ALLEN & MAJOR
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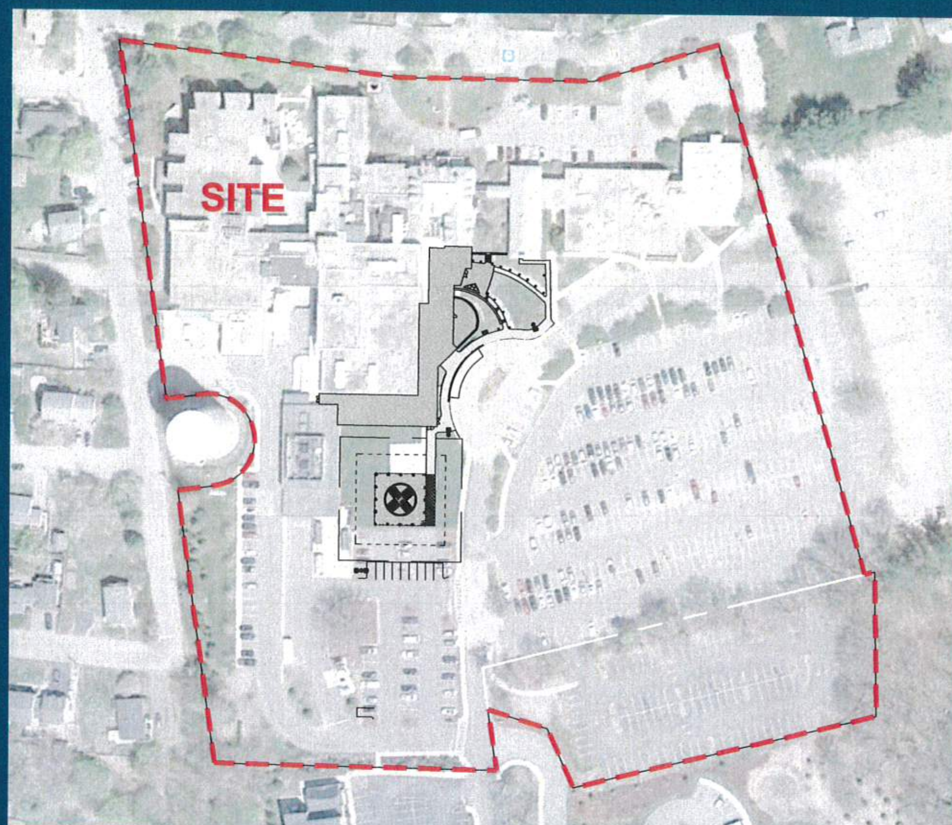
SITE LOCUS



ANNA JAQUES HOSPITAL

OR BUILDING EXPANSION
25 HIGHLAND AVE
NEWBURYPORT, MA

DRAINAGE REPORT

PREPARED: JANUARY 8, 2020

APPLICANT:
ANNA JAQUES HOSPITAL
25 HIGHLAND AVE
NEWBURYPORT, MA 01950

PREPARED BY:
ALLEN & MAJOR ASSOCIATES, INC.
100 COMMERCE WAY
WOBURN, MASSACHUSETTS 01888

COMMONWEALTH OF MASSACHUSETTS
TIMOTHY J. WILLIAMS
CIVIL
No.43119
REGISTERED PROFESSIONAL ENGINEER

1/8/20

A&M PROJECT NO. : 2669-01

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Section 1.0 Drainage Report

- **INTRODUCTION**

The purpose of this drainage report is to provide an overview of the proposed stormwater management system for the proposed development at Anna Jaques Hospital in Newburyport, MA. The report will show by means of narrative, calculations and exhibits that there is no increase in peak rate of runoff from the site at each of the study points for all design storm events.

The proposed site improvements will include a building addition of approximately 11,000± gross square feet, the reconstruction and relocation of the existing heliport, and the reconstruction of landscaping features within the affected area. With the reconstruction and relocation of the existing heliport; 12 parking spaces are proposed to be removed, and 10 parking spaces are to be reconstructed. Pedestrian sidewalks will be reconstructed in the same locations, and building access points will be maintained.

The stormwater management system (SMS) incorporates structural Best Management Practices to provide stormwater quality treatment, conveyance, and groundwater recharge. The SMS includes roof drains, drain manholes, underground piping, and subsurface infiltration systems. All of the stormwater runoff from the proposed development is collected and treated before being infiltrated or discharged.

- **SITE CATEGORIZATION FOR STORMWATER REGULATIONS**

The proposed site improvements at Anna Jaques Hospital are classified as a "new development" under the MA DEP Stormwater Management Standards due to the net increase in impervious area. A new development project is required to meet the all of Stormwater Management Standards listed within the MA DEP Stormwater Handbook.

- **SITE LOCATION AND ACCESS**

The development site is located at the southern side of the hospital at the existing main entrance and drop off area. The development area encompasses the lawn area with the heliport, the main entrance area, and the patio area at the basement level. The site has frontage Rawson Avenue and Highland Avenue with access from Highland Avenue and Wallace Bashaw Junior Way.

- **EXISTING SITE CONDITIONS**

The high point on site is located to the west of the development area near the water tower and is elevation 100 (NAVD 88). Within the development area the high point is located at the main entrance at elevation 99.75 (NAVD 88). The grade slopes moderately towards the heliport area which has an approximate grade of elevation 97 (NAVD 88). Within the development area there is also a basement level entrance to the northeast of the main entrance at elevation 93 (NAVD 88). The grade difference from the main entrance to the basement level entrance is retained by a tiered retaining wall system. These walls will be rebuilt in the same location in the proposed condition. The existing stormwater surface drainage flows were analyzed at three Study Points.

Study Point #1 is the contributing flow to the existing catch basin south of the development area which contributes to an existing on-site infiltration system.

Study Point #2 is the contributing flow from within the development area which flows onto the access drive to an on-site catch basin.

Study Point #3 is the summation of flow to existing on-site drainage infrastructure to the east. This area will be rebuilt to match existing site conditions and the existing stormwater collection system will be maintained or rebuilt in kind.

EXISTING SOIL CONDITIONS

The on-site soils were identified using the USDA Natural Resources Conservation Services (NRCS) Soil Survey for Essex County. The site is shown to primarily have a soil type of 254B Merrimac Fine Sandy Loam, 3 to 8 percent slopes which is classified as Hydrologic Soil Group “A”. A copy of the NRCS Soil Report is included in the Appendix of this report. According to the previously completed Geotechnical Investigation Report by Oak Engineers it was determined that the 254B Merrimac Fine Sandy Loam was consistent throughout the site. This Geotechnical Investigation Report has been included within the appendix of this report which includes test boring data throughout the site, and within the vicinity of the proposed subsurface infiltration system. Groundwater and bedrock were not encountered within any on-site borings, and test boring holes B102 and B106 within the vicinity of the proposed subsurface infiltration system were performed to a depth of 25 feet and 62 feet respectively.

USDA Natural Resources Conservation Services (NRCS) published Saturated Hydraulic Conductivity (Ksat) values for the Merrimac Fine Sandy Loam are 100 micrometers per second or 14.17 inches per hour. Based on a safety factor of 50% a conservative infiltration rate of 7.08 inches per hour was used in the analysis of the drainage design.

• DRAINAGE ANALYSIS METHODOLOGY

The stormwater runoff analysis of the existing and proposed conditions includes an estimate of the peak rate of runoff from various rainfall events. Peak runoff rates were developed using TR-55 Urban Hydrology for Small Watersheds, developed by the U.S. Department of Commerce, Engineering Division and the HydroCAD 10.00 computer program. Further, the analysis has been prepared in accordance with the City of Newburyport requirements, Massachusetts Department of Environmental Protection guidelines and standard engineering practices. The peak rate of runoff has been estimated for each watershed during the 2, 10, and 100-year storm events. The rainfall intensities are based on the Northeast Regional Climate Center (NRCC) extreme precipitation tables. A copy of the extreme precipitation tables is included in the Appendix of this report. These intensities were greater than the published values within the City of Newburyport Stormwater Management Standards.

• PEAK RATE OF RUNOFF

The proposed stormwater management system for the site will collect the roof water from the proposed addition and convey it to an underground stormwater infiltration system. This system has been designed to infiltrate the 100-yr storm and will not discharge to any on-site drainage networks. With the removal of the proposed building footprint area, the watershed areas will have a reduction in contributing area and impervious area.

The stormwater runoff model shows that the proposed site development reduces the rate of runoff during the 2, 10, and 100-year storm events, at the identified points of analysis (see tables below). The stormwater runoff model also shows that the proposed site development reduces the volume of runoff for all storm events at the identified points of analysis (see tables below). The HydroCAD worksheets are included in Section 3 and 4 of this report.

STUDY POINT #1 (on-site flow to existing catch basin & infiltration system)			
	2-Year	10-Year	100-Year
Existing Flow (CFS)	0.20	0.78	2.71
Proposed Flow (CFS)	0.08	0.50	2.00
Decrease (CFS)	**0.12**	**0.28**	**0.71**
Existing Volume (CF)	889	2,546	8,104
Proposed Volume (CF)	531	1,713	6,037
Decrease (CF)	**358**	**833**	**2,067**

STUDY POINT #2 (on-site flow to existing catch basin)			
	2-Year	10-Year	100-Year
Existing Flow (CFS)	0.06	0.20	0.68
Proposed Flow (CFS)	0.00	0.05	0.34
Decrease (CFS)	**0.06**	**0.15**	**0.34**
Existing Volume (CF)	234	652	2,033
Proposed Volume (CF)	53	247	1,061
Decrease (CF)	**181**	**405**	**972**

STUDY POINT #3 (on-site flow to existing stormwater system)			
	2-Year	10-Year	100-Year
Existing Flow (CFS)	0.18	0.61	1.97
Proposed Flow (CFS)	0.17	0.49	1.46
Decrease (CFS)	**0.01**	**0.12**	**0.51**
Existing Volume (CF)	709	1,922	5,875
Proposed Volume (CF)	598	1,511	4,363
Decrease (CF)	**111**	**411**	**1,512**

- **MA DEP STORMWATER PERFORMANCE STANDARDS**

The MA DEP Stormwater Management Policy was developed to improve water quality by implementing performance standards for stormwater management. The intent is to implement the stormwater management standards through the review of Notice of Intent filings by the issuing authority (Conservation Commission or DEP). The following section outlines how the proposed Stormwater Management System meets the standards set forth by the Policy.

BMP's implemented in the design include:

Subsurface Infiltration Systems (Perforated Pipe)
Specific maintenance schedule

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

Temporary erosion and sedimentation controls will be incorporated into the construction phase of the project. These temporary controls may include tubular sediment barriers, inlet sediment traps, diversion channels, slope stabilization, and stabilized construction entrances.

The Massachusetts Department of Environmental Protection has established ten (10) Stormwater Management Standards. The proposed development will be adding impervious area therefore will have to meet or exceed all (10) Stormwater Management Standards. A project that meets or exceeds the standards is presumed to satisfy the regulatory requirements regarding stormwater management. The Standards are as follows:

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

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

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

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

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

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

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

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

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

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

10. All illicit discharges to the stormwater management system are prohibited.

The following calculations and responses demonstrate that the proposed stormwater management system is in compliance with the performance standards as outlined in the MA DEP Stormwater Management Handbook.

- STANDARD #1: The proposed development will not introduce any new outfalls with direct discharge to a wetland area or waters of the Commonwealth of Massachusetts.

- STANDARD #2: The proposed development has been designed so that the post-development peak discharge rates do not exceed the predevelopment peak discharge rates. A summary of the existing and proposed discharge rates are included within this report.

- STANDARD #3: The existing annual recharge for the site has been approximated in the proposed condition. There is a proposed subsurface infiltration system designed to meet this requirement. Stormwater runoff generated from the impervious roof addition of the proposed development is routed through the infiltration BMP. The proposed Recharge Volume is based on the Static Method per the MA DEP Stormwater Management Standards, Volume 3, Chapter 1.

  The site is shown to primarily have a soil type of 254B Merrimac Fine Sandy Loam, 3 to 8 percent slopes which is classified as Hydrologic Soil Group "A". The required recharge volume is calculated as follows:

  Total impervious area (taken from HydroCAD model) = 20,723± square feet

  Recharge Volume (Rv) = (F) x (Impervious Area)

  Where:
  Rv = Required Recharge Volume, expressed in cubic feet
  F = Target Depth Factor associated with each Hydrologic Soil Group
  Impervious Area = proposed pavement, sidewalk, rooftop in square feet

  Recharge Volume (Rv) = (F) x (Impervious Area)
  = (0.60 inches)*(1/12 inches/ft)* (20,723 square feet) [for Soil Group A]
  = 1,036 ft^3

  Recharge Provided; Infiltration System Storage Volume = 2,429 ft^3 (See Appendix)

  2,429 ft^3 > 1,036 ft^3 Required

- STANDARD #4: The proposed stormwater management system has been designed to remove 80% of the average annual post-construction load of Total Suspended Solids (TSS). The proposed infiltration system has been designed utilizing an infiltration rate greater than 2.4 inches per hour, therefore the required water quality volume must equal 1.0 inch of runoff times the total impervious area of the post-development project site.

  Total impervious area (taken from HydroCAD model) = 20,723± square feet

  Water Quality Volume (WQV) = (1.0") x (Impervious Area)
  = (1.0 inch)*(1/12 inches/ft)* (20,723 square feet) = 1,727 ft^3

  Water Quality Volume Provided; Infiltration System Storage Volume= 2,429 ft^3 (See Appendix)

2,429 ft^3 > 1,727 ft^3 Required

The contributing drainage areas from the roof area and proposed heliport and parking areas will be treated utilizing the proposed and existing infiltration systems. The remainder of the proposed development area consists of pedestrian walkways and landscaping area and is not considered a pollutant generating area.

FLOW TO INFILTRATION SYSTEMS

BMP	TSS Removal Rate	Starting TSS Load	Amount Removed	Remaining Load
Subsurface Infiltration	0.80	1.0	0.80	0.20

TOTAL TSS REMOVAL	0.8 or 80%

- STANDARD #5: The site is not considered a land use with higher potential pollutant loads.
- STANDARD #6: The project site is not located within a Zone II nor an Interim Wellhead Protection Area.
- STANDARD #7: The proposed project is not considered a re-development project under the Stormwater Management Handbook guidelines as there is an increase in the amount of total impervious area.
- STANDARD #8: A plan to control construction-related impacts, including erosion, sedimentation and other pollutant sources during construction and land disturbance activities has been developed. A detailed Site Preparation and Erosion Control Plan is included in the Civil Drawings. A Pollution Prevention Plan is included within this document. The proponent will prepare and submit a Stormwater Pollution Prevention Plan (SWPPP) prior to commencement of construction activities which will result in the disturbance of one acre of land or more.
- STANDARD #9: A Long-Term Operation and Maintenance (O&M) Plan has been developed for the proposed stormwater management system and is included within this document. See Section 2.0 of this report.
- STANDARD #10: There are no expected illicit discharges to the stormwater management system. The applicant will submit the Illicit Discharge Compliance Statement prior to the discharge of stormwater runoff to the post-construction stormwater best management practices.

Section 2.0 Operation & Maintenance Plan

INTRODUCTION

In accordance with the standards set forth by the Stormwater Management Policy issued by the Department of Environmental Protection (DEP), Allen & Major Associates, Inc. has prepared the following Operation and Maintenance Plan for the Anna Jaques Hospital OR Building Expansion project.

The plan is broken down into three major sections. The first section describes construction-related erosion and sedimentation controls (Construction Period). The second section describes the long term pollution prevention measures (Long Term Pollution Prevention Plan). The third section is a post-construction operation and maintenance plan designed to address the long-term maintenance needs of the stormwater management system (Long Term Maintenance Plan).

NOTIFICATION PROCEDURES FOR CHANGE OF RESPONSIBILITY FOR O&M

The Stormwater Management System (SMS) for this project is owned by Anna Jaques Hospital (owner). The owner shall be responsible for the long-term operation and maintenance of this SMS as outlined in this Operation and Maintenance (O&M) Plan. Should ownership of the SMS change, the owner will continue to be responsible until the succeeding owner has assumed such responsibility.

In the event the SMS will serve multiple lots/owners, such as the subdivision of the existing parcel or creation of lease areas, the owner(s) shall establish an association on other legally enforceable arrangements under which the association or a single party shall have legal responsibility for the operation and maintenance of the entire SMS. The legal instrument creating such responsibility shall be recorded with the Registry of Deeds and promptly following its recording, a copy thereof shall be furnished to the Town.

CONTACT INFORMATION

Stormwater Management System Owner:	Anna Jaques Hospital 25 Highland Avenue Newburyport, MA Phone : (978) 463-1000

Emergency Contact Information:

- Anna Jaques Hospital (owner/operator) — Phone (978) 463-1000
- Allen & Major Associates, Inc. (Site Civil Engineer) — Phone (781) 935-6889
- Newburyport Public Works — Phone (978) 465-4464
- Newburyport Conservation Commission — Phone (978) 465-4400
- Newburyport Fire Department (non-emergency line) — Phone (978) 465-4427

CONSTRUCTION PERIOD

1. Contact the Conservation Commission Administrator and the Newburyport Engineering Division at least fourteen (14) days prior to start of construction to schedule a pre-construction meeting.

2. Install the tubular sediment barrier and construction fencing as shown on the Site Preparation and Erosion Control Plan.

3. Install the construction entrance at the location shown on the Site Preparation and Erosion Control Plan.

4. Site access shall be achieved only from the designated construction entrance.

5. Stockpiles shall be stabilized with erosion control matting or temporary seeding whenever practicable.

6. Install silt inlet protection at each drain inlet as soon as practicable.

7. Install erosion control fabric on all vegetated slopes as shown on the Site Preparation and Erosion Control Plan as soon as practicable.

8. All erosion control measures shall be inspected every seven days and within 24 hours of every rainfall event of 0.25" or greater.

9. All erosion control measures shall be maintained, repaired or replaced as required or at the direction of the owner's engineer, the Town Engineer, or the City's Conservation Agent.

10. Sediment accumulation up-gradient of the tubular sediment barriers greater than 6" in depth shall be removed and disposed of in accordance with all applicable regulations.

11. If it appears that sediment is exiting the site, immediate action shall be taken to stop the sediment from exiting the site. Silt sacks shall then be installed in all off-site catch basins adjacent to the site and the on-site erosion and sediment control measures shall be modified to prevent any future sediment from exiting the site.

12. The location of snow storage is to be reviewed with the City Engineer, the City Conservation Agent, and the engineer prior to placement.

13. The contractor shall comply with the General and Erosion Notes as shown on the Site Development Plans and Specifications.

14. The stabilized construction entrances shall be inspected every seven days and within 24 hours of every rainfall event of 0.25" or greater. The entrances shall be maintained by adding additional clean, angular, durable stone to remove the soil from the construction vehicle's tires when exiting the site. If soil is still leaving the site via the construction vehicle tires, adjacent roadways shall be kept clean by street sweeping.

15. Dust pollution shall be controlled using on-site water trucks.

LONG TERM POLLUTION PREVENTION PLAN

Standard #4 from the MA DEP Stormwater Management Handbook requires that a Long Term Pollution Prevention Plan (LTPPP) be prepared and incorporated as part of the Operation and Maintenance of the Stormwater Management System. The purpose of the LTPPP is to identify potential sources of pollution that may affect the quality of stormwater discharges, and to describe the implementation of practices to reduce the pollutants in stormwater discharges. The following items describe the source control and proper procedures for the LTPPP.

- **HOUSEKEEPING**
  An Operation and Maintenance (O&M) plan has been prepared and is included in this section of the report. The owner (or its designee) is responsible for adherence to the O&M plan is a strict and complete manner.

- **STORING OF MATERIALS AND WASTE PRODUCTS**
  There are no proposed exterior (un-covered) storage areas. The trash and waste program for the site includes an exterior screened trash enclosure. There will be a trash contractor used to pick up the waste material.

- **SNOW STORAGE**
  Snow shall be stored on site at the locations shown on the approved site plan. Snow shall be taken off site once snow storage locations on site become inadequate and begin to block access to and from the site or block the use of on site parking facilities. Any excess will be trucked off site and disposed of in accordance with the Town and MADEP requirements. The snow storage locations shall be reviewed with the property management company and the plowing contractor prior to winter conditions.

- **VEHICLE WASHING**
  Outdoor vehicle washing has the potential to result in high loads of nutrients, metals, and hydrocarbons during dry weather conditions, as the detergent-rich water used to wash the grime off the vehicle enters the stormwater drainage system. The proposed project does not include any designated vehicle washing areas, nor is it expected that any vehicle washing will take place on-site.

- **SPILL PREVENTION AND RESPONSE**
  Sources of potential spill hazards include vehicle fluids, liquid fuels, pesticides, paints, solvents, and liquid cleaning products. The majority of the spill hazards would likely occur within the building and would not enter the stormwater drainage system. However, there are spill hazards from vehicle fluids or liquid fuels located outside of the buildings. These exterior spill hazards have the potential to enter the stormwater drainage system and are to be addressed as follows:

  1. Spill Hazards of pesticides, paints, and solvents shall be remediated using the Manufacturers' recommended spill cleanup protocol.
  2. Vehicle fluids and liquid fuel spill shall be remediated according to the local and state regulations governing fuel spills.
  3. The owner shall have the following equipment and materials on hand to address a spill clean-up: brooms, dust pans, mops, rags, gloves, absorptive material, sand, sawdust, plastic and metal trash containers.
  4. All spills shall be cleaned up immediately after discovery
  5. Spills of toxic or hazardous material shall be reported, regardless of size, to the Massachusetts Department of Environmental Protection at 888-304-1133.

6. Should a spill occur, the pollution prevention plan will be adjusted to include measures to prevent another spill of a similar nature. A description of the spill, along with the causes and cleanup measures will be included in the updated pollution prevention plan.

- **MAINTENANCE OF LAWNS, GARDENS AND OTHER LANDSCAPED AREAS**

It should be recognized that this is a general guideline towards achieving high quality and well groomed landscaped areas. The grounds staff / landscape contractor must recognize the shortcomings of a general maintenance plan such as this, and modify and/or augment it based on weekly, monthly, and yearly observations. In order to assure the highest quality conditions, the staff must also recognize and appreciate the need to be aware of the constantly changing conditions of the landscaping and be able to respond to them on a proactive basis.

- **Fertilizer**

Maintenance practices should be aimed at reducing environmental, mechanical and pest stresses to promote healthy and vigorous growth. When necessary, pest outbreaks should be treated with the most sensitive control measure available. Synthetic chemical controls should be used only as a last resort to organic and biological control methods. Fertilizer, synthetic chemical controls and pest management applications (when necessary) shall be performed only by licensed applicators in accordance with the manufacturer's label instructions when environmental conditions are conducive to controlled product application.

Only slow-release organic fertilizers should be used in the planting and mulch areas to limit the amount of nutrients that could enter downstream resource areas. Fertilization of the planting and mulch areas will be performed within manufacturers labeling instructions and shall not exceed an NPK ratio of 1:1:1 (i.e. Triple 10 fertilizer mix), considered a low nitrogen mixture. Fertilizers approved for the use under this O&M Plan are as follows:

Type:	LESCO® 28-0-12 (Lawn Fertilizer)
	MERIT® 0.2 Plus Turf Fertilizer
	MOMENTUM™ Force Weed & Feed

- **Suggested Aeration Program**

In-season aeration of lawn areas is good cultural practice and is recommended whenever feasible. It should be accomplished with a solid thin tine aeration method to reduce disruption to the use of the area. The depth of solid tine aeration is similar to core type but should be performed when the soil is somewhat drier for a greater overall effect.

Depending on the intensity of use, it can be expected that all landscaped lawn areas will need aeration to reduce compaction at least once per year. The first operation should occur in late May following the spring season. Methods of reducing compaction will vary based on the nature of the compaction. Compaction on newly established landscaped areas is generally limited to the top 2-3" and can be alleviated using hollow core or thin tine aeration methods.

The spring aeration should consist of two passes at opposite directions with 1/4" hollow core tines penetrating 3-5" into the soil profile. Aeration should occur when the soil is moist but not saturated. The soil cores should be shattered in place and dragged or swept back into the turf to control thatch. If desired the cores may also be removed and the area top-dressed with sand or sandy loam. If the area drains on average too slowly, the topdressing should contain a higher percentage of sand. If it is draining on average too quickly, the top dressing should contain a higher percentage of soil and organic matter.

- **Landscape Maintenance Program Practices:**
  - **Lawn**
    1. Mow a minimum of once a week in spring, to a height of 2” to 2 1/2” high. Mowing should be frequent enough so that no more than 1/3 of grass blade is removed at each mowing. The top growth supports the roots; the shorter the grass is cut, the less the roots will grow. Short cutting also dries out the soil and encourages weeds to germinate.
    2. Mow approximately once every two weeks from July 1st to August 15th depending on lawn growth.
    3. Mow on a ten-day cycle in fall, when growth is stimulated by cooler nights and increased moisture.
    4. Do not remove grass clippings after mowing.
    5. Keep mower blades sharp to prevent ragged cuts on grass leaves, which cause a brownish appearance and increase the chance for disease to enter a leaf.
  - **Shrubs**
    1. Mulch not more than 3” depth with shredded pine or fir bark.
    2. Hand prune annually, immediately after blooming, to remove 1/3 of the above-ground biomass (older stems). Stem removals to occur within 6” of the ground to open up shrub and maintain two-year wood (the blooming wood).
    3. Hand prune evergreen shrubs only as needed to remove dead and damaged wood and to maintain the naturalistic form of the shrub. Never mechanically shear evergreen shrubs.
  - **Trees**
    1. Provide aftercare for new tree plantings for the first three years.
    2. Do not fertilize trees, it artificially stimulates them (unless tree health warrants).
    3. Water once a week for the first year; twice a month the second, once a month the third year.
    4. Prune trees on a four-year cycle.
  - **Invasive Species**
    1. Inform the Conservation Commission Agent prior to the removal of invasive species proposed either through hand work or through chemical removal.

o **STORAGE AND USE OF HERBICIDES AND PESTICIDES**

Integrated Pest Management is the combination of all methods (of pest control) which may prevent, reduce, suppress, eliminate, or repel an insect population. The main requirements necessary to support any pest population are food, shelter and water, and any upset of the balance of these will assist in controlling a pest population. Scientific pest management is the knowledgeable use of all pest control methods (sanitation, mechanical, chemical) to benefit mankind's health, welfare, comfort, property and food. A Pest Management Professional (PMP) will be retained who is licensed with the Commonwealth of Massachusetts Executive Office of Energy and Environmental Affairs, Department of Agricultural Resources.

The site manager will be provided with approved bulletin before entering into or renewing an agreement to apply pesticides for the control of indoor or structural pests. 333 CMR 13.08.

Before beginning each application, the applicator must inform the conservation commission and post a state and local approved notice on all of the entrances to the treated room or area. The applicator must leave such notices posted after the application. The notice will be posted at conspicuous point(s) of access to the area treated. The location and number of signs will be determined by the configuration of the area to be treated based on the applicator's best judgment. It is intended to give sufficient notice that no one comes into an area being treated unaware that the applicator is working and pesticides are being applied. However, if the contracting entity does not want the signs posted, he/she may sign a Department approved waiver indicating this.

The applicator or employer will provide to any person upon their request the following information on previously conducted applications:

1. Name and phone number of pest control company
2. Date and time of the application;
3. Name and license number of the applicator
4. Target pests
5. Name and EPA Registration Number of pesticide products applied

The notification must be made in writing. The intent is so that individuals, who wish to avoid exposure or want to avoid encountering the applicator, can make necessary arrangements. Applicators are required by law to follow all directions on the pesticide label and must take all steps necessary to avoid applications with people present in a room or area to be treated. Individuals occupying a room or area to be treated at the time of application shall be informed of the procedure. Whenever possible, the applicator should not apply pesticides with anyone present. That may mean treating other areas and returning when occupants have left, asking people to leave the area while the work is being done, or treating before or after people occupy the room. If people do not leave, the applicator must make it clear that he is there to apply pesticides. The applicator will be prepared to provide whatever information possible about the pesticides and techniques used.

- **PET WASTE MANAGEMENT**
  The owner's landscape crew (or designee) shall remove any obvious pet waste that has been left behind by pet owners within the project area. The pet waste shall be disposed of in accordance with local and state regulations.

- **OPERATIONS AND MANAGEMENT OF SEPTIC SYSTEMS**
  The proposed septic system shall be pumped every two to three years and when needed, keep a record of pumping, inspections, maintenance and repairs.

- **MANAGEMENT OF DEICING CHEMICALS AND SNOW**
  The owner's maintenance staff (or its designee) will be responsible for the clearing of the sidewalks and building entrances. The owner may be required to use a de-icing agent such as potassium chloride to maintain a safe walking surface. The de-icing agent for the walkways and building entrances will be kept within the storage rooms located within the building. De-icing

agents will not be stored outside. The owner's maintenance staff will limit the application of sand and salt.

LONG TERM MAINTENANCE PLAN – FACILITIES DESCRIPTION

The following is a description of the stormwater management system for the project site.

- **STORMWATER COLLECTION SYSTEM**

  The stormwater collection system is a series of inlets located at low points within the limits of the paved area. The inlets consist of catch basins with deep sumps and hooded outlets within the pavement area. The stormwater runoff from the building rooftop is collected using gutters, downspouts and roof drains. All of the roof drains and inlets are proposed to connect to Subsurface Infiltration Systems.

- **INFILTRATION SYSTEM**

  The proposed Infiltration is Perforated ADS Plastic Pipe. The proposed system is designed to have a manhole upstream of the system to provide access into the system. Inspect the system annually. For inspection checklist and maintenance procedures see the maintenance program provided within this report.

SUPPLEMENTAL INFORMATION (See following pages)

- OPERATION & MAINTENANCE SCHEDULE & CHECKLIST

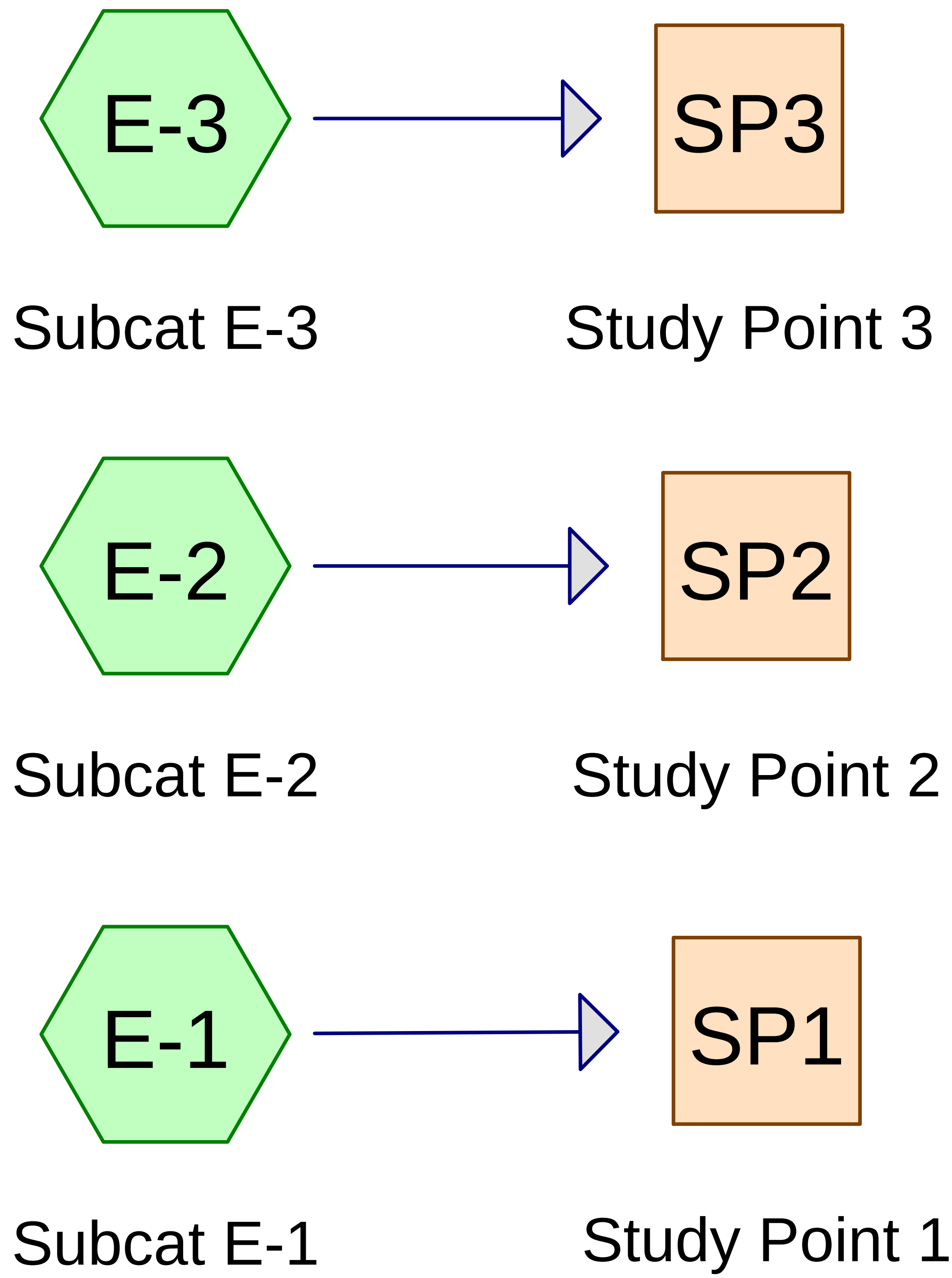
ANNA JAQUES HOSPITAL – OR BUILDING EXPANSION– #25 HIGHLAND AVE, NEWBURYPORT, MA

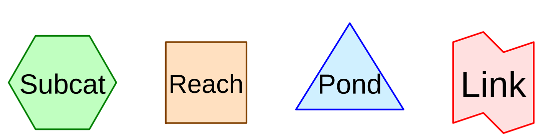
Note all cleanouts, anomalies, degradation, and corrections.

	Structure or Task	**Maintenance Activity**	**Maintenance Cost/Unit**	**Schedule**	**Estimated Annual Maintenance Cost**	**Inspection Performed By**	
						Date:	By:
BMP 1	Pavement	Perform vacuum sweeping. Maintain information that confirms the sweeping schedule and that all vacuum sweeps have been disposed in accordance with state and local requirements.	$1,000/sweeping for all pavements	Sweep twice Annually (Early spring & late fall)	$2,000		
BMP 2	Infiltration System	Perform a visual inspection of the System using the drain manhole for access (may require OSHA confined space measures). Use a Jet Vac to clean when the sediment depth reaches 3". Refer to attached manufacturer's information regarding maintenance procedures.	$1,000/inspection	Twice Annually (Early spring & late fall)	$1,000		
BMP 3	Catch Basins	Clamshell or vacuum sumps. Sediment should be removed when accumulated to a depth of 12", but not less than twice a year. Sediment and debris shall be removed by a vacuum truck. Disposal of the accumulated sediment and hydrocarbons must be in accordance with applicable local, state, and federal guidelines and regulations.	$1,000/inspection	Twice Annually (Early spring & late fall)	$1,000		

Section 3.0 HydroCAD Worksheets – Existing Conditions

EXISTING 2-YEAR STORM
EXISTING 10-YEAR STORM
EXSTING 100-YEAR STORM





Routing Diagram for 2699-01_Existing-Conditions
Prepared by Allen & Major Associates Inc. , Printed 1/2/2020
HydroCAD® 10.00-24 s/n 02881 © 2018 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
24,792	39	>75% Grass cover, Good, HSG A (E-1, E-2, E-3)
16,777	98	Paved parking, HSG A (E-1, E-2, E-3)
153	98	Roofs, HSG A (E-3)
41,722	**63**	**TOTAL AREA**

Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
41,722	HSG A	E-1, E-2, E-3
0	HSG B	
0	HSG C	
0	HSG D	
0	Other	
41,722		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover	Subcatchment Numbers
24,792	0	0	0	0	24,792	>75% Grass cover, Good	E-1, E-2, E-3
16,777	0	0	0	0	16,777	Paved parking	E-1, E-2, E-3
153	0	0	0	0	153	Roofs	E-3
41,722	**0**	**0**	**0**	**0**	**41,722**	**TOTAL AREA**	

Summary for Subcatchment E-1: Subcat E-1

Runoff = 0.20 cfs @ 12.10 hrs, Volume= 889 cf, Depth= 0.49"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.23"

Area (sf)	CN	Description
13,111	39	>75% Grass cover, Good, HSG A
8,498	98	Paved parking, HSG A
21,609	62	Weighted Average
13,111		60.68% Pervious Area
8,498		39.32% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Assumed**

Summary for Subcatchment E-2: Subcat E-2

Runoff = 0.06 cfs @ 12.10 hrs, Volume= 234 cf, Depth= 0.53"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.23"

Area (sf)	CN	Description
2,176	98	Paved parking, HSG A
3,099	39	>75% Grass cover, Good, HSG A
5,274	63	Weighted Average
3,099		58.75% Pervious Area
2,176		41.25% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Assumed**

Summary for Subcatchment E-3: Subcat E-3

Runoff = 0.18 cfs @ 12.10 hrs, Volume= 709 cf, Depth= 0.57"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.23"

Area (sf)	CN	Description
6,104	98	Paved parking, HSG A
153	98	Roofs, HSG A
8,582	39	>75% Grass cover, Good, HSG A
14,839	64	Weighted Average
8,582		57.83% Pervious Area
6,257		42.17% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Assumed**

Summary for Reach SP1: Study Point 1

Inflow Area = 21,609 sf, 39.32% Impervious, Inflow Depth = 0.49" for 2-Year event
Inflow = 0.20 cfs @ 12.10 hrs, Volume= 889 cf
Outflow = 0.20 cfs @ 12.10 hrs, Volume= 889 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 3

Summary for Reach SP2: Study Point 2

Inflow Area =	5,274 sf,	41.25% Impervious,	Inflow Depth = 0.53"	for 2-Year event	
Inflow =	0.06 cfs @	12.10 hrs,	Volume=	234 cf	
Outflow =	0.06 cfs @	12.10 hrs,	Volume=	234 cf,	Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 3

Summary for Reach SP3: Study Point 3

Inflow Area =	14,839 sf,	42.17% Impervious,	Inflow Depth = 0.57"	for 2-Year event	
Inflow =	0.18 cfs @	12.10 hrs,	Volume=	709 cf	
Outflow =	0.18 cfs @	12.10 hrs,	Volume=	709 cf,	Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 3

Summary for Subcatchment E-1: Subcat E-1

Runoff = 0.78 cfs @ 12.08 hrs, Volume= 2,546 cf, Depth= 1.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.96"

Area (sf)	CN	Description
13,111	39	>75% Grass cover, Good, HSG A
8,498	98	Paved parking, HSG A
21,609	62	Weighted Average
13,111		60.68% Pervious Area
8,498		39.32% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Assumed**

Summary for Subcatchment E-2: Subcat E-2

Runoff = 0.20 cfs @ 12.08 hrs, Volume= 652 cf, Depth= 1.48"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.96"

Area (sf)	CN	Description
2,176	98	Paved parking, HSG A
3,099	39	>75% Grass cover, Good, HSG A
5,274	63	Weighted Average
3,099		58.75% Pervious Area
2,176		41.25% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Assumed**

Summary for Subcatchment E-3: Subcat E-3

Runoff = 0.61 cfs @ 12.08 hrs, Volume= 1,922 cf, Depth= 1.55"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.96"

Area (sf)	CN	Description
6,104	98	Paved parking, HSG A
153	98	Roofs, HSG A
8,582	39	>75% Grass cover, Good, HSG A
14,839	64	Weighted Average
8,582		57.83% Pervious Area
6,257		42.17% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Assumed**

Summary for Reach SP1: Study Point 1

Inflow Area = 21,609 sf, 39.32% Impervious, Inflow Depth = 1.41" for 10-Year event
Inflow = 0.78 cfs @ 12.08 hrs, Volume= 2,546 cf
Outflow = 0.78 cfs @ 12.08 hrs, Volume= 2,546 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 3

Summary for Reach SP2: Study Point 2

Inflow Area = 5,274 sf, 41.25% Impervious, Inflow Depth = 1.48" for 10-Year event
Inflow = 0.20 cfs @ 12.08 hrs, Volume= 652 cf
Outflow = 0.20 cfs @ 12.08 hrs, Volume= 652 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 3

Summary for Reach SP3: Study Point 3

Inflow Area = 14,839 sf, 42.17% Impervious, Inflow Depth = 1.55" for 10-Year event
Inflow = 0.61 cfs @ 12.08 hrs, Volume= 1,922 cf
Outflow = 0.61 cfs @ 12.08 hrs, Volume= 1,922 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 3

Summary for Subcatchment E-1: Subcat E-1

Runoff = 2.71 cfs @ 12.08 hrs, Volume= 8,104 cf, Depth= 4.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=9.19"

Area (sf)	CN	Description
13,111	39	>75% Grass cover, Good, HSG A
8,498	98	Paved parking, HSG A
21,609	62	Weighted Average
13,111		60.68% Pervious Area
8,498		39.32% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Assumed**

Summary for Subcatchment E-2: Subcat E-2

Runoff = 0.68 cfs @ 12.08 hrs, Volume= 2,033 cf, Depth= 4.63"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=9.19"

Area (sf)	CN	Description
2,176	98	Paved parking, HSG A
3,099	39	>75% Grass cover, Good, HSG A
5,274	63	Weighted Average
3,099		58.75% Pervious Area
2,176		41.25% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Assumed**

Summary for Subcatchment E-3: Subcat E-3

Runoff = 1.97 cfs @ 12.08 hrs, Volume= 5,875 cf, Depth= 4.75"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=9.19"

Area (sf)	CN	Description
6,104	98	Paved parking, HSG A
153	98	Roofs, HSG A
8,582	39	>75% Grass cover, Good, HSG A
14,839	64	Weighted Average
8,582		57.83% Pervious Area
6,257		42.17% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Assumed**

Summary for Reach SP1: Study Point 1

Inflow Area = 21,609 sf, 39.32% Impervious, Inflow Depth = 4.50" for 100-Year event
Inflow = 2.71 cfs @ 12.08 hrs, Volume= 8,104 cf
Outflow = 2.71 cfs @ 12.08 hrs, Volume= 8,104 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 3

Summary for Reach SP2: Study Point 2

Inflow Area =	5,274 sf,	41.25% Impervious,	Inflow Depth = 4.63"	for 100-Year event
Inflow =	0.68 cfs @	12.08 hrs, Volume=	2,033 cf	
Outflow =	0.68 cfs @	12.08 hrs, Volume=	2,033 cf,	Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 3

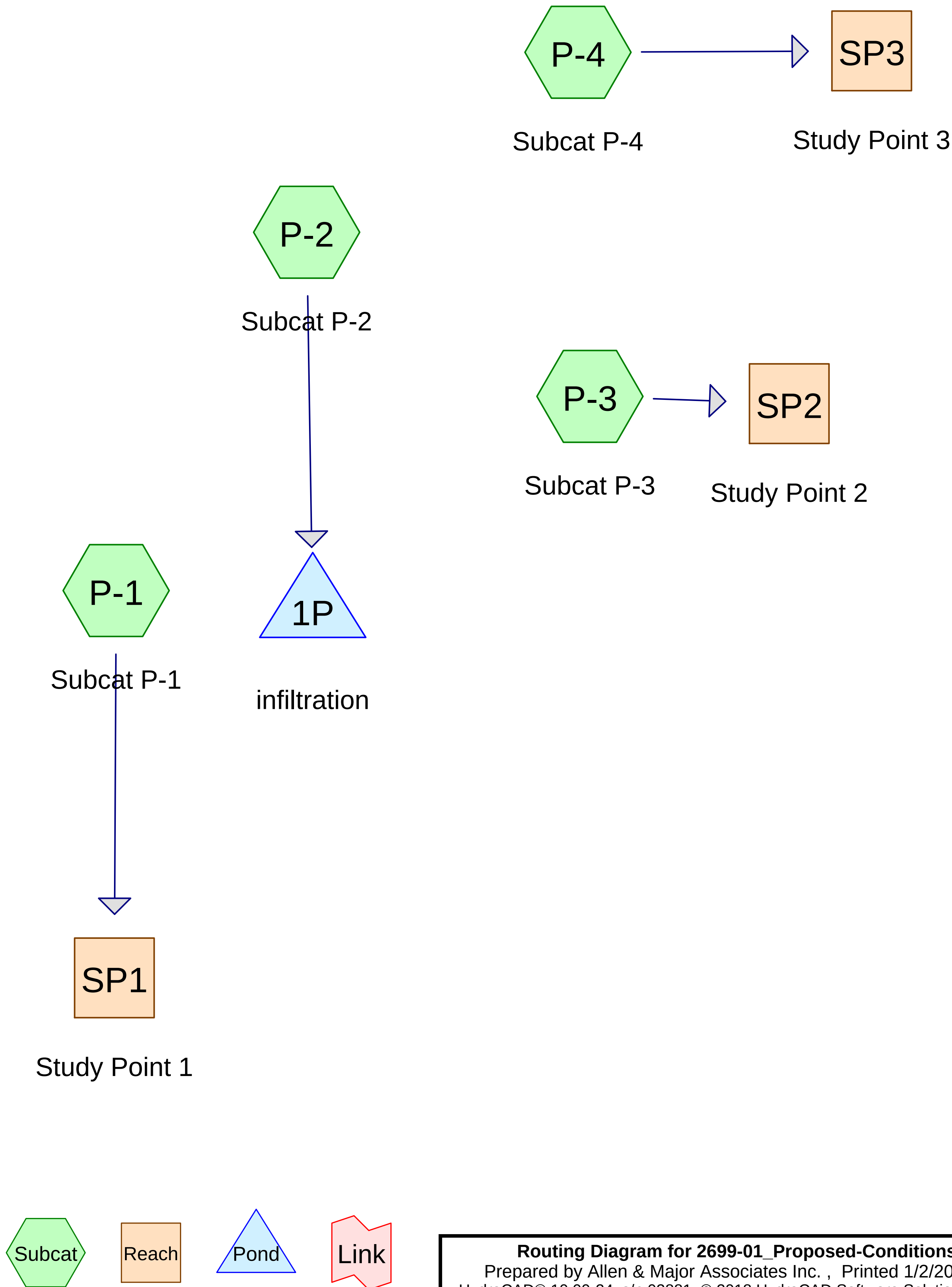
Summary for Reach SP3: Study Point 3

Inflow Area =	14,839 sf,	42.17% Impervious,	Inflow Depth = 4.75"	for 100-Year event
Inflow =	1.97 cfs @	12.08 hrs, Volume=	5,875 cf	
Outflow =	1.97 cfs @	12.08 hrs, Volume=	5,875 cf,	Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 3

Section 4.0 HydroCAD Worksheets – Proposed Conditions

PROPOSED 2-YEAR STORM
PROPOSED 10-YEAR STORM
PROPOSED 100-YEAR STORM



Routing Diagram for 2699-01_Proposed-Conditions
Prepared by Allen & Major Associates Inc. , Printed 1/2/2020
HydroCAD® 10.00-24 s/n 02881 © 2018 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
20,997	39	>75% Grass cover, Good, HSG A (P-1, P-2, P-3, P-4)
11,398	98	Paved parking, HSG A (P-1, P-2, P-3, P-4)
9,327	98	Roofs, HSG A (P-2)
41,722	**68**	**TOTAL AREA**

Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
41,722	HSG A	P-1, P-2, P-3, P-4
0	HSG B	
0	HSG C	
0	HSG D	
0	Other	
41,722		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover	Subcatchment Numbers
20,997	0	0	0	0	20,997	>75% Grass cover, Good	P-1, P-2, P-3, P-4
11,398	0	0	0	0	11,398	Paved parking	P-1, P-2, P-3, P-4
9,327	0	0	0	0	9,327	Roofs	P-2
41,722	**0**	**0**	**0**	**0**	**41,722**	**TOTAL AREA**	

Summary for Subcatchment P-1: Subcat P-1

Runoff = 0.08 cfs @ 12.12 hrs, Volume= 531 cf, Depth= 0.35"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.23"

Area (sf)	CN	Description
12,422	39	>75% Grass cover, Good, HSG A
5,689	98	Paved parking, HSG A
18,111	58	Weighted Average
12,422		68.59% Pervious Area
5,689		31.41% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Assumed**

Summary for Subcatchment P-2: Subcat P-2

Runoff = 0.70 cfs @ 12.07 hrs, Volume= 2,331 cf, Depth= 3.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.23"

Area (sf)	CN	Description
9,327	98	Roofs, HSG A
0	39	>75% Grass cover, Good, HSG A
5	98	Paved parking, HSG A
9,332	98	Weighted Average
0		0.00% Pervious Area
9,332		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Assumed**

Summary for Subcatchment P-3: Subcat P-3

Runoff = 0.00 cfs @ 12.42 hrs, Volume= 53 cf, Depth= 0.16"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.23"

Area (sf)	CN	Description
823	98	Paved parking, HSG A
3,244	39	>75% Grass cover, Good, HSG A
4,068	51	Weighted Average
3,244		79.76% Pervious Area
823		20.24% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Assumed**

Summary for Subcatchment P-4: Subcat P-4

Runoff = 0.17 cfs @ 12.09 hrs, Volume= 598 cf, Depth= 0.70"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.23"

Area (sf)	CN	Description
5,331	39	>75% Grass cover, Good, HSG A
4,880	98	Paved parking, HSG A
10,211	67	Weighted Average
5,331		52.21% Pervious Area
4,880		47.79% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Assumed**

Summary for Reach SP1: Study Point 1

Inflow Area = 18,111 sf, 31.41% Impervious, Inflow Depth = 0.35" for 2-Year event
Inflow = 0.08 cfs @ 12.12 hrs, Volume= 531 cf
Outflow = 0.08 cfs @ 12.12 hrs, Volume= 531 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 3

Summary for Reach SP2: Study Point 2

Inflow Area = 4,068 sf, 20.24% Impervious, Inflow Depth = 0.16" for 2-Year event
Inflow = 0.00 cfs @ 12.42 hrs, Volume= 53 cf
Outflow = 0.00 cfs @ 12.42 hrs, Volume= 53 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 3

Summary for Reach SP3: Study Point 3

Inflow Area = 10,211 sf, 47.79% Impervious, Inflow Depth = 0.70" for 2-Year event
Inflow = 0.17 cfs @ 12.09 hrs, Volume= 598 cf
Outflow = 0.17 cfs @ 12.09 hrs, Volume= 598 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 3

Summary for Pond 1P: infiltration

Inflow Area = 9,332 sf,100.00% Impervious, Inflow Depth = 3.00" for 2-Year event
Inflow = 0.70 cfs @ 12.07 hrs, Volume= 2,331 cf
Outflow = 0.17 cfs @ 12.43 hrs, Volume= 2,331 cf, Atten= 75%, Lag= 21.7 min
Discarded = 0.17 cfs @ 12.43 hrs, Volume= 2,331 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 93.07' @ 12.43 hrs Surf.Area= 1,016 sf Storage= 438 cf
Flood Elev= 96.50' Surf.Area= 1,016 sf Storage= 2,429 cf

Plug-Flow detention time= 11.7 min calculated for 2,331 cf (100% of inflow)
Center-of-Mass det. time= 11.7 min (766.9 - 755.3)

Volume	Invert	Avail.Storage	Storage Description
#1A	92.00'	1,231 cf	**11.75'W x 86.50'L x 4.50'H Field A** 4,574 cf Overall - 1,495 cf Embedded = 3,078 cf x 40.0% Voids
#2A	92.50'	1,198 cf	**ADS N-12 36"** x 8 Inside #1 Inside= 36.1"W x 36.1"H => 7.10 sf x 20.00'L = 142.0 cf Outside= 42.0"W x 42.0"H => 8.86 sf x 20.00'L = 177.2 cf 8 Chambers in 2 Rows 8.75' Header x 7.10 sf x 1 = 62.1 cf Inside
		2,429 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	92.00'	**7.080 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 50.00' Phase-In= 0.01'

Discarded OutFlow Max=0.17 cfs @ 12.43 hrs HW=93.07' (Free Discharge)
└─**1=Exfiltration** (Controls 0.17 cfs)

Summary for Subcatchment P-1: Subcat P-1

Runoff = 0.50 cfs @ 12.09 hrs, Volume= 1,731 cf, Depth= 1.15"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.96"

Area (sf)	CN	Description
12,422	39	>75% Grass cover, Good, HSG A
5,689	98	Paved parking, HSG A
18,111	58	Weighted Average
12,422		68.59% Pervious Area
5,689		31.41% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Assumed**

Summary for Subcatchment P-2: Subcat P-2

Runoff = 1.08 cfs @ 12.07 hrs, Volume= 3,673 cf, Depth= 4.72"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.96"

Area (sf)	CN	Description
9,327	98	Roofs, HSG A
0	39	>75% Grass cover, Good, HSG A
5	98	Paved parking, HSG A
9,332	98	Weighted Average
0		0.00% Pervious Area
9,332		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Assumed**

Summary for Subcatchment P-3: Subcat P-3

Runoff = 0.05 cfs @ 12.10 hrs, Volume= 247 cf, Depth= 0.73"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.96"

Area (sf)	CN	Description
823	98	Paved parking, HSG A
3,244	39	>75% Grass cover, Good, HSG A
4,068	51	Weighted Average
3,244		79.76% Pervious Area
823		20.24% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Assumed**

Summary for Subcatchment P-4: Subcat P-4

Runoff = 0.49 cfs @ 12.08 hrs, Volume= 1,511 cf, Depth= 1.78"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.96"

Area (sf)	CN	Description
5,331	39	>75% Grass cover, Good, HSG A
4,880	98	Paved parking, HSG A
10,211	67	Weighted Average
5,331		52.21% Pervious Area
4,880		47.79% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Assumed**

Summary for Reach SP1: Study Point 1

Inflow Area = 18,111 sf, 31.41% Impervious, Inflow Depth = 1.15" for 10-Year event
Inflow = 0.50 cfs @ 12.09 hrs, Volume= 1,731 cf
Outflow = 0.50 cfs @ 12.09 hrs, Volume= 1,731 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 3

Summary for Reach SP2: Study Point 2

Inflow Area = 4,068 sf, 20.24% Impervious, Inflow Depth = 0.73" for 10-Year event
Inflow = 0.05 cfs @ 12.10 hrs, Volume= 247 cf
Outflow = 0.05 cfs @ 12.10 hrs, Volume= 247 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 3

Summary for Reach SP3: Study Point 3

Inflow Area = 10,211 sf, 47.79% Impervious, Inflow Depth = 1.78" for 10-Year event
Inflow = 0.49 cfs @ 12.08 hrs, Volume= 1,511 cf
Outflow = 0.49 cfs @ 12.08 hrs, Volume= 1,511 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 3

Summary for Pond 1P: infiltration

Inflow Area = 9,332 sf,100.00% Impervious, Inflow Depth = 4.72" for 10-Year event
Inflow = 1.08 cfs @ 12.07 hrs, Volume= 3,673 cf
Outflow = 0.17 cfs @ 12.53 hrs, Volume= 3,673 cf, Atten= 84%, Lag= 27.5 min
Discarded = 0.17 cfs @ 12.53 hrs, Volume= 3,673 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 93.85' @ 12.53 hrs Surf.Area= 1,016 sf Storage= 941 cf
Flood Elev= 96.50' Surf.Area= 1,016 sf Storage= 2,429 cf

Plug-Flow detention time= 28.8 min calculated for 3,673 cf (100% of inflow)
Center-of-Mass det. time= 28.7 min (776.0 - 747.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	92.00'	1,231 cf	**11.75'W x 86.50'L x 4.50'H Field A** 4,574 cf Overall - 1,495 cf Embedded = 3,078 cf x 40.0% Voids
#2A	92.50'	1,198 cf	**ADS N-12 36"** x 8 Inside #1 Inside= 36.1"W x 36.1"H => 7.10 sf x 20.00'L = 142.0 cf Outside= 42.0"W x 42.0"H => 8.86 sf x 20.00'L = 177.2 cf 8 Chambers in 2 Rows 8.75' Header x 7.10 sf x 1 = 62.1 cf Inside
		2,429 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	92.00'	**7.080 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 50.00' Phase-In= 0.01'

Discarded OutFlow Max=0.17 cfs @ 12.53 hrs HW=93.85' (Free Discharge)
└─**1=Exfiltration** (Controls 0.17 cfs)

Summary for Subcatchment P-1: Subcat P-1

Runoff = 2.00 cfs @ 12.08 hrs, Volume= 6,037 cf, Depth= 4.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=9.19"

Area (sf)	CN	Description
12,422	39	>75% Grass cover, Good, HSG A
5,689	98	Paved parking, HSG A
18,111	58	Weighted Average
12,422		68.59% Pervious Area
5,689		31.41% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Assumed**

Summary for Subcatchment P-2: Subcat P-2

Runoff = 2.00 cfs @ 12.07 hrs, Volume= 6,960 cf, Depth= 8.95"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=9.19"

Area (sf)	CN	Description
9,327	98	Roofs, HSG A
0	39	>75% Grass cover, Good, HSG A
5	98	Paved parking, HSG A
9,332	98	Weighted Average
0		0.00% Pervious Area
9,332		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Assumed**

Summary for Subcatchment P-3: Subcat P-3

Runoff = 0.34 cfs @ 12.08 hrs, Volume= 1,061 cf, Depth= 3.13"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=9.19"

Area (sf)	CN	Description
823	98	Paved parking, HSG A
3,244	39	>75% Grass cover, Good, HSG A
4,068	51	Weighted Average
3,244		79.76% Pervious Area
823		20.24% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Assumed**

Summary for Subcatchment P-4: Subcat P-4

Runoff = 1.46 cfs @ 12.07 hrs, Volume= 4,363 cf, Depth= 5.13"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=9.19"

Area (sf)	CN	Description
5,331	39	>75% Grass cover, Good, HSG A
4,880	98	Paved parking, HSG A
10,211	67	Weighted Average
5,331		52.21% Pervious Area
4,880		47.79% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Assumed**

Summary for Reach SP1: Study Point 1

Inflow Area = 18,111 sf, 31.41% Impervious, Inflow Depth = 4.00" for 100-Year event
Inflow = 2.00 cfs @ 12.08 hrs, Volume= 6,037 cf
Outflow = 2.00 cfs @ 12.08 hrs, Volume= 6,037 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 3

Summary for Reach SP2: Study Point 2

Inflow Area = 4,068 sf, 20.24% Impervious, Inflow Depth = 3.13" for 100-Year event
Inflow = 0.34 cfs @ 12.08 hrs, Volume= 1,061 cf
Outflow = 0.34 cfs @ 12.08 hrs, Volume= 1,061 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 3

Summary for Reach SP3: Study Point 3

Inflow Area = 10,211 sf, 47.79% Impervious, Inflow Depth = 5.13" for 100-Year event
Inflow = 1.46 cfs @ 12.07 hrs, Volume= 4,363 cf
Outflow = 1.46 cfs @ 12.07 hrs, Volume= 4,363 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 3

Summary for Pond 1P: infiltration

Inflow Area = 9,332 sf,100.00% Impervious, Inflow Depth = 8.95" for 100-Year event
Inflow = 2.00 cfs @ 12.07 hrs, Volume= 6,960 cf
Outflow = 0.18 cfs @ 12.87 hrs, Volume= 6,960 cf, Atten= 91%, Lag= 47.7 min
Discarded = 0.18 cfs @ 12.87 hrs, Volume= 6,960 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 96.25' @ 12.87 hrs Surf.Area= 1,016 sf Storage= 2,327 cf
Flood Elev= 96.50' Surf.Area= 1,016 sf Storage= 2,429 cf

Plug-Flow detention time= 85.9 min calculated for 6,959 cf (100% of inflow)
Center-of-Mass det. time= 85.9 min (824.6 - 738.6)

Volume	Invert	Avail.Storage	Storage Description
#1A	92.00'	1,231 cf	**11.75'W x 86.50'L x 4.50'H Field A** 4,574 cf Overall - 1,495 cf Embedded = 3,078 cf x 40.0% Voids
#2A	92.50'	1,198 cf	**ADS N-12 36"** x 8 Inside #1 Inside= 36.1"W x 36.1"H => 7.10 sf x 20.00'L = 142.0 cf Outside= 42.0"W x 42.0"H => 8.86 sf x 20.00'L = 177.2 cf 8 Chambers in 2 Rows 8.75' Header x 7.10 sf x 1 = 62.1 cf Inside
		2,429 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	92.00'	**7.080 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 50.00' Phase-In= 0.01'

Discarded OutFlow Max=0.18 cfs @ 12.87 hrs HW=96.25' (Free Discharge)
└─**1=Exfiltration** (Controls 0.18 cfs)

Section 5.0 *Appendix*

NORTHEAST REGIONAL CLIMATE CENTER RAINFALL DATA

NATIONAL RESOURCES CONSERVATION SERVICE SOIL REPORT

GEOTECHNICAL INVESTIGATION REPORT BY OAK ENGINEERS

72-HOUR POND DRAIN CALCULATION

TOTAL RECHARGE VOLUME CALCULATION

DRAINAGE PIPE DESIGN ANALYSIS

ILLICIT DISCHARGE COMPLIANCE STATEMENT

NEWBURYPORT STORMWATER MANAGEMENT PERMIT APPLICATION

NORTHEAST REGIONAL CLIMATE CENTER RAINFALL DATA

Extreme Precipitation Tables

Northeast Regional Climate Center

Data represents point estimates calculated from partial duration series. All precipitation amounts are displayed in inches.

Smoothing	Yes
State	Massachusetts
Location	
Longitude	70.891 degrees West
Latitude	42.814 degrees North
Elevation	0 feet
Date/Time	Thu, 12 Dec 2019 14:46:16 -0500

Extreme Precipitation Estimates

	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr	24hr	48hr		1day	2day	4day	7day	10day	
1yr	0.27	0.41	0.51	0.67	0.83	1.06	**1yr**	0.72	0.99	1.24	1.59	2.06	2.70	2.98	**1yr**	2.39	2.87	3.30	4.00	4.68	**1yr**
2yr	0.33	0.51	0.63	0.83	1.05	1.33	**2yr**	0.90	1.21	1.54	1.97	2.51	3.23	3.60	**2yr**	2.86	3.46	3.97	4.72	5.38	**2yr**
5yr	0.39	0.60	0.76	1.01	1.29	1.66	**5yr**	1.12	1.52	1.95	2.49	3.20	4.12	4.62	**5yr**	3.65	4.44	5.11	6.03	6.79	**5yr**
10yr	0.43	0.68	0.86	1.17	1.52	1.98	**10yr**	1.31	1.80	2.33	3.00	3.85	4.96	5.59	**10yr**	4.39	5.38	6.19	7.27	8.10	**10yr**
25yr	0.51	0.81	1.03	1.42	1.89	2.47	**25yr**	1.63	2.26	2.93	3.80	4.91	6.33	7.19	**25yr**	5.60	6.92	7.97	9.31	10.23	**25yr**
50yr	0.58	0.93	1.18	1.65	2.23	2.95	**50yr**	1.92	2.68	3.50	4.56	5.91	7.63	8.71	**50yr**	6.75	8.37	9.66	11.22	12.21	**50yr**
100yr	0.65	1.05	1.36	1.92	2.62	3.51	**100yr**	2.26	3.19	4.19	5.48	7.12	9.19	10.54	**100yr**	8.13	10.14	11.71	13.54	14.58	**100yr**
200yr	0.74	1.21	1.57	2.25	3.10	4.17	**200yr**	2.67	3.79	5.00	6.57	8.56	11.08	12.76	**200yr**	9.81	12.27	14.19	16.34	17.42	**200yr**
500yr	0.89	1.46	1.90	2.75	3.86	5.26	**500yr**	3.33	4.76	6.33	8.36	10.94	14.20	16.45	**500yr**	12.57	15.82	18.31	20.97	22.05	**500yr**

Lower Confidence Limits

	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr	24hr	48hr		1day	2day	4day	7day	10day	
1yr	0.24	0.37	0.45	0.60	0.74	0.88	**1yr**	0.64	0.86	0.99	1.31	1.63	2.50	2.62	**1yr**	2.21	2.52	2.97	3.56	4.24	**1yr**
2yr	0.32	0.49	0.61	0.82	1.02	1.21	**2yr**	0.88	1.19	1.39	1.83	2.34	3.17	3.53	**2yr**	2.81	3.40	3.89	4.62	5.30	**2yr**
5yr	0.37	0.56	0.70	0.96	1.22	1.45	**5yr**	1.05	1.42	1.64	2.13	2.73	3.86	4.32	**5yr**	3.41	4.16	4.78	5.65	6.38	**5yr**
10yr	0.41	0.63	0.78	1.08	1.40	1.67	**10yr**	1.21	1.63	1.85	2.39	3.06	4.47	5.02	**10yr**	3.96	4.83	5.58	6.52	7.31	**10yr**
25yr	0.47	0.72	0.89	1.27	1.67	2.00	**25yr**	1.44	1.96	2.16	2.77	3.55	5.41	6.13	**25yr**	4.79	5.90	6.81	7.84	8.73	**25yr**
50yr	0.52	0.80	0.99	1.42	1.92	2.30	**50yr**	1.65	2.25	2.43	3.09	3.97	6.24	7.11	**50yr**	5.52	6.84	7.91	9.02	9.96	**50yr**
100yr	0.59	0.89	1.12	1.61	2.21	2.64	**100yr**	1.91	2.58	2.73	3.44	4.42	7.18	8.24	**100yr**	6.36	7.92	9.19	10.35	11.33	**100yr**
200yr	0.66	0.99	1.26	1.82	2.54	3.04	**200yr**	2.19	2.97	3.06	3.83	4.92	8.26	9.56	**200yr**	7.31	9.20	10.66	11.83	12.87	**200yr**
500yr	0.78	1.16	1.49	2.16	3.07	3.67	**500yr**	2.65	3.59	3.57	4.39	5.68	9.86	11.62	**500yr**	8.73	11.17	12.97	14.04	15.23	**500yr**

Upper Confidence Limits

	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr	24hr	48hr		1day	2day	4day	7day	10day	
1yr	0.29	0.45	0.55	0.74	0.91	1.08	**1yr**	0.78	1.06	1.31	1.71	2.17	2.88	3.18	**1yr**	2.55	3.06	3.54	4.35	4.98	**1yr**
2yr	0.34	0.53	0.65	0.88	1.08	1.30	**2yr**	0.94	1.27	1.50	1.97	2.51	3.30	3.69	**2yr**	2.92	3.55	4.08	4.90	5.55	**2yr**
5yr	0.42	0.64	0.80	1.09	1.39	1.68	**5yr**	1.20	1.64	1.93	2.54	3.24	4.40	4.94	**5yr**	3.89	4.75	5.48	6.45	7.24	**5yr**
10yr	0.50	0.76	0.94	1.32	1.70	2.06	**10yr**	1.47	2.01	2.34	3.10	3.92	5.49	6.17	**10yr**	4.86	5.93	6.89	8.06	8.91	**10yr**
25yr	0.62	0.95	1.18	1.68	2.22	2.70	**25yr**	1.91	2.64	3.05	4.05	5.08	7.37	8.32	**25yr**	6.52	8.00	9.32	10.82	11.75	**25yr**
50yr	0.74	1.12	1.40	2.01	2.71	3.31	**50yr**	2.34	3.23	3.73	4.96	6.19	9.24	10.43	**50yr**	8.18	10.03	11.75	13.55	14.49	**50yr**
100yr	0.88	1.33	1.67	2.41	3.31	4.05	**100yr**	2.85	3.96	4.56	6.09	7.56	11.61	13.09	**100yr**	10.27	12.59	14.80	17.04	17.87	**100yr**
200yr	1.05	1.58	2.00	2.89	4.03	4.98	**200yr**	3.48	4.86	5.59	7.47	9.23	14.61	16.45	**200yr**	12.93	15.82	18.69	21.41	22.06	**200yr**
500yr	1.32	1.97	2.53	3.68	5.24	6.51	**500yr**	4.52	6.36	7.31	9.83	12.03	19.85	22.25	**500yr**	17.56	21.40	25.39	28.94	29.24	**500yr**

Powered by ACIS
Northeast Regional Climate Center

NATIONAL RESOURCES CONSERVATION SERVICE SOIL REPORT

United States Department of Agriculture

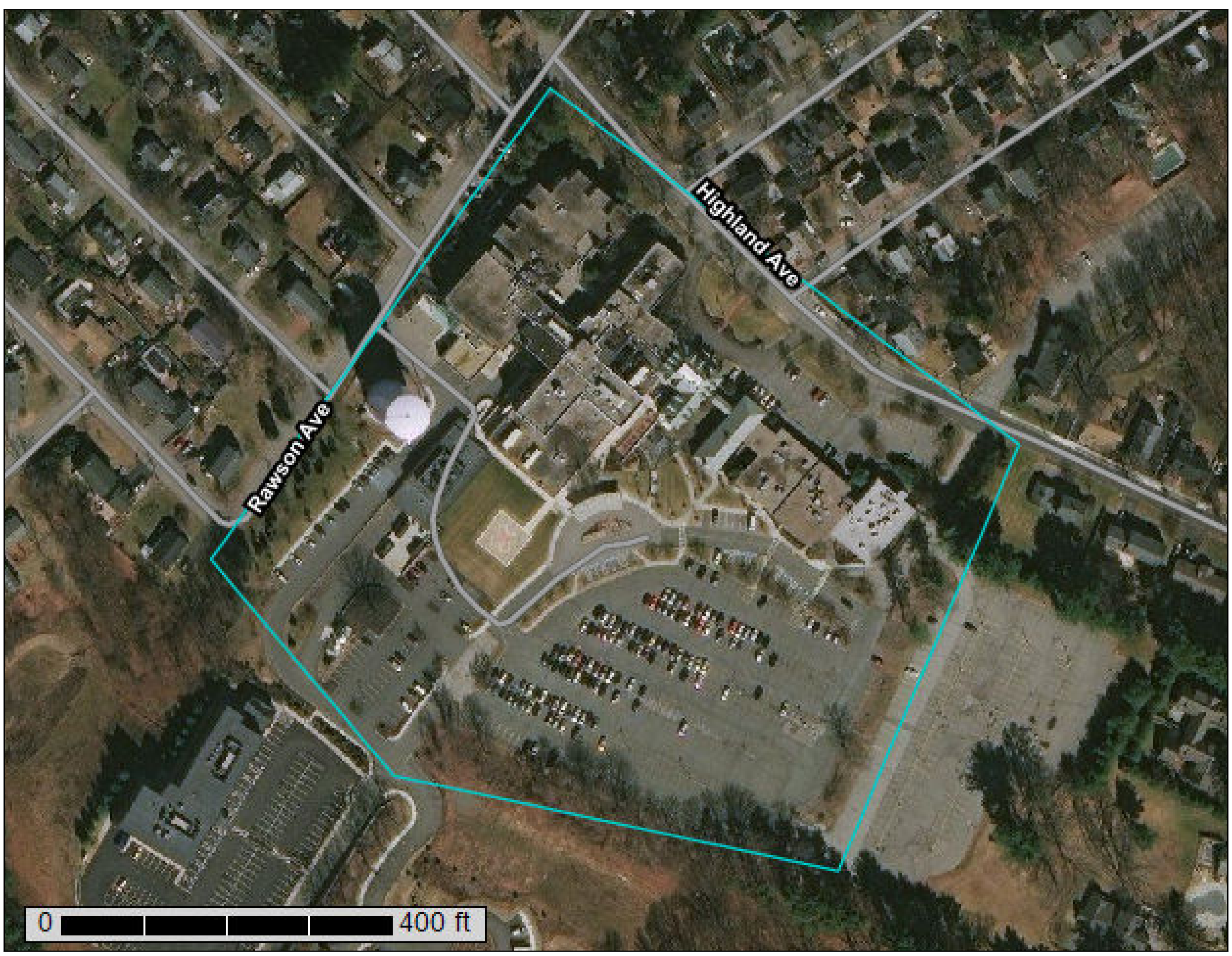
NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

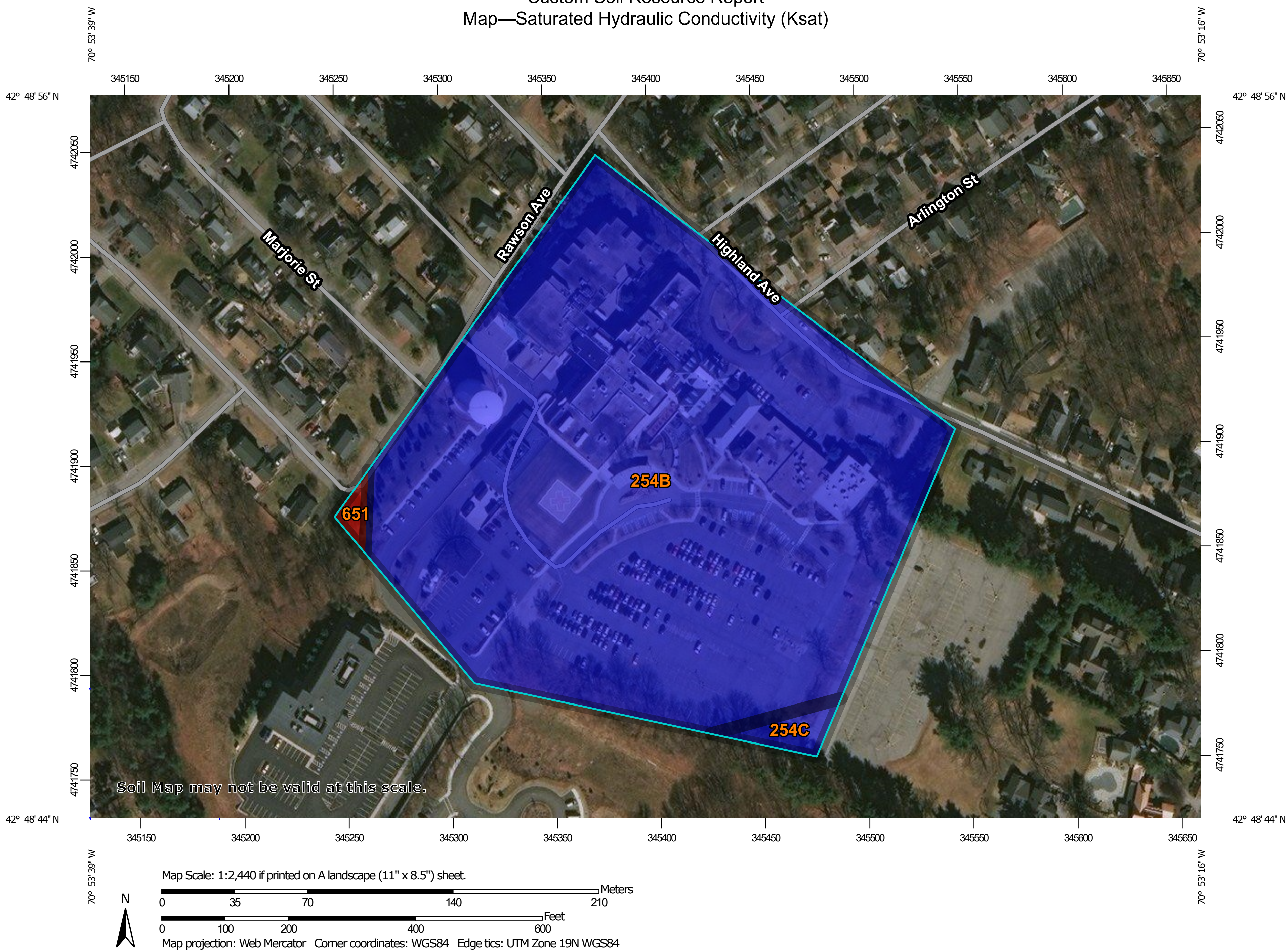
Custom Soil Resource Report for

Essex County, Massachusetts, Northern Part



November 15, 2019

Custom Soil Resource Report
Map—Saturated Hydraulic Conductivity (Ksat)



MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

- <= 70.7800
- > 70.7800 and <= 100.0000
- Not rated or not available

Soil Rating Lines

- <= 70.7800
- > 70.7800 and <= 100.0000
- Not rated or not available

Soil Rating Points

- <= 70.7800
- > 70.7800 and <= 100.0000
- Not rated or not available

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Essex County, Massachusetts, Northern Part
Survey Area Data: Version 15, Sep 12, 2019

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Dec 31, 2009—Sep 12, 2016

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—Saturated Hydraulic Conductivity (Ksat)

Map unit symbol	Map unit name	Rating (micrometers per second)	Acres in AOI	Percent of AOI
254B	Merrimac fine sandy loam, 3 to 8 percent slopes	100.0000	12.3	97.9%
254C	Merrimac fine sandy loam, 8 to 15 percent slopes	100.0000	0.2	1.5%
651	Udorthents, smoothed	70.7800	0.1	0.6%
Totals for Area of Interest			**12.5**	**100.0%**

Rating Options—Saturated Hydraulic Conductivity (Ksat)

Units of Measure: micrometers per second

Aggregation Method: Dominant Component

Component Percent Cutoff: None Specified

Tie-break Rule: Fastest

Interpret Nulls as Zero: No

Layer Options (Horizon Aggregation Method): Depth Range (Weighted Average)

Top Depth: 0

Bottom Depth: 100

Units of Measure: Inches

Soil Qualities and Features

Soil qualities are behavior and performance attributes that are not directly measured, but are inferred from observations of dynamic conditions and from soil properties. Example soil qualities include natural drainage, and frost action. Soil features are attributes that are not directly part of the soil. Example soil features include slope and depth to restrictive layer. These features can greatly impact the use and management of the soil.

Hydrologic Soil Group

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Custom Soil Resource Report
Map—Hydrologic Soil Group

Map Scale: 1:2,440 if printed on A landscape (11" x 8.5") sheet.

Meters: 0, 35, 70, 140, 210

Feet: 0, 100, 200, 400, 600

N

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 19N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Essex County, Massachusetts, Northern Part
Survey Area Data: Version 15, Sep 12, 2019

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Dec 31, 2009—Sep 12, 2016

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
254B	Merrimac fine sandy loam, 3 to 8 percent slopes	A	12.3	97.9%
254C	Merrimac fine sandy loam, 8 to 15 percent slopes	A	0.2	1.5%
651	Udorthents, smoothed	A	0.1	0.6%
Totals for Area of Interest			**12.5**	**100.0%**

Rating Options—Hydrologic Soil Group

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

GEOTECHNICAL INVESTIGATION REPORT BY OAK ENGINEERS

GEOTECHNICAL INVESTIGATION REPORT
HOSPITAL RENOVATIONS AND CENTRAL UTILITY PLANT RELOCATION
ANNA JAQUES HOSPITAL
25 HIGHLAND AVENUE
NEWBURYPORT, MASSACHUSETTS

Prepared for:

Anna Jaques Hospital
25 Highland Avenue
Newburyport, Massachusetts
c/o Mr. David Fowler, Senior Director of Support Services

Prepared by:

Oak Engineers
Brown's Wharf
Newburyport, Massachusetts
(978) 465-9877

Project 094.01169
November 17, 2010

Brian T. Nereson, E.I.T.	David R. Brogan, P.E.	Paul E. Serrano, P.E.
Geotechnical Engineer	Sr. Geotechnical Engineer	Geotechnical Consultant

EXECUTIVE SUMMARY

Oak Engineers (Oak) has prepared this Geotechnical Investigation Report for the Hospital Renovations and Central Utility Plant Relocation project at the Anna Jaques Hospital located at 25 Highland Avenue in Newburyport, Massachusetts for the purposes of evaluating existing subsurface conditions and providing geotechnical recommendations for design and construction of the proposed project. This report presents the results of our geotechnical investigation.

The Site is currently developed with paved parking and drive areas, landscaped areas, and multiple ancillary structures (i.e. office building, boiler building, garages, etc.). Existing topography generally slopes downward to the south from approximately elevation (El.) 101 feet near the Rawson Avenue entrance, to El. 95 feet near the Wallace Bashaw Jr. Way entrance. Existing grade along the north side of the existing power plant building is around El. 94 feet.

The proposed construction includes an approximately 7,100 square feet (sf) service building, an approximately 1,900 sf connector, and an approximately 140 sf outpatient entry. The proposed service building is planned to be two stories, with a partially below-grade lowest floor at El. 94.58 feet. The proposed connector is currently planned as a one story, partially below-grade structure with a finished floor at El. 94.58 feet. It is understood that future vertical expansion of the conductor is planned. The outpatient entry is to be one story with a finished floor at El. 94.25 feet.

In addition to the proposed buildings, construction will include asphalt-paved parking and drives, and landscaped areas and underground basins for stormwater management. Three retaining walls are planned, which will have a maximum length of approximately 180 linear feet, and a maximum height of approximately 8.5 feet. Cuts as deep as approximately 8.5 feet are planned along the south side of the proposed service building; cuts are generally 1 to 3 feet elsewhere. Fills of about 3 feet and 5 feet are proposed along the northwest side of the connector, and at the berm proposed along Rawson Avenue, respectively; fills are generally 1 foot or less elsewhere.

Subsurface explorations generally encountered topsoil or asphalt pavement, underlain in turn by a native eolian silty sand/silt deposit and a native glaciofluvial sand deposit. Groundwater was not encountered in any of the subsurface explorations, which were advanced to a maximum depth of approximately 62 feet bgs, which corresponds to approximately El. 38 feet.

Fill was encountered at the north end of the proposed connector and at the proposed outpatient entry to depths of approximately 5 feet bgs, corresponding to approximately El. 85 feet and El. 89 feet, respectively. In Oak's opinion, there is limited risk in leaving up to 12 inches of existing fill beneath proposed foundations in areas where the fill is directly underlain by native glaciofluvial sand, provided that the recommendations for foundation subgrade preparation and geotechnical construction observation, presented herein, are implemented.

The native eolian silty sand/silt is not suitable to remain in place below proposed foundations due to its low relative density. Where present below proposed foundations, the native eolian silty sand/silt and any overlying fill should be completely removed from within the foundation bearing zones and replaced with compacted structural fill. At the southern end of the proposed connector and within the proposed service building, it is anticipated that removal of native eolian soil from below proposed foundations will generally require over-excavation of about 1 foot or less, and possibly as much as 3 feet locally.

To avoid imparting lateral loads to the sides of existing foundation walls and foundations, foundations proposed directly adjacent to existing foundations should bear at the same level as the existing foundations. Additionally, proposed foundations should be structurally isolated from existing foundations. The existing foundation exposed in a test pit conducted along the west side of the 1995 portion of the existing building consists of a strip footing bearing approximately 6 feet below adjacent ground surface, which corresponds to approximately El. 92 feet. Foundations along the west wall of the 1965 portion of the existing building are anticipated to range from about El. 92 feet at the southwest corner, gradually stepping down to approximately El. 86.71 feet at the existing loading dock. Based on the proposed floor elevations, proposed Site grades, and the recommendations for foundation subgrade preparation presented herein, foundation excavations for the proposed connector are not anticipated to extend below the bottoms of existing foundations.

With proper site preparation, the proposed service building, connector, and outpatient entry may be supported on continuous and spread footings bearing on native glaciofluvial sand, 12 inches or less of existing fill directly underlain by glaciofluvial sand, or on compacted structural fill placed over native glaciofluvial sand. Slab-on-grade ground floors are suitable for the proposed buildings. Post construction total and differential settlements are anticipated to be less than ¾ inch and about 0.5 inch, respectively. In accordance with the *Massachusetts State Building Code, 7th Edition*, below grade occupied spaces should be dampproofed and perimeter foundation drains should be provided.

Foundation subgrades for the proposed cast-in-place concrete retaining walls which extend from the southern corners of the service building are anticipated to consist of native glaciofluvial sand. If native eolian silty sand/silt is encountered below proposed cast-in-place concrete retaining wall footings it should be completely removed from within the foundation bearing zone and replaced with compacted structural fill. It is anticipated that the proposed modular block retaining wall will be constructed on a nominal 12 inch thick bearing pad consisting of compacted gravel or crushed stone to be specified by the block manufacturer. Given the anticipated maximum wall height of 3 feet and the ability of modular block walls to better tolerate differential movements, the proposed bearing pad for the proposed modular block wall may bear on existing fill or native soils.

The Site soils which are likely to be encountered during earthwork activities are not suitable for reuse as structural fill or pavement base due to their relatively uniform gradation and/or high percentage of fines. Site soils may be reused as common fill to raise grades below pavement sections or in landscaped areas, provided they are free of deleterious materials and can be adequately compacted. Some of the on-site soils, especially the native eolian silty sand/silt, may be moisture sensitive and may be difficult to place and compact, especially from fall to spring and during wet periods. Moisture-density relationships should be determined at the start of construction to determine the appropriate range of working moisture content. Structural fill and aggregate base material for pavements will need to be imported to the Site.

At a minimum, it is recommended that Oak be retained to provide geotechnical construction observation for the following:

1. Test pits within the proposed outpatient entry and northern portions of the proposed service building to assess the likelihood for limited portions of existing fill to remain in-place beneath proposed foundations;

2. Building and retaining wall foundation excavations to verify suitable foundation bearing surfaces and assess the need for additional undercutting; and

3. Subgrade preparation for foundations, ground floor slabs, and pavements.

Geotechnical recommendations and design parameters for site preparation, temporary excavations, dewatering, foundations, slab-on-grade ground floors, pavements, underground utilities, earth-retaining structures, fill and backfill, and construction quality control are provided in this report.

TABLE OF CONTENTS

1.0 INTRODUCTION

Oak Engineers (Oak) has prepared this Geotechnical Investigation Report for the Hospital Renovations and Central Utility Plant Relocation project at the Anna Jaques Hospital located at 25 Highland Avenue in Newburyport, Massachusetts in general accordance with our Scope of Work and Fee Proposal dated June 4, 2010.

This investigation was performed to obtain site-specific subsurface soil information and make geotechnical evaluations and recommendations for the proposed project. As completed, Oak's scope of services for this geotechnical investigation included the following items:

1. Premarked the proposed exploration locations and notified DigSafe for utility clearance.

2. Arranged to have subsurface utilities in the proposed construction area located by a private utility locator. This task was not part of our proposed scope of services, but was necessary to locate underground site utilities not determined and marked by Dig Safe.

3. Arranged to have the explorations performed by drilling and excavation subcontractors and prepared a site-specific health and safety plan in accordance with Occupational Safety and Health Administration (OSHA) regulations.

4. Provided technical monitoring for the subsurface investigations, obtained soil samples, and prepared exploration logs.

5. Submitted select soil samples for geotechnical soil index testing (i.e., gradation) laboratory analyses.

6. Evaluated acquired field and laboratory data with respect to the proposed construction, and prepared this geotechnical investigation report presenting our findings, evaluations, and recommendations for design and construction including, but not limited to: site preparation; excavation and dewatering; fill and backfill; foundations and ground floor slabs; new pavements; lateral earth pressures; underground utilities; and construction quality control.

2.0 DESCRIPTION OF SITE AND PROPOSED CONSTRUCTION

The project area consists of central and southwest portions of the Anna Jaques Hospital campus in Newburyport, Massachusetts (the “Site”). A Site Location Map and a Subsurface Exploration Plan showing the existing and proposed Site layout are provided as Figure 1 and Figure 2, respectively.

The Site is currently developed with paved parking and drive areas, landscaped areas, and multiple ancillary structures (i.e. office building, boiler building, garages, etc.). Existing topography generally slopes downward to the south from approximately elevation (El.) 101 feet near the Rawson Avenue entrance, to El. 95 feet near the Wallace Bashaw Jr. Way entrance. Existing grade along the north side of the existing power plant building is around El. 94 feet.

Our current understanding of the existing Site layout, existing Site grades, and proposed development is based on the following plans:

1. “Overall Site Plan,” Drawing Number C-1, by Oak, last revised October 29, 2010;

2. “Existing Conditions/Site Preparation Plan,” Drawing Number C-2, by Oak, last revised October 29, 2010; and

3. “Grading, Drainage and Erosion Control Plan,” Drawing Number C-4, by Oak, last revised November 2, 2010.

Proposed construction includes an approximately 7,100 square feet (sf) service building and 1,900 sf connector running from the service building to the hospital, and a new 140 sf outpatient entry. The proposed service building is planned to be two stories, with a partially below-grade lowest floor at El. 94.58 feet. The proposed connector is currently planned as a one story, partially below-grade structure with a finished floor at El. 94.58 feet. It is understood that future vertical expansion of the connector is planned. The outpatient entry is to be one story with a finished floor at El. 94.25 feet.

In addition to the proposed buildings, construction will include asphalt-paved parking and drives, and landscaped areas. Three retaining walls are planned to support proposed cuts south of the service building. It is understood that the two retaining walls which extended from the southern corners of the service building will be cast-in-place concrete; the remaining wall will be modular block construction. The proposed retaining walls will have a maximum length of approximately 180 linear feet, and a maximum height of approximately 8.5 feet. Underground basins for stormwater management are planned in the southeast portions of the project area.

Cuts as deep as approximately 8.5 feet are planned along the south side of the proposed service building; cuts are generally 1 to 3 feet elsewhere. Fills of about 3 feet and 5 feet are proposed along the northwest side of the connector, and at the berm proposed along Rawson Avenue, respectively; fills are generally 1 foot or less elsewhere.

Maximum building foundation loads and settlement criteria provided by BVH Integrated Services of Bloomfield, Connecticut, the project structural engineer, are as follows:

Proposed Service Building Maximum Column Load = 150 kips
Proposed Connector Maximum Column Load = 240 kips (for future vertical expansion)
Proposed Outpatient Entry Maximum Column Load = 30 kips
Maximum total and differential foundation settlements of ¾ and one-half inch, respectively

3.0 SUBSURFACE INVESTIGATION

3.1 Subsurface Explorations

The subsurface explorations were conducted on November 2 and 3, 2010, and consisted of eleven test borings, identified as B101 through B111, and one test pit, identified as TP101, advanced at the approximate locations shown on Figure 2. Exploration locations were selected by Oak based on the plans referenced above and existing utilities. Exploration locations were established in the field by Oak by taping and pacing from identifiable Site features.

Drilling was performed by Great Works Pump and Test Boring of Rollinsford, New Hampshire using a rubber-tracked all-terrain vehicle drill rig with solid-stem or hollow-stem augers. Split-barrel sampling with standard penetration tests (American Society for Testing and Materials [ASTM] D 1586-08a) was conducted nearly continuously to a depth of 12 feet below the ground surface (bgs) and at 5-foot intervals thereafter in borings advanced within the proposed building areas, or nearly continuously to a depth of 10 feet bgs in the remaining borings. Borings were advanced to depths ranging from approximately 10 to 62 feet bgs. Refusal was not encountered within the depths explored in any of the explorations.

Test pitting was performed by T.W. Excavating Corporation of Rowley, Massachusetts using a Yanmar Vio35 mini excavator. The test pit was advanced to approximately 6.5 feet bgs.

An Oak representative monitored the subsurface exploration activities and prepared field exploration logs. Soil samples were placed in sealed containers and returned with the field logs to Oak's office for further evaluation. Soil samples were visually classified in general accordance with visual manual procedures (ASTM D 2488) and described using modified Burmister Soil Classification System descriptors.

Final exploration logs were prepared based on the field logs, visual classification of soil samples, and laboratory test results. The final boring and test pit logs are included as Appendix A. Stratification lines shown on the exploration logs represent approximate boundaries between soil types encountered. The actual transitions will be more gradual and may vary over short distances. Ground surface elevations presented on the exploration logs were estimated from the plan referenced on Figure 2, and are approximate.

4.0 LABORATORY TESTING

Laboratory testing was performed on selected soil samples recovered from the test borings. The laboratory testing program consisted of grain size sieve analyses performed by John Turner Consulting, Inc. of Dover, New Hampshire, who is accredited by the American Association of State Highway and Transportation Officials (AASHTO).

The laboratory test reports are included in Appendix B. The results of the laboratory tests are incorporated into the soil descriptions discussed in Section 5.1 and presented on the exploration logs included in Appendix A.

5.0 SUBSURFACE CONDITIONS

5.1 Subsurface Soils

Subsurface explorations generally encountered topsoil or asphalt pavement, underlain in turn by a native eolian silty sand/silt deposit and a native glaciofluvial sand deposit. A summary of subsurface conditions encountered in the explorations is provided in Table 1. The general characteristics of the subsurface layers are described below in order of increasing depth encountered below the ground surface.

Surficial Layers

Asphalt pavement was encountered at seven test boring locations, and was observed to range from approximately 2½ to 4 inches thick. Topsoil was encountered at 4 test boring locations and TP101, and extends to depths ranging from approximately 4 to 36 inches bgs.

Fill

Fill was encountered in six test borings and TP101 and extends to depths ranging from approximately 1.5 to 5 feet bgs in the test borings, and to at least 6.5 feet bgs in TP101. Fill is generally described as loose to very dense, brown, fine to coarse sand, some to little gravel, little to trace silt. Based on the results of laboratory testing and visual classification, the fill is classified as poorly graded sand (SP) or silty sand (SM) in general accordance with the Unified Soil Classification System (USCS).

Eolian Deposit

A native eolian deposit was encountered in seven test borings, to depths ranging from approximately 0.5 to 8.5 feet bgs. The eolian deposit is generally described as very loose to medium dense, brown, fine sand with some silt, or as silt and fine sand. Based on the results of laboratory testing and visual classification, the eolian deposit is classified as silty sand (SM) or silt (ML) in general accordance with the USCS.

Glaciofluvial Deposit

A native glaciofluvial deposit was encountered in each test boring below the fill or eolian deposit, to the depths explored. The glaciofluvial deposit is generally described as medium dense to dense, brown, fine to coarse sand, with some to little gravel and trace silt, or as fine to medium sand with trace silt. Based on the results of laboratory testing and visual classification, the glaciofluvial deposit is classified as poorly graded sand (SP) in general accordance with the USCS.

5.2 Groundwater

Groundwater was not encountered in any of the explorations, which ranged in depth from approximately 6.5 to 62 feet bgs. Groundwater levels at the Site will fluctuate due to season, temperature, precipitation, nearby underground utilities, and construction activity in the area. Therefore, water levels during and following construction may vary from our observations made at the time of the explorations.

5.3 Bedrock

Refusal surfaces and/or bedrock were not encountered in any of the explorations, which ranged in depth from approximately 6.5 to 62 feet bgs.

6.0 EVALUATIONS

Geotechnical engineering evaluations for this project are based on the subsurface conditions interpreted from and between widely spaced subsurface explorations, laboratory test results, and the design information currently available. Should differing information become known prior to or during construction, the following evaluations and recommendations should be reviewed by Oak.

6.1 Building Foundations and Ground Floors

Foundation walls of the proposed service building and connector will act as retaining walls and will need to resist lateral pressures from earth loads and surcharge loads. In accordance with the *Massachusetts State Building Code, 7th Edition,* Article 780, Sections 1807.2 and 1807.4, below grade occupied spaces should be dampproofed and perimeter foundation drains should be provided.

Fill was encountered at the north end of the proposed connector and at the proposed outpatient entry to depths of approximately 5 feet bgs, corresponding to approximately El. 85 feet and El. 89 feet, respectively. The fill encountered in these areas is granular in composition, appears to be free of deleterious materials, and is underlain directly by native glaciofluvial sand. In Oak's opinion, there is limited risk in leaving up to 12 inches of existing fill beneath proposed foundations in areas where the fill is directly underlain by native glaciofluvial sand, provided that the recommendations for foundation subgrade preparation and geotechnical construction observation, presented herein, are implemented.

The native eolian silty sand/silt is not suitable to remain in place below proposed foundations due to its low relative density. Where present below proposed foundations, the native eolian silty sand/silt and any overlying fill should be completely removed from within the foundation bearing zones (defined as the area beneath 1H:1V line sloped down and away from the bottom outside edge of foundations) and replaced with compacted structural fill.

At the southern end of the proposed connector and within the proposed service building, native eolian silty sand/silt was encountered to depths ranging from approximately 6 to 8.5 feet bgs, corresponding to elevations ranging from approximately El. 89.5 to El. 93 feet. It is anticipated that removal of native eolian soil from below proposed foundations will generally require over-excavation of about 1 foot or less, and possibly as much as 3 feet locally.

With proper site preparation, the proposed service building, connector, and outpatient entry may be supported on continuous and spread footings bearing on native glaciofluvial sand, 12 inches or less of existing fill directly underlain by glaciofluvial sand, or on compacted structural fill placed over native glaciofluvial sand. Post construction total and differential settlements are anticipated to be less than ¾ inch and about ½ inch, respectively.

To avoid imparting lateral loads to the sides of existing foundation walls and foundations, foundations proposed directly adjacent to existing foundations should bear at the same level as the existing foundations. Additionally, proposed foundations should be structurally isolated from existing foundations.

Existing fill and/or native eolian silty sand/silt may remain in place below ground floor slabs, provided they are free of organic or deleterious materials and are observed to be relatively firm, dry and stable at the time of construction. Slab-on-grade ground floors are considered suitable for the proposed service building connector and outpatient entry provided they are supported by at least 12 inches of compacted structural fill placed above suitable existing fill or native soil subgrades which have been evaluated in the field at the time of construction. Further undercutting of existing fill and/or native eolian soil below floor slabs might be required based on field evaluations.

6.2 Adjacent Structures

Test pit TP101 was advanced for the purpose of determining the type and depth of existing foundations associated with the 1995 portion of the hospital building which is located directly east and adjacent to the north end of the proposed connector. Underground utilities prevented excavation of an additional test pit along the 1965 portion of the hospital building. The existing building foundation exposed in TP101 consists of a strip footing bearing approximately 6 feet below adjacent ground surface, which corresponds to approximately El. 92 feet. An apparent roof drain constructed of solid 6-inch diameter PVC pipe was observed approximately 5 feet bgs. A sketch of the existing foundation, as observed at the test pit location, is included on the Test Pit Log in Appendix A.

The drawing titled “Phase II Framing Plans,” Sheet No. S-5, prepared by Markus Nocka Payette and Associates Inc., dated October 12, 1973 indicates that the 1965 portion of the existing building was intermittently underpinned along its west side during construction of the 1973 portion of the existing building. The plan shows that underpinning was performed using approach pit methods with the bottom of underpinning at least 4 feet below what is now existing grade. Bottom of underpinning is anticipated to range from about El. 92 feet at the southwest corner of the 1965 building, gradually stepping down to approximately El. 86.71 feet at the existing loading dock.

Based on the proposed floor elevations, proposed Site grades, and the recommendations for foundation subgrade preparation presented herein, foundation excavations for the proposed connector are not anticipated to extend below the bottoms of existing foundations. In general, care should be taken during earthwork activities to avoid disturbing soils from within the bearing zones (defined as the area beneath 1H:1V line sloped down and away from the bottom outside edge of foundations, floor slabs, and structures) of existing foundations and other adjacent structures. Excavations adjacent to existing structures, sidewalks, streets, and utilities should be properly shored to prevent shifting and/or settlement of these structures. Shoring and temporary foundation support of existing structures, if required, should be designed by a Professional Engineer licensed in the State of Massachusetts.

6.3 Retaining Walls

Foundation subgrades for the proposed cast-in-place concrete retaining walls which extend from the southern corners of the service building are anticipated to consist of native glaciofluvial sand. If native eolian silty sand/silt is encountered below proposed cast-in-place concrete retaining wall footings it should be completely removed from within the foundation bearing zone (defined as the area beneath 1H:1V line sloped down and away from the bottom outside edge of foundations) and replaced with compacted structural fill.

It is anticipated that the proposed modular block retaining wall will be constructed on a nominal 12 inch thick bearing pad consisting of compacted gravel or crushed stone to be specified by the block manufacturer. Subgrades beneath the granular bearing pad are anticipated to consist of relatively thin layers of existing fill and/or native eolian silty sand/silt. Given the anticipated maximum wall height of 3 feet and the ability of modular block walls to better tolerate differential movements, the bearing pad for the proposed modular block wall may bear on existing fill or native soils which have been evaluated in the field at the time of construction.

6.4 Groundwater

Subsurface explorations were advanced to a maximum depth of approximately 62 feet bgs, which corresponds to approximately El. 38 feet. Groundwater was not encountered in any of the explorations. Construction dewatering of groundwater is not anticipated to be necessary for construction of foundations and utilities.

6.5 Bedrock

Bedrock removal is not a construction consideration for the project.

7.0 CONSTRUCTION CONSIDERATIONS

7.1 Site Preparation

All topsoil, pavements, debris, frozen soils, and loose or disturbed soils should be removed from areas receiving new construction. Inorganic soils removed during Site stripping operations may be used as common fill for final Site grading outside the proposed building area, provided they meet the requirements for common fill as described herein.

It is understood that the existing power plant and wood-framed grey building will be demolished. Foundations and/or utilities associated with the existing buildings and any past uses should be removed from below the proposed building areas. Utilities to be relocated should be placed outside of the proposed building perimeters.

Underground structures located beneath the proposed pavements or landscaped areas should be removed to at least 2 feet below proposed finished grade. The ends of underground pipes and utility conduits which are located outside the proposed building footprints and which will be abandoned in place should be capped and/or filled with concrete or grouted.

7.2 Earthwork in Wet Environments

Portions of the existing fill soils, and the native eolian silty sand/silt may be sensitive to disturbance when wet, and may lose their load carrying capacity when disturbed. To reduce disturbance of exposed subgrade soils, it will be important to divert runoff and provide positive grading during construction.

The excavated on-site soils may be used as common fill below proposed pavement and landscape areas provided they can be placed and compacted in accordance with the recommendations provided herein. Some of the on-site soils, especially the native eolian silty sand/silt, may be moisture sensitive and may be difficult to place and compact, especially from fall to spring and during wet periods. Moisture-density relationships should be determined at the start of construction to determine the appropriate range of working moisture content. Working moisture content for moisture-sensitive soils typically ranges from about minus two to plus one percent (-2% to 1%) of the optimum moisture content as determined from moisture-density testing.

7.3 Temporary Excavations and Dewatering

Construction Site safety, means and methods, and sequencing of construction activities is the sole responsibility of the Contractor. Under no circumstances should the following information be interpreted to mean that Oak is assuming responsibility for construction Site safety, trench protection, or the Contractor's responsibilities. Such responsibility is not being implied and should not be inferred.

All temporary excavations should be performed according to OSHA Standards (29 CFR 1926 Subpart P). Temporary un-braced excavations completely within soils encountered in the explorations (OSHA Type C) should be cut no steeper than one and one-half horizontal to one vertical (1.5H:1V) under dry soil or dewatered conditions, to a maximum depth of 12 feet, for OSHA Type C soils.

Care should be taken during earthwork activities to avoid disturbing soils from within the foundation bearing zone (defined as the area beneath 1H:1V line sloped down and away from the bottom outside edge of foundations, floor slabs and structures) of the existing hospital building and other adjacent structures. Excavations adjacent to existing structures, sidewalks, streets, and utilities should be properly shored to prevent shifting and/or settlement of these structures. Shoring and temporary foundation support of existing structures, if required, should be designed by a Professional Engineer licensed in the State of Massachusetts.

Groundwater was not observed in any of the explorations performed during the subsurface investigation conducted in November 2010. While groundwater is not anticipated within foundation and utility excavations, dewatering might be required to remove perched water, water conveyed by adjacent existing utilities, and surface water runoff from the excavations. Surface water runoff should be directed away from excavations to reduce dewatering efforts and to protect subgrades from becoming soft and unstable. Excavation side slopes should be monitored for potential seepage and maintained to promote stability, accordingly.

Excavation, filling, foundation and floor slab construction, and utility installation and backfilling should be completed in dry conditions. Subgrade soils that become unstable should be undercut and replaced with structural fill, as necessary. Excavation side slopes should be monitored for potential seepage and maintained to promote stability, accordingly.

Temporary detention ponds, trenches, ditches, and dewatering sumps should not be made in areas to be filled.

7.4 Fill and Backfill

The following materials and compaction requirements are recommended for use in areas of fill and backfill. Applicable uses of the fill materials are discussed following the table.

Type	Size	% Passing	Compaction
Structural Fill	6" (150 mm)	100	95% ASTM D 1557
	3" (75 mm)	70–100	Maximum 8-inch lifts
	No. 4 (4.75 mm)	35–70	
	No. 40 (425 µm)	5–35	Maximum 3 inches particle size within 12 inches of foundations and slabs.
	No. 200 (75 µm)	0–10	
Common Fill	8"	100	95% ASTM D 1557 in paved areas 90% ASTM D 1557 in landscaped areas Maximum 12-inch lifts

Visual and laboratory classification of soils encountered in the subsurface explorations indicate the Site soils which are likely to be encountered during earthwork activities are not suitable for reuse as structural fill or pavement base due to their relatively uniform gradation and/or high percentage of fines. Structural fill and aggregate base material for pavements will need to be imported to the Site. Site soils may be reused as common fill provided they are free of deleterious materials and can be adequately compacted.

Soils proposed for reuse should be segregated and stockpiled. Prior to reuse on the Site, grain-size distribution testing will be required of proposed fill soils in order to evaluate their suitability for reuse. The moisture-density relationship (Proctor test) of soil confirmed for use as fill will be required to develop compaction criteria for use during fill placement.

Only compacted structural fill should be used as fill below proposed foundations or ground floor slabs, as backfill against foundations, or as fill below proposed retaining walls. Common fill should be used if raising grades beneath pavement sections and within landscaped areas.

Compacted structural fill below foundations, floor slabs, or proposed retaining walls should extend to the lateral limits defined by a 1H:1V line sloped down and away from the bottom outside edge of foundations or floor slabs to the top of re-compacted, suitable inorganic soils as determined by the project geotechnical engineer or his/her representative at the time of construction.

Bedding placed below utilities should be in accordance with the utility and manufacturer requirements. In general, utilities may be supported by compacted structural fill, or other suitable pipe bedding materials. Fill placed as backfill for utilities below building floor slabs should consist of compacted structural fill. Elsewhere, fill placed as backfill for utilities may consist of compacted common fill.

Excavations due to removal of existing structures and utilities should be backfilled in accordance with the recommendations provided above.

7.5 Subgrade Preparation

Up to 12 inches of existing granular fill may be left in-place beneath proposed foundations in areas where the fill is directly underlain by native glaciofluvial sand provided that the fill subgrades are free of organic or deleterious materials and are observed by the project geotechnical engineer or his/her representative to be relatively firm, dry and stable at the time of construction. It is anticipated that 12 inches of existing fill may be suitable to leave in-place beneath foundations within northern portions of the proposed connector and within the proposed outpatient entry. Test pits should be performed to verify fill thicknesses and underlying native soils.

The native eolian silty sand/silt and any overlying fill are not suitable to remain in place below proposed foundations, and should be over-excavated to native glaciofluvial sand and replaced with compacted structural fill within the foundation bearing zone (defined as the area beneath 1H:1V line sloped down and away from the bottom outside edge of foundations). It is anticipated that removal of native eolian soil from below foundations for the proposed service building and southern portions of the proposed connector will generally require over-excavation of about 1 foot or less, and possibly as much as 3 feet locally in southern areas of the proposed service building.

After Site stripping and excavation of unsuitable existing fill and native eolian silty sand/silt from below foundations, the exposed soil subgrades beneath the proposed building and 10 feet beyond, parking lots, loading areas, and driveways should be compacted with at least four complete passes of a 15-ton vibratory drum roller, in directions perpendicular to one another.

After compaction, accessible soil subgrades should be proof-rolled with a fully loaded tandem-axle dump truck, with each successive pass overlapping the previous one. Unstable subgrade areas shall be characterized by weaving or rutting of more than one inch. Any unstable areas encountered should be undercut at least 12 inches, or to competent soil, and replaced with compacted structural fill or common fill. The depth of undercutting and type of backfill material should be selected with consideration of proposed use (i.e., building or pavement) and soil and weather conditions encountered during construction.

Final foundation and floor slab subgrade preparation should include re-compaction of bearing surfaces. Care should be taken to limit disturbance to bearing surfaces prior to placement of concrete.

Any loose, softened, or disturbed material should be removed and replaced with compacted structural fill prior to placement of concrete. Excavated subgrades should not be left exposed overnight unless the forecast calls for above-freezing, clear conditions.

7.6 Underground Utilities

Utility trenches should be properly excavated and shored according to the recommendations provided above. Utility trenches should be backfilled according to the recommendations for fill and backfill provided above.

7.7 Construction Quality Control

Oak should be provided the opportunity to review the final design and specifications to ensure our recommendations presented herein have been properly interpreted and applied. At a minimum, it is recommended that Oak be retained to provide geotechnical construction observation for the following:

1. Test pits within the proposed outpatient entry and northern portions of the proposed service building to assess the likelihood for limited portions of existing fill to remain in-place beneath proposed foundations;

2. Building and retaining wall foundation excavations to verify suitable foundation bearing surfaces and assess the need for additional undercutting; and

3. Subgrade preparation for foundations, ground floor slabs, and pavements.

It is recommended that all fill, backfill and compaction be inspected and tested by a qualified firm to make sure the proper materials are placed and adequately compacted. Oak should review all soil inspection and testing reports.

8.0 DESIGN RECOMMENDATIONS

The recommendations provided below are based on interpretations of subsurface conditions at the Site and generally accepted geotechnical engineering principles. The recommendations below are provided for use in design of the building foundation and floors, and site work features for the project. Foundation design and construction will be greatly influenced by subsurface conditions at the Site. It is recommended that foundation design and construction be in accordance with all applicable ordinances, regulations, and rules.

8.1 Building Foundations

For the purposes of seismic design, the soil profile is classified as Site Class D (Stiff Soil, average N-value greater than 15 and less than 50) according to the *Minimum Design Loads for Buildings and Other Structures* (ASCE 7-10) published by American Society of Civil Engineers (ASCE). The soil profile Site Class is based on the conditions encountered to a maximum depth of 62 feet bgs within the proposed service building area, and assumes conditions similar to those encountered to a depth of 62 feet bgs continue below the depth of explorations. The Site soils are not susceptible to liquefaction to the depths explored.

With proper site preparation, the proposed service building, connector, and outpatient entry may be supported on continuous and spread footings bearing on native glaciofluvial sand, 12 inches or less of existing fill which is directly underlain by glaciofluvial sand and is observed to be free of organic or deleterious materials, firm, dry and stable by the project geotechnical engineer or his/her representative at the time of construction, or on compacted structural fill placed over native glaciofluvial sand. Structural fill should be placed in accordance with recommendations provided in Section 7.4, Fill and Backfill.

Footings should be proportioned for a maximum allowable contact pressure of 3,500 psf. Spread footings should be at least 3 feet wide, and continuous footings should be at least 2 feet wide. With proper site preparation, post-construction total and differential settlements are anticipated to be less than ¾ inch and ½ inch, respectively.

Lateral loads may be resisted by friction between the bottoms of footings and supporting subgrades, and by passive earth pressure against the sides of the foundation. A friction coefficient of 0.55 and an equivalent fluid unit weight of 200 pounds per cubic foot (pcf) against the sides of footings should be used.

Exterior footings should be placed a minimum of 4 feet below the lowest adjacent ground surface exposed to freezing. At heated interior locations, footings may be designed to bear 2 feet below the top of ground floor slab. If exposure to freezing is anticipated during or after construction, interior footings should be lowered to bear 4 feet below the top of ground floor slab.

It is recommended that proposed foundations planned directly adjacent to existing foundations be designed to bear at the same level as the existing foundations to avoid imparting excess lateral loads to the sides of existing foundation walls and foundations. Proposed foundations should be structurally isolated from existing foundations.

8.2 Floor Slabs

The proposed building floor slabs may be slab-on-grade construction bearing on at least 12 inches of compacted structural fill placed above proof-rolled and compacted subgrades of existing fill and/or native soils which are observed to be free of organic or deleterious materials, firm, dry and stable by the project geotechnical engineer or his/her representative at the time of construction. Fill used to raise grade beneath proposed floor slabs should consist of compacted structural fill. A subgrade modulus of 175 pounds per cubic inch (pci) should be used for design of building floor slabs supported by compacted structural fill. A vapor barrier is recommended to reduce moisture infiltration into the building.

Exterior slabs at entrances should be underlain by at least 4 feet of free-draining material such as the native glaciofluvial sand, compacted structural fill or crushed stone to reduce the potential for frost heaving. Surrounding site grades should slope away to reduce available moisture for frost and ice formation.

8.3 Foundation Drainage and Dampproofing

In accordance with the *Massachusetts State Building Code*, *7th Edition*, Article 780, Sections 1807.2 and 1807.4, below grade occupied spaces should be dampproofed and perimeter foundation drains should be provided. Dampproofing materials and products are typically specified by the project architect or structural engineer responsible for the building design. The following recommendations are provided for use in design of geotechnical aspects of the building.

Perimeter drains should consist of 4-inch diameter perforated PVC or Advanced Drainage Systems drain pipe embedded within at least 6 inches of crushed stone. Crushed stone should consist of Massachusetts Highway Department, Standard Specifications for Highways and Bridges, 1988, Item M2.01.4 Crushed Stone. The stone should be wrapped in a synthetic filter fabric such as Mirafi 140N or equal, to prevent clogging. Drains should pitch to flow by gravity to a surface drainage feature or approved storm drain. A minimum of two outlets is recommended so as not to depend on a single flow path.

Additionally, an impervious cover should be placed at the exterior ground surface adjacent to the proposed building to reduce infiltration of surface runoff. Roof drains should not be connected to perimeter foundation drains.

8.4 Pavements

Traffic loading used to develop the recommended flexible and rigid pavement sections provided below were based on information provided by Anna Jaques Hospital personnel and data reported in the Traffic Impact & Access Evaluation Memo prepared by Vanasse Hangen Brustlin, Inc. on September 14, 2010. It is understood that daily heavy duty traffic typically includes up to 5 box delivery trucks and 5 tractor trailer trucks. In addition, one commercial size front load garbage truck is anticipated weekly. From the memo referenced above, a total of 69 vehicles accessed the Rawson Avenue Site Drive during the evening peak hour of 3 to 4 PM. Using the K factor of 7% for Rawson Avenue, average daily traffic along the Rawson Avenue Site Drive is anticipated to be 986 passenger vehicles.

The pavement design and soil parameters used to develop the recommended flexible and rigid pavement sections using AASHTO methods are provided below.

Pavement Design Parameters	
Pavement design life	20 years
Initial Serviceability	
Flexible Pavement	4.2
Rigid Pavement	4.5
Terminal Serviceability	2.5
Reliability	90 percent

Soil Parameters

CBR (California Bearing Ratio)	5 (Silt, USCS classification ML)
Effective Soil Resilient Modulus	7,000 pounds per square inch (psi)
Westergaard Subgrade Modulus (k)	130 pci

It is anticipated that pavement subgrades will include existing fill, common fill placed to raise grade, or native soils. The common fill and native eolian silty sand/silt are likely to be moderately to highly susceptible to frost action, moisture sensitive, and fair to poor draining. Routine pavement maintenance including, but not limited to, crack sealing could help reduce the potential for ice lens formation and differential frost heaving of pavements.

The recommended pavement sections are designed to support post-construction traffic only, and are not designed to support construction traffic. The contractor is responsible for construction means and methods and should anticipate the need for methods to prevent disturbance, softening, or rutting of the subgrade, or damage to overlying fill materials resulting from construction traffic. Care must be taken to avoid disturbing subgrades by keeping construction traffic off the subgrade during wet conditions and/or inclement weather until a firm fill layer has been placed.

Soil subgrade conditions are presumed to remain as encountered during subsurface investigations, with no deleterious effects (increased silt, mud, or moisture content) due to equipment traffic during construction. Soil subgrade conditions should be evaluated in the field during construction and undercut or re-compacted, if necessary, to achieve clean and stable subgrade conditions. With proper site preparation, including compaction and proof-rolling of subgrades, the anticipated pavement subgrades should provide adequate support of the design traffic loads.

Recommended minimum flexible and rigid pavement sections are provided below. The materials specified below and placement methods should meet current Massachusetts Highway Department Standard Specifications for Highways and Bridges.

Flexible (Bituminous) Pavement Sections

Material	**Specification**	**Material Thickness (inches)**	
		Standard Duty	**Heavy Duty**
Bituminous Top Course	M3.11.03 Table A	1	1.5
Bituminous Base Course	M3.11.03 Table A	2	2.5
Aggregate Base	M2.01.7, Dense Graded Crushed Stone for Subbase	--	6
Aggregate Subbase	M1.03.1, Processed Gravel for Subbase	12	12

Rigid (Concrete) Pavement Sections

Material	**Specification**	**Material Thickness (inches)**
		Heavy Duty
Portland Cement Concrete	M4.02.00, 4,000 psi	6.5
Aggregate Base	M2.01.7, Dense Graded Crushed Stone for Subbase	12

8.5 Earth-Retaining Structures

In general, foundation and loading docks walls which support unbalanced earth pressures, and other earth-retaining structures should be designed to resist lateral pressures generated by soil backfill materials and any temporary or permanent surcharge loads. At-rest conditions should be used for the design of walls that are not free to deflect or rotate. Walls that are free to deflect or rotate may be designed using active conditions. Adequate drainage should be provided behind earth-retaining structures to prevent the buildup of hydrostatic forces. If drainage systems are not included in the design, the lateral pressures provided below should be modified accordingly to include hydrostatic forces.

The following parameters are based on Rankine's Lateral Earth Pressure Theory and should be used to compute the lateral earth pressures for flexible and rigid walls constructed with level backfill, whichever apply:

	Active	**At-Rest**
Coefficient of Lateral Earth Pressure	0.33	0.5
Equivalent Fluid Unit Weight, pcf	45	68

For sliding and overturning stability, the following design parameters are recommended for retaining wall footings bearing directly on native glaciofluvial sand or on a prepared crushed stone or gravel bearing pad:

Unit weight of granular backfill	135 pcf
Coefficient of sliding friction (μ)	0.55
Maximum foundation edge pressure for cast-in-place retaining walls bearing on native glaciofluvial sand or compacted structural fill	3,500 psf
Maximum foundation edge pressure for modular block retaining walls bearing on prepared crushed stone or gravel bearing pads	2,000 psf

The backfill should be adequately drained to minimize hydrostatic pressures behind the wall. Structural fill is recommended for backfill, with a drain installed behind and at the bottom of the retaining wall. Drains should consist of 4-inch-diameter perforated PVC or Advanced Drainage Systems™ drain pipe embedded within at least 6 inches of crushed stone. Crushed stone should consist of Massachusetts Highway Department, Standard Specifications for Highways and Bridges, 1988, Item M2.01.4 Crushed Stone. The stone should be wrapped in a synthetic filter fabric such as Mirafi 140N or equal, to prevent clogging. Drains should be pitched to allow for gravity flow and discharged to a surface drainage feature or an approved storm drain. Additionally, an impervious cover should be placed at the ground surface to reduce infiltration of surface runoff.

8.6 Underground Utilities

Bedding placed below utilities should be in accordance with the utility and manufacturer requirements. In general, utilities may be supported directly on a minimum 6-inch-thick layer of compacted structural fill, crushed stone, or other suitable pipe bedding materials. Fill placed as backfill for utilities below building floor slabs should consist of compacted structural fill or crushed stone. Elsewhere, fill placed as backfill for utilities may consist of compacted common fill.

9.0 CLOSURE

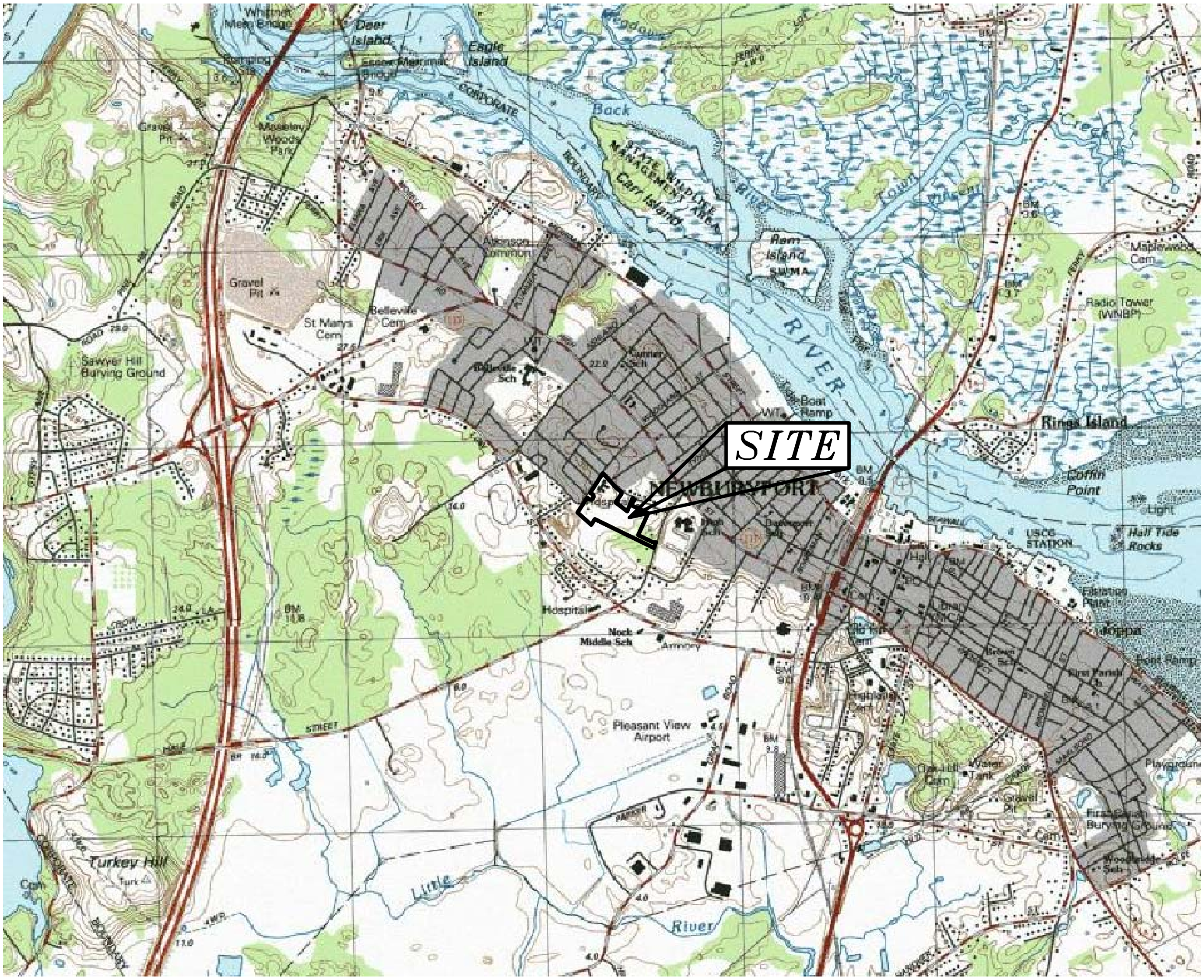
This report has been prepared to assist the site and structural engineers in the design and construction of foundations, ground floor slabs, pavements, and site structures related to the proposed Hospital Renovations and Utility Plant Relocation at the Anna Jaques Hospital in Newburyport, Massachusetts. This work has been completed in accordance with generally accepted foundation engineering practices. No other warranties, expressed or implied, are made. The evaluations and recommendations in this report were based on interpretations made at and between widely spaced subsurface explorations, and our current understanding of the proposed construction. Subsurface conditions between these exploration locations might vary from those indicated on the exploration logs. If the proposed construction or subsurface conditions encountered during construction differ from those described herein, Oak should be made aware of these differences and be provided the opportunity to review and amend our evaluations and recommendations as appropriate.

TABLE 1: SUMMARY OF SUBSURFACE CONDITIONS
Hospital Renovations and Central Utility Plant Relocation
Anna Jaques Hospital
25 Highland Avenue
Newburyport, Massachusetts

Exploration No.	Approximate Ground Surface Elevation (feet)	Approximate Termination Depth (feet)	Approximate Encountered Thickness (feet)			
			Surficial Layers (Pavement or Topsoil)	Fill (SP or SM)	Eolian Deposit (SM or ML)	Glaciofluvial Deposit (SP)
B101	90	17	0.3	5	--	12*
B102	101	25	1.5	--	6.5	17*
B103	99	27	0.3	1.2	5.5	18*
B104	98	27	0.3	--	8.2	18.5*
B105	98	27	3	--	3	21*
B106	100	62	0.3	3.2	5	53.5*
B107	94	27	0.3	4.7	--	22*
B108	96.5	10	0.3	1.7	6.3	2*
B109	97	10	0.3	2.2	3.5	4*
B110	95	10	0.3	--	4.2	5.5*
B111	96	10	0.8	--	3.2	6*
TP101	98	6.5	1	5.5	--	--

NOTES

1. All depths, elevations, and thicknesses are approximate.
2. Ground surface elevations were estimated from the plan referenced on Figure 2.
3. -- Indicates soil type was not encountered.
4. * indicates the exploration terminated within the deposit; therefore, the actual thickness may be greater than shown.
5. Groundwater was not encountered in any of the explorations.

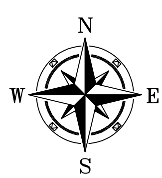


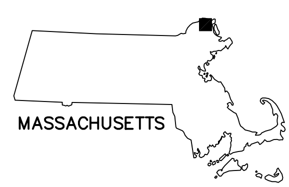
TAKEN FROM U.S.G.S. 7.5x15 MINUTE SERIES TOPOGRAPHIC MAP OF NEWBURYPORT, MASSACHUSETTS—1987

CONTOUR INTERVAL IS 3 METERS

SITE COORDINATES: LATITUDE 42°48'52"
LONGITUDE 70°53'29"

UTM COORDINATES: 47: 41: 737mN
3: 45: 418mE





QUADRANGLE LOCATION

0 1000 2000 3000 4000

SCALE in FEET
1: 25,000

OAK ENGINEERS Brown's Wharf Newburyport, MA 01950 (978) 465-9877	PREPARED FOR: ANNA JAQUES HOSPITAL 25 HIGHLAND AVENUE NEWBURYPORT, MASSACHUSETTS
DATE: NOVEMBER 2010 PROJECT: 094.01169 FIGURE: 1	SITE: RENOVATIONS AND CENTRAL UTILITY PLANT RELOCATION ANNA JAQUES HOSPITAL 25 HIGHLAND AVENUE NEWBURYPORT, MASSACHUSETTS

O: \2009\094.01169\Geotech\094.01169-00.dwg

0 40 80 160

SCALE in FEET
1"=80'

LEGEND:

B101 ⊕	TEST BORING
TP101 ⊞	TEST PIT

NOTES:

1. FIGURE BASED ON PLAN TITLED "GRADING, DRAINAGE AND EROSION CONTROL PLAN", DRAWING C-4, PREPARED BY OAK ENGINEERS, LATEST REVISION DATE 11/2/10.
2. EXPLORATION LOCATIONS ARE APPROXIMATE.
3. THIS PLAN HAS BEEN PREPARED FOR ANNA JAQUES HOSPITAL. ALL OTHER USES ARE NOT AUTHORIZED, UNLESS WRITTEN PERMISSION IS OBTAINED FROM OAK ENGINEERS.

OAK ENGINEERS
Brown's Wharf
Newburyport, MA 01950
(978) 465-9877

PREPARED FOR:
ANNA JAQUES HOSPITAL
25 HIGHLAND AVENUE
NEWBURYPORT, MASSACHUSETTS

SITE:
RENOVATIONS AND CENTRAL UTILITY PLANT RELOCATION
ANNA JAQUES HOSPITAL
25 HIGHLAND AVENUE
NEWBURYPORT, MASSACHUSETTS

SUBSURFACE EXPLORATION PLAN

DATE: NOVEMBER 2010
PROJECT: 094.01169
FIGURE: 2

O:\2009\094.01169\Geotech\094.01169-02 GEO.dwg Nov 15, 2010 - 11:23am

O:\2009\094.01169\Geotech\094.01169-02 GEO.dwg GEO Nov 15,2010- 11:23am

APPENDIX A

Exploration Logs

Geotechnical Investigation Report
Hospital Renovations and Central Utility Plant Relocation
Anna Jaques Hospital
25 Highland Avenue
Newburyport, Massachusetts

Oak Engineers
Project 094.01169

OAK ENGINEERS
Civil Engineers & Land Surveyors

BORING AND MONITORING WELL LOG: B101

Reviewed by: BTN	Total Depth: 17 Feet	Logged By: BTN
Date Reviewed: 11/16/10	Boring Diameter: 4 Inches	Date Drilled: 11/3/10 to 11/3/10
Surface Elevation (ft.): 90	Well Stickup: NA	Driller: GWTB

DEPTH	DESCRIPTION (Based on USCS and modified Burmister Soil Classification System)	SOIL PROFILE	SAMPLE	SAMPLE NUMBER	BLOWS (per 6")	SPT-N Value	PENETRATION/ RECOVERY	OVM (ppm) / DEXSIL (ppm)	WELL CONSTRUCTION
	4" ASPHALT.	Pavement							
	S1 (0.5-2.5') Medium dense, brown, fine to coarse SAND, some Gravel, trace silt.	Fill		S1	10-10-11-8	21	24/14		
	S2 (2.5-3.7') Very dense, brown, fine to coarse SAND, little gravel, trace silt. Sampler bouncing on possible cobble.			S2	8-16-50/2"	66+	14/6		
5	S3 (5-7') Dense, brown, fine to coarse SAND and GRAVEL, trace silt.	Glaciofluvial Deposit		S3	8-21-22-25	43	24/10		
	S4 (7-9') Dense, brown, fine to coarse SAND, some Gravel, trace silt.			S4	13-17-15-16	32	24/7		
	Drill action indicates change at 9'.								
10	S5 (10-12') Medium dense, brown, fine to medium SAND, trace silt.			S5	5-8-9-10	17	24/14		
15	S6 (15-17') Medium dense, gray/brown, fine SAND, trace silt, dry.			S6	5-7-10-13	17	24/18		
	End of boring 17'.								

WATER LEVELS:

During Drilling	End of Boring	Date:
NE	NE	11/3/10

WELL LEGEND: Filter Sand, Native Fill, Bentonite, Bentonite Grout, Concrete, PVC Screen, PVC Riser

NOTES:
1. Boring advanced using 2 1/4" solid-stem augers.
2. SPT's conducted using a 140 lb. safety hammer falling 30 inches using a cathead.
3. Sample designated with solid fill submitted for laboratory analysis.

CLIENT:
Anna Jaques Hospital

SITE:
Anna Jaques Hospital
25 Highland Avenue
Newburyport, MA

Project No.: 094.01169 | Page: 1

OAK ENGINEERS
Civil Engineers & Land Surveyors

BORING AND MONITORING WELL LOG: B102

Reviewed by:	BTN	Total Depth:	25 Feet	Logged By:	BTN
Date Reviewed:	11/16/10	Boring Diameter:	4 Inches	Date Drilled:	11/2/10 to 11/2/10
Surface Elevation (ft.):	101	Well Stickup:	NA	Driller:	GWTB

DEPTH	DESCRIPTION Based on USCS and modified Burmister Soil Classification System	SOIL PROFILE	SAMPLE	SAMPLE NUMBER	BLOWS (per 6")	SPT-N Value	PENETRATION/ RECOVERY	OVM (ppm) / DEXSIL (ppm)	WELL CONSTRUCTION
	S1 (0-2') Loose, dark brown, fine to medium SAND and ORGANIC SILT, trace fine roots.	Topsoil		S1	3-3-6-12	9	24/18		
	S2 (2-4') Loose, brown, fine SAND, some Silt.	Eolian Deposit		S2	7-5-5-5	10	24/24		
5	S3 (5-7') Loose, light brown, fine SAND, some Silt.	Glaciofluvial Deposit		S3	2-3-6-6	9	24/24		
	S4A (7-8') Loose, light brown, fine SAND, some Silt.			S4A	5-5	14	24/18		
	S4B (8-9') Medium dense, brown, fine medium SAND, some Gravel, trace silt.			S4B	9-10				
10	S5 (10-12') Medium dense, brown, fine to coarse SAND, some Gravel, trace silt, dry.			S5	13-12-12-12	24	24/18		
15	S6 (15-17') Medium dense, brown, fine to coarse SAND, some Gravel, trace silt, dry.			S6	6-12-12-13	24	24/16		

WATER LEVELS:

During Drilling	End of Boring	Date:
NE	NE	11/2/10

WELL LEGEND: Filter Sand, Native Fill, Bentonite, Bentonite Grout, Concrete, PVC Screen, PVC Riser

NOTES:
1. Boring advanced using 2 1/4" solid-stem augers.
2. SPT's conducted using a 140 lb. safety hammer falling 30 inches using a cathead.
3. Sample designated with solid fill submitted for laboratory analysis.

CLIENT:
Anna Jaques Hospital

SITE:
Anna Jaques Hospital
25 Highland Avenue
Newburyport, MA

Project No.: 094.01169

OAK ENGINEERS
Civil Engineers & Land Surveyors

BORING AND MONITORING WELL LOG: B102

Reviewed by: BTN	Total Depth: 25 Feet	Logged By: BTN
Date Reviewed: 11/16/10	Boring Diameter: 4 Inches	Date Drilled: 11/2/10 to 11/2/10
Surface Elevation (ft.): 101	Well Stickup: NA	Driller: GWTB

DEPTH	DESCRIPTION Based on USCS and modified Burmister Soil Classification System	SOIL PROFILE	SAMPLE	SAMPLE NUMBER	BLOWS (per 6")	SPT-N Value	PENETRATION/ RECOVERY	OVM (ppm) / DEXSIL (ppm)	WELL CONSTRUCTION
	S7 (20-22') Medium dense, brown, medium to coarse SAND, some Gravel, trace silt, dry.			S7	4-9-10-12	19	24/18		
25	End of boring 25'. Borehole collapsed, no sample at 25'.								
30									
35									

WATER LEVELS:

During Drilling	End of Boring	Date:
NE	NE	11/2/10

WELL LEGEND: Filter Sand, Native Fill, Bentonite, Bentonite Grout, Concrete, PVC Screen, PVC Riser

NOTES:
1. Boring advanced using 2 1/4" solid-stem augers.
2. SPT's conducted using a 140 lb. safety hammer falling 30 inches using a cathead.
3. Sample designated with solid fill submitted for laboratory analysis.

CLIENT:
Anna Jaques Hospital

SITE:
Anna Jaques Hospital
25 Highland Avenue
Newburyport, MA

Project No.: 094.01169

BORING AND MONITORING WELL LOG: B103

OAK ENGINEERS
Civil Engineers & Land Surveyors

Reviewed by: BTN	Total Depth: 27 Feet	Logged By: BTN
Date Reviewed: 11/16/10	Boring Diameter: 4 Inches	Date Drilled: 11/2/10 to 11/2/10
Surface Elevation (ft.): 99	Well Stickup: NA	Driller: GWTB

DEPTH	DESCRIPTION (Based on USCS and modified Burmister Soil Classification System)	SOIL PROFILE	SAMPLE	SAMPLE NUMBER	BLOWS (per 6")	SPT-N Value	PENETRATION/ RECOVERY	OVM (ppm) / DEXSIL (ppm)	WELL CONSTRUCTION
	3" ASPHALT.	Pavement							
	S1A (0.5-1.5') Dense, gray, coarse to fine SAND, little gravel and silt.	Fill		S1A	22-15	22	24/18		
	S1B (1.5-2.5') Medium dense, brown, fine SAND, some Silt, trace gravel.			S1B	7-7				
	S2 (2.5-4.5') Loose, light brown, fine SAND, some Silt.	Eolian Deposit		S2	4-4-3-3	7	24/17		
5	S3 (5-7') Very loose, light brown SILT and fine SAND, trace gravel and fine roots.			S3	2-1-2-3	3	24/24		
	S4 (7-9') Loose, brown, fine SAND, trace gravel and silt.	Glaciofluvial Deposit		S4	5-5-5-4	10	24/24		
10	S5 (10-12') Medium dense, brown, fine to coarse SAND, little gravel, trace silt.			S5	6-10-17-34	27	24/18		
15	S6 (15-17') Medium dense, brown, fine to coarse SAND, some Gravel, trace silt, dry.			S6	8-14-10-12	24	24/20		

WATER LEVELS:

During Drilling	End of Boring	Date:
NE	NE	11/2/10

WELL LEGEND: Filter Sand, Native Fill, Bentonite, Bentonite Grout, Concrete, PVC Screen, PVC Riser

NOTES:
1. Boring advanced using 2 1/4" solid-stem augers.
2. SPT's conducted using a 140 lb. safety hammer falling 30 inches using a cathead.
3. Sample designated with solid fill submitted for laboratory analysis.

CLIENT:
Anna Jaques Hospital

SITE:
Anna Jaques Hospital
25 Highland Avenue
Newburyport, MA

Project No.: 094.01169 | Page: 1

BORING AND MONITORING WELL LOG: B103

OAK ENGINEERS
Civil Engineers & Land Surveyors

Reviewed by: BTN	Total Depth: 27 Feet	Logged By: BTN
Date Reviewed: 11/16/10	Boring Diameter: 4 Inches	Date Drilled: 11/2/10 to 11/2/10
Surface Elevation (ft.): 99	Well Stickup: NA	Driller: GWTB

DEPTH	DESCRIPTION Based on USCS and modified Burmister Soil Classification System	SOIL PROFILE	SAMPLE	SAMPLE NUMBER	BLOWS (per 6")	SPT-N Value	PENETRATION/ RECOVERY	OVM (ppm) / DEXSIL (ppm)	WELL CONSTRUCTION
	S7 (20-22') Medium dense, brown, fine to medium SAND, trace gravel and silt, dry.			S7	7-9-6-7	15	24/14		
25	S8 (25-27') Medium dense, brown, fine to medium SAND, trace gravel and silt, dry.			S8	7-9-7-9	16	24/12		
	End of boring 27'.								
30									
35									

WATER LEVELS:

During Drilling	End of Boring	Date:
NE	NE	11/2/10

WELL LEGEND: Filter Sand, Native Fill, Bentonite, Bentonite Grout, Concrete, PVC Screen, PVC Riser

NOTES:
1. Boring advanced using 2 1/4" solid-stem augers.
2. SPT's conducted using a 140 lb. safety hammer falling 30 inches using a cathead.
3. Sample designated with solid fill submitted for laboratory analysis.

CLIENT:
Anna Jaques Hospital

SITE:
Anna Jaques Hospital
25 Highland Avenue
Newburyport, MA

Project No.: 094.01169

OAK ENGINEERS
Civil Engineers & Land Surveyors

BORING AND MONITORING WELL LOG: B104

Reviewed by:	BTN	Total Depth:	27 Feet	Logged By:	BTN
Date Reviewed:	11/16/10	Boring Diameter:	4 Inches	Date Drilled:	11/2/10 to 11/2/10
Surface Elevation (ft.):	98	Well Stickup:	NA	Driller:	GWTB

DEPTH	DESCRIPTION (Based on USCS and modified Burmister Soil Classification System)	SOIL PROFILE	SAMPLE	SAMPLE NUMBER	BLOWS (per 6")	SPT-N Value	PENETRATION/ RECOVERY	OVM (ppm) / DEXSIL (ppm)	WELL CONSTRUCTION
	3" ASPHALT.	Pavement							
	S1 (0.5-2.5') Medium dense, light brown, fine SAND and SILT.	Eolian Deposit		S1	6-6-9-9	15	24/14		
	S2 (2.5-4.5') Loose, light brown, fine SAND and SILT, root at 4.5'.			S2	8-3-2-7	5	24/24		
5	S3 (5-7') Loose, brown, fine SAND and SILT.			S3	4-3-2-1	5	24/7		
	S4 (7-9') Loose, brown, fine SAND and SILT to 8.5', over dense, brown GRAVEL, little fine to coarse sand.			S4	1-1-4-17	5	24/8		
10	Drill action indicates cobbles 9.5-10.5'.								
	S5 (10.5-12.5') Dense, brown, fine to coarse SAND, some Gravel, trace silt.	Glaciofluvial Deposit		S5	14-16-22-32	38	24/16		
	Drill action indicates change at 13.5'.								
15	S6 (15-17') Medium dense, brown/gray, fine to medium SAND, trace silt, dry.			S6	7-9-8-8	17	24/17		

WATER LEVELS:

During Drilling	End of Boring	Date:
NE	NE	11/2/10

WELL LEGEND: Filter Sand, Native Fill, Bentonite, Bentonite Grout, Concrete, PVC Screen, PVC Riser

NOTES:
1. Boring advanced using 2 1/4" solid-stem augers.
2. SPT's conducted using a 140 lb. safety hammer falling 30 inches using a cathead.
3. Sample designated with solid fill submitted for laboratory analysis.

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Project No.: 094.01169

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OAK ENGINEERS
Civil Engineers & Land Surveyors

BORING AND MONITORING WELL LOG: B104

Reviewed by:	BTN	Total Depth:	27 Feet	Logged By:	BTN
Date Reviewed:	11/16/10	Boring Diameter:	4 Inches	Date Drilled:	11/2/10 to 11/2/10
Surface Elevation (ft.):	98	Well Stickup:	NA	Driller:	GWTB

DEPTH	DESCRIPTION Based on USCS and modified Burmister Soil Classification System	SOIL PROFILE	SAMPLE	SAMPLE NUMBER	BLOWS (per 6")	SPT-N Value	PENETRATION/ RECOVERY	OVM (ppm) / DEXSIL (ppm)	WELL CONSTRUCTION
	S7 (20-22') Medium dense, brown, fine to medium SAND, trace gravel and silt, dry.			S7	7-6-8-8	14	24/17		
25	S8 (25-27') Medium dense, brown, fine to coarse SAND, trace gravel and silt, dry.			S8	9-9-8-8	17	24/14		
	End of boring 27'.								
30									
35									

WATER LEVELS:

During Drilling	End of Boring	Date:
NE	NE	11/2/10

WELL LEGEND: Filter Sand, Native Fill, Bentonite, Bentonite Grout, Concrete, PVC Screen, PVC Riser

NOTES:
1. Boring advanced using 2 1/4" solid-stem augers.
2. SPT's conducted using a 140 lb. safety hammer falling 30 inches using a cathead.
3. Sample designated with solid fill submitted for laboratory analysis.

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Project No.: 094.01169

OAK ENGINEERS
Civil Engineers & Land Surveyors

BORING AND MONITORING WELL LOG: B105

Reviewed by: BTN	Total Depth: 25 Feet	Logged By: BTN
Date Reviewed: 11/16/10	Boring Diameter: 4 Inches	Date Drilled: 11/2/10 to 11/2/10
Surface Elevation (ft.): 98	Well Stickup: NA	Driller: GWTB

DEPTH	DESCRIPTION Based on USCS and modified Burmister Soil Classification System	SOIL PROFILE	SAMPLE	SAMPLE NUMBER	BLOWS (per 6")	SPT-N Value	PENETRATION/ RECOVERY	OVM (ppm) / DEXSIL (ppm)	WELL CONSTRUCTION
	S1 (0-2') Loose, brown, fine to medium SAND, some Silt, trace gravel and fine roots.	Topsoil		S1	2-4-5-6	9	24/16		
	S2 (2-4') 12" Loose, brown, fine to medium SAND, some Silt, trace gravel and fine roots, over 9" light brown SILT, trace fine sand.	Eolian Deposit		S2	4-4-3-2	7	24/21		
5	S3A (5-6') Loose, gray/brown SILT, trace fine sand, moist.			S3A	4-6	21	12/10		
	S3B (6-7') Dense, brown, fine to coarse SAND, little silt and gravel, dry.			S3B	14-17		12/10		
	S4 (7-9') Very dense, brown, fine to coarse SAND, some Gravel, trace silt, dry.	Glaciofluvial Deposit		S4	20-26-37-32	63	24/20		
10	S5 (10-12') Dense, brown, fine to coarse SAND and GRAVEL, trace silt, dry.			S5	20-21-28-30	49	24/18		
	Auger cuttings consist of fine to medium SAND at 13'.								
15	S6 (15-17') Medium dense, gray, fine to medium SAND, trace silt, dry.			S6	8-9-8-9	17	24/16		

WATER LEVELS:

During Drilling	End of Boring	Date:
NE	NE	11/2/10

WELL LEGEND: Filter Sand, Native Fill, Bentonite, Bentonite Grout, Concrete, PVC Screen, PVC Riser

NOTES:
1. Boring advanced using 2 1/4" solid-stem augers.
2. SPT's conducted using a 140 lb. safety hammer falling 30 inches using a cathead.
3. Sample designated with solid fill submitted for laboratory analysis.

CLIENT:
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Project No.: 094.01169

OAK ENGINEERS
Civil Engineers & Land Surveyors

BORING AND MONITORING WELL LOG: B105

Reviewed by: BTN	Total Depth: 25 Feet	Logged By: BTN
Date Reviewed: 11/16/10	Boring Diameter: 4 Inches	Date Drilled: 11/2/10 to 11/2/10
Surface Elevation (ft.): 98	Well Stickup: NA	Driller: GWTB

DEPTH	DESCRIPTION Based on USCS and modified Burmister Soil Classification System	SOIL PROFILE	SAMPLE	SAMPLE NUMBER	BLOWS (per 6")	SPT-N Value	PENETRATION/ RECOVERY	OVM (ppm) / DEXSIL (ppm)	WELL CONSTRUCTION
	S7 (20-22') Medium dense, brown/gray, fine to medium SAND, trace gravel and silt, dry.			S7	7-7-8-9	16	24/24		
25	S8 (25-27') Medium dense, brown, fine to medium SAND, trace gravel and silt, dry.			S8	8-9-8-9	17	24/20		
	End of boring 27'.								
30									
35									

WATER LEVELS:

During Drilling	End of Boring	Date:
NE	NE	11/2/10

WELL LEGEND: Filter Sand, Native Fill, Bentonite, Bentonite Grout, Concrete, PVC Screen, PVC Riser

NOTES:
1. Boring advanced using 2 1/4" solid-stem augers.
2. SPT's conducted using a 140 lb. safety hammer falling 30 inches using a cathead.
3. Sample designated with solid fill submitted for laboratory analysis.

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Project No.: 094.01169

OAK ENGINEERS
Civil Engineers & Land Surveyors

BORING AND MONITORING WELL LOG: B106

Reviewed by:	BTN	Total Depth:	62 Feet	Logged By:	BTN
Date Reviewed:	11/16/10	Boring Diameter:	6 Inches	Date Drilled:	11/3/10 to 11/3/10
Surface Elevation (ft.):	100	Well Stickup:	NA	Driller:	GWTB

DEPTH	DESCRIPTION (Based on USCS and modified Burmister Soil Classification System)	SOIL PROFILE	SAMPLE	SAMPLE NUMBER	BLOWS (per 6")	SPT-N Value	PENETRATION/ RECOVERY	OVM (ppm) / DEXSIL (ppm)	WELL CONSTRUCTION
	2 1/2" ASPHALT.	Pavement							
	S1 (0.5-2.5') Dense, brown, fine to coarse SAND, some Gravel, trace silt.	Fill		S1	11-18-23-27	41	24/18		
	S2A (2.5-3.5') Medium dense, brown, fine to coarse SAND, some Gravel, trace silt.			S2A	17-12	19	12/6		
	S2B (3.5-4.5') Medium dense, brown, fine SAND, little silt.			S2B	7-5		12/6		
5	S3 (5-7') Medium dense, brown, fine SAND and SILT, root at 5'.	Eolian Deposit		S3	4-5-7-9	12	24/24		
	S4A (7-8.5') Medium dense, brown, fine SAND and SILT.			S4A	5-10	21	18/14		
	S4B (8.5-9') Medium dense, brown, fine to coarse SAND and GRAVEL, trace silt.	Glaciofluvial Deposit		S4B	11-15		6/3		
10	S5 (10-12') Medium dense, brown, fine to coarse SAND, little gravel, trace silt.			S5	4-6-8-7	14	24/16		
15	S6 (15-17') Medium dense, brown, medium to coarse SAND, trace fine gravel and silt.			S6	6-6-6-6	12	24/20		

WATER LEVELS:

During Drilling	End of Boring	Date:
NE	NE	11/3/10

WELL LEGEND: Filter Sand, Native Fill, Bentonite, Bentonite Grout, Concrete, PVC Screen, PVC Riser

NOTES:
1. Boring advanced using 3 1/4" hollow-stem augers.
2. SPT's conducted using a 140 lb. safety hammer falling 30 inches using a cathead.
3. Sample designated with solid fill submitted for laboratory analysis.

CLIENT:
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Project No.: 094.01169 Page: 1

BORING AND MONITORING WELL LOG: B106

OAK ENGINEERS
Civil Engineers & Land Surveyors

Reviewed by:	BTN	Total Depth:	62 Feet	Logged By:	BTN
Date Reviewed:	11/16/10	Boring Diameter:	6 Inches	Date Drilled:	11/3/10 to 11/3/10
Surface Elevation (ft.):	100	Well Stickup:	NA	Driller:	GWTB

DEPTH	DESCRIPTION Based on USCS and modified Burmister Soil Classification System	SOIL PROFILE	SAMPLE	SAMPLE NUMBER	BLOWS (per 6")	SPT-N Value	PENETRATION/ RECOVERY	OVM (ppm) / DEXSIL (ppm)	WELL CONSTRUCTION
	S7 (20-22') Medium dense, brown, medium to coarse SAND, trace silt.			S7	5-6-7-9	13	24/20		
25	S8 (25-27') Medium dense, brown, fine to coarse SAND, some gravel, trace silt.			S8	9-12-14-12	26	24/18		
30	S9 (30-32') Medium dense, brown, fine to coarse SAND, little gravel, trace silt.			S9	7-7-10-10	17	24/16		
35	S10 (35-37') Dense, brown, fine to coarse SAND, some Gravel, trace silt.			S10	13-21-17-12	38	24/18		

WATER LEVELS:

During Drilling	End of Boring	Date:
NE	NE	11/3/10

WELL LEGEND: Filter Sand, Native Fill, Bentonite, Bentonite Grout, Concrete, PVC Screen, PVC Riser

NOTES:
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2. SPT's conducted using a 140 lb. safety hammer falling 30 inches using a cathead.
3. Sample designated with solid fill submitted for laboratory analysis.

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Project No.: 094.01169

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OAK ENGINEERS
Civil Engineers & Land Surveyors

BORING AND MONITORING WELL LOG: B106

Reviewed by: BTN	Total Depth: 62 Feet	Logged By: BTN	
Date Reviewed: 11/16/10	Boring Diameter: 6 Inches	Date Drilled: 11/3/10 to 11/3/10	
Surface Elevation (ft.): 100	Well Stickup: NA	Driller: GWTB	

DEPTH	DESCRIPTION Based on USCS and modified Burmister Soil Classification System	SOIL PROFILE	SAMPLE	SAMPLE NUMBER	BLOWS (per 6")	SPT-N Value	PENETRATION/ RECOVERY	OVM (ppm) / DEXSIL (ppm)	WELL CONSTRUCTION
	S11 (40-42') Medium dense, brown, fine to medium SAND, trace silt.			S11	8-12-15-22	27	24/24		
45	S12 (45-47') Medium dense, brown, fine SAND, trace silt.			S12	10-13-16-19	29	24/16		
50	S13 (50'-52') Medium dense, brown, fine SAND, trace silt.			S13	12-13-16-17	29	24/22		
55	S14 (55-57') Dense, brown, fine SAND, trace silt.			S14	11-17-21-22	38	24/16		

WATER LEVELS:

During Drilling	End of Boring	Date:
NE	NE	11/3/10

WELL LEGEND: Filter Sand, Native Fill, Bentonite, Bentonite Grout, Concrete, PVC Screen, PVC Riser

NOTES:
1. Boring advanced using 3 1/4" hollow-stem augers.
2. SPT's conducted using a 140 lb. safety hammer falling 30 inches using a cathead.
3. Sample designated with solid fill submitted for laboratory analysis.

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BORING AND MONITORING WELL LOG: B106

OAK ENGINEERS
Civil Engineers & Land Surveyors

Reviewed by: BTN	Total Depth: 62 Feet	Logged By: BTN
Date Reviewed: 11/16/10	Boring Diameter: 6 Inches	Date Drilled: 11/3/10 to 11/3/10
Surface Elevation (ft.): 100	Well Stickup: NA	Driller: GWTB

DEPTH	DESCRIPTION Based on USCS and modified Burmister Soil Classification System	SOIL PROFILE	SAMPLE	SAMPLE NUMBER	BLOWS (per 6")	SPT-N Value	PENETRATION/ RECOVERY	OVM (ppm) / DEXSIL (ppm)	WELL CONSTRUCTION
	S15 (60-62') Dense, brown, fine SAND, trace silt.			S15	11-13-29-27	42	24/22		
	End of boring 62'.								
65									
70									
75									

WATER LEVELS:

During Drilling	End of Boring	Date:
NE	NE	11/3/10

WELL LEGEND: Filter Sand, Native Fill, Bentonite, Bentonite Grout, Concrete, PVC Screen, PVC Riser

NOTES:
1. Boring advanced using 3 1/4" hollow-stem augers.
2. SPT's conducted using a 140 lb. safety hammer falling 30 inches using a cathead.
3. Sample designated with solid fill submitted for laboratory analysis.

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Project No.: 094.01169

OAK ENGINEERS
Civil Engineers & Land Surveyors

BORING AND MONITORING WELL LOG: B107

Reviewed by:	BTN	Total Depth:	27 Feet	Logged By:	BTN
Date Reviewed:	11/16/10	Boring Diameter:	4 Inches	Date Drilled:	11/2/10 to 11/2/10
Surface Elevation (ft.):	94	Well Stickup:	NA	Driller:	GWTB

DEPTH	DESCRIPTION Based on USCS and modified Burmister Soil Classification System	SOIL PROFILE	SAMPLE	SAMPLE NUMBER	BLOWS (per 6")	SPT-N Value	PENETRATION/ RECOVERY	OVM (ppm) / DEXSIL (ppm)	WELL CONSTRUCTION
	3" ASPHALT.	Pavement							
	S1 (0.5-2.5') Loose, brown, fine to coarse SAND, little gravel, trace silt.	Fill		S1	3-3-3-3	6	24/6		
	S2 (2.5-4.5') Loose GRAVEL, some fine Sand and Silt.			S2	2-3-4-6	7	24/4		
5	S3 (5-7') Dense, brown, fine to coarse SAND, some Gravel, trace silt.	Glaciofluvial Deposit		S3	15-17-15-15	32	24/18		
	S4 (7-9') Medium dense, brown, fine to coarse SAND, some Gravel, trace silt.			S4	14-13-15-22	28	24/16		
10	S5 (10-12') Medium dense, brown, fine to coarse SAND, some Gravel, trace silt, dry.			S5	12-14-10-12	24	24/20		
	Drill action indicates change at 13'.								
15	S6 (15-17') Medium dense, gray/brown, fine SAND, trace silt, dry.			S6	7-9-10-10	19	24/24		

WATER LEVELS:

During Drilling	End of Boring	Date:
NE	NE	11/2/10

WELL LEGEND: Filter Sand, Native Fill, Bentonite, Bentonite Grout, Concrete, PVC Screen, PVC Riser

NOTES:
1. Boring advanced using 2 1/4" solid-stem augers.
2. SPT's conducted using a 140 lb. safety hammer falling 30 inches using a cathead.
3. Sample designated with solid fill submitted for laboratory analysis.

CLIENT:
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Newburyport, MA

Project No.: 094.01169

OAK ENGINEERS
Civil Engineers & Land Surveyors

BORING AND MONITORING WELL LOG: B107

Reviewed by: BTN	Total Depth: 27 Feet	Logged By: BTN
Date Reviewed: 11/16/10	Boring Diameter: 4 Inches	Date Drilled: 11/2/10 to 11/2/10
Surface Elevation (ft.): 94	Well Stickup: NA	Driller: GWTB

DEPTH	DESCRIPTION Based on USCS and modified Burmister Soil Classification System	SOIL PROFILE	SAMPLE	SAMPLE NUMBER	BLOWS (per 6")	SPT-N Value	PENETRATION/ RECOVERY	OVM (ppm) / DEXSIL (ppm)	WELL CONSTRUCTION
	S7 (20-22') Medium dense, brown, fine SAND, trace silt, dry.			S7	6-8-10-11	18	24/24		
25	S8 (25-27') Medium dense, gray, fine SAND, trace silt, dry.			S8	9-10-11-10	21	24/24		
	End of boring 27'.								
30									
35									

WATER LEVELS:

During Drilling	End of Boring	Date:
NE	NE	11/2/10

WELL LEGEND: Filter Sand, Native Fill, Bentonite, Bentonite Grout, Concrete, PVC Screen, PVC Riser

NOTES:
1. Boring advanced using 2 1/4" solid-stem augers.
2. SPT's conducted using a 140 lb. safety hammer falling 30 inches using a cathead.
3. Sample designated with solid fill submitted for laboratory analysis.

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Project No.: 094.01169

OAK ENGINEERS
Civil Engineers & Land Surveyors

BORING AND MONITORING WELL LOG: B108

Reviewed by: BTN	Total Depth: 10 Feet	Logged By: BTN
Date Reviewed: 11/16/10	Boring Diameter: 4 Inches	Date Drilled: 11/2/10 to 11/2/10
Surface Elevation (ft.): 96.5	Well Stickup: NA	Driller: GWTB

DEPTH	DESCRIPTION Based on USCS and modified Burmister Soil Classification System	SOIL PROFILE	SAMPLE	SAMPLE NUMBER	BLOWS (per 6")	SPT-N Value	PENETRATION/ RECOVERY	OVM (ppm) / DEXSIL (ppm)	WELL CONSTRUCTION
	4" TOPSOIL.	Topsoil							
	S1 (0.3-2') Loose, brown, fine to coarse SAND, little gravel, trace silt.	Fill		S1	3-5-5-5	10	24/12		
	S2 (2-4') Loose, light brown SILT, little fine sand, trace fine roots.	Eolian Deposit		S2	4-3-3-4	7	24/20		
5	S3 (4-6') Medium dense, brown, fine SAND, some Silt, moist.			S3	5-5-6-11	11	24/18		
	S4 (8-10') Medium dense, brown, fine to medium SAND, trace silt, dry.	Glaciofluvial Deposit		S4	5-6-7-7	13	24/18		
10	End of boring 10'.								
15									

WATER LEVELS:

During Drilling	End of Boring	Date:
NE	NE	11/2/10

WELL LEGEND: Filter Sand, Native Fill, Bentonite, Bentonite Grout, Concrete, PVC Screen, PVC Riser

NOTES:
1. Boring advanced using 2 1/4" solid-stem augers.
2. SPT's conducted using a 140 lb. safety hammer falling 30 inches using a cathead.
3. Sample designated with solid fill submitted for laboratory analysis.

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Project No.: 094.01169 Page: 1

OAK ENGINEERS
Civil Engineers & Land Surveyors

BORING AND MONITORING WELL LOG: B109

Reviewed by:	BTN	Total Depth:	10 Feet	Logged By:	BTN
Date Reviewed:	11/16/10	Boring Diameter:	4 Inches	Date Drilled:	11/2/10 to 11/2/10
Surface Elevation (ft.):	97	Well Stickup:	NA	Driller:	GWTB

DEPTH	DESCRIPTION Based on USCS and modified Burmister Soil Classification System	SOIL PROFILE	SAMPLE	SAMPLE NUMBER	BLOWS (per 6")	SPT-N Value	PENETRATION/ RECOVERY	OVM (ppm) / DEXSIL (ppm)	WELL CONSTRUCTION
	2 1/2" ASPHALT.	Pavement							
	S1 (0.5-2.5') Medium dense, brown, fine to medium SAND, trace gravel and silt.	Fill		S1	6-9-7-8	16	24/14		
	S2 (2.5-4.5') Dense, light brown, fine SAND and SILT.	Eolian Deposit		S2	11-15-16-16	31	24/16		
5	S3A (4.5-6') Dense, light brown, fine SAND and SILT.			S3A	19-24	47	18/18		
	S3B (6-6.5') Very dense, brown, fine to coarse SAND and GRAVEL, little silt.	Glaciofluvial Deposit		S3B	23-27		6/6		
	S4 (8-10') Dense, brown, fine to coarse SAND and GRAVEL, trace silt, dry.			S4	9-16-19-18	35	24/14		
10	End of boring 10'.								
15									

WATER LEVELS:

During Drilling	End of Boring	Date:
NE	NE	11/2/10

WELL LEGEND: Filter Sand, Native Fill, Bentonite, Bentonite Grout, Concrete, PVC Screen, PVC Riser

NOTES:
1. Boring advanced using 2 1/4" solid-stem augers.
2. SPT's conducted using a 140 lb. safety hammer falling 30 inches using a cathead.
3. Sample designated with solid fill submitted for laboratory analysis.

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Project No.: 094.01169 | Page: 1

OAK ENGINEERS
Civil Engineers & Land Surveyors

BORING AND MONITORING WELL LOG: B110

Reviewed by:	BTN	Total Depth:	10 Feet	Logged By:	BTN
Date Reviewed:	11/16/10	Boring Diameter:	4 Inches	Date Drilled:	11/2/10 to 11/2/10
Surface Elevation (ft.):	95	Well Stickup:	NA	Driller:	GWTB

DEPTH	DESCRIPTION (Based on USCS and modified Burmister Soil Classification System)	SOIL PROFILE	SAMPLE	SAMPLE NUMBER	BLOWS (per 6")	SPT-N Value	PENETRATION/ RECOVERY	OVM (ppm) / DEXSIL (ppm)	WELL CONSTRUCTION
	3" ASPHALT.	Pavement							
	S1A (0.5-1.5') Loose, brown, fine to medium SAND, trace silt.	Eolian Deposit		S1A	5-5	9	12/9		
	S1B (1.5-2.5') Loose, brown SILT and fine SAND, moist.			S1B	4-2		12/9		
	S2 (2.5-4.5') Medium dense, brown, fine SAND, some Silt, moist.			S2	8-10-12-12	22	24/20		
5	S3 (4.5-6.5') Dense, brown, fine to coarse SAND, some Gravel, trace silt.	Glaciofluvial Deposit		S3	18-19-21-24	40	24/12		
	S4 (8-10') Medium dense, brown, fine to coarse SAND, some Gravel, trace silt, dry.			S4	6-8-15-18	23	24/14		
10	End of boring 10'.								
15									

WATER LEVELS:

During Drilling	End of Boring	Date:
NE	NE	11/2/10

WELL LEGEND: Filter Sand, Native Fill, Bentonite, Bentonite Grout, Concrete, PVC Screen, PVC Riser

NOTES:
1. Boring advanced using 2 1/4" solid-stem augers.
2. SPT's conducted using a 140 lb. safety hammer falling 30 inches using a cathead.
3. Sample designated with solid fill submitted for laboratory analysis.

CLIENT:
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Project No.: 094.01169

BORING AND MONITORING WELL LOG: B111

OAK ENGINEERS
Civil Engineers & Land Surveyors

Reviewed by: BTN	Total Depth: 10 Feet	Logged By: BTN
Date Reviewed: 11/16/10	Boring Diameter: 4 Inches	Date Drilled: 11/2/10 to 11/2/10
Surface Elevation (ft.): 96	Well Stickup: NA	Driller: GWTB

DEPTH	DESCRIPTION Based on USCS and modified Burmister Soil Classification System	SOIL PROFILE	SAMPLE	SAMPLE NUMBER	BLOWS (per 6")	SPT-N Value	PENETRATION/ RECOVERY	OVM (ppm) / DEXSIL (ppm)	WELL CONSTRUCTION
	9" TOPSOIL.	Topsoil							
	S1 (0.8-2') Very loose, brown SILT and fine SAND, trace fine roots.	Eolian Deposit		S1	3-1-2-3	3	24/12		
	S2 (2-4') Medium dense, brown, fine SAND, some Silt.			S2	1-5-7-7	12	24/20		
5	S3 (4-6') Dense, brown, fine to coarse SAND and GRAVEL, trace silt.	Glaciofluvial Deposit		S3	8-17-17-17	34	24/15		
	S4 (8-10') Dense, brown, fine to coarse SAND and GRAVEL, trace silt.			S4	8-15-17-17	32	24/16		
10	End of boring 10'.								
15									

WATER LEVELS:

During Drilling	End of Boring	Date:
NE	NE	11/2/10

WELL LEGEND: Filter Sand, Native Fill, Bentonite, Bentonite Grout, Concrete, PVC Screen, PVC Riser

NOTES:
1. Boring advanced using 2 1/4" solid-stem augers.
2. SPT's conducted using a 140 lb. safety hammer falling 30 inches using a cathead.
3. Sample designated with solid fill submitted for laboratory analysis.

CLIENT:
Anna Jaques Hospital

SITE:
Anna Jaques Hospital
25 Highland Avenue
Newburyport, MA

Project No.: 094.01169

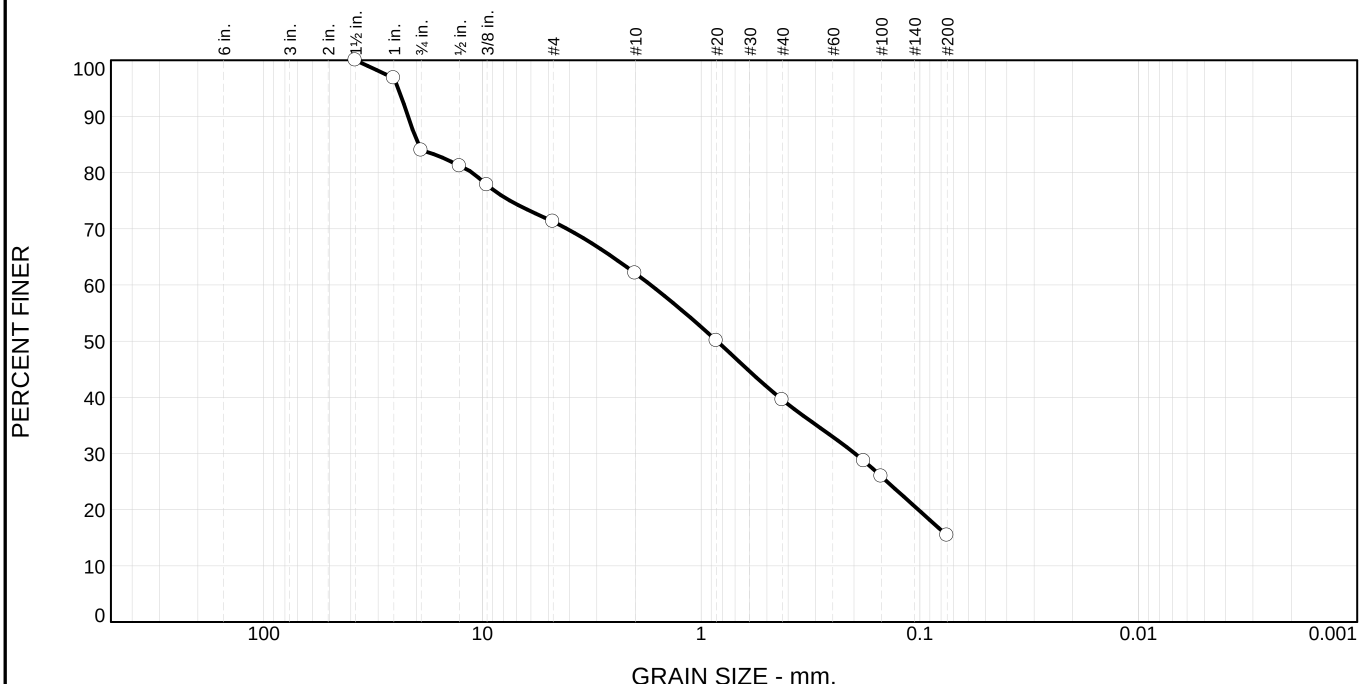
APPENDIX B

Laboratory Test Results

Geotechnical Investigation Report
Hospital Renovations and Central Utility Plant Relocation
Anna Jaques Hospital
25 Highland Avenue
Newburyport, Massachusetts

Oak Engineers
Project 094.01169

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	16.0	12.7	9.2	22.6	24.1	15.4	

Test Results (ASTM D 422 & ASTM D 1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1.5	100.0		
1	96.8		
3/4	84.0		
1/2	81.1		
3/8	77.8		
#4	71.3		
#10	62.1		
#20	50.1		
#40	39.5		
#80	28.7		
#100	25.9		
#200	15.4		

* (no specification provided)

Material Description

FINE-MEDIUM SAND, some gravel, little silt

Atterberg Limits (ASTM D 4318)

PL= **LL=** **PI=**

Classification

USCS (D 2487)= **AASHTO (M 145)=**

Coefficients

D_{90}= 21.8852 D_{85}= 19.6190 D_{60}= 1.7020
D_{50}= 0.8460 D_{30}= 0.1981 D_{15}=
D_{10}= C_u= C_c=

Remarks

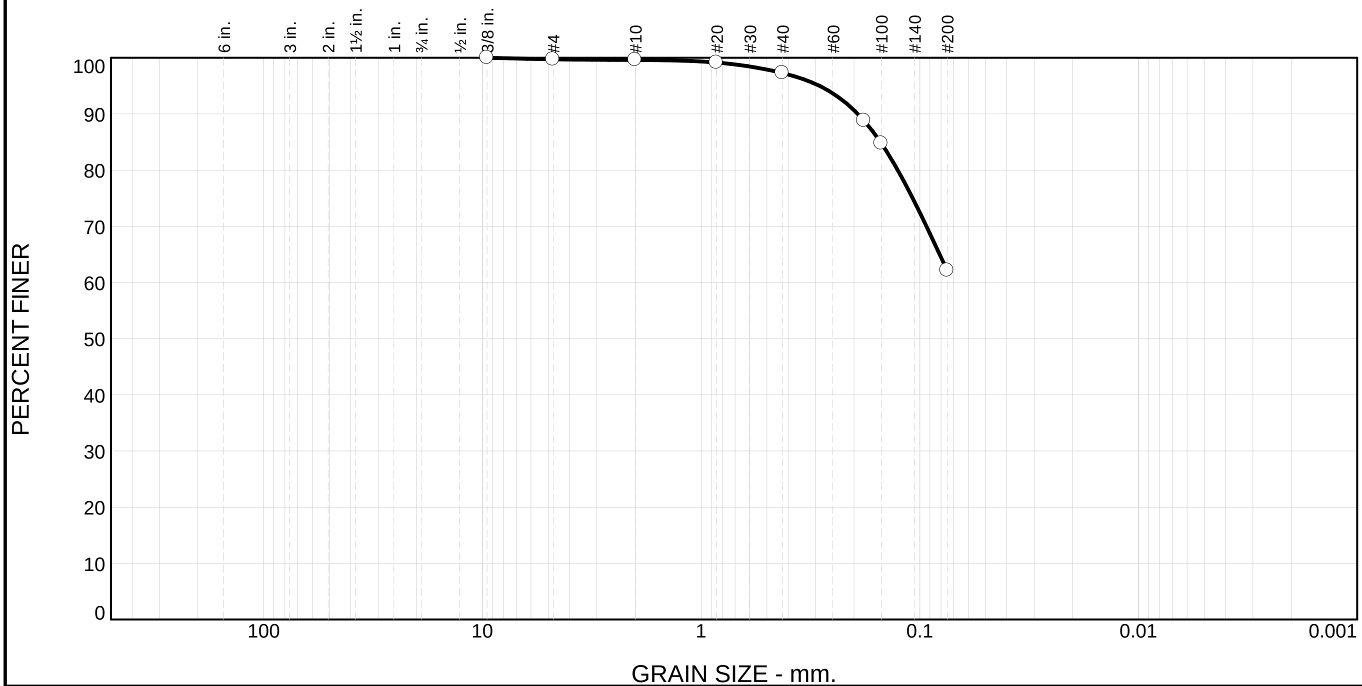
Date Received: 11-8-10 **Date Tested:** 11-8-10
Tested By: Scott TeBordo
Checked By: John Turner
Title: President

Location: B106, S1 and B107, S2 Composite
Sample Number: 10-829 **Depth:** n/a
Date Sampled: 11-8-10

JOHN TURNER
Dover, NH

Client: Ransom Environmental Consultants, Inc.
Project: Anna Jaques Hospital
Project No: 094.01169 **Report#:** 001

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.3	0.1	2.3	35.2	62.1	

Test Results (ASTM D 422 & ASTM D 1140)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
3/8	100.0		
#4	99.7		
#10	99.6		
#20	99.1		
#40	97.3		
#80	88.8		
#100	84.8		
#200	62.1		

* (no specification provided)

Material Description

SILT AND FINE SAND, trace gravel

Atterberg Limits (ASTM D 4318)

PL= **LL=** **PI=**

Classification

USCS (D 2487)= **AASHTO (M 145)=**

Coefficients

D_{90}= 0.1922 D_{85}= 0.1513 D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

Date Received: 11-8-10 **Date Tested:** 11-8-10
Tested By: Scott TeBordo
Checked By: John Turner
Title: President

Location: B103, S3
Sample Number: 10-830 **Depth:** 5.0 - 7.0 Feet **Date Sampled:** 11-8-10

JOHN TURNER
Dover, NH

Client: Ransom Environmental Consultants, Inc.
Project: Anna Jaques Hospital
Project No: 094.01169 **Report#:** 002

72-HOUR POND DRAIN CALCULATION

ALLEN & MAJOR ASSOCIATES, INC.

Project No.	2699-01	**Sheet**	1 of 1
Project Description	Anna Jaques Hospital		
	Newburyport MA		
Calculated By	ARM	**Date**	12/15/19
Checked By	ARM	**Date**	

Drawdown within 72 hours Analysis for Static Method

Perforated Pipe System

Infiltration Rate: 14.17 inches/hour *(From table 2.3.3: Rawls, Brakensiek, Saxton, 1982)*

Design Infiltration Rate: 7.09 inches/hour *(Assume 50% reduction for safety)*

Volume Provide for Infiltration: 2,429 cf

Basin bottom area: 1,016 sf

$Time_{drawdown}$ = (Required Recharge Volume in cubic feet as determined by the Static Method)(1/Design Infiltration Rate in inches per hour)(conversion for inches to feet)(1/bottom area in feet)

$Time_{drawdown}$ = (2,429 cf) (1 / 7.09 in/hr) (1ft/12 in.) (1 / 1,016 sf)

= 4.05 hours

TOTAL RECHARGE VOLUME CALCULATION

Project No.	2699-01	**Sheet**	1 of 1
Project Description	Anna Jaques Hospital		
	Newburyport, MA		
Calculated By	AM	**Date**	12/13/19
Checked By		**Date**	

Standard # 3: Groundwater Recharge

Proposed recharge system: Stone & Perforated Pipe / Infiltration System

In accordance with *MADEP – Volume 2, Technical Guide for Compliance with Massachusetts Stormwater Management Standards, dated January 2008*

A soils require a Volume to recharge of	0.60	inches
B soils require a Volume to recharge of	0.35	inches
C soils require a Volume to recharge of	0.25	inches
D soils require a Volume to recharge of	0.10	inches

Impervious area within: A-soils =	20,723	sf
Impervious area within: B-soils =	0	sf
Impervious area within: C-soils =	0	sf
Impervious area within: D-soils =	0	sf

Weighted Groundwater Recharge Depth = **0.60 in**

Total Site Volume required to be recharged =

20,723 sf x 1" / 12 x 0.60 in = 1,036 cf

Site Volume recharge provided by both =

Volume stored in perforated pipe (bottom of stone to invert out):

= 2,429 c.f. Total Volume Recharged > 1,036 cf (OK)

DRAINAGE PIPE DESIGN ANALYSIS

ALLEN & MAJOR ASSOCIATES, INC.

DRAINAGE PIPE DESIGN ANALYSIS

A&M Job No.	2699-01
Date:	12/15/2019

Project Location:
Anna Jaques Hospital
25 Highland Ave
Newburyport, MA

Prepared For:
Anna Jaques Hospital

Manning's Formula

V=1.486/n*R^2/3*S^1/2
Q = V*A
(25-Year storm)

Where: V is the veloctiy in Ft/sec.
n is Mannings coefficient of friction
R is the Hydraulic Radius
S is the slope of the pipe

R=Area/Wetted Perimeter

Where: Area=Pi*(R/12)2
Wetted Perimeter=2*Pi*R/12

PIPE	Q_{design} (cfs)	n	Diameter (inches)	A (ft^2)	Wp (ft)	R (ft)	S (feet/foot)	Q_{full} (cfs)	Q_{full} ≥ Q_{design}	V_{full} (ft/s)	Q_d/Q_f	Results Fig. 4-4A	V_{design} (ft/s)	V_{design} ≤ 10 ft/s
Roof Drain	1.38	0.013	12	0.79	3.14	0.25	0.0100	3.56	OK	4.54	0.39	0.91	4.13	OK

ILLICIT DISCHARGE COMPLIANCE STATEMENT

Illicit Discharge Compliance Statement

Responsibility:

The Owner is responsible for ultimate compliance with all provisions of the Massachusetts Stormwater Management Policy, the USEPA NPDES Construction General Permit and responsible for identifying and eliminating illicit discharges (as defined by the USEPA).

OWNER NAME: Anna Jaques Hospital

ADDRESS: 25 Highland Avenue
Newburyport, MA

TEL. NUMBER: (978)-463-1000

Engineer's Compliance Statement:

To the best of my knowledge, the attached plans, computations and specifications meet the requirements of Standard 10 of the Massachusetts Stormwater Handbook regarding illicit discharges to the stormwater management system and that no detectable illicit discharges exist on the site. All documents and attachments were prepared under my direction and qualified personnel properly gathered and evaluated the information submitted, to the best of my knowledge.

Included with this statement are site plans, drawn to scale, that identify the location of systems for conveying stormwater on the site and show that these systems do not allow the entry of any illicit discharges into the stormwater management system. The plans also show any systems for conveying wastewater and/or groundwater on the site and show that there are no connections between the stormwater and wastewater systems.

For a redevelopment project (if applicable), all actions taken to identify and remove illicit discharges, including without limitation, visual screening, dye or smoke testing, and the removal of any sources of illicit discharges to the stormwater management system are documented and included with this statement.

NEWBURYPORT STORMWATER MANAGEMENT PERMIT APPLICATION

Revised 05/15/14

STORMWATER MANAGEMENT PERMIT

APPLICATION

Received Date: ____________
Fee Paid: ____________
Date Paid: ____________
Permit #: ____________
Approved By: ____________
Approval Date: ____________
(For DPS use only)

Department of Public Services
Engineering Department
16A Perry Way
Newburyport, MA 01950
Telephone: 978-465-4464 x1711

1. Project / Site Information

Is site less than 10,000 sq ft of land disturbance? If 'no', then no permit required. If 'yes', continue below.

Project / Site Name: OR Building Expansion - Beth Israel Lahey Health, Anna Jaques Hospital

Project Street / Location: 25 Highland Ave, Newburyport, MA 01950

Assessor's Map: 39/44 Parcel(s): 39-44-E-2-A

Applicant Type (Check One) ☐ Single-Family ☒ Commercial and Other Non-Single-Family

Application Fee Structure		Proposed Project Land Disturbance (sq. ft.)	Application Fee (Non-Refundable)
Land disturbance less than 10,000 square feet	No permit required	44,817 SF	$200 + 45($1.00) = $245
Land disturbance 10,000 square feet and greater	$200.00 base fee plus $1.00 for every 1,000 square feet of land disturbance		

Total Area of Impervious Surfaces: (Within Limit of Work) (Paved, parking, decks, roofs, etc.) (sq. ft.)	Existing	Proposed	Net
	16,931 SF	19,315 SF	+2,384 SF

2. Applicant Information

Name: MARK L. Goldstein, PRES.
Address: 25 Highland Avenue
Phone: 978-463-1010
E-mail: mgoldstein@ajh.org

3. Owner Information

☒ *Check box if Owner is also the Applicant*

Name: ____________
Address: ____________
Phone: ____________
E-mail: ____________

4. Application Waiver

The project described above is exempt from meeting the stormwater management standards as outlined in the Newburyport Stormwater Management Ordinances (Chapter 17) for the following reason:

☐ Land disturbance is less than 10,000 square feet.

☐ Other: N/A

Attach any relevant and supporting documentation for an Application Waiver.

5. Certification

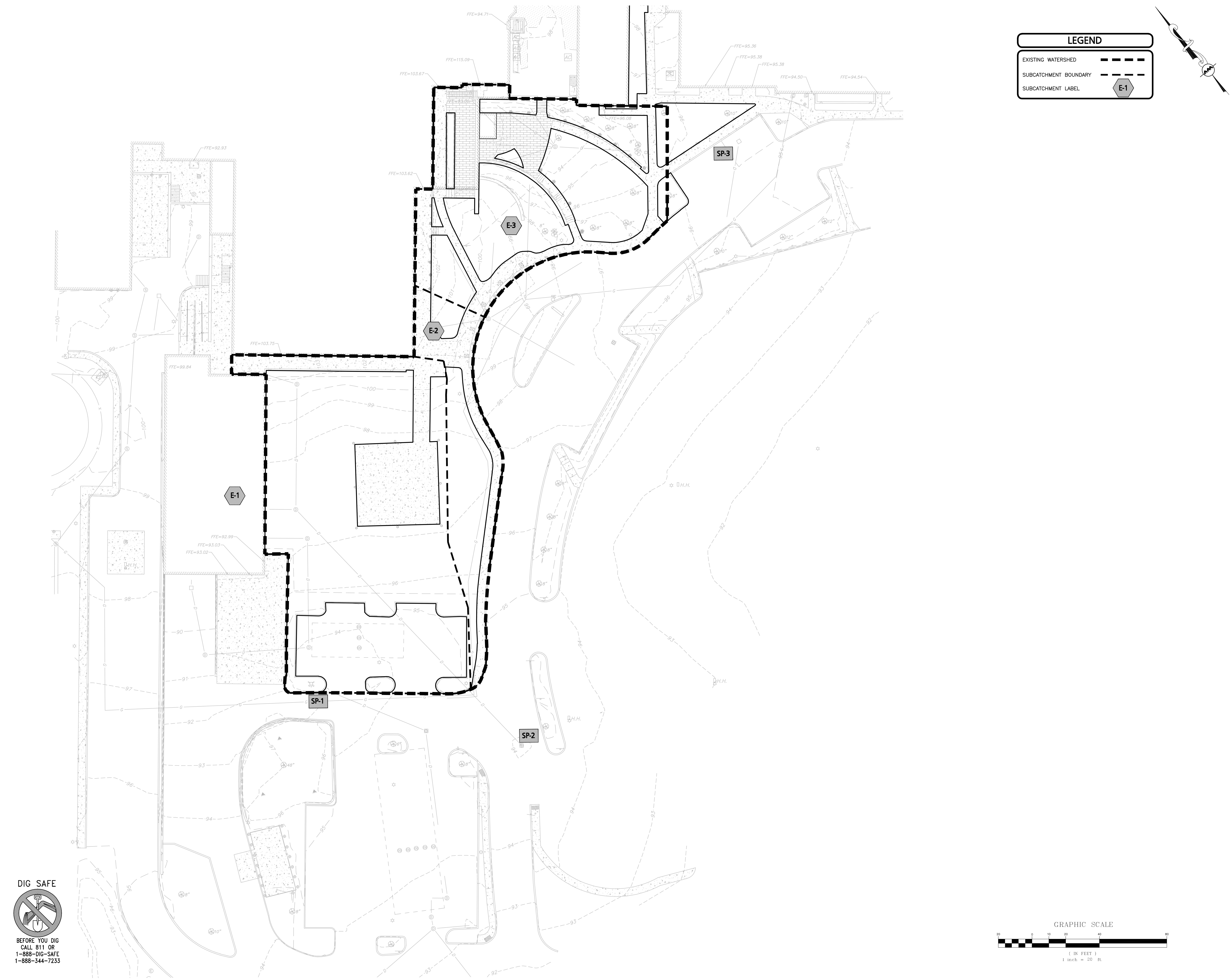
I hereby certify that the information contained herein including all attachments is true, accurate, and complete to the best of my knowledge. Further, I grant the Newburyport Department of Public Services and its agents permission to enter the property to verify the information in the application and to inspect for compliance with the resulting permit.

12/16/19

Applicant's Signature *Date*

12/16

Owner's Signature *Date*



N:\PROJECTS\2699-01\CIVIL\DRAWINGS\CURRENT\C-2699-01_WATERSHED-EXISTING.DWG

Beth Israel Lahey Health
Anna Jaques Hospital

Anna Jaques Hospital

OR Building Expansion

25 Highland Ave, Newburyport, MA 01950

Architect

JACA architects

9 Billings Road
North Quincy, MA 02171
Tel. 617 . 769 . 6300
Fax. 617 . 769 . 6399

Consultants

MEP/FP ENGINEER
R.W. Sullivan Engineering
529 Main St. Suite 203
Boston, MA 02129
Tel. 617.523.8227

LAND SURVEY, LANDSCAPE ARCHITECT & CIVIL ENGINEER
Allen & Major Associates, Inc.
100 Commerce Way, Suite 5
Woburn, MA 01801
Tel. 781.935.6889

STRUCTURAL ENGINEER
Schlick Engineering, LLC.
10 Main Street
Lakeville, MA 02347
Tel. 774.419.3796

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drawing checked by:	RB/ TJW
A&M project number:	2699-01

ISSUE	DATE
ISSUED FOR LOCAL PERMITTING	11-25-19
ISSUED FOR REQUEST FOR A ZONING DETERMINATION	12-09-19

Mark	Revision	Date
1" = ##'		

Stamp

Drawing Title

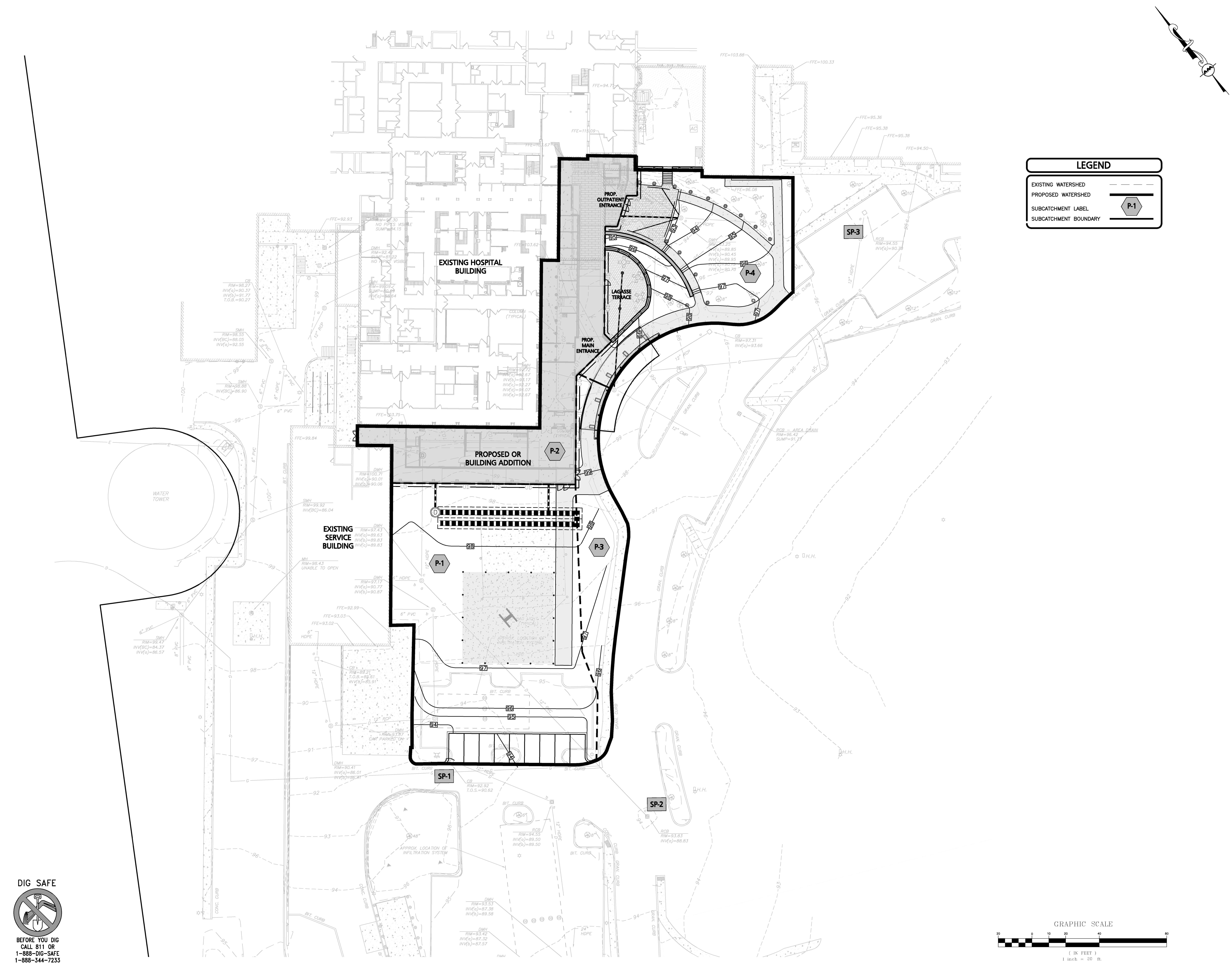
EXISTING WATERSHED PLAN

Scale:

Drawing Number:

EWS

JACA Project Number 190042



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drawing by:	AM/ SM/ RB/ TJW
drawing checked by:	RB/ TJW
A&M project number:	2699-01

ISSUE	DATE
ISSUED FOR LOCAL PERMITTING	11-25-19
ISSUED FOR SITE PLAN REVIEW AND SPECIAL PERMIT	12-18-19

Mark	Revision	Date
1" = 20'		

Stamp

Drawing Title

PROPOSED WATERSHED PLAN

Scale:

Drawing Number:

PWS

JACA Project Number 190042