3 | STORM DRAINAGE IMPACT ANALYSIS

BABSON COLLEGE

First Year Residence Hall

STORMWATER MANAGEMENT REPORT

SUBMITTED FOR:

Permitting Approval

PREPARED FOR:

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BABSON COLLEGE

FIRST YEAR RESIDENCE

STORMWATER MANAGEMENT REPORT

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HYDROLOGY

1.0 DESIGN OBJECTIVE AND METHODOLOGY

The proposed drainage design is based on the Town of Wellesley Department of Public Works Municipal Stormwater Drainage System Rules and Regulations (2008), the Massachusetts Department of Environmental Protection Stormwater Handbook (February 2008) and LEED for New Construction & Major Renovations Version 2.2.

The stormwater management system and associated mitigation plan were designed to achieve two major goals: to reduce the rate of runoff from the project area to below the most conservative limits of the three standards mentioned above, and to mitigate for any degradation of the quality of runoff discharged to the Town storm drainage system. As will be described below, the existing soils within the project limits have extremely limited capacity to infiltrate and therefore using captured stormwater to recharge groundwater will be difficult to achieve.

The Natural Resources Conservation Services ("NRCS"), formerly the Soil Conservation Service ("SCS"), Technical Releases No. 20 and 55 (TR-20 and TR-55), were used in the HydroCAD® computer software program to model the hydrology of the project site. This program was used to calculate existing and proposed conditions.

Design criteria included the following:

- The stormwater management system is designed for the 2-, 10-, 25- and 100-year storm events using HydroCAD®, a TR-20 and TR-55 based hydrologic software program.
- Post-development peak discharge runoff rate and volume of the 2-, 10-, 25- and 100-year design storm will not exceed the pre-development peak discharge runoff rates.
- Times of Concentration ("Tc") were arrived at using TR-55 methodologies. Sheet flow lengths of 100 feet maximum were used, as is standard practice in regional stormwater modeling. Minimum Tc is five minutes.
- Hydrologic Soils Group C soils were assumed from results of the Geotechnical report and the NRCS survey of Norfolk County, Massachusetts. (See Appendix C - Geotechnical Report and Figure 4 – Soil Survey Plan).
- All area drainage basins shall have a minimum of 1-foot sumps.
- All catch basins shall have a minimum of 4-foot sumps.
- Pipe sizing design is based on flows from the 10-year 24-hour rainfall for Norfolk County.
- Pipe velocities are maintained at a minimum of 2 feet per second ("fps") and a maximum of 10 fps.

The following rainfall amounts were used:

Table 1: Type III – 24 Hour Rainfall

Storm Event Type	
1 Year	2.50 Inches
2 Year	3.20 Inches
10 Year	4.70 Inches
25 Year	5.50 Inches
100 Year	6.70 Inches

Source: WinTR-55 Small Watershed Hydrology, Norfolk County, Massachusetts

2.0 EXISTING RUNOFF/DRAINAGE CONDITIONS

The site is located in the heart of the Babson College campus in Wellesley, Massachusetts. The project area is bounded to the south by Babson College Drive, to the west by the Arthur M. Blank Center, to the north by Tomasso Hall and Park Manor North, and to the east by Park Manor Central and Park Manor South. A stand of pine trees is located at the center of the site within a ground plane of unmaintained underbrush. The remainder of the site is a mix of evergreen and deciduous trees with law. Traversing the site are a number of asphalt pedestrian walkways, a maintenance access drive for the Park Manor buildings, a basketball court and a volleyball court.

Topography on the site is generally sloping southwest to northeast with average grades varying between 5% and 9%. A few portions of the lawn reach maximum slopes of 15%. The project area is outside the FEMA 100-Year Floodplain and contains no wetlands or protected habitats per MassDEP mapping services (See Figure 5).

The area of existing condition stormwater analysis is entirely within the property limits of Babson College and consists of four subcatchments found on Figure 1:

Study Point #1 (POA #1):

"EX-01" is the westernmost portion of the site that drains via sheet flow and shallow concentrated flow to Existing Catch Basin #1 (ECB-1) just east of the Blank Center. The catch basin connects via underground conduit to a ECB-2 just west of Tomasso Hall labeled Point of Analysis (POA) #1. POA #1 is connected via a series of storm lines to ECB-5 which discharges off of Babson property via a 20" VCP culvert under Forest Street.

Study Point #2 (POA #2):

"EX-02" is the second largest of the existing subcatchments and spans from south to north through the central portion of the project area. Primary flow types from this subcatchment consist of sheet flow across lawn and shallow concentrated flow across lawn and paving. The majority of the flow is collected by ECB-3 in the paved access drive that conveys the water to ECB-4 west of Publisher's Hall and adjacent to Forest Street. ECB-4 represents POA #2. POA #2 connects to ECB-5 which discharges off of Babson property via a 20" VCP culvert under Forest Street.

Study Point #3 (POA #3):

"EX-03" is the largest of the existing subcatchments and consists primarily of lawn area with scattered trees. The flow path across this catchment is sheet flow in lawn and shallow concentrated flow across paving and lawn. The

catchment is collected by ECB-6 just south of Publisher's Hall. ECB-6 represents POA#3. POA #3 discharges off of Babson property at ECB-10 in a 10" RCP culvert under Forest Street.

Study Point #4 (POA #4):

"EX-04" is an area at the eastern edge of the project site surrounding Park Manor Central. This area includes the basketball and volleyball courts as well as lawn and asphalt paving. Stormwater flow consists of sheet and shallow concentrated flow on lawn and asphalt paving. The area is collected by ECB-7 and ECB-8 which tie to one another at ECB-9. POA #4 eventually discharges off of Babson property at ECB-10 in a 10" RCP culvert under Forest Street.

3.0 PROPOSED RUNOFF/DRAINAGE CONDITIONS

The proposed site will consist of a new 200-bed dormitory, new entry plazas at each of the building entrances, new site walkways, new seating areas, and new planting. The building will be situated in such a way that two new quadrangles will be formed. The first, known as Tomasso Lawn, is envisioned as a more formal landscape where seating steps in a sloped lawn create an amphitheater experience. The seating elements will be placed between the existing trees in a manner that will preserve the naturalistic character of the space. The second space is the Residential Quad for which the intent is to foster the bucolic character of the existing landscape with a distinctive ensemble of law and trees. It is envisioned that the open space will be used for informal passive and active recreation.

Table 2: Surface Comparison (Acres)

Existing Pervious	Proposed Pervious	Existing Impervious	Proposed Impervious
5.37	4.88	1.00	1.49

The proposed improvements will result in a net increase in impervious area due to the new building roof and associated entry plazas. To mitigate for the increased impervious area, a subsurface detention structure will be installed to reduce flow rates below the pre-development conditions. The increase in impervious area will also likely result in additional suspended solids within the runoff from the site; therefore, a water quality structure will be introduced to maintain the quality of water running off the site in the post-development condition.

Study Point #1 (POA #1):

"PR-01" is the westernmost portion of the site that drains via sheet flow and shallow concentrated flow to Existing Catch Basin #1 (ECB-1) just east of the Blank Center. The catch basin connects via underground conduit to ECB-2 just west of Tomasso Hall labeled Point of Analysis POA #1. POA #1 is connected via a series of storm lines to ECB-5 which discharges off of Babson property via a 20" VCP culvert under Forest Street. Flow paths in PR-01 will generally resemble that of the existing conditions.

Study Point #2 (POA #2):

"PR-02" contains the area from the southwest side of the proposed dormitory around the western corner spanning to the north through the center of the project area. Primary flow types from this subcatchment consist of sheet flow and shallow concentrated flows across lawns and paving. These flows are collected by a proposed catch basin in the

paved access drive located to the west of the plaza located in front of Tomasso Hall which conveys the water through a proposed drainage manhole to a water quality structure to the northeast of the proposed dormitory.

"PR-10" is the area of the proposed dormitory roof and is collected by the roof drainage system. These flows are collected by roof drains and conveyed to a water quality manhole located to the northeast of the building. Once routed through the proposed water quality structure the flows from "PR-02" and "PR-10" are then conveyed to a proposed underground stormwater detention facility that is located to the north of Park Manor North. Flows are conveyed through a proposed outflow control structure and tied into ECB-4 connected to ECB-5, representing POA #2, via an existing 10" RCP.

"PR-03" is an area along the northwestern edge of the project site. It represents the subcatchment area that runs south to north, along the existing access drive. The flow path across this subcatchment is sheet flow in lawn and shallow concentrated flow across paving and lawn. The catchment is collected by ECB-4, which is routed to ECB-5 (POA #2) and discharged off Babson College property via an existing 20" VCP culvert. Flows within this study area are not expected to change as a result of the proposed work.

Study Point #3 (POA #3):

"PR-04" is the largest of the proposed subcatchments and consists primarily of lawn area with scattered trees. The access drive to the Park Manor buildings will be realigned with a planting area designed to collect stormwater located in the middle of the turnaround location. The flow path across this catchment is sheet flow in lawn and shallow concentrated flow across paving and lawn. The catchment is collected by ECB-6 just south of Publisher's Hall. ECB-6 represents POA#3. POA #3 discharges off of Babson property at ECB-10 in a 10" RCP culvert under Forest Street.

Study Point #4 (POA #4):

"PR-05" is an area at the eastern edge of the project site surrounding Park Manor Central. This area includes the basketball and volleyball courts as well as lawn and asphalt paving. Stormwater flow consists of sheet and shallow concentrated flow on lawn and asphalt paving. The area is collected by ECB-7 and ECB-8 which tie to one another at ECB-9. POA #4 eventually discharges off of Babson property at ECB-10 in a 10" RCP culvert under Forest Street.

A hydrologic study of the site was conducted in order to determine the impact of the proposed development on stormwater runoff in comparison to the existing conditions. The study determined that the proposed rates of runoff at the outlined points of analysis (POA) would be equal to or less than those of the existing conditions. (See Figure 2 – Proposed Drainage Areas).

Table 3: Peak Runoff Rates (CFS)

	2-Year Storm	10-Year Storm	25-Year Storm	100-Year Storm
POA #1*				
Existing Runoff	1.92	3.52	4.43	5.77
Proposed Runoff	1.22	2.37	3.01	4.01
POA #2†				
Existing Runoff	1.97	3.76	4.75	6.27
Proposed Runoff	0.98	3.12	4.32	6.02
POA #3*				
Existing Runoff	3.56	6.89	8.76	11.62
Proposed Runoff	2.73	5.49	7.06	9.48
POA #4*				
Existing Runoff	0.92	1.68	2.09	2.71
Proposed Runoff	0.61	1.26	1.64	2.21

†For POA #2 the subsurface detention system has been designed to reduce proposed flows from the 2-, 10-, 25-, and 100-year storm events to below their existing rates.
*For POA #1, POA #3, and POA #4 the increased pervious area and/or decreased size of catchment area has reduced proposed flows from the 2-, 10-, 25-, and 100-year storm events to below their existing rates.

4.0 INFILTRATION CAPACITY

Soils within the entire project area are classified as Hydrologic Ground C per the NRCS Soil Survey included in Figure 4 of this report. A geotechnical engineer performed an on-site investigation of the soils which included six test pits and three additional locations of infiltration testing (see Appendix C – Foundation Engineering Report). Soils were generally classified as poorly draining glacial till. The infiltration rates of the existing soils range from 0.003 inches per hour to 0.065 inches per hour. The Massachusetts Stormwater Handbook notes within Standard 3 of the regulations that minimum infiltration rates shall be no less than 0.17 inches per hour. Additionally, in running test models of infiltration basins, drawdown time exceed the 72 hour minimum described in the Standards. Therefore, recharge of groundwater cannot reasonable be achieved as part of the stormwater management plan for this project.

5.0 WATER QUALITY DESIGN

Stormwater discharges to the municipal system must adhere to required levels of pollutant reduction for Phosphorus, Nitrogen, Petroleum Hydrocarbons, heavy metals and floatable materials. Selected water quality structures shall meet or exceed all levels of reduction.

An 80% Total Suspended Solids (TSS) removal rate is required for the project. BMP removal rates were obtained from the Stormwater Management Handbook. Proprietary devices were based on the MASTEP database. Drainage from catchment area PR-02 will utilize treatments including deep sump catch basins and water quality separator unit. Exact manufacturers to be determined as design progresses. Proposed roof drains shall not discharge pollutants so that roof discharge is exempt from treatment requirements. Deep sump catch basins will achieve 25% TSS removal rate. Water quality unit will achieve 80% TSS removal rate. This system can achieve 82% TSS Removal.

Deep Catch Basins:	*1 x 25% = .25*	*1 - .25 = .75*
Water Quality Unit:	*.75 x 77% = .58*	*.75 - .58 = .18*

1 - .18 = .82 or 82% TSS Removal. Standard is met.

Erosion and Sediment Control practices will be implemented during construction to reduce the potential for undesired discharges into the municipal stormwater system. An Erosion Control plan will been incorporated with the design plans. The project also requires a Stormwater Pollution Prevention Plan (SWPPP) under the EPA NPDES program. This will be prepared prior to construction.

6.0 WATER SUPPLY PROTECTION DISTRICT

The proposed project is located in an area defined as a Water Supply Protection District and therefore is subject to Section XIVE of Town Code. Provisions will be made to protect against toxic and hazardous materials discharging to the groundwater as part of the SWPPP. Fill material will contain no solid waste, toxic or hazardous materials. Grade reduction for the landscape areas surrounding the building will maintain a minimum five foot cover over groundwater levels. As described above, on-site recharge is not feasible given the existing soil infiltration rates.

7.0 DESIGN FOR PHASE II

The stormwater management system is being designed for two phases of site work. Phase I shall include all dormitory construction and associated plazas, the Tomasso Lawn, walkway connections to College Drive, and walkways directly to the north and east of the building. The majority of the site work associated with the Residential Quad will be constructed in Phase II. This work would include regarding of the lawn, realignment of the access drive for the Park Manor buildings, and the creating of a planting area in the center of the turnaround area.

Given that Phase II is at a conceptual level of design, an allowance was incorporated into stormwater calculations to account for future changes in design. Impervious surface area was increased by 2,000 sf (approximately 25%) for conservative design and sizing of the stormwater system. The engineer responsible for the permitting of Phase II will need to confirm that the proposed design does not exceed this permitted plan plus 2,000 sf of impervious area. If impervious area increases, the engineer will be responsible for design of a new or expanded stormwater management system.

8.0 IMPACT ON ROAD CULVERTS

Per the Town of Wellesley Municipal Stormwater Drainage System Rules and Regulations, if peak discharge rates for the 10-year storm event exceed 0.50 cfs then the capacity of the stormwater system shall be studied. There are four Points of Analysis designated on Proposed Drainage Areas - Figure 2.

Points of Analysis #1 and #2 combine at ECB-5 which discharges via a 20" culvert under Forest Street. For the 10-year design storm, these two POAs currently contribute 7.28 CFS. The proposed design will contribute 5.49 CFS for the 10-year storm which represents a reduction of 25% from the existing conditions.

Points of Analysis #3 and #4 are routed to ECB-10 which outfalls via a 10" culvert under Forest Street. Proposed improvements will result in a net increase of permeable surface and a net decrease in overall contributing area. As a result, peak flow rates will be decreased by approximately 21% with the implementation of this project.

9.0 CONCLUSIONS

The stormwater management design incorporates Best Management Practices to protect the Water Supply Protection District while reducing the rate of Stormwater discharge to the municipal system. The series of water quality structures and deep sump catch basins will ensure the quality of water leaving the project area will exceed minimum requirements. During construction, the contactor will be held to the strict standards of the Stormwater Pollution Prevention Plan and erosion control measure shall be installed prior to the start of construction. A post-construction maintenance plan will be issued at a later point in the design process.