King Street Common

Final Environmental Impact Report
EEA #16921

Submitted to:
Executive Office of Energy and Environmental Affairs
MEPA Office
100 Cambridge Street, Suite 900
Boston, MA 02114

Submitted by:
Lupoli Development
280 Merrimack Street
Lawrence, MA 08413

Prepared by:
Epsilon Associates, Inc.
3 Mill & Main Place, Suite 250
Maynard, MA 01754

In Association with:
The Engineering Corp
PCA Architecture

October 15, 2025

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Chapter 1.0

Project Description and Permitting

1.0 PROJECT DESCRIPTION AND PERMITTING

1.1 Introduction

King Street is a transformational mixed-use Project (the Project) born of substantial investment and vision through the meaningful and longstanding partnership with the town of Littleton, the State of Massachusetts, and Lupoli Companies (the Proponent). The Project will deliver a meaningful amount of market and affordable housing units during a national and regional supply crisis as well as more than 115,000 square feet of retail space for a region looking for more dining, shopping and grocery options. What was once a former office park and parking field will become the regional home for thousands of people to work, live, stay, shop and play.

1.2 Project Site

The Project Site (the Site) is an approximately 47.4 acre (2,062,568 sf) parcel consisting of two parts: 550 King Street and 410 Great Road in Littleton Massachusetts. The first is on the east side of Great Road (Route 119) and is bounded by Interstate 495 to the north, Shea Street to the East, King Street (Route 110) to the south, and Great Road to the west. This portion of the Site is a former IBM office campus that is now vacant. The second smaller part of the Project Site is on the west side of Great Road and is bounded by a commercial lumber yard to the north, Great Road to the east, commercial development along King Street to the south, and a residential area off of White Street and Hillside Road to the west. Figure 1-1 is a USGS Locus and Figure 1-2 is an aerial locus of the Site.

Most of the eastern portion of the Site is comprised of buildings, paved parking areas, landscaped areas, and related ancillary facilities. The small undeveloped portion includes an area of deciduous trees around the northern border that buffers it from I-495. The western portion is currently developed with a commercial complex of attached buildings, housing a variety of small businesses, and a surface parking lot.

1.3 Changes Since the Draft EIR

Since the filing of the Project's DEIR, the Proponent has made several changes in response to agency comments and the progression of internal program development. These changes are listed below and discussed in this FEIR as needed. The updated site layout is provided on Figure 1-3 and in Appendix A.

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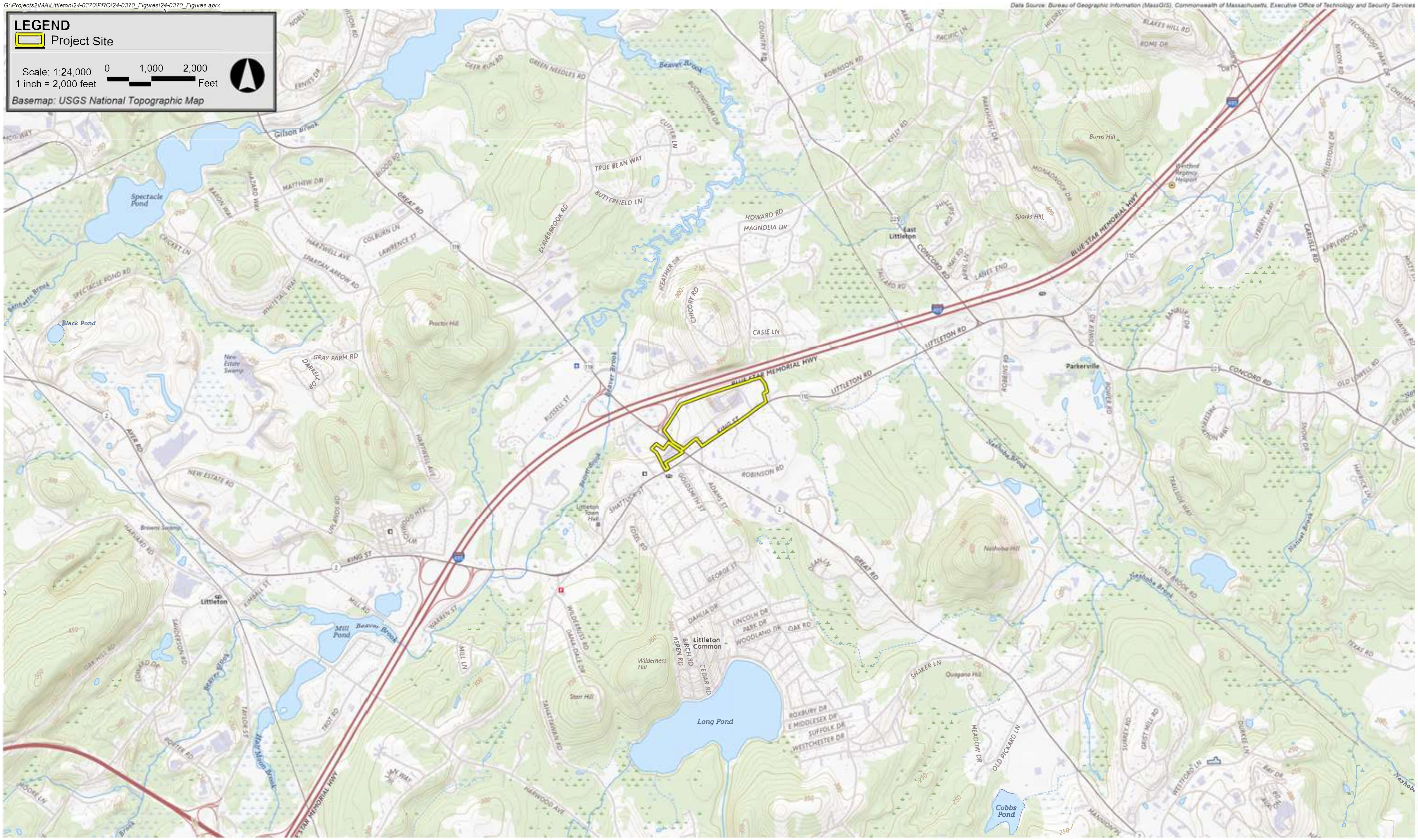
Data Source: Bureau of Geographic Information (MassGIS), Commonwealth of Massachusetts, Executive Office of Technology and Security Services



King Street Common Littleton, Massachusetts

Epsilon

Figure 1-1
USGS Locus Map

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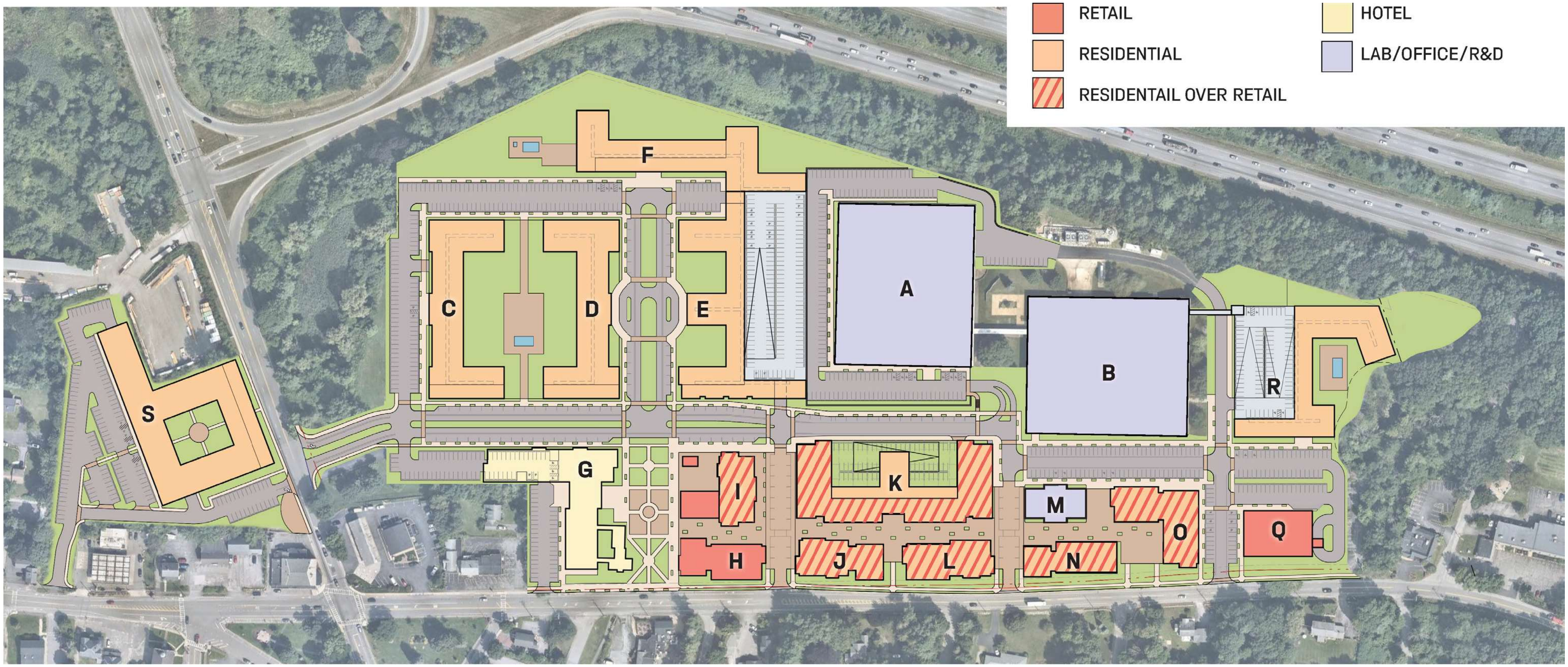
Data Source: Bureau of Geographic Information (MassGIS), Commonwealth of Massachusetts, Executive Office of Technology and Security Services

King Street Common Littleton, Massachusetts

Epsilon ASSOCIATES INC

Figure 1-2
Aerial Locus Map



BUILDING A: 272,619 GSF COMMERCIAL | 3 STORIES
BUILDING B: 272,901 GSF COMMERCIAL | 3 STORIES
BUILDING C: 168 UNITS | 173K GSF | 5 STORIES OVER PODIUM
BUILDING D: 168 UNITS | 173K GSF | 5 STORIES OVER PODIUM
BUILDING E: 155 UNITS | 178K GSF | 5 STORIES
BUILDING F: 155 UNITS | 160K GSF | 5 STORIES
BUILDING G: 150 HOTEL ROOMS | 4,200 FOOD SERVICE/BAR | 104K GSF | 4 STORIES
BUILDING H: 11,799 SF RETAIL | 12,288 GSF | 1 STORY
BUILDING I: 13,039 SF RETAIL | 9 UNITS | 33,153 GSF | 2.5 STORIES
BUILDING J: 10,479 SF RETAIL | 11 UNITS | 30,209 GSF | 2.5 STORIES
BUILDING K: 28,757 SF RETAIL | 42 UNITS | 92,860 GSF | 3 STORIES
BUILDING L: 10,772 SF RETAIL | 11 UNITS | 31,029 GSF | 2.5 STORIES

BUILDING M: 19,000 SF | OFFICE | 3 STORIES
BUILDING N: 9,514 SF RETAIL | 8 UNITS | 21,326 GSF | 2 STORIES
BUILDING O: 13,420 SF RETAIL | 12 UNITS | 36,628 STORIES
BUILDING Q: 13,020 GSF RETAIL | 1 STORY
BUILDING R: 65 UNITS | 70K GSF | 5 STORIES OVER PODIUM
BUILDING S: 285 UNITS | 290K GSF | 6 STORIES

TOTAL RESIDENTIAL: 804 + 285 = 1089 UNITS
TOTAL RETAIL: 115K GSF
TOTAL LAB/OFFICE/R&D: 564,520 GSF

King Street Common   Littleton, Massachusetts

Epsilon ASSOCIATES INC.

Figure 1-3
Current Proposed Project

1.3.1 Hotel Zoning Revisions

The proposd hotel's massing was adjusted after review of comments from the Littleton Planning Board, the Proponent's design team updated the layout of the hotel, Building G, to conform to zoning height requirements. The hotel is now limited to the four stories allowed in King Street Commons by building out the entire floor on the upper levels. The upper levels were previously stepped down to King Street. The building footprint is slightly extended at the west and north ends to stay at 150 rooms, and the gross square footage is reduced from 111,000 GSF in the DEIR to 104,000 GSF.

1.3.2 Internal Program Adjustments

- Buildings E, F, and the associated garage have been reconfigured
- The GSF has been adjusted for E and F to reflect the new building footprints.
- 8,000 sf of retail was eliminated from Building E and added to Building K
- Unit counts for C, D, E, and F were adjusted

A summary of these changes is shown in Table 1-1 below.

Table 1-1 Program Change Summary

Building	Previous GSF	Updated GSF	Change	Previous Unit Count	Updated Unit Count	Change
C	173,000	173,000	-	173	168	-5
D	173,000	173,000	-	173	168	-5
E	173,000	178,000	+5,000	149	155	+6
F	173,000	160,000	-13,000	151	155	+4

1.4 Project Description

The proposed redevelopment Project encompasses 19 buildings with a variety of programming elements including:

- 1,089 residential units;
- 115,500 sf of retail;
- 19,000 sf of office;
- 545,520 sf of light industrial use (which includes the two large former IBM buildings); and
- A 150 room, 104,000 sf hotel.

A total of 3,010 parking spaces are proposed, of which 1,446 will be in structured parking (garages, decks, parking under podiums) and the remainder at grade. All numbers are approximate. Figure 1-3 shows the locations and program distribution of square-footage around the Site and is included at larger scale in Appendix A.

1.5 Project Schedule

Construction of the Project will occur in phases, with the first phase anticipated to last approximately 22 months, beginning in 2026.

1.6 Project Benefits

The Project has been developed in close cooperation with the Town of Littleton and will result in a host of public benefits for the Town and the surrounding area, including boosting the local economy by providing both construction and permanent jobs; creating 1,089 new units of housing which can support the job creation; providing new public greenspace for local events with the addition of approximately 18 acres of open space; generating increased taxes for the Town through the increase in real estate value; increasing the tax base through the introduction of new commercial, office, and hotel space; rejuvenating Littleton Common, by creating a gateway to the Town and redeveloping a currently abandoned office complex, and the Proponent is contributing $29M towards a Town-wide sewer project, which accounts for 2/3 of that project's funds.

1.7 Permitting

The required reviews and permits are listed in Table 1-2.

Table 1-2 Anticipated Permits, Reviews and Approvals

Agency	Permit / Approval
Local	
Town of Littleton Planning Board	Re-Zoning establishing King Street Commons Zoning District – **Obtained 10/01/2021** Special Permits 550 King Street (Master Planned Development, Major Commercial Use, Major Industrial Use, Aquifer and Water Resource District and Sidewalk Curb Cut.) - **Originally obtained June 2022, Amended June 2024** Special Permits 410 Great Road (Master Planned Development, Village Common, Aquifer and Water Resource District and Sidewalk Curb Cut) -- **Obtained December 2022** Definitive Subdivision Approval -- **Obtained November 2023**

Table 1-2 Anticipated Permits, Reviews and Approvals (Continued)

Agency	Permit / Approval
Local	
Littleton Conservation Commission	Abbreviated Notice of Resource Area Delineation – to be filed at future date Order of Conditions
State	
Massachusetts Department of Transportation	State Highway Access Permit
Massachusetts Department of Environmental Protection	WP 68 Treatment Works Plan Approval for Ground Water Discharge and Reclaimed Water Use Facilities, without Permit Modification
	Groundwater Discharge Permit, if required
Federal	
Environmental Protection Agency	National Pollutant and Discharge Elimination System (NPDES) Construction General Permit (CGP)

Chapter 2.0

Land Alteration, Impervious Area, and Stormwater

2.0 LAND ALTERATION, IMPERVIOUS AREA, AND STORMWATER

2.1 Tree Planting

The Proponent will implement a comprehensive care and maintenance program to ensure the successful establishment of all replanted trees. This program will include regular watering, seasonal inspections, mulching, pruning as needed, and the replacement of any trees that fail to establish during the designated establishment period. Maintenance activities will be conducted in accordance with industry best practices and relevant local guidelines to promote healthy growth and long-term viability.

A comprehensive planting plan to be prepared by a licensed landscape architect will be incorporated into the plan set for each Project phase, detailing species selection, quantities, sizes, and planting locations to ensure appropriate and cohesive plantings are established throughout the development. These plans will also identify maintenance responsibilities and outline the duration and scope of the establishment period.

2.2 Land Alteration Mitigation

2.2.1 Tree Planting

The Proponent acknowledges the importance of tree mitigation and is committed to implementing effective and equitable measures to address tree loss associated with the Project. A comprehensive tree inventory and canopy assessment has informed a phased planting strategy that seeks to maximize on-site tree replacement while considering site-specific constraints, such as limited available space, utility conflicts, and grading requirements. As part of the FEIR, the Proponent commits to provide tree replanting at a 1:1 ratio.

If on-site conditions limit the feasibility of achieving a full 1:1 tree replacement ratio, the Proponent will explore opportunities for off-site planting in coordination with local officials and agencies. These efforts will prioritize areas within the community identified as having limited tree canopy coverage or heightened vulnerability to extreme heat impacts.

2.2.2 Impervious Area

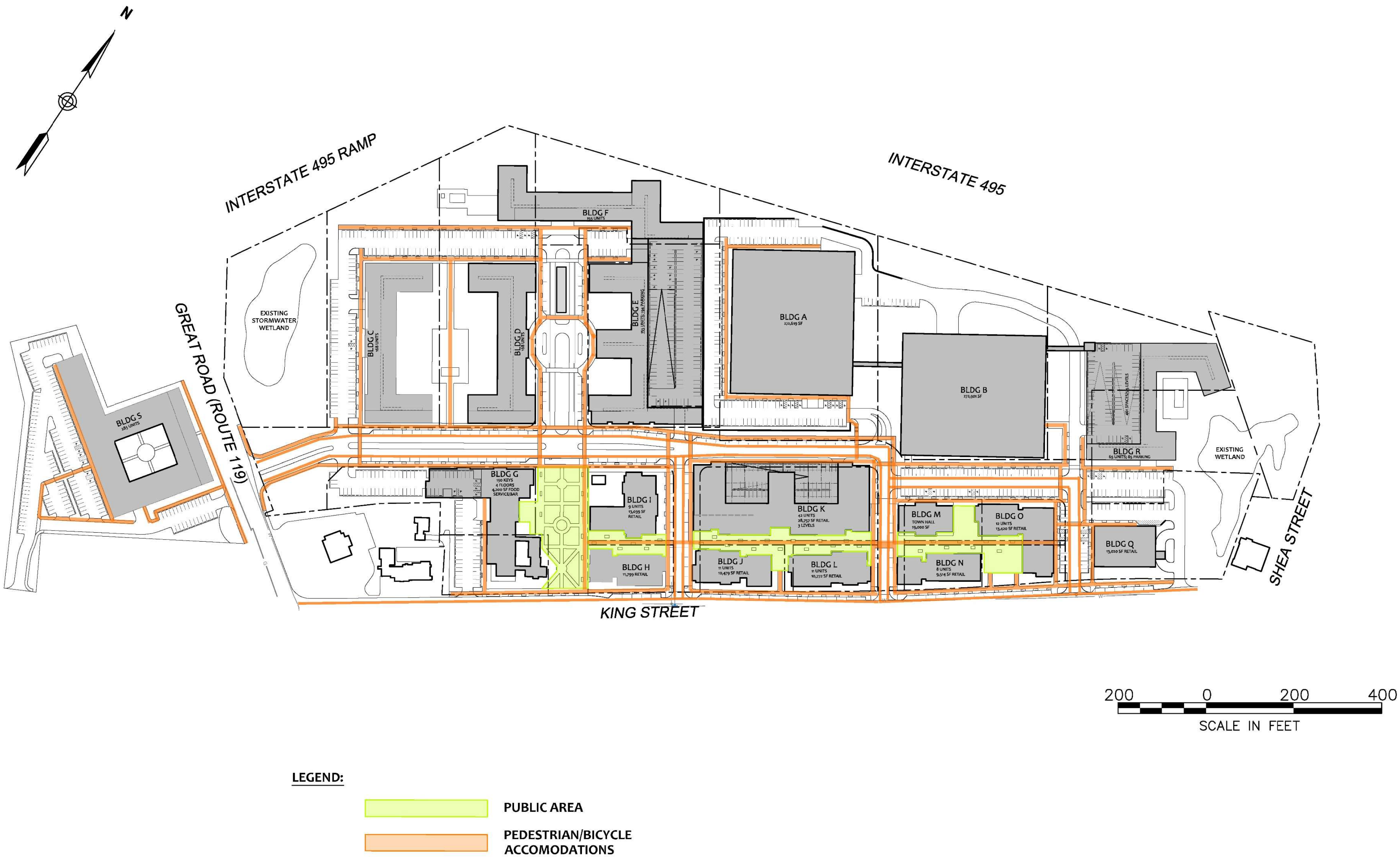
The Proponent is committed to minimizing land alteration and reducing impervious surfaces as part of the Project's overall environmental strategy. The majority of existing trees on-site are being preserved, and much of the proposed land alteration is concentrated in previously disturbed areas associated with the former IBM development. Additionally, the layout of the Site has changed since the last filing which resulted in slight modifications to the layout of Building E, Building F, and the immediate surrounding area. This modification resulted in reduction of approximately 17,167 SF of impervious surfaces. The use of pervious pavement for sidewalks, walkways, and low-traffic areas is under consideration, subject to Site conditions and maintenance requirements. Parking will be phased to match demand, with land banking and shared parking strategies being explored to avoid unnecessary paving. Additionally, disturbed areas will be mitigated through supplemental landscaping and tree planting to restore canopy cover, reduce heat island impacts, and enhance the Site’s ecology. These measures will help reduce environmental impacts while supporting sustainable Site design.

2.3 Stormwater Management

As of the filing of this FEIR, the Proponent is continuing to refine the design of the stormwater management system as part of the ongoing permitting and detailed engineering process. Updates to the layout, sizing, or treatment methods are documented in the updated Site Plan in Appendix A and Stormwater Report in Appendix B.

The stormwater management system will continue to be designed in accordance with the Massachusetts Stormwater Standards and applicable local requirements. Low Impact Design (LID) measures such as subsurface infiltration basins, water quality swales, infiltration basins, tree box filters, and other green infrastructure elements are being considered and will be incorporated to the extent practicable, based on site constraints and hydrologic conditions. The Stormwater Report identifies the specific LID measures to be implemented as part of the final design.

An updated Stormwater Report, including revised calculations, drainage area maps, and supporting documentation, is provided in Appendix B which reflects the modifications to the Site Plan and demonstrates that compliance with applicable stormwater management standards is maintained. Figures 2-1 and 2-2 show the post development conditions.



King Street Common Littleton, Massachusetts

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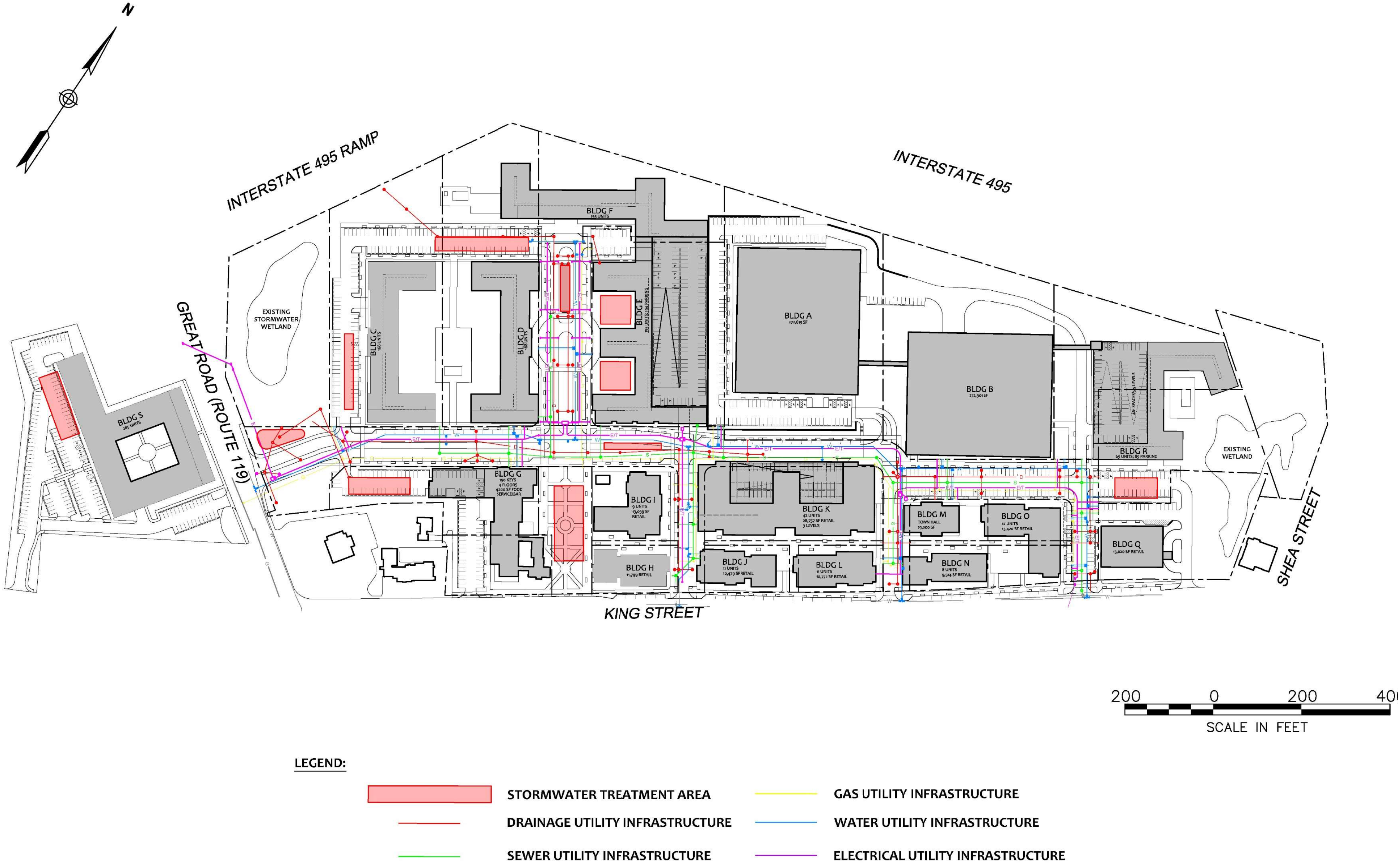
Figure 2-1

Post-Development Conditions – Public Areas, Pedestrian/Bike Accommodations



King Street Common   Littleton, Massachusetts

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Figure 2-2

Post-Development Conditions – Infrastructure

Chapter 3.0

Transportation

3.0 TRANSPORTATION

This chapter includes updates to the transportation operational and safety analysis based on comments received on the Draft Environmental Impact Report (DEIR) from the Massachusetts Environmental Policy Act (MEPA) office, state agencies, municipalities, and other stakeholders. It considers the coordination that has occurred with the Proponent, the Town of Littleton, and the Massachusetts Department of Transportation (MassDOT) on the scope, traffic impacts, and parking impacts associated with the Project. Furthermore, it provides clarity on the process to identify transportation impacts within the Project Site and provides mitigation for both Town of Littleton and MassDOT off-site infrastructure.

The FEIR provides detailed aspects supplementing the Traffic Impact, Access, and Parking Study, prepared using MassDOT and the Massachusetts Executive Office of Energy and Environmental Affairs (EEA) standard guidelines, that were presented in the DEIR. During the DEIR review process, the Proponent also submitted a *Supplemental Sensitivity Analysis – Access Management Changes* technical memorandum to MassDOT / MEPA prior to the Certificate on the DEIR on July 28, 2025. This technical memorandum was submitted at the request of MassDOT to further document access management and other off-site mitigation discussion prior to the issuance of the Secretary's Certificate on the DEIR. Through this supplemental process and other coordination with MassDOT, the Proponent has been responsive to the requests outlined by MEPA, MassDOT, and other stakeholders in its preparation of this FEIR.

3.1 Chapter Summary

3.1.1 Changes Since the DEIR

The FEIR outlines various changes to the Project; however, these changes are not expected to change the Site's projected trip generation or distribution of trips, as presented in the DEIR and other adjoining traffic impact documentation, in any noticeable way. Therefore, no further updates to the traffic operational analysis are provided in the FEIR following MassDOT's review of the traffic operational analysis presented in the *Supplemental Sensitivity Analysis – Access Management Changes* technical memorandum that was submitted to MassDOT / MEPA prior to the Certificate on the DEIR on July 28, 2025. Further traffic operational analysis, where necessary, will be coordinated with MassDOT as part of a future Functional Design Report (FDR) and Project Framework Document (PFD) that will be submitted during MassDOT's Permit to Access State Highway permitting process.

3.1.1.1 Changes in the Building Program & Layout

Figure 1-3 shows minor changes in the building program on a building-by-building basis. Overall, the Site Plan presents the same overall building program in terms of number of residential units and commercial square footage. Specifically, the transfer of residential units from one building to another (Buildings "C", "D", "E", and "F") only changes between 4 to 6 residential units per building and the overall unit counts remains as reported in the DEIR (1,089 units). The relocation of 8,000 square feet (SF) of retail space from Building "E" to Building "K" similarly maintains the overall Site floor area but relocates this small amount of floor area across the main drive aisle. These changes are generally minimal and are not anticipated to change the trip generation or distribution as previously reported once vehicles are off-site on the public roadway network.

3.1.1.2 Changes to Site Access

Subsequent to the filing of the DEIR, the Proponent's team further coordinated with MassDOT Public Private Development Unit (PPDU) and District 3 Office on-site access considerations. This coordination resulted in the filling of the aforementioned *Supplemental Sensitivity Analysis – Access Management Changes* technical memorandum on July 28, 2025. Modifications to the Site access schemes that were described in this technical memorandum were identified in the Secretary's Certificate on the DEIR. A detailed summary of the revised Site access scheme is described in Section 3.2.

3.1.1.3 Changes to Mitigation

The Proponent has proposed a comprehensive transportation mitigation program in the vicinity of the Site to improve vehicular, bicycle, and pedestrian operations and safety. Off-site mitigation and on-site amenities were described in detail in the DEIR and are further described, including new commitments, in Section 3.3 of this FEIR. Following the receipt of the Secretary's Certificate on the DEIR, the Proponent has provided commitment to the following additional mitigation measures:

- ♦ Removal of the previously proposed pedestrian crossing across Great Road (Route 119) to the west of the Site Driveway West, including the proposed accessible pedestrian curb ramps to connect the Site to the existing sidewalk along the southerly side of Great Road with appropriate warning signage. This location posed a sight-distance challenge and, upon further evaluation, did not present an acceptable pedestrian connection.

- ♦ In lieu of the removed above-mentioned pedestrian crossing, the Proponent will construct a new 580-foot sidewalk connection with vertical granite curbing along the northerly side of Great Road from the Site Driveway West to the Interstate 495 (I-495) NB Ramps. This improvement includes up to the following:

    - o The 5-foot sidewalk will be constructed to maintain a consistent 2-foot shoulder present between King Street and a point 200-feet west of the Site Driveway West so not to impact a culvert headwall and culvert pipe for the stormwater swale present along the northerly side of Great Road adjacent to the Great Road channelized right-turn lane to I-495 NB. Both the guardrail and stormwater swale will be modified / reset, where needed, at the back of sidewalk.

- Slight realignment of the Great Road channelized right-turn lane to I-495 NB to accommodate the above-mentioned sidewalk location and provide an unsignalized crosswalk across with appropriate traffic signs across the Great Road channelized right-turn lane to I-495 NB. Install a Rectangular Rapid Flashing Beacon (RRFB) for this uncontrolled pedestrian crossing.
- Construct a new signalized pedestrian crossing across Great Road on the easterly side of the I-495 NB Ramp approach with accessible pedestrian curb ramps, pedestrian traffic signal housings, and pedestrian push buttons.

♦ The DEIR identified that the Proponent would seek membership in the Middlesex 3 Transportation Management Association (TMA) which is utilized in neighboring Westford and communities to the northeast of Littleton. Addressing comments made by Metropolitan Area Planning Council (MAPC) on the DEIR, the Proponent will alter its commitment to seek membership in the reformed Crosstown Connect TMA which had originally been identified in the ENF. Although the status of reformation is not currently an active part of the development, the Proponent will look at opportunities to assist in the reformation of this TMA.

♦ The goal of the "Littleton Loop" is to connect the key destinations in the town with a connected trail network. The specific destinations along the "Littleton Loop" are Littleton Common, the MBTA Commuter Rail, Town Hall and the library, high school, and middle school complex. There is also a goal to connect the proposed King Street Common development and The Point Shopping Center on the opposite side of I-495. The Proponent will support pedestrian upgrades related to the "Littleton Loop" consistent with the 2023 Littleton Bicycle and Pedestrian Master Plan. This includes the following pedestrian and bicycle accommodation that had been identified in the DEIR and/or supplemented in this FEIR:

- Provide direct Site connectivity for pedestrians and bicycles from the Project to the existing King Street sidewalk and bicycle network.
- Provide direct connectivity for pedestrians along Great Road, including the construction of new sidewalk between the Site Driveway West and I-495 NB Ramps to allow ease of access to The Point Shopping Center. Further accommodation may be explored by MassDOT as part of MassDOT Project 613111 (Deck Replacement – State Route 119 over I-495) which is currently on the FY2029 State Transportation Improvement Program (TIP).
- Reconstruct existing accommodations in and around Littleton Common to enhance safety and accessibility.
- Modify the King Street cross-section to continue the existing bicycle lanes from their northerly terminus near Site Driveway South to Site Driveway North (extension of 850-feet).

- Construction of a shared-use path (SUP) along the site frontage from the Tuttle House Driveway to Site Driveway North (1,450-feet).

- At the request of MassDOT, the Proponent has removed all proposed on-street parallel parking stalls along the west side of King Street adjacent to the Proponent's property frontage as had been proposed in the DEIR.

- Although generally intended, the mitigation commitments will specifically denote providing wayfinding signs within the Project Site to direct residents, patrons, and other visitors to the appropriate driveway and access to pedestrian, public transportation, and bicycle facilities.

- At the request of MassDOT, the Proponent will commit to construct up to three pedestrian crossing locations across King Street between Meetinghouse Road and Site Driveway North where sufficient right-of-way exists. These locations would include, at a minimum, high-visibility crosswalks, pedestrian curb ramps, far-side level landings areas to allow for formal pedestrian areas on the easterly side of the roadway, and fluorescent yellow-green pedestrian warning and advance warning signage (W11-2, W16-7p, and W16-9p).

- The Proponent will commit to minor box widening, where needed, along King Street to maintain and/or expand a Complete Streets cross-section between the Tuttle House and Site Driveway North (Site frontage) to accommodate 11-foot travel lanes and a 5-foot bicycle lane along King Street . This improvement will hold the easterly edge of pavement along King Street as to not impact private property.

3.1.2 Coordination with MassDOT

3.1.2.1 MassDOT PPDU and District 3 Office

Following the submittal of the DEIR, the Proponent's team further coordinated with MassDOT Public Private Development Unit (PPDU) and District 3 Office on Wednesday, September 17, 2025. The Project team discussed the scope of this FEIR and other clarification items related to transportation, including the proposed sidewalk along the northerly side of Great Road, the consolidation of driveways and access management, the cross-section of King Street, and the phasing of off-site mitigation in relation to the construction of the development. The meeting generally confirmed the FEIR approach and off-site mitigation committed to by the Proponent. The meeting resulted in a request to discuss the King Street Complete Streets cross-section proposal with MassDOT Highway Design HQ.

3.1.2.2 MassDOT Highway Design HQ

The Proponent's team met with MassDOT Highway Design HQ on Monday, September 29, 2025, to discuss the cross-sectional elements of both King Street and Great Road as proposed by the Proponent. The meeting resulted in the following acknowledgments and requests:

- MassDOT Highway Design HQ is strongly supportive of extending the SUP to be meandering behind the tree to the north on the former Yangtze Restaurant property as there are destinations further north that should be provided means to access without a car, including the SUP. Given the space restrictions, MassDOT notes an 8-foot SUP around the tree would be generally acceptable.
- MassDOT Highway Design HQ generally prefers buffered bicycle lanes on this King Street corridor; however, they acknowledge the standard bicycle lanes are in existence and the SUP may be utilized as the bicycle accommodation for a Design Justification Workbook (DJW), which is a standardized method used to evaluate proposed design criteria in order to justify a project's design.
- MassDOT Highway Design HQ, in agreement with the Proponent, believes one of the proposed pedestrian crossings of King Street should be at the northerly end of the Site frontage to accommodate transitions to/from bicycle and pedestrian cross-section changes.
- MassDOT Highway Design HQ acknowledges that the easterly side of King Street should be held to avoid impacts to private property (no sidewalk addition or box widening).
- MassDOT Highway Design HQ acknowledges the new sidewalk mitigation along Great Road and generally agreed that further bicycle accommodation would generally be out of scope for a private developer as part of this Project.
- MassDOT Highway Design HQ acknowledged the Proponent's cross-section approach for King Street and Great Road and noted that a DJW and MassDOT's Complete Street's Engineer would provide final recommendation approval with a low risk of deviating from what was discussed.

3.2 Summary of Access Management Changes

In conjunction with the recommendations advocated by MassDOT, the Proponent offers the following proposed changes from the DEIR to the Site driveways as part of the updated Site plan for MEPA / MassDOT's review. These changes were presented in the *Supplemental Sensitivity Analysis – Access Management Changes* technical memorandum that was submitted to MassDOT / MEPA prior to the Certificate on the DEIR on July 28, 2025. These changes were acknowledged by MassDOT / MEPA in the Certificate on the DEIR.

Overall, the changes to the Site access management scheme reduce the driveway count for the 550 King Street location along King Street from five in the existing condition and five presented in the DEIR, to only four driveways. In addition, the Proponent has also committed to prohibiting left-turns from both the slightly offset #550 King Street (Site Driveway West) and #410 Great Road. These new Proponent commitments represent a meaningful reduction of access/egress means to/from the Site from both the existing and DEIR-proposed conditions. The number of King Street driveways will be further reduced if the Proponent is successful in working with the adjacent owner of #510 King Street to consolidate access.

3.2.1 Change in Number of Driveways

The following access management changes are related to the removal of previously proposed driveway locations:

- Completely eliminate the driveway as proposed on the easterly side of Building Q and its existing/proposed intersection with King Street [DEIR Study Intersection #15]. Note that this driveway was one of two former Yangtze River Restaurant (584 King Street) driveways that were sought to be retained. This effectively removes all former driveway locations at the Yangtze River Restaurant and reduces the number of proposed driveways along King Street from five to four.

3.2.2 Driveway Turn Restrictions

The following access management changes are related to turn restrictions on existing/proposed driveway locations to/from the Project Site:

Prohibit the exiting left-turn movement from Site Driveway West (aka Auman Street or former IBM West Driveway) southbound at its Great Road intersection [DEIR Study Intersection #5]. Following this change, the Site Driveway West location will allow both left- and right-turns from Great Road and only allow exiting right-turns from the driveway. Prohibition of left-turn out from driveway will be achieved through traffic signs, pavement markings, and geometric channelization.

Prohibit the exiting left-turn movement from 410 Great Road Driveway northbound at its Great Road intersection [DEIR Study Intersection #16]. Following this change, the 410 Great Road Driveway location at Great Road will allow both entering left- and right-turns from Great Road and only allow exiting right-turns from the driveway. Prohibition of left-turns out from the driveway will be achieved through traffic signs and pavement markings.

Note: The Proponent has indicated that they may further explore the final location of the 410 Great Road Driveway to Great Road and it may result in an alternate proposal to MassDOT to relocate this driveway further to the west along Great Road compared to what is shown in this FEIR. Any change will be formalized in a future Notice of Project Change (NPC) if applicable and the MassDOT Permit to Access State Highway process. It is paramount that the Proponent have an opportunity to reevaluate the above-mentioned left-turn egress prohibition with MassDOT should this driveway be relocated to a location that does not have the same blocking and queuing concerns identified by MassDOT.

3.2.3 Non-Site Driveway Consolidation

The Proponent is actively investigating an opportunity to consolidate the existing Tuttle House Driveway [DEIR Study Intersection #11] shown serving Building G (Hotel) and the existing/retained Tuttle House (534 King Street) structure with the existing two curb cut(s) for the adjacent multi-tenant commercial / residential property to the immediate south (510 King Street) with head-in parking directly off King Street.

Following the Certificate on the DEIR and the recent coordination meeting with MassDOT on Wednesday, September 17, 2025, the Proponent has started negotiations with the neighboring 510 King Street property to allow for the consolidation of driveways as noted in the DEIR Certificate and as endorsed by MassDOT. The intent of this approach is to complete this cross-access capabilities while retaining all other building structures, land uses, and utilities. Other than the cross-access facility, there is a need to close the existing two driveways for the 510 King Street property and the various head-in parking stalls which will necessitate rearranging the surface parking field on-site. A preliminary cross-access plan is provided in Figure 3-1. The specific details of this driveway closure, a final approved agreement with the neighboring property owner, and other necessary work will be presented to MassDOT in the future FDR and Permit to Access State Highway process.

Should the above-described approach prove infeasible, the Proponent would propose to withdraw and/or remove one (1) of the four (4) access driveway locations along King Street as proposed in the current FEIR. MassDOT has previously identified the Site Driveway Middle Driveway located between Buildings “L” and “N” to be their preference for removal; however, the Proponent would like to not identify the specific driveway for removal until the MassDOT Permit to Access State Highway design process as additional survey, minor building footprint relocations, and other such site plan revisions that will be discussed with the Town and may result in an alternate driveway being identified as the removal preference.

3.3 Mitigation Summary

The following section provides a summary of measures that the Proponent has committed to in order to improve the existing and future operations and safety of the study area intersections. The Proponent has proposed a comprehensive transportation mitigation program in the vicinity of the Site to improve vehicle, bicycle, and pedestrian operations and safety. This summary has been updated based on changes/additions to mitigation committed by the Proponent in advance of the FEIR submittal.

King Street Common Littleton, Massachusetts

Figure 3-1
Preliminary Cross-access Plan

TEC The Engineering Corp

3.3.1 Off-Site Commitments

The following subsection outlines the individual off-site transportation infrastructure mitigation that is intended to enhance the public roadway infrastructure. The phasing for construction of the off-site infrastructure is described in each item; however, the phasing of the various infrastructure work is desired by the Proponent to be constructed based on the following conditions:

Condition A: Prior to Initial Occupancy – The Proponent would construct the improvements at the Project's outset and be completed prior to occupancy of the first new building.

Condition B: Prior to Occupancy of No-Build Site Generated Trip Threshold – The TIAS provided in the DEIR describes a significant number of additional trips that could be added to the Site without exceeding the full reoccupancy site generated trip levels of Buildings "A" and "B" as depicted in the No-Build Condition. Whereas Buildings "A" and "B" are actively tenanting space (current occupancy outlines in the DEIR) and the potential exists for another use or space to come online without exceeding the No-Build traffic volume conditions, the Proponent desires the flexibility to introduce a mix of uses at the early stages of the Project that do not exceed the documented Site trip generation levels for the No-Build condition for the weekday daily, weekday morning peak hour, or weekday evening peak hour. This may also provide an opportunity for the Town and MassDOT to balance the direction flow of early Site generated traffic flow as opposed to a one-sided directional increase with just the reoccupancy of the remaining vacant space in Buildings "A" and "B".

Condition C: Prior to Occupancy of King Street Retail / Restaurant Blocks – The Project proposes transportation infrastructure work along King Street, such as cross-section modifications and sidewalk, which the Proponent desires to complete in conjunction with the occupancy of the adjacent retail / restaurant block buildings. These buildings will include a "Town Center" feel on the westerly side of King Street and will require construction vehicles to traverse and other connected construction activities to occur which could damage newly constructed infrastructure if completed too early. The King Street corridor has in-place existing bicycle lanes and sidewalk which would be retained; however, the practical construction of the King Street cross-section would be directly aligned with the construction of the adjacent retail / restaurant buildings.

Condition D: Prior to Occupancy of 410 Great Road – The Project proposes transportation infrastructure work along Great Road, such as sidewalk along the 410 King Street site frontage. These buildings will require construction vehicles to traverse and other connected construction activities to occur which could damage newly constructed infrastructure if completed too early. The Great Road corridor has in-place existing sidewalk which would be retained; however, the practical construction of this sidewalk replacement along Great Road would be directly aligned with the construction of the adjacent 410 Great Road location.

Condition E: Traffic Signal Timing Fine Tuning – Similar to many other large-scale projects, the Proponent will provide field fine-tuning of traffic signal timings, coordination, and phasing parameters, in the presence of MassDOT, at Condition A above, 80% occupancy of the Project, and at 100% occupancy of the Project. Modifications to the traffic signal timings will necessitate edits to the Traffic Signal Regulations on file with MassDOT. The Proponent will provide redlines to existing regulation as-built packages at Condition A above and 80% occupancy. The Proponent will generate new as-built Traffic Signal Regulations at 100% occupy and/or Project completion.

3.3.1.1 Intersection Improvements

Field Traffic Signal Timing Fine-Tuning

The Proponent has committed to the field fine-tune traffic signal timings, coordination, and phasing parameters, in the presence of MassDOT, at initial occupancy, the 80% and 100% Site occupancy levels (Condition E) to accommodate the additional traffic flow from the Project Site for the following locations:

- Great Road / Russell Street / Constitution Avenue
- Great Road / Interstate 495 SB Ramps

The implementation of these improvements will be reviewed and coordinated with MassDOT, who holds jurisdiction of the traffic signal.

Great Road / Interstate 495 NB Ramps

The Proponent has committed to the following improvements at the intersection of Great Road / Interstate 495 NB Ramps as part of Condition B, unless otherwise noted:

In conjunction with new sidewalk along the northerly side of Great Road, construct a new signalized pedestrian crossing with exclusive pedestrian phase, across Great Road on the easterly side of the I-495 NB Ramp approach with accessible pedestrian curb ramps, pedestrian traffic signal housings, and pedestrian push buttons.

Reconstruct a slight realignment of the Great Road channelized right-turn lane to I-495 NB to accommodate the sidewalk location and provide an unsignalized crosswalk across with appropriate traffic signs across the Great Road channelized right-turn lane to I-495 NB.

Optimize traffic signal timings at the intersection, in the presence of MassDOT, at initial occupancy, the 80% and 100% site occupancy levels (Condition E) to accommodate the additional traffic flow from the Project Site.

Great Road / Site Driveway West

The Proponent has committed to the following improvements at the intersection of Great Road / Site Driveway West as part of Condition A:

Reconstruct the Site Driveway West southbound approach to the intersection to include a channelized exclusive right-turn lane (no left-turn exiting egress) with a single northbound receiving lane and sidewalks along each side of the approach.

Reset the curb line along the northerly side of Great Road to open Great Road westbound to two lanes in conjunction with the driveway, as opposed to west of the driveway.

Restripe the inside travel lane along Great Road eastbound to be an exclusive left-turn lane directly in line with the downstream exclusive left-turn lane at King Street.

Great Road / King Street

The Proponent has committed to the following improvements at the intersection of Great Road / King Street as part of Condition B, unless otherwise noted:

Complete a 'partial' reconstruction of the traffic signal infrastructure at the intersection, including new overhead mast arm assemblies to mount signal housings as needed, a new Advanced Transportation Control (ATC) cabinet and controller system with Field Monitoring Unit (FMU) to support transit signal priority (TSP) and future coordinator connections, new demand-based vehicle and bicycle detection zones as needed, accommodations for emergency-vehicle pre-emption, Accessible Pedestrian Signal (APS) push buttons, and pedestrian countdown indications. Note that MassDOT has noted the Proponent may only need to upgrade those infrastructure parts and pieces that are in need of upgrade as opposed to a full traffic signal reconstruction.

Optimize traffic signal timings at the intersection, in the presence of MassDOT at initial occupancy, the 80% and 100% site occupancy levels (Condition E) to accommodate the additional traffic flow from the Project Site.

Reconstruct, as necessary, all sidewalk and pedestrian curb ramps at the intersection to support the new traffic signal infrastructure and provide Americans with Disabilities Act (ADA) / Architectural Access Board (AAB) / Public Right-of-Way Accessibility Guidelines (PROWAG) compliance. Where possible, as a result of the difficult grading along Great Road eastbound, provide two accessible ramps per intersection corner and realign the crosswalks to be as perpendicular as possible to the four approaches.

Complete a full pavement resurfacing for a minimum of 100 feet along each intersection approach to match new accessibility accommodations. The distance of resurfacing may extend to a point where the overall queueing on the approach is unaffected. This will be determined at the 25% Design stage of the MassDOT Permit to Access State Highway process. Reapply high-visibility pavement markings along each approach while maintaining the existing cross-sectional nature of each approach.

Implement traffic sign and pavement marking upgrades in the vicinity of the intersection to eliminate clutter and comply with the current version of the MUTCD.

Retain the existing bicycle lanes along each side of King Street through the intersection.

There is no feasible means at this location to further expand capacity through roadway expansion due to the proximity of buildings and public open space.

Great Road / Stevens Street / Adams Street / Meetinghouse Road

The Proponent has committed to the following improvements at the intersection of Great Road / Stevens Street / Adams Street / Meetinghouse Road as part of Condition B:

- Reconstruct, as necessary, all pedestrian curb ramps at the intersection to provide ADA / AAB / PROWAG compliance. Reapply high-visibility crosswalk markings between each ramp pair.
- Replace out-of-date pedestrian crossing traffic signs along Great Road for each crosswalk with new florescent yellow-green pedestrian crossing signage (W11-2 & W16-7pL) signs and advance pedestrian crossing (W11-2 & W16-9p) traffic signs upstream.

King Street / Goldsmith Street / Stevens Street / 476 King Street Driveway:

The Proponent has committed to the following improvements at the intersection of King Street / Goldsmith Street / Stevens Street / 476 King Street Driveway as part of Condition B:

Reconstruct the intersection's southwest corner between King Street and Goldsmith Street to provide a new curb line in conjunction with a curb extension to shorten pedestrian crossing distance and remove excess pavement area.

Construct a curb extension along the easterly side of Stevens Street, north of Goldsmith Street, to shorten pedestrian crossing distance and remove excess pavement area. Relocate the Goldsmith Street stop sign (R1-1) and stop line as necessary. Retain the existing bicycle lane along Steven Street.

Reconstruct, as necessary, all pedestrian curb ramps at the intersection to provide ADA / AAB / PROWAG compliance. Reapply high-visibility crosswalk markings between each ramp pair.

Replace out-of-date pedestrian crossing traffic signs along Great Road with new florescent yellow-green pedestrian crossing signage (W11-2 & W16-7pL) signs and advance pedestrian crossing (W11-2 & W16-9p) traffic signs upstream.

Other Pedestrian Infrastructure Upgrades

The Proponent will reconstruct accessible pedestrian ramps and crosswalks with appropriate pedestrian crossing signage (W11-2 & W16-7pL) signs and advance pedestrian crossing (W11-2 & W16-9p) traffic signs upstream, as needed, at the following locations prior to the following phasing conditions:

- Great Road / 410 Great Road Driveway (as part of Condition D)
- King Street / 410 Great Road Driveway (as part of Condition D)
- King Street / Meetinghouse Road (as part of Condition C)
- King Street / Tuttle House Driveway (as part of Condition C)
- King Street / Site Driveway South (as part of Condition C)
- King Street / Site Driveway Middle (as part of Condition C)
- King Street / Site Driveway North (as part of Condition C)

3.3.1.2 Corridor Improvements

Great Road

The Proponent has committed to the following improvements along the Great Road corridor as part of Condition B, unless otherwise noted:

- The Proponent will reconstruct ±400 feet of existing sidewalk along the southerly side of Great Road along the Site frontage of 410 Great Road with 6-inch vertical granite curbing to provide separation between vehicle and pedestrian traffic as part of Condition D.
- The Proponent will construct a new 580-foot sidewalk connection with vertical granite curbing along the northerly side of Great Road from the Site Driveway West to the I-495 NB Ramps. This improvement includes the following:
  - The 5-foot sidewalk will be constructed to maintain a consistent 2-foot shoulder present between King Street and a point 200-feet west of the Site Driveway West so not to impact a culvert headwall and culvert present below the I-495 NB Ramps at the west end of the guardrail adjacent to the Great Road channelized right-turn lane to I-495 NB. The guardrail will be replaced, where needed, at the back of the sidewalk.
  - Slight realignment of the Great Road channelized right-turn lane to I-495 NB to accommodate the sidewalk location and provide an unsignalized crosswalk across with appropriate traffic signs across the Great Road channelized right-turn lane to I-495 NB.
  - A minor modification in the stormwater swale along the northerly side of Great Road east of the Great Road channelized right-turn lane to I-495 NB between the drainage headwall to the east and the culvert headwall to the west.

A conceptual layout of the requested section of Great Road sidewalk is presented in Figure 3-2.

King Street Common   Littleton, Massachusetts

Figure 3-2

Great Road Sidewalk Layout

TEC The Engineering Corp

King Street

The Proponent has committed to the following improvements along the King Street corridor as part of Condition C, unless otherwise noted:

- ♦ The Proponent will reconstruct ±1,450 feet of existing sidewalk along the westerly side of King Street along the Site frontage between the Tuttle House Driveway and Site Driveway north as a 10-foot SUP with a 2-foot hardscape buffer and 6-inch vertical granite curbing to provide separation between vehicle and pedestrian traffic. The SUP will provide Site connectivity on each driveway into the Site.

- ♦ The Proponent will construct ±250 feet of new 8-foot wide (narrower) SUP along the westerly side of King Street along the Site frontage between Site Driveway north and the north end of Building Q. The SUP will wrap around the outside of a prominent public shade tree in front of the former Yangtze Restaurant property which the Town of Littleton has directly identified to the Proponent that they wish to retain.

- ♦ The Proponent will commit to constructing up to three pedestrian crossing locations across King Street between Meetinghouse Road and Site Driveway North where sufficient right-of-way exists. These locations would include, at a minimum, high-visibility crosswalks, pedestrian curb ramps, far-side level landings areas to allow for formal pedestrian areas on the easterly side of the roadway, and fluorescent yellow-green pedestrian warning and advance warning signage (W11-2, W16-7p, and W16-9p). One of these crossings will be located near the northerly extent of the Project (Building Q) at the request of MassDOT in order to facilitate transitions from roadway to SUP and bicycle lanes.

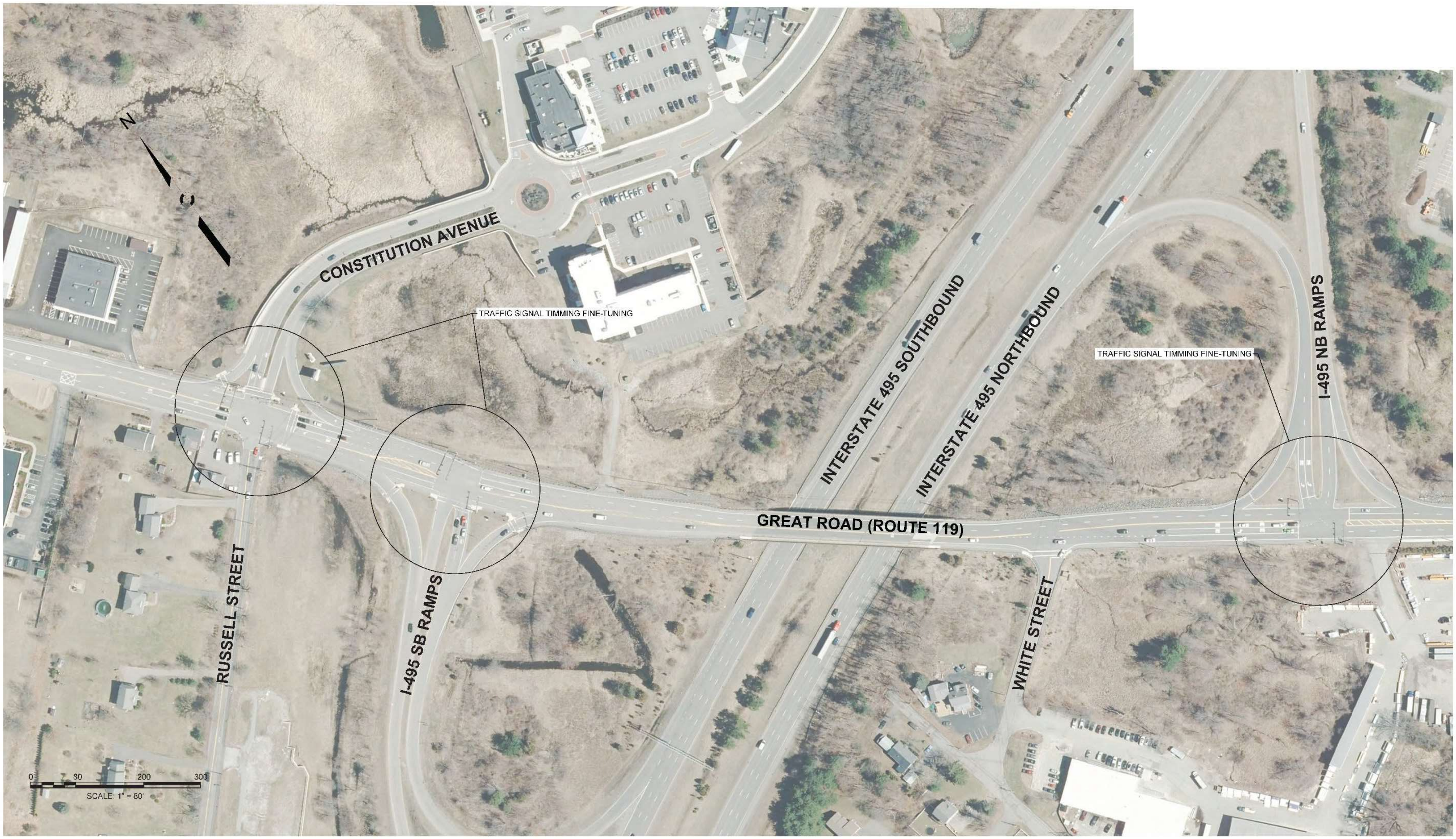
- ♦ King Street Cross Section – Complete Streets Layout:

    - o The Proponent will hold the easterly edge of pavement along King Street and box widen, where needed, along the westerly edge of pavement to provide a cross-section along the King Street site frontage between the Tuttle House Driveway and Site Driveway North to include an 11-foot travel (11-foot two-way left-turn lane south of Village Street) and 5-foot bicycle (minimum) in each direction or travel. This may result in a slight shift in roadway centerline that would be corrected through pavement shimming or similar methods.

A conceptual layout of off-site mitigation is presented in Figures 3-3A and 3-3B. Typical cross-sections of the King Street Complete Streets layout are presented in Figures 3-4A and 3-4B.

3.3.2 Transportation Demand Management Measures

The Proponent has committed to research and provide a dynamic TDM program in order to reduce vehicular trips to/from the Site. The Proponent is committed to providing the following TDM measures.



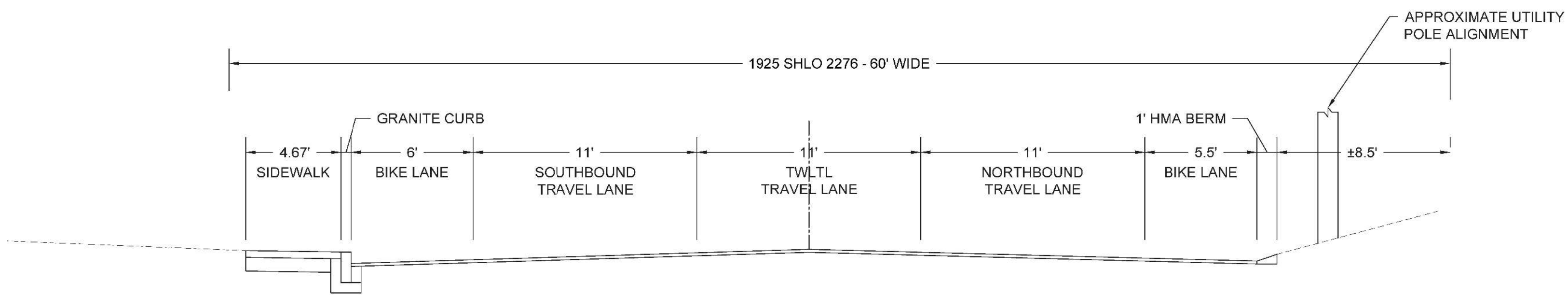
King Street Common Littleton, Massachusetts

Figure 3-3A
Off-Site Mitigation Overview - A

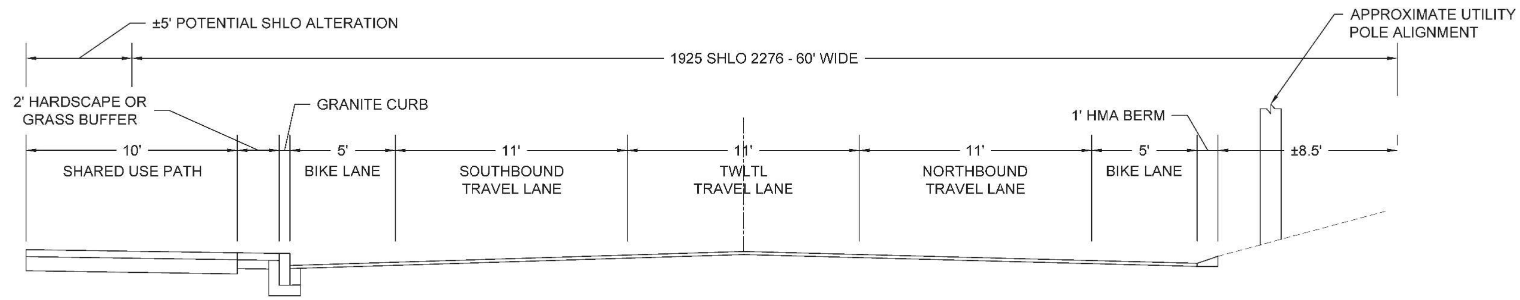
King Street Common **Littleton, Massachusetts**

Figure 3-3B
Off-Site Mitigation - Overview B

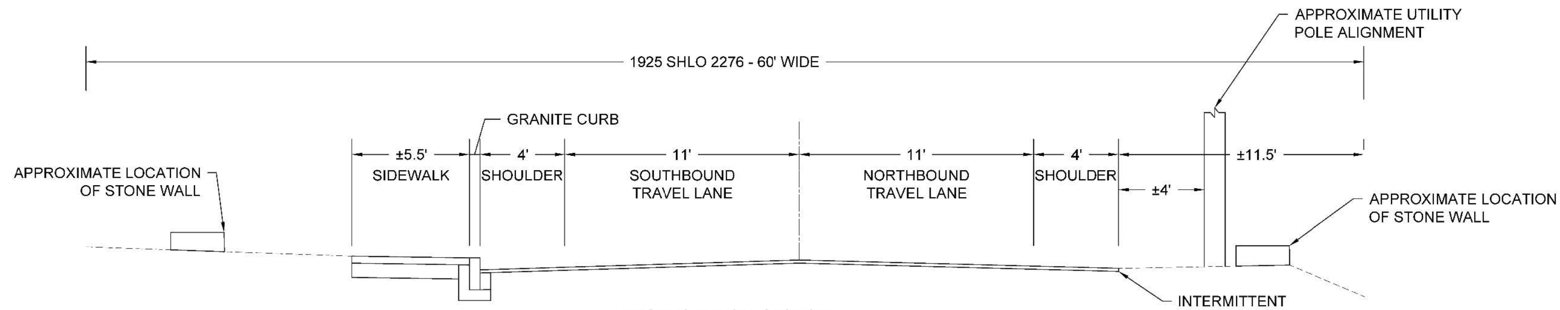
TEC The Engineering Corp



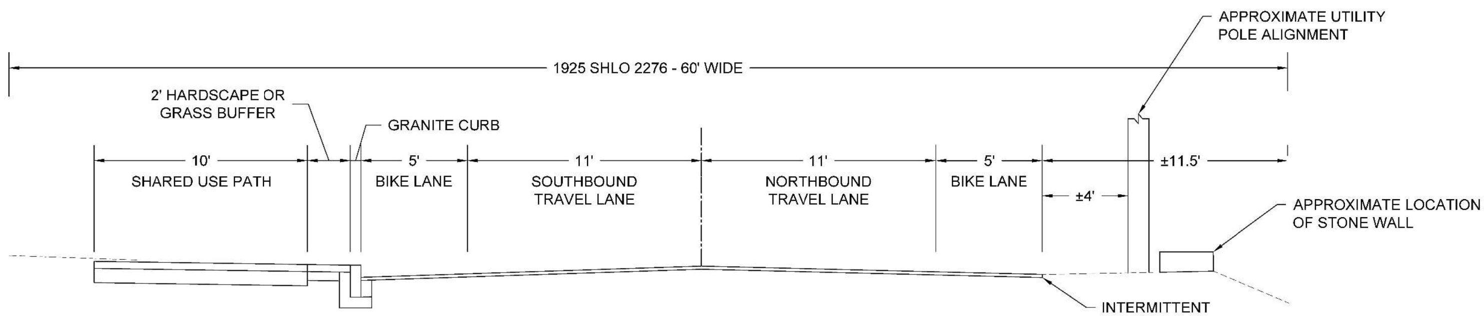
EXISTING TYPICAL SECTION
KING STREET
SOUTH OF AUMAN STREET
N.T.S.



PROPOSED TYPICAL SECTION
KING STREET
SOUTH OF AUMAN STREET
N.T.S.



EXISTING TYPICAL SECTION
KING STREET
NORTH OF 553 KING STREET DRIVEWAY
N.T.S.



PROPOSED TYPICAL SECTION
KING STREET
NORTH OF 553 KING STREET DRIVEWAY
N.T.S.

3.3.2.1 Parking Measures

Preferential Parking – Provide preferential parking for rideshare, carpool, and hybrid vehicles at locations throughout the Site's parking areas in close proximity to major entranceways. The designated spaces will be monitored to ensure that the license plates of those employees parking in the spots each day match the registrations of participants. Employees will only be allowed to use these spaces on the days that they are carpooling.

Electric Vehicle Stations – Electric vehicle (EV) charging stations will be provided at locations throughout the Site's parking areas in close proximity to major entranceways. The Proponent has committed to 20% of parking spaces being EV-ready.

Reduced Parking Supply – The Proponent is committed to reducing the parking supply by providing a minimal number of parking spaces to only the needed level of the demand.

3.3.2.2 Bicycle and Pedestrian Measures

Sidewalk Connectivity – The Site will provide connectivity of sidewalk infrastructure along King Street and Great Road and internal to the Site to each building within the construction limits for both the 410 Great Road and 550 King Street locations.

Bicycle Accommodations – The Site will include bicycle accommodation through the main drive aisle of the Site with connectivity to bicycle infrastructure along King Street. Internal bicycle accommodation may include bicycle lanes and/or shared use paths.

Bicycle Racks – The Proponent will provide secure, weather protected, long-term bicycle parking for employees and residents at designated locations within the Site. The Site plan will also provide bicycle racks for short-term users at several locations on-site.

Public Bicycle Vendor – The Proponent is exploring opportunities to implement a public bicycle vendor, such as Blue Bikes, on-site. If deemed feasible, a vendor station will be strategically located within the Site.

Employee Shower Facilities – The Proponent will coordinate with commercial tenants to provide showers for employees who commute by walking or biking.

Pedestrian Signal Equipment – See Off-Site Mitigation Commitments

Accessibility Compliance in Vicinity of Site – See Off-Site Mitigation Commitments

3.3.2.3 Public Transportation Measures

LRTA Bus Service – The Proponent seeks to continue LRTA bus service to the Site along LRTA Bus Route 15. The Proponent will relocate the existing bus stop location to a new location within the Site and provide a second bus stop location; each along the main drive aisle in the southbound direction. Each bus stop location will contain a pavement turn-out, bus shelter, trash receptacle, bike rack, and sufficient hardscape area to accommodate full accessibility and bus ramp access.

Public Transportation Shuttle Service – The Proponent is committed to providing access to the Littleton / I-495 Commuter Rail Station located approximately 2.5 miles south of the Project Site along Foster Street. The shuttle will be funded by the Proponent and be scheduled to coincide with train boarding / alighting schedules for the MBTA Fitchburg Line. The shuttle stop will be combined with one of the two LRTA bus stops on-site.

Maps / Schedules – Public transportation schedules with transit maps for LRTA Bus Route 15 and the MBTA Commuter Rail, as well as for all nearby connecting routes will be provided to each resident upon move-in and employees upon employment. Maps and schedules will also be posted on each floor of the residential buildings. Schedules and maps will also be provided in the lobby and near doorways in all other on-site buildings.

3.3.2.4 Standard TDM Measures

Employee Transportation Coordinator (ETC) – An ETC will be provided on-site to oversee, implement, monitor, and evaluate TDM measures, employed or funded by the Proponent. The ETC will be responsible for managing rideshare and carpool programs, as well as distributing information to residents and employees to encourage alternative means of transportation. The ETC will be responsible for posting and distributing announcements, holding promotional events to encourage rideshare, bicycling, and walking.

Transportation Management Association (TMA) – The Proponent will seek membership in the reformed Crosstown Connect TMA. Although the status of reformation is not currently an active part of the development, the Proponent will look at opportunities to assist in the reformation of this TMA. The TMA will assist the Proponent and the ETC in support of employees' commuting choices by providing flexible and sustainable transportation solutions.

Wayfinding – The Proponent will provide wayfinding signs within the Project Site to direct residents, patrons, and other visitors to the appropriate driveway and access to pedestrian, public transportation, and bicycle facilities.

Marketing of Transportation Options and Benefits – A welcome packet for all tenants and employees will be distributed at move-in or employment which includes information for all transportation related benefits, promotions, and local transportation options. It will also provide the location of LRTA / MBTA stops, transit schedules, EV and carpool parking locations, and any other emerging new mobility locations.

Vanpool and Carpool – The Proponent and the ETC will encourage vanpool and carpooling participation through marketing, events, and vanpool formation meetings. The ETC will implement a ride-matching program to assist employees and residents in finding appropriate carpool matches. The ETC will contact employees and residents to determine if they receive their match-lists, review the lists with them, and see if they have contacted anyone on the list or would like assistance in contacting people.

Guaranteed Ride Home Program – The ETC will be responsible for providing all employees who carpool, bicycle, or walk to work with an emergency ride home. This program eliminates the fear of being stranded on days that the employees are ridesharing or having to walk or bicycle in inclement weather conditions.

On-Site Laundry Services – The Proponent will provide laundry services on-site to allow for the reduction of trips to/from the Site of nearby laundromats.

Flex Hours – The Proponent will encourage tenants within the mixed-use development to provide flexible hours to employees.

Direct Deposit for Employees – The Proponent will encourage tenants within the mixed-use development to provide direct deposit to reduce employee trips to/from the Site.

Site Amenities – As a mixed-use development, the Site includes several on-site amenities, such as restaurants, retail, open space, and resident-specific amenities within the residential component of the Site. This location will assist in reducing vehicular demand and increase multi-use trips, which include parking capacity sized to meet minimum local requirements without providing excessive parking.

Promotional Events and Activities – The ETC will be responsible for organizing promotional events and activities to encourage rideshare and alternative transportation means. In addition, the ETC will distribute brochures to all new employees and residents as well as post posters and bulletins on various subjects from carpooling to the Guaranteed Ride Home program throughout the Site.

3.3.3 Transportation Monitoring Program

The Proponent is committed to implementing a Transportation Monitoring Program (TMP) which is intended to monitor traffic operations, parking occupancy, public transportation utilization, and pedestrian / bicycle use for a period following completion of the Project. The TMP will include providing traffic count information to the MassDOT District 3 office and the Town of Littleton for use of tracking site-generated trips. The intent of the monitoring program is to ensure that the Project impacts are consistent with those predicted in the Project's permitting process, evaluate the effectiveness of the TDM measures in meeting the mode share targets, and assess the need for additional off-site improvements or TDM measures.

The MassDOT / Town of Littleton monitoring program will include an evaluation of the following:

- Traffic operations at the intersections of:
  - Great Road / Interstate 495 SB Ramps
  - Great Road / Interstate 495 NB Ramps
  - Great Road / Site Driveway West
  - Great Road / 410 Great Road Driveway
  - Great Road / King Street
  - King Street / 410 Great Road Driveway
  - King Street / Tuttle House Driveway
  - King Street / Site Driveway South
  - King Street / Site Driveway Middle
  - King Street / Site Driveway North
- Adequacy of the constructed parking supply
- Safety evaluations based on available crash data
- Effectiveness of TDM measures

As part of the monitoring program, the Proponent will complete the following tasks annually for five years following occupancy of the proposed mixed-use development:

- Collect manual Turning Movement Counts (TMCs) during the weekday morning (7:00 AM to 9:00 AM), weekday evening (4:00 to 6:00 PM), and Saturday midday (11:00 AM to 2:00 PM) peak periods at the following intersections:
  - Great Road / Interstate 495 SB Ramps
  - Great Road / Interstate 495 NB Ramps
  - Great Road / Site Driveway West
  - Great Road / 410 Great Road Driveway
  - Great Road / King Street
  - King Street / 410 Great Road Driveway
  - King Street / Tuttle House Driveway
  - King Street / Site Driveway South
  - King Street / Site Driveway Middle

- King Street / Site Driveway North

♦ Collect ATR data for a continuous 7-day week-long period along Great Road, King Street, and each of the Site Driveway locations.

♦ Collect parking demand counts during the peak parking demand periods for the specific land use areas, including:

  - Residential and Hotel - 5:00 AM to 9:00 AM
  - Retail, Restaurants, R&D, Office, and Industrial - 10:00 AM to 5:00 PM

♦ Collect motor vehicle crash reports from the Town of Littleton Police Department and MassDOT for the most recent one-year period to ascertain changes in crash frequency, crash trends, and severity at the monitored locations.

♦ Complete an employee and resident travel survey to gage employee and resident travel patterns and mode share.

♦ Compare the TMCs collected above with those projected within the Traffic Impact, Access, and Parking Study (TIAPS) for the Project to determine whether the total vehicles entering each intersection exceeds the volumes projected.

♦ Perform a capacity and queuing analysis using Synchro / Sidra analysis software to evaluate the traffic operations at each of the intersections listed above and compare to the operations projected in the TIAPS prepared for the Project.

♦ Assess whether additional mitigation is necessary at any of the study intersections and identify measures to improve operations and/or reduce vehicular traffic volumes. The need or evaluation for further mitigation will be conditioned upon:

  - The measured Site generated traffic volumes for the Project exceeded the projected Site generated traffic volumes established in this TIAPS, or subsequent revisions as presented to the Town of Littleton, by more than 10 percent (i.e., 110 percent of the projected Site generated traffic volumes).
  - One or more of the movements at the monitored intersections is identified to be operating at or over capacity (defined as a V/C ratio equal to or exceeds 1.00) in consultation with MassDOT or the Town of Littleton.
  - There is a pronounced increase in the frequency of occurrence of motor vehicle crashes at a monitored location and the calculated motor vehicle crash rate exceeds the MassDOT average crash rate for similar locations.

- ♦ Corrective actions to reduce the unmitigated impact of the Project should be proposed and implemented based on the thresholds listed above. The corrective actions should be documented in the TMP, approved and coordinated with the Town and/or MassDOT if desired by the agencies, and be undertaken by the Proponent subject to receipt of all necessary rights, permits, and approvals.

- ♦ Assess whether the constructed parking supply is adequate for the parking demand as observed.

- ♦ Prepare a memorandum summarizing the results of the TMCs, ATRs, parking demand counts, traffic impact analysis for submission to MassDOT District 3 and the Town of Littleton.

The monitoring program will occur on an annual basis beginning six months after issuance of the first occupancy permit and continuing for five years following full occupancy of the Project. The monitoring program may be suspended at any time upon agreement with MassDOT and the Town of Littleton that the Project has sufficiently provided evidence that the upper limits of vehicle delay and trip projection would not be feasibly satisfied. The annual nature of the monitoring program may be postponed in consultation with the Town and MassDOT based on lack of need circumstances if no new development has occurred during full build-out. The monitoring program may also be suspended if five years have passed since the issuance of an occupancy permit for the Project and it will be recommended should an additional occupancy permit be issued.

Chapter 4.0

Wastewater

4.0 WASTEWATER

This Chapter provides clarifications and additional information requested in MassDEP's comments on the DEIR regarding wastewater flow management and the permitted discharge capacity associated with the existing wastewater treatment plant (WWTP). What follows is a breakdown of wastewater flows into: (1) existing flow associated with current site uses; (2) flow reserved for the Town of Littleton; and (3) projected wastewater flow generated by the proposed Project. This information is presented in the context of the existing and future capacity of the Littleton WWTP and any applicable permitting constraints.

4.1 Proposed Wastewater Flow

The wastewater generated by the proposed Project will be accommodated at the Littleton WWTP. Project implementation will occur in phases, and the advancement of future phases will be aligned with the availability of additional wastewater treatment capacity. As capacity is increased—through permit modifications, infrastructure improvements, or operational enhancements – the Project will progress accordingly to ensure that wastewater flows remain fully compliant with regulatory requirements and do not exceed permitted discharge limits. The Proponent will coordinate with local and state authorities to ensure that the proper disclosures for future phases are made, and permits are obtained.

4.2 Existing Wastewater Flow: 550 King Street

The existing wastewater flow figure of 63,577 gpd for the 550 King Street parcel cited in the DEIR was calculated using a design flow rate associated with the current uses of the Site. It does not reflect historical use of the Site and is not representative of current operating conditions. For clarification, in 2022 the existing office buildings were closed and subsequently the on-site treatment plant was inactive, so the existing figure represents a theoretical use where the actual value was zero gpd. The Proponent then purchased the property and in July 2023 was made aware that the current discharge permit was about to expire. The owner worked diligently with a consultant on the matter and, on November 28, 2023, a new groundwater discharge permit (Permit No. 79-7) was issued. As noted in MassDEP's comments, the current groundwater discharge permit authorizes up to 40,000 gallons per day of treated effluent. This permit is included as Appendix C of the FEIR. Any necessary modifications to the existing discharge permit or facility operations will be pursued in consultation with MassDEP and other relevant authorities.

4.3 Existing Wastewater Flow: 410 Great Road

The existing wastewater treatment system at the 410 Great Road parcel currently consists of an on-site Title 5 septic system designed to serve the historic uses of the property. When the Proponent purchased the property, they were made aware of a failed inspection report from 2022. The Owner has begun to vacate the property with plans to decommission the existing buildings on-site as well as the associated existing septic system. As part of the proposed development, wastewater flows from 410 Great Road will be routed to the Littleton WWTP, facilitating more efficient and centralized treatment. Project advancement will be contingent upon securing adequate treatment capacity, through either existing permitted capacity, planned infrastructure improvements, or permit modifications in coordination with MassDEP.

4.4 Future Wastewater Capacity

The Proponent continues to coordinate with the Town on securing additional wastewater capacity. The Town's ongoing efforts to increase capacity at the Littleton WWTP to accommodate the projected flows from the proposed Project has yielded some promising new possibilities; however, there are currently no planned or underway infrastructure improvements, permit modifications, or timelines relevant to expanding treatment capacity. Littleton Electric Light and Water Department (LELWD) continues to have dialogue with MassDEP but, at this time, LELWD has not made any significant progress to increasing the permitted discharge at 56 King Street. In Q1 of 2025, LELWD completed an infiltration test and calibrated their hydrological model for this site, and it appears that the model would support an increase in the permitted capacity. LELWD will be submitting a request to amend their permit with Mass DEP in Q4 of 2025.

As additional treatment capacity becomes available, future phases of the Project will proceed accordingly, ensuring that development is aligned with the WWTP's permitted capacity and regulatory requirements. The Project will not discharge wastewater for any phases of the development beyond the currently approved discharge volume of 150,000 gpd until sufficient expansion of the treatment system has occurred and the necessary permits acquired. LELWD will be responsible for obtaining a modified discharge permit with MassDEP for any expansion or increased flow to the system, while the Proponent will need to obtain written approval from LELWD specifying the additional allowed discharge volume from the Project.

Supporting technical analyses and coordination with the Town and regulatory authorities, including MassDEP and MEPA will be provided to demonstrate that wastewater disposal strategies for the Project are feasible and fully permitted or permit-ready.

4.5 Permit Status

Comments from MassDEP requested clarification on permitting for the wastewater flows at the 550 King Street location. The Proponent has a current permit for the existing wastewater flows at the 550 King Street location. On November 28, 2023, a groundwater discharge permit (Permit No. 79-7) was issued. As noted in MassDEP's comments, the current groundwater discharge permit authorizes up to 40,000 gallons per day of treated effluent. Any necessary future modifications to the existing discharge permit or facility operations will be pursued in consultation with MassDEP and other relevant authorities.

Chapter 5.0

Climate Change

5.0 CLIMATE CHANGE

5.1 Site Resilience Update

As described in the Draft EIR, the Proponent has developed the Project to be resistant to future climate conditions including heat. Following recommended practices from the RMAT tool, the Project's design will include efforts to retain existing trees on Site and planting shade trees and/or shrubs in grassed island areas where feasible to reduce the heat island effect; this will help to reduce this localized climate effect on the Site both now and in the future.

Since filing the Draft EIR, the Proponent has committed to expanding the Project's landscaping plan and providing tree replanting at a 1:1 ratio to trees removed. If on-site conditions limit the feasibility of achieving a full 1:1 tree replacement ratio, the Proponent will explore opportunities for off-site planting in coordination with local officials and agencies. These efforts will prioritize areas within the community identified as having limited tree canopy coverage or heightened vulnerability to extreme heat impacts.

Chapter 6.0

Greenhouse Gas Emissions

6.0 GREENHOUSE GAS EMISSIONS

6.1 Introduction and Project Overview

The Greenhouse Gas (GHG) analysis in Chapter 4 of the DEIR addressed the GHG emissions that would be generated by operation of the Project, and options that may reduce those emissions in accordance with the MEPA GHG Policy.

The GHG analysis focused on emissions of carbon dioxide (CO2). As noted in the GHG Policy, although there are other GHGs, CO2 is the predominant contributor to global warming. Furthermore, CO2 is by far the predominant GHG emitted from the types of sources related to this Project, and CO2 emissions can be calculated for these source types with readily available data.

The DEIR Certificate included comments from the MEPA Office and the Department of Energy Resources (DOER). The Project team had a consultation with DOER on September 5, 2025 to review the comments and discuss updates on the proposed designs, and modifications to the analysis scope. In this continuation of the GHG analysis, DOER's comments are addressed.

The Project includes the construction of 18 buildings 1,089 residential units; 115,500 sf of retail; 19,000 sf of office; 545,520 sf of light industrial use (which includes the two large former IBM buildings); and an 111,000 sf hotel (150-rooms) as outlined in Section 1.4 of this FEIR.

The Project buildings were separated into categories by typology for analysis as outlined in Table 6-1 below

Table 6-1 Building Categories

Group	Building Types	Building Label	Proposed Code Compliance
Group 1	Existing – to be reused	**A*** &B	Relative Performance
Group 2	Residential greater than 50 Units	C, D, E, **F***, R, S	HERS Certified Performance
Group 3	Residential less than 50 Units	I, J, **K***, L, N, O	HERS Certified Performance
Group 4	Hotel	G	Relative Performance
Group 5	Retail & Office	H, M, Q	Relative Performance

* Building used as protype for energy model.

6.2 Updates from the DEIR

<u>Hotel Space Heating System</u>

In response to comments from the DOER, the Proponent has updated the proposed mechanical design for the hotel building. Previously, the design included rooftop units with natural gas heat. These have been replaced with air source heat pumps which will provide both heating and cooling using electricity. The domestic hot water for the hotel will be provided using high-efficiency natural gas boilers. As discussed with DOER, this elimination of natural gas use for space heating satisfies the need to provide life cycle cost analysis around gas infrastructure on the Site.

Additional details about this system are provided in Appendix D and in the summary of emissions at the end of this Chapter.

6.3 Energy Modeling Update

Building energy modeling was performed by enviENERGY Studio. Modeling for the hotel and existing buildings was performed using eQuest v3.65, the Passive House models were developed in the WUFI software, and the HERS modeling for the residential buildings was provided by a third-party HERS rater using REM/RATE.

In response to DOER's comment letter on the DEIR, the following updates were made to address the shortcomings of certain energy modeling tools and to present more accurate calculations, particularly for service hot water energy consumption.

- **Group 2 Residential Buildings (more than 50 units):** The electric resistance hot water system was changed from in-unit to central in order to provide a more appropriate comparison with the central heat pump water heating system; however, the basis of design—and the baseline used in the cost analysis—remains in-unit electric resistance water heaters. In the initial analysis, the in-unit electric resistance scenario was compared against the central heat pump system, which resulted in a significantly larger difference in premium cost.

- **Modeling Limitations (TEDI vs. HERS Pathways):** Because of limitations in the modeling tools when comparing TEDI and HERS pathways, the annual hot water heating energy values in the HERS scenarios (for both Group 2 (>50 units) and Group 3 (<50 units)) were replaced with values generated from TEDI models. It is important to note that both HERS and Passive House models tend to underestimate DHW consumption. The remainder of the calculations, including annual energy consumption and GHG emissions, were updated accordingly.

- **Cost Adjustments:** Further review revealed that the cost of in-unit and central electric resistance water heaters had been underestimated. The material costs were therefore updated.

These changes indicate that in Group 2, when only considering operational costs, the central heat pump water heater scenario produces better cash flow compared to the central electric resistance scenario under both HERS and TEDI pathways. In Group 3, the in-unit heat pump water heater scenario generates better cash flow compared to the in-unit electric resistance scenario under both pathways. This outcome is due to the higher efficiency of heat pump water heaters relative to electric resistance heaters. These costs are discussed further in Section 6.4.1.

Finally, it should be noted that there was a slight space heating penalty in **Group 3** scenarios in the DEIR because in-unit heat pump water heaters draw air from the conditioned space, resulting in additional heating load during colder seasons. This was noted in DOER's comment letter and discussed during the Project Team's consultation. Both REM software (used for HERS ratings) and WUFI (used for Passive House modeling) account for this added heating load as well as the reduced cooling load when a heat pump water heater is located inside the unit.

The modeled "Baseline Case" for the existing buildings and the hotel is based on ASHRAE 90.1-2019 Appendix G. In TEDI and Relative Performance Scenarios, the following C406 measures are considered, depending on the sub-scenario, to achieve the required 15 points:

- C4062.3 – Renewable Space Heating (Residential buildings): 15 points;
- C406.2.4 – 10% Cooling Efficiency Improvement (Existing buildings and Hotel): 4 or 1 point;
- C406.3 – Reduced Lighting Power (Existing buildings and Hotel): 7 or 2 points;
- C406.6 – Dedicated Outdoor Air System (Hotel): 8 points;
- C406.7.4 – Heat Pump Water Heater (Hotel): 5 points;
- C406.8 – Enhanced Building Envelope (Hotel): 4 points;
- C406.9 – Reduced Air Infiltration (Hotel): 9 points;
- C406.10 – Energy Monitoring; and
- C406-11 – Fault Detection (Existing building): 2 and 1 point

Because the TEDI and HERS analyses do not utilize an ASHRAE baseline, those results are presented as a comparison between sub scenarios only.

Modeling results for the existing buildings and hotel are summarized in Tables 4-2 and 4-5. Compared to a code-compliant building, the "Proposed Cases" of the Project are expected to decrease GHG emissions by approximately 28.1 percent or approximately 2,186 tons of CO_2/year.

Modeling results for the residential buildings in groups 2 and 3 are provided in Table 6-2 and 6-3.

Detailed modeling inputs and outputs are provided in Appendix D.

Table 6-2 Group 2 -Residential Building Modeling

Group 2 Residential >50 Units (Building F Prototype)

Modeled Conditioned space	173,000 sf									
Design Conditioned space	173,000 sf									
Factor	1.0									
		PROPOSED Scenario 1a (HERS) All Electric + Electric Resistance Water Heating	**Scenario 1b (HERS) All Electric + Heat Pump Water Heating**	**Scenario 1c (HERS) All Electric + solar and resistance Water Heating**	**Scenario 2a (TEDI) All Electric + Electric Resistance Water Heating**	**Scenario 2b (TEDI) All Electric + Heat Pump Water Heating**	**Scenario 2c (TEDI) All Electric + solar and resistance Water Heating**	**Scenario 3a (Passive House) All Electric + Individual HP Water Heating**	**Scenario 3b (Passive House) All Electric + Central Heat Pump Water Heating**	**Scenario 3c (Passive House) All Electric + Solar and Backup Electric Water Heating**
DIRECT (NATURAL GAS)		MMBtu/yr	MMBtu/yr	MMBtu/yr	MMBtu/yr	MMBtu/yr	MMBtu/yr	MMBtu/yr	MMBtu/yr	MMBtu/yr
	subtotal	-	-	-	-	-	-	-	-	-
INDIRECT (ELECTRICITY)		MWh/yr	MWh/yr	MWh/yr	MWh/yr	MWh/yr	MWh/yr	MWh/yr	MWh/yr	MWh/yr
	subtotal	1,158	936	915	1,344	1,104	1,101	967	914	854
ENERGY USE INDEX		kBtu/sf/yr	kBtu/sf/yr	kBtu/sf/yr	kBtu/sf/yr	kBtu/sf/yr	kBtu/sf/yr	kBtu/sf/yr	kBtu/sf/yr	kBtu/sf/yr
		22.8	18.5	18.0	26.5	21.8	21.7	19.1	18.0	16.9
GHG EMISSIONS (2023)		tons/yr	tons/yr	tons/yr	tons/yr	tons/yr	tons/yr	tons/yr	tons/yr	tons/yr
Direct	Gas-Burning	0	0	0	0	0	0	0	0	0
Indirect	Electricity	394	318	311	457	376	375	329	311	291
	Total (2025)	394	318	311	457	376	375	329	311	291
GHG EMISSIONS (2035)		tons/yr	tons/yr	tons/yr	tons/yr	tons/yr	tons/yr	tons/yr	tons/yr	tons/yr
Direct	Gas-Burning	0	0	0	0	0	0	0	0	0
Indirect	Electricity	26	21	21	30	25	25	22	21	19
	Total (2050)	26	21	21	30	25	25	22	21	19

CO_2 Emission Factors:

Year	2025	2050	
Electricity [1]	750	50	lb/MWh
Natural Gas [2]	117	117	lb/MMBtu

[1] DOER letter on the Project's DEIR dated August 21, 2025

[2] EIA Fuel Emissions Factors, Weighted National Average (1029 Btu/scf)

Table 6-3 Group 3 -Residential Building Modeling

Group 3 Residential < 50 Units (Building K Prototype)								
Modeled Conditioned space		92,860 sf						
Design Conditioned space		92,860 sf						
Factor		1.0						
			PROPOSED Scenario 1a (HERS) All Electric + Electric Resistance Water Heating	Scenario 1b (HERS) All Electric + Heat Pump Water Heating	Scenario 2a (TEDI) All Electric + Electric Resistance Water Heating	Scenario 2b (TEDI) All Electric + Heat Pump Water Heating	Scenario 3a (Passive House) All Electric + Individual HP Water Heating + 16.5 kW PV Array*	Scenario 3b (Passive House) All Electric + Central Heat Pump Water Heating + 7.5 kW PV Array**
DIRECT (NATURAL GAS)			MMBtu/yr	MMBtu/yr	MMBtu/yr	MMBtu/yr	MMBtu/yr	MMBtu/yr
		subtotal	-	-	-	-	-	462
INDIRECT (ELECTRICITY)			MWh/yr	MWh/yr	MWh/yr	MWh/yr	MWh/yr	MWh/yr
		subtotal	537	434	584	461	403	404
ENERGY USE INDEX			kBtu/sf/yr	kBtu/sf/yr	kBtu/sf/yr	kBtu/sf/yr	kBtu/sf/yr	kBtu/sf/yr
			19.7	15.9	21.5	17.0	14.8	19.8
GHG EMISSIONS (2023)			tons/yr	tons/yr	tons/yr	tons/yr	tons/yr	tons/yr
Direct	Gas-Burning		0	0	0	0	0	25
Indirect	Electricity		183	148	199	157	137	137
		Total (2025)	183	148	199	157	137	162
GHG EMISSIONS (2035)			tons/yr	tons/yr	tons/yr	tons/yr	tons/yr	tons/yr
Direct	Gas-Burning		0	0	0	0	0	25
Indirect	Electricity		12	10	13	10	9	9
		Total (2050)	12	10	13	10	9	34

CO_2 Emission Factors:			
Year	2025	2050	
Electricity [1]	750	50	lb/MWh
Natural Gas [2]	117	117	lb/MMBtu

[1] DOER letter on the Project's DEIR dated August 21, 2025

[2] EIA Fuel Emissions Factors, Weighted National Average (1029 Btu/scf)

Table 6-4 Hotel Energy Modeling

		Hotel								
Modeled Conditioned space	111,000	sf								
Design Conditioned space	111,000	sf								
Factor	1.0									
		Baseline Case (ASHRAE 90.1-2019, App. G)	PROPOSED Scenario 2a Heat Pump Space Heating + Gas Kitchen + Central Gas Water Heating	Scenario 2b Heat Pump Space Heating + Gas Kitchen + Electric Resistance Water Heating	Scenario 2c Heat Pump Space Heating + Gas Kitchen + Central Heat Pump Water Heating	Scenario 2d Heat Pump Space Heating + Gas Kitchen + Solar and Backup Elec Resistance Water Heating	Scenario 3a Heat Pump Space Heating + C406.9 + Gas Kitchen + Central Gas Water Heating	Scenario 3b Heat Pump Space Heating + C406.9 + Gas Kitchen + Electric Resistance Water Heating	Scenario 3c Heat Pump Space Heating + C406.9 + Gas Kitchen + Central Heat Pump Water Heating	Scenario 3d Heat Pump Space Heating + C406.9 + Gas Kitchen + Solar and Backup Elec Resistance Water Heating
DIRECT (NATURAL GAS)		MMBtu/yr	MMBtu/yr	MMBtu/yr	MMBtu/yr	MMBtu/yr	MMBtu/yr	MMBtu/yr	MMBtu/yr	MMBtu/yr
	subtotal	4,215	1,435	478	478	478	1,435	78	478	478
INDIRECT (ELECTRICITY)		MWh/yr	MWh/yr	MWh/yr	MWh/yr	MWh/yr	MWh/yr	MWh/yr	MWh/yr	MWh/yr
	subtotal	1,310	1,039	1,299	1,112	1,105	1,034	1,293	1,101	1,094
ENERGY USE INDEX		kBtu/sf/yr	kBtu/sf/yr	kBtu/sf/yr	kBtu/sf/yr	kBtu/sf/yr	kBtu/sf/yr	kBtu/sf/yr	kBtu/sf/yr	kBtu/sf/yr
		78.2	44.9	44.2	38.5	38.3	44.7	40.5	38.1	37.9
Diff, % (compared to baseline)			**-43%**	**-43%**	**-51%**	**-51%**	**-43%**	**-48%**	**-51%**	**-52%**
GHG EMISSIONS (2023)		tons/yr	tons/yr	tons/yr	tons/yr	tons/yr	tons/yr	tons/yr	tons/yr	tons/yr
Direct	Gas-Burning	224	76	25	25	25	76	4	25	25
Indirect	Electricity	446	354	442	378	376	352	440	374	372
	Total (2025)	669	430	467	404	401	428	444	400	398
	Diff, tpy		**-240**	**-202**	**-266**	**-268**	**-242**	**-225**	**-270**	**-272**
Diff, % (compared to baseline)			**-35.8%**	**-30.2%**	**-39.7%**	**-40.0%**	**-36.1%**	**-33.7%**	**-40.3%**	**-40.6%**
GHG EMISSIONS (2035)		tons/yr	tons/yr	tons/yr	tons/yr	tons/yr	tons/yr	tons/yr	tons/yr	tons/yr
Direct	Gas-Burning	224	76	25	25	25	76	4	25	25
Indirect	Electricity	30	24	29	25	25	23	29	25	25
	Total (2050)	253	100	55	51	50	100	33	50	50
	Diff, tpy		**-154**	**-199**	**-203**	**-203**	**-154**	**-220**	**-203**	**-203**
Diff, % (compared to baseline)			**-23.0%**	**-29.7%**	**-30.3%**	**-30.3%**	**-23.0%**	**-32.9%**	**-30.3%**	**-30.4%**
CO_2 Emission Factors:										
Year	2025	2050								
Electricity [1]	750	50								
Natural Gas [2]	117	117								

[1] DOER letter on the Project's DEIR dated August 21, 2025

[2] EIA Fuel Emissions Factors, Weighted National Average (1029 Btu/scf)

6.4 Alternatives Cost Analysis

The Proponent's design team has selected the proposed designs described previously to strike a balance between energy efficiency and cost effectiveness. The design team produced a cost study that reviewed design, material and operational differences between the scenarios requested by DOER. This study helped inform the Proponent on the viability of the designs and demonstrates that the most practicable amount of mitigation is present in the Proposed designs.

Please refer to Appendix D for cost analysis that compares construction and operational estimates for each examined alternative.

6.4.1 Domestic Hot Water

Utilizing the domestic hot water consumption values from the TEDI models and existing databases, the team estimated the annual hot water energy use per unit for each residential group. Group 2 (>50 units) utilizes a central heat pump water heating system, for which we assumed the use of high-efficiency commercial CO_2 heat pumps. These systems can achieve a COP of 5, resulting in greater savings compared to in-unit heat pump water heaters, which were modeled with a COP of 3. This study shows that the residential buildings planned for the entire campus can save approximately $175,000 annually by central utilizing heat pump water heating systems, representing about 50% savings in annual operating costs.

However, there are design costs that, because the Project is early in design, cannot be accurately estimated along with the significantly higher up front cost of a central heat pump water heating system compared to in-unit electric resistance heaters that disadvantage this option. The cost increase is estimated at approximately $500,000 for a 150-unit building.

Finally, because the units are expected to be rented, the Proponent would not be able to appropriately bill tenants for the energy use associated with their hot water and the operational savings would not pay back the Proponent's capital investment

For these reasons, central hot water systems are not feasible for the Project at this time. The residential units that are planned across the campus will be constructed in phases and the Proponent will continue to evaluate designs and technologies that can reduce energy usage and operational costs as these phases progress. Additional information and cash flows that take expected conditions into account for hot water systems are provided in Appendix D.

6.5 Summary and Mitigation Commitments

6.5.1 Project GHG Summary

Tables 6-5 and 6-6 present a summary of the project GHG emissions for the Baseline and Proposed cases. Because the HERS studies do not calculate a baseline, the Project summary improvement over baseline includes the reductions shown by the hotel and existing buildings only. GHG emissions from the Project's stationary sources are calculated to be approximately 5,854 tons per year once fully complete compared to a baseline of 8,027 tons per year. This 2,186-ton per year reduction represents a 27.1 percent reduction in GHG emissions.

Table 6-7 shows the estimated total annual GHG emissions expected for the Project.

Table 6-5 Project Baseline Stationary Source GHG Totals by Building Type

Building Group	Modeled Building CO_2 (tons)	Modeled Building Size (sf)	Modeled Building CO_2/sf	Group Total Area (sf)	Total CO_2 by Building Type (tons)
Group 1 -Existing	2,720	279,619	0.0097	545,529	5307
Group 2 Residential >50 Units	183	173,000	0.0011	1,129,269	1192
Group 3 Residential <50 Units	394	92,860	0.0042	244,585	1038
Hotel	669	111,000	0.0060	111,000	669
Total	3,966				8,027

Table 6-6 Project Proposed Stationary Source GHG Totals by Building Type

Building Group	Modeled Building CO_2 (tons)	Modeled Building Size (sf)	Modeled Building CO_2/sf	Group Total Area (sf)	Total CO_2 by Building Type (tons)
Group 1 -Existing	1,730	279,619	0.0062	545,529	3375
Group 2 Residential >50 Units	155	173,000	0.0009	1,129,269	1192
Group 3 Residential <50 Units	394	92,860	0.0033	244,585	1038
Hotel	430	111,000	0.0037	111,000	430
Total	2,709				6,035

Table 6-7 Project GHG Emissions Summary

	Baseline	Proposed	Difference	
		tons/yr	tons/yr	Percent Change
Stationary Sources	8,027	6,035	-2,172	-26.5
Mobile Sources	3,710	3,690	-20	-1%

6.5.2 Proponent's Commitments to GHG Reduction

The Proponent is committed to environmental stewardship. As the Project design develops further, the Proponent expects that additional technologies described previously, or possibly new technologies developed in the interim period, may be adopted that will further decrease GHG emissions, but these are not yet ripe for selection. The Proponent will encourage the continued evaluation of energy efficiency and renewable energy measures throughout the life of the Project.

The Proponent is committed to the following mitigation elements for the Project:

- High performance building envelope;
- Light or reflective roofs;
- Reduced lighting power densities;
- High-efficiency HVAC equipment;
- Air source heat pump heating and cooling in residential and hotel buildings;
- High performance exterior lighting;
- Energy Star appliances;
- Low-flow fixtures;
- Recycling collection areas; and
- Construction waste recycling.

The Proponent has included in the design of the buildings, all feasible GHG emissions mitigation in order to avoid, reduce, minimize, or mitigate damage to the environment.

The Proponent is committed to implementing the energy efficiency and GHG emission reduction measures presented in this analysis but must retain an amount of design flexibility to allow for changes that will inevitably occur as design progresses. If, during design of the project, a specific combination of design strategies proves more advantageous from an engineering, economic, or space utilization perspective, the design of the buildings may vary from what has been described herein. Energy performance minima and associated GHG emission reductions will be adhered to.

6.5.3 Proponents' Commitments to Self-Certification

Upon completion of each building or group of buildings, the Proponent will submit a self-certification to the MEPA Office, prepared in accordance with the GHG Policy. This certification will identify the GHG mitigation measures incorporated into the building and will illustrate the degree of GHG reduction from a Baseline case, as Baseline is defined herein, and how such reductions are achieved. Details of the Proponent's implementation of operational measures will also be included.

Chapter 7.0

Mitigation and Draft Section 61 Findings

7.0 MITIGATION AND DRAFT SECTION 61 FINDINGS

7.1 Introduction

M.G.L. c. 30, s. 61 requires that "[a]ll authorities of the Commonwealth ... review, evaluate, and determine the impact on the natural environment of all works, projects or activities conducted by them and ... use all practicable means and measures to minimize [their] damage to the environment. ... Any determination made by an agency of the Commonwealth shall include a finding describing the environmental impact, if any, of the project and a finding that all feasible measures have been taken to avoid or minimize said impact." Each state agency that issues a permit for the Project shall issue a Section 61 Finding in connection with permit issuance, identifying mitigation that is relied upon to satisfy the Section 61 requirement. A proposed Section 61 Finding is provided in Section 7.3, and a table of mitigation measures is included as part of the Section 61 Finding.

7.2 Anticipated State Permits and Approvals

Table 7-1 identifies the Agencies that are expected to take Agency Action on the proposed Project and, therefore, issue Section 61 Findings. It also identifies the Agency Actions anticipated to be required.

Table 7-1 Anticipated State Permits and Approvals

Agency Name	Permit / Approval
Executive Office of Energy and Environmental Affairs	Massachusetts Environmental Policy Act (MEPA) Review
Massachusetts Department of Transportation	State Highway Access Permit
Massachusetts Department of Environmental Protection	WP 68 Treatment Works Plan Approval for Ground Water Discharge and Reclaimed Water Use Facilities, without Permit Modification Groundwater Discharge Permit, if required Wetlands Notice of Intent

7.3 Proposed Section 61 Findings

Project Name: King Street Common

Project Location: 550 King Street, Littleton, MA

Project Proponent: Lupoli Development

EEA Number: 16921

Date Noticed in Monitor: October 22, 2025

The potential environmental impacts of the Project have been characterized and quantified in the ENF dated January 31, 2025, the Draft EIR dated June 2, 2025, and this Final EIR, which are incorporated by reference into this Section 61 Finding. Throughout the planning and environmental review process, the Proponent has been working to develop measures to mitigate significant impacts of the Project. With the mitigation proposed and carried out in cooperation with state agencies, the [Agency] finds that there are no significant unmitigated impacts.

The Proponent recognizes that the identification and implementation of effective mitigation measures throughout the life of the Project, is central to its responsibilities under the Massachusetts Environmental Policy Act (MEPA). The Proponent has accordingly prepared the annexed Table of Mitigation Measures that specifies the mitigation that the Proponent will provide.

Now, therefore, [Agency], having reviewed the MEPA filings for the Project, including the mitigation measures itemized on the annexed Table of Mitigation Measures, finds pursuant to M.G.L. C. 30, S. 61 that with the implementation of the aforesaid measures, all practicable and feasible means and measures will have been taken to avoid or minimize potential damage from the Project to the environment.

____

[AGENCY]

____

By

____

[DATE]

Table 7-2, describing the measures to be implemented to mitigate the effects of the Project related to the required state permits and the schedule for implementation.

Table 7-2 Summary of Mitigation Measures

<table>
<tr><th>Mitigation</th><th>Schedule</th><th>Cost</th></tr>
<tr><td colspan="3">Land</td></tr>
<tr><td>The amount of land alteration necessary for the Project has been minimized through a variety of design measures, including the following:
♦ Selecting the specific building program for the Project Site and modifying the layout to reduce impacts to wetland resource areas and buffer zones;
♦ Placing stormwater management features and structures underneath paved areas that will already be disturbed; and
♦ Retaining exiting trees and planting new trees throughout the Site.</td><td>During construction & operation</td><td>Included in overall Project cost</td></tr>
<tr><td>The Proponent intends to provide tree plantings at a 1:1 ratio.</td><td>During operation</td><td>Included in overall Project cost</td></tr>
<tr><td colspan="3">Transportation</td></tr>
<tr><td>The following subsection outlines the individual off-site transportation infrastructure mitigation that is intended to enhance the public roadway infrastructure. The phasing for construction of the off-site infrastructure is described in each item; however, the phasing of the various infrastructure work is desired by the Proponent to be constructed based on the following phasing timeline conditions:
♦ Condition A: Prior to Initial Occupancy – The Proponent would construct the improvements at the Project's outset and be completed prior to occupancy of the first new building.
♦ Condition B: Prior to Occupancy of No-Build Site Generated Trip Threshold – The TIAS provided in the DEIR describes a significant number of additional trips that could be added to the site without exceeding the full reoccupancy site generated trip levels of Buildings "A" and "B" as depicted in the No-Build Condition. Whereas Buildings "A" and "B" are actively tenanting space (current occupancy outlines in the DEIR) and the potential exist for another use or space to come online without exceeding the No-Build traffic volume conditions, the Proponent desires the flexibility to introduce a mix of uses at the early stages of the Project that do not exceed the documented site trip generation levels for the No-Build condition for the weekday daily, weekday morning peak hour, or weekday evening peak hour. This may also provide an opportunity for the Town and MassDOT to balance the direction flow of early site generated traffic flow as opposed to a one-sided directional increase with just the reoccupancy of the remaining vacant space in Buildings "A" and "B".</td><td>Ongoing after each phase's completion</td><td>Included in overall Project cost</td></tr>
</table>

Table 7-2 Summary of Mitigation Measures (Continued)

Mitigation	Schedule	Cost
Transportation		
♦ *Condition C: Prior to Occupancy of King Street Retail / Restaurant Blocks* – The Project proposes transportation infrastructure work along King Street, such as cross-section modifications and sidewalk, which the proponent desires to complete in conjunction with the occupancy of the adjacent retail / restaurant block buildings. These buildings will include a "Town Center" feel on the westerly side of the King Street and will require construction vehicles to traverse and other connected construction activities to occur which could damage newly constructed infrastructure if completed too early. The King Street corridor has in-place existing bicycle lanes and sidewalk which would be retained; however, the practical construction of the King Street cross-section would be directly aligned with the construction of the adjacent retail / restaurant buildings. ♦ *Condition D: Prior to Occupancy of 410 Great Road* – The Project proposes transportation infrastructure work along Great Road, such as sidewalk along the 410 King Street site frontage. These buildings will require construction vehicles to traverse and other connected construction activities to occur which could damage newly constructed infrastructure if completed too early. The Great Road corridor has in-place existing sidewalk which would be retained; however, the practical construction of the this sidewalk replacement along Great Road would be directly aligned with the construction of the adjacent 410 Great Road location. ♦ *Condition E: Traffic Signal Timing Fine Tuning* – Similar to many other large-scale projects, the Proponent will provide field fine-tuning of traffic signal timings, coordination, and phasing parameters, in the presence of MassDOT, at Condition A above, 80% occupancy of the Project, and at 100% occupancy of the Project. Modifications to the traffic signal timings will necessitate edits to the Traffic Signal Regulations on file with MassDOT. The Proponent will provide redlines to existing regulation as-built packages at Condition A above and 80% occupancy. The Proponent will generate new as-built Traffic Signal Regulations at 100% occupy and/or Project completion.	Ongoing after each phase's completion	Included in overall Project cost

Table 7-2 Summary of Mitigation Measures (Continued)

Mitigation	Schedule	Cost
Transportation		
Great Road (Route 119) / Russell Street / Constitution Avenue: For the 2034 No-Build scenario, AM Weekday/PM Weekday/Saturday midday peak hour level of service (LOS) at this signalized intersection will be at Levels C/C/C (Average Delay = 22.7/31.7/32.1 seconds). For the 2034 Build without traffic mitigation scenario, AM Weekday/PM Weekday/Saturday midday peak hour LOS at this signalized intersection will be at Levels C/C/C (Average Delay = 22.5/31.4/31.9 seconds). There was no 2034 Build with traffic mitigation scenario evaluated for this location. Modifications to the traffic signal timings at this location are proposed as part of the Project's off-site mitigation at initial occupancy, the 80%, and 100% occupancy milestone intervals (Condition E) and will be completed in coordination with MassDOT.	Ongoing after each phase's completion	Included in overall Project cost
Great Road (Route 119) / Interstate 495 SB Ramps: For the 2034 No-Build scenario, AM Weekday/PM Weekday/Saturday midday peak hour level of service (LOS) at this signalized intersection will be at Levels C/C/C (Average Delay = 32.0/23.5/20.3 seconds). For the 2034 Build without traffic mitigation scenario, AM Weekday/PM Weekday/Saturday midday peak hour LOS at this signalized intersection will be at Levels C/C/C (Average Delay = 34.1/24.4/20.7 seconds). There was no 2034 Build with traffic mitigation scenario evaluated for this location. Modifications to the traffic signal timings at this location are proposed as part of the Project's off-site mitigation at initial occupancy, the 80%, and 100% occupancy milestone intervals (Condition E) and will be completed in coordination with MassDOT.	Ongoing after each phase's completion	Included in overall Project cost
Great Road (Route 119) / Interstate 495 NB Ramps: For the 2034 No-Build scenario, AM Weekday/PM Weekday/Saturday midday peak hour level of service (LOS) at this signalized intersection will be at Levels C/B/B (Average Delay = 23.1/13.2/15.7 seconds). For the 2034 Build without traffic mitigation scenario, AM Weekday/PM Weekday/Saturday midday peak hour LOS at this signalized intersection will be at Levels C/B/B (Average Delay = 23.0/15.7/17.2 seconds). There was no 2034 Build with traffic mitigation scenario evaluated for this location.	During construction & operation	Included in overall Project cost

Table 7-2 Summary of Mitigation Measures (Continued)

Mitigation	Schedule	Cost
Transportation		
The Proponent will implement an exclusive pedestrian traffic signal phase at this intersection in conjunction with the installation of a new crosswalk across Great Road east of the I-495 NB Ramp to be completed as part of Condition B. The Proponent will construct an uncontrolled pedestrian crossing with Rectangular Rapid Flashing Beacon (RRFB) across the Great Road WB channelized right-turn lane to I-495 NB with appropriate traffic signs and pavement markings. The Proponent will slightly modify the orientation of the Great Road WB channelized right-turn lane to I-495 NB in conjunction with sidewalk construction along the northerly side of Great Road. The modifications, specifically the addition of the exclusive pedestrian phase, may require the publication of a Project Framework Document (PFD) with MassDOT and Federal Highway Administration (FHWA). Modifications to the traffic signal timings at this location are proposed as part of the Project's off-site mitigation at initial occupancy, the 80%, and 100% occupancy milestone intervals (Condition E) and will be completed in coordination with MassDOT.	Ongoing after each phase's completion	Included in overall Project cost
Great Road (Route 119) / Site Driveway West: For the 2034 No-Build scenario, AM Weekday/PM Weekday/Saturday midday peak hour level of service (LOS) on the side-street movement of this unsignalized intersection will be at Levels F/F/E (Average Delay = 130.1/67.2/40.5 seconds). For the 2034 Build scenario, AM Weekday/PM Weekday/Saturday midday peak hour LOS on the side-street movement of this unsignalized intersection will be at Levels C/F/D (Average Delay = 17.4/153.5/32.5 seconds). There was no 2034 Build with traffic mitigation scenario evaluated for this location. Note that the Proponent will implement a left-turn prohibition along the Site Driveway West southbound approach. In addition to the left-turn prohibition, the Proponent will reconstruct the Site Driveway West southbound approach as a channelized exclusive right-turn lane to further deter left-turn egress. The Proponent will slightly reset the curb line along the northerly side of Great Road at this intersection to formalize Great Road westbound as two (2) lanes in conjunction with the driveway, as opposed to this occurring just west of the driveway. The Proponent will restripe the inside travel lane along Great Road eastbound to be an exclusive left-turn lane (operates as de facto left-turn lane) directly in line with the downstream exclusive left-turn lane at King Street. Infrastructure improvements at this intersection will be completed as part of Condition A.	Ongoing after each phase's completion	Included in overall Project cost

Table 7-2 Summary of Mitigation Measures (Continued)

Mitigation	Schedule	Cost
Transportation		
Great Road (Route 119) / 410 Great Road Driveway (Site Driveway): For the 2034 No-Build scenario, AM Weekday/PM Weekday/Saturday midday peak hour level of service (LOS) on the side-street movement of this unsignalized intersection will be at Levels A/B/B (Average Delay = 0.0/10.1/10.6 seconds). For the 2034 Build scenario, AM Weekday/PM Weekday/Saturday midday peak hour LOS on the side-street movement of this unsignalized intersection will be at Levels B/B/B (Average Delay = 11.4/10.3/10.9 seconds). There was no 2034 Build with traffic mitigation scenario evaluated for this location. Note that the Proponent will implement a left-turn prohibition along the 410 Great Road Site Driveway northbound approach. In addition to the left-turn prohibition, the Proponent will implement pavement markings and traffic signs to deter left-turn egress. Infrastructure improvements related to this driveway will be completed as part of Condition D.	Ongoing after each phase's completion	Included in overall Project cost
Great Road (Route 2A / 119) / King Street (Route 2A / 110): For the 2034 No-Build scenario, AM Weekday/PM Weekday/Saturday midday peak hour level of service (LOS) at this signalized intersection will be at Levels C/D/D (Average Delay = 32.8/44.8/38.5 seconds). For the 2034 Build without traffic mitigation scenario, AM Weekday/PM Weekday/Saturday midday peak hour LOS at this signalized intersection will be at Levels D/E/D (Average Delay = 32.8/58.8/39.1 seconds). There was no updated 2034 Build with traffic mitigation scenario evaluated for this location. The Proponent will reconstruct components of the existing traffic signal infrastructure such as a new Advance Transportation Controller (ATC), emergency vehicle preemption, pedestrian countdown signal heads, Accessible Pedestrian Signal (APS) push buttons, etc. It is not expected that this will include new overhead signal structures. The Proponent will reconstruct sidewalks and pedestrian curb ramps for the intersection, as necessary, to support the new traffic signal infrastructure. The Proponent will resurface pavement along each intersection approach to match new accessibility accommodations. The extent will be confirmed with MassDOT as part of the Permit to Access State Highway. The Proponent will provide all necessary pavement markings and traffic signs to support the identified improvements at the intersection. Infrastructure improvements at this intersection will be completed as part of Condition B. Modifications to the traffic signal timings at this location are proposed as part of the Project's off-site mitigation at initial occupancy, the 80%, and 100% occupancy milestone intervals (Condition E) and will be completed in coordination with MassDOT.	Ongoing after each phase's completion	Included in overall Project cost

Table 7-2 Summary of Mitigation Measures (Continued)

Mitigation	Schedule	Cost
Transportation		
Great Road (Route 2A / 119) / Stevens Street / Adams Street / Meetinghouse Road: For the 2034 No-Build scenario, AM Weekday/PM Weekday/Saturday midday peak hour level of service (LOS) on the side-street movement of this unsignalized intersection will be at Levels C/C/C (Average Delay = 20.1/19.2/22.0 seconds). For the 2034 Build scenario, AM Weekday/PM Weekday/Saturday midday peak hour LOS on the side-street movement of this unsignalized intersection will be at Levels C/C/C (Average Delay = 21.5/19.7/23.3 seconds). There was no 2034 Build with traffic mitigation scenario evaluated for this location. The Proponent will reconstruct, as necessary, all pedestrian curb ramps at the intersection to provide ADA / AAB / PROWAG compliance and reapply high-visibility crosswalk markings between each ramp pair. The Proponent will replace out-of-date pedestrian crossing traffic signs along Great Road for each crosswalk with new florescent yellow-green pedestrian crossing signage (W11-2 & W16-7pL) signs and advance pedestrian crossing (W11-2 & W16-9p) traffic signs upstream. These modifications do not change the traffic operational characteristics of the intersection. Infrastructure improvements at this intersection will be completed as part of Condition B.	Ongoing after each phase's completion	Included in overall Project cost
King Street (Route 2A / 110) / Goldsmith Street / Stevens Street / 476 King Street Driveway: For the 2034 No-Build scenario, AM Weekday/PM Weekday/Saturday midday peak hour level of service (LOS) on the side-street movement of this unsignalized intersection will be at Levels B/B/B (Average Delay = 13.0/12.2/11.6 seconds). For the 2034 Build scenario, AM Weekday/PM Weekday/Saturday midday peak hour LOS on the side-street movement of this unsignalized intersection will be at Levels B/B/B (Average Delay = 13.9/13.3/12.8 seconds). There was no 2034 Build with traffic mitigation scenario evaluated for this location.	Ongoing after each phase's completion	Included in overall Project cost

Table 7-2 Summary of Mitigation Measures (Continued)

Mitigation	Schedule	Cost
Transportation		
The Proponent will reconstruct the intersection's southwest corner between King Street and Goldsmith Street to provide a new curb line in conjunction with a curb extension to shorten pedestrian crossing distance and remove excess pavement area. The Proponent will construct a curb extension along the easterly side of Stevens Street, north of Goldsmith Street, to shorten pedestrian crossing distance and remove excess pavement area. The Proponent will reconstruct, as necessary, all pedestrian curb ramps at the intersection to provide ADA / AAB / PROWAG compliance and reapply high-visibility crosswalk markings between each ramp pair. The Proponent will replace out-of-date pedestrian crossing traffic signs along Great Road with new florescent yellow-green pedestrian crossing signage (W11-2 & W16-7pL) signs and advance pedestrian crossing (W11-2 & W16-9p) traffic signs upstream. These modifications do not change the traffic operational characteristics of the intersection. Infrastructure improvements at this intersection will be completed as part of Condition B.	Ongoing after each phase's completion	Included in overall Project cost
Other Intersection Pedestrian Infrastructure Upgrades: Traffic operational characteristics of the 2034 No-Build scenario and 2034 Build scenario are generally acceptable at other intersections within the mitigation limits of work along SHLO. The Proponent will additionally reconstruct accessible pedestrian ramps and crosswalks with appropriate pedestrian crossing signage (W11-2 & W16-7pL) signs and advance pedestrian crossing (W11-2 & W16-9p) traffic signs upstream, as needed, at the following locations prior to the following phasing conditions: ♦ Great Road (Route 119) / 410 Great Road Driveway (as part of Condition D) ♦ King Street (Route 2A / 119) / 410 Great Road Driveway (as part of Condition D) ♦ King Street (Route 110) / Meetinghouse Road (as part of Condition C) ♦ King Street (Route 110) / Tuttle House Driveway (as part of Condition C) ♦ King Street (Route 110) / Site Driveway South (as part of Condition C) ♦ King Street (Route 110) / Site Driveway Middle (as part of Condition C) ♦ King Street (Route 110) / Site Driveway North (as part of Condition C)	Ongoing after each phase's completion	Included in overall Project cost

Table 7-2 Summary of Mitigation Measures (Continued)

<table>
<tr><th>Mitigation</th><th>Schedule</th><th>Cost</th></tr>
<tr><td colspan="3">Transportation</td></tr>
<tr><td>Corridor Improvements (Great Road):

The Proponent has committed to the following improvements along the Great Road corridor as part of Condition B, unless otherwise noted:

♦ The Proponent will reconstruct ±400 feet of existing sidewalk along the southerly side of Great Road along the site frontage of 410 Great Road with 6-inch vertical granite curbing to provide separation between vehicle and pedestrian traffic as part of Condition D.

♦ The Proponent will construct a new ±580-foot sidewalk connection with vertical granite curbing along the northerly side of Great Road from the Site Driveway West to the I-495 NB Ramps. This improvement includes the following:

o The 5-foot sidewalk will be constructed to maintain a consistent 2-foot shoulder present between King Street and a point 200-feet west of the Site Driveway West so not to impact a culvert headwall and culvert present below the I-495 NB Ramps at the west end of the guardrail adjacent to the Great Road channelized right-turn lane to I-495 NB. The guardrail will be replaced, where needed, at the back of sidewalk.

o Slight realignment of the Great Road channelized right-turn lane to I-495 NB to accommodate the sidewalk location and provide an unsignalized crosswalk across with appropriate traffic signs across the Great Road channelized right-turn lane to I-495 NB.

o A minor modification in the stormwater swale along the northerly side of Great Road east of the Great Road channelized right-turn lane to I-495 NB between the drainage headwall to the east and the culvert headwall to the west.</td><td>Ongoing after each phase’s completion</td><td>Included in overall Project cost</td></tr>
<tr><td>Corridor Improvements (King Street):

The Proponent has committed the following improvements along the King Street corridor as part of Condition C, unless otherwise noted:

♦ The Proponent will reconstruct ±1,450 feet of existing sidewalk along the westerly side of King Street along the site frontage between the Tuttle House Driveway and Site Driveway North as a 10-foot shared-use path (SUP) with 2-foot hardscape buffer and 6-inch vertical granite curbing to provide separation between vehicle and pedestrian traffic. The SUP will provide site connectivity on each driveway into the site.</td><td>Ongoing after each phase’s completion</td><td>Included in overall Project cost</td></tr>
</table>

Table 7-2 Summary of Mitigation Measures (Continued)

Mitigation	Schedule	Cost
Transportation		
♦ The Proponent will construct ±250 feet of new 8-foot wide (narrower) SUP along the westerly side of King Street along the Site frontage between Site Driveway north and the north end of Building Q. The SUP will wrap around the outside of a prominent public shade tree in front of the former Yangtze Restaurant property which the Town of Littleton has directly identified to the Proponent a wish to retain. ♦ The Proponent will commit to constructing up to three pedestrian crossing locations across King Street between Meetinghouse Road and Site Driveway North where sufficient right-of-way exists. These locations would include, at a minimum, high-visibility crosswalks, pedestrian curb ramps, far-side level landings areas to allow for formal pedestrian areas on the easterly side of the roadway, and fluorescent yellow-green pedestrian warning and advance warning signage (W11-2, W16-7p, and W16-9p). One of these crossings will be located near the northerly extent of the project (Building Q) at the request of MassDOT in order to facilitate transitions from roadway to SUP and bicycle lanes. ♦ King Street Cross Section – Complete Streets Layout: o The Proponent will hold the easterly edge of pavement along King Street and box widen, where needed, along the westerly edge of pavement to provide a cross-section along the King Street site frontage between the Tuttle House Driveway and Site Driveway North to include an 11-foot travel (11-foot two-way left-turn lane south of Village Street) and 5-foot bicycle (minimum) in each direction or travel. This may result in a slight shift in roadway centerline that would be corrected through pavement shimming or similar methods.	Ongoing after each phase's completion	Included in overall Project cost
Transportation Demand Management Measures: The Proponent will develop and conduct TDM measures aimed at reducing site trip generation. These TDM measures shall include, but not be limited to: ♦ Preferential Parking - Provide preferential parking for rideshare, carpool, and hybrid vehicles at locations throughout the site's parking areas in close proximity to major entranceways. ♦ Electric Vehicle Stations – Electric vehicle (EV) charging stations will be provided at locations throughout the site's parking areas in close proximity to major entranceways.	After phase completion	Included in overall Project cost

Table 7-2 Summary of Mitigation Measures (Continued)

Mitigation	Schedule	Cost
Transportation		
♦ Reduced Parking Supply – The Proponent is committed to reducing the parking supply by providing minimal number of parking spaces to a level of the demand need only. ♦ Sidewalk Connectivity – The site will provide connectivity of sidewalk infrastructure along King Street and Great Road and internal to the site to each building within the construction limits for both the 410 Great Road and 550 King Street locations. ♦ Bicycle Accommodations – The site will include bicycle accommodation through the main drive aisle of the site with connectivity to bicycle infrastructure along King Street. ♦ Bicycle Racks – The Proponent will provide secure, weather protected, long-term bicycle parking for employees and residents at designated locations within the site. The site plan will also provide bicycle racks for short-term users at several locations on-site. ♦ Public Bicycle Vendor – The Proponent is exploring opportunities to implement a public bicycle vendor, such as Blue Bikes, on-site. ♦ Employee Shower Facilities - Coordinate with commercial tenants to provide showers for employees who commute by walking or biking. ♦ LRTA Bus Service –The Proponent will relocate the existing Lowell Regional Transit Authority (LRTA) bus stop location to a new location within the site and provide a second bus stop location; each along the main drive aisle in the southbound direction. Each bus stop location will contain a pavement turn-out, bus shelter, trash receptacle, bike rack, and sufficient hardscape area to accommodate full accessibility and bus ramp access. ♦ Public Transportation Shuttle Service – The Proponent is committed to provide access to the Littleton / I-495 Commuter Rail Station located 2.5 miles south of the Project Site along Foster Street. The shuttle will be funded by the Proponent and be scheduled to coincide with train boarding / alighting schedules for the Massachusetts Bay Transportation Authority (MBTA) Fitchburg Line. ♦ Maps / Schedules - Public transportation schedules with transit maps for LRTA Bus Route 15 and the MBTA Commuter Rail, as well as for all nearby connecting routes will be provided to each resident upon move-in and employees upon employment. Maps and schedules will also be posted on each floor of the residential buildings. Schedules and maps will also be provided in the lobby and near doorways in all other on-site buildings.	After phase completion	Included in overall Project cost

Table 7-2 Summary of Mitigation Measures (Continued)

Mitigation	Schedule	Cost
Transportation		
♦ Employee Transportation Coordinator (ETC) – An ETC will be provided on-site to oversee, implement, monitor, and evaluate TDM measures, employed or funded by the Proponent. ♦ Transportation Management Association (TMA) – The Proponent will seek membership in the reformed Crosstown Connect TMA. The Proponent will look at opportunities to assist in the reformation of this TMA. ♦ Wayfinding – The Proponent will provide wayfinding signs within the Project Site to direct residents, patrons, and other visitors to the appropriate driveway and access to pedestrian, public transportation, and bicycle facilities. ♦ Marketing of Transportation Options and Benefits - A welcome packet for all tenants and employees will be distributed at move-in or employment which includes information for all transportation related benefits, promotions, and local transportation options. ♦ Vanpool and Carpool – The Proponent, and the ETC, will encourage vanpool and carpooling participation through marketing, events, and vanpool formation meetings. The ETC will implement a ride-matching program to assist employees and residents in finding appropriate carpool matches. ♦ Guaranteed Ride Home Program – The ETC will be responsible for providing all employees who carpool, bicycle, or walk to work with an emergency ride home. ♦ On-Site Laundry Services - The Proponent will provide laundry services on-site to allow for the reduction of trips to/from the site of nearby laundromats. ♦ Flex Hours – The Proponent will encourage tenants within the mixed-use development to provide flexible hours to employees. ♦ Direct Deposit for Employees - The Proponent will encourage tenants within the mixed-use development to provide direct deposit to reduce employee trips to/from the site. ♦ Site Amenities – As a mixed-use development, the site includes several on-site amenities, such as restaurants, retail, open space, and resident-specific amenities within the residential component of the site. This location will assist in reducing vehicular demand and increase multi-use trips, which include parking capacity sized to meet minimum local requirements without providing excessive parking.	After phase completion	Included in overall Project cost

Table 7-2 Summary of Mitigation Measures (Continued)

Mitigation	Schedule	Cost
Transportation		
♦ Promotional Events and Activities – The ETC will be responsible for organizing promotional events and activities to encourage rideshare and alternative transportation means. In addition, the ETC will distribute brochures to all new employees and residents during, and post posters and bulletins on various subjects from carpooling to the Guaranteed Ride Home program throughout the site.	After phase completion	Included in overall Project cost
Agreements and Layout Alterations Prior to any site occupancy, the Proponent will submit to the MassDOT Boston and District 3 Offices any layout alteration plans, land damage agreements, and any other agreements necessary for or resulting from the implementation of the mitigation measures detailed in this Section 61 Finding.	Prior to any site occupancy	Included in overall Project cost
Transportation Monitoring Program The Proponent will conduct a traffic monitoring program beginning six (6) months after issuance of the first occupancy permit and continuing for five years following full occupancy of the Project. The monitoring program may be suspended at any time upon agreement with MassDOT and the Town of Littleton that the Project has sufficiently provided evidence that the upper limits of vehicle delay and trip projection would not be feasibly satisfied. The annual nature of the monitoring program may be postponed in consultation with the Town and MassDOT based on lack of need circumstances if no new development has occurred during full build-out. The monitoring program may also be suspended if five years have passed since the issuance of an occupancy permit for the Project and will recommence should an additional occupancy permit be issued. The monitoring program will include the following: ♦ Collect manual Turning Movement Counts (TMCs) during the weekday morning (7:00 AM to 9:00 AM), weekday evening (4:00 to 6:00 PM), and Saturday midday (11:00 AM to 2:00 PM) peak periods at the following intersections: ○ Great Road / Interstate 495 SB Ramps ○ Great Road / Interstate 495 NB Ramps ○ Great Road / Site Driveway West ○ Great Road / 410 Great Road Driveway ○ Great Road / King Street ○ King Street / 410 Great Road Driveway ○ King Street / Tuttle House Driveway ○ King Street / Site Driveway South ○ King Street / Site Driveway Middle	After phase completion	Included in overall Project cost

Table 7-2 Summary of Mitigation Measures (Continued)

Mitigation	Schedule	Cost
Transportation		
o King Street / Site Driveway North ♦ Collect ATR data for a continuous 7-day week-long period along Great Road, King Street, and each of the Site Driveway locations. ♦ Collect parking demand counts during the peak parking demand periods for the specific land use areas, including: o Residential and Hotel - 5:00 AM to 9:00 AM o Retail, Restaurants, R&D, Office, and Industrial - 10:00 AM to 5:00 PM ♦ Collect motor vehicle crash reports from the Town of Littleton Police Department and MassDOT for the most recent one-year period to ascertain changes in crash frequency, crash trends, and severity at the monitored locations. ♦ Complete an employee and resident travel survey to gage employee and resident travel patterns and mode share. ♦ Compare the TMCs collected above with those projected within the TIAPS for the Project to determine whether the total vehicles entering each intersection exceeds the volumes projected. ♦ Perform a capacity and queuing analysis using Synchro / Sidra analysis software to evaluate the traffic operations at each of the intersections listed above and compare to the operations projected in the TIAPS prepared for the Project. ♦ Assess whether additional mitigation is necessary at any of the study intersections and identify measures to improve operations and/or reduce vehicular traffic volumes. The need or evaluation for further mitigation will be conditioned upon: o The measured site generated traffic volumes for the Project exceeded the projected site generated traffic volumes established in this TIAPS, or subsequent revisions as presented to the Town of Littleton, by more than 10 percent (i.e., 110 percent of the projected site generated traffic volumes. o One or more of the movements at the monitored intersections is identified to be operating at or over capacity (defined as a V/C ratio equal to or exceeds 1.00) in consultation with MassDOT or the Town of Littleton. o There is a pronounced increase in the frequency of occurrence of motor vehicle crashes at a monitored location and the calculated motor vehicle crash rate excess the MassDOT average crash rate for similar locations.	After phase completion	Included in overall Project cost

Table 7-2 Summary of Mitigation Measures (Continued)

Mitigation	Schedule	Cost
Transportation		
♦ Corrective actions to reduce the unmitigated impact of the Project should be proposed and implemented based on the thresholds listed above. The corrective actions should be documented in the TMP, approved and coordinated with the Town and/or MassDOT if desired by the agencies, and be undertaken by the Proponent subject to receipt of all necessary rights, permits, and approvals. ♦ Assess whether the constructed parking supply is adequate for the parking demand as observed. ♦ Prepare a memorandum summarizing the results of the TMCs, ATRs, parking demand counts, traffic impact analysis for submission to MassDOT District 3 and the Town of Littleton. The Proponent will monitor the TDM program on an annual basis and prepare a TDM Report to update efforts to reduce site trip generation through employee programs and the use of alternate modes of transportation. The goal of the monitoring program will be to evaluate the assumptions made in the Traffic Impact Analysis and identify effectiveness of the Project mitigation measures and TDM program. The Proponent should consult with the MassDOT's Public/Private Development Unit (PPDU) and the District 3 Office in order to confirm a detailed scope of work for conduct of the traffic monitoring program at each location.	After phase completion	Included in overall Project cost
Stormwater Management		
Stormwater management and conveyance systems will comply with MassDEP's Stormwater Management Standards and the storm water control requirements provided in 310 CMR 19.205 of the Solid Waste Management Regulations.	During construction & operation	Included in overall Project cost
Erosion and sedimentation controls will be implemented to prevent stormwater impacts during construction or land disturbance activities. A Construction Stormwater Pollution Prevention Plan (SWPPP) will be prepared by the contractor prior to the start of construction identifying temporary best management practices (BMPs) for erosion and sedimentation control.	During construction	Included in the overall Project cost

Table 7-2 Summary of Mitigation Measures (Continued)

Mitigation	Schedule	Cost
Stormwater Management		
As described in the Stormwater Management Operation and Maintenance Plan, routine inspections will be conducted on a monthly basis and thorough investigations will be conducted twice a year. Tasks that are common to all systems include regular removal of accumulated sediments, floatables, and debris. Inspections will occur after every major storm event for the first six months after construction. Inspections will be conducted by a Professional Engineer registered in the Commonwealth of Massachusetts experienced in drainage design. Annual reports will be prepared detailing the status of the stormwater system and the maintenance performed. A copy of the annual report will be sent to the Town of Littleton, if requested.	During construction & operation	Included in overall Project cost
Water Use and Wastewater Generation		
The Project will use low flow fixtures to the extent practicable to reduce water use.	During construction & operation	Included in overall Project cost
Greenhouse Gas		
The building will be built under the Stretch Code and the Proponent is committed to the following mitigation elements for the Project: ♦ All-electric domestic hot water for residential spaces; ♦ All-electric Air Source Heat Pump space heating and domestic hot water heating for retail and office spaces; ♦ Reduced air leakage per C406.9 for retail and office spaces; ♦ 40% PV solar ready roofs; ♦ High performance building envelopes; ♦ Light or reflective roofs; ♦ Reduced lighting power densities; ♦ High-efficiency HVAC equipment; ♦ High performance exterior lighting; ♦ Low-flow fixtures; ♦ Recycling collection areas; and ♦ Construction waste recycling.	During construction	Part of overall construction cost

Table 7-2 Summary of Mitigation Measures (Continued)

Mitigation	Schedule	Cost
Greenhouse Gas		
Upon completion of the Project, the Proponent will submit a self-certification to the MEPA Office, prepared in accordance with the GHG Policy. This certification will identify the GHG mitigation measures incorporated into the building and will illustrate the degree of GHG reduction from a Baseline case, as Baseline is defined herein, and how such reductions are achieved. Details of the Proponent's implementation of operational measures will also be included.	Post Construction	Part of operating cost
Climate Resiliency		
The proposed stormwater infrastructure, including structure and pipe sizing and elevations, is designed to safely convey stormwater during the Resilient Mass Action Team (RMAT) 50-year, 24-hour storm event projected for the year 2070.	During construction & operation	Included in overall Project cost
To minimize the Project's susceptibility to drought conditions, the landscape design incorporates native and adaptive plant species.	During construction & operation	Included in overall Project cost
Construction Period		
Construction methodologies that ensure public safety and protect the immediate surrounding area will be employed. Techniques such as barricades and signage will be used. Construction management and scheduling will minimize impacts on the surrounding environment and will include plans for construction worker commuting and parking, routing plans for trucking and deliveries, and the control of noise and dust, as applicable.	During construction	Included in overall Project cost
"No Idling" signs will be included at the loading, delivery, pick-up and drop-off areas.	During construction	Included in overall Project cost
Plans for controlling fugitive dust during excavation and construction include mechanical street sweeping, wetting portions of the site during periods of high wind, and careful removal of debris by covered trucks.	During construction	Included in overall Project cost
Every reasonable effort will be made to minimize the noise impact of construction activities.	During construction	Included in overall Project cost

Chapter 8.0

Response to Comments

8.0 RESPONSE TO COMMENTS

This chapter provides responses to the comment letters received by the Secretary during the review period of the Draft EIR. The comment letters have been annotated and individual comments coded in the right-hand margin. The responses to the comments are listed below with the corresponding code numbers and a brief synopsis of the comments. Comment letters were received from the agencies, organizations and individuals listed in Table 8-1.

Table 8-1 Secretary's Certificate and Comment Letters

Commenter	Abbreviation
EEA Secretary's Certificate on the Draft EIR	MEPA
George A. Sanders, Sr.	GS
Michael	MG
Amy Tarlow-Lewis	ATL
Town of Littleton Planning Department & Planning Board	PB
Metropolitan Area Planning Council	MAPC
Dark Sky Massachusetts	DS
Donald MacIver, Littleton Sustainability Committee Member	DM
Erin H.	EH
Jo-Ann D.	JD
Sondra And Stephen Swartz	SS
Massachusetts Department of Transportation	DOT
Massachusetts Department of Environmental Protection's Central Regional Office	DEP
Department Of Energy Resources	DOER

The Commonwealth of Massachusetts
Executive Office of Energy and Environmental Affairs
100 Cambridge Street, Suite 900
Boston, MA 02114

Maura T. Healey
GOVERNOR

Kimberley Driscoll
LIEUTENANT GOVERNOR

Rebecca L. Tepper
SECRETARY

Tel: (617) 626-1000
Fax: (617) 626-1081
http://www.mass.gov/eea

August 22, 2025

CERTIFICATE OF THE SECRETARY OF ENERGY AND ENVIRONMENTAL AFFAIRS
ON THE
DRAFT ENVIRONMENTAL IMPACT REPORT

PROJECT NAME	: King Street Common
PROJECT MUNICIPALITY	: Littleton
PROJECT WATERSHED	: Merrimack & Concord
EEA NUMBER	: 16921
PROJECT PROPONENT	: Lupoli Development
DATE NOTICED IN MONITOR	: June 11, 2025

Pursuant to the Massachusetts Environmental Policy Act (MEPA; M.G.L. c. 30, ss. 61-62L) and Section 11.08 of the MEPA regulations (301 CMR 11.00), I have reviewed the Draft Environmental Impact Report (DEIR) and hereby determine that it **adequately and properly complies** with MEPA and its implementing regulations. The Proponent may prepare and submit for review a Final Environmental Impact Report (FEIR).

Project Description

As described in the DEIR, the project consists of the construction of 19 buildings having 1,089 residential units, 115,500 square feet (sf) of retail, 19,000 sf of office, 545,520 sf of light industrial use (which includes the two large former IBM buildings), and a 111,000 sf hotel (150-rooms). According to the filing, ten percent of the units will be affordable. A total of 3,010 parking spaces are proposed, of which 1,446 will be in structured parking (garages, decks, parking under podiums) and the remainder at grade.

The development will be divided into an east and a west site. The east site will consist of the following:

- BUILDING A: commercial

- BUILDING B: commercial
- BUILDING C: residential (173 units)
- BUILDING D: residential (173 units)
- Building E: residential (149 units) and retail
- BUILDING F: residential (151 units)
- BUILDING G: hotel (150 rooms) and a food service/bar
- BUILDING H: retail
- BUILDING I: residential (9 units) and retail
- BUILDING J: residential (11 units) and retail
- BUILDING K: residential (42 units) and retail
- BUILDING L: residential (11 units) and retail
- BUILDING M: office
- BUILDING N: residential (9 units) and retail
- BUILDING O: residential (12 units) and retail
- BUILDING Q: retail
- BUILDING R: residential (65 units)

The west site will consist of the following:

- BUILDING S: residential (285 units)

Project Site

The approximately 47.4-acre site is located within the Town of Littleton (Town). The project site consists of two sections (east (550 King Street) and west site (410 Great Road)). The east site is bounded by Interstate 495 to the north, Shea Street to the East, King Street (Route 110) to the south, and Great Road (Route 119) to the west. This portion of the site is a former IBM office campus that is now vacant. Under existing conditions, the east site is comprised of buildings, paved parking areas, landscaped areas, and related ancillary facilities. The undeveloped areas within the east site include an area of deciduous trees around the northern border that buffers it from I-495.

The smaller west site is bounded by a commercial lumber yard to the north, Great Road to the east, commercial development along King Street to the south, and a residential area off of White Street and Hillside Road to the west. The west site is currently developed with a commercial complex of attached buildings, housing a variety of small businesses, and a surface parking lot.

Bordering Vegetated Wetlands (BVW) are located in the southwest corner of the east site. There is an Isolated Vegetated Wetland (IVW) on the east site that extends onto 584 King Street. According to the Massachusetts Natural Heritage and Endangered Species Program (NHESP) Atlas (15th Edition), the site is not located within Priority or Estimated Habitat of Rare Species. The site is also not located within an Area of Critical Environmental Concern (ACEC). The project site is located within the Littleton Common (LIT.44), an area included in the Massachusetts Historical Commission's (MHC) Inventory of Historic and Archaeological Assets of the Commonwealth. The site includes the Conant Houghton and Company building, 410 Great

Road (LIT.44) and the Captain Thomas Nye House (the Simon Tuttle House), 534 King Street (LIT.25), which are historic resources included within the Littleton Common area. The Simon Tuttle House will be preserved and maintained. The Conant Houghton and Company building will be razed to facilitate the construction of the project.

The project site is not located within a Designated Geographic Area (one mile) of any Environmental Justice (EJ) Populations.[1] The site is located within five miles of ten EJ populations designated as Minority in Acton, Ayer, Boxborough, Chelmsford and Westford.

Environmental Impacts and Mitigation

Potential environmental impacts include alteration of 44.2 acres of land (includes 43.5 acres of already altered/developed land and 0.7 acres of new alternation), creation of approximately 2.3 acres of new impervious area (26.5 acres total on site when including existing structures and uses); generation of 13,338[2] New average daily trips (adt) (20,328[3] adt total); construction of 1,060 new parking spaces (3,010 total on site); generation of approximately 212,000 gallons per day (gpd) of water use and wastewater (total of 286,000 gpd on site); construction of 0.23 miles of new water mains; construction of 0.49 miles of sewer mains; and greenhouse gas (GHG) emissions associated with on-site energy use and transportation.

Measures to avoid, minimize and mitigate these impacts include implementation of a Transportation Demand Management (TDM) plan to reduce single-occupancy vehicles trips and installation of a stormwater management system consistent with the Stormwater Management Standards (SMS). The project will incorporate mitigation measures to reduce the projects GHG emissions and improve the resiliency of the project to address future climate conditions.

Jurisdiction and Permitting

The project is subject to the preparation of a Mandatory EIR pursuant to 301 CMR 11.03(6)(a)(6) because it requires Agency Action and will generate 3,000 or more new adt on roadways providing access to a single location, and 301 CMR 11.03(6)(a)(7) construction of 1,000 or more New parking spaces at a single location. The project also exceeds the ENF thresholds under 301 CMR 11.03(6)(b)(13) generation of 2,000 or more new adt on roadways providing access to a single location; 301 CMR 11.03(6)(b)(14) generation of 1,000 or more new adt on roadways providing access to a single location and construction of 150 or more new parking spaces at a single location; 301 CMR 11.03(6)(b)(15) construction of 300 or more new parking spaces at a single location; and 301 CMR 11.03(1)(b)(1) for the direct alteration of 25 or more acres of land, unless the Project is consistent with an approved conservation farm plan or forest cutting plan or other similar generally accepted agricultural or forestry practices.

[1] The EEA EJ Mapper is available at: https://www.mass.gov/info-details/environmental-justice-populations-in-massachusetts.

[2] A reduction from 15,990 adt proposed in the ENF. The filing states that trip distribution across the study area network for both the residential and commercial related trips has been updated since the TSL based on the most up-to-date data published by the US Census Bureau through its interactive “On the Map” database.

[3] A reduction from 21,020 adt proposed in the ENF.

The project requires a Vehicular Access Permit from the Massachusetts Department of Transportation (MassDOT). The project also requires a WP68 Permit for sewer main extensions from the Massachusetts Department of Environmental Protection (MassDEP). The project may require a Groundwater Discharge Permit from MassDEP. The project is subject to review under the May 2010 MEPA Greenhouse Gas (GHG) Emissions Policy and Protocol ("the GHG Policy").

The project will require Order of Conditions (OOCs) from the Littleton Conservation Commission (or in the case of an appeal, a Superseding Order of Conditions (SOC) from MassDEP). The project also requires a National Pollutant Discharge Elimination System (NPDES) Stormwater General Permit from the Environmental Protection Agency (EPA).

The project is not seeking Financial Assistance from an Agency. Therefore, MEPA jurisdiction is limited to those aspects of the project that are within the subject matter of any required or potentially required Agency Actions and that may cause Damage to the Environment, as defined in the MEPA regulations.

Review of the DEIR

The DEIR included an updated project description, existing and proposed conditions plans, revised estimates of project-related impacts, a Stormwater Report, a Transportation Impact Assessment (TIA), an air quality analysis, a greenhouse gas (GHG) emissions analysis, and an identification of measures to avoid, minimize and mitigate environmental impacts. The DEIR provided a response to comments on the ENF and draft Section 61 Findings. Comments from the Town of Littleton (through the Littleton Planning Department & Planning Board) express strong support for the project and commend the Proponent for developing much needed housing on the previously underutilized project site. Comments from the Littleton Planning Board note that the 150-room hotel would be a "welcome addition" to the Town, but that the five-story building cannot be within 255 feet of the King Street right-of-way line per the 550 King Street Common Zoning 173-233 H, Dimensional Requirements. Comments state that the location of the hotel currently violates local zoning. The FEIR should address this comment, and update project designs as appropriate. Comments from the public request additional information regarding traffic impacts, pedestrian and bicycle connections, light pollution and landscaping plan. The FEIR should address these comments.

As described further below, I note comments from MassDEP that continue to identify concerns regarding the lack of plan for disposal of the wastewater volume anticipated from the project site. The Proponent is directed to consult with MassDEP regarding outstanding wastewater concerns before filing the FEIR. The FEIR should provide a definitive estimate of wastewater demand for the site, and describe a plan to meet regulatory requirements for this infrastructure sufficient to accommodate the project.

Alternatives Analysis

The ENF previously included an alternatives analysis which considered a No-Build Alternative, a Logistics Facility Alternative, and the Preferred Alternative. As required by the

Scope, the Proponent also examined additional alternatives to avoid or minimize environmental impacts, including the consideration of a reduced build alternative that minimizes environmental impacts while also meeting housing production goals.

The DEIR examined a Reduced-Build Alternative that retains the targeted 1,089 residential units, 150-key hotel, and 545,228 sf of office and light industrial space; however, it reduces retail space to 28,000 sf (compared to 115,500 sf as proposed in the Preferred Alternative). This alternative would significantly reduce vehicle trips (7,172 compared to 13,338 for the Preferred Alternative) and slightly reduce water and wastewater generation (260,000 gpd compared to 286,000 gpd for the Preferred Alternative. However, the filing states that due to lost revenue from decreased retail space, the reduced build alternative would eliminate the proposed structured parking[4] and pedestrian-friendly amenities and green space. As a result, the Reduced Build Alternative creates additional surface-level parking and increases net impervious surface on site (30.3 acres of impervious area, compared to 26.5 acres for the Preferred Alternative, after deducting pervious areas/green space added by the project). As noted in comments from the Littleton Planning Department, the Town strongly supports the proposed mixed-used development and notes the public housing and commercial benefits the project will bring to the Town. Because of the increased impacts to impervious area, reduced public space and tax revenue for the Town and strong Town support for the Preferred Alternative, the Reduced Build Alternative was dismissed.

Land Alteration and Stormwater

As noted above, the project will alter approximately 44.2 acres of land, the majority of which has been previously disturbed, and create approximately 2.3 acres of new impervious area (26.5 total on site). In accordance with the Scope, the DEIR clarified the location, type, and extent of land alteration, which is shown in the table below.

Project Component	Previously Disturbed Area (SF)	Proposed Disturbed Area (SF)	Change (SF)
Buildings	265,560	734,366	+ 468,806
Roadways	91,903	216,808	+ 124,905
Parking Lots	662,065	117,413	- 544,652
Sidewalks	31,179	190,066	+ 158,887
Wastewater & Water Infrastructure	36,544	0	- 36,544
Stormwater	55,103	69,068	+ 13,965
Landscaping	840,708	771,012	- 69,696

In addition, the DEIR clarified that the project will alter 98,858 sf of vegetation primarily comprised of scrub shrub and some mature trees located primarily within currently landscaped areas. In total, the project will remove 302 mature trees. The DEIR states that tree clearing was minimized to the maximum extent practicable by retaining mature trees located along property

[4] The Reduced Build Alternative proposes additional surface-level parking.

lines and in proximity to wetlands. The filing states that in order to mitigate tree removal, 100 trees of equal sizes of those being removed will be replanted in landscaped areas throughout the site.

In order to mitigate increases in peak discharge rates as a result of the new impervious surfaces, a comprehensive stormwater management system has been designed that includes a combination of Best Management Practices (BMPs) and Low Impact Design (LID) strategies consisting of rain garden, subsurface infiltration basins, a subsurface detention basin, detention ponds, a wet pond, and proprietary water quality units. According to the DEIR, the stormwater management system has been designed to comply with the Stormwater Management Standards (SMS), including standard requirements for groundwater recharge, removal of at least 80 percent of the TSS from runoff and maintenance and reduction of pre-construction peak runoff rates under post-construction conditions for the present-day 2-, 10-, 25- and 100-year storms. The most current NOAA Atlas 14 precipitation data was used to evaluate peak runoff. As noted below, the stormwater management system will have sufficient capacity to handle projected increased precipitation under future climate conditions.

Traffic and Transportation

In accordance with the Scope, the DEIR includes a Transportation Impact Assessment (TIA) of the study area around the project site that evaluates the project's impacts on intersection operations, safety, and bicycle, pedestrian, and transit modes.

Study Area

The intersections within the study area that have been analyzed and evaluated include:

- Route 119 at Russell Street/Constitution Avenue;
- Route 119 at I-495 Southbound (SB) Ramps;
- Route 119 at White Street;
- Route 119 at I-495 Northbound (NB) Ramps;
- Route 119 at Site Driveway West;
- Route 2A/119 at Route 2A/110;
- Route 2A/119 at 410 Great Road Driveway;
- Route 2A/110 at Goldsmith Street/Stevens Street/476 King Street Driveway;
- Route 110 at Meetinghouse Road;
- Route 110 at Tuttle House Driveway;
- Route 110 at Site Driveway South;
- Route 110 at Site Driveway Middle;
- Route 110 at Site Driveway North;
- Route 110 at Building Q Site Driveway; and
- Route 119 at 410 Great Road Driveway.

Trip Generation / Distribution

To estimate vehicle trip generation, the Proponent used the Institute of Transportation Engineers (ITE) Trip Generation Manual, 11th Edition, for Land Use Codes (LUC) 221 – Multifamily Housing (Mid-Rise), LUC 310 – Hotel, LUC 710 – General Office Building, LUC 760 – Research and Development Center, LUC 821 – Shopping Plaza (40-150k), and LUC 932 – High-Turnover (Sit-Down) Restaurant. The proposed development is anticipated to generate a total of 20,328 unadjusted daily trips using this approach. After accounting for internal capture, walk/bike, transit and pass-by trips, the project is projected to generate 13,338[5] net new vehicle trips on an average weekday, with 340 trips during the weekday morning peak hour and 401 trips during the evening peak hour. Additionally, approximately 8,304 net new vehicle trips are expected on an average Saturday, with 647 trips during the Saturday midday peak hour.

According to the DEIR, trip distribution for the residential, office, R&D, retail, restaurant, and hotel uses was analyzed using gravity models based on U.S. Census data. The residential and employment traffic patterns relied on commuting data from the Town of Littleton's workforce and residential cities, while retail and restaurant traffic considered population and proximity within a 7.5-mile radius. The hotel traffic patterns were based on regional travel behavior, especially proximity to I-495.

Traffic Operations

The TIA provided peak period capacity analyses and level-of-service (LOS) designations for through traffic and turning movements at study area intersections under 2024 Existing, 2034 No Build, 2034 Build and 2034 Build with Mitigation conditions. LOS is represented using letter grades "A" through "F," with LOS A representing very low delays and free flow conditions and LOS F representing unacceptable conditions for most drivers and conditions in which vehicle demand generally exceeds roadway capacity. The intersections in the area surrounding the project site are generally anticipated to adequately accommodate traffic increases associated with the project. Specifically, the traffic study shows that the study signalized intersections generally operate at LOS D or better under Existing, No Build and Build conditions. The exception is the intersection of Great Road (Route 119)/King Street (Route 110) (degrades from LOS D 2034 No Build condition to LOS E for the 2034 Build condition during the weekday evening peak period). Comments from MassDOT state that the study area generally demonstrate sufficient operational performance to accommodate the projected traffic generated by the project.

Site Access

In accordance with MassDOT's recommendations, the Proponent removed the driveway on the east side of Building Q, which previously served the Yangtze River Restaurant, thereby reducing the number of King Street driveways from five to four. Additionally, left-turn exits

[5] As noted above, this represents a decrease from the vehicle trips presented in the ENF. The filing explains that trip distribution across the study area network for both the residential and commercial related trips has been updated since the TSL based on the most up-to-date data published by the US Census Bureau through its interactive "On the Map" database.

from Site Driveway West (the former IBM West Driveway) and the 410 Great Road Driveway will be prohibited, with these movements redirected to other site access points linked to existing signalized intersections. According to the filing, these restrictions will be enforced through signage, pavement markings, and channelization.

The filing states that the Proponent is considering the consolidation of the Tuttle House Driveway with nearby curb cuts at 510 King Street to reduce duplicate access points per MassDOT's recommendation. However, the filing notes, the existing Tuttle House driveway must remain open for the current tenants. Comments from MassDOT on the DEIR state that if access to the Tuttle House is not consolidated, MassDOT recommends that the Proponent explore alternative options for consolidating access. These alternative optoins should be included in the FEIR with the goal of minimizing the number of access points as much as possible. The Proponent should continue consultation with MassDOT to further refine the project's access management plan.

Off-Site Mitigation

As noted above, the intersection of Great Road/King Street degrades from LOS D 2034 No Build condition to LOS E for the 2034 Build condition during the weekday evening peak period. The Proponent has committed to the following improvements along and around King Street and Great Road:

- Complete a 'partial' reconstruction of the traffic signal infrastructure at the intersection including new overhead mast arm assemblies to mount signal housings as needed, a new Advanced Transportation Control (ATC) cabinet and controller system with Field Monitoring Unit (FMU) to support transit signal priority (TSP) and future coordinator connections, new demand based vehicle and bicycle detection as needed, accommodations for emergency-vehicle pre-emption, Accessible Pedestrian Signal (APS) push buttons, and pedestrian countdown indications.
- Optimize traffic signal timings at the intersection.
- Reconstruct, as necessary, all sidewalk and pedestrian curb ramps at the intersection to support the new traffic signal infrastructure and provide ADA / AAB / PROWAG compliance. Where possible, as a result of the difficult grading along Great Road eastbound, provide two (2) accessible ramps per intersection corner and realign the crosswalks to be as perpendicular as possible to the four (4) approaches. Complete a full pavement resurfacing for a minimum of 50 feet along each intersection approach to match new accessibility accommodations. The distance of resurfacing may extend to a point where the overall queueing on the approach is unaffected. This will be determined at the 25% Design stage of the Permit to Access State Highway process. Reapply high-visibility pavement markings along each approach while maintaining the existing cross-sectional nature of each approach. Implement traffic sign and pavement marking upgrades in the vicinity of the intersection to eliminate clutter and comply with the current version of the MUTCD.
- Complete a full pavement resurfacing for a minimum of 50 feet along each intersection approach to match new accessibility accommodations. The distance of resurfacing may extend to a point where the overall queueing on the approach is unaffected. This will be determined at the 25% Design stage of the Permit to Access State Highway process.

Reapply high-visibility pavement markings along each approach while maintaining the existing cross-sectional nature of each approach.
- Implement traffic sign and pavement marking upgrades in the vicinity of the intersection to eliminate clutter and comply with the current version of the MUTCD.
- Retain the existing bicycle lanes along each side of Route 110 through the intersection.
- In conjunction with the reconstruction, the Proponent will generate an as-built traffic signal regulation and plan for the intersection.
- The Proponent will remove the previously proposed on-street parking on the west side of Route 110 and will further evaluate the feasibility of a pedestrian crossing on Great Road, to add a median island for safety, and install Rectangular Rapid Flashing Beacons (RRFBs).
- Install up to three pedestrian crossings with appropriate signage and accessibility features on the east side of Route 110.
- Additionally, the Proponent is open to improving the Route 110 Complete Streets design to enhance walkability and bike access. The proposed upgrades include a shared-use path, dedicated bike lanes, and adjusted lane widths.

Comments from MassDOT state that all conceptual improvements should be refined and coordinated with MassDOT before submitting the FEIR. MassDOT comments state that the design of the pedestrian facilities may be finalized during the permitting process. However, comments note that it is essential that sufficient Right-of-Way (ROW) be reserved for the construction of these facilities. In addition, comments state that the proposed crossing on Route 110 follow the FHWA Step Guide. Additionally, comments recommend sidewalks be constructed along the east side of the site on Route 119 to connect with the traffic signal at the intersection of Route 119 and the northbound ramps of I-495, which should include a pedestrian crossing.

Transportation Demand Management

The DEIR states that the Proponent is committed to implementing a TDM program intended to reduce single-occupancy vehicle trips to the project site. These measures include:

- Preferential Parking - Provide preferential parking for rideshare, carpool, and hybrid vehicles at locations throughout the site's parking areas in close proximity to major entranceways. The designated spaces will be monitored to ensure that the license plates of those employees parking in the spots each day match the registrations of participants. Employees will only be allowed to use these spaces on the days that they are carpooling. Locations for preferential parking will be identified in future filings.
- Electric Vehicle Stations – Electric vehicle (EV) charging stations will be provided at locations throughout the site's parking areas in close proximity to major entranceways. Locations for the EV charging stations will be identified in future filings.
- Reduced Parking Supply – The Proponent is committed to reducing the parking supply by providing minimal number of parking spaces to a level of the demand need only.
- Sidewalk Connectivity – The site will provide connectivity of sidewalk infrastructure along King Street and Great Road and internal to the site to each building within the construction limits for both the 410 Great Road and 550 King Street locations.

- Bicycle Accommodations – The site will include bicycle accommodation through the main drive aisle of the site with connectivity to bicycle infrastructure along King Street. Internal bicycle accommodation may include bicycle lanes and/or shared use paths.
- Bicycle Racks – The Proponent will provide secure, weather protected, long-term bicycle parking for employees and residents at designated locations within the site. The site plan will also provide bicycle racks for short-term users at several locations on-site
- Public Bicycle Vendor – The Proponent is exploring opportunities to implement a public bicycle vendor, such as Blue Bikes, on-site. If deemed feasible, a vendor station will be strategically located within the site.
- Employee Shower Facilities - Coordinate with commercial tenants to provide showers for employees who commute by walking or biking.
- LRTA Bus Service – The Proponent seeks to continue LRTA bus service to the site along LRTA Bus Route 15. The Proponent will relocate the existing bus stop location to a new location within the site and provide a second bus stop location; each along the main drive aisle in the southbound direction. Each bus stop location will contain a pavement turn-out, bus shelter, trash receptacle, bike rack, and sufficient hardscape area to accommodate full accessibility and bus ramp access.
- Public Transportation Shuttle Service – The Proponent is committed to provide access to the Littleton / I-495 Commuter Rail Station located 2.5 miles south of the project site along Foster Street. The shuttle will be funded by the Proponent and be scheduled to coincide with train boarding / alighting schedules for the MBTA Fitchburg Line. The shuttle stop will be combined with one (1) of the two (2) LRTA bus stops on-site.
- Employee Transportation Coordinator (ETC) – An ETC will be provided on-site to oversee, implement, monitor, and evaluate TDM measures employed or funded by the Proponent. The ETC will be responsible for managing rideshare and carpool programs and distributing information to residents and employees to encourage alternative means of transportation. The ETC will post and distribute announcements and hold promotional events to encourage ridesharing, bicycling, and walking.
- Transportation Management Association (TMA) – The Applicant will seek membership in the Middlesex 3 Transportation Management Association (TMA), which is utilized in neighboring Westford and communities to the northeast of Littleton. The TMA will assist the Proponent and the ETC in support of employees' commuting choices by providing flexible and sustainable transportation solutions.
- Marketing of Transportation Options and Benefits - A welcome packet for all tenants and employees will be distributed at move-in or employment, which includes information for all transportation-related benefits, promotions, and local transportation options; including the location of LRTA / MBTA stops, transit schedules, EV and carpool parking locations, and any other emerging new mobility locations.
- Vanpool and Carpool – The Proponent and the ETC will encourage vanpool and carpooling participation through marketing, events, and vanpool formation meetings. The ETC will implement a ride-matching program to assist employees and residents in finding appropriate carpool matches. The ETC will contact employees and residents to determine if they receive their match-lists, review the lists with them, and see if they have contacted anyone on the list or would like assistance in contacting people.
- Guaranteed Ride Home Program – The ETC will be responsible for providing all employees who carpool, bicycle, or walk to work with an emergency ride home. This

program eliminates the fear of being stranded on days when the employees are ridesharing or must walk or bicycle in inclement weather conditions.
- On-Site Laundry Services - The Proponent will provide laundry services on-site to allow for the reduction of trips to/from the site of nearby laundromats.
- Flex Hours – The Proponent will encourage tenants within the mixed-use development to provide flexible hours to employees.
- Direct Deposit for Employees - The Proponent will encourage tenants within the mixed-use development to provide direct deposit to reduce employee trips to/from the site.
- Site Amenities – As a mixed-use development, the site includes several on-site amenities, such as restaurants, retail, open space, and resident-specific amenities within the residential component of the site. This location will assist in reducing vehicular demand and increase multi-use trips, including parking capacity sized to meet minimum local requirements without excessive parking.
- Promotional Events and Activities – The ETC will be responsible for organizing promotional events and activities to encourage rideshare and alternative transportation means. In addition, the ETC will distribute brochures to all new employees and residents during and post posters and bulletins on various subjects from carpooling to the Guaranteed Ride Home program throughout the site.

Transportation Monitoring Program

The Proponent has committed to conduct an annual Traffic Monitoring Program (TMP) for a period of five years, beginning six months after occupying the full-built project. The TMP will include:

- Collect manual Turning Movement Counts (TMCs) during the weekday morning (7:00 AM to 9:00 AM), weekday evening (4:00 to 6:00 PM), and Saturday midday (11:00 AM to 2:00 PM) peak periods at the following intersections:
  - Route 119/Interstate 495 SB Ramps;
  - Route 119/Interstate 495 NB Ramps;
  - Route 119/Site Driveway West;
  - Route 119/410 Great Road Driveway;
  - Route 119/Route 110;
  - Route 110/410 Great Road Driveway;
  - Route 110/Tuttle House Driveway;
  - Route 110/Site Driveway South;
  - Route 110/Site Driveway Middle;
  - Route 110/Site Driveway North; and
  - Route 110/Building Q Driveway.
- Adequacy of the constructed parking supply.
- Safety evaluations based on available crash data.
- Effectiveness of TDM measures.
- Collect ATR data for a continuous 7-day week-long period along Great Road, King Street, and each site driveway location.
- Collect parking demand counts during the peak parking demand periods for the specific land use areas, including:

  - Residential and Hotel - 5:00 AM to 9:00 AM
  - Retail, Restaurants, R&D, Office, and Industrial - 10:00 AM to 5:00 PM
- Collect motor vehicle crash reports from the Town of Littleton Police Department and MassDOT for the most recent one-year period to ascertain changes in crash frequency, crash trends, and severity at the monitored locations.
- Complete an employee and resident travel survey to gage employee and resident travel patterns and mode share.
- Compare the TMCs collected above with those projected within the TIA for the project to determine whether the total vehicles entering each intersection exceeds the volumes projected.
- Perform a capacity and queuing analysis using Synchro/Sidra analysis software to evaluate the traffic operations at each intersection listed above and compare them to the operations projected in the TIAPS prepared for the project.
- Assess whether additional mitigation is necessary at study intersections and identify measures to improve operations and/or reduce vehicular traffic volumes. The need for evaluation of further mitigation will be conditioned upon:
  - The measured site generated traffic volumes for the project exceeded the projected site generated traffic volumes established in this TIA, or subsequent revisions presented to the Town of Littleton, by more than 10 percent (i.e., 110 percent of the projected site generated traffic volumes.
  - One or more of the movements at the monitored intersections is identified to be operating at or over capacity (defined as a V/C ratio equal to or exceeds 1.00) in consultation with MassDOT or the Town of Littleton.
  - There is a pronounced increase in the frequency of occurrence of motor vehicle crashes at a monitored location, and the calculated motor vehicle crash rate exceeds the MassDOT average crash rate for similar locations.
- Corrective actions to reduce the unmitigated impact of the project should be proposed and implemented based on the thresholds listed above. The corrective actions should be documented in the TMP, approved and coordinated with the Town and/or MassDOT if desired by the agencies, and be undertaken by the Proponent subject to receipt of all necessary rights, permits, and approvals.
- Assess whether the constructed parking supply is adequate for the parking demand as observed.
- Prepare a memorandum summarizing the results of the TMCs, ATRs, parking demand counts, and traffic impact analysis for submission to MassDOT District 3 and the Town of Littleton.

Water and Wastewater

As discussed in the ENF Certificate, MassDEP comments on the ENF noted that Water Management Act (WMA) regulations at 310 CMR 36.22(6) require permittees to develop and implement a mitigation plan to offset the impacts of their increased withdrawal above a baseline volume to the extent feasible. Comments stated that the Littleton Water Department (LWD)'s baseline in the Merrimack River Basin is 1.06 mgd, which it has exceeded in recent years (1.16 mgd in 2023 and 1.12 mgd in 2022). Comments noted that LWD's baseline will likely be further exceeded with the additional demands required by the project.

As required by the Scope, the DEIR included a discussion of conservation measures the project will incorporate to mitigate increased water demand, as a way to assist the Town meet its mitigation obligations under WMA regulations. The DEIR states that the project is committed to minimizing irrigation, utilizing native and drought resistant landscaping, and implementing water demand management programs. The filing states that water fixtures and systems will be low flow, high efficiency fixtures and systems to minimize water usage. Comments from MassDEP indicate that the DEIR addressed all the comments made on the ENF and do not raise additional concerns regarding mitigation of water demand.

As stated in MassDEP comments, the existing site, which includes both 550 King Street and 410 Great Road, currently generates approximately 74,000 gpd of sanitary sewer which is directed to existing on-site disposal facilities. The Project is expected to generate approximately 286,000 gpd and be directed to the Town of Littleton's wastewater treatment system, which is currently under construction.

According to the DEIR, the Town of Littleton has allocated 150,000 gpd of capacity at its wastewater treatment plant (WWTP) for the project. The project's anticipated 286,000 gpd of wastewater exceeds this amount approved by the Town and the MassDEP permitted limit for the groundwater discharge at the WWTP (as reviewed in EEA #16537). The DEIR states that the Proponent is actively working with the Town to increase the capacity of the WWTP to accommodate the project.

The Scope required the Proponent explain how the existing flow, proposed flow reserved to the Town, and the project flow will be accommodated, whether at the WWTP or elsewhere. The DEIR acknowledges that the project as designed lacks sufficient capacity onsite or at the Littleton WWTP but that the 150,000 gpd currently allocated for the project will allow for the development of the project's initial phases (with future phases dependent on approval of additional capacity). The DEIR notes that the Town and Proponent are actively exploring ways to increase available capacity. However, as stated in comments from MassDEP, the DEIR does not identify the location for disposal of the volume of wastewater that exceeds current permitted limits. This must be provided in the FEIR. Comments from MassDEP state that until the Proponent identifies the location for disposal of the unaccounted for volume of wastewater, MassDEP cannot determine if the project will require additional permitting, including a new or amended Groundwater Discharge Permit.

The Scope directed the Proponent to provide calculation of the wastewater generation for the existing uses at both 550 King Street and 410 Great Road. The DEIR provided these calculations; however, comments from MassDEP state that the groundwater discharge permit for 550 King Street authorizes the discharge of only 40,000 gpd of treated wastewater. The DEIR notes that the existing wastewater flow for the 550 King Street parcel is 63,577 gpd, which exceeds the permit limit. Comments state that MassDEP received correspondence in 2022 from the operator of the treatment plant on the property that the 550 King Street facility was closed, so it is unclear what activities are generating the reported flow volume. The FEIR must report on what activities are generating the reported flow. In addition, the DEIR states that the 410 Great Road property has an existing wastewater flow of 10,412 gpd. Comments from MassDEP state that because this flow is greater than 10,000 gpd, that discharge requires a groundwater discharge permit. MassDEP records do not show a WP83 or WP79 permit application being filed for the property. In the FEIR, the Proponent should describe the wastewater treatment system at the 410 Great Road parcel as well as address the unresolved discrepancies in the estimate for existing wastewater flows at the project site.

As required by the Scope, the DEIR indicated that a transfer of ownership is not anticipated between the current permittee for that groundwater discharge at the 550 King Street[6] and the Proponent. Comments from MassDEP note that the Proponent does not currently have a permit for the existing wastewater flows at this location. Comments state that it appears that a property transfer may have occurred without written advance written notice to MassDEP, in accordance with the regulations as described in MassDEP's comment letter. Comments recommend that the Proponent review the regulatory requirements for transfer of the permit and provide details on how MassDEP requirements related to transfer of ownership will be met. The FEIR should address this comment.

As required by the Scope, the DEIR confirmed that the Town of Littleton will file a WP68 permit application to MassDEP for the installation of a 12-inch sewer main, which will convey sanitary sewer flows from the project to the Town's wastewater treatment facility. In accordance with the Scope, the DEIR also states that wastewater collection systems will be designed separately from stormwater systems and will not allow for the introduction of rainwater, noncontract cooling water, and groundwater from foundation drains, sump pumps, surface drainage or any other source of inflow. The DEIR states that the project is committed to a 4:1 I/I removal, which will be accomplished by constructing a new sewer system that will be tested in accordance with Section 35.19 - Sewer Pipe Testing and Section 35.23 – Sewer Manhole Leakage Testing of the Town of Littleton Sewer Use Rules and Regulations.

Climate Change

Adaptation and Resiliency

In accordance with the Scope, the FEIR evaluated whether the project will be resilient to the 2070 25-year, 50-year and 100-year storm conditions. The filing states that the projected 24-hour precipitation depth associated with the 2070 25-, 50- and 100-year storm events are 8.1", 9.2" and 10.4" respectively. As noted above, the project proposes a comprehensive stormwater management system that has been designed to attenuate peak runoff associated with present-day 2-, 10-, 25- and 100-year storms. The DEIR indicates that the stormwater design will also achieve peak attenuation up to the 2070 100-year storm event (10.4 inches). In addition, the filing states that the stormwater management system is designed to allow for future upgrades to adapt to climate change. According to the DEIR, many of the BMPs selected for the site are subsurface which can be increased in size, repaired, or replaced if necessary.

As required by the Scope, the Proponent consulted the Resilient MA Climate Change Projections Dashboard to identify any "hot spots" in proximity to the project site. According to the DEIR, one existing "hot spot" is located near the center the site. According to the DEIR, the

[6] 550 King Street LLC

project proposes to plant approximately 100 trees of similar size as mitigation for trees being removed. In addition, to mitigate against extreme heat, the DEIR states that the project will retain approximately 18 acres of open space to lessen the heat island effect. The FEIR should consider additional mitigation measures, particularly with respect to tree mitigation, and consider increasing tree plantings to at least a 1:1 ratio. To the extent site constraints prevent extensive measures such as additional tree planting, the Proponent could consider acquisitions to protect forested lands, tree replanting in areas identified as lacking tree canopy or experiencing extreme heat risks, and monetary contributions to support community wood banks or other efforts to mitigate heat and water quality burdens in surrounding neighborhoods.

GHG Emissions

This project is subject to review under the May 5, 2010, Revised MEPA Greenhouse Gas Emissions Policy and Protocol (MEPA GHG Policy), which requires Proponents to quantify carbon dioxide (CO_2) emissions and identify measures to avoid, minimize or mitigate such emissions.

Stationary Source

According to the DEIR, Project buildings were separated into categories by typology for the purposes of the GHG analysis.

Group	Building Types	Building Label	Proposed Code Compliance
Group 1	Existing – to be reused	**A*** &B	Relative Performance
Group 2	Residential greater than 50 Units	C, D, E, **F***, R, S	HERS Certified Performance
Group 3	Residential less than 50 Units	I, J, **K***, L, N, O	HERS Certified Performance
Group 4	Hotel	G	Relative Performance
Group 5	Retail & Office	H, M, Q	Relative Performance

The DEIR states that the project is committed to the following GHG mitigation:

- All-electric domestic hot water for residential spaces;
- All-electric Air Source Heat Pump (ASHP) space heating and domestic hot water heating for retail and office spaces;
- Reduced air leakage per C406.9 for retail and office spaces;
- 40% PV solar ready roofs;
- High performance building envelopes;
- Light or reflective roofs;
- Reduced lighting power densities;
- High-efficiency HVAC equipment;
- High performance exterior lighting;
- Low-flow fixtures;

Comments from the Massachusetts Department of Energy Resources (DOER) commend the decarbonization measures the project is committing to; however, DOER comments state that the analysis for Group 2 and Group 3 falsely indicate higher heating loads for HERS 36 vs

HERS 44. Comments state that these errors result in inaccurate final results for overall energy consumption across the various scenarios. Comments note that given that space heating will be ASHPs regardless of the chosen HERS score, the use of inaccurate MBtu figures in the comparison tables gives the flawed impression that electric resistance will be the most cost-effective form of space heating for the residential buildings. Comments state that HERS 40 with ASHP for both space and hot water heating in Group 2, and HERS 40 with ASHP for space heating and electric resistance for hot water in Group 3, will be the most cost effective, energy efficient, and grid-friendly method for construction and long-term operation. The FEIR should include further analyses as described in DOER's comments to provide an accurate comparison of the energy use for these residential scenarios.

Comments state that the project is still proposing gas space and hot water heating for the new hotel (Group 4). DOER comments strongly encourage reconsidering any introduction of new gas lines to the project. The FEIR should commit to this recommendation or provide the detailed analysis outlined in DOER comments including cost data for the gas system to service the project.

Mobile Sources/Air Quality

In accordance with the Scope, the DEIR included a mesoscale analysis of emissions of volatile organic compounds (VOCs) nitrogen oxides (NOx), particulate matters (PM2.5 and PM10), Diesel PM (DPM) and Carbon Dioxide (CO2) for the Existing, 2032 No Build, 2032 Build and 2032 Build with Mitigation scenarios. The DEIR indicates that the mesoscale analysis utilized the U.S. EPA MOVES4 Mobile Source Emission Factor Model and complied with the MassDEP Guidelines for Performing Mesoscale Analysis of Indirect Sources. As compared to Existing Conditions, emissions under the 2032 No Build Condition will decrease or remain the same for NOx, PM2.5, PM10, DPM and CO2. However, emissions from VOCs will increase from 4.2 tons per year (tpy) under Existing conditions to 6.2 tpy (an increase of 1.9 tpy) under the No Build condition. The general decrease in pollutants is largely due to improvements in engine technology that will result in cleaner fuels being used in truck operations overall in the regional economy; however, the project will increase emissions from future No Build to future Build conditions. As compared to 2032 No Build, emissions will increase under the 2032 Build Condition as follows: from 6.2 tpy to 6.6 tpy for VOCs (an increase of 0.4 tpy); from 0.8 tpy to 0.9 tpy for NOx (an increase of 0.1 tpy); from 0.09 tpy to 0.1 tpy for PM2.5 (an increase of 0.01); from 0.65 tpy to 0.7 tpy for PM10 (an increase of 0.05 tpy); from 0.027 tpy to 0.03 tpy for DPM (an increase of 0.003 tpy); and from 3,400 tpy to 3,710 tpy for CO2 (an increase of 310 tpy). However, even with these increases, emissions of all pollutants in the Build condition will remain below Existing conditions with the exception of VOCs.

As noted, the Proponent is committed to the implementation of a TDM plan to minimize traffic impacts, including associated air emissions. The implementation of the TDM measures is estimated to decrease the 2032 Build with Mitigation emissions as compared to 2032 Build conditions. Total emissions under future Build with Mitigation conditions decrease or remain the same from Existing conditions for all emissions other VOCs. As noted in the Scope below, the FEIR should continue to explore measures to reduce traffic related emission below existing conditions.

Construction Period

The project involves the demolition of existing structures on the property. As required by the Scope, the DEIR confirmed that before beginning any demolition or renovation, the Proponent will have the structures inspected by a licensed asbestos inspector to identify the presence, location and quantity of any asbestos-containing material (ACM) and prepare a written asbestos survey report. The DEIR states that no ACM or asbestos-containing waste material will be disposed of at a facility operating as a recycling facility in accordance with 310 CMR 16.05.

SCOPE

General

The FEIR should follow Section 11.07 of the MEPA regulations for outline and content and provide the information and analyses required in this Scope. It should clearly demonstrate that the Proponent has sought to avoid, minimize and mitigate Damage to the Environment to the maximum extent feasible.

Project Description and Permitting

The FEIR should describe the project and identify any changes since the filing of the MEPA 01
DEIR. It should identify and describe state, federal and local permitting and review requirements MEPA 02
associated with the project and provide an update on the status of each of these pending actions. The FEIR should include a description and analysis of applicable statutory and regulatory standards and requirements, and a discussion of the project's consistency with those standards.

The information and analyses identified in this Scope should be addressed within the main body of the FEIR and not in appendices. In general, appendices should be used only to provide raw data, such as drainage calculations, traffic counts, capacity analyses and energy modelling, that is otherwise adequately summarized with text, tables and figures within the main body of the FEIR. Information provided in appendices should be indexed with page numbers and separated by tabs, or, if provided in electronic format, include links to individual sections. Any references in the FEIR to materials provided in an appendix should include specific page numbers to facilitate review.

As discussed above, comments from the Littleton Planning Board note that the location MEPA 03
of the proposed 150-room hotel is prohibited by local zoning as it is within 255 feet of the King Street right-of-way. The FEIR should address this comment. To the extent project designs or land uses are modified in response to comments, an updated project description and associated impacts should be provided in the FEIR.

Land Alteration, Impervious Area, and Stormwater

The FEIR should describe the care and maintenance for replanted trees that will be MEPA 04
conducted by the Proponent to ensure establishment. To the extent that it is available, the FEIR
should include a comprehensive planting plan for the project. The FEIR should consider MEPA 05

additional mitigation measures, particularly with respect to tree mitigation, and consider increasing tree plantings to at least a 1:1 ratio. To the extent site constraints prevent extensive measures such as additional tree planting, the FEIR should consider tree replanting in areas identified as lacking tree canopy or experiencing extreme heat risks, and monetary contributions to support community efforts to mitigate heat and water quality burdens in surrounding neighborhoods.

The FEIR should continue to evaluate measures to reduce the amount of land alteration and conversion of impervious areas to pervious materials, including reductions in building program, roadway widths and parking areas; use of pervious pavement for roadways and/or sidewalks; land banking of parking, phased construction of parking or shared parking[7] until warranted by demand; and supplemental landscaping or tree planting to mitigate impacts associated with clearing. MEPA 06

The FEIR should identify any changes to the proposed stormwater management system design, including the identification of specific LID measures to be incorporated. To the extent any changes are proposed, an updated Stormwater Report should be provided with the FEIR. MEPA 07

Transportation

As stated in comments from MassDOT, if access to the Tuttle House is not consolidated, MassDOT recommends that the Proponent explore alternative options for consolidating access. These alternatives should be included in the FEIR with the goal of minimizing the number of access points as much as possible. The Proponent should continue consultation with MassDOT to further refine the Project's access management plan. MEPA 08 MEPA 09

As noted in MassDOT comments, the FEIR should commit to following the FHWA Step Guide for the proposed crossing on Route 119. The FEIR should commit to constructing sidewalks along the east side of the site on Route 119 to connect with the traffic signal at the intersection of Route 119 and the northbound ramps of I-495, which should include a pedestrian crossing. MEPA 10

As noted in comments from Metropolitan Area Planning Council (MAPC), the FEIR should explore the feasibility of creating a connection to/from the site with local pedestrian and bicycle accommodations including the "Littleton Loop." The FEIR should discuss the feasibility of this request. Comments from MAPC recommend that the Proponent partner with the Town as well as other major employers in the vicinity to support the reformation of the Crosstown Connect TMA.[8] The FEIR should discuss the potential reformation of the Crosstown Connect TMA and whether the Proponent could support this effort. MEPA 11 MEPA 12

As noted in comments from MAPC, the FEIR should explore the feasibility of creating a connection to/from the site with local pedestrian and bicycle accommodations including the "Littleton Loop." The FEIR should discuss the feasibility of this request. Comments from MAPC recommend that the Proponent partner with the Town as well as other major employers in the

[7] Described in detail in Metropolitan Area Planning Council's (MAPC) comments.
[8] https://www.crosstownconnect.org/

vicinity to support the reformation of the Crosstown Connect TMA.[9] The FEIR should discuss the potential reformation of the Crosstown Connect TMA and whether the Proponent could support this effort. The FEIR should report on any updates to TDM measures. MEPA 13

Wastewater

Per MassDEP comments, the FEIR must explain how the existing flow, proposed flow reserved to the Town, and the project flow of wastewater will be accommodated, whether at the WWTP or elsewhere. As noted in comments from MassDEP, the groundwater discharge permit for 550 King Street authorizes the discharge of only 40,000 gpd of treated wastewater; however, the DEIR states that the existing wastewater flow for the 550 King Street parcel is 63,577 gpd. In addition, MassDEP received correspondence in 2022 from the operator of the treatment plant on the property that the 550 King Street facility was closed. The FEIR must explain what activities are generating the reported flow volume. The FEIR should describe the wastewater treatment system at the 410 Great Road parcel as well as address the unresolved discrepancies in the estimate for existing wastewater flows at the project site as described above. The FEIR should provide a definitive estimate of wastewater demand for the site, and describe a plan to meet regulatory requirements for this infrastructure sufficient to accommodate the project. The FEIR should report on progress on the Town's efforts to increase capacity at the WWTP to accommodate the project. As indicated in MassDEP comments, sufficient information regarding the proposed location for disposal of the unaccounted for volume of wastewater from the project must be provided so as to accurately identify any additional permitting requirements. MEPA 14 MEPA 15 MEPA 16

As noted above, the Proponent does not currently have a permit for the existing wastewater flows at the 550 King Street location. Comments from MassDEP state that it appears that a property transfer of the underlying site may have occurred without written advance written notice to MassDEP. The Proponent should review the regulatory requirements for transfer of the permit and provide an update on the status of the permit transfer in the FEIR and provide details on how MassDEP requirements related to transfer of ownership will be met. MEPA 17

Climate Change

Adaptation and Resiliency

The FEIR should consider additional mitigation measures to make the site more resilient to extreme heat. In particular, the FEIR should discuss increasing tree plantings to at least a 1:1 mitigation ratio. To the extent site constraints prevent extensive measures such as additional tree planting, the FEIR should consider tree replanting in areas identified as lacking tree canopy or experiencing extreme heat risks, and monetary contributions to support community efforts to mitigate heat and water quality burdens in surrounding neighborhoods. MEPA 18

[9] https://www.crosstownconnect.org/

Greenhouse Gas Emissions (GHG)

Stationary Sources

The FEIR should provide the information and analyses requested in the detailed comment letter submitted by DOER, which is incorporated by reference herein. MEPA 19

The FEIR should commit to the following recommendations or provide the analysis as detailed in DOER's comments.

Building	Use	Recommendation
C	173 residential units	HERS 40 with ASHP for both space and water heating.
D	173 residential units	
E	149 residential units + retail	Residential: same as C, D Retail: electric air source heating and hot water; reduced air leakage C406.9
F	151 residential units	Same as C, D
G	Hotel (150 rooms)	Electric air source heating and hot water; reduced air leakage C406.9; electric cooking and drying
I	9 residential units + retail	HERS 40 with ASHP for space heating; electric resistance water heating Retail: electric air source heating and hot water; reduced air leakage C406.9
J	11 residential units + retail	
K	42 residential units + retail	
L	11 residential units + retail	
N	8 residential units + retail	Same as Buildings I, J, K, L
O	12 residential units + retail	
R	65 residential units	Same as Buildings C, D
S	285 residential units	

If commitments to the recommendations above are not made, then the FEIR should provide the evaluations as requested in DOER's comments.

Specifically, the FEIR should develop a "gap analysis" table that summarizes the key design changes to compare each requested HERS scenario. Design inputs should come from the results of HERs models, prepared by a qualified consultant. The gap analysis should also include reductions in HVAC equipment size enabled by increasingly improved building thermal performance, as well as reduction in peak electric usage due to improved thermal performance. The FEIR should provide a cost-estimate analysis tied to each row of the gap analysis, showing specific additional costs/reductions, as further detailed in DOER's letter.

As indicated in DOER comments, the FEIR should continue to consider alternatives to introducing new gas lines to this property. To assess these alternatives, the FEIR should provide MEPA 20 cost data for the gas system to service the project as requested by DOER (including cost to project, cost to ratepayers, costs covered by grants, costs financed, costs/financing from any other source(s)). The FEIR should also provide the plan and costs (from all sources: ratepayers, residents, etc) from the gas utility for eventual decommissioning/abandonment of the gas service by 2050, and also the plan and costs (from all sources: ratepayers, residents, etc) from the electric utility for eventual necessary upgrades to electric service by 2050 to support a transition from gas to electric. The FEIR should provide clear rationale for dismissing non-gas alternatives, and indicate why such alternatives are not feasible for the project in light of the cost analysis described above. MEPA 21

Mobile sources/Air Quality

As indicated above, emissions of VOCs under the Build 2034 condition are expected to increase as compared to Existing 2025 conditions, despite the assumption of improvements to engine technology resulting in lower emissions. The FEIR should continue to explore measures to reduce traffic related emission below existing conditions through enhanced TDM, improvements to surrounding intersection/roadway infrastructure, or other mitigation measures. To the extent feasible, emissions reductions achieved through TDM and other traffic mitigation measures should be quantified. The FEIR should consider an increased commitment to EV charging infrastructure or solar PV. To further offset future air impacts, the Proponent may consider on- or off-site tree plantings, maximization of indoor air filtration, and/or other supported strategies to improve air quality. MEPA 22 MEPA 23

<u>Mitigation and Draft Section 61 Findings</u>

The FEIR should include a separate chapter updating all proposed mitigation measures including construction-period measures. This chapter should also include a comprehensive list of all commitments made by the Proponent to avoid, minimize and mitigate the environmental and related public health impacts of the project, and should include a separate section outlining mitigation commitments relative to EJ populations. The filing should contain clear commitments to implement these mitigation measures, estimate the individual costs of each proposed measure, identify the parties responsible for implementation, and contain a schedule for implementation. The list of commitments should be provided in a tabular format organized by subject matter (traffic, water/wastewater, GHG, etc.) and identify the Agency Action or Permit associated with each category of impact. Draft Section 61 Findings should be separately included for each Agency Action to be taken on the project. The filing should clearly indicate which mitigation measures will be constructed or implemented based upon project phasing to ensure that adequate measures are in place to mitigate impacts associated with each development phase. MEPA 24

<u>Responses to Comments</u>

The FEIR should contain a copy of this Certificate and a copy of each comment letter received. The FEIR should contain a direct response to the Scope items in this Certificate. To ensure that the issues raised by commenters are addressed, the FEIR should also include direct responses to comments to the extent that they are within MEPA jurisdiction. This directive is not intended, and shall not be construed, to enlarge the Scope of the FEIR beyond what has been expressly identified in this certificate. MEPA 25

Circulation

The Proponent should circulate the FEIR to each Person or Agency who previously commented on the ENF or DEIR, each Agency from which the project will seek Permits, Land Transfers or Financial Assistance, and to any other Agency or Person identified in the Scope. A copy of the FEIR should be made available for review at the Littleton Public Library. MEPA 26

August 22, 2025
Date

Rebecca L. Tepper

Comments received:

07/20/2025	George Sanders
07/24/2025	Michael Gruar
08/03/2025	Amy Tarlow-Lewis
08/14/2025	Town of Littleton Planning Department & Planning Board
08/14/2025	Metropolitan Area Planning Council (MAPC)
08/15/2025	DarkSky Massachusetts
08/15/2025	Donald MacIver
08/15/2025	Erin Healy
08/15/2025	Jo-Ann Dery
08/15/2025	Sondra and Stephen Swartz
08/15/2025	Massachusetts Department of Transportation (MassDOT)
08/18/2025	Massachusetts Department of Environmental Protection (MassDEP)
08/21/2025	Massachusetts Department of Energy Resources (DOER)

RLT/NSP/nsp

SECRETARY'S CERTIFICATE ON THE DRAFT EIR

MEPA 01 **The FEIR should describe the project and identify any changes since the filing of the DEIR.**

Changes the Project since the filing of the DEIR are described in Section 1.3.

MEPA 02 **It should identify and describe state, federal and local permitting and review requirements associated with the project and provide an update on the status of each of these pending actions. The FEIR should include a description and analysis of applicable statutory and regulatory standards and requirements, and a discussion of the project's consistency with those standards.**

Permits expected for the Project are provided in Table 1-1 in Chapter 1.

MEPA 03 **As discussed above, comments from the Littleton Planning Board note that the location of the proposed 150-room hotel is prohibited by local zoning as it is within 255 feet of the King Street right-of-way. The FEIR should address this comment. To the extent project designs or land uses are modified in response to comments, an updated project description and associated impacts should be provided in the FEIR.**

The Proponent has updated the massing of the hotel to conform to zoning requirements. The program remains the same, and expected impacts are as described in the DEIR

MEPA 04 **The FEIR should describe the care and maintenance for replanted trees that will be conducted by the Proponent to ensure establishment. To the extent that it is available, the FEIR should include a comprehensive planting plan for the project.**

The Proponent will implement a comprehensive care and maintenance program to ensure the successful establishment of all replanted trees. Refer to Section 2.1 for additional information.

MEPA 05 **The FEIR should consider additional mitigation measures, particularly with respect to tree mitigation, and consider increasing tree plantings to at least a 1:1 ratio. To the extent site constraints prevent extensive measures such as additional tree planting, the FEIR should consider tree replanting in areas identified as lacking tree canopy or experiencing extreme heat risks, and monetary contributions to support community efforts to mitigate heat and water quality burdens in surrounding neighborhoods.**

The Proponent intends to provide tree plantings at a 1:1 ratio. This commitment is included in the mitigation section of this FEIR. Refer to Section 2.2 for additional information.

MEPA 06 **The FEIR should continue to evaluate measures to reduce the amount of land alteration and conversion of impervious areas to pervious materials, including reductions in building program, roadway widths and parking areas; use of pervious pavement for roadways and/or sidewalks; land banking of parking, phased construction of parking or shared parking until warranted by demand; and supplemental landscaping or tree planting to mitigate impacts associated with clearing.**

The Proponent is committed to minimizing land alteration and reducing impervious surfaces as part of the Project's overall environmental strategy. Section 2.2 provides additional information.

MEPA 07 **The FEIR should identify any changes to the proposed stormwater management system design, including the identification of specific LID measures to be incorporated. To the extent any changes are proposed, an updated Stormwater Report should be provided with the FEIR.**

An updated Stormwater Report, including revised calculations, drainage area maps, and supporting documentation, is provided in Appendix B which reflects the modifications to the Site Plan and demonstrates that compliance with applicable stormwater management standards is maintained. Refer to Section 2.3 for additional information.

MEPA 08 **if access to the Tuttle House is not consolidated, MassDOT recommends that the Proponent explore alternative options for consolidating access. These alternatives should be included in the FEIR with the goal of minimizing the number of access points as much as possible.**

Section 3.2.3 describes the current status of coordination between the Site and the neighboring 510 King Street property as to the consolidation of driveways.

MEPA 09 **The Proponent should continue consultation with MassDOT to further refine the Project's access management plan.**

The Proponent's Team met with MassDOT PPDU and MassDOT District 3 to further coordinate on Site access and off-site mitigation on Wednesday, September 17, 2025. The Proponent's Team also met with MassDOT Highway Design HQ on Monday, September 29, 2025, to further coordinate the proposed King Street and Great Road cross-sections. Chapter 3 outlines the up-to-date summary of both Site access and off-site transportation mitigation.

MEPA 10 **the FEIR should commit to following the FHWA Step Guide for the proposed crossing on Route 119. The FEIR should commit to constructing sidewalks along the east side of the site on Route 119 to connect with the traffic signal at the intersection of Route 119 and the northbound ramps of I-495, which should include a pedestrian crossing.**

Based on coordination with MassDOT, the pedestrian crossing location in question has been removed from the Project's off-site mitigation in lieu of constructing a new sidewalk along the northerly side of Great Road and a signalized crossing further west at Interstate 495 NB Ramps. The FHWA Step Guide will be utilized in the identification of candidate uncontrolled pedestrian crossing countermeasures at alternate locations of off-site mitigation.

MEPA 11 **As noted in comments from Metropolitan Area Planning Council (MAPC), the FEIR should explore the feasibility of creating a connection to/from the site with local pedestrian and bicycle accommodations including the "Littleton Loop." The FEIR should discuss the feasibility of this request.**

Section 3.3.1 outlines the Proponent's commitments to connectivity to the "Littleton Loop" that had been identified in the DEIR.

MEPA 12 **Comments from MAPC recommend that the Proponent partner with the Town as well as other major employers in the vicinity to support the reformation of the Crosstown Connect TMA. The FEIR should discuss the potential reformation of the Crosstown Connect TMA and whether the Proponent could support this effort.**

Section 3.3.2.4 provides a change in the TMA commitment from Middlesex 3 TMA to a reformed Crosstown Connect, including the Proponent seeking opportunities to assist in the reformation of this TMA where possible.

MEPA 13 **The FEIR should report on any updates to TDM measures.**

Section 3.3.2 outlines the current TDM program as committed to by the Proponent.

MEPA 14 **Per MassDEP comments, the FEIR must explain how the existing flow, proposed flow reserved to the Town, and the project flow of wastewater will be accommodated, whether at the WWTP or elsewhere. As noted in comments from MassDEP, the groundwater discharge permit for 550 King Street authorizes the discharge of only 40,000 gpd of treated wastewater; however, the DEIR states that the existing wastewater flow for the 550 King Street parcel is 63,577 gpd. In addition, MassDEP received correspondence in 2022 from the operator of the treatment plant on the property that the 550 King Street facility was closed. The FEIR must explain what activities are generating the reported flow volume**

The existing wastewater flow figure of 63,577 gpd for the 550 King Street parcel cited in the DEIR was calculated using a design flow rate associated with the current uses of the Site. It does not reflect historical use of the Site and is not representative of current operating conditions. For clarification, in 2022 the existing office buildings were closed and subsequently the on-site treatment plant was inactive, so the existing figure represents a theoretical use where the actual current value was 0 gpd. The Proponent then purchased the property and in July 2023 was made aware that the current discharge permit was about to expire. The owner worked diligently with a consultant on the matter and, on November 28, 2023, a new groundwater discharge permit (Permit No. 79-7) was issued.

As noted in MassDEP's comments, the current groundwater discharge permit authorizes up to 40,000 gallons per day of treated effluent. This permit is included as Appendix C of the FEIR. Any necessary modifications to the existing discharge permit or facility operations will be pursued in consultation with MassDEP and other relevant authorities.

The wastewater flow generated by the proposed Project will be accommodated at the Littleton WWTP. Project implementation will occur in phases and the advancement of future phases will be aligned with the availability of additional wastewater treatment capacity. Because the MEPA process requires the Project to be submitted as a whole, the capacity that will serve later phases is not yet in place. As capacity is increased—through permit modifications, infrastructure improvements, or operational enhancements – the Project will progress accordingly to ensure that wastewater flows remain fully compliant with regulatory requirements and do not exceed permitted discharge limits. The Proponent will coordinate with local and state authorities to ensure that the proper disclosures are made for future phases, and permits are obtained.

MEPA 15 **The FEIR should describe the wastewater treatment system at the 410 Great Road parcel as well as address the unresolved discrepancies in the estimate for existing wastewater flows at the project site as described above. The FEIR should provide a definitive estimate of wastewater demand for the site, and describe a plan to meet regulatory requirements for this infrastructure sufficient to accommodate the project.**

The existing wastewater treatment system at the 410 Great Road parcel currently consists of an on-site Title 5 septic system designed to serve the historic uses of the property. When the Proponent purchased the property, they were made aware of a failed inspection report from 2022. The Owner has begun to vacate the property with plans to decommission the existing buildings on-site as well as the associated existing septic system. As part of the proposed development, wastewater flows from 410 Great Road will be routed to the Littleton WWTP, facilitating more efficient and centralized treatment. Project advancement will be contingent upon securing adequate treatment capacity, through either existing permitted capacity, planned infrastructure improvements, or permit modifications in coordination with MassDEP.

MEPA 16 **The FEIR should report on progress on the Town's efforts to increase capacity at the WWTP to accommodate the project. As indicated in MassDEP comments, sufficient information regarding the proposed location for disposal of the unaccounted for volume of wastewater from the project must be provided so as to accurately identify any additional permitting requirements.**

The Proponent continues to coordinate with the Town on securing additional wastewater capacity. The Town's ongoing efforts to increase capacity at the Littleton WWTP to accommodate the projected flows from the proposed Project has yielded some promising new possibilities; however, there are currently no planned or underway infrastructure improvements, permit modifications, or timelines relevant to expanding treatment capacity. Littleton Electric Light and Water Department (LELWD) continues to have dialogue with MassDEP but, at this time, LELWD has not made any significant progress to increasing the permitted discharge at 56 King Street. In Q1 of 2025, LELWD completed an infiltration test and calibrated their hydrological model for this site, and it appears that the model would support an increase in the permitted capacity. LELWD will be submitting a request to amend their permit with Mass DEP in Q4 of 2025.

The Project will not discharge wastewater for any phases of the development beyond the currently approved discharge volume of 150,000 gpd until sufficient expansion of the treatment system has occurred and the necessary permits acquired.

MEPA 17 **As noted above, the Proponent does not currently have a permit for the existing wastewater flows at the 550 King Street location. Comments from MassDEP state that it appears that a property transfer of the underlying site may have occurred without written advance written notice to MassDEP. The Proponent should review the regulatory requirements for transfer of the permit and provide an update on the status of the permit transfer in the FEIR and provide details on how MassDEP requirements related to transfer of ownership will be met.**

The Proponent does indeed have a current permit for the existing wastewater flows at the 550 King Street location. Refer to Section 4.5 for additional information.

MEPA 18 **The FEIR should consider additional mitigation measures to make the site more resilient to extreme heat. In particular, the FEIR should discuss increasing tree plantings to at least a 1:1 mitigation ratio.**

To make the Site more resilient to extreme heat, the Proponent intends to provide tree plantings at a 1:1 ratio. This commitment is included in the mitigation section of this FEIR. Chapters 2 and 5 provide additional information.

MEPA 19 **The FEIR should provide the information and analyses requested in the detailed comment letter submitted by DOER, which is incorporated by reference herein. The FEIR should commit to the following recommendations or provide the analysis as detailed in DOER's comments.**

The updated information and analysis are provided in Chapter 6 of the FEIR with supporting documentation provided in Appendix D.

MEPA 20 **As indicated in DOER comments, the FEIR should continue to consider alternatives to introducing new gas lines to this property. To assess these alternatives, the FEIR should provide cost data for the gas system to service the project as requested by DOER (including cost to project, cost to ratepayers, costs covered by grants, costs financed, costs/financing from any other source(s)). The FEIR should also provide the plan and costs (from all sources: ratepayers, residents, etc) from the gas utility for eventual decommissioning/abandonment of the gas service by 2050, and also the plan and costs (from all sources: ratepayers, residents, etc) from the electric utility for eventual necessary upgrades to electric service by 2050 to support a transition from gas to electric.**

As discussed in consultation with DOER on September 5, 2025, the Proponent has agreed to commit to using electric air source heat pumps for space heating in the hotel, eliminating space heating natural gas use from the design. This design change was agreed to allow the Proponent to forgo the above noted analysis.

MEPA 21 **The FEIR should provide clear rationale for dismissing non-gas alternatives, and indicate why such alternatives are not feasible for the project in light of the cost analysis described above.**

The Proponent has eliminated natural use for space heating from the hotel design. Industry standards necessitate retaining the option for use in domestic hot water and kitchen uses. This was agreed in discussion with DOER.

MEPA 22 **The FEIR should continue to explore measures to reduce traffic related emission below existing conditions through enhanced TDM, improvements to surrounding intersection/roadway infrastructure, or other mitigation measures.**

The Project includes robust TDM measures which aim to reduce single occupancy trips thereby reducing mobile source emissions. These measures are discussed in Section 3.3.2.

MEPA 23 **The FEIR should consider an increased commitment to EV charging infrastructure or solar PV. To further offset future air impacts, the Proponent may consider on- or off-site tree plantings, maximization of indoor air filtration, and/or other supported strategies to improve air quality.**

The Proponent is committed to providing replanting at a 1:1 ratio to preserve shade on Site and reduce localized heat island effect. At this time, the Proponent is unable to commit to any additional EV charging or solar PV. The Proponent will continue to evaluate ways to increase these commitments as future phases are built.

MEPA 24 **The FEIR should include a separate chapter updating all proposed mitigation measures including construction-period measures. This chapter should also include a comprehensive list of all commitments made by the Proponent to avoid, minimize and mitigate the environmental and related public health impacts of the project, and should include a separate section outlining mitigation commitments relative to EJ populations.**

Chapter 7 of the FEIR includes updated mitigation measures for the Project.

MEPA 25 **The FEIR should contain a copy of this Certificate and a copy of each comment letter received. The FEIR should contain a direct response to the Scope items in this Certificate. To ensure that the issues raised by commenters are addressed, the FEIR should also include direct responses to comments to the extent that they are within MEPA jurisdiction.**

This chapter of the FEIR contains a copy of the Certificate as well as comments and responses from agencies and the public.

MEPA 26 **A copy of the FEIR should be made available for review at the Littleton Public Library.**

A copy of the FEIR will be sent to the Littleton Public Library for review by interested members of the public.

George A. Sanders, Sr.
672 Great Road
Littleton, Massachusetts 01460-1236
Email: ivygas1@yahoo.com
Telephone Number: 978-502-0969

July 20, 2025

The Most Honorable Rebecca Tepper, Secretary
Executive office of Energy and Environmental Affairs
100 Cambridge Street, 10th Floor, Suite 900
Boston, Massachusetts 02114

Re: DEIR on Project EEA #16921, 410, 550, and 584 King Street, Littleton, MA 01460 (Mr. Nicholas Perry)

Dear Madam Secretary:

It is my hope that your family, staff, and their families, and you are in the best of health and staying safe, as this leaves the undersigned doing well currently.

I am writing to you concerning [**public input**] on the aforementioned project here in the Town of Littleton, Massachusetts. My main concerns with this project are that it is a good fit for the community; I am concerned that the total discharge for wastewater, of 187,000 GS 01
gallons, did not include a 150-room hotel or the parcels at 410 and 584 King Street. It is imperative that all sewage generated at the three parcels be processed through a sewer wastewater treatment plant.

At the present time, Littleton is in the process of opening a new sewer wastewater treatment plant that has a maximum output of 242,000 gallons of wastewater that includes 150,000 gallons of wastewater from 550 King Street [**only**]. Under the 'Clean Water Act,' Littleton is working extremely hard to be a good green environmental community, when it comes to the amount of [**nitrogen**] getting into the ground water that is from septic systems here in Littleton. Littleton is a community that gets its drinking water from ground wells and that is why the development of these parcels is so [**crucia**l] that all building facilities are hooked up to a sewer treatment plant.

In addition, it is necessary that all buildings comply with Littleton's Planning Board approved "Form Base Code" of 240 feet from the edge of King Street. It is not in the [**clear**] where the five floors 150-room hotel is located on the parcel – it must be built beyond the 'Form Base Code' of 240 feet from the edge of King Street. GS 02

I am also hoping that the state will be a good partner in supporting infrastructure sewer and water funding for the 600 MBTA housing units at 550 King Street; those 600 MBTA Housing units are also [**not included**] in the discharge of 242,000 gallons of wastewater from the new sewer treatment plant at 242 King Street. GS 03

I cannot stress how vital it is for the state, the developer, and the town to get the sewer treatment plant expanded, by finding funding, land and developing a new cleaned wastewater discharge site for the sewage that is forthcoming.

The parcels must ensure that there is not any environmental denying of natural sunlight to housing across King Street (Due east).

My overall thoughts about these parcels on this project are that the developer intends to comply with the local and state codes and develop these parcels into first class facilities here in Littleton. I have spoken with the developer several times and I trust that he wants to comply with all requirements that are placed upon this project by local and state authorities; therefore, I really do not have any other concerns currently.

Very sincerely yours,

S/s George A. Sanders, Sr.
GEORGE A. SANDERS, SR.

cc: The Most Honorable Jim Arciero
The Most Honorable Nick Lawler

GEORGE A. SANDERS, SR.

GS 01 **I am concerned that the total discharge for wastewater, of 187,000 gallons, did not include a 150-room hotel or the parcels at 410 and 584 King Street. It is imperative that all sewage generated at the three parcels be processed through a sewer wastewater treatment plant.**

The wastewater discharge that was described in the DEIR was inclusive of all projected uses associated with the full build of the Project as currently designed. The Proponent continues to coordinate with the Town on securing additional wastewater capacity. The Town's ongoing efforts to increase capacity at the Littleton WWTP to accommodate the projected flows from the proposed Project has yielded some promising new possibilities; however, there are currently no planned or underway infrastructure improvements, permit modifications, or timelines relevant to expanding treatment capacity.

GS 02 **In addition, it is necessary that all buildings comply with Littleton's Planning Board approved "Form Base Code" of 240 feet from the edge of King Street. It is not in the [clear] where the five floors 150-room hotel is located on the parcel – it must be built beyond the 'Form Base Code' of 240 feet from the edge of King Street.**

The hotel's massing was adjusted to conform to zoning height requirements. The hotel is now limited to the 4 stories allowed in King Street Commons. This is discussed in Section 1.3.1.

GS 03 **I am also hoping that the state will be a good partner in supporting infrastructure sewer and water funding for the 600 MBTA housing units at 550 King Street; those 600 MBTA Housing units are also [not included] in the discharge of 242,000 gallons of wastewater from the new sewer treatment plant at 242 King Street.**

Comment noted.

Hello,

I've gone through most of the DEIR for King St Common, at least as far as traffic is concerned. One thing I want to get clarity on and/or highlight is bicycle connections to/from the west, along Great Road. Due to I-495 limiting the number of crossings, Great Road is currently the only connection between the center of town (i.e. the Common) and the northwestern portion of Littleton, including the Point shopping area, two local farm stands, and... my home. I end up biking on it semi-regularly, and while it doesn't have formal bike infrastructure, the shoulders are almost adequate for biking on. Given that context, i have a few questions:

1. When rebuilding the driveway connection to Great Road, will you ensure that the northern sidewalk (or at least, the stub that I see in the plans) is built north enough to allow for bike lanes, or at least bicycle-sized shoulders? MG 01
2. Is there any potential to widen the space for bicycles between the rebuilt driveway and King Street? (I suspect the answer is "not without significant impacts to neighboring properties", but I have to ask. MG 02
3. How closely are you working with MassDOT on bike/ped connections to the west? I know the bridge deck over 495 is planned to be replaced soon, and in addition to bicycle space, it really needs a sidewalk on the *north* side to better connect to Market Basket/the Point. MG 03

I'm looking forward to both your responses and further development of the project, it'll be great to make a dent in the housing crisis and put the land to much better use than a massive empty parking lot.

Thanks,

Michael

MICHAEL

MG 01 **When rebuilding the driveway connection to Great Road, will you ensure that the northern sidewalk (or at least, the stub that I see in the plans) is built north enough to allow for bike lanes, or at least bicycle-sized shoulders?**

The FEIR describes the intent to construct a new sidewalk connection along the northerly side of Great Road between the driveway and the I-495 Ramps which is a change from the DEIR and as recommended by MassDOT and MEPA. Note that the area to the east of this location is right-of-way restricted to the Proponent as well as the culvert location to the west which is replacement restrictive to the Proponent. The feasibility of limited bicycle accommodation along this stretch would come at the expense of the proposed pedestrian accommodation. Discussions with MassDOT Highway Design HQ on Monday, September 29, 2025, acknowledged the new sidewalk mitigation and MassDOT generally agreed that further bicycle accommodation would generally be out of scope for a private developer as part of this Project.

MG 02 **Is there any potential to widen the space for bicycles between the rebuilt driveway and King Street? (I suspect the answer is "not without significant impacts to neighboring properties", but I have to ask.**

As noted in the prior comment, the Right-of-Way in this area, including the location of vertical infrastructure (buildings, gas station subsurface and above-ground infrastructure, present steep grading) on adjacent properties is restrictive and the Proponent has no control over the existing development of these properties. Where space does exist, the Proponent is seeking to upgrade or enhance pedestrian accommodation along Great Road where the Site and/or MassDOT property can be altered.

MG 03 **How closely are you working with MassDOT on bike/ped connections to the west? I know the bridge deck over 495 is planned to be replaced soon, and in addition to bicycle space, it really needs a sidewalk on the north side to better connect to Market Basket/the Point.**

The FEIR describes the intent to construct a new sidewalk connection along the northerly side of Great Road between the driveway and the I-495 Ramps which is a change from the DEIR and as recommended by MassDOT and MEPA. This plan includes a crossing from the north side to the south side at the I-495 NB Ramps under traffic signal control. Further sidewalk to the west from this point would be anticipated to be completed by MassDOT as part of a future bridge project, if feasible, where there is currently no pedestrian accommodation provided today to terminate any new accommodation in a safer manner. Discussions with MassDOT Highway Design HQ on Monday, September 29, 2025, acknowledged the new sidewalk mitigation and MassDOT generally agreed that further bicycle accommodation would generally be out of scope for a private developer as part of this Project.

Executive Office of Energy and Environmental Affairs

Project Name: King Street Common / EEA# 16921

Public Comment

August 3, 2025

To Whom This May Concern,

I am writing to request that a new stop light is added to the intersection of Rusell Street and King Street Littleton, MA. See attached map. As a traffic public safety concern and for the health and wellness of children biking to school and people walking, an additional stop light must be added to increase the safety, accessibility, and walkability of our small town. ATL 01

As the town has grown there has been increased traffic and accidents over the years at the of Rusell Street and King Street intersection. There is too much traffic at school start and end times and at rush hour. Cars driving off and on to Rt 495 drive too fast and people use Russell Street as a cut-through to get to Rt 495 and to avoid the stop lights in the center of town. Cars also use Russell street from The Point (Market Basket) and the future King Street Project to cut to the West Acton side of town. It has become too dangerous over the years as the population has grown to safely pull in and out of Russell / King Street never mind the number of kids on bikes. As the King Street Project has been built out over the years and housing units have come online the number of cars will increase and so will the traffic pressures. Russell Street was built only to handle local traffic for local residents, and the upper elementary school and middles school. Please note a traffic light had been added many years ago when the new high school was built off King Street.

The Town of Littleton and the King Street Project should follow the state policies and guidance for implementing and leverage complete streets policies by designing and maintaining streets that accommodate all users, regardless of age, ability, or mode of transportation; walking, biking, transit, or driving.

I am hoping the Town of Littleton, State, and the Lupoli Company will consider a new traffic light to address traffic and pedestrian concerns as a direct result of the increased traffic pressure from the King Street project. Other traffic calming measures could also be utilized such as a full speed humps to slow down vehicles. Four-way stop signs can be another option to ensure cars stop without causing long delays at traffic lights. ATL 02

Enhanced pedestrian infrastructure with improving crosswalks should also be considered: Reshape, repaint to improve safety and visibility for pedestrians with curb extensions, raised crosswalks/intersections to slow vehicle speeds and improve accessibility for wheelchairs and strollers. And this must include good lighting, which is crucial for safe crossings, especially at night. ATL 03

Install Pedestrian Signals by implementing traditional walk/don't walk signals at the intersections or consider High Intensity Activated Crosswalks (HAWK) or Rectangular Rapid Flashing Beacons (RRFB) at mid-block crossings to improve safety and ease of crossing with signal timing and lowering speed limits. ATL 04

I am sure the Town of Littleton is fully versed on the how to secure funding through the Complete Streets Funding Program mechanism and other State or Federal Programs. These improvements can be funded through a combination of State, Federal funding with a contribution from the Lupoli Company, shifting the burden away from the Local taxpayer. There is a cost-benefit to investing in improved safety measures that will save lives, prevent injury, fewer accidents, reduced emergency response costs, and potentially lower insurance rates for the community.

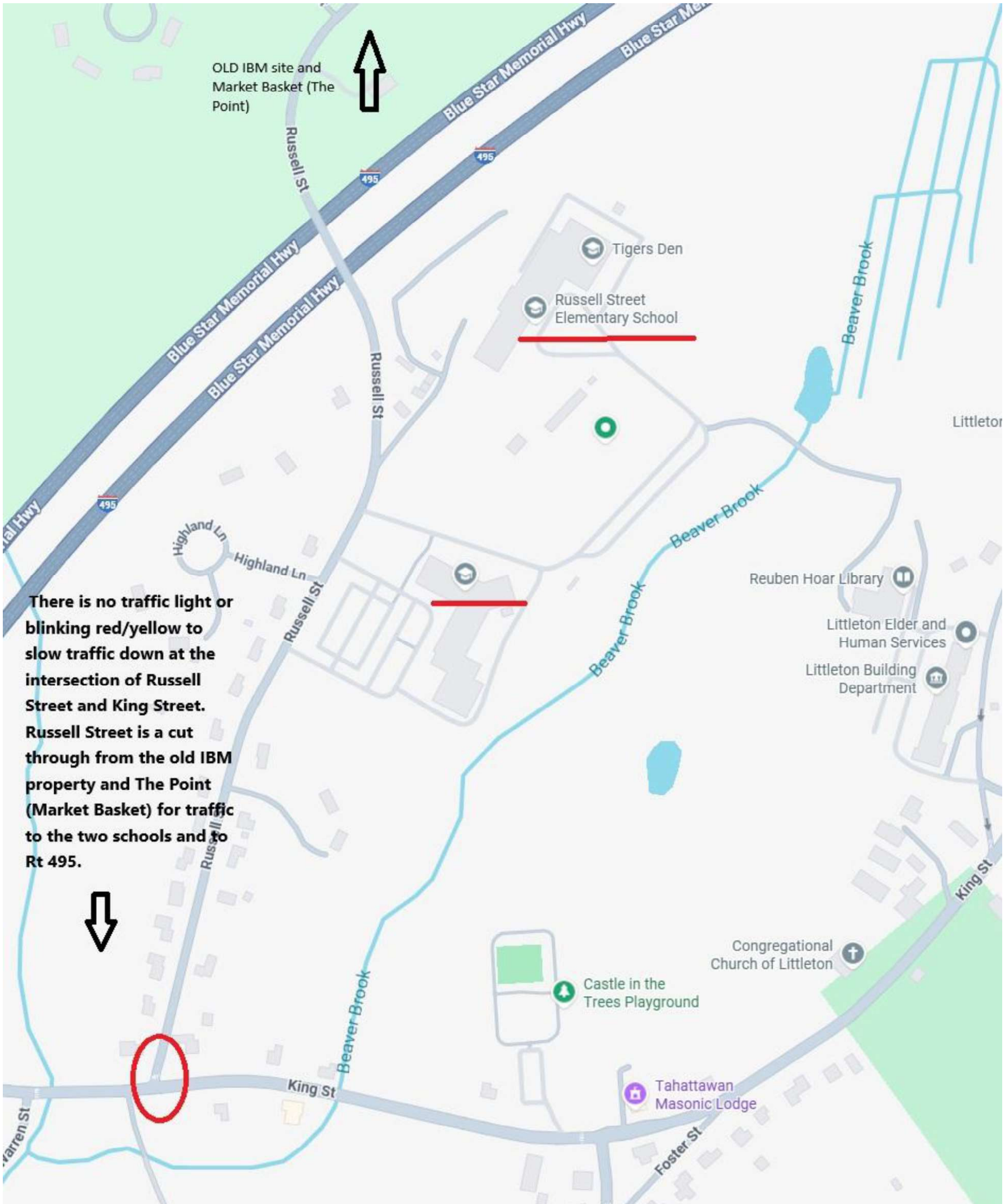
I support projects that connect destinations and residential areas with commercial districts, schools, and parks. But those projects must keep public safety, health, and wellness at its core.

Respectfully,

Amy Tarlow-Lewis

Amy Tarlow-Lewis
3 Omega Way
Littleton, MA 01460

Cell 617-678-0739
Astarlow@gmail.com


OLD IBM site and Market Basket (The Point)
Blue Star Memorial Hwy
495
Russell St
Tigers Den
Russell Street Elementary School
Beaver Brook
Littleton
Highland Ln
Reuben Hoar Library
Littleton Elder and Human Services
Littleton Building Department
There is no traffic light or blinking red/yellow to slow traffic down at the intersection of Russell Street and King Street. Russell Street is a cut through from the old IBM property and The Point (Market Basket) for traffic to the two schools and to Rt 495.
King St
Congregational Church of Littleton
Castle in the Trees Playground
Tahattawan Masonic Lodge
Foster St
Warren St

AMY TARLOW-LEWIS

ATL 01 **I am writing to request that a new stop light is added to the intersection of Rusell Street and King Street Littleton, MA. See attached map. As a traffic public safety concern and for the health and wellness of children biking to school and people walking, an additional stop light must be added to increase the safety, accessibility, and walkability of our small town.**

The intersection of King Street / Russell Street is not included in the Project's study area and has not been identified by MassDOT, who owns this intersection, through their direct review process as a need. A traffic control signal at the intersection has not been evaluated as part of this Project; however, this does not preclude MassDOT from exploring traffic control warranting conditions for this location in the future.

ATL 02 **I am hoping the Town of Littleton, State, and the Lupoli Company will consider a new traffic light to address traffic and pedestrian concerns as a direct result of the increased traffic pressure from the King Street project. Other traffic calming measures could also be utilized such as a full speed humps to slow down vehicles. Four-way stop signs can be another option to ensure cars stop without causing long delays at traffic lights.**

The intersection of King Street / Russell Street is not included in the Project's study area and has not been identified by MassDOT, who owns this intersection, through their direct review process as a need. A traffic control signal at the intersection has not been evaluated as part of this Project; however, this does not preclude MassDOT from exploring traffic control warranting conditions for this location in the future. Further exploration of traffic calming measures along Russell Street, as an existing condition, could be explored by the Town separate from this Project. Note that all-way stop and traffic signal installation is directly dependent on federally mandated warranting conditions and could be explored by the agency of jurisdiction separate of this Project.

ATL 03 **Enhanced pedestrian infrastructure with improving crosswalks should also be considered: Reshape, repaint to improve safety and visibility for pedestrians with curb extensions, raised crosswalks/intersections to slow vehicle speeds and improve accessibility for wheelchairs and strollers. And this must include good lighting, which is crucial for safe crossings, especially at night.**

Section 3.3.1 outlines a comprehensive outline of pedestrian improvements along both King Street and Great Road, as well as various intersections along these corridors and other locations around Littleton Common.

ATL 04 **Install Pedestrian Signals by implementing traditional walk/don't walk signals at the intersections or consider High Intensity Activated Crosswalks (HAWK) or Rectangular Rapid Flashing Beacons (RRFB) at mid-block crossings to improve safety and ease of crossing with signal timing and lowering speed limits.**

The Project will introduce a new signalized pedestrian crossing at the intersection of Great Road / I-495 NB Ramps. The Project also utilizes the FHWA Step Guide to identify candidate uncontrolled pedestrian crossing countermeasures at the three new crossing locations along King Street.

Littleton Planning Department & Planning Board
37 Shattuck Street
Littleton, MA 01460
August 13, 2025

Rebecca Tepper, Secretary
Executive Office of Energy and Environmental Affairs
100 Cambridge Street, Suite 900
Boston, MA 02114

PLANNING DEPARTMENT

P.O. Box 1305
Littleton, Massachusetts 01460

Littleton Planning Department

Dear Secretary, Tepper and EOEEA Team –

The Town of Littleton Planning Board and Department is reviewing the DEIR for consistency with prior local approvals and municipal planning goals outlined in our foundational municipal planning documents. Overall, this is a well-written document that considers those issues that were scoped by the State as required for this DEIR. The proposed development plan moves forward the goals of the town outlined in our 2017 Master Plan, our 2019 Littleton Common Revitalization Road Map, and our 2025 Senior Housing Affordability Needs Report. Concentrating new mixed-use development at/near existing commercial nodes on previously developed property also matches well with MAPC's Metro Common 2050 regional plan.

One point that seems to be undersold is that the King Street Common development is occurring primarily on un-used paved parking areas in an underutilized office park – in stark contrast to the "usual" development on previously undeveloped land. This proposal does not sacrifice public or private open space, or forest, or farmland, or riparian headwaters to develop. The (required) comparison to "no build" seems artificial and not reflective of the widespread conventional housing development that could occur on undeveloped land without this proposal. If the developer was able to make that comparison in the DEIR, it would be even clearer that the proposed development provides significant public benefit by providing housing and mixed-use development on land that is well-suited for redevelopment.

This development will rely heavily on Transportation Demand Management success. Creating and assuring success of alternatives to single-occupancy motorized vehicle trips will be key to mitigating potential traffic impacts as each phase is completed. Having one or more local Transportation Management Agencies able to quickly respond to and work with this new development will be crucial to mitigate potential traffic impacts. Today over 6,000 employees travel to Littleton for work daily from all directions, and this number will increase significantly as this new development moves forward. Providing transportation options from the west Leominster/Fitchburg, east Boston/Cambridge, north Lowell/Lawrence and south Hudson/Marlboro and beyond will be key to successfully integrating this development into the fabric of Littleton without overburdening local roadways and highways.

The development site at King Street Common is served directly by State Highways 2A/119, 110, and I-495. Close coordination with MassDOT to assure appropriate design and construction of pedestrian, bicycle, and vehicle traffic mitigation and safety measures will also be important to help serve future residents and commercial travel needs of the site.

In summary, the proposed development provides clear public benefit in the form of much- needed housing and mixed-use development in phases over the next several years.
Successful implementation of Transportation Demand Management and design and construction of traffic mitigation and safety measures will help ensure the success of this development is sustained long-term.

Thank you for the opportunity to provide comment on the DEIR. Littleton is looking forward to seeing this development move forward in a thoughtful and collaborative manner.

PLANNING BOARD
P.O. Box 1305
Littleton, Massachusetts 01460

Littleton Planning Board

Dear Secretary, Tepper and EOEEA Team –

Littleton is a place of many green open spaces. In various public meetings, the development team has shown renderings of visible, usable green spaces. DEIR report states on page 1-4 that the project will be "providing new public greenspace for local events with the addition of approximately 18 acres of open space." While original depictions in 2022 showed green space with green grass and trees, current depictions such as on the cover page of the DEIR report and the illustrative "fly-through" video from the June 23, 2025, joint Select Board and Planning Board meeting. The development team showed a very concrete, hardscape paver environment, lacking "usable green space." Page 5-2, section 5.1.3 describes Hotspots being addressed but in looking at the photo below it does not look like the development's plan is using materials to reduce Hotspots in this "community area." The developer should be required to use PB 01
more natural materials for patrons and residents gathering spaces. More grass is needed, and if grass isn't possible, what other materials are environmentally appropriate instead of just concrete and pavers? Usable green space is needed for residents to gather, not just "decorative" green in pots & planters. This also includes shaded public gathering spaces, e.g. picnic tables with umbrellas. Ask the PB 02
developer to identify where the 18 acres of open space is located on the site as it is clearly no longer present on the King Street side.

A 150-room hotel would be a welcome addition in the development and if the developer wants a five- PB 03
story building, then it cannot be within 255 feet of the King Street right-of-way line per the 550 King Street Common Zoning 173-233 H, Dimensional Requirements. DEIR information in figures 1-3 and 2-1, and Appendix A states that the 150 Hotel rooms will be 5 stories. The Planning Board has not approved five stories in the location identified in these three figures and board members firmly oppose any such variance within the 255 ft right of way. Prohibit the hotel at 5 stories as it violates the zoning at that location in the development.

Volume of vehicles, pedestrians and bicycles will increase with development, but at what time, effort, PB 04
and cost to residents. DEIR information provided by the developer indicates that current traffic volume "have adequate capacity to accommodate the additional demand created by the project (7-
66)." Developer's assumptions are not clearly provided for laymen to understand and are at odds with PB 05
residents' assumptions and common sense; how will capacity be managed? The intersection of 2A/119 and 110 presents a traffic hazard with the left turn onto Great Road from King Street towards Acton as traffic tends to back up past the proposed left turn lane. Likewise, the left and right hand turns out

of the main driveway of King Street Common onto Great Road are often delayed due to the queued traffic. The primary driveways to parking areas present a significant safety hazard for pedestrians in the retail areas. Perform detailed analysis and mitigation recommendations to ensure pedestrian safety. PB 06
Perform detailed analysis of these intersections for flow and alternate mitigations including removal of this driveway. PB 07
Provide guidance to the Town and the Developer for addressing traffic and transportation impacts by King Street Common with examples such as Lynnfield Marketplace and how they addressed new volume, connections with MassDot, and funding options available. PB 08

Littleton is a car-centric community, and the King Street Common developer needs to account for how non-KSC visitors will arrive at the new development. DEIR offers a few snippets of what it could offer non-KSC visitors, but not enough detail to reassure Littleton Residents of how they will get to King Street Common. Require the developer to; identify if public parking will be available, location and cost; whether any public transportation around Littleton will be offered other than the MBTA shuttle; what "Strong Pedestrian Crossings" mean on the plan dated April 12, 2024 (e.g. rapid flashing beacons); and how bicyclists will be able to safely get to the site from different points around Littleton including designated bike lanes on King Street and Great Road to access King Street Common. PB 09
Also, provide guidance (connections with MassDot, and funding options available) to the Town and the Developer for addressing bike lane access to and from KSC. PB 10

Sincerely,

Town of Littleton Planning Department & Planning Board

TOWN OF LITTLETON PLANNING DEPARTMENT & PLANNING BOARD

PB 01 **The developer should be required to use more natural materials for patrons and residents gathering spaces. More grass is needed, and if grass isn't possible, what other materials are environmentally appropriate instead of just concrete and pavers?**

The Proponent will work to identify and prioritize natural materials for gathering spaces on the Site. The landscape plan is not yet developed and will be developed and refined as the Project proceeds through local permitting by phase.

PB 02 **Ask the developer to identify where the 18 acres of open space is located on the site as it is clearly no longer present on the King Street side.**

The Project's current layout is presented in Figure 1-3 and in Appendix A. At the current stage in design, full landscape plans are not yet developed. Further information about the location of open space will be provided as the Project proceeds through local permitting by phase.

PB 03 **A 150-room hotel would be a welcome addition in the development and if the developer wants a five-story building, then it cannot be within 255 feet of the King Street right-of-way line per the 550 King Street Common Zoning 173-233 H, Dimensional Requirements. DEIR information in figures 1-3 and 2-1, and Appendix A states that the 150 Hotel rooms will be 5 stories. The Planning Board has not approved five stories in the location identified in these three figures and board members firmly oppose any such variance within the 255 ft right of way.**

The hotel's massing was adjusted to conform to zoning height requirements. The hotel is now limited to the 4 stories allowed in King Street Commons. This is discussed in Section 1.3.1.

PB 04 **Volume of vehicles, pedestrians and bicycles will increase with development, but at what time, effort, and cost to residents.**

The TIAS provided in the DEIR and subsequent Supplemental Sensitivity Analysis – Access Management Changes technical memorandum outlines the methodology of Site trip generation. The level of traffic from construction phase-to-phase can generally be based upon the percentage of individual land uses being constructed on a phase-to-phase basis. Note that this phasing could always change as individual tenants come online which is typically why the methodology is to show impact at full build-out unless tenant specific locations are known in advance.

Unlike many suburban development locations, the Site itself has the benefit of being directly adjacent to I-495 which will, like many other freeway adjacent projects, be able to take a vast majority of the regionally destined traffic. The Project provides the benefit of direct public transportation connection through LRTA buses and a shuttle service to the MBTA Commuter Rail Station. Finally, the Project provides direct connectivity through pedestrian and bicycle accommodation to allow for ease of access to other uses around the Littleton Common area.

PB 05 **Developer's assumptions are not clearly provided for laymen to understand and are at odds with residents' assumptions and common sense; how will capacity be managed?**

The Proponent has proposed a comprehensive transportation mitigation program in the vicinity of the site to improve vehicular, bicycle, and pedestrian operations and safety. Section 7.7 provides a summary of measures that are recommended to improve the existing and future operations and safety of the study area intersections.

PB 06 **Perform detailed analysis and mitigation recommendations to ensure pedestrian safety.**

The crosswalks at the end of each drive aisle / intersections connecting driveway side sidewalks are typical accommodations. The Site plan minimizes mid-block crossings on-site to limit the potential for uncontrolled conflict. The primary location of mid-block crossings in the Site plan is along the pedestrian-centric throughfare from Building "H" to Building "O" where pedestrian crossings include features such as traffic signs, high-visibility pavement markings, pavement texture changes, and in-street pedestrian signage.

PB 07 **Perform detailed analysis of these intersections for flow and alternate mitigations including removal of this driveway.**

The TIAS provided in the DEIR and subsequent Supplemental Sensitivity Analysis – Access Management Changes technical memorandum provides a detailed capacity and queue analysis adhering to MassDOT standards and Standard Practices for the Transportation Engineering Profession. Note the left-turn exit from the 550 King Street and 410 Great Road driveways along Great Road have been prohibited and detailed in Section 3.2 of the FEIR.

PB 08 **Provide guidance to the Town and the Developer for addressing traffic and transportation impacts by King Street Common with examples such as Lynnfield Marketplace and how they addressed new volume, connections with MassDot, and funding options available.**

Section 3.3 details a comprehensive transportation mitigation program in the vicinity of the Site to improve vehicle, bicycle, and pedestrian operations and safety. The mitigation program has been coordinated with MassDOT, who holds jurisdiction over King Street and Great Road, and will be further refined during MassDOT's design and Permit to Access State Highway process.

PB 09 **Require the developer to; identify if public parking will be available, location and cost; whether any public transportation around Littleton will be offered other than the MBTA shuttle; what "Strong Pedestrian Crossings" mean on the plan dated April 12, 2024 (e.g. rapid flashing beacons); and how bicyclists will be able to safely get to the site from different points around Littleton including designated bike lanes on King Street and Great Road to access King Street Common.**

In addition to an MBTA shuttle service to the MBTA Commuter Rail Station, the Project will enhance LRTA bus infrastructure on-site including two new shuttle bus stop locations. Section 3.3 details a comprehensive transportation mitigation program in the vicinity of the Site to improve vehicle, bicycle, and pedestrian operations and safety including significant amounts of new pedestrian infrastructure and enhancements to existing bicycle infrastructure, where feasible.

PB 10 **Also, provide guidance (connections with MassDot, and funding options available) to the Town and the Developer for addressing bike lane access to and from KSC.**

The Proponent seeks to retain and extend the bicycle lanes on King Street and provide connections to it through various Site connections. In addition, the Proponent is committed to installing new demand-based bicycle detection at the intersection of Great Road / King Street as part of traffic signal retrofits.

Smart Growth and Regional Collaboration

August 12, 2025

Secretary Rebecca Tepper
Executive Office of Energy & Environmental Affairs
Attention: Nicholas Perry, MEPA Office
100 Cambridge Street, Suite 900
Boston, MA 02114

RE: King Street Common Draft Environmental Impact Report, EEA No. 16921

Dear Secretary Tepper:

The Metropolitan Area Planning Council (MAPC) regularly reviews proposals deemed to have regional impacts. The Council reviews these projects for consistency with *MetroCommon 2050*, MAPC's regional land use and policy plan, as well as with Complete Streets policies and design approaches.

MAPC has a long-term commitment to alleviate regional traffic and environmental impacts, consistent with the recommendations of *MetroCommon 2050,* including *reducing vehicle miles traveled and the need for single-occupant vehicle travel through increased development in transit-oriented areas and walkable centers*[1], and *improving accessibility and regional connectivity*[2]. Furthermore, the Commonwealth has a statutory obligation to reduce greenhouse gas (GHG) emissions by at least 50% from 1990 levels by 2030, 75% by 2040, and 85% by 2050 to achieve net zero emissions by 2050, a commitment that MAPC wholeheartedly supports.

Lupoli Companies (the Proponent) proposes a mixed-use housing, commercial, and retail development totaling approximately 1.8 million square feet (sf) in Littleton. The 47.4 acre project site is generally bordered by Interstate 495 to the south, King Street to the north, and Great Road to the east. The proposed redevelopment Project comprises 19 buildings with programming elements that include: 1,089 residential units, 115,500 sf of retail space, 19,000 sf of office space, 545,520 sf of light industrial use, and a 111,000 sf hotel (150-rooms). The Proponent proposes 3,010 parking spaces, of which 1,446 will be structured parking and the remainder at grade. The Project is forecast to generate 19,692 vehicle trips on an average weekday. Overall, MAPC is supportive of this project which seeks to create a new, compact village center in an already developed area, reflecting Action 2.3 of MAPC's MetroCommon 2050.[3] What was formerly land used primarily for asphalt surface parking and mobility by automobile will be transformed into a walkable mixed-use community with an emphasis on public gathering space and much needed housing. We applaud the Proponent for investing in critical wastewater and sewer infrastructure and for committing to a strong transportation demand management (TDM) program that seeks to minimize trips to and from the site by single occupancy vehicle (SOV). To address concerns relevant to the abundance of on-site parking and long-term maintenance of the stormwater management system, MAPC recommends the following actions pursuant to the Proponent's submittal of the EIR:

[1] https://metrocommon.mapc.org/announcements/recommendations/2

[2] https://metrocommon.mapc.org/announcements/recommendations/1

[3] MAPC's MetroCommon 2050 Action 2.3: Ensure affordability and optimize land use around transit and smart growth locations. https://metrocommon.mapc.org/announcements/recommendations/2

Bicycle and Pedestrian Access

We are pleased to see many of the recommendations from our 2023 Littleton Bicycle and Pedestrian Plan featured in this DEIR including the addition of sidewalk infrastructure along King Street and Great Road and bicycle accommodations both throughout the site and with connectivity to King Street. New sidewalks, crossings, and street trees along King Street combined with maintenance of existing bike lanes will recharacterize the roadway as a pedestrian and bicycle-friendly environment with low traffic speeds. Noting that improving safe bicycle access and shared use paths was the top priority for the 700 local respondents of MAPC's public survey in 2023, **we strongly recommend that the Proponent commit to creating a safe connection to/from the site with the "Littleton Loop",** consistent with the Bicycle and Pedestrian Plan. This would provide non-motorized, active transportation access to Littleton Common, MBTA Commuter Rail, Town Hall and the library, high school, and middle school complex. We respectively request that this mitigation item be included in the Proponent's Section 61 Findings. MAPC 01

MassDOT is seeking a full replacement of the Great Road bridge deck and submitted a 25% design package on December 13, 2024. MAPC supports these efforts to replace this important bridge, but recommends that the replacement include robust pedestrian and bicycle accommodations, which would improve the dangerous crossing over I-495 for cyclists and pedestrians. MAPC understands that the Town of Littleton also supports the inclusion of pedestrian accommodations for this proposed project. **MAPC recommends a full replacement of the Great Road bridge deck with the inclusion of critical bike and pedestrian accommodations, and encourages the Proponent to support this effort.** MAPC 02

Parking

The Proponent proposes to significantly increase parking at the site, building 141 spaces in excess of what local zoning requires, and 1,060 more spaces than currently exist on the site (total of 3,010 spaces). While structured garages will decrease the overall parking footprint on site by 544,652 sf, this abundant supply of (free) parking will incentivize vehicle trips, exacerbate congestion and emissions, and undermine the Proponent's own TDM measures. Recognizing the Proponent's commitment to reducing the parking supply by providing the minimal number of parking spaces to a level of the demand only, MAPC recommends the following strategies to reduce this demand as well as the volume of parking at the site (in addition to preferential parking for carpools and rideshare as articulated in the DEIR):

- **Increase Shared Parking:** Due to the significant diversifying of land use at this site from current conditions, utilization patterns at parking facilities will vary widely throughout the day and night. As a result, it is likely that large portions of the proposed parking spaces could be consolidated and shared between buildings. The proposed development includes 115,500 sf of retail space - over 20,000+ sf is dedicated to restaurant space – along with 19,000 sf of office space and 545,520 sf of light industrial/research & development areas. This mix creates a strong opportunity for shared parking, particularly between the restaurant and office/R&D uses, allowing for a reduction in the overall parking supply. While the Proponent discussed shared parking in the DEIR, no quantitative proposal for shared parking was included. This should be addressed in the next MEPA filing. MAPC 03

- **Phase construction of parking:** To ensure that the supply of parking throughout the site does not exceed its demand and does not incentivize SOV trips, MAPC recommends that the structured parking, particularly in the residential buildings, be built in phases. Rather than waiting until occupancy of the entire project has been achieved to assess whether the constructed parking supply is adequate, **MAPC recommends monitoring occupancy as soon the first phase is occupied and altering the number of parking spaces to be constructed in the following phase accordingly.** This MAPC 04 phased approach to parking construction allows the Proponent to both avoid overbuilding and to adjust demand expectations based on forthcoming TDM measures such as increased bus access, active transportation improvements, and a new shuttle to the MBTA Commuter Rail.

TDM and TMAs
With 13,388 new vehicle trips expected to be generated by this project during the average weekday, a strong TDM program is imperative to minimizing vehicular trips to/from the site and could potentially shrink that volume considerably. MAPC commends the Proponent's commitment to TDM as a valuable component of this project. This is exemplified by their investment in a new, high quality bus stop on site, funding of a new fixed-route shuttle service to the MBTA Fitchburg Line station, membership in the Middlesex 3 TMA, and a multitude of other TDM measures carried out by an on-site Employee Transportation Coordinator (ETC). MAPC recommends the following additions/alterations to the TDM element of this project:

- **Support the Re-Launch of the Crosstown Connect TMA:** While membership in a TMA is a valuable piece of any successful TDM program, and the Middlesex 3 TMA is a highly renowned organization, its service area (Bedford, Billerica, Burlington, Carlisle, Chelmsford, Lowell, Tewksbury, Tyngsborough, Westford, and Woburn) aligns with some of the top communities from which workers commute. These communities are Littleton itself, Lowell, Westford, Leominster, and Chelmsford[4]**. MAPC recommends the Proponent partnering with the Town as well as other major employers in the vicinity including Amazon, FIBA Technologies, and Market Basket to support the reformation of the Crosstown Connect TMA**. Launched in the mid-2000s, the currently dormant public-private partnership between the Massachusetts communities of Acton, Boxborough, Concord, Littleton, Maynard, Sudbury, and Westford, along with local businesses, poses an enormous opportunity to reinvigorate a valuable piece of the transportation system within which the project is located. Reviving this partnership could also extend and amplify the impact of the Proponent's proposed new shuttle service throughout the region. MAPC 05
- **Ensure pedestrian access to the new bus stop is safe and convenient:** In addition to high quality design and facilities at the new bus stop extending LRTA service to the site, the Proponent must also ensure that pathways, sidewalks and other access routes to the stop are safe, maintained, and coupled with robust wayfinding. MAPC 06

Wastewater Treatment
The Town of Littleton is to be commended for making a major effort to develop wastewater treatment capacity to serve development in and near the town center area. The Proponent is contributing $29M towards the Town-wide sewer project, which accounts for 2/3 of that Project's funds. The project at full buildout will generate 286,000 gallons per day (gpd) of wastewater flow, which is beyond the capacity of the wastewater system currently under construction. The first phase of the project will utilize the available 150,000 gpd of capacity over the first five years. After that, additional wastewater capacity would need to be made available to accommodate the full buildout, which the Proponent is coordinating with the Town. This DEIR filing is based on the project's full buildout, so the first phase will be well within the limits of the impacts and mitigation designated for the full project. MAPC 07

MAPC has been supportive of the Town's efforts to develop its wastewater system, and this King Street Common proposal would bring forth the kind of mixed-use development that the system was designed to

[4] https://www.littletonma.org/DocumentCenter/View/9664/Littleton-2025-Community-Report

accommodate. The only caution is that, as with all wastewater systems, over the long term it will be MAPC 08
necessary to carefully maintain the system to minimize Inflow and Infiltration (I/I) which could reduce the available capacity for future phases of this project and other projects in Littleton. Some communities have established Sewer Banks to ensure that resources are available for ongoing maintenance to minimize I/I. This would be a measure implemented by the Town, not the Proponent, but it would be worth considering in order to ensure the long-term ability of the wastewater system to efficiently support current and future development in Littleton.

Stormwater/Climate Resilience

The proposed stormwater management system would be a great improvement over existing conditions, which consist of large parking areas with minimal treatment of stormwater. The King Street Common will feature underground facilities beneath paved areas to manage discharge stormwater to the ground. The facilities will be sized to accommodate stormwater flows for the current 100-year (1% chance) storm, and using the ResilientMass Action Team's (RMAT) Climate Resilience Design Standards Tool , stormwater generated by the projected year 2070 50-year (2% chance) storm will be managed. The system will comply with the Massachusetts Stormwater Handbook standards for a redevelopment project.

The DEIR makes an important observation about the proposed stormwater management system that MAPC would like to underscore:

> "Many of the Best Management Practices (BMPs) selected for the site are subsurface which can be increased in size, repaired, or replaced if necessary. Strict conformance to the Operation & Maintenance Plan will ensure long-term effectiveness of the stormwater management system and its ability to accommodate future year storm scenarios."

In fact, inadequate long-term maintenance of stormwater infrastructure is a nearly ubiquitous problem statewide, often leading to inadequate drainage and flooding, as well as water quality impacts to receiving waters. Even the best designed and constructed systems may fail if not properly maintained, and maintenance is often under-emphasized (or under-budgeted) after project development. To address this,
MAPC suggests that the Operation and Maintenance Plan should be included as part of the Section 61 MAPC 09
Findings, to help ensure that it will be enforced after the initial project review and approval is completed.

Thank you for the opportunity to comment on this project.

Sincerely,

Lizzi Weyant
Acting Executive Director

cc: James A. Duggan, Town Administrator
David Mohler, MassDOT

METROPOLITAN AREA PLANNING COUNCIL

MAPC 01 **Noting that improving safe bicycle access and shared use paths was the top priority for the 700 local respondents of MAPC's public survey in 2023, we strongly recommend that the Proponent commit to creating a safe connection to/from the site with the "Littleton Loop", consistent with the Bicycle and Pedestrian Plan. This would provide non-motorized, active transportation access to Littleton Common, MBTA Commuter Rail, Town Hall and the library, high school, and middle school complex. We respectively request that this mitigation item be included in the Proponent's Section 61 Findings.**

Section 3.1.1.3 provides a description of where and how the Project is creating a safe connection to/from the Site with the "Littleton Loop".

MAPC 02 **MAPC recommends a full replacement of the Great Road bridge deck with the inclusion of critical bike and pedestrian accommodations, and encourages the Proponent to support this effort.**

The Proponent supports the inclusion of critical bike and pedestrian accommodations atop Great Road over I-495 which is scheduled for deck replacement in FY2029. Note that the Project is only funded for deck replacement and may not include full expansions to accommodate new pedestrian and bicycle infrastructure beyond what is already within the bridge's cross-section. The Proponent is committed to constructing new sidewalk along the northerly side of Great Road between the Site and the I-495 NB Ramps which MassDOT would be able to tie directly into as part of any expansion to the deck replacement project. Discussions with MassDOT Highway Design HQ on Monday, September 29, 2025, acknowledged the new sidewalk mitigation and MassDOT generally agreed that further bicycle accommodation would generally be out of scope for a private developer as part of this Project.

MAPC 03 **The proposed development includes 115,500 sf of retail space – over 20,000+ sf is dedicated to restaurant space – along with 19,000 sf of office space and 545,520 sf of light industrial/research & development areas. This mix creates a strong opportunity for shared parking, particularly between the restaurant and office/R&D uses, allowing for a reduction in the overall parking supply. While the Proponent discussed shared parking in the DEIR, no quantitative proposal for shared parking was included. This should be addressed in the next MEPA filing.**

The TIAS included in the DEIR provided a detailed shared parking demand section based on industry standard peak parking demand rates. Based on ITE shared peak parking demand calculations, the 550 King Street location would demand 2,693 parking spaces, approximately 7% above the Town of Littleton zoning requirements for this location. Although slightly above zoning requirements, the proposed shared parking demand is only 1.5% above the parking supply proposed at the 550 King Street location. Whereas the location will offer the ability for shared parking, the Proponent has sought to provide a parking supply in line with shared parking rates as opposed to the much larger demand rates land use by land use while still supporting the potential for diverse tenant applicability. In addition, the additional parking supply will help to support public parking needs for the Littleton Common area.

MAPC 04 **Rather than waiting until occupancy of the entire project has been achieved to assess whether the constructed parking supply is adequate, MAPC recommends monitoring occupancy as soon the first phase is occupied and altering the number of parking spaces to be constructed in the following phase accordingly.**

Section 3.3.3 describes the detailed Transportation Monitoring Program which includes an evaluation of parking starting six months after issuance of the first occupancy permit.

MAPC 05 **MAPC recommends the Proponent partnering with the Town as well as other major employers in the vicinity including Amazon, FIBA Technologies, and Market Basket to support the reformation of the Crosstown Connect TMA.**

The DEIR identified that the Proponent would seek membership in the Middlesex 3 Transportation Management Association (TMA) which is utilized in neighboring Westford and communities to the northeast of Littleton. The Proponent will alter its commitment to seeking membership in the reformed Crosstown Connect TMA which had originally been identified in the ENF. Although the status of reformation is not current an active part of the development, the Proponent will look at opportunities to assist in the reformation of this TMA.

MAPC 06 **In addition to high quality design and facilities at the new bus stop extending LRTA service to the site, the Proponent must also ensure that pathways, sidewalks and other access routes to the stop are safe, maintained, and coupled with robust wayfinding.**

The Site plan includes a robust pedestrian and bicycle network with a commitment to provide wayfinding signs within the Project Site in order to direct residents, patrons, and other visitors to the appropriate driveway and access to pedestrian, public transportation, and bicycle facilities.

MAPC 07 **The first phase of the project will utilize the available 150,000 gpd of capacity over the first five years. After that, additional wastewater capacity would need to be made available to accommodate the full buildout, which the Proponent is coordinating with the Town. This DEIR filing is based on the project's full buildout, so the first phase will be well within the limits of the impacts and mitigation designated for the full project.**

This description is accurate; the Proponent continues to coordinate with the Town on securing additional wastewater capacity. As capacity is increased—through permit modifications, infrastructure improvements, or operational enhancements, the Project will progress accordingly to ensure that wastewater flows remain fully compliant with regulatory requirements and do not exceed permitted discharge limits. The Proponent will coordinate with local and state authorities to ensure that the proper disclosures are made for future phases, and permits are obtained.

MAPC 08 **The only caution is that, as with all wastewater systems, over the long term it will be necessary to carefully maintain the system to minimize Inflow and Infiltration (I/I) which could reduce the available capacity for future phases of this project and other projects in Littleton. Some communities have established Sewer Banks to ensure that resources are available for ongoing maintenance to minimize I/I. This would be a measure implemented by the Town, not the Proponent, but it would be worth considering in order to ensure the long-term ability of the wastewater system to efficiently support current and future development in Littleton.**

The Proponent will continue to coordinate with the Town to ensure that the needed capacity is available.

MAPC 09 **MAPC suggests that the [stormwater] Operation and Maintenance Plan should be included as part of the Section 61 Findings, to help ensure that it will be enforced after the initial project review and approval is completed.**

Table 7-2 includes the Proponent's commitment to the stormwater management Operation and Maintenance Plan. Refer to Appendix B for the complete stormwater report.

While not opposed to the project, I am writing on behalf of DarkSky Massachusetts, as an area resident who resides in Pepperell, MA, as well as someone who works near the development, to express significant environmental concern regarding the proposed development at

500 King Street, Littleton, MA

A specific concern is the potential for increased light pollution and its detrimental effect on our nighttime environment.

Of environmental concerns, light pollution is the fastest growing threat to our natural environment, growing at a national rate of 10% per year. Fortunately, the solution to the issue is easy and will save the developer/owner of said property by reducing energy waste while improving visibility for future/existing residents of the area.

One of the most impacted areas of my employment is planetary defense, the observation and tracking of faint, fast-moving objects, particularly near-Earth Asteroids (NEAs) and potentially hazardous asteroids (PHAs). These objects are extremely difficult to detect. Their visibility is a direct function of the darkness of the sky; any increase in background light from a source on the ground—often referred to as "skyglow"—directly reduces our ability to see them. It is like trying to spot a dim candle flame next to a bright streetlight.

Light pollution not only makes the initial discovery of these objects more challenging but also hinders crucial follow-up observations. After a new asteroid is discovered by a major survey, follow-up data from facilities like ours is vital for precisely calculating its orbit and determining if it poses a potential impact threat to Earth. Without the ability to perform these measurements accurately and efficiently, our contribution to planetary defense efforts is compromised.

As we have experienced from similar large developments in Littleton, Groton and Westford, the proposed development, without strict light pollution mitigation measures, poses a direct threat to the natural nighttime environment. If poorly designed or excessive lighting was installed it would result in a host of negative impacts, ranging from human health (increase in breast cancer rates), increase in pedestrian traffic accidents, disruption to animal/bird migration, decrease pollinator activity and much more, as listed in the State of the Science report outlining supporting research. It could also effectively "blind" the telescopes my students use.

We respectfully request that the developer give serious consideration to the following recommendations DS 01
to protect the observatory and its mission:

- **Mandate fully shielded, "dark-sky compliant" lighting** for all exterior lights, including parking lots, walkways, and building exteriors.
- **Limit the amount of total upward-directed light** from the property to an absolute minimum.
- **Require the use of warm-toned lighting** (below 2700K), as these wavelengths are less disruptive to human circadian rhythms, as well as astronomical observation.
- **Encourage the use of motion sensors and timers** to ensure lights are only on when necessary.

These best practices are supported by a broad range of professionals, ranging from the American Medical Association, the International Astronomical Union, as well as the Illuminating Engineering

Society (the same agency that writes the lighting specification recommendations for the world). We respectfully ask that a dialogue is initiated between the proponents of the development and DarkSky MA, as well as area astronomers, in order to mitigate light pollution to a reasonable level.

DARK SKY MASSACHUSETTS

DS 01 **We respectfully request that the developer give serious consideration to the following recommendation to protect the observatory and its mission:**

- **Mandate fully shielded, "dark-sky compliant" lighting for all exterior lights, including parking lots, walkways, and building exteriors.**
- **Limit the amount of total upward-directed light from the property to an absolute minimum.**
- **Require the use of warm-toned lighting (below 2700K), as these wavelengths are less disruptive to human circadian rhythms, as well as astronomical observation**
- **Encourage the use of motion sensors and timers to ensure lights are only on when necessary.**

Thank you for submitting a comment letter. The Proponent will consider to these recommendations when designing the outdoor lighting layouts for the Site.

Subject: Public Comments on DEIR "King Street Common" EEA # 16921, at 550 King St, Littleton, MA
To: Ms. Rebecca L. Tepper, EEA Secretary
c/o Mr. Nicholas Perry, MEPA Analyst
Nicholas.Perry@mass.gov
617-921-2961
MEPA Unit
100 Cambridge St., Suite 900
Boston, MA 02114
Date: August 15, 2025
From: Donald MacIver, Littleton Sustainability Committee Member
maciver01460@gmail.com
978-941-7588
43 Foster St., Littleton, MA 01460

Dear Mr. Nicholas Perry, MEPA Analyst:

The following comments are made with regard to the submitted DEIR for Littleton's "King Street Common" EEA 16921:

The proposed development is of a massive scale and impact for Littleton, a mid-size community (population estimated at just reaching 10,000) and located in a critical, congested, and central section of the town. A well-designed project thoroughly thought out is essential and worthwhile for both residents and developer.

I am requesting that a Supplementary DEIR (SDEIR) be required to address the following points including the admitted omission of more detailed plans (e.g., a promised future TBD plant and vegetation plan for the entire 47 acre, 19 building, 3,010 vehicle parking area project.).

The request that the EEA Secretary require a Supplementary DEIR (SDEIR) to address the following issues:

o **Need for Actively Partnering with Littleton Resident Stakeholders for Further Design Planning** DM 01
> There is a need for the project proponent to actively partner with resident community stakeholders and organizations in more detailed design planning to advance sustainability and to reduce overall negative impacts and, in particular, mitigate and adapt as need be for climate change. The town of Littleton with its committees and associated citizen organizations (as cited in the below cc list) are actively addressing climate change and currently are working on a town-wide Climate Action Plan (CAP). Additionally, there is a concerted effort to implement native vegetation landscapes (including replacing some nonnative plantings and reducing invasives as best possible). Many of those participants, are professional/ subject experts in their fields, and contribute their expertise as members on associated town committees. They know the town best and have been addressing many of the issues listed below.

o **Need for Project-wide Planting and vegetation Plan** (Project proponent has acknowledged that it is currently absent and forthcoming). It should include: DM 02
> Use of native plants for resiliency, for limited maintenance, promotion of healthy pollination and sustainability, support related wildlife (e.g., birds and other pollinators), and additionally promoting aesthetics.

> More native trees and shrubs and partnering with the town Conservation Commission and Tree Committee that are currently completing an emerging Tree Bylaw
> Effort needs to be made to limit lawn area in favor of more diverse native groundcovers and vegetation. Lawn area should be primarily limited to active pedestrian use, such as for providing planned amenities for residents and visitors (e.g., gathering areas, picnic areas, lawn games, etc.)
> An operation and maintenance plan for ensuring the well-being of the installed vegetation, shrubbery, and tree entities, and replacement, if need be.

o **Mitigation of Building Impacts** DM 03
> Consider CLT (Cross-Laminated Timber) construction as is used successfully for versatility, better efficiency (as well as for lower overall GHG emissions in the manufacture of building materials), and lower costs, as is performed throughout many countries in Europe and more recently increasingly domestically including private enterprise projects and on some collegiate campuses such as at UMass in Amherst and the College of the Atlantic, Bar Harbor, ME. Littleton-based New England Forestry Foundation has promoted and educated on the advantages and successful stories of implementing CLT construction and should be consulted.
> Implement Green Rooves and/or Roof-top Solar Panels (or at the very least, Cool Rooves). Good successful examples of green rooves exist in Cambridge and extensively in Montreal
> Capture and use of roof top rainwater to reduce irrigation needs. Certainly, some of the roof top surfaces of 19 buildings, many new, and their aggregate rain water volume can be repurposed in some meaningful manner as opposed to being dealt with as a storm water discharge problem.
> As was performed at residences in the civilian reuse/repurposing of the former Army Fort Devens Military Base, King Street Common residences should be pre-wired with internet cabling as an amenity for residents to virtually connect with others and participate in virtual conferencing to facilitate working at home and reducing daily vehicle trips.

o **Limiting and Softening Surface Parking Areas** DM 04
> Implement a plan to break up large expansive lots (for aesthetics and reduction of heat islands)
> There is a need for more native vegetation and shade islands with clumps of trees and other vegetation versus just narrow lined corridors of trees
> Consider solar carport and walkway canopies (considering both long-spans and shorter extents) (Successful examples are those implemented at UMass in Amherst; municipal school systems such as in Hopkinton, Sudbury, and Wayland; private enterprises such as Raytheon in Woburn, REI in Framingham, and Brockton's Signature Health Care Offices; and other institutions, such as the adjacent Acton's non-profit children's Discovery Museum)
> Project proponent should consult the LID recommendations prepared by Weston and Sampson whose efforts were commissioned as part of Littleton's Municipal Vulnerability Preparedness (MVP) program basis documentation. There is a need to limit impervious surface areas and where not possible to utilize LID techniques that are both attractive and functional such as "rain gardens" to detain, filter, and accommodate slow discharge.

o **Transportation Issues** DM 05
> Planned shuttle transport from 550 King St to the local commuter rail station and perhaps adjacent areas should be via electric vehicle
> As commented by the Town Planner, there is a need to incorporate the Acton-based CrossTown Connect Transportation Management System provided by the current TMA , in addition to any other transportation network systems that may serve northern town intercity links (e.g., Westford, Chelmsford, and Lawrence/ Merrimack Valley Area). Historically and currently, Littleton is more

connected to the adjacent community of Acton than those of the more northernly towns and is currently served by the CrossTown Connect Transportation Management Area. Connection to both certainly would be advantageous

> All transportation daily vehicle trip modelling aside, simple visual observation indicates that during the summertime, there often is significant traffic backup along King St./MA-Route 110 heading eastward toward the Westford town line and extending to the popular Kimball Farm Ice Cream and Recreation Area. The congestion at that destination (e.g., from vehicles heading eastward and trying to cut across the opposing westbound traffic to park at the designated parking lot on the north side often backs up traffic and is additionally exacerbated by pedestrians needing to cross the road system to access the facility on the south side of the road system). This backup can extend along King Street westward past the Great Road – King St. intersection a the center of the Town Common. While this traffic congestion issue is pre-existing and not of the making of proposed project developer, it will impact the proposed project's traffic flow. Technical companies previously occupying the 550 King Street site, being office buildings, generated traffic mostly at the beginning and end of traditional work hours and mostly used the "IBM Driveway/ Auman Street") intersection for quick access to MA Route 119 near the I-495 interchange, eliminating traffic burden on most local streets. The redevelopment of the 550 King Street site is for mixed-use (with residences and retail use) so it will generate mid-day vehicle trips as well. In addition to the consideration of the project's number of curb cuts onto King Street/ MA Route-110, MA DOT should address the pre-existing Westford congestion issue as well, for everyone's benefit.

I and my peers, both municipal committee members, and other interested residents, eagerly look forward to working with the Project Proponent, Lupoli Companies, and their consultants to further design the proposed project for mutual benefit and success. The Lupoli Companies have a history of creative development and possess adequate capacity to partner with the resident town stakeholders in a meaningful manner for creating an outstanding project that serves as a model for other communities and creates a stellar asset within their own portfolio of project accomplishments.

Thank you for the opportunity to comment and influence this significant and critical project.

Cc:
Town Administrator (TA)
Sustainability Committee (LSC)
Planning Board (LPB)
Conservation Commission (LCC)
Tree Committee (LTC)
Board of Health (LBH)
Littleton Conservation Trust (LCT), P.O. Box 594, Littleton, MA 01460
Metrowest Conservation Alliance (MCA) c/o Sudbury Valley Trustees (SVT), 18 Wolbach Rd., Sudbury, MA 01776
New England Forestry Foundation (NEFF), 32 Foster St., Littleton, MA 01460
Lupoli Companies, 280 Merrimack St., Lawrence, MA 01843

DONALD MACIVER, LITTLETON SUSTAINABILITY COMMITTEE MEMBER

DM 01 Need for Actively Partnering with Littleton Resident Stakeholders for Further Design Planning

The Project will proceed in phases which will each be reviewed through local processes and offer the opportunity for members of the public to interact with the Proponent and provide comments. The Proponent has taken steps to reduce impacts as described in this FEIR.

DM 02 Need for Project-wide Planting and vegetation Plan

The Project is in early design and will produce planning and vegetation plans as the design moves forward. At this time, the Project is committed to replacing trees on the Site at a 1:1 ratio. Additional details will be offered as part of the local permitting process for each Project phase.

DM 03 Mitigation of Building Impacts

The Project is committed to mitigating the impacts of the buildings through reflective roofs with solar ready areas to allow for future PV installations if feasible. Other sustainable design methods will be reviewed for feasibility as the Project moves forward. Refer to Table 7-2 for a list of the measures to be implemented to mitigate the effects of the Project related to the required state permits and the schedule for implementation.

DM 04 Limiting and Softening Surface Parking Areas

The Proponent will continue to provide required level of parking and will consider measures to locate lots and structures optimally around the Site.

The Project will provide a stormwater management system incorporating traditional and Low Impact Design (LID) Best Management Practices (BMPs). The analysis provided in Appendix B has been prepared to verify that the Project will not have an adverse effect on the stormwater conditions both on-site and off-site.

DM 05 Transportation Issues

The Project's transportation design is discussed in Chapter 3 of the FEIR. The Proponent's team has developed a robust set of mitigation measures which will offset the identified impacts.

Thank you for the opportunity to provide comments on the Draft EIR for the King Street Common project proposed in Littleton, MA. I understand that this project has been under consideration by Littleton Boards, and has some permits, but this state process is important and needs to be thorough. The Draft EIR has a wealth of information and I appreciate the work put into it by the proponent and the Littleton Planning Board. I do have some comments and questions that I think should be addressed.

1. Sec 2.2.3 – Three alternatives are considered – No Build, Reduced-Build and Developers Preferred. This is a major project in a very small town with limited infrastructure and geographic size. For current and future residents, there will be impacts from traffic and additional loads on our educational, public works and road infrastructure that will significantly affect us. There needs to be more information in the EIR on why only the Reduced-Build Alternative is considered as an option other than No-Build. There is no reduction in residential units between the two alternatives – I understand that there is a state requirement that Littleton add a certain number of units. Please include consideration of an alternative that includes only that number of units, without a hotel. EH 01

a. Also, since it is in the developer's interest to maximize profits from the project, stating that lost revenue from the lack of retail space results in losing amenities and increasing impervious surfaces is not sufficient and a more thorough analysis, with a review by a consultant selected by the Town of Littleton is required for a non-biased appraisal; this should be paid for by the developer. Also include a complete rationale for the Reduced-Build Alternative referencing actual quantitative analyses in place of broad statements EH 02

b. Why is the improvement in traffic and wastewater generation less important than the additional surface-level parking? I don't necessarily think it is. Please consider reducing hotel and living unit numbers to decrease paved parking areas. EH 03

2. Table 2-1 Alternatives Analysis Comparison, Reduced Build Alternative Column – Demonstrate and confirm that the Reduced Build Alt is optimized to pose the least impactful design to traffic; stress on local infrastructure and schools; and storm water runoff. EH 04

a. A quantitative analysis of the real gap in hotel, retail and housing space in Littleton and the surrounding area rather than just a statement. This should include empty similar housing units in this cost range, retail space, hotels, etc. There appears to be a surplus of retail space in the area, including in the new Point development. EH 05

b. Water use for the Proposed Project – Given the 212,000 gallons per day increase in water use, this needs a full, quantitative analysis of impacts to water resources and the sustainability of Littleton's Town water resources, with an emphasis on agricultural needs (considering the effects of climate change). We are routinely under drought conditions – it does not make sense that this is a sustainable proposal. EH 06

ERIN H.

EH 01 **There needs to be more information in the EIR on why only the Reduced-Build Alternative is considered as an option other than No-Build. There is no reduction in residential units between the two alternatives – I understand that there is a state requirement that Littleton add a certain number of units. Please include consideration of an alternative that includes only that number of units, without a hotel.**

The Program as presented represents a mix of uses that have been discussed with the Town and represent needed and useful additions the area. The Proponent will continue to engage with the Town and the public throughout the local permitting processes that will occur before each phase is permitted.

EH 02 **a more thorough analysis, with a review by a consultant selected by the Town of Littleton is required for a non-biased appraisal; this should be paid for by the developer. Also include a complete rationale for the Reduced-Build Alternative referencing actual quantitative analyses in place of broad statements**

The Proponent will comply with all review procedures required by the state and Town of Littleton.

EH 03 **Why is the improvement in traffic and wastewater generation less important than the additional surface-level parking? I don't necessarily think it is. Please consider reducing hotel and living unit numbers to decrease paved parking areas.**

The Proponent is committed to minimizing land alteration and reducing impervious surfaces as part of the Project's overall environmental strategy. Section 2.2 provides additional information. The Proponent will continue to refine the Project's design through the local permitting process that will precede each phase.

EH 04 **Demonstrate and confirm that the Reduced Build Alt is optimized to pose the least impactful design to traffic; stress on local infrastructure and schools; and storm water runoff**

The reduced build alternative provided in the DEIR represents a use that is permitted by zoning and the associated impacts. The exercise of creating a design is iterative, but the Project team confirms that this design is a meaningful step between the Proposed Project and leaving the Site as is; and the impacts reflect this.

EH 05 **A quantitative analysis of the real gap in hotel, retail and housing space in Littleton and the surrounding area rather than just a statement.**

Discission and demonstration of the need for proposed uses will be provided during the local permitting process.

EH 06 **Given the 212,000 gallons per day increase in water use, this needs a full, quantitative analysis of impacts to water resources and the sustainability of Littleton's Town water resources, with an emphasis on agricultural needs (considering the effects of climate change). We are routinely under drought conditions – it does not make sense that this is a sustainable proposal.**

The wastewater flow generated by the proposed Project will be accommodated at the Littleton WWTP. Project implementation will occur in phases, and the advancement of future phases will be aligned with the availability of additional wastewater treatment capacity. As capacity is increased—through permit modifications, infrastructure improvements, or operational enhancements, the Project will progress accordingly to ensure that wastewater flows remain fully compliant with regulatory requirements and do not exceed permitted discharge limits. The Proponent will coordinate with local and state authorities to ensure that the proper disclosures for future phases are made, and permits are obtained.

Regarding the King Street Common draft DEIR:

1) There is no section of the Draft that references the landscaping planned for the site. All landscaping plants should: JD 01

- Preserve sightlines for drivers.
- Include native plants only, preferably procured from local growers such as **The Native Plant Trust in Framingham**.
- Consult with the Littleton Conservation Trust and the Littleton Garden Club regarding native pants to be used.
- Strive to include as many species as possible from the **list of Dr. Robert Gegear**, a biodiversity expert from UMass. Dr. Gegear's list supports native pollinators at risk of extirpation.

2) There is no section of the Draft that addresses exterior lighting planed for the site. Nighttime illumination has very deleterious effects on nocturnal insects, amphibians, migrating birds, and human safety. All exterior lighting planned for the King Street Common Site should strive to minimize light trespass, and minimize the damage to native plants and animals. JD 02

- All exterior lighting should comply with the **Five Principles for Responsible Outdoor Lighting** set forth by **DarkSky International**.
- All exterior lighting should be useful. It should serve a clear purpose. Consider how light reflected up into the night sky will impact migrating birds.
- All exterior lighting should be targeted, falling only where it is needed. Careful shielding should direct the light only downward, never upward nor outward.
- All exterior lighting should be at the lowest level of light required. This saves energy and money, as well as residents' sleep.
- All exterior lighting should be controlled, so that it comes on only when needed. Motion-activated systems are much better than timers or light-sensitive systems, because they come on only when needed.
- All exterior lighting should be warm colored, preferably 240 Kelvin and lower. Avoid using blue-violet light, which is terrible for people as well as animals.
- Use only fixtures and light bulbs recommended by DarkSky International on their extensive **list of approved lighting devices**.

JO-ANN D.

JD 01 **All landscaping plants should:**

- **Preserve sightlines for drivers.**
- **Include native plants only, preferably procured from local growers such as The Native Plant Trust in Framingham.**
- **Consult with the Littleton Conservation Trust and the Littleton Garden Club regarding native plants to be used.**
- **Strive to include as many species as possible from the list of Dr. Robert Gegear, a biodiversity expert from UMass. Dr. Gegear's list supports native pollinators at risk of extirpation**

Thank you for submitting a comment letter. The design team will take these measures into consideration as the design progresses.

JD 02 **All exterior lighting planned for the King Street Common Site should strive to minimize light trespass, and minimize the damage to native plants and animals.**

The design team will work to minimize the amount of light trespass of exterior lighting on the Site.

Thank you for the opportunity to provide environmental impact feedback for 550 King Street - King Street Common - Littleton, MA.

We do not believe a sufficient traffic study has been executed for this project. It is unfortunate that the traffic study will only focus on the 550 King Street project area and not what is going on in the rest of the town. There is a project underway by Northern Bank on Great Road about 1/10th of a mile eastbound from this site. The additional traffic generated by this site does not appear to be considered. There has not been mention about the additional traffic along Route 110 and adjoining roads that gets diverted when Route 495 gets backed up due to an accident or heavy traffic As long-time residents of Littleton, residing between the 550 King Street and Northern Bank projects, we have experienced, firsthand, long wait times to exit and enter our street and these two sites are not yet operational. SS 01

Where is the documentation that these projects will comply with Littleton's Form Based Code (just to mention a couple: building height and setback)? Town government is so giddy about the projects at 550 King Street and Northern Bank - 265, 277, 287, 289 Great Road and 25 Robinson Road they may allow exceptions to the Town's Master Plan and Form Based Code. It as already occurred for the Northern Bank Project. SS 02

Additional significant challenges: SS 03

* Strain on Police, Fire & Highway Departments
* Overcrowded schools
* Increased water demand (water restrictions are already in effect)
* What products are used in the light industrial area? What is the process for how the precursors and waste is treated and handled?
* Current pedestrian crosswalks need improvement and new crosswalks should have the latest safety features (including Town Common area)

Sincerely,

Sondra and Stephen Swartz

Concerned Residents

SONDRA AND STEPHEN SWARTZ

SS 01 **We do not believe a sufficient traffic study has been executed for this project. It is unfortunate that the traffic study will only focus on the 550 King Street project area and not what is going on in the rest of the town.**

The traffic study that was provided in the DEIR and this FEIR was produced in consultation with the Massachusetts Department of Transportation. It follows best industry practices while also incorporating feedback from the department to ensure that the Project will function safely while minimizing disruption to surrounding areas. Refer to Appendix E of the DEIR.

SS 02 **Where is the documentation that these projects will comply with Littleton's Form Based Code (just to mention a couple: building height and setback)?**

The Project will comply with all applicable codes and will provide documentation as part of the local permitting process.

SS 03 **Additional significant challenges:**

- **Strain on Police, Fire & Highway Departments**
- **Overcrowded schools**
- **Increased water demand (water restrictions are already in effect**
- **What products are used in the light industrial area? What is the process for how the precursors and waste is treated and handled?**
- **Current pedestrian crosswalks need improvement and new crosswalks should have the latest safety features (including Town Common area)**

The Project will be proceeding through local permitting by phase where these issues will be reviewed.

Maura Healey, Governor
Kimberley Driscoll, Lieutenant Governor
Monica Tibbits-Nutt, Secretary & CEO

massDOT
Massachusetts Department of Transportation

August 15, 2025

Rebecca Tepper, Secretary
Executive Office of Energy and Environmental Affairs
100 Cambridge Street, Suite 900
Boston, MA 02114-2150

RE: Littleton – King Street Common – DEIR
(EEA #16921)

ATTN: MEPA Unit
Nicholas Perry

Dear Secretary Tepper:

On behalf of the Massachusetts Department of Transportation, I am submitting comments regarding the Draft Environmental Impact Report for the proposed King Street Common development in Littleton as prepared by the Office of Transportation Planning. If you have any questions regarding these comments, please contact J. Lionel Lucien, P.E., Manager of the Public/Private Development Unit, at (857) 368-8862.

Sincerely,

David J. Mohler
Executive Director
Office of Transportation Planning

DJM/jll

Ten Park Plaza, Suite 4160, Boston, MA 02116
Tel: 857-368-4636, TTY: 857-368-0655
www.mass.gov/massdot

cc: Jonathan Gulliver, Administrator, Highway Division
Carrie Lavallee, P.E., Chief Engineer, Highway Division
Barry Lorion, P.E., District 3 Highway Director
James Danila, P.E., State Traffic Engineer
Metropolitan Area Planning Council (MAPC)
Littleton Planning Board

MEMORANDUM

TO: David Mohler, Executive Director
Office of Transportation Planning

FROM: J. Lionel Lucien, P.E, Manager
Public/Private Development Unit

DATE: August 15, 2025

RE: Littleton – King Street Common – DEIR
(EEA #16921)

The Public/Private Development Unit (PPDU) has reviewed the Draft Environmental Impact Report (DEIR) for the proposed King Street Common development in Littleton (the "Project") submitted by Epsilon Associates, Inc., on behalf of Lupoli Development (the "Proponent"). The project site covers approximately 47.4 acres and is divided into two sections. The first section is located on the east side of Great Road (Route 119) and is bordered by Interstate 495 (I-495) to the north, Shea Street to the east, King Street (Route 110) to the south, and Route 119 to the west. This portion of the site was formerly an IBM office campus, which is now mostly vacant. The second, smaller section of the project site is situated on the west side of Route 119. It is bordered by a commercial lumber yard to the north, Route 119 to the east, commercial development along King Street to the south, and a residential area near White Street and Hillside Road to the west.

The Project entails the construction of 19 buildings, which will include 1,089 residential units; 115,500 square feet (sf) of retail space; 19,000 sf of office space, a 111,000-sf hotel with 150 rooms, and 545,520 sf of space designated for light industrial use. Additionally, the Project will provide 3,010 parking spaces, of which 1,446 are in structured parking (garages, decks, or parking spaces under podiums), and the remaining spaces are at ground level. Access to the Project will be provided via Auman Street, which runs along the northern side of Route 119.

The Project previously submitted an Environmental Notification Form (ENF) on February 7, 2025, for which the Secretary of Energy and Environmental Affairs issued a Certificate on March 10, 2025, requiring the Proponent to prepare a DEIR.

The DEIR includes a TIA prepared in accordance with the EEA/MassDOT *Transportation Impact Assessment (TIA) Guidelines*. The TIA consists of an analysis of the study area focusing on the Project's effects on intersection operations, safety, and modes such as bicycles, pedestrians, and transit. It generally responds to MassDOT's scope regarding the ENF. Additionally, the TIA features a comprehensive mitigation plan, and a Transportation

Demand Management (TDM) program designed to increase mode share in the Project study area. The following summarizes MassDOT's comments on the Project.

Trip Generation

To estimate vehicle trip generation, the Proponent used the Institute of Transportation Engineers (ITE) Trip Generation Manual, 11th Edition, for Land Use Codes (LUC) 221 – Multifamily Housing (Mid-Rise), LUC 310 – Hotel, LUC 710 – General Office Building, LUC 760 – Research and Development Center, LUC 821 – Shopping Plaza (40-150k), and LUC 932 – High-Turnover (Sit-Down) Restaurant. The mixed-use project is expected to produce 20,328 unadjusted daily trips using this approach. After accounting for internal capture, walk/bike, transit, pass-by trips, and credit for potential full reoccupancy of the existing IBM Corporation buildings, the Project is projected to generate 9,098 net new vehicle trips on an average weekday, with 340 trips during the weekday morning peak hour and 401 trips during the evening peak hour. Additionally, approximately 8,304 net new vehicle trips are expected on an average Saturday, with 647 trips during the Saturday midday peak hour.

Study Area

Based on the anticipated Project's trip generation, the Proponent includes the following intersections in the study area for traffic analysis:

- Route 119 at Russell Street/Constitution Avenue;
- Route 119 at I-495 Southbound (SB) Ramps;
- Route 119 at White Street;
- Route 119 at I-495 Northbound (NB) Ramps;
- Route 119 at Site Driveway West;
- Route 2A/119 at Route 2A/110;
- Route 2A/119 at 410 Great Road Driveway;
- Route 2A/110 at Goldsmith Street/Stevens Street/476 King Street Driveway;
- Route 110 at Meetinghouse Road;
- Route 110 at Tuttle House Driveway;
- Route 110 at Site Driveway South;
- Route 110 at Site Driveway Middle;
- Route 110 at Site Driveway North;
- Route 110 at Building Q Site Driveway; and
- Route 119 at 410 Great Road Driveway.

The study area is consistent with MassDOT's scope, which is identified in the ENF.

Trip Distribution

The trip distribution for the residential, office, R&D, retail, restaurant, and hotel uses was analyzed using gravity models based on U.S. Census data and other factors. The residential and employment traffic patterns relied on commuting data from the Town of Littleton's workforce and residential cities, while retail and restaurant traffic considered population and proximity within a 7.5-mile radius. The hotel traffic patterns were based on regional travel behavior, especially proximity to I-495, with some trips reflecting unfamiliarity with local roads.

Safety

Based on the MassDOT Top Crash Location database, crash data for the study area showed no intersections classified as high crash sites within the Metropolitan Area Planning Council (MAPC) boundaries. The Proponent contacted MassDOT regarding the Highway Safety Improvement Program (HSIP) eligibility of Great Road intersections with the I-495 ramps, as ramp terminals and similar configurations are excluded from MassDOT's crash cluster map due to geocoding issues. HSIP eligibility depends on Equivalent Property Damage Only (EPDO) scores, with a threshold of 109 for 2019–2021 within MAPC. Crash reports from MassDOT received on May 8, 2025, indicated that the two surface intersections at I-495 met this threshold, though a Road Safety Audit (RSA) was not required. Additionally, the DEIR calculated crash rates for these intersections and compared them to MassDOT's statewide and District 3 averages; the analysis used peak-hour traffic volumes and crash data to evaluate crash frequency and significance.

Traffic Operations

The TIA evaluated multiple intersections under 2024 Existing, 2034 No-Build, and 2034 Build conditions, revealing that most intersections are projected to operate at acceptable levels of service (LOS D or better) with volume-to-capacity (V/C) ratios below 1.00, indicating adequate capacity to handle future traffic demand. However, some movements at intersections like Great Road/Russell Street, Great Road/I-495 SB and NB ramps, and Great Road/White Street are expected to operate at higher LOS E. In contrast, specific turning movements at the Great Road/Site Driveway West and Great Road/King Street are predicted to degrade to LOS F, exceeding capacity with notable delays and queue increases. Despite these localized concerns, no primary project-specific mitigation is planned except for traffic signal timing adjustments and coordination tuning. The only intersection requiring mitigation is at Great Road/King Street due to overcapacity movements. Overall, the intersections generally demonstrate sufficient operational performance to accommodate the projected traffic generated by the Project.

During the preparation of the DEIR, the Proponent met with MassDOT to discuss the study's assumptions and analysis, proposed off-site mitigation, and safety and operational concerns associated with the site access plan. MassDOT provided conceptual feedback, recommending fewer driveways and restricted movements to maintain arterial flow. However, the DEIR did not include these recommendations. The Proponent subsequently met with MassDOT for further discussions on these issues and submitted a supplemental memo with a revised Site access management plan and a sensitivity analysis to evaluate traffic operations with the revised site access plan. The resulting 2034 Build [Revised] Condition analysis included in the supplemental memo incorporates redistributed site traffic during peak hours, with revised volumes shown alongside the original DEIR data for comparison. The sensitivity analysis indicates minimal impact on operations at most intersections, with only a slight increase in delay at the Great Road/King Street signalized intersections, still maintaining LOS E or better. These changes are expected to be manageable with signal timing adjustments, but overall, the revised access plan, as further described below, results in negligible operational impacts compared to the original DEIR.

Site Access

In accordance with MassDOT's recommendations, the Proponent proposes several modifications to the site access plan from the DEIR. Significant updates include removing the driveway on the east side of Building Q, which previously served the Yangtze River Restaurant, thereby reducing the number of King Street driveways from five to four. Traffic that used this eliminated access point will be rerouted to the nearby northern driveway between Buildings O and Q. Additionally, left-turn exits from Site Driveway West (the former IBM West Driveway) and the 410 Great Road Driveway will be prohibited, with these movements redirected to other site access points linked to existing signalized intersections. These restrictions will be enforced through signage, pavement markings, and channelization.

Additional proposed measures include considering the consolidation of the Tuttle House Driveway with nearby curb cuts at 510 King Street to reduce duplicate access points. However, the existing Tuttle House driveway must remain open for the current tenants. One on-street parking space on each side of the Middle Site Driveway (between Buildings L & M) will also be removed to improve traffic flow, and internal wayfinding signage will be added to assist with site navigation. These efforts aim to make site access more efficient, reduce turning conflicts, and improve safety by consolidating driveways and redirecting traffic to more effective access points. If the Tuttle House driveway consolidation is successful, the DOT 01
number of driveways on King Street could be further reduced.

If access to the Tuttle House is not consolidated, MassDOT recommends that the DOT 02
Proponent explore alternative options for consolidating access. These alternatives should be included in the Final EIR with the goal of minimizing the number of access points as much as possible. The Proponent should continue consultation with MassDOT to further refine the Project's access management plan.

<u>Off-Site Mitigation</u>

As part of MassDOT's request for a supplemental sensitivity analysis, the Proponent has considered several traffic-related components to improve access, safety, and pedestrian accommodation along and around Route 110. In response to this assessment, the Proponent will remove the previously proposed on-street parking on the west side of Route 110 and will further evaluate the feasibility of a pedestrian crossing on Great Road, to add a median island for safety, and install Rectangular Rapid Flashing Beacons (RRFBs).

Due to significant physical and legal constraints—including utility poles, historic stone walls, and topography—the Proponent indicates that they cannot build a sidewalk along the east side of King Street. Instead, they will install up to three pedestrian crossings with appropriate signage and accessibility features. Additionally, the Proponent is open to improving the Route 110 Complete Streets design to enhance walkability and bike access. The proposed upgrades include a shared-use path, dedicated bike lanes, and adjusted lane widths, while recognizing limitations where private property is not within their control. These conceptual improvements will be refined and coordinated with MassDOT before submitting the FEIR.

MassDOT emphasizes that the design of the pedestrian facilities may be finalized DOT 03
during the permitting process. Still, it is essential that sufficient Right-of-Way (ROW) be
reserved for the construction of these facilities. We also have ongoing concerns about the DOT 04
proposed crossing on Great Road, and we recommend that the Proponent consider necessary
improvements by following the FHWA Step Guide. Additionally, sidewalks should be DOT 05
constructed along the east side of the Site on Great Road to connect with the traffic signal at
the intersection of Great Road and the northbound ramps of I-495, which should include a
pedestrian crossing.

<u>Transportation Demand Management</u>

The Proponent is committed to implementing a TDM program to reduce single-occupancy vehicle trips to the Project site. These measures include:

- *Employee Transportation Coordinator (ETC)* – An ETC will be provided on-site to oversee, implement, monitor, and evaluate TDM measures employed or funded by the Proponent. The ETC will be responsible for managing rideshare and carpool programs and distributing information to residents and employees to encourage alternative means of transportation. The ETC will post and distribute announcements and hold promotional events to encourage ridesharing, bicycling, and walking.
- *Transportation Management Association (TMA)* – The Applicant will seek membership in the Middlesex 3 Transportation Management Association (TMA), which is utilized in neighboring Westford and communities to the northeast of

Littleton. The TMA will assist the Proponent and the ETC in support of employees' commuting choices by providing flexible and sustainable transportation solutions.

- Marketing of Transportation Options and Benefits - A welcome packet for all tenants and employees will be distributed at move-in or employment, which includes information for all transportation-related benefits, promotions, and local transportation options; including the location of LRTA / MBTA stops, transit schedules, EV and carpool parking locations, and any other emerging new mobility locations.
- *Vanpool and Carpool* – The Proponent and the ETC will encourage vanpool and carpooling participation through marketing, events, and vanpool formation meetings. The ETC will implement a ride-matching program to assist employees and residents in finding appropriate carpool matches. The ETC will contact employees and residents to determine if they receive their match-lists, review the lists with them, and see if they have contacted anyone on the list or would like assistance in contacting people.
- *Guaranteed Ride Home Program* – The ETC will be responsible for providing all employees who carpool, bicycle, or walk to work with an emergency ride home. This program eliminates the fear of being stranded on days when the employees are ridesharing or must walk or bicycle in inclement weather conditions.
- *On-Site Laundry Services* - The Proponent will provide laundry services on-site to allow for the reduction of trips to/from the site of nearby laundromats.
- *Flex Hours* – The Proponent will encourage tenants within the mixed-use development to provide flexible hours to employees.
- *Direct Deposit for Employees* - The Proponent will encourage tenants within the mixed-use development to provide direct deposit to reduce employee trips to/from the site.
- *Site Amenities* – As a mixed-use development, the site includes several on-site amenities, such as restaurants, retail, open space, and resident-specific amenities within the residential component of the site. This location will assist in reducing vehicular demand and increase multi-use trips, including parking capacity sized to meet minimum local requirements without excessive parking.
- *Promotional Events and Activities* – The ETC will be responsible for organizing promotional events and activities to encourage rideshare and alternative transportation means. In addition, the ETC will distribute brochures to all new employees and residents during and post posters and bulletins on various subjects from carpooling to the Guaranteed Ride Home program throughout the site.

The Proponent should report to MassDOT on any modifications to the Transportation DOT 06
Demand Management (TDM) program.

Transportation Monitoring Program

The Proponent has committed to conducting an annual Traffic Monitoring Program (TMP) for a period of five years, beginning six months after occupying the full-built project. The TMP will include:

- Collect manual Turning Movement Counts (TMCs) during the weekday morning (7:00 AM to 9:00 AM), weekday evening (4:00 to 6:00 PM), and Saturday midday (11:00 AM to 2:00 PM) peak periods at the following intersections:
  - Route 119/Interstate 495 SB Ramps;
  - Route 119/Interstate 495 NB Ramps;
  - Route 119/Site Driveway West;
  - Route 119/410 Great Road Driveway;
  - Route 119/Route 110;
  - Route 110/410 Great Road Driveway;
  - Route 110/Tuttle House Driveway;
  - Route 110/Site Driveway South;
  - Route 110/Site Driveway Middle;
  - Route 110/Site Driveway North; and
  - Route 110/Building Q Driveway.
- Adequacy of the constructed parking supply.
- Safety evaluations based on available crash data.
- Effectiveness of TDM measures.
- Collect ATR data for a continuous 7-day week-long period along Great Road, King Street, and each Site Driveway location.
- Collect parking demand counts during the peak parking demand periods for the specific land use areas, including:
  - Residential and Hotel - 5:00 AM to 9:00 AM
  - Retail, Restaurants, R&D, Office, and Industrial - 10:00 AM to 5:00 PM
- Collect motor vehicle crash reports from the Town of Littleton Police Department and MassDOT for the most recent one-year period to ascertain changes in crash frequency, crash trends, and severity at the monitored locations.
- Complete an employee and resident travel survey to gage employee and resident travel patterns and mode share.
- Compare the TMCs collected above with those projected within the TIA for the Project to determine whether the total vehicles entering each intersection exceeds the volumes projected.
- Perform a capacity and queuing analysis using Synchro/Sidra analysis software to evaluate the traffic operations at each intersection listed above and compare them to the operations projected in the TIAPS prepared for the Project.
- Assess whether additional mitigation is necessary at study intersections and identify measures to improve operations and/or reduce vehicular traffic volumes. The need for evaluation of further mitigation will be conditioned upon:
  - The measured site generated traffic volumes for the Project exceeded the projected site generated traffic volumes established in this TIA, or subsequent revisions presented to the Town of Littleton, by more than 10 percent (i.e., 110 percent of the projected site generated traffic volumes.

  - One or more of the movements at the monitored intersections is identified to be operating at or over capacity (defined as a V/C ratio equal to or exceeds 1.00) in consultation with MassDOT or the Town of Littleton.
  - There is a pronounced increase in the frequency of occurrence of motor vehicle crashes at a monitored location, and the calculated motor vehicle crash rate exceeds the MassDOT average crash rate for similar locations.
- Corrective actions to reduce the unmitigated impact of the Project should be proposed and implemented based on the thresholds listed above. The corrective actions should be documented in the TMP, approved and coordinated with the Town and/or MassDOT if desired by the agencies, and be undertaken by the Proponent subject to receipt of all necessary rights, permits, and approvals.
- Assess whether the constructed parking supply is adequate for the parking demand as observed.
- Prepare a memorandum summarizing the results of the TMCs, ATRs, parking demand counts, and traffic impact analysis for submission to MassDOT District 3 and the Town of Littleton.

The monitoring program will occur annually, beginning six (6) months after the issuance of the first occupancy permit, and will continue for five (5) years following the project's full occupancy.

Based on the Proponent's responsiveness to MassDOT commentary on the EENF, MassDOT recommends the preparation of a FEIR. The Proponent should continue close coordination with MassDOT during the preparation of the FEIR to refine the site access plan for the Project and address any outstanding comments. If you have any questions regarding these comments, please contact *William.M.Simon@dot.state.ma.us.* DOT 07

MASSACHUSETTS DEPARTMENT OF TRANSPORTATION

DOT 01 **If the Tuttle House driveway consolidation is successful, the number of driveways on King Street could be further reduced.**

The Proponent is actively investigating an opportunity to consolidate the existing Tuttle House Driveway [DEIR Study Intersection #11] shown serving Building G (Hotel) and the existing/retained Tuttle House (534 King Street) structure with the existing two curb cut(s) for the adjacent multi-tenant commercial / residential property to the immediate south (510 King Street) with head-in parking directly off King Street.

Following the Certificate on the DEIR and the recent coordination meeting with MassDOT on Wednesday, September 17, 2025, the Proponent has started negotiations with the neighboring 510 King Street property to allow for the consolidation of driveways, as noted in the DEIR Certificate and as endorsed by MassDOT. The intent of this approach is to complete this cross-access capabilities while retaining all other building structures, land uses, and utilities. Other than the cross-access facility, there is a need to close the existing two driveways for the 510 King Street property and the various head-in parking stalls which will necessitate rearranging the surface parking field on-site. A preliminary cross-access plan is provided in Figure 3-1. The specific details of this driveway closure, a final approved agreement with the neighboring property owner, and other necessary work will be presented to MassDOT in the future FDR and Permit to Access State Highway process.

Should the above-described approach prove infeasible, the Proponent would propose to withdraw and/or remove one (1) of the four (4) access driveway locations along King Street as proposed in the current FEIR. MassDOT has previously identified the Site Driveway Middle Driveway located between Buildings "L" and "N" to be their preference for removal; however, the Proponent would like to not identify the specific driveway for removal until the MassDOT Permit to Access State Highway design process as additional survey, minor building footprint relocations, and other such site plan revisions that will be discussed with the Town and may result in an alternate driveway being identified as the removal preference.

DOT 02 **If access to the Tuttle House is not consolidated, MassDOT recommends that the Proponent explore alternative options for consolidating access. These alternatives should be included in the Final EIR with the goal of minimizing the number of access points as much as possible. The Proponent should continue consultation with MassDOT to further refine the Project's access management plan.**

Section 3.2.3 describes the current status of coordination between the Site and the neighboring 510 King Street property as to the consolidation of driveways. Should the above-described approach prove infeasible, the Proponent would propose to withdraw and/or remove one (1) of the four (4) access driveway locations along King Street as proposed in the current FEIR. MassDOT has previously identified the Site Driveway Middle

Driveway located between Buildings "L" and "N" to be their preference for removal; however, the Proponent would like to not identify the specific driveway for removal until the MassDOT Permit to Access State Highway design process as additional survey, minor building footprint relocations, and other such site plan revisions that will be discussed with the Town and may result in an alternate driveway being identified as the removal preference.

DOT 03 **MassDOT emphasizes that the design of the pedestrian facilities may be finalized during the permitting process. Still, it is essential that sufficient Right-of-Way (ROW) be reserved for the construction of these facilities**

The Proponent intends to work with MassDOT during the Permit to Access State Highway process and the concurrent State Highway Layout (SHLO) Alteration process, as needed, to ensure that the future SHLO is compatible with the final building / pedestrian sidewalk layouts along King Street and Great Road.

DOT 04 **We also have ongoing concerns about the proposed crossing on Great Road, and we recommend that the Proponent consider necessary improvements by following the FHWA Step Guide.**

This crossing location has been eliminated from the off-site mitigation package. In lieu of this crossing, the Proponent is committed to the construction of new sidewalk along the northerly side of Great Road between the Site driveway and the I-495 NB Ramps.

DOT 05 **Additionally, sidewalks should be constructed along the east side of the Site on Great Road to connect with the traffic signal at the intersection of Great Road and the northbound ramps of I-495, which should include a pedestrian crossing.**

The Proponent is committed to the construction of new sidewalk along the northerly side of Great Road between the Site driveway and the I-495 NB Ramps, including a crossing location at the I-495 signalized intersection.

DOT 06 **The Proponent should report to MassDOT on any modifications to the Transportation Demand Management (TDM) program.**

Section 3.3.2 outlines the current TDM program as committed to by the Proponent.

DOT 07 **The Proponent should continue close coordination with MassDOT during the preparation of the FEIR to refine the site access plan for the Project and address any outstanding comments.**

The Proponent's Team met with MassDOT PPDU and MassDOT District 3 to further coordinate on Site access and off-site mitigation on Wednesday, September 17, 2025. The Proponent's team also met with MassDOT Highway Design HQ on Monday, September 29, 2025, to discuss the cross-sectional elements of both King Street and Great Road as proposed by the Proponent. Chapter 3 outlines the up-to-date summary of both Site access and off-site transportation mitigation.

MassDEP
Commonwealth of Massachusetts
Executive Office of Energy & Environmental Affairs
Department of Environmental Protection
Central Regional Office • 8 New Bond Street, Worcester MA 01606 • 508-792-7650

August 18, 2025

Secretary Rebecca Tepper
Executive Office of Environmental Affairs
100 Cambridge Street, 9th Floor
Boston, MA 02114

Attention: MEPA Unit – Nicholas Perry

Re: Draft Environmental Impact Report (DEIR)
King Street Common
Littleton
EEA #16921

Dear Secretary Tepper,

The Massachusetts Department of Environmental Protection's ("MassDEP") Central Regional Office has reviewed the DEIR for King Street Common Project (the "Project") located at 550 King Street (State Route 110) and 410 Great Road (State Route 119). Lupoli Companies LLC (the "Proponent") plans to construct 1,089 residential units, 115,500 square feet (sf) of retail space, 19,000 sf of office space, 545,520 sf of light industrial use, and a 150-room hotel on 47.4 acres. The Project site consists of a 43.19-acre parcel on the east side of Great Road (550 King Street), formerly an IBM office campus, and a 4.16-acre parcel on the west side of Great Road (410 Great Road), which includes various commercial uses. According to the consultant for the Proponent, all the buildings at 410 Great Road will be demolished. The buildings at 550 King Street will be redeveloped. A total of 3,010 parking spaces are proposed, of which 1,446 will be in structured parking (garages, decks, parking under podiums) and the remainder at grade.

The Project is under MEPA review because it meets or exceeds the following review thresholds:

- 301 CMR 11.03 (6)(a)(6) - Generation of 3,000 or more New adt on roadways providing access to a single location;
- 301 CMR 11.03 (6)(a)(6) - Generation of 3,000 or more New adt on roadways providing access to a single location;
- 301 CMR 11.03 (6)(a)(7) - Construction of 1,000 or more New parking spaces at a single location;

- 301 CMR 11.03 (6)(b)(13) - Generation of 2,000 or more New adt on roadways providing access to a single location;
- 301 CMR 11.03 (6)(b)(14) - Generation of 1,000 or more New adt on roadways providing access to a single location and construction of 150 or more New parking spaces at a single location;
- 301 CMR 11.03 (6)(b)(15) - Construction of 300 or more New parking spaces at a single location.

The Project also appears to exceed the review threshold for a new discharge of more than 100,000 gallons per day (gpd) to a sewer system under 301 CMR 11.03(5)(b)(4).

The Project requires the following State Agency Permits:

- Massachusetts Department of Transportation – State Highway Access Permit.
- MassDEP - Industrial Wastewater Holding Tank Compliance Certification (WP 56) [if needed];
- MassDEP – Treatment Works Plan Approval (WP68);
- MassDEP – Groundwater Discharge Permit (WP79 or WP83) [if needed].

The DEIR states that the Project has not changed since the ENF. MassDEP offers the following comments:

Wetlands

DEP 01

According to the DEIR, work will be within the Buffer Zone only. No site plans were included in the DEIR, but several of the figures show the Project footprint and location of wetlands, which indicate that a Notice of Intent (NOI) must be filed. MassDEP may provide comments to the Proponent and the Littleton Conservation Commission in the File Number Notification Letter issued following MassDEP's technical review of the NOI.

Water Management Act Program (WMAP)

The Proponent has addressed all the comments WMAP staff made on the ENF. WMAP staff have no further comments.

Wastewater

The Proponent has stated that the existing site, which includes both 550 King Street and 410 Great Road, currently generates approximately 74,000 gpd of sanitary sewer which is directed to existing on-site disposal facilities. The Project is expected to generate approximately 286,000 gpd and be directed to the Town of Littleton's wastewater treatment system, which is currently under construction. The 550 King Street development is currently permitted to discharge 150,000 GPD of wastewater to the Town of Littleton Wastewater Treatment System, which will allow for the development of the initial phases of the Project. The Proponent's team is actively working with the Town to increase this capacity.

According to the ENF, the Town of Littleton has allocated 150,000 gpd to its wastewater treatment plant (WWTP) for the Project. The Project's anticipated 286,000 gpd of wastewater exceeds the amount approved by the Town, the amount allocated for redevelopment in the MEPA filings for the Littleton wastewater project (EEA #16537), and the MassDEP permitted limit for the groundwater discharge at the WWTP. MassDEP requested that the Proponent explain how the existing flow, proposed flow reserved to the Town, and the Project flow will be accommodated, whether at the WWTP or elsewhere. The DEIR does not adequately address MassDEP's comments regarding wastewater disposal for the Project. The DEIR acknowledges that the Project as designed lacks sufficient capacity onsite or at the Littleton WWTP but states that "the full Project's DEP 02 impacts are provided." Until the Proponent identifies the location for disposal of the unaccounted for volume of wastewater, impacts from the Project cannot be evaluated, including whether additional MassDEP permits will be required.

MassDEP commented that the ENF did not explain the calculation of 74,000 gpd for wastewater generation from the existing uses at the Project site. MassDEP's groundwater discharge permit for 550 King Street authorizes the discharge of only 40,000 gpd of treated wastewater. In Appendix F of the DEIR, the Proponent states that the existing wastewater flow for the 550 King Street parcel is 63,577 gpd, which exceeds the permit limit. MassDEP received correspondence in 2022 from the operator of the treatment plant on the property that the 550 King Street facility was closed, so it is unclear what activities are generating the reported flow volume.

DEIR Appendix F also states that the 410 Great Road property has an existing wastewater flow of 10,412 gpd. Because this flow is greater than 10,000 gpd, that discharge requires a groundwater discharge permit. MassDEP records do not show a WP83 or WP79 permit application being filed for the property. In the FEIR, the Proponent should describe the wastewater treatment system at the 410 Great Road parcel as well as address the unresolved discrepancies in the estimate for existing wastewater flows at the Project Site. DEP 03

In its comments, MassDEP stated that the installation of a 12-inch sewer main will require the Town to file a WP68 permit application to MassDEP for review. MassDEP requested that the DEIR include technical information and an update on the Project's coordination with the Town and the status of the WP68 permit application, as well as a commitment to Inflow and Infiltration (I/I) removal. The Response to Comments states that the Proponent will continue to provide support to the Town in obtaining the WP68 permit. The Proponent will consult with the Town to develop a plan to ensure that a 4:1 I/I offset of the Project's wastewater flow is achieved.

According to the Proponent, wastewater collection systems will be designed separately from stormwater systems and will not allow for the introduction of rainwater, noncontract cooling water, and groundwater from foundation drains, sump pumps, surface drainage or any other source of inflow. Overflows from wastewater collection systems will also not be permitted. As part of the Project, a commitment to I/I removal will be made and accomplished by constructing a new sewer system that will be tested in accordance with Section 35.19 - Sewer Pipe Testing and Section 35.23 – Sewer Manhole Leakage Testing of the Town of Littleton Sewer Use Rules and Regulations. Any necessary mitigation efforts will be identified and documented.

In its comments on the ENF, MassDEP stated that the DEIR should report on whether a transfer of ownership is contemplated to the Proponent, and if so, provide details on how MassDEP requirements related to transfer of ownership will be met. In the Response to Comments, the DEIR stated that there is no transfer of ownership anticipated at this time. MassDEP notes again that the Proponent does not currently have a permit for the existing wastewater flows at the Project site; the current permittee is 550 King Street LLC. It appears that a property transfer may have occurred without written advance written notice to MassDEP, in accordance with the regulations as described in MassDEP's comment letter. MassDEP recommends that the Proponent review the regulatory requirements for transfer of the permit. DEP 04

MassDEP commented that if any of the proposed buildings require an industrial wastewater holding tank, per 314 CMR 18.00, the Proponent must submit a WP56 application for an industrial wastewater holding tank permit to MassDEP. According to the DEIR, none of the proposed buildings are expected to require an industrial wastewater holding tank.

Asbestos

The Project involves the demolition of existing structures on the property. In its comments on the ENF, MassDEP stated that before beginning any demolition or renovation, the Proponent is required to have the structures inspected by a licensed asbestos inspector to identify the presence, location and quantity of any asbestos-containing material (ACM) and prepare a written asbestos survey report. In its Response to Comments, the Proponent agreed to this requirement. The Proponent or a consultant will apply for and obtain Application BWP AQ36-Application for Non-Traditional Asbestos Abatement Work Practice Approval from MassDEP if any ACM must be abated through non-traditional methods. The disposal of ACM will be at a facility specifically approved by MassDEP, in accordance with 310 CMR 19.061. The DEIR states that no ACM or asbestos-containing waste material will be disposed of at a facility operating as a recycling facility in accordance with 310 CMR 16.05.

Solid Waste

In its comments on the ENF, MassDEP noted that the demolition activities may generate asphalt, brick and concrete (ABC) debris. The DEIR notes that the Proponent will notify MassDEP and the Board of Health at least 30 days before beginning the crushing operation if ABC debris will be crushed at the site of generation and used for fill in accordance with 310 CMR 16.03(2)(b)5

MassDEP appreciates the opportunity to comment on the Project. If you have any questions regarding these comments, please do not hesitate to contact JoAnne Kasper-Dunne, Central Regional Office MEPA Coordinator, at joanne.kasper-dunne@mass.gov.

Very truly yours,

Mary Jude Pigsley

Mary Jude Pigsley
Regional Director

cc: Commissioner's Office, MassDEP

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION

DEP 01 **According to the DEIR, work will be within the Buffer Zone only. No site plans were included in the DEIR, but several of the figures show the Project footprint and location of wetlands, which indicate that a Notice of Intent (NOI) must be filed.**

The Proponent intends to file an Abbreviated Notice of Resource Area Delineation to confirm the jurisdictional status, and location of the delineated wetland resource areas on the Site.

DEP 02 **MassDEP requested that the Proponent explain how the existing flow, proposed flow reserved to the Town, and the Project flow will be accommodated, whether at the WWTP or elsewhere. The DEIR does not adequately address MassDEP's comments regarding wastewater disposal for the Project. … Until the Proponent identifies the location for disposal of the unaccounted for volume of wastewater, impacts from the Project cannot be evaluated, including whether additional MassDEP permits will be required.**

The existing wastewater flow figure of 63,577 gpd for the 550 King Street parcel cited in the DEIR was calculated using a design flow rate associated with the current uses of the Site. It does not reflect historical use of the Site and is not representative of current operating conditions. In 2022 the existing office buildings were closed and subsequently the on-site treatment plant was inactive, so the existing figure represents a theoretical use where the actual current value was 0 gpd. The Proponent then purchased the property and in July 2023 was made aware that the current discharge permit was about to expire. The owner worked diligently with a consultant on the matter and, on November 28, 2023, a new groundwater discharge permit (Permit No. 79-7) was issued.

As noted in MassDEP's comments, the current groundwater discharge permit authorizes up to 40,000 gallons per day of treated effluent. This permit is included as Appendix C of the FEIR. Any necessary modifications to the existing discharge permit or facility operations will be pursued in consultation with MassDEP and other relevant authorities.

The wastewater flow generated by the proposed Project will be accommodated at the Littleton WWTP. Project implementation will occur in phases and the advancement of future phases will be aligned with the availability of additional wastewater treatment capacity. The Project as described in the DEIR and this FEIR reflect several phases of construction; because the MEPA process requires the Project to be submitted as a whole, the estimated flows reflect a full build of the Site and the capacity that will serve later phases is not yet in place. As capacity is increased—through permit modifications, infrastructure improvements, or operational enhancements, the Project will progress accordingly to ensure that wastewater flows remain fully compliant with regulatory requirements and do not exceed permitted discharge limits. The Proponent will coordinate with local and state authorities to ensure that the proper disclosures are made for future phases, and permits are obtained.

DEP 03 **In the FEIR, the Proponent should describe the wastewater treatment system at the 410 Great Road parcel as well as address the unresolved discrepancies in the estimate for existing wastewater flows at the Project Site.**

The existing wastewater treatment system at the 410 Great Road parcel currently consists of an on-site Title 5 septic system designed to serve the historic uses of the property. When the Proponent purchased the property, they were made aware of a failed inspection report from 2022. The Owner has begun to vacate the property with plans to decommission the existing buildings on-site as well as the associated existing septic system. As part of the proposed development, wastewater flows from 410 Great Road will be routed to the Littleton WWTP, facilitating more efficient and centralized treatment. Project advancement will be contingent upon securing adequate treatment capacity, through either existing permitted capacity, planned infrastructure improvements, or permit modifications in coordination with MassDEP.

DEP 04 **MassDEP notes again that the Proponent does not currently have a permit for the existing wastewater flows at the Project site; the current permittee is 550 King Street LLC. It appears that a property transfer may have occurred without written advance written notice to MassDEP, in accordance with the regulations as described in MassDEP's comment letter. MassDEP recommends that the Proponent review the regulatory requirements for transfer of the permit.**

In 2022 the existing office buildings were closed and subsequently the on-site treatment plant was inactive, so the existing figure represents a theoretical use where the actual current value was 0 gpd. The Proponent then purchased the property and in July 2023 was made aware that the current discharge permit was about to expire. The owner worked diligently with a consultant on the matter and, on November 28, 2023, a new groundwater discharge permit (Permit No. 79-7) was issued.

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COMMONWEALTH OF MASSACHUSETTS
EXECUTIVE OFFICE OF
ENERGY AND ENVIRONMENTAL AFFAIRS
DEPARTMENT OF ENERGY RESOURCES
100 CAMBRIDGE ST., SUITE 1020
BOSTON, MA 02114
Telephone: 617-626-7300
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Maura Healey
Governor

Kim Driscoll
Lt. Governor

Rebecca Tepper
Secretary

Elizabeth Mahony
Commissioner

19 August 2025

Rebecca Tepper, Secretary
Executive Office of Energy & Environmental Affairs
100 Cambridge Street
Boston, Massachusetts 02114
Attn: MEPA Unit

RE: King Street Common, Littleton, MA, EEA #16921

cc: Jo Ann Bodemer, Director of Energy Efficiency, Department of Energy Resources
Elizabeth Mahony, Commissioner, Department of Energy Resources

Dear Secretary Tepper:

We've reviewed the Draft Environmental Impact Report (DEIR) for the proposed project. The project consists of the following:

Building	Size	Stories	Use
A	272,000	3	Reused commercial
B	272,000	3	Reused commercial
C	173,000	5 over podium	173 residential units
D	173,000	5 over podium	173 residential units
E	173,000	5 over 8,000-sf retail	149 residential units + retail
F	173,000	5	151 residential units
G	111,000	5	Hotel (150 rooms)
H	12,000	1	Retail
I	33,100	2.5 over 13,000-sf retail	9 residential units + retail
J	30,000	2.5 over 10,500-sf retail	11 residential units + retail
K	93,000	3 over 20,000-sf retail	42 residential units + retail
L	31,000	2.5 over 11,000-sf retail	11 residential units + retail
M	19,000	3	Office
N	21,000	2 over 9,500-sf retail	8 residential units + retail
O	36,000	? over 13,000-sf retail	12 residential units + retail
Q	13,000	1	Retail
R	70,000	5 over podium	65 residential units
S	290,000	6	285 residential units

Total number of residential units is 1,089.

Executive Summary

Littleton is a Stretch code community, following the IECC 2021 with the 225 CMR Chapter 23 amendments.

The Group 5 office and retail buildings (H, M & Q), Retail and Office buildings have committed to the mitigation strategies suggested in the EIR, and no further analysis is required.

The Group 2 & Group 3 buildings have committed to all-electric Air Source Heat Pumps (ASHP), which is commended. However, the analyses of Group 2/Building F (representative of the 50+ residential mixed-use buildings) and Group 3/Building K (representative of the <50 residential mixed-use buildings) falsely indicate higher heating loads for HERS 36 vs HERS 44. These errors are found in the HERS reports and the "Performance and Cost Analysis Results" tables, and skew Tables 4-3 & 4-4, resulting in inaccurate final results for overall energy consumption across the various scenarios. Given that the space heating will be ASHPs regardless of the chosen HERS score, the use of inaccurate MBtu figures in the comparison tables gives the flawed impression that electric resistance will be the most cost-effective form of space heating for the residential buildings. The DOER believes that HERS 40 with ASHP for both space *and* hot water heating in Group 2, and HERS 40 with ASHP for space heating and electric resistance for hot water in Group 3, will be the most cost effective, energy efficient, and grid-friendly method for construction and long-term operation.

The DOER requests that further analyses be corrected/created in order to provide an accurate comparison of the energy use for these residential scenarios.

The DOER is disappointed to learn that gas space and hot water heating is the proposed solution for the new hotel, building G. Given the Commonwealth's aim to move to an all-renewable electric grid by 2050 and the continued effort to discontinue fossil fuel use, new construction with gas is short sighted and unnecessary --- electric space heating is the emerging industry standard, and gas space heating is quickly falling by the wayside. The DOER strongly encourages reconsidering any introduction of new gas lines to this property, and requests cost data for the gas system to service the project (including: cost to project, cost to ratepayers, costs covered by grants, costs financed, costs/financing from any other source(s)). Please also provide the plan and costs (from all sources: ratepayers, residents, etc) from the gas utility for eventual decommissioning/abandonment of the gas service by 2050, and also the plan and costs (from all sources: ratepayers, residents, etc) from the electric utility for eventual necessary upgrades to electric service by 2050 to support a transition from gas to electric.

Recommendations

If the project commits to the remaining detailed recommendations below, the DOER review will be complete and no analyses are required. DOER 01

Building	Use	Recommendation

C	173 residential units	HERS 40 with ASHP for both space and water heating.
D	173 residential units	
E	149 residential units + retail	Residential: same as C, D Retail: electric air source heating and hot water; reduced air leakage C406.9
F	151 residential units	Same as C, D
G	Hotel (150 rooms)	Electric air source heating and hot water; reduced air leakage C406.9; electric cooking and drying
I	9 residential units + retail	HERS 40 with ASHP for space heating; electric resistance water heating Retail: electric air source heating and hot water; reduced air leakage C406.9
J	11 residential units + retail	
K	42 residential units + retail	
L	11 residential units + retail	
N	8 residential units + retail	Same as Buildings I, J, K, L
O	12 residential units + retail	
R	65 residential units	Same as Buildings C, D
S	285 residential units	

Additional Evaluations

If the recommendations above are not followed, please provide the following evaluations:

Residential portion of Buildings C, D, E, F, R, S, (residential buildings with 50 or more units): DOER 02

- HERS 40, electric air source heat pump for both space *and* water heating
- HERS 44, electric air source heat pump for both space *and* water heating
- HERS 40, electric ASHP for space heating, electric resistance for water heating
- HERS 44, electric ASHP for space heating, electric resistance for water heating

Residential portion of Buildings I, J, K, L, N, O (residential buildings with less than 50 units): DOER 03

- HERS 40, electric ASHP for space heating, electric resistance for water heating
- HERS 44, electric ASHP for space heating, electric resistance for water heating

Once the analyses are revised and complete, please share the results with Littleton Electric in order for them to review the load requirements and share their feedback on the demand. Please also determine and share the delta between the cost to operate the ASHP versus the electric resistance for the domestic hot water. DOER 04 DOER 05

Using scenario/subscenario inputs and results, prepare the following table (one table each for residential > 50 and residential 50 or less) DOER 06

Item	Scenario 1	Scenario 2	etc
Roof R value			
Wall U value			
% wall			
Window U value			
% window			

Area-weighted vertical above grade U value			
Air infiltration (cfm at 75 PA)			
Ventilation energy recovery (% effectiveness)			
Solar heat gain coefficient (SHGC)			
Heating TEDI (kBtu/sf-yr)			
Cooling TEDI (kBtu/sf-yr)			
Peak annual space heating demand (MBtu/hr)			
Peak annual space cooling demand (MBtu/hr)			
Peak annual electric load (MW)			
Peak annual gas load (MBH)			
Natural gas consumption (MBtu/yr)			
Electric power consumption (MBtu/yr)			
Fossil fuel emissions (tons/yr)			
Electric emissions @ 2025 (tons/yr)			
Total emissions @ 2025 (tons/yr)			
Electric emissions @ 2050 (tons/yr)			
Total emissions @ 2050 (tons/yr)			
Space heating emissions @ 2025 (tons/yr)			
Space heating emissions @ 2050 (tons/yr)			
Water heating emissions @ 2025 (tons/yr)			
Water heating emissions @ 2050 (tons/yr)			

For emissions rate of electricity in 2025 and 2050, use approximate grid emission rates of 750 and 50 lbs/MWhr, respecitively. DOER 07

For each building use type, develop a "gap analysis" table that summarizes the key design changes to compare each requested HERS scenario. Design inputs should come from results of HERs models, prepared by a qualified consultant. DOER 08

Gap analysis should also include reductions in HVAC equipment size enabled by increasingly improved building thermal performance, as well as reduction in peak electric usage due to improved thermal performance. DOER 09

Provide a cost-estimate analysis tied to each row of the gap analysis, showing specific additional costs/reductions. DOER 10

Develop a cash flow model for each scenario, as follows: DOER 11

- Estimate net cost increase associated with each improved scenario;
    - Amortize this cost into annual cost increase using 30-year mortgage term, after netting against rebates and other tax incentives

- Estimate cost to operate per year;

- Net operating cost increase (or decrease) (operating + amortized).

Include the following in the next submission:

- Communications to Littleton Electric sharing the above scenario findings (kW demand, etc)

- Written communications from the electric utilities that present the following:

    - Utility estimate/analysis of the size of the electric utility needs, for each scenario

    - All costs to expand the electric system to service the project (including: cost to project, cost to ratepayers, costs covered by grants, costs financed, costs/financing from any other source(s))

Sincerely,
Massachusetts Department of Energy Resources

Becca Edson, AIA
Decarbonization Architect

Paul F. Ormond, P.E.
Energy Efficiency Engineer

DEPARTMENT OF ENERGY RESOURCES

DOER 01 **If the project commits to the remaining detailed recommendations below, the DOER review will be complete and no analyses are required.**

Additional analyses were provided as discussed with DOER in the consultation held on September 05, 2025.

DOER 02 **Residential portion of Buildings C, D, E, F, R, S, (residential buildings with 50 or more units):**

- **HERS 40, electric air source heat pump for both space and water heating**
- **HERS 44, electric air source heat pump for both space and water heating**
- **HERS 40, electric ASHP for space heating, electric resistance for water heating**
- **HERS 44, electric ASHP for space heating, electric resistance for water heating**

The above scenarios are were analyzed and associated emissions, loads and costs are provided in Appendix D.

DOER 03 **Residential portion of Buildings I, J, K, L, N, O (residential buildings with less than 50 units):**

- **HERS 40, electric ASHP for space heating, electric resistance for water heating**
- **HERS 44, electric ASHP for space heating, electric resistance for water heating**

The above scenarios were analyzed and associated emissions, loads, and costs are provided in Appendix D.

DOER 04 **Once the analyses are revised and complete, please share the results with Littleton Electric in order for them to review the load requirements and share their feedback on the demand.**

The Littleton Electric and Water Department provided a will serve letter acknowledging their capacity to serve the needs of the Project, and, as requested here, the Proponents team has communicated the estimated loads for their feedback. The letter from LEWLD and correspondence about estimated load is included in Appendix D.

DOER 05 **Please also determine and share the delta between the cost to operate the ASHP versus the electric resistance for the domestic hot water.**

The design team produced a comparison of the estimated operational cost of central domestic hot water systems using air source heat pump and electric resistance. The efficiency of the ASHP system results in lower operating costs across the campus once fully built.

DOER 06 **Using scenario/subscenario inputs and results, prepare the following table (one table each for residential > 50 and residential 50 or less)**

The requested data is provided in Table 6-2 and 6-3 with additional inputs and outputs provided Appendix D

DOER 07 **For emissions rate of electricity in 2025 and 2050, use approximate grid emission rates of 750 and 50 lbs/MWhr, respectively.**

These emission rates were used to calculate the estimated emissions associated with the Project.

DOER 08 **For each building use type, develop a "gap analysis" table that summarizes the key design changes to compare each requested HERS scenario. Design inputs should come from results of HERs models, prepared by a qualified consultant.**

Gap analysis, design inputs and cash flows are provided in Appendix D.

DOER 09 **Gap analysis should also include reductions in HVAC equipment size enabled by increasingly improved building thermal performance, as well as reduction in peak electric usage due to improved thermal performance.**

Adjustments to the HVAC sizing are included in the cost analysis provided in Appendix D.

DOER 10 **Provide a cost-estimate analysis tied to each row of the gap analysis, showing specific additional costs/reductions.**

The cost estimate analysis is provided in Appendix D.

DOER 11 **Develop a cash flow model for each scenario, as follows:**

- **Estimate net cost increase associated with each improved scenario;**
  - **Amortize this cost into annual cost increase using 30-year mortgage term, after netting against rebates and other tax incentives**
- **Estimate cost to operate per year;**
- **Net operating cost increase (or decrease) (operating + amortized).**

Gap analysis, design inputs and cash flows are provided in Appendix D.

DOER 12 **Include the following in the next submission:**

- **Communications to Littleton Electric sharing the above scenario findings (kW demand,etc)**

- **Written communications from the electric utilities that present the following:**

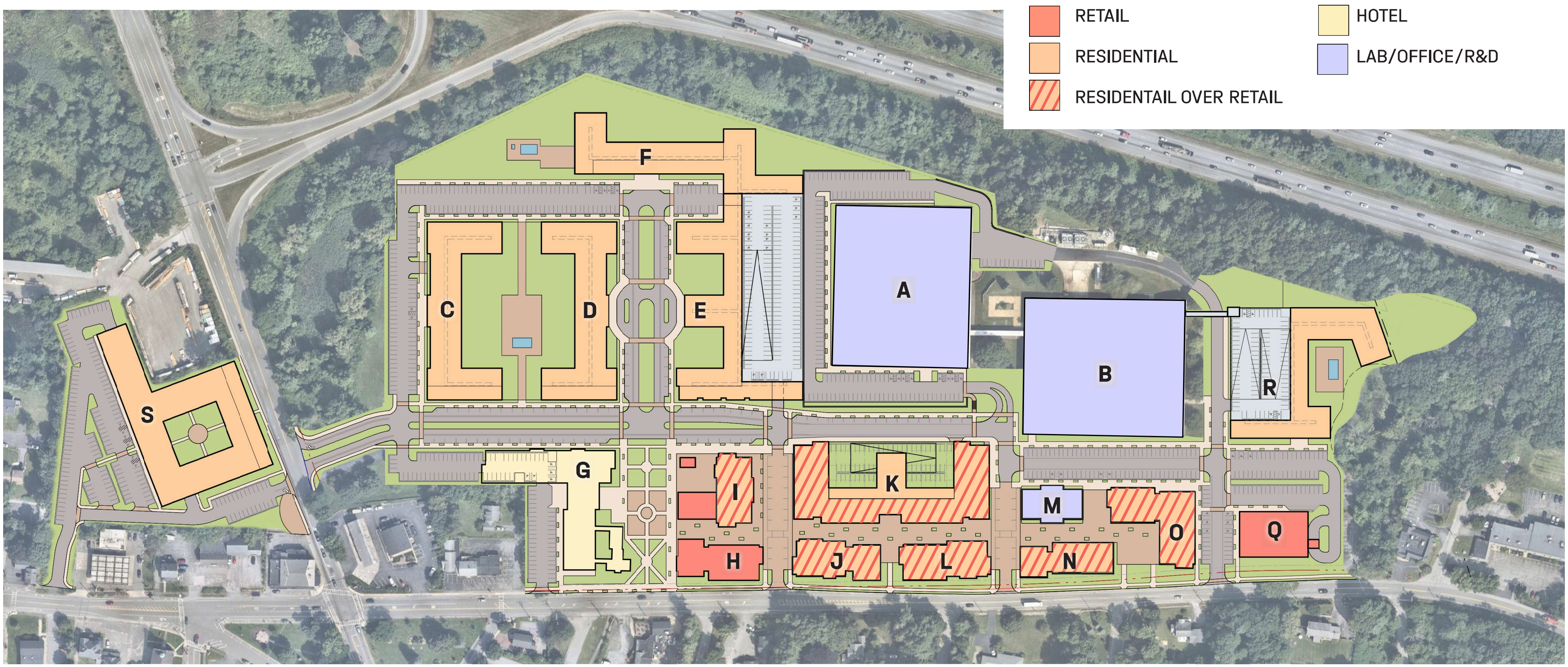
  - **Utility estimate/analysis of the size of the electric utility needs, for each scenario**

  - **All costs to expand the electric system to service the project (including: cost to project, cost to ratepayers, costs covered by grants, costs financed, costs/financing from any other source(s))**

Communications with LELWD are provided in Appendix D.

Appendix A

Project Plans



BUILDING A:	272,619 GSF COMMERCIAL | 3 STORIES
BUILDING B:	272,901 GSF COMMERCIAL | 3 STORIES
BUILDING C:	168 UNITS | 173K GSF | 5 STORIES OVER PODIUM
BUILDING D:	168 UNITS | 173K GSF | 5 STORIES OVER PODIUM
BUILDING E:	155 UNITS | 178K GSF | 5 STORIES
BUILDING F:	155 UNITS | 160K GSF | 5 STORIES
BUILDING G:	150 HOTEL ROOMS | 4,200 FOOD SERVICE/BAR | 104K GSF | 4 STORIES
BUILDING H:	11,799 SF RETAIL | 12,288 GSF | 1 STORY
BUILDING I:	13,039 SF RETAIL | 9 UNITS | 33,153 GSF | 2.5 STORIES
BUILDING J:	10,479 SF RETAIL | 11 UNITS | 30,209 GSF | 2.5 STORIES
BUILDING K:	28,757 SF RETAIL | 42 UNITS | 92,860 GSF | 3 STORIES
BUILDING L:	10,772 SF RETAIL | 11 UNITS | 31,029 GSF | 2.5 STORIES
BUILDING M:	19,000 SF | OFFICE | 3 STORIES
BUILDING N:	9,514 SF RETAIL | 8 UNITS | 21,326 GSF | 2 STORIES
BUILDING O:	13,420 SF RETAIL | 12 UNITS | 36,628 STORIES
BUILDING Q:	13,020 GSF RETAIL | 1 STORY
BUILDING R:	65 UNITS | 70K GSF | 5 STORIES OVER PODIUM
BUILDING S:	285 UNITS | 290K GSF | 6 STORIES

TOTAL RESIDENTIAL:	804 + 285 = 1089 UNITS
TOTAL RETAIL:	115K GSF
TOTAL LAB/OFFICE/R&D:	564,520 GSF


SITE 1
SITE 2
SITE 3
SITE 4
SITE 5
SITE 6
SITE 7
SITE 8
SITE 9
SITE 10
INFRASTRUCTURE 1
INFRASTRUCTURE 2
A
B
C
D
E
F
G
H
I
J
K
L
M
N
O
Q
R
S

Appendix B

Stormwater Report

DRAINAGE REPORT

King Street Common

550 King Street & 410 Great Road
Littleton, Massachusetts 01460

Prepared for: Lupoli Companies, LLC
280 Merrimack Street
Lawrence, MA 01843

Prepared by: **TEC, Inc.**
282 Merrimack Street, 2nd Floor
Lawrence, MA 01843

TEC
The Engineering Corp

May 2, 2025

Revised: September 15, 2025

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Narrative

Introduction

Lupoli Companies, LLC, “the Applicant” is proposing a mixed-use development at 550 King Street and 410 Great Road in Littleton, MA consisting of approximately 47.4 acres (2,062,568 SF) of developed land. It consists of two parts. The first is on the east side of Great Road (Route 119) and is bounded by Interstate 495 to the north, Shea Street to the East, King Street (Route 110) to the south, and Great Road to the west. This portion of the Site is a former IBM office campus that is now vacant. The second smaller part of the Project Site is on the west side of Great Road and is bounded by a commercial lumber yard to the north, Great Road to the east, commercial development along King Street to the south, and a residential area off of White Street and Hillside Road to the west. Most of the eastern portion of the Site comprises buildings, paved parking areas, landscaped areas, and related ancillary facilities. The undeveloped portion includes an area of deciduous trees around the northern border that buffers it from I-495. The western portion is currently developed with a commercial complex of attached buildings, housing a variety of small businesses, and a surface parking lot.

The proposed redevelopment Project encompasses 19 buildings having 1,089 residential units, 115,500 sf of retail, 19,000 sf of office, 545,520 sf of light industrial use (which includes the two large former IBM buildings), and a 111,000 sf hotel (150-rooms). A total of 3,010 parking spaces are proposed, of which 1,446 will be in structured parking (garages, decks, parking under podiums) and the remainder are at grade.

This drainage study was performed in order to assess the potential impacts of the proposed improvements and to provide measures to mitigate any impacts of the project. Currently, the Site consists of buildings, paved roadway and parking areas, gravel parking areas, concrete sidewalks, and wooded and landscaped areas. Runoff from the existing Site at 550 King Street is collected in catch basins and directed to one of five locations: a large, constructed stormwater wetland in the west corner of the Site, an outlet near the northwest edge of the Site, the existing closed drainage system in King Street, a wetland system at the east side of the Site, and an outlet near the northeast edge of the Site. The majority of runoff from the existing Site at 410 Great Road is not collected or treated, and instead sheet flows off of the property, and a minimal portion infiltrates into the ground. The project will provide a stormwater management system incorporating traditional and Low Impact Design (LID) Best Management Practices (BMPs). This analysis has been prepared to verify that the project will not have an adverse effect on the stormwater conditions both on-site and off-site.

The Stormwater Management Plan has been designed to comply with all pertinent state and local standards including the Massachusetts Stormwater Handbook. The proposed project improves upon existing conditions by reducing peak runoff rates, decreasing the risk of erosion and sedimentation, and improving stormwater runoff quality by removing total suspended solids (TSS).

Existing Conditions

The existing Site at 550 King Street is approximately 43.2 acres consisting of 53.7% impervious building roofs, paved driveways and parking areas, sidewalks, and water bodies/wetlands, and 46.3% pervious landscaped, vegetated, and wooded areas. Site topography generally grades away from the middle of the site, where runoff is conveyed via catch basins and drainage pipe networks to a large, constructed stormwater wetland in the west corner of the Site, an outlet near the northwest edge of the Site, the existing closed drainage system in King Street, a wetland system at the east side of the Site, and an outlet near the northeast edge of the Site. The elevation on Site ranges from approximately 301 feet in the center of the Site, to 257 feet at the west corner of the site and 281 feet at the east corner. The Site has two major 2:1 sloping hills, one in the center of the Site and one at the northwest corner of the Site. Another gently sloping hill exists at the west corner of the Site. The remainder of the Site is gently sloping.

The existing Site at 410 Great Road is approximately 4.2 acres consisting of 72.1% impervious building roofs, paved and gravel site driveways and parking areas, sidewalks, and 47.3% pervious vegetated and wooded areas. Site topography generally grades away from the south to the north, where runoff sheet flows to the north corner of the site or infiltrates into the ground. The elevation on Site ranges from approximately 275 feet in the southern corner of the Site, to 257 feet at the west corner of the site and 240 feet at the northern corner, gently sloping at approximately 3-5%.

The Sites are comprised of a variety of soil groups according to the Natural Resources Conservation Service Web Soil Survey (NRCS), which includes Paxton-Urban land complex, Udorthents-urban land complex, Woodbridge fine sandy loam, Merrimac-Urban land complex, Scarboro mucky fine sandy loam, and Canton fine sandy loam, which span from hydrologic soil groups A to D. Please refer to Appendix D to review the NRCS Soil Report which depicts the various soils present at and around the Site. Test pits were performed on December 21, 2023 and January 3, 2024. The test pits revealed that the Site is primarily composed of fill and sandy soils with locations of hydrologic soil groups A and C. Please see the attached Test Pit Logs for 550 King Street in Appendix G.

According to the FEMA Flood Insurance Rate Maps (FIRM), map number 25017C0236F, dated July 7, 2014, the project is located within an area of minimal flood hazard, denoted Zone X. Please see attached Figure 2 FEMA National Flood Hazard Layer FIRMette.

Proposed Conditions

As previously mentioned, the proposed redevelopment Project encompasses 19 buildings having 1,089 residential units, 115,500 sf of retail, 19,000 sf of office, 545,520 sf of light industrial use (which includes the two large former IBM buildings), and a 111,000 sf hotel (150-rooms). A total of 3,010 parking spaces are proposed, of which 1,446 will be in structured parking (garages, decks, parking under podiums) and the remainder are at grade. The Project is considered a redevelopment with an increase of 2.3 acres of impervious area as compared to the existing conditions. The proposed stormwater management system has been designed in accordance with the MassDEP Stormwater Management Policy and includes traditional and LID BMPs. BMPs proposed for the site include deep-sump and hooded catch basins, proprietary pretreatment devices, subsurface infiltration basins (SSIBs), and a surface-level infiltration basin. The stormwater management system has been designed to provide water quality treatment and water quantity control. The stormwater management system has been designed to provide water quality treatment for 1” of runoff from all proposed impervious area.

Methodology

The Stormwater Management Plan, which will be implemented as part of this project, will be designed to improve water quality, reduce pre-development peak discharge rates and volumes and provide groundwater recharge. The proposed stormwater management system will comply with the standards set forth in the Massachusetts Stormwater Handbook.

Existing and proposed hydrologic conditions were analyzed using HydroCAD, an SCS TR-20 based program, to calculate existing and proposed peak discharge rates. This method takes into account existing and proposed pervious and impervious areas including soil types and hydrologic classifications. The 2-, 10-, 25-, 50-, and 100-year, 24-hour storm frequencies were used in the analysis in accordance with the MassDEP and the Town of Littleton requirements. Additional storm scenarios, including the 2070 10-, 25-, 50-, and 100-year storms, will be assessed in evaluating the project's resiliency to urban and riverine flooding. The projected 24-hour precipitation depths associated with these storm events are 6.7, 8.1, 9.2, and 10.4 inches, respectively, based on publicly available data at the Resilient MA Climate Change Projections Dashboard. The "Regulatory Compliance" portion of this report addresses the MassDEP Stormwater Management Performance Standards under the Wetlands Protection Act.

The HydroCAD analysis was completed utilizing twelve (12) design points. The Design Points are as follows:

Design Point 1 (DP-1): An existing 18" flared end section outlet directed into the existing stormwater wetland, located in the west corner of the 550 King Street site.
Design Point 2 (DP-2): An existing 24" flared end section outlet directed into the existing stormwater wetland, located in the west corner of the 550 King Street site.
Design Point 3 (DP-3): An existing 48" pipe outlet directed into the existing stormwater wetland located in the west corner of the 550 King Street site.
Design Point 4 (DP-4): The closed drainage system within King Street (Route 110) near the easternmost 550 King Street entrance.
Design Point 5 (DP-5): Two adjacent existing 18" flared end section outlets directed into the wetland located in the northeast corner of the 550 King Street site.
Design Point 6 (DP-6): The existing stormwater wetland located in the west corner of the 550 King Street site. DP-1, DP-2, and DP-3 are directed to DP-6.
Design Point 7 (DP-7): An existing stormwater pond located in the south corner of the 550 King Street site to be removed during construction.
Design Point 8 (DP-8): An existing stormwater pond located in the south corner of the 550 King Street site to be removed during construction.
Design Point 9 (DP-9): The existing off-site headwall outlet to the stormwater wetland identified as DP-6.
Design Point 10 (DP-10): North of the 550 King Street property, adjacent to I-495.
Design Point 11 (DP-11): A wetland south of the 410 Great Road site.
Design Point 12 (DP-12): The Great Road closed drainage system located between the 410 Great Road and 550 King Street sites.

Pre-Development Runoff

The existing site, including both 550 King Street and 410 Great Road, contains approximately 946,605 SF of pervious area consisting of landscaped areas and undisturbed vegetated areas, and 1,067,022 SF of impervious area consisting of asphalt parking and roadway, sidewalks, building roof, and wetlands. Stormwater from the abutting lots U08-5-0, U08-6-0 and U08-7-0 also flows onto the site.

In the Site's current condition, there are 23 existing subcatchment areas which are conveyed to the twelve design points. The first number of the subcatchment denotes the design point the subcatchment is conveyed to. A minimum time of concentration of 6.0 minutes has been utilized in accordance with the Massachusetts Stormwater Handbook. The *Pre-Development Drainage Areas* are depicted in Figure D-1 of this report. This figure presents the delineation of the existing subcatchment areas and the design points.

Subcatchment areas 1.1, 2.1, 3.1-3, 4.1, and 5.1-3 consist of previously developed land. The subcatchments primarily consist of paved surface parking, and associated landscaping. Runoff from these subcatchments sheet flows over land prior to collection in a closed drainage system and is then conveyed to the respective design point.

Subcatchment area 1.2 consists of on-site landscaping, as well as a portion of the abutting parcels U08-5-0, 6-0, and 7-0, which are developed as commercial and residential properties. Runoff from this subcatchment infiltrates or sheet flows over land prior to collection in a closed drainage system and conveyance to DP-1.

Subcatchment areas 3.4 and 3.5 consist of building roof. Runoff from these subcatchments is collected in roof drains and conveyed to subsurface infiltration systems. Overflow from the infiltration systems is conveyed to DP-3.

Subcatchment area 6.1 consists of a wetland and the surrounding undisturbed vegetated buffer zone. Runoff from this subcatchment infiltrates or sheet flows over land to DP-6.

Subcatchment areas 7.1 and 8.1 consist of the historic Tuttle House and associated landscaping. Runoff from these subcatchments infiltrates or sheet flows over land to existing stormwater management ponds. The ponds lack outlet devices; it is presumed that the pond infiltrates.

Subcatchment areas 9.1 and 10.1-4 consist of pervious land with grassed and wooded land cover. Runoff from these subcatchments infiltrates or sheet flows over land to the respective design point.

Subcatchment areas 11.1 and 12.1 are located within the 410 Great Road site and consist of an existing building with associated paved surface parking and landscaping. Runoff from these subcatchments sheet flows to DP-11 and DP-12, respectively.

Individual subcatchments are described in greater detail in Appendix A.

Post-Development Runoff

The proposed site, including both 550 King Street and 410 Great Road, contains approximately 533,835 SF of pervious area consisting of landscaped areas and undisturbed vegetated areas, and 1,528,721 SF of impervious area consisting of asphalt parking and roadway, sidewalks, building roof, and wetlands. Stormwater from the abutting lots U08-5-0, U08-6-0 and U08-7-0 flows onto the site, consisting of approximately 21,929 SF impervious area and 14,250 SF pervious area.

The proposed stormwater management system is designed to mitigate the effects of the proposed development by reducing the peak rates of runoff as compared to the existing conditions. In the proposed conditions analysis, the same design points identified and analyzed under the existing conditions were analyzed. The 41 post-development subcatchment areas utilized to delineate stormwater flows for treatment and peak flow mitigation are identified in Figure D-2, Post Development Drainage Areas. The first number of the subcatchment identifies the design point the runoff is directed to. These subcatchments are summarized below. Individual subcatchments are described in greater detail in Appendix B.

Subcatchment areas 1.1 consist of paved roadway, paved surface parking, and associated landscaping. Runoff from this subcatchment sheet flows over land prior to collection in a closed drainage system. The drainage system conveys runoff to a proprietary water quality unit prior to discharge to DP-1.

Subcatchment area 1.2 consists of the abutting parcels U08-5-0, 6-0, and 7-0, which are developed as commercial and residential properties. Runoff from this subcatchment sheet flows over land prior to collection in a closed drainage system. The drainage system conveys runoff to a proprietary water quality unit prior to discharge to DP-1.

Subcatchment area 2.1 consists of paved roadway, paved surface parking, and associated landscaping. Runoff from this subcatchment sheet flows over land prior to collection in a closed drainage system. The drainage system conveys runoff to an infiltrating rain garden, with an overflow to DP-2.

Subcatchment area 2.2 consists of building roof, paved surface parking, and landscaping. Runoff is collected in roof leaders, or sheet flows into a closed drainage system. Runoff is then conveyed to subsurface infiltration basin P3. Overflow from P3 is conveyed to rain garden P1 prior to discharge to DP-2.

Subcatchment areas 3.1-5 consist of paved roadway, paved surface parking, and associated landscaping. Runoff from these subcatchments sheet flows over land prior to collection in a closed drainage system. The drainage system conveys runoff to subsurface infiltration basins, including P5, P7, and P8, prior to discharge to DP-3.

Subcatchment areas 3.6-11, 3.13-14, 3.17-18, and 3.21 primarily consist of building roofs, paved parking, sidewalks, and landscaping. Runoff is collected in roof leaders, or sheet flows into a closed drainage system. Runoff is then conveyed to subsurface infiltration basins P3, P4, P6, P7, P8, and P10 prior to discharge to DP-3.

Subcatchment area 3.12 primarily consists of a “town common” green space. Runoff from this subcatchment infiltrates, or it sheet flows into a closed drainage system, which is then directed to subsurface infiltration basin P7 prior to discharge to DP-3.

Subcatchment areas 3.15 and 3.19 each consist of land surrounding the two existing office buildings. Land cover consists of driveways, paved parking, utility pads, and landscaping. Runoff from these subcatchments sheet flows over land prior to collection in a closed drainage system. The drainage system conveys runoff to subsurface infiltration basins P6 and P9, respectively, prior to discharge to DP-3.

Subcatchment areas 3.16 and 3.20 each consist of one existing office building. Roof runoff is conveyed to subsurface infiltration basins P6 and P9, respectively, prior to discharge to DP-3.

Subcatchment area 4.1 consists of paved roadway, paved surface parking, and associated landscaping. Runoff from this subcatchment sheet flows over land prior to collection in a closed drainage system. The drainage system conveys runoff to a proprietary water quality unit prior to discharge to DP-4.

Subcatchment area 5.1 consists of paved roadway, paved surface parking, and associated landscaping. Runoff from this subcatchment sheet flows over land prior to collection in a closed drainage system. The drainage system conveys runoff to subsurface detention system P9 prior to discharge to DP-5.

Subcatchment areas 5.2 and 5.5 consist of building roof, structured and surface parking, and landscaping. Runoff from these subcatchments sheet flows into a closed drainage system, which is then directed to subsurface infiltration basin P10 prior to discharge to DP-5.

Subcatchment areas 5.3-4 consist of undisturbed vegetated wetland buffer. Runoff infiltrates of sheet flows into the adjacent wetland DP-5.

Subcatchment area 6.1 consists of an existing stormwater wetland and the surrounding undisturbed vegetated buffer zone. Runoff infiltrates or sheet flows to DP-6.

Subcatchment areas 9.1-2 and 10.1-4 consist of pervious land with grassed and wooded land cover. Runoff infiltrates or sheet flows to DP-9 or DP-10, respectively.

Subcatchment area 11.1 is located within the 410 Great Road site and consists of surface parking and associated landscaping. Runoff from this subcatchments sheet flows over land prior to collection in a closed drainage system.

Runoff is conveyed to subsurface infiltration basin P11 prior to discharge to DP-11.

Subcatchment area 11.2 is located within the 410 Great Road site and primarily consists of proposed building roof. Runoff is collected in roof leaders and conveyed to subsurface infiltration basin P11 prior to discharge to DP-11.

Subcatchment area 12.1 is located within the 410 Great Road site and consists of surface parking and associated landscaping. Runoff from this subcatchment sheet flows over land prior to collection in a closed drainage system conveyed to DP-12.

Table 1 550 King Street and 410 Great Road Peak Flow Summary

	2-Yr Storm		10-Yr Storm		25-Yr Storm		50-Yr Storm		100-Yr Storm	
Discharge Point	Exist (cfs)	Prop (cfs)	Exist (cfs)	Prop (cfs)	Exist (cfs)	Prop (cfs)	Exist (cfs)	Prop (cfs)	Exist (cfs)	Prop (cfs)
DP-1	2.02	1.01	3.46	2.23	4.75	3.28	6.00	4.29	7.55	5.53
DP-2	5.35	0.21	9.34	6.73	12.47	12.40	15.36	14.77	18.81	16.49
DP-3	31.70	20.47	60.82	43.55	79.12	63.05	111.19	78.48	132.35	101.23
DP-4	1.26	0.31	2.32	0.50	3.17	0.66	3.96	0.80	4.90	0.97
DP-5	12.86	2.67	21.80	7.50	28.83	11.38	35.33	14.99	43.13	19.07
DP-6	40.10	21.35	77.25	51.49	102.42	79.55	140.77	99.03	170.33	126.05
DP-7	3.78	0.00	7.85	0.00	11.25	0.00	14.47	0.00	18.39	0.00
DP-8	0.91	0.00	1.69	0.00	2.32	0.00	2.91	0.00	3.61	0.00
DP-9	2.94	0.00	6.43	0.03	9.40	0.26	12.24	0.88	15.71	2.04
DP-10	0.37	0.00	0.84	0.06	1.26	0.16	1.66	0.27	2.15	0.49
DP-11	4.64	0.30	9.19	5.64	12.92	10.55	16.41	13.44	20.64	20.14
DP-12	0.87	0.23	1.32	0.60	1.68	0.93	2.01	1.26	2.40	1.66

Table 2 550 King Street and 410 Great Road 2070 Peak Flow Summary

	10-Yr Storm		25-Yr Storm		50-Yr Storm		100-Yr Storm	
Discharge Point	Exist (cfs)	Prop (cfs)	Exist (cfs)	Prop (cfs)	Exist (cfs)	Prop (cfs)	Exist (cfs)	Prop (cfs)
DP-1	5.66	4.02	7.25	5.29	8.53	6.30	9.95	7.41
DP-2	14.59	14.23	18.15	16.56	20.93	32.87	23.95	44.77
DP-3	95.71	74.76	129.84	96.31	146.38	129.82	165.67	206.32
DP-4	3.75	0.76	4.72	0.93	5.48	1.07	6.31	1.22
DP-5	33.61	14.07	41.64	18.3	47.92	21.59	54.76	25.34
DP-6	123.53	94.35	166.14	120.38	189.44	170.91	216.01	262.88
DP-7	13.61	0.00	17.64	0.00	20.82	0.00	24.29	0.00
DP-8	2.75	0.00	3.48	0.00	4.04	0.00	4.66	0.00
DP-9	11.48	0.68	15.04	1.80	17.87	2.89	20.95	4.24
DP-10	1.55	0.24	2.06	0.43	2.46	0.67	2.91	0.95
DP-11	15.48	9.92	19.83	15.77	23.25	28.42	26.97	32.15
DP-12	1.92	1.17	2.33	1.58	2.65	1.91	2.99	2.28

TSS Removal

MassDEP Performance Standard 4 requires a TSS removal of at least 80%. The stormwater management plan for this project utilizes BMPs such as subsurface infiltration basins (SSIB), deep-sump and hooded catch basins, and proprietary flow-through devices to meet this standard. A minimum of 80% TSS removal is provided for runoff from all proposed impervious cover, with the exception of clean roof runoff. Runoff from impervious surfaces directed to infiltration practices receive 80% TSS removal credit per the Massachusetts Stormwater Handbook. Subcatchments 1.1, 1.2, 4.1, and 12.1 are not conveyed to infiltration practices. This impervious area is treated by hydrodynamic separators such as Contech CDS and Cascade units to 80% TSS removal. Units are sized based on final impervious cover and HydroCAD runoff modelling.

Because the site is designated a Land Use with a Higher Potential Pollutant Load (LUHPPL), 44% TSS Removal must be attained prior to infiltration. Both ADS Stormtech and Corrugated Metal Pipe (CMP) infiltration systems are proposed. Where runoff is infiltrated via an ADS Stormtech system, 44% TSS removal is attained by deep-sump and hooded catch basins and a proprietary Isolator Row Plus (IRP+) in series. Each BMP provides 25% TSS removal credit, for a cumulative 44% removal when placed in series. Where runoff is infiltrated via a CMP system, 44% TSS removal is achieved through proprietary hydrodynamic separators such as Contech CDS and Cascade units. The hydrodynamic separator units are sized for a flow, as determined by the HydroCAD model.

Please refer to Appendix E for further information and calculation worksheets regarding water quality data.

Regulatory Compliance

The DEP Stormwater Management Policy prescribes ten performance standards. The proposed project has been designed in accordance with these standards. Compliance with the standards is outlined below.

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

This project proposes no new untreated stormwater discharges or will cause erosion in the wetlands or waters of the Commonwealth. Similar drainage paths are maintained from pre to post development.

Standard 2: (Peak Rate Control and Flood Prevention)
Stormwater management systems must be designed so that post-development peak discharge rates do not exceed pre-development peak discharge rates. This Standard may be waived for land subject to coastal storm flowage.

As summarized in Table 1, the project does not increase peak runoff rates for the 2, 10, 25-, 50-, and 100-Year storm events. The HydroCAD analysis and output can be found in Appendix A: Hydrologic Calculations.

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

The project fully meets Standard 3. Ten infiltration BMPs are proposed, infiltrating a total water quality volume of 101,045 CF which exceeds the required 28,398 CF water quality volume. Due to the sites classification as a LUHPPL, the 1” value was utilized to calculate the water quality volume. Infiltration BMPs receive runoff from 79% of the proposed impervious cover. Please see the attached Appendix D for a summary of the proposed BMPs and how recharge requirements are met.

Tests pits confirming soil texture and estimated seasonal high groundwater (ESHGW) elevation will be completed prior to final design and construction of infiltration practices. Upon soil textural analysis completion, the time to drain for each BMP will be calculated to ensure each system completely drains within 72 hours. Mounding analyses will be completed where required by Massachusetts Stormwater Standards.

Standard 4: (80% TSS removal)

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

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

A Long-Term Pollution Prevention Plan is included as Appendix H. The Infiltration BMPs are sized to treat the water quality volume as seen in Appendix D. All runoff not directed to an infiltration practice is directed to a proprietary flow through device for treatment. Pretreatment in accordance with LUHPPL requirements. Please see Appendix E for the proposed treatment trains.

Standard 5: (Higher Potential Pollutant Loads (HPPL))

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

The proposed project is considered a land use with higher potential pollutant loads (LUHPPL) because it will generate greater than 1000 vehicle trips per day. Pretreatment requirements have been met.

Standard 6: (Critical Areas)

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

unless essential to the operation of the public water supply.

The project site is not located within any critical areas.

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

The project is considered a redevelopment project, and therefore is required to meet Stormwater Management Standards 2, 3, 4, 5 & 6 only to the maximum extent practicable.All existing stormwater discharges comply with Standard 1 only to the maximum extent practicable. The project complies with all other requirements of the Stormwater Management Standards and improves existing conditions. As a redevelopment of an existing site consisting of vast non-permeable parking lots, the new development will reduce the heat island effect and will result in an increase in the permeability of the site.

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

The project has been designed to include erosion and sedimentation controls to prevent impacts to the resource areas. Construction activities will be isolated from downgradient areas by installing erosion control measures including compost filter socks and inlet protection devices. A Construction Period Pollution Prevention Plan has been prepared for the Project.

Standard 9: (Operation and Maintenance)
A long-term operation and maintenance plan shall be developed and implemented to ensure that stormwater management systems function as designed.

The project will include a Long-Term Operation and Maintenance Plan as Appendix F to provide efficient operation of the features of the proposed drainage system.

Standard 10: (Illicit Discharges)
All illicit discharges to the stormwater management system are prohibited.

Only stormwater will be conveyed to the stormwater management system. No illicit materials or connections are permitted. An Illicit Discharge Compliance Statement is included as Appendix F.

Conclusion

The proposed site redevelopment will transform the existing site into a mixed-use development offering quality residential and commercial opportunities. The project provides a stormwater management system to mitigate the Site’s increase in impervious cover associated with the project and drastically increase the quality of runoff leaving the site. The stormwater management plan controls the flow of stormwater, reduces peak runoff rates, promotes stormwater infiltration and provides water quality treatment. The stormwater management plan provides erosion and sediment control resulting in cleaner stormwater runoff. The project has been designed in accordance with the Massachusetts Stormwater Handbook and will not adversely impact resource areas or abutting properties.

Figure 1 – Project Location Map
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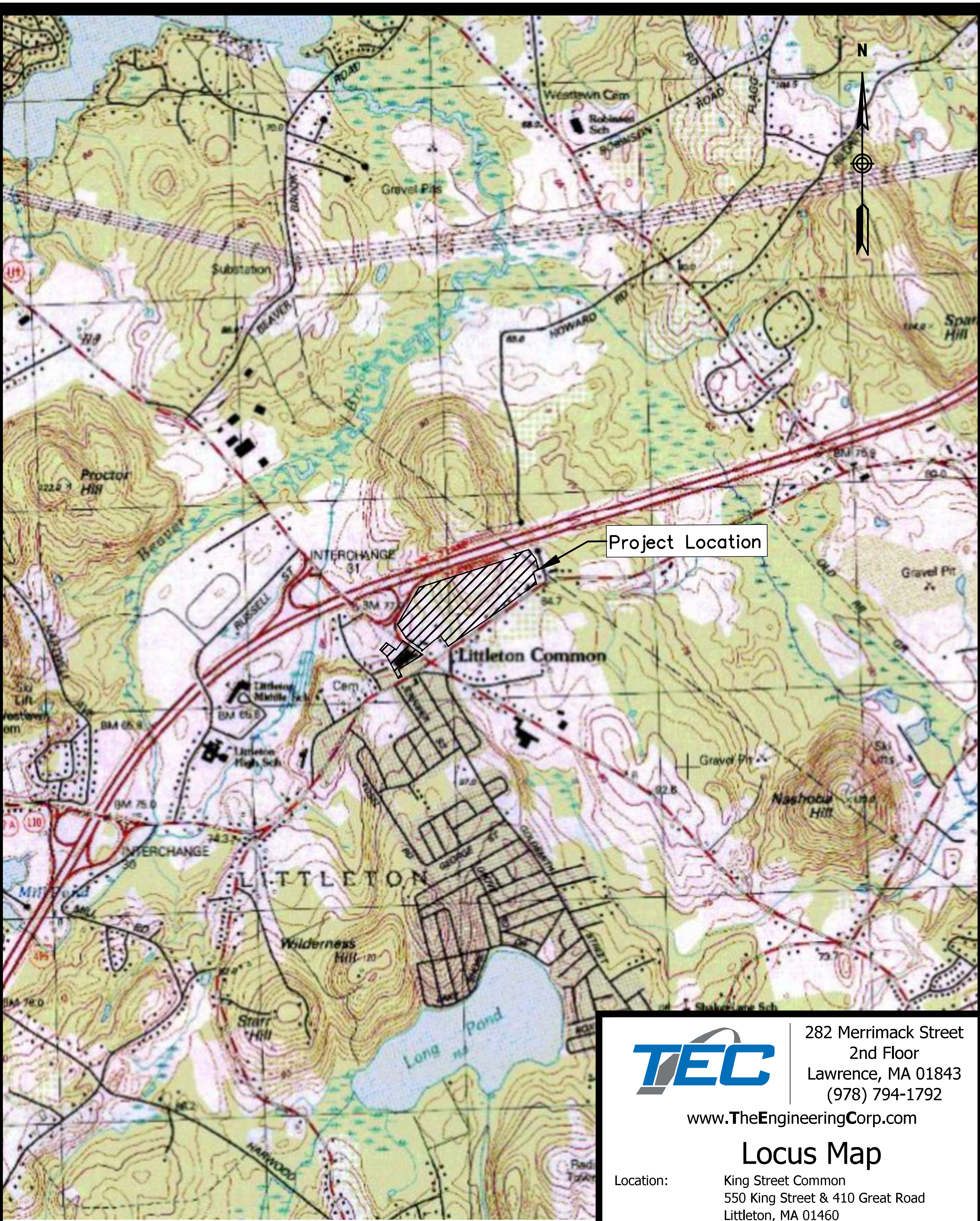

2000 0 2000 4000

SCALE IN FEET

April 7, 2025

TEC

282 Merrimack Street
2nd Floor
Lawrence, MA 01843
(978) 794-1792

www.TheEngineeringCorp.com

Locus Map

Location:	King Street Common 550 King Street & 410 Great Road Littleton, MA 01460
Prepared For:	Lupoli Companies, LLC 280 Merrimack Street Lawrence, MA 01843

Figure 2 – FEMA FIRM
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National Flood Hazard Layer FIRMette

71°28'34"W 42°33'12"N

71°27'56"W 42°32'46"N

Feet
0 250 500 1,000 1,500 2,000

1:6,000

Basemap Imagery Source: USGS National Map 2023

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS	Without Base Flood Elevation (BFE) *Zone A, V, A99*
	With BFE or Depth *Zone AE, AO, AH, VE, AR*
	Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD	0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
	Future Conditions 1% Annual Chance Flood Hazard *Zone X*
	Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
	Area with Flood Risk due to Levee *Zone D*
OTHER AREAS	NO SCREEN Area of Minimal Flood Hazard *Zone X*
	Effective LOMRs
	Area of Undetermined Flood Hazard *Zone D*
GENERAL STRUCTURES	Channel, Culvert, or Storm Sewer
	Levee, Dike, or Floodwall
OTHER FEATURES	20.2 / 17.5 Cross Sections with 1% Annual Chance Water Surface Elevation
	Coastal Transect
	513 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

N

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 9/15/2025 at 5:02 PM 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.

Figure 3 – NRCS Soil Map
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Soil Map

Map Scale: 1:6,980 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0, 100, 200, 400, 600

Feet: 0, 300, 600, 1200, 1800

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

MAP LEGEND

Area of Interest (AOI)
Area of Interest (AOI)

Soils
Soil Map Unit Polygons
Soil Map Unit Lines
Soil Map Unit Points

Special Point Features
Blowout
Borrow Pit
Clay Spot
Closed Depression
Gravel Pit
Gravelly Spot
Landfill
Lava Flow
Marsh or swamp
Mine or Quarry
Miscellaneous Water
Perennial Water
Rock Outcrop
Saline Spot
Sandy Spot
Severely Eroded Spot
Sinkhole
Slide or Slip
Sodic Spot

Spoil Area
Stony Spot
Very Stony Spot
Wet Spot
Other
Special Line Features

Water Features
Streams and Canals

Transportation
Rails
Interstate Highways
US Routes
Major Roads
Local Roads

Background
Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

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 distance or area are required.

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

Soil Survey Area: Middlesex County, Massachusetts
Survey Area Data: Version 24, Aug 27, 2024

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

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

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
6A	Scarboro mucky fine sandy loam, 0 to 3 percent slopes	9.7	4.6%
32B	Wareham loamy fine sand, 0 to 5 percent slopes	0.0	0.0%
51A	Swansea muck, 0 to 1 percent slopes	3.8	1.8%
103C	Charlton-Hollis-Rock outcrop complex, 8 to 15 percent slopes	0.3	0.2%
253A	Hinckley loamy sand, 0 to 3 percent slopes	3.0	1.4%
253D	Hinckley loamy sand, 15 to 25 percent slopes	4.3	2.0%
260B	Sudbury fine sandy loam, 3 to 8 percent slopes	6.8	3.2%
307E	Paxton fine sandy loam, 25 to 35 percent slopes, extremely stony	0.3	0.2%
310B	Woodbridge fine sandy loam, 3 to 8 percent slopes	45.2	21.4%
310C	Woodbridge fine sandy loam, 8 to 15 percent slopes	3.2	1.5%
311B	Woodbridge fine sandy loam, 0 to 8 percent slopes, very stony	5.7	2.7%
422B	Canton fine sandy loam, 0 to 8 percent slopes, extremely stony	7.1	3.3%
622C	Paxton-Urban land complex, 3 to 15 percent slopes	10.3	4.9%
623C	Woodbridge-Urban land complex, 3 to 15 percent slopes	6.7	3.2%
626B	Merrimac-Urban land complex, 0 to 8 percent slopes	23.7	11.2%
654	Udorthents, loamy	4.7	2.2%
655	Udorthents, wet substratum	17.8	8.4%
656	Udorthents-Urban land complex	58.5	27.7%
Totals for Area of Interest		**211.3**	**100.0%**

Figure D-1 Pre-Development Drainage Areas
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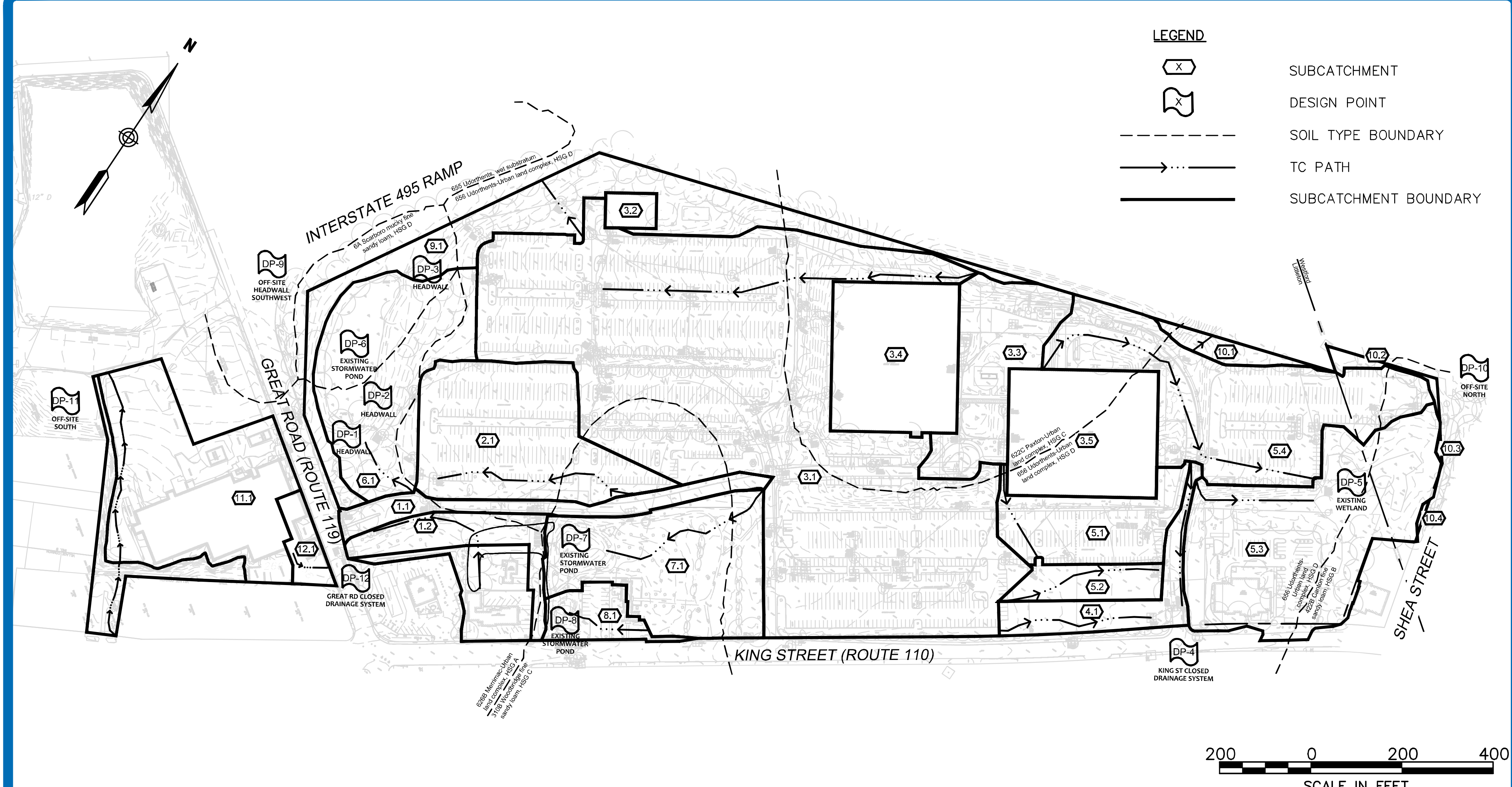

TEC
The Engineering Corp

Pre-Development Drainage Areas
King Street Common
Littleton, Massachusetts
May 2, 2025

Figure D-2 Post-Development Drainage Areas
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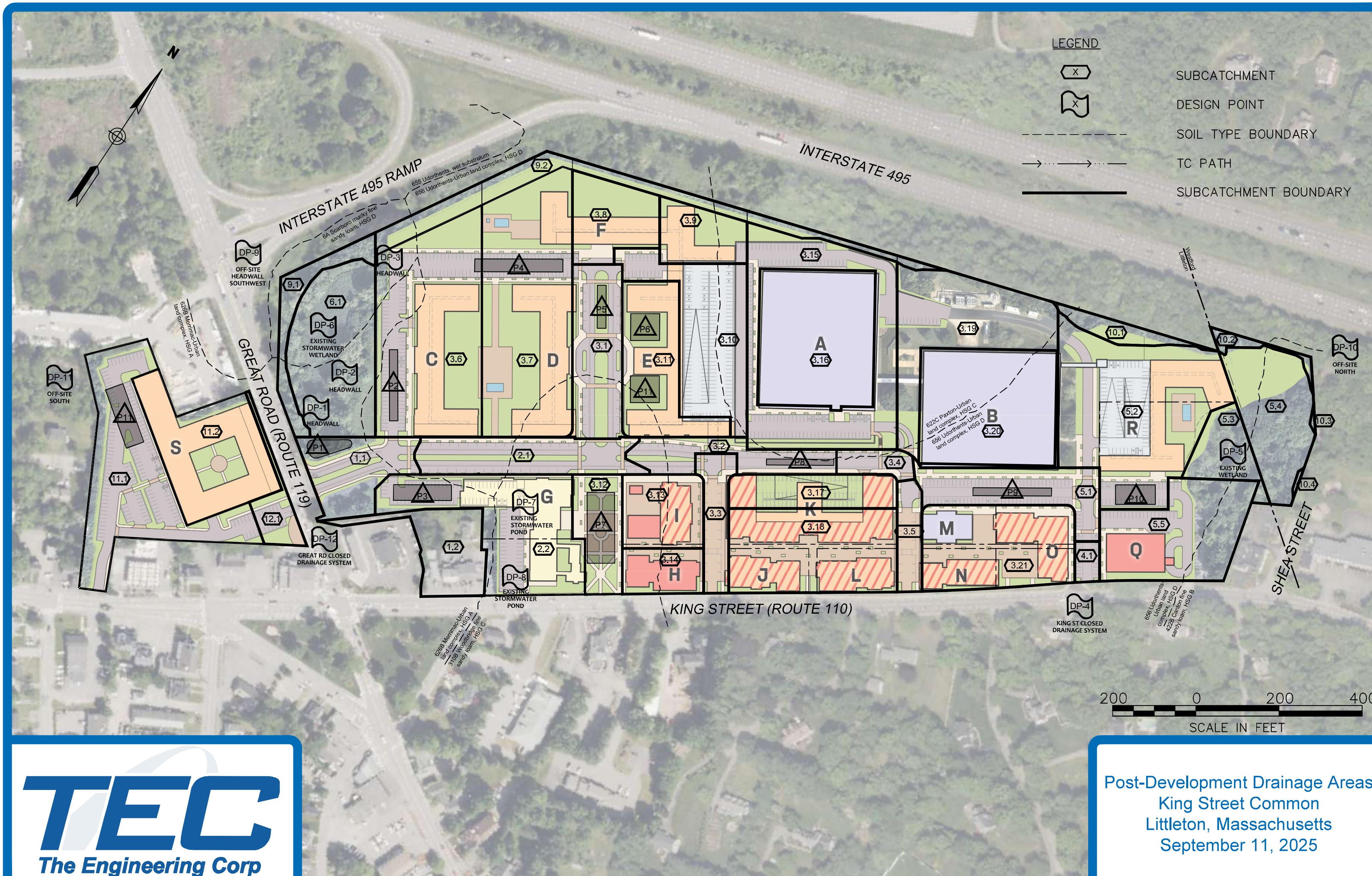

Post-Development Drainage Areas
King Street Common
Littleton, Massachusetts
September 11, 2025

TEC
The Engineering Corp

Appendix

The Engineering Corp

A

Pre-Development Drainage Areas

The Engineering Corp
282 Merrimack Street, 2nd Floor
Lawrence, MA 01843
978.794.1792
TheEngineeringCorp.com
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PRE-DEVELOPMENT DRAINAGE AREAS

550 KING STREET

SUBCATCHMENT	DESCRIPTION	PROPOSED COVER (SF) IMPERVIOUS	PROPOSED COVER (SF) PERVIOUS	TOTAL AREA (SF)	IMPERVIOUS COVER (%)
1.1	Roadway	28,862	8,182	37,044	78%
1.2	Landscaping and Abutting Lots	20,237	52,665	72,902	28%
2.1	Surface Parking	94,488	28,217	122,705	77%
3.1	Surface Parking	386,822	195,398	582,220	66%
3.2	Water Treatment Building	8,600	0	8,600	100%
3.3	Roadway and Landscaping	24,677	48,120	72,797	34%
3.4	Office Building	91,130	0	91,130	100%
3.5	Office Building	90,980	0	90,980	100%
4.1	Roadway and Landscaping	9,289	29,324	38,613	24%
5.1	Surface Parking	42,924	16,594	59,518	72%
5.2	Landscaping	178	25,282	25,460	1%
5.3	Building, Parking, and Undisturbed Land	73,286	99,793	173,079	42%
5.4	Surface Parking	98,233	57,396	155,629	63%
6.1	Existing Wetland	31,218	88,839	120,057	26%
7.1	Tuttle House Landscaping	1,330	114,564	115,894	1%
8.1	Tuttle House	9,409	14,408	23,817	40%
9.1	Undisturbed Land	0	118,327	118,327	0%
10.1	Undisturbed Land	0	12,178	12,178	0%
10.2	Undisturbed Land	0	5,430	5,430	0%
10.3	Undisturbed Land	0	521	521	0%
10.4	Undisturbed Land	0	612	612	0%
TOTAL CONTRIBUTING AREA		1,011,663	915,850	1,927,513	52%
TOTAL AREA ON SITE		991,426	863,185	1,854,611	53%

410 GREAT ROAD

SUBCATCHMENT	DESCRIPTION	PROPOSED COVER (SF) IMPERVIOUS	PROPOSED COVER (SF) PERVIOUS	TOTAL AREA (SF)	IMPERVIOUS COVER (%)
11.1	Building and Surface Parking	119,997	46,982	166,979	72%
12.1	Building	13,754	284	14,038	98%
TOTAL AREA ON SITE		133,751	47,266	181,017	74%

550 KING STREET & 410 GREAT ROAD	PROPOSED COVER (SF) IMPERVIOUS	PROPOSED COVER (SF) PERVIOUS	TOTAL AREA (SF)	IMPERVIOUS COVER (%)
TOTAL AREA	1,125,177	910,451	2,035,628	55%

NOTES:

1) **The subcatchments are delineated as shown on the figure "Pre-Development Drainage Areas"**
2) **The first number of the subcatchment identifies the design point the runoff is directed to.**

B

Post-Development Drainage Areas

TEC
The Engineering Corp
282 Merrimack Street, 2nd Floor
Lawrence, MA 01843
978.794.1792
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POST-DEVELOPMENT DRAINAGE AREAS

550 KING STREET		PROPOSED COVER (SF)			
SUBCATCHMENT	DESCRIPTION	IMPERVIOUS	PERVIOUS	TOTAL AREA (SF)	IMPERVIOUS COVER (%)
1.1	Roadway	20,014	20,273	40,287	50%
1.2	Abutting Lots	21,929	14,250	36,179	61%
2.1	Roadway	41,229	5,500	46,729	88%
2.2	Lot G	70,001	17,640	87,641	80%
3.1	Roadway	29,617	20,781	50,398	59%
3.2	Roadway	30,225	1,800	32,025	94%
3.3	Roadway	22,299	0	22,299	100%
3.4	Roadway	11,523	0	11,523	100%
3.5	Roadway	15,787	0	15,787	100%
3.6	Lot C	110,000	17,271	127,271	86%
3.7	Lot D	82,394	50,029	132,423	62%
3.8	Lot F	18,935	17,987	36,922	51%
3.9	Lot F and Parking	17,521	10,131	27,652	63%
3.10	Structured Parking	71,861	68	71,929	100%
3.11	Lot E	39,375	17,818	57,193	69%
3.12	Common	10,000	20,574	30,574	33%
3.13	Lot I	34,719	0	34,719	100%
3.14	Lot H	21,259	0	21,259	100%
3.15	Lot A: Land	75,351	14,000	89,351	84%
3.16	Lot A: Existing Building	91,130	0	91,130	100%
3.17	Lot K	32,969	0	32,969	100%
3.18	Lots K, J & L	81,927	0	81,927	100%
3.19	Lot B: Land	42,676	38,000	80,676	53%
3.20	Lot B: Existing Building	90,980	0	90,980	100%
3.21	Lots M, N & O	72,623	0	72,623	100%
4.1	Roadway	5,831	0	5,831	100%
5.1	Roadway	39,202	5,700	44,902	87%
5.2	Lot R	101,579	30,000	131,579	77%
5.3	Lot R: Undisturbed Land	12,806	11,004	23,810	54%
5.4	Westford Parcel	7,333	47,797	55,130	13%
5.5	Lot Q	52,973	18,263	71,236	74%
6.1	Existing Wetland	31,218	46,840	78,058	40%
9.1	Undisturbed Land	0	21,146	21,146	0%
9.2	Undisturbed Land	0	44,819	44,819	0%
10.1	Undisturbed Land	0	12,178	12,178	0%
10.2	Undisturbed Land	0	5,430	5,430	0%
10.3	Undisturbed Land	0	521	521	0%
10.4	Undisturbed Land	0	612	612	0%
TOTAL CONTRIBUTING AREA		1,407,286	510,432	1,917,718	73%
TOTAL AREA ON SITE		1,385,357	496,182	1,881,539	74%

410 GREAT ROAD		PROPOSED COVER (SF)			
SUBCATCHMENT	DESCRIPTION	IMPERVIOUS	PERVIOUS	TOTAL AREA (SF)	IMPERVIOUS COVER (%)
11.1	Surface Parking	61,121	28,018	89,139	69%
11.2	Building	14,475	55,402	69,877	21%
12.1	Surface Parking	12,235	9,766	22,001	56%
TOTAL AREA ON SITE		87,831	93,186	181,017	49%

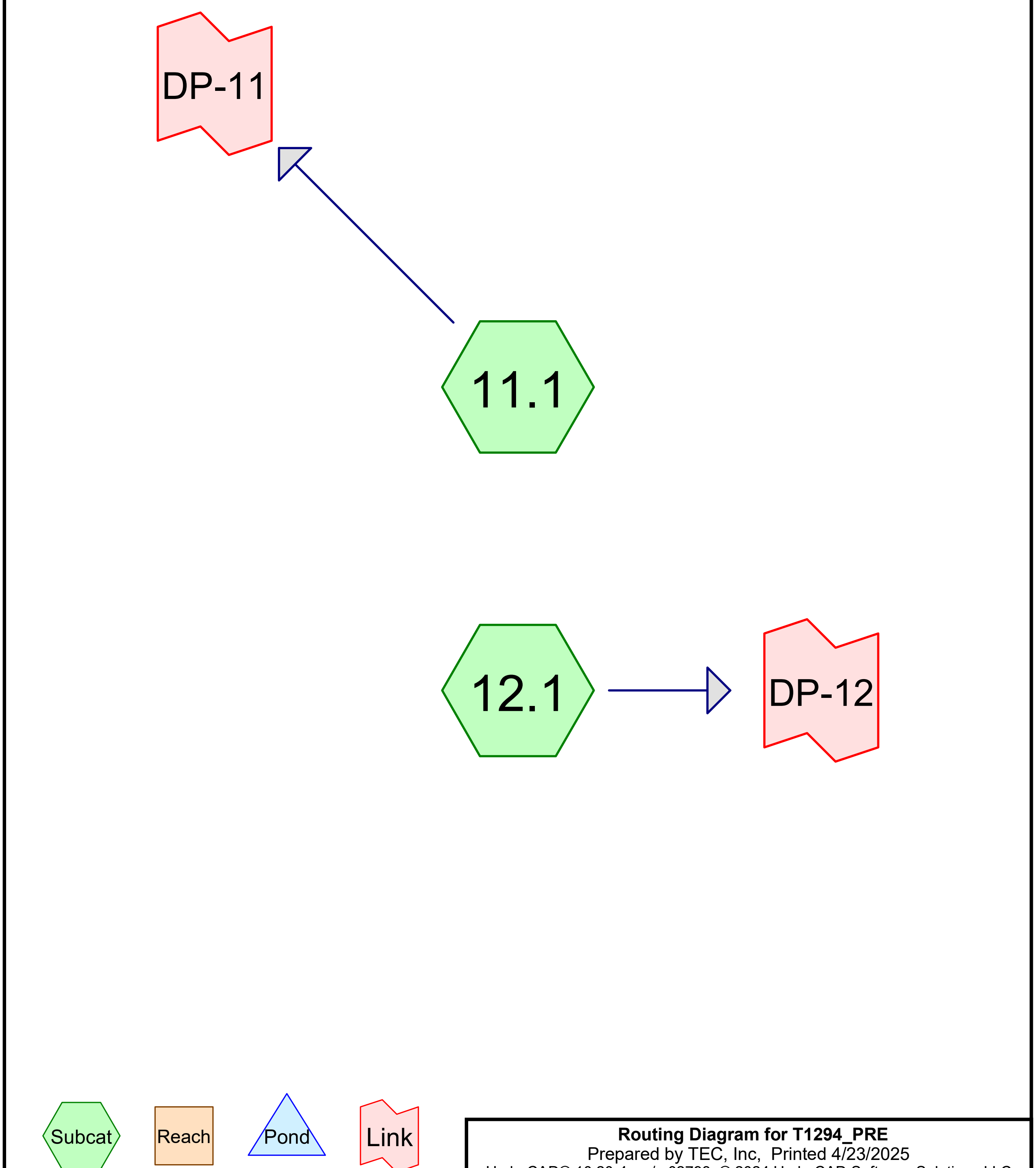
550 KING STREET & 410 GREAT ROAD	PROPOSED COVER (SF)			
	IMPERVIOUS	PERVIOUS	TOTAL AREA (SF)	IMPERVIOUS COVER (%)
TOTAL AREA	1,473,188	589,368	2,062,556	71%

NOTES:

1) **The subcatchments are delineated as shown on the figure "Post-Development Drainage Areas".**
2) **The first number of the subcatchment identifies the design point the runoff is directed to.**
3) **Subcatchment 3.1 is currently under construction. Construction drawings for all other subcatchments are not yet completed. Therefore, proposed pervious and impervious cover for all other subcathments is subject to change. Proposed impervious cover has been conservatively estimated.**

C

Hydrologic Calculations



Routing Diagram for T1294_PRE
Prepared by TEC, Inc, Printed 4/23/2025
HydroCAD® 10.20-4c s/n 02793 © 2024 HydroCAD Software Solutions LLC

Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-Year	NRCC 24-hr	D	Default	24.00	1	3.09	2
2	10-Year	NRCC 24-hr	D	Default	24.00	1	4.65	2
3	25-Year	NRCC 24-hr	D	Default	24.00	1	5.87	2
4	50-Year	NRCC 24-hr	D	Default	24.00	1	7.00	2
5	100-Year	NRCC 24-hr	D	Default	24.00	1	8.36	2
6	10-Year (2070)	NRCC 24-hr	D	Default	24.00	1	6.70	2
7	25-Year (2070)	NRCC 24-hr	D	Default	24.00	1	8.10	2
8	50-Year (2070)	NRCC 24-hr	D	Default	24.00	1	9.20	2
9	100-Year (2070)	NRCC 24-hr	D	Default	24.00	1	10.40	2

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
27,892	39	>75% Grass cover, Good, HSG A (11.1, 12.1)
23,405	96	Gravel surface, HSG A (11.1, 12.1)
48,067	98	Paved parking, HSG A (11.1, 12.1)
62,279	98	Roofs, HSG A (11.1, 12.1)
19,374	32	Woods/grass comb., Good, HSG A (11.1)
181,017	**82**	**TOTAL AREA**

Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
181,017	HSG A	11.1, 12.1
0	HSG B	
0	HSG C	
0	HSG D	
0	Other	
181,017		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover	Su Nu
27,892	0	0	0	0	27,892	>75% Grass cover, Good	
23,405	0	0	0	0	23,405	Gravel surface	
48,067	0	0	0	0	48,067	Paved parking	
62,279	0	0	0	0	62,279	Roofs	
19,374	0	0	0	0	19,374	Woods/grass comb., Good	
181,017	**0**	**0**	**0**	**0**	**181,017**	**TOTAL AREA**	

Time span=0.00-36.00 hrs, dt=0.04 hrs, 901 points x 3
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 11.1: Runoff Area=166,979 sf 58.88% Impervious Runoff Depth=1.32"
Flow Length=595' Tc=10.4 min CN=80 Runoff=4.64 cfs 18,338 cf

Subcatchment 12.1: Runoff Area=14,038 sf 85.72% Impervious Runoff Depth=2.75"
Flow Length=97' Tc=6.0 min CN=97 Runoff=0.87 cfs 3,214 cf

Link DP-11: Inflow=4.64 cfs 18,338 cf
Primary=4.64 cfs 18,338 cf

Link DP-12: Inflow=0.87 cfs 3,214 cf
Primary=0.87 cfs 3,214 cf

Total Runoff Area = 181,017 sf Runoff Volume = 21,553 cf Average Runoff Depth = 1.43"
39.04% Pervious = 70,671 sf 60.96% Impervious = 110,346 sf

Time span=0.00-36.00 hrs, dt=0.04 hrs, 901 points x 3
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 11.1: Runoff Area=166,979 sf 58.88% Impervious Runoff Depth=2.59"
Flow Length=595' Tc=10.4 min CN=80 Runoff=9.19 cfs 36,038 cf

Subcatchment 12.1: Runoff Area=14,038 sf 85.72% Impervious Runoff Depth=4.30"
Flow Length=97' Tc=6.0 min CN=97 Runoff=1.32 cfs 5,028 cf

Link DP-11: Inflow=9.19 cfs 36,038 cf
Primary=9.19 cfs 36,038 cf

Link DP-12: Inflow=1.32 cfs 5,028 cf
Primary=1.32 cfs 5,028 cf

Total Runoff Area = 181,017 sf Runoff Volume = 41,066 cf Average Runoff Depth = 2.72"
39.04% Pervious = 70,671 sf 60.96% Impervious = 110,346 sf

Summary for Subcatchment 11.1:

Runoff = 9.19 cfs @ 12.18 hrs, Volume= 36,038 cf, Depth= 2.59"
Routed to Link DP-11 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year Rainfall=4.65"

Area (sf)	CN	Description
55,161	98	Roofs, HSG A
21,684	96	Gravel surface, HSG A
43,152	98	Paved parking, HSG A
19,374	32	Woods/grass comb., Good, HSG A
27,608	39	>75% Grass cover, Good, HSG A
166,979	80	Weighted Average
68,666		41.12% Pervious Area
98,313		58.88% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.0	70	0.0431	0.15		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.13"
0.1	17	0.0294	3.48		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.3	56	0.0536	3.73		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.2	30	0.4330	3.29		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.0	11	0.0910	4.86		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.9	210	0.0405	4.09		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.1	24	0.0313	2.85		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.8	174	0.0345	3.77		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.0	3	0.3330	9.29		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
10.4	595	Total			

Summary for Subcatchment 12.1:

Runoff = 1.32 cfs @ 12.12 hrs, Volume= 5,028 cf, Depth= 4.30"
Routed to Link DP-12 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year Rainfall=4.65"

Area (sf)	CN	Description
4,915	98	Paved parking, HSG A
7,118	98	Roofs, HSG A
1,721	96	Gravel surface, HSG A
284	39	>75% Grass cover, Good, HSG A
14,038	97	Weighted Average
2,005		14.28% Pervious Area
12,033		85.72% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.1	24	0.4167	3.45		**Sheet Flow, Roof** Smooth surfaces n= 0.011 P2= 3.13"
0.4	73	0.0205	2.91		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.5	97	Total, Increased to minimum Tc = 6.0 min			

Summary for Link DP-11:

Inflow Area = 166,979 sf, 58.88% Impervious, Inflow Depth = 2.59" for 10-Year event
Inflow = 9.19 cfs @ 12.18 hrs, Volume= 36,038 cf
Primary = 9.19 cfs @ 12.18 hrs, Volume= 36,038 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs

Summary for Link DP-12:

Inflow Area = 14,038 sf, 85.72% Impervious, Inflow Depth = 4.30" for 10-Year event
Inflow = 1.32 cfs @ 12.12 hrs, Volume= 5,028 cf
Primary = 1.32 cfs @ 12.12 hrs, Volume= 5,028 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs

Time span=0.00-36.00 hrs, dt=0.04 hrs, 901 points x 3
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 11.1: Runoff Area=166,979 sf 58.88% Impervious Runoff Depth=3.66"
Flow Length=595' Tc=10.4 min CN=80 Runoff=12.92 cfs 50,986 cf

Subcatchment 12.1: Runoff Area=14,038 sf 85.72% Impervious Runoff Depth=5.51"
Flow Length=97' Tc=6.0 min CN=97 Runoff=1.68 cfs 6,451 cf

Link DP-11: Inflow=12.92 cfs 50,986 cf
Primary=12.92 cfs 50,986 cf

Link DP-12: Inflow=1.68 cfs 6,451 cf
Primary=1.68 cfs 6,451 cf

Total Runoff Area = 181,017 sf Runoff Volume = 57,437 cf Average Runoff Depth = 3.81"
39.04% Pervious = 70,671 sf 60.96% Impervious = 110,346 sf

Time span=0.00-36.00 hrs, dt=0.04 hrs, 901 points x 3
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 11.1: Runoff Area=166,979 sf 58.88% Impervious Runoff Depth=4.69"
Flow Length=595' Tc=10.4 min CN=80 Runoff=16.41 cfs 65,323 cf

Subcatchment 12.1: Runoff Area=14,038 sf 85.72% Impervious Runoff Depth=6.64"
Flow Length=97' Tc=6.0 min CN=97 Runoff=2.01 cfs 7,770 cf

Link DP-11: Inflow=16.41 cfs 65,323 cf
Primary=16.41 cfs 65,323 cf

Link DP-12: Inflow=2.01 cfs 7,770 cf
Primary=2.01 cfs 7,770 cf

Total Runoff Area = 181,017 sf Runoff Volume = 73,093 cf Average Runoff Depth = 4.85"
39.04% Pervious = 70,671 sf 60.96% Impervious = 110,346 sf

Time span=0.00-36.00 hrs, dt=0.04 hrs, 901 points x 3
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 11.1: Runoff Area=166,979 sf 58.88% Impervious Runoff Depth=5.96"
Flow Length=595' Tc=10.4 min CN=80 Runoff=20.64 cfs 82,979 cf

Subcatchment 12.1: Runoff Area=14,038 sf 85.72% Impervious Runoff Depth=8.00"
Flow Length=97' Tc=6.0 min CN=97 Runoff=2.40 cfs 9,359 cf

Link DP-11: Inflow=20.64 cfs 82,979 cf
Primary=20.64 cfs 82,979 cf

Link DP-12: Inflow=2.40 cfs 9,359 cf
Primary=2.40 cfs 9,359 cf

Total Runoff Area = 181,017 sf Runoff Volume = 92,337 cf Average Runoff Depth = 6.12"
39.04% Pervious = 70,671 sf 60.96% Impervious = 110,346 sf

Time span=0.00-36.00 hrs, dt=0.04 hrs, 901 points x 3
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 11.1: Runoff Area=166,979 sf 58.88% Impervious Runoff Depth=4.42"
Flow Length=595' Tc=10.4 min CN=80 Runoff=15.48 cfs 61,482 cf

Subcatchment 12.1: Runoff Area=14,038 sf 85.72% Impervious Runoff Depth=6.34"
Flow Length=97' Tc=6.0 min CN=97 Runoff=1.92 cfs 7,420 cf

Link DP-11: Inflow=15.48 cfs 61,482 cf
Primary=15.48 cfs 61,482 cf

Link DP-12: Inflow=1.92 cfs 7,420 cf
Primary=1.92 cfs 7,420 cf

Total Runoff Area = 181,017 sf Runoff Volume = 68,901 cf Average Runoff Depth = 4.57"
39.04% Pervious = 70,671 sf 60.96% Impervious = 110,346 sf

Summary for Subcatchment 11.1:

Runoff = 15.48 cfs @ 12.18 hrs, Volume= 61,482 cf, Depth= 4.42"
Routed to Link DP-11 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year (2070) Rainfall=6.70"

Area (sf)	CN	Description
55,161	98	Roofs, HSG A
21,684	96	Gravel surface, HSG A
43,152	98	Paved parking, HSG A
19,374	32	Woods/grass comb., Good, HSG A
27,608	39	>75% Grass cover, Good, HSG A
166,979	80	Weighted Average
68,666		41.12% Pervious Area
98,313		58.88% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.0	70	0.0431	0.15		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.13"
0.1	17	0.0294	3.48		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.3	56	0.0536	3.73		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.2	30	0.4330	3.29		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.0	11	0.0910	4.86		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.9	210	0.0405	4.09		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.1	24	0.0313	2.85		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.8	174	0.0345	3.77		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.0	3	0.3330	9.29		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
10.4	595	Total			

Summary for Subcatchment 12.1:

Runoff = 1.92 cfs @ 12.12 hrs, Volume= 7,420 cf, Depth= 6.34"
Routed to Link DP-12 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year (2070) Rainfall=6.70"

Area (sf)	CN	Description
4,915	98	Paved parking, HSG A
7,118	98	Roofs, HSG A
1,721	96	Gravel surface, HSG A
284	39	>75% Grass cover, Good, HSG A
14,038	97	Weighted Average
2,005		14.28% Pervious Area
12,033		85.72% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.1	24	0.4167	3.45		**Sheet Flow, Roof** Smooth surfaces n= 0.011 P2= 3.13"
0.4	73	0.0205	2.91		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.5	97	Total, Increased to minimum Tc = 6.0 min			

Summary for Link DP-11:

Inflow Area = 166,979 sf, 58.88% Impervious, Inflow Depth = 4.42" for 10-Year (2070) event
Inflow = 15.48 cfs @ 12.18 hrs, Volume= 61,482 cf
Primary = 15.48 cfs @ 12.18 hrs, Volume= 61,482 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs

Summary for Link DP-12:

Inflow Area = 14,038 sf, 85.72% Impervious, Inflow Depth = 6.34" for 10-Year (2070) event
Inflow = 1.92 cfs @ 12.12 hrs, Volume= 7,420 cf
Primary = 1.92 cfs @ 12.12 hrs, Volume= 7,420 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs

Time span=0.00-36.00 hrs, dt=0.04 hrs, 901 points x 3
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 11.1: Runoff Area=166,979 sf 58.88% Impervious Runoff Depth=5.72"
Flow Length=595' Tc=10.4 min CN=80 Runoff=19.83 cfs 79,577 cf

Subcatchment 12.1: Runoff Area=14,038 sf 85.72% Impervious Runoff Depth=7.74"
Flow Length=97' Tc=6.0 min CN=97 Runoff=2.33 cfs 9,055 cf

Link DP-11: Inflow=19.83 cfs 79,577 cf
Primary=19.83 cfs 79,577 cf

Link DP-12: Inflow=2.33 cfs 9,055 cf
Primary=2.33 cfs 9,055 cf

Total Runoff Area = 181,017 sf Runoff Volume = 88,632 cf Average Runoff Depth = 5.88"
39.04% Pervious = 70,671 sf 60.96% Impervious = 110,346 sf

Time span=0.00-36.00 hrs, dt=0.04 hrs, 901 points x 3
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 11.1: Runoff Area=166,979 sf 58.88% Impervious Runoff Depth=6.76"
Flow Length=595' Tc=10.4 min CN=80 Runoff=23.25 cfs 94,038 cf

Subcatchment 12.1: Runoff Area=14,038 sf 85.72% Impervious Runoff Depth=8.84"
Flow Length=97' Tc=6.0 min CN=97 Runoff=2.65 cfs 10,340 cf

Link DP-11: Inflow=23.25 cfs 94,038 cf
Primary=23.25 cfs 94,038 cf

Link DP-12: Inflow=2.65 cfs 10,340 cf
Primary=2.65 cfs 10,340 cf

Total Runoff Area = 181,017 sf Runoff Volume = 104,378 cf Average Runoff Depth = 6.92"
39.04% Pervious = 70,671 sf 60.96% Impervious = 110,346 sf

Time span=0.00-36.00 hrs, dt=0.04 hrs, 901 points x 3
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

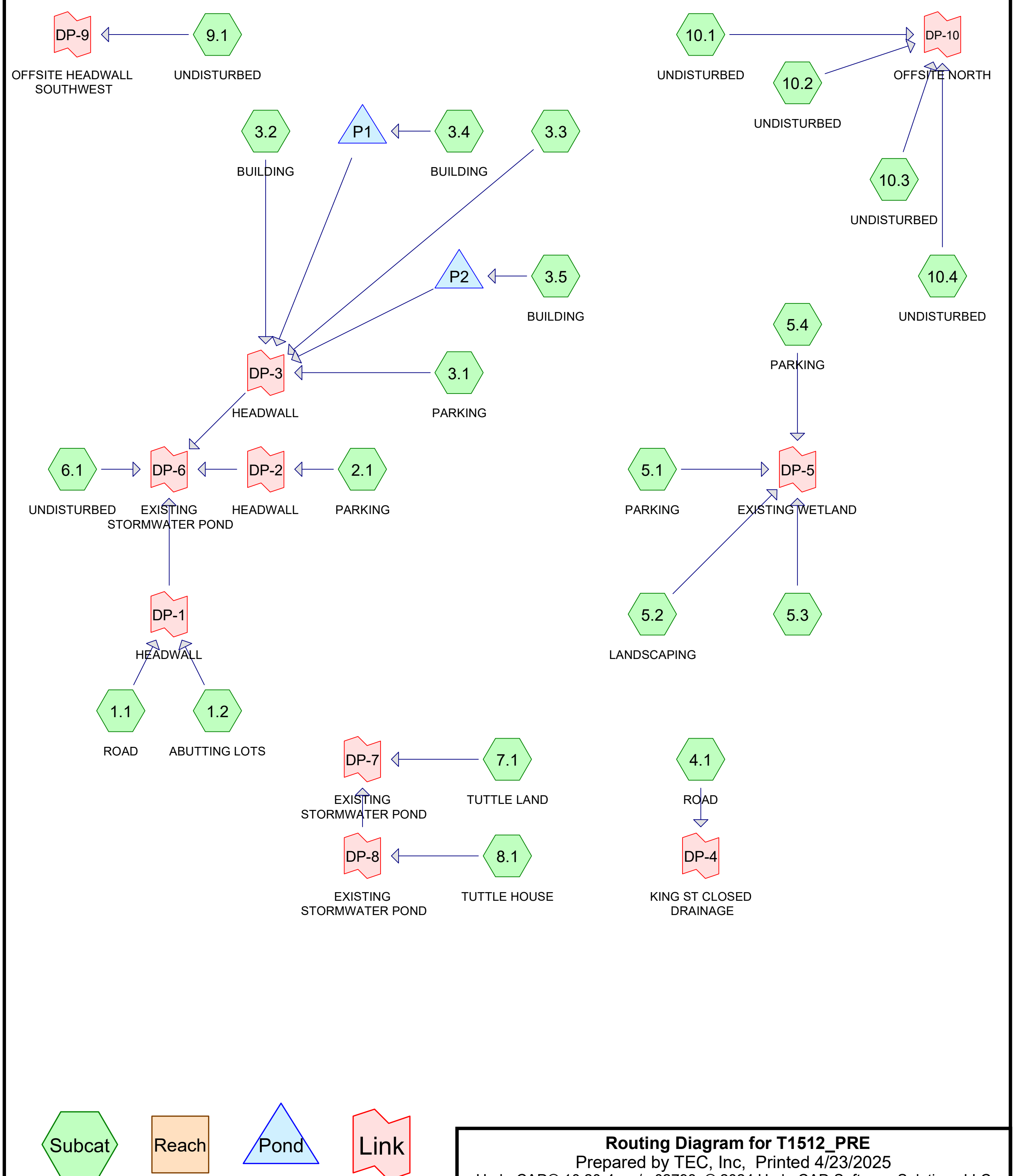
Subcatchment 11.1: Runoff Area=166,979 sf 58.88% Impervious Runoff Depth=7.90"
Flow Length=595' Tc=10.4 min CN=80 Runoff=26.97 cfs 109,984 cf

Subcatchment 12.1: Runoff Area=14,038 sf 85.72% Impervious Runoff Depth=10.04"
Flow Length=97' Tc=6.0 min CN=97 Runoff=2.99 cfs 11,743 cf

Link DP-11: Inflow=26.97 cfs 109,984 cf
Primary=26.97 cfs 109,984 cf

Link DP-12: Inflow=2.99 cfs 11,743 cf
Primary=2.99 cfs 11,743 cf

Total Runoff Area = 181,017 sf Runoff Volume = 121,727 cf Average Runoff Depth = 8.07"
39.04% Pervious = 70,671 sf 60.96% Impervious = 110,346 sf



Routing Diagram for T1512_PRE
Prepared by TEC, Inc, Printed 4/23/2025
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Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-Year	NRCC 24-hr	D	Default	24.00	1	3.09	2
2	10-Year	NRCC 24-hr	D	Default	24.00	1	4.65	2
3	25-Year	NRCC 24-hr	D	Default	24.00	1	5.87	2
4	50-Year	NRCC 24-hr	D	Default	24.00	1	7.00	2
5	100-Year	NRCC 24-hr	D	Default	24.00	1	8.36	2
6	10-Year (2070)	NRCC 24-hr	D	Default	24.00	1	6.70	2
7	25-Year (2070)	NRCC 24-hr	D	Default	24.00	1	8.10	2
8	50-Year (2070)	NRCC 24-hr	D	Default	24.00	1	9.20	2
9	100-Year (2070)	NRCC 24-hr	D	Default	24.00	1	10.40	2

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
59,169	39	>75% Grass cover, Good, HSG A (1.1, 1.2, 2.1)
42,731	61	>75% Grass cover, Good, HSG B (5.3, 5.4, 10.2)
275,131	74	>75% Grass cover, Good, HSG C (1.1, 1.2, 2.1, 3.1, 3.3, 5.1, 5.4, 7.1, 8.1, 9.1)
382,997	80	>75% Grass cover, Good, HSG D (1.1, 1.2, 3.1, 4.1, 5.1, 5.2, 5.3, 5.4, 7.1, 9.1, 10.1, 10.2)
105,266	98	Paved parking, HSG A (1.1, 1.2, 2.1)
9,790	98	Paved parking, HSG B (5.3, 5.4)
118,860	98	Paved parking, HSG C (1.1, 2.1, 3.1, 3.3, 5.4, 7.1, 8.1)
520,997	98	Paved parking, HSG D (1.1, 3.1, 4.1, 5.1, 5.2, 5.3, 5.4)
6,546	98	Roofs, HSG A (1.2)
90,980	98	Roofs, HSG A & C (3.5)
91,130	98	Roofs, HSG C (3.4)
8,600	98	Roofs, HSG D (3.2)
6,745	98	Water Surface, HSG A (6.1)
24,473	98	Water Surface, HSG D (6.1)
11,386	98	Wetland, HSG A (5.3)
16,890	98	Wetland, HSG B (5.3)
10,568	30	Woods, Good, HSG A (1.2)
4,117	55	Woods, Good, HSG B (10.2, 10.3, 10.4)
1,428	70	Woods, Good, HSG C (1.2, 10.1)
9,023	77	Woods, Good, HSG D (1.2, 10.1)
61,311	32	Woods/grass comb., Good, HSG A (6.1, 9.1)
8,040	72	Woods/grass comb., Good, HSG C (7.1, 8.1, 9.1)
61,335	79	Woods/grass comb., Good, HSG D (6.1, 9.1)
1,927,513	**85**	**TOTAL AREA**

Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
351,971	HSG A	1.1, 1.2, 2.1, 3.5, 5.3, 6.1, 9.1
73,528	HSG B	5.3, 5.4, 10.2, 10.3, 10.4
494,589	HSG C	1.1, 1.2, 2.1, 3.1, 3.3, 3.4, 5.1, 5.4, 7.1, 8.1, 9.1, 10.1
1,007,425	HSG D	1.1, 1.2, 3.1, 3.2, 4.1, 5.1, 5.2, 5.3, 5.4, 6.1, 7.1, 9.1, 10.1, 10.2
0	Other	
1,927,513		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover	Su Nu
59,169	42,731	275,131	382,997	0	760,028	>75% Grass cover, Good	
105,266	9,790	118,860	520,997	0	754,913	Paved parking	
97,526	0	91,130	8,600	0	197,256	Roofs	
6,745	0	0	24,473	0	31,218	Water Surface	
11,386	16,890	0	0	0	28,276	Wetland	
10,568	4,117	1,428	9,023	0	25,136	Woods, Good	
61,311	0	8,040	61,335	0	130,686	Woods/grass comb., Good	
351,971	**73,528**	**494,589**	**1,007,425**	**0**	**1,927,513**	**TOTAL AREA**	

Time span=0.00-36.00 hrs, dt=0.04 hrs, 901 points x 3
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1.1: ROAD Runoff Area=37,044 sf 77.91% Impervious Runoff Depth=2.25"
Tc=6.0 min CN=92 Runoff=2.01 cfs 6,934 cf

Subcatchment 1.2: ABUTTING LOTS Runoff Area=72,902 sf 27.76% Impervious Runoff Depth=0.27"
Flow Length=357' Tc=27.1 min CN=57 Runoff=0.11 cfs 1,665 cf

Subcatchment 2.1: PARKING Runoff Area=122,705 sf 77.00% Impervious Runoff Depth=1.82"
Flow Length=451' Tc=6.9 min CN=87 Runoff=5.35 cfs 18,589 cf

Subcatchment 3.1: PARKING Runoff Area=582,220 sf 66.44% Impervious Runoff Depth=2.16"
Flow Length=823' Tc=7.9 min CN=91 Runoff=28.64 cfs 104,567 cf

Subcatchment 3.2: BUILDING Runoff Area=8,600 sf 100.00% Impervious Runoff Depth=2.86"
Tc=6.0 min CN=98 Runoff=0.54 cfs 2,048 cf

Subcatchment 3.3: Runoff Area=72,797 sf 33.90% Impervious Runoff Depth=1.45"
Tc=6.0 min CN=82 Runoff=2.65 cfs 8,797 cf

Subcatchment 3.4: BUILDING Runoff Area=91,130 sf 100.00% Impervious Runoff Depth=2.86"
Tc=6.0 min CN=98 Runoff=5.71 cfs 21,703 cf

Subcatchment 3.5: BUILDING Runoff Area=90,980 sf 100.00% Impervious Runoff Depth=2.86"
Tc=6.0 min CN=98 Runoff=5.70 cfs 21,668 cf

Subcatchment 4.1: ROAD Runoff Area=38,613 sf 24.06% Impervious Runoff Depth=1.59"
Flow Length=339' Slope=0.0210 '/' Tc=11.4 min CN=84 Runoff=1.26 cfs 5,118 cf

Subcatchment 5.1: PARKING Runoff Area=59,518 sf 72.12% Impervious Runoff Depth=2.34"
Tc=6.0 min CN=93 Runoff=3.34 cfs 11,607 cf

Subcatchment 5.2: LANDSCAPING Runoff Area=25,460 sf 0.70% Impervious Runoff Depth=1.32"
Flow Length=343' Slope=0.0200 '/' Tc=11.7 min CN=80 Runoff=0.68 cfs 2,796 cf

Subcatchment 5.3: Runoff Area=173,079 sf 42.34% Impervious Runoff Depth=1.52"
Flow Length=284' Tc=38.3 min CN=83 Runoff=3.02 cfs 21,914 cf

Subcatchment 5.4: PARKING Runoff Area=155,629 sf 63.12% Impervious Runoff Depth=2.07"
Tc=6.0 min CN=90 Runoff=7.91 cfs 26,806 cf

Subcatchment 6.1: UNDISTURBED Runoff Area=120,057 sf 26.00% Impervious Runoff Depth=0.51"
Flow Length=159' Slope=0.0500 '/' Tc=7.2 min CN=64 Runoff=1.13 cfs 5,090 cf

Subcatchment 7.1: TUTTLE LAND Runoff Area=115,894 sf 1.15% Impervious Runoff Depth=1.08"
Flow Length=404' Tc=7.4 min CN=76 Runoff=2.91 cfs 10,393 cf

Subcatchment 8.1: TUTTLE HOUSE Runoff Area=23,817 sf 39.51% Impervious Runoff Depth=1.52"
Tc=6.0 min CN=83 Runoff=0.91 cfs 3,016 cf

Subcatchment 9.1: UNDISTURBED Runoff Area=118,327 sf 0.00% Impervious Runoff Depth=1.02"
Tc=6.0 min CN=75 Runoff=2.94 cfs 10,059 cf

Subcatchment 10.1: UNDISTURBED Runoff Area=12,178 sf 0.00% Impervious Runoff Depth=1.13"
Tc=6.0 min CN=77 Runoff=0.34 cfs 1,151 cf

Subcatchment 10.2: UNDISTURBED Runoff Area=5,430 sf 0.00% Impervious Runoff Depth=0.59"
Tc=0.0 min CN=66 Runoff=0.09 cfs 266 cf

Subcatchment 10.3: UNDISTURBED Runoff Area=521 sf 0.00% Impervious Runoff Depth=0.22"
Tc=6.0 min CN=55 Runoff=0.00 cfs 10 cf

Subcatchment 10.4: UNDISTURBED Runoff Area=612 sf 0.00% Impervious Runoff Depth=0.22"
Tc=6.0 min CN=55 Runoff=0.00 cfs 11 cf

Pond P1: Peak Elev=280.76' Storage=8,767 cf Inflow=5.71 cfs 21,703 cf
Discarded=0.10 cfs 12,029 cf Primary=1.82 cfs 5,677 cf Outflow=1.92 cfs 17,706 cf

Pond P2: Peak Elev=281.82' Storage=10,362 cf Inflow=5.70 cfs 21,668 cf
Discarded=0.19 cfs 21,644 cf Primary=0.00 cfs 0 cf Outflow=0.19 cfs 21,644 cf

Link DP-1: HEADWALL Inflow=2.02 cfs 8,599 cf
Primary=2.02 cfs 8,599 cf

Link DP-10: OFFSITE NORTH Inflow=0.37 cfs 1,438 cf
Primary=0.37 cfs 1,438 cf

Link DP-2: HEADWALL Inflow=5.35 cfs 18,589 cf
Primary=5.35 cfs 18,589 cf

Link DP-3: HEADWALL Inflow=31.70 cfs 121,090 cf
Primary=31.70 cfs 121,090 cf

Link DP-4: KING ST CLOSED DRAINAGE Inflow=1.26 cfs 5,118 cf
Primary=1.26 cfs 5,118 cf

Link DP-5: EXISTING WETLAND Inflow=12.86 cfs 63,124 cf
Primary=12.86 cfs 63,124 cf

Link DP-6: EXISTING STORMWATER POND Inflow=40.10 cfs 153,367 cf
Primary=40.10 cfs 153,367 cf

Link DP-7: EXISTING STORMWATER POND Inflow=3.78 cfs 13,409 cf
Primary=3.78 cfs 13,409 cf

Link DP-8: EXISTING STORMWATER POND Inflow=0.91 cfs 3,016 cf
Primary=0.91 cfs 3,016 cf

Link DP-9: OFFSITE HEADWALL SOUTHWEST Inflow=2.94 cfs 10,059 cf
Primary=2.94 cfs 10,059 cf

Total Runoff Area = 1,927,513 sf Runoff Volume = 284,208 cf Average Runoff Depth = 1.77"
47.51% Pervious = 915,850 sf 52.49% Impervious = 1,011,663 sf

Time span=0.00-36.00 hrs, dt=0.04 hrs, 901 points x 3
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1.1: ROAD Runoff Area=37,044 sf 77.91% Impervious Runoff Depth=3.75"
Tc=6.0 min CN=92 Runoff=3.26 cfs 11,570 cf

Subcatchment 1.2: ABUTTING LOTS Runoff Area=72,902 sf 27.76% Impervious Runoff Depth=0.92"
Flow Length=357' Tc=27.1 min CN=57 Runoff=0.75 cfs 5,610 cf

Subcatchment 2.1: PARKING Runoff Area=122,705 sf 77.00% Impervious Runoff Depth=3.24"
Flow Length=451' Tc=6.9 min CN=87 Runoff=9.34 cfs 33,119 cf

Subcatchment 3.1: PARKING Runoff Area=582,220 sf 66.44% Impervious Runoff Depth=3.64"
Flow Length=823' Tc=7.9 min CN=91 Runoff=47.06 cfs 176,750 cf

Subcatchment 3.2: BUILDING Runoff Area=8,600 sf 100.00% Impervious Runoff Depth=4.41"
Tc=6.0 min CN=98 Runoff=0.82 cfs 3,163 cf

Subcatchment 3.3: Runoff Area=72,797 sf 33.90% Impervious Runoff Depth=2.77"
Tc=6.0 min CN=82 Runoff=5.02 cfs 16,792 cf

Subcatchment 3.4: BUILDING Runoff Area=91,130 sf 100.00% Impervious Runoff Depth=4.41"
Tc=6.0 min CN=98 Runoff=8.66 cfs 33,519 cf

Subcatchment 3.5: BUILDING Runoff Area=90,980 sf 100.00% Impervious Runoff Depth=4.41"
Tc=6.0 min CN=98 Runoff=8.65 cfs 33,464 cf

Subcatchment 4.1: ROAD Runoff Area=38,613 sf 24.06% Impervious Runoff Depth=2.95"
Flow Length=339' Slope=0.0210 '/' Tc=11.4 min CN=84 Runoff=2.32 cfs 9,499 cf

Subcatchment 5.1: PARKING Runoff Area=59,518 sf 72.12% Impervious Runoff Depth=3.85"
Tc=6.0 min CN=93 Runoff=5.33 cfs 19,118 cf

Subcatchment 5.2: LANDSCAPING Runoff Area=25,460 sf 0.70% Impervious Runoff Depth=2.59"
Flow Length=343' Slope=0.0200 '/' Tc=11.7 min CN=80 Runoff=1.34 cfs 5,495 cf

Subcatchment 5.3: Runoff Area=173,079 sf 42.34% Impervious Runoff Depth=2.86"
Flow Length=284' Tc=38.3 min CN=83 Runoff=5.70 cfs 41,240 cf

Subcatchment 5.4: PARKING Runoff Area=155,629 sf 63.12% Impervious Runoff Depth=3.54"
Tc=6.0 min CN=90 Runoff=13.18 cfs 45,905 cf

Subcatchment 6.1: UNDISTURBED Runoff Area=120,057 sf 26.00% Impervious Runoff Depth=1.36"
Flow Length=159' Slope=0.0500 '/' Tc=7.2 min CN=64 Runoff=3.72 cfs 13,586 cf

Subcatchment 7.1: TUTTLE LAND Runoff Area=115,894 sf 1.15% Impervious Runoff Depth=2.25"
Flow Length=404' Tc=7.4 min CN=76 Runoff=6.22 cfs 21,731 cf

Subcatchment 8.1: TUTTLE HOUSE Runoff Area=23,817 sf 39.51% Impervious Runoff Depth=2.86"
Tc=6.0 min CN=83 Runoff=1.69 cfs 5,675 cf

Subcatchment 9.1: UNDISTURBED Runoff Area=118,327 sf 0.00% Impervious Runoff Depth=2.17"
Tc=6.0 min CN=75 Runoff=6.43 cfs 21,384 cf

Subcatchment 10.1: UNDISTURBED Runoff Area=12,178 sf 0.00% Impervious Runoff Depth=2.33"
Tc=6.0 min CN=77 Runoff=0.71 cfs 2,368 cf

Subcatchment 10.2: UNDISTURBED Runoff Area=5,430 sf 0.00% Impervious Runoff Depth=1.49"
Tc=0.0 min CN=66 Runoff=0.25 cfs 676 cf

Subcatchment 10.3: UNDISTURBED Runoff Area=521 sf 0.00% Impervious Runoff Depth=0.81"
Tc=6.0 min CN=55 Runoff=0.01 cfs 35 cf

Subcatchment 10.4: UNDISTURBED Runoff Area=612 sf 0.00% Impervious Runoff Depth=0.81"
Tc=6.0 min CN=55 Runoff=0.01 cfs 41 cf

Pond P1: Peak Elev=281.17' Storage=9,183 cf Inflow=8.66 cfs 33,519 cf
Discarded=0.10 cfs 12,510 cf Primary=8.60 cfs 16,959 cf Outflow=8.71 cfs 29,469 cf

Pond P2: Peak Elev=283.10' Storage=16,512 cf Inflow=8.65 cfs 33,464 cf
Discarded=0.19 cfs 23,121 cf Primary=0.45 cfs 3,026 cf Outflow=0.64 cfs 26,147 cf

Link DP-1: HEADWALL Inflow=3.46 cfs 17,180 cf
Primary=3.46 cfs 17,180 cf

Link DP-10: OFFSITE NORTH Inflow=0.84 cfs 3,120 cf
Primary=0.84 cfs 3,120 cf

Link DP-2: HEADWALL Inflow=9.34 cfs 33,119 cf
Primary=9.34 cfs 33,119 cf

Link DP-3: HEADWALL Inflow=60.82 cfs 216,691 cf
Primary=60.82 cfs 216,691 cf

Link DP-4: KING ST CLOSED DRAINAGE Inflow=2.32 cfs 9,499 cf
Primary=2.32 cfs 9,499 cf

Link DP-5: EXISTING WETLAND Inflow=21.80 cfs 111,758 cf
Primary=21.80 cfs 111,758 cf

Link DP-6: EXISTING STORMWATER POND Inflow=77.25 cfs 280,576 cf
Primary=77.25 cfs 280,576 cf

Link DP-7: EXISTING STORMWATER POND Inflow=7.85 cfs 27,406 cf
Primary=7.85 cfs 27,406 cf

Link DP-8: EXISTING STORMWATER POND Inflow=1.69 cfs 5,675 cf
Primary=1.69 cfs 5,675 cf

Link DP-9: OFFSITE HEADWALL SOUTHWEST Inflow=6.43 cfs 21,384 cf
Primary=6.43 cfs 21,384 cf

Total Runoff Area = 1,927,513 sf Runoff Volume = 500,740 cf Average Runoff Depth = 3.12"
47.51% Pervious = 915,850 sf 52.49% Impervious = 1,011,663 sf

Summary for Subcatchment 1.1: ROAD

Runoff = 3.26 cfs @ 12.13 hrs, Volume= 11,570 cf, Depth= 3.75"
Routed to Link DP-1 : HEADWALL

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year Rainfall=4.65"

Area (sf)	CN	Description
10,679	98	Paved parking, HSG A
8,340	98	Paved parking, HSG D
9,843	98	Paved parking, HSG C
1,545	39	>75% Grass cover, Good, HSG A
2,010	80	>75% Grass cover, Good, HSG D
4,627	74	>75% Grass cover, Good, HSG C
37,044	92	Weighted Average
8,182		22.09% Pervious Area
28,862		77.91% Impervious Area

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

Summary for Subcatchment 1.2: ABUTTING LOTS

Runoff = 0.75 cfs @ 12.43 hrs, Volume= 5,610 cf, Depth= 0.92"
Routed to Link DP-1 : HEADWALL

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year Rainfall=4.65"

Area (sf)	CN	Description
13,691	98	Paved parking, HSG A
6,546	98	Roofs, HSG A
10,568	30	Woods, Good, HSG A
560	70	Woods, Good, HSG C
36,836	39	>75% Grass cover, Good, HSG A
2,021	74	>75% Grass cover, Good, HSG C
2,220	80	>75% Grass cover, Good, HSG D
460	77	Woods, Good, HSG D
72,902	57	Weighted Average
52,665		72.24% Pervious Area
20,237		27.76% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.2	100	0.0550	0.07		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 3.13"
1.9	257	0.0200	2.28		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
27.1	357	Total			

Summary for Subcatchment 2.1: PARKING

Runoff = 9.34 cfs @ 12.14 hrs, Volume= 33,119 cf, Depth= 3.24"
Routed to Link DP-2 : HEADWALL

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year Rainfall=4.65"

Area (sf)	CN	Description
80,896	98	Paved parking, HSG A
13,592	98	Paved parking, HSG C
20,788	39	>75% Grass cover, Good, HSG A
7,429	74	>75% Grass cover, Good, HSG C
122,705	87	Weighted Average
28,217		23.00% Pervious Area
94,488		77.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.2	71	0.0500	0.23		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.13"
1.7	380	0.0320	3.63		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
6.9	451	Total			

Summary for Subcatchment 3.1: PARKING

Runoff = 47.06 cfs @ 12.15 hrs, Volume= 176,750 cf, Depth= 3.64"
Routed to Link DP-3 : HEADWALL

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year Rainfall=4.65"

Area (sf)	CN	Description
84,161	74	>75% Grass cover, Good, HSG C
48,407	98	Paved parking, HSG C
338,415	98	Paved parking, HSG D
111,237	80	>75% Grass cover, Good, HSG D
582,220	91	Weighted Average
195,398		33.56% Pervious Area
386,822		66.44% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.3	100	0.0970	0.32		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.13"
1.0	290	0.0970	5.01		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
1.6	433	0.0500	4.54		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
7.9	823	Total			

Summary for Subcatchment 3.2: BUILDING

Runoff = 0.82 cfs @ 12.12 hrs, Volume= 3,163 cf, Depth= 4.41"
Routed to Link DP-3 : HEADWALL

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year Rainfall=4.65"

Area (sf)	CN	Description
8,600	98	Roofs, HSG D
8,600		100.00% Impervious Area

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

Summary for Subcatchment 3.3:

Runoff = 5.02 cfs @ 12.13 hrs, Volume= 16,792 cf, Depth= 2.77"
Routed to Link DP-3 : HEADWALL

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year Rainfall=4.65"

Area (sf)	CN	Description
24,677	98	Paved parking, HSG C
48,120	74	>75% Grass cover, Good, HSG C
72,797	82	Weighted Average
48,120		66.10% Pervious Area
24,677		33.90% Impervious Area

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

Summary for Subcatchment 3.4: BUILDING

Runoff = 8.66 cfs @ 12.12 hrs, Volume= 33,519 cf, Depth= 4.41"
Routed to Pond P1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year Rainfall=4.65"

Area (sf)	CN	Description
91,130	98	Roofs, HSG C
91,130		100.00% Impervious Area

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

Summary for Subcatchment 3.5: BUILDING

Runoff = 8.65 cfs @ 12.12 hrs, Volume= 33,464 cf, Depth= 4.41"
Routed to Pond P2 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year Rainfall=4.65"

	Area (sf)	CN	Description
*	90,980	98	Roofs, HSG A & C
	90,980		100.00% Impervious Area

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

Summary for Subcatchment 4.1: ROAD

Runoff = 2.32 cfs @ 12.19 hrs, Volume= 9,499 cf, Depth= 2.95"
Routed to Link DP-4 : KING ST CLOSED DRAINAGE

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year Rainfall=4.65"

Area (sf)	CN	Description
29,324	80	>75% Grass cover, Good, HSG D
9,289	98	Paved parking, HSG D
38,613	84	Weighted Average
29,324		75.94% Pervious Area
9,289		24.06% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.7	100	0.0210	0.17		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.13"
1.7	239	0.0210	2.33		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
11.4	339	Total			

Summary for Subcatchment 5.1: PARKING

Runoff = 5.33 cfs @ 12.13 hrs, Volume= 19,118 cf, Depth= 3.85"
Routed to Link DP-5 : EXISTING WETLAND

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year Rainfall=4.65"

Area (sf)	CN	Description
16,294	80	>75% Grass cover, Good, HSG D
42,924	98	Paved parking, HSG D
300	74	>75% Grass cover, Good, HSG C
59,518	93	Weighted Average
16,594		27.88% Pervious Area
42,924		72.12% Impervious Area

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

Summary for Subcatchment 5.2: LANDSCAPING

Runoff = 1.34 cfs @ 12.19 hrs, Volume= 5,495 cf, Depth= 2.59"
Routed to Link DP-5 : EXISTING WETLAND

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year Rainfall=4.65"

Area (sf)	CN	Description
25,282	80	>75% Grass cover, Good, HSG D
178	98	Paved parking, HSG D
25,460	80	Weighted Average
25,282		99.30% Pervious Area
178		0.70% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.9	100	0.0200	0.17		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.13"
1.8	243	0.0200	2.28		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
11.7	343	Total			

Summary for Subcatchment 5.3:

Runoff = 5.70 cfs @ 12.52 hrs, Volume= 41,240 cf, Depth= 2.86"
Routed to Link DP-5 : EXISTING WETLAND

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year Rainfall=4.65"

	Area (sf)	CN	Description
	61,519	80	>75% Grass cover, Good, HSG D
	38,274	61	>75% Grass cover, Good, HSG B
	40,591	98	Paved parking, HSG D
	4,419	98	Paved parking, HSG B
*	11,386	98	Wetland, HSG A
*	16,890	98	Wetland, HSG B
	173,079	83	Weighted Average
	99,793		57.66% Pervious Area
	73,286		42.34% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.6	45	0.2222	0.10		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 3.13"
20.7	55	0.0273	0.04		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 3.13"
10.0	184	0.0150	0.31		**Shallow Concentrated Flow,** Forest w/Heavy Litter Kv= 2.5 fps
38.3	284	Total			

Summary for Subcatchment 5.4: PARKING

Runoff = 13.18 cfs @ 12.13 hrs, Volume= 45,905 cf, Depth= 3.54"
Routed to Link DP-5 : EXISTING WETLAND

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year Rainfall=4.65"

Area (sf)	CN	Description
11,602	98	Paved parking, HSG C
20,457	74	>75% Grass cover, Good, HSG C
5,371	98	Paved parking, HSG B
4,297	61	>75% Grass cover, Good, HSG B
81,260	98	Paved parking, HSG D
32,642	80	>75% Grass cover, Good, HSG D
155,629	90	Weighted Average
57,396		36.88% Pervious Area
98,233		63.12% Impervious Area

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

Summary for Subcatchment 6.1: UNDISTURBED

Runoff = 3.72 cfs @ 12.15 hrs, Volume= 13,586 cf, Depth= 1.36"
Routed to Link DP-6 : EXISTING STORMWATER POND

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year Rainfall=4.65"

Area (sf)	CN	Description
37,191	79	Woods/grass comb., Good, HSG D
51,648	32	Woods/grass comb., Good, HSG A
24,473	98	Water Surface, HSG D
6,745	98	Water Surface, HSG A
120,057	64	Weighted Average
88,839		74.00% Pervious Area
31,218		26.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.9	100	0.0500	0.24		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.13"
0.3	59	0.0500	3.60		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
7.2	159	Total			

Summary for Subcatchment 7.1: TUTTLE LAND

Runoff = 6.22 cfs @ 12.15 hrs, Volume= 21,731 cf, Depth= 2.25"
Routed to Link DP-7 : EXISTING STORMWATER POND

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year Rainfall=4.65"

Area (sf)	CN	Description
25,199	80	>75% Grass cover, Good, HSG D
86,555	74	>75% Grass cover, Good, HSG C
2,810	72	Woods/grass comb., Good, HSG C
1,330	98	Paved parking, HSG C
115,894	76	Weighted Average
114,564		98.85% Pervious Area
1,330		1.15% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.4	100	0.0900	0.31		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.13"
2.0	304	0.0260	2.60		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
7.4	404	Total			

Summary for Subcatchment 8.1: TUTTLE HOUSE

Runoff = 1.69 cfs @ 12.13 hrs, Volume= 5,675 cf, Depth= 2.86"
Routed to Link DP-8 : EXISTING STORMWATER POND

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year Rainfall=4.65"

Area (sf)	CN	Description
2,038	72	Woods/grass comb., Good, HSG C
9,409	98	Paved parking, HSG C
12,370	74	>75% Grass cover, Good, HSG C
23,817	83	Weighted Average
14,408		60.49% Pervious Area
9,409		39.51% Impervious Area

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

Summary for Subcatchment 9.1: UNDISTURBED

Runoff = 6.43 cfs @ 12.13 hrs, Volume= 21,384 cf, Depth= 2.17"
Routed to Link DP-9 : OFFSITE HEADWALL SOUTHWEST

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year Rainfall=4.65"

Area (sf)	CN	Description
72,237	80	>75% Grass cover, Good, HSG D
3,192	72	Woods/grass comb., Good, HSG C
9,091	74	>75% Grass cover, Good, HSG C
24,144	79	Woods/grass comb., Good, HSG D
9,663	32	Woods/grass comb., Good, HSG A
118,327	75	Weighted Average
118,327		100.00% Pervious Area

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

Summary for Subcatchment 10.1: UNDISTURBED

Runoff = 0.71 cfs @ 12.13 hrs, Volume= 2,368 cf, Depth= 2.33"
Routed to Link DP-10 : OFFSITE NORTH

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year Rainfall=4.65"

Area (sf)	CN	Description
868	70	Woods, Good, HSG C
8,563	77	Woods, Good, HSG D
2,747	80	>75% Grass cover, Good, HSG D
12,178	77	Weighted Average
12,178		100.00% Pervious Area

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

Summary for Subcatchment 10.2: UNDISTURBED

Runoff = 0.25 cfs @ 12.06 hrs, Volume= 676 cf, Depth= 1.49"
Routed to Link DP-10 : OFFSITE NORTH

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year Rainfall=4.65"

Area (sf)	CN	Description
1,523	55	Woods, Good, HSG B
1,461	55	Woods, Good, HSG B
160	61	>75% Grass cover, Good, HSG B
2,286	80	>75% Grass cover, Good, HSG D
5,430	66	Weighted Average
5,430		100.00% Pervious Area

Summary for Subcatchment 10.3: UNDISTURBED

Runoff = 0.01 cfs @ 12.14 hrs, Volume= 35 cf, Depth= 0.81"
Routed to Link DP-10 : OFFSITE NORTH

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year Rainfall=4.65"

Area (sf)	CN	Description
521	55	Woods, Good, HSG B
521		100.00% Pervious Area

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

Summary for Subcatchment 10.4: UNDISTURBED

Runoff = 0.01 cfs @ 12.14 hrs, Volume= 41 cf, Depth= 0.81"
Routed to Link DP-10 : OFFSITE NORTH

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year Rainfall=4.65"

Area (sf)	CN	Description
612	55	Woods, Good, HSG B
612		100.00% Pervious Area

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

Summary for Pond P1:

Inflow Area = 91,130 sf,100.00% Impervious, Inflow Depth = 4.41" for 10-Year event
Inflow = 8.66 cfs @ 12.12 hrs, Volume= 33,519 cf
Outflow = 8.71 cfs @ 12.12 hrs, Volume= 29,469 cf, Atten= 0%, Lag= 0.0 min
Discarded = 0.10 cfs @ 3.52 hrs, Volume= 12,510 cf
Primary = 8.60 cfs @ 12.12 hrs, Volume= 16,959 cf
Routed to Link DP-3 : HEADWALL

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs / 3
Peak Elev= 281.17' @ 12.12 hrs Surf.Area= 4,256 sf Storage= 9,183 cf

Plug-Flow detention time= 266.2 min calculated for 29,469 cf (88% of inflow)
Center-of-Mass det. time= 199.8 min (951.7 - 751.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	277.50'	3,808 cf	**44.25'W x 96.18'L x 3.50'H Field A** 14,895 cf Overall - 5,375 cf Embedded = 9,520 cf x 40.0% Voids
#2A	278.00'	5,375 cf	**ADS_StormTech SC-740 +Cap** x 117 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 117 Chambers in 9 Rows
		9,183 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	280.50'	**5.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#2	Discarded	277.50'	**1.020 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.10 cfs @ 3.52 hrs HW=277.54' (Free Discharge)
2=Exfiltration (Exfiltration Controls 0.10 cfs)

Primary OutFlow Max=8.49 cfs @ 12.12 hrs HW=281.16' TW=0.00' (Dynamic Tailwater)
1=Broad-Crested Rectangular Weir (Weir Controls 8.49 cfs @ 2.56 fps)

Summary for Pond P2:

Inflow Area = 90,980 sf,100.00% Impervious, Inflow Depth = 4.41" for 10-Year event
Inflow = 8.65 cfs @ 12.12 hrs, Volume= 33,464 cf
Outflow = 0.64 cfs @ 13.41 hrs, Volume= 26,147 cf, Atten= 93%, Lag= 76.9 min
Discarded = 0.19 cfs @ 7.60 hrs, Volume= 23,121 cf
Primary = 0.45 cfs @ 13.41 hrs, Volume= 3,026 cf
Routed to Link DP-3 : HEADWALL

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs / 3
Peak Elev= 283.10' @ 13.41 hrs Surf.Area= 8,201 sf Storage= 16,512 cf

Plug-Flow detention time= 477.3 min calculated for 26,118 cf (78% of inflow)
Center-of-Mass det. time= 378.6 min (1,130.5 - 751.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	280.00'	7,256 cf	**49.00'W x 167.38'L x 3.50'H Field A**
			28,705 cf Overall - 10,566 cf Embedded = 18,139 cf x 40.0% Voids
#2A	280.50'	10,566 cf	**ADS_StormTech SC-740 +Cap** x 230 Inside #1
			Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf
			Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap
			230 Chambers in 10 Rows
		17,822 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	283.00'	**5.0' long x 0.5' breadth Broad-Crested Rectangular Weir**
			Head (feet) 0.20 0.40 0.60 0.80 1.00
			Coef. (English) 2.80 2.92 3.08 3.30 3.32
#2	Discarded	280.00'	**1.020 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.19 cfs @ 7.60 hrs HW=280.04' (Free Discharge)
└─**2=Exfiltration** (Exfiltration Controls 0.19 cfs)

Primary OutFlow Max=0.45 cfs @ 13.41 hrs HW=283.10' TW=0.00' (Dynamic Tailwater)
└─**1=Broad-Crested Rectangular Weir** (Weir Controls 0.45 cfs @ 0.89 fps)

Summary for Link DP-1: HEADWALL

Inflow Area = 109,946 sf, 44.66% Impervious, Inflow Depth = 1.88" for 10-Year event
Inflow = 3.46 cfs @ 12.13 hrs, Volume= 17,180 cf
Primary = 3.46 cfs @ 12.13 hrs, Volume= 17,180 cf, Atten= 0%, Lag= 0.0 min
Routed to Link DP-6 : EXISTING STORMWATER POND

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs

Summary for Link DP-10: OFFSITE NORTH

Inflow Area = 18,741 sf, 0.00% Impervious, Inflow Depth = 2.00" for 10-Year event
Inflow = 0.84 cfs @ 12.10 hrs, Volume= 3,120 cf
Primary = 0.84 cfs @ 12.10 hrs, Volume= 3,120 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs

Summary for Link DP-2: HEADWALL

Inflow Area = 122,705 sf, 77.00% Impervious, Inflow Depth = 3.24" for 10-Year event
Inflow = 9.34 cfs @ 12.14 hrs, Volume= 33,119 cf
Primary = 9.34 cfs @ 12.14 hrs, Volume= 33,119 cf, Atten= 0%, Lag= 0.0 min
Routed to Link DP-6 : EXISTING STORMWATER POND

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs

Summary for Link DP-3: HEADWALL

Inflow Area = 845,727 sf, 71.21% Impervious, Inflow Depth = 3.07" for 10-Year event
Inflow = 60.82 cfs @ 12.14 hrs, Volume= 216,691 cf
Primary = 60.82 cfs @ 12.14 hrs, Volume= 216,691 cf, Atten= 0%, Lag= 0.0 min
Routed to Link DP-6 : EXISTING STORMWATER POND

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs

Summary for Link DP-4: KING ST CLOSED DRAINAGE

Inflow Area = 38,613 sf, 24.06% Impervious, Inflow Depth = 2.95" for 10-Year event
Inflow = 2.32 cfs @ 12.19 hrs, Volume= 9,499 cf
Primary = 2.32 cfs @ 12.19 hrs, Volume= 9,499 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs

Summary for Link DP-5: EXISTING WETLAND

Inflow Area = 413,686 sf, 51.88% Impervious, Inflow Depth = 3.24" for 10-Year event
Inflow = 21.80 cfs @ 12.13 hrs, Volume= 111,758 cf
Primary = 21.80 cfs @ 12.13 hrs, Volume= 111,758 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs

Summary for Link DP-6: EXISTING STORMWATER POND

Inflow Area = 1,198,435 sf, 64.84% Impervious, Inflow Depth = 2.81" for 10-Year event
Inflow = 77.25 cfs @ 12.14 hrs, Volume= 280,576 cf
Primary = 77.25 cfs @ 12.14 hrs, Volume= 280,576 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs

Summary for Link DP-7: EXISTING STORMWATER POND

Inflow Area = 139,711 sf, 7.69% Impervious, Inflow Depth = 2.35" for 10-Year event
Inflow = 7.85 cfs @ 12.14 hrs, Volume= 27,406 cf
Primary = 7.85 cfs @ 12.14 hrs, Volume= 27,406 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs

Summary for Link DP-8: EXISTING STORMWATER POND

Inflow Area = 23,817 sf, 39.51% Impervious, Inflow Depth = 2.86" for 10-Year event
Inflow = 1.69 cfs @ 12.13 hrs, Volume= 5,675 cf
Primary = 1.69 cfs @ 12.13 hrs, Volume= 5,675 cf, Atten= 0%, Lag= 0.0 min
Routed to Link DP-7 : EXISTING STORMWATER POND

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs

Summary for Link DP-9: OFFSITE HEADWALL SOUTHWEST

Inflow Area = 118,327 sf, 0.00% Impervious, Inflow Depth = 2.17" for 10-Year event
Inflow = 6.43 cfs @ 12.13 hrs, Volume= 21,384 cf
Primary = 6.43 cfs @ 12.13 hrs, Volume= 21,384 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs

Time span=0.00-36.00 hrs, dt=0.04 hrs, 901 points x 3
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1.1: ROAD Runoff Area=37,044 sf 77.91% Impervious Runoff Depth=4.94"
Tc=6.0 min CN=92 Runoff=4.23 cfs 15,255 cf

Subcatchment 1.2: ABUTTING LOTS Runoff Area=72,902 sf 27.76% Impervious Runoff Depth=1.60"
Flow Length=357' Tc=27.1 min CN=57 Runoff=1.46 cfs 9,706 cf

Subcatchment 2.1: PARKING Runoff Area=122,705 sf 77.00% Impervious Runoff Depth=4.39"
Flow Length=451' Tc=6.9 min CN=87 Runoff=12.47 cfs 44,919 cf

Subcatchment 3.1: PARKING Runoff Area=582,220 sf 66.44% Impervious Runoff Depth=4.83"
Flow Length=823' Tc=7.9 min CN=91 Runoff=61.32 cfs 234,345 cf

Subcatchment 3.2: BUILDING Runoff Area=8,600 sf 100.00% Impervious Runoff Depth=5.63"
Tc=6.0 min CN=98 Runoff=1.03 cfs 4,036 cf

Subcatchment 3.3: Runoff Area=72,797 sf 33.90% Impervious Runoff Depth=3.87"
Tc=6.0 min CN=82 Runoff=6.94 cfs 23,463 cf

Subcatchment 3.4: BUILDING Runoff Area=91,130 sf 100.00% Impervious Runoff Depth=5.63"
Tc=6.0 min CN=98 Runoff=10.96 cfs 42,770 cf

Subcatchment 3.5: BUILDING Runoff Area=90,980 sf 100.00% Impervious Runoff Depth=5.63"
Tc=6.0 min CN=98 Runoff=10.94 cfs 42,700 cf

Subcatchment 4.1: ROAD Runoff Area=38,613 sf 24.06% Impervious Runoff Depth=4.07"
Flow Length=339' Slope=0.0210 '/' Tc=11.4 min CN=84 Runoff=3.17 cfs 13,112 cf

Subcatchment 5.1: PARKING Runoff Area=59,518 sf 72.12% Impervious Runoff Depth=5.05"
Tc=6.0 min CN=93 Runoff=6.88 cfs 25,069 cf

Subcatchment 5.2: LANDSCAPING Runoff Area=25,460 sf 0.70% Impervious Runoff Depth=3.66"
Flow Length=343' Slope=0.0200 '/' Tc=11.7 min CN=80 Runoff=1.89 cfs 7,774 cf

Subcatchment 5.3: Runoff Area=173,079 sf 42.34% Impervious Runoff Depth=3.97"
Flow Length=284' Tc=38.3 min CN=83 Runoff=7.86 cfs 57,273 cf

Subcatchment 5.4: PARKING Runoff Area=155,629 sf 63.12% Impervious Runoff Depth=4.72"
Tc=6.0 min CN=90 Runoff=17.27 cfs 61,205 cf

Subcatchment 6.1: UNDISTURBED Runoff Area=120,057 sf 26.00% Impervious Runoff Depth=2.17"
Flow Length=159' Slope=0.0500 '/' Tc=7.2 min CN=64 Runoff=6.16 cfs 21,722 cf

Subcatchment 7.1: TUTTLE LAND Runoff Area=115,894 sf 1.15% Impervious Runoff Depth=3.27"
Flow Length=404' Tc=7.4 min CN=76 Runoff=9.01 cfs 31,564 cf

Subcatchment 8.1: TUTTLE HOUSE Runoff Area=23,817 sf 39.51% Impervious Runoff Depth=3.97"
Tc=6.0 min CN=83 Runoff=2.32 cfs 7,881 cf

Subcatchment 9.1: UNDISTURBED Runoff Area=118,327 sf 0.00% Impervious Runoff Depth=3.17"
Tc=6.0 min CN=75 Runoff=9.40 cfs 31,274 cf

Subcatchment 10.1: UNDISTURBED Runoff Area=12,178 sf 0.00% Impervious Runoff Depth=3.37"
Tc=6.0 min CN=77 Runoff=1.02 cfs 3,416 cf

Subcatchment 10.2: UNDISTURBED Runoff Area=5,430 sf 0.00% Impervious Runoff Depth=2.34"
Tc=0.0 min CN=66 Runoff=0.40 cfs 1,061 cf

Subcatchment 10.3: UNDISTURBED Runoff Area=521 sf 0.00% Impervious Runoff Depth=1.44"
Tc=6.0 min CN=55 Runoff=0.02 cfs 63 cf

Subcatchment 10.4: UNDISTURBED Runoff Area=612 sf 0.00% Impervious Runoff Depth=1.44"
Tc=6.0 min CN=55 Runoff=0.02 cfs 74 cf

Pond P1: Peak Elev=281.28' Storage=9,183 cf Inflow=10.96 cfs 42,770 cf
Discarded=0.10 cfs 12,661 cf Primary=11.22 cfs 26,047 cf Outflow=11.32 cfs 38,708 cf

Pond P2: Peak Elev=283.36' Storage=17,353 cf Inflow=10.94 cfs 42,700 cf
Discarded=0.19 cfs 23,850 cf Primary=3.09 cfs 11,029 cf Outflow=3.28 cfs 34,879 cf

Link DP-1: HEADWALL Inflow=4.75 cfs 24,961 cf
Primary=4.75 cfs 24,961 cf

Link DP-10: OFFSITE NORTH Inflow=1.26 cfs 4,613 cf
Primary=1.26 cfs 4,613 cf

Link DP-2: HEADWALL Inflow=12.47 cfs 44,919 cf
Primary=12.47 cfs 44,919 cf

Link DP-3: HEADWALL Inflow=79.12 cfs 298,921 cf
Primary=79.12 cfs 298,921 cf

Link DP-4: KING ST CLOSED DRAINAGE Inflow=3.17 cfs 13,112 cf
Primary=3.17 cfs 13,112 cf

Link DP-5: EXISTING WETLAND Inflow=28.83 cfs 151,321 cf
Primary=28.83 cfs 151,321 cf

Link DP-6: EXISTING STORMWATER POND Inflow=102.42 cfs 390,523 cf
Primary=102.42 cfs 390,523 cf

Link DP-7: EXISTING STORMWATER POND Inflow=11.25 cfs 39,445 cf
Primary=11.25 cfs 39,445 cf

Link DP-8: EXISTING STORMWATER POND Inflow=2.32 cfs 7,881 cf
Primary=2.32 cfs 7,881 cf

Link DP-9: OFFSITE HEADWALL SOUTHWEST Inflow=9.40 cfs 31,274 cf
Primary=9.40 cfs 31,274 cf

Total Runoff Area = 1,927,513 sf Runoff Volume = 678,682 cf Average Runoff Depth = 4.23"
47.51% Pervious = 915,850 sf 52.49% Impervious = 1,011,663 sf

Time span=0.00-36.00 hrs, dt=0.04 hrs, 901 points x 3
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1.1: ROAD Runoff Area=37,044 sf 77.91% Impervious Runoff Depth=6.05"
Tc=6.0 min CN=92 Runoff=5.12 cfs 18,691 cf

Subcatchment 1.2: ABUTTING LOTS Runoff Area=72,902 sf 27.76% Impervious Runoff Depth=2.31"
Flow Length=357' Tc=27.1 min CN=57 Runoff=2.22 cfs 14,053 cf

Subcatchment 2.1: PARKING Runoff Area=122,705 sf 77.00% Impervious Runoff Depth=5.48"
Flow Length=451' Tc=6.9 min CN=87 Runoff=15.36 cfs 56,029 cf

Subcatchment 3.1: PARKING Runoff Area=582,220 sf 66.44% Impervious Runoff Depth=5.94"
Flow Length=823' Tc=7.9 min CN=91 Runoff=74.44 cfs 288,137 cf

Subcatchment 3.2: BUILDING Runoff Area=8,600 sf 100.00% Impervious Runoff Depth=6.76"
Tc=6.0 min CN=98 Runoff=1.23 cfs 4,845 cf

Subcatchment 3.3: Runoff Area=72,797 sf 33.90% Impervious Runoff Depth=4.92"
Tc=6.0 min CN=82 Runoff=8.73 cfs 29,823 cf

Subcatchment 3.4: BUILDING Runoff Area=91,130 sf 100.00% Impervious Runoff Depth=6.76"
Tc=6.0 min CN=98 Runoff=13.08 cfs 51,344 cf

Subcatchment 3.5: BUILDING Runoff Area=90,980 sf 100.00% Impervious Runoff Depth=6.76"
Tc=6.0 min CN=98 Runoff=13.06 cfs 51,259 cf

Subcatchment 4.1: ROAD Runoff Area=38,613 sf 24.06% Impervious Runoff Depth=5.14"
Flow Length=339' Slope=0.0210 '/' Tc=11.4 min CN=84 Runoff=3.96 cfs 16,539 cf

Subcatchment 5.1: PARKING Runoff Area=59,518 sf 72.12% Impervious Runoff Depth=6.17"
Tc=6.0 min CN=93 Runoff=8.29 cfs 30,609 cf

Subcatchment 5.2: LANDSCAPING Runoff Area=25,460 sf 0.70% Impervious Runoff Depth=4.69"
Flow Length=343' Slope=0.0200 '/' Tc=11.7 min CN=80 Runoff=2.40 cfs 9,960 cf

Subcatchment 5.3: Runoff Area=173,079 sf 42.34% Impervious Runoff Depth=5.03"
Flow Length=284' Tc=38.3 min CN=83 Runoff=9.88 cfs 72,517 cf

Subcatchment 5.4: PARKING Runoff Area=155,629 sf 63.12% Impervious Runoff Depth=5.82"
Tc=6.0 min CN=90 Runoff=21.04 cfs 75,521 cf

Subcatchment 6.1: UNDISTURBED Runoff Area=120,057 sf 26.00% Impervious Runoff Depth=3.00"
Flow Length=159' Slope=0.0500 '/' Tc=7.2 min CN=64 Runoff=8.61 cfs 30,028 cf

Subcatchment 7.1: TUTTLE LAND Runoff Area=115,894 sf 1.15% Impervious Runoff Depth=4.26"
Flow Length=404' Tc=7.4 min CN=76 Runoff=11.66 cfs 41,117 cf

Subcatchment 8.1: TUTTLE HOUSE Runoff Area=23,817 sf 39.51% Impervious Runoff Depth=5.03"
Tc=6.0 min CN=83 Runoff=2.91 cfs 9,979 cf

Subcatchment 9.1: UNDISTURBED Runoff Area=118,327 sf 0.00% Impervious Runoff Depth=4.15"
Tc=6.0 min CN=75 Runoff=12.24 cfs 40,916 cf

Subcatchment 10.1: UNDISTURBED Runoff Area=12,178 sf 0.00% Impervious Runoff Depth=4.37"
Tc=6.0 min CN=77 Runoff=1.32 cfs 4,431 cf

Subcatchment 10.2: UNDISTURBED Runoff Area=5,430 sf 0.00% Impervious Runoff Depth=3.20"
Tc=0.0 min CN=66 Runoff=0.55 cfs 1,450 cf

Subcatchment 10.3: UNDISTURBED Runoff Area=521 sf 0.00% Impervious Runoff Depth=2.12"
Tc=6.0 min CN=55 Runoff=0.03 cfs 92 cf

Subcatchment 10.4: UNDISTURBED Runoff Area=612 sf 0.00% Impervious Runoff Depth=2.12"
Tc=6.0 min CN=55 Runoff=0.03 cfs 108 cf

Pond P1: Peak Elev=281.36' Storage=9,183 cf Inflow=13.08 cfs 51,344 cf
Discarded=0.10 cfs 12,740 cf Primary=13.11 cfs 34,533 cf Outflow=13.21 cfs 47,273 cf

Pond P2: Peak Elev=283.98' Storage=17,822 cf Inflow=13.06 cfs 51,259 cf
Discarded=0.19 cfs 24,209 cf Primary=16.08 cfs 19,141 cf Outflow=16.27 cfs 43,351 cf

Link DP-1: HEADWALL Inflow=6.00 cfs 32,745 cf
Primary=6.00 cfs 32,745 cf

Link DP-10: OFFSITE NORTH Inflow=1.66 cfs 6,081 cf
Primary=1.66 cfs 6,081 cf

Link DP-2: HEADWALL Inflow=15.36 cfs 56,029 cf
Primary=15.36 cfs 56,029 cf

Link DP-3: HEADWALL Inflow=111.19 cfs 376,481 cf
Primary=111.19 cfs 376,481 cf

Link DP-4: KING ST CLOSED DRAINAGE Inflow=3.96 cfs 16,539 cf
Primary=3.96 cfs 16,539 cf

Link DP-5: EXISTING WETLAND Inflow=35.33 cfs 188,607 cf
Primary=35.33 cfs 188,607 cf

Link DP-6: EXISTING STORMWATER POND Inflow=140.77 cfs 495,282 cf
Primary=140.77 cfs 495,282 cf

Link DP-7: EXISTING STORMWATER POND Inflow=14.47 cfs 51,096 cf
Primary=14.47 cfs 51,096 cf

Link DP-8: EXISTING STORMWATER POND Inflow=2.91 cfs 9,979 cf
Primary=2.91 cfs 9,979 cf

Link DP-9: OFFSITE HEADWALL SOUTHWEST Inflow=12.24 cfs 40,916 cf
Primary=12.24 cfs 40,916 cf

Total Runoff Area = 1,927,513 sf Runoff Volume = 847,448 cf Average Runoff Depth = 5.28"
47.51% Pervious = 915,850 sf 52.49% Impervious = 1,011,663 sf

Time span=0.00-36.00 hrs, dt=0.04 hrs, 901 points x 3
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1.1: ROAD Runoff Area=37,044 sf 77.91% Impervious Runoff Depth=7.40"
Tc=6.0 min CN=92 Runoff=6.18 cfs 22,844 cf

Subcatchment 1.2: ABUTTING LOTS Runoff Area=72,902 sf 27.76% Impervious Runoff Depth=3.26"
Flow Length=357' Tc=27.1 min CN=57 Runoff=3.22 cfs 19,810 cf

Subcatchment 2.1: PARKING Runoff Area=122,705 sf 77.00% Impervious Runoff Depth=6.80"
Flow Length=451' Tc=6.9 min CN=87 Runoff=18.81 cfs 69,539 cf

Subcatchment 3.1: PARKING Runoff Area=582,220 sf 66.44% Impervious Runoff Depth=7.28"
Flow Length=823' Tc=7.9 min CN=91 Runoff=90.12 cfs 353,217 cf

Subcatchment 3.2: BUILDING Runoff Area=8,600 sf 100.00% Impervious Runoff Depth=8.12"
Tc=6.0 min CN=98 Runoff=1.48 cfs 5,819 cf

Subcatchment 3.3: Runoff Area=72,797 sf 33.90% Impervious Runoff Depth=6.20"
Tc=6.0 min CN=82 Runoff=10.88 cfs 37,625 cf

Subcatchment 3.4: BUILDING Runoff Area=91,130 sf 100.00% Impervious Runoff Depth=8.12"
Tc=6.0 min CN=98 Runoff=15.64 cfs 61,665 cf

Subcatchment 3.5: BUILDING Runoff Area=90,980 sf 100.00% Impervious Runoff Depth=8.12"
Tc=6.0 min CN=98 Runoff=15.61 cfs 61,563 cf

Subcatchment 4.1: ROAD Runoff Area=38,613 sf 24.06% Impervious Runoff Depth=6.44"
Flow Length=339' Slope=0.0210 '/' Tc=11.4 min CN=84 Runoff=4.90 cfs 20,727 cf

Subcatchment 5.1: PARKING Runoff Area=59,518 sf 72.12% Impervious Runoff Depth=7.52"
Tc=6.0 min CN=93 Runoff=9.99 cfs 37,298 cf

Subcatchment 5.2: LANDSCAPING Runoff Area=25,460 sf 0.70% Impervious Runoff Depth=5.96"
Flow Length=343' Slope=0.0200 '/' Tc=11.7 min CN=80 Runoff=3.02 cfs 12,652 cf

Subcatchment 5.3: Runoff Area=173,079 sf 42.34% Impervious Runoff Depth=6.32"
Flow Length=284' Tc=38.3 min CN=83 Runoff=12.31 cfs 91,180 cf

Subcatchment 5.4: PARKING Runoff Area=155,629 sf 63.12% Impervious Runoff Depth=7.16"
Tc=6.0 min CN=90 Runoff=25.53 cfs 92,861 cf

Subcatchment 6.1: UNDISTURBED Runoff Area=120,057 sf 26.00% Impervious Runoff Depth=4.07"
Flow Length=159' Slope=0.0500 '/' Tc=7.2 min CN=64 Runoff=11.72 cfs 40,723 cf

Subcatchment 7.1: TUTTLE LAND Runoff Area=115,894 sf 1.15% Impervious Runoff Depth=5.49"
Flow Length=404' Tc=7.4 min CN=76 Runoff=14.90 cfs 52,988 cf

Subcatchment 8.1: TUTTLE HOUSE Runoff Area=23,817 sf 39.51% Impervious Runoff Depth=6.32"
Tc=6.0 min CN=83 Runoff=3.61 cfs 12,547 cf

Subcatchment 9.1: UNDISTURBED Runoff Area=118,327 sf 0.00% Impervious Runoff Depth=5.37"
Tc=6.0 min CN=75 Runoff=15.71 cfs 52,928 cf

Subcatchment 10.1: UNDISTURBED Runoff Area=12,178 sf 0.00% Impervious Runoff Depth=5.61"
Tc=6.0 min CN=77 Runoff=1.68 cfs 5,689 cf

Subcatchment 10.2: UNDISTURBED Runoff Area=5,430 sf 0.00% Impervious Runoff Depth=4.30"
Tc=0.0 min CN=66 Runoff=0.73 cfs 1,948 cf

Subcatchment 10.3: UNDISTURBED Runoff Area=521 sf 0.00% Impervious Runoff Depth=3.03"
Tc=6.0 min CN=55 Runoff=0.04 cfs 132 cf

Subcatchment 10.4: UNDISTURBED Runoff Area=612 sf 0.00% Impervious Runoff Depth=3.03"
Tc=6.0 min CN=55 Runoff=0.05 cfs 155 cf

Pond P1: Peak Elev=281.45' Storage=9,183 cf Inflow=15.64 cfs 61,665 cf
Discarded=0.10 cfs 12,799 cf Primary=15.27 cfs 44,788 cf Outflow=15.37 cfs 57,587 cf

Pond P2: Peak Elev=283.95' Storage=17,822 cf Inflow=15.61 cfs 61,563 cf
Discarded=0.19 cfs 24,451 cf Primary=15.35 cfs 29,165 cf Outflow=15.54 cfs 53,616 cf

Link DP-1: HEADWALL Inflow=7.55 cfs 42,654 cf
Primary=7.55 cfs 42,654 cf

Link DP-10: OFFSITE NORTH Inflow=2.15 cfs 7,923 cf
Primary=2.15 cfs 7,923 cf

Link DP-2: HEADWALL Inflow=18.81 cfs 69,539 cf
Primary=18.81 cfs 69,539 cf

Link DP-3: HEADWALL Inflow=132.35 cfs 470,614 cf
Primary=132.35 cfs 470,614 cf

Link DP-4: KING ST CLOSED DRAINAGE Inflow=4.90 cfs 20,727 cf
Primary=4.90 cfs 20,727 cf

Link DP-5: EXISTING WETLAND Inflow=43.13 cfs 233,991 cf
Primary=43.13 cfs 233,991 cf

Link DP-6: EXISTING STORMWATER POND Inflow=170.33 cfs 623,530 cf
Primary=170.33 cfs 623,530 cf

Link DP-7: EXISTING STORMWATER POND Inflow=18.39 cfs 65,535 cf
Primary=18.39 cfs 65,535 cf

Link DP-8: EXISTING STORMWATER POND Inflow=3.61 cfs 12,547 cf
Primary=3.61 cfs 12,547 cf

Link DP-9: OFFSITE HEADWALL SOUTHWEST Inflow=15.71 cfs 52,928 cf
Primary=15.71 cfs 52,928 cf

Total Runoff Area = 1,927,513 sf Runoff Volume = 1,053,908 cf Average Runoff Depth = 6.56"
47.51% Pervious = 915,850 sf 52.49% Impervious = 1,011,663 sf

Time span=0.00-36.00 hrs, dt=0.04 hrs, 901 points x 3
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1.1: ROAD Runoff Area=37,044 sf 77.91% Impervious Runoff Depth=5.76"
Tc=6.0 min CN=92 Runoff=4.88 cfs 17,777 cf

Subcatchment 1.2: ABUTTING LOTS Runoff Area=72,902 sf 27.76% Impervious Runoff Depth=2.12"
Flow Length=357' Tc=27.1 min CN=57 Runoff=2.01 cfs 12,856 cf

Subcatchment 2.1: PARKING Runoff Area=122,705 sf 77.00% Impervious Runoff Depth=5.19"
Flow Length=451' Tc=6.9 min CN=87 Runoff=14.59 cfs 53,067 cf

Subcatchment 3.1: PARKING Runoff Area=582,220 sf 66.44% Impervious Runoff Depth=5.64"
Flow Length=823' Tc=7.9 min CN=91 Runoff=70.96 cfs 273,826 cf

Subcatchment 3.2: BUILDING Runoff Area=8,600 sf 100.00% Impervious Runoff Depth=6.46"
Tc=6.0 min CN=98 Runoff=1.18 cfs 4,631 cf

Subcatchment 3.3: Runoff Area=72,797 sf 33.90% Impervious Runoff Depth=4.64"
Tc=6.0 min CN=82 Runoff=8.25 cfs 28,122 cf

Subcatchment 3.4: BUILDING Runoff Area=91,130 sf 100.00% Impervious Runoff Depth=6.46"
Tc=6.0 min CN=98 Runoff=12.52 cfs 49,067 cf

Subcatchment 3.5: BUILDING Runoff Area=90,980 sf 100.00% Impervious Runoff Depth=6.46"
Tc=6.0 min CN=98 Runoff=12.50 cfs 48,986 cf

Subcatchment 4.1: ROAD Runoff Area=38,613 sf 24.06% Impervious Runoff Depth=4.86"
Flow Length=339' Slope=0.0210 '/' Tc=11.4 min CN=84 Runoff=3.75 cfs 15,624 cf

Subcatchment 5.1: PARKING Runoff Area=59,518 sf 72.12% Impervious Runoff Depth=5.87"
Tc=6.0 min CN=93 Runoff=7.92 cfs 29,136 cf

Subcatchment 5.2: LANDSCAPING Runoff Area=25,460 sf 0.70% Impervious Runoff Depth=4.42"
Flow Length=343' Slope=0.0200 '/' Tc=11.7 min CN=80 Runoff=2.26 cfs 9,374 cf

Subcatchment 5.3: Runoff Area=173,079 sf 42.34% Impervious Runoff Depth=4.75"
Flow Length=284' Tc=38.3 min CN=83 Runoff=9.34 cfs 68,442 cf

Subcatchment 5.4: PARKING Runoff Area=155,629 sf 63.12% Impervious Runoff Depth=5.53"
Tc=6.0 min CN=90 Runoff=20.04 cfs 71,711 cf

Subcatchment 6.1: UNDISTURBED Runoff Area=120,057 sf 26.00% Impervious Runoff Depth=2.78"
Flow Length=159' Slope=0.0500 '/' Tc=7.2 min CN=64 Runoff=7.94 cfs 27,764 cf

Subcatchment 7.1: TUTTLE LAND Runoff Area=115,894 sf 1.15% Impervious Runoff Depth=3.99"
Flow Length=404' Tc=7.4 min CN=76 Runoff=10.96 cfs 38,548 cf

Subcatchment 8.1: TUTTLE HOUSE Runoff Area=23,817 sf 39.51% Impervious Runoff Depth=4.75"
Tc=6.0 min CN=83 Runoff=2.75 cfs 9,418 cf

Subcatchment 9.1: UNDISTURBED Runoff Area=118,327 sf 0.00% Impervious Runoff Depth=3.89"
Tc=6.0 min CN=75 Runoff=11.48 cfs 38,321 cf

Subcatchment 10.1: UNDISTURBED Runoff Area=12,178 sf 0.00% Impervious Runoff Depth=4.10"
Tc=6.0 min CN=77 Runoff=1.24 cfs 4,158 cf

Subcatchment 10.2: UNDISTURBED Runoff Area=5,430 sf 0.00% Impervious Runoff Depth=2.97"
Tc=0.0 min CN=66 Runoff=0.51 cfs 1,344 cf

Subcatchment 10.3: UNDISTURBED Runoff Area=521 sf 0.00% Impervious Runoff Depth=1.94"
Tc=6.0 min CN=55 Runoff=0.02 cfs 84 cf

Subcatchment 10.4: UNDISTURBED Runoff Area=612 sf 0.00% Impervious Runoff Depth=1.94"
Tc=6.0 min CN=55 Runoff=0.03 cfs 99 cf

Pond P1: Peak Elev=281.35' Storage=9,183 cf Inflow=12.52 cfs 49,067 cf
Discarded=0.10 cfs 12,723 cf Primary=12.88 cfs 32,276 cf Outflow=12.98 cfs 44,999 cf

Pond P2: Peak Elev=283.84' Storage=17,822 cf Inflow=12.50 cfs 48,986 cf
Discarded=0.19 cfs 24,133 cf Primary=12.71 cfs 16,957 cf Outflow=12.90 cfs 41,091 cf

Link DP-1: HEADWALL Inflow=5.66 cfs 30,633 cf
Primary=5.66 cfs 30,633 cf

Link DP-10: OFFSITE NORTH Inflow=1.55 cfs 5,685 cf
Primary=1.55 cfs 5,685 cf

Link DP-2: HEADWALL Inflow=14.59 cfs 53,067 cf
Primary=14.59 cfs 53,067 cf

Link DP-3: HEADWALL Inflow=95.71 cfs 355,812 cf
Primary=95.71 cfs 355,812 cf

Link DP-4: KING ST CLOSED DRAINAGE Inflow=3.75 cfs 15,624 cf
Primary=3.75 cfs 15,624 cf

Link DP-5: EXISTING WETLAND Inflow=33.61 cfs 178,663 cf
Primary=33.61 cfs 178,663 cf

Link DP-6: EXISTING STORMWATER POND Inflow=123.53 cfs 467,276 cf
Primary=123.53 cfs 467,276 cf

Link DP-7: EXISTING STORMWATER POND Inflow=13.61 cfs 47,966 cf
Primary=13.61 cfs 47,966 cf

Link DP-8: EXISTING STORMWATER POND Inflow=2.75 cfs 9,418 cf
Primary=2.75 cfs 9,418 cf

Link DP-9: OFFSITE HEADWALL SOUTHWEST Inflow=11.48 cfs 38,321 cf
Primary=11.48 cfs 38,321 cf

Total Runoff Area = 1,927,513 sf Runoff Volume = 802,354 cf Average Runoff Depth = 5.00"
47.51% Pervious = 915,850 sf 52.49% Impervious = 1,011,663 sf

Summary for Subcatchment 1.1: ROAD

Runoff = 4.88 cfs @ 12.12 hrs, Volume= 17,777 cf, Depth= 5.76"
Routed to Link DP-1 : HEADWALL

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year (2070) Rainfall=6.70"

Area (sf)	CN	Description
10,679	98	Paved parking, HSG A
8,340	98	Paved parking, HSG D
9,843	98	Paved parking, HSG C
1,545	39	>75% Grass cover, Good, HSG A
2,010	80	>75% Grass cover, Good, HSG D
4,627	74	>75% Grass cover, Good, HSG C
37,044	92	Weighted Average
8,182		22.09% Pervious Area
28,862		77.91% Impervious Area

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

Summary for Subcatchment 1.2: ABUTTING LOTS

Runoff = 2.01 cfs @ 12.40 hrs, Volume= 12,856 cf, Depth= 2.12"
Routed to Link DP-1 : HEADWALL

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year (2070) Rainfall=6.70"

Area (sf)	CN	Description
13,691	98	Paved parking, HSG A
6,546	98	Roofs, HSG A
10,568	30	Woods, Good, HSG A
560	70	Woods, Good, HSG C
36,836	39	>75% Grass cover, Good, HSG A
2,021	74	>75% Grass cover, Good, HSG C
2,220	80	>75% Grass cover, Good, HSG D
460	77	Woods, Good, HSG D
72,902	57	Weighted Average
52,665		72.24% Pervious Area
20,237		27.76% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.2	100	0.0550	0.07		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 3.13"
1.9	257	0.0200	2.28		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
27.1	357	Total			

Summary for Subcatchment 2.1: PARKING

Runoff = 14.59 cfs @ 12.14 hrs, Volume= 53,067 cf, Depth= 5.19"
Routed to Link DP-2 : HEADWALL

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year (2070) Rainfall=6.70"

Area (sf)	CN	Description
80,896	98	Paved parking, HSG A
13,592	98	Paved parking, HSG C
20,788	39	>75% Grass cover, Good, HSG A
7,429	74	>75% Grass cover, Good, HSG C
122,705	87	Weighted Average
28,217		23.00% Pervious Area
94,488		77.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.2	71	0.0500	0.23		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.13"
1.7	380	0.0320	3.63		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
6.9	451	Total			

Summary for Subcatchment 3.1: PARKING

Runoff = 70.96 cfs @ 12.15 hrs, Volume= 273,826 cf, Depth= 5.64"
Routed to Link DP-3 : HEADWALL

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year (2070) Rainfall=6.70"

Area (sf)	CN	Description
84,161	74	>75% Grass cover, Good, HSG C
48,407	98	Paved parking, HSG C
338,415	98	Paved parking, HSG D
111,237	80	>75% Grass cover, Good, HSG D
582,220	91	Weighted Average
195,398		33.56% Pervious Area
386,822		66.44% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.3	100	0.0970	0.32		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.13"
1.0	290	0.0970	5.01		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
1.6	433	0.0500	4.54		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
7.9	823	Total			

Summary for Subcatchment 3.2: BUILDING

Runoff = 1.18 cfs @ 12.12 hrs, Volume= 4,631 cf, Depth= 6.46"
Routed to Link DP-3 : HEADWALL

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year (2070) Rainfall=6.70"

Area (sf)	CN	Description
8,600	98	Roofs, HSG D
8,600		100.00% Impervious Area

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

Summary for Subcatchment 3.3:

Runoff = 8.25 cfs @ 12.13 hrs, Volume= 28,122 cf, Depth= 4.64"
Routed to Link DP-3 : HEADWALL

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year (2070) Rainfall=6.70"

Area (sf)	CN	Description
24,677	98	Paved parking, HSG C
48,120	74	>75% Grass cover, Good, HSG C
72,797	82	Weighted Average
48,120		66.10% Pervious Area
24,677		33.90% Impervious Area

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

Summary for Subcatchment 3.4: BUILDING

Runoff = 12.52 cfs @ 12.12 hrs, Volume= 49,067 cf, Depth= 6.46"
Routed to Pond P1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year (2070) Rainfall=6.70"

Area (sf)	CN	Description
91,130	98	Roofs, HSG C
91,130		100.00% Impervious Area

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

Summary for Subcatchment 3.5: BUILDING

Runoff = 12.50 cfs @ 12.12 hrs, Volume= 48,986 cf, Depth= 6.46"
Routed to Pond P2 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year (2070) Rainfall=6.70"

	Area (sf)	CN	Description
*	90,980	98	Roofs, HSG A & C
	90,980		100.00% Impervious Area

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

Summary for Subcatchment 4.1: ROAD

Runoff = 3.75 cfs @ 12.19 hrs, Volume= 15,624 cf, Depth= 4.86"
Routed to Link DP-4 : KING ST CLOSED DRAINAGE

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year (2070) Rainfall=6.70"

Area (sf)	CN	Description
29,324	80	>75% Grass cover, Good, HSG D
9,289	98	Paved parking, HSG D
38,613	84	Weighted Average
29,324		75.94% Pervious Area
9,289		24.06% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.7	100	0.0210	0.17		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.13"
1.7	239	0.0210	2.33		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
11.4	339	Total			

Summary for Subcatchment 5.1: PARKING

Runoff = 7.92 cfs @ 12.12 hrs, Volume= 29,136 cf, Depth= 5.87"
Routed to Link DP-5 : EXISTING WETLAND

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year (2070) Rainfall=6.70"

Area (sf)	CN	Description
16,294	80	>75% Grass cover, Good, HSG D
42,924	98	Paved parking, HSG D
300	74	>75% Grass cover, Good, HSG C
59,518	93	Weighted Average
16,594		27.88% Pervious Area
42,924		72.12% Impervious Area

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

Summary for Subcatchment 5.2: LANDSCAPING

Runoff = 2.26 cfs @ 12.19 hrs, Volume= 9,374 cf, Depth= 4.42"
Routed to Link DP-5 : EXISTING WETLAND

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year (2070) Rainfall=6.70"

Area (sf)	CN	Description
25,282	80	>75% Grass cover, Good, HSG D
178	98	Paved parking, HSG D
25,460	80	Weighted Average
25,282		99.30% Pervious Area
178		0.70% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.9	100	0.0200	0.17		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.13"
1.8	243	0.0200	2.28		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
11.7	343	Total			

Summary for Subcatchment 5.3:

Runoff = 9.34 cfs @ 12.52 hrs, Volume= 68,442 cf, Depth= 4.75"
Routed to Link DP-5 : EXISTING WETLAND

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year (2070) Rainfall=6.70"

	Area (sf)	CN	Description
	61,519	80	>75% Grass cover, Good, HSG D
	38,274	61	>75% Grass cover, Good, HSG B
	40,591	98	Paved parking, HSG D
	4,419	98	Paved parking, HSG B
*	11,386	98	Wetland, HSG A
*	16,890	98	Wetland, HSG B
	173,079	83	Weighted Average
	99,793		57.66% Pervious Area
	73,286		42.34% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.6	45	0.2222	0.10		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 3.13"
20.7	55	0.0273	0.04		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 3.13"
10.0	184	0.0150	0.31		**Shallow Concentrated Flow,** Forest w/Heavy Litter Kv= 2.5 fps
38.3	284	Total			

Summary for Subcatchment 5.4: PARKING

Runoff = 20.04 cfs @ 12.13 hrs, Volume= 71,711 cf, Depth= 5.53"
Routed to Link DP-5 : EXISTING WETLAND

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year (2070) Rainfall=6.70"

Area (sf)	CN	Description
11,602	98	Paved parking, HSG C
20,457	74	>75% Grass cover, Good, HSG C
5,371	98	Paved parking, HSG B
4,297	61	>75% Grass cover, Good, HSG B
81,260	98	Paved parking, HSG D
32,642	80	>75% Grass cover, Good, HSG D
155,629	90	Weighted Average
57,396		36.88% Pervious Area
98,233		63.12% Impervious Area

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

Summary for Subcatchment 6.1: UNDISTURBED

Runoff = 7.94 cfs @ 12.15 hrs, Volume= 27,764 cf, Depth= 2.78"
Routed to Link DP-6 : EXISTING STORMWATER POND

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year (2070) Rainfall=6.70"

Area (sf)	CN	Description
37,191	79	Woods/grass comb., Good, HSG D
51,648	32	Woods/grass comb., Good, HSG A
24,473	98	Water Surface, HSG D
6,745	98	Water Surface, HSG A
120,057	64	Weighted Average
88,839		74.00% Pervious Area
31,218		26.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.9	100	0.0500	0.24		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.13"
0.3	59	0.0500	3.60		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
7.2	159	Total			

Summary for Subcatchment 7.1: TUTTLE LAND

Runoff = 10.96 cfs @ 12.15 hrs, Volume= 38,548 cf, Depth= 3.99"
Routed to Link DP-7 : EXISTING STORMWATER POND

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year (2070) Rainfall=6.70"

Area (sf)	CN	Description
25,199	80	>75% Grass cover, Good, HSG D
86,555	74	>75% Grass cover, Good, HSG C
2,810	72	Woods/grass comb., Good, HSG C
1,330	98	Paved parking, HSG C
115,894	76	Weighted Average
114,564		98.85% Pervious Area
1,330		1.15% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.4	100	0.0900	0.31		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.13"
2.0	304	0.0260	2.60		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
7.4	404	Total			

Summary for Subcatchment 8.1: TUTTLE HOUSE

Runoff = 2.75 cfs @ 12.13 hrs, Volume= 9,418 cf, Depth= 4.75"
Routed to Link DP-8 : EXISTING STORMWATER POND

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year (2070) Rainfall=6.70"

Area (sf)	CN	Description
2,038	72	Woods/grass comb., Good, HSG C
9,409	98	Paved parking, HSG C
12,370	74	>75% Grass cover, Good, HSG C
23,817	83	Weighted Average
14,408		60.49% Pervious Area
9,409		39.51% Impervious Area

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

Summary for Subcatchment 9.1: UNDISTURBED

Runoff = 11.48 cfs @ 12.13 hrs, Volume= 38,321 cf, Depth= 3.89"
Routed to Link DP-9 : OFFSITE HEADWALL SOUTHWEST

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year (2070) Rainfall=6.70"

Area (sf)	CN	Description
72,237	80	>75% Grass cover, Good, HSG D
3,192	72	Woods/grass comb., Good, HSG C
9,091	74	>75% Grass cover, Good, HSG C
24,144	79	Woods/grass comb., Good, HSG D
9,663	32	Woods/grass comb., Good, HSG A
118,327	75	Weighted Average
118,327		100.00% Pervious Area

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

Summary for Subcatchment 10.1: UNDISTURBED

Runoff = 1.24 cfs @ 12.13 hrs, Volume= 4,158 cf, Depth= 4.10"
Routed to Link DP-10 : OFFSITE NORTH

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year (2070) Rainfall=6.70"

Area (sf)	CN	Description
868	70	Woods, Good, HSG C
8,563	77	Woods, Good, HSG D
2,747	80	>75% Grass cover, Good, HSG D
12,178	77	Weighted Average
12,178		100.00% Pervious Area

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

Summary for Subcatchment 10.2: UNDISTURBED

Runoff = 0.51 cfs @ 12.06 hrs, Volume= 1,344 cf, Depth= 2.97"
Routed to Link DP-10 : OFFSITE NORTH

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year (2070) Rainfall=6.70"

Area (sf)	CN	Description
1,523	55	Woods, Good, HSG B
1,461	55	Woods, Good, HSG B
160	61	>75% Grass cover, Good, HSG B
2,286	80	>75% Grass cover, Good, HSG D
5,430	66	Weighted Average
5,430		100.00% Pervious Area

Summary for Subcatchment 10.3: UNDISTURBED

Runoff = 0.02 cfs @ 12.13 hrs, Volume= 84 cf, Depth= 1.94"
Routed to Link DP-10 : OFFSITE NORTH

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year (2070) Rainfall=6.70"

Area (sf)	CN	Description
521	55	Woods, Good, HSG B
521		100.00% Pervious Area

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

Summary for Subcatchment 10.4: UNDISTURBED

Runoff = 0.03 cfs @ 12.13 hrs, Volume= 99 cf, Depth= 1.94"
Routed to Link DP-10 : OFFSITE NORTH

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year (2070) Rainfall=6.70"

Area (sf)	CN	Description
612	55	Woods, Good, HSG B
612		100.00% Pervious Area

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

Summary for Pond P1:

Inflow Area = 91,130 sf,100.00% Impervious, Inflow Depth = 6.46" for 10-Year (2070) event
Inflow = 12.52 cfs @ 12.12 hrs, Volume= 49,067 cf
Outflow = 12.98 cfs @ 12.12 hrs, Volume= 44,999 cf, Atten= 0%, Lag= 0.0 min
Discarded = 0.10 cfs @ 1.96 hrs, Volume= 12,723 cf
Primary = 12.88 cfs @ 12.12 hrs, Volume= 32,276 cf
Routed to Link DP-3 : HEADWALL

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs / 3
Peak Elev= 281.35' @ 12.12 hrs Surf.Area= 4,256 sf Storage= 9,183 cf

Plug-Flow detention time= 202.4 min calculated for 44,999 cf (92% of inflow)
Center-of-Mass det. time= 152.9 min (898.2 - 745.3)

Volume	Invert	Avail.Storage	Storage Description
#1A	277.50'	3,808 cf	**44.25'W x 96.18'L x 3.50'H Field A** 14,895 cf Overall - 5,375 cf Embedded = 9,520 cf x 40.0% Voids
#2A	278.00'	5,375 cf	**ADS_StormTech SC-740 +Cap** x 117 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 117 Chambers in 9 Rows
		9,183 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	280.50'	**5.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#2	Discarded	277.50'	**1.020 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.10 cfs @ 1.96 hrs HW=277.54' (Free Discharge)
└─**2=Exfiltration** (Exfiltration Controls 0.10 cfs)

Primary OutFlow Max=12.73 cfs @ 12.12 hrs HW=281.34' TW=0.00' (Dynamic Tailwater)
└─**1=Broad-Crested Rectangular Weir** (Weir Controls 12.73 cfs @ 3.03 fps)

Summary for Pond P2:

Inflow Area = 90,980 sf,100.00% Impervious, Inflow Depth = 6.46" for 10-Year (2070) event
Inflow = 12.50 cfs @ 12.12 hrs, Volume= 48,986 cf
Outflow = 12.90 cfs @ 12.20 hrs, Volume= 41,091 cf, Atten= 0%, Lag= 4.4 min
Discarded = 0.19 cfs @ 4.44 hrs, Volume= 24,133 cf
Primary = 12.71 cfs @ 12.20 hrs, Volume= 16,957 cf
Routed to Link DP-3 : HEADWALL

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs / 3
Peak Elev= 283.84' @ 12.20 hrs Surf.Area= 8,201 sf Storage= 17,822 cf

Plug-Flow detention time= 337.2 min calculated for 41,045 cf (84% of inflow)
Center-of-Mass det. time= 255.6 min (1,001.0 - 745.3)

Volume	Invert	Avail.Storage	Storage Description
#1A	280.00'	7,256 cf	**49.00'W x 167.38'L x 3.50'H Field A** 28,705 cf Overall - 10,566 cf Embedded = 18,139 cf x 40.0% Voids
#2A	280.50'	10,566 cf	**ADS_StormTech SC-740 +Cap** x 230 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 230 Chambers in 10 Rows
		17,822 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	283.00'	**5.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#2	Discarded	280.00'	**1.020 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.19 cfs @ 4.44 hrs HW=280.04' (Free Discharge)
└─**2=Exfiltration** (Exfiltration Controls 0.19 cfs)

Primary OutFlow Max=12.24 cfs @ 12.20 hrs HW=283.82' TW=0.00' (Dynamic Tailwater)
└─**1=Broad-Crested Rectangular Weir** (Weir Controls 12.24 cfs @ 2.99 fps)

Summary for Link DP-1: HEADWALL

Inflow Area = 109,946 sf, 44.66% Impervious, Inflow Depth = 3.34" for 10-Year (2070) event
Inflow = 5.66 cfs @ 12.13 hrs, Volume= 30,633 cf
Primary = 5.66 cfs @ 12.13 hrs, Volume= 30,633 cf, Atten= 0%, Lag= 0.0 min
Routed to Link DP-6 : EXISTING STORMWATER POND

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs

Summary for Link DP-10: OFFSITE NORTH

Inflow Area = 18,741 sf, 0.00% Impervious, Inflow Depth = 3.64" for 10-Year (2070) event
Inflow = 1.55 cfs @ 12.09 hrs, Volume= 5,685 cf
Primary = 1.55 cfs @ 12.09 hrs, Volume= 5,685 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs

Summary for Link DP-2: HEADWALL

Inflow Area = 122,705 sf, 77.00% Impervious, Inflow Depth = 5.19" for 10-Year (2070) event
Inflow = 14.59 cfs @ 12.14 hrs, Volume= 53,067 cf
Primary = 14.59 cfs @ 12.14 hrs, Volume= 53,067 cf, Atten= 0%, Lag= 0.0 min
Routed to Link DP-6 : EXISTING STORMWATER POND

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs

Summary for Link DP-3: HEADWALL

Inflow Area = 845,727 sf, 71.21% Impervious, Inflow Depth = 5.05" for 10-Year (2070) event
Inflow = 95.71 cfs @ 12.15 hrs, Volume= 355,812 cf
Primary = 95.71 cfs @ 12.15 hrs, Volume= 355,812 cf, Atten= 0%, Lag= 0.0 min
Routed to Link DP-6 : EXISTING STORMWATER POND

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs

Summary for Link DP-4: KING ST CLOSED DRAINAGE

Inflow Area = 38,613 sf, 24.06% Impervious, Inflow Depth = 4.86" for 10-Year (2070) event
Inflow = 3.75 cfs @ 12.19 hrs, Volume= 15,624 cf
Primary = 3.75 cfs @ 12.19 hrs, Volume= 15,624 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs

Summary for Link DP-5: EXISTING WETLAND

Inflow Area = 413,686 sf, 51.88% Impervious, Inflow Depth = 5.18" for 10-Year (2070) event
Inflow = 33.61 cfs @ 12.13 hrs, Volume= 178,663 cf
Primary = 33.61 cfs @ 12.13 hrs, Volume= 178,663 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs

Summary for Link DP-6: EXISTING STORMWATER POND

Inflow Area = 1,198,435 sf, 64.84% Impervious, Inflow Depth = 4.68" for 10-Year (2070) event
Inflow = 123.53 cfs @ 12.15 hrs, Volume= 467,276 cf
Primary = 123.53 cfs @ 12.15 hrs, Volume= 467,276 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs

Summary for Link DP-7: EXISTING STORMWATER POND

Inflow Area = 139,711 sf, 7.69% Impervious, Inflow Depth = 4.12" for 10-Year (2070) event
Inflow = 13.61 cfs @ 12.14 hrs, Volume= 47,966 cf
Primary = 13.61 cfs @ 12.14 hrs, Volume= 47,966 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs

Summary for Link DP-8: EXISTING STORMWATER POND

Inflow Area = 23,817 sf, 39.51% Impervious, Inflow Depth = 4.75" for 10-Year (2070) event
Inflow = 2.75 cfs @ 12.13 hrs, Volume= 9,418 cf
Primary = 2.75 cfs @ 12.13 hrs, Volume= 9,418 cf, Atten= 0%, Lag= 0.0 min
Routed to Link DP-7 : EXISTING STORMWATER POND

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs

Summary for Link DP-9: OFFSITE HEADWALL SOUTHWEST

Inflow Area = 118,327 sf, 0.00% Impervious, Inflow Depth = 3.89" for 10-Year (2070) event
Inflow = 11.48 cfs @ 12.13 hrs, Volume= 38,321 cf
Primary = 11.48 cfs @ 12.13 hrs, Volume= 38,321 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs

Time span=0.00-36.00 hrs, dt=0.04 hrs, 901 points x 3
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1.1: ROAD Runoff Area=37,044 sf 77.91% Impervious Runoff Depth=7.14"
Tc=6.0 min CN=92 Runoff=5.97 cfs 22,049 cf

Subcatchment 1.2: ABUTTING LOTS Runoff Area=72,902 sf 27.76% Impervious Runoff Depth=3.07"
Flow Length=357' Tc=27.1 min CN=57 Runoff=3.02 cfs 18,672 cf

Subcatchment 2.1: PARKING Runoff Area=122,705 sf 77.00% Impervious Runoff Depth=6.55"
Flow Length=451' Tc=6.9 min CN=87 Runoff=18.15 cfs 66,947 cf

Subcatchment 3.1: PARKING Runoff Area=582,220 sf 66.44% Impervious Runoff Depth=7.02"
Flow Length=823' Tc=7.9 min CN=91 Runoff=87.13 cfs 340,754 cf

Subcatchment 3.2: BUILDING Runoff Area=8,600 sf 100.00% Impervious Runoff Depth=7.86"
Tc=6.0 min CN=98 Runoff=1.43 cfs 5,633 cf

Subcatchment 3.3: Runoff Area=72,797 sf 33.90% Impervious Runoff Depth=5.95"
Tc=6.0 min CN=82 Runoff=10.47 cfs 36,124 cf

Subcatchment 3.4: BUILDING Runoff Area=91,130 sf 100.00% Impervious Runoff Depth=7.86"
Tc=6.0 min CN=98 Runoff=15.15 cfs 59,691 cf

Subcatchment 3.5: BUILDING Runoff Area=90,980 sf 100.00% Impervious Runoff Depth=7.86"
Tc=6.0 min CN=98 Runoff=15.12 cfs 59,593 cf

Subcatchment 4.1: ROAD Runoff Area=38,613 sf 24.06% Impervious Runoff Depth=6.19"
Flow Length=339' Slope=0.0210 '/' Tc=11.4 min CN=84 Runoff=4.72 cfs 19,922 cf

Subcatchment 5.1: PARKING Runoff Area=59,518 sf 72.12% Impervious Runoff Depth=7.26"
Tc=6.0 min CN=93 Runoff=9.67 cfs 36,018 cf

Subcatchment 5.2: LANDSCAPING Runoff Area=25,460 sf 0.70% Impervious Runoff Depth=5.72"
Flow Length=343' Slope=0.0200 '/' Tc=11.7 min CN=80 Runoff=2.90 cfs 12,133 cf

Subcatchment 5.3: Runoff Area=173,079 sf 42.34% Impervious Runoff Depth=6.07"
Flow Length=284' Tc=38.3 min CN=83 Runoff=11.84 cfs 87,592 cf

Subcatchment 5.4: PARKING Runoff Area=155,629 sf 63.12% Impervious Runoff Depth=6.90"
Tc=6.0 min CN=90 Runoff=24.68 cfs 89,539 cf

Subcatchment 6.1: UNDISTURBED Runoff Area=120,057 sf 26.00% Impervious Runoff Depth=3.86"
Flow Length=159' Slope=0.0500 '/' Tc=7.2 min CN=64 Runoff=11.12 cfs 38,630 cf

Subcatchment 7.1: TUTTLE LAND Runoff Area=115,894 sf 1.15% Impervious Runoff Depth=5.25"
Flow Length=404' Tc=7.4 min CN=76 Runoff=14.28 cfs 50,694 cf

Subcatchment 8.1: TUTTLE HOUSE Runoff Area=23,817 sf 39.51% Impervious Runoff Depth=6.07"
Tc=6.0 min CN=83 Runoff=3.48 cfs 12,053 cf

Subcatchment 9.1: UNDISTURBED Runoff Area=118,327 sf 0.00% Impervious Runoff Depth=5.13"
Tc=6.0 min CN=75 Runoff=15.04 cfs 50,604 cf

Subcatchment 10.1: UNDISTURBED Runoff Area=12,178 sf 0.00% Impervious Runoff Depth=5.37"
Tc=6.0 min CN=77 Runoff=1.61 cfs 5,446 cf

Subcatchment 10.2: UNDISTURBED Runoff Area=5,430 sf 0.00% Impervious Runoff Depth=4.09"
Tc=0.0 min CN=66 Runoff=0.70 cfs 1,851 cf

Subcatchment 10.3: UNDISTURBED Runoff Area=521 sf 0.00% Impervious Runoff Depth=2.85"
Tc=6.0 min CN=55 Runoff=0.04 cfs 124 cf

Subcatchment 10.4: UNDISTURBED Runoff Area=612 sf 0.00% Impervious Runoff Depth=2.85"
Tc=6.0 min CN=55 Runoff=0.04 cfs 145 cf

Pond P1: Peak Elev=281.42' Storage=9,183 cf Inflow=15.15 cfs 59,691 cf
Discarded=0.10 cfs 12,790 cf Primary=14.56 cfs 42,825 cf Outflow=14.66 cfs 55,615 cf

Pond P2: Peak Elev=284.01' Storage=17,822 cf Inflow=15.12 cfs 59,593 cf
Discarded=0.19 cfs 24,415 cf Primary=16.81 cfs 27,237 cf Outflow=17.00 cfs 51,652 cf

Link DP-1: HEADWALL Inflow=7.25 cfs 40,721 cf
Primary=7.25 cfs 40,721 cf

Link DP-10: OFFSITE NORTH Inflow=2.06 cfs 7,566 cf
Primary=2.06 cfs 7,566 cf

Link DP-2: HEADWALL Inflow=18.15 cfs 66,947 cf
Primary=18.15 cfs 66,947 cf

Link DP-3: HEADWALL Inflow=129.84 cfs 452,573 cf
Primary=129.84 cfs 452,573 cf

Link DP-4: KING ST CLOSED DRAINAGE Inflow=4.72 cfs 19,922 cf
Primary=4.72 cfs 19,922 cf

Link DP-5: EXISTING WETLAND Inflow=41.64 cfs 225,281 cf
Primary=41.64 cfs 225,281 cf

Link DP-6: EXISTING STORMWATER POND Inflow=166.14 cfs 598,871 cf
Primary=166.14 cfs 598,871 cf

Link DP-7: EXISTING STORMWATER POND Inflow=17.64 cfs 62,747 cf
Primary=17.64 cfs 62,747 cf

Link DP-8: EXISTING STORMWATER POND Inflow=3.48 cfs 12,053 cf
Primary=3.48 cfs 12,053 cf

Link DP-9: OFFSITE HEADWALL SOUTHWEST Inflow=15.04 cfs 50,604 cf
Primary=15.04 cfs 50,604 cf

Total Runoff Area = 1,927,513 sf Runoff Volume = 1,014,213 cf Average Runoff Depth = 6.31"
47.51% Pervious = 915,850 sf 52.49% Impervious = 1,011,663 sf

Time span=0.00-36.00 hrs, dt=0.04 hrs, 901 points x 3
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1.1: ROAD Runoff Area=37,044 sf 77.91% Impervious Runoff Depth=8.23"
Tc=6.0 min CN=92 Runoff=6.83 cfs 25,415 cf

Subcatchment 1.2: ABUTTING LOTS Runoff Area=72,902 sf 27.76% Impervious Runoff Depth=3.88"
Flow Length=357' Tc=27.1 min CN=57 Runoff=3.87 cfs 23,589 cf

Subcatchment 2.1: PARKING Runoff Area=122,705 sf 77.00% Impervious Runoff Depth=7.62"
Flow Length=451' Tc=6.9 min CN=87 Runoff=20.93 cfs 77,935 cf

Subcatchment 3.1: PARKING Runoff Area=582,220 sf 66.44% Impervious Runoff Depth=8.11"
Flow Length=823' Tc=7.9 min CN=91 Runoff=99.76 cfs 393,536 cf

Subcatchment 3.2: BUILDING Runoff Area=8,600 sf 100.00% Impervious Runoff Depth=8.96"
Tc=6.0 min CN=98 Runoff=1.62 cfs 6,421 cf

Subcatchment 3.3: Runoff Area=72,797 sf 33.90% Impervious Runoff Depth=7.01"
Tc=6.0 min CN=82 Runoff=12.20 cfs 42,499 cf

Subcatchment 3.4: BUILDING Runoff Area=91,130 sf 100.00% Impervious Runoff Depth=8.96"
Tc=6.0 min CN=98 Runoff=17.21 cfs 68,040 cf

Subcatchment 3.5: BUILDING Runoff Area=90,980 sf 100.00% Impervious Runoff Depth=8.96"
Tc=6.0 min CN=98 Runoff=17.18 cfs 67,928 cf

Subcatchment 4.1: ROAD Runoff Area=38,613 sf 24.06% Impervious Runoff Depth=7.25"
Flow Length=339' Slope=0.0210 '/' Tc=11.4 min CN=84 Runoff=5.48 cfs 23,337 cf

Subcatchment 5.1: PARKING Runoff Area=59,518 sf 72.12% Impervious Runoff Depth=8.35"
Tc=6.0 min CN=93 Runoff=11.04 cfs 41,437 cf

Subcatchment 5.2: LANDSCAPING Runoff Area=25,460 sf 0.70% Impervious Runoff Depth=6.76"
Flow Length=343' Slope=0.0200 '/' Tc=11.7 min CN=80 Runoff=3.40 cfs 14,338 cf

Subcatchment 5.3: Runoff Area=173,079 sf 42.34% Impervious Runoff Depth=7.13"
Flow Length=284' Tc=38.3 min CN=83 Runoff=13.80 cfs 102,827 cf

Subcatchment 5.4: PARKING Runoff Area=155,629 sf 63.12% Impervious Runoff Depth=7.99"
Tc=6.0 min CN=90 Runoff=28.30 cfs 103,610 cf

Subcatchment 6.1: UNDISTURBED Runoff Area=120,057 sf 26.00% Impervious Runoff Depth=4.76"
Flow Length=159' Slope=0.0500 '/' Tc=7.2 min CN=64 Runoff=13.71 cfs 47,618 cf

Subcatchment 7.1: TUTTLE LAND Runoff Area=115,894 sf 1.15% Impervious Runoff Depth=6.26"
Flow Length=404' Tc=7.4 min CN=76 Runoff=16.91 cfs 60,467 cf

Subcatchment 8.1: TUTTLE HOUSE Runoff Area=23,817 sf 39.51% Impervious Runoff Depth=7.13"
Tc=6.0 min CN=83 Runoff=4.04 cfs 14,150 cf

Subcatchment 9.1: UNDISTURBED Runoff Area=118,327 sf 0.00% Impervious Runoff Depth=6.14"
Tc=6.0 min CN=75 Runoff=17.87 cfs 60,508 cf

Subcatchment 10.1: UNDISTURBED Runoff Area=12,178 sf 0.00% Impervious Runoff Depth=6.39"
Tc=6.0 min CN=77 Runoff=1.90 cfs 6,480 cf

Subcatchment 10.2: UNDISTURBED Runoff Area=5,430 sf 0.00% Impervious Runoff Depth=5.01"
Tc=0.0 min CN=66 Runoff=0.85 cfs 2,267 cf

Subcatchment 10.3: UNDISTURBED Runoff Area=521 sf 0.00% Impervious Runoff Depth=3.63"
Tc=6.0 min CN=55 Runoff=0.05 cfs 158 cf

Subcatchment 10.4: UNDISTURBED Runoff Area=612 sf 0.00% Impervious Runoff Depth=3.63"
Tc=6.0 min CN=55 Runoff=0.06 cfs 185 cf

Pond P1: Peak Elev=281.54' Storage=9,183 cf Inflow=17.21 cfs 68,040 cf
Discarded=0.10 cfs 12,824 cf Primary=17.58 cfs 51,135 cf Outflow=17.68 cfs 63,959 cf

Pond P2: Peak Elev=284.03' Storage=17,822 cf Inflow=17.18 cfs 67,928 cf
Discarded=0.19 cfs 24,546 cf Primary=17.28 cfs 35,418 cf Outflow=17.48 cfs 59,964 cf

Link DP-1: HEADWALL Inflow=8.53 cfs 49,004 cf
Primary=8.53 cfs 49,004 cf

Link DP-10: OFFSITE NORTH Inflow=2.46 cfs 9,090 cf
Primary=2.46 cfs 9,090 cf

Link DP-2: HEADWALL Inflow=20.93 cfs 77,935 cf
Primary=20.93 cfs 77,935 cf

Link DP-3: HEADWALL Inflow=146.38 cfs 529,010 cf
Primary=146.38 cfs 529,010 cf

Link DP-4: KING ST CLOSED DRAINAGE Inflow=5.48 cfs 23,337 cf
Primary=5.48 cfs 23,337 cf

Link DP-5: EXISTING WETLAND Inflow=47.92 cfs 262,213 cf
Primary=47.92 cfs 262,213 cf

Link DP-6: EXISTING STORMWATER POND Inflow=189.44 cfs 703,566 cf
Primary=189.44 cfs 703,566 cf

Link DP-7: EXISTING STORMWATER POND Inflow=20.82 cfs 74,617 cf
Primary=20.82 cfs 74,617 cf

Link DP-8: EXISTING STORMWATER POND Inflow=4.04 cfs 14,150 cf
Primary=4.04 cfs 14,150 cf

Link DP-9: OFFSITE HEADWALL SOUTHWEST Inflow=17.87 cfs 60,508 cf
Primary=17.87 cfs 60,508 cf

Total Runoff Area = 1,927,513 sf Runoff Volume = 1,182,747 cf Average Runoff Depth = 7.36"
47.51% Pervious = 915,850 sf 52.49% Impervious = 1,011,663 sf

Time span=0.00-36.00 hrs, dt=0.04 hrs, 901 points x 3
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1.1: ROAD Runoff Area=37,044 sf 77.91% Impervious Runoff Depth=9.42"
Tc=6.0 min CN=92 Runoff=7.76 cfs 29,094 cf

Subcatchment 1.2: ABUTTING LOTS Runoff Area=72,902 sf 27.76% Impervious Runoff Depth=4.81"
Flow Length=357' Tc=27.1 min CN=57 Runoff=4.84 cfs 29,222 cf

Subcatchment 2.1: PARKING Runoff Area=122,705 sf 77.00% Impervious Runoff Depth=8.80"
Flow Length=451' Tc=6.9 min CN=87 Runoff=23.95 cfs 89,978 cf

Subcatchment 3.1: PARKING Runoff Area=582,220 sf 66.44% Impervious Runoff Depth=9.30"
Flow Length=823' Tc=7.9 min CN=91 Runoff=113.48 cfs 451,249 cf

Subcatchment 3.2: BUILDING Runoff Area=8,600 sf 100.00% Impervious Runoff Depth=10.16"
Tc=6.0 min CN=98 Runoff=1.84 cfs 7,281 cf

Subcatchment 3.3: Runoff Area=72,797 sf 33.90% Impervious Runoff Depth=8.16"
Tc=6.0 min CN=82 Runoff=14.09 cfs 49,516 cf

Subcatchment 3.4: BUILDING Runoff Area=91,130 sf 100.00% Impervious Runoff Depth=10.16"
Tc=6.0 min CN=98 Runoff=19.47 cfs 77,149 cf

Subcatchment 3.5: BUILDING Runoff Area=90,980 sf 100.00% Impervious Runoff Depth=10.16"
Tc=6.0 min CN=98 Runoff=19.43 cfs 77,022 cf

Subcatchment 4.1: ROAD Runoff Area=38,613 sf 24.06% Impervious Runoff Depth=8.42"
Flow Length=339' Slope=0.0210 '/' Tc=11.4 min CN=84 Runoff=6.31 cfs 27,089 cf

Subcatchment 5.1: PARKING Runoff Area=59,518 sf 72.12% Impervious Runoff Depth=9.55"
Tc=6.0 min CN=93 Runoff=12.53 cfs 47,358 cf

Subcatchment 5.2: LANDSCAPING Runoff Area=25,460 sf 0.70% Impervious Runoff Depth=7.90"
Flow Length=343' Slope=0.0200 '/' Tc=11.7 min CN=80 Runoff=3.94 cfs 16,770 cf

Subcatchment 5.3: Runoff Area=173,079 sf 42.34% Impervious Runoff Depth=8.29"
Flow Length=284' Tc=38.3 min CN=83 Runoff=15.93 cfs 119,578 cf

Subcatchment 5.4: PARKING Runoff Area=155,629 sf 63.12% Impervious Runoff Depth=9.18"
Tc=6.0 min CN=90 Runoff=32.23 cfs 119,005 cf

Subcatchment 6.1: UNDISTURBED Runoff Area=120,057 sf 26.00% Impervious Runoff Depth=5.77"
Flow Length=159' Slope=0.0500 '/' Tc=7.2 min CN=64 Runoff=16.59 cfs 57,763 cf

Subcatchment 7.1: TUTTLE LAND Runoff Area=115,894 sf 1.15% Impervious Runoff Depth=7.38"
Flow Length=404' Tc=7.4 min CN=76 Runoff=19.78 cfs 71,294 cf

Subcatchment 8.1: TUTTLE HOUSE Runoff Area=23,817 sf 39.51% Impervious Runoff Depth=8.29"
Tc=6.0 min CN=83 Runoff=4.66 cfs 16,455 cf

Subcatchment 9.1: UNDISTURBED Runoff Area=118,327 sf 0.00% Impervious Runoff Depth=7.25"
Tc=6.0 min CN=75 Runoff=20.95 cfs 71,493 cf

Subcatchment 10.1: UNDISTURBED Runoff Area=12,178 sf 0.00% Impervious Runoff Depth=7.51"
Tc=6.0 min CN=77 Runoff=2.22 cfs 7,625 cf

Subcatchment 10.2: UNDISTURBED Runoff Area=5,430 sf 0.00% Impervious Runoff Depth=6.05"
Tc=0.0 min CN=66 Runoff=1.02 cfs 2,736 cf

Subcatchment 10.3: UNDISTURBED Runoff Area=521 sf 0.00% Impervious Runoff Depth=4.53"
Tc=6.0 min CN=55 Runoff=0.06 cfs 197 cf

Subcatchment 10.4: UNDISTURBED Runoff Area=612 sf 0.00% Impervious Runoff Depth=4.53"
Tc=6.0 min CN=55 Runoff=0.07 cfs 231 cf

Pond P1: Peak Elev=281.60' Storage=9,183 cf Inflow=19.47 cfs 77,149 cf
Discarded=0.10 cfs 12,851 cf Primary=19.02 cfs 60,212 cf Outflow=19.13 cfs 73,064 cf

Pond P2: Peak Elev=284.14' Storage=17,822 cf Inflow=19.43 cfs 77,022 cf
Discarded=0.19 cfs 24,643 cf Primary=20.12 cfs 44,396 cf Outflow=20.31 cfs 69,039 cf

Link DP-1: HEADWALL Inflow=9.95 cfs 58,316 cf
Primary=9.95 cfs 58,316 cf

Link DP-10: OFFSITE NORTH Inflow=2.91 cfs 10,788 cf
Primary=2.91 cfs 10,788 cf

Link DP-2: HEADWALL Inflow=23.95 cfs 89,978 cf
Primary=23.95 cfs 89,978 cf

Link DP-3: HEADWALL Inflow=165.67 cfs 612,654 cf
Primary=165.67 cfs 612,654 cf

Link DP-4: KING ST CLOSED DRAINAGE Inflow=6.31 cfs 27,089 cf
Primary=6.31 cfs 27,089 cf

Link DP-5: EXISTING WETLAND Inflow=54.76 cfs 302,710 cf
Primary=54.76 cfs 302,710 cf

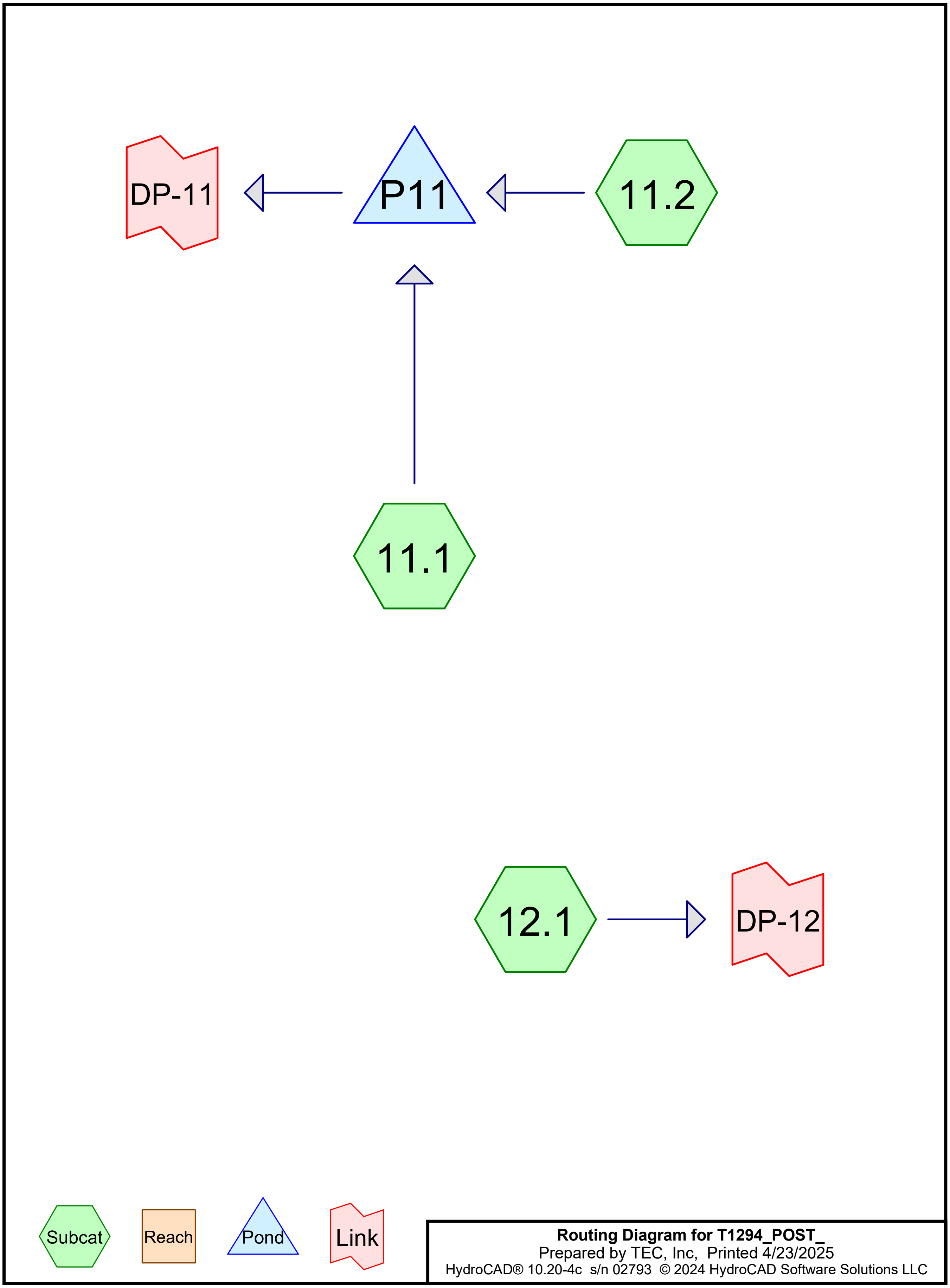
Link DP-6: EXISTING STORMWATER POND Inflow=216.01 cfs 818,711 cf
Primary=216.01 cfs 818,711 cf

Link DP-7: EXISTING STORMWATER POND Inflow=24.29 cfs 87,749 cf
Primary=24.29 cfs 87,749 cf

Link DP-8: EXISTING STORMWATER POND Inflow=4.66 cfs 16,455 cf
Primary=4.66 cfs 16,455 cf

Link DP-9: OFFSITE HEADWALL SOUTHWEST Inflow=20.95 cfs 71,493 cf
Primary=20.95 cfs 71,493 cf

Total Runoff Area = 1,927,513 sf Runoff Volume = 1,368,103 cf Average Runoff Depth = 8.52"
47.51% Pervious = 915,850 sf 52.49% Impervious = 1,011,663 sf



Routing Diagram for T1294_POST_
Prepared by TEC, Inc, Printed 4/23/2025
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Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-Year	NRCC 24-hr	D	Default	24.00	1	3.09	2
2	10-Year	NRCC 24-hr	D	Default	24.00	1	4.65	2
3	25-Year	NRCC 24-hr	D	Default	24.00	1	5.87	2
4	50-Year	NRCC 24-hr	D	Default	24.00	1	7.00	2
5	100-Year	NRCC 24-hr	D	Default	24.00	1	8.36	2
6	10-Year (2070)	NRCC 24-hr	D	Default	24.00	1	6.70	2
7	25-Year (2070)	NRCC 24-hr	D	Default	24.00	1	8.10	2
8	50-Year (2070)	NRCC 24-hr	D	Default	24.00	1	9.20	2
9	100-Year (2070)	NRCC 24-hr	D	Default	24.00	1	10.40	2

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
52,259	39	>75% Grass cover, Good, HSG A (11.1, 11.2, 12.1)
75,382	98	Paved parking, HSG A (11.1, 11.2, 12.1)
53,376	98	Roofs, HSG A (11.2)
181,017	**81**	**TOTAL AREA**

Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
181,017	HSG A	11.1, 11.2, 12.1
0	HSG B	
0	HSG C	
0	HSG D	
0	Other	
181,017		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover	Sub Num
52,259	0	0	0	0	52,259	>75% Grass cover, Good	
75,382	0	0	0	0	75,382	Paved parking	
53,376	0	0	0	0	53,376	Roofs	
181,017	**0**	**0**	**0**	**0**	**181,017**	**TOTAL AREA**	

Time span=0.00-36.00 hrs, dt=0.04 hrs, 901 points x 3
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 11.1: Runoff Area=96,897 sf 68.18% Impervious Runoff Depth=1.25"
Tc=6.0 min CN=79 Runoff=3.03 cfs 10,131 cf

Subcatchment 11.2: Runoff Area=69,877 sf 79.29% Impervious Runoff Depth=1.74"
Tc=6.0 min CN=86 Runoff=3.04 cfs 10,131 cf

Subcatchment 12.1: Runoff Area=14,243 sf 51.16% Impervious Runoff Depth=0.72"
Tc=6.0 min CN=69 Runoff=0.23 cfs 853 cf

Pond P11: Peak Elev=243.25' Storage=10,235 cf Inflow=6.07 cfs 20,263 cf
Discarded=0.24 cfs 20,265 cf Primary=0.00 cfs 0 cf Outflow=0.24 cfs 20,265 cf

Link DP-11: Inflow=0.00 cfs 0 cf
Primary=0.00 cfs 0 cf

Link DP-12: Inflow=0.23 cfs 853 cf
Primary=0.23 cfs 853 cf

Total Runoff Area = 181,017 sf Runoff Volume = 21,115 cf Average Runoff Depth = 1.40"
28.87% Pervious = 52,259 sf 71.13% Impervious = 128,758 sf

Time span=0.00-36.00 hrs, dt=0.04 hrs, 901 points x 3
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 11.1: Runoff Area=96,897 sf 68.18% Impervious Runoff Depth=2.50"
Tc=6.0 min CN=79 Runoff=6.08 cfs 20,210 cf

Subcatchment 11.2: Runoff Area=69,877 sf 79.29% Impervious Runoff Depth=3.14"
Tc=6.0 min CN=86 Runoff=5.39 cfs 18,295 cf

Subcatchment 12.1: Runoff Area=14,243 sf 51.16% Impervious Runoff Depth=1.71"
Tc=6.0 min CN=69 Runoff=0.60 cfs 2,026 cf

Pond P11: Peak Elev=243.98' Storage=13,938 cf Inflow=11.47 cfs 38,505 cf
Discarded=0.27 cfs 22,792 cf Primary=2.46 cfs 14,311 cf Outflow=2.74 cfs 37,102 cf

Link DP-11: Inflow=2.46 cfs 14,311 cf
Primary=2.46 cfs 14,311 cf

Link DP-12: Inflow=0.60 cfs 2,026 cf
Primary=0.60 cfs 2,026 cf

Total Runoff Area = 181,017 sf Runoff Volume = 40,531 cf Average Runoff Depth = 2.69"
28.87% Pervious = 52,259 sf 71.13% Impervious = 128,758 sf

Summary for Subcatchment 11.1:

Runoff = 6.08 cfs @ 12.13 hrs, Volume= 20,210 cf, Depth= 2.50"
Routed to Pond P11 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year Rainfall=4.65"

Area (sf)	CN	Description
61,121	98	Paved parking, HSG A
28,018	39	>75% Grass cover, Good, HSG A
4,948	98	Paved parking, HSG A
2,810	39	>75% Grass cover, Good, HSG A
96,897	79	Weighted Average
30,828		31.82% Pervious Area
66,069		68.18% Impervious Area

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

Summary for Subcatchment 11.2:

Runoff = 5.39 cfs @ 12.13 hrs, Volume= 18,295 cf, Depth= 3.14"
Routed to Pond P11 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year Rainfall=4.65"

Area (sf)	CN	Description
53,376	98	Roofs, HSG A
14,475	39	>75% Grass cover, Good, HSG A
2,026	98	Paved parking, HSG A
69,877	86	Weighted Average
14,475		20.71% Pervious Area
55,402		79.29% Impervious Area

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

Summary for Subcatchment 12.1:

Runoff = 0.60 cfs @ 12.13 hrs, Volume= 2,026 cf, Depth= 1.71"
Routed to Link DP-12 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year Rainfall=4.65"

Area (sf)	CN	Description
7,287	98	Paved parking, HSG A
6,956	39	>75% Grass cover, Good, HSG A
14,243	69	Weighted Average
6,956		48.84% Pervious Area
7,287		51.16% Impervious Area

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

Summary for Pond P11:

Inflow Area = 166,774 sf, 72.84% Impervious, Inflow Depth = 2.77" for 10-Year event
Inflow = 11.47 cfs @ 12.13 hrs, Volume= 38,505 cf
Outflow = 2.74 cfs @ 12.40 hrs, Volume= 37,102 cf, Atten= 76%, Lag= 16.2 min
Discarded = 0.27 cfs @ 12.40 hrs, Volume= 22,792 cf
Primary = 2.46 cfs @ 12.40 hrs, Volume= 14,311 cf
Routed to Link DP-11 :

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs / 3
Peak Elev= 243.98' @ 12.40 hrs Surf.Area= 6,598 sf Storage= 13,938 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 286.1 min (1,124.7 - 838.6)

Volume	Invert	Avail.Storage	Storage Description
#1A	241.00'	9,166 cf	**44.25'W x 149.10'L x 5.50'H Field A** 36,287 cf Overall - 13,373 cf Embedded = 22,914 cf x 40.0% Voids
#2A	241.75'	13,373 cf	**ADS_StormTech MC-3500 d +Cap** x 120 Inside #1 Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap 120 Chambers in 6 Rows Cap Storage= 14.9 cf x 2 x 6 rows = 178.8 cf
		22,539 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Device 4	243.25'	**18.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Discarded	241.00'	**1.020 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 237.00'
#3	Device 4	246.00'	**4.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#4	Primary	241.00'	**24.0" Round Culvert** L= 50.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 241.00' / 240.75' S= 0.0050 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf

Discarded OutFlow Max=0.27 cfs @ 12.40 hrs HW=243.98' (Free Discharge)
└─**2=Exfiltration** (Controls 0.27 cfs)

Primary OutFlow Max=2.46 cfs @ 12.40 hrs HW=243.98' TW=0.00' (Dynamic Tailwater)
└─**4=Culvert** (Passes 2.46 cfs of 16.79 cfs potential flow)
  ├─**1=Orifice/Grate** (Orifice Controls 2.46 cfs @ 2.90 fps)
  └─**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Link DP-11:

Inflow Area =	166,774 sf,	72.84% Impervious,	Inflow Depth = 1.03"	for 10-Year event
Inflow =	2.46 cfs @	12.40 hrs, Volume=	14,311 cf	
Primary =	2.46 cfs @	12.40 hrs, Volume=	14,311 cf,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs

Summary for Link DP-12:

Inflow Area =	14,243 sf,	51.16% Impervious,	Inflow Depth = 1.71"	for 10-Year event
Inflow =	0.60 cfs @	12.13 hrs, Volume=	2,026 cf	
Primary =	0.60 cfs @	12.13 hrs, Volume=	2,026 cf,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs

Time span=0.00-36.00 hrs, dt=0.04 hrs, 901 points x 3
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 11.1: Runoff Area=96,897 sf 68.18% Impervious Runoff Depth=3.56"
Tc=6.0 min CN=79 Runoff=8.59 cfs 28,777 cf

Subcatchment 11.2: Runoff Area=69,877 sf 79.29% Impervious Runoff Depth=4.29"
Tc=6.0 min CN=86 Runoff=7.24 cfs 24,958 cf

Subcatchment 12.1: Runoff Area=14,243 sf 51.16% Impervious Runoff Depth=2.61"
Tc=6.0 min CN=69 Runoff=0.93 cfs 3,100 cf

Pond P11: Peak Elev=244.72' Storage=17,298 cf Inflow=15.84 cfs 53,734 cf
Discarded=0.30 cfs 23,908 cf Primary=7.27 cfs 28,180 cf Outflow=7.57 cfs 52,088 cf

Link DP-11: Inflow=7.27 cfs 28,180 cf
Primary=7.27 cfs 28,180 cf

Link DP-12: Inflow=0.93 cfs 3,100 cf
Primary=0.93 cfs 3,100 cf

Total Runoff Area = 181,017 sf Runoff Volume = 56,834 cf Average Runoff Depth = 3.77"
28.87% Pervious = 52,259 sf 71.13% Impervious = 128,758 sf

Time span=0.00-36.00 hrs, dt=0.04 hrs, 901 points x 3
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 11.1: Runoff Area=96,897 sf 68.18% Impervious Runoff Depth=4.58"
Tc=6.0 min CN=79 Runoff=10.96 cfs 37,018 cf

Subcatchment 11.2: Runoff Area=69,877 sf 79.29% Impervious Runoff Depth=5.37"
Tc=6.0 min CN=86 Runoff=8.96 cfs 31,245 cf

Subcatchment 12.1: Runoff Area=14,243 sf 51.16% Impervious Runoff Depth=3.51"
Tc=6.0 min CN=69 Runoff=1.26 cfs 4,171 cf

Pond P11: Peak Elev=245.64' Storage=20,260 cf Inflow=19.91 cfs 68,263 cf
Discarded=0.34 cfs 24,786 cf Primary=10.89 cfs 41,711 cf Outflow=11.23 cfs 66,496 cf

Link DP-11: Inflow=10.89 cfs 41,711 cf
Primary=10.89 cfs 41,711 cf

Link DP-12: Inflow=1.26 cfs 4,171 cf
Primary=1.26 cfs 4,171 cf

Total Runoff Area = 181,017 sf Runoff Volume = 72,433 cf Average Runoff Depth = 4.80"
28.87% Pervious = 52,259 sf 71.13% Impervious = 128,758 sf

Time span=0.00-36.00 hrs, dt=0.04 hrs, 901 points x 3
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 11.1: Runoff Area=96,897 sf 68.18% Impervious Runoff Depth=5.84"
Tc=6.0 min CN=79 Runoff=13.82 cfs 47,188 cf

Subcatchment 11.2: Runoff Area=69,877 sf 79.29% Impervious Runoff Depth=6.68"
Tc=6.0 min CN=86 Runoff=11.00 cfs 38,903 cf

Subcatchment 12.1: Runoff Area=14,243 sf 51.16% Impervious Runoff Depth=4.66"
Tc=6.0 min CN=69 Runoff=1.66 cfs 5,528 cf

Pond P11: Peak Elev=246.47' Storage=22,463 cf Inflow=24.83 cfs 86,091 cf
Discarded=0.37 cfs 25,714 cf Primary=17.23 cfs 58,517 cf Outflow=17.60 cfs 84,231 cf

Link DP-11: Inflow=17.23 cfs 58,517 cf
Primary=17.23 cfs 58,517 cf

Link DP-12: Inflow=1.66 cfs 5,528 cf
Primary=1.66 cfs 5,528 cf

Total Runoff Area = 181,017 sf Runoff Volume = 91,619 cf Average Runoff Depth = 6.07"
28.87% Pervious = 52,259 sf 71.13% Impervious = 128,758 sf

Time span=0.00-36.00 hrs, dt=0.04 hrs, 901 points x 3
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 11.1: Runoff Area=96,897 sf 68.18% Impervious Runoff Depth=4.31"
Tc=6.0 min CN=79 Runoff=10.33 cfs 34,808 cf

Subcatchment 11.2: Runoff Area=69,877 sf 79.29% Impervious Runoff Depth=5.08"
Tc=6.0 min CN=86 Runoff=8.50 cfs 29,568 cf

Subcatchment 12.1: Runoff Area=14,243 sf 51.16% Impervious Runoff Depth=3.27"
Tc=6.0 min CN=69 Runoff=1.17 cfs 3,881 cf

Pond P11: Peak Elev=245.36' Storage=19,517 cf Inflow=18.83 cfs 64,375 cf
Discarded=0.33 cfs 24,562 cf Primary=9.92 cfs 38,074 cf Outflow=10.25 cfs 62,636 cf

Link DP-11: Inflow=9.92 cfs 38,074 cf
Primary=9.92 cfs 38,074 cf

Link DP-12: Inflow=1.17 cfs 3,881 cf
Primary=1.17 cfs 3,881 cf

Total Runoff Area = 181,017 sf Runoff Volume = 68,256 cf Average Runoff Depth = 4.52"
28.87% Pervious = 52,259 sf 71.13% Impervious = 128,758 sf

Summary for Subcatchment 11.1:

Runoff = 10.33 cfs @ 12.13 hrs, Volume= 34,808 cf, Depth= 4.31"
Routed to Pond P11 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year (2070) Rainfall=6.70"

Area (sf)	CN	Description
61,121	98	Paved parking, HSG A
28,018	39	>75% Grass cover, Good, HSG A
4,948	98	Paved parking, HSG A
2,810	39	>75% Grass cover, Good, HSG A
96,897	79	Weighted Average
30,828		31.82% Pervious Area
66,069		68.18% Impervious Area

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

Summary for Subcatchment 11.2:

Runoff = 8.50 cfs @ 12.13 hrs, Volume= 29,568 cf, Depth= 5.08"
Routed to Pond P11 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year (2070) Rainfall=6.70"

Area (sf)	CN	Description
53,376	98	Roofs, HSG A
14,475	39	>75% Grass cover, Good, HSG A
2,026	98	Paved parking, HSG A
69,877	86	Weighted Average
14,475		20.71% Pervious Area
55,402		79.29% Impervious Area

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

Summary for Subcatchment 12.1:

Runoff = 1.17 cfs @ 12.13 hrs, Volume= 3,881 cf, Depth= 3.27"
Routed to Link DP-12 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year (2070) Rainfall=6.70"

Area (sf)	CN	Description
7,287	98	Paved parking, HSG A
6,956	39	>75% Grass cover, Good, HSG A
14,243	69	Weighted Average
6,956		48.84% Pervious Area
7,287		51.16% Impervious Area

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

Summary for Pond P11:

Inflow Area = 166,774 sf, 72.84% Impervious, Inflow Depth = 4.63" for 10-Year (2070) event
Inflow = 18.83 cfs @ 12.13 hrs, Volume= 64,375 cf
Outflow = 10.25 cfs @ 12.22 hrs, Volume= 62,636 cf, Atten= 46%, Lag= 5.8 min
Discarded = 0.33 cfs @ 12.22 hrs, Volume= 24,562 cf
Primary = 9.92 cfs @ 12.22 hrs, Volume= 38,074 cf
Routed to Link DP-11 :

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs / 3
Peak Elev= 245.36' @ 12.22 hrs Surf.Area= 6,598 sf Storage= 19,517 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 183.7 min (1,003.9 - 820.1)

Volume	Invert	Avail.Storage	Storage Description
#1A	241.00'	9,166 cf	**44.25'W x 149.10'L x 5.50'H Field A** 36,287 cf Overall - 13,373 cf Embedded = 22,914 cf x 40.0% Voids
#2A	241.75'	13,373 cf	**ADS_StormTech MC-3500 d +Cap** x 120 Inside #1 Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap 120 Chambers in 6 Rows Cap Storage= 14.9 cf x 2 x 6 rows = 178.8 cf
		22,539 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Device 4	243.25'	**18.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Discarded	241.00'	**1.020 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 237.00'
#3	Device 4	246.00'	**4.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#4	Primary	241.00'	**24.0" Round Culvert** L= 50.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 241.00' / 240.75' S= 0.0050 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf

Discarded OutFlow Max=0.33 cfs @ 12.22 hrs HW=245.35' (Free Discharge)
└─**2=Exfiltration** (Controls 0.33 cfs)

Primary OutFlow Max=9.87 cfs @ 12.22 hrs HW=245.35' TW=0.00' (Dynamic Tailwater)
└─**4=Culvert** (Passes 9.87 cfs of 21.84 cfs potential flow)
  ├─**1=Orifice/Grate** (Orifice Controls 9.87 cfs @ 5.59 fps)
  └─**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Link DP-11:

Inflow Area = 166,774 sf, 72.84% Impervious, Inflow Depth = 2.74" for 10-Year (2070) event
Inflow = 9.92 cfs @ 12.22 hrs, Volume= 38,074 cf
Primary = 9.92 cfs @ 12.22 hrs, Volume= 38,074 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs

Summary for Link DP-12:

Inflow Area = 14,243 sf, 51.16% Impervious, Inflow Depth = 3.27" for 10-Year (2070) event
Inflow = 1.17 cfs @ 12.13 hrs, Volume= 3,881 cf
Primary = 1.17 cfs @ 12.13 hrs, Volume= 3,881 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs

Time span=0.00-36.00 hrs, dt=0.04 hrs, 901 points x 3
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 11.1: Runoff Area=96,897 sf 68.18% Impervious Runoff Depth=5.60"
Tc=6.0 min CN=79 Runoff=13.27 cfs 45,227 cf

Subcatchment 11.2: Runoff Area=69,877 sf 79.29% Impervious Runoff Depth=6.43"
Tc=6.0 min CN=86 Runoff=10.61 cfs 37,433 cf

Subcatchment 12.1: Runoff Area=14,243 sf 51.16% Impervious Runoff Depth=4.43"
Tc=6.0 min CN=69 Runoff=1.58 cfs 5,264 cf

Pond P11: Peak Elev=246.37' Storage=22,209 cf Inflow=23.89 cfs 82,660 cf
Discarded=0.37 cfs 25,550 cf Primary=15.77 cfs 55,265 cf Outflow=16.14 cfs 80,815 cf

Link DP-11: Inflow=15.77 cfs 55,265 cf
Primary=15.77 cfs 55,265 cf

Link DP-12: Inflow=1.58 cfs 5,264 cf
Primary=1.58 cfs 5,264 cf

Total Runoff Area = 181,017 sf Runoff Volume = 87,924 cf Average Runoff Depth = 5.83"
28.87% Pervious = 52,259 sf 71.13% Impervious = 128,758 sf

Time span=0.00-36.00 hrs, dt=0.04 hrs, 901 points x 3
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 11.1: Runoff Area=96,897 sf 68.18% Impervious Runoff Depth=6.63"
Tc=6.0 min CN=79 Runoff=15.59 cfs 53,568 cf

Subcatchment 11.2: Runoff Area=69,877 sf 79.29% Impervious Runoff Depth=7.50"
Tc=6.0 min CN=86 Runoff=12.26 cfs 43,666 cf

Subcatchment 12.1: Runoff Area=14,243 sf 51.16% Impervious Runoff Depth=5.39"
Tc=6.0 min CN=69 Runoff=1.91 cfs 6,393 cf

Pond P11: Peak Elev=247.65' Storage=22,539 cf Inflow=27.85 cfs 97,234 cf
Discarded=0.41 cfs 26,206 cf Primary=28.42 cfs 69,124 cf Outflow=28.83 cfs 95,330 cf

Link DP-11: Inflow=28.42 cfs 69,124 cf
Primary=28.42 cfs 69,124 cf

Link DP-12: Inflow=1.91 cfs 6,393 cf
Primary=1.91 cfs 6,393 cf

Total Runoff Area = 181,017 sf Runoff Volume = 103,627 cf Average Runoff Depth = 6.87"
28.87% Pervious = 52,259 sf 71.13% Impervious = 128,758 sf

Time span=0.00-36.00 hrs, dt=0.04 hrs, 901 points x 3
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 11.1: Runoff Area=96,897 sf 68.18% Impervious Runoff Depth=7.77"
Tc=6.0 min CN=79 Runoff=18.12 cfs 62,775 cf

Subcatchment 11.2: Runoff Area=69,877 sf 79.29% Impervious Runoff Depth=8.67"
Tc=6.0 min CN=86 Runoff=14.05 cfs 50,503 cf

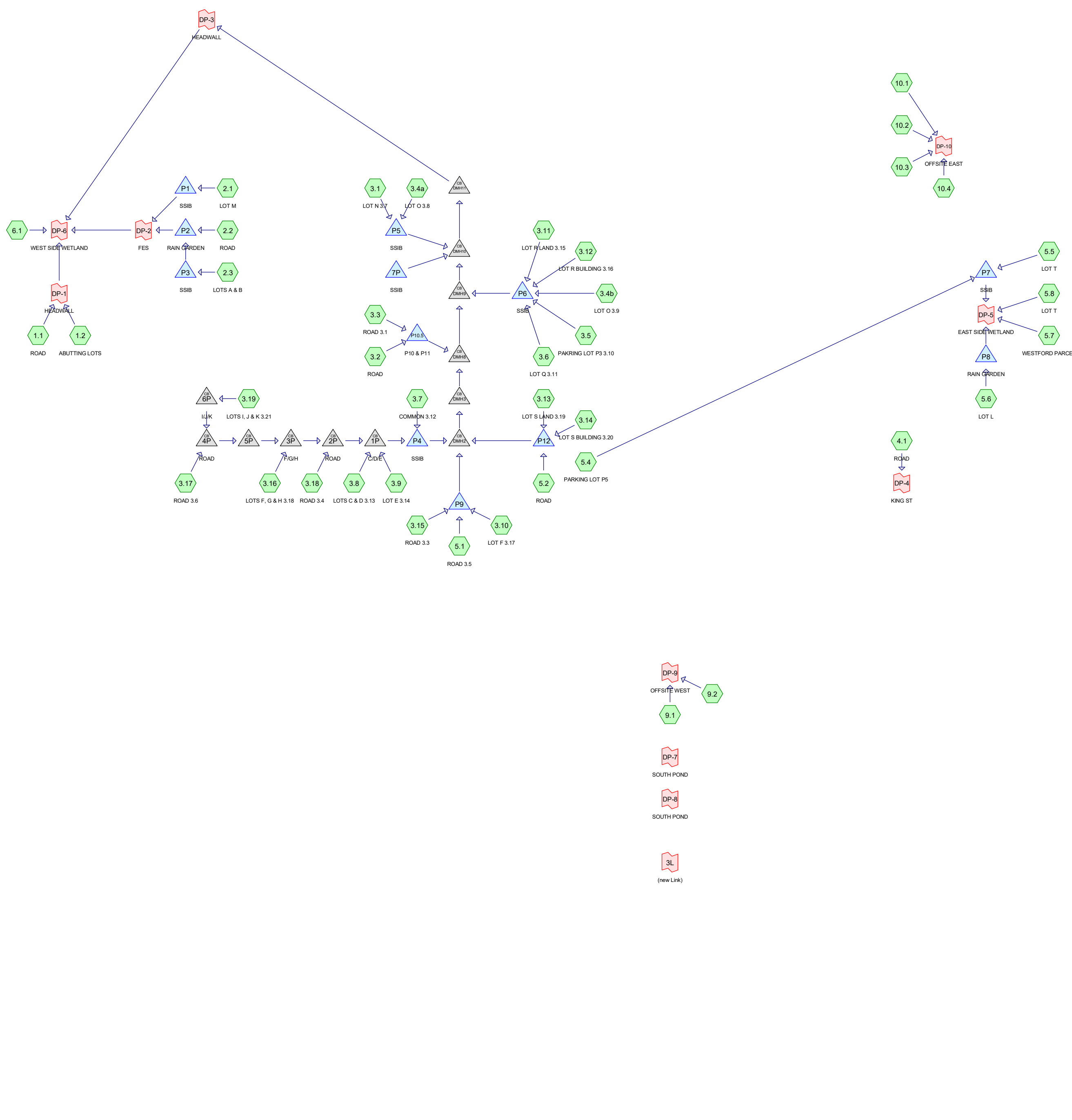
Subcatchment 12.1: Runoff Area=14,243 sf 51.16% Impervious Runoff Depth=6.45"
Tc=6.0 min CN=69 Runoff=2.28 cfs 7,657 cf

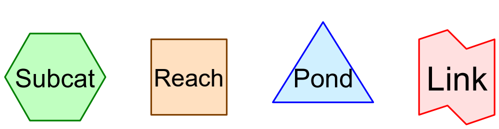
Pond P11: Peak Elev=248.85' Storage=22,539 cf Inflow=32.17 cfs 113,278 cf
Discarded=0.46 cfs 26,836 cf Primary=32.15 cfs 84,488 cf Outflow=32.61 cfs 111,324 cf

Link DP-11: Inflow=32.15 cfs 84,488 cf
Primary=32.15 cfs 84,488 cf

Link DP-12: Inflow=2.28 cfs 7,657 cf
Primary=2.28 cfs 7,657 cf

Total Runoff Area = 181,017 sf Runoff Volume = 120,935 cf Average Runoff Depth = 8.02"
28.87% Pervious = 52,259 sf 71.13% Impervious = 128,758 sf





Routing Diagram for T1594_POST_FEIR
Prepared by TEC, Inc, Printed 9/12/2025
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Project Notes

Rainfall events imported from "NRCS-Rain.txt" for 4157 MA Littleton Middlesex County Central

Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	1-Inch	NRCC 24-hr	D	Default	24.00	1	1.00	2
2	2-Year	NRCC 24-hr	D	Default	24.00	1	3.09	2
3	10-Year	NRCC 24-hr	D	Default	24.00	1	4.65	2
4	25-Year	NRCC 24-hr	D	Default	24.00	1	5.87	2
5	50-Year	NRCC 24-hr	D	Default	24.00	1	7.00	2
6	100-Year	NRCC 24-hr	D	Default	24.00	1	8.36	2
7	10-Year (2070)	NRCC 24-hr	D	Default	24.00	1	6.70	2
8	25-Year (2070)	NRCC 24-hr	D	Default	24.00	1	8.10	2
9	50-Year (2070)	NRCC 24-hr	D	Default	24.00	1	9.20	2
10	100-Year (2070)	NRCC 24-hr	D	Default	24.00	1	10.40	2

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
300,633	39	>75% Grass cover, Good, HSG A (1.1, 1.2, 2.1, 2.2, 3.1, 3.15, 3.17, 3.18, 3.2, 3.3, 3.4a, 3.4b, 3.6, 4.1, 5.1, 5.2, 5.4, 5.6, 5.7, 5.8, 6.1, 9.1, 10.1, 10.2)
66,350	61	>75% Grass cover, Good, HSG B (5.6, 5.7, 5.8, 10.2)
187,683	74	>75% Grass cover, Good, HSG C (2.2, 2.3, 3.11, 3.13, 3.15, 3.17, 3.18, 3.2, 3.4a, 3.4b, 3.5, 3.7, 5.1)
826,147	98	Paved parking, HSG A (1.1, 1.2, 2.2, 2.3, 3.1, 3.10, 3.15, 3.16, 3.17, 3.18, 3.19, 3.2, 3.3, 3.4a, 3.4b, 3.5, 3.6, 3.8, 3.9, 4.1, 5.1, 5.2, 5.4, 5.5, 5.6, 5.8)
109,358	98	Paved parking, HSG C (2.2, 3.11, 3.13, 3.15, 3.18, 3.2, 3.8, 3.9, 5.1)
120,000	98	Roofs, HSG A (2.1)
90,980	98	Roofs, HSG A & C (3.14)
91,130	98	Roofs, HSG C (3.12)
31,218	98	Water Surface, HSG A (6.1)
24,945	30	Woods, Good, HSG A (1.2, 6.1, 10.1)
4,084	55	Woods, Good, HSG B (10.2, 10.3, 10.4)
868	70	Woods, Good, HSG C (10.1)
58,082	32	Woods/grass comb., Good, HSG A (9.1, 9.2)
17,052	72	Woods/grass comb., Good, HSG C (3.11, 9.2)
1,928,530	**82**	**TOTAL AREA**

Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
1,452,005	HSG A	1.1, 1.2, 2.1, 2.2, 2.3, 3.1, 3.10, 3.14, 3.15, 3.16, 3.17, 3.18, 3.19, 3.2, 3.3, 3.4a, 3.4b, 3.5, 3.6, 3.8, 3.9, 4.1, 5.1, 5.2, 5.4, 5.5, 5.6, 5.7, 5.8, 6.1, 9.1, 9.2, 10.1, 10.2
70,434	HSG B	5.6, 5.7, 5.8, 10.2, 10.3, 10.4
406,091	HSG C	2.2, 2.3, 3.11, 3.12, 3.13, 3.15, 3.17, 3.18, 3.2, 3.4a, 3.4b, 3.5, 3.7, 3.8, 3.9, 5.1, 9.2, 10.1
0	HSG D	
0	Other	
1,928,530		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover	Su Nu
300,633	66,350	187,683	0	0	554,666	>75% Grass cover, Good	
826,147	0	109,358	0	0	935,505	Paved parking	
210,980	0	91,130	0	0	302,110	Roofs	
31,218	0	0	0	0	31,218	Water Surface	
24,945	4,084	868	0	0	29,897	Woods, Good	
58,082	0	17,052	0	0	75,134	Woods/grass comb., Good	
1,452,005	**70,434**	**406,091**	**0**	**0**	**1,928,530**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)	Node Name
1	5.1	0.00	0.00	2,150.0	0.0050	0.013	0.0	24.0	0.0	
2	1P	275.15	275.00	30.0	0.0050	0.013	0.0	36.0	0.0	
3	2P	276.32	275.25	215.0	0.0050	0.013	0.0	36.0	0.0	
4	3P	276.50	276.42	15.0	0.0053	0.013	0.0	36.0	0.0	
5	4P	278.70	277.70	200.0	0.0050	0.013	0.0	36.0	0.0	
6	5P	277.60	276.60	200.0	0.0050	0.013	0.0	36.0	0.0	
7	6P	279.10	278.80	60.0	0.0050	0.013	0.0	24.0	0.0	
8	7P	260.50	260.25	50.0	0.0050	0.013	0.0	24.0	0.0	
9	DMH10	254.00	254.50	77.0	-0.0065	0.011	0.0	48.0	0.0	
10	DMH11	254.00	253.50	67.0	0.0075	0.011	0.0	48.0	0.0	
11	DMH2	267.03	266.02	208.0	0.0049	0.011	0.0	36.0	0.0	
12	DMH3	265.92	264.85	214.0	0.0050	0.011	0.0	36.0	0.0	
13	DMH8	264.75	264.37	77.0	0.0049	0.011	0.0	42.0	0.0	
14	DMH9	259.28	257.90	276.0	0.0050	0.011	0.0	48.0	0.0	
15	P1	264.00	263.90	20.0	0.0050	0.013	0.0	12.0	0.0	
16	P10.5	271.00	270.50	100.0	0.0050	0.013	0.0	18.0	0.0	
17	P12	272.25	272.05	37.0	0.0054	0.013	0.0	24.0	0.0	
18	P2	253.71	253.36	32.0	0.0109	0.012	0.0	15.0	0.0	
19	P3	266.00	265.50	100.0	0.0050	0.013	0.0	24.0	0.0	
20	P4	275.50	275.40	20.0	0.0050	0.013	0.0	36.0	0.0	
21	P5	260.50	260.25	50.0	0.0050	0.013	0.0	24.0	0.0	
22	P6	273.00	272.50	100.0	0.0050	0.013	0.0	24.0	0.0	
23	P7	278.00	277.50	100.0	0.0050	0.013	0.0	24.0	0.0	
24	P8	266.10	266.00	20.0	0.0050	0.013	0.0	12.0	0.0	
25	P9	274.00	273.75	43.3	0.0058	0.013	0.0	18.0	0.0	

Time span=0.00-36.00 hrs, dt=0.04 hrs, 901 points x 3
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1.1: ROAD Runoff Area=26,307 sf 68.48% Impervious Runoff Depth=0.07"
Tc=6.0 min CN=79 Runoff=0.01 cfs 154 cf

Subcatchment 1.2: ABUTTING LOTS Runoff Area=46,595 sf 53.99% Impervious Runoff Depth=0.00"
Flow Length=211' Tc=23.6 min CN=70 Runoff=0.00 cfs 18 cf

Subcatchment 2.1: LOT M Runoff Area=127,271 sf 94.29% Impervious Runoff Depth=0.56"
Tc=6.0 min CN=95 Runoff=1.79 cfs 5,975 cf

Subcatchment 2.2: ROAD Runoff Area=46,717 sf 75.10% Impervious Runoff Depth=0.25"
Tc=6.0 min CN=88 Runoff=0.27 cfs 985 cf

Subcatchment 2.3: LOTS A & B Runoff Area=77,277 sf 74.08% Impervious Runoff Depth=0.40"
Tc=6.0 min CN=92 Runoff=0.77 cfs 2,592 cf

Subcatchment 3.1: LOT N 3.7 Runoff Area=132,423 sf 62.22% Impervious Runoff Depth=0.04"
Tc=6.0 min CN=76 Runoff=0.01 cfs 425 cf

Subcatchment 3.10: LOT F 3.17 Runoff Area=32,969 sf 100.00% Impervious Runoff Depth=0.79"
Tc=6.0 min CN=98 Runoff=0.62 cfs 2,173 cf

Subcatchment 3.11: LOT R LAND 3.15 Runoff Area=88,988 sf 29.38% Impervious Runoff Depth=0.10"
Tc=6.0 min CN=81 Runoff=0.10 cfs 727 cf

Subcatchment 3.12: LOT R BUILDING 3.16 Runoff Area=91,130 sf 100.00% Impervious Runoff Depth=0.79"
Tc=6.0 min CN=98 Runoff=1.70 cfs 6,006 cf

Subcatchment 3.13: LOT S LAND 3.19 Runoff Area=80,697 sf 28.62% Impervious Runoff Depth=0.10"
Tc=6.0 min CN=81 Runoff=0.09 cfs 659 cf

Subcatchment 3.14: LOT S BUILDING 3.20 Runoff Area=90,980 sf 100.00% Impervious Runoff Depth=0.79"
Tc=6.0 min CN=98 Runoff=1.70 cfs 5,996 cf

Subcatchment 3.15: ROAD 3.3 Runoff Area=32,025 sf 74.82% Impervious Runoff Depth=0.15"
Tc=6.0 min CN=84 Runoff=0.09 cfs 405 cf

Subcatchment 3.16: LOTS F, G & H 3.18 Runoff Area=81,934 sf 100.00% Impervious Runoff Depth=0.79"
Tc=6.0 min CN=98 Runoff=1.53 cfs 5,400 cf

Subcatchment 3.17: ROAD 3.6 Runoff Area=15,783 sf 80.68% Impervious Runoff Depth=0.25"
Tc=6.0 min CN=88 Runoff=0.09 cfs 333 cf

Subcatchment 3.18: ROAD 3.4 Runoff Area=22,298 sf 74.82% Impervious Runoff Depth=0.15"
Tc=6.0 min CN=84 Runoff=0.06 cfs 282 cf

Subcatchment 3.19: LOTS I, J & K 3.21 Runoff Area=72,569 sf 100.00% Impervious Runoff Depth=0.79"
Tc=6.0 min CN=98 Runoff=1.36 cfs 4,783 cf

Subcatchment 3.2: ROAD Runoff Area=24,520 sf 57.22% Impervious Runoff Depth=0.15"
Tc=6.0 min CN=84 Runoff=0.07 cfs 310 cf

Subcatchment 3.3: ROAD 3.1 Runoff Area=25,878 sf 60.23% Impervious Runoff Depth=0.03"
Tc=6.0 min CN=75 Runoff=0.00 cfs 65 cf

Subcatchment 3.4a: LOT O 3.8 Runoff Area=36,922 sf 51.28% Impervious Runoff Depth=0.01"
Tc=6.0 min CN=71 Runoff=0.00 cfs 24 cf

Subcatchment 3.4b: LOT O 3.9 Runoff Area=27,652 sf 63.36% Impervious Runoff Depth=0.06"
Tc=6.0 min CN=78 Runoff=0.01 cfs 134 cf

Subcatchment 3.5: PAKRING LOT P3 3.10 Runoff Area=71,929 sf 99.91% Impervious Runoff Depth=0.79"
Tc=6.0 min CN=98 Runoff=1.35 cfs 4,741 cf

Subcatchment 3.6: LOT Q 3.11 Runoff Area=57,193 sf 68.85% Impervious Runoff Depth=0.08"
Tc=6.0 min CN=80 Runoff=0.04 cfs 397 cf

Subcatchment 3.7: COMMON 3.12 Runoff Area=30,574 sf 0.00% Impervious Runoff Depth=0.02"
Flow Length=288' Slope=0.0050 '/' Tc=41.4 min CN=74 Runoff=0.00 cfs 59 cf

Subcatchment 3.8: LOTS C & D 3.13 Runoff Area=34,748 sf 100.00% Impervious Runoff Depth=0.79"
Tc=6.0 min CN=98 Runoff=0.65 cfs 2,290 cf

Subcatchment 3.9: LOT E 3.14 Runoff Area=21,259 sf 100.00% Impervious Runoff Depth=0.79"
Tc=6.0 min CN=98 Runoff=0.40 cfs 1,401 cf

Subcatchment 4.1: ROAD Runoff Area=5,837 sf 88.57% Impervious Runoff Depth=0.36"
Tc=6.0 min CN=91 Runoff=0.05 cfs 175 cf

Subcatchment 5.1: ROAD 3.5 Runoff Area=11,523 sf 79.93% Impervious Runoff Depth=0.25"
Flow Length=2,275' Tc=8.3 min CN=88 Runoff=0.06 cfs 243 cf

Subcatchment 5.2: ROAD Runoff Area=44,902 sf 82.02% Impervious Runoff Depth=0.22"
Tc=6.0 min CN=87 Runoff=0.22 cfs 838 cf

Subcatchment 5.4: PARKING LOT P5 Runoff Area=75,263 sf 66.43% Impervious Runoff Depth=0.06"
Tc=6.0 min CN=78 Runoff=0.02 cfs 366 cf

Subcatchment 5.5: LOT T Runoff Area=42,460 sf 100.00% Impervious Runoff Depth=0.79"
Tc=6.0 min CN=98 Runoff=0.79 cfs 2,798 cf

Subcatchment 5.6: LOT L Runoff Area=71,267 sf 55.43% Impervious Runoff Depth=0.06"
Flow Length=295' Slope=0.0500 '/' Tc=16.4 min CN=78 Runoff=0.01 cfs 347 cf

Subcatchment 5.7: WESTFORD PARCEL Runoff Area=55,128 sf 0.00% Impervious Runoff Depth=0.00"
Flow Length=115' Tc=21.2 min CN=55 Runoff=0.00 cfs 0 cf

Subcatchment 5.8: LOT T Runoff Area=37,553 sf 29.40% Impervious Runoff Depth=0.00"
Tc=6.0 min CN=59 Runoff=0.00 cfs 0 cf

Subcatchment 6.1: Runoff Area=86,779 sf 35.97% Impervious Runoff Depth=0.00"
Flow Length=125' Tc=22.3 min CN=59 Runoff=0.00 cfs 0 cf

Subcatchment 9.1: Runoff Area=26,390 sf 0.00% Impervious Runoff Depth=0.00"
Tc=6.0 min CN=35 Runoff=0.00 cfs 0 cf

Subcatchment 9.2: Runoff Area=56,084 sf 0.00% Impervious Runoff Depth=0.00"
Tc=6.0 min CN=41 Runoff=0.00 cfs 0 cf

Subcatchment 10.1: Runoff Area=12,176 sf 0.00% Impervious Runoff Depth=0.00"
Tc=6.0 min CN=35 Runoff=0.00 cfs 0 cf

Subcatchment 10.2: Runoff Area=5,430 sf 0.00% Impervious Runoff Depth=0.00"
Tc=0.0 min CN=48 Runoff=0.00 cfs 0 cf

Subcatchment 10.3: Runoff Area=488 sf 0.00% Impervious Runoff Depth=0.00"
Tc=6.0 min CN=55 Runoff=0.00 cfs 0 cf

Subcatchment 10.4: Runoff Area=612 sf 0.00% Impervious Runoff Depth=0.00"
Tc=6.0 min CN=55 Runoff=0.00 cfs 0 cf

Pond 1P: C/D/E Peak Elev=276.09' Inflow=4.09 cfs 14,489 cf
36.0" Round Culvert n=0.013 L=30.0' S=0.0050 '/' Outflow=4.09 cfs 14,489 cf

Pond 2P: ROAD Peak Elev=277.09' Inflow=3.04 cfs 10,798 cf
36.0" Round Culvert n=0.013 L=215.0' S=0.0050 '/' Outflow=3.04 cfs 10,798 cf

Pond 3P: F/G/H Peak Elev=277.34' Inflow=2.98 cfs 10,516 cf
36.0" Round Culvert n=0.013 L=15.0' S=0.0053 '/' Outflow=2.98 cfs 10,516 cf

Pond 4P: ROAD Peak Elev=279.20' Inflow=1.45 cfs 5,116 cf
36.0" Round Culvert n=0.013 L=200.0' S=0.0050 '/' Outflow=1.45 cfs 5,116 cf

Pond 5P: Peak Elev=278.14' Inflow=1.45 cfs 5,116 cf
36.0" Round Culvert n=0.013 L=200.0' S=0.0050 '/' Outflow=1.45 cfs 5,116 cf

Pond 6P: I/J/K Peak Elev=279.67' Inflow=1.36 cfs 4,783 cf
24.0" Round Culvert n=0.013 L=60.0' S=0.0050 '/' Outflow=1.36 cfs 4,783 cf

Pond 7P: SSIB Peak Elev=0.00' Storage=0 cf
Discarded=0.00 cfs 0 cf Primary=0.00 cfs 0 cf

Pond DMH10: Peak Elev=254.73' Inflow=0.47 cfs 5,261 cf
48.0" Round Culvert n=0.011 L=77.0' S=-0.0065 '/' Outflow=0.47 cfs 5,261 cf

Pond DMH11: Peak Elev=254.23' Inflow=0.47 cfs 5,261 cf
48.0" Round Culvert n=0.011 L=67.0' S=0.0075 '/' Outflow=0.47 cfs 5,261 cf

Pond DMH2: Peak Elev=267.30' Inflow=0.47 cfs 5,261 cf
36.0" Round Culvert n=0.011 L=208.0' S=0.0049 '/' Outflow=0.47 cfs 5,261 cf

Pond DMH3: Peak Elev=266.18' Inflow=0.47 cfs 5,261 cf
36.0" Round Culvert n=0.011 L=214.0' S=0.0050 '/' Outflow=0.47 cfs 5,261 cf

Pond DMH8: Peak Elev=265.01' Inflow=0.47 cfs 5,261 cf
42.0" Round Culvert n=0.011 L=77.0' S=0.0049 '/' Outflow=0.47 cfs 5,261 cf

Pond DMH9: Peak Elev=259.52' Inflow=0.47 cfs 5,261 cf
48.0" Round Culvert n=0.011 L=276.0' S=0.0050 '/' Outflow=0.47 cfs 5,261 cf

Pond P1: SSIB Peak Elev=264.53' Storage=1,208 cf Inflow=1.79 cfs 5,975 cf
Discarded=0.32 cfs 5,978 cf Primary=0.00 cfs 0 cf Outflow=0.32 cfs 5,978 cf

Pond P10.5: P10 & P11 Peak Elev=270.50' Storage=4 cf Inflow=0.07 cfs 376 cf
Discarded=0.05 cfs 376 cf Primary=0.00 cfs 0 cf Outflow=0.05 cfs 376 cf

Pond P12: Peak Elev=276.36' Storage=3,289 cf Inflow=1.99 cfs 7,493 cf
Outflow=0.47 cfs 5,261 cf

Pond P2: RAIN GARDEN Peak Elev=255.50' Storage=0 cf Inflow=0.27 cfs 985 cf
Discarded=0.27 cfs 985 cf Primary=0.00 cfs 0 cf Outflow=0.27 cfs 985 cf

Pond P3: SSIB Peak Elev=266.97' Storage=494 cf Inflow=0.77 cfs 2,592 cf
Discarded=0.15 cfs 2,592 cf Primary=0.00 cfs 0 cf Outflow=0.15 cfs 2,592 cf

Pond P4: SSIB Peak Elev=275.52' Storage=3,950 cf Inflow=4.09 cfs 14,548 cf
Discarded=0.44 cfs 14,551 cf Primary=0.00 cfs 0 cf Outflow=0.44 cfs 14,551 cf

Pond P5: SSIB Peak Elev=262.00' Storage=0 cf Inflow=0.01 cfs 449 cf
Discarded=0.01 cfs 449 cf Primary=0.00 cfs 0 cf Outflow=0.01 cfs 449 cf

Pond P6: SSIB Peak Elev=273.93' Storage=4,084 cf Inflow=3.15 cfs 12,005 cf
Discarded=0.22 cfs 12,006 cf Primary=0.00 cfs 0 cf Outflow=0.22 cfs 12,006 cf

Pond P7: SSIB Peak Elev=278.26' Storage=877 cf Inflow=0.79 cfs 3,164 cf
Outflow=0.28 cfs 3,123 cf

Pond P8: RAIN GARDEN Peak Elev=276.07' Storage=2,842 cf Inflow=0.01 cfs 347 cf
Outflow=0.01 cfs 329 cf

Pond P9: Peak Elev=274.35' Storage=623 cf Inflow=0.76 cfs 2,821 cf
Discarded=0.11 cfs 2,825 cf Primary=0.00 cfs 0 cf Outflow=0.11 cfs 2,825 cf

Link 3L: (new Link)
Primary=0.00 cfs 0 cf

Link DP-1: HEADWALL Inflow=0.01 cfs 172 cf
Primary=0.01 cfs 172 cf

Link DP-10: OFFSITE EAST Inflow=0.00 cfs 0 cf
Primary=0.00 cfs 0 cf

Link DP-2: FES Inflow=0.00 cfs 0 cf
Primary=0.00 cfs 0 cf

Link DP-3: HEADWALL Inflow=0.47 cfs 5,261 cf
Primary=0.47 cfs 5,261 cf

Link DP-4: KING ST Inflow=0.05 cfs 175 cf
Primary=0.05 cfs 175 cf

Link DP-5: EAST SIDE WETLAND Inflow=0.28 cfs 3,451 cf
Primary=0.28 cfs 3,451 cf

Link DP-6: WEST SIDE WETLAND Inflow=0.47 cfs 5,433 cf
Primary=0.47 cfs 5,433 cf

Link DP-7: SOUTH POND
Primary=0.00 cfs 0 cf

Link DP-8: SOUTH POND
Primary=0.00 cfs 0 cf

Link DP-9: OFFSITE WEST Inflow=0.00 cfs 0 cf
Primary=0.00 cfs 0 cf

Total Runoff Area = 1,928,530 sf Runoff Volume = 51,101 cf Average Runoff Depth = 0.32"
34.21% Pervious = 659,697 sf 65.79% Impervious = 1,268,833 sf

Time span=0.00-36.00 hrs, dt=0.04 hrs, 901 points x 3
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1.1: ROAD Runoff Area=26,307 sf 68.48% Impervious Runoff Depth=1.25"
Tc=6.0 min CN=79 Runoff=0.82 cfs 2,751 cf

Subcatchment 1.2: ABUTTING LOTS Runoff Area=46,595 sf 53.99% Impervious Runoff Depth=0.76"
Flow Length=211' Tc=23.6 min CN=70 Runoff=0.47 cfs 2,970 cf

Subcatchment 2.1: LOT M Runoff Area=127,271 sf 94.29% Impervious Runoff Depth=2.54"
Tc=6.0 min CN=95 Runoff=7.54 cfs 26,911 cf

Subcatchment 2.2: ROAD Runoff Area=46,717 sf 75.10% Impervious Runoff Depth=1.90"
Tc=6.0 min CN=88 Runoff=2.20 cfs 7,391 cf

Subcatchment 2.3: LOTS A & B Runoff Area=77,277 sf 74.08% Impervious Runoff Depth=2.25"
Tc=6.0 min CN=92 Runoff=4.20 cfs 14,465 cf

Subcatchment 3.1: LOT N 3.7 Runoff Area=132,423 sf 62.22% Impervious Runoff Depth=1.08"
Tc=6.0 min CN=76 Runoff=3.49 cfs 11,875 cf

Subcatchment 3.10: LOT F 3.17 Runoff Area=32,969 sf 100.00% Impervious Runoff Depth=2.86"
Tc=6.0 min CN=98 Runoff=2.07 cfs 7,852 cf

Subcatchment 3.11: LOT R LAND 3.15 Runoff Area=88,988 sf 29.38% Impervious Runoff Depth=1.38"
Tc=6.0 min CN=81 Runoff=3.08 cfs 10,256 cf

Subcatchment 3.12: LOT R BUILDING 3.16 Runoff Area=91,130 sf 100.00% Impervious Runoff Depth=2.86"
Tc=6.0 min CN=98 Runoff=5.71 cfs 21,703 cf

Subcatchment 3.13: LOT S LAND 3.19 Runoff Area=80,697 sf 28.62% Impervious Runoff Depth=1.38"
Tc=6.0 min CN=81 Runoff=2.79 cfs 9,301 cf

Subcatchment 3.14: LOT S BUILDING 3.20 Runoff Area=90,980 sf 100.00% Impervious Runoff Depth=2.86"
Tc=6.0 min CN=98 Runoff=5.70 cfs 21,668 cf

Subcatchment 3.15: ROAD 3.3 Runoff Area=32,025 sf 74.82% Impervious Runoff Depth=1.59"
Tc=6.0 min CN=84 Runoff=1.28 cfs 4,245 cf

Subcatchment 3.16: LOTS F, G & H 3.18 Runoff Area=81,934 sf 100.00% Impervious Runoff Depth=2.86"
Tc=6.0 min CN=98 Runoff=5.14 cfs 19,513 cf

Subcatchment 3.17: ROAD 3.6 Runoff Area=15,783 sf 80.68% Impervious Runoff Depth=1.90"
Tc=6.0 min CN=88 Runoff=0.74 cfs 2,497 cf

Subcatchment 3.18: ROAD 3.4 Runoff Area=22,298 sf 74.82% Impervious Runoff Depth=1.59"
Tc=6.0 min CN=84 Runoff=0.89 cfs 2,956 cf

Subcatchment 3.19: LOTS I, J & K 3.21 Runoff Area=72,569 sf 100.00% Impervious Runoff Depth=2.86"
Tc=6.0 min CN=98 Runoff=4.55 cfs 17,283 cf

Subcatchment 3.2: ROAD Runoff Area=24,520 sf 57.22% Impervious Runoff Depth=1.59"
Tc=6.0 min CN=84 Runoff=0.98 cfs 3,250 cf

Subcatchment 3.3: ROAD 3.1 Runoff Area=25,878 sf 60.23% Impervious Runoff Depth=1.02"
Tc=6.0 min CN=75 Runoff=0.64 cfs 2,200 cf

Subcatchment 3.4a: LOT O 3.8 Runoff Area=36,922 sf 51.28% Impervious Runoff Depth=0.81"
Tc=6.0 min CN=71 Runoff=0.70 cfs 2,501 cf

Subcatchment 3.4b: LOT O 3.9 Runoff Area=27,652 sf 63.36% Impervious Runoff Depth=1.19"
Tc=6.0 min CN=78 Runoff=0.82 cfs 2,750 cf

Subcatchment 3.5: PAKRING LOT P3 3.10 Runoff Area=71,929 sf 99.91% Impervious Runoff Depth=2.86"
Tc=6.0 min CN=98 Runoff=4.51 cfs 17,131 cf

Subcatchment 3.6: LOT Q 3.11 Runoff Area=57,193 sf 68.85% Impervious Runoff Depth=1.32"
Tc=6.0 min CN=80 Runoff=1.88 cfs 6,281 cf

Subcatchment 3.7: COMMON 3.12 Runoff Area=30,574 sf 0.00% Impervious Runoff Depth=0.97"
Flow Length=288' Slope=0.0050 '/' Tc=41.4 min CN=74 Runoff=0.30 cfs 2,461 cf

Subcatchment 3.8: LOTS C & D 3.13 Runoff Area=34,748 sf 100.00% Impervious Runoff Depth=2.86"
Tc=6.0 min CN=98 Runoff=2.18 cfs 8,276 cf

Subcatchment 3.9: LOT E 3.14 Runoff Area=21,259 sf 100.00% Impervious Runoff Depth=2.86"
Tc=6.0 min CN=98 Runoff=1.33 cfs 5,063 cf

Subcatchment 4.1: ROAD Runoff Area=5,837 sf 88.57% Impervious Runoff Depth=2.16"
Tc=6.0 min CN=91 Runoff=0.31 cfs 1,048 cf

Subcatchment 5.1: ROAD 3.5 Runoff Area=11,523 sf 79.93% Impervious Runoff Depth=1.90"
Flow Length=2,275' Tc=8.3 min CN=88 Runoff=0.50 cfs 1,823 cf

Subcatchment 5.2: ROAD Runoff Area=44,902 sf 82.02% Impervious Runoff Depth=1.82"
Tc=6.0 min CN=87 Runoff=2.04 cfs 6,802 cf

Subcatchment 5.4: PARKING LOT P5 Runoff Area=75,263 sf 66.43% Impervious Runoff Depth=1.19"
Tc=6.0 min CN=78 Runoff=2.23 cfs 7,485 cf

Subcatchment 5.5: LOT T Runoff Area=42,460 sf 100.00% Impervious Runoff Depth=2.86"
Tc=6.0 min CN=98 Runoff=2.66 cfs 10,112 cf

Subcatchment 5.6: LOT L Runoff Area=71,267 sf 55.43% Impervious Runoff Depth=1.19"
Flow Length=295' Slope=0.0500 '/' Tc=16.4 min CN=78 Runoff=1.48 cfs 7,087 cf

Subcatchment 5.7: WESTFORD PARCEL Runoff Area=55,128 sf 0.00% Impervious Runoff Depth=0.22"
Flow Length=115' Tc=21.2 min CN=55 Runoff=0.05 cfs 1,007 cf

Subcatchment 5.8: LOT T Runoff Area=37,553 sf 29.40% Impervious Runoff Depth=0.33"
Tc=6.0 min CN=59 Runoff=0.16 cfs 1,046 cf

Subcatchment 6.1: Runoff Area=86,779 sf 35.97% Impervious Runoff Depth=0.33"
Flow Length=125' Tc=22.3 min CN=59 Runoff=0.21 cfs 2,417 cf

Subcatchment 9.1: Runoff Area=26,390 sf 0.00% Impervious Runoff Depth=0.00"
Tc=6.0 min CN=35 Runoff=0.00 cfs 0 cf

Subcatchment 9.2: Runoff Area=56,084 sf 0.00% Impervious Runoff Depth=0.00"
Tc=6.0 min CN=41 Runoff=0.00 cfs 14 cf

Subcatchment 10.1: Runoff Area=12,176 sf 0.00% Impervious Runoff Depth=0.00"
Tc=6.0 min CN=35 Runoff=0.00 cfs 0 cf

Subcatchment 10.2: Runoff Area=5,430 sf 0.00% Impervious Runoff Depth=0.07"
Tc=0.0 min CN=48 Runoff=0.00 cfs 33 cf

Subcatchment 10.3: Runoff Area=488 sf 0.00% Impervious Runoff Depth=0.22"
Tc=6.0 min CN=55 Runoff=0.00 cfs 9 cf

Subcatchment 10.4: Runoff Area=612 sf 0.00% Impervious Runoff Depth=0.22"
Tc=6.0 min CN=55 Runoff=0.00 cfs 11 cf

Pond 1P: C/D/E Peak Elev=277.46' Inflow=14.83 cfs 55,587 cf
36.0" Round Culvert n=0.013 L=30.0' S=0.0050 '/' Outflow=14.83 cfs 55,587 cf

Pond 2P: ROAD Peak Elev=278.15' Inflow=11.32 cfs 42,249 cf
36.0" Round Culvert n=0.013 L=215.0' S=0.0050 '/' Outflow=11.32 cfs 42,249 cf

Pond 3P: F/G/H Peak Elev=278.42' Inflow=10.43 cfs 39,293 cf
36.0" Round Culvert n=0.013 L=15.0' S=0.0053 '/' Outflow=10.43 cfs 39,293 cf

Pond 4P: ROAD Peak Elev=279.76' Inflow=5.29 cfs 19,780 cf
36.0" Round Culvert n=0.013 L=200.0' S=0.0050 '/' Outflow=5.29 cfs 19,780 cf

Pond 5P: Peak Elev=278.87' Inflow=5.29 cfs 19,780 cf
36.0" Round Culvert n=0.013 L=200.0' S=0.0050 '/' Outflow=5.29 cfs 19,780 cf

Pond 6P: I/J/K Peak Elev=280.26' Inflow=4.55 cfs 17,283 cf
24.0" Round Culvert n=0.013 L=60.0' S=0.0050 '/' Outflow=4.55 cfs 17,283 cf

Pond 7P: SSIB Peak Elev=0.00' Storage=0 cf
Discarded=0.00 cfs 0 cf Primary=0.00 cfs 0 cf

Pond DMH10: Peak Elev=256.33' Inflow=20.47 cfs 93,332 cf
48.0" Round Culvert n=0.011 L=77.0' S=-0.0065 '/' Outflow=20.47 cfs 93,332 cf

Pond DMH11: Peak Elev=255.75' Inflow=20.47 cfs 93,332 cf
48.0" Round Culvert n=0.011 L=67.0' S=0.0075 '/' Outflow=20.47 cfs 93,332 cf

Pond DMH2: Peak Elev=268.49' Inflow=11.57 cfs 61,431 cf
36.0" Round Culvert n=0.011 L=208.0' S=0.0049 '/' Outflow=11.57 cfs 61,431 cf

Pond DMH3: Peak Elev=267.35' Inflow=11.57 cfs 61,431 cf
36.0" Round Culvert n=0.011 L=214.0' S=0.0050 '/' Outflow=11.57 cfs 61,431 cf

Pond DMH8: Peak Elev=266.14' Inflow=11.57 cfs 61,752 cf
42.0" Round Culvert n=0.011 L=77.0' S=0.0049 '/' Outflow=11.57 cfs 61,752 cf

Pond DMH9: Peak Elev=260.94' Inflow=20.47 cfs 93,332 cf
48.0" Round Culvert n=0.011 L=276.0' S=0.0050 '/' Outflow=20.47 cfs 93,332 cf

Pond P1: SSIB Peak Elev=266.71' Storage=11,211 cf Inflow=7.54 cfs 26,911 cf
Discarded=0.32 cfs 25,548 cf Primary=0.21 cfs 1,373 cf Outflow=0.53 cfs 26,921 cf

Pond P10.5: P10 & P11 Peak Elev=272.33' Storage=2,711 cf Inflow=1.62 cfs 5,450 cf
Discarded=0.05 cfs 4,885 cf Primary=0.03 cfs 321 cf Outflow=0.08 cfs 5,206 cf

Pond P12: Peak Elev=278.23' Storage=9,952 cf Inflow=10.53 cfs 37,771 cf
Outflow=3.54 cfs 35,535 cf

Pond P2: RAIN GARDEN Peak Elev=258.53' Storage=1,391 cf Inflow=2.20 cfs 8,800 cf
Discarded=0.80 cfs 8,807 cf Primary=0.00 cfs 0 cf Outflow=0.80 cfs 8,807 cf

Pond P3: SSIB Peak Elev=269.91' Storage=6,162 cf Inflow=4.20 cfs 14,465 cf
Discarded=0.15 cfs 13,058 cf Primary=0.24 cfs 1,409 cf Outflow=0.38 cfs 14,467 cf

Pond P4: SSIB Peak Elev=277.18' Storage=13,886 cf Inflow=14.91 cfs 58,048 cf
Discarded=0.44 cfs 34,219 cf Primary=8.17 cfs 23,855 cf Outflow=8.61 cfs 58,074 cf

Pond P5: SSIB Peak Elev=262.67' Storage=1,951 cf Inflow=4.19 cfs 14,376 cf
Discarded=1.14 cfs 14,414 cf Primary=0.00 cfs 0 cf Outflow=1.14 cfs 14,414 cf

Pond P6: SSIB Peak Elev=275.74' Storage=16,849 cf Inflow=15.99 cfs 58,121 cf
Discarded=0.22 cfs 25,804 cf Primary=8.84 cfs 31,581 cf Outflow=9.06 cfs 57,384 cf

Pond P7: SSIB Peak Elev=278.94' Storage=3,870 cf Inflow=4.88 cfs 17,597 cf
Outflow=1.95 cfs 17,550 cf

Pond P8: RAIN GARDEN Peak Elev=277.25' Storage=4,611 cf Inflow=1.48 cfs 7,087 cf
Outflow=0.81 cfs 7,058 cf

Pond P9: Peak Elev=276.22' Storage=6,120 cf Inflow=3.82 cfs 13,920 cf
Discarded=0.11 cfs 11,324 cf Primary=0.21 cfs 2,040 cf Outflow=0.32 cfs 13,364 cf

Link 3L: (new Link)
Primary=0.00 cfs 0 cf

Link DP-1: HEADWALL Inflow=1.01 cfs 5,720 cf
Primary=1.01 cfs 5,720 cf

Link DP-10: OFFSITE EAST Inflow=0.00 cfs 53 cf
Primary=0.00 cfs 53 cf

Link DP-2: FES Inflow=0.21 cfs 1,373 cf
Primary=0.21 cfs 1,373 cf

Link DP-3: HEADWALL Inflow=20.47 cfs 93,332 cf
Primary=20.47 cfs 93,332 cf

Link DP-4: KING ST Inflow=0.31 cfs 1,048 cf
Primary=0.31 cfs 1,048 cf

Link DP-5: EAST SIDE WETLAND Inflow=2.67 cfs 26,661 cf
Primary=2.67 cfs 26,661 cf

Link DP-6: WEST SIDE WETLAND Inflow=21.35 cfs 102,843 cf
Primary=21.35 cfs 102,843 cf

Link DP-7: SOUTH POND
Primary=0.00 cfs 0 cf

Link DP-8: SOUTH POND
Primary=0.00 cfs 0 cf

Link DP-9: OFFSITE WEST Inflow=0.00 cfs 14 cf
Primary=0.00 cfs 14 cf

Total Runoff Area = 1,928,530 sf Runoff Volume = 272,442 cf Average Runoff Depth = 1.70"
34.21% Pervious = 659,697 sf 65.79% Impervious = 1,268,833 sf

Time span=0.00-36.00 hrs, dt=0.04 hrs, 901 points x 3
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1.1: ROAD Runoff Area=26,307 sf 68.48% Impervious Runoff Depth=2.50"
Tc=6.0 min CN=79 Runoff=1.65 cfs 5,487 cf

Subcatchment 1.2: ABUTTING LOTS Runoff Area=46,595 sf 53.99% Impervious Runoff Depth=1.78"
Flow Length=211' Tc=23.6 min CN=70 Runoff=1.20 cfs 6,914 cf

Subcatchment 2.1: LOT M Runoff Area=127,271 sf 94.29% Impervious Runoff Depth=4.07"
Tc=6.0 min CN=95 Runoff=11.75 cfs 43,198 cf

Subcatchment 2.2: ROAD Runoff Area=46,717 sf 75.10% Impervious Runoff Depth=3.34"
Tc=6.0 min CN=88 Runoff=3.79 cfs 12,993 cf

Subcatchment 2.3: LOTS A & B Runoff Area=77,277 sf 74.08% Impervious Runoff Depth=3.75"
Tc=6.0 min CN=92 Runoff=6.81 cfs 24,136 cf

Subcatchment 3.1: LOT N 3.7 Runoff Area=132,423 sf 62.22% Impervious Runoff Depth=2.25"
Tc=6.0 min CN=76 Runoff=7.47 cfs 24,831 cf

Subcatchment 3.10: LOT F 3.17 Runoff Area=32,969 sf 100.00% Impervious Runoff Depth=4.41"
Tc=6.0 min CN=98 Runoff=3.13 cfs 12,126 cf

Subcatchment 3.11: LOT R LAND 3.15 Runoff Area=88,988 sf 29.38% Impervious Runoff Depth=2.68"
Tc=6.0 min CN=81 Runoff=5.95 cfs 19,861 cf

Subcatchment 3.12: LOT R BUILDING 3.16 Runoff Area=91,130 sf 100.00% Impervious Runoff Depth=4.41"
Tc=6.0 min CN=98 Runoff=8.66 cfs 33,519 cf

Subcatchment 3.13: LOT S LAND 3.19 Runoff Area=80,697 sf 28.62% Impervious Runoff Depth=2.68"
Tc=6.0 min CN=81 Runoff=5.40 cfs 18,010 cf

Subcatchment 3.14: LOT S BUILDING 3.20 Runoff Area=90,980 sf 100.00% Impervious Runoff Depth=4.41"
Tc=6.0 min CN=98 Runoff=8.65 cfs 33,464 cf

Subcatchment 3.15: ROAD 3.3 Runoff Area=32,025 sf 74.82% Impervious Runoff Depth=2.95"
Tc=6.0 min CN=84 Runoff=2.34 cfs 7,878 cf

Subcatchment 3.16: LOTS F, G & H 3.18 Runoff Area=81,934 sf 100.00% Impervious Runoff Depth=4.41"
Tc=6.0 min CN=98 Runoff=7.79 cfs 30,136 cf

Subcatchment 3.17: ROAD 3.6 Runoff Area=15,783 sf 80.68% Impervious Runoff Depth=3.34"
Tc=6.0 min CN=88 Runoff=1.28 cfs 4,390 cf

Subcatchment 3.18: ROAD 3.4 Runoff Area=22,298 sf 74.82% Impervious Runoff Depth=2.95"
Tc=6.0 min CN=84 Runoff=1.63 cfs 5,485 cf

Subcatchment 3.19: LOTS I, J & K 3.21 Runoff Area=72,569 sf 100.00% Impervious Runoff Depth=4.41"
Tc=6.0 min CN=98 Runoff=6.90 cfs 26,692 cf

Subcatchment 3.2: ROAD Runoff Area=24,520 sf 57.22% Impervious Runoff Depth=2.95"
Tc=6.0 min CN=84 Runoff=1.79 cfs 6,032 cf

Subcatchment 3.3: ROAD 3.1 Runoff Area=25,878 sf 60.23% Impervious Runoff Depth=2.17"
Tc=6.0 min CN=75 Runoff=1.41 cfs 4,677 cf

Subcatchment 3.4a: LOT O 3.8 Runoff Area=36,922 sf 51.28% Impervious Runoff Depth=1.86"
Tc=6.0 min CN=71 Runoff=1.70 cfs 5,710 cf

Subcatchment 3.4b: LOT O 3.9 Runoff Area=27,652 sf 63.36% Impervious Runoff Depth=2.42"
Tc=6.0 min CN=78 Runoff=1.68 cfs 5,570 cf

Subcatchment 3.5: PAKRING LOT P3 3.10 Runoff Area=71,929 sf 99.91% Impervious Runoff Depth=4.41"
Tc=6.0 min CN=98 Runoff=6.84 cfs 26,456 cf

Subcatchment 3.6: LOT Q 3.11 Runoff Area=57,193 sf 68.85% Impervious Runoff Depth=2.59"
Tc=6.0 min CN=80 Runoff=3.71 cfs 12,343 cf

Subcatchment 3.7: COMMON 3.12 Runoff Area=30,574 sf 0.00% Impervious Runoff Depth=2.09"
Flow Length=288' Slope=0.0050 '/' Tc=41.4 min CN=74 Runoff=0.70 cfs 5,321 cf

Subcatchment 3.8: LOTS C & D 3.13 Runoff Area=34,748 sf 100.00% Impervious Runoff Depth=4.41"
Tc=6.0 min CN=98 Runoff=3.30 cfs 12,781 cf

Subcatchment 3.9: LOT E 3.14 Runoff Area=21,259 sf 100.00% Impervious Runoff Depth=4.41"
Tc=6.0 min CN=98 Runoff=2.02 cfs 7,819 cf

Subcatchment 4.1: ROAD Runoff Area=5,837 sf 88.57% Impervious Runoff Depth=3.64"
Tc=6.0 min CN=91 Runoff=0.50 cfs 1,772 cf

Subcatchment 5.1: ROAD 3.5 Runoff Area=11,523 sf 79.93% Impervious Runoff Depth=3.34"
Flow Length=2,275' Tc=8.3 min CN=88 Runoff=0.86 cfs 3,205 cf

Subcatchment 5.2: ROAD Runoff Area=44,902 sf 82.02% Impervious Runoff Depth=3.24"
Tc=6.0 min CN=87 Runoff=3.55 cfs 12,119 cf

Subcatchment 5.4: PARKING LOT P5 Runoff Area=75,263 sf 66.43% Impervious Runoff Depth=2.42"
Tc=6.0 min CN=78 Runoff=4.56 cfs 15,161 cf

Subcatchment 5.5: LOT T Runoff Area=42,460 sf 100.00% Impervious Runoff Depth=4.41"
Tc=6.0 min CN=98 Runoff=4.03 cfs 15,617 cf

Subcatchment 5.6: LOT L Runoff Area=71,267 sf 55.43% Impervious Runoff Depth=2.42"
Flow Length=295' Slope=0.0500 '/' Tc=16.4 min CN=78 Runoff=3.06 cfs 14,356 cf

Subcatchment 5.7: WESTFORD PARCEL Runoff Area=55,128 sf 0.00% Impervious Runoff Depth=0.81"
Flow Length=115' Tc=21.2 min CN=55 Runoff=0.52 cfs 3,727 cf

Subcatchment 5.8: LOT T Runoff Area=37,553 sf 29.40% Impervious Runoff Depth=1.04"
Tc=6.0 min CN=59 Runoff=0.87 cfs 3,258 cf

Subcatchment 6.1: Runoff Area=86,779 sf 35.97% Impervious Runoff Depth=1.04"
Flow Length=125' Tc=22.3 min CN=59 Runoff=1.17 cfs 7,529 cf

Subcatchment 9.1: Runoff Area=26,390 sf 0.00% Impervious Runoff Depth=0.04"
Tc=6.0 min CN=35 Runoff=0.00 cfs 99 cf

Subcatchment 9.2: Runoff Area=56,084 sf 0.00% Impervious Runoff Depth=0.19"
Tc=6.0 min CN=41 Runoff=0.03 cfs 908 cf

Subcatchment 10.1: Runoff Area=12,176 sf 0.00% Impervious Runoff Depth=0.04"
Tc=6.0 min CN=35 Runoff=0.00 cfs 46 cf

Subcatchment 10.2: Runoff Area=5,430 sf 0.00% Impervious Runoff Depth=0.46"
Tc=0.0 min CN=48 Runoff=0.04 cfs 210 cf

Subcatchment 10.3: Runoff Area=488 sf 0.00% Impervious Runoff Depth=0.81"
Tc=6.0 min CN=55 Runoff=0.01 cfs 33 cf

Subcatchment 10.4: Runoff Area=612 sf 0.00% Impervious Runoff Depth=0.81"
Tc=6.0 min CN=55 Runoff=0.01 cfs 41 cf

Pond 1P: C/D/E Peak Elev=278.35' Inflow=22.91 cfs 87,303 cf
36.0" Round Culvert n=0.013 L=30.0' S=0.0050 '/' Outflow=22.91 cfs 87,303 cf

Pond 2P: ROAD Peak Elev=278.95' Inflow=17.59 cfs 66,703 cf
36.0" Round Culvert n=0.013 L=215.0' S=0.0050 '/' Outflow=17.59 cfs 66,703 cf

Pond 3P: F/G/H Peak Elev=279.20' Inflow=15.96 cfs 61,218 cf
36.0" Round Culvert n=0.013 L=15.0' S=0.0053 '/' Outflow=15.96 cfs 61,218 cf

Pond 4P: ROAD Peak Elev=280.16' Inflow=8.17 cfs 31,082 cf
36.0" Round Culvert n=0.013 L=200.0' S=0.0050 '/' Outflow=8.17 cfs 31,082 cf

Pond 5P: Peak Elev=279.49' Inflow=8.17 cfs 31,082 cf
36.0" Round Culvert n=0.013 L=200.0' S=0.0050 '/' Outflow=8.17 cfs 31,082 cf

Pond 6P: I/J/K Peak Elev=280.65' Inflow=6.90 cfs 26,692 cf
24.0" Round Culvert n=0.013 L=60.0' S=0.0050 '/' Outflow=6.90 cfs 26,692 cf

Pond 7P: SSIB Peak Elev=0.00' Storage=0 cf
Discarded=0.00 cfs 0 cf Primary=0.00 cfs 0 cf

Pond DMH10: Peak Elev=257.54' Inflow=43.55 cfs 198,830 cf
48.0" Round Culvert n=0.011 L=77.0' S=-0.0065 '/' Outflow=43.55 cfs 198,830 cf

Pond DMH11: Peak Elev=256.76' Inflow=43.55 cfs 198,830 cf
48.0" Round Culvert n=0.011 L=67.0' S=0.0075 '/' Outflow=43.55 cfs 198,830 cf

Pond DMH2: Peak Elev=269.43' Inflow=24.76 cfs 124,115 cf
36.0" Round Culvert n=0.011 L=208.0' S=0.0049 '/' Outflow=24.76 cfs 124,115 cf

Pond DMH3: Peak Elev=268.25' Inflow=24.76 cfs 124,115 cf
36.0" Round Culvert n=0.011 L=214.0' S=0.0050 '/' Outflow=24.76 cfs 124,115 cf

Pond DMH8: Peak Elev=266.96' Inflow=25.61 cfs 129,145 cf
42.0" Round Culvert n=0.011 L=77.0' S=0.0049 '/' Outflow=25.61 cfs 129,145 cf

Pond DMH9: Peak Elev=261.86' Inflow=43.55 cfs 198,830 cf
48.0" Round Culvert n=0.011 L=276.0' S=0.0050 '/' Outflow=43.55 cfs 198,830 cf

Pond P1: SSIB Peak Elev=267.47' Storage=14,602 cf Inflow=11.75 cfs 43,198 cf
Discarded=0.32 cfs 30,495 cf Primary=3.17 cfs 12,723 cf Outflow=3.49 cfs 43,218 cf

Pond P10.5: P10 & P11 Peak Elev=272.82' Storage=3,457 cf Inflow=3.20 cfs 10,708 cf
Discarded=0.05 cfs 5,237 cf Primary=1.03 cfs 5,030 cf Outflow=1.08 cfs 10,267 cf

Pond P12: Peak Elev=279.53' Storage=14,927 cf Inflow=17.59 cfs 63,593 cf
Outflow=8.21 cfs 61,357 cf

Pond P2: RAIN GARDEN Peak Elev=259.76' Storage=3,722 cf Inflow=6.29 cfs 21,847 cf
Discarded=1.09 cfs 17,780 cf Primary=3.59 cfs 4,069 cf Outflow=4.68 cfs 21,850 cf

Pond P3: SSIB Peak Elev=270.63' Storage=7,587 cf Inflow=6.81 cfs 24,136 cf
Discarded=0.15 cfs 15,290 cf Primary=3.75 cfs 8,853 cf Outflow=3.89 cfs 24,144 cf

Pond P4: SSIB Peak Elev=277.80' Storage=17,731 cf Inflow=23.13 cfs 92,624 cf
Discarded=0.44 cfs 39,919 cf Primary=15.16 cfs 52,722 cf Outflow=15.59 cfs 92,641 cf

Pond P5: SSIB Peak Elev=264.05' Storage=7,870 cf Inflow=9.18 cfs 30,541 cf
Discarded=1.14 cfs 30,574 cf Primary=0.00 cfs 0 cf Outflow=1.14 cfs 30,574 cf

Pond P6: SSIB Peak Elev=276.38' Storage=21,595 cf Inflow=26.83 cfs 97,750 cf
Discarded=0.22 cfs 27,134 cf Primary=17.97 cfs 69,685 cf Outflow=18.19 cfs 96,818 cf

Pond P7: SSIB Peak Elev=279.46' Storage=6,415 cf Inflow=8.59 cfs 30,778 cf
Outflow=3.78 cfs 30,730 cf

Pond P8: RAIN GARDEN Peak Elev=277.55' Storage=5,138 cf Inflow=3.06 cfs 14,356 cf
Outflow=2.92 cfs 14,319 cf

Pond P9: Peak Elev=276.80' Storage=8,170 cf Inflow=6.29 cfs 23,209 cf
Discarded=0.11 cfs 12,140 cf Primary=2.06 cfs 10,036 cf Outflow=2.16 cfs 22,176 cf

Link 3L: (new Link)
Primary=0.00 cfs 0 cf

Link DP-1: HEADWALL Inflow=2.23 cfs 12,401 cf
Primary=2.23 cfs 12,401 cf

Link DP-10: OFFSITE EAST Inflow=0.06 cfs 329 cf
Primary=0.06 cfs 329 cf

Link DP-2: FES Inflow=6.73 cfs 16,793 cf
Primary=6.73 cfs 16,793 cf

Link DP-3: HEADWALL Inflow=43.55 cfs 198,830 cf
Primary=43.55 cfs 198,830 cf

Link DP-4: KING ST Inflow=0.50 cfs 1,772 cf
Primary=0.50 cfs 1,772 cf

Link DP-5: EAST SIDE WETLAND Inflow=7.50 cfs 52,034 cf
Primary=7.50 cfs 52,034 cf

Link DP-6: WEST SIDE WETLAND Inflow=51.49 cfs 235,552 cf
Primary=51.49 cfs 235,552 cf

Link DP-7: SOUTH POND
Primary=0.00 cfs 0 cf

Link DP-8: SOUTH POND
Primary=0.00 cfs 0 cf

Link DP-9: OFFSITE WEST Inflow=0.03 cfs 1,007 cf
Primary=0.03 cfs 1,007 cf

Total Runoff Area = 1,928,530 sf Runoff Volume = 473,910 cf Average Runoff Depth = 2.95"
34.21% Pervious = 659,697 sf 65.79% Impervious = 1,268,833 sf

Summary for Subcatchment 1.1: ROAD

Runoff = 1.65 cfs @ 12.13 hrs, Volume= 5,487 cf, Depth= 2.50"
Routed to Link DP-1 : HEADWALL

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year Rainfall=4.65"

Area (sf)	CN	Description
18,016	98	Paved parking, HSG A
8,291	39	>75% Grass cover, Good, HSG A
26,307	79	Weighted Average
8,291		31.52% Pervious Area
18,016		68.48% Impervious Area

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

Summary for Subcatchment 1.2: ABUTTING LOTS

Runoff = 1.20 cfs @ 12.35 hrs, Volume= 6,914 cf, Depth= 1.78"
Routed to Link DP-1 : HEADWALL

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year Rainfall=4.65"

Area (sf)	CN	Description
4,565	30	Woods, Good, HSG A
16,875	39	>75% Grass cover, Good, HSG A
25,155	98	Paved parking, HSG A
46,595	70	Weighted Average
21,440		46.01% Pervious Area
25,155		53.99% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
22.9	100	0.0700	0.07		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 3.13"
0.7	111	0.0300	2.79		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
23.6	211	Total			

Summary for Subcatchment 2.1: LOT M

Runoff = 11.75 cfs @ 12.12 hrs, Volume= 43,198 cf, Depth= 4.07"
Routed to Pond P1 : SSIB

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year Rainfall=4.65"

Area (sf)	CN	Description
120,000	98	Roofs, HSG A
7,271	39	>75% Grass cover, Good, HSG A
127,271	95	Weighted Average
7,271		5.71% Pervious Area
120,000		94.29% Impervious Area

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

Summary for Subcatchment 2.2: ROAD

Runoff = 3.79 cfs @ 12.13 hrs, Volume= 12,993 cf, Depth= 3.34"
Routed to Pond P2 : RAIN GARDEN

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year Rainfall=4.65"

Area (sf)	CN	Description
15,072	98	Paved parking, HSG A
20,011	98	Paved parking, HSG C
5,168	39	>75% Grass cover, Good, HSG A
6,466	74	>75% Grass cover, Good, HSG C
46,717	88	Weighted Average
11,634		24.90% Pervious Area
35,083		75.10% Impervious Area

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

Summary for Subcatchment 2.3: LOTS A & B

Runoff = 6.81 cfs @ 12.13 hrs, Volume= 24,136 cf, Depth= 3.75"
Routed to Pond P3 : SSIB

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year Rainfall=4.65"

Area (sf)	CN	Description
57,250	98	Paved parking, HSG A
20,027	74	>75% Grass cover, Good, HSG C
77,277	92	Weighted Average
20,027		25.92% Pervious Area
57,250		74.08% Impervious Area

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

Summary for Subcatchment 3.1: LOT N 3.7

Runoff = 7.47 cfs @ 12.13 hrs, Volume= 24,831 cf, Depth= 2.25"
Routed to Pond P5 : SSIB

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year Rainfall=4.65"

Area (sf)	CN	Description
82,394	98	Paved parking, HSG A
50,029	39	>75% Grass cover, Good, HSG A
132,423	76	Weighted Average
50,029		37.78% Pervious Area
82,394		62.22% Impervious Area

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

Summary for Subcatchment 3.10: LOT F 3.17

Runoff = 3.13 cfs @ 12.12 hrs, Volume= 12,126 cf, Depth= 4.41"
Routed to Pond P9 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year Rainfall=4.65"

Area (sf)	CN	Description
32,969	98	Paved parking, HSG A
32,969		100.00% Impervious Area

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

Summary for Subcatchment 3.11: LOT R LAND 3.15

Runoff = 5.95 cfs @ 12.13 hrs, Volume= 19,861 cf, Depth= 2.68"
Routed to Pond P6 : SSIB

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year Rainfall=4.65"

Area (sf)	CN	Description
4,769	72	Woods/grass comb., Good, HSG C
58,078	74	>75% Grass cover, Good, HSG C
26,141	98	Paved parking, HSG C
88,988	81	Weighted Average
62,847		70.62% Pervious Area
26,141		29.38% Impervious Area

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

Summary for Subcatchment 3.12: LOT R BUILDING 3.16

Runoff = 8.66 cfs @ 12.12 hrs, Volume= 33,519 cf, Depth= 4.41"
Routed to Pond P6 : SSIB

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year Rainfall=4.65"

Area (sf)	CN	Description
91,130	98	Roofs, HSG C
91,130		100.00% Impervious Area

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

Summary for Subcatchment 3.13: LOT S LAND 3.19

Runoff = 5.40 cfs @ 12.13 hrs, Volume= 18,010 cf, Depth= 2.68"
Routed to Pond P12 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year Rainfall=4.65"

Area (sf)	CN	Description
57,605	74	>75% Grass cover, Good, HSG C
23,092	98	Paved parking, HSG C
80,697	81	Weighted Average
57,605		71.38% Pervious Area
23,092		28.62% Impervious Area

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

Summary for Subcatchment 3.14: LOT S BUILDING 3.20

Runoff = 8.65 cfs @ 12.12 hrs, Volume= 33,464 cf, Depth= 4.41"
Routed to Pond P12 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year Rainfall=4.65"

	Area (sf)	CN	Description
*	90,980	98	Roofs, HSG A & C
	90,980		100.00% Impervious Area

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

Summary for Subcatchment 3.15: ROAD 3.3

Runoff = 2.34 cfs @ 12.13 hrs, Volume= 7,878 cf, Depth= 2.95"
Routed to Pond P9 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year Rainfall=4.65"

Area (sf)	CN	Description
1,138	74	>75% Grass cover, Good, HSG C
6,926	39	>75% Grass cover, Good, HSG A
893	98	Paved parking, HSG C
23,068	98	Paved parking, HSG A
32,025	84	Weighted Average
8,064		25.18% Pervious Area
23,961		74.82% Impervious Area

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

Summary for Subcatchment 3.16: LOTS F, G & H 3.18

Runoff = 7.79 cfs @ 12.12 hrs, Volume= 30,136 cf, Depth= 4.41"
Routed to Pond 3P : F/G/H

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year Rainfall=4.65"

Area (sf)	CN	Description
81,934	98	Paved parking, HSG A
81,934		100.00% Impervious Area

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

Summary for Subcatchment 3.17: ROAD 3.6

Runoff = 1.28 cfs @ 12.13 hrs, Volume= 4,390 cf, Depth= 3.34"
Routed to Pond 4P : ROAD

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year Rainfall=4.65"

Area (sf)	CN	Description
821	74	>75% Grass cover, Good, HSG C
2,228	39	>75% Grass cover, Good, HSG A
12,734	98	Paved parking, HSG A
15,783	88	Weighted Average
3,049		19.32% Pervious Area
12,734		80.68% Impervious Area

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

Summary for Subcatchment 3.18: ROAD 3.4

Runoff = 1.63 cfs @ 12.13 hrs, Volume= 5,485 cf, Depth= 2.95"
Routed to Pond 2P : ROAD

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year Rainfall=4.65"

Area (sf)	CN	Description
792	74	>75% Grass cover, Good, HSG C
4,822	39	>75% Grass cover, Good, HSG A
622	98	Paved parking, HSG C
16,062	98	Paved parking, HSG A
22,298	84	Weighted Average
5,614		25.18% Pervious Area
16,684		74.82% Impervious Area

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

Summary for Subcatchment 3.19: LOTS I, J & K 3.21

Runoff = 6.90 cfs @ 12.12 hrs, Volume= 26,692 cf, Depth= 4.41"
Routed to Pond 6P : I/J/K

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year Rainfall=4.65"

Area (sf)	CN	Description
68,900	98	Paved parking, HSG A
3,669	98	Paved parking, HSG A
72,569	98	Weighted Average
72,569		100.00% Impervious Area

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

Summary for Subcatchment 3.2: ROAD

Runoff = 1.79 cfs @ 12.13 hrs, Volume= 6,032 cf, Depth= 2.95"
Routed to Pond P10.5 : P10 & P11

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year Rainfall=4.65"

Area (sf)	CN	Description
4,113	98	Paved parking, HSG A
2,649	39	>75% Grass cover, Good, HSG A
9,917	98	Paved parking, HSG C
7,841	74	>75% Grass cover, Good, HSG C
24,520	84	Weighted Average
10,490		42.78% Pervious Area
14,030		57.22% Impervious Area

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

Summary for Subcatchment 3.3: ROAD 3.1

Runoff = 1.41 cfs @ 12.13 hrs, Volume= 4,677 cf, Depth= 2.17"
Routed to Pond P10.5 : P10 & P11

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year Rainfall=4.65"

Area (sf)	CN	Description
15,587	98	Paved parking, HSG A
10,291	39	>75% Grass cover, Good, HSG A
25,878	75	Weighted Average
10,291		39.77% Pervious Area
15,587		60.23% Impervious Area

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

Summary for Subcatchment 3.4a: LOT O 3.8

Runoff = 1.70 cfs @ 12.13 hrs, Volume= 5,710 cf, Depth= 1.86"
Routed to Pond P5 : SSIB

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year Rainfall=4.65"

Area (sf)	CN	Description
18,935	98	Paved parking, HSG A
15,884	39	>75% Grass cover, Good, HSG A
2,103	74	>75% Grass cover, Good, HSG C
36,922	71	Weighted Average
17,987		48.72% Pervious Area
18,935		51.28% Impervious Area

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

Summary for Subcatchment 3.4b: LOT O 3.9

Runoff = 1.68 cfs @ 12.13 hrs, Volume= 5,570 cf, Depth= 2.42"
Routed to Pond P6 : SSIB

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year Rainfall=4.65"

Area (sf)	CN	Description
17,521	98	Paved parking, HSG A
8,584	39	>75% Grass cover, Good, HSG A
1,547	74	>75% Grass cover, Good, HSG C
27,652	78	Weighted Average
10,131		36.64% Pervious Area
17,521		63.36% Impervious Area

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

Summary for Subcatchment 3.5: PAKRING LOT P3 3.10

Runoff = 6.84 cfs @ 12.12 hrs, Volume= 26,456 cf, Depth= 4.41"
Routed to Pond P6 : SSIB

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year Rainfall=4.65"

Area (sf)	CN	Description
71,861	98	Paved parking, HSG A
68	74	>75% Grass cover, Good, HSG C
71,929	98	Weighted Average
68		0.09% Pervious Area
71,861		99.91% Impervious Area

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

Summary for Subcatchment 3.6: LOT Q 3.11

Runoff = 3.71 cfs @ 12.13 hrs, Volume= 12,343 cf, Depth= 2.59"
Routed to Pond P6 : SSIB

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year Rainfall=4.65"

Area (sf)	CN	Description
39,375	98	Paved parking, HSG A
17,818	39	>75% Grass cover, Good, HSG A
57,193	80	Weighted Average
17,818		31.15% Pervious Area
39,375		68.85% Impervious Area

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

Summary for Subcatchment 3.7: COMMON 3.12

Runoff = 0.70 cfs @ 12.57 hrs, Volume= 5,321 cf, Depth= 2.09"
Routed to Pond P4 : SSIB

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year Rainfall=4.65"

Area (sf)	CN	Description
30,574	74	>75% Grass cover, Good, HSG C
30,574		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
38.6	100	0.0050	0.04		**Sheet Flow,** Grass: Bermuda n= 0.410 P2= 3.13"
2.8	188	0.0050	1.14		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
41.4	288	Total			

Summary for Subcatchment 3.8: LOTS C & D 3.13

Runoff = 3.30 cfs @ 12.12 hrs, Volume= 12,781 cf, Depth= 4.41"
Routed to Pond 1P : C/D/E

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year Rainfall=4.65"

Area (sf)	CN	Description
15,933	98	Paved parking, HSG A
18,815	98	Paved parking, HSG C
34,748	98	Weighted Average
34,748		100.00% Impervious Area

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

Summary for Subcatchment 3.9: LOT E 3.14

Runoff = 2.02 cfs @ 12.12 hrs, Volume= 7,819 cf, Depth= 4.41"
Routed to Pond 1P : C/D/E

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year Rainfall=4.65"

Area (sf)	CN	Description
11,480	98	Paved parking, HSG A
9,779	98	Paved parking, HSG C
21,259	98	Weighted Average
21,259		100.00% Impervious Area

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

Summary for Subcatchment 4.1: ROAD

Runoff = 0.50 cfs @ 12.13 hrs, Volume= 1,772 cf, Depth= 3.64"
Routed to Link DP-4 : KING ST

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year Rainfall=4.65"

Area (sf)	CN	Description
5,170	98	Paved parking, HSG A
667	39	>75% Grass cover, Good, HSG A
5,837	91	Weighted Average
667		11.43% Pervious Area
5,170		88.57% Impervious Area

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

Summary for Subcatchment 5.1: ROAD 3.5

Runoff = 0.86 cfs @ 12.15 hrs, Volume= 3,205 cf, Depth= 3.34"
Routed to Pond P9 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year Rainfall=4.65"

Area (sf)	CN	Description
623	74	>75% Grass cover, Good, HSG C
1,690	39	>75% Grass cover, Good, HSG A
88	98	Paved parking, HSG C
9,122	98	Paved parking, HSG A
11,523	88	Weighted Average
2,313		20.07% Pervious Area
9,210		79.93% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	100	0.0200	1.36		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.13"
0.1	25	0.0200	2.87		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
7.0	2,150	0.0050	5.09	16.00	**Pipe Channel,** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013 Corrugated PE, smooth interior
8.3	2,275	Total			

Summary for Subcatchment 5.2: ROAD

Runoff = 3.55 cfs @ 12.13 hrs, Volume= 12,119 cf, Depth= 3.24"
Routed to Pond P12 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year Rainfall=4.65"

Area (sf)	CN	Description
8,075	39	>75% Grass cover, Good, HSG A
36,827	98	Paved parking, HSG A
44,902	87	Weighted Average
8,075		17.98% Pervious Area
36,827		82.02% Impervious Area

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

Summary for Subcatchment 5.4: PARKING LOT P5

Runoff = 4.56 cfs @ 12.13 hrs, Volume= 15,161 cf, Depth= 2.42"
Routed to Pond P7 : SSIB

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year Rainfall=4.65"

Area (sf)	CN	Description
50,000	98	Paved parking, HSG A
25,263	39	>75% Grass cover, Good, HSG A
75,263	78	Weighted Average
25,263		33.57% Pervious Area
50,000		66.43% Impervious Area

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

Summary for Subcatchment 5.5: LOT T

Runoff = 4.03 cfs @ 12.12 hrs, Volume= 15,617 cf, Depth= 4.41"
Routed to Pond P7 : SSIB

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year Rainfall=4.65"

Area (sf)	CN	Description
42,460	98	Paved parking, HSG A
42,460		100.00% Impervious Area

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

Summary for Subcatchment 5.6: LOT L

Runoff = 3.06 cfs @ 12.25 hrs, Volume= 14,356 cf, Depth= 2.42"
Routed to Pond P8 : RAIN GARDEN

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year Rainfall=4.65"

Area (sf)	CN	Description
39,500	98	Paved parking, HSG A
11,419	39	>75% Grass cover, Good, HSG A
20,348	61	>75% Grass cover, Good, HSG B
71,267	78	Weighted Average
31,767		44.57% Pervious Area
39,500		55.43% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.4	100	0.0500	0.11		**Sheet Flow,** Grass: Bermuda n= 0.410 P2= 3.13"
1.0	195	0.0500	3.35		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
16.4	295	Total			

Summary for Subcatchment 5.7: WESTFORD PARCEL

Runoff = 0.52 cfs @ 12.35 hrs, Volume= 3,727 cf, Depth= 0.81"
Routed to Link DP-5 : EAST SIDE WETLAND

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year Rainfall=4.65"

Area (sf)	CN	Description
41,151	61	>75% Grass cover, Good, HSG B
13,977	39	>75% Grass cover, Good, HSG A
55,128	55	Weighted Average
55,128		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.7	100	0.0900	0.08		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 3.13"
0.5	15	0.0333	0.46		**Shallow Concentrated Flow,** Forest w/Heavy Litter Kv= 2.5 fps
21.2	115	Total			

Summary for Subcatchment 5.8: LOT T

Runoff = 0.87 cfs @ 12.14 hrs, Volume= 3,258 cf, Depth= 1.04"
Routed to Link DP-5 : EAST SIDE WETLAND

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year Rainfall=4.65"

Area (sf)	CN	Description
11,040	98	Paved parking, HSG A
21,822	39	>75% Grass cover, Good, HSG A
4,691	61	>75% Grass cover, Good, HSG B
37,553	59	Weighted Average
26,513		70.60% Pervious Area
11,040		29.40% Impervious Area

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

Summary for Subcatchment 6.1:

Runoff = 1.17 cfs @ 12.35 hrs, Volume= 7,529 cf, Depth= 1.04"
Routed to Link DP-6 : WEST SIDE WETLAND

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year Rainfall=4.65"

Area (sf)	CN	Description
11,819	30	Woods, Good, HSG A
43,742	39	>75% Grass cover, Good, HSG A
31,218	98	Water Surface, HSG A
86,779	59	Weighted Average
55,561		64.03% Pervious Area
31,218		35.97% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.7	100	0.1333	0.09		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 3.13"
4.6	25	0.2400	0.09		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 3.13"
22.3	125	Total			

Summary for Subcatchment 9.1:

Runoff = 0.00 cfs @ 23.99 hrs, Volume= 99 cf, Depth= 0.04"
Routed to Link DP-9 : OFFSITE WEST

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year Rainfall=4.65"

Area (sf)	CN	Description
12,109	39	>75% Grass cover, Good, HSG A
14,281	32	Woods/grass comb., Good, HSG A
26,390	35	Weighted Average
26,390		100.00% Pervious Area

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

Summary for Subcatchment 9.2:

Runoff = 0.03 cfs @ 13.04 hrs, Volume= 908 cf, Depth= 0.19"
Routed to Link DP-9 : OFFSITE WEST

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year Rainfall=4.65"

Area (sf)	CN	Description
43,801	32	Woods/grass comb., Good, HSG A
12,283	72	Woods/grass comb., Good, HSG C
56,084	41	Weighted Average
56,084		100.00% Pervious Area

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

Summary for Subcatchment 10.1:

Runoff = 0.00 cfs @ 23.99 hrs, Volume= 46 cf, Depth= 0.04"
Routed to Link DP-10 : OFFSITE EAST

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year Rainfall=4.65"

Area (sf)	CN	Description
868	70	Woods, Good, HSG C
8,561	30	Woods, Good, HSG A
2,747	39	>75% Grass cover, Good, HSG A
12,176	35	Weighted Average
12,176		100.00% Pervious Area

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

Summary for Subcatchment 10.2:

Runoff = 0.04 cfs @ 12.08 hrs, Volume= 210 cf, Depth= 0.46"
Routed to Link DP-10 : OFFSITE EAST

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year Rainfall=4.65"

Area (sf)	CN	Description
1,523	55	Woods, Good, HSG B
1,461	55	Woods, Good, HSG B
160	61	>75% Grass cover, Good, HSG B
2,286	39	>75% Grass cover, Good, HSG A
5,430	48	Weighted Average
5,430		100.00% Pervious Area

Summary for Subcatchment 10.3:

Runoff = 0.01 cfs @ 12.14 hrs, Volume= 33 cf, Depth= 0.81"
Routed to Link DP-10 : OFFSITE EAST

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year Rainfall=4.65"

Area (sf)	CN	Description
488	55	Woods, Good, HSG B
488		100.00% Pervious Area

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

Summary for Subcatchment 10.4:

Runoff = 0.01 cfs @ 12.14 hrs, Volume= 41 cf, Depth= 0.81"
Routed to Link DP-10 : OFFSITE EAST

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
NRCC 24-hr D 10-Year Rainfall=4.65"

Area (sf)	CN	Description
612	55	Woods, Good, HSG B
612		100.00% Pervious Area

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

Summary for Pond 1P: C/D/E

Inflow Area = 248,591 sf, 96.52% Impervious, Inflow Depth = 4.21" for 10-Year event
Inflow = 22.91 cfs @ 12.12 hrs, Volume= 87,303 cf
Outflow = 22.91 cfs @ 12.12 hrs, Volume= 87,303 cf, Atten= 0%, Lag= 0.0 min
Primary = 22.91 cfs @ 12.12 hrs, Volume= 87,303 cf
Routed to Pond P4 : SSIB

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs / 3
Peak Elev= 278.35' @ 12.15 hrs
Flood Elev= 279.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	275.15'	**36.0" Round Culvert** L= 30.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 275.15' / 275.00' S= 0.0050 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 7.07 sf

Primary OutFlow Max=22.62 cfs @ 12.12 hrs HW=278.28' TW=277.57' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 22.62 cfs @ 3.20 fps)

Summary for Pond 2P: ROAD

Inflow Area = 192,584 sf, 95.50% Impervious, Inflow Depth = 4.16" for 10-Year event
Inflow = 17.59 cfs @ 12.12 hrs, Volume= 66,703 cf
Outflow = 17.59 cfs @ 12.12 hrs, Volume= 66,703 cf, Atten= 0%, Lag= 0.0 min
Primary = 17.59 cfs @ 12.12 hrs, Volume= 66,703 cf
Routed to Pond 1P : C/D/E

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs / 3
Peak Elev= 278.95' @ 12.14 hrs
Flood Elev= 279.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	276.32'	**36.0" Round Culvert**

L= 215.0' CPP, projecting, no headwall, Ke= 0.900
Inlet / Outlet Invert= 276.32' / 275.25' S= 0.0050 '/' Cc= 0.900
n= 0.013 Corrugated PE, smooth interior, Flow Area= 7.07 sf

Primary OutFlow Max=17.36 cfs @ 12.12 hrs HW=278.91' TW=278.28' (Dynamic Tailwater)
└─**1=Culvert** (Outlet Controls 17.36 cfs @ 3.58 fps)

Summary for Pond 3P: F/G/H

Inflow Area = 170,286 sf, 98.21% Impervious, Inflow Depth = 4.31" for 10-Year event
Inflow = 15.96 cfs @ 12.12 hrs, Volume= 61,218 cf
Outflow = 15.96 cfs @ 12.12 hrs, Volume= 61,218 cf, Atten= 0%, Lag= 0.0 min
Primary = 15.96 cfs @ 12.12 hrs, Volume= 61,218 cf
Routed to Pond 2P : ROAD

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs / 3
Peak Elev= 279.20' @ 12.13 hrs
Flood Elev= 279.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	276.50'	**36.0" Round Culvert** L= 15.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 276.50' / 276.42' S= 0.0053 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 7.07 sf

Primary OutFlow Max=12.93 cfs @ 12.12 hrs HW=279.18' TW=278.92' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 12.93 cfs @ 1.94 fps)

Summary for Pond 4P: ROAD

Inflow Area = 88,352 sf, 96.55% Impervious, Inflow Depth = 4.22" for 10-Year event
Inflow = 8.17 cfs @ 12.12 hrs, Volume= 31,082 cf
Outflow = 8.17 cfs @ 12.12 hrs, Volume= 31,082 cf, Atten= 0%, Lag= 0.0 min
Primary = 8.17 cfs @ 12.12 hrs, Volume= 31,082 cf
Routed to Pond 5P :

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs / 3
Peak Elev= 280.16' @ 12.14 hrs
Flood Elev= 279.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	278.70'	**36.0" Round Culvert** L= 200.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 278.70' / 277.70' S= 0.0050 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 7.07 sf

Primary OutFlow Max=7.78 cfs @ 12.12 hrs HW=280.14' TW=279.46' (Dynamic Tailwater)
└─**1=Culvert** (Outlet Controls 7.78 cfs @ 3.38 fps)

Summary for Pond 5P:

Inflow Area = 88,352 sf, 96.55% Impervious, Inflow Depth = 4.22" for 10-Year event
Inflow = 8.17 cfs @ 12.12 hrs, Volume= 31,082 cf
Outflow = 8.17 cfs @ 12.12 hrs, Volume= 31,082 cf, Atten= 0%, Lag= 0.0 min
Primary = 8.17 cfs @ 12.12 hrs, Volume= 31,082 cf
Routed to Pond 3P : F/G/H

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs / 3
Peak Elev= 279.49' @ 12.14 hrs
Flood Elev= 279.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	277.60'	**36.0" Round Culvert** L= 200.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 277.60' / 276.60' S= 0.0050 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 7.07 sf

Primary OutFlow Max=7.32 cfs @ 12.12 hrs HW=279.46' TW=279.18' (Dynamic Tailwater)
1=Culvert (Outlet Controls 7.32 cfs @ 2.28 fps)

Summary for Pond 6P: I/J/K

Inflow Area = 72,569 sf,100.00% Impervious, Inflow Depth = 4.41" for 10-Year event
Inflow = 6.90 cfs @ 12.12 hrs, Volume= 26,692 cf
Outflow = 6.90 cfs @ 12.12 hrs, Volume= 26,692 cf, Atten= 0%, Lag= 0.0 min
Primary = 6.90 cfs @ 12.12 hrs, Volume= 26,692 cf
Routed to Pond 4P : ROAD

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs / 3
Peak Elev= 280.65' @ 12.13 hrs
Flood Elev= 279.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	279.10'	**24.0" Round Culvert** L= 60.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 279.10' / 278.80' S= 0.0050 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf

Primary OutFlow Max=6.61 cfs @ 12.12 hrs HW=280.64' TW=280.14' (Dynamic Tailwater)
1=Culvert (Outlet Controls 6.61 cfs @ 3.52 fps)

Summary for Pond 7P: SSIB

Volume	Invert	Avail.Storage	Storage Description
#1A	262.00'	7,579 cf	**31.00'W x 192.00'L x 5.75'H Field A** 34,224 cf Overall - 15,276 cf Embedded = 18,948 cf x 40.0% Voids
#2A	262.25'	15,276 cf	**CMP Round 60** x 36 Inside #1 Effective Size= 60.0"W x 60.0"H => 19.63 sf x 20.00'L = 392.7 cf Overall Size= 60.0"W x 60.0"H x 20.00'L

	36 Chambers in 4 Rows
	29.00' Header x 19.63 sf x 2 = 1,138.8 cf Inside
22,855 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	262.00'	**8.270 in/hr Exfiltration over Surface area**
#2	Device 3	265.20'	**19.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Primary	260.50'	**24.0" Round Culvert** L= 50.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 260.50' / 260.25' S= 0.0050 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf

Discarded OutFlow Max=0.00 cfs @ 0.00 hrs HW=0.00' (Free Discharge)
└─**1=Exfiltration** (Controls 0.00 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=0.00' TW=254.50' (Dynamic Tailwater)
└─**3=Culvert** (Controls 0.00 cfs)
  └─**2=Orifice/Grate** (Controls 0.00 cfs)

Summary for Pond DMH10:

Inflow Area = 1,128,896 sf, 73.87% Impervious, Inflow Depth = 2.11" for 10-Year event
Inflow = 43.55 cfs @ 12.22 hrs, Volume= 198,830 cf
Outflow = 43.55 cfs @ 12.22 hrs, Volume= 198,830 cf, Atten= 0%, Lag= 0.0 min
Primary = 43.55 cfs @ 12.22 hrs, Volume= 198,830 cf
Routed to Pond DMH11 :

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs / 3
Peak Elev= 257.54' @ 12.22 hrs
Flood Elev= 267.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	254.50'	**48.0" Round Culvert** L= 77.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 254.00' / 254.50' S= -0.0065 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 12.57 sf

Primary OutFlow Max=43.01 cfs @ 12.22 hrs HW=257.51' TW=256.73' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 43.01 cfs @ 4.24 fps)

Summary for Pond DMH11:

Inflow Area = 1,128,896 sf, 73.87% Impervious, Inflow Depth = 2.11" for 10-Year event
Inflow = 43.55 cfs @ 12.22 hrs, Volume= 198,830 cf
Outflow = 43.55 cfs @ 12.22 hrs, Volume= 198,830 cf, Atten= 0%, Lag= 0.0 min
Primary = 43.55 cfs @ 12.22 hrs, Volume= 198,830 cf
Routed to Link DP-3 : HEADWALL

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs / 3
Peak Elev= 256.76' @ 12.22 hrs
Flood Elev= 262.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	254.00'	**48.0" Round Culvert** L= 67.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 254.00' / 253.50' S= 0.0075 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 12.57 sf

Primary OutFlow Max=43.01 cfs @ 12.22 hrs HW=256.73' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Barrel Controls 43.01 cfs @ 6.63 fps)

Summary for Pond DMH2:

Inflow Area = 572,261 sf, 79.85% Impervious, Inflow Depth = 2.60" for 10-Year event
Inflow = 24.76 cfs @ 12.22 hrs, Volume= 124,115 cf
Outflow = 24.76 cfs @ 12.22 hrs, Volume= 124,115 cf, Atten= 0%, Lag= 0.0 min
Primary = 24.76 cfs @ 12.22 hrs, Volume= 124,115 cf
Routed to Pond DMH3 :

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs / 3
Peak Elev= 269.43' @ 12.22 hrs
Flood Elev= 280.70'

Device	Routing	Invert	Outlet Devices
#1	Primary	267.03'	**36.0" Round Culvert** L= 208.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 267.03' / 266.02' S= 0.0049 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 7.07 sf

Primary OutFlow Max=24.57 cfs @ 12.22 hrs HW=269.42' TW=268.24' (Dynamic Tailwater)
└─**1=Culvert** (Outlet Controls 24.57 cfs @ 5.58 fps)

Summary for Pond DMH3:

Inflow Area = 572,261 sf, 79.85% Impervious, Inflow Depth = 2.60" for 10-Year event
Inflow = 24.76 cfs @ 12.22 hrs, Volume= 124,115 cf
Outflow = 24.76 cfs @ 12.22 hrs, Volume= 124,115 cf, Atten= 0%, Lag= 0.0 min
Primary = 24.76 cfs @ 12.22 hrs, Volume= 124,115 cf
Routed to Pond DMH8 :

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs / 3
Peak Elev= 268.25' @ 12.22 hrs
Flood Elev= 280.25'

Device	Routing	Invert	Outlet Devices
#1	Primary	265.92'	**36.0" Round Culvert** L= 214.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 265.92' / 264.85' S= 0.0050 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 7.07 sf

Primary OutFlow Max=24.57 cfs @ 12.22 hrs HW=268.24' TW=266.95' (Dynamic Tailwater)
└─**1=Culvert** (Outlet Controls 24.57 cfs @ 5.78 fps)

Summary for Pond DMH8:

Inflow Area = 622,659 sf, 78.15% Impervious, Inflow Depth = 2.49" for 10-Year event
Inflow = 25.61 cfs @ 12.23 hrs, Volume= 129,145 cf
Outflow = 25.61 cfs @ 12.23 hrs, Volume= 129,145 cf, Atten= 0%, Lag= 0.0 min
Primary = 25.61 cfs @ 12.23 hrs, Volume= 129,145 cf
Routed to Pond DMH9 :

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs / 3
Peak Elev= 266.96' @ 12.23 hrs
Flood Elev= 275.66'

Device	Routing	Invert	Outlet Devices
#1	Primary	264.75'	**42.0" Round Culvert** L= 77.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 264.75' / 264.37' S= 0.0049 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 9.62 sf

Primary OutFlow Max=25.43 cfs @ 12.23 hrs HW=266.95' TW=261.84' (Dynamic Tailwater)
└─**1=Culvert** (Barrel Controls 25.43 cfs @ 5.70 fps)

Summary for Pond DMH9:

Inflow Area = 959,551 sf, 76.35% Impervious, Inflow Depth = 2.49" for 10-Year event
Inflow = 43.55 cfs @ 12.22 hrs, Volume= 198,830 cf
Outflow = 43.55 cfs @ 12.22 hrs, Volume= 198,830 cf, Atten= 0%, Lag= 0.0 min
Primary = 43.55 cfs @ 12.22 hrs, Volume= 198,830 cf
Routed to Pond DMH10 :

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs / 3
Peak Elev= 261.86' @ 12.22 hrs
Flood Elev= 267.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	259.28'	**48.0" Round Culvert** L= 276.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 259.28' / 257.90' S= 0.0050 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 12.57 sf

Primary OutFlow Max=43.01 cfs @ 12.22 hrs HW=261.84' TW=257.51' (Dynamic Tailwater)
└─**1=Culvert** (Barrel Controls 43.01 cfs @ 7.20 fps)

Summary for Pond P1: SSIB

Inflow Area = 127,271 sf, 94.29% Impervious, Inflow Depth = 4.07" for 10-Year event
Inflow = 11.75 cfs @ 12.12 hrs, Volume= 43,198 cf
Outflow = 3.49 cfs @ 12.32 hrs, Volume= 43,218 cf, Atten= 70%, Lag= 11.9 min
Discarded = 0.32 cfs @ 9.32 hrs, Volume= 30,495 cf
Primary = 3.17 cfs @ 12.32 hrs, Volume= 12,723 cf
Routed to Link DP-2 : FES

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs / 3
Peak Elev= 267.47' @ 12.32 hrs Surf.Area= 5,731 sf Storage= 14,602 cf
Flood Elev= 270.75' Surf.Area= 5,731 sf Storage= 24,949 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 232.3 min (1,009.6 - 777.3)

Volume	Invert	Avail.Storage	Storage Description
#1A	264.00'	9,156 cf	**37.58'W x 152.48'L x 6.75'H Field A**
			38,683 cf Overall - 15,793 cf Embedded = 22,890 cf x 40.0% Voids
#2A	264.75'	15,793 cf	**ADS_StormTech MC-7200 +Cap** x 88 Inside #1
			Effective Size= 91.2"W x 60.0"H => 26.68 sf x 6.59'L = 175.9 cf
			Overall Size= 100.0"W x 60.0"H x 6.95'L with 0.36' Overlap
			88 Chambers in 4 Rows
			Cap Storage= 39.5 cf x 2 x 4 rows = 316.0 cf
		24,949 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	264.00'	**2.410 in/hr Exfiltration over Surface area**
#2	Device 4	266.50'	**14.0" Vert. Orifice/Grate** C= 0.600
			Limited to weir flow at low heads
#3	Device 4	269.95'	**4.0' long x 0.5' breadth Broad-Crested Rectangular Weir**
			Head (feet) 0.20 0.40 0.60 0.80 1.00
			Coef. (English) 2.80 2.92 3.08 3.30 3.32
#4	Primary	264.00'	**12.0" Round Culvert**
			L= 20.0' CPP, projecting, no headwall, Ke= 0.900
			Inlet / Outlet Invert= 264.00' / 263.90' S= 0.0050 '/' Cc= 0.900
			n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Discarded OutFlow Max=0.32 cfs @ 9.32 hrs HW=264.07' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.32 cfs)

Primary OutFlow Max=3.16 cfs @ 12.32 hrs HW=267.47' TW=0.00' (Dynamic Tailwater)
└─**4=Culvert** (Passes 3.16 cfs of 5.14 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 3.16 cfs @ 3.34 fps)
  └─**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond P10.5: P10 & P11

Inflow Area = 50,398 sf, 58.77% Impervious, Inflow Depth = 2.55" for 10-Year event
Inflow = 3.20 cfs @ 12.13 hrs, Volume= 10,708 cf
Outflow = 1.08 cfs @ 12.31 hrs, Volume= 10,267 cf, Atten= 66%, Lag= 10.8 min
Discarded = 0.05 cfs @ 10.08 hrs, Volume= 5,237 cf
Primary = 1.03 cfs @ 12.31 hrs, Volume= 5,030 cf
Routed to Pond DMH8 :

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs / 3
Peak Elev= 272.82' @ 12.31 hrs Surf.Area= 2,197 sf Storage= 3,457 cf
Flood Elev= 274.25' Surf.Area= 2,197 sf Storage= 5,012 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 254.5 min (1,101.3 - 846.8)

Volume	Invert	Avail.Storage	Storage Description
#1A	270.50'	2,152 cf	**21.25'W x 103.40'L x 3.75'H Field A** 8,240 cf Overall - 2,861 cf Embedded = 5,379 cf x 40.0% Voids
#2A	271.00'	2,861 cf	**ADS_StormTech SC-800 +Cap** x 56 Inside #1 Effective Size= 45.0"W x 33.0"H => 7.11 sf x 7.12'L = 50.6 cf Overall Size= 51.0"W x 33.0"H x 7.55'L with 0.43' Overlap 56 Chambers in 4 Rows Cap Storage= 3.4 cf x 2 x 4 rows = 27.4 cf
		5,012 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	271.00'	**18.0" Round Culvert** L= 100.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 271.00' / 270.50' S= 0.0050 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf
#2	Device 1	272.25'	**10.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	273.75'	**4.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#4	Discarded	270.50'	**1.020 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.05 cfs @ 10.08 hrs HW=270.54' (Free Discharge)
└─**4=Exfiltration** (Exfiltration Controls 0.05 cfs)

Primary OutFlow Max=1.03 cfs @ 12.31 hrs HW=272.82' TW=266.81' (Dynamic Tailwater)
└─**1=Culvert** (Passes 1.03 cfs of 7.70 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 1.03 cfs @ 2.57 fps)
  └─**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond P12:

Inflow Area = 216,579 sf, 69.67% Impervious, Inflow Depth = 3.52" for 10-Year event
Inflow = 17.59 cfs @ 12.13 hrs, Volume= 63,593 cf
Outflow = 8.21 cfs @ 12.25 hrs, Volume= 61,357 cf, Atten= 53%, Lag= 7.3 min
Primary = 8.21 cfs @ 12.25 hrs, Volume= 61,357 cf
Routed to Pond DMH2 :

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs / 3
Peak Elev= 279.53' @ 12.25 hrs Surf.Area= 4,598 sf Storage= 14,927 cf
Flood Elev= 283.00' Surf.Area= 4,598 sf Storage= 25,797 cf

Plug-Flow detention time= 75.6 min calculated for 61,289 cf (96% of inflow)
Center-of-Mass det. time= 54.5 min (845.6 - 791.1)

Volume	Invert	Avail.Storage	Storage Description
#1A	275.00'	7,325 cf	**19.00'W x 242.00'L x 8.00'H Field A** 36,784 cf Overall - 18,473 cf Embedded = 18,311 cf x 40.0% Voids
#2A	275.50'	18,473 cf	**CMP Round 84** x 24 Inside #1 Effective Size= 84.0"W x 84.0"H => 38.48 sf x 20.00'L = 769.7 cf Overall Size= 84.0"W x 84.0"H x 20.00'L 24 Chambers in 2 Rows
		25,797 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	272.25'	**24.0" Round Culvert** L= 37.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 272.25' / 272.05' S= 0.0054 '/' Cc= 0.900 n= 0.013, Flow Area= 3.14 sf
#2	Device 1	276.00'	**10.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	278.70'	**22.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 1	282.00'	**4.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Primary OutFlow Max=8.15 cfs @ 12.25 hrs HW=279.52' TW=269.41' (Dynamic Tailwater)
1=Culvert (Passes 8.15 cfs of 37.88 cfs potential flow)
- **2=Orifice/Grate** (Orifice Controls 4.63 cfs @ 8.48 fps)
- **3=Orifice/Grate** (Orifice Controls 3.53 cfs @ 3.08 fps)
- **4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond P2: RAIN GARDEN

Inflow Area = 123,994 sf, 74.47% Impervious, Inflow Depth = 2.11" for 10-Year event
Inflow = 6.29 cfs @ 12.18 hrs, Volume= 21,847 cf
Outflow = 4.68 cfs @ 12.29 hrs, Volume= 21,850 cf, Atten= 26%, Lag= 6.6 min
Discarded = 1.09 cfs @ 12.29 hrs, Volume= 17,780 cf
Primary = 3.59 cfs @ 12.29 hrs, Volume= 4,069 cf
Routed to Link DP-2 : FES

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs / 3
Peak Elev= 259.76' @ 12.29 hrs Surf.Area= 3,778 sf Storage= 3,722 cf
Flood Elev= 262.50' Surf.Area= 5,957 sf Storage= 12,809 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 23.8 min (833.6 - 809.8)

Volume	Invert	Avail.Storage	Storage Description
#1	255.50'	1,352 cf	**Custom Stage Data (Irregular)**Listed below (Recalc) 4,506 cf Overall x 30.0% Voids
#2	258.50'	11,457 cf	**Custom Stage Data (Irregular)**Listed below (Recalc)
		12,809 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
255.50	1,502	208.0	0	0	1,502
258.50	1,502	208.0	4,506	4,506	2,126

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
258.50	1,502	208.0	0	0	1,502
262.00	4,037	274.0	9,335	9,335	4,170
262.50	4,455	283.0	2,122	11,457	4,593

Device	Routing	Invert	Outlet Devices
#1	Primary	253.71'	**15.0" Round Culvert** L= 32.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 253.71' / 253.36' S= 0.0109 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 1.23 sf
#2	Discarded	255.50'	**8.270 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 251.50'
#3	Device 1	259.40'	**20.0" x 10.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 1	261.50'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=1.09 cfs @ 12.29 hrs HW=259.76' (Free Discharge)
└─**2=Exfiltration** (Controls 1.09 cfs)

Primary OutFlow Max=3.53 cfs @ 12.29 hrs HW=259.76' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Passes 3.53 cfs of 10.87 cfs potential flow)
  ├─**3=Orifice/Grate** (Weir Controls 3.53 cfs @ 1.96 fps)
  └─**4=Orifice/Grate** (Controls 0.00 cfs)

Summary for Pond P3: SSIB

```
Inflow Area =        77,277 sf,  74.08% Impervious,  Inflow Depth =   3.75"    for  10-Year event
Inflow      =      6.81 cfs @  12.13 hrs,  Volume=          24,136 cf
Outflow     =      3.89 cfs @  12.22 hrs,  Volume=          24,144 cf,  Atten= 43%,  Lag= 5.6 min
Discarded   =      0.15 cfs @   8.92 hrs,  Volume=          15,290 cf
Primary     =      3.75 cfs @  12.22 hrs,  Volume=           8,853 cf
   Routed to Pond P2 : RAIN GARDEN
```

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs / 3
Peak Elev= 270.63' @ 12.22 hrs Surf.Area= 2,620 sf Storage= 7,587 cf
Flood Elev= 272.00' Surf.Area= 2,620 sf Storage= 9,543 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 260.8 min (1,056.8 - 796.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	266.50'	3,245 cf	**20.00'W x 131.00'L x 5.50'H Field A** 14,410 cf Overall - 6,298 cf Embedded = 8,112 cf x 40.0% Voids
#2A	267.00'	6,298 cf	**CMP Round 54** x 18 Inside #1 Effective Size= 54.0"W x 54.0"H => 15.90 sf x 20.00'L = 318.1 cf Overall Size= 54.0"W x 54.0"H x 20.00'L 18 Chambers in 3 Rows 18.00' Header x 15.90 sf x 2 = 572.6 cf Inside
		9,543 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	266.50'	**2.410 in/hr Exfiltration over Surface area**
#2	Device 3	269.70'	**18.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Primary	266.00'	**24.0" Round Culvert** L= 100.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 266.00' / 265.50' S= 0.0050 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf

Discarded OutFlow Max=0.15 cfs @ 8.92 hrs HW=266.56' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.15 cfs)

Primary OutFlow Max=3.63 cfs @ 12.22 hrs HW=270.61' TW=259.63' (Dynamic Tailwater)
└─**3=Culvert** (Passes 3.63 cfs of 22.68 cfs potential flow)
  └─**2=Orifice/Grate** (Orifice Controls 3.63 cfs @ 3.24 fps)

Summary for Pond P4: SSIB

```
Inflow Area =       279,165 sf,  85.94% Impervious,  Inflow Depth =   3.98"    for  10-Year event
Inflow      =     23.13 cfs @  12.12 hrs,  Volume=          92,624 cf
Outflow     =     15.59 cfs @  12.20 hrs,  Volume=          92,641 cf,  Atten= 33%,  Lag= 4.5 min
Discarded   =      0.44 cfs @   7.04 hrs,  Volume=          39,919 cf
Primary     =     15.16 cfs @  12.20 hrs,  Volume=          52,722 cf
   Routed to Pond DMH2 :
```

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs / 3
Peak Elev= 277.80' @ 12.20 hrs Surf.Area= 7,800 sf Storage= 17,731 cf
Flood Elev= 279.50' Surf.Area= 7,800 sf Storage= 25,522 cf

Plug-Flow detention time= 82.1 min calculated for 92,538 cf (100% of inflow)
Center-of-Mass det. time= 82.4 min (850.7 - 768.3)

Volume	Invert	Avail.Storage	Storage Description
#1A	274.50'	8,985 cf	**60.00'W x 130.00'L x 5.00'H Field A**
			39,000 cf Overall - 16,537 cf Embedded = 22,463 cf x 40.0% Voids
#2A	275.00'	16,537 cf	**CMP Round 48** x 60 Inside #1
			Effective Size= 48.0"W x 48.0"H => 12.57 sf x 20.00'L = 251.3 cf
			Overall Size= 48.0"W x 48.0"H x 20.00'L
			60 Chambers in 10 Rows
			58.00' Header x 12.57 sf x 2 = 1,457.7 cf Inside
		25,522 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	275.50'	**36.0" Round Culvert**
			L= 20.0' CPP, projecting, no headwall, Ke= 0.900
			Inlet / Outlet Invert= 275.50' / 275.40' S= 0.0050 '/' Cc= 0.900
			n= 0.013 Corrugated PE, smooth interior, Flow Area= 7.07 sf
#2	Device 1	275.90'	**24.0" Vert. Orifice/Grate** C= 0.600
			Limited to weir flow at low heads
#3	Device 1	277.50'	**15.0" W x 12.0" H Vert. Orifice/Grate** C= 0.600
			Limited to weir flow at low heads
#4	Device 1	278.50'	**12.0" W x 12.0" H Vert. Orifice/Grate** C= 0.600
			Limited to weir flow at low heads
#5	Discarded	274.50'	**2.410 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.44 cfs @ 7.04 hrs HW=274.55' (Free Discharge)
└**5=Exfiltration** (Exfiltration Controls 0.44 cfs)

Primary OutFlow Max=15.15 cfs @ 12.20 hrs HW=277.80' TW=269.41' (Dynamic Tailwater)
└**1=Culvert** (Passes 15.15 cfs of 19.50 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 14.49 cfs @ 4.70 fps)
  ├**3=Orifice/Grate** (Orifice Controls 0.67 cfs @ 1.77 fps)
  └**4=Orifice/Grate** (Controls 0.00 cfs)

Summary for Pond P5: SSIB

Inflow Area =	169,345 sf,	59.84% Impervious,	Inflow Depth = 2.16"	for 10-Year event
Inflow =	9.18 cfs @	12.13 hrs, Volume=	30,541 cf	
Outflow =	1.14 cfs @	11.84 hrs, Volume=	30,574 cf,	Atten= 88%, Lag= 0.0 min
Discarded =	1.14 cfs @	11.84 hrs, Volume=	30,574 cf	
Primary =	0.00 cfs @	0.00 hrs, Volume=	0 cf	

Routed to Pond DMH10 :

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs / 3

Peak Elev= 264.05' @ 12.98 hrs Surf.Area= 5,952 sf Storage= 7,870 cf
Flood Elev= 267.75' Surf.Area= 5,952 sf Storage= 22,855 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 46.9 min (911.7 - 864.7)

Volume	Invert	Avail.Storage	Storage Description
#1A	262.00'	7,579 cf	**31.00'W x 192.00'L x 5.75'H Field A**
			34,224 cf Overall - 15,276 cf Embedded = 18,948 cf x 40.0% Voids
#2A	262.25'	15,276 cf	**CMP Round 60** x 36 Inside #1
			Effective Size= 60.0"W x 60.0"H => 19.63 sf x 20.00'L = 392.7 cf
			Overall Size= 60.0"W x 60.0"H x 20.00'L
			36 Chambers in 4 Rows
			29.00' Header x 19.63 sf x 2 = 1,138.8 cf Inside
		22,855 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	262.00'	**8.270 in/hr Exfiltration over Surface area**
#2	Device 3	265.20'	**19.0" Vert. Orifice/Grate** C= 0.600
			Limited to weir flow at low heads
#3	Primary	260.50'	**24.0" Round Culvert**
			L= 50.0' CPP, projecting, no headwall, Ke= 0.900
			Inlet / Outlet Invert= 260.50' / 260.25' S= 0.0050 '/' Cc= 0.900
			n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf

Discarded OutFlow Max=1.14 cfs @ 11.84 hrs HW=262.06' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 1.14 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=262.00' TW=254.50' (Dynamic Tailwater)
└─**3=Culvert** (Passes 0.00 cfs of 7.35 cfs potential flow)
  └─**2=Orifice/Grate** (Controls 0.00 cfs)

Summary for Pond P6: SSIB

Inflow Area = 336,892 sf, 73.03% Impervious, Inflow Depth = 3.48" for 10-Year event
Inflow = 26.83 cfs @ 12.13 hrs, Volume= 97,750 cf
Outflow = 18.19 cfs @ 12.20 hrs, Volume= 96,818 cf, Atten= 32%, Lag= 4.4 min
Discarded = 0.22 cfs @ 4.96 hrs, Volume= 27,134 cf
Primary = 17.97 cfs @ 12.20 hrs, Volume= 69,685 cf
Routed to Pond DMH9 :

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs / 3
Peak Elev= 276.38' @ 12.20 hrs Surf.Area= 9,298 sf Storage= 21,595 cf
Flood Elev= 279.00' Surf.Area= 9,298 sf Storage= 33,781 cf

Plug-Flow detention time= 139.5 min calculated for 96,711 cf (99% of inflow)
Center-of-Mass det. time= 134.0 min (922.6 - 788.6)

Volume	Invert	Avail.Storage	Storage Description
#1A	273.00'	11,571 cf	**40.25'W x 231.00'L x 5.50'H Field A**
			51,138 cf Overall - 22,210 cf Embedded = 28,927 cf x 40.0% Voids
#2A	273.50'	22,210 cf	**CMP Round 54** x 66 Inside #1
			Effective Size= 54.0"W x 54.0"H => 15.90 sf x 20.00'L = 318.1 cf
			Overall Size= 54.0"W x 54.0"H x 20.00'L
			66 Chambers in 6 Rows
			38.25' Header x 15.90 sf x 2 = 1,216.7 cf Inside
		33,781 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	273.00'	**24.0" Round Culvert**
			L= 100.0' CMP, square edge headwall, Ke= 0.500
			Inlet / Outlet Invert= 273.00' / 272.50' S= 0.0050 '/' Cc= 0.900
			n= 0.013, Flow Area= 3.14 sf
#2	Device 1	274.80'	**36.0" W x 16.0" H Vert. Orifice/Grate** C= 0.600
			Limited to weir flow at low heads
#3	Device 1	277.00'	**5.0' long x 0.5' breadth Broad-Crested Rectangular Weir**
			Head (feet) 0.20 0.40 0.60 0.80 1.00
			Coef. (English) 2.80 2.92 3.08 3.30 3.32
#4	Discarded	273.00'	**1.020 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.22 cfs @ 4.96 hrs HW=273.06' (Free Discharge)
└─**4=Exfiltration** (Exfiltration Controls 0.22 cfs)

Primary OutFlow Max=17.95 cfs @ 12.20 hrs HW=276.38' TW=261.84' (Dynamic Tailwater)
└─**1=Culvert** (Passes 17.95 cfs of 20.86 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 17.95 cfs @ 4.49 fps)
  └─**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond P7: SSIB

Inflow Area = 117,723 sf, 78.54% Impervious, Inflow Depth = 3.14" for 10-Year event
Inflow = 8.59 cfs @ 12.13 hrs, Volume= 30,778 cf
Outflow = 3.78 cfs @ 12.25 hrs, Volume= 30,730 cf, Atten= 56%, Lag= 7.7 min
Primary = 3.78 cfs @ 12.25 hrs, Volume= 30,730 cf
Routed to Link DP-5 : EAST SIDE WETLAND

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs / 3
Peak Elev= 279.46' @ 12.25 hrs Surf.Area= 6,295 sf Storage= 6,415 cf
Flood Elev= 282.00' Surf.Area= 6,295 sf Storage= 17,002 cf

Plug-Flow detention time= 46.0 min calculated for 30,730 cf (100% of inflow)
Center-of-Mass det. time= 45.0 min (847.5 - 802.6)

Volume	Invert	Avail.Storage	Storage Description
#1A	278.00'	5,452 cf	**42.25'W x 149.00'L x 4.00'H Field A** 25,181 cf Overall - 11,550 cf Embedded = 13,631 cf x 40.0% Voids
#2A	278.00'	11,550 cf	**CMP Round 42** x 56 Inside #1 Effective Size= 42.0"W x 42.0"H => 9.62 sf x 20.00'L = 192.4 cf Overall Size= 42.0"W x 42.0"H x 20.00'L 56 Chambers in 8 Rows 40.25' Header x 9.62 sf x 2 = 774.5 cf Inside
		17,002 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	278.00'	**24.0" Round Culvert** L= 100.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 278.00' / 277.50' S= 0.0050 '/' Cc= 0.900 n= 0.013, Flow Area= 3.14 sf
#2	Device 1	278.00'	**8.0" W x 24.0" H Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=3.76 cfs @ 12.25 hrs HW=279.46' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Passes 3.76 cfs of 8.03 cfs potential flow)
  └─**2=Orifice/Grate** (Orifice Controls 3.76 cfs @ 3.87 fps)

Summary for Pond P8: RAIN GARDEN

Inflow Area = 71,267 sf, 55.43% Impervious, Inflow Depth = 2.42" for 10-Year event
Inflow = 3.06 cfs @ 12.25 hrs, Volume= 14,356 cf
Outflow = 2.92 cfs @ 12.30 hrs, Volume= 14,319 cf, Atten= 5%, Lag= 3.0 min
Primary = 2.92 cfs @ 12.30 hrs, Volume= 14,319 cf
Routed to Link DP-5 : EAST SIDE WETLAND

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs / 3
Starting Elev= 276.00' Surf.Area= 3,274 sf Storage= 2,750 cf
Peak Elev= 277.55' @ 12.30 hrs Surf.Area= 4,442 sf Storage= 5,138 cf (2,387 cf above start)
Flood Elev= 278.00' Surf.Area= 4,807 sf Storage= 5,967 cf (3,216 cf above start)

Plug-Flow detention time= 249.1 min calculated for 11,568 cf (81% of inflow)
Center-of-Mass det. time= 101.2 min (965.6 - 864.4)

Volume	Invert	Avail.Storage	Storage Description
#1	273.00'	5,967 cf	**Custom Stage Data (Irregular)**Listed below (Recalc) 14,916 cf Overall x 40.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
273.00	1,400	180.0	0	0	1,400
274.00	1,968	199.0	1,676	1,676	2,004
275.00	2,593	218.0	2,273	3,949	2,668
276.00	3,274	237.0	2,927	6,876	3,392
277.00	4,012	255.0	3,637	10,513	4,139
278.00	4,807	274.0	4,404	14,916	4,981

Device	Routing	Invert	Outlet Devices
#1	Primary	266.10'	**12.0" Round Culvert** L= 20.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 266.10' / 266.00' S= 0.0050 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	277.50'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	277.00'	**2.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#4	Device 1	276.00'	**2.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=2.87 cfs @ 12.30 hrs HW=277.55' TW=0.00' (Dynamic Tailwater)
1=Culvert (Passes 2.87 cfs of 9.88 cfs potential flow)
2=Orifice/Grate (Weir Controls 0.28 cfs @ 0.72 fps)
3=Broad-Crested Rectangular Weir (Weir Controls 2.47 cfs @ 2.25 fps)
4=Orifice/Grate (Orifice Controls 0.13 cfs @ 5.83 fps)

Summary for Pond P9:

Inflow Area = 76,517 sf, 86.44% Impervious, Inflow Depth = 3.64" for 10-Year event
Inflow = 6.29 cfs @ 12.13 hrs, Volume= 23,209 cf
Outflow = 2.16 cfs @ 12.30 hrs, Volume= 22,176 cf, Atten= 66%, Lag= 10.6 min
Discarded = 0.11 cfs @ 8.52 hrs, Volume= 12,140 cf
Primary = 2.06 cfs @ 12.30 hrs, Volume= 10,036 cf
Routed to Pond DMH2 :

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs / 3
Peak Elev= 276.80' @ 12.30 hrs Surf.Area= 4,453 sf Storage= 8,170 cf
Flood Elev= 281.00' Surf.Area= 4,453 sf Storage= 17,756 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 249.8 min (1,038.3 - 788.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	274.00'	3,614 cf	**22.00'W x 122.00'L x 6.00'H Field A** 16,104 cf Overall - 7,069 cf Embedded = 9,035 cf x 40.0% Voids
#2A	274.50'	7,069 cf	**CMP Round 60** x 18 Inside #1 Effective Size= 60.0"W x 60.0"H => 19.63 sf x 20.00'L = 392.7 cf Overall Size= 60.0"W x 60.0"H x 20.00'L 18 Chambers in 3 Rows
#3B	274.00'	2,361 cf	**14.50'W x 122.00'L x 6.00'H Field B** 10,614 cf Overall - 4,712 cf Embedded = 5,902 cf x 40.0% Voids
#4B	274.50'	4,712 cf	**CMP Round 60** x 12 Inside #3 Effective Size= 60.0"W x 60.0"H => 19.63 sf x 20.00'L = 392.7 cf Overall Size= 60.0"W x 60.0"H x 20.00'L 12 Chambers in 2 Rows
		17,756 cf	Total Available Storage

Storage Group A created with Chamber Wizard
Storage Group B created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	274.00'	**18.0" Round Culvert** L= 43.3' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 274.00' / 273.75' S= 0.0058 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf
#2	Device 1	276.00'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	278.50'	**4.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#4	Discarded	274.00'	**1.020 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.11 cfs @ 8.52 hrs HW=274.07' (Free Discharge)
└─**4=Exfiltration** (Exfiltration Controls 0.11 cfs)

Primary OutFlow Max=2.05 cfs @ 12.30 hrs HW=276.80' TW=269.24' (Dynamic Tailwater)
└─**1=Culvert** (Passes 2.05 cfs of 11.66 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 2.05 cfs @ 3.05 fps)
  └─**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Link 3L: (new Link)

Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs

Summary for Link DP-1: HEADWALL

Inflow Area = 72,902 sf, 59.22% Impervious, Inflow Depth = 2.04" for 10-Year event
Inflow = 2.23 cfs @ 12.14 hrs, Volume= 12,401 cf
Primary = 2.23 cfs @ 12.14 hrs, Volume= 12,401 cf, Atten= 0%, Lag= 0.0 min
Routed to Link DP-6 : WEST SIDE WETLAND

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs

Summary for Link DP-10: OFFSITE EAST

Inflow Area = 18,706 sf, 0.00% Impervious, Inflow Depth = 0.21" for 10-Year event
Inflow = 0.06 cfs @ 12.08 hrs, Volume= 329 cf
Primary = 0.06 cfs @ 12.08 hrs, Volume= 329 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs

Summary for Link DP-2: FES

Inflow Area = 251,265 sf, 84.51% Impervious, Inflow Depth = 0.80" for 10-Year event
Inflow = 6.73 cfs @ 12.29 hrs, Volume= 16,793 cf
Primary = 6.73 cfs @ 12.29 hrs, Volume= 16,793 cf, Atten= 0%, Lag= 0.0 min
Routed to Link DP-6 : WEST SIDE WETLAND

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs

Summary for Link DP-3: HEADWALL

Inflow Area = 1,128,896 sf, 73.87% Impervious, Inflow Depth = 2.11" for 10-Year event
Inflow = 43.55 cfs @ 12.22 hrs, Volume= 198,830 cf
Primary = 43.55 cfs @ 12.22 hrs, Volume= 198,830 cf, Atten= 0%, Lag= 0.0 min
Routed to Link DP-6 : WEST SIDE WETLAND

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs

Summary for Link DP-4: KING ST

Inflow Area = 5,837 sf, 88.57% Impervious, Inflow Depth = 3.64" for 10-Year event
Inflow = 0.50 cfs @ 12.13 hrs, Volume= 1,772 cf
Primary = 0.50 cfs @ 12.13 hrs, Volume= 1,772 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs

Summary for Link DP-5: EAST SIDE WETLAND

Inflow Area = 281,671 sf, 50.77% Impervious, Inflow Depth > 2.22" for 10-Year event
Inflow = 7.50 cfs @ 12.29 hrs, Volume= 52,034 cf
Primary = 7.50 cfs @ 12.29 hrs, Volume= 52,034 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs

Summary for Link DP-6: WEST SIDE WETLAND

Inflow Area = 1,539,842 sf, 72.78% Impervious, Inflow Depth = 1.84" for 10-Year event
Inflow = 51.49 cfs @ 12.24 hrs, Volume= 235,552 cf
Primary = 51.49 cfs @ 12.24 hrs, Volume= 235,552 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs

Summary for Link DP-7: SOUTH POND

Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs

Summary for Link DP-8: SOUTH POND

Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs

Summary for Link DP-9: OFFSITE WEST

Inflow Area = 82,474 sf, 0.00% Impervious, Inflow Depth = 0.15" for 10-Year event
Inflow = 0.03 cfs @ 13.04 hrs, Volume= 1,007 cf
Primary = 0.03 cfs @ 13.04 hrs, Volume= 1,007 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs

Time span=0.00-36.00 hrs, dt=0.04 hrs, 901 points x 3
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1.1: ROAD Runoff Area=26,307 sf 68.48% Impervious Runoff Depth=3.56"
Tc=6.0 min CN=79 Runoff=2.33 cfs 7,813 cf

Subcatchment 1.2: ABUTTING LOTS Runoff Area=46,595 sf 53.99% Impervious Runoff Depth=2.70"
Flow Length=211' Tc=23.6 min CN=70 Runoff=1.86 cfs 10,493 cf

Subcatchment 2.1: LOT M Runoff Area=127,271 sf 94.29% Impervious Runoff Depth=5.28"
Tc=6.0 min CN=95 Runoff=15.01 cfs 56,025 cf

Subcatchment 2.2: ROAD Runoff Area=46,717 sf 75.10% Impervious Runoff Depth=4.50"
Tc=6.0 min CN=88 Runoff=5.02 cfs 17,522 cf

Subcatchment 2.3: LOTS A & B Runoff Area=77,277 sf 74.08% Impervious Runoff Depth=4.94"
Tc=6.0 min CN=92 Runoff=8.82 cfs 31,823 cf

Subcatchment 3.1: LOT N 3.7 Runoff Area=132,423 sf 62.22% Impervious Runoff Depth=3.27"
Tc=6.0 min CN=76 Runoff=10.83 cfs 36,066 cf

Subcatchment 3.10: LOT F 3.17 Runoff Area=32,969 sf 100.00% Impervious Runoff Depth=5.63"
Tc=6.0 min CN=98 Runoff=3.96 cfs 15,473 cf

Subcatchment 3.11: LOT R LAND 3.15 Runoff Area=88,988 sf 29.38% Impervious Runoff Depth=3.77"
Tc=6.0 min CN=81 Runoff=8.29 cfs 27,923 cf

Subcatchment 3.12: LOT R BUILDING 3.16 Runoff Area=91,130 sf 100.00% Impervious Runoff Depth=5.63"
Tc=6.0 min CN=98 Runoff=10.96 cfs 42,770 cf

Subcatchment 3.13: LOT S LAND 3.19 Runoff Area=80,697 sf 28.62% Impervious Runoff Depth=3.77"
Tc=6.0 min CN=81 Runoff=7.52 cfs 25,322 cf

Subcatchment 3.14: LOT S BUILDING 3.20 Runoff Area=90,980 sf 100.00% Impervious Runoff Depth=5.63"
Tc=6.0 min CN=98 Runoff=10.94 cfs 42,700 cf

Subcatchment 3.15: ROAD 3.3 Runoff Area=32,025 sf 74.82% Impervious Runoff Depth=4.07"
Tc=6.0 min CN=84 Runoff=3.19 cfs 10,875 cf

Subcatchment 3.16: LOTS F, G & H 3.18 Runoff Area=81,934 sf 100.00% Impervious Runoff Depth=5.63"
Tc=6.0 min CN=98 Runoff=9.85 cfs 38,454 cf

Subcatchment 3.17: ROAD 3.6 Runoff Area=15,783 sf 80.68% Impervious Runoff Depth=4.50"
Tc=6.0 min CN=88 Runoff=1.70 cfs 5,920 cf

Subcatchment 3.18: ROAD 3.4 Runoff Area=22,298 sf 74.82% Impervious Runoff Depth=4.07"
Tc=6.0 min CN=84 Runoff=2.22 cfs 7,572 cf

Subcatchment 3.19: LOTS I, J & K 3.21 Runoff Area=72,569 sf 100.00% Impervious Runoff Depth=5.63"
Tc=6.0 min CN=98 Runoff=8.73 cfs 34,059 cf

Subcatchment 3.2: ROAD Runoff Area=24,520 sf 57.22% Impervious Runoff Depth=4.07"
Tc=6.0 min CN=84 Runoff=2.44 cfs 8,327 cf

Subcatchment 3.3: ROAD 3.1 Runoff Area=25,878 sf 60.23% Impervious Runoff Depth=3.17"
Tc=6.0 min CN=75 Runoff=2.06 cfs 6,840 cf

Subcatchment 3.4a: LOT O 3.8 Runoff Area=36,922 sf 51.28% Impervious Runoff Depth=2.79"
Tc=6.0 min CN=71 Runoff=2.59 cfs 8,598 cf

Subcatchment 3.4b: LOT O 3.9 Runoff Area=27,652 sf 63.36% Impervious Runoff Depth=3.46"
Tc=6.0 min CN=78 Runoff=2.39 cfs 7,983 cf

Subcatchment 3.5: PAKRING LOT P3 3.10 Runoff Area=71,929 sf 99.91% Impervious Runoff Depth=5.63"
Tc=6.0 min CN=98 Runoff=8.65 cfs 33,759 cf

Subcatchment 3.6: LOT Q 3.11 Runoff Area=57,193 sf 68.85% Impervious Runoff Depth=3.66"
Tc=6.0 min CN=80 Runoff=5.20 cfs 17,464 cf

Subcatchment 3.7: COMMON 3.12 Runoff Area=30,574 sf 0.00% Impervious Runoff Depth=3.08"
Flow Length=288' Slope=0.0050 '/' Tc=41.4 min CN=74 Runoff=1.04 cfs 7,837 cf

Subcatchment 3.8: LOTS C & D 3.13 Runoff Area=34,748 sf 100.00% Impervious Runoff Depth=5.63"
Tc=6.0 min CN=98 Runoff=4.18 cfs 16,308 cf

Subcatchment 3.9: LOT E 3.14 Runoff Area=21,259 sf 100.00% Impervious Runoff Depth=5.63"
Tc=6.0 min CN=98 Runoff=2.56 cfs 9,978 cf

Subcatchment 4.1: ROAD Runoff Area=5,837 sf 88.57% Impervious Runoff Depth=4.83"
Tc=6.0 min CN=91 Runoff=0.66 cfs 2,349 cf

Subcatchment 5.1: ROAD 3.5 Runoff Area=11,523 sf 79.93% Impervious Runoff Depth=4.50"
Flow Length=2,275' Tc=8.3 min CN=88 Runoff=1.15 cfs 4,322 cf

Subcatchment 5.2: ROAD Runoff Area=44,902 sf 82.02% Impervious Runoff Depth=4.39"
Tc=6.0 min CN=87 Runoff=4.74 cfs 16,438 cf

Subcatchment 5.4: PARKING LOT P5 Runoff Area=75,263 sf 66.43% Impervious Runoff Depth=3.46"
Tc=6.0 min CN=78 Runoff=6.50 cfs 21,728 cf

Subcatchment 5.5: LOT T Runoff Area=42,460 sf 100.00% Impervious Runoff Depth=5.63"
Tc=6.0 min CN=98 Runoff=5.10 cfs 19,928 cf

Subcatchment 5.6: LOT L Runoff Area=71,267 sf 55.43% Impervious Runoff Depth=3.46"
Flow Length=295' Slope=0.0500 '/' Tc=16.4 min CN=78 Runoff=4.38 cfs 20,574 cf

Subcatchment 5.7: WESTFORD PARCEL Runoff Area=55,128 sf 0.00% Impervious Runoff Depth=1.44"
Flow Length=115' Tc=21.2 min CN=55 Runoff=1.10 cfs 6,632 cf

Subcatchment 5.8: LOT T Runoff Area=37,553 sf 29.40% Impervious Runoff Depth=1.76"
Tc=6.0 min CN=59 Runoff=1.58 cfs 5,496 cf

Subcatchment 6.1: Runoff Area=86,779 sf 35.97% Impervious Runoff Depth=1.76"
Flow Length=125' Tc=22.3 min CN=59 Runoff=2.18 cfs 12,700 cf

Subcatchment 9.1: Runoff Area=26,390 sf 0.00% Impervious Runoff Depth=0.22"
Tc=6.0 min CN=35 Runoff=0.02 cfs 493 cf

Subcatchment 9.2: Runoff Area=56,084 sf 0.00% Impervious Runoff Depth=0.51"
Tc=6.0 min CN=41 Runoff=0.26 cfs 2,407 cf

Subcatchment 10.1: Runoff Area=12,176 sf 0.00% Impervious Runoff Depth=0.22"
Tc=6.0 min CN=35 Runoff=0.01 cfs 227 cf

Subcatchment 10.2: Runoff Area=5,430 sf 0.00% Impervious Runoff Depth=0.94"
Tc=0.0 min CN=48 Runoff=0.13 cfs 427 cf

Subcatchment 10.3: Runoff Area=488 sf 0.00% Impervious Runoff Depth=1.44"
Tc=6.0 min CN=55 Runoff=0.02 cfs 59 cf

Subcatchment 10.4: Runoff Area=612 sf 0.00% Impervious Runoff Depth=1.44"
Tc=6.0 min CN=55 Runoff=0.02 cfs 74 cf

Pond 1P: C/D/E Peak Elev=279.16' Inflow=29.23 cfs 112,291 cf
36.0" Round Culvert n=0.013 L=30.0' S=0.0050 '/' Outflow=29.23 cfs 112,291 cf

Pond 2P: ROAD Peak Elev=279.84' Inflow=22.49 cfs 86,005 cf
36.0" Round Culvert n=0.013 L=215.0' S=0.0050 '/' Outflow=22.49 cfs 86,005 cf

Pond 3P: F/G/H Peak Elev=280.10' Inflow=20.27 cfs 78,433 cf
36.0" Round Culvert n=0.013 L=15.0' S=0.0053 '/' Outflow=20.27 cfs 78,433 cf

Pond 4P: ROAD Peak Elev=280.75' Inflow=10.42 cfs 39,979 cf
36.0" Round Culvert n=0.013 L=200.0' S=0.0050 '/' Outflow=10.42 cfs 39,979 cf

Pond 5P: Peak Elev=280.30' Inflow=10.42 cfs 39,979 cf
36.0" Round Culvert n=0.013 L=200.0' S=0.0050 '/' Outflow=10.42 cfs 39,979 cf

Pond 6P: I/J/K Peak Elev=281.10' Inflow=8.73 cfs 34,059 cf
24.0" Round Culvert n=0.013 L=60.0' S=0.0050 '/' Outflow=8.73 cfs 34,059 cf

Pond 7P: SSIB Peak Elev=0.00' Storage=0 cf
Discarded=0.00 cfs 0 cf Primary=0.00 cfs 0 cf

Pond DMH10: Peak Elev=258.58' Inflow=63.05 cfs 288,620 cf
48.0" Round Culvert n=0.011 L=77.0' S=-0.0065 '/' Outflow=63.05 cfs 288,620 cf

Pond DMH11: Peak Elev=257.50' Inflow=63.05 cfs 288,620 cf
48.0" Round Culvert n=0.011 L=67.0' S=0.0075 '/' Outflow=63.05 cfs 288,620 cf

Pond DMH2: Peak Elev=270.41' Inflow=37.99 cfs 177,407 cf
36.0" Round Culvert n=0.011 L=208.0' S=0.0049 '/' Outflow=37.99 cfs 177,407 cf

Pond DMH3: Peak Elev=269.12' Inflow=37.99 cfs 177,407 cf
36.0" Round Culvert n=0.011 L=214.0' S=0.0050 '/' Outflow=37.99 cfs 177,407 cf

Pond DMH8: Peak Elev=267.68' Inflow=40.39 cfs 186,626 cf
42.0" Round Culvert n=0.011 L=77.0' S=0.0049 '/' Outflow=40.39 cfs 186,626 cf

Pond DMH9: Peak Elev=262.56' Inflow=63.05 cfs 287,959 cf
48.0" Round Culvert n=0.011 L=276.0' S=0.0050 '/' Outflow=63.05 cfs 287,959 cf

Pond P1: SSIB Peak Elev=268.31' Storage=18,105 cf Inflow=15.01 cfs 56,025 cf
Discarded=0.32 cfs 33,088 cf Primary=5.70 cfs 22,944 cf Outflow=6.02 cfs 56,032 cf

Pond P10.5: P10 & P11 Peak Elev=273.51' Storage=4,343 cf Inflow=4.50 cfs 15,166 cf
Discarded=0.05 cfs 5,470 cf Primary=2.41 cfs 9,219 cf Outflow=2.46 cfs 14,689 cf

Pond P12: Peak Elev=280.19' Storage=17,454 cf Inflow=23.20 cfs 84,459 cf
Outflow=14.69 cfs 82,223 cf

Pond P2: RAIN GARDEN Peak Elev=260.40' Storage=5,316 cf Inflow=11.40 cfs 33,181 cf
Discarded=1.27 cfs 22,664 cf Primary=6.69 cfs 10,522 cf Outflow=7.96 cfs 33,186 cf

Pond P3: SSIB Peak Elev=271.10' Storage=8,429 cf Inflow=8.82 cfs 31,823 cf
Discarded=0.15 cfs 16,171 cf Primary=6.91 cfs 15,659 cf Outflow=7.06 cfs 31,831 cf

Pond P4: SSIB Peak Elev=278.23' Storage=20,204 cf Inflow=29.58 cfs 120,128 cf
Discarded=0.44 cfs 41,915 cf Primary=19.91 cfs 78,241 cf Outflow=20.34 cfs 120,156 cf

Pond P5: SSIB Peak Elev=265.40' Storage=14,185 cf Inflow=13.42 cfs 44,663 cf
Discarded=1.14 cfs 44,006 cf Primary=0.22 cfs 661 cf Outflow=1.36 cfs 44,667 cf

Pond P6: SSIB Peak Elev=276.88' Storage=25,154 cf Inflow=35.48 cfs 129,899 cf
Discarded=0.22 cfs 27,550 cf Primary=22.66 cfs 101,333 cf Outflow=22.88 cfs 128,883 cf

Pond P7: SSIB Peak Elev=279.85' Storage=8,365 cf Inflow=11.61 cfs 41,656 cf
Outflow=5.38 cfs 41,607 cf

Pond P8: RAIN GARDEN Peak Elev=277.62' Storage=5,265 cf Inflow=4.38 cfs 20,574 cf
Outflow=4.31 cfs 20,536 cf

Pond P9: Peak Elev=277.36' Storage=10,174 cf Inflow=8.24 cfs 30,670 cf
Discarded=0.11 cfs 12,581 cf Primary=3.51 cfs 16,944 cf Outflow=3.62 cfs 29,525 cf

Link 3L: (new Link)
Primary=0.00 cfs 0 cf

Link DP-1: HEADWALL Inflow=3.28 cfs 18,306 cf
Primary=3.28 cfs 18,306 cf

Link DP-10: OFFSITE EAST Inflow=0.16 cfs 787 cf
Primary=0.16 cfs 787 cf

Link DP-2: FES Inflow=12.40 cfs 33,466 cf
Primary=12.40 cfs 33,466 cf

Link DP-3: HEADWALL Inflow=63.05 cfs 288,620 cf
Primary=63.05 cfs 288,620 cf

Link DP-4: KING ST Inflow=0.66 cfs 2,349 cf
Primary=0.66 cfs 2,349 cf

Link DP-5: EAST SIDE WETLAND Inflow=11.38 cfs 74,272 cf
Primary=11.38 cfs 74,272 cf

Link DP-6: WEST SIDE WETLAND Inflow=79.55 cfs 353,092 cf
Primary=79.55 cfs 353,092 cf

Link DP-7: SOUTH POND
Primary=0.00 cfs 0 cf

Link DP-8: SOUTH POND
Primary=0.00 cfs 0 cf

Link DP-9: OFFSITE WEST Inflow=0.26 cfs 2,900 cf
Primary=0.26 cfs 2,900 cf

Total Runoff Area = 1,928,530 sf Runoff Volume = 641,757 cf Average Runoff Depth = 3.99"
34.21% Pervious = 659,697 sf 65.79% Impervious = 1,268,833 sf

Time span=0.00-36.00 hrs, dt=0.04 hrs, 901 points x 3
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1.1: ROAD Runoff Area=26,307 sf 68.48% Impervious Runoff Depth=4.58"
Tc=6.0 min CN=79 Runoff=2.98 cfs 10,050 cf

Subcatchment 1.2: ABUTTING LOTS Runoff Area=46,595 sf 53.99% Impervious Runoff Depth=3.62"
Flow Length=211' Tc=23.6 min CN=70 Runoff=2.51 cfs 14,050 cf

Subcatchment 2.1: LOT M Runoff Area=127,271 sf 94.29% Impervious Runoff Depth=6.41"
Tc=6.0 min CN=95 Runoff=18.01 cfs 67,939 cf

Subcatchment 2.2: ROAD Runoff Area=46,717 sf 75.10% Impervious Runoff Depth=5.59"
Tc=6.0 min CN=88 Runoff=6.16 cfs 21,776 cf

Subcatchment 2.3: LOTS A & B Runoff Area=77,277 sf 74.08% Impervious Runoff Depth=6.05"
Tc=6.0 min CN=92 Runoff=10.67 cfs 38,991 cf

Subcatchment 3.1: LOT N 3.7 Runoff Area=132,423 sf 62.22% Impervious Runoff Depth=4.26"
Tc=6.0 min CN=76 Runoff=14.03 cfs 46,981 cf

Subcatchment 3.10: LOT F 3.17 Runoff Area=32,969 sf 100.00% Impervious Runoff Depth=6.76"
Tc=6.0 min CN=98 Runoff=4.73 cfs 18,575 cf

Subcatchment 3.11: LOT R LAND 3.15 Runoff Area=88,988 sf 29.38% Impervious Runoff Depth=4.81"
Tc=6.0 min CN=81 Runoff=10.47 cfs 35,633 cf

Subcatchment 3.12: LOT R BUILDING 3.16 Runoff Area=91,130 sf 100.00% Impervious Runoff Depth=6.76"
Tc=6.0 min CN=98 Runoff=13.08 cfs 51,344 cf

Subcatchment 3.13: LOT S LAND 3.19 Runoff Area=80,697 sf 28.62% Impervious Runoff Depth=4.81"
Tc=6.0 min CN=81 Runoff=9.50 cfs 32,313 cf

Subcatchment 3.14: LOT S BUILDING 3.20 Runoff Area=90,980 sf 100.00% Impervious Runoff Depth=6.76"
Tc=6.0 min CN=98 Runoff=13.06 cfs 51,259 cf

Subcatchment 3.15: ROAD 3.3 Runoff Area=32,025 sf 74.82% Impervious Runoff Depth=5.14"
Tc=6.0 min CN=84 Runoff=3.98 cfs 13,717 cf

Subcatchment 3.16: LOTS F, G & H 3.18 Runoff Area=81,934 sf 100.00% Impervious Runoff Depth=6.76"
Tc=6.0 min CN=98 Runoff=11.76 cfs 46,162 cf

Subcatchment 3.17: ROAD 3.6 Runoff Area=15,783 sf 80.68% Impervious Runoff Depth=5.59"
Tc=6.0 min CN=88 Runoff=2.08 cfs 7,357 cf

Subcatchment 3.18: ROAD 3.4 Runoff Area=22,298 sf 74.82% Impervious Runoff Depth=5.14"
Tc=6.0 min CN=84 Runoff=2.77 cfs 9,551 cf

Subcatchment 3.19: LOTS I, J & K 3.21 Runoff Area=72,569 sf 100.00% Impervious Runoff Depth=6.76"
Tc=6.0 min CN=98 Runoff=10.42 cfs 40,886 cf

Subcatchment 3.2: ROAD Runoff Area=24,520 sf 57.22% Impervious Runoff Depth=5.14"
Tc=6.0 min CN=84 Runoff=3.04 cfs 10,503 cf

Subcatchment 3.3: ROAD 3.1 Runoff Area=25,878 sf 60.23% Impervious Runoff Depth=4.15"
Tc=6.0 min CN=75 Runoff=2.68 cfs 8,948 cf

Subcatchment 3.4a: LOT O 3.8 Runoff Area=36,922 sf 51.28% Impervious Runoff Depth=3.72"
Tc=6.0 min CN=71 Runoff=3.45 cfs 11,456 cf

Subcatchment 3.4b: LOT O 3.9 Runoff Area=27,652 sf 63.36% Impervious Runoff Depth=4.47"
Tc=6.0 min CN=78 Runoff=3.06 cfs 10,311 cf

Subcatchment 3.5: PAKRING LOT P3 3.10 Runoff Area=71,929 sf 99.91% Impervious Runoff Depth=6.76"
Tc=6.0 min CN=98 Runoff=10.32 cfs 40,525 cf

Subcatchment 3.6: LOT Q 3.11 Runoff Area=57,193 sf 68.85% Impervious Runoff Depth=4.69"
Tc=6.0 min CN=80 Runoff=6.60 cfs 22,374 cf

Subcatchment 3.7: COMMON 3.12 Runoff Area=30,574 sf 0.00% Impervious Runoff Depth=4.04"
Flow Length=288' Slope=0.0050 '/' Tc=41.4 min CN=74 Runoff=1.36 cfs 10,299 cf

Subcatchment 3.8: LOTS C & D 3.13 Runoff Area=34,748 sf 100.00% Impervious Runoff Depth=6.76"
Tc=6.0 min CN=98 Runoff=4.99 cfs 19,577 cf

Subcatchment 3.9: LOT E 3.14 Runoff Area=21,259 sf 100.00% Impervious Runoff Depth=6.76"
Tc=6.0 min CN=98 Runoff=3.05 cfs 11,978 cf

Subcatchment 4.1: ROAD Runoff Area=5,837 sf 88.57% Impervious Runoff Depth=5.94"
Tc=6.0 min CN=91 Runoff=0.80 cfs 2,889 cf

Subcatchment 5.1: ROAD 3.5 Runoff Area=11,523 sf 79.93% Impervious Runoff Depth=5.59"
Flow Length=2,275' Tc=8.3 min CN=88 Runoff=1.41 cfs 5,371 cf

Subcatchment 5.2: ROAD Runoff Area=44,902 sf 82.02% Impervious Runoff Depth=5.48"
Tc=6.0 min CN=87 Runoff=5.84 cfs 20,503 cf

Subcatchment 5.4: PARKING LOT P5 Runoff Area=75,263 sf 66.43% Impervious Runoff Depth=4.47"
Tc=6.0 min CN=78 Runoff=8.34 cfs 28,066 cf

Subcatchment 5.5: LOT T Runoff Area=42,460 sf 100.00% Impervious Runoff Depth=6.76"
Tc=6.0 min CN=98 Runoff=6.09 cfs 23,922 cf

Subcatchment 5.6: LOT L Runoff Area=71,267 sf 55.43% Impervious Runoff Depth=4.47"
Flow Length=295' Slope=0.0500 '/' Tc=16.4 min CN=78 Runoff=5.63 cfs 26,576 cf

Subcatchment 5.7: WESTFORD PARCEL Runoff Area=55,128 sf 0.00% Impervious Runoff Depth=2.12"
Flow Length=115' Tc=21.2 min CN=55 Runoff=1.72 cfs 9,757 cf

Subcatchment 5.8: LOT T Runoff Area=37,553 sf 29.40% Impervious Runoff Depth=2.51"
Tc=6.0 min CN=59 Runoff=2.32 cfs 7,842 cf

Subcatchment 6.1: Runoff Area=86,779 sf 35.97% Impervious Runoff Depth=2.51"
Flow Length=125' Tc=22.3 min CN=59 Runoff=3.22 cfs 18,123 cf

Subcatchment 9.1: Runoff Area=26,390 sf 0.00% Impervious Runoff Depth=0.49"
Tc=6.0 min CN=35 Runoff=0.07 cfs 1,086 cf

Subcatchment 9.2: Runoff Area=56,084 sf 0.00% Impervious Runoff Depth=0.92"
Tc=6.0 min CN=41 Runoff=0.83 cfs 4,289 cf

Subcatchment 10.1: Runoff Area=12,176 sf 0.00% Impervious Runoff Depth=0.49"
Tc=6.0 min CN=35 Runoff=0.03 cfs 501 cf

Subcatchment 10.2: Runoff Area=5,430 sf 0.00% Impervious Runoff Depth=1.49"
Tc=0.0 min CN=48 Runoff=0.24 cfs 675 cf

Subcatchment 10.3: Runoff Area=488 sf 0.00% Impervious Runoff Depth=2.12"
Tc=6.0 min CN=55 Runoff=0.02 cfs 86 cf

Subcatchment 10.4: Runoff Area=612 sf 0.00% Impervious Runoff Depth=2.12"
Tc=6.0 min CN=55 Runoff=0.03 cfs 108 cf

Pond 1P: C/D/E Peak Elev=280.04' Inflow=35.07 cfs 135,511 cf
36.0" Round Culvert n=0.013 L=30.0' S=0.0050 '/' Outflow=35.07 cfs 135,511 cf

Pond 2P: ROAD Peak Elev=281.03' Inflow=27.03 cfs 103,956 cf
36.0" Round Culvert n=0.013 L=215.0' S=0.0050 '/' Outflow=27.03 cfs 103,956 cf

Pond 3P: F/G/H Peak Elev=281.48' Inflow=24.26 cfs 94,405 cf
36.0" Round Culvert n=0.013 L=15.0' S=0.0053 '/' Outflow=24.26 cfs 94,405 cf

Pond 4P: ROAD Peak Elev=281.95' Inflow=12.50 cfs 48,243 cf
36.0" Round Culvert n=0.013 L=200.0' S=0.0050 '/' Outflow=12.50 cfs 48,243 cf

Pond 5P: Peak Elev=281.61' Inflow=12.50 cfs 48,243 cf
36.0" Round Culvert n=0.013 L=200.0' S=0.0050 '/' Outflow=12.50 cfs 48,243 cf

Pond 6P: I/J/K Peak Elev=282.37' Inflow=10.42 cfs 40,886 cf
24.0" Round Culvert n=0.013 L=60.0' S=0.0050 '/' Outflow=10.42 cfs 40,886 cf

Pond 7P: SSIB Peak Elev=0.00' Storage=0 cf
Discarded=0.00 cfs 0 cf Primary=0.00 cfs 0 cf

Pond DMH10: Peak Elev=259.76' Inflow=78.48 cfs 380,990 cf
48.0" Round Culvert n=0.011 L=77.0' S=-0.0065 '/' Outflow=78.48 cfs 380,990 cf

Pond DMH11: Peak Elev=258.07' Inflow=78.48 cfs 380,990 cf
48.0" Round Culvert n=0.011 L=67.0' S=0.0075 '/' Outflow=78.48 cfs 380,990 cf

Pond DMH2: Peak Elev=272.23' Inflow=48.02 cfs 228,360 cf
36.0" Round Culvert n=0.011 L=208.0' S=0.0049 '/' Outflow=48.02 cfs 228,360 cf

Pond DMH3: Peak Elev=270.24' Inflow=48.02 cfs 228,360 cf
36.0" Round Culvert n=0.011 L=214.0' S=0.0050 '/' Outflow=48.02 cfs 228,360 cf

Pond DMH8: Peak Elev=268.25' Inflow=52.47 cfs 241,674 cf
42.0" Round Culvert n=0.011 L=77.0' S=0.0049 '/' Outflow=52.47 cfs 241,674 cf

Pond DMH9: Peak Elev=263.10' Inflow=78.46 cfs 373,027 cf
48.0" Round Culvert n=0.011 L=276.0' S=0.0050 '/' Outflow=78.46 cfs 373,027 cf

Pond P1: SSIB Peak Elev=269.27' Storage=21,445 cf Inflow=18.01 cfs 67,939 cf
Discarded=0.32 cfs 34,643 cf Primary=6.52 cfs 33,297 cf Outflow=6.84 cfs 67,940 cf

Pond P10.5: P10 & P11 Peak Elev=274.04' Storage=4,830 cf Inflow=5.72 cfs 19,451 cf
Discarded=0.05 cfs 5,640 cf Primary=4.75 cfs 13,314 cf Outflow=4.80 cfs 18,954 cf

Pond P12: Peak Elev=280.77' Storage=19,579 cf Inflow=28.39 cfs 104,075 cf
Outflow=19.16 cfs 101,838 cf

Pond P2: RAIN GARDEN Peak Elev=260.92' Storage=6,836 cf Inflow=14.05 cfs 44,068 cf
Discarded=1.42 cfs 27,259 cf Primary=8.25 cfs 16,812 cf Outflow=9.67 cfs 44,070 cf

Pond P3: SSIB Peak Elev=271.43' Storage=8,936 cf Inflow=10.67 cfs 38,991 cf
Discarded=0.15 cfs 16,702 cf Primary=8.44 cfs 22,292 cf Outflow=8.58 cfs 38,994 cf

Pond P4: SSIB Peak Elev=278.63' Storage=22,329 cf Inflow=35.55 cfs 145,810 cf
Discarded=0.44 cfs 42,891 cf Primary=24.63 cfs 102,929 cf Outflow=25.07 cfs 145,820 cf

Pond P5: SSIB Peak Elev=265.91' Storage=16,499 cf Inflow=17.47 cfs 58,437 cf
Discarded=1.14 cfs 50,491 cf Primary=2.45 cfs 7,962 cf Outflow=3.59 cfs 58,453 cf

Pond P6: SSIB Peak Elev=277.43' Storage=28,843 cf Inflow=43.54 cfs 160,187 cf
Discarded=0.22 cfs 27,761 cf Primary=26.06 cfs 131,353 cf Outflow=26.28 cfs 159,114 cf

Pond P7: SSIB Peak Elev=280.20' Storage=10,148 cf Inflow=14.43 cfs 51,988 cf
Outflow=6.81 cfs 51,939 cf

Pond P8: RAIN GARDEN Peak Elev=277.68' Storage=5,360 cf Inflow=5.63 cfs 26,576 cf
Outflow=5.56 cfs 26,537 cf

Pond P9: Peak Elev=277.82' Storage=11,797 cf Inflow=10.04 cfs 37,663 cf
Discarded=0.11 cfs 12,861 cf Primary=4.35 cfs 23,594 cf Outflow=4.45 cfs 36,455 cf

Link 3L: (new Link)
Primary=0.00 cfs 0 cf

Link DP-1: HEADWALL Inflow=4.29 cfs 24,100 cf
Primary=4.29 cfs 24,100 cf

Link DP-10: OFFSITE EAST Inflow=0.27 cfs 1,371 cf
Primary=0.27 cfs 1,371 cf

Link DP-2: FES Inflow=14.77 cfs 50,109 cf
Primary=14.77 cfs 50,109 cf

Link DP-3: HEADWALL Inflow=78.48 cfs 380,990 cf
Primary=78.48 cfs 380,990 cf

Link DP-4: KING ST Inflow=0.80 cfs 2,889 cf
Primary=0.80 cfs 2,889 cf

Link DP-5: EAST SIDE WETLAND Inflow=14.99 cfs 96,076 cf
Primary=14.99 cfs 96,076 cf

Link DP-6: WEST SIDE WETLAND Inflow=99.03 cfs 473,321 cf
Primary=99.03 cfs 473,321 cf

Link DP-7: SOUTH POND
Primary=0.00 cfs 0 cf

Link DP-8: SOUTH POND
Primary=0.00 cfs 0 cf

Link DP-9: OFFSITE WEST Inflow=0.88 cfs 5,376 cf
Primary=0.88 cfs 5,376 cf

Total Runoff Area = 1,928,530 sf Runoff Volume = 802,349 cf Average Runoff Depth = 4.99"
34.21% Pervious = 659,697 sf 65.79% Impervious = 1,268,833 sf

Time span=0.00-36.00 hrs, dt=0.04 hrs, 901 points x 3
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1.1: ROAD Runoff Area=26,307 sf 68.48% Impervious Runoff Depth=5.84"
Tc=6.0 min CN=79 Runoff=3.75 cfs 12,811 cf

Subcatchment 1.2: ABUTTING LOTS Runoff Area=46,595 sf 53.99% Impervious Runoff Depth=4.78"
Flow Length=211' Tc=23.6 min CN=70 Runoff=3.32 cfs 18,542 cf

Subcatchment 2.1: LOT M Runoff Area=127,271 sf 94.29% Impervious Runoff Depth=7.76"
Tc=6.0 min CN=95 Runoff=21.61 cfs 82,302 cf

Subcatchment 2.2: ROAD Runoff Area=46,717 sf 75.10% Impervious Runoff Depth=6.92"
Tc=6.0 min CN=88 Runoff=7.52 cfs 26,942 cf

Subcatchment 2.3: LOTS A & B Runoff Area=77,277 sf 74.08% Impervious Runoff Depth=7.40"
Tc=6.0 min CN=92 Runoff=12.89 cfs 47,654 cf

Subcatchment 3.1: LOT N 3.7 Runoff Area=132,423 sf 62.22% Impervious Runoff Depth=5.49"
Tc=6.0 min CN=76 Runoff=17.92 cfs 60,546 cf

Subcatchment 3.10: LOT F 3.17 Runoff Area=32,969 sf 100.00% Impervious Runoff Depth=8.12"
Tc=6.0 min CN=98 Runoff=5.66 cfs 22,309 cf

Subcatchment 3.11: LOT R LAND 3.15 Runoff Area=88,988 sf 29.38% Impervious Runoff Depth=6.08"
Tc=6.0 min CN=81 Runoff=13.10 cfs 45,107 cf

Subcatchment 3.12: LOT R BUILDING 3.16 Runoff Area=91,130 sf 100.00% Impervious Runoff Depth=8.12"
Tc=6.0 min CN=98 Runoff=15.64 cfs 61,665 cf

Subcatchment 3.13: LOT S LAND 3.19 Runoff Area=80,697 sf 28.62% Impervious Runoff Depth=6.08"
Tc=6.0 min CN=81 Runoff=11.88 cfs 40,905 cf

Subcatchment 3.14: LOT S BUILDING 3.20 Runoff Area=90,980 sf 100.00% Impervious Runoff Depth=8.12"
Tc=6.0 min CN=98 Runoff=15.61 cfs 61,563 cf

Subcatchment 3.15: ROAD 3.3 Runoff Area=32,025 sf 74.82% Impervious Runoff Depth=6.44"
Tc=6.0 min CN=84 Runoff=4.92 cfs 17,190 cf

Subcatchment 3.16: LOTS F, G & H 3.18 Runoff Area=81,934 sf 100.00% Impervious Runoff Depth=8.12"
Tc=6.0 min CN=98 Runoff=14.06 cfs 55,442 cf

Subcatchment 3.17: ROAD 3.6 Runoff Area=15,783 sf 80.68% Impervious Runoff Depth=6.92"
Tc=6.0 min CN=88 Runoff=2.54 cfs 9,102 cf

Subcatchment 3.18: ROAD 3.4 Runoff Area=22,298 sf 74.82% Impervious Runoff Depth=6.44"
Tc=6.0 min CN=84 Runoff=3.43 cfs 11,969 cf

Subcatchment 3.19: LOTS I, J & K 3.21 Runoff Area=72,569 sf 100.00% Impervious Runoff Depth=8.12"
Tc=6.0 min CN=98 Runoff=12.45 cfs 49,105 cf

Subcatchment 3.2: ROAD Runoff Area=24,520 sf 57.22% Impervious Runoff Depth=6.44"
Tc=6.0 min CN=84 Runoff=3.77 cfs 13,162 cf

Subcatchment 3.3: ROAD 3.1 Runoff Area=25,878 sf 60.23% Impervious Runoff Depth=5.37"
Tc=6.0 min CN=75 Runoff=3.44 cfs 11,575 cf

Subcatchment 3.4a: LOT O 3.8 Runoff Area=36,922 sf 51.28% Impervious Runoff Depth=4.89"
Tc=6.0 min CN=71 Runoff=4.51 cfs 15,056 cf

Subcatchment 3.4b: LOT O 3.9 Runoff Area=27,652 sf 63.36% Impervious Runoff Depth=5.72"
Tc=6.0 min CN=78 Runoff=3.88 cfs 13,192 cf

Subcatchment 3.5: PAKRING LOT P3 3.10 Runoff Area=71,929 sf 99.91% Impervious Runoff Depth=8.12"
Tc=6.0 min CN=98 Runoff=12.34 cfs 48,672 cf

Subcatchment 3.6: LOT Q 3.11 Runoff Area=57,193 sf 68.85% Impervious Runoff Depth=5.96"
Tc=6.0 min CN=80 Runoff=8.29 cfs 28,421 cf

Subcatchment 3.7: COMMON 3.12 Runoff Area=30,574 sf 0.00% Impervious Runoff Depth=5.25"
Flow Length=288' Slope=0.0050 '/' Tc=41.4 min CN=74 Runoff=1.77 cfs 13,373 cf

Subcatchment 3.8: LOTS C & D 3.13 Runoff Area=34,748 sf 100.00% Impervious Runoff Depth=8.12"
Tc=6.0 min CN=98 Runoff=5.96 cfs 23,513 cf

Subcatchment 3.9: LOT E 3.14 Runoff Area=21,259 sf 100.00% Impervious Runoff Depth=8.12"
Tc=6.0 min CN=98 Runoff=3.65 cfs 14,385 cf

Subcatchment 4.1: ROAD Runoff Area=5,837 sf 88.57% Impervious Runoff Depth=7.28"
Tc=6.0 min CN=91 Runoff=0.97 cfs 3,541 cf

Subcatchment 5.1: ROAD 3.5 Runoff Area=11,523 sf 79.93% Impervious Runoff Depth=6.92"
Flow Length=2,275' Tc=8.3 min CN=88 Runoff=1.72 cfs 6,645 cf

Subcatchment 5.2: ROAD Runoff Area=44,902 sf 82.02% Impervious Runoff Depth=6.80"
Tc=6.0 min CN=87 Runoff=7.15 cfs 25,447 cf

Subcatchment 5.4: PARKING LOT P5 Runoff Area=75,263 sf 66.43% Impervious Runoff Depth=5.72"
Tc=6.0 min CN=78 Runoff=10.56 cfs 35,905 cf

Subcatchment 5.5: LOT T Runoff Area=42,460 sf 100.00% Impervious Runoff Depth=8.12"
Tc=6.0 min CN=98 Runoff=7.29 cfs 28,731 cf

Subcatchment 5.6: LOT L Runoff Area=71,267 sf 55.43% Impervious Runoff Depth=5.72"
Flow Length=295' Slope=0.0500 '/' Tc=16.4 min CN=78 Runoff=7.15 cfs 33,999 cf

Subcatchment 5.7: WESTFORD PARCEL Runoff Area=55,128 sf 0.00% Impervious Runoff Depth=3.03"
Flow Length=115' Tc=21.2 min CN=55 Runoff=2.54 cfs 13,933 cf

Subcatchment 5.8: LOT T Runoff Area=37,553 sf 29.40% Impervious Runoff Depth=3.49"
Tc=6.0 min CN=59 Runoff=3.27 cfs 10,923 cf

Subcatchment 6.1: Runoff Area=86,779 sf 35.97% Impervious Runoff Depth=3.49"
Flow Length=125' Tc=22.3 min CN=59 Runoff=4.58 cfs 25,241 cf

Subcatchment 9.1: Runoff Area=26,390 sf 0.00% Impervious Runoff Depth=0.93"
Tc=6.0 min CN=35 Runoff=0.33 cfs 2,044 cf

Subcatchment 9.2: Runoff Area=56,084 sf 0.00% Impervious Runoff Depth=1.51"
Tc=6.0 min CN=41 Runoff=1.72 cfs 7,068 cf

Subcatchment 10.1: Runoff Area=12,176 sf 0.00% Impervious Runoff Depth=0.93"
Tc=6.0 min CN=35 Runoff=0.15 cfs 943 cf

Subcatchment 10.2: Runoff Area=5,430 sf 0.00% Impervious Runoff Depth=2.25"
Tc=0.0 min CN=48 Runoff=0.37 cfs 1,019 cf

Subcatchment 10.3: Runoff Area=488 sf 0.00% Impervious Runoff Depth=3.03"
Tc=6.0 min CN=55 Runoff=0.04 cfs 123 cf

Subcatchment 10.4: Runoff Area=612 sf 0.00% Impervious Runoff Depth=3.03"
Tc=6.0 min CN=55 Runoff=0.05 cfs 155 cf

Pond 1P: C/D/E Peak Elev=281.24' Inflow=42.08 cfs 163,516 cf
36.0" Round Culvert n=0.013 L=30.0' S=0.0050 '/' Outflow=42.08 cfs 163,516 cf

Pond 2P: ROAD Peak Elev=282.67' Inflow=32.47 cfs 125,618 cf
36.0" Round Culvert n=0.013 L=215.0' S=0.0050 '/' Outflow=32.47 cfs 125,618 cf

Pond 3P: F/G/H Peak Elev=283.37' Inflow=29.05 cfs 113,649 cf
36.0" Round Culvert n=0.013 L=15.0' S=0.0053 '/' Outflow=29.05 cfs 113,649 cf

Pond 4P: ROAD Peak Elev=284.01' Inflow=14.99 cfs 58,207 cf
36.0" Round Culvert n=0.013 L=200.0' S=0.0050 '/' Outflow=14.99 cfs 58,207 cf

Pond 5P: Peak Elev=283.51' Inflow=14.99 cfs 58,207 cf
36.0" Round Culvert n=0.013 L=200.0' S=0.0050 '/' Outflow=14.99 cfs 58,207 cf

Pond 6P: I/J/K Peak Elev=284.66' Inflow=12.45 cfs 49,105 cf
24.0" Round Culvert n=0.013 L=60.0' S=0.0050 '/' Outflow=12.45 cfs 49,105 cf

Pond 7P: SSIB Peak Elev=0.00' Storage=0 cf
Discarded=0.00 cfs 0 cf Primary=0.00 cfs 0 cf

Pond DMH10: Peak Elev=261.88' Inflow=101.23 cfs 495,366 cf
48.0" Round Culvert n=0.011 L=77.0' S=-0.0065 '/' Outflow=101.23 cfs 495,366 cf

Pond DMH11: Peak Elev=259.08' Inflow=101.23 cfs 495,366 cf
48.0" Round Culvert n=0.011 L=67.0' S=0.0075 '/' Outflow=101.23 cfs 495,366 cf

Pond DMH2: Peak Elev=275.08' Inflow=59.75 cfs 290,782 cf
36.0" Round Culvert n=0.011 L=208.0' S=0.0049 '/' Outflow=59.75 cfs 290,782 cf

Pond DMH3: Peak Elev=272.00' Inflow=59.75 cfs 290,782 cf
36.0" Round Culvert n=0.011 L=214.0' S=0.0050 '/' Outflow=59.75 cfs 290,782 cf

Pond DMH8: Peak Elev=268.92' Inflow=65.62 cfs 309,199 cf
42.0" Round Culvert n=0.011 L=77.0' S=0.0049 '/' Outflow=65.62 cfs 309,199 cf

Pond DMH9: Peak Elev=264.37' Inflow=95.55 cfs 477,217 cf
48.0" Round Culvert n=0.011 L=276.0' S=0.0050 '/' Outflow=95.55 cfs 477,217 cf

Pond P1: SSIB Peak Elev=270.73' Storage=24,911 cf Inflow=21.61 cfs 82,302 cf
Discarded=0.32 cfs 35,796 cf Primary=7.45 cfs 46,513 cf Outflow=7.77 cfs 82,309 cf

Pond P10.5: P10 & P11 Peak Elev=274.20' Storage=4,971 cf Inflow=7.20 cfs 24,737 cf
Discarded=0.05 cfs 5,808 cf Primary=6.86 cfs 18,417 cf Outflow=6.92 cfs 24,225 cf

Pond P12: Peak Elev=281.53' Storage=22,160 cf Inflow=34.64 cfs 127,914 cf
Outflow=23.51 cfs 125,677 cf

Pond P2: RAIN GARDEN Peak Elev=261.41' Storage=8,471 cf Inflow=17.15 cfs 57,453 cf
Discarded=1.57 cfs 32,818 cf Primary=9.49 cfs 24,636 cf Outflow=11.06 cfs 57,454 cf

Pond P3: SSIB Peak Elev=271.92' Storage=9,462 cf Inflow=12.89 cfs 47,654 cf
Discarded=0.15 cfs 17,153 cf Primary=10.33 cfs 30,511 cf Outflow=10.48 cfs 47,664 cf

Pond P4: SSIB Peak Elev=279.20' Storage=24,582 cf Inflow=42.73 cfs 176,889 cf
Discarded=0.44 cfs 43,602 cf Primary=31.35 cfs 133,300 cf Outflow=31.78 cfs 176,902 cf

Pond P5: SSIB Peak Elev=266.59' Storage=19,385 cf Inflow=22.43 cfs 75,602 cf
Discarded=1.14 cfs 57,495 cf Primary=7.37 cfs 18,148 cf Outflow=8.50 cfs 75,643 cf

Pond P6: SSIB Peak Elev=278.49' Storage=33,735 cf Inflow=53.25 cfs 197,057 cf
Discarded=0.22 cfs 27,914 cf Primary=30.38 cfs 168,018 cf Outflow=30.60 cfs 195,932 cf

Pond P7: SSIB Peak Elev=280.67' Storage=12,413 cf Inflow=17.84 cfs 64,636 cf
Outflow=8.17 cfs 64,587 cf

Pond P8: RAIN GARDEN Peak Elev=277.73' Storage=5,462 cf Inflow=7.15 cfs 33,999 cf
Outflow=7.08 cfs 33,960 cf

Pond P9: Peak Elev=278.31' Storage=13,456 cf Inflow=12.20 cfs 46,145 cf
Discarded=0.11 cfs 13,078 cf Primary=5.09 cfs 31,805 cf Outflow=5.19 cfs 44,883 cf

Link 3L: (new Link)
Primary=0.00 cfs 0 cf

Link DP-1: HEADWALL Inflow=5.53 cfs 31,353 cf
Primary=5.53 cfs 31,353 cf

Link DP-10: OFFSITE EAST Inflow=0.49 cfs 2,241 cf
Primary=0.49 cfs 2,241 cf

Link DP-2: FES Inflow=16.94 cfs 71,149 cf
Primary=16.94 cfs 71,149 cf

Link DP-3: HEADWALL Inflow=101.23 cfs 495,366 cf
Primary=101.23 cfs 495,366 cf

Link DP-4: KING ST
Inflow=0.97 cfs 3,541 cf
Primary=0.97 cfs 3,541 cf

Link DP-5: EAST SIDE WETLAND
Inflow=19.07 cfs 123,403 cf
Primary=19.07 cfs 123,403 cf

Link DP-6: WEST SIDE WETLAND
Inflow=126.05 cfs 623,109 cf
Primary=126.05 cfs 623,109 cf

Link DP-7: SOUTH POND
Primary=0.00 cfs 0 cf

Link DP-8: SOUTH POND
Primary=0.00 cfs 0 cf

Link DP-9: OFFSITE WEST
Inflow=2.04 cfs 9,112 cf
Primary=2.04 cfs 9,112 cf

Total Runoff Area = 1,928,530 sf Runoff Volume = 1,000,220 cf Average Runoff Depth = 6.22"
34.21% Pervious = 659,697 sf 65.79% Impervious = 1,268,833 sf

Time span=0.00-36.00 hrs, dt=0.04 hrs, 901 points x 3
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1.1: ROAD Runoff Area=26,307 sf 68.48% Impervious Runoff Depth=4.31"
Tc=6.0 min CN=79 Runoff=2.80 cfs 9,450 cf

Subcatchment 1.2: ABUTTING LOTS Runoff Area=46,595 sf 53.99% Impervious Runoff Depth=3.37"
Flow Length=211' Tc=23.6 min CN=70 Runoff=2.34 cfs 13,088 cf

Subcatchment 2.1: LOT M Runoff Area=127,271 sf 94.29% Impervious Runoff Depth=6.11"
Tc=6.0 min CN=95 Runoff=17.21 cfs 64,774 cf

Subcatchment 2.2: ROAD Runoff Area=46,717 sf 75.10% Impervious Runoff Depth=5.30"
Tc=6.0 min CN=88 Runoff=5.86 cfs 20,642 cf

Subcatchment 2.3: LOTS A & B Runoff Area=77,277 sf 74.08% Impervious Runoff Depth=5.76"
Tc=6.0 min CN=92 Runoff=10.18 cfs 37,085 cf

Subcatchment 3.1: LOT N 3.7 Runoff Area=132,423 sf 62.22% Impervious Runoff Depth=3.99"
Tc=6.0 min CN=76 Runoff=13.17 cfs 44,046 cf

Subcatchment 3.10: LOT F 3.17 Runoff Area=32,969 sf 100.00% Impervious Runoff Depth=6.46"
Tc=6.0 min CN=98 Runoff=4.53 cfs 17,752 cf

Subcatchment 3.11: LOT R LAND 3.15 Runoff Area=88,988 sf 29.38% Impervious Runoff Depth=4.53"
Tc=6.0 min CN=81 Runoff=9.89 cfs 33,569 cf

Subcatchment 3.12: LOT R BUILDING 3.16 Runoff Area=91,130 sf 100.00% Impervious Runoff Depth=6.46"
Tc=6.0 min CN=98 Runoff=12.52 cfs 49,067 cf

Subcatchment 3.13: LOT S LAND 3.19 Runoff Area=80,697 sf 28.62% Impervious Runoff Depth=4.53"
Tc=6.0 min CN=81 Runoff=8.97 cfs 30,441 cf

Subcatchment 3.14: LOT S BUILDING 3.20 Runoff Area=90,980 sf 100.00% Impervious Runoff Depth=6.46"
Tc=6.0 min CN=98 Runoff=12.50 cfs 48,986 cf

Subcatchment 3.15: ROAD 3.3 Runoff Area=32,025 sf 74.82% Impervious Runoff Depth=4.86"
Tc=6.0 min CN=84 Runoff=3.77 cfs 12,958 cf

Subcatchment 3.16: LOTS F, G & H 3.18 Runoff Area=81,934 sf 100.00% Impervious Runoff Depth=6.46"
Tc=6.0 min CN=98 Runoff=11.25 cfs 44,116 cf

Subcatchment 3.17: ROAD 3.6 Runoff Area=15,783 sf 80.68% Impervious Runoff Depth=5.30"
Tc=6.0 min CN=88 Runoff=1.98 cfs 6,974 cf

Subcatchment 3.18: ROAD 3.4 Runoff Area=22,298 sf 74.82% Impervious Runoff Depth=4.86"
Tc=6.0 min CN=84 Runoff=2.62 cfs 9,022 cf

Subcatchment 3.19: LOTS I, J & K 3.21 Runoff Area=72,569 sf 100.00% Impervious Runoff Depth=6.46"
Tc=6.0 min CN=98 Runoff=9.97 cfs 39,073 cf

Subcatchment 3.2: ROAD Runoff Area=24,520 sf 57.22% Impervious Runoff Depth=4.86"
Tc=6.0 min CN=84 Runoff=2.88 cfs 9,921 cf

Subcatchment 3.3: ROAD 3.1 Runoff Area=25,878 sf 60.23% Impervious Runoff Depth=3.89"
Tc=6.0 min CN=75 Runoff=2.51 cfs 8,381 cf

Subcatchment 3.4a: LOT O 3.8 Runoff Area=36,922 sf 51.28% Impervious Runoff Depth=3.47"
Tc=6.0 min CN=71 Runoff=3.22 cfs 10,684 cf

Subcatchment 3.4b: LOT O 3.9 Runoff Area=27,652 sf 63.36% Impervious Runoff Depth=4.20"
Tc=6.0 min CN=78 Runoff=2.88 cfs 9,687 cf

Subcatchment 3.5: PAKRING LOT P3 3.10 Runoff Area=71,929 sf 99.91% Impervious Runoff Depth=6.46"
Tc=6.0 min CN=98 Runoff=9.88 cfs 38,729 cf

Subcatchment 3.6: LOT Q 3.11 Runoff Area=57,193 sf 68.85% Impervious Runoff Depth=4.42"
Tc=6.0 min CN=80 Runoff=6.23 cfs 21,058 cf

Subcatchment 3.7: COMMON 3.12 Runoff Area=30,574 sf 0.00% Impervious Runoff Depth=3.78"
Flow Length=288' Slope=0.0050 '/' Tc=41.4 min CN=74 Runoff=1.28 cfs 9,635 cf

Subcatchment 3.8: LOTS C & D 3.13 Runoff Area=34,748 sf 100.00% Impervious Runoff Depth=6.46"
Tc=6.0 min CN=98 Runoff=4.77 cfs 18,709 cf

Subcatchment 3.9: LOT E 3.14 Runoff Area=21,259 sf 100.00% Impervious Runoff Depth=6.46"
Tc=6.0 min CN=98 Runoff=2.92 cfs 11,447 cf

Subcatchment 4.1: ROAD Runoff Area=5,837 sf 88.57% Impervious Runoff Depth=5.64"
Tc=6.0 min CN=91 Runoff=0.76 cfs 2,745 cf

Subcatchment 5.1: ROAD 3.5 Runoff Area=11,523 sf 79.93% Impervious Runoff Depth=5.30"
Flow Length=2,275' Tc=8.3 min CN=88 Runoff=1.34 cfs 5,092 cf

Subcatchment 5.2: ROAD Runoff Area=44,902 sf 82.02% Impervious Runoff Depth=5.19"
Tc=6.0 min CN=87 Runoff=5.55 cfs 19,419 cf

Subcatchment 5.4: PARKING LOT P5 Runoff Area=75,263 sf 66.43% Impervious Runoff Depth=4.20"
Tc=6.0 min CN=78 Runoff=7.85 cfs 26,365 cf

Subcatchment 5.5: LOT T Runoff Area=42,460 sf 100.00% Impervious Runoff Depth=6.46"
Tc=6.0 min CN=98 Runoff=5.83 cfs 22,862 cf

Subcatchment 5.6: LOT L Runoff Area=71,267 sf 55.43% Impervious Runoff Depth=4.20"
Flow Length=295' Slope=0.0500 '/' Tc=16.4 min CN=78 Runoff=5.30 cfs 24,965 cf

Subcatchment 5.7: WESTFORD PARCEL Runoff Area=55,128 sf 0.00% Impervious Runoff Depth=1.94"
Flow Length=115' Tc=21.2 min CN=55 Runoff=1.55 cfs 8,893 cf

Subcatchment 5.8: LOT T Runoff Area=37,553 sf 29.40% Impervious Runoff Depth=2.30"
Tc=6.0 min CN=59 Runoff=2.11 cfs 7,198 cf

Subcatchment 6.1: Runoff Area=86,779 sf 35.97% Impervious Runoff Depth=2.30"
Flow Length=125' Tc=22.3 min CN=59 Runoff=2.93 cfs 16,634 cf

Subcatchment 9.1: Runoff Area=26,390 sf 0.00% Impervious Runoff Depth=0.41"
Tc=6.0 min CN=35 Runoff=0.04 cfs 909 cf

Subcatchment 9.2: Runoff Area=56,084 sf 0.00% Impervious Runoff Depth=0.80"
Tc=6.0 min CN=41 Runoff=0.66 cfs 3,749 cf

Subcatchment 10.1: Runoff Area=12,176 sf 0.00% Impervious Runoff Depth=0.41"
Tc=6.0 min CN=35 Runoff=0.02 cfs 420 cf

Subcatchment 10.2: Runoff Area=5,430 sf 0.00% Impervious Runoff Depth=1.34"
Tc=0.0 min CN=48 Runoff=0.21 cfs 605 cf

Subcatchment 10.3: Runoff Area=488 sf 0.00% Impervious Runoff Depth=1.94"
Tc=6.0 min CN=55 Runoff=0.02 cfs 79 cf

Subcatchment 10.4: Runoff Area=612 sf 0.00% Impervious Runoff Depth=1.94"
Tc=6.0 min CN=55 Runoff=0.03 cfs 99 cf

Pond 1P: C/D/E Peak Elev=279.80' Inflow=33.52 cfs 129,341 cf
36.0" Round Culvert n=0.013 L=30.0' S=0.0050 '/' Outflow=33.52 cfs 129,341 cf

Pond 2P: ROAD Peak Elev=280.70' Inflow=25.82 cfs 99,185 cf
36.0" Round Culvert n=0.013 L=215.0' S=0.0050 '/' Outflow=25.82 cfs 99,185 cf

Pond 3P: F/G/H Peak Elev=281.10' Inflow=23.20 cfs 90,163 cf
36.0" Round Culvert n=0.013 L=15.0' S=0.0053 '/' Outflow=23.20 cfs 90,163 cf

Pond 4P: ROAD Peak Elev=281.57' Inflow=11.95 cfs 46,047 cf
36.0" Round Culvert n=0.013 L=200.0' S=0.0050 '/' Outflow=11.95 cfs 46,047 cf

Pond 5P: Peak Elev=281.22' Inflow=11.95 cfs 46,047 cf
36.0" Round Culvert n=0.013 L=200.0' S=0.0050 '/' Outflow=11.95 cfs 46,047 cf

Pond 6P: I/J/K Peak Elev=281.97' Inflow=9.97 cfs 39,073 cf
24.0" Round Culvert n=0.013 L=60.0' S=0.0050 '/' Outflow=9.97 cfs 39,073 cf

Pond 7P: SSIB Peak Elev=0.00' Storage=0 cf
Discarded=0.00 cfs 0 cf Primary=0.00 cfs 0 cf

Pond DMH10: Peak Elev=259.46' Inflow=74.76 cfs 356,158 cf
48.0" Round Culvert n=0.011 L=77.0' S=-0.0065 '/' Outflow=74.76 cfs 356,158 cf

Pond DMH11: Peak Elev=257.93' Inflow=74.76 cfs 356,158 cf
48.0" Round Culvert n=0.011 L=67.0' S=0.0075 '/' Outflow=74.76 cfs 356,158 cf

Pond DMH2: Peak Elev=271.67' Inflow=45.47 cfs 214,730 cf
36.0" Round Culvert n=0.011 L=208.0' S=0.0049 '/' Outflow=45.47 cfs 214,730 cf

Pond DMH3: Peak Elev=269.89' Inflow=45.47 cfs 214,730 cf
36.0" Round Culvert n=0.011 L=214.0' S=0.0050 '/' Outflow=45.47 cfs 214,730 cf

Pond DMH8: Peak Elev=268.10' Inflow=49.47 cfs 226,941 cf
42.0" Round Culvert n=0.011 L=77.0' S=0.0049 '/' Outflow=49.47 cfs 226,941 cf

Pond DMH9: Peak Elev=262.97' Inflow=74.76 cfs 350,277 cf
48.0" Round Culvert n=0.011 L=276.0' S=0.0050 '/' Outflow=74.76 cfs 350,277 cf

Pond P1: SSIB Peak Elev=268.99' Storage=20,589 cf Inflow=17.21 cfs 64,774 cf
Discarded=0.32 cfs 34,300 cf Primary=6.33 cfs 30,482 cf Outflow=6.65 cfs 64,782 cf

Pond P10.5: P10 & P11 Peak Elev=273.95' Storage=4,752 cf Inflow=5.40 cfs 18,302 cf
Discarded=0.05 cfs 5,598 cf Primary=4.00 cfs 12,212 cf Outflow=4.06 cfs 17,810 cf

Pond P12: Peak Elev=280.61' Storage=19,005 cf Inflow=27.01 cfs 98,847 cf
Outflow=18.08 cfs 96,610 cf

Pond P2: RAIN GARDEN Peak Elev=260.80' Storage=6,455 cf Inflow=13.38 cfs 41,156 cf
Discarded=1.38 cfs 26,043 cf Primary=7.91 cfs 15,113 cf Outflow=9.29 cfs 41,156 cf

Pond P3: SSIB Peak Elev=271.34' Storage=8,808 cf Inflow=10.18 cfs 37,085 cf
Discarded=0.15 cfs 16,580 cf Primary=8.02 cfs 20,513 cf Outflow=8.17 cfs 37,093 cf

Pond P4: SSIB Peak Elev=278.52' Storage=21,775 cf Inflow=33.97 cfs 138,976 cf
Discarded=0.44 cfs 42,685 cf Primary=23.35 cfs 96,311 cf Outflow=23.79 cfs 138,997 cf

Pond P5: SSIB Peak Elev=265.79' Storage=15,951 cf Inflow=16.39 cfs 54,730 cf
Discarded=1.14 cfs 48,867 cf Primary=1.74 cfs 5,882 cf Outflow=2.88 cfs 54,749 cf

Pond P6: SSIB Peak Elev=277.27' Storage=27,785 cf Inflow=41.40 cfs 152,110 cf
Discarded=0.22 cfs 27,715 cf Primary=25.31 cfs 123,335 cf Outflow=25.53 cfs 151,050 cf

Pond P7: SSIB Peak Elev=280.11' Storage=9,666 cf Inflow=13.68 cfs 49,226 cf
Outflow=6.47 cfs 49,178 cf

Pond P8: RAIN GARDEN Peak Elev=277.66' Storage=5,336 cf Inflow=5.30 cfs 24,965 cf
Outflow=5.23 cfs 24,926 cf

Pond P9: Peak Elev=277.71' Storage=11,396 cf Inflow=9.56 cfs 35,801 cf
Discarded=0.11 cfs 12,798 cf Primary=4.16 cfs 21,809 cf Outflow=4.26 cfs 34,607 cf

Link 3L: (new Link)
Primary=0.00 cfs 0 cf

Link DP-1: HEADWALL Inflow=4.02 cfs 22,538 cf
Primary=4.02 cfs 22,538 cf

Link DP-10: OFFSITE EAST Inflow=0.24 cfs 1,202 cf
Primary=0.24 cfs 1,202 cf

Link DP-2: FES Inflow=14.23 cfs 45,595 cf
Primary=14.23 cfs 45,595 cf

Link DP-3: HEADWALL Inflow=74.76 cfs 356,158 cf
Primary=74.76 cfs 356,158 cf

Link DP-4: KING ST	Inflow=0.76 cfs 2,745 cf Primary=0.76 cfs 2,745 cf
Link DP-5: EAST SIDE WETLAND	Inflow=14.07 cfs 90,195 cf Primary=14.07 cfs 90,195 cf
Link DP-6: WEST SIDE WETLAND	Inflow=94.35 cfs 440,925 cf Primary=94.35 cfs 440,925 cf
Link DP-7: SOUTH POND	Primary=0.00 cfs 0 cf
Link DP-8: SOUTH POND	Primary=0.00 cfs 0 cf
Link DP-9: OFFSITE WEST	Inflow=0.68 cfs 4,658 cf Primary=0.68 cfs 4,658 cf

Total Runoff Area = 1,928,530 sf Runoff Volume = 759,325 cf Average Runoff Depth = 4.72"
34.21% Pervious = 659,697 sf 65.79% Impervious = 1,268,833 sf

Time span=0.00-36.00 hrs, dt=0.04 hrs, 901 points x 3
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1.1: ROAD Runoff Area=26,307 sf 68.48% Impervious Runoff Depth=5.60"
Tc=6.0 min CN=79 Runoff=3.60 cfs 12,279 cf

Subcatchment 1.2: ABUTTING LOTS Runoff Area=46,595 sf 53.99% Impervious Runoff Depth=4.55"
Flow Length=211' Tc=23.6 min CN=70 Runoff=3.16 cfs 17,669 cf

Subcatchment 2.1: LOT M Runoff Area=127,271 sf 94.29% Impervious Runoff Depth=7.50"
Tc=6.0 min CN=95 Runoff=20.92 cfs 79,554 cf

Subcatchment 2.2: ROAD Runoff Area=46,717 sf 75.10% Impervious Runoff Depth=6.67"
Tc=6.0 min CN=88 Runoff=7.26 cfs 25,951 cf

Subcatchment 2.3: LOTS A & B Runoff Area=77,277 sf 74.08% Impervious Runoff Depth=7.14"
Tc=6.0 min CN=92 Runoff=12.46 cfs 45,996 cf

Subcatchment 3.1: LOT N 3.7 Runoff Area=132,423 sf 62.22% Impervious Runoff Depth=5.25"
Tc=6.0 min CN=76 Runoff=17.17 cfs 57,924 cf

Subcatchment 3.10: LOT F 3.17 Runoff Area=32,969 sf 100.00% Impervious Runoff Depth=7.86"
Tc=6.0 min CN=98 Runoff=5.48 cfs 21,595 cf

Subcatchment 3.11: LOT R LAND 3.15 Runoff Area=88,988 sf 29.38% Impervious Runoff Depth=5.84"
Tc=6.0 min CN=81 Runoff=12.60 cfs 43,283 cf

Subcatchment 3.12: LOT R BUILDING 3.16 Runoff Area=91,130 sf 100.00% Impervious Runoff Depth=7.86"
Tc=6.0 min CN=98 Runoff=15.15 cfs 59,691 cf

Subcatchment 3.13: LOT S LAND 3.19 Runoff Area=80,697 sf 28.62% Impervious Runoff Depth=5.84"
Tc=6.0 min CN=81 Runoff=11.43 cfs 39,250 cf

Subcatchment 3.14: LOT S BUILDING 3.20 Runoff Area=90,980 sf 100.00% Impervious Runoff Depth=7.86"
Tc=6.0 min CN=98 Runoff=15.12 cfs 59,593 cf

Subcatchment 3.15: ROAD 3.3 Runoff Area=32,025 sf 74.82% Impervious Runoff Depth=6.19"
Tc=6.0 min CN=84 Runoff=4.74 cfs 16,523 cf

Subcatchment 3.16: LOTS F, G & H 3.18 Runoff Area=81,934 sf 100.00% Impervious Runoff Depth=7.86"
Tc=6.0 min CN=98 Runoff=13.62 cfs 53,668 cf

Subcatchment 3.17: ROAD 3.6 Runoff Area=15,783 sf 80.68% Impervious Runoff Depth=6.67"
Tc=6.0 min CN=88 Runoff=2.45 cfs 8,767 cf

Subcatchment 3.18: ROAD 3.4 Runoff Area=22,298 sf 74.82% Impervious Runoff Depth=6.19"
Tc=6.0 min CN=84 Runoff=3.30 cfs 11,504 cf

Subcatchment 3.19: LOTS I, J & K 3.21 Runoff Area=72,569 sf 100.00% Impervious Runoff Depth=7.86"
Tc=6.0 min CN=98 Runoff=12.06 cfs 47,534 cf

Subcatchment 3.2: ROAD Runoff Area=24,520 sf 57.22% Impervious Runoff Depth=6.19"
Tc=6.0 min CN=84 Runoff=3.63 cfs 12,651 cf

Subcatchment 3.3: ROAD 3.1 Runoff Area=25,878 sf 60.23% Impervious Runoff Depth=5.13"
Tc=6.0 min CN=75 Runoff=3.29 cfs 11,067 cf

Subcatchment 3.4a: LOT O 3.8 Runoff Area=36,922 sf 51.28% Impervious Runoff Depth=4.67"
Tc=6.0 min CN=71 Runoff=4.30 cfs 14,357 cf

Subcatchment 3.4b: LOT O 3.9 Runoff Area=27,652 sf 63.36% Impervious Runoff Depth=5.48"
Tc=6.0 min CN=78 Runoff=3.72 cfs 12,636 cf

Subcatchment 3.5: PAKRING LOT P3 3.10 Runoff Area=71,929 sf 99.91% Impervious Runoff Depth=7.86"
Tc=6.0 min CN=98 Runoff=11.96 cfs 47,114 cf

Subcatchment 3.6: LOT Q 3.11 Runoff Area=57,193 sf 68.85% Impervious Runoff Depth=5.72"
Tc=6.0 min CN=80 Runoff=7.97 cfs 27,256 cf

Subcatchment 3.7: COMMON 3.12 Runoff Area=30,574 sf 0.00% Impervious Runoff Depth=5.02"
Flow Length=288' Slope=0.0050 '/' Tc=41.4 min CN=74 Runoff=1.69 cfs 12,778 cf

Subcatchment 3.8: LOTS C & D 3.13 Runoff Area=34,748 sf 100.00% Impervious Runoff Depth=7.86"
Tc=6.0 min CN=98 Runoff=5.78 cfs 22,760 cf

Subcatchment 3.9: LOT E 3.14 Runoff Area=21,259 sf 100.00% Impervious Runoff Depth=7.86"
Tc=6.0 min CN=98 Runoff=3.53 cfs 13,925 cf

Subcatchment 4.1: ROAD Runoff Area=5,837 sf 88.57% Impervious Runoff Depth=7.02"
Tc=6.0 min CN=91 Runoff=0.93 cfs 3,416 cf

Subcatchment 5.1: ROAD 3.5 Runoff Area=11,523 sf 79.93% Impervious Runoff Depth=6.67"
Flow Length=2,275' Tc=8.3 min CN=88 Runoff=1.66 cfs 6,401 cf

Subcatchment 5.2: ROAD Runoff Area=44,902 sf 82.02% Impervious Runoff Depth=6.55"
Tc=6.0 min CN=87 Runoff=6.90 cfs 24,498 cf

Subcatchment 5.4: PARKING LOT P5 Runoff Area=75,263 sf 66.43% Impervious Runoff Depth=5.48"
Tc=6.0 min CN=78 Runoff=10.13 cfs 34,392 cf

Subcatchment 5.5: LOT T Runoff Area=42,460 sf 100.00% Impervious Runoff Depth=7.86"
Tc=6.0 min CN=98 Runoff=7.06 cfs 27,812 cf

Subcatchment 5.6: LOT L Runoff Area=71,267 sf 55.43% Impervious Runoff Depth=5.48"
Flow Length=295' Slope=0.0500 '/' Tc=16.4 min CN=78 Runoff=6.86 cfs 32,566 cf

Subcatchment 5.7: WESTFORD PARCEL Runoff Area=55,128 sf 0.00% Impervious Runoff Depth=2.85"
Flow Length=115' Tc=21.2 min CN=55 Runoff=2.38 cfs 13,105 cf

Subcatchment 5.8: LOT T Runoff Area=37,553 sf 29.40% Impervious Runoff Depth=3.30"
Tc=6.0 min CN=59 Runoff=3.08 cfs 10,316 cf

Subcatchment 6.1: Runoff Area=86,779 sf 35.97% Impervious Runoff Depth=3.30"
Flow Length=125' Tc=22.3 min CN=59 Runoff=4.31 cfs 23,838 cf

Subcatchment 9.1: Runoff Area=26,390 sf 0.00% Impervious Runoff Depth=0.84"
Tc=6.0 min CN=35 Runoff=0.27 cfs 1,843 cf

Subcatchment 9.2: Runoff Area=56,084 sf 0.00% Impervious Runoff Depth=1.39"
Tc=6.0 min CN=41 Runoff=1.54 cfs 6,498 cf

Subcatchment 10.1: Runoff Area=12,176 sf 0.00% Impervious Runoff Depth=0.84"
Tc=6.0 min CN=35 Runoff=0.12 cfs 850 cf

Subcatchment 10.2: Runoff Area=5,430 sf 0.00% Impervious Runoff Depth=2.10"
Tc=0.0 min CN=48 Runoff=0.35 cfs 950 cf

Subcatchment 10.3: Runoff Area=488 sf 0.00% Impervious Runoff Depth=2.85"
Tc=6.0 min CN=55 Runoff=0.03 cfs 116 cf

Subcatchment 10.4: Runoff Area=612 sf 0.00% Impervious Runoff Depth=2.85"
Tc=6.0 min CN=55 Runoff=0.04 cfs 145 cf

Pond 1P: C/D/E Peak Elev=280.99' Inflow=40.74 cfs 158,158 cf
36.0" Round Culvert n=0.013 L=30.0' S=0.0050 '/' Outflow=40.74 cfs 158,158 cf

Pond 2P: ROAD Peak Elev=282.33' Inflow=31.43 cfs 121,473 cf
36.0" Round Culvert n=0.013 L=215.0' S=0.0050 '/' Outflow=31.43 cfs 121,473 cf

Pond 3P: F/G/H Peak Elev=282.98' Inflow=28.13 cfs 109,969 cf
36.0" Round Culvert n=0.013 L=15.0' S=0.0053 '/' Outflow=28.13 cfs 109,969 cf

Pond 4P: ROAD Peak Elev=283.59' Inflow=14.52 cfs 56,301 cf
36.0" Round Culvert n=0.013 L=200.0' S=0.0050 '/' Outflow=14.52 cfs 56,301 cf

Pond 5P: Peak Elev=283.12' Inflow=14.52 cfs 56,301 cf
36.0" Round Culvert n=0.013 L=200.0' S=0.0050 '/' Outflow=14.52 cfs 56,301 cf

Pond 6P: I/J/K Peak Elev=284.19' Inflow=12.06 cfs 47,534 cf
24.0" Round Culvert n=0.013 L=60.0' S=0.0050 '/' Outflow=12.06 cfs 47,534 cf

Pond 7P: SSIB Peak Elev=0.00' Storage=0 cf
Discarded=0.00 cfs 0 cf Primary=0.00 cfs 0 cf

Pond DMH10: Peak Elev=261.35' Inflow=96.31 cfs 473,302 cf
48.0" Round Culvert n=0.011 L=77.0' S=-0.0065 '/' Outflow=96.31 cfs 473,302 cf

Pond DMH11: Peak Elev=258.82' Inflow=96.31 cfs 473,302 cf
48.0" Round Culvert n=0.011 L=67.0' S=0.0075 '/' Outflow=96.31 cfs 473,302 cf

Pond DMH2: Peak Elev=274.46' Inflow=57.41 cfs 278,783 cf
36.0" Round Culvert n=0.011 L=208.0' S=0.0049 '/' Outflow=57.41 cfs 278,784 cf

Pond DMH3: Peak Elev=271.62' Inflow=57.41 cfs 278,784 cf
36.0" Round Culvert n=0.011 L=214.0' S=0.0050 '/' Outflow=57.41 cfs 278,784 cf

Pond DMH8: Peak Elev=268.78' Inflow=63.01 cfs 296,214 cf
42.0" Round Culvert n=0.011 L=77.0' S=0.0049 '/' Outflow=63.01 cfs 296,214 cf

Pond DMH9: Peak Elev=263.72' Inflow=92.06 cfs 457,188 cf
48.0" Round Culvert n=0.011 L=276.0' S=0.0050 '/' Outflow=92.06 cfs 457,188 cf

Pond P1: SSIB Peak Elev=270.46' Storage=24,288 cf Inflow=20.92 cfs 79,554 cf
Discarded=0.32 cfs 35,624 cf Primary=7.29 cfs 43,942 cf Outflow=7.61 cfs 79,566 cf

Pond P10.5: P10 & P11 Peak Elev=274.18' Storage=4,951 cf Inflow=6.92 cfs 23,718 cf
Discarded=0.05 cfs 5,778 cf Primary=6.56 cfs 17,430 cf Outflow=6.61 cfs 23,208 cf

Pond P12: Peak Elev=281.38' Storage=21,671 cf Inflow=33.45 cfs 123,341 cf
Outflow=22.73 cfs 121,104 cf

Pond P2: RAIN GARDEN Peak Elev=261.33' Storage=8,165 cf Inflow=16.57 cfs 54,875 cf
Discarded=1.54 cfs 31,761 cf Primary=9.28 cfs 23,116 cf Outflow=10.82 cfs 54,876 cf

Pond P3: SSIB Peak Elev=271.83' Storage=9,363 cf Inflow=12.46 cfs 45,996 cf
Discarded=0.15 cfs 17,075 cf Primary=10.00 cfs 28,924 cf Outflow=10.14 cfs 45,999 cf

Pond P4: SSIB Peak Elev=279.08' Storage=24,198 cf Inflow=41.36 cfs 170,936 cf
Discarded=0.44 cfs 43,499 cf Primary=29.90 cfs 127,456 cf Outflow=30.33 cfs 170,955 cf

Pond P5: SSIB Peak Elev=266.45' Storage=18,814 cf Inflow=21.48 cfs 72,281 cf
Discarded=1.14 cfs 56,207 cf Primary=6.35 cfs 16,114 cf Outflow=7.49 cfs 72,321 cf

Pond P6: SSIB Peak Elev=278.23' Storage=32,786 cf Inflow=51.39 cfs 189,981 cf
Discarded=0.22 cfs 27,890 cf Primary=29.40 cfs 160,975 cf Outflow=29.61 cfs 188,865 cf

Pond P7: SSIB Peak Elev=280.58' Storage=11,971 cf Inflow=17.19 cfs 62,204 cf
Outflow=7.92 cfs 62,155 cf

Pond P8: RAIN GARDEN Peak Elev=277.72' Storage=5,443 cf Inflow=6.86 cfs 32,566 cf
Outflow=6.79 cfs 32,527 cf

Pond P9: Peak Elev=278.22' Storage=13,147 cf Inflow=11.79 cfs 44,519 cf
Discarded=0.11 cfs 13,043 cf Primary=4.96 cfs 30,223 cf Outflow=5.06 cfs 43,266 cf

Link 3L: (new Link)
Primary=0.00 cfs 0 cf

Link DP-1: HEADWALL Inflow=5.29 cfs 29,948 cf
Primary=5.29 cfs 29,948 cf

Link DP-10: OFFSITE EAST Inflow=0.43 cfs 2,062 cf
Primary=0.43 cfs 2,062 cf

Link DP-2: FES Inflow=16.56 cfs 67,058 cf
Primary=16.56 cfs 67,058 cf

Link DP-3: HEADWALL Inflow=96.31 cfs 473,302 cf
Primary=96.31 cfs 473,302 cf

Link DP-4: KING ST	Inflow=0.93 cfs 3,416 cf Primary=0.93 cfs 3,416 cf
Link DP-5: EAST SIDE WETLAND	Inflow=18.30 cfs 118,103 cf Primary=18.30 cfs 118,103 cf
Link DP-6: WEST SIDE WETLAND	Inflow=120.38 cfs 594,146 cf Primary=120.38 cfs 594,146 cf
Link DP-7: SOUTH POND	Primary=0.00 cfs 0 cf
Link DP-8: SOUTH POND	Primary=0.00 cfs 0 cf
Link DP-9: OFFSITE WEST	Inflow=1.80 cfs 8,341 cf Primary=1.80 cfs 8,341 cf

Total Runoff Area = 1,928,530 sf Runoff Volume = 962,073 cf Average Runoff Depth = 5.99"
34.21% Pervious = 659,697 sf 65.79% Impervious = 1,268,833 sf

Time span=0.00-36.00 hrs, dt=0.04 hrs, 901 points x 3
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1.1: ROAD Runoff Area=26,307 sf 68.48% Impervious Runoff Depth=6.63"
Tc=6.0 min CN=79 Runoff=4.23 cfs 14,543 cf

Subcatchment 1.2: ABUTTING LOTS Runoff Area=46,595 sf 53.99% Impervious Runoff Depth=5.51"
Flow Length=211' Tc=23.6 min CN=70 Runoff=3.83 cfs 21,401 cf

Subcatchment 2.1: LOT M Runoff Area=127,271 sf 94.29% Impervious Runoff Depth=8.60"
Tc=6.0 min CN=95 Runoff=23.83 cfs 91,181 cf

Subcatchment 2.2: ROAD Runoff Area=46,717 sf 75.10% Impervious Runoff Depth=7.74"
Tc=6.0 min CN=88 Runoff=8.36 cfs 30,149 cf

Subcatchment 2.3: LOTS A & B Runoff Area=77,277 sf 74.08% Impervious Runoff Depth=8.23"
Tc=6.0 min CN=92 Runoff=14.25 cfs 53,018 cf

Subcatchment 3.1: LOT N 3.7 Runoff Area=132,423 sf 62.22% Impervious Runoff Depth=6.26"
Tc=6.0 min CN=76 Runoff=20.34 cfs 69,091 cf

Subcatchment 3.10: LOT F 3.17 Runoff Area=32,969 sf 100.00% Impervious Runoff Depth=8.96"
Tc=6.0 min CN=98 Runoff=6.23 cfs 24,616 cf

Subcatchment 3.11: LOT R LAND 3.15 Runoff Area=88,988 sf 29.38% Impervious Runoff Depth=6.88"
Tc=6.0 min CN=81 Runoff=14.72 cfs 51,034 cf

Subcatchment 3.12: LOT R BUILDING 3.16 Runoff Area=91,130 sf 100.00% Impervious Runoff Depth=8.96"
Tc=6.0 min CN=98 Runoff=17.21 cfs 68,040 cf

Subcatchment 3.13: LOT S LAND 3.19 Runoff Area=80,697 sf 28.62% Impervious Runoff Depth=6.88"
Tc=6.0 min CN=81 Runoff=13.35 cfs 46,279 cf

Subcatchment 3.14: LOT S BUILDING 3.20 Runoff Area=90,980 sf 100.00% Impervious Runoff Depth=8.96"
Tc=6.0 min CN=98 Runoff=17.18 cfs 67,928 cf

Subcatchment 3.15: ROAD 3.3 Runoff Area=32,025 sf 74.82% Impervious Runoff Depth=7.25"
Tc=6.0 min CN=84 Runoff=5.50 cfs 19,355 cf

Subcatchment 3.16: LOTS F, G & H 3.18 Runoff Area=81,934 sf 100.00% Impervious Runoff Depth=8.96"
Tc=6.0 min CN=98 Runoff=15.48 cfs 61,174 cf

Subcatchment 3.17: ROAD 3.6 Runoff Area=15,783 sf 80.68% Impervious Runoff Depth=7.74"
Tc=6.0 min CN=88 Runoff=2.82 cfs 10,186 cf

Subcatchment 3.18: ROAD 3.4 Runoff Area=22,298 sf 74.82% Impervious Runoff Depth=7.25"
Tc=6.0 min CN=84 Runoff=3.83 cfs 13,477 cf

Subcatchment 3.19: LOTS I, J & K 3.21 Runoff Area=72,569 sf 100.00% Impervious Runoff Depth=8.96"
Tc=6.0 min CN=98 Runoff=13.71 cfs 54,182 cf

Subcatchment 3.2: ROAD Runoff Area=24,520 sf 57.22% Impervious Runoff Depth=7.25"
Tc=6.0 min CN=84 Runoff=4.21 cfs 14,819 cf

Subcatchment 3.3: ROAD 3.1 Runoff Area=25,878 sf 60.23% Impervious Runoff Depth=6.14"
Tc=6.0 min CN=75 Runoff=3.91 cfs 13,233 cf

Subcatchment 3.4a: LOT O 3.8 Runoff Area=36,922 sf 51.28% Impervious Runoff Depth=5.64"
Tc=6.0 min CN=71 Runoff=5.17 cfs 17,343 cf

Subcatchment 3.4b: LOT O 3.9 Runoff Area=27,652 sf 63.36% Impervious Runoff Depth=6.51"
Tc=6.0 min CN=78 Runoff=4.38 cfs 15,001 cf

Subcatchment 3.5: PAKRING LOT P3 3.10 Runoff Area=71,929 sf 99.91% Impervious Runoff Depth=8.96"
Tc=6.0 min CN=98 Runoff=13.59 cfs 53,704 cf

Subcatchment 3.6: LOT Q 3.11 Runoff Area=57,193 sf 68.85% Impervious Runoff Depth=6.76"
Tc=6.0 min CN=80 Runoff=9.34 cfs 32,209 cf

Subcatchment 3.7: COMMON 3.12 Runoff Area=30,574 sf 0.00% Impervious Runoff Depth=6.01"
Flow Length=288' Slope=0.0050 '/' Tc=41.4 min CN=74 Runoff=2.02 cfs 15,317 cf

Subcatchment 3.8: LOTS C & D 3.13 Runoff Area=34,748 sf 100.00% Impervious Runoff Depth=8.96"
Tc=6.0 min CN=98 Runoff=6.56 cfs 25,944 cf

Subcatchment 3.9: LOT E 3.14 Runoff Area=21,259 sf 100.00% Impervious Runoff Depth=8.96"
Tc=6.0 min CN=98 Runoff=4.02 cfs 15,873 cf

Subcatchment 4.1: ROAD Runoff Area=5,837 sf 88.57% Impervious Runoff Depth=8.11"
Tc=6.0 min CN=91 Runoff=1.07 cfs 3,945 cf

Subcatchment 5.1: ROAD 3.5 Runoff Area=11,523 sf 79.93% Impervious Runoff Depth=7.74"
Flow Length=2,275' Tc=8.3 min CN=88 Runoff=1.91 cfs 7,436 cf

Subcatchment 5.2: ROAD Runoff Area=44,902 sf 82.02% Impervious Runoff Depth=7.62"
Tc=6.0 min CN=87 Runoff=7.96 cfs 28,519 cf

Subcatchment 5.4: PARKING LOT P5 Runoff Area=75,263 sf 66.43% Impervious Runoff Depth=6.51"
Tc=6.0 min CN=78 Runoff=11.93 cfs 40,829 cf

Subcatchment 5.5: LOT T Runoff Area=42,460 sf 100.00% Impervious Runoff Depth=8.96"
Tc=6.0 min CN=98 Runoff=8.02 cfs 31,702 cf

Subcatchment 5.6: LOT L Runoff Area=71,267 sf 55.43% Impervious Runoff Depth=6.51"
Flow Length=295' Slope=0.0500 '/' Tc=16.4 min CN=78 Runoff=8.09 cfs 38,661 cf

Subcatchment 5.7: WESTFORD PARCEL Runoff Area=55,128 sf 0.00% Impervious Runoff Depth=3.63"
Flow Length=115' Tc=21.2 min CN=55 Runoff=3.08 cfs 16,692 cf

Subcatchment 5.8: LOT T Runoff Area=37,553 sf 29.40% Impervious Runoff Depth=4.13"
Tc=6.0 min CN=59 Runoff=3.89 cfs 12,934 cf

Subcatchment 6.1: Runoff Area=86,779 sf 35.97% Impervious Runoff Depth=4.13"
Flow Length=125' Tc=22.3 min CN=59 Runoff=5.46 cfs 29,887 cf

Subcatchment 9.1: Runoff Area=26,390 sf 0.00% Impervious Runoff Depth=1.25"
Tc=6.0 min CN=35 Runoff=0.55 cfs 2,751 cf

Subcatchment 9.2: Runoff Area=56,084 sf 0.00% Impervious Runoff Depth=1.93"
Tc=6.0 min CN=41 Runoff=2.35 cfs 9,018 cf

Subcatchment 10.1: Runoff Area=12,176 sf 0.00% Impervious Runoff Depth=1.25"
Tc=6.0 min CN=35 Runoff=0.26 cfs 1,269 cf

Subcatchment 10.2: Runoff Area=5,430 sf 0.00% Impervious Runoff Depth=2.77"
Tc=0.0 min CN=48 Runoff=0.47 cfs 1,253 cf

Subcatchment 10.3: Runoff Area=488 sf 0.00% Impervious Runoff Depth=3.63"
Tc=6.0 min CN=55 Runoff=0.04 cfs 148 cf

Subcatchment 10.4: Runoff Area=612 sf 0.00% Impervious Runoff Depth=3.63"
Tc=6.0 min CN=55 Runoff=0.06 cfs 185 cf

Pond 1P: C/D/E Peak Elev=282.16' Inflow=46.41 cfs 180,835 cf
36.0" Round Culvert n=0.013 L=30.0' S=0.0050 '/' Outflow=46.41 cfs 180,835 cf

Pond 2P: ROAD Peak Elev=283.87' Inflow=35.84 cfs 139,019 cf
36.0" Round Culvert n=0.013 L=215.0' S=0.0050 '/' Outflow=35.84 cfs 139,019 cf

Pond 3P: F/G/H Peak Elev=284.68' Inflow=32.01 cfs 125,542 cf
36.0" Round Culvert n=0.013 L=15.0' S=0.0053 '/' Outflow=32.01 cfs 125,542 cf

Pond 4P: ROAD Peak Elev=285.46' Inflow=16.53 cfs 64,368 cf
36.0" Round Culvert n=0.013 L=200.0' S=0.0050 '/' Outflow=16.53 cfs 64,368 cf

Pond 5P: Peak Elev=284.84' Inflow=16.53 cfs 64,368 cf
36.0" Round Culvert n=0.013 L=200.0' S=0.0050 '/' Outflow=16.53 cfs 64,368 cf

Pond 6P: I/J/K Peak Elev=286.26' Inflow=13.71 cfs 54,182 cf
24.0" Round Culvert n=0.013 L=60.0' S=0.0050 '/' Outflow=13.71 cfs 54,182 cf

Pond 7P: SSIB Peak Elev=0.00' Storage=0 cf
Discarded=0.00 cfs 0 cf Primary=0.00 cfs 0 cf

Pond DMH10: Peak Elev=265.12' Inflow=129.82 cfs 567,162 cf
48.0" Round Culvert n=0.011 L=77.0' S=-0.0065 '/' Outflow=129.82 cfs 567,162 cf

Pond DMH11: Peak Elev=260.54' Inflow=129.82 cfs 567,162 cf
48.0" Round Culvert n=0.011 L=67.0' S=0.0075 '/' Outflow=129.82 cfs 567,162 cf

Pond DMH2: Peak Elev=278.37' Inflow=67.70 cfs 329,705 cf
36.0" Round Culvert n=0.011 L=208.0' S=0.0049 '/' Outflow=67.70 cfs 329,705 cf

Pond DMH3: Peak Elev=274.64' Inflow=67.70 cfs 329,705 cf
36.0" Round Culvert n=0.011 L=214.0' S=0.0050 '/' Outflow=67.70 cfs 329,705 cf

Pond DMH8: Peak Elev=270.98' Inflow=75.08 cfs 351,341 cf
42.0" Round Culvert n=0.011 L=77.0' S=0.0049 '/' Outflow=75.08 cfs 351,341 cf

Pond DMH9: Peak Elev=269.16' Inflow=121.77 cfs 542,201 cf
48.0" Round Culvert n=0.011 L=276.0' S=0.0050 '/' Outflow=121.77 cfs 542,201 cf

Pond P1: SSIB Peak Elev=317.92' Storage=24,949 cf Inflow=23.83 cfs 91,181 cf
Discarded=0.32 cfs 36,287 cf Primary=21.82 cfs 54,913 cf Outflow=22.14 cfs 91,200 cf

Pond P10.5: P10 & P11 Peak Elev=274.28' Storage=5,012 cf Inflow=8.12 cfs 28,052 cf
Discarded=0.05 cfs 5,897 cf Primary=7.94 cfs 21,636 cf Outflow=8.00 cfs 27,533 cf

Pond P12: Peak Elev=282.05' Storage=23,753 cf Inflow=38.49 cfs 142,727 cf
Outflow=25.87 cfs 140,489 cf

Pond P2: RAIN GARDEN Peak Elev=261.66' Storage=9,352 cf Inflow=21.91 cfs 65,827 cf
Discarded=1.65 cfs 36,154 cf Primary=11.66 cfs 29,675 cf Outflow=13.31 cfs 65,828 cf

Pond P3: SSIB Peak Elev=273.26' Storage=9,543 cf Inflow=14.25 cfs 53,018 cf
Discarded=0.15 cfs 17,349 cf Primary=14.26 cfs 35,678 cf Outflow=14.40 cfs 53,027 cf

Pond P4: SSIB Peak Elev=279.69' Storage=25,522 cf Inflow=47.17 cfs 196,152 cf
Discarded=0.44 cfs 43,907 cf Primary=36.98 cfs 152,268 cf Outflow=37.41 cfs 196,174 cf

Pond P5: SSIB Peak Elev=267.17' Storage=21,443 cf Inflow=25.51 cfs 86,434 cf
Discarded=1.14 cfs 61,510 cf Primary=10.29 cfs 24,961 cf Outflow=11.43 cfs 86,472 cf

Pond P6: SSIB Peak Elev=284.14' Storage=33,781 cf Inflow=59.24 cfs 219,989 cf
Discarded=0.22 cfs 27,979 cf Primary=47.59 cfs 190,859 cf Outflow=47.81 cfs 218,838 cf

Pond P7: SSIB Peak Elev=280.99' Storage=13,850 cf Inflow=19.95 cfs 72,531 cf
Outflow=8.97 cfs 72,481 cf

Pond P8: RAIN GARDEN Peak Elev=277.76' Storage=5,521 cf Inflow=8.09 cfs 38,661 cf
Outflow=8.01 cfs 38,622 cf

Pond P9: Peak Elev=278.63' Storage=14,500 cf Inflow=13.53 cfs 51,408 cf
Discarded=0.11 cfs 13,172 cf Primary=6.13 cfs 36,949 cf Outflow=6.23 cfs 50,121 cf

Link 3L: (new Link)
Primary=0.00 cfs 0 cf

Link DP-1: HEADWALL Inflow=6.30 cfs 35,944 cf
Primary=6.30 cfs 35,944 cf

Link DP-10: OFFSITE EAST Inflow=0.67 cfs 2,855 cf
Primary=0.67 cfs 2,855 cf

Link DP-2: FES Inflow=32.87 cfs 84,587 cf
Primary=32.87 cfs 84,587 cf

Link DP-3: HEADWALL Inflow=129.82 cfs 567,162 cf
Primary=129.82 cfs 567,162 cf

Link DP-4: KING ST Inflow=1.07 cfs 3,945 cf
Primary=1.07 cfs 3,945 cf

Link DP-5: EAST SIDE WETLAND Inflow=21.59 cfs 140,728 cf
Primary=21.59 cfs 140,728 cf

Link DP-6: WEST SIDE WETLAND Inflow=170.91 cfs 717,581 cf
Primary=170.91 cfs 717,581 cf

Link DP-7: SOUTH POND
Primary=0.00 cfs 0 cf

Link DP-8: SOUTH POND
Primary=0.00 cfs 0 cf

Link DP-9: OFFSITE WEST Inflow=2.89 cfs 11,769 cf
Primary=2.89 cfs 11,769 cf

Total Runoff Area = 1,928,530 sf Runoff Volume = 1,124,329 cf Average Runoff Depth = 7.00"
34.21% Pervious = 659,697 sf 65.79% Impervious = 1,268,833 sf

Time span=0.00-36.00 hrs, dt=0.04 hrs, 901 points x 3
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1.1: ROAD Runoff Area=26,307 sf 68.48% Impervious Runoff Depth=7.77"
Tc=6.0 min CN=79 Runoff=4.92 cfs 17,043 cf

Subcatchment 1.2: ABUTTING LOTS Runoff Area=46,595 sf 53.99% Impervious Runoff Depth=6.59"
Flow Length=211' Tc=23.6 min CN=70 Runoff=4.56 cfs 25,570 cf

Subcatchment 2.1: LOT M Runoff Area=127,271 sf 94.29% Impervious Runoff Depth=9.79"
Tc=6.0 min CN=95 Runoff=27.00 cfs 103,875 cf

Subcatchment 2.2: ROAD Runoff Area=46,717 sf 75.10% Impervious Runoff Depth=8.93"
Tc=6.0 min CN=88 Runoff=9.55 cfs 34,748 cf

Subcatchment 2.3: LOTS A & B Runoff Area=77,277 sf 74.08% Impervious Runoff Depth=9.42"
Tc=6.0 min CN=92 Runoff=16.19 cfs 60,693 cf

Subcatchment 3.1: LOT N 3.7 Runoff Area=132,423 sf 62.22% Impervious Runoff Depth=7.38"
Tc=6.0 min CN=76 Runoff=23.79 cfs 81,462 cf

Subcatchment 3.10: LOT F 3.17 Runoff Area=32,969 sf 100.00% Impervious Runoff Depth=10.16"
Tc=6.0 min CN=98 Runoff=7.04 cfs 27,911 cf

Subcatchment 3.11: LOT R LAND 3.15 Runoff Area=88,988 sf 29.38% Impervious Runoff Depth=8.03"
Tc=6.0 min CN=81 Runoff=17.04 cfs 59,573 cf

Subcatchment 3.12: LOT R BUILDING Runoff Area=91,130 sf 100.00% Impervious Runoff Depth=10.16"
Tc=6.0 min CN=98 Runoff=19.47 cfs 77,149 cf

Subcatchment 3.13: LOT S LAND 3.19 Runoff Area=80,697 sf 28.62% Impervious Runoff Depth=8.03"
Tc=6.0 min CN=81 Runoff=15.45 cfs 54,022 cf

Subcatchment 3.14: LOT S BUILDING Runoff Area=90,980 sf 100.00% Impervious Runoff Depth=10.16"
Tc=6.0 min CN=98 Runoff=19.43 cfs 77,022 cf

Subcatchment 3.15: ROAD 3.3 Runoff Area=32,025 sf 74.82% Impervious Runoff Depth=8.42"
Tc=6.0 min CN=84 Runoff=6.33 cfs 22,467 cf

Subcatchment 3.16: LOTS F, G & H 3.18 Runoff Area=81,934 sf 100.00% Impervious Runoff Depth=10.16"
Tc=6.0 min CN=98 Runoff=17.50 cfs 69,364 cf

Subcatchment 3.17: ROAD 3.6 Runoff Area=15,783 sf 80.68% Impervious Runoff Depth=8.93"
Tc=6.0 min CN=88 Runoff=3.22 cfs 11,739 cf

Subcatchment 3.18: ROAD 3.4 Runoff Area=22,298 sf 74.82% Impervious Runoff Depth=8.42"
Tc=6.0 min CN=84 Runoff=4.40 cfs 15,643 cf

Subcatchment 3.19: LOTS I, J & K 3.21 Runoff Area=72,569 sf 100.00% Impervious Runoff Depth=10.16"
Tc=6.0 min CN=98 Runoff=15.50 cfs 61,436 cf

Subcatchment 3.2: ROAD Runoff Area=24,520 sf 57.22% Impervious Runoff Depth=8.42"
Tc=6.0 min CN=84 Runoff=4.84 cfs 17,202 cf

Subcatchment 3.3: ROAD 3.1 Runoff Area=25,878 sf 60.23% Impervious Runoff Depth=7.25"
Tc=6.0 min CN=75 Runoff=4.58 cfs 15,635 cf

Subcatchment 3.4a: LOT O 3.8 Runoff Area=36,922 sf 51.28% Impervious Runoff Depth=6.72"
Tc=6.0 min CN=71 Runoff=6.13 cfs 20,674 cf

Subcatchment 3.4b: LOT O 3.9 Runoff Area=27,652 sf 63.36% Impervious Runoff Depth=7.64"
Tc=6.0 min CN=78 Runoff=5.10 cfs 17,614 cf

Subcatchment 3.5: PAKRING LOT P3 3.10 Runoff Area=71,929 sf 99.91% Impervious Runoff Depth=10.16"
Tc=6.0 min CN=98 Runoff=15.36 cfs 60,894 cf

Subcatchment 3.6: LOT Q 3.11 Runoff Area=57,193 sf 68.85% Impervious Runoff Depth=7.90"
Tc=6.0 min CN=80 Runoff=10.82 cfs 37,671 cf

Subcatchment 3.7: COMMON 3.12 Runoff Area=30,574 sf 0.00% Impervious Runoff Depth=7.12"
Flow Length=288' Slope=0.0050 '/' Tc=41.4 min CN=74 Runoff=2.38 cfs 18,136 cf

Subcatchment 3.8: LOTS C & D 3.13 Runoff Area=34,748 sf 100.00% Impervious Runoff Depth=10.16"
Tc=6.0 min CN=98 Runoff=7.42 cfs 29,417 cf

Subcatchment 3.9: LOT E 3.14 Runoff Area=21,259 sf 100.00% Impervious Runoff Depth=10.16"
Tc=6.0 min CN=98 Runoff=4.54 cfs 17,998 cf

Subcatchment 4.1: ROAD Runoff Area=5,837 sf 88.57% Impervious Runoff Depth=9.30"
Tc=6.0 min CN=91 Runoff=1.22 cfs 4,524 cf

Subcatchment 5.1: ROAD 3.5 Runoff Area=11,523 sf 79.93% Impervious Runoff Depth=8.93"
Flow Length=2,275' Tc=8.3 min CN=88 Runoff=2.18 cfs 8,571 cf

Subcatchment 5.2: ROAD Runoff Area=44,902 sf 82.02% Impervious Runoff Depth=8.80"
Tc=6.0 min CN=87 Runoff=9.10 cfs 32,926 cf

Subcatchment 5.4: PARKING LOT P5 Runoff Area=75,263 sf 66.43% Impervious Runoff Depth=7.64"
Tc=6.0 min CN=78 Runoff=13.89 cfs 47,942 cf

Subcatchment 5.5: LOT T Runoff Area=42,460 sf 100.00% Impervious Runoff Depth=10.16"
Tc=6.0 min CN=98 Runoff=9.07 cfs 35,946 cf

Subcatchment 5.6: LOT L Runoff Area=71,267 sf 55.43% Impervious Runoff Depth=7.64"
Flow Length=295' Slope=0.0500 '/' Tc=16.4 min CN=78 Runoff=9.44 cfs 45,397 cf

Subcatchment 5.7: WESTFORD PARCEL Runoff Area=55,128 sf 0.00% Impervious Runoff Depth=4.53"
Flow Length=115' Tc=21.2 min CN=55 Runoff=3.89 cfs 20,821 cf

Subcatchment 5.8: LOT T Runoff Area=37,553 sf 29.40% Impervious Runoff Depth=5.09"
Tc=6.0 min CN=59 Runoff=4.79 cfs 15,919 cf

Subcatchment 6.1: Runoff Area=86,779 sf 35.97% Impervious Runoff Depth=5.09"
Flow Length=125' Tc=22.3 min CN=59 Runoff=6.76 cfs 36,786 cf

Subcatchment 9.1: Runoff Area=26,390 sf 0.00% Impervious Runoff Depth=1.77"
Tc=6.0 min CN=35 Runoff=0.92 cfs 3,892 cf

Subcatchment 9.2: Runoff Area=56,084 sf 0.00% Impervious Runoff Depth=2.58"
Tc=6.0 min CN=41 Runoff=3.32 cfs 12,068 cf

Subcatchment 10.1: Runoff Area=12,176 sf 0.00% Impervious Runoff Depth=1.77"
Tc=6.0 min CN=35 Runoff=0.42 cfs 1,796 cf

Subcatchment 10.2: Runoff Area=5,430 sf 0.00% Impervious Runoff Depth=3.56"
Tc=0.0 min CN=48 Runoff=0.61 cfs 1,609 cf

Subcatchment 10.3: Runoff Area=488 sf 0.00% Impervious Runoff Depth=4.53"
Tc=6.0 min CN=55 Runoff=0.06 cfs 184 cf

Subcatchment 10.4: Runoff Area=612 sf 0.00% Impervious Runoff Depth=4.53"
Tc=6.0 min CN=55 Runoff=0.07 cfs 231 cf

Pond 1P: C/D/E Peak Elev=292.57' Inflow=52.59 cfs 205,597 cf
36.0" Round Culvert n=0.013 L=30.0' S=0.0050 '/' Outflow=52.59 cfs 205,597 cf

Pond 2P: ROAD Peak Elev=303.75' Inflow=40.63 cfs 158,183 cf
36.0" Round Culvert n=0.013 L=215.0' S=0.0050 '/' Outflow=40.63 cfs 158,183 cf

Pond 3P: F/G/H Peak Elev=297.92' Inflow=36.23 cfs 142,539 cf
36.0" Round Culvert n=0.013 L=15.0' S=0.0053 '/' Outflow=36.23 cfs 142,539 cf

Pond 4P: ROAD Peak Elev=304.11' Inflow=18.73 cfs 73,175 cf
36.0" Round Culvert n=0.013 L=200.0' S=0.0050 '/' Outflow=18.73 cfs 73,175 cf

Pond 5P: Peak Elev=294.55' Inflow=18.73 cfs 73,175 cf
36.0" Round Culvert n=0.013 L=200.0' S=0.0050 '/' Outflow=18.73 cfs 73,175 cf

Pond 6P: I/J/K Peak Elev=298.33' Inflow=15.50 cfs 61,436 cf
24.0" Round Culvert n=0.013 L=60.0' S=0.0050 '/' Outflow=15.50 cfs 61,436 cf

Pond 7P: SSIB Peak Elev=0.00' Storage=0 cf
Discarded=0.00 cfs 0 cf Primary=0.00 cfs 0 cf

Pond DMH10: Peak Elev=279.24' Inflow=206.32 cfs 671,740 cf
48.0" Round Culvert n=0.011 L=77.0' S=-0.0065 '/' Outflow=206.32 cfs 671,741 cf

Pond DMH11: Peak Elev=267.62' Inflow=206.32 cfs 671,741 cf
48.0" Round Culvert n=0.011 L=67.0' S=0.0075 '/' Outflow=206.32 cfs 671,741 cf

Pond DMH2: Peak Elev=299.98' Inflow=92.69 cfs 386,438 cf
36.0" Round Culvert n=0.011 L=208.0' S=0.0049 '/' Outflow=92.69 cfs 386,439 cf

Pond DMH3: Peak Elev=288.84' Inflow=92.69 cfs 386,439 cf
36.0" Round Culvert n=0.011 L=214.0' S=0.0050 '/' Outflow=92.69 cfs 386,439 cf

Pond DMH8: Peak Elev=287.91' Inflow=100.88 cfs 412,748 cf
42.0" Round Culvert n=0.011 L=77.0' S=0.0049 '/' Outflow=100.88 cfs 412,748 cf

Pond DMH9: Peak Elev=290.75' Inflow=193.03 cfs 636,420 cf
48.0" Round Culvert n=0.011 L=276.0' S=0.0050 '/' Outflow=193.03 cfs 636,421 cf

Pond P1: SSIB Peak Elev=379.53' Storage=24,949 cf Inflow=27.00 cfs 103,875 cf
Discarded=0.32 cfs 36,788 cf Primary=32.02 cfs 67,097 cf Outflow=32.34 cfs 103,884 cf

Pond P10.5: P10 & P11 Peak Elev=284.24' Storage=5,012 cf Inflow=9.43 cfs 32,837 cf
Discarded=0.05 cfs 6,000 cf Primary=9.77 cfs 26,309 cf Outflow=9.82 cfs 32,309 cf

Pond P12: Peak Elev=303.58' Storage=25,797 cf Inflow=43.99 cfs 163,971 cf
Outflow=45.72 cfs 161,734 cf

Pond P2: RAIN GARDEN Peak Elev=261.97' Storage=10,554 cf Inflow=25.41 cfs 77,883 cf
Discarded=1.75 cfs 40,794 cf Primary=12.89 cfs 37,097 cf Outflow=14.64 cfs 77,892 cf

Pond P3: SSIB Peak Elev=274.06' Storage=9,543 cf Inflow=16.19 cfs 60,693 cf
Discarded=0.15 cfs 17,562 cf Primary=16.27 cfs 43,135 cf Outflow=16.42 cfs 60,697 cf

Pond P4: SSIB Peak Elev=295.78' Storage=25,522 cf Inflow=53.50 cfs 223,733 cf
Discarded=0.44 cfs 44,218 cf Primary=66.07 cfs 179,535 cf Outflow=66.50 cfs 223,753 cf

Pond P5: SSIB Peak Elev=283.08' Storage=22,855 cf Inflow=29.92 cfs 102,136 cf
Discarded=1.14 cfs 66,889 cf Primary=30.58 cfs 35,320 cf Outflow=31.72 cfs 102,208 cf

Pond P6: SSIB Peak Elev=320.15' Storage=33,781 cf Inflow=67.79 cfs 252,902 cf
Discarded=0.22 cfs 28,048 cf Primary=92.16 cfs 223,672 cf Outflow=92.38 cfs 251,720 cf

Pond P7: SSIB Peak Elev=281.57' Storage=15,909 cf Inflow=22.96 cfs 83,888 cf
Outflow=10.22 cfs 83,838 cf

Pond P8: RAIN GARDEN Peak Elev=277.81' Storage=5,600 cf Inflow=9.44 cfs 45,397 cf
Outflow=9.35 cfs 45,358 cf

Pond P9: Peak Elev=279.70' Storage=17,213 cf Inflow=15.43 cfs 58,949 cf
Discarded=0.11 cfs 13,270 cf Primary=12.38 cfs 45,170 cf Outflow=12.48 cfs 57,633 cf

Link 3L: (new Link)
Primary=0.00 cfs 0 cf

Link DP-1: HEADWALL Inflow=7.41 cfs 42,613 cf
Primary=7.41 cfs 42,613 cf

Link DP-10: OFFSITE EAST Inflow=0.95 cfs 3,820 cf
Primary=0.95 cfs 3,820 cf

Link DP-2: FES Inflow=44.77 cfs 104,194 cf
Primary=44.77 cfs 104,194 cf

Link DP-3: HEADWALL Inflow=206.32 cfs 671,741 cf
Primary=206.32 cfs 671,741 cf

Link DP-4: KING ST Inflow=1.22 cfs 4,524 cf
Primary=1.22 cfs 4,524 cf

Link DP-5: EAST SIDE WETLAND Inflow=25.34 cfs 165,936 cf
Primary=25.34 cfs 165,936 cf

Link DP-6: WEST SIDE WETLAND Inflow=262.68 cfs 855,334 cf
Primary=262.68 cfs 855,334 cf

Link DP-7: SOUTH POND
Primary=0.00 cfs 0 cf

Link DP-8: SOUTH POND
Primary=0.00 cfs 0 cf

Link DP-9: OFFSITE WEST Inflow=4.24 cfs 15,960 cf
Primary=4.24 cfs 15,960 cf

Total Runoff Area = 1,928,530 sf Runoff Volume = 1,303,572 cf Average Runoff Depth = 8.11"
34.21% Pervious = 659,697 sf 65.79% Impervious = 1,268,833 sf

D

Recharge Data

The Engineering Corp
282 Merrimack Street, 2nd Floor
Lawrence, MA 01843
978.794.1792
TheEngineeringCorp.com
Create | Design | Innovate

PROPOSED BEST MANAGEMENT PRACTICES

550 KING STREET

BEST MANAGEMENT PRACTICE (BMP)	SIZE & TYPE	PRETREATMENT DEVICE	SUBCATCHMENT(S) DIRECTED TO BMP	IMPERVIOUS COVER DIRECTED TO BMP (SF)				REQUIRED RECHARGE VOLUME (CF)	REQUIRED 1" WATER QUALITY VOLUME (CF)	PROVIDED RECHARGE AND WATER QUALITY VOLUME(CF)
				HSG A	HSG B	HSG C	HSG D			
P1	Rain Garden with Infiltration	CDS	2.1			23,665	17,564	807	3,436	3,578
P2	54" CMP Subsurface Infiltration	CDS	2.2	15,164		51,467	3,370	2,346	5,833	5,901
P3	ADS Stormtech MC-7200 Infiltration	IRP+	3.6	11,193			98,807	1,746	9,167	10,228
P4	60" CMP Subsurface Infiltration	CDS	3.7, 3.8			12,091	89,238	1,256	8,444	13,063
P5	ADS Stormtech SC-800 Infiltration	IRP+	3.1			9,917	19,700	468	2,468	2,496
P6	54" CMP Subsurface Infiltration	CDS	3.9, 3.10, 3.11, 3.15, 3.16			199,100	96,138	6,246	24,603	25,935
P7	48" CMP Subsurface Infiltration	CDS	3.3, 3.5, 3.12, 3.13, 3.14, 3.18, 3.21			40,027	218,587	3,351	21,551	21,933
P8	60" CMP Subsurface Infiltration	CDS	3.2, 3.4, 3.17	65,159		981		4,138	5,512	5,650
P9	84" CMP Subsurface Detention	NA	3.19, 3.20, 5.1			75,442	95,041	See Note 5		
P10	ADS Stormtech MC-4500 Infiltration	IRP+	5.2, 5.5				142,874	1,503	11,906	12,261

A. TOTAL SITE IMPERVIOUS AREA (SF)	1,407,286
B. IMPERVIOUS AREA DIRECTED TO INFILTRATION BMPS (SF)	1,115,042
INFILTRATION ADJUSTMENT FACTOR (A/B)	1.26

410 GREAT ROAD

BEST MANAGEMENT PRACTICE (BMP)	SIZE & TYPE	PRETREATMENT DEVICE	SUBCATCHMENT(S) DIRECTED TO BMP	IMPERVIOUS COVER DIRECTED TO BMP (SF)				REQUIRED RECHARGE VOLUME (CF)	REQUIRED 1" WATER QUALITY VOLUME (CF)	PROVIDED RECHARGE AND WATER QUALITY VOLUME (CF)
				HSG A	HSG B	HSG C	HSG D			
P11	ADS Stormtech MC-3500 Infiltration	IRP+	11.1, 11.2	121,471				6,438	10,123	10,255

A. TOTAL SITE IMPERVIOUS AREA (SF)	128,758
B. IMPERVIOUS AREA DIRECTED TO INFILTRATION BMPS (SF)	121,471
INFILTRATION ADJUSTMENT FACTOR (A/B)	1.06

NOTES:

1) **Test pits have been conducted as noted on the "Test Pit Plan". Where a test pit has not yet been conducted in the location fo a proposed BMP, the groundwater elevation was interpolated from known groundwater elevations. A minimum of four feet of separation between the estimated seasonal high groundwater table (ESHGWT) elevation and the proposed bottom of infiltration practice elevation was provided. The ESHGWT shall be confirmed prior to construction, and proposed infiltration BMPs shall be adjusted accordingly.**
2) **Not all of the proposed impervious surface is directed to an infiltration BMP. The adjustment factor has been provided to meet Standard 3.**
3) **Approximate BMP locations and footprints are shown on the figure "Post Development Drainage Areas".**
4) **BMP sizing, elevations, and outlets are provided in the HydroCAD Report.**
5) **Due to groundwater conditions in the location of P9, infiltration cannot be achieved. Other locations for P9 have been evaluated but are not feasible given existing site features to remain and the necessity of providng a functional space in the proposed conditions. The 1" water quality flow shall be treated by a proprietary flow through device to meet Standard 4.**
6) **All ADS Stormtech chambers shall be outfitted with an Isolator Row Plow (IRP+) to achieve 44% pretreatment requirements prior to infiltration.**
7) **All CMP infiltration systems shall be preceded by a Contech CDS or Cascade water quality unit of adequate size to achieve the 44% pretreatment requirement prior to infiltration.**

E

Water Quality Data

INSTRUCTIONS:
1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
2. Select BMP from Drop Down Menu
3. After BMP is selected, TSS Removal and other Columns are automatically completed.

Version 1, Automated: Mar. 4, 2008

TSS Removal Calculation Worksheet

Location: Impervious area not routed to infiltration system

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Deep Sump and Hooded Catch Basin	**0.25**	**1.00**	**0.25**	**0.75**
Water Quality Unit	**(minimum)** **0.73**	**0.75**	**0.55**	**0.20**
	0.00	**0.56**	**0.00**	**0.20**
	0.00	**0.56**	**0.00**	**0.20**
	0.00	**0.56**	**0.00**	**0.20**

Total TSS Removal = **80% (minimum)**

Separate Form Needs to be Completed for Each Outlet or BMP Train

Project: **King Street Common**
Prepared By: **MWC**
Date: **4/23/2025**

*Equals remaining load from previous BMP (E) which enters the BMP

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed
1. From MassDEP Stormwater Handbook Vol. 1

INSTRUCTIONS:
1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
2. Select BMP from Drop Down Menu
3. After BMP is selected, TSS Removal and other Columns are automatically completed.

Version 1, Automated: Mar. 4, 2008

TSS Removal Calculation Worksheet

Location: Impervious area routed to CMP infiltration

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Deep Sump and Hooded Catch Basin	**0.25**	**1.00**	**0.25**	**0.75**
Water Quality Unit	**(minimum)** **0.25**	**0.75**	**0.19**	**0.56**
Infiltration Basin	**0.80**	**0.56**	**0.45**	**0.11**
	0.00	**0.11**	**0.00**	**0.11**
	0.00	**0.11**	**0.00**	**0.11**

Total TSS Removal = 89% (minimum)

Separate Form Needs to be Completed for Each Outlet or BMP Train

Project: **King Street Common**
Prepared By: **MWC**
Date: **4/23/2025**

*Equals remaining load from previous BMP (E) which enters the BMP

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed
1. From MassDEP Stormwater Handbook Vol. 1

Mass. Dept. of Environmental Protection

INSTRUCTIONS:
1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
2. Select BMP from Drop Down Menu
3. After BMP is selected, TSS Removal and other Columns are automatically completed.

Version 1, Automated: Mar. 4, 2008

TSS Removal Calculation Worksheet

Location: Impervious area routed to ADS Stormtech infiltration

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Deep Sump and Hooded Catch Basin	0.25	1.00	0.25	0.75
Isolator Row Plus	0.25	0.75	0.19	0.56
Infiltration Basin	0.80	0.56	0.45	0.11
	0.00	0.11	0.00	0.11
	0.00	0.11	0.00	0.11

Total TSS Removal = **89%**

Separate Form Needs to be Completed for Each Outlet or BMP Train

Project: King Street Common
Prepared By: MWC
Date: 4/23/2025

*Equals remaining load from previous BMP (E) which enters the BMP

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed
1. From MassDEP Stormwater Handbook Vol. 1

Mass. Dept. of Environmental Protection

F

Soil Data

United States Department of Agriculture

NRCS

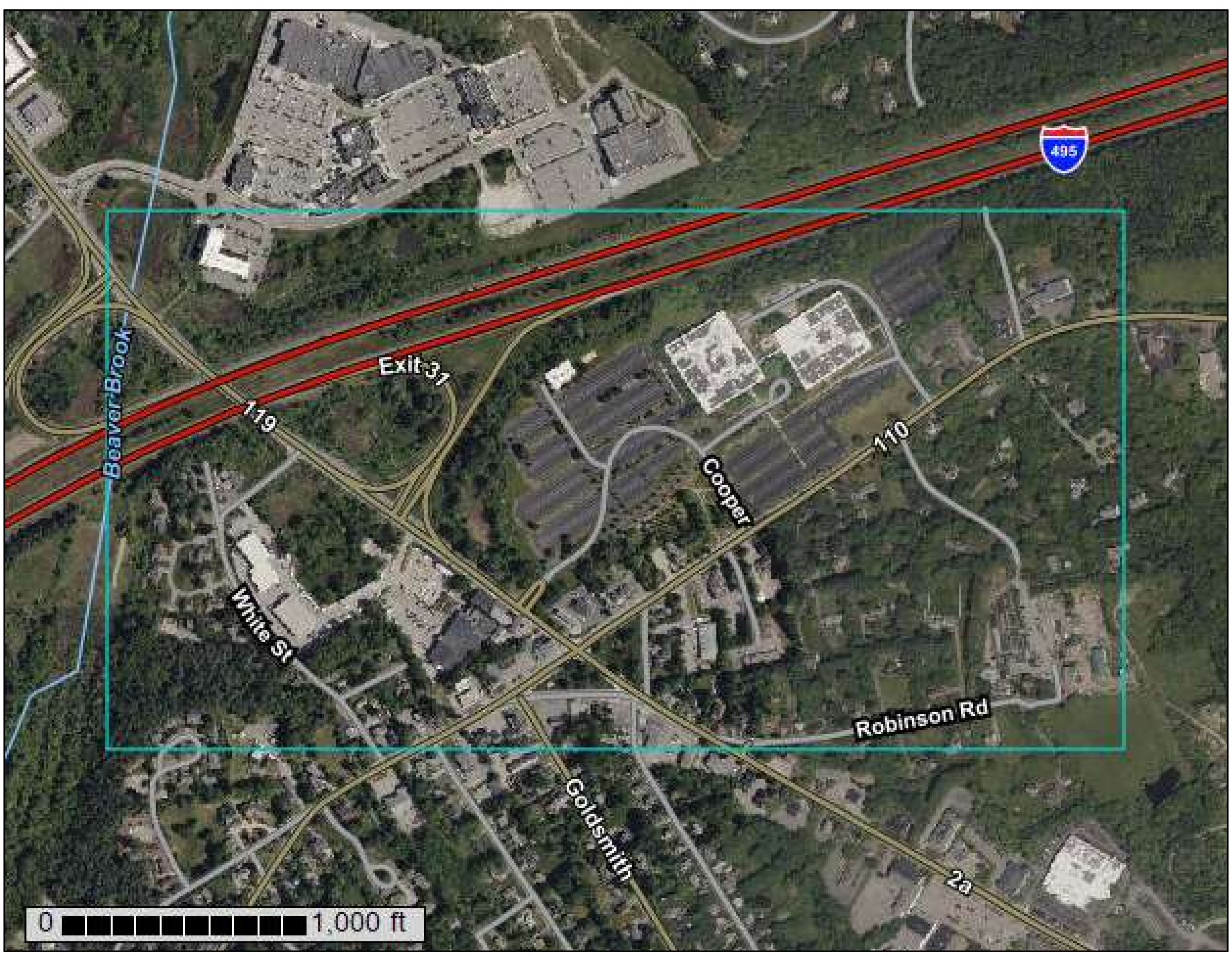
Natural Resources Conservation Service

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

Custom Soil Resource Report for

Middlesex County, Massachusetts

King Street Common



April 8, 2025

Preface

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

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

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

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

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

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

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map

Map Scale: 1:6,980 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0, 100, 200, 400, 600

Feet: 0, 300, 600, 1200, 1800

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

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

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 distance or area are required.

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

Soil Survey Area: Middlesex County, Massachusetts
Survey Area Data: Version 24, Aug 27, 2024

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

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

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
6A	Scarboro mucky fine sandy loam, 0 to 3 percent slopes	9.7	4.6%
32B	Wareham loamy fine sand, 0 to 5 percent slopes	0.0	0.0%
51A	Swansea muck, 0 to 1 percent slopes	3.8	1.8%
103C	Charlton-Hollis-Rock outcrop complex, 8 to 15 percent slopes	0.3	0.2%
253A	Hinckley loamy sand, 0 to 3 percent slopes	3.0	1.4%
253D	Hinckley loamy sand, 15 to 25 percent slopes	4.3	2.0%
260B	Sudbury fine sandy loam, 3 to 8 percent slopes	6.8	3.2%
307E	Paxton fine sandy loam, 25 to 35 percent slopes, extremely stony	0.3	0.2%
310B	Woodbridge fine sandy loam, 3 to 8 percent slopes	45.2	21.4%
310C	Woodbridge fine sandy loam, 8 to 15 percent slopes	3.2	1.5%
311B	Woodbridge fine sandy loam, 0 to 8 percent slopes, very stony	5.7	2.7%
422B	Canton fine sandy loam, 0 to 8 percent slopes, extremely stony	7.1	3.3%
622C	Paxton-Urban land complex, 3 to 15 percent slopes	10.3	4.9%
623C	Woodbridge-Urban land complex, 3 to 15 percent slopes	6.7	3.2%
626B	Merrimac-Urban land complex, 0 to 8 percent slopes	23.7	11.2%
654	Udorthents, loamy	4.7	2.2%
655	Udorthents, wet substratum	17.8	8.4%
656	Udorthents-Urban land complex	58.5	27.7%
Totals for Area of Interest		**211.3**	**100.0%**

Map Unit Descriptions

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

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

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

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

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

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

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

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

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

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

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

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

Middlesex County, Massachusetts

6A—Scarboro mucky fine sandy loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2svky
Elevation: 0 to 1,320 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 250 days
Farmland classification: Not prime farmland

Map Unit Composition

Scarboro and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Scarboro

Setting

Landform: Drainageways, outwash deltas, outwash terraces, depressions
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope, tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Sandy glaciofluvial deposits derived from schist and/or sandy glaciofluvial deposits derived from gneiss and/or sandy glaciofluvial deposits derived from granite

Typical profile

Oe - 0 to 3 inches: mucky peat
A - 3 to 11 inches: mucky fine sandy loam
Cg1 - 11 to 21 inches: sand
Cg2 - 21 to 65 inches: gravelly coarse sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (1.42 to 14.17 in/hr)
Depth to water table: About 0 to 2 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 4.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: A/D
Ecological site: F144AY031MA - Very Wet Outwash
Hydric soil rating: Yes

Minor Components

Swansea

Percent of map unit: 10 percent
Landform: Bogs, swamps
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Wareham

Percent of map unit: 5 percent
Landform: Depressions
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Walpole

Percent of map unit: 5 percent
Landform: Deltas, depressions, outwash terraces, depressions, outwash plains
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

32B—Wareham loamy fine sand, 0 to 5 percent slopes

Map Unit Setting

National map unit symbol: vqnd
Elevation: 0 to 2,100 feet
Mean annual precipitation: 45 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Wareham and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Wareham

Setting

Landform: Deltas, depressions, terraces
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Loose sandy glaciofluvial deposits

Typical profile

H1 - 0 to 10 inches: loamy fine sand
H2 - 10 to 24 inches: loamy sand
H3 - 24 to 34 inches: stratified sand to fine sand
H4 - 34 to 65 inches: stratified coarse sand to sand

Properties and qualities

Slope: 0 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (6.00 to 20.00 in/hr)
Depth to water table: About 6 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 4.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: A/D
Ecological site: F144AY028MA - Wet Outwash
Hydric soil rating: Yes

Minor Components

Sudbury

Percent of map unit: 10 percent
Landform: Plains, terraces
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread, dip
Down-slope shape: Linear
Across-slope shape: Concave
Hydric soil rating: No

Scarboro

Percent of map unit: 5 percent
Landform: Terraces
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: Yes

Deerfield

Percent of map unit: 5 percent
Landform: Depressions, stream terraces, deltas
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: No

51A—Swansea muck, 0 to 1 percent slopes

Map Unit Setting

National map unit symbol: 2trl2
Elevation: 0 to 1,140 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

Swansea and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Swansea

Setting

Landform: Bogs, swamps
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Highly decomposed organic material over loose sandy and gravelly glaciofluvial deposits

Typical profile

Oa1 - 0 to 24 inches: muck
Oa2 - 24 to 34 inches: muck
Cg - 34 to 79 inches: coarse sand

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.17 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: Rare
Frequency of ponding: Frequent
Available water supply, 0 to 60 inches: Very high (about 16.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8w
Hydrologic Soil Group: B/D
Ecological site: F144AY043MA - Acidic Organic Wetlands
Hydric soil rating: Yes

Minor Components

Freetown

Percent of map unit: 10 percent
Landform: Bogs, swamps
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Whitman

Percent of map unit: 5 percent
Landform: Drainageways, depressions
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Scarboro

Percent of map unit: 5 percent
Landform: Drainageways, depressions
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope, tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

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: Ridges, hills
Landform position (two-dimensional): Backslope

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

Typical profile
Oe - 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
Surface area covered with cobbles, stones or boulders: 9.0 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): 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
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Moderate (about 8.7 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: B
Ecological site: F144AY034CT - Well Drained Till Uplands
Hydric soil rating: No

Description of Hollis, Extremely Stony

Setting
Landform: Ridges, hills
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Nose slope, side slope, crest
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
Surface area covered with cobbles, stones or boulders: 9.0 percent
Depth to restrictive feature: 8 to 23 inches to lithic bedrock
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
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Very low (about 2.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Ecological site: F144AY033MA - Shallow Dry Till Uplands
Hydric soil rating: No

Description of Rock Outcrop

Setting

Landform: Ridges, hills
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 supply, 0 to 60 inches: 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: Ground moraines, hills, drumlins
Landform position (two-dimensional): Backslope, footslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Linear
Hydric soil rating: No

Canton, extremely stony

Percent of map unit: 5 percent
Landform: Moraines, hills, ridges
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex, linear
Across-slope shape: Convex
Hydric soil rating: No

Chatfield, extremely stony

Percent of map unit: 5 percent
Landform: Ridges, hills
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Nose slope, side slope, crest
Down-slope shape: Convex
Across-slope shape: Linear, convex
Hydric soil rating: No

Ridgebury, extremely stony

Percent of map unit: 2 percent
Landform: Hills, drainageways, drumlins, depressions, ground moraines
Landform position (two-dimensional): Footslope, toeslope
Landform position (three-dimensional): Head slope, base slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

253A—Hinckley loamy sand, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2svm7
Elevation: 0 to 1,420 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 250 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

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

Description of Hinckley

Setting

Landform: Outwash terraces, outwash plains, kame terraces, outwash deltas
Landform position (three-dimensional): Tread
Down-slope shape: Concave, convex, linear
Across-slope shape: Convex, linear, concave
Parent material: Sandy and gravelly glaciofluvial deposits derived from gneiss and/or granite and/or schist

Typical profile

Oe - 0 to 1 inches: moderately decomposed plant material
A - 1 to 8 inches: loamy sand
Bw1 - 8 to 11 inches: gravelly loamy sand

Bw2 - 11 to 16 inches: gravelly loamy sand
BC - 16 to 19 inches: very gravelly loamy sand
C - 19 to 65 inches: very gravelly sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 99.90 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 3.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3s
Hydrologic Soil Group: A
Ecological site: F144AY022MA - Dry Outwash
Hydric soil rating: No

Minor Components

Merrimac

Percent of map unit: 5 percent
Landform: Outwash deltas, outwash terraces, kame terraces
Landform position (three-dimensional): Tread
Down-slope shape: Concave, convex, linear
Across-slope shape: Convex, linear, concave
Hydric soil rating: No

Windsor

Percent of map unit: 5 percent
Landform: Outwash deltas, kame terraces, outwash terraces
Landform position (three-dimensional): Tread
Down-slope shape: Concave, convex, linear
Across-slope shape: Convex, linear, concave
Hydric soil rating: No

Sudbury

Percent of map unit: 4 percent
Landform: Outwash deltas, outwash terraces, kame terraces
Landform position (three-dimensional): Tread
Down-slope shape: Concave, convex, linear
Across-slope shape: Convex, linear, concave
Hydric soil rating: No

Walpole

Percent of map unit: 1 percent
Landform: Deltas, depressions, outwash terraces, depressions, outwash plains
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Concave
Across-slope shape: Concave

Hydric soil rating: Yes

253D—Hinckley loamy sand, 15 to 25 percent slopes

Map Unit Setting

National map unit symbol: 2svmc
Elevation: 0 to 1,460 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

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

Description of Hinckley

Setting

Landform: Kames, kame terraces, outwash deltas, outwash terraces, moraines, eskers, outwash plains
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Head slope, nose slope, side slope, crest, riser
Down-slope shape: Concave, convex, linear
Across-slope shape: Convex, linear, concave
Parent material: Sandy and gravelly glaciofluvial deposits derived from gneiss and/or granite and/or schist

Typical profile

Oe - 0 to 1 inches: moderately decomposed plant material
A - 1 to 8 inches: loamy sand
Bw1 - 8 to 11 inches: gravelly loamy sand
Bw2 - 11 to 16 inches: gravelly loamy sand
BC - 16 to 19 inches: very gravelly loamy sand
C - 19 to 65 inches: very gravelly sand

Properties and qualities

Slope: 15 to 25 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 99.90 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 3.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A
Ecological site: F144AY022MA - Dry Outwash
Hydric soil rating: No

Minor Components

Merrimac

Percent of map unit: 8 percent
Landform: Eskers, outwash terraces, kames, outwash plains, moraines
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Head slope, nose slope, side slope, crest, riser
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Windsor

Percent of map unit: 5 percent
Landform: Kames, kame terraces, moraines, eskers, outwash deltas, outwash terraces, outwash plains
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Head slope, nose slope, side slope, crest, riser
Down-slope shape: Concave, convex, linear
Across-slope shape: Convex, linear, concave
Hydric soil rating: No

Sudbury

Percent of map unit: 2 percent
Landform: Eskers, kame terraces, outwash deltas, moraines, outwash plains, outwash terraces
Landform position (two-dimensional): Backslope, footslope
Landform position (three-dimensional): Base slope, tread
Down-slope shape: Convex, concave, linear
Across-slope shape: Convex, concave, linear
Hydric soil rating: No

260B—Sudbury fine sandy loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 9915
Elevation: 0 to 2,100 feet
Mean annual precipitation: 45 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 145 to 240 days
Farmland classification: All areas are prime farmland

Map Unit Composition

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

Description of Sudbury

Setting

Landform: Plains, terraces
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread, dip
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Friable loamy eolian deposits over loose sandy glaciofluvial deposits

Typical profile

H1 - 0 to 8 inches: fine sandy loam
H2 - 8 to 20 inches: fine sandy loam
H3 - 20 to 27 inches: loamy sand
H4 - 27 to 65 inches: stratified gravelly coarse sand to sand

Properties and qualities

Slope: 2 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: About 18 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 4.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: B
Ecological site: F144AY027MA - Moist Sandy Outwash
Hydric soil rating: No

Minor Components

Merrimac

Percent of map unit: 8 percent
Landform: Terraces, plains
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Tread, rise
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Wareham

Percent of map unit: 4 percent
Landform: Depressions, deltas, terraces
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread, dip

Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Windsor
Percent of map unit: 2 percent
Landform: Flats, deltas, terraces
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread, rise
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Unnamed
Percent of map unit: 1 percent

307E—Paxton fine sandy loam, 25 to 35 percent slopes, extremely stony

Map Unit Setting
National map unit symbol: 2w67q
Elevation: 0 to 1,400 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition
Paxton, extremely stony, and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Paxton, Extremely Stony

Setting
Landform: Ground moraines, hills, drumlins
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex, linear
Across-slope shape: Linear, convex
Parent material: Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

Typical profile
Oe - 0 to 2 inches: moderately decomposed plant material
A - 2 to 10 inches: fine sandy loam
Bw1 - 10 to 17 inches: fine sandy loam
Bw2 - 17 to 28 inches: fine sandy loam
Cd - 28 to 67 inches: gravelly fine sandy loam

Properties and qualities
Slope: 25 to 35 percent

Surface area covered with cobbles, stones or boulders: 9.0 percent
Depth to restrictive feature: 20 to 43 inches to densic material
Drainage class: Well drained
Runoff class: 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 18 to 37 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 4.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: C
Ecological site: F144AY007CT - Well Drained Dense Till Uplands
Hydric soil rating: No

Minor Components

Charlton, extremely stony

Percent of map unit: 8 percent
Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Woodbridge, extremely stony

Percent of map unit: 1 percent
Landform: Hills, drumlins, ground moraines
Landform position (two-dimensional): Backslope, footslope
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Chatfield, extremely stony

Percent of map unit: 1 percent
Landform: Ridges, hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

310B—Woodbridge fine sandy loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2t2ql
Elevation: 0 to 1,470 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: All areas are prime farmland

Map Unit Composition

Woodbridge, fine sandy loam, and similar soils: 82 percent
Minor components: 18 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Woodbridge, Fine Sandy Loam

Setting

Landform: Ground moraines, drumlins, hills
Landform position (two-dimensional): Summit, backslope, footslope
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

Typical profile

Ap - 0 to 7 inches: fine sandy loam
Bw1 - 7 to 18 inches: fine sandy loam
Bw2 - 18 to 30 inches: fine sandy loam
Cd - 30 to 65 inches: gravelly fine sandy loam

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: 20 to 39 inches to densic material
Drainage class: Moderately well drained
Runoff class: Medium
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 18 to 30 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 3.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: C/D
Ecological site: F144AY037MA - Moist Dense Till Uplands

Hydric soil rating: No

Minor Components

Paxton

Percent of map unit: 10 percent
Landform: Drumlins, ground moraines, hills
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Nose slope, side slope, crest
Down-slope shape: Convex, linear
Across-slope shape: Convex
Hydric soil rating: No

Ridgebury

Percent of map unit: 8 percent
Landform: Depressions, ground moraines, hills, drainageways
Landform position (two-dimensional): Toeslope, backslope, footslope
Landform position (three-dimensional): Base slope, head slope, dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

310C—Woodbridge fine sandy loam, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 2w689
Elevation: 0 to 1,370 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: Farmland of statewide importance

Map Unit Composition

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

Description of Woodbridge

Setting

Landform: Ground moraines, hills, drumlins
Landform position (two-dimensional): Backslope, footslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

Typical profile

Ap - 0 to 7 inches: fine sandy loam
Bw1 - 7 to 18 inches: fine sandy loam

Bw2 - 18 to 30 inches: fine sandy loam
Cd - 30 to 65 inches: gravelly fine sandy loam

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: 20 to 39 inches to densic material
Drainage class: Moderately well 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 18 to 30 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 4.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C/D
Ecological site: F144AY037MA - Moist Dense Till Uplands
Hydric soil rating: No

Minor Components

Paxton

Percent of map unit: 10 percent
Landform: Ground moraines, hills, drumlins
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

Percent of map unit: 4 percent
Landform: Depressions, ground moraines, hills, drainageways, drumlins
Landform position (two-dimensional): Footslope, toeslope
Landform position (three-dimensional): Head slope, base slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Sutton

Percent of map unit: 1 percent
Landform: Ground moraines, hills
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

311B—Woodbridge fine sandy loam, 0 to 8 percent slopes, very stony

Map Unit Setting

National map unit symbol: 2t2qr
Elevation: 0 to 1,440 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: Farmland of statewide importance

Map Unit Composition

Woodbridge, very stony, and similar soils: 82 percent
Minor components: 18 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Woodbridge, Very Stony

Setting

Landform: Ground moraines, hills, drumlins
Landform position (two-dimensional): Summit, backslope, footslope
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

Typical profile

Oe - 0 to 2 inches: moderately decomposed plant material
A - 2 to 9 inches: fine sandy loam
Bw1 - 9 to 20 inches: fine sandy loam
Bw2 - 20 to 32 inches: fine sandy loam
Cd - 32 to 67 inches: gravelly fine sandy loam

Properties and qualities

Slope: 0 to 8 percent
Surface area covered with cobbles, stones or boulders: 1.6 percent
Depth to restrictive feature: 20 to 43 inches to densic material
Drainage class: Moderately well drained
Runoff class: Medium
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 19 to 27 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 4.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s

Hydrologic Soil Group: C/D
Ecological site: F144AY037MA - Moist Dense Till Uplands
Hydric soil rating: No

Minor Components

Paxton, very stony

Percent of map unit: 10 percent
Landform: Ground moraines, hills, drumlins
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Crest, side slope
Down-slope shape: Convex, linear
Across-slope shape: Linear, convex
Hydric soil rating: No

Ridgebury, very stony

Percent of map unit: 8 percent
Landform: Hills, drainageways, drumlins, depressions, ground moraines
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Head slope, base slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

422B—Canton fine sandy loam, 0 to 8 percent slopes, extremely stony

Map Unit Setting

National map unit symbol: 2w818
Elevation: 0 to 1,180 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Canton, extremely stony, and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Canton, Extremely Stony

Setting

Landform: Moraines, hills, ridges
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Nose slope, side slope, crest
Down-slope shape: Convex, linear
Across-slope shape: Convex
Parent material: Coarse-loamy over sandy melt-out till derived from gneiss, granite, and/or schist

Typical profile

Oi - 0 to 2 inches: slightly decomposed plant material
A - 2 to 5 inches: fine sandy loam
Bw1 - 5 to 16 inches: fine sandy loam
Bw2 - 16 to 22 inches: gravelly fine sandy loam
2C - 22 to 67 inches: gravelly loamy sand

Properties and qualities

Slope: 0 to 8 percent
Surface area covered with cobbles, stones or boulders: 9.0 percent
Depth to restrictive feature: 19 to 39 inches to strongly contrasting textural stratification
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): 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
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 3.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: B
Ecological site: F144AY034CT - Well Drained Till Uplands
Hydric soil rating: No

Minor Components

Charlton, extremely stony

Percent of map unit: 6 percent
Landform: Ridges, ground moraines, hills
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Convex, linear
Across-slope shape: Convex
Hydric soil rating: No

Scituate, extremely stony

Percent of map unit: 6 percent
Landform: Hills, ground moraines, drumlins
Landform position (two-dimensional): Summit, backslope, footslope
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Convex, linear
Across-slope shape: Convex
Hydric soil rating: No

Montauk, extremely stony

Percent of map unit: 4 percent
Landform: Recessionial moraines, ground moraines, hills, drumlins
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Convex, linear
Across-slope shape: Convex

Hydric soil rating: No

Swansea

Percent of map unit: 4 percent
Landform: Marshes, depressions, bogs, swamps, kettles
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

622C—Paxton-Urban land complex, 3 to 15 percent slopes

Map Unit Setting

National map unit symbol: 2w67k
Elevation: 0 to 930 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Paxton and similar soils: 45 percent
Urban land: 35 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Paxton

Setting

Landform: Ground moraines, hills, drumlins
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Convex, linear
Across-slope shape: Convex
Parent material: Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

Typical profile

Ap - 0 to 8 inches: fine sandy loam
Bw1 - 8 to 15 inches: fine sandy loam
Bw2 - 15 to 26 inches: fine sandy loam
Cd - 26 to 65 inches: gravelly fine sandy loam

Properties and qualities

Slope: 3 to 15 percent
Depth to restrictive feature: 20 to 39 inches to densic material
Drainage class: Well drained
Runoff class: Medium
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 18 to 37 inches
Frequency of flooding: None

Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 4.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Ecological site: F144AY007CT - Well Drained Dense Till Uplands
Hydric soil rating: No

Description of Urban Land

Typical profile

M - 0 to 10 inches: cemented material

Properties and qualities

Slope: 3 to 15 percent
Depth to restrictive feature: 0 inches to manufactured layer
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 supply, 0 to 60 inches: 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: Unranked

Minor Components

Woodbridge

Percent of map unit: 9 percent
Landform: Ground moraines, hills, drumlins
Landform position (two-dimensional): Summit, backslope, footslope
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Charlton

Percent of map unit: 6 percent
Landform: Hills
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Udorthents

Percent of map unit: 4 percent
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Ridgebury

Percent of map unit: 1 percent

Landform: Drumlins, depressions, ground moraines, hills, drainageways
Landform position (two-dimensional): Footslope, toeslope
Landform position (three-dimensional): Head slope, base slope
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Hydric soil rating: Yes

623C—Woodbridge-Urban land complex, 3 to 15 percent slopes

Map Unit Setting

National map unit symbol: 2w68b
Elevation: 0 to 550 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Woodbridge and similar soils: 58 percent
Urban land: 28 percent
Minor components: 14 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Woodbridge

Setting

Landform: Ground moraines, hills, drumlins
Landform position (two-dimensional): Summit, backslope, footslope
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

Typical profile

Ap - 0 to 7 inches: fine sandy loam
Bw1 - 7 to 18 inches: fine sandy loam
Bw2 - 18 to 30 inches: fine sandy loam
Cd - 30 to 65 inches: gravelly fine sandy loam

Properties and qualities

Slope: 3 to 15 percent
Depth to restrictive feature: 20 to 39 inches to densic material
Drainage class: Moderately well 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 18 to 30 inches
Frequency of flooding: None

Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 4.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C/D
Ecological site: F144AY037MA - Moist Dense Till Uplands
Hydric soil rating: No

Description of Urban Land

Typical profile

M - 0 to 10 inches: cemented material

Properties and qualities

Slope: 3 to 15 percent
Depth to restrictive feature: 0 inches to manufactured layer
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 supply, 0 to 60 inches: 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: Unranked

Minor Components

Paxton

Percent of map unit: 9 percent
Landform: Ground moraines, hills, drumlins
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Convex, linear
Across-slope shape: Convex
Hydric soil rating: No

Ridgebury

Percent of map unit: 5 percent
Landform: Hills, drainageways, drumlins, depressions, ground moraines
Landform position (two-dimensional): Footslope, toeslope
Landform position (three-dimensional): Head slope, base slope
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Hydric soil rating: Yes

626B—Merrimac-Urban land complex, 0 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2tyr9
Elevation: 0 to 820 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 250 days
Farmland classification: Not prime farmland

Map Unit Composition

Merrimac and similar soils: 45 percent
Urban land: 40 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Merrimac

Setting

Landform: Outwash plains, outwash terraces, moraines, eskers, kames
Landform position (two-dimensional): Summit, shoulder, backslope, footslope
Landform position (three-dimensional): Side slope, crest, riser, tread
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy glaciofluvial deposits derived from granite, schist, and gneiss over sandy and gravelly glaciofluvial deposits derived from granite, schist, and gneiss

Typical profile

Ap - 0 to 10 inches: fine sandy loam
Bw1 - 10 to 22 inches: fine sandy loam
Bw2 - 22 to 26 inches: stratified gravel to gravelly loamy sand
2C - 26 to 65 inches: stratified gravel to very gravelly sand

Properties and qualities

Slope: 0 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 99.90 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 2 percent
Maximum salinity: Nonsaline (0.0 to 1.4 mmhos/cm)
Sodium adsorption ratio, maximum: 1.0
Available water supply, 0 to 60 inches: Low (about 4.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: A
Ecological site: F144AY022MA - Dry Outwash
Hydric soil rating: No

Description of Urban Land

Typical profile

M - 0 to 10 inches: cemented material

Properties and qualities

Slope: 0 to 8 percent
Depth to restrictive feature: 0 inches to manufactured layer
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 supply, 0 to 60 inches: 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: Unranked

Minor Components

Hinckley

Percent of map unit: 5 percent
Landform: Deltas, kames, eskers, outwash plains
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Head slope, nose slope, side slope, crest, rise
Down-slope shape: Convex
Across-slope shape: Convex, linear
Hydric soil rating: No

Sudbury

Percent of map unit: 5 percent
Landform: Deltas, terraces, outwash plains
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Windsor

Percent of map unit: 5 percent
Landform: Outwash terraces, dunes, outwash plains, deltas
Landform position (three-dimensional): Tread, riser
Down-slope shape: Linear, convex
Across-slope shape: Linear, convex
Hydric soil rating: No

654—Udorthents, loamy

Map Unit Setting

National map unit symbol: vr1l
Elevation: 0 to 3,000 feet
Mean annual precipitation: 32 to 50 inches
Mean annual air temperature: 45 to 50 degrees F
Frost-free period: 110 to 200 days
Farmland classification: Not prime farmland

Map Unit Composition

Udorthents, loamy, and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Udorthents, Loamy

Setting

Parent material: Loamy alluvium and/or sandy glaciofluvial deposits and/or loamy glaciolacustrine deposits and/or loamy marine deposits and/or loamy basal till and/or loamy lodgment till

Properties and qualities

Depth to restrictive feature: More than 80 inches
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None

Minor Components

Udorthents, sandy

Percent of map unit: 10 percent
Hydric soil rating: No

Urban land

Percent of map unit: 5 percent
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear

Udorthents, wet substratum

Percent of map unit: 5 percent
Hydric soil rating: Yes

655—Udorthents, wet substratum

Map Unit Setting

National map unit symbol: vr1n
Elevation: 0 to 3,000 feet
Mean annual precipitation: 32 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 110 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Udorthents, Wet Substratum

Setting

Parent material: Loamy alluvium and/or sandy glaciofluvial deposits and/or loamy glaciolacustrine deposits and/or loamy marine deposits and/or loamy basal till and/or loamy lodgment till

Properties and qualities

Slope: 0 to 8 percent
Depth to restrictive feature: More than 80 inches
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None

Minor Components

Urban land

Percent of map unit: 8 percent
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear

Freetown

Percent of map unit: 4 percent
Landform: Depressions, bogs
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Swansea

Percent of map unit: 3 percent
Landform: Depressions, bogs

Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

656—Udorthents-Urban land complex

Map Unit Setting

National map unit symbol: 995k
Elevation: 0 to 3,000 feet
Mean annual precipitation: 32 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 110 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Udorthents and similar soils: 45 percent
Urban land: 35 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Udorthents

Setting

Parent material: Loamy alluvium and/or sandy glaciofluvial deposits and/or loamy glaciolacustrine deposits and/or loamy marine deposits and/or loamy basal till and/or loamy lodgment till

Properties and qualities

Slope: 0 to 15 percent
Depth to restrictive feature: More than 80 inches
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None

Description of Urban Land

Setting

Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Excavated and filled land

Minor Components

Canton

Percent of map unit: 10 percent
Landform: Hills
Landform position (two-dimensional): Backslope, toeslope

Landform position (three-dimensional): Side slope, base slope
Down-slope shape: Linear
Across-slope shape: Convex
Hydric soil rating: No

Merrimac

Percent of map unit: 5 percent
Landform: Terraces, plains
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Tread, rise
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Paxton

Percent of map unit: 5 percent
Landform: Hillslopes
Landform position (two-dimensional): Summit, backslope
Landform position (three-dimensional): Head slope, side slope
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

References

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep-water habitats of the United States. U.S. Fish and Wildlife Service FWS/OBS-79/31.

Federal Register. July 13, 1994. Changes in hydric soils of the United States.

Federal Register. September 18, 2002. Hydric soils of the United States.

Hurt, G.W., and L.M. Vasilas, editors. Version 6.0, 2006. Field indicators of hydric soils in the United States.

National Research Council. 1995. Wetlands: Characteristics and boundaries.

Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_054262

Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service, U.S. Department of Agriculture Handbook 436. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053577

Soil Survey Staff. 2010. Keys to soil taxonomy. 11th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053580

Tiner, R.W., Jr. 1985. Wetlands of Delaware. U.S. Fish and Wildlife Service and Delaware Department of Natural Resources and Environmental Control, Wetlands Section.

United States Army Corps of Engineers, Environmental Laboratory. 1987. Corps of Engineers wetlands delineation manual. Waterways Experiment Station Technical Report Y-87-1.

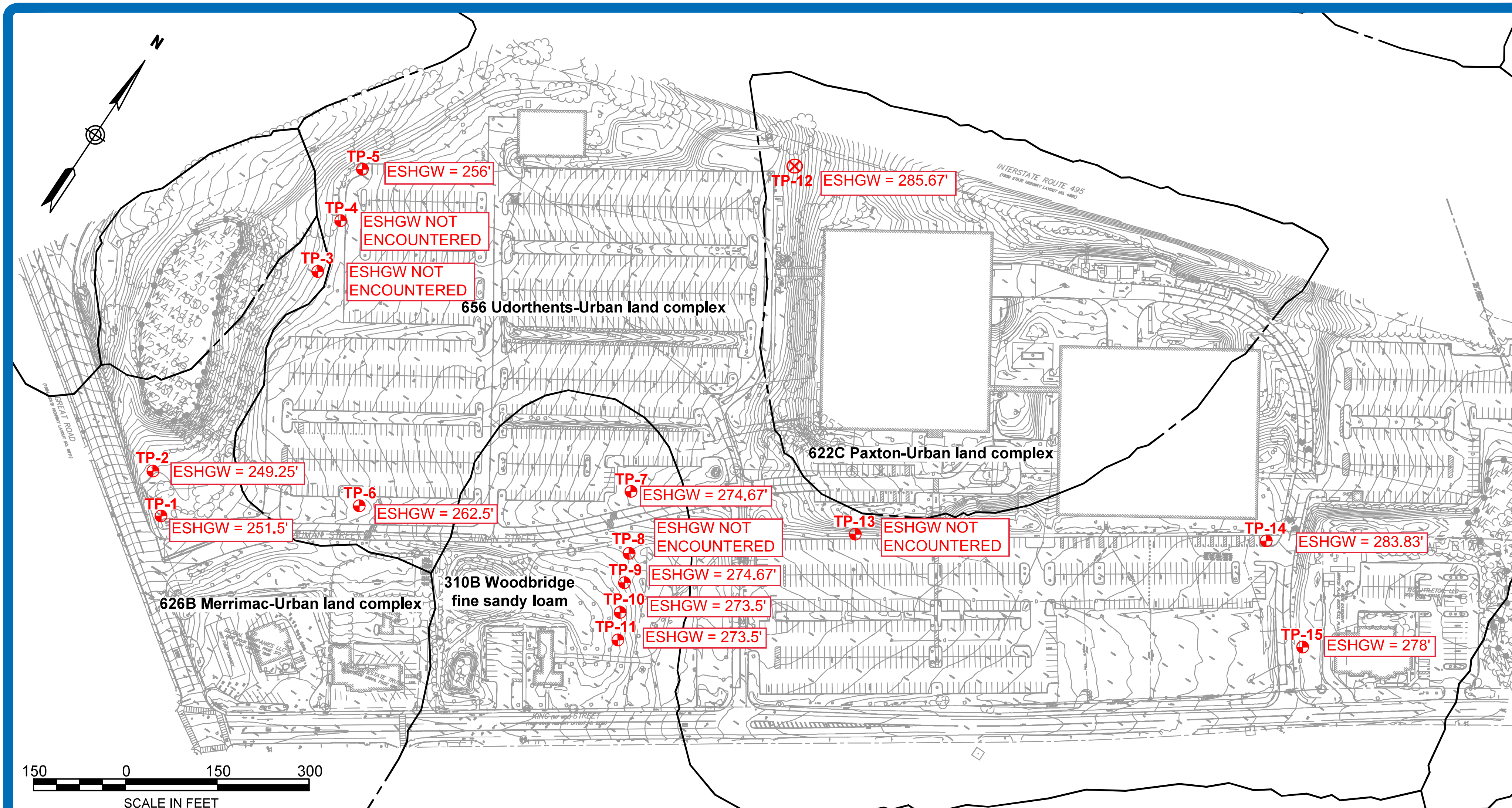
United States Department of Agriculture, Natural Resources Conservation Service. National forestry manual. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/home/?cid=nrcs142p2_053374

United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelprdb1043084

United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2_054242

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053624

United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210. http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052290.pdf



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NOTES:

1. TEST PITS SHALL BE CONDUCTED IN ACCORDANCE WITH THE MASSACHUSETTS STORMWATER HANDBOOK VOLUME 3 CHAPTER 1.

Test Pit Plan

King Street Commons
550 King Street
Littleton, Massachusetts
December 15, 2023

The Engineering Corp
282 Merrimack Street, 2nd Floor
Lawrence, MA 01843
978.794.1792
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Create | Design | Innovate

Project: King Street Commons
Location: 550 King Street, Littleton, MA 01460

Client: 550 King Street, LLC
Address: 290 Merrimack Street, Lawrence, MA 01843

Date: 12/21/2023 **Wetlands:** 150'+ **Zone II:** 310'+ **Soil Symbol:** 626B **Soil Name:** Merrimac-Urban land Complex **Soil Class:** A

Test Pit: TP-1 **Elevation:** 259.5

Depth	Soil Horizon	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Soil Texture	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-48"	Fill	-	-	-	-	-	-	-	-	-	Pipes, bricks, stone curbs, and stones
48-102"	2C	10YR 5/4	-	-	-	Gravely Sand	35	20	SG	Loose	-

Parent Material: Loamy glaciofluvial deposits **Depth to Bedrock:** - **Standing Water:** 96" **ESHGW:** -

Additional Notes:

Test Pit Performed by: William Burnham, E.I.T. **Soil Evaluator Number:** 14752

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Project: King Street Commons
Location: 550 King Street, Littleton, MA 01460

Client: 550 King Street, LLC
Address: 290 Merrimack Street, Lawrence, MA 01843

Date: 12/21/2023 **Wetlands:** 115'+ **Zone II:** 260'+ **Soil Symbol:** 626B **Soil Name:** Merrimac-Urban land Complex **Soil Class:** A

Test Pit: TP-2 **Elevation:** 257

Depth	Soil Horizon	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Soil Texture	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-48"	Fill	-	-	-	-	-	-	-	-	-	Gravel, Sand, Stones, and Ash
48-50"	Apb	10YR 2/1	-	-	-	Sandy Loam	5	-	Massive	Friable	-
50-57"	Bw	10YR 3/6	-	-	-	Sandy Loam	10	-	Massive	Friable	-
57-96"	2C	10YR 5/4	-	-	-	Gravely Sand	35	20	SG	Loose	Large Stones

Parent Material: Loamy glaciofluvial deposits **Depth to Bedrock:** - **Standing Water:** 93" **ESHGW:** -

Additional Notes:

Test Pit Performed by: William Burnham, E.I.T. **Soil Evaluator Number:** 14752

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Project: King Street Commons
Location: 550 King Street, Littleton, MA 01460

Client: 550 King Street, LLC
Address: 290 Merrimack Street, Lawrence, MA 01843

Date: 12/21/2023 **Wetlands:** 135'+ **Zone II:** 200'+ **Soil Symbol:** 626B **Soil Name:** Merrimac-Urban land Complex **Soil Class:** A

Test Pit: TP-3 **Elevation:** 260.5

Depth	Soil Horizon	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Soil Texture	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-8"	Fill 1	-	-	-	-	-	-	-	-	-	Topsoil material
8-108"	Fill 2	10YR 8/4	-	-	-	Sand	10	-	SG	Loose	See add. notes

Parent Material: Loamy glaciofluvial deposits **Depth to Bedrock:** - **Standing Water:** - **ESHGW:** Not encountered

Additional Notes: Sand (Fill 2) collaprisng around excavation, with no water observed. Test pit located approximately 50' away from existing leach field.

Test Pit Performed by: William Burnham, E.I.T. **Soil Evaluator Number:** 14752

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Project: King Street Commons
Location: 550 King Street, Littleton, MA 01460

Client: 550 King Street, LLC
Address: 290 Merrimack Street, Lawrence, MA 01843

Date: 12/21/2023 **Wetlands:** 190'+ **Zone II:** 180'+ **Soil Symbol:** 656 **Soil Name:** Udorthents-Urban land Complex **Soil Class:** -

Test Pit: TP-4 **Elevation:** 262

Depth	Soil Horizon	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Soil Texture	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-42"	Fill 1	-	-	-	-	-	-	-	-	-	Topsoil material
42-102"	Fill 2	10YR 8/4	-	-	-	Sand	5	-	SG	Loose	See add. notes

Parent Material: Loamy alluvium & glaciofluvial deposits **Depth to Bedrock:** - **Standing Water:** - **ESHGW:** Not encountered

Additional Notes: Sand (Fill 2) collaprisng around excavation, with no water observed. Test pit located approximately 30' away from existing leach field.

Test Pit Performed by: William Burnham, E.I.T. **Soil Evaluator Number:** 14752

Project: King Street Commons
Location: 550 King Street, Littleton, MA 01460

Client: 550 King Street, LLC
Address: 290 Merrimack Street, Lawrence, MA 01843

Date: 12/21/2023 **Wetlands:** 235'+ **Zone II:** 180'+ **Soil Symbol:** 656 **Soil Name:** Udorthents-Urban land Complex **Soil Class:** -

Test Pit: TP-5 **Elevation:** 262

Depth	Soil Horizon	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Soil Texture	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-10"	Fill 1	-	-	-	-	-	-	-	-	-	Topsoil material
10-102"	Fill 2	10YR 4/3	-	-	-	Sand	30	10	SG	Loose	Gravel, stones, bricks, and filter fabric

Parent Material: Loamy alluvium & glaciofluvial deposits **Depth to Bedrock:** - **Standing Water:** - **ESHGW:** 72"

Additional Notes: Filter fabric present at 72", with water seeping at all sides of filter fabric "layer". Majority of fill 2 material comprised on sand material. Test Pit Located appoximately 100' from existing leach field.

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Project: King Street Commons
Location: 550 King Street, Littleton, MA 01460

Client: 550 King Street, LLC
Address: 290 Merrimack Street, Lawrence, MA 01843

Date: 12/21/2023 **Wetlands:** 350'+ **Zone II:** 500'+ **Soil Symbol:** 656 **Soil Name:** Udorthents-Urban land Complex **Soil Class:** -

Test Pit: TP-6 **Elevation:** 267.5

Depth	Soil Horizon	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Soil Texture	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-25"	Fill	-	-	-	-	-	-	-	-	-	Topsoil material
25-29"	Apb	10YR 2/1	-	-	-	Loamy Sand	5	-	Massive	Friable	-
29-37"	Bw	10YR 3/6	-	-	-	Loamy Sand	10	5	Massive	Friable	-
37-78"	2C	10YR 5/4	60"	7.5YR 6/8	10	Gravely Sand	40	10	SG	Loose	Very Gravely

Parent Material: Loamy alluvium & glaciofluvial deposits **Depth to Bedrock:** - **Standing Water:** 70" **ESHGW:** 60"

Additional Notes: Redoximorphic features present at 60"

Test Pit Performed by: William Burnham, E.I.T. **Soil Evaluator Number:** 14752

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Project: King Street Commons
Location: 550 King Street, Littleton, MA 01460

Client: 550 King Street, LLC
Address: 290 Merrimack Street, Lawrence, MA 01843

Date: 12/21/2023 **Wetlands:** 720'+ **Zone II:** 800'+ **Soil Symbol:** 310B **Soil Name:** Woodbridge fine sandy loam **Soil Class:** C/D

Test Pit: TP-7 **Elevation:** 284

Depth	Soil Horizon	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Soil Texture	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-114"	Fill	-	-	-	-	-	-	-	-	-	See add. notes

Parent Material: Coarse-loamy lodgement till **Depth to Bedrock:** - **Standing Water:** 112" **ESHGW:** -

Additional Notes: Fill material made up of topsoil, stones, brick, branches, trash, and gravel.

Test Pit Performed by: William Burnham, E.I.T. **Soil Evaluator Number:** 14752

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Project: King Street Commons
Location: 550 King Street, Littleton, MA 01460

Client: 550 King Street, LLC
Address: 290 Merrimack Street, Lawrence, MA 01843

Date: 1/3/2024 **Wetlands:** 730'+ **Zone II:** 850'+ **Soil Symbol:** 310B **Soil Name:** Woodbridge fine sandy loam **Soil Class:** C/D

Test Pit: TP-8 **Elevation:** 280

Depth	Soil Horizon	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Soil Texture	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-6"	Fill 1	-	-	-	-	-	-	-	-	-	Topsoil material
6-24"	Fill 2	-	-	-	-	-	-	-	-	-	Dense material
24-44"	Apb	10YR 2/1	-	-	-	Loamy Sand	10	-	Massive	Friable	See add. notes
44-52"	Bw	10YR 4/6	-	-	-	Gravely Sand	30	10	SG	Loose	-
52-120"	Cd	10YR 4/4	-	-	-	Gravely Sand	30	40	SG	Loose	-

Parent Material: Coarse-loamy lodgement till **Depth to Bedrock:** - **Standing Water:** - **ESHGW:** Not encountered

Additional Notes: No signs of redoximorphic features within test pit. Dense layer (Cd) contained large bolders/stones. Apb layer contained a mixture of "natural" A-layer soil with topsoil fill material (similar to Fill 1).

Test Pit Performed by: William Burnham, E.I.T. **Soil Evaluator Number:** 14752

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Project: King Street Commons
Location: 550 King Street, Littleton, MA 01460

Client: 550 King Street, LLC
Address: 290 Merrimack Street, Lawrence, MA 01843

Date: 1/3/2024 **Wetlands:** 770'+ **Zone II:** 900'+ **Soil Symbol:** 310B **Soil Name:** Woodbridge fine sandy loam **Soil Class:** C/D

Test Pit: TP-9 **Elevation:** 279.5

Depth	Soil Horizon	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Soil Texture	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-6"	Fill 1	-	-	-	-	-	-	-	-	-	Topsoil material
6-54"	Fill 2	-	-	-	-	-	-	-	-	-	See add. notes
54-102"	Cd	10YR 4/4	58"	10YR 8/3	50	Gravely Sand	50	30	SG	Loose	-

Parent Material: Coarse-loamy lodgement till **Depth to Bedrock:** 102" **Standing Water:** - **ESHGW:** 58"

Additional Notes: Fill 2 contained large boulders and dense material. Dense, bedrock-like material reached at 102". Large gray depleations observed between 58-64", with the color of the depleations noted above.

Test Pit Performed by: William Burnham, E.I.T. **Soil Evaluator Number:** 14752

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Project: King Street Commons
Location: 550 King Street, Littleton, MA 01460

Client: 550 King Street, LLC
Address: 290 Merrimack Street, Lawrence, MA 01843

Date: 1/3/2024 **Wetlands:** 800'+ **Zone II:** 950'+ **Soil Symbol:** 310B **Soil Name:** Woodbridge fine sandy loam **Soil Class:** C/D

Test Pit: TP-10 **Elevation:** 277

Depth	Soil Horizon	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Soil Texture	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-8"	Ap	10YR 2/2	-	-	-	Loamy Sand	10	-	Massive	Friable	-
8-30"	Bw	10YR 5/4	-	-	-	Loamy Sand	20	-	Massive	Friable	-
30-84"	C	10YR 6/3	42"	10YR 5/6	5	Sand	30	20	SG	Loose	See add. notes

Parent Material: Coarse-loamy lodgement till **Depth to Bedrock:** - **Standing Water:** - **ESHGW:** 42"

Additional Notes: C horizon contained gravel, fine sand, and cobbles/stones. Sand collapsing around bottom of test pit. Thin redoximorpic feature line observed within C horizon.

Test Pit Performed by: William Burnham, E.I.T. **Soil Evaluator Number:** 14752

Project: King Street Commons
Location: 550 King Street, Littleton, MA 01460

Client: 550 King Street, LLC
Address: 290 Merrimack Street, Lawrence, MA 01843

Date: 1/3/2024 **Wetlands:** 850'+ **Zone II:** 1000'+ **Soil Symbol:** 310B **Soil Name:** Woodbridge fine sandy loam **Soil Class:** C/D

Test Pit: TP-11 **Elevation:** 277

Depth	Soil Horizon	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Soil Texture	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-6"	Fill 1	-	-	-	-	-	-	-	-	-	Topsoil material
6-36"	Fill 2	-	-	-	-	-	-	-	-	-	See add. notes
36-102"	Cd	10YR 6/3	42"	5YR 4/6	10	Gravely Sand	40	30	SG	Loose	See add. notes

Parent Material: Coarse-loamy lodgement till **Depth to Bedrock:** 102" **Standing Water:** - **ESHGW:** 42"

Additional Notes: Fill 2 contained sandy fill with organics present. Cd horizon contained large stones, gravel, and sand. Dense material located across bottom of test pit, with sandy collapsing in at bottom of test pit. Small amounts of trash present within Fill 1 material.

Test Pit Performed by: William Burnham, E.I.T. **Soil Evaluator Number:** 14752

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Project: King Street Commons
Location: 550 King Street, Littleton, MA 01460

Client: 550 King Street, LLC
Address: 290 Merrimack Street, Lawrence, MA 01843

Date: 12/21/2023 **Wetlands:** 910'+ **Zone II:** 930'+ **Soil Symbol:** 622C **Soil Name:** Paxton-Urban land complex **Soil Class:** C

Test Pit: TP-12 **Elevation:** 289.5

Depth	Soil Horizon	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Soil Texture	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-24"	Fill	-	-	-	-	-	-	-	-	-	Topsoil material
24"-90"	Cd	10YR 5/4	-	-	-	Sandy Loam	50	20	Massive	friable	-

Parent Material: Coarse-loamy lodgement till **Depth to Bedrock:** - **Standing Water:** 88" **ESHGW:** 46"

Additional Notes: TP-12 approximately 20' off parking lot corner, and 15' from fence line. Water observed seeping from sidewall at 46"

Test Pit Performed by: William Burnham, E.I.T. **Soil Evaluator Number:** 14752

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Project: King Street Commons
Location: 550 King Street, Littleton, MA 01460

Client: 550 King Street, LLC
Address: 290 Merrimack Street, Lawrence, MA 01843

Date: 1/3/2024 **Wetlands:** 950'+ **Zone II:** 1000'+ **Soil Symbol:** 656 **Soil Name:** Udorthents-Urban land Complex **Soil Class:** -

Test Pit: TP-13 **Elevation:** 289

Depth	Soil Horizon	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Soil Texture	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-10"	Fill	-	-	-	-	-	-	-	-	-	Topsoil Material
10-90"	Cd	2.5Y 4/2	-	-	-	Gravely Sandy Loam	50	10	Massive	Firm	See add. notes

Parent Material: Loamy alluvium & glaciofluvial deposits **Depth to Bedrock:** - **Standing Water:** - **ESHGW:** Not encountered

Additional Notes: Side slopes of test pit started to collapse at bottom of excavation. Cd horizon contained dense, gravel filled soil.

Test Pit Performed by: William Burnham, E.I.T. **Soil Evaluator Number:** 14752

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Project: King Street Commons
Location: 550 King Street, Littleton, MA 01460

Client: 550 King Street, LLC
Address: 290 Merrimack Street, Lawrence, MA 01843

Date: 1/3/2024 **Wetlands:** 350'+ **Zone II:** 1000'+ **Soil Symbol:** 656 **Soil Name:** Udorthents-Urban land Complex **Soil Class:** -

Test Pit: TP-14 **Elevation:** 287.5

Depth	Soil Horizon	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Soil Texture	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-14"	Fill 1	-	-	-	-	-	-	-	-	-	Topsoil material
14-36"	Fill 2	-	-	-	-	-	-	-	-	-	See add. notes
36-40"	Apb	10YR 2/2	-	-	-	Loamy Sand	5	-	Massive	Friable	-
40-108"	C	10YR 4/4	44"	5YR 5/8	10	Sand	20	5	SG	Loose	-

Parent Material: Loamy alluvium & glaciofluvial deposits **Depth to Bedrock:** - **Standing Water:** - **ESHGW:** 44"

Additional Notes: Fill 2 contains organic material, trash, old pipes, and stones. Redoximorphic features observed just below the Apb horizon.

Test Pit Performed by: William Burnham, E.I.T. **Soil Evaluator Number:** 14752

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Project: King Street Commons
Location: 550 King Street, Littleton, MA 01460

Client: 550 King Street, LLC
Address: 290 Merrimack Street, Lawrence, MA 01843

Date: 1/3/2024 **Wetlands:** 300'+ **Zone II:** 1000'+ **Soil Symbol:** 656 **Soil Name:** Udorthents-Urban land Complex **Soil Class:** -

Test Pit: TP-15 **Elevation:** 282

Depth	Soil Horizon	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Soil Texture	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-12"	Ap	10YR 2/1	-	-	-	Loamy Sand	5	-	Massive	Friable	-
12-30"	Bw	7.5YR 4/6	-	-	-	Loamy Sand	10	-	Massive	Friable	-
30-84"	C	10YR 4/4	48"	5YR 4/6	5	Gravely Sand	40	10	Massive	Friable	-

Parent Material: Loamy alluvium & glaciofluvial deposits **Depth to Bedrock:** - **Standing Water:** 82" **ESHGW:** 48"

Additional Notes: Water was observed seeping at approximately 54".

Test Pit Performed by: William Burnham, E.I.T. **Soil Evaluator Number:** 14752

G

Construction Period Pollution Prevention Plan

G. CONSTRUCTION PERIOD POLLUTION PREVENTION PLAN

King Street Common

550 King Street & 410 Great Road
Littleton, Massachusetts 01460

Prepared For: Lupoli Companies, LLC
280 Merrimack Street
Lawrence, MA 01843

Prepared By: TEC, Inc.
282 Merrimack Street, 2nd Floor
Lawrence, MA 01843

April 7, 2025

CONSTRUCTION PERIOD POLLUTION PREVENTION AND EROSION AND SEDIMENTATION CONTROL PLAN
April 7, 2025

Name of Applicant:	**Lupoli Companies, LLC**
Name of Facility:	**King Street Common**
Location:	**550 King Street & 410 Great Road, Littleton, MA**

Good Housekeeping BMPs

Minimize the potential for contaminants to enter or runoff the site during construction activities. Fuel and other equipment fluids will be properly stored. The Contractor shall establish secure storage areas that collect any spillage to meet requirements of the Town of Littleton Fire Department regarding the storage of flammable materials. The Contractor shall complete and submit the plans to the Engineer.

General Requirements
The following presents a proactive approach to all of the best management practices, erosion and sedimentation controls, mitigation measures, and monitoring activities for this Project.

Compost Filter Tube
Compost filter tubes are used as temporary erosion control where construction activities will disturb existing surfaces. They will be installed at the Project limit of work, along the downgradient slopes, upgradient from any resource areas (if applicable), and wherever shown on the proposed approved erosion control plan. When installed correctly and inspected frequently, compost filter tubes can be an effective barrier to sediment leaving the site in stormwater runoff.

Storm Drain Inlet Protection
Storm drain inlet protection measures prevent soil and debris from entering storm drain inlets. It is known that existing inlet protection devices are currently installed prior to the demolition of the former Littleton Police Station. Contractor shall inspect the existing inlet protection devices and replace or install new devices, if needed, to the drain inlets shown on the approved erosion control plan prior to the start of the King Street Common project. Storm drain inlet protection will be installed at all downgradient catch basins adjacent to the project site outside the protection of other erosion control barriers, including to the proposed locations shown on the approved erosion control plan and at low points within the construction site that are connected to the storm drainage system.

Temporary Seeding and Slope Stabilization
Seeding shall be used to temporarily stabilize areas that will not be brought to final grade for a period of more than 30 working days and to stabilize disturbed areas before final grading or in a season not suitable for permanent seeding. Stabilization of open soil surfaces will be implemented within 14 days after grading or construction activities have temporarily or permanently ceased, unless there is sufficient snow cover to prohibit implementation. Vegetative slope stabilization will be used to minimize erosion on slopes of 3:1 or steeper. Annual grasses, such as annual rye, will be used to ensure rapid germination and production of root mass. Permanent stabilization will be completed with the planting of perennial grasses or legumes. Establishment of temporary and permanent vegetative cover may be established by hydroseeding or sodding. A suitable topsoil, good seedbed preparation and adequate lime, fertilizer, and water will be provided for effective establishment of these vegetative stabilization methods. Root systems restrain the soils so that they are less apt to be dislodged and carried offsite by stormwater runoff or wind. Temporary

seeding also reduces the problems associated with mud and dust from bare soil surfaces during construction. Mulch will also be used after permanent seeding to protect soil from the impact of falling rain and to increase the capacity of the soil to absorb water.

General Maintenance
Refer to the Maintenance/Evaluation Checklist (at the end of this section) identifying inspection and maintenance measures for each specific practice.

The contractor or subcontractor will be responsible for implementing each control shown on the Approved Plans and mentioned in the Construction Period Pollution Prevention Plan (CPPP Plan). In accordance with EPA regulations, the contractor must sign a copy of a certification to verify that a plan has been prepared and that permit regulations are understood.

The onsite contractor will inspect all sediment and erosion control structures weekly and after each major rainfall event (0.5" or greater).
Records of the inspections will be prepared and maintained onsite by the contractor as required by the Plan.

- Silt shall be removed from behind barriers if half-way from the top of the erosion control device or as needed.
- Damaged or deteriorated items will be repaired/replaced immediately after identification.
- Sediment that is collected in structures shall be disposed of properly.
- At a minimum establish good housekeeping BMPs for:

    - Material handling and waste management
    - Vehicle staging areas
    - Equipment vehicle fueling and maintenance
    - Spill prevention and control

Erosion control structures shall remain in place until all disturbed earth has been securely stabilized. After removal of structures, disturbed areas shall be regraded and stabilized as necessary.

Spill Prevention and Control

The Contractor will actively maintain and manage the site activities with the procedures outlined in this CPPP Plan. In the event of petroleum or other deleterious substance spill, action will be taken by the Contractor to contain and remove the spill. The Contractor will comply with the relevant section(s) of the Oil Pollution Prevention Act, 40 CFR 112.7.

Responsibility
All project personnel share the responsibility for the initial control and reporting of the oil and other substance spill, especially the personnel that first discover the spill. The Site Safety and Health Officer (SSHO) will be responsible for determining the necessary safety equipment and for establishing safety practices to be followed by the Contractor during the clean-up operations. All personnel will be trained in the use of and location of this equipment, prior to the commencement of the construction.

The Contractor's goal is to provide effective, efficient, and coordinated action to minimize or mitigate damages to the environment and public health and welfare from oil or other substance discharges, conforming to applicable federal, state, and local regulations, as well as other provisions and restrictions. In the event of spills or releases that may occur during the Project, a representative on-site qualified by OSHA training requirements (29 CFR 1910.120) for a Level 3 Hazmat Technician will be provided and will have the responsibility and authority for supervising the cleanup. If the representative determines that the cleanup operations are beyond the capacity of the Contractor, assistance shall be requested from its Subcontractor.

In the event of an emergency spill, the Contractor will be responsible for retaining the environmental Subcontractor. The selected environmental subcontractor will develop a Hazardous Materials Health and Safety Plan, which will be referenced when a spill or release is discovered, and the control of the spill or release is beyond the scope of the Spill Prevention Control and Countermeasure plan. The Contractor's Project Manager is responsible for giving the SSHO directions for initiating the Hazardous Materials Health and Safety Plan.

Alert and reporting procedures will become effective immediately upon observance and indication of a spill or discharge of oil or other substances on the project.

Reportable observations are:

1. Leaks or spills
2. Soils which are discolored or have an odor
3. Discharge of oil or other similar substances from drain pipes

The Engineer will be informed immediately of all substantial spills, releases, or other substance discharges. All telephone numbers for the Emergency Response agencies will be posted on site. The Contractor or its Subcontractors will implement control and countermeasures immediately.

Fuel and Oil Delivery Trucks

The equipment superintendent or designee will monitor all truck unloading procedures to verify all hoses are tight and do not leak, and if necessary, will tighten, adjust, or replace them to prevent a release of any kind. In the event of a major spill, alert and initial report procedures will be implemented, and an emergency response contractor will be called in to perform the cleanup.

Equipment

Motorized equipment that require fuel and oil to operate will be inspected prior to the start of each work shift by the operator (in the field) to ensure there is no leakage of oil, fuel, or other material. Trucks will be inspected prior to use for potential leaks or drips. If a leak is found, repairs will be made immediately, and spillage will be cleaned up manually using sorbent material. Vehicles that are found to be leaking will be immediately taken out of service until repairs can be made.

Drum Storage

Drum storage, if any, will be located in a secure area within the Project limits away from environmental areas of concern. Petroleum liquids and other substances stored in drums will be kept in a drum container that consists of a drum rack and drip containment pan that is capable of containing 110% of the stored volume should the drum rupture.

Lubrication / Oil Maintenance

Replacement lubrication will be directly deposited from the lubrication truck to the equipment lubrication reservoir. No other container system will be used to transport oil to the equipment. Mobile equipment will be serviced off site or in the lay-down area. Equipment that cannot be moved will be serviced in the field. The Contractor will place a containment pan or absorbent below the service area prior to initiating service activities in the field. Waste disposal will be completed by the Contractor or by a waste disposal firm. Miscellaneous lubricants for operating equipment will be limited to daily quantities.

Spent Oil
Oil that has already been used on the job will be disposed of via a certified waste disposal firm. Spent oil will be stored in a labeled (hazardous waste signs) and vented fuel storage cell located at the staging area awaiting disposal by a certified waste disposal firm (i.e. Enpro, Inc.). The staging area will be located within the boundary of the project and inspected daily for leaks or spills. The storage cell will be bermed to contain 110% of the largest container or 10% of the total volume in storage, whichever is greater.

Special Oil Spill Equipment

Sorbent Pads
Sorbent pads will be available to absorb oil and petroleum compounds. If necessary, the pads will be used to absorb oil spills or leaks by placing them on the oil and giving them adequate time to absorb it. The sorbent pads will be stored in equipment box located in the maintenance area. The pads shall float and be water repellent, so they can absorb oil on water. Saturated/contaminated pads will be placed in an appropriate container and stored within the maintenance area. A certified waste disposal firm will dispose of the approved containers.

Sorbent Compound
The compound will be used for contaminants spilled on decks or hard surfaces. In most cases, it can be applied directly to spills, but if the spill is large, it can be used to form a dike around the spill to prevent further migration.

Best Management Practices – Maintenance/Evaluation Checklist Construction Practices
550 King Street & 410 Great Road, Littleton, Massachusetts, 01460

Best Management Practices:	Inspection Frequency:	Date Inspected and Inspector:	Minimum Maintenance and Key Items to Check:	Cleaning/Repair Needed: ☐YES | ☐NO List Items:	Date of Cleaning / Repair:	Performed By:
Compost Filter Tube	Inspect once a week and after each rain event		Silt shall be removed from the compost filter tube if reaches half-way from the top of tube and as needed. The underside of tube should be laid in close contact with the earth and reset as necessary.			
Silt Sacks	Inspect once a week and after each rain event		Remove accumulated sediment when capacity is reduced to half.			
Temporary Seeding and Slopes	Inspect once a week and after each rain event		Seeding shall be used to temporarily stabilize areas that will not be brought to final grade for a period of more than 30 working days and to stabilize disturbed areas before final grading or in a season not suitable for permanent seeding. Stabilization of open soil surfaces will be implemented within 14 days after grading or construction activities have temporarily or permanently ceased, unless there is sufficient snow cover to prohibit implementation.			

H

Operations & Maintenance Plan

H. OPERATIONS AND MAINTENANCE PLAN

King Street Common
550 King Street & 410 Great Road
Littleton, Massachusetts 01460

Prepared For: Lupoli Companies, LLC
280 Merrimack Street
Lawrence, MA 01843

Prepared By: TEC, Inc.
282 Merrimack Street, 2nd Floor
Lawrence, MA, 01843

TEC The Engineering Corp

April 7, 2025

Stormwater Management Operation and Maintenance Plan
April 7, 2025

Name of Applicant: **Lupoli Companies, LLC**
Name of Facility: **King Street Common**
Location: **550 King Street & 410 Great Road, Littleton, MA**

A detailed, written log of all scheduled preventative and corrective maintenance performed for the stormwater management measures must be kept on site, including a record of all inspections and copies of maintenance-related work orders.

A record of regularly scheduled inspection and maintenance items is outlined as shown in the **"Inspection and Maintenance Checklist"**. Maintenance required and actions taken shall be recorded in the **"Inspection and Maintenance Log"**. The funding, operation, and maintenance of all stormwater management Best Management Practices (BMPs) shall be provided by the Town of Dedham.

Maintenance routine and schedule:

- Routine inspections will be conducted on a monthly basis and thorough investigations will be conducted twice a year. Tasks that are common to all systems include regular removal of accumulated sediments, floatables and debris. Inspections will occur after every major storm event for the first six (6) months after construction. Inspections will be conducted by a Professional Engineer registered in the Commonwealth of Massachusetts experienced in drainage design.

Annual reports will be prepared detailing the status of the stormwater system and the maintenance performed. A copy of the annual report will be sent to the Town of Littleton, if requested.

The owner agrees to comply with a minimum maintenance schedule as follows:

1. **Monthly inspection for damaged or clogged catch basins and area drains. Annual cleaning of existing catch basins and proposed area drains:**

   Inlet grates shall be inspected and cleared from debris to maintain inlet capacity on a monthly basis and done as needed.

   Sumps and inlets shall be cleaned once per year and inspected on a monthly basis for excess of sediment (12" or greater), floatable trash, debris, and oil. If such items exists, sumps and inlets shall be cleaned as needed. All sediments shall be properly handled and disposed of in accordance with local, state, and federal guidelines and regulations.

2. **Inspection and cleaning of drainage pipes/subdrains, drainage manholes, and cleanouts:**

   Drainage pipes and cleanout structures shall be inspected and cleaned of sediment at least every five (5) years or as required to maintain adequate functionality of the stormwater conveyance system. All sediments shall be properly handled and disposed of in accordance with local, state, and federal guidelines and regulations.

3. **Subsurface Infiltration Basins:**

   The subsurface infiltration basin inlets, outlets, and inspection ports shall be inspected at a minimum twice per year, and after every major storm event. Basins equipped with an Isolator Row Plus shall be inspected and maintained in accordance with the attached manufacturer's instruction. CMP infiltration systems shall be inspected and maintained in accordance with the applicable manufacturer's directions. Sediment shall be removed at a minimum annually.

4. Bioretention Areas and Rain Gardens:

As a minimum, the stormwater BMPs will be inspected monthly and after every major storm event (greater than 0.5" and for only the first six (6) months) to ensure functionality, inspect for erosion, and to remove litter and debris. At least twice during growing seasons, the BMPs side slopes, embankments, and drain inlets will be cleared of accumulated sediment and overgrown vegetation. Drain inlets should have debris removed to maintain consistent release velocities. Dead vegetation should be removed and replaced in the fall of spring each year. Invasive species should be removed as needed to prevent these species from spreading into the BMPs. Replace mulch every two years, in the early spring, and replace entire media and all vegetation as needed in the late spring or early summer.

5. Water Quality Unit (CDS & Cascade Units):

Water quality unit shall be monitored on a regular basis per the manufacturer's specifications. The water quality shall be cleaned bi-annually, or in accordance with manufacturer specifications, and clear from any sediment, floatable trash, debris, and oil.

6. Grass Landscaping:

The grass landscaping and plantings will be inspected after every major storm event for the two (2) months after seeding to ensure functionality. Thereafter, inspections should take place every six (6) months in the spring and fall and after severe storm events. Grass and mulched landscaping showing signs of wear and erosion will be re-loamed/re- seeded or re-mulched as necessary to prevent further erosion from taking place.

7. Snow Removal:

Snow will be stored within the landscape areas, but not near or within the Bioretention Area, Rain Garden, and/or along the pervious pavement. During large storm events, snow shall be removed offsite.

<u>The Long-Term Pollution Prevention Plan</u>

The Applicant agrees to comply with the following Long-Term Pollution Prevention Plan to ensure long-term stormwater quality discharge from the site:

Good Housekeeping Practices:

The project will be maintained by the owner, including snow removal, de-icing, and BMP inspection and maintenance.

Provisions for storing materials and waste products inside or under covers:

Not Applicable

Vehicle Washing Controls:

Vehicle washing is not anticipated as a reasonably foreseeable use within the Town Green.

Requirements for routine inspections and maintenance of stormwater BMPs:

The owner will be responsible for providing the necessary inspections and maintenance for the stormwater BMPs.

Spill prevention and response plans:

The Applicant will be responsible for informing neighboring abutters on the emergency spill. The Applicant will follow proper spill prevention control and response procedures should a spill occur on the pavement surface. Proper spill control products, such as a granular dry absorbent shall be used.

A spill of greater than 10 gallons of oil or a spill of any quantity that has reached a surface water or into a sewer/drainage system, must be immediately reported, and if needed be reported to the state or federal authority. In the event of a hazardous waste spill on-site, the following protocol should be followed:

- If there is a potentially flammable, toxic, or explosive condition, evacuate the vicinity of the spill.
- If it's believed that a reportable or dangerous condition exists, immediately call the Littleton Fire Department to notify them of the release.
- If it is believed that a reportable condition exists, immediately call the Massachusetts Department of Environmental Protection (DEP) to notify them of the release. Call the DEP Emergency Response Section toll free statewide number, 1-888-304-1133. Be prepared to provide the following information to the DEP and Dedham Fire Department:
    - Identity of the caller
    - Contact phone number
    - Location of the spill
    - Type of product spilled
    - Approximate quantity or product spilled
    - Extent of actual and/or potential water pollution
    - Date and time of spill

Provisions for maintenance of landscaped areas:

The Applicant will maintain the landscaped areas.

Requirements for storage and use of fertilizers, herbicides, and pesticides:

There would be no foreseeable need for storage fertilizers, herbicides, and pesticides. The use of fertilizers, herbicides, pesticides shall be decided by the Applicant at their discretion.

Pet waste management provisions:

Not Applicable.

Provisions for operation and management of septic systems:

Not Applicable.

Provision for solid waste and industrial materials management:

Not Applicable

Snow disposal and plowing plans related to Wetland Resource Areas:

Not Applicable.

Winter Road Salt and/or Sand use and Storage restrictions:

There would be no foreseeable need for storage of salt and/or sand. The use for salt and/or sand shall be safe to use on concrete surfaces.

Street sweeping schedules:

Street sweeping is encouraged, but not applicable to this site.

Provisions for prevention of illicit discharges to the stormwater management system:

Only stormwater is proposed to be conveyed through the stormwater management system. No illicit materials will be permitted.

Documentation that Stormwater BMPs are designed to provide for shutdown and containment *in the event of a spill or discharges to or near critical areas or from LUHPPL:*

Not Applicable.

Training staff/personnel to implement the Long-Term Pollution Prevention Plan:

The Applicant shall provide training to staff members to implement the contents and requirements of the Stormwater Operation and Maintenance Plan and the LTPPP.

List of Emergency contacts for implementing Long-Term Pollution Prevention Plan:

Lupoli Companies, LLC (978) 681-7777

INSPECTION AND MAINTENANCE CHECKLIST

King Street Common

For Year: _________

	Inspection Item[1]	Inspection Frequency* Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
1	Catch Basin and Area Drain												
2	Drainage Pipes, Manholes, & Cleanouts	at least every 5 years or as needed.											
3	Subsurface Infiltration Basins	Refer to Maintenance Guide											
4	Bioretention Area & Rain Garden	Every month and after major storm events											
5	Water Quality Unit												
6	Grass Landscaping												

	Maintenance Item[1]	Maintenance Frequency* Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
1	Catch Basin and Area Drain												
2	Drainage Pipes, Manholes, & Cleanouts	at least every 5 years or as needed.											
3	Subsurface Infiltration Basins	Refer to Maintenance Guide											
4	Bioretention Area & Rain Garden												
5	Water Quality Unit												
6	Grass Landscaping												

1. Refer to the description for all items noted within the "Inspection and Maintenance Checklist".

Name of Applicant: **Lupoli Companies, LLC**
Name of Facility: **King Street Common**
Location: **550 King Street and 410 Great Road, Littleton, MA**

Inspection and Maintenance Log

Inspection No.	Date	Inspections Performed	Maintenance Actions Taken
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			

*Additional Sheets shall be added as needed.

Isolator® Row Plus
O&M Manual

ADS StormTech™

The Isolator® Row Plus

Introduction

An important component of any Stormwater Pollution Prevention Plan is inspection and maintenance. The StormTech Isolator Row Plus is a technique to inexpensively enhance Total Suspended Solids (TSS), Total Phosphorus (TP), Total Petroluem Hydrocarbons (TPH) and Total Nitrogen (TN) removal with easy access for inspection and maintenance.

The Isolator Row Plus

The Isolator Row Plus is a row of StormTech chambers, either SC-160, SC-310, SC-310-3, SC-740, DC-780, SC-800, MC-3500, MC-4500 or MC-7200 models, are lined with filter fabric and connected to a closely located manhole for easy access. The fabric lined chambers provide for sediment settling and filtration as stormwater rises in the Isolator Row Plus and passes through the filter fabric. The open bottom chambers allow stormwater to flow vertically out of the chambers. Sediments are captured in the Isolator Row Plus protecting the adjacent stone and chambers storage areas from sediment accumulation.

ADS Isolator Row and Plus fabric are placed between the stone and the Isolator Row Plus chambers. The woven geotextile provides a media for stormwater filtration, a durable surface for maintenance, prevents scour of the underlying stone and remains intact during high pressure jetting.

The Isolator Row Plus is designed to capture the "first flush" runoff and offers the versatility to be sized on a volume basis or a flow-rate basis. An upstream manhole provides access to the Isolator Row Plus and includes a high/low concept such that stormwater flow rates or volumes that exceed the capacity of the Isolator Row Plus bypass through a manifold to the other chambers. This is achieved with an elevated bypass manifold or a high-flow weir. This creates a differential between the Isolator Row Plus row of chambers and the manifold to the rest of the system, thus allowing for settlement time in the Isolator Row Plus. After Stormwater flows through the Isolator Row Plus and into the rest of the chamber system it is either exfiltrated into the soils below or passed at a controlled rate through an outlet manifold and outlet control structure.

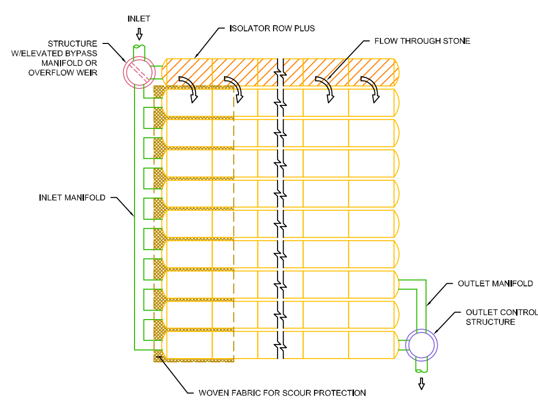
The Isolator Row Plus Flamp™ is a flared end ramp apparatus attached to the inlet pipe on the inside of the chamber end cap. The FLAMP provides a smooth transition from pipe invert to fabric bottom. It is configured to improve chamber function performance by enhancing outflow of solid debris that would otherwise collect at the chamber's end, or more difficult to remove and require confined space entry into the chamber area. It also serves to improve the fluid and solid flow into the access pipe during maintenance and cleaning and to guide cleaning and inspection equipment back into the inlet pipe when complete.

The Isolator Row Plus may be part of a treatment train system. The treatment train design and pretreatment device selection by the design engineer is often driven by regulatory requirements. Whether pretreatment is used or not, StormTech recommend using the Isolator Row Plus to minimize maintenance requirements and maintenance costs.

Note: *See the StormTech Design Manual for detailed information on designing inlets for a StormTech system, including the Isolator Row Plus.*

Looking down the Isolator Row Plus from the manhole opening, ADS Plus Fabric is shown between the chamber and stone base.

StormTech Isolator Row Plus with Overflow Structure (not to scale)



Isolator Row Plus Inspection/Maintenance

Inspection

The frequency of inspection and maintenance varies by location. A routine inspection schedule needs to be established for each individual location based upon site specific variables. The type of land use (i.e. industrial, commercial, residential), anticipated pollutant load, percent imperviousness, climate, etc. all play a critical role in determining the actual frequency of inspection and maintenance practices.

At a minimum, StormTech recommends annual inspections. Initially, the Isolator Row Plus should be inspected every 6 months for the first year of operation. For subsequent years, the inspection should be adjusted based upon previous observation of sediment deposition.

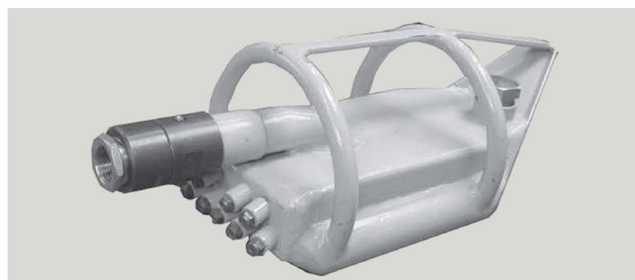
The Isolator Row Plus incorporates a combination of standard manhole(s) and strategically located inspection ports (as needed). The inspection ports allow for easy access to the system from the surface, eliminating the need to perform a confined space entry for inspection purposes.

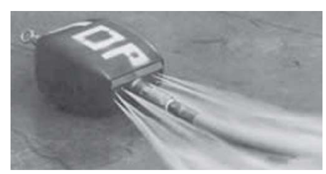
If upon visual inspection it is found that sediment has accumulated, a stadia rod should be inserted to determine the depth of sediment. When the average depth of sediment exceeds 3" (75 mm) throughout the length of the Isolator Row Plus, clean-out should be performed.

Maintenance

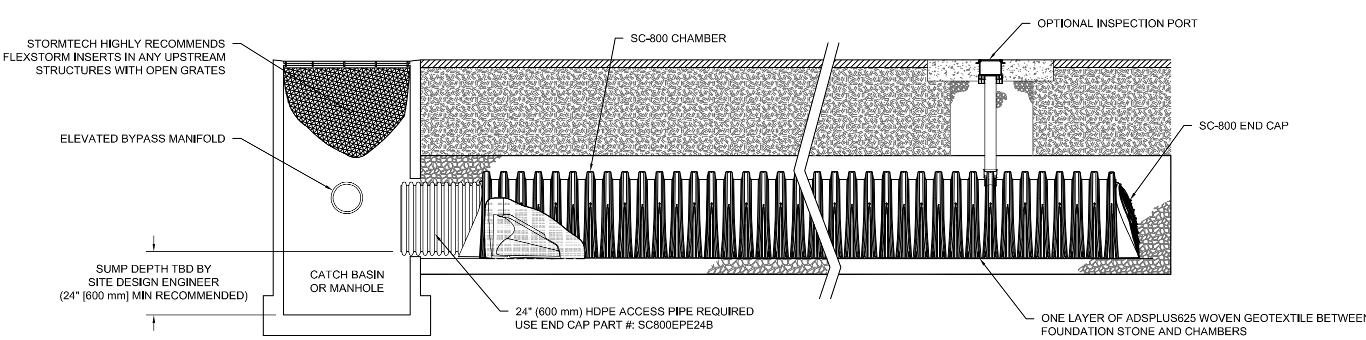
The Isolator Row Plus was designed to reduce the cost of periodic maintenance. By “isolating” sediments to just one row, costs are dramatically reduced by eliminating the need to clean out each row of the entire storage bed. If inspection indicates the potential need for maintenance, access is provided via a manhole(s) located on the end(s) of the row for cleanout. If entry into the manhole is required, please follow local and OSHA rules for a confined space entry.

Maintenance is accomplished with the JetVac process. The JetVac process utilizes a high pressure water nozzle to propel itself down the Isolator Row Plus while scouring and suspending sediments. As the nozzle is retrieved, the captured pollutants are flushed back into the manhole for vacuuming. Most sewer and pipe maintenance companies have vacuum/JetVac combination vehicles. Selection of an appropriate JetVac nozzle will improve maintenance efficiency. Fixed nozzles designed for culverts or large diameter pipe cleaning are preferable. Rear facing jets with an effective spread of at least 45” are best. StormTech recommends a maximum nozzle pressure of 2000 psi be utilized during cleaning. JetVac reels can vary in length. For ease of maintenance, ADS recommends Isolator Row Plus lengths up to 200' (61 m). **The JetVac process shall only be performed on StormTech Isolator Row Plus that have ADS Plus Fabric (as specified by StormTech) over their angular base stone.**





StormTech Isolator Row Plus (*not to scale*)



Isolator Row Plus Step By Step Maintenance Procedures

Step 1

Inspect Isolator Row Plus for sediment.

A) Inspection ports (if present)
  i. Remove lid from floor box frame
  ii. Remove cap from inspection riser
  iii. Using a flashlight and stadia rod,measure depth of sediment and record results on maintenance log.
  iv. If sediment is at or above 3 inch depth, proceed to Step 2. If not, proceed to Step 3.

B) All Isolator Row Plus
  i. Remove cover from manhole at upstream end of Isolator Row Plus
  ii. Using a flashlight, inspect down Isolator Row Plus through outlet pipe
    1. Mirrors on poles or cameras may be used to avoid a confined space entry
    2. Follow OSHA regulations for confined space entry if entering manhole
  iii. If sediment is at or above the lower row of sidewall holes (approximately 3 inches), proceed to Step 2.
  If not, proceed to Step 3.

Step 2

Clean out Isolator Row Plus using the JetVac process.

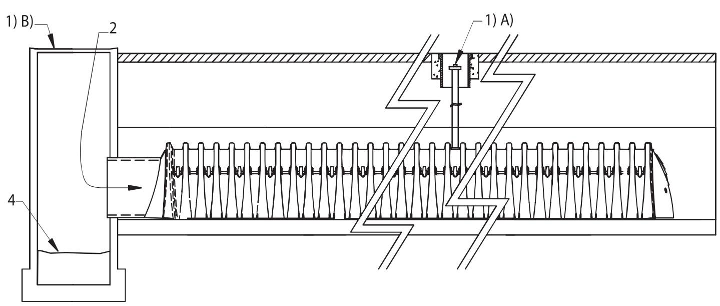
A) A fixed floor cleaning nozzle with rear facing nozzle spread of 45 inches or more is preferable
B) Apply multiple passes of JetVac until backflush water is clean
C) Vacuum manhole sump as required

Step 3

Replace all caps, lids and covers, record observations and actions.

Step 4

Inspect & clean catch basins and manholes upstream of the StormTech system.



Sample Maintenance Log

Date	Stadia Rod Readings		Sediment Depth (1)–(2)	Observations/Actions	Inspector
	Fixed point to chamber bottom (1)	Fixed point to top of sediment (2)			
3/15/11	6.3 ft	none		New installation. Fixed point is CI frame at grade	DJM
9/24/11		6.2	0.1 ft	Some grit felt	SM
6/20/13		5.8	0.5 ft	Mucky feel, debris visible in manhole and in Isolator Row Plus, maintenance due	NV
7/7/13	6.3 ft		0	System jetted and vacuumed	DJM

adspipe.com

800-821-6710

I

Illicit Discharge Compliance Statement

I. ILLICIT DISCHARGE STATEMENT

Illicit Discharge Compliance Statement

Name of Applicant: **Lupoli Companies, LLC**
Name of Facility: **King Street Common**
Location: **550 King Street & 410 Great Road, Littleton, MA**

The Construction Plans for the King Street Common project, located at 550 King Street & 410 Great Road, Littleton, MA, meet the requirements of Standard 10 of the MassDEP Stormwater Management Handbook.

The Construction Plans were prepared by qualified personnel at the direction of the Applicant. The Construction Plans identify the location of stormwater management and utility systems. As designed, the systems do not allow for any connections between the stormwater management and sanitary sewer utilities.

Signature: ______________________________
(To be signed prior to occupancy)

Appendix C

MassDEP 2023 Final Permit

MassDEP
Commonwealth of Massachusetts
Executive Office of Energy & Environmental Affairs

Department of Environmental Protection

Central Regional Office • 8 New Bond Street, Worcester MA 01606 • 508-792-7650

November 28, 2023

Salvatore Lupoli, President
550 King Street, LLC
290 Merrimack Street
Lawrence, MA 01843

By e-mail: mfurnari@lupolico.com

RE: City/Town: Littleton
Final Permit
Program Identifier: WP 12, GW#79-7
Accela Identifier: 23-WP12-0023-REN
Facility Name: 550 King Street, LLC WWTF
Authorization Type: Groundwater Discharge

Dear Mr. Lupoli:

In response to your request for a permit renewal to discharge treated wastewater from the 550 King Street, LLC WWTF, located at 550 King Street in Littleton, MA and after due public notice, I hereby issue the attached final permit.

No comments objecting to the issuance or terms of the permit were received by the Department during the public comment period. Therefore, in accordance with 314 CMR 2.08, the permit becomes effective on the date of issuance.

Parties aggrieved by the issuance of this permit are hereby advised of their right to request an Adjudicatory Hearing under the provision of Chapter 30A of the Massachusetts General Laws and 314 CMR 1.00, Rules for the Conduct of Adjudicatory Proceedings. Unless the person requesting the adjudicatory hearing requests and is granted a stay of the terms and conditions of the permit, the permit shall remain fully effective.

Please contact the undersigned at Daniel.J.Kurpaska@mass.gov or at 857-207-2000 or James Laughlin at James.Laughlin@mass.gov should you have any questions.

Sincerely,

Daniel J. Kurpaska
Section Chief, Wastewater Management
Bureau of Water Resources

79-7 Final Permit (Littleton) - 158

ecc: Littleton Board of Health

Maria Furnari – Lupoli Development

Joe Malloy – WhiteWater, Inc.

Ray Willis – Onsite Engineering, Inc.

MassDEP
Commonwealth of Massachusetts
Executive Office of Energy & Environmental Affairs

Department of Environmental Protection

Central Regional Office • 8 New Bond Street, Worcester MA 01606 • 508-792-7650

INDIVIDUAL GROUNDWATER DISCHARGE PERMIT

Name and Address of Applicant:	550 King Street, LLC 290 Merrimack Street Lawrence, MA 01843
Date of Application:	July 11, 2023
Application Number:	23-WP12-0023-REN
Permit No.	79-7
Date of Issuance:	November 28, 2023
Date of Expiration:	November 28, 2028
Effective Date:	November 28, 2023

AUTHORITY FOR ISSUANCE

Pursuant to authority granted by Chapter 21, Sections 26-53 of the Massachusetts General Laws, as amended, 314 CMR 2.00, and 314 CMR 5.00, the Massachusetts Department of Environmental Protection (the Department or MassDEP) hereby issues the following permit to: 550 King Street, LLC (hereinafter called "the permittee") authorizing discharges to the ground from the on site wastewater treatment facility located at 550 King Street in Littleton, Massachusetts serving a 490,000 SF commercial office park, such authorization being expressly conditional on compliance by the permittee with all terms and conditions of the permit hereinafter set forth.

November 28, 2023

Daniel J. Kurpaska
Section Chief, Wastewater Management
Bureau of Water Resources

Date

I. SPECIAL CONDITIONS

A. Effluent Limits

1) The permittee is authorized to discharge into the ground from the wastewater treatment facilities for which this permit is issued a treated effluent whose characteristics within one month of startup (facility closed and has been pumping and hauling since February 2022) and continuing thereafter shall not exceed the following values:

Effluent Characteristics	Discharge Limitations
Flow	40,000 gallons per day (gpd)
Biochemical Oxygen Demand (BOD_5)	30 mg/l
Total Suspended Solids (TSS)	30 mg/l
Nitrate Nitrogen	10 mg/l
Total Nitrogen (NO_2+NO_3+TKN)	10 mg/l
Oil & Grease	15 mg/l

a) The pH of the effluent shall not be less than 6.5 nor greater than 8.5 at any time or not more than 0.2 standard units outside the naturally occurring range.

b) The discharge of the effluent shall not result in any demonstrable adverse effect on the groundwater or violate any water quality standards that have been promulgated.

c) The monthly average concentration of BOD and TSS in the discharge shall not exceed 15 percent of the monthly average concentrations of BOD and TSS in the influent into the permittee's wastewater treatment facility.

d) When the average annual flow exceeds 80 percent of the permitted flow limitations, the permittee shall submit a report to the Department describing what steps the permittee will take in order to remain in compliance with the permit limitations and conditions, inclusive of the flow limitations established in this permit.

B. Monitoring and Reporting

1) The permittee shall monitor and record the quality of the **influent** and the quality and quantity of the **effluent** prior to discharge to the leaching facilities according to the following schedule and other provisions:

INFLUENT:

Parameter	Minimum Frequency of Analysis	Sample Type
BOD_5	Monthly	24 Hr. Composite
TSS	Monthly	24 Hr. Composite
Total Solids	Monthly	24 Hr. Composite
Ammonia Nitrogen	Monthly	24 Hr. Composite
Total Nitrogen (NO_2+NO_3+TKN)	Monthly	24 Hr. Composite

EFFLUENT:

Parameter	Minimum Frequency of Analysis	Sample Type
Flow	Daily	Reading-report-Max-Min-Avg
pH	Daily	Grab
BOD_5	Monthly	24 Hr. Composite
TSS	Monthly	24 Hr. Composite
Nitrate Nitrogen	Monthly	24 Hr. Composite
Total Nitrogen (NO_2+NO_3+TKN)	Monthly	24 Hr. Composite
Oil & Grease	Monthly	Grab
Total Phosphorus	Annually	Grab
Orthophosphate	Annually	Grab
Volatile Organic Compounds	Annually	Grab

a) After one full year of monitoring the Total Phosphorus and Orthophosphate results, the Department may determine, upon the request of the permittee, that the frequency of monitoring may be reduced if, in the judgment of the Department, the results of the sampling indicate that existing phosphorus levels will not adversely impact downgradient receptors. If the Department reduces the frequency of monitoring for Total Phosphorus and Orthophosphate, the Department reserves the right to resume more frequent monitoring if the Department determines that phosphorus levels are impacting downgradient receptors.

2) The permittee shall monitor, record and report the quality of water in the approved upgradient monitoring wells **DK-17**, **DK-G** and **SH-2** and approved downgradient monitoring wells **SH-1**, **DK-8** and **DK-3A** as shown on the Martinage Engineering Associate's Monitoring Well Plan dated August 18, 2016, according to the following schedule and other provisions:

Parameter	Minimum Frequency of Analysis
pH	Monthly
Static Water Level	Monthly
Specific Conductance	Monthly
Nitrate Nitrogen	Quarterly
Total Nitrogen (NO_2+NO_3+TKN)	Quarterly
Total Phosphorus	Annually
Orthophosphate	Annually
Volatile Organic Compounds	Annually

a) Static Water Level shall be expressed as an elevation and shall be referenced to the surveyed datum established for the site. It shall be calculated by subtracting the depth to the water table from the surveyed elevation of the top of the monitoring well's PVC well casing/riser.

b) After one full year of monitoring the Total Phosphorus and Orthophosphate results, the Department may determine, upon the request of the permittee, that the frequency of monitoring may be reduced if, in the judgment of the Department, the results of the sampling indicate that existing phosphorus levels will not adversely impact downgradient receptors. If the Department reduces the frequency of monitoring for Total Phosphorus and Orthophosphate, the Department reserves the right to resume more frequent monitoring if the Department determines that phosphorus levels are impacting downgradient receptors.

3) Any grab sample or composite sample required to be taken less frequently than daily shall be taken during the period of Monday through Friday inclusive. All composite samples shall be taken over the operating day.

4) The permittee shall submit all monitoring reports within 30 days of the last day of the reporting month to MassDEP and to the Nashoba Associated Boards of Health. All discharge monitoring reports submitted to MassDEP must be submitted through eDEP. To register for electronic submission go to: **http://www.mass.gov/eea/agencies/massdep/service/online/edep-online-filing.html**

C. Supplemental Conditions

1) The permittee shall notify the Department at least thirty (30) days in advance of the proposed transfer of ownership of the facility for which this permit is written. Said notification shall include a written agreement between the existing and new permittees containing a specific date for transfer of permit, responsibility, coverage and liability between them.

2) A staffing plan for the facility shall be submitted to the Department once every two years and whenever there are staffing changes. The staffing plan shall include the following components:

a) The operator(s)'s name(s), operator grade(s) and operator license number(s);
b) The number of operational days per week;

c) The number of operational shifts per week;
d) The number of shifts per day;
e) The required personnel per shift;
f) Saturday, Sunday and holiday staff coverage;
g) Emergency operating personnel

3) The permittee is responsible for the operation and maintenance of all sewers, pump stations, and treatment units for the permitted facility, which shall be operated and maintained under the direction of a properly certified wastewater operator.

4) Operation and maintenance of the proposed facility must be in accordance with 314 CMR 12.00, "Operation and Maintenance and Pretreatment Standards for Wastewater Treatment Works and Indirect Discharges", and, 257 CMR 2.00, "Rules and Regulations for Certification of Operators of Wastewater Treatment Facilities".

a) The facility has been rated (in accordance with 257 CMR 2.00), to be a Grade **4** facility. Therefore, the permittee shall provide for oversight by a Massachusetts Certified Wastewater Treatment plant operator (Chief Operator) Grade **4** or higher. The permittee will also provide for a backup operator who shall possess at least a valid Grade **3** license.

b) The date and time of the operator's inspection along with the operator's name and certification shall be recorded in the logbook on location at the treatment facility. All daily inspection logs consistent with the O&M Manual requirements shall be kept at the facility for a period of three (3) years.

c) Records of operation of wastewater treatment facilities or disposal systems required by the Department shall be submitted on forms supplied by the Department or on other forms approved by the Department for such use. Monthly reports shall be certified by the wastewater treatment plant operator in charge and shall be included in the discharge monitoring reports submitted each month.

5) If the operation and maintenance of the facility is contracted to a private concern, the permittee shall submit a copy of the contract, consistent with what is required by the approved Operation & Maintenance manual and signed only by the contractor, to the appropriate MassDEP Regional Office within thirty (30) days of permit issuance. Along with the contract, a detailed listing of all contract operation obligations of the proposed contractor at other facilities shall also be submitted.

6) Any additional connections to the sewer system, beyond the existing 490,000 SF commercial office park shall be approved by MassDEP and the local Board of Health prior to the connection.

7) All tests or analytical determinations to determine compliance with permit standards and requirements:

a) Effluent samples shall be collected, transported and stored in accordance with *Standard Methods for the Examination of Water and Wastewater;*

b) Monitoring must be conducted according to test procedures approved under 40 CFR Part 136 unless other methods are approved by the Department; and,

c) Samples shall be analyzed by a Massachusetts Certified laboratory unless otherwise approved by the Department.

8) The permittee shall notify the appropriate MassDEP Regional Office, in writing, within thirty (30) days of the following events:

a) The date of treatment plant start up.
b) Any interruption of the treatment system operation, other than routine maintenance.
c) Final shutdown of the treatment system.

9) The permittee shall contract to have any and all solids and sludges generated by the treatment system for which this permit is issued removed off site by a properly licensed waste hauler for disposal at an EPA/MassDEP approved facility. The name and license number of the hauler along with the quantity of wastes removed and the date(s) of removal shall be reported by the permittee in writing to the appropriate MassDEP Regional Office.

10) At year fifteen (*2038)* following the expected maintenance and upgrade to bring the facility back online in 2023, the permittee shall submit two reports to the Department for its review and approval:

a) An engineering report, prepared by a registered professional engineer, that outlines in sufficient detail what modifications (if any) to the facility or other changes are required to insure that the facility can remain in compliance with its GWDP and other applicable requirements through the next 5 year permit term (year 2043) and beyond; and

b) A financial plan that contains the cost estimates for implementing the facility modifications or other changes identified in the engineering report, and describes and demonstrates, how and when the permittee will finance the needed facility modifications or other changes.

11) In the event that effluent limits are not met, or the discharge is determined to impair groundwater quality in accordance with 314 CMR 5.16(1), the permittee may be obligated to modify, supplement or replace the permitted treatment process so as to ensure that the discharge does not impair the ability of the groundwater to act as an actual or potential source of potable water.

12) Pursuant to M.G.L. Chapter 21A, section 18(a), and 310 CMR 4.03, holders of this Permit may be subject to annual compliance assurance fees as assessed each year on July 1st and invoiced by MassDEP. Failure of the Permit holder to pay applicable annual compliance assurance fees shall result in the automatic suspension of the permit by operation of law under the statute. If fee non-payment continues for sixty days or more, MassDEP has the statutory option of revoking the Permit, denying any other pending permit applications filed by the Permit holder or taking other enforcement action. Permit holders are required to notify MassDEP in writing if they wish to relinquish or transfer a permit. Failure to do so will result in the continued assessment of fees.

D. Appeal Rights

During the thirty (30) day period following issuance of this permit, a Notice of Claim for an Adjudicatory Appeal may be sent by any person aggrieved (the "Petitioner") by the issuance to:

Case Administrator
Office of Appeals and Dispute Resolution
Massachusetts Department of Environmental Protection
100 Cambridge Street, Suite 900
Boston, MA 02108

310 CMR 1.01(6)(b) requires the Notice of Claim to: include sufficient facts to demonstrate aggrieved person status; state the facts which are grounds for the appeal specifically, clearly and concisely; and, state relief sought. The permit shall become or remain effective at the end of the 30 day appeal period unless the person filing the Notice of Claim requests, and is granted, a stay of its terms and conditions. If a permit is modified under 314 CMR 2.10, only the modified terms and conditions may be subject to an Adjudicatory Appeal. All other aspects of the existing permit shall remain in effect during any such Adjudicatory Appeal.

Per 310 CMR 4.06, the hearing request to the Commonwealth will be dismissed if the filing fee is not paid. Unless the Petitioner is exempt or granted a waiver, a valid check payable to the Commonwealth to Massachusetts in the amount of $100.00 must be mailed to:

Commonwealth of Massachusetts
Department of Environmental Protection
P.O. Box 4062
Boston, MA 02211

The filing fee is not required if the Petitioner is a city, town, county, or district of the Commonwealth, federally recognized Indian tribe housing authority effective January 14, 1994, or any municipal housing authority; or, per MGL 161A s. 24, the Massachusetts Bay Transportation Authority. The Department may waive the adjudicatory hearing filing fee for a Petitioner who shows that paying the fee will create an undue financial hardship. A Petitioner seeking a waiver must file, along with the hearing request, an affidavit setting forth the facts believed to support the claim of undue financial hardship.

II. GENERAL PERMIT CONDITIONS

5.16: General Conditions

The following conditions apply to all individual and general permits:

(1) No discharge authorized in the permit shall cause or contribute to a violation of 314 CMR 4.00: *Massachusetts Surface Water Quality Standards*. Upon promulgation of any amended standard, the permit may be modified to comply with such standard in accordance with the procedures in 314 CMR 2.10: *Modification, Suspension, Revocation and Renewal of Permits and General Permit Coverage* and 314 CMR 5.12. Except as otherwise provided in 314 CMR 5.10(3)(c), 5.10(4)(a)2. and 5.10(9), no discharge authorized in the permit shall impair the ability of the ground water to serve as an actual or potential source of potable water.

Evidence that a discharge impairs the ability of the ground water to serve as an actual or potential source of potable water includes, without limitation, analysis of samples taken in a downgradient well that demonstrates one or more exceedances of the applicable water quality based effluent limitations set forth in 314 CMR 5.10. In those cases where it is shown that a measured parameter exceeds the applicable water quality based effluent limitations set forth in 314 CMR 5.10 at the upgradient monitoring well, evidence that a discharge impairs the ability of the ground water to serve as an actual or potential source of potable water is deemed to exist if a measured parameter in any downgradient well exceeds the level of that same measured parameter in the upgradient well for the same sampling period. A statistical procedure approved by the Department shall be used to determine when a measured parameter exceeds the allowable level.

(2) Duty to Comply. The permittee shall comply at all times with the terms and conditions of the permit, 314 CMR 5.00, M.G.L. c. 21, §§ 26 through 53, and all applicable state and federal statutes and regulations.

(3) Standards and Prohibitions for Toxic Pollutants. The permittee shall comply with effluent standards or prohibitions established by § 307(a) of the Federal Act, 33 U.S.C. § 1317(a), for toxic pollutants within the time provided in the regulations that establish these standards or prohibitions, even if the permit has not yet been modified to incorporate the requirement.

(4) Proper Operation and Maintenance. The permittee shall at all times properly operate and maintain all facilities and equipment installed or used to achieve compliance with the terms and conditions of the permit, 314 CMR 12.00: *Operation and Maintenance and Pretreatment Standards for Wastewater Treatment Works and Indirect Discharges*, and 257 CMR 2.00: *Certification of Operators of Wastewater Treatment Facilities*. All equipment shall be maintained in an acceptable condition for its intended use.

(5) Duty to Halt or Reduce Activity. Upon reduction, loss, or failure of the treatment facility, the permittee shall, to the extent necessary to maintain compliance with its permit, control production, discharges, or both, until the facility is restored or an alternative method of treatment is provided. A permittee may not raise as a defense in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of the permit.

(6) Power Failure. In order to maintain compliance with the effluent limitations and prohibitions of the permit, the permittee shall either:

(a) provide an alternative power source sufficient to operate the wastewater control facilities; or

(b) halt, reduce or otherwise control production or all discharges upon the reduction, loss, or failure of the primary source of power to the wastewater control facilities.

(7) Duty to Mitigate. The permittee shall take all reasonable steps to minimize or prevent any adverse impact on human health or the environment resulting from non-compliance with the permit. Additionally, the permittee shall take all necessary steps to prevent an operational upset of the PWTF or POTW.

(8) Duty to Provide Information. The permittee and any operator of the permitted facility shall furnish to the Department within a reasonable time as specified by the Department any information which the Department may request to determine whether cause exists for modifying, suspending, revoking and reissuing, or terminating the permit, or to determine whether the permittee is complying with the terms and conditions of the permit.

(9) Inspection and Entry. The permittee shall allow the Department or its authorized representatives to:

(a) Enter upon the permittee's premises where a regulated facility or activity is located or conducted, or where records required by the permit are kept;
(b) Have access to and copy, at reasonable times, any records that must be kept under the conditions of the permit;
(c) Inspect at reasonable times any facilities, equipment, practices, or operations regulated or required under the permit; and
(d) Sample or monitor at reasonable times for the purpose of determining compliance with the terms and conditions of the permit.

(9A) The permittee shall physically secure the treatment works and monitoring wells and limit access to the treatment works and monitoring wells only to those personnel required to operate, inspect and maintain the treatment works and to collect samples.

(9B) The permittee shall identify each monitoring well by permanently affixing to the steel protective casing of the well a tag with the identification number listed in the permit.

(10) Monitoring. Samples and measurements taken for the purpose of monitoring shall be representative of the monitored activity. Monitoring must be conducted according to test procedures approved under 40 CFR Part 136 unless other test procedures are specified in the permit.

(11) Recordkeeping. The permittee shall retain records of all monitoring information, including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation, copies of all reports required by the permit, and all records of all data used to complete the application for the permit, for a period of at least five years from the date of the sample, measurement, report or application. This period may be extended by request of the Department at any time. Records of monitoring information shall include without limitation:

(a) The date, exact place, and time of sampling or measurements;
(b) The individual(s) who performed the sampling or measurement;
(c) The date(s) analyses were performed;
(d) The individual(s) who performed the analyses;
(e) The analytical techniques or methods used; and
(f) The results of such analyses.

(12) Prohibition of Bypassing. Except as provided in 314 CMR 5.16(13), bypassing is prohibited and the Department may take enforcement action against a permittee for bypassing unless:

(a) The bypass was unavoidable to prevent loss of life, personal injury, or severe property damage;
(b) There were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment downtime. This condition is not satisfied if the permittee could have installed adequate backup equipment to prevent a bypass which occurred during normal periods of equipment downtime or preventive maintenance; and
(c) The permittee submitted notice of the bypass to the Department:

1. In the event of an anticipated bypass, at least ten days in advance, if possible; or

2. In the event of an unanticipated bypass, as soon as the permittee has knowledge of the bypass and no later than 24 hours after its first occurrence.

(13) Bypass not Exceeding Limitations. The permittee may allow a bypass to occur which does not cause effluent limitations to be exceeded, but only if necessary for the performance of essential maintenance or to assure efficient operation of treatment facilities.

(14) Permit Actions. The permit may be modified, suspended, or revoked for cause. The filing of a request by the permittee for a permit modification, reissuance, or termination, or a notification of planned changes or anticipated non-compliance does not stay any permit condition.

(15) Duty to Reapply. If the permittee wishes to continue an activity regulated by the permit after the expiration date of the permit, the permittee must apply for and obtain a new permit. The permittee shall submit a new application at least 180 days before the expiration date of the existing permit, unless permission for a later date has been granted by the Department in writing.

(16) Property Rights. The permit does not convey any property rights of any sort or any exclusive privilege.

(17) Other Laws. The issuance of a permit does not authorize any injury to persons or property or invasion of other private rights, nor does it relieve the permittee of its obligation to comply with any other applicable Federal, State, or local law, or regulation.

(18) Oil and Hazardous Substance Liability. Nothing in the permit shall be construed to preclude the institution of any legal action or relieve the permittee of any responsibilities, liabilities, or penalties to which the permittee is or may be subject under § 311 of the Federal Act, 33 U.S.C. § 1321, and M.G.L. c. 21E.

(19) Removed Substances. Solids, sludges, filter backwash, or other pollutants removed in the course of treatment or control of wastewaters shall be disposed in a manner consistent with applicable Federal and State laws and regulations including, but not limited to, the Massachusetts Clean Waters Act, M.G.L. c. 21, §§ 26 through 53, and the Federal Act, 33 U.S.C. § 1251 *et seq.*, the Massachusetts Hazardous Waste Management Act, M.G.L. c. 21C, and the Federal Resource Conservation and Recovery Act, 42 U.S.C. § 6901, *et seq.*, 310 CMR 19.000: *Solid Waste Management* and 310 CMR 30.000: *Hazardous Waste*.

(20) Reporting Requirements.

(a) Monitoring Reports. Monitoring results shall be reported on a Discharge Monitoring Report (DMR) at the intervals specified in the permit. If a permittee monitors any pollutant more frequently than required by the permit, the results of this monitoring shall be included in the calculation and reporting of the data submitted in the DMR. Beginning on December 2, 2017, a permittee shall submit all DMRs electronically, using the electronic reporting system designated by the Department. A permittee may seek a waiver of this requirement by submitting a written request for the Department's approval.

(b) Compliance Schedules. Reports of compliance or non-compliance with, or any progress reports on interim and final requirements contained in any compliance schedule in the permit shall be submitted no later than 14 days following each schedule date.

(c) Planned Changes. The permittee shall give notice to the Department as soon as possible of any planned physical alterations or additions to the permitted facility or activity which could significantly

change the nature or increase the quantity of pollutants discharged. Unless and until the permit is modified, any new or increased discharge in excess of permit limits or not specifically authorized by the permit constitutes a violation.
(d) Anticipated Non-compliance. The permittee shall give advance notice to the Department of any planned changes in the permitted facility or activity which may result in non-compliance with permit requirements.
(e) 24 Hour Reporting. The permittee shall report any non-compliance which may endanger health or the environment. Any information shall be communicated orally within 24 hours of the time the permittee becomes aware of the circumstances. A written submission shall also be provided within five days of the time the permittee becomes aware of the circumstances. The written submission shall contain: a description of the non-compliance, including exact dates and times, and if the non-compliance has not been corrected, the anticipated time it is expected to continue; and steps taken or planned to reduce, eliminate, and prevent reoccurrence of the non-compliance. The following shall be included as information which must be reported within 24 hours:

1. Any unanticipated bypass which exceeds any effluent limitation in the permit; and
2. Any violation of a maximum daily discharge limitation for any of the pollutants required by the permit to be reported within 24 hours.

(f) Other Non-compliance. The permittee shall report all instances of non-compliance not reported under 314 CMR 5.16(20)(a), (b), or (e) at the time monitoring reports are submitted. The reports shall contain the information listed in 314 CMR 5.16(20)(e).
(g) Toxics. All manufacturing, commercial, mining, or silvicultural dischargers must notify the Department as soon as they know or have reason to believe:

1. That any activity has occurred, or will occur, that would result in the discharge of any toxic pollutant listed in 314 CMR 3.17: *Appendix B - Toxic Pollutants* not limited by the permit, if that discharge will exceed the highest of the following notification levels:
    a. 100 micrograms per liter (100 ug/l);
    b. 200 micrograms per liter (200 ug/l) for acrolein and acrylonitrile, 500 micrograms per liter (500 ug/l) for 2,4-dinitrophenol, and for 2-methyl-4,6-dinitrophenol, and one milligram per liter (1 mg/l) for antimony;
    c. Five times the maximum concentration value reported for that pollutant in the permit application; or
2. That they have begun or expect to begin to use or manufacture as an intermediate or final product or byproduct any toxic pollutant which was not reported in the permit application.

(h) Indirect Dischargers. All Publicly Owned Treatment Works shall provide adequate notice to the Department of the following:

1. Any new introduction of pollutants into the POTW from an indirect discharger which would be subject to § 301 or § 306 of the Federal Act, 33 U.S.C. § 1311 or 1316, if it were directly discharging those pollutants; and
2. Any substantial change in the volume or character of pollutants being introduced into the POTW by a source introducing pollutants into the POTW at the time of issuance of the permit.

(i) Information. Where a permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application or in any report to the Department, it shall promptly submit the relevant facts or correct information.
(j) The permittee shall notify the Department in writing within seven days of any change in contract operators.

(21) Signatory Requirement. All applications, reports, or information submitted to the Department shall be signed and certified in accordance with 314 CMR 5.14 and 5.15.

(22) Severability. The provisions of the permit are severable. If any provision of the permit, or the application of any provision of the permit to any circumstance, is held invalid, the application of such provision to other circumstances, and the remainder of the permit, shall not be affected thereby.

(23) Reopener Clause. The Department reserves the right to make appropriate revisions to the permit to establish any appropriate effluent limitations, schedules of compliance, or other provisions, as authorized by the Massachusetts Clean Waters Act, M.G.L. c. 21, §§ 26 through 53, or the Federal Act, 33 U.S.C. § 1251 *et seq*., to bring all discharges into compliance with these statutes.

(24) Approval of Treatment Works. All discharges and associated treatment works authorized in 314 CMR 5.00 shall remain in compliance with the terms and conditions of the permit. Any modification of the approved treatment works shall require written approval of the Department prior to the construction of the modification.

(25) Transfer of Permits.

(a) RCRA Facilities. Any permit which authorizes the operation of a RCRA facility subject to the requirements of 314 CMR 8.07: *Standards for all other RCRA Facilities* shall be valid only for the person to whom it is issued and may not be transferred.

(b) Transfers by Modification. Except as provided in 314 CMR 5.16(25)(a) and (c), a permit may be transferred by the permittee to a new permittee if the permit has been modified or revoked and reissued in accordance with 314 CMR 5.12(2), or a minor modification is made to identify the new permittee in accordance with 314 CMR 5.12(3) and (4).

(c) Automatic Transfers. For facilities other than Privately Owned Wastewater Treatment Facilities (PWTFs) that treat at least some sewage from residential uses, hospitals, nursing or personal care facilities, residential care facilities, or assisted living facilities, PWTFs that have been required to establish, fund and maintain financial assurance mechanism(s) pursuant to 314 CMR 5.15(6), and RCRA facilities subject to the requirements of 314 CMR 8.07: *Standards for all other RCRA Facilities*, a permit may be automatically transferred in accordance with 314 CMR 5.12(5).

(26) Permit Compliance Fees and Inspection Information. Except as otherwise provided, any permittee required to obtain a ground water discharge permit pursuant to M.G.L. c. 21, § 43, and 314 CMR 5.00 shall submit the annual compliance assurance fee established in accordance with M.G.L. c. 21A, § 18 and 310 CMR 4.00: *Timely Action Schedule and Fee Provisions*, as provided in 314 CMR 2.12: *Applications, Fees and Inspection Information*. The requirement to submit the annual compliance fee does not apply to any local government unit other than an authority. Any permittee required to obtain a ground water discharge permit pursuant to M.G.L. c. 21, § 43 and 314 CMR 5.00, may be required to submit inspection information annually, as provided in 314 CMR 2.12.

MassDEP 重要 महत्वपूर्ण σημαντικός Important կարևոր quan trọng مهم

Communication for Non-English-Speaking Parties

This document is important and should be translated immediately.

If you need this document translated, please contact MassDEP's Director of Environmental Justice at the telephone number listed below.

Español Spanish

Este documento es importante y debe ser traducido inmediatamente. Si necesita traducir este documento, póngase en contacto con el Director de Justicia Ambiental de MassDEP (*MassDEP's Director of Environmental Justice*) en el número de teléfono que figura más abajo.

Português Portuguese

Este documento é importante e deve ser traduzido imediatamente. Se você precisar traduzir este documento, entre em contato com o Diretor de Justiça Ambiental do MassDEP no número de telefone listado abaixo.

繁體中文 Chinese Traditional

本文檔很重要，需要即刻進行翻譯。
如需對本文檔進行翻譯，請透過如下列示電話號碼與 MassDEP 的環境司法總監聯絡。

简体中文 Chinese Simplified

这份文件非常重要，需要立即翻译。
如果您需要翻译这份文件，请通过下方电话与 MassDEP 环境司法主任联系。

Ayisyen Kreyòl Haitian Creole

Dokiman sa a enpòtan epi yo ta dwe tradui l imedyatman. Si w bezwen tradui dokiman sa a, tanpri kontakte Direktè. Jistis Anviwònmantal MassDEP a nan nimewo telefòn ki endike anba a.

Việt Vietnamese

Tài liệu này và quan trọng và phải được dịch ngay. Nếu quý vị cần bản dịch của tài liệu này, vui lòng liên hệ với Giám Đốc Phòng Công Lý Môi Trường của MassDEP theo số điện thoại được liệt kê bên dưới.

ប្រទេសកម្ពុជា Khmer/Cambodian

ឯកសារនេះមានសារៈសំខាន់
ហើយគប្បីគួរត្រូវបានបកប្រែភ្លាមៗ។.
ប្រសិនបើអ្នកត្រូវការអោយឯកសារនេះបកប្រែ
សូមទាក់ទងនាយកផ្នែកយុត្តិធម៌បរិស្ថានរបស់
MassDEPតាមរយៈលេខទូរស័ព្ទដែលបានរាយដូចខា
ងក្រោម។

Kriolu Kabuverdianu Cape Verdean

Es dokumentu sta important i tenki ser tradusidu immediatamenti. Se nho ta presisa ke es dokumentu sta tradisidu, por favor kontata O Diretor di Justisia di Environman di DEP ku es numero di telifoni menxionadu di baixo.

Contact Deneen Simpson 857-406-0738
Massachusetts Department of Environmental Protection
100 Cambridge Street 9th Floor Boston, MA 02114
TTY# MassRelay Service 1-800-439-2370 • https://www.mass.gov/environmental-justice
(Version revised 8.2.2023) 310 CMR 1.03(5)(a)

Русский Russian

Это чрезвычайно важный документ, и он должен быть немедленно переведен. Если вам нужен перевод этого документа, обратитесь к директору Департамента экологического правосудия MassDEP (MassDEP's Director of Environmental Justice) по телефону, указанному ниже.

العربية Arabic

هذه الوثيقة مهمة وتجب ترجمتها على الفور.

إذا كنت بحاجة إلى ترجمة هذه الوثيقة، فيرجى الاتصال بمدير العدالة البيئية فيMassDEP على رقم الهاتف المذكور أدناه.

한국어 Korean

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հայերեն Armenian

Այս փաստաթուղթը կարևոր է, և պետք է անհապաղ թարգմանել այն:
Եթե Ձեզ անհրաժեշտ է թարգմանել այս փաստաթուղթը, դիմեք Մասաչուսեթսի շրջակա միջավայրի պահպանության նախարարության (MassDEP) Բնապահպանական հարցերով արդարադատության ղեկավարին (Director of Environmental Justice)՝ ստորև նշված հեռախոսահամարով

فارسی Farsi Persian

این نوشتار بسیار مهمی است و باید فوراً ترجمه شود.
اگر نیاز به ترجمه این نوشتار دارید لطفاً با مدیر عدالت محیط زیستی MassDEP در شماره تلفن ذکر شده زیر تماس بگیرید.

Français French

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हिन्दी Hindi

यह दस्तावेज महत्वपूर्ण है और इसका अनुवाद तुरंत किया जाना चाहिए। यदि आपको इस दस्तावेज का अनुवाद कराने की जरूरत है, तो कृपया नीचे दिए गए टेलीफोन नंबर पर MassDEP के पर्यावरणीय न्याय निदेशक से संपर्क करें।

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(Version revised 8.2.2023) 310 CMR 1.03(5)(a)

Appendix D

Greenhouse Gas

Energy Report

King Street Common Development

Littleton, MA

Prepared by: enviENERGY Studio
Date: September 30, 2025

enviENERGY

Table of Contents

FEIR Updates

In response to DOER's comment letter on the DEIR, the following updates were made to address the shortcomings of certain energy modeling tools and to present more accurate calculations, particularly for service hot water energy consumption.

1- **Modeling Limitations (TEDI vs. HERS Pathways):** Because of limitations in the modeling tools when comparing TEDI and HERS pathways, the annual hot water heating energy values in the HERS scenarios (for both Group 2 (>50 units) and Group 3 (<50 units)) were replaced with values generated from TEDI models. It is important to note that both HERS and Passive House models tend to underestimate DHW consumption. The remainder of the calculations, including annual energy consumption and GHG emissions, were updated accordingly.

2- **Group 2 Residential Buildings (more than 50 units):** In the HERS scenario, the heat pump hot water system was changed from in-unit to a central system; however, the basis of design—and the baseline used in the cost analysis—remains in-unit electric resistance water heaters. The results of this analysis, presented on page 12, indicate a net operating cost penalty in all other scenarios, including heat pump water heaters. This is primarily due to the significantly higher cost of a central heat pump water heating system compared to in-unit electric resistance heaters, estimated at approximately $500,000 for a 150-unit building. In order to provide a more appropriate comparison with the central heat pump water heating system, another version of this cost analysis was created – please refer to page 13 - where the electric resistance hot water system was changed from in-unit to central. The cost increase between central electric and heat pump system is approximately $300,000 which results in a positive cash flow in the central heat pump scenario. However, it should be noted that even though the central heat pump system results in energy cost savings, the Proponent would not be able to appropriately bill tenants for their energy use so this scheme may not work for the project.

3- **Cost Adjustments:** Further review revealed that the cost of in-unit and central electric resistance water heaters had been underestimated. The material costs were therefore updated.

These changes indicate that in **Group 2**, the central heat pump water heater scenario produces better cash flow compared to the central electric resistance scenario under both HERS and TEDI pathways. In **Group 3**, the in-unit heat pump water heater scenario generates better cash flow compared to the in-unit electric resistance scenario under both pathways. This outcome is due to the higher efficiency of heat pump water heaters relative to electric resistance heaters.

Finally, it should be noted that there is a slight space heating penalty in **Group 3** scenarios because in-unit heat pump water heaters draw air from the conditioned space, resulting in additional heating load during colder seasons. Both REM software (used for HERS ratings) and WUFI (used for Passive House modeling) account for this added heating load as well as the reduced cooling load when a heat pump water heater is located inside the unit.

Executive Summary

The King Street Common development consists of 18 buildings which were grouped into five (5) categories in the DOER comment letter as well as our analysis.

- **Group 1:** Buildings A and B (existing buildings to be reused) - Building A was used as a prototype for this analysis and the following scenarios were evaluated:
  - Compliance with the Relative Performance Pathway, utilizing gas for space heating and analyzing four types of water heating systems: gas, electric heat pump, electric resistance, and solar + resistance.
  - Compliance with the Relative Performance Pathway, utilizing electric air source heat pump for space heating and analyzing four types of water heating systems: gas, electric heat pump, electric resistance, and solar + resistance.
  - Compliance with the EnerPhit standard, utilizing electric air source heat pump for space heating and analyzing four types. of water heating systems: gas, electric heat pump, electric resistance, and solar + resistance
- **Group 2:** Residential portion of Buildings C, D, E, F, R, S (residential buildings with 50 or more units) – Building F was used as a prototype and the following scenarios were evaluated. Please note that the proponent made a commitment to an all-electric space heating system for all residential buildings and therefore, the scenario with gas space heating was not considered.
  - Compliance with the Targeted Performance (TEDI) Pathway, utilizing electric air source heat pump for space heating and analyzing three types of water heating systems: electric heat pump, electric resistance, and solar + resistance.
  - Compliance with the HERS Pathway (40 or less), utilizing electric air source heat pump for space heating and analyzing three types of water heating systems: electric heat pump, electric resistance, and solar + resistance.
  - Compliance with Passive House, utilizing electric air source heat pump for space heating and analyzing three types of water heating systems: electric heat pump, electric resistance, and solar + resistance.
- **Group 3:** Residential portion of Buildings I, J, K, L, N, O (residential buildings with less than 50 units) – Building K was used as a prototype for this analysis. Similar to Group 2, only electric space heating scenarios were evaluated.
- **Group 4:** Building G – For the hotel building, the following scenarios were evaluated. Please note that the proponent made a commitment to an all-electric space heating system for the hotel building and therefore, the scenario with gas space heating was deleted from this report:
  - Compliance with the Relative Performance Pathway, utilizing gas for space heating and analyzing four types of water heating systems: gas, electric heat pump, electric resistance, and solar + resistance. Not applicable.

  - Compliance with the Relative Performance Pathway, utilizing electric air source heat pump for space heating and analyzing four types of water heating systems: gas, electric heat pump, electric resistance, and solar + resistance.
  - Compliance with the Relative Performance Pathway, including the C406.9 – Reduced Air Leakage in the proposed design, utilizing electric air source heat pump for space heating and analyzing four types of water heating systems: gas, electric heat pump, electric resistance, and solar + resistance.
- Group 5: Retail and Office buildings: The project commits to DOER's suggested mitigation strategies for these building types as outlined below. Therefore, no further analysis was performed. Office building M and retails will utilize electric air source heating and hot water and will target a reduced air leakage per IECC 2021 C406.9.

enviENERGY Studio developed energy models for each group and investigated the compliance of each sub-scenario with the Massachusetts Stretch Energy Code requirements. The energy modeling results were used for a gap analysis and a cash flow model for each scenario, including first cost increase associated and net operating cost savings or increase with each improved scenario. The increase in first cost was amortized into an annual cost increase using 30-year mortgage term.

The energy models were developed in eQuest DOE2.3 simulation software, referencing the provided conceptual drawings. The study and analysis presented in this report focus on aspects of energy efficiency and GHG reductions most applicable to the early stages of design.

Energy Modeling Approach

Using the guidelines outlined in Appendix G of ASHRAE 90.1-2019 and TEDI Guidelines in conjunction with the Massachusetts Amendments, baseline and proposed building designs were modeled. Please note that the proposed estimated energy performance and cost are not predictions of actual energy consumptions or costs for the proposed design after construction. The actual energy use will differ from these estimates due to the variations in occupancy patterns and schedules, weather conditions, and building operation and maintenance. Still, the energy modeling results should serve as an accurate comparison tool.

Building parameters for the Baseline and Proposed cases are summarized as follows:

Residential Buildings

Climate Zone 5A	Building F	Building K
HVAC System Type	Heat Pump	Heat Pump
Space Heating fuel	Electricity	Electricity
Space Cooling fuel	Electricity	Electricity
DHW	Gas, electric resistance, heat pump, solar + resistance	Gas, electric resistance, heat pump
Window-to-Wall Ratio	25%	26%
Energy Recovery	77% to 78% effectiveness	78% to 82% effectiveness
TEDI Thresholds	Cooling: 22 kBtu/sf; Heating: 2.80 kBtu/sf	Cooling: 15 kBtu/sf; Heating: 3.20 kBtu/sf

Hotel

Climate Zone 5A	Stretch Energy Code Baseline (ASHRAE 90.1-2019) + MA Amendments	Proposed Design
HVAC System Type	System 1 & 3 – PTAC and packages single zone	Air source heat pump and ERV
Space Heating Type	Natural gas boilers	air source heat pump for heating and cooling
Space Cooling Type	Direct expansion	
Window-to-Wall Ratio	24%	24%
Energy Recovery	Only in corridors; 75% effectiveness	75% effectiveness

Cost Analysis Inputs

Operational Cost: Littleton has a municipal utility plant, and it is not in the Mass Save territory. The utility rates are obtained from the Littleton Electric Light & Water Departments (LELWD) and National Grid websites and are listed below.

Residential:

- A flat electricity rate of $0.1343 per kWh was used
- A flat gas rate of $1.70 per therm was used

Commercial:

- A flat electricity rate of $0.14197 per kWh was used for the hotel building and an aggregated (peak and off-peak) electricity rate of $0.18032 per kWh was used for the existing building A
- A flat gas rate of $1.70 per therm was used for the hotel building and a flat gas rate of $1.90 per therm was used for the existing building A

Rebates and Tax Incentives: As noted earlier, Littleton is not in the Mass Save territory and it was confirmed by ICF that these projects are not eligible for rebates through Mass Save. Littleton is part of the Municipal Light Plant and they have limited rebated for electric resistance and heat pump water heaters[1]; however, it is noted that new construction is ineligible for these rebates. We did not include any federal tax credits in our calculations because they are either on pause or have been eliminated. Finally, we search the DSIRE platform for any potential rebates and tax incentives applicable to heat pump systems and solar water heat and it was indicated that these buildings won't be eligible for any of the existing programs.[2]

[1] lelwd.com/rebates/
[2] DSIRE

Material and Construction Cost: No additional construction cost was included in this analysis. The net cost increase of materials was either provided by the proponent based on their similar projects or was obtained from the eia research paper published in 2023. Updated Buildings Sector Appliance and Equipment Costs and Efficiencies

The material costs are summarized in the table below:

Mitigation Strategy	Cost of Material
Additional 1" of continuous insulation	$2 per inch per floor plan area
Cost of triple-pane windows vs. double-pane	$15 per window area
Electric resistance water heater (in-unit)	$600 per unit
Electric resistance water heater (central)	$76,000
Solar water heaters	$8,060 per 40 sf[3]
In-unit Rheem heat pump water heater	$1,900 per unit
Central heat pump water heaters plus storage tank	Lync Agesis A 500 ($254,000) + Lync LC 500 ($34,000)- each hp pairs with two storages[3]
Bringing gas line to the project	$125,000
Cost increase for transformer	$100,000 to $250,000

Amortized Annual Cost Increase: To amortize the cost increase into an annual cost increase using a 30-year mortgage term, the following formula was used:

$$A = P \times \frac{r\,(1+r)^n}{(1+r)^n - 1}$$

A = annual payment

P = principal (initial cost)

r = annual interest rate, assumed to be 6.5%

n = number of years (30 years)

The amortization factor for 6.5% over 30 years will be approximately **0.076577**, which was used as a multiplier in this analysis and for all scenarios.

The following pages demonstrate the code compliance pathways and cost analysis for all scenarios.

[3] CO2-ASHPs-for-Domestic-Hot-Water_Final_Sealed.pdf

Group 1: Building A Cost Analysis and EnerPhit Results

Building A Design Strategies, Inputs, and Outputs	Scenario 1a Gas Space Heating + Central Gas Water Heating	Scenario 1b Gas Space Heating + Electric Resistance Water Heating	Scenario 1c Gas Space Heating + Central Heat Pump Water Heating	Scenario 1d Gas Space Heating + Solar and Backup Elec Resistance Water Heating	Scenario 2a Heat Pump Space Heating + Central Gas Water Heating	Scenario 2b Heat Pump Space Heating + Electric Resistance Water Heating	Scenario 2c Heat Pump Space Heating + Central Heat Pump Water Heating	Scenario 2d Heat Pump Space Heating + Solar and Backup Elec Resistance Water Heating	Scenario 3a - EnerPhit Heat Pump Space Heating + Heat Pump Water Heating
Roof R value	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-50
Wall U value	0.055	0.055	0.055	0.055	0.055	0.055	0.055	0.055	0.055
% wall	70%	70%	70%	70%	70%	70%	70%	70%	70%
Window U value	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.14
% window	30%	30%	30%	30%	30%	30%	30%	30%	30%
Area-weighted vertical above grade U value	0.1285	0.1285	0.1285	0.1285	0.1285	0.1285	0.1285	0.1285	0.0805
Air infiltration (cfm at 75 PA)	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.2
Ventilation energy recovery	75%	75%	75%	75%	75%	75%	75%	75%	80%
Solar heat gain coefficient (SHGC)	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.3
Heating TEDI (kBtu/sf-yr)	-	-	-	-	-	-	-	-	1.7
Cooling TEDI (kBtu/sf-yr)	-	-	-	-	-	-	-	-	1
Peak annual space heating demand (Mbtu/hr)	4.10	4.10	4.10	4.10	3.40	3.40	3.40	3.40	-
Peak annual space cooling demand (Mbtu/hr)	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	-
Peak annual electric load (MW)	2.20	2.20	2.20	2.20	2.60	2.70	2.70	2.70	-
Peak annual gas load (MBH)	4,200	4,160	4,160	4,160	0.4	0	0	0	0
Annual space heating energy (MBtu)	5,516	5,516	5,516	5,516	3,193	3,193	3,193	3,193	1,590
Annual water heating energy (MBtu)	418	385	96	87	418	385	96	87	96
Natural gas consumption (MBtu/yr)	5,934	5,516	5,516	5,516	418	0	0	0	0
Electric power consumption (MBtu/yr)	14,193	14,578	14,289	14,280	16,985	17,370	17,081	17,072	
Annual energy consumption (Mbtu/yr)	20,127	20,094	19,805	19,796	17,403	17,370	17,081	17,072	15,900
predicted EUI (kBtu/sf.yr)	74.0	73.9	72.8	72.8	64.0	63.9	62.8	62.8	60.0
Electric power consumption (MWh/yr)	4,159	4,271	4,187	4,184	4,977	5,089	5,005	5,002	4,659
Fossil fuel emissions (tons/yr)	344.2	319.9	319.9	319.9	24.2	0.0	0.0	0.0	0.0
Electric emissions @ 2025 (tons/yr)	1,559.6	1,601.6	1,570.1	1,569.0	1,866.4	1,908.4	1,876.9	1,875.8	1,747.0
Total emissions @2025 (tons/yr)	1,903.8	1,921.6	1,890.1	1,888.9	1,890.6	1,908.4	1,876.9	1,875.8	1,747.0
Electric emissions @ 2050 (tons/yr)	104.0	106.8	104.7	104.6	124.4	127.2	125.1	125.1	116.5
Total emissions @2050 (tons/yr)	448.1	426.7	424.6	424.5	148.7	127.2	125.1	125.1	116.5
Space heating emissions @ 2025 (tons/yr)	606.1	606.1	606.1	606.1	350.8	350.8	350.8	350.8	174.7
Space heating emissions @ 2050 (tons/yr)	40.4	40.4	40.4	40.4	23.4	23.4	23.4	23.4	11.6
Water heating emissions @ 2025 (tons/yr)	45.9	42.3	10.5	9.6	45.9	42.3	10.5	9.6	10.5
Water heating emissions @ 2050 (tons/yr)	3.1	2.8	0.7	0.6	3.1	2.8	0.7	0.6	0.7

Emission Rates
Natural Gas: 116 lbs/MMBtu
Electricity (2025): 750 lbs/MWh
Electricity (2050): 50 lbs/MWh

Utility Cost
Natural Gas: $1.90/therm
Electricity: $0.18032/kWh

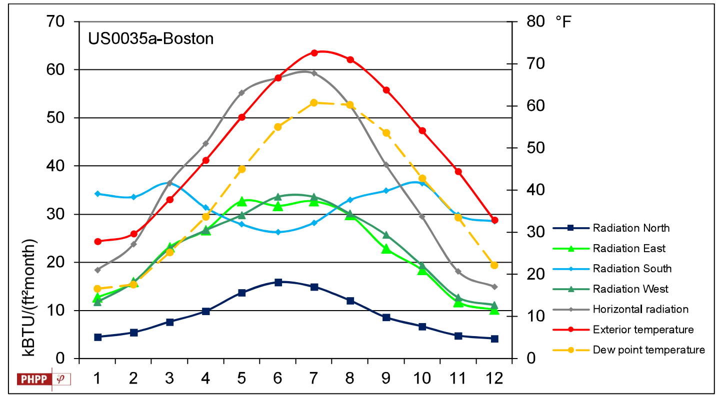
Building A Cost Analysis	Scenario 1a Gas Space Heating + Central Gas Water Heating	Scenario 1b Gas Space Heating + Electric Resistance Water Heating	Scenario 1c Gas Space Heating + Central Heat Pump Water Heating	Scenario 1d Gas Space Heating + Solar and Backup Elec Resistance Water Heating	Scenario 2a Heat Pump Space Heating + Central Gas Water Heating	Scenario 2b Heat Pump Space Heating + Electric Resistance Water Heating	Scenario 2c Heat Pump Space Heating + Central Heat Pump Water Heating	Scenario 2d Heat Pump Space Heating + Solar and Backup Elec Resistance Water Heating	Scenario 3a - EnerPhit Heat Pump Space Heating + Heat Pump Water Heating
Annual electricity cost ($)	$ 749,950.88	$ 770,146.72	$ 754,999.84	$ 754,458.88	$ 897,452.64	$ 917,648.48	$ 902,501.60	$ 901,960.64	$ 840,049.22
Annual gas cost ($)	$ 112,746.00	$ 104,804.00	$ 104,804.00	$ 104,804.00	$ 7,942.00	$ -	$ -	$ -	$ -
Annual operating cost ($)	$ 862,696.88	$ 874,950.72	$ 859,803.84	$ 859,262.88	$ 905,394.64	$ 917,648.48	$ 902,501.60	$ 901,960.64	$ 840,049.22
Annual operating cost savings ($)		$ (12,253.84)	$ 2,893.04	$ 3,434.00	$ (42,697.76)	$ (54,951.60)	$ (39,804.72)	$ (39,263.76)	$ 22,647.66
Cost increase for electrification (transformer upgrade)		$ -	$ -	$ -	$ 250,000.00	$ 250,000.00	$ 250,000.00	$ 250,000.00	$ 250,000.00
Cost increase for additianl continous insulation		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 120,000.00
Cost increase for electric water heaters		$ 6,000.00	$ -	$ -	$ -	$ 6,000.00	$ -	$ -	
Cost increase for central heat pump water heaters		$ -	$ 9,500.00	$ -	$ -	$ -	$ 9,500.00	$ -	$ 9,500.00
Cost increase for solar water heaters		$ -	$ -	$ 50,000.00	$ -	$ -	$ -	$ 50,000.00	$ -
Net cost increase of materials ($)		$ 6,000.00	$ 9,500.00	$ 50,000.00	$ 250,000.00	$ 256,000.00	$ 259,500.00	$ 300,000.00	$ 379,500.00
Net cost increase of construction ($)		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Net consulting soft cost increase ($)		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Net cost savings from rebates ($)		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Amortized Annual Cost Increase (30-yr Mortgage)		$ (459.46)	$ (727.49)	$ (3,828.87)	$ (19,144.36)	$ (19,603.83)	$ (19,871.85)	$ (22,973.23)	$ (29,061.14)
Net operating cost savings (operating+amortized)		$ (12,713.30)	$ 2,165.55	$ (394.87)	$ (61,842.12)	$ (74,555.43)	$ (59,676.57)	$ (62,236.99)	$ (6,413.48)

Building A and B are existing office buildings which are planned to be converted into light industrial spaces. Therefore, these buildings should follow the "Change of Use and Occupancy" pathway of the Stretch Energy Code. Three sets of scenarios were evaluated for the project: Scenarios 1 and 2 follow the Relative performance Pathway, where scenario 1 utilizes gas for space heating and scenario 2 utilizes heat pump for space heating; scenario 3 follows the EnerPhit pathway, utilizing heat pump for space heating and domestic hot water system. As shown above, even though the EnerPhit pathway results in annual operational cost savings, due to the increase in material cost and lack of utility incentives and tax credits, there is a net operating cost penalty over a 30-year period, considering a flat interest rate and no inflation for the utility cost. The preliminary EnerPhit results are presented below.

Result overview

Annual heating demand	1.75	kBTU/(ft²yr)
Heating load	1.28	BTU/hr.ft²
Frequency of overheating	-	%
Sensible cooling	0.18	kBTU/(ft²yr)
Latent cooling	0.01	kBTU/(ft²yr)
Cooling load	0.95	BTU/hr.ft²
PER demand	29.03	kBTU/(ft²yr)

	Data for heating Annual method	Data from monthly balance Heating	Cooling	
Heating / cooling period	198	243	153	d/a
Heating / cooling degree hours	6042	7181	-2001	°F.day/yr
Radiation North	39	83	98	kBTU/(ft²yr)
Radiation East	107	226	158	kBTU/(ft²yr)
Radiation South	205	225	161	kBTU/(ft²yr)
Radiation West	107	82	100	kBTU/(ft²yr)
Horizontal radiation	167	241	266	kBTU/(ft²yr)

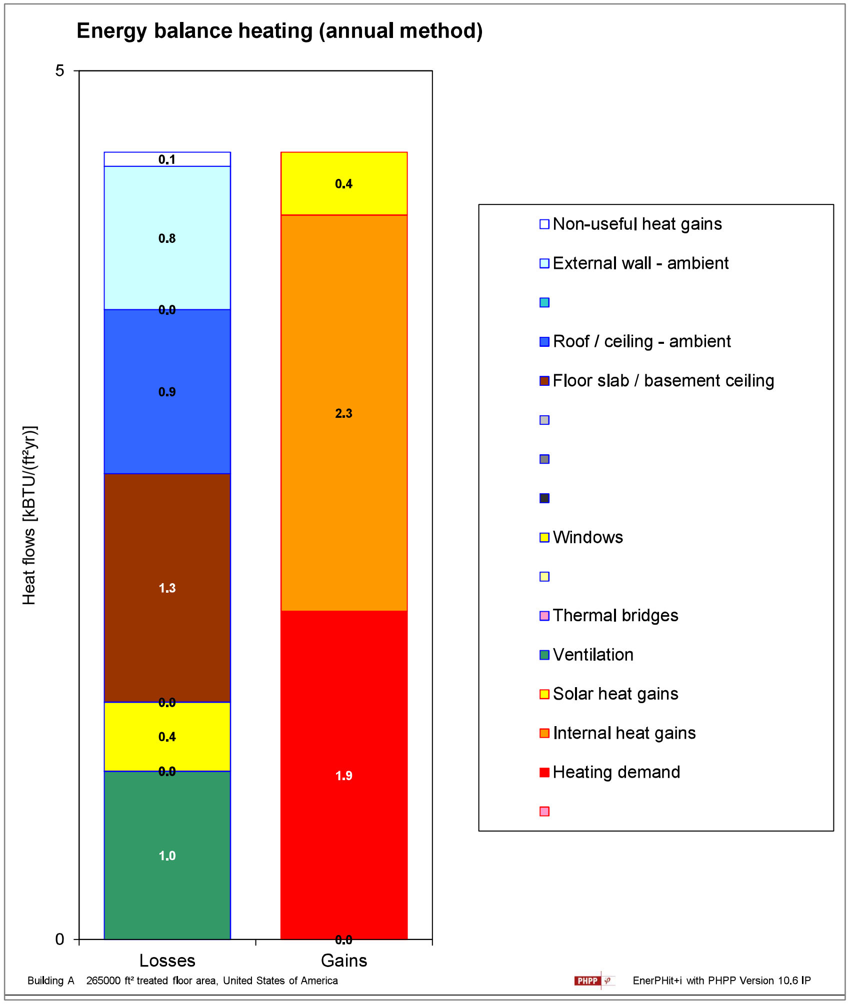


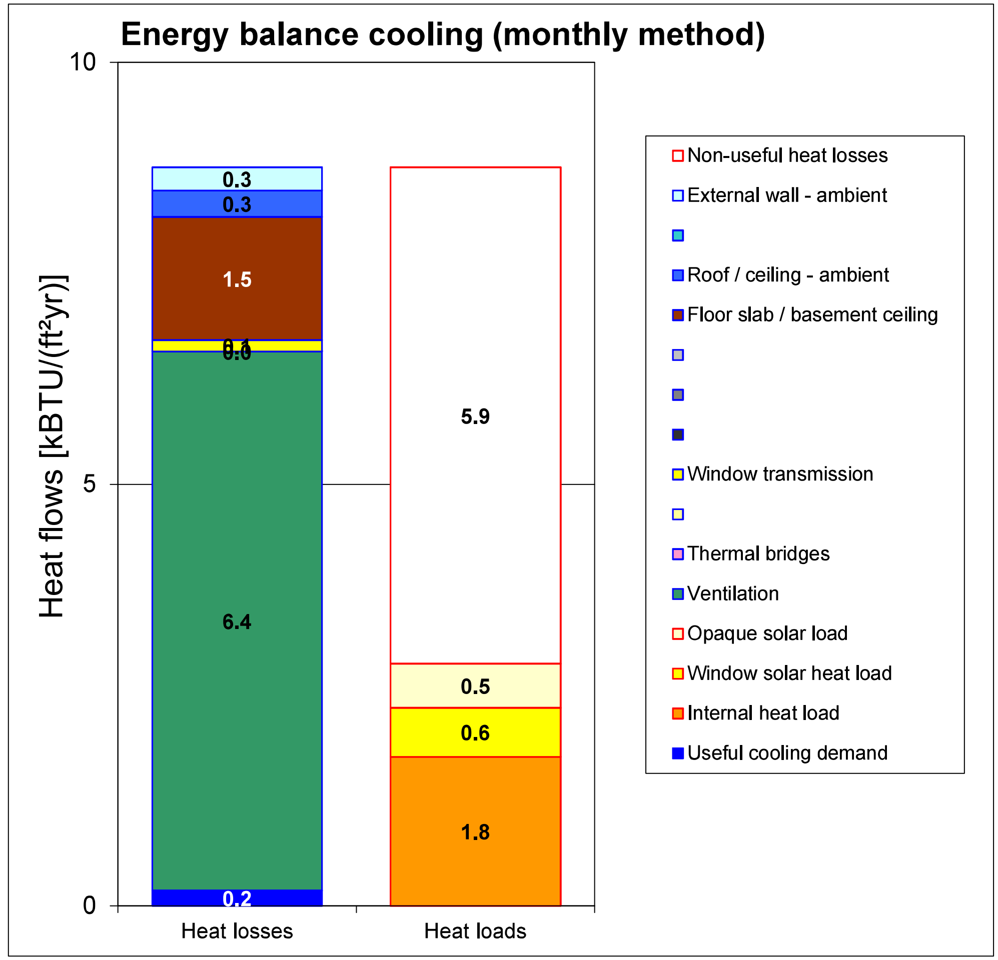
Specific building characteristics with reference to the treated floor area

				Criteria	Alternative criteria	Fullfilled?[2]
	Treated floor area ft²	265000				
Space heating	Heating demand kBTU/(ft²yr)	2	≤	7.92	-	Yes
	Heating load BTU/(hr.ft²)	1	≤	-	-	
Space cooling	Cooling & dehum. demand kBTU/(ft²yr)	0	≤	4.75		Yes
	Frequency of overheating (> 77 °F) %	-	≤	-		-
	Frequency of excessively high humidity (> 0.012 lb/lb) %	1	≤	10		Yes
Airtightness	Pressurisation test result n_{50} 1/h	0.3	≤	1.0		Yes
Non-renewable Primary Energy (PE)	PE demand kBTU/(ft²yr)	60	≤	38		No
Primary Energy Renewable (PER)	PER demand kBTU/(ft²yr)	29	≤	-	-	-
	Generation of renewable energy (in relation to projected building footprint area) kBTU/(ft²yr)	0	≥	-	-	

[2] Empty field: data missing; '-': No requirement

Note: Project is an industrial space and even though a lower process load was considered for the project, the predicted EUI is exceeding the EnerPhit limits and that might be due to the limitation of building type and data in the EnerPhit calculator.


Energy balance heating (annual method)
Heat flows [kBTU/(ft²yr)]
5
0
0.1
0.8
0.0
0.9
1.3
0.0
0.4
0.0
1.0
0.4
2.3
1.9
0.0
Losses
Gains
Non-useful heat gains
External wall - ambient
Roof / ceiling - ambient
Floor slab / basement ceiling
Windows
Thermal bridges
Ventilation
Solar heat gains
Internal heat gains
Heating demand
Building A 265000 ft² treated floor area, United States of America
EnerPHit+i with PHPP Version 10.6 IP


Energy balance cooling (monthly method)
Heat flows [kBTU/(ft²yr)]
10
5
0
0.3
0.3
1.5
6.4
0.2
5.9
0.5
0.6
1.8
Heat losses
Heat loads
Non-useful heat losses
External wall - ambient
Roof / ceiling - ambient
Floor slab / basement ceiling
Window transmission
Thermal bridges
Ventilation
Opaque solar load
Window solar heat load
Internal heat load
Useful cooling demand

Group 2: Building F Performance and Cost Analysis Results (In-Unit Electric Resistance vs. Heat Pump Hot Water System)

Building F Design Strategies, Inputs, and Outputs	Scenario 1a (HERS 44) All Electric + In-Unit Electric Resistance Water Heating	Scenario 1b (HERS 36) All Electric + Central Heat Pump Water Heating	Scenario 1c (HERS 40) All Electric + solar and resistance Water Heating	Scenario 2a (TEDI) All Electric + In-Unit Electric Resistance Water Heating	Scenario 2b (TEDI) All Electric + Central Heat Pump Water Heating	Scenario 2c (TEDI) All Electric + solar and resistance Water Heating	Scenario 3a (Passive House) All Electric + Individual HP Water Heating	Scenario 3b (Passive House) All Electric + Central Heat Pump Water Heating	Scenario 3c (Passive House) All Electric + Solar and Backup Elec Resistance
Roof R value	R-49	R-49	R-49	R-40	R-40	R-40	R-40	R-40	R-40
Wall U value	0.039	0.039	0.039	0.047	0.047	0.047	0.040	0.040	0.040
% wall	75%	75%	75%	75%	75%	0.75	75%	75%	75%
Window U value	0.26 Res / 0.25 CW	0.26 Res / 0.25 CW	0.26 Res / 0.25 CW	0.22 Res / 0.25 CW	0.22 Res / 0.25 CW	0.22 Res / 0.25 CW	0.18 Res / 0.25 CW	0.18 Res / 0.25 CW	0.18 Res / 0.25 CW
% window	25%	25%	25%	25%	25%	0.25	25%	25%	25%
Area-weighted vertical above grade U value	0.088	0.088	0.088	0.081	0.081	0.081	0.076	0.076	0.076
Air infiltration (cfm at 75 PA)	0.33	0.33	0.33	0.30	0.30	0.30	~0.08 (0.06 @CFM50)	~0.08 (0.06 @CFM50)	~0.08 (0.06 @CFM50)
Ventilation energy recovery	78%	78%	78%	77%	77%	77%	77%	77%	77%
Solar heat gain coefficient (SHGC)	0.26	0.26	0.26	0.27	0.27	0.27	0.27	0.27	0.27
Heating TEDI/ PHIUS Heating Demand (kBtu/sf-yr)	-	-	-	2.49	2.49	2.49	*4.52*	*4.52*	*4.68*
Cooling TEDI/ / PHIUS Cooling Demand(kBtu/sf-yr)	-	-	-	10.18	10.18	10.18	*4.51*	*2.96*	*2.82*
Peak annual space heating demand (Mbtu/hr)	-	-	-	0.445	0.449	0.449	0.72	0.72	0.72
Peak annual space cooling demand (Mbtu/hr)	-	-	-	0.444	0.445	0.445	0.31	0.25	0.24
Peak annual electric load (MW)	-	-	-	0.345	0.309	0.345	*N/A**	*N/A**	*N/A**
Peak annual gas load (MBH)	-	-	-	0	0	0	0	0	0
Annual space heating energy (MBtu)	402	402	402	174	174	174	292	292	301
Annual water heating energy (MBtu)	1,188	368	359	1,188	368	359	344	237	230.7
Natural gas consumption (MBtu/yr)	0	0	0	0	0	0	0	0	0
Electric power consumption (MBtu/yr)	3,953	3,194	3,124	4,588	3,767	3,758	3,300	3,119	2,915
Electric power consumption (MWh/yr)	1,158	936	915	1,344	1,104	1,101	967	914	854
Fossil fuel emissions (tons/yr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Electric emissions @ 2025 (tons/yr)	434.4	351.0	343.2	504.0	413.9	412.9	362.7	342.8	320.4
Total emissions @2025 (tons/yr)	434.4	351.0	343.2	504.0	413.9	412.9	362.7	342.8	320.4
Electric emissions @ 2050 (tons/yr)	29.0	23.4	22.9	33.6	27.6	27.5	24.2	22.9	21.4
Total emissions @2050 (tons/yr)	29.0	23.4	22.9	33.6	27.6	27.5	24.2	22.9	21.4
Space heating emissions @ 2025 (tons/yr)	44.2	44.2	44.2	19.1	19.1	19.1	32.0	32.0	33.1
Space heating emissions @ 2050 (tons/yr)	2.9	2.9	2.9	1.3	1.3	1.3	2.1	2.1	2.2
Water heating emissions @ 2025 (tons/yr)	130.5	40.4	39.4	130.5	40.4	39.4	37.8	26.0	25.4
Water heating emissions @ 2050 (tons/yr)	8.7	2.7	2.6	8.7	2.7	2.6	2.5	1.7	1.7

Emission Rates
Natural Gas: 116 lbs/MMBtu
Electricity (2025): 750 lbs/MWh
Electricity (2050): 50 lbs/MWh
Only available for heating and cooling; not overall in WUFI Passive

Utility Cost
Natural Gas: $1.70/therm
Electricity: $0.13431/kWh

Building F Cost Analysis	Scenario 1a (HERS 44) All Electric + In-Unit Electric Resistance Water Heating	Scenario 1b (HERS 36) All Electric + Central Heat Pump Water Heating	Scenario 1c (HERS 40) All Electric + solar and resistance Water Heating	Scenario 2a (TEDI) All Electric + In-Unit Electric Resistance Water Heating	Scenario 2b (TEDI) All Electric + Central Heat Pump Water Heating	Scenario 2c (TEDI) All Electric + solar and resistance Water Heating	Scenario 3a (Passive House) All Electric + Individual HP Water Heating	Scenario 3b (Passive House) All Electric + Central Heat Pump Water Heating	House) All Electric + Solar and Backup Elec Resistance Water Heating
Annual electricity cost ($)	$ 155,568	$ 125,701	$ 122,931	$ 180,529	$ 148,250	$ 147,884	$ 129,895	$ 122,765	$ 114,756
Annual gas cost ($)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Annual operating cost ($)	$ 155,568	$ 125,701	$ 122,931	$ 180,529	$ 148,250	$ 147,884	$ 129,895	$ 122,765	$ 114,756
Annual operating cost savings ($)	$ 24,961	$ 54,828	$ 57,598		$ 32,279	$ 32,645	$ 50,634	$ 57,764	$ 65,773
Cost increase for additianl continous insulation	$ 346,000	$ 346,000	$ 346,000		$ -	$ -	$ 692,000	$ 692,000	$ 692,000
Cost increase for in-unit heat pump water heaters	$ -	$ -	$ -		$ -	$ -	$ 195,000	$ -	$ -
Cost increase for central heat pump water heaters	$ -	$ 520,000	$ -		$ 520,000	$ -	$ -	$ 520,000	$ 650,000
Cost increase for solar water heaters	$ -	$ -	$ 650,000		$ -	$ 650,000	$ -	$ -	$ -
Net cost increase of materials ($)	$ 346,000	$ 866,000	$ 996,000		$ 520,000	$ 650,000	$ 887,000	$ 1,212,000	$ 1,342,000
Net cost increase of construction ($)	$ -	$ -	$ -		$ -	$ -	$ -	$ -	
Net consulting soft cost increase ($)	$ 30,000	$ 30,000	$ 30,000		$ -	$ -	$ 160,000	$ 160,000	$ 160,000
Net cost savings from rebates ($)	$ -	$ -	$ -		$ -	$ -	$ -	$ -	$ -
Amortized Annual Cost Increase (30-yr Mortgage)	$ (28,793)	$ (68,613)	$ (78,568)		$ (39,820)	$ (49,775)	$ (80,177)	$ (105,064)	$ (115,019)
Net operating cost savings (operating+amortized)	$ (3,832)	$ (13,785)	$ (20,970)		$ (7,541)	$ (17,130)	$ (29,542)	$ (47,301)	$ (49,247)

Group 2: Building F Performance and Cost Analysis Results (Central Electric Resistance vs. Heat Pump Hot Water System)

Building F Design Strategies, Inputs, and Outputs	*Scenario 1a (HERS 44) All Electric + In-Unit Electric Resistance Water Heating*	*Scenario 1b (HERS 36) All Electric + Central Heat Pump Water Heating*	*Scenario 1c (HERS 40) All Electric + solar and resistance Water Heating*	*Scenario 2a (TEDI) All Electric + Central Electric Resistance Water Heating*	*Scenario 2b (TEDI) All Electric + Central Heat Pump Water Heating*	*Scenario 2c (TEDI) All Electric + solar and resistance Water Heating*	*Scenario 3a (Passive House) All Electric + Individual HP Water Heating*	*Scenario 3b (Passive House) All Electric + Central Heat Pump Water Heating*	*Scenario 3c (Passive House) All Electric + Solar and Backup Elec Resistance*
Roof R value	R-49	R-49	R-49	R-40	R-40	R-40	R-40	R-40	R-40
Wall U value	0.039	0.039	0.039	0.047	0.047	0.047	0.040	0.040	0.040
% wall	75%	75%	75%	75%	75%	0.75	75%	75%	75%
Window U value	0.26 Res / 0.25 CW	0.26 Res / 0.25 CW	0.26 Res / 0.25 CW	0.22 Res / 0.25 CW	0.22 Res / 0.25 CW	0.22 Res / 0.25 CW	0.18 Res / 0.25 CW	0.18 Res / 0.25 CW	0.18 Res / 0.25 CW
% window	25%	25%	25%	25%	25%	0.25	25%	25%	25%
Area-weighted vertical above grade U value	0.088	0.088	0.088	0.081	0.081	0.081	0.076	0.076	0.076
Air infiltration (cfm at 75 PA)	0.33	0.33	0.33	0.30	0.30	0.30	~0.08 (0.06 @CFM50)	~0.08 (0.06 @CFM50)	~0.08 (0.06 @CFM50)
Ventilation energy recovery	78%	78%	78%	77%	77%	77%	77%	77%	77%
Solar heat gain coefficient (SHGC)	0.26	0.26	0.26	0.27	0.27	0.27	0.27	0.27	0.27
Heating TEDI/ PHIUS Heating Demand (kBtu/sf-yr)	-	-	-	2.49	2.49	2.49	*4.52*	*4.52*	*4.68*
Cooling TEDI/ / PHIUS Cooling Demand(kBtu/sf-yr	-	-	-	10.18	10.18	10.18	*4.51*	*2.96*	*2.82*
Peak annual space heating demand (Mbtu/hr)	-	-	-	0.445	0.449	0.449	0.72	0.72	0.72
Peak annual space cooling demand (Mbtu/hr)	-	-	-	0.444	0.445	0.445	0.31	0.25	0.24
Peak annual electric load (MW)	-	-	-	0.345	0.309	0.345	*N/A**	*N/A**	*N/A**
Peak annual gas load (MBH)	-	-	-	0	0	0	0	0	0
Annual space heating energy (MBtu)	402	402	402	174	174	174	292	292	301
Annual water heating energy (MBtu)	1,188	368	359	1,188	368	359	344	237	230.7
Natural gas consumption (MBtu/yr)	0	0	0	0	0	0	0	0	0
Electric power consumption (MBtu/yr)	3,953	3,194	3,124	4,588	3,767	3,758	3,300	3,119	2,915
Electric power consumption (MWh/yr)	1,158	936	915	1,344	1,104	1,101	967	914	854
Fossil fuel emissions (tons/yr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Electric emissions @ 2025 (tons/yr)	434.4	351.0	343.2	504.0	413.9	412.9	362.7	342.8	320.4
Total emissions @2025 (tons/yr)	434.4	351.0	343.2	504.0	413.9	412.9	362.7	342.8	320.4
Electric emissions @ 2050 (tons/yr)	29.0	23.4	22.9	33.6	27.6	27.5	24.2	22.9	21.4
Total emissions @2050 (tons/yr)	29.0	23.4	22.9	33.6	27.6	27.5	24.2	22.9	21.4
Space heating emissions @ 2025 (tons/yr)	44.2	44.2	44.2	19.1	19.1	19.1	32.0	32.0	33.1
Space heating emissions @ 2050 (tons/yr)	2.9	2.9	2.9	1.3	1.3	1.3	2.1	2.1	2.2
Water heating emissions @ 2025 (tons/yr)	130.5	40.4	39.4	130.5	40.4	39.4	37.8	26.0	25.4
Water heating emissions @ 2050 (tons/yr)	8.7	2.7	2.6	8.7	2.7	2.6	2.5	1.7	1.7

Emission Rates
Natural Gas: 116 lbs/MMBtu
Electricity (2025): 750 lbs/MWh
Electricity (2050): 50 lbs/MWh
**Only available for heating and cooling; not overall in WUFI Passive*

Utility Cost
Natural Gas: $1.70/therm
Electricity: $0.13431/kWh

Building F Cost Analysis	*Scenario 1a (HERS 44) All Electric + In-Unit Electric Resistance Water Heating*	*Scenario 1b (HERS 36) All Electric + Central Heat Pump Water Heating*	*Scenario 1c (HERS 40) All Electric + solar and resistance Water Heating*	*Scenario 2a (TEDI) All Electric + Central Electric Resistance Water Heating*	*Scenario 2b (TEDI) All Electric + Central Heat Pump Water Heating*	*Scenario 2c (TEDI) All Electric + solar and resistance Water Heating*	*Scenario 3a (Passive House) All Electric + Individual HP Water Heating*	*Scenario 3b (Passive House) All Electric + Central Heat Pump Water Heating*	*House) All Electric + Solar and Backup Elec Resistance Water Heating*
Annual electricity cost ($)	$ 155,568	$ 125,701	$ 122,931	$ 180,529	$ 148,250	$ 147,884	$ 129,895	$ 122,765	$ 114,756
Annual gas cost ($)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Annual operating cost ($)	$ 155,568	$ 125,701	$ 122,931	$ 180,529	$ 148,250	$ 147,884	$ 129,895	$ 122,765	$ 114,756
Annual operating cost savings ($)	$ 24,961	$ 54,828	$ 57,598		$ 32,279	$ 32,645	$ 50,634	$ 57,764	$ 65,773
Cost increase for additiant continous insulation	$ 346,000	$ 346,000	$ 346,000		$ -	$ -	$ 692,000	$ 692,000	$ 692,000
Cost increase for in-unit water heaters	$ -	$ -	$ -		$ -	$ -	$ 195,000	$ -	$ -
Cost increase for central heat pump water heaters	$ -	$ 305,200	$ -		$ 305,200	$ -	$ -	$ 305,200	$ 650,000
Cost increase for solar water heaters	$ -	$ -	$ 650,000		$ -	$ 650,000	$ -	$ -	$ -
Net cost increase of materials ($)	$ 346,000	$ 651,200	$ 996,000		$ 305,200	$ 650,000	$ 887,000	$ 997,200	$ 1,342,000
Net cost increase of construction ($)	$ -	$ -	$ -		$ -	$ -	$ -	$ -	
Net consulting soft cost increase ($)	$ 30,000	$ 30,000	$ 30,000		$ -	$ -	$ 160,000	$ 160,000	$ 160,000
Net cost savings from rebates ($)	$ -	$ -	$ -		$ -	$ -	$ -	$ -	$ -
Amortized Annual Cost Increase (30-yr Mortgage)	$ (28,793)	$ (52,165)	$ (78,568)		$ (23,371)	$ (49,775)	$ (80,177)	$ (88,615)	$ (115,019)
Net operating cost savings (operating+amortized)	$ (3,832)	$ 2,664	$ (20,970)		$ 8,908	$ (17,130)	$ (29,542)	$ (30,852)	$ (49,247)

Building F represents a residential building with more than 50 units. Three sets of scenarios were evaluated for the project: Scenarios 1 follow the Certified Pathway (HERS), Scenarios 2 follow the Targeted Performance (TEDI) Pathway, and Scenarios 3 follow the Certified Pathway (Passive House). Residential buildings will be all-electric and therefore, no gas space heating analysis was performed. Additionally, the Passive House requirements couldn't be met with electric resistance water heaters and therefore, Scenario 3 was run with both in-unit heat pump water heaters and central heat pump water heaters. As shown above, even though the Passive House pathway results in annual operational cost savings, due to the increase in material cost and lack of utility incentives and tax credits, there is a net operating cost penalty over a 30-year period, considering a flat interest rate and no inflation for the utility cost. The preliminary HERS, TEDI, and Passive House results are presented below.

TEDI Analysis

Exterior Wall Option	Scenario Description	eQUEST runs	Punched Window U-Value	Storefront U-value	Window SHGC	Slab on Grade	Wood-Framed Walls	Roof Assembly U-Value	Inf Rate 75 Pa (CFM/SF)	WWR	HR Effect %	Modeled TEDI Cooling (kBtu/SF)	Modeled TEDI Heating (kBtu/SF)	PASSED or FAILED	Notes
1	**Roof Assembly:** R-40 CI **Exterior Wall:** R-21 Batt + 1.5 Inches of C.I. **Slab on Grade Insulation:** R-10 C.I.	A	**0.22**	0.25	0.27	R-10 C.I.	0.047	0.025	**0.35**	25%	75%	10.04	-3.08	FAILED	Increased Window U-value; Increased Infiltration
		B	**0.22**	0.25	0.27	R-10 C.I.	0.047	0.025	0.3	25%	77%	10.18	-2.49	PASSED	Increased Window U-value+ 77% EFF
		C	0.18	0.25	0.27	R-10 C.I.	0.047	0.025	**0.35**	25%	75%	10.26	-2.70	PASSED	Increased Infiltration
		D	0.18	0.25	0.27	R-10 C.I.	0.047	0.025	0.3	25%	75%	10.34	-2.43	PASSED	Basis of Design
		E	0.18	0.25	0.27	R-10 C.I.	0.047	0.025	**0.25**	25%	75%	10.42	-2.16	PASSED	Reduced Infiltration
		F	0.18	0.25	0.27	R-10 C.I.	0.047	0.025	0.3	25%	**77%**	10.41	-2.15	PASSED	Increased Heat Recovery Effectivness
2	**Roof Assembly:** R-40 CI **Exterior Wall:** R-21 Batt + 3 Inches of C.I. **Slab on Grade Insulation:** R-10 C.I.	D	0.18	0.25	0.27	R-10 C.I.	**0.04**	0.025	0.3	25%	75%	10.39	-2.22	PASSED	Increased Wall Insulation
		E	0.18	0.25	0.27	R-10 C.I.	**0.04**	0.025	**0.25**	25%	75%	10.48	-1.97	PASSED	Reduced Infiltration
		F	0.18	0.25	0.27	R-10 C.I.	**0.04**	0.025	0.3	25%	**77%**	10.46	-1.95	PASSED	Increased Heat Recovery Effectivness

TEDI Cooling Threshold (kBtu/SF)	Modeled TEDI Heating Threshold (kBtu/SF)
22.00	2.80

This run was used

Table 1 Standardized Assumptions for Residential Buildings > 75,000-sf

Thermal Block Type	Schedule Index (Note 1)	Misc. Loads*	Lighting Power	Ventilation Rate	Occupant Density	Occupant Heat Gain	
						Btu/h-person	
		W/sf	W/sf	CFM/sf	sf/Person	Sensible	Latent
Residential	A	1.74	0.41	0.096	245	257	166
Supporting Spaces (heated and cooled)	B	0.2	0.46	0.08	1000	257	166
Non-residential Thermal Blocks	C	1.15	0.66	0.11	200	257	166

* Use a sensible fraction of 1.0 and a latent fraction of 0.0 for all thermal blocks with the exception that Residential should be modeled with a latent fraction of 0.14.

HERS Results: Electric Resistance Water Heaters

Home Energy Rating Certificate

Property
Lupoli Bldg F, 3 Bed
Lupoli
King Street Crossing
Littleton, MA 01460

HERS
Rating Type: Projected Rating
Rating Date: 2025-04-24
Registry ID:

Certified Energy Rater: Mark Price
Rating Number:

Projected Rating: Based on Plans - Field Confirmation Required.

HERS Index: 44 | **Efficient Home Comparison: 56% Better**

General Information

Conditioned Area	1415 sq. ft.	House Type	Apartment, end unit
Conditioned Volume	14150 cubic ft.	Foundation	Apt above enclosed space
Bedrooms	3		

Mechanical Systems Features

Air-source heat pump:	Electric, Htg: 13.3 HSPF. Clg: 18.8 SEER.
Water Heating:	Conventional, Electric, 0.95 EF, 40.0 Gal.
Duct Leakage to Outside	0.01 CFM25
Ventilation System	Balanced: ERV, 73 cfm, 63.0 watts.
Programmable Thermostat	Heat=Yes; Cool=Yes

Building Shell Features

Ceiling Flat	NA	Slab	None
Sealed Attic	NA	Exposed Floor	NA
Vaulted Ceiling	R-49.0	Window Type	U-Value: 0.260, SHGC: 0.260
Above Grade Walls	R-32.0	Infiltration Rate	5.00 ACH50
Foundation Walls	NA	Method	Blower door

Lights and Appliance Features

Interior Fluor Lighting (%)	0.0	Range/Oven Fuel	Electric
Interior LED Lighting (%)	100.0	Clothes Dryer Fuel	Electric
Refrigerator (kWh/yr)	650	Clothes Dryer CEF	3.73
Dishwasher (kWh/yr)	270	Ceiling Fan (cfm/Watt)	0.00

Estimated Annual Energy Cost

Use	MMBtu	Cost	Percent
Heating	3.2	$161	12%
Cooling	0.8	$40	3%
Hot Water	7.6	$380	29%
Lights/Appliances	14.7	$733	56%
Photovoltaics	0.0	$0	0%
Service Charges		$0	0%
Total	**26.4**	**$1314**	**100%**

Criteria

This home meets or exceeds the minimum criteria for the following:

Mark Price
Price Sustainability Assoc.
28 Walnut Street
Maynard, MA 01754
978.760.2723

Certified Energy Rater:

REM/Rate - Residential Energy Analysis and Rating Software v16.3.4.1025
This information does not constitute any warranty of energy costs or savings. © 1985-2024 NORESCO, Westminster, Colorado.
The Home Energy Rating Standard Disclosure for this home is available from the rating provider.

HERS Results: Heat Pump Water Heaters

Home Energy Rating Certificate

Property
Lupoli Bldg F, 3 Bed
Lupoli
King Street Crossing
Littleton, MA 01460

HERS

Rating Type:	Projected Rating	Certified Energy Rater:	Mark Price
Rating Date:	2025-04-24	Rating Number:	
Registry ID:			

Projected Rating: Based on Plans - Field Confirmation Required.

HERS Index: 36 **Efficient Home Comparison: 64% Better**

General Information

Conditioned Area	1415 sq. ft.	House Type	Apartment, end unit
Conditioned Volume	14150 cubic ft.	Foundation	Apt above enclosed space
Bedrooms	3		

Mechanical Systems Features

Air-source heat pump:	Electric, Htg: 13.3 HSPF. Clg: 18.8 SEER.
Water Heating:	Heat pump, Electric, 4.00 EF, 50.0 Gal.
Duct Leakage to Outside	0.01 CFM25
Ventilation System	Balanced: ERV, 73 cfm, 63.0 watts.
Programmable Thermostat	Heat=Yes; Cool=Yes

Building Shell Features

Ceiling Flat	NA	Slab	None
Sealed Attic	NA	Exposed Floor	NA
Vaulted Ceiling	R-49.0	Window Type	U-Value: 0.260, SHGC: 0.260
Above Grade Walls	R-32.0	Infiltration Rate	5.00 ACH50
Foundation Walls	NA	Method	Blower door

Lights and Appliance Features

Interior Fluor Lighting (%)	0.0	Range/Oven Fuel	Electric
Interior LED Lighting (%)	100.0	Clothes Dryer Fuel	Electric
Refrigerator (kWh/yr)	650	Clothes Dryer CEF	3.73
Dishwasher (kWh/yr)	270	Ceiling Fan (cfm/Watt)	0.00

Estimated Annual Energy Cost

Use	MMBtu	Cost	Percent
Heating	4.1	$204	20%
Cooling	0.5	$27	3%
Hot Water	1.7	$83	8%
Lights/Appliances	14.7	$733	70%
Photovoltaics	0.0	$0	0%
Service Charges		$0	0%
Total	**21.0**	**$1047**	**100%**

Criteria

This home meets or exceeds the minimum criteria for the following:

Mark Price
Price Sustainability Assoc.
28 Walnut Street
Maynard, MA 01754
978.760.2723

Certified Energy Rater:

REM/Rate - Residential Energy Analysis and Rating Software v16.3.4.1025
This information does not constitute any warranty of energy costs or savings. © 1985-2024 NORESCO, Westminster, Colorado.
The Home Energy Rating Standard Disclosure for this home is available from the rating provider.

HERS Results: Solar Water Heater

Home Energy Rating Certificate

Property
Lupoli Bldg F, 3 Bed
Lupoli
King Street Crossing
Littleton, MA 01460

HERS
Rating Type: Projected Rating
Rating Date: 2025-04-24
Registry ID:

Certified Energy Rater: Mark Price
Rating Number:

Projected Rating: Based on Plans - Field Confirmation Required.

HERS Index: 40 **Efficient Home Comparison: 60% Better**

General Information

Conditioned Area	1415 sq. ft.	House Type	Apartment, end unit
Conditioned Volume	14150 cubic ft.	Foundation	Apt above enclosed space
Bedrooms	3		

Mechanical Systems Features

Air-source heat pump:	Electric, Htg: 13.3 HSPF. Clg: 18.8 SEER.
Water Heating:	Conventional, Electric, 0.95 EF, 40.0 Gal.
Duct Leakage to Outside	0.01 CFM25
Ventilation System	Balanced: ERV, 73 cfm, 63.0 watts.
Programmable Thermostat	Heat=Yes; Cool=Yes

Building Shell Features

Ceiling Flat	NA	Slab	None
Sealed Attic	NA	Exposed Floor	NA
Vaulted Ceiling	R-49.0	Window Type	U-Value: 0.260, SHGC: 0.260
Above Grade Walls	R-32.0	Infiltration Rate	5.00 ACH50
Foundation Walls	NA	Method	Blower door

Lights and Appliance Features

Interior Fluor Lighting (%)	0.0	Range/Oven Fuel	Electric
Interior LED Lighting (%)	100.0	Clothes Dryer Fuel	Electric
Refrigerator (kWh/yr)	650	Clothes Dryer CEF	3.73
Dishwasher (kWh/yr)	270	Ceiling Fan (cfm/Watt)	0.00

Estimated Annual Energy Cost

Use	MMBtu	Cost	Percent
Heating	3.2	$161	14%
Cooling	0.8	$40	3%
Hot Water	7.6	$380	32%
Lights/Appliances	14.7	$733	62%
Photovoltaics	-2.8	$-139	-12%
Service Charges		$0	0%
Total	**23.6**	**$1174**	**100%**

Criteria

This home meets or exceeds the minimum criteria for the following:

Mark Price
Price Sustainability Assoc.
28 Walnut Street
Maynard, MA 01754
978.760.2723

Certified Energy Rater:

REM/Rate - Residential Energy Analysis and Rating Software v16.3.4.1025

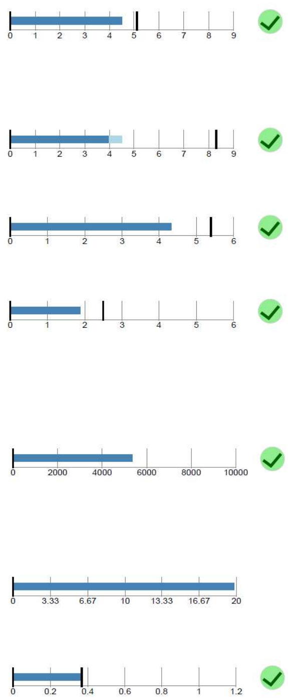
The Home Energy Rating Standard Disclosure for this home is available from the rating provider.

Passive House Results

In-Unit Heat Pump Water Heaters

PASSIVEHOUSE REQUIREMENTS

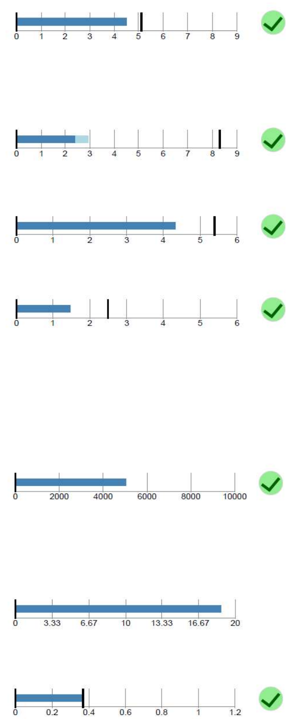
Certificate criteria:	**Phius CORE 2021**	
Heating demand		
specific:	**4.52**	kBtu/ft²yr
target:	**5.1**	kBtu/ft²yr
total:	753,895.98	kBtu/yr
Cooling demand		
sensible:	**3.98**	kBtu/ft²yr
latent:	**0.53**	kBtu/ft²yr
specific:	**4.51**	kBtu/ft²yr
target:	**8.3**	kBtu/ft²yr
total:	751,764.56	kBtu/yr
Heating load		
specific:	**4.32**	Btu/hr ft²
target:	**5.4**	Btu/hr ft²
total:	720,728.73	Btu/hr
Cooling load		
specific:	**1.89**	Btu/hr ft²
target:	**2.5**	Btu/hr ft²
total:	314,589.69	Btu/hr
Source energy		
total:	**1,934,268.85**	kWh/yr
specific:	**5,343**	kWh/Person yr
target:	**10,625**	kWh/Person yr
total:	**6,599,347.85**	kBtu/yr
specific:	39.58	kBtu/ft²yr
Site energy		
total:	3,299,673.93	kBtu/yr
specific:	19.79	kBtu/ft²yr
total:	967,134.43	kWh/yr
specific:	5.8	kWh/ft²
Air tightness		
ACH50:	**0.37**	1/hr
CFM50 per envelope area:	**0.06**	cfm/ft²
target:	**0.37**	1/hr
target CFM50:	**0.06**	cfm/ft²



Central Heat Pump Water Heaters

PASSIVEHOUSE REQUIREMENTS

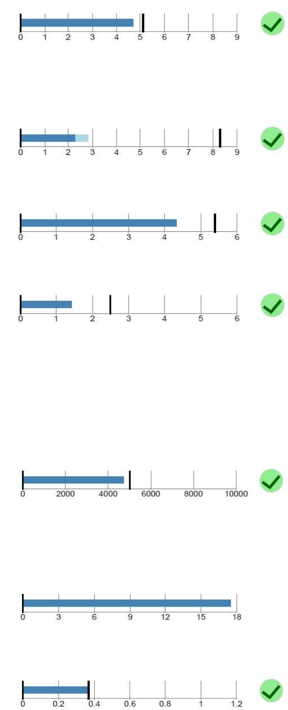
Certificate criteria:	**Phius CORE 2021**	
Heating demand		
specific:	**4.52**	kBtu/ft²yr
target:	**5.1**	kBtu/ft²yr
total:	753,895.98	kBtu/yr
Cooling demand		
sensible:	**2.42**	kBtu/ft²yr
latent:	**0.53**	kBtu/ft²yr
specific:	**2.96**	kBtu/ft²yr
target:	**8.3**	kBtu/ft²yr
total:	492,778.98	kBtu/yr
Heating load		
specific:	**4.32**	Btu/hr ft²
target:	**5.4**	Btu/hr ft²
total:	720,728.73	Btu/hr
Cooling load		
specific:	**1.47**	Btu/hr ft²
target:	**2.5**	Btu/hr ft²
total:	245,297.88	Btu/hr
Source energy		
total:	**1,828,104.16**	kWh/yr
specific:	**5,050**	kWh/Person yr
target:	**10,625**	kWh/Person yr
total:	**6,237,134.63**	kBtu/yr
specific:	37.41	kBtu/ft²yr
Site energy		
total:	3,118,567.32	kBtu/yr
specific:	18.71	kBtu/ft²yr
total:	914,052.08	kWh/yr
specific:	5.48	kWh/ft²
Air tightness		
ACH50:	**0.37**	1/hr
CFM50 per envelope area:	**0.06**	cfm/ft²
target:	**0.37**	1/hr
target CFM50:	**0.06**	cfm/ft²



Solar + Electric Resistance Water Heaters

PASSIVEHOUSE REQUIREMENTS

Certificate criteria:	**Phius CORE 2021**	
Heating demand		
specific:	**4.68**	kBtu/ft²yr
target:	**5.1**	kBtu/ft²yr
total:	780,374.03	kBtu/yr
Cooling demand		
sensible:	**2.29**	kBtu/ft²yr
latent:	**0.53**	kBtu/ft²yr
specific:	**2.82**	kBtu/ft²yr
target:	**8.3**	kBtu/ft²yr
total:	470,580.08	kBtu/yr
Heating load		
specific:	**4.32**	Btu/hr ft²
target:	**5.4**	Btu/hr ft²
total:	720,728.73	Btu/hr
Cooling load		
specific:	**1.43**	Btu/hr ft²
target:	**2.5**	Btu/hr ft²
total:	238,588.83	Btu/hr
Source energy		
total:	**1,708,841.89**	kWh/yr
specific:	**4,721**	kWh/Person yr
target:	**5,000**	kWh/Person yr
total:	**5,830,235.04**	kBtu/yr
specific:	34.97	kBtu/ft²yr
Site energy		
total:	2,915,117.52	kBtu/yr
specific:	17.49	kBtu/ft²yr
total:	854,420.94	kWh/yr
specific:	5.12	kWh/ft²
Air tightness		
ACH50:	**0.37**	1/hr
CFM50 per envelope area:	**0.06**	cfm/ft²
target:	**0.37**	1/hr
target CFM50:	**0.06**	cfm/ft²



Group 3: Building K Performance and Cost Analysis Results

Building K

Design Strategies, Inputs, and Outputs	Scenario 1a (HERS 44) All Electric + In-unit Electric Resistance Water Heating	Scenario 1b (HERS 36) All Electric + In-unit Heat Pump Water Heating	Scenario 2a (TEDI) All Electric + In-unit Electric Resistance Water Heating	Scenario 2b (TEDI) All Electric + In-Unit Heat Pump Water Heating	Scenario 3a (Passive House) All Electric + Individual HP Water Heating + 16.5 kW PV Array*	Scenario 3b (Passive House) All Electric + Central Heat Pump Water Heating + 7.5 kW PV Array**
Roof R value	R-49	R-49	R-50	R-50	R-60	R-60
Wall U value	0.039	0.039	0.040	0.040	0.028	0.028
% wall	74%	74%	74%	74%	74%	74%
Window U value	0.26 Res / 0.25 CW	0.26 Res / 0.25 CW	U-0.1675	U-0.1675	U-0.15	U-0.15
% window	26%	26%	26%	26%	26%	26%
Area-weighted vertical above grade U value	0.090	0.090	0.073	0.073	0.060	0.060
Air infiltration (cfm at 75 PA)	0.33	0.33	0.20	0.20	~0.08 (0.06 @CFM50)	~0.08 (0.06 @CFM50)
Ventilation energy recovery	78%	78%	80%	80%	82%	82%
Solar heat gain coefficient (SHGC)	0.26	0.26	0.27	0.27	0.22	0.22
Heating TEDI/ PHIUS Heating Demand (kBtu/sf-yr)	-	-	3.12	3.12	*5.69*	*5.69*
Cooling TEDI/ / PHIUS Cooling Demand(kBtu/sf-yr)	-	-	8.70	8.70	*2.22*	*1.71*
Peak annual space heating demand (Mbtu/hr)	-	-	0.201	0.201	0.41	0.41
Peak annual space cooling demand (Mbtu/hr)	-	-	0.166	0.166	0.14	0.12
Peak annual electric load (MW)	-	-	0.139	0.121	*N/A**	*N/A**
Peak annual gas load (MBH)	-	-	0	0	0	0
Annual space heating energy (MBtu)	165	208	86	86	163	163
Annual water heating energy (MBtu)	636	218	636	218	109	82
Natural gas consumption (MBtu/yr)	0	0	0	0	0	0
Electric power consumption (MBtu/yr)	1,834	1,482	1,992	1,575	1,376	1,379
Electric power consumption (MWh/yr)	537	434	584	461	403	404
Fossil fuel emissions (tons/yr)	0.0	0.0	0.0	0.0	0.0	0.0
Electric emissions @ 2025 (tons/yr)	201.5	162.9	218.9	173.0	151.3	151.5
Total emissions @2025 (tons/yr)	201.5	162.9	218.9	173.0	151.3	151.5
Electric emissions @ 2050 (tons/yr)	13.4	10.9	14.6	11.5	10.1	10.1
Total emissions @2050 (tons/yr)	13.4	10.9	14.6	11.5	10.1	10.1
Space heating emissions @ 2025 (tons/yr)	18.2	22.8	9.4	9.4	17.9	17.9
Space heating emissions @ 2050 (tons/yr)	1.2	1.5	0.6	0.6	1.2	1.2
Water heating emissions @ 2025 (tons/yr)	69.8	24.0	69.8	24.0	12.0	9.0
Water heating emissions @ 2050 (tons/yr)	4.7	1.6	4.7	1.6	0.8	0.6

Emission Rates
Natural Gas: 116 lbs/MMBtu
Electricity (2025): 750 lbs/MWh
Electricity (2050): 50 lbs/MWh
**Only available for heating and cooling; not overall in WUFI Passive*

Utility Cost
Natural Gas: $1.70/therm
Electricity: $0.13431/kWh
*Individual HPHW scenario requires an additional 21,000 kWh from a 16.5 kW solar PV array to comply with Phius source energy requirements
**Individual HPHW scenario requires an additional 10,000 kWh from a 7.5 kW solar PV array to comply with Phius source energy requirements

Building K

Cost Analysis	Scenario 1a (HERS 44) All Electric + In-unit Electric Resistance Water Heating	Scenario 1b (HERS 36) All Electric + In-unit Heat Pump Water Heating	Scenario 2a (TEDI) All Electric + In-unit Electric Resistance Water Heating	Scenario 2b (TEDI) All Electric + In-Unit Heat Pump Water Heating	Scenario 3a (Passive House) All Electric + Individual HP Water Heating + 16.5 kW PV Array*	Scenario 3b (Passive House) All Electric + Central Heat Pump Water Heating + 7.5 kW PV Array**
Annual electricity cost ($)	$ 72,173.22	$ 58,336.80	$ 78,388.37	$ 61,963.19	$ 54,178.30	$ 54,268.45
Annual gas cost ($)	$ -	$ -	$ -	$ -	$ -	$ -
Annual operating cost ($)	$ 72,173.22	$ 58,336.80	$ 78,388.37	$ 61,963.19	$ 54,178.30	$ 54,268.45
Annual operating cost savings ($)	$ 6,215.15	$ 20,051.57		$ 16,425.18	$ 24,210.07	$ 24,119.92
Cost increase for additianl continous insulation	$ -	$ -		$ -	$ 266,000.00	$ 266,000.00
Cost increase/ savings for windows	$ (149,295.00)	$ (149,295.00)		$ -	$ -	$ -
Cost increase for in-unit heat pump water heaters	$ -	$ 54,600.00		$ 54,600.00	$ 54,600.00	$ -
Cost increase for central heat pump water heaters	$ -	$ -		$ -	$ -	$ 288,000.00
Net cost increase of materials ($)	$ (149,295.00)	$ (94,695.00)		$ 54,600.00	$ 320,600.00	$ 554,000.00
Net cost increase of construction ($)	$ -	$ -		$ -	$ -	$ -
Net consulting soft cost increase ($)	$ 30,000.00	$ 30,000.00		$ -	$ 160,000.00	$ 160,000.00
Net cost savings from rebates ($)	$ -	$ -		$ -	$ -	$ -
Amortized Annual Cost Increase (30-yr Mortgage)	$ 9,135.31	$ 4,954.18		$ (4,181.13)	$ (36,803.12)	$ (54,676.29)
Net operating cost savings (operating+amortized)	$ 15,350.46	$ 25,005.75		$ 12,244.06	$ (12,593.05)	$ (30,556.37)

Building K represents a residential building with less than 50 units. Three sets of scenarios were evaluated for the project: Scenarios 1 follow the Certified Pathway (HERS), Scenarios 2 follow the Targeted Performance (TEDI) Pathway, and Scenarios 3 follow the Certified Pathway (Passive House). Residential buildings will be all-electric and therefore, no gas space heating analysis was performed. Additionally, the Passive House requirements couldn't be met with electric resistance water heaters and therefore, Scenario 3 was run with both in-unit heat pump water heaters and central heat pump water heaters. As shown above, even though the Passive House pathway results in annual operational cost savings, due to the increase in material cost and lack of utility incentives and tax credits, there is a net operating cost penalty over a 30-year period, considering a flat interest rate and no inflation for the utility cost. The preliminary HERS, TEDI, and Passive House results are presented below.

TEDI Analysis

Exterior Wall Option	Scenario Description	eQUEST runs	Punched Window U-Value	Punched Window SHGC	Wood-Framed Walls	Roof Assembly U-Value	Inf Rate 75 Pa (CFM/SF)	Fan Power ASHP (kW/cfm)	Fan Power DOAS (kW/cfm)	WWR%	HR Effect %	TEDI Cooling Limit (kBtu/SF)	Modeled TEDI Cooling (kBtu/SF)	TEDI Heating Limit (kBtu/SF)	Modeled TEDI Heating (kBtu/SF)	PASSED or FAILED	Notes
1	**Roof Assembly:** Flat Roof, R-40 CI **Exterior Wall:** R-21 Batt + **1.5 Inches of CI** for Wood-framed **Floor/Slab on Grade Insulation:** R-15 for 24 inches below (IECC 2021)	A	0.18	0.27	0.047	0.025	0.3	0.00012	0.000742893	26.0%	75%	15.00	8.59	3.20	-5.67	FAILED	R21 Batt + 1.5 inches of CI for WF
		B	0.18	0.27	0.047	0.025	0.25	0.00012	0.000742893	26.0%	75%	15.00	8.64	3.20	-5.06	FAILED	Scenario 1A w/ reduced infiltration (0.25 CFM/SF)
		C	0.18	0.27	0.047	0.025	0.25	0.00012	0.000742893	26.0%	77%	15.00	8.69	3.20	-4.98	FAILED	Scenario 1B w/ improved HR effectiveness 77%
2	**Roof Assembly:** Flat Roof, R-40 CI **Exterior Wall:** R-21 Batt + **3 Inches** of CI for Wood-framed **Floor/Slab on Grade Insulation:** R-15 for 24 inches below (IECC 2021)	A	0.18	0.27	0.04	0.025	0.3	0.00012	0.000742893	26.0%	75%	15.00	8.62	3.20	-5.29	FAILED	R21 Batt + 3 inches of CI for WF
		B	0.18	0.27	0.04	0.025	0.25	0.00012	0.000742893	26.0%	75%	15.00	8.67	3.20	-4.68	FAILED	Scenario 2A w/ reduced infiltration (0.25 CFM/SF)
		C	0.18	0.27	0.04	0.025	0.25	0.00012	0.000742893	26.0%	77%	15.00	8.66	3.20	-4.59	FAILED	Scenario 2B w/ improved HR effectiveness 77%
		D	0.18	0.27	0.04	0.02	0.2	0.00012	0.000742893	26.0%	77%	15.00	8.67	3.20	-3.77	FAILED	Scenario 2C w/ improved roof U-0.02 and improved infiltration of 0.2 CFM/SF
		E+F	0.1675	0.27	0.04	0.02	0.2	0.00012	0.000742893	26.0%	80%	15.00	8.70	3.20	-3.12	PASSED	Scenario 2C w/ improved roof U-0.02, improved infiltration of 0.20 CFM/SF and improved HR effectiveness 80%

Hetaing Treshold	Cooling Threshold
3.2	15

Passive House Results

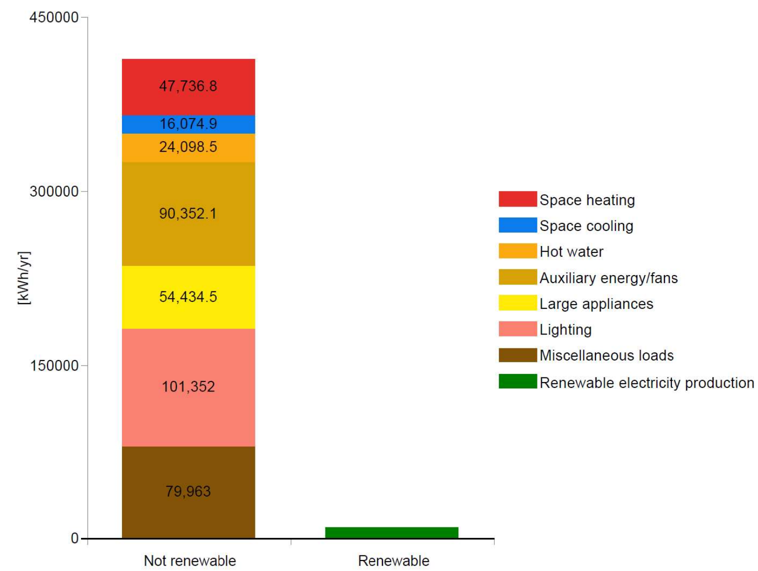
Central Heat Pump Water Heaters

PASSIVEHOUSE REQUIREMENTS

Certificate criteria: Phius CORE 2021

Heating demand		
specific:	**5.69**	kBtu/ft²yr
target:	**7.7**	kBtu/ft²yr
total:	421,272.98	kBtu/yr
Cooling demand		
sensible:	**1.29**	kBtu/ft²yr
latent:	**0.42**	kBtu/ft²yr
specific:	**1.71**	kBtu/ft²yr
target:	**5.1**	kBtu/ft²yr
total:	126,537.3	kBtu/yr
Heating load		
specific:	**5.6**	Btu/hr ft²
target:	**5.8**	Btu/hr ft²
total:	414,803.51	Btu/hr
Cooling load		
specific:	**1.66**	Btu/hr ft²
target:	**1.7**	Btu/hr ft²
total:	122,592.04	Btu/hr
Source energy		
total:	**727,302.09**	kWh/yr
specific:	**5,595**	kWh/Person yr
target:	**4,850**	kWh/Person yr
total:	**2,481,412.78**	kBtu/yr
specific:	33.53	kBtu/ft²yr
Site energy		
total:	1,378,562.66	kBtu/yr
specific:	18.63	kBtu/ft²yr
total:	404,056.71	kWh/yr
specific:	5.46	kWh/ft²
Air tightness		
ACH50:	**0.46**	1/hr
CFM50 per envelope area:	**0.06**	cfm/ft²
target:	**0.46**	1/hr
target CFM50:	**0.06**	cfm/ft²

OVERVIEW



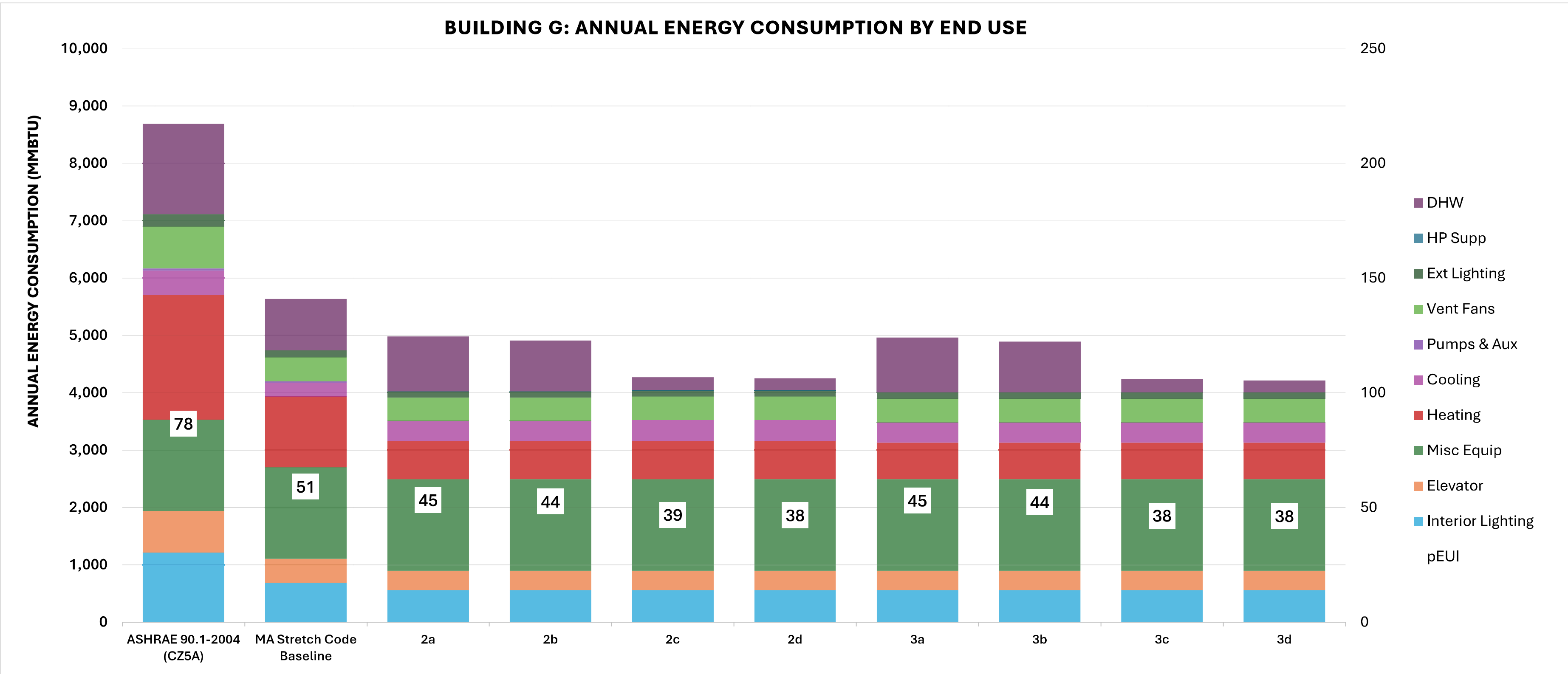
Group 4: Building G Performance and Cost Analysis Results

Building G Design Strategies, Inputs, and Outputs	Scenario 2a Heat Pump Space Heating + Gas Kitchen + Central Gas Water Heating	Scenario 2b Heat Pump Space Heating + Gas Kitchen + Electric Resistance Water Heating	Scenario 2c Heat Pump Space Heating + Gas Kitchen + Central Heat Pump Water Heating	Scenario 2d Heat Pump Space Heating + Gas Kitchen + Solar and Backup Elec Resistance Water Heating	Scenario 3a Heat Pump Space Heating + C406.9 + Gas Kitchen + Central Gas Water Heating	Scenario 3b Heat Pump Space Heating + C406.9 + Gas Kitchen + Electric Resistance Water Heating	Scenario 3c Heat Pump Space Heating + C406.9 + Gas Kitchen + Central Heat Pump Water Heating	Scenario 3d Heat Pump Space Heating + C406.9 + Gas Kitchen + Solar and Backup Elec Resistance Water Heating
Roof R value	R-40	R-40	R-40	R-40	R-40	R-40	R-40	R-40
Wall U value	0.047	0.047	0.047	0.047	0.047	0.047	0.047	0.047
% wall	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76
Window U value	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
% window	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24
Area-weighted vertical above grade U value	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063
Air infiltration (cfm at 75 PA)	0.35	0.35	0.35	0.35	0.20	0.20	0.20	0.20
Ventilation energy recovery	75%	75%	75%	75%	75%	75%	75%	75%
Solar heat gain coefficient (SHGC)	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Heating TEDI (kBtu/sf-yr)	7.76	7.76	7.76	7.76	7.31	7.31	7.31	7.31
Cooling TEDI (kBtu/sf-yr)	11.70	11.70	11.70	11.70	11.80	11.80	11.80	11.80
Peak annual space heating demand (Mbtu/hr)	0.60	0.60	0.60	0.60	0.57	0.57	0.57	0.57
Peak annual space cooling demand (Mbtu/hr)	0.27	0.27	0.29	0.29	0.27	0.27	0.27	0.27
Peak annual electric load (MW)	0.29	0.37	0.30	0.37	0.28	0.36	0.30	0.36
Peak annual gas load (MBH)	400	100	100	100	400	100	100	100
Annual space heating energy (MBtu)	660	660	660	660	635	635	635	635
Annual water heating energy (MBtu)	957	885	228	205	957	885	228	205
Natural gas consumption (MBtu/yr)	1,435	478	478	478	1,435	78	478	478
Electric power consumption (MBtu/yr)	3,548	4,433	3,796	3,773	3,528	4,413	3,757	3,734
Annual energy consumption (Mbtu/yr)	4,983	4,911	4,274	4,251	4,963	4,492	4,235	4,212
predicted EUI (kBtu/sf.yr)	44.9	44.2	38.5	38.3	44.7	40.5	38.2	37.9
Electric power consumption (MWh/yr)	1,039	1,299	1,112	1,105	1,034	1,293	1,101	1,094
Fossil fuel emissions (tons/yr)	83.2	27.7	27.7	27.7	83.2	4.5	27.7	27.7
Electric emissions @ 2025 (tons/yr)	389.8	487.0	417.1	414.5	387.7	484.9	412.7	410.2
Total emissions @2025 (tons/yr)	473.0	514.8	444.8	442.3	470.9	489.5	440.5	438.0
Electric emissions @ 2050 (tons/yr)	26.0	32.5	27.8	27.6	25.8	32.3	27.5	27.3
Total emissions @2050 (tons/yr)	109.2	60.2	55.6	55.4	109.1	36.9	55.3	55.1
Space heating emissions @ 2025 (tons/yr)	72.6	72.5	72.5	72.5	69.8	69.8	69.8	69.8
Space heating emissions @ 2050 (tons/yr)	4.8	4.8	4.8	4.8	4.7	4.7	4.7	4.7
Water heating emissions @ 2025 (tons/yr)	105.1	97.2	25.0	22.5	105.1	97.2	25.0	22.5
Water heating emissions @ 2050 (tons/yr)	7.0	6.5	1.7	1.5	7.0	6.5	1.7	1.5

Emission Rates
Natural Gas: 116 lbs/MMBtu
Electricity (2025): 750 lbs/MWh
Electricity (2050): 50 lbs/MWh

Cost Analysis	Scenario 2a Heat Pump Space Heating + Gas Kitchen + Central Gas Water Heating	Scenario 2b Heat Pump Space Heating + Gas Kitchen + Electric Resistance Water Heating	Scenario 2c Heat Pump Space Heating + Gas Kitchen + Central Heat Pump Water Heating	Scenario 2d Heat Pump Space Heating + Gas Kitchen + Solar and Backup Elec Resistance Water Heating	Scenario 3a Heat Pump Space Heating + C406.9 + Gas Kitchen + Central Gas Water Heating	Scenario 3b Heat Pump Space Heating + C406.9 + Gas Kitchen + Electric Resistance Water Heating	Scenario 3c Heat Pump Space Heating + C406.9 + Gas Kitchen + Central Heat Pump Water Heating	Scenario 3d Heat Pump Space Heating + C406.9 + Gas Kitchen + Solar and Backup Elec Resistance Water Heating
Annual electricity cost ($)	$ 147,568.87	$ 184,384.11	$ 157,890.80	$ 156,942.87	$ 146,765.60	$ 183,580.27	$ 156,259.85	$ 155,312.77
Annual gas cost ($)	$ 24,398.40	$ 8,132.80	$ 8,132.80	$ 8,126.00	$ 24,396.70	$ 1,332.80	$ 8,132.80	$ 8,126.00
Annual operating cost ($)	$ 171,967.27	$ 192,516.91	$ 166,023.60	$ 165,068.87	$ 171,162.30	$ 184,913.07	$ 164,392.65	$ 163,438.77
Annual operating cost savings ($)	$ (10,529.25)	$ (31,078.88)	$ (4,585.58)	$ (3,630.85)	$ (9,724.28)	$ (23,475.05)	$ (2,954.63)	$ (2,000.75)
Cost savings for gas line	$ (125,000.00)	$ (125,000.00)	$ (125,000.00)	$ (125,000.00)	$ (125,000.00)	$ (125,000.00)	$ (125,000.00)	$ (125,000.00)
Cost increase for electrification (transformer upgrade)	$ 100,000.00	$ 100,000.00	$ 100,000.00	$ 100,000.00	$ 100,000.00	$ 100,000.00	$ 100,000.00	$ 100,000.00
Cost increase for electric water heaters	$ -	$ 152,400.00	$ -	$ -	$ -	$ 152,400.00	$ -	$ -
Cost increase for central heat pump water heaters	$ -	$ -	$ 288,000.00	$ -	$ -	$ -	$ 288,000.00	$ -
Cost increase for solar water heaters	$ -	$ -	$ -	$ 350,000.00	$ -	$ -	$ -	$ 350,000.00
Net cost increase of materials ($)	$ (25,000.00)	$ 127,400.00	$ 263,000.00	$ 325,000.00	$ (25,000.00)	$ 127,400.00	$ 263,000.00	$ 325,000.00
Net cost increase of construction ($)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Net consulting soft cost increase ($)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Net cost savings from rebates ($)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Amortized Annual Cost Increase (30-yr Mortgage)	$ 1,914.44	$ (9,755.97)	$ (20,139.87)	$ (24,887.67)	$ 1,914.44	$ (9,755.97)	$ (20,139.87)	$ (24,887.67)
Net operating cost savings (operating+amortized)	$ (8,614.81)	$ (40,834.85)	$ (24,725.45)	$ (28,518.51)	$ (7,809.85)	$ (33,231.02)	$ (23,094.49)	$ (26,888.41)

Building G represents is a hotel (R-1) building. Two sets of scenarios were evaluated for the project, following the Relative Performance Pathway: Scenarios 2 utilizes heat pump space heating, and Scenarios 3 uses heat pump space heating as well as reduced infiltration rate. Scenario 1, gas space heating, was excluded from this updated report. The preliminary results are presented below.




Building G Hotel: Annual GHG Emissions Reduction
Annual GHG Emissions (MT CO2e)
700
600
500
400
300
200
100
-
392
224
265
139
311
76
388
25
333
25
331
25
309
76
387
25
329
25
327
25
ASHRAE 90.1-2004 (CZ5A)
MA Stretch Code Baseline
2a
2b
2c
2d
3a
3b
3c
3d
Natural Gas
Electricity

Impacts of Utility Incentives on Cash Flow

As noted earlier, Littleton is not part of the Mass Save territory and therefore, these projects are not eligible for Passive House incentives. To investigate the impact of these incentives on the project cash-flow, we ran the cost analysis with the Mass Save Passive House incentives which are $3,750 per unit if certification is achieved, plus $250 per heat pump water heater and up to $25,000 cost of WUFI modeling. As shown below, scenario 3a, heat pump space heating and in-unit heat and central pump water heaters, results in positive cash-flow.

Building F

Design Strategies, Inputs, and Outputs	Scenario 1a (HERS 44) All Electric + Cetnral Electric Resistance Water Heating	Scenario 1b (HERS 36) All Electric + Central Heat Pump Water Heating	Scenario 1c (HERS 40) All Electric + solar and resistance Water Heating	Scenario 2a (TEDI) All Electric + Central Electric Resistance Water Heating	Scenario 2b (TEDI) All Electric + Central Heat Pump Water Heating	Scenario 2c (TEDI) All Electric + solar and resistance Water Heating	Scenario 3a (Passive House) All Electric + Individual HP Water Heating	Scenario 3b (Passive House) All Electric + Central Heat Pump Water Heating	Scenario 3c (Passive House) All Electric + Solar and Backup Elec Resistance Water Heating
Roof R value	R-49	R-49	R-49	R-40	R-40	R-40	R-40	R-40	R-40
Wall U value	0.039	0.039	0.039	0.047	0.047	0.047	0.040	0.040	0.040
% wall	75%	75%	75%	75%	75%	0.75	75%	75%	75%
Window U value	0.26 Res / 0.25 CW	0.26 Res / 0.25 CW	0.26 Res / 0.25 CW	0.22 Res / 0.25 CW	0.22 Res / 0.25 CW	0.22 Res / 0.25 CW	0.18 Res / 0.25 CW	0.18 Res / 0.25 CW	0.18 Res / 0.25 CW
% window	25%	25%	25%	25%	25%	0.25	25%	25%	25%
Area-weighted vertical above grade U value	0.088	0.088	0.088	0.081	0.081	0.081	0.076	0.076	0.076
Air infiltration (cfm at 75 PA)	0.33	0.33	0.33	0.30	0.30	0.30	~0.08 (0.06 @CFM50)	~0.08 (0.06 @CFM50)	~0.08 (0.06 @CFM50)
Ventilation energy recovery	78%	78%	78%	77%	77%	77%	77%	77%	77%
Solar heat gain coefficient (SHGC)	0.26	0.26	0.26	0.27	0.27	0.27	0.27	0.27	0.27
Heating TEDI/ PHIUS Heating Demand (kBtu/sf-yr)	-	-	-	2.49	2.49	2.49	*4.52*	*4.52*	*4.68*
Cooling TEDI/ / PHIUS Cooling Demand(kBtu/sf-yr)	-	-	-	10.18	10.18	10.18	*4.51*	*2.96*	*2.82*
Peak annual space heating demand (Mbtu/hr)	-	-	-	0.445	0.449	0.449	0.72	0.72	0.72
Peak annual space cooling demand (Mbtu/hr)	-	-	-	0.444	0.445	0.445	0.31	0.25	0.24
Peak annual electric load (MW)	-	-	-	0.345	0.309	0.345	*N/A**	*N/A**	*N/A**
Peak annual gas load (MBH)	-	-	-	0	0	0	0	0	0
Annual space heating energy (MBtu)	402	402	402	174	174	174	292	292	301
Annual water heating energy (MBtu)	1,188	368	359	1,188	368	359	344	237	230.7
Natural gas consumption (MBtu/yr)	0	0	0	0	0	0	0	0	0
Electric power consumption (MBtu/yr)	3,953	3,194	3,124	4,588	3,767	3,758	3,300	3,119	2,915
Electric power consumption (MWh/yr)	1,158	936	915	1,344	1,104	1,101	967	914	854
Fossil fuel emissions (tons/yr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Electric emissions @ 2025 (tons/yr)	434.4	351.0	343.2	504.0	413.9	412.9	362.7	342.8	320.4
Total emissions @2025 (tons/yr)	434.4	351.0	343.2	504.0	413.9	412.9	362.7	342.8	320.4
Electric emissions @ 2050 (tons/yr)	29.0	23.4	22.9	33.6	27.6	27.5	24.2	22.9	21.4
Total emissions @2050 (tons/yr)	29.0	23.4	22.9	33.6	27.6	27.5	24.2	22.9	21.4
Space heating emissions @ 2025 (tons/yr)	44.2	44.2	44.2	19.1	19.1	19.1	32.0	32.0	33.1
Space heating emissions @ 2050 (tons/yr)	2.9	2.9	2.9	1.3	1.3	1.3	2.1	2.1	2.2
Water heating emissions @ 2025 (tons/yr)	130.5	40.4	39.4	130.5	40.4	39.4	37.8	26.0	25.4
Water heating emissions @ 2050 (tons/yr)	8.7	2.7	2.6	8.7	2.7	2.6	2.5	1.7	1.7

Emission Rates
Natural Gas: 116 lbs/MMBtu
Electricity (2025): 750 lbs/MWh
Electricity (2050): 50 lbs/MWh
**Only available for heating and cooling; not overall in WUFI Passive*

Utility Cost
Natural Gas: $1.70/therm
Electricity: $0.13431/kWh

Building F

Cost Analysis	Scenario 1a (HERS 44) All Electric + Cetnral Electric Resistance Water Heating	Scenario 1b (HERS 36) All Electric + Central Heat Pump Water Heating	Scenario 1c (HERS 40) All Electric + solar and resistance Water Heating	Scenario 2a (TEDI) All Electric + Central Electric Resistance Water Heating	Scenario 2b (TEDI) All Electric + Central Heat Pump Water Heating	Scenario 2c (TEDI) All Electric + solar and resistance Water Heating	Scenario 3a (Passive House) All Electric + Individual HP Water Heating	Scenario 3b (Passive House) All Electric + Central Heat Pump Water Heating	Scenario 3c (Passive House) All Electric + Solar and Backup Elec Resistance Water Heating
Annual electricity cost ($)	$ 155,568	$ 125,701	$ 122,931	$ 180,529	$ 148,250	$ 147,884	$ 129,895	$ 122,765	$ 114,756
Annual gas cost ($)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Annual operating cost ($)	$ 155,568	$ 125,701	$ 122,931	$ 180,529	$ 148,250	$ 147,884	$ 129,895	$ 122,765	$ 114,756
Annual operating cost savings ($)	$ 24,961	$ 54,828	$ 57,598		$ 32,279	$ 32,645	$ 50,634	$ 57,764	$ 65,773
Cost increase for additianl continous insulation	$ 346,000	$ 346,000	$ 346,000		$ -	$ -	$ 692,000	$ 692,000	$ 692,000
Cost increase for in-unit heat pump water heaters	$ -	$ -	$ -		$ -	$ -	$ 195,000	$ -	$ -
Cost increase for central heat pump water heaters	$ -	$ 305,200	$ -		$ 305,200	$ -	$ -	$ 305,200	$ 650,000
Cost increase for solar water heaters	$ -	$ -	$ 650,000		$ -	$ 650,000	$ -	$ -	$ -
Net cost increase of materials ($)	$ 346,000	$ 651,200	$ 996,000		$ 305,200	$ 650,000	$ 887,000	$ 997,200	$ 1,342,000
Net cost increase of construction ($)	$ -	$ -	$ -		$ -	$ -	$ -	$ -	
Net consulting soft cost increase ($)	$ 30,000	$ 30,000	$ 30,000		$ -	$ -	$ 160,000	$ 160,000	$ 160,000
Net cost savings from rebates ($)	$ -	$ -	$ -		$ -	$ -	$ (600,000)	$ (637,500)	$ (562,500)
Amortized Annual Cost Increase (30-yr Mortgage)	$ (28,793)	$ (52,165)	$ (78,568)		$ (23,371)	$ (49,775)	$ (34,230)	$ (39,797)	$ (71,945)
Net operating cost savings (operating+amortized)	$ (3,832)	$ 2,664	$ (20,970)		$ 8,908	$ (17,130)	$ 16,404	$ 17,966	$ (6,172)

Operational Cost Comparison: Domestic Hot Water System

Utilizing the domestic hot water consumption values from the TEDI models and our existing database, we estimated the annual hot water energy use per unit for each residential group. Please note that **Group 2 (>50 units)** utilizes a central heat pump water heating system, for which we assumed the use of high-efficiency commercial CO_2 heat pumps. These systems can achieve a COP of 5, resulting in greater savings compared to in-unit heat pump water heaters, which were modeled with a COP of 3. This study shows that the residential buildings planned for the entire campus can save approximately **$175,000 annually** by utilizing heat pump water heating systems, representing about **50% savings in annual operating costs. However, there are design costs that, because the Project is early in design, cannot be accurately estimated. Additionally, the Proponent would not be able to appropriately bill tenants for their energy use so this scheme would not work for the Project.**

Buildings with		Annual Water Heating Energy (MBTU)		Annual Water Heating Cost ($)		Savings (%)
More Than 50	**# Units**	**Electric Resistance**	**Heat Pump**	**Electric Resistance**	**Heat Pump**	**HP vs. Electric**
C	173	1,361	653	$ 53,562	$ 25,710	
D	173	1,361	653	$ 53,562	$ 25,710	
E	149	1,172	563	$ 46,132	$ 22,143	
F	151	1,188	570	$ 46,751	$ 22,440	
S	285	2,242	1,076	$ 88,238	$ 42,354	
R	65	511	245	$ 20,124	$ 9,660	
Total	996	7,836	3,761	308,369	148,017	52.0%

Hot Water Consumption per unit - Central System (MBTU)	7.9	3.8

Electricity Rate $0.1343 $/kWh

Buildings with		Annual Water Heating Energy (MBTU)		Annual Water Heating Cost ($)		Savings (%)
Less Than 50	**# Units**	**Electric Resistance**	**Heat Pump**	**Electric Resistance**	**Heat Pump**	**HP vs. Electric**
H	9	71	32	$ 2,798	$ 1,265	
J	11	87	39	$ 3,420	$ 1,546	
K	42	332	150	$ 13,057	$ 5,902	
L	11	87	39	$ 3,420	$ 1,546	
N	8	63	29	$ 2,487	$ 1,124	
O	12	95	43	$ 3,731	$ 1,686	
Total	93	735	332	28,912	13,068	54.8%

Hot Water Consumption per unit - In-Unit System (MBTU)	7.9	3.6

LITTLETON
LELWD
ELECTRIC LIGHT & WATER DEPARTMENTS

39 Ayer Road, P.O. Box 2406
Littleton, MA 01460-3406
978.540.2222
FAX: 978.486.3552
www.lelwd.com

Nick Lawler, General Manager

August 28, 2025

Gary Armstrong
550 King Street LLC
290 Merrimack Street, 2nd Floor
Lawrence, MA 01843

Re: Will Serve Letter for 550 King Street Redevelopment, Littleton

Dear Mr. Armstrong:

Littleton Electric Light & Water Department ("LELWD" or "LWD") is the provider of electric, water and sewer services in the Town of Littleton. Such services are available to 550 King Street, dependent upon the conditions set forth below.

Electric Service: In accordance with LELWD's tariffs and terms and conditions of service, LELWD can make electricity available to 550 King Street. The ability of LELWD to provide service will depend on the outcome of any necessary engineering studies, installation of equipment and/or construction of facilities required to serve as a result of such studies, and the payment of the associated costs therewith by 550 King Street LLC, in addition to the granting of easements, if required.

Water Service: Water service may be provided to 550 King Street in accordance with LWD's Water Use Rules and Regulations, which fully describe the process for applying for service, availability of service, and terms and conditions of service.

Sewer Service: Pursuant to the Reserved Capacity Sewer Betterment Agreement between the Littleton Board of Water Commissioners and 550 King Street LLC dated June 14, 2023 ("Agreement,"), LWD has agreed to reserve 150,000 gpd or 455 REUs of sewer capacity for use by 550 King Street. The Agreement makes no representations as to additional capacity beyond that amount in future years.

Once you provide us with the necessary information on electric demand and water requirements, applications and supporting documentation and finalized plans for your project, LELWD will then be able to determine any required upgrades and betterments, the costs thereof and the possible in-service date for your utility services.

Sincerely,

Nick Lawler

Nicholas Lawler, P.E.
Littleton Electric Light & Water Departments
nlawler@lelwd.com
978-540-2251

From:	Nick Lawler
To:	Alex Brooks; David Ketchen
Cc:	
Subject:	RE: 550 King Street Electric Service
Date:	Thursday, September 25, 2025 4:42:16 PM

Awesome, thanks for the quick response. We will have no issues with servicing this electrical load.

Thanks,

Nick Lawler, P.E.
General Manager
Littleton Electric Light and Water Departments
nlawler@lelwd.com
978.540.2251

From: Alex Brooks <abrooks@epsilonassociates.com>
Sent: Thursday, September 25, 2025 9:51 AM
To: Nick Lawler <NLawler@lelwd.com>; David Ketchen <dketchen@lelwd.com>
Subject: Re: 550 King Street Electric Service

Hi Nick,

Thanks for getting back to me.

That is correct, based on prototype modeling of the building designs, that is the estimated annual peak load range.

Alex Brooks
Epsilon Associates, Inc

From: Nick Lawler <NLawler@lelwd.com>
Sent: Wednesday, September 24, 2025 4:35 PM
To: Alex Brooks <abrooks@epsilonassociates.com>; David Ketchen <dketchen@lelwd.com>
Subject: RE: 550 King Street Electric Service

Alex, are you saying that the annual peak load for the 12 residential buildings will be 4,423 kW to 5,195 kW?

Thanks,

Nick Lawler, P.E.
General Manager
Littleton Electric Light and Water Departments
nlawler@lelwd.com
978.540.2251

From: Alex Brooks <abrooks@epsilonassociates.com>
Sent: Wednesday, September 24, 2025 12:36 PM
To: Nick Lawler <NLawler@lelwd.com>; David Ketchen <dketchen@lelwd.com>

Subject: 550 King Street Electric Service

Hi Nick and David,

My name is Alex Brooks, I work for Epsilon Associates, and we are working with Lupoli on the state permitting for the King Street Common project.

The team in the process of compiling an Environmental Impact Report as part of MEPA review and the Department of Energy Resources has requested that the project team provide some information about expected electrical loads to verify that LEWLD is aware of the needed service.

Based on residential designs that include heating and cooling provided by electric air source heat pumps, at this time, is estimated that the once the 12 residential buildings that are currently planned for the campus are built, the annual load would range from **5,195kW** and **4,423 kW** depending on the hot water systems installed.
The date for this full build condition is not known and would be completed after several phases of construction, but I am providing these overall figures because the state review looks at the completed project a whole.

We will be including the attached will serve letter to the Project's submission to the state but is there any additional information that the above estimates would help your team provide?
I know that being early in the project design may make this hard to answer, but I am happy to discuss on a call, my number is below. Please let me know what questions you have.

Thank you,

Alex Brooks, CEM | Senior Engineer, Sustainability Services

Epsilon Associates, Inc.
3 Mill & Main, Suite 250
Maynard, Massachusetts 01754

Fax: 978.897.0099
abrooks@epsilonassociates.com
www.epsilonassociates.com

Appendix E

Circulation List

APPENDIX E CIRCULATION LIST

Rebecca Tepper, Secretary
Executive Office of Energy and
Environmental Affairs
Attn: MEPA Office
100 Cambridge Street, Suite 900
Boston, MA 02114
MEPA@mass.gov

Department of Environmental Protection
Attn: Commissioner's Office/
MEPA Coordinator
One Winter Street
Boston, MA 02108
helena.boccadoro@mass.gov

Department of Environmental Protection
Central Regional Office
Attn: MEPA Coordinator
8 New Bond Street
Worcester, MA 01606
Andrea.briggs@mass.gov

Massachusetts Department of Transportation
Public/Private Development Unit
10 Park Plaza, Suite 4150
Boston, MA 02116
MassDOTPPDU@dot.state.ma.us

Massachusetts Department of Transportation
District #3
Attn: MEPA Coordinator
499 Plantation Parkway
Worcester, MA 01605
Kevin.R.Robenhymer@dot.state.ma.us
Eric.Nascimento@dot.state.ma.us

Massachusetts Historical Commission
The MA Archives Building
220 Morrissey Boulevard
Boston, MA 02125 *(one hard copy)*

Metropolitan Area Planning Council
60 Temple Place, 6th Floor
Boston, MA 02111
mpillsbury@mapc.org
afelix@mapc.org

MEPA Office
Attn: EEA EJ Director
100 Cambridge Street, Suite 900
Boston, MA 02144
MEPA-EJ@mass.gov

Department of Energy Resources
Attn: MEPA Director
100 Cambridge Street, 10th Floor
Boston, MA 02114
Paul.ormund@mass.gov

Energy Facilities Siting Board
Attn: MEPA Coordinator
One South Station
Boston, MA 02114
andrew.greene@mass.gov
Yonathan.mengesha@mass.gov

Littleton Planning Board
Attn: Maren Toohill
37 Shattuck Street, 1st Floor B100
Littleton, MA 01460
MToohill@littletonma.org

Littleton Select Board
Attn: Karen Lee Morrison, Chair
37 Shattuck Street
PO Box 1305
Littleton, MA 01460
lmontgomery@littletonma.org

Littleton Conservation Commission
37 Shattuck Street
1st Floor, B100
Littleton, MA 01460
conservation@littletonma.org

Littleton Board of Health
37 Shattuck St Ste 303
Littleton, MA 01460
health@littletonma.org

Littleton Public Library
35 Shattuck Street
Littleton, MA 01460 *(hard copy)*

George A. Sanders, Sr.
ivygas1@yahoo.com

Michael Gruar

Amy Tarlow-Lewis
Astarlow@gmail.com

DarkSky Massachusetts

Donald MacIver
Littleton Sustainability Committee Member
maciver01460@gmail.com

Erin Healy

Jo-Ann Dery

Sondra and Stephen Swartz

Project-Specific EJ Refence List

Populate this Project-Specific Reference List with the appropriate contacts from all 4 tabs in the EJ Reference List workbook

Project Name: King Street Common

Project Address: 550 King Street Littleton, MA

MA Municipalities in Project's DGA: Littleton, Westford

Date Generated: 5/30/2025

Filing Type:

☐ ENF/EENF ☑ DEIR/FEIR ☐ SEIR ☐ Other

First Name	Last Name	Title	Phone	Email	Affiliation	Contact Type *(autopopulates)*
Claire	B.W. Muller	Movement Building Director	(508) 308-9261	claire@uumassaction.org	Unitarian Universalist Mass Action Network	Statewide CBO
Julia	Blatt	Executive Director	(617) 714-4272	juliablatt@massriversalliance.org	Mass Rivers Alliance	Statewide CBO
Jodi	Valenta	Massachusetts State Director	(617) 367-6200	Jodi.Valenta@tpl.org	The Trust for Public Land	Statewide CBO
Kerry	Bowie	Board President	Not Provided	kerry@msaadapartners.com	Browning the GreenSpace	Statewide CBO
Sylvia	Broude	Executive Director	(617) 292-4821	sylvia@communityactionworks.org	Community Action Works	Statewide CBOLocal CBO
Britteny	Jenkins	Vice President	Not Provided	Bjenkins@clf.org	Conservation Law Foundation	Statewide CBO
Alex	St. Pierre	Director of Communities & Toxics	Not Provided	aestpierre@clf.org	Conservation Law Foundation	Statewide CBO
Paulina	Muratore	Director of Transportation Justice and Infrastructure	Not Provided	pmuratore@clf.org	Conservation Law Foundation	Statewide CBO
Breanne	Frank	Associate Attorney	Not Provided	bfrank@clf.org	Conservation Law Foundation	Statewide CBO
Amy	Boyd Rabin	Vice President of Policy	(617) 221-8258	aboydrabin@environmentalleague.org	Environmental League of Massachusetts	Statewide CBO
Ben	Hellerstein	MA State Director	(617) 747-4368	ben@environmentmassachusetts.org	Environment Massachusetts	Statewide CBO
Robb	Johnson	Executive Director	(978) 443-2233	robb@massland.org	Mass Land Trust Coalition	Statewide CBO
Cindy	Luppi	New England Director	(617) 338-8131 x208	cluppi@cleanwater.org	Clean Water Action	Statewide CBO
Dálida	Rocha	Executive Director	Not Provided	dalida@n2nma.org	Neighbor to Neighbor Mass.	Statewide CBOLocal CBO
Lena Miles	Entin Gresham	Director of Individual Giving Campaign Director	Not Provided	Lena@N2NMa.org Miles@N2NMa.org	Neighbor to Neighbor Mass.	Statewide CBOLocal CBO
Rob	Moir	Executive Director	Not Provided	rob@oceanriver.org	Ocean River Institute	Statewide CBO
Vickash	Mohanka	Director, MA Chapter	Not Provided	vick.mohanka@sierraclub.org	Sierra Club MA	Statewide CBO
Heidi	Ricci	Director of Policy	Not Provided	hricci@massaudubon.org	Mass Audubon	Statewide CBO
Bettina	Washington	Tribal Historic Preservation Officer	(508) 560-9014	thpo@wampanoagtribe-nsn.gov	Wampanoag Tribe of Gay Head (Aquinnah)	Federal Tribe
Brian	Weeden	Chair	(774) 413-0520	Brian.Weeden@mwtribe-nsn.go	Mashpee Wampanoag Tribe	Federal Tribe
David	Weeden	THPO/Director	(774) 327.0068	David.Weeden@mwtribe-nsn.g	Mashpee Wampanoag Tribe	Federal Tribe
Nakia	Hendricks Jr.	Office Manager	Not Provided	106Review@mwtribe-nsn.gov	Mashpee Wampanoag Tribe	Federal Tribe
Alma	Gordon	President	Not Provided	tribalcouncil@chappaquiddickw	Chappaquiddick Tribe of the Wampanoag Nation	Indigenous Org
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