

Highlands Village

COMPREHENSIVE PERMIT APPLICATION – BRAINTREE ZBA

5. SITE DEVELOPMENT INFORMATION

- a. Site Engineering Report**
- b. Stormwater Report**
- c. Stormwater Operation & Maintenance Plan**
- d. Drainage Supporting Calculations**
- e. PES Associates – Environmental Review 2017**

Site Engineering Report

For:

**Highlands Village
357 Grove Street
Braintree, MA**

Prepared By:



**Hardy + Man Design Group, PC
1285 Washington Street
Weymouth, MA 02189**

January 17, 2020

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Existing Site Conditions

The existing site consists of three parcels of land located at the southeasterly portion of the intersection of Grove and Liberty Streets in Braintree. The individual parcels currently contain two single family houses and one (currently vacant) automotive garage. The existing total lot area is approximately 3.36 AC (146,700 SF). The zoning for the parcels is mixed and consists of Residence A, Residence B and General Business.

The developed portion of the existing lot is primarily along the areas adjacent to Grove and Liberty Streets and is served by public sewer, water, electric and gas utilities available in the adjacent roadways. The rear of the existing site is mostly unimproved with pavement or buildings and is a mixture of wooded and grassed areas. Additionally, an existing sewer easement crosses the site from Thetford Street to Grove Street.

A Bordering Vegetated Wetland area exists in the center of the site and the majority of the site drains toward the wetlands before discharge easterly through an existing corrugated metal pipe. A smaller portion of the site drains toward Grove Street. The topography of the site ranges from elevation 180 near the southwesterly corner of the site to elevation 154 along Grove Street.

The locus is at the intersection of Grove and Liberty Streets. The intersection mainly consists of commercial properties including a deli/convenience store, a large shopping plaza, and a now vacant commercial lot. The area to the east consists of a mixture of residential parcels and medical and office uses towards the Braintree/Weymouth municipal boundary. The area to the south consists of a well-developed residential area accessed from Liberty Street. The area to the west consists of large commercial parcels in the immediate area with a mixture of residential and commercial uses westerly along Grove Street. The area to the north along Liberty Street is primarily residential uses.

Proposed Conditions

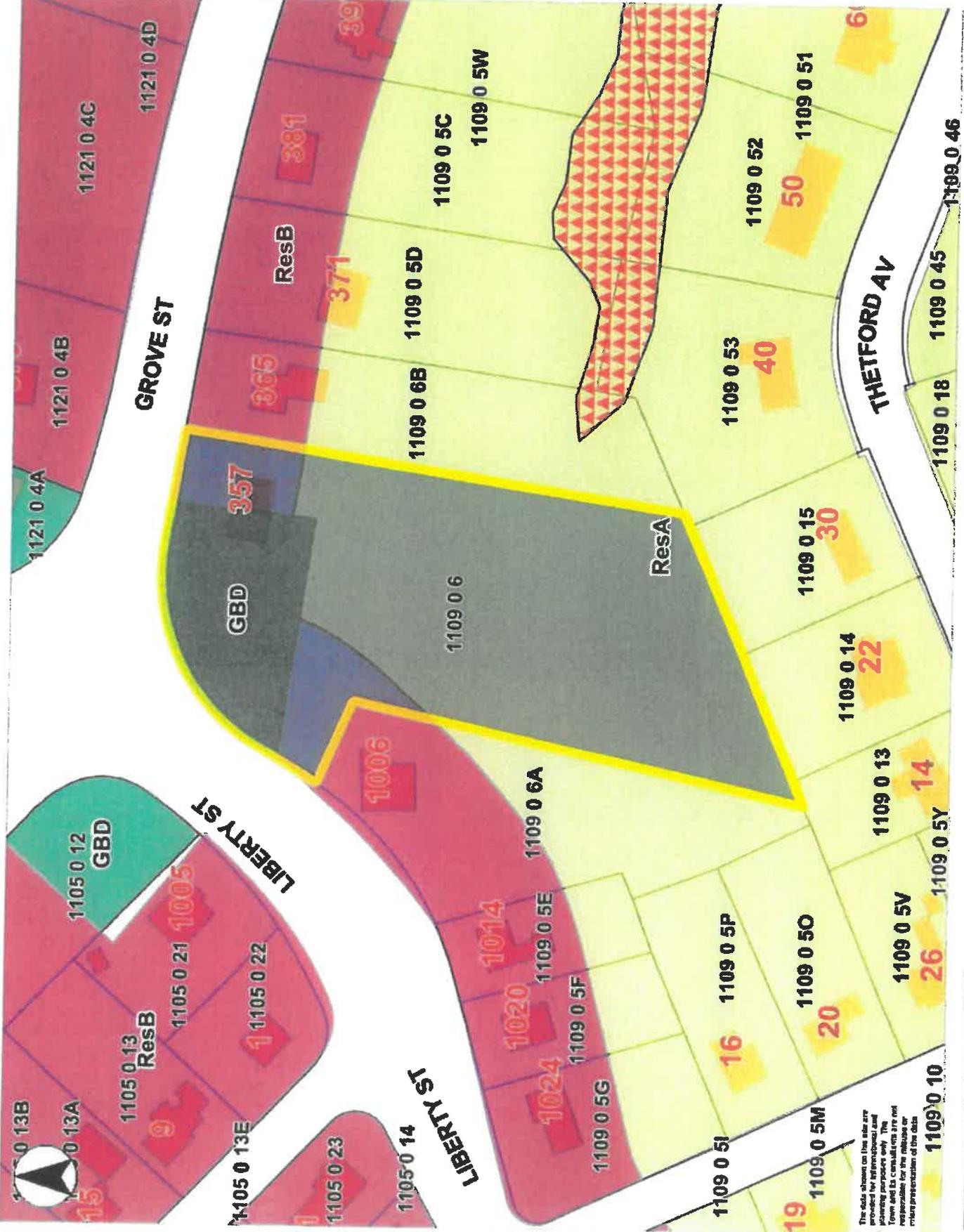
The applicant proposes the construction of a residential apartment building with 96 units. The building has an approximately 24,000 SF footprint and has three stories. Two driveways will access the site, one from Grove Street and one from Liberty Street. The parking lot will include 146 parking spaces.

The building will be served by new proposed utilities (sewer, water, gas, etc.) connected to available infrastructure in the adjacent roadways. A section of the existing sewer that traverses the site will be relocated to accommodate the proposed building.

The proposed building, parking area, and walkways will result in approximately 63,000 SF of net new impervious coverage on the site. Runoff from the impervious surfaces will be routed to one of four proposed infiltration systems on site. The proposed stormwater management and erosion control design of the proposed development will meet the Massachusetts Department of Environmental Protection Stormwater Management Standards.

Supporting Maps

- Police Station
- Fire Station
- Library
- Town Hall
- DEP Water Treatment Building
- Barrier Beach System
- Barrier Beach-Coast
- Barrier Beach-Coast
- Barrier Beach-Strub
- Bog
- Coastal Bank Bluff or
- Coastal Beach
- Coastal Dune
- Coastal Wetland
- Chertney Bog
- Open Water
- Rocky Intertidal Sho
- Salt Marsh
- Shallow Marsh Mead
- Thru Swamp
- Wooded Swamp Cor
- Wooded Swamp Wet
- Wooded Swamp Mts
- Zoning
- BWLD
- Cluster 1
- Cluster 2
- Commercial (COMM)
- General Business D1
- Highway Business D
- Office Business D
- Residential A (ResA)
- Residential B (ResB)
- Residential C (ResC)
- Buildings
- Parcels
- Town Boundary
- MA Highways
- Interstate
- US Highway
- Numbered Routes
- Abutting Towns Labels
- Streets
- Major Stream
- Waterodies



Braintree GIS

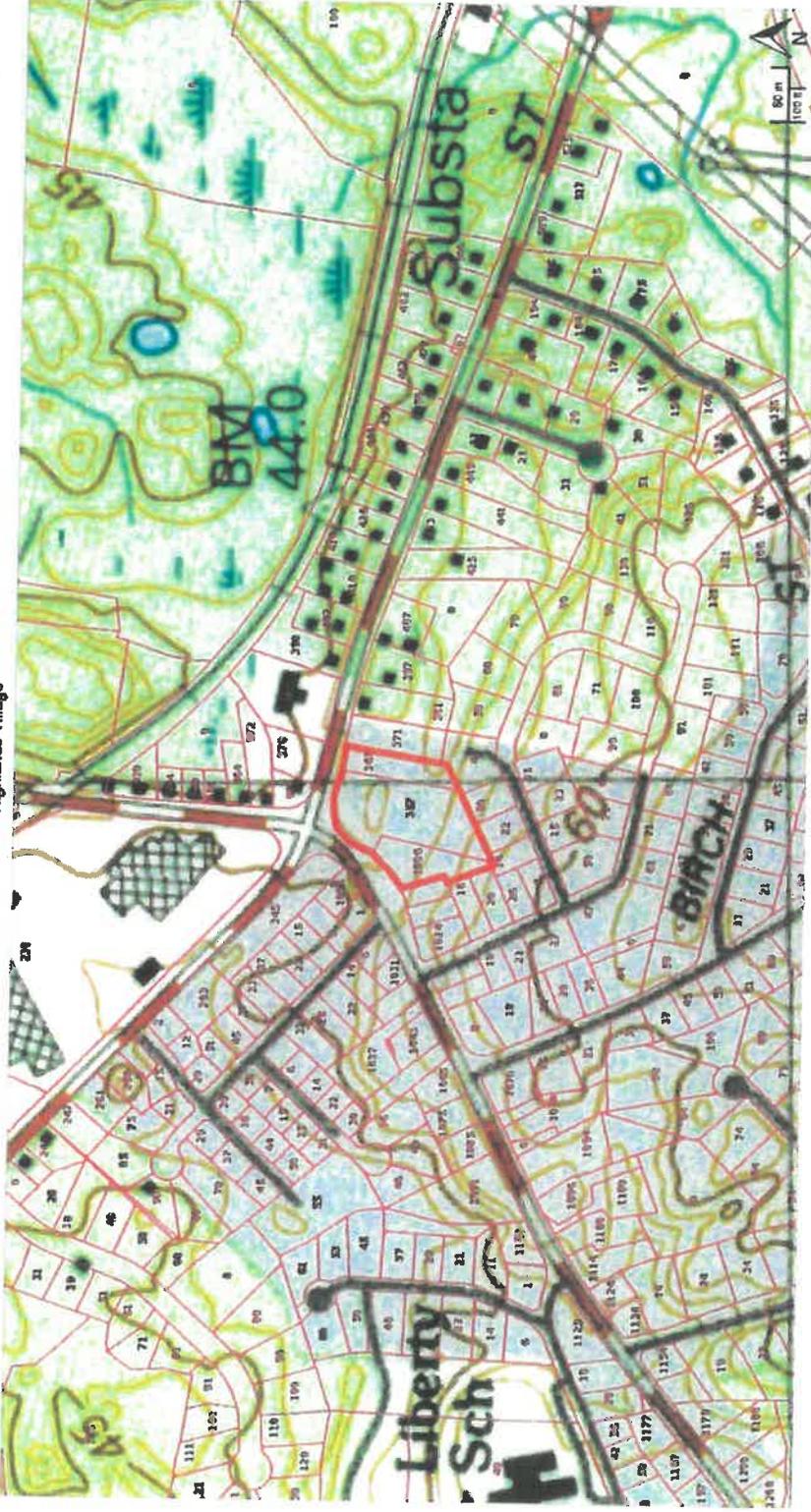
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The data shown on this site are provided for informational and planning purposes only. The Town and its consultants are not responsible for the release or misrepresentation of the data.

Highlands Village

Highlands Village



National Flood Hazard Layer FIRMette



42°11'33.60"N



Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PAUSE, LAYOUT

SPECIAL FLOOD HAZARD AREAS

- Without Base Flood Elevation (BFE)
Zone A, V, APM
- With BFE or Depth Zone AE, AD, AH, VE, AP
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD

- 0.2% Annual Chance Flood Hazard, Area of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone:
- Future Conditions 1% Annual Chance Flood Hazard Zone X
- Area with Reduced Flood Risk due to Levees. See Notes. Zone X
- Area with Flood Risk due to Levee Zone D

OTHER AREAS

- Area of Minimal Flood Hazard Zone X
- Effective LOMRs
- Area of Undetermined Flood Hazard Zone

GENERAL STRUCTURES

- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES

- Cross Sections with 1% Annual Chance
- Water Surface Elevation
- Coastal Transect
- Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS

- Digital Data Available
- No Digital Data Available
- Unmapped

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards.

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 1/22/2020 at 11:30:11 AM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

Stormwater Report

For:

**Highlands Village
357 Grove Street
Braintree, MA**

Prepared By:



**Hardy + Man Design Group, PC
1285 Washington Street
Weymouth, MA 02189**

January 17, 2020

Existing Site Conditions

The existing site consists of three parcels of land located on Grove Street at the southerly intersection of Liberty Street in Braintree. The parcels currently contain two single family houses and one automotive garage. The existing impervious area is 18,374 SF.

A wetland area exists in the center of the site and the majority of the site drains toward the wetlands. A smaller portion of the site drains toward Grove Street. The topography of the site ranges from elevation 180 near the southwesterly corner of the site to elevation 154 along Grove Street.

Test pits were performed Shawn Hardy P.E. on December 23, 2019. Soils were found to be fine-grain sand and the estimated seasonal high groundwater table elevation was found to be at a depth of 52-58" below the surface. Soil logs are depicted on the plan set cover sheet.

Methodology

This drainage analysis will utilize TR-55 drainage guidelines which is an industry standard for urban hydrology small watersheds. The accompanying calculations analyze the increase in runoff from the proposed site development under a 24-hour 6.8-inch rain event, which approximates a 100-year storm event. Calculations were also performed for 25-year, 10-year, and 2-year storm events.

Proposed Conditions

The applicant proposes the construction of a residential apartment building with 96 units. Two driveways will access the site, one from Grove Street and one from Liberty Street. The parking lot will include 146 parking spaces.

The proposed building, parking area, and sidewalks will result in 81,261 SF of proposed impervious area, resulting in 62,887 SF of net new impervious coverage on the site. Runoff from the roadway will be routed to one of four Cultec infiltration systems on site. The systems consist of a total of 146 330XLHD and 36 150XLHD Cultec chambers. The proposed chambers and surrounding stone will provide 14,430 cubic feet of storage.

Two watershed areas were evaluated on site to ensure the infiltration systems were designed to decrease or match the existing peak flowrates for the 2-year, 10-year, 25-year, and 100-year rainfall events. One watershed area discharges to the wetland on site and the other flows toward Grove Street.

The following table depicts the peak runoff rates and volumes for the roadway, sidewalk, and driveways for the existing and proposed conditions for each storm event.

Wetland Area - Peak Discharge Rates (cfs)

	2-year	10-year	25-year	100-year
Existing Conditions	0.01	0.11	0.43	1.37
Proposed Conditions	0.00	0.02	0.42	1.03

Wetland Area - Runoff Volume (af)

	2-year	10-year	25-year	100-year
Existing Conditions	0.004	0.041	0.087	0.169
Proposed Conditions	0.001	0.012	0.042	0.015

Grove Street Area - Peak Discharge Rates (cfs)

	2-year	10-year	25-year	100-year
Existing Conditions	0.72	1.66	2.41	3.47
Proposed Conditions	0.00	0.01	0.03	0.11

Grove Street Area - Runoff Volume (af)

	2-year	10-year	25-year	100-year
Existing Conditions	0.059	0.120	0.169	0.240
Proposed Conditions	0.000	0.004	0.009	0.018

The proposed infiltration systems were also designed to infiltrate all recharge volume within 72 hours.

The proposed stormwater management and erosion control design of the proposed development will meet the Massachusetts Department of Environmental Protection Stormwater Management Standards as follows.

Standard 1: No New Untreated Discharges

The proposed improvements will not create any new untreated conveyances. Runoff from impervious areas is to be collected for infiltration and treatment prior to discharge. The proposal provides treatment of runoff where none exists today.

Standard 2: Peak Rate Attenuation

As stated and depicted in the tables, the proposed development results in a decrease in off-site stormwater flows and volumes.

Standard 3: Recharge

Infiltration systems have been provided to infiltrate required volumes.

Standard 4: Water Quality

Runoff from proposed impervious areas is to be treated by a chain consisting of a deep-sump catch basins and leaching gullies prior to discharge. An operation and maintenance plan has also been included with this submission to serve as a Long Term Pollution Prevention Plan. The plan is intended to maximize treatment of runoff from impervious areas where none exists today.

Standard 5: Land Uses with Higher Pollutant Loads (LUHPPLs)

The site is not a LUHPPL.

Standard 6: Critical Areas

The project is not located within a critical area.

Standard 7: Redevelopment

The project does not qualify as a redevelopment and stormwater controls have been designed to meet the required Stormwater Management Standards.

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

The Operation and Maintenance Plan included with this submittal will ensure proper maintenance of the pollution, erosion and sedimentation measures proposed during construction.

Standard 9: Operation and Maintenance Plan

An Operation and Maintenance Plan intended to ensure the continued proper functioning of the existing stormwater controls has been included with this submittal.

Standard 10: Prohibition of Illicit Discharges

An Illicit Discharge Statement will be provided prior to discharge to post-construction BMP's as required.

Erosion and Sedimentation Control Measures

Erosion control measures to be employed include a staked "Filter Sock" erosion control barrier and catch basin siltsacks as depicted in the site plan. The erosion control measures shall be inspected daily and be kept in place until such time that disturbed areas are re-vegetated or paved and are no longer a potential source of siltation.

A stabilized construction entrance is proposed at the entrance to the site along Grove Street and Liberty Street as depicted on the plans.

Conclusion

The stormwater management systems will reduce the stormwater runoff flowrate and volume by providing four on-site infiltration systems. In total, 182 chambers are proposed on site resulting in 14,430 cf of storage. The systems have been sized to reduce or match existing peak flowrates and runoff volumes for the 2-year, 10-year, 25-year, and 100-year rainfall events and drain within 72 hours.

During construction, the proposed erosion control measures protect sedimentation from construction activities from migrating from the site onto the public street and abutting properties.

The proposed stormwater management and erosion control design of the proposed development will meet the Massachusetts Department of Environmental Protection Stormwater Management Standards.

Operation and Maintenance Plan

Stormwater Operation and Maintenance Plan

357 Grove Street
Braintree, MA
January 17, 2020

Stormwater Management System Owner:

Property Owner

The following Operation and Maintenance Plan is intended as a guide for maintaining the structural and non-structural BMP's post-construction. In order to document maintenance activities, the attached maintenance log should be kept on site. A minimum of two years' worth of records should be up to date and available for review and inspection, if requested by City officials. The transfer of ownership (e.g. from developer to condo association) also includes the transfer of the maintenance obligation to the new owners. In order to ensure the proposed stormwater management system continues to function as designed and to prevent any adverse impacts down-gradient, proper maintenance is required.

Operation and Maintenance Plan During Construction

All erosion and sediment control measures must be in place prior to any disturbance.

Inlet Protection: catch basins shall be protected from siltation during construction through the use of siltation fabric. The siltation fabric must be installed under the catch basin grates and the grates must be secured to prevent untreated seepage. The fabric should be inspected daily and immediately after a rainstorm. Sediment deposits must be removed promptly and fabric must be repaired as necessary.

Perimeter Silt Protection: A "Silt Sock" (or approved equal) perimeter fence must be installed around the perimeter of work limits and material stockpiles. Installation shall be in accordance with manufacturer specifications and attached details. Silt fence shall be inspected daily. Trapped sediments shall be removed and repairs shall be made promptly.

Stabilized Construction Entrance: A Stabilized Construction Entrance is proposed at the entrance to the site along Grove and Liberty Streets as depicted on the plans. It should be inspected daily and repaired as needed.

Operation and Maintenance Activities

Catch Basin and Dump Sump Drain Manhole Inspection and Cleaning: Catch basins shall be inspected at least four (4) times per year and cleaned a minimum of two (2) times per year. Inspections should include the frame and grate, outlet pipe, hood and overall structure. Cleaning of catch basins shall be conducted in the early spring (after winter sanding and before spring

rains), if there are 18-inches of accumulated sediments or if a noticeable hydrocarbon sheen is present. The sumps shall be cleaned utilizing a vacuum or clamshell type device.

Infiltration Basin Inspection and Cleaning: The subsurface infiltration basin does not require regular maintenance if pretreatment devices (catch basins and deep sump drain manholes) are properly maintained. The system has inspection ports that should be inspected when the other on-site stormwater devices are inspected. If sediment build-up within the retention system is found during inspection, the sediment shall be removed by vacuumed method through the inspection ports.

Snow and Ice: During winter snow season, snow shall be mechanically removed. Snow shall be stock pile at the landscape areas on-site where it can naturally melt. Snow melt runoff can then be slowly infiltrated into the ground or treated by the stormwater management system. If excessive snow encountered, the excessive snow shall be removed by a private contractor for off-site disposal. At no time snow shall be pushed off site to the public right of way of abutting lands.

Supporting Calculations

Infiltration Structure Sizing Calculations

Volume of Infiltration System #1

44 Chambers x 52.2 cf +1.50' Row Adjustment x 7.45 sf x 4 Rows = 2,339.6 cf Chamber Storage
5,939.7 cf Field - 2,339.6 cf Chambers = 3,600.1 cf Stone x 40.0% Voids = 1,440.0 cf Stone Storage
Chamber Storage + Stone Storage = 3,779.6 cf

Volume of Infiltration System #2

78 Chambers x 52.2 cf +1.50' Row Adjustment x 7.45 sf x 6 Rows = 4,135.3 cf Chamber Storage
10,208.0 cf Field - 4,135.3 cf Chambers = 6,072.7 cf Stone x 40.0% Voids = 2,429.1 cf Stone Storage
Chamber Storage + Stone Storage = 6,564.4 cf

Volume of Infiltration System #3

36 Chambers x 27.2 cf +0.75' Row Adjustment x 2.65 sf x 6 Rows = 989.4 cf Chamber Storage
3,429.3 cf Field - 989.4 cf Chambers = 2,439.9 cf Stone x 40.0% Voids = 976.0 cf Stone Storage
Chamber Storage + Stone Storage = 1,965.4 cf

Volume of Infiltration System #4

24 Chambers x 52.2 cf +1.50' Row Adjustment x 7.45 sf x 4 Rows = 1,296.5 cf Chamber Storage
3,357.2 cf Field - 1,296.5 cf Chambers = 2,060.7 cf Stone x 40.0% Voids = 824.3 cf Stone Storage
Chamber Storage + Stone Storage = 2,120.8 cf

Total Site Storage

3,780 cf + 6,564 cf + 1,965 cf + 2,121 cf = 14,430 cf

Massachusetts Stormwater Standards - Required Recharge Volume

$$R_v = F \times \text{Impervious Area}$$

Where:

R_v = Required Recharged Volume

F = Target Depth Factor, for Type A Soils = 0.6 inches

Impervious Area = 81,261 sf

$$R_v = 0.6 \text{ inches} \times 1 \text{ ft}/12 \text{ inches} \times 81,261 \text{ sf} = \underline{4,063 \text{ cf}}$$

Proposed Storage Volume 14,430 cf > Required Recharge Volume 4,063 cf

Time to Infiltrate – Static Method

$$\text{Time to Infiltrate} = R_v / (K \times \text{Bottom of Stone Area} \times n)$$

Where

R_v = Recharged Volume

K = Rawls Rate (per Table 2.3.3 in the Mass Stormwater Handbook) = Sand = 8.27 inches/hour

n = stone voids = 0.40

Time to Infiltrate – Infiltration System #1

Bottom of Stone Area Infiltration Area = 80.50' x 20.83' = 1,677 sf

$$\text{Time to Infiltrate} = 3,779.6 \text{ cf} / (8.27 \text{ in/hr} \times 1 \text{ ft}/12 \text{ inches} \times 1,677 \text{ sf} \times 0.40) = \underline{8.2 \text{ hours}}$$

8.2 hours < 72 hours : Meets Standard

Time to Infiltrate – Infiltration System #2

Bottom of Stone Area Infiltration Area = 94.50' x 30.50' = 2,882 sf

$$\text{Time to Infiltrate} = 6,564.4 \text{ cf} / (8.27 \text{ in/hr} \times 1 \text{ ft}/12 \text{ inches} \times 2,882 \text{ sf} \times 0.40) = \underline{8.3 \text{ hours}}$$

8.3 hours < 72 hours : Meets Standard

Time to Infiltrate – Infiltration System #3

Bottom of Stone Area Infiltration Area = 64.25' x 21.00' = 1,349 sf

Time to Infiltrate= 1,965.4 cf / (8.27 in/hr x 1 ft/12 inches x 1,349 sf x 0.40) = 5.3 hours

5.3 hours < 72 hours : Meets Standard

Time to Infiltrate – Infiltration System #4

Bottom of Stone Area Infiltration Area = 45.50' x 20.83' = 948 sf

Time to Infiltrate= 2,120.8 cf / (8.27 in/hr x 1 ft/12 inches x 948 sf x 0.40) = 8.1 hours

8.1 hours < 72 hours : Meets Standard

Soil Data

MAP LEGEND

	Area of Interest (AOI)		Soil Area
	Soils		Story Spot
	Soil Map Unit Polygons		Very Stony Spot
	Soil Map Unit Lines		Wet Spot
	Soil Map Unit Points		Other
	Special Point Features		Special Line Features
	Blowout		Water Features
	Borrow Pit		Streams and Canals
	Clay Spot		Transportation
	Closed Depression		Rails
	Gravel Pit		Interstate Highways
	Gravelly Spot		US Routes
	Landfill		Major Roads
	Lava Flow		Local Roads
	Marsh or swamp		Background
	Mine or Quarry		Aerial Photography
	Miscellaneous Water		
	Perennial Water		
	Rock Outcrop		
	Saline Spot		
	Sandy Spot		
	Severely Eroded Spot		
	Sinkhole		
	Slide or Slip		
	Sodic Spot		

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:25,000.

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

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

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:

Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distances 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: Norfolk and Suffolk Counties, Massachusetts
Survey Area Data: Version 15, Sep 12, 2019

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

Date(s) aerial images were photographed: Aug 31, 2019—Sep 24, 2019

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
71B	Ridgebury fine sandy loam, 3 to 8 percent slopes, extremely stony	7.8	22.1%
103C	Charlton-Holla-Rock outcrop complex, 8 to 15 percent slopes	7.0	19.8%
300B	Montauk fine sandy loam, 3 to 8 percent slopes	0.2	0.5%
300C	Montauk fine sandy loam, 8 to 15 percent slopes	4.4	12.3%
307D	Paxton fine sandy loam, 15 to 25 percent slopes, extremely stony	0.3	0.8%
317B	Schuette fine sandy loam, 3 to 8 percent slopes, extremely stony	10.0	28.1%
602	Urban land, 0 to 15 percent slopes	5.8	16.2%
Totals for Area of Interest		35.5	100.0%

Norfolk and Suffolk Counties, Massachusetts

71B—Ridgebury fine sandy loam, 3 to 8 percent slopes, extremely stony

Map Unit Setting

National map unit symbol: 2w69c

Elevation: 0 to 1,290 feet

Mean annual precipitation: 36 to 71 inches

Mean annual air temperature: 39 to 55 degrees F

Frost-free period: 140 to 240 days

Farmland classification: Not prime farmland

Map Unit Composition

Ridgebury, extremely stony, and similar soils: 80 percent

Minor components: 20 percent

*Estimates are based on observations, descriptions, and transects of
the mapunit.*

Description of Ridgebury, Extremely Stony

Setting

Landform: Drainageways, hills, ground moraines, drumlins,
depressions

Landform position (two-dimensional): Toeslope, footslope

Landform position (three-dimensional): Base slope, head slope

Down-slope shape: Concave

Across-slope shape: Concave

Parent material: Coarse-loamy lodgment till derived from gneiss,
granite, and/or schist

Typical profile

Oe - 0 to 1 inches: moderately decomposed plant material

A - 1 to 6 inches: fine sandy loam

Bw - 6 to 10 inches: sandy loam

Bg - 10 to 19 inches: gravelly sandy loam

Cd - 19 to 66 inches: gravelly sandy loam

Properties and qualities

Slope: 3 to 8 percent

Percent of area covered with surface fragments: 9.0 percent

Depth to restrictive feature: 15 to 35 inches to densic material

Natural drainage class: Poorly drained

Runoff class: Very high

Capacity of the most limiting layer to transmit water (Ksat): Very
low to moderately low (0.00 to 0.14 in/hr)

Depth to water table: About 0 to 6 inches

Frequency of flooding: None

Frequency of ponding: None

Salinity, maximum in profile: Nonsaline (0.0 to 1.9 mmhos/cm)

Available water storage in profile: Low (about 3.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 7s

Hydrologic Soil Group: D

Hydric soil rating: Yes

Minor Components

Woodbridge, extremely stony

Percent of map unit: 10 percent

Landform: Hills, drumlins, ground moraines

Landform position (two-dimensional): Footslope, summit,
backslope

Landform position (three-dimensional): Crest, side slope

Down-slope shape: Convex

Across-slope shape: Linear

Hydric soil rating: No

Whitman, extremely stony

Percent of map unit: 8 percent

Landform: Depressions

Down-slope shape: Concave

Across-slope shape: Concave

Hydric soil rating: Yes

Paxton, extremely stony

Percent of map unit: 2 percent

Landform: Drumlins, ground moraines, hills

Landform position (two-dimensional): Shoulder, summit, backslope

Landform position (three-dimensional): Crest, side slope

Down-slope shape: Linear, convex

Across-slope shape: Convex, linear

Hydric soil rating: No

Data Source Information

Soil Survey Area: Norfolk and Suffolk Counties, Massachusetts

Survey Area Data: Version 15, Sep 12, 2019

Norfolk and Suffolk Counties, Massachusetts

103C—Charlton-Hollis-Rock outcrop complex, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 2wzp1
Elevation: 0 to 1,390 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Charlton, extremely stony, and similar soils: 50 percent
Hollis, extremely stony, and similar soils: 20 percent
Rock outcrop: 10 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Charlton, Extremely Stony

Setting

Landform: Hills, ridges
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear, convex
Across-slope shape: Convex
Parent material: Coarse-loamy melt-out till derived from granite, gneiss, and/or schist

Typical profile

O_e - 0 to 2 inches: moderately decomposed plant material
A - 2 to 4 inches: fine sandy loam
Bw - 4 to 27 inches: gravelly fine sandy loam
C - 27 to 65 inches: gravelly fine sandy loam

Properties and qualities

Slope: 8 to 15 percent
Percent of area covered with surface fragments: 9.0 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (K_{sat}):
Moderately low to high (0.14 to 14.17 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water storage in profile: Moderate (about 8.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 7s

Hydrologic Soil Group: B

Hydric soil rating: No

Description of Hollis, Extremely Stony

Setting

Landform: Hills, ridges

Landform position (two-dimensional): Backslope, shoulder, summit

Landform position (three-dimensional): Crest, side slope, nose slope

Down-slope shape: Convex

Across-slope shape: Linear, convex

Parent material: Coarse-loamy melt-out till derived from granite, gneiss, and/or schist

Typical profile

Oi - 0 to 2 inches: slightly decomposed plant material

A - 2 to 7 inches: gravelly fine sandy loam

Bw - 7 to 16 inches: gravelly fine sandy loam

2R - 16 to 26 inches: bedrock

Properties and qualities

Slope: 8 to 15 percent

Percent of area covered with surface fragments: 9.0 percent

Depth to restrictive feature: 8 to 23 inches to lithic bedrock

Natural drainage class: Somewhat excessively drained

Runoff class: Very high

Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 to 0.00 in/hr)

Depth to water table: More than 80 inches

Frequency of flooding: None

Frequency of ponding: None

Salinity, maximum in profile: Nonsaline (0.0 to 1.9 mmhos/cm)

Available water storage in profile: Very low (about 2.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 7s

Hydrologic Soil Group: D

Hydric soil rating: No

Description of Rock Outcrop

Setting

Landform: Hills, ridges

Parent material: Igneous and metamorphic rock

Typical profile

R - 0 to 79 inches: bedrock

Properties and qualities

Slope: 8 to 15 percent

Depth to restrictive feature: 0 inches to lithic bedrock

Runoff class: Very high

Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 to 0.00 in/hr)

Available water storage in profile: Very low (about 0.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 8

Hydrologic Soil Group: D

Hydric soil rating: No

Minor Components

Woodbridge, extremely stony

Percent of map unit: 8 percent

Landform: Hills, drumlins, ground moraines

Landform position (two-dimensional): Backslope, footslope

Landform position (three-dimensional): Side slope

Down-slope shape: Convex

Across-slope shape: Linear

Hydric soil rating: No

Chatfield, extremely stony

Percent of map unit: 5 percent

Landform: Hills, ridges

Landform position (two-dimensional): Summit, backslope, shoulder

Landform position (three-dimensional): Crest, side slope, nose slope

Down-slope shape: Convex

Across-slope shape: Linear, convex

Hydric soil rating: No

Canton, extremely stony

Percent of map unit: 5 percent

Landform: Ridges, hills, moraines

Landform position (two-dimensional): Backslope

Landform position (three-dimensional): Side slope

Down-slope shape: Convex, linear

Across-slope shape: Convex

Hydric soil rating: No

Ridgebury, extremely stony

Percent of map unit: 2 percent

Landform: Drainageways, hills, ground moraines, drumlins, depressions

Landform position (two-dimensional): Toeslope, footslope

Landform position (three-dimensional): Base slope, head slope

Down-slope shape: Concave

Across-slope shape: Concave

Hydric soil rating: Yes

Data Source Information

Soil Survey Area: Norfolk and Suffolk Counties, Massachusetts
Survey Area Data: Version 15, Sep 12, 2019

Norfolk and Suffolk Counties, Massachusetts

602—Urban land, 0 to 15 percent slopes

Map Unit Setting

National map unit symbol: vkyj

Mean annual precipitation: 32 to 50 inches

Mean annual air temperature: 45 to 50 degrees F

Frost-free period: 120 to 200 days

Farmland classification: Not prime farmland

Map Unit Composition

Urban land: 99 percent

Minor components: 1 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Urban Land

Setting

Parent material: Excavated and filled land

Minor Components

Rock outcrops

Percent of map unit: 1 percent

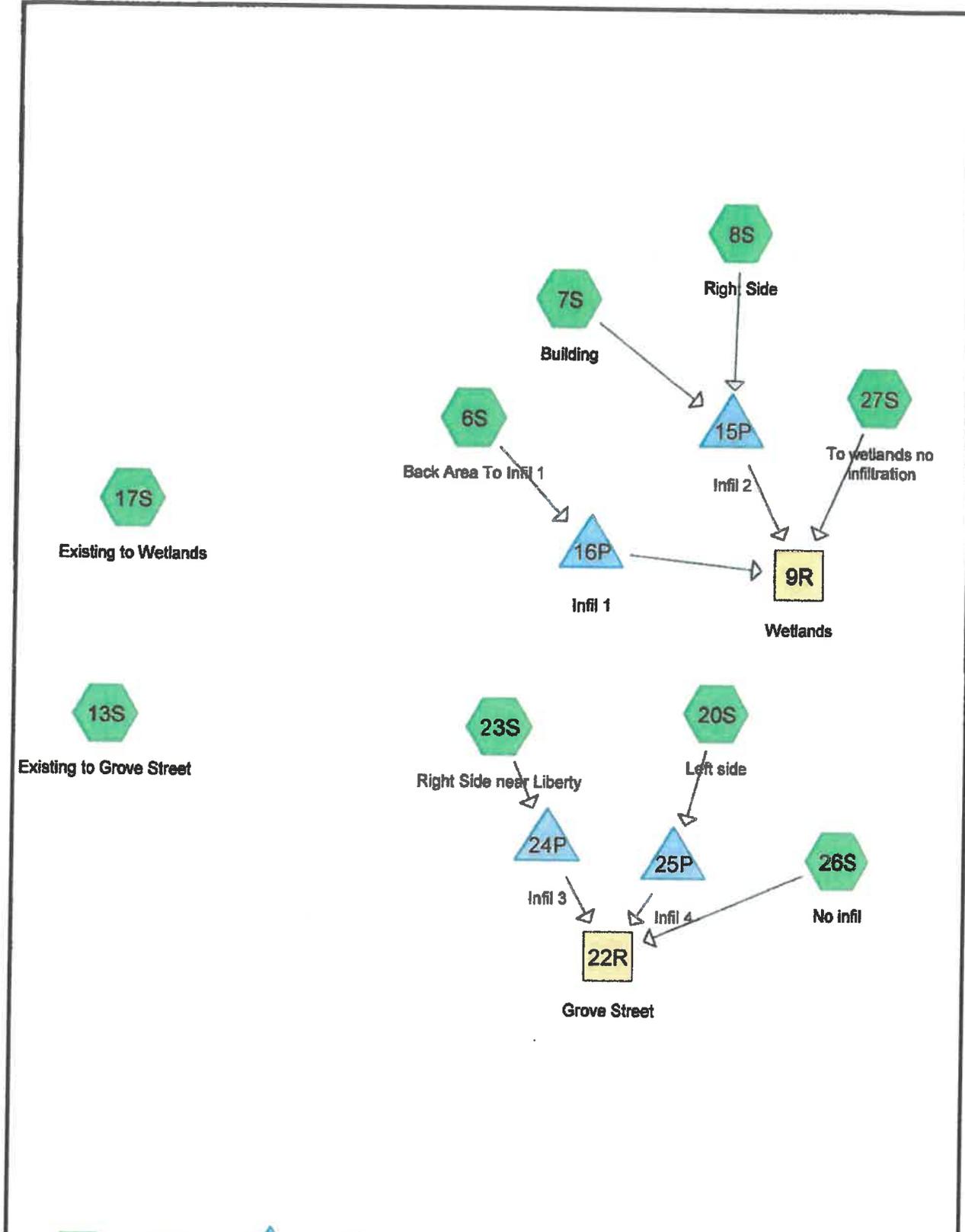
Hydric soil rating: Unranked

Data Source Information

Soil Survey Area: Norfolk and Suffolk Counties, Massachusetts

Survey Area Data: Version 15, Sep 12, 2019

HydroCAD Documentation



Routing Diagram for 357 Grove Street
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357 Grove Street

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Type III 24-hr 2 year Rainfall=3.40"

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Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
 Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 6S: Back Area To Infil 1	Runoff Area=20,135 sf 95.24% Impervious Runoff Depth=2.84" Tc=5.0 min CN=95 Runoff=1.50 cfs 0.109 af
Subcatchment 7S: Bullding	Runoff Area=24,022 sf 100.00% Impervious Runoff Depth=3.17" Tc=5.0 min CN=98 Runoff=1.89 cfs 0.146 af
Subcatchment 8S: Right Side	Runoff Area=20,984 sf 70.19% Impervious Runoff Depth=1.56" Tc=5.0 min CN=80 Runoff=0.91 cfs 0.063 af
Subcatchment 13S: Existing to Grove	Runoff Area=41,149 sf 39.22% Impervious Runoff Depth=0.75" Tc=5.0 min CN=66 Runoff=0.72 cfs 0.059 af
Subcatchment 17S: Existing to Wetlands	Runoff Area=105,072 sf 2.13% Impervious Runoff Depth=0.02" Tc=5.0 min CN=41 Runoff=0.01 cfs 0.004 af
Subcatchment 20S: Left side	Runoff Area=14,809 sf 76.99% Impervious Runoff Depth=1.85" Tc=5.0 min CN=84 Runoff=0.77 cfs 0.052 af
Subcatchment 23S: Right Side near Liberty	Runoff Area=15,400 sf 77.49% Impervious Runoff Depth=1.93" Tc=5.0 min CN=85 Runoff=0.83 cfs 0.057 af
Subcatchment 26S: No Infil	Runoff Area=13,274 sf 0.00% Impervious Runoff Depth=0.00" Tc=5.0 min CN=39 Runoff=0.00 cfs 0.000 af
Subcatchment 27S: To wetlands no	Runoff Area=37,597 sf 0.00% Impervious Runoff Depth=0.01" Tc=5.0 min CN=40 Runoff=0.00 cfs 0.001 af
Reach 9R: Wetlands	Inflow=0.00 cfs 0.001 af Outflow=0.00 cfs 0.001 af
Reach 22R: Grove Street	Inflow=0.00 cfs 0.000 af Outflow=0.00 cfs 0.000 af
Pond 15P: Infil 2	Peak Elev=160.59' Storage=2,022 cf Inflow=2.79 cfs 0.208 af Discarded=0.60 cfs 0.208 af Primary=0.00 cfs 0.000 af Outflow=0.60 cfs 0.208 af
Pond 16P: Infil 1	Peak Elev=156.48' Storage=0.023 af Inflow=1.50 cfs 0.109 af Discarded=0.36 cfs 0.109 af Primary=0.00 cfs 0.000 af Outflow=0.36 cfs 0.109 af
Pond 24P: Infil 3	Peak Elev=156.10' Storage=0.009 af Inflow=0.83 cfs 0.057 af Outflow=0.28 cfs 0.057 af
Pond 25P: Infil 4	Peak Elev=155.85' Storage=0.011 af Inflow=0.77 cfs 0.052 af Outflow=0.20 cfs 0.052 af

Total Runoff Area = 6.714 ac Runoff Volume = 0.490 af Average Runoff Depth = 0.88"
66.93% Pervious = 4.426 ac 34.07% Impervious = 2.287 ac

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Type III 24-hr 2 year Rainfall=3.40"

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Summary for Subcatchment 6S: Back Area To Infil 1

Runoff = 1.50 cfs @ 12.07 hrs, Volume= 0.109 af, Depth= 2.84"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 year Rainfall=3.40"

Area (sf)	CN	Description
19,176	98	Paved parking, HSG A
959	39	>75% Grass cover, Good, HSG A
20,135	95	Weighted Average
959		4.76% Pervious Area
19,176		95.24% Impervious Area

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

Summary for Subcatchment 7S: Building

Runoff = 1.89 cfs @ 12.07 hrs, Volume= 0.146 af, Depth= 3.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 year Rainfall=3.40"

Area (sf)	CN	Description
24,022	98	Unconnected roofs, HSG A
24,022		100.00% Impervious Area
24,022		100.00% Unconnected

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

Summary for Subcatchment 8S: Right Side

Runoff = 0.91 cfs @ 12.08 hrs, Volume= 0.063 af, Depth= 1.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 year Rainfall=3.40"

Area (sf)	CN	Description
14,728	98	Paved roads w/curbs & sewers, HSG B
6,256	39	>75% Grass cover, Good, HSG A
20,984	80	Weighted Average
6,256		29.81% Pervious Area
14,728		70.19% Impervious Area

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Type III 24-hr 2 year Rainfall=3.40"

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

Summary for Subcatchment 13S: Existing to Grove Street

Runoff = 0.72 cfs @ 12.09 hrs, Volume= 0.059 af, Depth= 0.75"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 year Rainfall=3.40"

Area (sf)	CN	Description
16,138	98	Paved parking, HSG A
17,705	49	50-75% Grass cover, Fair, HSG A
7,306	36	Woods, Fair, HSG A
41,149	66	Weighted Average
25,011		60.78% Pervious Area
16,138		39.22% Impervious Area

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

Summary for Subcatchment 17S: Existing to Wetlands

Runoff = 0.01 cfs @ 20.95 hrs, Volume= 0.004 af, Depth= 0.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 year Rainfall=3.40"

Area (sf)	CN	Description
2,236	98	Paved parking, HSG A
26,764	49	50-75% Grass cover, Fair, HSG A
66,603	36	Woods, Fair, HSG A
9,469	36	Woods, Fair, HSG A
105,072	41	Weighted Average
102,836		97.87% Pervious Area
2,236		2.13% Impervious Area

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

Summary for Subcatchment 20S: Left side

Runoff = 0.77 cfs @ 12.08 hrs, Volume= 0.052 af, Depth= 1.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 year Rainfall=3.40"

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Type III 24-hr 2 year Rainfall=3.40"

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Area (sf)	CN	Description
10,902	98	Paved parking, HSG A
3,407	39	>75% Grass cover, Good, HSG A
* 500	98	sidewalks
14,809	84	Weighted Average
3,407		23.01% Pervious Area
11,402		76.99% Impervious Area

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

Summary for Subcatchment 23S: Right Side near Liberty

Runoff = 0.83 cfs @ 12.07 hrs, Volume= 0.057 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 year Rainfall=3.40"

Area (sf)	CN	Description
11,075	98	Paved parking, HSG A
3,467	39	>75% Grass cover, Good, HSG A
* 858	98	sidewalks
15,400	85	Weighted Average
3,467		22.51% Pervious Area
11,933		77.49% Impervious Area

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

Summary for Subcatchment 26S: No infil

Runoff = 0.00 cfs @ 23.45 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 year Rainfall=3.40"

Area (sf)	CN	Description
13,274	39	>75% Grass cover, Good, HSG A
13,274		100.00% Pervious Area

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

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Type III 24-hr 2 year Rainfall=3.40"

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Summary for Subcatchment 27S: To wetlands no infiltration

Runoff = 0.00 cfs @ 22.15 hrs, Volume= 0.001 af, Depth= 0.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 year Rainfall=3.40"

Area (sf)	CN	Description
18,469	39	>75% Grass cover, Good, HSG A
* 2,479	76	gravel path
7,180	36	Woods, Fair, HSG A
9,469	36	Woods, Fair, HSG A
37,597	40	Weighted Average
37,597		100.00% Pervious Area

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

Summary for Reach 9R: Wetlands

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.359 ac, 56.38% Impervious, Inflow Depth = 0.00" for 2 year event
 Inflow = 0.00 cfs @ 22.15 hrs, Volume= 0.001 af
 Outflow = 0.00 cfs @ 22.15 hrs, Volume= 0.001 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Reach 22R: Grove Street

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.998 ac, 53.66% Impervious, Inflow Depth = 0.00" for 2 year event
 Inflow = 0.00 cfs @ 23.45 hrs, Volume= 0.000 af
 Outflow = 0.00 cfs @ 23.45 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Pond 15P: Infil 2

Inflow Area = 1.033 ac, 86.10% Impervious, Inflow Depth = 2.42" for 2 year event
 Inflow = 2.79 cfs @ 12.07 hrs, Volume= 0.208 af
 Outflow = 0.60 cfs @ 12.48 hrs, Volume= 0.208 af, Atten= 78%, Lag= 24.6 min
 Discarded = 0.60 cfs @ 12.48 hrs, Volume= 0.208 af
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2

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Type III 24-hr 2 year Rainfall=3.40"

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Peak Elev= 160.59' @ 12.48 hrs Surf.Area= 2,882 sf Storage= 2,022 cf

Plug-Flow detention time= 17.8 min calculated for 0.208 af (100% of inflow)

Center-of-Mass det. time= 17.8 min (797.4 - 779.6)

Volume	Invert	Avail.Storage	Storage Description
#1A	159.50'	2,429 cf	30.50'W x 94.50'L x 3.54'H Field A
			10,208 cf Overall - 4,135 cf Embedded = 6,073 cf x 40.0% Voids
#2A	160.00'	4,135 cf	Cultec R-330XLHD x 78 Inside #1
			Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf
			Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap
			Row Length Adjustment= +1.50' x 7.45 sf x 6 rows
		6,564 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	159.50'	8.270 in/hr Exfiltration over Wetted area
#2	Primary	161.50'	4.0" Vert. Orifice/Grate C= 0.600

Discarded OutFlow Max=0.60 cfs @ 12.48 hrs HW=160.59' (Free Discharge)

↳1=Exfiltration (Exfiltration Controls 0.60 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=159.50' (Free Discharge)

↳2=Orifice/Grate (Controls 0.00 cfs)

Summary for Pond 16P: Infil 1

Inflow Area = 0.462 ac, 95.24% Impervious, Inflow Depth = 2.84" for 2 year event
 Inflow = 1.50 cfs @ 12.07 hrs, Volume= 0.109 af
 Outflow = 0.36 cfs @ 12.45 hrs, Volume= 0.109 af, Atten= 76%, Lag= 22.5 min
 Discarded = 0.36 cfs @ 12.45 hrs, Volume= 0.109 af
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
 Peak Elev= 156.48' @ 12.45 hrs Surf.Area= 0.039 ac Storage= 0.023 af

Plug-Flow detention time= 14.7 min calculated for 0.109 af (100% of inflow)
 Center-of-Mass det. time= 14.7 min (792.9 - 778.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	155.50'	0.033 af	20.83'W x 80.50'L x 3.54'H Field A
			0.136 af Overall - 0.054 af Embedded = 0.083 af x 40.0% Voids
#2A	156.00'	0.054 af	Cultec R-330XLHD x 44 Inside #1
			Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf
			Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap
			Row Length Adjustment= +1.50' x 7.45 sf x 4 rows
		0.087 af	Total Available Storage

Storage Group A created with Chamber Wizard

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Type III 24-hr 2 year Rainfall=3.40"

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Device	Routing	Invert	Outlet Devices
#1	Primary	157.20'	4.0" Vert. Orifice/Grate C= 0.600
#2	Discarded	155.50'	8.270 in/hr Exfiltration over Wetted area

Discarded OutFlow Max=0.36 cfs @ 12.45 hrs HW=156.48' (Free Discharge)
 ↳2=Exfiltration (Exfiltration Controls 0.36 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=155.50' (Free Discharge)
 ↳1=Orifice/Grate (Controls 0.00 cfs)

Summary for Pond 24P: Infil 3

Inflow Area = 0.354 ac, 77.49% Impervious, Inflow Depth = 1.93" for 2 year event
 Inflow = 0.83 cfs @ 12.07 hrs, Volume= 0.057 af
 Outflow = 0.28 cfs @ 12.37 hrs, Volume= 0.057 af, Atten= 66%, Lag= 17.9 min
 Discarded = 0.28 cfs @ 12.37 hrs, Volume= 0.057 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
 Peak Elev= 156.10' @ 12.37 hrs Surf.Area= 0.031 ac Storage= 0.009 af

Plug-Flow detention time= 6.9 min calculated for 0.057 af (100% of inflow)
 Center-of-Mass det. time= 6.9 min (829.3 - 822.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	155.50'	0.022 af	21.00'W x 64.25'L x 2.54'H Field A
#2A	156.00'	0.023 af	0.079 af Overall - 0.023 af Embedded = 0.056 af x 40.0% Voids Cultec R-150XLHD x 36 Inside #1 Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap Row Length Adjustment= +0.75' x 2.65 sf x 6 rows
		0.045 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	155.50'	8.270 in/hr Exfiltration over Wetted area

Discarded OutFlow Max=0.28 cfs @ 12.37 hrs HW=156.10' (Free Discharge)
 ↳1=Exfiltration (Exfiltration Controls 0.28 cfs)

Summary for Pond 25P: Infil 4

Inflow Area = 0.340 ac, 76.99% Impervious, Inflow Depth = 1.85" for 2 year event
 Inflow = 0.77 cfs @ 12.08 hrs, Volume= 0.052 af
 Outflow = 0.20 cfs @ 12.45 hrs, Volume= 0.052 af, Atten= 73%, Lag= 22.5 min
 Discarded = 0.20 cfs @ 12.45 hrs, Volume= 0.052 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
 Peak Elev= 155.85' @ 12.45 hrs Surf.Area= 0.022 ac Storage= 0.011 af

Plug-Flow detention time= 12.6 min calculated for 0.052 af (100% of inflow)

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Type III 24-hr 2 year Rainfall=3.40"

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Center-of-Mass det. time= 12.6 min (838.5 - 825.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	155.00'	0.019 af	20.83'W x 45.50'L x 3.54'H Field A 0.077 af Overall - 0.030 af Embedded = 0.047 af x 40.0% Voids
#2A	155.50'	0.030 af	Cultec R-330XLHD x 24 Inside #1 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 4 rows
		0.049 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	155.00'	8.270 in/hr Exfiltration over Wetted area

Discarded OutFlow Max=0.20 cfs @ 12.45 hrs HW=155.85' (Free Discharge)
↳1=Exfiltration (Exfiltration Controls 0.20 cfs)

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Type III 24-hr 10 year Rainfall=4.70"

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Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
 Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 6S: Back Area To Infil 1	Runoff Area=20,135 sf 95.24% Impervious Runoff Depth=4.12" Tc=5.0 min CN=95 Runoff=2.13 cfs 0.159 af
Subcatchment 7S: Building	Runoff Area=24,022 sf 100.00% Impervious Runoff Depth=4.46" Tc=5.0 min CN=98 Runoff=2.62 cfs 0.205 af
Subcatchment 8S: Right Side	Runoff Area=20,984 sf 70.19% Impervious Runoff Depth=2.63" Tc=5.0 min CN=80 Runoff=1.54 cfs 0.106 af
Subcatchment 13S: Existing to Grove	Runoff Area=41,149 sf 39.22% Impervious Runoff Depth=1.53" Tc=5.0 min CN=66 Runoff=1.66 cfs 0.120 af
Subcatchment 17S: Existing to Wetlands	Runoff Area=105,072 sf 2.13% Impervious Runoff Depth=0.20" Tc=5.0 min CN=41 Runoff=0.11 cfs 0.041 af
Subcatchment 20S: Left side	Runoff Area=14,809 sf 76.99% Impervious Runoff Depth=3.00" Tc=5.0 min CN=84 Runoff=1.23 cfs 0.085 af
Subcatchment 23S: Right Side near Liberty	Runoff Area=15,400 sf 77.49% Impervious Runoff Depth=3.09" Tc=5.0 min CN=85 Runoff=1.32 cfs 0.091 af
Subcatchment 26S: No infil	Runoff Area=13,274 sf 0.00% Impervious Runoff Depth=0.14" Tc=5.0 min CN=39 Runoff=0.01 cfs 0.004 af
Subcatchment 27S: To wetlands no	Runoff Area=37,597 sf 0.00% Impervious Runoff Depth=0.17" Tc=5.0 min CN=40 Runoff=0.02 cfs 0.012 af
Reach 9R: Wetlands	Inflow=0.02 cfs 0.012 af Outflow=0.02 cfs 0.012 af
Reach 22R: Grove Street	Inflow=0.01 cfs 0.004 af Outflow=0.01 cfs 0.004 af
Pond 15P: Infil 2	Peak Elev=161.36' Storage=3,821 cf Inflow=4.17 cfs 0.311 af Discarded=0.64 cfs 0.311 af Primary=0.00 cfs 0.000 af Outflow=0.64 cfs 0.311 af
Pond 16P: Infil 1	Peak Elev=157.07' Storage=0.042 af Inflow=2.13 cfs 0.159 af Discarded=0.38 cfs 0.159 af Primary=0.00 cfs 0.000 af Outflow=0.38 cfs 0.159 af
Pond 24P: Infil 3	Peak Elev=156.62' Storage=0.021 af Inflow=1.32 cfs 0.091 af Outflow=0.29 cfs 0.091 af
Pond 25P: Infil 4	Peak Elev=156.59' Storage=0.024 af Inflow=1.23 cfs 0.085 af Outflow=0.22 cfs 0.085 af

Total Runoff Area = 6.714 ac Runoff Volume = 0.823 af Average Runoff Depth = 1.47"
65.93% Pervious = 4.426 ac 34.07% Impervious = 2.287 ac

357 Grove Street

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Type III 24-hr 10 year Rainfall=4.70"

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Summary for Subcatchment 6S: Back Area To Infil 1

Runoff = 2.13 cfs @ 12.07 hrs, Volume= 0.159 af, Depth= 4.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 year Rainfall=4.70"

Area (sf)	CN	Description
19,176	98	Paved parking, HSG A
959	39	>75% Grass cover, Good, HSG A
20,135	95	Weighted Average
959		4.76% Pervious Area
19,176		95.24% Impervious Area

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

Summary for Subcatchment 7S: Building

Runoff = 2.62 cfs @ 12.07 hrs, Volume= 0.205 af, Depth= 4.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 year Rainfall=4.70"

Area (sf)	CN	Description
24,022	98	Unconnected roofs, HSG A
24,022		100.00% Impervious Area
24,022		100.00% Unconnected

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

Summary for Subcatchment 8S: Right Side

Runoff = 1.54 cfs @ 12.07 hrs, Volume= 0.106 af, Depth= 2.63"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 year Rainfall=4.70"

Area (sf)	CN	Description
14,728	98	Paved roads w/curbs & sewers, HSG B
6,256	39	>75% Grass cover, Good, HSG A
20,984	80	Weighted Average
6,256		29.81% Pervious Area
14,728		70.19% Impervious Area

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Type III 24-hr 10 year Rainfall=4.70"

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

Summary for Subcatchment 13S: Existing to Grove Street

Runoff = 1.66 cfs @ 12.08 hrs, Volume= 0.120 af, Depth= 1.53"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 year Rainfall=4.70"

Area (sf)	CN	Description
16,138	98	Paved parking, HSG A
17,705	49	50-75% Grass cover, Fair, HSG A
7,306	36	Woods, Fair, HSG A
41,149	66	Weighted Average
25,011		60.78% Pervious Area
16,138		39.22% Impervious Area

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

Summary for Subcatchment 17S: Existing to Wetlands

Runoff = 0.11 cfs @ 12.44 hrs, Volume= 0.041 af, Depth= 0.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 year Rainfall=4.70"

Area (sf)	CN	Description
2,236	98	Paved parking, HSG A
26,764	49	50-75% Grass cover, Fair, HSG A
66,603	36	Woods, Fair, HSG A
9,469	36	Woods, Fair, HSG A
105,072	41	Weighted Average
102,836		97.87% Pervious Area
2,236		2.13% Impervious Area

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

Summary for Subcatchment 20S: Left side

Runoff = 1.23 cfs @ 12.07 hrs, Volume= 0.085 af, Depth= 3.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 year Rainfall=4.70"

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Type III 24-hr 10 year Rainfall=4.70"

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Area (sf)	CN	Description
10,902	98	Paved parking, HSG A
3,407	39	>75% Grass cover, Good, HSG A
* 500	98	sidewalks
14,809	84	Weighted Average
3,407		23.01% Pervious Area
11,402		76.99% Impervious Area

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

Summary for Subcatchment 23S: Right Side near Liberty

Runoff = 1.32 cfs @ 12.07 hrs, Volume= 0.091 af, Depth= 3.09"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 year Rainfall=4.70"

Area (sf)	CN	Description
11,075	98	Paved parking, HSG A
3,467	39	>75% Grass cover, Good, HSG A
* 858	98	sidewalks
15,400	85	Weighted Average
3,467		22.51% Pervious Area
11,933		77.49% Impervious Area

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

Summary for Subcatchment 26S: No infil

Runoff = 0.01 cfs @ 13.75 hrs, Volume= 0.004 af, Depth= 0.14"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 year Rainfall=4.70"

Area (sf)	CN	Description
13,274	39	>75% Grass cover, Good, HSG A
13,274		100.00% Pervious Area

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

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Type III 24-hr 10 year Rainfall=4.70"

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Summary for Subcatchment 27S: To wetlands no infiltration

Runoff = 0.02 cfs @ 12.48 hrs, Volume= 0.012 af, Depth= 0.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 year Rainfall=4.70"

Area (sf)	CN	Description
18,469	39	>75% Grass cover, Good, HSG A
2,479	76	gravel path
7,180	36	Woods, Fair, HSG A
9,469	36	Woods, Fair, HSG A
37,597	40	Weighted Average
37,597		100.00% Pervious Area

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

Summary for Reach 9R: Wetlands

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.359 ac, 56.38% Impervious, Inflow Depth = 0.06" for 10 year event
 Inflow = 0.02 cfs @ 12.48 hrs, Volume= 0.012 af
 Outflow = 0.02 cfs @ 12.48 hrs, Volume= 0.012 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Reach 22R: Grove Street

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.998 ac, 53.66% Impervious, Inflow Depth = 0.04" for 10 year event
 Inflow = 0.01 cfs @ 13.75 hrs, Volume= 0.004 af
 Outflow = 0.01 cfs @ 13.75 hrs, Volume= 0.004 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Pond 15P: Infil 2

Inflow Area = 1.033 ac, 86.10% Impervious, Inflow Depth = 3.61" for 10 year event
 Inflow = 4.17 cfs @ 12.07 hrs, Volume= 0.311 af
 Outflow = 0.64 cfs @ 12.55 hrs, Volume= 0.311 af, Atten= 85%, Lag= 28.6 min
 Discarded = 0.64 cfs @ 12.55 hrs, Volume= 0.311 af
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2

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Type III 24-hr 10 year Rainfall=4.70"

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Peak Elev= 161.36' @ 12.55 hrs Surf.Area= 2,882 sf Storage= 3,821 cf

Plug-Flow detention time= 36.9 min calculated for 0.311 af (100% of inflow)

Center-of-Mass det. time= 36.9 min (810.6 - 773.8)

Volume	Invert	Avail.Storage	Storage Description
#1A	159.50'	2,429 cf	30.50'W x 94.50'L x 3.54'H Field A
#2A	160.00'	4,135 cf	10,208 cf Overall - 4,135 cf Embedded = 6,073 cf x 40.0% Voids Cultec R-330XLHD x 78 Inside #1 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 6 rows
		6,564 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	159.50'	8.270 in/hr Exfiltration over Wetted area
#2	Primary	161.50'	4.0" Vert. Orifice/Grate C= 0.600

Discarded OutFlow Max=0.64 cfs @ 12.55 hrs HW=161.36' (Free Discharge)

↳1=Exfiltration (Exfiltration Controls 0.64 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=159.50' (Free Discharge)

↳2=Orifice/Grate (Controls 0.00 cfs)

Summary for Pond 16P: Infil 1

Inflow Area = 0.462 ac, 95.24% Impervious, Inflow Depth = 4.12" for 10 year event
 Inflow = 2.13 cfs @ 12.07 hrs, Volume= 0.159 af
 Outflow = 0.38 cfs @ 12.51 hrs, Volume= 0.159 af, Atten= 82%, Lag= 26.4 min
 Discarded = 0.38 cfs @ 12.51 hrs, Volume= 0.159 af
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
 Peak Elev= 157.07' @ 12.51 hrs Surf.Area= 0.039 ac Storage= 0.042 af

Plug-Flow detention time= 27.4 min calculated for 0.159 af (100% of inflow)
 Center-of-Mass det. time= 27.4 min (796.4 - 768.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	155.50'	0.033 af	20.83'W x 80.50'L x 3.54'H Field A
#2A	156.00'	0.054 af	0.136 af Overall - 0.054 af Embedded = 0.083 af x 40.0% Voids Cultec R-330XLHD x 44 Inside #1 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 4 rows
		0.087 af	Total Available Storage

Storage Group A created with Chamber Wizard

357 Grove Street

Type III 24-hr 10 year Rainfall=4.70"

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Device	Routing	Invert	Outlet Devices
#1	Primary	157.20'	4.0" Vert. Orifice/Grate C= 0.600
#2	Discarded	155.50'	8.270 In/hr Exfiltration over Wetted area

Discarded OutFlow Max=0.38 cfs @ 12.51 hrs HW=157.07' (Free Discharge)
 ↳2=Exfiltration (Exfiltration Controls 0.38 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=155.50' (Free Discharge)
 ↳1=Orifice/Grate (Controls 0.00 cfs)

Summary for Pond 24P: Infil 3

Inflow Area = 0.354 ac, 77.49% Impervious, Inflow Depth = 3.09" for 10 year event
 Inflow = 1.32 cfs @ 12.07 hrs, Volume= 0.091 af
 Outflow = 0.29 cfs @ 12.48 hrs, Volume= 0.091 af, Atten= 78%, Lag= 24.3 min
 Discarded = 0.29 cfs @ 12.48 hrs, Volume= 0.091 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
 Peak Elev= 156.62' @ 12.48 hrs Surf.Area= 0.031 ac Storage= 0.021 af

Plug-Flow detention time= 17.8 min calculated for 0.091 af (100% of inflow)
 Center-of-Mass det. time= 17.8 min (826.9 - 809.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	155.50'	0.022 af	21.00'W x 64.25'L x 2.54'H Field A
#2A	156.00'	0.023 af	0.079 af Overall - 0.023 af Embedded = 0.056 af x 40.0% Voids Cultec R-150XLHD x 36 Inside #1 Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap Row Length Adjustment= +0.75' x 2.65 sf x 6 rows
		0.045 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	155.50'	8.270 In/hr Exfiltration over Wetted area

Discarded OutFlow Max=0.29 cfs @ 12.48 hrs HW=156.62' (Free Discharge)
 ↳1=Exfiltration (Exfiltration Controls 0.29 cfs)

Summary for Pond 25P: Infil 4

Inflow Area = 0.340 ac, 76.99% Impervious, Inflow Depth = 3.00" for 10 year event
 Inflow = 1.23 cfs @ 12.07 hrs, Volume= 0.085 af
 Outflow = 0.22 cfs @ 12.53 hrs, Volume= 0.085 af, Atten= 82%, Lag= 27.2 min
 Discarded = 0.22 cfs @ 12.53 hrs, Volume= 0.085 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
 Peak Elev= 156.59' @ 12.53 hrs Surf.Area= 0.022 ac Storage= 0.024 af

Plug-Flow detention time= 30.1 min calculated for 0.085 af (100% of inflow)

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Type III 24-hr 10 year Rainfall=4.70"

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Center-of-Mass det. time= 30.1 min (842.2 - 812.1)

Volume	Invert	Avail.Storage	Storage Description
#1A	155.00'	0.019 af	20.83'W x 45.50'L x 3.54'H Field A 0.077 af Overall - 0.030 af Embedded = 0.047 af x 40.0% Voids
#2A	155.50'	0.030 af	Cultec R-330XLHD x 24 Inside #1 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 4 rows
		0.049 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	155.00'	8.270 In/hr Exfiltration over Wetted area

Discarded OutFlow Max=0.22 cfs @ 12.53 hrs HW=156.59' (Free Discharge)
↳1=Exfiltration (Exfiltration Controls 0.22 cfs)

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Type III 24-hr 25 year Rainfall=5.60"

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Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
 Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 6S: Back Area To Infil 1	Runoff Area=20,135 sf 95.24% Impervious Runoff Depth=5.01" Tc=5.0 min CN=95 Runoff=2.57 cfs 0.193 af
Subcatchment 7S: Building	Runoff Area=24,022 sf 100.00% Impervious Runoff Depth=5.36" Tc=5.0 min CN=98 Runoff=3.13 cfs 0.246 af
Subcatchment 8S: Right Side	Runoff Area=20,984 sf 70.19% Impervious Runoff Depth=3.42" Tc=5.0 min CN=80 Runoff=2.00 cfs 0.137 af
Subcatchment 13S: Existing to Grove	Runoff Area=41,149 sf 39.22% Impervious Runoff Depth=2.15" Tc=5.0 min CN=66 Runoff=2.41 cfs 0.169 af
Subcatchment 17S: Existing to Wetlands	Runoff Area=105,072 sf 2.13% Impervious Runoff Depth=0.43" Tc=5.0 min CN=41 Runoff=0.43 cfs 0.087 af
Subcatchment 20S: Left side	Runoff Area=14,809 sf 76.99% Impervious Runoff Depth=3.82" Tc=5.0 min CN=84 Runoff=1.56 cfs 0.108 af
Subcatchment 23S: Right Side near Liberty	Runoff Area=15,400 sf 77.49% Impervious Runoff Depth=3.93" Tc=5.0 min CN=85 Runoff=1.66 cfs 0.116 af
Subcatchment 26S: No infil	Runoff Area=13,274 sf 0.00% Impervious Runoff Depth=0.34" Tc=5.0 min CN=39 Runoff=0.03 cfs 0.009 af
Subcatchment 27S: To wetlands no	Runoff Area=37,597 sf 0.00% Impervious Runoff Depth=0.38" Tc=5.0 min CN=40 Runoff=0.12 cfs 0.028 af
Reach 9R: Wetlands	Inflow=0.42 cfs 0.042 af Outflow=0.42 cfs 0.042 af
Reach 22R: Grove Street	Inflow=0.03 cfs 0.009 af Outflow=0.03 cfs 0.009 af
Pond 15P: Infil 2	Peak Elev=161.90' Storage=4,982 cf Inflow=5.13 cfs 0.384 af Discarded=0.67 cfs 0.374 af Primary=0.21 cfs 0.010 af Outflow=0.87 cfs 0.384 af
Pond 16P: Infil 1	Peak Elev=157.45' Storage=0.053 af Inflow=2.57 cfs 0.193 af Discarded=0.40 cfs 0.189 af Primary=0.12 cfs 0.004 af Outflow=0.52 cfs 0.193 af
Pond 24P: Infil 3	Peak Elev=157.07' Storage=0.031 af Inflow=1.66 cfs 0.116 af Outflow=0.31 cfs 0.116 af
Pond 25P: Infil 4	Peak Elev=157.19' Storage=0.034 af Inflow=1.56 cfs 0.108 af Outflow=0.24 cfs 0.108 af

Total Runoff Area = 6.714 ac Runoff Volume = 1.093 af Average Runoff Depth = 1.95"
65.93% Pervious = 4.426 ac 34.07% Impervious = 2.287 ac

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Type III 24-hr 25 year Rainfall=5.60"

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Summary for Subcatchment 6S: Back Area To Infil 1

Runoff = 2.57 cfs @ 12.07 hrs, Volume= 0.193 af, Depth= 5.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 year Rainfall=5.60"

Area (sf)	CN	Description
19,176	98	Paved parking, HSG A
959	39	>75% Grass cover, Good, HSG A
20,135	95	Weighted Average
959		4.76% Pervious Area
19,176		95.24% Impervious Area

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

Summary for Subcatchment 7S: Building

Runoff = 3.13 cfs @ 12.07 hrs, Volume= 0.246 af, Depth= 5.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 year Rainfall=5.60"

Area (sf)	CN	Description
24,022	98	Unconnected roofs, HSG A
24,022		100.00% Impervious Area
24,022		100.00% Unconnected

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

Summary for Subcatchment 8S: Right Side

Runoff = 2.00 cfs @ 12.07 hrs, Volume= 0.137 af, Depth= 3.42"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 year Rainfall=5.60"

Area (sf)	CN	Description
14,728	98	Paved roads w/curbs & sewers, HSG B
6,256	39	>75% Grass cover, Good, HSG A
20,984	80	Weighted Average
6,256		29.81% Pervious Area
14,728		70.19% Impervious Area

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Type III 24-hr 25 year Rainfall=5.60"

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

Summary for Subcatchment 13S: Existing to Grove Street

Runoff = 2.41 cfs @ 12.08 hrs, Volume= 0.169 af, Depth= 2.15"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 year Rainfall=5.60"

Area (sf)	CN	Description
16,138	98	Paved parking, HSG A
17,705	49	50-75% Grass cover, Fair, HSG A
7,306	36	Woods, Fair, HSG A
41,149	66	Weighted Average
25,011		60.78% Pervious Area
16,138		39.22% Impervious Area

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

Summary for Subcatchment 17S: Existing to Wetlands

Runoff = 0.43 cfs @ 12.32 hrs, Volume= 0.087 af, Depth= 0.43"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 year Rainfall=5.60"

Area (sf)	CN	Description
2,236	98	Paved parking, HSG A
26,764	49	50-75% Grass cover, Fair, HSG A
66,603	36	Woods, Fair, HSG A
9,469	36	Woods, Fair, HSG A
105,072	41	Weighted Average
102,836		97.87% Pervious Area
2,236		2.13% Impervious Area

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

Summary for Subcatchment 20S: Left side

Runoff = 1.56 cfs @ 12.07 hrs, Volume= 0.108 af, Depth= 3.82"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 year Rainfall=5.60"

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Type III 24-hr 25 year Rainfall=5.60"

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Area (sf)	CN	Description
10,902	98	Paved parking, HSG A
3,407	39	>75% Grass cover, Good, HSG A
* 500	98	sidewalks
14,809	84	Weighted Average
3,407		23.01% Pervious Area
11,402		76.99% Impervious Area

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

Summary for Subcatchment 23S: Right Side near Liberty

Runoff = 1.66 cfs @ 12.07 hrs, Volume= 0.116 af, Depth= 3.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 year Rainfall=5.60"

Area (sf)	CN	Description
11,075	98	Paved parking, HSG A
3,467	39	>75% Grass cover, Good, HSG A
* 858	98	sidewalks
15,400	85	Weighted Average
3,467		22.51% Pervious Area
11,933		77.49% Impervious Area

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

Summary for Subcatchment 26S: No Infil

Runoff = 0.03 cfs @ 12.37 hrs, Volume= 0.009 af, Depth= 0.34"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 year Rainfall=5.60"

Area (sf)	CN	Description
13,274	39	>75% Grass cover, Good, HSG A
13,274		100.00% Pervious Area

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

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Type III 24-hr 25 year Rainfall=5.60"

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Summary for Subcatchment 27S: To wetlands no infiltration

Runoff = 0.12 cfs @ 12.34 hrs, Volume= 0.028 af, Depth= 0.38"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 year Rainfall=5.60"

Area (sf)	CN	Description
18,469	39	>75% Grass cover, Good, HSG A
* 2,479	76	gravel path
7,180	36	Woods, Fair, HSG A
9,469	36	Woods, Fair, HSG A
37,597	40	Weighted Average
37,597		100.00% Pervious Area

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

Summary for Reach 9R: Wetlands

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.359 ac, 56.38% Impervious, Inflow Depth = 0.21" for 25 year event
 Inflow = 0.42 cfs @ 12.47 hrs, Volume= 0.042 af
 Outflow = 0.42 cfs @ 12.47 hrs, Volume= 0.042 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Reach 22R: Grove Street

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.998 ac, 53.66% Impervious, Inflow Depth = 0.10" for 25 year event
 Inflow = 0.03 cfs @ 12.37 hrs, Volume= 0.009 af
 Outflow = 0.03 cfs @ 12.37 hrs, Volume= 0.009 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Pond 15P: Infil 2

Inflow Area = 1.033 ac, 86.10% Impervious, Inflow Depth = 4.46" for 25 year event
 Inflow = 5.13 cfs @ 12.07 hrs, Volume= 0.384 af
 Outflow = 0.87 cfs @ 12.53 hrs, Volume= 0.384 af, Atten= 83%, Lag= 27.3 min
 Discarded = 0.67 cfs @ 12.53 hrs, Volume= 0.374 af
 Primary = 0.21 cfs @ 12.53 hrs, Volume= 0.010 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2

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Type III 24-hr 25 year Rainfall=5.60"

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Peak Elev= 161.90' @ 12.53 hrs Surf.Area= 2,882 sf Storage= 4,982 cf

Plug-Flow detention time= 46.2 min calculated for 0.384 af (100% of inflow)

Center-of-Mass det. time= 46.2 min (816.8 - 770.6)

Volume	Invert	Avail.Storage	Storage Description
#1A	159.50'	2,429 cf	30.50'W x 94.50'L x 3.54'H Field A 10,208 cf Overall - 4,135 cf Embedded = 6,073 cf x 40.0% Voids
#2A	160.00'	4,135 cf	Cultec R-330XLHD x 78 Inside #1 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 6 rows
		6,564 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	159.50'	8.270 In/hr Exfiltration over Wetted area
#2	Primary	161.50'	4.0" Vert. Orifice/Grate C= 0.600

Discarded OutFlow Max=0.67 cfs @ 12.53 hrs HW=161.90' (Free Discharge)

↳1=Exfiltration (Exfiltration Controls 0.67 cfs)

Primary OutFlow Max=0.21 cfs @ 12.53 hrs HW=161.90' (Free Discharge)

↳2=Orifice/Grate (Orifice Controls 0.21 cfs @ 2.35 fps)

Summary for Pond 16P: Infil 1

Inflow Area = 0.462 ac, 95.24% Impervious, Inflow Depth = 5.01" for 25 year event
 Inflow = 2.57 cfs @ 12.07 hrs, Volume= 0.193 af
 Outflow = 0.52 cfs @ 12.48 hrs, Volume= 0.193 af, Atten= 80%, Lag= 24.8 min
 Discarded = 0.40 cfs @ 12.48 hrs, Volume= 0.189 af
 Primary = 0.12 cfs @ 12.48 hrs, Volume= 0.004 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
 Peak Elev= 157.45' @ 12.48 hrs Surf.Area= 0.039 ac Storage= 0.053 af

Plug-Flow detention time= 33.8 min calculated for 0.193 af (100% of inflow)
 Center-of-Mass det. time= 33.8 min (798.2 - 764.4)

Volume	Invert	Avail.Storage	Storage Description
#1A	155.50'	0.033 af	20.83'W x 80.50'L x 3.54'H Field A 0.136 af Overall - 0.054 af Embedded = 0.083 af x 40.0% Voids
#2A	156.00'	0.054 af	Cultec R-330XLHD x 44 Inside #1 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 4 rows
		0.087 af	Total Available Storage

Storage Group A created with Chamber Wizard

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Type III 24-hr 25 year Rainfall=5.60"

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Device	Routing	Invert	Outlet Devices
#1	Primary	157.20'	4.0" Vert. Orifice/Grate C= 0.600
#2	Discarded	155.50'	8.270 in/hr Exfiltration over Wetted area

Discarded OutFlow Max=0.40 cfs @ 12.48 hrs HW=157.45' (Free Discharge)
 ↳2=Exfiltration (Exfiltration Controls 0.40 cfs)

Primary OutFlow Max=0.12 cfs @ 12.48 hrs HW=157.45' (Free Discharge)
 ↳1=Orifice/Grate (Orifice Controls 0.12 cfs @ 1.71 fps)

Summary for Pond 24P: Infil 3

Inflow Area = 0.354 ac, 77.49% Impervious, Inflow Depth = 3.93" for 25 year event
 Inflow = 1.66 cfs @ 12.07 hrs, Volume= 0.116 af
 Outflow = 0.31 cfs @ 12.51 hrs, Volume= 0.116 af, Atten= 81%, Lag= 26.5 min
 Discarded = 0.31 cfs @ 12.51 hrs, Volume= 0.116 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
 Peak Elev= 157.07' @ 12.51 hrs Surf.Area= 0.031 ac Storage= 0.031 af

Plug-Flow detention time= 27.0 min calculated for 0.116 af (100% of inflow)
 Center-of-Mass det. time= 27.0 min (829.3 - 802.3)

Volume	Invert	Avail.Storage	Storage Description
#1A	155.50'	0.022 af	21.00"W x 64.25"L x 2.54"H Field A 0.079 af Overall - 0.023 af Embedded = 0.056 af x 40.0% Voids
#2A	156.00'	0.023 af	Cultec R-150XLHD x 36 Inside #1 Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap Row Length Adjustment= +0.75' x 2.65 sf x 6 rows
		0.045 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	155.50'	8.270 in/hr Exfiltration over Wetted area

Discarded OutFlow Max=0.31 cfs @ 12.51 hrs HW=157.07' (Free Discharge)
 ↳1=Exfiltration (Exfiltration Controls 0.31 cfs)

Summary for Pond 25P: Infil 4

Inflow Area = 0.340 ac, 76.99% Impervious, Inflow Depth = 3.82" for 25 year event
 Inflow = 1.56 cfs @ 12.07 hrs, Volume= 0.108 af
 Outflow = 0.24 cfs @ 12.56 hrs, Volume= 0.108 af, Atten= 85%, Lag= 29.1 min
 Discarded = 0.24 cfs @ 12.56 hrs, Volume= 0.108 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
 Peak Elev= 157.19' @ 12.56 hrs Surf.Area= 0.022 ac Storage= 0.034 af

Plug-Flow detention time= 43.5 min calculated for 0.108 af (100% of inflow)

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Type III 24-hr 25 year Rainfall=5.60"

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Center-of-Mass det. time= 43.5 min (848.7 - 805.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	155.00'	0.019 af	20.83"W x 45.50"L x 3.54"H Field A
#2A	155.50'	0.030 af	0.077 af Overall - 0.030 af Embedded = 0.047 af x 40.0% Voids Cultec R-330XLHD x 24 Inside #1 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 4 rows
		0.049 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	155.00'	8.270 in/hr Exfiltration over Wetted area

Discarded OutFlow Max=0.24 cfs @ 12.56 hrs HW=157.19' (Free Discharge)
↑1=Exfiltration (Exfiltration Controls 0.24 cfs)

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Type III 24-hr 100 year Rainfall=6.80"

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Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
 Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 6S: Back Area To Infil 1	Runoff Area=20,135 sf 95.24% Impervious Runoff Depth=6.21" Tc=5.0 min CN=95 Runoff=3.14 cfs 0.239 af
Subcatchment 7S: Building	Runoff Area=24,022 sf 100.00% Impervious Runoff Depth=6.56" Tc=5.0 min CN=98 Runoff=3.81 cfs 0.302 af
Subcatchment 8S: Right Side	Runoff Area=20,984 sf 70.19% Impervious Runoff Depth=4.51" Tc=5.0 min CN=80 Runoff=2.62 cfs 0.181 af
Subcatchment 13S: Existing to Grove	Runoff Area=41,149 sf 39.22% Impervious Runoff Depth=3.05" Tc=5.0 min CN=66 Runoff=3.47 cfs 0.240 af
Subcatchment 17S: Existing to Wetlands	Runoff Area=105,072 sf 2.13% Impervious Runoff Depth=0.84" Tc=5.0 min CN=41 Runoff=1.37 cfs 0.169 af
Subcatchment 20S: Left side	Runoff Area=14,809 sf 76.99% Impervious Runoff Depth=4.95" Tc=5.0 min CN=84 Runoff=2.00 cfs 0.140 af
Subcatchment 23S: Right Side near Liberty	Runoff Area=15,400 sf 77.49% Impervious Runoff Depth=5.06" Tc=5.0 min CN=85 Runoff=2.12 cfs 0.149 af
Subcatchment 26S: No Infil	Runoff Area=13,274 sf 0.00% Impervious Runoff Depth=0.70" Tc=5.0 min CN=39 Runoff=0.11 cfs 0.018 af
Subcatchment 27S: To wetlands no	Runoff Area=37,597 sf 0.00% Impervious Runoff Depth=0.77" Tc=5.0 min CN=40 Runoff=0.40 cfs 0.055 af
Reach 9R: Wetlands	Inflow=1.03 cfs 0.115 af Outflow=1.03 cfs 0.115 af
Reach 22R: Grove Street	Inflow=0.11 cfs 0.018 af Outflow=0.11 cfs 0.018 af
Pond 15P: Infil 2	Peak Elev=162.90' Storage=6,401 cf Inflow=6.43 cfs 0.483 af Discarded=0.71 cfs 0.441 af Primary=0.47 cfs 0.042 af Outflow=1.18 cfs 0.483 af
Pond 16P: Infil 1	Peak Elev=157.89' Storage=0.065 af Inflow=3.14 cfs 0.239 af Discarded=0.41 cfs 0.221 af Primary=0.30 cfs 0.018 af Outflow=0.72 cfs 0.239 af
Pond 24P: Infil 3	Peak Elev=158.01' Storage=0.045 af Inflow=2.12 cfs 0.149 af Outflow=0.34 cfs 0.149 af
Pond 25P: Infil 4	Peak Elev=158.35' Storage=0.047 af Inflow=2.00 cfs 0.140 af Outflow=0.27 cfs 0.140 af

Total Runoff Area = 6.714 ac Runoff Volume = 1.493 af Average Runoff Depth = 2.67"
65.93% Pervious = 4.426 ac 34.07% Impervious = 2.287 ac

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Type III 24-hr 100 year Rainfall=6.80"

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Summary for Subcatchment 6S: Back Area To Infil 1

Runoff = 3.14 cfs @ 12.07 hrs, Volume= 0.239 af, Depth= 6.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 year Rainfall=6.80"

Area (sf)	CN	Description
19,176	98	Paved parking, HSG A
959	39	>75% Grass cover, Good, HSG A
20,135	95	Weighted Average
959		4.76% Pervious Area
19,176		95.24% Impervious Area

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

Summary for Subcatchment 7S: Building

Runoff = 3.81 cfs @ 12.07 hrs, Volume= 0.302 af, Depth= 6.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 year Rainfall=6.80"

Area (sf)	CN	Description
24,022	98	Unconnected roofs, HSG A
24,022		100.00% Impervious Area
24,022		100.00% Unconnected

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

Summary for Subcatchment 8S: Right Side

Runoff = 2.62 cfs @ 12.07 hrs, Volume= 0.181 af, Depth= 4.51"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 year Rainfall=6.80"

Area (sf)	CN	Description
14,728	98	Paved roads w/curbs & sewers, HSG B
6,256	39	>75% Grass cover, Good, HSG A
20,984	80	Weighted Average
6,256		29.81% Pervious Area
14,728		70.19% Impervious Area

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Type III 24-hr 100 year Rainfall=6.80"

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

Summary for Subcatchment 13S: Existing to Grove Street

Runoff = 3.47 cfs @ 12.08 hrs, Volume= 0.240 af, Depth= 3.05"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 year Rainfall=6.80"

Area (sf)	CN	Description
16,138	98	Paved parking, HSG A
17,705	49	50-75% Grass cover, Fair, HSG A
7,306	36	Woods, Fair, HSG A
41,149	66	Weighted Average
25,011		60.78% Pervious Area
16,138		39.22% Impervious Area

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

Summary for Subcatchment 17S: Existing to Wetlands

Runoff = 1.37 cfs @ 12.11 hrs, Volume= 0.169 af, Depth= 0.84"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 year Rainfall=6.80"

Area (sf)	CN	Description
2,236	98	Paved parking, HSG A
26,764	49	50-75% Grass cover, Fair, HSG A
66,603	36	Woods, Fair, HSG A
9,469	36	Woods, Fair, HSG A
105,072	41	Weighted Average
102,836		97.87% Pervious Area
2,236		2.13% Impervious Area

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

Summary for Subcatchment 20S: Left side

Runoff = 2.00 cfs @ 12.07 hrs, Volume= 0.140 af, Depth= 4.95"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 year Rainfall=6.80"

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Type III 24-hr 100 year Rainfall=6.80"

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Area (sf)	CN	Description
10,902	98	Paved parking, HSG A
3,407	39	>75% Grass cover, Good, HSG A
* 500	98	sidewalks
14,809	84	Weighted Average
3,407		23.01% Pervious Area
11,402		76.99% Impervious Area

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

Summary for Subcatchment 23S: Right Side near Liberty

Runoff = 2.12 cfs @ 12.07 hrs, Volume= 0.149 af, Depth= 5.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 year Rainfall=6.80"

Area (sf)	CN	Description
11,075	98	Paved parking, HSG A
3,467	39	>75% Grass cover, Good, HSG A
* 858	98	sidewalks
15,400	85	Weighted Average
3,467		22.51% Pervious Area
11,933		77.49% Impervious Area

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

Summary for Subcatchment 26S: No infil

Runoff = 0.11 cfs @ 12.13 hrs, Volume= 0.018 af, Depth= 0.70"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 year Rainfall=6.80"

Area (sf)	CN	Description
13,274	39	>75% Grass cover, Good, HSG A
13,274		100.00% Pervious Area

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

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Type III 24-hr 100 year Rainfall=6.80"

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Summary for Subcatchment 27S: To wetlands no infiltration

Runoff = 0.40 cfs @ 12.12 hrs, Volume= 0.055 af, Depth= 0.77"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 year Rainfall=6.80"

Area (sf)	CN	Description
18,469	39	>75% Grass cover, Good, HSG A
* 2,479	76	gravel path
7,180	36	Woods, Fair, HSG A
9,469	36	Woods, Fair, HSG A
37,597	40	Weighted Average
37,597		100.00% Pervious Area

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

Summary for Reach 9R: Wetlands

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.359 ac, 56.38% Impervious, Inflow Depth = 0.59" for 100 year event
 Inflow = 1.03 cfs @ 12.39 hrs, Volume= 0.115 af
 Outflow = 1.03 cfs @ 12.39 hrs, Volume= 0.115 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Reach 22R: Grove Street

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.998 ac, 53.66% Impervious, Inflow Depth = 0.21" for 100 year event
 Inflow = 0.11 cfs @ 12.13 hrs, Volume= 0.018 af
 Outflow = 0.11 cfs @ 12.13 hrs, Volume= 0.018 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Pond 15P: Infil 2

Inflow Area = 1.033 ac, 86.10% Impervious, Inflow Depth = 5.60" for 100 year event
 Inflow = 6.43 cfs @ 12.07 hrs, Volume= 0.483 af
 Outflow = 1.18 cfs @ 12.51 hrs, Volume= 0.483 af, Atten= 82%, Lag= 26.3 min
 Discarded = 0.71 cfs @ 12.51 hrs, Volume= 0.441 af
 Primary = 0.47 cfs @ 12.51 hrs, Volume= 0.042 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2

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Type III 24-hr 100 year Rainfall=6.80"

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Peak Elev= 162.90' @ 12.51 hrs Surf.Area= 2,882 sf Storage= 6,401 cf

Plug-Flow detention time= 50.8 min calculated for 0.483 af (100% of inflow)

Center-of-Mass det. time= 50.8 min (817.9 - 767.1)

Volume	Invert	Avail.Storage	Storage Description
#1A	159.50'	2,429 cf	30.50'W x 94.50'L x 3.54'H Field A 10,208 cf Overall - 4,135 cf Embedded = 6,073 cf x 40.0% Voids
#2A	160.00'	4,135 cf	Cultec R-330XLHD x 78 Inside #1 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 6 rows
		6,564 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	159.50'	8.270 in/hr Exfiltration over Wetted area
#2	Primary	161.50'	4.0" Vert. Orifice/Grate C= 0.600

Discarded OutFlow Max=0.71 cfs @ 12.51 hrs HW=162.90' (Free Discharge)

↳1=Exfiltration (Exfiltration Controls 0.71 cfs)

Primary OutFlow Max=0.47 cfs @ 12.51 hrs HW=162.90' (Free Discharge)

↳2=Orifice/Grate (Orifice Controls 0.47 cfs @ 5.35 fps)

Summary for Pond 16P: Infil 1

Inflow Area = 0.462 ac, 95.24% Impervious, Inflow Depth = 6.21" for 100 year event
 Inflow = 3.14 cfs @ 12.07 hrs, Volume= 0.239 af
 Outflow = 0.72 cfs @ 12.45 hrs, Volume= 0.239 af, Atten= 77%, Lag= 22.9 min
 Discarded = 0.41 cfs @ 12.45 hrs, Volume= 0.221 af
 Primary = 0.30 cfs @ 12.45 hrs, Volume= 0.018 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
 Peak Elev= 157.89' @ 12.45 hrs Surf.Area= 0.039 ac Storage= 0.065 af

Plug-Flow detention time= 35.6 min calculated for 0.239 af (100% of inflow)
 Center-of-Mass det. time= 35.6 min (795.4 - 759.7)

Volume	Invert	Avail.Storage	Storage Description
#1A	155.50'	0.033 af	20.83'W x 80.50'L x 3.54'H Field A 0.136 af Overall - 0.054 af Embedded = 0.083 af x 40.0% Voids
#2A	156.00'	0.054 af	Cultec R-330XLHD x 44 Inside #1 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 4 rows
		0.087 af	Total Available Storage

Storage Group A created with Chamber Wizard

357 Grove Street

Type III 24-hr 100 year Rainfall=6.80"

Prepared by Hardy + Man Group, P.C.

Printed 1/22/2020

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Device	Routing	Invert	Outlet Devices
#1	Primary	157.20'	4.0" Vert. Orifice/Grate C= 0.600
#2	Discarded	155.50'	8.270 in/hr Exfiltration over Wetted area

Discarded OutFlow Max=0.41 cfs @ 12.45 hrs HW=157.89' (Free Discharge)
 ↳2=Exfiltration (Exfiltration Controls 0.41 cfs)

Primary OutFlow Max=0.30 cfs @ 12.45 hrs HW=157.89' (Free Discharge)
 ↳1=Orifice/Grate (Orifice Controls 0.30 cfs @ 3.48 fps)

Summary for Pond 24P: Infil 3

Inflow Area = 0.354 ac, 77.49% Impervious, Inflow Depth = 5.06" for 100 year event
 Inflow = 2.12 cfs @ 12.07 hrs, Volume= 0.149 af
 Outflow = 0.34 cfs @ 12.54 hrs, Volume= 0.149 af, Atten= 84%, Lag= 28.1 min
 Discarded = 0.34 cfs @ 12.54 hrs, Volume= 0.149 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
 Peak Elev= 158.01' @ 12.54 hrs Surf.Area= 0.031 ac Storage= 0.045 af

Plug-Flow detention time= 39.1 min calculated for 0.149 af (100% of inflow)
 Center-of-Mass det. time= 39.1 min (834.3 - 795.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	155.50'	0.022 af	21.00'W x 64.25'L x 2.54'H Field A 0.079 af Overall - 0.023 af Embedded = 0.056 af x 40.0% Voids
#2A	156.00'	0.023 af	Cultec R-150XLHD x 36 Inside #1 Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap Row Length Adjustment= +0.75' x 2.65 sf x 6 rows
		0.045 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	155.50'	8.270 in/hr Exfiltration over Wetted area

Discarded OutFlow Max=0.34 cfs @ 12.54 hrs HW=158.01' (Free Discharge)
 ↳1=Exfiltration (Exfiltration Controls 0.34 cfs)

Summary for Pond 25P: Infil 4

Inflow Area = 0.340 ac, 76.99% Impervious, Inflow Depth = 4.95" for 100 year event
 Inflow = 2.00 cfs @ 12.07 hrs, Volume= 0.140 af
 Outflow = 0.27 cfs @ 12.59 hrs, Volume= 0.140 af, Atten= 87%, Lag= 31.0 min
 Discarded = 0.27 cfs @ 12.59 hrs, Volume= 0.140 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
 Peak Elev= 158.35' @ 12.59 hrs Surf.Area= 0.022 ac Storage= 0.047 af

Plug-Flow detention time= 59.9 min calculated for 0.140 af (100% of inflow)

357 Grove Street

Prepared by Hardy + Man Group, P.C.

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Type III 24-hr 100 year Rainfall=6.80"

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Center-of-Mass det. time= 59.9 min (857.8 - 797.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	155.00'	0.019 af	20.83'W x 45.50'L x 3.54'H Field A
#2A	155.50'	0.030 af	0.077 af Overall - 0.030 af Embedded = 0.047 af x 40.0% Voids Cultec R-330XLHD x 24 Inside #1 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 4 rows
			0.049 af Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	155.00'	8.270 In/hr Exfiltration over Wetted area

Discarded OutFlow Max=0.27 cfs @ 12.59 hrs HW=158.35' (Free Discharge)
↑1=Exfiltration (Exfiltration Controls 0.27 cfs)



May 9, 2017

Mr. Mike Healy
Senior Vice President/CLO
South Shore Bank
1530 Main Street
South Weymouth, MA 02190

Re: Review of Environmental Reports for RTN 4-3013926
357 Grove Street, Braintree Massachusetts 02184
PES Project # 17-11568

Dear Mr. Healy:

At your request, *PES Associates, Inc. (PES)* has reviewed environmental reports provided to us regarding the above-referenced property (the Site). These reports included the "Class A-2 Response Action Outcome Statement and Method 3 Risk Characterization" (RAO Report) prepared in April 2009 by *Corporate Environmental Advisors (CEA)* of West Boylston, MA, and the "Underground Storage Tank Closure Report" (UST Report) prepared for the Site in August 2014 by *Envirotrac* of Sharon, MA. Our conclusions, opinions, and recommendations are based solely on the contents of the reviewed reports.

Site Background

The Site at 357 Grove Street is an approximately 2.06-acre property located at the intersection of Grove Street and Liberty Street in a commercial and residential area of Braintree, Massachusetts. The portion of the Site closest to the intersection (approximately 0.44 acres) was formerly a Sunoco Station. As of August 2014, the remainder of the Site was undeveloped.

According to the RAO report, the Site was initially developed as a gasoline service station in 1959 by *Sunoco*. In 1984, a 16,000-gallon gasoline UST was removed and replaced by three 6,000-gallon, single-walled fiberglass-reinforced plastic USTs for the storage of gasoline, which were then removed in June 2014, as detailed in the UST report. In 1994, a 550-gallon used oil UST and a 550-gallon fuel oil UST were also removed from the Site. The Site is reportedly attached to municipal water and sewer.

**Class A-2 Response Action Outcome Statement and Method 3 Risk Characterization,
Corporate Environmental Advisors, April 2009**

In April 1996, a petroleum release was discovered at the Site during the removal of an oil/water separator (OWS). The Massachusetts Department of Environmental Protection (MassDEP) has a record of this release under Release Tracking Number (RTN) 4-3013926. The initial notification to MassDEP pertained to the detection of diesel and waste oil related petroleum compounds, but later gasoline related compounds were also detected in soil and groundwater in the vicinity of former USTs and the OWS.

Between 1997 and February 2009, comprehensive assessment and response actions were conducted at the Site under the Massachusetts Contingency Plan (MCP). Assessment activities included the advancement of soil test borings and the installation of groundwater monitoring wells, and subsequent sampling and analysis of soil and groundwater to evaluate pre- and post-remediation environmental conditions. Monitored natural attenuation was selected as a remediation method, with periodic groundwater and soil sampling and analysis conducted until 2009.

Soils at the developed portion of the Site consisted of fine to coarse grained sand, with silt and gravel. Shallow refusal, likely bedrock, was noted in the southern part of the developed area at depths of three to ten feet below grade. Groundwater flow was determined to be to the north-northwest, with groundwater between approximately 8 and 11 feet below grade.

CEA concluded that the oil and/or hazardous material (OHM) impacts associated with the documented releases from the former OWS area and dispenser island were confined to the property boundaries. In the report, *CEA* stated that the disposal site was the property boundary along the west, north and east sides, with the southern boundary following the curb line and rear of the building.

Additionally, *CEA* concluded that two distinct areas of the Site had been impacted by the historical OHM release: the former OWS excavation area, and the gasoline UST/dispenser island area. Confirmatory sampling indicated that only minor residual contamination remained in the former OWS/UIC area. However, residual volatile petroleum hydrocarbon (VPH) concentrations that are above the applicable Method 1 S-1 Standards (most stringent) remained in soils located to the west of the dispenser island and northeast of the gasoline UST area, at depths ranging between 10 to 15 feet below grade (as confirmed by analytical tests conducted on soil samples collected from test boring locations SB-1 (8'-10'), SB-3/MW-11 (11'-13'), MW-6 (10'-12'), and

MW-8 (15'), which was located just beyond the property boundary). Please refer to the area marked in red on the attached figure. Additionally, groundwater samples exceeding applicable GW-2 standards (i.e. those associated with the evaluation of indoor air impacts) were collected from monitoring well locations MW-6 and MW-11 at the time of Site closure.

CES subsequently conducted a Method 3 (site specific) Risk Assessment, and determined that there was no risk to health, safety, public welfare or the environment for current and future uses associated with the residual contamination. However, in reviewing the Method 3 Risk Assessment, *PES* noted that it did not evaluate potential vapor intrusion for wells MW-6 and MW-11, as those wells were not located near site buildings at the time of the assessment. In the event a building is planned for construction in the vicinity of these two well locations, an assessment of any potential vapor intrusion from the impacted groundwater should be conducted.

Underground Storage Tank Closure Report, *EnviroTrac*, August 2014

On June 17 and 18, 2014, *EnviroTrac* oversaw the removal of three 6,000-gallon gasoline single-walled fiberglass-reinforced USTs from the Site, as well as the associated dispensers and piping. During the removal activities, the condition of the USTs and piping were documented, and soil samples from the UST excavation, dispenser area and piping runs were collected for field screening and laboratory analysis. The soil excavation and UST system removal activities were conducted by *Sorco Corporation (Sorco)* of Tyngsborough, Massachusetts.

On June 17, 2014, *Sorco* removed the three USTs from the excavation. No evidence of breakage, loose fittings, wear, staining, indentations, cracks, or leakage was observed on any of the USTs. An inspector from the Town of Braintree Fire Department was present to observe the removal of the tanks. After the inspection, the USTs were cleaned, placed in a roll-off dumpster, crushed with an excavator and disposed appropriately. On June 18, 2014, the dispensers and associated piping were excavated and removed. The piping was double-walled and exhibited no evidence of breakage, wear or leakage. The UST excavation and former dispenser line trenches were then backfilled.

Soil samples collected by *EnviroTrac* from the sidewalls and bottom of the former tank location were submitted to a laboratory for VPH analysis, and no VPH compounds were detected in the soil samples. Additionally, field screening of pipe trenches and dispenser locations indicated ambient volatile levels. Based on the observations and analytical data obtained during the tank removal activities, *EnviroTrac* concluded that no evidence of a release associated with the USTs was present, and no further investigation or remedial action was recommended.

Conclusions

Based on our review of the above reports, *PES* concludes the following:

- There is no concern associated with the USTs removed from the Site in 2014.
- Residual contamination exceeding S-1 soil and GW-2 groundwater standards remained at the Site in 2009, in the approximate area marked in red on the attached Site plan. While no immediate risk is associated with this residual contamination, any soil removed from this area during future redevelopment or utility work would need to be managed as Remediation Waste under the MCP. This would require proper segregation of the material, collection of a waste characterization sample, and disposal of the soil to an approved facility under the bill of lading process.
- The Method 3 risk assessment supporting the RAO did not consider potential indoor vapor intrusion in the vicinity of MW-6 and MW-11. If future site redevelopment includes the construction of a building near or over this area, a vapor barrier beneath the building should be considered as a safety precaution.

Recommendations

PES recommends the following with respect to the Site:

- Since the RAO was prepared over 8 years ago, it is possible that residual contamination may have degraded significantly. If monitoring wells MW-6 and/or MW-11 still exist and are serviceable, *PES* recommends resampling them for VPH analysis to determine whether residual contaminant levels exceed applicable groundwater standards which could create a vapor intrusion concern if the Site is redeveloped.

We appreciate this opportunity to assist *South Shore Bank* with this project. Should you have any questions, or if we can be of further assistance, please do not hesitate to contact us.

Sincerely,
PES Associates, Inc.

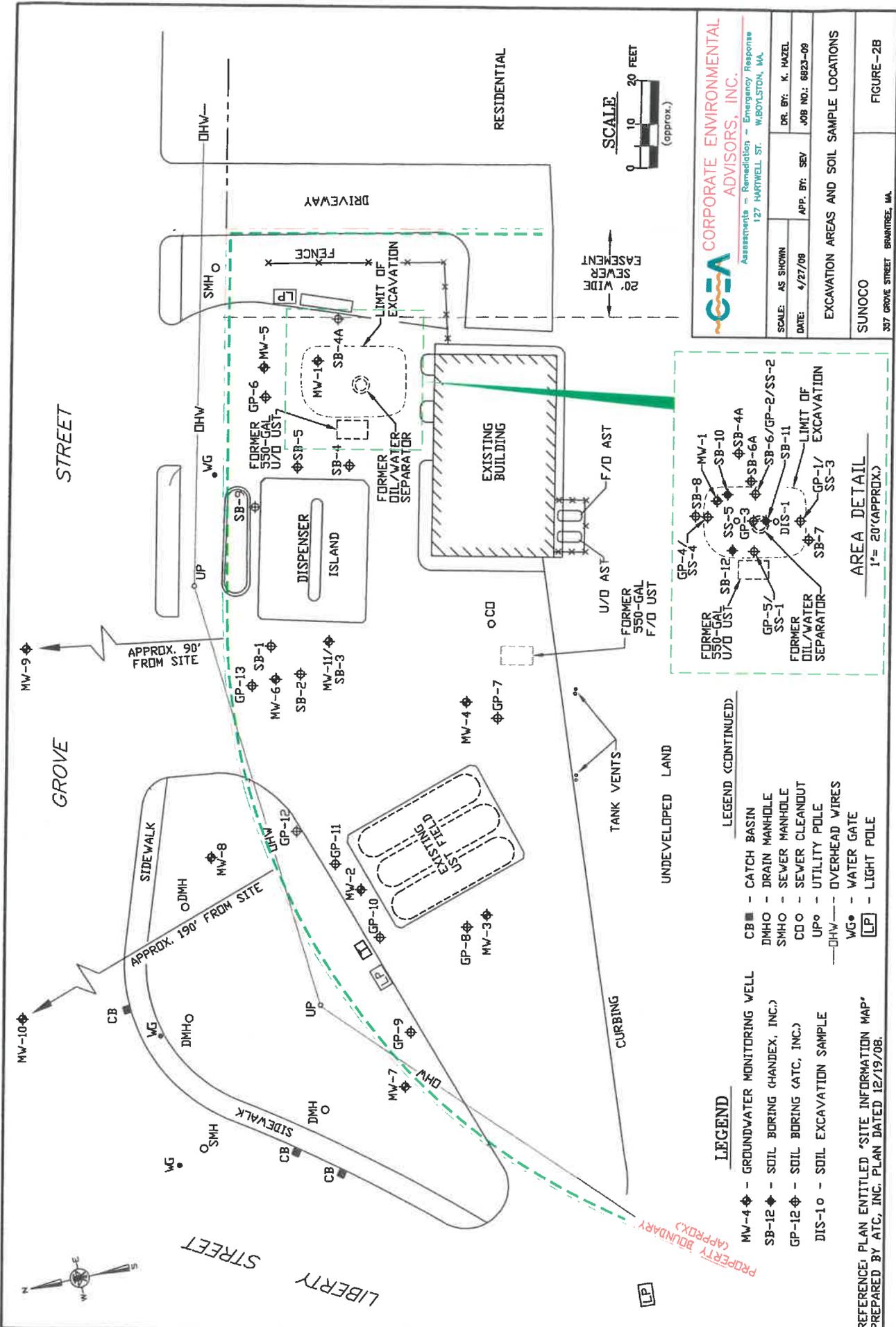


Ellen Blackburn
Environmental Professional



Scott McIsaac
Program Manager

Attachment



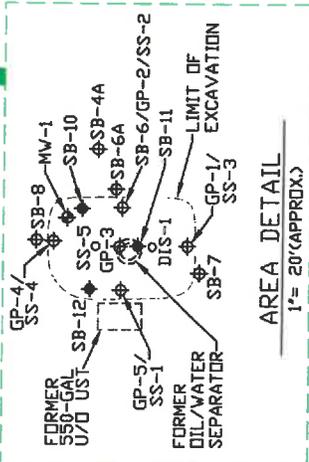
CEA CORPORATE ENVIRONMENTAL ADVISORS, INC.
 Assessments - Remediation - Emergency Response
 127 HARTWELL ST. WOBURSTON, MA.

SCALE: AS SHOWN	DR. BY: K. HAZEL
DATE: 4/27/08	APP. BY: SEV
JOB NO.: 6823-09	

EXCAVATION AREAS AND SOIL SAMPLE LOCATIONS

SUNOCO
 307 GROVE STREET BRANTREE, MA.

FIGURE-2B



LEGEND (CONTINUED)

- MV-4 - GROUNDWATER MONITORING WELL
- SB-12 - SOIL BORING (HANDEX, INC.)
- GP-12 - SOIL BORING (ATC, INC.)
- DIS-1 - SOIL EXCAVATION SAMPLE
- CB - CATCH BASIN
- DMHO - DRAIN MANHOLE
- SMHO - SEWER MANHOLE
- CO - SEWER CLEANOUT
- UP - UTILITY POLE
- DHW - OVERHEAD WIRES
- WG - WATER GATE
- LP - LIGHT POLE

REFERENCE: PLAN ENTITLED "SITE INFORMATION MAP" PREPARED BY ATC, INC. PLAN DATED 12/19/08.

HIGHLANDS VILLAGE

COMPREHENSIVE PERMIT APPLICATION – BRAINTREE ZBA

6. TRAFFIC IMPACT ASSESSMENT

Traffic Impact Assessment

For:

Residential Units with Off-Street Parking

At:

357 Grove Street

In:

Braintree, Massachusetts

Prepared For:

Liberty Grove, LLC
Braintree, Mass.

Prepared By:



January 2020

Residential Dwelling units

**"357 Grove Street"
Braintree, Massachusetts**

Gillon Associates Co.
111 River Street, N. Weymouth, MA 02191-2104
Telephone: (781) 589-7339
E-mail: jt.gillon@comcast.net

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EXECUTIVE SUMMARY

- **Grove Street currently carries approximately 25,250 vehicles per weekday adjacent to the site.**
- **This project is expected to generate approximately 33 morning driveway peak hour trips with nine inbound and 24 outbound. This project is also expected to generate approximately 43 evening peak hour trips with 26 inbound and 17 outbound.**
- **This report provides an identification of the expected traffic generated by the project along with an assessment of baseline (Base) and projected traffic operating characteristics. The Base traffic volumes and roadway improvements at the Grove Street / Liberty Street intersection were obtained from the #60 Columbian Street traffic assessment prepared by VHB in May 2019 for the old "Lottery Building" replacement by Brigham and Women's Physicians Organization.**
- **The minor increased traffic volume at the improved and re-signalized Grove Street / Liberty Street intersection is expected to result in virtually no noticeable increase in delay or queuing. The overall intersection will continue to operate at an acceptable "D" level of service under all scenarios. Each individual approach level of service will not change either during both morning and evening peak hours between Base and Build conditions.**
- **This Grove Street / Columbian Street intersection is expected to result in virtually no noticeable increase in delay or queuing. The overall intersection will continue to operate at a "C" level of service under all scenarios. The only approach level of service that may experience a change during the evening peak hour is the Grove Street southwest bound left-turn movement that may change from a "B" to a "C", although this project will not add one vehicle to that movement.**
- **The required stopping sight distance from the new site driveway intersections on both Grove Street and Liberty Street is provided.**

INTRODUCTION

Gillon Associates has evaluated the anticipated traffic impacts resulting from the construction of 96 residential dwelling units to be located at the southeasterly quadrant of the Grove Street / Liberty Street intersection in Braintree, Massachusetts (Figure 1).

The purpose of this report is to evaluate potential traffic impacts, which may be created by the expected addition of vehicular traffic either originating from or destined to the site. Specifically, this report assesses traffic operational characteristics of the Grove Street / Liberty Street and Grove Street / Columbian Street intersections as well as the new site driveway intersections on both Grove Street and Liberty Street.

This report provides an identification of the expected traffic generated by the project along with an assessment of baseline (Base) and projected traffic operating characteristics. The Base traffic volumes and roadway improvements at the Grove Street / Liberty Street intersection were obtained from the #60 Columbian Street traffic assessment prepared by VHB in May 2019 for the old "Lottery Building" replacement by Brigham and Women's Physicians Organization.

Site related traffic projections are based on similar land use and size.

PROJECT DESCRIPTION

The project includes replacement of the existing building with a four-story residential building. There will be one all-access driveway on Grove Street and one right-turn-in and right-turn-out driveway on Liberty Street as shown on Figure 2.

EXISTING TRAFFIC CONDITIONS

Regional Roadway Network

The site is served by Grove Street and Liberty Street which provide access to both local and regional roadway facilities. To the north, Liberty Street connects with Middle Street providing linkage to Route 3 for access to Boston via Union Street. To the east, Grove Street connects with SR 18 (Main Street) in Weymouth, at the Route 3 intersection just south of Route 53. To the west, Grove Street becomes Plain Street before intersecting with John Mahar Highway and Hancock Street (Route 37) just south of Braintree Center.

Traffic Setting

The project is situated within a residential area on Liberty Street with high commercial use on Grove Street. The site at 357 Grove Street had been used formerly as a gasoline station. Grove Street has a roadway pavement width of approximately 44 feet adjacent to the site where it widens at the signalized Liberty Street intersection. Liberty Street is constructed with a short frontage roadway from south of Hickory Road to about 125 feet south of Grove Street. This feature limits the new site driveway traffic to right-turns-in and right-turns-out only.

Existing Traffic Volumes

Grove Street currently carries approximately 25,250 vehicles per weekday and Liberty Street accommodates about 15,000 vehicles per weekday. Peak hour traffic volumes were also observed and recorded at both Grove Street intersections at Liberty Street and Columbia Street for the medical office traffic study prior to increasing for normal growth and projecting new growth associated with the medical office building.

FUTURE TRAFFIC CONDITIONS

In order to assess the future traffic demands on the adjacent roadways, the latent demand or normal growth in traffic volumes which will occur prior to occupying the new residential units has to be identified. This growth in traffic volume will be associated with normal increases due to new development and an increase of licensed drivers, as well as employment opportunities in the area.

Background Traffic Growth

The baseline peak hour traffic volumes were taken directly from the medical office building "Build" conditions since those volumes reflected existing volumes inflated to account for normal growth and site specific volumes at the medical office building through both intersections being evaluated. That project also included intersection mitigation commitments for the Grove Street / Liberty Street intersection as shown on Figure 3. The baseline or "Base" year traffic flows onto which the site related traffic will be added for our projected year analysis purposes are shown for weekday morning and evening peak hours on Figures 4 and 5 respectively.

Trip Generation and Distribution

It is expected that the proposed residential development will exhibit the same general trip generating characteristics as in other suburban residential communities. In addition to local rates observed and compiled by this firm, the Institute of Transportation Engineers (ITE) provides data on a variety of land uses and there is a considerable amount of empirical data available. Figure 6 provides a trip generation summary listing the ITE equations along with the resulting trip generation values for the development site. The ITE methodology of utilizing the fitted curve was adopted for this report. This project is expected to generate approximately 33 morning driveway peak hour trips with nine inbound and 24 outbound. This project is also expected to generate approximately 43 evening peak hour trips with 26 inbound and 17 outbound. Although approving agencies generally allow a credit for the former the former land use, this previous-use credit for the gas station was not taken.

Directional distribution trip assignments are shown on Figure 7. This assignment reflects both the existing roadway peak hour flows as well as the US Census Journey-to-Work characteristics provided on this Figure. The two access driveways feeding the internal parking area are connected and provide flexibility to distribute site traffic to and through the signalized intersection as well as to account for the restricted turns on Liberty Street due to the short frontage road. Site generated traffic volumes associated with the project are shown on Figures 8 and 9. Projected weekday morning and evening peak hour traffic volumes representing a build condition for the site in the year 2027 are provided on Figures 10 and 11 respectively.

TRAFFIC OPERATIONAL ANALYSIS

This section of the report provides a quantitative analysis of anticipated traffic operational characteristics for the build scenarios. These series of capacity analyses were conducted for weekday morning and evening peak hours to determine the potential impact of the proposed residential project.

Analysis Methodology and Findings

The analysis is based on the "Highway Capacity Manual" for both signalized and non-signalized driveway intersections. This manual has been published by the Transportation Board of the National Research Council and approved by the National Academy of Sciences, National Academy of Engineering, and the Institute of Medicine. Synchro Software version 10 was utilized in the assessment.

At un-signalized intersections the manual assumes that the through and right-turn movements along any main street will operate unrestricted but conflicting movements will be subjected to various periods of delay depending primarily on the frequency of adequate safe gaps to complete these movements. These periods of delay are generally categorized in "Levels of Service" (LOS) ranging from "A" for very short or no delays through "F" for extensive delays. The Massachusetts Highway Design Manual indicates that a "D" Level of Service is acceptable on roadways such as those in the study area. A table comparing levels of service and seconds of delay is provided in the Appendix of this report.

Grove Street at Liberty Street

The minor increased traffic volume at this improved and re-signalized Grove Street / Liberty Street intersection is expected to result in virtually no noticeable increase in delay or queuing. As can be seen on Figure 12 and the calculations provided herein, the overall intersection will continue to operate at an acceptable "D" level of service under all scenarios. Each individual approach level of service will not change either during both morning and evening peak hours. In essence, the proposed roadway improvements, programmed and completed as mitigation for the medical office building, will not depreciate due to the addition and construction of this project.

Grove Street at Columbian Street

Here too, the minor increased traffic volume at the Grove Street / Columbian Street intersection is expected to result in virtually no noticeable increase in delay or queuing. The overall intersection will continue to operate at a "C" level of service under all scenarios. The only approach level of service that may experience a change during the evening peak hour is the Grove Street southwest bound left-turn movement that may change from a "B" to a "C". Although the residential project will not add any traffic to that particular movement, the baseline delay of 19.8 seconds ("B" level) may only change to 20.0 seconds at a "C" level due to balancing of green time at the intersection. In essence, the addition of traffic through this intersection will not be noticeable to Braintree residents using this intersection.

Grove Street and Liberty Street at Site Driveways

These un-signalized intersections will continue to result in no delay to either Grove Street or Liberty Street in the vicinity of the site since all main street approaches will continue to operate at an "A" level of service even after occupancy of the project during both commuting peak hours. The Grove Street driveway is expected to operate at a "B" level of service in the morning peak hour and at a "C" in the evening peak hour. The Liberty Street driveway is expected to operate at a "C" level of service in the morning peak hour and at a "B" in the evening peak hour.

SIGHT DISTANCE EVALUATION

The driveways on both Grove Street and Liberty Street were evaluated to assess adequate stopping sight distance. The approaching vehicle on both roadways must be able to stop in time to avoid making contact with a vehicle emerging from either of the two new driveways. The required stopping sight distance from either a minor street or driveway is obtained from "A Policy on Geometric Design of Highways and Streets" as published by the American Association of State Highway and Transportation Officials (AASHTO) 7th Edition published in 2018.

On page 9-43 of the AASHTO manual, it states "The vertex (decision point) of the departure sight triangle on the minor road should be taken 4.4m [14.5 feet] from the edge of the major-road traveled way". The manual explains "This represents the typical position of the minor-road driver's eye when a vehicle is stopped relatively close to the major road. Field observations of vehicle stopping positions

found that, where needed, drivers will stop with the front of their vehicle 2.0 m [6.5 feet] or less from the edge of the major-road traveled way.” Further, on page 9-43 it states “Measurements of passenger cars indicate that the distance from the front of the vehicle to the driver’s eye for the current U.S. passenger car population is nearly always 2.4 m [8 feet] or less.”

Unlike the minimum safe stopping distance (MSSD) along a section of roadway, stopping sight distance at a minor street is not measured along either the center line or gutter line of a roadway. On page 9-35 of the manual, it is stated “If the available sight distance for an entering or crossing vehicle (at an intersection corner) is at least equal to the appropriate stopping sight distance for the major road, then drivers have sufficient sight distance to anticipate and avoid collisions.”

The motorist leaving the minor site roadway has an eye height of 3.5 feet and he must be able to see another object (approaching vehicle) with a drivers height of 3.5 feet from a point 14.5 feet back from the travel way. The required stopping distance for each minor roadway or driveway is based on the on the AASHTO formula on page 3-5 as follows:

$$d = 1.47 Vt + 1.075 \frac{V^2}{a}$$

Where: V = Speed (mph)
t = perception & Reaction time (2.5 seconds)
a = deceleration of vehicle (11.2 ft/sec.²)

A speed survey on Grove Street was conducted with a “Gensis” hand-held radar gun, Model: GHS as manufactured by Decatur Electronics, Inc. Although the average speed varied between 33 and 37 miles per hour (mph), the 85th percentile speed, commonly referred to as the design speed, was 38 miles per hour westbound and 40 mph eastbound (Figure 13).

$$d = 1.47 * 40 * 2.5 + 1.075 * \frac{(40)^2}{11.2}$$

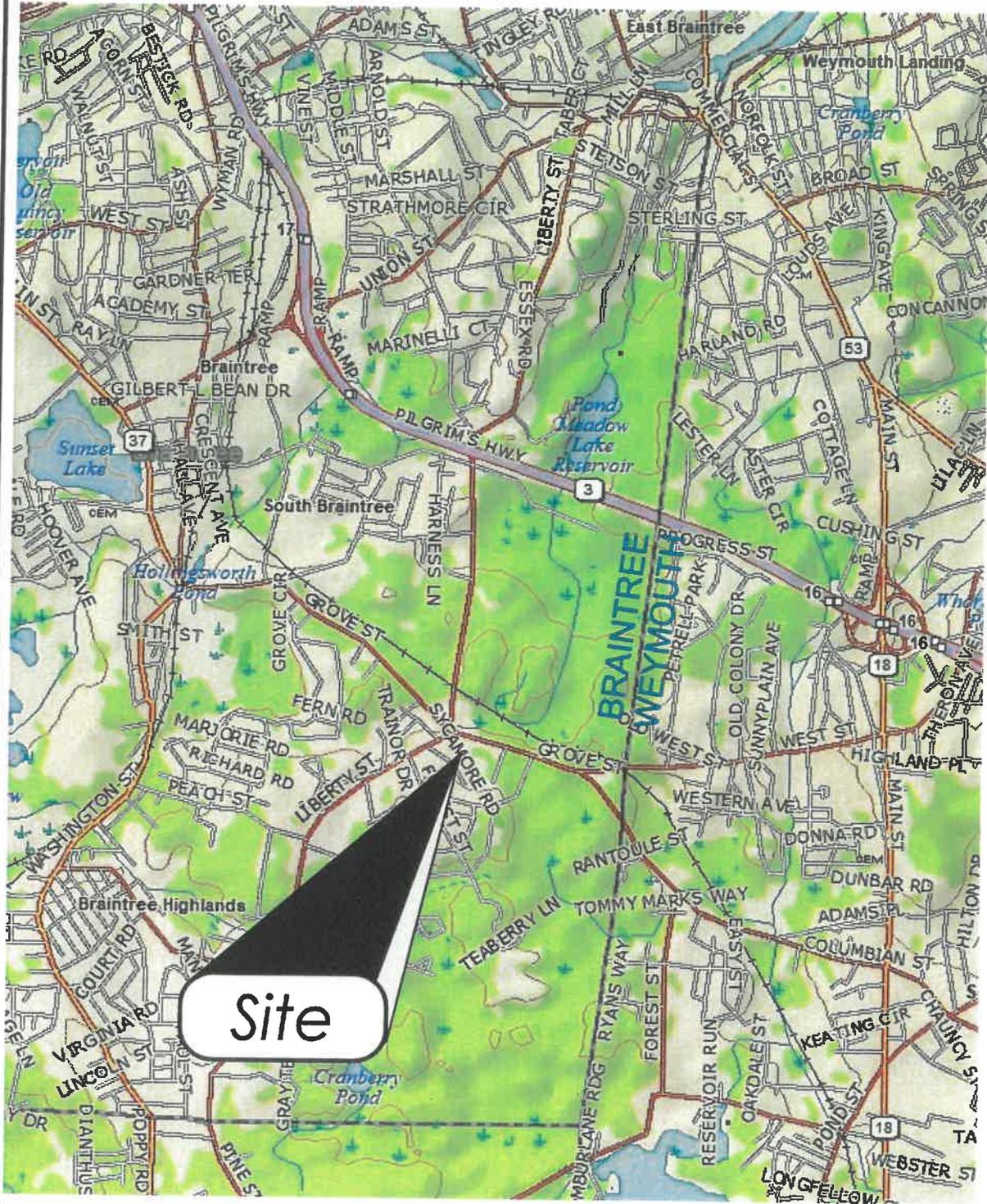
$$\text{Required } d = 147 + 154 = 301 \text{ feet}$$

Field measurements confirm there is well over 450 feet of stopping sight distance to both the east and west of the new driveway intersection. Thus, the available stopping sight distance is more than adequate on Grove Street.

Similarly a speed survey was conducted for the northbound direction on Liberty Street since traffic will be approaching the new driveway in this direction. The average speed here was 31 miles per hour (mph), and the 85th percentile speed was 34 miles per hour. The required stopping sight distance here is 236 feet. Field measurements confirm there is well over 350 feet of stopping sight distance to the south of the new driveway intersection. Thus, the available stopping sight distance is more than adequate on Liberty Street as well.

CRASH ASSESSMENT

Since crash data was researched from the Massachusetts Department of Transportation records over the latest available three-year period for the medical office building and the programmed intersection improvements on Grove Street at Liberty Street will probably make this intersection much safer, a re-evaluation on outdated material was deemed not necessary or insightful.



General Location Map

Figure 1

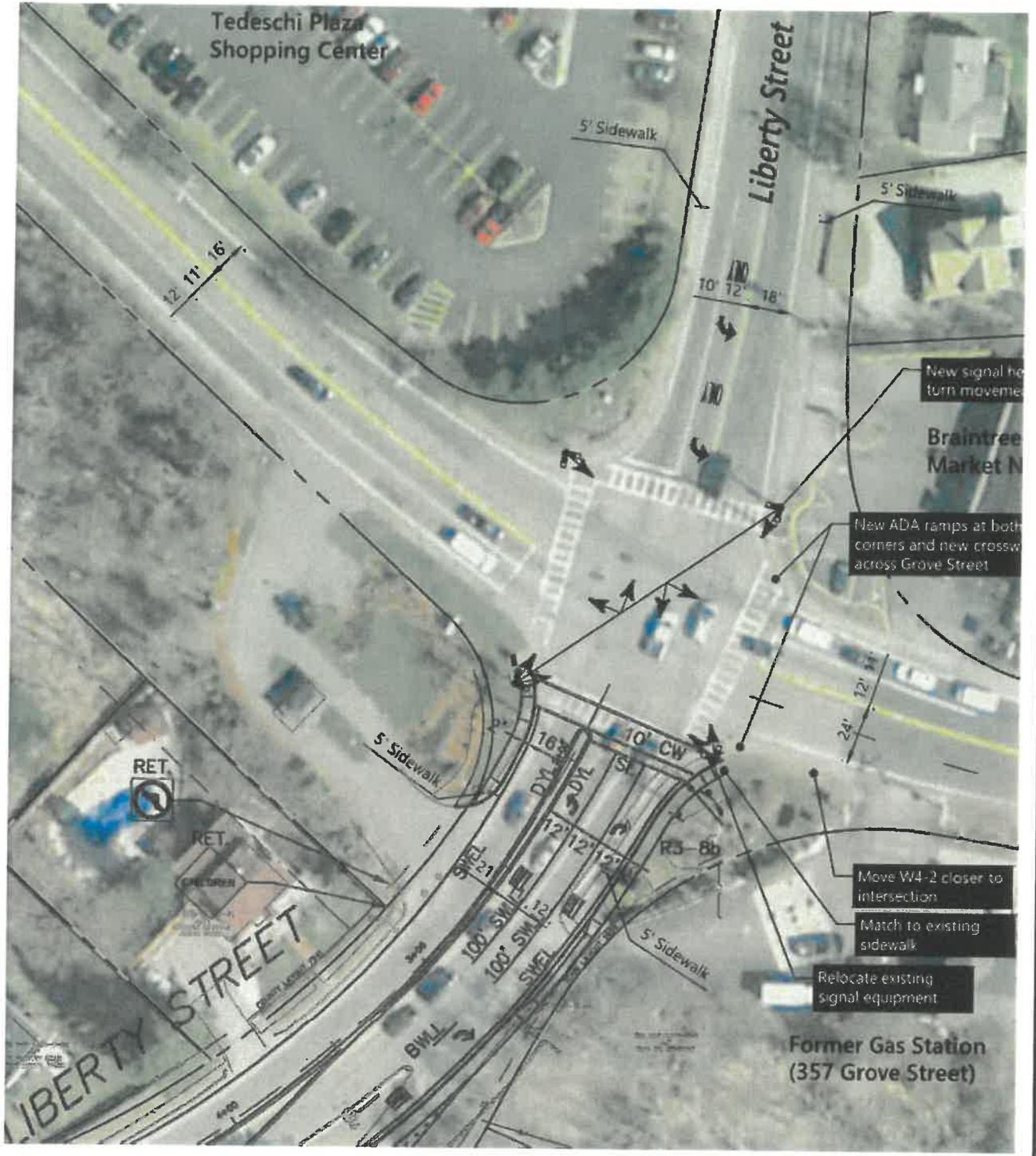


Approximate Scale: 1 inch = 800 feet

Locus Map

Figure 2

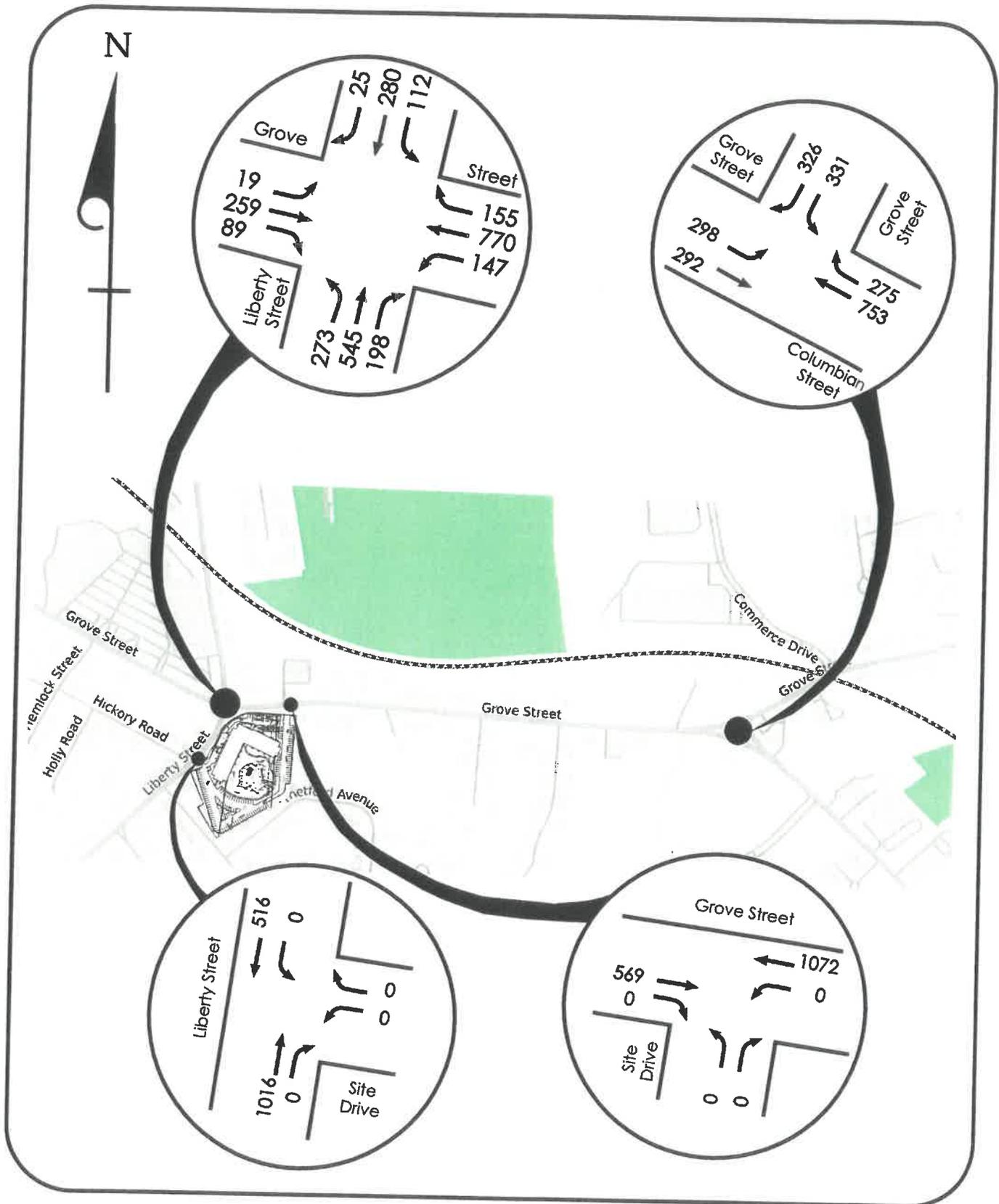
 **Gillon Associates**
Traffic & Parking Specialists



“Option B” Roadway Improvements (Base Condition)

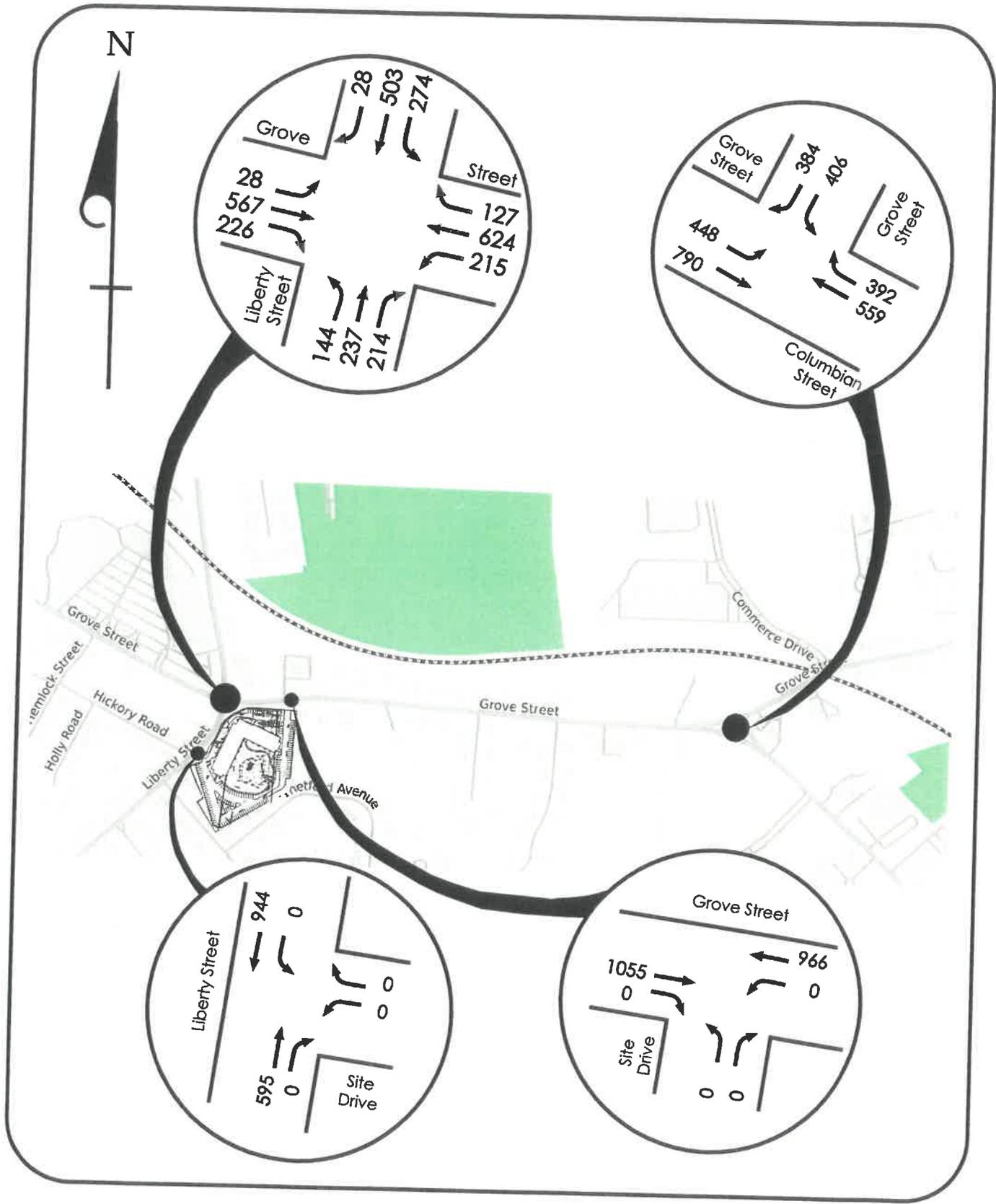
Figure 3





Grove Street at Liberty Street Weekday Morning Base Peak Hour Traffic Volume (With Medical Clinic)

Figure 4



Grove Street at Liberty Street Weekday Evening
Base Peak Hour Traffic Volume (With Medical Clinic)

Figure 5

PROPOSED HOUSING

Source of Data
 ITE Report (10th Edition)
 ITE Land Use Code: 221
 Three to Ten Floors
 Multifamily Housing
 Volume 2, Pages 71-75

	<u>AM</u>			<u>PM</u>		
	<u>IN</u>	<u>OUT</u>	<u>TOTAL</u>	<u>IN</u>	<u>OUT</u>	<u>TOTAL</u>
Trips per Unit	Ln(T) = 0.98 Ln(x) - 0.98			Ln(T) = 0.96 Ln(x) - 0.63		
Directional Split	26%	74%		61%	39%	
Trips Projected (Based on 96 Units)	9	24	33	26	17	43

WEEKDAY

$T = 5.45 (x) - 1.75$

$T = 5.45 (96) - 1.75$

Vehicle Trips = 522 (261 Inbound & 261 Outbound)



Morning Volumes are Away From Site, Afternoon Volumes are Toward Site

Roadway	At	Orientation Movement				2-Hour Total	
		North	South	East	West		
Grove Street	Liberty Street	719	516	569	1068	2872	
	AM	805	595	966	821	3187	
	PM	1524	1111	1535	1889	6059	
2-Hour Split (%)		Actual	25.2%	18.3%	25.3%	31.2%	100%
		Used	30%	15%	25%	30%	100%

Table Showing Directional Distribution Based on Census - Journey-to-Work

Braintree Employment Destinations	Number of Commuters	Percent (%)	Census	Orientation Movement				Total		
				North	South	East	West			
	5603	38.0%	30%	2427	16.4%	2806	19.0%	3925	26.6%	14761
				30%	15%	25%	30%			100%

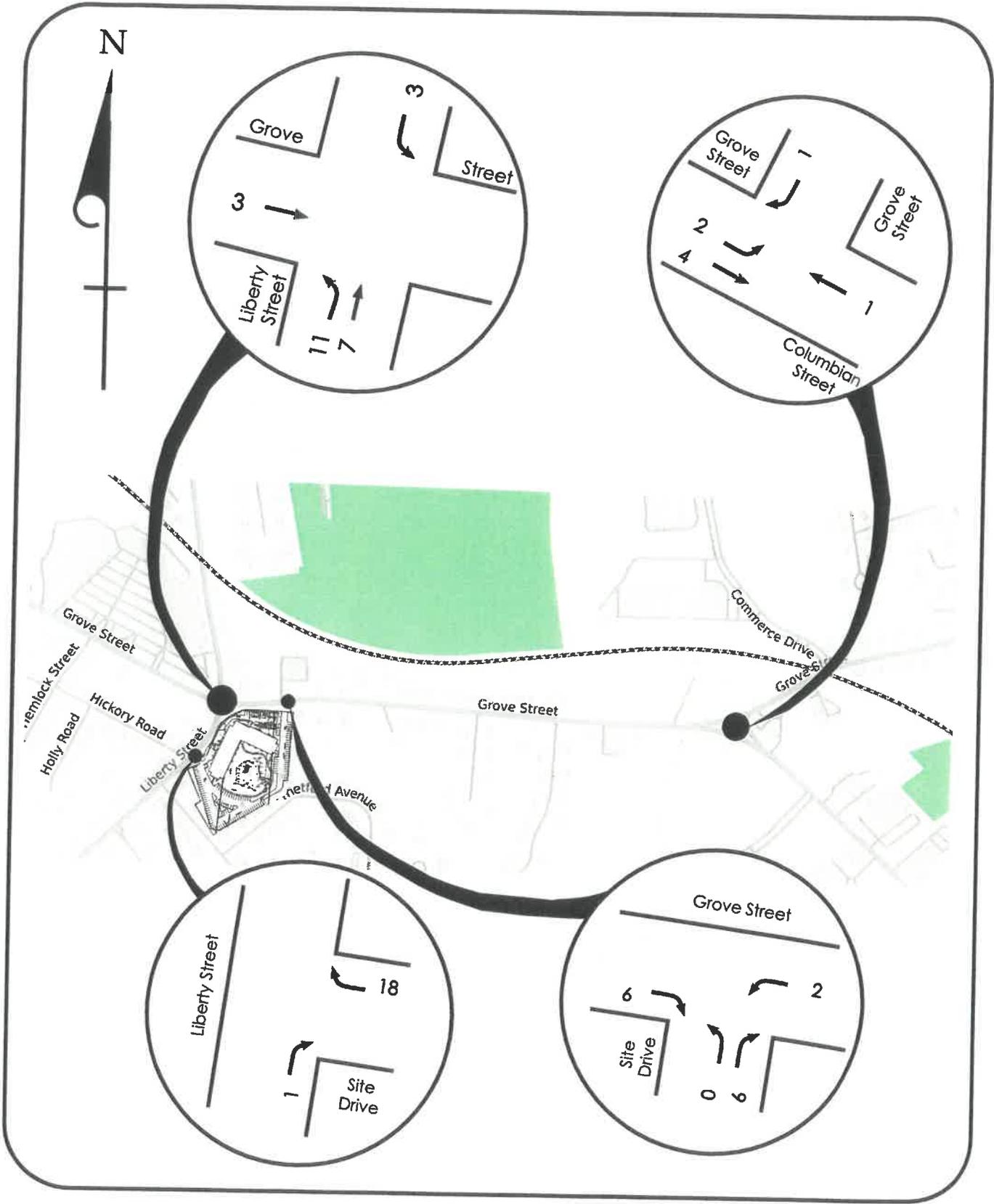


NOTE: The Liberty Street Driveway is limited to Right-Turn-In and Right-Turn-Out Only With a Raised Island Traffic Destined to the South Must be Diverted Westerly to Route 37

Directional Distribution

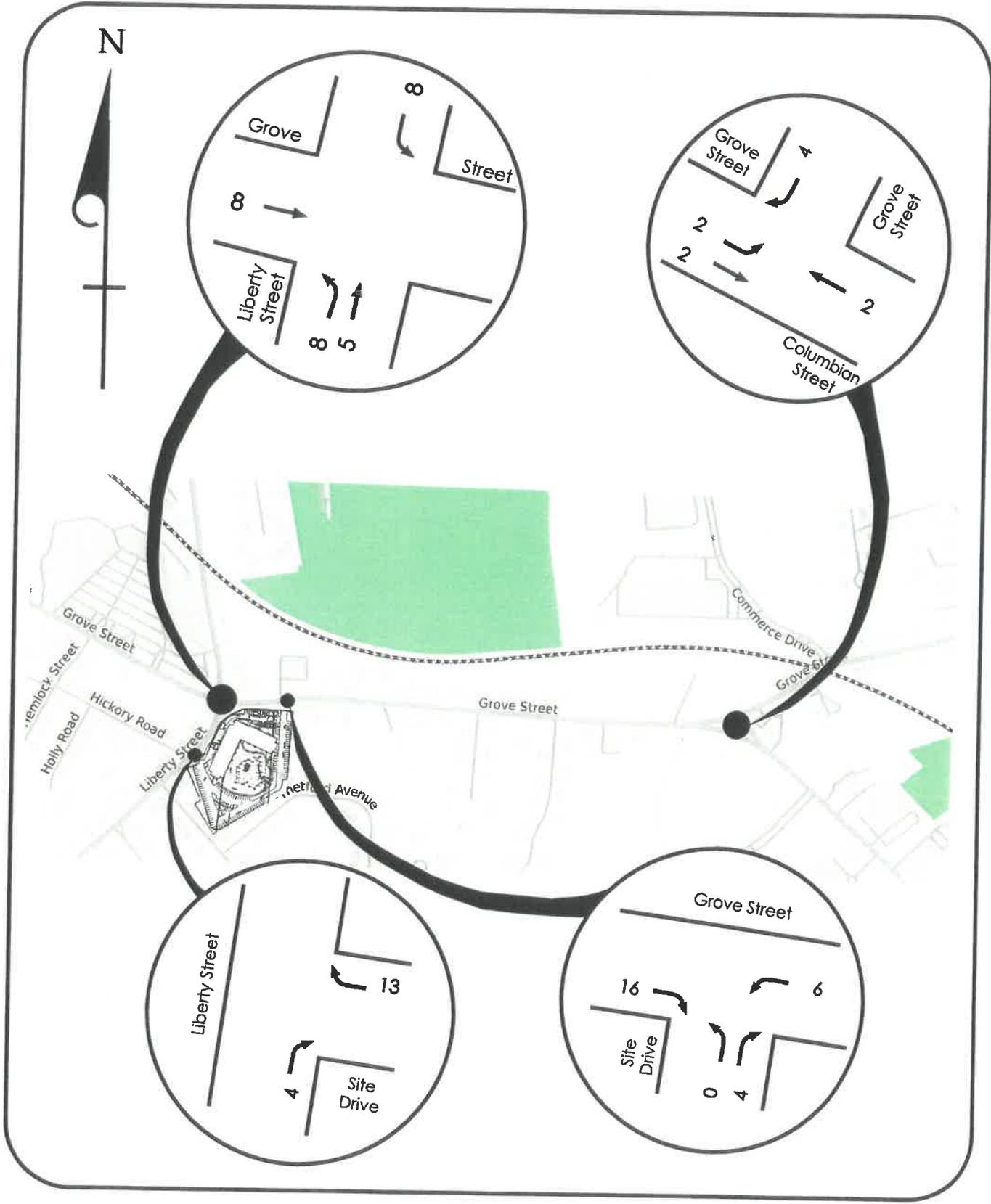
Figure 7





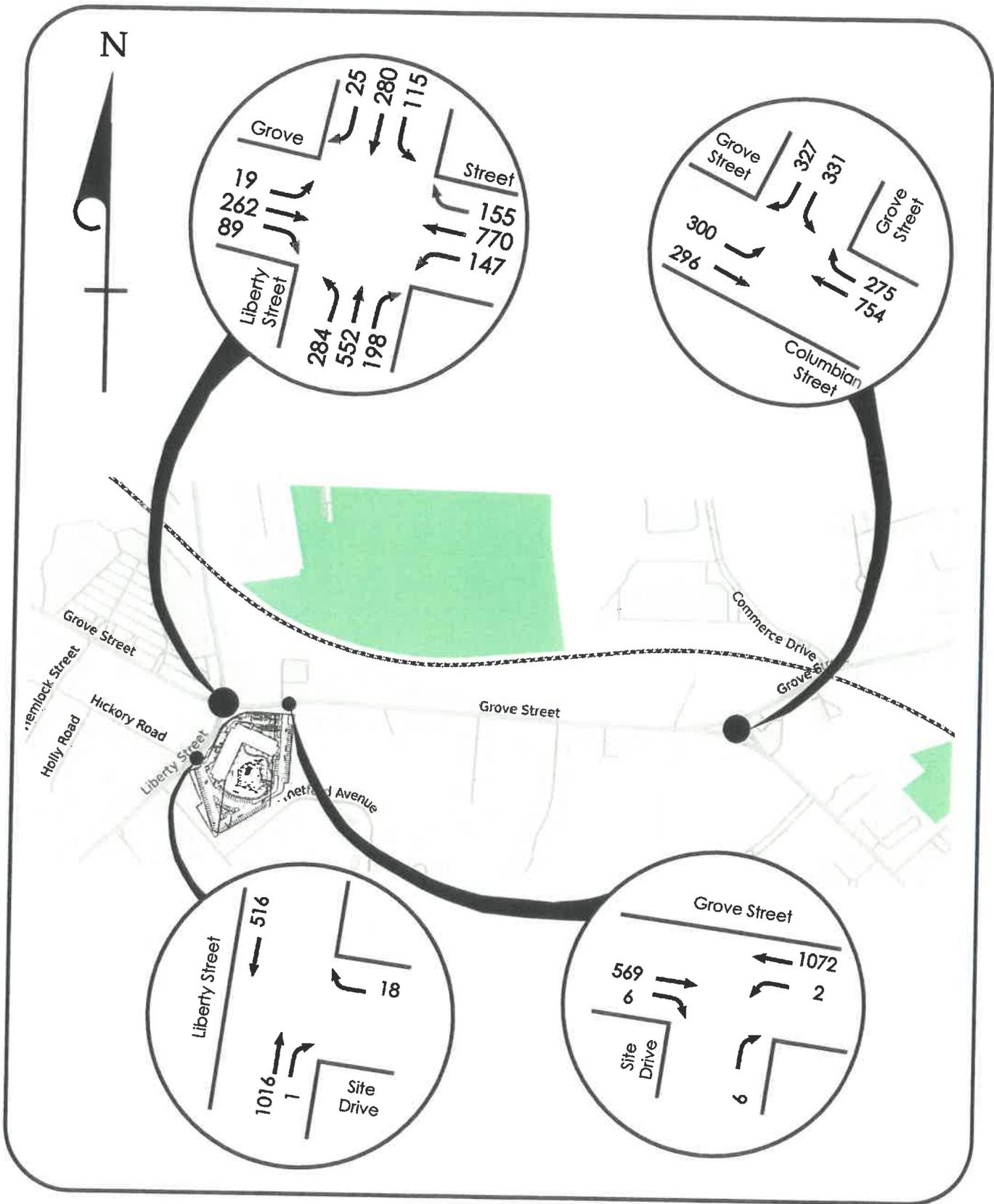
Grove Street at Liberty Street Weekday Morning
Site Generated Traffic Volume

Figure 8



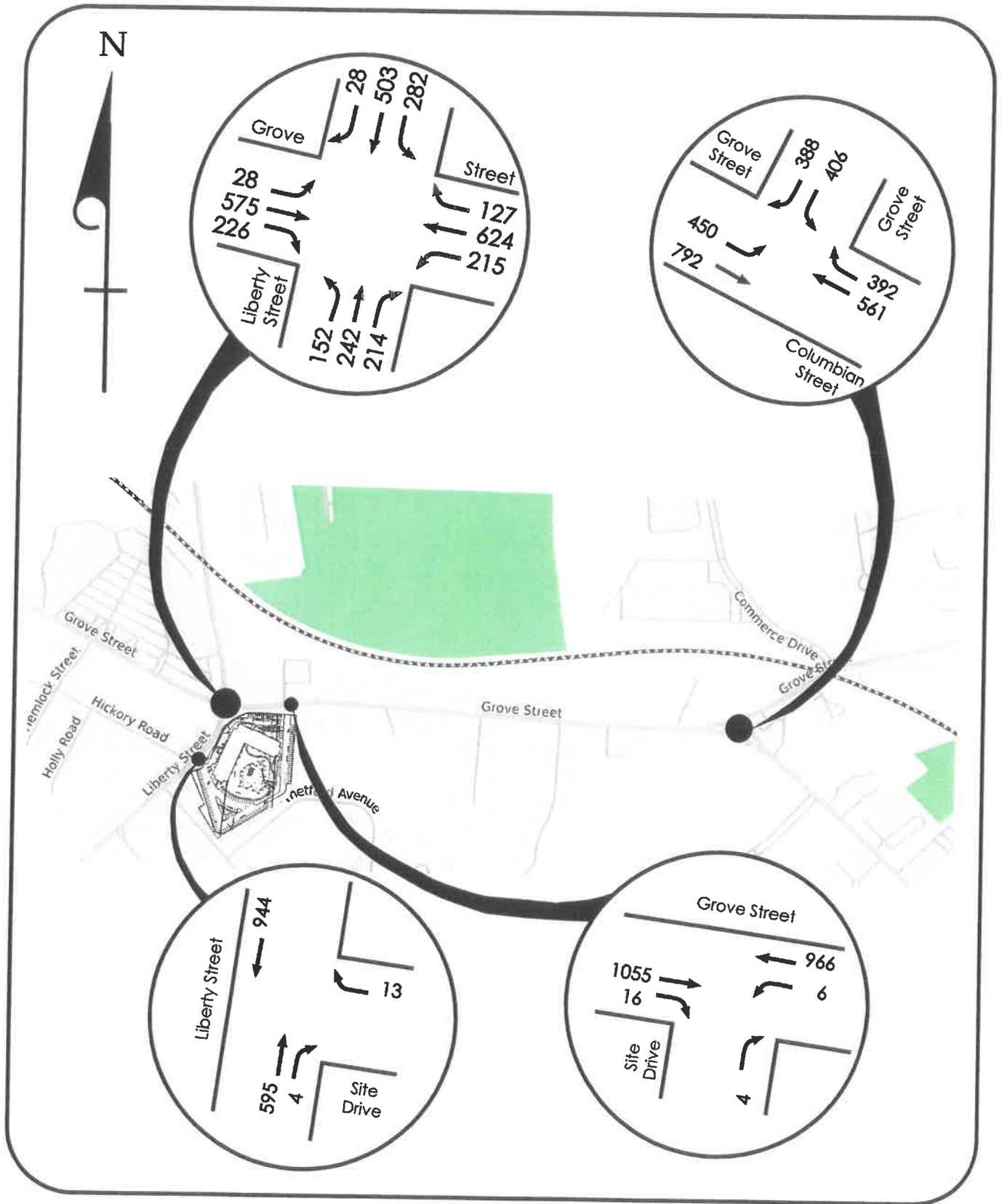
Grove Street at Liberty Street Weekday Evening
Site Generated Traffic Volume

Figure 9



Grove Street at Liberty Street Weekday Morning
Projected Peak Hour Traffic Volume

Figure 10



Grove Street at Liberty Street Weekday Evening
 Projected Peak Hour Traffic Volume

Figure 11

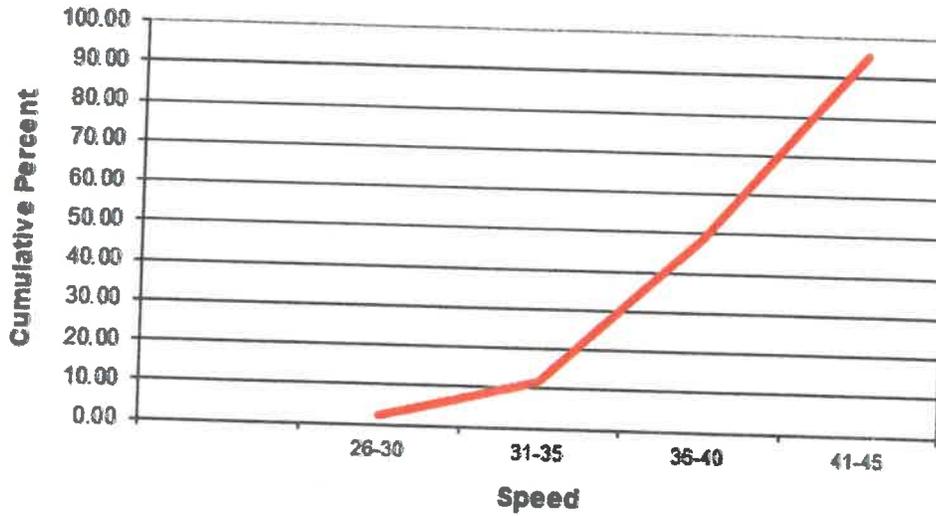
**Projected
With "Option B" Configuration**

	Base Condition		Build Condition	
	<u>AM</u>	<u>PM</u>	<u>AM</u>	<u>PM</u>
<u>Grove Street at Liberty Street</u>				
Traffic Control Signal				
Overall Level of Service	D	D	D	D
Overall Delay (Seconds)	43.0	46.5	44.3	47.3
Grove Street East Bd. (All Moves)	B	C	B	C
Grove Street West Bd. (All Moves)	C	D	C	D
Libby Street North Bd. (All Moves)	E	D	E	D
Libby Street South Bd. (All Moves)	D	E	D	E
<u>Grove Street at Columbian Street</u>				
Traffic Control Signal				
Overall Level of Service	C	C	C	C
Overall Delay (Seconds)	23.3	24.9	23.3	24.9
Grove Street East Bd. (All Moves)	C	C	C	C
Grove Street Southwest Bd. (Left-turn Move)	C	B	C	C
Columbian Street West Bd. (All Moves)	C	C	C	C
<u>Grove Street at Site Driveway</u>				
"STOP" Control				
Grove Street East & West Bd. (All Moves)	-	-	A	A
Site Driveway North Bd. (All Moves)	-	-	B	C
<u>Liberty Street at Site Driveway</u>				
"STOP" Control				
Liberty Street North Bd. (All Moves)	-	-	A	A
Site Driveway West Bd. (Right Turn Only)	-	-	C	B

Levels of Service

Figure 12





Speed Data

	20-25	26-30	31-35	36-40	41-45	Tota	Speed	Cum. %
Eastbound	0	1	6	13	2	22	26-30	2.33
Westbound	1	3	10	7	0	21	31-35	11.63
	1	4	16	20	2	43	36-40	48.84
							41-45	95.35
							46-50	100.00

Eastbound SPEED	Percent	Cum %
30	3.69%	3.69%
31	3.81%	7.50%
33	4.06%	11.56%
35	4.31%	15.87%
35	4.31%	20.17%
35	4.31%	24.48%
35	4.31%	28.78%
36	4.43%	33.21%
36	4.43%	37.64%
36	4.43%	42.07%
37	4.55%	46.62%
37	4.55%	51.17%
37	4.55%	55.72%
38	4.67%	60.39%
38	4.67%	65.07%
39	4.80%	69.86%
39	4.80%	74.66%
39	4.80%	79.46%
40	4.92%	84.38%
40	4.92%	89.30%
42	5.17%	94.46%
45	5.54%	100.00%

Westbound SPEED	Percent	Cum %
24	3.44%	3.44%
28	4.02%	7.46%
29	4.16%	11.62%
29	4.16%	15.78%
31	4.45%	20.23%
31	4.45%	24.68%
31	4.45%	29.12%
32	4.59%	33.72%
32	4.59%	38.31%
34	4.88%	43.19%
34	4.88%	48.06%
34	4.88%	52.94%
34	4.88%	57.82%
35	5.02%	62.84%
36	5.16%	68.01%
36	5.16%	73.17%
36	5.16%	78.34%
37	5.31%	83.64%
38	5.45%	89.10%
38	5.45%	94.55%
38	5.45%	100.00%

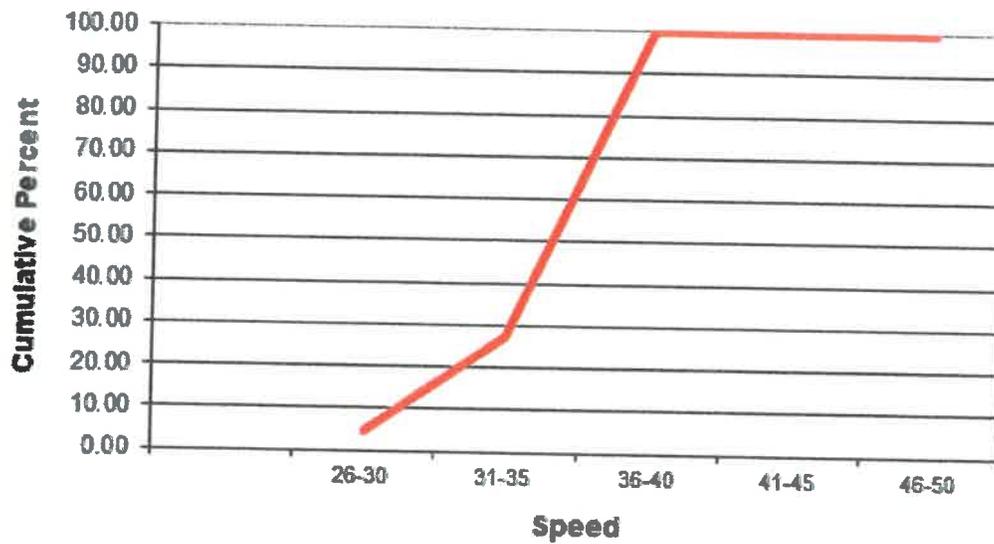
Avg. = 37 85th % = 40 mph

Avg = 33 85th % = 38 mph

Grove Street Speed Characteristics

Figure 13





Speed	Observed	Percent	Cum. %
20-25	1	4.55	4.55
26-30	5	22.73	27.27
31-35	16	72.73	100.00
36-40	0	0.00	100.00
41-45	0	0.00	100.00
	22	100.00	

Northbound SPEED	Percent	Cum %
24	3.48%	3.48%
28	4.06%	7.54%
28	4.06%	11.59%
28	4.06%	15.65%
28	4.06%	19.71%
29	4.20%	23.91%
31	4.49%	28.41%
31	4.49%	32.90%
31	4.49%	37.39%
32	4.64%	42.03%
32	4.64%	46.67%
32	4.64%	51.30%
33	4.78%	56.09%
33	4.78%	60.87%
33	4.78%	65.65%
33	4.78%	70.43%
33	4.78%	75.22%
33	4.78%	80.00%
34	4.93%	84.93%
34	4.93%	89.86%
35	5.07%	94.93%
35	5.07%	100.00%

Avg = 31 85th % = 34 mph

Liberty Street North Bound Speed Characteristics

Figure 14



APPENDIX

Signalized Intersections

LOS	Control Delay per Vehicle (s/veh)
A	≤ 10
B	> 10-20
C	> 20-35
D	> 35-55
E	> 55-80
F	> 80

Un-Signalized Intersections

Level of Service	Average Control Delay (s/veh)
A	0-10
B	> 10-15
C	> 15-25
D	> 25-35
E	> 35-50
F	> 50

Intersection Levels of Service

Braintree
Grove St at Liberty St

Base
Weekday Morning Peak Hr

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕↕			↕↕		↗	↖	↗	↖	↖	↖
Traffic Volume (vph)	19	259	89	147	770	155	273	545	198	112	280	25
Future Volume (vph)	19	259	89	147	770	155	273	545	198	112	280	25
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		0%			0%			0%			-3%	
Lane Util. Factor	0.95	0.95	0.95	0.95	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.964			0.978				0.850		0.988	
Flt Protected		0.997			0.993		0.950			0.950		
Satd. Flow (prot)	0	3224	0	0	3413	0	1805	1881	1568	1762	1832	0
Flt Permitted		0.856			0.770		0.218			0.125		
Satd. Flow (perm)	0	2768	0	0	2647	0	414	1881	1568	232	1832	0
Right Turn on Red			No			Yes			No			Yes
Satd. Flow (RTOR)					22							4
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		787			760			563			552	
Travel Time (s)		17.9			17.3			12.8			12.5	
Peak Hour Factor	0.88	0.88	0.88	0.96	0.96	0.96	0.88	0.88	0.88	0.85	0.85	0.85
Heavy Vehicles (%)	6%	10%	1%	2%	3%	2%	0%	1%	3%	4%	4%	4%
Adj. Flow (vph)	22	294	101	153	802	161	310	619	225	132	329	29
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	417	0	0	1116	0	310	619	225	132	358	0
Enter Blocked Intersection	No											
Lane Alignment	Left	Left	Right									
Median Width(ft)		0			0			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.98	0.98	0.98
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	1	2		1	2		1	2	1	1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru	Right	Left	Thru	
Leading Detector (ft)	20	100		20	100		20	100	20	20	100	
Trailing Detector (ft)	0	0		0	0		0	0	0	0	0	
Detector 1 Position(ft)	0	0		0	0		0	0	0	0	0	
Detector 1 Size(ft)	20	6		20	6		20	6	20	20	6	
Detector 1 Type	CI+Ex	CI+Ex		CI+Ex	CI+Ex		CI+Ex	CI+Ex	CI+Ex	CI+Ex	CI+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 2 Position(ft)		94			94			94			94	
Detector 2 Size(ft)		6			6			6			6	
Detector 2 Type		CI+Ex			CI+Ex			CI+Ex			CI+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA		pm+pt	NA		pm+pt	NA	Perm	pm+pt	NA	
Protected Phases		2		1	5		7	4	Perm	pm+pt	NA	
Permitted Phases	2			5			4		4	8		
Detector Phase	2	2		1	5		7	4	4	3	8	

**Braintree
Grove St at Liberty St**

Base
Weekday Morning Peak Hr

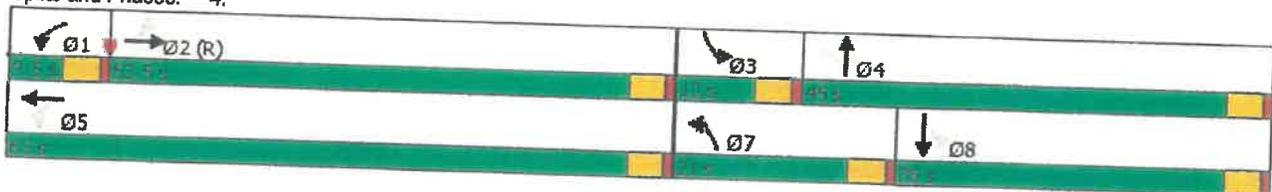
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Switch Phase												
Minimum Initial (s)	5.0	5.0		5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	20.0	20.0		9.5	9.5		9.5	20.0	20.0	9.5	20.0	
Total Split (s)	53.5	53.5		9.5	63.0		21.0	45.0	45.0	12.0	36.0	
Total Split (%)	44.6%	44.6%		7.9%	52.5%		17.5%	37.5%	37.5%	10.0%	30.0%	
Maximum Green (s)	49.0	49.0		5.0	58.5		16.5	40.5	40.5	7.5	31.5	
Yellow Time (s)	3.5	3.5		3.5	3.5		3.5	3.5	3.5	3.5	3.5	
All-Red Time (s)	1.0	1.0		1.0	1.0		1.0	1.0	1.0	1.0	1.0	
Lost Time Adjust (s)		0.0			0.0		0.0	0.0	0.0	0.0	0.0	
Total Lost Time (s)		4.5			4.5		4.5	4.5	4.5	4.5	4.5	
Lead/Lag	Lag	Lag		Lead			Lead	Lag	Lag	Lead	Lag	
Lead-Lag Optimize?	Yes	Yes		Yes			Yes	Yes	Yes	Yes	Yes	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Recall Mode	C-Max	C-Max		None	None		None	Max	Max	None	Max	
Act Effct Green (s)		58.5			58.5		52.5	40.5	40.5	39.4	31.9	
Actuated g/C Ratio		0.49			0.49		0.44	0.34	0.34	0.33	0.27	
v/c Ratio		0.31			0.86		0.84	0.98	0.43	0.77	0.73	
Control Delay		19.3			34.6		45.1	70.2	33.8	53.2	50.0	
Queue Delay		0.0			0.0		0.0	0.0	0.0	0.0	0.0	
Total Delay		19.3			34.6		45.1	70.2	33.8	53.2	50.0	
LOS		B			C		D	E	C	D	D	
Approach Delay		19.3			34.6			56.4			50.8	
Approach LOS		B			C			E			D	
Queue Length 50th (ft)		100			383		160	471	134	61	252	
Queue Length 95th (ft)		132			490		#262	#684	203	#134	338	
Internal Link Dist (ft)		707			680			483			472	
Turn Bay Length (ft)												
Base Capacity (vph)		1349			1301		372	634	529	172	489	
Starvation Cap Reductn		0			0		0	0	0	0	0	
Spillback Cap Reductn		0			0		0	0	0	0	0	
Storage Cap Reductn		0			0		0	0	0	0	0	
Reduced v/c Ratio		0.31			0.86		0.83	0.98	0.43	0.77	0.73	

Intersection Summary

Area Type: Other
 Cycle Length: 120
 Actuated Cycle Length: 120
 Offset: 0 (0%), Referenced to phase 2:EBTL and 6:, Start of Green
 Natural Cycle: 90
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.98
 Intersection Signal Delay: 43.0
 Intersection Capacity Utilization 98.5%
 Analysis Period (min) 15
 Intersection LOS: D
 ICU Level of Service F

95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.

Splits and Phases: 4:



Braintree
Grove St at Liberty

Base
Weekday Evening Peak Hr

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕↕			↕↕		↗	↖	↗	↖	↖	↗
Traffic Volume (vph)	28	567	226	215	624	127	144	237	214	274	503	28
Future Volume (vph)	28	567	226	215	624	127	144	237	214	274	503	28
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		0%			0%			0%			-3%	
Lane Util. Factor	0.95	0.95	0.95	0.95	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.959			0.980				0.850		0.992	
Flt Protected		0.998			0.989		0.950			0.950		
Satd. Flow (prot)	0	3394	0	0	3447	0	1787	1900	1599	1832	1891	0
Flt Permitted		0.883			0.571		0.130			0.358		
Satd. Flow (perm)	0	3003	0	0	1990	0	245	1900	1599	690	1891	0
Right Turn on Red			No			Yes			No			Yes
Satd. Flow (RTOR)					21							2
Link Speed (mph)		30			30			30				30
Link Distance (ft)		787			760			563				552
Travel Time (s)		17.9			17.3			12.8				12.5
Peak Hour Factor	0.97	0.97	0.97	0.94	0.94	0.94	0.95	0.95	0.95	0.95	0.95	0.95
Heavy Vehicles (%)	4%	2%	1%	1%	2%	0%	1%	0%	1%	0%	1%	4%
Adj. Flow (vph)	29	585	233	229	664	135	152	249	225	288	529	29
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	847	0	0	1028	0	152	249	225	288	558	0
Enter Blocked Intersection	No											
Lane Alignment	Left	Left	Right									
Median Width(ft)		0			0			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.98	0.98	0.98
Turning Speed (mph)	15		9	15	15	9	15		9	15		9
Number of Detectors	1	2		1	2		1	2	1	1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru	Right	Left	Thru	
Leading Detector (ft)	20	100		20	100		20	100	20	20	100	
Trailing Detector (ft)	0	0		0	0		0	0	0	0	0	
Detector 1 Position(ft)	0	0		0	0		0	0	0	0	0	
Detector 1 Size(ft)	20	6		20	6		20	6	20	20	6	
Detector 1 Type	CI+Ex	CI+Ex		CI+Ex	CI+Ex		CI+Ex	CI+Ex	CI+Ex	CI+Ex	CI+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 2 Position(ft)		94			94			94			94	
Detector 2 Size(ft)		6			6			6			6	
Detector 2 Type		CI+Ex			CI+Ex			CI+Ex			CI+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA		pm+pt	NA		pm+pt	NA	Perm	pm+pt	NA	
Protected Phases		2		1	5		7	4		3	8	
Permitted Phases	2			5			4		4	8		
Detector Phase	2	2		1	5		7	4	4	3	8	

**Braintree
Grove St at Liberty**

Base
Weekday Evening Peak Hr

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Switch Phase												
Minimum Initial (s)	5.0	5.0		5.0	5.0		5.0	5.0	5.0	5.0	5.0	
Minimum Split (s)	20.0	20.0		9.5	9.5		9.5	20.0	20.0	9.5	20.0	
Total Split (s)	57.5	57.5		9.5	67.0		13.0	35.0	35.0	18.0	40.0	
Total Split (%)	47.9%	47.9%		7.9%	55.8%		10.8%	29.2%	29.2%	15.0%	33.3%	
Maximum Green (s)	53.0	53.0		5.0	62.5		8.5	30.5	30.5	13.5	35.5	
Yellow Time (s)	3.5	3.5		3.5	3.5		3.5	3.5	3.5	3.5	3.5	
All-Red Time (s)	1.0	1.0		1.0	1.0		1.0	1.0	1.0	1.0	1.0	
Lost Time Adjust (s)		0.0			0.0		0.0	0.0	0.0	0.0	0.0	
Total Lost Time (s)		4.5			4.5		4.5	4.5	4.5	4.5	4.5	
Lead/Lag	Lag	Lag		Lead			Lead	Lag	Lag	Lead	Lag	
Lead-Lag Optimize?	Yes	Yes		Yes			Yes	Yes	Yes	Yes	Yes	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Recall Mode	C-Max	C-Max		None	None		None	Max	Max	None	Max	
Act Effect Green (s)		62.5			62.5		39.2	30.7	30.7	48.4	35.5	
Actuated g/C Ratio		0.52			0.52		0.33	0.26	0.26	0.40	0.30	
v/c Ratio		0.54			0.98		0.81	0.51	0.55	0.71	1.00	
Control Delay		20.8			52.3		56.7	42.8	44.8	36.7	79.7	
Queue Delay		0.0			0.0		0.0	0.0	0.0	0.0	0.0	
Total Delay		20.8			52.3		56.7	42.8	44.8	36.7	79.7	
LOS		C			D		E	D	D	D	E	
Approach Delay		20.8			52.3			46.9				65.0
Approach LOS		C			D			D				E
Queue Length 50th (ft)		222			391		76	166	152	156	430	
Queue Length 95th (ft)		281			#558		#177	251	236	231	#669	
Internal Link Dist (ft)		707			680			483			472	
Turn Bay Length (ft)												
Base Capacity (vph)		1564			1046		188	485	408	407	560	
Starvation Cap Reductn		0			0		0	0	0	0	0	
Spillback Cap Reductn		0			0		0	0	0	0	0	
Storage Cap Reductn		0			0		0	0	0	0	0	
Reduced v/c Ratio		0.54			0.98		0.81	0.51	0.55	0.71	1.00	

Intersection Summary

Area Type: Other

Cycle Length: 120

Actuated Cycle Length: 120

Offset: 0 (0%), Referenced to phase 2:EBTL and 6:, Start of Green

Natural Cycle: 80

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 1.00

Intersection Signal Delay: 46.5

Intersection Capacity Utilization 109.9%

Analysis Period (min) 15

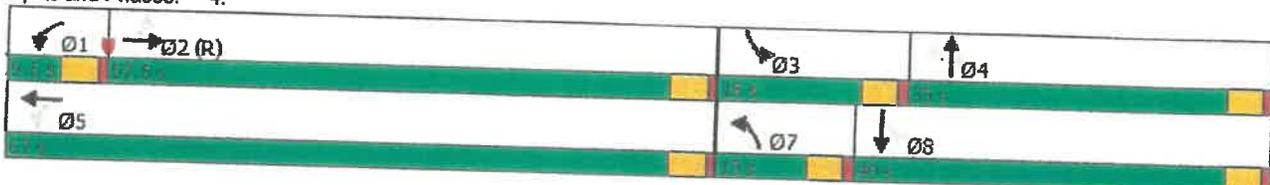
Intersection LOS: D

ICU Level of Service H

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

Splits and Phases: 4:



Braintree
Grove St at Liberty St

Projected
Weekday Morning Peak Hr

	↖	→	↘	↙	←	↖	↙	↑	↘	↘	↓	↙
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕↕			↕↕		↘	↑	↗	↘	↗	
Traffic Volume (vph)	19	262	89	147	770	155	284	552	198	115	280	25
Future Volume (vph)	19	262	89	147	770	155	284	552	198	115	280	25
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		0%			0%			0%			-3%	
Lane Util. Factor	0.95	0.95	0.95	0.95	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.964			0.978				0.850		0.988	
Flt Protected		0.997			0.993		0.950			0.950		
Satd. Flow (prot)	0	3224	0	0	3413	0	1805	1881	1568	1762	1832	0
Flt Permitted		0.857			0.768		0.215			0.127		
Satd. Flow (perm)	0	2771	0	0	2640	0	408	1881	1568	235	1832	0
Right Turn on Red			No			Yes			No			Yes
Satd. Flow (RTOR)					22						4	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		787			760			563			552	
Travel Time (s)		17.9			17.3			12.8			12.5	
Peak Hour Factor	0.88	0.88	0.88	0.96	0.96	0.96	0.88	0.88	0.88	0.85	0.85	0.85
Heavy Vehicles (%)	6%	10%	1%	2%	3%	2%	0%	1%	3%	4%	4%	4%
Adj. Flow (vph)	22	298	101	153	802	161	323	627	225	135	329	29
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	421	0	0	1116	0	323	627	225	135	358	0
Enter Blocked Intersection	No											
Lane Alignment	Left	Left	Right									
Median Width(ft)		0			0			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.98	0.98	0.98
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	1	2		1	2		1	2	1	1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru	Right	Left	Thru	
Leading Detector (ft)	20	100		20	100		20	100	20	20	100	
Trailing Detector (ft)	0	0		0	0		0	0	0	0	0	
Detector 1 Position(ft)	0	0		0	0		0	0	0	0	0	
Detector 1 Size(ft)	20	6		20	6		20	6	20	20	6	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 2 Position(ft)		94			94			94			94	
Detector 2 Size(ft)		6			6			6			6	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA		pm+pt	NA		pm+pt	NA	Perm	pm+pt	NA	
Protected Phases		2		1	5		7	4		3	8	
Permitted Phases	2			5			4		4	8		
Detector Phase	2	2		1	5		7	4	4	3	8	

**Braintree
Grove St at Liberty St**

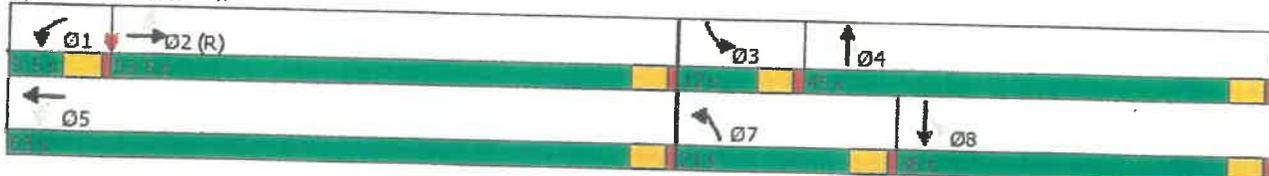
**Projected
Weekday Morning Peak Hr**

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Switch Phase												
Minimum Initial (s)	5.0	5.0		5.0	5.0		5.0	5.0	5.0	5.0	5.0	
Minimum Split (s)	20.0	20.0		9.5	9.5		9.5	20.0	20.0	9.5	20.0	
Total Split (s)	53.5	53.5		9.5	63.0		21.0	45.0	45.0	12.0	36.0	
Total Split (%)	44.6%	44.6%		7.9%	52.5%		17.5%	37.5%	37.5%	10.0%	30.0%	
Maximum Green (s)	49.0	49.0		5.0	58.5		16.5	40.5	40.5	7.5	31.5	
Yellow Time (s)	3.5	3.5		3.5	3.5		3.5	3.5	3.5	3.5	3.5	
All-Red Time (s)	1.0	1.0		1.0	1.0		1.0	1.0	1.0	1.0	1.0	
Lost Time Adjust (s)		0.0			0.0		0.0	0.0	0.0	0.0	0.0	
Total Lost Time (s)		4.5			4.5		4.5	4.5	4.5	4.5	4.5	
Lead/Lag	Lag	Lag		Lead			Lead	Lag	Lag	Lead	Lag	
Lead-Lag Optimize?	Yes	Yes		Yes			Yes	Yes	Yes	Yes	Yes	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Recall Mode	C-Max	C-Max		None	None		None	Max	Max	None	Max	
Act Effct Green (s)		58.5			58.5		52.5	40.5	40.5	39.1	31.6	
Actuated g/C Ratio		0.49			0.49		0.44	0.34	0.34	0.33	0.26	
v/c Ratio		0.31			0.86		0.88	0.99	0.43	0.79	0.74	
Control Delay		19.4			34.8		49.4	73.2	33.8	55.6	50.4	
Queue Delay		0.0			0.0		0.0	0.0	0.0	0.0	0.0	
Total Delay		19.4			34.8		49.4	73.2	33.8	55.6	50.4	
LOS		B			C		D	E	C	E	D	
Approach Delay		19.4			34.8			59.1				51.8
Approach LOS		B			C			E				D
Queue Length 50th (ft)		100			384		168	480	134	62	252	
Queue Length 95th (ft)		134			491		#289	#699	203	#138	338	
Internal Link Dist (ft)		707			680			483				472
Turn Bay Length (ft)												
Base Capacity (vph)		1350			1298		370	634	529	171	485	
Starvation Cap Reductn		0			0		0	0	0	0	0	
Spillback Cap Reductn		0			0		0	0	0	0	0	
Storage Cap Reductn		0			0		0	0	0	0	0	
Reduced v/c Ratio		0.31			0.86		0.87	0.99	0.43	0.79	0.74	

Intersection Summary

Area Type: Other
 Cycle Length: 120
 Actuated Cycle Length: 120
 Offset: 0 (0%), Referenced to phase 2:EBTL and 6:, Start of Green
 Natural Cycle: 90
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.99
 Intersection Signal Delay: 44.3
 Intersection Capacity Utilization 99.1%
 Analysis Period (min) 15
 Intersection LOS: D
 ICU Level of Service F
 # 95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.

Splits and Phases: 4:



Braintree
Grove St at Liberty St

Projected
Weekday Evening Peak Hr

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔		↔	↔	↔	↔	↔	↔
Traffic Volume (vph)	28	575	226	215	624	127	152	242	214	282	503	28
Future Volume (vph)	28	575	226	215	624	127	152	242	214	282	503	28
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		0%			0%			0%			-3%	
Lane Util. Factor	0.95	0.95	0.95	0.95	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.959			0.980				0.850		0.992	
Flt Protected		0.998			0.989		0.950			0.950		
Satd. Flow (prot)	0	3394	0	0	3447	0	1787	1900	1599	1832	1891	0
Flt Permitted		0.884			0.569		0.131			0.347		
Satd. Flow (perm)	0	3006	0	0	1983	0	246	1900	1599	669	1891	0
Right Turn on Red			No			Yes			No			Yes
Satd. Flow (RTOR)					21						2	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		787			760			563			552	
Travel Time (s)		17.9			17.3			12.8			12.5	
Peak Hour Factor	0.97	0.97	0.97	0.94	0.94	0.94	0.95	0.95	0.95	0.95	0.95	0.95
Heavy Vehicles (%)	4%	2%	1%	1%	2%	0%	1%	0%	1%	0%	1%	4%
Adj. Flow (vph)	29	593	233	229	664	135	160	255	225	297	529	29
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	855	0	0	1028	0	160	255	225	297	558	0
Enter Blocked Intersection	No											
Lane Alignment	Left	Left	Right									
Median Width(ft)		0			0			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.98	0.98	0.98
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	1	2		1	2		1	2	1	1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru	Right	Left	Thru	
Leading Detector (ft)	20	100		20	100		20	100	20	20	100	
Trailing Detector (ft)	0	0		0	0		0	0	0	0	0	
Detector 1 Position(ft)	0	0		0	0		0	0	0	0	0	
Detector 1 Size(ft)	20	6		20	6		20	6	20	20	6	
Detector 1 Type	CI+Ex	CI+Ex		CI+Ex	CI+Ex		CI+Ex	CI+Ex	CI+Ex	CI+Ex	CI+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 2 Position(ft)		94			94			94			94	
Detector 2 Size(ft)		6			6			6			6	
Detector 2 Type		CI+Ex			CI+Ex			CI+Ex			CI+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA		pm+pt	NA		pm+pt	NA	Perm	pm+pt	NA	
Protected Phases		2		1	5		7	4		3	8	
Permitted Phases	2			5			4		4	8		
Detector Phase	2	2		1	5		7	4	4	3	8	

Braintree
Grove St at Liberty St

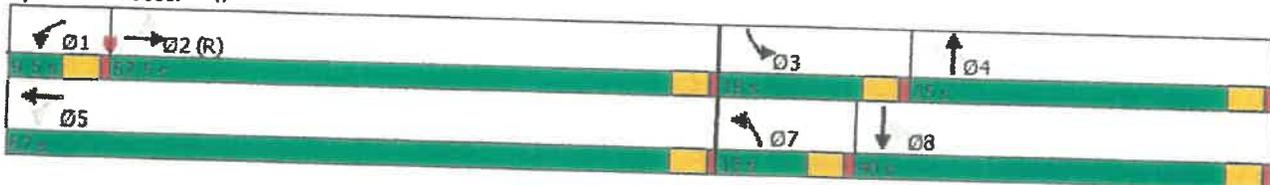
Projected
Weekday Evening Peak Hr

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Switch Phase												
Minimum Initial (s)	5.0	5.0		5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	20.0	20.0		9.5	9.5		9.5	20.0	20.0	9.5	20.0	
Total Split (s)	57.5	57.5		9.5	67.0		13.0	35.0	35.0	18.0	40.0	
Total Split (%)	47.9%	47.9%		7.9%	55.8%		10.8%	29.2%	29.2%	15.0%	33.3%	
Maximum Green (s)	53.0	53.0		5.0	62.5		8.5	30.5	30.5	13.5	35.5	
Yellow Time (s)	3.5	3.5		3.5	3.5		3.5	3.5	3.5	3.5	3.5	
All-Red Time (s)	1.0	1.0		1.0	1.0		1.0	1.0	1.0	1.0	1.0	
Lost Time Adjust (s)		0.0			0.0		0.0	0.0	0.0	0.0	0.0	
Total Lost Time (s)		4.5			4.5		4.5	4.5	4.5	4.5	4.5	
Lead/Lag	Lag	Lag		Lead			Lead	Lag	Lag	Lead	Lag	
Lead-Lag Optimize?	Yes	Yes		Yes			Yes	Yes	Yes	Yes	Yes	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Recall Mode	C-Max	C-Max		None	None		None	Max	Max	None	Max	
Act Effct Green (s)		62.5			62.5		39.0	30.5	30.5	48.5	35.5	
Actuated g/C Ratio		0.52			0.52		0.32	0.25	0.25	0.40	0.30	
v/c Ratio		0.55			0.99		0.85	0.53	0.55	0.74	1.00	
Control Delay		20.9			53.2		62.6	43.3	44.9	38.7	79.7	
Queue Delay		0.0			0.0		0.0	0.0	0.0	0.0	0.0	
Total Delay		20.9			53.2		62.6	43.3	44.9	38.7	79.7	
LOS		C			D		E	D	D	D	E	
Approach Delay		20.9			53.2			48.7			65.4	
Approach LOS		C			D			D			E	
Queue Length 50th (ft)		224			393		80	171	152	161	430	
Queue Length 95th (ft)		284			#560		#195	257	236	#244	#669	
Internal Link Dist (ft)		707			680			483			472	
Turn Bay Length (ft)												
Base Capacity (vph)		1565			1042		189	482	406	401	560	
Starvation Cap Reductn		0			0		0	0	0	0	0	
Spillback Cap Reductn		0			0		0	0	0	0	0	
Storage Cap Reductn		0			0		0	0	0	0	0	
Reduced v/c Ratio		0.55			0.99		0.85	0.53	0.55	0.74	1.00	

Intersection Summary

Area Type: Other
 Cycle Length: 120
 Actuated Cycle Length: 120
 Offset: 0 (0%), Referenced to phase 2:EBTL and 6:, Start of Green
 Natural Cycle: 80
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 1.00
 Intersection Signal Delay: 47.3
 Intersection Capacity Utilization 110.6%
 Analysis Period (min) 15
 Intersection LOS: D
 ICU Level of Service H
 # 95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.

Splits and Phases: 4:



Braintree
Grove St at Columbian St

Base
Weekday Morning Peak Hr



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↶	↷	↷		↶	↷
Traffic Volume (vph)	298	292	753	275	331	326
Future Volume (vph)	298	292	753	275	331	326
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Grade (%)		0%	0%		-3%	
Lane Util. Factor	1.00	1.00	0.95	0.95	1.00	1.00
Frt			0.960			0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1703	1776	3382	0	1779	1591
Flt Permitted	0.122				0.950	
Satd. Flow (perm)	219	1776	3382	0	1779	1591
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)			86			354
Link Speed (mph)		30	30		30	
Link Distance (ft)		787	760		552	
Travel Time (s)		17.9	17.3		12.5	
Peak Hour Factor	0.88	0.88	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	6%	7%	3%	1%	3%	3%
Adj. Flow (vph)	339	332	818	299	360	354
Shared Lane Traffic (%)						
Lane Group Flow (vph)	339	332	1117	0	360	354
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(ft)		12	12		12	
Link Offset(ft)		0	0		0	
Crosswalk Width(ft)		16	16		16	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	0.98	0.98
Turning Speed (mph)	15			9	15	9
Number of Detectors	1	2	2		1	1
Detector Template	Left	Thru	Thru		Left	Right
Leading Detector (ft)	20	100	100		20	20
Trailing Detector (ft)	0	0	0		0	0
Detector 1 Position(ft)	0	0	0		0	0
Detector 1 Size(ft)	20	6	6		20	20
Detector 1 Type	CI+Ex	CI+Ex	CI+Ex		CI+Ex	CI+Ex
Detector 1 Channel						
Detector 1 Extend (s)	0.0	0.0	0.0		0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0		0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0		0.0	0.0
Detector 2 Position(ft)		94	94			
Detector 2 Size(ft)		6	6			
Detector 2 Type		CI+Ex	CI+Ex			
Detector 2 Channel						
Detector 2 Extend (s)		0.0	0.0			
Turn Type	pm+pt	NA	NA		Prot	Free
Protected Phases	5	2	6		7	
Permitted Phases	2					Free
Detector Phase	5	2	6		7	

Braintree
Grove St at Columbia St

Base
 Weekday Morning Peak Hr



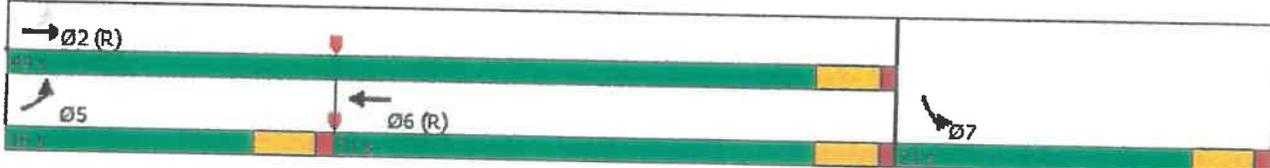
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Switch Phase						
Minimum Initial (s)	5.0	5.0	5.0		5.0	
Minimum Split (s)	9.5	20.0	9.5		9.5	
Total Split (s)	18.0	49.0	31.0		21.0	
Total Split (%)	25.7%	70.0%	44.3%		30.0%	
Maximum Green (s)	13.5	44.5	26.5		16.5	
Yellow Time (s)	3.5	3.5	3.5		3.5	
All-Red Time (s)	1.0	1.0	1.0		1.0	
Lost Time Adjust (s)	0.0	0.0	0.0		0.0	
Total Lost Time (s)	4.5	4.5	4.5		4.5	
Lead/Lag	Lead		Lag			
Lead-Lag Optimize?	Yes		Yes			
Vehicle Extension (s)	3.0	3.0	3.0		3.0	
Recall Mode	None	C-Max	C-Max		None	
Act Effct Green (s)	45.0	45.0	28.1		16.0	70.0
Actuated g/C Ratio	0.64	0.64	0.40		0.23	1.00
v/c Ratio	0.85	0.29	0.79		0.88	0.22
Control Delay	35.1	6.5	22.8		51.6	0.3
Queue Delay	0.0	0.0	0.0		0.0	0.0
Total Delay	35.1	6.5	22.8		51.6	0.3
LOS	D	A	C		D	A
Approach Delay		20.9	22.8		26.2	
Approach LOS		C	C		C	
Queue Length 50th (ft)	90	55	208		149	0
Queue Length 95th (ft)	#208	89	#300		#290	0
Internal Link Dist (ft)		707	680		472	
Turn Bay Length (ft)						
Base Capacity (vph)	426	1141	1410		419	1591
Starvation Cap Reductn	0	0	0		0	0
Spillback Cap Reductn	0	0	0		0	0
Storage Cap Reductn	0	0	0		0	0
Reduced v/c Ratio	0.80	0.29	0.79		0.86	0.22

Intersection Summary

Area Type: Other
 Cycle Length: 70
 Actuated Cycle Length: 70
 Offset: 0 (0%), Referenced to phase 2:EBTL and 6:WBT, Start of Green
 Natural Cycle: 55
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.88
 Intersection Signal Delay: 23.3
 Intersection Capacity Utilization 81.3%
 Analysis Period (min) 15
 Intersection LOS: C
 ICU Level of Service D

95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.

Splits and Phases: 4:



Braintree
Grove at Columbian

Base
Weekday Evening Peak Hr



Lane Group	EBL	EST	WBT	WBR	SBL	SBR
Lane Configurations	↵	↑	↑↑		↵	↵
Traffic Volume (vph)	448	790	559	392	406	384
Future Volume (vph)	448	790	559	392	406	384
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Grade (%)		0%	0%		-3%	
Lane Util. Factor	1.00	1.00	0.95	0.95	1.00	1.00
Frft			0.938			0.850
Fit Protected	0.950				0.950	
Satd. Flow (prot)	1805	1881	3333	0	1814	1623
Fit Permitted	0.147				0.950	
Satd. Flow (perm)	279	1881	3333	0	1814	1623
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)			266			400
Link Speed (mph)		30	30		30	
Link Distance (ft)		787	760		552	
Travel Time (s)		17.9	17.3		12.5	
Peak Hour Factor	0.91	0.91	0.99	0.99	0.96	0.96
Heavy Vehicles (%)	0%	1%	2%	1%	1%	1%
Adj. Flow (vph)	492	868	565	396	423	400
Shared Lane Traffic (%)						
Lane Group Flow (vph)	492	868	961	0	423	400
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(ft)		12	12		12	
Link Offset(ft)		0	0		0	
Crosswalk Width(ft)		16	16		16	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	0.98	0.98
Turning Speed (mph)	15			9	15	9
Number of Detectors	1	2	2		1	1
Detector Template	Left	Thru	Thru		Left	Right
Leading Detector (ft)	20	100	100		20	20
Trailing Detector (ft)	0	0	0		0	0
Detector 1 Position(ft)	0	0	0		0	0
Detector 1 Size(ft)	20	6	6		20	20
Detector 1 Type	CI+Ex	CI+Ex	CI+Ex		CI+Ex	CI+Ex
Detector 1 Channel						
Detector 1 Extend (s)	0.0	0.0	0.0		0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0		0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0		0.0	0.0
Detector 2 Position(ft)		94	94			
Detector 2 Size(ft)		6	6			
Detector 2 Type		CI+Ex	CI+Ex			
Detector 2 Channel						
Detector 2 Extend (s)		0.0	0.0			
Turn Type	pm+pt	NA	NA		Prot	Free
Protected Phases	5	2	6		4	
Permitted Phases	2					Free
Detector Phase	5	2	6		4	

Braintree
Grove at Columbian

Base
Weekday Evening Peak Hr



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Switch Phase						
Minimum Initial (s)	5.0	5.0	5.0		5.0	
Minimum Split (s)	9.5	20.0	9.5		9.5	
Total Split (s)	20.0	47.0	27.0		23.0	
Total Split (%)	28.6%	67.1%	38.6%		32.9%	
Maximum Green (s)	15.5	42.5	22.5		18.5	
Yellow Time (s)	3.5	3.5	3.5		3.5	
All-Red Time (s)	1.0	1.0	1.0		1.0	
Lost Time Adjust (s)	0.0	0.0	0.0		0.0	
Total Lost Time (s)	4.5	4.5	4.5		4.5	
Lead/Lag	Lead		Lag			
Lead-Lag Optimize?	Yes		Yes			
Vehicle Extension (s)	3.0	3.0	3.0		3.0	
Recall Mode	None	C-Max	C-Max		None	
Act Effct Green (s)	43.0	43.0	22.7		18.0	70.0
Actuated g/C Ratio	0.61	0.61	0.32		0.26	1.00
v/c Ratio	0.96	0.75	0.76		0.91	0.25
Control Delay	49.5	15.2	19.8		51.3	0.4
Queue Delay	0.0	0.0	0.0		0.0	0.0
Total Delay	49.5	15.2	19.8		51.3	0.4
LOS	D	B	B		D	A
Approach Delay		27.6	19.8		26.5	
Approach LOS		C	B		C	
Queue Length 50th (ft)	156	241	140		174	0
Queue Length 95th (ft)	#343	392	210		#330	0
Internal Link Dist (ft)		707	680		472	
Turn Bay Length (ft)						
Base Capacity (vph)	515	1155	1261		479	1623
Starvation Cap Reductn	0	0	0		0	0
Spillback Cap Reductn	0	0	0		0	0
Storage Cap Reductn	0	0	0		0	0
Reduced v/c Ratio	0.96	0.75	0.76		0.88	0.25

Intersection Summary

Area Type: Other

Cycle Length: 70

Actuated Cycle Length: 70

Offset: 0 (0%), Referenced to phase 2:EBTL and 6:WBT, Start of Green

Natural Cycle: 50

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.96

Intersection Signal Delay: 24.9

Intersection LOS: C

Intersection Capacity Utilization 92.2%

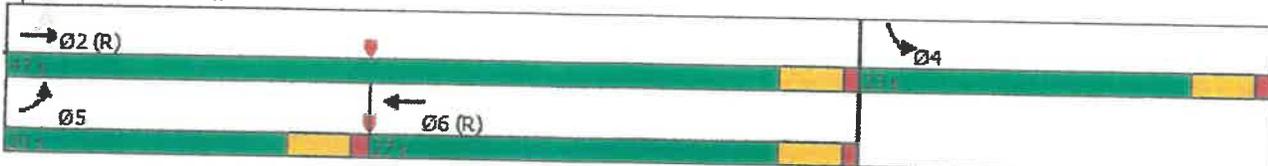
ICU Level of Service F

Analysis Period (min) 15

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

Splits and Phases: 4:



Braintree
Grove St at Columbian St

Projected
Weekday Morning Peak Hr

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↔	↑	↕	↔	↔	↕
Traffic Volume (vph)	300	296	754	275	331	327
Future Volume (vph)	300	296	754	275	331	327
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Grade (%)		0%	0%		-3%	
Lane Util. Factor	1.00	1.00	0.95	0.95	1.00	1.00
Frt			0.960			0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1703	1776	3382	0	1779	1591
Flt Permitted	0.123				0.950	
Satd. Flow (perm)	220	1776	3382	0	1779	1591
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)			85			355
Link Speed (mph)		30	30		30	
Link Distance (ft)		787	760		552	
Travel Time (s)		17.9	17.3		12.5	
Peak Hour Factor	0.88	0.88	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	6%	7%	3%	1%	3%	3%
Adj. Flow (vph)	341	336	820	299	360	355
Shared Lane Traffic (%)						
Lane Group Flow (vph)	341	336	1119	0	360	355
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(ft)		12	12		12	
Link Offset(ft)		0	0		0	
Crosswalk Width(ft)		16	16		16	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	0.98	0.98
Turning Speed (mph)	15			9	15	9
Number of Detectors	1	2	2		1	1
Detector Template	Left	Thru	Thru		Left	Right
Leading Detector (ft)	20	100	100		20	20
Trailing Detector (ft)	0	0	0		0	0
Detector 1 Position(ft)	0	0	0		0	0
Detector 1 Size(ft)	20	6	6		20	20
Detector 1 Type	CI+Ex	CI+Ex	CI+Ex		CI+Ex	CI+Ex
Detector 1 Channel						
Detector 1 Extend (s)	0.0	0.0	0.0		0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0		0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0		0.0	0.0
Detector 2 Position(ft)		94	94			
Detector 2 Size(ft)		6	6			
Detector 2 Type		CI+Ex	CI+Ex			
Detector 2 Channel						
Detector 2 Extend (s)		0.0	0.0			
Turn Type	pm+pt	NA	NA		Prot	Free
Protected Phases	5	2	6		7	
Permitted Phases	2					Free
Detector Phase	5	2	6		7	

Braintree
Grove St at Columbian St.

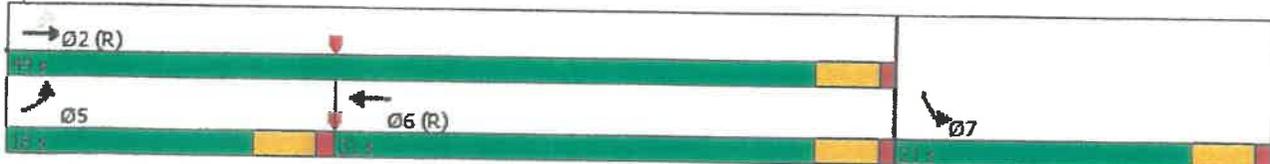
Projected
Weekday Morning Peak Hr

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Switch Phase						
Minimum Initial (s)	5.0	5.0	5.0		5.0	
Minimum Split (s)	9.5	20.0	9.5		9.5	
Total Split (s)	18.0	49.0	31.0		21.0	
Total Split (%)	25.7%	70.0%	44.3%		30.0%	
Maximum Green (s)	13.5	44.5	26.5		16.5	
Yellow Time (s)	3.5	3.5	3.5		3.5	
All-Red Time (s)	1.0	1.0	1.0		1.0	
Lost Time Adjust (s)	0.0	0.0	0.0		0.0	
Total Lost Time (s)	4.5	4.5	4.5		4.5	
Lead/Lag	Lead		Lag			
Lead-Lag Optimize?	Yes		Yes			
Vehicle Extension (s)	3.0	3.0	3.0		3.0	
Recall Mode	None	C-Max	C-Max		None	
Act Effect Green (s)	45.0	45.0	28.1		16.0	70.0
Actuated g/C Ratio	0.64	0.64	0.40		0.23	1.00
v/c Ratio	0.85	0.29	0.79		0.88	0.22
Control Delay	35.4	6.5	23.0		51.6	0.3
Queue Delay	0.0	0.0	0.0		0.0	0.0
Total Delay	35.4	6.5	23.0		51.6	0.3
LOS	D	A	C		D	A
Approach Delay		21.0	23.0		26.1	
Approach LOS		C	C		C	
Queue Length 50th (ft)	90	56	208		149	0
Queue Length 95th (ft)	#210	91	#303		#290	0
Internal Link Dist (ft)		707	680		472	
Turn Bay Length (ft)						
Base Capacity (vph)	427	1141	1408		419	1591
Starvation Cap Reductn	0	0	0		0	0
Spillback Cap Reductn	0	0	0		0	0
Storage Cap Reductn	0	0	0		0	0
Reduced v/c Ratio	0.80	0.29	0.79		0.86	0.22

Intersection Summary

Area Type: Other
 Cycle Length: 70
 Actuated Cycle Length: 70
 Offset: 0 (0%), Referenced to phase 2:EBTL and 6:WBT, Start of Green
 Natural Cycle: 55
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.88
 Intersection Signal Delay: 23.3
 Intersection Capacity Utilization 81.5%
 Analysis Period (min) 15
 Intersection LOS: C
 ICU Level of Service D
 # 95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.

Splits and Phases: 4:



Braintree
Grove St at Columbian St

Projected
Weekday Evening Peak Hr



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↕	↑	↑↓	↘	↙	↗
Traffic Volume (vph)	450	792	561	392	406	388
Future Volume (vph)	450	792	561	392	406	388
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Grade (%)		0%	0%		-3%	
Lane Util. Factor	1.00	1.00	0.95	0.95	1.00	1.00
Frt			0.938			0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1805	1881	3333	0	1814	1623
Flt Permitted	0.148				0.950	
Satd. Flow (perm)	281	1881	3333	0	1814	1623
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)			266			404
Link Speed (mph)		30	30		30	
Link Distance (ft)		787	760		552	
Travel Time (s)		17.9	17.3		12.5	
Peak Hour Factor	0.91	0.91	0.99	0.99	0.96	0.96
Heavy Vehicles (%)	0%	1%	2%	1%	1%	1%
Adj. Flow (vph)	495	870	567	396	423	404
Shared Lane Traffic (%)						
Lane Group Flow (vph)	495	870	963	0	423	404
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(ft)		12	12		12	
Link Offset(ft)		0	0		0	
Crosswalk Width(ft)		16	16		16	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	0.98	0.98
Turning Speed (mph)	15			9	15	9
Number of Detectors	1	2	2		1	1
Detector Template	Left	Thru	Thru		Left	Right
Leading Detector (ft)	20	100	100		20	20
Trailing Detector (ft)	0	0	0		0	0
Detector 1 Position(ft)	0	0	0		0	0
Detector 1 Size(ft)	20	6	6		20	20
Detector 1 Type	CI+Ex	CI+Ex	CI+Ex		CI+Ex	CI+Ex
Detector 1 Channel						
Detector 1 Extend (s)	0.0	0.0	0.0		0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0		0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0		0.0	0.0
Detector 2 Position(ft)		94	94			
Detector 2 Size(ft)		6	6			
Detector 2 Type		CI+Ex	CI+Ex			
Detector 2 Channel						
Detector 2 Extend (s)		0.0	0.0			
Turn Type	pm+pt	NA	NA		Prot	Free
Protected Phases	5	2	6		4	
Permitted Phases	2					Free
Detector Phase	5	2	6		4	

Braintree
Grove St at Columbian St

Projected
Weekday Evening Peak Hr



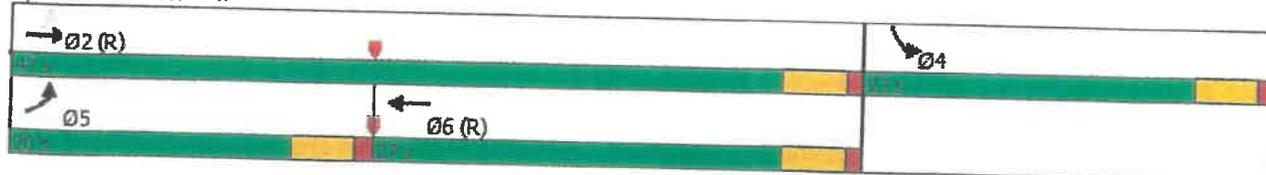
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Switch Phase						
Minimum Initial (s)	5.0	5.0	5.0		5.0	
Minimum Split (s)	9.5	20.0	9.5		9.5	
Total Split (s)	20.0	47.0	27.0		23.0	
Total Split (%)	28.6%	67.1%	38.6%		32.9%	
Maximum Green (s)	15.5	42.5	22.5		18.5	
Yellow Time (s)	3.5	3.5	3.5		3.5	
All-Red Time (s)	1.0	1.0	1.0		1.0	
Lost Time Adjust (s)	0.0	0.0	0.0		0.0	
Total Lost Time (s)	4.5	4.5	4.5		4.5	
Lead/Lag	Lead		Lag			
Lead-Lag Optimize?	Yes		Yes			
Vehicle Extension (s)	3.0	3.0	3.0		3.0	
Recall Mode	None	C-Max	C-Max		None	
Act Effct Green (s)	43.0	43.0	22.6		18.0	70.0
Actuated g/C Ratio	0.61	0.61	0.32		0.26	1.00
v/c Ratio	0.95	0.75	0.77		0.91	0.25
Control Delay	49.1	15.2	20.0		51.3	0.4
Queue Delay	0.0	0.0	0.0		0.0	0.0
Total Delay	49.1	15.2	20.0		51.3	0.4
LOS	D	B	C		D	A
Approach Delay		27.5	20.0		26.4	
Approach LOS		C	C		C	
Queue Length 50th (ft)	158	242	140		174	0
Queue Length 95th (ft)	#344	392	211		#330	0
Internal Link Dist (ft)		707	680		472	
Turn Bay Length (ft)						
Base Capacity (vph)	519	1155	1255		479	1623
Starvation Cap Reductn	0	0	0		0	0
Spillback Cap Reductn	0	0	0		0	0
Storage Cap Reductn	0	0	0		0	0
Reduced v/c Ratio	0.95	0.75	0.77		0.88	0.25

Intersection Summary

Area Type: Other
 Cycle Length: 70
 Actuated Cycle Length: 70
 Offset: 0 (0%), Referenced to phase 2:EBTL and 6:WBT, Start of Green
 Natural Cycle: 50
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.95
 Intersection Signal Delay: 24.9
 Intersection Capacity Utilization 92.4%
 Analysis Period (min) 15
 Intersection LOS: C
 ICU Level of Service F

95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.

Splits and Phases: 4:



**Braintree
Grove St at Site Dr**

**Projected
Morning Peak Hour**

Intersection						
Int Delay, s/veh	0					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↕		↕		↕	
Traffic Vol, veh/h	569	6	2	1072	0	6
Future Vol, veh/h	569	6	2	1072	0	6
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	85	85	85	85	85	85
Heavy Vehicles, %	5	0	0	5	0	0
Mvmt Flow	669	7	2	1261	0	7
Major/Minor	Major1	Major2	Minor1			
Conflicting Flow All	0	0	676	0	1938	673
Stage 1	-	-	-	-	673	-
Stage 2	-	-	-	-	1265	-
Critical Hdwy	-	-	4.1	-	6.4	6.2
Critical Hdwy Stg 1	-	-	-	-	5.4	-
Critical Hdwy Stg 2	-	-	-	-	5.4	-
Follow-up Hdwy	-	-	2.2	-	3.5	3.3
Pot Cap-1 Maneuver	-	-	925	-	73	459
Stage 1	-	-	-	-	511	-
Stage 2	-	-	-	-	268	-
Platoon blocked, %	-	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	925	-	72	459
Mov Cap-2 Maneuver	-	-	-	-	72	-
Stage 1	-	-	-	-	507	-
Stage 2	-	-	-	-	268	-
Approach	EB	WB	NB			
HCM Control Delay, s	0	0	13			
HCM LOS						B
Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT	
Capacity (veh/h)	459	-	-	925	-	
HCM Lane V/C Ratio	0.015	-	-	0.003	-	
HCM Control Delay (s)	13	-	-	8.9	0	
HCM Lane LOS	B	-	-	A	A	
HCM 95th %tile Q(veh)	0	-	-	0	-	

Braintree
Grove St at Site Dr

Projected
Evening Peak Hour

Intersection							
Int Delay, s/veh	0.1						
Movement	EBT	EBR	WBL	WBT	NBL	NBR	
Lane Configurations	↔		↔		↔		
Traffic Vol, veh/h	1055	16	6	966	0	4	
Future Vol, veh/h	1055	16	6	966	0	4	
Conflicting Peds, #/hr	0	0	0	0	0	0	
Sign Control	Free	Free	Free	Free	Stop	Stop	
RT Channelized	-	None	-	None	-	None	
Storage Length	-	-	-	-	0	-	
Veh in Median Storage, #	0	-	-	0	0	-	
Grade, %	0	-	-	0	0	-	
Peak Hour Factor	85	85	85	85	85	85	
Heavy Vehicles, %	5	0	0	5	0	0	
Mvmt Flow	1241	19	7	1136	0	5	
Major/Minor	Major1	Major2	Minor1				
Conflicting Flow All	0	0	1260	0	2401	1251	
Stage 1	-	-	-	-	1251	-	
Stage 2	-	-	-	-	1150	-	
Critical Hdwy	-	-	4.1	-	6.4	6.2	
Critical Hdwy Stg 1	-	-	-	-	5.4	-	
Critical Hdwy Stg 2	-	-	-	-	5.4	-	
Follow-up Hdwy	-	-	2.2	-	3.5	3.3	
Pot Cap-1 Maneuver	-	-	559	-	37	213	
Stage 1	-	-	-	-	272	-	
Stage 2	-	-	-	-	304	-	
Platoon blocked, %	-	-	-	-	-	-	
Mov Cap-1 Maneuver	-	-	559	-	36	213	
Mov Cap-2 Maneuver	-	-	-	-	36	-	
Stage 1	-	-	-	-	263	-	
Stage 2	-	-	-	-	304	-	
Approach	EB	WB	NB				
HCM Control Delay, s	0	0.1	22.3				
HCM LOS				C			
Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT		
Capacity (veh/h)	213	-	-	559	-		
HCM Lane V/C Ratio	0.022	-	-	0.013	-		
HCM Control Delay (s)	22.3	-	-	11.5	0		
HCM Lane LOS	C	-	-	B	A		
HCM 95th %tile Q(veh)	0.1	-	-	0	-		

Braintree
Liberty St at Site drive

Projected
Morning Peak Hour

Intersection

Int Delay, s/veh 0.4

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations		↗	↘			
Traffic Vol, veh/h	0	18	1016	1	0	0
Future Vol, veh/h	0	18	1016	1	0	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	16979
Grade, %	0	-	-2	-	-	0
Peak Hour Factor	85	85	85	85	85	85
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	21	1195	1	0	0

Major/Minor	Minor1	Major1
Conflicting Flow All	- 1196	0 0
Stage 1	-	-
Stage 2	-	-
Critical Hdwy	- 6.22	-
Critical Hdwy Stg 1	-	-
Critical Hdwy Stg 2	-	-
Follow-up Hdwy	- 3.318	-
Pot Cap-1 Maneuver	0 227	-
Stage 1	0	-
Stage 2	0	-
Platoon blocked, %	-	-
Mov Cap-1 Maneuver	- 227	-
Mov Cap-2 Maneuver	-	-
Stage 1	-	-
Stage 2	-	-

Approach	WB	NB
HCM Control Delay, s	22.5	0
HCM LOS	C	

Minor Lane/Major Mvmt	NBT	NBRWBLn1
Capacity (veh/h)	-	- 227
HCM Lane V/C Ratio	-	- 0.093
HCM Control Delay (s)	-	- 22.5
HCM Lane LOS	-	- C
HCM 95th %tile Q(veh)	-	- 0.3

Braintree
Liberty St at Site drive

Projected
Evening Peak Hour

Intersection

Int Delay, s/veh 0.3

Movement WBL WBR NBT NBR SBL SBT

Lane Configurations		↖	↗			
Traffic Vol, veh/h	0	13	595	4	0	0
Future Vol, veh/h	0	13	595	4	0	0
Conflicting Peds. #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	16979
Grade, %	0	-	-2	-	-	0
Peak Hour Factor	85	85	85	85	85	85
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	15	700	5	0	0

Major/Minor Minor1 Major1

Conflicting Flow All	-	703	0	0
Stage 1	-	-	-	-
Stage 2	-	-	-	-
Critical Hdwy	-	6.22	-	-
Critical Hdwy Stg 1	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-
Follow-up Hdwy	-	3.318	-	-
Pot Cap-1 Maneuver	0	438	-	-
Stage 1	0	-	-	-
Stage 2	0	-	-	-
Platoon blocked, %			-	-
Mov Cap-1 Maneuver	-	438	-	-
Mov Cap-2 Maneuver	-	-	-	-
Stage 1	-	-	-	-
Stage 2	-	-	-	-

Approach WB NB

HCM Control Delay, s	13.5	0
HCM LOS	B	

Minor Lane/Major Mvmt NBT NBRWBLn1

Capacity (veh/h)	-	-	438
HCM Lane V/C Ratio	-	-	0.035
HCM Control Delay (s)	-	-	13.5
HCM Lane LOS	-	-	B
HCM 95th %tile Q(veh)	-	-	0.1

HIGHLANDS VILLAGE

COMPREHENSIVE PERMIT APPLICATION – BRAINTREE ZBA

7. REQUESTED WAIVERS TO LOCAL REQUIREMENTS

a. Tabular Zoning Comparison

HIGHLANDS VILLAGE

COMPREHENSIVE PERMIT APPLICATION – BRAINTREE ZBA

- 135-703 We requires a waiver to this section as it relates to residentially zoned land. As outlined in waiver request of Section 135-306, the parcel includes General Business and residential zoned land. We request to allow for off street parking to be allowed in the residential section as provided for on the project plans.
- 135-705 Request Waiver to allow for Multifamily dwellings as proposed on subject property consisting of a total of 96 units on 3.37 acres.
- 135-708 Request waiver to allow for project as proposed which allows for areas of less than 300 square feet and less than 10 foot dimensional areas to be included in calculations.
- 135-709 Request waiver to height limitation to allow for project a proposed. Building height has been established as 62 feet.
- 135-711 Request waiver from Site Plan Review. ZBA will be reviewing the project in accordance with Comprehensive Permit standards.
- 135-806 Request waiver to allow for the project as proposed and for the ZBA to decrease the required number of parking spaces at the project from 2 spaces per unit to a minimum of 1.5 spaces per unit.
- 135-812 Request waiver to the section to allow for the Landscaping to be as approved by the ZBA. The Applicant will plan to complete a detailed landscape plan when the building location and parking areas have been agreed upon with the ZBA. We have utilized vertical granite curbing at the driveway entrances and bituminous (asphalt) curb on the interior of the site.
- 135-1201 Request Waiver to section to allow for the project to be constructed as designed. It is expected to be a modest NET cut at the site which may need to be removed. Grading is modest but will be within 25 of the property lines.
- 135-1203 Request Waiver to Erosion Control regulations for procedural purposes to allow for ZBA to issue any required permits under the section.
- 135-1204 Request Waiver to allow for ZBA to accept Traffic Analysis as submitted.

General Waiver Request:

We respectfully request the Board waive town permit fees, connection fees, linkage fee and/or any fees related to the affordable units at the proposed development.

This list is intended to allow for relief from local regulations to allow for the construction of the project as has been proposed. If it is subsequently determined that relief is required from a regulation not reflected, it shall be agreed the Applicant can request the additional waiver from the ZBA which shall NOT be considered a substantial change.

HIGHLANDS VILLAGE

COMPREHENSIVE PERMIT APPLICATION - BRAINTREE ZBA

TABULAR ZONING COMPARISON

	<u>Current Residence A</u>	<u>Current Residence B</u>	<u>Current Current GB</u>	<u>Proposed</u>
Lot Area Minimum (Sq Ft)	25,000	15,000	15,000	146,797
Lot Width Minimum (Ft)	125	100	100	408.2
Lot Frontage Minimum (Ft)	75	50	50	549.2
Lot Depth Minimum (Ft)	120	100	100	520.7
Front Yard Setback (Ft)	20	20	10	31.3
Side Yard Setback (Ft)	10	10	10	53.0
Rear Yard Setback (Ft)	30	30	20	174.3
Max Building Height (Ft)	35	35	50	62*
Max Story Height	3	3	3	4*
Max Building Coverage (%)	35%	35%	70%	16.4%
Maximum Lot Coverage (%)	70%	70%	90%	55.6%
Minimum Open Space (%)	30%	30%	10%	44.4%

*** Waiver Requested**

HIGHLANDS VILLAGE

COMPREHENSIVE PERMIT APPLICATION – BRAINTREE ZBA

8. PROJECT FINANCIAL INFORMATION

**Application for Chapter 40B Project Eligibility/Site Approval
for MassHousing-Financed and New England Fund (“NEF”) Rental Projects**

Section 5: FINANCIAL INFORMATION – Site Approval Application Rental 40B

In order to issue Site Approval, MassHousing must find (as required by 760 CMR 56.04 (4)) that an initial pro forma has been reviewed and that the Proposed Project appears financially feasible and consistent with the Chapter 40B Guidelines, and that the Proposed Project is fundable under the applicable program.

Name of Proposed Project: Highlands Village

Initial Capital Budget (please enter “0” when no such source or use is anticipated)

Sources

Description	Source	Budgeted
Private Equity	Owner's Cash Equity	5,000,000.00
Private Equity	Tax Credit Equity	
Private Equity	Developer Fee Contributed or Loaned	1,000,000.00
Private Equity	Developer Overhead Contributed or Loaned	
Other Private Equity		
Public/Soft Debt		
Subordinate Debt		
Permanent Debt	South Shore Bank	18,500,000.00
Permanent Debt		
Construction Debt	<i>For informational purposes only, not to be included in Sources total</i>	
Additional Source (please identify)		
Additional Source (please identify)		
Total Sources		\$24,500,000.00

Pre-Permit Land Value, Reasonable Carrying Costs

Item	Budgeted
Site Acquisition: pre-permit land value (to be determined by MassHousing commissioned appraisal) plus reasonable carrying costs.	2,000,000

Uses (Costs)

Item	Budgeted
Acquisition Cost (Actual)	
Actual Acquisition Cost: Land	2,000,000.00
Actual Acquisition Cost: Buildings	0.00
Subtotal Acquisition Costs	2,000,000.00
Construction Costs-Building Structural Costs (Hard Costs)	
Building Structure Costs	12,000,000.00
Hard Cost Contingency	625,000.00
Subtotal – Building Structural Costs (Hard Costs)	12,625,000.00
Construction Costs-Site Work (Hard Costs)	
Earth Work	550,000.00
Utilities: On Site	150,000.00
Utilities: Off-Site	25,000.00
Roads and Walks	150,000.00
Site Improvement	125,000.00
Lawns and Planting	75,000.00
Geotechnical Condition	15,000.00
Environmental Remediation	25,000.00
Demolition	45,000.00
Unusual Site Conditions/Other Site Work	250,000.00
Subtotal –Site Work (Hard Costs)	1,410,000.00
Construction Costs-General Conditions, Builders Overhead and Profit (Hard Costs)	
General Conditions	1,300,000.00
Builder's Overhead	1,050,000.00
Builder's Profit	250,000.00
Subtotal – General Conditions Builders Overhead and Profit (Hard Costs)	2,600,000.00
General Development Costs (Soft Costs)	
Appraisal and Marketing Study <i>(not 40B "as is" appraisal)</i>	5,000.00
Marketing and Initial Rent Up <i>(include model units, if any)</i>	200,000.00
Real Estate Taxes <i>(during construction)</i>	30,000.00
Utility Usage <i>(during construction)</i>	25,000.00
Insurance <i>(during construction)</i>	140,000.00
Security <i>(during construction)</i>	25,000.00
Inspecting Engineer	40,000.00

Budgeted

General Development Costs (Soft Costs) – Continued

Fees to Others	0.00
Construction Loan Interest	900,000.00
Fees to Construction Lender	100,000.00
Fees to Permanent Lender	100,000.00
Architecture/Engineering	350,000.00
Survey, Permits, etc.	250,000.00
Clerk of the Works	75,000.00
Construction Manager	200,000.00
Bond Premiums (<i>Payment/Performance/Lien Bond</i>)	140,000.00
Environmental Engineer	20,000.00
Legal	100,000.00
Title (<i>including title insurance</i>) and Recording	25,000.00
Accounting and Cost Certification (<i>incl. 40B</i>)	25,000.00
Relocation	0.00
40B Site Approval Processing Fee	2,500.00
40B Technical Assistance/Mediation Fund Fee	4,350.00
40B Land Appraisal Cost (<i>as-is value</i>)	3,500.00
40B Final Approval Processing Fee	2,500.00
40B Subsidizing Agency Cost Certification Examination Fee	5,000.00
40B Monitoring Agent Fees	0.00
MIP	15,000.00
Credit Enhancement	
Letter of Credit Fees	
Other Financing Fees: Tax Credit Allocation Fee	
Other Financing Fees	700,000.00
Development Consultant	150,000.00
Other Consultants (<i>describe</i>) <u>Lottery</u>	25,000.00
Other Consultants (<i>describe</i>) _____	
Syndication Costs	
Soft Cost Contingency	200,000.00
Other Development (Soft) Costs	150,000.00
Subtotal – General Development Costs (Soft Costs)	4,007,850.00
Developer Fee and Overhead	
Developer Fee	1,150,000.00
Developer Overhead	
Subtotal – Developer Fee and Overhead	1,150,000.00
Capitalized Reserves	
Development Reserves	
Initial Rent-Up Reserves	
Operating Reserves	600,000.00
Net Worth Account	
Other Capitalized Reserves	
Subtotal – Capitalized Reserves	600,000.00

Summary of Subtotals

Item	Budgeted
Acquisition: Land	2,000,000.00
Acquisition: Building	0.00
Building Structural Costs (Hard Costs)	12,625,000.00
Site Work (Hard Costs)	1,410,000.00
General Conditions, Builder's Overhead, Profit (Hard Costs)	2,600,000.00
Developer Fee and Overhead	1,150,000.00
General Development Costs (Soft Costs)	4,007,850.00
Capitalized Reserves	600,000.00
Total Development Costs (TDC)	24,392,850.00
Summary	
Total Sources	24,500,000.00
Total Uses (TDC)	24,392,850.00

Projected Developer Fee and Overhead*: \$1,150,000

Maximum Allowable Developer Fee and Overhead**: \$1,365,000

Projected Developer Fee and Overhead equals 85.4% of Maximum Allowable Fee and Overhead

** Note in particular the provisions of Section IV.B.5.a of the Guidelines, which detail the tasks (i) for which a developer may or may not receive compensation beyond the Maximum Allowable Developer Fee and Overhead and (ii) the costs of which must, if the tasks were performed by third parties, be included within the Maximum Allowable Developer Fee and Overhead.*

*** Please consult the most recent DHCD Qualified Allocation Plan (QAP) to determine how to calculate the Maximum Allowable Developer Fee and Overhead. If you have questions regarding this calculation, please contact MassHousing.*

Initial Unit/Rent Schedule

Affordable Units @ 80% AMI	Studio	1 Bedroom	2 Bedroom	3 Bedroom	4 Bedroom
Number of Units	2	15	5	2	
Number Square Feet	518 - 585	752 - 811	975	1106 - 1150	
Monthly Rent	\$1,417	\$1,598	\$1,765	\$1,925	
Utility Allowance	\$144	\$187	\$242	\$305	

Affordable Units @ 50% AMI	Studio	1 Bedroom	2 Bedroom	3 Bedroom	4 Bedroom
Number of Units					
Number Square Feet					
Monthly Rent					
Utility Allowance					

Describe utility allowance assumptions (*utilities to be paid by tenants*):

Market Rate Units	Studio	1 Bedroom	2 Bedroom	3 Bedroom	4 Bedroom
Number of Units	5	44	15	8	
Number Square Feet	518 - 585	752 - 811	975	1106 - 1150	
Monthly Rent	\$1,613	\$1,880 - \$2,043	\$2,438	\$2,875	

Initial Rental Operating Pro-Forma (for year one of operations)

Item	Notes	Amount
Permanent Debt Assumptions	75% Of TDC	\$18,500,000
Loan Amount	Lender:	
Annual Rate	4.375%	
Term	30 Years	
Amortization	30 Years	
Lender Required Debt Service Coverage Ratio	1.25	
Gross Rental Income		\$2,342,422
Other Income (utilities, parking)		0
Less Vacancy (Market Units)	5% (vacancy rate)	\$93,435
Less Vacancy (Affordable Units)	5% (vacancy rate)	\$23,686
Gross Effective Income		\$2,225,301
Less Operating Expenses	Per Unit: \$5,939	\$ 570,144
Net Operating Income		\$1,655,094
Less Permanent Loan Debt Service		\$ 1,119,098
Cash Flow		\$ 535,996
Debt Service Coverage		1.47

Describe "other income": _____

Rental Operating Expense Assumption

Item	Notes	Amount
Assumed Maximum Operating Expenses	Calculated based on Net Operating Income, Debt Service and required Debt Service Coverage listed above.	\$826,428
Assumed Maximum Operating Expense/Unit*	Number of Units:	\$8,608

* MassHousing may request further detail regarding projected operating expenses if such expenses appear higher or lower than market comparables.

HIGHLANDS VILLAGE

COMPREHENSIVE PERMIT APPLICATION – BRAINTREE ZBA

9. AFFORDABLE MARKETING PLAN

- a. Unit Designation Listing
- b. Affordable Unit Breakdown
- c. Maximum Affordable Rents
- d. Long Term Monitoring – Regulatory Agreement
Monitoring Statement & Fees



your resource for Affordable Housing



**HIGHLANDS VILLAGE
Braintree, MA**

**Marketing and Outreach Plan
Lottery Plan**

Introduction

Highlands Village is a proposed residential community to consist of 96 rental apartment homes in Braintree, MA which shall provide 24 affordable studio, one, two & three bedroom homes to the areas affordable renters. The project is located on approximately 3.37 acres and will include a single residential building with associated surface parking. The marketing program and minority outreach for Highlands Village will be throughout the greater Boston areas to households in need of quality, affordable housing.

The apartment homes will be distributed based upon criteria established by the Department of Housing and Community Development (DHCD) and the Local Initiative Program (LIP). These apartment homes will be distributed in one lottery through two lottery pools: Local Preference Pool and Open Pool. The apartment homes will be made available to eligible applicants earning up to 80% of the great Boston median income, adjusted for household size.

The objective of the marketing program is to identify a sufficient pool of applicants for the available apartment homes. Based upon the lottery results, all applicants would have their proper rank in the appropriate pools. This will enable us to quickly determine who would have the first opportunity to lease an upcoming home.

Potential tenants will not be discriminated against on the basis of race, color, religious creed, marital status, military status, disability, national origin, sex, age, ancestry, sexual preference, source of income, presence of children, or any other basis prohibited by local, state or federal law.

What follows is a list of activities and materials we intend to utilize to assist in the projects affordable marketing, processing of the applicants and our attempts to reach out to the Boston-Cambridge-Quincy, MA-NH HUD Metro FMR Area and area minority populations.

General Information

Highlands Village is to be a newly constructed residential community of 96 apartments. These apartments will be located in a single 4 story building with elevator service. The apartment homes will range in size from 518 square feet for a studio apartment to approximately 1,150 square feet for a three bedroom unit. The homes will feature stainless appliances, solid surface countertops and in-unit washer and dryers. These will all be smoke free buildings. There is extensive surface parking available to residents at no charge. The projected unit mix and sizes are as follows:

<u>Home Type</u>	<u>Square Feet Per Home</u>	<u>Market #/Type</u>	<u>Affordable #/Type</u>
Studio	518 – 585	5	2



One Bedroom	752- 811	44	15
Two Bedroom	975	15	5
Three Bedroom	1,106 – 1,150	8	2

The 24 affordable homes will be distributed, by lottery, to households who meets the eligibility requirements and income requirements at or below 80% of the area median income, for the Boston-Cambridge-Quincy, MA-NH HUD Metro FMR Area, adjusted for Household size. The following rents were determined using the 2019 income limits. Final rents will be determined prior to the lottery.

80% of Median

Boston-Cambridge-Quincy, MA-NH HUD Metro FMR	Household Size	80% of Adjusted Median Family Income	Monthly Income	Max Rent (30% of monthly income)	Utility Allowance	Final Rent
Studio	1	\$62,450	\$5,204	\$1,561	\$144	\$1,417
One Bedroom	2	\$71,400	\$5,950	\$1,785	\$187	\$1,598
Two Bedroom	3	\$80,300	\$6,691	\$2,007	\$242	\$1,765
Three Bedroom	4	\$89,200	\$7,443	\$2,229	\$305	\$1,925

Tenants are responsible for their electric, gas and water & sewer usage.

Liberty Grove LLC will be sponsoring an application process and lottery to rank the eligible program applicants and have hired MCO Housing Services, LLC as their lottery agent to oversee the process. MCO Housing Services, of Harvard, MA, has been providing Lottery Services to area developers for over 20 years.

Marketing and Outreach Plan

Braintree is located 12 miles south of Boston and 11 miles north of Brockton. The town is ideally situated at the crossroads of Route I-93 (128) and Route 3 for easy access to the Greater Boston area. MBTA subway service is available on the Red Line via the Alewife/Ashmont Line and the Braintree Line. The Kingston/Plymouth and Middleborough/Lakeville Lines of the Commuter Rails from Braintree Station and Red Lines from Quincy Adams Station. The Commuter rail station is available in Weymouth Landing on the Greenbush line. Member of the Massachusetts Bay Transportation Authority (MBTA), with service to Quincy Center, Weymouth Landing, the Brockton line, South Shore Plaza and Randolph, also THE RIDE, a paratransit service for the elderly and disabled. Carey’s Bus Lines provides commuter service to Boston.

Application availability and a public information meeting will be announced, with a minimum of two ads, through the South B Zone of the Community Newspaper Co., which includes the weekly papers for Abington/Rockland, Braintree, Cohasset, Hanover, Hingham, Marshfield, Norwell, Scituate, Weymouth. Ads will be placed in the Patriot Ledger. We will work closely with the *Braintree Forum* (part of South B Zone), to have an article placed to ensure awareness of the project and the available affordable housing opportunity.

Minority outreach will be conducted through the Bay State Banner, Sampan and El Mundo. A mailing will be sent to local social service and public organizations. A listing on www.massaccesshousingregistry.org website will also announce the lottery and application availability.



MCO Housing Services will post Highlands Village lottery information and application on line at www.mcohousingervices.com which will be available for immediate download by applicants. MCO Housing Services, LLC will also send an email blast to our email list making all aware of the availabilities at Highlands Village. The email list at MCO Housing Services currently consist of over 12,000 individuals and families seeking affordable housing opportunities. Applications can be requested through MCO Housing Services, LLC by phone, in person or by email. We encourage applicants to meet with a representative from MCO Housing Services, LLC when submitting their application to confirm the application package is complete. Applications will also be available locally for pick up at the Braintree Town Hall (Town Clerks Office), Highlands Village Leasing Office and the Braintree Public Library. MCO Housing Services, LLC can be reached at:

MCO Housing Services, LLC
 206 Ayer Road
 P.O. Box 372
 Harvard, MA 01451
 (978) 456-8388
 FAX: (978) 456-8986
lotteryinfo@mcohousingervices.com

A Public Information Meeting will be scheduled at the Braintree Town Hall or another accessible location where questions regarding program eligibility requirements, preferences for selections and the lottery process will be addressed. A confirmation letter or email will be sent to each eligible applicant with their lottery code after the application deadline. Lottery codes will be announced during the lottery drawing, to ensure applicant's privacy.

Eligibility Criteria

1. Income can not exceed the following maximum allowable income guidelines, adjusted for household size, as follows:

Household Size	1	2	3	4
Up to 80% Max Gross Income Limits	\$62,450	\$71,400	\$80,300	\$89,200

This assumes a household size of 1-4 people. This income limits are subject to change based upon DHCD updating.

- 2. When Applicant assets total \$5,000 or less, the actual interest/dividend income received is to be included in the annual income. When assets exceed \$5,000, annual income is to include the greater of actual income from assets or a .06% of assets imputed income calculation.
- 3. Potential tenants may not own another home, including a home which may be in a Trust. The affordable unit must be their principal, full-time residence.

The lottery application is used to determine income eligibility so applicants have an opportunity to lease an affordable unit. An applicant with an opportunity to lease will also need to go through the leasing process as determined by the Leasing Agent and property developer. This process may include credit screening, CORI, minimum income requirements and landlord reference checks. If applicants do not pass the Leasing Office screening, they will not be able to lease a unit. The Leasing Office approval will be conducted after the lottery.

Each affordable tenant will need to have their income reviewed annually to maintain the affordable residence. Approximately 60 - 90 days before lease renewal, current affordable residents will need to provide updated financial documentation for Re-certification for continued eligibility. Current residents are considered income eligible for an affordable unit as long their household income does not exceed 140% of median income, adjusted



for household size. Once household income exceeds 140% of the maximum allowable income, adjusted for household size, the tenant will no longer be an income-eligible tenant and will have the option of paying market rent or moving out at end of lease.

Complete financial documentation will be required to participate in the lottery. Applications will be logged in upon receipt and the review of applications will take place after the application deadline. Incomplete applications will not be included in the lottery and those applicants will be notified after the application deadline. As stated above, we strongly encourage applicants to meet with a representative from MCO Housing Services, LLC when submitting their application to confirm the application package is complete to ensure acceptance into the lottery.

The distribution of affordable homes will be based upon household size preferences criteria established by DHCD. Specifically, the unit size you can request will be based upon the following:

1. There is a least one occupant per bedroom.
2. A husband and wife, or those in a similar living arrangement, shall be required to share a bedroom. Other household members may share but shall not be required to share a bedroom.
3. A person described in the first sentence of (2) above shall not be required to share a bedroom if a consequence of sharing would be a severe adverse impact on his or her mental or physical health. The lottery agent must receive reliable medical documentation as to such impact of sharing.
4. A household may count an unborn child as a household member. The household must submit proof of pregnancy with the application.
5. If the applicant is in the process of a divorce or separation, the applicant must provide proof that the divorces or separation has begun or has been finalized, as set forth in the application.

There will be a percentage of handicapped accessible (Group IIA) units at the property. Since the buildings have elevators, all apartment homes are considered to handicapped adaptable (Group I). Disabled applicants may request reasonable accommodations or modifications of the housing, when such accommodations or modifications are necessary to afford the disabled person equal opportunity to use and enjoy the housing.

Lottery Process

Due to the nature of the affordable units' availability it is important for everyone to understand the procedure. Please understand the allowable income guidelines are adjusted based upon your household size and that program requirements are subject to changes in local, state or federal regulations. As has been mentioned, the final rents and maximum income will be established prior to the lottery.

There will be a total of 24 apartment homes being distributed at Highlands Village which will be completed over an estimated 4 month time frame. These homes will be distributed by lottery through 2 pools – the local pool and the open pool. Up to 16 of the homes will be available to people qualifying for local preference in Braintree. To qualify for local preference an applicant must meet one of the following criteria:

- Current Braintree Resident
- Employed by the Town of Braintree or the Braintree Public Schools
- Employee working in the Town of Braintree or with a bonafide offer of employment with a company located in Braintree.
- Parents of children attending the Braintree Public Schools

An applicant's proof of local preference will be required with the application submittal and will be verified by the Town if they have an opportunity to lease an apartment home. All applicant (including local applicants) will be included in the Open Pool.

All applicants for a given pool will be pulled at the time of the lottery. This will establish the rankings for the distribution of the homes. Homes will be distributed first to households based upon their required number of bedrooms.

Once the lottery rankings have been determined and your income has been certified by MCO Housing Services, LLC your information will be forwarded to the Leasing Office for their credit and background checks. If the Leasing Office determines you are eligible, you will then be offered a specific unit.

If either the leasing office or MCO Housing Services, LLC determines you do not meet their eligibility criteria at that time, you will not be able to lease a unit.

Monitoring Agent and Tenant Annual Eligibility Certification

Masshousing will act as Monitoring Agent in making the final determining applicants' income eligibility. The annual tenant re-certification will be conducted by MCO Housing Services, LLC.

Waiting Lists, Re-Marketing or Continuous Marketing

Although owner/management agent standards for waiting lists or re-marketing the community to affordable prospects to generate sufficient applications after the initial rent-up stage may vary, the following are generally applicable: the wait list is re-opened when it contains less than the number of applicants anticipated to be placed in the next 12 months, or, if the waiting list has not closed, additional marketing is undertaken to generate at least enough applicants needed to fill the previous year's vacancies. The specific guidelines from DHCD for these policies are included below.

a. Minimum Application Period

At such or similar points in time, consistent with a Developer or management agent's policies and practices with respect to marketing and wait lists, when a wait list (whether for a project or a particular unit type) is re-opened or units are remarketed, a minimum application period during which applicants may receive and submit applications is required. The appropriate length of the application period may vary depending on the number of units that are or will become available. In some instances, 20 or more business days will be appropriate, but in no event shall the application period be less than 10 business days.

b. "First Come, First Served"

A "first-come, first-serve" method of generating the waiting list order of new applicants that apply during said application period shall not be permitted as it may present an impediment to equal housing opportunity for some applicants, including some applicants with disabilities. Therefore, a random selection or other fair and equitable procedure for purposes of adding persons to a wait list upon opening the wait list or remarketing the units must be utilized, subject to the approval of the Subsidizing Agency. This does not require any changes to the wait list as it exists prior to adding the new applicants.

c. Continuous Marketing/Persons with Disabilities

If the wait list is not closed and marketing is ongoing continuously in order to generate sufficient applicants, then, so as to avoid a disparate impact on persons with disabilities who require a reasonable accommodation with the application process, including additional time to receive, complete and/or submit an application, and who therefore may be disadvantaged by wait list placement based upon the date/time of receipt of the application, the application will be date/time stamped prior to being mailed or otherwise provided to such applicants and upon submission of a complete application the household shall be placed on the wait list based upon such date/time stamp, *provided that* the application is returned or postmarked not more than 30 days

of such date/time stamp. The ongoing affirmative and general marketing/outreach materials will contain language that explicitly gives notice of the availability of reasonable accommodations with respect to the application process and a telephone number for applicants who may want to request a reasonable accommodation and/or assistance with the application process.

Unit Turnover

The affordable and accessible units will be listed on the MassAccess website upon turnover.

Summary

This outreach program will ensure residents from Braintree and the surrounding communities will be notified of the available opportunities at Highlands Village and will ensure for the smooth and fair processing of all potential applicants. It is our intention to work with the Town of Braintree to incorporate local requests and ideas.

**HIGHLANDS VILLAGE
UNIT DESIGNATION REPORT**

<u>Affordable Units</u>	<u>Floor</u>	<u>Unit Number</u>	<u>Bedrooms</u>	<u>Square Feet</u>
	1	101	2	975
	1	102	1	752
X	1	103	1	752
	1	104	2	975
X	1	105	3	1,150
	1	106	1	752
	1	107	1	752
X	1	108	1	752
	1	109	1+Den	811
X	1	110	1+Den	811
	1	111	1+Den	811
	1	112	3	1,106
	1	113	3	1,106
	1	114	1+Den	811
	1	115	2	975
X	1	116	2	975
	1	117	1+Den	811
	1	118	1+Den	811
	1	119	1+Den	811
	1	120	1+Den	811
X	1	121	1+Den	811
	1	122	2	975
	2	201	2	975
	2	202	1	752
X	2	203	1	752
	2	204	2	975
	2	205	1	752
	2	206	3	1,150
	2	207	1	752
X	2	208	1	752
	2	209	1	752
	2	210	1+Den	811
X	2	211	1+Den	811
	2	212	1+Den	811
	2	213	3	1,106
	2	214	3	1,106
	2	215	1+Den	811
X	2	216	2	975
	2	217	2	975
X	2	218	1+Den	811
	2	219	1+Den	811
X	2	220	Studio	518
	2	221	1+Den	811
	2	222	1+Den	811
X	2	223	1+Den	811

	2	224	2	975
	3	301	2	975
	3	302	1	752
X	3	303	1	752
	3	304	2	975
	3	305	1	752
X	3	306	Studio	585
	3	307	Studio	585
X	3	308	1	752
	3	309	1	752
	3	310	1	752
	3	311	1+Den	811
	3	312	1+Den	811
X	3	313	1+Den	811
	3	314	3	1,106
	3	315	3	1,106
X	3	316	1+Den	811
	3	317	2	975
X	3	318	2	975
	3	319	1+Den	811
	3	320	1+Den	811
	3	321	Studio	518
	3	322	1+Den	811
	3	323	1+Den	811
X	3	324	1+Den	811
	3	325	2	975
X	4	401	2	975
	4	402	1	752
	4	403	1	752
X	4	404	2	975
	4	405	1	752
	4	406	Studio	585
	4	407	Studio	585
	4	408	1	752
	4	409	1	752
	4	410	1	752
	4	411	1+Den	811
	4	412	1+Den	811
	4	413	1+Den	811
	4	414	3	1,106
X	4	415	3	1,106
	4	416	1+Den	811
	4	417	2	975
	4	418	2	975
	4	419	1+Den	811
X	4	420	1+Den	811
	4	421	Studio	518
	4	422	1+Den	811
	4	423	1+Den	811
	4	424	1+Den	811
	4	425	2	975



your resource for Affordable Housing



MAXIMUM PROPERTY RENTS

YEAR: 2019 Income Limits

PROPERTY: Highlands Village - Proposed

FMR AREA: Boston

FINANCING PROGRAM: DHCD

Utility Allowance: Braintree Housing Authority Effective: 5/1/2019

Boston	Household Size	80% Median Income	Monthly Income	Max Rent*	Utility Allowance	Final Rent
Studio	1	\$62,450	\$5,204	\$1,561	\$144	\$1,417
1 Bedroom	2	\$71,400	\$5,950	\$1,785	\$187	\$1,598
2 Bedroom	3	\$80,300	\$6,691	\$2,007	\$242	\$1,765
3 Bedroom	4	\$89,200	\$7,433	\$2,230	\$305	\$1,925

* 30% of Median

Tenant Paid Utilities --- Per Bedroom Count				
	One	Two	Three	Studio
Heat Gas	\$48	\$56	\$68	42
Cooking-Electric	\$11	\$15	\$19	9
Other Electric	\$38	\$52	\$64	30
Water Heat-Gas	\$11	\$15	\$18	9
Water	\$29	\$38	\$50	20
Sewer	\$50	\$66	\$86	34
Other	\$0	\$0	\$0	0
Total	\$187	\$242	\$305	\$144

Completed By: MCO Date: 9/19/2019

HIGHLANDS VILLAGE
Affordable Unit Breakdown

	<u>Studio</u>	<u>1 Bedroom</u>	<u>1 Bed + Den</u>	<u>2 Bedroom</u>	<u>3 Bedroom</u>	<u>Totals</u>
Ground	-	2	2	1	1	6
Floor 2	1	2	3	1	-	7
Floor 3	1	2	3	1	-	7
Floor 4	-	-	1	2	1	4
<u>Totals</u>	2	6	9	5	2	24
Market #	7	23	36	20	10	96
Affordable %	28.57%	26.09%	25.00%	25.00%	20.00%	25.00%

REGULATORY AND USE AGREEMENT

[Rental]

***For Comprehensive Permit Projects in Which Funding is Provided
By Other Than a State Agency***

This Regulatory and Use Agreement (this "Agreement") is made this ___ day of _____, 20___, by and between the Massachusetts Housing Finance Agency acting as Subsidizing Agency (the "Subsidizing Agency"), as defined under the provisions of 760 CMR 56.02, on behalf of the Department of Housing and Community Development ("DHCD"), and _____, a Massachusetts _____ having a mailing address at _____, and its successors and assigns (the "Developer").

RECITALS

WHEREAS, the Developer intends to construct a housing development known as _____ at a ___-acre site located at _____ in the [City/Town] of _____, Massachusetts (the "Municipality"), more particularly described in Exhibit A attached hereto and made a part hereof (the "Development"); and

WHEREAS, DHCD has promulgated Regulations at 760 CMR 56.00 (as may be amended from time to time, the "Regulations") relating to the issuance of comprehensive permits under Chapter 40B, Sections 20-23, of the Massachusetts General Laws (as may be amended from time to time, the "Act") and pursuant thereto has issued its Comprehensive Permit Guidelines (as may be amended from time to time, the "Guidelines") and, collectively with the Regulations and the Act, the "Comprehensive Permit Rules");

WHEREAS, the Development is being financed with a loan of approximately \$ _____ by _____, a Federal Home Loan Bank of Boston ("FHLBB") member bank (the "NEF Lender"), a non-governmental entity for which the Massachusetts Housing Finance Agency acts as Subsidizing Agency pursuant to the Comprehensive Permit Rules; and

WHEREAS, the Massachusetts Housing Finance Agency will serve as Subsidizing Agency on behalf of DHCD pursuant to the Comprehensive Permit Rules and in accordance with the terms and provisions hereof; and

WHEREAS, the Developer has received a comprehensive permit (the "Comprehensive Permit") from the Zoning Board of Appeals of the Municipality in accordance with the Act, which permit is [recorded/filed] at the _____ County [Registry of Deeds/Registry District of the Land Court] ("Registry") [in Book _____, Page ___ / as Document No. _____], as amended

Development, junior to the lien securing the Loan, to secure payment by the Developer of such fees and expenses. The Subsidizing Agency and its designee may perfect a lien on the Development by recording/filing in the Registry one or more certificates setting forth the amount of the costs and expenses due and owing.

(d) The Developer hereby grants to the Subsidizing Agency or its designee the right to enter upon the Development for the purpose of enforcing the terms of this Agreement, or of taking all actions with respect to the Development which the Subsidizing Agency may determine to be necessary or appropriate to prevent, remedy or abate any violation of this Agreement.

MONITORING AGENT; FEES; SUCCESSOR SUBSIDIZING AGENCY

17. The Subsidizing Agency intends to monitor the Developer's compliance with the requirements of this Agreement. The Developer hereby agrees to pay the Subsidizing Agency fees as partial compensation for its services hereunder, as set forth on Appendix B hereto, initially in the amounts and on the dates therein provided, and hereby grants to the Subsidizing Agency a security interest in Development Revenues as security for the payment of such fees subject to the lien of the Mortgage and this Agreement shall constitute a security agreement with respect thereto.

18. The Subsidizing Agency shall have the right to engage a third party (the "Monitoring Agent") to monitor compliance with all or a portion of the ongoing requirements of this Agreement. The Subsidizing Agency shall notify the Developer and the Municipality in the event the Subsidizing Agency engages a Monitoring Agent, and in such event (i) as partial compensation for providing these services, the Developer hereby agrees to pay to the Monitoring Agent an annual monitoring fee in an amount reasonably determined by the Subsidizing Agency, payable within thirty (30) days of the end of each Fiscal Year of the Developer during the Term of this Agreement, but not in excess of the amounts as shown on Appendix B hereto and any fees payable under Section 17 hereof shall be net of such fees payable to a Monitoring Agent; and (ii) the Developer hereby agrees that the Monitoring Agent shall have the same rights, and be owed the same duties, as the Subsidizing Agency under this Agreement, and shall act on behalf of the Subsidizing Agency hereunder, to the extent that the Subsidizing Agency delegates its rights and duties by written agreement with the Monitoring Agent. The Monitoring Agent shall apply and adhere to the applicable standards, guidance and policies of DHCD relating to the administrative responsibilities of subsidizing agencies where available, and otherwise shall apply and adhere to the standards and practices of the Subsidizing Agency where applicable.

CONSTRUCTION AND FINAL COST CERTIFICATION

19. The Developer shall provide to the Subsidizing Agency evidence that the final plans and specifications for the Development comply with the requirements of the Comprehensive Permit and that the Development was built substantially in accordance with such plans and specifications. Upon Substantial Completion, the Developer shall provide the Subsidizing Agency with a certificate of the architect for the Development in the form of a "Certificate of Substantial Completion" (AIA Form G704) or such other form of completion certificate acceptable to the Subsidizing Agency.

APPENDIX B

FEE PAYABLE TO SUBSIDIZING AGENCY

- **Masshousing NEF Rental Regulatory Agreement Affordability and Limited Dividend Monitoring Fees**
 - Initial Fee Due upon Execution of the Regulatory Agreement by MassHousing
 - \$7,500
 - Annual Fee Payable at the time of Initial Occupancy and Annually thereafter
 - \$200 per affordable unit per year

HIGHLANDS VILLAGE

COMPREHENSIVE PERMIT APPLICATION – BRAINTREE ZBA

10. DEVELOPER BACKGROUND & FILING FEE

Filing Fee = \$3000 + (\$100 x 96 units) = \$12,600

GEORGE CLEMENTS INVESTMENTS, INC.

**GEORGE CLEMENTS, PRESIDENT
63 MONATIQUOT AVENUE
BRAINTREE, MASSACHUSETTS 02184
(781) 974-0844**

George Clements Investments, Inc. has been operating in varying capacities in the real estate sector for nearly 20 years. We started out as a contracting business with a focus on the commercial sector performing renovations and build out for corporate clients in the South Shore area. We were able to form strong relationships with asset managers and property owners and shifted our focus to providing management and consulting services. We also initiated some independent development activities. Below is a general list of the activities performed since 2000. If you would like additional details on any of the referenced activities, please advise.

- | | |
|-------------|---|
| 2000 – 2013 | Asset Manager and Commercial Contractor |
| 2013 – 2015 | Polaroid Corporation Site Redevelopment, New Bedford, MA

Operated as the lead consultant to the private equity firm that took over a Polaroid facility consisting of approximately 750,000 square feet on over 120 acres. The multi year project created one of the area's largest seafood trucking hubs and a recycling facility. |
| 2016 – 2018 | Private Developments, Braintree, MA.

Renovation of Church into Commercial usage as well as the development of condominium communities. |
| 2018 – 2019 | Private developments as well as consulting to lenders in dealing with troubled assets and helping to reposition assets for greater commercial value. |

Clements Investments LLC
George Clements
63 Monatiquot Ave.
Braintree, MA 02184

514

53-7144/2113

DATE 2/7/20

PAY
TO THE
ORDER OF

Town of Braintree

\$ 12,600-

DOLLARS

Twelve Thousand Six Hundred

South Shore Bank

FOR APPLICATION FEE LIBRARY CARE 403

SCA

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