UNIVERSITY OF CINCINNATI

EAST CAMPUS STORMWATER OPPORTUNITIES PLAN

HEALTH SCIENCES BUILDING & SHIELDS STREET EXTENSION

Submitted By:

HUMAN NATURE

STRAND ASSOCIATES®

January 2016

INTRODUCTION

In recent years, the University of Cincinnati (University) has demonstrated a commitment to identifying and implementing sustainable goals and objectives throughout University's Uptown Campuses. Although this has resulted in many successful initiatives, sustainable management of stormwater runoff has yet to be fully implemented throughout the Uptown Campuses. Given the University's location within the combined sewer system, which is owned and maintained by the Metropolitan Sewer District of Greater Cincinnati (MSD), effective stormwater management is particularly critical in the context of combined sewer overflows (CSOs) that occur downstream from the University during rainfall events.

The University embarked on an initial stormwater master planning effort approximately five years ago. The project team of Strand Associates, Inc. and Human Nature, Inc. (Project Team) assisted the University with a coarse evaluation of green infrastructure alternatives throughout both the West and East campuses, culminating in the *Campus Opportunities Plan* report in September 2011. This evaluation provided the University with a planning-level framework in which to consider the impacts of stormwater runoff and opportunities to implement green infrastructure, such as bioretention systems/rain gardens, permeable pavement, and site-specific stormwater Best Management Practices (BMPs).

Subsequent to the previous stormwater master planning project, the University expressed interest in evaluating specific opportunities for sustainable stormwater management at locations on East Campus where several improvement projects are currently being planned and designed. The objective of the evaluation is to promote sustainability and a healthy campus with green space areas, while also minimizing the impacts of stormwater runoff on the local combined sewer system. The University is currently coordinating with a design team on a redevelopment project to demolish the existing Wherry Hall and construct a new Health Science Building (HSB). The University is also designing improvements for the Shields Street Extension Project to the north of the Kettering Lab Complex Building. As part of these redevelopment projects, the Project Team explored opportunities for sustainable stormwater management to meet local regulations as well as to promote a healthy campus.

In addition to the Wherry Hall/HSB redevelopment project, the University is also in the process of exploring conceptual mid-term and long-term site improvement concept alternatives for the East Campus. As a result, the University requested that the Project Team identify sustainable stormwater management opportunities throughout the East Campus. This stormwater master planning effort is intended to be integrated into the site improvement concept alternatives currently being developed by others, which are generally bound by Goodman Drive to the south and Shields Street to the north. The ultimate goals of the master planning effort include water quantity reduction (and corresponding combined sewer overflow reduction) and water quality improvement.

This report will ultimately be organized into three sections: Stormwater Management Planning, East Campus Stormwater Management Opportunities Plan, and Health Sciences Building Redevelopment Project. Due to the timeframe of design phases, the initial report focuses primarily on the HSB redevelopment project, with opportunities for stormwater management in the broader East Campus context to follow. The Health Sciences Building Redevelopment Project section characterizes land cover types, describes MSD regulations, and describes specific stormwater management concepts that can be considered for the HSB redevelopment project. This report also contains an Appendix that includes 11x17 versions of figures.

Site Analysis Boundary

The site analysis boundary consists of two separate areas: the Health Sciences Building project area, covering a total of 3.00 acres, and the Shields Street Extension project area, covering a total of 0.32 acres. The boundaries, shown in **Figure 1**, were developed based on the following plans provided to the Project Team by the University:

- *Health Sciences Building: Schematic Design Site Utility Plan* (October 16, 2015), produced by EMH&T and Moody Nolan, and
- *Shields Street Extension* (October 2015), produced by the Kleingers Group.

The bounding roadways include Eden Avenue to the east, Panzeca Way to the south, and Shields Street to the north. Existing buildings located within or adjacent to the site analysis boundaries include Wherry Hall, the Radiation Safety building, the Health Professions Building, Kettering Lab Complex, and the Eden Avenue Garage. The Project Team used these boundaries for analyzing existing and proposed land cover conditions, estimating annual stormwater runoff volume, and identifying potential stormwater management opportunities.

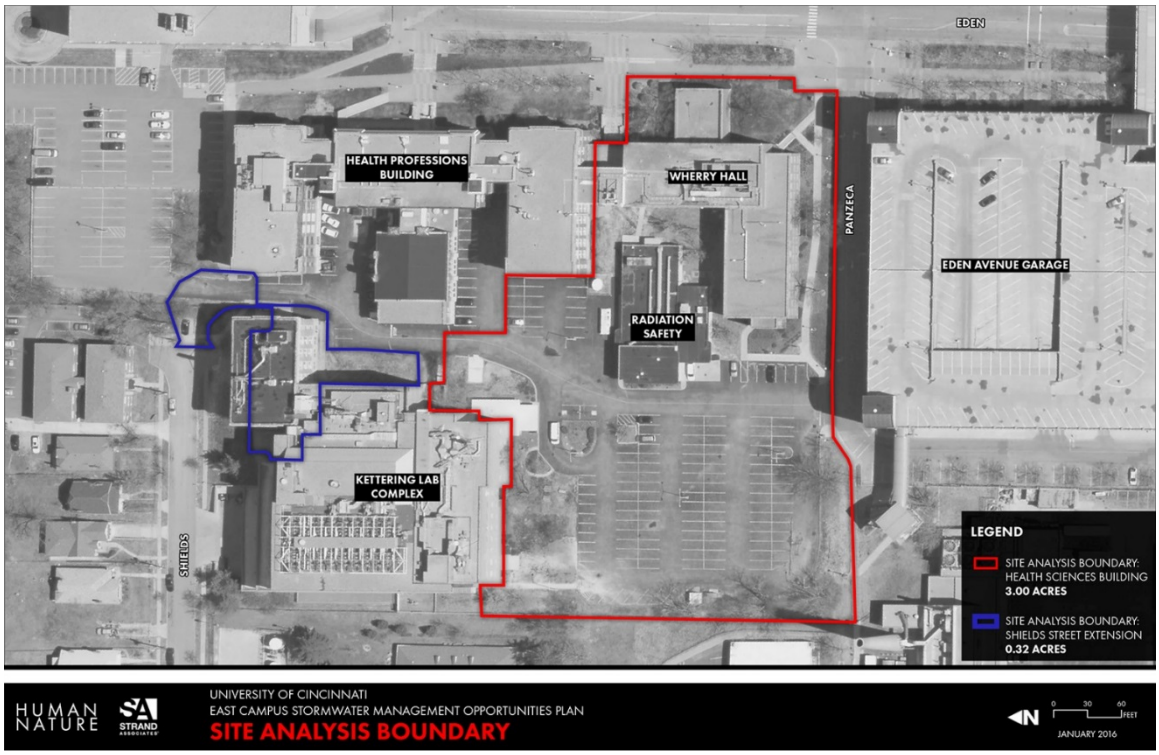


Figure 1: Site Analysis Boundary
A full-size version of this map is provided in Appendix A.

Existing Conditions

The Project Team analyzed existing conditions for the sewer system and land cover. In regard to the existing sewer system, all areas of the University's East Campus – including the site analysis boundary shown in **Figure 1** – are located within the combined sewer system owned and maintained by MSD. The existing sewer system is shown in **Figure 2**. Information for the existing sewer system is based on geographic information systems (GIS) data and site survey conducted by the Kleingers Group. The HSB site analysis boundary contains separate storm sewers that collect stormwater runoff from the existing surface parking lot and open space areas and discharge to the MSD combined sewer on Panzeca Way. In general, surface runoff from the HSB site flows from the northeast to the south and southwest. Stormwater runoff from the Shields Street Extension site analysis boundary flows from to the north and northwest before discharging into the MSD combined sewer on Shields Street.

There are two existing underground detention tanks adjacent to the site analysis boundaries. These include the Eden Garage North Tank, with a storage volume of approximately 20,420 gallons, and the Kettering Lab Addition Tank, with a storage volume of approximately 23,500 gallons. There are 1.81 acres of drainage area tributary to the Eden Garage North Tank and 0.56 acres tributary to the Kettering Lab Addition Tank. Based on a review of drawings and calculations obtained from the University, both of these tanks were constructed approximately 25 years ago and were designed to meet MSD stormwater detention regulations for redevelopment within the combined sewer system.

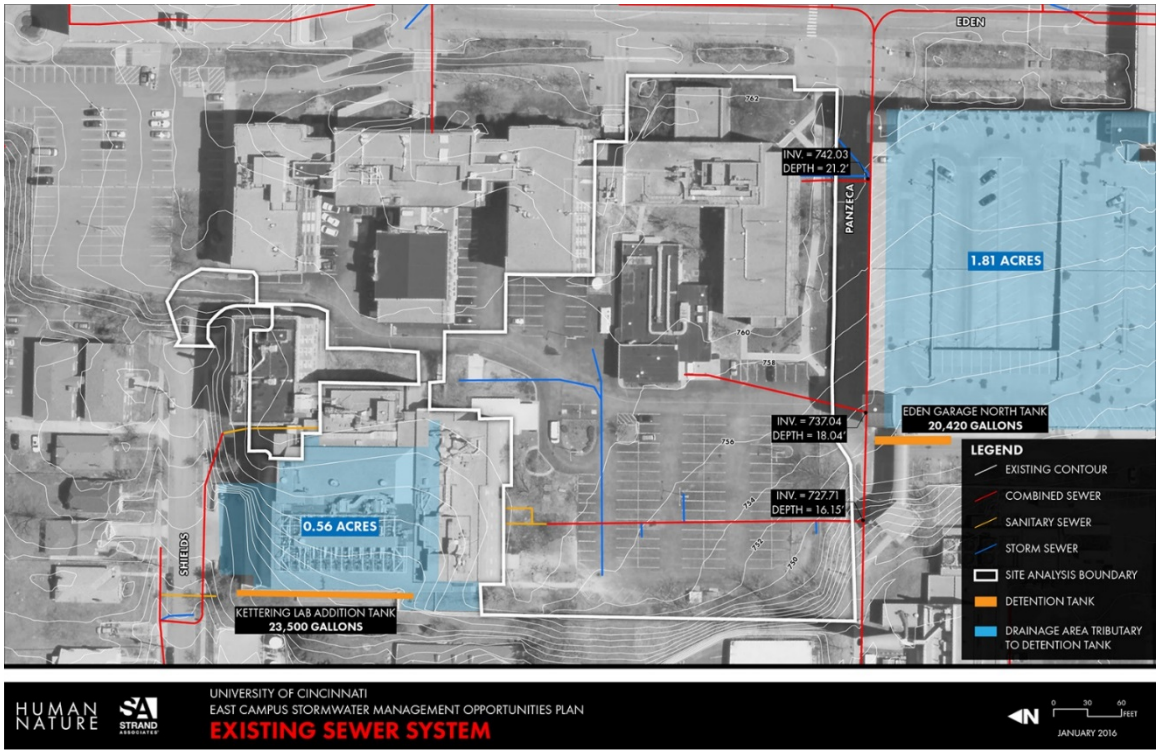


Figure 2: Existing Sewer System

A full-size version of this map is provided in Appendix A.

In regard to existing land cover, the two site analysis boundaries consist mostly of impervious surfaces, which include building rooftops, surface parking lots, and sidewalks or other paved areas. Pervious surfaces include grass or ground cover vegetation. Existing land cover types are represented in **Figure 3**. The HSB site contains 2.15 acres of impervious surfaces (72 percent of the site analysis boundary) and 0.85 acres of pervious surfaces (28 percent of the site analysis boundary). The estimated annual stormwater runoff volume generated within the HSB boundary is 2.11 million gallons based on a typical year of rainfall.

The Shields Street Extension contains 0.21 acres of impervious surface and 0.11 acres of pervious surface, which represent 66 percent and 34 percent, respectively, of the total land cover in the boundary. The estimated annual stormwater runoff volume generated is 0.21 million gallons based on a typical year of rainfall.

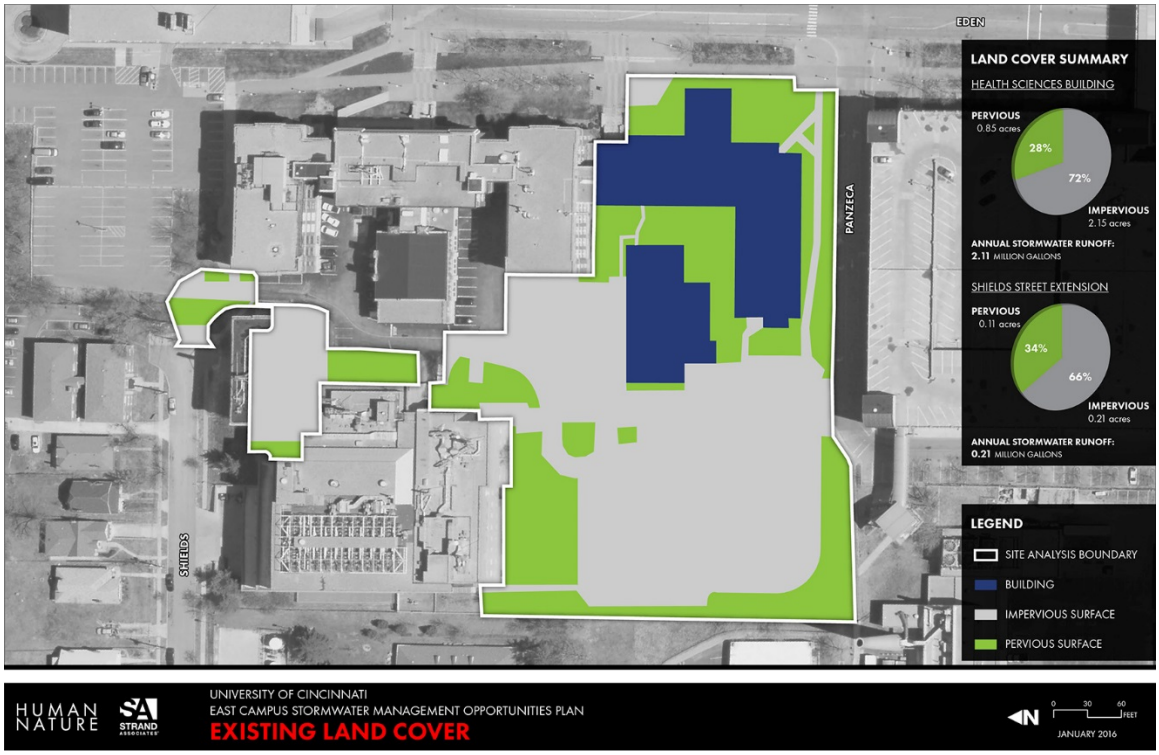


Figure 3: Existing Land Cover
A full-size version of this map is provided in Appendix A.

Site Concept Plan

The Project Team analyzed future conditions within the site analysis boundaries based on the previously-mentioned concept plans provided by the University. The proposed site concept plans are represented in **Figure 4**. The proposed plan for the HSB site includes:

- Removing Wherry Hall, the adjacent surface parking areas, and adjacent sidewalks and paved areas.
- Constructing the Health Sciences Building.
- Constructing an entryway for the Kettering Lab Complex at the building's southeast corner.
- Constructing an entrance for the Health Professions Building at the building's southern edge.
- Constructing a network of sidewalks and a vehicular access route from the northwest corner of Eden Avenue and Panzeca Way to the southern edge of the Kettering Lab Complex.
- Constructing a series of open space areas adjacent to the new buildings and sidewalks.

Future land cover in the HSB site analysis boundary is anticipated to consist of 1.63 acres of impervious surfaces and 1.37 acres of pervious surfaces. The estimated annual stormwater runoff volume is 1.76 million gallons, which represents a decrease of approximately 17 percent when compared to the existing condition runoff volume.

The proposed plan for the Shields Street Extension area includes constructing a connection between Shields Street and the access way between the Kettering Lab Complex and Health Professions Building. Based on conversations with the University, vehicular access to this new connection would be restricted to authorized University vehicles. Future land cover in the Shields Street Extension site analysis boundary is anticipated to consist of 0.25 acres of impervious surfaces and 0.07 acres of pervious surfaces. The estimated annual stormwater runoff volume is 0.24 million gallons, which represents an increase of approximately 14 percent when compared to existing conditions runoff volumes.

The provided concepts plans included information for the proposed stormwater management systems. The proposed stormwater management system at each site is represented in **Figure 5**. At the HSB site, the concept plan shows the installation of a separate storm sewer network which will connect to the existing MSD combined sewer on Panzeca Way. Stormwater runoff is collected from the proposed building and open space areas via surface catch basins or grated manhole lids and directed to a proposed underground storage system located under a future open space area between the proposed building and Eden Avenue. The underground storage system is identified as MC-3500 StormTech chambers (48 total). A smaller segment of proposed storm sewers at the south of the proposed building will connect directly to the existing combined sewer on Panzeca Way. The concept plan also includes the potential realignment of the existing combined sewer line that is impacted by the placement of the HSB building, although the University has indicated there are elevation challenges associated with the currently proposed realignment alternative.

At the Shields Street Extension Site, the concept plan shows the installation of a separate storm sewer system that will connect to the existing MSD combined sewer on Shields Street. Based on the initial conceptual plan provided by the University, the site improvements do not appear to include stormwater management features to capture, store and detain stormwater runoff.

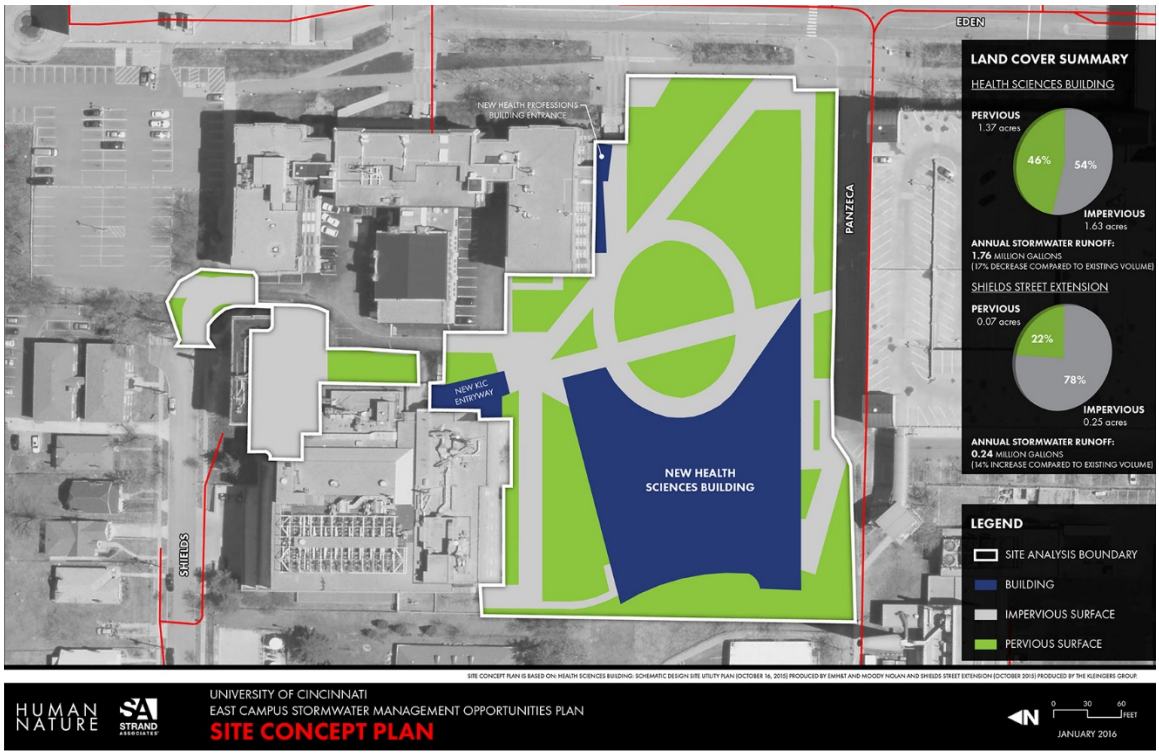


Figure 4: Site Concept Plan
A full-size version of this map is provided in Appendix A.

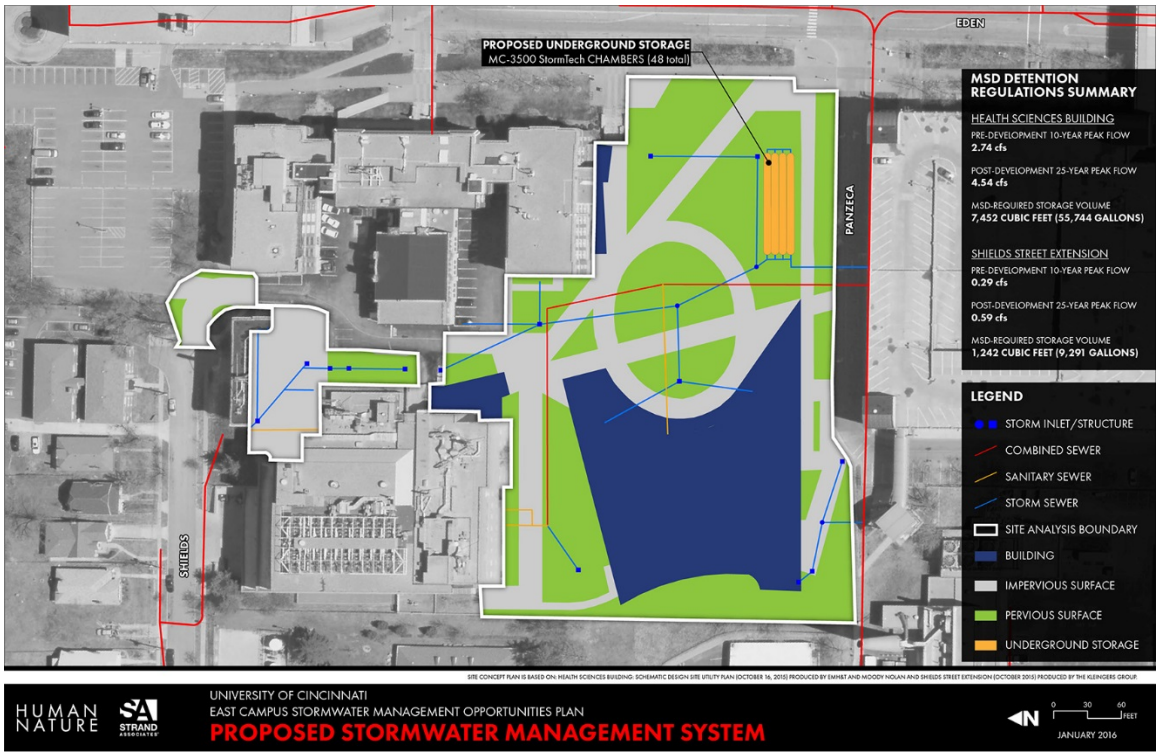


Figure 5: Proposed Stormwater Management System
A full-size version of this map is provided in Appendix A.

MSD Detention Regulations

Stormwater runoff from the University's East Campus drains into the existing combined sewer system owned and maintained by MSD. As a result, new development and re-development projects that are implemented by the University are subject to MSD's regulations for stormwater management within the combined sewer system service area. The objective of the regulations is to effectively manage and detain stormwater runoff from a development site to maintain or improve upon existing runoff conditions, thus preventing additional contribution of flow into the combined system to avoid increases to combined sewer overflows. Specifically, Article III of MSD's *Rules and Regulations* includes detention requirements for stormwater connections or modifications within the combined sewer system. Section 303 of the regulations states the following:

> "*The volume of stormwater detained shall be the difference in runoff volume from the predeveloped site over a ten-year event of one hour duration and the postdeveloped site under a twenty-five year event of one hour duration. The peak rate of runoff from the site after development for a twenty-five year storm event of one hour duration shall not exceed the predevelopment site peak runoff for a ten-year event of one hour duration*."

The regulations require the use of the Rational Method to calculate peak flow rates for small drainage areas, with standard runoff coefficients provided and specific rainfall intensities to use for the 10-year and 25-year rainfall events.

MSD's regulations were followed for the purposes of developing planning-level estimates of stormwater storage needed to meet the regulations for both the HSB redevelopment project and the Shields Street Extension project. **Tables 1** and **2** provide information on the land use characteristics of each site, along with the calculation used to determine the storage volume required to meet the objective of the regulations.

	Pre-Development Conditions	Post-Development Conditions
Redevelopment Boundary Area	3.00 acres	3.00 acres
Impervious Area	2.15 acres	1.63 acres
Pervious Area	0.85 acres	1.37 acres
Composite Runoff Coefficient	0.45	0.63
Rainfall Intensity	2.03 inches/hour (10-year)	2.42 inches/hour (25-year)
Peak Flow Rate	2.74 cubic feet/second (Q_{10})	4.54 cubic feet/second (Q_{25})
Storage Volume Required $S = 4{,}140\ (Q_{25} - Q_{10})$	$S = 4{,}140\ (4.54 - 2.74) =$ **7,452 cubic feet** = **55,744 gallons**	

Table 1: Land Use Characteristics and Storage Volume Requirements for Health Sciences Building Redevelopment Project

	Pre-Development Conditions	Post-Development Conditions
Redevelopment Boundary Area	0.317 acres	0.317 acres
Impervious Area	0.210 acres	0.246 acres
Pervious Area	0.107 acres	0.071 acres
Composite Runoff Coefficient	0.45	0.77
Rainfall Intensity	2.03 inches/hour (10-year)	2.42 inches/hour (25-year)
Peak Flow Rate	0.29 cubic feet/second (Q_{10})	0.59 cubic feet/second (Q_{25})
Storage Volume Required $S = 4,140 (Q_{25} - Q_{10})$	$S = 4,140 (0.59-0.29) =$ **1,242 cubic feet** = **9,291 gallons**	

Table 2: Land Use Characteristics and Storage Volume Requirements for Shields Street Extension Project

It should be noted that MSD's storage volume requirements are focused entirely on managing the quantity (peak flow rate) of stormwater runoff from a new development or redevelopment site within the combined sewer system. However, the University has expressed interest in implementing sustainable stormwater management such as green infrastructure to reduce the runoff volume back into the combined sewer system, which could ultimately improve water quality through reduction of downstream combined sewer overflows to local waterways. The implementation of visible and sustainable stormwater management features is also consistent with the University's goal of promoting a healthy campus. Green infrastructure features such as bioretention systems and permeable pavement can provide for the storage of stormwater runoff (that could be used to meet MSD regulations) while also providing opportunities to reduce the volume of stormwater runoff that drains from the site and ultimately providing a water quality benefit. Therefore, the Project Team evaluated stormwater management opportunities with a focus on sustainable stormwater options, which are described in the following section.

Stormwater Management Opportunities

As previously described in the Site Design Concept section, the current preliminary design of the HSB redevelopment site includes a new storm sewer system that is routed to a sub-surface series of StormTech chambers for stormwater storage and detention purposes. This approach could potentially be sufficient to meet MSD's rules and regulations for stormwater detention within the combined sewer system, while also allowing for infiltration of stormwater runoff into the native soil at the bottom of the StormTech chambers. The StormTech system also typically includes a row of chambers wrapped in filter fabric to capture sediment found in stormwater runoff, which would require occasional access for maintenance. The site plan also included two general areas where bioretention areas are being considered.

The University has expressed interest in capturing, storing, and re-using stormwater runoff that could be used for irrigation of new open space zones. This type of approach has been implemented at a few additional locations on campus, including just across Eden Avenue in the Eden Quad zone. Based on the Project Team's evaluation of the HSB redevelopment project and surrounding areas, there appears to be feasible opportunities to capture and re-use stormwater runoff for irrigation. One option includes the capture of stormwater runoff from adjacent building rooftops.

The new HSB rooftop encompasses approximately 0.76 acres of surface area, which could be collected and routed directly to an irrigation storage tank as part of the HSB redevelopment project. Additionally, the existing Health Professions Building currently has between 15 and 20 external downspouts around the western perimeter of the building that capture runoff from the entire rooftop, which also happens to encompass approximately 0.76 acres of surface area. The proposed HSB utility plan includes a new storm sewer segment that extends to the southwestern corner of the Health Professions Building. The Project Team recommends that another new storm sewer collection system be extended around the western perimeter of the building to convey and capture that additional stormwater runoff to be used for irrigation.

The Project Team has developed the Stormwater Management Concept 1 plan (**Figure 6**) to display opportunities for the capture and storage of stormwater runoff at the HSB redevelopment site for irrigation. Approximately 1.46 acres of open space areas could potentially be available for irrigation within the site analysis boundary. Using an average demand of one inch per week results in a weekly irrigation demand of approximately 39,645 gallons. The combination of HSB and Health Professions Building rooftops is 1.52 acres, which could potentially supply average weekly runoff volumes of between 24,000 and 38,000 gallons (depends upon seasonal variation) based on typical/average monthly rainfall totals for the Cincinnati region. The stormwater runoff from the two buildings alone for irrigation would not quite supply enough volume to meet the irrigation demand associated with 1.46 acres. Options to ensure the average weekly supply would exceed the average weekly demand include routing additional areas to an irrigation tank (about 0.5 acres more needed), or only providing irrigation for approximately 1.1 acres of open space area based on the supply provided by the rooftops. The implementation of storage for irrigation (rainwater harvesting) is considered a sustainable stormwater management approach, due to the benefits associated with reduced stormwater runoff and reduced use of potable water for irrigation.

For the Shields Street Extension project, the University provided the Project Team with a preliminary design developed by others. The current preliminary design does not appear to include stormwater management controls to capture and detain runoff during rainfall events. The Project Team recommends the implementation of green infrastructure in the form of permeable pavement (pavers) at strategic locations within the planned improvements area. Specifically, a row of 12 parking spaces on the northern edge of the proposed parking lot could be utilized for permeable pavers to capture and store stormwater runoff generated from the entire parking lot area. The surface area of these parking spaces consists of approximately 2,000 square feet based on typical parking stall dimensions of 9 feet wide by 19 feet long. Assuming 24 inches of aggregate below the permeable pavers that can be utilized for storage, and accounting for the void space provided within the aggregate storage layer, the permeable pavers would provide about 9,874 gallons of stormwater storage. This volume of storage could be sufficient to meet MSD regulations for detention within the combined sewer system for the Shields Street Extension project. An example conceptual cross section of permeable pavers within a vehicular parking area, along with example pictures, is displayed in **Figure 7**.

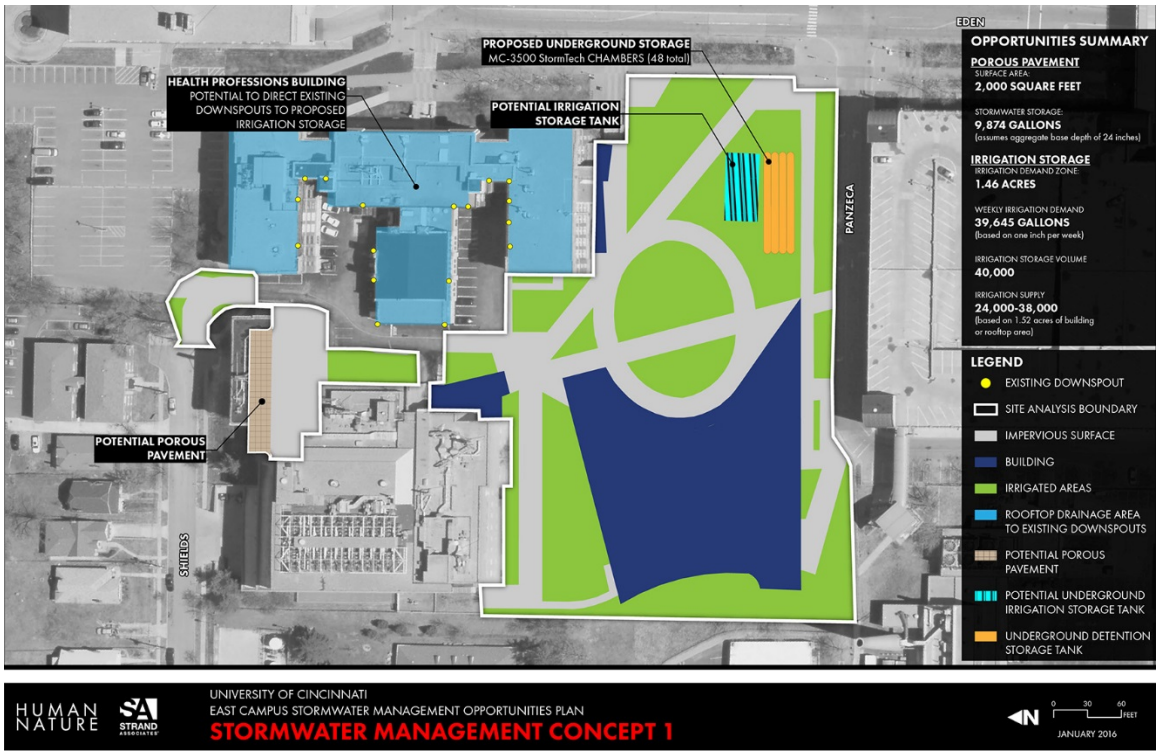


Figure 6: Stormwater Management Concept 1
A full-size version of this map is provided in Appendix A.

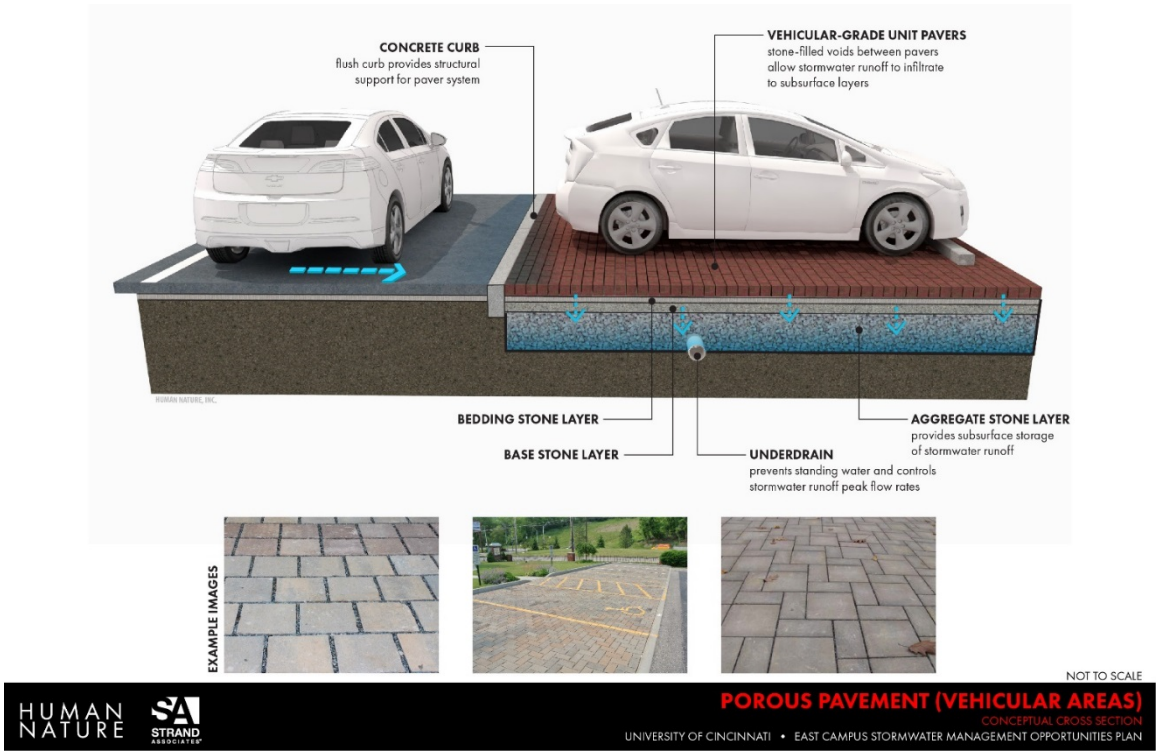


Figure 7: Example Conceptual Cross Section for Porous Pavement (Vehicular Areas)
A full-size version of this map is provided in Appendix A.

The Project Team has also developed Stormwater Management Concept 2 (**Figure 8**) to highlight potential areas for permeable pavers and bioretention systems that could be used to capture, store and detain stormwater runoff in lieu of traditional stormwater storage tanks at the HSB redevelopment site. The proposed HSB site plan includes a significant amount of sidewalk and plaza areas throughout the site that could be constructed with permeable pavers instead of traditional impervious surface materials (i.e. concrete). The permeable paver areas would be intended to capture the rainfall directly on the surface of the pavers, but could also collect runoff from areas immediately adjacent to the pavers. An aggregate layer below the surface of the pavers would be used to provide storage of stormwater runoff. The University has indicated that the HSB site will need to include a "travel lane" for vehicular access, including fire truck access and vehicular access to a loading dock area at the southwest corner of the Kettering Lab Complex building. Therefore, the permeable pavers will need to provide enough aggregate base for structural support needed for this periodic vehicular access potential. An example conceptual cross section of permeable pavers within a pedestrian area, along with example pictures, is displayed in **Figure 9.**

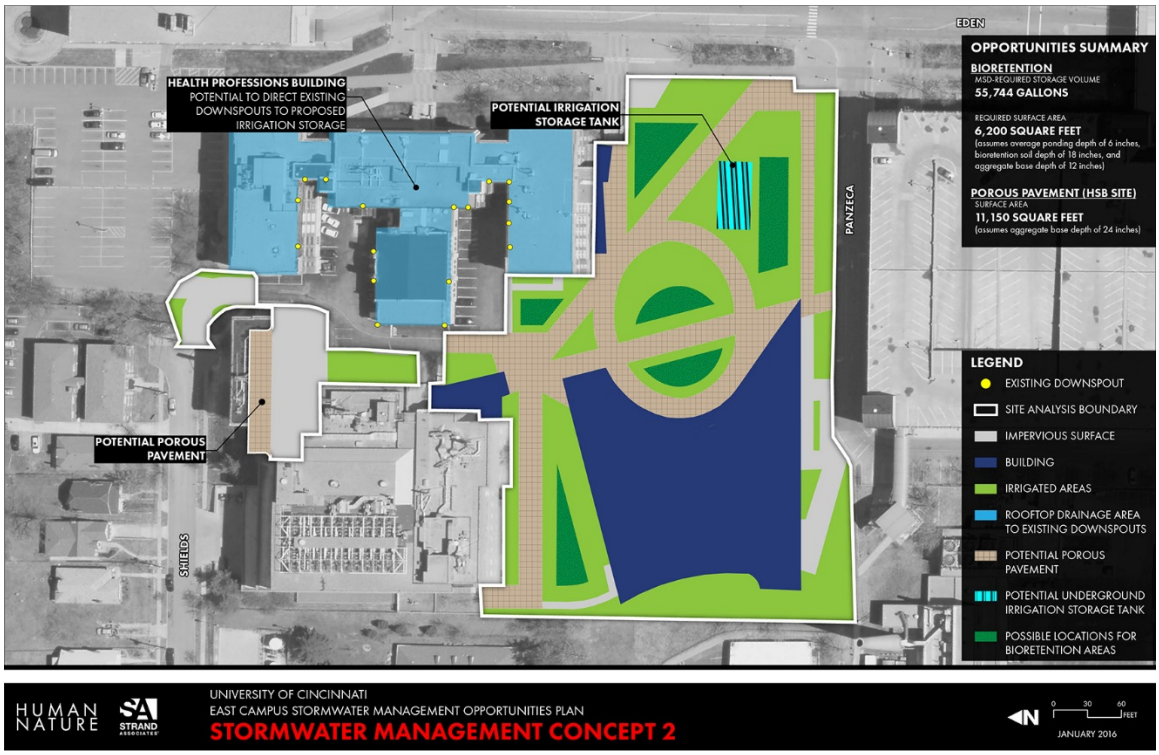


Figure 8: Stormwater Management Concept 2
A full-size version of this map is provided in Appendix A.

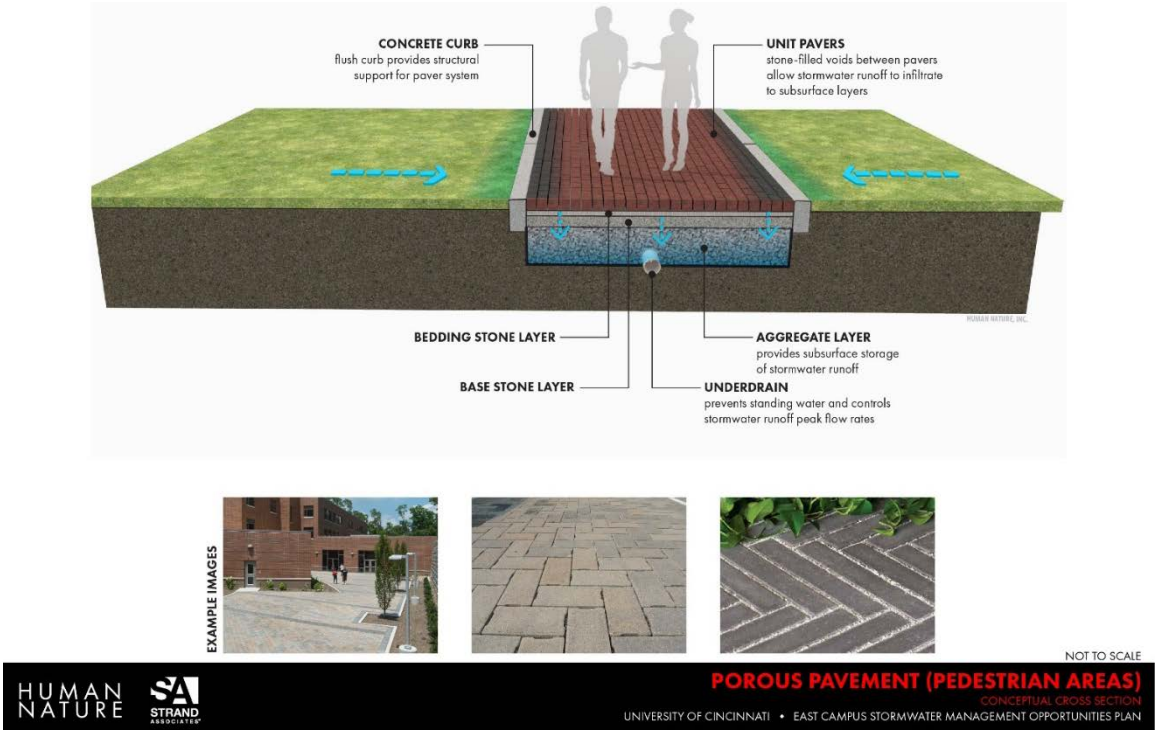


Figure 9: Example Conceptual Cross Section for Porous Pavement (Pedestrian Areas)
A full-size version of this map is provided in Appendix A.

In addition to permeable pavers, strategic locations for bioretention areas could be implemented within the proposed open space areas shown on the HSB site utility plan. The bioretention areas would be intended to capture, treat/filter, and store stormwater runoff before slowly releasing back into the combined sewer system. Bioretention systems can also reduce the volume of stormwater runoff through native soil infiltration, absorption within an amended soil layer, and evapotranspiration through native plantings. The Project Team has proposed potential bioretention areas throughout the HSB site, located primarily at locations where stormwater inlets have been proposed to capture stormwater runoff. The bioretention areas would capture the stormwater runoff from the surrounding area on the surface of the feature, prior to filtering through a bioretention soil media. Typical bioretention systems allow for up to 6 to 12 inches of ponding on the surface of the feature, before infiltrating during and following rainfall events. An example conceptual cross section of a bioretention basin or rain garden, along with example pictures, is displayed in **Figure 10**.

Due to the University's desire to consider sustainable stormwater management features, coupled with the need to provide stormwater storage either to meet MSD detention regulations or to provide opportunities for irrigation, the University could consider stormwater management features that achieve multiple objectives. For example, bioretention areas could be constructed above a stormwater storage system (such as StormTech chambers), and be hydraulically connected through a sub-surface aggregate system. In this scenario, stormwater runoff would first flow through the bioretention system, before draining down into an aggregate storage layer that could include StormTech chambers to provide additional storage capacity. The storage provided within the StormTech chambers could also be used for irrigation purposes in lieu of a separate or stand-alone irrigation storage system. In addition, there may be circumstances with the proposed storm sewer system that result in new storm sewers that are too deep to feasibly daylight onto the surface of a bioretention area, which could require the need for sub-surface collection of stormwater runoff for either detention or irrigation purposes. An example conceptual cross section of a bioretention basin above a StormTech chamber storage system, along with example pictures, is displayed in **Figure 11**.

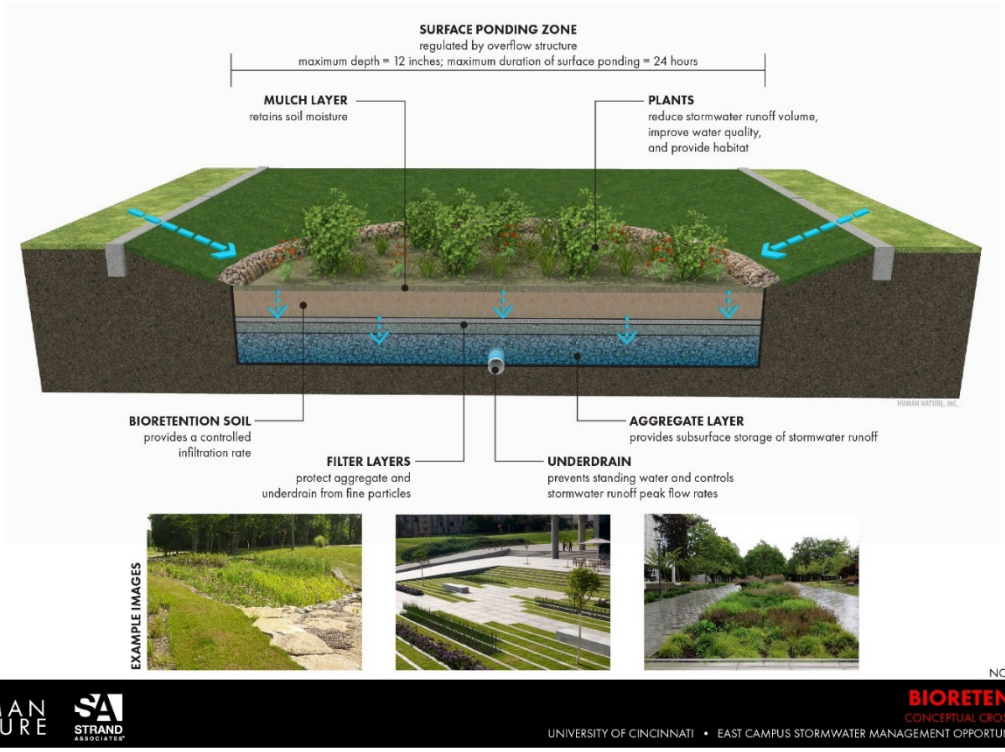


Figure 10: Example Conceptual Cross Section for Bioretention

A full-size version of this map is provided in Appendix A.

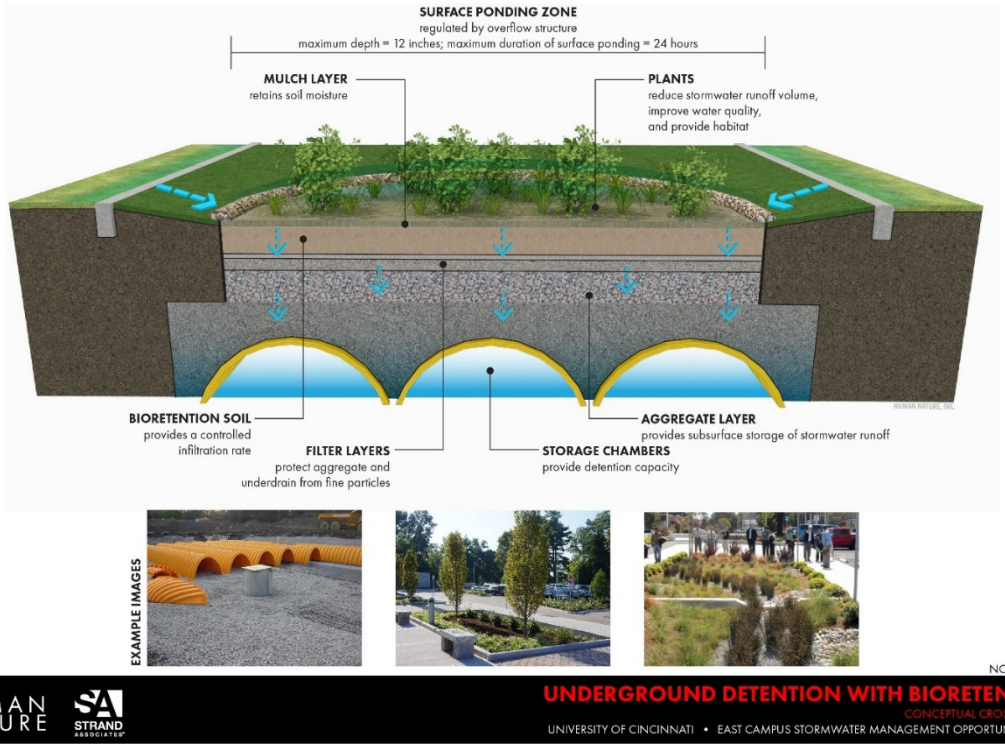


Figure 11: Example Conceptual Cross Section for Underground Detention with Bioretention

A full-size version of this map is provided in Appendix A.

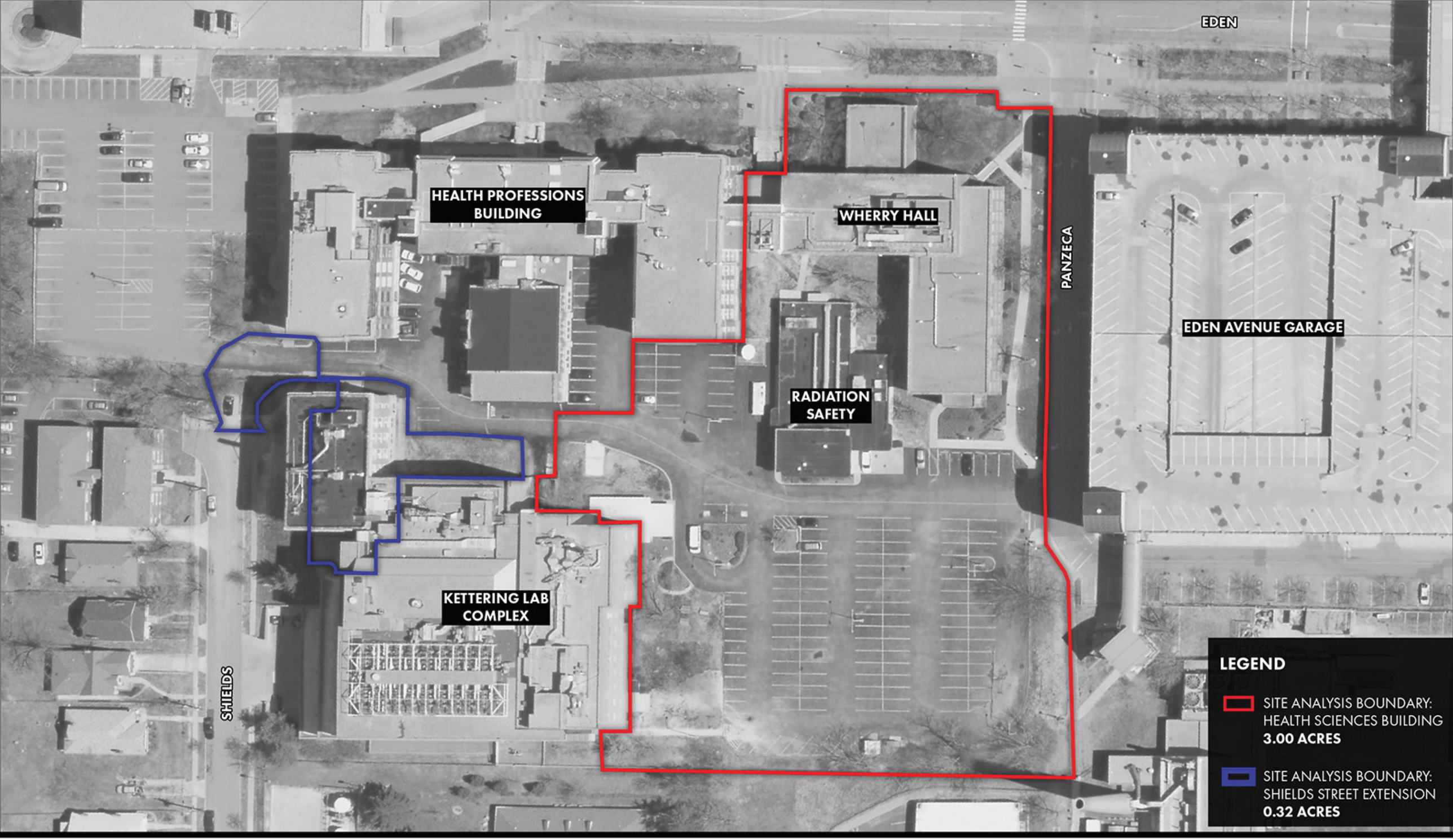
As previously described in the MSD Detention Regulations section, the HSB site requires approximately 55,744 gallons of stormwater storage to meet MSD's regulations. A combination of permeable pavers and bioretention areas could be implemented to provide adequate storage to satisfy the regulations. If considering bioretention areas only, approximately 6,200 square feet of bioretention would be needed to achieve the storage requirement target. This assumes an average ponding depth of 6 inches, bioretention soil depth of 18 inches, and aggregate base depth of 12 inches. If considering permeable pavement areas only, approximately 11,150 square feet of permeable pavers would be needed to achieve the storage requirement target. This assumes an average aggregate base depth of 24 inches to be used for stormwater storage.

SUMMARY

The implementation of sustainable stormwater management features can achieve multiple objectives, including meeting MSD regulatory obligations for stormwater detention within the combined sewer system and also promoting a healthy campus. For the HSB redevelopment site and the Shields Street extension site on the University's East Campus, the opportunities described above can achieve these objectives while also demonstrating the University's commitment to sustainable initiatives. Reductions in stormwater runoff volume and improvements to the quality of stormwater runoff are consistent with the goals of previously developed stormwater master plans for the University. The visibility of these types of green infrastructure features, including permeable pavers and bioretention areas, can also provide opportunities for awareness and education of stormwater initiatives and how these types of features can be implemented to achieve multiple objectives. Conceptual graphics similar to those developed by the Project Team could be used for educational signage or other educational materials. Depending upon the design configuration of these features, there may also be opportunities for the University to collect data and research the specific benefits provided by the features, including runoff volume reduction and water quality improvements.

APPENDIX A

11x17 Maps



HUMAN NATURE

STRAND ASSOCIATES®

UNIVERSITY OF CINCINNATI

EAST CAMPUS STORMWATER MANAGEMENT OPPORTUNITIES PLAN

SITE ANALYSIS BOUNDARY

N

0 30 60 FEET

JANUARY 2016

EDEN

762

INV. = 742.03
DEPTH = 21.2'

PANZECA

1.81 ACRES

760

758

EDEN GARAGE NORTH TANK
20,420 GALLONS

INV. = 737.04
DEPTH = 18.04'

756

INV. = 727.71
DEPTH = 16.15'

754

752

750

0.56 ACRES

SHIELDS

KETTERING LAB ADDITION TANK
23,500 GALLONS

LEGEND

- EXISTING CONTOUR
- COMBINED SEWER
- SANITARY SEWER
- STORM SEWER
- SITE ANALYSIS BOUNDARY
- DETENTION TANK
- DRAINAGE AREA TRIBUTARY TO DETENTION TANK

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UNIVERSITY OF CINCINNATI
EAST CAMPUS STORMWATER MANAGEMENT OPPORTUNITIES PLAN

EXISTING SEWER SYSTEM

N

0 30 60 FEET

JANUARY 2016

EDEN

PANZECA

SHIELDS

LAND COVER SUMMARY

HEALTH SCIENCES BUILDING

ANNUAL STORMWATER RUNOFF:
2.11 MILLION GALLONS

SHIELDS STREET EXTENSION

ANNUAL STORMWATER RUNOFF:
0.21 MILLION GALLONS

LEGEND

- SITE ANALYSIS BOUNDARY
- BUILDING
- IMPERVIOUS SURFACE
- PERVIOUS SURFACE

HUMAN NATURE

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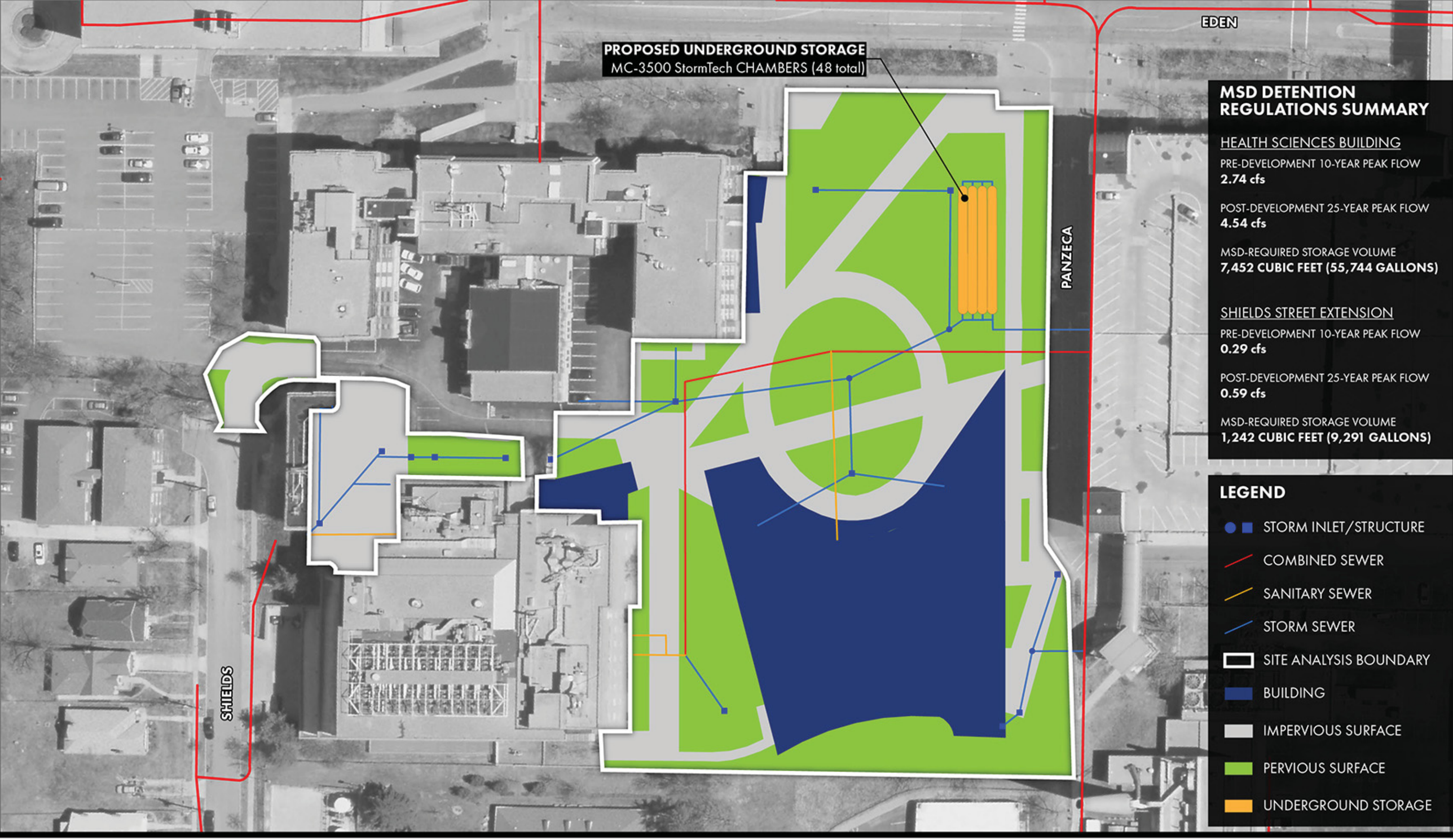
UNIVERSITY OF CINCINNATI
EAST CAMPUS STORMWATER MANAGEMENT OPPORTUNITIES PLAN

EXISTING LAND COVER

N

0 30 60 FEET

JANUARY 2016



MSD DETENTION REGULATIONS SUMMARY

HEALTH SCIENCES BUILDING

PRE-DEVELOPMENT 10-YEAR PEAK FLOW
2.74 cfs

POST-DEVELOPMENT 25-YEAR PEAK FLOW
4.54 cfs

MSD-REQUIRED STORAGE VOLUME
7,452 CUBIC FEET (55,744 GALLONS)

SHIELDS STREET EXTENSION

PRE-DEVELOPMENT 10-YEAR PEAK FLOW
0.29 cfs

POST-DEVELOPMENT 25-YEAR PEAK FLOW
0.59 cfs

MSD-REQUIRED STORAGE VOLUME
1,242 CUBIC FEET (9,291 GALLONS)

LEGEND

- STORM INLET/STRUCTURE
- COMBINED SEWER
- SANITARY SEWER
- STORM SEWER
- SITE ANALYSIS BOUNDARY
- BUILDING
- IMPERVIOUS SURFACE
- PERVIOUS SURFACE
- UNDERGROUND STORAGE

SITE CONCEPT PLAN IS BASED ON: HEALTH SCIENCES BUILDING: SCHEMATIC DESIGN SITE UTILITY PLAN (OCTOBER 16, 2015) PRODUCED BY EMH&T AND MOODY NOLAN AND SHIELDS STREET EXTENSION (OCTOBER 2015) PRODUCED BY THE KLEINGERS GROUP.

HUMAN NATURE

STRAND ASSOCIATES®

UNIVERSITY OF CINCINNATI
EAST CAMPUS STORMWATER MANAGEMENT OPPORTUNITIES PLAN

PROPOSED STORMWATER MANAGEMENT SYSTEM

N

0 30 60 FEET

JANUARY 2016

EDEN

NEW HEALTH PROFESSIONS BUILDING ENTRANCE

PANZECA

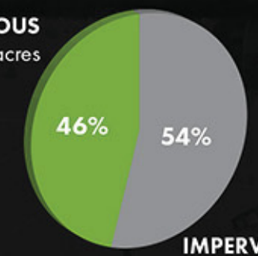
NEW KLC ENTRYWAY

NEW HEALTH SCIENCES BUILDING

SHIELDS

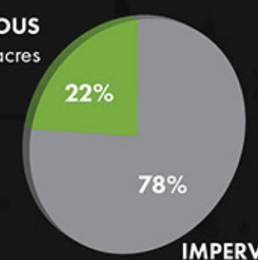
LAND COVER SUMMARY

HEALTH SCIENCES BUILDING



ANNUAL STORMWATER RUNOFF:
1.76 MILLION GALLONS
(17% DECREASE COMPARED TO EXISTING VOLUME)

SHIELDS STREET EXTENSION



ANNUAL STORMWATER RUNOFF:
0.24 MILLION GALLONS
(14% INCREASE COMPARED TO EXISTING VOLUME)

LEGEND

- SITE ANALYSIS BOUNDARY
- BUILDING
- IMPERVIOUS SURFACE
- PERVIOUS SURFACE

SITE CONCEPT PLAN IS BASED ON: HEALTH SCIENCES BUILDING: SCHEMATIC DESIGN SITE UTILITY PLAN (OCTOBER 16, 2015) PRODUCED BY EMH&T AND MOODY NOLAN AND SHIELDS STREET EXTENSION (OCTOBER 2015) PRODUCED BY THE KLEINGERS GROUP.

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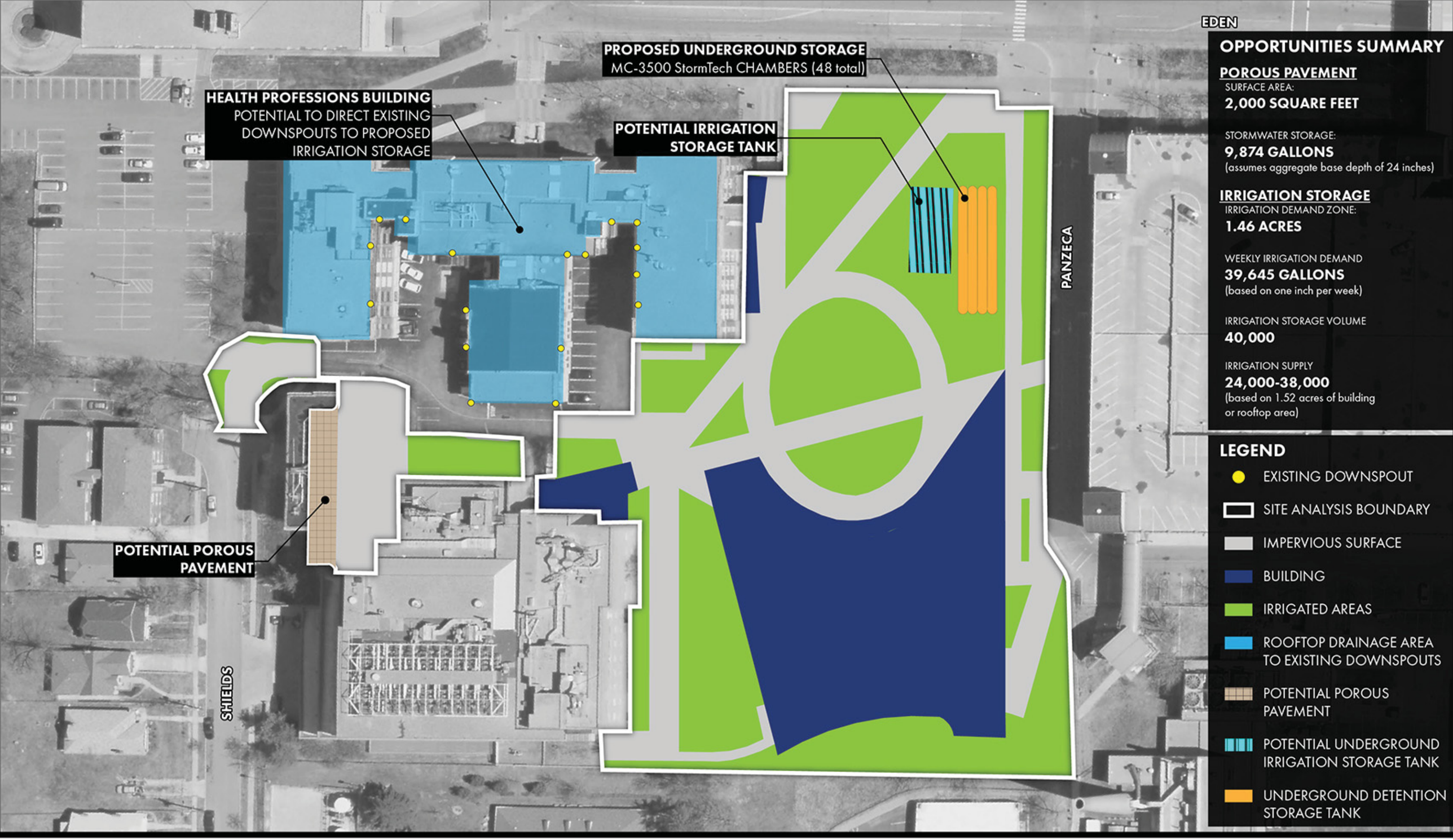
SITE CONCEPT PLAN

N

0 30 60 FEET

JANUARY 2016



OPPORTUNITIES SUMMARY

POROUS PAVEMENT

SURFACE AREA:
2,000 SQUARE FEET

STORMWATER STORAGE:
9,874 GALLONS
(assumes aggregate base depth of 24 inches)

IRRIGATION STORAGE

IRRIGATION DEMAND ZONE:
1.46 ACRES

WEEKLY IRRIGATION DEMAND
39,645 GALLONS
(based on one inch per week)

IRRIGATION STORAGE VOLUME
40,000

IRRIGATION SUPPLY
24,000-38,000
(based on 1.52 acres of building or rooftop area)

LEGEND

- EXISTING DOWNSPOUT
- SITE ANALYSIS BOUNDARY
- IMPERVIOUS SURFACE
- BUILDING
- IRRIGATED AREAS
- ROOFTOP DRAINAGE AREA TO EXISTING DOWNSPOUTS
- POTENTIAL POROUS PAVEMENT
- POTENTIAL UNDERGROUND IRRIGATION STORAGE TANK
- UNDERGROUND DETENTION STORAGE TANK

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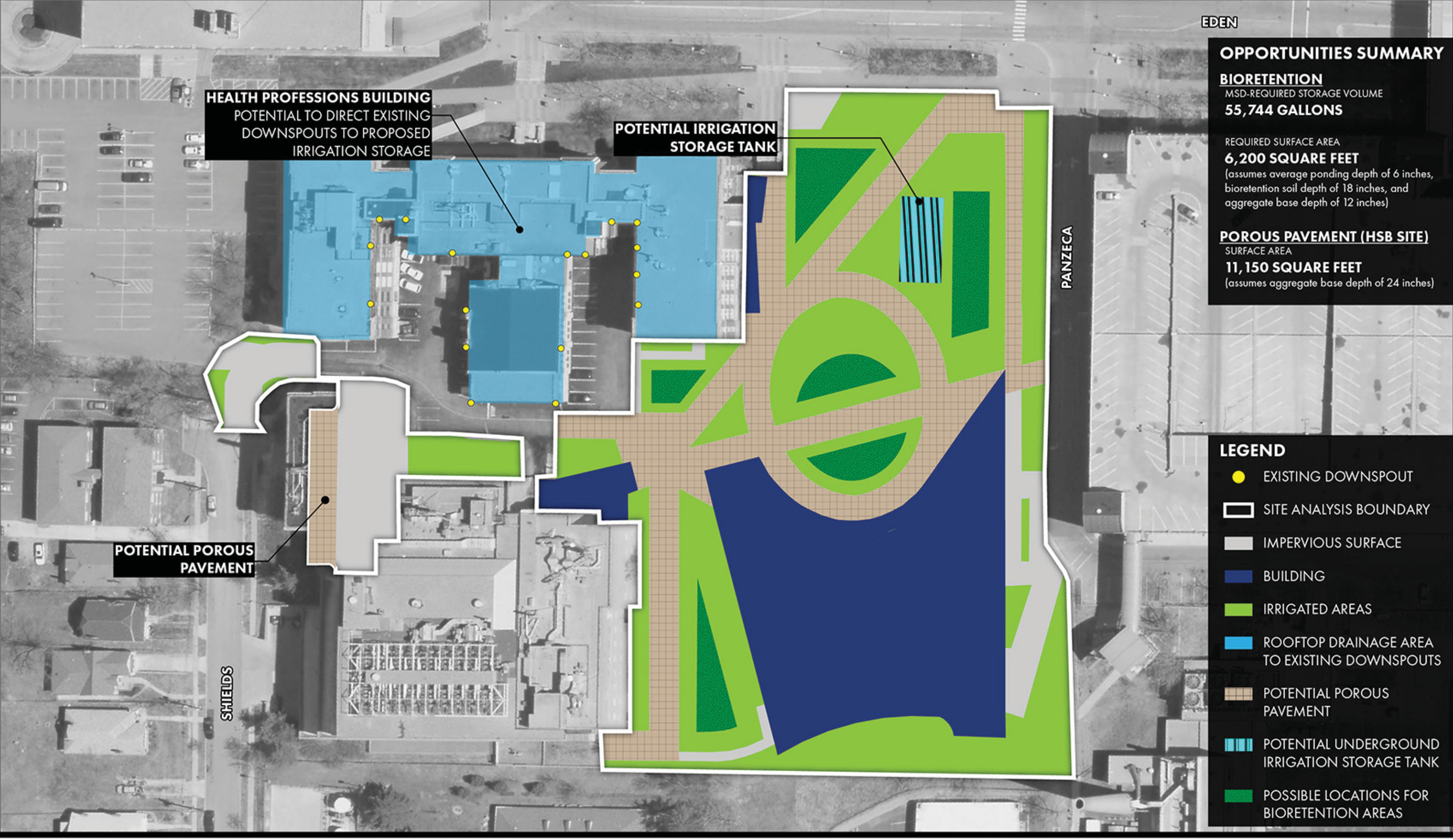
EAST CAMPUS STORMWATER MANAGEMENT OPPORTUNITIES PLAN

STORMWATER MANAGEMENT CONCEPT 1

N

0 30 60 FEET

JANUARY 2016



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EAST CAMPUS STORMWATER MANAGEMENT OPPORTUNITIES PLAN

STORMWATER MANAGEMENT CONCEPT 2

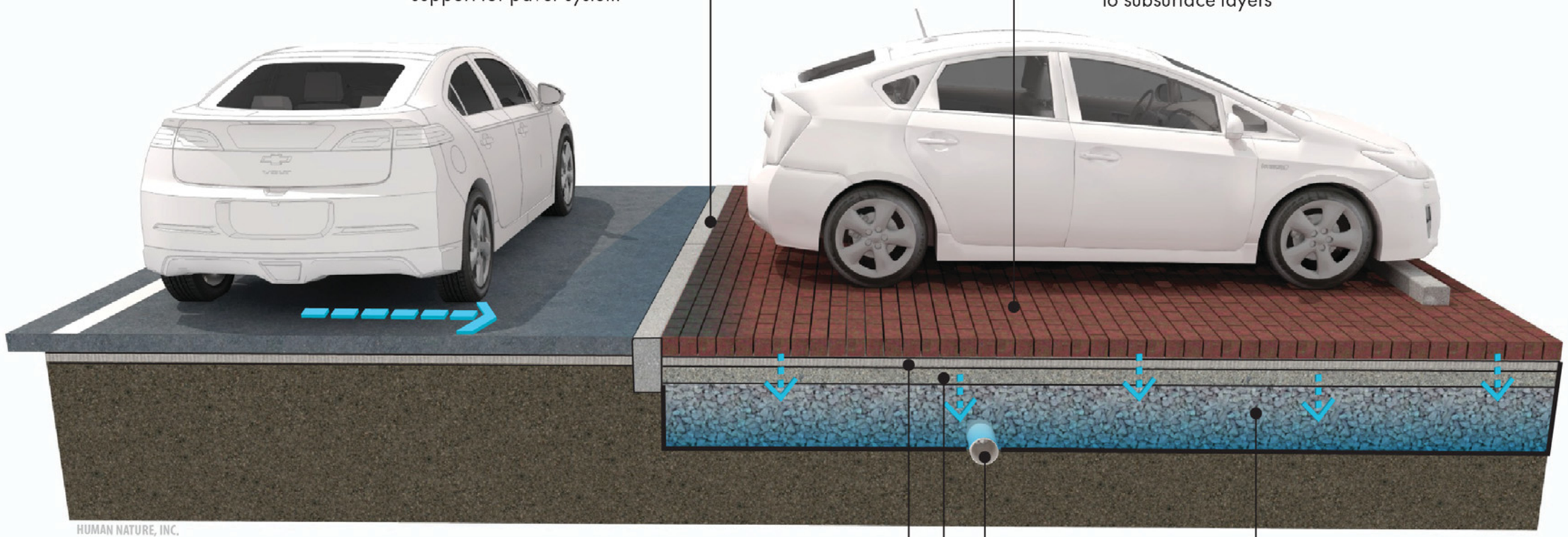
N

0 30 60 FEET

JANUARY 2016

CONCRETE CURB
flush curb provides structural support for paver system

VEHICULAR-GRADE UNIT PAVERS
stone-filled voids between pavers allow stormwater runoff to infiltrate to subsurface layers



HUMAN NATURE, INC.

BEDDING STONE LAYER

BASE STONE LAYER

UNDERDRAIN
prevents standing water and controls stormwater runoff peak flow rates

AGGREGATE STONE LAYER
provides subsurface storage of stormwater runoff

EXAMPLE IMAGES

NOT TO SCALE

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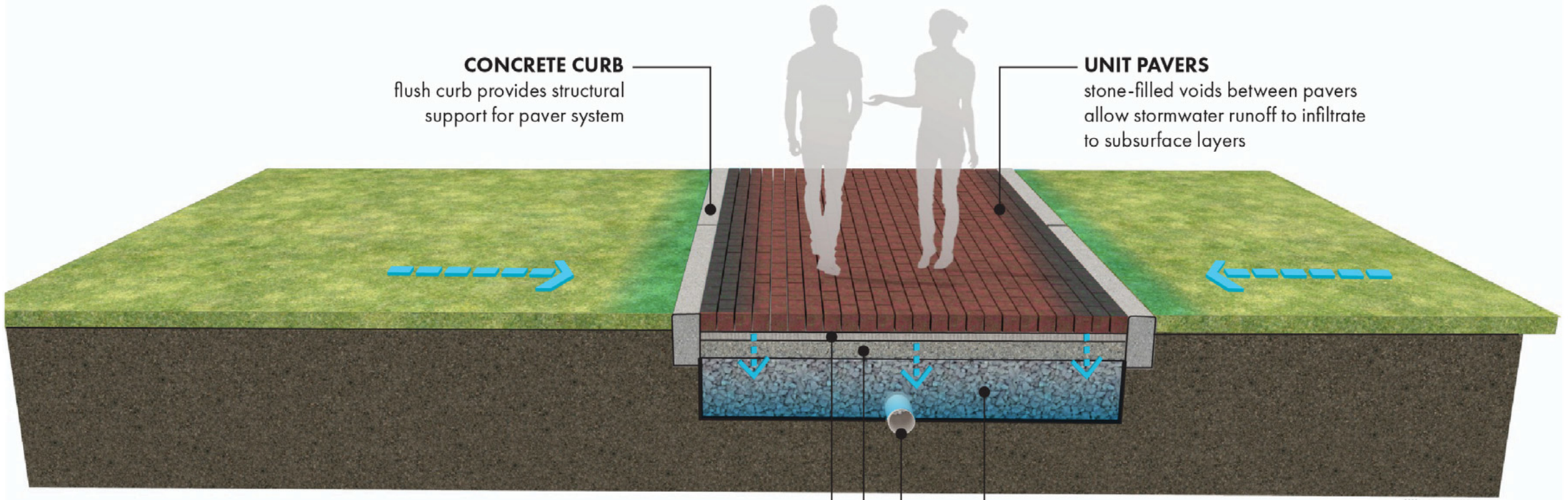
POROUS PAVEMENT (VEHICULAR AREAS)

CONCEPTUAL CROSS SECTION

UNIVERSITY OF CINCINNATI • EAST CAMPUS STORMWATER MANAGEMENT OPPORTUNITIES PLAN

CONCRETE CURB
flush curb provides structural support for paver system

UNIT PAVERS
stone-filled voids between pavers allow stormwater runoff to infiltrate to subsurface layers



HUMAN NATURE, INC.

BEDDING STONE LAYER

AGGREGATE LAYER
provides subsurface storage of stormwater runoff

BASE STONE LAYER

UNDERDRAIN
prevents standing water and controls stormwater runoff peak flow rates

EXAMPLE IMAGES

NOT TO SCALE

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POROUS PAVEMENT (PEDESTRIAN AREAS)

CONCEPTUAL CROSS SECTION

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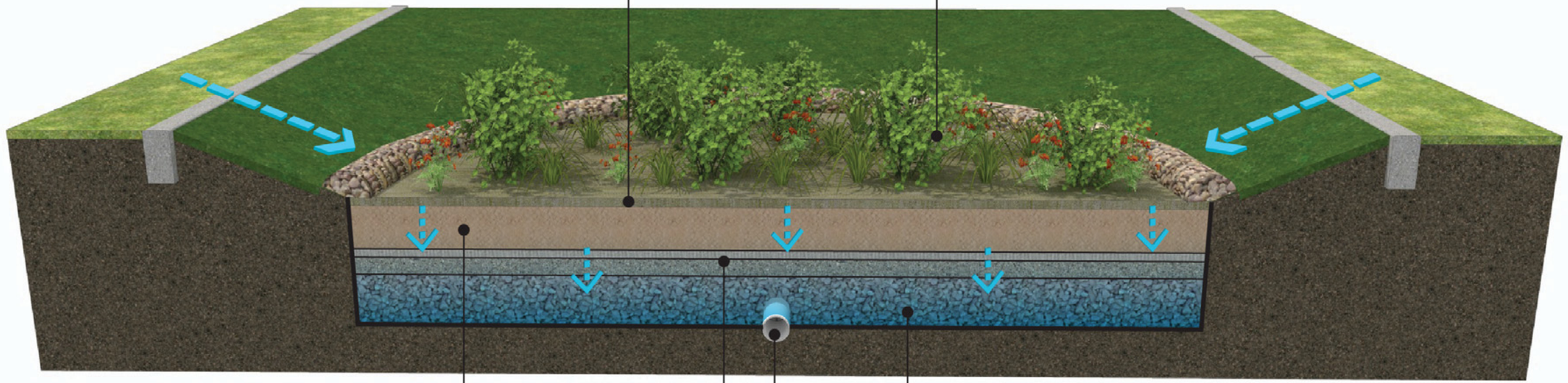
SURFACE PONDING ZONE
regulated by overflow structure
maximum depth = 12 inches; maximum duration of surface ponding = 24 hours

MULCH LAYER
retains soil moisture

PLANTS
reduce stormwater runoff volume,
improve water quality,
and provide habitat



BIORETENTION SOIL
provides a controlled
infiltration rate

FILTER LAYERS
protect aggregate and
underdrain from fine particles

UNDERDRAIN
prevents standing water and controls
stormwater runoff peak flow rates

AGGREGATE LAYER
provides subsurface storage of stormwater runoff

EXAMPLE IMAGES

NOT TO SCALE

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BIORETENTION

CONCEPTUAL CROSS SECTION

UNIVERSITY OF CINCINNATI • EAST CAMPUS STORMWATER MANAGEMENT OPPORTUNITIES PLAN

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PLANTS
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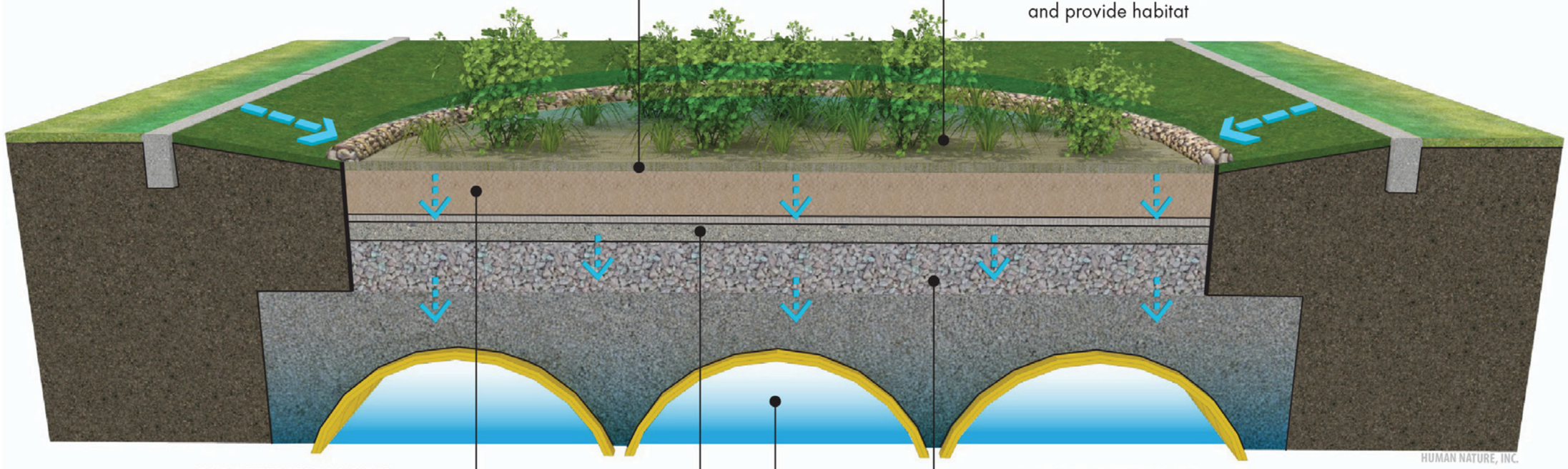
and provide habitat



BIORETENTION SOIL
provides a controlled
infiltration rate

FILTER LAYERS
protect aggregate and
underdrain from fine particles

STORAGE CHAMBERS
provide detention capacity

AGGREGATE LAYER
provides subsurface storage of stormwater runoff

EXAMPLE IMAGES

NOT TO SCALE

HUMAN NATURE

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UNDERGROUND DETENTION WITH BIORETENTION

CONCEPTUAL CROSS SECTION

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