Appendix

A

STUDENT REACH

DESIGN PROPOSAL

Credits

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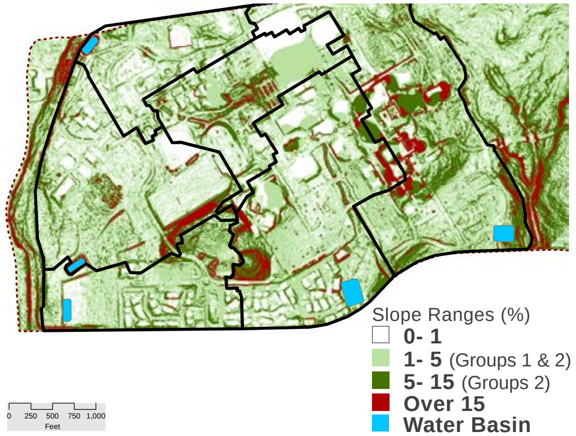
Eco Friendly Prototype
Rain Gardens
Dorm Communal Space
Dormitories
Swale
Destination Breezeway

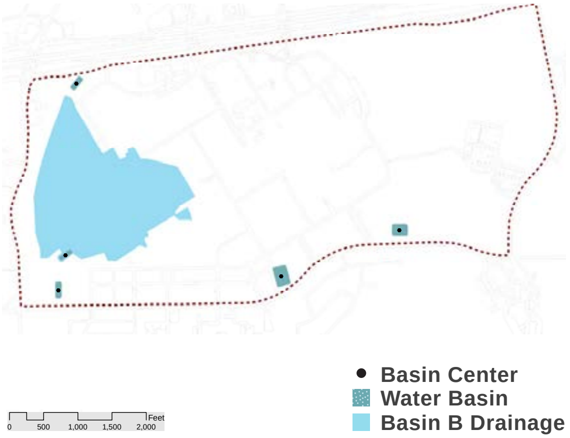
Introduction

The student reach project proposal aims to achieve the following goals: integrate green infrastructure solutions for the future UTSA primary promenade, known as the PASEO, provide educational opportunities to students, surrounding communities, and to connect the campus along the Paseo extending east to west; while engaging student interaction. The student reach proposal is to be implemented along four graduate student housing dorms, as well as two academic facilities. Currently, the site is a steep sloped hill overseeing the campus recreation fields and beyond. The proposal is to revitalize the area and accommodate student life. The proposal is to treat storm water, and runoff for various purposes. First, it is to treat water through permeable pavement, rain gardens, plant selection, and ultimately to a bioswale. Through the bioswale, the runoff water will be collected in the far west bioretention system, which will treat most of the water and discharge it to the aquifer. Currently on site, there is a sand filtering system which lacks aesthetic in addition to the challenges of maintenance due to the use of geotextile liner.

The proposal is to replace the BMP with a series of Low Impact Development practices in a treatment train process including luscious rain gardens, a swale, water harvesting through the roofs and cisterns. The proposal is to allow for creating open spaces that connect UTSA and its surrounding communities, while serving as an inception and destination for people traveling through the student reach promenade. The overall outcome of the student reach proposal, is to eliminate the quantity of storm water runoff, improve the quality of water, and renaturalize the extended and existing UTSA Paseo.

Through this, we expect to incorporate green infrastructure and architecture to better define the existing conditions, and improve the likelihood of human interaction along the UTSA Paseo. Our site is in dire need of these changes, and these strategies will accommodate present and future water treatment; along with student cultural goals. We derived the Student Reach proposal from the extension and connection between students and their natural surroundings along the UTSA Paseo. Student reach is to revitalize our site for years to come, and teach students about Low Impact Development (LID) and how it could make a great impact towards our environment on micro to macro levels of implementation.



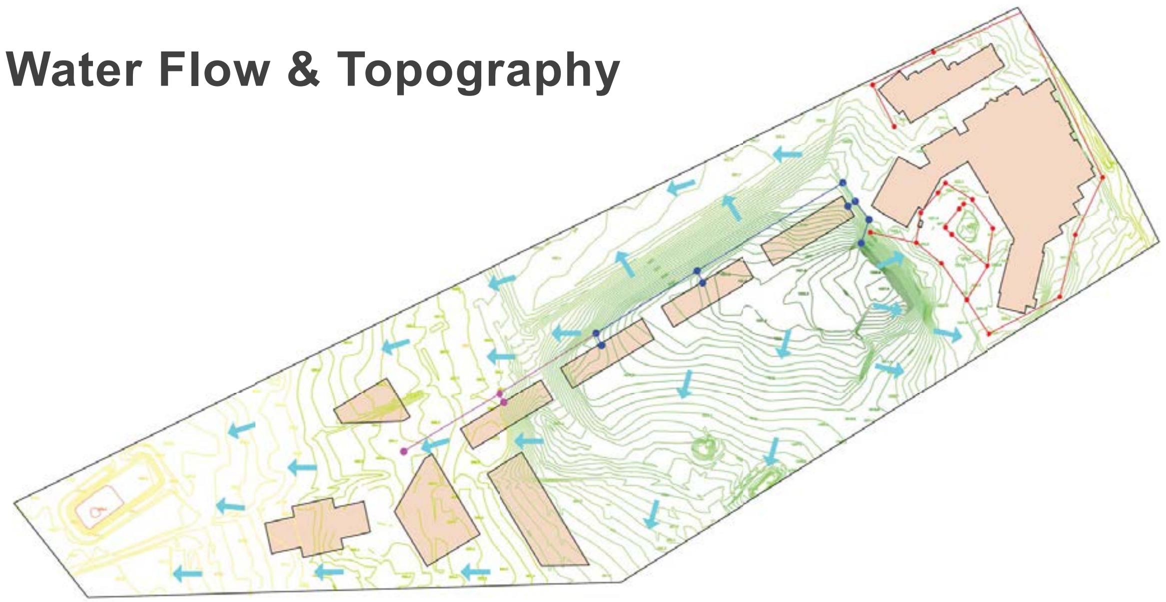


Appendix A


North Paseo
Main Paseo
South Paseo
Future Paseo
Future Paseo
Design Zones (Paseo Extension)
Image Location
Existing Buildings
Future Buildings
Water Quality Basin-C (WQB-C)

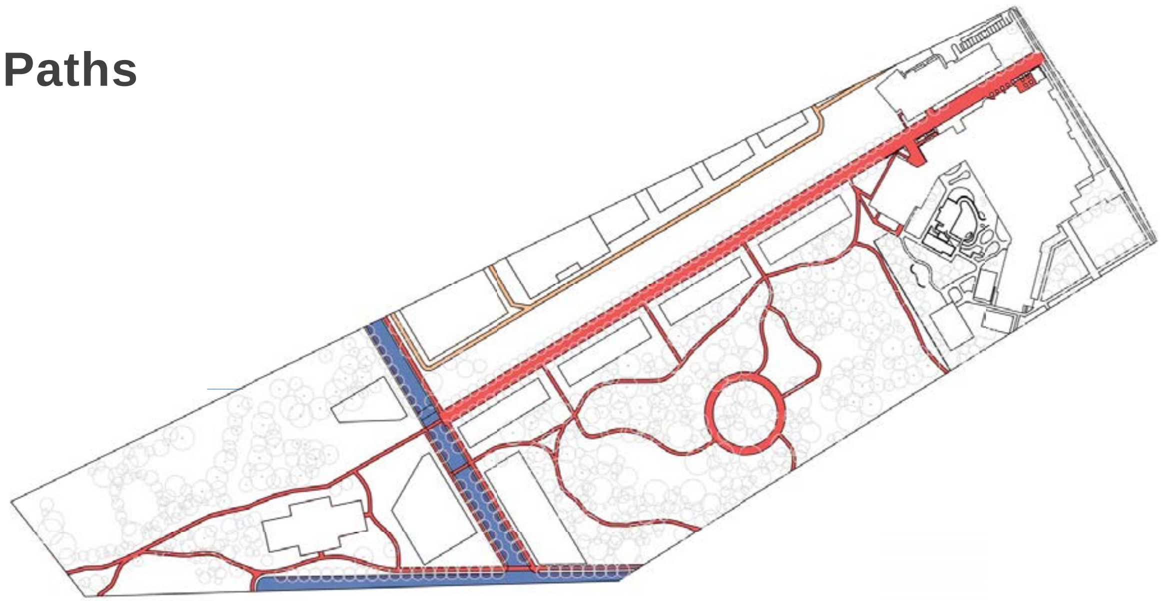
Site Analysis

Water Flow & Topography



- Existing Storm Drain
- Proposed Storm Drain
- Addition to Proposal
- Water Shed

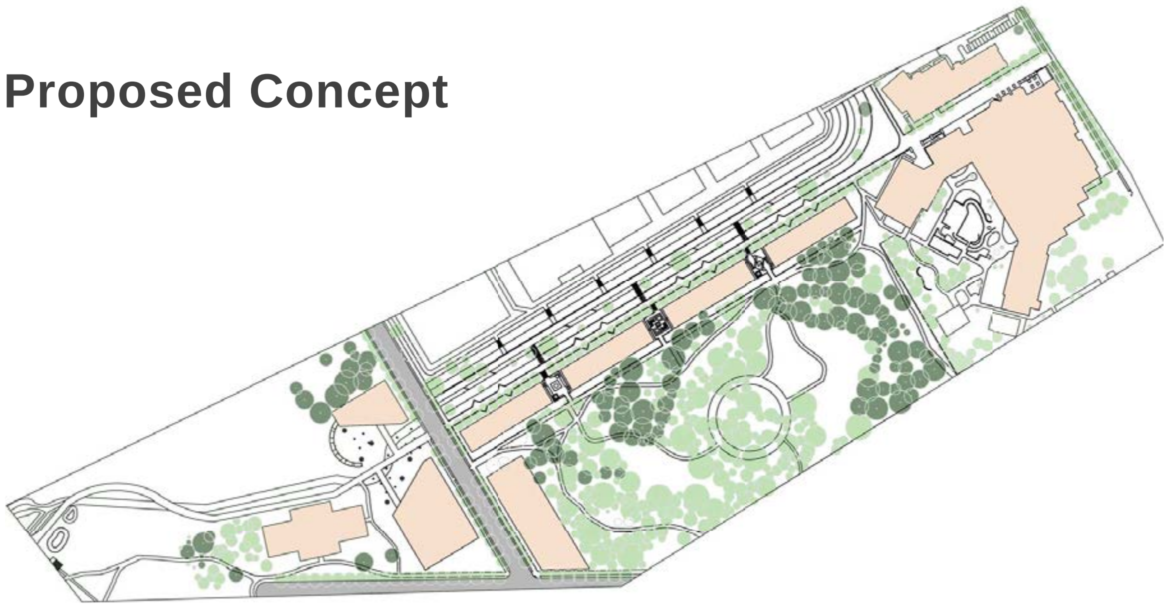
Paths



- Vehicle Circulation
- Pedestrian Circulation
- Rec Trail

Building Locations

Proposed Concept



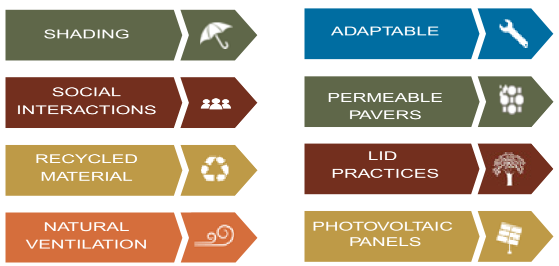
Innovations & Design Features

- Prototypes
- Cistern
- Bioretention
- Paseo Structures
- Existing Building
- Future Building
- Design Zones

In the proposed design of the Paseo, the student will benefit from multiple nodes that were created throughout the new portion of the Paseo. These nodes include communal spaces in the cistern locations, the shaded structures around the bioretention areas, and throughout the sitting areas facing the four dorm buildings. These places will provide educational opportunities on Low Impact Development (LID), environmentally friendly techniques, renewable energy, and water conservation. Through placemaking principles, the newly created structures and open spaces along the new Paseo will be visually and formally connected through utilizing prototype shading elements made of the same materials throughout the proposed structures. The following paragraphs shed light on the detailed designs of these structures.

Eco-friendly Prototypes

(Promenade extending east to west)



- Transitional experience along Paseo.
- Landscape and water management.
- Social interaction.
- Possible research opportunities.
- Campus as living lab.
- Shading, LID practices, and adaptable.

Eight Eco-Friendly Prototype structures along the Paseo provide a transformational experience for students entering the campus from the west and southwest sides, commuting across the Paseo. The structures are placed sequentially to maximize opportunities for sitting, walking, leisure and viewing the LID practices along the Paseo. Located in front of the dorms along the main high-traffic passage, the structures also provide views towards the recreational fields and overlook a wide variety of activity areas that are just a few feet from the terraced hill and the bioswale. The shaded areas allow the students and their families to enjoy outdoor seating under canopies made of reclaimed wood with solar panels on the multiple pyramid-shaped roofs.

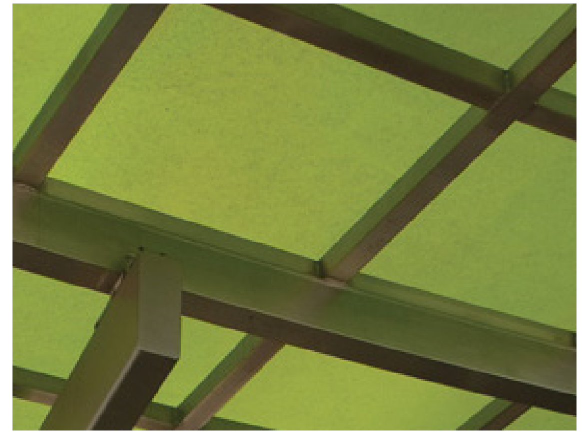
Bioretention

(Far west)

- Allow for knowledge to be attained from the implementation of green infrastructure typologies.
- Places of gatherings, and bicycle rentals.
- Provides natural settings that are both pleasing, and therapeutic for people.

To raise the awareness of LID, the bioretention area offers multiple places and destinations for students and communities alike. It provides commuters from the west and southwest sides of campus an opportunity for gathering through shaded structures designed around multiple bioretention areas as well as bicycle lanes and shaded walkways. This phase of the comprehensive proposal for WQB-B provides a more natural setting towards improving the quality of life, utilizing harvested rain water for irrigation, and reducing the quantity of runoff, and enhances the quality of infiltrated stormwater through the proposed treatment train of LID practices.

F1 source: efc.web.unc.edu



F2 source: www.3-form.com

Cisterns

(Communal areas along graduate dormitories)

- WATER HARVESTING
- SHADING
- SOCIAL INTERACTIONS
- RECYCLED MATERIAL
- NATURAL VENTILATION
- ADAPTABLE
- PERMEABLE PAVERS
- LID PRACTICES
- PHOTOVOLTAIC PANELS

- Communal areas allow for educational opportunities, and possible research. (STARS)

To provide shaded connected spaces between the proposed dormitories, the communal spaces create unique experience for graduate students and their families to socialize and relax. The places, where three water harvesting cisterns will be placed, are comprised of a mixture of native plants, seating areas, and hardscape elements. They are also surrounded by a series of green typologies along the Paseo and the hill, which enhance awareness of LID and its importance to the futures of our campus and society as a whole. Cisterns located in these interconnected areas will not only add a landmark feature in the center of each communal space, but create an opportunity for sustainability education and provide irrigation cost savings.

Westgate Prototype

(Gateway to campus)

- WATER HARVESTING
- SHADING
- SOCIAL INTERACTIONS
- RECYCLED MATERIAL
- NATURAL VENTILATION
- ADAPTABLE
- PERMEABLE PAVERS
- LID PRACTICES
- PHOTOVOLTAIC PANELS

- Prototype Shading Structures provide resting, social, water harvesting areas.
- Raises LID awareness and student/ community hub.
- Materials connect people to Hispanic heritage.

As a destination at the far west end of the new Paseo, a series of shading structures featuring colored and tinted glass is proposed. The system acts as a visual element directing pedestrians and bikers towards the Paseo. The colored glass is inspired by colorful Hispanic culture and is made of low-emission material. The material is used across all proposed edifices to enhance visual and thematic connectivity and to link all implementation phases into one cohesive project. The shading structures also create a hub for students to promote social and educational interaction with one another and with nature through learning about LID techniques as well as their environmental and conservation benefits.

Design Phases

Overall design complements the projected 2030 UTSA campus growth; with the implementation of six phase's that span 30 years. The phases incorporate square footage, material selection, and green infrastructure implementation. All phases address an expansion along the UTSA PASEO that stretches from east to west, and address storm water catchment and treatment along with social aspects correlated to enhance the quality of life for students and the surrounding community. Throughout these phases, LID can serve as a beacon towards full implementation of green typologies around campus, surrounding communities, and the city.

Phase I

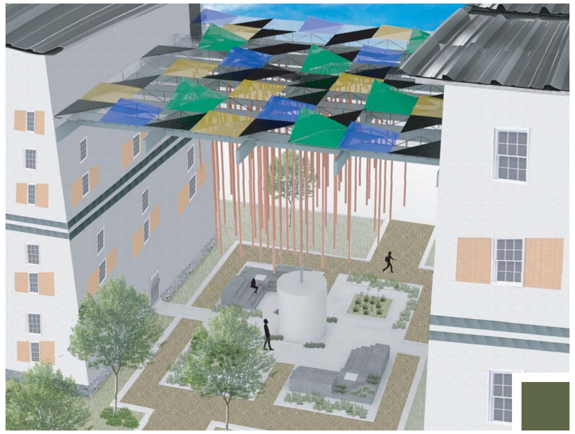
(Bioretention Basins)

This phase includes gathering spaces and allows for educational opportunities on campus. The set of unlined bioretention basins comprise a prominent natural feature that will replace the WQB-B and infiltrate water to the aquifer. As the final destination of the proposed treatment train, the basins are expected to treat stormwater traveling along the bioswale, and provide an eco-friendly shaded places for students and community.

Phase II

(Bio swale)

Phase II encompasses terracing the steep hill on the southern boundary of the recreational field. Adjusted slopes of the terraced site will comply with the site requirements and Site Capability Model (SCM) explained in section B-3 of the report. A combination of LID practices will be located on the top, middle, and lower part of the terraces. The combination includes a bioswale that extends along the Paseo on the lower part of the terraces; a series of rain gardens extended on one of terraces, 20'-wide pedestrian and biking path paved using appropriate permeable pavement and a permeable concrete service and emergency road behind the dorms. Drought tolerant plants are cautiously selected from UTSA approved plant list as well as other sources for plants compatible with Hill Country Region. This phase, aims to reduce stormwater runoff, and offer multiple places for social interaction.



Phase III

(Water Harvesting)

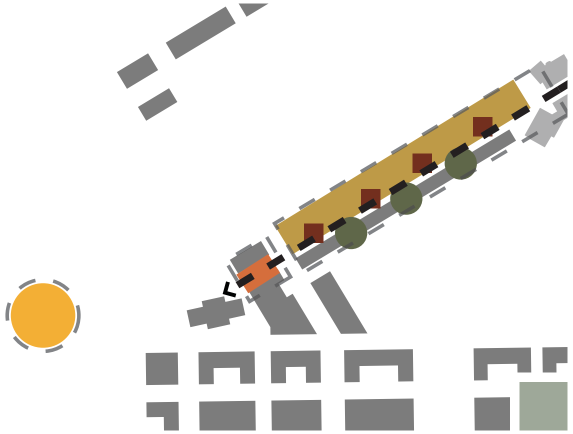
Phase III includes implementing three water storage tanks in the open spaces located between four graduate students dorms. The direct interaction with water systems, harvesting, reuse, and irrigation, will broaden opportunities to learn about water consumption and conservation in San Antonio. Three above-grade cisterns are proposed to collect water from the butterfly roofs of the dorms, and retain it for site irrigation.

Phase IV
(Sustainable installations)

Implementation of eight eco-friendly structures is the primary constituents of Phase IV. The structures will be located along the main Paseo and overlook the terraced hill and its integrated rain gardens and bioswale. The structures allow for pedestrians and bikers to rest, and socialize while overlooking activities along a steep slope. The slope also offer places to site, on built-in gabions, and watch the games.

Phase V
(Water catchment roof)

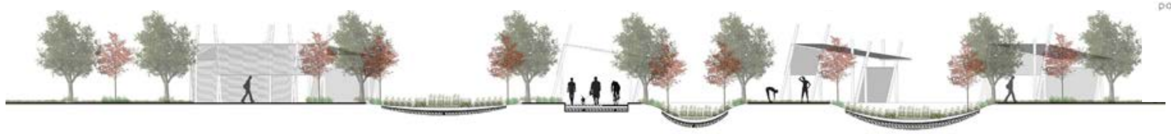
Phase V comprises a large space truss that holds a grid roof shading system between two anticipated academic building. The system allows for both shading and water catchment through adjusting the slope of the roof panels to direct the water towards the bioswale, which passes through the open space between the two buildings. This phase connects –visually and hydrologically- the terraced hill with the bioetention basins of Phase I. It also allows for an experience for the traveler coming and going along the Paseo to observe the integrated system of water harvesting, filtration, and infiltration. It is an educational experience on how a treatment train works, and how stormwater runoff will be mitigated. The open space will also act as a hub for gathering around food trucks, where the summer breezes will be enjoyable during hot summer days. This area is a re-naturalized memento to the existing Sombrilla.

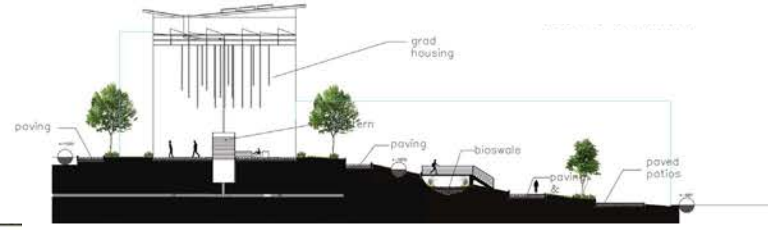


Phase VI
(Retrofitting open spaces)

Phase VI encompasses multiple open spaces along the existing Paseo. These spaces are in dire need of green infrastructure solutions, as well as the need for retrofitting to complement the theme introduced in the new Paseo. Although these areas will enhance the quality of a fully integrated Paseo, they were not further developed in this proposal. They are however recommended for retrofitting through implementing various LID measures.

Sustainable Structures





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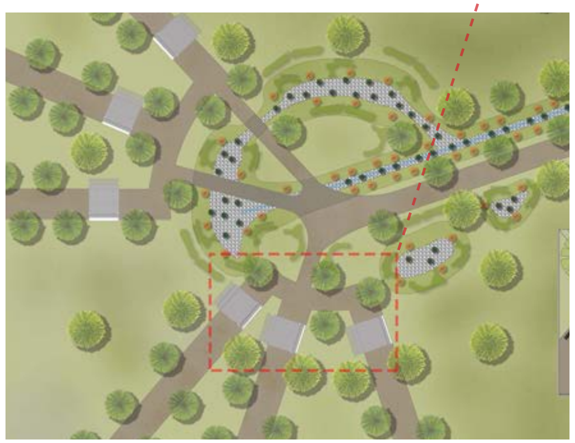
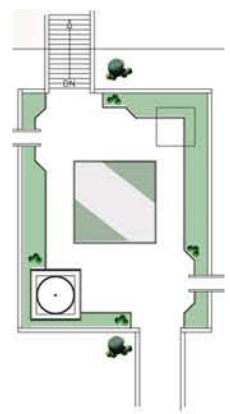


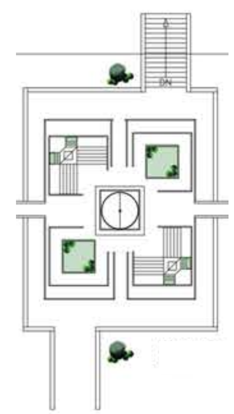
Community Hub

(part of Phase I)

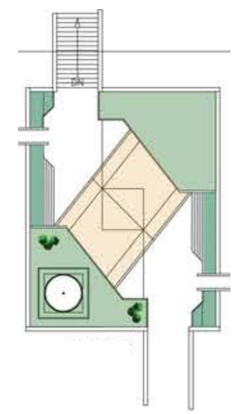
This project is driven by the need to enhance a very neglected sand filter system, and to bring students and communities together. This project serves as a gateway to the UTSA main campus; following a longitudinal axis. The project addresses water quality issues, technological techniques, and social interaction. The site allows for a transition between natural and built environment.



Zen Garden Plan



Educational Plan



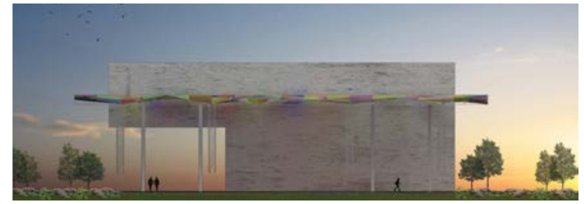
REC Activity Plan

Dorm Communal Space

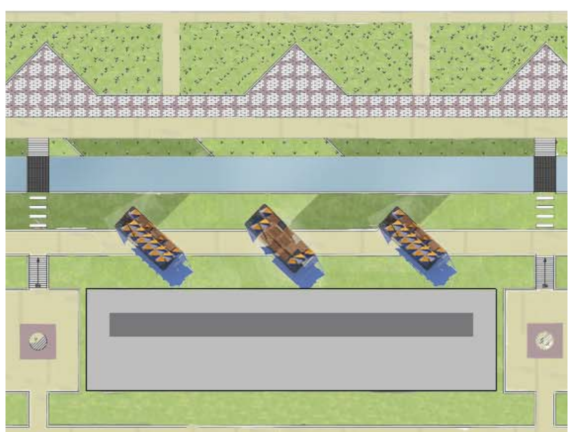
(part of Phase III)

These structures are located between dormitory buildings. These three structures are aimed to address water harvesting as well as providing a shaded space between dormitory buildings.

F4



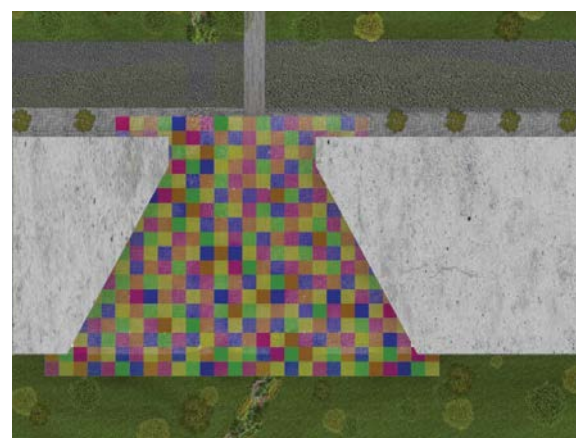
F5



Eco-Friendly Prototype

(part of Phase IV)

A total of 12 structures that are utilizing passive heating strategy with moveable sun shading, solar power through PV panels, and educating individuals along the way these prominent nodes are a place of rest, relaxation catered to the day and while providing views of UTSA buildings and rec fields from a number of locations along this sloped front porch of the dorms.



Destination Breezeway

(part of Phase V)

This project originated from the idea of creating an outdoor experience for the student and faculty underneath a colorful plastic shading device while still manipulating the roof to control the water flow into the bio swale.

Plant Selection

Paving Materials
(Along Paseo/ Walkways)

Permeable Asphalt
Water to returns to the ground faster. Reduces water collection on roads and paths

Interlocking Permeable Pavers
Tightly linked and water to return to ground quicker

Trees
(Along Paseo/ entire site)

● 

Live Oak
Quercus virginiana
40- 50 ft. tall

Texas Mountain Laurel
Sophora secundiflora
15- 25 ft. tall

● 

Desert Willow
Chilopsis linearis
15- 40 ft. tall

Ground cover
(Setback areas/ Bio swales/ patio areas)

Western Wild Petunia
Ruella occidentalis
1- 2 ft. tall

Autumn Sage
Salvia greggii
2- 3 ft. tall

Damianita
Chrysactinia mexicana
1- 2 ft. tall

Winecup
Callirhoe involucrata
8- 12” in tall

● 

Cedar Sage
Salvia roemeriana
1- 1.5 ft. tall

● 

Buffalo Grass
Bouteloua dactyloides
8- 10” tall

Pale Leaf Yucca
Yucca pallida
1- 2 ft. tall

● 

Red Yucca
Hesperaloe parviflora
3- 5 ft. tall

● *On UTSA recommended plant list*

No plant species substitutions will be allowed

Resiliency

San Antonio receives less than 31 inches of rainfall on average every year. The implementations of various LID typologies that treat and utilize the storm water runoff to its upmost potential enhance water conservation and quality. The integrated-system proposed in this project encompasses a treatment train starts with collecting rainfall from roof systems into the cisterns; treating stormwater as it flows down on a series of LID practices including permeable pavement, rain gardens, gabions, natural landscape, bioswale, and finally an unlined bioretention basins. Through appropriately-terraced slopes and various levels of typologies for filtering water and air pollutants, and appropriate selections of materials, a high performance will be anticipated. The system also offer a reservoir for peak time rain events, which exceed current and short-term estimates due to global warming phenomenon, which enhances campus resiliency and adoptability for the anticipated climate change

F6

F7

F8

F9

F10

F11

sources:

F6 housedesignnewsworld.blogspot.com
F7 archive.constant
F8 nacto.org
F9 coastlandscapemanagement.com
F10 davey.com
F11 elektroimpuls.bg

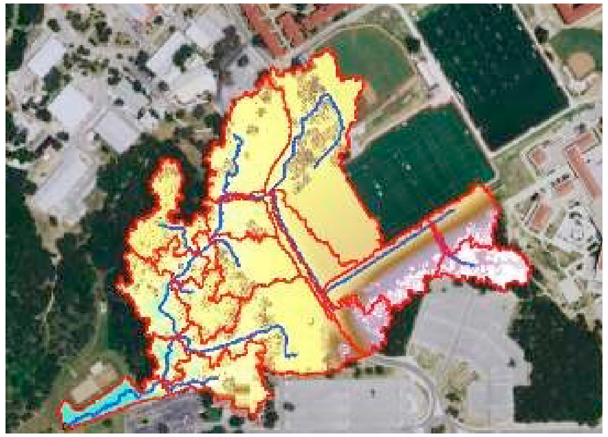
Drainage Area delineation using GIS tools

impacts. Solar access to the site offers a good environment for the proposed plants. Orientation of PV panels on the roof system of eight structures along the Paseo is tailored to capture solar energy which will be used to illuminate the Paseo at night, which offer a safe and welcoming environment. Power generated from the PV panels will also be used to power pumps of the three cisterns in order to for distribution of cistern water to use the stored water for irrigation.

Rainfall over urban areas causes pollutants to be carried to the ground by surface runoff. Due to the Edwards Aquifer rules, the use of permanent BMPs is required on areas over the aquifer, such as UTSA, to prevent pollution. LID also help reduce the peak runoff rates and runoff volumes of storms (Center for Research, 2011). Bioretention basins are best management practices that use adsorption, plant uptake, microbial activity, filtration, and sedimentation to remove pollutants, and provide high removal of sediment, metals, and organic material (Dorman et. Al., 2013). Also, studies indicate that bioretention basins remove TSS by 89%, which comply with the aquifer's rules (Dorman, et. al., 2013).

As an important factor for predicting the size and locations of LID practices is to delineate the drainage area that contributes to the place where LID is planning to practices will be installed. In this project, the contributing zones were delineated using areas in the campus where LID could be installed as outlet of the regional watershed. The drainage area was calculated using a Digital Elevation Model (DEM) and a watershed processing tool in ArcGIS called HEC- GeoHMS. This software is able to transform the drainage paths and watershed boundaries into a hydraulic data structure that represents the drainage network. After determining the location of LID structures, the DEM model was processed to find the drainage network as well as the sub-areas that contribute for each LID location. Also, in addition to the water stored in the cisterns, blowdown water of the reclaimed Engineering buildings AC condensate was tested for possible irrigation use. Multiple pollutants were tested, and the results showed that blowdown water can be used to irrigate the flora of the BMP, the results are shown in the attached BMP Equations table.

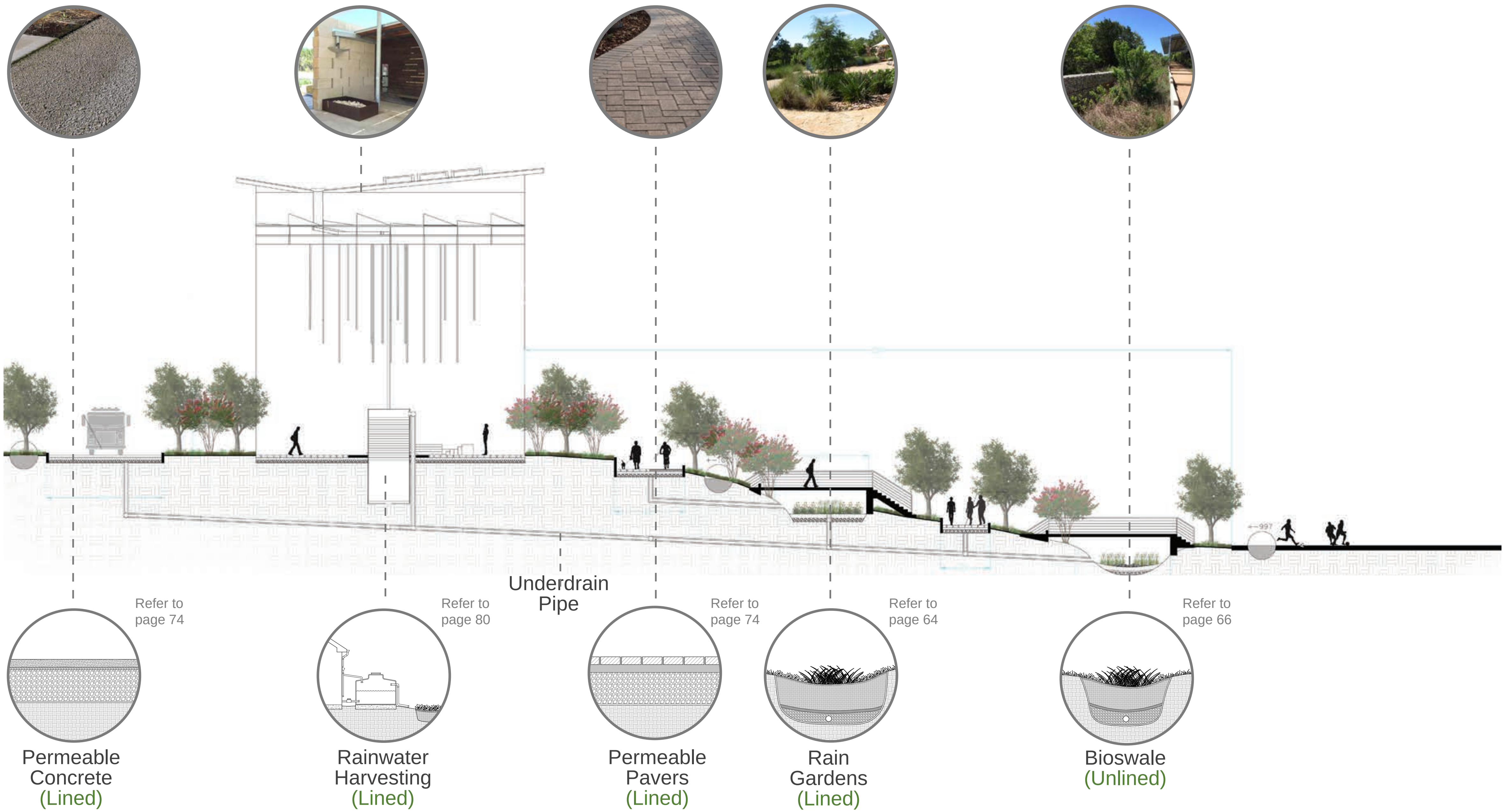
Pervious Area	10 acres
Impervious Area	15 acres
Required TSS Removal	12,852 lb.
Bioretention Basins Needed	3
Footprint Area for each one	10,512.08ft2



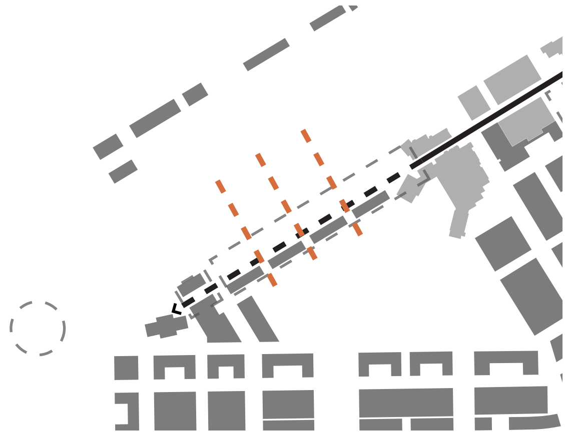
BMP Equations

Equation 3-1	LM= 27.2 (AN x P)
Equation 3-2	Equation 3-2 LR= (BMP efficiency) xPx (Ai x 34.6 + Ap x 0.54)
Equation 3-3	F= LM/ΣLR
Equation 3-4	WQV= Rainfall depth x Runoff Coefficient x Area
Where: LM= Required TSS removal (pounds) AN= Net increase in impervious area (acres) P= Average annual precipitation (inches) LR= Load removed by each BMP	Where: LM= Required TSS removal (pounds) AN= Net increase in impervious area (acres) P= Average annual precipitation (inches) LR= Load removed by each BMP BMP efficiency=TSS removal efficiency (table 3-4) Ai= impervious tributary area to the BMP (ac) Ap= pervious tributary area to the BMP (ac) P= average annual precipitation (table 3-3) F= Fraction of annual rainfall treated by BMP

Performance



Location of Section
Future Paseo
Design Zones
Existing Paseo
Existing Building
Future Building



AC Condensate Chemical Properties	AC Condesate H20	Reclaimed H20	Blowdown H20
Turbidity (NTU)	2.51	0.65	2.5
pH	5.75	5.72	8.05
Conductivity (microsiemens/cm)	9.65	11.71	2.23
Alkalinity (mg/L CaCO3)	2	4	111
Hardness due to Calcium (mg/L CaCO3	225	250	1296
Total Hardness (mg/L CaCO3)	225	250	1684
Copper (mg/L)	1.851	1.905	0.037
Zinc (mg/L)	0	0	0
Sodium (mg/L)	0.627	0.108	76.52
Phosphorus (mg/L PO4)	0.38	0.56	2.75

Water Treatment & Management

Infiltration through bioswale provides natural filtering of stormwater runoff, rather than the typical water shed that parking lots of existing site provide. Replacing the current sand filter with bioretention areas, will allow for most of the storm water to be treated prior to infiltration into the Edwards Aquifer Recharge Zone. Rain gardens located along the new Paseo with proper terracing of existing hill and appropriate vegetation, will improve water flow, filtration, and infiltration into the recharge zone.

The three proposed cisterns, each will be located in the communal spaces, and they would retain 35,000 gallons = 4,679ft^3; 3 tanks at (12'X11.5') in dimension. With this collected water, the irrigation of 49,400ft^2 of vegetation will be possible throughout dry days of the year, and would negate the need for city water. Overflow of collected rain water, would be further directed towards the rain gardens, bioswale, and to the bioretention areas in the far west.

AC condensate H20 reclaimed from the power plant, located near the Central Quad of the campus, estimated as 3,300,000 Gallon per year, will be utilized for plant irrigation during the low rain events. The attached table addresses the different chemical properties that are present during and after treatment. The pH range is suitable for plant root systems. The chemicals were analyzed by the Civil and Environmental Engineering (CEE) students under the supervision of CEE faculty advisors.

NOTE: Blow down H2O has 388 mg/L CaCo3 of Magnesium and 1296 mg/L CaCo3 of Cal. The desirable pH range in the root zone that is comfortable for most plants is 5.5-6.5. Conductivity should not be a problem. Alkalinity should not be a problem either. Hardness should not affect plants directly but the soils. Sodium should not be a problem. Copper can be a problem. More phosphorus may be needed.

Maintenance

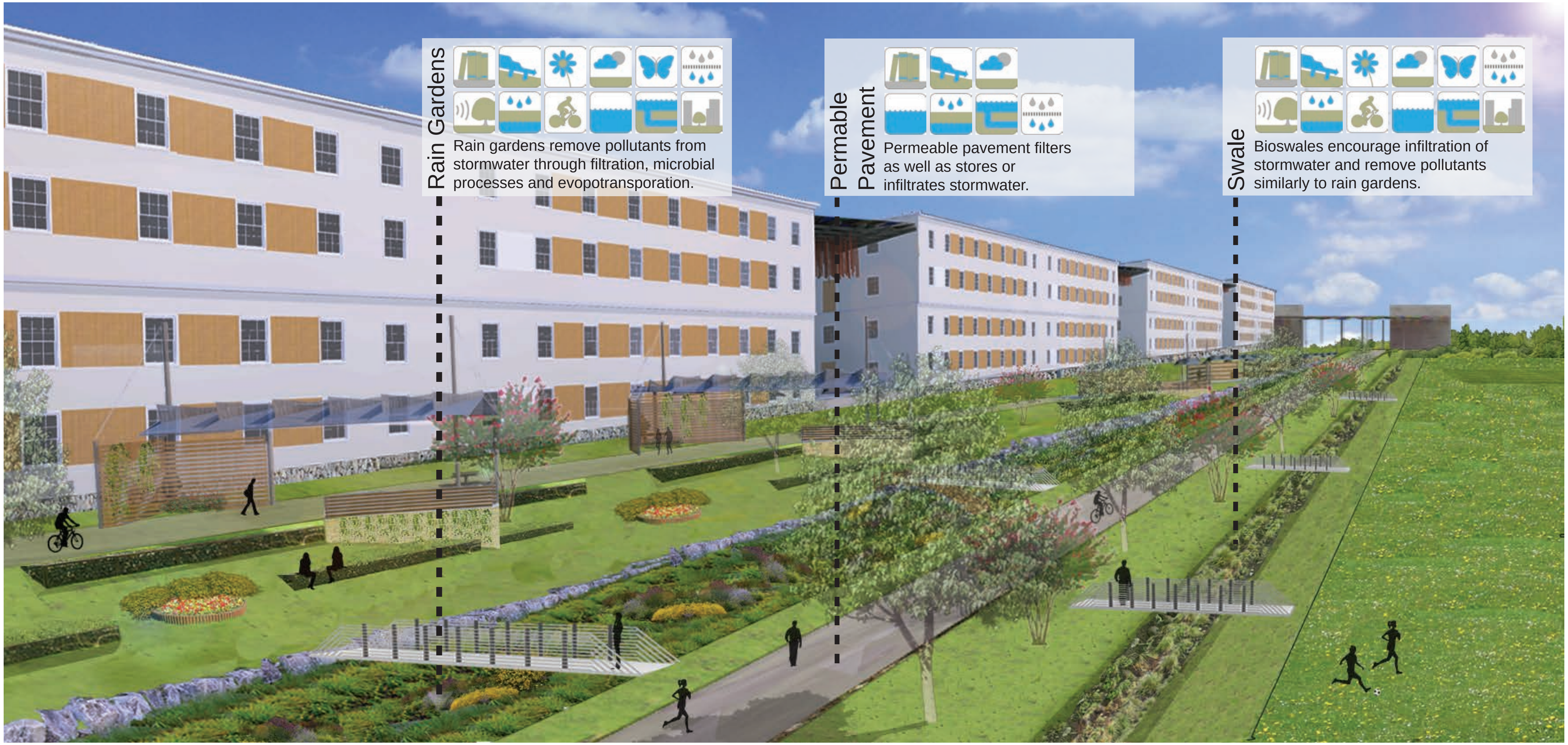


Table 1 **Design & Maintenance Considerations for Student Reach Design Proposal**

<table>
<tr><th>Student Reach</th><th>Total Area (sq ft)</th><th>Likely Overall Maintenance Complexity Level</th><th>Most Likely Maintenance Issues</th><th colspan="2">Anticipated Inspection & Maintenance Frequency</th><th>Proactive Design Considerations</th><th>Proactive Maintenance Tasks</th></tr>
<tr><td>Bioretention Basins</td><td>10,000</td><td rowspan="5">Simple</td><td rowspan="3">• Sediment buildup
• Litter & debris accumulation
• Invasive vegetation</td><td rowspan="5">Before and after major rainfall events</td><td rowspan="3">Quarterly</td><td rowspan="3">• Provide a sedimentation forebay, chamber or filter strip to capture and prevent excess sediment from flowing into and clogging system
• Ensure ease of access for maintenance personnel to perform litter, debris and invasive vegetation removal as well as new vegetation installation
• Ensure ease of access for heavy equipment in the event that soil media removal and replacement must occur</td><td rowspan="3">• Clear debris, sediment, and invasive vegetation at least quarterly
• Replace dead vegetation at least quarterly
•Will likely require initial irrigation for plant establishment. Once vegetation has been established, irrigation will only be needed during the dry season or under extreme drought conditions. This will sustain vegetation health and effectiveness.</td></tr>
<tr><td>Bioswale</td><td>22,615</td></tr>
<tr><td>Rain Gardens</td><td>47,091</td></tr>
<tr><td>Rainwater Cisterns*</td><td>4,679</td><td>• Debris & sediment buildup inside cisterns</td><td rowspan="2">Twice annually</td><td>• Incorporate filtration components to strain debris from captured rainwater and prevent passage of it into storage cisterns
• Ensure cisterns have adequate storage or overflow capacity to handle anticipated rainfall</td><td>• Clear gutters, downspouts, filters and tanks of debris and sediment at least twice annually
• Ensure that tanks are adequately ballested before major wind related storms</td></tr>
<tr><td>Permeable Pavement</td><td>42,343</td><td>• Sediment buildup
• Litter & debris accumulation
• Underdrain pipe clogging</td><td>• Provide a sedimentation forebay, chamber or filter strip to capture and prevent excess sediment from flowing into and clogging system</td><td>• Perform preventative vacuuming at least twice annually</td></tr>
<tr><td colspan="8">*Units are cubic feet</td></tr>
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