The University of Texas at Austin

Design and Construction Standards

Design Criteria

Design Basis

Stormwater Management

All renovation and new construction activities on The University of Texas at Austin campuses are required to meet the UT Austin Design and Construction Standards (DCS) from the planning and design stages through actual construction and facilities maintenance. These standards reflect the planning, design, construction, maintenance, and other facilities asset expertise of University personnel. Any exceptions shall be submitted by the Project Manager as a Standards Exception Request and incorporated after approval is received from the respective Division Champion. The Design and Construction Standards are managed by Campus Operations and updated with the advice of multiple campus groups at The University of Texas at Austin. This document is the property of UT Austin, and use of this document, in part or in whole, for any purpose other than for a UT Austin project may not be done without written permission of the University.

For any comments or questions related to UT Austin Design and Construction Standards, please contact Campus Operations at: campus_standards@austin.utexas.edu.

The issuance and revision history of this Section is tabulated below. Please destroy any previous copy in your possession.

Rev Date	Pages	Remarks	Documents Referenced
3/9/2022	All	New Design Criteria submitted for review.	
8/31/2022	All	New Design Criteria published.	
2/29/2024	12-13	Minor edit – 4.1 – Clarifies the use of permeable pavers on UT projects.	
4/11/2025	All	Standard re-evaluation and update.	
6/1/2025	All	Updated Design Criteria published.	
6/1/2026	All	Administrative Updates	

PART 1 - INTRODUCTION

1.1 PURPOSE:

A. This standard provides information to the Professional Service Provider (PSP) to establish a basis of design. The responsibility of the Engineer is to apply the principles of this section and the ones that follow so that the University of Texas at Austin (University) may comply with related permits and regulations, reduce risk of flooding to the University, understand and eliminate impacts to adjacent and downstream property owners, and maintain a more resilient storm water system. Deviations from these guidelines must be justified through life cycle cost analysis (LCCA) and submitted to the University for approval.

1.2 CODES AND REGULATIONS:

A. Stormwater Code Compliance: This Codes and Standards document governs construction on UT-Austin campus facilities in all areas regulated by The University's MS4 permit. Note that the City of Austin (COA) codes will apply where construction is outside of the UT-Austin campus or where they interface with COA infrastructure.

B. UT Austin Phase 1 – Municipal Separate Storm Sewer System (MS4) Permit

C. UT Austin Stormwater Management Plan (SWMP) - SWMP can be found on the ehs.utexas.edu website.

D. Implementation Plan for Five Total Maximum Daily Loads (TMDL) for Bacteria in Four Austin Streams

E. City of Austin Environmental Criteria Manual Section 1.4.2. "City of Austin Erosion and Sedimentation Control Policy"

F. City of Austin Environmental Criteria Manual Section 1.6.7 "Green Storm Water Quality Infrastructure"

1.3 RELATED DOCUMENTS:

A. 01 56 39 Tree Preservation and Protection

B. 01 57 23 Temporary Storm Water Pollution Control

C. Division 32 Exterior Improvements standards

D. Division 33 Utilities standards

1.4 DEFINITIONS:

A. Adverse Impact – to cause or allow runoff to increase in rate, concentration (e.g. sheet flow to piped flow), quantity, or discharge additional pollutants when comparing pre-project and post-project conditions.

B. Best Management Practice (BMP) – a water quality practice or design element which prevents the temporary or permanent discharge of pollutants from a site. BMPs are structural, vegetative or managerial practices used to treat, prevent or reduce water pollution.

C. Gray Infrastructure–Gray infrastructure is traditional stormwater infrastructure in the built environment such as gutters, drains, pipes, and retention basins.

D. Green Infrastructure– Green infrastructure mimics nature and captures rainwater where it falls, and includes permeable pavement, rain gardens, bioretention cells (or bioswales), vegetative swales, infiltration trenches, green roofs, planter boxes, rainwater harvesting (rain barrels or cisterns), rooftop (downspout) disconnection, and urban tree canopies.

E. Impervious Cover – impermeable construction covering the natural land surface.

F. Partial Pervious Cover – impermeable construction with gaps which allow a portion of the runoff to infiltrate into the underlying soils without any restriction at any level above or below the surface.

1. Decks – an uncovered wood deck that has drainage spaces with a minimum of 3/8" between the deck boards and that is located over a pervious surface shall be calculated to have 50% pervious cover.

2. Permeable pavers – paving systems that are specifically designed to allow water infiltration and are installed over pervious cover may use a percentage of the horizontal surface area based on manufacturer data. Generally, the testing for newly installed permeable pavers achieves approximately 50% of the published values. If the infiltration rate from on-site testing does not achieve the design value for pervious cover, the design shall be revised.

G. Pervious Cover – natural surfaces which allow runoff to infiltrate into the underlying soils without restriction at any level above or below the surface.

H. Redevelopment – complete or partial demolition of existing facilities (e.g. buildings, parking, storage, etc.) to allow for new construction of facilities. This criterion considers any redevelopment equal to new development/construction in terms of its impact on storm water. Therefore, as it applies to the code there are no distinctions between existing and proposed conditions impervious cover for redevelopment projects. All impervious cover will be considered an impact regardless of when it was constructed.

I. Total Maximum Daily Load (TMDL) – a limit for a given constituent of storm water discharges which is codified by a permit from TCEQ to address stream impairments.

1.5 AUTHORITY:

A. Maintaining a storm water system which minimizes loss or damage to University, student, and faculty property in addition to complying with water quality regulations requires the coordination of multiple University departments. The following areas of storm water infrastructure have been identified along with the primary agency having authority or responsibility for the various aspects of their life cycle:

1. Water Quality BMP Design and Construction – Environmental Health and Safety (EHS) is the Authority Having Jurisdiction (AHJ) over ensuring that the design and construction of water quality BMPs meets all applicable permits. This authority is given by 8-1020 of the UT Austin Handbook of Operating Procedures (Environmental Health and Safety Policy).

2. Vegetated Water Quality BMP Operations and Maintenance – Landscape Services is the University department responsible for maintaining vegetated water quality BMPs.

3. Structural Water Quality BMP Operations and Maintenance – Utilities and Energy Management (UEM) is the University department responsible for the operations and maintenance of structural water quality BMPs.

4. Storm Drainage Design and Construction, Operations and Maintenance – UEM is the University department responsible for the review of design and construction. UEM also conducts operations and maintenance of storm drainage and detention facilities.

1.6 GENERAL DESIGN REQUIREMENTS

A. It is the intent of these design requirements, when followed, to provide reductions in the discharge of pollutants from the MS4 to the maximum extent practicable

B. Flood control–A project must present a design that results in No Adverse Impact to the site or regional drainage area. A project's design shall not allow runoff to increase in rate, concentration (e.g. sheet flow to piped flow), quantity, or discharge additional pollutants when comparing pre-project and post-project conditions.

C. Projects involving construction of impervious cover greater than 4,000 sq. ft. must provide water quality BMPs to mitigate increases in pollutant discharge. This applies whether the project is a new development or a redevelopment.

D. Impervious cover contributes to increased rates and quantities of runoff, increases in pollutant discharge, and increases erosion potential. As buildings and impervious cover are constructed, renovated, or replaced the following requirements will be used to prevent the negative effects of impervious cover:

1. New development project limits will be defined by the maximum limits of proposed buildings, site features, and underground utilities. All proposed buildings and impervious cover within the project limits must be directed to a water quality BMP.

2. Redevelopment project limits will be defined by the maximum limits of proposed buildings, site features, and underground utilities. All proposed buildings and modified impervious cover within the project limits must be directed to a water quality BMP. Where existing buildings or impervious cover are to remain without any modification within the project limits, they may be exempted from BMP requirements.

    a. Interior only renovations will not be considered redevelopment.

PART 2 - DESIGN COORDINATION AND REVIEWS

Successful projects involving stormwater management result from UT departmental (stakeholder) collaboration when project is awarded to PSP. Stakeholders include EHS, UEM, and Landscape Services. The following section details a process which supports more cohesive and cost-effective designs, reduced review times and schedule impacts:

2.1 INTEGRATED SITE PLANNING KICK-OFF MEETING

A. At the beginning of the design team's development of Schematic Design drawings, the design team will schedule a meeting with EHS, Landscape Services, and UEM for a design charrette focused on a holistic approach to site, storm water, and integrated BMP design. Issues that must be resolved include:

1. Site constraints – barriers to the construction of integrated site BMPs (e.g. root protection zones, underground utilities, existing building foundations). Project budget is not an applicable site constraint.

2. Site layout – elements of the site design to include parking, walkways, outdoor gathering spaces, landscape areas, and existing structural Water Quality BMPs.

3. Existing storm drainage – infrastructure used to convey storm water in the vicinity of the project and capacity or lack thereof to serve the proposed improvements. Of particular note will be known flooding downstream of the proposed project.

4. Mitigation techniques – methods integrated into the site design to mitigate the projects water quality discharges and storm water runoff. All projects must identify significant Vegetation and Soils Protection Zones (VSPZs) to safeguard existing healthy vegetation and undisturbed soils that support hydrologic and ecological function. VSPZs shall be clearly identified in site plans and include supporting erosion controls like fencing and tree protection. The protection of these zones should be communicated to all contractors and subcontractors prior to mobilization. Some examples of VSPZs include but are not limited to: heritage/protected trees and their critical root zones, riparian buffers and stream corridors, pollinator gardens and established native plant beds, rain gardens, bioswales, and other green infrastructure, and vegetated areas with slopes at or greater than 3:1.

5. Geotechnical investigation – method of sampling, frequency, and location of sample collection (where used).

6. Criteria/Code – discussion of interpretations, where they exist, in criteria or code that will affect the design.

7. Elevator sump discharge – oil separator, discharge to storm, and discharge capture.

8. Identifying appropriate construction activity areas that include but not limited to:

   a. Construction entry/exit and washout areas
   b. Laydown/staging of materials
   c. Alternate vehicular/pedestrian path of travel
   d. Landscape modifications that facilitate construction, (i.e. tree trimming)

B. The design team will submit meeting minutes from the BMP kick-off meeting summarizing the discussion, decisions made, and action items.

2.2 CONSTRUCTION DOCUMENT SUBMITTAL REQUIREMENTS

A. DD submittal requirements:

1. Preliminary sections of the basis of design report or technical memorandum summarizing the approach to BMP design and the calculations performed.

   a. Engineer will submit a narrative which includes discussion of how the proposed design complies with the requirements of this criteria.

2. Preliminary runoff volume and water quality calculations that support compliance with section 1.6 General Design Requirements

3. Annotated site plan – colored highlighting differentiating impervious cover treated by a BMP vs. areas which are not treated (refer to Fig. 6.1 Annotated Site Plan Example).

4. Overall drainage area map – Including on-site and off-site drainage areas.

   a. Off-site drainage areas are those areas which are not a part of the proposed project but contribute to the limits of analysis as determined in section 3.4 A.3.

5. Utility plan(s) – colored highlighting differentiating existing and proposed storm drainage with BMPs highlighted (refer to Fig. 6.3 Utility Plan Example).

B. CD submittal requirements:

1. Updated versions of all documents submitted with the DD submittal.

2. Technical specifications covering the full scope of construction work for BMPs and storm water infrastructure including related landscape elements (e.g. landscape materials, BMP media, storm drainage, geotextiles, geomembranes, etc.). Engineer will utilize COA construction specifications and approved materials and vendors where not specifically identified by UT.

PART 3 - DESIGN REQUIREMENTS

3.1 INTEGRATED SITE PLANNING

A. Defining Constraints

1. Geotechnical data – conduct infiltration testing and identify areas of the site which have higher infiltration potential. Likewise, areas of the site which have clay soils may be less desirable but unavoidable. Consider the proximity of sited BMPs in these areas to buildings and walls which will be negatively impacted by the fluctuation of soil moisture in clayey soils.

2. Structures – identify the limits of existing and proposed building or wall foundations. Evaluate water proofing or drainage layers which may be impacted by nearby siting of infiltration BMPs. Consider crawl spaces or suspended slab foundations as building foundation elements and identify these elements.

   a. Projects within the Main Campus shall consider the location of the UT tunnel system and the requirements for buffering from those tunnels. Infiltration BMPs directly above the UT tunnel system will be prohibited.

3. Utilities – are a constraint for the construction of BMPs. BMPs by their nature invite infiltration of storm water and often require extensive excavation. Locate all existing utilities on the site and define the cover using the American Society of Civil Engineers (ASCE) Quality Level-A or “pothole” data or provide assumptions and state the assumptions.

   a. Utility trenches – often utility trenches include a primary and secondary bedding material made up of aggregate and/or sand. These porous layers can become conduits for infiltrated runoff even in conditions where a BMP hasn’t been constructed. Encouraging further groundwater infiltration into these trenches can impact these trenches and the utilities they carry and therefore should be avoided.
   b. Utility access – consider long term maintenance of utilities beneath BMPs. Water lines located beneath BMPs will be prohibited. Other utilities like sanitary sewer should also be avoided or encased to discourage increasing infiltration of storm water into the sanitary sewer system. UEM Mechanical Distribution will only maintain building pretreatment devices that are located to allow for direct adjacent access to the unit’s manhole lids with a heavy-duty pick-up truck and trailer mounted vacuum unit that has a combined weight that may exceed 10,000 lbs.
   c. Utility age/condition – consider the age, material, and expected life of a given utility. Identify aged lines or utilities in poor condition as constraints which are to be resolved in combination with other site design activities. Disturbance of the soils above or near these utilities may negatively impact these utilities causing unanticipated failure and necessary replacement.
   d. Proposed utilities – organize proposed utilities on the site to avoid crossing BMPs and tree protection zones as a priority. In all cases parallel utility alignments adjacent to or within BMPs will be avoided. Provide adequate space outside of the BMP to access and maintain utilities, particularly water lines. Utility crossings of BMPs will be encased either by a casing or concrete.

4. Cultural resources – rely upon the project archeologist to define standing structures which are historic or potential sites of archeological significance. Archeological permitting may add requirements such as construction observation for excavation at various depths which may affect the depth of proposed BMPs or require a liner to discourage infiltration. In the case of standing structures, the project architect, archeologist, and structural engineer should work collaboratively with the site civil to determine a horizontal buffer from the building's foundation for BMPs and site grading. This includes grading away from the structure thus avoiding moisture within a historic building or its foundations.

5. Existing Trees – trees are valuable assets and provide SWQ benefits through rainfall interception, uptake, filtration and evaporation. Similar to utilities, existing trees are a constraint for the construction of BMP's. Site surveys shall accurately measure tree locations and diameters, label survey with existing tree tag numbers, and show full critical root zones (CRZ's). Follow all UT Tree Preservation and Protection standards when designing BMP's.

B. Geotechnical Evaluation

1. Introduction – define geotechnical/soils and subsurface information prior to the design of BMPs. Demonstrate the feasibility of the project design using the following criteria.

2. Minimum Soil Conditions – subgrade saturated hydraulic conductivity must be greater than the maximum steady infiltration rate for clay soils generally accepted as 0.20 in/hr (Hillel, D. 1982. Introduction to soil physics. Academic Press, San Diego, CA) for infiltrating BMPs to be constructed without an underdrain.

3. Water Table – the depth below the lowest elevation of an infiltration BMP (with or without an impermeable lining) to the highest seasonally high groundwater elevation or capillary fringe of normal groundwater must be greater than twelve (12) inches.

4. Rock – the depth to bedrock must be greater than twelve (12) inches. In instances where rock is near the bottom of the infiltration layer of a BMP the designer should consider the gradient of the rock formation to evaluate the potential for infiltration over time. Permanent groundwater within the BMP will affect the plant life and biota in addition to reducing soil storage whereby decreasing the efficiency of the BMP.

5. Infiltration testing will conform with City of Austin Environmental Criteria Manual section 1.6.7.4 "Infiltration Rate Evaluation".

6. Technical memoranda required in Part 2 above will provide a copy of the relevant geotechnical data used and clearly identify which values have been used. Include citations of the literary sources where desktop study is used for establishing the design values. The geotechnical report will provide the methods used for field sampling data where used.

7. Geotechnical recommendations will include discussion and consideration of seasonal groundwater, lenses and seams impacted by infiltration, and design considerations for structures in proximity to proposed BMPs.

C. Site planning and BMP siting

1. Fundamental design principal – coordination and creative thought by multiple disciplines will result in the highest and best integration of BMPs into the design of any project.

2. Civil engineer – the civil engineer is responsible for management of storm water. Assess and design for any drainage impacts from off-site areas. Identify the site constraints, drainage areas, and design criteria prior to the preparation of a site layout by the landscape architect. Work collaboratively with the project landscape architect to discuss how these

elements of the design should influence of the site design. Minimum elements the civil engineer will be responsible for detailing related to BMPs in the plans and specifications include:

a. Storm drainage piping (including underdrains)
b. Sizing of inlets
c. Existing or proposed utilities and their protection
d. Confirming the project results in no adverse impacts
e. Any grading with the 100-year floodplain and identify specific measures taken to offset impacts
f. Water quality volume computations
g. BMP sizing computations

3. Landscape architect – Water quality BMPs provide opportunities to function as design features. Therefore, collaboration between the landscape architect, civil engineer, and Landscape Services is imperative. Often water quality BMPs provide a design statement (e.g. exposed or highlighted rainwater harvesting, rain gardens, etc.) and can be woven into the design so as not to take away from the other priorities for space making. The landscape architect should lead the effort of siting BMPs while working with the civil engineer and Landscape Services to add the validation that the design will meet the technical goals. The landscape architect will work collaboratively with the civil engineer to identify the drainage areas and constraints early in the design process prior to the site plan development to avoid late or "after-thought" additions of water quality BMPs or structures. Minimum elements the landscape architect will be responsible for detailing related to BMPs in the plans and specifications include:

a. Tree protection/root barriers (existing and proposed)
b. Soil/BMP media
c. Hardscape elements and flatwork (not otherwise detailed on the civil plans)
d. Plant material selection:
    a. Designer will consider the impact of sunlight on plant selection including seasonal movements and building heights
e. Irrigation plans (where appropriate)
f. Site lighting, handholes (conduit, footings/stability, etc.) impacts

4. It may be desirable for the UT PM to request alternative BMPs and layouts as a part of the design scope. In these instances, each alternative must meet these design criteria without exception. Prepare a listing of advantages and disadvantages which will include the increase or decrease in estimated construction cost and life cycle operations and maintenance costs for each alternative presented. Work with the UT PM and project architect to provide a copy of the alternatives presented and related materials to EHS, Landscape Services, and UEM for review and comment.

3.2 WATER QUALITY BMPS

A. Water Quality Volume

1. The water quality volume for treatment will be calculated for each sub-area of the project using the 95th percentile rainfall event, roughly equivalent to the regional "2 Year Storm". Design rainfall has been set to the value below for the Austin area facilities. Use historic rainfall gauge data closest to the site and perform a statistical analysis to define the 95th percentile rainfall event where these criteria are applied to geographic areas outside of the Austin metropolitan area.

   Water quality volume will be dependent on the amount of impervious cover in a given sub-basin. The equation below provides the water quality volume for each sub-basin:

$$WWWWWW = AA_{ii} \times pp_{9999}$$ ***EQ. 33-1***

where,

$WWWWWW$ = water quality volume (cu. ft.)
AA_{ii} = area of impervious cover (sq. ft.)
pp_{95} = 2.1-in or 0.18-ft

2. Fee-in-lieu/Water Quality Volume exception request--If a project is unable to meet the required water quality volume due to site constraints, the project manager must submit a standards exception request (https://pmcservices.utexas.edu/design-construction-standards/standards-exceptions) to be allowed to propose an alternative means of compliance with the standard. Lack of project funding is not a justified reason for an exceptions request and will not receive consideration. The exception request must include: detailed explanation and analysis of why the project cannot comply with the standard, and supporting water quality calculations.

   a. If a project is unable to provide the required Water Quality Volume onsite, the applicant may request an exemption and pay a fee-in-lieu at a rate of $90.00 per cubic foot of unmet volume.
   b. Alternatively, the project may request to provide equivalent treatment volume elsewhere on campus, as feasible, and with approval from the University Architect

B. Biofiltration/Bioretention

1. Introduction – a biofiltration system is an enhanced filtration device that typically utilizes more than one treatment mechanism for removing pollutants from stormwater runoff. Space should be provided at the inlet into these BMPs for energy dissipation and collection of heavy debris and floatables. Bioretention, biofiltration, and other types of innovative Green Infrastructure/Low Impact Design (LID) are preferred over end-point solutions and an effort shall be made to accommodate these features before an exception request is granted.

   The biofiltration media removes pollutants using a pre-approved community of plants rooted in the media and microorganisms which develop there. This is unlike a sand filter basin which relies on sediment removal alone. These biological systems provide treatment of runoff beyond removal of sediments and the constituents in those sediments. The root systems of the vegetation within the biofiltration media aerate the media which sustains higher rates of infiltration for a longer period of time.

2. Basin Surface Areas and Volumes – the following equation gives the minimum surface area required for the filtration basin:

$$AA_{ff} = \frac{WWWWWW \times dd_{mmmmddiimm}}{\left(kk \times tt \times \frac{dd_{pppppdd}}{ff_{ss}} + dd_{mmmmddiimm}\right)}$$ ***EQ. 33-2***

where,

AA_{ff} = required surface area of the media (sq. ft.)
$WWWWWW$ = water quality volume (cu. ft.)
$dd_{mmmmmmiimm}$ = depth of the filter media (ft)
kk = hydraulic conductivity, minimum of underlying soil infiltration rate or maximum allowable 3 ft/day (ft/day)

tt = drawdown time (maximum of two, days)
$dd_{pppppppmm}$ = maximum head over the filter media (ft)
ff_{ss} = dimensionless factor of safety (minimum of 2)

3. Sedimentation/Debris trap – the following criteria are provided for smaller distributed systems. Larger drainage areas, particularly those with heavy debris and sediments like expansive parking lots should utilize sedimentation and pretreatment systems like those detailed in the City of Austin Environmental Criteria Manual section 1.6.7.

   Use rock mulch between three to six inches in size to create a preformed scour pool at the location where flows enter BMPs. The minimum length in the direction of flow will be two times the width of the inflow inlet. The depth of the pool should be half the width but no more than 12-inches. The rock mulch should be mounded equal to the depth of the pool above the elevation of the bioretention media. This forms a plunge pool that allows for the settlement of heavy debris and energy dissipation to avoid the development of rills in the bioretention area.

4. Biofiltration Media – in order to provide acceptable drainage and plant growth characteristics, the biofiltration media will meet the following criteria:

   Percent Organic Matter (by weight) of 0.5—5.0%
   Texture Analysis (particle size distribution):
   - Percent Sand 70—90%
   - Percent Clay 3—10%
   - Percent Silt plus Clay ≤27%

   Note: This media specification conforms to the City of Austin Environmental Criteria.

5. Lining – a geomembrane or concrete barrier will be used where the shrink-swell of clay soils or proximity to structures or utilities require limiting infiltration. Storage open to the underlying soils for infiltration will utilize a geotextile fabric to prevent the migration of fines into the aggregate above.

C. Porous Pavement

1. Introduction – porous pavements are a load-bearing durable surface with an underlying storage layer usually comprised of coarse aggregate. Locations where vehicular turning movements or heavy sediment loads are expected are not well suited to porous pavements and should be avoided, such as parking lot drive aisles and roadway intersections. However, porous pavements can be suitable substitutes for low traffic paved surfaces. By providing porous pavements and properly sized underground storage the pavement is self-mitigating.

   a. Porous Interlocking Concrete Pavement (PICP) – acceptable for both pedestrian and vehicular traffic. These systems consist of high strength concrete units that are separated by open or stone-filled joints that allow stormwater to infiltrate. UT Austin prefers the use of open joint pavers however, filled joints may be considered where the need is justified by the PSP. The concrete units are laid on an open graded, single-sized granular base.
   b. Porous asphalt (PA) – acceptable for bicycle lanes, low traffic roadways, and parking lot drive aisles. Consists of regular bituminous asphalt in which the fines have been screened and reduced whereby creating void spaces and making it permeable.
   c. Porous concrete pavement – acceptable for pedestrian pathways. Similar to standard concrete however, does not include the fine aggregates whereby creating

greater pore space. The higher porosity creates a lower strength compared to conventional concrete which is why it is not recommended for vehicular traffic.

d. The design of porous pavement systems will not accept run-on from drainage areas outside of the porous pavement extents. Any porous pavement system used must include a system to retain the edge of the paving and prevent raveling or premature deterioration.

2. Storage volume – the following equation gives the minimum surface area required for the filtration basin:

$$dd = ff_{ss} \times \frac{WWWWWW}{aa \times pp} \qquad \textbf{\textit{EQ. 33-3}}$$

where,

dd = DEPTH OF AGGREGATE (FT.)
ff_{ss} = dimensionless factor of safety (minimum of 2)
$WWWWWW$ = WATER QUALITY VOLUME (CU. FT.)
AA = SURFACE AREA OF THE POROUS PAVEMENT (SQ. FT.)
pp = POROSITY OF SELECTED AGGREGATE

3. Lining – a geomembrane or concrete barrier will be used where the shrink-swell of clay soils or proximity to structures or utilities require limiting infiltration. Storage open to the underlying soils for infiltration will utilize a geotextile fabric to prevent the migration of fines into the aggregate above.

4. Slopes – use of porous pavement systems are restricted to mild slopes less than to 20:1 grade or five percent (less than 5%).

5. Pavement design – designer must define the necessary material properties, pavement design requirements, and subgrade/drainage layers which provide the design life for the anticipated loads and hydrological requirements simultaneously.

6. Factor of safety – the nature of porous pavements does not allow for removal of sediments, it is expected that over the design life of the pavement that siltation and clogging will occur. For this reason, a minimum factor of safety of two (2) has been established to account for clogging. The designer will consider this value as a minimum and increase the factor of safety as needed based on specific site conditions and runoff characteristics;

7. Joints – the designer will consider the use of the space where porous pavements will be used when selecting the appropriateness of its use and the selection of joints, where necessary. Some of these considerations include vehicle turning movements and ADA compliance, among others. Designer will work with the vendor of selected materials to define spacing, joint construction, and compliance with requirements for each project.

D. End Point Designs – Sand Filter Basins/Batch Detention/Cartridge Filtration/ Hydrodynamic Separators

1. Applicability – The use of sand filter basins and hydrodynamic separators is generally discouraged. These systems primarily target sediment removal, assuming that associated nutrients, biological agents, and chemical contaminants will be captured as well. As gray infrastructure, they convey runoff directly to receiving waters, thereby reducing opportunities for natural infiltration, storage, and evapotranspiration. Natural infiltration and groundwater recharge are critical for maintaining base flows in streams, sustaining healthy ecosystems, and preserving long-term water availability.

This guidance encourages the disconnection of impervious cover and the distribution of open space typically reserved for these "end-of-pipe" solutions across the site. A more integrated approach to Best Management Practice (BMP) design can often eliminate the need for such measures.

2. Batch Detention and Cartridge Filtration mechanisms are not permitted for use

3. In rare circumstances where no viable alternatives exist, the use of Sand Filter Basins and Hydrodynamic Separators (e.g. StormTroopers) may be appropriate as a last resort. In such cases, a Standards Exception Request may be submitted to use end-point solutions to achieve stormwater goals.

4. Design – the designer will refer to the latest edition of the TCEQ RG-348 "Complying with the Edwards Aquifer Rules—Technical Guidance on Best Management Practices" for the design requirements of sand filters, batch detention, cartridge filtration, and hydrodynamic separator systems where used. The water quality design defined in this criterion will replace the event depth used in RG-348.

3.3 HYDROLOGIC AND HYDRAULIC DESIGN

A. Limits of Impact Analysis

1. Introduction – the limit of analysis will be different for each project and will differ by geographic area of UT Austin campuses. Limits of analysis will need to include a comprehensive evaluation of flood risks along discharge flow paths. Evaluation of the flow paths should extend beyond UT Austin property boundaries to include roadways and private property that may be impacted by increases in flow or erosion. At no point should the study extend beyond the limits of a FEMA studied floodplain unless the project is proposed within a FEMA Zone A or AE floodplain.

2. Purpose – UT Austin is a part of many community initiatives aimed at improving water quality and reducing flood risk for the Austin area. UT Austin risks increasing flooding and erosion potential of streams as a sponsor of construction activities that have the potential to increase flood risk. The purpose of this criteria is to identify the specific risks and mitigate them by altering the project design to eliminate increases in flood risk and stream erosion.

3. Determination – the UT Austin PM or project sponsor prior to soliciting for a design team will contact EHS and UEM to discuss the project location and known issues within the project area. Discussions may include campus or facility-wide master planning studies to identify areas of flood risk, storm drain with poor condition and/or capacity, and coordination with other campus initiatives. The UT Austin PM, project sponsor, EHS, and UEM will agree on the design team's limits of analysis based on these discussions before finalizing the design team's scope-of-work.

B. Hydrology

1. Introduction – hydrologic methods used by the designer will reflect the hydraulic modeling used to design the project. Generally, the requirements of the City of Austin Drainage Criteria Manual will apply.

C. Hydraulics

1. Introduction – hydraulic design may be completed by the designer using a wide range of modeling software and/or spreadsheet calculations. Software, when used, may include coupled one-dimensional/two-dimensional (1D/2D) modeling which allows the designer to simulate the volumetric-time dependency of discharges in a spatial extent. In so doing, a designer may demonstrate the efficacy of integrated BMPs in reducing the impact of

proposed site improvements. When used, the designer will provide documentation of all modeling assumptions used in a narrative form along with copies of the modeling for review. Parameters used to simulate infiltration must be equal to those used in supporting the sizing of the BMP above without exception.

PART 4 - PRODUCTS

4.1 PERMEABLE PAVERS

A. Permeable pavers are prohibited for use on the UT campus. A Standards Exception Request may be submitted to use permeable pavers to achieve stormwater goals. The Standards Exception Request shall include the information in this section to make a case for use of permeable pavers.

B. Designer will select a vendor and product from the following approved list:

1. Keystone
2. Pavestone

C. Site Selection

1. Land use: Permeable pavers should be limited to pedestrian areas, or areas with very low vehicular traffic volumes. These systems are not intended or designed for repetitive axel loads. Installation shall be prohibited within loading zones, fire lanes, driveways, or ADA ramps.

2. Vegetation: Pavers should not be installed under or around dense vegetation, or any similar landscape feature which produces debris such as falling leaves, berries, or seeds.

3. Hot Spots: Permeable paver systems depend upon infiltration into the underlying permeable subgrade. Due to the potential for groundwater contamination, porous pavement shall not be allowed under stormwater hot spots or in areas where land use or activities generate highly contaminated runoff or yield high sediment loads. Hot spot runoff frequently contains pollutant concentrations exceeding those typically observed in stormwater. Hot spots include, but are not limited to, commercial nurseries, auto salvage facilities, hazardous materials generators (where containers are exposed to rainfall), vehicle fueling and maintenance areas, and vehicle and equipment washing dry or steam cleaning facilities, food production/distribution loading dock and trash compactor areas.

4. Slopes: The use of Permeable paver systems shall be restricted to gentle slopes up to a 20 to 1 grade (5%). On steeper slopes the potential for water seepage out of the pavement surface limits effectiveness.

D. Construction

1. Proper construction of permeable pavement systems requires measures to preserve natural infiltration rates prior to placement of the pavement, as well as measures to protect the system from the time that pavement construction is complete to the end of site construction. The following recommendations apply to all permeable pavement systems.

   a. General

      a. Keep mud and sediment-laden runoff away from the pavement area.
      b. Temporarily divert runoff or install sediment control measures as necessary to reduce the amount of sediment run-on to the pavement.
      c. Cover surfaces with a heavy impermeable membrane when construction activities threaten to deposit sediment onto the pavement area.
      d. Low ground pressure (LGP) track equipment should be used within the pavement area to limit over-compacting the subgrade. Wheel loads such as,

passenger cars and pick-up trucks should not be allowed on the pavement area during construction.

b. Subgrade Preparation: Since permeable pavers are an infiltration practice it is imperative that the permeability of the underlying native soils be preserved. The following recommendations apply to all permeable paver systems.

   a. It is important to protect the subgrade from over compaction, accumulation of fines, excessive construction equipment traffic, and surface ponding. Any accumulation of debris, fines, or sediment that has occurred during subgrade preparation should be removed prior to starting the gravel bed installation.
   b. Grading shall not take place during wet soil conditions to minimize sealing of the soil surface.
   c. In situations where the subgrade has been over compacted or the permeability has been diminished scarification should take place to a depth sufficient to match the naturally occurring in-situ state. Typically, scarification should be a minimum of four (4) to six (6) inches in depth.

c. Gravel Bed Preparation: The gravel bed should consist of clean, crushed gravel, free of mud, clay, vegetation or other debris, conforming to ASTM C 33 for stone quality. Size gradation shall conform to ASTM C-33 No. 57 or No. 67 as described in City of Austin Standard Specification 510.2.(a), Pipe Bedding Stone.

   a. Placement of gravel bed can occur after the following:

      a) The design saturated hydraulic conductivity of the subgrade has been verified using the criteria stated in Section 1.6.7.4.
      b) The Environmental Inspector has approved the gravel bed preparation.
      c) Any accumulation of debris, fines, or sediment that has occurred during the placement of the gravel bed installation has been removed.

d. Porous Pavement Installation: Contractor installation qualifications require that the contractor provide to the UT Austin Environmental inspector, at the preliminary construction meeting, a statement attesting to qualifications and demonstrating experience with the following porous pavement procedures and tests.

   a. If the installing contractor and pavement producer do not have sufficient experience with permeable paver systems, the installing contractor shall retain an experienced consultant to monitor production, handling, and placement operations at the contractor's expense.

E. Post Construction Inspection

1. The porous pavement surface saturated hydraulic conductivity must be greater than or equal to 50 in/hr.

   a. Use the following testing methods to verify the surface saturated hydraulic conductivity:

      a. For porous concrete and porous asphalt use ASTM C1701.
      b. For open-jointed block pavement, PICP, or CGP use ASTM C1781.

   b. All inspection, infiltration testing, and maintenance activities shall be documented and made available to EHS inspection staff upon request.

4.2 BIOFILTRATION MEDIA

A. Suppliers of biofiltration media must have laboratory testing conducted at a minimum of six-month intervals to verify percent organic matter and texture analysis. The media must not contain any contaminated soils and be free of any household or hazardous waste. It must be free of stones, trash, and other undesirable material, and must not contain weeds or weed seeds. Saturated hydraulic conductivity will be established by material testing or literature with confirmation of the organic matter content and texture analysis by a competent professional.

B. The criteria are intended to meet the NRCS definition of soils with "moderate" to "high" available water capacity. The criteria should ensure that the media has sufficient water holding capacity to support vigorous plant growth, enhancing the ability for plants to survive during dry periods. It should also sustain a healthy microorganism population which, in concert with the plants, should enhance biological removal of pollutants in stormwater.

C. The percent organic matter criterion is needed to ensure healthy vegetation. Plants native to the region have adapted to surviving in soils with minimal organic matter content. Consider this aspect of the BMP media in plant selections. Higher organic matter content is not desirable as pollutant nutrients may be exported from the media, which is counter to the removal that is intended in this type of BMP. Immature compost, manure, compost derived from animal or human sources, and unstable forms of organic matter that may export nutrients should not be included in the biofiltration media. Recommended sources of organic matter include that found naturally in native topsoil, humus, coconut coir fiber, and mature plant-derived composts with an established fungal component. The biofiltration media must be certified by the project engineer or their designee (e.g. contractor, soil supplier, or appropriate qualified alternative individual) as meeting the above performance criteria (based on submittal of delivery tickets, test results, etc.) before acceptance by UT.

4.3 UNDERGROUND STORM WATER PIPES – REFER TO DIVISION 22 AND DIVISION 33

4.4 BMP PLANT PALLETTE

A. Plants planted within BMPs will come from the following plant list. Care will be given to the selection of the plants and the grading of the BMP and the infiltration rates of the underlying soils. A mixture of wetland, emergent wetland, and upland plantings are expected. Deviations from this plant list may be acceptable (including consideration of close crop options where appropriate) but will require substantiation and the approval of Landscape Services:

Common Name
Dwarf Palmetto (shade)
American beautyberry (shade)
Turks cap (shade)
Chile pequin (part-shade)
Bushy bluestem
Texas sedge
Inland sea oats (shade)
Gulf muhly
Switchgrass
River fern (shade)
Fall Aster
Fall obedient plant
Copper Canyon daisy
Mistflower

Pigeonberry (shade)
Horseherb (shade)
Spiderwort (shade)
Bee balm (monarda)
Cherokee sedge

PART 5 - CONSTRUCTION PHASE AND QUALITY ASSURANCE

5.1 CONSTRUCTION MEETINGS

A. Unless noted otherwise, UT EHS, Landscape Services, and UEM shall be included for all meeting invites.

1. Pre-Construction Meetings.
2. Project Progress Meetings – Departments may not attend all meetings, but will likely attend when construction progress includes construction of storm drainage, BMPs, or landscaping.
3. BMP specific on-site meetings – These meetings may occur at the request of the Owner's Designated Representative (ODR), designer of record, or by the contractor.
4. Project Closeout – As part of the final punch-walk, these departments may identify items to the ODR and/or designer of record that are required to be corrected by the contractor. Items identified by these departments must be confirmed complete and closed by an authorized representative of the department noted the deficiency and the ODR.

5.2 SUBMITTALS

A. EHS, Landscape Services, and UEM shall be included as part of the submittal review process (unless noted otherwise by the respective department). Submittals will consist of cut sheets or product documentation or certifications documenting compliance with these criteria, technical specifications, and construction drawings. These are minimum requirements, additional documentation or other submittals may be required by the designer:

1. Storm drain and underdrain piping
2. Geomembranes and/or geotextiles
3. Permeable pavers
4. Biofiltration media (laboratory testing certification)
5. Rock mulch/inlet/outfall/rip-rap
6. Pre-cast structure shop drawings
7. Post-Installation Inspection Televising Report

5.3 MATERIALS TESTING

A. In-situ verification testing

1. Testing will be performed on the native soil prior to the start of BMP construction within 24 hours of exposing the surface of the infiltration surface. This testing will confirm that the saturated hydraulic conductivity values used during design are present in-situ.
2. PSP is responsible for observing the testing and ensuring results fall within acceptable limits. EHS and Landscape Services must be invited to observe the testing and will receive a copy of the results.

3. PSP is responsible for confirming that the soil beneath infiltration type BMPs being installed in an area subjected to construction equipment or material storage is scarified prior to installation of the BMP.

B. Biofiltration media

1. Testing will be performed by the vendor supplying the media. Lab results documenting testing within the prior six-month period will be acceptable. EHS and Landscape Services must receive a copy of the lab results.

PART 6 - FIGURES

6.1 ANNOTATED SITE PLAN EXAMPLE

6.2 OVERALL DRAINAGE AREA MAP EXAMPLE

6.3 UTILITY PLAN EXAMPLE

END OF STANDARD

Figure 6.1—Annotated Site Plan Example

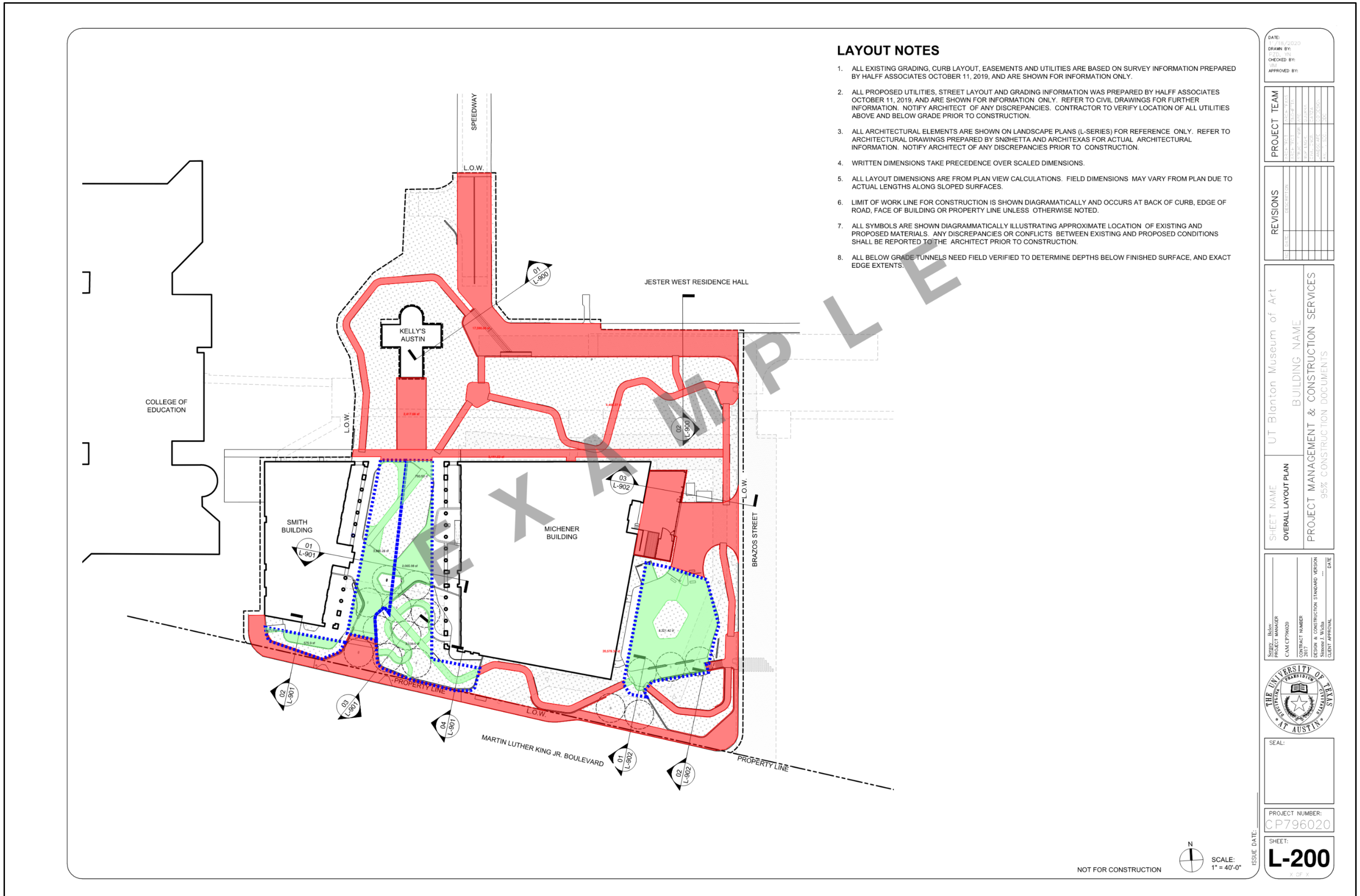
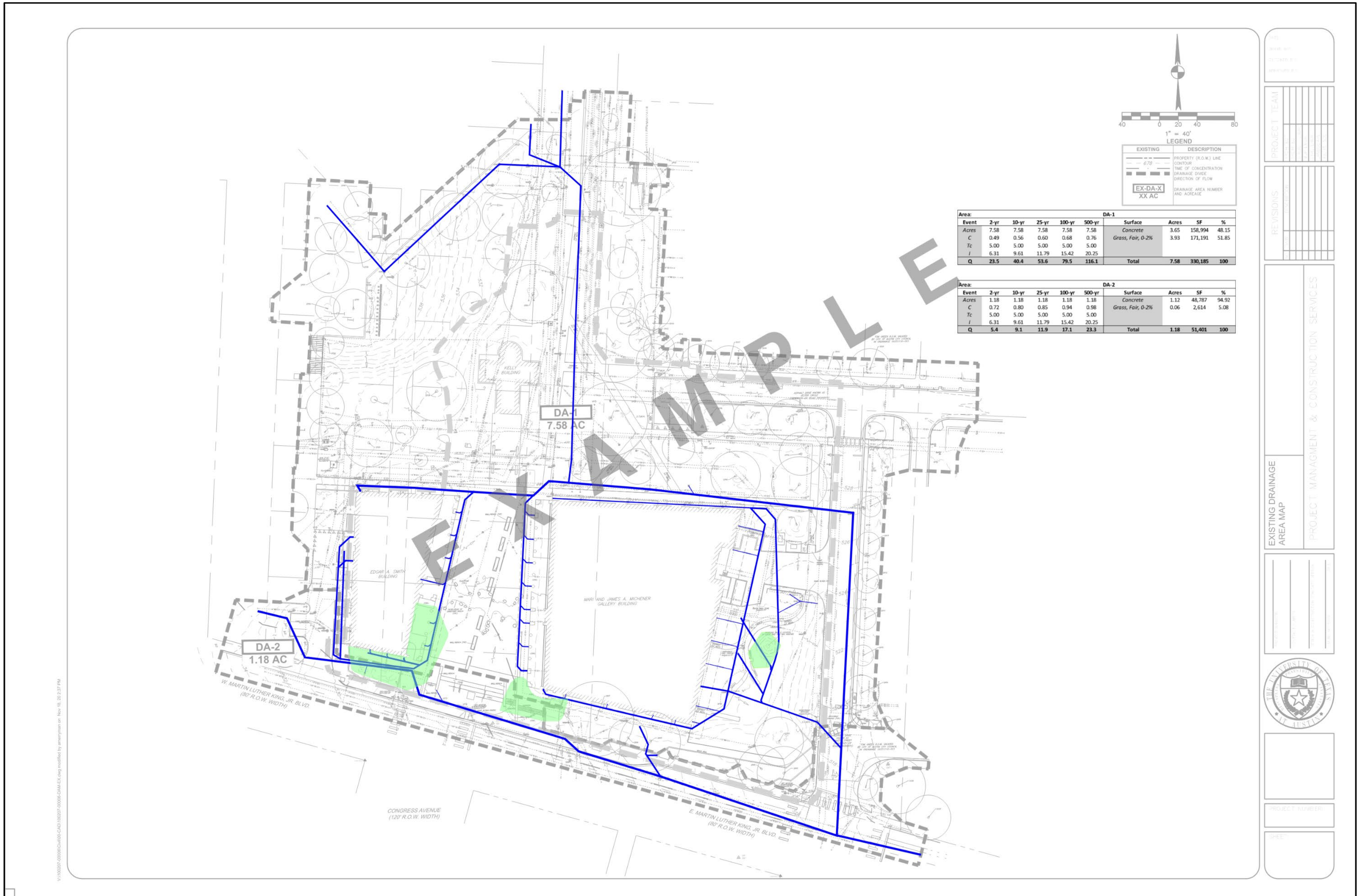


Figure 6.2—Overall Drainage Area Map Example



Area:						DA-1			
Event	2-yr	10-yr	25-yr	100-yr	500-yr	Surface	Acres	SF	%
Acres	7.58	7.58	7.58	7.58	7.58	*Concrete*	3.65	158,994	48.15
C	0.49	0.56	0.60	0.68	0.76	*Grass, Fair, 0-2%*	3.93	171,191	51.85
Tc	5.00	5.00	5.00	5.00	5.00				
I	6.31	9.61	11.79	15.42	20.25				
Q	**23.5**	**40.4**	**53.6**	**79.5**	**116.1**	**Total**	**7.58**	**330,185**	**100**

Area:						DA-2			
Event	2-yr	10-yr	25-yr	100-yr	500-yr	Surface	Acres	SF	%
Acres	1.18	1.18	1.18	1.18	1.18	*Concrete*	1.12	48,787	94.92
C	0.72	0.80	0.85	0.94	0.98	*Grass, Fair, 0-2%*	0.06	2,614	5.08
Tc	5.00	5.00	5.00	5.00	5.00				
I	6.31	9.61	11.79	15.42	20.25				
Q	**5.4**	**9.1**	**11.9**	**17.1**	**23.3**	**Total**	**1.18**	**51,401**	**100**

Figure 6.3—Utility Plan Example