President's Message
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Executive Summary

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COMMUNITY ENGAGEMENT & TRADITION

As the sixth-oldest college in the United States, Moravian College has established its legacy as a provider of values-based liberal arts education in a caring environment, through which it nurtures in students the capacities for leadership, lifelong learning, and positive societal contributions. Throughout two and a half centuries, Moravian College has thoughtfully planned its future along a path that has proven successful. In today's era of changing technology, pedagogy, and student expectations, the College has prudently pursued a Master Plan to guide its next fifty years of growth and development.
This Master Plan gives physical form to the institutional mission identified in the College’s 2008 – 2015 Strategic Plan:

“Moravian College is a residential, liberal arts college that draws on the Moravian traditions of community, engagement in the world, and balance among body, mind, and spirit in the life of the individual. The College seeks to develop in students of all backgrounds the capacity to learn, reflect, reason, communicate, and act with integrity as individuals and in association with others. This education prepares men and women for advanced study and continuous learning, individual achievement, and leadership and service for the common good.

Thus, we envision a strong and vital Moravian College that, in the future, will be:

**A COMMUNITY OF THE GREAT EMBRACE**, welcoming men and women from all walks of life, locally, nationally, and globally;

**A COMMUNITY OF LIBERAL LEARNING**, where scholarship, intellectual curiosity and creative expression invigorate all facets of our lives;

**A COMMUNITY OF SERVICE**, which equips and empowers men and women to serve others with professional skill, grace, and integrity, including those who live out their lives on the periphery of society;

**A COMMUNITY OF WISE STEWARDS**, who care for and enhance our treasures of heritage, people and place for generations to come;

As such, Moravian will be a leader within higher education—a community of choice for students, faculty, and administrators, a model of excellence.”

**WHY PLAN NOW?**
This Master Plan provides a flexible framework for future campus development that allows Moravian to grow in both a functional and visually appealing manner, one that respects its rich heritage and identity of place. The Plan also enables the College to develop its physical grounds in support of the 2008 – 2015 Strategic Plan: providing a strong liberal-arts education to students of all backgrounds. The Master Plan responds to programmatic relationships, the creation of open spaces and pedestrian connections, natural systems, parking needs, and building systems. It has developed as an adaptable document that will accommodate changes in program, priorities, and funding. Based on principles that are expressive of the College’s unique history, culture, location, and mission, the Plan establishes an agenda for development that helps strengthen the physical environment of the campus without prescription or limiting creativity.

Moravian College’s leadership has embarked on a variety of planning activities in the past five to seven years, making the timing right to coalesce these various efforts into one, cohesive campus master plan. The 2002 PEAR Plan (Physical Education, Athletics, and Recreation), 2006 Dream Commission Report (Residence Life), 2006 MAP II (Moravian Academic Plan), Property Acquisition Plan, and 2008 College Strategic Plan have all influenced the master plan. Another major effort influencing the master plan has been the extensive Preservation Master Plan for Moravian College completed for the three campuses in early 2009. The City of Bethlehem has recently updated its own ten-year comprehensive plan, which
has obvious implications for the College. As well, leadership within the College continues to focus on strategic partnerships with groups such as the Bethlehem Area Moravians, the City of Bethlehem government, and the Lehigh Valley Association of Independent Colleges and Universities (LVAIC). There is obvious excitement about the timing and synergy between these multiple efforts, which directly inform the plan. The result is a plan to guide the College’s development for the next fifty years.

Several other factors make the timing right for a new campus master plan at Moravian College. Moravian completed its last master plan in the mid-1970s, with updates based on building programs in 1998 and 2002. However, this previous plan focused primarily on building footprints and campus axes and alignments within distinct precincts of campus. The College community has come to realize the importance of including other factors, such as department adjacencies, connectivity at multiple scales, partnerships with the city and surrounding neighborhood, greenways, and sustainability, in this campus master plan. Taking a fresh approach and creating a new master plan ensures that these factors are incorporated as central themes.
MASTER PLAN GUIDING PRINCIPLES
Upon observing the campus and interviewing over 100 campus constituents, the planning process established a set of guiding principles representing important aspects of the campus and surrounding neighborhood. The guidelines will direct future growth on Moravian’s campus. Informed by the mission, vision, and strategic plan of the campus, the guiding principles are the foundation for future planning.

Honor Our Culture
» Support the College’s mission to educate the Mind, Body, and Spirit
» Cherish Moravian’s rich heritage and history
» Respond to change by embracing the “new” and maintaining harmony with the “old”
» Promote diversity while supporting the individual

Improve the Sense of Place
» Develop a cohesive identity: branding locally, thinking globally
» Build a greater sense of community, positioned for growth
» Create and restore landscapes on campus
» Advocate for the preservation of the historic fabric of campus
» Adopt sustainable practices for adaptive reuse and new projects
Three Campuses – One College – Multiple Connections
» Integrate Main Street, Hurd, and the Moravian Athletic Complex, and celebrate their contributions to the College’s identity
» Cultivate the Moravian Mile as an asset to the campus and City of Bethlehem
» Nurture and grow the pedestrian connections to the College and the City
» Strengthen and expand the College’s relationships with the City of Bethlehem
» Explore innovative partnerships that improve multiple community connections

HIGHLIGHTS OF THE PLAN

The following highlights touch on the thematic goals and recommendations of Moravian’s master plan. Unless otherwise noted, this list applies to both the Main Street Campus and the Hurd Campus. The planning team equally considered and weighed the needs of the two campuses. The goals are broadly inclusive of both campuses. How they will be implemented is specific to each campus.

The ‘Final Plan’ section of this report explains these goals at greater length.

» Improve utilization of campus geography and buildings
» Focus Main Street campus growth to the south and east
» Locate select campus elements north of Elizabeth Avenue, with improved connectivity (parking, recreation, Comenius Center, nursing)
» Concentrate academic and student needs within the core of Main Street campus
» Strengthen pedestrian connections, crossings, and campus gateways
» Decant parking to the perimeter of campus
» Enhance the landscape to create a holistic network of courtyards and connected open spaces
» Integrate with the urban context and continue collaboration with the City of Bethlehem
Existing campus (at left) and Proposed master plan (at right)
Introduction

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VALUES STATEMENT

Prior to the start of the planning process, the Moravian College community identified thirteen important features central to the Moravian experience. The planning team used these thirteen points to develop principles that guided the Master Plan process from inception to conclusion.
This image represents Moravian College’s mission and values in a graphic form. The larger the word, the more frequently it appeared in the values statement of the College.
THE THIRTEEN POINTS INCLUDE:

» Moravian College comprises three distinct institutions (a traditional, residential liberal arts college; an evening division; and a graduate theological seminary), each with a unique mission and philosophy, with a shared heritage and commitment to an education grounded in the liberal arts.

» We must meet the academic and co-curricular needs of our students, faculty and staff in a manner consistent with our commitment that education includes mind, body and spirit.

» We wish to effectively integrate and celebrate the three physical campuses within the City of Bethlehem (Main Street Campus, Hurd Campus and the Moravian Athletic Complex).

» We wish to create a greater sense of community while positioning the College for future growth.

» We strive to embrace “the new” in harmony with “the old” as we address matters of institutional importance.

» We are an integrated Community of Learning, committed to be responsive to the changing needs of students, faculty and the local and global environment.

» We are committed to the creation of a sustainable community including matters of the environment, energy consumption and building “longevity.”

» Moravian aspires to be a pedestrian friendly campus and to provide attractive and appropriate “green space.”

» We are committed to be good neighbors and partners with the City in order to enhance our place in the community; we wish to strengthen our position as a community resource and continue to provide cultural, intellectual, athletic and other services to residents and community leaders.

» We are committed to strengthening our position as a Residential College.

» The College has a rich cultural and historical tradition that we want to maintain and celebrate.

» Moravian College is committed to becoming a campus with “curb appeal” that is attractive and responsive to current and future students, our employees and visitors.

» Moravian College welcomes, respects, and accommodates individuality and diversity in backgrounds, perspective, teaching and learning.
The planning process at Moravian College involved a broad range of participants, including faculty, staff, students, alumni, and community members. An Oversight Committee reviewed the progress of the Plan at periodic dates between February and October 2009. The Oversight Committee, combined with a team of consultants, formed the “planning team” for the project. The planning team consulted representatives from the City of Bethlehem, the Moravian Theological Seminary, the Moravian Church, and the Comenius Center during the phases of the project, which included:

**OBSERVATION PHASE**
The Observation Phase measured the quantitative and qualitative aspects of the campus, providing an overall understanding of the College and insight towards the development of guiding principles that reflect the culture, philosophies, and setting of the Moravian College campus. These principles are the foundation for the Concept Plan.

**CONCEPT DEVELOPMENT**
The Concept Plan is a graphic representation of the Guiding Principles and summarizes the analysis gathered during the Observation Phase. Broad-brush in its approach, the Concept Plan diagrammatically conveys the ideas generated during the Observation Phase, ensuring the plan remains true to its original intentions throughout the entire design process.
PRECINCT STUDIES
This phase studied the campus in detail by testing design solutions for discrete areas of campus. The planning team developed potential spatial organizations for buildings, investigated various program adjacencies, and integrated open space concepts to find the optimal relationship for each design.

DESIGN GUIDELINES
The Design Guidelines Phase resulted in broad recommendations to direct the design of future projects at Moravian College. The Guidelines will sustain the Plan’s intentions by preserving special qualities of the campus while addressing issues that relate to site planning, landscaping, and building mass and character. In addition, the Guidelines address gates, walls, signage, site furnishings, walks, and sustainability initiatives.

FINAL PLAN
To produce the Final Plan, the team refined the ideas and concepts generated during the previous four phases. The Final Plan detailed and documented within this report proposes buildings, open spaces, and landscape treatments for the campus. Included in this report, and essential to implementation, is a project list (found at beginning of Appendix), that describes how the Final Plan will be achieved over time.
Observations and Analysis

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CONTEXT

CAMPUS HISTORY

As the sixth oldest College in the United States, Moravian’s history is rich and deep and is intertwined with the history of the Moravian Church and the City of Bethlehem. The College’s history is actually that of two separate Moravian schools, which merged relatively recently, in 1954. The origins of those schools, however, began several centuries prior with the creation of the Moravian Church. As a religious community, the Moravians have historically valued education for both men and women of all social and economic classes. An early leader of the faith, John Amos Comenius, championed these ideals, earning him the appellation of “the father of modern education.”
The earliest Moravian settlers in the United States carried Comenius’s notions of education with them. It is not surprising, then, that within a year of establishing the town of Bethlehem, Pennsylvania, the Moravian community established its first school. Believing that all human souls were capable of redemption, the Moravians felt it imperative to offer education to all people, as a means to salvation. This also influenced their strong missionary efforts in the New World.

In 1742, the Countess Benigna von Zinzendorf established a boarding school for girls. This school had a dynamic history: moving locations, backfilling spaces within the Church’s property holdings, and expanding educational programs. Prior to and during the American Revolution, the school earned a strong reputation and attracted young women from across the fledgling American colonies. In 1785, the school began admitting non-Moravian students due to strong demand, calling itself the “Moravian Seminary for Young Ladies.” The school’s music program flourished during the early to mid-1800s by attracting top instructors from European conservatories. This, in turn, increased student enrollment in the program and earned the City of Bethlehem a reputation for being a center for musical talent and performance. In 1913, the school changed its name to the “Moravian Seminary and College for Women.” Its music and fine arts programs continued as the foundation and bedrock of the school. The eminence of Moravian’s early music program remains relevant and strong today.

In 1743, one year after the Countess Zinzendorf established the boarding school for girls, the Moravian community in Bethlehem established a boys’ school. Like the girls’ school, the boys’ school shared a dynamic experience of moves, name changes, and expansion. In 1759, the boys’ school moved to Nazareth, Pennsylvania, where it remained until it closed in 1929. Long before its closing, the Moravian College and Theological Seminary (referred to as the “Men’s College”) split from the boys’ school program and evolved separately. In 1863, the state of Pennsylvania granted accreditation to the Men’s College and Seminary. In 1888, while the boys’ school remained in Nazareth, the Men’s College relocated to a tract of vacant farmland on the north side of the City of Bethlehem, which the Bethlehem Moravian congregation gave to the school. The Men’s College immediately added two buildings to house the functions of the school: Comenius Hall (1890) and Zinzendorf Hall (1890). By 1896, the Men’s College had also begun offering a liberal arts degree program. In 1922, it achieved accreditation from the Association of Colleges and Secondary Schools of the Middle Atlantic States. This was a major milestone for the Men’s College, awarded just twenty years prior to its bicentennial celebration.

The twentieth century witnessed significant changes to the higher education system in the United States. Major world conflicts, wild economic cycles, and enhanced access to education shaped the fates of many schools. The Men’s College and the Moravian Seminary and College for Women were not immune to these forces of change. During the initial decades of the twentieth century, the Moravian Seminary and College for Women thrived, as families began to invest in higher education. However, by the mid-1900s, the Moravian Seminary and College for Women was a struggling institution, largely because it lacked an endowment and its financial resources were dependent on student tuition and fees. Student enrollment had dropped for a number of reasons, including the unfulfilled need for accreditation from the Middle States Association. Other potential factors included a low birthrate during the Depression, the abundance of jobs for high school graduates, which made college seem less necessary, and the impact of the Korean War on students’ ability to afford private school or college. The Men’s College also struggled during the first half of the twentieth century. Many of its students had to leave school in order to serve in WWI and WWII. However, by the late 1940s, the school began to reap the benefits of investments made in new
facilities in the 1940s. The pent up demand for higher education among returning veterans increased enrollment at the Men’s College from 191 to 336 students in a single year.

By 1950, it was evident that the fortunes of the two Colleges were on divergent paths. While the Men’s College planned for expansion and construction of new buildings, the Trustees of the Moravian Seminary and College for Women planned for closure of some of its programs and consolidation of others. In 1953, a Trustee for the Men’s College recommended a trial merger of the two schools. Administrations of both schools quickly agreed and announced the merger in 1954. On January 1, 1955, the merger was made official, and the new consolidated school adopted its present-day name, “Moravian College.” This merger made Moravian College the first coeducation, private college in the Lehigh Valley, a distinction that honors the legacy of Countess Zinzendorf’s boarding school established in 1741. In 2001, what had been known as the Church Street campus, home to the Moravian Seminary and College for Women, adopted the name “Priscilla Payne Hurd Campus” (or “Hurd Campus”) to honor a longtime benefactor and trustee of the College. The Men’s College campus is known as the Main Street Campus. Steel Field, acquired by the College in 1962, is known today as the Moravian Athletic Complex and the third of Moravian’s three campuses.

Since 1955, Moravian College has adapted quite well. It has followed a course of measured growth and continued excellence in liberal arts education. The twenty-first century mission of the College provides a direct link back to the initial values instilled by John Amos Comenius. For example, the Moravian Theological Seminary moved to the Bahnson Center in 1976, and continues today as an ecumenical learning community that prepares men and women for Christian leadership. Moravian enrolls students from varied socioeconomic, religious, racial, and ethnic backgrounds. The College expresses its Moravian heritage in musical and artistic programs of great distinction, which it shares with the Bethlehem community. With its cultural offerings, its historic campuses, the community service of its undergraduates, and its programs of graduate and professional education for adults, the College has become a valued part of the fabric of Bethlehem.

Moravian College, as the descendent of two separate educational institutions, maintains a distinctive collection of buildings, each with unusual and significant stories of their own. Many of the buildings on the Hurd Campus were constructed as part of the original Moravian settlement. Overtime, the College assumed use and ownership of these buildings. They represent the oldest in the College’s collection. Buildings constructed prior to 1840 were built for uses other than educational facilities and have been adaptively reused and repurposed over the course of two and a half centuries.


31

1600 – 1780

COLONIAL COLLEGES AND THE “NEW” UNITED STATES

1748 – Single Brethrens’ House
1768 – Widows’ House

The Single Brethrens’ House is the oldest building on Moravian’s campus. It was originally used by the Moravian Church to house the single men of the church.

1800 – 1865

EARLY AMERICAN COLLEGE BUILDING BOOM

1819 – Frueaff House
1820 – Hamilton House (purchased in 1889 by the Men’s College)
1840 – Day House
1848 – Old Chapel/Hearst Hall
1854 – Main Hall
1859 – West Hall
1867 – Peter Hall
1867 – Clewell Hall

View looking west on Church Street; Hurd Campus buildings line the left side of the street.

1870 – 1900

HIGHER EDUCATION’S GILDED AGE

1873 – South Hall
1890 – Payne Gallery
1891 – Comenius Hall
1891 – Zinzendorf Hall
1893 – Borhek Chapel

The Payne Art Gallery was originally a gymnasium but was converted to an art studio in 1963.

OBSERVATIONS AND ANALYSIS :: 31
1910 – 1940

HIGHER EDUCATION BETWEEN THE WORLD WARS

1907 – Harvey Memorial Library
1913 – Monocacy Hall
1916 – Grandstand at Steel Fields
1923 – Memorial Science Building
1930 – Colonial Hall

Today, Colonial Hall houses many of the College’s administrative offices.

1945 – 1970

HIGHER EDUCATION’S GOLDEN AGE

1952 – Johnston Hall
1960 – Rau Hassler Dormitory
1962 – The HUB
1962 – Steel Field (purchased by College)
1964 – Berhnhardt Hall
1965 – Wilhelm Hall
1967 – Reeves Library
1971 – Hall of Science
1972 – Jo Smith Hall

Johnston Hall is the campus’s athletic building, housing the basketball court, coaches’ offices, and training facilities.

1975 – 1995

CLOSE OF THE TWENTIETH CENTURY

1978 – Beck Hall
1978 – deSchweinitz Hall
1982 – Foy Concert Hall
1988 – Hillside Complex
1989 – Spangenberg
1989 – Antes
1989 – Burnside
1989 – Lenape
1990 – Nitschmann
1991 – Breidegam Field House

The Hillside Complex consists mainly of townhouse-style apartments for three to five students, and two larger units used for special interest housing.
The Priscilla Payne Hurd Academic Complex (PPHAC) was the first new building on campus in over ten years.

2000 – present day

TWENTY-FIRST CENTURY EDUCATION

2003 – Priscilla Payne Hurd Academic Complex (PPHAC)
2009 – Hurd Integrated Living Learning (HILL) facility
CITY HISTORY
As evidenced by the history of the College, the fabric of the school and the City of Bethlehem are woven tightly. Their shared history dates to 1741, when the Moravian settlers established the town, and to one year later when that community established the first school to educate its children. The College now occupies several of the buildings original to the City on the Priscilla Payne Hurd campus.

The oldest areas of Bethlehem, which are located along Main, Church, West Market, and New Streets, possess a distinct characteristic even when compared to other colonial-era towns. This is because Bethlehem began as a communal society, based on the tenets of the Moravian faith. Building plans for new construction in Bethlehem required approval from church leaders in the old country. As a result, many of Bethlehem’s original buildings have untainted European characteristics. The physical layout and design of the City today also reflects the original tenets of communal living. For example, Bethlehem’s town planning and layout favored a grid system because it created no obvious hierarchy of land or uses. The Moravian Cemetery, not a commanding estate or town hall, enjoys a prominent position in the center of what was the original town.

The Bethlehem Moravians clustered their buildings tightly for reasons of both safety and function, while also giving physical form to its mission and theological philosophies. Bethlehem’s primary communal buildings line Church Street in a manner that denotes no hierarchy between each building. These buildings today comprise the Hurd Campus. Originally, an industrial area formed in the center of Bethlehem; the Moravian community collectively “owned” these buildings and mills. The founding families in Bethlehem also created communal gardens in the center of town and, later, south of town on Sand Island. Farm buildings populated the area to the north, and the community kept extensive farmlands in this area, with orchards to the east of town. The Bethlehem Moravians donated a portion of this farmland to provide a home to the Men’s College, which eventually became Moravian College’s Main Street Campus.
By the 1760s, the Moravians began to move away from the communal living model, and their settlement transitioned into a church-village. However, Bethlehem has retained many of those identifiable features. The City’s founding members believed in letting intangible ideals direct and inform the physical landscape. Today, this provides a helpful precedent for the College as it addresses its own Master Planning principles.

In 1845, Bethlehem had a population of just over 1,000 residents and was officially incorporated as a borough. This seems distant when compared to the thriving community of 72,704 residents that Bethlehem is today. During the Industrial Revolution, Bethlehem gained renown globally for its coal, iron, and steel production. Ease of access through the railroad and canals enhanced Bethlehem’s position. During this period, the Bethlehem Steel Corporation shaped the fortunes of the City. In 1942, Bethlehem Steel was the second-largest steel corporation in the world, with a mill campus that extended over four miles along the Lehigh River and employed thousands. The strength of Bethlehem Steel grew during World War II; it became the largest single manufacturer of military materials in the world. At its peak, the company employed 32,000 people in Bethlehem. However, Bethlehem Steel followed the same sad trajectory of other steel corporations in the US. By the end of 1995, it had ceased steel-making operations at its Bethlehem plant. Largely, the City of Bethlehem has managed to weather this major economic loss; although today, manufacturing represents only 15 percent of the City’s economy. The memory of Bethlehem Steel has a physical presence in the blast furnaces that remain a backdrop to the City and the College.
REGIONAL CONTEXT

Today, the historic city of Bethlehem is centrally located in one of the fastest growing areas in Pennsylvania. Allentown, just ten miles west of downtown Bethlehem, is the third largest city in the state, after Philadelphia and Pittsburgh. Close proximity to New York City (80 miles) and Philadelphia (70 miles), along with a network of interstate highways, has fueled much of the growth. Interstate 78 provides direct access to New York City to the east, and Interstate 476 provides quick travel to Philadelphia to the south. State Route 22 is the main artery into downtown Bethlehem off these major highways. Further to the north, Interstate 80 stretches from New York City to San Francisco, California, putting the city of Bethlehem on a highly used, cross-country corridor.

Bethlehem is part of the Allentown-Bethlehem-Easton metropolitan area, the sixty-fourth largest in the country (out of 362), with a population of 794,961 people. According to the US Census Bureau, the City of Bethlehem has an estimated 2008 population of 72,241 people, an increase of one percent since 2000. Poverty, high school graduation, and employment rates in Bethlehem are all close to the national average. However, the most noticeable demographic shift in Bethlehem in the past decades has been the increase in Hispanic/Latino population.

In 2000, 18.2 percent of the Bethlehem population identified as Hispanic or Latino. A 2008 estimate places this percentage at 21.3 percent, appreciably higher than the US average of 14.7 percent. According to the same estimates, 17 percent of those living in the city of Bethlehem speak Spanish (or Spanish Creole) at home. These changing demographics have meaningful implications for Moravian College; the oldest educational values of the Moravians, championed by John Amos Comenius, are that learning should be available to all, that teaching should be in accord with human nature, and that education should be applied to practical uses. The College’s strategic mission has expanded in recent years to better reflect the needs of its surrounding community, ensuring that learning is available to all regardless of race and socio-economic barriers.
Moravian is not alone in providing high quality education in the Lehigh Valley. The College is a member of the Lehigh Valley Association of Independent Colleges (LVAIC). The members of this consortium consist of Cedar Crest College, DeSales University, Lafayette College, Lehigh University, Moravian College, and Muhlenberg College. LVAIC schools employ over 5,000 individuals and enroll more than 15,000 full- and part-time students. LVAIC estimates the economic impact of its schools is over $1 billion annually. Moravian College has found its involvement in LVAIC to provide opportunities to share information, technology, and resources with its peers.

The Vicinity Plan shows the College’s context within the City of Bethlehem. Existing road, water and open space systems that influence a visitor’s experience arriving at campus are represented.
ZONING

As the campus and city histories make evident, Moravian College is a central facet of the city of Bethlehem. The two are cooperative partners, with the community benefiting from several collaborative projects. The College follows City zoning regulations on uses and construction. However, the Private Institutional zone that the College falls under is intentionally flexible:

“The City intends to be flexible regarding what is allowed in the core of the Moravian campuses. However, special attention should be paid to ensuring campus edges are compatible with adjacent neighborhoods. For example, tall heights may be most appropriate in the core of a campus, while a three-story height limit may be more appropriate next to a neighborhood.”

Clear communication and sharing of information between the College and the City will ensure that this healthy relationship continues into the future. The parallel efforts of completing the City’s Comprehensive Plan as well as the College’s Master Plan will prove beneficial to further collaborative partnerships of shared interests.
Recent improvements to Moravian’s campus have been successful at integrating the built environment within the natural landscape. For instance, pedestrian paths have been improved with consistent site furnishings such as benches, receptacles, and plantings. The Moravian brand has been strengthened with prominent new banners that create a cohesive look. By taking these steps, the College has reinforced the importance of creating welcoming environments inside and outside the buildings. The Master Plan increases the size and number of open spaces on campus and integrates them into a network to reinforce connectivity and maintain a compact, walkable campus.
TOPOGRAPHY
Moravian College is located in the Lehigh River Valley at an elevation of approximately 300 feet above sea level. The campuses are situated above the lower elevations of the Monocacy Creek to the west and the Lehigh River to the south. The Main Street Campus is relatively flat, except on the western edge where the topography drops approximately forty feet to the Monocacy Creek flood plain. The center of the Hurd Campus is at an elevation of 260 feet and drops off approximately thirty-five feet to the flood plain of the Lehigh River.

GEOLOGY
The campus is situated upon dolomite, a carbonate rock associated with karst topography and sinkhole formation. Consideration should be given to sinkhole formation when planning and designing stormwater management features.

The predominant soil type present on the Main Street Campus and the Moravian Athletic Complex – Urban land, Boonton complex or UbB – generally has bedrock at 3 – 10 feet below the surface. This soil type increases stormwater runoff tendencies.
HYDROLOGY

The campus is part of the Lehigh River drainage area and the Monocacy Creek Watershed, located along the eastern bank of the lower reach of Monocacy Creek. The Main Street Campus is approximately one mile from the confluence of Monocacy Creek with the Lehigh River, and the Hurd Campus is located directly on the confluence. Along stretches of the Monocacy, a well-preserved riparian corridor is present that keeps the creek shaded and cool during the summer months. This provides an excellent habitat for migrating and nesting birds; over eighty species of birds have been documented annually along the banks of the Monocacy. The cold waters of the creek also provide ideal habitat for fish species such as wild trout.

- Portions of both the Hurd and Main Street campus fall within the Monocacy’s flood plains.
- Drainage problems are evident on campus.
- Currently, the College does not employ any water quality treatment or quantity control measures. However, most storm events are small (1.5 inches or less), meaning that the College can effectively use landscaped areas for filtering and treatment of water before it returns to groundwater or the Monocacy Creek.
- Current irrigation practices utilize potable water at Betty Prince Field and the main Quad.
- There is some erosion/gully formation at isolated stormwater outfall locations.

This diagram shows the extents of the Monocacy Creek watershed as well as the 100 year floodplain boundary of both the Monocacy Creek and the Lehigh River.
VEGETATION AND OPEN SPACES
The College maintains a cultivated network of open spaces on campus. Turf grass is the primary species in these areas, and the campus tree canopy provides many environmental benefits to the campus community. However, open spaces could be better connected and extended to the perimeter of campus.

» The native forestation on the west edge of the Main Street Campus provides a natural buffer to Mauch Chunk Road, late afternoon sun, and cold winter winds.

» The lawns in front of Comenius and Colonial Hall are considered significant for visitors, students and alumni. These well-defined open spaces are tied together through a sense of symmetry and enclosure that is enhanced by the median along Main Street.
While located in the center of campus, the plaza in front of the PPHAC on the Main Street campus is underutilized and could be improved as a campus gathering space by softening and shading the space.

The rich natural environment on the Hurd campus is primarily made up of wooded areas and tree-lined streets across from the Moravian Church.

The forested edge of the Monocacy Creek screens nearby parking lots and provides a sense of privacy to both campuses.

The lawns just south of the HILL and the pleasure grounds to the north are amenities for residents.

TRAIL SYSTEM

The Monocacy Creek corridor is a great asset, and with small improvements (i.e. better signage, lighting, resurfacing), the community could take greater advantage of the connections it affords.

A hiking/biking Monocacy Trail system exists adjacent to the Monocacy Creek for approximately three miles extending from the Ice House at Sand Island in Bethlehem to the falls at Monocacy Park.

The trail is easily accessed from the Hurd Campus via a tunnel or wooden staircase under the Hill to Hill Bridge. Main Street Campus connections are limited to a fairly steep climb up Elizabeth Road from the trail, crossing over the Creek and Mauch Chunk Road. However, it was observed and mentioned during the focus group workshops that numerous students, faculty, and staff bike along the trail to Union Boulevard and take Monocacy Street north into campus, to avoid the steep hill along the western edge of the Main Street campus.
Throughout the College’s history, its Trustees, administrators, faculty, staff, students, and alumni have been good stewards of the campus. In particular, the last two decades have witnessed a significant series of physical improvements to all aspects of campus life. Academic departments moved into the newly constructed PPHAC. Residence Life built the Hillside, Spangenburg, Antes, Burnside, Lenape, Nitschmann residence halls, and, most recently, the Hurd Integrated Living Learning facility (the HILL). The construction of Briedegam Field House greatly benefited the athletics and recreation program. The College has evaluated campus buildings and infrastructure so that those in urgent need of critical maintenance and repair will receive prioritized funding and renovation work.
CAMPUS AND BUILDING LAND USES

» On the Main Street Campus, the distinction between uses is well-defined and stratified. Student housing rings the westernmost periphery of campus. Academic and student life buildings are within the core of campus, and administrative buildings tend to ring the easternmost periphery of campus.

» On the Hurd Campus, uses are more integrated between buildings. Some of the academic buildings here contain student life functions, such as gallery space and/or performance space. Often, the public is invited to attend events in these spaces. The new Hurd Integrated Living Learning (HILL) facility is a mixed used building, with residential, academic, and student life spaces.

» The Moravian Athletic Complex is used solely for athletics and recreation purposes.
SHUTTLE BUS AND WALKING DISTANCES

The College offers a shuttle bus service for all students, faculty, and staff. This shuttle provides free service between the Main Street Campus, the Priscilla Payne Hurd Campus, and St. Luke’s Hospital. The shuttle does not serve the Moravian Athletic Complex so most students will walk along Laurel Street and Elizabeth Avenue to reach it from the Main Street campus.

» The shuttle is student-oriented and does not serve commuter traffic.
» The buses begin their runs at 7:00 a.m. and continue until half an hour after Reeves Library closes. They depart continuously from two locations: in front of the HUB, and in front of the HILL.
» Currently, the College runs two or three shuttles depending on class schedules, transporting 1,200 daily riders.
» As pedestrian circulation is the lifeblood of campus activity, five-minute walking circles are shown from the center of each campus. The diagram shows each circle with a radius of ¼ mile walk.
» Using this method, a twenty-minute walk separates the Main Street and Hurd campuses, while the distance from Comenius Hall to the Moravian Athletic Complex is about a seven-minute walk.

These diagrams show circles with a radius of a five-minute walking distance overlaid with the campus shuttle route.
VEHICULAR CIRCULATION

Academic and residence life functions occur on both the Main Street and Hurd campuses, making strong connections between the two critical to the operations of the College. The shuttle bus system serves as the primary mode of transportation between the campuses, supplemented by walking and bicycling.

» While the new HILL facility on the Hurd campus will increase the number of patrons that use the shuttle, the introduction of a third shuttle bus is expected to meet this demand.

» The grid network of streets around the campuses helps to diffuse traffic and provides routing options for emergency vehicles, visitors, and the shuttle bus.

» Streets surrounding campus are maintained by either the State or the City, depending on the street. Elizabeth Avenue is a key part of the region’s road network and is classified by PENNDOT as a minor arterial, with less than 10,000 cars per day.
PEDESTRIAN CIRCULATION
Several areas were noted where pedestrian safety is a concern as a result of conflicts with vehicular traffic, primarily on high volume roads adjacent to campus such as Main Street and Elizabeth Street.

» The College is limited in its ability to address certain pedestrian conflict zones. For instance, problem areas along West Elizabeth Avenue are a result of topography and the proximity of existing housing to the street. This is not a problem with an easy solution.

» Campus Safety indicated that vehicular crashes are not uncommon at the intersection of Elizabeth Avenue and Main Street. Further south, the intersection of Main Street and Broad Street was identified as a vehicular crash “hot spot” in the City’s Comprehensive Plan.

» Best management practices that would increase the visibility of pedestrians and slow vehicular traffic could alleviate some of the conflict areas along Locust, Laurel, Main, and Church Streets.

» Traffic speeds and volumes within the campus are generally low enough that pedestrian safety is not as noticeable a problem as at the campus edges.

» Internal campus roads incur minimal traffic and could be transformed to better serve the campus population.
There is a perception by the college community that there are too few parking spaces on campus. However, parking counts suggest the supply of parking meets the campus community’s demand. Lots that are only slightly more distant from the campus core usually have spaces available.

- There are approximately 850 parking spaces on the three campuses.
- Street parking and surface lots that are adjacent to academic and athletic buildings or housing on campus are in high demand, as expected.
- The parking system is managed conservatively and strictly enforced; making day-to-day parking problems comparatively few.
- During special events, the College experiences higher parking demands that create issues with remote parking, accessibility to the campus, and pedestrian safety.
These diagrams show the surface parking lots on the Main Street and Hurd campuses aggregated as one mass, to illustrate the space they take up in land acreage. On both campuses, the acreage of all the surface lots combined is equal to approximately the area of the core campus.
EDGES AND GATEWAYS

There are multiple entry points to all of Moravian’s campuses but when coupled with limited campus signage, it can confuse and disorient first-time visitors.

» The intersections of Main Street and Locust Street, and Elizabeth Avenue and Main Street mark the primary vehicular gateways to the Main Street campus. Other gateways emphasizing vehicular arrival are located at the intersections of Mauch Chunk Road and Elizabeth Avenue, and Elizabeth Avenue and Center Street.

» The Hurd campus’ primary gateways are located at the intersections of Main Street and Church Street, and Church Street and New Street. Vehicular traffic can enter the campus from the west off Main Street and from the south off of Lehigh Street.

These diagrams illustrate the multiple gateways and entry points to Moravian’s campuses.
SERVICE AND LOADING ACCESS
Service access is required in some manner to every building. Ideally, building placement, landscaping, or walls should screen loading docks and service drives from view.
» Collier Hall of Science is a good example of how a building can screen the view of service access.
» The service dock at the HUB is visible to the public, and sometimes interferes with pedestrian movements.
» In some locations, service access and pedestrian circulation share the same path, such as the western portion of Locust Street and the path between Johnston Hall and Reeves Library.
» Deliveries and maintenance vehicles were observed during class hours and between class changes, creating potential conflicts between these vehicles and pedestrians on campus.

UTILITIES INFRASTRUCTURE
The age of certain buildings on campus makes it difficult to modernize all mechanical and electrical systems. The College recognizes the need for upgrades, and the plan proposes to systematically upgrade infrastructure by pairing these upgrades with other building projects in the phasing plan. Initial observations of the College’s utilities infrastructure:
» Primary electrical service is supplied to the Main Street Campus from a lineup of exterior switchgear located west of Reeves Library. The electrical systems on campus will require routine maintenance and systematic upgrades to ensure operational reliability and compliance with codes.
» Both stand-alone gas and oil fired boilers located in individual buildings provide heating for the Main Street Campus.
» Cooling for core academic buildings on the Main Street Campus is supplied by water-cooled chillers and an underground piping distribution system. This underground chilled water piping distribution system was planned to be extended to serve additional campus buildings.
» Numerous underground fuel oil storage tanks (for building heating) exist throughout campus. Many are decades old and reportedly single wall construction. These tanks pose leak hazards and lack modern leak detection systems.
» Boilers that are at the end of their useful life provide heat for the Hurd Center for Music and Art.
» Cooling for the Hurd Campus is provided via two air-cooled chillers that are generally new and in excellent condition.
Concept Development

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During the Observation Phase, the planning team interviewed over 100 people, representing every major group within the campus, to understand how they viewed the College. Students described faculty that cared about their education inside and outside of the classroom. They also described friendly and caring administrative and support staff. Alumni explained the legacies of Moravian graduates within their own families. Faculty praised students interested in learning and an administration that supported faculty teaching. All complimented the College’s grounds and historic buildings. These interviews revealed that Moravian College is a cherished place both physically and in the minds of those who know it. The challenge for the master planning process thus became to protect and enhance what is cherished while setting a course for change and growth of the College in the twenty-first century.

The planning team created a set of guiding principles that captured the themes heard most frequently during the interview process and built upon the values presented by the College community. Campus groups, including the Oversight Committee, reviewed these principles and agreed that they would guide the planning process.
GUIDING PRINCIPLES

HONOR OUR CULTURE
» Support the College’s mission to educate the mind, body, and spirit
» Cherish Moravian’s rich heritage and history
» Respond to change by embracing the “new” and maintaining harmony with the “old”
» Promote diversity while supporting the individual

IMPROVE THE SENSE OF PLACE
» Develop a cohesive identity: branding locally, thinking globally
» Build a greater sense of community, positioned for growth
» Create and restore landscapes on campus
» Advocate for the preservation of the historic fabric of campus
» Adopt sustainable practices for adaptive reuse and new projects

THREE CAMPUSES – ONE COLLEGE – MULTIPLE CONNECTIONS
» Integrate Main Street, Hurd, and the Moravian Athletic Complex campuses, and celebrate their contributions to the College’s identity
» Cultivate the Moravian Mile as an asset to the campus and City
» Nurture and grow the pedestrian connections to the College and the City
» Strengthen and expand the College’s relationships with the City of Bethlehem
» Explore innovative partnerships that improve multiple community connections

CONCEPT PLAN

The planning team developed a Concept Plan to illustrate and give physical representation to the Guiding Principles. The Concept Plan identified areas that would be tested during the precinct studies phase of work. The plan is conceptual in nature and is meant to be interpreted loosely.

The key concepts represented by this plan are:
» Connectivity at Multiple Scales
  - Through landscaping improvements
  - Within and between campuses
  - From the city scale to the campus scale down to the building scale
» Partnerships with the Community
» Improve Utilization of the Campus Core
» Stewardship of the Campus
  - Improve vehicular and pedestrian circulation
  - Integrate building renovations with planned growth
MORAVIAN COLLEGE
MASTER PLAN

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STREETSCAPE CONNECTIVITY

In order to better connect and integrate Moravian College’s campuses with the surrounding context, the planning team studied the urban scale and the relationship of the College within the historic City of Bethlehem. A collective strength exists between the College, the City, the Neighborhood, and the Moravian Church to improve the streetscape and frontage along the mile-long stretch of Main Street in the future. The Elm Street streetscape program, the Historic District streetscape, and the Bethlehem Main Street programs are currently in place to improve physical appearances by enhancing exterior building conditions and the local streetscape. Moravian College has already improved the streetscape at the entrance to the College between Locust Street and Elizabeth Avenue with a beautifully landscaped median, College banners, and new light posts. The master plan recommends extending this treatment south between Locust Street and Laurel Street to further enhance the sense of place and improve the arrival sequence to the College. In addition, it is recommended that a joint effort be made to improve the area of Main Street between Laurel Street and Union Boulevard for the mutual benefit of the neighborhood, College, Church, and City.
URBAN FRAMEWORK PLAN

The Urban Framework plan establishes a strategy for a series of goals the College could implement through strategic partnerships with its neighbors over time:

» Develop a recognizable identity for the College: branding locally, while thinking globally
» Cultivate the Moravian Mile as an asset to the campus and City of Bethlehem
» Improve and enhance the Monocacy Creek Greenway
Precinct Studies

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Master plans must balance visionary strategies with financially achievable goals. To do so, the framework of the plan needs to be flexible and practical so that it can be implemented in phases as funds become available. Following the direction of the College’s Strategic Plan 2008-2015, the following themes drove the initiative to create the proper physical environment needed for excellence in teaching, learning and performing at Moravian College:

» Addressing deferred maintenance
» Identifying older buildings in need of renovation and renewal
» Providing new space to meet future needs for academic and co-curricular functions
Focused studies of small areas of campus (precincts) were used to test initial ideas set forth by the Concept Plan. The planning team combined and refined design concepts for each area studied based on input from the campus community through a series of interactive workshops. These workshops allowed frank discussion of the pros and cons of many different ideas that then allowed the group to arrive at the ideal solution for all involved.

Over the course of multiple worksessions, the planning team met with representatives from academic affairs, student and residence life, and athletics and recreation. Before presenting the various design options, the planning team led the group on a guided campus tour. This tour allowed the planning team to point out areas of opportunity and encouraged participants to view the campus with a discerning eye in order to ensure a productive and engaging discussion. By involving members of the campus community and responding to their suggestions, these studies reflect the needs and desires of the campus community.

Detailed design options were developed for each precinct. These highlights provide a brief summary of the site and programmatic parameters that were tested for each focus area:
ACADEMIC AFFAIRS

Academic Affairs discussions focused on the locations and adjacencies of academic facilities. Many of the issues discussed are highlighted in the College's Strategic Plan. The planning team considered practical issues such as building setbacks and massing, treatment of open space and entryways, pedestrian and vehicular circulation systems, service points, and landscape treatment. The Academic Life session identified a number of ideas that were ultimately included in the master plan:

» New space for the Comenius Center
» Renovations to Comenius Hall
» Renovation and expansion to the Collier Hall of Science
» Programs to fill underutilized space within Reeves Library
» Future academic building locations
» Academic/community outreach facilities
» Devoted space for the Nursing Department
» Future mixed use building containing academic space with a new College bookstore
» Additions to Foy Hall to provide needed functional space
» Improved critical adjacencies of specific departments
STUDENT AND RESIDENCE LIFE

Student and Residence Life discussions focused on the locations and relationships of student-oriented facilities and ways to further build community between the students on the Main Street and Hurd campuses. Some of the issues discussed included: off-campus College housing that has or is planned to come off-line in the near future, the addition of 230 students in the new HILL facility, a more unified and central facility for student affairs, facilities that may become too expensive to maintain over time and should be replaced, strategic locations for new gathering spaces, repurposing the mix of amenities within the HUB, and converting paved areas to green quads within the core of campus. The following ideas incorporated into the master plan allow the College to meet current student life program needs and address future opportunities as the student body evolves:

» New “hang-out” space (to replace the Zinzendorf ‘Dog House’)
» Health services located closer to the residential community
» New residence halls that frame well-defined quads and open spaces
» A critical mass of upperclassmen, faculty/staff and/or Greek housing along Main Street and Laurel Street
» Renovations to Main Hall and specific floors of the Brethren’s House
» Future student union space adjacent or connected to the HUB
» The relocation of student affairs offices to the core of campus (currently located on the corner of Main and Elizabeth)
PHYSICAL EDUCATION, ATHLETICS, AND RECREATION (PEAR)

PEAR discussions focused on the current locations and relationships of athletic and recreation facilities. Some of the issues discussed included relocation of the tennis courts, the entry/arrival sequence for athletic events, the balance of parking during large events, incorporating Betty Prince field more fully into campus, and better utilization of Breidegam Field House and Johnston Hall. Participants noted that many of the concepts proposed by the 2002 PEAR Plan continue to be relevant, and they sought opportunities to incorporate these elements into the larger College master plan. All were interested in solutions for their respective program needs and the campus at large. A variety of scenarios were tested and ultimately refined to include the following concepts in the final master plan:

» New fitness center
» Functional addition to Breidegam for restrooms, storage and ancillary space
» Terrace to overlook Betty Prince Field
» Additional parking north of Elizabeth Avenue
» New tennis courts just north of Greenwich Street
» Addition to north end of Breidegam Field House
» Enhancements to Betty Prince Field – artificial turf and lighting
» New field house at the Moravian Athletic Complex
» Additional parking and support space at the Moravian Athletic Complex
» Addition to Johnston Hall for a natatorium
CONNECTIVITY AND URBAN PLANNING

After refining the previous precinct study schemes, the planning team met with a group of campus representatives as well as leaders from the City of Bethlehem Planning and Economic Development departments. The meeting focused on Moravian’s three campuses as well as a plan that addressed the urban framework. The City and College discussed approaching the State together, once the master plan is adopted, to explore and secure grant funding. The following concepts were discussed and incorporated into the master plan:

» Addition of a pedestrian footbridge crossing the Monocacy Creek to Lehigh Street
» Improvements to the sense of arrival of Moravian College visitors at the intersection of Main Street, Church Street and the Hill-to-Hill Bridge
» Coordination with City programs (façade improvement programs, targeted loan pool)
» Enhancement of the commercial business mix along Main Street
» Strengthening of connections from Main Street campus to the Moravian Athletic Complex with streetscape enhancements
Final Plan

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The final plan represents the best ideas and efforts of many people who care deeply about Moravian College. The plan is a synthesis of concepts that were thoroughly tested, revised, and balanced to meet both the short and long term goals of the College. The master plan illustrates the campus at final build-out and is intended to act as a “road-map” for campus administration to implement over time. It identifies existing campus assets, future opportunities, and areas of concern to be addressed.
Moravian College is a tight-knit campus community with direct links to adjacent neighborhoods, the historic downtown business district, and the greater Bethlehem area. As such, the Plan had to consider multiple design options and treatments because multiple stakeholders will be affected by the College’s decisions. The College is a defining component of Bethlehem, and there is tremendous opportunity for the College, City and Church, to partner on shared interests.

The plan recognizes the significant importance and potential that lies within the College’s main Quad. Located at the center of campus, it is a space that affords students, faculty, staff, and visitors the chance to interact with each other in an active and flexible outdoor space. On college campuses, these types of outdoor spaces evoke a sense of place and intimacy, as well as functioning as learning environments and places for spontaneous gathering. It is an asset that the College already possesses, and with careful planning and restoration, can be made even better. The Plan capitalizes on this through designs that create a pedestrian-only zone while strengthening the edges of the space to give it greater cohesion.

The master plan also identifies areas of primary concern for the College. For instance, while Moravian College has pushed in recent years to improve its buildings and infrastructure on campus, it must continue unabated with these efforts with several key facilities requiring upgrading or replacing. A second area of concern is the pedestrian/vehicular conflict zones throughout the campus and surrounding neighborhoods. The master plan addresses these issues holistically by integrating a comprehensive parking plan with pedestrian paths that reinforce connectivity of the buildings and open spaces on campus.
THEMATIC DRIVERS

The following thematic campus drivers informed the master plan and capture the essence of the plan itself:

IMPROVE UTILIZATION OF CAMPUS GEOGRAPHY AND BUILDINGS

As one of the oldest colleges in the United States, the historical significance of Moravian’s buildings and grounds spans nearly three centuries and represents a diverse array of social, religious and architectural influences. As the 267 year old campus continues to evolve, it is important to recognize and preserve those aspects of its history that have helped define its character and identity. Ongoing and preventive maintenance of the campus’ unique collection of buildings and grounds is an important task to continue in the future.

The College identified several projects that require renovation: Comenius Hall, Collier Hall, South Hall, Main Hall, and Betty Prince Field. As one of the most recognizable buildings on Moravian’s campus, Comenius Hall anchors a significant east-west axis across from Colonial Hall and is in need of major renovation. Collier Hall of Science is sited at one of the primary entrances to campus at the corner of Locust Street and Main Street and was constructed in 1970. Once renovations are completed, Collier Hall will have a more welcoming facade that incorporates the massing and fenestration patterns found

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in the buildings adjacent to it. South and Main Halls on the Hurd campus are also in need of system upgrades and interior renovations. These improvements will allow better utilization and functionality of the space for the entire campus community. Betty Prince Field requires improvements to enhance the ecological health of the field and the nearby forest area. In all cases, the master plan supports the proposed renovations projects identified by the College.

FOCUS MAIN STREET CAMPUS GROWTH TO THE SOUTH AND EAST

In order to better connect the three campuses and focus campus growth as closely to the core as possible, the master plan recommends that future development should occur along the south and east edges of Laurel Street and Main Street. During the planning process, the team explored options for growth in the northern direction but this was an unfavorable solution for numerous reasons, primarily due to the pedestrian and vehicular crossing conflicts on Elizabeth Avenue.
LOCATE SELECT CAMPUS ELEMENTS NORTH OF ELIZABETH AVENUE WITH IMPROVED CONNECTIVITY

The existing crosswalk at Elizabeth Avenue and Monocacy Street has recently been improved with blinking lights and additional signage. By improving two strategic crossings at Elizabeth Avenue, the College will create safer pedestrian paths and more direct connections to the new tennis courts, parking lots and future academic buildings from the campus core. The northern edge of campus is an ideal location for additional parking for these destination-oriented campus functions.

However, pedestrian safety is a chief concern along this roadway. As a solution, the master plan proposes a pedestrian bridge connection from the west side of Breidegam Field House across Elizabeth Avenue in approximate alignment with Cortland Street. The concept of an elevated pedestrian bridge will safely move pedestrians and service vehicles above the busy road and connect new uses north of Elizabeth Avenue back to the campus core. Prominent signage at the northwest corner of campus will alert drivers that they have entered a collegiate environment and should proceed with caution. Additional landscaping and wrought-iron fencing will guide pedestrians to safe crossing points at the pedestrian bridge and the illuminated sidewalk on Monocacy Street.
CONCENTRATE ACADEMIC AND STUDENT NEEDS WITHIN THE CORE OF MAIN STREET CAMPUS

One of the primary goals of the master plan is to create a compact and walkable pedestrian-oriented environment. By concentrating all the academic and student life needs within the core of the Main Street campus, the need to frequently cross Elizabeth Avenue will be mitigated. The HUB is currently the heart of the campus where most student life functions originate. The conversion of internal campus streets to wide pedestrian paths will create the intimate quality of space found between Reeves Library and Comenius Hall. Additional quads, landscaping, and pathway networks will reinforce the pedestrian scale of campus. As well, the core campus has multiple buildable sites available that will accommodate future growth, and provide a denser mix of uses.

Pedestrian safety is enhanced with additional green space, safe crossings, and a more robust network of paths throughout the campuses.
ENHANCE PEDESTRIAN PATHWAYS, REDUCE VEHICULAR CONFLICTS, IMPROVE CROSSINGS AND CAMPUS GATEWAYS

The uniformity in Moravian College's network of paths creates a strong sense of place. The master plan recommends further enhancements to this network by establishing a hierarchy between paths that are purely pedestrian and those that accommodate service/emergency vehicle access. These wider paths will replace some existing campus roads to form a campus circulation spine dedicated to pedestrians.

By closing portions of Laurel Street, Locust Street, Monocacy Street, and the drive behind Bernhardt-Wilhelm Hall, an important transformation will occur on campus. New pathways will be enhanced with pedestrian lighting, benches, and landscaping that reinforce the collegiate qualities of campus. Similarly, by closing the turnaround in front of Bernhardt-Wilhelm and Rau-Hassler halls, the College will gain a much needed sanctuary for study, relaxation and socialization. As the College transforms its streets into pedestrian paths, preserving accessibility to key areas and buildings on campus will be essential. Service access for emergency vehicles, trash removal, special events, deliveries, student move-ins, and maintenance must be accommodated on a year-round basis.

As the College takes steps to alter the road network on campus, it will need to re-assess shuttle routes to ensure that service continues to meet student needs. The master plan recommends that the shuttle be rerouted so that it turns onto Laurel Street once Locust Street is closed. Once the addition to the HUB is constructed, this will shift the balance of activity further south, closer to the residence halls and a new quad on the south side of the PPHAC.
The master plan highlights a number of projects that will improve transition points between the campus and the surrounding community. Improvements to sidewalks, streetscapes, and campus gateways will strengthen the College’s identity.

Improved crosswalks are recommended at the following intersections:
» Elizabeth Avenue and Monocacy Street
» Elizabeth Avenue and Main Street
» Main Street and Locus Street
» Main Street and Laurel Street
» W. Church Street and New Street
» W. Lehigh Street and Main Street
» Spring Street and Main Street
» Main Street and W. Church Street
Gateway signage locations are recommended at the corners of Mauch Chunk Road and Elizabeth Avenue, Center Street and Elizabeth Avenue, and the intersection of Main Street and Church Street in the vicinity of the Single Brethren’s House. An extension of the landscaped median on Main Street one block south to Laurel Street will create a gateway or portal to campus, improving the experience of first time visitors to the College. Additional signage should also be added as visitors approach Moravian College from both Routes 22, 78, and the New Street bridge. Further study in the form of a signage master plan may be necessary to effectively improve the College’s signage and wayfinding infrastructure.
DECANT PARKING TO THE PERIMETER OF CAMPUS

To transform the campus into a more walkable environment with strong pedestrian connections, the master plan recommends that the College decant parking to the perimeter of campus over time. This initiative is successful when it operates under a “one on, one off” scenario, where parking lots are removed only after a replacement lot has been constructed. The plan illustrates that parking can be relocated from the core without incurring a loss in the total number of spaces. There are currently 758 spaces on the Main Street campus; under the proposed plan, the total will increase to 1,094 spaces. This equates to a net gain of 336 parking spaces, enough to meet future campus demand.

Most new parking is located along the north and west edges of the Main Street campus. The new pedestrian bridge will connect 450 spaces north of Elizabeth to the campus core. Another 350 spaces will be located behind the westernmost residence halls, including 230 spaces proposed below Betty Prince Field. The plan raises Betty Prince Field ten feet above its current grade, allowing for one level of parking beneath it. Vehicular access to this facility will be from Mauch Chunk Road. Pedestrians will access campus by a stepped path that leads to a new viewing terrace at Breidegam Hall.

Currently, surface parking on the south edge of the Hurd Campus takes up almost half of the campus' open space. The planning team identified a potential opportunity to reduce some of this surface parking by collaborating with the City to use large downtown lots. These lots are used for various festivals and events that occur throughout the year such as Musikfest and Christkindlmarkt. However, there may be opportunities to use these lots for Moravian College parking during non-peak times. Additionally, the parking lot bound by W. Lehigh Street, Main Street, and the Hill-to-Hill bridge could provide capacity for an additional 110 cars, if the College could gain sole use of it.
ENHANCE THE LANDSCAPE TO CREATE A HOLISTIC NETWORK OF COURTYARDS AND CONNECTED OPEN SPACES

Currently, the physical grounds of the College are comprised of a variety of open spaces that anchor distinct areas of the campuses, such as the lawns by Comenius and Colonial Halls, the main quad behind the HUB, and the former pleasure grounds on the Hurd campus. These spaces provide opportunities for relaxation, study, socialization, special events, and recreation. The proposed open space network respects these existing spaces and seeks to create more. The diagrams shown on the right highlight the edges of existing and proposed buildings that will define future open spaces on campus. From this diagram, one begins to understand the network of open spaces that will connect the Main Street campus in all directions. As the College replaces streets with pedestrian paths, these tree-lined spaces will function as corridors that connect buildings and open spaces on campus.

The studies prepared by Biohabitats, found in the appendix of this report, provides recommendations for preserving, restoring, and creating green infrastructure throughout the campus. Green infrastructure is a combination of natural and designed features linked and integrated across the College’s landscapes. Best Management Practices (BMP’s), or applied green infrastructure techniques and strategies, for Moravian include features such as bioretention, turf conversion, green roofs, pervious pavement, rain gardens, cisterns, and constructed wetlands. These practices will increase and enhance local bio-diversity, improve site aesthetics, lower irrigation water demand, lower fuel and maintenance costs, reduce stormwater runoff, and filter pollutants from water that drains off impervious surfaces.
Existing Open Space Network

Proposed Open Space Network
The master plan proposes that new residence halls be sited along the southern and western edges of the main Quad. These buildings will frame the green lawn and provide better definition to the open space. They will also introduce additional student activity, allowing a greater population of the campus community to enjoy this intimate open space.

Tying into the Monocacy Creek Trail System is an important way to further connect Main Street and Hurd campuses. The master plan proposes a future connection to the trail along Mauch Chunk Road at the south-western corner of the campus to encourage the campus community to walk, bike, and access recreational trail amenities frequently.

The following recommendations will produce positive results that support the campus’ open spaces:
» Survey, inventory, and assess the existing tree specimens on each campus.
» Develop a tree preservation plan that includes treatment programs for preserving existing historic trees and a strategy for renewing the tree canopy with incremental plantings.
» Adopt a pruning strategy to improve the architectural (i.e. space-defining) role of the tree canopy, enhance views from surrounding streets, improve the structural stability and branching pattern of existing trees, and address deferred maintenance of existing trees.
» Develop curatorial and collection policies to guide future plantings on campus for use as living collections that demonstrate sustainable practices.
» Adjust locations of existing site furniture to maximize use.
» Introduce additional site furniture for use as outdoor classrooms, performance spaces, and informal gatherings.
INTEGRATE WITH THE URBAN CONTEXT AND CONTINUE COLLABORATION WITH THE CITY OF BETHLEHEM

There are several projects that will strengthen the relationship between the Bethlehem community and Moravian College once completed. The academic mixed-use building at the corner of Main Street and Laurel Street is proposed to not only house an academic department but the College bookstore as well. This location will create a space for both the College and community to interact and form a stronger presence for the College on Main Street.

Future infill housing along the south and east periphery of campus is an important aspect of the College's desire to lead by example in improving the surrounding community. Improvements to Laurel Street's pedestrian environment will further assimilate the Moravian Athletic Complex with the Main Street campus. Streetscape improvements along Church Street in the form of signage, crosswalks, and vehicular access to the Hurd campus will continue to link the College with the historic fabric of downtown Bethlehem.
SUMMARY

The Master Plan provides Moravian College with a framework to guide building and open space development for the next fifty years. Elements of this plan have been holistically integrated so that the whole is greater than the sum of its parts. Many of the concepts are elegantly simple, powerfully transformative, and financially achievable. As the College implements this plan, the changes to the physical campus will be recognizable and will elevate the stature and identity of the College regionally and nationally.
Design Guidelines

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DESIGN GUIDELINES

Moravian College has three inter-related yet decidedly distinct campuses, each possessing a unique set of design characteristics. The diversity of each campus setting is a strength, defining how buildings are organized around quads, courtyards, streets, and open spaces. This represents an intimacy in scale and function that the College wishes to retain over time.
With careful building placement, sensitivity to scale, preservation of historic structures, enhancement of open space, and the selection of high quality materials, the College will maintain its sense of beauty through time. To this end, the Master Plan provides a clear framework that will guide future developments. These attributes, when harnessed with innovative and sustainable design practices, will allow for continued variety in architectural expressions, from traditional to contemporary, without compromising the overall campus aesthetic.

The intent of these Design Guidelines is to strengthen the cohesion and quality of the College’s grounds and buildings. This will be achieved through a series of broad recommendations for building typology, scale, massing, materials, and façade composition. Additionally, the Guidelines include recommendations for landscaping, open spaces, paths and walks, gateways, signage, and site furnishings. Future building designs shall adhere to sound architectural principles, attention to detail, and appropriate and innovative use of materials to respect the contextual setting of Moravian College.
Main Street Campus’, prominent axial relationships

- = Major Axis
- = Minor Axis

Main Street Campus, prominent axial relationships
AXES AND ORGANIZING ELEMENTS

An axis is a line that provides organizational structure to built forms and the spaces between. This organizational structure can be literal when represented by streets or paved walks, or figurative as when buildings are arranged around a quad or open space. Because of the amount of land available for future expansion, the Main Street Campus presents the greatest opportunity for implementing an organizational structure. Having evolved over time from a city grid system, the campus’s arrangement of buildings follows a generally orthogonal framework. Currently Main, Laurel, Locust, and Monocacy Streets provide a strong organizational grid. However, portions of these streets will be removed, and the figurative axes within these Guidelines will guide future development. It is recommended that future buildings are placed along current axes that will be extended and enhanced.

The axis between Comenius and Colonial Halls will remain a powerful historic reference, retaining its significance by placing future buildings to frame this important open space. A number of minor axes help guide the placement of future buildings by siting structures at the end of view corridors and embellishing the settings with lawns, walks, tree alignments, and site furnishings. The north-south axes on either side of the HUB will increase in importance as streets are removed and new buildings are constructed under the Master Plan’s implementation. The proposed pedestrian bridge across Elizabeth Avenue will create a new axis that connects the west side of Breidegam Hall to the parking lots, tennis courts, and Facilities Management on the north side of Elizabeth. It will also create a more pronounced connection to student housing on the south side of the Main Street campus.

The Guidelines recommend that the new Field House at the Moravian Athletic Complex contain an iconic element that is on axis with HUB II, visually reinforcing the connection between the two campuses. Future streetscape improvements along Laurel Street will compliment this strategy as well.

Because of its compact size, the Hurd Campus has different considerations than the Main Street campus. The “front,” or public face, of the Hurd Campus is well defined and orients with the city grid of Church and Main Streets. This strong street presence should be maintained. The interior of the Hurd Campus, however, has the ability to be more flexible. A rigid structure of axial alignments would not be in character with this campus, which started as a women’s college with romantic-era Pleasure Grounds behind the buildings. The landscape here is softer and less formal. With the addition of the HILL in 2009, the southern edge of this campus in now anchored. The proposed buildings on the Hurd Campus are envisioned as connecting the the HILL to further integrate the functions within the facilities. All proposed projects on the Hurd Campus will respect the campus’s historic treatment of buildings and grounds, as specified in the College’s Preservation Master Plan.
Main Street Campus', prominent open spaces

- Manicured
- Natural
- Working
LANDSCAPE AND OPEN SPACE

Moravian College possesses a wide variety of landscaped open spaces that define, in part, the nature of each campus. Landscape features on a college campus are one of the most important in contributing to the overall collegiate aesthetic; Moravian has been diligent in preserving and maintaining the quality of these features on its campuses.

The Main Street campus is comprised of natural, informal, and formal landscaped settings that provide a diversity of space for studying, lounging, organized athletic sports, and special events. The formal lawn in front of Comenius Hall is one of the most memorable places on campus and contributes significantly to the identity of the College. The courtyards surrounding Monocacy Hall and Reeves Library offer a different type of environment. Smaller and intimate, but laced with pedestrian walks, they offer the opportunity to relax in the heart of campus and engage socially with others if so desired. The Quad represents the largest open space on campus, characterized by playing fields, embankments for lounging or watching sporting events, and a ring of mature trees.

The master plan recommends replicating these types of spaces as new projects occur on campus. This transformation will be most evident and beneficial when portions of Laurel, Monocacy, and Locust Streets are removed in the core of the campus. In essence, lawns, courtyards, pedestrian paths, and landscaping will replace parking lots and streets to reinforce the collegiate aesthetic.

The Hurd Campus has a rich history of landscape amenities that have served the campus for more than two centuries. Today, the open spaces between the buildings on the Hurd Campus are reminiscent of the nineteenth century Moravian Pleasure Grounds. This landscape will garner further use and importance as future renovations and building additions are completed. This area will serve as an informal recreational space, as well as the practice field for the marching band.

The arrangement of athletic venues is well established at the Moravian Athletic Complex. However, the College can ensure the continued preservation and improvement of these fields by augmenting the existing landscape treatments. By making the Moravian Athletic Complex similar in appearance to the Main Street Campus and improving the streetscape that connects them, the perceptual distance between the two will be reduced.

Integrated within the architecture of the landscape for all three campuses are Best Management Practices (BMPs) that enhance local biodiversity, improve site aesthetics, lower irrigation demands of potable water, and control storm water run-off. By implementing BMPs such as bioretention areas, turf conversion, green roofs, pervious pavement, rain gardens, cisterns, and constructed wetlands, the College will improve site conditions and become a more sustainable place.
BUILDING TYPOLOGY

A building can be described by its program, size, form, location on campus, and the way it defines an exterior space. Campuses are composed of collections of buildings with similar programs such as academic, residential, athletic, and student life uses. The programs often determine the building’s size and location on campus. Groupings of similar uses frequently occur because of the desire to maximize functional adjacencies and congregate similar typologies.

Intuitively, a building should reflect its programmatic uses through the characteristics embodied in the building envelope, mass, and detailing. That is why a residence hall has a higher surface to glass ratio, numerous windows to provide natural light to living spaces, well detailed entries to reinforce the residential quality of the space, and a relatively narrow width to length footprint. Variations on the façade can inform the locations of study lounges, living/learning classrooms, and lobbies.

Similarly, a science building will be characterized as having a smaller surface to glass ration, tall floor-to-floor heights to accommodate interstitial utility distribution, roof treatments to conceal fume hood exhaust stacks, and wide width to length proportions to satisfy lab module requirements. The master plan recognizes these adjacency requirements by locating new buildings near buildings of similar uses on campus.

FAÇADE COMPOSITION

Regardless of the architectural style of a building, the façade design often follows a set of basic principles including prominent entry, a vertical tripartite defined by the base middle, and top, and a system of proportions. The organization of the elements can be an individual aesthetic expression or, when used consistently on multiple buildings, a recognized style of the campus. The perceived scale of a building can be greatly affected by the manner in which its façade is divided. This organization of proportion can be equally adept in both traditional and contemporary architecture. Colonial and Comenius Halls represent designs that balance the tripartite organization in a traditional manner. The HILL represents a modern expression that uses the same composition of elements that enables it to be comfortably adjacent to buildings that are over 200 years old. The HILL illustrates how new buildings can include such traditional elements as a base/middle/top, rhythmic bay spacing, and scaled proportions that are responsive to the contextual setting.

BUILDING DISPOSITION

Most of the buildings on the Main Street and Hurd campuses fall into two categories: edge definer of open space or edge definer of a street. On the Main Street campus, the buildings that frame the Quad define only open space but are integral to the character of the space that is defined. New buildings proposed on Laurel and Main Streets are an example of the second category. These buildings will reinforce the campus edge and define important streets. The HUB, PPHAC, and Collier Hall perform dual purposes by defining both street edges and open spaces. As new buildings are sited on campus, careful disposition planning will
need to address multiple façade orientations, entry locations, and open space framing in a holistic manner. Adding to the complexity, the Master Plan proposes to convert select campus streets into pedestrian paths and landscaped open spaces. This means that with implementation, buildings that once faced a street will front a pathway or lawn instead. While these new settings will be more elegant and approachable, they will require forethought and planning.

On the Hurd campus, buildings have defined the southern edge of Church Street for over 200 years, and this is the predominant orientation for all buildings on the campus. However, the HILL creates a new precedent. The HILL was sited to frame the lawns and gardens to the south of the existing buildings, thus anchoring a large courtyard. In doing so, the HILL will enhance the character of the campus and create a landscaped setting for the College community to enjoy. The new buildings proposed for the eastern edge of campus will compliment both the internal and external edge conditions of the campus and reinforce the benefits the HILL.
To define outdoor space, the Guidelines establish build-to lines for campus. These build-to lines are not setback requirements but space-making edges to which buildings should adhere.

» Buildings shall remain parallel and perpendicular to adjoining streets. This geometry reinforces view corridors, street edges, wayfinding, and entry locations.

» Buildings shall retain a minimum of 60 percent of their frontage along the build-to line. This recognizes that buildings are designed with setbacks and variations in mass and height to balance proportions and create visual interest.

» Buildings shall meet build-to lines on more than one façade when sited on a corner condition. The intent is for a building in this condition to present a strong visual presence in multiple directions when facing a street, quad, or major pedestrian path.
MASS AND PROPORTION

Topography, site area, build-to lines, and the height of adjacent buildings will dictate the mass of a building. Each site will be different; therefore, each building must be responsive to these physical planning parameters.

Several key elements will define a building’s massing: building height, geometry of plan – length and width, and roof form. The buildings on Moravian’s campuses range from large, one-story structures to buildings of three and four stories, and most are rectangular in plan geometry. Older buildings typically have gabled roofs, while newer buildings have flat roofs. Moravian’s newest building, the HILL, strikes a balance between the two styles. This represents an approach that is respectful of context and responds to adjacent buildings. The Guidelines require this type of approach for future projects.
SCALE

Architectural scale is important because it helps to define the overall character of a campus. A college campus will achieve an appropriate scale by paying careful attention to how the features of a building, particularly at the ground level, relate to the scale of the human body. At the ground level, the scale should be inviting and welcoming to people walking by. Moravian College possesses a rich diversity of door treatments, window types, columns, arches, chimneys, and cornices. These elements relate to the human scale and create a texture of detail that is interesting to anyone walking by. Often, the way that a building’s design integrates these elements will provide visual clues as to the programmatic use of a building. Future buildings must reflect this intimacy of scale in the details of design. Doing so will allow a wide range of architectural styles to coexist in a manner similar to the rest of campus.

Architectural scale can also describe how buildings relate to one another and the surrounding open space. Ideally, the arrangement of buildings will be such that it makes intuitive sense to any person “using” campus by providing visual clues about the importance and hierarchy or particular buildings and landscapes. For example, any person arriving at Moravian immediately knows that Comenius Hall is an important building, either for its current uses or its place in the history of campus. However, not all buildings should be “heroes,” as it would create confusion. It is more important to have well-designed “soldier” buildings such as the Reeves Library that frame streets and open spaces. Clearly defined entrances, windows that allow glimpses of indoor activities, and special pavers or landscape treatments are other methods to cultivate architectural scale and hierarchy on campus.
BUILDING MATERIALS

Red brick and natural stone are two of the most prevalent building materials on campus, and they are used on all types of building including academic, athletic, administrative, and residence halls. These materials, which are frequently used together on the same building, give the College a distinct character that should be reinforced in all new developments on campus.

In addition to red brick and natural stone, there are a number of prominently featured roof materials such as slate, copper, asphalt shingles, and metal standing seam. Buildings that are more recent have an increased expression of glass, metal panels, and metal window framing systems. All of these materials are acceptable on future buildings when carefully applied and appropriately detailed. Whenever possible and appropriate, the use of recycled and rapidly renewable materials shall be encouraged.
PATHS AND WALKWAYS

A robust system of concrete walkways currently connects open spaces and buildings on each campus. The consistent use of this material helps one to understand its function as a major pedestrian walkway surface. Asphalt paving should be reserved for secondary uses on campus such as service drives, jogging paths, and forest trails. The College uses special pavers in front of specific buildings to highlight their importance. For example, the sidewalk that connects Comenius and Colonial Halls, including the crosswalk on Main Street, are brick. Such subtle details establish a desired hierarchy to campus pathways. To achieve best results, special pavers should be consistent across campus.

A central component of the the Master Plan is a recommendation that College remove portions of Locust, Monocacy, and Laurel streets on the Main Street campus and replace them with a new pedestrian path type. This new type of path will be distinguished with unit pavers that complement the existing palette of materials on campus. They will vary in width, from 16 to 24 feet, depending on the location on campus. And, they must accommodate the weight of emergency and services vehicles. The removal these streets will beautify the campus aesthetic without compromising the service and emergency access required for campus buildings.
GATEWAYS

At Moravian, formal elements such as piers, title walls, and wrought iron fences mark the edges of campuses and reinforce the College’s identity. These elements suggest a sense of permanence befitting Moravian’s history. In a few locations, however, wood signs are the primary means of identification. Based on interviews and recommendations from the college community, the Guidelines recommend that the College strengthen the identity of the College in several key areas. This can be accomplished by incorporating the materials such as brick, stone, wrought iron, landscaping, and lighting into the new gateway designs at the following locations:

» From the west - on the new bridge over Elizabeth Avenue, and on the corner of Betty Prince Field (Replace wooden sign)
» From the north - at the corner of Elizabeth Avenue and Center Street (Replace wooden sign)
» From the south - at the intersection of Church and Main Streets
SIGNAGE

The College has implemented a building identification and directional signage system that is relatively consistent in color and purpose. However, the most significant element within the signage system is missing: the type of sign that formally identifies the College. The College would benefit from a more comprehensive signage plan that addresses current and future conditions on campus while implementing a hierarchy of signage types that provide consistent wayfinding and identification from regional highways, gateways, and within the three campuses.

As an example, the banner system on Main Street readily identifies the presence of the College to visitors approaching the Main Street campus; however, similar elements on the approach to the Hurd Campus and Moravian Athletic Complex are virtually nonexistent. The Guidelines recommend a consistent treatment to each campus to reinforce their individual and collective identity.
SITE FURNISHINGS AND AMENITIES

The use of standardized furnishings and fixtures on all three campuses unifies the outdoor spaces and establishes the unique identity of the College. The consistent use of light fixtures, benches, trash receptacles, and bike racks are required as part of each new capital project or site improvement.

Walls and fencing can help define areas and edges of the campus, and subtly reinforce the collegiate environment. For example, seat walls are an effective way to define space and providing an impromptu opportunity for resting, reading, waiting, and socializing. When fencing or seat walls are located at a building’s entrance, they help to make wayfinding easier and more intuitive. Plantings and landscaping can function as type of fence when designed appropriately to guide pedestrian movement and screen unsightly views. As the College community begins using the parking lots along Elizabeth Avenue more frequently, the College should use a combination of fencing and landscaping to guide pedestrians to safe crossings and prevent jaywalking. Similarly, the College can use fencing at athletic venues to improve safety, enhance crowd control, and limit accessibility to certain areas. Consistent style, material, and color should define all site furnishings, whether benches or fencing, in order to create a unified aesthetic campus-wide.
Moravian College has endorsed a Statement of Principles on Sustainability that sets forth a mission to enhance treasures of heritage, people and place for generations to come. This commitment will foster conservation, protection, and enhancement of resources through College policy and personal behavior. Good teaching and learning practices, administrative policies, and civic engagement will preserve the quality of life that the College values.

In addition, the College has adopted a Sustainability Action Plan that affects all departments and College functions. The topics included in the Plan range from “Waste Reduction and Recycling” to “Sustainability and The Curriculum,” and the recommendations are intended to be implemented over time so that they become a routine part of everyday life. The College has also stated that it will become one of the signatories of the American College and University Presidents Climate Commitment by Spring 2010.
Acknowledgements

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Principle Contributors: Ted Brown, PE, LEED AP; Jennifer A. Dowdell, LEED AP, Associate ASLA

MEP Engineers: Mueller and Associates, Inc.; Baltimore, Maryland
Principle Contributors: Robert Marino, PE, LEED AP; Kenneth Rock, PE, LEED AP
Appendix

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Appendix

119 Phasing Matrix

121 Parking, Transportation, and Circulation Analysis
Martin/Alexiou/Bryson

139 Utility Infrastructure Evaluation
Mueller Associates, Inc.

163 Stormwater and Landscape Management Assessment
Biohabitats, Inc.
## Appendix

### Project List

<table>
<thead>
<tr>
<th>Project</th>
<th>Future Use</th>
<th># of Stories</th>
<th># of beds</th>
<th>Footprint Area</th>
<th>Total Area or Quantity</th>
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<td>Renovate Hillside S for Health Center relocation*</td>
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<td>New Elizabeth Street Bridge</td>
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<td>Close Locust &amp; Monocacy Streets</td>
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<td>Upgrade Baseball Field</td>
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<td>Demolish Townhouses, Back Hall, deSchweinitz House and Hillside Complex*</td>
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<td>New Fitness Center</td>
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<td>New Residence Hall north of Anna Nitkamann House</td>
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<td>New Tennis Courts</td>
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<td>Close Laurel Street</td>
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<td><strong>Hurd Campus</strong></td>
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<td>Renovate Main Hall</td>
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<td>New Bridge to Parking Lot at W. Lehigh St. and Main St.</td>
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<td>Improve intersections along W. Church St.</td>
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<td>Construct Residence Hall connected to the HILL building</td>
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<td>85</td>
<td>7,600</td>
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## Project List

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<tr>
<th>Phase: Three</th>
<th>Project</th>
<th>Future Use</th>
<th># of Stories</th>
<th># of beds</th>
<th>Footprint Area</th>
<th>Total Area or Quantity</th>
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<tbody>
<tr>
<td>Main Street Campus</td>
<td>Demolish 3 Seminary Houses*</td>
<td>N/A</td>
<td>N/A</td>
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<td>N/A</td>
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<tr>
<td></td>
<td>Demolish Field House at Steel Field*</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
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<tr>
<td></td>
<td>Purchase 6 Main St. properties*</td>
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<tr>
<td></td>
<td>New Addition to Breidegam Field House</td>
<td>Athletic</td>
<td>1</td>
<td>18,400</td>
<td>18,400</td>
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<tr>
<td></td>
<td>Renovate Betty Prince Field with parking below</td>
<td>Athletic / Parking</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
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<td></td>
<td>New Field House at Steel Field</td>
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<td>2</td>
<td>15,000</td>
<td>30,000</td>
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<td></td>
<td>New Parking Lots at Steel Field</td>
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<td>N/A</td>
<td>N/A</td>
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<td></td>
<td>New Academic Center with bookstore</td>
<td>Academic / Student Life</td>
<td>4</td>
<td>20,600</td>
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<td></td>
<td>New Seminary Housing</td>
<td>Residential</td>
<td>3</td>
<td>28,080</td>
<td>84,240</td>
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<td>Hurd Campus</td>
<td>Renovate Brethren's House 5th and 6th floor</td>
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<td>N/A</td>
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<td></td>
<td>New Connection to Main Hall (elevator)</td>
<td>Residences</td>
<td>5</td>
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### Phase: Four

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<tr>
<th>Main Street Campus</th>
<th>Project</th>
<th>Future Use</th>
<th># of Stories</th>
<th># of beds</th>
<th>Footprint Area</th>
<th>Total Area or Quantity</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Demolish 7 properties at corner of Main St. and W. Greenwich St.*</td>
<td>N/A</td>
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<tr>
<td></td>
<td>Purchase industrial properties along Mauch Chink Rd.*</td>
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<tr>
<td></td>
<td>Purchase 10+ Laurel St. properties (between Main and Monocacy)*</td>
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<td>N/A</td>
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<tr>
<td></td>
<td>Purchase 9 Center St. properties*</td>
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<tr>
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<td>New Mixed-Use Project</td>
<td>Mixed-Use</td>
<td>3</td>
<td>6,000</td>
<td>18,000</td>
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<td>New Housing and Mixed-Use Projects</td>
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<td>87,840</td>
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<td>New Academic/Community Outreach Projects</td>
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<td>16,400</td>
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<td></td>
<td>Pool Addition to Johnston Hall</td>
<td>Athletic</td>
<td>1</td>
<td>18,400</td>
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<td></td>
<td>Improve Laurel St. Streetscapes</td>
<td>Open Space</td>
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<td>Addition to Reeves Library</td>
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<td>3,300</td>
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<td></td>
<td>New Academic Building</td>
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<td></td>
<td>Future Development (unknown)</td>
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<td>N/A</td>
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<tr>
<td>Hurd Campus</td>
<td>New Residential / Mixed Use facility</td>
<td>Residential / Mixed-Use</td>
<td>4</td>
<td>6,500</td>
<td>26,000</td>
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</tr>
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**TOTALS** | 773 | 273,310 | 805,570 |

**Notes:**

* *an enabling project within the phasing sequence to allow subsequent buildings to follow with a minimal net loss of space, beds and/or parking.*

** *bed count will need further study by College and residential life leadership*
1.0 Observations
1.1 Campus Setting
1.2 Intercampus Connections
1.3 Parking
1.4 Pedestrian Safety
1.5 Vehicular Circulation and Safety
1.6 Use of Alternative Modes

2.0 Recommendations
2.1 Pedestrians
2.2 Bicycles
2.3 Vehicular Circulation
2.4 Parking

3.0 Phased Parking Plan
TRANSPORTATION AND THE MASTER PLAN

OVERVIEW

The physical campus and the transportation system are closely linked at Moravian College. The campus shuttle, walks, roads and parking lots all work together to facilitate access to the campus and movement within the campus. Not only do these facilities enable this movement, they are often the armature around which the physical plan of the College is developed. The transportation system extends beyond the College’s two campuses, encompassing several of the streets adjoining the campuses that are part of the regional transportation network in the historic city of Bethlehem.

The following section provides an assessment of the existing transportation system and highlights areas of the master plan intended to enhance campus connections. Included in this section is an analysis of the existing and future parking.

OBSERVATIONS

One of the first steps in the master planning process includes an assessment of the existing transportation system at Moravian College, highlighting key strengths and deficiencies. The key observations include:

- Academic and residence life functions occur on both the Main Street and Hurd campuses, which are approximately one mile apart, and therefore connections between them are critical to the operations of the College (note that, unless one or the other campus is specified in the report, the term “campus” refers to both campuses). The shuttle bus system serves as the primary mode of transportation between the campuses, though many choose to walk or bike. A third shuttle will be introduced this fall and is expected to accommodate the increased demand associated with the opening of the new HILL.

- There are several areas around the campus where conflicts with vehicular traffic have raised concerns for pedestrian safety. Problem areas along West Elizabeth Avenue, as an example, which result from topography and the proximity of existing structures to the street, are not easily solved. Several locations along Locust, Laurel, Main, and Church Streets are also of concern.

- Overall, the parking supply appears to be adequate to meet the day-to-day needs of the College. While typical high-demand locations, particularly the few in the campus core, have little vacancy, those lots that are slightly more distant
regularly have spaces available. As the parking system generally has good compliance and enforcement, day-to-day parking problems are comparatively few. However, it was noted that higher parking demands that occur during special events can be an issue.

THE CAMPUS SETTING

Moravian College has two academic campuses, the Main Street Campus and the Hurd Campus, located about a mile apart and connected by Main Street. Additionally, the Moravian Athletic Complex contains athletic fields for many of the varsity sports, including the football stadium. It is located roughly ¼ mile east of the HUB between Laurel Street and Elizabeth Avenue.

Each campus is compact and pedestrian-oriented. The College maintains a high quality pedestrian environment on the campuses. The Main Street Campus is surrounded by residential neighborhoods on three sides and the pedestrian-friendly atmosphere extends well beyond the campus boundary.

Over the years, the College has worked to improve the pedestrian environment, particularly by restricting vehicle traffic from the campus cores. Within the campus, traffic speeds and volumes are generally low enough that pedestrian safety is not at risk. There are several locations, though, where vehicles penetrate the campus and can conflict with pedestrian circulation. These are discussed further below.

Because of the compact nature of the campuses, few people travel around the campus by any means other than walking. Most students live on campus and thus do not commute to campus. While nearly all faculty and staff commute to campus by car, very few use a car to travel around the campus.

INTERCAMPUS CONNECTIONS

Academic and residence life functions occur on both the Main Street and Hurd campuses and therefore connections between them are critical to the operations of the College. While the campuses themselves are compact, they are far enough removed from each other that few people choose to walk or
bike between the two, particularly in the winter, instead relying on the high-frequency shuttle system the College has developed.

Shuttle

The primary means of travel between the Main Street and Hurd campuses is the shuttle. It stops at the HUB on the Main Street campus and in front of the HILL on the Hurd campus. The shuttle also serves the North Street garage on request. The shuttle runs in a continuous loop between these locations beginning at 7:00 am and continuing until 8:30 pm. At this point, the frequency is reduced so that it leaves the HUB at the hour and half-hour and Hurd Campus at :15 and :45 minutes after the hour. During the peak periods, the shuttle buses operate continuously except for short driver breaks. With all shuttles in operation, they arrive every 5-10 minutes, a high enough frequency that there is no need for a schedule.

Based on discussions with the Assistant Director of Facilities Management, who oversees the shuttle operations, the current operations scheme is very flexible and seems to work very well. The drivers are reliable and work hard to provide quality bus service and handle day-to-day operational challenges – such as avoiding bunching and handling higher demands at class change time or evening events – on their own. The shuttles are owned by the College and operated by College employees. There is currently a 32-seat school-bus type vehicle, a 24-seat shuttle and a 12-seat shuttle with lift gate for ADA operations, though there are few requests for ADA accommodations. The 24-seat shuttle was ordered for fall, 2009, in anticipation of the increased ridership associated with the opening of the HILL.

Currently, the three shuttles transport roughly 1,200 riders over the course of a typical day. Because demand is largely driven by academic schedules, the shuttle schedule is adjusted based on actual demand. With the opening of the HILL, the shuttle stop on the Hurd campus was relocated to the southern entrance to the HILL. This provides a conditioned space to wait for the shuttle, something previously lacking.

Currently, the shuttle does not stop between campuses except at the North Street garage, at the corner of North Street and Main Street, where it will stop at request to accommodate freshman who chose to purchase a permit in the garage. Anecdotally, though, many use the shuttle to access the shops and restaurants along Main Street, most of which are adjacent to the Hurd campus. By moving the shuttle stop away from Main Street to the HILL, this may make it more difficult for such town-gown intermingling. Currently city buses queue, load and unload along Main Street between Broad Street and North Street, and a sign indicates it is a Moravian College shuttle stop. It is likely, then, that the Moravian shuttle could use this location on a regular basis if student, faculty and staff demand for such a stop is sufficiently high.

Pedestrians

While the shuttle is the primary means of transportation between the campuses for most students, several will walk, particularly in nice
weather. The elevation change and grade along Main Street can be a deterrent for some. As the shuttle does not serve the Moravian Athletic Complex, most will walk along Laurel Street to reach it from the Main Street campus. Although the area adjacent to the campuses and between them is generally safe, particularly in the daytime, there is a desire to improve pedestrian safety at night.

Bicycles

As with pedestrians, the terrain along Main Street limits the number of students biking between campuses. While there are no signed bike routes between the two campuses, sharrows (share the road markings) have been installed along Main Street. Frequent vehicular obstructions and relatively little room for bikes to move outside the travel lane make this route less attractive, though. There are several other unmarked routes between the two campuses, however, which utilize lower volume roads and generally provide a better biking environment.

Vehicle Circulation

Faculty and staff are allowed to park at both the Main Street and Hurd campuses, however, the number of spaces is limited at the Hurd campus so they encouraged to use the shuttle; as discussed below, most students are not allowed to park at both campuses so do not have the option of driving.

PARKING

Parking on campus has undergone dramatic change in recent years and will continue to be in flux this coming year as the system adapts to the anticipated changes in demand resulting from the new HILL on the Hurd campus. In response to complaints of overcrowding and insufficient parking, a Parking Task Force was convened which analyzed campus parking and made several recommendations to address the issue, most of which have been implemented. In total, there are roughly 850 spaces on campus.

Employees

Employees are granted parking permits for free. They are allowed to park in any faculty/staff lot on Main Street or Hurd campus with the permit. While employees generally have a space, there are complaints that if one leaves during the day, that space will likely be filled by someone else, forcing the individual to park further away from their office. Overall there are few issues with insufficient employee parking at the system level, however.

Students

Students are treated differently depending upon whether they are resident students or commuter students. Commuter students have parking privileges similar to those of employees and generally share the faculty/staff lots. Residents are subject to much stricter parking limitations. Permits are granted on a first-come, first-served basis with priority given according to seniority at the school (i.e. seniors have
first pick, followed by juniors, etc). Freshmen are generally not allowed to purchase a permit.

Students are not allowed to park a car within ½ mile of the campus without a parking permit and are subject to stiff fines if found in violation of the rule. Resident premium spaces are located along West Laurel Street and reserved for these students 24 hours a day. There are approximately 70 of these permits available for $300 per year. Resident permits for other lots are available for $150 per year and allow parking only on Main Street or Hurd campus but not both. There is no cross-parking allowed between premium spaces and regular spaces for either permit holder. All resident spaces are sold on a one-to-one basis; that is, only as many permits are sold as there are spaces in the allocated lots. Additionally, approximately 100 $50 permits are available, allowing students to park on-street within ½ mile of the campus. These spaces are public spaces on city streets so there is no guarantee of space availability. Between five and 10 students typically elect to purchase monthly permits in a city parking garage. Although the garage is slightly less than ½ mile from campus, it is considered exempt from the parking exclusion zone.

The recent sharp reduction in parking oversell for student permits has largely eliminated the student parking problem on campus, though there are some who complain when they are not offered a permit. This is not surprising, however, given that the previous oversell was roughly 4.5 permits per space, and it is impressive that the transition has been as smooth as it has. In fact, the biggest complaint is often that spaces, particularly the highly visible premium spaces, sit empty much of the time, though remote lots such as S and T are typically empty. Additionally, Campus Safety was unable to sell reduced-price permits for spaces at the Moravian Athletic Complex. The implication being that students are unwilling to walk a great distance to their cars so would rather not have a car on campus or will risk trying to find a space in the neighborhood rather than park and walk some distance. If necessary, the student oversell could likely be increased slightly, say to 1.05, in order to increase the effective supply.

Event Parking

As the total parking supply on campus is not large, the college can have difficulty hosting special events. Parking for sporting events at the Moravian Athletic Complex and Concerts at Foy Hall can be particularly problematic. The college provides no parking at the Moravian Athletic Complex to any visitors other than officials and coaches. Parking of team buses can be problematic and often requires the buses to be parked several blocks away.

While much of the year events at Hurd campus can utilize the Hill-to-Hill lot, there are many weeks of the year when this lot is unavailable and the roughly 80 spaces in the U lot are insufficient. Events such as the music festival and the Christmas market fill up the Hill-to-Hill lot as well as all adjacent spaces to meet the demand. In all, this lot is unavailable nearly three months a year.

For college events, such as preview or parents’ weekends, visitors are directed to park adjacent to the Main Street campus and shuttled, as necessary, to the Hurd campus.
PEDESTRIAN SAFETY

Both the Main Street and Hurd campuses are adjacent to high-volume roads. Coupled with the pedestrian focus of the campuses, this often leads to pedestrian-vehicle conflicts. The primary areas of concern are along West Elizabeth Avenue and Main Street. Although volumes and speeds tend to be lower, there is also some concern about pedestrian safety at West Church Street along the Hurd Campus. Traffic speeds and volumes within the campus are generally low enough that pedestrian safety is not as noticeable a problem as at the campus edges. There are numerous conflict zones, however, that could benefit from additional treatments or even road closures or other traffic restrictions.

Elizabeth Avenue

To address the concerns along West Elizabeth Avenue, a pedestrian-activated beacon has been installed at Monocacy Street. Motorists, in general, seem to obey the crossing lights and will stop when pedestrians are present though many will speed through the corridor when the lights are not blinking.

There are high pedestrian volumes crossing at both Iron Street and Fork Street down the hill to the west. This foot-traffic is primarily destined to the college residences just north of Elizabeth Avenue and is often social in nature so activity occurs both day and night. At these locations the grade along Elizabeth Avenue makes the installation of traffic calming or flashing beacons more difficult. The curve just west of Fork Street makes installation of a beacon at Iron Street likely not possible, but it may be possible at Fork Street. One concern, though, is whether uphill-bound vehicles will be able to stop and start safely on the grade in the winter.

The problem along Elizabeth Avenue is generally accentuated by the abrupt transition from a suburban, almost light industrial, environment to the campus setting. There are no signage or other cues to inform drivers that they are entering the College environs. The lack of sidewalk along the south side of the street, as well as portions of the north side of the street, only serves to accentuate the problem.

The Master Plan proposes a pedestrian to span West Elizabeth Avenue. The elevations are such that a pedestrian overpass could be installed to line up with the west edge of Breidegam Fieldhouse and require little additional fill while still providing sufficient vehicle clearance.

In general, the best way to address pedestrian safety along West Elizabeth Avenue, however, will likely be...
to move as much of the college program and residences south of the street as possible in order to minimize the need for the crossing.

Main Street

Main Street between Locust Street and Elizabeth Avenue was recently improved with a landscaped median and, textured mid-block crosswalk and banners. The treatment seems quite effective at slowing traffic as well as establishing the “campus zone” to assist in the psychological distinction for drivers. The extension of this treatment a block south to Laurel Street would help to further define the campus zone and gateway. Overall, both the City and College are amenable to such an extension. In general, Main Street north of Goepp Street seems excessively wide as there are no curb cuts and thus limited left-turning traffic. Additional treatments, in line with the Elm Street Study, could enhance both pedestrian and bicycle safety along this corridor.

Hurd Campus

While vehicle speeds tend to be lower near the Hurd campus, there is some concern about pedestrian safety crossing West Church Street. At the intersection with Main Street, parked cars can obscure crossing pedestrians. To the west, there is also a conflict where Church Street curves down the hill to Spring Street. Pedestrians headed to and from the Hill-to-Hill parking lot will often cross mid-block to access the campus. Unfortunately the horizontal and vertical curves present sight distance issues so that placing a mid-block crosswalk at this location is not safe. Instead, pedestrians should be encouraged to cross at the existing crosswalk at Main Street west of Monocacy Creek. If this location continues to be of concern, it may be necessary to install a barrier along the north side of the street to prevent jaywalking.

VEHICLE CIRCULATION AND SAFETY

Vehicle circulation on and around the campuses is generally good with few problems. Elizabeth Avenue is part of the regional road network and classified as a minor arterial. Main Street serves as a collector. Both roads carry many trips per day through the campus. Campus Safety indicated that vehicular crashes occur at the intersection of Elizabeth Avenue and Main Street. Further south, the intersection of Main Street and Broad Street was identified as a vehicular crash “hot spot” in the City’s Comprehensive Plan.

Intersection Safety

Because of the grades, sight distance is a problem at several intersections. The intersection of Elizabeth Avenue and Iron Street is problematic, particularly for southbound traffic on Iron Street. The grade, coupled with the retaining wall at the northeast corner of the intersection, makes it nearly impossible to see traffic approaching from either direction without entering the intersection. The intersection of Laurel Street and Mauch Chunk Road also suffers from limited sight distance. Vegetation and the curve of Mauch Chunk Road obscure the view of vehicles on Laurel Street.

The intersection of Laurel Street and Geissinger Street is non-standard and potentially hazardous. In general, though, vehicle speeds are low enough in this area
that motorists can safely navigate any potential uncertainty.

The on-street parking along Main Street and several other locations adjacent to the campus is such that parked cars can sometimes obstruct the view of traffic. The college indicated that the City will typically work with them to address such problems by limiting parking adjacent to the intersections as necessary. This could also include the installation of bump-outs to reduce pedestrian crossing distances and increase visibility.

Campus Vehicle Circulation

There are several roads through the campus which serve only to provide emergency vehicle access, accommodate special events and provide limited service vehicle access. These include West Locust Street, west of Main Street; the access drive to the western residential complex on the Main Street campus (Wilhelm Hall, Bernhardt Hall, etc); and Monocacy Street north of Laurel Street. Removal of these streets would have minimal effect on vehicle circulation but could significantly improve the pedestrian environment and safety. Any such transition would need to allow access to emergency service vehicles and support the weight of these vehicles.

While the grid nature of the street network adjacent to the campus helps to diffuse traffic and provide routing options for emergency responders, it may increase through traffic. It may be possible, therefore, to consider changes to this network if they enhance pedestrian safety or the overall campus environment. In general, the streets adjacent to the campus are city streets so any changes in circulation patterns would need their approval and should generally not be seen as detrimental to the adjoining neighborhoods. Key streets in this category include West Laurel Street west of Main Street as well as Fork Street, Iron Street and Monococy Street between Greenwhich Street and West Elizabeth Avenue. While it would not likely be feasible to close all of these streets, it is not unreasonable to assume that some subset could be closed or restricted.

USE OF ALTERNATIVE MODES

The compact nature of each campus results in a largely pedestrian-based movement about the campus. Nearly all students live on campus so, overall, there is not a strong need to promote alternative modes. Moreover, the terrain adjacent to the campus makes commuting on foot or by bike less attractive, particularly in the winter.

While there is some bicycle use on campus, it accounts for a small percentage of the trips. Because of the lack of bike storage on campus, few students or employees commute to campus by bike. Bike racks are provided in some locations and the new residence hall will have a dedicated bike storage room. Discussions with College staff indicated that bike usage would likely increase if adequate storage facilities were available, particularly secure, long-term storage allowing employees to park all day and students to safely store a bike over night or when otherwise not in use. During good weather, biking could provide a
pleasant alternative to the shuttle when traveling between campuses, however the current routes are somewhat convoluted and there is some concern of personal security along portions of the route. Terrain is the largest impediment, coupled with the fact that the shuttle service is very convenient and faster.

Lehigh and Northampton Transportation Authority (LANTA) buses do not directly serve the Main Street campus but the Bethlehem transit center is at the corner of Broad Street and North Guetter Street, immediately adjacent to the Bethlehem parking garage. Commuters could readily catch the shuttle at this location to either campus. The inbound route B crosses the Hill-to-Hill bridge and turns up Main Street in front of the Hurd campus. There is no indication that many, if any, commuters use the bus, however. Given that parking is free and generally available on campus for both commuting students and employees, there is little incentive to take the bus unless one does not have access to a car.

In addition to operating the campus shuttle, the shuttle vehicles are used to provide service to area attractions on the weekends. Currently a student group contracts with Facilities to provide two trips on Friday evening to a destination of their choosing. The destinations rotate from week to week and include local malls, Wegmans and other anchor retailers. As scheduling permits, the shuttles are also available at cost to student groups for evening social activities such as formals or bowling.

There is no formal transportation demand management (TDM) program, though some informal carpooling takes place. The Parking Task Force proposed the introduction of a carshare program (such as Philly CarShare or ZipCar) to the campus, but there is not currently such a service.
**RECOMMENDATIONS**

Drawing on the campus planning principles, several improvements to the campus transportation system were developed. Highlights include:

- Enhance the character of the Main Street campus and improve pedestrian safety by closing or restricting traffic on streets within the core of the campus.
- Improve connections between the campuses by shuttle, foot and bike.
- Improve pedestrian safety along West Elizabeth Avenue and Main Street through traffic calming and improved crossings. An improved and redefined streetscape will reinforce the signal to drivers that they are ‘on campus’ and encourage them to slow down and anticipate pedestrian traffic. Additionally, as program is shifted south of West Elizabeth Avenue, this will reduce the need to cross the street.
- Increase parking options and quantity to accommodate special events. The master plan phasing will ensure that replacement parking is found before existing parking is displaced. Continue to relocate parking out of the campus core.
- Enhance the campus gateways and college character at these locations to reinforce the sense of arrival for visitors to the campus.

**PEDESTRIANS**

Pedestrian circulation is and will remain at the heart of the Moravian College transportation system. For this reason, the primary recommendations focus on the further improvement of the pedestrian environment.

**Street Closures**

While the core of the campus is very pedestrian-friendly, the vehicular conflicts at the edges should be reduced as the campus develops. To further improve the open space and campus quality, several streets at the edges of the campus should be closed. In conjunction with physical plan improvements, these closures will greatly enhance the open-space framework on the campus.

As they are at the core of the Main Street campus it is recommended that Locust Street west of Main Street and Locust Street be closed early in the implementation of the Master Plan.

The redevelopment of the Main Street campus residential zone has, at its heart, the closure of Laurel Street west of Monocacy. Along with the closure of the adjacent block of Geissinger Street, this will create a new residential quad and a greater sense of connectivity with the rest of the campus. As the campus develops, it may be beneficial to restrict public traffic along Laurel between Monocacy Street and Main Street and Monocacy Street north of Frankford Street.

As part of the redevelopment of the Main Street campus north of West Elizabeth Street, it is recommended that Iron Street and Fork Street south of Greenwich Street both be closed. This will reduce the pedestrian-vehicle conflicts in the area. Elimination of pedestrian crossings at these streets will also enhance the success of the pedestrian bridge.

**Shuttles**

The shuttle will continue to play an important role in the campus transportation system. The College should
1. Extend median and enhance streetscape and pedestrian crossings along Main Street
2. Create pedestrian plaza and walkway over Elizabeth Avenue
3. Enhance streetscape and pedestrian crossings along Elizabeth Avenue
4. Enhance streetscape and pedestrian crossings along Mauch Chunk Road
5. Connect campus paths to greenway trail
6. Enhance streetscape and pedestrian crossings along Laurel Street

1. Maintain shuttle stop at HUB until construction of HUB II
2. Create quality shuttle stop at HUB II with adjacent indoor waiting area

1. Close Locust and Monocacy Streets
2. Close Geissinger Street
3. Close Laurel Street west of Monocacy Street
4. Close Fork and Iron Streets

capitalize on opportunities to improve the quality, reliability and capacity of the shuttle. As specific projects are considered, it will be important to consider the impact on the campus shuttle. The closure of Locust and Monocacy Streets in front of the HUB, for example, will require a temporary stop until the HUB II can be completed. This should be as close to the HUB as possible and include a covered waiting area. With the construction of the HUB II, a new indoor waiting area should be provided within close proximity of the stop. Such improvements recognize the important role of the shuttle in the campus transportation system and help to reduce any perceived delay of traveling between campuses.
As noted in the observations section, many currently use the shuttle to gain easy access to the shops and businesses along the south end of Main Street. As part of the ongoing monitoring of the shuttle usage, the College should evaluate travel patterns and preferences to determine whether a new stop along Main Street is necessary.

**BICYCLES**

There is evidence that a greater percentage of the campus community would bike to and between campuses if enhanced facilities were available, a trend reflected across the country. The College should develop a standard for the placement and quantity of bicycle parking. This should include spaces both in residence halls as well as proximate to academic buildings.

To promote bicycle use between the campuses, it will be important to work with the City to enhance the routes between the campuses and raise awareness of the recommended routes. Improvements should also include enhanced bicycle storage and route signage.

**VEHICLE CIRCULATION**

While there is little vehicle circulation on the campus today, the current pedestrian core is bounded by streets on all sides, limiting the growth and quality of campus commensurate with the core. As the core expands, it is recommended that public traffic on several adjacent streets be restricted and eventually prohibited. The streets recommended for such changes follows with details of each given below:

- Locust Street west of Main Street
- Monocacy Street between Locust Street and Frankford Street
- Laurel Street west of Main Street
- Geissinger Street north of West Frankford Street
- Fork Street south of Greenwich Street
- Iron Street south of Greenwich Street

In all cases, accommodations would be made to ensure continued emergency and service vehicle access to buildings, as well as access for move-in/move-out. The phasing plan for the Campus Master Plan details the recommended timeframe for conversion of each of these streets. During the process it will be important to maintain a dialog with both the campus community and the City and adjoining neighborhoods emphasizing the goals and benefits of each project.

**Street Closures**

As discussed in the observations section, there is little public traffic on Locust west of Main Street and Monocacy north of Laurel Street. Closure of these streets would have negligible impact on vehicle circulation and would provide a substantial enhancement to the pedestrian environment on the core campus. As noted above, closure of these streets will require revision to the campus shuttle and construction of a new shuttle stop. Additionally, until a combined loading facility is constructed with the HUB II, the southern end of Monocacy will need to remain open to service vehicles to maintain access to the HUB loading dock.

West of Main Street, Laurel Street primarily serves traffic to and from the College. As it dead-ends just a few block to the east at the Moravian Athletic Complex, through traffic should be minimal. It is recommended that the closure be in two phases. In the first phase, Laurel Street would be closed west of Monocacy to create a new residential quad.
Concurrently, Geissinger Street would be closed to complete the quad.

In later phases of the Campus Master Plan, the portion of Laurel Street between Monocacy Street and Main Street would be closed to public traffic. Monocacy Street between Laurel Street and Frankford Street would be closed simultaneously. In order to maintain convenient shuttle service and access to loading docks on adjacent buildings, one or both of these streets would need to remain open to limited traffic. Additionally, because of the central role these streets play in access to the southern half of the Main Street campus, it will be crucial to involve city emergency officials early in the design stages to ensure that the new access patterns meet their needs.

As part of the improvements along Elizabeth Street, it is recommended that Fork Street and Iron Street be closed south of Greenwich Street. The intersections of both of these streets with Elizabeth Avenue are deficient today for both vehicles and pedestrians. Their closure will provide a substantial safety benefit and enable the construction of the pedestrian overpass at only a minor inconvenience to motorists.

Streetscaping

As discussed above, there are several additional locations adjacent to the campus where pedestrians and vehicles are in conflict. In these areas, it is important to reinforce the campus character of the street and, where necessary, install traffic calming devices in conjunction with streetscaping to slow vehicle traffic. Main Street, West Elizabeth Avenue, Mauch Chunk Road and West Church Street are all candidates for such improvements.

Key first steps will include typical improvements such as landscaping, lighting and street furniture. In areas where vehicle speeds are a concern, traffic-calming devices will be important. Raised intersections and other intersection treatments such as stamped or colored pavement are quite effective at calming traffic and reinforcing the pedestrian nature of the street. Similar treatments can be applied at crosswalks as was done with the recent Main Street streetscaping project.

Approach Sequence and Wayfinding

A final, important piece of the campus character from the motorist’s viewpoint is the campus arrival sequence. By improving the arrival sequence and establishing gateway elements, motorists – both visitors and passers-by – are reminded they have entered the College’s campus. The sense of arrival aids visitors in their orientation and provides through traffic a reminder to slow down. Key locations for gateway elements include along West Elizabeth Avenue, approaching Main Street; along Main Street approaching Laurel Street; and at the intersection of Mauch Chunk Road and West Elizabeth Avenue. Although the historic nature of the campus and site limitations restrict the range of treatments at the Hurd campus, elements providing a similar gateway effect should be pursued along West Church Street, particularly in the vicinity of the intersection with Main Street.

PARKING

As the College’s physical form changes, most of these changes will affect existing parking on the campus. Over three-quarters of the existing parking will need to be rebuilt through the course of the plan. While the end result will be an improved parking system with higher quality lots and an increased capacity, the changes will require ongoing management and communication efforts to minimize confusion or dissatisfaction.

In all, the Main Street campus and Moravian Athletic Complex will see total parking capacity increase from roughly 750 spaces today to over 1,100 spaces at the completion of the master plan, a nearly 50 percent increase. Parking on the Hurd campus is expected to remain at current levels. As much of this parking increase would come from the construction of a garage beneath a reconstructed, elevated Betty Prince Field, the timing of which is currently unknown, the phasing plan ensures that throughout the implementation of the Campus Master Plan, the total parking spaces on the campus do not decrease below current levels. The accompanying table details the anticipated losses and gains for each of the projects identified in the Campus Master Plan. The estimated new spaces allow for full-size 9-foot spaces as well as landscape and storm water treatment improvements.

In order to reduce the parking demand for both employees and students, it is recommended that the college initiate a TDM program. Components could include discounted bus passes and incentives for carpooling, walking or biking to work. There are many opportunities for partnering with LANTA to reduce costs. Experiences at other institutions show that such
programs can significantly reduce employee parking demands (in some cases by one quarter or more).

A guaranteed ride home program is often cited as the most important enabling program. It ensures a ride home in case of emergency for those who would otherwise be stranded. Similarly sized programs often provide only a few rides a month, using taxi vouchers, for low total cost.
<table>
<thead>
<tr>
<th>Phase</th>
<th>Spaces Lost</th>
<th>Spaces Gained</th>
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<th>Net End</th>
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<td>1 Construct Comenius Center</td>
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<td>3 Renovate Collier Hall</td>
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<td>4 Main Street Improvements</td>
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<td>14 Upgrade Baseball Field</td>
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<td>3 Construct Residence Hall</td>
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<td>4 Construct Parking Lot</td>
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</table>
1.0 Mechanical and Electrical Systems
1.1 Existing Conditions
1.2 Recommendations
2.0 Electrical Systems
2.1 Existing Conditions
2.2 Recommendations
3.0 Sustainability Initiatives
4.0 Summary - Campus Building Loads (Heating and Cooling)
5.0 Summary – Campus Building Loads (Electrical)
MECHANICAL AND ELECTRICAL SYSTEMS

OVERVIEW

Background data on existing mechanical and electrical equipment and distribution systems including installation dates/age, capacity, condition, operation and maintenance information were obtained from Facilities Management personnel and supplemented with limited on site survey. A tour of campus buildings including a descriptive overview of the systems was conducted in February 2009.

Mechanical and electrical systems’ infrastructure, including chillers, boilers, piping distribution systems, electrical service equipment and electrical distribution systems, were evaluated relative to their ability to adequately and efficiently supply existing, planned renovations and planned new construction for the Main and Hurd campuses. Master Planning recommendations for replacement, upgrade or retention of mechanical and electrical systems’ infrastructure are provided to support the phased Master Plan.

MECHANICAL SYSTEMS

Existing Conditions Mechanical - Main Street Campus

Generally, academic buildings on the Main Street Campus are heated via stand-alone boilers. Limited buildings are heated via hot water or steam supplied from an adjacent building. Both gas and oil-fired boilers exist.

District water-cooled chiller plants, located in the Collier Hall of Science and Priscilla Payne Hurd Academic Complex (PPHAC) provide chilled water to multiple buildings via an underground piping distribution system for cooling. When the PPHAC was constructed in 2002, the building was designed to house a district cooling plant. One of two planned central chillers and cooling towers was installed along with underground piping distribution. Piping mains routed out the south end of the PPHAC were capped for future extension. The exact location and extent of this piping was not known at the time of this writing but it is known to generally extend and terminate at West Laurel Street. Chilled water plants are de-energized during the heating season when ambient outside air can be utilized for free cooling.
The Haupert Union Building (HUB) was constructed in 1962. It houses the main dining hall and kitchen on campus. The building has expanded significantly through the construction of several building additions. Two (2) Weil McLain hot water boilers (approximately 10 years old) exist in the HUB and are fired by either oil or natural gas. A 10,000-gallon above ground fuel oil storage tank exists adjacent to the building.

Cooling for the HUB building is provided via the central cooling plants; however the Prosser Auditorium has a dedicated DX rooftop air handling unit to provide 12 month cooling to the auditorium when the central cooling plants are off line. It was reported that temperature control zoning within the HUB is generally poor.

The Priscilla Payne Hurd Academic Complex (PPHAC) building was constructed in 2002 and houses classrooms, faculty offices, and student spaces. The building is heated via (2) dual fuel boilers located in the Collier Hall of Sciences building. These two boilers were replaced in Collier under the PPHAC construction contract.
The PPHAC building houses one 500-ton Trane centrifugal liquid chiller (Model CVH485) that generates half of the central cooling plants’ 1,000 ton capacity. A 500-ton cooling tower exists on the roof to reject heat from the cooling process. The building was designed for the installation of one future 500-ton chiller and rooftop cooling tower.

The PPHAC also houses the campus Network Server Room which is supplied from a pair of split-system A/C units. The units are planned to be tied into a proposed emergency generator for improved reliability. The Hurd Academic Complex building reportedly has superior HVAC systems, although the Atrium Lobby heating systems are ineffective during cold periods. Heating and cooling is provided to the lobby via overhead air distribution with no perimeter heat at the floor to offset expansive glass transmission losses and infiltration from multiple exterior doors.

The Collier Hall of Sciences building was constructed in the 1970’s and is reportedly in need of renovation/upgrade. Mechanical and electrical systems serving the building are original and in poor condition, with the exception of the boilers, chillers, and cooling towers which have been replaced. The building houses physics laboratories on the first floor, chemistry labs and tiered classrooms on the second floor, and biology labs on the third floor. Utility/duct shafts exist in the core of the building accessible at each floor with structural grating providing flexibility for utility and duct modifications. Two dual-fuel boilers were replaced under the PPHAC construction and serve both Collier and the PPHAC. The boilers are Cleaver Brooks flexible water tube type (Model FLE 200-900-160 HW). A 10,000-gallon underground storage tank exists to supply fuel oil to the boilers.
Two nominal 250-ton chillers exist in the Collier penthouse mechanical equipment room comprising half of the central cooling plants’ 1,000 ton capacity. The chillers are Carrier R-22 (Model 23XL2121EC60) water-cooled, screw compressor type. A two-cell Baltimore Aircoil forced draft cooling tower exists on the roof of Collier Hall of Sciences, coupled to the two chillers for heat rejection. The mechanical systems in Collier are generally original, reportedly in poor condition, and in need of replacement. The boilers, chillers, and cooling tower are the exception and potentially have several years of remaining service life although phase-out of refrigerant R-22 must be considered.

Comenius Hall is a classroom building, heated via two Weil McLain steam boilers (Model BGL-1394WF). The boilers also serve Memorial Hall, Monocacy Hall, and Zinzendorf Hall via underground piping between the buildings. Comenius is connected to the central chilled water distribution system. The systems are reportedly in need of upgrade.

Memorial Hall was the original campus science building and currently houses general classrooms. HVAC systems serving the building are hydronic fan coil units. Steam from the Comenius Hall boilers is piped underground into the building and converted to hot water for heating. Chilled water is provided from the central distribution system.

Monocacy Hall is similarly served with steam from Comenius Hall and chilled water from the campus distribution system. The lower level was reportedly not cooled under the building renovation requiring the installation of Mitsubishi split systems when a new program requiring cooling was added. A small addition housing a two-story elevator to the front of the building was recently completed.
Zinzendorf Hall utilizes steam from Comenius Hall to generate hot water for heating. The hot water also provides heat for adjacent Hamilton Hall. Cooling is provided by residential window air conditioning units. Hamilton Hall has Nursing Faculty Offices on the first floor, student housing on the second floor and the third floor is currently vacant.

Reeves Library was originally constructed in 1967. Two bookend additions were constructed circa 1990. The original central building was cooled via stand alone chiller and cooling tower but has since been connected to the campus chilled water distribution system. The building’s chiller and cooling tower are abandoned in place. The two building additions are conditioned via heat pumps.
Johnston Hall houses the main competitive basketball arena. Two large air handling units were installed on mezzanines constructed within handball courts and serve the main gymnasium. The air handling units are supplied with chilled water from the campus distribution system. Heating is provided from a Weil McLain steam boiler (Model 1688) within the building; the boiler is reportedly 2 years old and is in excellent condition.

Breidegam Fieldhouse is a large multi-purpose space for athletics and assemblies. The building is heated and ventilated only by means of gas-fired H&V units suspended on a platform above the center of the space. Summertime functions are limited due to the lack of mechanical cooling.
Rau Hall and Hassler Hall are student residence buildings, constructed in 1958. In the late 1980’s, the buildings were mechanically cooled via a stand-alone air-cooled chiller (Trane Model CGACC706RNNJG42135CGM) on grade. The chiller is reported to be in poor condition and in need of replacement. The buildings utilize unit ventilators for heating and cooling. Two dual-fuel boilers exist in the buildings for heat. A 10,000-gallon underground storage tank exists for boiler fuel oil.

Lenape House, Burnside House, and Antes House are student residence townhouses. The buildings are heated and cooled via all electric heat pumps. Beck Hall and De Schweinitz House are also residence halls. Cooling is provided via portable terminal air conditioners (PTACs) in each space. A residential gas-furnace provides heat.

Bernhardt Hall and Wilhelm Hall residence halls have two dual-fuel hot water boilers manufactured by Weil McLain.

A 6,000-gallon underground fuel oil storage tank exists for boiler fuel. The building utilizes hot water radiators under the windows to offset heat losses and reportedly provides poor temperature control. Student complaints on heating control are common. Split-system air conditioning units exist for the Resident Director (RD) apartments.

August Spangenberg House is equipped with gas-fired hot water heaters that serve radiators located under the windows. The buildings are mechanically cooled via a stand-alone air-cooled chiller (Bohn Model ACWC-50RD) located on grade. The chiller is reported to be in poor condition and in need of replacement. Anna Nitschmann House is supplied with heating water from August Spangenberg House.
The Hillside Complex of residence halls consists of 6 building units. The oldest of the units (1 through 4) were constructed in 1999. Units 5 and 6 were constructed in 2001. Individual apartments are conditioned via residential gas-fired furnaces with dx cooling coupled to outdoor air-cooled condensing units.

Jo Smith Hall is a female residence hall constructed in 1970. The building is reportedly in excellent condition. The building is conditioned via portable terminal air conditioning (PTAC) units with electric heat. A gas-fired RayPak unit exists in the basement to provide domestic water needs.

The Bahnson Center was constructed in 1975. The building is conditioned with electric heat and chilled water from an air-cooled chiller on the roof. The chiller is a Trane Model CGAA-3006-MB.

Colonial Hall is a building housing mostly administrative offices. There are six (6) Caravan Slant Fin boilers to provide heat for the building. An air-cooled chiller, manufactured by Technical Systems (Model 30A0CD80-SPCF) exists on grade within a stone-clad enclosure to provide cooling. HVAC systems are generally 4-pipe unit ventilators, with an AHU in the attic serving down to the 3rd floor.
Existing Conditions Mechanical - Hurd Campus

The Hurd Center for Music and Art is comprised of the Foy Concert Hall, Payne Art Gallery, South Hall (Art), 1867 Chapel Building - Peter Hall, West Hall (Music), and Single Brethren’s House (Music); all interconnected. Two oil-fired steam boilers (installed circa 1964), manufactured by HB Smith, are located in the basement of the West Hall and provide heat and domestic hot water (winter) for the entire five building complex. Fuel oil for the boilers is stored in a single 10,000-gallon underground storage tank. Space heating is provided by a combination of steam radiators in older buildings and central air systems in newer or renovated buildings. The boilers operate only during the heating season; domestic hot water is provided when boilers are off-line via Raypak heaters.

Two independent chilled water systems provide cooling to portions of the building complex; some areas of the buildings are not mechanically cooled. Generally, one air-cooled chiller serves the southernmost buildings and one air-cooled chiller serves the northernmost buildings.

A Carrier air-cooled chiller (Model 30GB045510), originally installed to serve Foy Concert Hall and the Payne Art Gallery, is abandoned on the east side of the Foy building. A replacement chiller, manufactured by Trane (Model CGAFC60EAEA1000D00H00N000T0W00), has a capacity of 60 tons is located just north of the abandoned chiller on the east side of Foy Concert Hall. The chiller was recently installed (within the past couple of years) and is reported to be in excellent condition.

The northern buildings of the Hurd Center are served from the (2) boilers in the Hurd Center. Heating is provided via steam radiators that are reportedly difficult to control. There is no mechanical cooling in Main Hall.

Main Hall is supplied from the (2) boilers in the Hurd Center. Heating is provided via steam radiators that are reportedly difficult to control. There is no mechanical cooling in Main Hall.

Frueauff House (President’s House) is a residence for the dean and faculty. The building and systems are reportedly in good condition and are well maintained. The structure has a stand alone oil-fired boiler for heat and residential grade split system air conditioning units for cooling.

Widow’s House was acquired by the College approximately 20 years ago and serves as a residence hall for seminary students. Some Moravian Church widows also live in the building. The building has a stand alone oil-fired boiler for heat and residential window air conditioning units for cooling.

Clewell Hall is a male dormitory building with approximately 20 beds. The building is heated via an oil-fired boiler that is in need of replacement due to its age/condition. There is no mechanical cooling in the building. Operable windows provide ventilation.
Cooling for core academic buildings (Collier Hall of Science, Comenius Hall, Haupert Union Building, Johnston Hall, Memorial Hall, Monocacy Hall, Priscilla Payne Hurd Academic Complex, Reeves Library, and Zinzendorf Hall) on the Main Street campus is supplied from an underground chilled water piping distribution system. Currently, two 250-ton chillers located in Collier Hall of Science and one 500-ton chiller located in PPHAC generate chilled water to supply the system. The PPHAC building was designed and constructed to accept a second 500-ton chiller to increase the chilled water plant’s capacity from 1,000 to 1,500 tons and the existing underground piping distribution system was reportedly planned to be extended to serve buildings at the west end of campus.

Centralized cooling plant(s), generating cooling for service to multiple building locations are widely and effectively used on college campuses due to the close proximity of buildings (loads) and the associated advantages. These advantages, partially taken from the 2008 ASHRAE Handbook - HVAC Systems and Equipment, include the following:

- System reliability is improved through the economical installation of firm or stand-by capacity.
- Larger and fewer pieces of equipment generally reduce the facility’s overall operation and maintenance costs.
- Centralized locations minimize restrictions on servicing accessibility.
- Energy-efficient design strategies, energy recovery, thermal storage, and energy management can be simpler and more cost effective to implement.
- Standardizing equipment can be beneficial for redundancy and stocking replacement parts.
- Load diversity of multiple buildings allows reduced equipment capacity.
- Acoustical treatment of cooling equipment can be more easily managed in limited, appropriately designed location(s) in lieu of within each building.
- Many older buildings were never initially designed for mechanical cooling and their structure and configuration may not be suitable for large cooling equipment, thereby limiting system options and requiring compromise.
- Centralized plants can generally be planned for economical expansion to support future buildings or future increased loads.

Building construction, building renovation, and site improvements (e.g., closure of Locust, Monocacy and West Laurel Streets and associated landscape improvements) on the Main Street campus proposed under the Master Plan, provide opportunity to expand the existing chilled water central plants and piping distribution system. It is recommended that academic and residence hall buildings in the core (generally bounded by West Elizabeth Street, Main Street, West Laurel Street, and Mauch Chunk Road) of the Main campus be served by the central chilled water distribution system. Other smaller and remote buildings are proposed to have stand-alone systems. Conversion of building chilled water service from air-cooled chillers at Rau/Hassler Halls and August Spangenberg House to service via the underground chilled water distribution system supports the landscape and campus aesthetic improvements through the removal of this at-grade equipment.
A cooling load analysis for each of the existing and proposed buildings is summarized in Table M-1; buildings currently served by the central chilled water plant and distribution system and those existing and new buildings proposed to be added to the system are highlighted. Further, estimated cooling loads are summarized per Master Plan phase. Phase I loads total approximately 1,340 cooling tons and include the buildings currently served, Breidegam Fieldhouse to be renovated and construction of the west addition, Collier Hall of Science renovation and additions, and the new Monocacy Residence Hall. The chilled water plant expansion under Phase I would include...
the installation of the 500-ton chiller and cooling tower to PPHAC and extension of underground chilled water piping to both Breidegam Fieldhouse and Monocacy Residence Hall.

Phase II of the Master Plan includes the demolition of 11 buildings in the south west corner of campus, renovation of Johnston Hall, and the construction of HUB-II, Fitness Center, and three Residence Halls. These projects and their associated site improvements is when the underground chilled water piping should be extended to complete the loop around the west side of campus. The estimated peak cooling load for buildings to be supplied by the central plant under Phase II is approximately 2,000 tons. A third chilled water equipment location, within the HUB-II building, is proposed to supply the distribution loop and meet the increased load. The HUB-II plant capacity is proposed to be 1,500 tons comprised of three 500-ton chillers, increasing the ultimate plant capacity to 3,000 tons. Chiller installation can be staged to match the cooling load requirements as buildings are added to the system. New buildings including Academic Center and Bookstore, Breidegam Fieldhouse addition, Johnston Hall addition, Reeves Library addition, and Academic Building will be added to the loop under subsequent Master Plan phases. Existing buildings including Anna Nitschmann House, August Spangenberg House, Bernhardt/Wilhelm Halls, Hamilton Hall, Jo Smith Hall, and Rau/Hassler Halls are also proposed to be added to the loop. The ultimate peak cooling load for all existing and new buildings proposed to be served is 2,740 tons.

Because most buildings on campus are currently heated via stand alone systems within each building, it is recommended that this approach be continued for new buildings. Although similar benefits could be realized for a centralized heating plants to those described above for centralized cooling plant, factors including high capital cost, increased system complexity, possible requirement for a stationary engineer, stack/emissions issues, and lack of a plant location outweigh the benefits. Sustainable and energy efficient system options including geothermal, dual fuel high efficiency condensing boilers, and energy recovery should be evaluated through energy modeling and life cycle cost analyses. Numerous underground fuel oil storage tanks (for building heating) exist throughout campus. Many tanks are old and are reportedly single wall construction. These tanks pose leak hazards and should be replaced with double-wall tanks with modern leak detection systems.

Many existing buildings on the Main Street campus are in need of renovation to upgrade or replace mechanical (HVAC, plumbing and fire protection) systems and automatic temperature controls due to their age, condition, operational efficiency, or inability to provide adequate temperature and relative humidity control. These renovations would occur consistent with the recommended phasing of the Master Plan.

Master Plan Recommendations Mechanical - Hurd Campus

Because buildings comprising the Hurd Center for Music and Art are interconnected, heating and cooling service should remain centralized for the buildings in this complex. The two existing boilers, providing heat for both the Hurd Center and Main Hall, have exceeded their useful service life and a replacement project with new high efficiency, dual fuel boilers should be implemented. Replacement boilers should be selected with capacity to meet the peak heating demand as well as provide partial redundancy in the event of a single boiler failure. The existing hot water distribution piping should be evaluated and replaced or upgraded as required to provide a reliable heating system. Portions of the complex are not adequately heated and system upgrades should be implemented as the various buildings of the complex are renovated.

The two existing, at-grade, air-cooled chillers serving the Hurd Center for Music and Art have a combined nominal capacity of 140 tons, are in good condition, and have several years of remaining service life. The peak load to provide cooling for the entire existing Hurd Center is estimated to be approximately 300 tons - refer to Table M-1. The peak load grows to approximately 410 tons due to the proposed Hurd Center additions and if Main Hall and Frueauf House are desired to be cooled and supplied from the Hurd Center plant. Because these future loads significantly exceed the existing chillers’ capacity, it is recommended that a new water-cooled chiller plant, similar to that in Collier Hall of Science or PPHAC on the Main Street campus, be installed within the South Hall service/circulation addition (Master Plan Phase II) with two 210-ton chillers located within an interior mechanical equipment room and cooling towers on the addition roof. The existing air-cooled chillers could be salvaged and relocated to supply cooling to a remote building not planned to be connected to the central cooling plants (i.e., the new residence hall connected to the HILL (Hurd Integrated Living Learning)).

New residence hall buildings, planned for the east side of the Hurd campus, are proposed to have stand-alone HVAC systems. Sustainable and energy efficient system options including geothermal heat pumps, dedicated outside air systems (DOAS), and energy recovery should be evaluated through energy modeling and life cycle cost analyses.

Many existing buildings on the Hurd campus are in need of renovation to upgrade or replace mechanical (HVAC, plumbing and fire protection) systems and automatic temperature controls due to their age, condition, operational efficiency, or inability to provide adequate temperature and relative humidity control. These renovations would occur consistent with the recommended phasing of the Master Plan.
ELECTRICAL SYSTEMS

Existing Conditions Electrical - Main Street Campus

Primary electrical service is supplied to the Main Street Campus from a lineup of exterior switchgear located behind Reeves Library. The service is supplied by a single PP&L feeder and the nominal service voltage is 12.47 kV. There is little available documentation for the medium voltage switchgear and underground distribution system. There is a one line diagram (a hand-drawn sketch) with revisions dated through January 25, 2001; however subsequent modifications to the system have not been documented. For instance, the one line diagram indicates six switchgear sections and a seventh section designated as “Future Switch Location”. Based on observations of the switchgear made during a site visit on February 26, 2009, the seventh section has been added.

The one line diagram for the switchgear indicates one section for the incoming PP&L service, one section for the main service disconnect switch, and one section each for four radial feeders. The more recently added seventh section contains the switch for a fifth feeder, dedicated to supply the Priscilla Payne Hurd Academic Complex.
The one line diagram indicates the following buildings connected to each feeder:

**Feeder No. 1**
- Reeves Library - Three 250 kVA, single phase, oil-filled transformers are located in a vault adjacent to the building.

**Feeder No. 2**
- Johnston Hall – Square D 15 kV switchgear is located in a main electrical room in the building. The switchgear includes three fused load interrupter switches – one main disconnect, one to supply Johnston Hall and Breidegam Fieldhouse, and one to supply Collier Hall of Sciences, Colonial Hall, Bahnson Center and Sigma Sigma Sigma. Secondary service for Johnston Hall is derived from a 150 kVA dry type transformer located in the main electrical room.
- Breidegam Fieldhouse – Secondary service is derived from a 500 kVA transformer.
- Collier Hall of Sciences – Secondary service is derived from a 1500 kVA dry type transformer located in the boiler room.
- Colonial Hall / Bahnson Center / Sigma Sigma Sigma – Secondary service is derived from a 500 kVA exterior pad-mounted transformer.

**Feeder No. 3**
- Haupert Union Building – Secondary service is derived from a 750 kVA transformer.
- Rau Hall / Hassler Hall – Secondary service is derived from a 500 kVA exterior pad-mounted transformer.
- Bernhardt Hall / Wilhelm Hall – Secondary service is derived from a 500 kVA dry type transformer located in a main electrical room.
- Antes Townhouse / Burnside Townhouse / Lenape Townhouse / de Schweinitz House / Beck Hall – Secondary service is derived from a 225 kVA exterior pad-mounted transformer.

**Feeder No. 4**
- Comenius Hall / Monocacy Hall / Zinzendorf Hall / Hamilton Hall / Memorial Hall – 208Y/120V service is derived from a 225 kVA dry type transformer located in the basement of Comenius Hall.
- Hillside Complex – Secondary service is derived from four exterior pad-mounted transformers (one 37.5 kVA, two 50 kVA, and one 75 kVA).
- Jo Smith Hall – Secondary service is derived from a 501 kVA transformer bank located in the main electrical room.
- Anna Nitschmann House / August Spangenburg House – Secondary service is derived from a 300 kVA exterior pad mounted transformer.

**Feeder No. 5**
- Priscilla Payne Hurd Academic Complex – Secondary service is derived from a 1500 kVA dry type transformer.

According to facilities management personnel preventative maintenance is performed on the medium voltage equipment on a three-year cycle.

There are a number of properties owned by the College that are not supplied from the campus medium voltage service, but rather from secondary services directly from PP&L. These include Zeta Tau Alpha, Lenox House, and Alumni House, all of the properties north of West Elizabeth Avenue, and the properties along Monocacy Street south of West Laurel Street.

Electrical energy consumption (kWh) for each building is metered and logged. There is no system in place for monitoring electrical demand, power factor, or power quality.

There are no systems in place for automatic control of lighting fixtures.

Fire alarm systems in many of the buildings have been upgraded. The campus is moving towards Simplex fire alarms systems as a standard. Service for these systems has been good. The building fire alarm systems are monitored remotely by Campus Safety via Keltron fire alarm interfaces. This system provides a common alarm or trouble signal only, requiring a safety officer to be dispatched to the building to determine the cause of the signal.

Natural gas engine generator sets were observed in a number of buildings, ranging in size from 7.5 kW to 40 kW. All were manufactured by either Onan or Kohler, and there are both interior and exterior installations. These generators provide standby power for emergency lighting. A second generator is planned for the Priscilla Payne Hurd Academic Complex to provide standby power for the server room. Campus Safety and the Health Center both have propane powered generators.
Existing Conditions Electrical - Hurd Campus

The Hurd Center for Music and Art is comprised of Foy Concert Hall, Payne Art Gallery, South Hall, the 1867 Chapel Building - Peter Hall, West Hall, and Single Brethren’s House. Electrical service for this complex is supplied from a single exterior pad mounted PP&L transformer. This service was installed in 1977. The remaining buildings on this campus (Main Hall, Frueauff House, Widow’s House, and Clewell Hall) all are supplied directly from PP&L secondary services. Electrical service for Day House will be supplied from the new dormitory building currently under construction.

There are no emergency generators on this campus. Emergency lighting is provided by wall-mounted emergency lighting units with integral batteries.

Electrical energy consumption (kWh) for each building is metered and logged. There is no system in place for monitoring electrical demand, power factor, or power quality.

The upper two floors of South Hall are not in use due to the poor condition of the electrical power distribution system.

There are no systems in place for automatic control of lighting fixtures.

Fire alarm systems in many of the buildings have been upgraded. There are some areas, such as Foy Concert Hall, where additional fire alarm devices are required. The campus is moving towards Simplex fire alarms systems as a standard. Service for these systems has been good. The building fire alarm systems are monitored remotely by
Campus Safety via Keltron fire alarm interfaces. This system provides a common alarm or trouble signal only, requiring a safety officer to be dispatched to the building to determine the cause of the signal.

**Master Plan Recommendations Electrical - Main Street Campus**

The priority for planning the electrical infrastructure to support the campus master plan will be upgrading and expanding the 12.47kV PP&L electrical service and the 12.47kV campus underground distribution system. Although the existing system meets the present needs of the College, improvements in flexibility and reliability will be required to accommodate the growth and expansion of the campus. The following items should be considered in planning these improvements:

**Additional Service Feeder** – The existing service originates with a single 12.47kV overhead line from PP&L. An underground line would be less susceptible to outages due to weather or accidents, and would be an aesthetic improvement as well. A second 12.47kV line as an alternate source, with automatic changeover, would provide an improvement in service reliability.

**Service Switchgear Configuration** – The existing service equipment consists of a lineup of exterior switchgear located adjacent to Reeves Library. The switchgear includes a single fused main, a PP&L metering section, and five fused switches for outgoing distribution feeders. If a second line from PP&L is available, two alternate configurations of switchgear may be considered. One configuration would include two main circuit breakers, one primary and one alternate, with automatic changeover, supplying a single bus. The other configuration would be two main circuit breakers and two busses, with a normally open tie breaker connecting them, and each line supplying roughly half the load. In the event of an outage on one of the supply lines, the associated main would open and the tie would close, allowing the entire load to be supplied from the remaining line.

**Distribution System Configuration** – The existing distribution system consists of five radial feeders originating at the exterior switchgear. An outage on any of the feeders will result in an outage for all of the connected buildings, with no alternate source of supply. If the main-tie-main switchgear configuration described above is considered, two alternate distribution configurations may be implemented. In a loop primary system, a feeder loop is formed by connecting two feeders originating on either side of the tie breaker. The feeders are connected through a series of loop sectionalizing switches, all but one normally closed. The normally open switch provides the break in the loop and prevents paralleling of utility sources. Each loop sectionalizing switch has a fused load switch to supply a building transformer. By operation of the sectionalizing switches it is possible to isolate sections of the loop for maintenance or repair while maintaining service to the connected buildings during an outage. In a primary selective system, radial feeder pairs are formed by feeders originating on either side of the tie breaker. The feeder pairs are connected to a series of duplex selector switches, with one or the other of the feeder pair normally switched on and the other switched off. Each selector switch has a fused load switch to supply a building transformer. In the event of an outage on one feeder the load can be switched to the other.

**Underground Infrastructure** – With the exception of direct buried cable supplying Hillside Complex Buildings #1, #2, and #3, the feeders are routed through a system of manholes interconnected with conduit. An expansion of the existing underground distribution system will be required to supply new buildings. A system of manholes on a regular spacing (no more than 300 feet) will facilitate extension of primary feeders to new buildings as they are constructed. Concrete-encased duct banks with adequate spare capacity will provide protection for primary feeders and flexibility for the addition of new feeders as the campus expands.

**System Documentation** – A comprehensive one-line diagram should be prepared for the electrical service and distribution system, as well as a short circuit study, overcurrent protective device coordination study, and arc flash hazard analysis. Arc flash hazard labeling should be provided for all electrical service and distribution equipment. The one-line diagram and studies should be maintained and updated as the campus grows and as changes are made to the systems.

Implementation of improvements to the primary electrical service and distribution system will need to be carefully coordinated with building construction and demolition, street improvements and closures, and open space development. Each of the phases of the campus master plan provides opportunities for integrating the expansion of the system with planned construction activities.

**Phase I** – The existing 12.47kV distribution system does not supply buildings north of West Elizabeth Avenue. Existing College-owned buildings north of Elizabeth are supplied from individual PP&L secondary electrical services. With the exception of the new Comenius Center on Monocacy Street, most of the proposed development north of Elizabeth consists of parking lots, and therefore relatively little electrical load growth is anticipated in this area during Phase I. Rather than extend the 12.47kV distribution across Elizabeth, it will likely be more cost-effective to continue supplying buildings and facilities in this part of campus from individual services. However, the construction of the Elizabeth Street Bridge during this phase does offer the opportunity to put infrastructure in place for a future extension of primary electrical.
distribution to the north. This might include conduits integrated into the construction of the bridge, terminating in manholes on either side of the street.

The planned improvements to Main Street and closure of Locust and Monocacy Streets should include construction of manholes and underground duct banks to form the first part of a distribution loop around the campus.

As an interim solution during this phase, existing Feeder No. 4, which supplies the residence halls south of West Laurel Street, would be extended to supply electrical service to the new Monocacy Residence Hall.

Phase II – With approximately 240,000 gross square feet of new building construction proposed during this phase, there is a need for expansion of the primary electrical distribution system, as well as an opportunity to begin implementing the improvements noted above. Discussions with the electrical utility company, PP&L, should focus on a second feeder from either the south (West Frankford Street) or west (Mauch Chunk Road), where most of the new development is occurring. The location of new service switchgear will depend in part on the direction from which the new utility feeder will originate. Possible locations include the proposed Residence Hall south of Wilhelm Hall, or Hub II. (Of course the location will also depend on the sequence in which the new buildings are constructed.) Space for a dedicated electrical equipment room will be required within the building. Although extension of the existing PP&L feeder to this new service location may not be practical or economically feasible at this time, space planning should include provisions for this in the future, to accommodate the double-ended switchgear configuration described previously.

Primary feeders in underground duct banks would be extended from the new service equipment to supply new buildings, and the Monocacy Residence Hall could be transferred to the new service as well. New duct banks and manholes should be planned as a continuation of, and connection to, any underground infrastructure installed in Phase I, with the intent of creating a continuous loop around the main body of the campus.

This phase also includes the demolition of many of the residence halls in the southwest section of the campus, which will reduce the number of buildings connected to the existing primary electrical service and distribution, in particular those on existing Feeder Nos. 3 and 4. As existing buildings are either demolished or transferred to the new service, in this or future phases, the existing exterior switchgear can eventually be retired and removed.

Phase III – Construction of the Academic Center and Seminary Housing will require extension of the primary electrical distribution system to the east, to supply buildings on either side of Main Street. New construction proposed on the Moravian Athletic Complex is remote enough from the main campus that it will not warrant extension of the primary electrical distribution system this far to the east. The new Field House will be more practically supplied from a separate PP&L service.

Phase IV – Significant new construction will require the further extension of the primary electrical distribution system throughout the campus. If the exterior switchgear adjacent to Reeves Library is still in operation, it will be nearing the end of its normal service life and should be removed. Any buildings still connected to this service should be transferred to the other. Development north of West Elizabeth Avenue may warrant extension of the primary electrical distribution system to this part of campus, if infrastructure is in place for crossing the street. Depending on the extent of planned development for the Moravian Athletic Complex, the planned improvements to Laurel Street offer an opportunity for extension of primary electrical distribution further to the east.

General Recommendations – Automatic lighting control systems should be implemented throughout the campus as buildings are renovated or new buildings constructed. These systems may include a combination of occupancy, daylight-harvesting, and time schedule controls.

A comprehensive power monitoring system should be implemented for the campus. In addition to energy consumption, the system should be capable of monitoring and logging load demand and power quality values. The system should be networked for ease of use and access to information. This system will allow facilities management personnel to monitor energy consumption and the effectiveness of energy-saving initiatives, measure available capacity in existing services to accommodate renovation and expansion projects, and track power quality issues from the utility.

Master Plan Recommendations Electrical - Hurd Campus

Phase II and III of the campus master plan include renovations to Main Hall, South Hall, and the Brethren’s House, as well as construction of additions to Foy Hall, South Hall, and a connection between Main Hall and the Brethren’s House. These renovations should include replacement of aging electrical infrastructure, implementation of energy-saving measures, and improvements to life safety systems. The Hurd Center for Music and Art, which comprises Foy Concert Hall, Payne Art Gallery, South Hall, Peter Hall, West Hall, and the Brethren’s House, is in essence a single building and planning for electrical system improvements should be comprehensive. Consideration should be given to relocating the main PP&L electrical service for the Hurd Center to an electrical equipment room in the proposed addition to South Hall. The existing exterior pad-mounted transformer could then be eliminated. The new service
would be sized to supply the expansion and renovation of the Hurd Center complex, and a new interior power distribution system provided. Automatic lighting control systems should be implemented throughout the complex, and might include a combination of occupancy, daylight-harvesting, and time schedule controls. The fire alarm system should be supplemented as required to ensure that notification appliances (horns or speakers, and strobe lights) are located in accordance with current code requirements and to accommodate any changes to the interior layout.

A comprehensive power monitoring system should be implemented for each of the electrical services on this campus. (There are currently separate electrical services for the Hurd Center, Main Hall, Frueauff House, Widow’s House, Clewell Hall, and the HILL.) In addition to energy consumption, the system should be capable of monitoring and logging load demand and power quality values. The system should be networked for ease of use and access to information. Such a system would allow facilities management personnel to monitor energy consumption and the effectiveness of energy-saving initiatives, measure available capacity in existing services to accommodate renovation and expansion projects, and track power quality issues from the utility.

Phases II and IV also include the construction of a new residence hall and a residential/mixed use facility in the vicinity of the HILL. It is unlikely that the electrical service for the HILL was planned with capacity for additional buildings; therefore new PP&L electrical services will be required. All new electrical services should be integrated into the campus-wide power monitoring system.

SUSTAINABLE INITIATIVES

As projects within the Master Plan are designed and constructed, the vital role that buildings play in minimizing environmental impact and reducing energy use in particular must be recognized. Implementation of sustainable strategies must strike an appropriate balance between first-cost investments and long-term life cycle savings, while meeting the parameters of comfort, performance, and environmental stewardship.

Consideration should be given to the following specific sustainable strategies related to energy and water use reduction:

- Energy-efficient lighting fixtures and controls that work in concert with the natural daylight, dimming systems, and occupancy
- Heating, ventilating, and air conditioning (HVAC) systems that are sized and specified to complement a high-efficiency building shell with improved insulation, roof reflectance, glazing and skin materials, and reduced lighting loads
- HVAC systems that incorporate efficient equipment and heat recovery systems that transfer heating or cooling from the exhaust air to the incoming ventilation air
- Direct Digital Control systems able to respond to changing conditions accurately and quickly and that document space conditions and energy consumption
- Energy management and control sequences, such as demand-based control and economizer cycles
- ASHRAE Energy Standard 90.1 compliant design as a minimum standard, and enhancements to exceed the requirements by at least 30%
- Air monitors that track exhaust and incoming air used in conjunction with monitors measuring relative humidity, carbon dioxide, and temperature to provide a comfortable, energy-efficient indoor environment that meets Ventilation Standards
- Local controllability of HVAC and lighting systems for occupant comfort
- Air conditioning devices that do not use CFC refrigerants
- Plumbing and waste systems that incorporate low water flow devices and reduce water usage over conventional systems by at least 30%
- Appropriate exhaust systems to remove contaminants before they enter occupied spaces.
- Captured or recycled water for site irrigation, flushing toilets and urinals, and cooling tower make-up
- Specification of locally available materials

APPENDIX :: 157
## Priscilla Payne Hurd Campus - Existing Buildings

<table>
<thead>
<tr>
<th>Ref. #</th>
<th>Building Name</th>
<th>Building Use</th>
<th>Year Built</th>
<th>Building Area</th>
<th>Cooling Estimated Unitary Load (BTU/ton)</th>
<th>Estimated Load (tons)</th>
<th>Heating Estimated Unitary Load (BTU/GSF)</th>
<th>Estimated Load (BTU/hr)</th>
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<tbody>
<tr>
<td>1</td>
<td>Clewell Hall</td>
<td>Residence Hall/Residential</td>
<td>1880</td>
<td>7,831</td>
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<td>300</td>
<td>26</td>
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<td>1a</td>
<td>Foy Concert Hall</td>
<td>Special Use/Assembly</td>
<td>1982</td>
<td>23,838</td>
<td></td>
<td>280</td>
<td>85</td>
<td>40</td>
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<td>3</td>
<td>Fueauff House Garage</td>
<td>Maintenance/Storage</td>
<td>1869</td>
<td>99</td>
<td></td>
<td>30</td>
<td>29</td>
<td></td>
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<td>2</td>
<td>Fueauff House (President's House)</td>
<td>Residence Hall/Residential</td>
<td>1818</td>
<td>5,356</td>
<td></td>
<td>280</td>
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<tr>
<td>1d</td>
<td>Water Hall - Residence</td>
<td>Residence Hall/Residential</td>
<td>1854</td>
<td>22,000</td>
<td></td>
<td>330</td>
<td>73</td>
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<td>2a</td>
<td>Payne Art Gallery</td>
<td>Support Functions</td>
<td>1911</td>
<td>6,300</td>
<td></td>
<td>270</td>
<td>23</td>
<td>40</td>
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<tr>
<td>1d</td>
<td>Peter Hall (New Chapel Building)</td>
<td>Support Functions</td>
<td>1915</td>
<td>11,808</td>
<td>p</td>
<td>280</td>
<td>42</td>
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<tr>
<td>3a</td>
<td>Quadrennial Hall</td>
<td>Classroom/Instruction</td>
<td>1948</td>
<td>22,510</td>
<td>p</td>
<td>280</td>
<td>80</td>
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<td>1c</td>
<td>South Hall (Art Department)</td>
<td>Classroom/Instruction</td>
<td>1915</td>
<td>13,616</td>
<td></td>
<td>280</td>
<td>49</td>
<td>45</td>
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<tr>
<td>1e</td>
<td>West Hall (Music Department)</td>
<td>Classroom/Instruction</td>
<td>1859</td>
<td>14,134</td>
<td>p</td>
<td>280</td>
<td>54</td>
<td>45</td>
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<tr>
<td>1f</td>
<td>Single Brethren's House</td>
<td>Residence Hall/Residential</td>
<td>1818</td>
<td>84,942</td>
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<td>1b</td>
<td>South Hall (Art Department)</td>
<td>Classroom/Instruction</td>
<td>1859</td>
<td>14,134</td>
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<td>280</td>
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Sum, Existing Buildings (Hurd Campus) 194,224 499 9,078

## Priscilla Payne Hurd Campus - Proposed Buildings

<table>
<thead>
<tr>
<th>Ref. #</th>
<th>Proposed Addition to South Hall</th>
<th>Service/Circulation</th>
<th>01</th>
<th>16,000</th>
<th>300</th>
<th>53</th>
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<tr>
<td>2a</td>
<td>Proposed Addition to Foy Hall</td>
<td>Storage/Performance</td>
<td>02</td>
<td>7,000</td>
<td>280</td>
<td>25</td>
<td>40</td>
<td>175</td>
</tr>
<tr>
<td>3a</td>
<td>Proposed Residence Hall connected to Hill Bldg</td>
<td>Residence Hall/Residential</td>
<td>03</td>
<td>22,000</td>
<td>300</td>
<td>75</td>
<td>35</td>
<td>643</td>
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<tr>
<td>4a</td>
<td>Proposed Residential/Mixed Use Facility</td>
<td>Residence Hall/Residential</td>
<td>04</td>
<td>25,000</td>
<td>300</td>
<td>87</td>
<td>35</td>
<td>742</td>
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<td>5a</td>
<td>Proposed Connection (allow) to Main Hall</td>
<td>Service/Circulation</td>
<td>05</td>
<td>1,500</td>
<td>300</td>
<td>4</td>
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<td>36</td>
</tr>
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</table>

Sum, Proposed Buildings (Hurd Campus) 73,250 494 2,068

Sum, Hurd Center for Music and Art 93,226 334

Peak Demand (existing plant capacity, tons) 300

Diversity/Part Load factor (Peak Demand / estimated Connected Load) 0.90

Estimated Peak Demand (tons) 410

Diversity factor 0.80

### Notes/ Legend:

- **t** building proposed to be renovated (superscript = master plan phase)
- **n** building proposed to be demolished (superscript = master plan phase)
- **u** existing building reference number (from College campus map)
- **x** new building reference number (subscript N = new)
- **y** buildings supplied from existing central cooling plant(s)
- **z** buildings proposed to be served from future or expanded central cooling plant(s)

### Existing Building Chilled Water Plants:

- **a** Collier Hall of Science building houses (2) Carrier 250-ton screw chillers and serves into the campus piping distribution system
- **b** PPHAC houses (1) Trane 500-ton centrifugal chiller and serves into the campus piping distribution system
- **d** DX rooftop unit for Prosser Auditorium
- **e** Connected to the campus chilled water piping distribution system (Collier and PPHAC chillers)
- **f** Trane rooftop air-cooled chiller
- **g** Technical Systems at grade air-cooled chiller
- **h** Bohn at grade air-cooled chiller
- **j** Split system a/c units
- **k** Electric heat pumps
- **m** Trane at grade air-cooled chiller
- **n** Trane at grade air-cooled chiller (80 tons)
- **p** Trane at grade air-cooled chiller (80 tons)

APPENDIX :: 159
<table>
<thead>
<tr>
<th>Ref. #</th>
<th>Building Name</th>
<th>Building Use</th>
<th>Year Built</th>
<th>Building Area</th>
<th>Electrical Service Voltage</th>
<th>Transformer Rating (kVA) &amp; Location (int/ext.)</th>
<th>Estimated Unitary Load (VA/GSP)</th>
<th>Estimated Demand Load (kVA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>Alpha Sigma Alpha</td>
<td>Residence Hall/Residential</td>
<td>1964</td>
<td>3,261</td>
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<td>18</td>
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<tr>
<td>22</td>
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<td>4,910</td>
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<td>500 ext.</td>
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<tr>
<td>23</td>
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<td>4,751</td>
<td></td>
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<tr>
<td>26</td>
<td>Beck Hall</td>
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<td>1980</td>
<td>4,466</td>
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<tr>
<td>27</td>
<td>Breidegam Fieldhouse</td>
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<td></td>
<td>4</td>
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<tr>
<td>38</td>
<td>Campus Safety</td>
<td>Administration/Offices</td>
<td>1982</td>
<td>2,141</td>
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<td>a</td>
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<tr>
<td>47</td>
<td>Center for Information Technology</td>
<td>Administration/Offices</td>
<td>2004</td>
<td>8,400</td>
<td>n/a</td>
<td>a</td>
<td>2.6</td>
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</tr>
<tr>
<td>53</td>
<td>Hamilton Hall</td>
<td>Classroom/Instruction</td>
<td>1975</td>
<td>5,437</td>
<td></td>
<td>1</td>
<td>12.47KV</td>
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<tr>
<td>57</td>
<td>Health Services</td>
<td>Administration/Offices</td>
<td>1962</td>
<td>6,916</td>
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<tr>
<td>59</td>
<td>Hill #1</td>
<td>Residence Hall/Residential</td>
<td>1999</td>
<td>4,649</td>
<td></td>
<td>4</td>
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<td>50 ext.</td>
</tr>
<tr>
<td>61</td>
<td>Hill #2</td>
<td>Residence Hall/Residential</td>
<td>1999</td>
<td>4,649</td>
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<td>4</td>
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<td>50 ext.</td>
</tr>
<tr>
<td>63</td>
<td>Hill #3</td>
<td>Residence Hall/Residential</td>
<td>1999</td>
<td>4,649</td>
<td></td>
<td>4</td>
<td>12.47KV</td>
<td>50 ext.</td>
</tr>
<tr>
<td>69</td>
<td>Hill #4</td>
<td>Residence Hall/Residential</td>
<td>1999</td>
<td>4,649</td>
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<td>4</td>
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</tr>
<tr>
<td>71</td>
<td>Hill #5</td>
<td>Residence Hall/Residential</td>
<td>2001</td>
<td>4,649</td>
<td></td>
<td>4</td>
<td>12.47KV</td>
<td>50 ext.</td>
</tr>
<tr>
<td>73</td>
<td>Hill #6</td>
<td>Residence Hall/Residential</td>
<td>2001</td>
<td>4,649</td>
<td></td>
<td>4</td>
<td>12.47KV</td>
<td>50 ext.</td>
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<tr>
<td>75</td>
<td>Jo Smith Hall</td>
<td>Residence Hall/Residential</td>
<td>1970</td>
<td>23,768</td>
<td></td>
<td>4</td>
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<tr>
<td>77</td>
<td>Johnston Hall</td>
<td>Administration/Offices</td>
<td>1952</td>
<td>39,807</td>
<td></td>
<td>2</td>
<td>12.47KV</td>
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<tr>
<td>79</td>
<td>Kolonia House</td>
<td>Administration/Offices</td>
<td>1975</td>
<td>3,177</td>
<td></td>
<td>3</td>
<td>12.47KV</td>
<td>150 int.</td>
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<tr>
<td>81</td>
<td>Lenape House</td>
<td>Residence Hall/Residential</td>
<td>1988</td>
<td>7,299</td>
<td></td>
<td>3</td>
<td>12.47KV</td>
<td>150 int.</td>
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<tr>
<td>83</td>
<td>Lenox House</td>
<td>Administration/Offices</td>
<td>1925</td>
<td>2,050</td>
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<td>a</td>
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<tr>
<td>85</td>
<td>LVAIC</td>
<td>Administration/Offices</td>
<td>1925</td>
<td>2,353</td>
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<td>a</td>
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<tr>
<td>87</td>
<td>Memorial Hall</td>
<td>Classroom/Instruction</td>
<td>1923</td>
<td>8,861</td>
<td></td>
<td>4</td>
<td>12.47KV</td>
<td>501 int.</td>
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<tr>
<td>89</td>
<td>Monocacy Hall</td>
<td>Administration/Offices</td>
<td>1912</td>
<td>6,008</td>
<td></td>
<td>4</td>
<td>12.47KV</td>
<td>501 int.</td>
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<tr>
<td>91</td>
<td>Priscilla Payne Hurd Academic Complex</td>
<td>Classroom/Instruction</td>
<td>2002</td>
<td>55,000</td>
<td></td>
<td>5</td>
<td>12.47KV</td>
<td>1500 ext.</td>
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<tr>
<td>93</td>
<td>Rau / Hasler Halls</td>
<td>Residence Hall/Residential</td>
<td>1958</td>
<td>34,690</td>
<td></td>
<td>3</td>
<td>12.47KV</td>
<td>500 ext.</td>
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<tr>
<td>95</td>
<td>Reeves Library</td>
<td>Library</td>
<td>1967</td>
<td>80,427</td>
<td></td>
<td>1</td>
<td>12.47KV</td>
<td>750 int.</td>
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<tr>
<td>97</td>
<td>Seminary Row Residences</td>
<td>Residence Hall/Residential</td>
<td>1964</td>
<td>18,923</td>
<td></td>
<td>3</td>
<td>12.47KV</td>
<td>501 int.</td>
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<tr>
<td>99</td>
<td>Sigma Sigma Sigma</td>
<td>Residence Hall/Residential</td>
<td>1964</td>
<td>4,530</td>
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<td>2</td>
<td>12.47KV</td>
<td>501 int.</td>
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<tr>
<td>101</td>
<td>Steel Field Grandstand</td>
<td>Support Functions</td>
<td>1940</td>
<td>13,909</td>
<td>n/a</td>
<td>a</td>
<td>2.0</td>
<td>30</td>
</tr>
<tr>
<td>103</td>
<td>Student Affairs</td>
<td>Administration/Offices</td>
<td>1982</td>
<td>4,543</td>
<td>n/a</td>
<td>a</td>
<td>2.6</td>
<td>10</td>
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<tr>
<td>105</td>
<td>Student Development Career Center</td>
<td>Administration/Offices</td>
<td>1982</td>
<td>3,173</td>
<td>n/a</td>
<td>a</td>
<td>2.6</td>
<td>10</td>
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<tr>
<td>107</td>
<td>Zeta Tau Alpha (1202 Main Street)</td>
<td>Residence Hall/Residential</td>
<td>1991</td>
<td>4,387</td>
<td>n/a</td>
<td>a</td>
<td>4.0</td>
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<tr>
<td>109</td>
<td>Zinzendorf Hall</td>
<td>Classroom/Instruction</td>
<td>1875</td>
<td>8,824</td>
<td></td>
<td>4</td>
<td>12.47KV</td>
<td>501 int.</td>
</tr>
</tbody>
</table>

**Sum (all buildings):** 771,087

**Sum (minus buildings to be demolished):** 656,647

**Sum (buildings supplied from existing 12.47kV campus distribution system):** 678,677

**Sum (buildings supplied from existing 12.47kV campus distribution system after demolition):** 601,894
<table>
<thead>
<tr>
<th>Ref. #</th>
<th>Building Name</th>
<th>Building Type</th>
<th>Master Plan Phase</th>
<th>Building Area</th>
<th>Estimated Unitary Load (VA/GSF)</th>
<th>Estimated Demand Load (kVA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1N</td>
<td>Proposed Residence Hall</td>
<td>Residence Hall/Residential</td>
<td>II</td>
<td>32,400</td>
<td>4.0</td>
<td>130</td>
</tr>
<tr>
<td>2N</td>
<td>Proposed Residence Hall</td>
<td>Residence Hall/Residential</td>
<td>II</td>
<td>62,640</td>
<td>4.0</td>
<td>250</td>
</tr>
<tr>
<td>3N</td>
<td>Proposed Residence Hall</td>
<td>Residence Hall/Residential</td>
<td>II</td>
<td>19,440</td>
<td>4.0</td>
<td>80</td>
</tr>
<tr>
<td>4N</td>
<td>Proposed Monocacy Residence Hall</td>
<td>Residence Hall/Residential</td>
<td>I</td>
<td>43,740</td>
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<td>170</td>
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<td>5N</td>
<td>Proposed HUB II</td>
<td>Student Center</td>
<td>II</td>
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<tr>
<td>6aN</td>
<td>Proposed Breidagam West Addition &amp; Terrace</td>
<td>Athletic Facility</td>
<td>I</td>
<td>7,200</td>
<td>3.0</td>
<td>20</td>
</tr>
<tr>
<td>6bN</td>
<td>Proposed Field House Addition &amp; Pool Addition</td>
<td>Athletic Facility</td>
<td>III &amp; IV</td>
<td>36,800</td>
<td>3.0</td>
<td>110</td>
</tr>
<tr>
<td>6cN</td>
<td>Proposed Fitness Center</td>
<td>Athletic Facility</td>
<td>II</td>
<td>48,000</td>
<td>3.0</td>
<td>140</td>
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<tr>
<td>7N</td>
<td>Proposed Addition to Reeves Library</td>
<td>Library</td>
<td>IV</td>
<td>9,900</td>
<td>3.0</td>
<td>30</td>
</tr>
<tr>
<td>8N</td>
<td>Proposed Comenius Center</td>
<td>Support Functions</td>
<td>I</td>
<td>9,000</td>
<td>2.0</td>
<td>20</td>
</tr>
<tr>
<td>9N</td>
<td>Proposed Academic/Community Outreach Projects</td>
<td>Support Functions</td>
<td>IV</td>
<td>30,000</td>
<td>2.0</td>
<td>60</td>
</tr>
<tr>
<td>10N</td>
<td>Proposed Academic/Community Outreach Projects</td>
<td>Support Functions</td>
<td>IV</td>
<td>9,000</td>
<td>2.0</td>
<td>20</td>
</tr>
<tr>
<td>11N</td>
<td>Proposed Academic/Community Outreach Projects</td>
<td>Support Functions</td>
<td>IV</td>
<td>9,000</td>
<td>2.0</td>
<td>20</td>
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<tr>
<td>12N</td>
<td>Proposed Academic Building</td>
<td>Classroom/Instruction</td>
<td>IV</td>
<td>19,440</td>
<td>4.5</td>
<td>90</td>
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<tr>
<td>13aN</td>
<td>Proposed Breidegam West Addition &amp; Terrace</td>
<td>Athletic Facility</td>
<td>I</td>
<td>7,200</td>
<td>3.0</td>
<td>20</td>
</tr>
<tr>
<td>13bN</td>
<td>Proposed Field House Addition &amp; Pool Addition</td>
<td>Athletic Facility</td>
<td>III &amp; IV</td>
<td>36,800</td>
<td>3.0</td>
<td>110</td>
</tr>
<tr>
<td>13cN</td>
<td>Proposed Fitness Center</td>
<td>Athletic Facility</td>
<td>II</td>
<td>48,000</td>
<td>3.0</td>
<td>140</td>
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<tr>
<td>7N</td>
<td>Proposed Addition to Reeves Library</td>
<td>Library</td>
<td>IV</td>
<td>9,900</td>
<td>3.0</td>
<td>30</td>
</tr>
<tr>
<td>8N</td>
<td>Proposed Comenius Center</td>
<td>Support Functions</td>
<td>I</td>
<td>9,600</td>
<td>2.0</td>
<td>20</td>
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<tr>
<td>9N</td>
<td>Proposed Academic/Community Outreach Projects</td>
<td>Support Functions</td>
<td>IV</td>
<td>30,000</td>
<td>2.0</td>
<td>60</td>
</tr>
<tr>
<td>10N</td>
<td>Proposed Academic/Community Outreach Projects</td>
<td>Support Functions</td>
<td>IV</td>
<td>9,000</td>
<td>2.0</td>
<td>20</td>
</tr>
<tr>
<td>11N</td>
<td>Proposed Academic/Community Outreach Projects</td>
<td>Support Functions</td>
<td>IV</td>
<td>9,000</td>
<td>2.0</td>
<td>20</td>
</tr>
<tr>
<td>12N</td>
<td>Proposed Academic Building</td>
<td>Classroom/Instruction</td>
<td>IV</td>
<td>19,440</td>
<td>4.5</td>
<td>90</td>
</tr>
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</table>

Sum 748,440 2,560
Sum (buildings proposed to be served from expanded 12.47kV campus distribution system) 659,640 2,350
Sum (existing & proposed buildings to be served from expanded 12.47kV campus distribution system) 1,261,534 4,610

Notes/ Legend:
- †II building proposed to be renovated (superscript = master plan phase)
- ‡IV building proposed to be demolished (superscript = master plan phase)
- 12 existing building reference number (from College campus map)
- 12a new building reference number (subscript N = new)

**Existing Buildings:**

<table>
<thead>
<tr>
<th>Ref. #</th>
<th>Building Name</th>
<th>Building Type</th>
<th>Master Plan Phase</th>
<th>Building Area</th>
<th>Estimated Unitary Load (VA/GSF)</th>
<th>Estimated Demand Load (kVA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Clewell Hall</td>
<td>Dormitory/Residential</td>
<td>1880</td>
<td>7,831</td>
<td>n/a</td>
<td>4.0</td>
</tr>
<tr>
<td>5</td>
<td>Friessauff House Garage</td>
<td>Maintenance/Storage</td>
<td>1818</td>
<td>5,366</td>
<td>n/a</td>
<td>4.0</td>
</tr>
<tr>
<td>3</td>
<td>Fueauff House (President's House)</td>
<td>Dormitory/Residential</td>
<td>1818</td>
<td>5,366</td>
<td>n/a</td>
<td>4.0</td>
</tr>
<tr>
<td>2</td>
<td>Main Hall - Residence</td>
<td>Dormitory/Residential</td>
<td>1854</td>
<td>22,090</td>
<td>n/a</td>
<td>4.0</td>
</tr>
<tr>
<td>1b</td>
<td>Payne Art Gallery</td>
<td>Support Functions</td>
<td>1911</td>
<td>6,300</td>
<td>n/a</td>
<td>2.0</td>
</tr>
<tr>
<td>1d</td>
<td>Peter Hall (New Chapel Building)</td>
<td>Support Functions</td>
<td>1867</td>
<td>11,808</td>
<td>n/a</td>
<td>2.0</td>
</tr>
<tr>
<td>1f</td>
<td>Single Brethren's House</td>
<td>Classroom/Instruction</td>
<td>1748</td>
<td>22,510</td>
<td>n/a</td>
<td>4.5</td>
</tr>
<tr>
<td>1c</td>
<td>South Hall (Art Department)</td>
<td>Classroom/Instruction</td>
<td>1916</td>
<td>13,616</td>
<td>n/a</td>
<td>4.5</td>
</tr>
<tr>
<td>1e</td>
<td>West Hall (Music Department)</td>
<td>Classroom/Instruction</td>
<td>1859</td>
<td>15,154</td>
<td>n/a</td>
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<tr>
<td>10</td>
<td>Widow's House</td>
<td>Dormitory/Residential</td>
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<td>64,932</td>
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Sum 196,474 723
Sum (Hurd Center for Music and Art buildings supplied from a common PP&L service) 93,226 310

**Proposed Buildings:**

<table>
<thead>
<tr>
<th>Ref. #</th>
<th>Building Name</th>
<th>Building Type</th>
<th>Master Plan Phase</th>
<th>Building Area</th>
<th>Estimated Unitary Load (VA/GSF)</th>
<th>Estimated Demand Load (kVA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1N</td>
<td>Proposed Addition to South Hall</td>
<td>Service/Circulation</td>
<td>II</td>
<td>16,500</td>
<td>2.0</td>
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</tr>
<tr>
<td>2N</td>
<td>Proposed Addition to Foy Hall</td>
<td>Storage/Performance</td>
<td>II</td>
<td>16,500</td>
<td>2.0</td>
<td>30</td>
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<tr>
<td>3N</td>
<td>Proposed Residence Hall connected to Hill Bldg</td>
<td>Dormitory/Residential</td>
<td>II</td>
<td>22,500</td>
<td>4.0</td>
<td>90</td>
</tr>
<tr>
<td>4N</td>
<td>Proposed Residential/Mixed Use Facility</td>
<td>Dormitory/Residential</td>
<td>IV</td>
<td>26,000</td>
<td>4.0</td>
<td>100</td>
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<tr>
<td>5N</td>
<td>Proposed Connection (elevator) to Main Hall</td>
<td>Service/Circulation</td>
<td>III</td>
<td>1,250</td>
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Sum 73,250 233
Sum (existing and proposed buildings) 269,724 956
Sum (Hurd Center, existing and proposed buildings) 116,726 350

Notes/ Legend:
- building proposed to be renovated (superscript = master plan phase)
- building proposed to be demolished (superscript = master plan phase)
- existing building reference number (from College campus map)
- new building reference number (subscript N = new)
- buildings supplied from existing 12.47kV campus distribution system
- buildings proposed to be served from expanded 12.47kV campus distribution system

**Existing Building Transformers:**
- a Building supplied directly from PP&L. Service voltage and transformer rating unknown.
- b Ann Bixenman House and August Spangenberg House supplied from a common 300kVA transformer.
- c Antes, Burmide, and Lenape Townhouses, Beck Hall, and de Schweinitz Hall supplied from a common 225kVA transformer.
- d Bahnsen Center, Colonial Hall / Admissions Center, and Sigma Sigma Sigma supplied from a common 500kVA transformer.
- e Borebeck Chapel, Comenius Hall, Comenius Center, Hamilton Hall, Memorial Hall, Monacacy Hall, and Zinzendorf Hall supplied from a common 225kVA transformer.
- f Day Hall to be supplied from new Hill residence building.
- g Foy Concert Hall, Payne Art Gallery, Peter Hall, Single Brethren's House, South Hall, and West Hall supplied directly from a single PP&L service transformer. Service voltage and transformer rating unknown.
1.0 INTRODUCTION

As part of the master planning efforts by Ayers/Saint/Gross, Biohabitats collected and analyzed data on the ecology, drainage issues and existing stormwater practices, and landscape management practices on the Moravian College campus. This report provides an overview of the observations, assessment findings, and design and management considerations for the campus. The summary reflects a combination of desktop and field analyses conducted by Biohabitats to better understand existing conditions, and provides strategies and recommendations in order to move forward with appropriate sustainable implementation strategies in conjunction with the broader campus master planning efforts.

Many of the observations, analyses, and recommendations are related to preserving, restoring, or creating green infrastructure throughout the campus. Green infrastructure is a combination of natural and designed features that are linked and integrated across landscapes on campus. It provides a variety of ecological, engineering, and educational benefits, such as improved habitat, plant diversity, heat island reduction, aesthetic enhancement, teaching or learning spaces, water conservation, improvements in water quality and stormwater management.

Best Management Practices (BMPs) are applied green infrastructure techniques and strategies aimed at improving environmental quality using passive natural processes. Highlighted BMPs that can be integrated into the green infrastructure include features such as bioretention, improved landscape management practices (turf conversion), green roofs, pervious pavement, rain gardens, cisterns, and constructed wetlands. These practices serve to increase and enhance local biodiversity, improve site aesthetics, lower irrigation water demand, lower fuel and maintenance costs, reduce stormwater runoff and filter pollutants from water draining from impervious surfaces.
2.0 ECOLOGICAL CHARACTERIZATION AND LANDSCAPE OBSERVATIONS

Biohabitats performed a rapid field reconnaissance of ecological conditions on the Moravian College property in March of 2009. This visual landscape observation was used to clarify and supplement supplied project data in conjunction with research and desktop analysis through geographic information system (GIS) digital inventory mapping.

The campus is divided into three precincts within the City of Bethlehem, PA – The Hurd Campus (the original campus along Church Street in historic Bethlehem), The Main Street Campus (8/10ths of a mile north), and the Moravian Athletic Complex, (two blocks east of the Main Street Campus). The intent of this report is to characterize the important ecological attributes of the campus and to inform the Master Planning process regarding the nature of various ecological and stormwater attributes. An overview of the findings and recommendations is provided below.
2.1. GEOGRAPHY AND GEOLOGY

Moravian College is located along the eastern bank of Monocacy Creek, in the Monocacy Creek Watershed in Bethlehem. The college rests in the Great Valley Section of the Valley and Ridge Physiographic Province of Eastern Pennsylvania. This Province is characterized by low to moderate relief, a dendritic and karst drainage pattern and terrain.

The Monocacy Creek watershed is dominated by two types of bedrock: shale in the northern third and limestone in the lower two thirds of the watershed, where the college is located. Some areas are susceptible to low water levels as a result of losing water to limestone aquifers.

Geologically, the campus lies entirely on the Allentown Formation, which is made up of dolomite. (Figure1)

Dolomite is a carbonate rock associated with karst topography and sinkhole formation. Consideration should be given to sinkhole formation when planning and designing stormwater management features. (Source: Monocacy Creek Watershed Conservation Management Plan 1999) http://www.wildlandspa.org/Rivers/pdf/Monocacy/executivesummary.pdf

The Urban land, Boonton complex (UbB) soil, detailed in the Soils section that follows, generally has an average depth to bedrock of 3 to 10 feet and an increased stormwater runoff tendency.
Figure 1. Regional Geology
2.2. SOILS

The Main Street and Hurd Campuses lie predominantly on the Urban land Duffield complex soil series with 0-8% slopes (UoB) and 8-25% slopes (UoD) on the northern portion of the site. (Figures 2 & 3) Duffield series is characterized by deep, well drained silt-loam soils formed from limestone bedrock (http://www2.ftw.nrcs.usda.gov/osd/dat/D/DUFFIELD.html). The Urban land Duffield complex is a disturbed version of the Duffield series with variable soil depths due to development impacts.

The soil along the western border of the Main Street Campus is Ryder-Rock outcrop complex (RzF) with a smaller portion of Middlebury silt loam (Mb). A patch in the center of the Main Street Campus and the majority of the Moravian Athletic Complex have Urban land, Boonton complex (UbB) soil, characterized by greatly altered topography due to urbanization and development. (Figure 2) This soil complex generally has an average depth to bedrock of 3 to 10 feet and an increased stormwater runoff tendency.
Figure 2. Site Soils on Main Street Campus and the Moravian Athletic Complex
Figure 3. Site Soils on Hurd Campus
2.3. TOPOGRAPHY

Moravian College is located in the Lehigh Valley at an elevation of approximately 300 feet above sea level. The campus site is situated above the lower elevations of the Monocacy Creek with the Lehigh River to the south. (Figures 4, 5 & 6) The Main Street Campus is relatively flat with the exception of the western edge where it dips into the Monocacy Creek floodplain. (Figures 8 & 9) The Hurd Campus has higher elevations and steep slopes (i.e., >15%) in much of the northern portion of the campus before it levels off into the Monocacy Creek and Lehigh River floodplains.
Figure 4. Regional topography
Figure 6. Hurd Campus topography
2.4. HYDROLOGY

Moravian College is located along the eastern bank of the lower reach of Monocacy Creek. Main Street Campus is approximately one mile from the confluence with the Lehigh River and the Hurd Campus is located right on the confluence. (Figures 7, 8 & 9) The Monocacy Creek Watershed is 48.8 square miles and is mainly within the boundaries of Northampton County, but a small portion falls within Lehigh County. (Figure 7) Its headwaters lie in the slate belt, near the borough of Chapman (elevation 900ft.). The Creek flows approximately 20 miles to its confluence with the Lehigh River with an average slope of about 0.6%.

In many areas along the Monocacy there is well-preserved riparian corridor that keeps the creek shaded and cool during the summer months and provides excellent habitat for migrating and nesting birds. Over 80 species of birds have been documented annually along the banks of the Monocacy.

The Creek is one of only 56 limestone streams in the state of Pennsylvania. The limestone geology means it can have stretches that are referred to as a “losing stream”, where stream flow is constantly being lost to subsurface groundwater flow. During the dry summer months, sections of the Monocacy can completely run dry.

Limestone streams are also associated with cold water springs that occur due to bedrock outcroppings. The cold and clean water inputs provide ideal habitat for cold water fish species such as trout. The Monocacy’s lower portions contain many of these springs, which make it a Class A wild trout stream in the vicinity of Moravian College. (http://www.pipeline.com/~rlfreed/mabou.htm). The Creek has been renowned for its ability to sustain naturally reproducing trout populations, according to a study done by the Wildlands Conservancy in the late 1990s. More recent studies by the Wildlands Conservancy, however, have documented nutrient concentrations in excess of EPA guidelines. Increased development and poor farming practices are suspected as the primary sources.

Watershed Association led restoration efforts are underway and the Lehigh Valley Planning Commission (LVPC) is focused on mitigating potential adverse impacts from residential and industrial development.

The watershed has two active local organizations: the Monocacy Creek Watershed Association and the Monocacy Creek Citizen’s Action Committee (CAC). (http://www.wildlandspa.org/Rivers/pdf/Monocacy/executivesummary.pdf)
Figure 7. Regional Hydrology (NWI wetlands designations defined in Appendix)
Figure 8. Floodplain and Wetlands: Main Street Campus and the Moravian Athletic Complex (NWI wetlands designations defined in Appendix)
Figure 9. Floodplain: Hurd Campus
2.5. FOREST RESOURCES

Much of the Moravian College campus vegetation is in planned landscapes and urban street trees. A limited amount of unmanaged forest “natural” area exists on the west side of the Main Street Campus forming an ecological connection to the forested Monocacy Creek riparian corridor east of Betty Prince Field. More sizable forest patches run along the Creek corridor going northward from the campus boundary. There are also significant forest resources on the southern side of the Lehigh River. (Figure 10)

The forested area on the western edge of the Main Street campus is along a steep slope and is composed of a native tree overstory but with a non-native invasive understory. Bush honeysuckle dominates the understory, preventing native regeneration and reducing biodiversity. Invasive plants are present throughout: Japanese honeysuckle, shrub honeysuckle, Ailanthus, Norway maple, to name a few. Native species in this area include: Red Oak, Black Walnut, White Ash, and Aspen.

2.6 POTENTIAL RARE, THREATENED AND ENDANGERED SPECIES/ HABITAT

No rare or unique plant communities were observed within these forest stands or on the actively maintained areas on Moravian Campus during the rapid field reconnaissance in March 2009. A report on the conservation and management of the Monocacy Creek Watershed done in the late 1990s notes that there are no species of special concern that have been spotted and consequently reported to the Pennsylvania Natural Heritage Program. “A Natural Areas Inventory of Lehigh and Northampton Counties, Pennsylvania Update 2005” was prepared by the Pennsylvania Science Office of the Nature Conservancy, and it confirmed that there are no areas of special concern, rare, threatened or endangered species listed for the Moravian College campus. http://www.lvpc.org/lvpc_site/commission/publications.html#natural, http://www.lvpc.org/pdf/greenwayPlan/lvgp06.pdf
Figure 10. Regional Forest Cover
2.7 CAMPUS LANDSCAPE MANAGEMENT

Campus Trees

The campus tree canopy provides many environmental benefits to the campus community. Aside from the aesthetic benefits, trees on campus can contribute to an improvement in air and water quality, save energy, and improve economic sustainability (Figure 11). Many of the older canopy trees on the Main Street Campus appear to be healthy native upland species like red oak (*Quercus rubra*) and forested low areas have floodplain species like green ash (*Fraxinus pennsylvanica*). An unbroken canopy connection with the riparian forest along the Monocacy Creek provides beneficial habitat to local and regional wildlife which utilize both types of forest.

However, both new construction, which has caused the removal of some trees, and the loss of older overstory trees are creating canopy gaps. A tree replacement strategy should be developed for all campus trees to ensure an improved continuous tree canopy. To adequately plan for filling future canopy gaps, the current status of the overstory trees and a further assessment of the need for replacement plantings are necessary.

Turf on Campus

The turf areas on Moravian’s campus serve an important collegiate aesthetic and function. The landscape frontage of Comenius Hall is considered significant for visitors, students and alumni. (Figure 12) The importance of that and other iconic lawns for supporting collegiate activity and providing a certain landscape aesthetic is well understood. Existing landscape management practices on campus include minimal and low maintenance techniques (i.e., using plants from graduation as plantings around campus, etc).

Extensive lawns are not without their drawbacks. The turf areas on campus can be labor-intensive. They lack significant ecological benefit and provide minimal habitat quality. According to the EPA, gas powered mowers may contribute over 5% of U.S. greenhouse gas emissions. Maintenance staff indicated that many of the turf areas have compaction problems and poor soil quality. Continuous need for aeration and irrigation (from potable water sources) were also discussed.
Corridors, Trails, and Greenways – Monocacy Creek
Trail and Connections to Moravian College

The Monocacy Creek corridor is a great asset and with small improvements (i.e. better signage, lighting, resurfacing), it could be more highly used given its existing connections. A hiking/biking Monocacy Trail system exists adjacent to the Monocacy Creek for approximately 3 miles extending from the Ice House at Sand Island in Bethlehem to the falls at Monocacy Park. (Figure 13) The trail is easily accessed from the Hurd Campus via a tunnel or wooden staircase under the Hill to Hill Bridge. (Figure 14 Points 6, 11, 12 & Figure 15)
Figure 14. Monocacy Creek Trail Map, existing conditions and potential campus connections
The compacted red shale trail travels north along the eastern bank of the Monocacy Creek until Union Blvd. (Point 10) This section of trail has relatively poor ecological health with little natural vegetation and hardened stream banks. From here the trail continues north on the west bank of the Monocacy Creek with an access point on the west side of the Union Street bridge. (Points 9, 5, 4, & 3) There is a short section of wooden boardwalk and more compacted red shale until Burnside Plantation (Point 2) where it crosses the Plantation lawn and travels north on the Plantation driveway to Eaton Ave./ Schoenersville Road/ Elizabeth Ave (due west of the Main Street Campus). (Point 1) Although the trail in this section is lined by forest, much of the vegetation and stream banks have been impacted by urban encroachment in the form of rail lines, roads and industry. While no longer providing ideal ecological conditions, this riparian area provides a primary ecological corridor for wildlife.

Main Street Campus connections are limited to a fairly steep climb up Elizabeth Road from the trail, crossing over the Creek and Mauch Chunk Road. (Points 1 & 8, and Figure 16) Alternative connections could be made near the West Laurel Street entrance via an existing rail bridge over Monocacy Creek. Issues with this alternative include the risk of crossing an active rail line, private property and a dangerous curve on Mauch Chunk Road. This will be explored further in section 5.1.

General issues of note along the trail include poor surface for biking, on some portions, and limited lighting and night security issues, which may hinder use after dark.
2.8 EXISTING STORMWATER MANAGEMENT CONDITIONS

Stormwater management is an issue throughout the Main Street Campus, and to a lesser extent on the Moravian Athletics Complex and Hurd Campuses. With one exception, there are no existing stormwater management practices on campus. The exception is a long (150-foot) seepage trench behind Beck and deSchweinitz. (Figure 17) There are many locations on campus where PVC pipes have been added to existing downspouts to help with conveyance of water away from building foundations. (Figure 18) The lack of stormwater management across campus is understandable based on the age of much of the development, which pre-dates most stormwater management regulations. Existing storm drain mapping was obtained from the city of Bethlehem, based on available GIS data. (Figures 19 & 20)

The HILL on Hurd Campus has incorporated more state of the practice stormwater management (a swale and cistern) that will provide good precedent and experience for the College. These practices are consistent with a green and sustainable infrastructure philosophy that is described in more detail later in this document.

Annual rainfall in Bethlehem, PA is between 45 and 48 inches per year. Rainfall is normally distributed fairly uniformly over the twelve months although May is the wettest month. (source: www.ocs.orst.edu/prism). The majority of storm events are small (i.e., 1.5-inches or less), which means that landscape areas can be effectively used for filtering and treatment of the water before it returns to the groundwater or Monocacy Creek.
Figure 19. Existing Storm Drains: Main Street Campus and the Moravian Athletic Complex (based on available City of Bethlehem GIS Data)
Figure 20. Existing Storm Drains: Hurd Campus (based on available City of Bethlehem GIS Data)
3. RELEVANT LOCAL REGULATORY FRAMEWORK

Moravian is subject to the City of Bethlehem’s stormwater management regulations and review process. The regulations reflect typical stormwater management requirements for urbanizing areas and address major considerations such as water quality and water quantity treatment and natural resource protection associated with steep slopes and floodplains. A summary of the major elements of the City of Bethlehem’s Stormwater Management regulations is provided below. The complete City stormwater ordinance can be found at: http://www.bethlehem-pa.gov/about/ordinance/pdf/ARTICLE0925.pdf.

3.1 REGULATED ACTIVITIES

Development activity (inclusive of all phases) that is less than 10,000 square feet is exempt from having to prepare and submit drainage plans. Even with this exemption, the activity must:

- Not threaten health, safety, property (e.g. provide adequate and safe conveyance)
- Still meet water quality standards in the regulations through one of these measures:
  - Sheet flow through vegetated buffer
  - Disconnect roof downspouts to vegetated areas in non-erosive fashion
  - Infiltration
  - Other BMPs acceptable to the City

Drainage systems must collect and safely convey stormwater flows from the site as well as any runoff from upland areas that flows onto the site. If the upland area is undeveloped, drainage systems must be designed assuming full buildout in the upland area.
3.2 STORMWATER MANAGEMENT CRITERIA

Projects that are subject to review by the City must meet a full range of water quality and water quantity control criteria, including:

Shallow groundwater recharge – Infiltrate 0.25-inches of runoff over the impervious surface area

Water quality treatment – Either treat the runoff from a 1.25-inch rainfall event or the difference in runoff volume from predevelopment to post-development for the 2-year return period storm, whichever is larger. The treatment must be accomplished using acceptable best management practices.

Peak discharge control – Post development 2-year peak runoff discharge rate cannot exceed the pre-development rate by more than 30% to prevent physical degradation of receiving waters. For the Hurd Campus area, additional peak discharge control requirements could apply based on the Monocacy Creek Act 167 Watershed Management Plan. Under this plan, areas that include the Hurd Campus location are required to provide peak discharge control for the 10-, 25-, and 100-year return frequency storm such that post development peak discharges do not exceed predevelopment peak discharges (source: http://www.lvpc.org/pdf/act167/act16706.pdf).

3.3 ACCEPTABLE PRACTICES

For post construction stormwater management strategies, low impact development techniques are encouraged. This includes promoting infiltration and volume reduction strategies where feasible and using vegetative filtering systems that are distributed across a site as the primary means to provide water quality and channel protection control. Acceptable BMPs to provide the necessary control include:

- Bioretention
- Capture/Reuse
- Constructed Wetlands
- Dry Extended Detention Ponds
- Minimum Disturbance/Minimum Maintenance Practices
- Significant Reduction of Existing Impervious Cover
- Stormwater Filters (Sand, Peat, Compost, etc.)
- Vegetated Buffers/Filter Strips
- Vegetated Roofs
- Vegetated Swales
- Water Quality Inserts for Inlets
- Wet Detention Ponds

3.4 SPECIAL CONSIDERATIONS

There are three site conditions and constraints present on campus that the College should be aware of as planning for future growth occurs. These are:

Karst – Due to the common presence of karst geology, which is susceptible to sinkhole formation, the City has thorough site investigation and infiltration practice design requirements that must be followed. In general, if preliminary site investigations identify the presence of carbonate rock, then infiltration should be de-emphasized and even avoided as a primary stormwater management strategy. Where this is the case, practices that rely on vegetative filtering (e.g., bioretention, swales, filter strips) are the more appropriate practice to use.

Floodplains – Section 1327.06 of the zoning ordinance gives the details on regulations for development in the floodway and flood fringe. There is no specific mention of restrictions on adding fill within the flood fringe (the area within the 100 year flood plain but not within the floodway). It is recommended, however, that the College communicate with the City prior to proposed design or construction activity within the regulatory floodplains of Monocacy Creek or the Lehigh River to ensure applicable permit requirements will be met. The Hurd Campus and the vicinity of Betty Prince Field are the two areas where this consideration is most applicable.

Steep Slopes – The City of Bethlehem Zoning Ordinance addresses the regulation of developing on steep slopes. In general, there are tiered requirements that relate site size, maximum site slope, and site impervious cover. Two slope groups, 15-25% and greater than 25%, are identified with associated limits to minimum lot size and maximum site impervious cover. The summary table from the City ordinance showing the requirements is provided below. (Table 1)

Based on the City’s mapping, there are steep slopes identified on the Hurd Campus and some on the Main Street Campus near Breidegam Field House. The City’s slope map can be accessed at: http://bethlehem-pa.giv/dept/planning_Zoning_Permits/compplan/PDF/maps/Steep%Slopes.pdf. A screen capture of the campus areas is provided below. (Figure 21)
### Table 1: Slope Summary Table from City ordinance

<table>
<thead>
<tr>
<th>If the maximum slope within the construction area is:</th>
<th>The minimum lot area shall be:</th>
<th>The maximum site impervious coverage of the lot shall be:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Over 15% and up to 25%</td>
<td>1 acre</td>
<td>25%</td>
</tr>
<tr>
<td>Over 25% and up to 35%</td>
<td>4 acres</td>
<td>10%</td>
</tr>
<tr>
<td>Over 35%</td>
<td>10 acres</td>
<td>5%</td>
</tr>
</tbody>
</table>

![Figure 21. Steep Slopes from City of Bethlehem](image_url)

**Legend:**
- Yellow: Steep Slopes 15 - 25%
- Red: Steep Slopes Over 25%
4.0 GREEN INFRASTRUCTURE RECOMMENDATIONS

Green infrastructure in the campus context is a strategically planned and managed network of stormwater and landscape management practices. It uses native landscape systems to create functional working landscapes with multiple benefits including water quality and quantity treatment, habitat enhancement, respite, recreation, and educational opportunities.

4.1. MONOCACY CREEK GREENWAY: CORRIDOR ENHANCEMENT, CAMPUS CONNECTIONS, AND RECREATION OPPORTUNITIES

There are several opportunities to help provide a clear connection at the southern end of the Monocacy Trail to the Lehigh Canal Trail, to and from the Hurd Campus. In addition, connections from the trail to the Main Street Campus are possible and can be linked to the existing access trail between the Breidegam Field House and Betty Prince Field. (Figure 14, red dashed and green dashed lines)

An improved access trail along the edge of the Betty Prince Field could provide a less steep option for connecting to the Trail than a trail extension that paralleled Elizabeth Avenue, and it would bring pedestrians and bikers into the campus near the Field House and Rau and Hassler Halls. An alternative solution to the existing Main Street Campus connection could be a new pedestrian bridge spanning Monocacy Creek, the rail line and Mauch Chunk Road, and connecting to the campus at the west end of Laurel Street.

Safety conditions would also need to be upgraded along the existing trail. Suggestions for improvements include: improved lighting along the trail; improved signage for clearer way-finding; an increase in the number of emergency call boxes; and increases in the security personnel presence with a potential cooperative agreement between the campus and city police. The College could also consider ways to increase a presence on the trails through cooperative programs/partnerships between organizations and groups that maintain the current trail systems.
4.2. CAMPUS RECOMMENDATIONS: EXISTING CONDITIONS BY LANDSCAPE LOCATION

Many opportunities exist for improving the existing conditions on the Main Street campus (Figure 22), while providing capture, detention, treatment and perhaps infiltration of a portion of the stormwater runoff prior to its ultimate delivery to Monocacy Creek. This section focuses on enhancements and retrofit opportunities that are relevant under existing conditions and could be applied in various locations, as well as in potential future development scenarios.

While limited opportunities for green infrastructure improvements exist at the Hurd Campus and the Moravian Athletic Complex under current conditions, the master planning concepts show new areas of opportunity for better integration with the surrounding ecology and stormwater treatment. (See section 4.3 for further consideration of future conditions under the development scenario established in this Master Plan.)

Continued attention should focus on the interface between the woodland on the western edge of the Main Street campus and the southern edge of the Hurd campus and the transition to the more formal campus landscapes. It is important to enhance and strengthen this native woodland area, connecting both to the Monocacy Creek riparian corridor and to the green fingers of vegetation that reach into the center of the campus and potentially connect to other green infrastructure practices.
Figure 22. Stormwater and Ecological Opportunities – Main Street Campus examples under existing conditions
Forests

Conserving existing forest is a general goal for natural resource sustainability. Forest resources are integral to the campus green infrastructure network, providing habitat; open space and recreational areas; connections to the regional ecosystem; some teaching, research, and cultural opportunities; and stormwater management, among other benefits. A vigorous forest cover is also critical to maintaining healthy stream ecosystems and flood control. Forests made up of native tree and understory species have a higher ecological function than invasive exotic tree and understory species. Invasive exotic species may be defined as non-native species that can adapt, grow and spread rapidly in an area, to the exclusion and displacement of native vegetation valuable to local fauna and ecological processes. Invasive species control and restoration of native forest species is recommended as a management strategy to maintain the function of the two existing forest stands.

Campus woodland health and broader ecological connections could be addressed through the establishment of sound management practices on campus, improving the ecological health of campus woodland areas and incorporating ecological features and practices as natural amenities that integrate into the campus aesthetic. Opportunities on the campus include the maintenance and enhancement of the remaining forest area on the western edge of the Main Street campus and the southern and western edge of the Hurd campus and management of the invasive species in all the woodland areas (Figure 22, Area J).

Forest enhancement can be accomplished through the planting of appropriate native vegetation, which will increase species diversity and supplement forest regeneration. Invasive species can be managed through the future implementation of an integrated vegetation management plan. This plan would utilize a combination of appropriate technologies available (chemical, mechanical, biological) to help control and manage the invasive plant species and allow native plants the opportunity for regeneration.

The following are a summary of forest recommendations:

- Plant appropriate native vegetation, including plants in the canopy, understory, herbaceous and groundcover layers.
- Implement an integrated vegetation management plan.

Campus Trees

There are no native forest stands in the center of the Main Street Campus but the existing ornamental landscape trees serve some ecological function. There is some evidence of a loss of tree canopy due to aging and new construction, which is occurring without an adequate tree replacement strategy in place. During discussions with campus staff it has also been noted that there has been a loss of new plantings due to vandalism and poor plant/site selection.

A complete tree inventory is advised in order to assist in the development of a long-term tree replacement and management plan. Through this inventory significant tree resources can be identified, mapped and evaluated. An evaluation of health conditions can then be used to determine the urgency of care or replacement for individual trees.

As part of a long-term tree replacement strategy to improve the overall health of the Moravian College tree canopy, tree removal and/or trimming should be incorporated. Key indicators of tree health which should be taken into consideration include: dead wood, cracks, weak branch unions, decay, cankers, root problems, and poor tree architecture. Criteria for tree removal include: current and future maintenance costs, years of estimated useful life, ecological value, structural integrity, and public welfare and safety. Diminishing aesthetics, amenity features, and engineering values, such as noise abatement and wind reduction should be secondary indicators.

The removal/replacement process must clearly identify priorities for tree removal. A sequence for removal might suggest that dead or dying trees would be first, followed by trees posing a potential hazard to adjacent property, buildings, parked cars or people. The next priority might be tree stumps and then the final category could be trees growing in other undesirable locations.

The college already reuses some woody materials from clearing for mulching or on onsite composting. This approach should be continued and explored for expansion. Where excess mulch and organic material is generated, the College can look to partner with the community to find offsite uses.

For future design and construction, mature trees should be preserved and protected for their ecological value, especially in the case of native trees. In areas where the historic aesthetic will not be interrupted, campus planners should consider replacing lost non-native trees with native species in the herbaceous layer, understory
Native plants, once established, require little irrigation, fertilization and are resistant to most native pests and diseases, providing a relatively "low-maintenance" landscape. Each native plant species is a member of a balanced ecological community that includes other plants, animals and microorganisms. This natural balance keeps each species in check, allowing it to thrive in conditions where it is suited, but preventing it from becoming invasive, as plants introduced from other areas can be. The following provide some useful references for native plant lists (See Appendix for example native plant list):
http://www.habitatresourcenetwork.org/Sources.html;
http://www.habitatresourcenetwork.org/NativePlants.htm;

Interviews with College staff and faculty indicated some interest in establishing a campus arboretum, using the many mature trees currently on campus as the initial collection. If this concept is pursued, it would be beneficial to have a staff horticulturalist to manage the arboretum, monitor tree health, and direct species selection.

The following are a summary of the campus tree recommendations:

- Perform a complete tree inventory, and as part of that, evaluate health conditions of all campus trees.
- Create a long-term tree replacement strategy, including tree removal & trimming, and prioritizing removal needs.
- Preserve and protect mature native trees.
- Replace lost nonnative trees with native vegetation in herbaceous, understory and overstory layers.
- Increase overall tree canopy across the campus, including inclusion in parking and streetscape design.

Turf

There are opportunities on campus for maintenance efficiencies and alternative practices that would lead toward improvements in turf condition, ultimately lowering maintenance demands and generating cost savings. Converting turf to native plantings has multiple benefits including: increasing soil permeability, reducing overall mowing maintenance, reducing potable irrigation water demand, increasing canopy cover for rainfall interception and heat island mitigation. Turf conversion can also be linked to providing areas for stormwater management through creation of rain gardens and other vegetated stormwater BMPs. The Bahnson Center is an interesting example of where alternatives to turf are already employed on campus in lieu of traditional mown turf (Figure 23).

There may also be some opportunity for edible landscapes in some residence hall areas. This would be a multifunctional landscape opportunity, combining turf conversion with productive landscapes that could contribute to cultivating a sense of stewardship within the student community and support a broader sustainability mission of the College (Figure 22, Area E).

The following are a summary of turf conversion recommendations:

- Existing, heavily used or iconic turf areas should be maintained using integrated pest management, reduced mowing, and other sustainable strategies.
- Turf areas prone to flooding or in areas that receive rooftop or parking runoff should be retrofit as rain gardens or other stormwater BMPs.
- Marginal or unused turf areas should be planted with native vegetation.
- Turf areas located near campus dining facilities should be considered for planting of community

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gardens, or urban farms, for use in the adjacent dining facilities.

- Turf areas outside of dining facilities, along major thoroughfares, or in attractive gathering spaces should be converted to planted seating and gathering areas to allow students to enjoy the campus landscape.

**Hardscape Plazas and Quads**

In hardscape quad/plaza areas, permeable/porous pavement should be considered to minimize impervious surfaces (Figure 24). The perimeter of quads represent ideal spaces to convert to depressional areas for stormwater collection. These areas can be planted with native vegetation to provide vibrant colors and texture. Planting can be both formal and informal and provide aesthetic benefits through seasonal color, aroma, and shade.

The following are a summary of hardscape area recommendations:

- Permeable or porous pavement should be considered for repair and replacement of hardscape.
- Use perimeter areas of plazas for bioretention plantings.

**Rooftops – Green roofs & Bioretention**

Green roofs provide an opportunity to absorb and slow stormwater runoff from rooftops (Figure 25). Additionally, a planted roof can lower summer cooling needs and provide a useable space for study, vegetable/herb/flower gardening, or other activities. LEED offers points for green roofs in new construction. Green roofs should be considered when appropriate and complimentary to the building’s design.

Alternatively, runoff from rooftops can be harvested or slowed and filtered through bioretention/infiltiration. Runoff from rooftops can be treated using rain gardens, stormwater planters, infiltration trenches. These practices are placed adjacent to buildings and should be designed to complement or enhance the existing landscape plantings.

Biotention opportunities occur in several locations on campus including: the cul-de-sac at West Locust Street, the area on the quad side of Breidegam Field House, and at the corner of the Hall of Science (Figure 22, Areas B, F, I). There are also a number of opportunities in the Old Quad around Monocacy, Memorial, Comenius halls, where stormwater is currently directed away from building foundations with exposed pvc pipes. These are areas that would benefit from an aesthetic treatment of rainwater in gardens and context sensitive cisterns (Figure 22, Area L).

The following are a summary of greenroof recommendations:

- If roof repair is necessary, consider green roofs.
Treat rooftop runoff with rain gardens, stormwater planters, infiltration trenches, or cisterns.

Roofops - Rainwater Harvesting

Rather than treating stormwater as a nuisance to be disposed of, rainwater harvesting is a technique used to capture and reuse this valuable resource (Figure 26). Harvested rainwater may be collected from any impervious area such as a rooftop, plaza, or parking lot. Rooftop harvesting tends to be the most common, in part due to it being a cleaner source. Water can be stored in above-ground cisterns or underground storage tanks with capacities up to 10,000 gallons. The water collected can be used for lawn and garden watering, watering down artificial turf playing fields, as well as indoor uses such as toilet flushing. In some cases the cisterns are used to provide aesthetic-driven water features. Storing rainwater also conserves potable water and reduces water utility costs. Gravity flow or pumps can be used to distribute the water. Reuse of graywater or treated wastewater could also be re-used to lower or replace the demand for potable water for irrigation purposes. Areas of opportunity on campus include the rooftop and potential hardscape runoff around Breidegam Field House, as well as in the Old Quad area mentioned above (Figure 22, Areas F & L).

The following is a summary of rainwater harvesting recommendations:

- Consider cisterns and or other storage devices for storing hardscape runoff flowing from buildings as well as impervious areas.

Streets

Traffic calming needs, particularly along certain roadways including West Elizabeth Avenue, Locust Street, and Main Street present unique opportunities for integrated stormwater management (Figure 22, Areas A & D). This combined with potentially poor drainage conditions could be addressed with stormwater retrofit measures along roadways of concern. Road runoff can be captured in stormwater tree pits or rain gardens located in curb extensions (Figure 27). These features also promote traffic calming, improving safety for drivers, pedestrians, and bicyclists. Porous pavement could be considered for bike lanes, parking lanes, or infrequently-used roads, or campus service drives.

Locust Streets and Laurel Street, two streets that may become even more important with the increased connections to the Moravian Athletic Complex in the master plan concept, could incorporate this combination of traffic calming, streetscape stormwater treatment, and integrated pedestrian access. These two streets in particular provide a unique opportunity to explore designs that highlight integrated stormwater with the pedestrian experience, as "urban ecological corridors" (Figure 22, Area D). The median on Main Street has the potential for stormwater retrofitting as a vegetated bioretention traffic median island.
Consider porous paving in parking stalls, bike lanes, campus service drives

Parking Lots

The retrofit/expansion/relocation of existing lots could allow for innovative stormwater management opportunities in capturing and treating the runoff from these impervious surfaces. Increasing tree canopy and combining these areas with stormwater receiving zones to filter water and support plant life would provide multiple benefits, including the provision of further habitat areas and the mitigation of urban heat island effects. Runoff from parking lots can be treated by rain gardens placed around the perimeter or in linear islands within the parking lots (Figure 28). If space allows, grass filter strips placed between the parking lot and rain gardens will promote additional infiltration and reduce the pollutant load and velocity entering the rain gardens. Replacing all or part of a parking lot with porous pavement or paver blocks is another option. Pavers or colored porous concrete can be used to visually demarcate special parking areas (Figure 22 Area K).

The following are a summary of parking lot recommendations:

- Establish a reforested buffer of a minimum width of 25 feet along the Creek.

- Integrate vegetated stormwater treatment islands in the parking lot, to receive sheet flow, filter and treat stormwater, and provide benefits to the plantings in the islands.

- Integrate tree plantings in stormwater receiving areas (stormwater treatment islands) to establish canopy coverage, aiming to provide shade to 50% of the site area within five years.

- Consider permeable paving surfaces for parking stalls and design stalls for compact cars.

- Look to integrate Monocacy Creek Trail through parking access.
Regenerative Stormwater Conveyance

Conveying stormwater through pipes or concrete channels degrades the surrounding environment by speeding up flows, causing erosion, and denying infiltration. Regenerative Stormwater Conveyance (RSC) uses stream restoration techniques to create open channel flow, allowing sediment settling in pools, aeration in riffle structures, and restored ecological function (Figure 29). RSC is used to convey water down slopes from impervious areas or pipe outfalls. It is composed of a sand seepage bed, riffle weirs made of boulders and cobbles, a mulch and compost layer, and native plants. RSC is less intrusive than other conveyance stabilization techniques. It dissipates energy by slowing the flows, provides infiltration through the sand bed, and has a natural appearance. These vegetated channels create opportunities for aesthetically valuable green infrastructure.

Regenerative stormwater conveyance is suggested for the current stormwater trench located behind Beck and de Schweinitz, as well as the portion of West Laurel draining downhill toward Mauch Chunk Road (Areas N & G). Similarly there are intriguing opportunities for a combination of bioswale and regenerative conveyance along the edge of the main quad/playing field between Jo Smith and Wilhelm Halls (Figure 22, Area C). This very visible space would provide an opportunity for educational signage and aesthetic benefits, combined with the rainwater treatment and habitat enhancement.

Living Walls

Living walls are vertical gardens on building facades. The structures of living walls can vary from simple wire trellis to support vines to more intensive frames and fabrics hosting a variety of plant species. Living walls can improve the aesthetic quality of large, unattractive building facades, lessen the need for cooling in warm weather, can be combined with green roofs to slow stormwater runoff from rooftops, can be used for experimental and educational programs, and can even be used to grow food crops. The facades of proposed new buildings should be considered for living wall installation.

The following is the summary of living wall recommendations:

- Consider living walls for buildings/ parking decks where shade and vegetation could contribute to the aesthetic and cooling of a structure, as well as providing some stormwater treatment.
4.3. RECOMMENDATIONS: UNDER FUTURE MASTER PLAN

The proposed Master Plan concepts for Moravian College provide numerous opportunities for the College to embrace and enhance the strong ecological and natural resource assets that currently exist on and adjacent to campus. The notes below are associated with the numbered/colored areas on Figure 30.

1. It will be important to keep in mind the value of the woodland along the western edge of the Main Street Campus and the southern edge of the Hurd Campus. Respecting the interface between built structures and the forested area, as well as and finding ways to make that transition softer and allow for the retention of potential habitat connections to the Monocacy Creek riparian corridor, will require enhancement and restoration of these areas with native vegetation and adaptive management strategies.

2. Of related importance is the changing relationship with the woodland edge with the expansion of Breidegam Field House, where it will be important to retain some of the mature native canopy and integrate the woodland aesthetic into the suggested staging area/plaza and new parking lot under an improved Betty Prince Field. This new construction will provide exciting opportunities to integrate beneficial stormwater storage and reuse in the form of cisterns with the stored water becoming available to water the new field, as well as a living wall along edges of the parking structure.

3. There are many opportunities to showcase small-scale innovative stormwater practices woven into the landscape context, including regenerative stormwater conveyance and turf conversion to native landscapes, especially in the campus residential area that is filling out the southwestern edge of the Main Street campus, as well as around the new residential hall on Hurd campus. These areas would provide visual and landscape amenities creating texture and depth in the open spaces created by the new residential halls.

4. The Master Plan shows great care to increase the tree canopy in and around parking lots across the campuses. The increased canopy could also be integrated with stormwater management within and along the edges of these parking lots. As future development goes forward it will be important to incorporate stormwater management retrofits (e.g. bioretention, infiltration trenches, permeable paving) around existing parking lots that remain in the master plan concepts as surface lots.

5. The proposed new structures across the Main Street campus will generate increased stormwater runoff in many areas already impacted by increased runoff volumes and velocities. Using strategies such as green roofs, cisterns, and rooftop rainwater harvesting should be considered, so as to not exacerbate the current runoff conditions. Integrated bioretention gardens and alternatives to turf in the site design of these buildings also provide further potential for stormwater management. However site design will have to take into consideration the karst character of the soils in this area.

6. The Master Plan also provides an increased presence of street trees along the east-west routes between Main Street campus and the Moravian Athletic Complex along Locust and Laurel. This treatment provides an excellent opportunity to design these new byways as urban ecological corridors, as described in Section 4.2 in Streetscapes, incorporating pedestrian access, stormwater management, and traffic calming.
Figure 30. Stormwater and Landscape Opportunities associated with Master Plan
5.0 SUMMARY

5.1 THE GREEN INFRASTRUCTURE APPROACH

A green infrastructure stormwater and landscape management philosophy highlights the application of aesthetic native landscape systems and practices. Creating more sustainable green infrastructure means transitioning from practices that degrade the environment toward creating working landscapes that perform important ecological functions. Examples of these functions include: receiving, retaining, and filtering stormwater; creating natural habitats for diverse ecosystems; providing educational opportunities; and reducing the overall operation and maintenance burden for campus staff.

A long-term recommendation for the Moravian College campus is to develop a water budget for the site that mimics the natural, undisturbed infiltration capacity of the land to the maximum extent practicable using a distributed stormwater management approach. A priority should be placed on using Best Management Practices (BMPs) that emphasize vegetative filtering, uptake, and infiltration (taking into account the karst formations), following innovative design approaches and techniques that go above and beyond state or local guidance.

The proposed Master Plan for Moravian provides numerous opportunities for the College to embrace and enhance the ecological and natural resource assets that currently exist on and adjacent to campus. Integrating these opportunities into future capital improvement efforts will be important as the College moves forward towards achieving sustainable outcomes in the landscape. Combining landscape enhancements with innovative and distributed stormwater management should be part of the overall strategy that is implemented. Key opportunities identified as part of this planning effort include the following, broken down into stormwater, landscape ecology, and general sustainability and cost considerations.
Stormwater

- **Promoting an emphasis on water as a resource as opposed to a nuisance** – Improved stormwater management on existing parking lots and streetscape enhancement zones, promoting the integration of techniques to treat rooftop runoff through use of functional landscape zones that receive and beneficially use runoff. Alternatives such as rain barrels and cisterns can be explored for temporary capture and reuse of runoff for irrigation purposes. These areas could act as outward signs of the college’s investment in stewardship and regional ecological health. The Creek is the most important ecological icon in the project area so the way in which the College responds to and respects the Monocacy will communicate a lot about the value of the resource to the surrounding community.

- **Treating water close to the source** – Use BMPs to capture and treat runoff from small storms (< 1.5”). In areas not prone to sinkhole formation, promote shallow groundwater recharge.

- **Disconnection and reduction of impervious surface** – Applicable BMPs include green roofs, porous pavement, bioswales, raingardens, stormwater planters and the removal of under served paved areas.

- **Limiting new impervious surface** – To the greatest extent possible, locate new impervious surfaces (buildings, parking lots) on existing disturbed areas. For example, consolidate surface parking and replace with structured or underground parking and redevelop the reclaimed area. This will minimize the growth of the impervious footprint of the campus, lower regulatory burdens, and minimize additional impacts on already-stressed waterways.

- **Providing larger storm flood control, as needed** – Avoid increases in peak discharge through use of distributed practices, temporary detention and/or rainwater harvesting strategies for graywater reuse.

The proposed stormwater management practices that are part of this approach have several benefits, including:

- **Hydrology** – Providing runoff treatment close to the source will reduce the volume and velocity of runoff, which will curtail flooding for small events (< 1.5”) and potentially alleviate flooding for larger events.

- **Water quality** – Water quality improvement efforts can help the City of Bethlehem meet Stormwater NPDES permit requirements. The College can build on their relationship with the City and other neighbors with such efforts and look to explore additional ways to partner and cost share on efforts that benefit the City, the College, and the region as a whole.

- **Maintenance** – Capturing runoff close to the source will reduce the frequency and extent of maintenance for College infrastructure such as storm drains and open channels. Native landscape plantings incorporated into BMPs will provide efficiencies in campus landscape maintenance requirements by reducing demand for mowing, irrigation, fertilization, and pest control normally needed for turf areas or non-native plantings.

- **Aesthetic appeal** – Many BMPs can provide aesthetic improvements to sites through the use of native plants that flower and the use of trees that provide canopy coverage and shade. These environments provide a great opportunity for outdoor, multi-functional learning spaces.

- **Utility costs** – Harvested and detained rainwater can be used as a resource to irrigate landscaping, especially for lawns and athletic fields, and reduce utility bills.

### Landscape ecology

- **Creating opportunities for multi-functional landscapes** – Incorporating the inclusion of micro-habits and ecological stepping stones in these functional landscapes while providing the campus community with educational and stewardship opportunities.

- **Embracing the native character of the Monocacy Creek natural woodland edge and riparian buffer** – Integrate the woodland features into the landscape character of the campus, especially along the western edge where the residential halls are prevalent, providing a native woodland residential landscape. Minimizing impacts to existing forest along western edge of Main Street campus and the southern edge of Hurd Campus. Respecting steep slopes and flood fringe limitations set by local zoning (Betty Prince Field and on Hurd Campus) (Sections 1372.06 and 1318.29 of City of Bethlehem Zoning Regulations)

- **Implementing restoration and enhancement opportunities along the Monocacy Creek riparian corridor** – Strengthening buffers and highlighting further connections between the...
existing trail system and the different campuses. This corridor has the potential to be a major north/south connector for the Hurd and Main Street campus that can provide a pleasant pedestrian/bike experience for students, faculty and staff and a better context for users of the natural landscape.

- **Increasing tree canopy and native vegetation throughout all campuses** – Consideration of long-term tree/forest management and replacement plan for the campus. Pursuing turf conversion opportunities as the context of the campus landscape permits.

- **Limiting ecological disturbance** – Avoid encroaching on the edges of forested areas if at all possible and maintain or preserve existing landscape ecological connections.

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**Genera sustainability and costs**

- **Implementation of all of the above elements to support broader ecological and sustainability objectives** – Use of the natural resource elements on campus to highlight sustainability efforts by the College is one of the more visible ways to engage the College community.

- **Balancing first (initial) costs with long term benefits** – Initial costs can be higher for a distributed approach, but this approach has other benefits that are not captured by a first-cost analysis, such as improved campus aesthetics, an overall reduction in maintenance, improved water quality, and opportunities to educate the College community about sustainability principles and natural systems function.
APPENDIX

NWI WETLANDS ATTRIBUTES


PFO1A = Palustrine Forested Broad Leaved Deciduous Temporary
POWZh = Palustrine Open Water Intermittently Exposed/Permanent, Diked/Impounded
POWZx = Palustrine Open Water Intermittently Exposed/Permanent, Excavated
PSS1/EM5A = Palustrine broad-leaved deciduous shrub/ Palustrine emergent narrow leaved persistent temporary
PSS1A = Palustrine Scrub/Shrub Broad Leaved Deciduous Temporary
R5OWH = Riverine unknown perennial open water permanently flooded systems

PLANT LIST

Partial Native Plant List for campus applications including stormwater inundation areas

<table>
<thead>
<tr>
<th>Moravian College – Partial Native Plant List</th>
</tr>
</thead>
<tbody>
<tr>
<td>*plants appropriate for stormwater BMP applications</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Shade Trees</th>
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</thead>
<tbody>
<tr>
<td>Acer rubrum (Red maple)*</td>
</tr>
<tr>
<td>Acer saccharum (Sugar maple)</td>
</tr>
<tr>
<td>Betula nigra 'Heritage' (Heritage river birch)*</td>
</tr>
<tr>
<td>Betula papyrifera (Paper birch)</td>
</tr>
<tr>
<td>Betula populifolia (Gray birch)*</td>
</tr>
<tr>
<td>Betula populifolia 'Whitespire' (Whitespire gray birch)*</td>
</tr>
<tr>
<td>Fagus grandifolia (American beech)</td>
</tr>
<tr>
<td>Liquidambar styraciflua (Sweetgum)*</td>
</tr>
<tr>
<td>Nyssa sylvatica (Blackgum)*</td>
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<tr>
<td>Populus tremuloides (Quaking aspen)</td>
</tr>
<tr>
<td>Quercus alba (White oak)</td>
</tr>
<tr>
<td>Quercus bicolor (Swamp white oak)*</td>
</tr>
<tr>
<td>Quercus cocinnea (Scarlet oak)</td>
</tr>
<tr>
<td>Quercus phellos (Willow oak)*</td>
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<tr>
<td>Quercus rubra (Northern red oak)</td>
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<tr>
<td>Understory Trees</td>
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<tr>
<td><em>Amelanchier arborea 'Autumn Brilliance' (Autumn Brilliance serviceberry)</em></td>
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<tr>
<td><em>Amelanchier canadensis (Serviceberry)</em></td>
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<td><em>Carpinus caroliniana (Ironwood)</em></td>
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<tr>
<td>*Cercis canadensis (Eastern redbud)</td>
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<td>*Cercis canadensis 'Alba' (White eastern redbud)</td>
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<td><em>Chionanthus virginicus (Fringe tree)</em></td>
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<td>*Cornus florida (Flowering dogwood)</td>
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<td>*Cornus florida 'Cloud 9' (Cloud 9 flowering dogwood)</td>
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<tr>
<td><em>Magnolia virginiana (Sweetbay magnolia)</em></td>
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<td><em>Sassafras albidum (Sassafras)</em></td>
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<td>Evergreen Trees</td>
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<td><em>Chamaecyparis thyoides (Atlantic white cedar)</em></td>
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<td>*Ilex opaca (American holly)</td>
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<td>*Ilex opaca 'Jersey Princess' (Jersey Princess American holly)</td>
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<td>*Ilex opaca 'Satyr Hill' (Satyr Hill American holly)</td>
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<tr>
<td>*Juniperus virginiana (Eastern red cedar)</td>
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<td>*Pinus strobus (Eastern white pine)</td>
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<td><em>Taxodium distichum (Bald cypress)</em></td>
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<td>*Tsuga canadensis (Canada hemlock)</td>
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<td>Shrubs</td>
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<td><em>Aronia arbutifolia 'Brilliantissima' (Red chokeberry)</em></td>
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<td>*Calycanthus floridus 'Athens' (Carolina allspice)</td>
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<td><em>Cornus sericea (Red-osier dogwood)</em></td>
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<td><em>Cornus sericea 'Cardinal' (Cardinal red-osier dogwood)</em></td>
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<td><em>Hamamelis virginiana (American witchhazel)</em></td>
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<td><em>Lindera benzoin (Northern spicebush)</em></td>
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<td><strong>Viburnum acerifolium</strong> (Maple-leaved viburnum)</td>
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<td><strong>Viburnum dentatum</strong> (Southern arrowwood)</td>
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<tr>
<td><strong>Viburnum trilobum</strong> (Highbush cranberry)</td>
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### Grasses + Sedges + Rushes

| **Andropogon gerardii** (Big bluestem) |
| **Bouteloua curtipendula** (Sideoats grama) |
| **Chasmanthium latifolium** (River oats) |
| **Carex crinata** (Fringed sedge) |
| **Carex lurida** (Shallow sedge) |
| **Carex pensylvanica** (Pennsylvania sedge) |
| **Deschampsia cespitosa** (Tufted hairgrass) |
| **Deschampsia flexuosa** (Common hairgrass) |
| **Juncus canadensis** (Canada rush) |
| **Juncus effusus** (Soft rush) |
| **Muhlenbergia capillaris** (Pink Muhly Grass) |
| **Panicum virgatum** (Switchgrass) |
| **Panicum virgatum 'Dallas Blues'** (Switchgrass) |
| **Panicum virgatum 'Heavy Metal'** (Switchgrass) |
| **Panicum virgatum 'Rotstrahlbusch'** (syn Hanse Herms') (Switchgrass) |
| **Schizachyrium scoparium** (Little bluestem) |
| **Schizachyrium scoparium 'The Blues'** (Little bluestem) |
| **Scirpus cyperinus** (Woolgrass) |
| **Sorghastrum nutans 'Sioux Blue'** (Sioux Blue indian grass) |

### Herbaceous + Ferns

<p>| <strong>Asclepias incarnata</strong> (Swamp milkweed) |
| <strong>Asclepias purpurascens</strong> (Purple milkweed) |
| <strong>Asclepias tuberosa</strong> (Butterfly weed) |
| <strong>Baptisia australis</strong> (False blue indigo) |
| <strong>Dryopteris marginalis</strong> (Evergreen wood fern) |
| <strong>Echinacea purpurea</strong> (Purple coneflower) |
| <strong>Echinacea purpurea 'Kim's Knee High'</strong> (Dwarf purple coneflower) |
| <strong>Eupatorium perfoliatum</strong> (Boneset) |</p>
<table>
<thead>
<tr>
<th>Species</th>
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<tr>
<td><em>Eupatorium purpureum</em></td>
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<td>(Common sneezeweed)*</td>
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<td>(American alumroot)</td>
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<td><em>Heuchera villosa</em> 'Autumn Bride'</td>
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<td><em>Hibiscus moscheutos</em></td>
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<td><em>Solidago caesia</em></td>
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<td>(Wrinkleleaf goldenrod)</td>
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<td><em>Verbena hastata</em></td>
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<td><em>Vernonia noveboracensis</em></td>
<td>(New York ironweed)*</td>
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**Sources:**


