DRAINAGE REPORT

For

Stevens Mill Owner LLC

PROPOSED

"Mill Redevelopment Project"

8 Mill Street
Dudley, Massachusetts
Worcester County

Prepared by:

BOHLER ENGINEERING
352 Turnpike Road
Southborough, MA 01772
(508) 480-9900 TEL.

John A. Kucich
Massachusetts P.E. Lic. #41530

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I. EXECUTIVE SUMMARY

This report examines the changes in drainage that can be expected as the result of the redevelopment of the former Steven's Mill site located at the corner of Mill Street and Ardlock Place in the Town of Dudley, Massachusetts. The site, which contains approximately 7± acres of land, contains the existing mill building, above and below grade canals, parking and loading areas, landscaping, and shrub/wooded areas.

The proposed project includes the redevelopment of the former Steven's Mill building, which includes the demolition of a portion of the building in the southeast, improvements to an existing surface infiltration basin, and the construction of a new amenity space, new paved parking areas, landscaping, storm water management components and associated utilities. Roadway improvements are proposed within Ardlock Place including but not limited to roadway widening and new pedestrian sidewalks and will be designed by others. In coordination with the Abutting Property Owner, a new access drive will be constructed on the adjacent property to provide access from the project to Mill Street.

This report addresses a comparative analysis of the pre- and post-development site runoff conditions. Additionally, this report provides calculations documenting the design of the proposed stormwater conveyance/management system as illustrated within the accompanying Site Development Plans prepared by Bohler. The project will also provide erosion and sedimentation controls during the demolition and construction periods, as well as long term stabilization of the site.

For the purposes of this analysis the pre- and post-development drainage conditions were analyzed at two (2) "design points" where stormwater runoff currently drains to under existing conditions. These design points are described in further detail in **Section II** below. A summary of the existing and proposed conditions peak runoff rates for the 2-, 10-, 25-, and 100-year storms can be found in **Table 1.1** below. In addition, as a redevelopment the project has been designed to meet to the greatest extent practicable the Stormwater Management Standards as detailed herein.

Table 1.1: Design Point Peak Runoff Rate Summary

Point of Analysis	2-Year Storm			10-Year Storm			25-Year Storm			100-Year Storm		
	Pre	Post	Δ	Pre	Post	Δ	Pre	Post	Δ	Pre	Post	Δ
DP1	13.49	9.52	**-3.97**	25.25	20.43	**-4.82**	32.03	29.35	**-2.68**	41.96	39.39	**-2.54**
DP2**	0.11	0.28	**0.17**	0.16	0.42	**0.26**	0.19	0.49	**0.30**	0.24	0.60	**0.36**

**Flows are represented in cubic feet per second (cfs)*

** The increase in flows associated with DP2 (Ardlock Place) is due to the proposed improvements associated with the roadway widening project. Refer to plans to be prepared by others for more information.

II. EXISTING SITE CONDITIONS

Existing Site Description

The site consists of approximately 7± acres on two (2) parcels of land located at the corner of Mill Street and Ardlock Place in the Town of Dudley, Massachusetts. The eastern portion of the site contains shrub/wooded areas that abut the French River, and an open canal which connects Low Pond, located west of Mill Street, to the French River. The western portion of the site contains the former Steven's Mill building and associated above and below grade canals, paved and compacted gravel parking lots, pavement within Ardlock Place, loading areas, and landscaped areas. The offsite areas impacted by the project contain an existing paved parking area and a grassed lot that previously contained a residential structure with driveway.

On-Site Soil Information

The soils at the site are mapped as Paxton-Urban land complex which is classified by the Natural Resource Conservation Service (NRCS) as Hydrologic Soil Group (HSG) "C". On-soil testing performed in September 2021 encountered mostly fill materials, and in some areas fill underlain by ledge or potentially buried pavement. Test pits did not observe the presence of or indications of seasonal high ground water (SHGW). Additional subsurface investigations are expected to be performed during the early stages of construction as the site is brought closer to finished grade and natural soil consistency and groundwater elevations can be confirmed in the areas of the proposed underground stormwater systems. The entire site has been analyzed as HSG "C" for the purposes of this analysis. Refer to **Appendix C** for additional information.

Existing Collection and Conveyance

Runoff generated onsite flows in the easterly direction to the French River. A portion of this runoff associated with the building and areas adjacent to the building is captured in the above grade canal that connects Low Pond to the French River. Existing drainage structures located southeast of the building appear to collect runoff from the loading area and discharge flows to the French River. Runoff associated with the abutting Tri-Valley building and associated parking area to the north of the site, as well as the parking area associated with the site to the northeast flows both overland or is collected by a series of catch basins within the parking lot, and discharge to an existing stormwater basin in the northeastern portion of the site. Overflow from the basin discharges to the French River. Remaining areas onsite flow overland in the easterly direction to the French River. Runoff generated in Ardlock Place flows along the gutter line and offsite to the south. Runoff from the offsite areas drains overland into the existing paved parking area or directly to the French River.

Slopes on the site range from 1.5%-50% with on-site elevations ranging from 460 at Mill Street to 410 at the French River.

Existing Watersheds and Design Point Information

For the purposes of this analysis, the pre- and post-development drainage conditions were analyzed at two (2) "design points" where stormwater runoff currently drains to under existing conditions. The total area analyzed is approximately 7.9± acres, of which approximately 2± acres is located offsite. The site was subdivided into five (5) separate sub-catchments for the existing conditions as described below. The minimum time of concentration for all proposed areas is calculated as 6 minutes (0.1 hr).

Design Point #1 (EDP1) is the French River located east of the subject site. Under existing conditions this design point receives stormwater flows from approximately 7.9± acres of land, designated as Watersheds "E1a", "E1b", "E1c", and "E1d". The sub-catchments associated with EDP1 are described in more detail below in **Table 2.1**.

Table 2.1: EDP1 Sub-catchment Summary

Sub-catchment Name	Total Area (acres)	Cover Description	Curve Number (CN)	Time of Concentration (Tc, minutes)	Hydrologic Routing
E1a	0.4±	Paved parking	98	6.0	Existing Basin (B1)
E1b	2.1±	(Offsite) Rooftops, paved parking, grass	91	6.3	Existing Basin (B1)
E1c	0.4±	Paved parking, grass, basin bottom, rock slope	88	6.0	Existing Basin (B1)
E1d	5.6±	Rooftops, paved parking, dirt roads, rock slope, grass, brush, waterway	86	6.8	French River (EDP1)

Design Point #2 (EDP2) is Ardlock Place located west of the subject site. Under existing conditions this design point receives stormwater flows from approximately 0.04± acres of pavement, designated as Watershed "E2". E2 has a CN of 98 and a Tc of 6 minutes.

Refer to **Table 1.1** for the calculated existing conditions peak rates of runoff at each design point. For additional hydrologic information, refer to **Appendix D** and the Drainage Area Maps in the appendices of this report for a graphical representation of the existing drainage areas.

III. PROPOSED SITE CONDITIONS

Proposed Development Description

The proposed project consists of the redevelopment of the existing Stevens Mill site, which includes the demolition of a portion of the building, improvements to an existing surface infiltration basin, and construction of new paved parking areas, landscaping, associated utilities, and stormwater management systems. Roadway improvements are proposed within Ardlock Place including but not limited to roadway widening and new pedestrian sidewalks and will be designed by others. Additional offsite improvements include the construction of a new shared driveway to Mill Street, shared overflow parking areas, and access drive to the proposed development.

Proposed Development Collection and Conveyance

Majority of the site has been designed to drain to deep-sump, hooded catch basins which will capture and convey stormwater runoff, via an underground pipe system, to one of three (3)

proposed underground stormwater management systems and one (1) existing surface infiltration basin. As on-site soil testing only encountered fill materials, the underground stormwater management systems have not been modelled as infiltrating basins at this time. Based on location and depth of the existing infiltration basin on the site, it is assumed that the systems will be able to provide infiltration once soil conditions are confirmed, but this has not been accounted for when determine peak runoff rates and groundwater recharge. Pretreatment of stormwater runoff will be provided by a combination of the deep-sump, hooded catch basins and proprietary treatment units prior to discharge into the proposed infiltration system. A portion of the rooftop runoff that is not flowing direct / overland to the onsite canal has been designed to flow to the infiltration systems. Remaining areas will flow overland direct to the onsite canal or French River.

Runoff generated from the abutting Tri-Valley site will continue to be captured in a series of existing catch basins and flow via an existing underground pipe system across the project site to the existing infiltration basin, ultimately matching existing drainage conditions.

Runoff from the new off-site driveways and paved areas are proposed to be collected in new deep-sump and hooded catch basins which will convey stormwater runoff to a proposed underground stormwater system before discharging to the existing surface infiltration basin.

The best management practices (BMPs) incorporated into the proposed stormwater management system have been designed to meet the total suspended solid (TSS) removal requirements as set forth in the Massachusetts Department of Environmental Protection Stormwater Handbook standards. Refer to **Appendix F** for calculations. In addition, a Stormwater Operation and Maintenance (O&M) Plan, attached in **Appendix G**, has been developed which includes scheduled maintenance and periodic inspections of stormwater management structures.

Proposed Watersheds and Design Point Information

The project has been designed to maintain existing drainage watersheds to the greatest extent possible, with the same design points described in **Section II** above. The site was subdivided into nine (9) separate sub catchments for the proposed conditions as described below. The minimum time of concentration for all proposed areas is calculated as 6 minutes (0.1 hr).

Design Point #1 (PDP1) is the French River located east of the subject site. Under proposed conditions this design point receives stormwater flows from approximately 7.8± acres of land, designated as Watersheds "E1b", "E1d", "P1a", "P1b", "P1c", "P1d", "P1e" and "P1f". The sub-catchments associated with PDP1 are described in more detail below in **Table 3.1**.

Table 3.1: PDP1 Sub-catchment Summary

Sub-catchment Name	Total Area (acres)	Cover Description	Curve Number (CN)	Time of Concentration (Tc, minutes)	Hydrologic Routing
P1a	0.1±	Paved parking, grass	92	6.0	Existing Basin (B1)
P1b	0.8±	Paved parking, grass	96	6.0	Existing Basin (B1)
P1c	0.2±	Basin bottom, rock slope, grass	83	6.0	Existing Basin (B1)
P1d	1.9±	Rooftops, paved parking, grass, brush, rock slope, waterway	80	6.0	French River (PDP1)
P1e	1.5±	Rooftops, paved parking, grass	93	6.0	Underground System (UG-A)
P1f	1.7±	Rooftops, Paved parking, grass	94	6.0	Underground System (UG-B)
P1g	1.8±	Rooftops, Paved parking, grass	93	6.3	Existing Basin (B1)
P1h	0.4±	Rooftops, Paved parking, grass	95	6.3	Underground System (UG-C)

Design Point #2 (PDP2) is Ardlock Place located west of the subject site. Under proposed conditions this design point receives stormwater flows from approximately 0.1± acres of pavement, designated as Watershed "P2". P2 has a CN of 98 and a Tc of 6 minutes.

Refer to **Table 1.1** for the calculated proposed conditions peak rates of runoff. For additional hydrologic information, refer to **Appendix D** and the Drainage Area Maps in the appendices of this report for a graphical representation of the proposed drainage areas.

IV. METHODOLOGY

Peak Flow Calculations

Methodology utilized to design the proposed stormwater management system includes compliance with the guidelines set forth in the latest edition of the Massachusetts DEP Stormwater Handbook. The pre- and post-development runoff rates being discharged from the site were computed using the HydroCAD computer program. The drainage area and outlet information were entered into the program, which routes storm flows based on NRCS TR-20 and TR-55 methods. The other components of the model were determined following standard NRCS procedures for Curve Numbers (CNs) and times of concentrations documented in the appendices of this report. The rainfall data utilized and listed below in **Table 4.1** below for stormwater calculations is based on Technical Paper-40. Refer to **Appendix F** for more information.

Table 4.1: Worcester County Rainfall Intensities

Frequency	2 year	10 year	25 year	100 year
Rainfall* (inches)	3.00	4.50	5.30	6.50

*Values derived from Hydrology Handbook for Conservation Commissioners prepared by Mass DEP (TP-40 Maps)

The proposed stormwater management as designed will provide a decrease in peak rates of runoff from the proposed facility for the 2-, 10-, 25- and 100-year design storm events to the French River (PDP1). The increase in flows associated with Ardlock Place (PDP2) is due to the proposed improvements associated with the roadway widening project, which will be designed by others. It is notable that the project proposes an overall decrease in peak rates of runoff at both PDP1 and PDP2 when combined. The proposed project as designed meets, or exceeds, the MADEP Stormwater Management standards. Compliance with these standards is described further below.

V. STORMWATER MANAGEMENT STANDARDS

Standard #1: No New Untreated Discharges

The project has been designed so that proposed impervious areas shall be collected and passed through the proposed drainage system for treatment prior to discharge.

Standard #2: Peak Rate Attenuation

As outlined in **Table 1.1**, the development of the site and the proposed stormwater management system have been designed so that post-development peak rates of runoff are below pre-development conditions for the 2-, 10-, 25- and 100-year storm events at PDP1. Due to the proposed roadway widening associated with Ardlock Place, there is a minor increase in peak rates of runoff to PDP2. The roadway improvements will be designed and detailed by others. It is notable that the project proposes an overall decrease in peak rates of runoff at both PDP1 and PDP2 when combined. As mentioned above, the underground stormwater systems have not been modelled as infiltration systems and no exfiltration from the basin is considered when determining the reduction in peak flow rates.

Standard #3: Recharge

The project as proposed will involve the creation of 48,961± square feet of new impervious area and is required to infiltrate 1,827 cubic feet of stormwater as defined in Stormwater Standard 3 and factoring in only 56% of the impervious area is directed to the existing infiltration basin. The existing infiltration basin provides a total of 4,349 cubic feet of volume below the lowest outlet for groundwater recharge. Refer to **Appendix F** of this report for calculations documenting required and provided recharge volumes.

It is further notable that while the three underground stormwater systems have not been modelled to provide infiltration at this time, they provide an additional 10,224 cubic feet of storage below the lowest outlets. It is assumed that additional stormwater testing will allow for infiltration to occur in at least one these basins, which will provide groundwater recharge in addition to the existing basin which provides sufficient volume to meet this standard.

The DEP Stormwater Standards require that the infiltration BMP drains completely within 72 hours of the end of the storm event. Calculations showing that the existing infiltration basin will drain within 72 hours are included in **Appendix F** of this report.

Test pits did not observe the presence of or indications of seasonal high ground water (SHGW), therefore it is expected that a four (4) foot separation to estimated seasonal high groundwater is provided and a groundwater mounding analysis is not required. Should additional soil testing in

the areas of the underground systems reveal groundwater within 4' of the bottom of the system, these would be maintained as detention systems as currently modelled.

Standard #4: Water Quality

Water quality treatment is provided via a combination of deep sump catch basins, proprietary water quality structures, and surface and subsurface infiltration systems. TSS removal calculations are included in **Appendix F** of this report. The project as proposed will involves a total of ±3.7 acres impervious area that requires water quality treatment and is required to treat 13,365 cubic feet of water quality volume as defined in Stormwater Standard 4. Water quality volume is equal to one (1) inch of runoff times the total impervious area of the post development project site, excluding existing offsite impervious areas. Water quality volume calculations did not include roof areas in the total impervious area. The four (4) stormwater management systems provide 18,517 cubic feet of water quality volume below the lowest outlets for water quality treatment. Water quality units have been sized to meet the one (1) inch water quality flow rate for water quality treatment. Refer to **Appendix F** of this report for calculations documenting required and provided water quality volumes.

Standard #5: Land Use with Higher Potential Pollutant Loads

Not Applicable for this project.

Standard #6: Critical Areas

A Zone II has been established for the site and covers the entirety of the development. The proposed stormwater management system has been designed to provide at least eighty percent (80%) removal of Total Suspended Solids (TSS) through the use of several Best Management Practices (BMPs), including deep-sump hooded catch basins, proprietary water quality units, and infiltration systems. The deep-sump hooded catch basins and water quality units will provide a minimum of 44% TSS removal prior to discharge to all infiltration basins. Refer to **Appendix F** for TSS removal calculations.

Priority Habitats of Rare Species has been established in the eastern portion of the site by the Natural Heritage and Endangered Species Program (NHESP). There is no work proposed on the project that will impact these areas

Standard #7: Redevelopment

The project is a redevelopment and is required to meet certain Standards to the maximum extent practicable. Although it is a redevelopment, the project has been designed to meet the standards as if it were a new development.

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

The proposed project will provide construction period erosion and sedimentation controls as indicated within the site plan set provided for this project. This includes a proposed construction exit, protection for stormwater inlets, protection around temporary material stock piles and various other techniques as outlined on the erosion and sediment control sheets. Additionally, the project is required to file a Notice of Intent with the US EPA and implement a Stormwater Pollution Prevention Plan (SWPPP) during the construction period. The SWPPP will be prepared prior to the start of construction and will be implemented by the site contractor under the guidance and responsibility of the project's proponent.

Standard #9: Operation and Maintenance Plan (O&M Plan)

An Operation and Maintenance (O&M) Plan for this site has been prepared and is included in **Appendix G** of this report. The O&M Plan includes a list of responsible parties and outlines procedures and time tables for the long-term operation and maintenance of the proposed site stormwater management system, including initial inspections upon completion of construction, and periodic monitoring of the system components, in accordance with established practices and the manufacturer's recommendations.

Standard #10: Prohibition of Illicit Discharges

The proposed stormwater system will only convey allowable non-stormwater discharges (firefighting waters, irrigation, air conditioning condensates, etc.) and will not contain any illicit discharges from prohibited sources. An Illicit Discharge Statement is included in **Appendix G** of this report.

VI. SUMMARY

In summary, the proposed stormwater management system illustrated on the drawings prepared by Bohler results in a reduction in peak rates of runoff from the subject site when compared to pre-development conditions for the 2-, 10-, 25- and 100-year storm frequencies to the French River (PDP1). The increase in flows associated with Ardlock Place (PDP2) is due to the proposed improvements associated with the roadway widening project, which will be designed by others. It is notable that the project proposes an overall decrease in peak rates of runoff at both PDP1 and PDP2 when combined.

In addition, the proposed best management practices will result in an effective removal of total suspended solids from the post-development runoff. The pre-development versus post-development stormwater discharge comparisons are contained in **Table 1.1**.

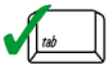
APPENDIX A: MASSACHUSETTS STORMWATER MANAGEMENT CHECKLIST

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands Program

Checklist for Stormwater Report

A. Introduction

Important: When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.



A Stormwater Report must be submitted with the Notice of Intent permit application to document compliance with the Stormwater Management Standards. The following checklist is NOT a substitute for the Stormwater Report (which should provide more substantive and detailed information) but is offered here as a tool to help the applicant organize their Stormwater Management documentation for their Report and for the reviewer to assess this information in a consistent format. As noted in the Checklist, the Stormwater Report must contain the engineering computations and supporting information set forth in Volume 3 of the Massachusetts Stormwater Handbook. The Stormwater Report must be prepared and certified by a Registered Professional Engineer (RPE) licensed in the Commonwealth.

The Stormwater Report must include:

- The Stormwater Checklist completed and stamped by a Registered Professional Engineer (see page 2) that certifies that the Stormwater Report contains all required submittals.[1] This Checklist is to be used as the cover for the completed Stormwater Report.
- Applicant/Project Name
- Project Address
- Name of Firm and Registered Professional Engineer that prepared the Report
- Long-Term Pollution Prevention Plan required by Standards 4-6
- Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan required by Standard 8[2]
- Operation and Maintenance Plan required by Standard 9

In addition to all plans and supporting information, the Stormwater Report must include a brief narrative describing stormwater management practices, including environmentally sensitive site design and LID techniques, along with a diagram depicting runoff through the proposed BMP treatment train. Plans are required to show existing and proposed conditions, identify all wetland resource areas, NRCS soil types, critical areas, Land Uses with Higher Potential Pollutant Loads (LUHPPL), and any areas on the site where infiltration rate is greater than 2.4 inches per hour. The Plans shall identify the drainage areas for both existing and proposed conditions at a scale that enables verification of supporting calculations.

As noted in the Checklist, the Stormwater Management Report shall document compliance with each of the Stormwater Management Standards as provided in the Massachusetts Stormwater Handbook. The soils evaluation and calculations shall be done using the methodologies set forth in Volume 3 of the Massachusetts Stormwater Handbook.

To ensure that the Stormwater Report is complete, applicants are required to fill in the Stormwater Report Checklist by checking the box to indicate that the specified information has been included in the Stormwater Report. If any of the information specified in the checklist has not been submitted, the applicant must provide an explanation. The completed Stormwater Report Checklist and Certification must be submitted with the Stormwater Report.

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[1] The Stormwater Report may also include the Illicit Discharge Compliance Statement required by Standard 10. If not included in the Stormwater Report, the Illicit Discharge Compliance Statement must be submitted prior to the discharge of stormwater runoff to the post-construction best management practices.

[2] For some complex projects, it may not be possible to include the Construction Period Erosion and Sedimentation Control Plan in the Stormwater Report. In that event, the issuing authority has the discretion to issue an Order of Conditions that approves the project and includes a condition requiring the proponent to submit the Construction Period Erosion and Sedimentation Control Plan before commencing any land disturbance activity on the site.

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands Program

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

The following checklist is intended to serve as a guide for applicants as to the elements that ordinarily need to be addressed in a complete Stormwater Report. The checklist is also intended to provide conservation commissions and other reviewing authorities with a summary of the components necessary for a comprehensive Stormwater Report that addresses the ten Stormwater Standards.

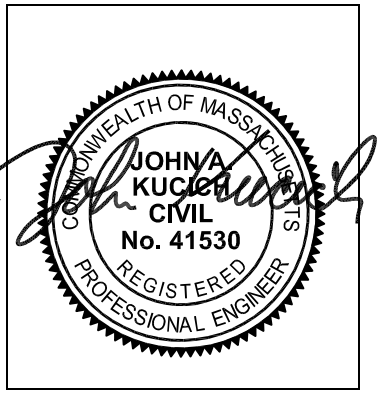
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the item is not applicable (N.A.) and provide the reasons for that determination.

A complete checklist must include the Certification set forth below signed by the Registered Professional Engineer who prepared the Stormwater Report.

Registered Professional Engineer's Certification

I have reviewed the Stormwater Report, including the soil evaluation, computations, Long-term Pollution Prevention Plan, the Construction Period Erosion and Sedimentation Control Plan (if included), the Long-term Post-Construction Operation and Maintenance Plan, the Illicit Discharge Compliance Statement (if included) and the plans showing the stormwater management system, and have determined that they have been prepared in accordance with the requirements of the Stormwater Management Standards as further elaborated by the Massachusetts Stormwater Handbook. I have also determined that the information presented in the Stormwater Checklist is accurate and that the information presented in the Stormwater Report accurately reflects conditions at the site as of the date of this permit application.

Registered Professional Engineer Block and Signature



4/15/2022

Signature and Date

Checklist

Project Type: Is the application for new development, redevelopment, or a mix of new and redevelopment?

☐ New development

☒ Redevelopment

☐ Mix of New Development and Redevelopment

Checklist for Stormwater Report

Checklist (continued)

LID Measures: Stormwater Standards require LID measures to be considered. Document what environmentally sensitive design and LID Techniques were considered during the planning and design of the project:

☒ No disturbance to any Wetland Resource Areas

☐ Site Design Practices (e.g. clustered development, reduced frontage setbacks)

☐ Reduced Impervious Area (Redevelopment Only)

☐ Minimizing disturbance to existing trees and shrubs

☐ LID Site Design Credit Requested:

- ☐ Credit 1
- ☐ Credit 2
- ☐ Credit 3

☐ Use of "country drainage" versus curb and gutter conveyance and pipe

☐ Bioretention Cells (includes Rain Gardens)

☐ Constructed Stormwater Wetlands (includes Gravel Wetlands designs)

☐ Treebox Filter

☐ Water Quality Swale

☐ Grass Channel

☐ Green Roof

☒ Other (describe): Improved existing surface infiltration basin

Standard 1: No New Untreated Discharges

☒ No new untreated discharges

☒ Outlets have been designed so there is no erosion or scour to wetlands and waters of the Commonwealth

☒ Supporting calculations specified in Volume 3 of the Massachusetts Stormwater Handbook included.

Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

☐ Standard 2 waiver requested because the project is located in land subject to coastal storm flowage and stormwater discharge is to a wetland subject to coastal flooding.

☐ Evaluation provided to determine whether off-site flooding increases during the 100-year 24-hour storm.

☒ Calculations provided to show that post-development peak discharge rates do not exceed pre-development rates for the 2-year and 10-year 24-hour storms. If evaluation shows that off-site flooding increases during the 100-year 24-hour storm, calculations are also provided to show that post-development peak discharge rates do not exceed pre-development rates for the 100-year 24-hour storm.

Standard 3: Recharge

☒ Soil Analysis provided.

☒ Required Recharge Volume calculation provided.

☐ Required Recharge volume reduced through use of the LID site Design Credits.

☒ Sizing the infiltration, BMPs is based on the following method: Check the method used.

☒ Static ☐ Simple Dynamic ☐ Dynamic Field[1]

☐ Runoff from all impervious areas at the site discharging to the infiltration BMP.

☒ Runoff from all impervious areas at the site is *not* discharging to the infiltration BMP and calculations are provided showing that the drainage area contributing runoff to the infiltration BMPs is sufficient to generate the required recharge volume.

☒ Recharge BMPs have been sized to infiltrate the Required Recharge Volume.

☐ Recharge BMPs have been sized to infiltrate the Required Recharge Volume *only* to the maximum extent practicable for the following reason:

- ☐ Site is comprised solely of C and D soils and/or bedrock at the land surface
- ☐ M.G.L. c. 21E sites pursuant to 310 CMR 40.0000
- ☐ Solid Waste Landfill pursuant to 310 CMR 19.000
- ☐ Project is otherwise subject to Stormwater Management Standards only to the maximum extent practicable.

☒ Calculations showing that the infiltration BMPs will drain in 72 hours are provided.

☐ Property includes a M.G.L. c. 21E site or a solid waste landfill and a mounding analysis is included.

[1] 80% TSS removal is required prior to discharge to infiltration BMP if Dynamic Field method is used.

Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

☐ The infiltration BMP is used to attenuate peak flows during storms greater than or equal to the 10-year 24-hour storm and separation to seasonal high groundwater is less than 4 feet and a mounding analysis is provided.

☒ Documentation is provided showing that infiltration BMPs do not adversely impact nearby wetland resource areas.

Standard 4: Water Quality

The Long-Term Pollution Prevention Plan typically includes the following:

- Good housekeeping practices;
- Provisions for storing materials and waste products inside or under cover;
- Vehicle washing controls;
- Requirements for routine inspections and maintenance of stormwater BMPs;
- Spill prevention and response plans;
- Provisions for maintenance of lawns, gardens, and other landscaped areas;
- Requirements for storage and use of fertilizers, herbicides, and pesticides;
- Pet waste management provisions;
- Provisions for operation and management of septic systems;
- Provisions for solid waste management;
- Snow disposal and plowing plans relative to Wetland Resource Areas;
- Winter Road Salt and/or Sand Use and Storage restrictions;
- Street sweeping schedules;
- Provisions for prevention of illicit discharges to the stormwater management system;
- 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;
- Training for staff or personnel involved with implementing Long-Term Pollution Prevention Plan;
- List of Emergency contacts for implementing Long-Term Pollution Prevention Plan.

☒ A Long-Term Pollution Prevention Plan is attached to Stormwater Report and is included as an attachment to the Wetlands Notice of Intent.

☒ Treatment BMPs subject to the 44% TSS removal pretreatment requirement and the one inch rule for calculating the water quality volume are included, and discharge:

- ☒ is within the Zone II or Interim Wellhead Protection Area
- ☐ is near or to other critical areas
- ☐ is within soils with a rapid infiltration rate (greater than 2.4 inches per hour)
- ☐ involves runoff from land uses with higher potential pollutant loads.

☐ The Required Water Quality Volume is reduced through use of the LID site Design Credits.

☒ Calculations documenting that the treatment train meets the 80% TSS removal requirement and, if applicable, the 44% TSS removal pretreatment requirement, are provided.

Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

☒ The BMP is sized (and calculations provided) based on:

- ☒ The ½" or 1" Water Quality Volume or
- ☒ The equivalent flow rate associated with the Water Quality Volume and documentation is provided showing that the BMP treats the required water quality volume.

☒ The applicant proposes to use proprietary BMPs, and documentation supporting use of proprietary BMP and proposed TSS removal rate is provided. This documentation may be in the form of the propriety BMP checklist found in Volume 2, Chapter 4 of the Massachusetts Stormwater Handbook and submitting copies of the TARP Report, STEP Report, and/or other third party studies verifying performance of the proprietary BMPs.

☐ A TMDL exists that indicates a need to reduce pollutants other than TSS and documentation showing that the BMPs selected are consistent with the TMDL is provided.

Standard 5: Land Uses With Higher Potential Pollutant Loads (LUHPPLs)

☐ The NPDES Multi-Sector General Permit covers the land use and the Stormwater Pollution Prevention Plan (SWPPP) has been included with the Stormwater Report.

☐ The NPDES Multi-Sector General Permit covers the land use and the SWPPP will be submitted ***prior to*** the discharge of stormwater to the post-construction stormwater BMPs.

☐ The NPDES Multi-Sector General Permit does ***not*** cover the land use.

☐ LUHPPLs are located at the site and industry specific source control and pollution prevention measures have been proposed to reduce or eliminate the exposure of LUHPPLs to rain, snow, snow melt and runoff, and been included in the long term Pollution Prevention Plan.

☐ All exposure has been eliminated.

☐ All exposure has ***not*** been eliminated and all BMPs selected are on MassDEP LUHPPL list.

☐ The LUHPPL has the potential to generate runoff with moderate to higher concentrations of oil and grease (e.g. all parking lots with >1000 vehicle trips per day) and the treatment train includes an oil grit separator, a filtering bioretention area, a sand filter or equivalent.

Standard 6: Critical Areas

☒ The discharge is near or to a critical area and the treatment train includes only BMPs that MassDEP has approved for stormwater discharges to or near that particular class of critical area.

☒ Critical areas and BMPs are identified in the Stormwater Report.

Checklist for Stormwater Report

Checklist (continued)

Standard 7: Redevelopments and Other Projects Subject to the Standards only to the maximum extent practicable

☒ The project is subject to the Stormwater Management Standards only to the maximum Extent Practicable as a:

- ☐ Limited Project
- ☐ Small Residential Projects: 5-9 single family houses or 5-9 units in a multi-family development provided there is no discharge that may potentially affect a critical area.
- ☐ Small Residential Projects: 2-4 single family houses or 2-4 units in a multi-family development with a discharge to a critical area
- ☐ Marina and/or boatyard provided the hull painting, service and maintenance areas are protected from exposure to rain, snow, snow melt and runoff
- ☐ Bike Path and/or Foot Path
- ☒ Redevelopment Project
- ☐ Redevelopment portion of mix of new and redevelopment.

☐ Certain standards are not fully met (Standard No. 1, 8, 9, and 10 must always be fully met) and an explanation of why these standards are not met is contained in the Stormwater Report.

☐ The project involves redevelopment and a description of all measures that have been taken to improve existing conditions is provided in the Stormwater Report. The redevelopment checklist found in Volume 2 Chapter 3 of the Massachusetts Stormwater Handbook may be used to document that the proposed stormwater management system (a) complies with Standards 2, 3 and the pretreatment and structural BMP requirements of Standards 4-6 to the maximum extent practicable and (b) improves existing conditions.

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

A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan must include the following information:

- Narrative;
- Construction Period Operation and Maintenance Plan;
- Names of Persons or Entity Responsible for Plan Compliance;
- Construction Period Pollution Prevention Measures;
- Erosion and Sedimentation Control Plan Drawings;
- Detail drawings and specifications for erosion control BMPs, including sizing calculations;
- Vegetation Planning;
- Site Development Plan;
- Construction Sequencing Plan;
- Sequencing of Erosion and Sedimentation Controls;
- Operation and Maintenance of Erosion and Sedimentation Controls;
- Inspection Schedule;
- Maintenance Schedule;
- Inspection and Maintenance Log Form.

☒ A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan containing the information set forth above has been included in the Stormwater Report.

Checklist for Stormwater Report

Checklist (continued)

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control (continued)

☐ The project is highly complex and information is included in the Stormwater Report that explains why it is not possible to submit the Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan with the application. A Construction Period Pollution Prevention and Erosion and Sedimentation Control has ***not*** been included in the Stormwater Report but will be submitted ***before*** land disturbance begins.

☐ The project is ***not*** covered by a NPDES Construction General Permit.

☐ The project is covered by a NPDES Construction General Permit and a copy of the SWPPP is in the Stormwater Report.

☒ The project is covered by a NPDES Construction General Permit but no SWPPP been submitted. The SWPPP will be submitted BEFORE land disturbance begins.

Standard 9: Operation and Maintenance Plan

☒ The Post Construction Operation and Maintenance Plan is included in the Stormwater Report and includes the following information:

- ☒ Name of the stormwater management system owners;
- ☒ Party responsible for operation and maintenance;
- ☒ Schedule for implementation of routine and non-routine maintenance tasks;
- ☒ Plan showing the location of all stormwater BMPs maintenance access areas;
- ☐ Description and delineation of public safety features;
- ☐ Estimated operation and maintenance budget; and
- ☒ Operation and Maintenance Log Form.

☐ The responsible party is ***not*** the owner of the parcel where the BMP is located and the Stormwater Report includes the following submissions:

- ☐ A copy of the legal instrument (deed, homeowner's association, utility trust or other legal entity) that establishes the terms of and legal responsibility for the operation and maintenance of the project site stormwater BMPs;
- ☐ A plan and easement deed that allows site access for the legal entity to operate and maintain BMP functions.

Standard 10: Prohibition of Illicit Discharges

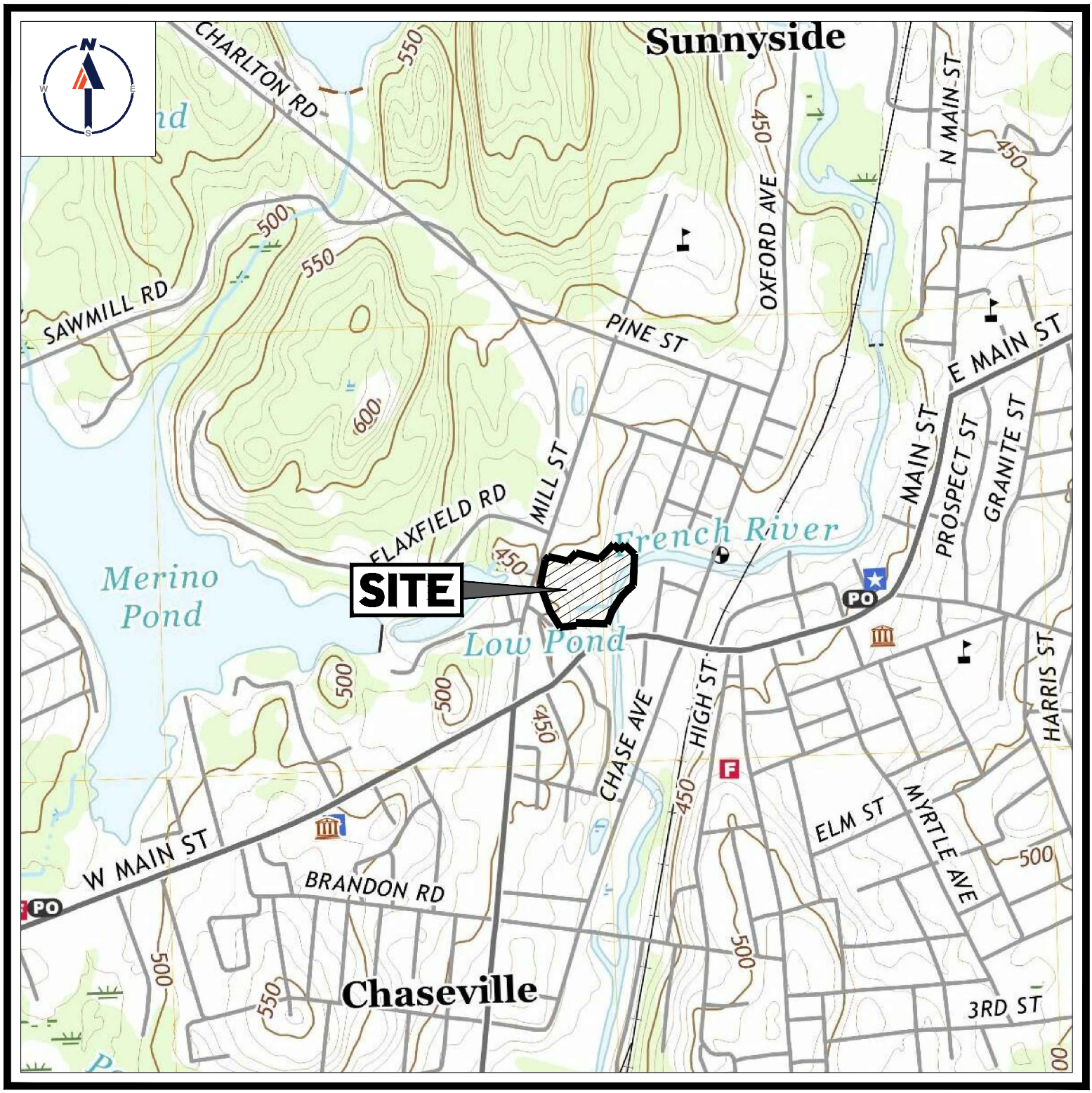
☒ The Long-Term Pollution Prevention Plan includes measures to prevent illicit discharges;

☒ An Illicit Discharge Compliance Statement is attached;

☐ NO Illicit Discharge Compliance Statement is attached but will be submitted ***prior to*** the discharge of any stormwater to post-construction BMPs.

APPENDIX B: PROJECT LOCATION MAPS

- *USGS MAP*
- *FEMA FIRMETTE*
- *GIS ONLINE MAPPING*



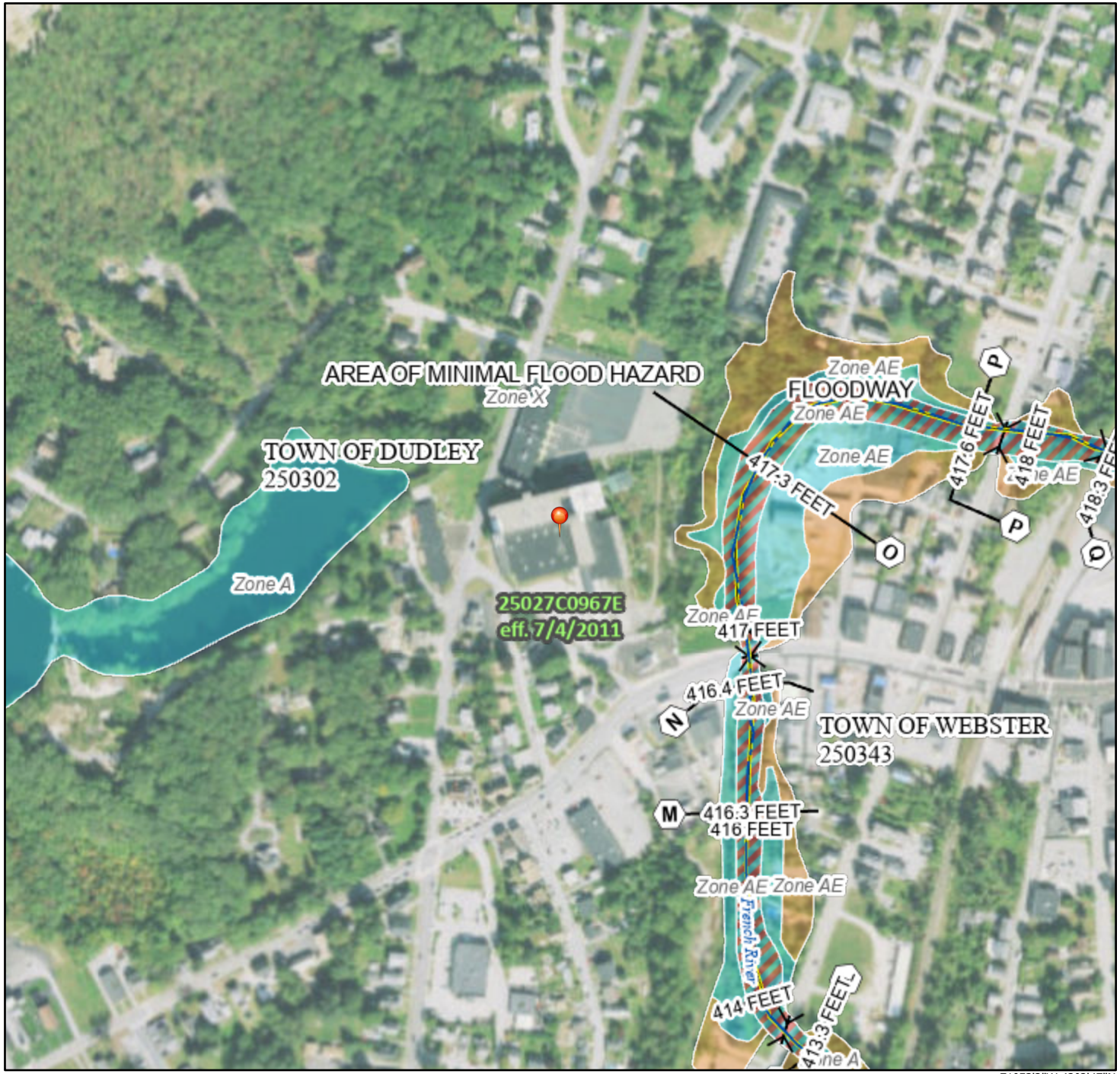
USGS MAP

SCALE: 1" = 1,000'
SOURCE: WEBSTER MASSACHUSETTS USGS QUADRANGLE

National Flood Hazard Layer FIRMette

FEMA

71°53'40"W 42°3'14"N



71°53'2"W 42°2'47"N

0 250 500 1,000 1,500 2,000 Feet

1:6,000

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

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 Cross Sections with 1% Annual Chance
- 17.5 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

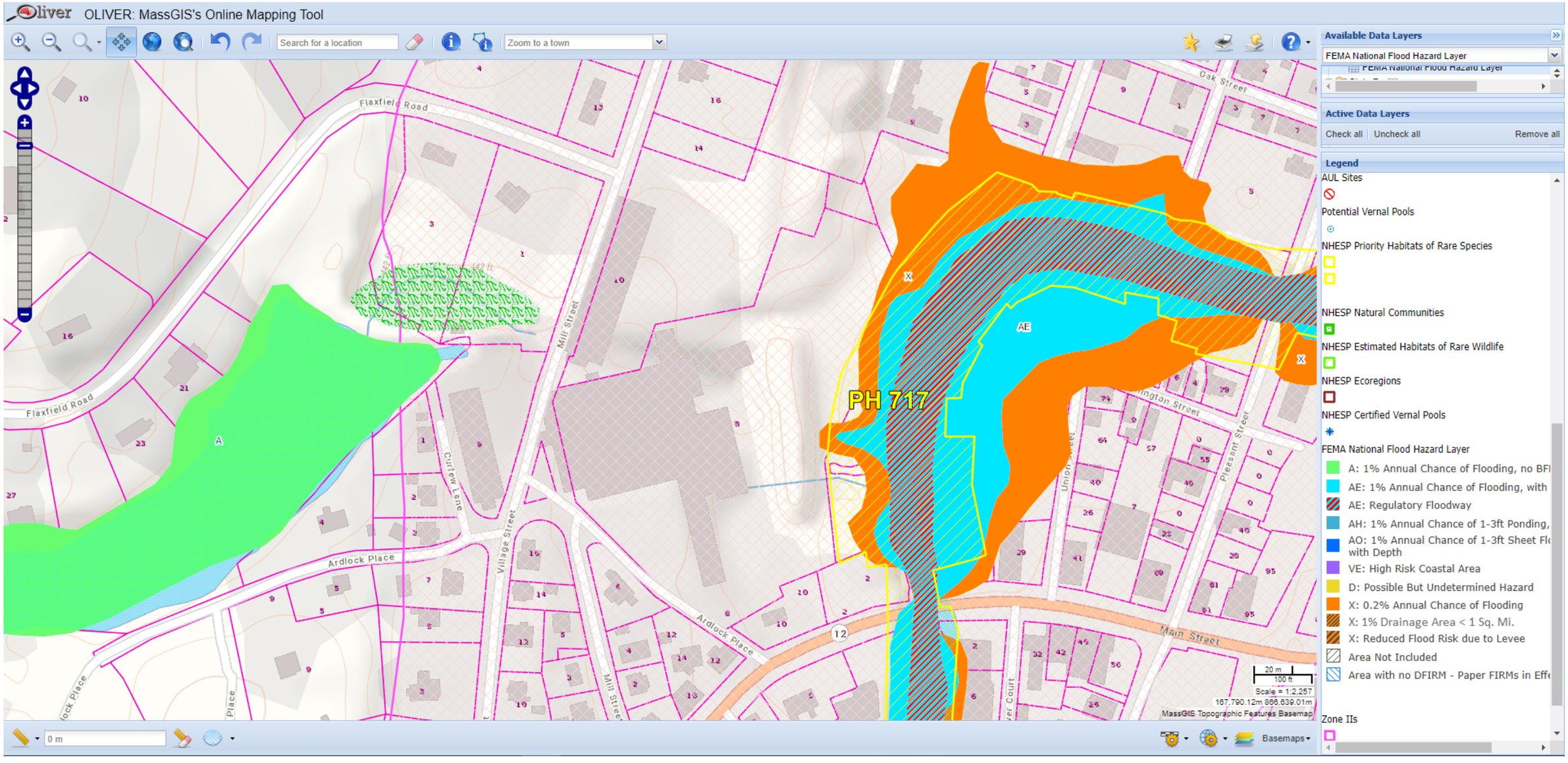
N

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 5/26/2021 at 10:04 AM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

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


OLIVER: MassGIS's Online Mapping Tool
Search for a location
Zoom to a town
Available Data Layers
FEMA National Flood Hazard Layer
Active Data Layers
Check all
Uncheck all
Remove all
Legend
AUL Sites
Potential Vernal Pools
NHESP Priority Habitats of Rare Species
NHESP Natural Communities
NHESP Estimated Habitats of Rare Wildlife
NHESP Ecoregions
NHESP Certified Vernal Pools
FEMA National Flood Hazard Layer
A: 1% Annual Chance of Flooding, no BFI
AE: 1% Annual Chance of Flooding, with
AE: Regulatory Floodway
AH: 1% Annual Chance of 1-3ft Ponding,
AO: 1% Annual Chance of 1-3ft Sheet Flo with Depth
VE: High Risk Coastal Area
D: Possible But Undetermined Hazard
X: 0.2% Annual Chance of Flooding
X: 1% Drainage Area < 1 Sq. Mi.
X: Reduced Flood Risk due to Levee
Area Not Included
Area with no DFIRM - Paper FIRMs in Effe
Zone IIs
Flaxfield Road
Oak Street
Mill Street
Curfew Lane
Village Street
Ardlock Place
Union Street
Pleasant Street
Main Street
PH 717
AE
A
X
20 m
100 ft
Scale = 1:2,257
167,790.12m 866,639.01m
MassGIS Topographic Features Basemap
0 m
Basemaps

APPENDIX C: SOIL AND WETLAND INFORMATION

- *NCRS CUSTOM SOIL RESOURCE REPORT*
- *SOIL TESTING*
- *WETLAND/WATERCOURSES REPORT*

Site Location or lot #	Stevens Mill				DEEP HOLE # TP 1
Applicant/owner:	Camden Properties				
DATE:	9/27/2021	WEATHER:	Sunny	TEMP: 80 º	
LOCATION: (Refer to sketch attached)					
PERFORMED BY:	Brandon Barry, E.I.T. (Mass SE#14024)				
WITNESSED BY:	N/A - Drainage Only				
Land Use:	Parking Area		Landform:		
Vegetation:	N/A		Slope:	1-3%	
Stone Walls:	☐ Y ☒ N		Surface Stones:	☐ Y ☒ N	

Distance From:			
Open Water Bodies:	>100 ft ft.	Possible Wet Area:	> 100 ft.
Drinking Water Well:	N/A ft.	Drainageway:	N/A ft.
Property Line:	+/- 50' ft.	Other:	

DEEP OBSERVATION HOLE LOG

Depth	Soil Horizon	Soil Texture	Soil Color	Other: Structures; Stones; Boulders; Consistency; % gravel
0-104"	FILL	Fill		C&S Stones, Large Boulders, buried pavement at bottom of hole
	-	-		
"	-	-		
	-	-		

Parent Material (geologic):	-	Depth to Bedrock:	N/A
Depth to Groundwater:	Standing Water in Hole:	N/A	
	Weeping From Pit Face:	N/A	
	Estimated Seasonal High Groundwater:		N/A

DETERMINATION FOR SEASONAL HIGH WATER TABLE

Method used:		Depth observed standing in obs. hole:					
		Depth to weeping from side of obs. hole:					
		Depth to soil mottles, description:					
		Groundwater adjustment:					
Index Well #:	NA	Reading Date:	NA	Index Well Level:	NA	Adj. Factor:	NA
Adj. ground water level:		NA					

Notes:	

Site Location or lot #	Stevens Mill				DEEP HOLE # TP 2
Applicant/owner:	Camden Properties				
DATE:	9/27/2021	WEATHER:	Sunny	TEMP: 80 º	
LOCATION: (Refer to sketch attached)					
PERFORMED BY:	Brandon Barry, E.I.T. (Mass SE#14024)				
WITNESSED BY:	N/A - Drainage Only				
Land Use:	Parking Area		Landform:		
Vegetation:	N/A		Slope:	1-3%	
Stone Walls:	☐ Y ☒ N		Surface Stones:	☐ Y ☒ N	

Distance From:			
Open Water Bodies:	>100 ft ft.	Possible Wet Area:	> 100 ft.
Drinking Water Well:	N/A ft.	Drainageway:	N/A ft.
Property Line:	+/-100' ft.	Other:	

DEEP OBSERVATION HOLE LOG

Depth	Soil Horizon	Soil Texture	Soil Color	Other: Structures; Stones; Boulders; Consistency; % gravel
0-106"	FILL	Fill		Peastone at bottom of hole
	-	-		
"	-	-		
	-	-		

Parent Material (geologic):	-	Depth to Bedrock:	N/A
Depth to Groundwater:	Standing Water in Hole:	N/A	
	Weeping From Pit Face:	N/A	
	Estimated Seasonal High Groundwater:		N/A

DETERMINATION FOR SEASONAL HIGH WATER TABLE

Method used:		Depth observed standing in obs. hole:					
		Depth to weeping from side of obs. hole:					
		Depth to soil mottles, description:					
		Groundwater adjustment:					
Index Well #:	NA	Reading Date:	NA	Index Well Level:	NA	Adj. Factor:	NA
Adj. ground water level:		NA					

Notes:	

Site Location or lot #	Stevens Mill				DEEP HOLE # TP 3-1
Applicant/owner:	Camden Properties				
DATE:	9/27/2021	WEATHER:	Sunny	TEMP: 80 º	
LOCATION: (Refer to sketch attached)					
PERFORMED BY:	Brandon Barry, E.I.T. (Mass SE#14024)				
WITNESSED BY:	N/A - Drainage Only				
Land Use:	Unpaved Accessway		Landform:		
Vegetation:	N/A		Slope:	1-3%	
Stone Walls:	☐ Y ☒ N		Surface Stones:	☒ Y ☐ N	

Distance From:			
Open Water Bodies:	>100 ft ft.	Possible Wet Area:	> 100 ft.
Drinking Water Well:	N/A ft.	Drainageway:	N/A ft.
Property Line:	+/-100' ft.	Other:	

DEEP OBSERVATION HOLE LOG

Depth	Soil Horizon	Soil Texture	Soil Color	Other: Structures; Stones; Boulders; Consistency; % gravel
0-18"	FILL	Fill		Ledge at Bottom
	-	-		
"	-	-		
	-	-		

Parent Material (geologic):	-	Depth to Bedrock:	N/A
Depth to Groundwater:	Standing Water in Hole:	N/A	
	Weeping From Pit Face:	N/A	
	Estimated Seasonal High Groundwater:		N/A

DETERMINATION FOR SEASONAL HIGH WATER TABLE

Method used:		Depth observed standing in obs. hole:					
		Depth to weeping from side of obs. hole:					
		Depth to soil mottles, description:					
		Groundwater adjustment:					
Index Well #:	NA	Reading Date:	NA	Index Well Level:	NA	Adj. Factor:	NA
Adj. ground water level:		NA					

Notes:	Ledge at bottom of hole

Site Location or lot #	Stevens Mill				DEEP HOLE # TP 3-2
Applicant/owner:	Camden Properties				
DATE:	9/27/2021	WEATHER:	Sunny	TEMP: 80 º	
LOCATION: (Refer to sketch attached)					
PERFORMED BY:	Brandon Barry, E.I.T. (Mass SE#14024)				
WITNESSED BY:	N/A - Drainage Only				
Land Use:	Unpaved Accessway		Landform:		
Vegetation:	N/A		Slope:	1-3%	
Stone Walls:	☐ Y ☒ N		Surface Stones:	☒ Y ☐ N	

Distance From:			
Open Water Bodies:	>100 ft ft.	Possible Wet Area:	> 100 ft.
Drinking Water Well:	N/A ft.	Drainageway:	N/A ft.
Property Line:	+/-100' ft.	Other:	

DEEP OBSERVATION HOLE LOG

Depth	Soil Horizon	Soil Texture	Soil Color	Other: Structures; Stones; Boulders; Consistency; % gravel
0-28"	FILL	Fill		Ledge at Bottom
	-	-		
"	-	-		
	-	-		

Parent Material (geologic):	-	Depth to Bedrock:	N/A
Depth to Groundwater:	Standing Water in Hole:	N/A	
	Weeping From Pit Face:	N/A	
	Estimated Seasonal High Groundwater:		N/A

DETERMINATION FOR SEASONAL HIGH WATER TABLE

Method used:		Depth observed standing in obs. hole:					
		Depth to weeping from side of obs. hole:					
		Depth to soil mottles, description:					
		Groundwater adjustment:					
Index Well #:	NA	Reading Date:	NA	Index Well Level:	NA	Adj. Factor:	NA
Adj. ground water level:		NA					

Notes:	Ledge at bottom of hole

Site Location or lot #	Stevens Mill			DEEP HOLE # TP 4
Applicant/owner:	Camden Properties			
DATE:	9/27/2021	WEATHER:	Sunny	TEMP: 80 º
LOCATION: (Refer to sketch attached)				
PERFORMED BY:	Brandon Barry, E.I.T. (Mass SE#14024)			
WITNESSED BY:	N/A - Drainage Only			
Land Use:	Parking Area	Landform:		
Vegetation:	N/A	Slope:	1-3%	
Stone Walls:	☐ Y ☒ N	Surface Stones:	☒ Y ☐ N	

Distance From:			
Open Water Bodies:	>100 ft ft.	Possible Wet Area:	> 100 ft.
Drinking Water Well:	N/A ft.	Drainageway:	N/A ft.
Property Line:	+/-100' ft.	Other:	

DEEP OBSERVATION HOLE LOG

Depth	Soil Horizon	Soil Texture	Soil Color	Other: Structures; Stones; Boulders; Consistency; % gravel
0-108"	FILL	Fill		Buried asphalt at 28" (+/-3" thick), large stones throughout
	-	-		
"	-	-		
	-	-		

Parent Material (geologic):	-	Depth to Bedrock:	N/A
Depth to Groundwater:	Standing Water in Hole:	N/A	
	Weeping From Pit Face:	N/A	
	Estimated Seasonal High Groundwater:		N/A

DETERMINATION FOR SEASONAL HIGH WATER TABLE

Method used:		Depth observed standing in obs. hole:					
		Depth to weeping from side of obs. hole:					
		Depth to soil mottles, description:					
		Groundwater adjustment:					
Index Well #:	NA	Reading Date:	NA	Index Well Level:	NA	Adj. Factor:	NA
Adj. ground water level:		NA					

Notes:	

Site Location or lot #	Stevens Mill				DEEP HOLE # TP 5
Applicant/owner:	Camden Properties				
DATE:	9/27/2021	WEATHER:	Sunny	TEMP: 80 º	
LOCATION: (Refer to sketch attached)					
PERFORMED BY:	Brandon Barry, E.I.T. (Mass SE#14024)				
WITNESSED BY:	N/A - Drainage Only				
Land Use:	Parking Area		Landform:		
Vegetation:	N/A		Slope:	1-3%	
Stone Walls:	☐ Y ☒ N		Surface Stones:	☒ Y ☐ N	

Distance From:			
Open Water Bodies:	>100 ft ft.	Possible Wet Area:	> 100 ft.
Drinking Water Well:	N/A ft.	Drainageway:	N/A ft.
Property Line:	+/-100' ft.	Other:	

DEEP OBSERVATION HOLE LOG

Depth	Soil Horizon	Soil Texture	Soil Color	Other: Structures; Stones; Boulders; Consistency; % gravel
0-114"	FILL	Fill		Buried asphalt at 58" (+/-3" thick), large stones throughout
	-	-		
"	-	-		
	-	-		

Parent Material (geologic):	-	Depth to Bedrock:	N/A
Depth to Groundwater:	Standing Water in Hole:	N/A	
	Weeping From Pit Face:	N/A	
	Estimated Seasonal High Groundwater:		N/A

DETERMINATION FOR SEASONAL HIGH WATER TABLE

Method used:		Depth observed standing in obs. hole:					
		Depth to weeping from side of obs. hole:					
		Depth to soil mottles, description:					
		Groundwater adjustment:					
Index Well #:	NA	Reading Date:	NA	Index Well Level:	NA	Adj. Factor:	NA
Adj. ground water level:		NA					

Notes:	

September 3, 2021

Email (bbarry@bohlereng.com)

Mr. Brandon Barry
Bohler Engineering
352 Turnpike Road
Southborough, MA 01772

Re: Wetland Resource Area Analysis Report [LEC File #: BoE\21-105.04]
Stevens Mill
Map 117 Lots 120 and 120-2
8 Mill Street
Dudley, Massachusetts

Dear Mr. Barry:

Pursuant to your request, LEC Environmental Consultants, Inc., (LEC) conducted a site evaluation and Wetland Resource Area boundary determination at the above-referenced site in Dudley, Massachusetts. Our site evaluation was conducted in accordance with the *Massachusetts Wetlands Protection Act* (*Act*, M.G.L. c. 131, s. 40), its implementing Regulations (*Act Regulations,* 310 CMR 10.00), the Town of Dudley Conservation Commission Bylaw (Chapter 294, effective 9/9/2008, *Bylaw*), and the *Federal Clean Water Act* (33 U.S.C. 1344, s.404, the *CWA*) and its *Regulations* (33 CFR and 40 CFR, the *CWA Regulations*). LEC also employed the criteria provided in *Delineating Bordering Vegetated Wetlands Under the Massachusetts Wetlands Protection Act* (March 1995) and *Field Indicators for Identifying Hydric Soils in New England* (Version 4, June 2018, the *Field Indicators Guide*). The following report provides a general site description, wetland delineation methodology, and a description of the Wetland Resource Areas and potential regulatory implications.

General Site Description

The 6.95± acre Site, known as Stevens Mill, is comprised of two parcels located in the Stevens Linen Works Historic District within east-central Dudley, Massachusetts (Attachment A, Figure 1). The Site is located east of Mill Street, north of West Main Street (Route 12) and Ardlock Place, and west of the French River and the Dudley/Webster municipal boundary. The Site is associated with a former mill complex (Stevens Linen Mill) as noted by the Massachusetts Cultural Resources Information System (MACRIS, Attachment B) and contains existing and former mill building areas, parking lot, and associated site amenities. The rear of the building area is degraded by broken pavement. A sewer line and electric distribution line containing wooden utility poles and overhead wires occurs within the eastern portion of the Site parallel to the French River. A second electric distribution line branches off from the main distribution line towards the mill building. East of the main building, the site descends

gently and then moderately approximately 25 feet to the south/east towards the French River, which is located at the bottom of a steep embankment along the eastern property boundary. A stormwater basin, containing steep embankments, two pipe inlets, and outfall structure, occurs within the northeast portion of the site.

Photo 1. View of rear of mill building and degraded areas of broken pavement

Photo 2. View of rear of mill building and degraded areas of broken pavement

Photo 3. View of easement containing sewer and electric distribution lines.

The main hydrologic features associated with the Site includes the French River and an unnamed perennial tributary to the French River. On-site, the tributary flows aboveground in open channels and belowground beneath buildings and through culverts. Wetlands are located within topographic low spots adjacent to the French River and north of the Site on Map 112 Lot 102 (off Green Street, owned by Massachusetts Electric Company). The eastern portion of the site includes forested and scrub-shrub upland areas and a meadow occurs in the footprint of the sewer and electrical distribution lines.

Vegetation within the forested hillside upland includes a canopy of northern red oak (*Quercus rubra*), black cherry (*Prunus serotina*), norway maple (*Acer platanoides*), white oak (*Quercus alba*), catalpa (*Catalpa speciosa*), eastern cottonwood (*Populus deltoides*), and elm (*Ulmus* sp.). The understory includes saplings from the canopy, with American hornbeam (*Carpinus caroliniana*), common hawthorn (*Crataegus monogyna*), Japanese barberry (*Berberis thunbergia*), honeysuckle (*Lonicera* sp.), burning bush (*Euonymus occidentalis*), northern arrowwood (*Viburnum dentatum*), dogwood (*Cornus* sp.), sweet pepperbush (*Clethra alnifolia*), and common winterberry (*Ilex verticillata*). The ground cover includes patches of poison ivy (*Toxicodendron radicans*). Along the forested edges vegetation included smooth sumac (*Rhus glabra*), Japanese knotweed (*Polygonum cuspidatum*), and entanglements of grape (*Vitus* sp.) and asian bittersweet (*Celastrus orbiculatus*).

According to the Natural Resources Conservation Service (NRCS) Web Soil Survey for Worcester County, Southern Part, the site contains Paxton-Urban land complex, 8 to 15 percent slopes (Map Unit 622C). NRCS describes Paxton-Urban land complex as very deep, gently sloping and strongly sloping, well drained Paxton soil and areas that are used for parking lots, building, and other structures. This soil complex includes about 40 percent Paxton soil, 35 percent Urban land, and 25 percent included soils (e.g., Udorthents, Woodbridge, Ridgebury, and Canton soils).

LEC inspected soil conditions within the forested upland using a hand-held, Dutch-style auger, and observed an 8-inch thick fine sandy loam topsoil (A horizon) with a soil matrix color of 10YR 3/2. The topsoil is underlain by an 11+ inch thick weathered fine sandy loam (transitioning to sandy loam with depth) subsoil (Bw horizon) with a soil matrix color of 10YR 4/6. The high chroma matrix of the B-Horizon does not qualify the soil profile as 'hydric' in accordance with the *Field Indicators Guide*. Hydric soil conditions encountered within the wetland are described below.

Natural Heritage and Endangered Species Program (NHESP) Designation

According to the 15th Edition (August 1, 2021) of the Natural Heritage Endangered Species Program (NHESP) *Massachusetts Natural Heritage Atlas*, a portion of the site adjacent to the French River is located within *Estimated Habitat of Rare Wildlife* (EH 580) and *Priority Habitat of Rare Species* (PH 717). There are no mapped certified or potential vernal pools on the site (Attachment A, Figure 2).

Wetland Boundary Determination

On June 15 2021, LEC conducted a site evaluation to identify and characterize existing on-site protectable Wetland Resource Areas and to delineate their boundaries. The extent of Wetland Resource Areas was determined through observations of existing plant communities, hydrologic indicators, and bankfull indicators in accordance with the *Act*, the *Act Regulations*, the *Bylaw*, the *CWA*, and the *CWA Regulations*. Based on our observations and review of pertinent maps, LEC determined that the on-site Wetland Resource Areas associated are Bordering Vegetated Wetland (BVW), Bank-Mean Annual High Water (MAHW) line to French River and unnamed perennial stream, Land Under Water Bodies and Waterways (LUW), Riverfront Area, Bordering Land Subject to Flooding (BLSF), and 100-foot Buffer Zone from outermost Wetland Resource Areas of BVW/Bank/BLSF. Off-site, the Wetland Resource Areas include BVW and Bank to intermittent stream and the above-named areas, excluding the unnamed

perennial stream. No vernal pools or isolated wetlands were identified on or in immediate proximity to the Site.

The boundaries of BVW were demarcated in the field with blaze orange surveyor's flagging tape embossed with the words "LEC Resource Area Boundary" in bold, black print. The BVW flags are numbered 1 through 2 and 2-1 through 2-12. The boundary of Bank-MAHW line to the French River and a portion of the unnamed perennial stream was demarcated in the field with blue surveyor's flagging tape and numbered B97 through B129. The remaining segments of the unnamed perennial stream are confined by mill building foundation walls, vertical retaining walls, and/or vertical rock faces and were not demarcated with flagging tape.

DEP Bordering Vegetated Wetland (310 CMR 10.55) Delineation Field Data Forms are included to support the wetland delineation (Attachment C).

A brief description of the delineated Wetland Resource Areas is provided below.

Bordering Vegetated Wetlands

Bordering Vegetated Wetland (BVW)

According to the *Act Regulations* [310 CMR 10.55(2)], Bordering Vegetated Wetlands are defined as: *freshwater wetlands which border on creeks, rivers, streams, ponds, and lakes…Bordering Vegetated Wetlands are areas where the soils are saturated and/or inundated such that they support a predominance of wetland indicator plants…The boundary of Bordering Vegetated Wetlands is the line within which 50% or more of the vegetational community consists of wetland indicator plants and saturated or inundated conditions exist.*

According to the Bylaw, Section 294-14, *a wetland includes wet meadows, marshes, bogs and swamps of all kinds, regardless of whether they border on surface waters.*

The steep slopes adjacent to the perennial stream and French River generally preclude the establishment of BVW. However, a short segment of fringing BVW occurs on the French River near the confluence with the unnamed perennial stream. A BVW (2-1 through 2-12) occurs north of the Site and west of the French River within land owned by the Massachusetts Electric Company (Map 112 Lot 102) (Photos 4 and 5). The eastern wetland boundary generally occurs at the bottom of a fill slope from electric distribution line. The wetland is characterized as a palustrine forested and scrub-shrub wetland transitioning to a wet meadow to the south. The wetland borders on the Bank of an intermittent stream that flows easterly through a culvert located below the electric distribution line and into the French River.

Vegetation within the scrub-shrub/forested portion of the BVW includes a canopy of red maple (*Acer rubrum*). The understory includes saplings from the overstory and redosier dogwood (*Cornus sericea.)* and northern arrowwood. The ground cover includes patches of sensitive fern (*Onoclea sensibilis*) and skunk cabbage (*Symplocarpus foetidus*). Vegetation within the wet meadow portion of the BVW includes jewelweed (Impatiens capensis), sensitive fern, sedge (*Carex* sp.), and goldenrod (*Solidago* sp.).

LEC inspected soil conditions within the BVW using a hand-held, Dutch-style auger and observed a 12-inch mucky sandy loam topsoil (A horizon) with a soil matrix color of 10YR 3/1 transitioning to a soil matrix color of 10YR 2/1 at 12 inches. Redoximorphic depletions with a color of 10YR 5/1 were

observed starting at 15-inches from the mineral soil surface. This soil profile meets the Redox Dark Surface (F7.) Indicator in accordance with the *Field Indicators Guide.*

Photo 4. View of forested portion of 2-Series BVW and intermittent stream in vicinity of culvert.

Photo 5. View of wet meadow portion of 2-Series BVW.

Bank-Mean Annual High Water Line

According to the *Act Regulations*, Mean Annual High Water (MAHW) is defined as *the line that is apparent from visible markings or changes in the character of soils or vegetation due to the prolonged presence of water and that distinguishes between predominantly aquatic and predominantly terrestrial land. Field indicators of bankfull conditions shall be used to determine the mean annual high-water line. Bankfull field indicators include but are not limited to: changes in slope, changes in vegetation, stain lines, top of pointbars, changes in bank materials, or bank undercuts…* [the *Act Regulations,* 310 CMR 10.58(2)(a)(2)].

Bank is defined at 310 CMR 10.54(2)(a) as *the portion of land surface which normally abuts and confines a water body. The upper boundary of a bank is the first observable break in the slope or the mean annual flood level, whichever is lower. The lower boundary of a bank is the mean annual low flow level.*

According to the Bylaw, Section 294-14, *Except as otherwise provided in this bylaw or in regulations of the Commission, the definitions of terms in this bylaw shall be as set forth in the Wetlands Protection Act (MGL c. 131, § 40) and Regulations (310 CMR 10.00).* The Bylaw does not provide a definition of LUW so the *Act Regulations* definition prevails.

The French River and unnamed tributary to the French River are shown as perennial on the current USGS Topographic Map. Off-site, the unnamed tributary flows easterly from Low Pond over an impoundment for approximately 220 feet before flowing through a culvert located beneath Mill Street and a mill building. The tributary daylights east of the off-site mill building and flows through two, 15-20 foot wide channels generally contained by vertical stone retaining walls for a short distance (100± feet in the eastern channel and 60± feet for the western channel) where it flows below the on-site mill building. The tributary daylights forming a single channel for a short distance (70± feet) before flowing belowground through a 155± foot long culvert. The tributary daylights a final time and flows 130± feet where it empties into the French River (Photo 6).

The Bank, comprised of small boulders, intermittently exposed roots, and/or soil, is thickly vegetated and exhibits an abrupt transition from the stream channel to the upland area. The height of Bank is 2-3 feet and contains undercuts (Photo 7). The MAHW line of the French River and unnamed perennial stream is coincident with top of Bank. The Bank-MAHW line of the southeast portion of French River is estimated since extremely dense stands of vegetation precluded access.

Photo 6. Westerly view of perennial stream near the confluence with the French River. Note vertical rock faces confining the river.

Photo 7. View of the French River and bank heights of 2- 3 feet.

Land Under Water Bodies and Waterways

According to 310 CMR 10.56(2), *Land Under Water Bodies and Waterways is the land beneath any creek, river, stream, pond or lake. Said land may be comprised of organic muck or peat, fine sediment or bedrock. The boundary of Land Under Water Bodies and Waterways is the mean annual low water level.*

According to the Bylaw, Section 294-14, *Except as otherwise provided in this bylaw or in regulations of the Commission, the definitions of terms in this bylaw shall be as set forth in the Wetlands Protection Act (MGL c. 131, § 40) and Regulations (310 CMR 10.00).* The Bylaw does not provide a definition of LUW so the *Act Regulations* definition prevails.

Land Under Waterway is associated with the land area beneath the French River and unnamed perennial stream. The 40 to 50-foot wide channel of the French River and 20± foot wide channel of the unnamed perennial stream contains coarse sands, gravels, pebbles, and small boulders.

Bordering Land Subject to Flooding (BLSF)

BLSF is defined in the *Act Regulations*, 310 CMR 10.57 2 (a), as *an area with low, flat topography adjacent to and inundated by flood waters rising from creeks, rivers, streams, ponds or lakes. It extends from the banks of these waterways and water bodies.*

According to the Bylaw, Section 294-14, *Except as otherwise provided in this bylaw or in regulations of the Commission, the definitions of terms in this bylaw shall be as set forth in the Wetlands Protection Act (MGL c. 131, § 40) and Regulations (310 CMR 10.00).* The Bylaw does not provide a definition of LUW so the *Act Regulations* definition prevails.

According to the July 4, 2010 FEMA Flood Insurance Rate Map (FEMA FIRM) for the Town of Dudley, Worcester County, Massachusetts (Map Number: 25027C0817E), a portion of the site is located within Floodway Areas in Zone AE (NAVD 1988, EL 417' (at West Main Street bridge) to 418' (at Pleasant Street bridge): *the floodway is the channel of the stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.* The remainder of the site is located within Zone X (unshaded): *Areas determined to be outside the 0.2% annual chance floodplain* (Attachment A, Figure 3).

BLSF is present where Zone AE extends beyond the BVW and Bank boundary to roughly elevation 417'. Based on a review of the existing conditions plan, the BLSF is generally confined to the steep embankments of the French River.

Riverfront Area

Riverfront Area is defined in the *Act Regulations*, 310 CMR 10.58 2(a), as *the area of land between a river's mean annual high-water line and a parallel line measured horizontally 200 feet away. Where a river runs through a culvert more than 200 feet in length, the riverfront area stops at a perpendicular line at the upstream end of the culvert and resumes at the downstream end.*

According to the Bylaw, Section 294-14, *Except as otherwise provided in this bylaw or in regulations of the Commission, the definitions of terms in this bylaw shall be as set forth in the Wetlands Protection Act (MGL c. 131, § 40) and Regulations (310 CMR 10.00).* The Bylaw does not provide a definition of LUW so the *Act Regulations* definition prevails.

Riverfront Area extends 200 feet horizontally from the Bank-MAHW line of the French River and unnamed perennial tributary. Riverfront Area includes BVW, BLSF, forested upland, and previously disturbed/developed areas associated with the mill complex. To the extent that some or all of the Site can be designated as an Historic Mill Complex the Site may be grandfathered or exempted from requirements for Riverfront Area (i.e., 310 CMR 10.58).

Bylaw Resource Areas and Buffer Zones

According to the *Bylaw*, Section 294-2(A)(1), the following areas are protectable as Resource Areas:

> *(a) One hundred feet horizontally lateral from the bank of any freshwater wetlands, marshes, wet meadows, bogs, swamps, vernal pools, banks, reservoirs, lakes, ponds, and beaches.*
>
> *(b) One hundred feet horizontally lateral from the water elevation of the one-hundred-year storm.*
>
> *(c) Two hundred feet horizontally lateral from the mean annual high-water elevation of any perennial stream or river.*

According to the Bylaw, Section 294-2(B), *a twenty-five-foot strip of continuous, undisturbed, indigenous vegetative cover along the resource area boundary within the one-hundred-foot buffer zone shall be maintained, where practicable, in order to protect water quality, improve water recharge, reduce erosion and pollution to the adjacent wetland resource areas, and provide wildlife habitat.*

The 100-foot Buffer Zone extends 100 feet horizontally from the outermost limits of Bank, BVW and/or BLSF and includes forested upland and previously disturbed/developed areas associated with the mill complex.

Summary

LEC conducted a site evaluation and wetland delineation June 15, 2021 to determine the extent of Wetland Resource Areas subject to jurisdiction under the *Act*, *Act Regulations*, the *Bylaw*, the *CWA*, and *CWA Regulations.* Based on our site evaluation and review of pertinent maps, LEC determined that BVW, Bank, LUW, Riverfront Area, BLSF, and Bylaw Resource Areas (i.e., 100 feet from BVW/Bank/BLSF) are located on and/or adjacent to the subject property, as jurisdictional under the *Act*, *Bylaw*, and/or *CWA*. Any work proposed within the Wetland Resource Areas and/or their 100-foot Buffer Zone will require compliance with performance standards enumerated in the *Act Regulations*, *Bylaw*, and *CWA*, and filing for the appropriate permits with the Town of Dudley Conservation Commission and/or the Massachusetts Department of Environmental Protection, US Army Corps of Engineers, and may require additional wetlands permitting depending on the extent and scope of work.

Thank you for the opportunity to provide these services. Should you have any questions or require additional information, do not hesitate to contact me in our Worcester office at 508-753-3077 or at akendall@lecenvironmental.com.

Sincerely,

LEC Environmental Consultants, Inc.

Andrea Kendall, PWS
Senior Environmental Scientist

alk: projects\21-105 BoE WRAA

Attachment A

Figure 1: USGS Topographic Map
Figure 2: USGS Color Ortho Imagery with NHESP Estimated & Priority Habitats
Figure 3: FEMA Flood Insurance Rate Map

LEC
Environmental Consultants, Inc.
Wakefield, MA
781.245.2500
www.lecenvironmental.com

8 Mill Street
Dudley, MA

September,3 2021

N

0 250 500 Feet

LEC
Environmental Consultants, Inc.
Wakefield, MA
781.245.2500
www.lecenvironmental.com

8 Mill Street
Dudley, MA

September, 2021

N

0 100 200 Feet

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) Report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS Report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study Report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study Report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study Report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Massachusetts State Plane Mainland Zone (FIPS zone 2001). The **horizontal datum** was NAD 83, GRS 1980 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713-3242**, or visit its website at http://www.ngs.noaa.gov.

Base map information shown on this FIRM was derived from digital orthophotography. Base map files were provided in digital format by Massachusetts Geographic Information Systems (MassGIS). Ortho imagery was produced at a scale of 1:5,000. Aerial photography is dated April 2005.

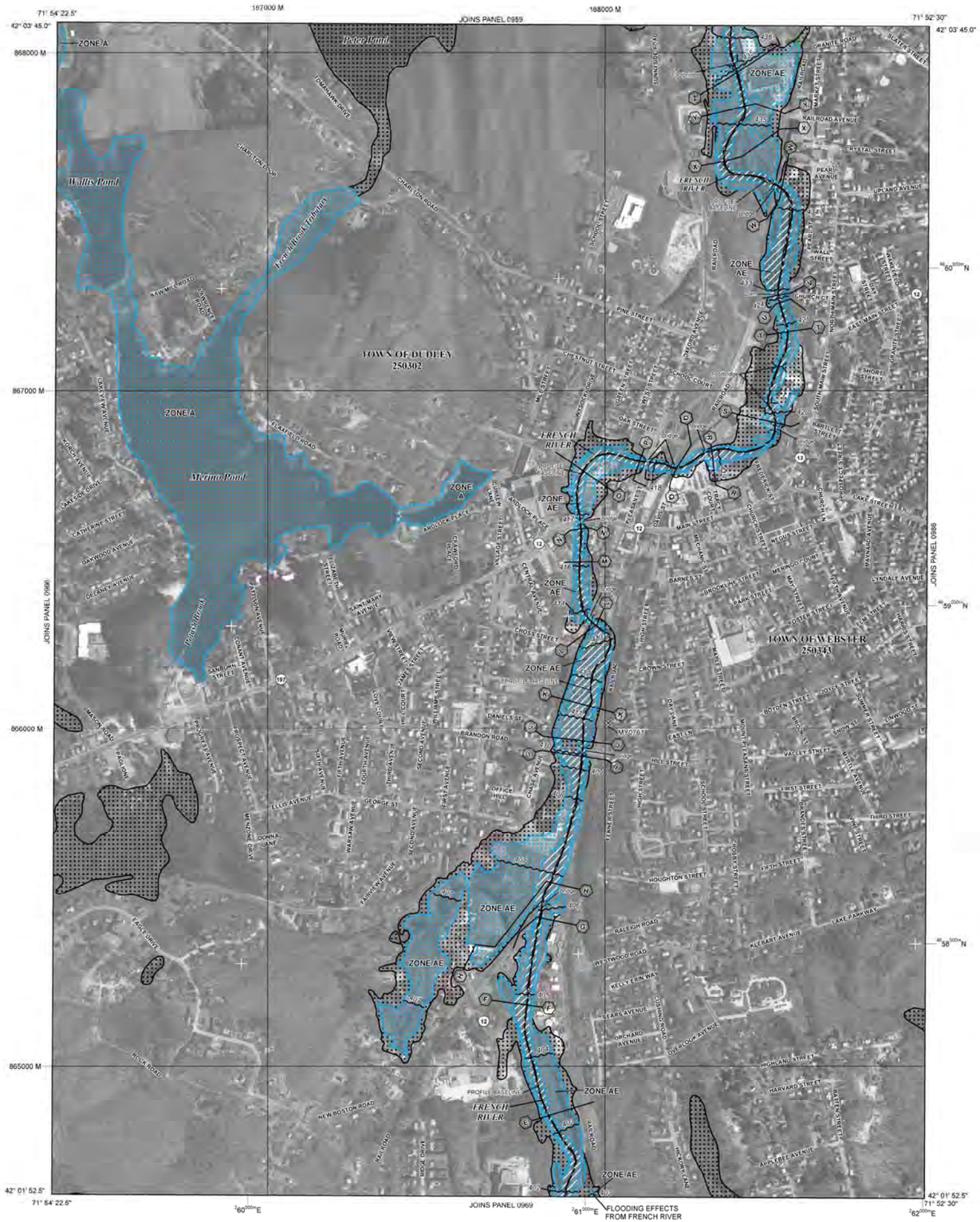
The **profile baselines** depicted on this map represent the hydraulic modeling baselines that match the flood profiles in the FIS report. As a result of improved topographic data, the **profile baseline**, in some cases, may deviate significantly from the channel centerline or appear outside the SFHA.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

For information on available products associated with this FIRM visit the **Map Service Center (MSC)** website at http://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the MSC website.

If you have **questions about this map**, how to order products, or the National Flood Insurance Program in general, please call the **FEMA Map Information eXchange (FMIX)** at **1-877-FEMA-MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip.



LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Areas formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

- 1% Annual Chance Floodplain Boundary
- 0.2% Annual Chance Floodplain Boundary
- Floodway boundary
- Zone D boundary
- CBRS and OPA boundary
- Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths, or flood velocities.
- 513 — Base Flood Elevation line and value; elevation in feet*
- (EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*

*Referenced to the North American Vertical Datum of 1988

- A — A — Cross section line
- 23 — 23 — Transect line
- Culvert
- Bridge
- 45° 02' 08", 93° 02' 12" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83) Western Hemisphere
- 4989000 M — 1000-meter ticks: Massachusetts State Plane Mainland Zone (FIPS Zone 2001), Lambert Conformal Conic projection
- 5960000 N — 1000-meter Universal Transverse Mercator grid values, zone 19N
- DX5510 — Bench mark (see explanation in Notes to Users section of this FIRM panel)
- M1.5 — River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index.

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
July 4, 2011

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 500'

250 0 500 1000 FEET
150 0 150 300 METERS

NFIP
NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0967E

FIRM

FLOOD INSURANCE RATE MAP

WORCESTER COUNTY, MASSACHUSETTS (ALL JURISDICTIONS)

PANEL 967 OF 1075
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
DUDLEY, TOWN OF	250302	0967	E
WEBSTER, TOWN OF	250343	0967	E

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
25027C0967E
EFFECTIVE DATE
JULY 4, 2011

Federal Emergency Management Agency

Attachment B

Massachusetts Cultural Resources Information System
Inventory No. DUD.229
Stevens Linen Mill Complex

Massachusetts Cultural Resource Information System
Scanned Record Cover Page

Inventory No:	DUD.229
Historic Name:	Stevens Linen Mill - Main Building
Common Name:	
Address:	8 Mill St
City/Town:	Dudley
Village/Neighborhood:	Webster
Local No:	117-120, 212-8, 901
Year Constructed:	c 1862
Architect(s):	Main, Charles T. Company
Architectural Style(s):	Italianate
Use(s):	Abandoned or Vacant; Boiler Or Engine Room; Business Office; Textile Mill Cotton
Significance:	Archaeology, Historic; Architecture; Commerce; Engineering; Ethnic Heritage; Industry
Area(s):	DUD.A: Stevens Linen Mill Complex DUD.H: Stevens Linen Works Historic District
Designation(s):	Nat'l Register District (09/17/2010)
Building Materials(s):	Roof: Asphalt Shingle; Slate; Tar, Built-up Wall: Brick; Concrete Cinderblock; Coursed Ashlar; Granite; Steel; Stone, Cut; Stone, Uncut Foundation: Granite; Stone, Cut

NRDIS- 9/17/10

DUD. 229

FORM B - Building

Massachusetts Historical Commission
Massachusetts Archives Building
220 Morrissey Boulevard
Boston, Massachusetts 02125

Assessor's #	USGS Quad	Area(s)	Form Number
212/8	Webster	(H) A	117

Town

Place (neighborhood or village)
Stevens Mill

Photograph

(3"x3" or 3-1/2x5" black and white only) Label photo on back with town and property address. Record film roll and negative numbers here on form. Staple photo to left side of form over this space. Attach additional photos to continuation sheets.

Roll	Negative(s)
3	

Address 8 Mill Street

Historic Name Stevens Mill

Uses: Present

Original

Date of Construction 1859-63

Source Date stone

Style/Form Italianate

Architect/Builder Charles T. Main

Exterior Material:

Foundation Cut granite

Wall/Trim Cut granite

Roof Asphalt shingles

Outbuildings/secondary structure
Dye House, dam, pond, bridge,

Major Alterations (with dates)
Some windows replaced, 1998 steel and glass addition, associated historic mill building demolished

Sketch Map

North Toward Top

Condition Good

Moved no ☑ yes ☐ **Date**

Acreage 9.2

Setting Mill village

Recorded by Sanford Johnson

Organization Dudley Historical Commission

Date (month/year) 6/01

Follow Massachusetts Historical Commission Survey Manual instructions for completing this form.

DuD.229

BUILDING FORM

[A] 229, 451-454, 926-928

ARCHITECTURAL DESCRIPTION

☑ see continuation sheet

Describe architectural features. Evaluate the characteristics of this building in terms of other buildings within the community.

HISTORICAL NARRATIVE

☑ see continuation sheets

Discuss the history of the building. Explain its associations with local (or state) history. Include uses of the building, and the role(s) the owners /occupants played within the community.

BIBLIOGRAPHY and/or REFERENCES

☑ continuation sheet

*** All properties mentioned in bold type with ** are individually inventoried resources*

☑ Recommended for listing in the National Register of Historic Places. If checked, you must attach a completed National Register Criteria Statement Form.

DUD.229

INVENTORY FORM CONTINUATION SHEET

Town	**Property Address**
Dudley	Stevens Mill

Massachusetts Historical Commission
220 Morrissey Boulevard
Massachusetts Archives Building
Boston, MA 02125

Area(s)	**Form No.**
A	229, WS1-454, 926, 928

The Stevens Mill Complex was documented to standards in place in 1970 and in 1981 during surveys completed at those times. That research is contained on **MHC Area Form A**. The purpose of this Building Form is to update existing documentation with information from previously unutilized resources, as well as to note changes in the fabric of the resource since its previous survey.

ARCHITECTURAL DESCRIPTION:
Describe architectural, structural and landscape features and evaluate in terms of other areas within the community.

Stevens Mill

The Stevens Linen Mill Complex on Mill Street experienced many building campaigns between 1812 and 1995. Federal period buildings have been demolished or replaced by the mid 19th century construction. Some possible surviving Federal elements are the adjacent segments of Village and Mill Streets, the culvert under Mill Street, and the raceway. The stone mill built in 1812 survived until the late 1990s when it was demolished along with the bridge over Mill Street that connected it to the Main Mill, the core of the complex. The main mill is the largest building in the complex, constructed of cut granite with Italianate style ornamental elements and two matching towers. Mill owners used yellow brick for the 1913 Panel Brick style north-side addition which was expanded in the 1920s. Most recently, a one-story glass and metal enclosure with elements of International style design was added to the south elevation between the stone wings.

The principal component of the mill is the four-story, gabled block at the core of the complex. This was part of the 1858-1864 building campaign, along with the towers and two wings, all of cut granite that was quarried in the north part of the town. Weaving, spinning and spooling took place in the **Main Building** which, at the time of construction, was one-half story taller than it is now. Nine gabled dormers, now removed, originally lit the attic on the south slope of the gabled roof. The Main Building is twenty-two bays along the north and south elevations five across the east and west side-gabled walls. Dimensions are 207' x 70' according to the 1877 Barlow's Insurance Company survey. Windows are now a variety of modern and historic sash types with the oldest surviving examples of the 6/6 double-hung and triple-hung 8/8/8 sash types. Several former window openings are now blocked in with cinderblock while others contain louvered vents. Windows are trimmed with segmental arched tops and granite sills.

The gabled, two and one-half-story, ten by two-bay **West Wing** is oriented perpendicular to the Main Building and measures 80' x 24'. This building housed office space and shares the arched window tops, stone sills and corner quoins. The gabled, two and one-half-story, 13 by two-bay **East Wing** is also oriented perpendicular to the Main Building and measures 110' x 40'. Originally built of cut stone like the rest of the mill, the East Wing was increased in height by one half story with a brick addition and expanded to the south. Both the West and East wings have been relieved of their gabled dormers. The Main Building combined with the wings forms a

DUD.229

broad U-shaped plan that, when built, was open to the south. The open area is now occupied by the modern steel and glass **1998 addition** with its band of windows across the facade.

It is the two square, six-story, Italianate style **towers** flanking the large, central four-story block that dominate views of the mill from points throughout the village and across the French River. Various window types, including arch-topped sash with ornamental keystones and imposts, occuli and loopholes, together with the cornice treatment, corner quoins of cut granite and the low pyramidal hipped roofs articulate the design of the matching towers.

Mid 19th century construction comprising the southern portion of the Stevens Mill was enlarged in the early 20th century with a yellow brick three-story tower which forms an attachment via an enclosed footbridge to the one-story **Carding Mill**. Both the tower and the shallow-pitch gabled mill were built in **1913** according to date panels and engineer's plans. Dimensions of the Panel Brick style, 35 by 8-bay Carding Mill are 300' x 70'. Decorative elements include the arched window tops, stone window sills, corbeled, bracketed eaves, molded cornice and stepped gabled crest above the center entry. Windows were originally double or triple-hung sash but have nearly all been blocked with cinderblock. An entry and a louvered vent remain on the northern and southern ends of the building.

The **1812/1859 Old Mill** used for carding, sorting and hackling (combing) and located across Mill Street was partially demolished in the 1990s. Surviving components include the foundation and the brick, one-story **South Wing** as well as a date stone marked 1859 that has been placed on a concrete footing as a memorial to the demolished building. The Old Mill was connected to the Main Building via a footbridge over Mill Street, a well-known local landmark. Ancillary buildings were scattered around the Old Mill and have been removed except for the Dye house, ¼ mile west on Ardlock Place.

Infrastructure for channeling water under roads and into raceways was an integral part of the Stevens Mill Complex. Mill Street crosses the outflow of Merino Pond between the Main Building and the former Old Mill. A coursed rubble-stone **barrel-arched bridge** built of with fieldstone vussoirs and dry laid fieldstone spandrel raises Mill Street ten feet over the stream. The arch is approximately fifteen feet across at its base and five feet in height. Above the spandrel is the mortared cobblestone parapet which may have been built after the original construction. Upstream of the bridge and former Old Mill is a dam retaining a pond of several acres. The **dam** is most visible from Flaxfield Road and appears to be built 10-15' high of uncut stone. The dam extends perpendicular to Mill street for approximately 100'. A wing wall lines the edge of the stream on the south side. Water flows over the top of the dam to the stream bed below and on toward the culvert under Mill Street.

HISTORICAL NARRATIVE:

Explain historical development of the area. Discuss how the area relates to the historical development of the community.

History of the Stevens Mill is well-documented on **MHC Area Form A and Building Form #901** written in 1970 and updated in 1981. The bulk of historical detail is derived from the informative Barlow's Insurance survey of 1877, from primary and secondary sources in local libraries, the American Textile History Museum and from industry journal articles concerning the Stevens Mill. That research is not duplicated here but is augmented by research in post-1981 accessions to the ATHM, and other previously unrecognized resources.

Federal Period 1775-1830

Prior to the Stevens Mill becoming Dudley's largest industrial facility, its site on the west bank of the French River was farmland owned by Joseph Arnold according to a 1905 letter written by M. J. Stevens. A deed of transfer dated 1790 as well as the 1795 map of Dudley indicate a sawmill and gristmill on the French River near the millsite. These were locally patronized facilities, probably fewer than two stories high, built on a timber frames in a fashion and scale similar to a barn, as was typical of pre-industrial period mills.

During the early 19th century, Dudley included as its eastern section much of the existing town of Webster. It was here that the industrial pioneer Samuel Slater came in 1810 to build a larger and updated version of his 1793 Pawtucket Mill. Mr. Slater apprenticed during the 1780s in Belper, England at the mill of Jedediah Strutt. He learned techniques of design and construction of machinery for weaving textiles that, in relation to handwork, qualified as mass production. He built the first American textile mill based on British principles that he brought when he emigrated to Rhode Island in 1789. Upon his arrival in Webster, Mr. Slater developed the privilege on the east bank of the French River into a large-scale industrial village that included employee housing and support buildings, all of which served as a model to industrialists throughout the region. The example of Mr. Slater's machinery combined with the area's abundant water power and the American government's deteriorating relationship with Great Britain, chief fabric importer to America, resulted in development of several mills whose owners sought to capitalize on the demand for textile fabrics.

Among the people who viewed the economic situation as an opportunity to begin manufacturing cloth on a large scale was a group of Dudley's leading citizens. Investors included Aaron Tufts, Jepthah Bacon, Learned Corbin and Phineas Bemis, some of Dudley's leading agrarians from the town center. Thus was born the Merino Woolen Manufacturing Company, incorporated in February, 1812. While the company survived for only six years after the end of the War of 1812, the privilege was established as a productive source of mill power. The mill operated under new ownership for several years after the war but remained an early industrial facility.

Early Industrial Period 1830-1870

Henry Hale Stevens recognized the potential for an expanded facility in 1846 and, already being in possession of flax weaving machinery, moved from North Andover and began constructing the town's largest industrial complex. At that time the complex consisted of Mill #1 which was the 1812 stone factory built west of Mill Street over the outflow of Merino Pond. Mill employees numbered 40 at the start of the business and census records indicate Mr. Stevens owned $50,000 worth of property. This was the largest amount in town. According to an 1850 plan of the complex which was drawn for inclusion with a property deed, the Mill #1 was 113' x 36', had a basement, attic, tin roof and a chimney or smoke stack at the west wall. The canal for taking water to the wheel(s) ran under the center of the mill and was covered on the upstream (west) side of the mill. Also to the west were the slaughter house, stone store house and three residences near the existing Curfew Lane, one of which is labeled "Boarding House". South of Mill #1 and of the intersection of Mill and Village Streets existed the wood-framed Store House #2. To the east of Mill Street was another workers' residence, labeled #13, the wood-framed Counting Room and the stone, one-story Dry House. The plan shows at its bottom or easterly edge a line intended to represent the west wall of Mill #2 which was a stone building of one story with basement and Bleach House attached. While no plan has been found for the 1812 Merino Woolen Company Mill complex, the 1850 plan of the Stevens Mill pre-dates the period of major reconstruction and may depict essential elements of the early 19th century Merino Woolen facility. With the exception of some of the housing,

it is doubtful any of the mill-related resources depicted on the plan survived either the mid 19th century reconstruction or subsequent changes.

Residents of the village growing up around the mill were largely of Irish birth according to census information from 1850. French Canadians were also commonly employed at this time, although not to the complete exclusion of native born working class residents. Company boarding house rolls, however, suggest almost all residents were Irish-born.

Construction activity between 1855 and 1864 resulted in the bulk of the resources that comprise the existing complex. These include infrastructural elements such as dams retaining Merino Pond, canals and raceways, and a bridge carrying Mill Street over the outflow of Merino Pond (Powder Horn Brook). The dam is described in a 1860 Webster Times article as a 320' long, 27' high and of the heaviest construction. Raceways were built around this time to conduct water to the stone wheel house, built in 1859 according to the date stone now part of the ornamental marker in the parking lot across Mill Street. The former wheel house contained a wheel 40' in diameter which powered the looms via two leather belts 78' and 87' in length. Dudley selectmen entertained a petition from Mr. Stevens to realign Mill Street and to build a new stone arch bridge in 1859.

The Main Mill was constructed from 1860-1864. It contained weaving, spooling, winding, spinning and storage space in the attic; the East Wing held storage, repairs and dressing operations; the West Wing had offices, pattern rooms and storage. The two Italianate style towers appear to be ornamental, having been assigned no specific use on historic plans. The five-story mill was sited perpendicular to the Old Mill across Mill Street and bears a date stone in the west elevation reading 1864. The north elevation has a stone marked 1863, the presence of which confirms that the mill complex was built in an extended campaign. Federal census figures from 1860 reveal Mr. Stevens owned $75,000 in property and machinery and employed 100 female and 50 male hands. Power for the looms came solely from the flow of the outflow of Merino Pond at this time. Mr. Stevens also ran a saw mill operation that employed one-man.

The Old Mill was in use in 1877 as sorting, hackling and carding space. The multi-year project to build the new mill necessitated the removal of buildings depicted on the 1850 plan including the stone Dry House, the Counting House, Boarding House No. 13 and Mill No. 2, all located east of the Old Mill. The canal for the outflow of Merino Pond was relocated so that it followed a straighter path to the French River and the smoke stack that had been at the west of the Old Mill was relocated at the east side of the 1864 mill. Bleaching operations that had taken place in Mill No. 2 were removed 1/2 mile to the west in a separate facility.

Late Industrial Period 1870-1915

Physical changes to the mill complex during the Late Industrial Period were small in comparison to the previous period which saw the large-scale construction of the five-story Main Mill, its East and West Wings and accompanying Towers, Wheel House, Boiler House and outbuildings. Graphic images from 1870, 1877, 1878, 1898 and 1913 depict little new development amidst the complex. There was, however, a new wing built of yellow brick that was added to the north west corner of the Main Mill. The Hackling and Carding facility was designed by Boston engineer Charles T. Main in 1913 and built in the same year. Two electric motors occupied a central aisle oriented across the building's short axis or perpendicular to Mill Street. Shafts emanating from the motor assembly ran parallel to the street and projected power to the looms along the building's 300' length.

While there seems to have been relatively little physical increase in scale, written sources describe a gradual increase in productivity, employment and profits resulting the Stevens Mill's status as national leader in linen crash fabric production. This occurred despite Henry Hale Stevens' retirement in 1877. 1880 census records show the Stevens Company employed 487 people, including 102 children. The mill operated 10 months per year and was powered by two wheels and a turbine. In 1889, the mill had 350 looms, a capitalization of $350,000 and produced 6 million yards of crash per year. Company records at the ATHM indicate that in 1890, production had increased 40% since 1880. According to similar documents form 1907, the mill employed 650 hands although this may be an annual high given the appearance of seasonal fluctuation in employment reflected in the company's own records. For example, in 1900 employees ranged in number from 505 to 645.

Employment at the Stevens Mill signified a certain amount of job-security and the promise of social advancement for immigrants. To native-born mill hands, working in the mill meant escaping farm work and social isolation in the countryside. During the Late Industrial Period, employees typically worked 10 hours per day on around 250 days per year. Half the workers were under 21 years of age and 14 employees were between 10 and 14 years. Over half were women. Jobs performed by men included roughing, carding, hackling, warping, weaving, loom fixing and machining. Women engaged in preparing, spooling, dressing and warping. Men earned as much as three times the female wage, depending on their work. The company provided no reading room or night school as at some other textile mills. Roughly one third of employees paid $36 per year for a company-owned tenement. Six employees had bought their homes from the company. During this time, the mill was powered by a combination of water and steam. The above information is taken from manufacturers reports, engineers' plans, company records and other documents on file at the ATHM.

Early Modern Period 1915-1945

Expansion continued during the early part of the period. An addition to the 1913 Carding and Hackling Mill, also designed by engineer Charles T. Main of Boston, was built in 1928. This addition increased capacity by 100 looms to a total of 750. The 700 employees in 1930 outstripped all other American linen toweling producers at that time and competed with Scottish linen manufacturers. Industrial historian Orra Stone suggested in 1930 this was the oldest continuously operated textile mill in the country. A 1939 newspaper article places the number of employees at 900.

Changes to the Stevens Mill Complex during and after the Depression followed trends occurring throughout the textile industry in New England. Demand for the Stevens product declined due to competition with manufacturers outside the region. Costs for maintaining the aging physical plant and for paying unionized labor must have increased. Profit shrinkage brought about a corporate reorganization and a name-change to Stevens Linen Associates by the new owner H. Wadsworth Crawford in 1938. Efforts to economize succeeded and the mill remained in business through the period. World War II helped the company recover from the effects of the Depression by providing contracts to the military to make towels and automobile-related fabrics. The company later expanded into manufacture of fire hose casing and synthetic blended fabrics. It was during the mid 20th century that the calendar towel, printed with scenic pictures, became popular and provided the Stevens Mill with another niche of the textile market.

Conclusion

Recent changes to the mill include the 1998 addition of a glass-walled block that spans the courtyard between the two Italianate Towers and Wings. The one-story, flat-roofed section contains textile production activities such as spinning and weaving. This replaced an earlier and smaller flat-roofed block from the mid 20th century. During the 1990s, the bridge over Village Street connecting the main mill to the Mill #1, as well as the Mill #1 itself, were demolished. Although the Mill #1 had been relegated to use as the Mechanical Department, it maintained the village's historical association with early industrial manufacturing. Loss of the mill left a vacant parcel in the core of the town's largest industrial complex. These changes took place under ownership by Toltec Fabrics, Inc. who acquired the mill from the Stevens Company in the mid 1990s. Historic mill buildings flanking the road and the elevated walkway above had been part of the village for over a century and were a defining elements in the town's industrial history.

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DUD.229

INVENTORY FORM CONTINUATION SHEET

Town
Dudley

Property Address

Massachusetts Historical Commission
220 Morrissey Boulevard
Massachusetts Archives Building
Boston, MA 02125

Area(s)
Stevens Mill (A)

Form No. 229
451-454
924-928

MHC#	Street	Address	Date	Historic Name	Style/Form
451		Ardlock Place	ca. 1867	Dye/Bleach House	No style
452		Mill Street	1900	Brick addition to east tower	No style
453		Mill Street	1998	Spinning Room	No style
454		Mill Street	1913	Carding Mill	Panel Brick
926		Mill Street	ca. 1859	Mill Street Bridge	N/A
927		Mill Street	ca. 1859	Dam	N/A
117	12	Mill Street	1859-63	Stevens Mill	Italianate
928		N/A	ca. 1859	Mill Pond	N/A

DUD.229

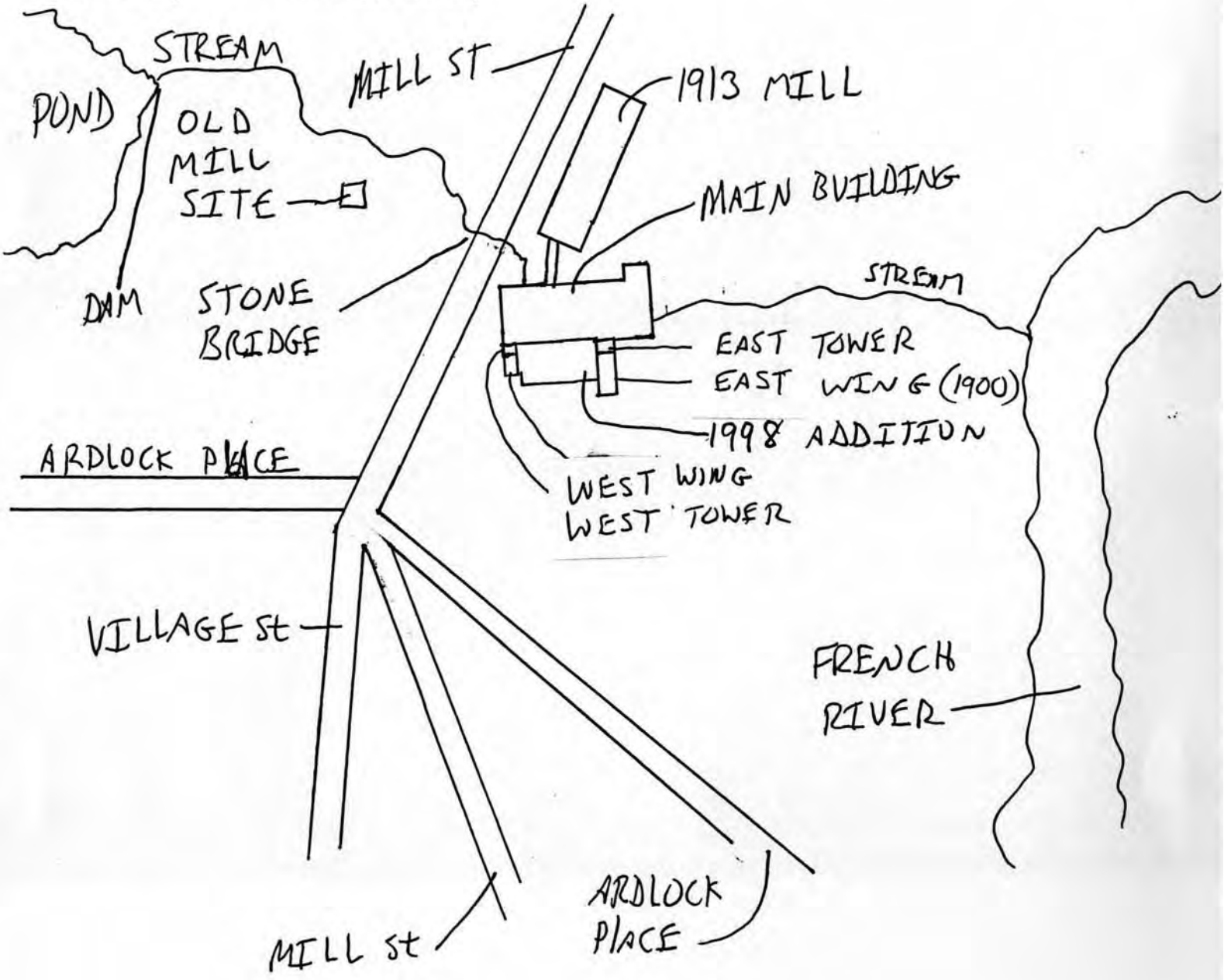
INVENTORY FORM CONTINUATION SHEET

Massachusetts Historical Commission
220 Morrissey Boulevard
Massachusetts Archives Building
Boston, MA 02125

Town Dudley
Property Address Mill Street

229
Area(s) Stevens Mill Area A
Form No. 451-459, 926-928

Sketch map **North Toward Top**



DUD.229

Massachusetts Historical Commission
Massachusetts Archives Building
220 Morrissey Boulevard
Boston, Massachusetts 02125

Community: Dudley
Property Address: 12 Mill Street

Area(s): A
Form No.: 2-9, 451-454, 922

National Register of Historic Places Criteria Statement Form

Check all that apply:

Individually eligible **X**

Eligible only in a historic district

Contributing to a potential historic district

Potential historic district

Criteria: **X** A **X** B **X** C D

Criteria considerations: A B C D E F G

Statement of significance by: Sanford Johnson

The criteria that are checked in the above sections must be justified here.

The Stevens Linen Mill at 12 Mill Street is eligible for listing in the National Register of Historic Places under criteria A, B and C. The mill satisfies requirements for significance under criterion A for its association with the events in the development of the industrial component of the town's economy. Textiles were made in several locations in the town since the early 19th century. The Merino Woolen Mill was built on the Stevens Mill site in 1812. Henry Hale Stevens of North Andover bought the mill privilege in 1846 and shortly began erecting the town's largest industrial facility. Requirements for criterion B are satisfied by virtue of the fact that Mr. Stevens, the mill's owner and chief designer and operative had a large influence on mill design and operation throughout the region. His ideas were put into use locally at John Chase's Mill on Chase Avenue to the south. Mr. Stevens built his mill using locally quarried stone, probably from the northeastern part of town where a vein of gneiss was exposed. Elements of the Italianate style of design such as arched window openings and the suggestion of corner quoins are evident in the construction. Rhythmic fenestration, prominent matching towers and heavy stone construction make the factory potentially eligible under criterion C. It remains in industrial use and retains integrity of design, location, setting, association and materials. It is eligible at the state level.

1913 Block, Stevens Mill

Stevens Mill, 1913 Block, south view

Stevens Mill, north view

Stevens Mill, date stone

Stevens Mill, west side, Mill St

Stevens Mill Dam (DUD.927)

Stevens Dam, Mill St, west side

Sterens Mill, Mill St. Bridge (DUD.926)

Pe-WEB

DUD.229

FORM F - STRUCTURE

MASSACHUSETTS HISTORICAL COMMISSION

In Area no.	Form no.
A	~~901~~ 229

Town Dudley, Massachusetts

Address Village Street

Name Stevens Linen Mill

Present use upholstery, linen manufacture

Present owner Stevens Linen Assoc., Inc.

Type of structure (check one)

bridge	____	pound	____
canal	____	powder house	____
dam	____	street	____
fort	____	tower	____
gate	____	tunnel	____
kiln	____	wall	____
lighthouse	____	windmill	____

other textile mill

4. Map. Draw sketch of structure location in relation to nearest cross streets, buildings, other structures, natural features. Indicate north.

see attached sheet

5. Description

Date 1859-1864 and 1900-1913

Source Dudley histories

Construction material granite

Dimensions main block, 300x70 feet

Setting near French River

Condition excellent

DO NOT WRITE IN THIS SPACE
USGS Quadrant ____
MHC Photo no. ____

6. Recorded by E. Gordon, M. Lyman

Organization American Landmarks, Inc.

Date March, 1981

(over)

5M-5-73-075074

DUD.229

7. Original owner (if known) Stevens Linen Works

Original use linen towel manufacturing

Subsequent uses (if any) and dates same, plus diversification

8. Historical significance.

The story of the Stevens Mill has been discussed in several detailed histories. These works include an article from Textile Age, May, 1946, "200th Anniversary Celebration, Dudley, Mass.", 1932, and "Stevens Linen, Its First Century and a Half", by Pearle L. Crawford. A brief synopsis of the Steven's Mill development is set forth below.

Henry Hale Stevens of North Andover, Mass. founded Dudley's Stevens Linen Works in 1846 on the site of the old Merino Wool Factory (incorporated in 1812). H. H. Stevens was the son of Capt. Nathanial Stevens, who first introduced American-made flannels to the world markets.

Between 1858 and 1864, H. H. Stevens undertook an ambitious building campaign to expand his manufacturing business. The monumental stone buildings, waterways, and machinery, which were built for the complex between 1858 and 1864 are of architectural, engineering, and social significance. Initially, a forty foot breast wheel with 15 foot buckets furnished the power to operate the mill. In 1867, a bleach house, presently a dye house, was built next to the upper dam- at the head of Ardlock Place. In 1877, Henry Hale Stevens retired and E. P. Morton was elected chief agent. In that year, the Stevens Mill had a capacity of 300 looms and flax and jute were used for the production of "crash, diaper, etc.."

In 1900, extensive enlargements of the building were made, additional machinery was installed, and in 1913, a new mill, 300x70 feet, for hackling and carding was built. In 1907, John M. Crawford became the resident agent. In 1927, more space was needed for an addition to the weaving and finishing departments and a building of 154x54 feet was erected.

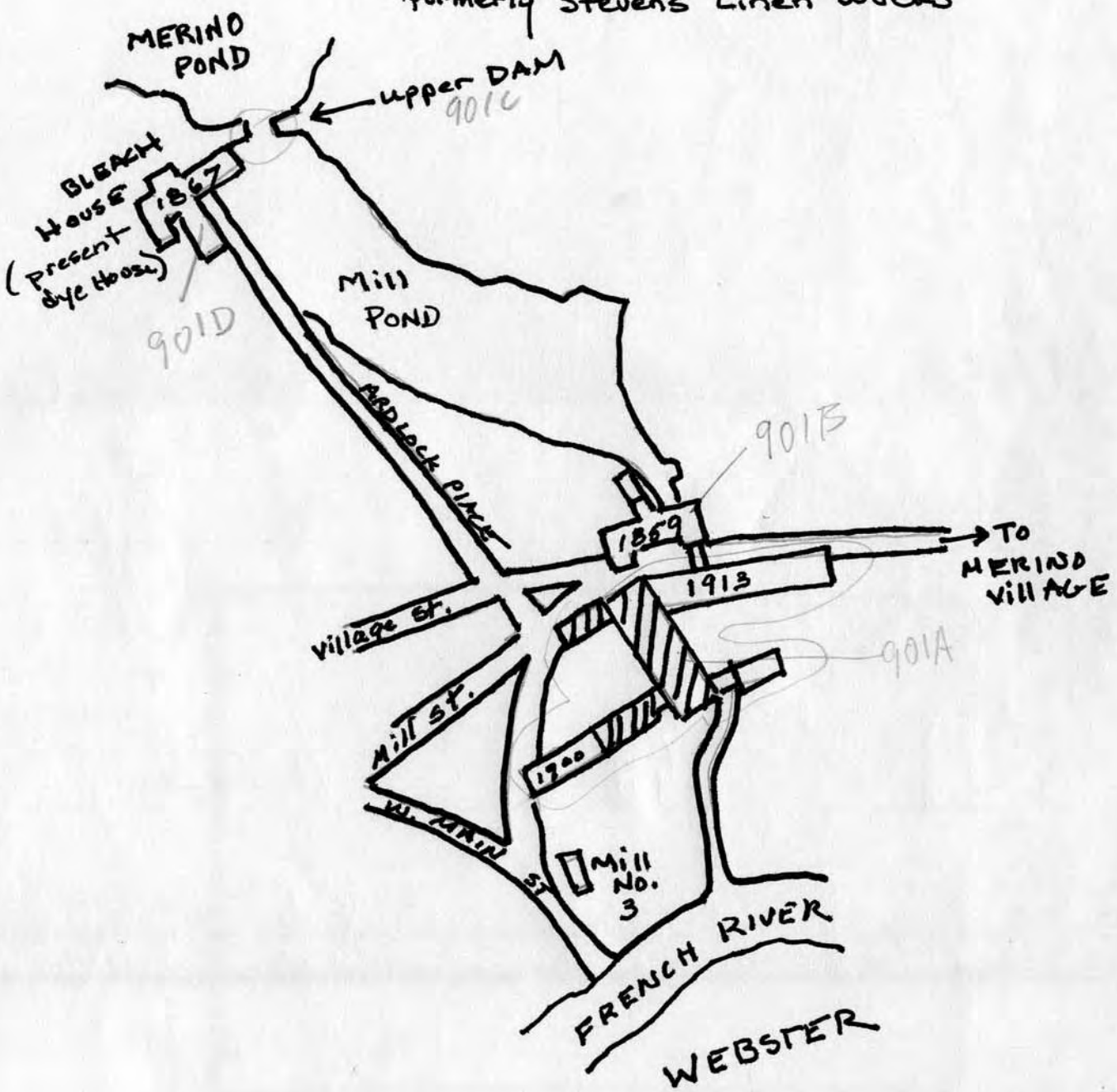
By 1932, the Stevens Plant was the largest in the country making linen crash toweling, and towels exclusively. It had a capacity of 15 million yards per year. It continues today, the only factory in the Country that produces on linen machinery a finished fabric from raw stock.

9. Bibliography and/or references such as local histories, deeds, assessor's records, early maps, etc.

"200th Anniversary Celebration, Dudley, MA.", 1932
Textile Age, May, 1946
Webster Times, Centennial Edition, 1859-1959,

1831 - Z. KEACH MAP
1870 - F.W. BEERS & CO. ATLAS
1878 - BECK AND PAUL: BIRDSEYE VIEW OF WEBSTER, MA
1898 - STADLEY & CO, ATLAS

STEVENS LINEN ASSOCIATES
formerly Stevens Linen Works



1862-1864

DUD. 229

1877 Insurance Survey, Courtesy of the Merrimack Valley Textile Museum

No. 5017.

THE STEVENS LINEN WORKS,

WEBSTER, MASS.

OWNED by Company.
GOODS—Crash, Diaper, &c.
STOCK—Flax, have used Jute.
CAPACITY—300 looms.

POWER—Water and Steam.
EXPOSURE—None.
SURVEYED—November, 1877. C. A. B.

DESCRIPTION.

No. 1—OLD MILL—Three stories and attic, stone, metal roof. First story, carding. Second story, sorting and shaking, one card for carding cords from stock bales. Third story, hackling by hand and with machinery. Attic, not in use. Wood passage to third story of **No. 2.**

No. 2—MAIN BUILDING—HEIGHT-four stories, attic and basement. SIZE-207x70 feet, with east wing 110x40, and west wing 80x24 feet. WALLS-heavy stone. ROOF-slate. CORNICE-stone. SCUTTLE-from towers. LADDERS-movable and fixed. FLOORS-heavy, double, and arranged for flooding. CEILING-close board finish. STAIRS-in east and west towers. ELEVATOR-on north side, iron doors each story. First story, weaving. Second story, weaving. Third story, spooling, winding and preparing. Fourth story, spinning. Attic, storage of rubbish. Basement, beetling, packing; jute machinery, not in use.

East Wing—Two stories and basement, same construction as **No. 2.** Basement, storage of goods. First story, repair shop. Second story, dressing.

West Wing—Same as **No. 2.** Occupied for office, pattern room and storage.

No. 3—Wheel and Engine House—One story and basement, stone, slate roof. Basement, pump. First story, jute carding machinery, not in use; iron door to **No. 2.**

No. 4—Store House—Two stories, stone, shingle roof; wood passage from first story enters second story of **No. 1.**

No. 5—Wheel House—One story and attic, stone, slate roof. First story, wheel. Attic, combing.

No. 6—Boiler House—One story, brick, gravel roof.

No. 7—Dry Shed—One story, frame.

No. 8—Waste House—One story, frame.

SPECIAL FEATURES.

Heating—Steam, pipes well arranged.

Lighting—Gas, made in retorts.

Watchman—Nights, with Buerk watch.

Pickers—None. Hackling and carding machinery are located in **No. 1.**

Drying is done by atmospheric exposure in building **No. 7.**

Oils—Lubricating on machinery.

Waste—Removed daily.

Hours of Work—Ten.

Boilers—Two Harrison and three of tubular kind in **No. 6,** well set.

FIRE APPLIANCES.

Fire Pump—Two rotary pumps, good size, located in **No. 3** and **No. 5.** One good size steam pump also at boilers. Locations are good.

Vertical Pipe—One in each tower of **No. 2,** hose connected each floor. Also outside on same and two on **No. 1,** hose connections each story.

Tank—None.

Hydrants—One in yard, and at pump.

Hose—1,500 feet.

Sprinklers—Each story of **No. 1,** from pump.

Casks and Buckets—Good supply, well distributed.

Steam Jets—None.

Extinguishers—None.

Lightning Rods—Yes.

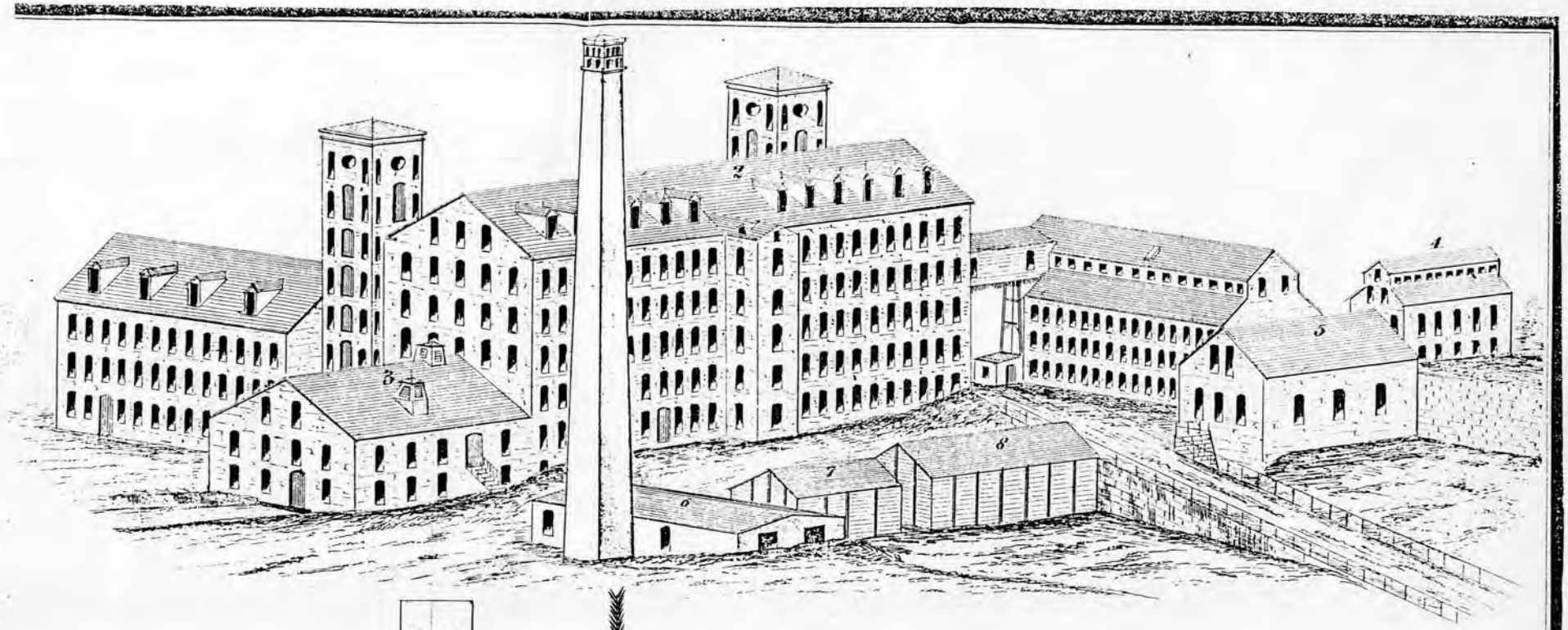
Ladders—Movable and fixed. Ladders and balconies at outside vertical pipes.

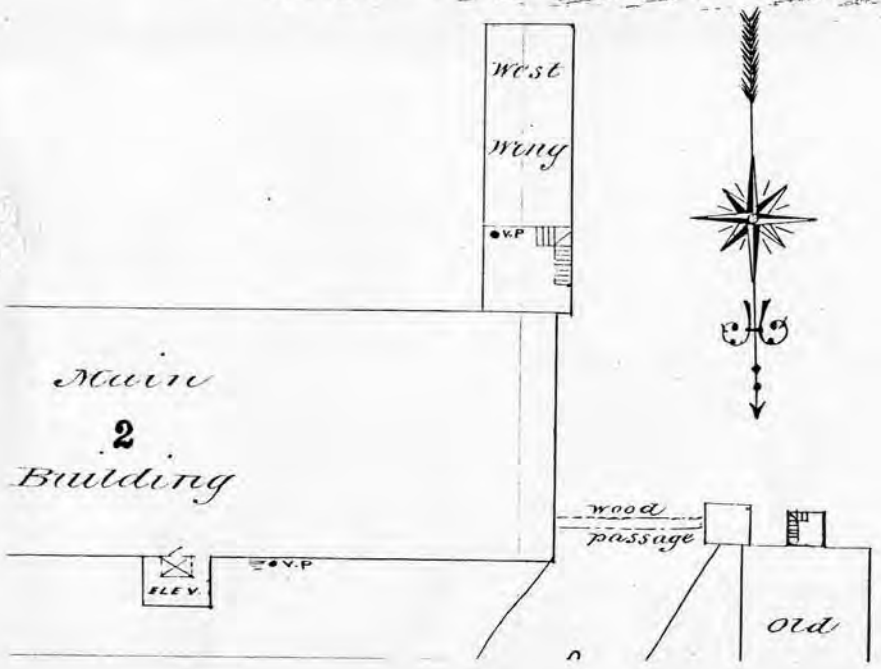
Auxiliary Aid—None.

CHARACTER.

Building No. 2 and wings are of very superior construction and in neat condition. **No. 1** is quite old, floors worn, but has substantial walls, and is, probably, from nature of operations more liable to fire than the rest, though sprinkler pipes and other appliances give good protection. Management appears careful and experienced.

DUD.229





THE STEVENS LINEN WORKS,

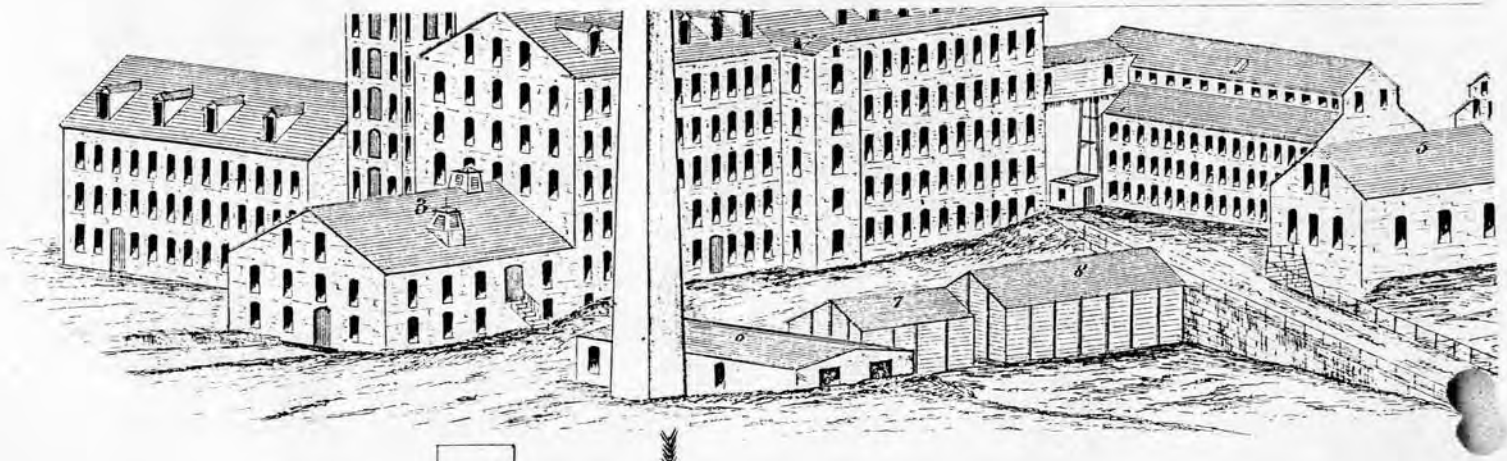
Webster,

Mass.

Scale of Feet

0 50 100 150.

DUD.229

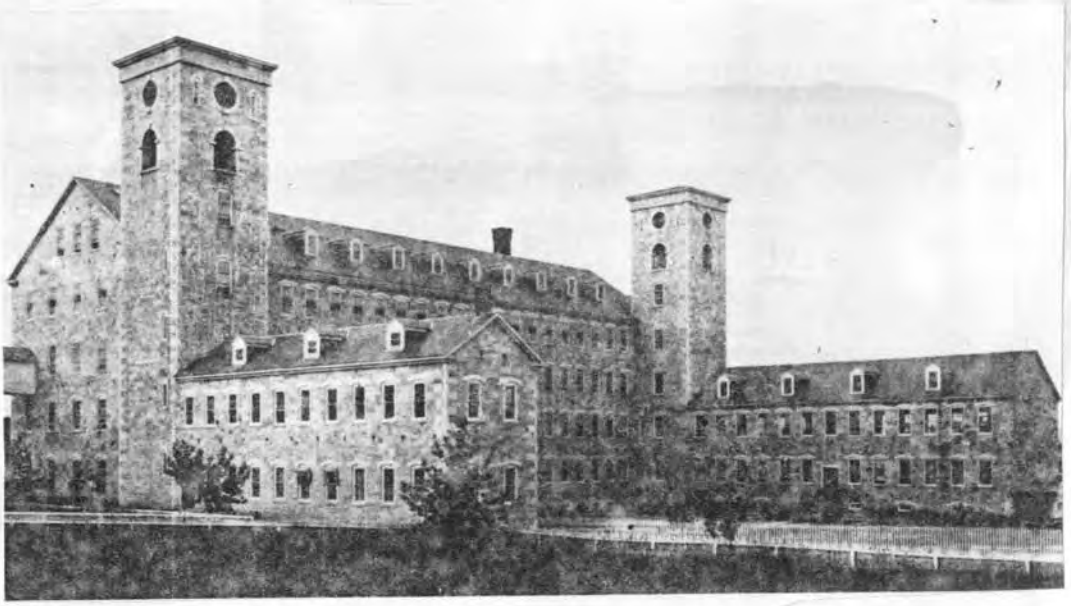


THE STEVENS LINEN W

Webster;

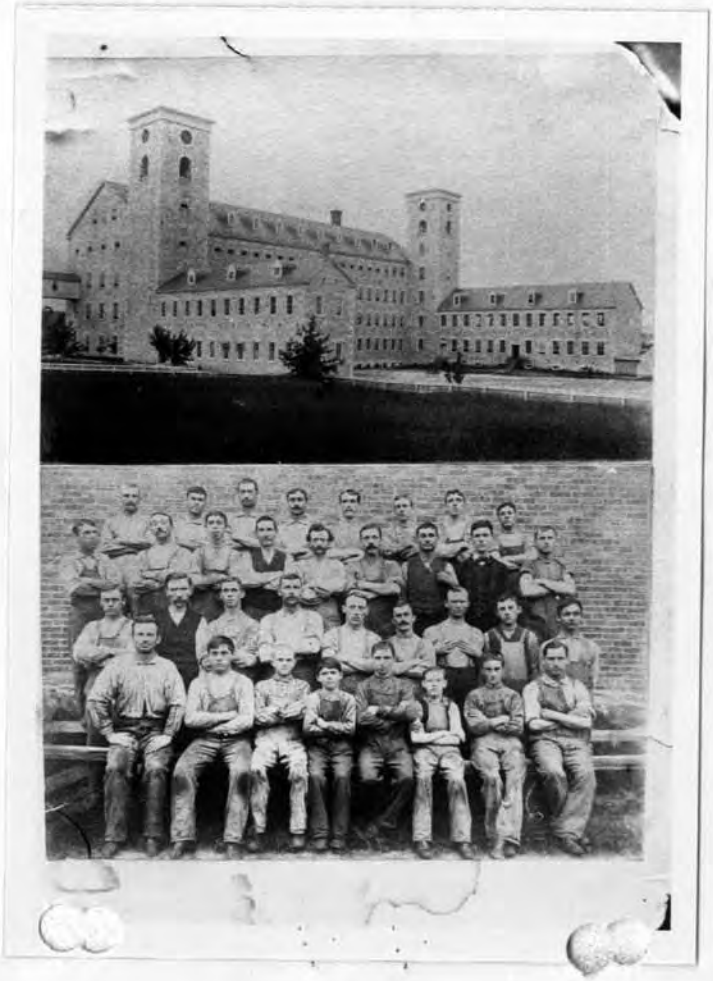
Mass.

DUD.229



24. Steven Linen Works, Mill Street

Forground to background: office (2½ stories), west tower, Mill No. 2 (5½ stories), east tower, east wing (2½ stories, currently 3½ stories).



Stevens Mill workers late 19th c. photograph courtesy of the Pearle L. Crawford Memorial Library

901D

Dye House, built in 1867 as a Bleach House Adjacent to Upper Dam and Mill Pond.

901D & 901C

901A

Looking south on Village Street. Huckling and Carding Mill, built in 1913, is in forground.

Mill No. 2 Interior

Photographs taken March, 1981

Enigmatic inscription chiseled on lintel of Mill No. 1. Built in 1859 by Henry HALE STEVENS.

STEVENS Mill:
West Tower

DUD.229 ~~I-51~~

	Area A	~~Area 50~~ Structure 901

(Dudley)
~~Webster~~ (Worcester Ctr.)
(Merino Village)

Address Mill Street ~~at~~ Main Street at Merino Pond (Low Pond)

Stevens Linen Associates, Inc.

Original & present Industrial (Textile products)

Present owner Stevens Linen Associates, Inc.

Open to public No.

~~1868~~ 1862-65

~~1864~~ (Mill) Style Industrial (Italian influence in design details)

Literature
Music
Indians
Other Technology
Development of town/city

Source of date Building Marker; secondary works

Architect Unknown

Architectural reason for inventorying:

Style merit; focal point of industrial community. OR part of Area # B

3. CONDITION Excellent Good Fair Deteriorated Moved Altered Added 1900; 1913; 1927 1909

Survey Considerations: B:1; B:3; B:7; B:8; B:10; B:12; B:14; B:13

4. DESCRIPTION

FOUNDATION/BASEMENT: High Regular Low Material (Block stone cut & coursed) (207' x 701')

WALL COVER: Wood _____ Brick Stone Other _____

ROOF: Ridge Gambrel Flat (Ridge roof with dormers removed in 1900) Hip Mansard _____
Towers (2 Identical end corner towers) Cupola Dormer windows Balustrade Grillwork _____

CHIMNEYS: 1 2 3 4 Center End Interior Irregular Cluster Elaborate

STORIES: 1 2 3 4 . ATTACHMENTS: Wings & Ell Shed _____

PORCHES: 1 2 3 4 None PORTICO None Balcony

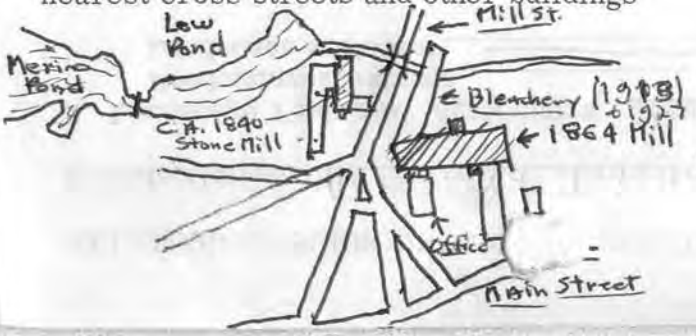
FACADE: Gable end: Front/side Ornament: None.

Entrance: Sides & Front: Center/Side Details: None.

Windows: Spacing: Regular/Irregular Identical/Varied (Stone segmental Arch lintels)

Corners: Plain Pilasters Quoins Cornerboards _____

5. Indicate location of building in relation to nearest cross streets and other buildings



6. Footage of structure from street 150-175±
Property has 1000± feet frontage on street

Recorder Bryant F. Tolles, Jr. - Special Consultant

For M.H.C.

Photo # 70-3126 Date 7/30/70

SEE REVERSE SIDE

DUD.229

RELATION OF SURROUNDING STRUCTURE

1. Outbuildings Associated Industrial structures

2. Landscape Features: Agriculture Open~~,~~ Wooded Garden: Formal/Informal
Predominant features
Landscape architect

3. Neighboring Structures
Style: Colonial Federal Greek Revival Gothic Revival Italian Villa Lombard Rom.
Venetian Gothic Mansard Richardsonian Modern ~~Industrial~~

Use: Residential Commercial Religious & Industrial Conditions: Excellent Good~~,~~ Fair Deteriorated

---

GIVE A BRIEF DESCRIPTION OF HISTORIC IMPORTANCE OF SITE (Refer and elaborate on theme circled on front of form)

7. Stone, Orra L. History of Massachusetts Industries, 4 vols. ~~New York~~ Boston and Chicago: Lewis Historical Publishing Company, 1930. (I, p. 84)

BIBLIOGRAPHY AND/OR REFERENCE

1. Marvin, Abijah P. et al. History of Worcester County, Massachusetts, 2 vols. Boston: C. F. Jewett & Co., 1879. (II, pp. 467-72) (I, 438-40)
2. North Andover, Massachusetts. Merrimack Valley Textile Museum. Durlow and Bunnerett. Insurance survey (1877.)
3. ~~The Book of Dudley - 200th Anniversary Celebration.~~ Webster, Massachusetts: Times Publishing Company, 1932. ~~(pp)~~
4. Hurd, D. Hamilton, ed. History of Worcester County, Massachusetts, 2 vols. Philadelphia: J. W. Lewis & Co., 1889. (II, p. 1366)
5. Ammidown, Holmes. Historical Collections, 2 vols. New York: By the Author, 1874. (I, pp. 335-36)
6. Crane, Ellery B. History of Worcester County, Massachusetts. 3 vols. New York and Chicago: Lewis Historical Publishing Company, 1924. (III, p. 137; II, p. 805)

RESTRICTIONS

Original Owner:
Deed Information: Book Number Page , Registry of Deeds

Area A ~~Area B~~ ~~A~~ 50

DUD.229 901

FORM A - AREA AND SITE SURVEY
MASSACHUSETTS HISTORICAL COMMISSION
Office of the Secretary, State House, Boston

1. Town ~~Webster~~ Dudley (Worcester County)

2. Name of area or section Merino Village (Stevens Linen Associates, Inc.)

6. Please comment on the Historical or

General Date or Period (1830's - 1890's) Mfg.

Is the area uniform? No.

In style No. (Varying industrial styles)

In condition No. (Fair to good)

In type of ownership No. (Residential private and business)

In use (Explain) No. (Residential, commercial & industrial)

Is area potentially threatened? Yes.

By Zoning Possibly.

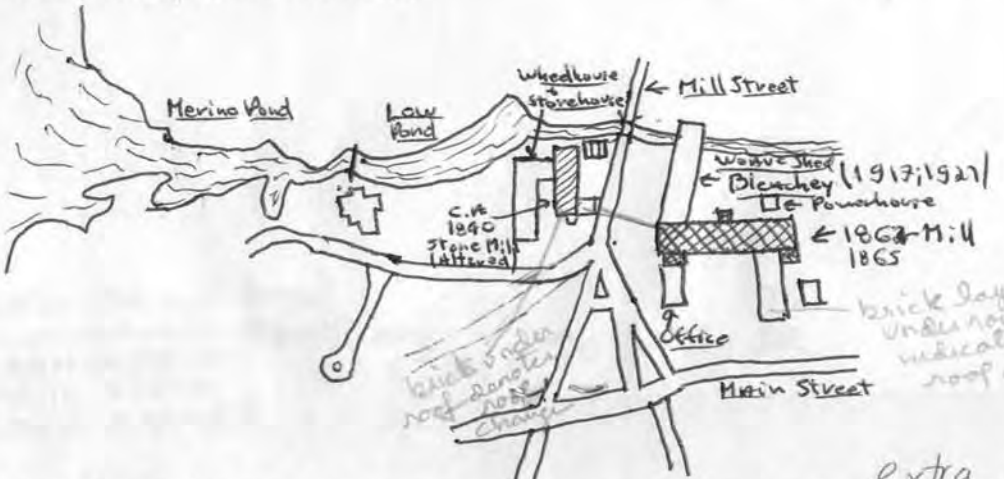
By Roads No.

By Developers Unknown.

By Deterioration Somewhat.

Survey Considerations: A:2; A:3; A:5; A:6; A:7; A:9.

7. Draw a general map of the area involved. Please indicate in red any known historic sites on which individual reports are contemplated on Form B. Indicate street boundaries of area and any route numbers.



70 - 3120
70 - 3125
71 - 92

extra prints in photograph file
71.45 thru 71.50

Recorder Bryant F. Tolles, Jr. (7/30/70)
Special Consultant

For M.H.C.
(Name of Organization)

NOTE: Recorder should obtain written permission from Commission or sponsoring organization before using this form.

FORM - MHCA - 10M-6-66-943017

DUD.229

Bibliography:

1. Marvin, Abijah P. et. Al. History of Worcester County, Massachusetts, 2 vols. Boston: C. F. Jewett & Co., 1879. (II, 467-72) (I, pp 438-40)
2. North Andover, Massachusetts. ~~Boots~~ Merrimack Valley Textile Museum. Bartlow and Bancroft insurance survey (1877.)
*3. The Book of Dudley - 200th Anniversary Celebration. Webster, Massachusetts: Times Publishing Company, 1932.
4. Hurd, D. Hamilton, ed. History of Worcester County, Massachusetts. 2 vols. Philadelphia: J. W. Lewis & Co., 1889 (II, p. 1366)
5. Ammidown, Holmes. Historical Collections 2 vols. New York: By the Author, 1874. (I, pp. 435-36)
*6. Crane, Ellery B. History of Worcester County, Massachusetts. 3 vols. New York and Chicago: Lewis Historical Publishing Company, 1924. (I, p 139, II, p. 805)
7. Stone, Orra L. History of Massachusetts Industries. 4 vols. ~~New York~~ Boston and Chicago: The S. J. Clarke Publishing Company, 1930. (I, p 84)

Attachment C

MassDEP Bordering Vegetated Wetland Delineation Field Data Forms

MassDEP Bordering Vegetated Wetland (310 CMR 10.55) Delineation Field Data Form

Applicant: _____ Prepared by: LEC Environmental Consultants, Inc. Project location: 8 Mill Street, Dudley,MA
Andrea Kendall, Senior Environmental Scientist LEC File #: BoE\21-105.04 DEP File #:_____

Check all that apply:

- ❑ Vegetation alone presumed adequate to delineate BVW boundary: fill out Section I only
- ☑ Vegetation and other indicators of hydrology used to delineate BVW boundary: fill out Sections I and II
- ❑ Method other than dominance test used (attach additional information)

Section I.

Vegetation	Observation Plot Number: 1 (wetland)		Transect Number: 1 (WF 2-11)	Date: June 15, 2021
A. Sample Layer & Plant Species (by common/scientific name)	B. Percent Cover (Midpoints used)	C. Percent Dominance	D. Dominant Plant (yes or no)	E. Wetland Indicator Category*
Ground Cover				
Jewelweed (*Impatiens capensis*)	10.5%	12.5%	No	
Goldenrod (*Solidago* sp.)	63%	75%	Yes	Presume Wet
Sensitive fern (*Onoclea sensibilis*)	10.5%	12.5%	No	
Shrub/Sapling				
Redosier dogwood (*Cornus sericea*)	10.5%	100%	Yes	FACW+*
Tree (Absent)				

* *Use an asterisk to mark wetland indicator plants: plant species listed in the Wetlands Protection Act (MGL c.131, s.40); plants in the genus Sphagnum; plants listed as FAC, FAC+, FACW-, FACW, FACW+, or OBL; or plants with physiological or morphological adaptations. If any plants are identified as wetland indicator plants due to physiological or morphological adaptations, describe the adaptation next to the asterisk.*

Vegetation conclusion:

Number of dominant wetland indicator plants: 2 Number of dominant non-wetland indicator plants: 0

Is the number of dominant wetland plants equal to or greater than the number of dominant non-wetland plants? (yes) no

If vegetation alone is presumed adequate to delineate the BVW boundary, submit this form with the Request for Determination of Applicability or Notice of Intent

Section II. Indicators of Hydrology

Hydric Soil Interpretation

1. Soil Survey

Is there a published soil survey for this site? (yes) no
title/date: NRCS Web Soil Survey and Worcester County, Massachusetts, Southern Part, Version 12, September 12, 2019
map number: 622C
soil type mapped: Paxton-Urban land complex, 8 to 155 percent slopes
hydric soil inclusions: Ridgebury

Are field observations consistent with soil survey? yes (no)
Remarks:

2. Soil Description

Horizon	Depth	Matrix Color	Mottles Color
A	0-12”	10YR 3/1 mucky fsl	
B_w	12-20”	10YR 2/1 mucky sl	10YR 5/1 @ 15”

Remarks:

3. Other:

Conclusion: Is soil hydric? (yes) no

Other Indicators of Hydrology: (check all that apply & describe)

- ❑ Site Inundated: _____
- ❑ Depth to free water in observation hole: _____
- ☑ Depth to soil saturation in observation hole: at surface
- ❑ Water marks: _____
- ❑ Drift lines: _____
- ❑ Sediment Deposits: _____
- ☑ Drainage patterns in BVW: _____
- ❑ Oxidized rhizospheres: _____
- ☑ Water-stained leaves: _____
- ❑ Recorded Data (streams, lake, or tidal gauge; aerial photo; other):
  _____
  _____
  _____
- ❑ Other: _____

Vegetation and Hydrology Conclusion

	Yes	No
Number of wetland indicator plants ≥ # of non-wetland indicator plants	X	____
Wetland hydrology present:		
Hydric soil present	X	____
Other indicators of hydrology present	X	____
Sample location is in a BVW	X	____

Submit this form with the Request for Determination of Applicability or Notice of Intent.

MassDEP Bordering Vegetated Wetland (310 CMR 10.55) Delineation Field Data Form

Applicant: _____ Prepared by: LEC Environmental Consultants, Inc. Project location: 8 Mill Street, Dudley,MA
Andrea Kendall, Senior Environmental Scientist LEC File #: BoE\21-105.04 DEP File #:_____

Check all that apply:

- ❑ Vegetation alone presumed adequate to delineate BVW boundary: fill out Section I only
- ☑ Vegetation and other indicators of hydrology used to delineate BVW boundary: fill out Sections I and II
- ❑ Method other than dominance test used (attach additional information)

Section I.

Vegetation	Observation Plot Number: 2 (upland)		Transect Number: 1 (WF 2-11)	Date: June 15, 2021
A. Sample Layer & Plant Species (by common/scientific name)	B. Percent Cover (Midpoints used)	C. Percent Dominance	D. Dominant Plant (yes or no)	E. Wetland Indicator Category*
Ground Cover				
Jewelweed (*Impatiens capensis*)	38.0%	38%	Yes	FACW*
Pennsylvania sedge (*Carex pensylvanica*)	38.0%	38%	Yes	Not Listed
Climbing nightshade (*Solanum dulcamara*)	12.0%	12%	No	
Goldenrod (*Solidago* sp.)	12.0%	12%	No	
Shrub/Sapling				
Smooth sumac (*Rhus glabra*)	38.0%	100%	Yes	Not Listed
Tree				
Red maple (*Acer rubrum*)	12.0%	100%	Yes	FAC*
Vine				
Asian bittersweet (*Celastrus orbiculatus*)	3.0%	100%	Yes	UPL

* *Use an asterisk to mark wetland indicator plants: plant species listed in the Wetlands Protection Act (MGL c.131, s.40); plants in the genus Sphagnum; plants listed as FAC, FAC+, FACW-, FACW, FACW+, or OBL; or plants with physiological or morphological adaptations. If any plants are identified as wetland indicator plants due to physiological or morphological adaptations, describe the adaptation next to the asterisk.*

Vegetation conclusion:

Number of dominant wetland indicator plants: 2 Number of dominant non-wetland indicator plants: 3

Is the number of dominant wetland plants equal to or greater than the number of dominant non-wetland plants? yes (no)

If vegetation alone is presumed adequate to delineate the BVW boundary, submit this form with the Request for Determination of Applicability or Notice of Intent

Section II. Indicators of Hydrology

Hydric Soil Interpretation

1. Soil Survey

Is there a published soil survey for this site? (yes) no
title/date: NRCS Web Soil Survey and Worcester County, Massachusetts, Southern Part, Version 12, September 12, 2019
map number: 622C
soil type mapped: Paxton-Urban land complex, 8 to 155 percent slopes
hydric soil inclusions: Ridgebury

Are field observations consistent with soil survey? (yes) no
Remarks:

2. Soil Description

Horizon	Depth	Matrix Color	Mottles Color
A	0-8”	10YR 3/2 fsl	
B_w	8-19”	10YR 4/6 fsl to sl with depth	

Remarks:

3. Other:

Conclusion: Is soil hydric? yes (no)

Other Indicators of Hydrology: (check all that apply & describe)

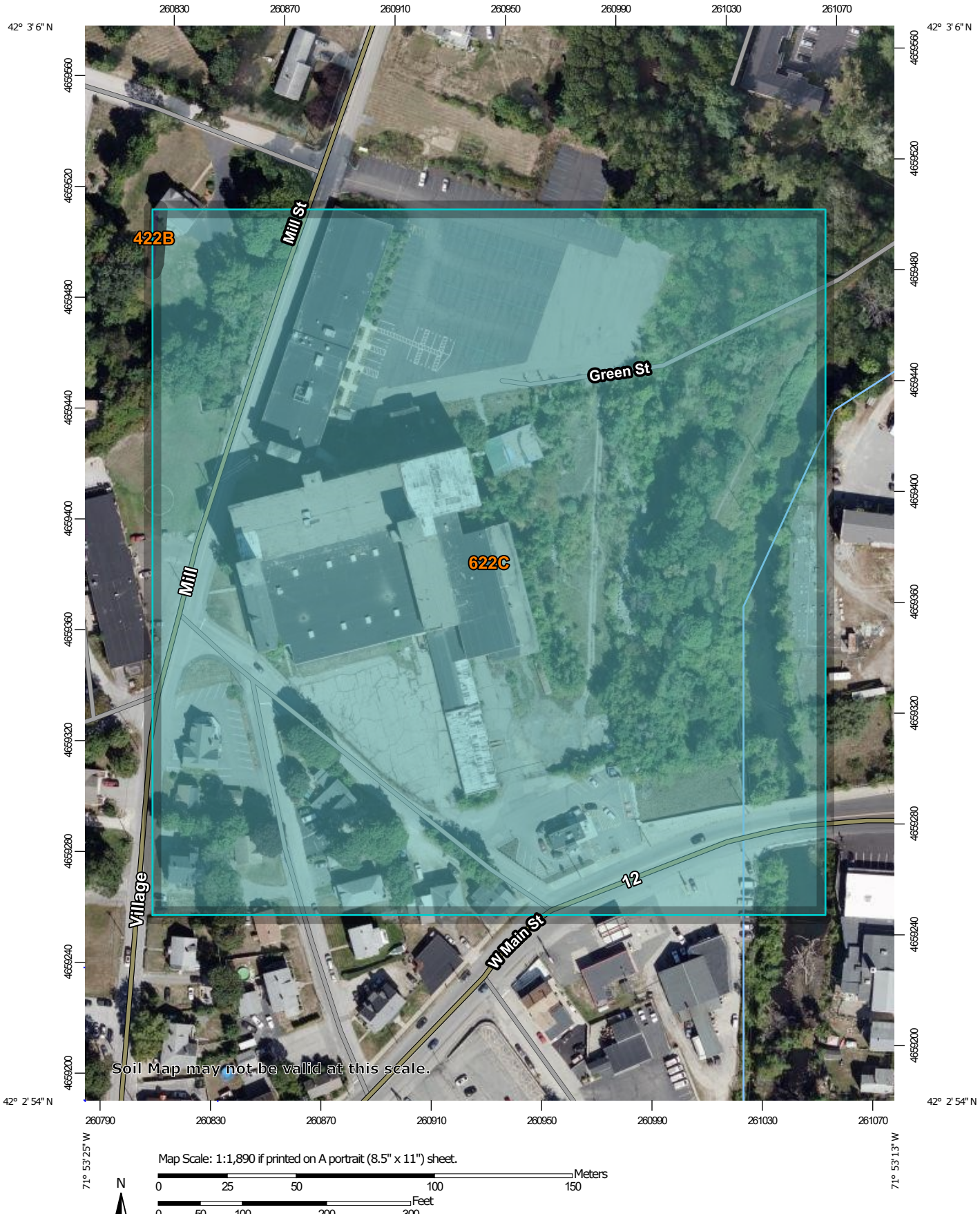
- ❑ Site Inundated: _____
- ❑ Depth to free water in observation hole: _____
- ❑ Depth to soil saturation in observation hole: _____
- ❑ Water marks: _____
- ❑ Drift lines: _____
- ❑ Sediment Deposits: _____
- ❑ Drainage patterns in BVW: _____
- ❑ Oxidized rhizospheres: _____
- ❑ Water-stained leaves: _____
- ❑ Recorded Data (streams, lake, or tidal gauge; aerial photo; other):
  _____
  _____
  _____
- ❑ Other: _____

Vegetation and Hydrology Conclusion

	Yes	No
Number of wetland indicator plants ≥ # of non-wetland indicator plants	_____	X
Wetland hydrology present:		
Hydric soil present	_____	X
Other indicators of hydrology present	_____	X
Sample location is in a BVW	_____	X

Submit this form with the Request for Determination of Applicability or Notice of Intent.

Hydrologic Soil Group—Worcester County, Massachusetts, Southern Part
(Stevens Mill, Dudley MA)



Map Scale: 1:1,890 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 25 50 100 150

Feet
0 50 100 200 300

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

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

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

Soil Rating Lines

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

Soil Rating Points

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

Water Features

- Streams and Canals

Transportation

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

Background

- Aerial Photography

MAP INFORMATION

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

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

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

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

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

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of 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: Worcester County, Massachusetts, Southern Part
Survey Area Data: Version 13, Jun 11, 2020

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

Date(s) aerial images were photographed: Sep 16, 2020—Oct 1, 2020

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.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
422B	Canton fine sandy loam, 0 to 8 percent slopes, extremely stony	B	0.0	0.1%
622C	Paxton-Urban land complex, 8 to 15 percent slopes	C	15.4	99.9%
Totals for Area of Interest			**15.4**	**100.0%**

Description

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

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

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

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

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

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

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

Rating Options

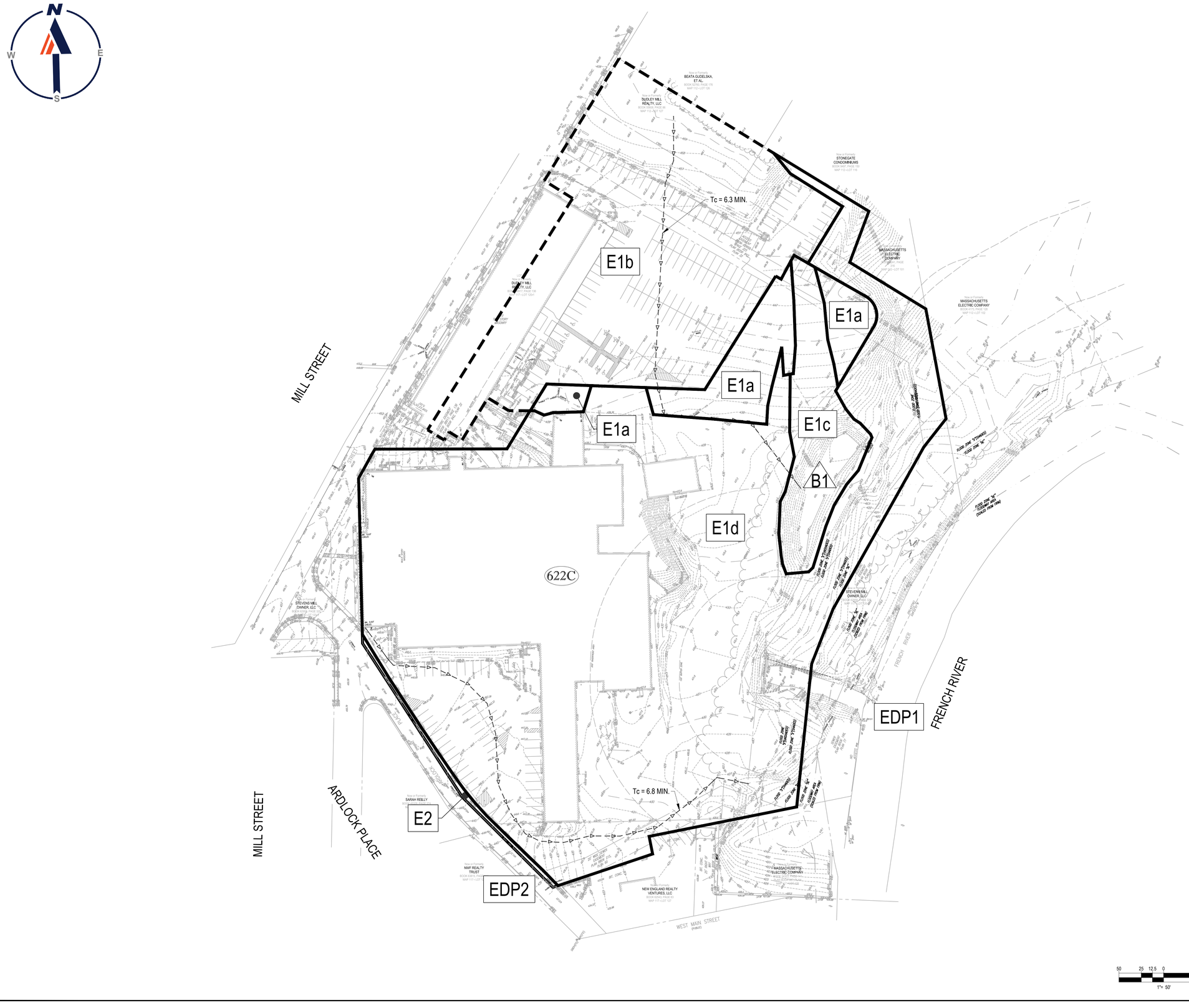
Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

APPENDIX D: EXISTING CONDITIONS HYDROLOGIC ANALYSIS

- *EXISTING CONDITIONS DRAINAGE MAP*
- *EXISTING CONDITIONS HYDROCAD COMPUTATIONS*



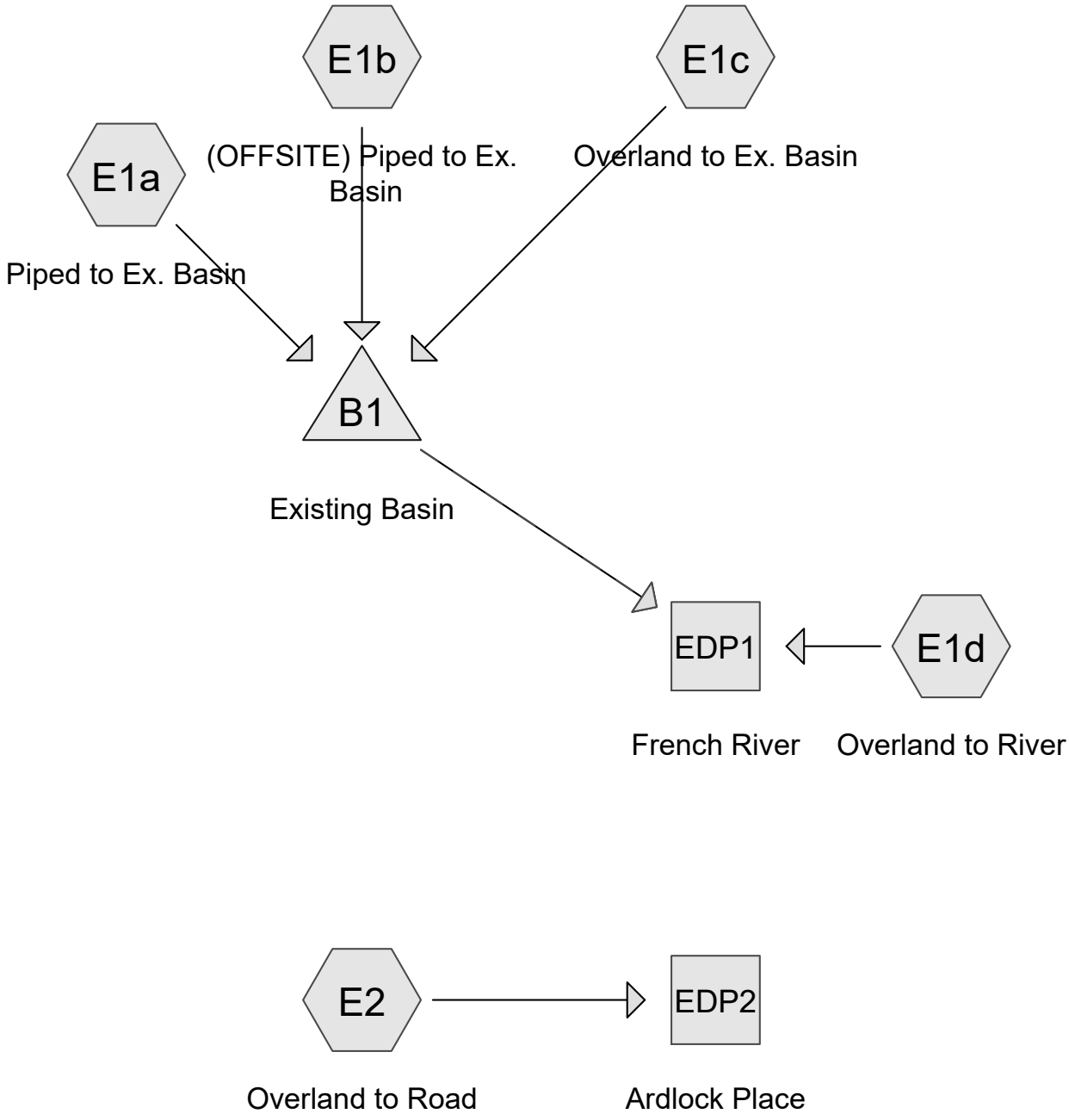
PRE-DEVELOPMENT DRAINAGE ANALYSIS EXHIBIT

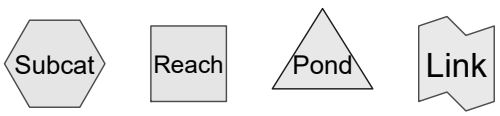
8 MILL STREET
DUDLEY, MA

PREPARED BY

BOHLER

SCALE:1"=50 DATE: 04/052022





Routing Diagram for W211100 Existing
Prepared by Bohler Engineering, Printed 4/12/2022

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.953	74	>75% Grass cover, Good, HSG C (E1b, E1c, E1d)
1.946	65	Brush, Good, HSG C (E1d)
0.108	87	Dirt roads, HSG C (E1d)
3.116	98	Paved parking, HSG C (E1a, E1b, E1c, E1d, E2)
0.211	98	Rock Slope, HSG C (E1c, E1d)
2.021	98	Roofs, HSG C (E1b, E1d)
0.051	98	Water Surface, 0% imp, HSG C (E1c)
0.144	98	Waterway, HSG C (E1d)

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
8.549	HSG C	E1a, E1b, E1c, E1d, E2
0.000	HSG D	
0.000	Other	

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	0.953	0.000	0.000	0.953	>75% Grass cover, Good	E1b, E1c, E1d
0.000	0.000	1.946	0.000	0.000	1.946	Brush, Good	E1d
0.000	0.000	0.108	0.000	0.000	0.108	Dirt roads	E1d
0.000	0.000	3.116	0.000	0.000	3.116	Paved parking	E1a, E1b, E1c, E1d, E2
0.000	0.000	0.211	0.000	0.000	0.211	Rock Slope	E1c, E1d
0.000	0.000	2.021	0.000	0.000	2.021	Roofs	E1b, E1d
0.000	0.000	0.051	0.000	0.000	0.051	Water Surface, 0% imp	E1c
0.000	0.000	0.144	0.000	0.000	0.144	Waterway	E1d

Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
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 E1a: Piped to Ex. Basin Runoff Area=17,868 sf 100.00% Impervious Runoff Depth=2.77"
Tc=6.0 min CN=98 Runoff=1.16 cfs 0.095 af

Subcatchment E1b: (OFFSITE) Piped to Runoff Area=91,648 sf 71.09% Impervious Runoff Depth=2.07"
Flow Length=528' Tc=6.3 min CN=91 Runoff=4.90 cfs 0.363 af

Subcatchment E1c: Overland to Ex. Basin Runoff Area=18,238 sf 44.78% Impervious Runoff Depth=1.82"
Tc=6.0 min CN=88 Runoff=0.87 cfs 0.063 af

Subcatchment E1d: Overland to River Runoff Area=242,993 sf 60.24% Impervious Runoff Depth=1.66"
Flow Length=602' Tc=6.8 min CN=86 Runoff=10.44 cfs 0.773 af

Subcatchment E2: Overland to Road Runoff Area=0.038 ac 100.00% Impervious Runoff Depth=2.77"
Tc=6.0 min CN=98 Runoff=0.11 cfs 0.009 af

Reach EDP1: French River Inflow=13.49 cfs 1.257 af
Outflow=13.49 cfs 1.257 af

Reach EDP2: Ardlock Place Inflow=0.11 cfs 0.009 af
Outflow=0.11 cfs 0.009 af

Pond B1: Existing Basin Peak Elev=427.35' Storage=4,704 cf Inflow=6.93 cfs 0.521 af
Discarded=0.02 cfs 0.037 af Primary=3.73 cfs 0.484 af Secondary=0.00 cfs 0.000 af Outflow=3.75 cfs 0.521 af

Summary for Subcatchment E1a: Piped to Ex. Basin

Runoff = 1.16 cfs @ 12.09 hrs, Volume= 0.095 af, Depth= 2.77"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-yr Rainfall=3.00"

Area (sf)	CN	Description
17,868	98	Paved parking, HSG C
17,868		100.00% Impervious Area

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

Summary for Subcatchment E1b: (OFFSITE) Piped to Ex. Basin

Runoff = 4.90 cfs @ 12.09 hrs, Volume= 0.363 af, Depth= 2.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-yr Rainfall=3.00"

Area (sf)	CN	Description
11,171	98	Roofs, HSG C
26,492	74	>75% Grass cover, Good, HSG C
53,985	98	Paved parking, HSG C
91,648	91	Weighted Average
26,492		28.91% Pervious Area
65,156		71.09% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.9	50	0.0300	0.17		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.00"
0.1	27	0.2000	3.13		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.0	289	0.0600	4.97		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.3	162	0.0310	7.99	6.27	**Pipe Channel, 433.5-428.53** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Corrugated PE, smooth interior
6.3	528	Total			

Summary for Subcatchment E1c: Overland to Ex. Basin

Runoff = 0.87 cfs @ 12.09 hrs, Volume= 0.063 af, Depth= 1.82"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-yr Rainfall=3.00"

	Area (sf)	CN	Description
	2,231	98	Water Surface, 0% imp, HSG C
	7,840	74	>75% Grass cover, Good, HSG C
	6,843	98	Paved parking, HSG C
*	1,324	98	Rock Slope, HSG C
	18,238	88	Weighted Average
	10,071		55.22% Pervious Area
	8,167		44.78% Impervious Area

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

Summary for Subcatchment E1d: Overland to River

Runoff = 10.44 cfs @ 12.10 hrs, Volume= 0.773 af, Depth= 1.66"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-yr Rainfall=3.00"

	Area (sf)	CN	Description
	76,859	98	Roofs, HSG C
*	7,851	98	Rock Slope, HSG C
*	6,266	98	Waterway, HSG C
	55,399	98	Paved parking, HSG C
	4,687	87	Dirt roads, HSG C
	84,753	65	Brush, Good, HSG C
	7,178	74	>75% Grass cover, Good, HSG C
	242,993	86	Weighted Average
	96,618		39.76% Pervious Area
	146,375		60.24% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.5	44	0.0300	0.16		**Sheet Flow, 451.13-449.82** Grass: Short n= 0.150 P2= 3.00"
2.1	520	0.0430	4.21		**Shallow Concentrated Flow, 449.82-427.25** Paved Kv= 20.3 fps
0.2	38	0.0590	3.91		**Shallow Concentrated Flow, 427.25-425** Unpaved Kv= 16.1 fps
6.8	602	Total			

Summary for Subcatchment E2: Overland to Road

Runoff = 0.11 cfs @ 12.09 hrs, Volume= 0.009 af, Depth= 2.77"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-yr Rainfall=3.00"

Area (ac)	CN	Description
0.038	98	Paved parking, HSG C
0.038		100.00% Impervious Area

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

Summary for Reach EDP1: French River

Inflow Area = 8.511 ac, 64.08% Impervious, Inflow Depth = 1.77" for 2-yr event
Inflow = 13.49 cfs @ 12.11 hrs, Volume= 1.257 af
Outflow = 13.49 cfs @ 12.11 hrs, Volume= 1.257 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Reach EDP2: Ardlock Place

Inflow Area = 0.038 ac,100.00% Impervious, Inflow Depth = 2.77" for 2-yr event
Inflow = 0.11 cfs @ 12.09 hrs, Volume= 0.009 af
Outflow = 0.11 cfs @ 12.09 hrs, Volume= 0.009 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Pond B1: Existing Basin

Inflow Area = 2.933 ac, 71.38% Impervious, Inflow Depth = 2.13" for 2-yr event
Inflow = 6.93 cfs @ 12.09 hrs, Volume= 0.521 af
Outflow = 3.75 cfs @ 12.23 hrs, Volume= 0.521 af, Atten= 46%, Lag= 8.5 min
Discarded = 0.02 cfs @ 12.23 hrs, Volume= 0.037 af
Primary = 3.73 cfs @ 12.23 hrs, Volume= 0.484 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 427.35' @ 12.23 hrs Surf.Area= 3,921 sf Storage= 4,704 cf

Plug-Flow detention time= 57.5 min calculated for 0.521 af (100% of inflow)
Center-of-Mass det. time= 58.2 min (856.3 - 798.1)

Volume	Invert	Avail.Storage	Storage Description
#1	425.60'	17,983 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
425.60	0	0	0
426.00	2,231	446	446
427.00	3,644	2,938	3,384
428.00	4,436	4,040	7,424
429.00	5,221	4,829	12,252
430.00	6,240	5,731	17,983

Device	Routing	Invert	Outlet Devices
#1	Discarded	425.60'	**0.270 in/hr Exfiltration over Surface area**
#2	Primary	425.60'	**28.0" Round Culvert** L= 50.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 425.60' / 425.00' S= 0.0120 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 4.28 sf
#3	Device 2	426.00'	**12.0" Vert. Orifice/Grate** C= 0.600
#4	Device 2	427.26'	**34.0" W x 24.0" H Vert. Orifice/Grate** C= 0.600
#5	Secondary	429.40'	**20.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Discarded OutFlow Max=0.02 cfs @ 12.23 hrs HW=427.35' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.02 cfs)

Primary OutFlow Max=3.71 cfs @ 12.23 hrs HW=427.35' TW=0.00' (Dynamic Tailwater)
└**2=Culvert** (Passes 3.71 cfs of 12.19 cfs potential flow)
  ├**3=Orifice/Grate** (Orifice Controls 3.48 cfs @ 4.43 fps)
  └**4=Orifice/Grate** (Orifice Controls 0.23 cfs @ 0.94 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=425.60' TW=0.00' (Dynamic Tailwater)
└**5=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
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 E1a: Piped to Ex. Basin Runoff Area=17,868 sf 100.00% Impervious Runoff Depth=4.26"
Tc=6.0 min CN=98 Runoff=1.76 cfs 0.146 af

Subcatchment E1b: (OFFSITE) Piped to Runoff Area=91,648 sf 71.09% Impervious Runoff Depth=3.50"
Flow Length=528' Tc=6.3 min CN=91 Runoff=8.08 cfs 0.613 af

Subcatchment E1c: Overland to Ex. Basin Runoff Area=18,238 sf 44.78% Impervious Runoff Depth=3.20"
Tc=6.0 min CN=88 Runoff=1.51 cfs 0.112 af

Subcatchment E1d: Overland to River Runoff Area=242,993 sf 60.24% Impervious Runoff Depth=3.00"
Flow Length=602' Tc=6.8 min CN=86 Runoff=18.66 cfs 1.396 af

Subcatchment E2: Overland to Road Runoff Area=0.038 ac 100.00% Impervious Runoff Depth=4.26"
Tc=6.0 min CN=98 Runoff=0.16 cfs 0.014 af

Reach EDP1: French River Inflow=25.25 cfs 2.226 af
Outflow=25.25 cfs 2.226 af

Reach EDP2: Ardlock Place Inflow=0.16 cfs 0.014 af
Outflow=0.16 cfs 0.014 af

Pond B1: Existing Basin Peak Elev=427.80' Storage=6,547 cf Inflow=11.34 cfs 0.871 af
Discarded=0.03 cfs 0.041 af Primary=7.90 cfs 0.830 af Secondary=0.00 cfs 0.000 af Outflow=7.93 cfs 0.871 af

Summary for Subcatchment E1a: Piped to Ex. Basin

Runoff = 1.76 cfs @ 12.09 hrs, Volume= 0.146 af, Depth= 4.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-yr Rainfall=4.50"

Area (sf)	CN	Description
17,868	98	Paved parking, HSG C
17,868		100.00% Impervious Area

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

Summary for Subcatchment E1b: (OFFSITE) Piped to Ex. Basin

Runoff = 8.08 cfs @ 12.09 hrs, Volume= 0.613 af, Depth= 3.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-yr Rainfall=4.50"

Area (sf)	CN	Description
11,171	98	Roofs, HSG C
26,492	74	>75% Grass cover, Good, HSG C
53,985	98	Paved parking, HSG C
91,648	91	Weighted Average
26,492		28.91% Pervious Area
65,156		71.09% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.9	50	0.0300	0.17		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.00"
0.1	27	0.2000	3.13		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.0	289	0.0600	4.97		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.3	162	0.0310	7.99	6.27	**Pipe Channel, 433.5-428.53** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Corrugated PE, smooth interior
6.3	528	Total			

Summary for Subcatchment E1c: Overland to Ex. Basin

Runoff = 1.51 cfs @ 12.09 hrs, Volume= 0.112 af, Depth= 3.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-yr Rainfall=4.50"

	Area (sf)	CN	Description
	2,231	98	Water Surface, 0% imp, HSG C
	7,840	74	>75% Grass cover, Good, HSG C
	6,843	98	Paved parking, HSG C
*	1,324	98	Rock Slope, HSG C
	18,238	88	Weighted Average
	10,071		55.22% Pervious Area
	8,167		44.78% Impervious Area

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

Summary for Subcatchment E1d: Overland to River

Runoff = 18.66 cfs @ 12.10 hrs, Volume= 1.396 af, Depth= 3.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-yr Rainfall=4.50"

	Area (sf)	CN	Description
	76,859	98	Roofs, HSG C
*	7,851	98	Rock Slope, HSG C
*	6,266	98	Waterway, HSG C
	55,399	98	Paved parking, HSG C
	4,687	87	Dirt roads, HSG C
	84,753	65	Brush, Good, HSG C
	7,178	74	>75% Grass cover, Good, HSG C
	242,993	86	Weighted Average
	96,618		39.76% Pervious Area
	146,375		60.24% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.5	44	0.0300	0.16		**Sheet Flow, 451.13-449.82** Grass: Short n= 0.150 P2= 3.00"
2.1	520	0.0430	4.21		**Shallow Concentrated Flow, 449.82-427.25** Paved Kv= 20.3 fps
0.2	38	0.0590	3.91		**Shallow Concentrated Flow, 427.25-425** Unpaved Kv= 16.1 fps
6.8	602	Total			

Summary for Subcatchment E2: Overland to Road

Runoff = 0.16 cfs @ 12.09 hrs, Volume= 0.014 af, Depth= 4.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-yr Rainfall=4.50"

Area (ac)	CN	Description
0.038	98	Paved parking, HSG C
0.038		100.00% Impervious Area

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

Summary for Reach EDP1: French River

Inflow Area = 8.511 ac, 64.08% Impervious, Inflow Depth = 3.14" for 10-yr event
Inflow = 25.25 cfs @ 12.12 hrs, Volume= 2.226 af
Outflow = 25.25 cfs @ 12.12 hrs, Volume= 2.226 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Reach EDP2: Ardlock Place

Inflow Area = 0.038 ac,100.00% Impervious, Inflow Depth = 4.26" for 10-yr event
Inflow = 0.16 cfs @ 12.09 hrs, Volume= 0.014 af
Outflow = 0.16 cfs @ 12.09 hrs, Volume= 0.014 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Pond B1: Existing Basin

Inflow Area = 2.933 ac, 71.38% Impervious, Inflow Depth = 3.56" for 10-yr event
Inflow = 11.34 cfs @ 12.09 hrs, Volume= 0.871 af
Outflow = 7.93 cfs @ 12.18 hrs, Volume= 0.871 af, Atten= 30%, Lag= 5.3 min
Discarded = 0.03 cfs @ 12.18 hrs, Volume= 0.041 af
Primary = 7.90 cfs @ 12.18 hrs, Volume= 0.830 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 427.80' @ 12.18 hrs Surf.Area= 4,277 sf Storage= 6,547 cf

Plug-Flow detention time= 42.9 min calculated for 0.870 af (100% of inflow)
Center-of-Mass det. time= 43.6 min (828.8 - 785.2)

Volume	Invert	Avail.Storage	Storage Description
#1	425.60'	17,983 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
425.60	0	0	0
426.00	2,231	446	446
427.00	3,644	2,938	3,384
428.00	4,436	4,040	7,424
429.00	5,221	4,829	12,252
430.00	6,240	5,731	17,983

Device	Routing	Invert	Outlet Devices
#1	Discarded	425.60'	**0.270 in/hr Exfiltration over Surface area**
#2	Primary	425.60'	**28.0" Round Culvert** L= 50.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 425.60' / 425.00' S= 0.0120 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 4.28 sf
#3	Device 2	426.00'	**12.0" Vert. Orifice/Grate** C= 0.600
#4	Device 2	427.26'	**34.0" W x 24.0" H Vert. Orifice/Grate** C= 0.600
#5	Secondary	429.40'	**20.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Discarded OutFlow Max=0.03 cfs @ 12.18 hrs HW=427.79' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=7.82 cfs @ 12.18 hrs HW=427.79' TW=0.00' (Dynamic Tailwater)
└**2=Culvert** (Passes 7.82 cfs of 16.59 cfs potential flow)
  ├**3=Orifice/Grate** (Orifice Controls 4.30 cfs @ 5.47 fps)
  └**4=Orifice/Grate** (Orifice Controls 3.52 cfs @ 2.34 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=425.60' TW=0.00' (Dynamic Tailwater)
└**5=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
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 E1a: Piped to Ex. Basin Runoff Area=17,868 sf 100.00% Impervious Runoff Depth=5.06"
Tc=6.0 min CN=98 Runoff=2.08 cfs 0.173 af

Subcatchment E1b: (OFFSITE) Piped to Runoff Area=91,648 sf 71.09% Impervious Runoff Depth=4.27"
Flow Length=528' Tc=6.3 min CN=91 Runoff=9.76 cfs 0.749 af

Subcatchment E1c: Overland to Ex. Basin Runoff Area=18,238 sf 44.78% Impervious Runoff Depth=3.95"
Tc=6.0 min CN=88 Runoff=1.85 cfs 0.138 af

Subcatchment E1d: Overland to River Runoff Area=242,993 sf 60.24% Impervious Runoff Depth=3.75"
Flow Length=602' Tc=6.8 min CN=86 Runoff=23.11 cfs 1.742 af

Subcatchment E2: Overland to Road Runoff Area=0.038 ac 100.00% Impervious Runoff Depth=5.06"
Tc=6.0 min CN=98 Runoff=0.19 cfs 0.016 af

Reach EDP1: French River Inflow=32.03 cfs 2.761 af
Outflow=32.03 cfs 2.761 af

Reach EDP2: Ardlock Place Inflow=0.19 cfs 0.016 af
Outflow=0.19 cfs 0.016 af

Pond B1: Existing Basin Peak Elev=427.99' Storage=7,374 cf Inflow=13.68 cfs 1.060 af
Discarded=0.03 cfs 0.042 af Primary=10.27 cfs 1.019 af Secondary=0.00 cfs 0.000 af Outflow=10.30 cfs 1.060 af

Summary for Subcatchment E1a: Piped to Ex. Basin

Runoff = 2.08 cfs @ 12.09 hrs, Volume= 0.173 af, Depth= 5.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-yr Rainfall=5.30"

Area (sf)	CN	Description
17,868	98	Paved parking, HSG C
17,868		100.00% Impervious Area

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

Summary for Subcatchment E1b: (OFFSITE) Piped to Ex. Basin

Runoff = 9.76 cfs @ 12.09 hrs, Volume= 0.749 af, Depth= 4.27"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-yr Rainfall=5.30"

Area (sf)	CN	Description
11,171	98	Roofs, HSG C
26,492	74	>75% Grass cover, Good, HSG C
53,985	98	Paved parking, HSG C
91,648	91	Weighted Average
26,492		28.91% Pervious Area
65,156		71.09% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.9	50	0.0300	0.17		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.00"
0.1	27	0.2000	3.13		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.0	289	0.0600	4.97		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.3	162	0.0310	7.99	6.27	**Pipe Channel, 433.5-428.53** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Corrugated PE, smooth interior
6.3	528	Total			

Summary for Subcatchment E1c: Overland to Ex. Basin

Runoff = 1.85 cfs @ 12.09 hrs, Volume= 0.138 af, Depth= 3.95"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-yr Rainfall=5.30"

	Area (sf)	CN	Description
	2,231	98	Water Surface, 0% imp, HSG C
	7,840	74	>75% Grass cover, Good, HSG C
	6,843	98	Paved parking, HSG C
*	1,324	98	Rock Slope, HSG C
	18,238	88	Weighted Average
	10,071		55.22% Pervious Area
	8,167		44.78% Impervious Area

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

Summary for Subcatchment E1d: Overland to River

Runoff = 23.11 cfs @ 12.10 hrs, Volume= 1.742 af, Depth= 3.75"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-yr Rainfall=5.30"

	Area (sf)	CN	Description
	76,859	98	Roofs, HSG C
*	7,851	98	Rock Slope, HSG C
*	6,266	98	Waterway, HSG C
	55,399	98	Paved parking, HSG C
	4,687	87	Dirt roads, HSG C
	84,753	65	Brush, Good, HSG C
	7,178	74	>75% Grass cover, Good, HSG C
	242,993	86	Weighted Average
	96,618		39.76% Pervious Area
	146,375		60.24% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.5	44	0.0300	0.16		**Sheet Flow, 451.13-449.82** Grass: Short n= 0.150 P2= 3.00"
2.1	520	0.0430	4.21		**Shallow Concentrated Flow, 449.82-427.25** Paved Kv= 20.3 fps
0.2	38	0.0590	3.91		**Shallow Concentrated Flow, 427.25-425** Unpaved Kv= 16.1 fps
6.8	602	Total			

Summary for Subcatchment E2: Overland to Road

Runoff = 0.19 cfs @ 12.09 hrs, Volume= 0.016 af, Depth= 5.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-yr Rainfall=5.30"

Area (ac)	CN	Description
0.038	98	Paved parking, HSG C
0.038		100.00% Impervious Area

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

Summary for Reach EDP1: French River

Inflow Area = 8.511 ac, 64.08% Impervious, Inflow Depth = 3.89" for 25-yr event
Inflow = 32.03 cfs @ 12.11 hrs, Volume= 2.761 af
Outflow = 32.03 cfs @ 12.11 hrs, Volume= 2.761 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Reach EDP2: Ardlock Place

Inflow Area = 0.038 ac,100.00% Impervious, Inflow Depth = 5.06" for 25-yr event
Inflow = 0.19 cfs @ 12.09 hrs, Volume= 0.016 af
Outflow = 0.19 cfs @ 12.09 hrs, Volume= 0.016 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Pond B1: Existing Basin

Inflow Area = 2.933 ac, 71.38% Impervious, Inflow Depth = 4.34" for 25-yr event
Inflow = 13.68 cfs @ 12.09 hrs, Volume= 1.060 af
Outflow = 10.30 cfs @ 12.17 hrs, Volume= 1.060 af, Atten= 25%, Lag= 4.6 min
Discarded = 0.03 cfs @ 12.17 hrs, Volume= 0.042 af
Primary = 10.27 cfs @ 12.17 hrs, Volume= 1.019 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 427.99' @ 12.17 hrs Surf.Area= 4,427 sf Storage= 7,374 cf

Plug-Flow detention time= 38.4 min calculated for 1.060 af (100% of inflow)
Center-of-Mass det. time= 39.1 min (819.5 - 780.4)

Volume	Invert	Avail.Storage	Storage Description
#1	425.60'	17,983 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
425.60	0	0	0
426.00	2,231	446	446
427.00	3,644	2,938	3,384
428.00	4,436	4,040	7,424
429.00	5,221	4,829	12,252
430.00	6,240	5,731	17,983

Device	Routing	Invert	Outlet Devices
#1	Discarded	425.60'	**0.270 in/hr Exfiltration over Surface area**
#2	Primary	425.60'	**28.0" Round Culvert**
			L= 50.0' CPP, projecting, no headwall, Ke= 0.900
			Inlet / Outlet Invert= 425.60' / 425.00' S= 0.0120 '/' Cc= 0.900
			n= 0.013 Corrugated PE, smooth interior, Flow Area= 4.28 sf
#3	Device 2	426.00'	**12.0" Vert. Orifice/Grate** C= 0.600
#4	Device 2	427.26'	**34.0" W x 24.0" H Vert. Orifice/Grate** C= 0.600
#5	Secondary	429.40'	**20.0' long x 10.0' breadth Broad-Crested Rectangular Weir**
			Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60
			Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Discarded OutFlow Max=0.03 cfs @ 12.17 hrs HW=427.97' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=10.07 cfs @ 12.17 hrs HW=427.97' TW=0.00' (Dynamic Tailwater)
└**2=Culvert** (Passes 10.07 cfs of 17.85 cfs potential flow)
  ├**3=Orifice/Grate** (Orifice Controls 4.59 cfs @ 5.84 fps)
  └**4=Orifice/Grate** (Orifice Controls 5.48 cfs @ 2.71 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=425.60' TW=0.00' (Dynamic Tailwater)
└**5=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
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 E1a: Piped to Ex. Basin Runoff Area=17,868 sf 100.00% Impervious Runoff Depth=6.26"
Tc=6.0 min CN=98 Runoff=2.55 cfs 0.214 af

Subcatchment E1b: (OFFSITE) Piped to Runoff Area=91,648 sf 71.09% Impervious Runoff Depth=5.45"
Flow Length=528' Tc=6.3 min CN=91 Runoff=12.27 cfs 0.955 af

Subcatchment E1c: Overland to Ex. Basin Runoff Area=18,238 sf 44.78% Impervious Runoff Depth=5.11"
Tc=6.0 min CN=88 Runoff=2.36 cfs 0.178 af

Subcatchment E1d: Overland to River Runoff Area=242,993 sf 60.24% Impervious Runoff Depth=4.89"
Flow Length=602' Tc=6.8 min CN=86 Runoff=29.78 cfs 2.271 af

Subcatchment E2: Overland to Road Runoff Area=0.038 ac 100.00% Impervious Runoff Depth=6.26"
Tc=6.0 min CN=98 Runoff=0.24 cfs 0.020 af

Reach EDP1: French River Inflow=41.96 cfs 3.575 af
Outflow=41.96 cfs 3.575 af

Reach EDP2: Ardlock Place Inflow=0.24 cfs 0.020 af
Outflow=0.24 cfs 0.020 af

Pond B1: Existing Basin Peak Elev=428.22' Storage=8,423 cf Inflow=17.17 cfs 1.347 af
Discarded=0.03 cfs 0.043 af Primary=13.53 cfs 1.304 af Secondary=0.00 cfs 0.000 af Outflow=13.56 cfs 1.347 af

Summary for Subcatchment E1a: Piped to Ex. Basin

Runoff = 2.55 cfs @ 12.09 hrs, Volume= 0.214 af, Depth= 6.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr Rainfall=6.50"

Area (sf)	CN	Description
17,868	98	Paved parking, HSG C
17,868		100.00% Impervious Area

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

Summary for Subcatchment E1b: (OFFSITE) Piped to Ex. Basin

Runoff = 12.27 cfs @ 12.09 hrs, Volume= 0.955 af, Depth= 5.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr Rainfall=6.50"

Area (sf)	CN	Description
11,171	98	Roofs, HSG C
26,492	74	>75% Grass cover, Good, HSG C
53,985	98	Paved parking, HSG C
91,648	91	Weighted Average
26,492		28.91% Pervious Area
65,156		71.09% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.9	50	0.0300	0.17		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.00"
0.1	27	0.2000	3.13		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.0	289	0.0600	4.97		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.3	162	0.0310	7.99	6.27	**Pipe Channel, 433.5-428.53** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Corrugated PE, smooth interior
6.3	528	Total			

Summary for Subcatchment E1c: Overland to Ex. Basin

Runoff = 2.36 cfs @ 12.09 hrs, Volume= 0.178 af, Depth= 5.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr Rainfall=6.50"

	Area (sf)	CN	Description
	2,231	98	Water Surface, 0% imp, HSG C
	7,840	74	>75% Grass cover, Good, HSG C
	6,843	98	Paved parking, HSG C
*	1,324	98	Rock Slope, HSG C
	18,238	88	Weighted Average
	10,071		55.22% Pervious Area
	8,167		44.78% Impervious Area

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

Summary for Subcatchment E1d: Overland to River

Runoff = 29.78 cfs @ 12.10 hrs, Volume= 2.271 af, Depth= 4.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr Rainfall=6.50"

	Area (sf)	CN	Description
	76,859	98	Roofs, HSG C
*	7,851	98	Rock Slope, HSG C
*	6,266	98	Waterway, HSG C
	55,399	98	Paved parking, HSG C
	4,687	87	Dirt roads, HSG C
	84,753	65	Brush, Good, HSG C
	7,178	74	>75% Grass cover, Good, HSG C
	242,993	86	Weighted Average
	96,618		39.76% Pervious Area
	146,375		60.24% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.5	44	0.0300	0.16		**Sheet Flow, 451.13-449.82** Grass: Short n= 0.150 P2= 3.00"
2.1	520	0.0430	4.21		**Shallow Concentrated Flow, 449.82-427.25** Paved Kv= 20.3 fps
0.2	38	0.0590	3.91		**Shallow Concentrated Flow, 427.25-425** Unpaved Kv= 16.1 fps
6.8	602	Total			

Summary for Subcatchment E2: Overland to Road

Runoff = 0.24 cfs @ 12.09 hrs, Volume= 0.020 af, Depth= 6.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr Rainfall=6.50"

Area (ac)	CN	Description
0.038	98	Paved parking, HSG C
0.038		100.00% Impervious Area

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

Summary for Reach EDP1: French River

Inflow Area = 8.511 ac, 64.08% Impervious, Inflow Depth = 5.04" for 100-yr event
Inflow = 41.96 cfs @ 12.11 hrs, Volume= 3.575 af
Outflow = 41.96 cfs @ 12.11 hrs, Volume= 3.575 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Reach EDP2: Ardlock Place

Inflow Area = 0.038 ac,100.00% Impervious, Inflow Depth = 6.26" for 100-yr event
Inflow = 0.24 cfs @ 12.09 hrs, Volume= 0.020 af
Outflow = 0.24 cfs @ 12.09 hrs, Volume= 0.020 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Pond B1: Existing Basin

Inflow Area = 2.933 ac, 71.38% Impervious, Inflow Depth = 5.51" for 100-yr event
Inflow = 17.17 cfs @ 12.09 hrs, Volume= 1.347 af
Outflow = 13.56 cfs @ 12.16 hrs, Volume= 1.347 af, Atten= 21%, Lag= 4.1 min
Discarded = 0.03 cfs @ 12.16 hrs, Volume= 0.043 af
Primary = 13.53 cfs @ 12.16 hrs, Volume= 1.304 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 428.22' @ 12.16 hrs Surf.Area= 4,609 sf Storage= 8,423 cf

Plug-Flow detention time= 33.6 min calculated for 1.346 af (100% of inflow)
Center-of-Mass det. time= 34.3 min (809.0 - 774.6)

Volume	Invert	Avail.Storage	Storage Description
#1	425.60'	17,983 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
425.60	0	0	0
426.00	2,231	446	446
427.00	3,644	2,938	3,384
428.00	4,436	4,040	7,424
429.00	5,221	4,829	12,252
430.00	6,240	5,731	17,983

Device	Routing	Invert	Outlet Devices
#1	Discarded	425.60'	**0.270 in/hr Exfiltration over Surface area**
#2	Primary	425.60'	**28.0" Round Culvert** L= 50.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 425.60' / 425.00' S= 0.0120 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 4.28 sf
#3	Device 2	426.00'	**12.0" Vert. Orifice/Grate** C= 0.600
#4	Device 2	427.26'	**34.0" W x 24.0" H Vert. Orifice/Grate** C= 0.600
#5	Secondary	429.40'	**20.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

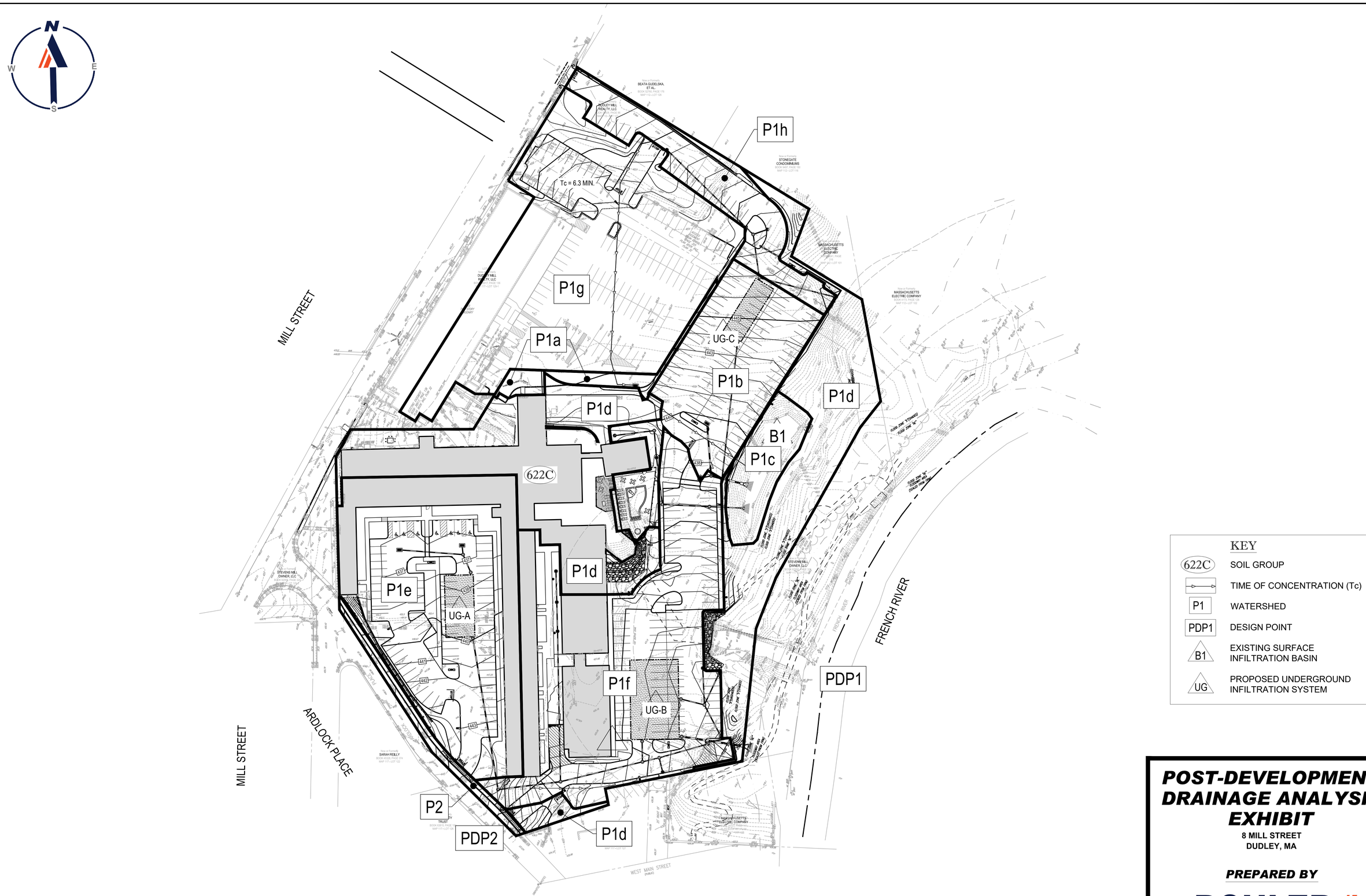
Discarded OutFlow Max=0.03 cfs @ 12.16 hrs HW=428.21' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=13.36 cfs @ 12.16 hrs HW=428.21' TW=0.00' (Dynamic Tailwater)
└**2=Culvert** (Passes 13.36 cfs of 19.52 cfs potential flow)
  ├**3=Orifice/Grate** (Orifice Controls 4.94 cfs @ 6.30 fps)
  └**4=Orifice/Grate** (Orifice Controls 8.41 cfs @ 3.13 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=425.60' TW=0.00' (Dynamic Tailwater)
└**5=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

APPENDIX E: PROPOSED CONDITIONS HYDROLOGIC ANALYSIS

- *PROPOSED CONDITIONS DRAINAGE MAP*
- *PROPOSED CONDITIONS HYDROCAD CALCULATIONS*



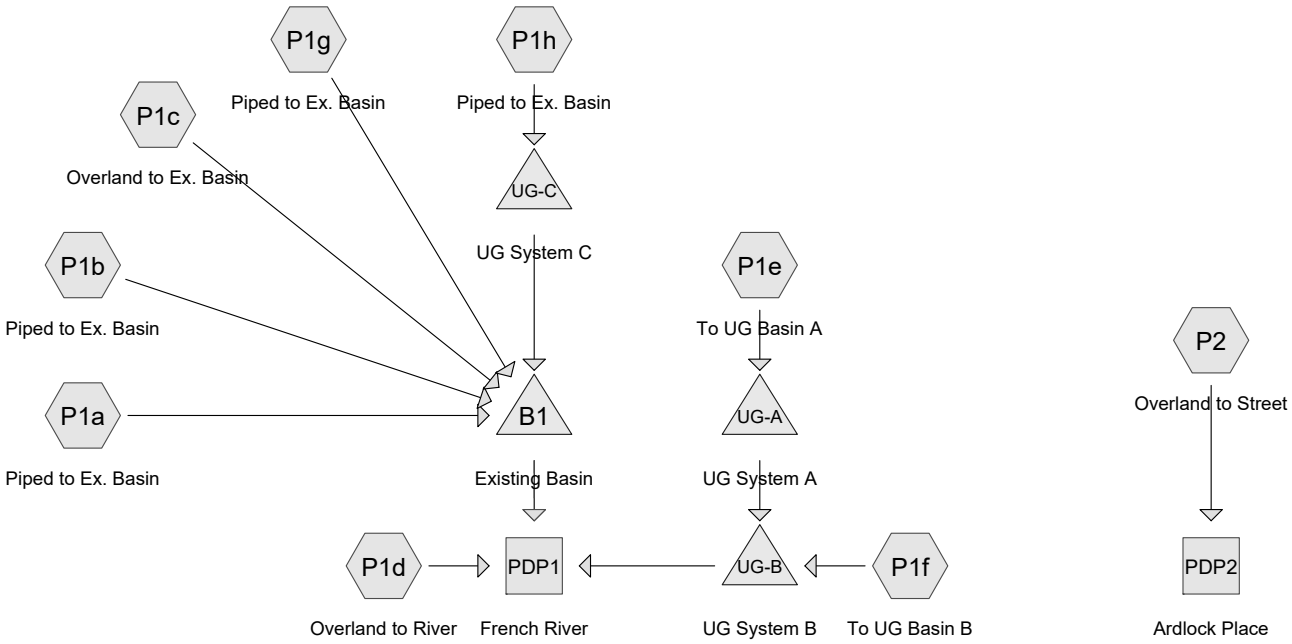
POST-DEVELOPMENT DRAINAGE ANALYSIS EXHIBIT

8 MILL STREET
DUDLEY, MA

PREPARED BY

BOHLER

SCALE:1"=50' DATE: 04/05/2022



Subcat Reach Pond Link

Routing Diagram for W211100 Proposed
Prepared by Bohler Engineering, Printed 4/14/2022

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
1.564	74	>75% Grass cover, Good, HSG C (P1a, P1b, P1c, P1d, P1e, P1f, P1g, P1h)
0.830	65	Brush, Good, HSG C (P1d)
4.279	98	Paved parking, HSG C (P1a, P1b, P1d, P1e, P1f, P1g, P1h, P2)
0.100	98	Rock Slope, HSG C (P1c, P1d)
1.566	98	Roofs, HSG C (P1d, P1e, P1f, P1g)
0.064	98	Water Surface, 0% imp, HSG C (P1c)
0.144	98	Waterway, HSG C (P1d)

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
8.547	HSG C	P1a, P1b, P1c, P1d, P1e, P1f, P1g, P1h, P2
0.000	HSG D	
0.000	Other	

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	1.564	0.000	0.000	1.564	>75% Grass cover, Good	P1a, P1b, P1c, P1d, P1e, P1f, P1g, P1h
0.000	0.000	0.830	0.000	0.000	0.830	Brush, Good	P1d
0.000	0.000	4.279	0.000	0.000	4.279	Paved parking	P1a, P1b, P1d, P1e, P1f, P1g, P1h, P2
0.000	0.000	0.100	0.000	0.000	0.100	Rock Slope	P1c, P1d
0.000	0.000	1.566	0.000	0.000	1.566	Roofs	P1d, P1e, P1f, P1g
0.000	0.000	0.064	0.000	0.000	0.064	Water Surface, 0% imp	P1c
0.000	0.000	0.144	0.000	0.000	0.144	Waterway	P1d

Summary for Subcatchment P1a: Piped to Ex. Basin

Runoff = 0.24 cfs @ 12.09 hrs, Volume= 0.018 af, Depth= 2.16"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-yr Rainfall=3.00"

Area (sf)	CN	Description
1,088	74	>75% Grass cover, Good, HSG C
3,292	98	Paved parking, HSG C
4,380	92	Weighted Average
1,088		24.84% Pervious Area
3,292		75.16% Impervious Area

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

Summary for Subcatchment P1b: Piped to Ex. Basin

Runoff = 2.15 cfs @ 12.09 hrs, Volume= 0.167 af, Depth= 2.55"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-yr Rainfall=3.00"

Area (sf)	CN	Description
2,455	74	>75% Grass cover, Good, HSG C
31,815	98	Paved parking, HSG C
34,270	96	Weighted Average
2,455		7.16% Pervious Area
31,815		92.84% Impervious Area

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

Summary for Subcatchment P1c: Overland to Ex. Basin

Runoff = 0.37 cfs @ 12.09 hrs, Volume= 0.027 af, Depth= 1.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-yr Rainfall=3.00"

	Area (sf)	CN	Description
	2,797	98	Water Surface, 0% imp, HSG C
	5,933	74	>75% Grass cover, Good, HSG C
*	1,031	98	Rock Slope, HSG C
	9,761	83	Weighted Average
	8,730		89.44% Pervious Area
	1,031		10.56% Impervious Area

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

Summary for Subcatchment P1d: Overland to River

Runoff = 2.78 cfs @ 12.10 hrs, Volume= 0.205 af, Depth= 1.25"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-yr Rainfall=3.00"

	Area (sf)	CN	Description
	23,532	98	Roofs, HSG C
*	3,309	98	Rock Slope, HSG C
*	6,289	98	Waterway, HSG C
	36,157	65	Brush, Good, HSG C
	13,910	74	>75% Grass cover, Good, HSG C
	2,347	98	Paved parking, HSG C
	85,544	80	Weighted Average
	50,067		58.53% Pervious Area
	35,477		41.47% Impervious Area

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

Summary for Subcatchment P1e: To UG Basin A

Runoff = 3.63 cfs @ 12.09 hrs, Volume= 0.271 af, Depth= 2.25"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-yr Rainfall=3.00"

Area (sf)	CN	Description
13,300	74	>75% Grass cover, Good, HSG C
32,937	98	Paved parking, HSG C
16,692	98	Roofs, HSG C
62,929	93	Weighted Average
13,300		21.13% Pervious Area
49,629		78.87% Impervious Area

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

Summary for Subcatchment P1f: To UG Basin B

Runoff = 4.38 cfs @ 12.09 hrs, Volume= 0.331 af, Depth= 2.35"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-yr Rainfall=3.00"

Area (sf)	CN	Description
11,674	74	>75% Grass cover, Good, HSG C
45,521	98	Paved parking, HSG C
16,507	98	Roofs, HSG C
73,702	94	Weighted Average
11,674		15.84% Pervious Area
62,028		84.16% Impervious Area

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

Summary for Subcatchment P1g: Piped to Ex. Basin

Runoff = 4.53 cfs @ 12.09 hrs, Volume= 0.341 af, Depth= 2.25"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-yr Rainfall=3.00"

Area (sf)	CN	Description
11,465	98	Roofs, HSG C
17,529	74	>75% Grass cover, Good, HSG C
50,108	98	Paved parking, HSG C
79,102	93	Weighted Average
17,529		22.16% Pervious Area
61,573		77.84% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.9	50	0.0300	0.17		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.00"
0.1	27	0.2000	3.13		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.0	289	0.0600	4.97		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.3	162	0.0310	7.99	6.27	**Pipe Channel, 433.5-428.53** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Corrugated PE, smooth interior
6.3	528	Total			

Summary for Subcatchment P1h: Piped to Ex. Basin

Runoff = 1.13 cfs @ 12.09 hrs, Volume= 0.086 af, Depth= 2.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-yr Rainfall=3.00"

Area (sf)	CN	Description
2,230	74	>75% Grass cover, Good, HSG C
16,167	98	Paved parking, HSG C
18,397	95	Weighted Average
2,230		12.12% Pervious Area
16,167		87.88% Impervious Area

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

Summary for Subcatchment P2: Overland to Street

Runoff = 0.28 cfs @ 12.09 hrs, Volume= 0.022 af, Depth= 2.77"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-yr Rainfall=3.00"

Area (ac)	CN	Description
0.097	98	Paved parking, HSG C
0.097		100.00% Impervious Area

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

Summary for Reach PDP1: French River

Inflow Area = 8.450 ac, 70.91% Impervious, Inflow Depth = 1.46" for 2-yr event
Inflow = 9.52 cfs @ 12.20 hrs, Volume= 1.025 af
Outflow = 9.52 cfs @ 12.20 hrs, Volume= 1.025 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Reach PDP2: Ardlock Place

Inflow Area = 0.097 ac,100.00% Impervious, Inflow Depth = 2.77" for 2-yr event
Inflow = 0.28 cfs @ 12.09 hrs, Volume= 0.022 af
Outflow = 0.28 cfs @ 12.09 hrs, Volume= 0.022 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Pond B1: Existing Basin

Inflow Area = 3.350 ac, 78.05% Impervious, Inflow Depth = 2.03" for 2-yr event
Inflow = 7.29 cfs @ 12.09 hrs, Volume= 0.567 af
Outflow = 5.42 cfs @ 12.17 hrs, Volume= 0.550 af, Atten= 26%, Lag= 4.7 min
Discarded = 0.03 cfs @ 12.17 hrs, Volume= 0.122 af
Primary = 5.39 cfs @ 12.17 hrs, Volume= 0.428 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 428.01' @ 12.17 hrs Surf.Area= 4,440 sf Storage= 7,286 cf

Plug-Flow detention time= 374.1 min calculated for 0.550 af (97% of inflow)
Center-of-Mass det. time= 356.9 min (1,156.8 - 799.9)

Volume	Invert	Avail.Storage	Storage Description
#1	426.00'	17,820 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
426.00	2,797	0	0
427.00	3,644	3,221	3,221
428.00	4,436	4,040	7,261
429.00	5,221	4,829	12,089
430.00	6,240	5,731	17,820

Device	Routing	Invert	Outlet Devices
#1	Discarded	426.00'	**0.270 in/hr Exfiltration over Surface area**
#2	Primary	425.60'	**28.0" Round Culvert** L= 50.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 425.60' / 425.00' S= 0.0120 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 4.28 sf
#3	Device 2	427.30'	**34.0" W x 24.0" H Vert. Orifice/Grate** C= 0.600
#4	Secondary	429.60'	**20.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Discarded OutFlow Max=0.03 cfs @ 12.17 hrs HW=428.00' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=5.29 cfs @ 12.17 hrs HW=428.00' TW=0.00' (Dynamic Tailwater)
↑**2=Culvert** (Passes 5.29 cfs of 18.03 cfs potential flow)
↑**3=Orifice/Grate** (Orifice Controls 5.29 cfs @ 2.68 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=426.00' TW=0.00' (Dynamic Tailwater)
↑**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond UG-A: UG System A

Inflow Area = 1.445 ac, 78.87% Impervious, Inflow Depth = 2.25" for 2-yr event
Inflow = 3.63 cfs @ 12.09 hrs, Volume= 0.271 af
Outflow = 2.97 cfs @ 12.17 hrs, Volume= 0.176 af, Atten= 18%, Lag= 4.6 min
Primary = 2.97 cfs @ 12.17 hrs, Volume= 0.176 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 434.23' @ 12.17 hrs Surf.Area= 2,600 sf Storage= 4,738 cf

Plug-Flow detention time= 178.2 min calculated for 0.176 af (65% of inflow)
Center-of-Mass det. time= 79.5 min (874.4 - 794.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	431.50'	2,354 cf	**34.75'W x 74.82'L x 3.50'H Field A** 9,100 cf Overall - 3,216 cf Embedded = 5,884 cf x 40.0% Voids
#2A	432.00'	3,216 cf	**ADS_StormTech SC-740 +Cap** x 70 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 7 Rows of 10 Chambers
		5,569 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	432.00'	**15.0" Round Culvert** L= 183.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 432.00' / 430.00' S= 0.0109 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf
#2	Device 1	433.85'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=2.78 cfs @ 12.17 hrs HW=434.21' TW=423.19' (Dynamic Tailwater)
↑**1=Culvert** (Passes 2.78 cfs of 5.87 cfs potential flow)
↑**2=Sharp-Crested Rectangular Weir** (Weir Controls 2.78 cfs @ 1.96 fps)

Summary for Pond UG-B: UG System B

Inflow Area = 3.137 ac, 81.72% Impervious, Inflow Depth = 1.94" for 2-yr event
Inflow = 6.37 cfs @ 12.14 hrs, Volume= 0.507 af
Outflow = 3.07 cfs @ 12.36 hrs, Volume= 0.393 af, Atten= 52%, Lag= 13.0 min
Primary = 3.07 cfs @ 12.36 hrs, Volume= 0.393 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 423.42' @ 12.36 hrs Surf.Area= 6,083 sf Storage= 8,085 cf

Plug-Flow detention time= 162.9 min calculated for 0.393 af (77% of inflow)
Center-of-Mass det. time= 77.5 min (896.3 - 818.8)

Volume	Invert	Avail.Storage	Storage Description
#1A	421.50'	5,411 cf	**63.25'W x 96.18'L x 3.50'H Field A** 21,291 cf Overall - 7,764 cf Embedded = 13,527 cf x 40.0% Voids
#2A	422.00'	7,764 cf	**ADS_StormTech SC-740 +Cap** x 169 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 13 Rows of 13 Chambers
		13,175 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	422.00'	**24.0" Round Culvert** L= 79.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 421.00' / 422.00' S= -0.0127 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf
#2	Device 1	422.75'	**24.0" W x 6.0" H Vert. Orifice/Grate** C= 0.600
#3	Device 1	424.20'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=3.06 cfs @ 12.36 hrs HW=423.42' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Passes 3.06 cfs of 7.62 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 3.06 cfs @ 3.06 fps)
  └─**3=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond UG-C: UG System C

Inflow Area = 0.422 ac, 87.88% Impervious, Inflow Depth = 2.45" for 2-yr event
Inflow = 1.13 cfs @ 12.09 hrs, Volume= 0.086 af
Outflow = 0.03 cfs @ 16.04 hrs, Volume= 0.013 af, Atten= 97%, Lag= 237.0 min
Primary = 0.03 cfs @ 16.04 hrs, Volume= 0.013 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 440.02' @ 16.04 hrs Surf.Area= 1,889 sf Storage= 3,202 cf

Plug-Flow detention time= 590.8 min calculated for 0.013 af (15% of inflow)
Center-of-Mass det. time= 370.2 min (1,153.2 - 783.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	437.50'	1,726 cf	**25.25'W x 74.82'L x 3.50'H Field A** 6,612 cf Overall - 2,297 cf Embedded = 4,315 cf x 40.0% Voids
#2A	438.00'	2,297 cf	**ADS_StormTech SC-740 +Cap** x 50 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 5 Rows of 10 Chambers
		4,023 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	438.00'	**12.0" Round Culvert** L= 165.0' CPP, projecting, no headwall, Ke= 0.900

Inlet / Outlet Invert= 438.00' / 434.00' S= 0.0242 '/' Cc= 0.900
n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.79 sf

#2	Device 1	440.00'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=0.03 cfs @ 16.04 hrs HW=440.02' TW=427.39' (Dynamic Tailwater)
↑**1=Culvert** (Passes 0.03 cfs of 3.68 cfs potential flow)
↑**2=Sharp-Crested Rectangular Weir** (Weir Controls 0.03 cfs @ 0.45 fps)

Summary for Subcatchment P1a: Piped to Ex. Basin

Runoff = 0.40 cfs @ 12.09 hrs, Volume= 0.030 af, Depth= 3.60"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-yr Rainfall=4.50"

Area (sf)	CN	Description
1,088	74	>75% Grass cover, Good, HSG C
3,292	98	Paved parking, HSG C
4,380	92	Weighted Average
1,088		24.84% Pervious Area
3,292		75.16% Impervious Area

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

Summary for Subcatchment P1b: Piped to Ex. Basin

Runoff = 3.31 cfs @ 12.09 hrs, Volume= 0.265 af, Depth= 4.04"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-yr Rainfall=4.50"

Area (sf)	CN	Description
2,455	74	>75% Grass cover, Good, HSG C
31,815	98	Paved parking, HSG C
34,270	96	Weighted Average
2,455		7.16% Pervious Area
31,815		92.84% Impervious Area

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

Summary for Subcatchment P1c: Overland to Ex. Basin

Runoff = 0.70 cfs @ 12.09 hrs, Volume= 0.051 af, Depth= 2.73"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-yr Rainfall=4.50"

	Area (sf)	CN	Description
	2,797	98	Water Surface, 0% imp, HSG C
	5,933	74	>75% Grass cover, Good, HSG C
*	1,031	98	Rock Slope, HSG C
	9,761	83	Weighted Average
	8,730		89.44% Pervious Area
	1,031		10.56% Impervious Area

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

Summary for Subcatchment P1d: Overland to River

Runoff = 5.56 cfs @ 12.09 hrs, Volume= 0.403 af, Depth= 2.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-yr Rainfall=4.50"

	Area (sf)	CN	Description
	23,532	98	Roofs, HSG C
*	3,309	98	Rock Slope, HSG C
*	6,289	98	Waterway, HSG C
	36,157	65	Brush, Good, HSG C
	13,910	74	>75% Grass cover, Good, HSG C
	2,347	98	Paved parking, HSG C
	85,544	80	Weighted Average
	50,067		58.53% Pervious Area
	35,477		41.47% Impervious Area

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

Summary for Subcatchment P1e: To UG Basin A

Runoff = 5.81 cfs @ 12.09 hrs, Volume= 0.446 af, Depth= 3.71"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-yr Rainfall=4.50"

Area (sf)	CN	Description
13,300	74	>75% Grass cover, Good, HSG C
32,937	98	Paved parking, HSG C
16,692	98	Roofs, HSG C
62,929	93	Weighted Average
13,300		21.13% Pervious Area
49,629		78.87% Impervious Area

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

Summary for Subcatchment P1f: To UG Basin B

Runoff = 6.92 cfs @ 12.09 hrs, Volume= 0.538 af, Depth= 3.82"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-yr Rainfall=4.50"

Area (sf)	CN	Description
11,674	74	>75% Grass cover, Good, HSG C
45,521	98	Paved parking, HSG C
16,507	98	Roofs, HSG C
73,702	94	Weighted Average
11,674		15.84% Pervious Area
62,028		84.16% Impervious Area

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

Summary for Subcatchment P1g: Piped to Ex. Basin

Runoff = 7.25 cfs @ 12.09 hrs, Volume= 0.561 af, Depth= 3.71"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-yr Rainfall=4.50"

Area (sf)	CN	Description
11,465	98	Roofs, HSG C
17,529	74	>75% Grass cover, Good, HSG C
50,108	98	Paved parking, HSG C
79,102	93	Weighted Average
17,529		22.16% Pervious Area
61,573		77.84% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.9	50	0.0300	0.17		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.00"
0.1	27	0.2000	3.13		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.0	289	0.0600	4.97		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.3	162	0.0310	7.99	6.27	**Pipe Channel, 433.5-428.53** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Corrugated PE, smooth interior
6.3	528	Total			

Summary for Subcatchment P1h: Piped to Ex. Basin

Runoff = 1.75 cfs @ 12.09 hrs, Volume= 0.138 af, Depth= 3.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-yr Rainfall=4.50"

Area (sf)	CN	Description
2,230	74	>75% Grass cover, Good, HSG C
16,167	98	Paved parking, HSG C
18,397	95	Weighted Average
2,230		12.12% Pervious Area
16,167		87.88% Impervious Area

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

Summary for Subcatchment P2: Overland to Street

Runoff = 0.42 cfs @ 12.09 hrs, Volume= 0.034 af, Depth= 4.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-yr Rainfall=4.50"

Area (ac)	CN	Description
0.097	98	Paved parking, HSG C
0.097		100.00% Impervious Area

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

Summary for Reach PDP1: French River

Inflow Area = 8.450 ac, 70.91% Impervious, Inflow Depth = 2.85" for 10-yr event
Inflow = 20.43 cfs @ 12.18 hrs, Volume= 2.007 af
Outflow = 20.43 cfs @ 12.18 hrs, Volume= 2.007 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Reach PDP2: Ardlock Place

Inflow Area = 0.097 ac,100.00% Impervious, Inflow Depth = 4.26" for 10-yr event
Inflow = 0.42 cfs @ 12.09 hrs, Volume= 0.034 af
Outflow = 0.42 cfs @ 12.09 hrs, Volume= 0.034 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Pond B1: Existing Basin

Inflow Area = 3.350 ac, 78.05% Impervious, Inflow Depth = 3.48" for 10-yr event
Inflow = 11.66 cfs @ 12.09 hrs, Volume= 0.972 af
Outflow = 9.18 cfs @ 12.16 hrs, Volume= 0.955 af, Atten= 21%, Lag= 4.1 min
Discarded = 0.03 cfs @ 12.16 hrs, Volume= 0.126 af
Primary = 9.15 cfs @ 12.16 hrs, Volume= 0.830 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 428.30' @ 12.16 hrs Surf.Area= 4,675 sf Storage= 8,647 cf

Plug-Flow detention time= 228.4 min calculated for 0.955 af (98% of inflow)
Center-of-Mass det. time= 219.6 min (1,007.2 - 787.6)

Volume	Invert	Avail.Storage	Storage Description
#1	426.00'	17,820 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
426.00	2,797	0	0
427.00	3,644	3,221	3,221
428.00	4,436	4,040	7,261
429.00	5,221	4,829	12,089
430.00	6,240	5,731	17,820

Device	Routing	Invert	Outlet Devices
#1	Discarded	426.00'	**0.270 in/hr Exfiltration over Surface area**
#2	Primary	425.60'	**28.0" Round Culvert** L= 50.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 425.60' / 425.00' S= 0.0120 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 4.28 sf
#3	Device 2	427.30'	**34.0" W x 24.0" H Vert. Orifice/Grate** C= 0.600
#4	Secondary	429.60'	**20.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Discarded OutFlow Max=0.03 cfs @ 12.16 hrs HW=428.30' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=9.05 cfs @ 12.16 hrs HW=428.30' TW=0.00' (Dynamic Tailwater)
2=Culvert (Passes 9.05 cfs of 20.11 cfs potential flow)
3=Orifice/Grate (Orifice Controls 9.05 cfs @ 3.20 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=426.00' TW=0.00' (Dynamic Tailwater)
4=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond UG-A: UG System A

Inflow Area = 1.445 ac, 78.87% Impervious, Inflow Depth = 3.71" for 10-yr event
Inflow = 5.81 cfs @ 12.09 hrs, Volume= 0.446 af
Outflow = 5.64 cfs @ 12.11 hrs, Volume= 0.351 af, Atten= 3%, Lag= 1.3 min
Primary = 5.64 cfs @ 12.11 hrs, Volume= 0.351 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 434.43' @ 12.11 hrs Surf.Area= 2,600 sf Storage= 4,978 cf

Plug-Flow detention time= 135.0 min calculated for 0.351 af (79% of inflow)
Center-of-Mass det. time= 56.6 min (838.1 - 781.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	431.50'	2,354 cf	**34.75'W x 74.82'L x 3.50'H Field A** 9,100 cf Overall - 3,216 cf Embedded = 5,884 cf x 40.0% Voids
#2A	432.00'	3,216 cf	**ADS_StormTech SC-740 +Cap** x 70 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 7 Rows of 10 Chambers
		5,569 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	432.00'	**15.0" Round Culvert** L= 183.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 432.00' / 430.00' S= 0.0109 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf
#2	Device 1	433.85'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=5.51 cfs @ 12.11 hrs HW=434.42' TW=424.10' (Dynamic Tailwater)
↑**1=Culvert** (Passes 5.51 cfs of 6.26 cfs potential flow)
↑**2=Sharp-Crested Rectangular Weir** (Weir Controls 5.51 cfs @ 2.48 fps)

Summary for Pond UG-B: UG System B

Inflow Area = 3.137 ac, 81.72% Impervious, Inflow Depth = 3.40" for 10-yr event
Inflow = 12.48 cfs @ 12.10 hrs, Volume= 0.889 af
Outflow = 8.14 cfs @ 12.21 hrs, Volume= 0.774 af, Atten= 35%, Lag= 6.8 min
Primary = 8.14 cfs @ 12.21 hrs, Volume= 0.774 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 424.51' @ 12.21 hrs Surf.Area= 6,083 sf Storage= 11,987 cf

Plug-Flow detention time= 115.5 min calculated for 0.774 af (87% of inflow)
Center-of-Mass det. time= 56.6 min (857.4 - 800.8)

Volume	Invert	Avail.Storage	Storage Description
#1A	421.50'	5,411 cf	**63.25'W x 96.18'L x 3.50'H Field A** 21,291 cf Overall - 7,764 cf Embedded = 13,527 cf x 40.0% Voids
#2A	422.00'	7,764 cf	**ADS_StormTech SC-740 +Cap** x 169 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 13 Rows of 13 Chambers
		13,175 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	422.00'	**24.0" Round Culvert** L= 79.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 421.00' / 422.00' S= -0.0127 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf
#2	Device 1	422.75'	**24.0" W x 6.0" H Vert. Orifice/Grate** C= 0.600
#3	Device 1	424.20'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=7.94 cfs @ 12.21 hrs HW=424.49' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Passes 7.94 cfs of 14.60 cfs potential flow)
  └─**2=Orifice/Grate** (Orifice Controls 5.88 cfs @ 5.88 fps)
  └─**3=Sharp-Crested Rectangular Weir** (Weir Controls 2.06 cfs @ 1.78 fps)

Summary for Pond UG-C: UG System C

Inflow Area = 0.422 ac, 87.88% Impervious, Inflow Depth = 3.92" for 10-yr event
Inflow = 1.75 cfs @ 12.09 hrs, Volume= 0.138 af
Outflow = 0.72 cfs @ 12.32 hrs, Volume= 0.065 af, Atten= 59%, Lag= 13.8 min
Primary = 0.72 cfs @ 12.32 hrs, Volume= 0.065 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 440.15' @ 12.32 hrs Surf.Area= 1,889 sf Storage= 3,338 cf

Plug-Flow detention time= 258.0 min calculated for 0.065 af (47% of inflow)
Center-of-Mass det. time= 135.6 min (906.6 - 771.1)

Volume	Invert	Avail.Storage	Storage Description
#1A	437.50'	1,726 cf	**25.25'W x 74.82'L x 3.50'H Field A** 6,612 cf Overall - 2,297 cf Embedded = 4,315 cf x 40.0% Voids
#2A	438.00'	2,297 cf	**ADS_StormTech SC-740 +Cap** x 50 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 5 Rows of 10 Chambers
		4,023 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	438.00'	**12.0" Round Culvert** L= 165.0' CPP, projecting, no headwall, Ke= 0.900

Inlet / Outlet Invert= 438.00' / 434.00' S= 0.0242 '/' Cc= 0.900
n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.79 sf

#2	Device 1	440.00'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=0.70 cfs @ 12.32 hrs HW=440.14' TW=428.12' (Dynamic Tailwater)
1=Culvert (Passes 0.70 cfs of 3.83 cfs potential flow)
2=Sharp-Crested Rectangular Weir (Weir Controls 0.70 cfs @ 1.23 fps)

Summary for Subcatchment P1a: Piped to Ex. Basin

Runoff = 0.48 cfs @ 12.09 hrs, Volume= 0.037 af, Depth= 4.38"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-yr Rainfall=5.30"

Area (sf)	CN	Description
1,088	74	>75% Grass cover, Good, HSG C
3,292	98	Paved parking, HSG C
4,380	92	Weighted Average
1,088		24.84% Pervious Area
3,292		75.16% Impervious Area

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

Summary for Subcatchment P1b: Piped to Ex. Basin

Runoff = 3.93 cfs @ 12.09 hrs, Volume= 0.317 af, Depth= 4.83"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-yr Rainfall=5.30"

Area (sf)	CN	Description
2,455	74	>75% Grass cover, Good, HSG C
31,815	98	Paved parking, HSG C
34,270	96	Weighted Average
2,455		7.16% Pervious Area
31,815		92.84% Impervious Area

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

Summary for Subcatchment P1c: Overland to Ex. Basin

Runoff = 0.88 cfs @ 12.09 hrs, Volume= 0.064 af, Depth= 3.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-yr Rainfall=5.30"

	Area (sf)	CN	Description
	2,797	98	Water Surface, 0% imp, HSG C
	5,933	74	>75% Grass cover, Good, HSG C
*	1,031	98	Rock Slope, HSG C
	9,761	83	Weighted Average
	8,730		89.44% Pervious Area
	1,031		10.56% Impervious Area

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

Summary for Subcatchment P1d: Overland to River

Runoff = 7.11 cfs @ 12.09 hrs, Volume= 0.517 af, Depth= 3.16"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-yr Rainfall=5.30"

	Area (sf)	CN	Description
	23,532	98	Roofs, HSG C
*	3,309	98	Rock Slope, HSG C
*	6,289	98	Waterway, HSG C
	36,157	65	Brush, Good, HSG C
	13,910	74	>75% Grass cover, Good, HSG C
	2,347	98	Paved parking, HSG C
	85,544	80	Weighted Average
	50,067		58.53% Pervious Area
	35,477		41.47% Impervious Area

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

Summary for Subcatchment P1e: To UG Basin A

Runoff = 6.96 cfs @ 12.09 hrs, Volume= 0.541 af, Depth= 4.49"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-yr Rainfall=5.30"

Area (sf)	CN	Description
13,300	74	>75% Grass cover, Good, HSG C
32,937	98	Paved parking, HSG C
16,692	98	Roofs, HSG C
62,929	93	Weighted Average
13,300		21.13% Pervious Area
49,629		78.87% Impervious Area

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

Summary for Subcatchment P1f: To UG Basin B

Runoff = 8.26 cfs @ 12.09 hrs, Volume= 0.649 af, Depth= 4.60"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-yr Rainfall=5.30"

Area (sf)	CN	Description
11,674	74	>75% Grass cover, Good, HSG C
45,521	98	Paved parking, HSG C
16,507	98	Roofs, HSG C
73,702	94	Weighted Average
11,674		15.84% Pervious Area
62,028		84.16% Impervious Area

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

Summary for Subcatchment P1g: Piped to Ex. Basin

Runoff = 8.69 cfs @ 12.09 hrs, Volume= 0.680 af, Depth= 4.49"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-yr Rainfall=5.30"

Area (sf)	CN	Description
11,465	98	Roofs, HSG C
17,529	74	>75% Grass cover, Good, HSG C
50,108	98	Paved parking, HSG C
79,102	93	Weighted Average
17,529		22.16% Pervious Area
61,573		77.84% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.9	50	0.0300	0.17		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.00"
0.1	27	0.2000	3.13		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.0	289	0.0600	4.97		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.3	162	0.0310	7.99	6.27	**Pipe Channel, 433.5-428.53** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Corrugated PE, smooth interior
6.3	528	Total			

Summary for Subcatchment P1h: Piped to Ex. Basin

Runoff = 2.09 cfs @ 12.09 hrs, Volume= 0.166 af, Depth= 4.72"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-yr Rainfall=5.30"

Area (sf)	CN	Description
2,230	74	>75% Grass cover, Good, HSG C
16,167	98	Paved parking, HSG C
18,397	95	Weighted Average
2,230		12.12% Pervious Area
16,167		87.88% Impervious Area

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

Summary for Subcatchment P2: Overland to Street

Runoff = 0.49 cfs @ 12.09 hrs, Volume= 0.041 af, Depth= 5.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-yr Rainfall=5.30"

Area (ac)	CN	Description
0.097	98	Paved parking, HSG C
0.097		100.00% Impervious Area

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

Summary for Reach PDP1: French River

Inflow Area = 8.450 ac, 70.91% Impervious, Inflow Depth = 3.61" for 25-yr event
Inflow = 29.35 cfs @ 12.16 hrs, Volume= 2.544 af
Outflow = 29.35 cfs @ 12.16 hrs, Volume= 2.544 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Reach PDP2: Ardlock Place

Inflow Area = 0.097 ac,100.00% Impervious, Inflow Depth = 5.06" for 25-yr event
Inflow = 0.49 cfs @ 12.09 hrs, Volume= 0.041 af
Outflow = 0.49 cfs @ 12.09 hrs, Volume= 0.041 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Pond B1: Existing Basin

Inflow Area = 3.350 ac, 78.05% Impervious, Inflow Depth = 4.27" for 25-yr event
Inflow = 14.20 cfs @ 12.10 hrs, Volume= 1.191 af
Outflow = 11.69 cfs @ 12.17 hrs, Volume= 1.174 af, Atten= 18%, Lag= 4.2 min
Discarded = 0.03 cfs @ 12.17 hrs, Volume= 0.127 af
Primary = 11.66 cfs @ 12.17 hrs, Volume= 1.047 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 428.48' @ 12.17 hrs Surf.Area= 4,813 sf Storage= 9,483 cf

Plug-Flow detention time= 190.9 min calculated for 1.173 af (99% of inflow)
Center-of-Mass det. time= 184.0 min (966.3 - 782.3)

Volume	Invert	Avail.Storage	Storage Description
#1	426.00'	17,820 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
426.00	2,797	0	0
427.00	3,644	3,221	3,221
428.00	4,436	4,040	7,261
429.00	5,221	4,829	12,089
430.00	6,240	5,731	17,820

Device	Routing	Invert	Outlet Devices
#1	Discarded	426.00'	**0.270 in/hr Exfiltration over Surface area**
#2	Primary	425.60'	**28.0" Round Culvert** L= 50.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 425.60' / 425.00' S= 0.0120 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 4.28 sf
#3	Device 2	427.30'	**34.0" W x 24.0" H Vert. Orifice/Grate** C= 0.600
#4	Secondary	429.60'	**20.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Discarded OutFlow Max=0.03 cfs @ 12.17 hrs HW=428.47' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=11.47 cfs @ 12.17 hrs HW=428.47' TW=0.00' (Dynamic Tailwater)
↑**2=Culvert** (Passes 11.47 cfs of 21.20 cfs potential flow)
↑**3=Orifice/Grate** (Orifice Controls 11.47 cfs @ 3.47 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=426.00' TW=0.00' (Dynamic Tailwater)
↑**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond UG-A: UG System A

Inflow Area = 1.445 ac, 78.87% Impervious, Inflow Depth = 4.49" for 25-yr event
Inflow = 6.96 cfs @ 12.09 hrs, Volume= 0.541 af
Outflow = 6.55 cfs @ 12.12 hrs, Volume= 0.445 af, Atten= 6%, Lag= 2.1 min
Primary = 6.55 cfs @ 12.12 hrs, Volume= 0.445 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 434.54' @ 12.11 hrs Surf.Area= 2,600 sf Storage= 5,094 cf

Plug-Flow detention time= 121.9 min calculated for 0.445 af (82% of inflow)
Center-of-Mass det. time= 52.0 min (828.6 - 776.6)

Volume	Invert	Avail.Storage	Storage Description
#1A	431.50'	2,354 cf	**34.75'W x 74.82'L x 3.50'H Field A** 9,100 cf Overall - 3,216 cf Embedded = 5,884 cf x 40.0% Voids
#2A	432.00'	3,216 cf	**ADS_StormTech SC-740 +Cap** x 70 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 7 Rows of 10 Chambers
		5,569 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	432.00'	**15.0" Round Culvert** L= 183.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 432.00' / 430.00' S= 0.0109 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf
#2	Device 1	433.85'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=6.42 cfs @ 12.12 hrs HW=434.52' TW=424.62' (Dynamic Tailwater)
↑**1=Culvert** (Inlet Controls 6.42 cfs @ 5.23 fps)
↑**2=Sharp-Crested Rectangular Weir** (Passes 6.42 cfs of 6.95 cfs potential flow)

Summary for Pond UG-B: UG System B

Inflow Area = 3.137 ac, 81.72% Impervious, Inflow Depth = 4.19" for 25-yr event
Inflow = 14.64 cfs @ 12.10 hrs, Volume= 1.094 af
Outflow = 12.32 cfs @ 12.17 hrs, Volume= 0.980 af, Atten= 16%, Lag= 4.2 min
Primary = 12.32 cfs @ 12.17 hrs, Volume= 0.980 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 424.80' @ 12.17 hrs Surf.Area= 6,083 sf Storage= 12,691 cf

Plug-Flow detention time= 102.3 min calculated for 0.980 af (90% of inflow)
Center-of-Mass det. time= 51.3 min (846.3 - 794.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	421.50'	5,411 cf	**63.25'W x 96.18'L x 3.50'H Field A** 21,291 cf Overall - 7,764 cf Embedded = 13,527 cf x 40.0% Voids
#2A	422.00'	7,764 cf	**ADS_StormTech SC-740 +Cap** x 169 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 13 Rows of 13 Chambers
		13,175 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	422.00'	**24.0" Round Culvert** L= 79.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 421.00' / 422.00' S= -0.0127 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf
#2	Device 1	422.75'	**24.0" W x 6.0" H Vert. Orifice/Grate** C= 0.600
#3	Device 1	424.20'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=11.79 cfs @ 12.17 hrs HW=424.76' TW=0.00' (Dynamic Tailwater)
↑**1=Culvert** (Passes 11.79 cfs of 15.87 cfs potential flow)
↑**2=Orifice/Grate** (Orifice Controls 6.39 cfs @ 6.39 fps)
3=Sharp-Crested Rectangular Weir (Weir Controls 5.40 cfs @ 2.46 fps)

Summary for Pond UG-C: UG System C

Inflow Area = 0.422 ac, 87.88% Impervious, Inflow Depth = 4.72" for 25-yr event
Inflow = 2.09 cfs @ 12.09 hrs, Volume= 0.166 af
Outflow = 1.68 cfs @ 12.17 hrs, Volume= 0.093 af, Atten= 19%, Lag= 5.0 min
Primary = 1.68 cfs @ 12.17 hrs, Volume= 0.093 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 440.26' @ 12.17 hrs Surf.Area= 1,889 sf Storage= 3,449 cf

Plug-Flow detention time= 220.3 min calculated for 0.093 af (56% of inflow)
Center-of-Mass det. time= 109.2 min (876.0 - 766.7)

Volume	Invert	Avail.Storage	Storage Description
#1A	437.50'	1,726 cf	**25.25'W x 74.82'L x 3.50'H Field A** 6,612 cf Overall - 2,297 cf Embedded = 4,315 cf x 40.0% Voids
#2A	438.00'	2,297 cf	**ADS_StormTech SC-740 +Cap** x 50 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 5 Rows of 10 Chambers
		4,023 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	438.00'	**12.0" Round Culvert** L= 165.0' CPP, projecting, no headwall, Ke= 0.900

Inlet / Outlet Invert= 438.00' / 434.00' S= 0.0242 '/' Cc= 0.900
n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.79 sf

#2	Device 1	440.00'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=1.51 cfs @ 12.17 hrs HW=440.24' TW=428.47' (Dynamic Tailwater)
↑**1=Culvert** (Passes 1.51 cfs of 3.94 cfs potential flow)
↑**2=Sharp-Crested Rectangular Weir** (Weir Controls 1.51 cfs @ 1.60 fps)

Summary for Subcatchment P1a: Piped to Ex. Basin

Runoff = 0.60 cfs @ 12.09 hrs, Volume= 0.047 af, Depth= 5.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr Rainfall=6.50"

Area (sf)	CN	Description
1,088	74	>75% Grass cover, Good, HSG C
3,292	98	Paved parking, HSG C
4,380	92	Weighted Average
1,088		24.84% Pervious Area
3,292		75.16% Impervious Area

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

Summary for Subcatchment P1b: Piped to Ex. Basin

Runoff = 4.85 cfs @ 12.09 hrs, Volume= 0.395 af, Depth= 6.03"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr Rainfall=6.50"

Area (sf)	CN	Description
2,455	74	>75% Grass cover, Good, HSG C
31,815	98	Paved parking, HSG C
34,270	96	Weighted Average
2,455		7.16% Pervious Area
31,815		92.84% Impervious Area

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

Summary for Subcatchment P1c: Overland to Ex. Basin

Runoff = 1.15 cfs @ 12.09 hrs, Volume= 0.085 af, Depth= 4.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr Rainfall=6.50"

	Area (sf)	CN	Description
	2,797	98	Water Surface, 0% imp, HSG C
	5,933	74	>75% Grass cover, Good, HSG C
*	1,031	98	Rock Slope, HSG C
	9,761	83	Weighted Average
	8,730		89.44% Pervious Area
	1,031		10.56% Impervious Area

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

Summary for Subcatchment P1d: Overland to River

Runoff = 9.48 cfs @ 12.09 hrs, Volume= 0.693 af, Depth= 4.24"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr Rainfall=6.50"

	Area (sf)	CN	Description
	23,532	98	Roofs, HSG C
*	3,309	98	Rock Slope, HSG C
*	6,289	98	Waterway, HSG C
	36,157	65	Brush, Good, HSG C
	13,910	74	>75% Grass cover, Good, HSG C
	2,347	98	Paved parking, HSG C
	85,544	80	Weighted Average
	50,067		58.53% Pervious Area
	35,477		41.47% Impervious Area

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

Summary for Subcatchment P1e: To UG Basin A

Runoff = 8.68 cfs @ 12.09 hrs, Volume= 0.683 af, Depth= 5.68"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr Rainfall=6.50"

Area (sf)	CN	Description
13,300	74	>75% Grass cover, Good, HSG C
32,937	98	Paved parking, HSG C
16,692	98	Roofs, HSG C
62,929	93	Weighted Average
13,300		21.13% Pervious Area
49,629		78.87% Impervious Area

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

Summary for Subcatchment P1f: To UG Basin B

Runoff = 10.26 cfs @ 12.09 hrs, Volume= 0.817 af, Depth= 5.79"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr Rainfall=6.50"

Area (sf)	CN	Description
11,674	74	>75% Grass cover, Good, HSG C
45,521	98	Paved parking, HSG C
16,507	98	Roofs, HSG C
73,702	94	Weighted Average
11,674		15.84% Pervious Area
62,028		84.16% Impervious Area

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

Summary for Subcatchment P1g: Piped to Ex. Basin

Runoff = 10.84 cfs @ 12.09 hrs, Volume= 0.859 af, Depth= 5.68"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr Rainfall=6.50"

Area (sf)	CN	Description
11,465	98	Roofs, HSG C
17,529	74	>75% Grass cover, Good, HSG C
50,108	98	Paved parking, HSG C
79,102	93	Weighted Average
17,529		22.16% Pervious Area
61,573		77.84% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.9	50	0.0300	0.17		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.00"
0.1	27	0.2000	3.13		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.0	289	0.0600	4.97		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.3	162	0.0310	7.99	6.27	**Pipe Channel, 433.5-428.53** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Corrugated PE, smooth interior
6.3	528	Total			

Summary for Subcatchment P1h: Piped to Ex. Basin

Runoff = 2.58 cfs @ 12.09 hrs, Volume= 0.208 af, Depth= 5.91"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr Rainfall=6.50"

Area (sf)	CN	Description
2,230	74	>75% Grass cover, Good, HSG C
16,167	98	Paved parking, HSG C
18,397	95	Weighted Average
2,230		12.12% Pervious Area
16,167		87.88% Impervious Area

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

Summary for Subcatchment P2: Overland to Street

Runoff = 0.60 cfs @ 12.09 hrs, Volume= 0.051 af, Depth= 6.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr Rainfall=6.50"

Area (ac)	CN	Description
0.097	98	Paved parking, HSG C
0.097		100.00% Impervious Area

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

Summary for Reach PDP1: French River

Inflow Area = 8.450 ac, 70.91% Impervious, Inflow Depth = 4.77" for 100-yr event
Inflow = 39.39 cfs @ 12.14 hrs, Volume= 3.359 af
Outflow = 39.39 cfs @ 12.14 hrs, Volume= 3.359 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Reach PDP2: Ardlock Place

Inflow Area = 0.097 ac,100.00% Impervious, Inflow Depth = 6.26" for 100-yr event
Inflow = 0.60 cfs @ 12.09 hrs, Volume= 0.051 af
Outflow = 0.60 cfs @ 12.09 hrs, Volume= 0.051 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Pond B1: Existing Basin

Inflow Area = 3.350 ac, 78.05% Impervious, Inflow Depth = 5.45" for 100-yr event
Inflow = 19.89 cfs @ 12.09 hrs, Volume= 1.521 af
Outflow = 15.95 cfs @ 12.16 hrs, Volume= 1.504 af, Atten= 20%, Lag= 4.0 min
Discarded = 0.03 cfs @ 12.16 hrs, Volume= 0.128 af
Primary = 15.91 cfs @ 12.16 hrs, Volume= 1.376 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 428.75' @ 12.16 hrs Surf.Area= 5,026 sf Storage= 10,819 cf

Plug-Flow detention time= 156.2 min calculated for 1.504 af (99% of inflow)
Center-of-Mass det. time= 149.1 min (925.5 - 776.4)

Volume	Invert	Avail.Storage	Storage Description
#1	426.00'	17,820 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
426.00	2,797	0	0
427.00	3,644	3,221	3,221
428.00	4,436	4,040	7,261
429.00	5,221	4,829	12,089
430.00	6,240	5,731	17,820

Device	Routing	Invert	Outlet Devices
#1	Discarded	426.00'	**0.270 in/hr Exfiltration over Surface area**
#2	Primary	425.60'	**28.0" Round Culvert** L= 50.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 425.60' / 425.00' S= 0.0120 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 4.28 sf
#3	Device 2	427.30'	**34.0" W x 24.0" H Vert. Orifice/Grate** C= 0.600
#4	Secondary	429.60'	**20.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Discarded OutFlow Max=0.03 cfs @ 12.16 hrs HW=428.74' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=15.73 cfs @ 12.16 hrs HW=428.74' TW=0.00' (Dynamic Tailwater)
2=Culvert (Passes 15.73 cfs of 22.84 cfs potential flow)
3=Orifice/Grate (Orifice Controls 15.73 cfs @ 3.85 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=426.00' TW=0.00' (Dynamic Tailwater)
4=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond UG-A: UG System A

Inflow Area = 1.445 ac, 78.87% Impervious, Inflow Depth = 5.68" for 100-yr event
Inflow = 8.68 cfs @ 12.09 hrs, Volume= 0.683 af
Outflow = 7.12 cfs @ 12.14 hrs, Volume= 0.588 af, Atten= 18%, Lag= 3.4 min
Primary = 7.12 cfs @ 12.14 hrs, Volume= 0.588 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 434.96' @ 12.14 hrs Surf.Area= 2,600 sf Storage= 5,525 cf

Plug-Flow detention time= 108.7 min calculated for 0.588 af (86% of inflow)
Center-of-Mass det. time= 47.2 min (818.0 - 770.8)

Volume	Invert	Avail.Storage	Storage Description
#1A	431.50'	2,354 cf	**34.75'W x 74.82'L x 3.50'H Field A** 9,100 cf Overall - 3,216 cf Embedded = 5,884 cf x 40.0% Voids
#2A	432.00'	3,216 cf	**ADS_StormTech SC-740 +Cap** x 70 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 7 Rows of 10 Chambers
		5,569 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	432.00'	**15.0" Round Culvert** L= 183.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 432.00' / 430.00' S= 0.0109 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf
#2	Device 1	433.85'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=7.10 cfs @ 12.14 hrs HW=434.94' TW=424.99' (Dynamic Tailwater)
↑**1=Culvert** (Inlet Controls 7.10 cfs @ 5.79 fps)
↑**2=Sharp-Crested Rectangular Weir** (Passes 7.10 cfs of 14.09 cfs potential flow)

Summary for Pond UG-B: UG System B

Inflow Area = 3.137 ac, 81.72% Impervious, Inflow Depth = 5.37" for 100-yr event
Inflow = 17.14 cfs @ 12.09 hrs, Volume= 1.404 af
Outflow = 15.75 cfs @ 12.15 hrs, Volume= 1.290 af, Atten= 8%, Lag= 3.4 min
Primary = 15.75 cfs @ 12.15 hrs, Volume= 1.290 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 425.00' @ 12.15 hrs Surf.Area= 6,083 sf Storage= 13,169 cf

Plug-Flow detention time= 87.3 min calculated for 1.289 af (92% of inflow)
Center-of-Mass det. time= 46.0 min (834.0 - 788.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	421.50'	5,411 cf	**63.25'W x 96.18'L x 3.50'H Field A** 21,291 cf Overall - 7,764 cf Embedded = 13,527 cf x 40.0% Voids
#2A	422.00'	7,764 cf	**ADS_StormTech SC-740 +Cap** x 169 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 13 Rows of 13 Chambers
		13,175 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	422.00'	**24.0" Round Culvert** L= 79.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 421.00' / 422.00' S= -0.0127 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf
#2	Device 1	422.75'	**24.0" W x 6.0" H Vert. Orifice/Grate** C= 0.600
#3	Device 1	424.20'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=15.74 cfs @ 12.15 hrs HW=425.00' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Passes 15.74 cfs of 16.88 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 6.80 cfs @ 6.80 fps)
  └─**3=Sharp-Crested Rectangular Weir** (Weir Controls 8.94 cfs @ 2.92 fps)

Summary for Pond UG-C: UG System C

Inflow Area = 0.422 ac, 87.88% Impervious, Inflow Depth = 5.91" for 100-yr event
Inflow = 2.58 cfs @ 12.09 hrs, Volume= 0.208 af
Outflow = 2.52 cfs @ 12.11 hrs, Volume= 0.135 af, Atten= 2%, Lag= 1.5 min
Primary = 2.52 cfs @ 12.11 hrs, Volume= 0.135 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 440.34' @ 12.11 hrs Surf.Area= 1,889 sf Storage= 3,516 cf

Plug-Flow detention time= 190.3 min calculated for 0.135 af (65% of inflow)
Center-of-Mass det. time= 90.8 min (852.5 - 761.7)

Volume	Invert	Avail.Storage	Storage Description
#1A	437.50'	1,726 cf	**25.25'W x 74.82'L x 3.50'H Field A** 6,612 cf Overall - 2,297 cf Embedded = 4,315 cf x 40.0% Voids
#2A	438.00'	2,297 cf	**ADS_StormTech SC-740 +Cap** x 50 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 5 Rows of 10 Chambers
		4,023 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	438.00'	**12.0" Round Culvert** L= 165.0' CPP, projecting, no headwall, Ke= 0.900

Inlet / Outlet Invert= 438.00' / 434.00' S= 0.0242 '/' Cc= 0.900
n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.79 sf

#2	Device 1	440.00'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=2.45 cfs @ 12.11 hrs HW=440.33' TW=428.67' (Dynamic Tailwater)
1=Culvert (Passes 2.45 cfs of 4.04 cfs potential flow)
2=Sharp-Crested Rectangular Weir (Weir Controls 2.45 cfs @ 1.88 fps)

APPENDIX F: STORMWATER CALCULATIONS

- *TP40 RAINFALL DATA*
- *MA STANDARD #3 – RECHARGE AND DRAWDOWN TIME*
- *MA STANDARD #4 – WATER QUALITY AND TSS REMOVAL*

Stage-Area-Storage for Pond B1: Existing Basin (continued)

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
427.06	3,692	3,441
427.07	3,699	3,478
427.08	3,707	3,515
427.09	3,715	3,552
427.10	3,723	3,589
427.11	3,731	3,626
427.12	3,739	3,663
427.13	3,747	3,701
427.14	3,755	3,738
427.15	3,763	3,776
427.16	3,771	3,814
427.17	3,779	3,851
427.18	3,787	3,889
427.19	3,794	3,927
427.20	3,802	3,965
427.21	3,810	4,003
427.22	3,818	4,041
427.23	3,826	4,080
427.24	3,834	4,118
427.25	3,842	4,156
427.26	3,850	4,195
427.27	3,858	4,233
427.28	3,866	4,272
427.29	3,874	4,311
427.30	3,882	4,349
427.31	3,890	4,388
427.32	3,897	4,427
427.33	3,905	4,466
427.34	3,913	4,505
427.35	3,921	4,544
427.36	3,929	4,584
427.37	3,937	4,623
427.38	3,945	4,662
427.39	3,953	4,702
427.40	3,961	4,741
427.41	3,969	4,781
427.42	3,977	4,821
427.43	3,985	4,861
427.44	3,992	4,901
427.45	4,000	4,940
427.46	4,008	4,981
427.47	4,016	5,021
427.48	4,024	5,061
427.49	4,032	5,101
427.50	4,040	5,142
427.51	4,048	5,182
427.52	4,056	5,222
427.53	4,064	5,263
427.54	4,072	5,304
427.55	4,080	5,344
427.56	4,088	5,385
427.57	4,095	5,426
427.58	4,103	5,467
427.59	4,111	5,508
427.60	4,119	5,549
427.61	4,127	5,591
427.62	4,135	5,632
427.63	4,143	5,673
427.64	4,151	5,715
427.65	4,159	5,756
427.66	4,167	5,798
427.67	4,175	5,840
427.68	4,183	5,882
427.69	4,190	5,923
427.70	4,198	5,965
427.71	4,206	6,007
427.72	4,214	6,049
427.73	4,222	6,092
427.74	4,230	6,134
427.75	4,238	6,176
427.76	4,246	6,219
427.77	4,254	6,261
427.78	4,262	6,304
427.79	4,270	6,346
427.80	4,278	6,389
427.81	4,286	6,432
427.82	4,293	6,475
427.83	4,301	6,518
427.84	4,309	6,561
427.85	4,317	6,604
427.86	4,325	6,647
427.87	4,333	6,691
427.88	4,341	6,734
427.89	4,349	6,777
427.90	4,357	6,821
427.91	4,365	6,864
427.92	4,373	6,908
427.93	4,381	6,952
427.94	4,388	6,996
427.95	4,396	7,040
427.96	4,404	7,084
427.97	4,412	7,128
427.98	4,420	7,172
427.99	4,428	7,216
428.00	4,436	7,261
428.01	4,444	7,305
428.02	4,452	7,349
428.03	4,460	7,394
428.04	4,467	7,439
428.05	4,475	7,483
428.06	4,483	7,528
428.07	4,491	7,573
428.08	4,499	7,618
428.09	4,507	7,663
428.10	4,515	7,708
428.11	4,522	7,753

Stage-Area-Storage for Pond UG-A: UG System A (continued)

Elevation (feet)	Storage (cubic-feet)	Elevation (feet)	Storage (cubic-feet)	Elevation (feet)	Storage (cubic-feet)
433.09	2,783	433.62	3,775	434.15	4,632
433.10	2,803	433.63	3,793	434.16	4,646
433.11	2,822	433.64	3,811	434.17	4,660
433.12	2,842	433.65	3,828	434.18	4,674
433.13	2,861	433.66	3,846	434.19	4,687
433.14	2,881	433.67	3,863	434.20	4,701
433.15	2,900	433.68	3,881	434.21	4,714
433.16	2,920	433.69	3,898	434.22	4,727
433.17	2,939	433.70	3,915	434.23	4,740
433.18	2,958	433.71	3,933	434.24	4,753
433.19	2,978	433.72	3,950	434.25	4,766
433.20	2,997	433.73	3,967	434.26	4,778
433.21	3,016	433.74	3,984	434.27	4,791
433.22	3,035	433.75	4,001	434.28	4,803
433.23	3,054	433.76	4,018	434.29	4,815
433.24	3,074	433.77	4,035	434.30	4,827
433.25	3,093	433.78	4,052	434.31	4,839
433.26	3,112	433.79	4,069	434.32	4,851
433.27	3,131	433.80	4,085	434.33	4,863
433.28	3,150	433.81	4,102	434.34	4,874
433.29	3,169	433.82	4,119	434.35	4,886
433.30	3,188	433.83	4,135	434.36	4,897
433.31	3,207	433.84	4,152	434.37	4,908
433.32	3,226	433.85	4,168	434.38	4,920
433.33	3,244	433.86	4,185	434.39	4,931
433.34	3,263	433.87	4,201	434.40	4,942
433.35	3,282	433.88	4,218	434.41	4,953
433.36	3,301	433.89	4,234	434.42	4,964
433.37	3,320	433.90	4,250	434.43	4,975
433.38	3,338	433.91	4,266	434.44	4,986
433.39	3,357	433.92	4,282	434.45	4,996
433.40	3,375	433.93	4,298	434.46	5,007
433.41	3,394	433.94	4,314	434.47	5,018
433.42	3,413	433.95	4,330	434.48	5,028
433.43	3,431	433.96	4,346	434.49	5,039
433.44	3,450	433.97	4,362	434.50	5,049
433.45	3,468	433.98	4,378	434.51	5,060
433.46	3,486	433.99	4,393	434.52	5,070
433.47	3,505	434.00	4,409	434.53	5,081
433.48	3,523	434.01	4,424	434.54	5,091
433.49	3,541	434.02	4,440	434.55	5,101
433.50	3,560	434.03	4,455	434.56	5,112
433.51	3,578	434.04	4,470	434.57	5,122
433.52	3,596	434.05	4,485	434.58	5,133
433.53	3,614	434.06	4,500	434.59	5,143
433.54	3,632	434.07	4,515	434.60	5,153
433.55	3,650	434.08	4,530	434.61	5,164
433.56	3,668	434.09	4,545	434.62	5,174
433.57	3,686	434.10	4,560	434.63	5,185
433.58	3,704	434.11	4,574	434.64	5,195
433.59	3,722	434.12	4,589	434.65	5,205
433.60	3,740	434.13	4,603	434.66	5,216
433.61	3,758	434.14	4,617	434.67	5,226

Stage-Area-Storage for Pond UG-B: UG System B

Elevation (feet)	Storage (cubic-feet)	Elevation (feet)	Storage (cubic-feet)	Elevation (feet)	Storage (cubic-feet)
421.50	0	422.03	1,370	422.56	4,046
421.51	24	422.04	1,421	422.57	4,096
421.52	49	422.05	1,473	422.58	4,145
421.53	73	422.06	1,524	422.59	4,194
421.54	97	422.07	1,575	422.60	4,244
421.55	122	422.08	1,626	422.61	4,293
421.56	146	422.09	1,677	422.62	4,342
421.57	170	422.10	1,728	422.63	4,391
421.58	195	422.11	1,779	422.64	4,441
421.59	219	422.12	1,830	422.65	4,490
421.60	243	422.13	1,881	422.66	4,539
421.61	268	422.14	1,933	422.67	4,588
421.62	292	422.15	1,984	422.68	4,637
421.63	316	422.16	2,035	422.69	4,686
421.64	341	422.17	2,086	422.70	4,734
421.65	365	422.18	2,136	422.71	4,783
421.66	389	422.19	2,187	422.72	4,832
421.67	414	422.20	2,238	422.73	4,881
421.68	438	422.21	2,289	422.74	4,929
421.69	462	422.22	2,340	422.75	4,978
421.70	487	422.23	2,391	422.76	5,026
421.71	511	422.24	2,442	422.77	5,075
421.72	535	422.25	2,492	422.78	5,123
421.73	560	422.26	2,543	422.79	5,171
421.74	584	422.27	2,594	422.80	5,220
421.75	608	422.28	2,644	422.81	5,268
421.76	633	422.29	2,695	422.82	5,316
421.77	657	422.30	2,745	422.83	5,364
421.78	681	422.31	2,796	422.84	5,413
421.79	706	422.32	2,846	422.85	5,461
421.80	730	422.33	2,897	422.86	5,509
421.81	754	422.34	2,947	422.87	5,557
421.82	779	422.35	2,998	422.88	5,604
421.83	803	422.36	3,048	422.89	5,652
421.84	827	422.37	3,098	422.90	5,700
421.85	852	422.38	3,148	422.91	5,748
421.86	876	422.39	3,199	422.92	5,795
421.87	900	422.40	3,249	422.93	5,843
421.88	925	422.41	3,299	422.94	5,890
421.89	949	422.42	3,349	422.95	5,938
421.90	973	422.43	3,399	422.96	5,985
421.91	998	422.44	3,449	422.97	6,033
421.92	1,022	422.45	3,499	422.98	6,080
421.93	1,046	422.46	3,549	422.99	6,127
421.94	1,071	422.47	3,599	423.00	6,174
421.95	1,095	422.48	3,649	423.01	6,222
421.96	1,119	422.49	3,699	423.02	6,269
421.97	1,144	422.50	3,749	423.03	6,316
421.98	1,168	422.51	3,798	423.04	6,363
421.99	1,192	422.52	3,848	423.05	6,409
422.00	1,217	422.53	3,898	423.06	6,456
422.01	1,268	422.54	3,947	423.07	6,503
422.02	1,319	422.55	3,997	423.08	6,550

Stage-Area-Storage for Pond UG-C: UG System C (continued)

Elevation (feet)	Storage (cubic-feet)	Elevation (feet)	Storage (cubic-feet)	Elevation (feet)	Storage (cubic-feet)
439.09	3,171	439.62	4,301	440.15	5,276
439.10	3,193	439.63	4,321	440.16	5,292
439.11	3,215	439.64	4,341	440.17	5,308
439.12	3,237	439.65	4,361	440.18	5,324
439.13	3,260	439.66	4,381	440.19	5,340
439.14	3,282	439.67	4,401	440.20	5,355
439.15	3,304	439.68	4,421	440.21	5,370
439.16	3,326	439.69	4,441	440.22	5,385
439.17	3,348	439.70	4,461	440.23	5,400
439.18	3,370	439.71	4,480	440.24	5,415
439.19	3,392	439.72	4,500	440.25	5,429
439.20	3,414	439.73	4,519	440.26	5,443
439.21	3,436	439.74	4,539	440.27	5,458
439.22	3,458	439.75	4,558	440.28	5,472
439.23	3,480	439.76	4,578	440.29	5,485
439.24	3,502	439.77	4,597	440.30	5,499
439.25	3,523	439.78	4,616	440.31	5,513
439.26	3,545	439.79	4,635	440.32	5,526
439.27	3,567	439.80	4,654	440.33	5,539
439.28	3,588	439.81	4,673	440.34	5,552
439.29	3,610	439.82	4,692	440.35	5,565
439.30	3,632	439.83	4,711	440.36	5,578
439.31	3,653	439.84	4,730	440.37	5,591
439.32	3,675	439.85	4,749	440.38	5,604
439.33	3,696	439.86	4,768	440.39	5,617
439.34	3,718	439.87	4,786	440.40	5,629
439.35	3,739	439.88	4,805	440.41	5,642
439.36	3,760	439.89	4,823	440.42	5,654
439.37	3,782	439.90	4,842	440.43	5,667
439.38	3,803	439.91	4,860	440.44	5,679
439.39	3,824	439.92	4,879	440.45	5,691
439.40	3,846	439.93	4,897	440.46	5,703
439.41	3,867	439.94	4,915	440.47	5,716
439.42	3,888	439.95	4,933	440.48	5,728
439.43	3,909	439.96	4,951	440.49	5,740
439.44	3,930	439.97	4,969	440.50	5,751
439.45	3,951	439.98	4,987	440.51	5,763
439.46	3,972	439.99	5,005	440.52	5,775
439.47	3,993	440.00	5,022	440.53	5,787
439.48	4,014	440.01	5,040	440.54	5,799
439.49	4,034	440.02	5,058	440.55	5,811
439.50	4,055	440.03	5,075	440.56	5,822
439.51	4,076	440.04	5,092	440.57	5,834
439.52	4,097	440.05	5,110	440.58	5,846
439.53	4,117	440.06	5,127	440.59	5,858
439.54	4,138	440.07	5,144	440.60	5,870
439.55	4,158	440.08	5,161	440.61	5,881
439.56	4,179	440.09	5,178	440.62	5,893
439.57	4,199	440.10	5,194	440.63	5,905
439.58	4,220	440.11	5,211	440.64	5,917
439.59	4,240	440.12	5,228	440.65	5,929
439.60	4,261	440.13	5,244	440.66	5,941
439.61	4,281	440.14	5,260	440.67	5,952

Mill Redevelopment Project
8 Mill Street
Dudley, MA
Bohler Job Number: W211100
April 13, 2021

MA DEP Standard 3: Drawdown Time Calculations

Drawdown Time - Existing Basin (B1)	
Volume below outlet pipe (Rv) (cf)	4,349
Soil Type	Silt Loam - C
Infiltration rate (K)*	0.27
Bottom Area (sf)	2,797
Drawdown time (Hours)*	69.1

Prepared By:
Bohler Engineering
352 Turnpike Road
Southborough, MA 01772
(508) 480-9900

Mill Redevelopment Project
8 Mill Street
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April 13, 2021

MA DEP Standard 4: Water Quality Volume Calculations

Water Quality Volume Required	
Water Quality Volume runoff (in.)*	1.0
Total Post Development Impervious Area (sf)	160,384
Required Water Quality Volume (cf)	13,365

*Water Quality volume runoff is equal to 1.0 inches of runoff times the total impervious area of the post development project site, excluding offsite areas.

Water Quality Volume Provided*	
Existing Basin (B1)	4,349
Underground System (UG-A)	4,168
Underground System (UG-B)	4,978
Underground System (UG-C)	5,022
Total Provided Water Quality Volume (cf)	18,517

Provided greater than or Equal to Required

*Volume provided below lowest outlet pipe in cubic feet (cf)

Prepared By:
Bohler Engineering
352 Turnpike Road
Southborough, MA 01772
(508) 480-9900

Available Models

CDS Model	Treatment Capacity[3] (cfs)	Maximum Sediment Storage Capacity (CF)
1515	1.0	26
w/ 1' added sump	1.0	33
w/ 2' added sump	1.0	40
w/ 3' added sump	1.0	47
2015_4	1.4	50
w/ 1' added sump	1.4	63
w/ 2' added sump	1.4	75
w/ 3' added sump	1.4	88
2015	1.4	79
w/ 1' added sump	1.4	98
w/ 2' added sump	1.4	118
2020	2.2	90
w/ 1' added sump	2.2	110
w/ 2' added sump	2.2	129
2025	3.2	97
w/ 1' added sump	3.2	117
w/ 2' added sump	3.2	136
3020	3.9	134
w/ 1' added sump	3.9	163
w/ 2' added sump	3.9	191
3030	6.1	157
w/ 1' added sump	6.1	185
w/ 2' added sump	6.1	213
4030	7.9	329
w/ 1' added sump	7.9	379
w/ 2' added sump	7.9	429
4040	12.4	381
w/ 1' added sump	12.4	431
w/ 2' added sump	12.4	482

1. Structure diameter represents the typical inside dimension of the concrete structure. Offline systems will require additional concrete diversion components
2. Depth below pipe can vary to accommodate site specific design. Depth below pipe invert represents the depth from the pipe invert to the inside bottom of concrete structure.
3. Treatment Capacity is based on laboratory testing using OK-110 (average d50 particle size of approximately 100 microns) and a 2400 micron screen.

Sediment Depths Indicating Required Servicing*			
CDS Model	Standard Sediment Depth (in.)	w/ 1' added Sump Sediment Depth (in.)	w/ 2' added Sump Sediment Depth (in.)
1515	18	27	36
2015_4	18	30	42
2015	18	30	42
2020	18	30	42
2025	18	30	42
3020	18	30	42
3030	18	39	42
4030	27	39	51
4040	27	39	51

* Based on 75% capacity of isolated sump.

TSS Removal Calculation Worksheet

Location: Pretreatment to Surface Infiltration Basin (B1)

A BMP[1]	B TSS Removal Rate[1]	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
Deep Sump and Hooded Catch Basins	**0.25**	**1.00**	**0.25**	**0.75**
Proprietary Water Quality Structure	**0.80**	**0.75**	**0.60**	**0.15**

Total TSS Removal = **85%**

Project: **W211100**

Prepared By: **Bohler Engineering**

Date: **10/13/2021**

*Equals remaining load from previous BMP (E) which enters the BMP

Prepared By:
Bohler Engineering
352 Turnpike Road
Southborough, MA 01772
(508) 480-9900

F-1. Rainfall Data for Massachusetts from *Rainfall Frequency Atlas of the United States* (TP-40)

- Users of this Handbook should note that current MA DEP written guidance (see DEP Waterlines newsletter -- Fall 2000) requires the use of TP-40 Rainfall Data for calculations under the Wetlands Protection Regulations and the Stormwater Management Policy. More stringent design storms may be used under a local bylaw or ordinance. However, DEP will continue to require the use of TP-40 in any case it reviews under the Wetlands Protection Act and Stormwater Management Policy.

Adjusted Technical Paper 40 Design Storms for 24-hour Event by County

County Name	1-yr 24-hr	2-yr 24-hr	5-yr 24-hr	10-yr 24-hr	25-yr 24-hr	50-yr 24-hr	100-yr 24-hr
Barnstable	2.5	3.6	4.5	4.8	5.7	6.4	7.1
Berkshire	2.5	2.9	3.8	4.4	5.1	5.9	6.4
Bristol	2.5	3.4	4.3	4.8	5.6	6.3	7.0
Dukes	2.5	3.6	4.6	4.9	5.8	6.5	7.2
Essex	2.5	3.1	3.9	4.5	5.4	5.9	6.5
Franklin	2.5	2.9	3.8	4.3	5.1	5.8	6.2
Hampden	2.5	3.0	4.0	4.6	5.3	6.0	6.5
Hampshire	2.5	3.0	3.9	4.5	5.2	5.9	6.4
Middlesex	2.5	3.1	4.0	4.5	5.3	5.9	6.5
Nantucket	2.5	3.6	4.6	4.9	5.8	6.5	7.2
Norfolk	2.5	3.2	4.1	4.7	5.5	6.1	6.7
Plymouth	2.5	3.4	4.3	4.7	5.6	6.2	7.0
Suffolk	2.5	3.2	4.0	4.6	5.5	6.0	6.6
Worcester	2.5	3.0	4.0	4.5	5.3	5.9	6.5

Mill Redevelopment Project
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April 13, 2021

MA DEP Standard 3: Recharge Volume Calculations

Required Recharge Volume - A Soils (0.60 in.)	
Existing Site Impervious Area (ac)	0.000
Proposed Site Impervious Area (ac)	0.000
Proposed Increase in Site Impervious Area (ac)	0.000
Recharge Volume Required (cf)	**0**

Required Recharge Volume - B Soils (0.35 in.)	
Existing Site Impervious Area (ac)	0.000
Proposed Site Impervious Area (ac)	0.000
Proposed Increase in Site Impervious Area (ac)	0.000
Recharge Volume Required (cf)	**0**

Required Recharge Volume - C Soils (0.25 in.)	
Existing Site Impervious Area (ac)	3.552
Proposed Site Impervious Area (ac)	4.676
Proposed Increase in Site Impervious Area (ac)	1.124
Recharge Volume Required (cf)	**1,020**

Required Recharge Volume - D Soils (0.10 in.)	
Existing Site Impervious Area (ac)	0.000
Proposed Site Impervious Area (ac)	0.000
Proposed Increase in Site Impervious Area (ac)	0.000
Recharge Volume Required (cf)	**0**

Total Recharge Volume Required (cf)	**1,020**

Recharge Volume Adjustment Factor	
Impervious Area Directed to Infiltration BMP (ac)	**2.610**
%Impervious Directed to Infiltration BMP	56%
Adjustment Factor	1.79
Adjusted Total Recharge Volume Required (cf)	**1,827**

Provided Recharge Volume*	
Existing Basin (B1)	4,349
Total Recharge Volume Provided (cf)	**4,349**

Provided greater than or Equal to Required

*Volume provided below lowest outlet in cubic feet (cf)

Prepared By:
Bohler Engineering
352 Turnpike Road
Southborough, MA 01772
(508) 480-9900

APPENDIX G: OPERATION AND MAINTENANCE

- *STORMWATER OPERATION AND MAINTENANCE PLAN*
- *INSPECTION REPORT*
- *INSPECTION AND MAINTENANCE LOG FORM*
- *LONG-TERM POLLUTION PREVENTION PLAN*
- *ILLICIT DISCHARGE STATEMENT*
- *SPILL PREVENTION*
- *PROPOSED OPERATION AND MAINTENANCE MAP*
- *MANUFACTURER'S INSPECTION AND MAINTENANCE MANUALS*

CONTECH®
ENGINEERED SOLUTIONS

CDS® Inspection and Maintenance Guide

CDS TECHNOLOGIES

Maintenance

The CDS system should be inspected at regular intervals and maintained when necessary to ensure optimum performance. The rate at which the system collects pollutants will depend more heavily on site activities than the size of the unit. For example, unstable soils or heavy winter sanding will cause the grit chamber to fill more quickly but regular sweeping of paved surfaces will slow accumulation.

Inspection

Inspection is the key to effective maintenance and is easily performed. Pollutant transport and deposition may vary from year to year and regular inspections will help ensure that the system is cleaned out at the appropriate time. At a minimum, inspections should be performed twice per year (e.g. spring and fall) however more frequent inspections may be necessary in climates where winter sanding operations may lead to rapid accumulations, or in equipment washdown areas. Installations should also be inspected more frequently where excessive amounts of trash are expected.

The visual inspection should ascertain that the system components are in working order and that there are no blockages or obstructions in the inlet and separation screen. The inspection should also quantify the accumulation of hydrocarbons, trash, and sediment in the system. Measuring pollutant accumulation can be done with a calibrated dipstick, tape measure or other measuring instrument. If absorbent material is used for enhanced removal of hydrocarbons, the level of discoloration of the sorbent material should also be identified during inspection. It is useful and often required as part of an operating permit to keep a record of each inspection. A simple form for doing so is provided.

Access to the CDS unit is typically achieved through two manhole access covers. One opening allows for inspection and cleanout of the separation chamber (cylinder and screen) and isolated sump. The other allows for inspection and cleanout of sediment captured and retained outside the screen. For deep units, a single manhole access point would allows both sump cleanout and access outside the screen.

The CDS system should be cleaned when the level of sediment has reached 75% of capacity in the isolated sump or when an appreciable level of hydrocarbons and trash has accumulated. If absorbent material is used, it should be replaced when significant discoloration has occurred. Performance will not be impacted until 100% of the sump capacity is exceeded however it is recommended that the system be cleaned prior to that for easier removal of sediment. The level of sediment is easily determined by measuring from finished grade down to the top of the sediment pile. To avoid underestimating the level of sediment in the chamber, the measuring device must be lowered to the top of the sediment pile carefully. Particles at the top of the pile typically offer less resistance to the end of the rod than consolidated particles toward the bottom of the pile. Once this measurement is recorded, it should be compared to the as-built drawing for the unit to determine weather the height of the sediment pile off the bottom of the sump floor exceeds 75% of the total height of isolated sump.

Cleaning

Cleaning of a CDS systems should be done during dry weather conditions when no flow is entering the system. The use of a vacuum truck is generally the most effective and convenient method of removing pollutants from the system. Simply remove the manhole covers and insert the vacuum hose into the sump. The system should be completely drained down and the sump fully evacuated of sediment. The area outside the screen should also be cleaned out if pollutant build-up exists in this area.

In installations where the risk of petroleum spills is small, liquid contaminants may not accumulate as quickly as sediment. However, the system should be cleaned out immediately in the event of an oil or gasoline spill should be cleaned out immediately. Motor oil and other hydrocarbons that accumulate on a more routine basis should be removed when an appreciable layer has been captured. To remove these pollutants, it may be preferable to use absorbent pads since they are usually less expensive to dispose than the oil/water emulsion that may be created by vacuuming the oily layer. Trash and debris can be netted out to separate it from the other pollutants. The screen should be power washed to ensure it is free of trash and debris.

Manhole covers should be securely seated following cleaning activities to prevent leakage of runoff into the system from above and also to ensure that proper safety precautions have been followed. Confined space entry procedures need to be followed if physical access is required. Disposal of all material removed from the CDS system should be done in accordance with local regulations. In many jurisdictions, disposal of the sediments may be handled in the same manner as the disposal of sediments removed from catch basins or deep sump manholes.

CDS Model	Diameter		Distance from Water Surface to Top of Sediment Pile		Sediment Storage Capacity	
	ft	m	ft	m	y^3	m^3
CDS1515	3	0.9	3.0	0.9	0.5	0.4
CDS2015	4	1.2	3.0	0.9	0.9	0.7
CDS2015	5	1.3	3.0	0.9	1.3	1.0
CDS2020	5	1.3	3.5	1.1	1.3	1.0
CDS2025	5	1.3	4.0	1.2	1.3	1.0
CDS3020	6	1.8	4.0	1.2	2.1	1.6
CDS3025	6	1.8	4.0	1.2	2.1	1.6
CDS3030	6	1.8	4.6	1.4	2.1	1.6
CDS3035	6	1.8	5.0	1.5	2.1	1.6
CDS4030	8	2.4	4.6	1.4	5.6	4.3
CDS4040	8	2.4	5.7	1.7	5.6	4.3
CDS4045	8	2.4	6.2	1.9	5.6	4.3
CDS5640	10	3.0	6.3	1.9	8.7	6.7
CDS5653	10	3.0	7.7	2.3	8.7	6.7
CDS5668	10	3.0	9.3	2.8	8.7	6.7
CDS5678	10	3.0	10.3	3.1	8.7	6.7

Table 1: CDS Maintenance Indicators and Sediment Storage Capacities

Support

- Drawings and specifications are available at www.contechstormwater.com.
- Site-specific design support is available from our engineers.

Contech Engineered Solutions LLC provides site solutions for the civil engineering industry. Contech's portfolio includes bridges, drainage, sanitary sewer, stormwater, earth stabilization and wastewater treament products. For information, visit www.ContechES.com or call 800.338.1122

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CDS Inspection & Maintenance Log

CDS Model: _____ Location: _____

Date	Water depth to sediment[1]	Floatable Layer Thickness[2]	Describe Maintenance Performed	Maintenance Personnel	Comments

1. The water depth to sediment is determined by taking two measurements with a stadia rod: one measurement from the manhole opening to the top of the sediment pile and the other from the manhole opening to the water surface. If the difference between these measurements is less than the values listed in table 1 the system should be cleaned out. **Note: to avoid underestimating the volume of sediment in the chamber, the measuring device must be carefully lowered to the top of the sediment pile.**

2. For optimum performance, the system should be cleaned out when the floating hydrocarbon layer accumulates to an appreciable thickness. In the event of an oil spill, the system should be cleaned immediately.

STORMWATER OPERATION AND MAINTENANCE PLAN

Mill Redevelopment Project
8 Mill Street
Dudley, MA

RESPONSIBLE PARTY DURING CONSTRUCTION:

Stevens Mill Owner LLC
1201 Hampton Street
Columbia, SC 29201

RESPONSIBLE PARTY POST CONSTRUCTION:

Stevens Mill Owner LLC
1201 Hampton Street
Columbia, SC 29201

Construction Phase

During the construction phase, all erosion control devices and measures shall be maintained in accordance with the final record plans, local/state approvals and conditions, the EPA Construction General Permit and the Stormwater Pollution Prevention Plan (SWPPP) if applicable. Additionally, the maintenance of all erosion / siltation control measures during construction shall be the responsibility of the general contractor. Contact information of the OWNER and CONTRACTOR shall be listed in the SWPPP for this site. The SWPPP also includes information regarding construction period allowable and illicit discharges, housekeeping and emergency response procedures. Upon proper notice to the property owner, the Town/City or its authorized designee shall be allowed to enter the property at a reasonable time and in a reasonable manner for the purposes of inspection.

Post Development Controls

Once construction is completed, the post development stormwater controls are to be operated and maintained in compliance with the following permanent procedures (note that the continued implementation of these procedures shall be the responsibility of the Owner or its assignee):

1. Parking lots and on-site driveways: Sweep at least two (2) times per year and on a more frequent basis depending on sanding operations. All resulting sweepings shall be collected and properly disposed of offsite in accordance with MADEP and other applicable requirements.

2. Catch basins, yard drains, trench drains, manholes and piping: Inspect two (2) times per year and at the end of foliage and snow-removal seasons. These features shall be cleaned two (2) times per year or whenever the depth of deposits is greater than or equal to one half the depth from the bottom of the invert of the lowest pipe in the catch basin or underground system. Accumulated sediment and hydrocarbons present must be removed and properly disposed of offsite in accordance with MADEP and other applicable requirements.

3. Water Quality Unit (Proprietary Separator): Follow manufacturer's recommendations (attached).

4. Surface Infiltration Basin: Preventative maintenance after every major storm event during the first three (3) months of operation and at least twice per year thereafter. Inspect structure and pretreatment BMP to ensure proper operation after every major storm event (generally equal or greater to 3.0 inches in 24 hours) for the first three months. Mow the buffer area, side slopes and basin bottom if grassed floor, rake if stone or sand bottom, remove trash and debris, remove grass clippings and accumulated organic matter. Any sediment removed shall be disposed of in accordance with MADEP and other applicable requirements.

5. Underground Basins: Preventative maintenance after every major storm event during the first three (3) months of operation and at least twice per year thereafter. Inspect structure and pretreatment BMP to ensure proper operation after every major storm event (generally equal or greater to 3.0 inches in 24 hours) for the first three months. The outlet of the basin, if any, shall be inspected for erosion and sedimentation, and rip-rap shall be promptly repaired in the case of erosion. Sediment collecting in the bottom of the basin shall be inspected twice annually, and removal shall commence any time the sediment reaches a depth of six inches anywhere in the basin. Any sediment removed shall be disposed of in accordance with MADEP and other applicable requirements.

All components of the stormwater system will be accessible by the owner or their assignee.

STORMWATER MANAGEMENT SYSTEM

POST-CONSTRUCTION INSPECTION REPORT

LOCATION:

Mill Redevelopment Project
8 Mill Street
Dudley, MA

RESPONSIBLE PARTY:

Stevens Mill Owner LLC
1201 Hampton Street
Columbia, SC 29201

NAME OF INSPECTOR:	INSPECTION DATE:
Note Condition of the Following (sediment depth, debris, standing water, damage, etc.):	
Catch Basins / Area Drains:	
Discharge Points/ Flared End Sections / Rip Rap:	
Subsurface Infiltration Systems:	
Surface Infiltration Basin:	
Water Quality Units:	

Other:
Note Recommended Actions to be taken on the Following (sediment and/or debris removal, repairs, etc.):
Catch Basins / Area Drains:
Discharge Points / Flared End Sections / Rip Rap:
Subsurface Infiltration Systems:
Surface Infiltration Basin:
Water Quality Units:
Other:
Comments:

STORMWATER INSPECTION AND MAINTENANCE LOG FORM

Mill Redevelopment Project
8 Mill Street – Dudley, MA

Stormwater Management Practice	Responsible Party	Date	Maintenance Activity Performed

LONG-TERM POLLUTION PREVENTION PLAN

Mill Redevelopment Project
8 Mill Street
Dudley, MA

RESPONSIBLE PARTY DURING CONSTRUCTION:

Stevens Mill Owner LLC
1201 Hampton Street
Columbia, SC 29201

RESPONSIBLE PARTY POST CONSTRUCTION:

Stevens Mill Owner LLC
1201 Hampton Street
Columbia, SC 29201

For this site, the Long-Term Pollution Prevention Plan will consist of the following:

- The property owner shall be responsible for "good housekeeping" including proper periodic maintenance of building and pavement areas, curbing, landscaping, etc.
- Proper storage and removal of solid waste (dumpsters).
- Sweeping of parking lots and driveways a minimum of twice per year with a commercial cleaning unit. Any sediment removed shall be disposed of in accordance with applicable local and state requirements.
- Regular inspections and maintenance of Stormwater Management System as noted in the "O&M Plan".
- Snow removal shall be the responsibility of the property owner. Snow shall not be plowed, dumped and/or placed in infiltration basins or similar stormwater controls. Salting and/or sanding of pavement / walkway areas during winter conditions shall only be done in accordance with all state/local requirements and approvals.
- Trash and other debris shall be removed from all areas of the site at least twice yearly.
- Pet waste shall be disposed of in accordance with local regulations. Pet waste shall not be disposed of in a storm drain or catch basin.
- Snow piles shall be located adjacent to or on pervious surfaces in upland areas. This will allow snow melt water to filter in to the soil, leaving behind sand and debris which can be removed in the springtime.

- In no case shall snow be disposed of or stored in resource areas (wetlands, floodplain, streams or other water bodies).
- In no case shall snow be disposed of or stored in the infiltration basins.
- If necessary, stockpiled snow will be removed from the Site and disposed of at an off-site location in accordance with all local, state and federal regulations.
- The amount of sand and deicing chemicals shall be kept at the minimum amount required to provide safe pedestrian and vehicle travel.
- Deicing chemicals are recommended as a pretreatment to storm events to minimize the amount of applied sand.
- Sand and deicing chemicals should be stockpiled under covered storage facilities that prevent precipitation and adjacent runoff from coming in contact with the deicing materials. Stockpile areas shall be located outside resource areas.

OPERATON AND MAINTENANCE TRAINING PROGRAM

The Owner will coordinate an annual in-house training session to discuss the Operations and Maintenance Plan, the Long-Term Pollution Prevention Plan, and the Spill Prevention Plan and response procedures. Annual training will include the following:

Discuss the Operations and Maintenance Plan

- Explain the general operations of the stormwater management system and its BMPs
- Identify potential sources of stormwater pollution and measures / methods of reducing or eliminating that pollution
- Emphasize good housekeeping measures

Discuss the Spill Prevention and Response Procedures

- Explain the process in the event of a spill
- Identify potential sources of spills and procedures for cleanup and /or reporting and notification
- Complete a yearly inventory or Materials Safety Data sheets of all tenants and confirm that no potentially harmful chemicals are in use.

ILLICIT DISCHARGE STATEMENT

Certain types of non-stormwater discharges are allowed under the U.S. Environmental Protection Agency Construction General Permit. These types of discharges will be allowed under the conditions that no pollutants will be allowed to come in contact with the water prior to or after its discharge. The control measures which have been outlined previously in this LTPPP will be strictly followed to ensure that no contamination of these non-storm water discharges takes place. Any existing illicit discharges, if discovered during the course of the work, will be reported to MassDEP and the local DPW, as applicable, to be addressed in accordance with their respective policies. No illicit discharges will be allowed in conjunction with the proposed improvements.

SPILL PREVENTION AND RESPONSE PROCEDURES (POST CONSTRUCTION)

In order to prevent or minimize the potential for a spill of Hazardous Substances or Oil or come into contact with stormwater, the following steps will be implemented:

1. All Hazardous Substances or Oil (such as pesticides, petroleum products, fertilizers, detergents, acids, paints, paint solvents, cleaning solvents, etc.) will be stored in a secure location, with their lids on, preferably under cover, when not in use.

2. The minimum practical quantity of all such materials will be kept on site.

3. A spill control and containment kit (containing, for example, absorbent materials, acid neutralizing powder, brooms, dust pans, mops, rags, gloves, goggles, plastic and metal trash containers, etc.) will be provided on site.

4. Manufacturer's recommended methods for spill cleanup will be clearly posted and site personnel will be trained regarding these procedures and the location of the information and cleanup supplies.

5. It is the OWNER's responsibility to ensure that all Hazardous Waste on site is disposed of properly by a licensed hazardous material disposal company. The OWNER is responsible for not exceeding Hazardous Waste storage requirements mandated by the EPA or state and local authorities.

In the event of a spill of Hazardous Substances or Oil, the following procedures should be followed:

1. All measures should be taken to contain and abate the spill and to prevent the discharge of the Hazardous Substance or Oil to stormwater or off-site. (The spill area should be kept well ventilated and personnel should wear appropriate protective clothing to prevent injury from contact with the Hazardous Substances.)

2. For spills of less than five (5) gallons of material, proceed with source control and containment, clean-up with absorbent materials or other applicable means unless an imminent hazard or other circumstances dictate that the spill should be treated by a professional emergency response contractor.

3. For spills greater than five (5) gallons of material immediately contact the MADEP at the toll-free 24-hour statewide emergency number: **1-888-304-1133**, the local fire department (**9-1-1**) and an approved emergency response contractor. Provide information on the type of material spilled, the location of the spill, the quantity spilled, and the time of the spill to the emergency response contractor or coordinator, and proceed with prevention, containment and/or clean-up if so desired. (Use the form provided, or similar).

4. If there is a Reportable Quantity (RQ) release, then the National Response Center should be notified immediately at (800) 424-8802; within 14 days a report should be submitted to the EPA regional office describing the release, the date and circumstances of the release and the steps taken to prevent another release. This Pollution Prevention Plan should be updated to reflect any such steps or actions taken and measures to prevent the same from reoccurring.

SPILL PREVENTION CONTROL AND COUNTERMEASURE FORM

Mill Redevelopment Project
8 Mill Street
Dudley, MA

Where a release containing a hazardous substance occurs, the following steps shall be taken by the facility manager and/or supervisor:

1. Immediately notify the Dudley Fire Department (at **9-1-1**)

2. All measures must be taken to contain and abate the spill and to prevent the discharge of the pollutant(s) to off-site locations, receiving waters, wetlands and/or resource areas.

3. Notify the Dudley Board of Health at (508) 949-8017 and the Dudley Conservation Commission at (508) 949-8011.

4. Provide documentation from licensed contractor showing disposal and cleanup procedures were completed as well as details on chemicals that were spilled to the Town of Dudley Board of Health and Conservation Commission.

Date of spill:_____ Time:_____ Reported By:_____

Weather Conditions:_____

Material Spilled	**Location of Spill**	**Approximate Quantity of Spill (in gallons)**	**Agency(s) Notified**	**Date of Notification**

Cause of Spill:_____
_____

Measures Taken to Clean up Spill:_____
_____

Type of equipment: _____ Make: _____ Size:_____

License or S/N: _____

Location and Method of Disposal_____
_____

Procedures, method, and precautions instituted to prevent a similar occurrence from recurring:_____
_____

Additional Contact Numbers:

- DEPARTMENT OF ENVIRONMENTAL PROTECTION (DEP) EMERGENCY PHONE: 1-888-304-1133
- NATIONAL RESPONSE CENTER PHONE: (800) 424-8802
- U.S. ENVIRONMENTAL PROTECTION AGENCYPHONE: (888) 372-7341