# STONEFIELD

# STORMWATER MANAGEMENT REPORT

CHASE

**PROPOSED BANK WITH DRIVE-THRU ATM**
**PARCEL ID: MAP 14 LOT 13**
**165 NEWBURYPORT TURNPIKE (MA ROUTE 1)**
**TOWN OF ROWLEY**
**ESSEX COUNTY, MASSACHUSETTS**

**PREPARED FOR:**
**CORE STATES GROUP**

**PREPARED BY:**
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**REPORT DATE:**
**MARCH 8, 2024**

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# 1.0 PROJECT DESCRIPTION

Core States Group is proposing to redevelop Map 14, Lot 13, commonly known as 165 Newburyport Turnpike (US Route 1), located along the northbound side of Newburyport Turnpike at the intersection with Haverhill Street (herein referred to as the "project site") to accommodate a 3,432 SF freestanding Chase Bank with drive-thru ATM. Additional improvements include a proposed parking lot, lighting, utility services, and stormwater management systems.

The property is located within the Retail District, Floodplain District, and Water Protection District. The proposed development is surrounded in all directions by several commercial uses such as restaurants, banks, and gift shops. The site will be accessed via Newburyport Turnpike and Haverhill Street. Refer to **APPENDIX A** for project maps of the project site.

**The project site is 67,765 SF (1.56 acres), the extent of land disturbance is 50,173 SF (1.15 acres), and 22,501 SF (0.52 acres) of new impervious surfaces will be created by the project. The overall drainage area was modeled as 56,270 SF (1.29 acres).**

This Report has been prepared to analyze the potential stormwater runoff impacts of the proposed project site and outline proposed measures to conform to the stormwater management regulations set forth by the Town of Rowley, and the Massachusetts Department of Environmental Protection.

# 2.0 EXISTING CONDITIONS

## EXISTING SITE DEVELOPMENT

The project site fronts Haverhill Street to the North, and Newburyport Turnpike to the West. The project site has been historically developed as gas station, which has since been removed. The existing site consists of curbing, pavement, and areas of fill based on the removal of portions of the previous use. An Aerial Map depicting the existing site conditions can be found in **APPENDIX A**.

## EXISTING TOPOGRAPHY

The high point of the project site is in the northwestern corner of the parcel along Newburyport Turnpike. Runoff sheet flows to the southeastern corner of the parcel, ultimately discharging into an on-site conveyance system. Grades on site generally range from 2% to 9% within the previously developed areas and stays consistent as it approaches the on-site conveyance system.

## PROJECT SITE SOILS

Soil mapping was obtained from the National Resource Conservation Service (NRCS) for the project site and immediate area. Generally, the project site is underlain with one major soil group, classified as (255B) Windsor Loamy Sand. The table below provides a summary of soils for the project site. Additional information regarding the NRCS soil mapping can be found in **APPENDIX B**.

**TABLE 1: NRCS SOIL MAPPING RESULTS**

| Soil Unit Code | Soil Description | Approximate Project Coverage | Drainage Class | Hydrologic Soil Group |
|---|---|---|---|---|
| 255B | Windsor Loamy Sand 3% to 8% Slopes | 100% | Excessively Drained | A |

A Geotechnical Investigation Report was performed by Whitestone Associates, Inc. (report dated November 16, 2023), which consisted of 7 soil borings being performed onsite. The site is significantly impacted by a large layer of fill encountered on-site at depths ranging from 15 to 22 feet below grade. Based on the investigation, seasonal high groundwater was encountered at depths ranging from 8 to 10 feet below grade. Based on the fill encountered on-site infiltration practices would not be feasible within the fill layer and/or practical for this site. Refer to **APPENDIX B** for the full Geotechnical Investigation.

## WATERSHED / RECEIVING WATERS – TMDL DESIGNATION

Under existing conditions, the site drains on-site to the on-site stormwater conveyance system that discharges to the adjacent vegetated wetlands connecting to Bachelder Brook which is not listed as impaired waterway. It should be noted that Bachelder Brook ultimately discharges to Mill River which is listed as a Category 5 stream per the

Massachusetts Year 2022 Integrated List of Waters prepared by the Massachusetts department of Environmental Protection.

## EXISTING ENVIRONMENTAL INVENTORY

Based on the preliminary FEMA flood insurance rate mapping (FEMA Map #25009C0258G issued 02/20/2023), a portion of the site near the vegetated wetlands lies within Flood Zone A. The project is not proposing any disturbance within the Flood Zone. The FEMA Map can be found in **APPENDIX A** of this Report.

Based on an investigation completed by DeRosa Environmental Consulting (Mike DeRosa) there are state (MassDEP) regulated freshwater wetlands on-site and within 100 feet of the project site that are subject to the Wetlands Protection Act Regulations (310 CMR). The limits of the areas and associated buffer zone were delineated and shown on the Site Plans prepared by Stonefield in conjunction with this Report. The Applicant will be proceeding with a Notice of Intent (NOI) with the Town of Rowley Conservation Commission (ConCom) for the project. Delineations of these protected areas can be found in **APPENDIX A** of this Report.

# 3.0 PROPOSED CONDITIONS

## PROPOSED SITE DEVELOPMENT

The proposed redevelopment will consist of a 3,432 SF freestanding Chase Bank with drive-thru ATM. Additional improvements include lighting, landscaping, utility services, stormwater management conveyance and infiltration systems. The site will be accessed via driveways along Newburyport Turnpike and Haverhill Street. Refer to **APPENDIX A** for a Site Plan depicting the proposed project improvements.

## PROPOSED TOPOGRAPHY

Project site topography and drainage patterns will generally remain similar to existing conditions. In order to accommodate ADA facilities and stormwater management facilities the grades will be adjusted accordingly.

## ANTICIPATED ENVIRONMENTAL INVENTORY IMPACTS

The proposed redevelopment will disturb land within environmentally regulated areas (buffer areas). As such, permits for buffer zone disturbances will be sought from the MassDEP to perform work within these areas. The Township will remain apprised of the MassDEP permitting status as the project moves forward.

# 4.0 STORMWATER MANAGEMENT METHODOLOGY & PARAMETERS

## HYDROLOGIC METHODOLOGY

The analysis program "HydroCAD" Version 10.0 by HydroCAD Software Solutions was utilized to calculate and plot the runoff hydrographs. The program incorporates the time of concentration, C values, rainfall data, and project drainage areas to calculate the runoff characteristics. The existing and proposed drainage areas have been analyzed utilizing Intensity-Duration-Frequency data obtained from NOAA for the project area; specifics of the rainfall distribution can be found in **APPENDIX C.** Additional key variables utilized in the analysis include:

**TABLE 2: HYDROCAD DESIGN VARIABLES**

| **Variable** | **Input** | **Variable** | **Input** |
|---|---|---|---|
| Runoff Calculation Method | SCS TR-20 | NRCS Rainfall Frequency Data Set | Essex |
| Pervious/Impervious CN Calculations | Separate | Storm Intervals (Year Events) | 2, 10, 25, 100 |
| Stage-Storage Relationship | Dynamic | Storm Duration | 24 Hours |
| Minimum time of concentration | 6.0 minutes | Storm Curve | NOAA D |

Additional information regarding the hydrologic calculations can be found in **APPENDIX C**.

# 5.0 STORMWATER ANALYSIS

## EXISTING DRAINAGE AREAS

Under current conditions, the project site has one (1) Point of Interest. POI-1 consists of the wooded area in the southeastern corner of the property site (existing wetland). See below for a short summary of each area:

**TABLE 4: SUMMARY OF EXISTING DRAINAGE AREAS**

| Drainage Area | Description | Area Extents | Impervious Area | Time of Concentration |
|---|---|---|---|---|
| E-1A | Existing Drainage to On-Site Inlet | 53,681 SF | 28,244 SF | 6.0 Minutes* |
| E-1B | Existing Drainage to Stormwater Conveyance System | 1,528 SF | 1,528 SF | 6.0 Minutes* |
| POI (E-1) | Ultimate Point of Interest: Existing Drainage to Conveyance System | **55,209 SF** | **29,772 SF** | N/A |

***The minimum time of concentration was utilized due to the high level of impervious coverage and proximity to the corresponding point of interest.**

All existing drainage areas were delineated based on field surveying data and the boundary, topographic, and utility survey prepared by Control Point dated February 26, 2024, Sketch Plan of Land prepared by Meridian Associates, dated 10/28/2009, and Nearmap aerial imagery retrieved 02/12/2024. Hydrologic calculations and parameters for each drainage area can be found in **APPENDIX C**; specific drainage area delineations and land cover can be found in **APPENDIX E.**

## PROPOSED DRAINAGE AREAS

Under proposed conditions, the general drainage patterns and ultimate point of interest will be maintained. The intent behind the proposed delineations is capture and treat runoff as well as divert runoff to stormwater management basins. The diverted land from these drainage areas is proposed to be sent to various stormwater management features (in P-1A, P-1B, and P-1C) to meet the Town of Rowley and Massachusetts Department of Environmental Protection Stormwater Management Standards as outlined in the next Report section. See below for a short summary of each area:

**TABLE 5: SUMMARY OF PROPOSED DRAINAGE AREAS**

| Drainage Area | Description | Area Extents | Impervious Area | Time of Concentration |
|---|---|---|---|---|
| P-1A | Proposed Drainage to Bioretention Basin | 16,813 SF | 9,721 SF | 6.0 Minutes* |
| P-1B | Proposed Drainage to Aboveground Infiltration Basin | 29,817 SF | 16,540 SF | 6.0 Minutes* |
| P-1C | Proposed Drainage to Aboveground Infiltration Basin | 8,579 SF | 7,251 SF | 6.0 Minutes* |
| POI (P-1) | Ultimate Point of Interest: Proposed Overall Drainage | **55,209 SF** | **33,512 SF** | N/A |

***The minimum time of concentration was utilized due to the high level of impervious coverage / land disturbance and proximity to existing and proposed stormwater pipe conveyance systems.**

All proposed drainage areas were delineated based on the proposed grading design overlain on field survey data and the boundary, topographic, and utility survey prepared by Control Point dated February 26, 2024. Hydrologic calculations and parameters for each drainage area can be found in **APPENDIX C**; specific drainage area delineations and land cover can be found in **APPENDIX E.**

## STORMWATER MANAGEMENT DESIGN PARAMETERS

See below for a summary of each design parameter and compliance requirements:

**TABLE 6: STORMWATER DESIGN STANDARDS SUMMARY**

| Design Parameter | Design Target for Compliance |
|---|---|
| Standard 1: *Stormwater Discharge* | Demonstrate that no new stormwater conveyances will discharge untreated stormwater directly to or cause erosion in wetlands or waters. |
| Standard 2: *Stormwater Quantity* | Demonstrate the post-development peak discharge rates do not exceed pre-development peak discharge rates. |
| Standard 3: *Groundwater Recharge* | Demonstrate the 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. |
| Standard 4: *Stormwater Quality* | Stormwater management measures shall be designed to reduce the post-construction load of total suspended solids (TSS) in stormwater runoff generated from the water quality design storm by 80 percent of the anticipated load from existing and proposed impervious coverage onsite. |
| Standard 5: *High Pollutant Loads* | Demonstrate that the discharge of stormwater runoff from land uses with higher potential pollutant loads will be eliminated or reduced through complete protection from potential runoff or use of a specific structural BMP. |
| Standard 6: *Critical Areas* | Discharges near or to Zone II Areas and/or Interim Wellhead Protection Areas will use specific source control, pollution prevention measures, and specific stormwater BMPs to manage discharge.<br><br>Discharges to Outstanding Resource Waters and/or Special Resource Waters will be removed and relocated away from the receiving water and/or wetland and receive highest and best practical method of treatment.<br><br>The discharge to Zone I and/or Zone A has been removed as it is prohibited since it is not essential to the operation of a public water supply. |

*{Note - there are 10 design standards listed in the manual. 7-10 do not have to do with the design and have been included in the sections below but should not be included in this table.}*

### STANDARD 1 – STORMWATER DISCHARGE

No new stormwater conveyance discharges of untreated water are proposed directly to wetlands or waters of the Commonwealth. The ultimate discharge points of the system are connected to the on-site stormwater conveyance system. Under existing conditions no on-site impervious surfaces are being treated and under proposed conditions all on-site impervious will be treated prior to discharging to the vegetated wetlands and Bachelder Brook.

### STANDARD 2 – STORMWATER QUANTITY

The site includes the implementation of an aboveground extended detention basin to attenuate peak stormwater runoff rates. Under post-development conditions the runoff flow rates are reduced. Detailed hydrologic calculations for each drainage area can be found in **APPENDIX C**. The table below outlines the regulatory compliance parameters for runoff quantity on the project site:

**TABLE 7: STORMWATER RUNOFF QUANTITY SUMMARY (POI-1)**

| Rainfall Event | Existing Flow Rate | Proposed Flow Rate | Proposed % Reduction |
|---|---|---|---|
| 2-Year | 1.94 CFS | 1.51 CFS | 22.16% |
| 10-Year | 2.99 CFS | 2.11 CFS | 30.10% |
| 25-Year | 3.88 CFS | 2.53 CFS | 35.31% |
| 100-Year | 6.37 CFS | 6.13 CFS | 3.45% |

**TABLE 8: STORMWATER RUNOFF VOLUME SUMMARY (POI-1)**

| Rainfall Event | Existing Flow Rate | Proposed Flow Rate |
|---|---|---|
| 2-Year | 7,239 CF | 8,147 CF |
| 10-Year | 11,750 CF | 13,129 CF |
| 25-Year | 15,735 CF | 17,427 CF |
| 100-Year | 24,921 CF | 27,141 CF |

### STANDARD 3 – GROUNDWATER RECHARGE

The property was historically an active Gas Station and consists of historic fill ranging in depth of 15 to 22 feet and groundwater depths ranging from 8 to 10 feet below the surface across the site. The site underwent a Release Abatement Measure Plan (RTN #3-31368) during the demolition process to remediate the site, and received a Certificate of Compliance (RCC #05-2015) for the proposed work. The Environmental Consultant for the Property Owner (Lord Environmental, Inc.) is in the process of completing a Permanent Solution Statement (PSS) for the subject property.

Given the project's historic use (previous contamination), the soil conditions on-site (existing historic fill), and the vicinity to the environmental sensitive features (wetlands) the project is not proposing infiltration practices and/or to recharge runoff on-site.

### STANDARD 4 – STORMWATER QUALITY CONTROL

Under existing conditions, the site does not provide any water quality treatment of runoff on-site prior to discharging to the wetlands to the rear of the property. Under proposed conditions all on-site impervious will be captured and 80% of the average annual post-construction load of Total Suspended Solids (TSS) will be treated. As the site is within a Zone II and discharges to a wetland, 44% TSS pre-treatment is required prior to discharging to the wetlands and a required water quality volume of 1.0 inches times the total impervious area.

The water quality standard is met through the implementation of proprietary water quality treatment devices (Contech CDS 1515-3). The project will collect and treat all existing and proposed impervious surfaces through two (2) CDS 1515-3 by Contech Engineering Solutions, Inc. (WQ-1 and WQ-2) providing the required 80% TSS removal. Please refer to the **Appendix** of the report for the water quality flow rate (WQF) calculations and supporting estimated TSS removal calculations for the proposed units highlighting compliance with Standard 4.

### STANDARD 5 – HIGH POLLUTANT LOADS

The proposed use for the development is a freestanding bank with a drive-thru ATM which is not considered a Land Use with Higher Potential Pollutant Loads (LUHPPL) by the MassDEP and therefore is exempt from Standard 5 requirements. It should be noted the previous use was a considered a Land Use with Higher Potential Pollutant Loads (LUHPPL), therefore it is an improvement from a stormwater perspective to introduce a less intense use.

### STANDARD 6 – CRITICAL AREAS

Since the site is within Zone II and discharges to a wetland area and therefore, catch basins equipped with hoods and proprietary treatment systems area proposed to provide water quality treatment on-site.

### STANDARD 7 – REDEVELOPMENT PROJECT

The site is not considered a redevelopment project and must comply with all Standards as defined in the Massachusetts Department of Environmental Protection Stormwater Management Standards.

### STANDARD 8 – EROSION, SEDIMENTATION, AND POLLUTION PREVENTION PLAN

A Soil Erosion & Sediment Control Plan has been prepared in accordance with the latest edition of Volume 2 of the Massachusetts Stormwater Handbook and the Erosion and Sedimentation Control Guidelines. This plan can be found within the Site Plan prepared by Stonefield in conjunction with this Report. Proposed temporary measures during construction include silt fencing, stabilized construction entrances, hay bales, and inlet filters. No land disturbance will occur until all applicable permits have been obtained. Details for all proposed control measures have also been provided.

### STANDARD 9 – STORMWATER FACILITY OPERATIONS AND MAINTENANCE

A Stormwater Operations & Maintenance Manual has been included in this Pollution Prevention Plan. Any necessary easements or covenants associated with the stormwater improvements will be recorded prior to the start of construction.

### STANDARD 10 – ILLICIT DISCHARGES

The proposed stormwater management system discharges are entirely comprised of stormwater. Firefighting, water line flushing, landscape irrigation, uncontaminated groundwater, potable water sources, foundation drains, air conditioning condensation, footing drains, and water for street washing are prohibited to discharge onsite and will therefore not result in an illicit discharge.

### TOWN OF ROWLEY – STORMWATER MANAGEMENT AND EROSION CONTROL BYLAW

The proposed developed has been designed and developed in accordance with the Town of Rowley Stormwater Management and Erosion Control Bylaw (Effective June 2, 2021) and the Applicant will be seeking a Stormwater Management Permit (SMP) for the project. The project includes Erosion and Sediment Control Plans, Stormwater Management Plan (SWMP), and Operations and Maintenance Plan (O&M) in accordance with the Bylaw standards as part of the submitted package.

# 6.0 EROSION, SEDIMENTATION, AND POLLUTION PREVENTION

### TEMPORARY EROSION AND SEDIMENT CONTROL MEASURES

Under proposed conditions, erosion and sediment controls will be utilized to limit the potential effects due to construction of the proposed development. Refer to the Soil Erosion and Sediment Control Plans in **APPENDIX A** of this report. The following includes the temporary sediment controls proposed for this project:

**Construction Entrance** – To provide a stable entrance and exit from a construction site and keep mud and sediment off public roads, a temporary stone-stabilized pad located at points of vehicular ingress and egress on a construction site. If the action of the vehicle traveling over the gravel pad is not sufficient to remove the majority of the mud, then the tires must be washed before the vehicle enters a public road. If washing is used, provisions must be made to intercept the wash water and trap sediment before it is carried off-site.

**Dust Control** – To reduce surface and air movement of dust from exposed soil surfaces during land disturbing, demolition, and construction activities, preventative measures must be taken. Sprinkling or other approved methods must be used to reduce dust generated on the site. Dust control shall be provided by the general contractor to a degree acceptable to the owner/operator, and in compliance with the applicable local and state dust control requirements.

**Inlet Protection** – A sediment filter or an excavated impounding area around a storm drain, drop inlet, or curb inlet must be used to prevent sediment from entering storm drainage systems prior to permanent stabilization of the disturbed area. During construction, the inlet protection measures shall be replaced as needed to ensure proper function of the structure.

**Preserving Natural Vegetation** – Natural vegetation should be preserved whenever possible, but especially on steep slopes, near perennial and intermittent watercourses or swales, and on building sites in wooded areas. Clearly flag or mark areas around trees that are to be saved. It is preferable to keep ground disturbance away from the trees at least as far out as the dripline. If possible, place a barrier/fencing around the trees. Inspect flagged areas regularly to make sure flagging has not been removed. If tree roots have been exposed or injured, re-cover and/or seal them.

**Sediment Fence** – A temporary sediment barrier consisting of a filter fabric stretched across and attached to supporting posts and entrenched must be established along the perimeter of areas to be disturbed before initiation of and during construction. The sediment fence is constructed of stakes and synthetic filter fabric with a rigid wire fence backing where necessary for support. Sediment fence can be purchased with pockets presewn to accept use of steel fence posts. Silt fences should be inspected immediately after each rainfall and at least daily during prolonged

rainfall. Repair as necessary. If the fabric tears, decomposes, or in any way becomes ineffective, replace it immediately. Replace burlap used in sediment fences after no more than 60 days.

**Compost Filter Sock** – A temporary tubular mesh sleeve that contains compost of a well-shredded organic material for a linear treatment that provides stormwater pollutant removal through filtration of pollutants from overland flow. The compost filter sock is placed at the bottom of the silt fence and should be repaired as necessary. Filter socks shall be inspected immediately after each rainfall and at least daily during prolonged rainfall as well as at least once weekly. If the fabric tears, decomposes, or in any way becomes ineffective, replace it immediately. Filter socks shall be replaced after 6 months. Upon completion of temporary control, the sock may be cut open and the mulch spread as a soil supplement.

**Temporary Seeding** – Disturbed areas that will not be brought to final grade for a period of more than 30 working days or in a season not suitable for permanent seeding shall be temporarily seeded to minimize erosion and sediment loss. Other stabilization methods may be used and shall be in conformance with the *Massachusetts Erosion and Sediment Control Guidelines for Urban and Suburban Areas*, latest edition.

**Temporary Soil Stockpile** – Locate the topsoil stockpile so that it does not interfere with work on the site. Side slopes of the stockpile should not exceed 2:1. Surround all topsoil stockpiles with an interceptor dike with gravel outlet and silt fence. Either seed or cover stockpiles with clear plastic or other mulching materials within 7 days of the formation of the stockpile. Topsoil should not be placed while in a frozen or muddy condition, when the subgrade is excessively wet, or when conditions exist that may otherwise be detrimental to proper grading or proposed sodding or seeding. Do not place topsoil on slopes steeper than 2:1. Maintain protective cover on stockpiles until needed.

### PERMANENT EROSION AND SEDIMENT CONTROL MEASURES

**Permanent Seeding** – Permanent seeding of grass and planting trees and shrubs shall be established on any graded or cleared area where long-lived plant cover is needed to stabilize the soil in accordance with the accompanying plans. Areas which will not be brought to final grade for a year or more shall also be seeded permanently. Inspect seeded areas for failure and make necessary repairs and reseed immediately. Conduct or follow-up survey after one year and replace failed plants where necessary.

**Riprap** – A permanent, erosion-resistant ground cover of large, loose, angular stone must be installed in accordance with the accompanying plans to protect slopes, streambanks, channels, or areas subject to erosion by wave action. Riprap should be checked at least annually and after every major storm for displaced stones, slumping, and erosion at edges, especially downstream or downslope. If the riprap has been damaged, it should be repaired immediately before further damage can take place.

### CONSTRUCTION PHASING PLAN AND SEQUENCE OF OPERATIONS

The Soil Erosion & Sediment Control Plans have been phased in order to effectively control erosion and sedimentation and minimize impacts due to seasonal changes. Please refer to **APPENDIX A** for half size Soil Erosion & Sediment Control Plans for detailed construction sequencing.

### FINAL SITE STABILIZATION

Recommended practices for final surface stabilization include surface roughening, terrace, topsoiling, permanent seeding, sodding, trees and shrub planting, mulching, and riprap. The stabilization measures shall be in conformance with the *Massachusetts Erosion and Sediment Control Guidelines for Urban and Suburban Areas*, latest edition.

# 7.0 STORMWATER FACILITY OPERATIONS AND MAINTENANCE

Operation and maintenance of the permanent stormwater control Best Management Practices (BMPs) shall be the responsibility of the operator of the project site at the time that the applicable maintenance is required. The current owner and responsible agent of the project is:

Contact / Operator to be Confirmed Prior to Construction
Operator: **TBD**
Email: **TBD**
Phone Number: **TBD**

A copy of this report shall be kept on-site at all times both during and after construction. Upon reviewing agency approval, the title and date of the maintenance plan as well as the contact information of the current agent responsible for maintaining the stormwater management measures for the project shall be recorded on the deed of the property on which the measures are located as required by the applicable agencies. Any future change in this information such as change in property ownership shall also be recorded on the deed.

The current responsible agent shall evaluate the maintenance plan for effectiveness at least annually and revise the plan as necessary. A detailed, written log of all preventative and corrective maintenance performed for each stormwater management measure must be kept, including a record of all inspections and copies of maintenance-related work orders. Upon request from a public entity with jurisdiction over the project area the responsible agent shall make available the maintenance plan and associate logs and other records for review.

### MAINTENANCE EQUIPMENT AND PERSONNEL

The current responsible agent shall ensure that adequate equipment and training is provided to maintenance personnel to perform the required maintenance tasks. Confined Space Entry Certification shall be required by personnel entering underground structures and pipes. The material and equipment necessary for inspection and maintenance activities shall include, but not be limited to, the following:

- *Detention Basins:* Instruments to perform visual inspection of underground pipes and outlet structures, equipment to pump stormwater from the basin in the event of maintenance, vacuum truck and hose for removal of sediment from basin bottom, and necessary safety equipment.

- *Manufactured Treatment Device Equipment:* Inspection probe, scale to measure filter bags, disposal bags, replacement filter modules, skimmer or net and necessary safety equipment.

- *Landscape Areas:* Material and equipment customary in landscape maintenance practices.

- *Street Sweeping:* Litter vacuum or leaf/litter blower to collect sediment from asphalt surface, brooms, and disposal bags.

- *Oil and Grit Interceptors:* Vacuum truck and hose to pump out stormwater for disposal.

- *Hood and Sump Equipment:* Vacuum truck and hose to pump out stormwater for disposal.

The estimated operation and maintenance budget is estimated shall be established during the construction process and prior to implementing the stormwater measures. Approximate breakdown of yearly routine maintenance items have been noted below (excludes structural repairs):

**TABLE 10: OPERATION AND MAINTENANCE BUDGET**

| | |
|---|---|
| Basin Inspection and Maintenance | $3,000.00 per year |
| Manufactured Treatment Device(s) | $10,000.00 per year |
| Landscape Areas | $5,000.00 per year |
| Hood and Sump Equipment | $5,000.00 per year |
| Street Sweeping | $2,500.00 per year |

**GENERAL MAINTENANCE – STREETS AND PARKING AREAS**

Roadways with curbs and catch basins must be swept at a minimum of once per year. Roadways with curbs and catch basins that discharge to nitrogen or phosphorus impaired waters or their tributaries are swept at a minimum of twice per year, once in the spring and once in the fall. Sweeping on rural uncurbed roads and parking lots with no catch basins must be conducted on an as-needed basis. All street sweepings collected must be disposed of. The responsible party may temporarily store street sweepings in labor yards, but street sweepings must be disposed of offsite in a reasonable timeframe. Street sweepings may not be disposed of on parking lots or lands.

The following street and parking lot sweeping procedures shall be performed to reduce the discharge of pollutants:

**Sweeping**

- Street sweeping will be conducted in dry weather. Sweeping will not be conducted during or immediately after rainstorms.
- Dry cleaning methods will be used whenever possible with the exception of very fine water spray for dust control. Avoid wet cleaning or flushing of the pavement.
- When necessary, parking bans will be enacted to facilitate sweeping on busy streets
- Sweeping will be conducted in a manner that avoids depositing debris into storm drains.
- Sweeping equipment (mechanical, regenerative air, vacuum filter, tandem sweeping) will be selected depending on the level of debris. Brush alignment, sweeper speed, rotation rate, and sweeping patterns will be set to optimate levels to manage debris.
- Sweeping equipment will be routinely inspected and maintained to reduce the potential for leaks.

**Disposal**

- The reuse of sweepings is recommended by MassDEP. If street sweepings are reused, e.g. as anti-skid material or fill in parking lots), they will be properly filtered to remove solid waste, such as paper or

trash, in accordance with their intended reuse. All reuse and/or disposal of street sweeping swill be managed in accordance with current MassDEP policies and regulations.
http://www.mass.gov/eea/docs/dep/recycle/laws/stsweep.pdf

- Street sweepings can be stored for up to one year in approved temporary storage areas. Storage areas will be protected to prevent erosion and runoff and should be located away from wetland resource areas and buffer zones, surface water, or groundwater.
- Sweepings are classified as solid waste and are disposed of at solid waste disposal sites.

### GENERAL MAINTENANCE – WINTER ROAD MAINTENANCE

Snow and ice operations on state-owned roads and parkways must be coordinated with MassDOT. MassDOT documents their extensive snow and ice control program every 5 years in an Environmental Status and Planning Report (ESPR). MassDOT's Snow and Ice Control Program ESPR from 2017 includes extensive measures to limit chemical usage, improve road salt efficiency, and protect environmental resources. All snow and ice operators are required to be trained annually on the MassDOT practices. MassDOT's latest ESPR can be found here: https://www.mass.gov/doc/massdot-snow-and-ice-control-environmental-status-planning-report-2017/download

The following winter maintenance procedures shall be performed to reduce the discharge of pollutants:

- Minimize the use and optimize the application of sodium chloride and other salt (while maintaining public safety) and consider opportunities for use of alternative methods.
- Optimize sand and/or chemical application rates through the use, where practicable, of automated application equipment (e.g. zero velocity spreaders), anti-icing and pre-wetting techniques. Implementation of pavement management systems, and alternate chemicals. Maintain records of the application of sand, anti-icing and/or de-icing chemicals to document the reduction of chemicals to meet established goals.
- Prevent exposure of de-icing product (salt, sand, or alternative products) storage piles to precipitation by enclosing or covering the storage piles. Implement good housekeeping, diversions, containment, or other measures to minimize exposure resulting from adding to or removing materials from the pile. Store piles in such a manner as not to impact surface water resources, groundwater resources, recharge areas, and wells.
- The MS4 permit prohibits snow disposal into waters of the United States. Snow disposal activities, including selection of appropriate snow disposal sites, will adhere to the Massachusetts Department of Environmental Protection Snow Disposal Guidance, Guideline No. BWR G2015-01 (Effective Date: December 21, 2015), located at:
http://www.mass.gov/eea/agencies/massdep/water/regulations/snow-disposal-guidance.html
- MassDEP Snow Disposal Guidance for ice melting operations and skating rinks shall be followed.

### GENERAL MAINTENANCE – STRUCTURAL STORMWATER BMPS

In order to function properly and provide associated stormwater benefits, structural stormwater BMPs must be kept in good working order. Structural stormwater BMPs shall be inspected annually at a minimum. During inspections, the following BMP components will be reviewed for signs of potential issues, as listed below:

**Deep Sump Catch Basins** – Ensure that the trapped sedimentation levels are not greater than 50% of the sump volume with inspections and cleaning at least four times per year and that all inlet and outlet pipes are functioning as expected.

**Proprietary Devices** – Ensure that equipment is inspected and cleaned in accordance with manufacturer requirements no less than twice a year after installation and no less than once a year thereafter.

**Extended Dry Detention Basins** – Ensure that the inlet and outlet pipes are functioning as designed, the outlet structures are not clogged and have acceptable outflow release velocities, there is no subsidence, erosion, or cracking or tree growth on the embankment, there is no damage to the to the emergency spillway, there are no signs of erosion and rutting on the side slopes, and evaluate the level of sedimentation and trash accumulation for acceptable levels.

**Level Spreaders, Catch Basins, and Outlet Structures** – Ensure that the flow paths are not blocked, the contributing areas are reaching the correct BMP areas, there are no signs of erosion, inlet and outlet pipes are functioning as designed, the outlet structures are not clogged and have acceptable outflow release velocities, there is no subsidence, erosion, or cracking, and evaluate the level of sedimentation and trash accumulation for acceptable levels.

During inspection, assign a level of service to each item reviewed. Areas where follow up maintenance is warranted will be indicated. The following maintenance activities will occur at structural BMPs based on condition determined during annual inspections: remove excess sediment, trash, and debris; re-establish vegetation; remove invasive vegetation; re-grade areas as necessary to ensure proper flow patterns; stabilize eroded areas via vegetation establishment, placement of stone, or other energy dissipation measures.

**TABLE 11: BMP MAINTENANCE SCHEDULE**

| Activity | Responsible Party | Time of Year | Frequency |
|---|---|---|---|
| **General** | | | |
| Mow | Operations or contracted services | Spring through Fall | As needed, annually minimum |
| Remove dead vegetation | Operations | Fall and Spring | Bi-annually |
| Remove invasive vegetation | Operations or contracted services | Spring or Fall | Annually |
| Prune | Operations | Spring or Fall | Annually |
| **If Identified During Inspections (As Needed)** | | | |
| Replace dead vegetation | Engineering | Spring | As needed |
| Stabilize eroded areas | Engineering | Spring through Fall | As needed |
| Re-grade areas to ensure proper flow patterns | Engineering | Spring through Fall | As needed |
| Remove excess sediment, trash, and debris | Engineering | Spring through Fall | As needed |
| Repair structural damage | Engineering | Spring through Fall | As needed |
| **Vegetated BMPs** | | | |
| Mulch void areas | Operations or contracted services | Spring | Annually |
| Replace all media and vegetation and repair as needed | Engineering or contracted services | Late Spring / Early Summer | As needed |
| **Aboveground BMPs** | | | |
| Mow / rake buffer area, side slopes, and basin bottom | Operations or contracted services | Fall and Spring | Bi-annually |
| Remove trash, debris, and organic matter | Engineering | Fall and Spring | Bi-annually |
| **Subsurface BMPs** | | | |
| Inspect subsurface components, as feasible | Engineering | Spring through Fall | Annually |
| Remove trash, debris, and organic matter | Engineering | Fall and Spring | Bi-annually |

## STORMWATER CORRECTIVE MAINTENANCE ACTIONS

Depending on many factors, such as the performance of preventative maintenance actions, weather, or unexpected incidents. Corrective requirements may not be precisely anticipated; however, a list of potential corrective maintenance actions may assist the responsible party in planning and estimating costs in advance.

| ***Potential Corrective Maintenance Actions*** | ***Stormwater Management Measures*** |
|---|---|
| ▪ Repair/replacement of eroded or damaged riprap apron<br>▪ Repair/replacement of missing or damaged trash racks<br>▪ Repair/replacement of damaged inlet/outlet pipes<br>▪ Revegetation of eroded side slope, aquatic bench, marsh, basin bottom, grass swales, etc. | Extended Dry Detention Basin (B-1) |
| ▪ Replace parts / system as deemed necessary by manufacturer<br>▪ Repair/replacement of damaged inlet/outlet pipes | Proprietary Systems (WQ-1 & WQ-2) |
| ▪ Repair/replacement of damaged inlet/outlet pipes<br>▪ Replace parts / system as deemed necessary by manufacturer | Catch Basins, Outlet Structures |

## INSPECTION AND LOGS OF ALL PREVENTATIVE AND CORRECTIVE MEASURES

The person responsible for maintenance shall maintain a detailed log of all preventative and corrective maintenance for the structural stormwater management measures incorporated into the design of the development, including a record of all inspections and copies of all maintenance-related work orders.

A maintenance plan shall include a schedule of regular inspections and tasks, and detailed logs of all preventative and corrective maintenance performed on the stormwater management measure, including all maintenance-related work orders. The person with maintenance responsibility must retain and, upon request, make available the maintenance plan and associated logs and other records for review by a public entity with administrative, health, environmental, or safety authority over the site. Inspection Checklists in the Field Manual for the stormwater management measures on this site include:

- Appendix F-1: General Inspection Checklist Log
- Appendix F-2: General Preventative Maintenance Log
- Appendix F-3: General Corrective Maintenance Log
- Appendix F-4: Annual Evaluation Records

All inspection and maintenance activities shall be recorded to document frequency of inspection and maintenance, and implementation of corrective action. All regularly scheduled inspections, inspections following one (1) inch of precipitation, maintenance activities, and repairs shall be recorded. Refer to **APPENDIX F** of this Manual for the BMP Inspection & Maintenance Log for this facility. This log shall be considered a minimum standard for recording purposes, the Operator and Inspection/Maintenance Personnel are encouraged to supplement the Log with additional notes and photos.

### ANNUAL EVALUATION OF THE EFFECTIVENESS OF THE PLAN

The person responsible for maintenance shall evaluate the effectiveness of the maintenance plan at least once per year and adjust the plan and the deed as needed. The responsible party should evaluate the effectiveness of the maintenance plan by comparing the maintenance plan with the actual performance of the maintenance. The items to evaluate may include, but not limited to:

- Whether the inspections have been performed as scheduled;
- Whether the preventive maintenance has been performed as scheduled;
- Whether the frequency of preventative maintenance needs to increase or decrease;
- Whether the planned resources were enough to perform the maintenance;
- Whether the repairs were completed on time;
- Whether the actual cost was consistent with the estimated cost;
- Whether the inspection, maintenance, and repair records have been kept.

If actual performance of those items has been deviated from the maintenance plan, the responsible party should find the causes and implement solutions in a revised maintenance plan.

# 8.0 CONCLUSIONS

As demonstrated in this Report, the increase in impervious surfaces associated with the project will be satisfactorily mitigated by the introduction of an water quality treatment practices and an aboveground extended dry detention.

The proposed project complies with all applicable stormwater management regulations and standards. As such, the project is not anticipated to have any adverse drainage impacts on neighboring properties, downstream watercourses, or adjoining conveyance systems.

# 9.0 REFERENCES

1. Massachusetts Stormwater Handbook and Stormwater Standards, last amended January 2, 2008

   https://www.mass.gov/guides/massachusetts-stormwater-handbook-and-stormwater-standards

2. Massachusetts Complete Erosion and Sedimentation Control Guidelines for Urban and Suburban Areas: A Guide for Planners, Designers, and Municipal Officials, last amended May 2003

   https://www.mass.gov/doc/complete-erosion-and-sedimentation-control-guidelines-a-guide-for-planners-designers-and/download

3. Town of Rowley Protective Zoning Bylaw, last amended June 22, 2020

   https://www.townofrowley.net/zoning-board-appeals/pages/zoning-bylaws

# APPENDIX A
# PROJECT FIGURES

## INVENTORY

**FIGURE 1: USGS LOCATION MAP**

**FIGURE 2: AERIAL MAP**

**FIGURE 3: TAX & ZONING MAP**

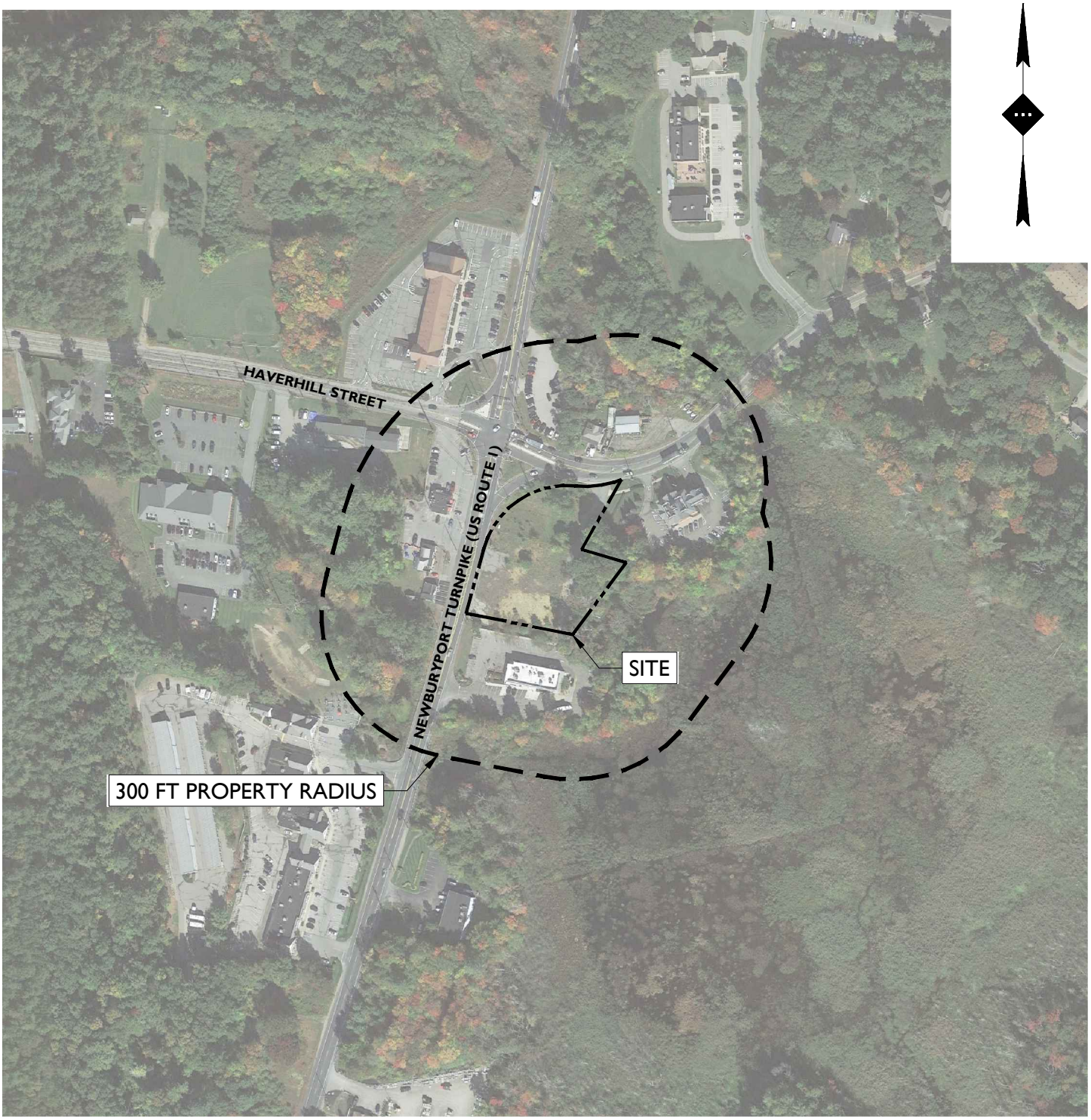
**FIGURE 4: FEMA MAP**

**FIGURE 5: WETLAND MAP**

**FIGURE 6: OVERALL SITE PLAN (NOT TO SCALE)**

**FIGURE 7: SESC PLAN (NOT TO SCALE)**

**FIGURE 8: LANDSCAPE PLAN (NOT TO SCALE)**




# AERIAL MAP

300' 0' 300' 600'

GRAPHIC SCALE IN FEET

1"= 300'

SOURCE: AERIAL MAP RETRIEVED FROM GOOGLE EARTH PRO, DATED 10/21/2021

CHASE

## PROPOSED BANK WITH DRIVE-THRU ATM

TAX MAP 14, LOT 13
165 NEWBURYPORT TURNPIKE
TOWN OF ROWLEY
ESSEX COUNTY, MASSACHUSETTS

| | |
|---|---|
| DRAWN BY: | JV |
| CHECKED BY: | GMC |
| DATE: | 02/16/2024 |
| SCALE: | 1" = 300' |
| PROJECT ID: | BOS-230034 |

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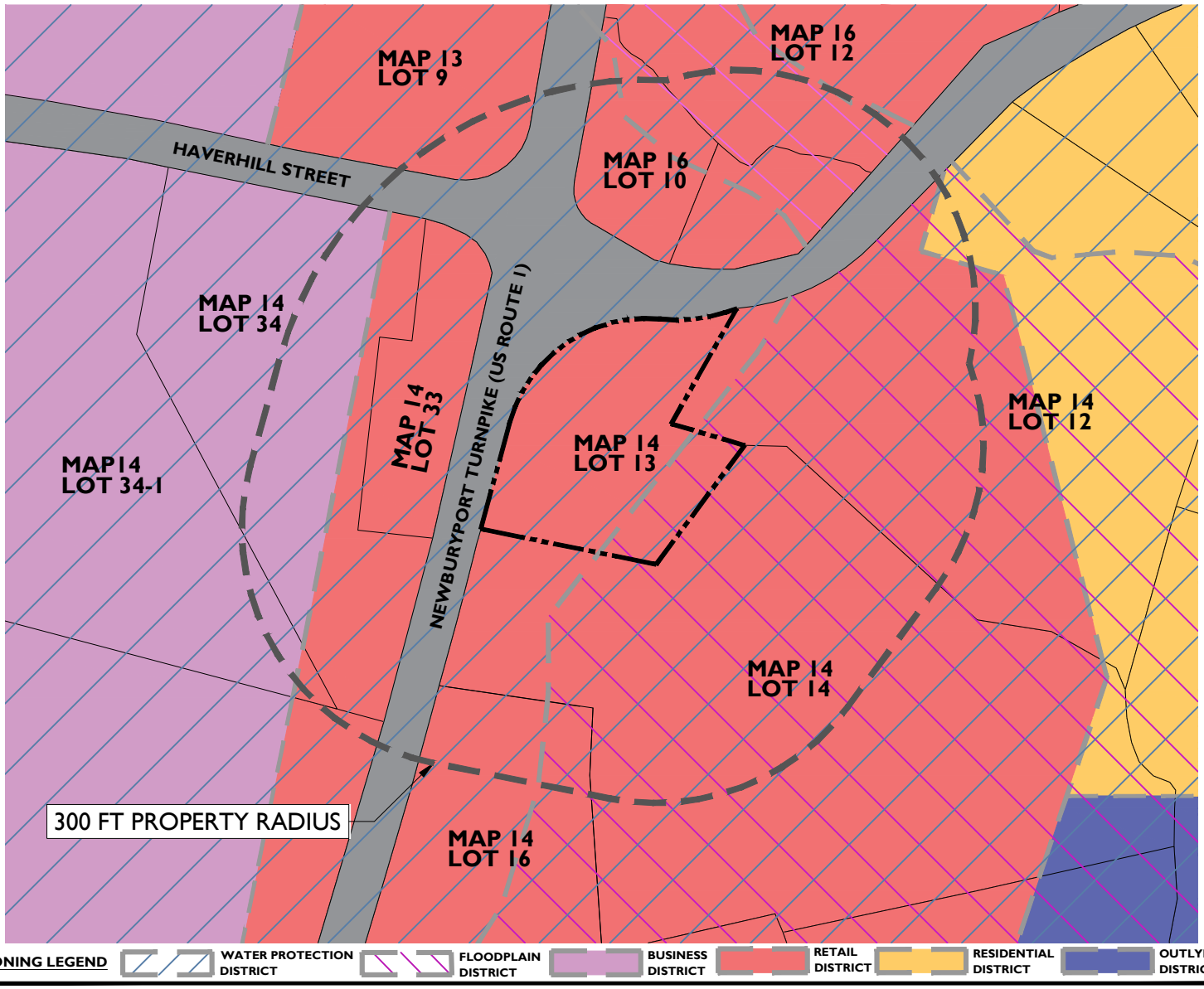


# TAX & ZONING MAP

200' 0' 200' 400'

GRAPHIC SCALE IN FEET

1"= 200'

SOURCE: TOWN OF ROWLEY TAX MAP, DATED 6/14/2024, ZONE MAP OF ROWLEY, DATED 6/1/2011

CHASE

## PROPOSED BANK WITH DRIVE-THRU ATM

TAX MAP 14, LOT 13
165 NEWBURYPORT TURNPIKE
TOWN OF ROWLEY
ESSEX COUNTY, MASSACHUSETTS

| | |
|---|---|
| DRAWN BY: | JV |
| CHECKED BY: | GMC |
| DATE: | 02/16/2024 |
| SCALE: | 1" = 200' |
| PROJECT ID: | BOS-230034 |

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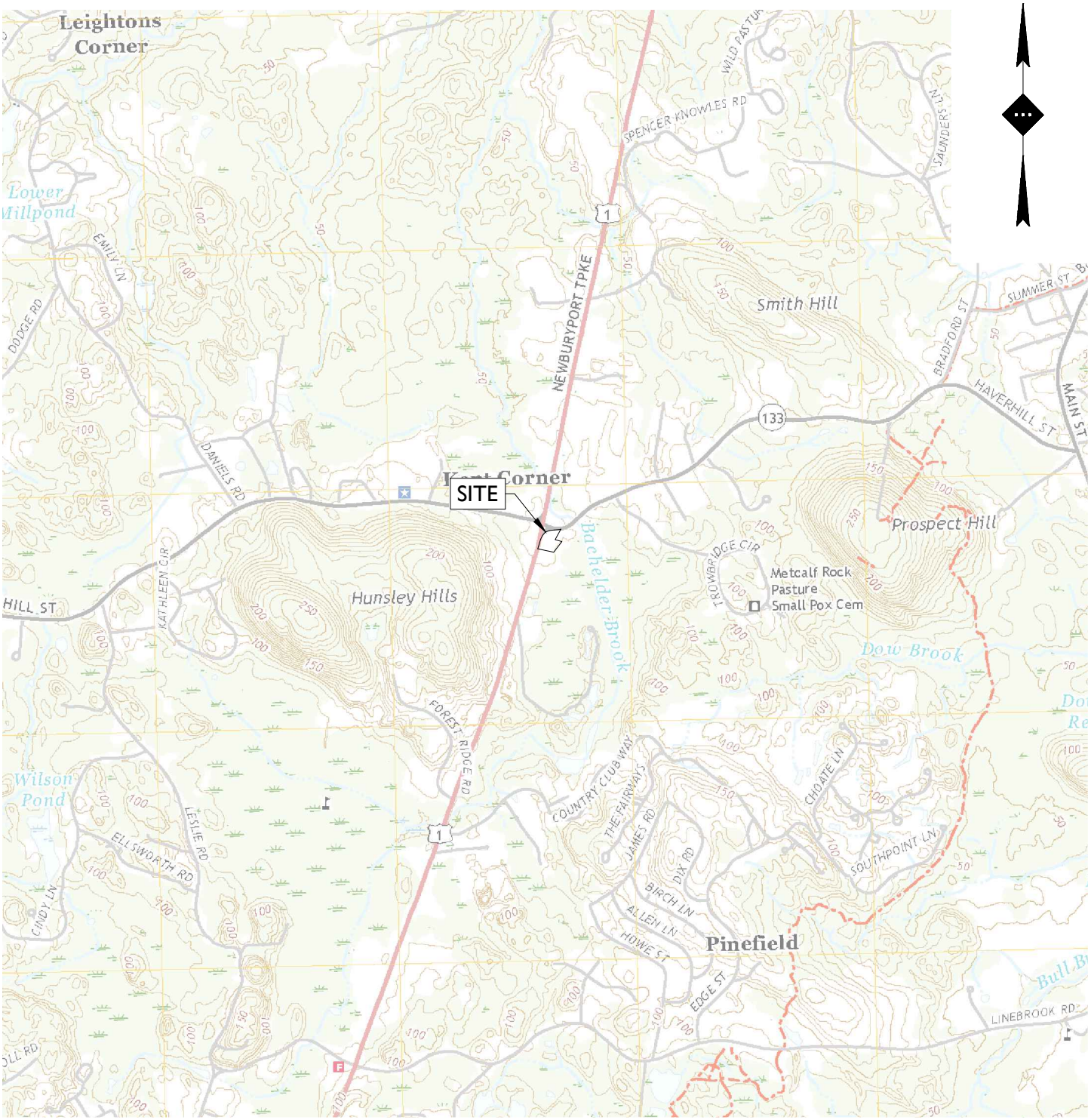


# USGS QUADRANGLE MAP

2000' 0' 2000' 4000'

GRAPHIC SCALE IN FEET

1"= 2000'

SOURCE: USGS QUADRANGLE MAPS 7.5 SERIES GEORGETOWN, MASSACHUSETTS 2021

| | |
|---|---|
| DRAWN BY: | JV |
| CHECKED BY: | GMC |
| DATE: | 02/16/2024 |
| SCALE: | 1" = 2,000' |
| PROJECT ID: | BOS-230034 |

CHASE

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TAX MAP 14, LOT 13
165 NEWBURYPORT TURNPIKE
TOWN OF ROWLEY
ESSEX COUNTY, MASSACHUSETTS

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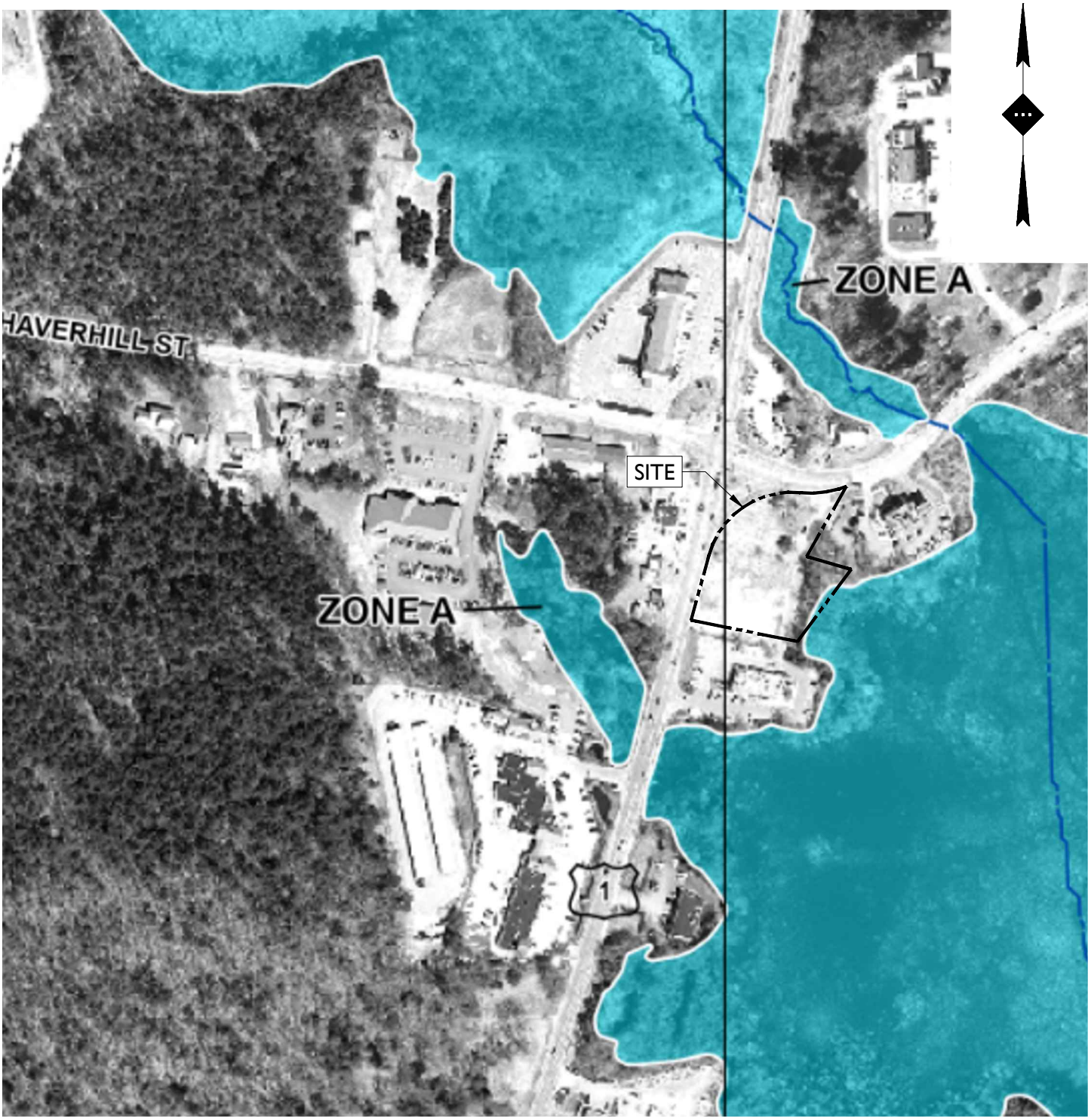


# EFFECTIVE FEMA FLOOD INSURANCE RATE MAP

300' 0' 300' 600'

GRAPHIC SCALE IN FEET

1"= 300'

SOURCE: FLOOD INSURANCE RATE MAP, TOWN OF IPSWICH & TOWN OF ROWLEY, ESSEX COUNTY, MASSACHUSETTS, 25009C0258G, REVISED FEBRUARY 20, 2023

CHASE

## PROPOSED BANK WITH DRIVE-THRU ATM

TAX MAP 14, LOT 13
165 NEWBURYPORT TURNPIKE
TOWN OF ROWLEY
ESSEX COUNTY, MASSACHUSETTS

| | |
|---|---|
| DRAWN BY: | JV |
| CHECKED BY: | GMC |
| DATE: | 02/16/2024 |
| SCALE: | 1" = 300' |
| PROJECT ID: | BOS-230034 |

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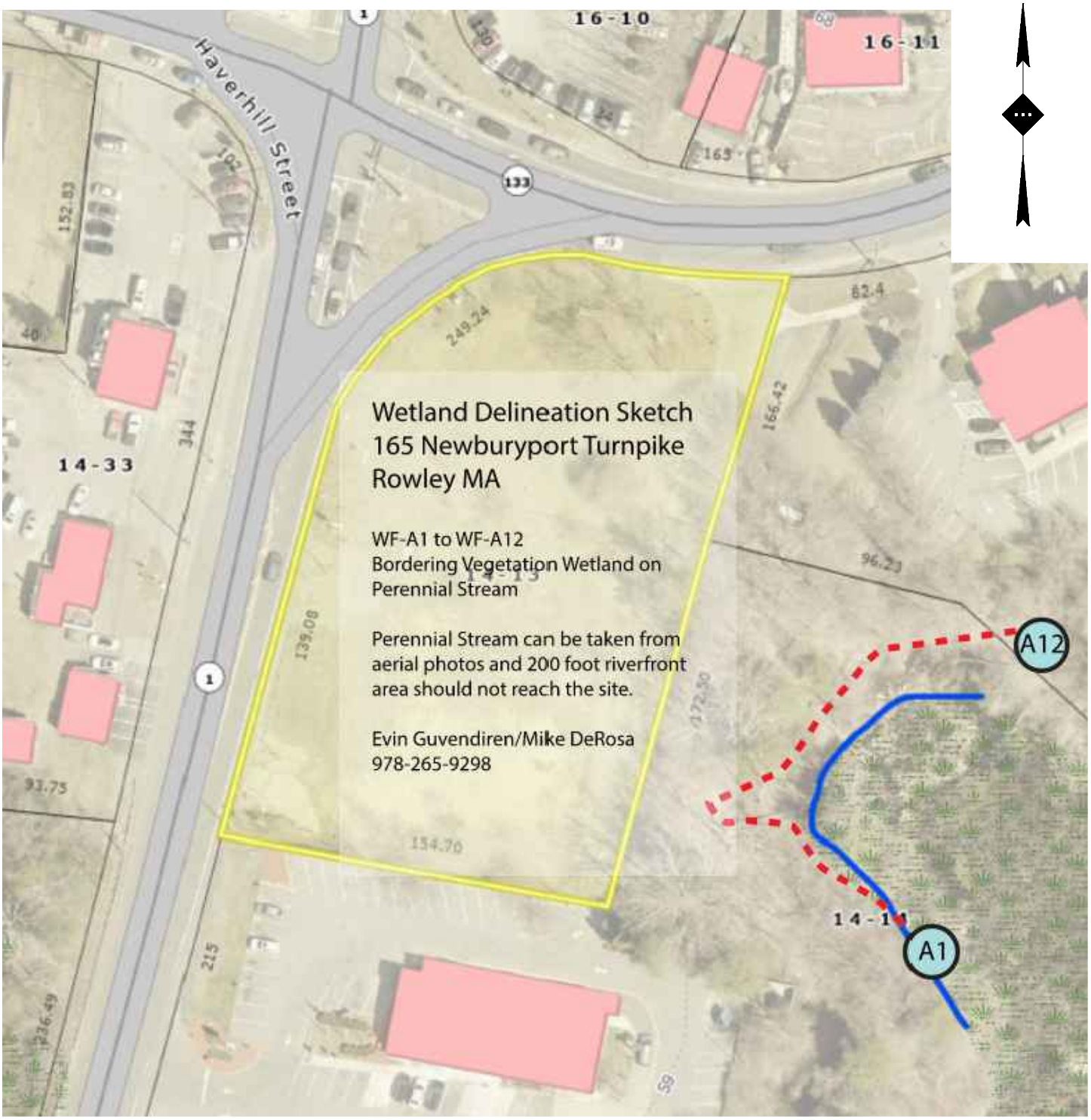


# WETLAND DELINEATION SKETCH

N 0' N E

GRAPHIC SCALE IN FEET

N.T.S.

SOURCE: WETLAND DELINEATION REPORT PREPARED BY DEROSA ENVIRONMENTAL CONSULTING INC. DATED 02/08/2024

CHASE

**PROPOSED BANK WITH DRIVE-THRU ATM**

TAX MAP 14, LOT 13
165 NEWBURYPORT TURNPIKE
TOWN OF ROWLEY
ESSEX COUNTY, MASSACHUSETTS

| | |
|---|---|
| **DRAWN BY:** | JV |
| **CHECKED BY:** | GMC |
| **DATE:** | 02/16/2024 |
| **SCALE:** | N.T.S |
| **PROJECT ID:** | BOS-230034 |


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# Wetland Delineation Report

## 165 Newburyport Turnpike
## Rowley, Massachusetts

Evin Guvendiren/Mike DeRosa

February 8, 2024

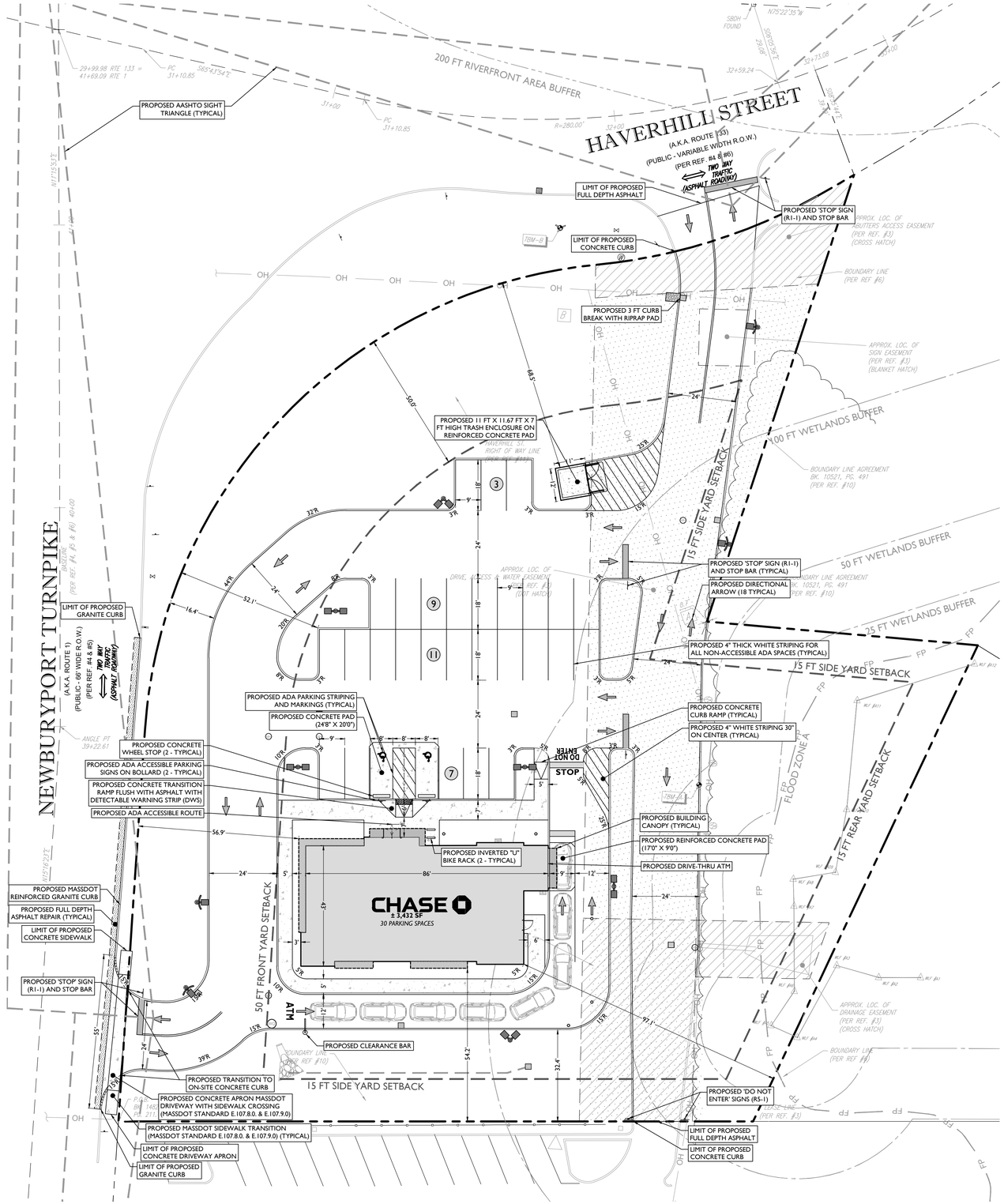
## Findings

Wetland, Delineation of Chase Bank site at 165 Newburyport Turnpike in Rowley, MA. Canopy consisted principally of red maple, white pine, and red oak. Shrub community is dominated by sweet pepperbush, Asiatic bittersweet, poison ivy, glossy buckthorn, honeysuckle, and sapling black cherry. Herbaceous community was sparse given the time of year, but included sensitive fern, cinnamon fern, and cattail.

The area is flooded by a beaver dam blockage at the culverts beneath Haverhill Street between the Institute for Savings building and the entrance to the Market Basket shopping plaza. This dam is routinely removed by the Rowley DPW in their effort to keep it open and flowing beneath Haverhill Street.

WF-A1 to WF-A12

February 8, 2024




## LAND USE AND ZONING

**BLOCK 14, LOT 13**

**RETAIL DISTRICT - FLOODPLAIN DISTRICT - WATER PROTECTION DISTRICT**

| | | | |
|---|---|---|---|
| **PROPOSED USE** | | | |
| BANK | SPECIAL PERMIT * | | |
| DRIVE-THRU FACILITIES | SPECIAL PERMIT | | |
| **ZONING REQUIREMENT** | **REQUIRED** | **EXISTING** | **PROPOSED** |
| MINIMUM LOT AREA | (N/S) | 67,765 SF (1.56 AC) | NO CHANGE |
| MINIMUM LOT FRONTAGE | (N/S) | 485.7 SF | NO CHANGE |
| MINIMUM LOT WIDTH (AT FRONT SETBACK) | 100 FT | 327.7 FT | NO CHANGE |
| MINIMUM LOT WIDTH | 40 FT | 424.1 FT | NO CHANGE |
| MINIMUM LOT PERIMETER | 1,711.2 FT ** | 1,159.1 FT (EN) | NO CHANGE |
| MINIMUM FRONT YARD SETBACK | 50 FT *** | ± 25 FT | 56.9 FT |
| MINIMUM SIDE YARD SETBACK | 15 FT | ± 68.5 FT | 54.2 FT |
| MINIMUM REAR YARD SETBACK | 15 FT | ± 162.0 FT | 97.1 FT |
| MAXIMUM BUILDING LOT COVERAGE | 25% (16,941 SF) | 3.5% (2,380 SF) | 5.1% (3,432 SF) |
| MAXIMUM LOT COVERAGE | 50% (33,882 SF) | 55.8% (37,850 SF ) | 49.7% (33,657 SF) |
| MAXIMUM BUILDING HEIGHT | 35 FT | 1 STORY | 21.5 FT |

(N/S) NOT SPECIFIED
(EN) EXISTING NON-CONFORMITY
* ALL PROPOSED USES IN FLOODPLAIN DISTRICT MUST BE GRANTED SPECIAL PERMIT APPROVAL
** MINIMUM LOT PERIMETER CALCULATED AS FOLLOWS: 1 FT LOT PERIMETER PER 39.6 SF OF LOT AREA
*** FOR BUILDING FACADES 150 FT AND LESS IN LENGTH, FRONT SETBACK = 50 FT

## PARKING REQUIREMENTS

| CODE SECTION | REQUIRED | PROPOSED |
|---|---|---|
| TABLE OF REQUIRED OFF-STREET PARKING SPACES | REQUIRED PARKING SPACES (SERVICE ESTABLISHMENT):<br>ONE SPACE PER 200 SF OF FLOOR AREA (3,432 SF / 200 SF) = 17 SPACES | 30 SPACES |
| § 6.1.3.2.3 (b) | MINIMUM PARKING SETBACK REQUIREMENTS:<br>50 FT FROM STREET LINE | 50 FT |

| SYMBOL | DESCRIPTION |
|---|---|
| | PROPERTY LINE |
| | SETBACK LINE |
| | SAWCUT LINE |
| | PROPOSED CURB |
| | PROPOSED FLUSH OPENING |
| | PROPOSED SIGNS |
| | PROPOSED BUILDING |
| | PROPOSED CONCRETE |
| | PROPOSED AREA LIGHT |
| | PROPOSED BUILDING DOORS |

**GENERAL NOTES**

1. THE CONTRACTOR SHALL VERIFY AND FAMILIARIZE THEMSELVES WITH THE EXISTING SITE CONDITIONS AND THE PROPOSED SCOPE OF WORK (INCLUDING DIMENSIONS, LAYOUT, ETC.) PRIOR TO INITIATING THE IMPROVEMENTS IDENTIFIED WITHIN THESE DOCUMENTS. SHOULD ANY DISCREPANCY BE FOUND BETWEEN THE EXISTING SITE CONDITIONS AND THE PROPOSED WORK THE CONTRACTOR SHALL NOTIFY STONEFIELD ENGINEERING & DESIGN, LLC. PRIOR TO THE START OF CONSTRUCTION.
2. THE CONTRACTOR SHALL OBTAIN ALL NECESSARY PERMITS AND ENSURE THAT ALL REQUIRED APPROVALS HAVE BEEN OBTAINED PRIOR TO THE START OF CONSTRUCTION. COPIES OF ALL REQUIRED PERMITS AND APPROVALS SHALL BE KEPT ON SITE AT ALL TIMES DURING CONSTRUCTION.
3. ALL CONTRACTORS WILL, TO THE FULLEST EXTENT PERMITTED BY LAW, INDEMNIFY AND HOLD HARMLESS STONEFIELD ENGINEERING & DESIGN, LLC. AND IT'S SUB-CONSULTANTS FROM AND AGAINST ANY DAMAGES AND LIABILITIES INCLUDING ATTORNEY'S FEES ARISING OUT OF CLAIMS BY EMPLOYEES OF THE CONTRACTOR IN ADDITION TO CLAIMS CONNECTED TO THE PROJECT AS A RESULT OF NOT CARRYING THE PROPER INSURANCE FOR WORKERS COMPENSATION, LIABILITY INSURANCE, AND LIMITS OF COMMERCIAL GENERAL LIABILITY INSURANCE.
4. THE CONTRACTOR SHALL NOT DEVIATE FROM THE PROPOSED IMPROVEMENTS IDENTIFIED WITHIN THIS PLAN SET UNLESS APPROVAL IS PROVIDED IN WRITING BY STONEFIELD ENGINEERING & DESIGN, LLC.
5. THE CONTRACTOR IS RESPONSIBLE TO DETERMINE THE MEANS AND METHODS OF CONSTRUCTION.
6. THE CONTRACTOR SHALL NOT PERFORM ANY WORK OR CAUSE DISTURBANCE ON A PRIVATE PROPERTY NOT CONTROLLED BY THE PERSON OR ENTITY WHO HAS AUTHORIZED THE WORK WITHOUT PRIOR WRITTEN CONSENT FROM THE OWNER OF THE PRIVATE PROPERTY.
7. THE CONTRACTOR IS RESPONSIBLE TO RESTORE ANY DAMAGED OR UNDERMINED STRUCTURE OR SITE FEATURE THAT IS IDENTIFIED TO REMAIN ON THE PLAN SET. ALL REPAIRS SHALL USE NEW MATERIALS TO RESTORE THE FEATURE TO ITS EXISTING CONDITION AT THE CONTRACTORS EXPENSE.
8. CONTRACTOR IS RESPONSIBLE TO PROVIDE THE APPROPRIATE SHOP DRAWINGS, PRODUCT DATA, AND OTHER REQUIRED SUBMITTALS FOR REVIEW. STONEFIELD ENGINEERING & DESIGN, LLC. WILL REVIEW THE SUBMITTALS IN ACCORDANCE WITH THE DESIGN INTENT AS REFLECTED WITHIN THE PLAN SET.
9. THE CONTRACTOR IS RESPONSIBLE FOR TRAFFIC CONTROL IN ACCORDANCE WITH MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES, LATEST EDITION.
10. THE CONTRACTOR IS REQUIRED TO PERFORM ALL WORK IN THE PUBLIC RIGHT-OF-WAY IN ACCORDANCE WITH THE APPROPRIATE GOVERNING AUTHORITY AND SHALL BE RESPONSIBLE FOR THE PROCUREMENT OF STREET OPENING PERMITS.
11. THE CONTRACTOR IS REQUIRED TO RETAIN AN OSHA CERTIFIED SAFETY INSPECTOR TO BE PRESENT ON SITE AT ALL TIMES DURING CONSTRUCTION & DEMOLITION ACTIVITIES.
12. SHOULD AN EMPLOYEE OF STONEFIELD ENGINEERING & DESIGN, LLC. BE PRESENT ON SITE AT ANY TIME DURING CONSTRUCTION, IT DOES NOT RELIEVE THE CONTRACTOR OF ANY OF THE RESPONSIBILITIES AND REQUIREMENTS LISTED IN THE NOTES WITHIN THIS PLAN SET.

20' 0' 20' 40'
GRAPHIC SCALE IN FEET
1" = 20'

| ISSUE | DATE | BY | DESCRIPTION |
|---|---|---|---|
| 01 | 03/08/2024 | JV | MUNICIPAL SUBMISSION - SITE PLAN REVIEW |

NOT APPROVED FOR CONSTRUCTION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SITE PLAN

# CHASE
## PROPOSED BANK WITH DRIVE-THRU ATM

MAP: 14 LOT: 13
145 NEWBURYPORT TURNPIKE (US ROUTE 1)
TOWN OF ROWLEY
ESSEX COUNTY, MASSACHUSETTS


JOSHUA H. KLINE, P.E.
MASSACHUSETTS LICENSE No. 53936
LICENSED PROFESSIONAL ENGINEER


STONEFIELD engineering & design

SCALE: 1" = 20' | PROJECT ID: BOS-230034

TITLE: SITE PLAN

DRAWING: C-4

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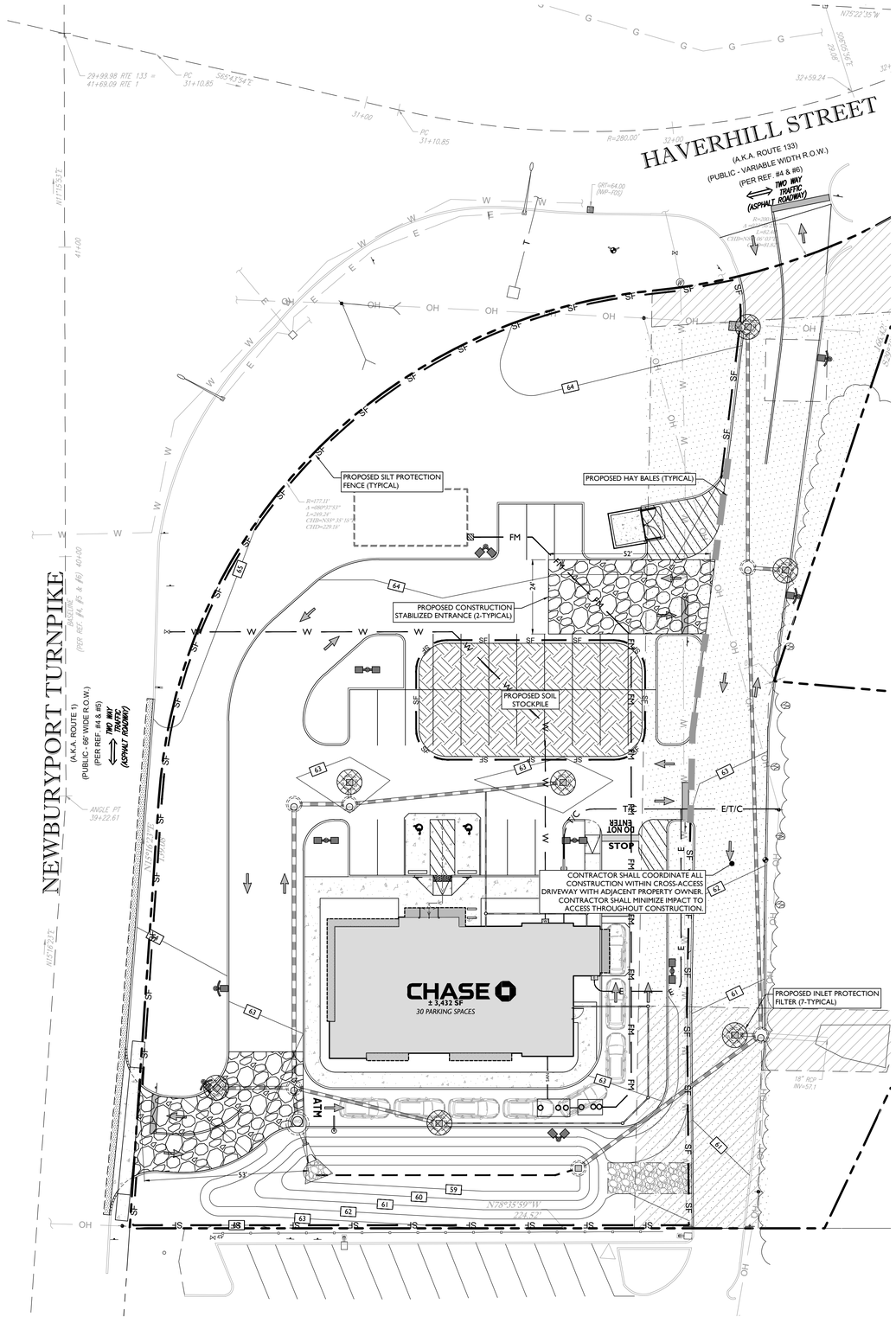
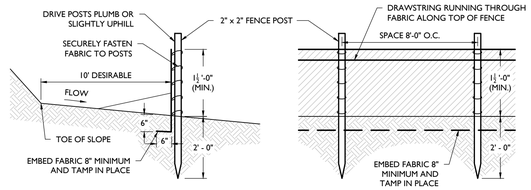
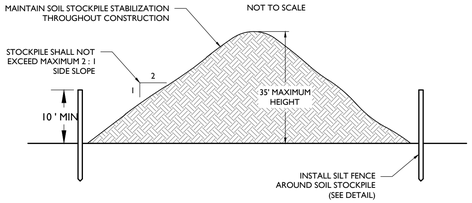



NOTES:
1. SECURELY FASTEN GEOTEXTILE TO FENCE POST BY USE OF WIRE TIES, HOG RINGS, STAPLES OR POCKETS. FOUR TO SIX FASTENERS PER POST.
2. GEOTEXTILE FABRIC TO BE EMBEDDED 8" (MIN.) AND TAMP IN PLACE.
3. SECURELY FASTEN ENDS OF INDIVIDUAL ROLLS OF GEOTEXTILE TO A POST BY WRAPPING EACH END OF THE GEOTEXTILE AROUND THE POST TWICE AND ATTACHING AS SPECIFIED IN NOTE 1 ABOVE. SPLICING OF INDIVIDUAL ROLLS SHALL NOT OCCUR AT LOW POINTS.
4. SET SILT FENCE WITHIN PROJECT LIMITS. 10'-0" IS DESIRABLE.

## SILT FENCE DETAIL

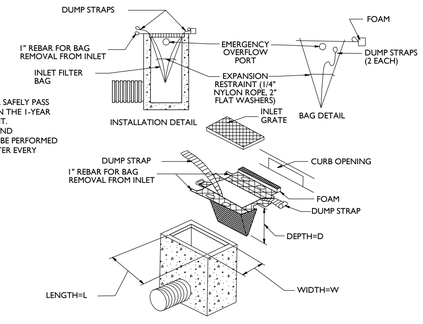
NOT TO SCALE




NOTES:
1. LOCATE THE TOPSOIL STOCKPILE SO THAT IT DOES NOT INTERFERE WITH WORK ON THE SITE.
2. SURROUND ALL TOPSOIL STOCKPILES WITH AN INTERCEPTOR DIKE WITH GRAVEL OUTLET AND SILT FENCE.
3. EITHER SEED OR COVER STOCKPILES WITH CLEAR PLASTIC OR OTHER MULCHING MATERIALS WITHIN 7 DAYS OF THE FORMATION OF THE STOCKPILE.

## SOIL STOCKPILE DETAIL

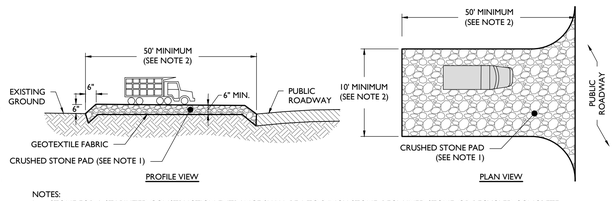
NOT TO SCALE




NOTES:
1. THE FILTER BAG SHALL SAFELY PASS FLOWS GREATER THAN THE 1-YEAR 24-HOUR STORM EVENT.
2. SEDIMENT REMOVAL AND MAINTENANCE SHALL BE PERFORMED FREQUENTLY AND AFTER EVERY STORM EVENT.

## INLET FILTER BAG DETAIL

NOT TO SCALE




NOTES:
1. STONE FOR A STABILIZED CONSTRUCTION ENTRANCE SHALL BE 1 TO 3-INCH STONE, RECLAIMED STONE, OR RECYCLED CONCRETE EQUIVALENT PLACED ON A STABLE FOUNDATION AS SPECIFIED IN THE PLAN.
2. THE MINIMUM LENGTH OF THE GRAVEL PAD SHALL BE 50 FEET, EXCEPT FOR A SINGLE RESIDENTIAL LOT WHERE A 30 FOOT MINIMUM LENGTH MAY BE USED. THE WIDTH SHALL BE 10' MINIMUM OR THE FULL WIDTH OF THE ACCESS POINT, WHICHEVER IS GREATER.
3. GEOTEXTILE FILTER FABRIC SHALL BE PLACED BETWEEN THE STONE FILL AND THE EARTH SURFACE BELOW THE PAD TO REDUCE THE MIGRATION OF SOIL PARTICLES FROM THE UNDERLYING SOIL INTO THE STONE AND VICE VERSA. FILTER CLOTH IS NOT REQUIRED FOR A SINGLE FAMILY RESIDENCE LOT.
4. IF THE SLOPE TOWARD THE ROAD EXCEEDS 2%, CONSTRUCT A RIDGE, 6 TO 8 INCHES HIGH WITH 3:1 SIDE SLOPES, ACROSS THE FOUNDATION APPROXIMATELY 15 FEET FROM THE ENTRANCE TO DIVERT RUNOFF AWAY FROM THE PUBLIC ROAD.
5. ALL SURFACE WATER THAT IS FLOWING TO OR DIVERTED TOWARD THE CONSTRUCTION ENTRANCE SHOULD BE PIPED BENEATH THE ENTRANCE. IF PIPING IS IMPRACTICAL, A BERM WITH 5:1 SLOPES THAT CAN BE CROSSED BY VEHICLES MAY BE SUBSTITUTED FOR THE PIPE.
6. WASHING: IF THE SITE CONDITIONS ARE SUCH THAT THE MAJORITY OF MUD IS NOT REMOVED FROM THE VEHICLE TIRES BY THE GRAVEL PAD, THEN THE TIRES SHOULD BE WASHED BEFORE THE VEHICLE ENTERS THE ROAD OR STREET. THE WASH AREA SHOULD BE A LEVEL AREA WITH 3-INCH WASHED STONE MINIMUM, OR A COMMERCIAL RACK. WASH WATER SHOULD BE DIRECTED INTO A SEDIMENT TRAP, A VEGETATED FILTER STRIP, OR OTHER APPROVED SEDIMENT TRAPPING DEVICE. SEDIMENT SHOULD BE PREVENTED FROM ENTERING ANY WATERCOURSES.
7. A FILTER FABRIC FENCE SHOULD BE INSTALLED DOWN-GRADIENT FROM THE CONSTRUCTION ENTRANCE IN ORDER TO CONTAIN ANY SEDIMENT-LADEN RUNOFF FROM THE ENTRANCE.

## STABILIZED CONSTRUCTION ACCESS DETAIL

NOT TO SCALE

811 Know what's **below** **Call** before you dig.

| SYMBOL | DESCRIPTION |
|---|---|
| | PROPERTY BOUNDARY |
| | ADJACENT PROPERTY BOUNDARY |
| LOD | PROPOSED LIMIT OF DISTURBANCE |
| SF | PROPOSED SILT FENCE |
| | PROPOSED STOCKPILE & EQUIPMENT STORAGE |
| | PROPOSED STABILIZED CONSTRUCTION ENTRANCE |
| | PROPOSED INLET PROTECTION FILTER |

**SOIL EROSION AND SEDIMENT CONTROL NOTES**

1. THE CONTRACTOR IS RESPONSIBLE FOR SOIL EROSION AND SEDIMENT CONTROL IN ACCORDANCE WITH LOCAL, STATE, AND FEDERAL REQUIREMENTS.
2. THE CONTRACTOR IS RESPONSIBLE FOR DUST CONTROL IN COMPLIANCE WITH LOCAL, STATE, AND FEDERAL AIR QUALITY STANDARDS.
3. THE CONTRACTOR IS RESPONSIBLE TO INSPECT ALL SOIL EROSION AND SEDIMENT CONTROL MEASURES WEEKLY AND AFTER A PRECIPITATION EVENT GREATER THAN 1 INCH. THE CONTRACTOR SHALL MAINTAIN AN INSPECTION LOG ON SITE AND DOCUMENT CORRECTIVE ACTION TAKEN THROUGHOUT THE COURSE OF CONSTRUCTION AS REQUIRED.

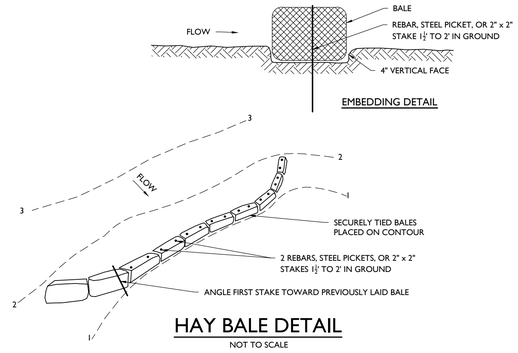
**SOIL CHARACTERISTICS CHART**

| | |
|---|---|
| TYPE OF SOIL | WINDSOR LOAMY SAND, 3 TO 8% SLOPES |
| PERCENT OF SITE COVERAGE | 100.0% |
| HYDROLOGIC SOIL GROUP | A |
| DEPTH TO RESTRICTIVE LAYER | > 80 INCHES |
| SOIL PERMEABILITY | 1.42 TO 99.90 IN/HR |
| DEPTH TO WATER TABLE | > 80 INCHES |

**SEQUENCE OF CONSTRUCTION**

1. INSTALL CONSTRUCTION ENTRANCE AND SILT FENCE (2 DAYS).
2. DEMOLISH EXISTING PAVEMENT WHERE APPLICABLE (7 DAYS)
3. ROUGH GRADING AND TEMPORARY SEEDING (21 DAYS)
4. BASIN CONSTRUCTION INCLUDING STABILIZATION (14 DAYS)
5. BUILDING CONSTRUCTION AND SITE IMPROVEMENTS (100 DAYS)
6. INSTALL CURBSIDE SEDIMENT BARRIERS. (1 DAY)
7. SOIL RESTORATION MEASURES (3 DAYS)
8. LANDSCAPING IMPROVEMENTS AND FINAL SEEDING & TOP SOILING (7 DAYS)
9. REMOVE SOIL EROSION MEASURES (1 DAY)

NOTE: TIME DURATIONS ARE APPROXIMATE AND ARE INTENDED TO ACT AS A GENERAL GUIDE TO THE CONSTRUCTION TIMELINE. ALL DURATIONS ARE SUBJECT TO CHANGE BY CONTRACTOR. CONTRACTOR SHALL SUBMIT CONSTRUCTION SCHEDULE TO THE TOWN AND ENGINEER. CONTRACTOR SHALL PHASE CONSTRUCTION ACCORDINGLY.




## HAY BALE DETAIL

NOT TO SCALE

20' 0' 20' 40'
GRAPHIC SCALE IN FEET
1" = 20'

| ISSUE | DATE | BY | DESCRIPTION |
|---|---|---|---|
| 01 | 03/08/2024 | JV | MUNICIPAL SUBMISSION - SITE PLAN REVIEW |

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STONEFIELD engineering & design
Rutherford, NJ · New York, NY · Salem, MA
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www.stonefieldeng.com
120 Washington Street, Suite 201, Salem, MA 01970
Phone 617.203.2076

SITE PLAN

CHASE

PROPOSED BANK WITH DRIVE-THRU ATM

MAP: 14 LOT: 13
165 NEWBURYPORT TURNPIKE (US ROUTE 1)
TOWN OF ROWLEY
ESSEX COUNTY, MASSACHUSETTS

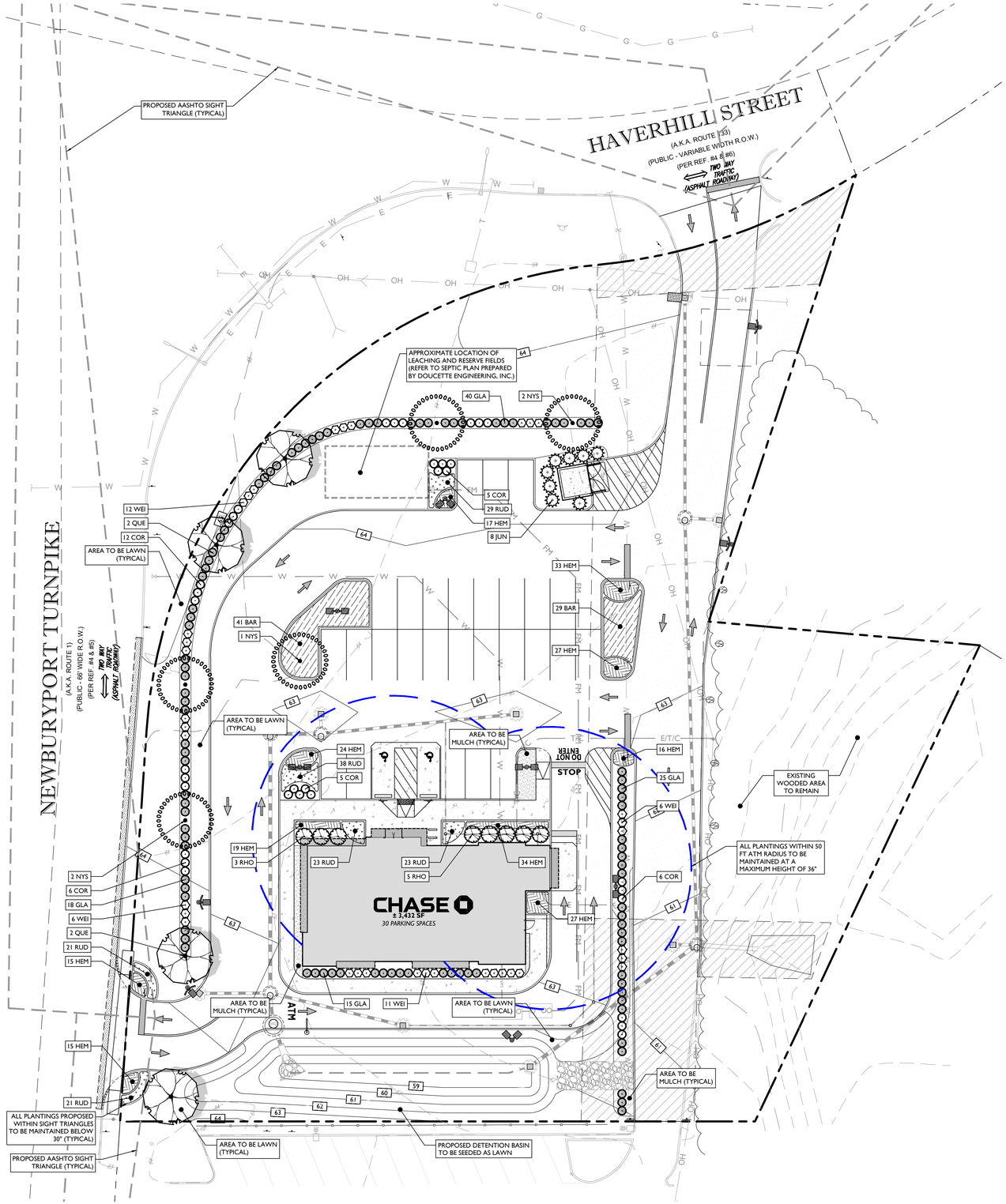
JOSHUA H. KLINE, P.E.
MASSACHUSETTS LICENSE No. 53936
LICENSED PROFESSIONAL ENGINEER

STONEFIELD engineering & design

SCALE: 1" = 20' | PROJECT ID: BOS-230034

TITLE:
**SOIL EROSION & SEDIMENT CONTROL PLAN**

DRAWING:
**C-8**




## PLANT SCHEDULE

| SYMBOL | CODE | QTY | BOTANICAL NAME | COMMON NAME | SIZE | CONTAINER | REMARKS |
|---|---|---|---|---|---|---|---|
| | | | DECIDUOUS TREES | | | | |
| | NYS | 5 | NYSSA SYLVATICA | TUPELO | 2.5" - 3" CAL | B&B | NATIVE, SALT TOLERANT |
| | QUE | 4 | QUERCUS RUBRA | NORTHERN RED OAK | 2.5" - 3" CAL | B&B | NATIVE, SALT TOLERANT |
| | | | EVERGREEN TREES | | | | |
| | JUN | 9 | JUNIPERUS VIRGINIANA 'J.N. SELECT GREEN' | EMERALD FEATHER EASTERN REDCEDAR | 6' - 7' HT | B&B | NATIVE, SALT TOLERANT |
| | | | SHRUBS | | | | |
| | COR | 34 | CORNUS STOLONIFERA 'FARROW' | ARCTIC FIRE RED TWIG DOGWOOD | 18" - 24" | POT | NATIVE |
| | WEI | 45 | WEIGELA FLORIDA 'BRAMWELL' | FINE WINE WEIGELA | 18" - 24" | POT | HARDY, TOLERANT OF CLIMATIC CONDITIONS, ATTRACTS WILDLIFE |
| | | | EVERGREEN SHRUBS | | | | |
| | GLA | 97 | ILEX GLABRA 'COMPACTA' | COMPACT INKBERRY | 18" - 24" | POT | NATIVE, DROUGHT TOLERANT, SALT TOLERANT |
| | RHO | 8 | RHODODENDRON X 'P.J.M. ELITE' | P.J.M. ELITE RHODODENDRON | 18" - 24" | POT | HARDY, TOLERANT OF CLIMATIC CONDITIONS, ATTRACTS WILDLIFE |
| | | | GROUND COVERS | | | | |
| | BAR | 70 | JUNIPERUS HORIZONTALIS 'BAR HARBOR' | BAR HARBOR CREEPING JUNIPER | 1 GAL. | POT (36" O.C.) | NATIVE, DROUGHT TOLERANT |
| | | | PERENNIALS AND GRASSES | | | | |
| | HEM | 242 | HEMEROCALLIS X 'STELLA DE ORO' | STELLA DE ORO DAYLILY | 1 GAL. | POT (18" O.C.) | HARDY, TOLERANT OF CLIMATIC CONDITIONS, ATTRACTS WILDLIFE |
| | RUD | 113 | RUDBECKIA HIRTA | BLACK-EYED SUSAN | 1 GAL. | POT (18" O.C.) | NATIVE, ATTRACTS INSECTS & POLLINATORS |

NOTE: IF ANY DISCREPANCIES OCCUR BETWEEN AMOUNTS SHOWN ON THE LANDSCAPE PLAN AND WITHIN THE PLANT LIST, THE PLAN SHALL DICTATE.

811

Know what's **below**
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**IRRIGATION NOTE:**

IRRIGATION CONTRACTOR TO PROVIDE A DESIGN FOR AN IRRIGATION SYSTEM SEPARATING PLANTING BEDS FROM LAWN AREA. PRIOR TO CONSTRUCTION, DESIGN IS TO BE SUBMITTED TO THE PROJECT LANDSCAPE DESIGNER FOR REVIEW AND APPROVAL. WHERE POSSIBLE, DRIP IRRIGATION AND OTHER WATER CONSERVATION TECHNIQUES SUCH AS RAIN SENSORS SHALL BE IMPLEMENTED. CONTRACTOR TO VERIFY MAXIMUM ON SITE DYNAMIC WATER PRESSURE AVAILABLE MEASURED IN PSI. PRESSURE REDUCING DEVICES OR BOOSTER PUMPS SHALL BE PROVIDED TO MEET SYSTEM PRESSURE REQUIREMENTS. DESIGN TO SHOW ALL VALVES, PIPING, HEADS, BACKFLOW PREVENTION, METERS, CONTROLLERS, AND SLEEVES WITHIN HARDSCAPE AREAS.

**LANDSCAPING NOTES**

1. THE CONTRACTOR SHALL RESTORE ALL DISTURBED GRASS AND LANDSCAPED AREAS TO MATCH EXISTING CONDITIONS UNLESS INDICATED OTHERWISE WITHIN THE PLAN SET.
2. THE CONTRACTOR SHALL RESTORE ALL DISTURBED LAWN AREAS WITH A MINIMUM 4 INCH LAYER OF TOPSOIL AND SEED.
3. THE CONTRACTOR SHALL RESTORE MULCH AREAS WITH A MINIMUM 3 INCH LAYER OF MULCH .
4. THE MAXIMUM SLOPE ALLOWABLE IN LANDSCAPE RESTORATION AREAS SHALL BE 3 FEET HORIZONTAL TO 1 FOOT VERTICAL (3:1 SLOPE) UNLESS INDICATED OTHERWISE WITHIN THE PLAN SET.
5. THE CONTRACTOR IS REQUIRED TO LOCATE ALL SPRINKLER HEADS IN AREA OF LANDSCAPING DISTURBANCE PRIOR TO CONSTRUCTION. THE CONTRACTOR SHALL RELOCATE SPRINKLER HEADS AND LINES IN ACCORDANCE WITH OWNER'S DIRECTION WITHIN AREAS OF DISTURBANCE.
6. THE CONTRACTOR SHALL ENSURE THAT ALL DISTURBED LANDSCAPED AREAS ARE GRADED TO MEET FLUSH AT THE ELEVATION OF WALKWAYS AND TOP OF CURB ELEVATIONS EXCEPT UNLESS INDICATED OTHERWISE WITHIN THE PLAN SET. NO ABRUPT CHANGES IN GRADE ARE PERMITTED IN DISTURBED LANDSCAPING AREAS.

20' 0' 20' 40'
GRAPHIC SCALE IN FEET
1" = 20'

| ISSUE | DATE | BY | DESCRIPTION |
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SITE PLAN

CHASE
PROPOSED BANK WITH DRIVE-THRU ATM

MAP: 14 LOT: 13
165 NEWBURYPORT TURNPIKE (US ROUTE 1)
TOWN OF ROWLEY
ESSEX COUNTY, MASSACHUSETTS


JOSHUA H. KLINE, P.E.
MASSACHUSETTS LICENSE No. 53936
LICENSED PROFESSIONAL ENGINEER


STONEFIELD engineering & design

SCALE: 1" = 20' | PROJECT ID: BOS-230034

TITLE:
LANDSCAPING PLAN

DRAWING:
C-9

Z:\BOSTON\BOS2023\BOS-230034 CORE STATES - 165 NEWBURYPORT TURNPIKE, ROWLEY, MA\CAD\DWG\TOP\SDP-PLANS.DWG

# APPENDIX B
# PROJECT SOILS

## INVENTORY

**B-1: NRCS SOILS REPORT**

**B-2: WHITESTONE GEOTECHNICAL 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


February 6, 2024

# Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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# Contents

# Custom Soil Resource Report
## Soil Map


Map Scale: 1:848 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 10 20 40 60

Feet
0 40 80 160 240

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

# Map Unit Legend

| Map Unit Symbol | Map Unit Name | Acres in AOI | Percent of AOI |
|---|---|---|---|
| 255B | Windsor loamy sand, 3 to 8 percent slopes | 1.5 | 100.0% |
| **Totals for Area of Interest** | | **1.5** | **100.0%** |

# Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

# Essex County, Massachusetts, Northern Part

## 255B—Windsor loamy sand, 3 to 8 percent slopes

### Map Unit Setting

*National map unit symbol:* 2svkf
*Elevation:* 0 to 1,210 feet
*Mean annual precipitation:* 36 to 71 inches
*Mean annual air temperature:* 39 to 55 degrees F
*Frost-free period:* 140 to 250 days
*Farmland classification:* Farmland of statewide importance

### Map Unit Composition

*Windsor and similar soils:* 85 percent
*Minor components:* 15 percent
*Estimates are based on observations, descriptions, and transects of the mapunit.*

### Description of Windsor

#### Setting

*Landform:* Outwash terraces
*Landform position (three-dimensional):* Tread
*Down-slope shape:* Linear
*Across-slope shape:* Linear
*Parent material:* Loose sandy glaciofluvial deposits derived from granite and/or schist and/or gneiss

#### Typical profile

*Oe - 0 to 1 inches:* moderately decomposed plant material
*A - 1 to 3 inches:* loamy sand
*Bw - 3 to 25 inches:* loamy sand
*C - 25 to 65 inches:* sand

#### Properties and qualities

*Slope:* 3 to 8 percent
*Depth to restrictive feature:* More than 80 inches
*Drainage class:* Excessively drained
*Runoff class:* Negligible
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately high to very high (1.42 to 99.90 in/hr)
*Depth to water table:* More than 80 inches
*Frequency of flooding:* None
*Frequency of ponding:* None
*Maximum salinity:* Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
*Available water supply, 0 to 60 inches:* Low (about 4.5 inches)

#### Interpretive groups

*Land capability classification (irrigated):* None specified
*Land capability classification (nonirrigated):* 2s
*Hydrologic Soil Group:* A
*Ecological site:* F145XY008MA - Dry Outwash
*Hydric soil rating:* No

### Minor Components

#### Hinckley

*Percent of map unit:* 10 percent
*Landform:* Eskers
*Landform position (three-dimensional):* Side slope
*Down-slope shape:* Convex
*Across-slope shape:* Convex
*Ecological site:* F145XY008MA - Dry Outwash
*Hydric soil rating:* No

#### Deerfield, loamy sand

*Percent of map unit:* 5 percent
*Landform:* Terraces
*Landform position (three-dimensional):* Tread
*Down-slope shape:* Linear
*Across-slope shape:* Linear
*Ecological site:* F144AY027MA - Moist Sandy Outwash
*Hydric soil rating:* No

# Custom Soil Resource Report
## Map—Hydrologic Soil Group


Map Scale: 1:848 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 10 20 40 60

Feet: 0 40 80 160 240

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 19, Sep 10, 2023

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

Date(s) aerial images were photographed: May 22, 2022—Jun 5, 2022

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 |
|---|---|---|---|---|
| 255B | Windsor loamy sand, 3 to 8 percent slopes | A | 1.5 | 100.0% |
| **Totals for Area of Interest** | | | **1.5** | **100.0%** |

## Rating Options—Hydrologic Soil Group

*Aggregation Method:* Dominant Condition

*Component Percent Cutoff: None Specified*

*Tie-break Rule:* Higher

# References

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WHITESTONE
An Employee-Owned Company

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# REPORT OF GEOTECHNICAL INVESTIGATION

## PROPOSED CHASE BANK BRANCH
## 165 NEWBURYPORT TURNPIKE
## MAP 14, LOT 13
## ROWLEY, ESSEX COUNTY, MASSACHUSETTS

***Prepared for:***

**STONEFIELD ENGINEERING & DESIGN, LLC**
**120 Washington Street**
**Suite 201**
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***Prepared by:***

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**Richard W.M. McLaren, P.E.**
**Senior Consultant**

**Ryan R. Roy, P.E.**
**Vice President**

**Whitestone Project No.: GM2321010.000**
**November 16, 2023**

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November 16, 2023

*via email*

**STONEFIELD ENGINEERING & DESIGN, LLC**
120 Washington Street
Suite 201
Salem, Massachusetts 01970

Attention: Joshua H. Kline, P.E.
Team Lead

**Regarding: GEOTECHNICAL INVESTIGATION**
**PROPOSED CHASE BANK BRANCH**
**165 NEWBURYPORT TURNPIKE**
**MAP 14, LOT 13**
**ROWLEY, ESSEX COUNTY, MASSACHUSETTS**
**WHITESTONE PROJECT NO.: GM2321010.000**

Dear Mr. Kline:

Whitestone Associates, Inc. (Whitestone) is pleased to submit the attached *Report of Geotechnical Investigation* for the above-referenced project. The report presents the results of Whitestone's site visit and subsurface exploration, and includes design recommendations for the proposed foundations, floor slab, pavements, and related earthwork associated with the proposed Chase Bank branch.

Whitestone appreciates the opportunity to be of continued service to Stonefield Engineering & Design, LLC. Should you have questions regarding the attached report, please contact us at (508) 485-0755.

Sincerely,

**WHITESTONE ASSOCIATES, INC.**

Richard W.M. McLaren, P.E.
Senior Consultant

Ryan R. Roy, P.E.
Vice President

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Enclosures

# REPORT OF
# GEOTECHNICAL INVESTIGATION
## Proposed Chase Bank Branch
## 165 Newburyport Turnpike
## Rowley, Essex County, Massachusetts

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# REPORT OF
# GEOTECHNICAL INVESTIGATION
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## FIGURES



## APPENDICES

# SECTION 1.0
# Summary of Findings

Whitestone Associates, Inc. (Whitestone) has conducted an exploration and evaluation of the subsurface conditions at the site of the proposed Chase Bank branch to be located at 165 Newburyport Turnpike in Rowley, Essex County, Massachusetts. Based on a July 11, 2023 *Site Plan* provided by Stonefield Engineering & Design, LLC (Stonefield) of Salem, Massachusetts, the proposed development will include construction of a single-story Chase Bank building with a footprint of approximately 3,400-square feet, a drive-up ATM, and associated pavements, landscaping, and utilities. No new stormwater management facilities or retaining walls are proposed at this time.

The geotechnical investigation included conducting a reconnaissance of the project site, advancing seven borings, and collecting soil samples for physical characterization and laboratory testing. Site subsurface conditions generally consisted of topsoil overlying a significant thickness of existing fill, which is underlain by a glaciofluvial deposit. Groundwater was encountered in the borings at depths of eight feet below ground surface (fbgs) to 10 fbgs.

The significant depth of existing fill (up to 22 feet) would require extensive overexcavation, including below the relatively shallow groundwater table, and replacement with structural fill to ground support the proposed building. Whitestone, therefore recommends that consideration be given to supporting the building on the existing fill improved in place by rammed aggregate piers (RAPs). A RAP is a stiff and densified inclusion of rammed crushed aggregate, which is typically installed by driving a mandrel through the unsuitable soils and injecting thin lifts of aggregate through the mandrel, which then densifies the aggregate. The stiff aggregate pier and lateral stress increase in the matrix soil improves the composite soil strength, providing suitable material for foundation support. Whitestone preliminarily anticipates the RAPs would extend up to approximately 20 fbgs to 25 fbgs. Following installation of the RAPs, the building would be supported on conventional shallow foundations deriving support from the improved existing fill or structural fill placed on the improved existing fill. The subgrade should be reviewed by the geotechnical engineer, as specified in this report. A ground-supported floor slab would also derive support from the existing fill improved with RAPs. Additionally, the site conditions support the use of typical pavement sections using standard Commonwealth of Massachusetts Department of Transportation (MassDOT) specified materials, with the possible risk of increased maintenance where organic materials underlie paved areas.

The above summary is intended to provide an overview of the geotechnical findings and recommendations and is not fully developed. Greater detail is presented in the following sections. The entire report must be read for comprehensive understanding of the information contained herein.

# SECTION 2.0
# Introduction

## 2.1 AUTHORIZATION

Joshua H. Kline, P.E., Team Lead at Stonefield, issued authorization to Whitestone to conduct a geotechnical investigation on this site relevant to the construction of a proposed Chase Bank branch located at 165 Newburyport Turnpike, Rowley, Essex County, Massachusetts. The geotechnical investigation was conducted in general accordance with Whitestone's September 27, 2023 proposal to Stonefield.

## 2.2 PURPOSE

The purpose of this exploration and analysis was to:

- ascertain the various soil profile components at test locations;
- estimate the engineering characteristics of the proposed foundation bearing and subgrade materials;
- provide geotechnical criteria for use by the design engineers in preparing the foundation, floor slab, and pavement design;
- provide recommendations for required earthwork and subgrade preparation;
- record groundwater and/or bedrock levels (if encountered) at the time of the investigation and discuss their potential impact on the proposed construction; and
- recommend additional investigation and/or analysis, if warranted.

## 2.3 SCOPE

The scope of the exploration and analysis included the subsurface exploration, field testing and sampling, laboratory testing, and a geotechnical engineering analysis and evaluation of the subsurface materials. This *Report of Geotechnical Investigation* is limited to addressing the site conditions related to the physical support of the proposed construction.

### 2.3.1 Field Exploration

Field exploration of the project site was conducted by means of seven borings, identified as B-1 through B-7, advanced with a rubber track-mounted CME 55LT drill rig. The borings were advanced to termination depths that ranged from nine fbgs to 27 fbgs. The explorations were backfilled with excavated materials generated from the investigation. Test locations are shown on the *Boring Location Plan* included as Figure 1. The boring *Records of Subsurface Exploration* are provided in Appendix A.

Test locations were based on project information provided to Whitestone at the time of the investigation, including the *Site Plan* provided by Stonefield. The subsurface tests were conducted in the presence of a Whitestone representative, who conducted field tests, recorded visual classifications, and collected samples of the various strata encountered. Test locations were established in the field using normal taping procedures and estimated right angles. These locations are presumed to be approximate.

Borings and Standard Penetration Tests (SPTs) were conducted in general accordance with ASTM International (ASTM) designation D1586. The Standard Penetration Resistance value (N) can be used as an indicator of the consistency of fine-grained soils and the relative density of coarse-grained soils. The N-value for various soil types can be correlated with the engineering behavior of earthworks and foundations.

Groundwater level observations, where encountered, were recorded during and immediately after the completion of field operations prior to backfilling test locations. Seasonal variations, temperature effects, and recent rainfall conditions may influence the levels of the groundwater and observed levels will depend on the permeability of the soils. Groundwater elevations derived from sources other than seasonally observed groundwater monitoring wells may not be representative of true groundwater levels.

### 2.3.2 Laboratory Testing

Laboratory testing was conducted to determine additional, pertinent engineering characteristics of representative samples of on-site soils. The laboratory testing was conducted in general accordance with applicable ASTM standard test methods and included physical testing of the existing fill.

**Physical/Textural Analysis:** Two representative samples of the site soils were subjected to laboratory testing that included moisture content determination (ASTM D2216) and washed gradation analyses (ASTM D422) in order to conduct supplementary engineering soil classifications and to assess possible re-use of the site soils as structural fill. The results of the laboratory testing are summarized in the following table:

| LABORATORY TESTING SUMMARY | | | | | |
|---|---|---|---|---|---|
| **Boring** | **Sample Number** | **Depth (fbgs)** | **Moisture Content (%)** | **Passing No. 200 Sieve (%)** | **USCS Classification** |
| B-1 | S-2 | 2.0 - 4.0 | 24.1 | 15.1 | FILL (SM) |
| B-5 | S-3 | 5.0 - 7.0 | 4.9 | 9.9 | FILL (SW-SM) |

The engineering classifications are useful when considered in conjunction with the additional site data to estimate properties of the soil types encountered and to predict soil behavior under construction and service loads. Laboratory test results are provided in Appendix B.

# SECTION 3.0
# Site Description

## 3.1 LOCATION AND DESCRIPTION

The subject site is located at 165 Newburyport Turnpike in Rowley, Essex County, Massachusetts, Latitude 42.7043 North, Longitude 70.9091 West. The site is a vacant, 1.56-acre parcel that is further identified as Map 14, Lot 13.

The irregularly shaped site is bounded to the west by Newburyport Turnpike; to the north by Haverhill Street; to the east by undeveloped, wooded land and wet lands, then Bachelder Brook; and to the south by a McDonald's restaurant. Access to the site will be from Newburyport Turnpike and Haverhill Street. The site of the proposed construction is shown on the *Boring Location Plan* included as Figure 1.

## 3.2 EXISTING CONDITIONS

**Existing Development:** At the time of Whitestone's investigation, the site was vacant and partially paved. The site was previously developed with a commercial building within the southern portion of the site. The building was demolished around 2015.

**Topography:** Based on a review of the *USGS 7.5 Minute Series Georgetown Quadrangle, Massachusetts* (2021) and a July 12, 2023 *Boundary, Topographic & Utility Survey* by Control Point Associates, Inc. of Southborough Massachusetts, and on Whitestone's visual observations, the site slopes down slightly to the southeast from approximately 65 feet above National American Vertical Datum of 1988 (NAVD) to 62 feet above NAVD.

**Utilities:** Any utilities servicing the site would have been disconnected when the previous building was demolished. The utility information contained in this report is presented for general discussion only and is not intended for construction purposes.

**Site Drainage:** Surface run-off will generally flow to the southeast, toward the adjacent wooded area near Bachelder Brook.

## 3.3 SITE GEOLOGY

Based on a review of the U.S. Geological Survey *Surficial Materials Map of the Georgetown Quadrangle (2018),* the site is underlain by coarse glacial stratified (glaciofluvial) deposits. The *Geologic Map of Massachusetts*, prepared by U.S. Geological Survey, indicates that the subject property is underlain, at depth, by the Lower Devonian and Upper Silurian-age Newbury Volcanic Complex - Upper Members, consisting of mudstone and siltstone, part of the Milford-Dedham Zone.

## 3.4 PROPOSED CONSTRUCTION

Based on the aforementioned *Site Plan* provided by Stonefield, the proposed development will include construction of a single-story Chase Bank building with a footprint of approximately 3,400-square feet, a drive-up ATM, and associated pavements, landscaping, and utilities. Site grades are not anticipated to change significantly as the current site elevation matches the adjacent roadways. No new stormwater management facilities or retaining walls are proposed at this time.

Whitestone anticipates the proposed building will be a single-story, masonry and metal-framed structure constructed with a ground-supported concrete floor slab and no basement. Maximum column and wall loads are expected to be on the order of:

- interior column loads - 60.0 kips;
- load bearing walls - 2.0 kips per linear foot; and
- floor slab loads - 125 pounds per square foot.

The scope of Whitestone's investigation and the professional advice contained in this report were generated based on the project details and loading noted herein. Revisions or additions to the design details enumerated in this report should be brought to the attention of Whitestone for additional evaluation as warranted.

# SECTION 4.0
# Subsurface Conditions

Details of the subsurface materials encountered in the borings are presented on the *Records of Subsurface Exploration* in Appendix A of this report. The subsurface conditions encountered in the test locations consisted of the following generalized strata in order of increasing depth.

## 4.1 SUBSURFACE SOIL CONDITIONS

**Surface Cover Materials:** The borings encountered 1.5 inches to seven inches of topsoil at the ground surface. A portion of the site on the western side is paved.

**Existing Fill:** Beneath the surface cover materials, the borings encountered existing fill, generally consisting of brown to gray (occasionally black), loose to medium dense (occasionally dense or very dense), silty sand with gravel to poorly graded sand with silt and gravel (occasionally well-graded sand with silt and gravel), trace organics and roots, asphalt and brick pieces. SPT N-values recorded within the existing fill were variable, ranging from four blows per foot (bpf) to 58 bpf. Where penetrated, the existing fill extended to depths of 8.5 fbgs to 22 fbgs, but typically 15.5 fbgs to 22 fbgs. Borings B-6 and B-7 terminated in the existing fill at a depth of nine fbgs.

**Organic Layer:** Beneath the existing fill, boring B-5 encountered an organic layer, consisting of black, medium dense, organic silt (USCS: OL). Boring B-5 terminated in the organic layer at a depth of nine fbgs.

**Glaciofluvial Deposit:** Beneath the existing fill or organic layer, borings B-1 through B-4 encountered a natural glaciofluvial deposit, consisting of gray to gray-brown, medium dense (occasionally very loose or loose), silty sand with gravel (USCS: SM) to sandy silt and gravel (USCS: ML). SPT N-values recorded within this stratum were variable, ranging from two bpf to 26 bpf. Borings B-1 through B-4 terminated in the glaciofluvial deposit at depths ranging from 24 fbgs to 27 fbgs.

## 4.2 GROUNDWATER

Groundwater was encountered in the borings at depths of eight fbgs to 10 fbgs during the exploration. Static and perched/trapped water conditions generally will fluctuate seasonally and following periods of precipitation. Groundwater fluctuates significantly throughout the year in this area and may be shallower at different times of the year.

# SECTION 5.0
# Conclusions and Recommendations

## 5.1 GENERAL

The significant depth of existing fill would require extensive overexcavation, including below the relatively shallow groundwater table, dewatering, and replacement with structural fill to ground support the proposed building. Whitestone therefore recommends that consideration be given to supporting the building on the existing fill improved in place by RAPs. A RAP is a stiff and densified inclusion of rammed crushed aggregate, which is typically installed by driving a mandrel through the unsuitable soils and injecting thin lifts of aggregate through the mandrel, which then densifies the aggregate. The stiff aggregate pier and lateral stress increase in the matrix soil improves the composite soil strength, providing suitable material for foundation support. Whitestone preliminarily anticipates the RAPs would extend up to approximately 20 fbgs to 25 fbgs. Following installation of the RAPs, the building would be supported on conventional shallow foundations deriving support from the improved existing fill or structural fill placed on the improved existing fill. The subgrade should be reviewed by the geotechnical engineer, as specified in this report. A ground-supported floor slab would also derive support from the existing fill improved with RAPs. Additionally, the site conditions support the use of typical pavement sections using standard MassDOT specified materials.

## 5.2 SITE PREPARATION AND EARTHWORK

**Surface Cover Stripping:** Prior to stripping operations, any underground utilities should be identified and secured. Pavements, trees, bushes, vegetation, topsoil, organic matter, should be removed from within and at least five feet beyond the limits of the proposed structure footprint, as well as any other area that will require controlled structural fill placement. Removal of any trees and bushes should also include excavating significant roots, which will require removal of more than the few inches of topsoil encountered at the ground surface in the borings. The contractor should be required to perform earthwork in accordance with the recommendations in this report, including backfilling any excavation, etc. with structural fill. Fill or backfill placed within the proposed structural areas should be placed as structural fill in accordance with Section 5.2, 5.3, and 5.11 of this report.

**Surface Preparation/Proofrolling:** Prior to placing fill or subbase materials to raise or restore grades to the desired subgrade elevations, the existing exposed soils should be compacted to a firm surface with several passes in two perpendicular directions of a minimum 10-ton vibratory roller. The surface should then be proofrolled with a loaded tandem axle truck in the presence of the geotechnical engineer to help identify soft or loose pockets that may require removal and replacement, or further evaluation. Proofrolling should be conducted after a suitable period of dry and non-freezing weather to reduce the likelihood of degrading an otherwise stable subgrade. Should construction be started during the winter months, Whitestone should be contacted for alternate surface preparation procedures. Fill or backfill should be placed and compacted in accordance with Section 5.3.

**Ground Improvement - Rammed Aggregate Piers:** Because of the significant depth of unsuitable existing fill and the relatively shallow groundwater table, Whitestone recommends supporting the proposed foundations and floor slab on the existing fill improved in place by RAPs. The recommended propriety RAP system should be designed and installed by a licensed RAP foundation contractor. The final design should be reviewed by the owner's engineers.

A RAP is a stiff and highly densified inclusion of rammed crushed aggregate that is installed by advancing a hole and ramming thin lifts of crushed aggregate within the hole. The first lift of aggregate forms a bulb below the bottoms of the piers, thereby pre-stressing and pre-straining the soils to a depth equal to at least one pier diameter below drill depths. Subsequent lifts are typically about 12-inches in thickness. Ramming takes place with a tamper that both densifies the aggregate and forces the aggregate laterally into the sidewalls of the hole. This action increases the lateral stress in surrounding soil, thereby further stiffening the stabilized composite soil mass. The combination of the installation of the stiff aggregate pier and lateral stress increase in the matrix soil improves the composite soil strength and controls settlement to within tolerable limits. The RAPs are typically installed by driving a mandrel through the unsuitable soils and injecting thin lifts of compacted aggregate through the mandrel.

Preliminary Design Considerations: For this project, Whitestone preliminarily anticipates the RAPs will extend up to approximately 20 fbgs to 25 fbgs. Obstructions in the existing fill and denser zones will require pre-drilling at some RAP locations.

Final Design Considerations: Design representatives of the propriety system detail the soil reinforcement system using loads provided by the project structural engineer and geotechnical information provided by the geotechnical engineer. Whitestone recommends that a licensed RAP foundation installer provide the final design, layout, and installation of the RAPs. The final design should be reviewed by the owner's geotechnical and structural engineers.

Construction Phase Testing and Inspection: Where a RAP foundation system is selected, Whitestone recommends the following:

- One demonstration pier should be installed with the Contractor's standard procedures and then load-tested to confirm the modulus. The load testing setup and procedures should be selected by the RAP contractor and submitted for review to the project geotechnical engineers. The demonstration pier should be installed at the grade level.

- The RAP element installation operations should be conducted under the observation of the geotechnical engineer's representative in order to reduce the potential for short RAP element installations and excessive aggregate lift thickness.

- After the foundation soils have been reinforced with RAP elements, the treated ground surface should be clear and cleaned to the satisfaction of the geotechnical engineer, subsequent fill operations may proceed, and shallow foundations and floor slab may be constructed at design elevations.

**Weather Performance Criteria:** Portions of the existing fill are moisture sensitive. Every effort should be made to maintain drainage of surface water runoff away from construction areas by grading and limiting the exposure of excavations and prepared subgrades to precipitation. Accordingly, excavation and fill placement procedures should be conducted during favorable weather conditions. Overexcavation of saturated soils and replacement with controlled structural fill per Section 5.3 of this report may be required prior to resuming work on disturbed subgrade materials.

**Subgrade Protection and Maintenance:** Portions of the existing fill are moisture sensitive. Every effort should be made to minimize disturbance of the on-site materials by construction traffic and surface runoff. The on-site soils will deteriorate when subjected to repeated wetting and construction traffic and likely will require extensive drying or overexcavation and replacement. Construction schedules and budgets should account for contingencies, such as importing materials to raise grades or restore overexcavations when construction must occur following wet weather or on an expedited basis. However, if properly protected and maintained as recommended herein, the site soils will provide adequate support for the proposed construction. The site contractors should employ necessary means and methods to protect the subgrade including, but not limited to the following:

- leaving the existing pavement in place as long as practical to protect the subgrade from freeze-thaw cycles and exposure to inclement weather;
- sealing exposed subgrade soils on a daily basis with a smooth drum roller operated in static mode;
- regrading the site as needed to maintain positive drainage away from construction areas;
- removing wet surficial soils and ruts immediately; and
- limiting exposure to construction traffic especially following inclement weather and subgrade thawing.

## 5.3 STRUCTURAL FILL AND BACKFILL

**Imported Fill Material:** Imported material placed as structural fill or backfill to raise elevations or restore design grades should consist of clean, relatively well-graded sand or gravel with a maximum particle size of three inches and up to 15 percent, by weight, of material finer than a #200 sieve. Imported material should be free of silt, clay, organics, and deleterious material. Imported material should be approved by a qualified geotechnical engineer prior to delivery to the site.

**On-Site Material Reuse:** Whitestone anticipates that portions of the existing fill will be structurally suitable for selective reuse as fill/backfill material, provided that soil moisture contents are controlled within three percent of optimum moisture level, particles larger than three inches in diameter are either removed or crushed, and objectionable portions, such as organics and/or debris, are segregated. Reuse of the site soils will be contingent on careful review in the field by the owner's geotechnical engineer by visual observation during construction as recommended herein.

**Submerged Fill:** Where required due to groundwater consideration should be given to placing an open-graded, 0.75-inch crushed stone in the wet (flooding, perched water, or groundwater) to provide a working mat, expedite dewatering efforts and enable subsequent placement of structural fill or backfill in the dry. Prior to placing submerged fill materials, free water and disturbed materials should be removed to the extent recommended by the geotechnical engineer. A fines barrier geotextile, such as Mirafi 140N or equivalent, should be placed at the base and sides of the overexcavation to separate the crushed stone from underlying and adjacent soils. The fabric also should be placed on top of the crushed stone prior to subsequent fill placement, if fill soils with a substantial amount of fines are to be used to restore grade.

**Compaction and Placement Requirements:** Fill and backfill should be placed in maximum 12-inch thick loose lifts when compacted using a vibratory drum roller with a minimum weight of one ton, and in maximum eight-inch thick loose lifts when compacted with a plate compactor. Structural fill and backfill should be compacted to at least 95 percent of the maximum dry density within three percent of the optimum moisture content, as determined by ASTM D1557 (Modified Proctor).

**Structural Fill Testing:** A sample of the imported fill material or on-site material proposed for reuse as structural fill or backfill should be submitted to the owner's geotechnical engineer for analysis and approval at least one week prior to its use. The placement of fill and backfill should be monitored by a qualified engineering technician, so that the specified material and lift thicknesses are properly installed. A sufficient number of in-place density tests should be conducted, so that the specified compaction is achieved throughout the height of the fill or backfill.

## 5.4 GROUNDWATER CONTROL

Groundwater was encountered in the borings during this investigation at depths ranging from eight fbgs to 10 fbgs. Shallower perched/trapped water may be encountered during construction above less permeable strata. As such, construction phase dewatering may consist of removing surface water runoff, infiltrating water, or trapped water at this site. Whitestone anticipates that construction phase dewatering would include installing temporary sump pits and filtered pumps within trenches and excavations.

Proper grading and drainage should be incorporated into the site design and construction phase grading to discourage ponding of surface runoff. Every effort should be made to maintain drainage of surface run-off away from construction areas by grading. The contractor should limit exposure of excavations and prepared subgrades to rainfall. Overexcavation of wet soils and replacement with controlled structural fill per Section 5.3 of this report may be required prior to resuming work on disturbed subgrade soils.

## 5.5 FOUNDATIONS

**Shallow Foundation Design Criteria:** Whitestone recommends supporting the proposed structure on conventional spread and continuous wall footings designed to bear on the existing fill following ground improvement via RAPs or structural fill placed over the RAP, improved site soils, provided the subgrade is properly evaluated and compacted in accordance with Sections 5.2, 5.3, and 5.11 of this report. Following in-trench compaction of foundation subgrades, foundations bearing within these materials may be designed to impart a maximum net allowable bearing pressure of 4,000 pounds per square foot (psf).

Foundation subgrades should be compacted in the presence of the geotechnical engineer to densify loose upper soils and disturbed soils. Regardless of loading conditions, new foundations should be sized no less than minimum dimensions of 24-inches for continuous wall footings and 36-inches for isolated column footings.

Footings should be designed such that the maximum toe pressure due to the combined effect of vertical loads (including soil weight) and overturning moment does not exceed the recommended maximum allowable bearing pressure. In addition, positive contact pressure should be maintained throughout the base of the footings such that no uplift or tension exists between the base of the footings and the supporting soil. Uplift loads should be resisted by the weight of the concrete footing. Side friction should be neglected when proportioning the footings, and lateral resistance should be provided by friction resistance at the base of the footings. A coefficient of friction (ultimate) against sliding of 0.4 is recommended for use in the design of concrete foundations bearing within the site soils or imported structural fill.

**Foundation Inspection/Overexcavation Criteria:** Whitestone recommends that the suitability of the bearing materials along new footing bottoms be reviewed by a geotechnical engineer prior to placing concrete for the footings. Special attention should be given to any areas of the site underlain by soft/loose conditions. In the event that isolated areas of unsuitable materials are encountered in footing excavations, overexcavation and replacement of the materials or deeper foundation embedment may be necessary to provide a suitable footing subgrade. Overexcavation to be restored with structural fill should extend at least one foot laterally beyond footing edges for each vertical foot of overexcavation. Lateral overexcavation may be eliminated if grade is restored with lean concrete.

**Settlement:** Whitestone estimates post construction settlements of new building foundations will be on the order of less than one inch, if the recommendations outlined in this report are properly implemented. Differential settlements of new building foundations should be less than about one half inch.

**Frost Coverage:** Footings subject to frost action should be placed at least 48 inches below adjacent exterior grades in accordance with the *Commonwealth of Massachusetts State Building Code* to provide protection from frost penetration. Interior footings not subject to frost action may be placed at a minimum depth of 18 inches below the slab subgrade but should not be placed on existing fill unless improved by RAPs.

## 5.6 FLOOR SLAB

Following RAP ground improvement, Whitestone anticipates that the improved existing fill, and/or compacted structural fill placed over the improved existing fill will be suitable for support of the proposed floor slab provided these materials are properly evaluated, compacted, and proofrolled in accordance with Sections 5.2, 5.3, and 5.11 of this report during favorable weather conditions. Areas that are, or become, softened or disturbed as a result of wetting and/or repeated exposure to construction traffic or contain objectionable materials should be removed and replaced with compacted structural fill. The properly prepared on-site soils are expected to yield a minimum subgrade modulus (k) of 150 psi/in.

A minimum 12-inch layer of MassDOT *M1.03.01 Processed Gravel for Sub-base* (or approved equivalent) should be placed below the floor slab to provide a uniform granular base. If the floor supports moisture-sensitive covering or equipment, a moisture vapor barrier should also be installed beneath the floor slab in accordance with flooring manufacturer's recommendations.

## 5.7 PAVEMENT DESIGN CRITERIA

**General:** Whitestone anticipates that the properly inspected and approved existing fill, improved by surface compaction, and/or compacted structural fill and/or backfill placed to raise or restore design elevations will be suitable for support of the proposed pavements, provided these materials are properly evaluated, compacted, and proofrolled in accordance with Sections 5.2, 5.3, and 5.11 of this report during favorable weather conditions. Overexcavation and replacement/recompaction and/or the placement of a geogrid may be required in pavement areas due to the presence of existing fill.

Although organic material was only encountered in one boring, additional organic material may underlie the existing fill between the widely spaced borings. There is therefore a possible risk of increased maintenance. Whitestone anticipates that shimming to re-level portions of the asphaltic concrete surface may be required during the design life of the pavement.

**Design Criteria:** A California Bearing Ratio value of eight has been assigned to the properly prepared subgrade soils for pavement design purposes. This value was correlated with pertinent soil support values and assumed traffic loads to prepare flexible and rigid pavement designs per the AASHTO *Guide for the Design of Pavement Structures*.

Design traffic loads were assumed based on typical volumes for similar facilities and correlated with 18-kip equivalent single axle loads (ESAL) for a 20-year life. Estimated maximum pavement loads of 30,000 ESALs and 75,000 ESALs were used for the standard-duty and heavy-duty pavement areas, respectively. These values assume the pavements primarily will accommodate both automobile and limited heavier truck traffic, with the heavier truck traffic designated to the main drive lanes. Actual loading experienced is anticipated to be less than these values.

**Pavement Sections:** Pavement components should meet material specifications from MassDOT *Standard Specifications* specified below. The recommended flexible pavement sections are tabulated below:

| **FLEXIBLE PAVEMENT SECTION** | | | |
|---|---|---|---|
| **Layer** | **Material** | **Standard-Duty Thickness (Inches)** | **Heavy-Duty Thickness (Inches)** |
| Asphalt Surface Course | MassDOT Table M3.11.4-1 "½ inch" | 1.5 | 1.5 |
| Asphalt Binder Course | MassDOT Table M3.11.4-1 "¾ inch" | 1.5 | 2.5 |
| Granular Subbase | MassDOT M2.01.07 Dense-graded Crushed Stone for Subbase | 12.0 | 12.0 |

A rigid concrete pavement should be used to provide suitable support at areas of high traffic or severe turns, such as at the drive-up ATM, trash enclosure, and ingress/egress location(s). The recommended rigid pavement is tabulated below:

| RIGID PAVEMENT SECTION | | |
|---|---|---|
| **Layer** | **Material** | **Thickness (inches)** |
| Surface | 4,000 psi air-entrained concrete | 6.0 [1] |
| Granular Subbase | MassDOT M2.01.07 Dense-graded Crushed Stone for Subbase | 12.0 |

Note [1]: The outer edges of concrete pavements are susceptible to damage as trucks move from rigid pavement to adjacent flexible pavement. Therefore, the thickness at the outer two feet of the rigid concrete pavement should be 12 inches. The concrete should be reinforced with at least one layer of six-inch by six-inch W5.4/W5.4 welded wire fabric (ASTM A185).

**Additional Design Considerations:** The pavement section thickness designs presented in this report are based on the design parameters detailed herein and are contingent on proper construction, inspection, and maintenance. Additional pavement thickness may be required by local code. The designs are contingent on achieving the minimum soil support value in the field. To accomplish this requirement, subgrade soil and supporting fill or backfill must be placed, compacted, and evaluated in accordance with Sections 5.2, 5.3, and 5.11 of this report. Proper drainage should be provided for the pavement structure, including appropriate grading and surface water control.

The performance of the pavement also will depend on the quality of materials and workmanship. Whitestone recommends that MassDOT standards for materials, workmanship, and maintenance be applied to this site. Project specifications should include verifying that the installed asphaltic concrete material composition is within tolerance for the specified materials and that the percentage of air voids of the installed pavement is within specified ranges for the respective materials. Rigid concrete pavements should be suitably air-entrained, jointed, and reinforced in general accordance with ACI 330R-08 *Guide for the Design and Construction of Concrete Parking Lots*.

## 5.8 RETAINING WALLS/LATERAL EARTH PRESSURES

Proposed site retaining walls were not indicated at this time. Whitestone should be notified if retaining walls or structures resisting lateral earth pressures are planned. The following recommendations are provided for preliminary planning of any retaining walls, below-grade walls, and other structures reliant on granular materials to provide adequate drainage. However, the parameters are not directly applicable to the design of mechanically stabilized earth (MSE) retaining walls, which require proprietary design methods for the selected earth retention system.

**Lateral Earth Pressures:** Retaining/below-grade walls should be capable of withstanding active and at-rest earth pressures. Backfill soils adjacent to these structures should consist of freely draining granular fill composed primarily of coarse to fine sand. With an active earth pressure coefficient ($K_a$) of 0.33, level backfill, and an assumed maximum backfill soil unit weight of 140 pounds per cubic foot (pcf), an equivalent fluid pressure of 46 psf per foot of wall height should be used in design of retaining/below-grade walls which are free to rotate.

Retaining/below-grade walls and wall corners typically are restrained from lateral movement and should be designed using at-rest earth pressures. A coefficient of at-rest earth pressure ($K_o$) of 0.5, for a level backfill, is recommended for retaining/below-grade walls designed to resist at-rest earth pressures, which assume no lateral movement. With an assumed maximum total unit weight of backfill of approximately 140 pcf, an equivalent fluid pressure of 70 pounds per square foot per foot of wall height should be used in design of restrained retaining/below-grade wall and wall corners. A coefficient of friction of 0.4 against sliding can be used for concrete on the existing site soils. Additional lateral earth pressures from a sloped backfill or any temporary or long-term surcharge loads also should be included in the design. Retaining wall design should include a global stability analysis.

**Backfill Criteria:** Whitestone recommends that granular soils be used to backfill behind retaining walls. The granular backfill materials should consist of clean, relatively well-graded sand or gravel with a maximum particle size of three inches and up to 15 percent of material finer than a #200 U.S. Standard sieve.

Whitestone recommends that backfill directly behind any walls be compacted with light, hand-held compactors. Heavy compactors and grading equipment should not be allowed to operate within a zone of influence measured at a 45-degree angle from the base of the walls during backfilling to avoid developing excessive temporary or long-term lateral soil pressures.

**Wall Drainage:** Positive drainage should be provided at the base of the below-grade walls. Where wall drainage is not provided, the wall should be designed to withstand full hydrostatic pressure.

Whitestone should be notified if any other retaining structures or design considerations requiring lateral earth pressure estimations are proposed. Specific recommendations for temporary retaining structures are beyond Whitestone's scope of work.

## 5.9 SEISMIC AND LIQUEFACTION CONSIDERATIONS

The subsurface conditions are most consistent with a Site Class D, as defined by the Commonwealth of Massachusetts *State Building Code (Ninth Edition)*. Based on the type of building (single story), seismic zone, and soil profile, liquefaction considerations are not expected to have a substantial impact on design. Installation of RAPs will improve the soils supporting the building, further reducing the risk of earthquake induced liquefaction.

## 5.10 EXCAVATIONS

The site soils encountered during this investigation typically are, at a minimum, consistent with Type C Soil Conditions as defined by 29 CFR Part 1926 (OSHA), which require a maximum unbraced excavation angle of 1.5:1 (horizontal:vertical). Actual conditions encountered during construction, such as the organic layer, should be evaluated by a competent person (as defined by OSHA), so that safe excavation methods and/or shoring and bracing requirements are implemented.

## 5.11 SUPPLEMENTAL POST INVESTIGATION SERVICES

**Construction Inspection and Monitoring:** The owner's geotechnical engineer with specific knowledge of the site subsurface conditions and design intent should conduct inspection, testing, and consultation during construction as described in previous sections of this report. Monitoring and testing should also be conducted to confirm that any encountered underground structures, such as foundations of the demolished building, are properly backfilled, the existing surface cover materials and existing fill are properly removed, and suitable materials, used for controlled fill, are properly placed and compacted over suitable subgrade soils. The proofrolling of all subgrades prior to foundation, floor slab, and pavement support should be witnessed and documented by the owner's geotechnical engineer, the installation of the recommended ground improvement RAPs should also be monitored by the owner's geotechnical engineer.

# SECTION 6.0
# General Comments

Supplemental recommendations may be required upon finalization of construction plans or if significant changes are made in the characteristics or location of the proposed structure. Soil bearing conditions should be checked at the appropriate time for consistency with those conditions encountered during Whitestone's geotechnical investigation.

The recommendations presented herein should be utilized by a qualified engineer in preparing the project plans and specifications. The engineer should consider these recommendations as minimum physical standards, which may be superseded by local and regional building codes and structural considerations. These recommendations are prepared for the sole use of Stonefield Engineering & Design, LLC and Chase Bank for the specific project detailed and should not be used by any third party. These recommendations are relevant to the design phase and should not be substituted for construction specifications.

The possibility exists that conditions between borings may differ from those at specific test locations, and conditions may not be as anticipated by the designers or contractors. In addition, the construction process may alter soil and rock conditions. Therefore, experienced geotechnical personnel should observe and document the construction procedures used and the conditions encountered.

Whitestone assumes that a qualified contractor will be employed to conduct the construction work, and that the contractor will be required to exercise care to ensure excavations are conducted in accordance with applicable regulations and good practice. Particular attention should be paid to avoiding damaging or undermining adjacent properties and maintaining slope stability.

Whitestone recommends that the services of the geotechnical engineer be engaged to test and evaluate the materials in the footing excavations prior to concreting in order to determine that the materials will support the bearing pressures. Monitoring and testing also should be conducted to check that suitable materials are used for controlled fills and that they are properly placed and compacted over suitable subgrade.

The exploration and analysis of the foundation conditions reported herein are considered sufficient in detail and scope to form a reasonable basis for the foundation design. The recommendations submitted for the proposed construction are based on the available soil information and the design details furnished by Stonefield Engineering & Design, LLC. Deviations from the noted subsurface conditions encountered during construction should be brought to the attention of the geotechnical engineer.

*The geotechnical engineer warrants that the findings, recommendations, specifications, or professional advice contained herein have been promulgated after being prepared in accordance with generally accepted professional engineering practice in the fields of foundation engineering, soil mechanics, and engineering geology. No other warranties, express or implied, are made.*

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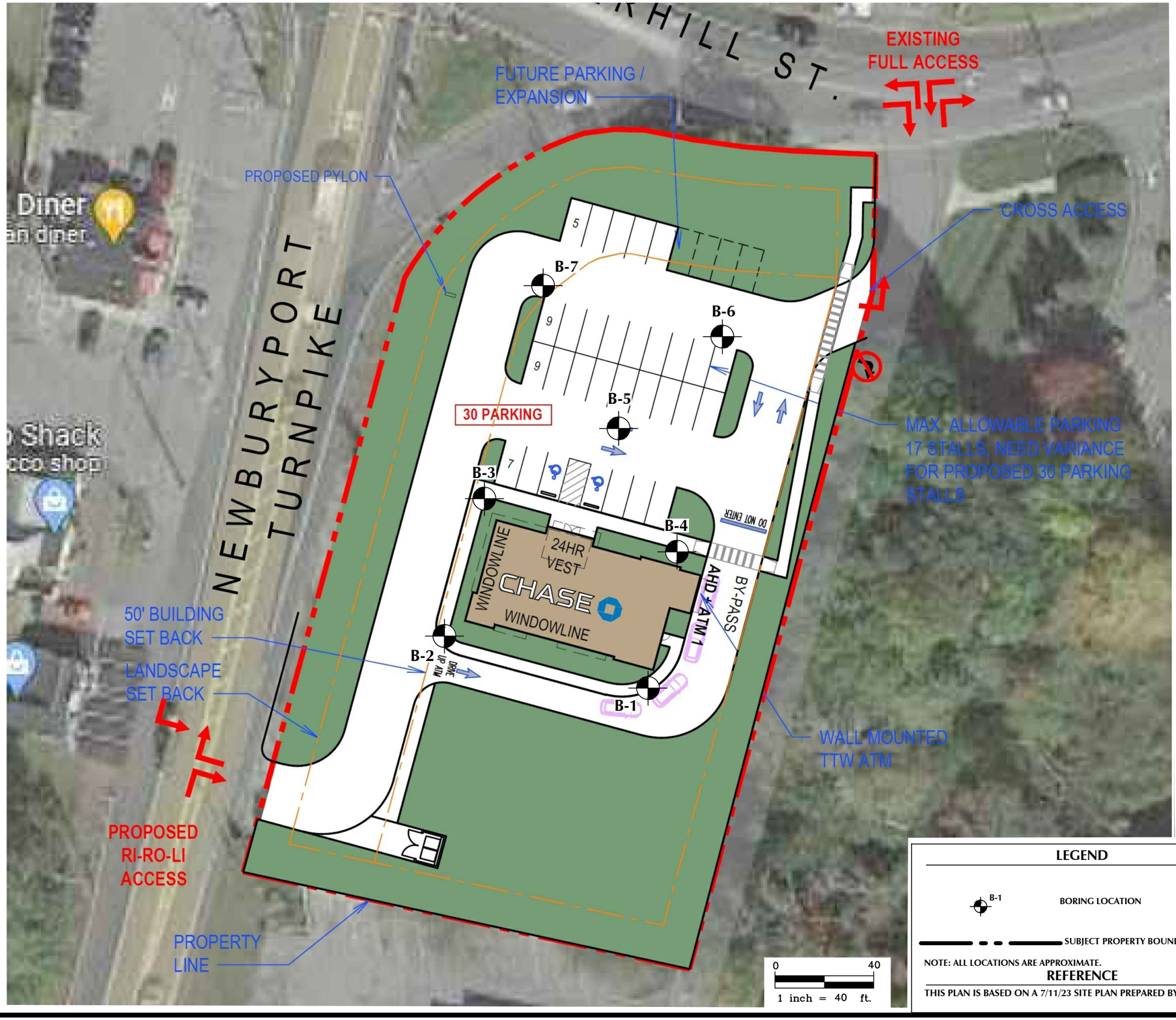
# FIGURE 1
# Boring Location Plan




## LEGEND

B-1 BORING LOCATION

SUBJECT PROPERTY BOUNDARY

NOTE: ALL LOCATIONS ARE APPROXIMATE.

**REFERENCE**

THIS PLAN IS BASED ON A 7/11/23 SITE PLAN PREPARED BY CHASE.


WHITESTONE
*An Employee-Owned Company*
352 TURNPIKE ROAD, SUITE 105, SOUTHBOROUGH, MA 01772
508.485.0755 WHITESTONEASSOC.COM


DRAWING TITLE: **BORING LOCATION PLAN**

CLIENT: STONEFIELD ENGINEERING & DESIGN, LLC

PROJECT: PROPOSED CHASE BANK BRANCH
165 NEWBURYPORT TURNPIKE
MAP 14, LOT 13
ROWLEY, ESSEX COUNTY, MASSACHUSETTS

| | |
|---|---|
| PROJECT #: GM2321010.000 | |
| DESIGNED BY: MR | PROJ. MGR.: RR |
| DATE: 11/15/23 | FIGURE: 1 |
| SCALE: 1" = 40' | |

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# APPENDIX A
# Records of Subsurface Exploration

WHITESTONE

# RECORD OF SUBSURFACE EXPLORATION

**Boring No.:** B-1

Page 1 of 1

| | | | |
|---|---|---|---|
| **Project:** | Proposed Chase Bank Branch | **WAI Project No.:** | GM2321010.000 |
| **Location:** | 165 Newburyport Turnpike, Rowley, Essex County, Massachusetts | **Client:** | Stonefield Engineering & Design, LLC |
| **Surface Elevation:** | ± 62.0 feet Above NAVD88 | **Date Started:** | 10/25/2023 |
| **Termination Depth:** | 24.0 feet bgs | **Date Completed:** | 10/25/2023 |
| **Proposed Location:** | Building | **Logged By:** | ZH |
| **Drill / Test Method:** | HSA / SPT | **Contractor:** | GS |
| | | **Equipment:** | CME 55LT |

| | Water Depth (feet bgs) | Elevation (ft NAVD88) | Cave-In Depth (feet bgs) | Elevation (ft NAVD88) |
|---|---|---|---|---|
| **During:** | 8.0 | 54.0 | | |
| **At Completion:** | -- | -- | **At Completion:** | -- / -- |
| **24 Hours:** | -- | -- | **24 Hours:** | -- / -- |

| Depth (feet) | No | Type | Blows Per 6" | Rec. (in.) | N | DEPTH (feet) | STRATA | DESCRIPTION OF MATERIALS (Classification) | REMARKS |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 0.0 | | | |
| | | | | | | | TS | 1.5" Topsoil | |
| 0 - 2 | S-1 | | 4 - 27 - 31 - 11 | 12 | 58 | | | Brown, Very Dense, Silty Sand with Gravel, Asphalt, Brick (FILL) | |
| 2 - 4 | S-2 | | 4 - 4 - 12 - 9 | 12 | 16 | | | As Above, Medium Dense (FILL) | |
| | | | | | | 5.0 | | | |
| 5 - 7 | S-3 | | 5 - 3 - 4 - 17 | 10 | 7 | | EXISTING FILL | As Above, Loose (FILL) | |
| 7 - 9 | S-4 | | 10 - 7 - 7 - 18 | 4 | 14 | | | As Above, Medium Dense, Trace Organics (FILL) | |
| | | | | | | 10.0 | | | |
| 10 - 12 | S-5 | | 4 - 5 - 4 - 3 | 9 | 9 | | | As Above, Loose (FILL) | |
| | | | | | | 14.5 | | As Above (FILL) | |
| 14 - 16 | S-6 | | 5 - 6 - 8 - 10 | 8 | 14 | 15.0 | | Gray, Medium Dense, Silty Sand with Gravel (SM) | |
| | | | | | | | GLACIO-FLUVIAL DEPOSIT | | |
| | | | | | | 20.0 | | | |
| 20 - 22 | S-7 | | 18 - 11 - 15 - 13 | 15 | 26 | | | As Above (SM) | |
| 22 - 24 | S-8 | | 11 - 14 - 12 - 10 | 20 | 26 | | | As Above (SM) | |
| | | | | | | 25.0 | | Boring Log B-1 Terminated at Depth of 24.0 Feet Below Ground Surface. | |

NOTES: bgs = below ground surface, msl = mean sea level, NA = Not Applicable, NE = Not Encountered, NS = Not Surveyed, P = Perched

WHITESTONE

# RECORD OF SUBSURFACE EXPLORATION

**Boring No.:** B-2

Page 1 of 1

| | | | |
|---|---|---|---|
| **Project:** | Proposed Chase Bank Branch | **WAI Project No.:** | GM2321010.000 |
| **Location:** | 165 Newburyport Turnpike, Rowley, Essex County, Massachusetts | **Client:** | Stonefield Engineering & Design, LLC |
| **Surface Elevation:** | ± 63.0 feet Above NAVD88 | **Date Started:** | 10/25/2023 |
| **Termination Depth:** | 24.0 feet bgs | **Date Completed:** | 10/25/2023 |
| **Proposed Location:** | Building | **Logged By:** | ZH |
| **Drill / Test Method:** | HSA / SPT | **Contractor:** | GS |
| | | **Equipment:** | CME 55LT |

| | Water Depth (feet bgs) | Elevation (ft NAVD88) | Cave-In Depth (feet bgs) | Elevation (ft NAVD88) |
|---|---|---|---|---|
| **During:** | 8.0 | 55.0 | | |
| **At Completion:** | -- | -- | **At Completion:** -- | -- |
| **24 Hours:** | -- | -- | **24 Hours:** -- | -- |

| SAMPLE INFORMATION | | | | | | DEPTH | STRATA | | DESCRIPTION OF MATERIALS (Classification) | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|
| Depth (feet) | No | Type | Blows Per 6" | Rec. (in.) | N | (feet) | | | | |
| | | | | | | 0.0 | | | | |
| | | | | | | | TS | | 6" Topsoil | |
| 0 - 2 | S-1 | | 6 - 21 - 29 - 13 | 7 | 50 | | | | Brown, Dense to Very Dense, Poorly Graded Sand with Silt and Gravel (FILL) | |
| 2 - 4 | S-2 | | 10 - 12 - 21 - 10 | 0 | 33 | | | | No Recovery. Dense | |
| | | | | | | 5.0 | | | | |
| 5 - 7 | S-3 | | 8 - 10 - 10 - 9 | 11 | 20 | | | | Brown, Medium Dense, Silty Sand with Gravel (FILL) | |
| 7 - 9 | S-4 | | 11 - 13 - 13 - 12 | 6 | 26 | | | | As Above (FILL) | |
| | | | | | | 10.0 | | | | |
| 10 - 12 | S-5 | | 6 - 5 - 4 - 5 | 10 | 9 | | EXISTING FILL | | As Above, Loose (FILL) | |
| | | | | | | 15.0 | | | | |
| 15 - 17 | S-5 | | 2 - 3 - 3 - 5 | 12 | 6 | | | | As Above (FILL) | |
| | | | | | | 20.0 | | | | |
| 20 - 22 | S-6 | | 6 - 6 - 4 - 5 | 16 | 10 | | | | As Above, Gray-Brown, Loose to Medium Dense (FILL) | |
| | | | | | | 22.0 | | | | |
| 22 - 24 | S-5 | | 4 - 2 - 2 - 4 | 22 | 4 | | GLACIO-FLUVIAL DEPOSIT | | Gray-Brown, Very Loose to Loose, Silty Sand with Gravel (SM) | |
| | | | | | | 25.0 | | | Boring Log B-2 Terminated at Depth of 24.0 Feet Below Ground Surface. | |

NOTES: bgs = below ground surface, msl = mean sea level, NA = Not Applicable, NE = Not Encountered, NS = Not Surveyed, P = Perched

WHITESTONE

# RECORD OF SUBSURFACE EXPLORATION

**Boring No.:** B-3

Page 1 of 1

| | | | |
|---|---|---|---|
| **Project:** | Proposed Chase Bank Branch | **WAI Project No.:** | GM2321010.000 |
| **Location:** | 165 Newburyport Turnpike, Rowley, Essex County, Massachusetts | **Client:** | Stonefield Engineering & Design, LLC |
| **Surface Elevation:** | ± 65.0 feet Above NAVD88 | **Date Started:** | 10/25/2023 |
| **Termination Depth:** | 24.0 feet bgs | **Date Completed:** | 10/25/2023 |
| **Proposed Location:** | Building | **Logged By:** | ZH |
| **Drill / Test Method:** | HSA / SPT | **Contractor:** | GS |
| | | **Equipment:** | CME 55LT |

| Water Depth \| Elevation (feet bgs) \| (ft NAVD88) | | Cave-In Depth \| Elevation (feet bgs) \| (ft NAVD88) | |
|---|---|---|---|
| **During:** | 10.0 \| 55.0 | | |
| **At Completion:** | -- \| -- | **At Completion:** | -- \| -- |
| **24 Hours:** | -- \| -- | **24 Hours:** | -- \| -- |

| SAMPLE INFORMATION | | | | | | DEPTH | STRATA | | DESCRIPTION OF MATERIALS (Classification) | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|
| Depth (feet) | No | Type | Blows Per 6" | Rec. (in.) | N | (feet) | | | | |
| | | | | | | 0.0 | | | | |
| | | | | | | | TS | | 3" Topsoil | |
| 0 - 2 | S-1 | | 3 - 5 - 3 - 3 | 20 | 8 | | | | Brown, Loose, Silty Sand with Gravel (FILL) | |
| 2 - 4 | S-2 | | 4 - 4 - 4 - 4 | 18 | 8 | | | | As Above (FILL) | |
| | | | | | | 5.0 | | | | |
| 5 - 7 | S-3 | | 5 - 7 - 8 - 12 | 15 | 15 | | | | As Above, Medium Dense (FILL) | |
| 7 - 9 | S-4 | | 10 - 8 - 8 - 7 | 17 | 9 | | EXISTING FILL | | As Above, Loose (FILL) | |
| | | | | | | 10.0 | | | | |
| 10 - 12 | S-5 | | 5 - 5 - 4 - 4 | 15 | 9 | | | | Gray-Brown, Loose, Silty Sand (FILL) | |
| | | | | | | 15.0 | | | | |
| | | | | | | 15.5 | | | As Above, Medium Dense (FILL) | |
| 15 - 17 | S-6 | | 6 - 11 - 12 - 15 | 18 | 23 | | | | Gray, Medium Dense, Silty Sand with Gravel (SM) | |
| | | | | | | 20.0 | GLACIO-FLUVIAL DEPOSIT | | | |
| 20 - 22 | S-7 | | WOH - 5 - 11 - 15 | 21 | 16 | | | | As Above, Gray-Brown (SM) | |
| 22 - 24 | S-8 | | 14 - 9 - 10 - 12 | 24 | 19 | | | | As Above (SM) | |
| | | | | | | 25.0 | | | Boring Log B-3 Terminated at Depth of 24.0 Feet Below Ground Surface. | |

NOTES: bgs = below ground surface, msl = mean sea level, NA = Not Applicable, NE = Not Encountered, NS = Not Surveyed, P = Perched

WHITESTONE

# RECORD OF SUBSURFACE EXPLORATION

**Boring No.:** B-4

Page 1 of 1

| | | | |
|---|---|---|---|
| **Project:** | Proposed Chase Bank Branch | **WAI Project No.:** | GM2321010.000 |
| **Location:** | 165 Newburyport Turnpike, Rowley, Essex County, Massachusetts | **Client:** | Stonefield Engineering & Design, LLC |
| **Surface Elevation:** | ± 63.0 feet Above NAVD88 | **Date Started:** | 10/25/2023 |
| **Termination Depth:** | 27.0 feet bgs | **Date Completed:** | 10/25/2023 |
| **Proposed Location:** | Building | **Logged By:** | ZH |
| **Drill / Test Method:** | HSA / SPT | **Contractor:** | GS |
| | | **Equipment:** | CME 55LT |

| Water Depth \| Elevation (feet bgs) \| (ft NAVD88) | | Cave-In Depth \| Elevation (feet bgs) \| (ft NAVD88) | |
|---|---|---|---|
| **During:** | 10.0 \| 53.0 | | |
| **At Completion:** | -- \| -- | **At Completion:** | -- \| -- |
| **24 Hours:** | -- \| -- | **24 Hours:** | -- \| -- |

| SAMPLE INFORMATION | | | | | | DEPTH | STRATA | | DESCRIPTION OF MATERIALS (Classification) | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|
| Depth (feet) | No | Type | Blows Per 6" | Rec. (in.) | N | (feet) | | | | |
| | | | | | | 0.0 | | | | |
| | | | | | | | TS | | 5" Topsoil | |
| 0 - 2 | S-1 | | 7 - 10 - 17 - 15 | 11 | 27 | | | | Brown, Medium Dense, Poorly Graded Sand with Silt and Gravel (FILL) | |
| 2 - 4 | S-2 | | 15 - 13 - 12 - 10 | 16 | 25 | | | | As Above (FILL) | |
| | | | | | | 5.0 | | | | |
| 5 - 7 | S-3 | | 5 - 3 - 4 - 3 | 6 | 7 | | | | As Above, Loose (FILL) | |
| 7 - 9 | S-4 | | 3 - 2 - 4 - 4 | 7 | 6 | | EXISTING FILL | | Brown, Loose, Silty Sand with Gravel (FIL) | |
| | | | | | | 10.0 | | | | |
| 10 - 12 | S-5 | | 5 - 5 - 5 - 10 | 10 | 10 | | | | As Above, Loose to Medium Dense (FILL) | |
| | | | | | | 15.0 | | | | |
| 15 - 17 | S-6 | | WOH /12" - 5 - 14 | 21 | 5 | 16.0 | | | Gray, Very Loose, Silty Sand (FILL) | |
| | | | | | | | | | Gray, Medium Dense, Sandy Silt with Gravel (ML) | |
| | | | | | | 20.0 | GLACIO-FLUVIAL DEPOSIT | | | |
| 20 - 22 | S-7 | | 3 - 11 - 11 - 18 | 20 | 22 | | | | As Above, Gray-Brown (ML) | |
| | | | | | | 25.0 | | | | |

NOTES: bgs = below ground surface, msl = mean sea level, NA = Not Applicable, NE = Not Encountered, NS = Not Surveyed, P = Perched

WHITESTONE

# RECORD OF SUBSURFACE EXPLORATION

**Boring No.:** B-4 (2)



| | | | |
|---|---|---|---|
| **Project:** | Proposed Chase Bank Branch | **WAI Project No.:** | GM2321010.000 |
| **Location:** | 165 Newburyport Turnpike, Rowley, Essex County, Massachusetts | **Client:** | Stonefield Engineering & Design, LLC |
| **Surface Elevation:** | ± 63.0 feet Above NAVD88 | **Date Started:** | 10/25/2023 |
| **Termination Depth:** | 27.0 feet bgs | **Date Completed:** | 10/25/2023 |
| **Proposed Location:** | Building | **Logged By:** | ZH |
| **Drill / Test Method:** | HSA / SPT | **Contractor:** | GS |
| | | **Equipment:** | CME 55LT |

| | Water Depth (feet bgs) | Elevation (ft NAVD88) | Cave-In Depth (feet bgs) | Elevation (ft NAVD88) |
|---|---|---|---|---|
| **During:** | 10.0 | 53.0 | | |
| **At Completion:** | -- | -- | **At Completion:** | -- / -- |
| **24 Hours:** | -- | -- | **24 Hours:** | -- / -- |

| SAMPLE INFORMATION | | | | | | DEPTH | STRATA | DESCRIPTION OF MATERIALS (Classification) | REMARKS |
|---|---|---|---|---|---|---|---|---|---|
| Depth (feet) | No | Type | Blows Per 6" | Rec. (in.) | N | (feet) | | | |
| | | | | | | 25.0 | | | |
| 25 - 27 | S-8 | X | 3 - 1 - 1 - 3 | 22 | 2 | | GLACIO-FLUVIAL DEPOSIT | Gray, Very Loose, Sandy Silt with Gravel (ML) | |
| | | | | | | | | Boring Log B-4 Terminated at Depth of 27.0 Feet Below Ground Surface. | |
| | | | | | | 30.0 | | | |
| | | | | | | 35.0 | | | |
| | | | | | | 40.0 | | | |
| | | | | | | 45.0 | | | |
| | | | | | | 50.0 | | | |

NOTES: bgs = below ground surface, msl = mean sea level, NA = Not Applicable, NE = Not Encountered, NS = Not Surveyed, P = Perched

WHITESTONE

# RECORD OF SUBSURFACE EXPLORATION

**Boring No.:** B-5

Page 1 of 1

| | | | |
|---|---|---|---|
| **Project:** | Proposed Chase Bank Branch | **WAI Project No.:** | GM2321010.000 |
| **Location:** | 165 Newburyport Turnpike, Rowley, Essex County, Massachusetts | **Client:** | Stonefield Engineering & Design, LLC |
| **Surface Elevation:** | ± 64.0 feet Above NAVD88 | **Date Started:** | 10/25/2023 |
| **Termination Depth:** | 9.0 feet bgs | **Date Completed:** | 10/25/2023 |
| **Proposed Location:** | Parking | **Logged By:** | ZH |
| **Drill / Test Method:** | HSA / SPT | **Contractor:** | GS |
| | | **Equipment:** | CME 55LT |

| Water Depth \| Elevation (feet bgs) \| (ft NAVD88) | | Cave-In Depth \| Elevation (feet bgs) \| (ft NAVD88) | |
|---|---|---|---|
| **During:** | -- \| -- | | |
| **At Completion:** | -- \| -- | **At Completion:** | -- \| -- |
| **24 Hours:** | -- \| -- | **24 Hours:** | -- \| -- |

| SAMPLE INFORMATION | | | | | | DEPTH | STRATA | | DESCRIPTION OF MATERIALS (Classification) | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|
| Depth (feet) | No | Type | Blows Per 6" | Rec. (in.) | N | (feet) | | | | |
| | | | | | | 0.0 | | | | |
| | | | | | | | TS | | 7" Topsoil | |
| 0 - 2 | S-1 | | 5 - 6 - 5 - 4 | 11 | 11 | | EXISTING FILL | | Brown, Medium Dense, Poorly Graded Sand with Silt and Gravel (FILL) | |
| 2 - 4 | S-2 | | 3 - 3 - 5 - 3 | 4 | 8 | | | | As Above, Loose, Roots (FILL) | |
| | | | | | | 5.0 | | | | |
| 5 - 7 | S-3 | | 3 - 5 - 12 - 14 | 10 | 17 | | | | Brown, Medium Dense, Well-Graded Sand with Silt and Gravel (FILL) | |
| 7 - 9 | S-4 | | 11 - 7 - 6 - 25 | 12 | 13 | | | | As Above (FILL) | |
| | | | | | | 8.5 | ORGANIC | | Black, Medium Dense, Organic Silt (OL) | |
| | | | | | | 10.0 | | | Boring Log B-5 Terminated at Depth of 9.0 Feet Below Ground Surface. | |
| | | | | | | 15.0 | | | | |
| | | | | | | 20.0 | | | | |
| | | | | | | 25.0 | | | | |

NOTES: bgs = below ground surface, msl = mean sea level, NA = Not Applicable, NE = Not Encountered, NS = Not Surveyed, P = Perched

WHITESTONE

# RECORD OF SUBSURFACE EXPLORATION

**Boring No.:** B-6

Page 1 of 1

| | | | |
|---|---|---|---|
| **Project:** | Proposed Chase Bank Branch | **WAI Project No.:** | GM2321010.000 |
| **Location:** | 165 Newburyport Turnpike, Rowley, Essex County, Massachusetts | **Client:** | Stonefield Engineering & Design, LLC |
| **Surface Elevation:** | ± 64.0 feet Above NAVD88 | **Date Started:** | 10/25/2023 |
| **Termination Depth:** | 9.0 feet bgs | **Date Completed:** | 10/25/2023 |
| **Proposed Location:** | Parking | **Logged By:** | ZH |
| **Drill / Test Method:** | HSA / SPT | **Contractor:** | GS |
| | | **Equipment:** | CME 55LT |

| | Water Depth (feet bgs) | Elevation (ft NAVD88) | Cave-In Depth (feet bgs) | Elevation (ft NAVD88) |
|---|---|---|---|---|
| **During:** | -- | -- | | |
| **At Completion:** | -- | -- | **At Completion:** | -- / -- |
| **24 Hours:** | -- | -- | **24 Hours:** | -- / -- |

| SAMPLE INFORMATION | | | | | | DEPTH | STRATA | | DESCRIPTION OF MATERIALS (Classification) | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|
| Depth (feet) | No | Type | Blows Per 6" | Rec. (in.) | N | (feet) | | | | |
| | | | | | | 0.0 | | | | |
| | | | | | | | TS | | 2" Topsoil | |
| 0 - 2 | S-1 | | 4 - 8 - 6 - 5 | 12 | 14 | | EXISTING FILL | | Brown, Medium Dense, Poorly Graded Sand with Silt and Gravel (FILL) | |
| 2 - 4 | S-2 | | 4 - 2 - 2 - 1 | 6 | 4 | | | | As Above, Very Loose to Loose (FILL) | |
| | | | | | | 5.0 | | | | |
| 5 - 7 | S-3 | | WOH - 2 - 2 - 2 | 5 | 4 | | | | As Above, with Topsoil (FILL) | |
| 7 - 9 | S-4 | | 4 - 3 - 26 - 20 | 14 | 29 | | | | Brown, Medium Dense, Silty Sand with Gravel (FILL) | |
| | | | | | | 10.0 | | | Boring Log B-6 Terminated at Depth of 9.0 Feet Below Ground Surface. | |
| | | | | | | 15.0 | | | | |
| | | | | | | 20.0 | | | | |
| | | | | | | 25.0 | | | | |

NOTES: bgs = below ground surface, msl = mean sea level, NA = Not Applicable, NE = Not Encountered, NS = Not Surveyed, P = Perched

WHITESTONE

# RECORD OF SUBSURFACE EXPLORATION

**Boring No.:** B-7

Page 1 of 1

| | | | |
|---|---|---|---|
| **Project:** | Proposed Chase Bank Branch | **WAI Project No.:** | GM2321010.000 |
| **Location:** | 165 Newburyport Turnpike, Rowley, Essex County, Massachusetts | **Client:** | Stonefield Engineering & Design, LLC |
| **Surface Elevation:** | ± 65.0 feet Above NAVD88 | **Date Started:** | 10/25/2023 |
| **Termination Depth:** | 9.0 feet bgs | **Date Completed:** | 10/25/2023 |
| **Proposed Location:** | Parking | **Logged By:** | ZH |
| **Drill / Test Method:** | HSA / SPT | **Contractor:** | GS |
| | | **Equipment:** | CME 55LT |

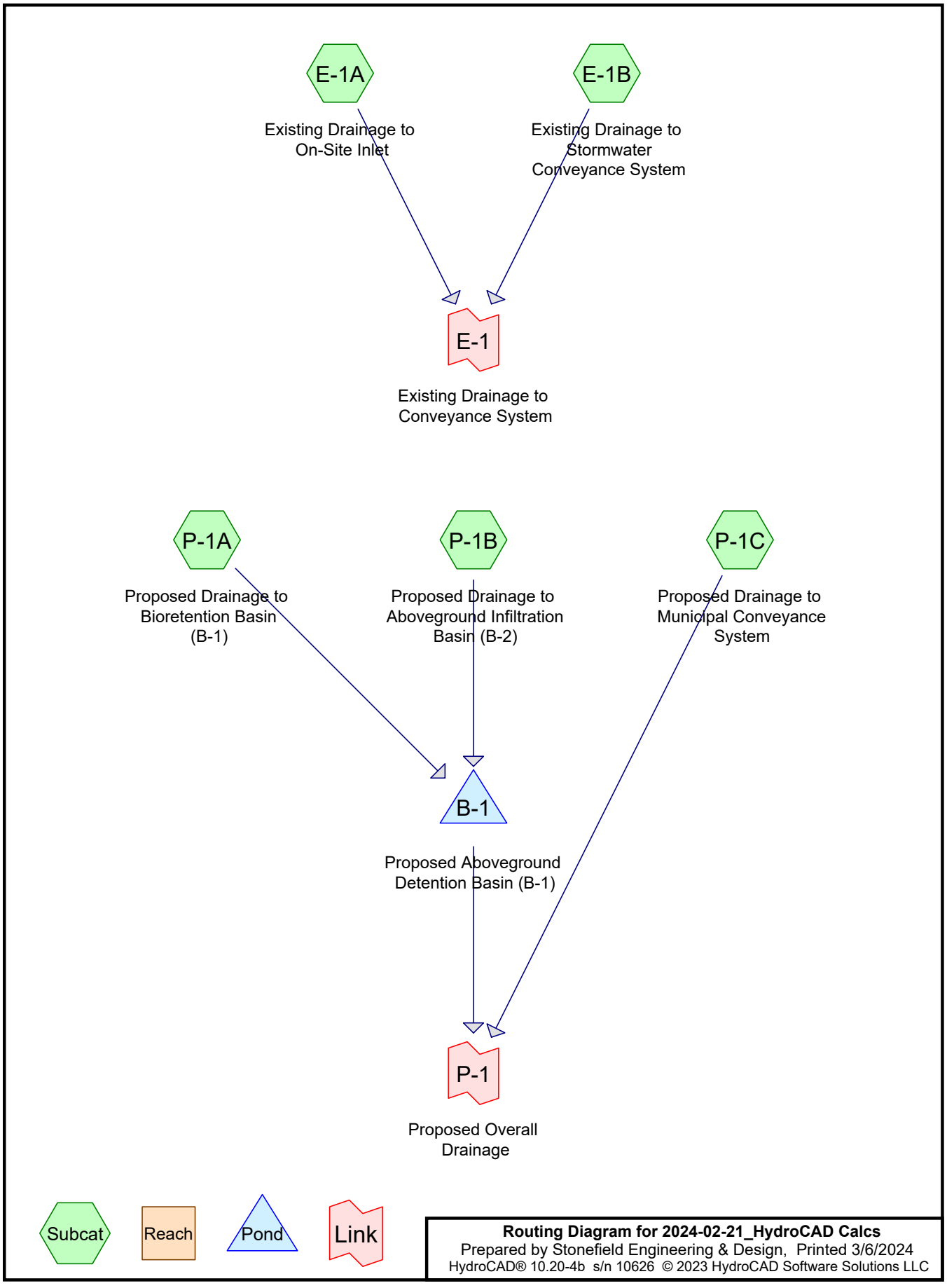
| | Water Depth (feet bgs) | Elevation (ft NAVD88) | Cave-In Depth (feet bgs) | Elevation (ft NAVD88) |
|---|---|---|---|---|
| **During:** | -- | -- | | |
| **At Completion:** | -- | -- | **At Completion:** | -- / -- |
| **24 Hours:** | -- | -- | **24 Hours:** | -- / -- |

| SAMPLE INFORMATION | | | | | | DEPTH | STRATA | | DESCRIPTION OF MATERIALS (Classification) | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|
| Depth (feet) | No | Type | Blows Per 6" | Rec. (in.) | N | (feet) | | | | |
| | | | | | | 0.0 | | | | |
| | | | | | | | TS | | 7" Topsoil | |
| 0 - 2 | S-1 | | 3 - 7 - 11 - 12 | 18 | 18 | | EXISTING FILL | | Brown to Black, Medium Dense, Poorly Graded Sand with Silt and Gravel (FILL) | |
| 2 - 4 | S-2 | | 9 - 10 - 9 - 7 | 9 | 19 | | | | As Above, Brown (FILL) | |
| | | | | | | 5.0 | | | | |
| 5 - 7 | S-3 | | 4 - 8 - 6 - 4 | 10 | 14 | | | | As Above (FILL) | |
| 7 - 9 | S-4 | | 6 - 4 - 4 - 4 | 3 | 8 | | | | As Above, Loose (FILL) | |
| | | | | | | 10.0 | | | Boring Log B-7 Terminated at Depth of 9.0 Feet Below Ground Surface. | |
| | | | | | | 15.0 | | | | |
| | | | | | | 20.0 | | | | |
| | | | | | | 25.0 | | | | |

NOTES: bgs = below ground surface, msl = mean sea level, NA = Not Applicable, NE = Not Encountered, NS = Not Surveyed, P = Perched

# APPENDIX C
# HYDROLOGIC & HYDRAULIC CALCULATIONS

## INVENTORY




**Routing Diagram for 2024-02-21_HydroCAD Calcs**
Prepared by Stonefield Engineering & Design, Printed 3/6/2024

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

**Subcatchment E-1A: Existing Drainage to** Runoff Area=53,681 sf 52.61% Impervious Runoff Depth=1.54"
Tc=6.0 min CN=39/98 Runoff=1.84 cfs 6,867 cf

**Subcatchment E-1B: Existing Drainage to** Runoff Area=1,528 sf 100.00% Impervious Runoff Depth=2.92"
Tc=6.0 min CN=0/98 Runoff=0.10 cfs 372 cf

**Subcatchment P-1A: Proposed Drainage** Runoff Area=16,813 sf 57.82% Impervious Runoff Depth=1.69"
Tc=6.0 min CN=39/98 Runoff=0.63 cfs 2,364 cf

**Subcatchment P-1B: Proposed Drainage** Runoff Area=29,817 sf 55.47% Impervious Runoff Depth=1.62"
Tc=6.0 min CN=39/98 Runoff=1.08 cfs 4,022 cf

**Subcatchment P-1C: Proposed Drainage to** Runoff Area=8,579 sf 84.52% Impervious Runoff Depth=2.47"
Tc=6.0 min CN=39/98 Runoff=0.47 cfs 1,763 cf

**Pond B-1: Proposed Aboveground Detention** Peak Elev=59.77' Storage=682 cf Inflow=1.71 cfs 6,385 cf
Outflow=1.12 cfs 6,384 cf

**Link E-1: Existing Drainage to Conveyance System** Inflow=1.94 cfs 7,239 cf
Primary=1.94 cfs 7,239 cf

**Link P-1: Proposed Overall Drainage** Inflow=1.51 cfs 8,147 cf
Primary=1.51 cfs 8,147 cf

**Total Runoff Area = 110,418 sf Runoff Volume = 15,387 cf Average Runoff Depth = 1.67"**
**42.69% Pervious = 47,134 sf 57.31% Impervious = 63,284 sf**

## Summary for Subcatchment E-1A: Existing Drainage to On-Site Inlet

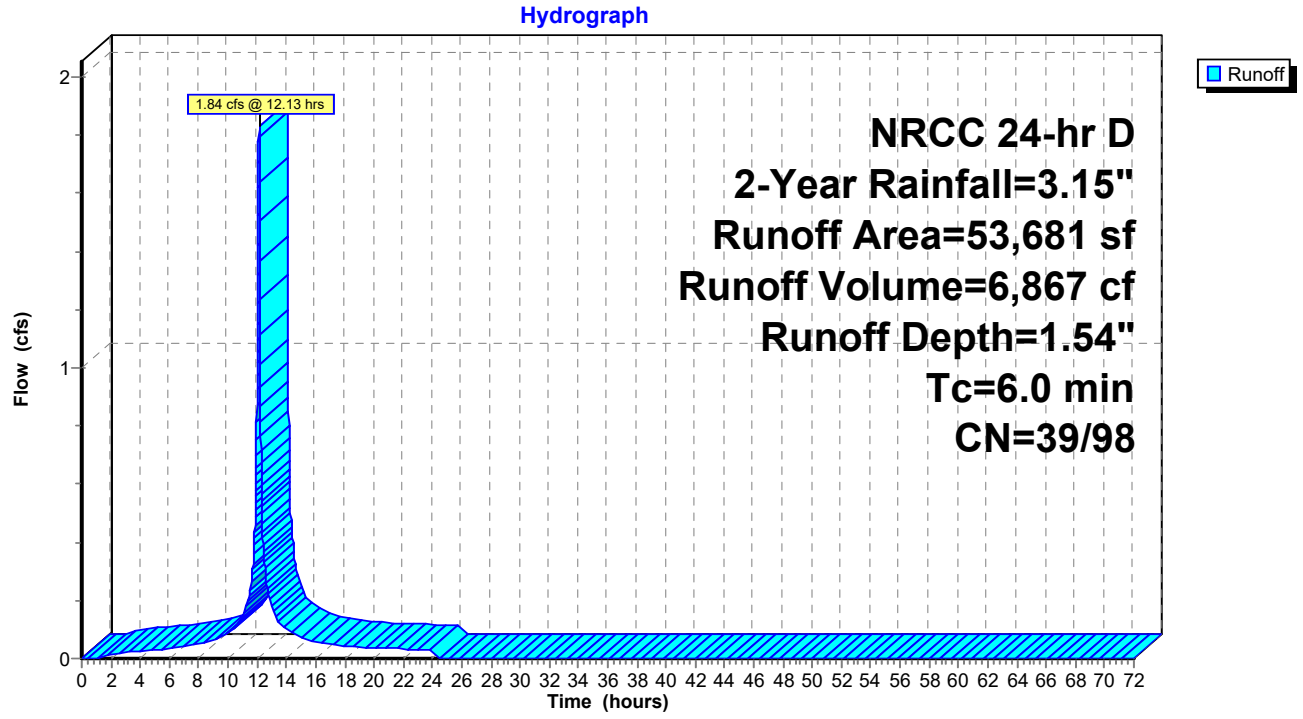
Runoff = 1.84 cfs @ 12.13 hrs, Volume= 6,867 cf, Depth= 1.54"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 2-Year Rainfall=3.15"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 28,244 | 98 | Impervious Area |
| | 25,437 | 39 | >75% Grass cover, Good, HSG A |
| | 53,681 | 70 | Weighted Average |
| | 25,437 | 39 | 47.39% Pervious Area |
| | 28,244 | 98 | 52.61% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Minimum TOC** |

## Subcatchment E-1A: Existing Drainage to On-Site Inlet



## Summary for Subcatchment E-1B: Existing Drainage to Stormwater Conveyance System

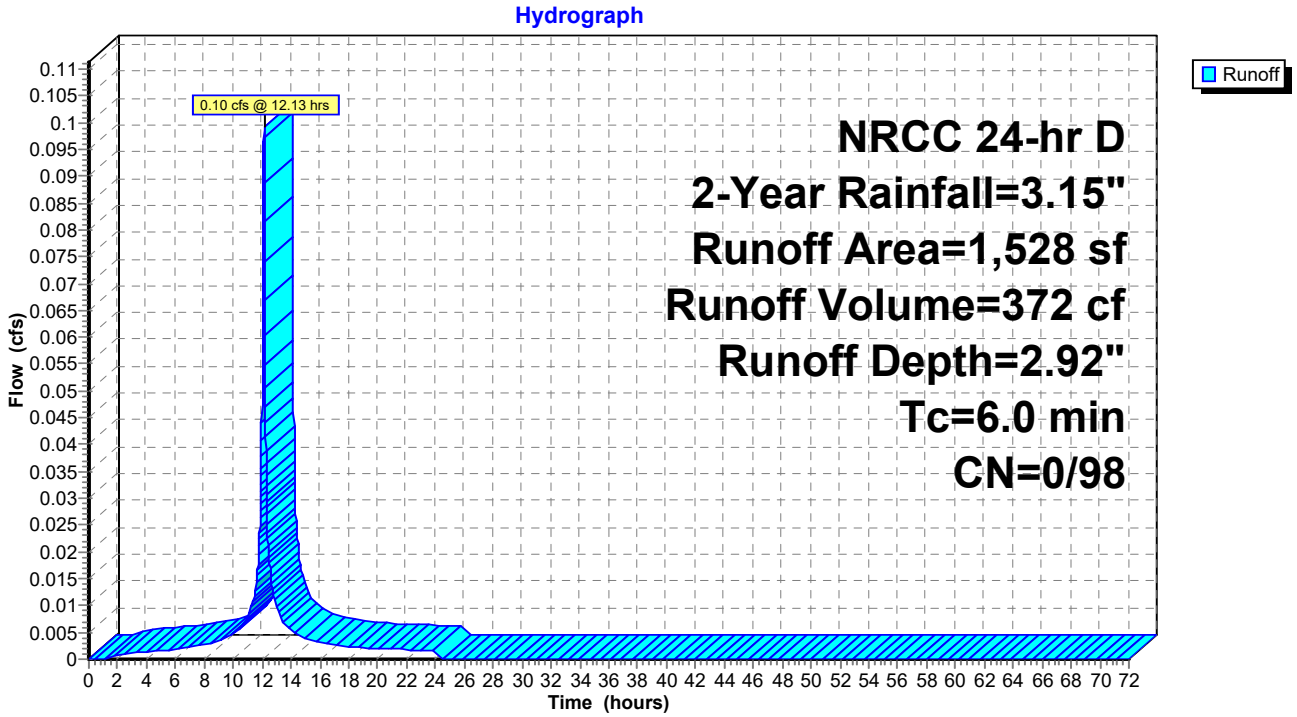
Runoff = 0.10 cfs @ 12.13 hrs, Volume= 372 cf, Depth= 2.92"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 2-Year Rainfall=3.15"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 1,528 | 98 | Impervious Areas |
| | 1,528 | 98 | 100.00% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Minimum TOC** |

### Subcatchment E-1B: Existing Drainage to Stormwater Conveyance System



## Summary for Subcatchment P-1A: Proposed Drainage to Bioretention Basin (B-1)

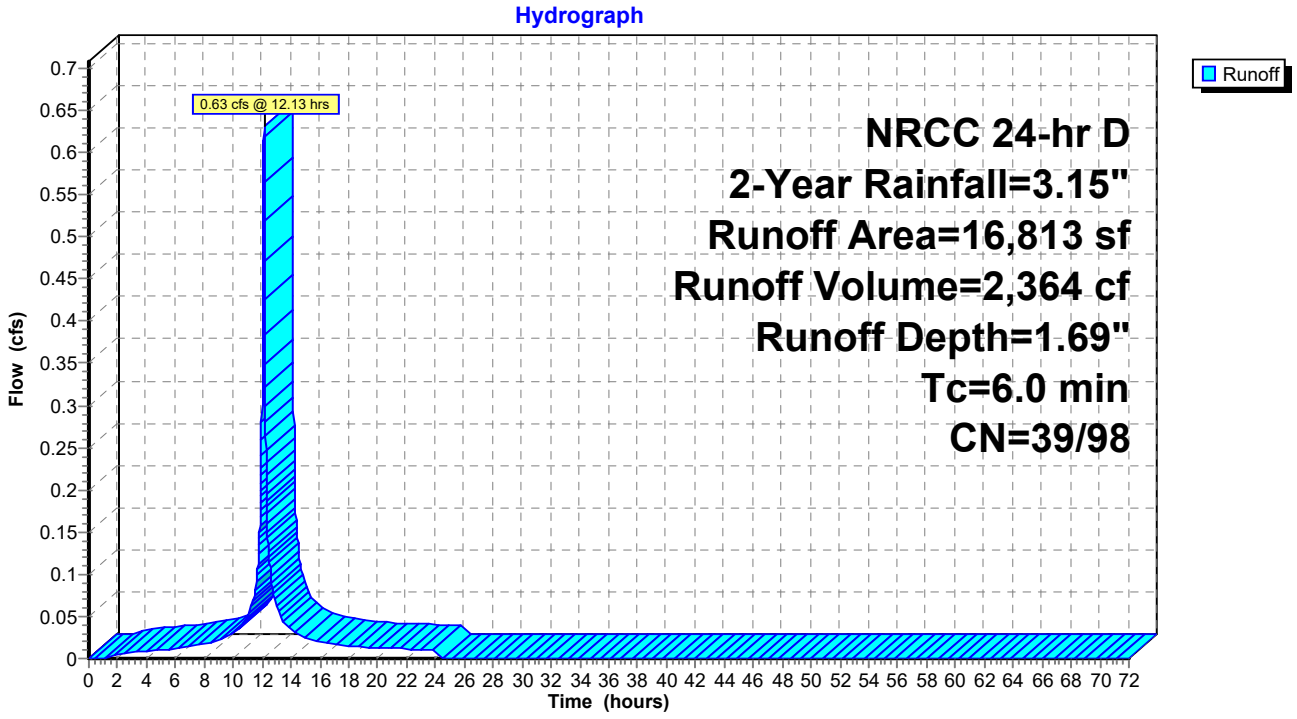
Runoff = 0.63 cfs @ 12.13 hrs, Volume= 2,364 cf, Depth= 1.69"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 2-Year Rainfall=3.15"

| Area (sf) | CN | Description |
|---|---|---|
| 9,721 | 98 | Paved parking, HSG A |
| 7,092 | 39 | >75% Grass cover, Good, HSG A |
| 16,813 | 73 | Weighted Average |
| 7,092 | 39 | 42.18% Pervious Area |
| 9,721 | 98 | 57.82% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, MInimum ToC** |

## Subcatchment P-1A: Proposed Drainage to Bioretention Basin (B-1)



## Summary for Subcatchment P-1B: Proposed Drainage to Aboveground Infiltration Basin (B-2)

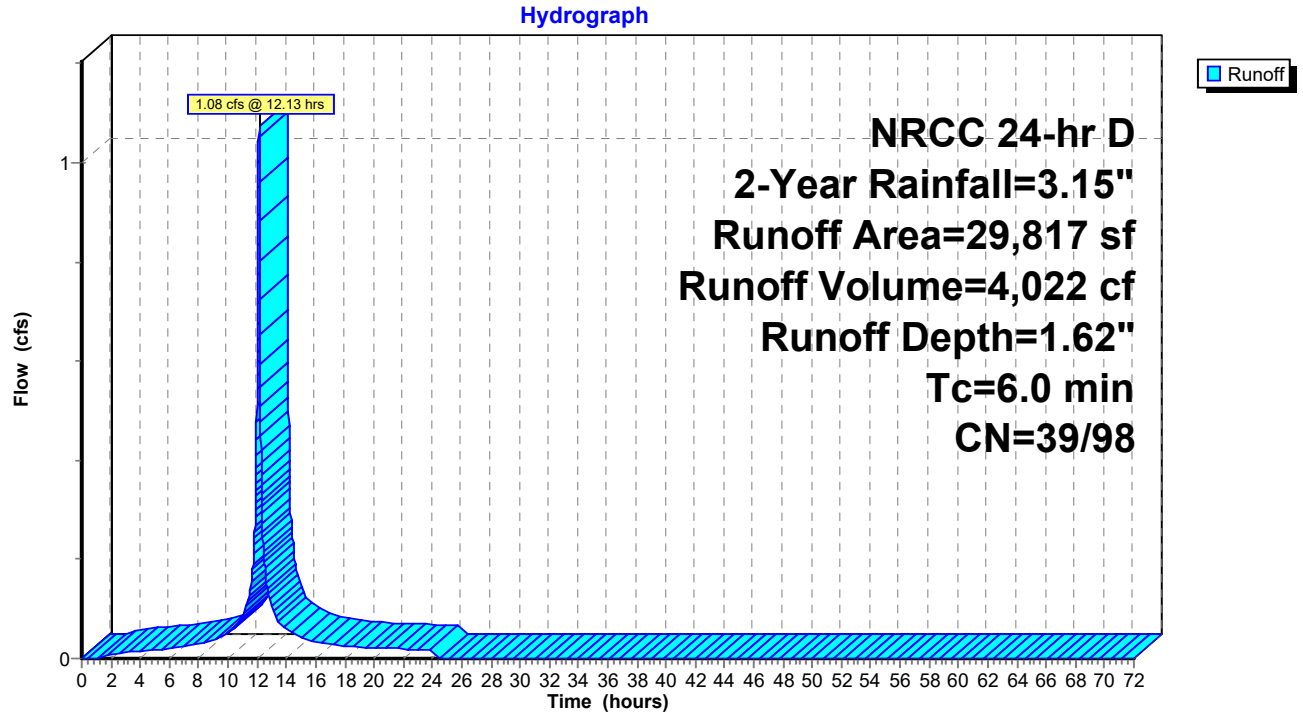
Runoff = 1.08 cfs @ 12.13 hrs, Volume= 4,022 cf, Depth= 1.62"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 2-Year Rainfall=3.15"

| Area (sf) | CN | Description |
|---|---|---|
| 16,540 | 98 | Paved parking, HSG A |
| 13,277 | 39 | >75% Grass cover, Good, HSG A |
| 29,817 | 72 | Weighted Average |
| 13,277 | 39 | 44.53% Pervious Area |
| 16,540 | 98 | 55.47% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Minimum ToC** |

### Subcatchment P-1B: Proposed Drainage to Aboveground Infiltration Basin (B-2)



## Summary for Subcatchment P-1C: Proposed Drainage to Municipal Conveyance System

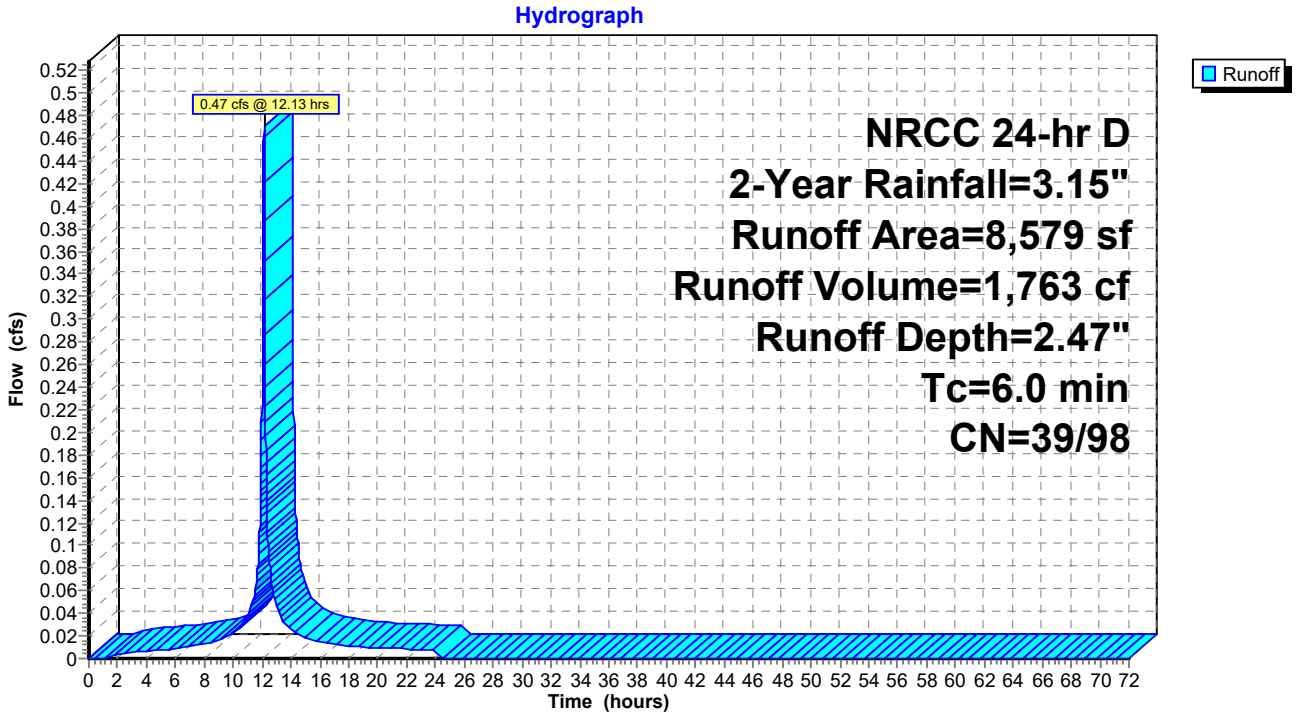
Runoff = 0.47 cfs @ 12.13 hrs, Volume= 1,763 cf, Depth= 2.47"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 2-Year Rainfall=3.15"

| Area (sf) | CN | Description |
|---|---|---|
| 7,251 | 98 | Paved parking, HSG A |
| 1,328 | 39 | >75% Grass cover, Good, HSG A |
| 8,579 | 89 | Weighted Average |
| 1,328 | 39 | 15.48% Pervious Area |
| 7,251 | 98 | 84.52% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Minimum ToC** |

### Subcatchment P-1C: Proposed Drainage to Municipal Conveyance System



## Summary for Pond B-1: Proposed Aboveground Detention Basin (B-1)

Inflow Area = 46,630 sf, 56.32% Impervious, Inflow Depth = 1.64" for 2-Year event
Inflow = 1.71 cfs @ 12.13 hrs, Volume= 6,385 cf
Outflow = 1.12 cfs @ 12.19 hrs, Volume= 6,384 cf, Atten= 35%, Lag= 3.9 min
Primary = 1.12 cfs @ 12.19 hrs, Volume= 6,384 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 59.77' @ 12.19 hrs Surf.Area= 1,125 sf Storage= 682 cf

Plug-Flow detention time= 21.0 min calculated for 6,384 cf (100% of inflow)
Center-of-Mass det. time= 20.9 min ( 781.8 - 760.8 )

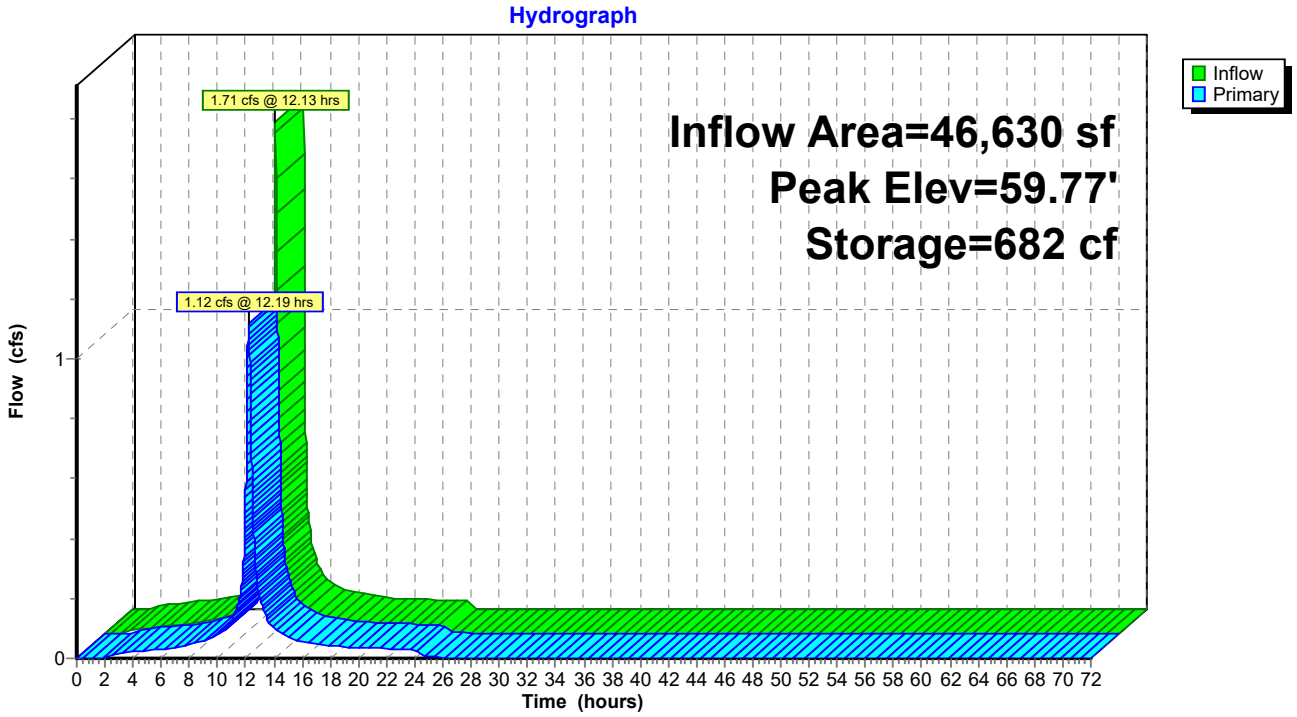
| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 59.00' | 5,738 cf | **Aboveground Storage (Irregular)** Listed below (Recalc) |

| Elevation (feet) | Surf.Area (sq-ft) | Perim. (feet) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) | Wet.Area (sq-ft) |
|---|---|---|---|---|---|
| 59.00 | 659 | 189.5 | 0 | 0 | 659 |
| 60.00 | 1,285 | 215.2 | 955 | 955 | 1,511 |
| 61.00 | 2,002 | 243.7 | 1,630 | 2,585 | 2,577 |
| 62.00 | 2,850 | 283.7 | 2,414 | 4,999 | 4,276 |
| 62.25 | 3,065 | 288.4 | 739 | 5,738 | 4,502 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 59.00' | **15.0" Horiz. 15" Outlet Pipe** C= 0.600<br>Limited to weir flow at low heads |
| #2 | Device 1 | 59.00' | **8.0" Vert. Low Flow Orifice** C= 0.600<br>Limited to weir flow at low heads |
| #3 | Device 1 | 60.50' | **24.0" x 24.0" Horiz. Overflow Grate** C= 0.600<br>Limited to weir flow at low heads |

**Primary OutFlow** Max=1.11 cfs @ 12.19 hrs HW=59.77' TW=0.00' (Dynamic Tailwater)
└**1=15" Outlet Pipe** (Passes 1.11 cfs of 5.20 cfs potential flow)
  ├**2=Low Flow Orifice** (Orifice Controls 1.11 cfs @ 3.19 fps)
  └**3=Overflow Grate** ( Controls 0.00 cfs)

## Pond B-1: Proposed Aboveground Detention Basin (B-1)

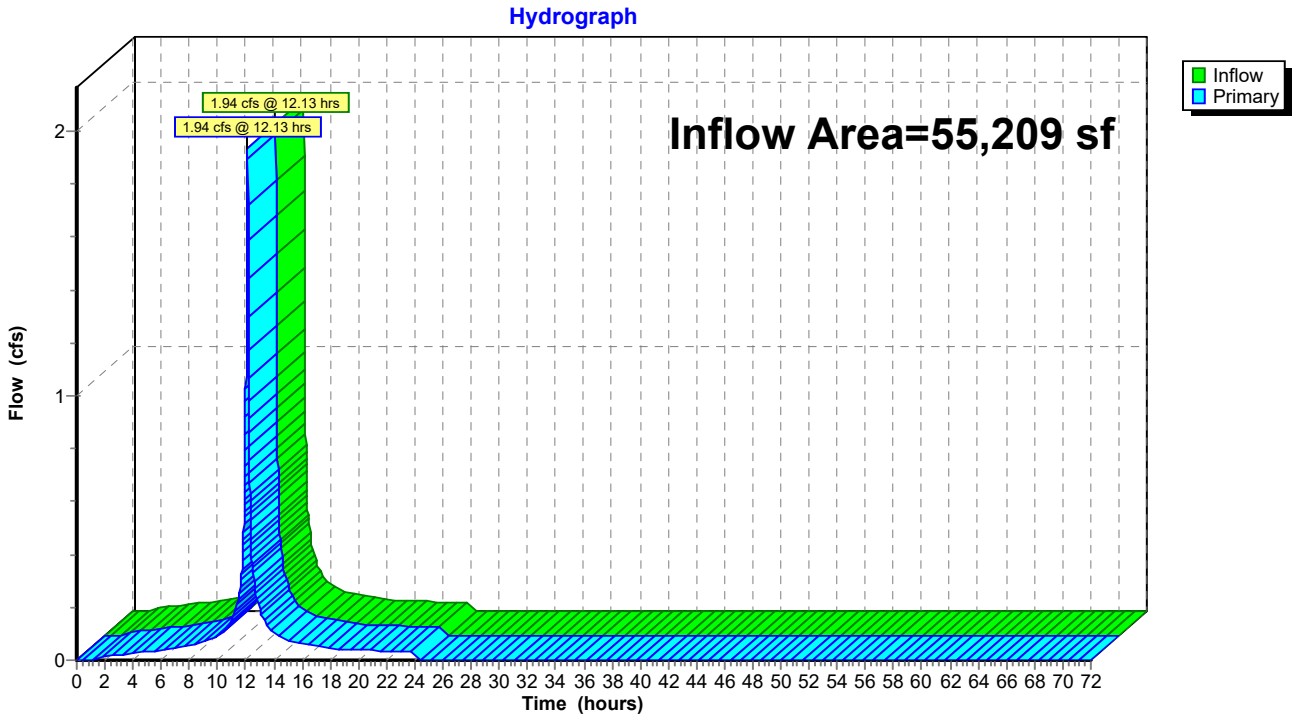


## Summary for Link E-1: Existing Drainage to Conveyance System

Inflow Area = 55,209 sf, 53.93% Impervious, Inflow Depth = 1.57" for 2-Year event
Inflow = 1.94 cfs @ 12.13 hrs, Volume= 7,239 cf
Primary = 1.94 cfs @ 12.13 hrs, Volume= 7,239 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

## Link E-1: Existing Drainage to Conveyance System

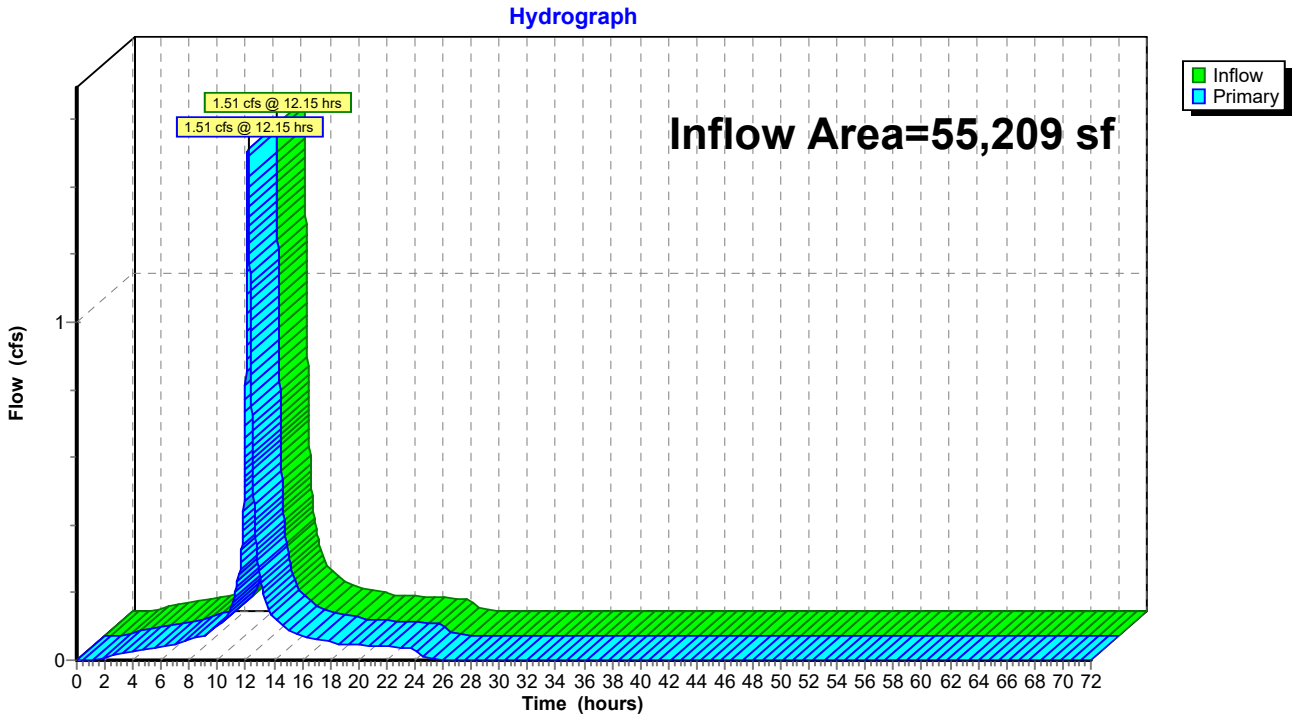


## Summary for Link P-1: Proposed Overall Drainage

Inflow Area = 55,209 sf, 60.70% Impervious, Inflow Depth = 1.77" for 2-Year event
Inflow = 1.51 cfs @ 12.15 hrs, Volume= 8,147 cf
Primary = 1.51 cfs @ 12.15 hrs, Volume= 8,147 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

## Link P-1: Proposed Overall Drainage



Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

**Subcatchment E-1A: Existing Drainage to** Runoff Area=53,681 sf 52.61% Impervious Runoff Depth=2.50"
Tc=6.0 min CN=39/98 Runoff=2.84 cfs 11,165 cf

**Subcatchment E-1B: Existing Drainage to** Runoff Area=1,528 sf 100.00% Impervious Runoff Depth=4.59"
Tc=6.0 min CN=0/98 Runoff=0.15 cfs 585 cf

**Subcatchment P-1A: Proposed Drainage** Runoff Area=16,813 sf 57.82% Impervious Runoff Depth=2.73"
Tc=6.0 min CN=39/98 Runoff=0.98 cfs 3,820 cf

**Subcatchment P-1B: Proposed Drainage** Runoff Area=29,817 sf 55.47% Impervious Runoff Depth=2.62"
Tc=6.0 min CN=39/98 Runoff=1.66 cfs 6,516 cf

**Subcatchment P-1C: Proposed Drainage to** Runoff Area=8,579 sf 84.52% Impervious Runoff Depth=3.91"
Tc=6.0 min CN=39/98 Runoff=0.73 cfs 2,794 cf

**Pond B-1: Proposed Aboveground** Peak Elev=60.12' Storage=1,116 cf Inflow=2.64 cfs 10,336 cf
Outflow=1.49 cfs 10,335 cf

**Link E-1: Existing Drainage to Conveyance System** Inflow=2.99 cfs 11,750 cf
Primary=2.99 cfs 11,750 cf

**Link P-1: Proposed Overall Drainage** Inflow=2.11 cfs 13,129 cf
Primary=2.11 cfs 13,129 cf

**Total Runoff Area = 110,418 sf Runoff Volume = 24,880 cf Average Runoff Depth = 2.70"**
**42.69% Pervious = 47,134 sf 57.31% Impervious = 63,284 sf**

## Summary for Subcatchment E-1A: Existing Drainage to On-Site Inlet

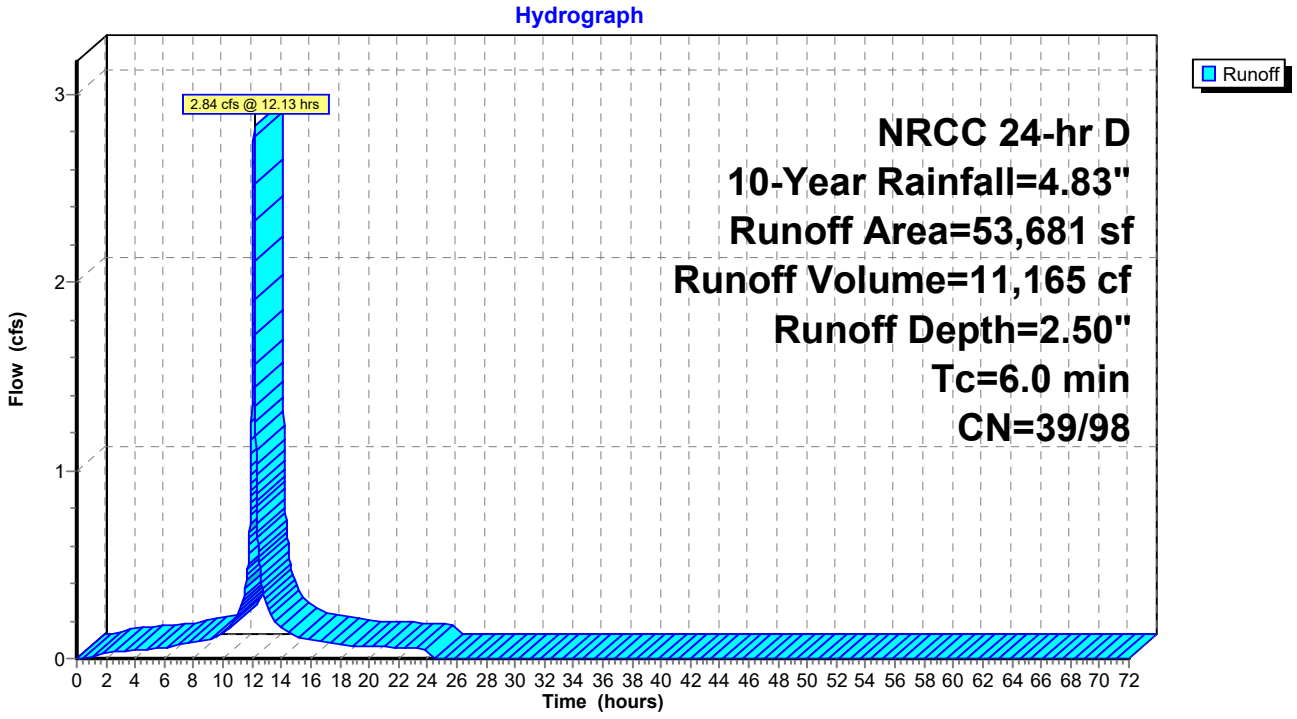
Runoff = 2.84 cfs @ 12.13 hrs, Volume= 11,165 cf, Depth= 2.50"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 10-Year Rainfall=4.83"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 28,244 | 98 | Impervious Area |
| | 25,437 | 39 | >75% Grass cover, Good, HSG A |
| | 53,681 | 70 | Weighted Average |
| | 25,437 | 39 | 47.39% Pervious Area |
| | 28,244 | 98 | 52.61% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Minimum TOC** |

## Subcatchment E-1A: Existing Drainage to On-Site Inlet



## Summary for Subcatchment E-1B: Existing Drainage to Stormwater Conveyance System

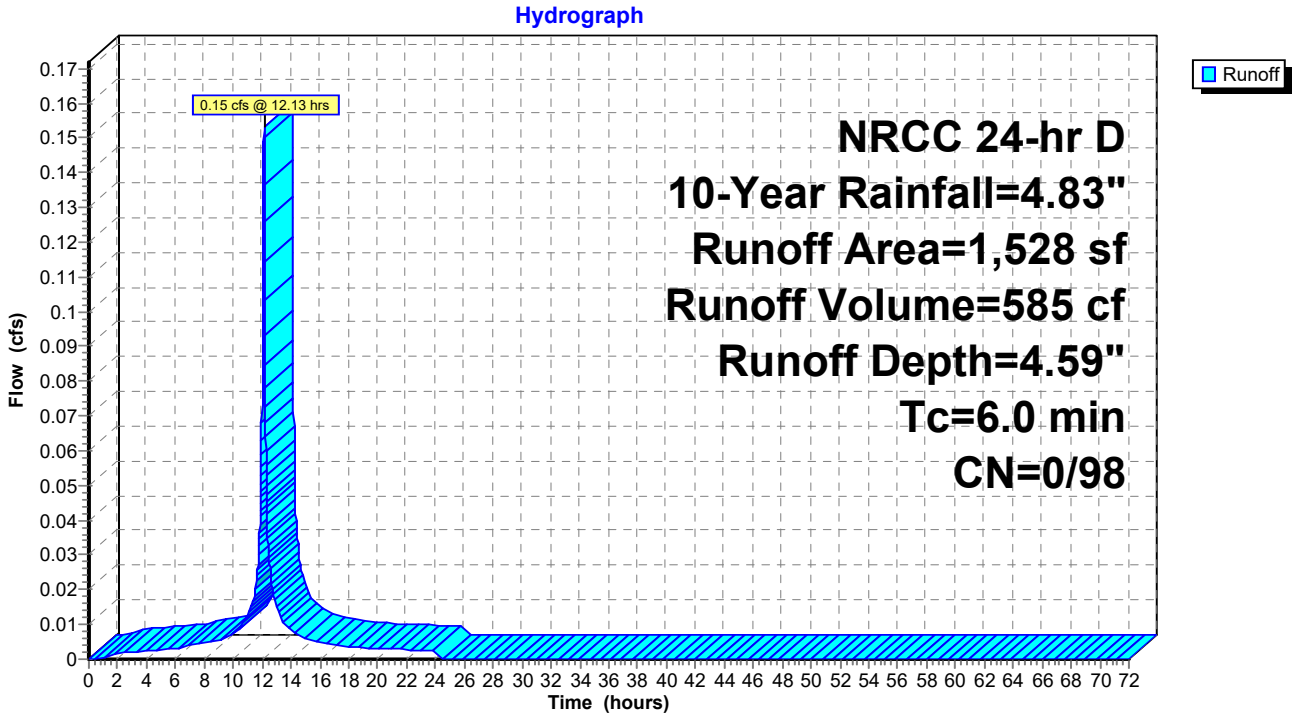
Runoff = 0.15 cfs @ 12.13 hrs, Volume= 585 cf, Depth= 4.59"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 10-Year Rainfall=4.83"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 1,528 | 98 | Impervious Areas |
| | 1,528 | 98 | 100.00% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Minimum TOC** |

### Subcatchment E-1B: Existing Drainage to Stormwater Conveyance System



## Summary for Subcatchment P-1A: Proposed Drainage to Bioretention Basin (B-1)

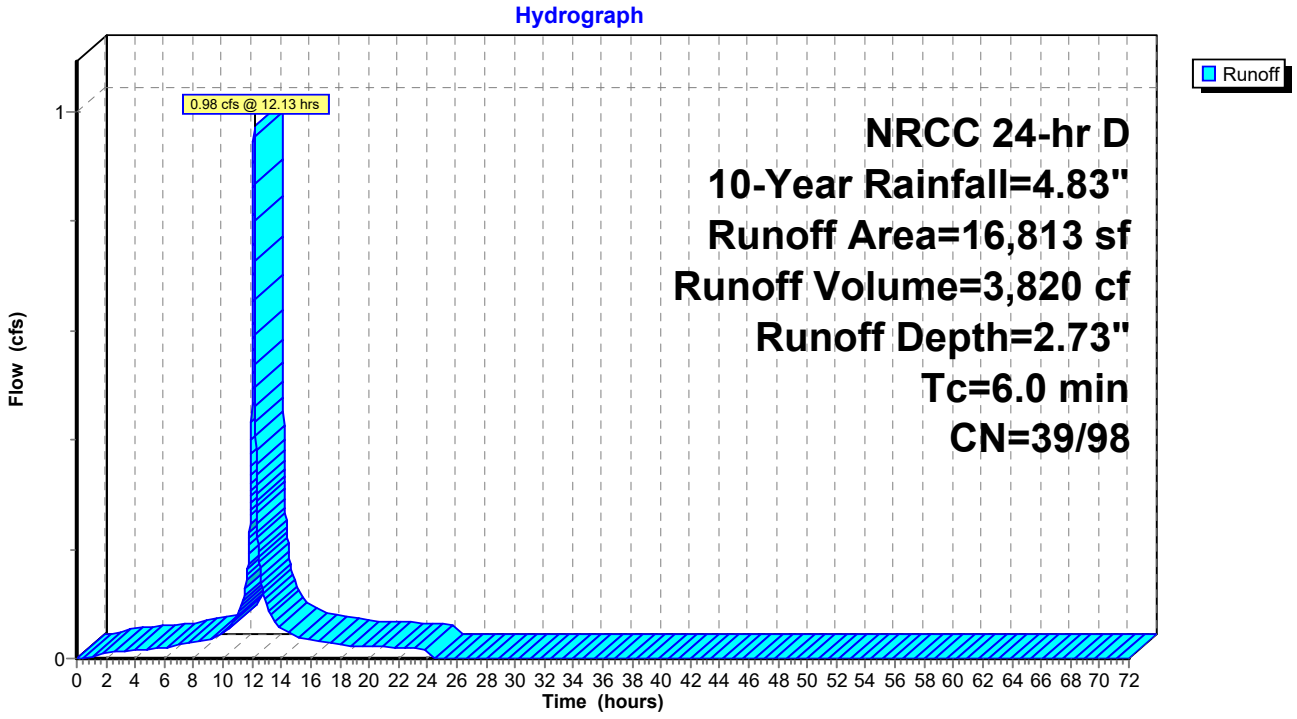
Runoff = 0.98 cfs @ 12.13 hrs, Volume= 3,820 cf, Depth= 2.73"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 10-Year Rainfall=4.83"

| Area (sf) | CN | Description |
|---|---|---|
| 9,721 | 98 | Paved parking, HSG A |
| 7,092 | 39 | >75% Grass cover, Good, HSG A |
| 16,813 | 73 | Weighted Average |
| 7,092 | 39 | 42.18% Pervious Area |
| 9,721 | 98 | 57.82% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, MInimum ToC** |

## Subcatchment P-1A: Proposed Drainage to Bioretention Basin (B-1)



## Summary for Subcatchment P-1B: Proposed Drainage to Aboveground Infiltration Basin (B-2)

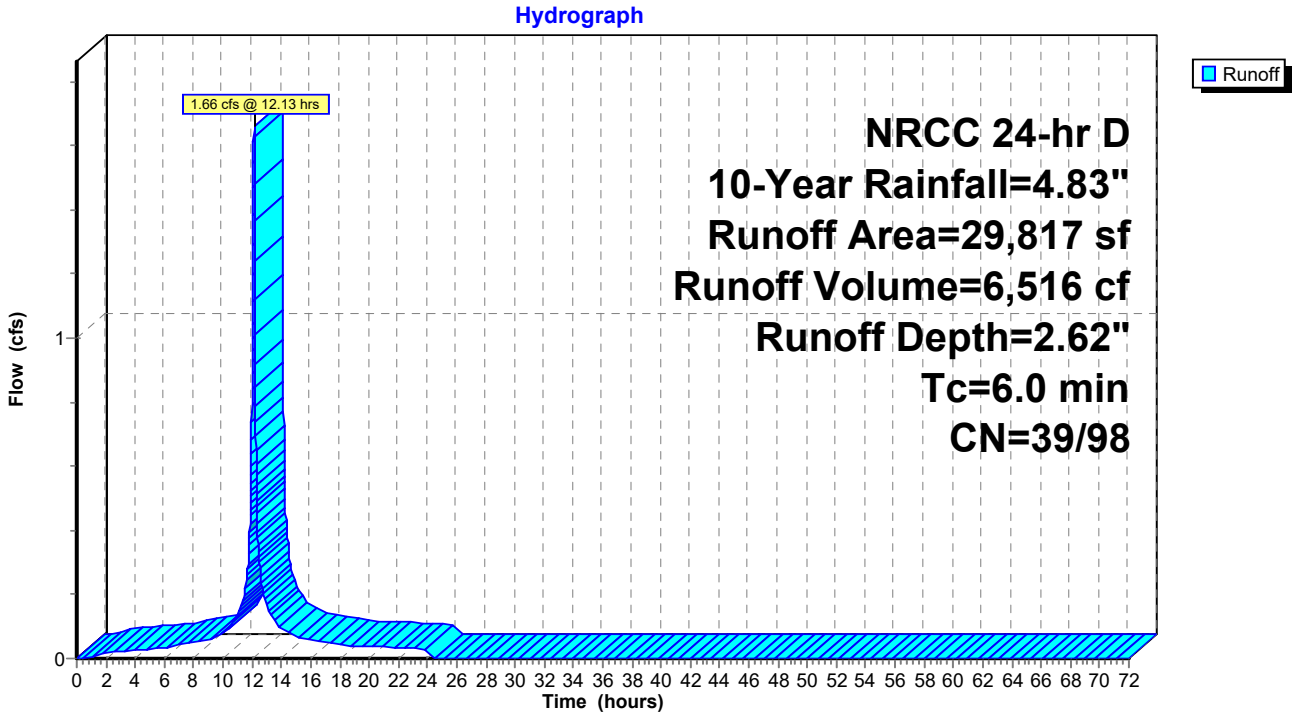
Runoff = 1.66 cfs @ 12.13 hrs, Volume= 6,516 cf, Depth= 2.62"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 10-Year Rainfall=4.83"

| Area (sf) | CN | Description |
|---|---|---|
| 16,540 | 98 | Paved parking, HSG A |
| 13,277 | 39 | >75% Grass cover, Good, HSG A |
| 29,817 | 72 | Weighted Average |
| 13,277 | 39 | 44.53% Pervious Area |
| 16,540 | 98 | 55.47% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Minimum ToC** |

### Subcatchment P-1B: Proposed Drainage to Aboveground Infiltration Basin (B-2)



## Summary for Subcatchment P-1C: Proposed Drainage to Municipal Conveyance System

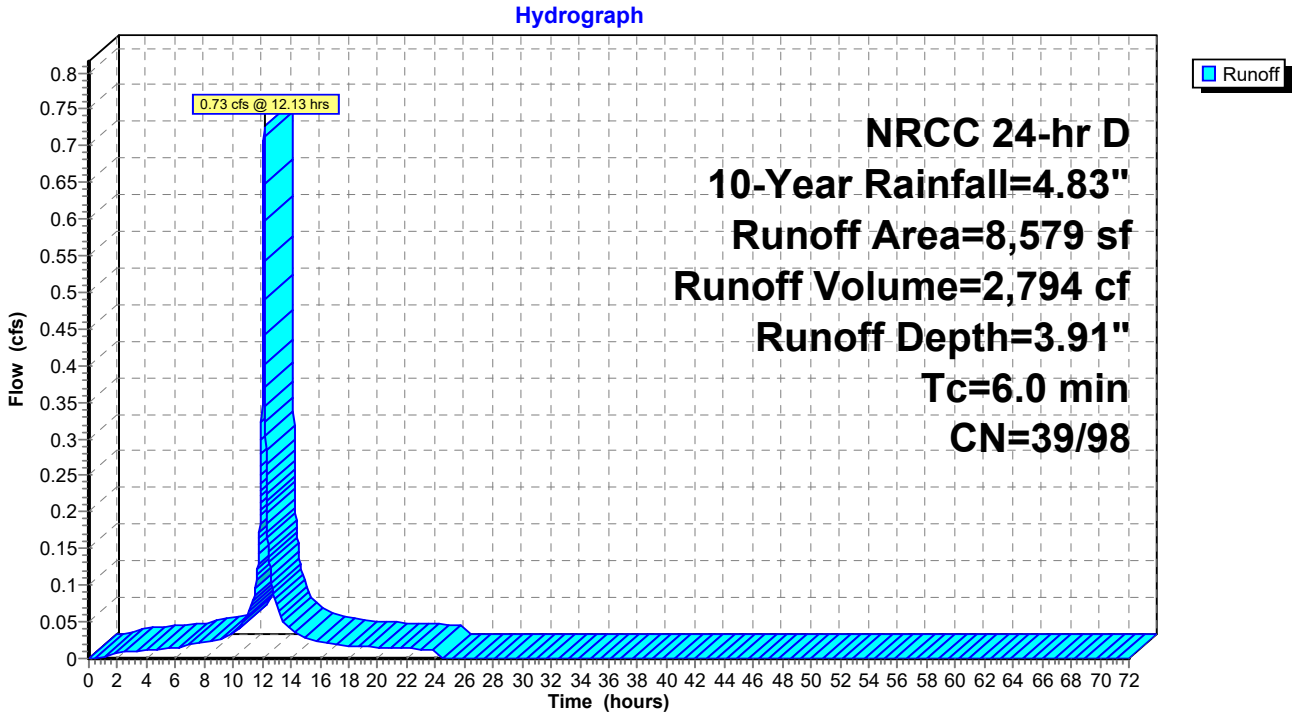
Runoff = 0.73 cfs @ 12.13 hrs, Volume= 2,794 cf, Depth= 3.91"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 10-Year Rainfall=4.83"

| Area (sf) | CN | Description |
|---|---|---|
| 7,251 | 98 | Paved parking, HSG A |
| 1,328 | 39 | >75% Grass cover, Good, HSG A |
| 8,579 | 89 | Weighted Average |
| 1,328 | 39 | 15.48% Pervious Area |
| 7,251 | 98 | 84.52% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Minimum ToC** |

### Subcatchment P-1C: Proposed Drainage to Municipal Conveyance System



## Summary for Pond B-1: Proposed Aboveground Detention Basin (B-1)

Inflow Area = 46,630 sf, 56.32% Impervious, Inflow Depth = 2.66" for 10-Year event
Inflow = 2.64 cfs @ 12.13 hrs, Volume= 10,336 cf
Outflow = 1.49 cfs @ 12.21 hrs, Volume= 10,335 cf, Atten= 43%, Lag= 4.7 min
Primary = 1.49 cfs @ 12.21 hrs, Volume= 10,335 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 60.12' @ 12.21 hrs Surf.Area= 1,364 sf Storage= 1,116 cf

Plug-Flow detention time= 17.9 min calculated for 10,335 cf (100% of inflow)
Center-of-Mass det. time= 17.8 min ( 778.1 - 760.4 )

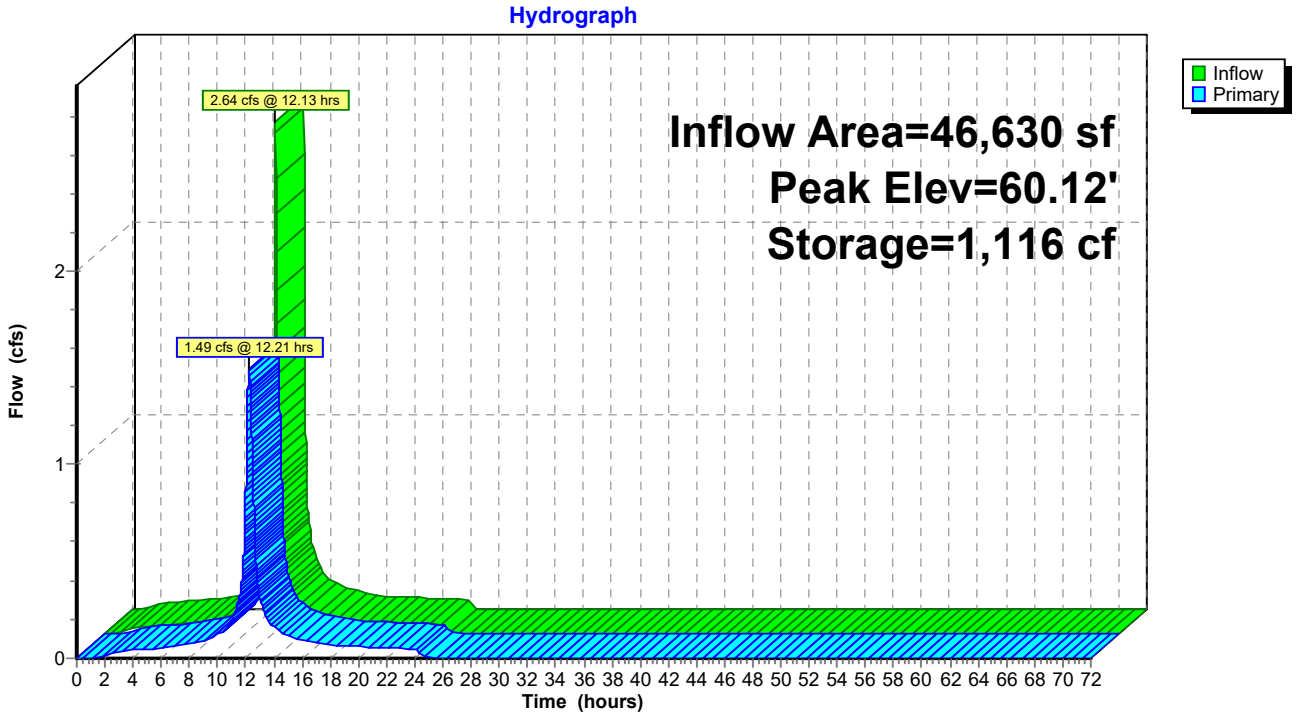
| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 59.00' | 5,738 cf | **Aboveground Storage (Irregular)** Listed below (Recalc) |

| Elevation (feet) | Surf.Area (sq-ft) | Perim. (feet) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) | Wet.Area (sq-ft) |
|---|---|---|---|---|---|
| 59.00 | 659 | 189.5 | 0 | 0 | 659 |
| 60.00 | 1,285 | 215.2 | 955 | 955 | 1,511 |
| 61.00 | 2,002 | 243.7 | 1,630 | 2,585 | 2,577 |
| 62.00 | 2,850 | 283.7 | 2,414 | 4,999 | 4,276 |
| 62.25 | 3,065 | 288.4 | 739 | 5,738 | 4,502 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 59.00' | **15.0" Horiz. 15" Outlet Pipe** C= 0.600<br>Limited to weir flow at low heads |
| #2 | Device 1 | 59.00' | **8.0" Vert. Low Flow Orifice** C= 0.600<br>Limited to weir flow at low heads |
| #3 | Device 1 | 60.50' | **24.0" x 24.0" Horiz. Overflow Grate** C= 0.600<br>Limited to weir flow at low heads |

**Primary OutFlow** Max=1.49 cfs @ 12.21 hrs HW=60.12' TW=0.00' (Dynamic Tailwater)
└─**1=15" Outlet Pipe** (Passes 1.49 cfs of 6.26 cfs potential flow)
  ├─**2=Low Flow Orifice** (Orifice Controls 1.49 cfs @ 4.28 fps)
  └─**3=Overflow Grate** ( Controls 0.00 cfs)

## Pond B-1: Proposed Aboveground Detention Basin (B-1)

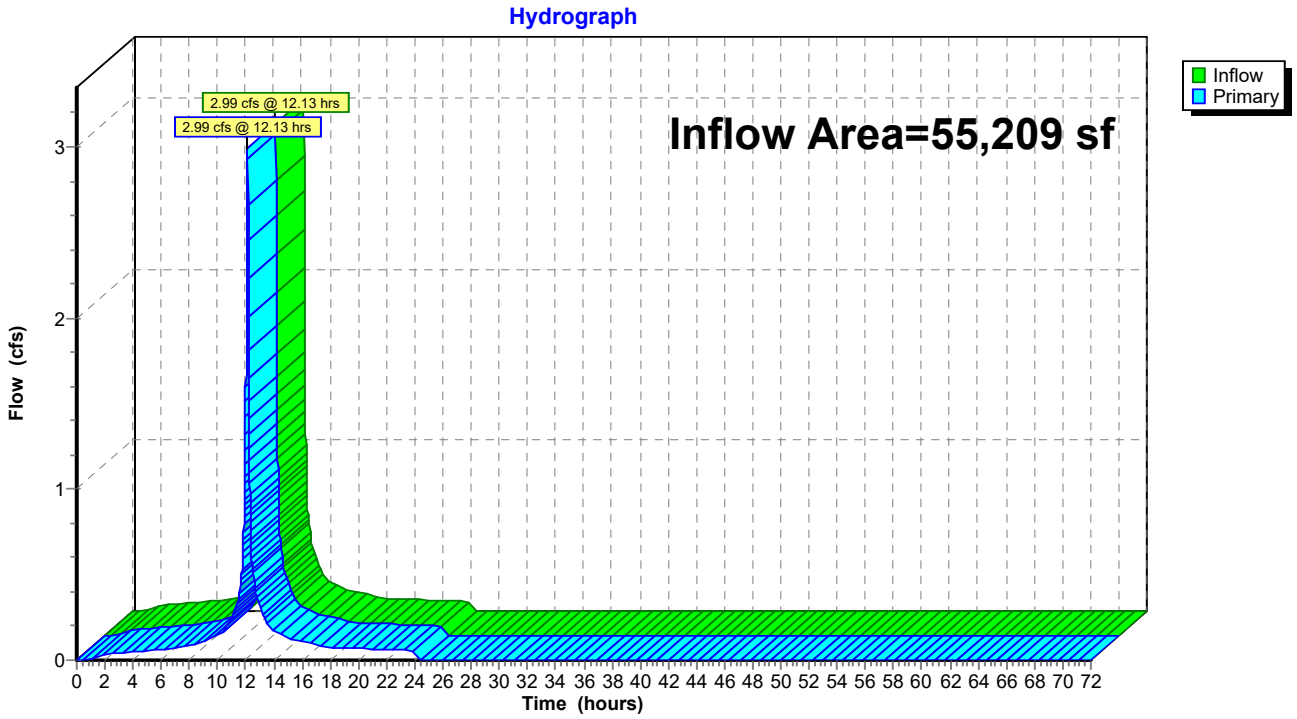


## Summary for Link E-1: Existing Drainage to Conveyance System

Inflow Area = 55,209 sf, 53.93% Impervious, Inflow Depth = 2.55" for 10-Year event
Inflow = 2.99 cfs @ 12.13 hrs, Volume= 11,750 cf
Primary = 2.99 cfs @ 12.13 hrs, Volume= 11,750 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

## Link E-1: Existing Drainage to Conveyance System

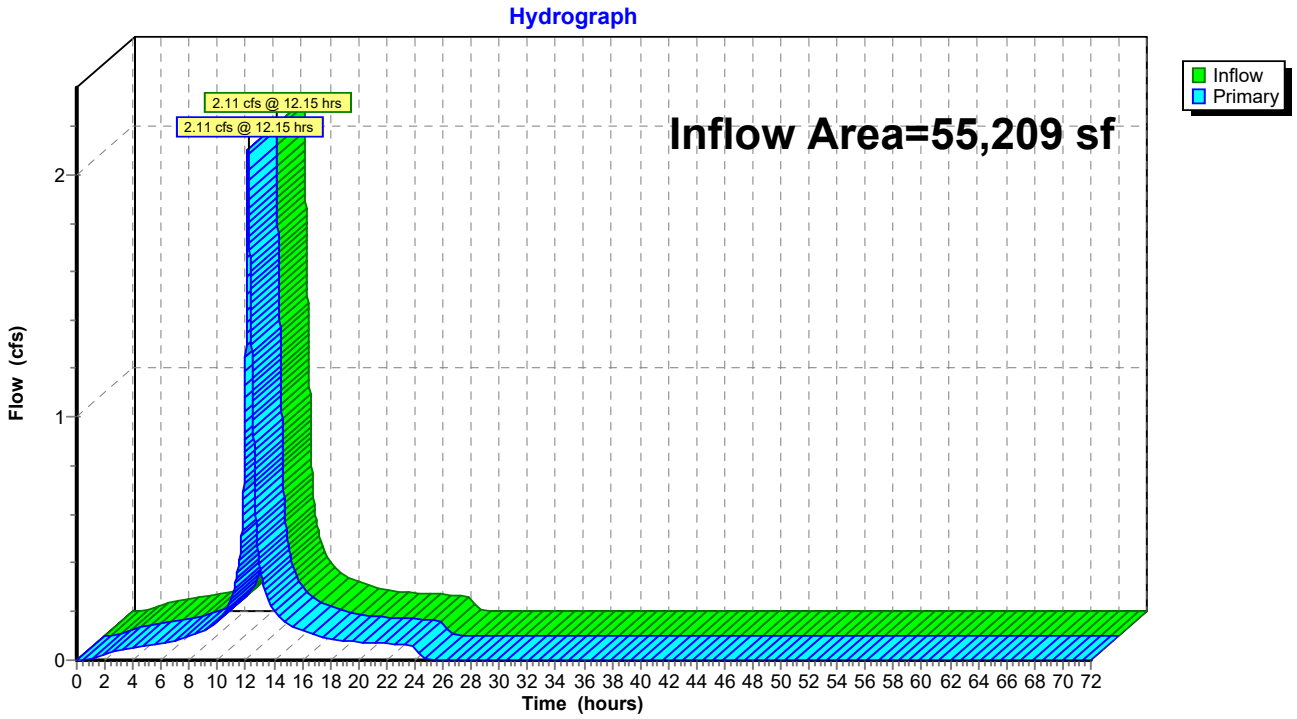


## Summary for Link P-1: Proposed Overall Drainage

Inflow Area = 55,209 sf, 60.70% Impervious, Inflow Depth = 2.85" for 10-Year event
Inflow = 2.11 cfs @ 12.15 hrs, Volume= 13,129 cf
Primary = 2.11 cfs @ 12.15 hrs, Volume= 13,129 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

## Link P-1: Proposed Overall Drainage



Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

**Subcatchment E-1A: Existing Drainage to** Runoff Area=53,681 sf 52.61% Impervious Runoff Depth=3.35"
Tc=6.0 min CN=39/98 Runoff=3.68 cfs 14,981 cf

**Subcatchment E-1B: Existing Drainage to** Runoff Area=1,528 sf 100.00% Impervious Runoff Depth=5.92"
Tc=6.0 min CN=0/98 Runoff=0.20 cfs 754 cf

**Subcatchment P-1A: Proposed Drainage** Runoff Area=16,813 sf 57.82% Impervious Runoff Depth=3.63"
Tc=6.0 min CN=39/98 Runoff=1.26 cfs 5,088 cf

**Subcatchment P-1B: Proposed Drainage** Runoff Area=29,817 sf 55.47% Impervious Runoff Depth=3.50"
Tc=6.0 min CN=39/98 Runoff=2.15 cfs 8,707 cf

**Subcatchment P-1C: Proposed Drainage to** Runoff Area=8,579 sf 84.52% Impervious Runoff Depth=5.08"
Tc=6.0 min CN=39/98 Runoff=0.93 cfs 3,633 cf

**Pond B-1: Proposed Aboveground** Peak Elev=60.41' Storage=1,538 cf Inflow=3.42 cfs 13,795 cf
Outflow=1.74 cfs 13,794 cf

**Link E-1: Existing Drainage to Conveyance System** Inflow=3.88 cfs 15,735 cf
Primary=3.88 cfs 15,735 cf

**Link P-1: Proposed Overall Drainage** Inflow=2.53 cfs 17,427 cf
Primary=2.53 cfs 17,427 cf

**Total Runoff Area = 110,418 sf Runoff Volume = 33,163 cf Average Runoff Depth = 3.60"**
**42.69% Pervious = 47,134 sf 57.31% Impervious = 63,284 sf**

## Summary for Subcatchment E-1A: Existing Drainage to On-Site Inlet

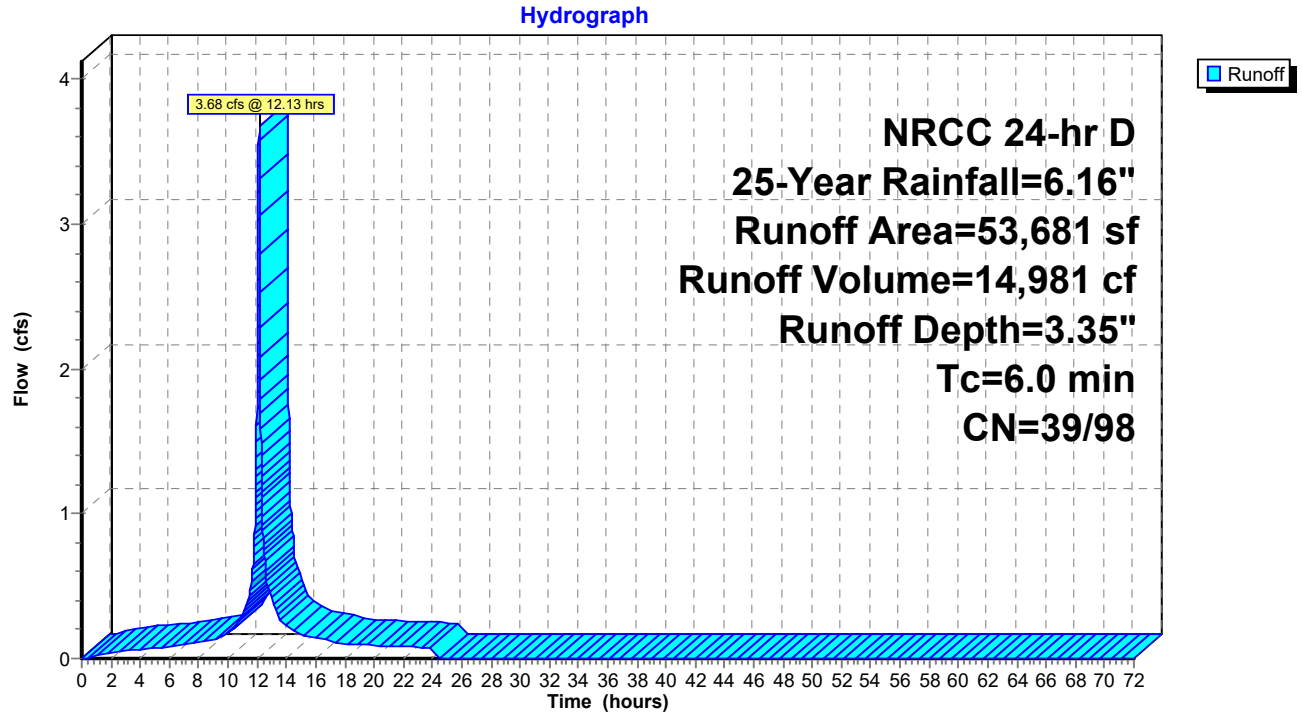
Runoff = 3.68 cfs @ 12.13 hrs, Volume= 14,981 cf, Depth= 3.35"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 25-Year Rainfall=6.16"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 28,244 | 98 | Impervious Area |
| | 25,437 | 39 | >75% Grass cover, Good, HSG A |
| | 53,681 | 70 | Weighted Average |
| | 25,437 | 39 | 47.39% Pervious Area |
| | 28,244 | 98 | 52.61% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Minimum TOC** |

## Subcatchment E-1A: Existing Drainage to On-Site Inlet



## Summary for Subcatchment E-1B: Existing Drainage to Stormwater Conveyance System

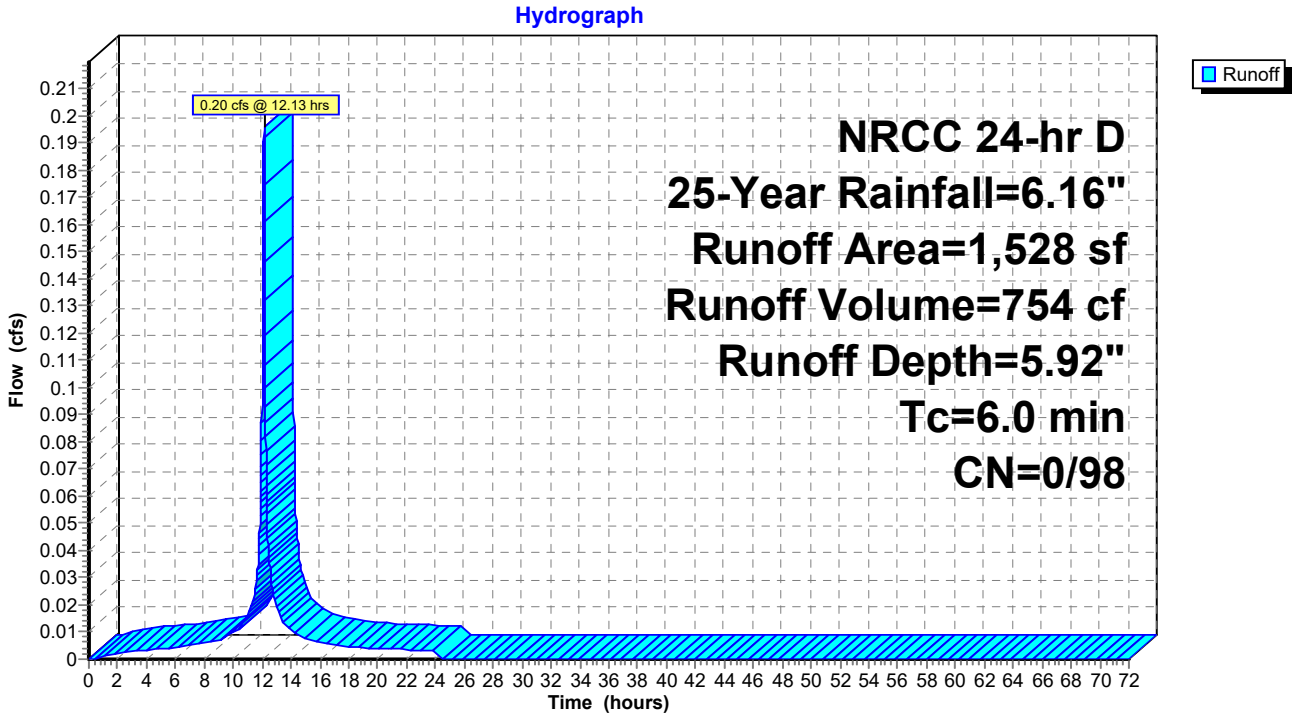
Runoff = 0.20 cfs @ 12.13 hrs, Volume= 754 cf, Depth= 5.92"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 25-Year Rainfall=6.16"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 1,528 | 98 | Impervious Areas |
| | 1,528 | 98 | 100.00% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Minimum TOC** |

### Subcatchment E-1B: Existing Drainage to Stormwater Conveyance System



## Summary for Subcatchment P-1A: Proposed Drainage to Bioretention Basin (B-1)

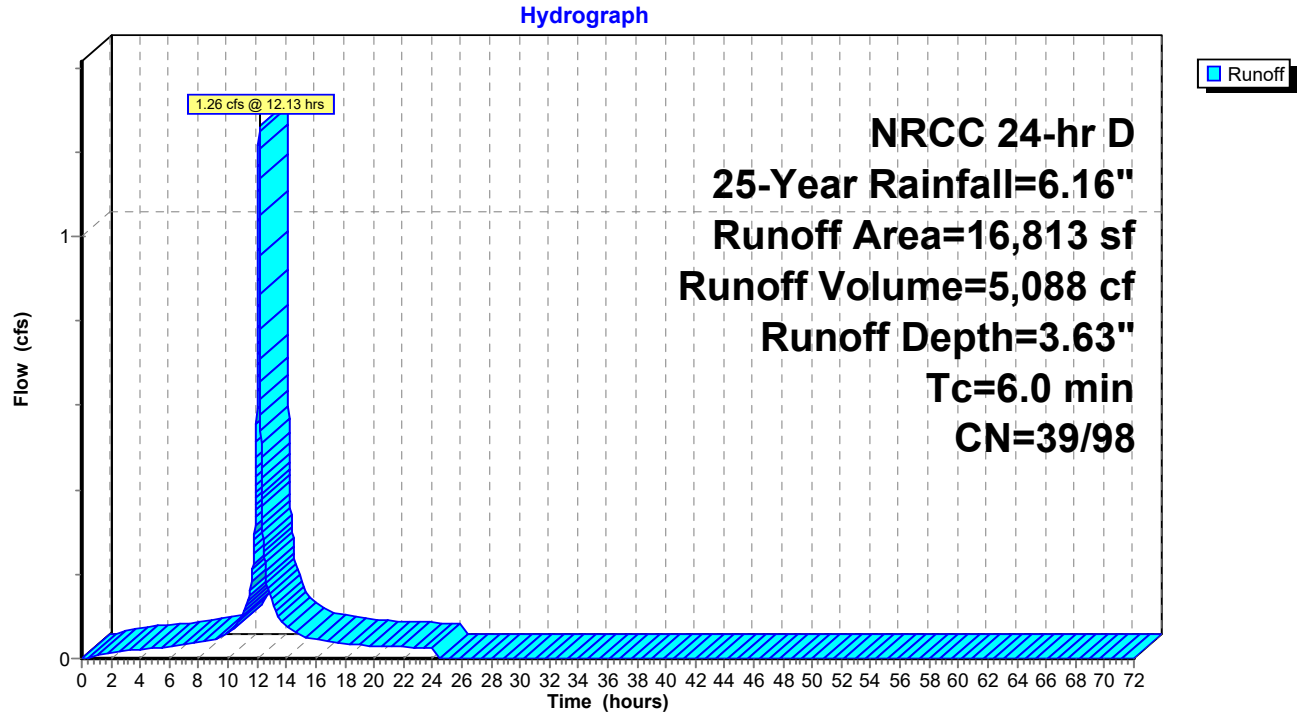
Runoff = 1.26 cfs @ 12.13 hrs, Volume= 5,088 cf, Depth= 3.63"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 25-Year Rainfall=6.16"

| Area (sf) | CN | Description |
|---|---|---|
| 9,721 | 98 | Paved parking, HSG A |
| 7,092 | 39 | >75% Grass cover, Good, HSG A |
| 16,813 | 73 | Weighted Average |
| 7,092 | 39 | 42.18% Pervious Area |
| 9,721 | 98 | 57.82% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, MInimum ToC** |

## Subcatchment P-1A: Proposed Drainage to Bioretention Basin (B-1)



## Summary for Subcatchment P-1B: Proposed Drainage to Aboveground Infiltration Basin (B-2)

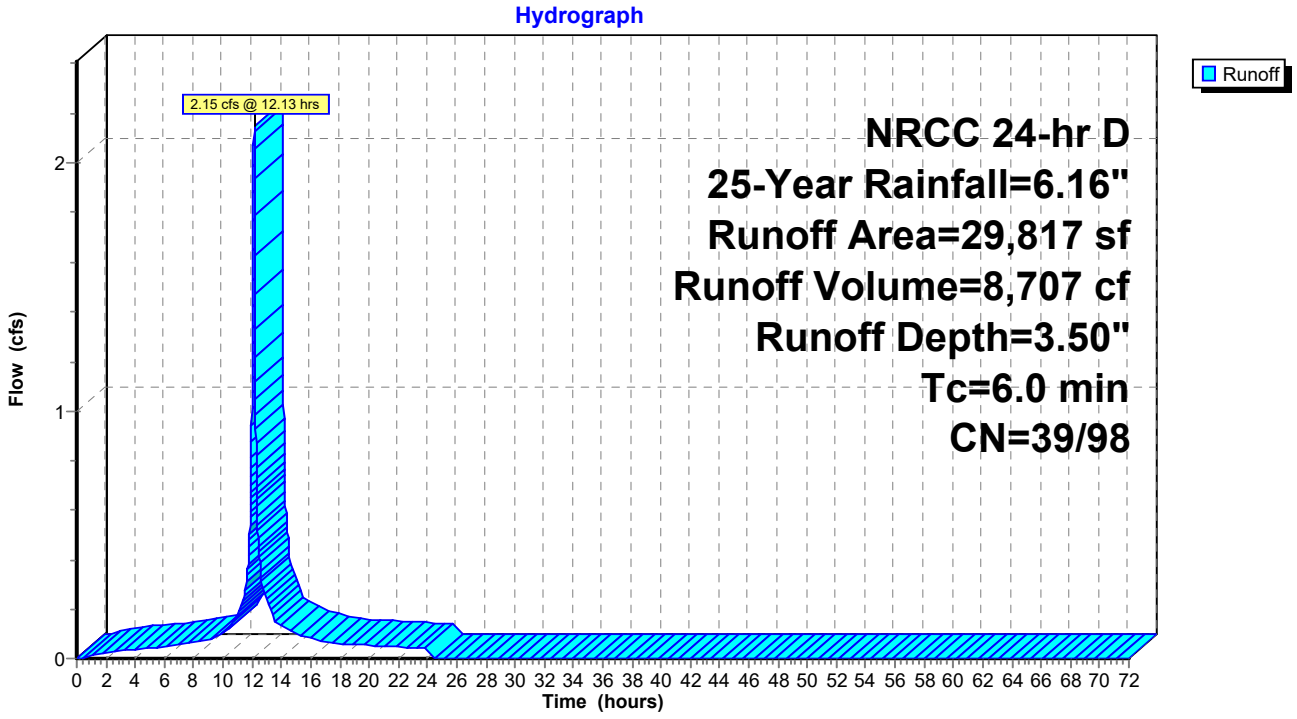
Runoff = 2.15 cfs @ 12.13 hrs, Volume= 8,707 cf, Depth= 3.50"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 25-Year Rainfall=6.16"

| Area (sf) | CN | Description |
|---|---|---|
| 16,540 | 98 | Paved parking, HSG A |
| 13,277 | 39 | >75% Grass cover, Good, HSG A |
| 29,817 | 72 | Weighted Average |
| 13,277 | 39 | 44.53% Pervious Area |
| 16,540 | 98 | 55.47% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Minimum ToC** |

### Subcatchment P-1B: Proposed Drainage to Aboveground Infiltration Basin (B-2)



## Summary for Subcatchment P-1C: Proposed Drainage to Municipal Conveyance System

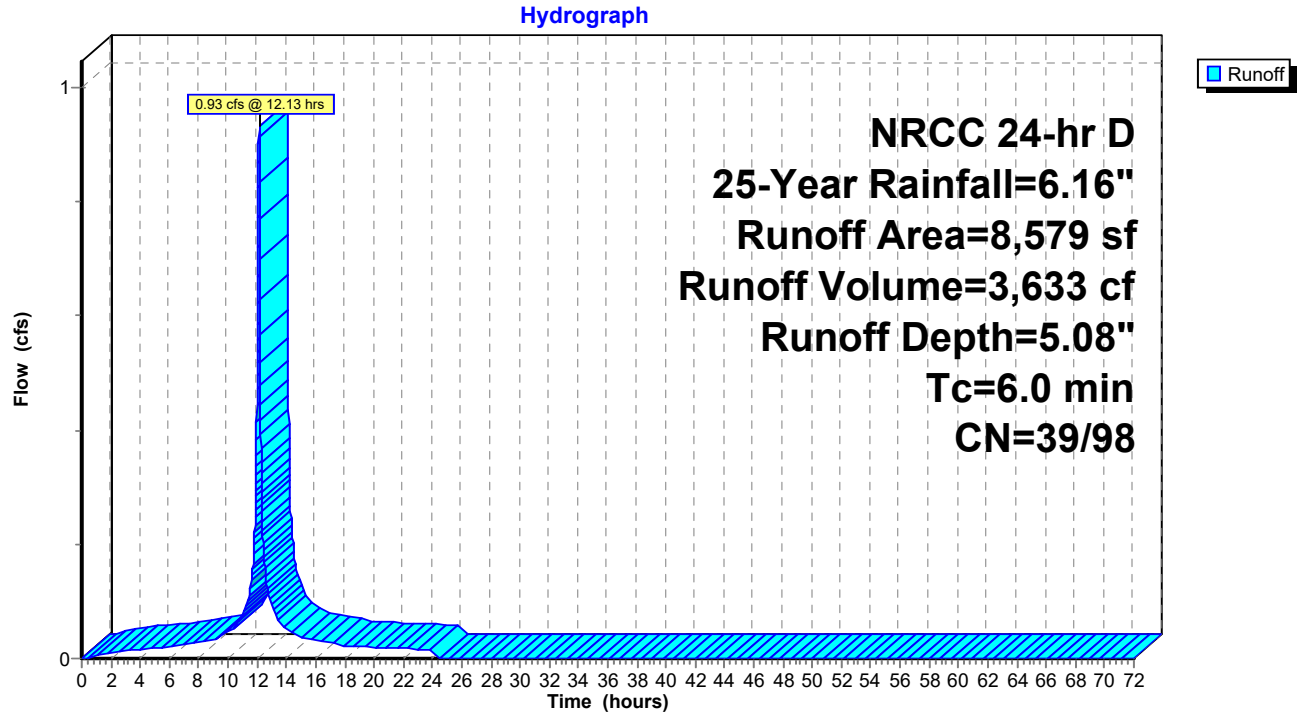
Runoff = 0.93 cfs @ 12.13 hrs, Volume= 3,633 cf, Depth= 5.08"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 25-Year Rainfall=6.16"

| Area (sf) | CN | Description |
|---|---|---|
| 7,251 | 98 | Paved parking, HSG A |
| 1,328 | 39 | >75% Grass cover, Good, HSG A |
| 8,579 | 89 | Weighted Average |
| 1,328 | 39 | 15.48% Pervious Area |
| 7,251 | 98 | 84.52% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Minimum ToC** |

### Subcatchment P-1C: Proposed Drainage to Municipal Conveyance System



## Summary for Pond B-1: Proposed Aboveground Detention Basin (B-1)

Inflow Area = 46,630 sf, 56.32% Impervious, Inflow Depth = 3.55" for 25-Year event
Inflow = 3.42 cfs @ 12.13 hrs, Volume= 13,795 cf
Outflow = 1.74 cfs @ 12.22 hrs, Volume= 13,794 cf, Atten= 49%, Lag= 5.6 min
Primary = 1.74 cfs @ 12.22 hrs, Volume= 13,794 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 60.41' @ 12.22 hrs Surf.Area= 1,560 sf Storage= 1,538 cf

Plug-Flow detention time= 16.3 min calculated for 13,792 cf (100% of inflow)
Center-of-Mass det. time= 16.5 min ( 778.9 - 762.4 )

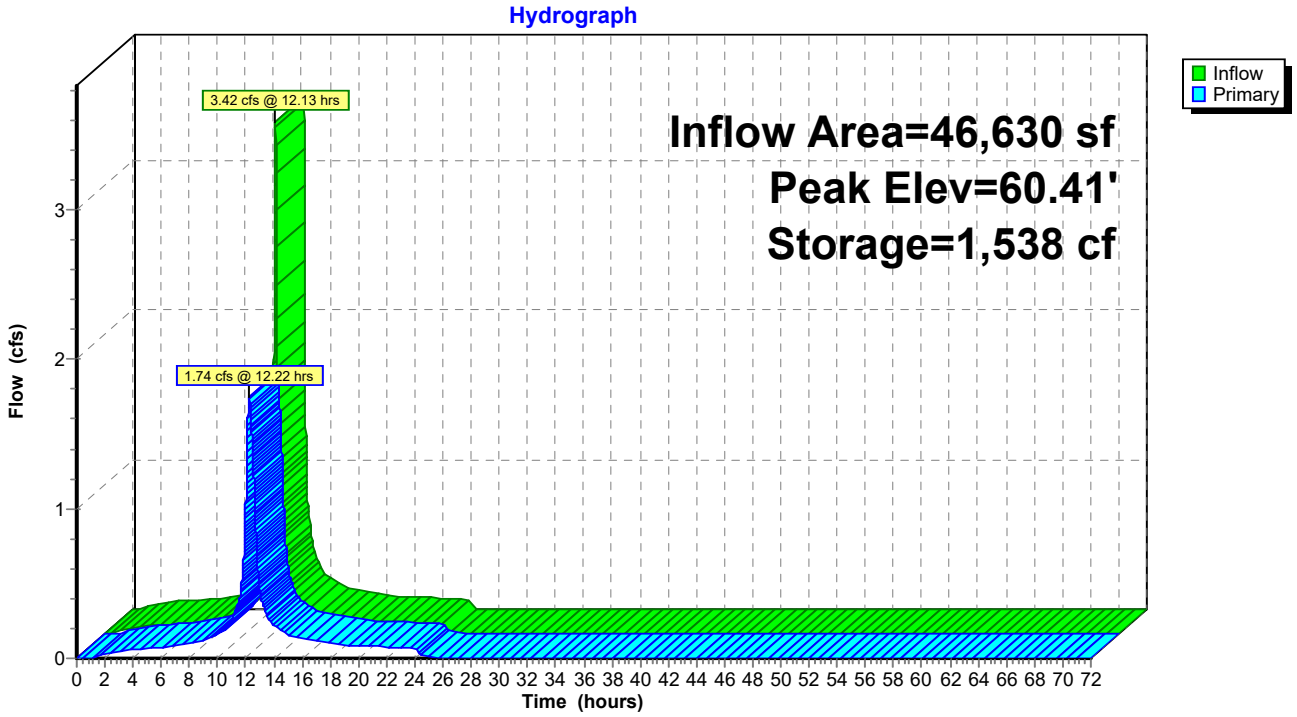
| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 59.00' | 5,738 cf | **Aboveground Storage (Irregular)** Listed below (Recalc) |

| Elevation (feet) | Surf.Area (sq-ft) | Perim. (feet) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) | Wet.Area (sq-ft) |
|---|---|---|---|---|---|
| 59.00 | 659 | 189.5 | 0 | 0 | 659 |
| 60.00 | 1,285 | 215.2 | 955 | 955 | 1,511 |
| 61.00 | 2,002 | 243.7 | 1,630 | 2,585 | 2,577 |
| 62.00 | 2,850 | 283.7 | 2,414 | 4,999 | 4,276 |
| 62.25 | 3,065 | 288.4 | 739 | 5,738 | 4,502 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 59.00' | **15.0" Horiz. 15" Outlet Pipe** C= 0.600<br>Limited to weir flow at low heads |
| #2 | Device 1 | 59.00' | **8.0" Vert. Low Flow Orifice** C= 0.600<br>Limited to weir flow at low heads |
| #3 | Device 1 | 60.50' | **24.0" x 24.0" Horiz. Overflow Grate** C= 0.600<br>Limited to weir flow at low heads |

**Primary OutFlow** Max=1.74 cfs @ 12.22 hrs HW=60.41' TW=0.00' (Dynamic Tailwater)
└─**1=15" Outlet Pipe** (Passes 1.74 cfs of 7.02 cfs potential flow)
  ├─**2=Low Flow Orifice** (Orifice Controls 1.74 cfs @ 5.00 fps)
  └─**3=Overflow Grate** ( Controls 0.00 cfs)

## Pond B-1: Proposed Aboveground Detention Basin (B-1)

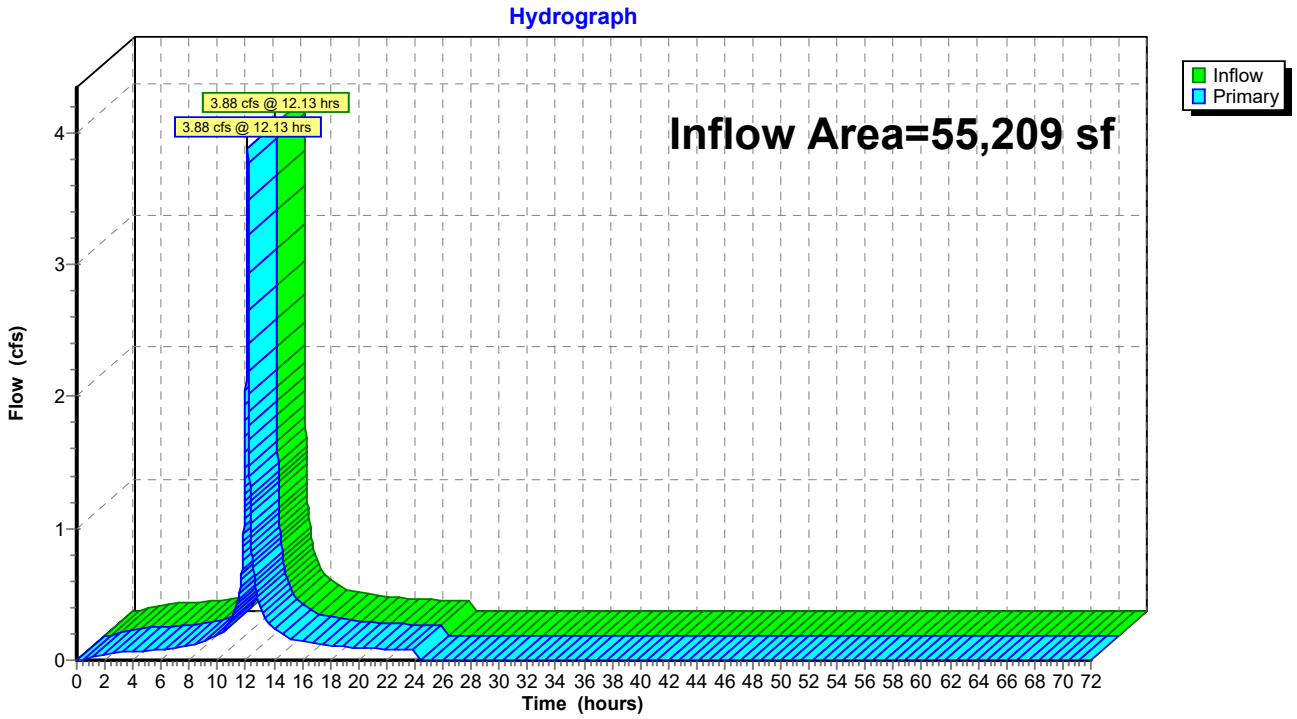


## Summary for Link E-1: Existing Drainage to Conveyance System

Inflow Area = 55,209 sf, 53.93% Impervious, Inflow Depth = 3.42" for 25-Year event
Inflow = 3.88 cfs @ 12.13 hrs, Volume= 15,735 cf
Primary = 3.88 cfs @ 12.13 hrs, Volume= 15,735 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

## Link E-1: Existing Drainage to Conveyance System

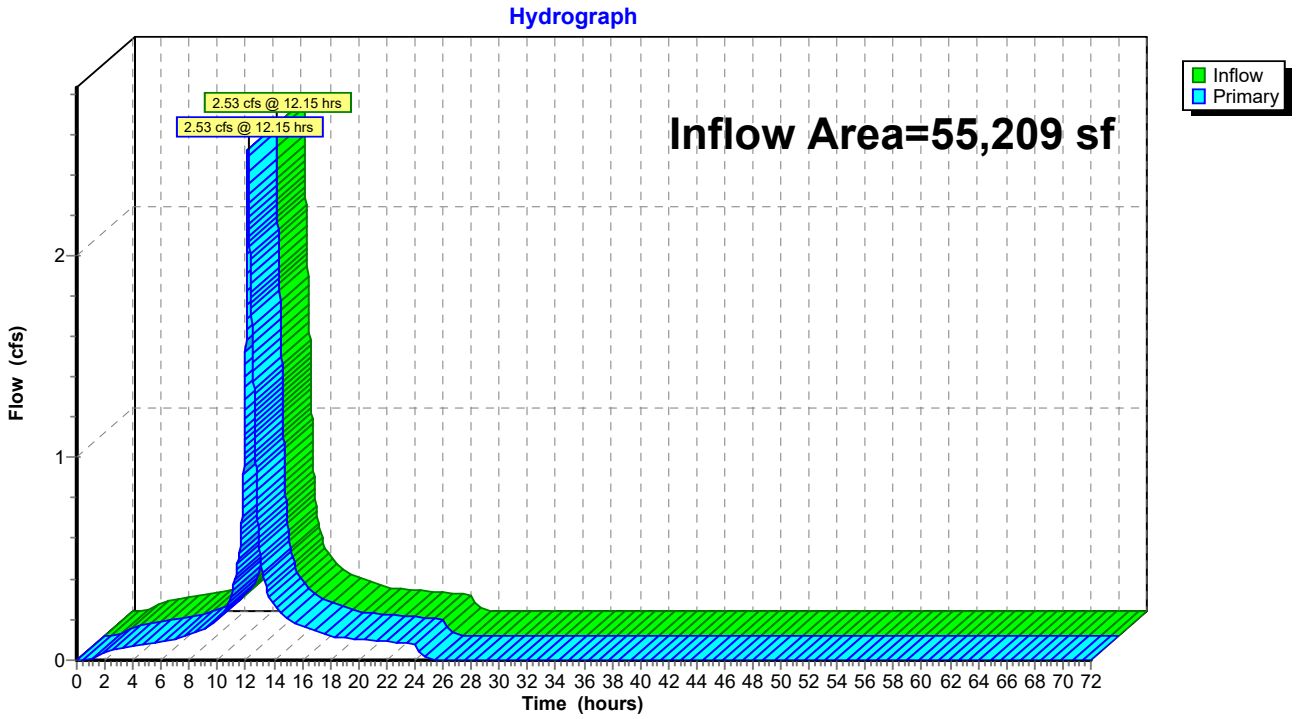


## Summary for Link P-1: Proposed Overall Drainage

Inflow Area = 55,209 sf, 60.70% Impervious, Inflow Depth = 3.79" for 25-Year event
Inflow = 2.53 cfs @ 12.15 hrs, Volume= 17,427 cf
Primary = 2.53 cfs @ 12.15 hrs, Volume= 17,427 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

## Link P-1: Proposed Overall Drainage



Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

**Subcatchment E-1A: Existing Drainage to** Runoff Area=53,681 sf 52.61% Impervious Runoff Depth=5.32"
Tc=6.0 min CN=39/98 Runoff=6.08 cfs 23,814 cf

**Subcatchment E-1B: Existing Drainage to** Runoff Area=1,528 sf 100.00% Impervious Runoff Depth=8.70"
Tc=6.0 min CN=0/98 Runoff=0.29 cfs 1,108 cf

**Subcatchment P-1A: Proposed Drainage** Runoff Area=16,813 sf 57.82% Impervious Runoff Depth=5.69"
Tc=6.0 min CN=39/98 Runoff=2.04 cfs 7,978 cf

**Subcatchment P-1B: Proposed Drainage** Runoff Area=29,817 sf 55.47% Impervious Runoff Depth=5.53"
Tc=6.0 min CN=39/98 Runoff=3.51 cfs 13,733 cf

**Subcatchment P-1C: Proposed Drainage to** Runoff Area=8,579 sf 84.52% Impervious Runoff Depth=7.60"
Tc=6.0 min CN=39/98 Runoff=1.40 cfs 5,431 cf

**Pond B-1: Proposed Aboveground** Peak Elev=60.73' Storage=2,074 cf Inflow=5.55 cfs 21,711 cf
Outflow=4.89 cfs 21,710 cf

**Link E-1: Existing Drainage to Conveyance System** Inflow=6.37 cfs 24,921 cf
Primary=6.37 cfs 24,921 cf

**Link P-1: Proposed Overall Drainage** Inflow=6.13 cfs 27,141 cf
Primary=6.13 cfs 27,141 cf

**Total Runoff Area = 110,418 sf Runoff Volume = 52,063 cf Average Runoff Depth = 5.66"**
**42.69% Pervious = 47,134 sf 57.31% Impervious = 63,284 sf**

## Summary for Subcatchment E-1A: Existing Drainage to On-Site Inlet

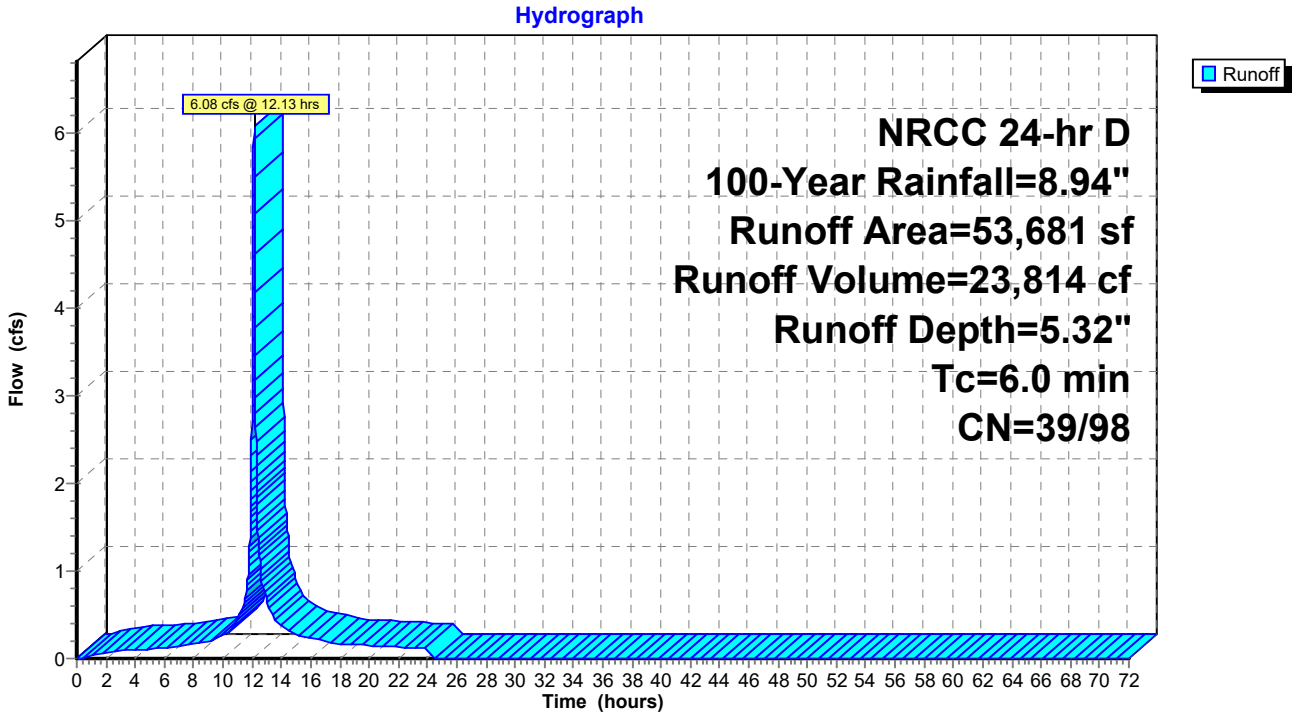
Runoff = 6.08 cfs @ 12.13 hrs, Volume= 23,814 cf, Depth= 5.32"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 100-Year Rainfall=8.94"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 28,244 | 98 | Impervious Area |
| | 25,437 | 39 | >75% Grass cover, Good, HSG A |
| | 53,681 | 70 | Weighted Average |
| | 25,437 | 39 | 47.39% Pervious Area |
| | 28,244 | 98 | 52.61% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Minimum TOC** |

## Subcatchment E-1A: Existing Drainage to On-Site Inlet



## Summary for Subcatchment E-1B: Existing Drainage to Stormwater Conveyance System

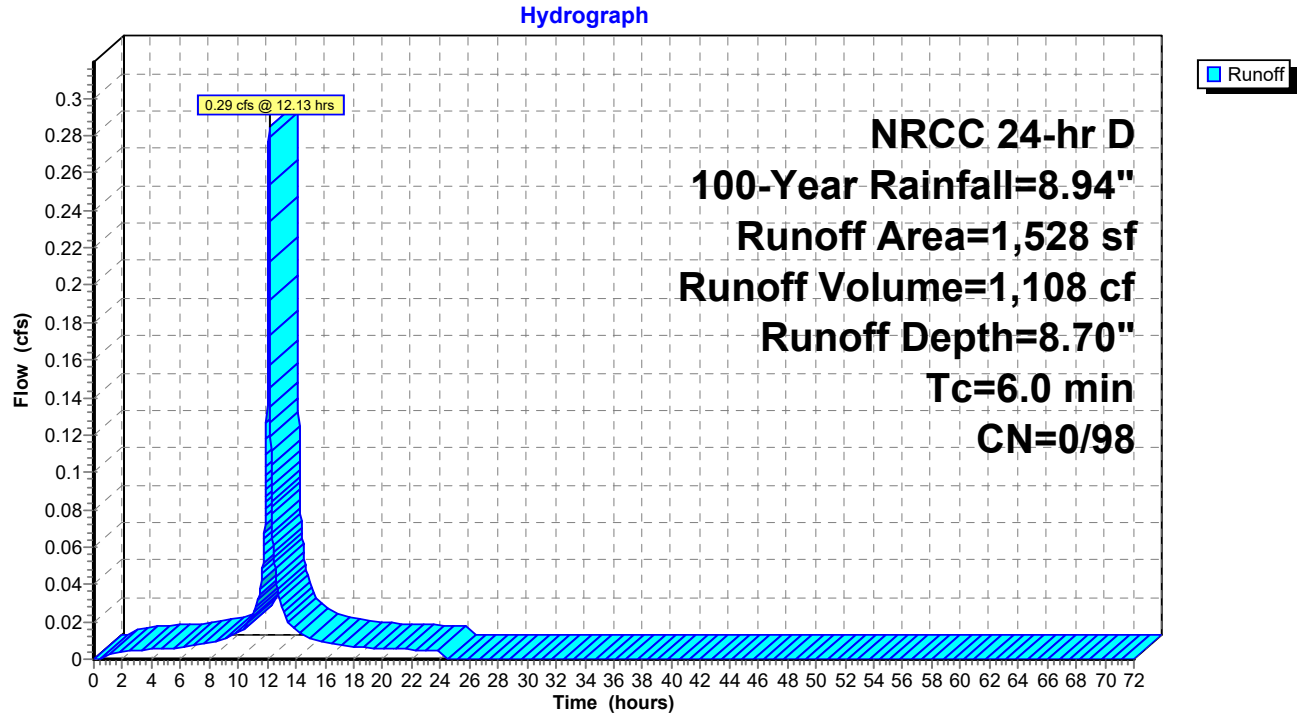
Runoff = 0.29 cfs @ 12.13 hrs, Volume= 1,108 cf, Depth= 8.70"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 100-Year Rainfall=8.94"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 1,528 | 98 | Impervious Areas |
| | 1,528 | 98 | 100.00% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Minimum TOC** |

### Subcatchment E-1B: Existing Drainage to Stormwater Conveyance System



## Summary for Subcatchment P-1A: Proposed Drainage to Bioretention Basin (B-1)

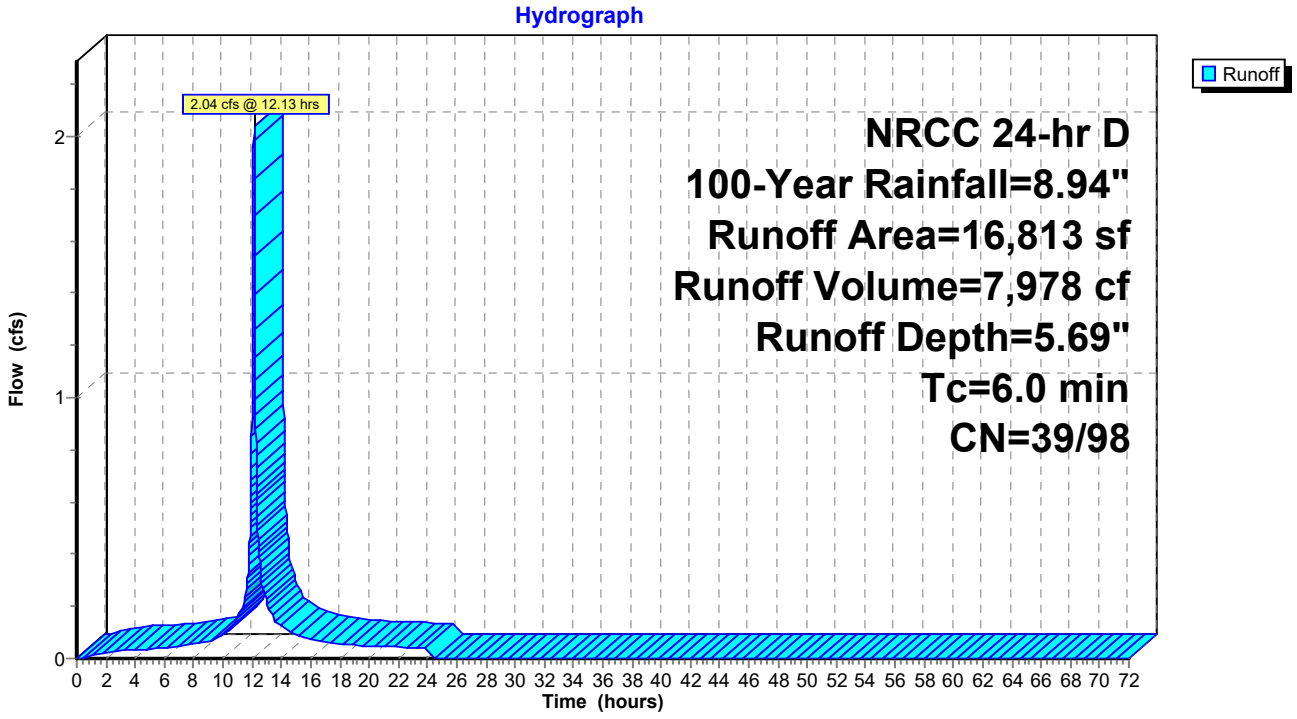
Runoff = 2.04 cfs @ 12.13 hrs, Volume= 7,978 cf, Depth= 5.69"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 100-Year Rainfall=8.94"

| Area (sf) | CN | Description |
|---|---|---|
| 9,721 | 98 | Paved parking, HSG A |
| 7,092 | 39 | >75% Grass cover, Good, HSG A |
| 16,813 | 73 | Weighted Average |
| 7,092 | 39 | 42.18% Pervious Area |
| 9,721 | 98 | 57.82% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, MInimum ToC** |

## Subcatchment P-1A: Proposed Drainage to Bioretention Basin (B-1)



## Summary for Subcatchment P-1B: Proposed Drainage to Aboveground Infiltration Basin (B-2)

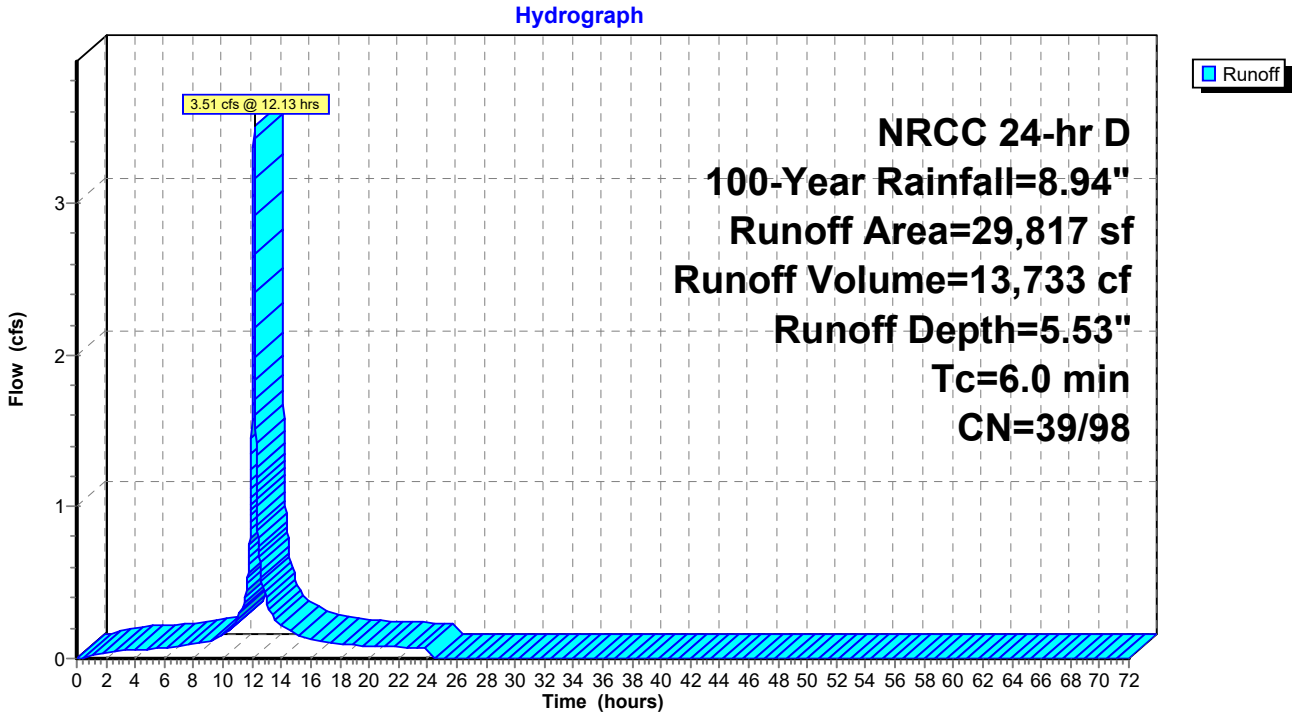
Runoff = 3.51 cfs @ 12.13 hrs, Volume= 13,733 cf, Depth= 5.53"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 100-Year Rainfall=8.94"

| Area (sf) | CN | Description |
|---|---|---|
| 16,540 | 98 | Paved parking, HSG A |
| 13,277 | 39 | >75% Grass cover, Good, HSG A |
| 29,817 | 72 | Weighted Average |
| 13,277 | 39 | 44.53% Pervious Area |
| 16,540 | 98 | 55.47% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Minimum ToC** |

### Subcatchment P-1B: Proposed Drainage to Aboveground Infiltration Basin (B-2)



## Summary for Subcatchment P-1C: Proposed Drainage to Municipal Conveyance System

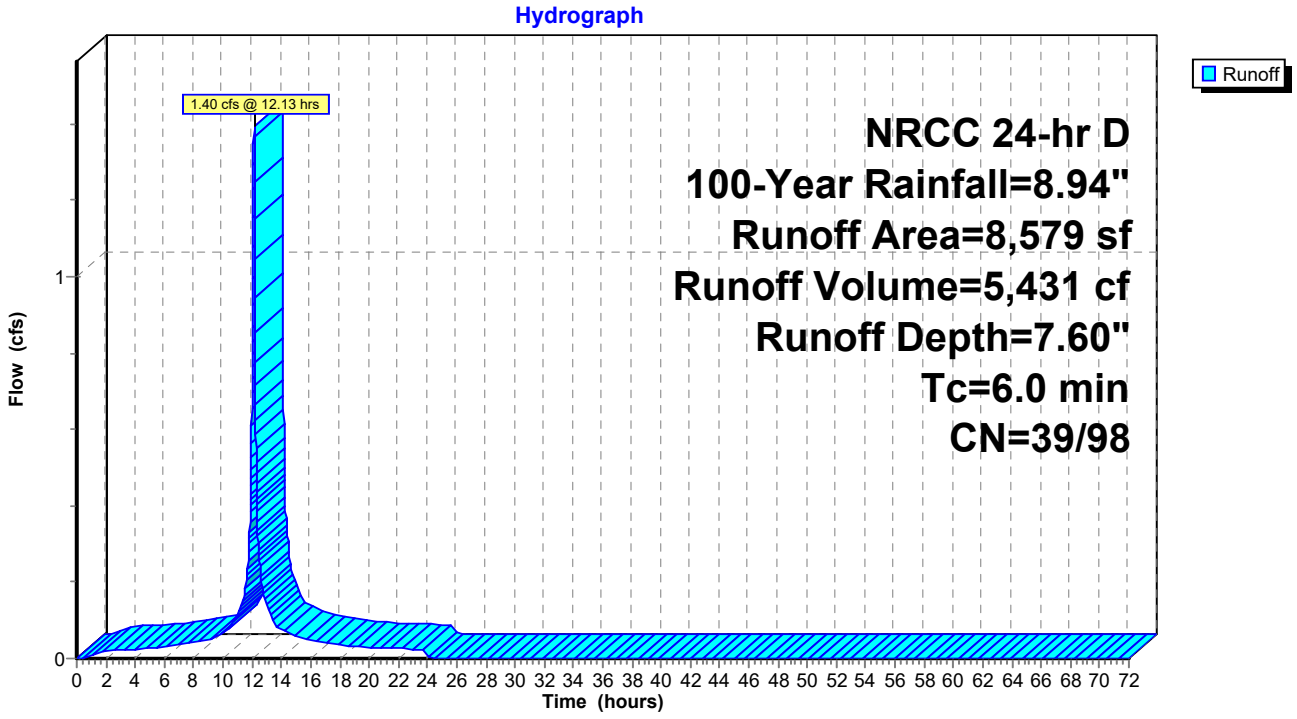
Runoff = 1.40 cfs @ 12.13 hrs, Volume= 5,431 cf, Depth= 7.60"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 100-Year Rainfall=8.94"

| Area (sf) | CN | Description |
|---|---|---|
| 7,251 | 98 | Paved parking, HSG A |
| 1,328 | 39 | >75% Grass cover, Good, HSG A |
| 8,579 | 89 | Weighted Average |
| 1,328 | 39 | 15.48% Pervious Area |
| 7,251 | 98 | 84.52% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, Minimum ToC** |

### Subcatchment P-1C: Proposed Drainage to Municipal Conveyance System



## Summary for Pond B-1: Proposed Aboveground Detention Basin (B-1)

Inflow Area = 46,630 sf, 56.32% Impervious, Inflow Depth = 5.59" for 100-Year event
Inflow = 5.55 cfs @ 12.13 hrs, Volume= 21,711 cf
Outflow = 4.89 cfs @ 12.16 hrs, Volume= 21,710 cf, Atten= 12%, Lag= 2.0 min
Primary = 4.89 cfs @ 12.16 hrs, Volume= 21,710 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 60.73' @ 12.16 hrs Surf.Area= 1,793 sf Storage= 2,074 cf

Plug-Flow detention time= 14.0 min calculated for 21,707 cf (100% of inflow)
Center-of-Mass det. time= 14.1 min ( 779.9 - 765.7 )

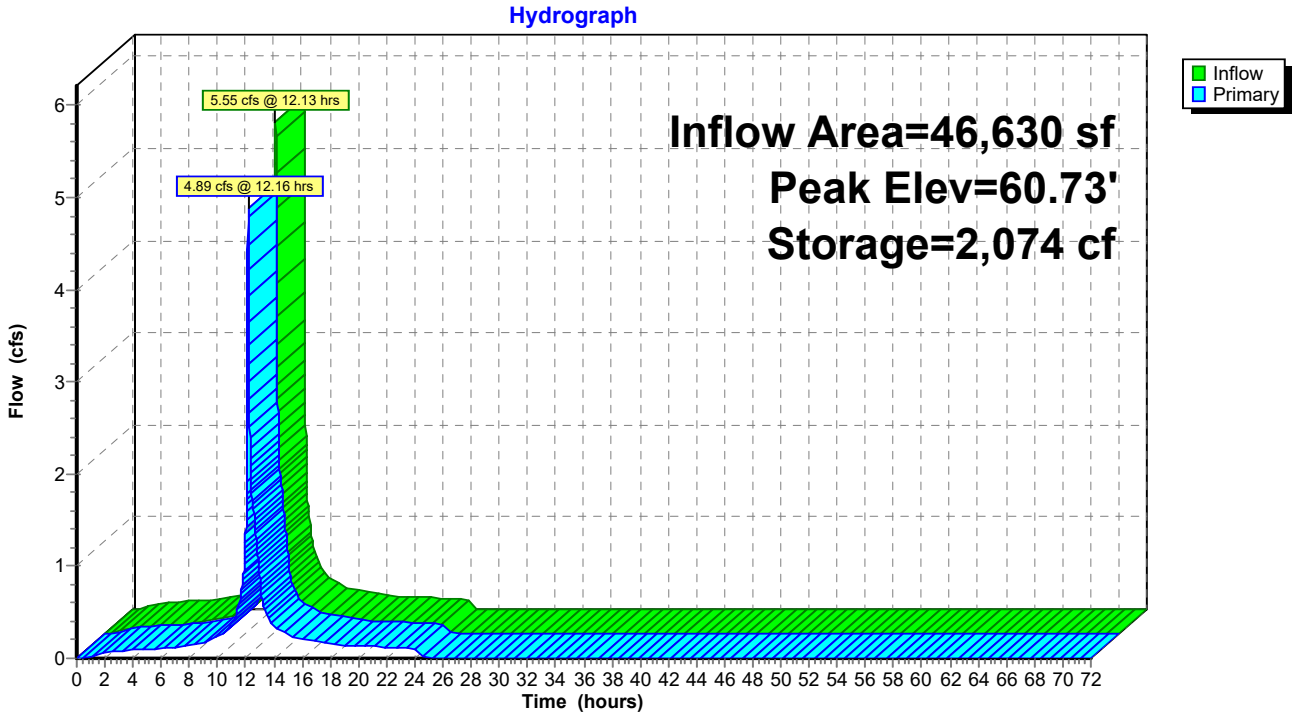
| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 59.00' | 5,738 cf | **Aboveground Storage (Irregular)** Listed below (Recalc) |

| Elevation (feet) | Surf.Area (sq-ft) | Perim. (feet) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) | Wet.Area (sq-ft) |
|---|---|---|---|---|---|
| 59.00 | 659 | 189.5 | 0 | 0 | 659 |
| 60.00 | 1,285 | 215.2 | 955 | 955 | 1,511 |
| 61.00 | 2,002 | 243.7 | 1,630 | 2,585 | 2,577 |
| 62.00 | 2,850 | 283.7 | 2,414 | 4,999 | 4,276 |
| 62.25 | 3,065 | 288.4 | 739 | 5,738 | 4,502 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 59.00' | **15.0" Horiz. 15" Outlet Pipe** C= 0.600<br>Limited to weir flow at low heads |
| #2 | Device 1 | 59.00' | **8.0" Vert. Low Flow Orifice** C= 0.600<br>Limited to weir flow at low heads |
| #3 | Device 1 | 60.50' | **24.0" x 24.0" Horiz. Overflow Grate** C= 0.600<br>Limited to weir flow at low heads |

**Primary OutFlow** Max=4.87 cfs @ 12.16 hrs HW=60.73' TW=0.00' (Dynamic Tailwater)
- **1=15" Outlet Pipe** (Passes 4.87 cfs of 7.77 cfs potential flow)
  - **2=Low Flow Orifice** (Orifice Controls 1.99 cfs @ 5.69 fps)
  - **3=Overflow Grate** (Weir Controls 2.88 cfs @ 1.57 fps)

## Pond B-1: Proposed Aboveground Detention Basin (B-1)

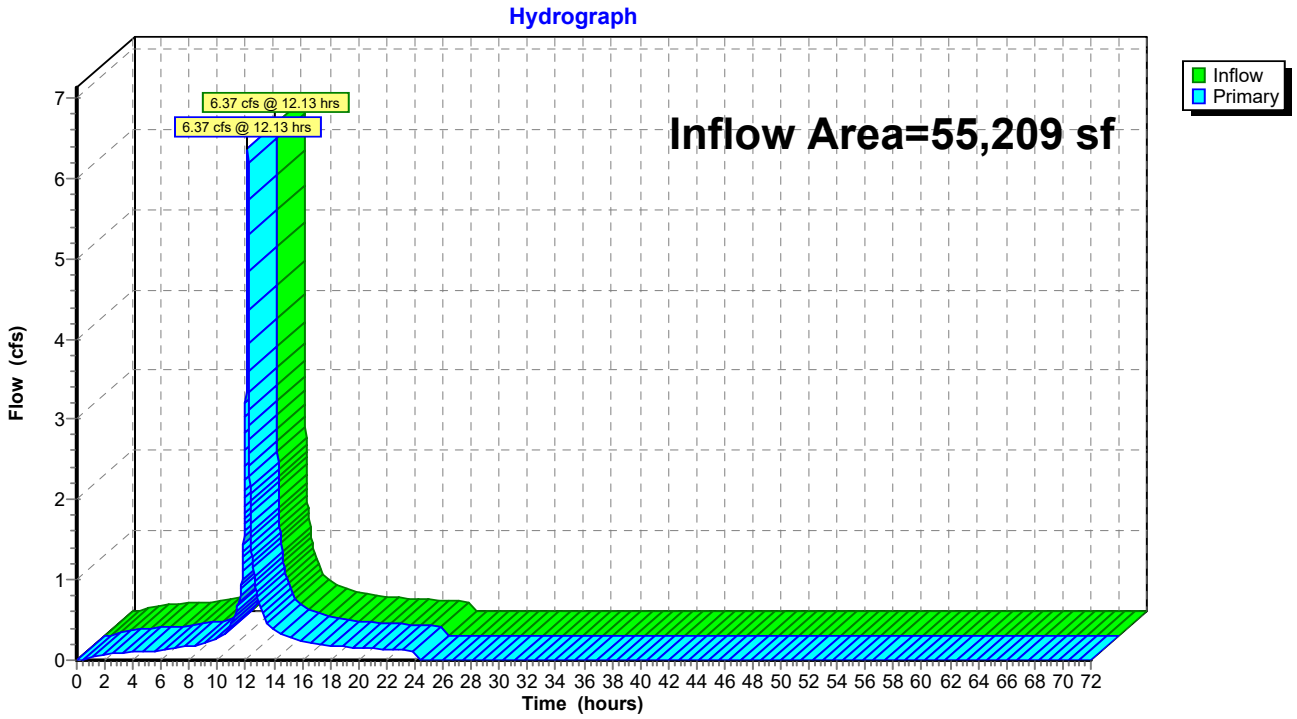


## Summary for Link E-1: Existing Drainage to Conveyance System

Inflow Area = 55,209 sf, 53.93% Impervious, Inflow Depth = 5.42" for 100-Year event
Inflow = 6.37 cfs @ 12.13 hrs, Volume= 24,921 cf
Primary = 6.37 cfs @ 12.13 hrs, Volume= 24,921 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

## Link E-1: Existing Drainage to Conveyance System

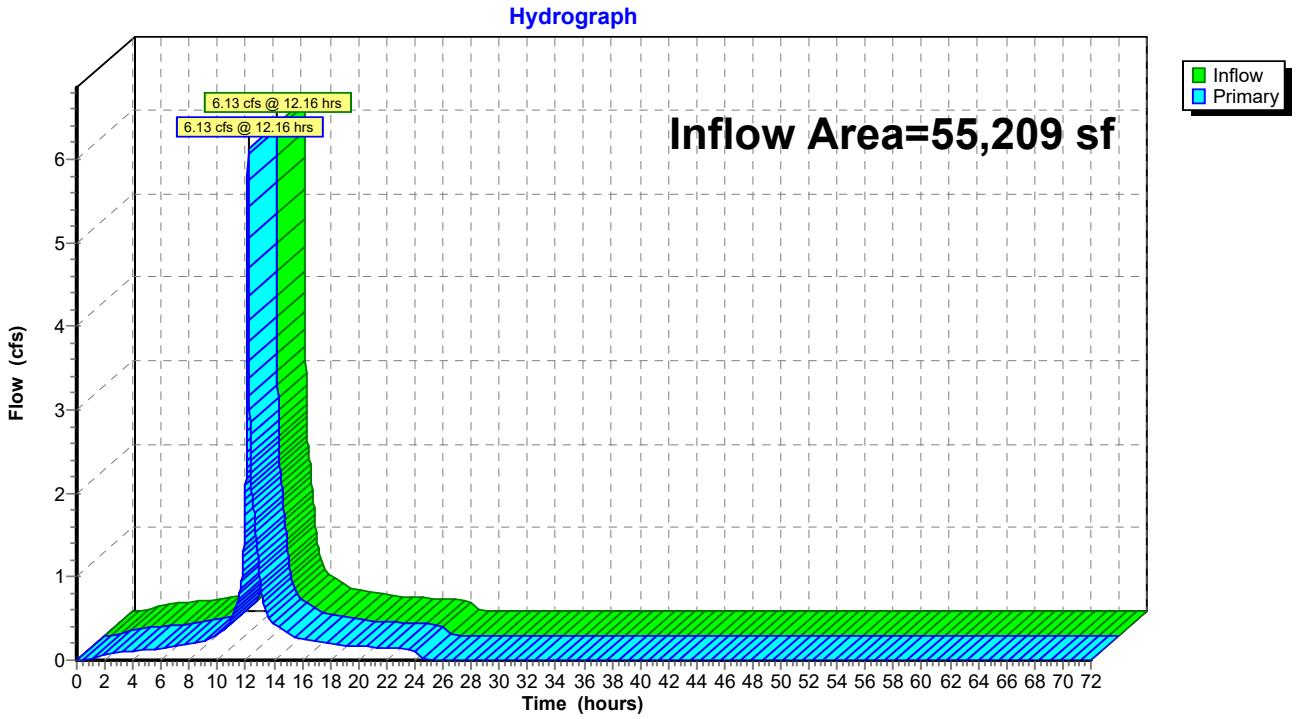


## Summary for Link P-1: Proposed Overall Drainage

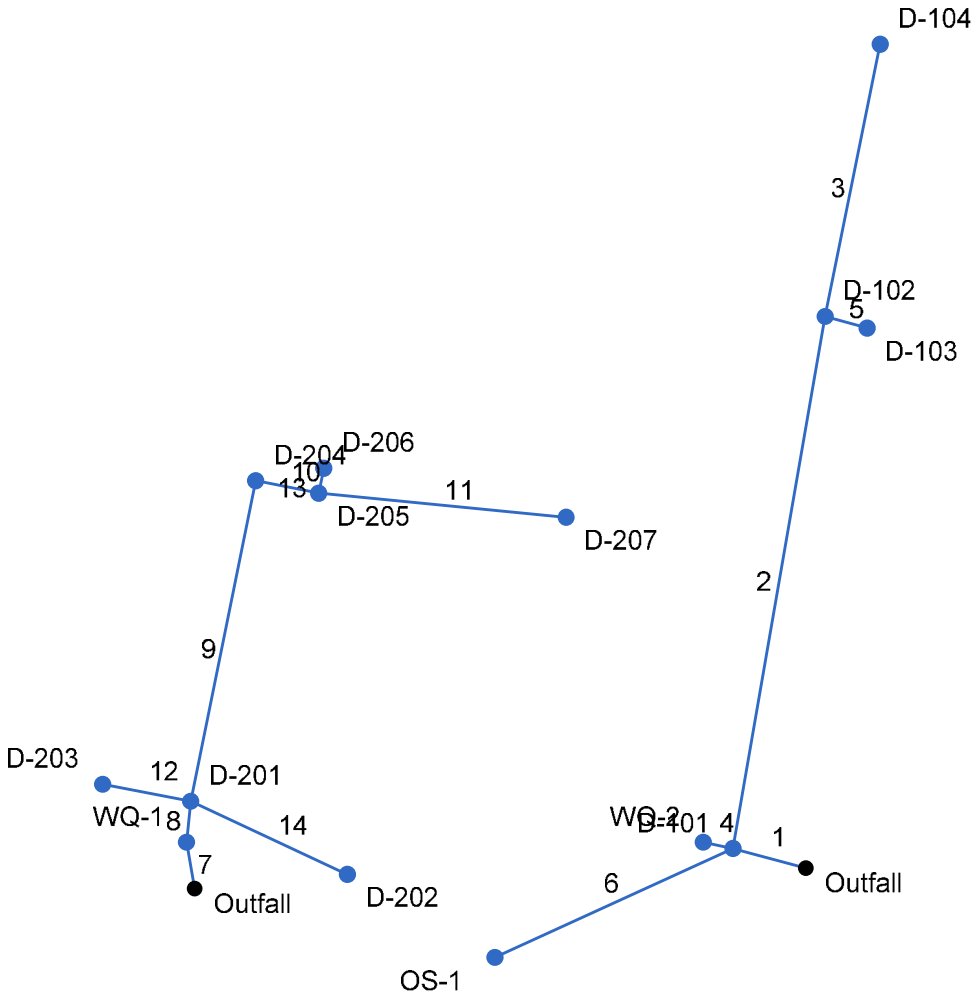
Inflow Area = 55,209 sf, 60.70% Impervious, Inflow Depth = 5.90" for 100-Year event
Inflow = 6.13 cfs @ 12.16 hrs, Volume= 27,141 cf
Primary = 6.13 cfs @ 12.16 hrs, Volume= 27,141 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

## Link P-1: Proposed Overall Drainage



# Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan




| Project File: 2024-03-06_Pipe Sizing_Rowley, MA.stm | Number of lines: 14 | Date: 3/6/2024 |
|---|---|---|

# SED

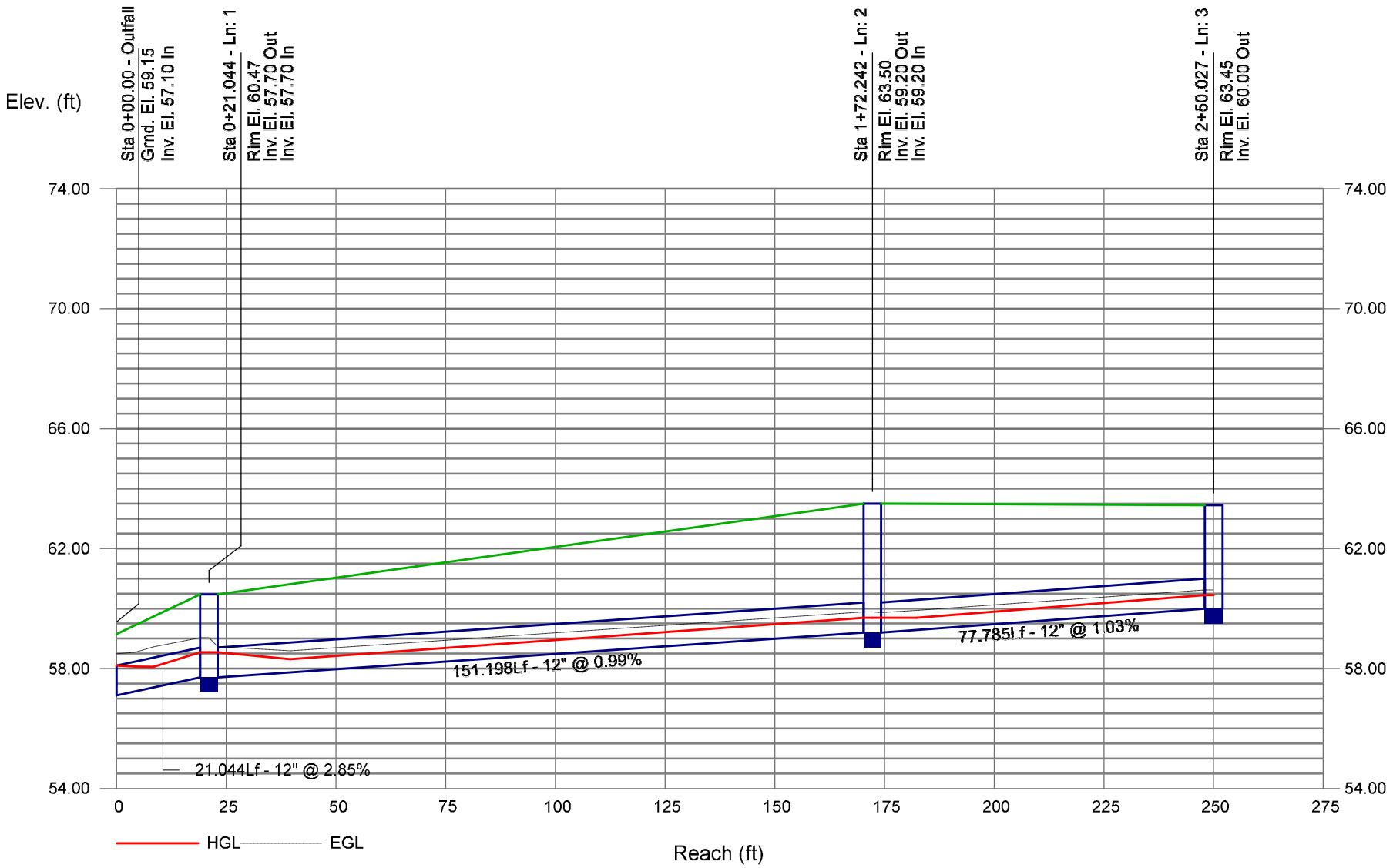
| Line No. | Line ID | Invert Dn (ft) | Invert Up (ft) | Line Size (in) | Line Slope (%) | Flow Rate (cfs) | Vel Dn (ft/s) | Capac Full (cfs) | HGL Dn (ft) | HGL Up (ft) | Drng Area (ac) | Tc (min) | i Inlet (in/hr) | n-val Pipe | Gnd/Rim El Dn (ft) | Gnd/Rim El Up (ft) | Line Length (ft) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | D-101 to Outfall | 57.10 | 57.70 | 12 | 2.85 | 3.93 | 5.00 | 6.01 | 58.10 | 58.54 j | 0.00 | 7.3 | 0.00 | 0.013 | 59.15 | 60.47 | 21.044 | |
| 2 | D-102 to D-101 | 57.70 | 59.20 | 12 | 0.99 | 1.37 | 1.94 | 3.55 | 58.54 | 59.69 j | 0.00 | 6.4 | 0.00 | 0.013 | 60.47 | 63.50 | 151.198 | |
| 3 | D-104 to D-103 | 59.20 | 60.00 | 12 | 1.03 | 1.13 | 2.91 | 3.61 | 59.69 | 60.45 j | 0.17 | 6.0 | 7.44 | 0.013 | 63.50 | 63.45 | 77.785 | |
| 4 | WQ-2 to D-101 | 57.70 | 57.80 | 12 | 1.18 | 0.99 | 1.40 | 3.86 | 58.54 | 58.22 | 0.16 | 6.0 | 7.44 | 0.013 | 60.47 | 60.35 | 8.495 | |
| 5 | D-103 to D-102 | 59.20 | 59.30 | 12 | 0.82 | 0.28 | 0.73 | 3.23 | 59.69 | 59.52 | 0.04 | 6.0 | 7.44 | 0.013 | 63.50 | 63.50 | 12.191 | |
| 6 | OS-1 to D-101 | 57.70 | 58.10 | 12 | 0.55 | 1.74 | 2.47 | 2.63 | 58.54 | 58.71 | 0.00 | 6.0 | 0.00 | 0.013 | 60.47 | 62.20 | 73.104 | |
| 7 | WQ-1 to Outfall | 59.00 | 59.10 | 15 | 0.76 | 4.16 | 3.39 | 5.62 | 60.25 | 60.30 | 0.00 | 7.3 | 0.00 | 0.013 | 0.00 | 62.75 | 13.193 | |
| 8 | D-201 to WQ-1 | 59.10 | 59.15 | 12 | 0.43 | 4.17 | 5.30 | 2.34 | 60.35 | 60.51 | 0.00 | 7.2 | 0.00 | 0.013 | 62.75 | 62.70 | 11.561 | |
| 9 | D-204 to D-201 | 59.15 | 59.60 | 15 | 0.49 | 3.05 | 2.48 | 4.53 | 60.95 | 61.15 | 0.00 | 6.6 | 0.00 | 0.013 | 62.70 | 63.10 | 91.562 | |
| 10 | D-205 to D-204 | 59.60 | 59.70 | 15 | 0.56 | 3.07 | 2.50 | 4.83 | 61.25 | 61.29 | 0.00 | 6.5 | 0.00 | 0.013 | 63.10 | 62.90 | 17.908 | |
| 11 | D-207 to D-205 | 59.70 | 60.00 | 12 | 0.43 | 1.76 | 2.24 | 2.34 | 61.39 | 61.56 | 0.26 | 6.0 | 7.44 | 0.013 | 62.90 | 62.75 | 69.392 | |
| 12 | D-203 to D-201 | 59.15 | 59.40 | 12 | 1.00 | 0.56 | 0.71 | 3.56 | 60.95 | 60.96 | 0.10 | 6.0 | 7.44 | 0.013 | 62.70 | 62.40 | 25.018 | |
| 13 | D-206 to D-205 | 59.70 | 59.85 | 12 | 2.10 | 1.43 | 1.82 | 5.16 | 61.39 | 61.40 | 0.30 | 6.0 | 7.44 | 0.013 | 62.90 | 62.80 | 7.146 | |
| 14 | D-202 to D-201 | 59.15 | 59.55 | 12 | 0.83 | 0.79 | 1.01 | 3.24 | 60.95 | 60.97 | 0.12 | 6.0 | 7.44 | 0.013 | 62.70 | 62.35 | 48.258 | |

Project File: 2024-03-06_Pipe Sizing_Rowley, MA.stm | Number of lines: 14 | Date: 3/6/2024

NOTES: Intensity = 38.51 / (Inlet time + 3.80) ^ 0.72 -- Return period = 25 Yrs. ; ** Critical depth

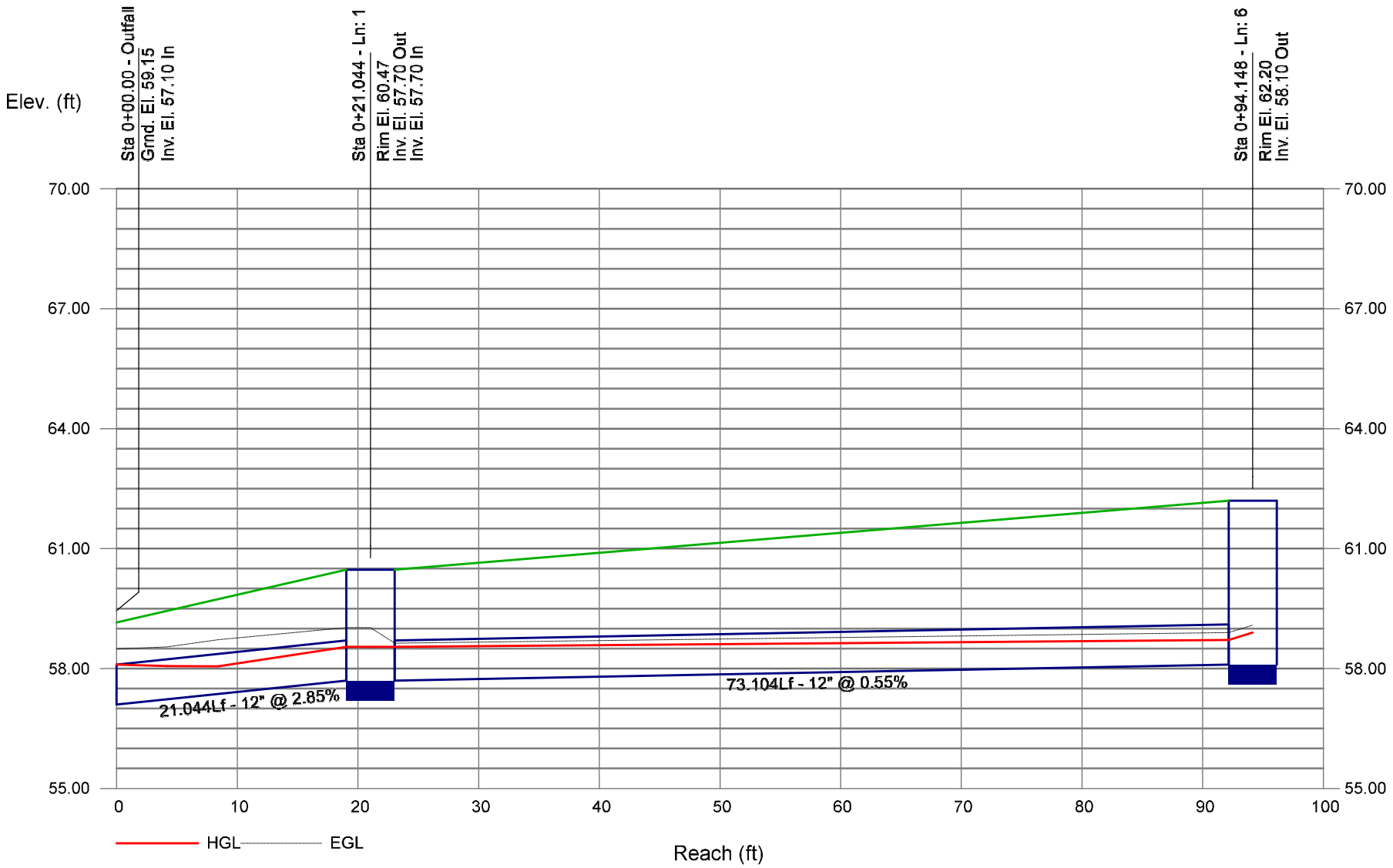
# Storm Sewer Profile

Proj. file: 2024-03-06_Pipe Sizing_Rowley, MA.stm



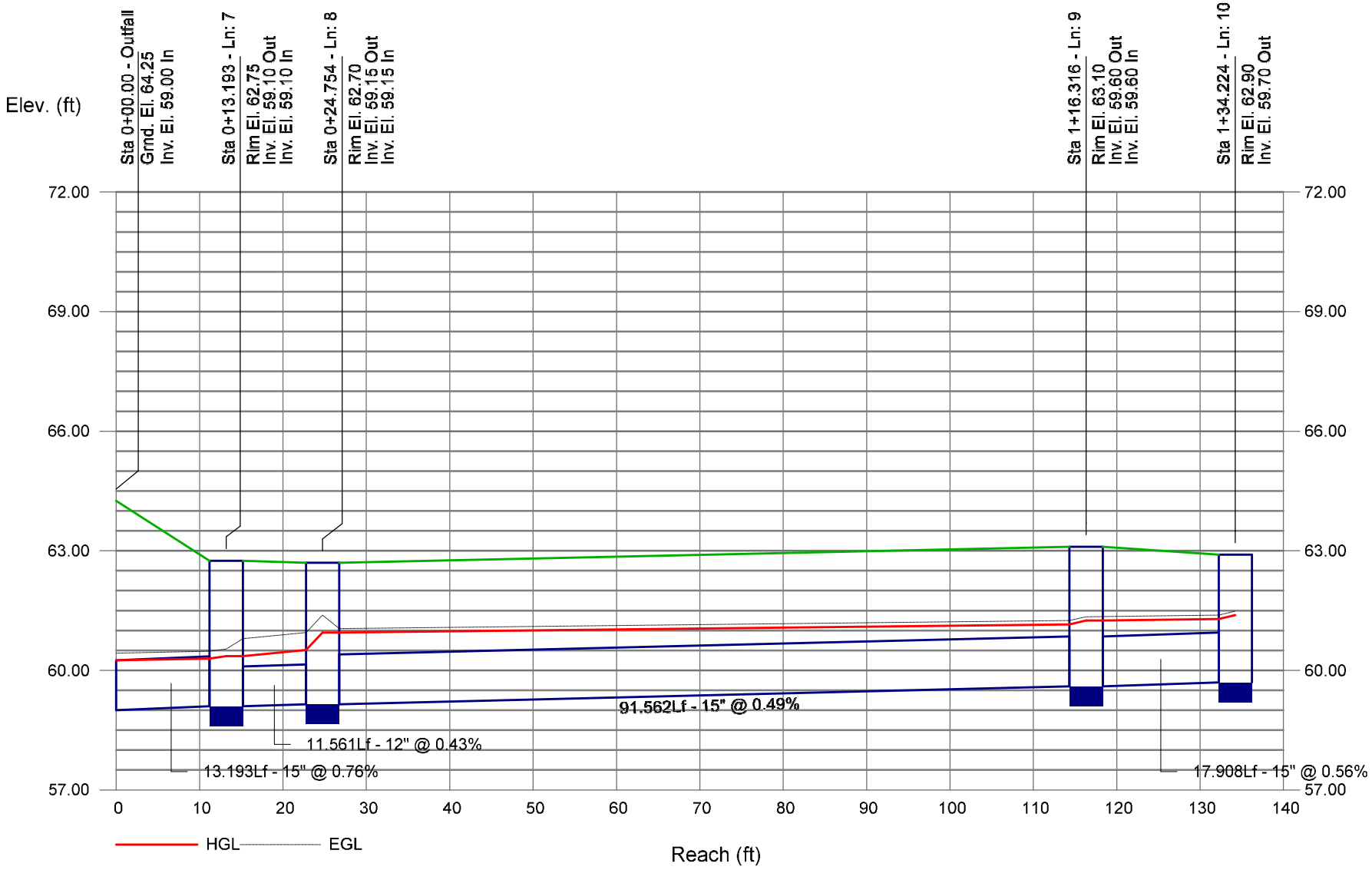
# Storm Sewer Profile

Proj. file: 2024-03-06_Pipe Sizing_Rowley, MA.stm



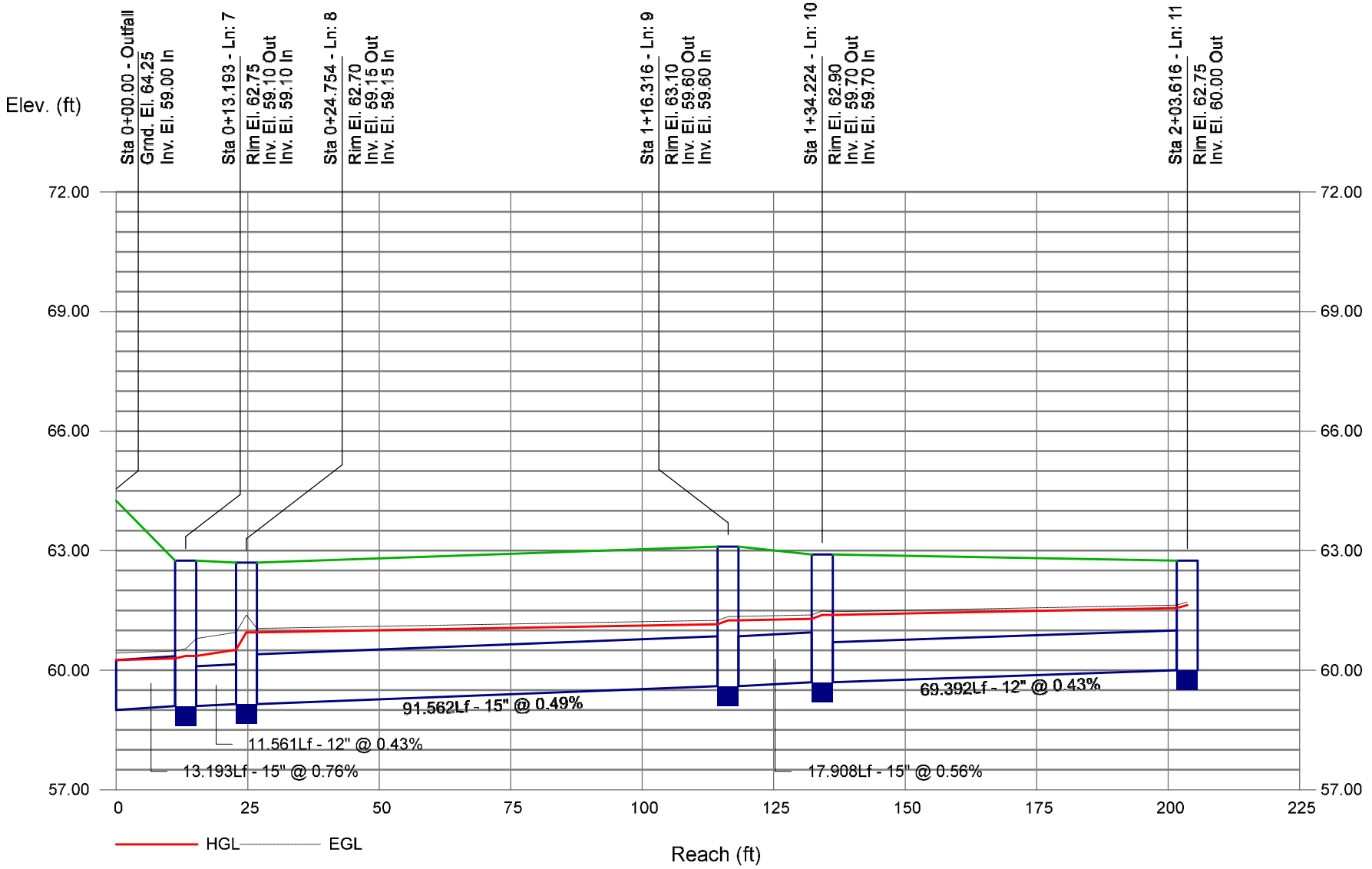
# Storm Sewer Profile

Proj. file: 2024-03-06_Pipe Sizing_Rowley, MA.stm



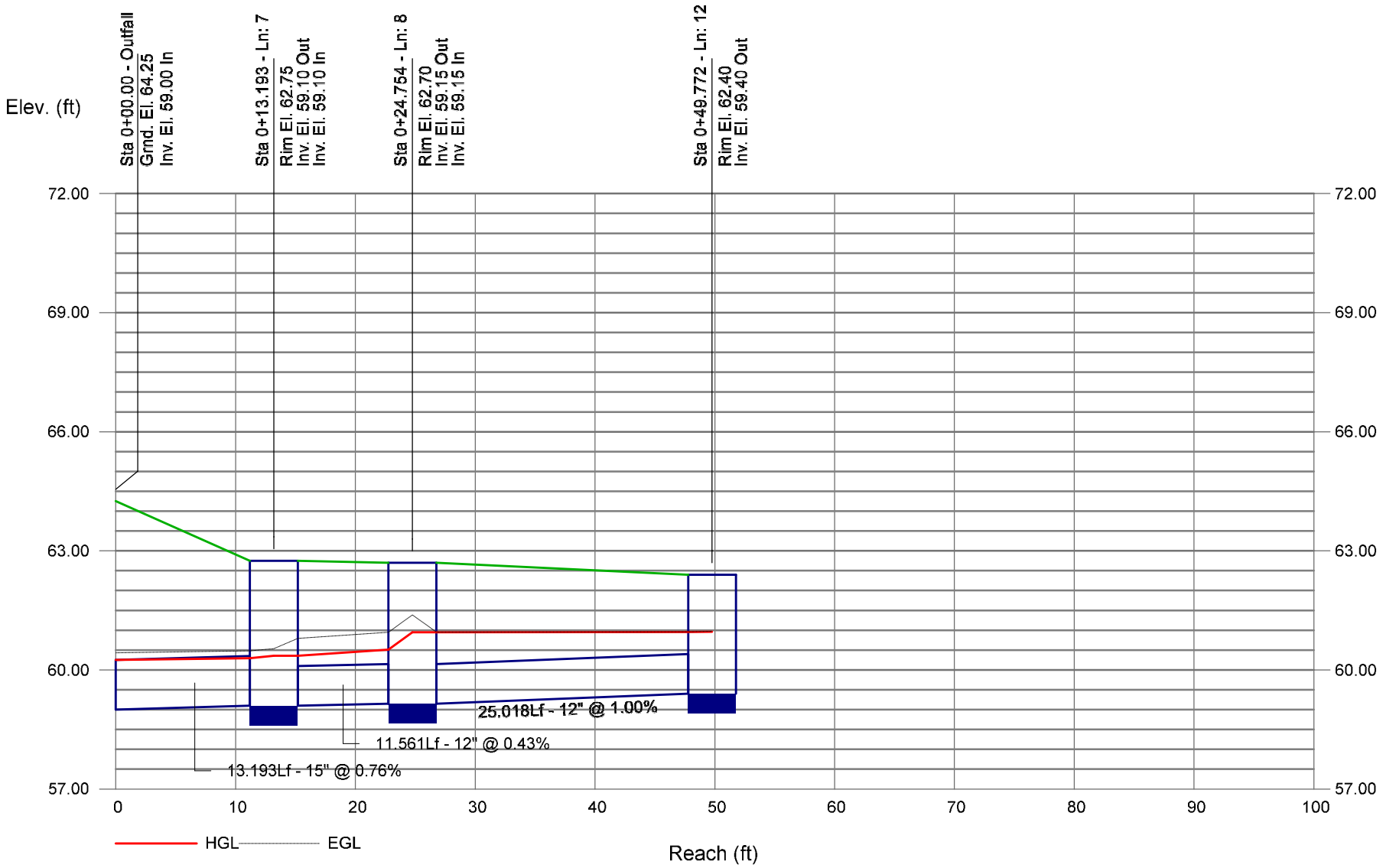
# Storm Sewer Profile

Proj. file: 2024-03-06_Pipe Sizing_Rowley, MA.stm



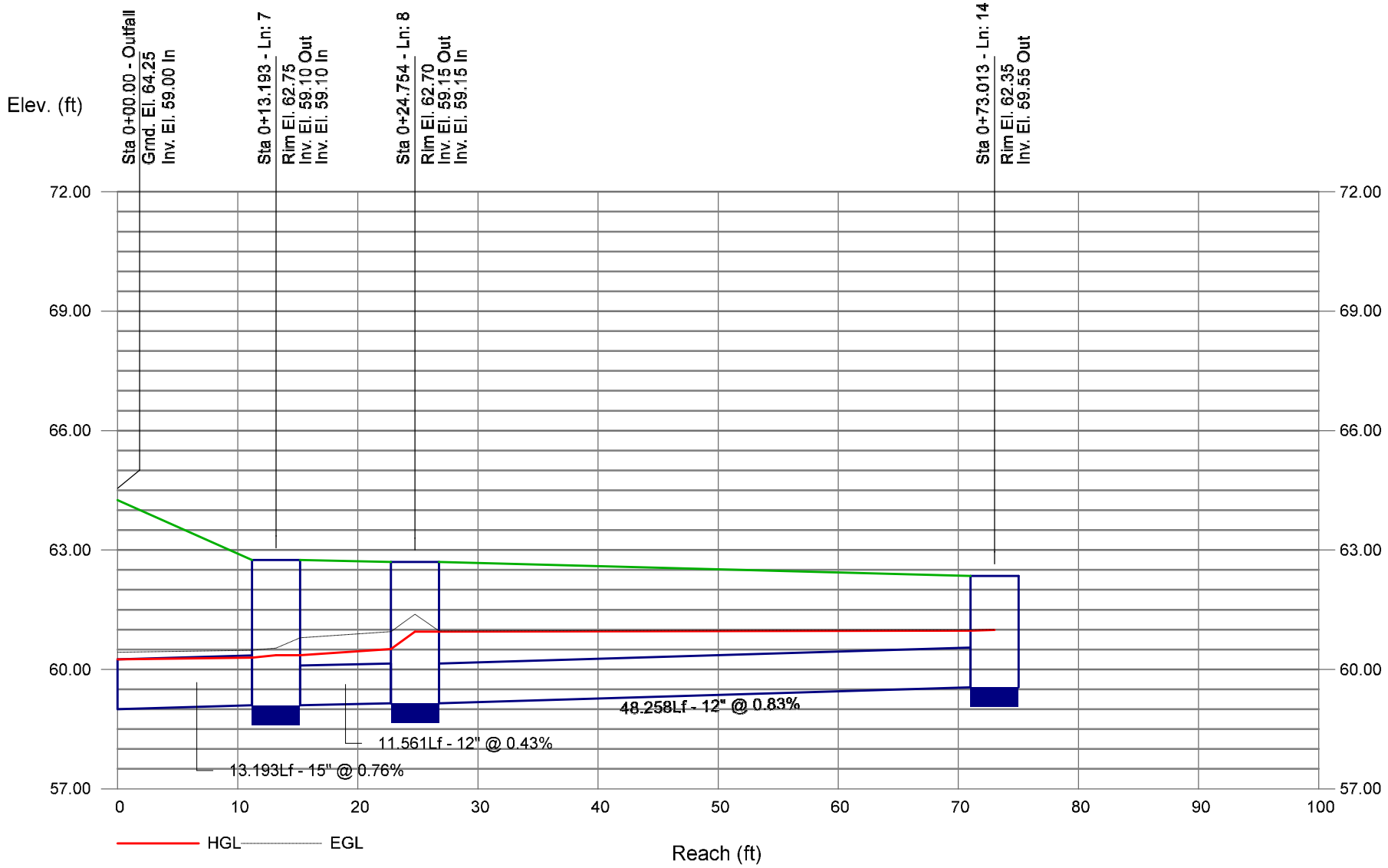
# Storm Sewer Profile

Proj. file: 2024-03-06_Pipe Sizing_Rowley, MA.stm



# Storm Sewer Profile

Proj. file: 2024-03-06_Pipe Sizing_Rowley, MA.stm



# APPENDIX D
# CONTECH MTD LAB CERTIFICATIONS

**Project:** Chase Bank - Rowley
**Location:** Rowley, MA
**Prepared For:** Stonefield

**Purpose:** To calculate the water quality flow rate (WQF) over a given site area. In this situation the WQF is derived from the first 1" of runoff from the contributing impervious surface.

**Reference:** Massachusetts Dept. of Environmental Protection Wetlands Program / United States Department of Agriculture Natural Resources Conservation Service TR-55 Manual

**Procedure:** Determine unit peak discharge using Figure 1 or 2. Figure 2 is in tabular form so is preferred. Using the tc, read the unit peak discharge (qu) from Figure 1 or Table in Figure 2. qu is expressed in the following units: cfs/mi$^2$/watershed inches (csm/in).

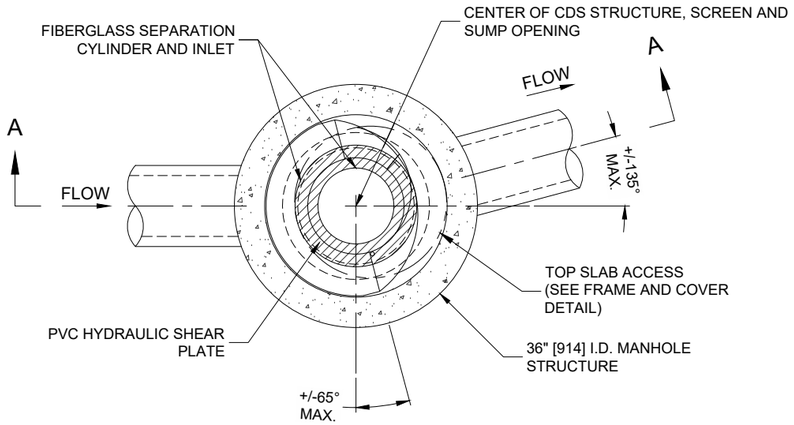
Compute Q Rate using the following equation:

$$Q = (qu)\ (A)\ (WQV)$$

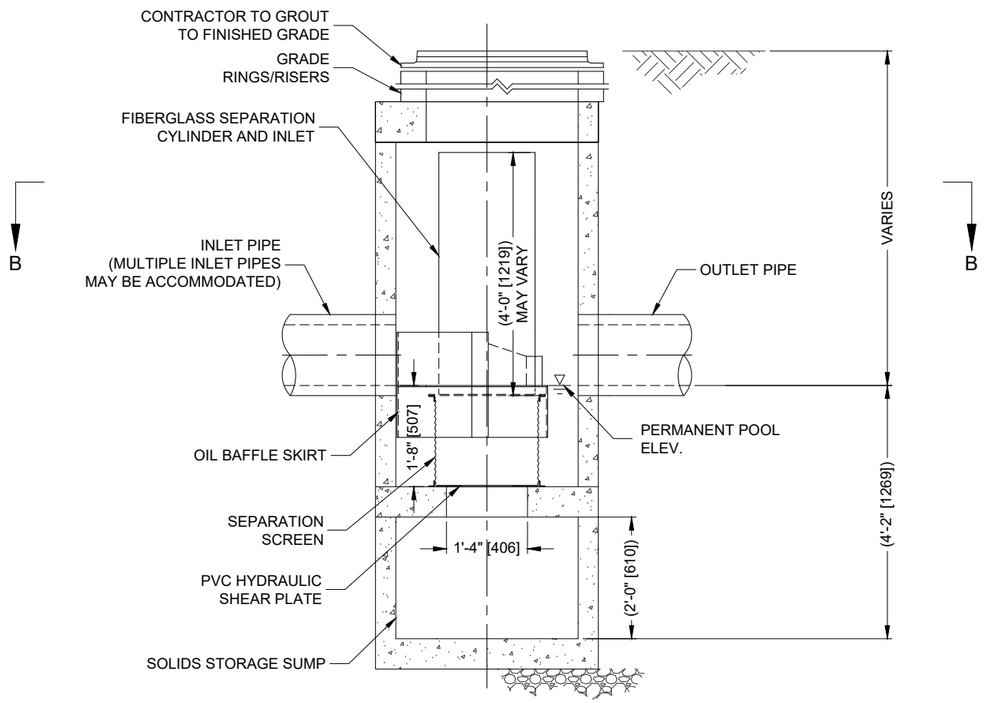
where:

Q = flow rate associated with first 1" of runoff
qu = the unit peak discharge, in csm/in.
A = impervious surface drainage area (in square miles)
WQV = water quality volume in watershed inches (1" in this case)

| Structure Name | Impv. (acres) | A (miles$^2$) | $t_c$ (min) | $t_c$ (hr) | WQV (in) | qu (csm/in.) | Q (cfs) |
|---|---|---|---|---|---|---|---|
| WQ-1 | 0.61 | 0.0009559 | 6.0 | 0.100 | 1.00 | 774.00 | 0.74 |
| WQ-2 | 0.16 | 0.0002500 | 6.0 | 0.100 | 1.00 | 774.00 | 0.19 |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |




**PLAN VIEW B-B**
N.T.S.



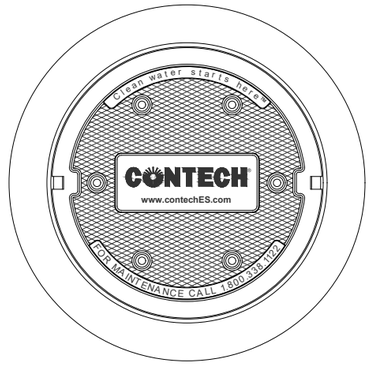

**ELEVATION A-A**
N.T.S.



## CDS1515-3-C DESIGN NOTES

CDS1515-3-C RATED TREATMENT CAPACITY IS 1.0 CFS, OR PER LOCAL REGULATIONS.

THE STANDARD CDS1515-3-C CONFIGURATION IS SHOWN.




**FRAME AND COVER**
(DIAMETER VARIES)
N.T.S.

## SITE SPECIFIC DATA REQUIREMENTS

| | | | |
|---|---|---|---|
| STRUCTURE ID | | | |
| WATER QUALITY FLOW RATE (CFS OR L/s) | | | * |
| PEAK FLOW RATE (CFS OR L/s) | | | * |
| RETURN PERIOD OF PEAK FLOW (YRS) | | | * |
| SCREEN APERTURE (2400 OR 4700) | | | * |
| PIPE DATA: | I.E. | MATERIAL | DIAMETER |
| INLET PIPE 1 | * | * | * |
| INLET PIPE 2 | * | * | * |
| OUTLET PIPE | * | * | * |
| RIM ELEVATION | | | * |
| ANTI-FLOTATION BALLAST | | WIDTH | HEIGHT |
| | | * | * |

NOTES/SPECIAL REQUIREMENTS:

* PER ENGINEER OF RECORD

GENERAL NOTES
1. CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
2. FOR SITE SPECIFIC DRAWINGS WITH DETAILED STRUCTURE DIMENSIONS AND WEIGHT, PLEASE CONTACT YOUR CONTECH ENGINEERED SOLUTIONS LLC REPRESENTATIVE. www.ContechES.com
3. CDS WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING. CONTRACTOR TO CONFIRM STRUCTURE MEETS REQUIREMENTS OF PROJECT.
4. STRUCTURE SHALL MEET AASHTO HS20 LOAD RATING, ASSUMING EARTH COVER OF 0' - 2', AND GROUNDWATER ELEVATION AT, OR BELOW, THE OUTLET PIPE INVERT ELEVATION. ENGINEER OF RECORD TO CONFIRM ACTUAL GROUNDWATER ELEVATION. CASTINGS SHALL MEET AASHTO M306 AND BE CAST WITH THE CONTECH LOGO..
5. IF REQUIRED, PVC HYDRAULIC SHEAR PLATE IS PLACED ON SHELF AT BOTTOM OF SCREEN CYLINDER. REMOVE AND REPLACE AS NECESSARY DURING MAINTENANCE CLEANING.
6. CDS STRUCTURE SHALL BE PRECAST CONCRETE CONFORMING TO ASTM C-478 AND AASHTO LOAD FACTOR DESIGN METHOD.

INSTALLATION NOTES
A. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
B. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE CDS MANHOLE STRUCTURE.
C. CONTRACTOR TO INSTALL JOINT SEALANT BETWEEN ALL STRUCTURE SECTIONS AND ASSEMBLE STRUCTURE.
D. CONTRACTOR TO PROVIDE, INSTALL, AND GROUT INLET AND OUTLET PIPE(S). MATCH PIPE INVERTS WITH ELEVATIONS SHOWN. ALL PIPE CENTERLINES TO MATCH PIPE OPENING CENTERLINES.
E. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO ASSURE UNIT IS WATER TIGHT, HOLDING WATER TO FLOWLINE INVERT MINIMUM. IT IS SUGGESTED THAT ALL JOINTS BELOW PIPE INVERTS ARE GROUTED.

CONTECH ENGINEERED SOLUTIONS LLC
www.contechES.com
9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-338-1122 513-645-7000 513-645-7993 FAX

CDS1515-3-C
ONLINE CDS
STANDARD DETAIL

CONTECH ENGINEERED SOLUTIONS

CDS TECHNOLOGIES

# CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION
# BASED ON THE RATIONAL RAINFALL METHOD

## CHASE BANK - ROWLEY
## ROWLEY, MA

| | | | |
|---|---|---|---|
| Area | **0.61 ac** | Unit Site Designation | **WQ-1** |
| Weighted C | **0.9** | Rainfall Station # | **67** |
| $t_c$ | **6 min** | | |
| CDS Model | **1515-3** | CDS Treatment Capacity | **1.0 cfs** |

| Rainfall Intensity[1] (in/hr) | Percent Rainfall Volume[1] | Cumulative Rainfall Volume | Total Flowrate (cfs) | Treated Flowrate (cfs) | Incremental Removal (%) |
|---|---|---|---|---|---|
| 0.08 | 41.0% | 41.0% | 0.04 | 0.04 | 38.7 |
| 0.16 | 23.9% | 64.9% | 0.09 | 0.09 | 21.8 |
| 0.24 | 11.5% | 76.5% | 0.13 | 0.13 | 10.2 |
| 0.32 | 7.4% | 83.9% | 0.18 | 0.18 | 6.3 |
| 0.40 | 4.4% | 88.3% | 0.22 | 0.22 | 3.7 |
| 0.48 | 2.9% | 91.2% | 0.26 | 0.26 | 2.3 |
| 0.56 | 1.8% | 93.0% | 0.31 | 0.31 | 1.4 |
| 0.64 | 1.2% | 94.2% | 0.35 | 0.35 | 0.9 |
| 0.72 | 1.6% | 95.8% | 0.40 | 0.40 | 1.1 |
| 0.80 | 0.8% | 96.6% | 0.44 | 0.44 | 0.5 |
| 1.00 | 0.6% | 97.1% | 0.55 | 0.55 | 0.3 |
| 1.40 | 1.4% | 98.6% | 0.77 | 0.77 | 0.6 |
| 1.80 | 0.9% | 99.5% | 0.99 | 0.99 | 0.3 |
| 2.20 | 0.5% | 100.0% | 1.21 | 1.00 | 0.1 |
| 0.00 | 0.0% | 100.0% | 0.00 | 0.00 | 0.0 |
| 0.00 | 0.0% | 100.0% | 0.00 | 0.00 | 0.0 |
| 0.00 | 0.0% | 100.0% | 0.00 | 0.00 | 0.0 |
| 0.00 | 0.0% | 100.0% | 0.00 | 0.00 | 0.0 |
| 0.00 | 0.0% | 100.0% | 0.00 | 0.00 | 0.0 |
| 0.00 | 0.0% | 100.0% | 0.00 | 0.00 | 0.0 |
| 0.00 | 0.0% | 100.0% | 0.00 | 0.00 | 0.0 |
| | | | | | 88.2 |
| | | | | Removal Efficiency Adjustment[2] = | 0.0% |
| | | | | Predicted % Annual Rainfall Treated = | 99.9% |
| | | | | **Predicted Net Annual Load Removal Efficiency =** | **88.2%** |

1 - Based on 7 years of data from NCDC station #3276, Groveland, Essex County, MA
2 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.

# CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION
# BASED ON THE RATIONAL RAINFALL METHOD

## CHASE BANK - ROWLEY
## ROWLEY, MA

| | | | |
|---|---|---|---|
| Area | **0.16 ac** | Unit Site Designation | **WQ-2** |
| Weighted C | **0.9** | Rainfall Station # | **67** |
| $t_c$ | **6 min** | | |
| CDS Model | **1515-3** | CDS Treatment Capacity | **1.0 cfs** |

| Rainfall Intensity[1] (in/hr) | Percent Rainfall Volume[1] | Cumulative Rainfall Volume | Total Flowrate (cfs) | Treated Flowrate (cfs) | Incremental Removal (%) |
|---|---|---|---|---|---|
| 0.08 | 41.0% | 41.0% | 0.01 | 0.01 | 39.6 |
| 0.16 | 23.9% | 64.9% | 0.02 | 0.02 | 22.8 |
| 0.24 | 11.5% | 76.5% | 0.03 | 0.03 | 10.9 |
| 0.32 | 7.4% | 83.9% | 0.05 | 0.05 | 7.0 |
| 0.40 | 4.4% | 88.3% | 0.06 | 0.06 | 4.1 |
| 0.48 | 2.9% | 91.2% | 0.07 | 0.07 | 2.7 |
| 0.56 | 1.8% | 93.0% | 0.08 | 0.08 | 1.6 |
| 0.64 | 1.2% | 94.2% | 0.09 | 0.09 | 1.1 |
| 0.72 | 1.6% | 95.8% | 0.10 | 0.10 | 1.4 |
| 0.80 | 0.8% | 96.6% | 0.12 | 0.12 | 0.7 |
| 1.00 | 0.6% | 97.1% | 0.14 | 0.14 | 0.5 |
| 1.40 | 1.4% | 98.6% | 0.20 | 0.20 | 1.2 |
| 1.80 | 0.9% | 99.5% | 0.26 | 0.26 | 0.7 |
| 2.20 | 0.5% | 100.0% | 0.32 | 0.32 | 0.4 |
| 0.00 | 0.0% | 100.0% | 0.00 | 0.00 | 0.0 |
| 0.00 | 0.0% | 100.0% | 0.00 | 0.00 | 0.0 |
| 0.00 | 0.0% | 100.0% | 0.00 | 0.00 | 0.0 |
| 0.00 | 0.0% | 100.0% | 0.00 | 0.00 | 0.0 |
| 0.00 | 0.0% | 100.0% | 0.00 | 0.00 | 0.0 |
| 0.00 | 0.0% | 100.0% | 0.00 | 0.00 | 0.0 |
| 0.00 | 0.0% | 100.0% | 0.00 | 0.00 | 0.0 |
| | | | | | 94.8 |
| | | | | Removal Efficiency Adjustment[2] = | 0.0% |
| | | | | Predicted % Annual Rainfall Treated = | 100.0% |
| | | | | **Predicted Net Annual Load Removal Efficiency =** | **94.8%** |

1 - Based on 7 years of data from NCDC station #3276, Groveland, Essex County, MA
2 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.

# APPENDIX E
# DRAINAGE AREA MAPS

## INVENTORY

**SHEET 1 OF 3: EXISTING DRAINAGE AREA MAP**

**SHEET 2 OF 3: PROPOSED DRAINAGE AREA MAP**

**SHEET 3 OF 3: PROPOSED INLET DRAINAGE AREA MAP**


| SYMBOL | DESCRIPTION |
|---|---|
| | PROPERTY LINE |
| | AREA OF DRAINAGE ANALYSIS |
| | EXISTING DRAINAGE AREA |
| | EXISTING TIME OF CONCENTRATION |
| | EXISTING PERVIOUS AREA |

20' 0' 20' 40'
GRAPHIC SCALE IN FEET
1" = 20'

| ISSUE | DATE | BY | DESCRIPTION |
|---|---|---|---|
| 01 | 03/05/2024 | JV | FOR MUNICIPAL SUBMISSION - PLANNING BOARD |

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DRAINAGE AREA MAPS

CHASE

PROPOSED BANK WITH DRIVE-THRU ATM

MAP: 14 LOT: 13
145 NEWBURYPORT TURNPIKE (ROUTE 1)
TOWN OF ROWLEY
ESSEX COUNTY, MASSACHUSETTS


JOSHUA H. KLINE, P.E.
MASSACHUSETTS LICENSE No. 53936
LICENSED PROFESSIONAL ENGINEER

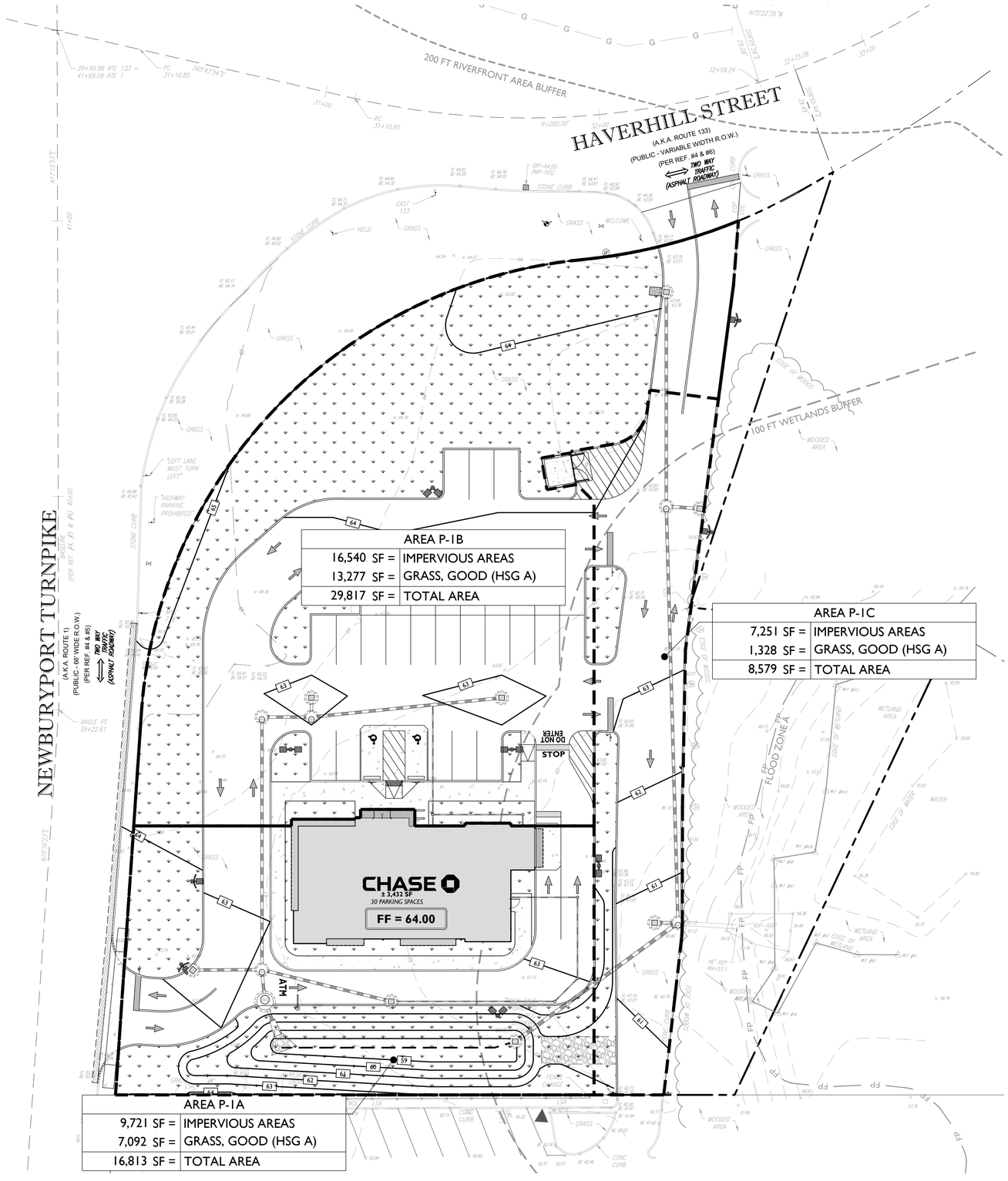

STONEFIELD engineering & design

SCALE: 1" = 20' | PROJECT ID: BOS-230034

TITLE: EXISTING DRAINAGE AREA

DRAWING: 1 OF 2

Z:\BOSTON\2023\23BOS-230034 CONSTATE - 145 NEWBURYPORT TURNPIKE, ROWLEY, MA\CAD\SHEET\DRAINAGE AREA MAP\230034-EXIST_DRAINAGE AREA MAP.DWG




| SYMBOL | DESCRIPTION |
|---|---|
| | PROPERTY LINE |
| 100 | PROPOSED GRADING CONTOUR |
| RIDGELINE | PROPOSED GRADING RIDGELINE |
| | PROPOSED STORMWATER STRUCTURES |
| | PROPOSED STORMWATER PIPING |
| | AREA OF DRAINAGE ANALYSIS |
| | PROPOSED DRAINAGE AREA |
| | PROPOSED TIME OF CONCENTRATION |
| | PROPOSED PERVIOUS AREA |

20' 0' 20' 40'
GRAPHIC SCALE IN FEET
1" = 20'

| ISSUE | DATE | BY | DESCRIPTION |
|---|---|---|---|
| 01 | 03/05/2024 | JV | FOR MUNICIPAL SUBMISSION - PLANNING BOARD |

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DRAINAGE AREA MAPS

CHASE

PROPOSED BANK WITH DRIVE-THRU ATM

MAP: 14 LOT: 13
145 NEWBURYPORT TURNPIKE (ROUTE 1)
TOWN OF ROWLEY
ESSEX COUNTY, MASSACHUSETTS


JOSHUA H. KLINE, P.E.
MASSACHUSETTS LICENSE No. 53936
LICENSED PROFESSIONAL ENGINEER

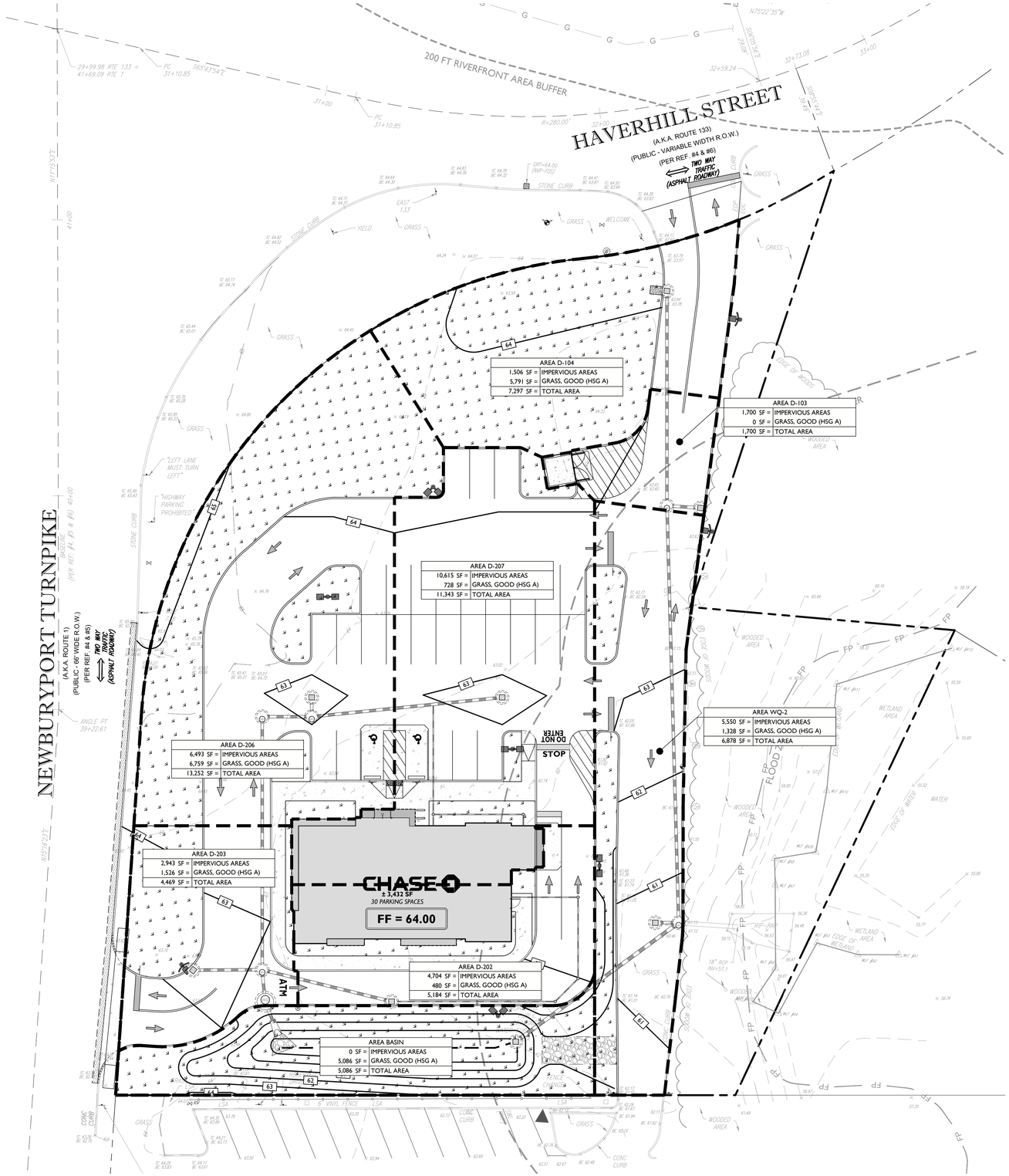

STONEFIELD engineering & design

SCALE: 1" = 20' | PROJECT ID: BOS-230034

TITLE:
PROPOSED DRAINAGE AREA

DRAWING:
2 OF 2

Z:\BOSTON\BOS\2023\BOS-230034.CORE STATE - 145 NEWBURYPORT TURNPIKE, ROWLEY, MA\CAD\SUBMITTED\DRAINAGE AREA MAPS\BOS-230034_DRAINAGE AREA MAPS.DWG




## SYMBOL / DESCRIPTION

| SYMBOL | DESCRIPTION |
|---|---|
| | PROPERTY LINE |
| 100 | PROPOSED GRADING CONTOUR |
| RIDGELINE | PROPOSED GRADING RIDGELINE |
| | PROPOSED STORMWATER STRUCTURES |
| | PROPOSED STORMWATER PIPING |
| | AREA OF DRAINAGE ANALYSIS |
| | PROPOSED DRAINAGE AREA |
| | PROPOSED TIME OF CONCENTRATION |
| | PROPOSED PERVIOUS AREA |

| ISSUE | DATE | BY | DESCRIPTION |
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DRAINAGE AREA MAPS

# CHASE
## PROPOSED BANK WITH DRIVE-THRU ATM

MAP: 144 LOT: 12
145 NEWBURYPORT TURNPIKE (ROUTE 1)
TOWN OF ROWLEY
ESSEX COUNTY, MASSACHUSETTS


JOSHUA H. KLINE, P.E.
MASSACHUSETTS LICENSE No. 53926
LICENSED PROFESSIONAL ENGINEER


STONEFIELD engineering & design

SCALE: 1" = 20' | PROJECT ID: BOS-230034

TITLE:
**PROPOSED DRAINAGE AREA**

DRAWING:
**2 OF 2**

Z:\BOSTON\BOS\2023\BOS-230034 CORE STATE - 145 NEWBURYPORT TURNPIKE, ROWLEY, MA\CAD\EXHIBITS\DRAINAGE AREA MAPS\2024-03-05_DRAINAGE AREA MAPS.DWG

# APPENDIX F
# INSPECTION CHECKLISTS

## INVENTORY

**F-1: GENERAL INSPECTION CHECKLIST LOG**

**F-2: GENERAL PREVENTATIVE MAINTENANCE LOG**

**F-3: GENERAL CORRECTIVE MAINTENANCE LOG**

**F-4: ANNUAL EVALUATION LOG**

## INSPECTION CHECKLIST LOG

1. **The responsible party shall report issues to the local authority and mosquito commission as required by local ordinances and regulatory authorities.**
2. **The maintenance crew should fill out the checklist in the field manual when performing each inspection/maintenance task.**
3. **After the maintenance task is performed, the checklist should be filed in the Maintenance Plan and recorded in the log below.**

| ***Cycle of Inspection*** | ***Stormwater Management Measure No.*** | ***Checklist No.*** | ***Date(s) of Inspection*** |
|---|---|---|---|
| (1st Quarter) | | | |
| (2nd Quarter) | | | |
| (3rd Quarter) | | | |
| (4th Quarter) | | | |
| (Unscheduled Inspection; e.g., after 1" rain) | | | |
| | | | |
| (1st Quarter) | | | |
| (2nd Quarter) | | | |
| (3rd Quarter) | | | |
| (4th Quarter) | | | |
| (Unscheduled Inspection; e.g., after 1" rain) | | | |
| | | | |
| (1st Quarter) | | | |

| *Cycle of Inspection* | *Stormwater Management Measure No.* | *Checklist No.* | *Date(s) of Inspection* |
|---|---|---|---|
| (2nd Quarter) | | | |
| (3rd Quarter) | | | |
| (4th Quarter) | | | |
| (Unscheduled Inspection; e.g., after 1" rain) | | | |
| | | | |
| (1st Quarter) | | | |
| (2nd Quarter) | | | |
| (3rd Quarter) | | | |
| (4th Quarter) | | | |
| (Unscheduled Inspection; e.g., after 1" rain) | | | |
| | | | |
| (1st Quarter) | | | |
| (2nd Quarter) | | | |
| (3rd Quarter) | | | |
| (4th Quarter) | | | |
| (Unscheduled Inspection; e.g., after 1" rain) | | | |

## PREVENTATIVE MAINTENANCE LOG

| Maintenance Schedule | Stormwater Management Measure No. | Preventative Maintenance Record No. | Date(s) of Maintenance |
|---|---|---|---|
| (1st Quarter) | | | |
| (2nd Quarter) | | | |
| (3rd Quarter) | | | |
| (4th Quarter) | | | |
| (Unscheduled Maintenance work; e.g., after 1" rain) | | | |
| | | | |
| (1st Quarter) | | | |
| (2nd Quarter) | | | |
| (3rd Quarter) | | | |
| (4th Quarter) | | | |
| (Unscheduled Inspection; e.g., after 1" rain) | | | |
| | | | |

## CORRECTIVE MAINTENANCE LOG

| *Maintenance Schedule* | *Stormwater Management Measure No.* | *Corrective Maintenance Record No.* | *Date(s) of Maintenance* |
|---|---|---|---|
| (1st Quarter) | | | |
| (2nd Quarter) | | | |
| (3rd Quarter) | | | |
| (4th Quarter) | | | |
| (Unscheduled Maintenance work; e.g., after 1" rain) | | | |
| | | | |
| (1st Quarter) | | | |
| (2nd Quarter) | | | |
| (3rd Quarter) | | | |
| (4th Quarter) | | | |
| (Unscheduled Inspection; e.g., after 1" rain) | | | |
| | | | |

## ANNUAL EVALUATION RECORD

The person responsible for maintenance shall evaluate the effectiveness of the maintenance plan at least once per year and adjust the plan and the deed as needed.

The responsible party should evaluate the effectiveness of the maintenance plan by comparing the maintenance plan with the actual performance of the maintenance. The items to evaluate may include, but not limited to,

- Whether the inspections have been performed as scheduled;
- Whether the preventive maintenance has been performed as scheduled;
- Whether the frequency of preventative maintenance needs to increase or decrease;
- Whether the planned resources were enough to perform the maintenance;
- Whether the repairs were completed on time;
- Whether the actual cost was consistent with the estimated cost;
- Whether the inspection, maintenance, and repair records have been kept.

If actual performance of those items has been deviated from the maintenance plan, the responsible party should find the causes and implement solutions in a revised maintenance plan.

| ***Evaluator(s)*** | ***Date of Evaluation*** | ***Decision*** |
|---|---|---|
| | | __Maintain current version OR<br><br>__Revise current version<br>Revision date _____<br>(also update the last revision date on the cover page)<br><br>__Requires a new deed recording<br>(also update the last recording information on the cover page) |
| | | __Maintain current version OR<br><br>__Revise current version<br>Revision date _____<br>(also update the last revision date on the cover page)<br><br>__Requires a new deed recording<br>(also update the last recording information on the cover page) |
| | | __Maintain current version OR<br><br>__Revise current version<br>Revision date _____<br>(also update the last revision date on the cover page)<br><br>__Requires a new deed recording<br>(also update the last recording information on the cover page) |