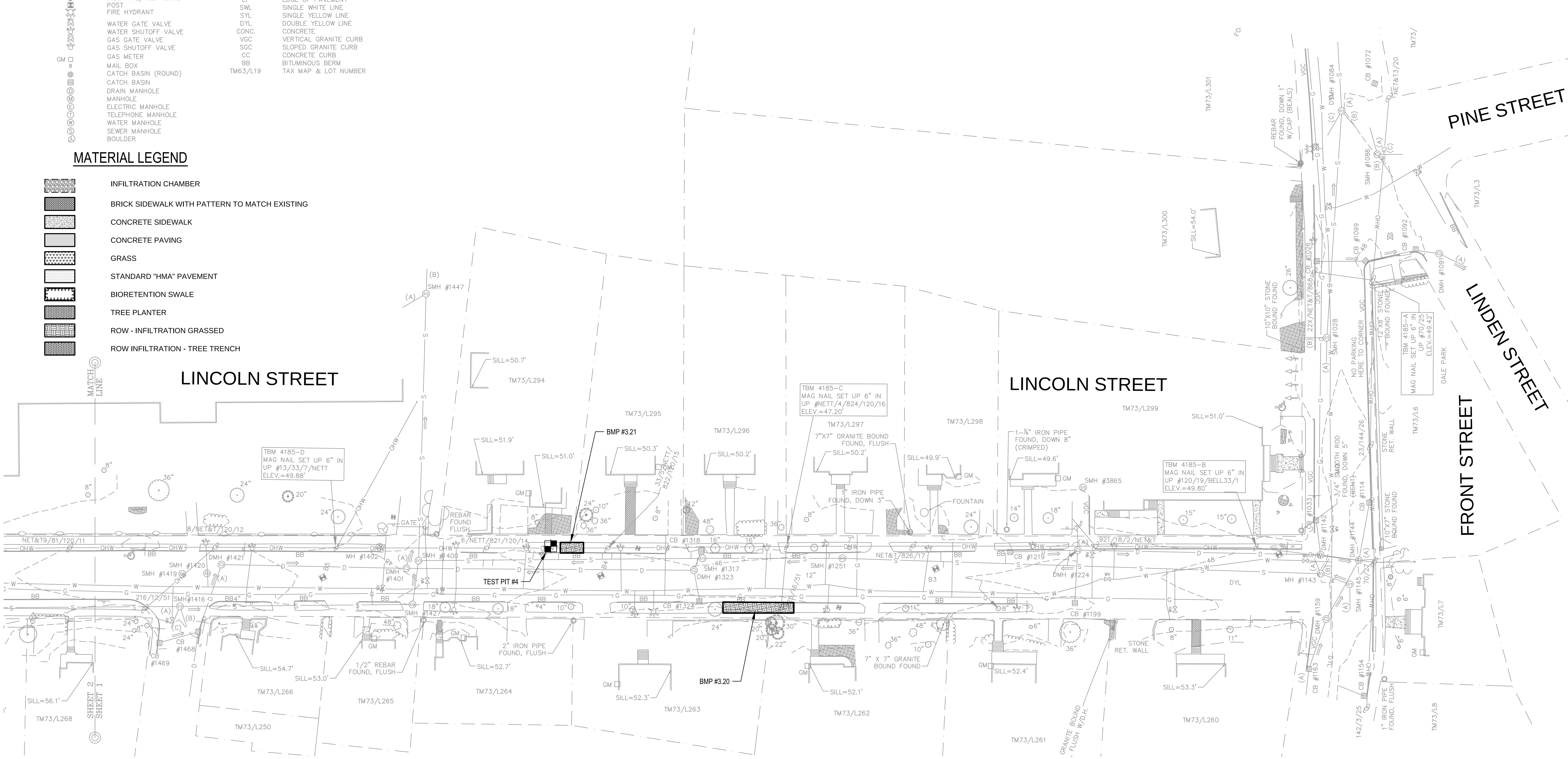
TREE STUMP
CONIFEROUS TREE
DECIDUOUS TREE
CONIFEROUS SHRUB
DECIDUOUS BUSH
BORING
PEDESTRIAN MAT
CONCRETE
LANDSCAPED AREA
CRUSHED STONE
BRICK
TYP. TYPICAL
EP EDGE OF PAVEMENT
SWL SINGLE WHITE LINE
SYL SINGLE YELLOW LINE
DYL DOUBLE YELLOW LINE
CONC. CONCRETE
VGC VERTICAL GRANITE CURB
SGC SLOPED GRANITE CURB
CC CONCRETE CURB
BB BITUMINOUS BERM
TM63/L19 TAX MAP & LOT NUMBER

MATERIAL LEGEND

INFILTRATION CHAMBER
BRICK SIDEWALK WITH PATTERN TO MATCH EXISTING
CONCRETE SIDEWALK
CONCRETE PAVING
GRASS
STANDARD "HMA" PAVEMENT
BIORETENTION SWALE
TREE PLANTER
ROW - INFILTRATION GRASSED
ROW INFILTRATION - TREE TRENCH

BMP #	BMP Type	Inlet Invert Elevation (ft)	Length (ft)	Width (ft)	Depth (ft)	Surface Area (ft2)	Storage Volume (ft3)	Soil Type	Drainage Area (acres)	Annual TN Load (lbs)	System Size
3.20	ROW Infiltration- Grassed	44.6	55	5	4	275	440	A	1.60	13.9	1/2" WQV
3.21	ROW Infiltration- Grassed	45.3	4	5	4	20	32	A	0.24	1.4	1/2" WQV

BMP ID	Soil Type	Hydrologic Soil Group	Hydraulic Conductivity (SSSNNE)	Depth to Bedrock	Test Pit ID	Field Technician	Site Visit Date
BMP 3.20	Charlton Fine Sandy Loam	A	0.6 - 6.0 in/hr	32+ inches	TP4	A. Moskal, M. Roseen	12/6/2016
BMP 3.21	Charlton Fine Sandy Loam	A	0.6 - 6.0 in/hr	32+ inches	TP4	A. Moskal, M. Roseen	12/6/2016



EXISTING AND PROPOSED CONDITIONS PLAN - 2 LINCOLN STREET SOUTH

SCALE: 1" = 40'

0 20 40 60 80'
SCALE 1"=40' AT ORIGINAL SIZE

NOTE:
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2	6/4/17	95% REVIEW	RR

WATERSTONE ENGINEERING
INNOVATIVE STORMWATER MANAGEMENT
9 GRETAS WAY
STRATHAM, NH 03885
(p) 603.686.2488

95% DESIGN FOR WATER INTEGRATION FOR SQUAMSCOTT - EXETER (WISE) INTEGRATED PLAN (IP) PHASE 1
LINCOLN STREET SUBWATERSHED NUTRIENT CONTROL STRATEGIES

PREPARED FOR:
TOWN OF EXETER
DEPT. OF PUBLIC WORKS
11 NEWFIELDS ROAD

DESIGNED BY: RR
DRAFTED BY: CDS
CHECKED BY: RR

STATE OF NEW HAMPSHIRE
ROBERT M. ROSEEN
No. 12215
LICENSED PROFESSIONAL ENGINEER

EXISTING AND PROPOSED CONDITIONS - PLAN 2

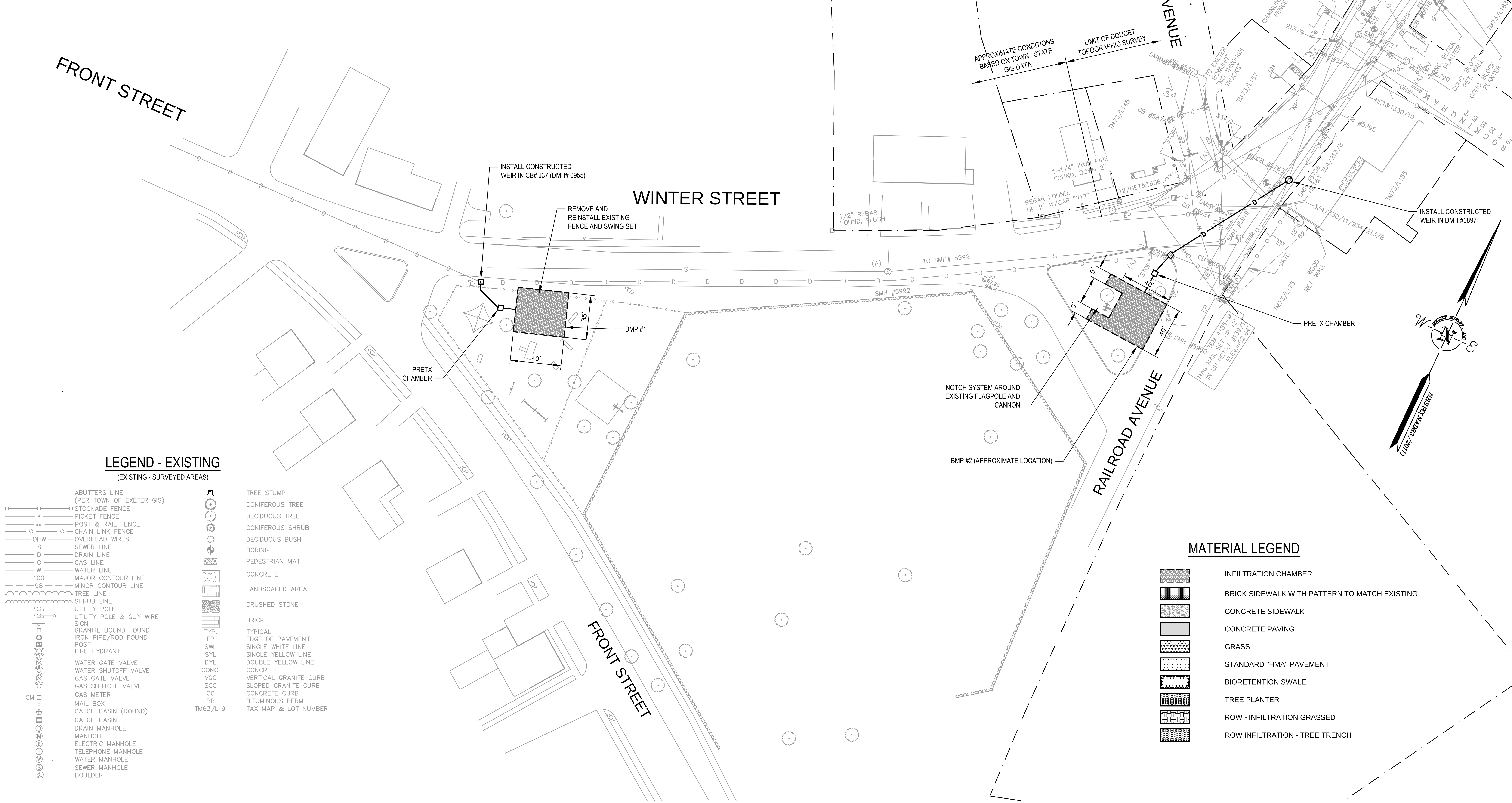
JOB #: 16928
SCALE: AS SHOWN
CONTRCT #: N/A

C2

BMP #	BMP Type	Inlet Invert Elevation (ft)	Length (ft)	Width (ft)	Depth (ft)	Surface Area (ft2)	Storage Volume (ft3)	Soil Type	Drainage Area (acres)	Annual TN Load (lbs)	System Size
1	Subsurface Infiltration	56.9	40	35	8	1400	4,816	A	12.88	76.6	1/2" WQV
2*	Subsurface Infiltration	49.2	50	24	10	1200	5,696	A	24.56	157.6	1/2" WQV

*Drainage area and Annual TN Load estimates exclude area and load managed by BMP 1

BMP ID	Soil Type	Hydrologic Soil Group	Hydraulic Conductivity (SSSNNE)	Depth to Bedrock	Test Pit ID	Field Technician	Site Visit Date
BMP 1	Charlton Fine Sandy Loam	A	0.6 - 6.0 in/hr	54+ inches	TP1	A. Moskal, M. Roseen	11/28/2016
BMP 2	Charlton Fine Sandy Loam	A	0.6 - 6.0 in/hr	41+ inches	TP2	A. Moskal, M. Roseen	12/6/2016



EXISTING AND PROPOSED CONDITIONS PLAN - 3 WINTER STREET

SCALE: 1" = 40'

0 20 40 60 80'
SCALE 1"=40' AT ORIGINAL SIZE

NOTE:
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2	6/4/17	95% REVIEW	RR

WATERSTONE ENGINEERING
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9 GRETA'S WAY
STRATHAM, NH 03885
(p) 603.686.2488

95% DESIGN FOR WATER INTEGRATION FOR SQUAMSCOTT - EXETER (WISE) INTEGRATED PLAN (IP) PHASE 1
LINCOLN STREET SUBWATERSHED NUTRIENT CONTROL STRATEGIES

PREPARED FOR:
TOWN OF EXETER
DEPT. OF PUBLIC WORKS
11 NEWFIELDS ROAD

DESIGNED BY: RR
DRAFTED BY: CDS
CHECKED BY: RR

STATE OF NEW HAMPSHIRE
ROBERT M. ROSEEN
No. 12215
LICENSED PROFESSIONAL ENGINEER

EXISTING AND PROPOSED CONDITIONS PLAN - 3

JOB #: 16928
SCALE: AS SHOWN
CONTRCT #: N/A

C3

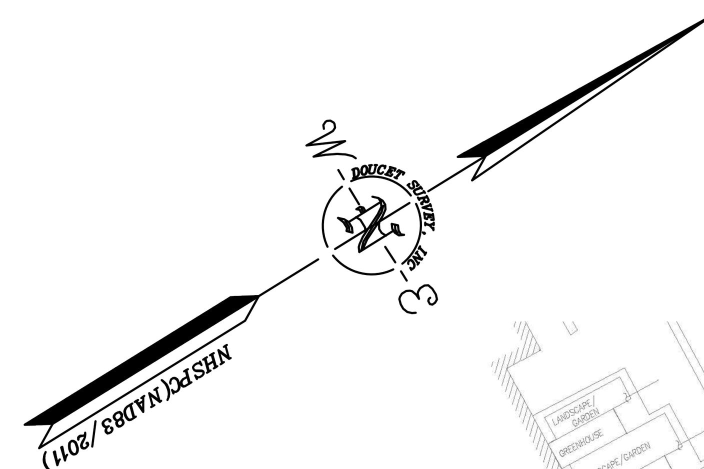
LEGEND - EXISTING

(EXISTING - SURVEYED AREAS)

ABUTTERS LINE (PER TOWN OF EXETER GIS)	TREE STUMP
STOCKADE FENCE	CONIFEROUS TREE
V PICKET FENCE	DECIDUOUS TREE
<> POST & RAIL FENCE	CONIFEROUS SHRUB
CHAIN LINK FENCE	DECIDUOUS BUSH
OHW OVERHEAD WIRES	BORING
S SEWER LINE	PEDESTRIAN MAT
D DRAIN LINE	CONCRETE
G GAS LINE	LANDSCAPED AREA
W WATER LINE	CRUSHED STONE
100 MAJOR CONTOUR LINE	BRICK
98 MINOR CONTOUR LINE	TYP. TYPICAL
TREE LINE	EP EDGE OF PAVEMENT
SHRUB LINE	SWL SINGLE WHITE LINE
UTILITY POLE	SYL SINGLE YELLOW LINE
UTILITY POLE & GUY WIRE	DYL DOUBLE YELLOW LINE
SIGN	CONC. CONCRETE
GRANITE BOUND FOUND	VGC VERTICAL GRANITE CURB
IRON PIPE/ROD FOUND	SGC SLOPED GRANITE CURB
POST	CC CONCRETE CURB
HYD FIRE HYDRANT	BB BITUMINOUS BERM
WV WATER GATE VALVE	TM63/L19 TAX MAP & LOT NUMBER
WSO WATER SHUTOFF VALVE	
GV GAS GATE VALVE	
GSO GAS SHUTOFF VALVE	
GM GAS METER	
MAIL BOX	
CATCH BASIN (ROUND)	
CATCH BASIN	
D DRAIN MANHOLE	
M MANHOLE	
E ELECTRIC MANHOLE	
T TELEPHONE MANHOLE	
W WATER MANHOLE	
S SEWER MANHOLE	
BOULDER	

BMP #	BMP Type	Inlet Invert Elevation (ft)	Length (ft)	Width (ft)	Depth (ft)	Surface Area (ft2)	Storage Volume (ft3)	Soil Type	Drainage Area (acres)	Annual TN Load (lbs)	System Size
5	Subsurface Infiltration	36.7	78	10	10	780	3,822	A	20.29	138.3	1/4" WQV

BMP ID	Soil Type	Hydrologic Soil Group	Hydraulic Conductivity (SSSNNE)	Depth to Bedrock	Test Pit ID	Field Technician	Site Visit Date
BMP 5	Charlton Fine Sandy Loam	A	0.6 - 6.0 in/hr	28+ inches	TP6	A. Moskal, M. Roseen	12/7/2016



TEST PITS

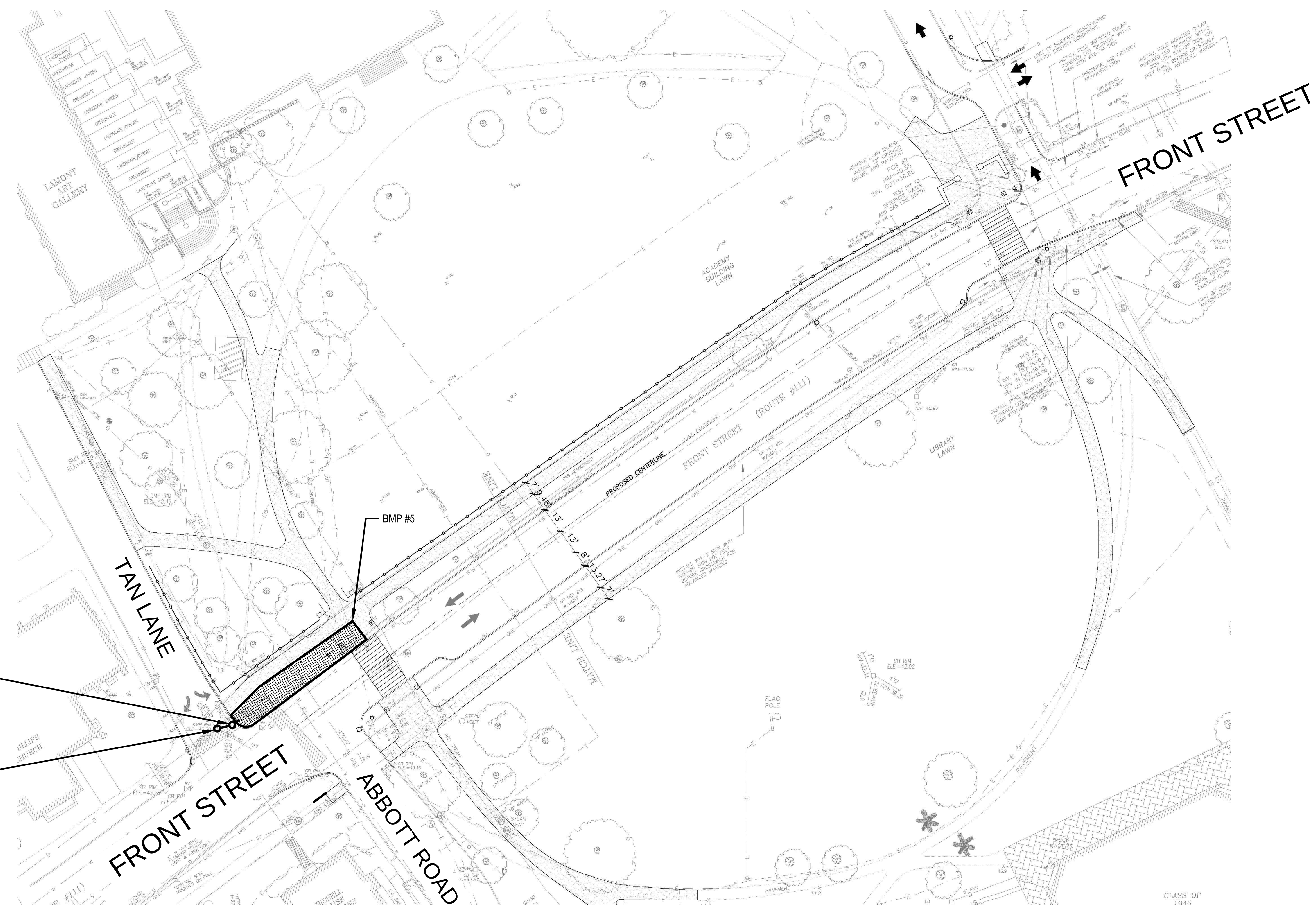
TEST PITS MUST BE CONDUCTED AT EACH LOCATION TO VERIFY SOILS AND SEASONAL HIGH WATER TABLE

MATERIAL LEGEND

- INFILTRATION CHAMBER
- BRICK SIDEWALK WITH PATTERN TO MATCH EXISTING
- CONCRETE SIDEWALK
- CONCRETE PAVING
- GRASS
- STANDARD "HMA" PAVEMENT
- BIORETENTION SWALE
- TREE PLANTER
- ROW - INFILTRATION GRASSED
- ROW INFILTRATION - TREE TRENCH

PRETX STRUCTURE

INSTALL CONSTRUCTED WEIR IN MH# 52 (DMH-0804)



NOTES:

1. ALL ELECTRIC, GAS, TEL. WATER, SEWER AND DRAIN SERVICES ARE SHOWN IN SCHEMATIC FASHION, THEIR LOCATIONS ARE NOT PRECISE OR NECESSARILY ACCURATE. NO WORK WHATSOEVER SHALL BE UNDERTAKEN ON THIS SITE USING THIS PLAN TO LOCATE THE ABOVE SERVICES. CONSULT WITH THE PROPER AUTHORITIES CONCERNED WITH THE SUBJECT SERVICE LOCATIONS FOR INFORMATION REGARDING SUCH. CALL DIG-SAFE AT 1-888-DIG-SAFE.

2. BASE MAP INFORMATION TAKEN FROM PLAN ENTITLED FRONT STREET CROSS WALK CONCEPT DRAWING L-1 DATED JANUARY 21, 2014 AS PREPARED BY KZLA KYLE ZICK LANDSCAPE ARCHITECTURE, INC. 36 BROWNFIELD STREET, BOSTON, MA 02108.

EXISTING AND PROPOSED CONDITIONS PLAN - 4 FRONT STREET

SCALE: 1" = 40'

0 20 40 60 80'

SCALE 1"=40' AT ORIGINAL SIZE

This Drawing shall not be used for Construction unless Signed and Sealed For Construction.

NO	DATE	DESCRIPTION	CKD
1	4/9/17	35% REVIEW	RR
2	6/4/17	95% REVIEW	RR

WATERSTONE ENGINEERING
INNOVATIVE STORMWATER MANAGEMENT
9 GRETA'S WAY
STRATHAM, NH 03885
(p) 603.686.2488

95% DESIGN FOR WATER INTEGRATION FOR SQUAMSCOTT - EXETER (WISE) INTEGRATED PLAN (IP) PHASE 1

LINCOLN STREET SUBWATERSHED NUTRIENT CONTROL STRATEGIES

PREPARED FOR:
TOWN OF EXETER
DEPT. OF PUBLIC WORKS
11 NEWFIELDS ROAD

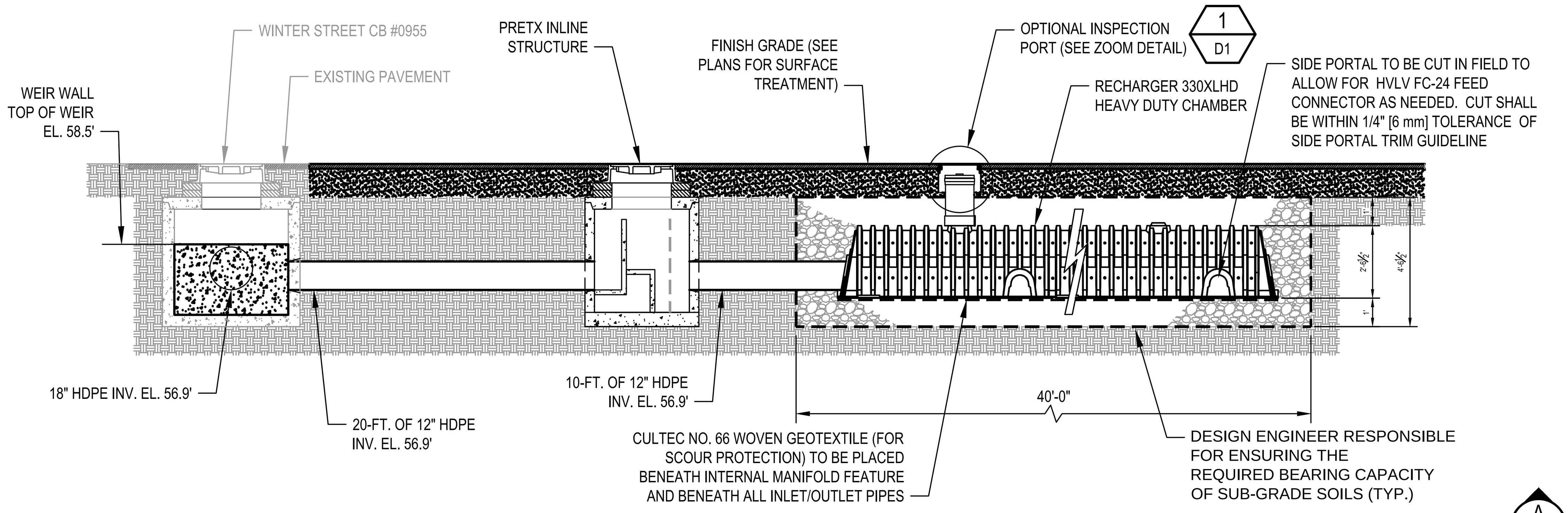
DESIGNED BY:	RR
DRAFTED BY:	CDS
CHECKED BY:	RR

STATE OF NEW HAMPSHIRE ROBERT M. ROSEEN No. 12215 LICENSED PROFESSIONAL ENGINEER

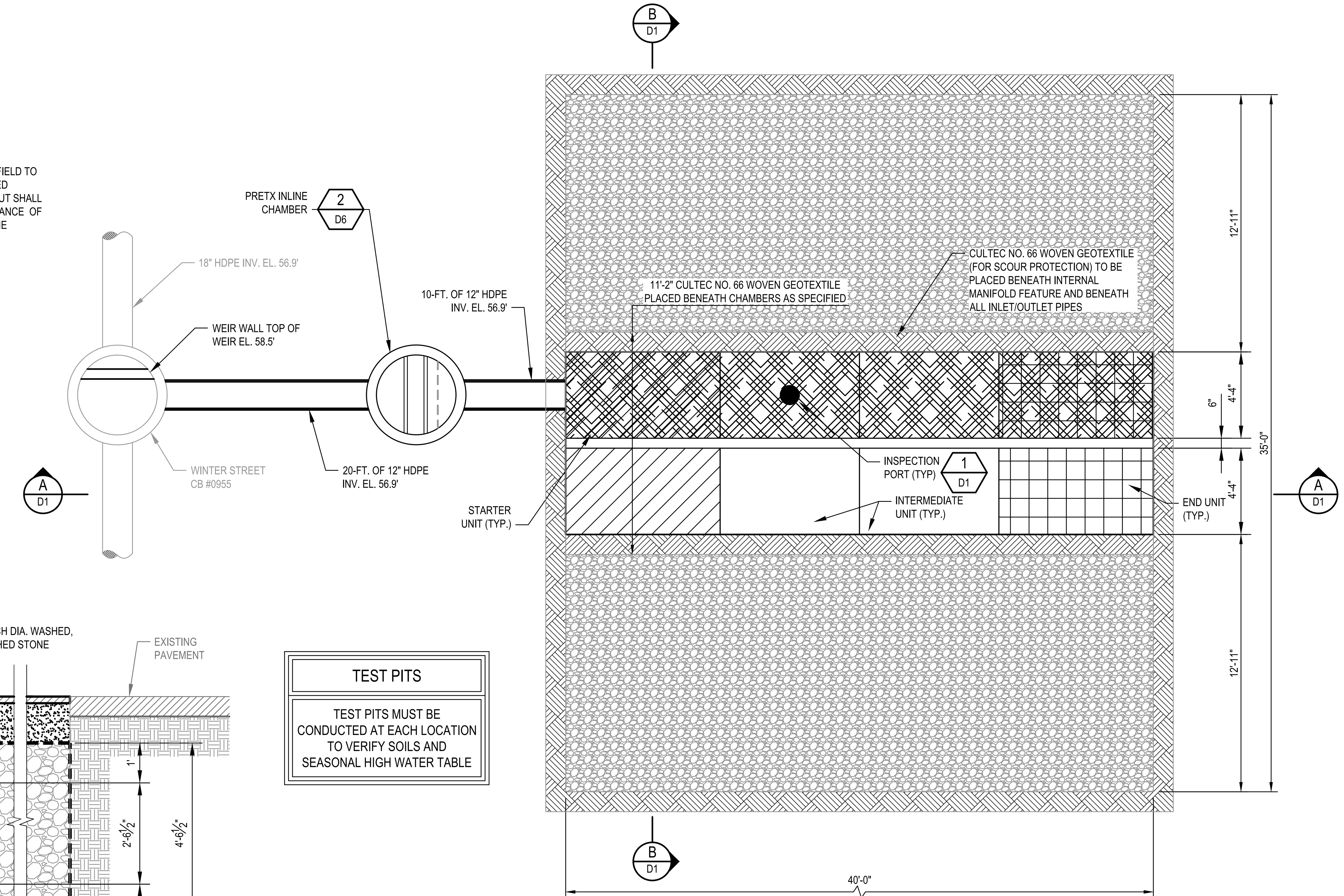
EXISTING AND PROPOSED CONDITIONS PLAN - 4

JOB #:	16928
SCALE:	AS SHOWN
CONTRCT #:	N/A

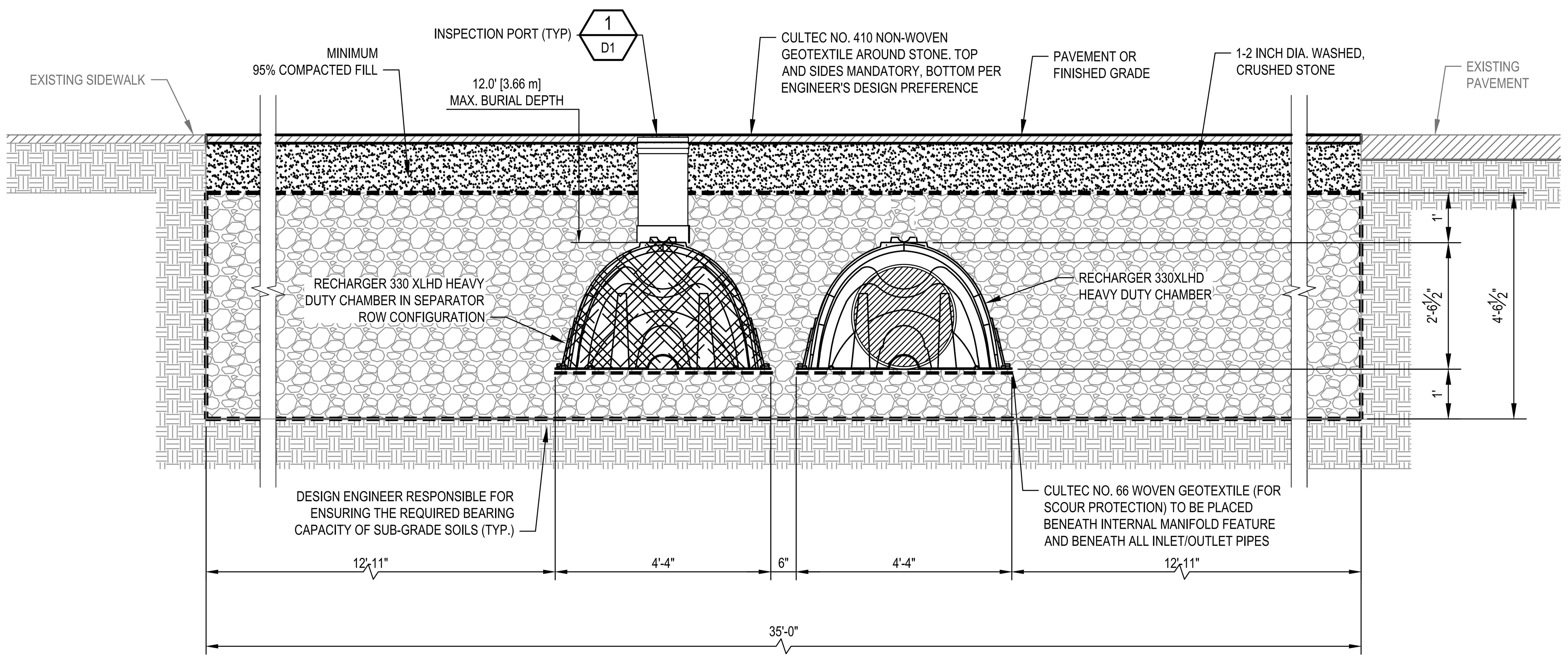
C4



A SECTION
D1 SCALE : NOT TO SCALE



TEST PITS
TEST PITS MUST BE CONDUCTED AT EACH LOCATION TO VERIFY SOILS AND SEASONAL HIGH WATER TABLE



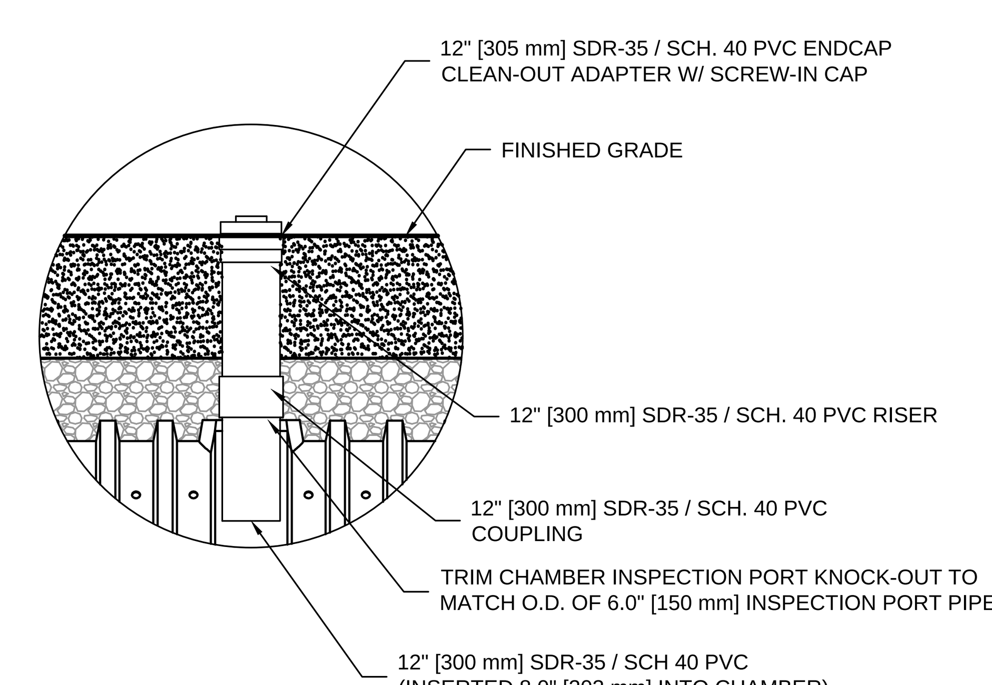
B SECTION
D1 SCALE : NOT TO SCALE

PLAN
CULTEC RECHARGER® 330
STORMWATER MANAGEMENT SYSTEM
NOT TO SCALE

MATERIALS LIST		
(SEE COVER SHEET FOR COMBINED PROJECT MATERIALS LIST)		
RECHARGER 330XLSHD STARTER	2	PIECES
RECHARGER 330XLIHD INTERMEDIATE	4	PIECES
RECHARGER 330XLEHD END	2	PIECES
CULTEC NO. 66 WOVEN GEOTEXTILE 7.5' x 300'	10	LINEAL FEET
SEPARATOR ROW MATERIALS LIST		
CULTEC NO. 410 NON-WOVEN GEOTEXTILE 7.5' x 300' (TO WRAP SEPARATOR ROW)	14.22	SQ. YDS
CULTEC NO. 66 WOVEN GEOTEXTILE 7.5' x 300' (BENEATH SEPARATOR ROW)	0.20	ROLLS

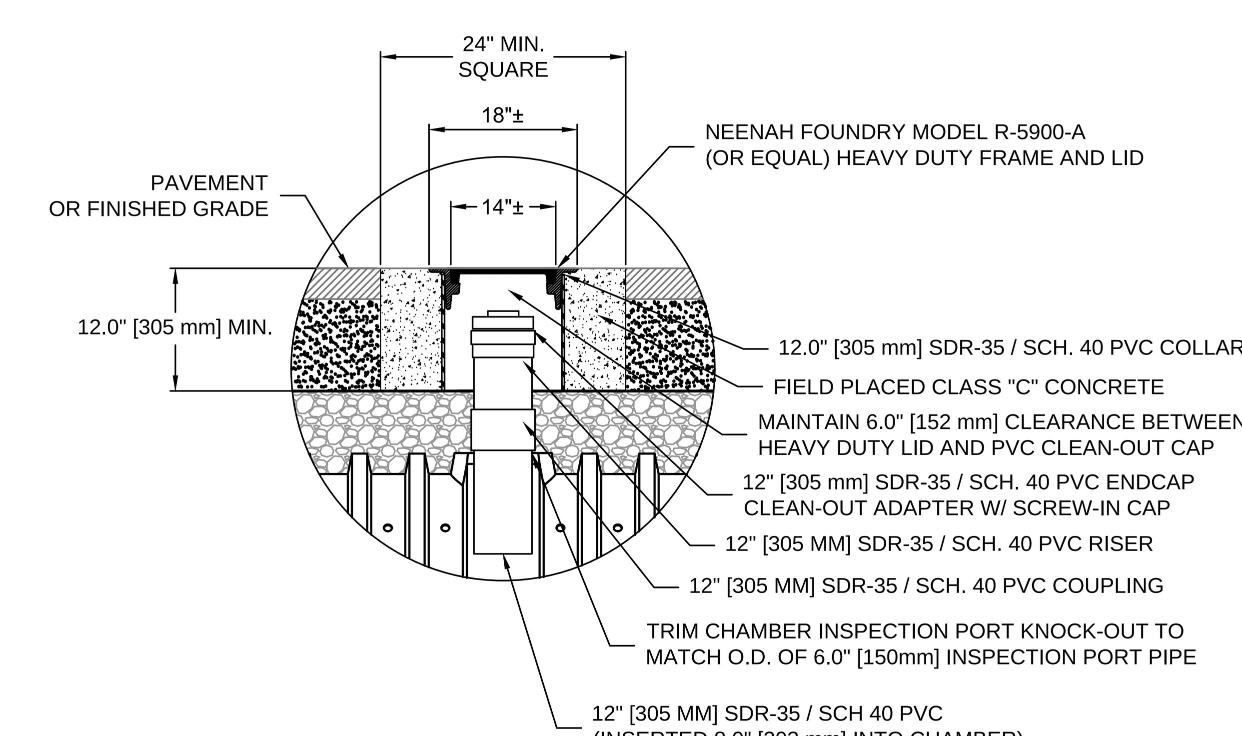
CULTEC RECHARGER® 330 XLHD LEGEND

- RECHARGER 330XLSHD STARTER
- RECHARGER 330XLIHD INTERMEDIATE
- RECHARGER 330XLEHD END
- CULTEC NO. 66 WOVEN GEOTEXTILE
- CULTEC NO. 410 NON-WOVEN GEOTEXTILE



BEYOND PAVED SURFACES

1 DETAIL
D1 SCALE : 3/4" = 1'-0"



WITHIN PAVED SURFACES

2 DETAIL
D1 SCALE : 3/4" = 1'-0"

NOTE:
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WATERSTONE ENGINEERING
INNOVATIVE STORMWATER MANAGEMENT
9 GRETA'S WAY
STRATHAM, NH 03885
(p) 603.686.2488

95% DESIGN FOR WATER INTEGRATION FOR SQUAMSCOTT - EXETER (WISE) INTEGRATED PLAN (IP) PHASE 1
LINCOLN STREET SUBWATERSHED NUTRIENT CONTROL STRATEGIES

PREPARED FOR:
TOWN OF EXETER
DEPT. OF PUBLIC WORKS
11 NEWFIELDS ROAD

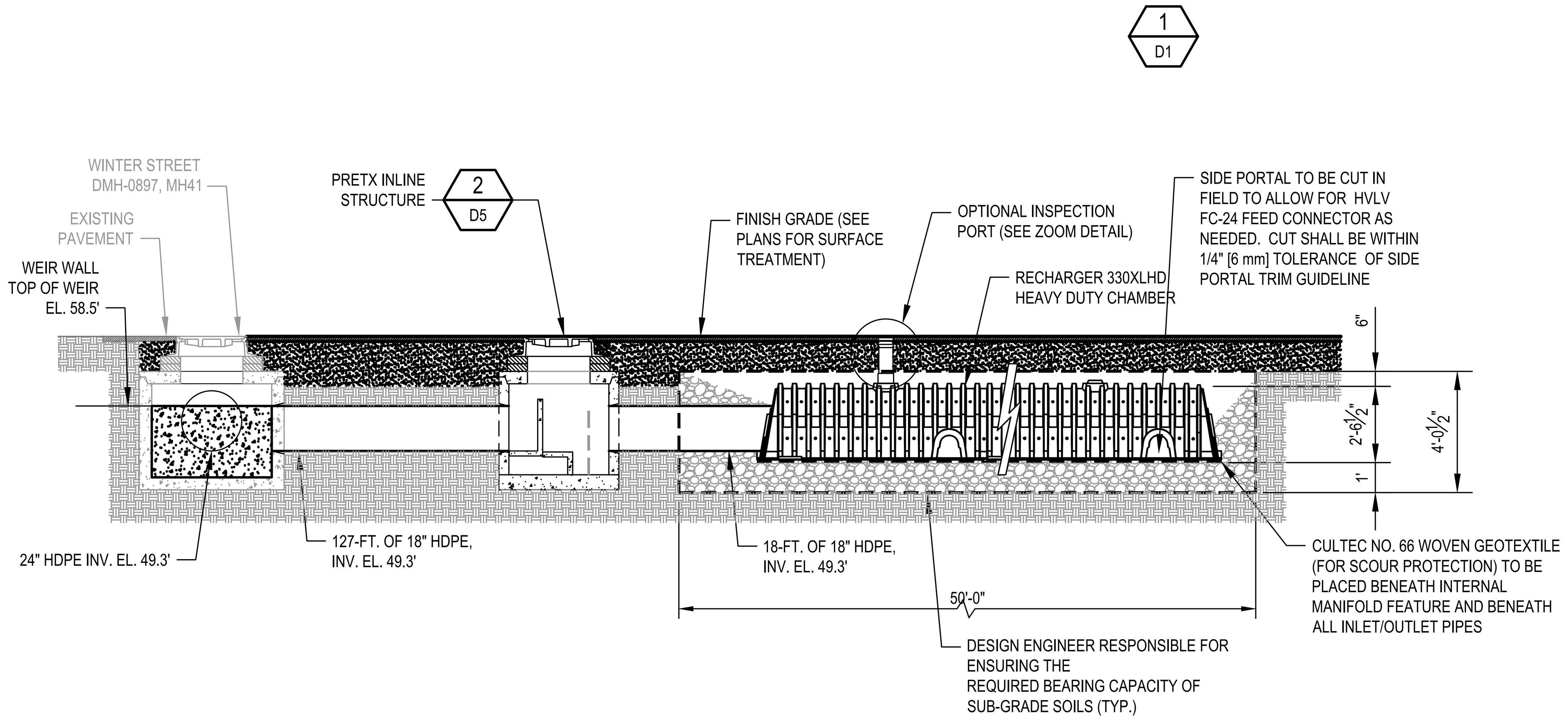
DESIGNED BY:	RR
DRAFTED BY:	CDS
CHECKED BY:	RR

STATE OF NEW HAMPSHIRE
ROBERT M. ROSEEN
No. 12215
LICENSED
PROFESSIONAL ENGINEER

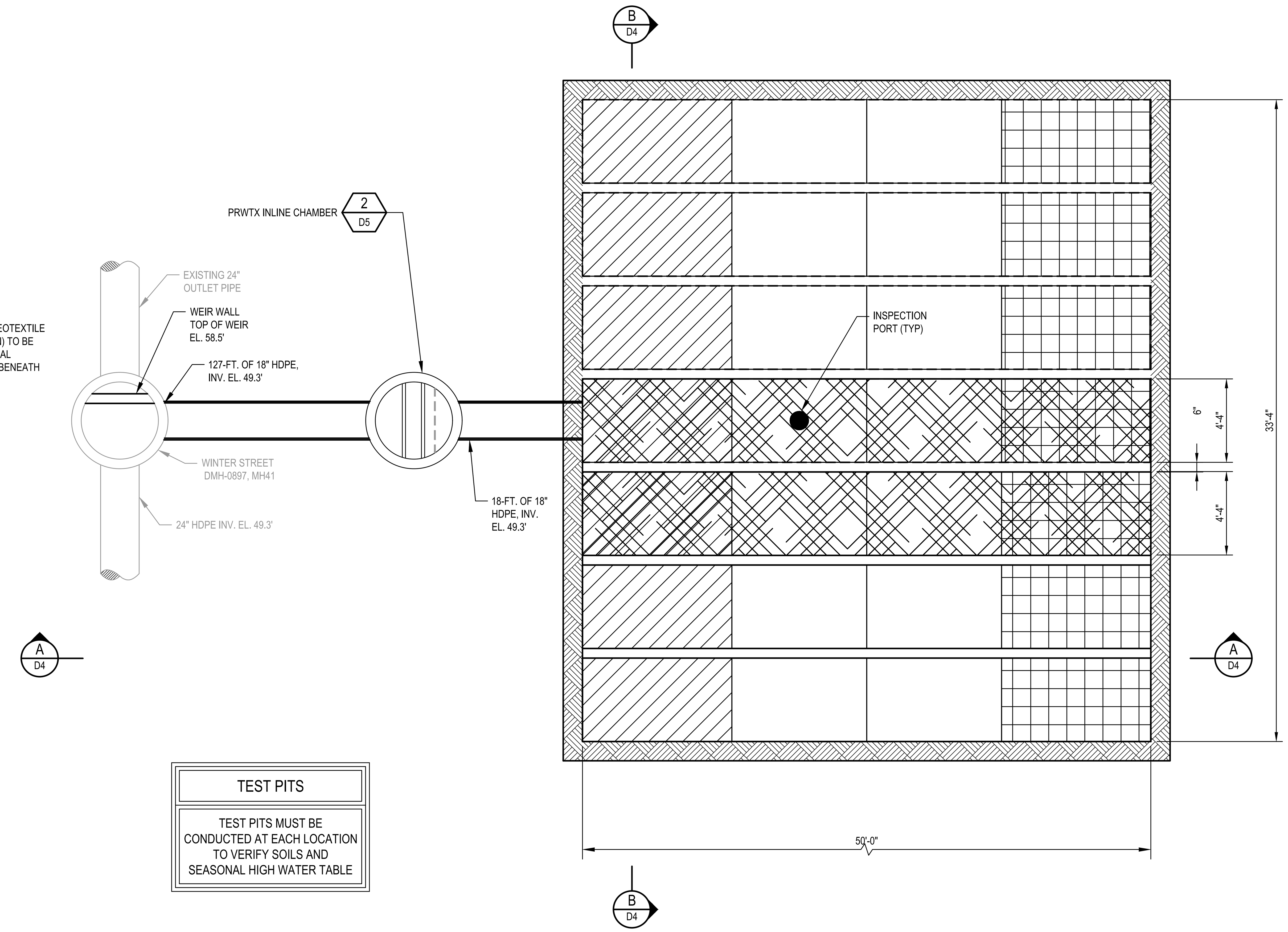
SUBSURFACE INFILTRATION BMP-1 DETAILS

JOB #:	16928
SCALE:	AS SHOWN
CONTRCT #:	N/A

D1

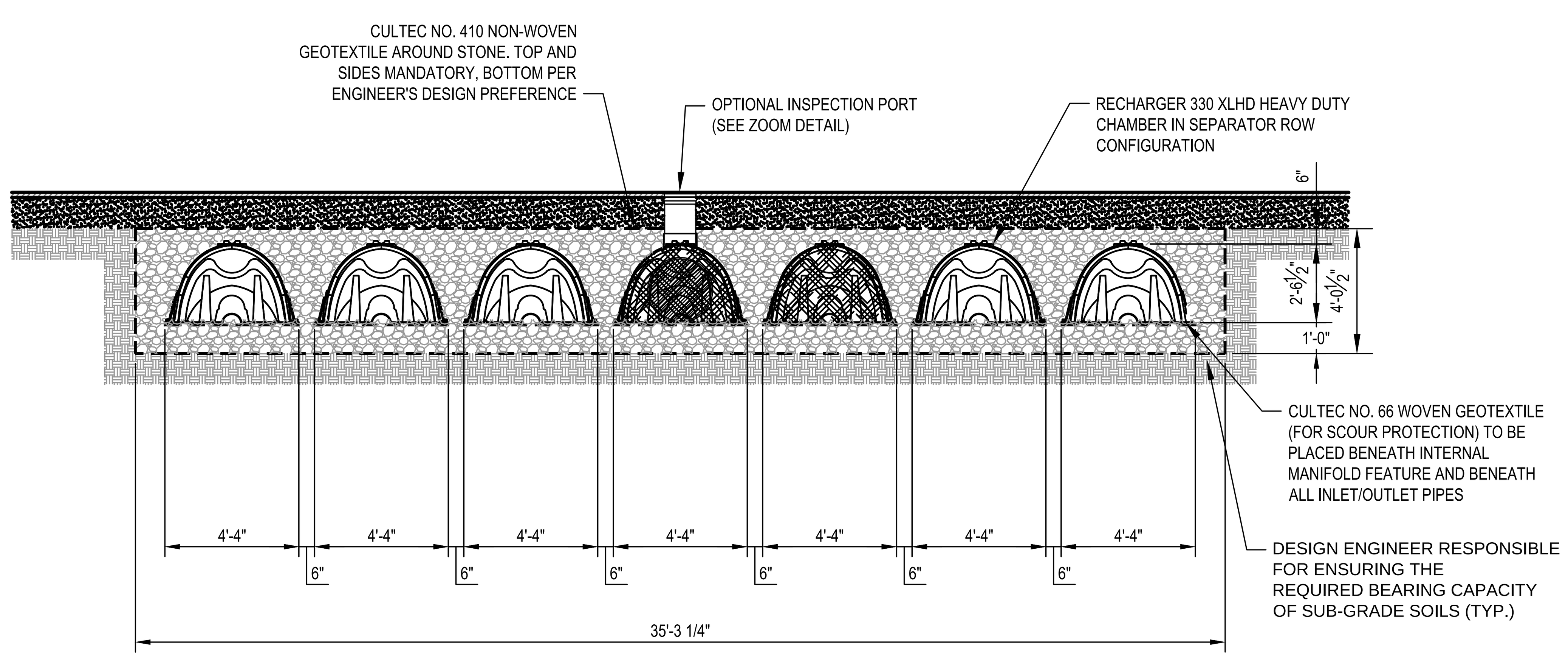


A
D4
SECTION
SCALE : NOT TO SCALE



PLAN
CULTEC RECHARGER® 330
STORMWATER MANAGEMENT SYSTEM
NOT TO SCALE

TEST PITS
TEST PITS MUST BE CONDUCTED AT EACH LOCATION TO VERIFY SOILS AND SEASONAL HIGH WATER TABLE



B
D4
SECTION
SCALE : NOT TO SCALE

MATERIALS LIST		
(SEE COVER SHEET FOR COMBINED PROJECT MATERIALS LIST)		
RECHARGER 330XLSHD STARTER	2	PIECES
RECHARGER 330XLIHD INTERMEDIATE	4	PIECES
RECHARGER 330XLEHD END	2	PIECES
CULTEC NO. 66 WOVEN GEOTEXTILE 7.5' x 300'	10	LINEAL FEET
SEPARATOR ROW MATERIALS LIST		
CULTEC NO. 410 NON-WOVEN GEOTEXTILE 7.5' x 300' (TO WRAP SEPARATOR ROW)	14.22	SQ. YDS
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CULTEC RECHARGER® 330 XLHD LEGEND

RECHARGER 330XLSHD STARTER

RECHARGER 330XLIHD INTERMEDIATE

RECHARGER 330XLEHD END

CULTEC NO. 66 WOVEN GEOTEXTILE

CULTEC NO. 410 NON-WOVEN GEOTEXTILE

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INNOVATIVE STORMWATER MANAGEMENT
9 GRETA'S WAY
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95% DESIGN FOR WATER INTEGRATION FOR SQUAMSCOTT - EXETER (WISE) INTEGRATED PLAN (IP) PHASE 1

LINCOLN STREET SUBWATERSHED NUTRIENT CONTROL STRATEGIES

PREPARED FOR:
TOWN OF EXETER
DEPT. OF PUBLIC WORKS
11 NEWFIELDS ROAD

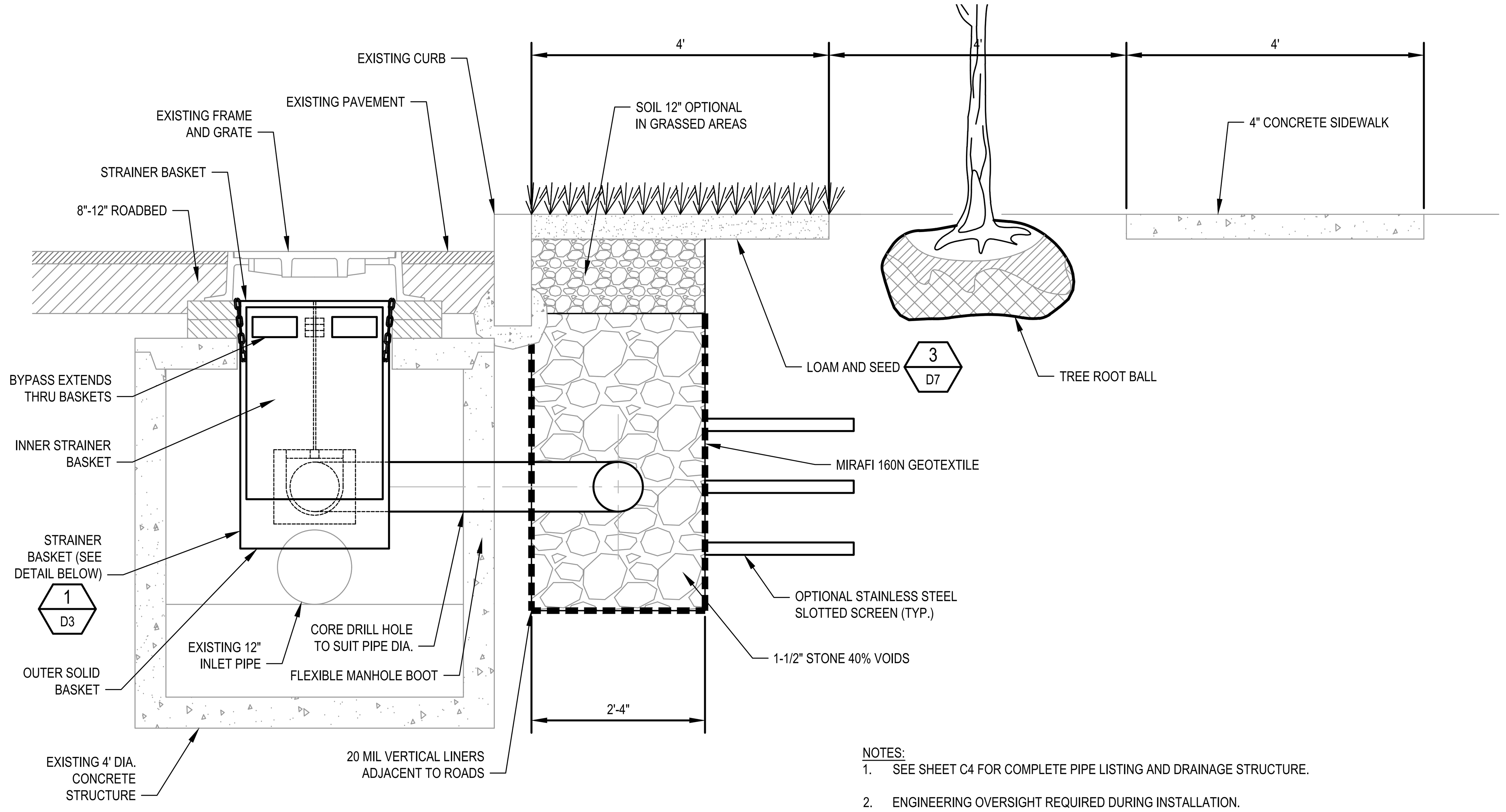
DESIGNED BY:	RR
DRAFTED BY:	CDS
CHECKED BY:	RR

STATE OF NEW HAMPSHIRE
ROBERT M. ROSEEN
No. 12215
LICENSED
PROFESSIONAL ENGINEER

BIOFILTER
BMP-2
DETAILS

JOB #:	16928
SCALE:	AS SHOWN
CONTRCT #:	N/A

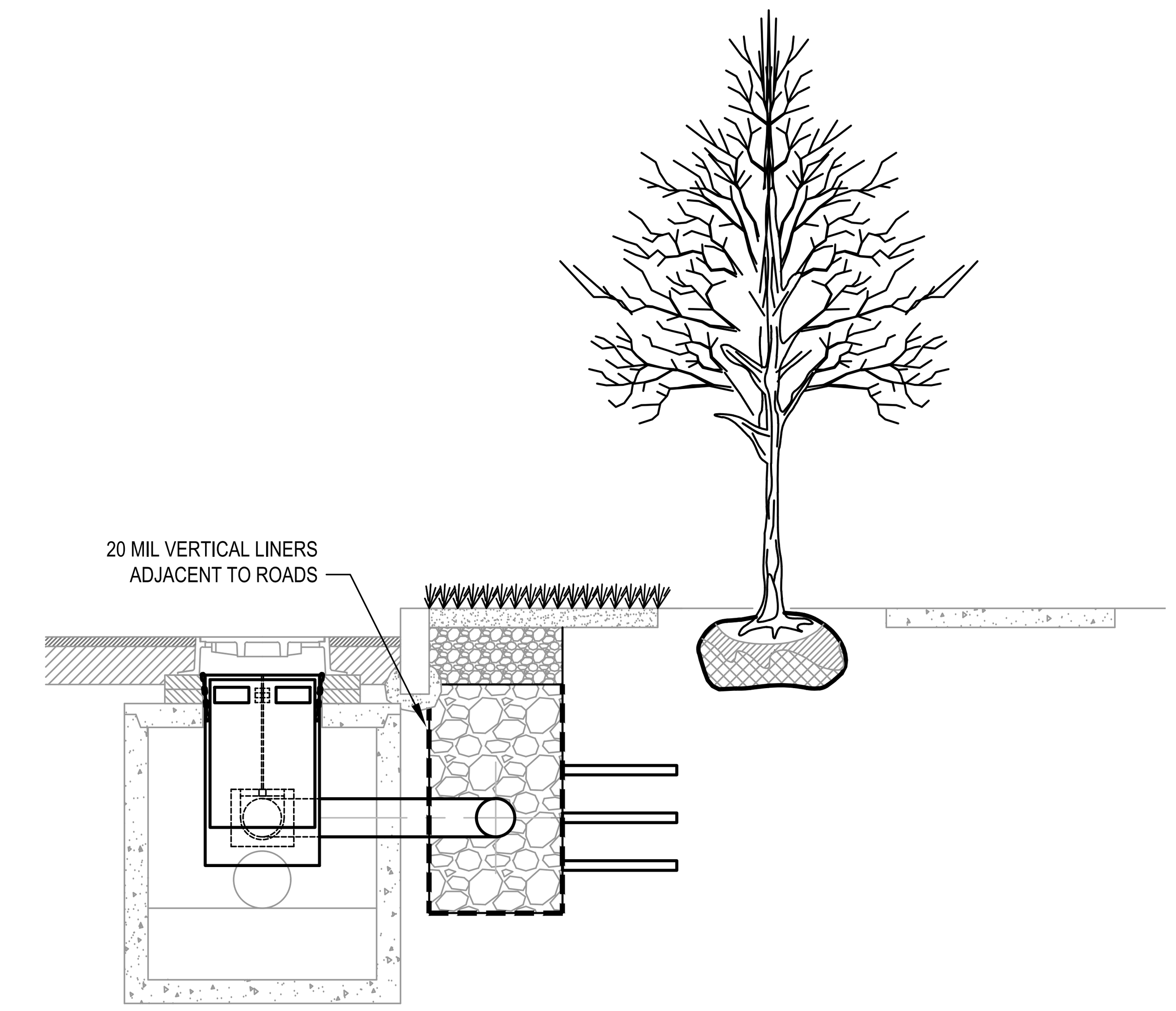
D2



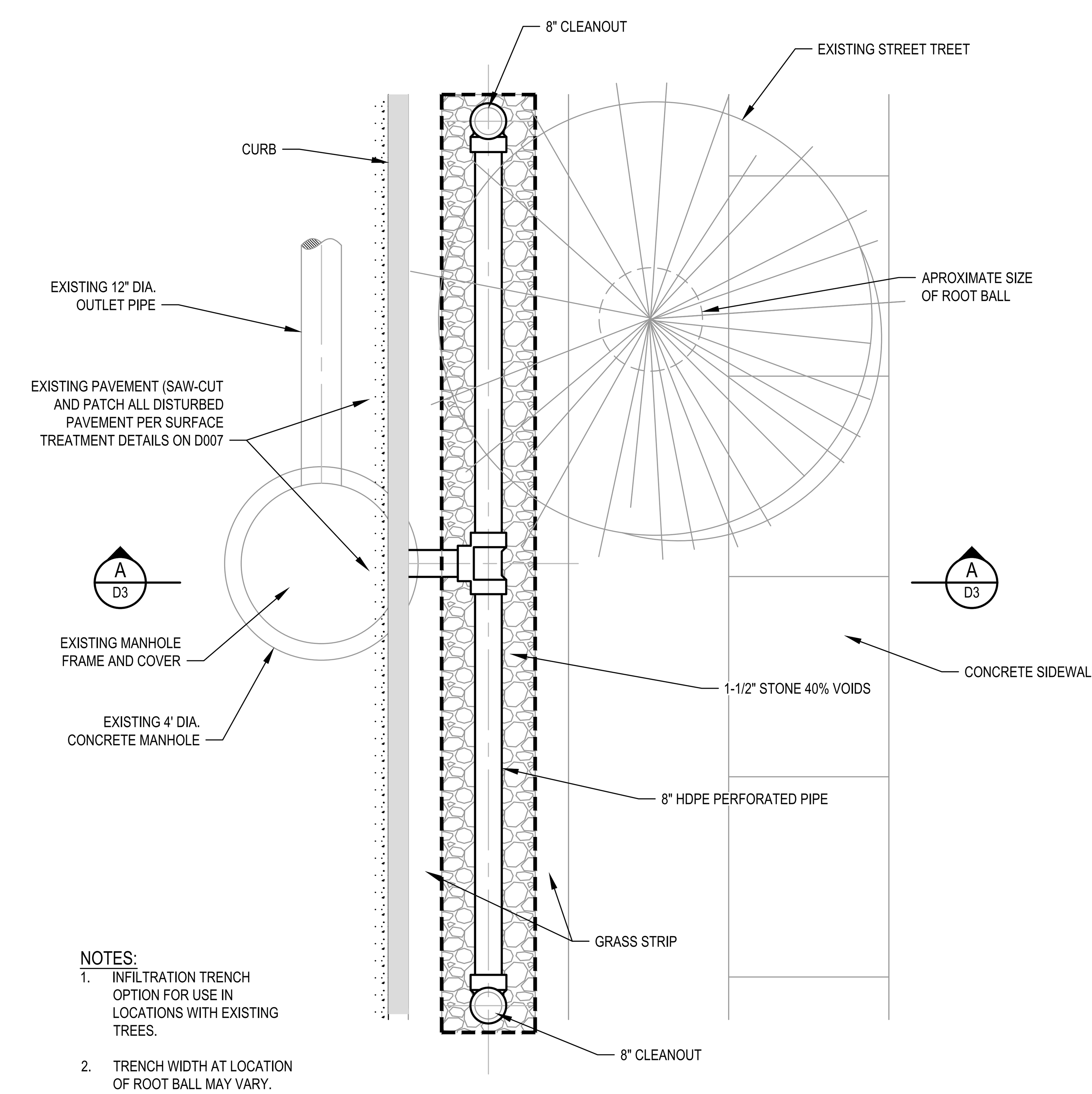
NOTES:
1. RIGHT OF WAY (ROW) INFILTRATION RETROFIT IS IDEAL FOR LOW COST RETROFITS OF EXISTING DRAINAGE INFRASTRUCTURE WHERE ROW EXIST.
2. ROW INFILTRATION RETROFIT INSTALL WITHIN EXISTING CATCH BASIN WITH CHAINS AND CLIPS TO HANG BELOW GRATE AND STRAIN AND REMOVE SOLIDS AND DEBRIS PRIOR TO INFILTRATION.
3. SOLIDS AND DEBRIS RETAINED IN INNER AND OUTER BASKETS.

NOTES:
1. SEE SHEET C4 FOR COMPLETE PIPE LISTING AND DRAINAGE STRUCTURE.
2. ENGINEERING OVERSIGHT REQUIRED DURING INSTALLATION.
3. PRESERVE EXISTING SIDEWALK, ROAD, CURB, CATCH BASIN AND TREES.
4. SYSTEMS DO NOT TIE INTO EXISTING DRAINAGE UNLESS LOW COST CONDUCTIVITY SOILS ARE PRESNET IN WHICH CASE PERFORATED UNDERDRAINS TIE INTO EXISTING CATCH BASINS AT BMP OUTLET.
5. ALL SYSTEMS INCLUDEACF PRETX PRETREATMENT SYSTEM FOR REMOVAL OF SEDIMENT, TRASH AND DEBRIS AND FOCUSED EASE OF MAINTENANCE AT MANHOLE BY VACTOR TRUCK.
6. ALL BYPASS IS BACK INTO ROAD AND GUTTERLINE AND INTO EXISTING STORM DRAINAGE INFRASTRUCTURE.
7. PVC LINER ON VERTICAL WALL AND AGAINST ROADBASE, ALL OTHER FACES GEOTEXTILE LINER.
8. STONE DEPTH AND WIDTH VARIES BASED ON AVAILABLE MEDIAN SIZE AND EXISTING INVERTS.

RIGHT-OF-WAY RETROFIT DETAIL
SCALE: NOT TO SCALE

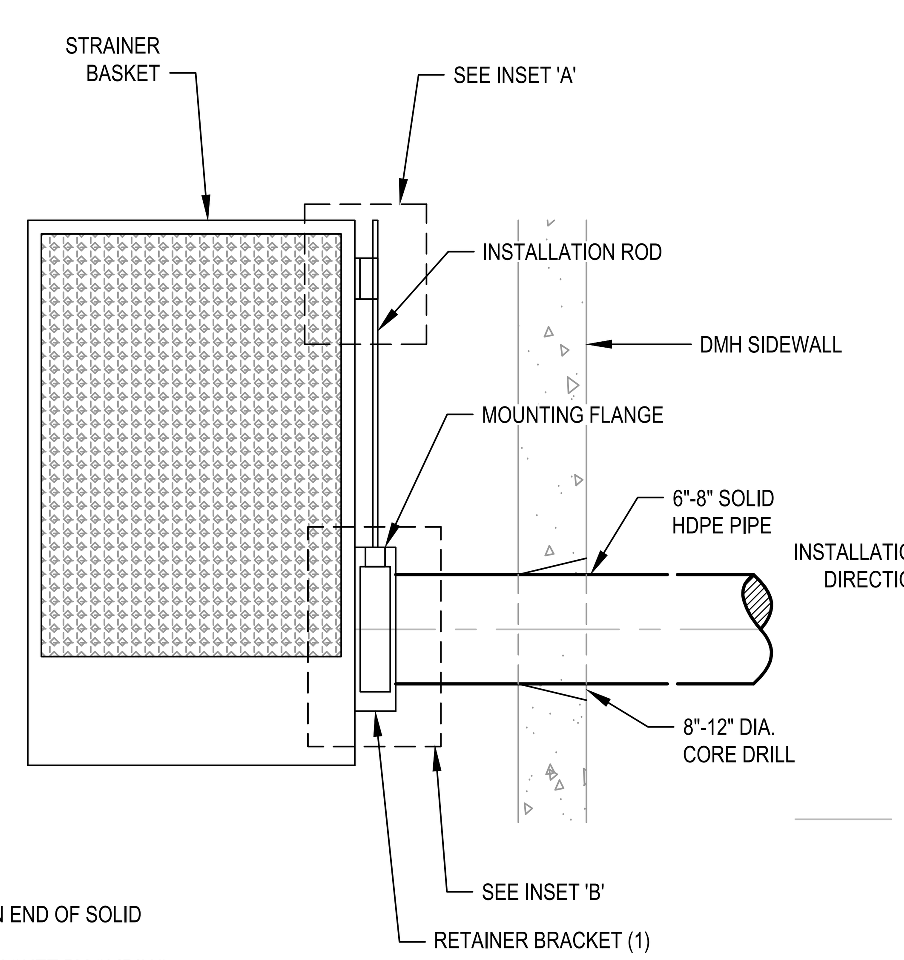


A SECTION
D3
SCALE : NOT TO SCALE



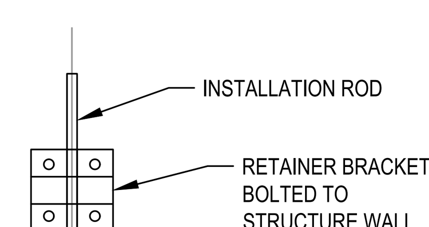
NOTES:
1. INFILTRATION TRENCH OPTION FOR USE IN LOCATIONS WITH EXISTING TREES.
2. TRENCH WIDTH AT LOCATION OF ROOT BALL MAY VARY.

ALT B TYPICAL TREE TRENCH INFILTRATION DETAIL
SCALE: NOT TO SCALE

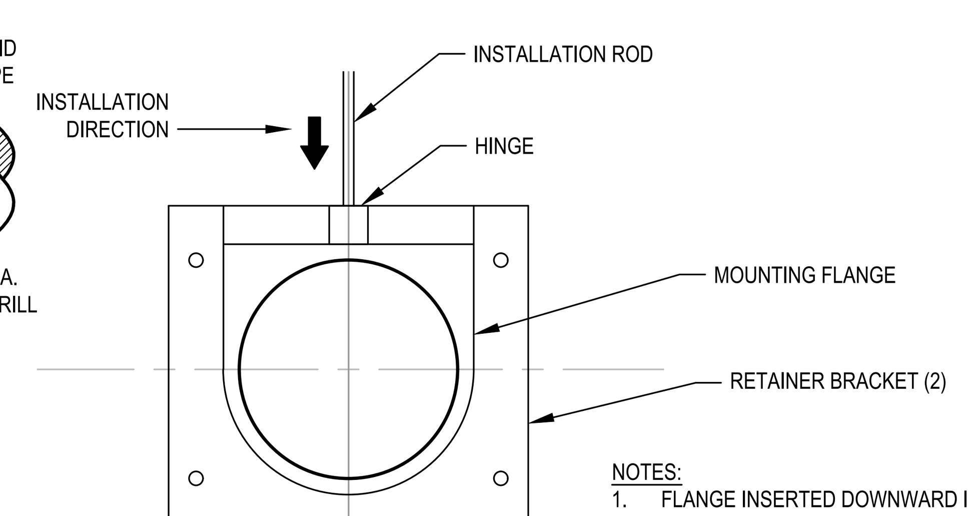


INSTALLATION PROCESS:
1. MOUNTING FLANGE INSTALLED ON END OF SOLID PIPE.
2. PIPE CONNECTED TO STRAINER BASKET BY SLIDING FLANGE INTO RETAINER BRACKET(1) WITH INSTALLATION ROD.
3. INSTALLATION ROD FIXED INTO PLACE BY RETAINER BRACKET (2).
4. REMOVAL IS REVERSE PROCEDURE.
5. HDPE BSKET AND STRAINER WITH 3/8" OPENINGS.

1 STRAINER BASKET CONNECTION DETAIL
D3
SCALE: NOT TO SCALE



INSET DETAIL 'A'
SCALE: NOT TO SCALE



NOTES:
1. FLANGE INSERTED DOWNWARD INTO BRACKET (1)
2. ROD FIXED IN PLACE WITH BRACKET (2)

INSET DETAIL 'B'
SCALE: NOT TO SCALE

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WATERSTONE ENGINEERING
INNOVATIVE STORMWATER MANAGEMENT
9 GRETA'S WAY
STRATHAM, NH 03885
(p) 603.686.2488

95% DESIGN FOR WATER INTEGRATION FOR SQUAMSCOTT - EXETER (WISE) INTEGRATED PLAN (IP) PHASE 1

LINCOLN STREET SUBWATERSHED NUTRIENT CONTROL STRATEGIES

PREPARED FOR:
TOWN OF EXETER
DEPT. OF PUBLIC WORKS
11 NEWFIELDS ROAD

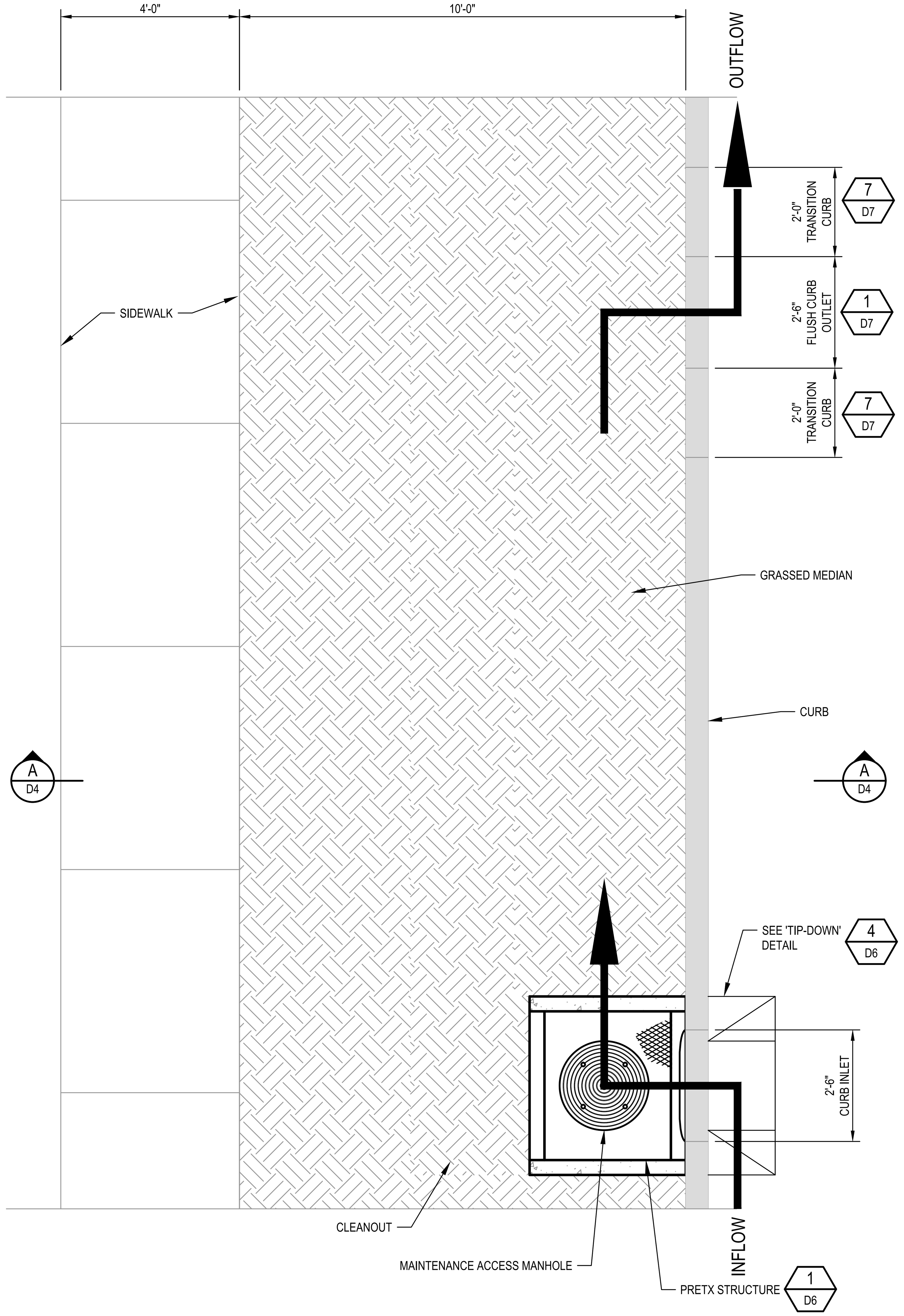
DESIGNED BY: RR
DRAFTED BY: CDS
CHECKED BY: RR

STATE OF NEW HAMPSHIRE
ROBERT M. ROSEEN
No. 12214
LICENSED PROFESSIONAL ENGINEER

RIGHT-OF-WAY INFILTRATION DETAILS

JOB #: 16928
SCALE: AS SHOWN
CONTRCT #: N/A

D3



1 D4 TYPICAL GRASSED BIOSWALE DETAIL

SCALE: NOT TO SCALE

NOTES:

1. SEE SHEET C4 FOR COMPLETE PIPE LISTING AND DRAINAGE STRUCTURE.
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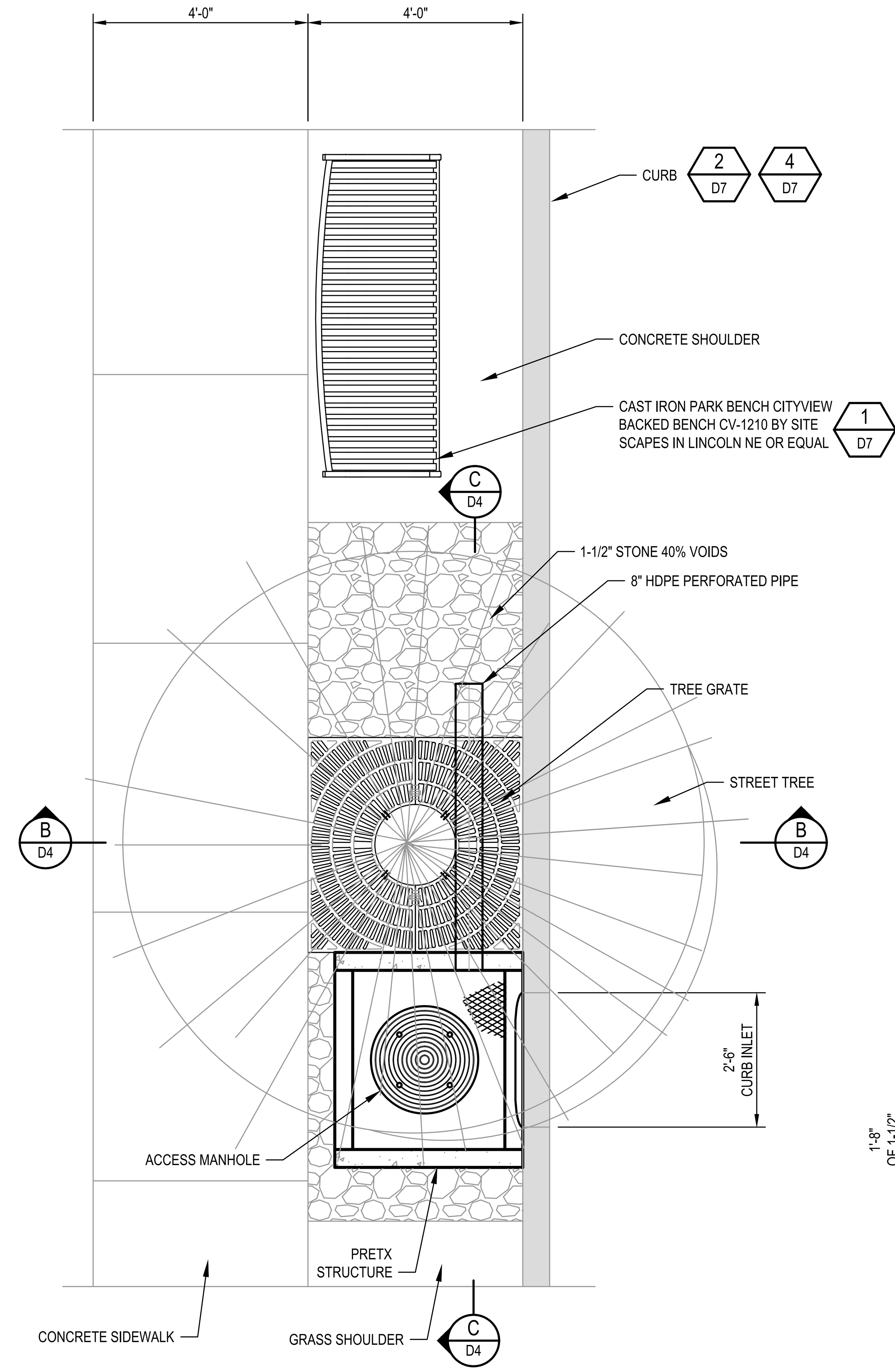
7. PVC LINER ON VERTICAL WALL AND AGAINST ROADBASE, ALL OTHER FACES GEOTEXTILE LINER.
8. STONE DEPTH AND WIDTH VARIES BASED ON AVAILABLE MEDIAN SIZE AND EXISTING INVERTS.

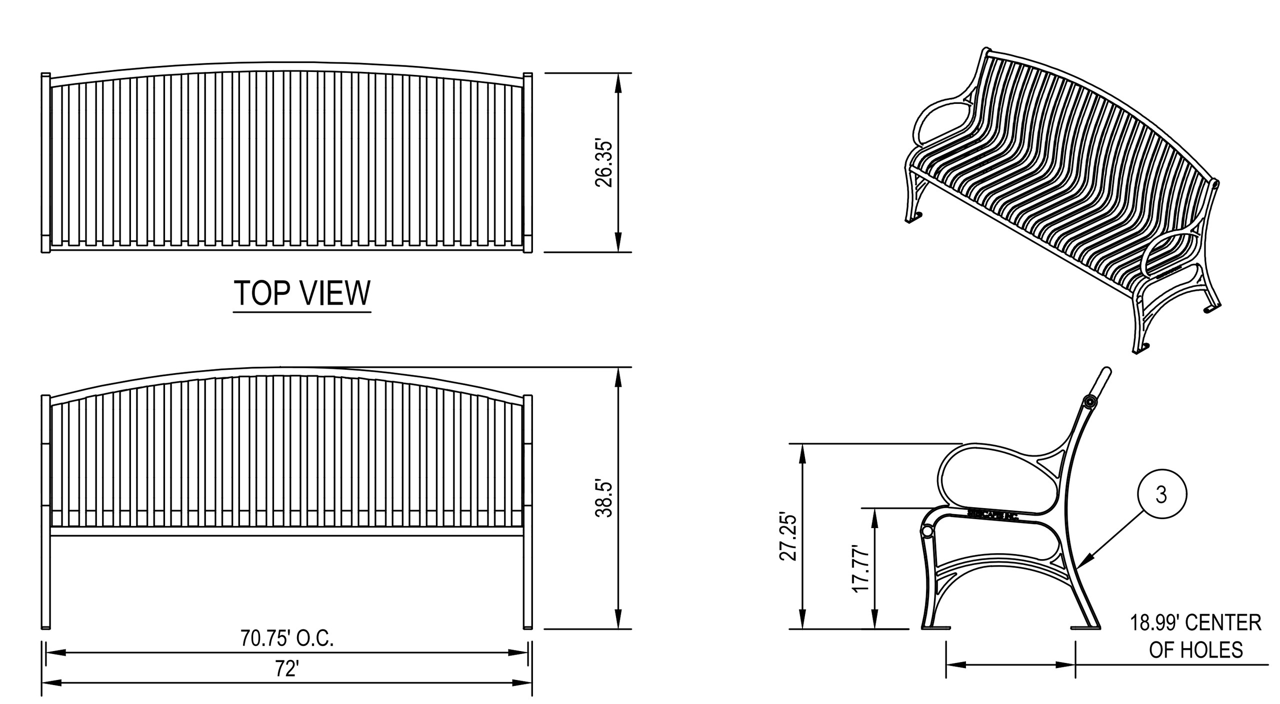
NOTES:

1. BIORETENTION SOIL MIX SHALL CONSIST OF 30% LOAM, 5% WATER TREATMENT RESIDUALS, 65% SAND.
2. DO NOT COMPACT SUBGRADE AT BOTTOM OF EXCAVATION.
3. NO BIORETENTION SOIL MIX SHALL BE PLACED UNTIL AFTER ENGINEERING APPROVAL AND INSPECTION OF SUBGRADE.
4. SEE DRAINAGE PLAN FOR STRUCTURE ELEVATION AND INVERTS, PIPE TYPE, LENGTH AND SLOPE, AND BIORETENTION AREA DIMENSIONS.
5. GRAVEL DEPTH MAY VARY FOR STORAGE.



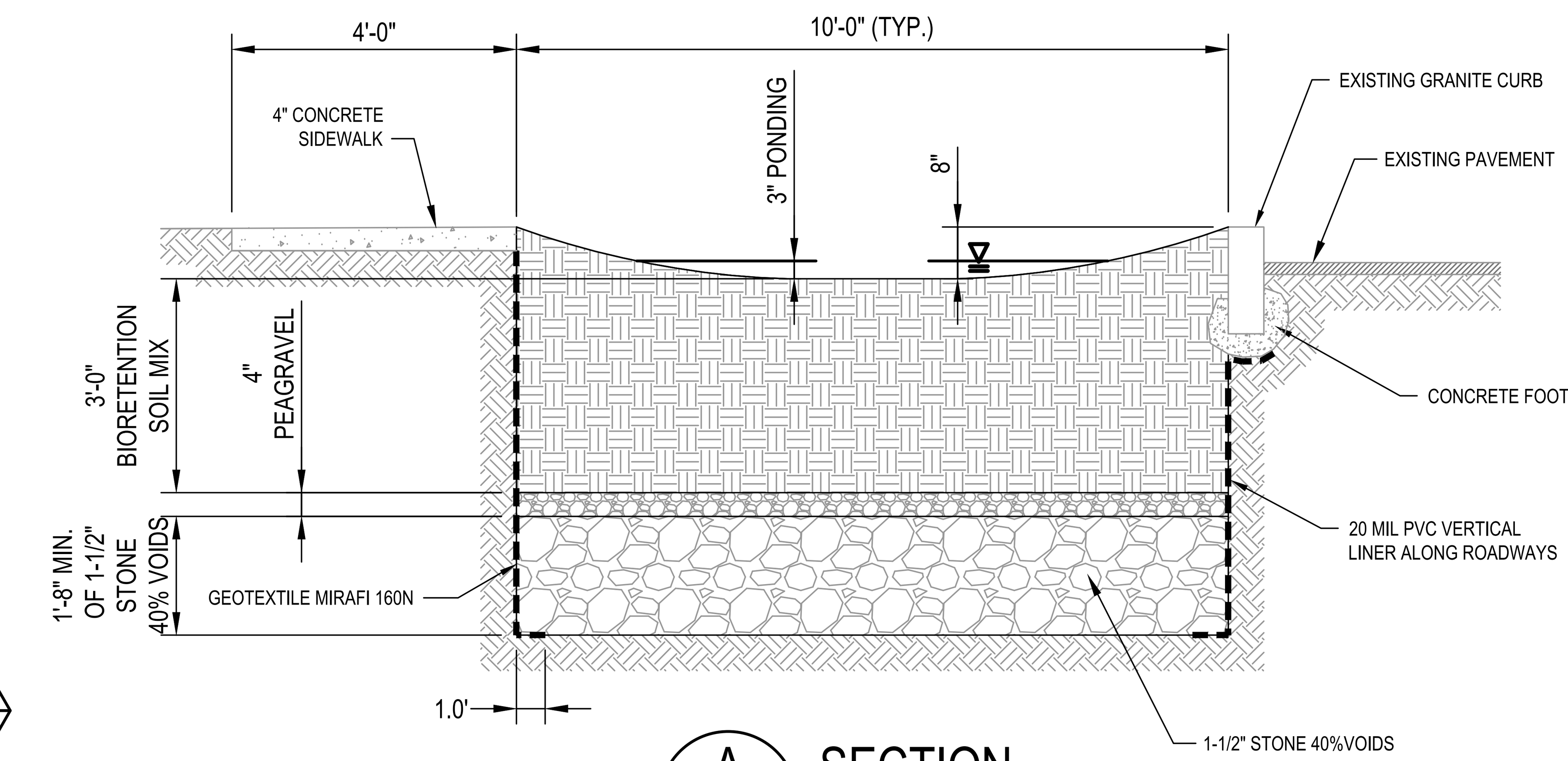
2 D4 ALT A TYPICAL TREE PLANTER DETAIL

SCALE: NOT TO SCALE



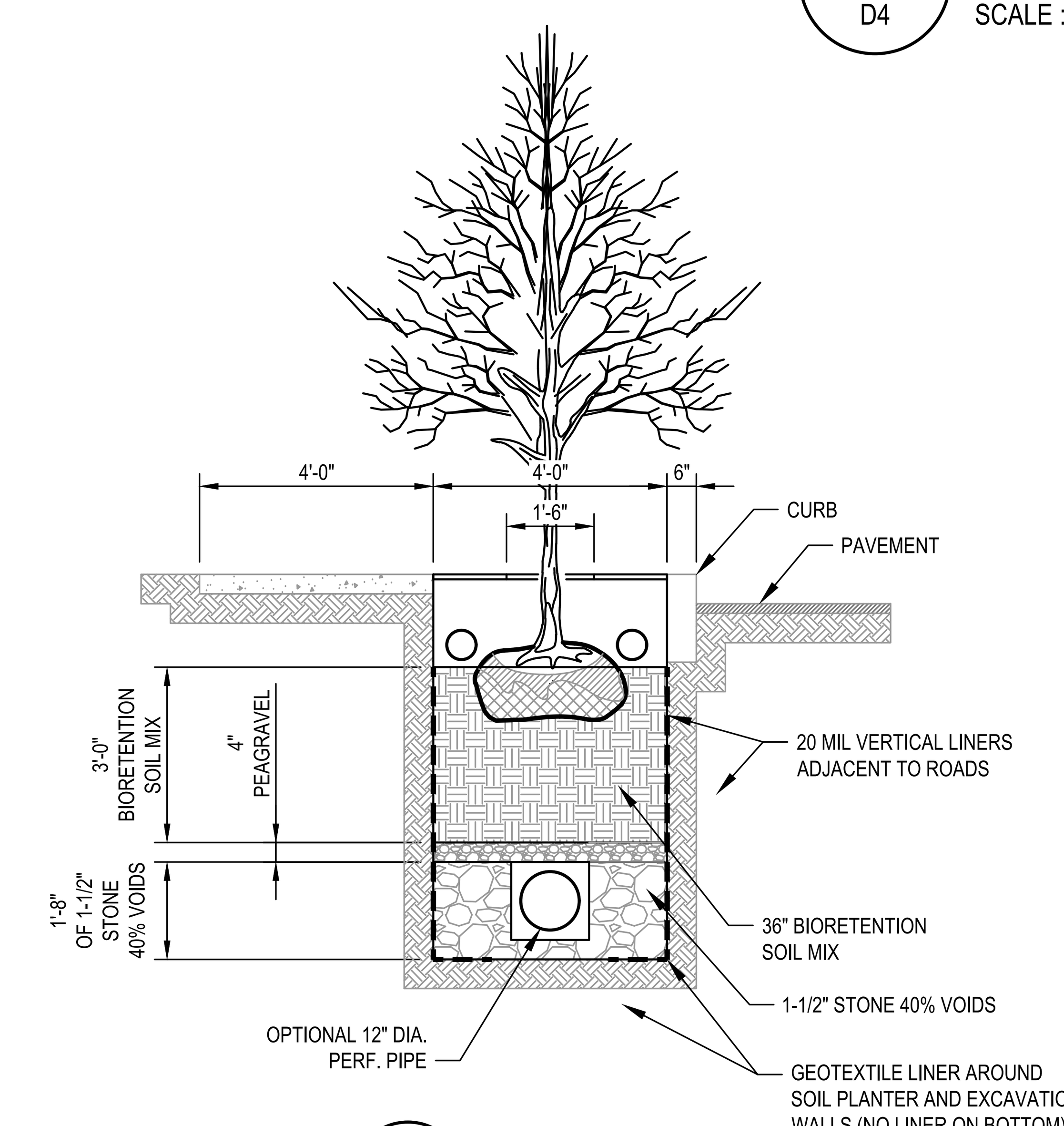
3 D4 PARK BENCH DETAIL

SCALE: NOT TO SCALE



A D4 SECTION

SCALE : NOT TO SCALE



B D4 SECTION

SCALE : NOT TO SCALE

TEST PITS
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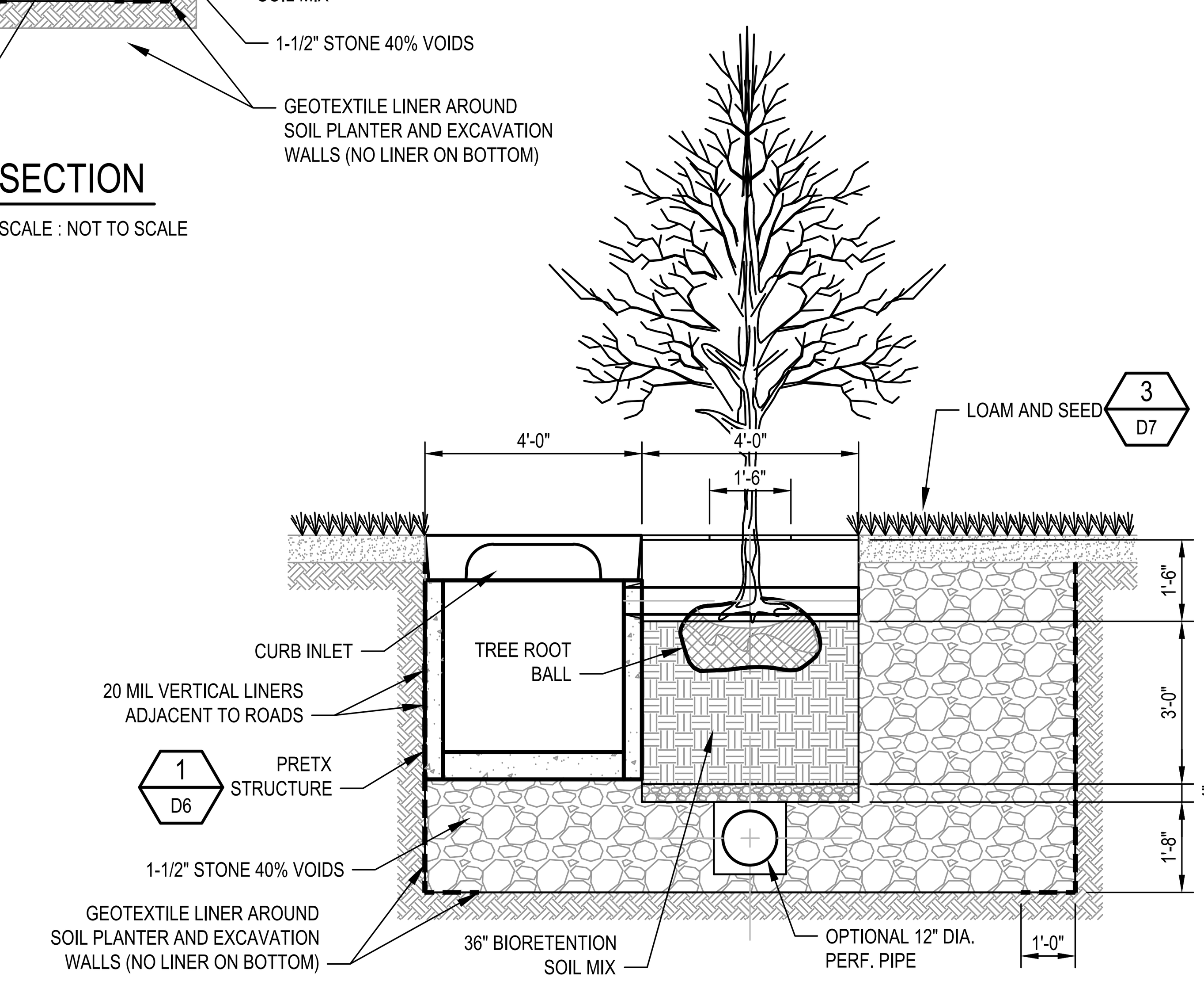

C D4 SECTION

SCALE : NOT TO SCALE

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WATERSTONE ENGINEERING

INNOVATIVE STORMWATER MANAGEMENT

9 GRETA'S WAY
STRATHAM, NH 03885
(p) 603.686.2488

95% DESIGN FOR WATER INTEGRATION FOR SQUAMSCOTT - EXETER (WISE) INTEGRATED PLAN (IP) PHASE 1

LINCOLN STREET SUBWATERSHED NUTRIENT CONTROL STRATEGIES

PREPARED FOR:
TOWN OF EXETER
DEPT. OF PUBLIC WORKS
11 NEWFIELDS ROAD

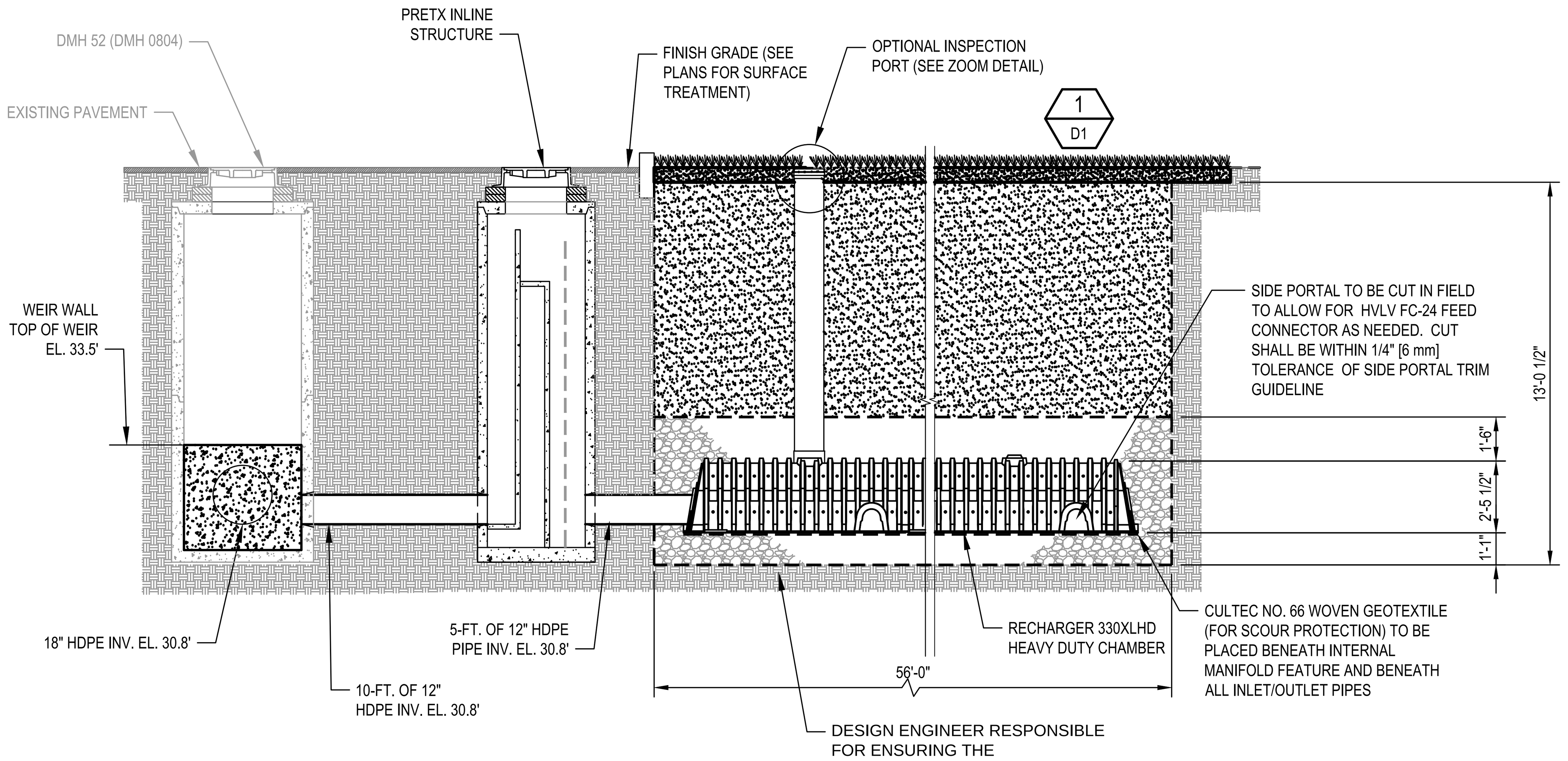
DESIGNED BY:	RR
DRAFTED BY:	CDS
CHECKED BY:	RR

STATE OF NEW HAMPSHIRE
ROBERT M. ROSEEN
No. 12214
LICENSED PROFESSIONAL ENGINEER

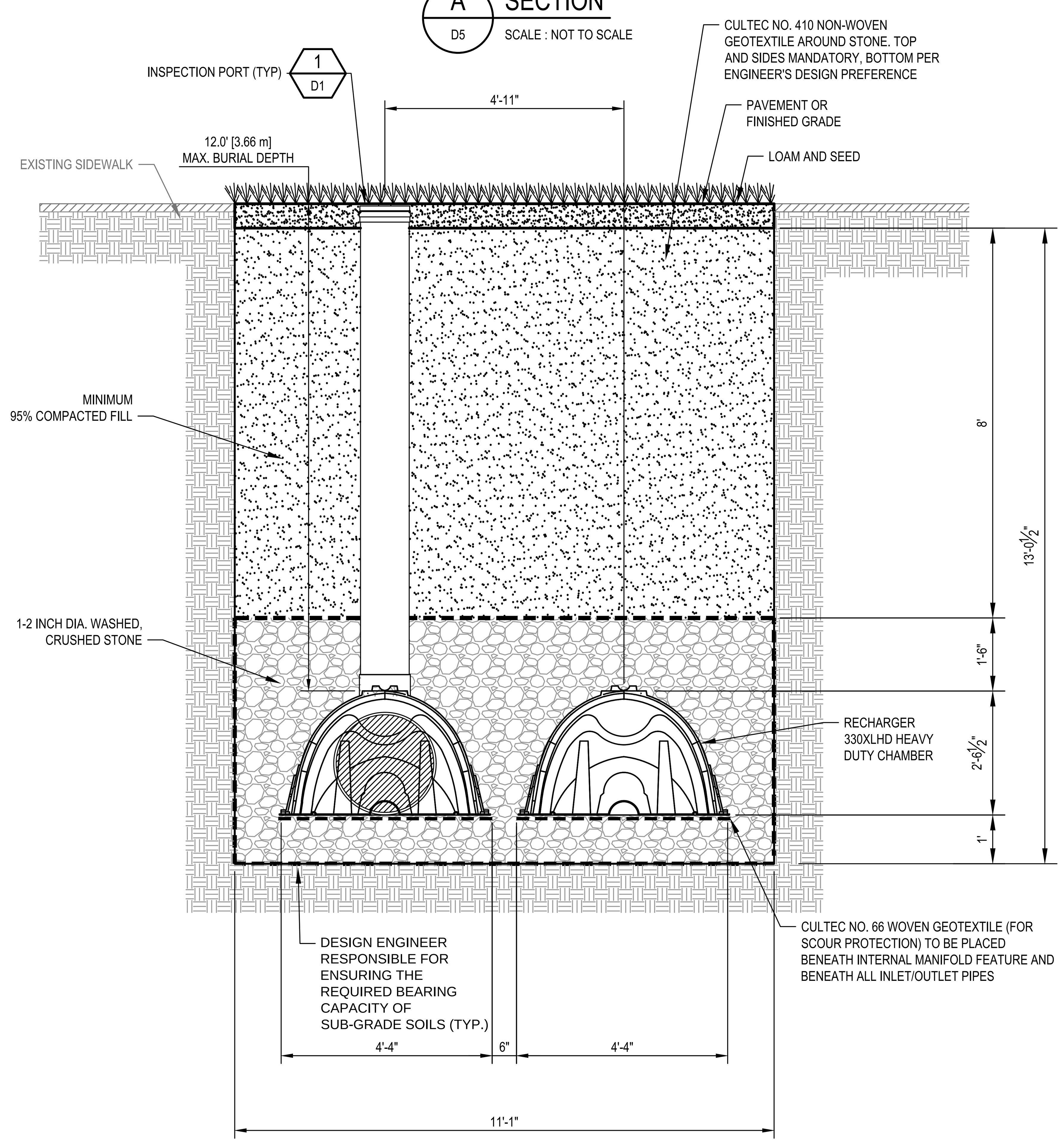
TREE PLANTER AND BIOSWALE DETAILS

JOB #:	16928
SCALE:	AS SHOWN
CONTRCT #:	N/A

D4



A SECTION
D5 SCALE : NOT TO SCALE



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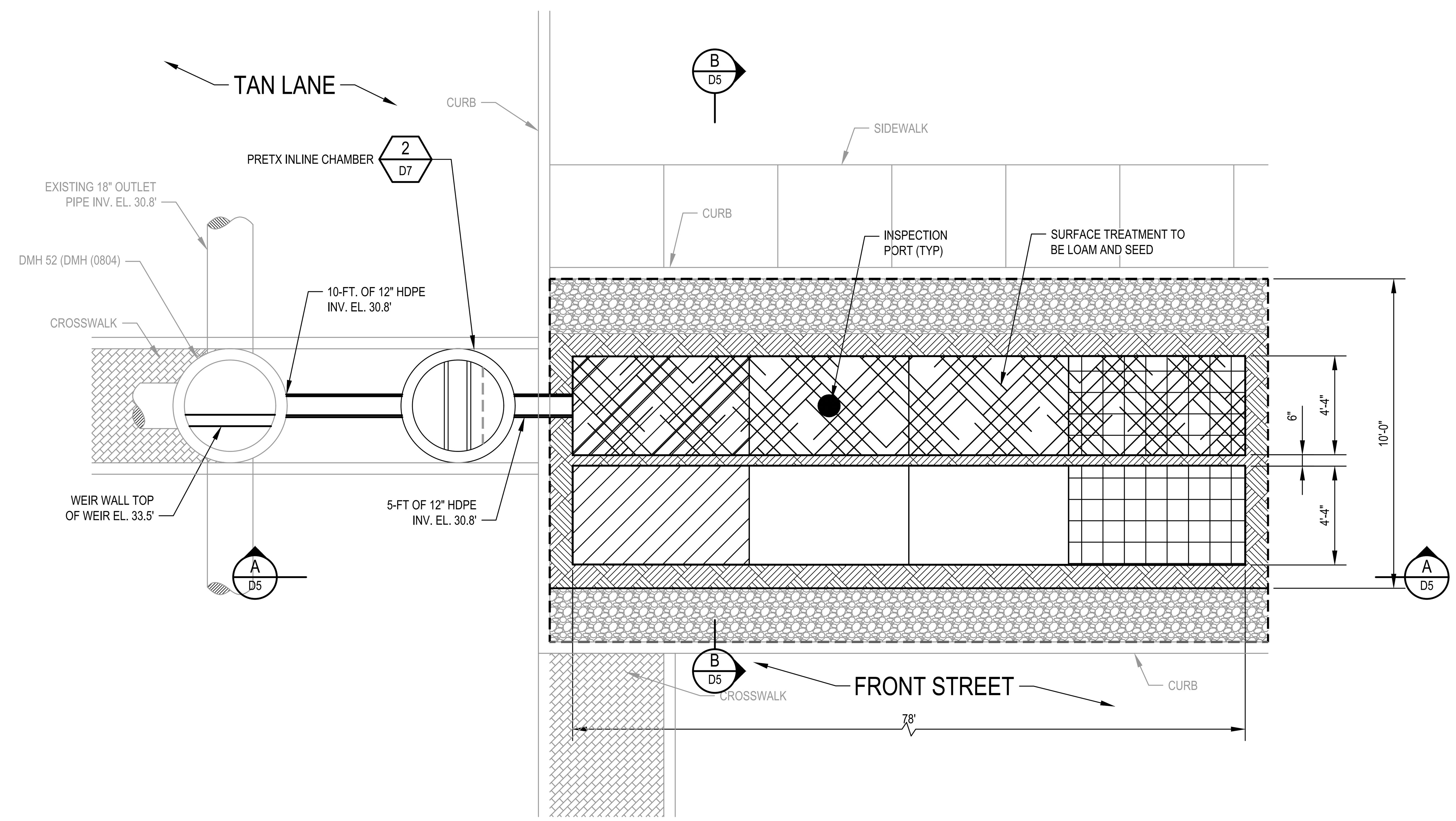
2. UNDERGROUND UTILITIES SHOWN ARE APPROXIMATE. EXACT LOCATIONS OF EXISTING UNDERGROUND UTILITIES SHALL BE DETERMINED BY THE CONTRACTOR IN THE FIELD PRIOR TO CONSTRUCTION.

B SECTION
D5 SCALE : NOT TO SCALE



PLAN
CULTEC RECHARGER® 330
STORMWATER MANAGEMENT SYSTEM
NOT TO SCALE

TEST PITS
TEST PITS MUST BE CONDUCTED AT EACH LOCATION TO VERIFY SOILS AND SEASONAL HIGH WATER TABLE

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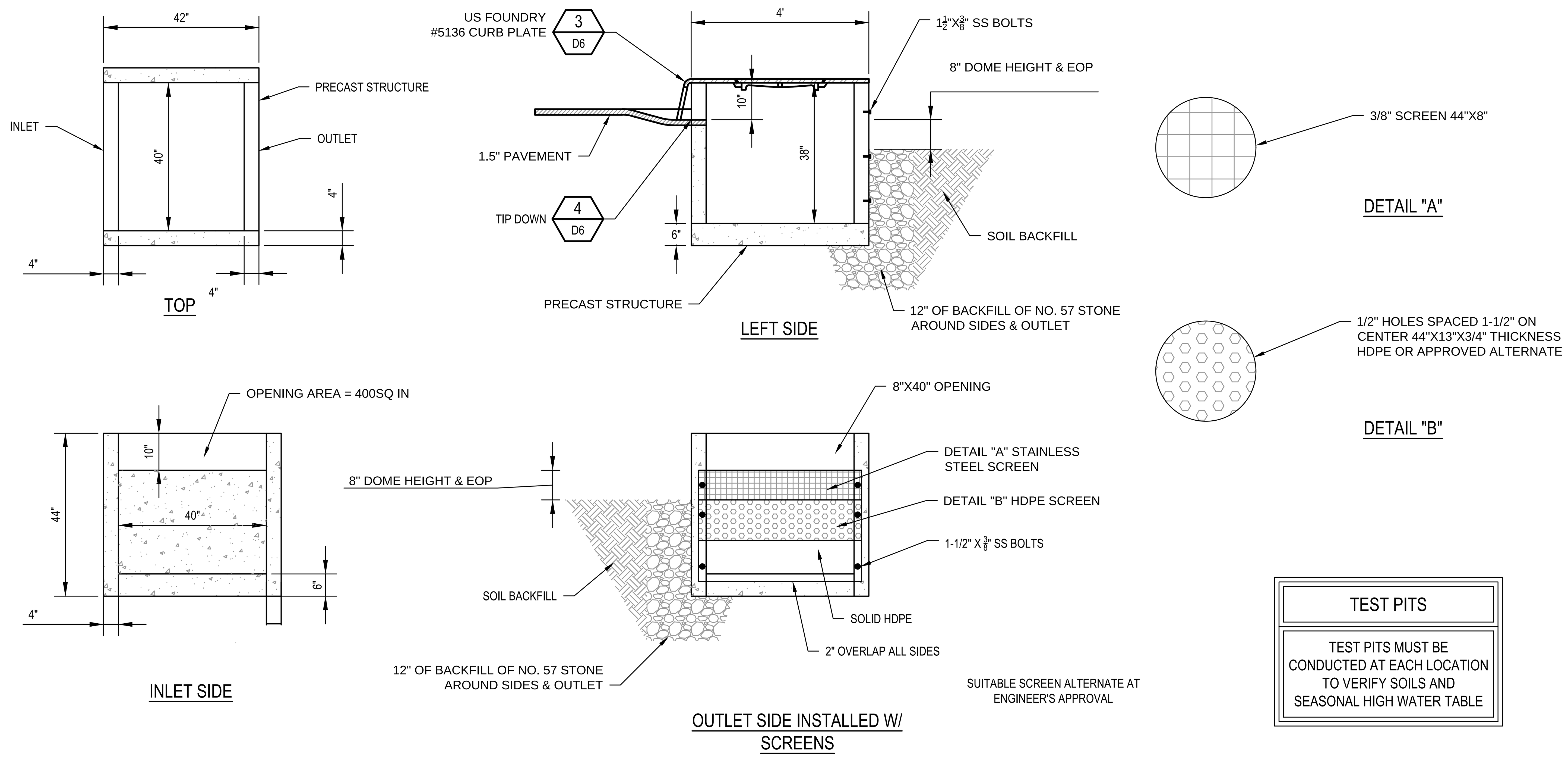
LICENSED
PROFESSIONAL ENGINEER

BIOFILTER
BMP-5
DETAILS

JOB #: 16928
SCALE: AS SHOWN
CONTRCT #: N/A

D5



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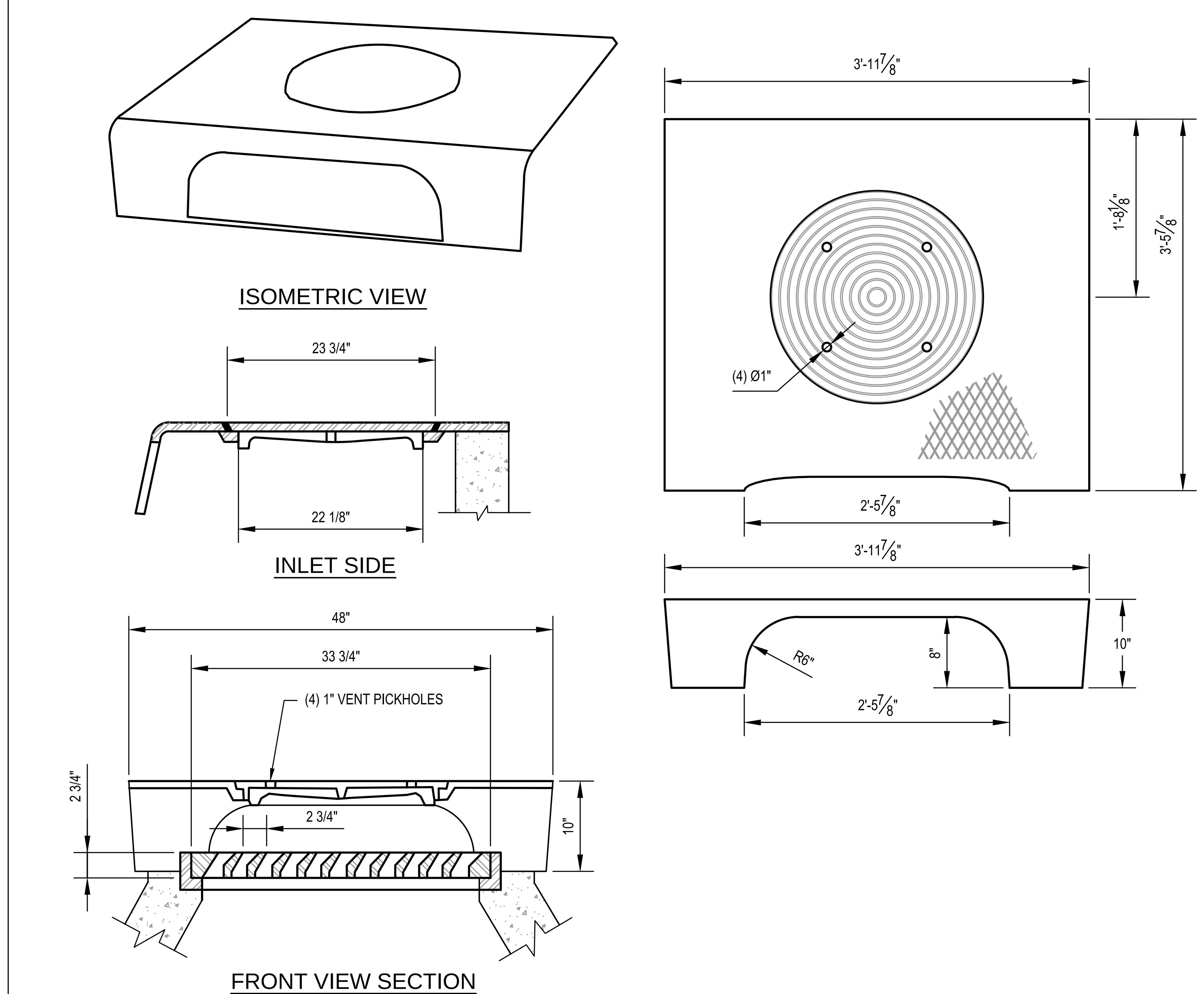
1 D6 ACF PRETX PRETREATMENT DETAIL

NOT TO SCALE



3 D6 USF-5136 CURB PLATE

NOT TO SCALE

PRETX SPECIFICATIONS

I. GENERAL

THE PRE-TX SYSTEM IS A PRE-FILTER AND CRITICAL MAINTENANCE DEVICE THAT EXTENDS THE OPERATING LIFE AND REDUCES THE MAINTENANCE BURDEN OF BIOFILTRATION SYSTEMS BY FILTERING OUT TRASH AND DEBRIS FROM THE INLET.

II. APPLICATION AND BENEFITS

PRETX CAN BE USED IN REPLACE OF CATCH BASINS AT A COMPARABLE PRICE. IT FUNCTIONS AS AN INLET PRE-FILTER FOR BIORETENTION SYSTEMS, PRE-FILTER FOR STORMWATER PLANTERS, PRE-FILTER FOR INFILTRATION SYSTEMS.

THE PRE-FILTER ENABLES THE SIMPLIFIED MAINTENANCE OF BIOFILTRATION SYSTEMS AT THE INLET IN AN ACCESSIBLE LOCATION WITH NO SPECIAL EQUIPMENT REQUIRED. THE ABSENCE OF A PRE-FILTER MAY ALLOW TRASH AND DEBRIS TO PREMATURELY CLOG THE BIOFILTRATION MEDIA OR INFILTRATION BED. THE RAPID ACCUMULATION OF TRASH AND DEBRIS CAN REQUIRE FREQUENT MAINTENANCE FOR AESTHETICS IN HIGH LOADING LAND USES AND REDUCE THE INFILTRATION RATE OF FILTRATION MEDIA.

INSTALLATION IS SIMPLE AND COMPARABLE TO COMMON CATCH BASINS AND GRATES AND REQUIRES NO SPECIAL TOOLS OUR TRAINING.

THE PRE-TX IS MADE OF PRE-CAST CONCRETE, HDPE, AND STAINLESS STEEL AND IS RESISTANT TO RUST AND ROT FROM CORROSIVE WINTER RUNOFF.

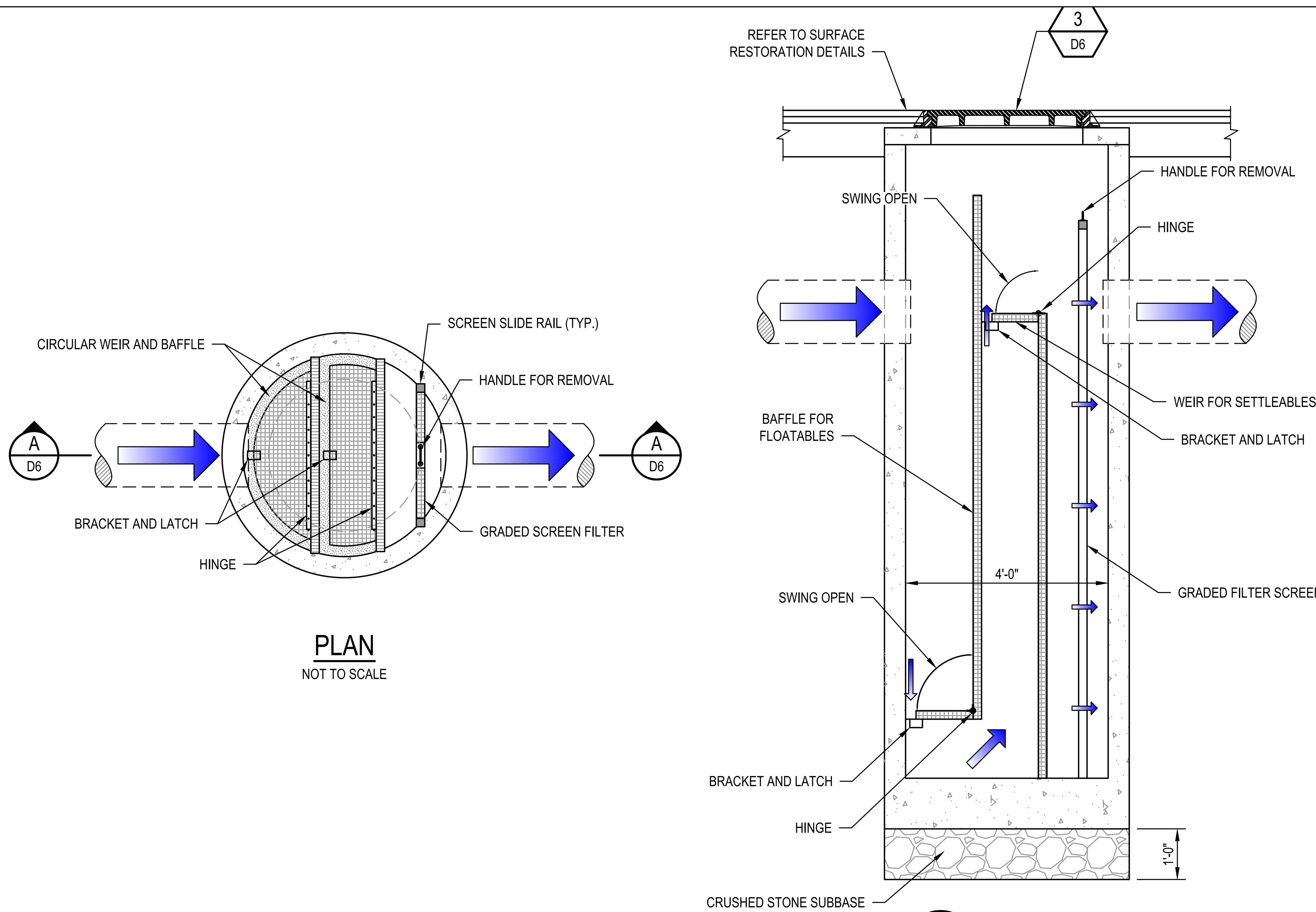
MAINTENANCE OF THE PRE-TX IS SIMPLE AND REQUIRES STANDARD VACTOR TRUCKS FOR CATCH BASIN CLEANING AND NO SPECIAL EQUIPMENT. SIMPLY REMOVE THE CURB PLATE COVER AND REMOVE DEBRIS BY USE OF PRESSURE WASHER AND VACUUM.

III. NOTES

PRE TX INLINE STRUCTURE IS RETROFIT OF EXISTING DEEP SUMP CATCH BASIN OR MANHOLE FOR SUBSURFACE PRETREATMENT OF FLOW WITHIN PIPE DRAINAGE.

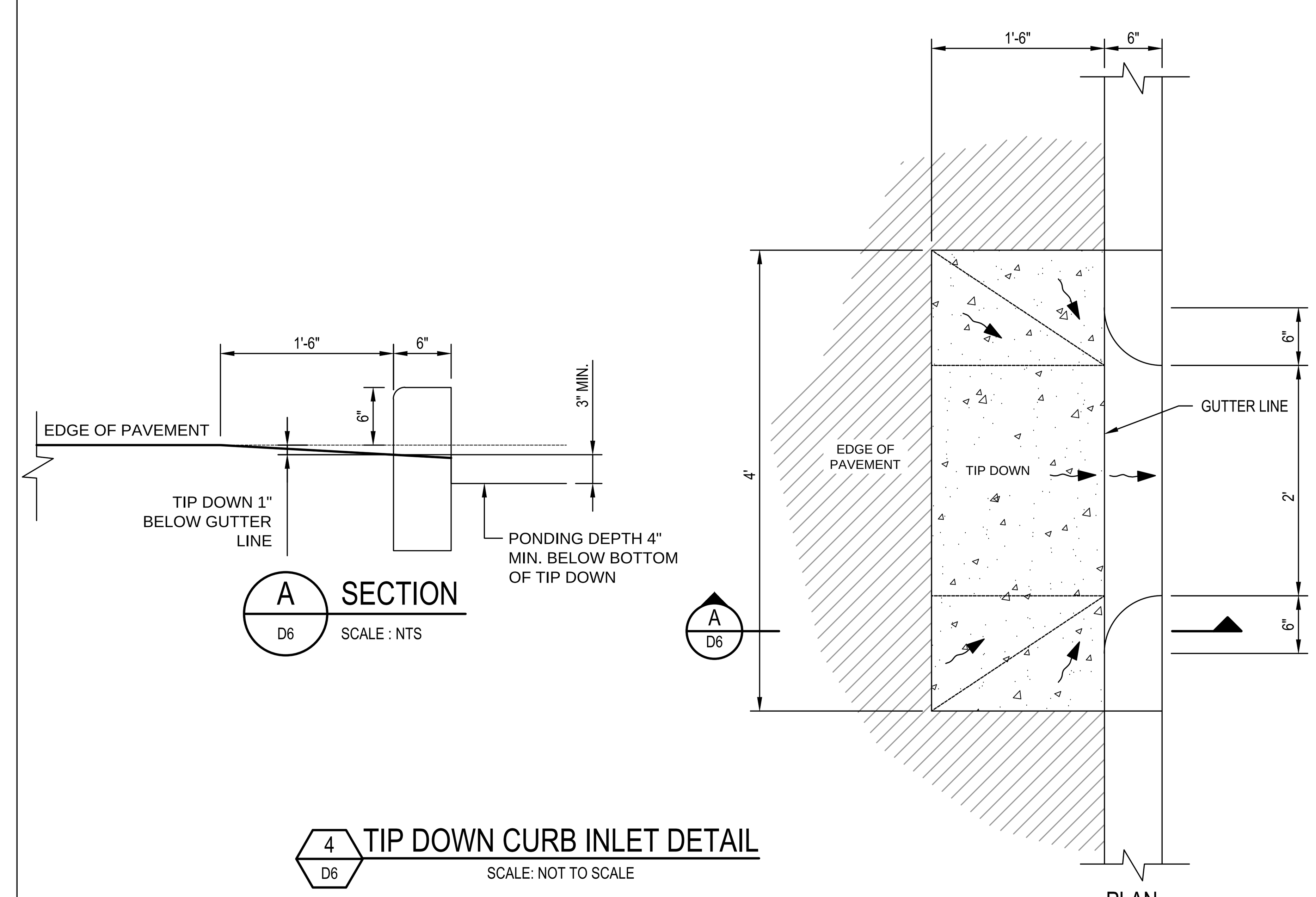
PRE TX SURFACE IS FOR PRETEAMENT OF RUNOFF ALONG CURB LINE OR PAVEMENT INTENDED TO REPLACE A CATCH BASIN.

PRETREATMENT UNITS ARE TO BE MAINTAINED BY USE OF VACTOR TRUCK IN SAME MANNER AS A CATCH BASIN.



2 D6 ACF PRETX INLINE PRETREATMENT DETAIL

NOT TO SCALE



4 D6 TIP DOWN CURB INLET DETAIL

SCALE: NOT TO SCALE

This Drawing shall not be used for Construction unless Signed and Sealed For Construction.

NO	DATE	DESCRIPTION	CKD
1	4/9/17	35% REVIEW	RR
2	6/4/17	95% REVIEW	RR

WATERSTONE ENGINEERING
INNOVATIVE STORMWATER MANAGEMENT
9 GRETA'S WAY
STRATHAM, NH 03885
(p) 603.686.2488

95% DESIGN FOR WATER INTEGRATION FOR SQUAMSCOTT - EXETER (WISE) INTEGRATED PLAN (IP) PHASE 1

LINCOLN STREET SUBWATERSHED NUTRIENT CONTROL STRATEGIES

PREPARED FOR:
TOWN OF EXETER
DEPT. OF PUBLIC WORKS
11 NEWFIELDS ROAD

DESIGNED BY:	RR
DRAFTED BY:	CDS
CHECKED BY:	RR

STATE OF NEW HAMPSHIRE
ROBERT M. ROSEEN
No. 12218
LICENSED PROFESSIONAL ENGINEER

MISC. DETAILS-1

JOB #:	16928
SCALE:	AS SHOWN
CONTRCT #:	N/A

D6

CONSTRUCTION NOTES:

1. EXAMINATION
   A. VERIFY LAYOUT AND ORIENTATION OF BIORETENTION AREA AND CONNECTIONS.
   B. VERIFY EXCAVATION BASE IS READY TO RECEIVE WORK AND EXCAVATIONS, DIMENSIONS, AND ELEVATIONS ARE AS INDICATED ON DRAWINGS.
2. PREPARATION
   A. CALL DIGSAFE AT 811 NOT LESS THAN THREE WORKING DAYS BEFORE PERFORMING WORK.
   B. REQUEST UNDERGROUND UTILITIES TO BE LOCATED AND MARKED WITHIN AND SURROUNDING CONSTRUCTION AREAS.
   C. IDENTIFY REQUIRED LINES, LEVELS, CONTOURS, AND DATUM.
   D. CLEAR AND GRUB THE PROPOSED BIORETENTION AREA.
3. EXCAVATION
   A. EXCAVATE BIORETENTION AREA IN ACCORDANCE WITH GENERAL NOTES AND SPECIFICATIONS.
   B. TO MINIMIZE COMPACTION, WORK EXCAVATORS OR BACKHOES FROM THE SIDES TO EXCAVATE THE BIORETENTION AREA TO ITS APPROPRIATE DESIGN DEPTH AND DIMENSIONS. USE EXCAVATING EQUIPMENT WITH ADEQUATE REACH SO THEY DO NOT WORK IN THE FOOTPRINT OF THE BIORETENTION AREA. IF APPLICABLE AND PER THE ENGINEERS DIRECTION USE A CELL CONSTRUCTION APPROACH IN LARGER BIORETENTION BASINS, WHEREBY THE BASIN IS SPLIT INTO 500 TO 1000 SQUARE FOOT TEMPORARY CELLS WITH A 10 TO 15 FOOT EARTH BRIDGE IN BETWEEN, SO THAT CELLS CAN BE EXCAVATED FROM THE SIDE.
   C. EXCAVATE AND SEAL ANY PRETREATMENT CELLS AND/OR SEDIMENT FOREBAYS FIRST AND SEALED TO TRAP SEDIMENTS PER THE DRAWINGS.
   B. ROUGH GRADE THE BIORETENTION AREA DURING GENERAL CONSTRUCTION. EXCAVATE THE BIORETENTION FACILITIES TO WITHIN 1 FOOT OF UNDERDRAIN BOTTOM.
   E. IF THE BIORETENTION AREA IS TO BE USED AS A TEMPORARY DRAINAGE STORAGE BASIN DURING THE EARLY STAGES OF PROJECT CONSTRUCTION, THE SIDE SLOPES SHOULD BE TEMPORARILY STABILIZED AND SILT FENCE INSTALLED ALONG THE TOE OF THE ROUGH GRADED BIORETENTION SLOPES TO MINIMIZE EXCESSIVE SEDIMENTATION OF THE BIORETENTION FLOOR.
4. COMPACTION
   A. MINIMIZE COMPACTION OF BOTH THE BASE OF THE BIORETENTION AREA AND THE REQUIRED BACKFILL. COMPACTION WILL SIGNIFICANTLY CONTRIBUTE TO DESIGN FAILURE.
   B. USE EXCAVATOR OR BACKHOES TO EXCAVATE THE BIORETENTION AREA
   C. IF THE BIORETENTION AREA IS EXCAVATED USING A LOADER, USE ONLY WIDE TRACK OR MARSH TRACK EQUIPMENT, OR LIGHT EQUIPMENT WITH TURF TYPE TIRES. USE OF EQUIPMENT WITH NARROW TRACKS OR NARROW TIRES, RUBBER TIRES WITH LARGE LUGS, OR HIGH PRESSURE TIRES CAUSE EXCESSIVE COMPACTION RESULTING IN REDUCED INFILTRATION RATES AND STORAGE VOLUMES AND IS NOT ACCEPTABLE.
   D. COMPACTION CAN BE ALLEVIATED AT THE BASE OF THE BIORETENTION FACILITY BY USING A PRIMARY TILLING OPERATION SUCH AS A CHISEL PLOW, RIPPER, OR SUBSOILER. THESE TILLING OPERATIONS ARE PERFORMED TO REFRACTURE THE SOIL PROFILE THROUGH THE 12-IN COMPACTION ZONE. SUBSTITUTE METHODS MUST BE APPROVED BY THE ENGINEER. ROTOILLERSTYPICALLY DO NOT TILL DEEP ENOUGH TO REDUCE THE EFFECTS OF COMPACTION FROM HEAVY EQUIPMENT. DO NOT COMPACT BIORETENTION SOIL WITH MECHANICAL EQUIPMENT.
5. EMBANKMENT/BERM FILL
   A. CONSTRUCT EMBANKMENT/BERM IN ACCORDANCE WITH SPECIFICATIONS AND AS INDICATED ON DRAWINGS.
6. INSTALLATION
   A. DO NOT CONSTRUCT THE BIORETENTION AREA UNTIL ALL DISTURBED AREAS WITHIN THE CONTRIBUTING DRAINAGE AREAS HAVE BEEN GRADED AND STABILIZED.
   B. REMOVE SEDIMENT ACCUMULATED ALONG THE EXCAVATION FLOOR DURING SITE CONSTRUCTION PRIOR TO CONTINUING WITH THE BIORETENTION FACILITY CONSTRUCTION.
   C. FORM BOTTOM OF EXCAVATION TO CORRECT ELEVATION.
   D. IF INFILTRATION IS PROMOTED, THEN RIP THE BOTTOM SOILS TO A DEPTH OF SIX INCHES TO PROMOTE GREATER INFILTRATION.
   E. INSTALL THE FILTER FABRIC ALONG THE EXCAVATION SIDE WALLS AS SPECIFIED IN THE DRAWINGS, IF FILTER FABRIC IS TO BE INSTALLED PLACE THE FILTER FABRIC ON THE SIDES OF THE BIORETENTION AREA WITH A MINIMUM SIX INCH OVERLAP AT ALL JOINTS.
   F. INSTALL ANY TEMPORARY EROSION AND SEDIMENT CONTROLS TO DIVERT STORMWATER AWAY FROM THE
   G. BIORETENTION AREA DURING FINAL CONSTRUCTION AND UNTIL IT IS COMPLETED. SPECIAL PROTECTION
   H. MEASURES SUCH AS EROSION CONTROL FABRICS MAY BE NEEDED TO PROTECT VULNERABLE SIDE
   I. SLOPES FROM EROSION DURING THE CONSTRUCTION PROCESS.
   J. ESTABLISH ELEVATIONS AND PIPE INVERTS FOR INLETS AND OUTLETS AS INDICATED ON DRAWINGS
   K. INSTALL THE OVERFLOW OUTLET STRUCTURE AS INDICATED ON DRAWINGS.
   L. INSTALL UNDERDRAIN, INCLUDING 1.5" PERFORATED PIPE, GRAVEL AND FILTER FABRIC ON TOP OF THE UNDERDRAIN GRAVEL AS INDICATED ON DRAWINGS. PLACE GRAVEL AROUND THE UNDERDRAIN PIPE AS INDICATED IN THE DETAILS. OBSERVATION WELLS AND/OR CLEAN-OUT PIPES MUST BE PROVIDED.
   M. INSTALL PEA GRAVEL LAYER AS INDICTED ON DRAWINGS.
   N. DELIVER APPROVED BIORETENTION SOIL AND STORE ON ADJACENT IMPERVIOUS AREA OR PLASTIC SHEETING.
7. BACKFILLING
   A. BACKFILL WITH APPROVED BIORETENTION SOIL TO THE DESIGN GRADE AS SPECIFIED IN THE DRAWINGS.
   B. PLACE SOIL IN 12 INCH LIFTS UNTIL DESIRED TOP ELEVATION OF BIORETENTION SOIL IS ACHIEVED. DO NOT USE HEAVY EQUIPMENT WITHIN THE BIORETENTION BASIN. HEAVY EQUIPMENT CAN BE USED AROUND THE PERIMETER OF THE BASIN TO SUPPLY SOILS AND SAND. WAIT 3 DAYS TO CHECK FOR SETTLEMENT, AND ADD ADDITIONAL MEDIA AS NEEDED
   C. DO NOT COMPACT BIORETENTION SOIL WITH MECHANICAL EQUIPMENT.
   D. GRADE BIORETENTION MATERIALS WITH LIGHT EQUIPMENT SUCH AS A COMPACT LOADER OR A DOZER/LOADER WITH MARSH TRACKS.
   E. STABILIZE ALL REMAINING DISTURBED AREAS AND SIDE SLOPES WITH SEEDING, HYDROSEEDING, AND/OR EROSION CONTROL BLANKETS AS INDICATED ON DRAWINGS.
8. PLANTING
   A. PLANT BIORETENTION AREA IN ACCORDANCE WITH PLANTING PLANS AND SPECIFICATIONS.
   B. THE PRIMARY FUNCTION OF THE BIORETENTION STRUCTURE IS TO IMPROVE WATER QUALITY. DO NOT ADD FERTILIZERS OR OTHER SOIL AMENDMENTS TO THE BIORETENTION SOILS UNLESS INSTRUCTED BY THE ENGINEER. THE PLANTING SOIL SPECIFICATIONS PROVIDE ENOUGH ORGANIC MATERIAL TO ADEQUATELY SUPPLY NUTRIENTS FROM NATURAL CYCLING.
   C. INSTALL BIORETENTION PLANTINGS AS INDICATED ON DRAWINGS AND WATER AS NOTED ON DRAWINGS AND IN SPECS.
   D. DO NOT PLANT BEFORE THE REMAINING DISTURBED AREAS SURROUNDING THE FACILITY ARE STABILIZED.
   E. REMOVE SEDIMENT ACCUMULATED IN THE BIORETENTION AREA DURING THE PLANTING PHASE.
   F. IF SUITABLE VEGETATIVE COVER HAS NOT BEEN ESTABLISHED ALONG THE BIORETENTION SIDE SLOPES PRIOR TO PLANTING, INSTALL A SILT FENCE PERIMETER AT THE TOE OF THE BIORETENTION SLOPES AND LEAVE IN PLACE UNTIL AN APPROVED VEGETATIVE COVER HAS BEEN ESTABLISHED.
   G. REMOVE REMAINING EROSION AND SEDIMENT CONTROLS ONLY AFTER SURROUNDING DISTURBED AREAS HAVE BEEN PROPERLY STABILIZED.
   H. CONDUCT FINAL CONSTRUCTION INSPECTION WITH ENGINEER.
9. CLEAN UP
   A. AFTER COMPLETION OF THE WORK, REMOVE AND PROPERLY DISPOSE ALL DEBRIS, CONSTRUCTION MATERIALS, RUBBISH, EXCESS SOIL, ETC., FROM THE PROJECT SITE. REPAIR PROMPTLY ANY IDENTIFIED DEFICIENCIES AND LEAVE THE PROJECT SITE IN A CLEAN AND SATISFACTORY CONDITION

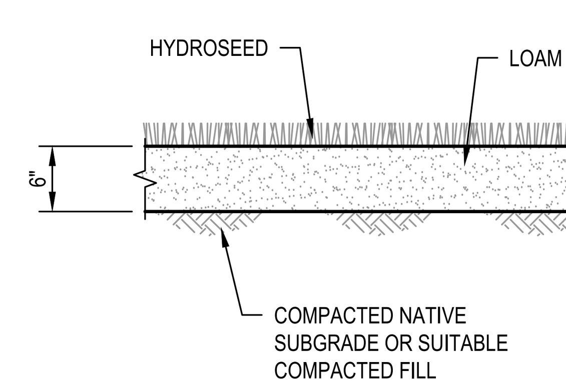
CONSTRUCTION SEQUENCE:

THE FOLLOWING CONSTRUCTION SEQUENCE IS TO BE USED AS A GENERAL GUIDELINE. COORDINATE WITH THE OWNER, ENGINEERS, AND LANDSCAPE ARCHITECTS AND SUBMIT A PROPOSED CONSTRUCTION SEQUENCE FOR REVIEW AND APPROVAL PRIOR TO CONSTRUCTION.

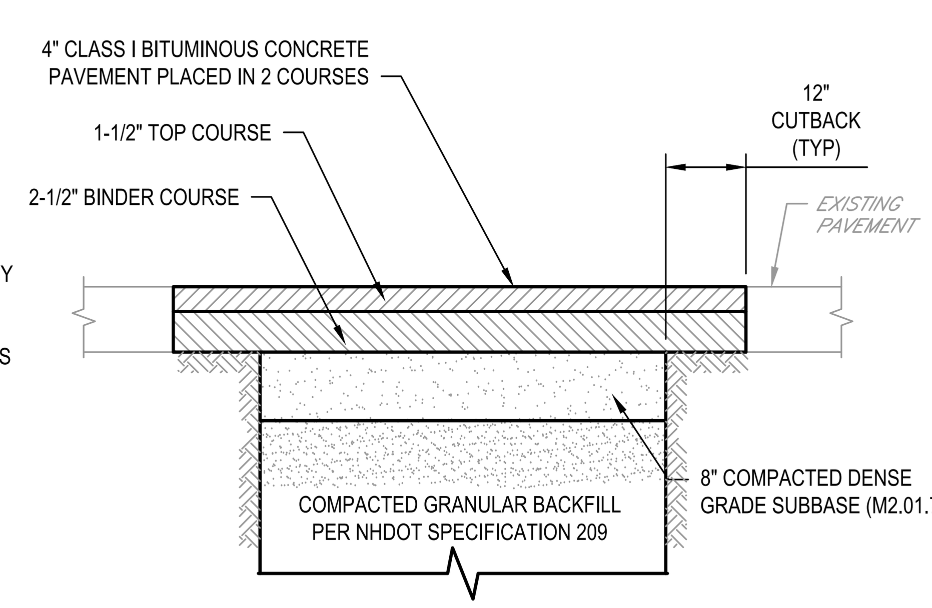
1. CONDUCT A PRE-CONSTRUCTION MEETING.
2. CHECK FOR EXISTING UTILITIES PRIOR TO ANY EXCAVATION.
3. CLEAR AND GRUB THE PROPOSED BIORETENTION AREA
4. ROUGH GRADE THE BIORETENTION AREA DURING GENERAL CONSTRUCTION.
5. EXCAVATE PRETREATMENT CELLS AND/OR SEDIMENT FOREBAYS PRIOR TO BIORETENTION CONSTRUCTION.
6. DO NOT CONSTRUCT THE BIORETENTION AREA UNTIL ALL DISTURBED AREAS WITHIN THE CONTRIBUTING DRAINAGE AREAS HAVE BEEN GRADED AND STABILIZED.
7. INSTALL TEMPORARY EROSION AND SEDIMENT CONTROLS TO DIVERT STORMWATER AWAY FROM THE BIORETENTION AREA.
8. EXCAVATE THE BIORETENTION FACILITY TO THE BOTTOM INVERT OF THE SUBDRAIN SYSTEM.
9. INSTALL THE FILTER FABRIC ALONG THE EXCAVATION SIDE WALLS. ENGINEER FIELD VISIT AND REPORT REQUIRED SEE NOTE (3) BELOW.
10. RIP THE BOTTOM SOILS TO A DEPTH OF SIX INCHES TO PROMOTE GREATER INFILTRATION.
11. INSTALL THE OVERFLOW OUTLET STRUCTURE AS SPECIFIED IN THE DRAWINGS.
12. INSTALL UNDERDRAIN AS INDICATED ON DRAWINGS. ENGINEER FIELD VISIT AND REPORT REQUIRED PRIOR TO COVERING THE UNDERRAIN. SEE NOTE (3) BELOW.
13. INSTALL PEA GRAVEL LAYER AS INDICATED ON DRAWINGS.
14. DELIVER APPROVED BIORETENTION SOIL AND STORE ON ADJACENT IMPERVIOUS AREA OR PLASTIC SHEETING.
15. BACKFILL WITH APPROVED BIORETENTION SOIL TO THE DESIGN GRADE (UN-COMPACTED) AS INDICATED ON DRAWINGS. ENGINEER FIELD VISIT AND REPORT REQUIRED SEE NOTE (3) BELOW. SUBMIT A SOIL SAMPLE (1 GALLON) TO THE ENGINEER PRIOR TO SOIL DELIVERY TO THE SITE.
16. STABILIZE ALL REMAINING DISTURBED AREAS AND SIDE SLOPES WITH SEEDING, HYDROSEEDING, AND/OR EROSION CONTROL BLANKETS AS INDICATED ON DRAWINGS. ENGINEER FIELD VISIT AND REPORT REQUIRED SEE NOTE (3) BELOW.
17. INSTALL BIORETENTION PLANTINGS AS INDICATED ON DRAWINGS. DO NOT PLANT BEFORE THE REMAINING DISTURBED AREAS SURROUNDING THE FACILITY ARE STABILIZED.
18. CONDUCT FINAL CONSTRUCTION INSPECTION WITH ENGINEER. ENGINEER FIELD VISIT AND REPORT REQUIRED SEE NOTE (3) BELOW.
19. REMOVE REMAINING EROSION AND SEDIMENT CONTROLS ONLY AFTER SURROUNDING DISTURBED AREAS HAVE BEEN PROPERLY STABILIZED. NOTES:
20. SEE GENERAL CONSTRUCTION NOTES FOR OVERALL CONSTRUCTION SEQUENCE.
21. SEE GENERAL NOTES/ SPECIFICATIONS/ CONSTRUCTION DETAILS FOR DETAILED CONSTRUCTION REQUIREMENTS.
22. MANDATORY NOTIFICATION/APPROVAL OF THE PROJECT ENGINEER IS REQUIRED PRIOR TO PROCEEDING WITH NEXT STAGE. CALL THE ENGINEER (HORSLEY WITTEN GROUP, INC.) AT 508-833-6600 PRIOR TO 12:00 NOON THE PROCEEDING DAY TO ARRANGE FOR ANY REQUESTED FIELD VISITS.

BIORETENTION SOIL MEDIA (BSM):

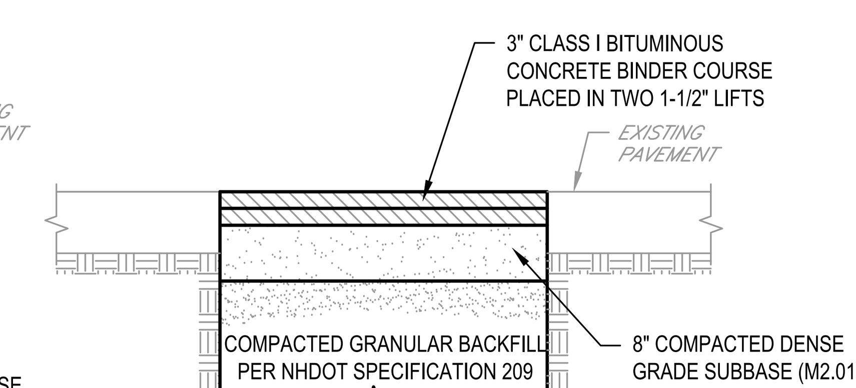
1. BSM COMPONENTS SHALL BE MIXED THOROUGHLY AND UNIFORMLY IN BATCHES NOT TO EXCEED 20 CUBIC YARDS OR AT THE DISCRETION OF THE SUPERVISING ENGINEER. SOIL FILTER MEDIA SHALL BE PERMEABLE ENOUGH TO INSURE DRAINAGE OF THE STORMWATER PLANTER WITHIN 24 TO 48 HOURS MAXIMUM. NO OTHER MATERIALS OR SUBSTANCES THAT MAY BE HARMFUL TO PLANT GROWTH, OR PROVE A HINDRANCE TO THE PLANTING OR MAINTENANCE OPERATIONS CAN BE MIXED WITHIN THE FILTER.
2. THE BSM SHALL MEET THE SOIL COMPOSITION CRITERIA LISTED BELOW.
   A. 65% MEDIUM SAND.
   B. 30% LOAM
   C. 5% WATER TREATMENT RESIDUALS
   D. 8-12% ORGANIC MATTER
3. PROVIDE A SOIL TEST OF THE BIORETENTION SOIL FOR CONFORMANCE TO THE FOLLOWING CRITERIA:
   A. PH RANGE: 6.0-7.0.
   B. MAGNESIUM: MINIMUM 32 PPM.
   C. PHOSPHOROUS (P205): NOT TO EXCEED 40 PPM.
   D. POTASSIUM (K2O): MINIMUM 78 PPM.
   E. SOLUBLE SALTS: NOT TO EXCEED 500 PPM.
4. IF THE SOIL PH IS NOT WITHIN THE ACCEPTABLE RANGE, AMEND WITH LIME TO RAISE THE PH OR WITH IRON SULFATE TO LOWER THE PH, AS NECESSARY. ALL TESTING SHOULD BE PERFORMED BY THE SAME TESTING FACILITY TO MAINTAIN CONSISTENT RESULTS. SUBMIT THE SOIL SAMPLE RESULTS TO THE ENGINEER REVIEW AND APPROVAL PRIOR TO DELIVERY TO THE PROJECT SITE.
5. VOLUME OF FILTER MEDIA BASED ON 110% OF PLAN VOLUME TO ACCOUNT FOR SETTLING OR COMPACTION.
6. DO NOT MIX, DUMP OR STORE ANY OTHER MATERIALS OR SUBSTANCES THAT MAYBE HARMFUL TO PLANT GROWTH OR PROVE A HINDRANCE TO THE PLANTING MAINTENANCE OR OPERATIONS WITHIN THE BIORETENTION AREA.
7. FILTER FABRIC
   A. NON-WOVEN GEOTEXTILE FABRIC WITH FLOW RATE OF > 110 GALLON/MINUTES/SQUARE FOOT.
   B. CLASS "C" APPARENT OPENING SIZE (ASTM-D-4751).
   C. GRAB TENSILE STRENGTH (ATSM-D-4632) BURST STRENGTH (ASTM-D-4833).
8. PEA GRAVEL
   A. 3/8" WASHED STONE
   B. UNDERDRAIN GRAVEL
   C. 3/4" CRUSHED WASHED STONE, CLEAN AND FREE OF ALL FINES AND MEETING AASHTO M-43.
9. UNDERDRAIN
   A. 12"HDPE PERFORATED UNDERDRAIN PIPE WITH ½" DIAMETER PERFORATIONS OR APPROVED EQUAL.
   B. TS AND Y'S FITTINGS AS REQUIRED FOR THE UNDERDRAIN CONFIGURATION INDICATED ON DRAWING.
   C. CONNECTIONS TO STORM DRAIN SYSTEM.
   D. UNDERDRAIN CLEANOUTS
10. NON PERFORATED HDPE PIPE, ELBOW, CAP, AND ALL ASSOCIATED FITTINGS.
11. EROSION CONTROL BLANKET (3:1 SIDE SLOPES ONLY)
   A. WOVEN, 100% BIODEGRADABLE JUTE FIBER 7.70 LBS/1000 SOFT. BIONET S150BN OR APPROVED EQUIVALENT.



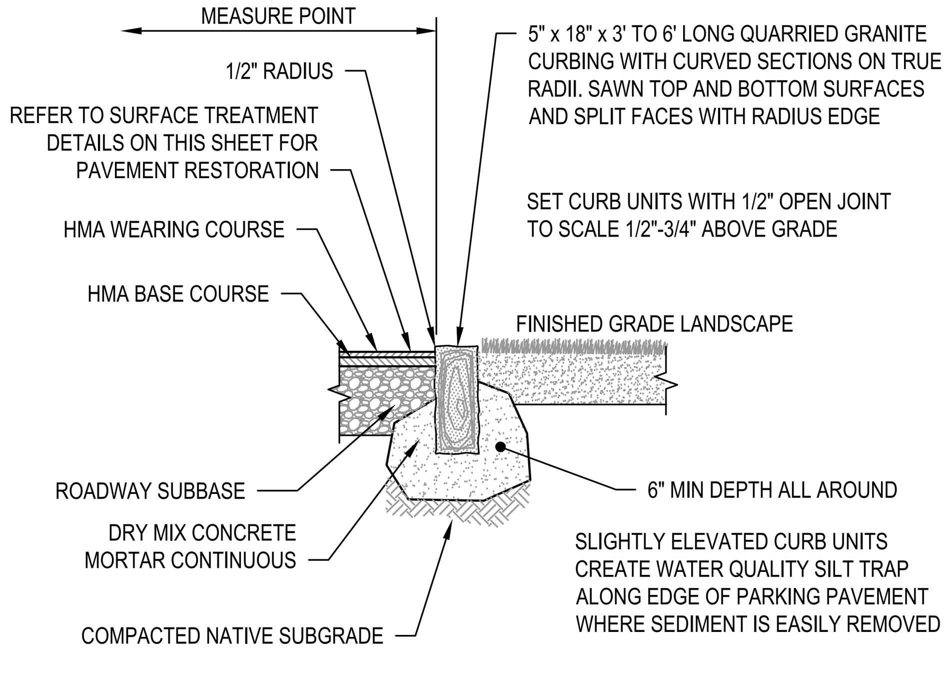
3 D7 LOAM AND SEED-SECTION
NOT TO SCALE



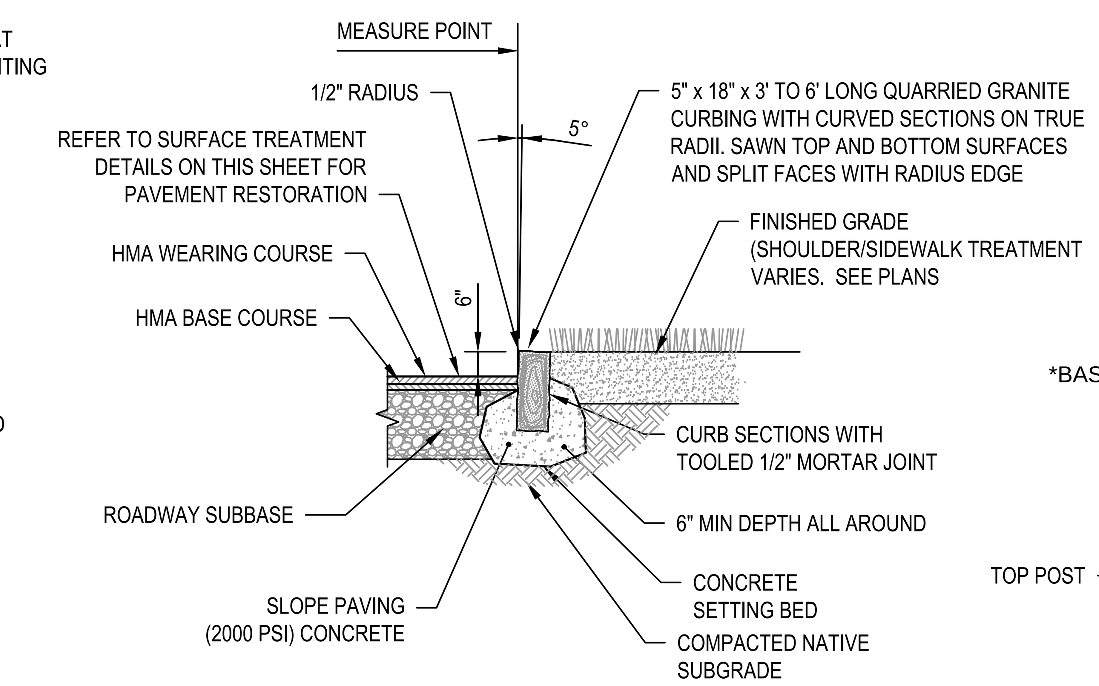
5 D7 STANDARD "HMA" FINAL PAVEMENT DETAIL MISCELLANEOUS AREAS AND APRONS
NOT TO SCALE



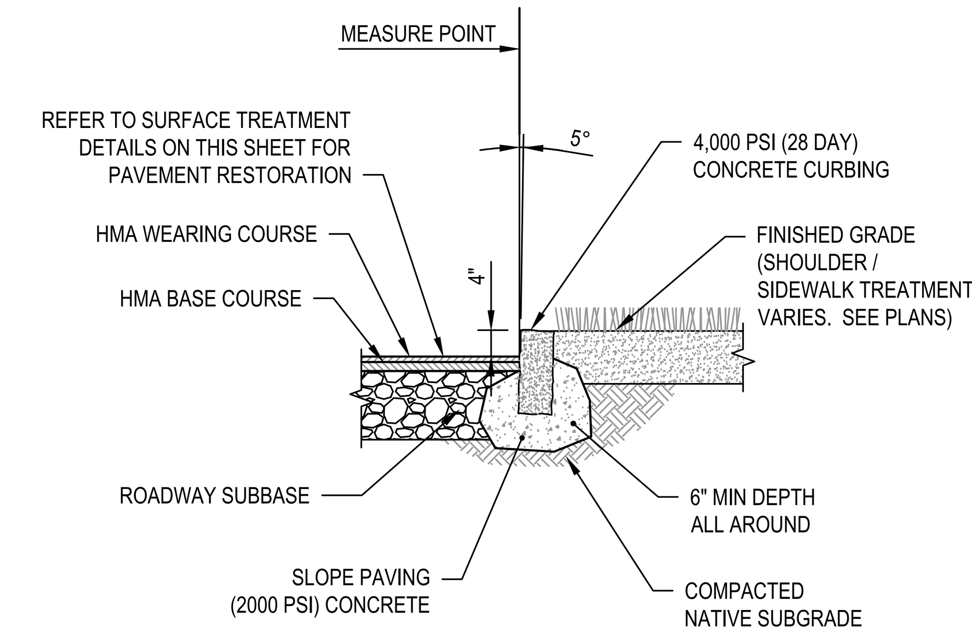
6 D7 STANDARD "HMA" TEMPORARY PAVEMENT DETAIL
NOT TO SCALE



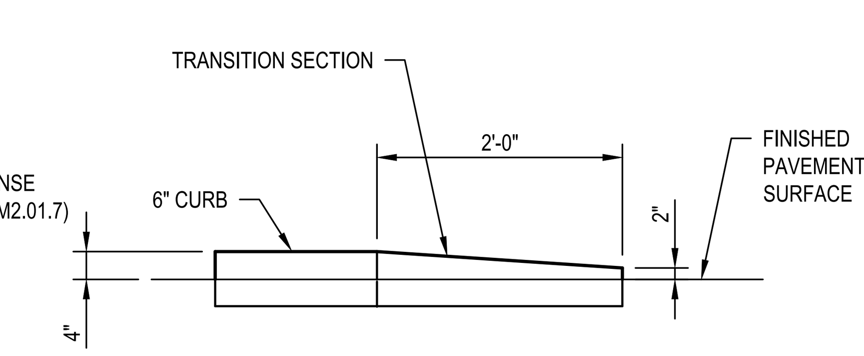
1 D7 FLUSH CURB
NOT TO SCALE



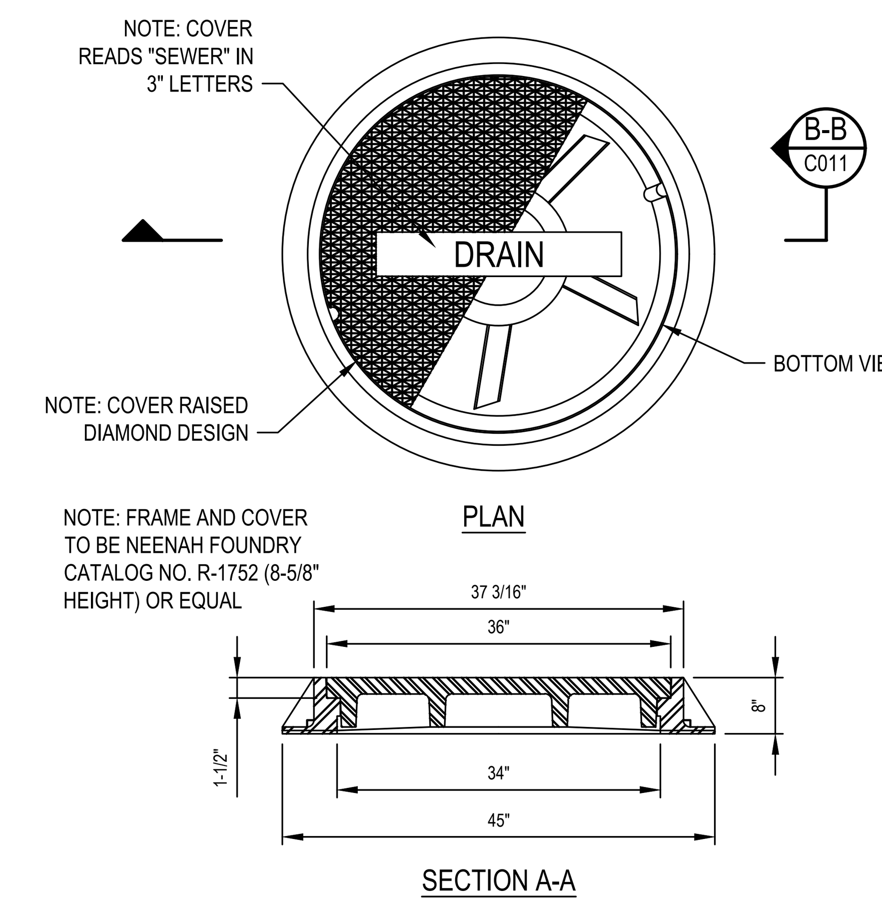
2 D7 VERTICAL GRANITE CURB
NOT TO SCALE



4 D7 VERTICAL CONCRETE CURB
NOT TO SCALE

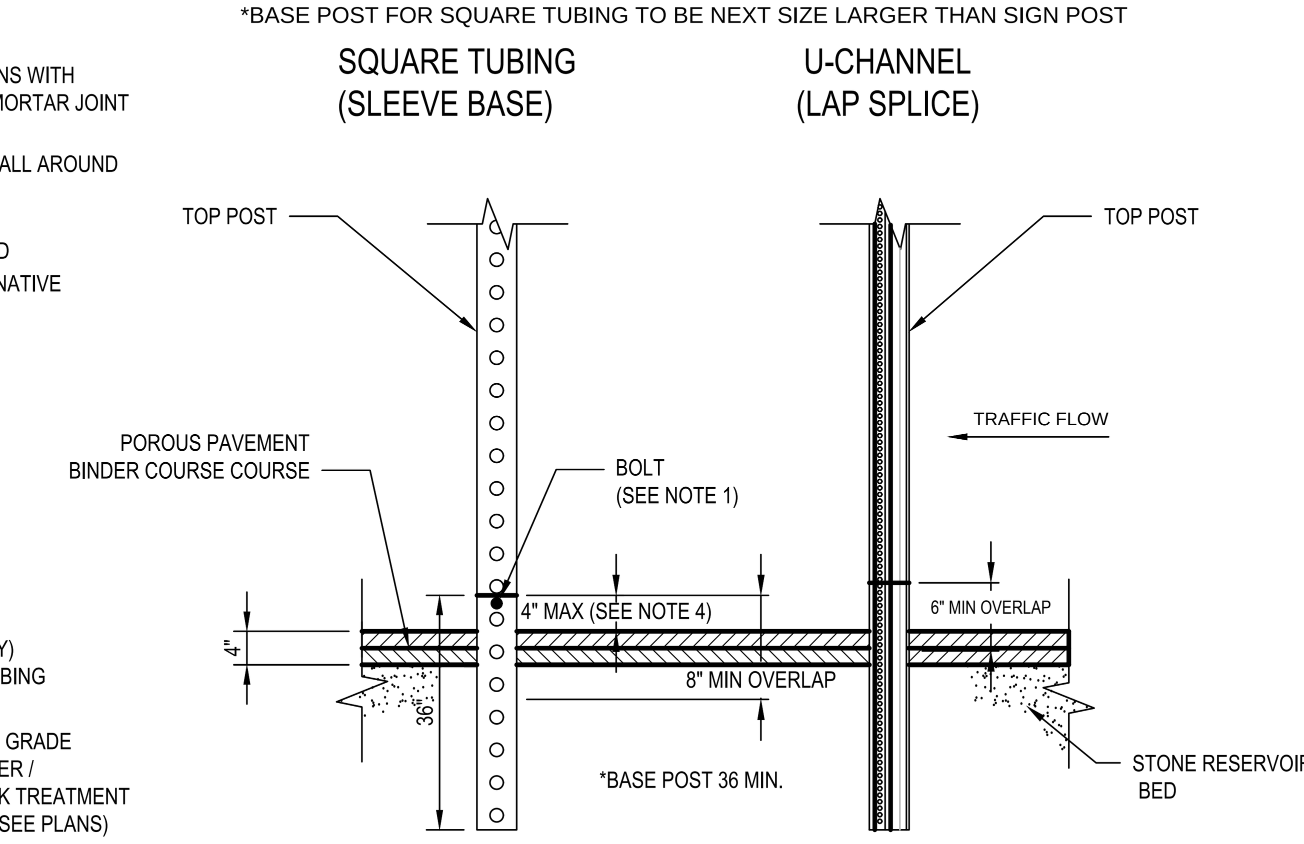


7 D7 END CURB ELEVATION
NOT TO SCALE



4 C011 MANHOLE FRAME AND COVER DETAIL
NOT TO SCALE

*BASE POST FOR SQUARE TUBING TO BE NEXT SIZE LARGER THAN SIGN POST



GENERAL NOTES

1. ALL SQUARE TUBING SIGN POST REQUIREMENTS ARE BASED ON A 10 OR 12 GAUGE THICKNESS ASTM A570 GRADE 50 STEEL, A MINIMUM YIELD STRENGTH OF 60,0000 PSI AND A 70 MPH WIN LOAD. ALL U-CHANNEL SIGN POST REQUIREMENTS ARE BASED ON A MINIMUM YIELD STRENGTH OF 80,000 PSI AND A 85 MPH WIND LOAD
2. STEEL POSTS, BASE POSTS, AND SLIP BASES FOR ALUMINUM PANEL SIGNS SHALL BE SELECTED FROM MADOT APPROVED PRODUCT LIST.
3. BASE POSTS SHALL NOT EXCEED MORE THAN 4" ABOVE GROUND LEVEL AND SHALL BE OF THE SAME WEIGHT/GAGE AND TYPE AS THE SIGN POST.
4. INTERMIXING OF U-CHANNEL AND SQUARE TUBING POST, POSTS OF DIFFERENT WEIGHTS/GAUGES IS PROHIBITED.
5. SUPPLEMENTAL SIGNS SHALL NOT BE ATTACHED DIRECTLY TO PRIMARY PANELS.
6. SPACING BETWEEN SUPPLEMENTAL PANELS AND PRIMARY PANELS SHALL NOT EXCEED 6"
7. SIGN PANELS PLACED PARALLEL TO TRAFFIC SHALL BE MOUNTED ON A MULTI-DIRECTIONAL BREAKAWAY SYSTEM
8. AN APPROVED SLIP BASE IS REQUIRED WITH THE DOUBLE POST AND TRIPLE POST INSTALLATION
9. SEE MANUFACTURERS DRAWINGS FOR SPECIFIC ASSEMBLY INFORMATION (POST TO BASE POST OVERLAP) INCLUDING TYPES OF NUTS BOLTS WASHERS AND OTHER PARTS REQUIRED FOR PRODUCT USE.
10. LAP-SPLICE OR MULTI-DIRECTIONAL SLIP BASE MAY BE USED.

8 D7 BASE POST INSTALLATION DETAIL FOR SQUARE AND U-CHANNEL SYSTEMS
NOT TO SCALE

NO	DATE	DESCRIPTION	CKD
1	4/9/17	35% REVIEW	RR
2	6/4/17	95% REVIEW	RR

WATERSTONE ENGINEERING
INNOVATIVE STORMWATER MANAGEMENT
9 GRETA'S WAY
STRATHAM, NH 03885
(p) 603.686.2488

95% DESIGN FOR WATER INTEGRATION FOR SQUAMSCOTT - EXETER (WISE) INTEGRATED PLAN (IP) PHASE 1

LINCOLN STREET SUBWATERSHED NUTRIENT CONTROL STRATEGIES

PREPARED FOR:
TOWN OF EXETER
DEPT. OF PUBLIC WORKS
11 NEWFIELDS ROAD

DESIGNED BY:	RR
DRAFTED BY:	CDS
CHECKED BY:	RR

STATE OF NEW HAMPSHIRE
ROBERT M. ROSEEN
No. 12215
LICENSED
PROFESSIONAL ENGINEER

MISC. DETAILS-2

JOB #:	16928
SCALE:	AS SHOWN
CONTRCT #:	N/A

D7

CULTEC RECHARGER® 330XLHD PRODUCT SPECIFICATIONS

GENERAL

CULTEC RECHARGER 330XLHD CHAMBERS ARE DESIGNED FOR UNDERGROUND STORMWATER MANAGEMENT. THE CHAMBERS MAY BE USED FOR RETENTION, RECHARGING, DETENTION OR CONTROLLING THE FLOW OF ON-SITE STORMWATER RUNOFF.

CHAMBER PARAMETERS

1. THE CHAMBERS SHALL BE MANUFACTURED BY CULTEC, INC. OF BROOKFIELD, CT, USA. (203-775-4416 OR 1-800-428-5832)
2. THE CHAMBER SHALL BE VACUUM THERMOFORMED OF BLACK HIGH MOLECULAR WEIGHT HIGH DENSITY POLYETHYLENE (HMWHDPE).
3. THE CHAMBER SHALL BE ARCHED IN SHAPE.
4. THE CHAMBER SHALL BE OPEN-BOTTOMED.
5. THE CHAMBER SHALL BE JOINED USING AN INTERLOCKING OVERLAPPING RIB METHOD. CONNECTIONS MUST BE FULLY SHOULDERED OVERLAPPING RIBS, HAVING NO SEPARATE COUPLINGS OR SEPARATE END WALLS
6. THE NOMINAL CHAMBER DIMENSIONS OF THE CULTEC RECHARGER 330XLHD SHALL BE 30.5 INCHES (775 mm) TALL, 52 INCHES (1321 mm) WIDE AND 8.5 FEET (2.59 m) LONG. THE INSTALLED LENGTH OF A JOINED RECHARGER 330XLHD SHALL BE 7 FEET (2.13 m).
7. MAXIMUM INLET OPENING ON THE CHAMBER ENDWALL IS 24 INCHES (600 mm).
8. THE CHAMBER SHALL HAVE TWO SIDE PORTALS TO ACCEPT CULTEC HVLV® FC-24 FEED CONNECTORS TO CREATE AN INTERNAL MANIFOLD. THE NOMINAL DIMENSIONS OF EACH SIDE PORTAL SHALL BE 10.5 INCHES (267 mm) HIGH BY 11.5 INCHES (292 mm) WIDE. MAXIMUM ALLOWABLE OUTER DIAMETER (O.D.) PIPE SIZE IN THE SIDE PORTAL IS 11.75 INCHES (298 mm).
9. THE NOMINAL CHAMBER DIMENSIONS OF THE CULTEC HVLV FC-24 FEED CONNECTOR SHALL BE 12 INCHES (305 mm) TALL, 16 INCHES (406 mm) WIDE AND 24.2 INCHES (614 mm) LONG.
10. THE NOMINAL STORAGE VOLUME OF THE RECHARGER 330XLHD CHAMBER SHALL BE 7.459 FT³ / FT (0.693 m³ / m) - WITHOUT STONE. THE NOMINAL STORAGE VOLUME OF A JOINED RECHARGER 330XLHD SHALL BE 52.213 FT³ / UNIT (1.478 m³ / UNIT) - WITHOUT STONE.
11. THE NOMINAL STORAGE VOLUME OF THE HVLV FC-24 FEED CONNECTOR SHALL BE 0.913 FT³ / FT (0.085 m³ / m) - WITHOUT STONE.
12. THE RECHARGER 330XLHD CHAMBER SHALL HAVE FIFTY-SIX DISCHARGE HOLES BORED INTO THE SIDEWALLS OF THE UNIT'S CORE TO PROMOTE LATERAL CONVEYANCE OF WATER.
13. THE RECHARGER 330XLHD CHAMBER SHALL HAVE 16 CORRUGATIONS.
14. THE ENDWALL OF THE CHAMBER, WHEN PRESENT, SHALL BE AN INTEGRAL PART OF THE CONTINUOUSLY FORMED UNIT. SEPARATE END PLATES CANNOT BE USED WITH THIS UNIT.
15. THE RECHARGER 330XLRHD STAND ALONE UNIT MUST BE FORMED AS A WHOLE CHAMBER HAVING TWO FULLY FORMED INTEGRAL ENDWALLS AND HAVING NO SEPARATE END PLATES OR SEPARATE END WALLS.
16. THE RECHARGER 330XLSHD STARTER UNIT MUST BE FORMED AS A WHOLE CHAMBER HAVING ONE FULLY FORMED INTEGRAL ENDWALL AND ONE PARTIALLY FORMED INTEGRAL ENDWALL WITH A LOWER TRANSFER OPENING OF 14 INCHES (356 mm) HIGH X 34.5 INCHES (876 mm) WIDE.
17. THE RECHARGER 330XLIHD INTERMEDIATE UNIT MUST BE FORMED AS A WHOLE CHAMBER HAVING ONE FULLY OPEN ENDWALL AND ONE PARTIALLY FORMED INTEGRAL ENDWALL WITH A LOWER TRANSFER OPENING OF 14 INCHES (356 mm) HIGH X 34.5 INCHES (876 mm) WIDE.
18. THE RECHARGER 330XLEHD END UNIT MUST BE FORMED AS A WHOLE CHAMBER HAVING ONE FULLY FORMED INTEGRAL ENDWALL AND ONE FULLY OPEN END WALL AND HAVING NO SEPARATE END PLATES OR END WALLS.
19. THE HVLV FC-24 FEED CONNECTOR MUST BE FORMED AS A WHOLE CHAMBER HAVING TWO OPEN END WALLS AND HAVING NO SEPARATE END PLATES OR SEPARATE END WALLS. THE UNIT SHALL FIT INTO THE SIDE PORTALS OF THE RECHARGER 330XLHD AND ACT AS CROSS FEED CONNECTIONS.
20. CHAMBERS MUST HAVE HORIZONTAL STIFFENING FLEX REDUCTION STEPS BETWEEN THE RIBS.
21. HEAVY DUTY UNITS ARE DESIGNATED BY A COLORED STRIPE FORMED INTO THE PART ALONG THE LENGTH OF THE CHAMBER.
22. THE CHAMBER SHALL HAVE A 6 INCH (152 mm) DIAMETER RAISED INTEGRAL CAP AT THE TOP OF THE ARCH IN THE CENTER OF EACH UNIT TO BE USED AS AN OPTIONAL INSPECTION PORT OR CLEAN-OUT.
23. THE UNITS MAY BE TRIMMED TO CUSTOM LENGTHS BY CUTTING BACK TO ANY CORRUGATION.
24. THE CHAMBER SHALL BE MANUFACTURED IN AN ISO 9001:2008 CERTIFIED FACILITY.
25. MAXIMUM ALLOWED COVER OVER TOP OF UNIT SHALL BE 12 FEET (3.66 m)
26. THE CHAMBER SHALL BE DESIGNED TO WITHSTAND TRAFFIC LOADS WHEN INSTALLED ACCORDING TO CULTEC'S RECOMMENDED INSTALLATION INSTRUCTIONS.

330XLHD 1.0

GENERAL NOTES

SEPARATOR ROW™ SPECIFICATIONS

GENERAL

CULTEC'S SEPARATOR ROW IS USED AS AN INEXPENSIVE MEANS OF REMOVING TOTAL SUSPENDED SOLIDS FROM THE CHAMBER SYSTEM, AS WELL AS PROVIDING EASIER ACCESS FOR INSPECTION AND MAINTENANCE.

INSTALLATION INSTRUCTIONS

A SEPARATOR ROW IS INSTALLED ON A 1-2 INCH [25-51 mm] WASHED, CRUSHED STONE BASE. TYPICALLY, THE CULTEC CHAMBER MODEL USED FOR THE SEPARATOR ROW IS THE SAME CHAMBER USED THROUGHOUT THE ENTIRE CHAMBER BED.

STORMWATER IS DISTRIBUTED TO THE SEPARATOR ROW BY A PRIMARY FEED SYSTEM THAT DIVERTS FLOW TO THE SEPARATOR ROW AND A SECONDARY BYPASS FEED SYSTEM THAT DIVERTS THE FLOW OF CLEAN WATER TO THE OTHER PARTS OF THE UNDERGROUND STORMWATER MANAGEMENT SYSTEM. THE DISTRIBUTION SYSTEM MAY BE BY PIPES SET AT A LOWER ELEVATION THAT PERMIT THE FIRST FLUSH TO THE SEPARATOR ROW VERSUS OTHER PARTS OF THE UNDERGROUND SYSTEM. THIS INITIAL FLOW MAY BE MANAGED BY A BAFFLE OR WEIR. THE SIZING OF THE PIPE(S) THAT PROVIDE STORM WATER TO THE SEPARATOR ROW IS TO BE DETERMINED BY THE DESIGN ENGINEER AND IS BASED UPON THE REQUIREMENT TO ACCOMMODATE THE DESIGN FLOW AND SERVICE CONVENIENCE.

THE CHAMBERS UTILIZED IN THE SEPARATOR ROW ARE TO BE COMPLETELY WRAPPED WITH CULTEC NO. 410 NON-WOVEN GEOTEXTILE. THIS CREATES A PASS-THROUGH FILTER ARRANGEMENT TO SEPARATE TOTAL SUSPENDED SOLIDS IN THE TRANSFER OF STORM WATER TO OTHER CHAMBERS THROUGHOUT THE UNDERGROUND STORMWATER MANAGEMENT SYSTEM.

ONCE WRAPPED, THE SEPARATOR ROW IS TO THEN PLACED ENTIRELY OVER 2 LAYERS OF CULTEC NO. 66 WOVEN GEOTEXTILE. THIS WOVEN GEOTEXTILE PROVIDES A DURABLE SURFACE WITHIN THE ROW FOR MAINTENANCE PROCEDURES AS WELL AS TO PREVENT ANY SCOURING OF THE STONE BASE DURING HIGH PRESSURE JETTING.

THE RECOMMENDED INSTALLATION OF SEPARATOR ROW CHAMBERS, IN REGARD TO STONE SEPARATION AND STONE ABOVE THE UNIT, ALONG WITH OTHER MINIMUM BURIAL, MATERIALS AND METHOD SPECIFICATIONS DETAILED FOR THE PROPER INSTALLATION, IS THE SAME AS CULTEC'S REQUIREMENT DETAILED IN THE COMPANY'S INSTALLATION GUIDELINES WITH THE EXCEPTION OF THE PLACEMENT OF THE REQUIRED FILTERING FABRICS. PLEASE REFER TO CULTEC'S CURRENT INSTALLATION INSTRUCTIONS FOR STORMWATER CHAMBERS AS A GUIDE.

MAINTENANCE PROCEDURES

CULTEC RECOMMENDS INSPECTIONS OF THE SEPARATOR ROW TO BE PERFORMED EVERY SIX MONTHS FOR THE FIRST YEAR. THE FREQUENCY OF INSPECTION CAN THEN BE ADJUSTED BASED UPON PREVIOUS OBSERVATION OF SEDIMENT DEPOSITION.

WHILE CLEANING IS POSSIBLE FROM A SINGLE MANHOLE IN SHORTER LINES, A CLEAN-OUT OPTION FROM EITHER END OF A LINE IS PREFERABLE, PARTICULARLY FOR LONGER RUNS. CLEANING INVOLVES FLUSHING SEDIMENT FROM THE BASE FABRIC OF THE SEPARATOR ROW.

ACCESS WILL BE PROVIDED VIA A MANHOLE(S) LOCATED AT THE END(S) OF THE ROW FOR CLEAN OUT.

MAINTENANCE OF THE SEPARATOR ROW IS TO BE ACCOMPLISHED WITH A JETVAC PROCESS.

THE JETVAC IS TO BE SENT DOWN THE ENTIRE LENGTH OF THE SEPARATOR ROW. AS THE HIGH PRESSURE WATER NOZZLE IS RETRIEVED, THE CAPTURED SEDIMENTS ARE PUSHED BACK INTO THE MANHOLE FOR VACUUMING.

SR 1.0

GENERAL NOTES

CULTEC HVLV FC-24 FEED CONNECTOR PRODUCT SPECIFICATIONS

GENERAL

CULTEC HVLV FC-24 FEED CONNECTORS ARE DESIGNED TO CREATE AN INTERNAL MANIFOLD FOR CULTEC RECHARGER MODEL 330XLHD STORMWATER CHAMBERS.

CHAMBER PARAMETERS

1. THE CHAMBERS SHALL BE MANUFACTURED BY CULTEC, INC. OF BROOKFIELD, CT. (203-775-4416 OR 1-800-428-5832)
2. THE CHAMBER SHALL BE VACUUM THERMOFORMED OF BLACK HIGH MOLECULAR WEIGHT HIGH DENSITY POLYETHYLENE (HMWHDPE).
3. THE CHAMBER SHALL BE ARCHED IN SHAPE.
4. THE CHAMBER SHALL BE OPEN-BOTTOMED.
5. THE NOMINAL CHAMBER DIMENSIONS OF THE CULTEC HVLV FC-24 FEED CONNECTOR SHALL BE 12 INCHES (305 mm) TALL, 16 INCHES (406 mm) WIDE AND 24.2 INCHES (614 mm) LONG.
6. THE NOMINAL STORAGE VOLUME OF THE HVLV FC-24 FEED CONNECTOR SHALL BE 0.913 FT³ / FT (0.085 m³ / m) - WITHOUT STONE.
7. THE HVLV FC-24 FEED CONNECTOR CHAMBER SHALL HAVE 2 CORRUGATIONS.
8. THE HVLV FC-24 FEED CONNECTOR MUST BE FORMED AS A WHOLE CHAMBER HAVING TWO OPEN END WALLS AND HAVING NO SEPARATE END PLATES OR SEPARATE END WALLS. THE UNIT SHALL FIT INTO THE SIDE PORTALS OF THE CULTEC RECHARGER STORMWATER CHAMBER AND ACT AS CROSS FEED CONNECTIONS CREATING AN INTERNAL MANIFOLD.
9. THE CHAMBER SHALL BE DESIGNED TO WITHSTAND TRAFFIC LOADS WHEN INSTALLED ACCORDING TO CULTEC'S RECOMMENDED INSTALLATION INSTRUCTIONS.
10. THE CHAMBER SHALL BE MANUFACTURED IN AN ISO 9001:2008 CERTIFIED FACILITY.

CULTEC NO. 66™ WOVEN GEOTEXTILESPECIFICATIONS

GENERAL

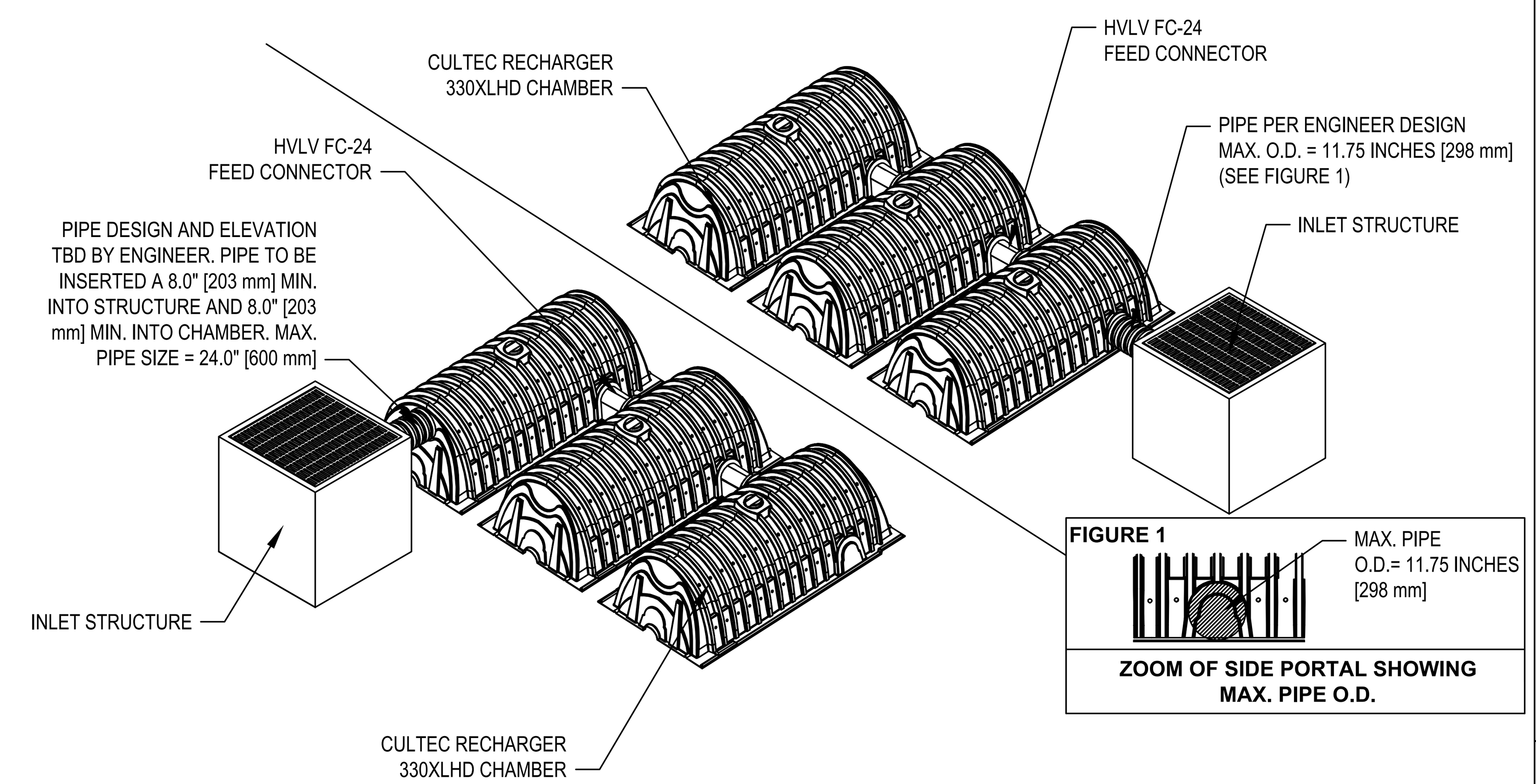
CULTEC NO. 66™ WOVEN GEOTEXTILE IS UTILIZED AS AN UNDERLAYMENT TO PREVENT SCOURING CAUSED BY WATER MOVEMENT WITHIN THE CULTEC CHAMBERS AND FEED CONNECTORS UTILIZING THE CULTEC MANIFOLD FEATURE.

GEOTEXTILE PARAMETERS

1. THE GEOTEXTILE SHALL BE PROVIDED BY CULTEC, INC. OF BROOKFIELD, CT. (203-775-4416 OR 1-800-428-5832)
2. THE GEOTEXTILE SHALL BE BLACK IN APPEARANCE.
3. THE GEOTEXTILE SHALL HAVE A TENSILE STRENGTH OF 315 LBS (1.40KN) PER ASTM D4632 TESTING METHOD.
4. THE GEOTEXTILE SHALL HAVE A TENSILE ELONGATION RESISTANCE OF 15% PER ASTM D4632 TESTING METHOD.
5. THE GEOTEXTILE SHALL HAVE A MULLEN BURST RESISTANCE OF 600PSI (4138 KPA) PER ASTM D3786 TESTING METHOD.
6. THE GEOTEXTILE SHALL HAVE A TEAR RESISTANCE OF 115 LBS (0.51 KN) PER ASTM D4533 TESTING METHOD.
7. THE GEOTEXTILE SHALL HAVE A PUNCTURE RESISTANCE OF 150 LBS (0.66 KN) PER ASTM D4833 TESTING METHOD.
8. THE GEOTEXTILE SHALL HAVE A CBR PUNCTURE RESISTANCE OF 900 LBS (4.00 KN) PER ASTM D6241 TESTING METHOD.
9. THE GEOTEXTILE SHALL HAVE A UV RESISTANCE OF 70% @ 500 HRS. PER ASTM D4355 TESTING METHOD.
10. THE GEOTEXTILE SHALL HAVE A PERMITTIVITY RATING OF 0.05 SEC-1 PER ASTM D4491 TESTING METHOD.
11. THE GEOTEXTILE SHALL HAVE A WATER FLOW RATING OF 4 GPM/FT2 (160 LPM/M2) PER ASTM D4491 TESTING METHOD.
12. THE GEOTEXTILE SHALL HAVE A PERCENT OPEN AREA OF <1% PER CW-02215 TESTING METHOD.
13. THE GEOTEXTILE SHALL HAVE AN APPARENT OPENING SIZE OF 40 US STD. SIEVE (0.425 MM) PER ASTM D4751 TESTING METHOD.
14. THE GEOTEXTILE SHALL CONSIST OF A 100% HIGH-TENACITY, SILT-FILM POLYPROPYLENE YARNS.

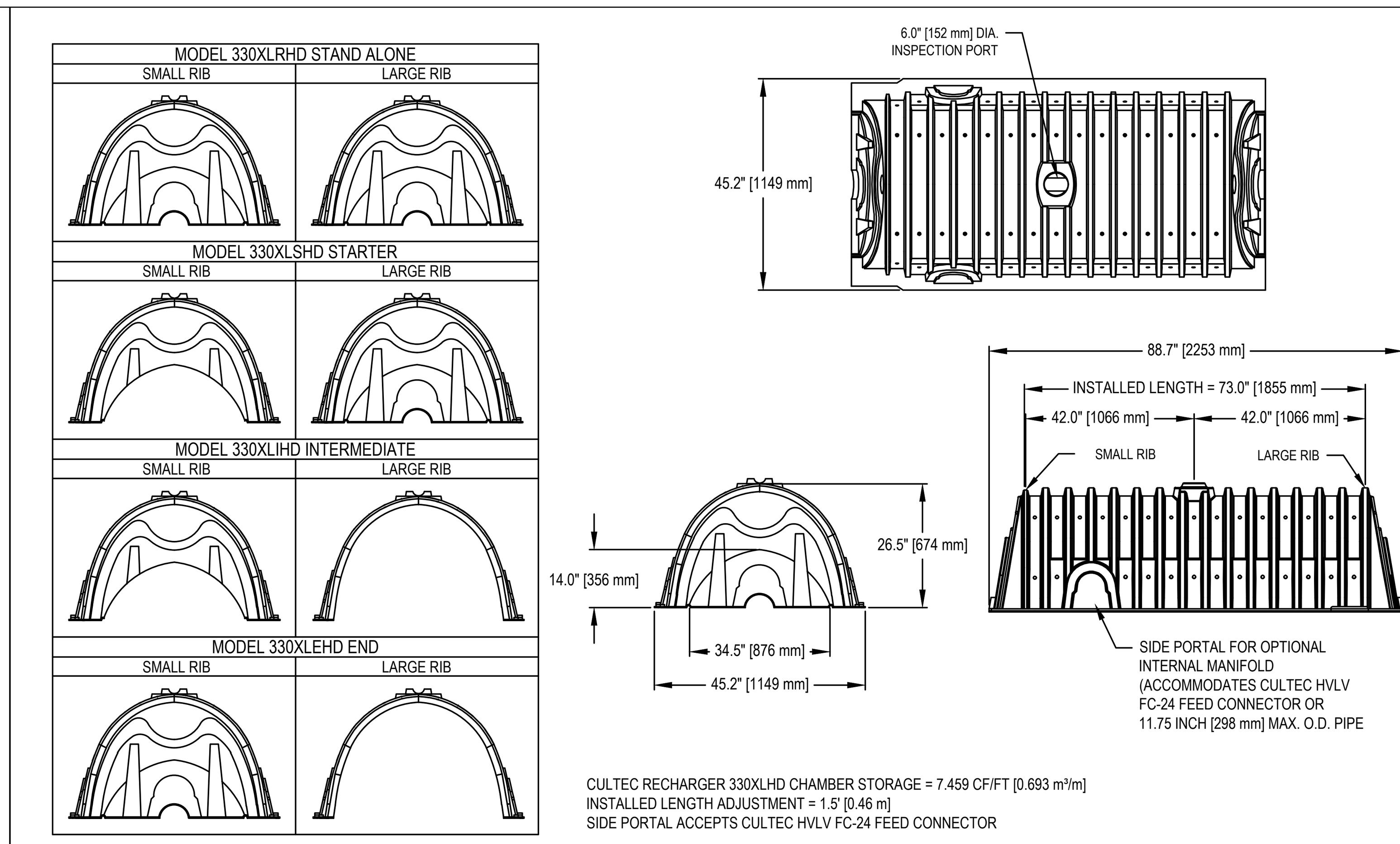
330XLHD 1.0

GENERAL NOTES



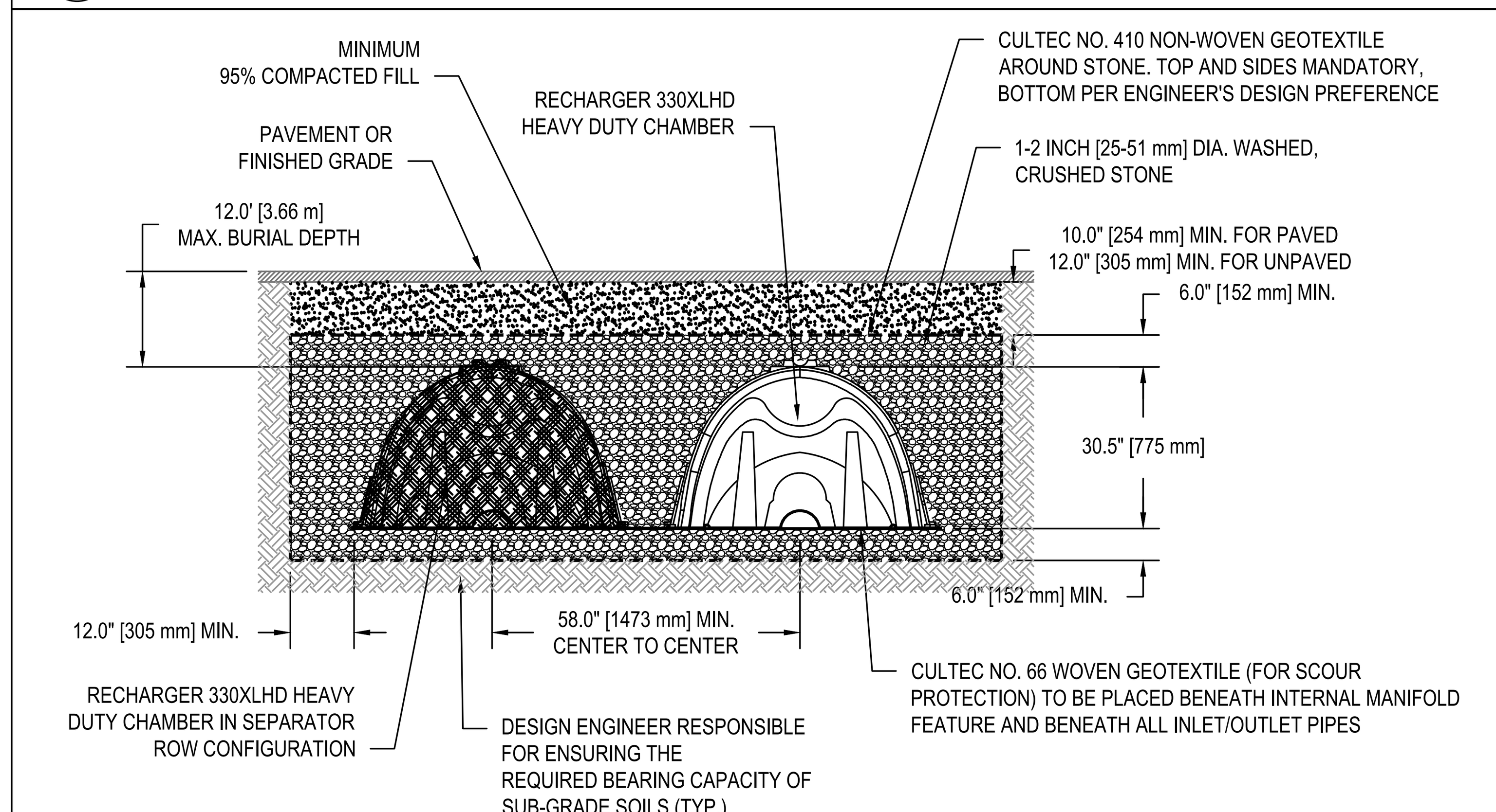
330XLHD 4.0

CULTEC TYPICAL INLET CONNECTION



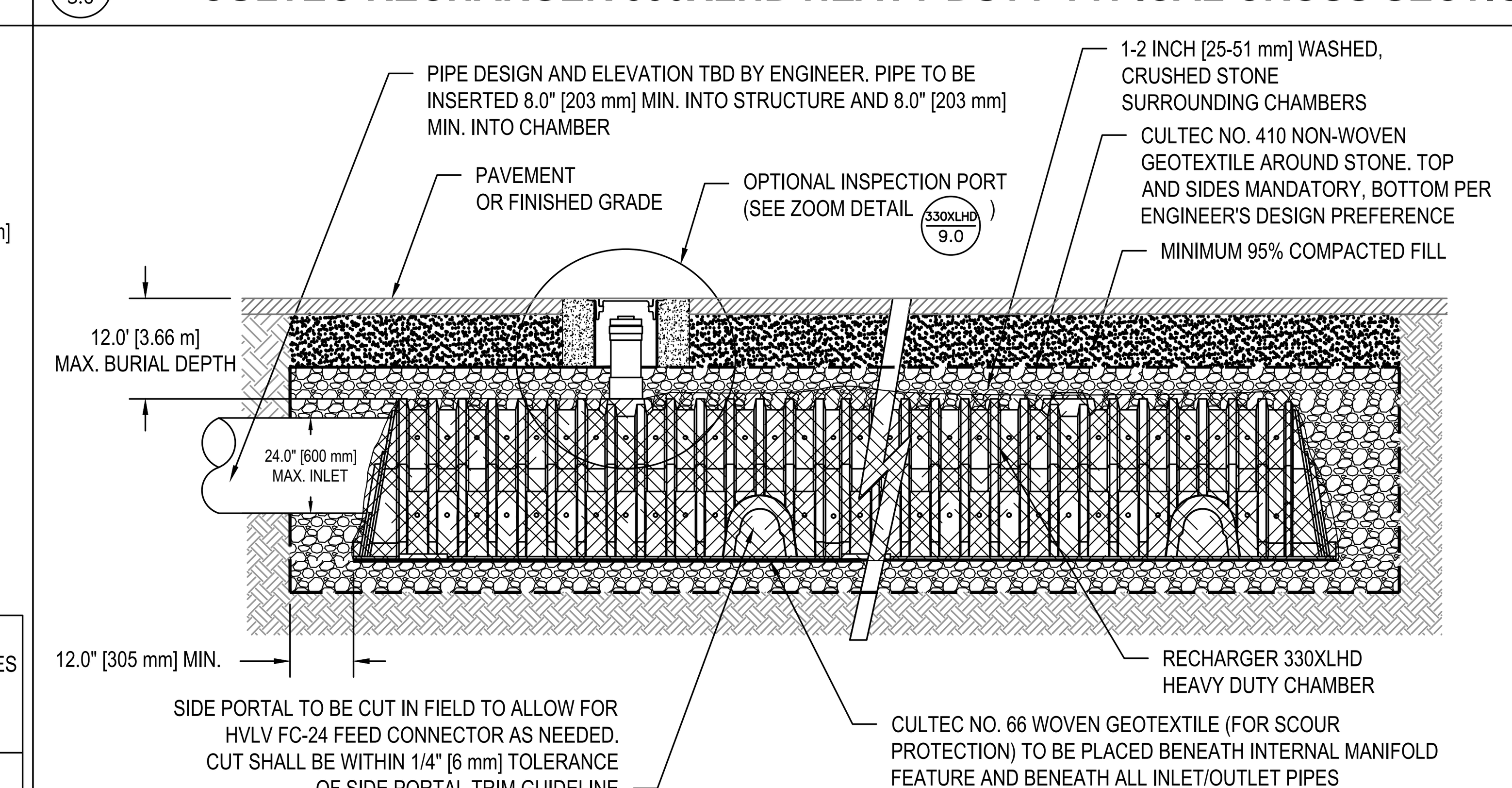
330XLHD 2.0

CULTEC RECHARGER 330XLHD HEAVY DUTY THREE VIEW



330XLHD 5.0

CULTEC RECHARGER 330XLHD HEAVY DUTY TYPICAL CROSS SECTION



330XLHD 10.0

CULTEC INTERNAL MANIFOLD- OPTIONAL INSPECTION PORT DETAIL

INFORMATION PROVIDED BY CULTEC, INC.

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NOTE:
ALL ELECTRIC, GAS, TEL. WATER, SEWER AND DRAIN SERVICES ARE SHOWN IN SCHEMATIC FASHION. THEIR LOCATIONS ARE NOT PRECISE OR NECESSARILY ACCURATE. NO WORK WHATSOEVER SHALL BE UNDERTAKEN ON THIS SITE USING THIS PLAN TO LOCATE THE ABOVE SERVICES. CONSULT WITH THE PROPER AUTHORITIES CONCERNED WITH THESE SERVICES. LOCATIONS FOR INFORMATION REGARDING SUCH. CALL DIG-SAFE AT 811.

Plans Not To Be used for Construction unless Signed and Sealed For Construction.

NO	DATE	DESCRIPTION	CKD
1	4/9/17	35% REVIEW	RR
2	6/4/17	95% REVIEW	RR

WATERSTONE ENGINEERING
INNOVATIVE STORMWATER MANAGEMENT
9 GRETA'S WAY
STRATHAM, NH 03885
(p) 603.686.2488

95% DESIGN FOR WATER INTEGRATION FOR SQUAMSCOTT - EXETER (WISE) INTEGRATED PLAN (IP) PHASE 1
LINCOLN STREET SUBWATERSHED NUTRIENT CONTROL STRATEGIES

PREPARED FOR:
TOWN OF EXETER
DEPT. OF PUBLIC WORKS
11 NEWFIELDS ROAD

DESIGNED BY: RR
DRAFTED BY: CDS
CHECKED BY: RR

STATE OF NEW HAMPSHIRE
ROBERT M. ROSEEN
No. 12215
LICENSED
PROFESSIONAL ENGINEER

SUBSURFACE INFILTRATION CULTEC DETAILS

JOB #: 16928
SCALE: AS SHOWN
CONTRCT #: N/A

D8