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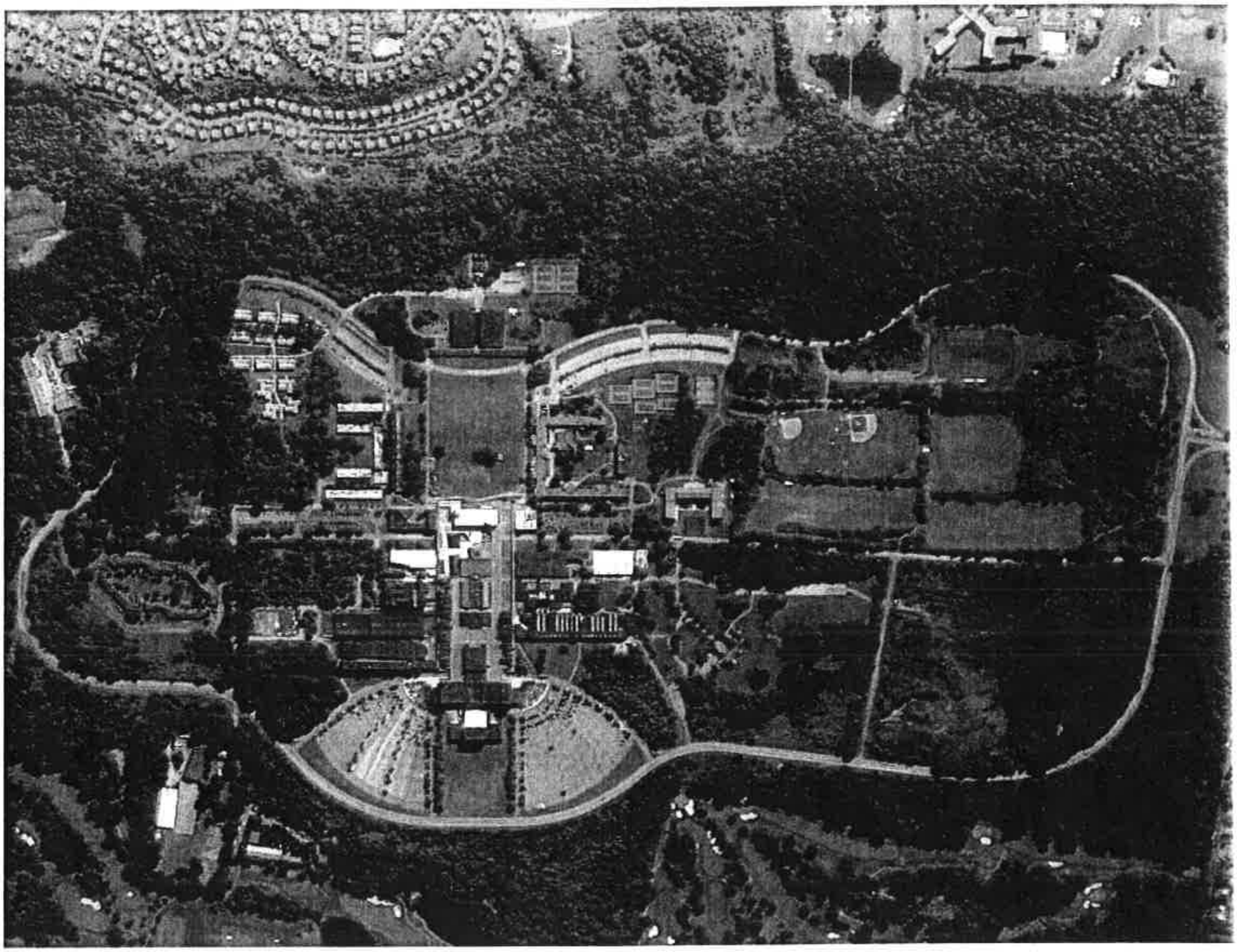
FEASIBILITY STUDY FOR SUNY PURCHASE COLLEGE



Owner:
Purchase College, State University of New York
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Purchase, NY 10577

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II. EXECUTIVE SUMMARY

The SUNY Purchase College campus presents a unique opportunity in that it serves as a role model in a higher learning environment to advance green infrastructure design. We propose a dual approach to manage stormwater runoff from two of the impervious asphalt pavement sources, parking lots and pedestrian paths. The proposal tackles each one in a manner that could be replicated around other areas of the campus.

The project will consist of two major green infrastructure practices, bioretention swales and porous pavers. These systems redirect stormwater to infiltrate, evapotranspire, detain and remediate runoff generated from impervious asphalt parking and sidewalk surfaces. They help to slow, absorb and filter to remediate polluted water. Stormwater management within the design is based on soft infrastructure systems that reduce sole reliance on traditional hard engineered solutions that can lack generative vegetal and biological structures.

Our goal is to demonstrate through the pilot projects that these practices could be implemented across the entire campus. These stormwater management practices used more broadly across the Blind Brook watershed could significantly reduce the frequency and volume of flooding downstream and simultaneously make significant improvements in the water quality, especially immediately after wet weather events. The proposal communicates a larger vision for environmental stewardship towards the broader watershed community through productive landscape strategies and public education.

The proposed pilot projects would educate students and faculty about the beauty and effectiveness of these green infrastructure practices. Active educational opportunities can be provided to the Environmental Studies department through monitoring. The projects can inspire the next generation of green infrastructure stewards who will advocate for

III. PROJECT OBJECTIVES

We aim to achieve the following goals:

- Reduce the quantity of stormwater entering the system by promoting the infiltration of stormwater through soil media, thereby increasing the retention and detention capacity of the watershed.
- Reduce the first flush surface runoff entering the wetlands through direct drainage.
- Directly remove pollutants through phytoremediation.
- Provide the College's Environmental Studies program the opportunity to measure the performance of the system through a monitoring plan.
- Promote ecological stewardship through active engagement, fostering the community's environmental awareness.
- Utilize the bioretention basins as an educational opportunity to teach the students and faculty about green infrastructure design.
- Demonstrate the feasibility and cost effectiveness of this pilot project for future implementation elsewhere on the campus.
- Promote micro habitat for native fauna and flora.
- Generate economic activity through construction of green infrastructure.

IV. EXISTING CONDITIONS
4.1 Project Location/Address

Purchase College, State University of New York is located in the hamlet of Purchase, within the Town of Harrison, in the southeast section of Westchester County. The W-1 and W-2 parking lots are located on the west side of the campus, flanking the central axis. The Fort Awesome residential hall is located near the center of the campus, south of the central axis.

4.2 Current Land Use

The SUNY Purchase campus is located on approximately 505 acres in Westchester County. It is surrounded by golf clubs, low and moderate density residential neighborhoods, commercial business offices and the Westchester County airport. It lies within the area zoned as R-2 One-Family Residence district.

The campus is organized along an east-west axis with the academic buildings flanking both sides and residential halls primarily on the east side. There are outdoor athletic facilities including tennis and basketball courts, and baseball and football fields.

Main vehicular circulation is along Brigid Flanagan Drive which forms a loop around the whole campus, while Lincoln Avenue serves mainly as the service road and runs north-south through the center, with the Facilities Management offices at the north end.

4.3 USGS Soil Classification/Bedrock Depth

The W-1 and W-2 parking lots lie within an area of the campus that is classified as urban land, Fort Awesome and its surrounding paths are within Paxton Fine Sandy Loam (2-8% slopes) which is hydrologic group C. Some areas of the campus contain lithic bedrock which lies approximately 6 feet below the surface.

4.4 Site Topography

The campus is sited on what used to be an active farm, with meadows and deciduous forest land. The campus has some rocky areas around the high points in the northern section and 20% or greater slopes to the east and west outside of the main vehicular loop road, but otherwise mostly consists of areas with gentle slopes between 2 % to 15%.

4.5 Stormwater Flowpath

The campus is divided roughly in to five sub drainage watersheds, with the high point occurring at the north end of the campus. The east side eventually drains to the Blind Brook which runs the length of the campus, and the west side eventually drains to a tributary which meets up with the Blind Brook south of the campus. Ultimately, the Blind Brook empties five miles away in to the Long Island Sound.

4.6 Depth to Water Table

Site investigations have not taken place yet as the project is still in the planning phase, however field tests will be conducted in conjunction with the design and engineering phase to confirm that the depth to the water table is at an acceptable distance.

4.7 Nearest/Receiving Water Body

The SUNY Purchase campus is part of the watershed that run through a series of drainage swales and wetlands that feed in to the Blind Brook, which ultimately empties in to the Long Island Sound.

4.8 Other Site Considerations

There are wetlands, approximately 80 acres in total, within and adjacent to the campus, and floodplains along the Blind Brook. All of these areas are affected by the stormwater runoff from the developed areas of the campus, and accumulate to affect the communities downstream.

4.9 Boring Logs, Infiltration Tests, or Other Subsurface Investigations

Site investigations have not taken place yet as the project is still in the planning phase, however field tests will be conducted in conjunction with the design and engineering phase.

V. PROJECT DESCRIPTION

5.1.a Recommended Green Infrastructure (GI) Practice: Bioretention

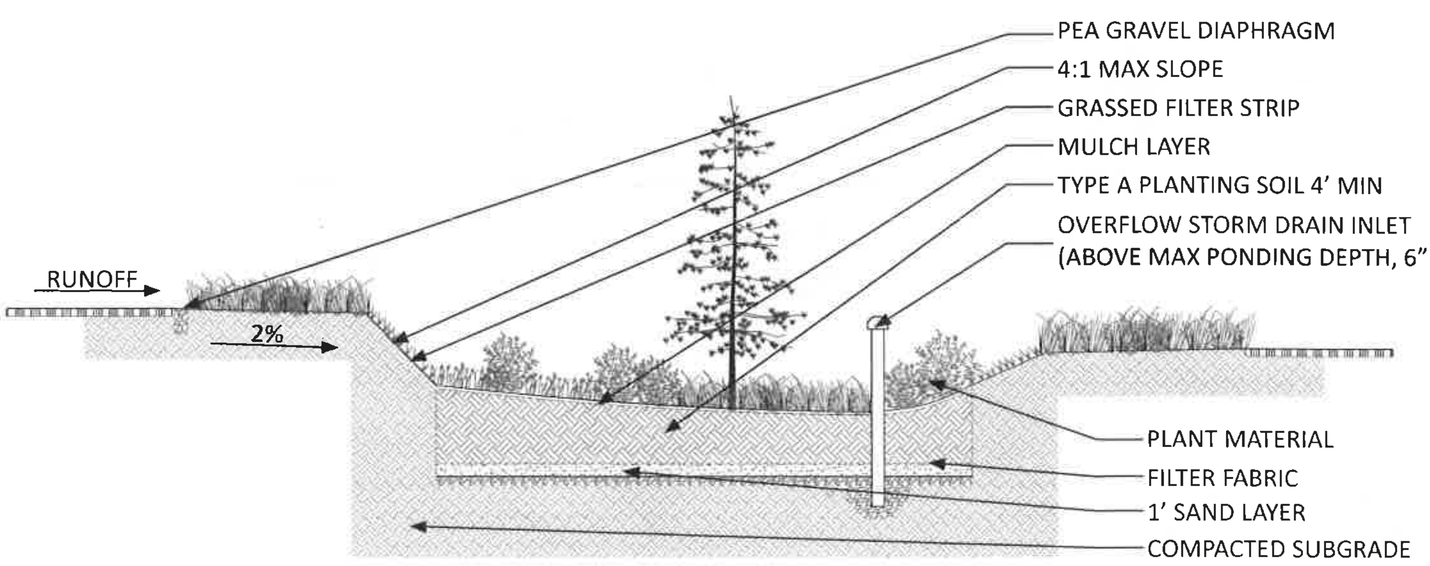
The parking lots are suited to the green infrastructure practice of bioretention basins to manage its stormwater runoff. These bioswales utilize engineered soils and vegetation to capture, treat and slowly absorb and filter surface water runoff. Stormwater will enter the bioretention basins through surface flow downhill from east to west. It will be pre-treated by flowing over a grass filter and gravel diaphragm, before entering the bioswale. At the down-gradient end, an overflow pipe will carry water in excess of 6" of ponding to be released back into the storm sewer system. The installation of the system will decrease the volume of water and reduce pollutants such as phosphorus, nitrogen, metals and pathogens from reaching the Blind Brook.

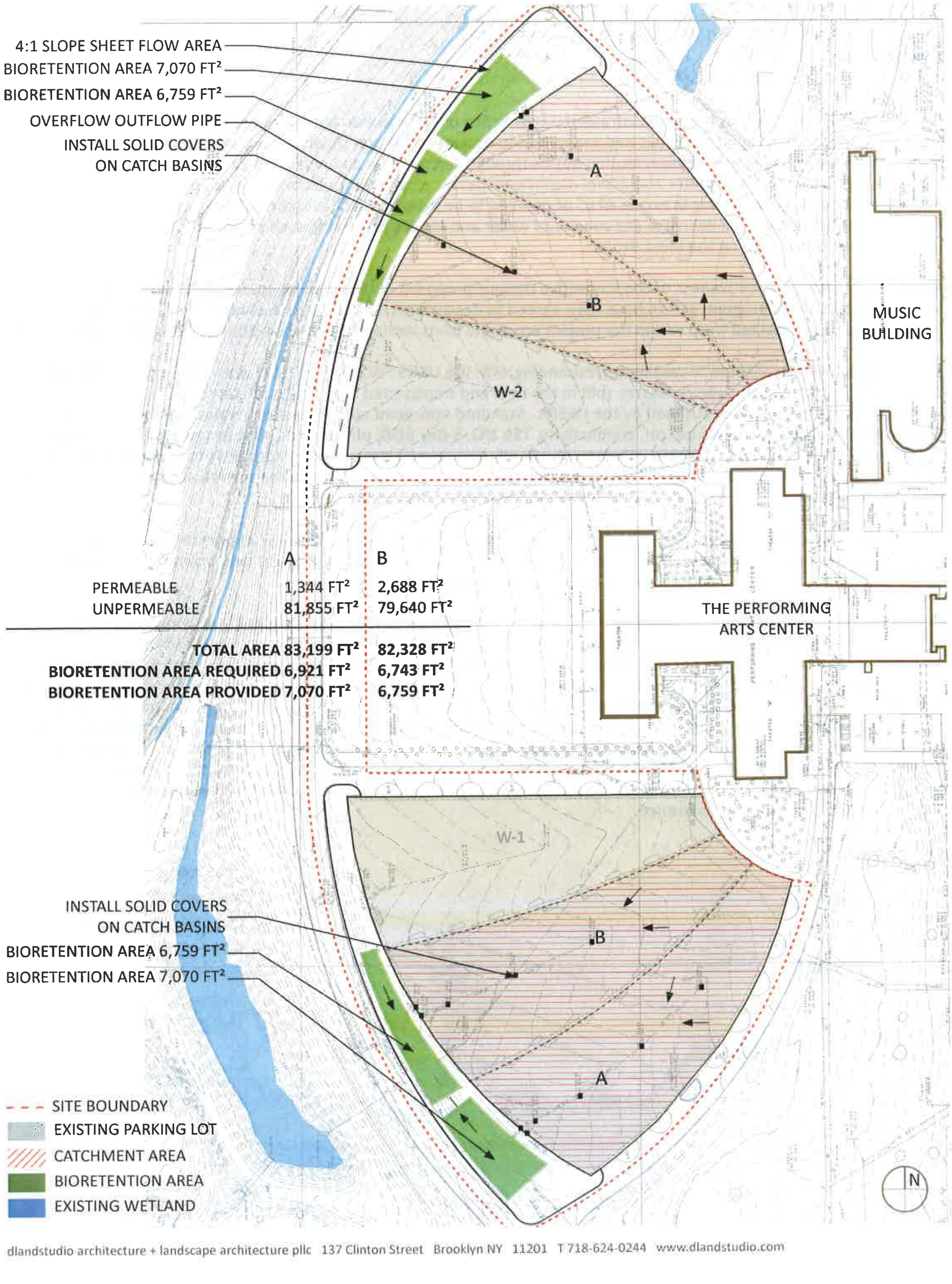
In order to assess the effectiveness of the innovative designs proposed in this application, faculty members of the Environmental Studies program at Purchase have agreed to design a set of comparative studies using hydrologic and water quality data collected from within the project areas and from similar areas on campus not affected by the projects.

Grab-samples will be collected bi-weekly corresponding with the USGS "Water Year" (October 1-September 30), with monthly All samples will include replicates split in the field and transported back to the lab on-ice for analysis within 24 hours as per best practices outlined by the USEPA. Standard non-point source physiochemical parameters to be evaluated will include temperature, pH, conductivity, TSS, DO, 5-day BOD, phosphorus, nitrates, turbidity, total organic carbon and TKN. In addition, chloride, ethylene glycol, oil, and several trace-metals most likely to occur from parking areas including, Mercury, Iron, Copper, Chromium, and Aluminum, will also be measured as well as discharge rates from each sample location.

Each of these comprehensive studies will be completed annually for three years and will involve the direct supervision of a team of undergraduate senior interns at the college. These paid interns will collect the field samples, and conduct the laboratory analysis under the supervision of the Environmental Studies faculty.

Results will be analyzed jointly between the faculty and the interns as part of their on-going year-long independent senior research requirements. All preliminary results will be included in the college's Stormwater Master Plan and reported annually to NY DEC as per the terms of our current NPDES permit. Furthermore all advanced comparative analysis will annually be presented at a peer-reviewed conference hosted on campus each spring, and published by the college library in the form of their completed senior theses. At the conclusion of the three year monitoring program, environmental studies faculty members will synthesis the results of this collective effort for publication possibly in the Journal of Environmental Studies and Sciences, and/or as a white paper for the Center for Watershed Protection, or the NSF-supported Consortium for the Advancement of Hydrologic Science. Environmental Studies Faculty are also committed to proposing the distribution of their results through a USEPA sponsored NPEDES webinar, and at the annual SUNY sustainable campuses conference.

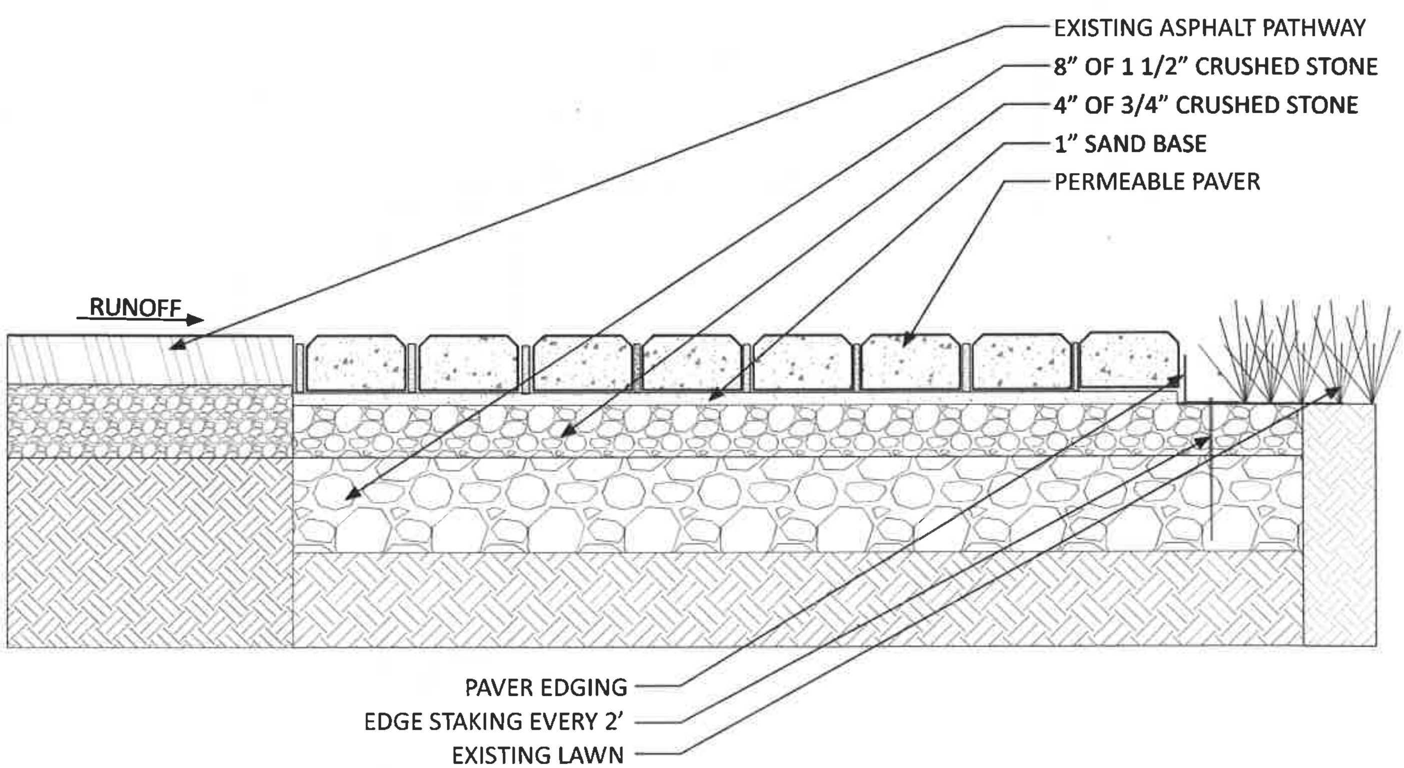


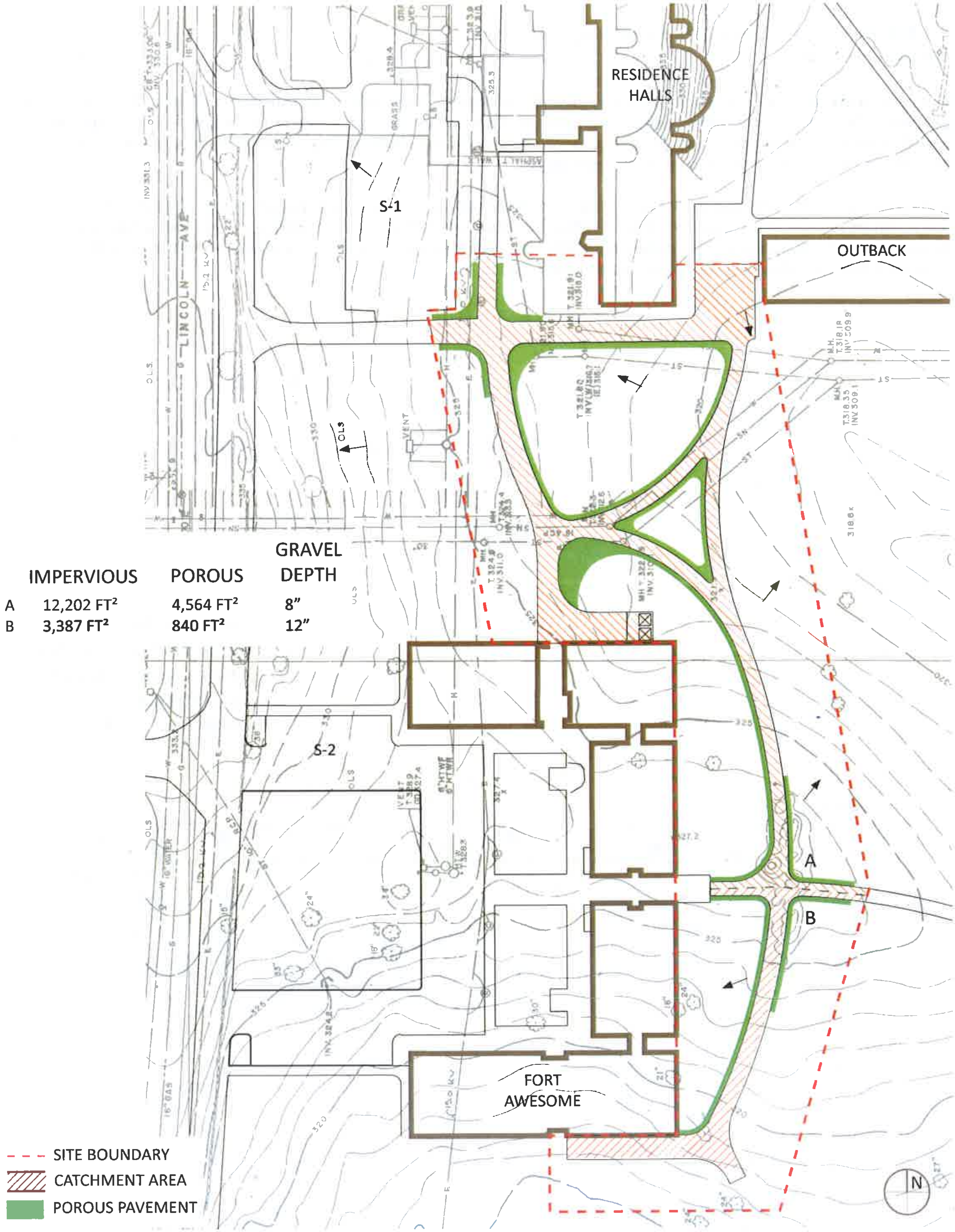

4:1 SLOPE SHEET FLOW AREA
BIORETENTION AREA 7,070 FT²
BIORETENTION AREA 6,759 FT²
OVERFLOW OUTFLOW PIPE
INSTALL SOLID COVERS ON CATCH BASINS
A
B
W-2
MUSIC BUILDING
THE PERFORMING ARTS CENTER
A B
PERMEABLE 1,344 FT² 2,688 FT²
UNPERMEABLE 81,855 FT² 79,640 FT²
TOTAL AREA 83,199 FT² 82,328 FT²
BIORETENTION AREA REQUIRED 6,921 FT² 6,743 FT²
BIORETENTION AREA PROVIDED 7,070 FT² 6,759 FT²
W-1
B
INSTALL SOLID COVERS ON CATCH BASINS
BIORETENTION AREA 6,759 FT²
BIORETENTION AREA 7,070 FT²
A
SITE BOUNDARY
EXISTING PARKING LOT
CATCHMENT AREA
BIORETENTION AREA
EXISTING WETLAND
N

5.1.b Recommended Green Infrastructure (GI) Practice:
Porous Pavement

The pedestrian paths are an ideal location to utilize porous pavers. They provide the support and utility of conventional pavement, but limit the amount of impervious surfaces. They contribute to site infiltration, manage runoff from the limited adjacent asphalt pavement, provide pollutant and runoff reduction, and an aesthetic improvement which differentiate them from the vehicular circulation ways.

The porous paver system consists of prefabricated concrete unit pavers which are approximately 3" thick. The units are designed to interlock in a pattern that provides open joint areas that are filled with aggregate that allows water to percolate in to the ground. The system is installed on a series of aggregate layers and geotextile that provide the structural base, which allows for occasional vehicular loads.





	IMPERVIOUS	POROUS	GRAVEL DEPTH
A	12,202 FT²	4,564 FT²	8”
B	3,387 FT²	840 FT²	12”

5.2 Feasibility Analysis of Selected GI Practice

5.2.1 Drainage Area

The potential stormwater catchment area for the bioretention basins is the asphalt paved areas in each of the two parking lots. The total area of proposed catchment is 331,054 square feet (7.6 acres).

The potential stormwater catchment area for the porous pavers is the adjacent asphalt path, which varies in width from 10 to 14 feet. The total area of proposed catchment is 15,589 square feet (0.36 acres).

5.2.2 Site Grading

The proposed projects work with the existing topography, intercepting existing flow patterns as stormwater moves along. As such, no grading outside of the bioretention swales is proposed.

5.2.3 Stormwater Flowpath

The projects will utilize existing stormwater flow patterns:

1. **The parking lots are currently graded to drain from east to west, towards a large grass buffer area. Each lot is divided** in to three approximately equal drainage areas, with a swale and a series of catch basins running down the center.

2. **The pedestrian paths roughly follow the existing topography of the grass areas, with roughly a highpoint around the center of the residential hall. This divides the area in to two drainage areas, one towards the north and one towards the** south.

5.2.4 Design Considerations

Parking Lot Bioretention:

The proposed bioretention project deals with the largest parking area on campus, the adjacent W-1 and W-2 lots, which together make up over 11 acres of asphalt pavement for 1,750 cars. The lot is primarily designated for freshmen residents, visitors and commuters.

The lots are graded between 2% to 3% without any steeply sloped areas, so utilizing the existing grading, stormwater can be directed to bioretention swales by installing solid covers on the catch basins and allowing the surface flow to run downhill towards a grass strip. Bioretention areas can be installed in these grass areas. In order to maintain a minimum 2:1 proportion in plan, the grass areas are only large enough to accommodate two of the three catchment areas in each lot.

Pedestrian Path Porous Pavers:

The proposed porous paver project deals with the pedestrian paths which are primarily paved with asphalt and flanked on both sides with grass, no curbs. The paths are narrower in certain areas of the campus, and the increased need to **widen some of them has manifested itself in soil rutted edges that result in muddy puddles after a rain storm. Instead of** installing more impervious asphalt, we are proposing the use of porous pavers to accommodate the increased width of **the existing paths.**

The location is for residential use, which limits the possibility of contamination from industrial or commercial uses. The site is fairly flat which gives the water time to infiltrate and lessens the chance of erosion. The porous pavers would be along both sides of the paths which are setback from the buildings and any other underground structures which could **possibly be detrimentally impacted by the green infrastructure practice.**

5.2.5 GI Practice Sizing & Water Quality Volume (WQv) Calculations

The following calculations were used to properly size the system required for stormwater capture:

PARKING LOTS W-1 AND W-2 BIORETENTION

STORMWATER COMPUTATION FOR BIORETENTION BASIN (A):

1. DRAINAGE AREA
    TOTAL AREA = 83199 SF = 1.91 AC
        P = 1.2
        I = 98%
        Rv = 0.05 + (0.009X98) = 0.94
        WQv = 7786.35 cf

2. REQUIRED FILTER BED AREA WITH BIORETENTION SOIL
    df = 4 ft
    k = 0.5 ft/day
    hf = .05 ft
    tf = 2 days

    Af = [(WQv) * (df)]/[(k) * (hf + df) * (tf)]
    Af = [(7786x4)/(.05x (.05+4)x2)]
    Af = 6921 sf

    ACTUAL VOLUME PROVIDED = 7070 cf

STORMWATER COMPUTATION FOR BIORETENTION BASIN (B):

1. DRAINAGE AREA
    TOTAL AREA = 82328 SF = 1.89 AC
        P = 1.2
        I = 97%
        Rv = 0.05 + (0.009X97) = 0.92
        WQv = 7585.97 sf

2. REQUIRED FILTER BED AREA WITH BIORETENTION SOIL
    df = 4 ft
    k = 0.5 ft/day
    hf = .05 ft
    tf = 2 days

    Af = [(WQv) * (df)]/[(k) * (hf + df) * (tf)]
    Af = [(7585.97x4)/(.05x (.05+4)x2)]
    Af = 6743 sf

    ACTUAL VOLUME PROVIDED = 6,759 sf

PEDESTRIAN PATHS AROUND FORT AWESOME POROUS PAVERS

STORMWATER COMPUTATION FOR POROUS PAVEMENT (A):

1. DRAINAGE AREA

TOTAL AREA = 12,202 SF = .28 AC

P = 1.2

I = 100%

Rv = 0.05 + (0.009X100) = 0.95

WQv = 1158.70 cf

2. REQUIRED POROUS PAVEMENT AREA

IR = .50 in/ho

Vw = 1,159 cf

n = .40

dt = .67 ft

Ap = Vw/ (n) dt

Ap = 1,159/ (.40) .67

Ap = 4,323 sf

SURFACE AREA PROVIDED = 4564 sf

STORMWATER COMPUTATION FOR POROUS PAVEMENT (B):

1. DRAINAGE AREA

TOTAL AREA = 3,387 SF = .08 AC

P = 1.2

I = 100%

Rv = 0.05 + (0.009X100) = 0.97

WQv = 330.62 cf

2. REQUIRED POROUS PAVEMENT AREA

IR = .50 in/ho

Vw = 331 cf

n = .40

dt = 1 ft

Ap = Vw/ (n) dt

Ap = 331/ (.40) 1

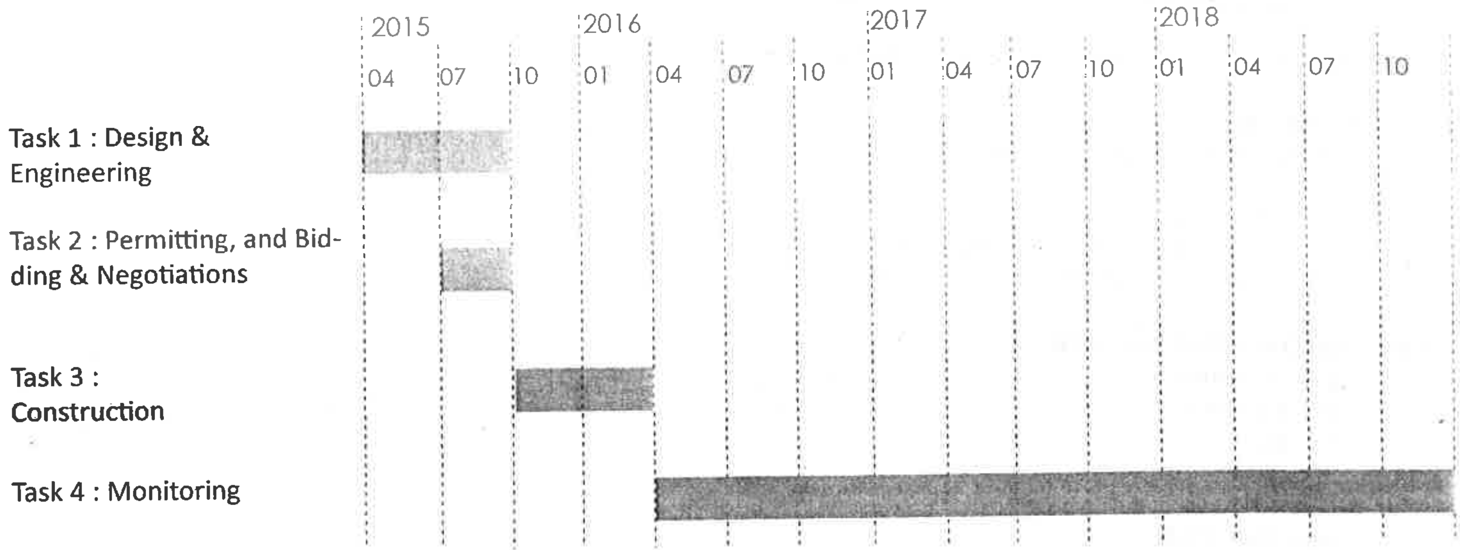
Ap = 827 sf

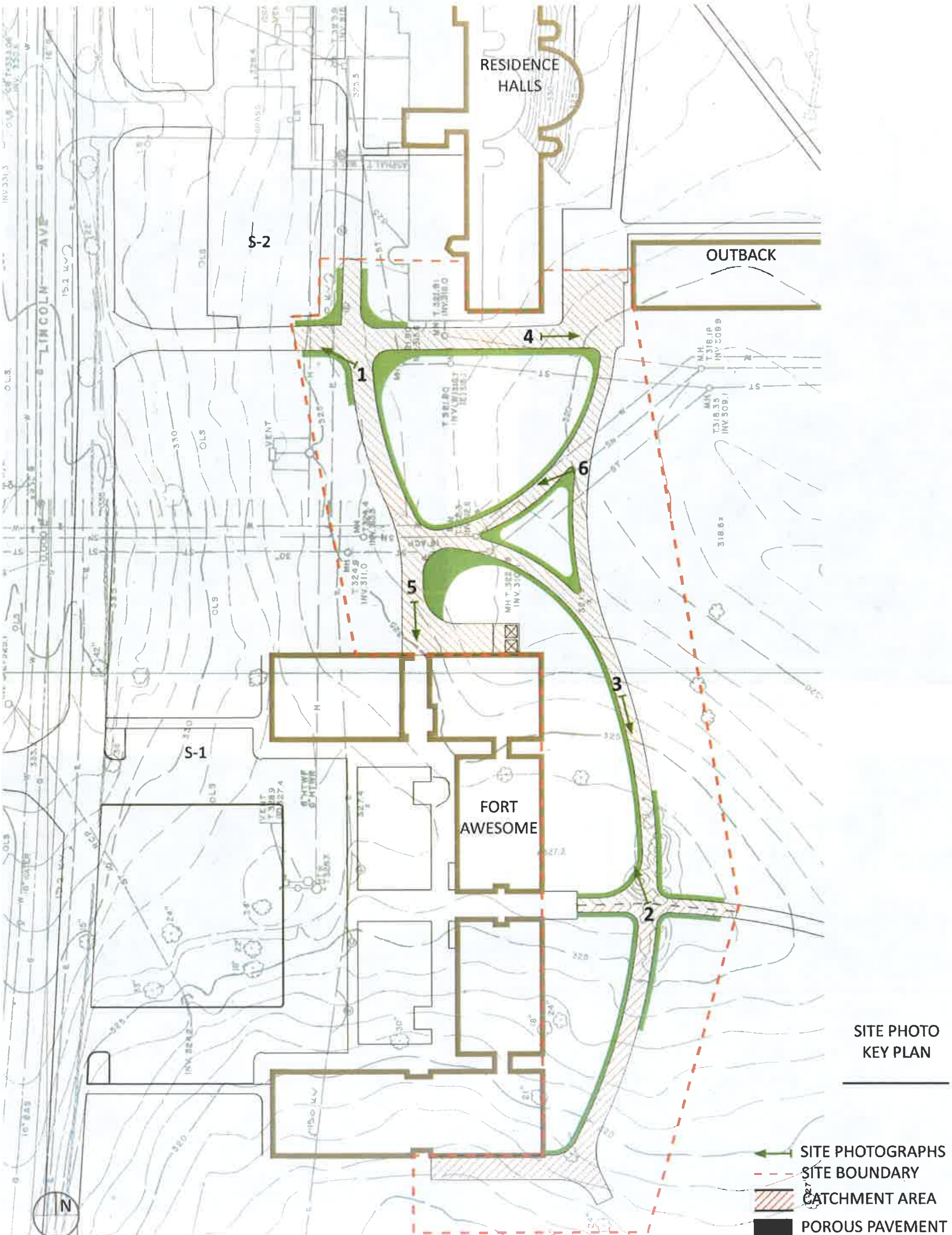
SURFACE AREA PROVIDED = 840 sf

5.3 Other Alternatives Considered

Additional stormwater in the third catchment area in each lot, W-1 and W-2 could possibly be managed by combining the bioretention areas. However, this pushes the drainage area up to the maximum of 5 acres per bioretention area, with a portion of the area to be managed by the existing storm drainage system.

VI. Proposed Project Schedule





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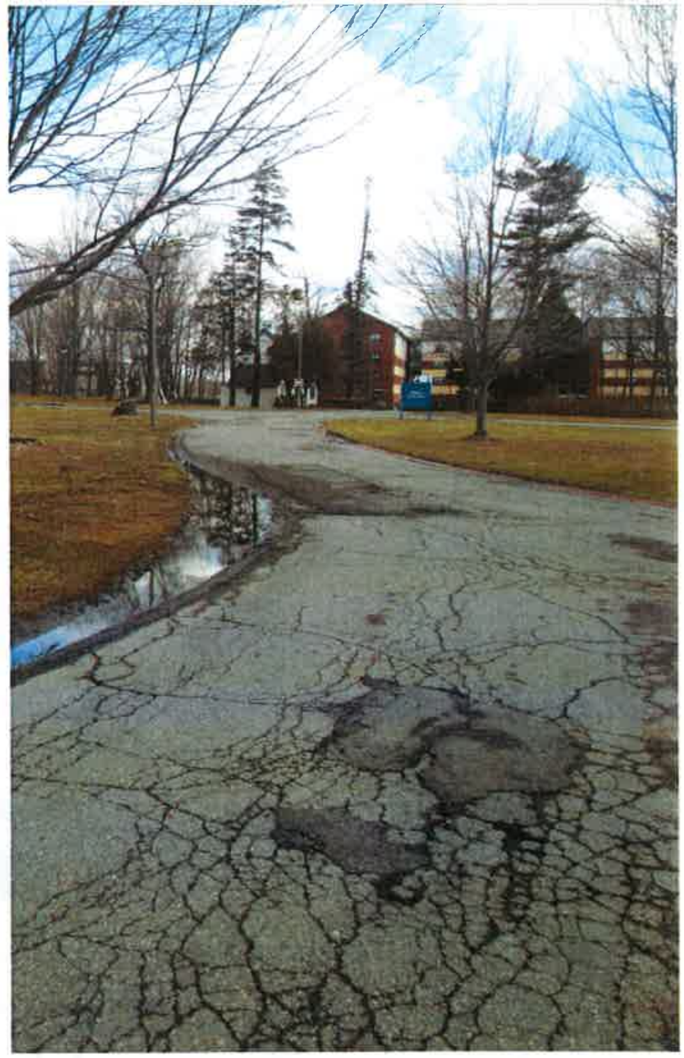
POROUS PAVER, SITE PHOTOGRAPH 1



POROUS PAVER SITE, PHOTOGRAPH 2

POROUS PAVER SITE, PHOTOGRAPH 3

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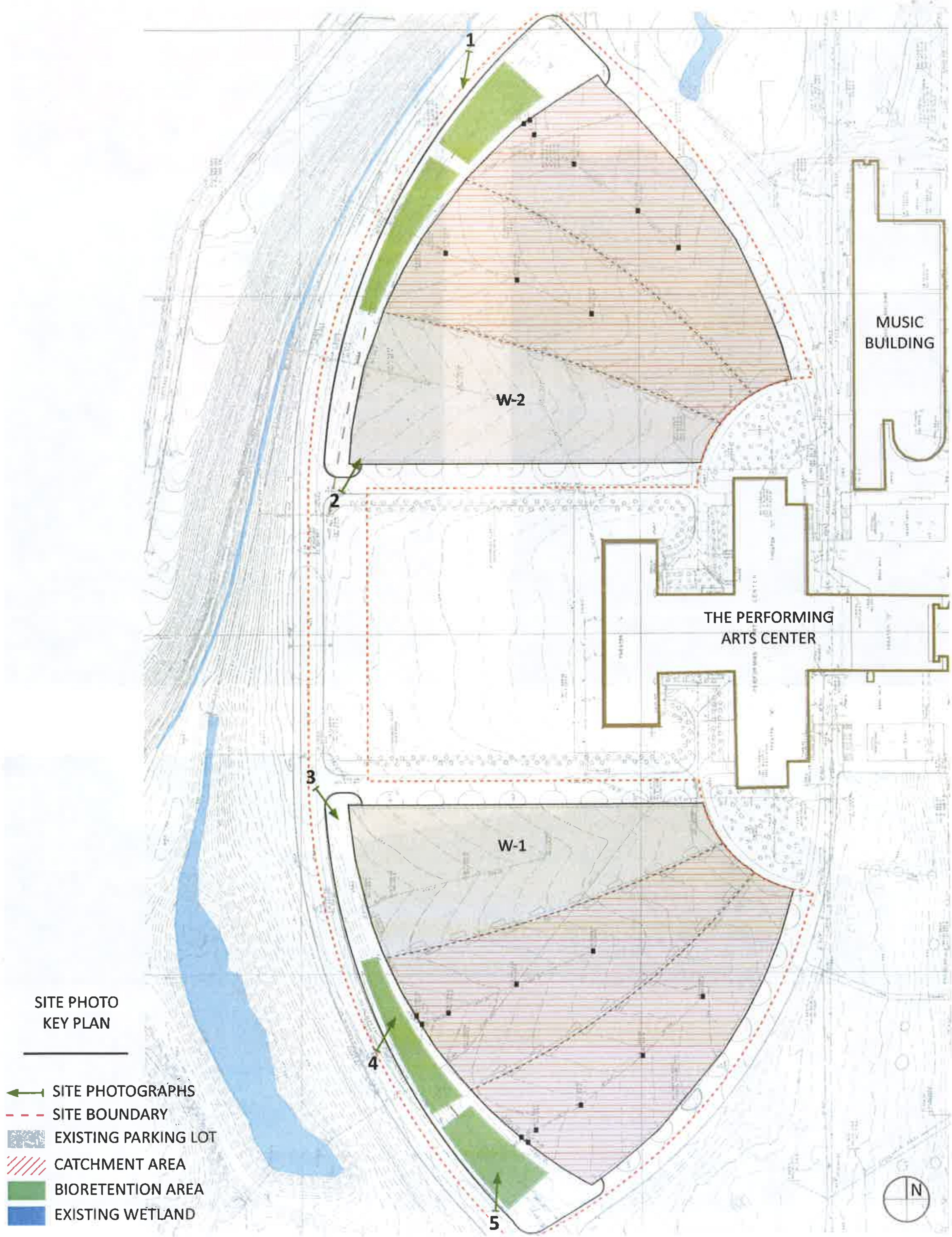
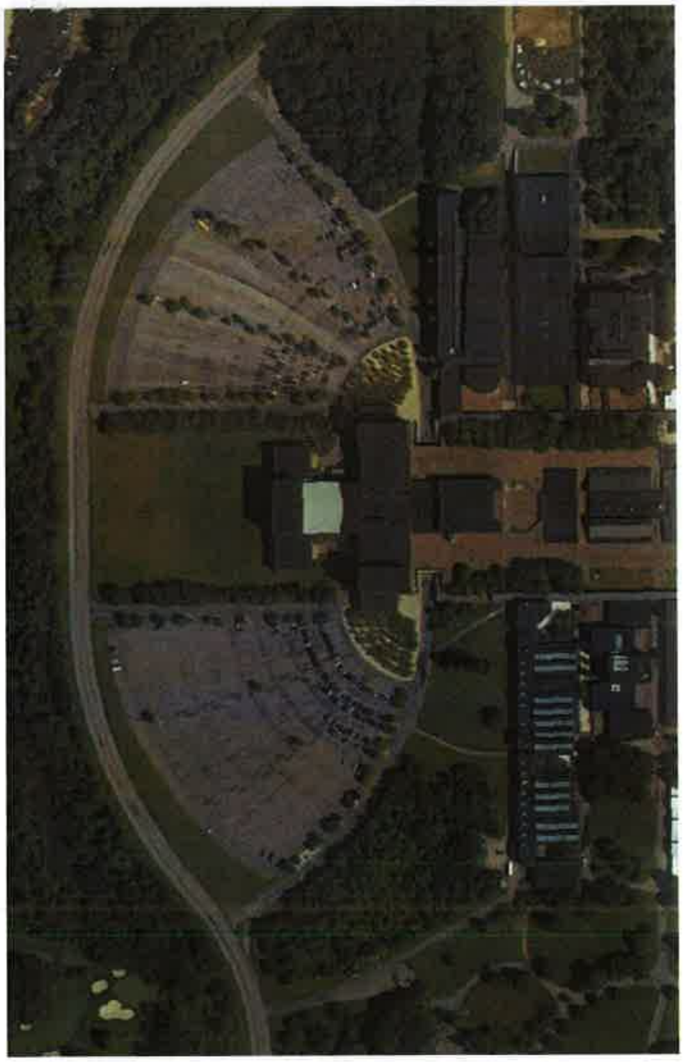
POROUS PAVER SITE, PHOTOGRAPH 4

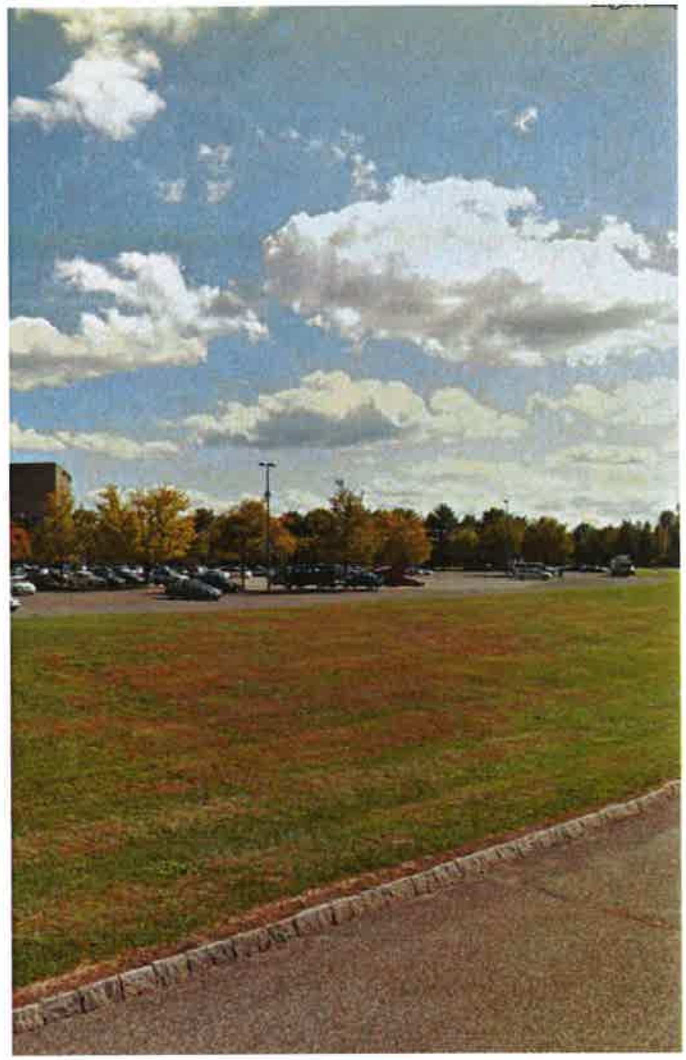
POROUS PAVER SITE, PHOTOGRAPH 5

POROUS PAVER SITE, PHOTOGRAPH 6


1
2
3
4
5
W-2
W-1
MUSIC BUILDING
THE PERFORMING ARTS CENTER
SITE PHOTO KEY PLAN
SITE PHOTOGRAPHS
SITE BOUNDARY
EXISTING PARKING LOT
CATCHMENT AREA
BIORETENTION AREA
EXISTING WETLAND
N

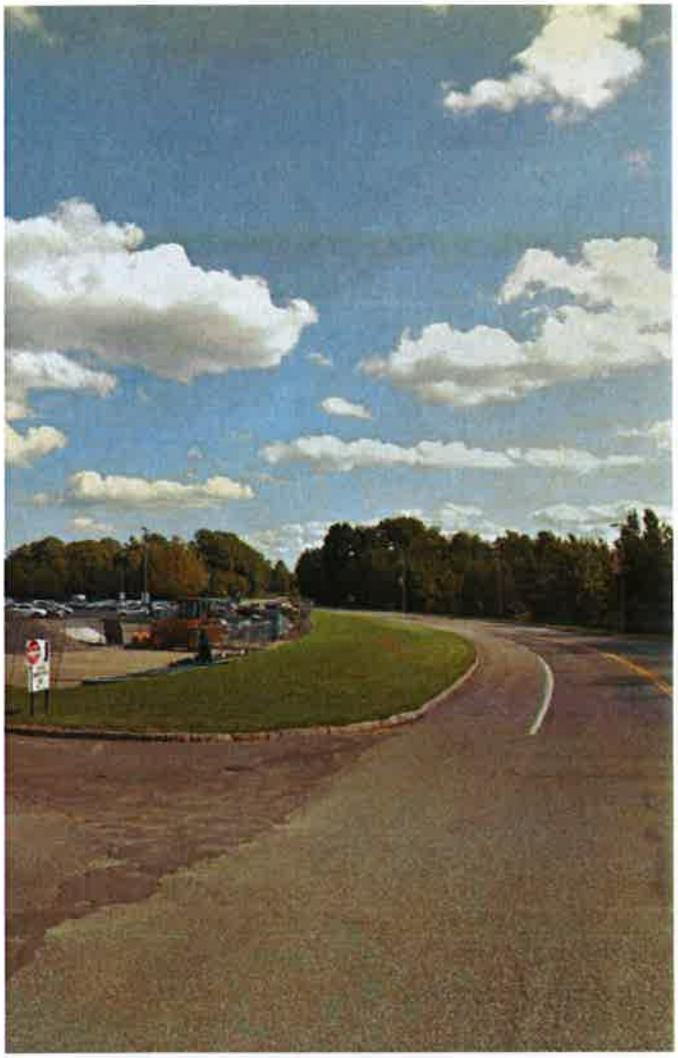


(W - 2, W - 1) PROPOSED BIORETENTION AREA, AERIAL VIEW

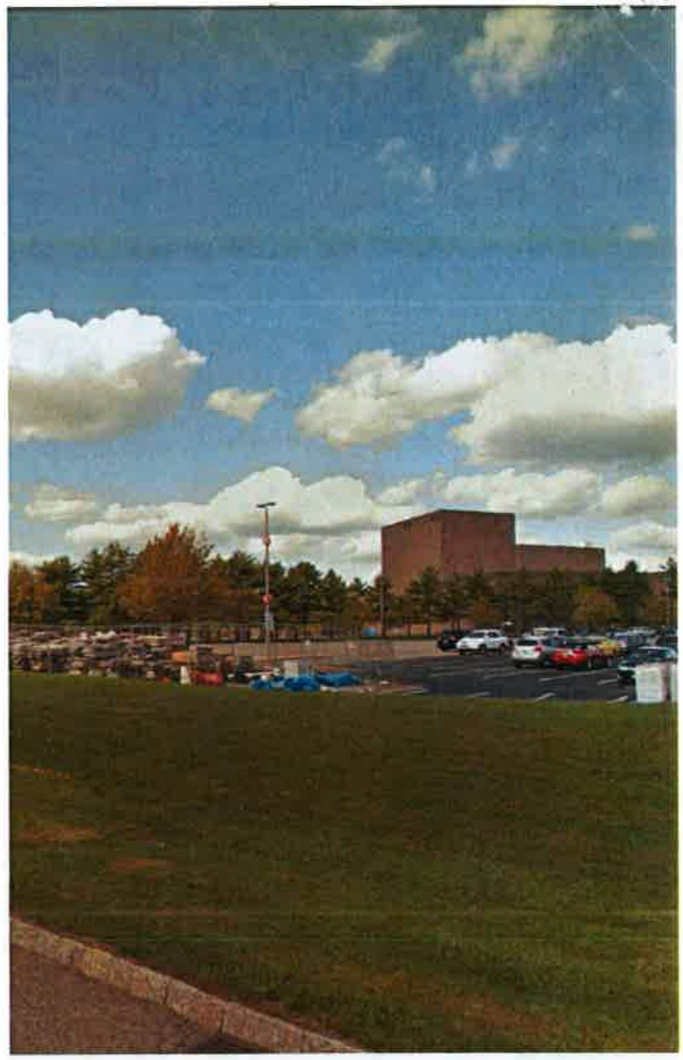


(W -2) PROPOSED BIORETENTION AREA, SITE PHOTOGRAPH 1

(W -2) PROPOSED BIORETENTION AREA, SITE PHOTOGRAPH



(W -1) PROPOSED BIORETENTION AREA, SITE PHOTOGRAPH 3



(W -1) PROPOSED BIORETENTION AREA, SITE PHOTOGRAPH 4

(W -1) PROPOSED BIORETENTION AREA, SITE PHOTOGRAPH 5