ANGELO STATE UNIVERSITY

MEMBER, TEXAS TECH UNIVERSITY SYSTEM

CENTENNIAL MASTER PLAN 2028 | UPDATE 2019

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CENTENNIAL MASTER PLAN 2028

UPDATE 2019

President's Statement

As we anticipate celebrating Angelo State University's 100th anniversary in 2028, our Centennial Master Plan 2028 enters its final decade. For the 2019 update, our plans are realistic, yet goal-driven, and informed by numerous factors including:

- enrollment trends
- facility conditions
- housing projections
- academic space requirements
- traffic flow

Our commitment is to continue offering our students an excellent academic and co-curricular environment. As well, we want our faculty and staff to have resources that strengthen their ability to deliver quality education and support services.

The initial phases of our Centennial Master Plan transformed our campus into a dynamic, student-centered, residential campus for undergraduates. The results are tangible as we see students utilizing the recreation center, University Center and outdoor areas on campus almost around the clock. During this time, we also grew our graduate and dual credit enrollment tremendously.

The final phase will position us to grow and adapt to changes beyond our first 100 years and continue to produce graduates that successfully meet the demands of an ever-changing job market. Angelo State is already well-known for its beautiful campus and modern facilities, and we intend to grow its reputation as a destination university.

Sincerely,
Brian J. May, Ph.D.
President

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Acknowledgments

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Angie Wright .... Vice President for Finance and Administration
Dr. Javier Flores .... Vice President for Student Affairs and Enrollment Management
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ASU
10,000
STRONG
Sept. 14, 2017
ROSCOE
D. RAM

Introductory Information

Introduction

Angelo State University initiated the second update to its Centennial Master Plan in early 2018. The major intent of the updated plan is to guide the programmatic and physical development of the University as it progresses toward its centennial in 2028.

This report consists of three major components, which are updates to the: Facilities Master Plan, Design Guidelines, and Space Analysis. Each update reflects current conditions, including newly established programmatic priorities, recent construction on campus, and current state-backed initiatives for higher education. These updates are reflected in the Budget Estimates as well.

The University formed a Campus Master Plan Committee to oversee and develop the update to the Master Plan. Coinciding with the development of this update, a consulting team was engaged to conduct two studies, the results of which are included as appendices to this document. The consultant team includes Carter-Fentress/SKG Engineering for civil engineering and Jose I. Guerra Engineering, Inc. for mechanical, electrical, and plumbing (MEP) engineering.

Several significant changes to the University's Facilities Inventory occurred between the fall 2017 and fall 2018 reporting dates. These actual space changes for 2018 are reflected in the E&G data given in charts in the Space Analysis chapter; however, the Fall 2018 Texas Higher Education Coordinating Board (THECB) Space Projection Model calculating predicted space for 2018 was not available at the time data was prepared for this publication. The data for fall 2017 was used as a baseline for all future enrollment and space projections. Education and General (E&G) is defined as: assets used for academic instruction, research, and support of the institution's mission.

Executive Summary

Since the completion of the Centennial Master Plan in 2005, a number of important changes have taken place at Angelo State University. Perhaps the most significant development since the Centennial Master Plan was published in 2005 is the incorporation of the University into the Texas Tech University System in June of 2007. Additionally, enrollment growth has continued from about 6,000 in 2004 to 6,400 in the fall of 2009. From 2010 to 2017, ASU experienced a historic growth increase, over 52%. Also during that period, the University has greatly increased utilization of teaching space, improving the Space Usage Efficiency (SUE) score from 141 in fall 2009 to 158 in fall 2017, exceeding the Texas Higher Education Coordinating Board (THECB) recommended compliance standard of 150. This metric measures the efficiency by which the University uses classrooms and class labs for academic credit-generating activity. Work continues to improve the classroom portion of that score to meet or exceed the THECB standard.

Since the 2011 Master Plan Update, three cutting edge academic buildings were completed: the Hunter Strain Engineering Laboratories Building, Health and Human Services Building and Biology Greenhouse. The Hunter Strain Engineering Laboratories Building, completed in May 2017, came to fruition by means of charitable donations. The leading edge facility contains five fully equipped engineering labs for ASU's new David L. Hirschfeld Department of Engineering. The Health and Human Services (HHS) Building, mentioned in the 2011 Master Plan, was funded by charitable donation and the 2014 Texas Revenue Bond distributions. The HHS Building, completed in January 2018, houses the Archer College of Health and Human Services and has over 58,000 gross square feet of classrooms, faculty offices, nursing labs, physical therapy labs, computer labs and health care simulation labs. The Biology Greenhouse, completed in September of 2018 and funded by Texas Higher Education Funding distributions, gives ASU's Biology Department access to a fully automated greenhouse facility containing three separate climate chambers and a support building.

ASU completed a 162-bed addition to the Centennial Village Residence Hall in summer of 2018. Furthermore, a number of athletic facilities have been erected, each completely financed by West Texas' philanthropic community. The LeGrand Stadium at 1st Community Credit Union Field, renovated for hosting football in 2014, was upgraded by the addition of a restroom and concessions building and a new running track in August of 2017. Refreshed tennis courts for the University's newly added women's division II tennis team and the four-level Mayer Press Box also enhanced the stadium grounds in the spring of 2018.

The University achieved the enrollment of 10,000 students in 2017, three years ahead of its goal. Shortly after joining the Texas Tech University System in 2007, ASU set an enrollment goal in its "Vision 2020" strategic plan of 10,000 students by the year 2020. In its current strategic plan, "Envisioning 100 Years & Beyond," the University has now targeted a goal of 14,000 students by 2028. The THECB Space Projection Models suggest an addition of roughly 500,000 net assignable square feet (NASF) with 386,000 E&G square feet to accommodate this goal. However, by continuing to improve current classroom utilization, backfilling underutilized E&G spaces and capturing non-E&G spaces to utilize in the event the E&G deficit is too great, the University will only add 295,000 NASF, with 133,000 E&G square feet; and 40% of that proposed NASF is designated for housing. The University will continue the on-campus residence requirement of new first-time (NFT) students. An addition of 800 beds have been included to accomplish this requirement while increasing enrollment. Improved utilization will also continue to be a priority. Support facilities such as improved dining, student organization spaces, infrastructure additions and Information Technology (IT) space will also be included in the plan.

Overall, the Master Plan Update aspires to provide the programmatic and physical planning strategy necessary to assist ASU to meet or exceed its ambitious goals in preparation for its centennial in 2028.

Angelo State University campus

ASU coaster

Planning Process

This Master Plan Update was a collaboration of the ASU Master Plan Committee, headed by Cody Guins and Jessica Manning, many members of the ASU community, including faculty, staff and students, as well as the consulting team. The effort was divided into two major parts: an analysis of space utilization and space need and the creation and forming of physical design options into a single cohesive master plan.

Since the adoption of the Centennial Master Plan, the University completed "Vision 2020," a strategic plan that encompassed both a plan for academic programs and initiatives in an overall strategic plan. ASU's Strategic Planning Council is continuously establishing and reviewing strategies in support of the University's master goals. Building upon the progress achieved under "Vision 2020," the University has developed a new strategic plan, "Envisioning 100 Years & Beyond." These plans added a depth of academic and institutional direction that was not a part of the Centennial Master Plan.

The process began with a kick-off meeting, at which time the committee became acquainted, laid out and agreed upon a process, reviewed updates to university facilities, and conducted interviews with ASU faculty and staff. Subcommittees analyzed and reviewed space utilization with key university personnel, calculated space projections, and proposed strategic options or "building blocks." The physical design phase then began with a visioning session, followed by a meeting at which a number of design alternatives were discussed, and finally, a meeting to review and fine-tune the final plan.

Angelo State University campus sign

Rotunda at Houston Harte University Center

Physical Planning Issues

The ASU campus is located on a 269-acre tract of land southwest of downtown San Angelo. The campus is bordered on the west and the western half of its north and south edges by single-family residential developments. The rest of the southern border is mostly lined with churches and San Angelo Independent School District land. Crockett Elementary School, Glenn Middle School, and the SAISD Administration Building are all south of campus. Part of the north edge is bordered by a mixture of apartments and retail, and the eastern edges are bound by South Jackson Street and Knickerbocker Road.

With the exception of a few localized conditions, such as the depressed grade at South Jackson Street and low areas around the Porter Henderson Library, the ASU campus is generally flat and grades down from southwest to northeast. Drainage issues are being studied concurrent with the preparation of this update by way of partnership with Carter-Fentress Engineering/SKG Engineering, and a final report supplements the Reports chapter.

Little to no natural foliage remains on the site, as unbuilt areas have been either landscaped or cleared. There are, however, a large number of carefully tended mature trees, which were planted early in the history of the campus.

The buildings on the ASU campus are organized into six planning sectors: Academic, Services, Dining, Campus Housing, Recreation and Athletics. There is some intermixing between zones (and buildings that serve multiple functions, such as the Ben Kelly Center for Human Performance with both academic and recreational functions), but by and large, the facilities are grouped according to use. Parking is primarily located in a ring outside the campus buildings. The larger, less utilized lots are on the eastern end of campus. The parking on the western end and the middle of campus are normally full, during peak hours, since most of the academic and service buildings are located in this area.

Map of ASU location within San Angelo

Demographics and Enrollment

In this document, demographics are considered using fall 2017 enrollment as the current student enrollment.

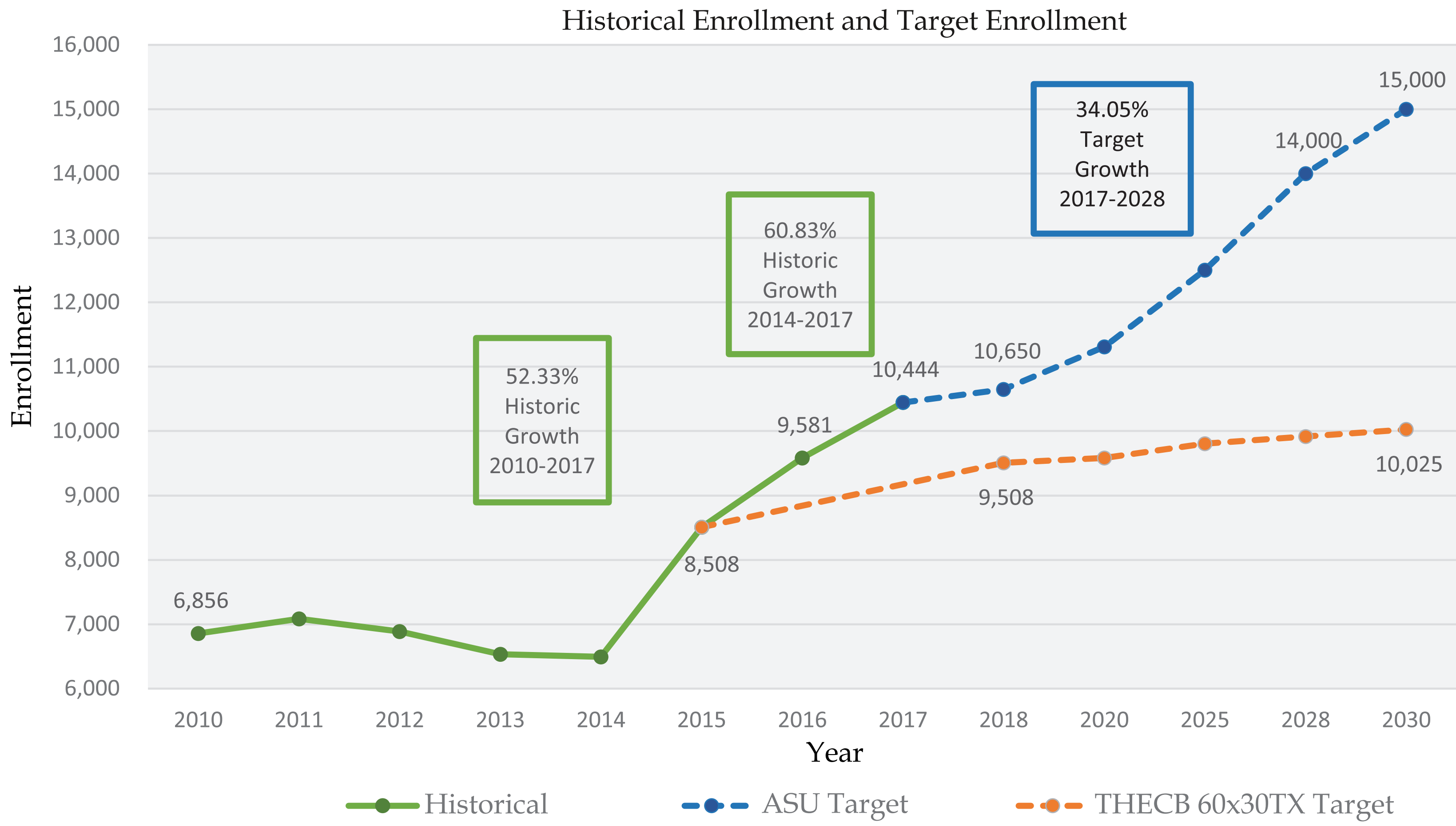
Historical Enrollment and Target Enrollment

The University's enrollment had grown steadily for the 20 years leading up to 2015. Fall 2015 marked a significant increase in overall enrollment growth. With increases in graduate students, new first-time freshmen, dual credit students and retention, fall 2016 enrollment reached 9,581. Student enrollment is currently around 10,400, with the change in enrollment at approximately 60% from fall 2014 to fall 2017.

With direction from President Brian J. May and his executive leadership team, Angelo State University has set an enrollment goal of 14,000 by 2028 and 15,000 by 2030, based on proven strategies that fulfill public demand while balancing the educational success of its students. The Texas Higher Education Coordinating Board, as part of its Texas Higher Education Strategic Plan, 60x30TX, has set target enrollment for ASU at 10,025 by 2030.

As outlined in ASU's strategic plan, "Envisioning 100 Years & Beyond," a compounded annual change of approximately 2.82% is required to meet the 15,000-enrollment goal by 2030. Cumulative target growth from 2017-2028 will be 34.05%.

ASU's goals are to improve enrollment and retention by: growing the dual credit program; expanding the transfer student population through implementing new fully online programs; and improving the second-year retention rate by a multilayered approach.



Sources: Texas Higher Education Coordinating Board 60x30TX Enrollment Forecast 2017-2030 (January 2017)
Angelo State University Strategic Plan: "Envisioning 100 Years & Beyond"

Enrollment by Gender

The University has 53% female and 47% male first-time degree-seeking students. This ratio has stayed fairly constant over the last ten years and is similar to ratios at other Texas public universities.

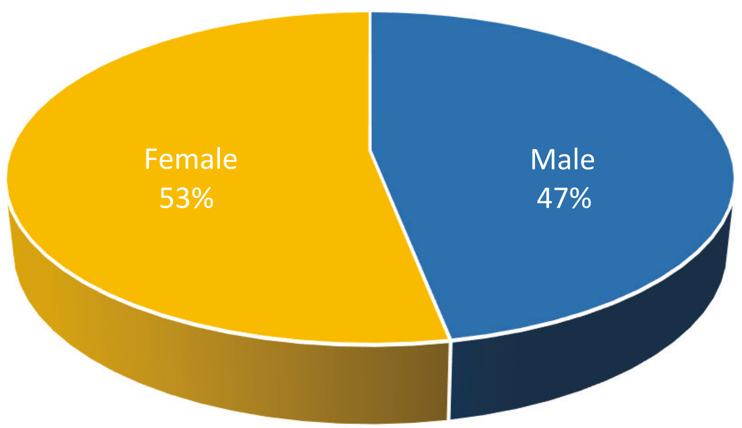
Enrollment by Level

The University has a high dual credit population at 28% of total students. Freshmen, sophomores, juniors and seniors are distributed at 18%, 12%, 11%, and 15%, respectively; thereby total undergraduate students are about 56%. Post baccalaureate and masters are 16%. This distribution of undergraduate to graduate students has changed dramatically in the last three years. With the addition of a dual credit offsite program, undergraduate enrollment has grown 20.4%. The retention of freshmen from fall to spring has dramatically increased to 89% due to the implementation of Signature Courses and support systems that assist students at various levels of academic ability.

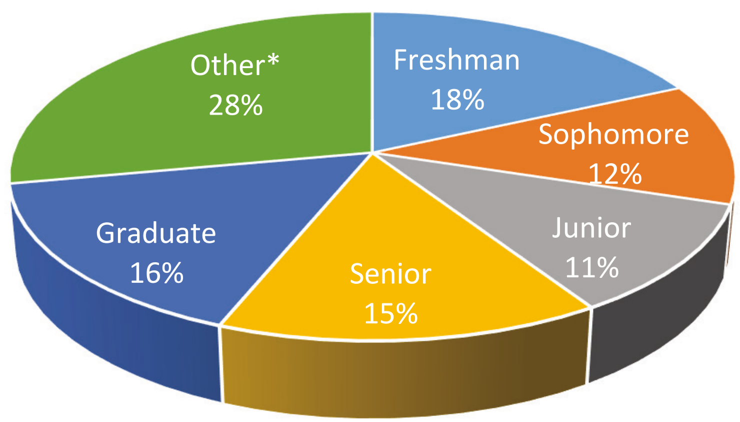
Enrollment by College

As university enrollment has grown, the University has established new programs in areas such as civil engineering. The College of Arts and Humanities offers a great deal of the core curriculum which augments degree program enrollment. The University has created new departments such as the David L. Hirschfeld Department of Engineering housed in the College of Science and Engineering. The Archer College of Health and Human Services also added two new departments - Health Science Professions and Social Work.

Enrollment by Gender

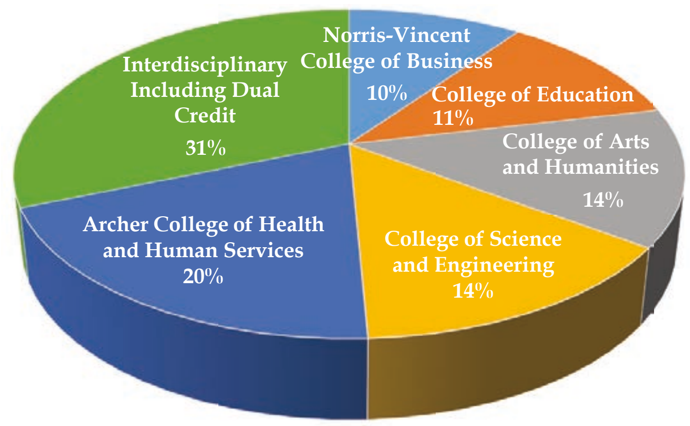


Enrollment by Level



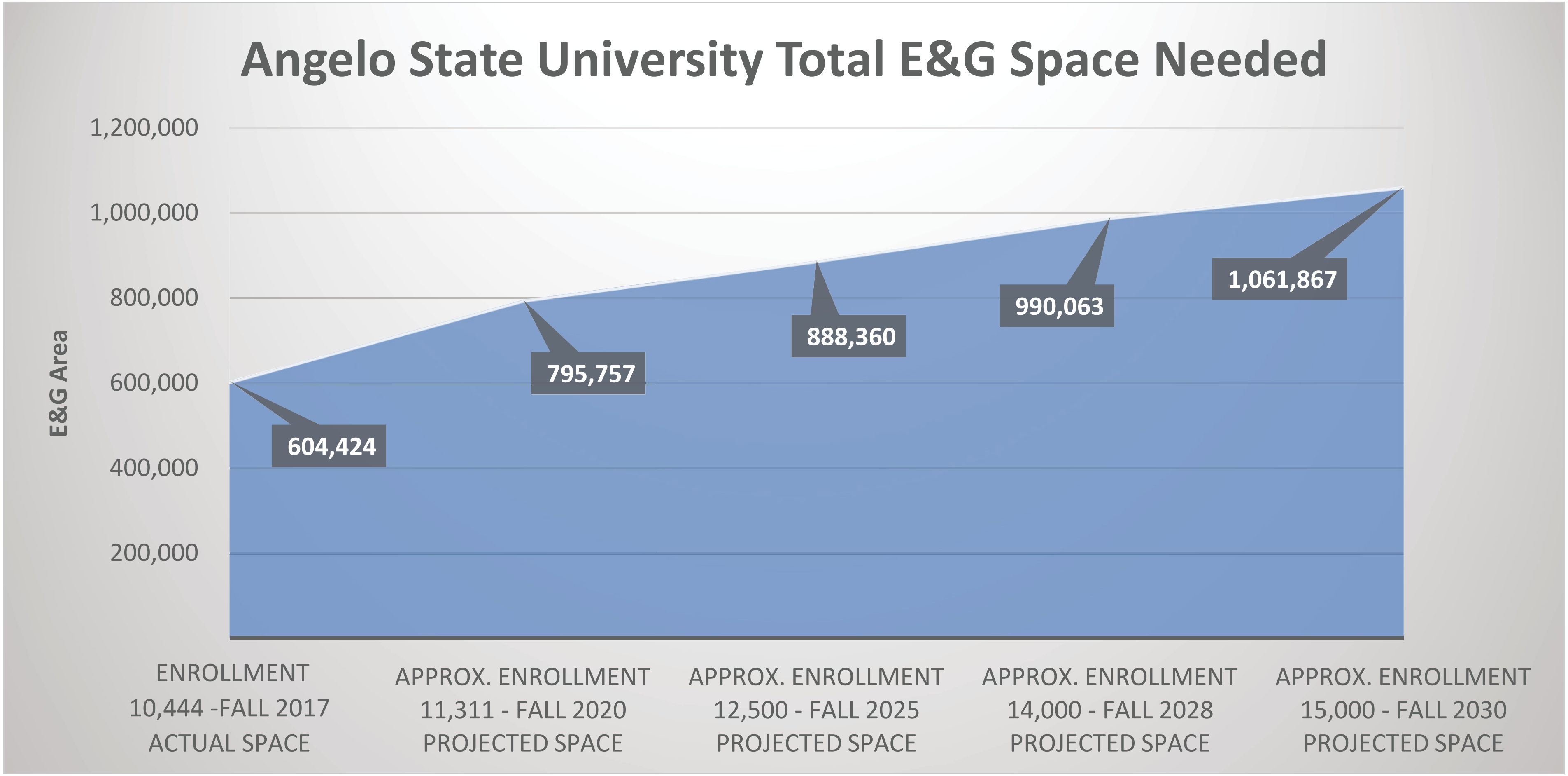
** Includes offsite dual credit students*

Enrollment by College



Space Planning Issues

Based on the THECB Space Projection Model, in order to accommodate student enrollment targets of 14,000 in 2028 and 15,000 in 2030, the University will need to gain over 386,000 E&G square feet by 2028 and then an additional 70,000 by 2030. In addition to the academic, or E&G, space the University will require, there are a series of important associated and support spaces known as non-E&G space. For the purposes of this report, housing, dining, auxiliary, student services, student recreation, athletic spaces, and their associated infrastructure are included under this definition.



Master Plan Goals

Challenges for the Master Plan

As the Master Plan aspires to be a comprehensive document, it provides information and insight into programmatic, physical planning, social, and financial issues affecting the university community. Each of these criteria presents its own set of challenges although, in reality, many of them are interrelated.

For example, on the programmatic side, perhaps the greatest challenge is gaining an understanding of what space is required to accommodate academic growth. This challenge is complicated by the desire of the University to aggressively expand its online and dual credit offerings as components of its enrollment. This additional development forces the University and consultants to quickly measure the potential impact of the growth through online education, and based on experience and research, to make educated judgments about space needs.

From a social standpoint, the University desires to increase the percentage of students on campus in order to improve the activity and quality of campus life. This model ties into the physical planning aspect as questions arise about where to locate additional housing. One of the challenges is to locate additional housing to meet university goals and at the same time locate it near activity centers, or provide new activity centers that are convenient to all housing. Financial considerations are also layered onto this analysis, as challenging economic times make the provision of additional housing even more difficult than it would ordinarily be.

The physical planning aspect must make all the other criteria flow into a single harmonious concept that has balanced all of the trade-offs inherent in these dissimilar criteria and arrive at a plan that all university stakeholders can support.

The University expects that the collaboration in overcoming challenges in creation of the plan will continue in a similar fashion during the implementation of the plan.

Goals - Programmatic

The major programmatic goals for the Master Plan are to:

- Assure that facilities are adequate for the accommodation of 14,000 students by 2028. Many of these will be online students.
- Provide more spaces for the support of distance education curricula including faculty and IT space.
- Provide adequate spaces for student support, services, activities, and administration.
- Provide appropriate space for the successful incorporation of the THECB 60x30TX initiative.
- Display projected program space requirements with associated enrollment projections rather than with time (by year) projections.

Goals - Physical

A. Accommodate the Building Program

1. ***Plan facilities for 14,000 students***
   The Master Planning Committee has set a target of 14,000 students by 2028. This is an ambitious goal, but its achievement will have positive effects on campus life, academic priorities, and university funding. The facilities and infrastructure needed to accommodate a larger student body will be the primary force behind most facets of the Master Plan.

2. ***Accommodate additional students in campus housing***
   Enhancing campus life is a crucial aspect of this Master Plan. By housing students, the campus will become a livelier, more fulfilling place. While ASU grows, it will maintain the requirement for new first-time (NFT) students to reside on campus. The increased number of students on campus will also positively impact recreational facilities, food service, and other student services disproportionately greater than the increase in the total student population.

3. ***Develop a cohesive infrastructure expansion scheme***
   Buildings are only a part of a successful master plan. Roadways, safe walkways, utilities, signage, technology, and other parts of the campus infrastructure are equally important. The Master Plan should address the infrastructure-related implications of the goal for growth.

B. Maintain a Strong, Active Campus

1. ***Focus the campus core on academics***
   Academics are of primary importance to ASU, and the Master Plan should strengthen the existing academic area. Student services, housing, pedestrian walkways, and other facilities should support the academic core. This has implications for where buildings are sited in the Master Plan.

2. ***Create places where students feel comfortable congregating outside***
   Actively managed outdoor and indoor spaces are only part of a healthy campus life. Students, faculty members, and staff should also have access to outdoor seating and recreation areas around campus where they can gather, study, and play. There should be a variety of spaces, both formal and informal, so that groups and individuals with a multitude of preferences are accommodated. Some of these kinds of spaces were built recently or are under construction now, and that trend should continue.

C. Improve Pedestrian Experiences

1. ***Create and enhance a series of strong, well-used centers along the mall***
   The mall should not serve just as a corridor leading from one end of the campus to the other; rather, it should act as the connection between a number of activity-oriented spaces and facilities. The level of campus activity is one of the best measures of the success of a university in attracting and retaining students. The University can enhance campus life by carefully siting facilities like recreation centers, student services buildings, and food service centers to create strong areas of activity. These centers of activity, some of which are already under construction, should be located in conjunction with the academic core and should support the academic goals of the institution.

2. ***Reinforce the pedestrian-friendly qualities of campus***
   Creating a pedestrian-friendly campus requires more than just paving; it also entails attractive spaces, useful furniture, a high level of activity, and a comfortable scale. The University will focus on walkways, outdoor and indoor spaces, and other pedestrian-related amenities described in the Master Plan accordingly.

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CENTENNIAL VILLAGE

Facilities Master Plan

Introduction

The main component of this report is the Facilities Master Plan. The plan modifies and adds to existing campus facilities in order to create a sense of place and better fulfill the mission of the University. The plan proposes physical developments, such as new buildings and renovations to existing buildings, as well as new parking and site development. The plan is divided into four development phases based on project priorities.

Angelo State University Master Plan

Building List

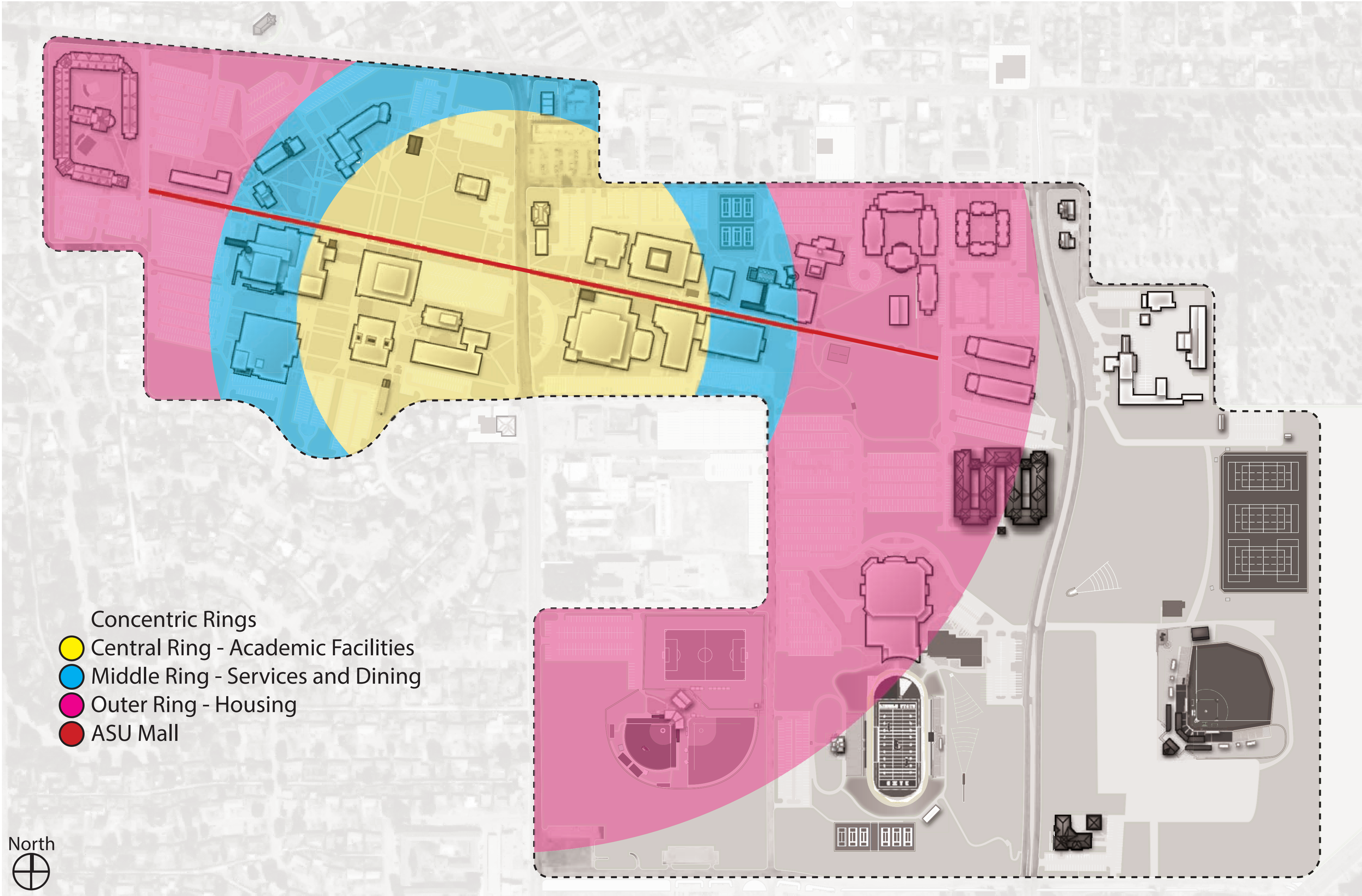
1. Centennial Village Residence Hall
2. Carr Residence Hall
3. Hardeman Student Services Center
4. General Services Building
5. **E&G Services Building**
6. Houston Harte University Center
7. Carr Education-Fine Arts Building
8. Sol Mayer Administration Building
9. **Student Building**
10. Porter Henderson Library
11. Academic Building
12. Biology Greenhouse
13. Cavness Science Building
14. Science III Building
15. **Stephens Chapel**
16. **Academic Science Building**
17. **Academic II Building (After University Clinic Demolition)**
18. Administrative Support Center
19. **Angelo State University Mayer Museum**
20. Herrington House
21. Center For International Studies Building
22. Health and Human Services Building
23. Ben Kelly Center for Human Performance
24. Vincent Building
25. Einstein Bros. Bagel Building
26. Mathematics-Computer Science Building
27. Rassman Building
28. Hunter Strain Engineering Laboratories
29. **Academic III Building (After Vanderventer Tennis Courts Demolition)**
30. Central Plant
31. Food Service Center
32. Concho Hall High Rise Residence Hall
33. **Tennis Courts**
34. Sand Volleyball Courts (Recreation)
35. Pavilion
36. **Plaza Verde Residence Hall**
37. Vanderventer Residence Apartments
38. **Robert and Mary Massie Residence Halls**
39. **Texan Residence Hall**
40. Junell Center
41. University Sports Medicine Clinic
42. **Indoor Softball Batting Cages**
43. Mayer Softball Stadium
44. Varsity Soccer Field
45. Softball/Soccer Concessions
46. Intramural Softball Field
47. **Sand Volleyball Facility (NCAA)**
48. Mayer Press Box at LeGrand Stadium
49. LeGrand Stadium
50. Tennis Courts
51. LeGrand Stadium Eastside Concessions/ Restrooms
52. LeGrand Alumni and Visitors Center
53. **Indoor Athletics Facility**
54. 1st Community Credit Union Stadium
55. Norris Baseball Complex
56. **Golf Facility**
57. Intramural Fields
58. Psychology Lab
59. Facilities Management
60. Residence - Guest House
61. Residence - Facilities Management Director
62. South Harrison Building
63. Reidy Building (Leased)

NOTE:
Bold Denotes New Facilities

Campus master plan

Planning Structure

The conceptual organization of the Master Plan is essentially three concentric rings. Naturally, the Master Plan focuses academic development in the area centered near the intersection of South Johnson Street and the mall. The core of the plan, the central ring, is Academic Facilities. The middle ring is Services and Dining. The outer ring is Housing. The linear, east-west mall splits the rings through their concentric center. The linearity of the mall emphasizes a natural flow of pedestrian traffic as the day progresses. Early in the morning, pedestrian traffic is evident between the outer ring and the middle ring as students get breakfast and prepare for classes. In late morning to early afternoon, most pedestrian traffic is concentrated at the academic core during class times and as students travel to and from the middle ring for lunch or a "between class" snack. Finally, the pattern reverses in late afternoon to early evening, when the students retire from classes, hit the gym, visit their favorite recreation area or enjoy dinner at the Houston Harte University Center (UC) or the Food Service Center. This flow works well for campus, and the University intends to build upon this.



Facilities master plan concentric rings

Planning Sector: Academic

As mentioned in the "Planning Structure" section, the Academic Sector is the heart of campus, centered at the mall and South Johnson Street and comprising the center ring of the three concentric rings. The Academic Sector, or core, encompasses all ten of the main academic buildings on campus. It also contains the Porter Henderson Library and the Ben Kelly Center for Human Performance. The ten main academic buildings are:

- Cavness Science Building, constructed in 1968
- Academic Building, constructed in 1968
- Carr Education-Fine Arts Building, constructed in 1976
- Rassman Building, constructed in 1983
- Vincent Building, constructed in 1985
- Mathematics-Computer Science Building, constructed in 1996
- Science III Building, constructed in 2005
- Hunter Strain Engineering Laboratories, constructed in 2017
- Health and Human Services Building, constructed in 2018
- Biology Greenhouse, constructed in 2018

Operated by the ASU Agriculture Department, the Management, Instruction and Research (MIR) Center is a key academic facility located about six miles north of San Angelo on the north shore of O.C. Fisher Lake. The MIR Center sits on 6,000 acres of range and farm land and includes everything from a feed mill and traditional laboratories to a food product development lab and an elevated multimedia classroom. With the 2014 addition of the Mayer-Rousselot Agriculture Education Center, the facilities provide opportunities to enhance practical agriculture education with diverse, hands-on learning.

Though the University intends to pursue aggressive enrollment growth, a large portion of that growth is expected to come through online education, dual credit classes and remote teaching locations. Thus, fewer new large academic buildings are required on the main campus than proposed in the previous Master Plan Update. However, the current academic buildings will continue to be updated to keep the University on the cutting edge of technology and education. One of those updates is transpiring at the Academic Building, as it undergoes a major exterior renovation. This project is included under the first priority phase.

By continuing to increase space utilization in academic facilities, the University intends to improve efficiency of existing academic spaces and reduce the need to build new, yet marginally utilized facilities. Nevertheless, this Master Plan Update indicates three smaller, new academic buildings near the northwest corner of the South Johnson Street–mall intersection.

Management, Instruction and Research Center

Under the first priority phase, the new Angelo State University Mayer Museum will house 12,200 square feet of E&G space of its 18,600 net assignable square feet (NASF). The facility will contain the West Texas Collection's consultation and archive spaces. The West Texas Collection is a collection of historical and genealogical manuscripts, records, books, and pictorial and other related materials, which focuses on the general history of West Texas, including events, families, businesses and organizations. The ASU Mayer Museum will also house flexible exhibit galleries that can accommodate formal banquets for over 200 guests. On the east end of the building, a Visual Arts wing will house a ceramics lab and a painting and drawing studio.

The University intends to improve science and engineering facilities in its second and third priority phases. The Cavness Science Building, constructed in 1968, continues to receive significant updates; however, an addition of a new, state-of-the-art science facility is needed. A new 50,000 E&G square foot


Leading the flock at the MIR Center

(52,000 NASF) science facility (Academic Science Building) proposed under the second priority will house labs, classrooms and offices for the College of Science and Engineering.

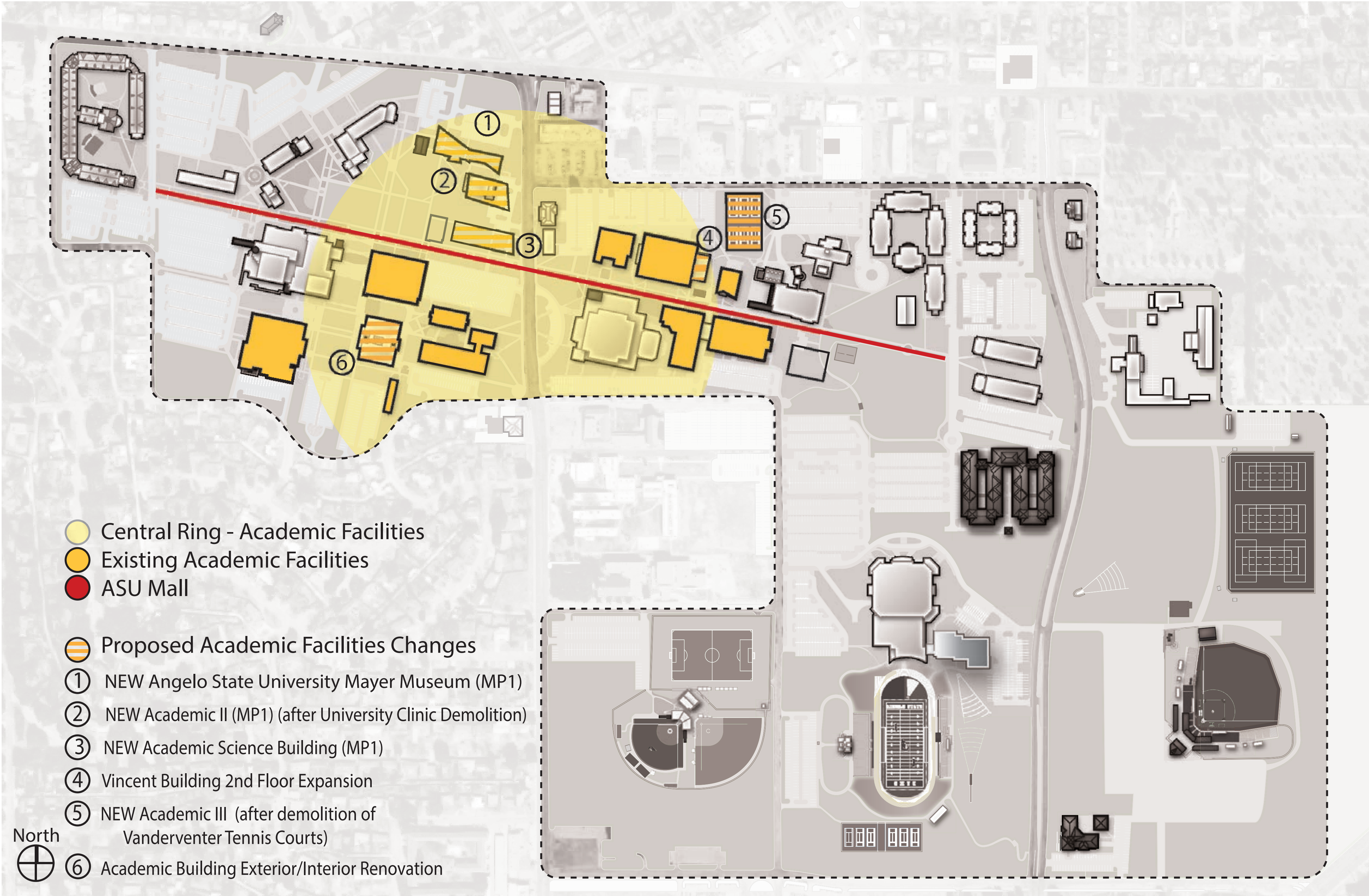
The Vincent Building was overcrowded until the completion of the Health and Human Services Building next door, allowing the Archer College of Health and Human Services to relocate. This also allowed additional room for departments to vacate temporary and leased spaces. Furthermore, this allows for current growth and space needs for the College of Science and Engineering. If yet more space is needed for this college, the eastern wing of the Vincent Building is designed to accommodate a second floor. This can be erected to add 3,132 E&G square feet (3,480 NASF) to the building and is included under the University's third priority phase.

The third new academic building (Academic II) is proposed to contain 20,120 E&G square feet (20,950 NASF) of general academic space and is considered under the fourth priority phase. This project will construct a new two-story building to support growth in the undergraduate programs. The building will include classrooms, computer labs, art labs and faculty offices.

If a fourth academic building (Academic III) is needed, the Vanderventer tennis courts adjacent to the Vincent Building and Hunter Strain Engineering Laboratories are in an ideal building location, still within the academic core. The tennis courts for general use could be relocated to the Campus Green area. Tennis courts for Athletics are located on the south side of campus adjacent to LeGrand Stadium.

Vincent Building

Architectural section rendering of the Angelo State University Mayer Museum
Image credit Kinney Franke Architects, AIA



Existing and proposed academic facilities

Planning Sector: Services

The Services Sector is within the middle concentric ring of campus between the academic core and the outer Housing ring. The Services Sector shares this ring with the Dining Sector. This sector includes a variety of service facilities, including: the Hardeman Student Services Building that houses student, faculty and staff services; Sol Mayer Administration Building; University Clinic; Center for International Studies; Houston Harte University Center (UC); and the General Services Building that houses the Print Shop, OneCard and Parking Services offices.

The UC incorporates a large dining facility, which is further outlined in the "Dining Sector" section, but it also houses many services, including University Business Services, Special Events Facilities and Services, Mail Services, the Campus Bookstore (Ram Central Station), the Campus Banking Center, Career Development, Affiliated Military and Veterans Services , the Eva Camuñez Tucker Center for the Study of Southwestern History and Culture, the C.J. Davidson Conference Center, and multiple event areas and conference rooms. The UC contains offices for Student Affairs, Student Life, Student Government, and Multicultural and Student Activities Programs, as well as the Center for Student Involvement. It is safe to say the UC is among the busiest places on campus from late morning until early afternoon on most weekdays.

The UC currently houses the Dr. Ralph R. Chase West Texas Collection. The collection is to be relocated to the new Angelo State University Mayer Museum, named in honor of Richard and Betty Mayer, to allow easier accessibility for the general public and to free up additional space on the second floor of the UC for much-needed conference rooms and meeting area space.

While the C.J. Davidson Conference Center and several other spaces on campus can support large events, there is not a dedicated up-to-date auditorium space on campus. Instead of building a standalone facility, the University may enlarge and update the existing auditorium at the Sol Mayer Administration Building to fill this role. It is located near the UC, which will allow events requiring multiple venues to take place in the two facilities, and parking is adequately located nearby. Careful study of potential difficulties with expanding and/or renovating that space is necessary; the layout of the existing space and accessibility issues may make a renovation project difficult. This project is considered under the third priority phase.

A new Stephens Chapel, named in honor of F.L. "Steve" and Pollyanna Stephens, is another first priority phase project of the Master Plan Update. This inter-faith chapel will provide a place of prayer and tranquility for all students and ASU community members. The Stephens Chapel will also be available for pertinent events to include worship services, weddings and funerals.

Looking to the future, the Master Plan is proposing a new police station on University-owned property in lieu of leased property. The Master Plan also addresses additional administrative and student services. The University has identified either a new building or renovation of the Carr Residence Hall on the west side of campus for these purposes. The new police building and the renovation of Carr Residence Hall are second priority projects.

Lastly, the demolition of the University Clinic is proposed to make way for the previously mentioned general academic building, under the fourth priority projects.

Carr Residence Hall

University Clinic

Planning Sector: Dining

The Dining Sector, along with the Services Sector, is within the middle concentric ring of campus, between the academic core and the outer Housing ring. This sector contains over a dozen dining concepts among four different facilities located in two general areas of campus. Both areas are where the mall intersects the middle (Services/Dining) ring, in response to the natural flow between the academic core and the outer rings. The four facilities housing dining locations are: the Houston Harte University Center (UC), Porter Henderson Library Learning Commons, Food Service Center and Einstein Bros. Bagels on the mall. Dining options inside the UC include Crossroads Café, renovated in 2016, featuring four distinctive dining concepts: the Ranch Smokehouse, an original brand inspired by ASU's Meat and Food Science program; crEATe; Revolution Noodle; and Chick-fil-A, which was expanded to more than double its original size. Additional food service venues within the UC include Subway, On The Go and a fully licensed Starbucks, which was added in 2016.

ASU's dining program incorporates mobile options via two Ram Carts that travel along the mall to conveniently provide grab-and-go selections to students on the move. In addition to campus dining, the food service facilities within the Dining Sector also support department and event catering services for all campus facilities, as well as the dining options that are available in concessions areas at athletic venues.

The Food Service Center renovation, scheduled for completion in 2019, is another first priority project. This project will bring new infrastructure, modern updates and community-focused circulation to a weathered 50-year old building. The new design will also create more flexibility among the concepts within the space, allowing the University to readily convert from residential to retail dining (and back) as needed to support the varying demands throughout the academic year.

Houston Harte University Center

Crossroads Café inside the Houston Harte University Center

Food Service Center prior to 2019 renovation

Roscoe's Den at Food Service Center prior to 2019 renovation

Architectural rendering inside renovated Food Service Center
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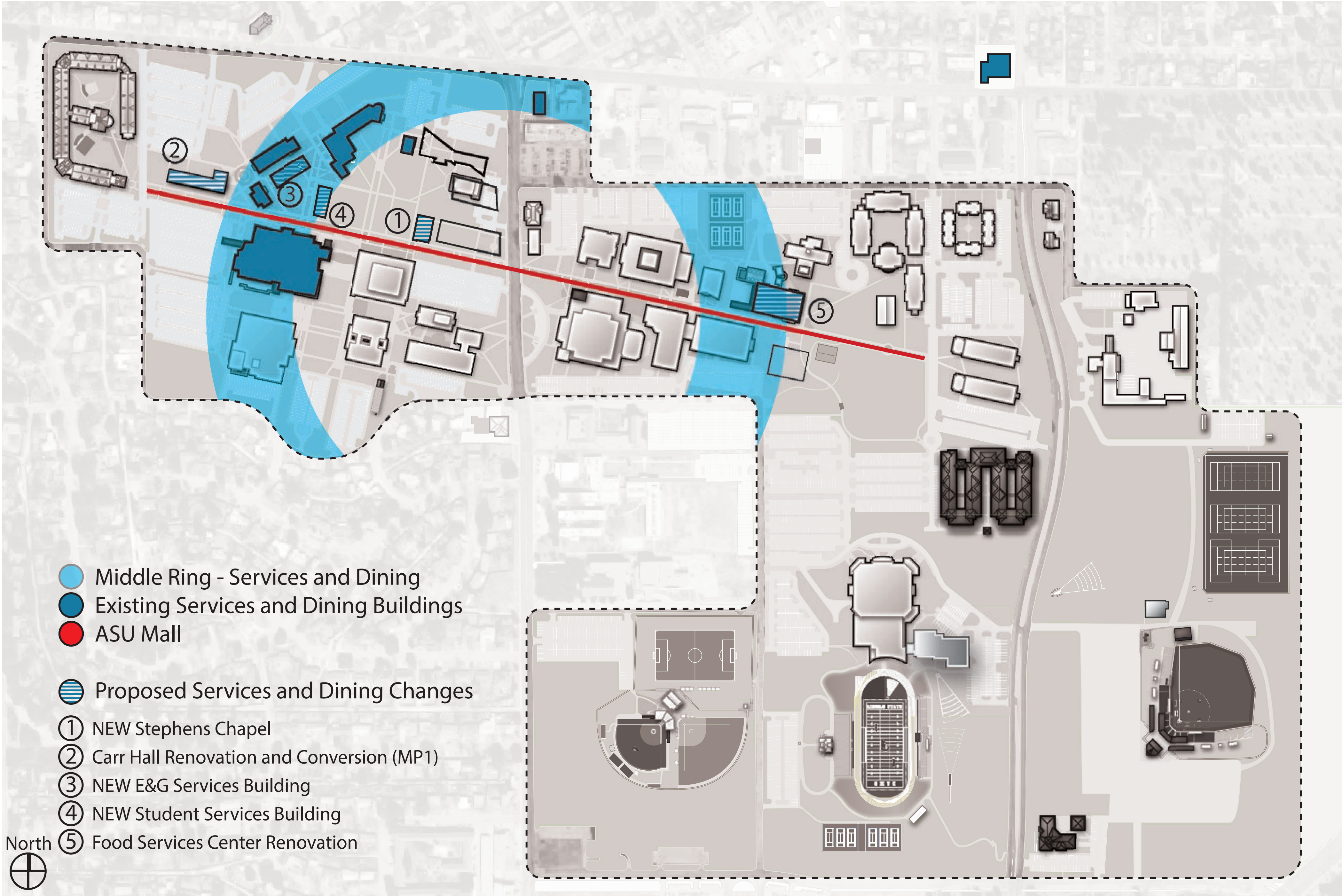


Existing and proposed services and dining facilities

Planning Sector: Campus Housing

Campus Housing is located along the outer ring of campus, with over half located around a large Campus Green situated to the east of the Food Service Center on the east end of campus.

The three largest halls were built within the last 15 years, Texan Hall (2003), Centennial Village (2008) and Plaza Verde (2011). Additionally, 162 new beds were added to Centennial Village in the summer of 2018. Over 1,600 beds are effectively located in new facilities, out of 2,213 total beds across campus.

The renovation of Concho Hall is included with the first priority projects. This project will completely overhaul the plumbing, HVAC and electrical systems within the high-rise, then reconfigure the rooms to a private-room floor plan providing a low-cost private bedroom option and maintaining the landmark building. This improvement is expected to add over 300 beds.

Concho Residence Hall to be renovated

The addition of three stand-alone buildings to the Plaza Verde complex is included in the second priority phase. These buildings would be supported by the Plaza Verde clubhouse and would each hold an additional 100 beds. These beds could be configured in the same manner as existing Plaza Verde rooms, or the number of beds could be reduced and private rooms could be offered.

The space between the existing Texan Hall complex and the Junell Center is ideal for an addition to Texan Hall. This project, adding roughly 200 additional beds, is included in the third priority phase.

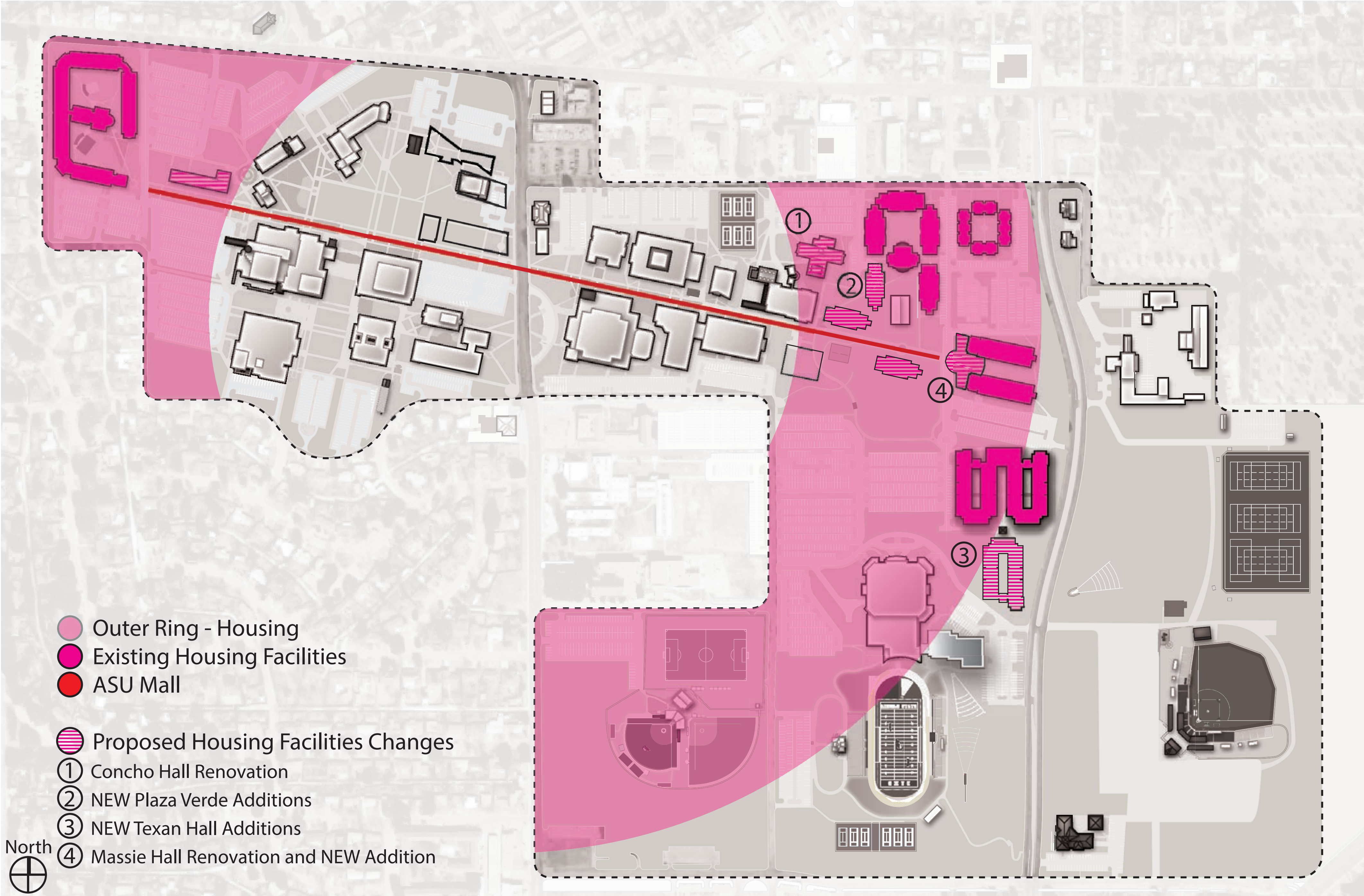
The Robert and Mary Massie Halls are relatively popular and can be suitably renovated in the future as needed, so they are retained in the Master Plan. The plan shows an addition to the halls, which will join them into one complex. This addition will house common spaces and some additional rooms. While the role of this addition as a means to unite the two halls and reduce personnel-related operating expenses is important, it is no less important that the addition is designed as a termination point for the mall.

Not all students desire the same type of housing, and the types of accommodations students prefer may change over time. A variety of housing types, including single suites of various sizes, as well as doubles and apartments, should be constructed as student preferences dictate. In fact, individual residence halls may possibly contain more than one housing type, though apartment-type housing may be separated from other types. Diverse housing choices will encourage students to remain in campus housing past their sophomore years.

Currently, many students leave because off-campus housing offers alternatives that are not available on campus. Construction of sufficient amounts of high-quality, apartment-like campus housing with amenities older students desire, including privacy and flexibility, would offer advantages of proximity and community, which non-university housing cannot.

Site for future wings of Plaza Verde Residence Hall

Robert and Mary Massie Residence Halls



Existing and proposed housing facilities

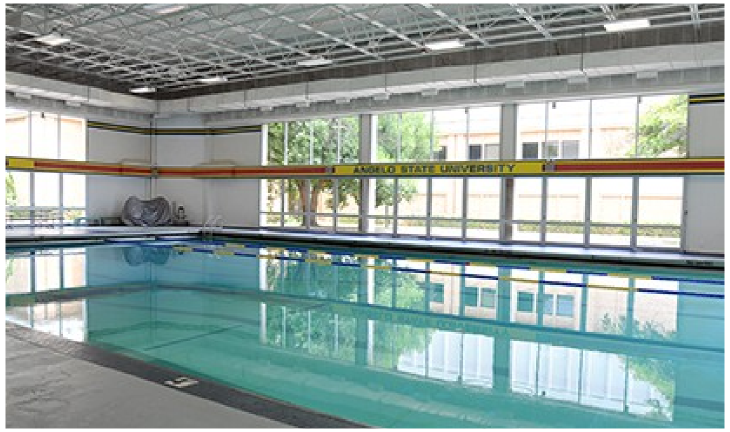
Planning Sector: Recreation

Campus recreational facilities play an important role in campus life, and as the enhancement of campus life is one of the primary goals in this Master Plan, the recreational facilities are carefully sited and sized, maximizing their positive impact on campus activity. The current location of the Ben Kelly Center for Human Performance (CHP) is favorable; it is near the center of campus, at the edge of the inner and middle rings, and has high-visibility components along the mall. It was expanded in 2011 and the gymnasium was renovated in 2018. The CHP will continue to be updated, expanded and refreshed in its current location to accommodate the bustling University Recreation programs.

The intramural fields on the east side of South Jackson Street were refurbished, including the addition of turf in 2014. The popular intramural fields host an abundant culture of activities, incorporating "open-use" activities, intramural sports, extramural sports and club sports.

The ASU Lake Facilities are located on the shore of Lake Nasworthy, fewer than five miles from the main campus, and include a club house, boat ramp, basketball court and sand volleyball pit. The location is operated seasonally by the Outdoor Adventures division of University Recreation to provide general use opportunities for students, faculty, staff and university guests. Among the amenities offered are mountain bicycle and kayak check-outs. As Outdoor Adventures programming continues to grow in popularity and student participation, additional opportunities may arise for further improvements at this location.

In the third priority projects list, the auxiliary softball field, near the Mayer Softball Complex, will be retrofitted with synthetic turf to host intramural/extramural softball activities and NCAA Division II (D-II) softball games during ASU-hosted tournaments.



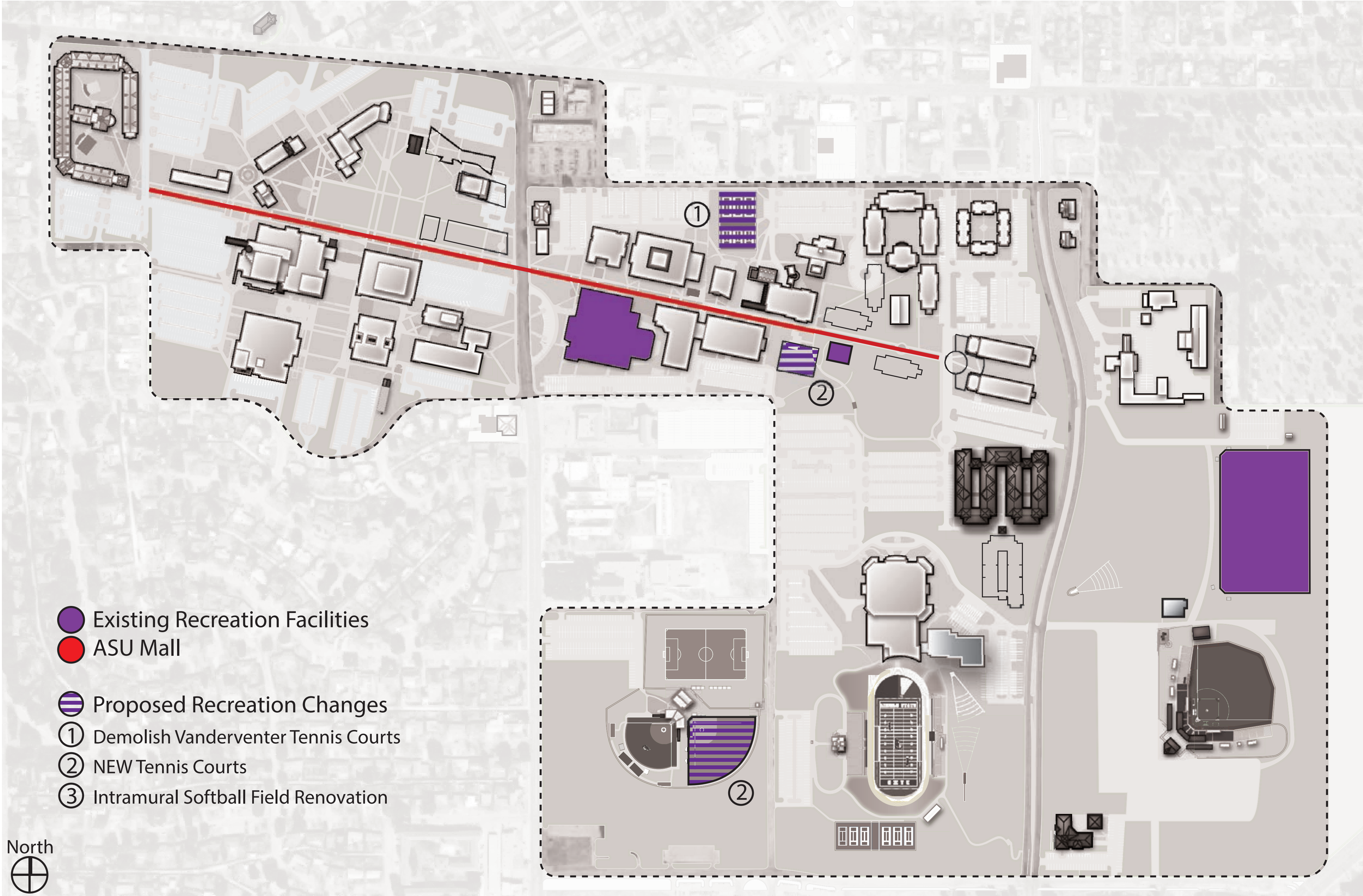
Pool facility at Ben Kelly Center for Human Performance


ASU Lake Facilities


Ben Kelly Center for Human Performance 2011 expansion


Canoeing on Lake Nasworthy at the ASU Lake Facilities


Interior of Ben Kelly Center for Human Performance



Existing and proposed recreation facilities

Planning Sector: Athletics

Since the last Master Plan Update, many improvements have been made to ASU's athletic facilities. One of the largest changes happened when the University made the historic move to play Rams home football games on campus, and in 2014, accommodated them at LeGrand Stadium. Between 2013 and 2018, LeGrand Stadium, which hosts the University's D-II track and field, women's tennis and football programs, underwent several additions, renovations and refurbishments. These improvements included: eastside stands, field lights and flatwork in 2014; westside stand seatbacks in 2015; a 2,300 square foot eastside restroom and concessions building in 2017; complete running track renovation in 2017; tennis court refresh in 2017/2018; the four-level, 7,200 square foot, Mayer Press Box in early 2018; and a 50-foot videoboard in late 2018.

Severe droughts brought pressure on the Concho Valley to reduce water consumption from 2010 to 2015. In response, ASU implemented synthetic turf projects at three of its four athletic fields: Mayer Stadium (softball) in 2013, LeGrand Stadium at 1st Community Credit Union Field (football) in 2013, and Foster Field at 1st Community Credit Union Stadium (baseball) in 2015.

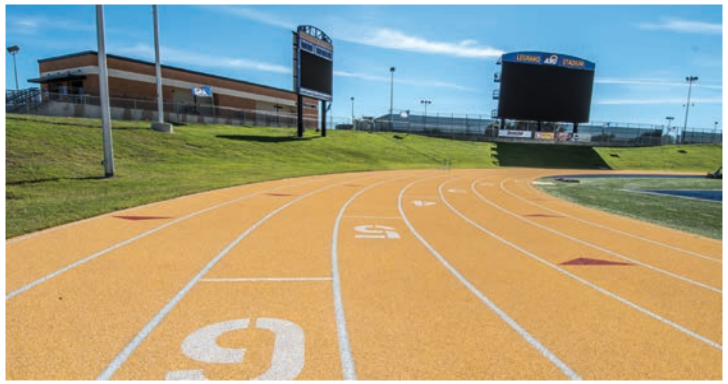
The University also refurbished the D-II baseball facility in 2015, adding new blue chair backs and a new outfield fence, and refreshing the support buildings and press box. The adjacent Norris Baseball Clubhouse, originally constructed in 2011, was expanded in 2018, augmenting the facility with a new entrance and batting cages.

Mayer Stadium was improved in 2015 with covered grandstands and a press box. The neighboring ASU Soccer Complex was supplemented with covered grandstands and press and officiating boxes in 2017. As a testament to the continued efforts of ASU's Office of Development and dedicated university supporters, nearly all of the aforementioned athletic projects were donor funded.

In 2017, ASU Athletics announced it would start its D-II women's tennis team. Since then, the courts were refurbished and a locker room was constructed for the ASU women's golf and tennis teams in the vacated Athletic Training space, completed in early 2019. The ASU Athletic Training Department relocated into the newly-constructed University Sports Medicine Clinic east of the Junell Center. The women's tennis team currently practices and competes at the newly-refurbished ASU Tennis Complex on the south end of LeGrand Stadium. A women's golf indoor/outdoor practice location for driving and putting is being planned in the second priority projects list.

Two new indoor facilities are being formulated with the third priority projects: a small facility for softball and large facility for track and field. Softball has identified a need of an indoor batting and pitching facility to the west of Mayer Stadium. With the gaining popularity of indoor track events and competition, ASU has considered an indoor track and field facility west of the Foster Field parking lot.

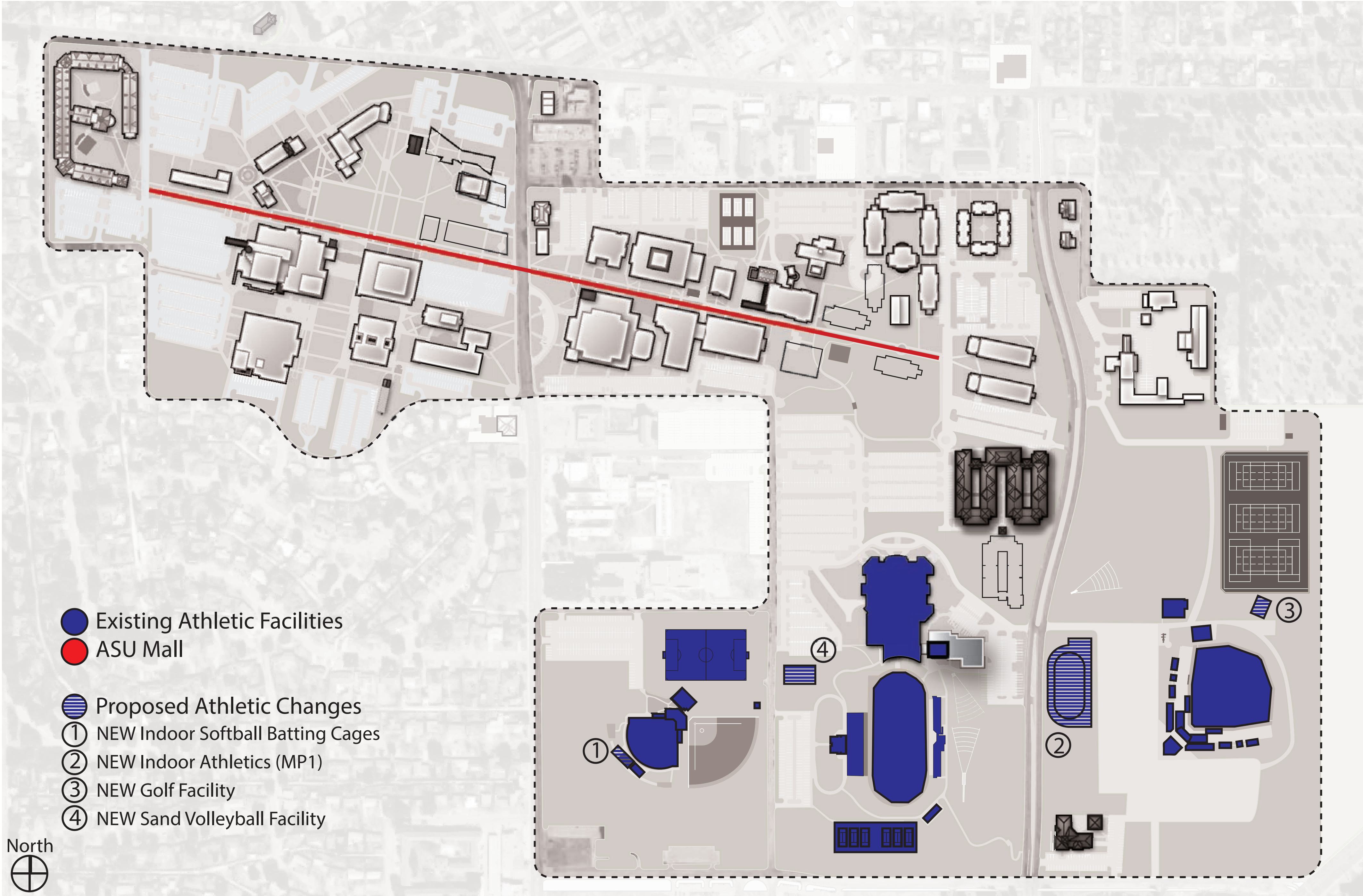
In the future, ASU Athletics looks to add women's sand volleyball to its NCAA programs. By adding this program, minor additions and modifications would need to be made in the Junell Center for locker rooms, and an outdoor game court would be needed. This facility has been identified in the Master Plan with the fourth priority projects.



Track at LeGrand Stadium at 1st Community Credit Union Field

Junell Center volleyball game

Potential site for new indoor Athletic Center



Existing and proposed athletic facilities

Planning Sector: Infrastructure

Logically, as the campus grows, infrastructure that supports the campus must grow with it. The University has identified five major infrastructure components that require planning:

1. Transportation Infrastructure – this is separately considered in the "Transportation and Campus Circulation" section
2. HVAC Plant Infrastructure
3. Stormwater Drainage and Pollution Prevention Infrastructure
4. Information Network Infrastructure
5. General Utility Infrastructure

HVAC Plant Infrastructure

ASU utilizes chilled and heated water to condition the air of seventeen of its larger buildings. In summary, this system uses a “hydronic” process at a “central plant” to chill and heat water; then circulates that water to each building’s air conditioning system. Chilled water, used to cool buildings, is tempered amongst six centrifugal chillers, totaling 4,000 tons of cooling capacity, which loosely translates between 1 and 1.5 million square feet of cooling capacity in San Angelo’s climate. Condenser water is circulated through 8 cooling tower cells to reject the chiller heat to atmosphere. Heated water, used to heat and dehumidify buildings, is heated with two 1,000,000 btuh, natural gas-fired boilers. The campus also utilizes a domestic hot-water system that delivers hot “tap-water” to many of the facilities across campus from six gas-fired, domestic water boilers. These three systems are conveyed from the east end of campus to the west end of campus in insulated pipes within a large, sub-surface, concrete tunnel.

Hot, dry, West Texas summers are taxing on the University’s hydronic system, particularly on the chilled water portion. The plant’s chilled water capacity and volume are adequate, both currently and to accommodate future expansion; however, the linear orientation of campus creates potentially massive issues in flow, pressure and efficiency, especially considering the University’s expansion plans. Virtually all of the campus’ chilled water supply/demand must travel down a single 18-inch loop, starting from the plant in central/east campus, into deep west campus, one-third of a mile away. This bottleneck causes a condition where the chilled water pumps must push the water from the plant at an inefficient high pressure. For example, the linear orientation of the campus creates a downstream supply issue for facilities further from the plant (e.g., Carr Education-Fine Arts Building). When buildings closer to the plant demand chilled water (e.g., Health and Human Services Building), the plant must work harder to satisfy the demand downstream, thus more inefficiencies. Another issue the University is facing is evaporation in the dated cooling towers at the plant. This is to be expected; however, the towers are increasingly becoming more inefficient, thus evaporating more water than desired. This is a large problem for the University and is counterproductive to its water conservation efforts.

Two logical approaches that the University has explored to solve the flow and pressure issues are: increase the main pipe size down the tunnel or add a second plant on the west end of campus. Increasing the pipe size is not feasible, due to the length of down time to replace thousands of feet of pipe in the tunnel. A separate parallel pipe could be installed to increase the capacity, but the tunnel would need to be widened to fit the redundant pipe. This would be an extremely costly and logistically difficult improvement. Consequently, adding a second plant on the east end of campus is the most plausible direction. Not only will this ease the “downstream” burden for the existing plant, it will create redundancy with the existing plant. When the new plant is operational and looped into the system, much-needed repairs can occur at the existing plant that are not feasible currently.

This was a solution discussed in the last Master Plan Update, but it has since been confirmed and detailed through a new study. The University hired Jose I. Guerra, Inc., Consulting Engineers, to complete an entire chilled water study of campus, evaluating the existing central plant facilities, equipment and chilled water distribution and providing guidance to aid in the planning of future improvements. The report and recommendations therein are attached in the Reports chapter.

Stormwater Drainage and Pollution Prevention Infrastructure

ASU is an authorized Small Municipal Separate Storm Sewer System under the Texas Pollution Discharge Elimination System (TPDES Small MS4) and thus permitted to discharge stormwater by the Texas Commission on Environmental Quality (TCEQ). This permit and authorization from TCEQ requires the University to conduct stringent and regular planning, controlling, inspecting and monitoring of the stormwater collection, drainage and discharge systems.

The University utilizes a mixture of surface run-off and sub-surface run-off stormwater conveyance systems across campus. Consciously controlling run-off, ASU has developed several detention/impediment measures throughout the years and will continue to do so as development occurs. For new building projects, ASU will lessen the site run-off from before the project occurred. When site confinements restrict a new project design to reduce options to control run-off, a co-located mitigation measure may be considered somewhere else on campus.

The University has hired Carter-Fentress Engineering/ SKG Engineering to complete an entire drainage study of campus, evaluating the existing stormwater facilities and providing guidance to aid in the planning of future storm drainage improvements. The report and recommendations therein are attached in the Reports chapter.

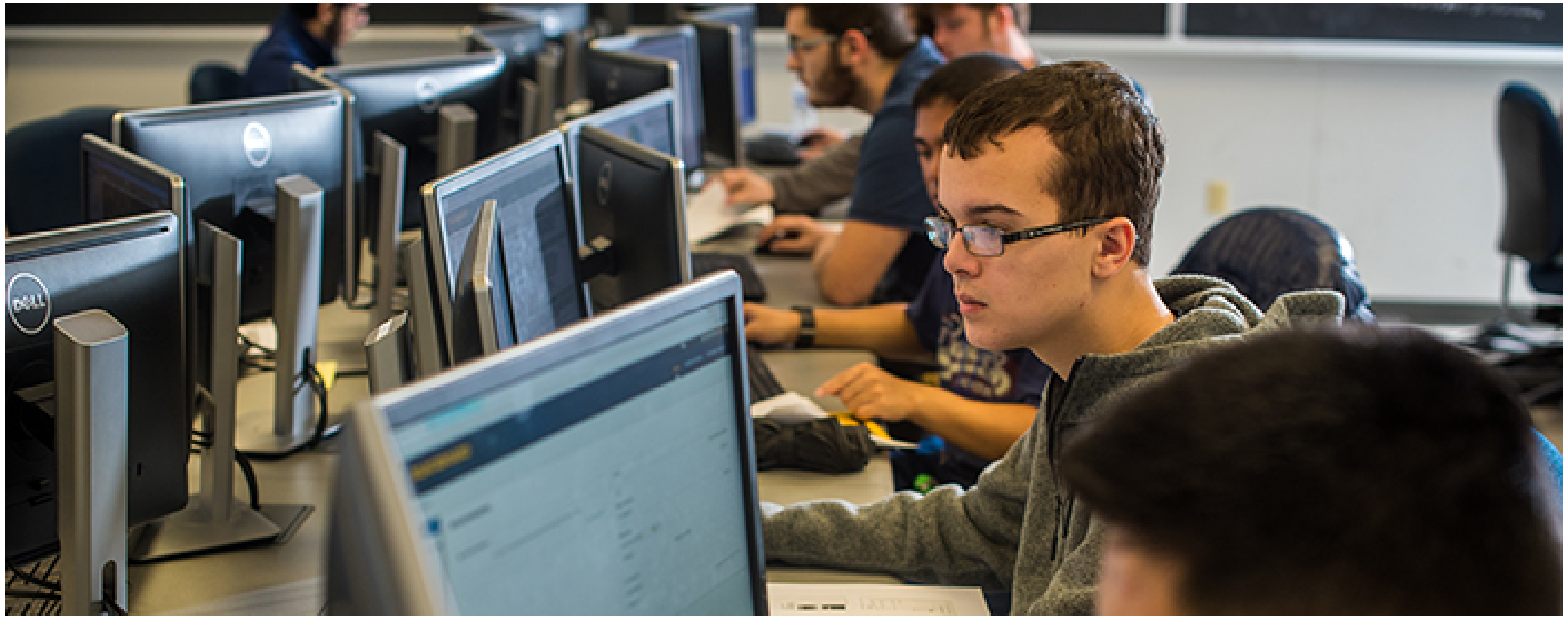
Information Network Infrastructure

The University has developed, over the years, an intricate network of high-speed fiber connections between buildings and its data center in the Rassman Building. Some of the key strategies to maintain and enhance the IT physical infrastructure are as follows:

- Provide a robust, resilient and reliable wired and wireless data network infrastructure of intra-building fiber and inter-building copper cabling.
- All new installations will be Category 6/6a or better copper wiring.
- Add pathways in all new construction projects for expansion and for fiber/copper infrastructure.
- Evaluate fiber or wireless connectivity from building to building to create a redundant ring for increased reliability.
- Continue to increase wireless capacity in all areas to meet the needs of mobile students, faculty and staff.
- Maintain and upgrade data center hardware to ensure scalability to meet future needs.
- Develop additional and redundant power, cooling and generator backup infrastructure in the Rassman Data Center to continue to meet the needs and availability of campus services.
- Evaluate secondary data center and redundant locations on campus for critical hardware and services.

The University has a complex physical environment with many locations to secure and protect, all in an academic learning environment. These environments support research, teaching and learning, clinical care, and administrative functions that require accessing or maintaining campus resources. The scope of the University surveillance and access control is to address protecting campus facilities that maintain University resources from physical and environmental threats in order to reduce the risk of loss, theft, damage, interruption or unauthorized access to those resources. Any new construction will attempt to add access control to all exterior doors, as well as classroom or office suite areas, as specified by the needs of the occupants of the building. Additions to existing buildings will continue to occur on a year-to-year basis as funding is identified and allocated for exterior doors, classrooms and office suite areas, as needed.

All surveillance installations are reviewed with the University Police Department designee to develop appropriate coverage of all new or existing spaces where network security cameras are requested. Any recorded surveillance data must be requested through the appropriate designee within the University Police Department.



Students working in a computer lab

General Utility Infrastructure

ASU's campus contains an intricate network of utilities, both privately owned by ASU and franchise/municipal-owned. The electrical service provider, American Electric Power Company, Inc. (AEP), has made several upgrades to the campus area recently, improving capacity for future expansion and redundancy for emergencies and maintenance. Atmos Energy Corporation distributes the campus' natural gas network and is currently upgrading the area's line capacity, which will allow for upcoming development. The City of San Angelo provides domestic water and sanitary sewer services to campus. The sanitary sewer grid and capacities in and around campus appear to be adequate for future expansion, but there are concerns with water flow and pressure - mainly on the west end of campus. ASU and the City are working in tandem during the design phases of the ASU Mayer Museum to incorporate a second domestic 16-18-inch water tap off of South Johnson Street. This will improve service to the west side of campus and accommodate a demand increase that is planned in that area.

Cooling towers at Central Plant from super slab

Planning Sector: Transportation and Campus Circulation

Public Transportation

San Angelo currently has a growing public transportation program. The University would benefit from additional transit connections to different parts of the city and surrounding communities. As ASU's enrollment grows, the need for the University to provide parking and roadway infrastructure will be mitigated by encouraging students to utilize mass transportation.

Currently, the University has partnered with the Concho Valley Transit District (CVTD) to provide a regularly scheduled, student-specific route named "Ram Tram." This route travels to needed places around San Angelo and stops on the east, west and central portions of campus. There are also three other CVTD stops near campus, as shown on the accompanying diagram. The University will continue to work with CVTD to meet the needs of the ASU community for regular routes and stops.

Pedestrian Circulation

The mall is the dominant pedestrian feature on campus, and it will remain so. The grounds along and around the pedestrian walkways will be landscaped in accordance with the design guidelines. With the addition of academic buildings along South Johnson Street, a reinforcement of two secondary walkways will prevail – one along South Johnson Street and the other at a current location from the Sol Mayer Administration Building to the Library.

Campus Roadways

South Johnson Street, Rosemont Drive and South Van Buren Street all penetrate the campus boundaries on a north-south pathway. Measures should be taken on these streets to calm traffic, especially where they cross the mall. Currently, only Rosemont Drive has raised pedestrian crossings where the street meets the mall, but the same is desired for the other two streets as well. South of Shamrock Drive, Rosemont Drive is city-owned. At the Rosemont-Shamrock intersection, an awkward parking lot entry compromises traffic flow. This could be improved by a round-about, which would need careful coordination considering storm drainage systems and City planning. Since South Johnson Street is still a city street in its entirety, careful coordination with the City of San Angelo will be needed to accomplish a raised crosswalk. The University has decided not to pursue the closing of South Johnson Street, as it is a vital traffic corridor. However, ASU will continue to pursue strategies in tandem with the City to increase pedestrian safety.

Vanderventer Avenue and portions of Dena Drive are other vehicular traffic routes that could be hazardous to pedestrians. Distinct crosswalks along these streets could reduce risks for pedestrians walking to and from parking lots to campus. Furthermore, consideration should be given to the addition of a cross-traffic warning system at the intersection of Vanderventer and South Jackson Street, which is a common route for maintenance vehicles.

South Jackson Street bisects the eastern end of campus, mainly separating athletic venues. Through cooperation with the University, the City of San Angelo installed an automated crosswalk warning system for pedestrians traveling across South Jackson Street near the Junell Center and the University Sports Medicine Clinic.

Raised Crosswalk at Rosemont Drive

Bike Paths

As the campus continues to develop, alternatives to walking will still be needed. Enhancing campus amenities for bicyclists and encouraging the use of bicycles, rather than automobiles, can reduce the infrastructure required for automobiles. Given the significantly higher costs of developing roadways and parking for automobiles versus developing paths and walks for bicycles and pedestrians, non-vehicular and mass transportation should be encouraged wherever feasible.

Proper accommodations for bicycles should be provided at all buildings, just as parking is provided for vehicles. Bicycle racks should be placed at all buildings, and walks will connect bicycle lanes and paths to buildings, as necessary. These amenities are particularly important at residence halls and places where students will gather, such as the UC or the Ben Kelly Center for Human Performance.

Bicycle at Porter Henderson Library

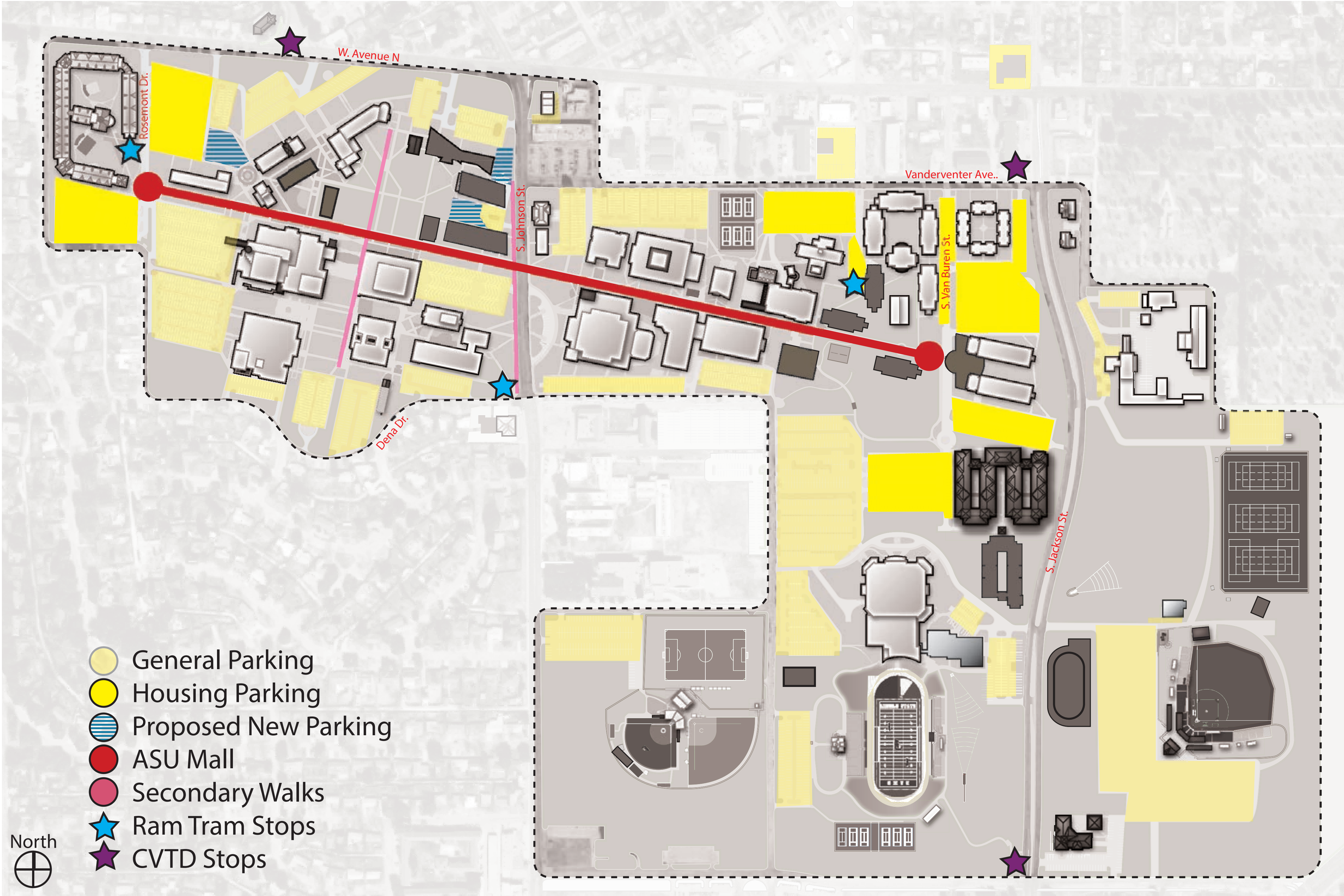
Parking

ASU currently has a parking surplus. As with most university campuses, however, ASU has a deficit of parking spaces in the areas where students and faculty prefer to park. This is, to some extent, both an unavoidable and an irremediable situation. If parking lots of sufficient size were to be intermixed with the academic core of campus, then the quality and continuity of the campus would suffer tremendously. Large garages could improve the situation from a functional perspective, but they can be unsightly and are not financially viable options. Parking is therefore mainly located in a ring outside the main facilities.

Roscoe and Bella with a parking permit

Three new parking lots are proposed in the Master Plan, all on the west side of campus. This effort will relieve pressure on the current academic, housing and staff lots in that area. The projected growth of the student population at ASU will obviously require commensurate growth in parking. As a larger percentage of the student body lives in campus housing, the number of spaces provided for those students must grow, as well. Because of the increasing demands on parking availability as the student population grows, ASU's current policy of allowing residential students to park only in spaces designated for their use should continue. At the build-out of the Master Plan, parking will be limited, and if residential students are allowed to park in general parking, then inefficiencies and parking shortages will result. Encouraging bicycling is another way to reduce this problem. In the Master Plan, parking has generally been located near housing in quantities sufficient to allow residential students to park near their residence halls.

Roscoe and the Ram Tram



Transportation and campus circulation map

Land Acquisition

The growth targets for the University will require the purchase of additional land. Land adjacent to the University will be considered for purchase as it becomes available.

ASU owns land southeast of the main campus that, because of its distance from the center of campus, is more useful for commercial and other uses than for directly University-related purposes. About 19 acres of this land are unused in this master plan. The unused land fronts on Knickerbocker Road, so it has the benefits of frontage on a heavily-traveled thoroughfare. Because the land is not used in the Master Plan, it is available for lease to a private developer or can be developed commercially by the University. ASU should retain ownership of this land in the event that it is required by future campus development, but any such need is well beyond the horizon of this Master Plan. Long-term campus development of the land could include parking, housing, athletic or recreational uses. It is also possible to create a larger leasable area by reconfiguring parking around the baseball stadium, should that prove financially worthwhile.

Project Priorities and Phasing

The Master Plan Update advocates for many new projects for the University, including infrastructure projects, new buildings and remodels/expansions to existing buildings. Land acquisition will be a part of the effort in order to make room for needed facilities. As explained in the Space Analysis chapter, the University is to continue to improve classroom utilization. Remodeling existing classrooms, tailoring to the needs of class sizes, is another strategy of capitalizing existing building square footage – although the University has done this in the past and will continue to use this practice in the future, not every project is listed.

The Master Plan Update proposes that the needed infrastructure and facilities be added in four phases, in proceeding order of need.

Phase I

The first phase is focused on projects that are underway and/or have begun the planning process, have been identified on the five-year master plan (MP1) for the Texas Higher Education Coordinating Board (THECB), and funding has been secured or requested for feasibility analysis. This priority phase is suggested to be composed of the following projects:

Academic Facilities

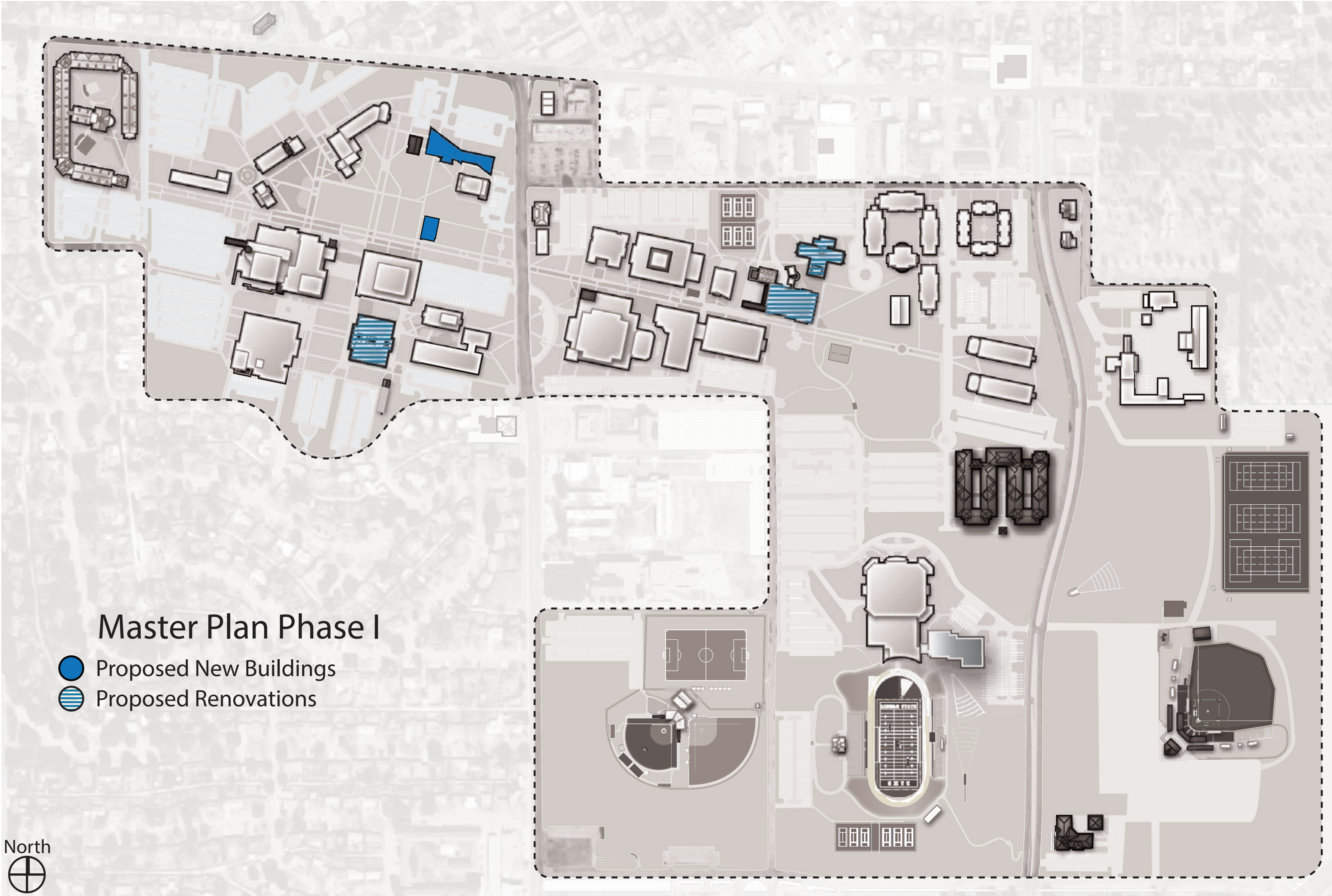
- Angelo State University Mayer Museum
    - Correlating Projects: This will relinquish space in the UC for conference rooms and in the Carr Education-Fine Arts Building for additional visual arts labs.
- Academic Building Exterior Remodels

Services and Dining Facilities

- Stephens Chapel
- Food Service Center Renovation

Housing Facilities

- Concho Hall Renovation (estimated 300-bed addition)



Phase I site plan

Phase II

The second priority phase projects have been identified on the five-year master plan (MP1) for the THECB and spatially identified for locations on campus. Funding and approval have not been finalized for these projects. This priority phase is suggested to be composed of the following projects:

Academic Facilities

- New Science Building
    - Correlating Projects: Cavness Science Building spaces will be free to renovate if labs relocate to new building.

Services and Dining Facilities

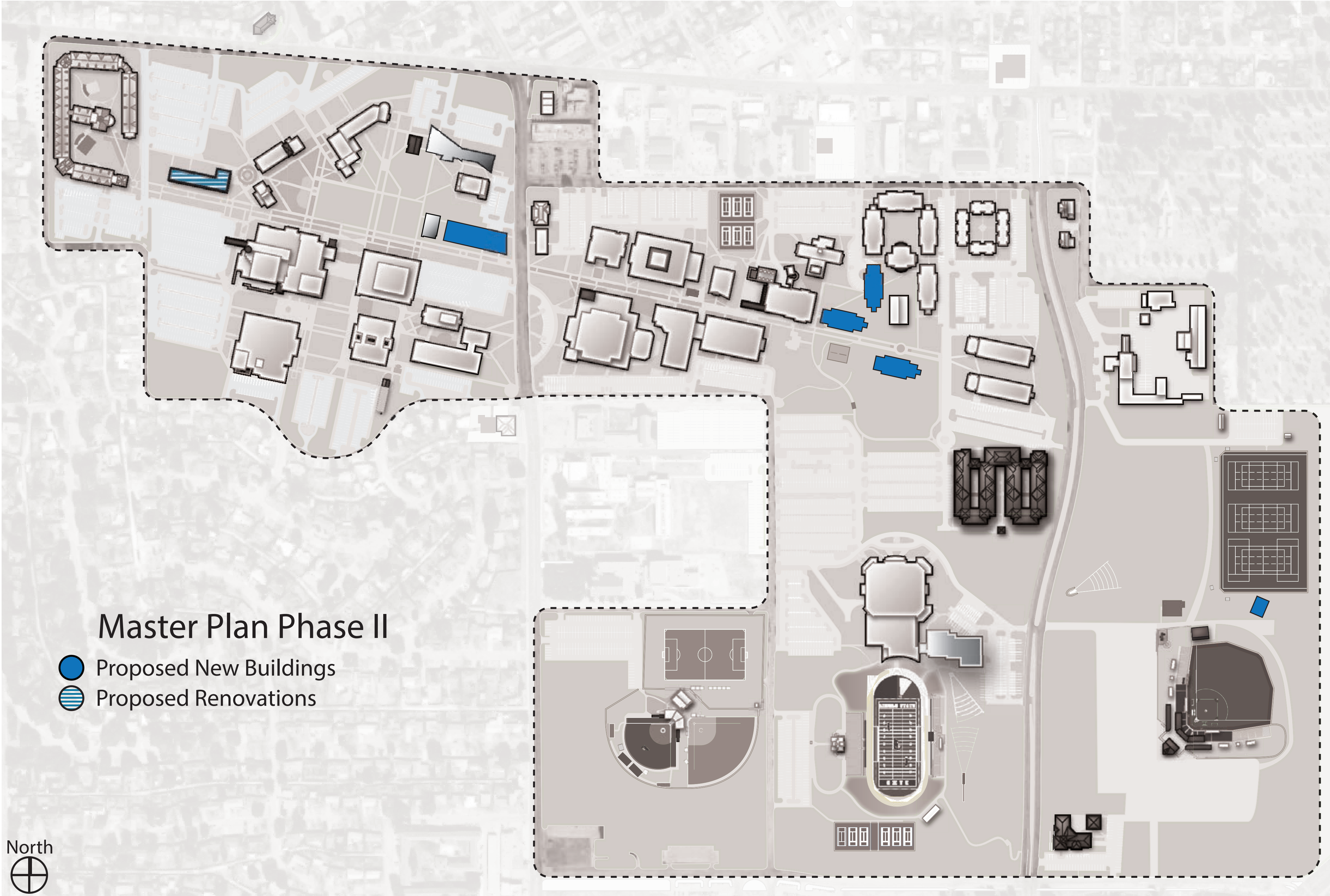
- Carr Residence Hall Conversion (to Police Facility and Services Offices)
    - Correlating Projects: Plaza Verde Phase 2 may need to be completed prior to this project in order to maintain adequate bed capacity.

Housing Facilities

- Plaza Verde Phase 2 (300-bed addition)

Athletic and Recreation Facilities

- Golf Practice Facility



Phase II site plan

Phase III

The third priority phase projects may have been identified on the five-year master plan (MP1) for the THECB, and campus locations are pending. Funding and approval have not been finalized for these projects. This priority phase is suggested to be composed of the following projects:

Academic Facilities

- Vincent Building Second Floor Expansion

Services and Dining Facilities

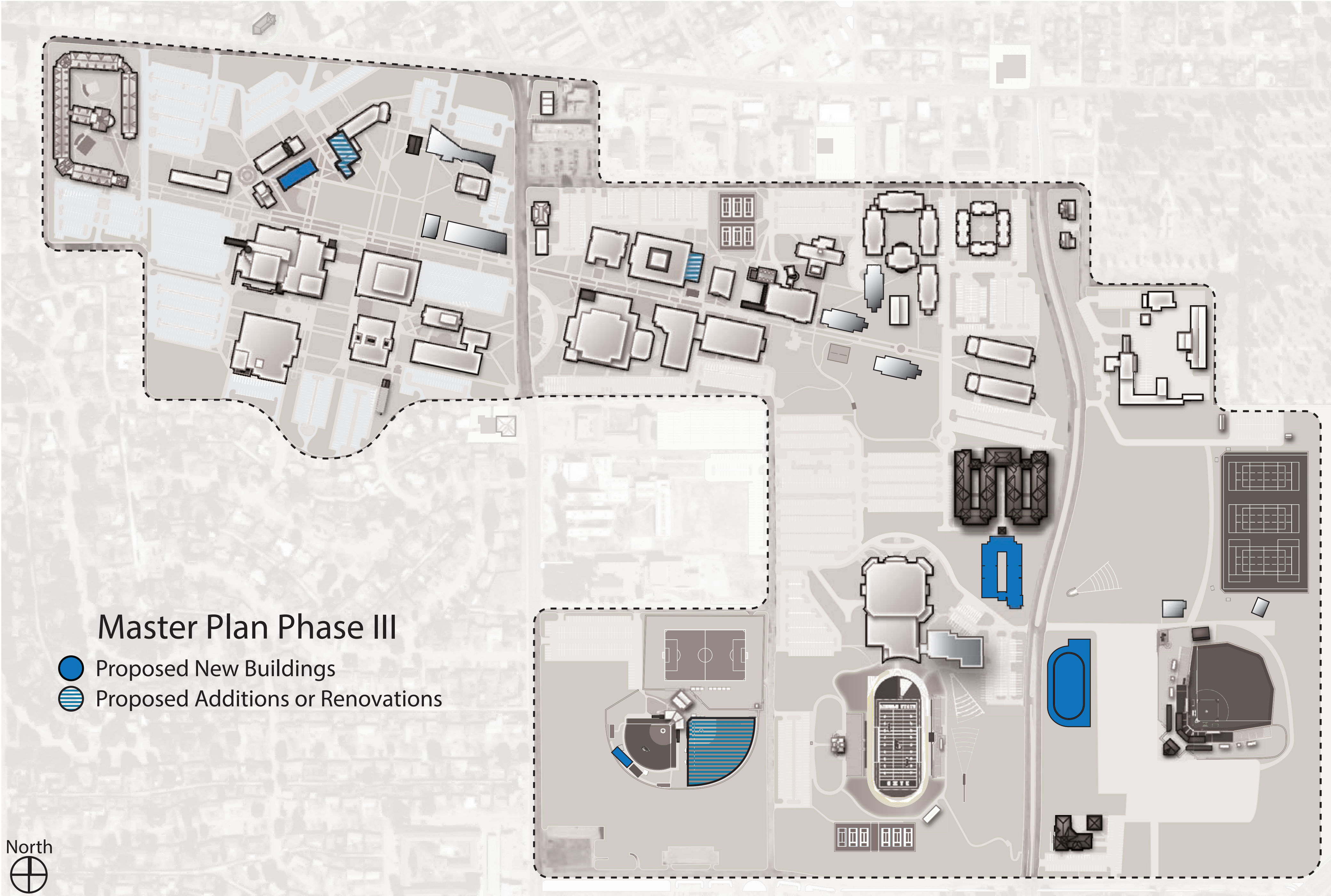
- ASU Auditorium Renovation
  (Sol Mayer Administration Building)
- E&G Service Building

Housing Facilities

- Texan Hall Phase 2 (200-bed addition)

Athletic and Recreation Facilities

- Softball Recreation Field Renovation
- Indoor Softball Batting Cage Facility
- Indoor Track and Field Facility



Phase III site plan

Phase IV

The fourth priority phase projects may not have been identified on the five-year master plan (MP1) for the THECB, and campus locations are speculative. Funding and approval have not been analyzed for these projects. This priority phase is suggested to be composed of the following projects:

Academic Facilities

- New General Academic Building (Academic II)
  - Correlating Projects: Clinic Demolition will precede this project; Central Plant Phase III will precede and be in conjunction with this project.
- New General Academic Building (Academic III)
  - Correlating Projects: Recreation Tennis Court Relocation will precede this project.

Services and Dining Facilities

- Clinic Demolition
- Student Services Building

Housing Facilities

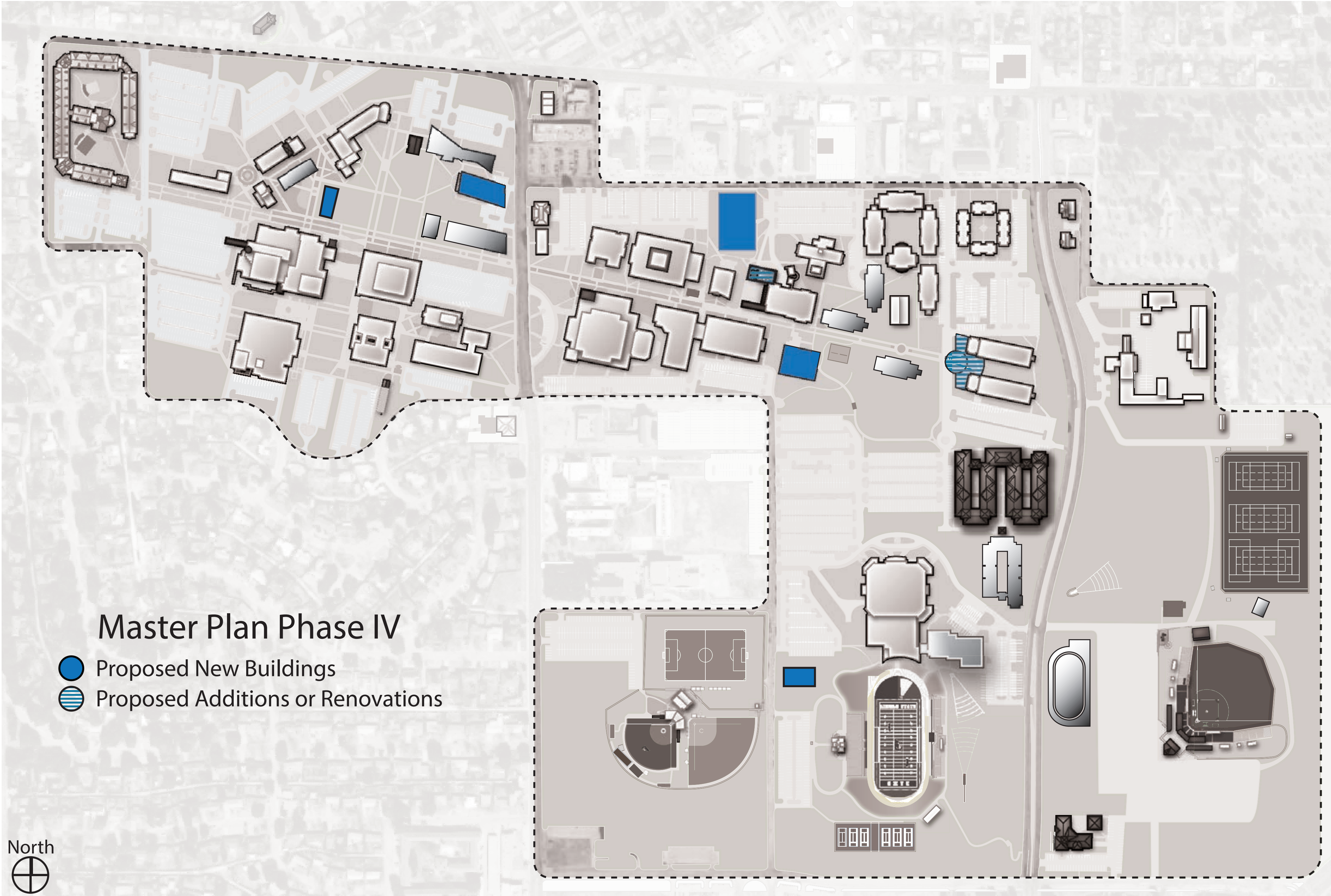
- Robert and Mary Massie Hall Renovation/Addition

Infrastructure Facilities

- Central Plant Phase III

Athletic and Recreation Facilities

- Sand Volleyball Competition and Practice Facility



Phase IV site plan

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CENTER FOR HUMAN
PERFORMANCE

Design Guidelines

Introduction

The Design Guidelines are intended to provide for an aesthetically coherent campus, through the advocacy of a framework of architectural and other physical design elements. The guidelines presented in this document represent an update to the original Design Guidelines published in 2005 and 2011.

Purpose

Useful architectural guidelines are not a prescriptive list of requirements and limitations. Rather, guidelines are the result of an analysis of existing practices intersected by recommendations for strengthening and clarifying the elements already present on campus. While portions of these guidelines do set out fairly strict codes for certain aspects of campus development, most of the guidelines should be viewed as principles which can be incorporated into projects in many different ways. For example, the recommendations for brick types and colors should be followed for most, if not all, projects. The more abstract principles for siting a building with regard to the mall should be interpreted appropriately for each individual building.

As Angelo State University grows toward the goals outlined in this master plan, the pressures of available land, limited funds, and increasing needs will influence the design and construction of new facilities. Expedient solutions to these demands and the scattered aesthetic responses of many different designers must not be allowed to dominate new development. It is the responsibility of each designer who works on the ASU campus to build upon the strengths of the campus.

These design guidelines provide an aesthetic structure for future projects, and adherence to these guidelines will produce a unified, cohesive campus. ASU's campus is rare in that it was developed in a consistent manner even without a formal set of guidelines. That consistency means that these guidelines are to some extent a codification of existing campus practices such as building materials and overall building forms. This is a relatively minor part of these guidelines, however; more importantly, these guidelines and the Master Plan together describe the spatial and organizational principles of a future campus which will retain ASU's unique qualities yet will create a richer, more active place.

Houston Harte University Center

Porter Henderson Library

Junell Center

Architectural Design Guidelines

Relationship of Buildings to the Mall and Open Space

Pedestrians are the heart of campus activity. Without foot traffic, campuses are little more than suburban collections of buildings surrounded by parking lots. The ASU mall is the most important conduit of pedestrian traffic, and so it should be more than a walk lined with buildings. Relationships between buildings and the mall should be symbiotic - the buildings should help form the mall, and the mall should enhance the buildings. The proportions, activity, and appearance of the mall should be primary considerations for every new building project.

The width and linear outline of the mall should not be altered. In fact, buildings should enliven the walkways by accenting the simple, plain edges of the mall. Points of visual interest should be established along the mall in order to provide focus and relief. This also may be done with singular elements, such as artwork.

One of the most crucial aspects of a cohesive campus atmosphere is the establishment of active, attractive outdoor spaces. In places, buildings should compress the mall to create these spaces and to give a sense of enclosure. Without well-defined borders, edges, and enclosures that create subsets of spaces within it, the mall is merely an attractive means to get from one place to another, not a generator of social activity.

Most of the length of the mall consists of a doubled walkway separated by a strip of grass or landscaping. For reasons of continuity, this pattern should be continued in future extensions to the mall. The total width of the mall, including grassed areas between the walkways, ranges from 30 to 60 feet wide. If new major connecting walkways similar to the mall are established, consideration should be given to designing them to correspond in size and layout with the existing mall.

Trees at ASU Mall

Rassman Building

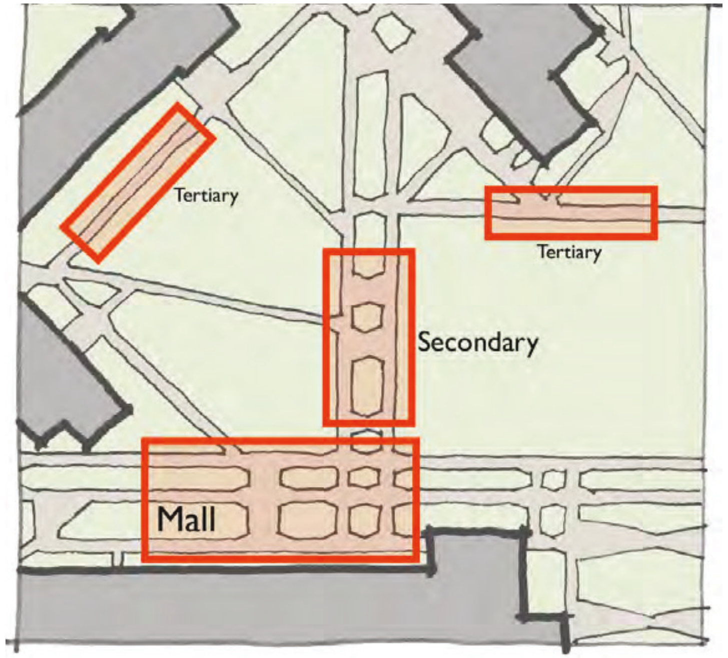

Sun Helix

Other Walks

Other walkways on campus bear relation to the mall, but they differ in their size, layout, and how they relate to the buildings and spaces around them. Existing walks are almost exclusively concrete with a pebble finish. New walks should be broom-finish concrete except for locations where special circumstances dictate other paving methods. Two other types of walks can be classified as follows:

- Secondary Walks - Walk systems that generally run at right angles to the mall. These walks connect major points and consist of doubled walkways along most of their length. They are 25 to 40 feet in total width, including grassed or landscaped areas between separate walkway portions. Secondary walks are not nearly as long as the mall itself, but are more extensive than the tertiary walks which serve to connect buildings to parking lots and to one another.
- Tertiary Walks - Short, single walks that connect buildings with one another and to parking lots. They are five to ten feet wide, depending on how heavily they are used.

Campus aerial photo



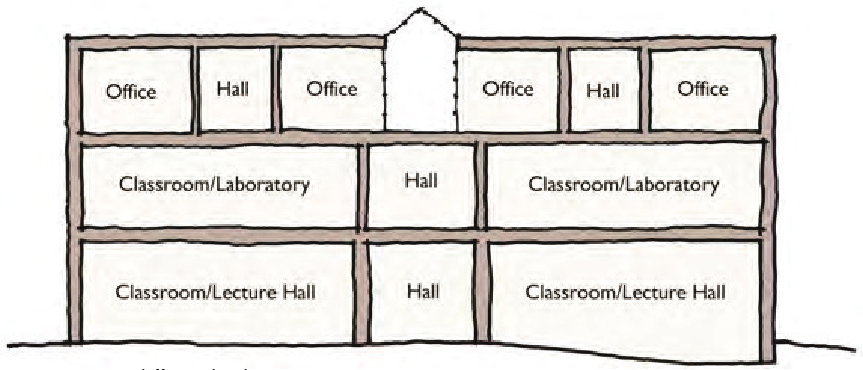
Different walkway types

Vertical Building Organization

Academic buildings, housing, and administrative buildings should not exceed three levels in height. Overall building heights should be 50 feet or less. The floor heights of new buildings should also correspond with those of existing buildings, so the overall scale of new buildings is compatible with that of existing buildings. Particular levels best accommodate different types of uses as follows:

- First Level: Pedestrian circulation, large classrooms, lecture halls, and building services
- Second Level: Classrooms, laboratories, and offices
- Third Level: Faculty and administrative offices

This breakdown of uses obviously cannot apply directly to non-academic buildings, but the logic behind this organization can be used. Heavily used areas like auditoriums, gymnasia, and other gathering spaces should be located on the ground floor. Smaller gathering rooms like dance studios, conference rooms, and laboratories should be located on second levels. Third levels should be reserved for offices and low-use spaces. This organization will reduce travel times between classes and will minimize the number of elevators and other costly vertical circulation elements.



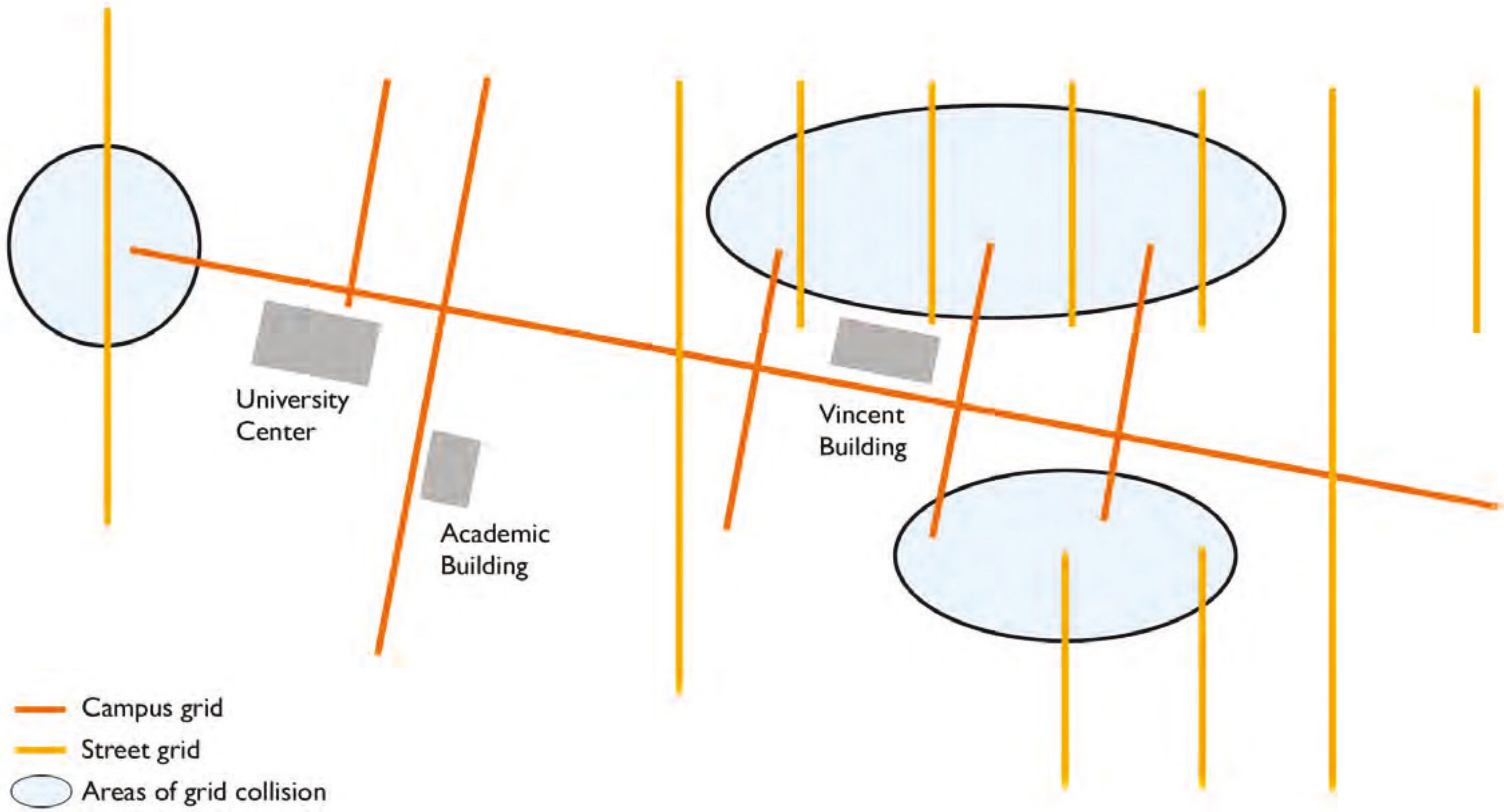
Uses at different levels

Building Shapes

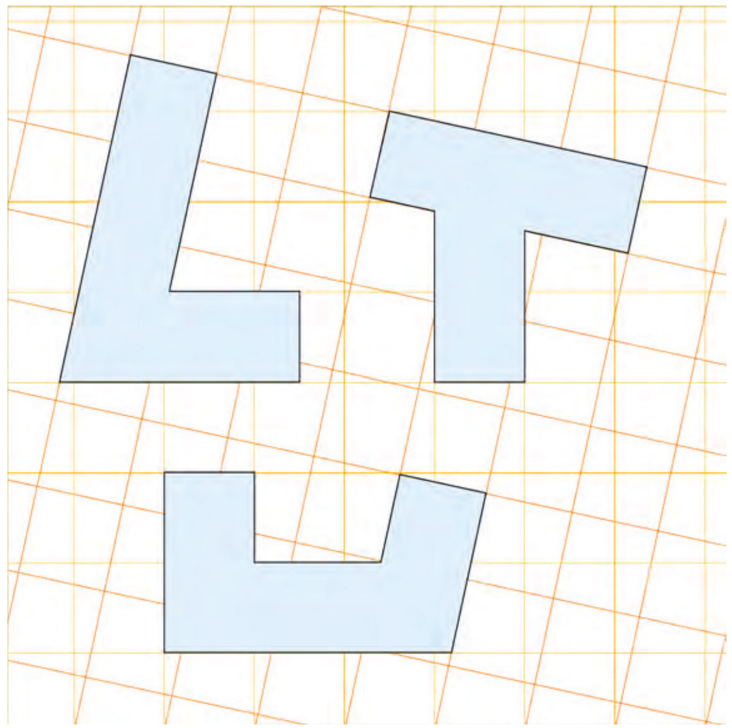
The mall, and therefore most of the ASU campus, is rotated relative to the street grid that surrounds the campus. Because most ASU buildings front the mall and do not have frontage on the surrounding streets, building shapes have responded only to the mall.

As the campus expands into new areas around the edges of campus, both grids will affect the design of buildings. In order to respond appropriately to both the existing ASU campus and the buildings around the University, shapes of buildings near the intersection of the campus grid and the street grid should reflect both grids. This will also maximize the area usable for buildings.

Building shapes should not be complex. In most cases, building shapes should be modified versions of simple shapes like "L," "U," and "T." The conjunction of grids and the built response to that juxtaposition will create spaces that are more interesting and will produce more appropriate architectural responses for the existing campus and its surroundings.



Campus axes



Building shapes at grid collisions

Facade Organization

Some expression of building structure should be apparent from the facade. Buildings should delineate structural columns through the presence of masonry piers, by the modulation of the wall plane, or through a series of openings that relate to the building's structure. The structural system should organize window openings in masonry walls into combinations of smaller openings within bays. Horizontal elements inserted into the facade, such as windows and grilles, must not extend for lengths that exceed those of the building's structural bays without some expression of the supporting structure.

Buildings should be visually organized into separate base and body portions. Multi-story arcades and vertically undifferentiated facades can have an alienating affect upon pedestrians. Without a visual reference to lend scale to wall surfaces, buildings can seem cold and unaccommodating. Some buildings and facilities on campus accomplish this through a changing of texture or materials, when arcades, vertical modulations and openings are not feasible.

Arcades

Arcades along the edges of buildings provide shelter from sun, wind, and rain. They are not merely functional spaces, however; they can also help animate the edges between buildings and the mall. Arcades form intermediate zones between interior and exterior spaces that can extend the usage of the building outside in good weather and can temper the extremes of temperature in poor weather. Where possible, the sides of buildings inside arcades should be glazed. Opaque interior arcade walls should be washed with light. Arcades are also prime locations for artwork or architectural crafts. Arcades should be no taller than the first or second level of the building to which they attach. The warmth and animation that an arcade gives a building's exterior can be lost if the arcade is scaled to relate to the height of the building rather than to the height of a person. Inappropriate scale would also compromise any shelter the arcade provides.

Facade at Health and Human Services Building

Facade at Carr Education and Fine Arts Building

Facade and arcade at Vincent Building

Change of texture at Houston Harte University Center

Change of materials at Plaza Verde Residence Hall

Vertical modulations at MCS Building

Arcade at Math-Computer Science (MCS) Building

Arcade at Houston Harte University Center

Arcade at Porter Henderson Library

Glazing

New campus buildings should have an appropriate balance of glazing to satisfy natural light and heat gain/ energy savings requirements, with an emphasis on areas at ground level to open buildings up to the mall. This is particularly important in buildings that serve social functions. Transparency should be incorporated at active areas like cafes, lobbies, student recreation facilities, and performing arts spaces. Increased use of glazing will also help reduce the need for artificial lighting. Higher levels of natural light in classrooms and offices create spaces that are more inviting for students, staff, and faculty. Care should be observed, however, to ensure that large glazed areas have a minimal detrimental impact on energy efficiency. Glazing should be low-e and/or insulated as determined by the project designers, and glazing should be shaded and shielded to reduce direct exposure to sun and wind as necessary.

Heavily tinted, colored, or reflective glass must not be used. The transparency of glass is just as important as the color rendering performance of lighting. Where additional protection from sun is necessary, the University should investigate options such as overhangs, arcades, and solar shades.

Entries

The shape and location of building entries should give strong visual clues about their functions. Main building entrances should be immediately obvious to pedestrians from the form of the entrance itself. Building signage should support that appearance, but signage should not be necessary in order for visitors to locate a main building entrance. Main entrances should be oriented toward the mall, not toward parking lots at the rear or sides of buildings.

The scale of entrances is also important. Large-scaled building elements might satisfy the need to assign architectural significance to an entrance. However, it is also important to maintain a relationship between the scale of the entry and the people who use it. This can be accomplished, for example, by inserting a single-story entry within a multi-story element. The design and scale of entries should also reinforce the body-base organization described in the “Facade Organization” subsection.

Entry at Cavness Science Building

Glazing at Hunter Strain Engineering Lab

Entry at Hardeman Student Services Center

Glazing at Houston Harte University Center

Entry at Hunter Strain Engineering Lab

Entry at Centennial Village Residence Hall

Roof Articulation

Most buildings at ASU have low-slope membrane roofs, and new large academic buildings should as well. Relatively narrow one or two-story academic buildings may have hipped roofs. A 6:12 pitch should be used. Residential buildings should have hipped roofs with pitches of 6:12.

Buildings with unique functions are exceptions to these rules, particularly when the function of those buildings dictates certain roof types. Certain types of buildings should be visually prominent in ways that general academic buildings are not. Roof articulation can accomplish this. Hipped roofs with steeper pitches than 6:12 or gabled roofs could be considered.

Junell Center with Texan Hall in backround

Centennial Village Residence Hall

Stephens Chapel
Image credit Kinney Franke Architects, AIA

Materials and Colors

As previously stated, ASU's campus is rare in that it was developed in a consistent manner even without a formal set of guidelines. Typically, this consistency can be observed with building materials and colors; in fact, many buildings throughout San Angelo use the same materials and colors. Subsequently, it is easy to understand why this consistency is found here – regional geology. San Angelo's Concho Valley geology consists largely of a light peach-colored sandy clay soil in flats and valleys. Chunks of weathered limestone are found in these areas. Surrounding the Concho Valley, in virtually every direction is limestone-formation hill country. The brick used on campus not only represents the sandy clay soil in color, some of it was actually manufactured from the region's sandy clay. The light-colored (white to beige) bands found on campus buildings represent the limestone rock.

There are many types of brick used on campus, but most fall into a narrow range of color and size. Future buildings should be constructed with bricks of similar color and size, and designers of new buildings should pay particular attention to the types used in nearby buildings. In the absence of a prevailing brick example, the brick on the Ben Kelly Center for Human Performance should be used as an example.

West campus contains the older buildings on campus, such as the Hardeman Building and the Sol Mayer Administration Building; these buildings display a lighter peach-colored brick mix, whereas the newer buildings in central and east campus display a richer orange or even "burnt" peach-colored brick mix. Designers should use the examples of these mixes in the two-brick blend variety.

White stucco is used on many campus buildings either as an accent or as a primary facade element. However, this use should not be the main light-colored accent. Designers should refer to the cast stone examples set by the Hardeman Building and the Sol Mayer Administration Building. Brick should be the dominant building material, and stone or cast stone, rather than stucco, should be used as a material to accent the brick. The overuse and misuse of accent material on campus buildings detract from the warmth and visual strength of brick. Metal trim, including storefront, glazing trim and curtain wall metal, is a secondary accent on campus buildings. The final color of these on new buildings will be agreed upon by the designer and ASU Administration. The predominant color of this trim accent is a dark bronze, however there is quite a bit of clear anodized aluminum trim as well. Other metal trims have been raw copper, galvanized, white painted, black painted, champagne anodized and gray anodized.

The brick used on most ASU buildings dominates ASU's existing color palette. There are predominately two types of brick mixes used on various campus buildings. Brick on new buildings, and therefore, the color palette of new buildings, should center on the color of the brick in that area of campus. As with metal trim materials and roof types, special buildings may depart from this color palette, but any departure should be done carefully and with full recognition of the intent and consequences of such a decision.

Concho geology - red dirt
Image credit www.alltrails.com

ASU Blend brick at Ben Kelly Center for Human Performance

Material and Colors at Plaza Verde Residence Hall

Concho geology - limestone
Image credit www.landsoftexas.com

Light colored brick with limestone accents at Centennial Village

Light brick color of Sol Mayer Administration Building

Residence Halls

One of the primary determinants of the level of activity of campus life is on-campus housing. Well-executed housing will attract and retain students, while substandard housing will have an adverse impact both on recruitment efforts and on the retention of students who live in campus housing.

Campus housing should not just provide places for students to live, but should create an environment for learning that students cannot obtain anywhere else. For example, common areas should be located close to student rooms and suites so that students are encouraged to gather and socialize. The building should have a common entry point that will serve as the primary point of communication. Housing should have landscaped exterior areas - courtyards, plazas, green areas, or informal playing fields – for use by student residents.

Texan Hall

A variety of different room and suite types should be built over time as students' preferences change so that all students are well accommodated. Provisions should be made for handicapped access to all parts of the building. Housing should be located near campus dining locations. Expensive construction types are not required; rather, the suitability of the design to the creation of a collegiate atmosphere is paramount. Materials should bear correspondence to those used for academic buildings, though the forms, and to some extent the materials of the residence halls, should be distinct from the academic buildings.

Concho Hall

As there will be a high level of activity around campus housing both day and night, security is a primary concern. There should be transparency in housing common areas to promote visibility. Access to the facilities should be well controlled. Walkways to and around the housing should be well illuminated and free of brush which might obscure vision. Shrubs and other low plants should be a maximum of approximately 24 inches high, and trees should be trimmed clear to a minimum height of seven or eight feet, as appropriate to the type of tree.

Vanderventer Apartments

Activities at sand volleyball court in the Campus Green

Other Guidelines

Exterior Lighting

Lighting is an important part of the campus environment both for safety and appearance. Good lighting creates a welcoming atmosphere, which is an important part of generating nighttime campus life. Ground-mounted bollard lights and other building-mounted fixtures are more appropriately scaled for pedestrians than tall light poles and should be used where possible. Lighting should be enhanced in areas that are relatively heavily used at night, such as around the Super Slab, Food Service Center, Ben Kelly Center for Human Performance and around the Library, and well-lit connections should extend from these areas to housing and food service facilities.

LED fixtures are preferred. Lamps should be selected for color-rendering performance and for efficiency. Lamps should have a color rendering index value of 78 or above. Low and high-pressure sodium should not be used for general outdoor lighting. Lamp types should be standardized as much as possible to provide even lighting and to minimize the costs associated with maintaining many different types of lamps.

Lighted bollards at Academic Building

Pole-mounted lighting fixtures should be standardized for new projects and replacement of existing fixtures. The campus currently has at least six types of light standards. This number should be reduced to perhaps two or three that can be used appropriately in different situations. Taller light standards with unobtrusive fixtures can be used to provide overall low fill light levels in large spaces, but bollard lights or fixtures on standards of 12 feet or less should illuminate pedestrian walks and plazas.

Poles along walkways and in plazas should be spaced to achieve light levels that range from one to five foot-candles. At no point should light levels vary more than 4:1 within a 100 square foot area. Lamps should be 70 to 120 watts, depending upon conditions. Wall-mounted sconces cannot provide large amounts of general-purpose light, but sconces can help define spaces by highlighting architectural elements. Exposed lamps are not allowed to eliminate glare.

Good lighting heightens the interest of spaces at night, but it also makes people feel safe. Encouraging this feeling of safety is not simply a matter of increasing the amount of light in a space. Actually, high nighttime light levels often create glare and shadows which contribute to a feeling of insecurity. Safe lighting consists of applying low but very even levels of light to areas like parking lots and walkways, and slightly higher levels of light to plazas and areas immediately outside buildings. Higher light levels can and should be cast on building exteriors, as this provides the impression of brightness without negatively affecting night-adapted vision.

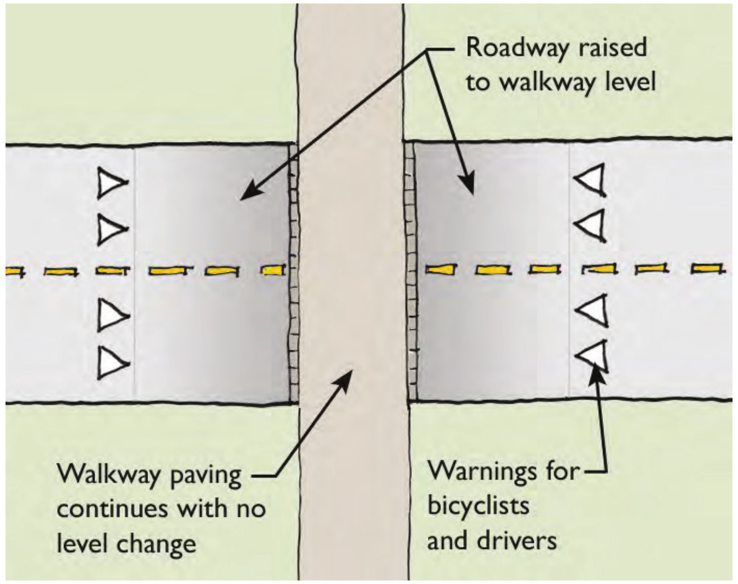
Porter Henderson Library

Vehicular Circulation

As befits a pedestrian-centric campus, roadways on campus should be sized to provide only the necessary space for vehicles to circulate, not to encourage traffic flow. Where high levels of traffic are expected, travel lanes should be no more than 11 feet wide. Where low to moderate levels of traffic are expected, lanes may be as narrow as ten feet wide. The placement of loading docks and service drives should be carefully considered to reduce their impact on the pedestrian character of the campus.

Parking lanes should be used in moderation. They provide extra parking capacity and slow traffic in adjacent travel lanes, but they take up valuable right-of-way that might be better utilized as pedestrian walks and green space. Parking lanes can also create traffic problems at class change times; students obstruct traffic by waiting for spaces. Where used, parking lanes should be eight feet wide (on moderately trafficked streets) or seven feet wide (on lightly trafficked streets). Pedestrian crossings should be prominently marked and designed to make drivers aware that they are crossing a pedestrian thoroughfare.

Raised intersections and distinctive surfacing, as illustrated, may be used at heavily used crossings. Care should be taken to avoid obstructing bicycle traffic, and all crossings must comply with the Texas Accessibility Standards, roadway design manuals and drainage considerations. The aforementioned mall crossing at South Johnson Street is an example of this solution.



Raised pedestrian crossing


Mechanical screen at Math - Computer Science Building

Mechanical Equipment

Mechanical and other building-mounted equipment should not be directly evident to those in close proximity to buildings. Where possible, it should be screened from the view of those at greater distances as well. Auditory screening is no less important than visual screening; mechanical equipment should be located and shielded to minimize sonic intrusion for pedestrians around buildings as well as for those inside the buildings. Heavy materials such as brick and stone perform significantly better than foliage or wood enclosures at reducing sound, so those types of materials are preferred. Enclosures for mechanical equipment should be incorporated as part of the architectural design of the building.

Wall-mounted air supply and exhaust grilles must be located and sized in order to fit the design of the building. Continuous horizontal grilles must not extend uninterrupted for lengths which exceed the length of the structural bays of the building without an expression of supporting structure. Fresh air intakes should not be placed near trash containers, loading docks, service drives, or emergency generator exhausts. Building air exhaust and laboratory exhausts should be located away from fresh air intake locations so that exhaust air is not pulled back into the building. Laboratory and kitchen exhaust stacks should be clustered together when possible, should be kept away from building edges, and should be painted a muted gray color in order to blend with the sky.

Landscape

There are many notable trees on the ASU campus. The new buildings, which will be required to accommodate future ASU students, will unfortunately eliminate some trees, but maximum effort shall be implemented into building designs to preserve as many trees as possible. Specimen trees, where “specimen” is loosely defined as a large, old, particularly well-formed, visually significant, or rare tree, should be preserved wherever possible. Well-established oak trees are a campus staple and should be preserved wherever possible. As construction projects do remove specimen trees, they should be replaced by native saplings of three caliper inches or larger. Replacement of large trees should continue as older stock dies or becomes unhealthy, and new trees should be added as ASU’s property expands. Non-native trees such as palms should be avoided.

ASU has well-developed and carefully maintained planting beds. New projects should generally include xeriscape elements, where appropriate, with generously interspersed native trees and plants. Future plant choices must keep water conservation in mind, though plantings in special locations may require more water-intensive plants. Plantings should not be limited to areas along the mall and near buildings; they are just as important in parking lots and along the edges of campus. Landscaped areas should be used to define campus borders, particularly where those edges and corners are not otherwise held by buildings. Landscaping should be incorporated with lighting and into the design of parking lots along with walkways and other pedestrian-centric features. The University should also explore possibilities for water retention and stormwater reuse in conjunction with new projects. As regulations regarding stormwater retention and detention become more stringent, options for using this water for irrigation will continue to become more feasible.

Xeriscape at ASU Mall

Tree at Health and Human Services Building

Site Furniture and Hardscape

Site furniture should be standardized among several types. As existing furniture deteriorates, it should be replaced with a designated style, and new construction should specify this style as well. High quality painted/powder-coated metal, teak or natural limestone furniture should be standard; these types minimize maintenance. As it is now, furniture should be located along the mall and other major pedestrian paths. Trash containers should be placed throughout the campus, including near and in parking lots.

Paving materials for new pedestrian walkways should be broom-finish concrete. However, large paved plazas may be paved with a material that contrasts or coordinates with the concrete in order to prevent those spaces from becoming dull. Split-face Dryden limestone, for example, is more appropriate for large plazas where vast expanses of concrete would be monotonous. Courtyards, particularly any courtyards interior to buildings, may be paved with materials such as limestone that coordinate with the materials used on the building.

Hardscape and furniture at Vincent Building

Furniture at Einstein Bros. Bagels

Hammock farm at Robert and Mary Massie Residence Halls

Hardscape at Academic Building

Accessibility

All new site improvements and buildings must comply with Texas Accessibility Standards. Accessibility should be designed into projects from the beginning of the process. As the ASU campus does not have significant grade changes, site walks should incorporate stairs only as secondary elements. New campus buildings must include accessible entries with automated opening devices.

Accessibility ramps at Health and Human Services Building

Sustainability

Awareness of environmental topics and interest in energy and resource conservation has become a significant issue in building construction. Some of these topics have even been adapted into law for state-owned buildings. While many opportunities are available only at the level of building design, and not at the master planning level, there are also many situations that can be addressed on a site-wide basis.

Stormwater Design

Impervious cover creates stormwater runoff. Minimizing impervious cover, such as buildings, hardscape, and other paving, can reduce stormwater detention requirements and limit polluted runoff. As noted in the Stormwater Drainage Study (reference Carter-Fentress/SKG Consultant Report), ASU's campus contains large and small stormwater control measures. As development occurs, it is paramount and required by Texas Commission on Environmental Quality (TCEQ) to mitigate stormwater runoff, at minimum, as it was increased by that certain development. ASU can accomplish this in many ways and should consider all methods for each particular project. ASU has incorporated the following stormwater control methods on campus: rainwater collection, detention basins, subsurface drainage systems, surface run-off impediment devices/systems, pervious land cover (flatwork and landscaping) and subsurface infiltration systems.

It is also state law, administered through TCEQ, to develop, implement and maintain a stormwater pollution prevention plan during construction operations disturbing land.

Water Conservation and Water Efficient Landscaping

ASU should select future campus landscaping to minimize watering requirements. Furthermore, usage of collected rainwater can reduce consumption of potable water. Campus landscaping design standards take these considerations into account.

ASU does not receive a great amount of annual rainfall, but rainwater should be collected for later use in order to minimize irrigation requirements. This is possible in individual building projects as well as in a campus-wide system. The designers of each project should research the viability, cost, and benefits of implementing rainwater collection, storage, and distribution for irrigation. One way to begin this process without overburdening any particular project with campus-wide costs would be to require individual projects to collect enough water to supply most of the needs of the landscaping installed in that project. The lessons learned in those projects should dictate whether it is to ASU's benefit to implement campus-wide systems. Rainwater reclamation systems must be easy to maintain, operate and control; they should be located above ground where possible.

Condensation from HVAC systems should be collected and utilized for irrigation or other non-potable water uses. Collection can occur in tanks at individual buildings, or through a campus-wide strategy.

Designs should include water-conserving plumbing fixtures to meet or exceed plumbing code requirements.

Water collection cistern at Biology Greenhouse

Energy Performance and Systems Commissioning

The State of Texas mandates that all new buildings meet the requirements of the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) standard 90.1. This mandate requires that all new state buildings use at least 14% less energy than a base building as described in ASHRAE 90.1 Appendix G. There are several different paths to compliance for this mandate. Designers should encompass all available technological solutions to reduce energy and natural resource use to meet and exceed Building Code standards for all facility systems, including lighting, heating/cooling/ventilation, building envelope and plumbing systems.

Windows should be shaded wherever possible. Shades can either be applied individually to windows or they can be large structures or extensions of roofs which shade a larger area of glass. Designers should investigate both horizontal and vertical shades, as they can both be effective depending on exposure. Wind uplift is a consideration – shades should be wind resistant per code requirements.

Exterior sunshades at Plaza Verde Residence Hall

The footprints of buildings are somewhat determined by the master plan, but the massing and fenestration of those buildings are resolved by individual designers. The way building masses are arranged and how windows are placed on those masses can have a considerable effect on building performance. Designers should investigate ways to locate the largest amounts of glass on north and shaded south faces. Prevailing wind directions should also influence how buildings and outdoor spaces are oriented. Summer winds tend to come from the south, so that exposure should be open.

Building commissioning by a certified third party agent is intended to ensure that as-built conditions match designers' intentions. The sophisticated HVAC and controls systems of modern buildings require coordination and confirmation of operation.

Use of natural light at Plaza Verde Commons Building

Because of this, the commissioning process is a requirement for most buildings and a best practice for building construction. By commissioning a facilities systems before operation, the campus team can maximize energy savings, minimize operations cost, and greatly reduce maintenance issues of the systems.

Energy efficient lighting and ventilation at Health and Human Services Building

Light Pollution Reduction

Minimizing light pollution will primarily benefit the school by reducing energy costs. Light pollution is brightening of the night sky caused by man-made sources, which could have a disruptive effect on natural cycles and obstruct the observation of stars and planets. Exterior lighting systems should be carefully designed to place light only where it is needed and only in the amounts which are required. Campus lighting design standards take these considerations into account.

Storage and Collection of Recyclables

ASU is committed to facilitating recycling on campus and partnering with the local community to promote environmental stewardship. The recycling program should be continued and expanded as possible.

Building and Material Reuse

One of the most basic strategies to conserve energy is to conserve buildings. Designers should target extending the lives of buildings, and where this is financially feasible and sensible for the University, this should be (and frequently is) done. However, implications of changing building usage, the investments required to maintain and make older buildings accessible and safe, and long-term university strategies should also be considered. Even when buildings cannot be feasibly renovated or reused, their materials often can. Structural elements, brick, furniture, certain types of flooring, and finish materials like doors, frames, and paneling can all be salvaged and reused on new projects.

Bridge at the Campus Green with paths made from salvaged concrete sections


Student Field Trips

Space Analysis

Introduction

The Space Analysis provides the foundation for the physical planning decisions made in the creation of the Master Plan Update. It quantifies and organizes space requirements, provides insight into the utilization of space, and aligns projected space needs with projected enrollment.

For the purposes of this Master Plan Update, demographics are considered using fall 2017 enrollment as the current student enrollment. Fall 2018 information is included where available; however, in many instances, current year comparison data was not available at the time data was prepared for this publication.

Several significant changes to the University's Facilities Inventory occurred between the fall 2017 and fall 2018 reporting dates. The actual space changes for 2018 are reflected in the E&G data and charts and are outlined in more detail within this Space Analysis chapter.

This chapter consists of three major elements:

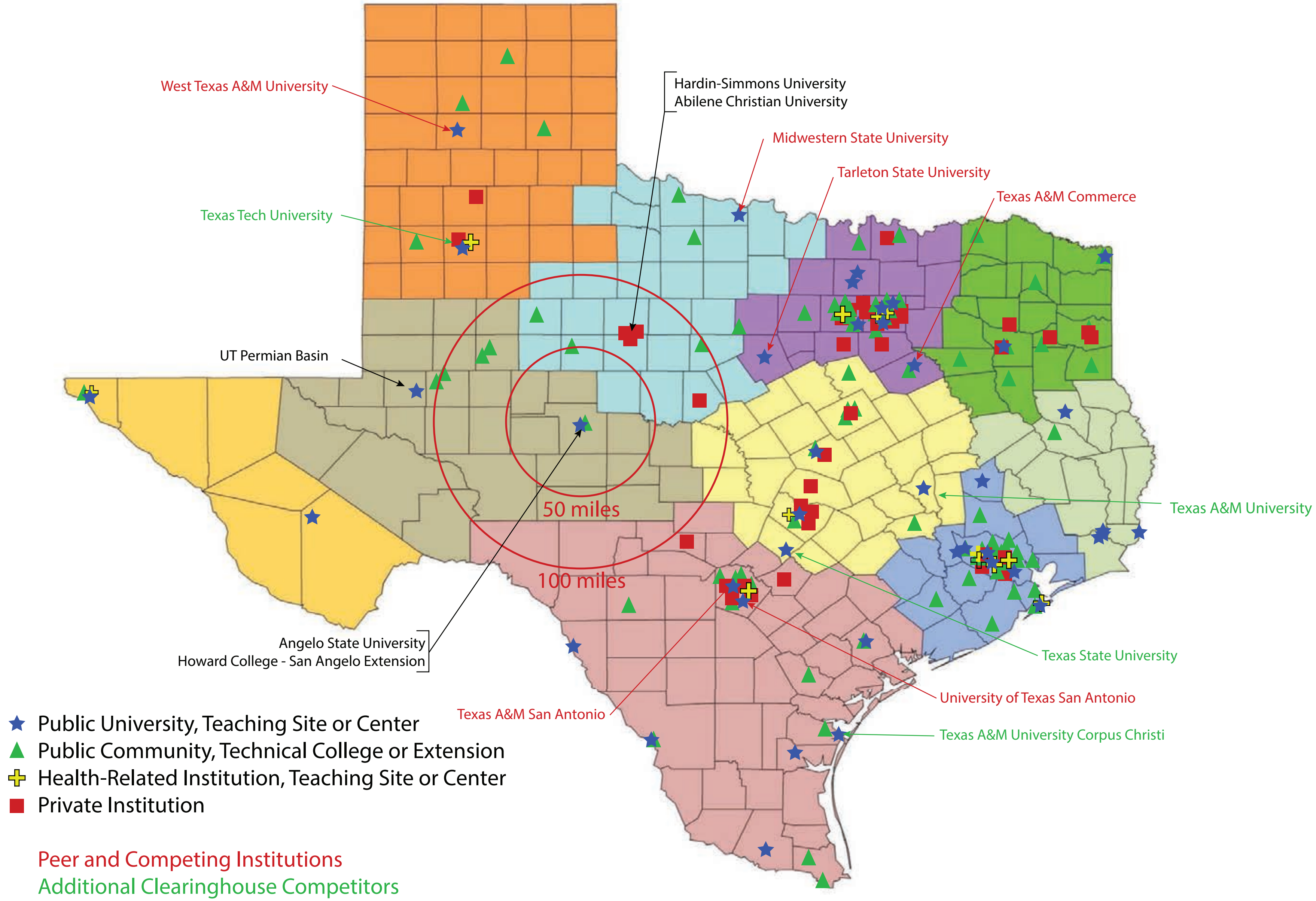
- Demographics and Enrollment Projections
- Space Utilization Analysis
- Space Projections

Please note that enrollment and population figures were based on fall 2017 data.

Demographics and Enrollment Projections

Other Institutions in the Region

There are only two higher educational institutions within a 50-mile radius of San Angelo: Angelo State University and Howard College – San Angelo Extension. Thirteen (13) institutions, including satellite campuses, are located within a 100-mile radius area such as Abilene Christian University and Hardin-Simmons University. The University of Texas Permian Basin is located in the west Texas region outside of the 100-mile radius.



In this document, demographics are considered using fall 2017 enrollment as the current student enrollment.

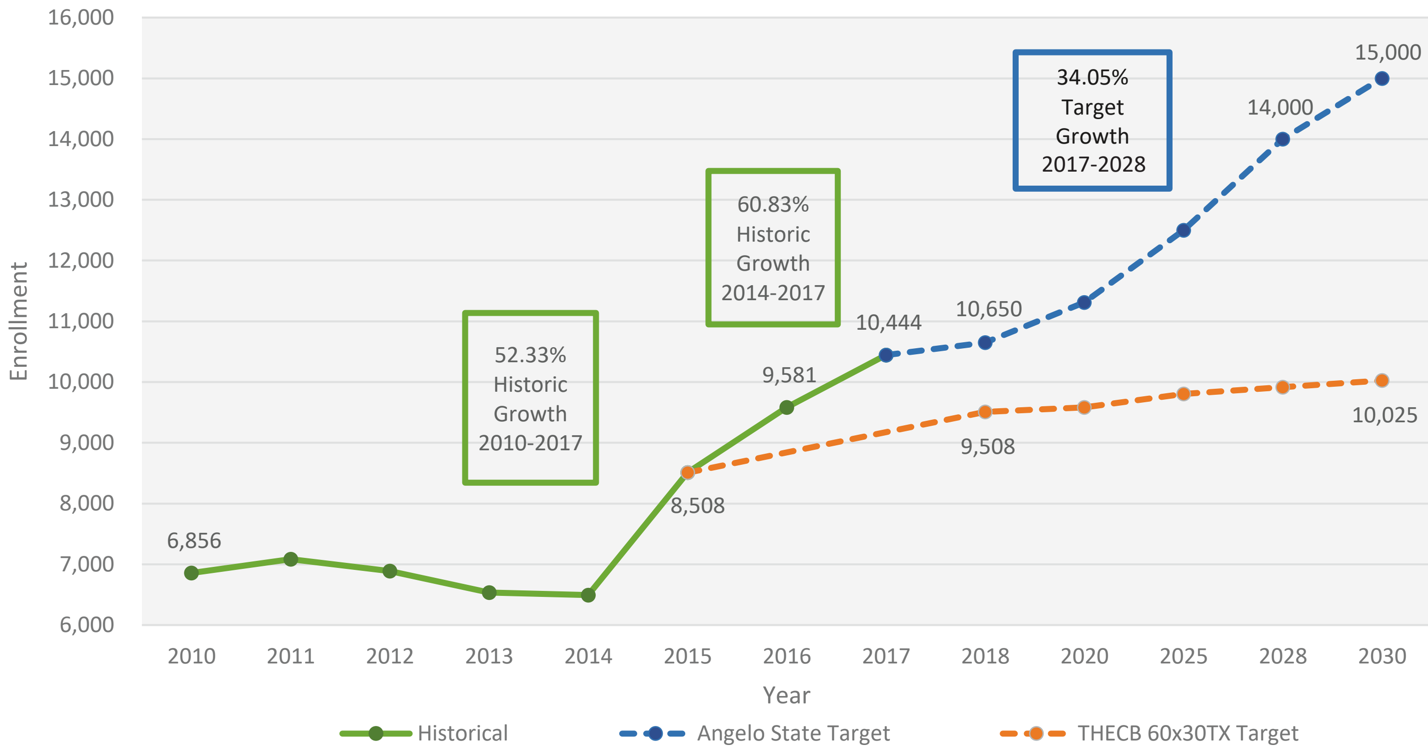
Historical Enrollment and Target Enrollment

Angelo State University had a steady enrollment history for the 20 years leading up to 2015. The change in enrollment between 2009 and 2014 was 1.68%. Fall 2015 began a significant increase in overall enrollment growth. With increases in graduate students, new first-time freshmen, dual credit students and retention, fall 2016 enrollment reached 9,581. Student enrollment is currently 10,444 and the change in enrollment from fall 2014 to fall 2017 was approximately 60.83%.

With direction from Dr. Brian May and his executive leadership team, Angelo State University has developed a strategic plan that set an enrollment goal of 15,000 by 2030 based on proven strategies that fulfill public demand while balancing the educational success of its students. The Texas Higher Education Coordinating Board (THECB), as part of its Texas Higher Education Strategic Plan, 60x30TX, has a target enrollment for ASU of 10,025 by that same date.

As outlined in Angelo State University's strategic plan, "Envisioning 100 Years & Beyond," a compounded annual change of approximately 2.82% is required to meet the 15,000-enrollment goal by 2030. Cumulative target growth from 2017-2028 will be 34.05%.

Historical Enrollment and Target Enrollment



Sources: Texas Higher Education Coordinating Board 60x30TX Enrollment Forecast 2017-2030 (January 2017)
Angelo State University - "Envisioning 100 Years & Beyond"

Peer and Competing Institution Historical Enrollments and Projections

The peer and competing institutions' enrollment targets presented in this section are based on the THECB 60x30TX initiative adopted in 2015. The plan includes four broad goals: the overarching goal is for at least 60% of Texans ages 25-34 to earn a certificate or degree by 2030; and the remaining three goals are increasing student completions, identifying marketable skills, and lowering student debt.

ASU enrollment has significantly increased in the last several years, even meeting the 2020 goal a few years early. In order to reach the 2030 enrollment goals, the University has determined that it will need to improve student retention and continue to increase enrollment. Improving first- and second-year retention rates, growing the dual credit program, implementing fully online programs, increasing transfer enrollment, and focusing on improving quality perceptions by growing the Honors Program will aid in increasing and maintaining student enrollment.

Houston Harte University Center spine

Selected Peer Universities

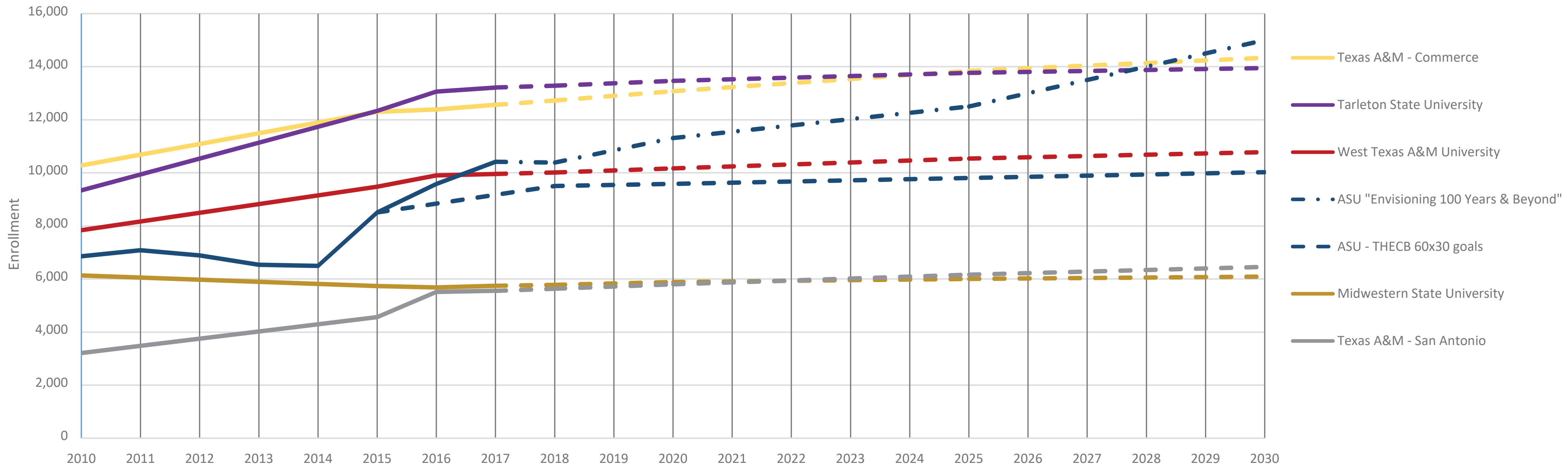
With one notable exception, ASU's peer universities experienced steady enrollment in the past. Two institutions with very similar enrollment in 2010 had differing results in their growth. Midwestern State University has actually lost enrollment, while West Texas A&M University has experienced similar growth to ASU. Both Texas A&M University-Commerce and Tarleton State University led the growth among the peer institutions. Texas A&M University-San Antonio has been selected as a peer institution to watch. The THECB, as part of the 60x30TX plan, set targeted goals through 2030 that require institutions to work toward increasing an educated population.

Enrollment Target Observations

ASU's goal of 15,000 student enrollment will include both on- and off-campus student growth. New fully online degree programs are planned to significantly grow the online undergraduate student enrollment, positively impacting transfer enrollment. When calculating future space needs, online student enrollment was taken into account.

In order to meet enrollment goals, ASU will continue to improve student retention and graduation rates. Growth of the dual credit program will also assist in reaching targeted enrollment. Graduate school enrollment should stay steady in the short-term and then increase with the addition of one to two new programs.

Selected Peer Universities

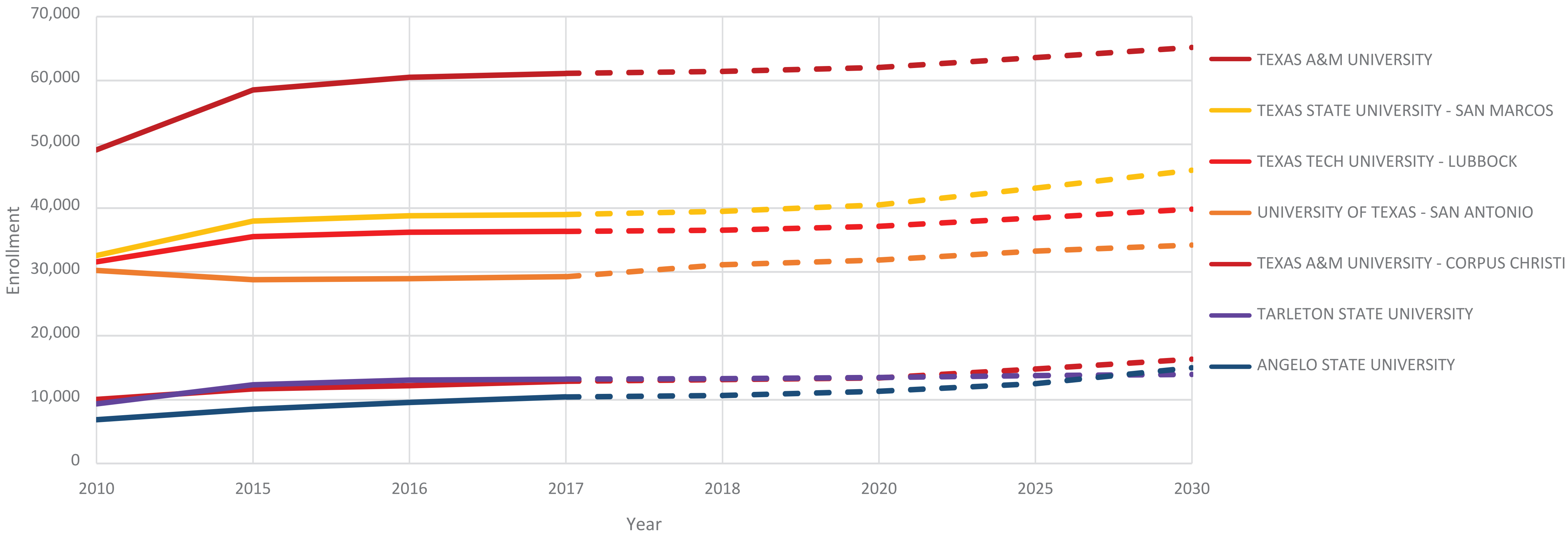


Sources: Texas Higher Education Coordinating Board 60x30TX Enrollment Forecast 2017-2030 (January 2017)
Angelo State University - "Envisioning 100 Years & Beyond"

Clearinghouse Competitor Universities

Each fall, ASU uses data from the National Student Clearinghouse, a nationwide repository for higher education data, to identify their true competitors. A list of admitted students and applicants that did not matriculate for a particular recruitment year is bounced against Clearinghouse data in order to learn what institutions they chose to attend. The graph below identifies ASU's fall 2018 top six competitors. Texas Tech University, Texas State University, and Tarleton State University consistently make the top of the list of competitors. In previous years, West Texas A&M University, and this past year North Texas University, both made the top six list. To more effectively position ASU in the market, research is completed on programs, initiatives, branding, etc., to positively affect recruitment efforts.

Clearinghouse Competitor Universities



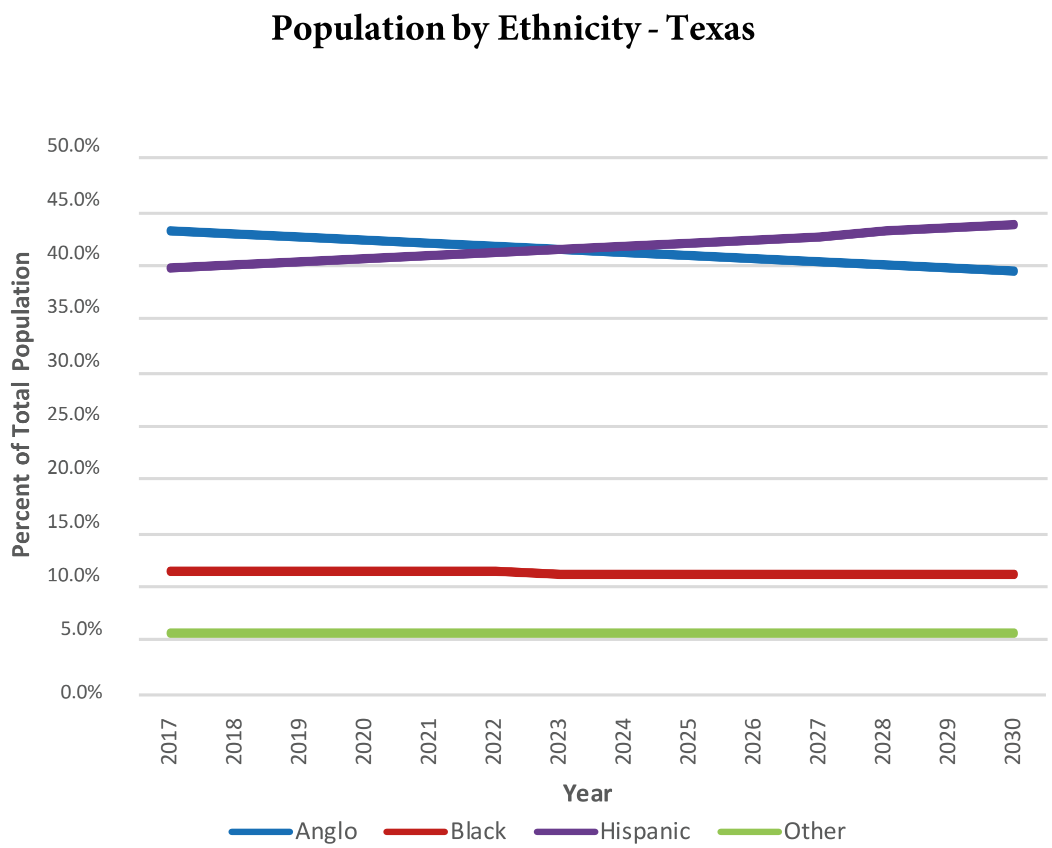
Data Sources: National Student Clearinghouse to determine competitors
Sources: Texas Higher Education Coordinating Board 60x30TX Enrollment Forecast 2017-2030 (January 2017)
Angelo State University - "Envisioning 100 Years & Beyond"

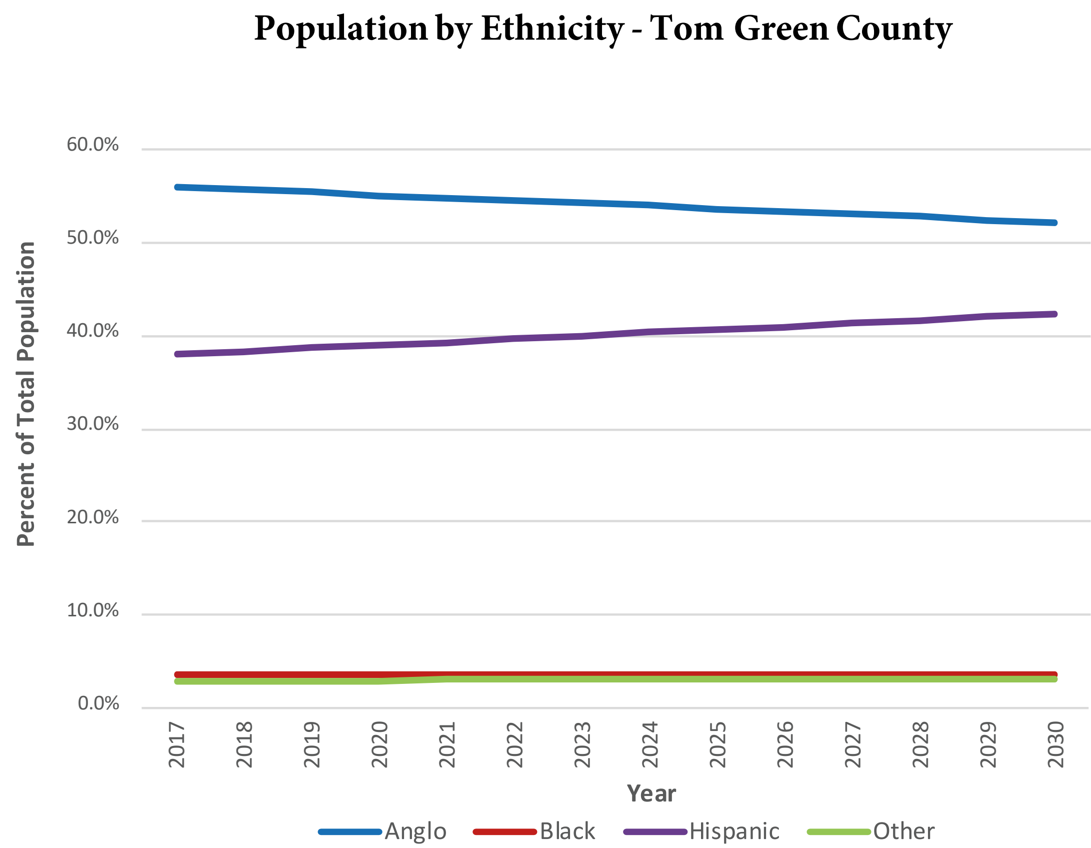
Historical Population Change for the City, County and State

Population in the City of San Angelo, Tom Green County and the State of Texas has grown in the last century, although compared to the State, the City and County growth started slowing down after the 1970's. Most recently, the City and County population has matched the fluctuations of populations based on the oil industry activity in the region. The growth rate of the City and County between 2010 and 2017 was around 3% while that of the State of Texas was nearly 6%.

Population by Ethnicity

The following charts show projected population by ethnicity for the state and county. San Angelo's population ethnicity is anticipated to mirror the state and county.





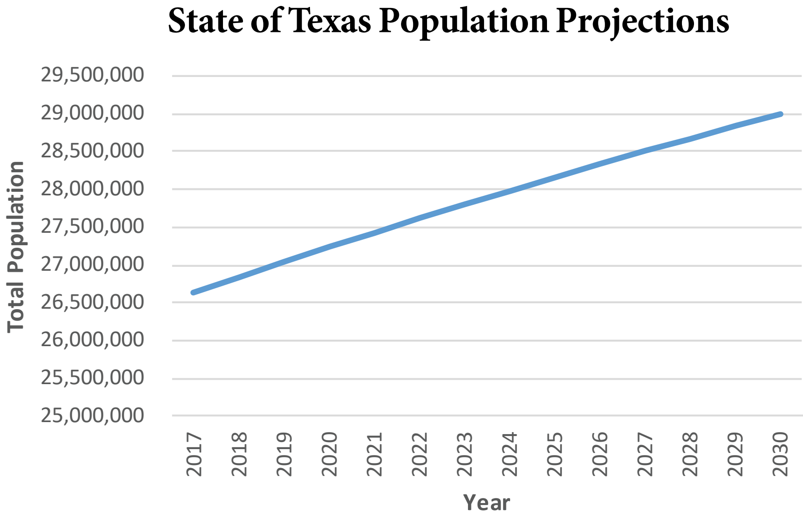
Source: Texas Demographic Center

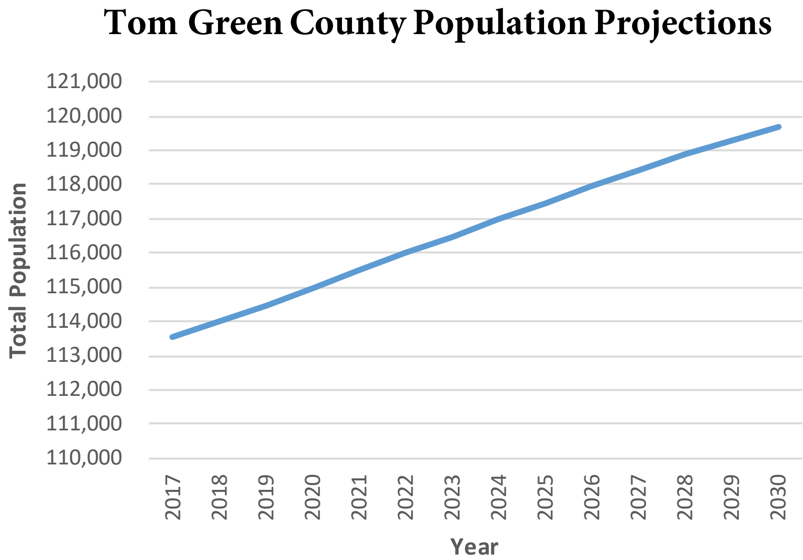
Population Projection for the State, County and City

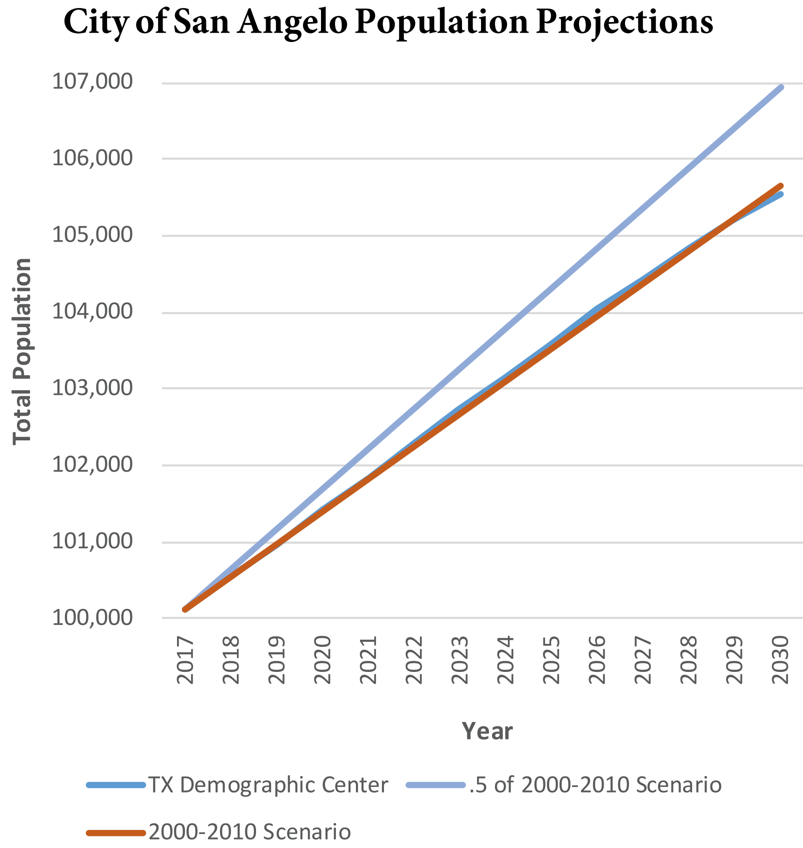
Population for the State of Texas is projected to grow to approximately 29 million by 2030. Several methodologies for projecting population have been used to show a range of possible growth scenarios in the charts on this page.

Regional demographics will continue to support the University's student enrollment. Students originating from Tom Green County in 2017 comprise approximately 28.7% of first-time degree-seeking students at ASU. These are students entering higher education directly after their high school graduations. Approximately 12.1% of first-time degree-seeking students are from the surrounding 20 counties. The remainder of the students are primarily from other Texas cities not included in the calculations above. A limited number of students, 2.5%, come from other states or foreign countries.

Growth in Tom Green County and the surrounding 20 counties is projected to be steady. With a projected growth of 5.7% for Tom Green County in 2030, ASU should expect 478 students from the immediate area (452 in Tom Green County in 2017). With all recruitment efforts staying the same and with the projected growth of the State of Texas from 26.5M to 29M (9.4%), ASU can expect 1,678 students from Texas in 2030. Based on new dual credit initiatives both domestically and internationally, along with the growth of online programs, ASU should be able to reach 2,200 first-time degree-seeking students in 2030.







Source:Texas Demographic Center

Enrollment by Gender

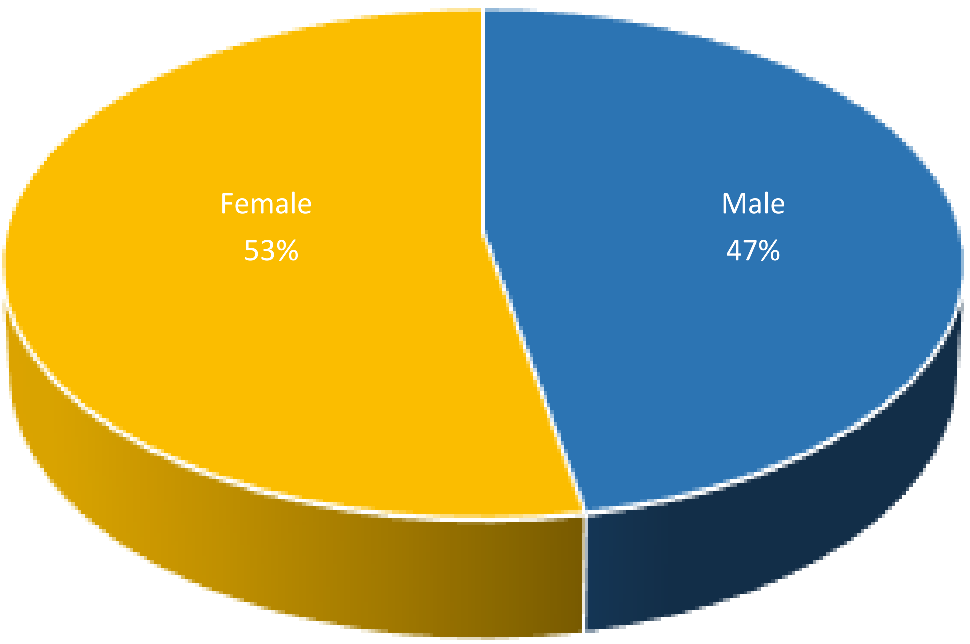
ASU has 53% female and 47% male first-time degree-seeking students. This ratio has stayed fairly constant over the last ten years and is similar to ratios found in other Texas public universities.

Historical Enrollment by Ethnicity

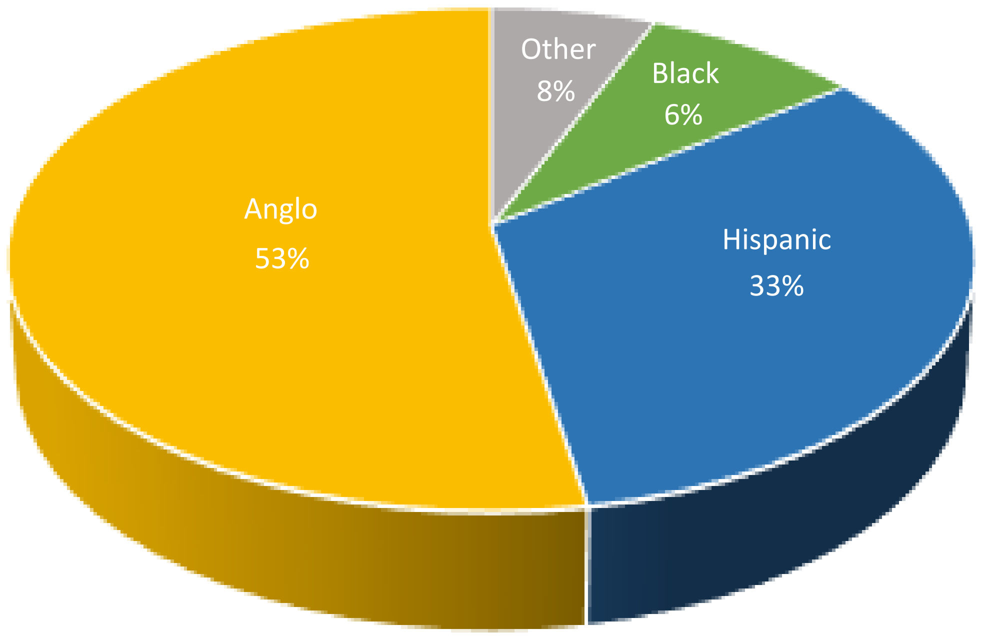
White (non-Hispanic) students comprised 52.8% of the total student population in fall 2017, down from 64.8% in the fall of 2009. Hispanic students have continued to increase in the same period comprising 32.5% of total students. Black (non-Hispanic) and other ethnicity groups comprised approximately 14.7% of the student population. This follows the trend in other Texas public universities.

Since 2010, Texas public universities across the state have seen a decrease in white students attending college and a significant increase in the Hispanic population. ASU's ethnic population changes are clearly mirroring the rest of the state.

Enrollment by Gender



Enrollment by Ethnicity



Source: ASU Institutional Data

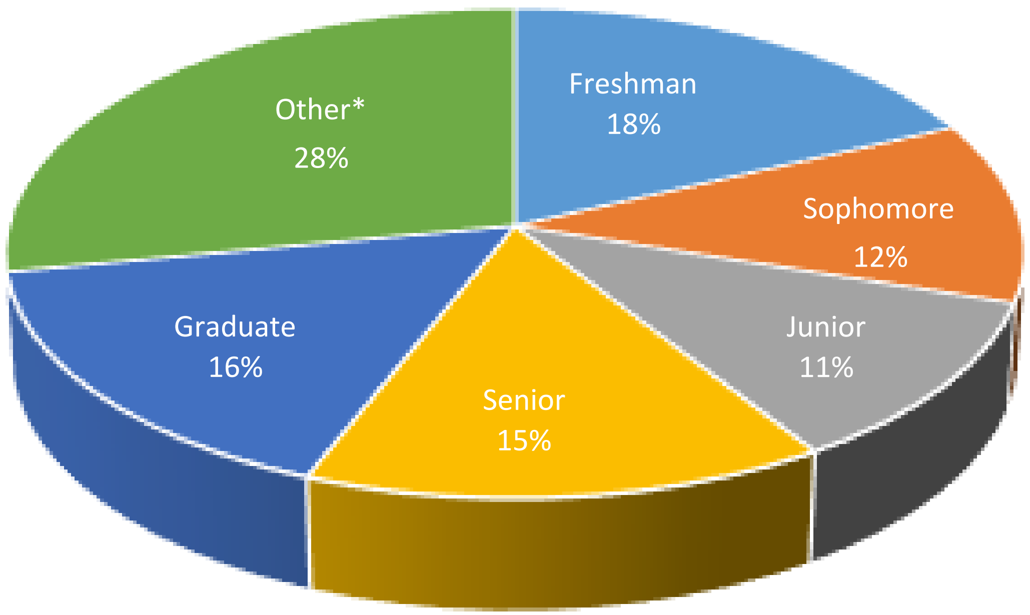
Enrollment by Level

The University has a high dual credit population at 28% of total students. Freshmen, sophomores, juniors and seniors are distributed at 18%, 12%, 11%, and 15%, respectively; thereby total undergraduate students are about 56%. Post baccalaureate and masters are 16%. This distribution of undergraduate to graduate students has changed dramatically in the last three years. With the addition of the dual credit offsite program, undergraduates have grown 20.4%. The retention of freshmen from fall to spring has dramatically increased to 89% due to the implementation of Signature Courses and the support systems in place to assist students at various levels of academic ability.

Enrollment by College

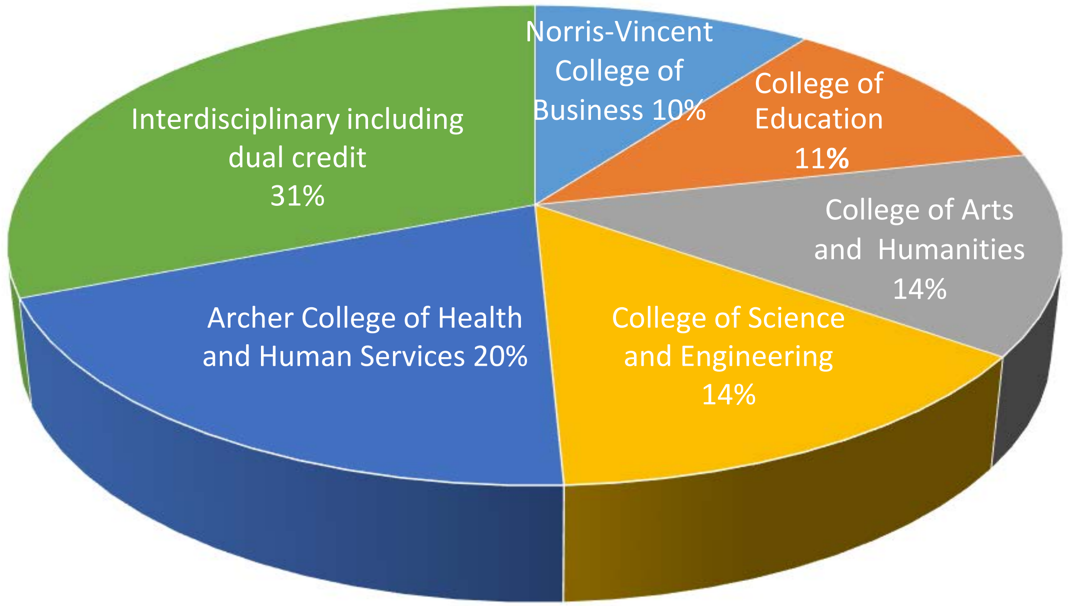
As university enrollment has grown, new programs have been established in areas such as civil engineering. The College of Arts and Humanities offers a great deal of the core curriculum which augments degree program enrollment. New departments have been created such as the David L. Hirschfeld Department of Engineering housed in the College of Science and Engineering. The Archer College of Health and Human Services also has two new departments - Health Science Professions and Social Work.

Enrollment by Level



** Includes offsite dual credit students*

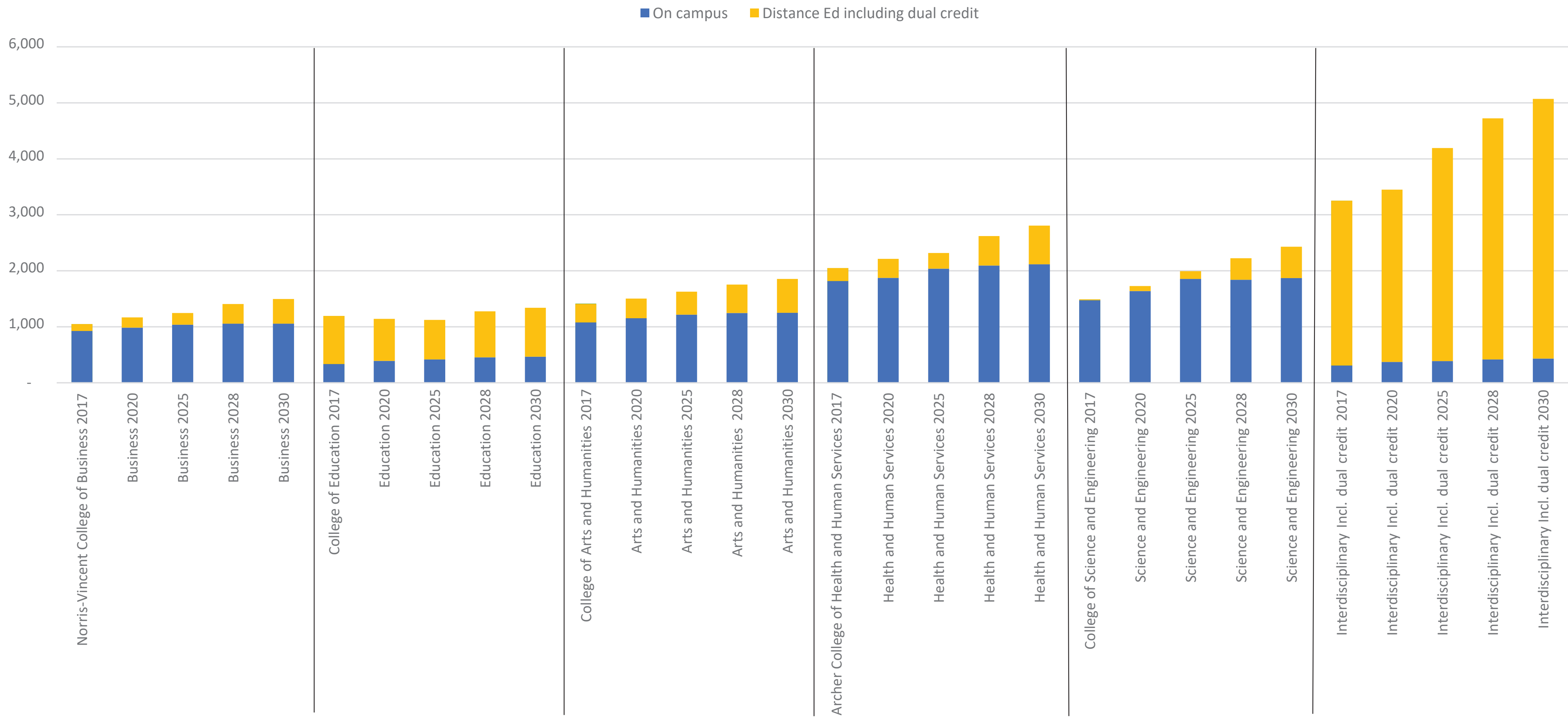
Enrollment by College



Target Enrollment Goals

The University has identified departmental enrollment goals in order to reach the campus goal of 15,000 students within the next thirteen years. These enrollment goals are illustrated in the following tables.

Student Enrollment by College Projections



Target Enrollments - Undergraduate Students (Total)

DEPARTMENTS	Fall 2015	Fall 2016	Fall 2017	Fall 2018	Target Fall 2020	Target Fall 2025	Target Fall 2028	Target Fall 2030	Annual Percent Change 2017-2030	Annual Percent Change 2018-2030
UNDERGRADUATE STUDENTS										
Accouning, Economics, Finance	230	265	287	295	307	341	370	379	2.47%	
Agriculture	365	385	408	450	436	484	526	539	2.47%	
Biology	319	318	346	376	370	411	446	457	2.47%	
Chemistry and Biochemistry	81	72	69	68	74	82	83	85	1.86%	
Communications and Mass Media	196	223	187	187	200	222	242	248	2.47%	
Computer Science	214	250	267	268	286	317	345	353	2.47%	
David L. Hirschfeld Dept of Engineering	53	125	164	204	267	449	496	583	19.73%	
English and Modern Languages	171	155	153	143	163	181	197	202	2.47%	
Health Science Professions	n/a	n/a	n/a	162	117	130	141	145		-0.90%
History	130	146	140	153	149	166	180	184	2.47%	
Kinesiology	486	524	496	500	529	588	639	655	2.47%	
Management and Marketing	542	623	614	698	656	729	792	811	2.47%	
Mathematics	77	70	71	78	76	84	91	94	2.47%	
Nursing	622	649	643	687	654	710	776	815	2.06%	
Physical Therapy	8	38	115	3	5	6	6	7	-7.25%	
Physics and Geosciences	176	154	114	98	121	127	141	145	2.09%	
Political Science and Philosophy	50	67	63	62	67	75	81	83	2.47%	
Psy, Soc, and Social Work (Old Dept)	428	419	351	n/a	n/a	n/a	n/a	n/a		
Psychology and Sociology (New Dept fall 2017)	n/a	n/a	30	335	407	452	491	503		4.17%
Security Studies and Criminal Justice	390	389	408	443	436	484	526	539	2.47%	
Social Work (new Dept in fall 2017)	n/a	n/a	56	140	146	162	176	180	17.16%	
Teacher Education	344	359	338	354	361	401	436	446	2.47%	
University Studies	320	345	341	268	384	591	727	800	10.36%	
Visual and Performing Arts	199	205	201	233	215	239	260	266	2.47%	
Dual Credit	1872	2315	2911	2794	3126	3729	4008	4129	3.22%	
Total Undergraduate Students	7273	8096	8771	9000	9551	11161	12175	12648	3.40%	
Total Student Enrollment	8506	9583	10444	10650	11201	12500	14000	15000	3.36%	

Target Enrollments - Undergraduate Students (On-Campus Students)

DEPARTMENTS	Fall 2015	Fall 2016	Fall 2017	Fall 2018	Target Fall 2020	Target Fall 2025	Target Fall 2028	Target Fall 2030	Annual Percent Change 2017-2030	Annual Percent Change 2018-2030
UNDERGRADUATE STUDENTS										
Accounting, Economics, Finance	228	258	278	279	301	323	331	330	1.44%	
Agriculture	361	381	398	431	432	462	474	472	1.44%	
Biology	317	315	337	361	366	392	402	400	1.44%	
Chemistry & Biochemistry	80	72	67	64	73	78	75	75	0.89%	
Communication and Mass Media	194	218	180	176	195	209	214	214	1.44%	
Computer Science	213	248	261	254	283	303	311	310	1.44%	
David L. Hirschfeld Dept of Engineering	53	125	160	193	265	431	449	514	16.95%	
English & Modern Languages	166	153	149	134	161	173	177	176	1.44%	
Health Science Professions	n/a	n/a	n/a	152	117	125	128	128		-1.35%
History	130	145	137	146	148	159	163	163	1.44%	
Kinesiology	484	519	482	479	523	560	575	572	1.44%	
Management and Marketing	534	612	590	655	639	685	703	700	1.44%	
Mathematics	75	68	67	74	73	78	80	80	1.44%	
Nursing	541	601	605	653	625	655	675	690	1.07%	
Physical Therapy	8	38	108	3	0	0	0	0		
Physics and Geosciences	176	153	112	93	121	122	127	127	1.10%	
Political Science & Philosophy	49	65	59	59	64	68	70	70	1.44%	
Psy, Soc, & Social Work (Old Dept)	404	399	318	n/a	n/a	n/a	n/a	n/a		
Psychology and Sociology (New Dept fall 2017)	n/a	n/a	27	304	288	309	317	316		0.32%
Security Studies and Criminal Justice	316	301	294	302	319	342	351	349	1.44%	
Social Work (new Dept in fall 2017)	n/a	n/a	51	121	141	151	155	154		2.32%
Teacher Education	339	353	326	332	353	378	388	387	1.44%	
University Studies	304	317	305	227	320	318	301	288	-0.44%	
Visual and Performing Arts	198	202	195	223	211	226	232	231	1.44%	
Dual Credit	46	53	69	43	43	42	43	44	-2.77%	
Total Undergraduate Students	5216	5596	5576	5759	6061	6592	6743	6790	1.67%	
Total Student Enrollment	5512	5887	5937	6114	6416	6954	7107	7193	1.63%	

Target Enrollments - Graduate Students (Total)

DEPARTMENTS	Fall 2015	Fall 2016	Fall 2017	Fall 2018	Target Fall 2020	Target Fall 2025	Target Fall 2028	Target Fall 2030	Annual Percent Change 2017-2030
GRADUATE STUDENTS									
Accounting, Economics, Finance	18	14	12	23	12	9	11	15	1.47%
Agriculture	32	34	23	20	21	16	21	27	1.47%
Biology	21	15	17	12	15	12	15	20	1.47%
Communication and Mass Media	10	15	20	20	18	14	18	23	1.47%
Curriculum and Instruction	616	796	882	823	822	634	883	1113	2.01%
English and Modern Languages	9	11	20	20	18	14	18	23	1.47%
Kinesiology	57	52	48	50	44	34	44	57	1.47%
Management and Marketing	30	80	135	167	162	153	212	286	8.54%
Nursing	82	86	93	90	87	67	85	111	1.47%
Physical Therapy	75	78	81	81	88	81	106	133	4.97%
Psy, Soc, and Social Work (Old Dept)	136	116	1	n/a	n/a	n/a	n/a	n/a	
Psychology and Sociology (New Dept fall 2017)	n/a	n/a	127	133	132	112	158	212	5.15%
Security Studies and Criminal Justice	147	190	209	204	194	150	192	249	1.47%
Social Work (new Dept in fall 2017)	n/a	n/a	6	6	37	42	61	84	96.47%
Total Graduate Students	1233	1487	1673	1650	1650	1339	1825	2352	3.12%

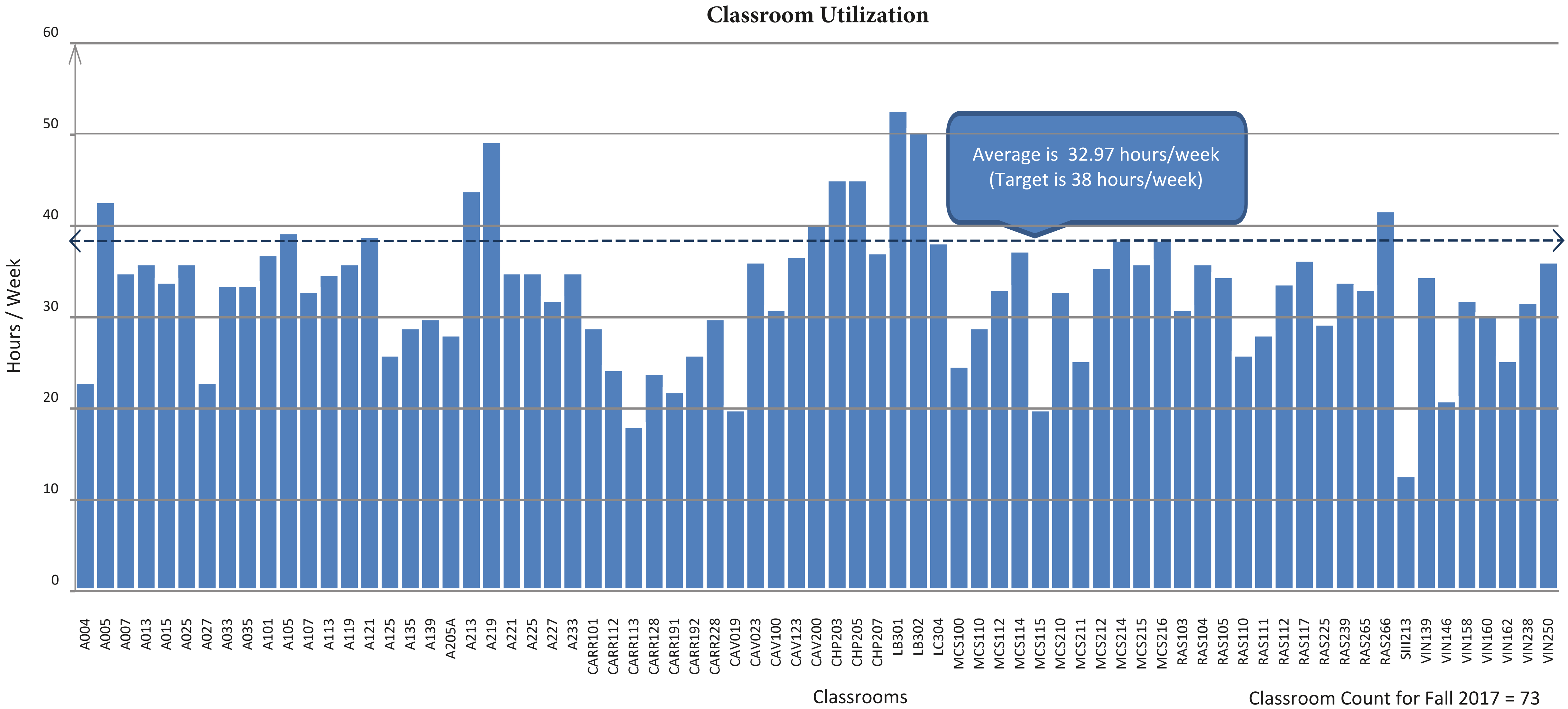
Target Enrollments - Graduate Students (On-Campus Students)

DEPARTMENTS	Fall 2015	Fall 2016	Fall 2017	Fall 2018	Target Fall 2020	Target Fall 2025	Target Fall 2028	Target Fall 2030	Annual Percent Change 2017-2030
GRADUATE STUDENTS									
Accounting, Economics, Finance	18	14	14	24	12	10	10	11	-1.80%
Agriculture	28	31	26	21	21	19	18	20	-1.80%
Biology	21	15	19	13	15	14	13	14	-1.80%
Communication and Mass Media	9	15	22	21	18	16	16	17	-1.80%
Curriculum and Instruction	0	2	1	1	1	1	1	1	-1.80%
English and Modern Languages	9	8	22	21	18	16	16	17	-1.80%
Kinesiology	56	52	49	50	41	36	34	38	-1.80%
Management and Marketing	4	8	32	42	28	26	24	24	-1.87%
Nursing	0	0	0	0	0	0	0	0	
Physical Therapy	75	78	92	84	88	95	91	97	0.46%
Psy, Soc, and Social Work (Old Dept)	76	68	1	n/a	n/a	n/a	n/a	n/a	
Psychology and Sociology (New Dept fall 2017)	n/a	n/a	75	73	75	79	88	102	2.75%
Security Studies and Criminal Justice	0	0	0	0	0	0	0	0	
Social Work (new Dept in fall 2017)	n/a	n/a	7	6	37	49	53	61	59.3%
Total Graduate Students	296	291	361	355	355	362	364	403	0.89%

Space Utilization Analysis

Classroom Utilization

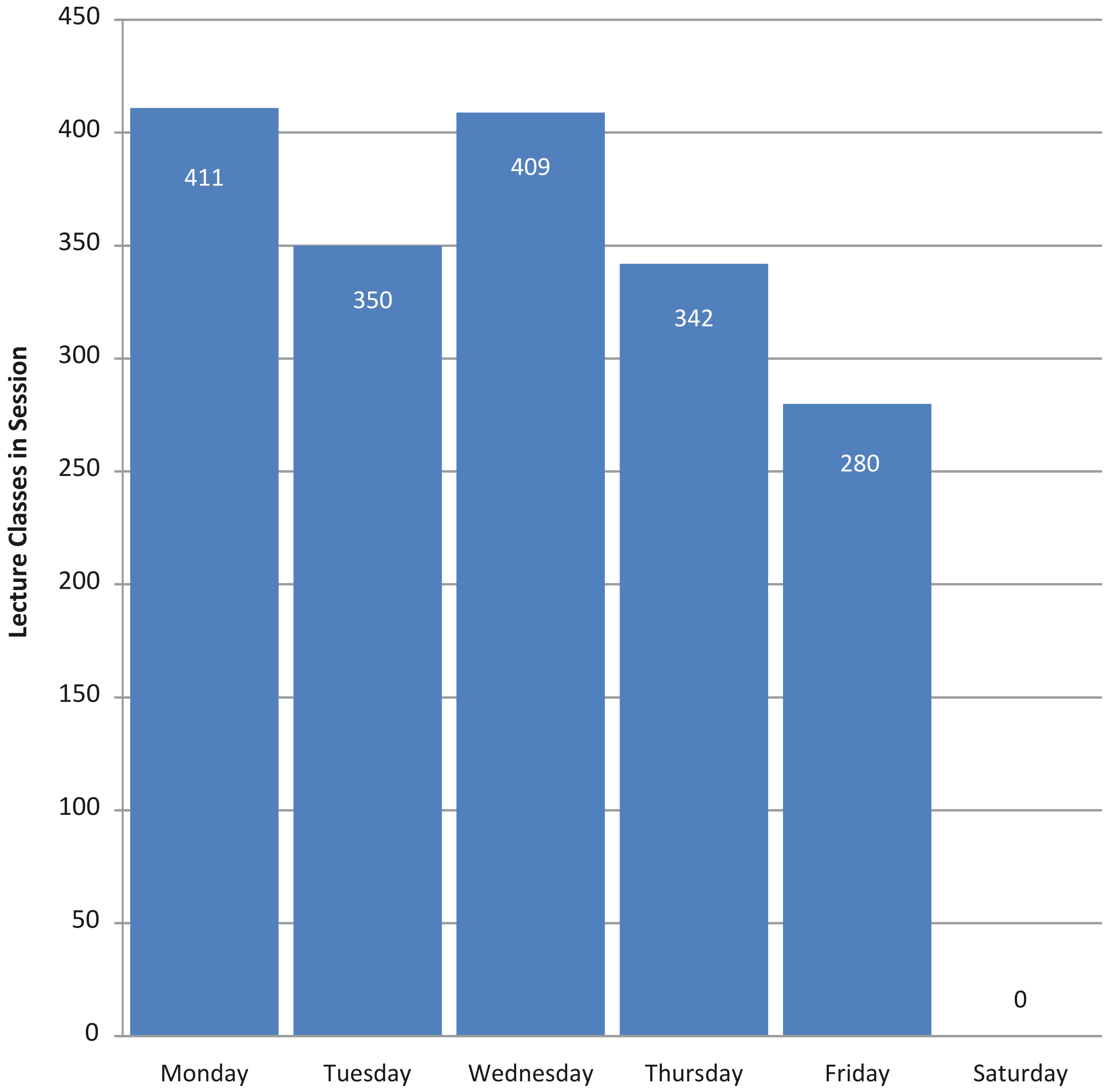
The following pages contain graphs and data illustrating fall 2017 utilization findings.



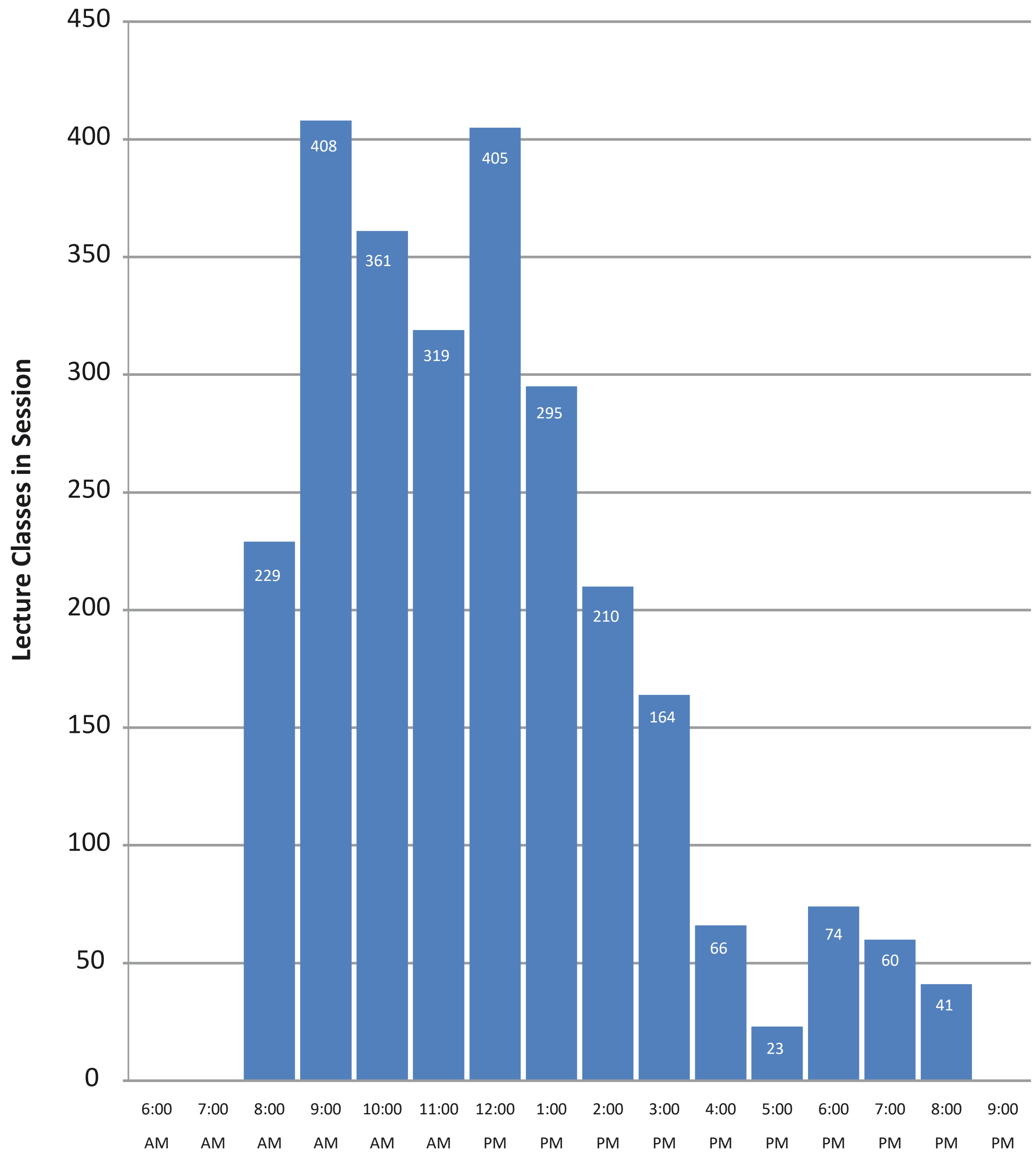
Classrooms with Usage Over THECB Target (38 hours/week) (lab and lecture hours included)		
Room	*Total Hours/Week*	*Subjects*
LC304 (* 6.4 HPW Labs)	38.30	COMM, MM
MCS214	38.60	GS, MATH
MCS216	38.60	GS, MATH
A121	39.00	GER, RUSS, SPAN, CENG, PSY, GS, FREN
A105	39.40	COMM, SWK, MM, HIST
CAV200 (* 5.4 HPW Labs)	40.40	GS, BIOL, CHEM, FSCI, PA
RAS266	41.80	FINC, MKTG, KIN, MGMT, CS, FSCI, CENG
A005	42.80	ENGL
A213 (* 3 HPW Labs)	44.00	PSY, GS, COMM, SOC, SWK, AGSC
CHP203	45.20	KIN, CSF, GS
CHP205	45.20	CSRF, KIN, GS
A219	49.40	PSY, GS, SWK, SOC
LB302	50.40	COMM, MM
LB301	52.80	COMM, MM, SOC, PHYS
* Indicates a classroom in which both labs and lecture classes are held		Fall 2017 Banner Data

Classrooms with Usage < 33 hours/week (labs and lecture class hours included)	
Room	*Total Hours/Week*
SIII213 (*7.8 Lab HPW)	12.80
CARR113	18.20
CAV19 (*2.0 Lab HPW)	20.00
MCS115	20.00
VIN146	21.00
CARR191	22.00
A4	23.00
A27 (*2.0 Lab HPW)	23.00
CARR128	24.00
MCS100 (*4.4 Lab HPW)	24.80
VIN162 (*10.2 Lab HPW)	25.40
MCS211	25.40
RAS110 (*2.0 Lab HPW)	26.00
A125 (* 2.0 Lab HPW)	26.00
CARR192	26.00
RAS111 (*6.0 Lab HPW)	28.20
A205A (*2.0 Lab HPW)	28.20
CARR101	29.00
MCS110	29.00
A135	29.00
RAS225	29.40
A139	30.00
CARR228 (* 5.0 Lab HPW)	30.00
VIN160 (*10.2 Lab HPW)	30.20
CAV100	31.00
RAS103	31.00
VIN238 (*6.6 Lab HPW)	31.80
VIN158 (*5.6 Lab HPW)	32.00
A227	32.00
* Indicates a classroom in which both labs and lecture classes are held	Fall 2017 Banner data

Lecture Classes in Session by Day of the Week



Lecture Classes in Session by Time of Day



Average Utilization by Building		
	Classrooms	Labs
Academic Building	34	20
Carr Education and Fine Arts	25	37
Cavness Science Building	33	23
Ben Kelly Center for Human Performance	43	n/a
Junell Center	n/a	41
Porter Henderson Library	47	n/a
Math and Computer Science	32	n/a
Rassman Building	33	n/a
Science III Building	13	29
Vincent Nursing and Physical Science	30	22
Target	**38**	**25**
Average Utilization	**33**	**27 with proration / 25 without proration**

Average Classroom Station Size by Building			
Classrooms	***Stations***	***Classroom NASF***	***NASF/Station***
Cavness Science Building	412	6,290	15.27
Academic Building	917	21,864	23.84
Porter Henderson Library	86	3,364	39.12
Ben Kelly Center for Human Performance	118	3,005	25.47
Carr Education and Fine Arts	338	7,674	22.70
Rassman Building	566	13,006	22.98
Vincent Nursing and Physical Science	281	7,807	27.78
Math and Computer Science	670	11,744	17.53
Science III Building	30	1,037	34.57
Campus	**3,418**	**75,791**	**22.17**
Definition of terms:			
Station - Student seating capacity			
NASF - Net Assignable Square Feet			

General Classroom Utilization Notes

- Classrooms in the Porter Henderson Library spaces are being highly utilized.
- Classrooms in Ben Kelly Center for Human Performance are highly utilized.
- Lowest utilization of classrooms is in the Science III Building.
- There is spare capacity in the Academic Building classrooms.
- Carr Education and Fine Arts and Science III labs are very well utilized.

Classroom Comments

While illustrating a marked improvement in utilization and right-sized scheduling over the last update of this document, these statistics indicate that ongoing assessment of room use designations is warranted. A continued in-depth study of classroom and lab assignments is required, and this necessity is achieved through the annual Predominant Use Study conducted by the University's Space Planning Coordinator with input from academic Deans and Department Chairs.

ASU is at times utilizing classroom spaces for laboratory use; and conversely, there are classroom hours scheduled in labs. Additionally, classes and labs are being taught in spaces that are not designated as classrooms or labs. Each of these scenarios lowers the overall classroom utilization rates and, as such, are monitored regularly by the academic schedulers. In conjunction with the ongoing review of room use designations, strategic scheduling efforts must be maintained to continue to reduce the number of hours taught outside of designated classrooms and labs.

Classroom Utilization Observations

Studying the utilization of classrooms has revealed that both classroom and lab utilization numbers can be increased by matching labs and classrooms to their most appropriate spaces. More importantly, the real focus for ASU should be to ensure its spaces are being scheduled to their best and highest use and to identify shortages of space where they actually occur, rather than where they are perceived to be. The University has already begun to address this issue and is working to increase not only utilization of classrooms and labs but also the use of available room capacity in each space.

If lecture hours that are taught in labs or other non-classrooms are relocated to classroom spaces and the number of classroom spaces are reduced from 73 to 67, then classroom utilization will rise to the THECB target for utilization of 38 hours per week.
Angelo State University's current lab utilization exceeds the THECB target of 25 hours per week.

Classroom Capacity Analysis

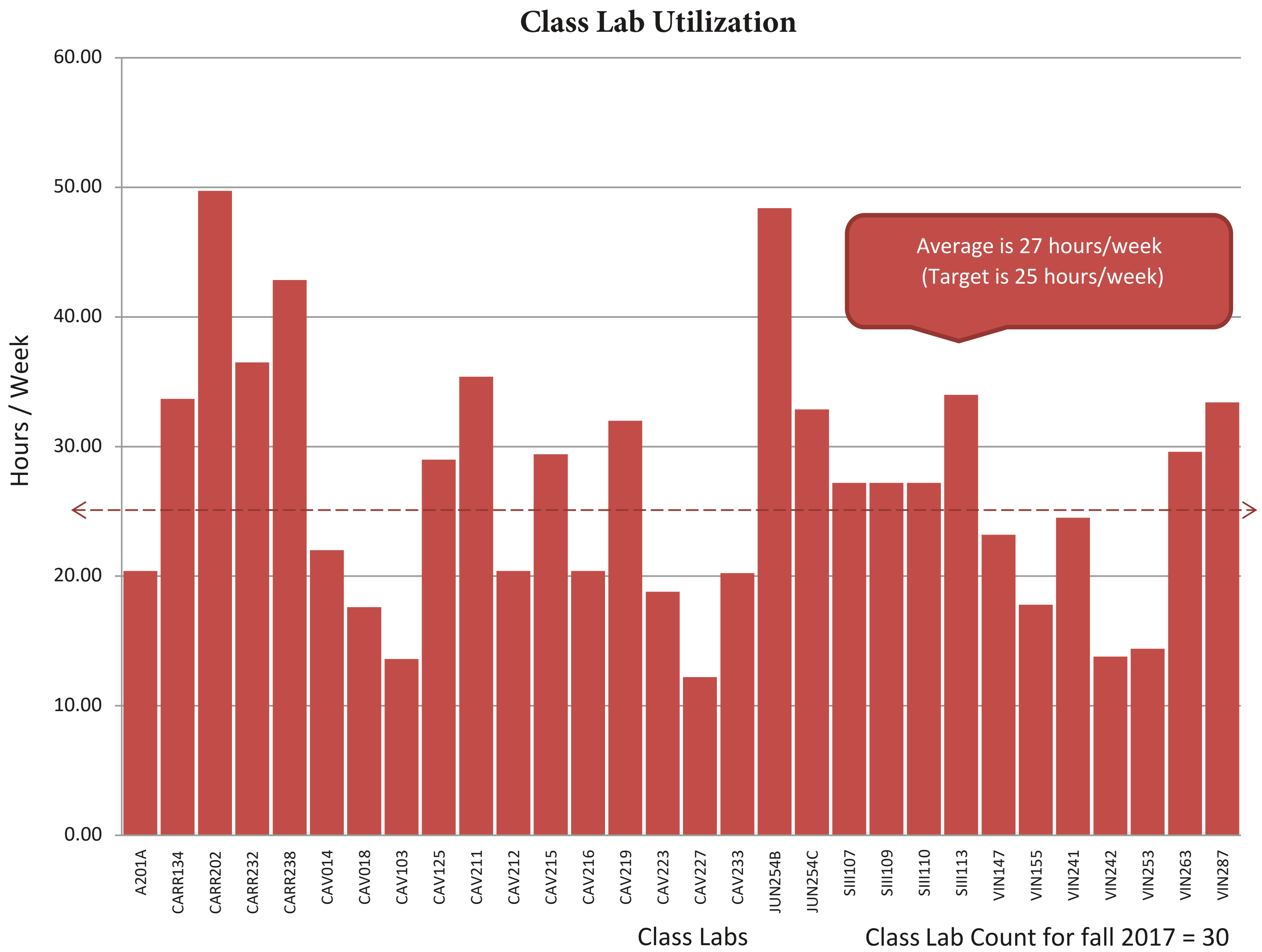
The chart below looks at the total student enrollment at varying section sizes and the total required room hours per week. It then looks at available rooms and their capacity and tabulates how many of each size room is required. The chart compares the required number of rooms of each size with available/existing rooms. It appears that ASU has an excess of available classrooms, but the sizes of these classrooms may not be ideal. Most effective scheduling of the spaces will require "right-sizing" of classrooms to meet demand at particular capacities. Continuing to replace tablet arm desks with multi-functional classroom furniture will allow for a variety of room configurations to support changes in capacity demands.

Classroom Capacity Analysis

SECTION SIZE	TOTAL STUDENTS ENROLLED IN ALL LECTURE SECTIONS	TOTAL REQUIRED HOURS PER WEEK	MAXIMUM ROOM CAPACITY	TOTAL REQUIRED ROOMS	NO. OF AVAILABLE ROOMS	BALANCE
001-016	2,115	566	20	15	4	(11)
017-032	9,114	1,164	40	31	37	6
033-044	4,770	392	55	11	20	9
045-059	2,454	140	70	4	5	1
060-076	1,559	70	90	2	3	1
077-099	870	29	110	1	2	1
100-142	239	6	150	1	0	(1)
143-190	161	3	200	1	1	0
191-261	261	3	225+	1	1	0
Totals	**21,543**	**2,373**		**67**	**73**	**6**

Laboratory Utilization

The following pages contain graphs illustrating fall 2017 laboratory utilization findings. Laboratory utilization was discussed in the previous "Classroom Utilization" subsection.

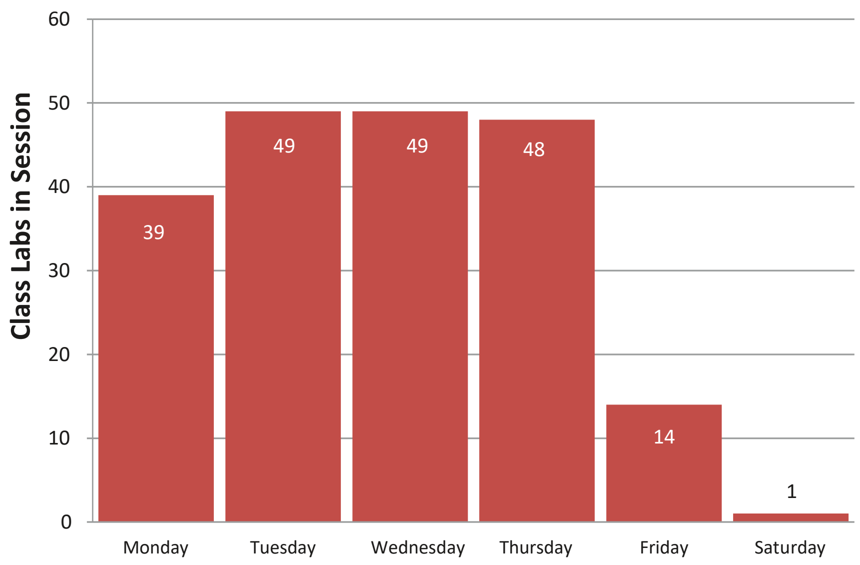


Class Labs with Usage Under THECB Target (25 hours/week) (lab and lecture hours included)

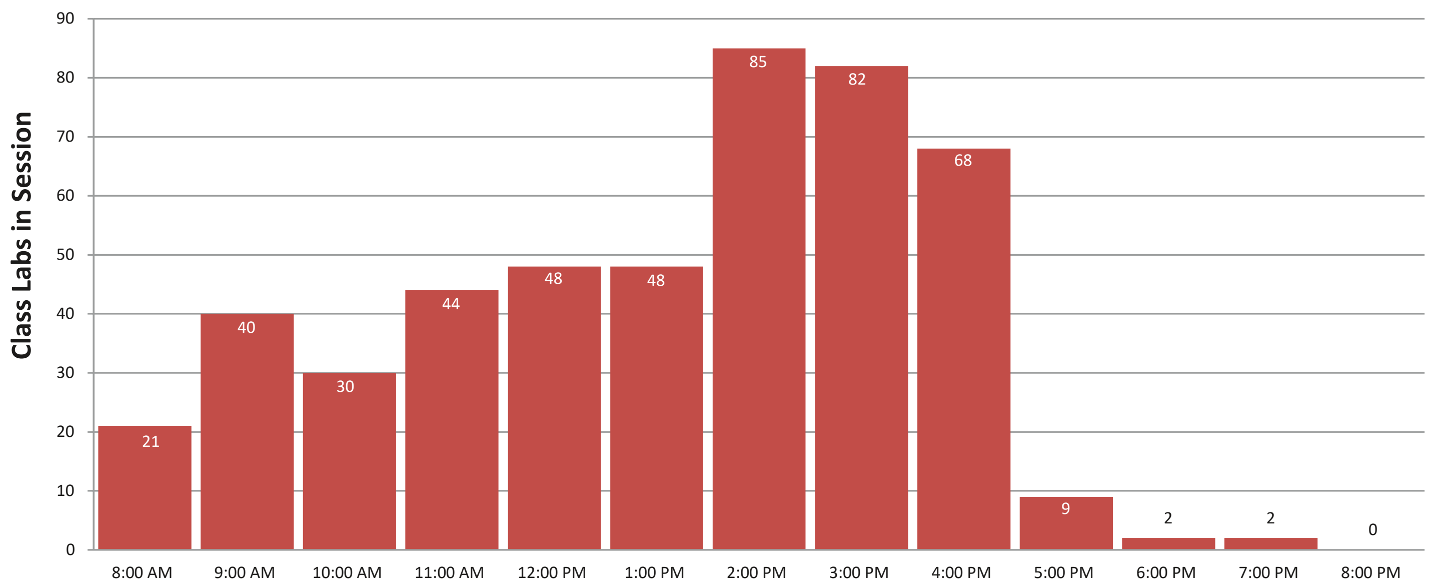
Room	*Total Hours/Week*	*Subjects*
A201A (* 9.0 HPW Lecture)	20.4	PSY, PA, HONR
CAV014	22.0	BIOL
CAV018	17.6	BIOL
CAV103	13.6	BIOL
CAV212	20.4	CHEM
CAV216	20.4	CHEM
CAV223 (*9.0 HPW Lecture)	18.8	PA, CHEM
CAV227	12.2	CENG, CHEM
CAV233	20.2	CHEM
VIN147 (*12.0 Lecture)	23.2	GEOL, PHYS
VIN155 (*9.0 Lecture)	17.8	PS
VIN241 (*22.3 lecture)	24.5	NUR, ENGR, NUR, ASCI
VIN242 (*10.2 lecture)	13.8	NUR
VIN253	14.4	NUR

* Indicates a class lab in which both labs and lecture classes are held. Fall 2017 Banner Data

Lab Classes in Session by Day of the Week



Lab Classes in Session by Time of Day



Average Class Lab Station Size by Building			
Classrooms	***Work Stations***	***Class Lab NASF***	***NASF/Station***
Cavness Science Building	310	11,868	38.28
Academic Building	21	375	17.86
Carr Education and Fine Arts	211	6,205	29.41
Vincent Nursing and Physical Science	231	7,006	30.33
Junell Center	141	2,544	18.04
Science III Building	30	1,037	34.57
Campus	**944**	**29,035**	**30.76**
Definition of terms:			
Station - Student seating/working capacity			
NASF - Net Assignable Square Feet			

Space Projections – E&G

The Texas Higher Education Coordinating Board (THECB) developed a space planning tool for higher educational institutions. The Space Projection Model is designed to predict necessary Education and General (E&G) space based on the number of full-time student equivalents (FTSE) and other parameters.

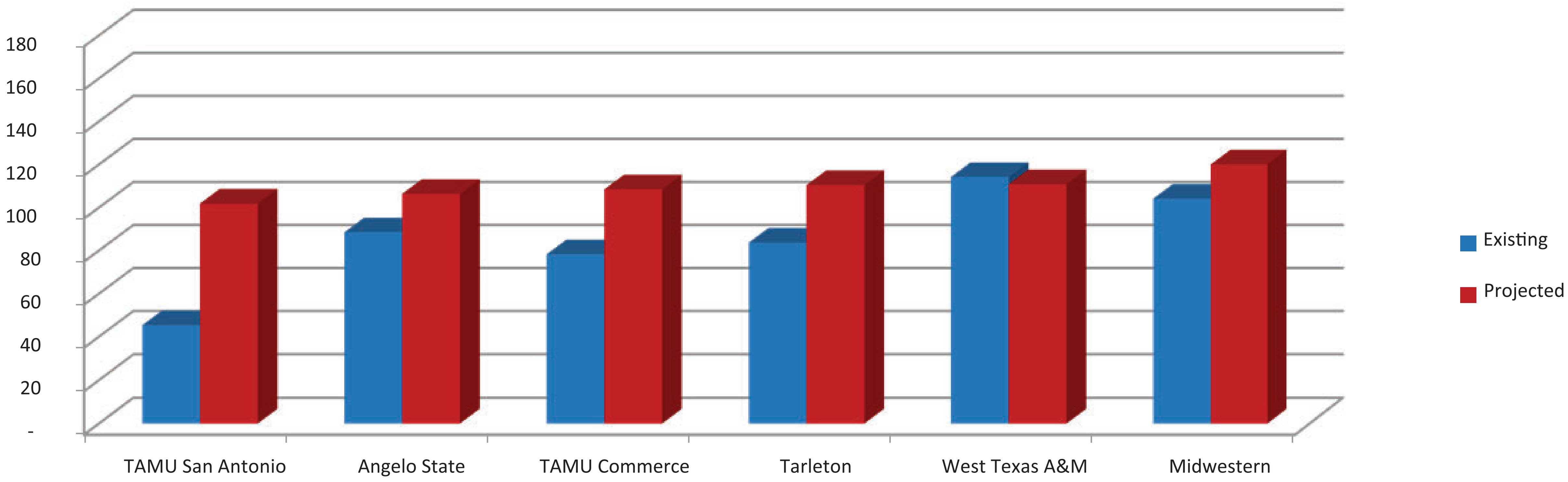
Below is a recent history of the actual and predicted space, as published in the THECB Space Projection Model.

According to the most current THECB projection based on fall 2017 information, ASU has a deficit of approximately 87,000 E&G square feet as a total. This space projection indicates the University has an adequate amount of space to meet their academic missions at this time; however, there is a lack of office space. The THECB calculations do not take into account the age and functionality of existing space. Additionally, the school has grown to 10,000 students in advance of the anticipated goal year of 2020, and a significant amount of additional space will be needed to support the targeted 2030 enrollment.

Summary Space Model Data	Teaching		Library		Research		Office		Support		Predicted Total	E&G Approved-Not Online	Actual		Unadjusted Surplus/ Deficit	Adjusted Surplus/ Deficit
	Predicted	Actual	Predicted	Actual	Predicted	Actual	Predicted	Actual	Predicted	Actual			Total	Adjusted		
Fall 2010	**282,340**	283,483	**87,848**	48,659	**15,902**	23,025	**176,922**	141,576	**50,671**	42,786	**613,683**	15,343	539,529	554,872	(74,154)	**(58,811)**
Fall 2011	**290,638**	301,071	**88,519**	71,276	**16,215**	24,021	**194,210**	143,766	**53,062**	42,786	**642,644**	0	582,920	582,920	(59,724)	**(59,724)**
Fall 2012	**289,298**	303,024	**87,779**	69,297	**16,197**	20,625	**180,624**	139,405	**51,651**	42,786	**625,548**	0	575,137	575,137	(50,410)	**(50,410)**
Fall 2013	**271,025**	300,195	**84,553**	71,999	**15,301**	19,460	**178,468**	145,704	**49,441**	41,952	**598,788**	0	579,310	579,310	(19,478)	**(19,478)**
Fall 2014	**266,579**	306,904	**83,796**	74,247	**15,157**	20,327	**163,314**	152,585	**47,596**	38,664	**576,442**	0	592,727	592,727	16,285	**16,285**
Fall 2015	**309,671**	302,433	**90,623**	75,208	**18,189**	21,891	**173,528**	153,157	**53,281**	43,667	**645,292**	0	596,356	596,356	(48,936)	**(48,936)**
Fall 2016	**337,668**	302,827	**95,066**	77,061	**19,577**	20,139	**188,784**	153,662	**57,699**	44,064	**698,794**	6,300	597,753	604,053	(101,041)	**(94,741)**
Fall 2017	**353,763**	312,682	**98,054**	79,502	**20,483**	18,203	**194,024**	154,435	**59,969**	39,602	**726,293**	34,923	604,424	639,347	(121,869)	**(86,946)**

Historically, the University has had an overall deficit of E&G space and considers this to be the norm, as do most other Texas Universities. The chart below compares the E&G square footage per full time student equivalent among the peer universities. In fall 2017, ASU had an average of 89 actual E&G square feet while THECB projected 106. The peer universities ranged from 45 to 114 actual and 102 to 120 projected.

E&G Square Feet per Full Time Student Equivalent



Source: THECB Fall 2017 Space Projection Model

The space projection is calculated by five factors: teaching, library, research, office and support spaces. The Space Projection Model used in this study is available through the THECB web page. Spaces that are not considered as E&G were calculated separately and are discussed in a later section.

ASU developed an evaluation of space needs broken down by each college. This will allow the University to assess the footprint of each school and how it affects the overall campus needs.

THECB 5 Factor Room Types (Assignable Square Feet)	Enrollment 10,444 Fall 2017 Actual	Approx. Enrollment 10,650 Fall 2018 Actual	Projected Enrollment 11,311 Fall 2020	Projected Enrollment 12,500 Fall 2020	Projected Enrollment 14,000 Fall 2028	Projected Enrollment 15,000 Fall 2030
Teaching	312,682	271,228	390,838	439,880	492,307	529,467
Research	18,203	20,388	22,425	25,023	27,966	30,009
Office	154,435	160,857	212,287	236,882	264,742	284,082
Support	39,602	39,821	65,705	73,351	81,748	87,677
Library	79,502	79,705	104,502	113,224	123,301	130,632
Angelo State University Total E&G Space	604,424	571,999	795,757	888,360	990,064	1,061,867

THECB Calculations by College (5 Factor Space Only)	Enrollment 10,444 Fall 2017 Actual	Approx. Enrollment 10,650 Fall 2018 Actual	Projected Enrollment 11,311 Fall 2020	Projected Enrollment 12,500 Fall 2020	Projected Enrollment 14,000 Fall 2028	Projected Enrollment 15,000 Fall 2030
Norris-Vincent College of Business	38,020	35,169	48,459	53,595	59,834	63,595
College of Education	18,114	16,756	22,022	23,370	25,771	28,225
College of Arts and Humanities	182,548	168,882	233,781	258,439	289,538	308,350
Archer College of Health and Human Services	80,903	75,588	103,120	114,075	127,960	137,095
College of Science and Engineering	159,517	150,325	210,428	244,231	273,456	297,576
Interdisciplinary including dual credit	6,219	5,753	7,740	8,075	8,455	8,717
Library	79,502	79,705	104,502	113,224	123,302	130,632
Support	39,602	39,821	65,705	73,351	81,748	87,677
Angelo State University Total E&G Space	604,425	571,999	795,757	888,360	990,064	1,061,867

This chart was developed as a tool for the University. It details E&G space needs by college. It links enrollment goals for each year through 15,000 students with the colleges' anticipated enrollment figures by overall headcount, on-campus headcount and FTSE starting with the fall 2017 actual and THECB predicted E&G space.

The following years are Angelo State University projected figures. This will allow the University to look at space needs in conjunction with actual enrollment in addition to anticipated enrollment. If one college grows faster or slower than anticipated, their space needs can be adjusted accordingly.

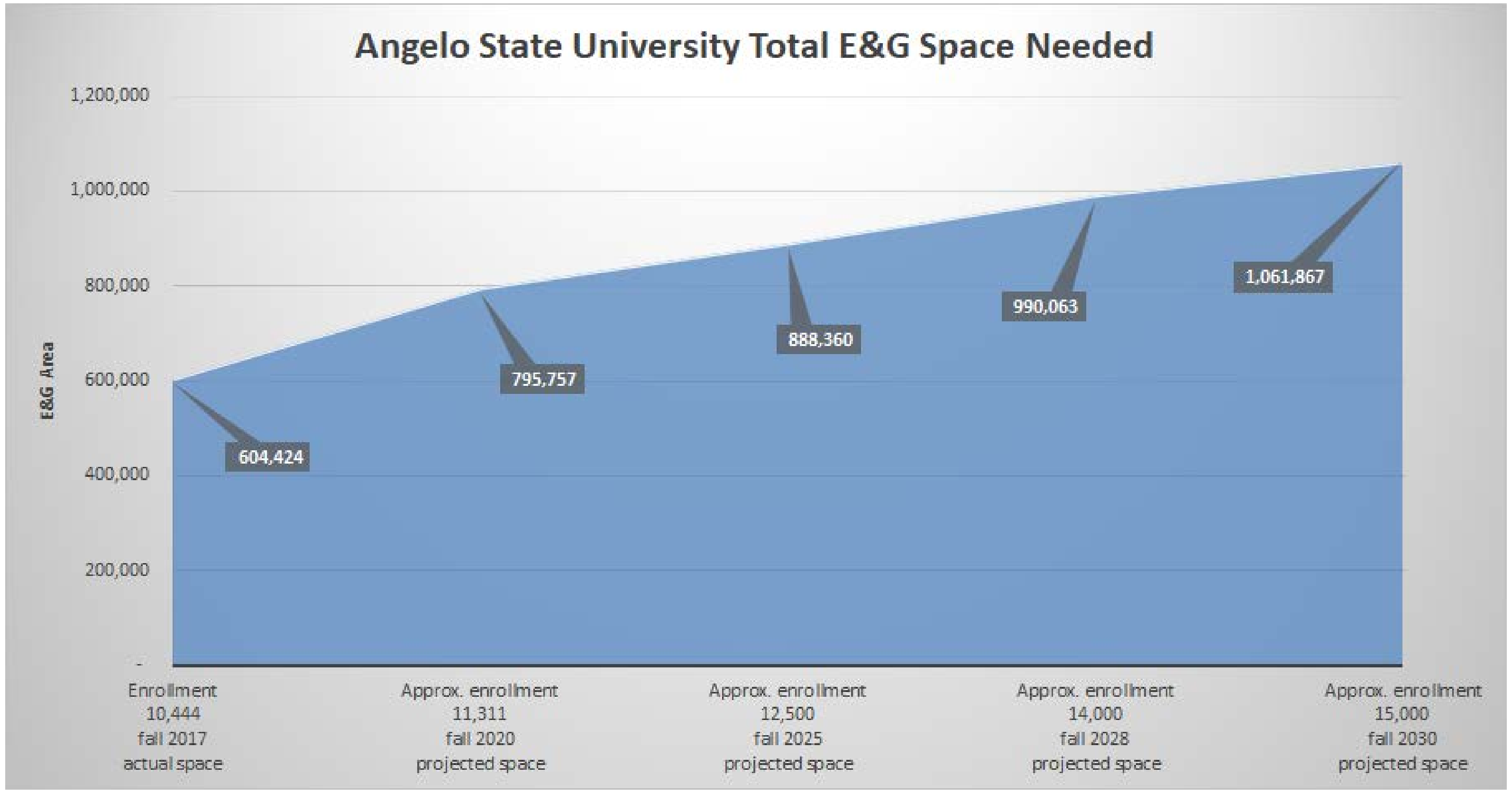
	Fall 2017 Actual	2017 Enrollments			THECB Predicted	2018 Enrollments			THECB Projection	2019 Enrollments			THECB Projection	2020 Enrollments			THECB Projection	2021 Enrollments			THECB Projection
(5 Factor Spaces Only)		Enrollment Head Count	On Campus Head Count	THECB FTSE	2017	Enrollment Head Count	On Campus Head Count	THECB FTSE	2018	Enrollment Head Count	On Campus Head Count	THECB FTSE	2019	Enrollment Head Count	On Campus Head Count	THECB FTSE	2020	Enrollment Head Count	On Campus Head Count	THECB FTSE	2021
Norris-Vincent College of Business	38,020	1,047	926	659	44,585	1,050	978	659	44,682	1,108	981	685	46,571	1,167	985	711	48,459	1,173	1,008	725	49,486.20
College of Education	18,114	1,193	334	374	21,305	1,160	336	375	21,288	1,150	364	374	21,655	1,140	393	372	22,022	1,129	402	373	22,292
College of Arts and Humanities	182,548	1,416	1,078	2,698	214,072	1,543	1,125	2,698	214,531	1,523	1,139	2,818	224,156	1,503	1,153	2,937	233,781	1,516	1,181	2,995	238,713
Archer College of Health and Human Services	80,903	2,048	1,818	1,132	94,690	2,132	1,932	1,132	94,917	2,173	1,903	1,179	99,019	2,214	1,873	1,226	103,120	2,216	1,934	1,253	105,311
College of Science and Engineering	159,517	1,489	1,473	1,860	186,387	1,532	1,518	1,860	186,868	1,630	1,578	1,990	198,648	1,728	1,639	2,120	210,428	1,766	1,707	2,193	217,189
Interdisciplinary including dual credit	6,219	3,251	308	104	7,230	3,233	225	150	7,309	3,341	299	130	7,525	3,449	374	109	7,740	3,580	380	109	7,807
Library	79,502				98,054				100,175				102,339				104,502				106,246
Support	39,602				59,969				61,507				63,606				65,705				67,234
Angelo State University E&G Total	604,425	10,444	5,937	6,827	726,292	10,650	6,114	6,874	731,277	10,925	6,265	7,175	763,517	11,201	6,416	7,475	795,757	11,381	6,613	7,648	814,278

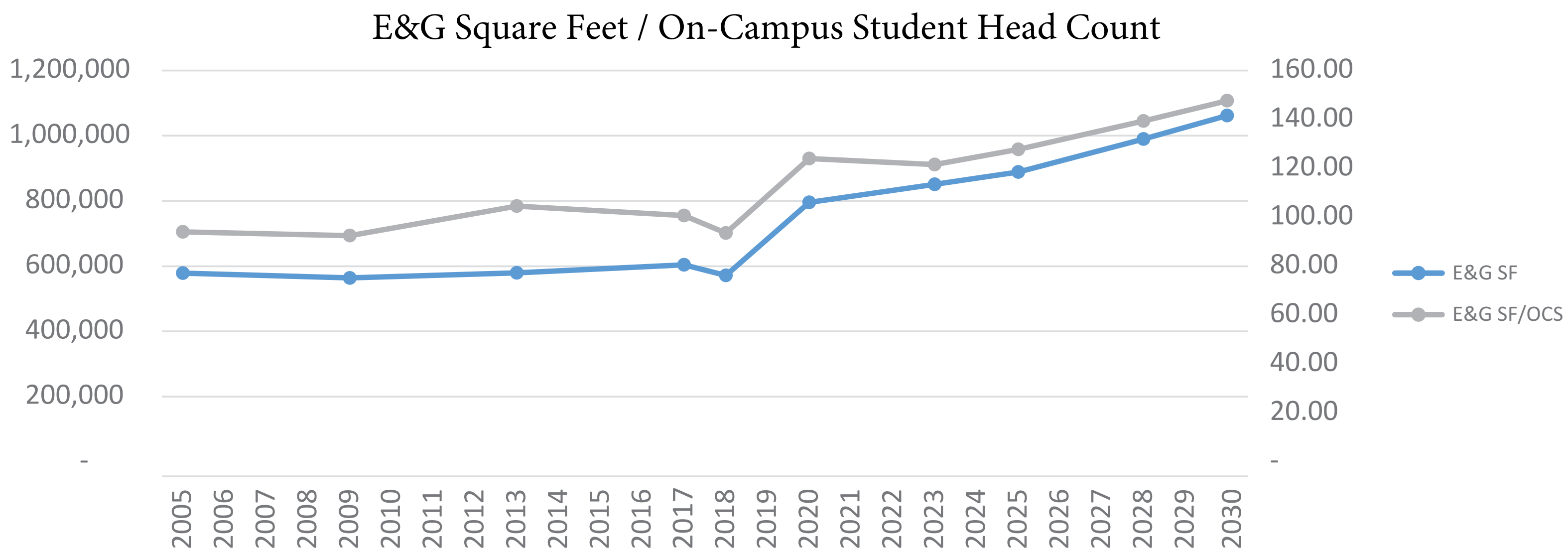
		2022 Enrollments			THECB Projection	2023 Enrollments			THECB Projection	2024 Enrollments			THECB Projection	2025 Enrollments			THECB Projection	2026 Enrollments			THECB Projection
		Enrollment Head Count	On Campus Head Count	THECB FTSE	2022	Enrollment Head Count	On Campus Head Count	THECB FTSE	2023	Enrollment Head Count	On Campus Head Count	THECB FTSE	2024	Enrollment Head Count	On Campus Head Count	THECB FTSE	2025	Enrollment Head Count	On Campus Head Count	THECB FTSE	2026
Norris-Vincent College of Business		1,179	1,032	739	50,513	1,185	1,056	753	51,541	1,215	1,047.00	767	52,568	1,245	1,038	781	53,595	1,298.53	1,044	810.33	55,675
College of Education		1,119	411	374	22,561	1,109	420	375	22,831	1,115	419	376	23,100	1,122	417	377	23,370	1,173	429	388	24,170
College of Arts and Humanities		1,529	1,210	3,053	243,644	1,542	1,238	3,112	248,576	1,585	1,227	3,170	253,507	1,627	1,216	3,228	258,439	1,669	1,226	3,359	268,805
Archer College fo Health and Human Services		2,218	1,994	1,281	107,502	2,220	2,054	1,308	109,693	2,268	2,046	1,336	111,884	2,317	2,038	1,363	114,075	2,418	2,056	1,420	118,703
College of Science and Engineering		1,804	1,775	2,265	223,949	1,842	1,844	2,338	230,710	1,919	1,850	2,410	237,470	1,995	1,857	2,483	244,231	2,071	1,852	2,582	253,973
Interdisciplinary including dual credit		3,711	387	109	7,874	3,842	394	109	7,941	4,018	391	109	8,008	4,194	388	109	8,075	4,370	397	109	8,202
Library					107,991				109,735				111,480				113,224				116,583
Support					68,763				70,293				71,822				73,351				76,150
		11,561	6,809	7,821	832,798	11,740	7,006	7,995	851,319	12,120	6,980	8,168	869,839	12,500	6,954	8,341	888,360	13,000	7,005	8,668	922,261

		2027 Enrollments			THECB Projection	2028 Enrollments			THECB Projection	2029 Enrollments			THECB Projection	2030 Enrollments			THECB Projection
		Enrollment Head Count	On Campus Head Count	THECB FTSE	2027	Enrollment Head Count	On Campus Head Count	THECB FTSE	2028	Enrollment Head Count	On Campus Head Count	THECB FTSE	2029	Enrollment Head Count	On Campus Head Count	THECB FTSE	2030
Norris-Vincent College of Business		1,352	1,051	840	57,754	1,406	1,057	869	59,834	1,451	1,057	894	61,715	1,497	1,057	918	63,595
College of Education		1,224	441	399	24,971	1,275	453	410	25,771	1,307	460	435	26,998	1,340	467	459	28,225
College of Arts and Humanities		1,712	1,237	3,489	279,172	1,754	1,247	3,620	289,538	1,805	1,249	3,730	298,944	1,857	1,251	3,839	308,350
Archer College of Health and Human Services		2,519	2,074	1,476	123,332	2,620	2,092	1,533	127,960	2,712	2,104	1,589	132,528	2,805	2,116	1,644	137,095
College of Science and Engineering		2,148	1,847	2,681	263,714	2,224	1,842	2,780	273,456	2,328	1,856	2,907	285,516	2,431	1,870	3,033	297,576
Interdisciplinary including dual credit		4,546	407	110	8,328	4,722	417	110	8,455	4,896	424	110	8,586	5,070	431	110	8,717
Library					119,942				123,301				126,967				130,632
Support					78,949				81,748				84,713				87,677
		13,500	7,056	8,995	956,162	14,000	7,107	9,322	990,063	14,500	7,150	9,663	1,025,965	15,000	7,193	10,003	1,061,867

In order to accommodate student enrollment targets of 14,000 in 2028 and 15,000 in 2030, the University will need to gain over 386,000 E&G square feet by 2028 and then an additional 70,000 by 2030. This does not take into account the additional support (non-E&G) space that will be required as well.

The chart below at the right depicts the relationship of E&G space needed to satisfy the on-campus headcount. It is anticipated that the on-campus headcount will be 7,107 by 2028 and the E&G square footage will need to be 990,063. This is roughly 139 square feet of E&G space for each on-campus headcount student, and in 2017, ASU required 102 square feet of E&G space for each on-campus headcount student. This E&G space required acts as a baseline for planning future facilities. The growth in this figure also explains the dynamic of needing more E&G space as the off-campus enrollment population grows. As an example, although a student is enrolled in an online program or a dual credit offsite program, E&G space is still required on campus to support that student, namely space to house faculty, registration and advising staff, instructional designers, library resources, and physical infrastructure to accommodate technology and service needs.





Space Projections – Non-E&G

In addition to the Academic (E&G) space the University will require, there are a series of important associated and support spaces known as non-E&G space. For the purposes of this report, housing, dining, auxiliary/student services, student recreation, athletic spaces, and their associated infrastructure are included under this definition.

Information Technology

The ASU Information Technology department is in continuous need of space as the IT service industry continues to expand into evolving facets of higher education. For example, additional space will be needed to support the growth of online learning. The network infrastructure, including data center, switchgear, fiber plant and support facilities, will be upgraded as buildings are added to the campus. The University is planning an upgrade to the Campus Data Center and support space currently housed in the Rassman Building.

Housing

In order to support a growing on-campus student population and a second-year requirement for on-campus housing, the University plans to add an additional 800 beds to campus. The complete Housing Study can be found in the Reports chapter of this plan.

Dining

Renovations have been made to the existing Houston Harte University Center (UC) dining services and are planned for the Food Service Center to help fulfill future needs of on-campus dining. Convenient locations of a full-service Starbucks, Common Grounds coffee bar in the Library and an Einstein Bros. Bagels box concept have supplemented dining options for a traveling student population. The University will continue to develop "on-demand" dining options such as the Ram Carts and the "Get" mobile app.

Administrative/Student Services Space

Services needed by students for enrollment and other critical functions are centrally located on the western portion of campus. As enrollment grows, the needed space for services will increase. The University plans to add approximately 11,700 gross square feet (GSF) in the vicinity of the current services.

A growing on-campus student population will increase demand for meeting, conference, and event programming space for faculty, staff, and student organizations. As the Dr. Ralph R. Chase West Texas Collection on the second floor of the UC relocates to the planned Angelo State University Mayer Museum, there will be an opportunity to convert the vacated space into additional meeting, event, and support space. Currently, the C.J. Davidson Conference Center, with an audience capacity of 774, is the most frequently booked space in the UC and remains in high demand throughout the year. The Nasworthy Suite, with an audience capacity of 90, is the next largest space in the building. The addition of a second floor conference space that can support capacities of 300-500 is suggested to address the growing need for mid-sized event space and allow for the operation of concurrent events.

Recreation Space

Existing University Recreation facilities should be improved by adding turf to meet the demands of recreational and club sports. Expansion of field lighting and replacement of existing turf fields are highly recommended. Additional parking upgrades to the Intramural Complex are needed. Space allocation and upgrades in the Ben Kelly Center for Human Performance Building are recommended for student group practices. As the number of students participating in recreational sports increases, the programs will benefit from storage space, restrooms, and potential concessions located near the outdoor fields.

Athletics

While ASU's Athletics facilities are well positioned for current needs, the young and growing golf program requires a practice facility. There is a need for indoor softball batting cages as well as a need for an indoor track facility, and the future addition of sand volleyball as a sport will require facilities and locker rooms.

Recent Space Changes

Several significant changes to the University's Facilities Inventory occurred between the fall 2017 and fall 2018 reporting dates. These actual space changes for 2018 are reflected in the E&G data given in charts in this Space Analysis chapter; however, the fall 2018 THECB Space Projection Model calculating predicted space for 2018 was not available at the time data was prepared for this publication.

Building:	Changes to Area:		
	GSF	NASF	E&G
Health and Human Services Building	58,007	25,332	24,744
Norris Baseball Complex Expansion	3,389	2,770	-
East and West Office Annex Buildings	(10,080)	(5,612)	(5,612)
Reidy Building (Leased)	-	(1,667)	(1,667)
WED Center	(7,730)	(4,279)	(471)
Mayer Press Box at LeGrand Stadium	7,185	2,529	-
University Sports Medicine Clinic	6,360	4,910	2,454
Biology Greenhouse	4,531	-	-
Wing Addition at Centennial Village	47,668	32,772	4,172
Ben Kelly Center for Human Performance	-	-	(54,696)
Totals	109,330	56,755	(31,076)

Conclusion

The intent of the space analysis is to highlight the challenges and opportunities that stand before Angelo State University with respect to space needs. The projected need for additional space when student enrollment reaches 15,000 students is just over 386,000 E&G square feet; however, there are opportunities to improve utilization of existing space.

For example, additional dynamics impacting teaching space at ASU involve the gradual evolution of faculty preference to teach in rooms that enable more collaboration among students, and in some cases, have more flexible layouts. These changes are taking place now and involve the substitution of tables and chairs for tablet arm desks. This has caused a reduction in capacity of affected classrooms, since the table and chair layout needs more space than the tablet arms. At the same time, there is a deficit of small capacity classrooms (under 16) based on the enrollment of classes while there is a surplus of rooms with a capacity of 17-44. The University will continue to make great strides in utilization of classrooms as have been apparent the last few years. In order to continue to positively impact classroom utilization, small sections should be consolidated when possible for best fit in the larger rooms, and the overall number of classrooms will have to be reduced.

Furthermore, smaller classrooms can be converted to address non-instructional needs, such as student study rooms, lounges, and office spaces. These efforts should be coordinated with the arrival of the new buildings to assure adequate inventory of appropriate classroom sizes and improved utilization.

In keeping with ASU's strategic plan, “Envisioning 100 Years & Beyond,” the planning horizon in this Master Plan Update extends to 2030 when enrollment is expected to reach 15,000. Interim space needs have been aligned with enrollment. Thirteen (13) interim levels of projected enrollment and space needs have been provided for the University’s use, broken down by college and by type of space.

Phasing of Master Plan projects has been proposed in the Facilities Master Plan chapter of this document. Both E&G and non-E&G projects have been prioritized into four distinct phases.

Angelo State

Budget Estimates

Introduction

As stated in previous chapters, the projects composing the Facilities Master Plan chapter have been prioritized by Angelo State University under feasibility and financial analysis. The following budgets are compiled utilizing the fall 2018 Texas Higher Education Coordinating Board (THECB) Construction Costs including factors of escalation. Budgets for projects under Pre-construction and Construction have already been approved by the Texas Tech University System Board of Regents.

Budget Estimates by Priority Phase

Phase	Project Name	Facility Type	Stage	NASF Added	E&G SF Added		Budget
1	Academic Building Exterior Remodel	Academic	Under Construction	-	-	$	1,999,995.00
1	Stephens Chapel	Services	Under Construction	2,232.00	-	$	1,925,000.00
1	Food Service Renovation	Dining	Under Construction	-	-	$	8,600,000.00
1	Angelo State University Mayer Museum	Academic	Under Preconstruction	18,600.00	12,200.00	$	17,100,000.00
1	Concho Hall Renovation	Academic	Planning, MP1 Submitted	-	-	$	34,800,000.00
2	New Science Building	Academic	MP1 Submitted	52,000.00	50,000.00	$	52,300,000.00
2	Carr Residence Hall Conversion	Services	MP1 Submitted	-	10,808.00	$	5,650,000.00
2	Golf Practice Facility	Athletic	Development and Planning	800.00	-	$	225,000.00
2	Plaza Verde Residences Phase 2	Housing	Speculative	60,594.00	-	$	30,705,000.00
3	Indoor Track and Field Facility	Athletic	MP1 Submitted	31,500.00	-	$	26,200,000.00
3	ASU Auditorium Renovation	Services	Development and Planning, MP1 Submitted	4,953.00	-	$	3,150,000.00
3	Vincent Building Second Floor Expansion	Academic	Speculative	3,480.00	3,132.00	$	2,320,000.00
3	Texan Hall Phase 2	Housing	Speculative	50,100.00	-	$	20,470,000.00
3	Softball Recreation Field Renovation	Recreation	Speculative	-	-	$	900,000.00
3	Indoor Softball Batting Cage	Athletic	Speculative	2,500.00	-	$	500,000.00
4	Clinic Demolition	Services	Speculative	(3,922.00)		$	250,000.00
4	Academic II	Academic	MP1 Submitted, Speculative	20,950.00	20,120.00	$	21,850,000.00
4	Central Plant Phase 3	Infrastructure	Speculative	2,000.00	-	$	4,000,000.00
4	Massie Hall Renovation and Addition	Housing	Speculative	9,990.00	-	$	6,500,000.00
4	Sand Volleyball Facility	Athletic	Speculative	-	-	$	750,000.00
4	Academic III	Academic	Theoretical	39,000.00	37,050.00	$	39,225,000.00
			Total	**294,777.00**	**133,310.00**	**$**	**279,419,995.00**

Phase	NASF Added	E&G SF Added	Budget
Phase 1 Total	**20,832.00**	**12,200.00**	**64,424,995.00**
Phase 2 Total	**113,394.00**	**60,808.00**	**88,880,000.00**
Phase 3 Total	**92,533.00**	**3,132.00**	**53,540,000.00**
Phase 4 Total	**68,018.00**	**57,170.00**	**72,575,000.00**
Total	**294,777.00**	**133,310.00**	**279,419,995.00**

Budget Estimates by Planning Sector

Phase	Project Name	Facility Type	Stage	NASF Added	E&G SF Added		Budget
1	Academic Building Exterior Remodel	Academic	Under Construction	-	-	$	1,999,995.00
1	Angelo State University Mayer Museum	Academic	Under Preconstruction	18,600.00	12,200.00	$	17,100,000.00
1	Concho Hall Renovation	Academic	Planning, MP1 Submitted	-	-	$	34,800,000.00
2	New Science Building	Academic	MP1 Submitted	52,000.00	50,000.00	$	52,300,000.00
3	Vincent Building Second Floor Expansion	Academic	Speculative	3,480.00	3,132.00	$	2,320,000.00
4	Academic II	Academic	MP1 Submitted, Speculative	20,950.00	20,120.00	$	21,850,000.00
4	Academic III	Academic	Theoretical	39,000.00	37,050.00	$	39,225,000.00
1	Stephens Chapel	Services	Under Construction	2,232.00	-	$	1,925,000.00
2	Carr Residence Hall Conversion	Services	MP1 Submitted	-	10,808.00	$	5,650,000.00
3	ASU Auditorium Renovation	Services	Development and Planning, MP1 Submitted	4,953.00	-	$	3,150,000.00
4	Clinic Demolition	Services	Speculative	(3,922.00)		$	250,000.00
1	Food Service Renovation	Dining	Under Construction	-	-	$	8,600,000.00
2	Plaza Verde Residences Phase 2	Housing	Speculative	60,594.00	-	$	30,705,000.00
3	Texan Hall Phase 2	Housing	Speculative	50,100.00	-	$	20,470,000.00
4	Massie Hall Renovation and Addition	Housing	Speculative	9,990.00	-	$	6,500,000.00
3	Softball Recreation Field Renovation	Recreation	Speculative	-	-	$	900,000.00
2	Golf Practice Facility	Athletic	Development and Planning	800.00	-	$	225,000.00
3	Indoor Track and Field Facility	Athletic	MP1 Submitted	31,500.00	-	$	26,200,000.00
3	Indoor Softball Batting Cage	Athletic	Speculative	2,500.00	-	$	500,000.00
4	Sand Volleyball Facility	Athletic	Speculative	-	-	$	750,000.00
4	Central Plant Phase 3	Infrastructure	Speculative	2,000.00	-	$	4,000,000.00
			Total	**294,777.00**	**133,310.00**	**$**	**279,419,995.00**

Phase	NASF Added	E&G SF Added		Budget
Academic Facility Total	**134,030.00**	**122,502.00**	**$**	**169,594,995.00**
Services Facility Total	**3,263.00**	**10,808.00**	**$**	**10,975,000.00**
Dining Facility Total	**-**	**-**	**$**	**8,600,000.00**
Housing Facility Total	**120,684.00**	**-**	**$**	**57,675,000.00**
Recreation Facility Total	**-**	**-**	**$**	**900,000.00**
Athletic Facility Total	**34,800.00**	**-**	**$**	**27,675,000.00**
Infrastructure Facility Total	**2,000.00**	**-**	**$**	**4,000,000.00**
Total	**294,777.00**	**133,310.00**	**$**	**279,419,995.00**

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Reports

Introduction

This chapter describes the campus infrastructure and how it will support the Master Plan. It includes assessments of current conditions and recommendations on system improvement with campus development in the following areas: Hydronic Chilled Water Study by Jose I. Guerra, Inc. Consulting Engineers and Stormwater Drainage Study by Carter-Fentress Engineering, Municipal and Development Solution along with SKG Engineering, LLC. A housing report is also included from Angelo State University Housing and Residential Programs.

Jose I. Guerra, Inc.
Consulting Engineers
Civil • Structural • Mechanical • Electrical

**ASU Central Plant - Feasibility Study for
Angelo State University
San Angelo, Texas**

**Draft Review September 20, 2019
Prepared by Jose I. Guerra, Inc.**

Submitted By:
Jose I. Guerra Inc.
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1. Introduction

1.1 PLANT CONTEXT AND PURPOSE

The ASU central plant is located near the center of campus in the basement of the Food Services Building. It provides continuous cooling and heating services to multiple buildings on campus. The plant currently houses a total of six water-cooled centrifugal chillers, five horizontal split-case chilled water pumps, five horizontal split-case condenser water pumps and a large built-in-place cooling tower assembly comprised of eight cells. The facility also houses the campus heating water and domestic hot water production systems.

The central plant was originally constructed as an integral part of the original campus and has been continuously built out over time. Much of the equipment is in good working condition while some of the equipment that is operating today is original equipment that is outdated and has met or exceeded its useful life expectancy.

1.2 SCOPE OF STUDY

Jose I. Guerra, Inc. worked with ASU staff to perform a comprehensive study of all the existing central plant equipment and identify a strategic path for increasing the cooling and heating capacity of the central plant based on ASU's values and future needs. This included the evaluation of existing plant conditions, identifying the campus goals, the development of a phased equipment replacement plan and a detailed approach to maintaining thermal utility service online throughout the implementation of any upgrades and additions. The goal of the study was to assist ASU to improve the way their central plant currently operates and to establish a clear direction for moving forward with future plant upgrades in alignment with ASU's mission to deliver clean, affordable, reliable utilities and excellent thermal utility service to the campus.

1.3 PROCESS AND STAKEHOLDER VALUES

The information gathering process for the study involved engaging multiple stakeholders through a series of meetings and onsite tours. The report included input from the plant facility superintendent and complete staff of operators throughout the process. As the study progressed, feedback from stakeholders was incorporated and built upon based on the following values and strategies:

ASU Plant Values

- **Care and Concern** – demonstrating dedication, care and concern for campus resources, the community, the environment and the University.
- **Safety** – dedication to providing both a safe work environment and safe delivery of thermal energy services.
- **Innovation** – seek innovative ways to improve service delivery, meet campus expectations and expand the value of thermal energy services provided to the campus.

All of the input was invaluable in helping the team understand how the plant operates currently and what the needs of the plant are and will be in the future. The entire team used this collected information to shape and inform the final Report, in the approach, strategy and details.

2. Goals

2.1 ASU FACILITIES GOALS

Jose I. Guerra, Inc. worked closely with ASU staff to identify the campus goals and future needs. At the top of the list is water conservation. Water conservation is a realized issue and a serious challenge facing the ASU Facilities group.

The campus is also projecting growth that will need to be supported by the campus distributed utilities. ASU estimates an additional 2,000 tons of cooling capacity and an additional 16,000 MBH of heating capacity will be required within the next decade. The intent of this document is to establish a clear path to develop the additional plant capacity required and minimize the impacts to campus operations.

An important purpose of this report is to align planned plant improvements and additions with the mission of ASU facilities. ASU's mission sets a clear direction for the institution into the next decade and this report is a document describing a strategy to address the need for facility improvements and for capital investments to support that mission.

2.2 STRATEGIC PLAN

Jose I. Guerra, Inc. worked with ASU staff to perform a comprehensive audit of all the installed equipment and identify a strategic path for improving and expanding the campus plant capacity to achieve the goals that ASU has established for the near future. The facilities Report assesses the need for repairs, modernization, upgrades, and/or new construction and identifies options and solutions to address current and future needs. The plan was assembled based on the following core values and goals:

Core Values:

- Optimize Plant Safety
- Care and Concern for the Campus, community and the environment
- Reliability, energy efficiency and water conservation
- Maintaining adequate capacity to successfully keep up with growing campus needs
- Optimizing Physical Infrastructure and configuration

Goals:

- Reliability and Efficiency: Upgrade existing equipment and controls to create a plant that offers reliable thermal energy and operates more efficiently.
- Safety and code compliance: Establish a strategy to address facility improvements required to meet current code requirements and maintain a safe work environment.
- Customer Service: Develop a comprehensive plan to address current system deficiencies and future building projects.
- Optimize Plant infrastructure: Establish a future equipment configuration that best utilizes available space/real estate and existing piping infrastructure. Create and maintain a level of consistency in new equipment and controls installed in the plant.
- Optimize plant efficiency: Establish a strategy to maximize the plant efficiency and water consumption and quantify the effect of plant operations as the system improvements are implemented.
- Maximize Plant Capacity: Establish a strategy to maximize the plant capacity within the current property constraints. Optimize the plant facilities and resources in accommodating growth and improvements within the campus.

2.3 RELIABILITY AND EFFICIENCY

As a major contribution to the improvement of plant efficiency and reliability, ASU would like to replace the existing cooling towers with new, more water and energy efficient equipment. The existing towers are antiquated and operating at a poor efficiency with a water loss that is becoming difficult and costly to accommodate. It is the intention of ASU to remove all towers currently in operation and replace them with new equipment that operates more efficiently and consumes less water.

Another significant contribution to improved plant efficiency and reliability are upgrades to the plant control system and control devices throughout the distribution. ASU intends to upgrade the existing system with various control elements that will greatly improve the facilities group's ability to maintain the system and evaluate and document performance over time.

2.4 OPTIMIZE PLANT CAPACITY AND INFRASTRUCTURE

In order to keep up with campus growth, maintain redundancy, optimize plant infrastructure, improve reliability and minimize maintenance ASU intends to develop a future campus plant layout that best utilizes available plant floor space, real estate, future projects and existing piping infrastructure.

As a part of this study Jose I. Guerra, Inc. evaluated the existing plant equipment and piping configurations as well as available real estate and floor space to establish the required added capacity that the campus anticipates including additional plant locations.

2.5 OPTIMIZE PLANT EFFICIENCY

At the completion of the plant build out plan the intent is to have all the major plant equipment and controls configured and operating in a manner that is conducive to the implementation of a third-party energy optimization algorithm similar to CPO-30 and Hartman Loop technology.

3. Evaluation of Existing Conditions

3.1 EXISTING MECHANICAL SYSTEMS

The existing central plant is located in the basement level of the Food Services Building and serves the entire campus. Chilled water, heating water and domestic hot water are all produced in this single plant and distributed throughout the campus.

The campus heating water system and one chiller were all replaced in a 2006 construction package and that equipment is in new condition. The existing chillers and pumps are in good working condition and are expected to continue to serve the campus into the near future. The existing cooling tower system is outdated and has met or exceeded its useful life expectancy and is intended to be replaced.

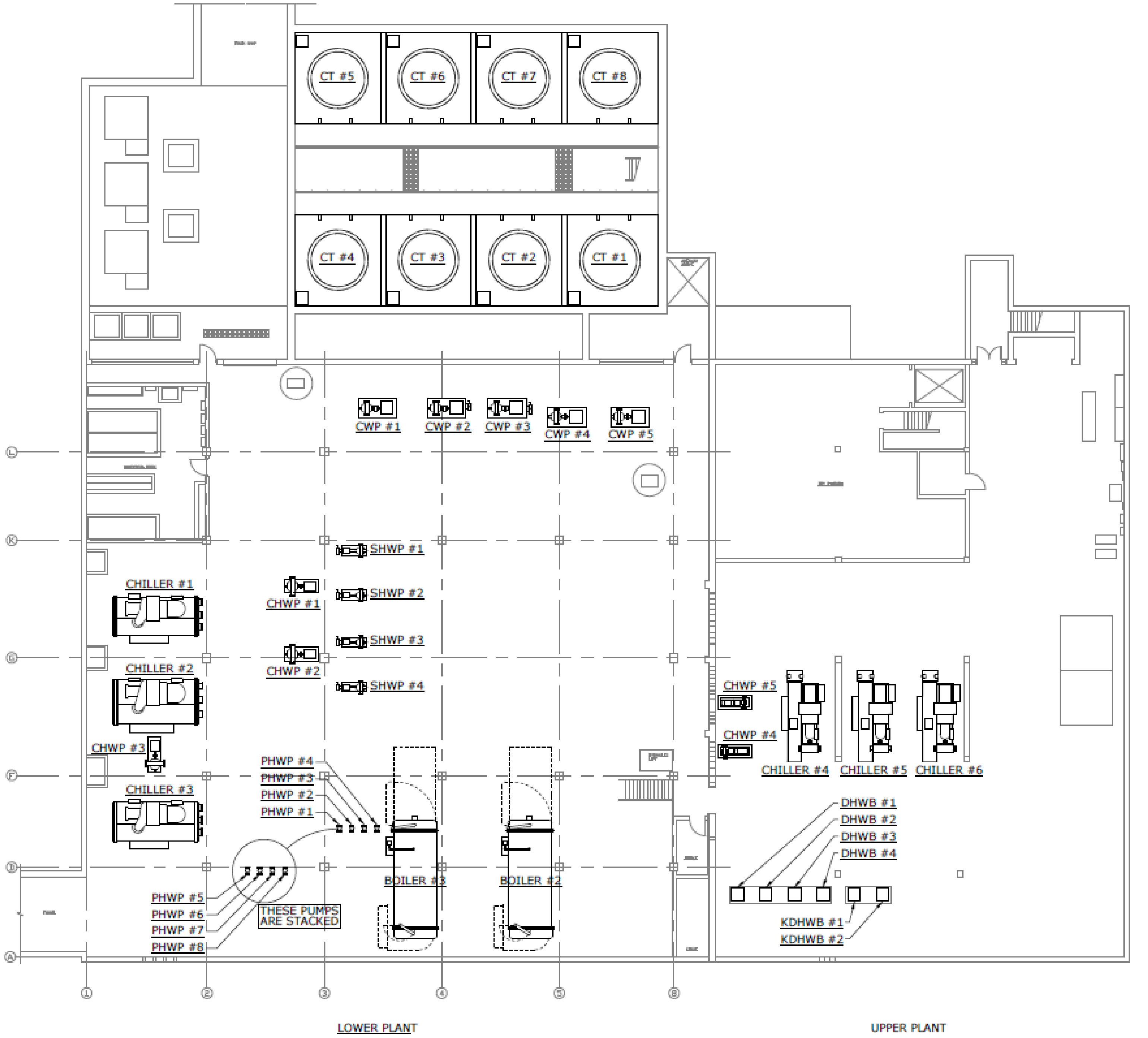
Existing installed systems include:

- 3 - 1000 Ton centrifugal water-cooled chillers with dedicated chilled water pump piped in a variable primary configuration.
- 2 – 500 Ton centrifugal water-cooled chillers with dedicated chilled water pump piped in a variable primary configuration.
- 1 – 250 Ton centrifugal water-cooled chiller piped in a redundant configuration.
- 1 built up tower assembly – 4,250 Tons with constant speed condenser water pumps and fans.
- 2 – 700 HP boilers with a primary and secondary pumping configuration.

MECHANICAL EQUIPMENT LIST — EXISTING

PROJECT: ASU CHILLED WATER STUDY
REV: 1
REV. DATE: 09/19/19

EQUIPMENT	MODEL/EQUIPMENT DESCRIPTION	SERIAL NO.	NOMINAL TONNAGE	NOMINAL MBH	EFF. % OR KW/TON	FLOW (GPM)	HEAD (FT.)	MOTOR DATA				
								BHP	HP	KW	VOLTAGE/PHASE	CONTROL CV OR VSD
CHILLERS												
CHILLER #1	TRANE CVHF1060 CENTRIFUGAL CHILLER	L07B00936	1060	12,720		1714					460/3	
CHILLER #2	TRANE CVHF1280 CENTRIFUGAL CHILLER	L94E04946	1280	15,360		1714					460/3	
CHILLER #3	TRANE CVHF1060 CENTRIFUGAL CHILLER	L98B01383	1060	12,720		1714					460/3	
CHILLER #4	TRANE CVHF555 CENTRIFUGAL CHILLER	L99M04998M	555	6,660		860					460/3	
CHILLER #5	TRANE CVHF555 CENTRIFUGAL CHILLER	L99M05010M	555	6,660		860					460/3	
CHILLER #6	TRANE CVHS250 CENTRIFUGAL CHILLER	L11M04466	250	3,000							460/3	
PRIMARY CHILLED WATER PUMPS												
CHWP #1	PACO SPLIT CASE PUMP				82%	1714	80	95	125	71	460/3	VSD
CHWP #2	TACO TA SERIES SPLIT CASE PUMP				82%	1714	80	95	125	71	460/3	VSD
CHWP #3	TACO TA SERIES SPLIT CASE PUMP				82%	1714	80	95	125	71	460/3	VSD
CHWP #4	ARMSTRONG MOTOR				76%	857	85	53	75	39	460/3	VSD
CHWP #5	BALDOR MOTOR				76%	857	85	53	75	39	460/3	VSD
CONDENSER WATER PUMPS												
CWP #1	SPLIT CASE PUMP				80%	3000	80	76	75	57	460/3	VSD
CWP #2	SPLIT CASE PUMP				80%	3000	80	76	75	57	460/3	VSD
CWP #3	SPLIT CASE PUMP				80%	3000	80	76	75	57	460/3	VSD
CWP #4	SPLIT CASE PUMP				70%	1500	85	46	50	34	460/3	VSD
CWP #5	SPLIT CASE PUMP				70%	1500	85	46	50	34	460/3	VSD
COOLING TOWERS												
CT #1	COOLING TOWER								40			
CT #2	COOLING TOWER								40			
CT #3	COOLING TOWER								40			
CT #4	COOLING TOWER								40			
CT #5	COOLING TOWER								40			
CT #6	COOLING TOWER								40			
CT #7	COOLING TOWER								40			
CT #8	COOLING TOWER								40			
BOILERS												
BOILER #2	CB200-700-125 FIRETUBE BOILER	0L084287	700	23,433					30		460/3	
BOILER #3	CB200-700HP FIRETUBE BOILER	L91939	700	23,433					30		460/3	
KDHWB #1	EVA1500WN1-UEFM DOMESTIC HOT WATER BOILER	64959402	-	1,500	88%						208/3	
KDHWB #2	EVA1500WN1-UEFM DOMESTIC HOT WATER BOILER	64959403	-	1,500	88%						208/3	
DHWB #1	EVA2000WN1-UEFM DOMESTIC HOT WATER BOILER	64959405	-	2,000	88%						208/3	
DHWB #2	EVA2000WN1-UEFM DOMESTIC HOT WATER BOILER	64959404	-	2,000	88%						208/3	
DHWB #3	EVA2000WN1-UEFM DOMESTIC HOT WATER BOILER	64959406	-	2,000	88%						208/3	
DHWB #4	EVA2000WN1-UEFM DOMESTIC HOT WATER BOILER	64959407	-	2,000	88%						208/3	
PRIMARY HOT WATER PUMPS												
PHWP-1-07	ARMSTRONG 4380 SERIES VERTICAL INLINE PUMP					612	17.1		5		208/3	VSD
PHWP-2-07	ARMSTRONG 4380 SERIES VERTICAL INLINE PUMP					612	17.1		5		208/3	VSD
PHWP-3-07	ARMSTRONG 4380 SERIES VERTICAL INLINE PUMP					612	17.1		5		208/3	VSD
PHWP-4-07	ARMSTRONG 4380 SERIES VERTICAL INLINE PUMP					612	17.1		5		208/3	VSD
PHWP-5-07	ARMSTRONG 4380 SERIES VERTICAL INLINE PUMP					612	17.1		5		208/3	VSD
PHWP-6-07	ARMSTRONG 4380 SERIES VERTICAL INLINE PUMP					612	17.1		5		208/3	VSD
PHWP-7-07	ARMSTRONG 4380 SERIES VERTICAL INLINE PUMP					612	17.1		5		208/3	VSD
PHWP-8-07	ARMSTRONG 4380 SERIES VERTICAL INLINE PUMP					612	17.1		5		208/3	VSD
SECONDARY HOT WATER PUMPS												
SHWP #1	SECONDARY HOT WATER PUMP				78%	682	180	40	50	30	460/3	VSD
SHWP #2	SECONDARY HOT WATER PUMP				78%	682	180	40	50	30	460/3	VSD
SHWP #3	SECONDARY HOT WATER PUMP				78%	682	180	40	50	30	460/3	VSD
SHWP #4	SECONDARY HOT WATER PUMP				78%	682	180	40	50	30	460/3	VSD



The information was furnished by ASU

1 CENTRAL PLANT EQUIPMENT LAYOUT - EXISTING
NO SCALE

3.2 EXISTING CAMPUS LOADS

Jose I. Guerra, Inc. assembled a campus cooling and heating load matrix based on available as-built documentation for each building and information gathered on various site observations. Heating and cooling peak loads for each building were established allowing for the development of a total peak load for the plant based on the overall load profile for the campus. The building loads were then compared to actual operating conditions throughout the year through monitoring of the campus building automation system.

ASU HYDRONIC SYSTEMS MATRIX

PROJECT: ASU CHILLED WATER STUDY
REV: 1
REV. DATE: 09/03/19

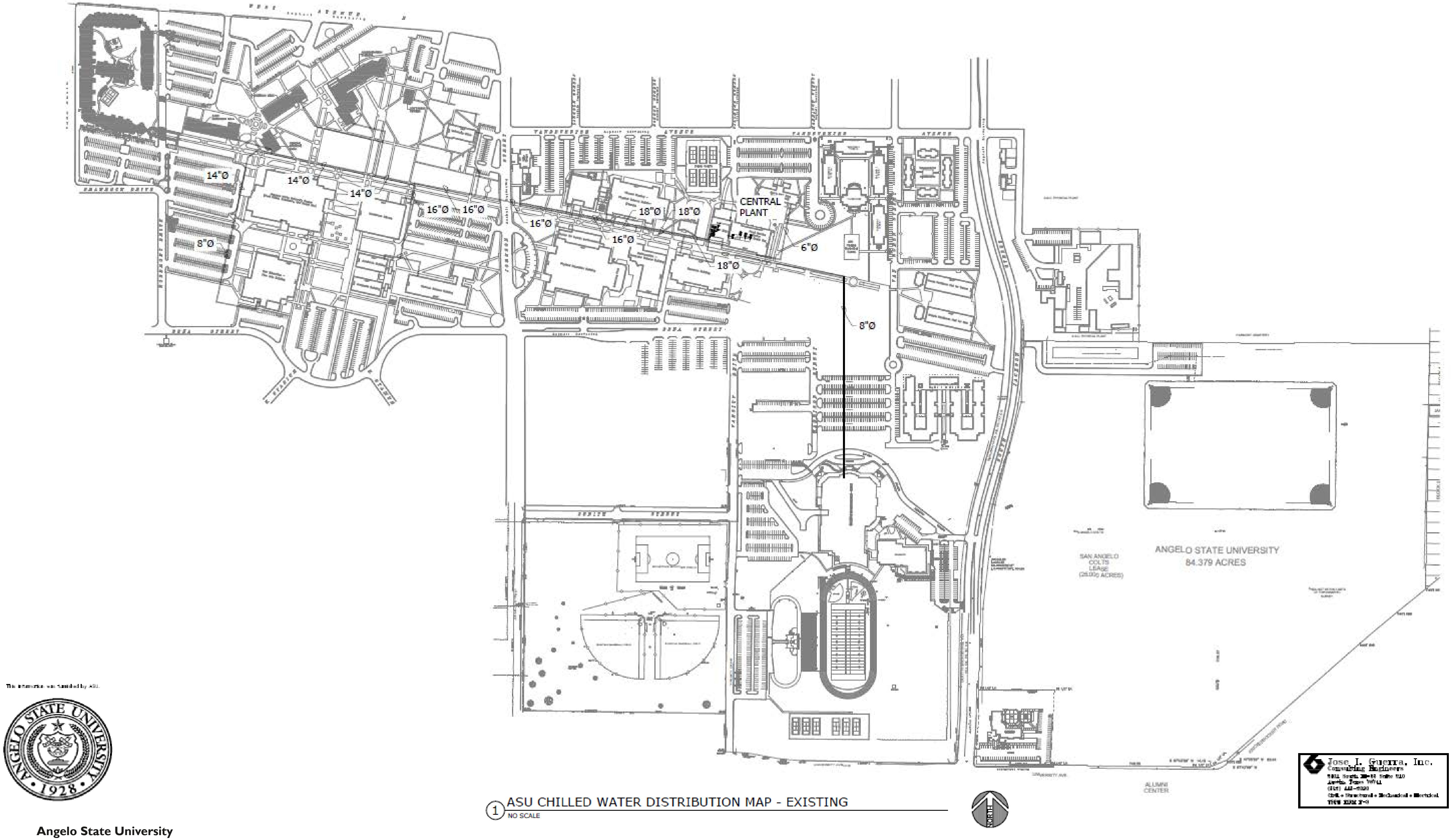
BUILDING	AREA (FT^2)	COOLING LOAD (TONS)	HEATING LOAD (MBH)	CHILLED WATER DESIGN FLOW AT 12°F dT (GPM)	HEATING WATER DESIGN FLOW AT 20°F dT (GPM)	PIPE SIZE (IN.)	
						CHW	HW
ACADEMICS	58,632	167.5	1206.1	335.0	1447.4	6	6
ADMINISTRATION	39,202	112.0	806.4	224.0	967.7	8	6
CARR EFA	80,184	229.1	1649.5	458.2	1979.4	6	6
CARR HALL	18,014	51.5	370.6	102.9	444.7	4	4
CAVNESS	82,543	235.8	1698.0	471.7	2037.6	6	6
CLINIC	8,118	23.2	167.0	46.4	200.4	6	6
CONCHO HALL	103,883	296.8	2137.0	593.6	2564.4	6	6
GENERAL SERVICES	22,468	64.2	462.2	128.4	554.6	6	4
HARDEMAN STUDENT SERVICES	24,592	70.3	505.9	140.5	607.1	4	4
HEALTH AND HUMAN SERVICES	80,500	230.0	1656.0	460.0	1987.2	6	6
HOUSTON HARTE UNIVERSITY CENTER	111,674	319.1	2297.3	638.1	2756.8	10	8
JUNELL	135,000	385.7	2777.1	771.4	3332.6	8	6
MCS	86,248	246.4	1774.2	492.8	2129.1	6	6
PORTER HENDERSON LIBRARY	78,926	225.5	1623.6	451.0	1948.3	8	6
RASSMAN	62,162	177.6	1278.8	355.2	1534.5	6	6
SCIENCE III	22,500	64.3	462.9	128.6	555.4	5	4
VINCENT NURSING	84,795	242.3	1744.4	484.5	2093.2	6	6
NEW ASU MUSEUM	22,066	63.0	453.9	180.0	127.0	4	4
TOTALS		3,204 TONS	23,071 MBH	6,455 GPM	2,389 GPM		

3.3 EXISTING CAMPUS PIPING DISTRIBUTION SYSTEMS

Jose I Guerra, Inc. met with facilities and documented the existing chilled water and heating water piping distribution systems from the existing plant to each individual building. A complete hydronic model of the campus thermal utility systems was developed based on site information, as-built documentation and building loads utilizing the computer aided modeling software Pipe-Flo Professional. The Pipe-Flo model was used to evaluate the way the current system is operating as well as impacts of future plant upgrades on the operation of the systems.

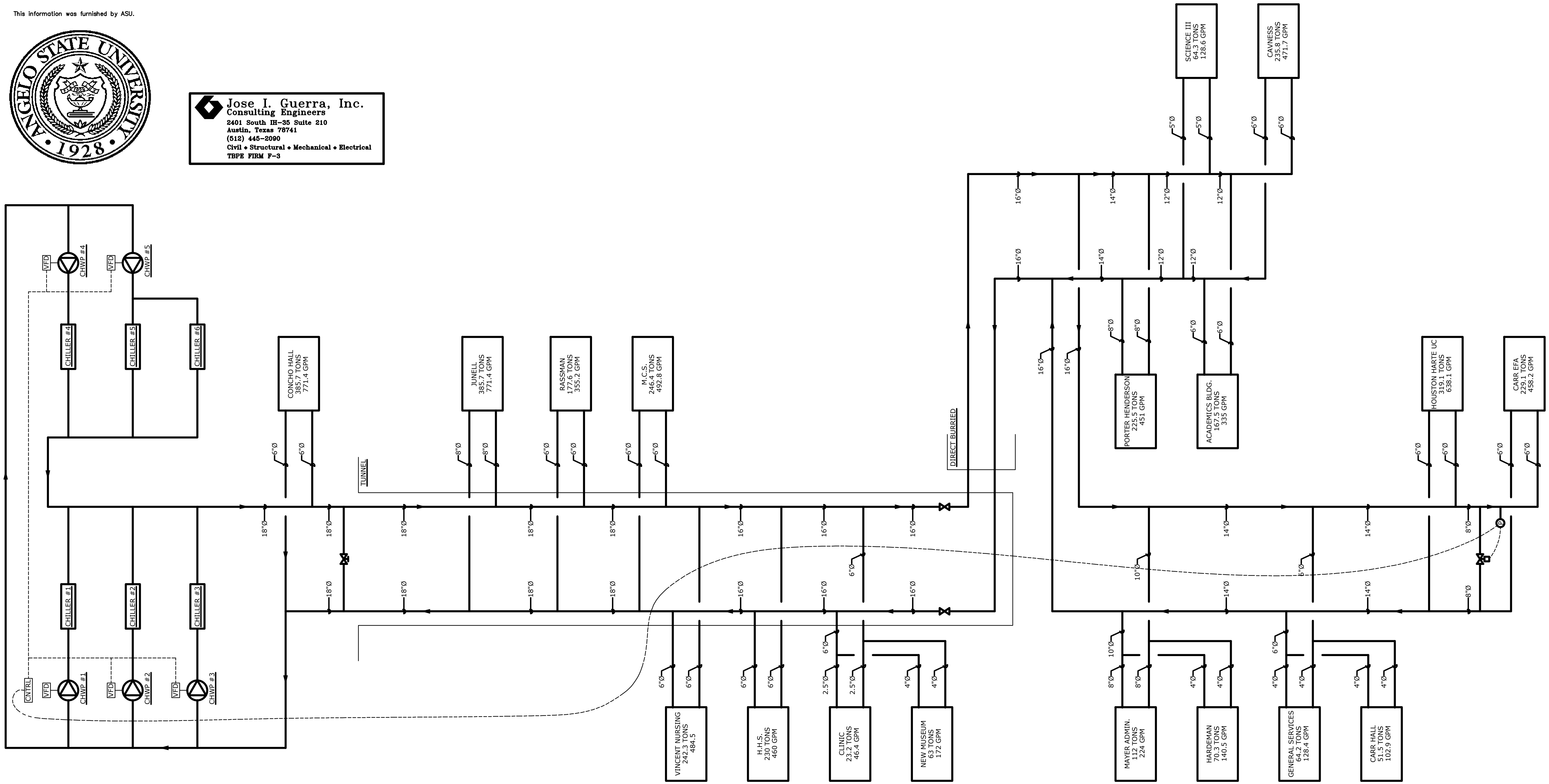
The current chilled water piping is arranged in a variable primary system configuration with each chiller piped directly to a dedicated primary chilled water pump. The chilled water pumps are variable volume controlled to a single static pressure sensor located in the chilled water supply line. Minimum flow through each chiller is intended to be controlled through a single bypass line from the chilled water supply to return header. This valve has continually read on the front end to be 100% closed throughout the system evaluation, however throughout our evaluation we consistently saw a blended return water temperature that was less than the header return temperature. This indicated that there was some amount of chilled water supply that was being bypassed. The impact of the chilled water bypass volume is a potential contribution to the shortage of chilled water flow based on the production. This condition was listed as a deficiency that needs to be investigated and the control sequence validated to ensure proper long-term operation of the chilled water system.

Chilled water is distributed to the majority of the buildings on campus through 18" supply and return pipes located in a tunnel originating at the central plant and leading west through campus. Evaluation of the Pipe-Flo model identified the existing 18" supply and return chilled water pipes located in the tunnel as a limiting factor in the piping distribution system. Despite having the installed cooling capacity required to meet the current needs of the campus, the flow required to realize the full capacity is hindered by an existing 18 inch piping system that results in a pressure drop that goes exponential as flow increases.



1 ASU CHILLED WATER DISTRIBUTION MAP - EXISTING
NO SCALE

This information was furnished by ASU.



1 ASU CAMPUS CHILLED WATER PIPING SCHEMATIC - EXISTING

NO SCALE

3.4 EXISTING CONTROL SYSTEMS

The central plant control system is part of the campus overall Building Automation System (BAS) manufactured by Andover. The Andover manufactured product is the Continuum line (Version 1.94 sp1). The Andover product line is owned by Schneider Electric Corporation presently.

BAS was installed over the last 20 years by Ener-Tel Services, Inc. Ener-Tel Services maintains an office in San Angelo and has provided support to ASU over these years. Ener-Tel continues to support ASU presently.

ASU control systems have the topology of multiple Local Area Networks (LANs) for the buildings on campus which are also members of a larger Campus Wide Area Network (WAN).

The BAS WAN includes operator workstations in six locations on campus. The Andover Cyberstation workstations reside in the Central Plant, Police Station, Math & Computer Science Building, Electronics Building, and Physical Plant Office.

Field devices for the BAS are maintained by ASU personnel. Maintenance is provided on an as needed basis. The field devices have been exposed to normal wear and tear and many are not functioning correctly or at all.

3.5 EXISTING ELECTRICAL SYSTEMS

The facility is currently served from three 12470-480/277V 3ph. 4W pad mounted oil filled service transformers that are owned and maintained by West Texas Utility Company. Each service transformer then serves three 4000A, 480/277V service entrance rated disconnect switches. Chiller #1 cooling towers are served from MCC-I-87, Chiller #2 and #3 cooling towers are served from MCC-III-94, chiller #4 and #5 are served from MCC-II-87.

4. Study Results

4.1 STUDY SUMMARY

The plant study addresses upgrades necessary to meet the current campus cooling and heating loads as well as future needs. Each of the following elements are important aspects of the study that were considered and addressed:

- Current chilled water production capacity.
- Current and future campus chilled water peak demands.
- Current chilled water piping distribution and limitations.
- Current heating water production capacity.
- Current and future campus heating water peak demands.
- Current heating water piping distribution and limitations.
- Condenser water system operation and efficiencies.
- Current system deficiencies.
- Additional chilled water and heating water production options.
- Plant efficiency throughout the upgrades.
- Piping configurations within the chilled water, heating water and condenser water systems.
- Current and future projects that directly affect the plant.
- Controls continuity.

Jose I. Guerra, Inc. worked closely with ASU staff to gather information on and evaluate the above elements through exhaustive research of as-built documents, onsite observations, input from ASU staff and plant operators, and analysis performed utilizing the computer aided modeling software Pipe-Flo Professional. We were able to establish an understanding of how the central plant is operating today and identify a strategic path for increasing the cooling and heating capacity of the central plant based on ASU's values and future needs. Based on the findings of this study, we have provided a detailed approach to building out the campus plant capacity in a manner that maximizes the production capability while maintaining the plant online and functional.

4.2 SUMMARY OF FINDINGS

Much of the mechanical equipment operating in the ASU central plant has been updated or replaced over time. Chillers and chilled water pumps appear to be well maintained and in good working condition.

The existing cooling towers appear to have been installed as part of the original construction and have met or exceeded their useful life expectancy. The antiquated cooling towers are a drain on natural resources and inefficiencies in the condenser water system are derating the chillers and affecting the overall efficiency of the chilled water system. The replacement of the entire cooling tower system is recommended.

Based on the overall campus cooling loads and the installed plant cooling capacity the current campus cooling demand is meeting or very close to exceeding the installed cooling capacity of the plant. Based on this we have presented an approach to address projects scheduled for the near future.

The existing chilled water and heating water piping configurations set limitations on additional capacity that can be installed within the confines of the existing central plant. Based on these limitations, we have presented an approach to address additional plant cooling capacity located at the west end of the tunnel near the Clinic building, where these limitations become negligible.

Based on the overall campus heating loads and the installed plant heating capacity, the current heating water plant is adequate to meet the current campus demands. Based on this understanding we included added heating capacity options to address future needs only.

Throughout the course of the study there were mechanical system deficiencies that we identified as needing to be addressed in order to properly monitor and quantify plant operations. We have compiled and included a detailed list of deficiencies and recommend addressing these deficiencies in the near future to improve maintenance and better assist the team moving forward into plant upgrades.

5. Future Build Out & Recommendations

5.1 OVERVIEW

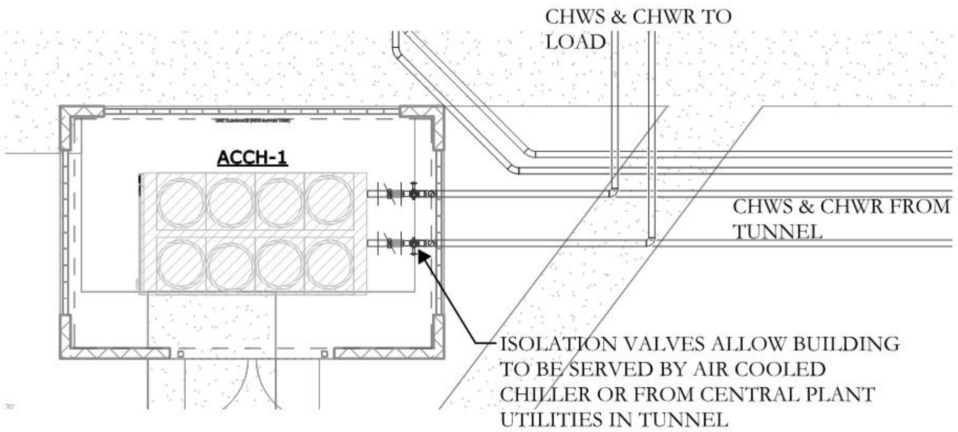
Jose I. Guerra worked closely with ASU to develop a clear, concise plan for implementing future plant upgrades in alignment with ASU's mission and goals. The Report is an expression of ASU's intention for the future and provides guidance to accomplish that vision.

5.2 CENTRAL PLANT SYSTEM UPGRADES AND ADDITIONAL CAPACITY

Over the next several years the campus is expected to grow with additional building projects that will come with added heating and cooling requirements. Based on the campus loads the current plant cooling capacity has adequate redundancy, but is not sufficient to accommodate any additional cooling loads. The piping through the tunnel is limited and not adaquate to accommodate any additional flow to the west. The result is a plan that includes the addition of a new chilled water and heating water plant west of Johnson street, the addition of new cooling towers and piping modifications to serve the chillers in the upper plant (4, 5, & 6), and the replacement of the existing cooling towers.

5.3 APPROACH TO ADDRESS PROJECTS SCHEDULED FOR THE NEAR FUTURE

As the ASU campus continues to grow, a solution for providing thermal utility services to new projects that precede the implementation of additional plant capacity is needed. The existing heating water capacity is adequate to meet current and near future demands, therefore projects projected for the near future may connect directly to the campus heating water system. The existing chilled water capacity, however, is not adequate to meet future demands. Jose I. Guerra, Inc. recommends an approach that includes the addition of a new air-cooled chiller to serve each new project, piped in a configuration conducive to a future plant connection. Once additional plant capacity is installed and functional, each building can be converted and connected directly to the plant distribution system.



5.4 RECOMMENDED IMMEDIATE UPGRADES TO THE EXISTING SYSTEM

Throughout the development of the report there were mechanical system deficiencies that we identified as needing to be addressed in order to properly monitor and quantify plant operations. Our approach was to develop a flow model that closely matched the functions that were observed through the installed campus BAS system. We found that many of the flow, temperature, and pressure transmitters and other devices were not functioning properly or in some case not in place.

Below is a detailed list of deficiencies that we believe need to be addressed in the near future to improve maintenance and better assist the team moving forward into plant upgrades.

ASU CHILLED WATER SYSTEM DEFICIENCIES

BUILDING	DEFFICIENCIES
ACADEMICS	1. CONTROL VALVE POSITION STATUS READING 100% OPEN ALL THE TIME. 2. NO dP SENSOR INDICATING. 3. FLOW METER MAY NOT BE WORKING (FLOW HAS NOT FLUCTUATED FROM 29 GPM).
ADMINISTRATION	1. CONTROL VALVE POSITION STATUS READING 100% OPEN ALL THE TIME. 2. NO dP SENSOR INDICATING. 3. FLOW METER MAY NOT BE READING CORRECTLY (FLOW HAS NOT FLUCTUATED FROM 29 GPM).
CARR EFA	1. CONTROL VALVE POSITION STATUS READING 100% OPEN ALL THE TIME.
CARR HALL	1. GROUPED WITH GENERAL SERVICES ON FRONT END. GENERAL SERVICES NOTES APPLY HERE.
CAVNESS	1. CONTROL VAVLE POSITION STATUS READING 100% OPEN ALL THE TIME. 2. EWT & LWT SENSORS INDICATING 80°F AND 63.3°F RESPECTIVELY.
CLINIC	1. CONTROL VALVE POSITION STATUS READING 100% OPEN ALL THE TIME. 2. FLOW METER NOT WORKING. 3. NO dP SENSOR INDICATING.
CONCHO HALL	1. FRONT END INDICATING "NO VALVE OR FLOW METER." 2. EWT & LWT SENSORS NOT INDICATING.
GENERAL SERVICES	1. CONTROL VALVE POSITION STATUS READING 100% OPEN ALL THE TIME. 2. FLOW METER MAY NOT BE WORKING. FLOW READS 0 GPM AT ALL TIMES. 3. NO dP SENSOR INDICATING.
HARDEMAN STUDENT SERVICES	1. CONTROL VALVE POSITION STATUS READING 100% OPEN ALL THE TIME. 2. NO DIFFERENTIAL PRESSURE IS INDICATING ON THE FRONT END.
HEALTH AND HUMAN SERVICES	-
HOUSTON HARTE UNIVERSITY CENTER	1. CONTROL VALVE POSITION STATUS READING 100% OPEN ALL THE TIME.
JUNELL	1. CONTROL VAVLE POSITION STATUS READING 100% ALL THE TIME. 2. FRONT END INDICATING "NO VALVE."
MCS	1. FLOW METER NOT WORKING. FLOW RATE IS 0 GPM AT ALL TIMES. 2. FRONT END INDICATING "NO VALVE." 3. LWT SENSOR NOT WORKING.
PORTER HENDERSON LIBRARY	1. CONTROL VALVE POSITION STATUS READING 100% OPEN ALL THE TIME. 2. NO dP SENSOR INDICATING.
RASSMAN	1. CONTROL VALVE POSITION STATUS READING 100% OPEN ALL THE TIME. 2. FLOW METER MAY NOT BE WORKING. FLOW RATE IS 0 GPM AT ALL TIMES. 3. NO dP SENSOR INDICATING.
SCIENCE III	1. CONTROL VALVE POSITION STATUS READING 100% OPEN ALL THE TIME. 2. FRONT END INDICATING "NO FLOW SHOWN ON THIS LOOP. DP'S ONLY." 3. NO FLOW METER.
VINCENT NURSING	1. CONTROL VALVE POSITION STATUS READING 100% OPEN ALL THE TIME. 2. NO dP SENSOR INDICATING. 3. EWT & LWT SENSORS NOT WORKING. INDICATING -327.7°F FOR BOTH.
OVERALL CHILLED WATER SYSTEM	1. ALL BYPASS VALVES IN SYSTEM - VALVE POSITION STATUS READING 100% CLOSED AT ALL TIMES. 2. CHILLED WATER RETURN TEMPERATURE READING HIGHER THAN CHILLED WATER RETURN HEADER TEMPERATURE, INDICATING CHILLED WATER SUPPLY IS BYPASSING SOMEWHERE IN THE SYSTEM.

5.5 RECOMMENDED APPROACH TO ACCOMMODATE NEW PLANT UPGRADES

The following proposed upgrades are presented as three individual projects. Project #1 and Project #2 have no specific time line allocated and may be implemented at any time and in any order; that is, Project #1 may be implemented before, after, or concurrently with Project #2.

In order to accommodate the new proposed upgrades while also maintaining continuous thermal utility service throughout the process, it is imperative that Project #3 be implemented only after the completion of both Project #1 and Project #2.

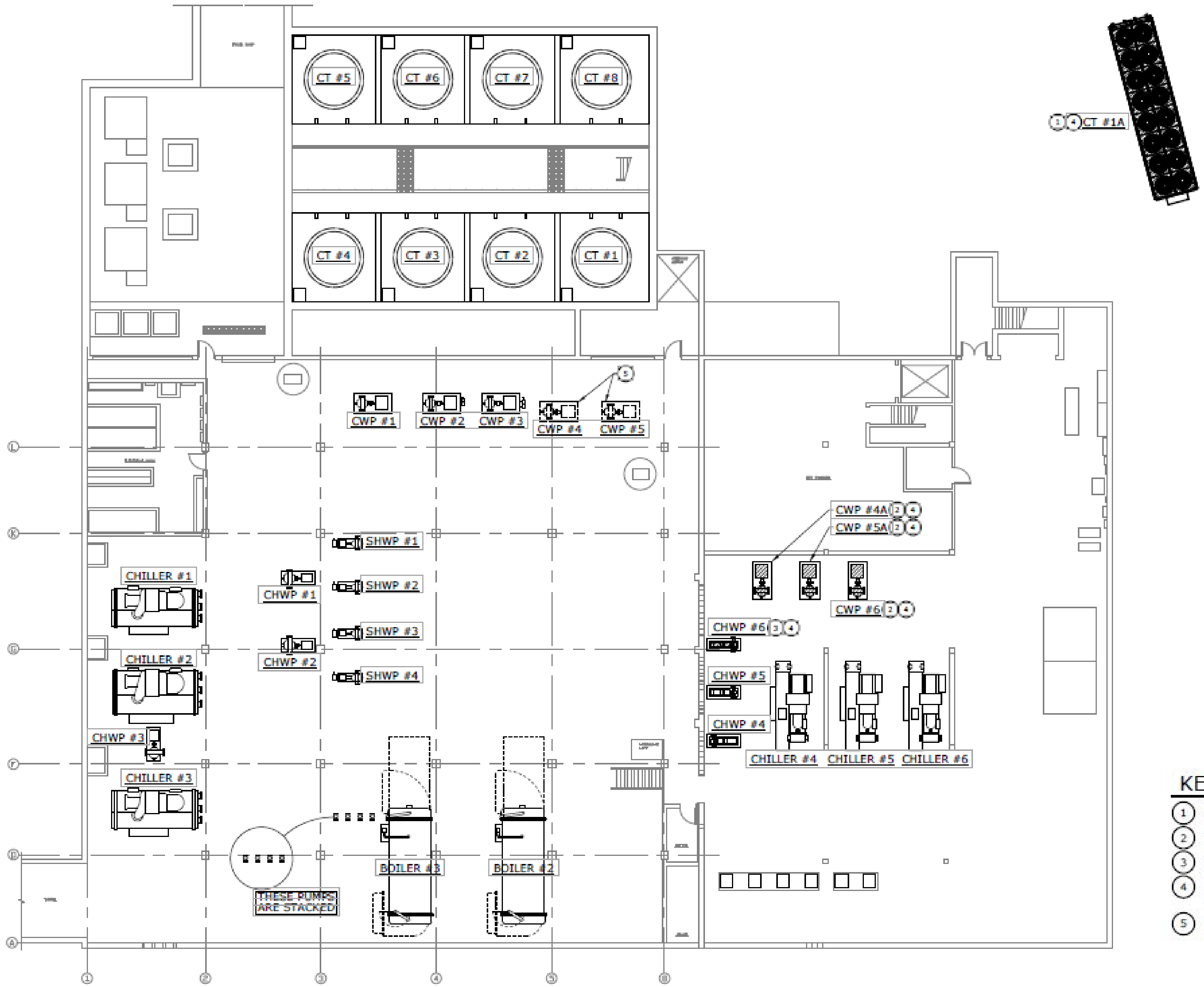
PROJECT #1 – UPPER PLANT MODIFICATIONS

In order to get existing chiller #6 online continuously and to support the replacement of the existing outdated cooling towers, we recommend providing a new condenser water system to serve all three of the chillers located in the upper plant (4, 5, & 6) independent of the existing cooling tower system and providing a dedicated chilled water pump to serve chiller 6.

- 5 – 250 Ton standard or adiabatic cooling tower cells to serve 1,250 tons of chiller capacity.
- 3 – Condenser water pumps, one dedicated to each chiller.
- 1 – New dedicated chilled water pump to serve chiller #6
- Plant control system modifications and integration into the campus BAS System.

The new towers and condenser water system can be constructed while the existing chillers are operating in their current configuration. The plant outage impact will be limited to chillers 4, 5 & 6 and can be minimized to the time required for disconnect and reconnect. The upper plant disconnect and reconnect work can be accomplished at any time outside of peak cooling while operating the campus on the existing cooling capacity of chillers #3, 4 & 5 (3,000 Tons available).

The location identified for the new tower assemble is in the location of the current storage building located just outside the upper plant. The storage building will be demolished, and the tower assembled in its place.



1 CENTRAL PLANT EQUIPMENT LAYOUT - PROJECT #1

NO SCALE

KEYED NOTES:

1. INSTALL NEW 1,250 TON COOLING TOWER SYSTEM TO SERVE UPPER PLANT.
2. NEW CONDENSER WATER PUMP INSTALLED ON CONCRETE INERTIA BASE.
3. NEW CHILLED WATER PUMP INSTALLED ON CONCRETE INERTIA BASE.
4. INSTALL ALL CONDENSER WATER AND CHILLED WATER PIPING AND MAKE READY FOR SWITCHOVER PRIOR TO TAKING EXISTING CHILLERS 4, 5, & 6 OFFLINE.
5. AFTER UPPER PLANT HAS BEEN SWITCHED OVER TO STAND-ALONE CONDENSER WATER SYSTEM, DECOMMISSION EXISTING CONDENSER WATER PUMPS #4 & #5.

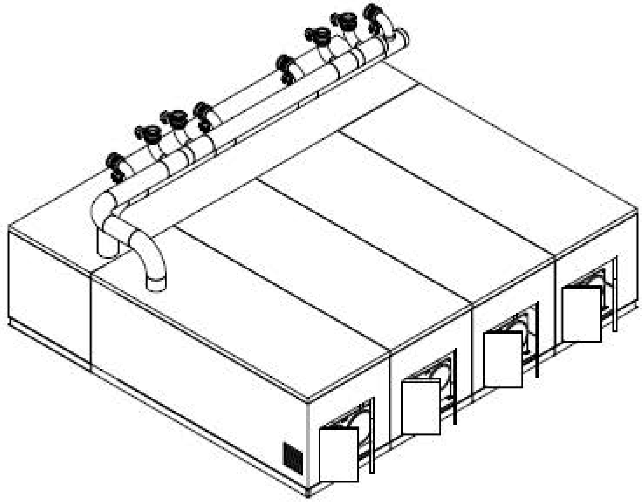
Jose I. Guerra, Inc.
Consulting Engineers

PROJECT #2 – NEW CHILLED WATER & HEATING WATER PLANT WEST OF JOHNSON STREET

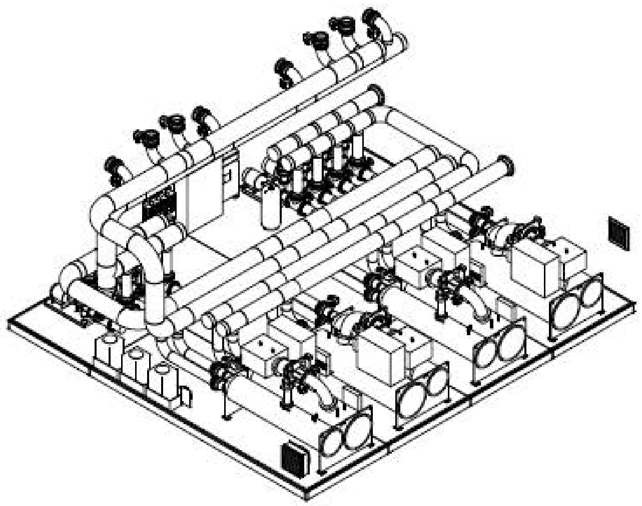
Based on our understanding of the installed systems and future plant needs we propose the addition of a new chilled water and heating water plant with a minimum of 2,000 Tons of cooling and 16,000 MBH of additional heating capacity.

- 2,000 Tons of variable speed water cooled centrifugal chiller capacity.
- Dedicated primary chilled water pumps (one matched to each chiller).
- 16,000 MBH of gas fired boilers.
- Dedicated primary heating water pumps (one matched to each boiler).
- Secondary heating water pumps.
- Cooling towers (2,000 Tons)
    - Option #1: New cooling towers shall employ variable speed fans and drift eliminators for improved water and energy efficiency.
    - Option #2: New Adiabatic cooling towers
- New plant control system integrated into the campus BAS System.

Based on the findings of this study and our understanding of the current chilled water distribution, its limitations, and the future needs of the campus on the west side of Johnson Street, our recommended location for the new utility plant is at the end of the existing utility tunnel west of Johnson Street. This location is ideal for reconnecting to the existing piping distribution inside the existing tunnel and serving future expansion to the west. Based on this we identified the site of the existing Clinic building as a prime location to consider for the new plant. The plant could be integrated into a new building project in that area or be a new modular, standalone plant.

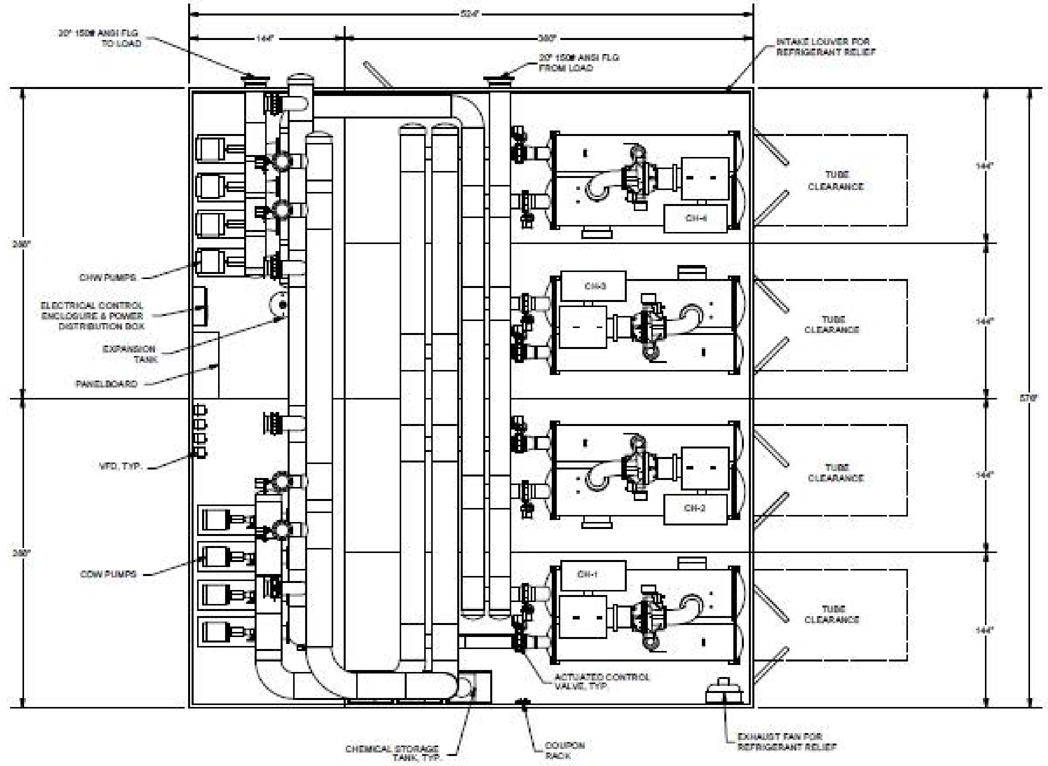


MODULAR CHILLER PLANT ENCLOSURE - ISOMETRIC



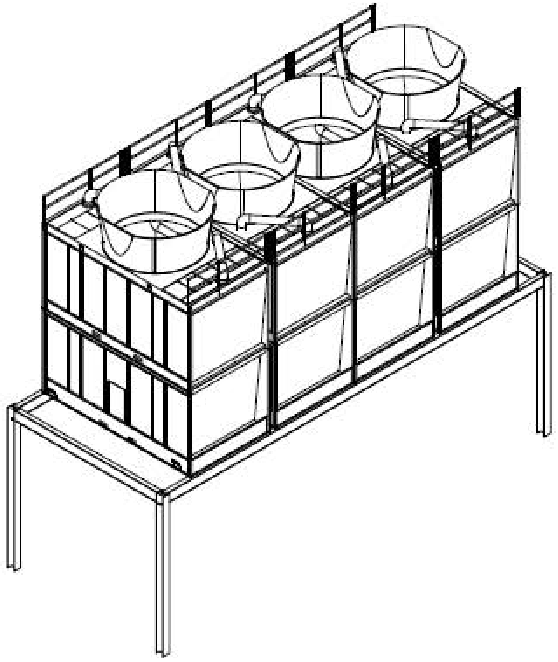
MODULAR CHILLER PLANT - ISOMETRIC

(ENCLOSURE & CT EQUIP.
REMOVED FOR CLARITY)

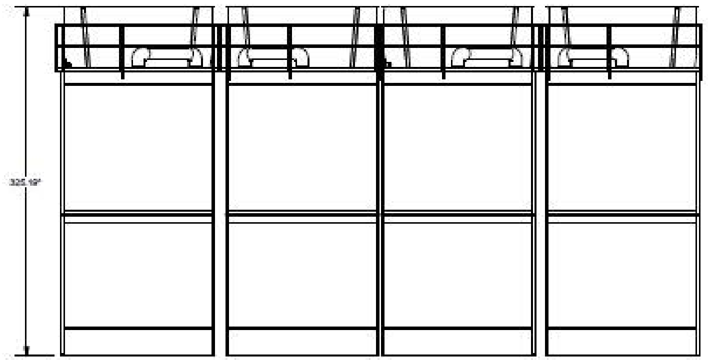


MODULAR CHILLER PLANT - FLOOR PLAN

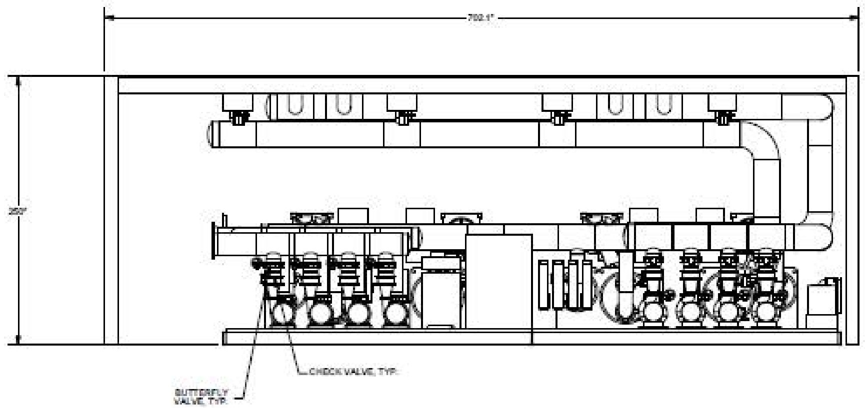
(1) PROPOSED MODULAR CHILLER PLANT
NO SCALE



COOLING TOWER - ISOMETRIC



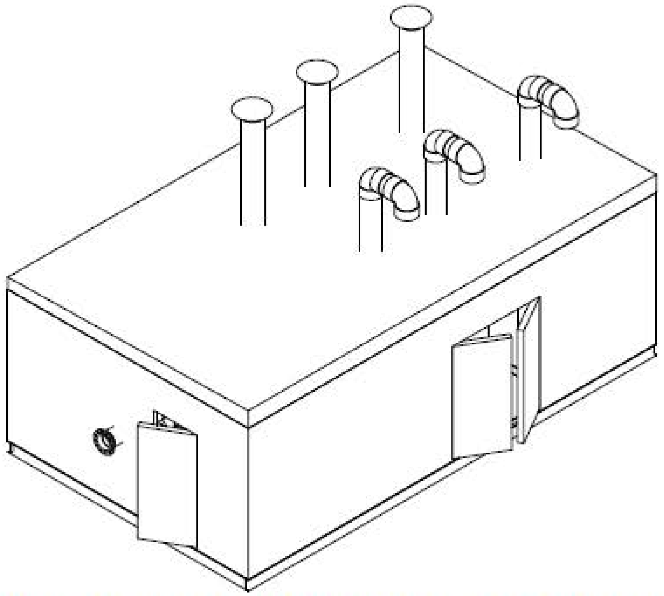
COOLING TOWER - ELEVATION



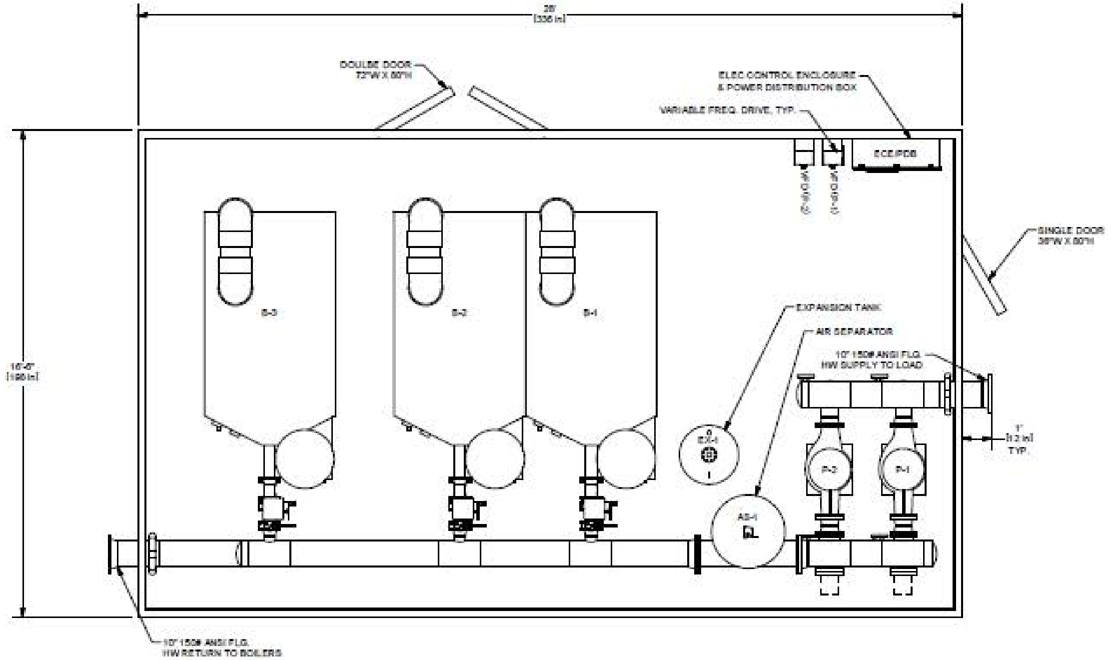
MODULAR CHILLER PLANT - ELEVATION

① PROPOSED MODULAR CHILLER PLANT - CONT'D
NO SCALE

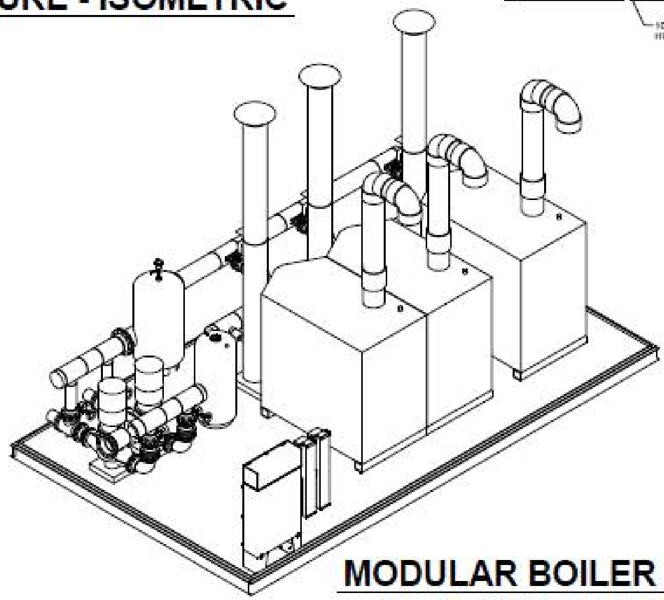
Jose I. Guerra, Inc.



BOILER PLANT ENCLOSURE - ISOMETRIC



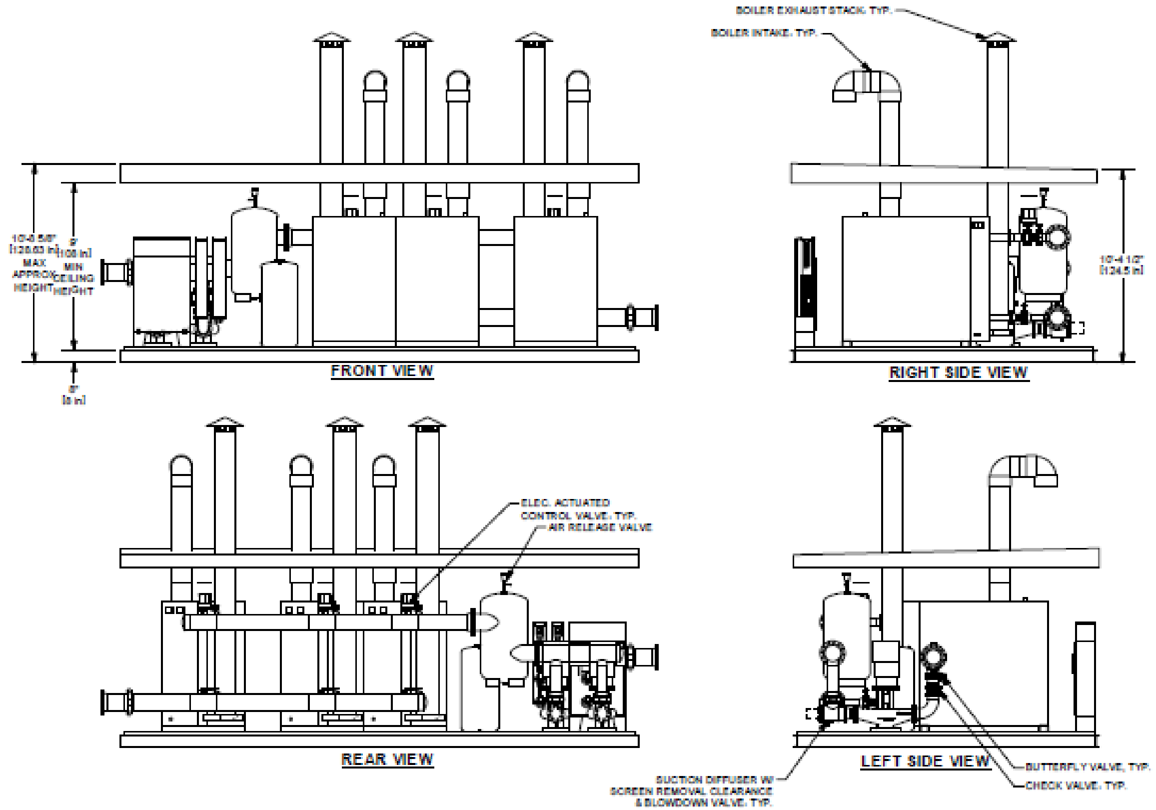
MODULAR BOILER PLANT - PLAN VIEW



MODULAR BOILER PLANT - ISOMETRIC
(ENCLOSURE REMOVED FOR CLARITY)

1 PROPOSED MODULAR BOILER PLANT
NO SCALE

Jose I. Guerra, Inc.



1 PROPOSED MODULAR BOILER PLANT - CONT'D

NO SCALE

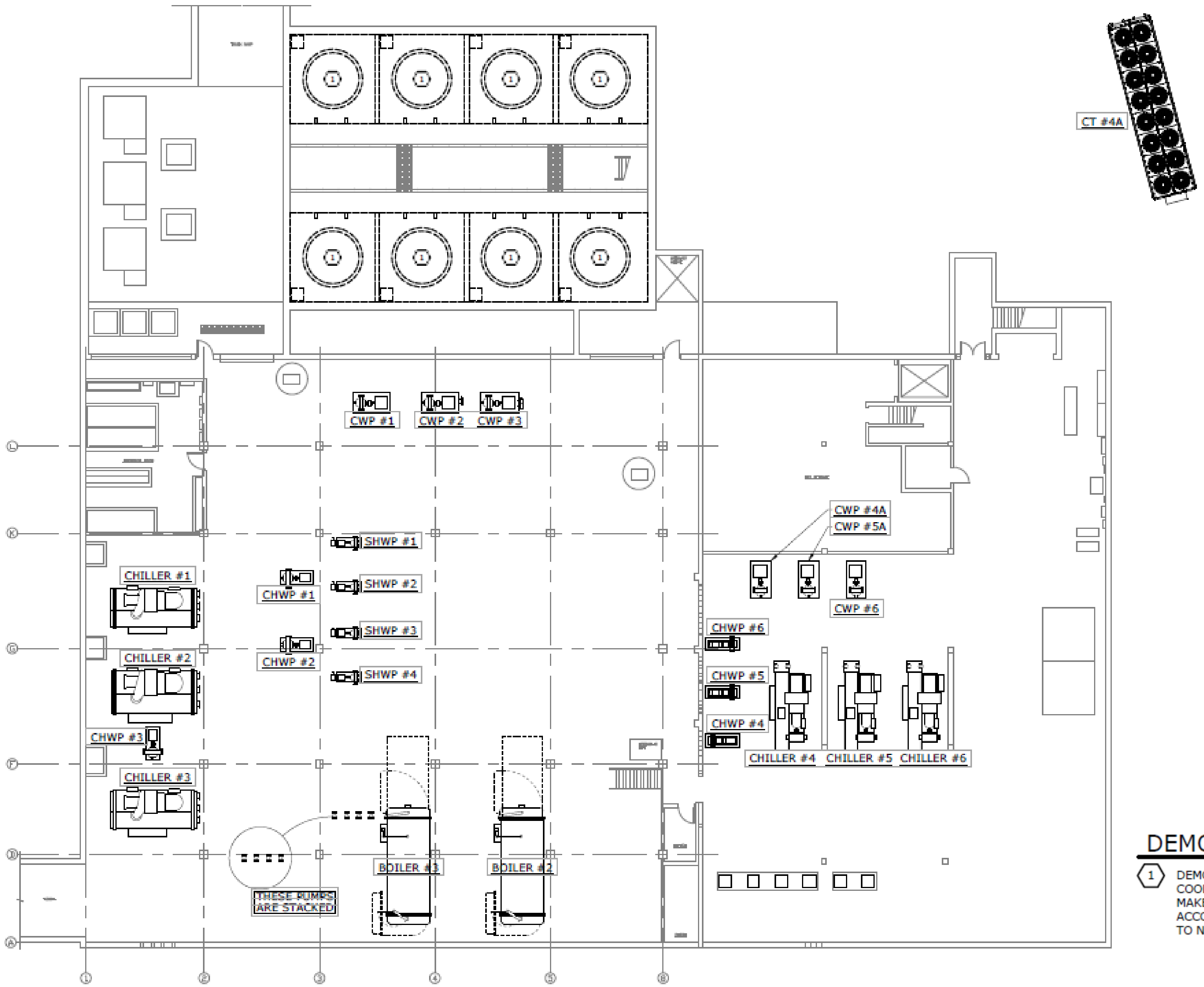
Angelo State University

PROJECT #3 – LOWER PLANT MODIFICATIONS (REPLACE COOLING TOWERS)

As a major contribution to the improvement of plant efficiency and reliability, ASU would like to replace the existing cooling towers with new, more water and energy efficient equipment. The existing towers are antiquated and operating at a poor efficiency with a water loss that is becoming difficult and costly to accommodate. We recommend the existing cooling tower system be demolished and replaced with a new cooling tower system that operates more efficiently and consumes less water.

- Demolish 8 built-in-place cooling tower cells.
- New cooling towers to serve chillers 1, 2 & 3 (3,000 tons).
- Plant control system modifications and integration into the campus BAS System.

Once the campus has 2,000 tons of new cooling capacity in place west of Johnson street (Project #2) and the upper plant on a stand-alone condenser water system (Project #1), the campus can operate on the combined capacity of the new 2,000 ton cooling plant and the 1,250 ton upper plant, a total of 3,150 tons, while the existing tower assembly is demolished and the new tower is constructed. The new tower assembly will be constructed in the same location as the existing towers.



This information was furnished by ASU.

DEMOLITION KEYED NOTES:

1. DEMOLISH EXISTING BUILT-IN-PLACE COOLING TOWER & PREP AREA FOR NEW COOLING TOWER SYSTEM INSTALLATION. EXISTING CONDENSER WATER PIPING & MAKE UP WATER PIPING TO BE DEMOLISHED SELECTIVELY AS REQUIRED TO ACCOMMODATE NEW COOLING TOWER INSTALLATION. PREP PIPING FOR CONNECTION TO NEW COOLING TOWER SYSTEM.

1 CENTRAL PLANT EQUIPMENT LAYOUT - PROJECT #3 DEMO

NO SCALE

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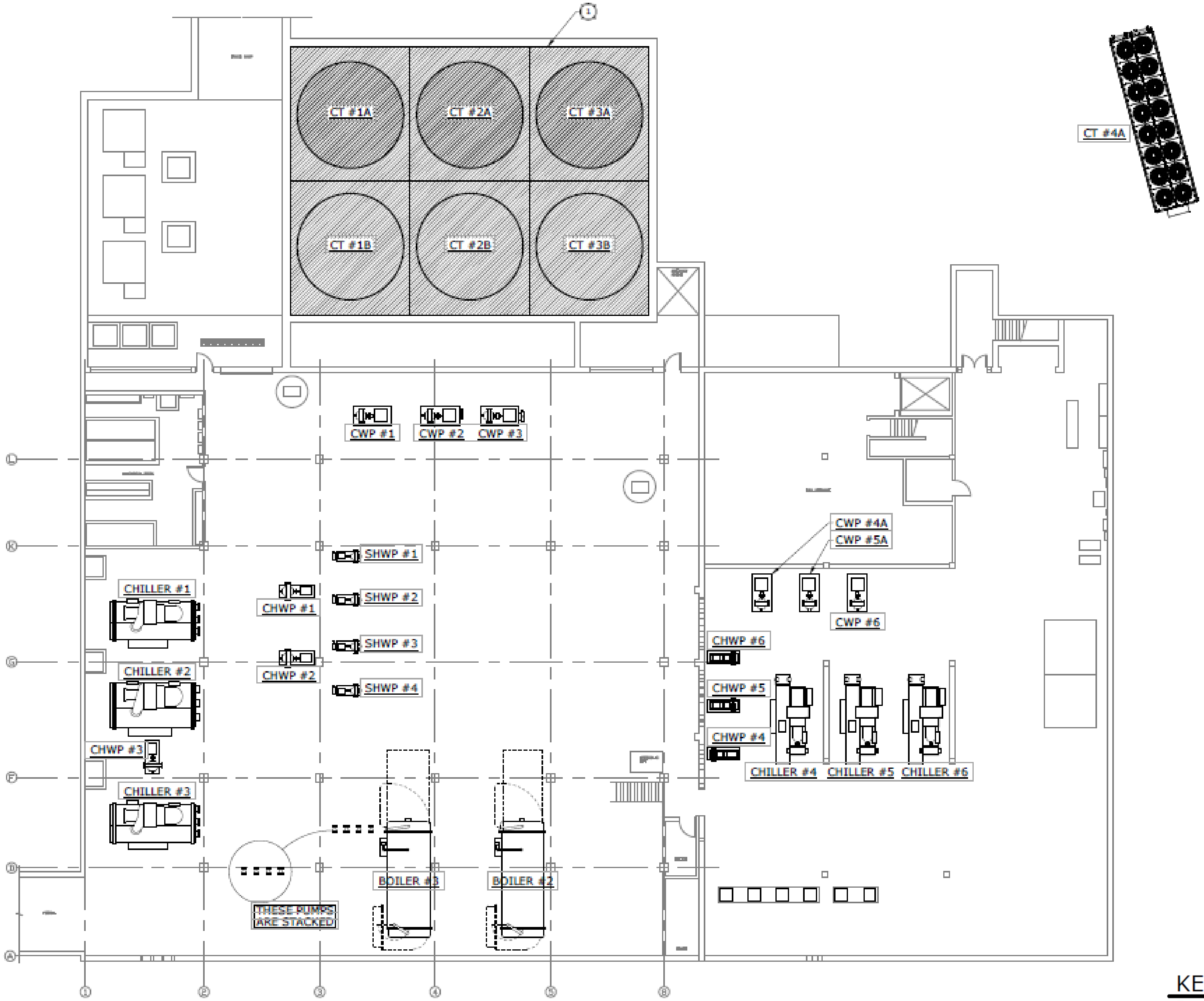
TBPE FIRM F-3

This information was furnished by ASU.



KEYED NOTES:

1. INSTALL NEW 3,000 TON COOLING TOWER SYSTEM AND CONNECT TO EXISTING CONDENSER WATER PIPING AND MAKE UP WATER PIPING SERVING LOWER PLANT.

1 CENTRAL PLANT EQUIPMENT LAYOUT - PROJECT #3 RENOVATION

NO SCALE

NORTH

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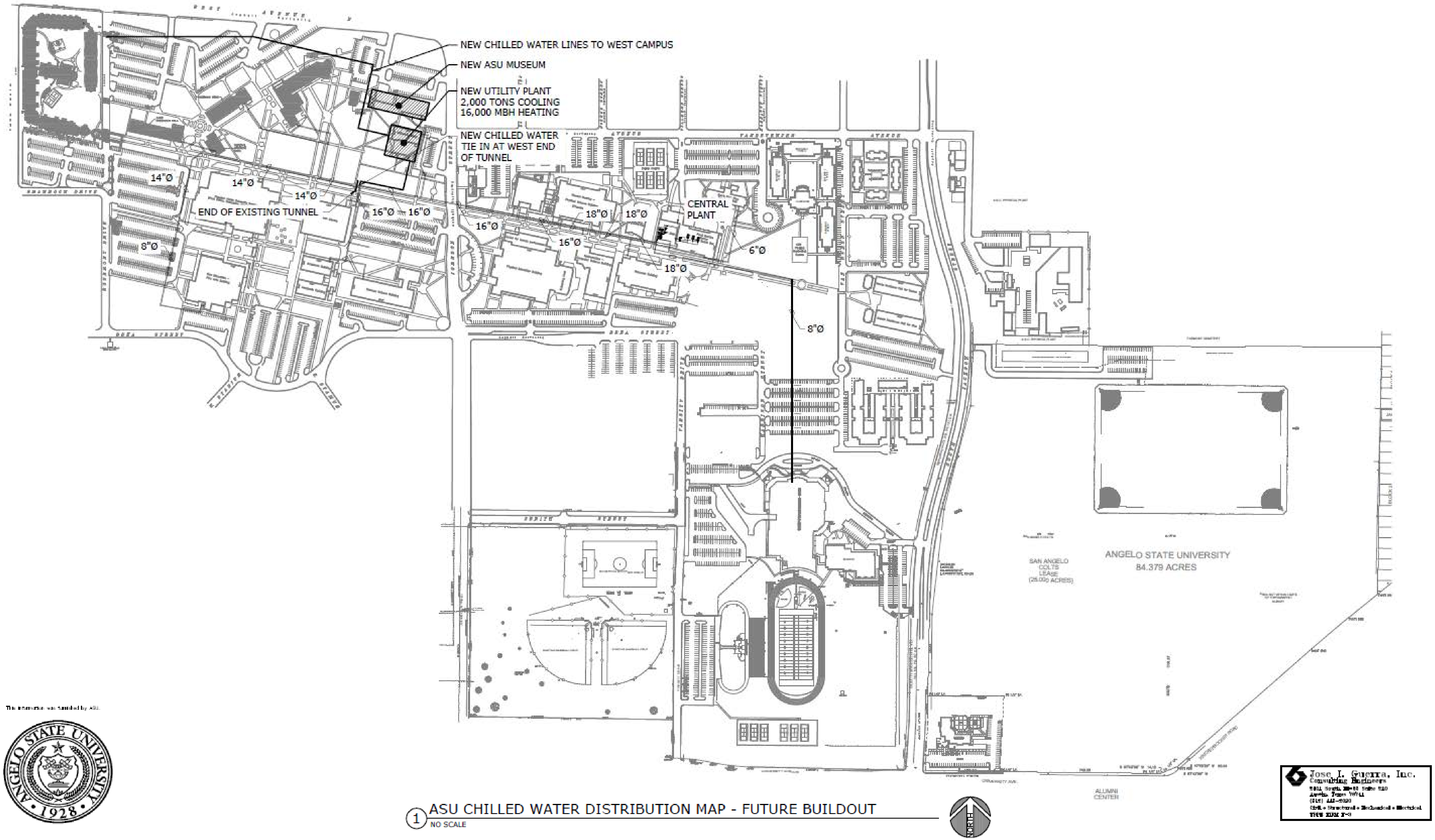
TBPE FIRM F-3

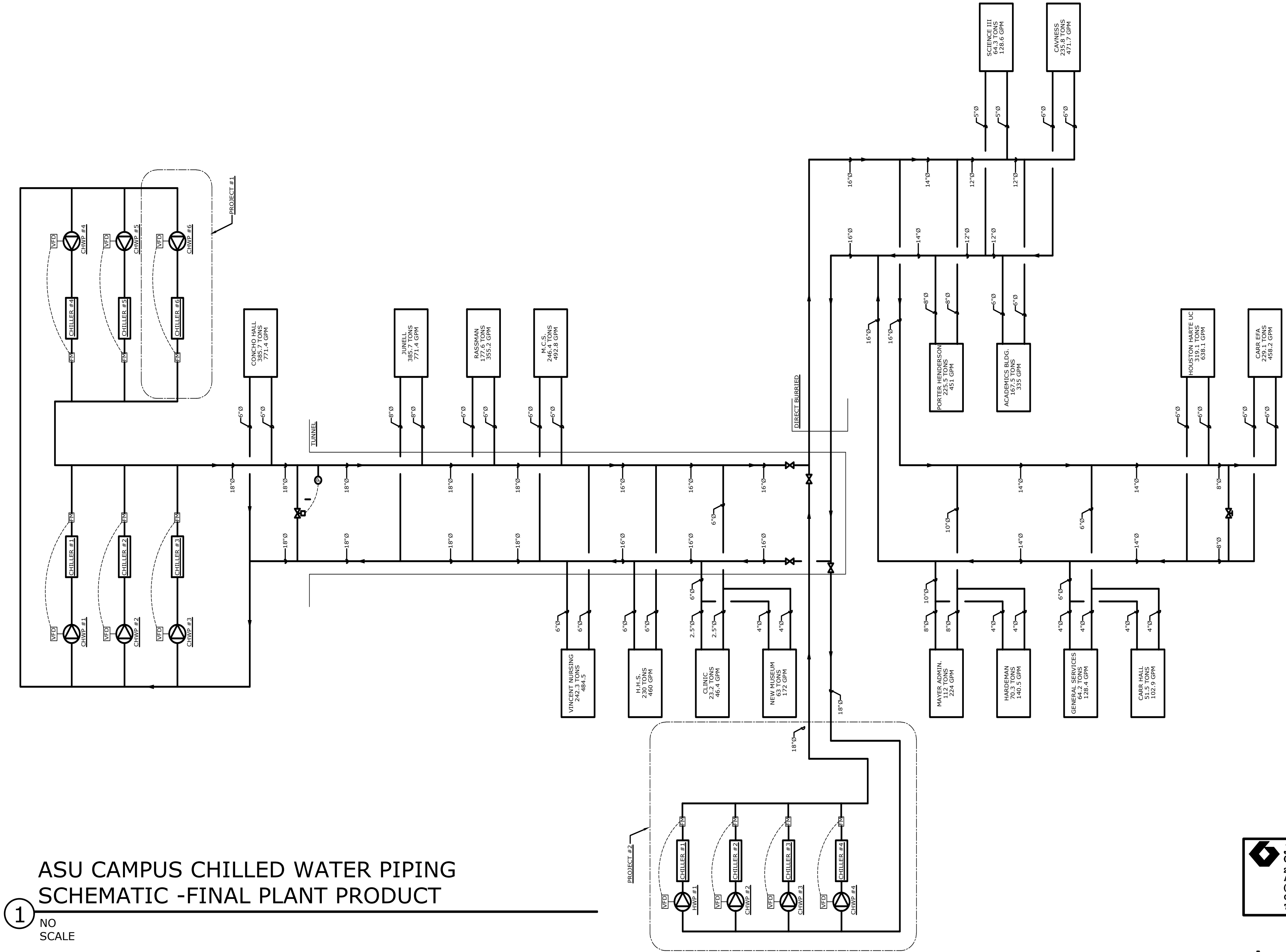
5.6 FINAL PLANT PRODUCT

At the completion of Project #3, the ASU campus will have a total of 6,250 tons of installed cooling capacity and 62,800 MBH of installed heating capacity. This plant configuration will be adequate to serve the campus well into the foreseeable future based on our understanding of the scheduled growth while also aligning with ASU's mission to deliver clean, affordable, reliable utilities and excellent thermal utility service to the campus.



1 ASU CHILLED WATER DISTRIBUTION MAP - FUTURE BUILDOUT

NO SCALE



This information was furnished by ASU.

ASU CAMPUS CHILLED WATER PIPING SCHEMATIC -FINAL PLANT PRODUCT

1 NO SCALE

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5.7 ELECTRICAL SYSTEM UPGRADES

The existing Motor Control Centers (MCC) shall be utilized to refeed the new cooling towers. The exiting contactor, Start/Stop, and HOA switch shall be removed from the MCC buckets.

The new packaged chilled water plant shall be served from two 12470-480/277V 3ph. 4W pad mounted oil filled service transformers that will be owned and maintained by West Texas Utility Company. The service transformers shall be capable of serving two 4000A 480/277V 3ph. 4w services.

5.8 CONTROL SYSTEM UPGRADES

The existing central plant control system is the Andover Continuum line (Version 1.94 sp1). This software version may be upgraded to the most current software platform. The existing Andover Direct Digital Controller (DDC) product line is compatible with the software upgrade without requiring a firmware changeout. This upgrade should be considered for inclusion in upcoming plant upgrade programs.

The BAS WAN operator workstations software version may be upgraded to the most current operator workstation software platform. This upgrade should be considered for inclusion in upcoming plant upgrade programs.

The proposed new central plant control system should be reviewed to insure compatibility with the Andover Continuum line (Version 2.03). The new central plant control approach may be an independent control system reporting over to the BAS using BACnet/IP protocol, or incorporate the direct use of Andover Continuum BAS hardware. This approach should be considered for inclusion in upcoming plant upgrade programs.

Engineering Report

Master Drainage Plan
Angelo State University

Location:

San Angelo, Texas
Tom Green County

Prepared For:

Angelo State University
2601 W. Avenue N
San Angelo, Texas
April 14, 2020

Carter-Fentress Engineering Project No. 1110

PRELIMINARY

Project Engineers:
Erica Carter, P.E.
Russell Gully, P.E., R.P.L.S.

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ATTACHMENTS

EXISTING ATTACHMENTS

PROPOSED ATTACHMENTS

Executive Summary

The Angelo State University Master Drainage Plan was prepared to help the University determine problem areas within the main campus and generate quality solutions that addresses each major issue. A Stormwater Management Program was created for Angelo State University ("ASU") in 2016, to ensure that construction sites were limiting contamination of the stormwater. No other drainage or stormwater documents have been provided from ASU.

Through thorough evaluation and discussions with ASU staff, four major drainage problem areas were identified on the campus. Each major area is identified in the report, conveying the existing design flow rates and capacity. The four problem areas were prioritized by impact to human life for a 2-year or 100-year storm, damage to property, and history of flooding. Multiple solutions were provided for each problem area with data to back it up. Each solution was generated to keep the future infrastructure in mind, safety of the campus, and maintenance minimal.

Section 1 - Introduction

Angelo State University is a fast-growing college institution that now has up to 10,000 students enrolled. Drainage issues have been occurring on the campus and have been more noticeable with the escalated population and infrastructure growth. The stormwater runoff occurring on the school campus is currently channelized mainly through the surrounding road systems. Storm sewers have been developed for a few of the newer, but even some of those outlets discharge to the streets. ASU is in the middle of a developed residential neighborhood of San Angelo, Texas. The campus itself is fully developed on the west side, and on the east side has about 50 acres of undeveloped land.

1.1 Purpose

The purpose of this Master Drainage Plan is to identify the problematic drainage areas and systems located on the Angelo State University campus and provide a solution for these impacted areas. This plan provided for ASU was developed by following a step by step process of the following stature:

- Background research and information gathering,
- Identify possible drainage area issues with information,
- Confirm problematic drainage area issues with hydrologic models,
- Prioritize problem areas by looking at certain impact categories,
- Create multiple solutions to each problem area,
- Investigate generated solutions to check for authenticity, and
- Select solutions that are most cost effective, future driven, and safe for the public.

1.2 Data Collection

Drainage data collected for this Master Drainage Plan includes:

- Gathering existing drainage system information from "As-Built" drawings,
- Speaking with ASU staff about specific areas,
- City of San Angelo Drainage Manual,
- Field visits, photographs, and
- Topographic Map based on Lidar Data provided by the City of San Angelo.

Section 2 – Methodology and Prioritization

2.1 Methodology of Calculations

The Methodology used to determine time of concentration ("Tc") is outlined in the City of San Angelo Drainage Manual. The 2-year and 100-year flows were determined using the Rational Method found in the City of San Angelo Drainage Manual. Flow calculations were found using the intensity-duration-frequency relationship used for design rainfall for the San Angelo area.

To determine the capacity for the storm drains located on campus, the size and slope of the existing pipe was used. These parameters were plugged into the Prinsco Water Management Solutions drainage calculator, which provided the capacity. Multiple iterations were done to figure out proposed sizes needed for the storm drains.

Existing detention pond areas and outlet sizes where provided by SKG Engineering. Each pond was evaluated using the PondPack V8i computer aided model. This model computed results for each of the existing condition and proposed solution options discussed in Section 3 & 4.

2.2 Prioritization of Major Drainage Issues

Measuring the priority of each of the drainage issues was based off on three key impact categories. First, the impacts to human life were looked at in these drainage features for a 2-year & 100-year storm. Secondly, the damage to property was analyzed for the same storm scenario. Third, the history of flooding that these areas have experienced.

- Impact to human life is the most important issue that needs to be protected against on a college campus. This issue reflects when a drainage system is unsafe for people to carry on daily activity when a 2-year or 100-year storm is occurring because the system is inadequate. Only one problematic area doesn't meet this category
- Damage to property due to a storm happens in every storm by erosion or sediment transfer. The damage evaluated for this category would be when the erosion is bad enough to cause roadway, sidewalk, berm, or facility destruction. Since the streets around the ASU campus are used as the main stormwater conveyance, these roadways experience pothole damage that has to be repaired multiple times on a yearly basis.
- The history of flooding around and near the ASU campus is something that is very helpful when identifying problem areas. Knowing where the problems are occurring, gives the engineers a starting point to be able to track the drainage route back to the source and identify why this problem area is happening.

Section 3 – Summary of Existing Stormwater Systems

The four major drainage systems on the ASU campus are identified in this section, and the existing information about each system. The information in this section includes all details about the system and the existing drainage area that is accumulated at the system; this can be found in the Existing Attachments below.

3.1 South Jackson Street Storm Drain

This storm drain is located in a middle of the largest drainage area on the campus and is significantly undersized. The existing 30" storm drain is currently at a slope of 0.5% and is able to intake about 31 cfs. By creating a separate drainage area just for S. Jackson St., an estimated flow to the inlet was calculated to be 125 cfs and 265 cfs for a 2-year and 100-year storm, respectfully. The existing drainage numbers for S. Jackson street can be found in Attachment I.

3.2 Drainage Area 1 Outlet & Storage

Drainage Area 1 is made up of a 137.3-acre watershed that currently all drains east behind the ASU intramural fields to Jack Street. One undersized storage pond (Campus Green Pond) is used to slow runoff on a 15.3-acre watershed of the total 137.3 acres of the watershed. This leaves 122 acres draining to Jack St. with no other storage ponds. Two things currently are slowing the drainage down Jack St. and keeping it at a lower impact then what they could be. The first is that the 30" storm drain on S. Jackson St. discussed above is undersized. Thus, it doesn't impact the outlet area near Jack St. as fast, but it does cause problems on S. Jackson Street. The second is that about 49 acres of this watershed is currently undeveloped and can contain runoff longer than an impervious surface. The problem with this drainage area is that it is going to cause a major issue down Jack St. to Austin St. and possibly to Bryant Blvd. if not contained properly with future development.

3.3 Campus Green/Detention Pond

The existing Campus Green/Detention Pond has 15.3 acres of developed land that drains to it from the west. This pond covers roughly 75,000 sq. ft. and is 3.5' in depth and has three (3) 12" outlets at various elevation noted on the drainage area map. An analysis was performed on the pond that concluded that this pond is not able to contain a hundred-year storm event. Please see the Existing Analysis Report gathered from PondPak V8i for the Campus Green/Detention Pond in Attachment III.

3.4 Detention Pond Near Mayer Field

The existing pond near Mayer Field on the south side of the 8.7-acre watershed is currently not able to contain a 2-year or 100-year storm event. This pond covers roughly 22,000 sq. ft. and is 3.5' in depth and has one (1) 8" outlet at an elevation of 1896.67'. This pond currently has a storm drain running to it from Mayer Field that has a turf surface. Please see the Existing Analysis Report gathered from PondPak V8i for the Detention Pond Near Mayer Field in Attachment IV.

Section 4 – Proposed Solutions

Each major problem area listed has at least two solutions provided. All calculations and documentation used to identify a possible solution for each location will be provided in the Proposed Attachments following the report. The following issues are listing in the order of high priority to low priority. Each solution is only a close approximation and would need further information to get an exact result and solution for the drainage system.

4.1 South Jackson Street Storm Drain

The storm drain that is located on South Jackson St. is the most problematic system that ASU has on their campus. For this storm drain to meet the requirements for a 2-year storm the one drainpipe size would need to be increased to a 52" storm drain. To meet the 100-year requirement, the university would need to install two (2) custom made 52" storm drainpipes or purchase two (2) standard 60" storm drains. CFE recommends installing the drainpipes that will facilitate a 100-year storm.

Other options looked at for storm system during this analysis were finding ways to increase the drainage areas to the Campus Green/ Detention Pond and Mayer Field Pond to reduce the amount of flow coming from the existing watershed to the storm drain. Most of this area has already been developed with parking or some sort of infrastructure, and to regrade would mean there would have to be destruction of concrete paved roads and parking. The storm drain would still need to be increased in size unless the drainage area for S. Jackson was reduced to 13 acres.

The advantages of developing this storm drain to meet the capacity of a 100-year storm drain comes from the life impact priority, destruction of property, and history. When this storm drain backs up, the campus staff has seen multiple cars get stuck in the middle of the street due to the high rise of the water that creates a 'pond' in the middle of South Jackson Street. The cost to fix this issue would be the biggest disadvantage because this storm sewer is over 1600' long and is under a turfed ASU intramural field. Would highly recommend updating this storm sewer before any other future development is built over the existing storm drain. Another disadvantage to this problem is that the pipe is already at a 0.5% slope and has an outlet flowline elevation of 1869.06', and adding a larger circular pipe as proposed will mean that the outlet flowline elevation will have to be at a lower elevation than existing. The outlet will cause problems with the next solution proposed in Section 4.2 if it is lowered. One solution that would help with this problem is adding a pipe cross section that is irregular shaped to be about 2.5' in depth and 8' long. This cross-sectional area will still be able to drain the required amount and not create a lower outlet elevation.

4.2 Drainage Area 1 Outlet & Storage

The solution that we recommend for this large watershed, is creating a detention pond on the east side of the of the intermural field that will allow for a right sized storm drain on Jackson St. and fully developed 122-acre watershed to drain to the proposed pond and outlet down Jack St. as if the 122-acre watershed were all undeveloped. See the Proposed Detention Pond near Knickerbocker in Attachment II to see the different areas this pond would take up behind the ASU intramural field at different elevations.

Again, the option of increasing the drainage areas to the Campus Green/ Detention Pond and Softball Complex Pond was discussed. Any area that can be taken off would be helpful on decreasing the size of the pond and Jackson street storm sewer.

Advantages of this pond is that it will solve the drainage issue for all future development on the east side of the campus. This pond will be a detention so it will not retain any water for more than 24 hours after the storm event is over. The main disadvantage of this pond is going to be the amount of property that it is going to take over. Unfortunately, since this is such a big drainage area the pond in any scenario provided will take up almost 2 acres of land to 5 acres at the biggest. Another disadvantage to this pond is the elevations in the area. Currently, the outlet from S. Jackson exits at an elevation of 1869.06' and the lowest ground level on ASU property is 1868.00'.

4.3 Campus Green/Detention Pond

For this pond to meet requirements, we recommend the bottom elevation (1896.50') area to be increased to at about 60,000 sq. feet. This will generate a slope of 1:4 foot on all sides of the pond, and most importantly contain a 100-year storm-event for the watershed. Outlet structure shall stay the same for this pond because it will meet the needs of the system. Alternate options include increasing the height of the berm to 1901.00' and the expansion of the berm as needed to keep a safe slope of 1:3 feet.

Advantages to increasing the size of this pond is mainly for the pond to contain a 100-year storm for the existing watershed that drains to it. Another advantage would be opening the possibility of increasing the drainage area that drains to it. This pond has a large area and increasing the height by just 1 foot after expanding the bottom could create room for about 8 more acres of land. This disadvantages of expanding the bottom of this pond is that it is now serving as the campus green for the Angelo State University students. This is a place where students can have a big open space to play games or any other activities and expanding the bottom would disrupt this during construction and leave the field without grass for a while.

4.4 Detention Pond Near Mayer Field

We recommend the bottom elevation (1896.50') area needs to be increased to at about 14,500 sq. feet for the Mayer Field Pond to meet requirements. This will generate a slope of 1:3 feet on all sides of the pond, and the outlet on the pond will need to be changed to two (2) 12" culverts at an elevation of 1896.50' and sloping down 0.5% over 43.5' to an elevation of 1896.25'. Other options include lowering and widening the bottom elevation of the pond and outlet and lowering the berm height to 1899.3. This option would keep any 100-year storm from backing up into the storm pipe from the softball field and would also need to adjust the outlet in size and depth. Please see Options 1 & 2 calculations and results in Attachment IV.

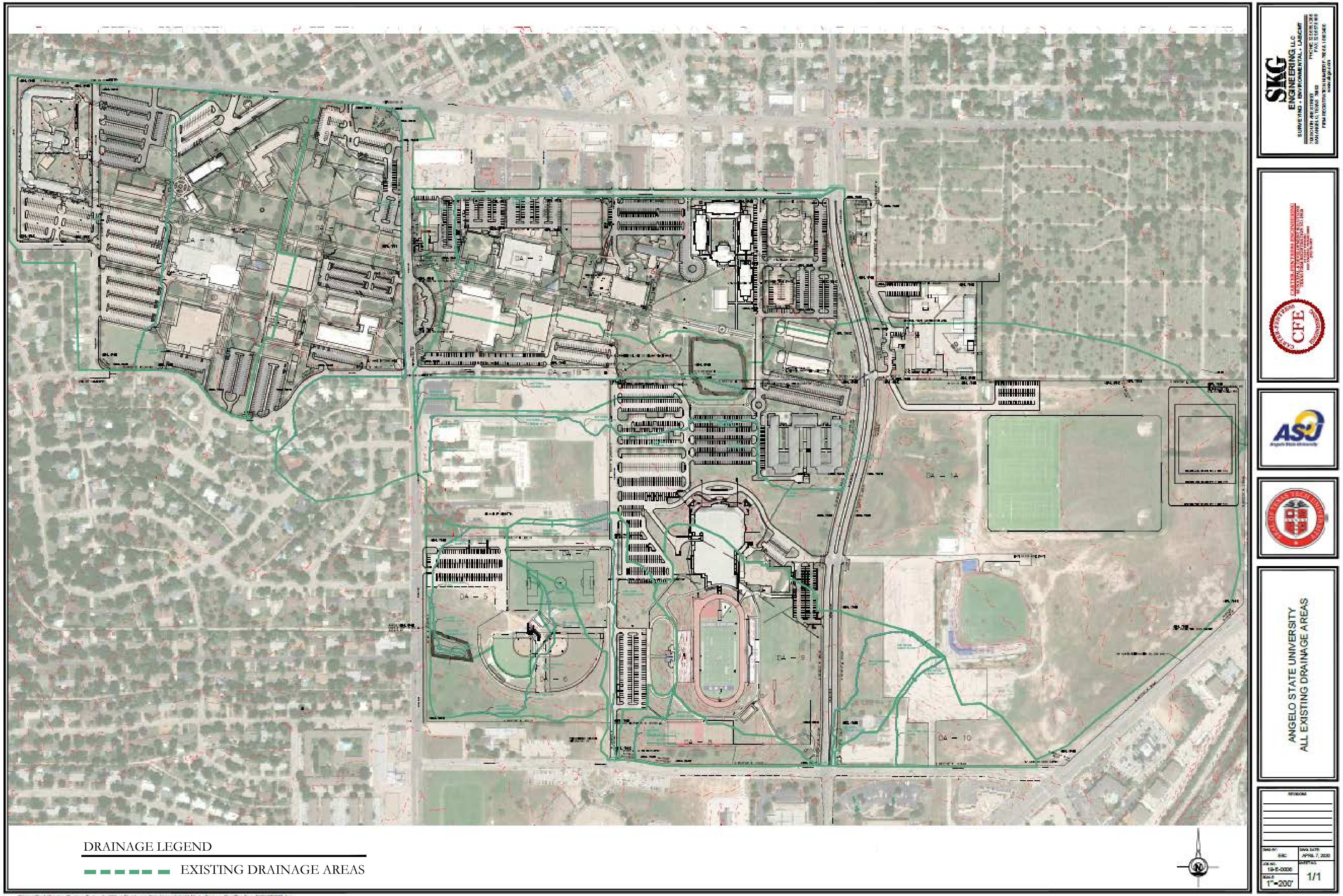
Advantages to this pond are very similar to the advantages of the Campus Green/Detention Pond. The bottom area expansion will be advantageous for the pond to be able to handle both storm events that will drain to it. This pond is currently not as big as the Campus Green, but it does have plenty of room for expansion on the south side. This pond would be able to expand in depth and in area due to the slope of the region. CFE estimates that the pond would be able to contain at least 20 more acres of drainage. Disadvantages to this storm system is the location. The location of the pond is in a spot where only minimal runoff can reach the pond, and the existing environment would have to be drastically changed for there to be an increase in runoff to this pond.

Conclusion

Carter-Fentress Engineering completed a master drainage plan for the property owned by Angelo State University. Carter-Fentress Engineering in conjunction with SKG Engineering, modeled the drainage areas to find the major drainage issues happening on the campus. The calculations showed that all the existing detention ponds were under-developed, and the storm drain on S. Jackson St. is unable to handle the capacity of its intake. CFE provided multiple solutions to each of these problems with the information given. Further investigation on each of these problem sites would be needed to be able to give an accurate and precise solution.

EXISTING ATTACHMENTS

CARTER-FENTRESS ENGINEERING

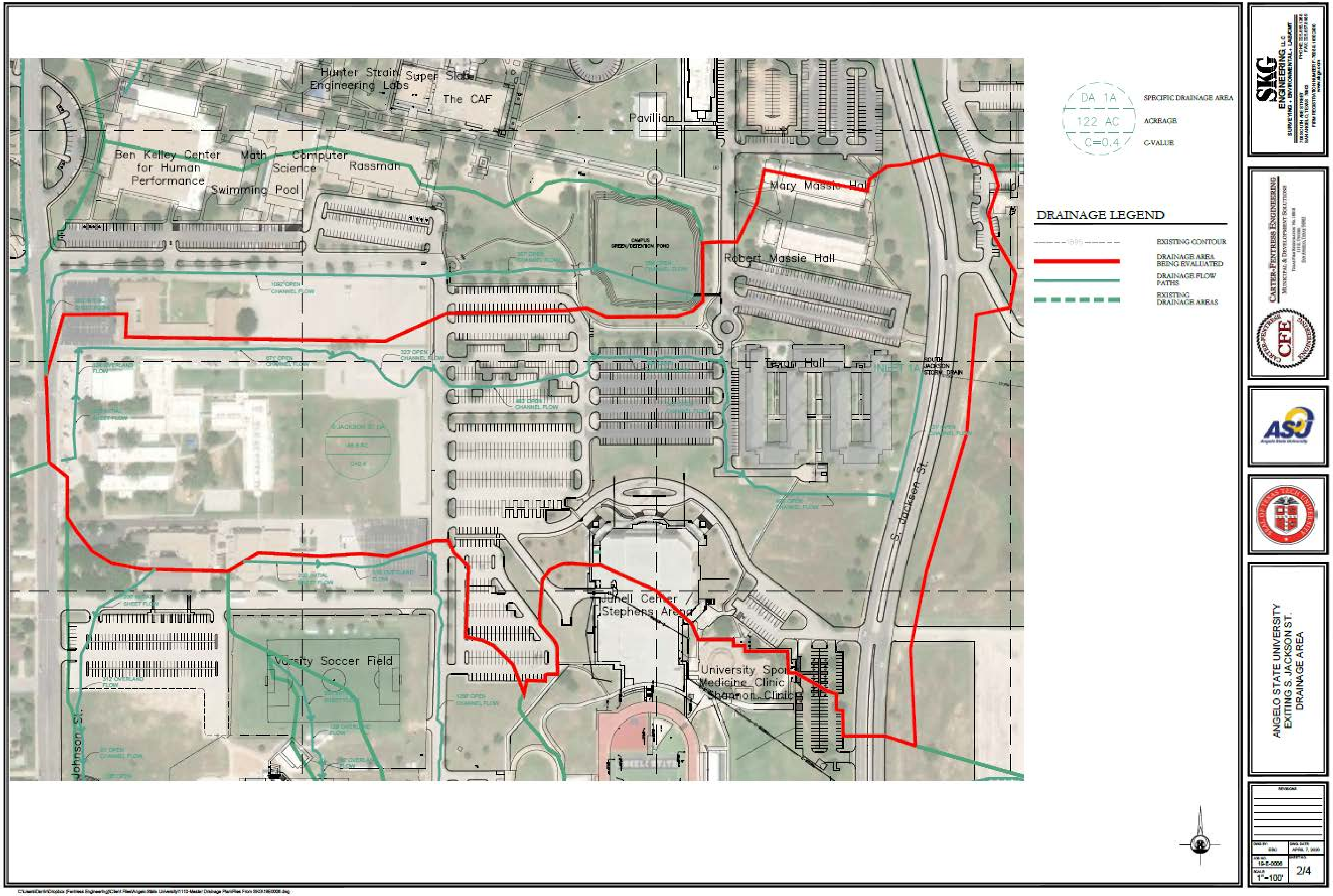


Due to large image file, some fonts may be illegible. For a higher resolution copy please contact Facilities Planning and Construction.

ATTACHMENT I

EXISTING SOUTH JACKSON STREET STORM DRAIN

CARTER-FENTRESS ENGINEERING



Due to large image file, some fonts may be illegible. For a higher resolution copy please contact Facilities Planning and Construction.

RATIONAL METHOD: EXISTING CONDITIONS

Project Description: Angelo State Univeristy
San Angelo, Texas

Project No.: 1110

* TAKEN FROM CITY OF SAN ANGELO DRAINAGE MANUAL
** REFER TO DRAINAGE AREA MAPS

	UNITS USED
LENGTH	FT
T_C	MINS
VELOCITY	FT/SEC

1) VELOCITY (OVERLAND FLOW) $V = C\sqrt{S}$

2)TIME OF CONCENTRATION $T_C = L/(V \times 60)$

3) VELOCITY (OPEN CHANNEL FLOW) $V = \frac{1.49 \times R^{\frac{2}{3}} \times \sqrt{S}}{n}$

S. JACKSON ST. DA

Step		K	C	Rainfall Intensity, I=b/(Td+d)^e				I (in/hr)	A	Qpeak
				b	d	e	Tc	I (in/hr)	(acres)	(cfs)
	2-YR	1.00	0.40	53.5	10.3	0.865	23.5	2.54	46.8	47.6
	100-YR	1.00	0.40	112.5	14.7	0.816	23.5	5.75	46.8	107.7

	INITIAL SHEET FLOW		OVERLAND FLOW				
	**HYDRAULIC LENGTH (L)	*TIME OF CONCENTRATION (T_c) (Table 5-6)	**HYDRAULIC LENGTH (L)	**SLOPE (S)	*VELOCITY COEFFICIENT (C) (Table 5-7)	VELOCITY (V)	TIME OF CONCENTRATION (T_c)
EXISTING CONDITIONS	200	15	124	0.003	20	1.10	1.9

	OPEN CHANNEL FLOW					
	**HYDRAULIC LENGTH (L)	HYDRAULIC RADIUS (R) (Estimated)	**SLOPE (S)	*MANNING'S COEFFICIENT (n) (Table 9-2)	VELOCITY (V)	TIME OF CONCENTRATION (T_c)
EXISTING CONDITIONS	671	0.75	0.009	0.016	7.29	1.5

	OPEN CHANNEL FLOW					
	**HYDRAULIC LENGTH (L)	HYDRAULIC RADIUS (R) (Estimated)	**SLOPE (S)	*MANNING'S COEFFICIENT (n) (Table 9-2)	VELOCITY (V)	TIME OF CONCENTRATION (T_c)
EXISTING CONDITIONS	323	0.75	0.006	0.016	5.95	0.9

	OPEN CHANNEL FLOW					
	**HYDRAULIC LENGTH (L)	HYDRAULIC RADIUS (R) (Estimated)	**SLOPE (S)	*MANNING'S COEFFICIENT (n) (Table 9-2)	VELOCITY (V)	TIME OF CONCENTRATION (T_c)
EXISTING CONDITIONS	483	0.75	0.01	0.016	7.69	1.0

	OPEN CHANNEL FLOW					
	**HYDRAULIC LENGTH (L)	HYDRAULIC RADIUS (R) (Estimated)	**SLOPE (S)	*MANNING'S COEFFICIENT (n) (Table 9-2)	VELOCITY (V)	TIME OF CONCENTRATION (T_c)
EXISTING CONDITIONS	324	0.75	0.0077	0.016	6.75	0.8

	OPEN CHANNEL FLOW					
	**HYDRAULIC LENGTH (L)	HYDRAULIC RADIUS (R) (Estimated)	**SLOPE (S)	*MANNING'S COEFFICIENT (n) (Table 9-2)	VELOCITY (V)	TIME OF CONCENTRATION (T_c)
EXISTING CONDITIONS	408	0.75	0.017	0.03	5.35	1.3

	OPEN CHANNEL FLOW							
	**HYDRAULIC LENGTH (L)	HYDRAULIC RADIUS (R) (Estimated)	**SLOPE (S)	*MANNING'S COEFFICIENT (n) (Table 9-2)	VELOCITY (V)	TIME OF CONCENTRATION (T_c)	Total Time of Concentration (MIN)	Total Time of Concentration (HRS)
EXISTING CONDITIONS	331	0.75	0.015	0.03	5.02	1.1	23.5	0.4

CALCULATOR PURPOSE

The Prinsco Drainage Calculator estimates the capacity of tile drainage systems. A particular pipe size on a given grade will only carry a certain amount of water. The steeper the grade of the installed pipe, the more water it will carry.

- Checks the capacity of drain tile on existing drainage systems
- Sizes the piping needed on the acreage to be drained
- Checks the capacity of drain tile on a new drainage system
- Calculates the pipe size based on how quickly you want the land drained

BY ACREAGE
BY PIPE SIZE

Drainage Calculator by Pipe Size

Our drainage calculator was developed in partnership with the University of Minnesota Extension to assist you in the preliminary design and understanding of your drainage needs. We encourage you to contact your local design profes or contractor for more specific design guidance and criteria.

These calculations are based on the Manning's Roughness ASAE EP 260.3 Plastic Tubing Drainage Chart and shou used for estimating purposes only. Consult a Water Table Management Professional for design criteria information

? = Definition

Enter the Diameter of the pipe (inches)**:**	30
Enter the Grade (%): ?	0.5 %
	View Results (see below)

	Q, Flow ?			**Velocity** ?
	c.f.s.	**g.p.m**	**acre - in./24 hrs.**	**ft./sec.**
Single-Wall	18.889	8477.9	449.59	3.85
Dual-Wall	31.498	14137.2	749.70	6.42

	Acres Drained					
	Drainage Coefficient (in: /24 hours) ?					
	1/8"	**1/4"**	**3/8"**	**1/2"**	**3/4"**	**1"**
Single-Wall	3596.72	1798.36	1198.91	899.18	599.45	449.59
Dual-Wall	5997.64	2998.82	1999.21	1499.41	999.61	749.70

CALCULATE BY ACREAGE

developed in partnership with

UNIVERSITY OF MINNESOTA EXTENSION

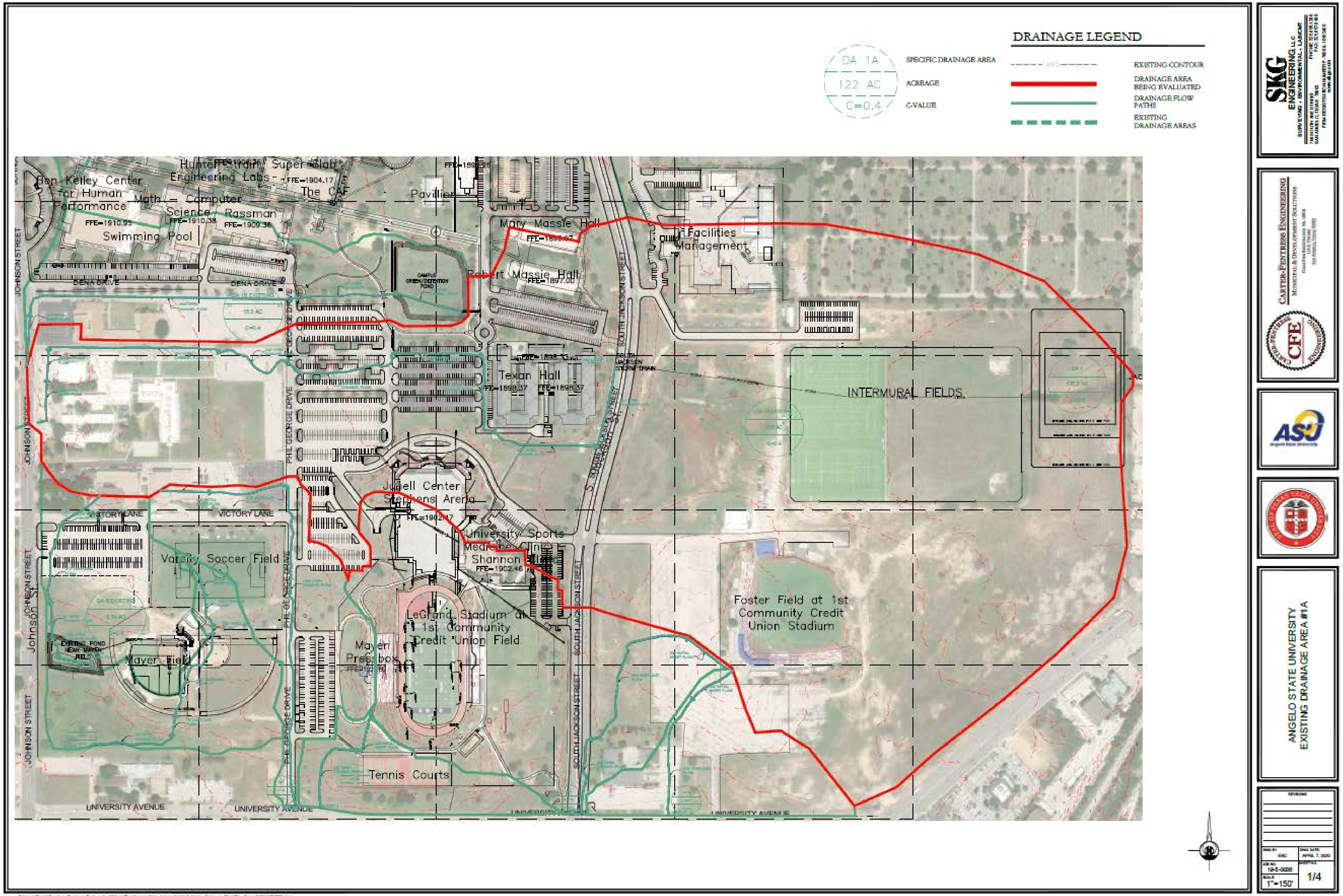
Site Map Privacy Policy Contact Us Find a Sales Rep

https://www.prinsco.com/resources/drainage-calculator-by-pipe-size/

ATTACHMENT II

DRAINAGE AREA 1 EXISTING CONDITIONS

CARTER-FENTRESS ENGINEERING



Due to large image file, some fonts may be illegible. For a higher resolution copy please contact Facilities Planning and Construction.

RATIONAL METHOD: EXISTING

Project Description: Angelo State Univeristy
San Angelo, Texas

Project No.: 1110

* TAKEN FROM CITY OF SAN ANGELO DRAINAGE MANUAL

** REFER TO DRAINAGE AREA MAPS

	UNITS USED
LENGTH	FT
T_C	MINS
VELOCITY	FT/SEC

1) VELOCITY (OVERLAND FLOW) $V = C\sqrt{S}$

2)TIME OF CONCENTRATION $T_C = L/(V \times 60)$

3) VELOCITY (OPEN CHANNEL FLOW) $V = \frac{1.49 \times R^{\frac{2}{3}} \times \sqrt{S}}{n}$

TOTAL DA 1B

Step		K	C	Rainfall Intensity, I=b/(Td+d)^e				I (in/hr)	A	Qpeak
				b	d	e	Tc		(acres)	(cfs)
	2-YR	1.00	0.40	53.5	10.3	0.865	19.4	2.85	15.3	17.5
	100-YR	1.00	0.40	112.5	14.7	0.816	19.4	6.32	15.3	38.8

	INITIAL SHEET FLOW		OVERLAND FLOW					OPEN CHANNEL FLOW					
	**HYDRAULIC LENGTH (L)	*TIME OF CONCENTRATION (T_c) (Table 5-6)	**HYDRAULIC LENGTH (L)	**SLOPE (S)	*VELOCITY COEFFICIENT(C) (Table 5-7)	VELOCITY (V)	TIME OF CONCENTRATION (T_c)	**HYDRAULIC LENGTH (L)	HYDRAULIC RADIUS (R) (Estimated)	**SLOPE (S)	*MANNING'S COEFFICIENT (n) (Table 9-2)	VELOCITY (V)	TIME OF CONCENTRATION (T_c)
EXISTING CONDITIONS	200	15	124	0.003	20	1.10	1.9	671	0.75	0.009	0.016	7.29	1.5

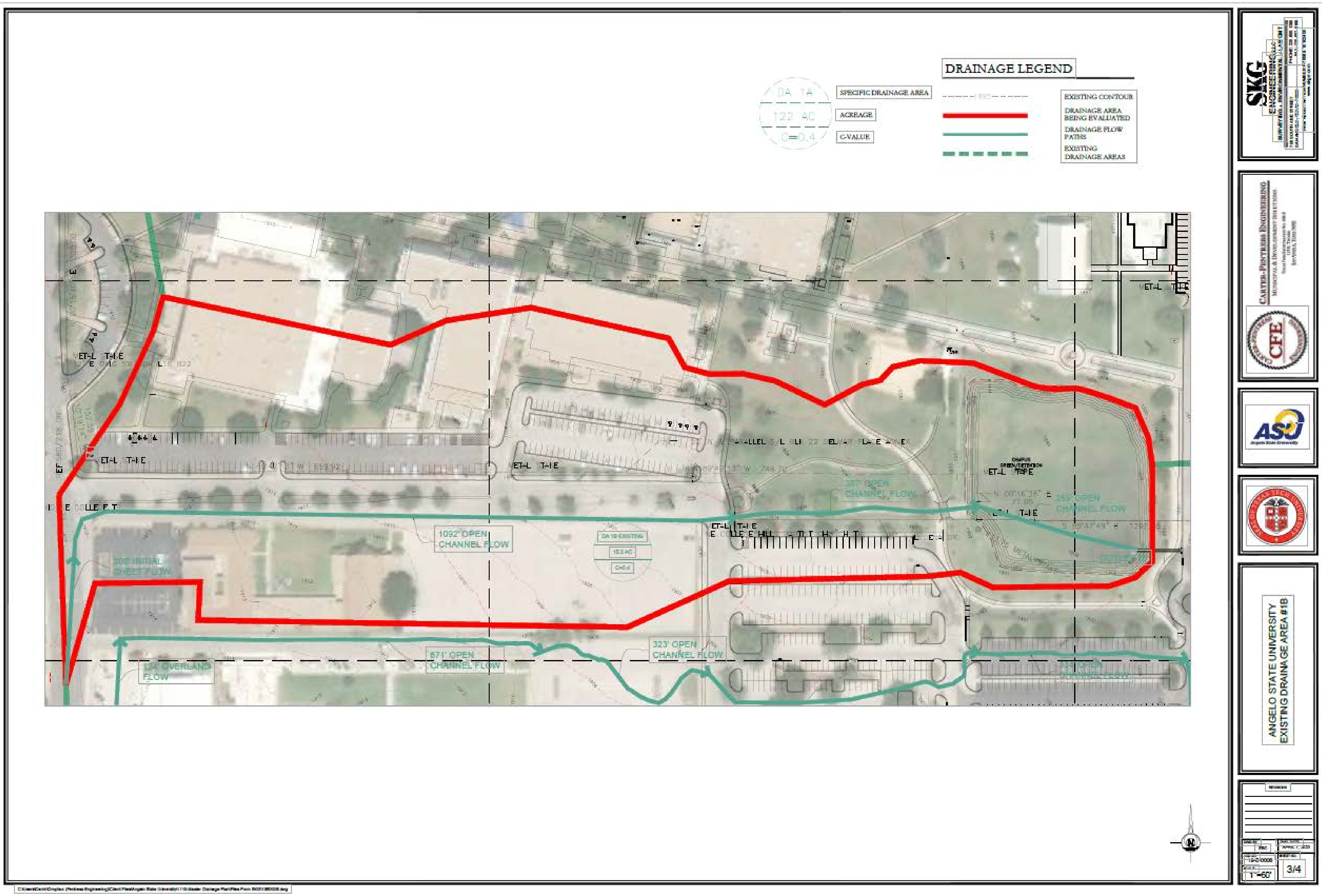
	OPEN CHANNEL FLOW						OPEN CHANNEL FLOW					
	**HYDRAULIC LENGTH (L)	HYDRAULIC RADIUS (R) (Estimated)	**SLOPE (S)	*MANNING'S COEFFICIENT (n) (Table 9-2)	VELOCITY (V)	TIME OF CONCENTRATION (T_c)	**HYDRAULIC LENGTH (L)	HYDRAULIC RADIUS (R) (Estimated)	**SLOPE (S)	*MANNING'S COEFFICIENT (n) (Table 9-2)	VELOCITY (V)	TIME OF CONCENTRATION (T_c)
EXISTING CONDITIONS	323	0.75	0.006	0.016	5.95	0.9	483	0.75	0.01	0.016	7.69	1.0

	OPEN CHANNEL FLOW						OPEN CHANNEL FLOW					
	**HYDRAULIC LENGTH (L)	HYDRAULIC RADIUS (R) (Estimated)	**SLOPE (S)	*MANNING'S COEFFICIENT (n) (Table 9-2)	VELOCITY (V)	TIME OF CONCENTRATION (T_c)	**HYDRAULIC LENGTH (L)	HYDRAULIC RADIUS (R) (Estimated)	**SLOPE (S)	*MANNING'S COEFFICIENT (n) (Table 9-2)	VELOCITY (V)	TIME OF CONCENTRATION (T_c)
EXISTING CONDITIONS	324	0.75	0.0077	0.016	6.75	0.8	408	0.75	0.017	0.03	5.35	1.3

	OPEN CHANNEL FLOW							
	**HYDRAULIC LENGTH (L)	HYDRAULIC RADIUS (R) (Estimated)	**SLOPE (S)	*MANNING'S COEFFICIENT (n) (Table 9-2)	VELOCITY (V)	TIME OF CONCENTRATION (T_c)	Total Time of Concentration (MIN)	Total Time of Concentration (HRS)
EXISTING CONDITIONS	331	0.75	0.015	0.03	5.02	1.1	23.5	0.4

ATTACHMENT III

EXISTING CAMPUS GREEN/ DETENTION POND



Due to large image file, some fonts may be illegible. For a higher resolution copy please contact Facilities Planning and Construction.

RATIONAL METHOD: EXISTING

Project Description: Angelo State Univeristy
San Angelo, Texas

Project No.: 1110

* TAKEN FROM CITY OF SAN ANGELO DRAINAGE MANUAL
** REFER TO DRAINAGE AREA MAPS

	UNITS USED
LENGTH	FT
T_C	MINS
VELOCITY	FT/SEC

1) VELOCITY (OVERLAND FLOW) $V = C\sqrt{S}$

2) TIME OF CONCENTRATION $T_C = L/(V \times 60)$

3) VELOCITY (OPEN CHANNEL FLOW) $V = \frac{1.49 \times R^{\frac{2}{3}} \times \sqrt{S}}{n}$

TOTAL DA 1B

Step		K	C	Rainfall Intensity, I=b/(Td+d)^e					A	Qpeak
				b	d	e	Tc	I (in/hr)	(acres)	(cfs)
	2-YR	1.00	0.40	53.5	10.3	0.865	19.4	2.85	15.3	17.5
	100-YR	1.00	0.40	112.5	14.7	0.816	19.4	6.32	15.3	38.8

	INITIAL SHEET FLOW		OPEN CHANNEL FLOW						OPEN CHANNEL FLOW						OPEN CHANNEL FLOW							
	**HYDRAULIC LENGTH (L)	*TIME OF CONCENTRATION (T_c) (Table 5-6)	**HYDRAULIC LENGTH (L)	HYDRAULIC RADIUS (R) (Estimated)	**SLOPE (S)	*MANNING'S COEFFICIENT (n) (Table 9-2)	VELOCITY (V)	TIME OF CONCENTRATION (T_c)	**HYDRAULIC LENGTH (L)	HYDRAULIC RADIUS (R) (Estimated)	**SLOPE (S)	*MANNING'S COEFFICIENT (n) (Table 9-2)	VELOCITY (V)	TIME OF CONCENTRATION (T_c)	**HYDRAULIC LENGTH (L)	HYDRAULIC RADIUS (R) (Estimated)	**SLOPE (S)	*MANNING'S COEFFICIENT (n) (Table 9-2)	VELOCITY (V)	TIME OF CONCENTRATION (T_c)	Total Time of Concentration (MIN)	Total Time of Concentration (HRS)
EXISTING CONDITIONS	200	15	1092	0.75	0.008	0.016	6.88	2.6	387	0.75	0.016	0.016	9.72	0.7	259	0.75	0.01	0.03	4.10	1.1	19.4	0.3

PondMaker Worksheet Detailed Report: CAMPUS GREEN POND - EXISTING CONDITIONS

Element Details	
ID	43
Label	CAMPUS GREEN POND - EXISTING CONDITIONS
Select Pond to Design	PO-2
Flow Allowed Below Target	80.0
Flow Allowed Above Target	0.0
Flow Allowed Below Target	80.0
Flow Allowed Above Target	10.0
Volume Allowed Below Target	80.0
Volume Allowed Above Target	80.0
Tolerance Display	Display PASS for values within specified tolerance

Notes

Volume

Pond Type	Elevation-Volume	Use Void Space?	False

Elevation-Volume

Pond Elevation (ft)	Pond Volume (ft³)
1,896.45	0.000
1,898.00	5,117.150
1,899.00	35,705.910
1,900.00	100,526.140

Infiltration

Infiltration Method	No Infiltration

Output

Detention Time	None

Initial Conditions

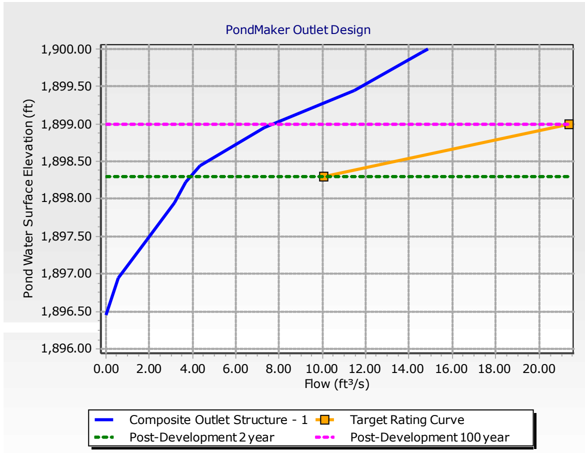
Is Outflow Averaging On?	False	Define Starting Water Surface Elevation	Pond Invert

PondMaker Worksheet Detailed Report: CAMPUS GREEN POND - EXISTING CONDITIONS

PondMaker Worksheet (Outlet Design)

Design Scenario	Design Return Event	Target Peak Outflow (ft³/s)	Target Outflow Volume (ft³)	Peak Pond Inflow (ft³/s)	Total Inflow Volume (ft³)
Post-Development 2 year	2	10.08	87,120.001	18.49	18,722.000
Post-Development 100 year	100	21.39	217,800.003	36.60	46,113.000

Estimated Storage (ft³)	Estimated Max Water Surface Elevation (ft)	Estimated Freeboard Depth	Design Outlet Structure	Estimated Peak Outflow (ft³/s)	Estimated Peak Outflow vs. Target
14,311.786	1,898.30	Pass	Composite Outlet Structure - 1	3.90	Pass
35,791.626	1,899.00	Fail	Composite Outlet Structure - 1	7.73	Pass

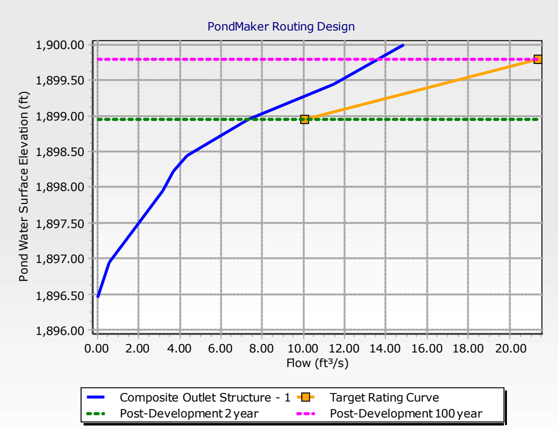


PondMaker Worksheet Detailed Report: CAMPUS GREEN POND - EXISTING CONDITIONS

PondMaker Worksheet (Routing Design)

Design Scenario	Design Return Event	Target Peak Outflow (ft³/s)	Computed Peak Outflow (ft³/s)	Computed Peak Outflow vs. Target	Target Outflow Volume (ft³)
Post-Development 2 year	2	10.08	7.31	Pass	87,120.001
Post-Development 100 year	100	21.39	13.65	Pass	217,800.003

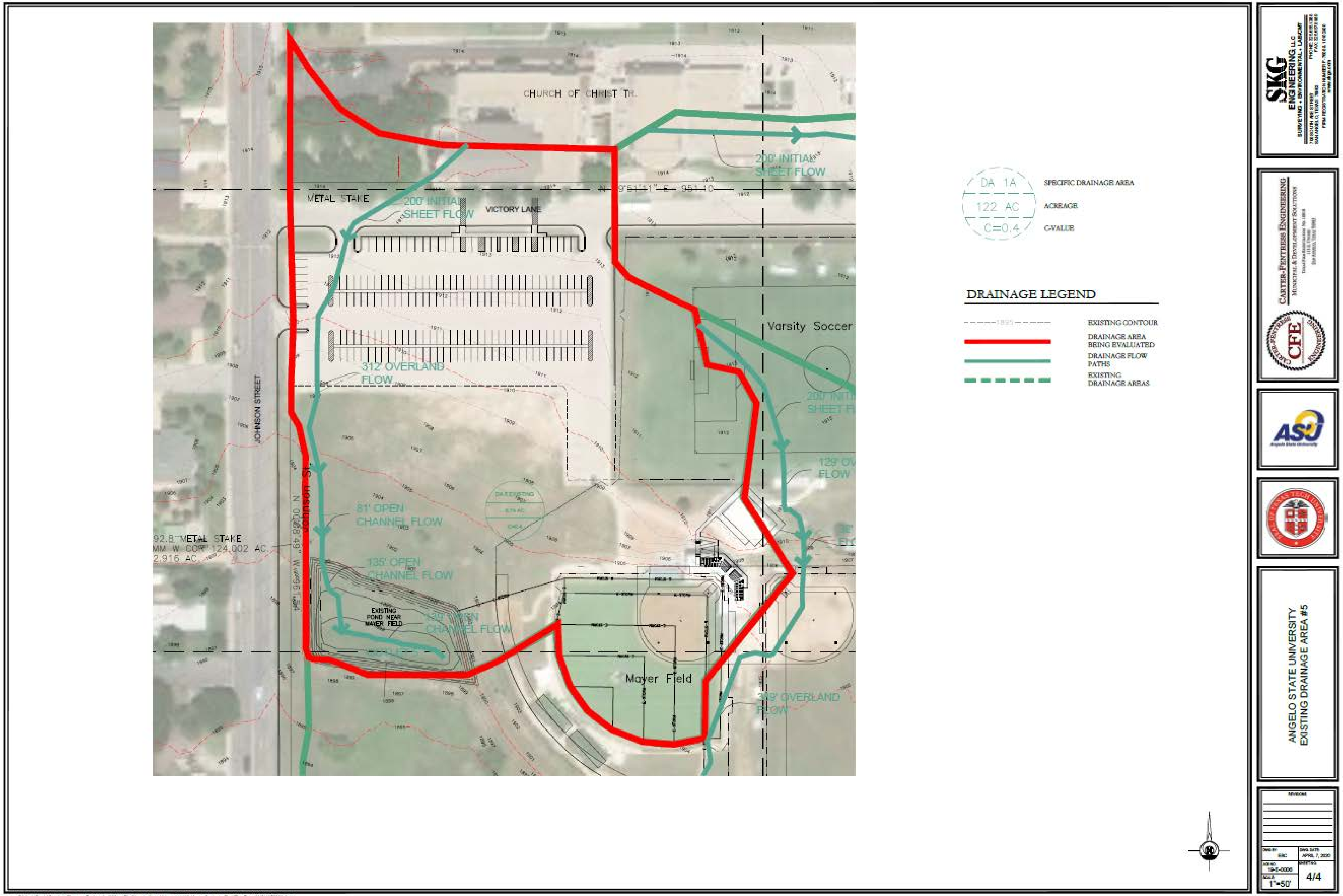
Computed Volume Outflow (ft³)	Computed Outflow Volume vs. Target	Routing Outlet Structure	Computed Max Water Elevation (ft)	Freeboard Depth	Maximum Storage (ft³)
42,317.386	Pass	Composite Outlet Structure - 1	1,898.95	Pass	34,230.000
105,491.856	Pass	Composite Outlet Structure - 1	1,899.80	Fail	87,419.000



ATTACHMENT IV

EXISTING DETENTION POND

NEAR MAYER FIELD


CHURCH OF CHRIST TR.
METAL STAKE
VICTORY LANE
200' INITIAL SHEET FLOW
312' OVERLAND FLOW
JOHNSON STREET
81' OPEN CHANNEL FLOW
135' OPEN CHANNEL FLOW
EXISTING POND NEAR MAYER FIELD
Varsity Soccer
Mayer Field
DA 1A
122 AC
C=0.4
SPECIFIC DRAINAGE AREA
ACREAGE
C-VALUE
DRAINAGE LEGEND
EXISTING CONTOUR
DRAINAGE AREA BEING EVALUATED
DRAINAGE FLOW PATHS
EXISTING DRAINAGE AREAS
SKG ENGINEERING
CARTER-PENTRESS ENGINEERING
ANGELO STATE UNIVERSITY
EXISTING DRAINAGE AREA #5
1"=50'
4/4

RATIONAL METHOD: EXISTING CONDITIONS

Project Description: Angelo State Univeristy
San Angelo, Texas

Project No.: 1110

* TAKEN FROM CITY OF SAN ANGELO DRAINAGE MANUAL

** REFER TO DRAINAGE AREA MAPS

	UNITS USED
LENGTH	FT
T_C	MINS
VELOCITY	FT/SEC

1) VELOCITY (OVERLAND FLOW) $V = C\sqrt{S}$

2) TIME OF CONCENTRATION $T_C = L/(V \times 60)$

3) VELOCITY (OPEN CHANNEL FLOW) $V = \frac{1.49 \times R^{\frac{2}{3}} \times \sqrt{S}}{n}$

TOTAL DA 5

Step		K	C	Rainfall Intensity, I=b/(Td+d)^e					A	Qpeak
				b	d	e	Tc	I (in/hr)	(acres)	(cfs)
	2-YR	1.00	0.40	53.5	10.3	0.865	17.8	2.99	8.7	10.4
	100-YR	1.00	0.40	112.5	14.7	0.816	17.8	6.57	8.7	23.0

	INITIAL SHEET FLOW		OVERLAND FLOW					OPEN CHANNEL FLOW						OPEN CHANNEL FLOW					
	**HYDRAULIC LENGTH (L)	*TIME OF CONCENTRATION (T_c) (Table 5-6)	**HYDRAULIC LENGTH (L)	**SLOPE (S)	*VELOCITY COEFFICIENT(C) (Table 5-7)	VELOCITY (V)	TIME OF CONCENTRATION (T_c)	**HYDRAULIC LENGTH (L)	HYDRAULIC RADIUS (R) (Estimated)	**SLOPE (S)	*MANNING'S COEFFICIENT (n) (Table 9-2)	VELOCITY (V)	TIME OF CONCENTRATION (T_c)	**HYDRAULIC LENGTH (L)	HYDRAULIC RADIUS (R) (Estimated)	**SLOPE (S)	*MANNING'S COEFFICIENT (n) (Table 9-2)	VELOCITY (V)	TIME OF CONCENTRATION (T_c)
EXISTING CONDITIONS	200	15	312	0.027	20	3.29	1.6	81	0.75	0.037	0.03	7.89	0.2	135	0.75	0.023	0.03	6.22	0.4

	OPEN CHANNEL FLOW							
	**HYDRAULIC LENGTH (L)	HYDRAULIC RADIUS (R) (Estimated)	**SLOPE (S)	*MANNING'S COEFFICIENT (n) (Table 9-2)	VELOCITY (V)	TIME OF CONCENTRATION (T_c)	Total Time of Concentration (MIN)	Total Time of Concentration (HRS)
EXISTING CONDITIONS	139	0.75	0.007	0.03	3.43	0.7	17.8	0.3

PondMaker Worksheet Detailed Report: EXISTING POND NEAR MAYER FIELD

Element Details	
ID	43
Label	EXISTING POND NEAR MAYER FIELD
Select Pond to Design	PO-2
Flow Allowed Below Target	80.0
Flow Allowed Above Target	0.0
Flow Allowed Below Target	80.0
Flow Allowed Above Target	10.0
Volume Allowed Below Target	80.0
Volume Allowed Above Target	80.0
Tolerance Display	Display PASS for values within specified tolerance

Notes

Volume

Pond Type	Elevation-Volume	Use Void Space?	False

Elevation-Volume

Pond Elevation (ft)	Pond Volume (ft³)
1,896.50	0.000
1,898.00	5,086.500
1,899.00	14,543.190
1,900.00	31,793.070

Infiltration

Infiltration Method	No Infiltration

Output

Detention Time	None

Initial Conditions

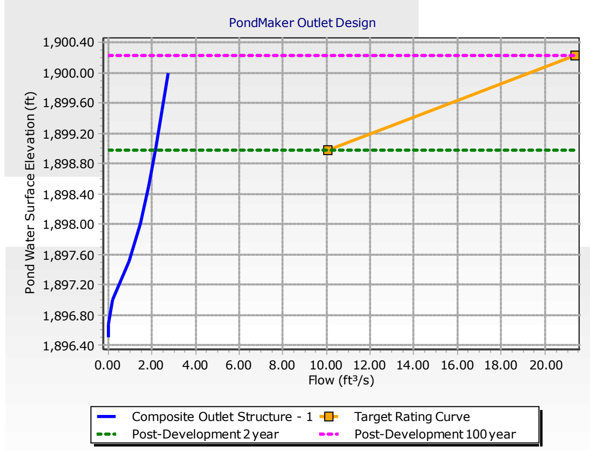
Is Outflow Averaging On?	False	Define Starting Water Surface Elevation	Pond Invert

PondMaker Worksheet Detailed Report: EXISTING POND NEAR MAYER FIELD

PondMaker Worksheet (Outlet Design)

Design Scenario	Design Return Event	Target Peak Outflow (ft³/s)	Target Outflow Volume (ft³)	Peak Pond Inflow (ft³/s)	Total Inflow Volume (ft³)
Post-Development 2 year	2	10.08	87,120.001	18.49	18,722.000
Post-Development 100 year	100	21.39	217,800.003	36.60	46,113.000

Estimated Storage (ft³)	Estimated Max Water Surface Elevation (ft)	Estimated Freeboard Depth	Design Outlet Structure	Estimated Peak Outflow (ft³/s)	Estimated Peak Outflow vs. Target
14,311.786	1,898.98	Pass	Composite Outlet Structure - 1	2.62	Pass
35,791.626	1,900.23	Fail	Composite Outlet Structure - 1	5.04	Pass

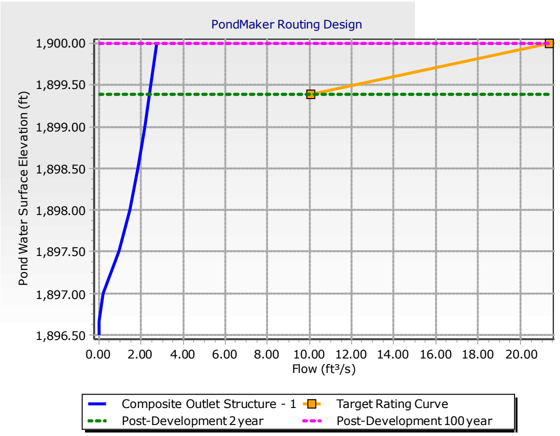


PondMaker Worksheet Detailed Report: EXISTING POND NEAR MAYER FIELD

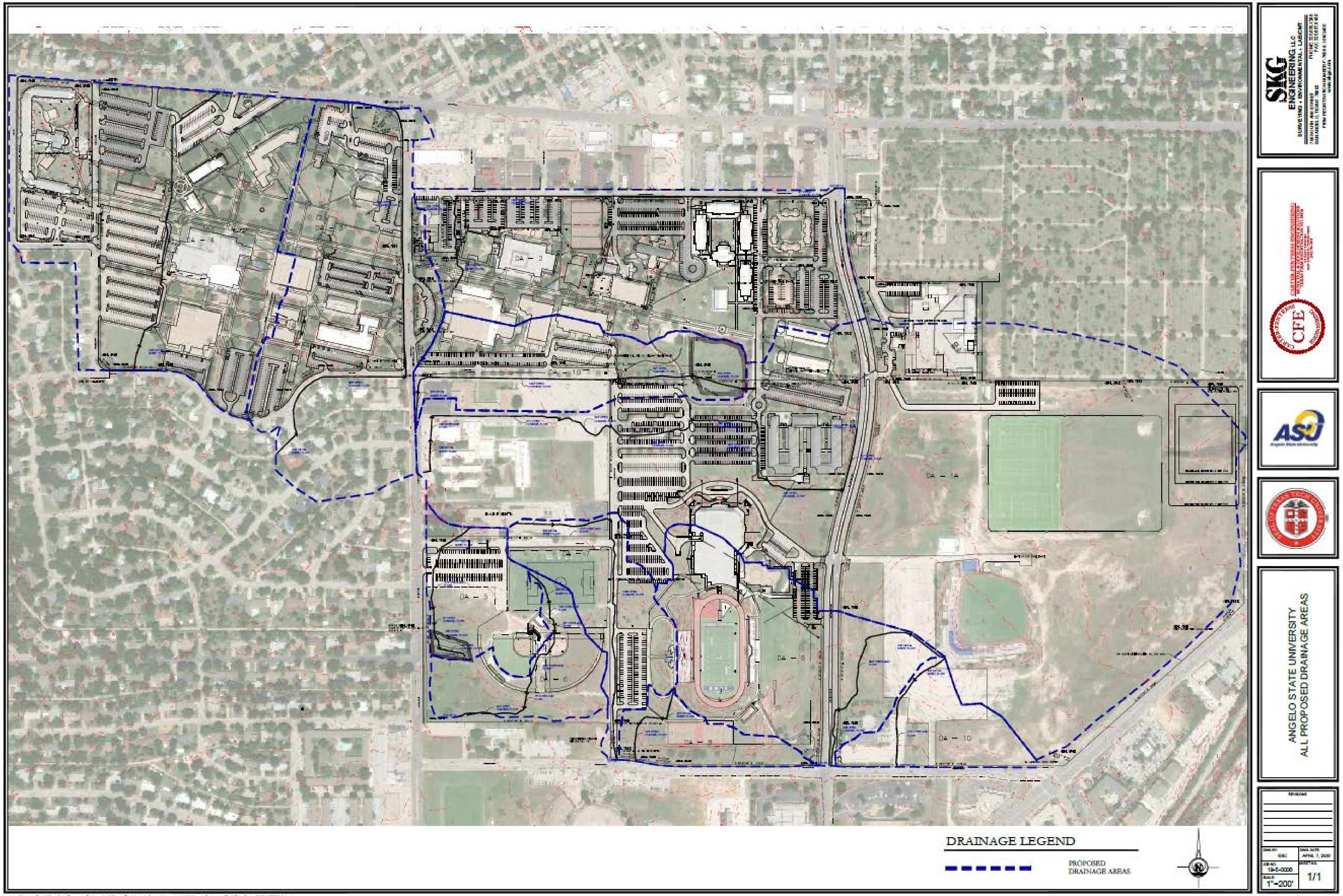
PondMaker Worksheet (Routing Design)

Design Scenario	Design Return Event	Target Peak Outflow (ft³/s)	Computed Peak Outflow (ft³/s)	Computed Peak Outflow vs. Target	Target Outflow Volume (ft³)
Post-Development 2 year	2	10.08	2.41	Pass	87,120.001
Post-Development 100 year	100	21.39	2.72	Fail	217,800.003

Computed Volume Outflow (ft³)	Computed Outflow Volume vs. Target	Routing Outlet Structure	Computed Max Water Elevation (ft)	Freeboard Depth	Maximum Storage (ft³)
23,596.988	Pass	Composite Outlet Structure - 1	1,899.39	Fail	21,271.000
67,032.945	Pass	Composite Outlet Structure - 1	1,900.00	Fail	31,793.000



PROPOSED ATTACHMENTS

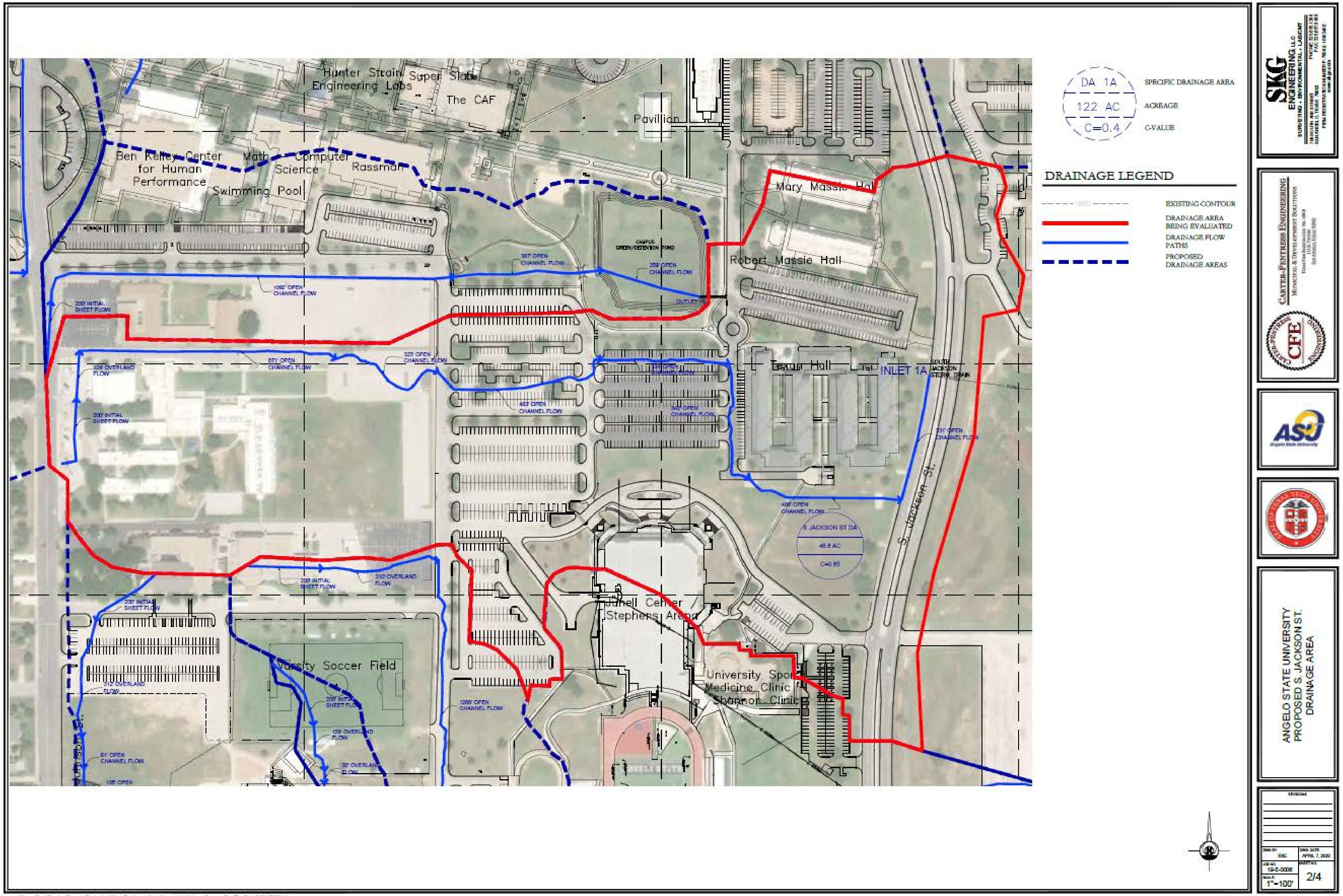


Due to large image file, some fonts may be illegible. For a higher resolution copy please contact Facilities Planning and Construction.

ATTACHMENT I

SOUTH JACKSON STREET STORM DRAIN IMPROVEMENTS

CARTER-FENTRESS ENGINEERING



Due to large image file, some fonts may be illegible. For a higher resolution copy please contact Facilities Planning and Construction.

RATIONAL METHOD: DEVELOPED CONDITIONS

Project Description: Angelo State Univeristy
San Angelo, Texas

Project No.: 1110

* TAKEN FROM CITY OF SAN ANGELO DRAINAGE MANUAL
** REFER TO DRAINAGE AREA MAPS

UNITS USED	
LENGTH	FT
T_C	MINS
VELOCITY	FT/SEC

1) VELOCITY (OVERLAND FLOW) $V = C\sqrt{S}$

2) TIME OF CONCENTRATION $T_C = L/(V \times 60)$

3) VELOCITY (OPEN CHANNEL FLOW) $V = \frac{1.49 \times R^{\frac{2}{3}} \times \sqrt{S}}{n}$

S. JACKSON ST. DA

Step		K	C	Rainfall Intensity, I=b/(Td+d)^e					A	Qpeak
				b	d	e	Tc	I (in/hr)	(acres)	(cfs)
	2-YR	1.00	0.85	53.5	10.3	0.865	18.5	2.92	46.8	116.1
	100-YR	1.00	0.85	112.5	14.7	0.816	18.5	6.45	46.8	256.5

	INITIAL SHEET FLOW		OVERLAND FLOW				
	**HYDRAULIC LENGTH (L)	*TIME OF CONCENTRATION (T_c) (Table 5-6)	**HYDRAULIC LENGTH (L)	**SLOPE (S)	*VELOCITY COEFFICIENT(C) (Table 5-7)	VELOCITY (V)	TIME OF CONCENTRATION (T_c)
DEVELOPED CONDITIONS	200	10	124	0.003	20	1.10	1.9

	OPEN CHANNEL FLOW					
	**HYDRAULIC LENGTH (L)	HYDRAULIC RADIUS (R) (Estimated)	**SLOPE (S)	*MANNING'S COEFFICIENT (n) (Table 9-2)	VELOCITY (V)	TIME OF CONCENTRATION (T_c)
DEVELOPED CONDITIONS	671	0.75	0.009	0.016	7.29	1.5

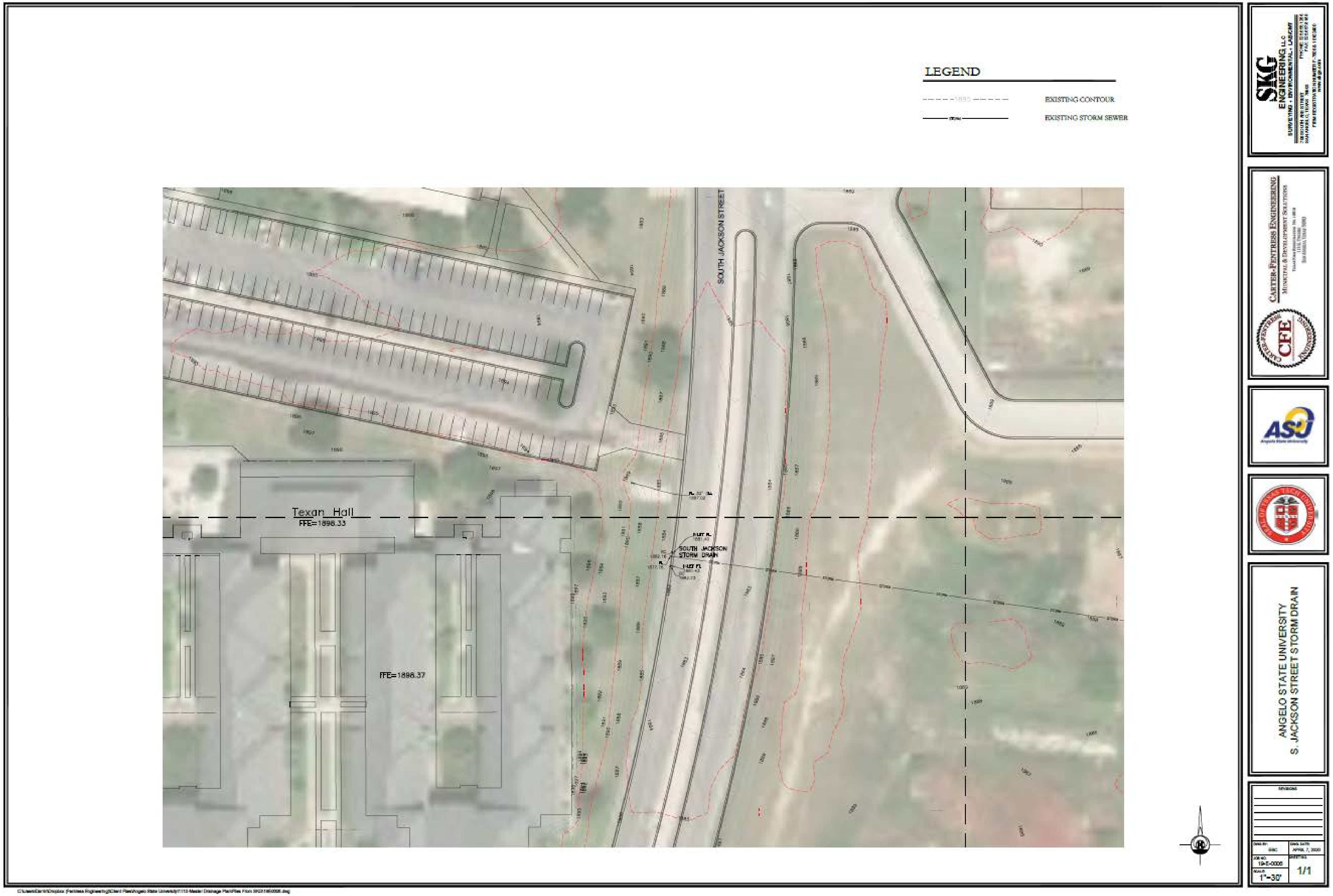
	OPEN CHANNEL FLOW					
	**HYDRAULIC LENGTH (L)	HYDRAULIC RADIUS (R) (Estimated)	**SLOPE (S)	*MANNING'S COEFFICIENT (n) (Table 9-2)	VELOCITY (V)	TIME OF CONCENTRATION (T_c)
DEVELOPED CONDITIONS	323	0.75	0.006	0.016	5.95	0.9

	OPEN CHANNEL FLOW					
	**HYDRAULIC LENGTH (L)	HYDRAULIC RADIUS (R) (Estimated)	**SLOPE (S)	*MANNING'S COEFFICIENT (n) (Table 9-2)	VELOCITY (V)	TIME OF CONCENTRATION (T_c)
DEVELOPED CONDITIONS	483	0.75	0.01	0.016	7.69	1.0

	OPEN CHANNEL FLOW					
	**HYDRAULIC LENGTH (L)	HYDRAULIC RADIUS (R) (Estimated)	**SLOPE (S)	*MANNING'S COEFFICIENT (n) (Table 9-2)	VELOCITY (V)	TIME OF CONCENTRATION (T_c)
DEVELOPED CONDITIONS	324	0.75	0.0077	0.016	6.75	0.8

	OPEN CHANNEL FLOW					
	**HYDRAULIC LENGTH (L)	HYDRAULIC RADIUS (R) (Estimated)	**SLOPE (S)	*MANNING'S COEFFICIENT (n) (Table 9-2)	VELOCITY (V)	TIME OF CONCENTRATION (T_c)
DEVELOPED CONDITIONS	408	0.75	0.017	0.03	5.35	1.3

	OPEN CHANNEL FLOW							
	**HYDRAULIC LENGTH (L)	HYDRAULIC RADIUS (R) (Estimated)	**SLOPE (S)	*MANNING'S COEFFICIENT (n) (Table 9-2)	VELOCITY (V)	TIME OF CONCENTRATION (T_c)	Total Time of Concentration (MIN)	Total Time of Concentration (HRS)
DEVELOPED CONDITIONS	331	0.75	0.015	0.03	5.02	1.1	18.5	0.3



Due to large image file, some fonts may be illegible. For a higher resolution copy please contact Facilities Planning and Construction.

CALCULATOR PURPOSE

The Prinsco Drainage Calculator estimates the capacity of tile drainage systems. A particular pipe size on a given grade will only carry a certain amount of water. The steeper the grade of the installed pipe, the more water it will carry.

- Checks the capacity of drain tile on existing drainage systems
- Sizes the piping needed on the acreage to be drained
- Checks the capacity of drain tile on a new drainage system
- Calculates the pipe size based on how quickly you want the land drained

BY ACREAGE
BY PIPE SIZE

Drainage Calculator by Pipe Size

Our drainage calculator was developed in partnership with the University of Minnesota Extension to assist you in the preliminary design and understanding of your drainage needs. We encourage you to contact your local design profes or contractor for more specific design guidance and criteria.

These calculations are based on the Manning's Roughness ASAE EP 260.3 Plastic Tubing Drainage Chart and shou used for estimating purposes only. Consult a Water Table Management Professional for design criteria information

? = Definition

Enter the Diameter of the pipe (inches):	52
Enter the Grade (%): ?	0.5 %
	View Results (see below)

	Q, Flow ?			Velocity ?
	c.f.s.	g.p.m	acre - in./24 hrs.	ft./sec.
Single-Wall	81.957	36784.8	1950.71	5.56
Dual-Wall	136.498	61264.4	3248.88	9.26

	Acres Drained					
	Drainage Coefficient (in: /24 hours) ?					
	1/8"	1/4"	3/8"	1/2"	3/4"	1"
Single-Wall	15605.70	7802.85	5201.90	3901.42	2600.95	1950.71
Dual-Wall	25991.02	12995.51	8663.67	6497.76	4331.84	3248.88

CALCULATE BY ACREAGE

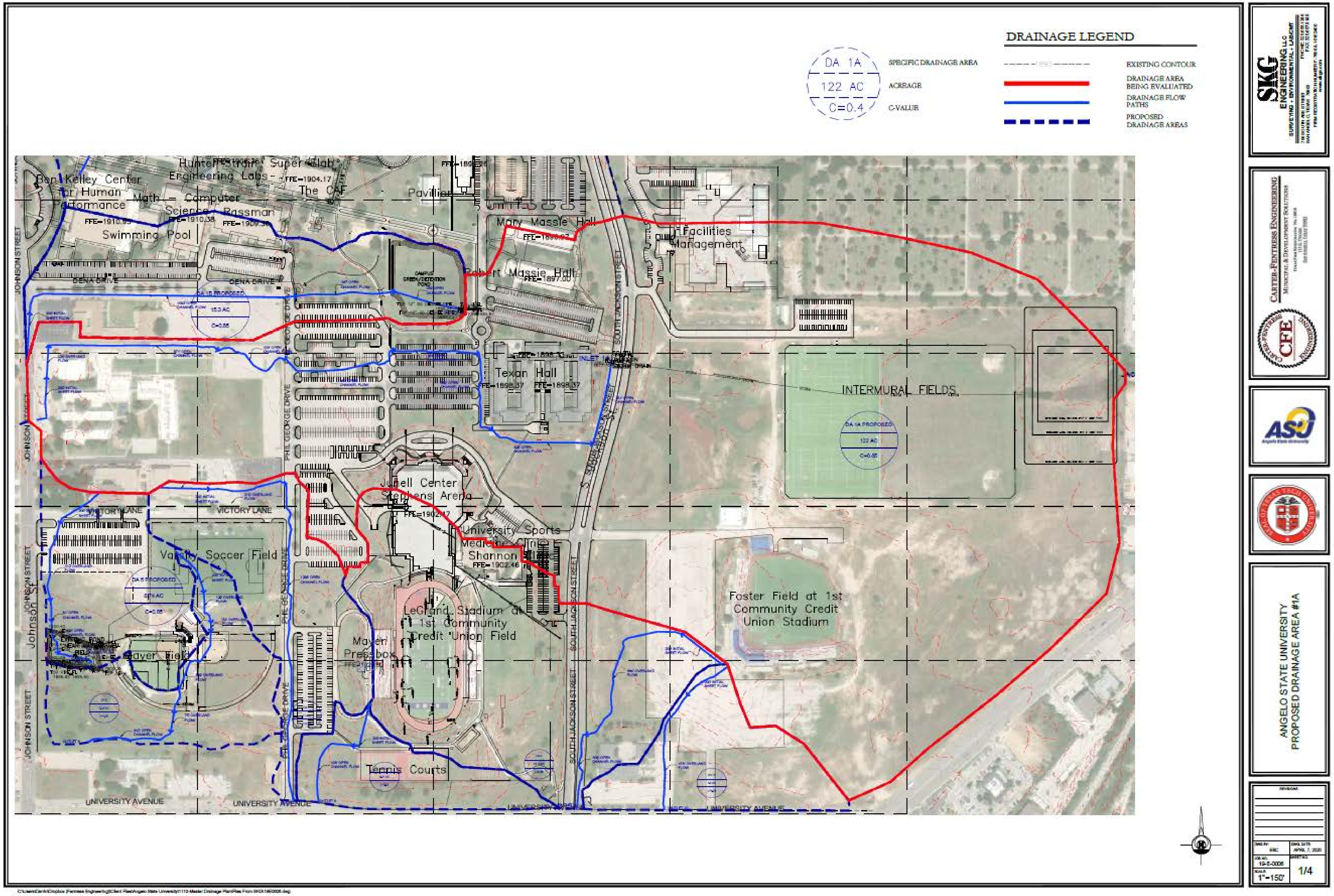
developed in partnership with

UNIVERSITY OF MINNESOTA EXTENSION

ATTACHMENT II

PROPOSED DETENTION POND

NEAR KICKERBOCKER RD.



Due to large image file, some fonts may be illegible. For a higher resolution copy please contact Facilities Planning and Construction.

RATIONAL METHOD: EXISTING CONDITIONS

Project Description: Angelo State Univeristy
San Angelo, Texas

Project No : 1110

* TAKEN FROM CITY OF SAN ANGELO DRAINAGE MANUAL
** REFER TO DRAINAGE AREA MAPS

	UNITS USED
LENGTH	FT
T_C	MINS
VELOCITY	FT/SEC

1) VELOCITY (OVERLAND FLOW) $V = C\sqrt{S}$

2) TIME OF CONCENTRATION $T_C = L/(V \times 60)$

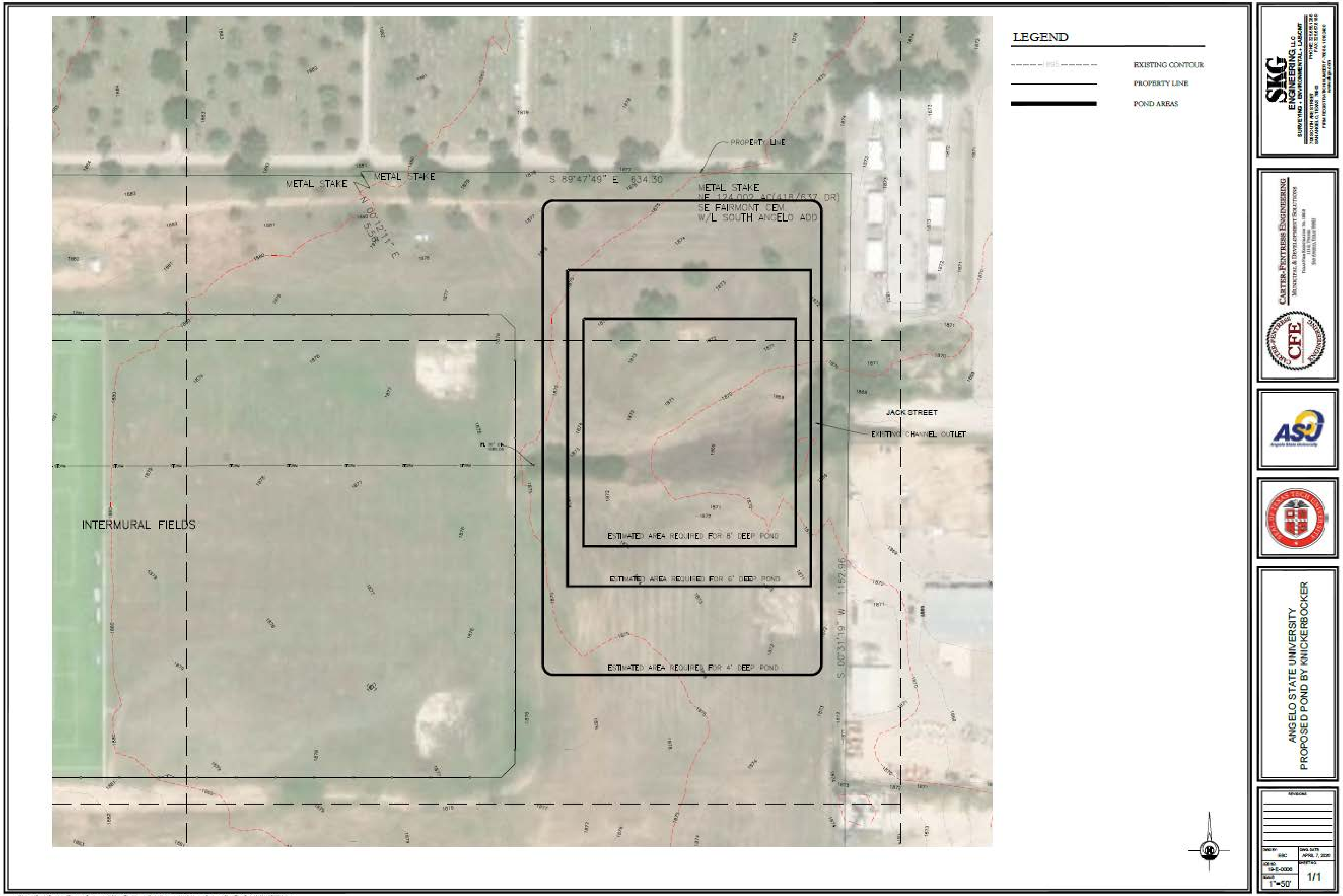
3) VELOCITY (OPEN CHANNEL FLOW) $V = \frac{1.49 \times R^{\frac{2}{3}} \times \sqrt{S}}{n}$

TOTAL DA 1A

Step		K	C	Rainfall Intensity I=b/(Td+d)^e				I (in/hr)	A	Qpeak
				b	d	e	Tc	I (in/hr)	(acres)	(cfs)
	2-YR	1.00	0.40	53.5	10.3	0.865	23.5	2.54	122.0	124.0
	100-YR	1.00	0.40	112.5	14.7	0.816	23.5	5.75	122.0	280.7

	INITIAL SHEET FLOW		OVERLAND FLOW					OPEN CHANNEL FLOW						OPEN CHANNEL FLOW						OPEN CHANNEL FLOW					
	**HYDRAULIC LENGTH (L)	*TIME OF CONCENTRATION (T_c) (Table 5-6)	**HYDRAULIC LENGTH (L)	**SLOPE (S)	*VELOCITY COEFFICIENT(C) (Table 5-7)	VELOCITY (V)	TIME OF CONCENTRATION (T_c)	**HYDRAULIC LENGTH (L)	HYDRAULIC RADIUS (R) (Estimated)	**SLOPE (S)	*MANNING'S COEFFICIENT (n) (Table 9-2)	VELOCITY (V)	TIME OF CONCENTRATION (T_c)	**HYDRAULIC LENGTH (L)	HYDRAULIC RADIUS (R) (Estimated)	**SLOPE (S)	*MANNING'S COEFFICIENT (n) (Table 9-2)	VELOCITY (V)	TIME OF CONCENTRATION (T_c)	**HYDRAULIC LENGTH (L)	HYDRAULIC RADIUS (R) (Estimated)	**SLOPE (S)	*MANNING'S COEFFICIENT (n) (Table 9-2)	VELOCITY (V)	TIME OF CONCENTRATION (T_c)
DEVELOPED CONDITIONS	200	10	124	0.003	20	1.10	1.9	671	0.75	0.009	0.016	7.29	1.5	323	0.75	0.006	0.016	5.95	0.9	483	0.75	0.01	0.016	7.69	1.0

	OPEN CHANNEL FLOW						OPEN CHANNEL FLOW						OPEN CHANNEL FLOW							
	**HYDRAULIC LENGTH (L)	HYDRAULIC RADIUS (R) (Estimated)	**SLOPE (S)	*MANNING'S COEFFICIENT (n) (Table 9-2)	VELOCITY (V)	TIME OF CONCENTRATION (T_c)	**HYDRAULIC LENGTH (L)	HYDRAULIC RADIUS (R) (Estimated)	**SLOPE (S)	*MANNING'S COEFFICIENT (n) (Table 9-2)	VELOCITY (V)	TIME OF CONCENTRATION (T_c)	**HYDRAULIC LENGTH (L)	HYDRAULIC RADIUS (R) (Estimated)	**SLOPE (S)	*MANNING'S COEFFICIENT (n) (Table 9-2)	VELOCITY (V)	TIME OF CONCENTRATION (T_c)	Total Time of Concentration (MIN)	Total Time of Concentration (HRS)
DEVELOPED CONDITIONS	324	0.75	0.0077	0.016	6.75	0.8	408	0.75	0.017	0.03	5.35	1.3	331	0.75	0.015	0.03	5.02	1.1	18.5	0.3



Due to large image file, some fonts may be illegible. For a higher resolution copy please contact Facilities Planning and Construction.

PondMaker Worksheet Detailed Report: 4 FT. DEPTH POND SIZING

Element Details

ID	43
Label	4 FT. DEPTH POND SIZING
Select Pond to Design	PO-2
Flow Allowed Below Target	80.0
Flow Allowed Above Target	0.0
Flow Allowed Below Target	80.0
Flow Allowed Above Target	10.0
Volume Allowed Below Target	80.0
Volume Allowed Above Target	80.0
Tolerance Display	Display PASS for values within specified tolerance

Notes

Volume

Pond Type	Elevation-Volume	Use Void Space?	False

Elevation-Volume

Pond Elevation (ft)	Pond Volume (ft³)
1,865.00	0.000
1,866.00	199,145.920
1,867.00	403,879.270
1,868.00	614,256.620
1,869.00	830,334.500
1,869.50	940,527.100

Infiltration

Infiltration Method	No Infiltration

Output

Detention Time	None

Initial Conditions

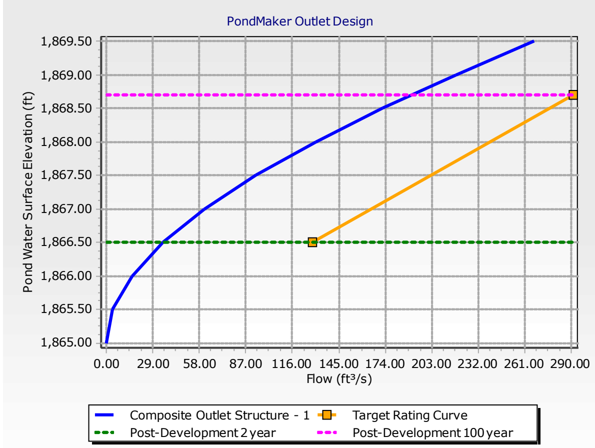
Is Outflow Averaging On?	False	Define Starting Water Surface Elevation	Pond Invert

PondMaker Worksheet Detailed Report: 4 FT. DEPTH POND SIZING

PondMaker Worksheet (Outlet Design)

Design Scenario	Design Return Event	Target Peak Outflow (ft³/s)	Target Outflow Volume (ft³)	Peak Pond Inflow (ft³/s)	Total Inflow Volume (ft³)
Post-Development 2 year	2	128.81	87,120.001	284.98	375,712.000
Post-Development 100 year	100	291.16	217,800.003	575.53	932,361.000

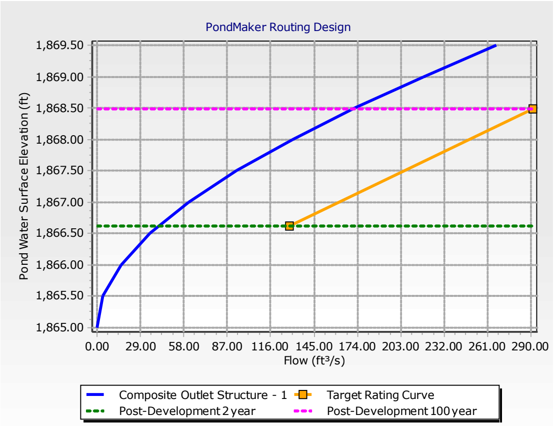
Estimated Storage (ft³)	Estimated Max Water Surface Elevation (ft)	Estimated Freeboard Depth	Design Outlet Structure	Estimated Peak Outflow (ft³/s)	Estimated Peak Outflow vs. Target
304,187.612	1,866.51	Pass	Composite Outlet Structure - 1	958.23	Fail
766,573.312	1,868.70	Fail	Composite Outlet Structure - 1	1,222.22	Fail



PondMaker Worksheet Detailed Report: 4 FT. DEPTH POND SIZING

PondMaker Worksheet (Routing Design)

Design Scenario	Design Return Event	Target Peak Outflow (ft³/s)	Computed Peak Outflow (ft³/s)	Computed Peak Outflow vs. Target	Target Outflow Volume (ft³)	Computed Volume Outflow (ft³)	Computed Outflow Volume vs. Target	Routing Outlet Structure	Computed Max Water Elevation (ft)	Freeboard Depth	Maximum Storage (ft³)
Post-Development 2 year	2	128.81	41.29	Pass	87,120.001	360,759.020	Fail	Composite Outlet Structure - 1	1,866.61	Pass	324,824.000
Post-Development 100 year	100	291.16	170.73	Pass	217,800.003	902,748.380	Fail	Composite Outlet Structure - 1	1,868.48	Pass	718,482.000



PondMaker Worksheet Detailed Report: 6 FT. DEPTH POND SIZING

Element Details

ID	43
Label	6 FT. DEPTH POND SIZING
Select Pond to Design	PO-2
Flow Allowed Below Target	80.0
Flow Allowed Above Target	0.0
Flow Allowed Below Target	80.0
Flow Allowed Above Target	10.0
Volume Allowed Below Target	80.0
Volume Allowed Above Target	80.0
Tolerance Display	Display PASS for values within specified tolerance

Notes

Volume

Pond Type	Elevation-Volume	Use Void Space?	False

Elevation-Volume

Pond Elevation (ft)	Pond Volume (ft³)
1,863.50	0.000
1,865.00	115,323.000
1,866.00	239,636.000
1,867.00	353,011.000
1,868.00	482,520.000
1,869.00	615,114.000
1,869.50	754,610.000

Infiltration

Infiltration Method	No Infiltration

Output

Detention Time	None

Initial Conditions

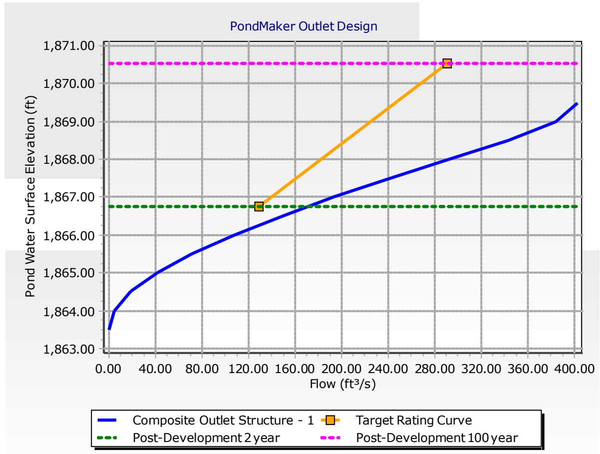
Is Outflow Averaging On?	False	Define Starting Water Surface Elevation	Pond Invert

PondMaker Worksheet Detailed Report: 6 FT. DEPTH POND SIZING

PondMaker Worksheet (Outlet Design)

Design Scenario	Design Return Event	Target Peak Outflow (ft³/s)	Target Outflow Volume (ft³)	Peak Pond Inflow (ft³/s)	Total Inflow Volume (ft³)
Post-Development 2 year	2	128.81	87,120.001	284.98	375,712.000
Post-Development 100 year	100	291.16	217,800.003	575.53	932,361.000

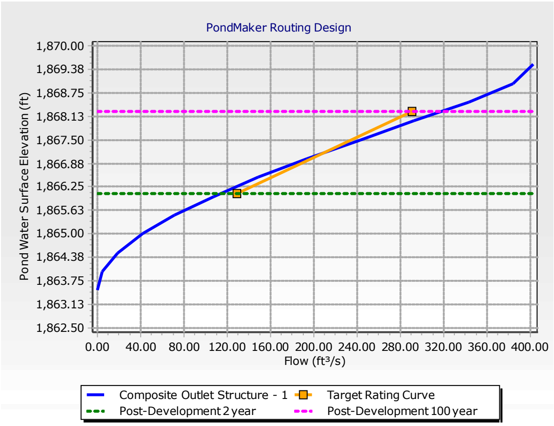
Estimated Storage (ft³)	Estimated Max Water Surface Elevation (ft)	Estimated Freeboard Depth	Design Outlet Structure	Estimated Peak Outflow (ft³/s)	Estimated Peak Outflow vs. Target
304,187.612	1,866.77	Pass	Composite Outlet Structure - 1	958.23	Fail
766,573.312	1,870.53	Fail	Composite Outlet Structure - 1	1,222.22	Fail



PondMaker Worksheet Detailed Report: 6 FT. DEPTH POND SIZING

PondMaker Worksheet (Routing Design)

Design Scenario	Design Return Event	Target Peak Outflow (ft³/s)	Computed Peak Outflow (ft³/s)	Computed Peak Outflow vs. Target	Target Outflow Volume (ft³)	Computed Volume Outflow (ft³)	Computed Outflow Volume vs. Target	Routing Outlet Structure	Computed Max Water Elevation (ft)	Freeboard Depth	Maximum Storage (ft³)
Post-Development 2 year	2	128.81	112.24	Pass	87,120.001	366,692.583	Fail	Composite Outlet Structure - 1	1,866.06	Pass	246,512.000
Post-Development 100 year	100	291.16	319.71	Pass	217,800.003	909,981.753	Fail	Composite Outlet Structure - 1	1,868.27	Pass	517,739.000



PondMaker Worksheet Detailed Report: 8 FT. DEPTH POND SIZING

Element Details

ID	43
Label	8 FT. DEPTH POND SIZING
Select Pond to Design	PO-2
Flow Allowed Below Target	80.0
Flow Allowed Above Target	0.0
Flow Allowed Below Target	80.0
Flow Allowed Above Target	10.0
Volume Allowed Below Target	80.0
Volume Allowed Above Target	80.0
Tolerance Display	Display PASS for values within specified tolerance

Notes

Volume

Pond Type	Elevation-Volume	Use Void Space?	False

Elevation-Volume

Pond Elevation (ft)	Pond Volume (ft³)
1,861.50	0.000
1,862.50	82,123.000
1,863.50	174,348.000
1,864.50	261,839.000
1,866.50	357,746.000
1,867.50	458,657.000
1,868.50	567,915.000
1,869.50	690,239.000

Infiltration

Infiltration Method	No Infiltration

Output

Detention Time	None

Initial Conditions

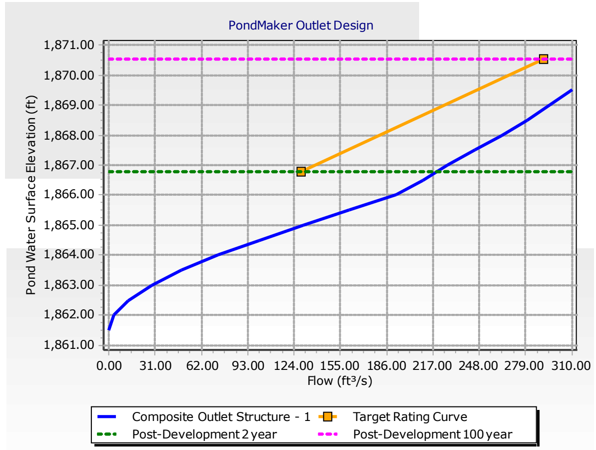
Is Outflow Averaging On?	False	Define Starting Water Surface Elevation	Pond Invert

PondMaker Worksheet Detailed Report: 8 FT. DEPTH POND SIZING

PondMaker Worksheet (Outlet Design)

Design Scenario	Design Return Event	Target Peak Outflow (ft³/s)	Target Outflow Volume (ft³)	Peak Pond Inflow (ft³/s)	Total Inflow Volume (ft³)
Post-Development 2 year	2	128.81	87,120.001	284.98	375,712.000
Post-Development 100 year	100	291.16	217,800.003	575.53	932,361.000

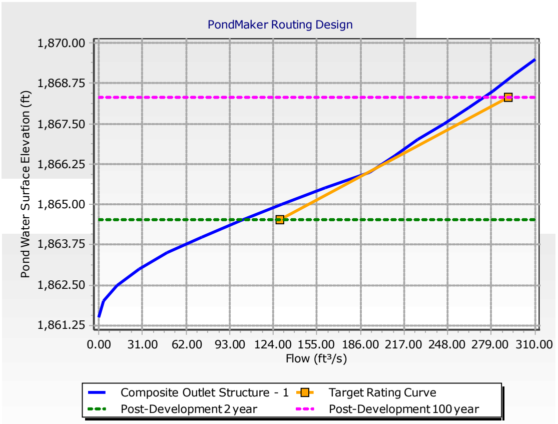
Estimated Storage (ft³)	Estimated Max Water Surface Elevation (ft)	Estimated Freeboard Depth	Design Outlet Structure	Estimated Peak Outflow (ft³/s)	Estimated Peak Outflow vs. Target
304,187.612	1,866.77	Pass	Composite Outlet Structure - 1	958.23	Fail
766,573.312	1,870.53	Fail	Composite Outlet Structure - 1	1,222.22	Fail



PondMaker Worksheet Detailed Report: 8 FT. DEPTH POND SIZING

PondMaker Worksheet (Routing Design)

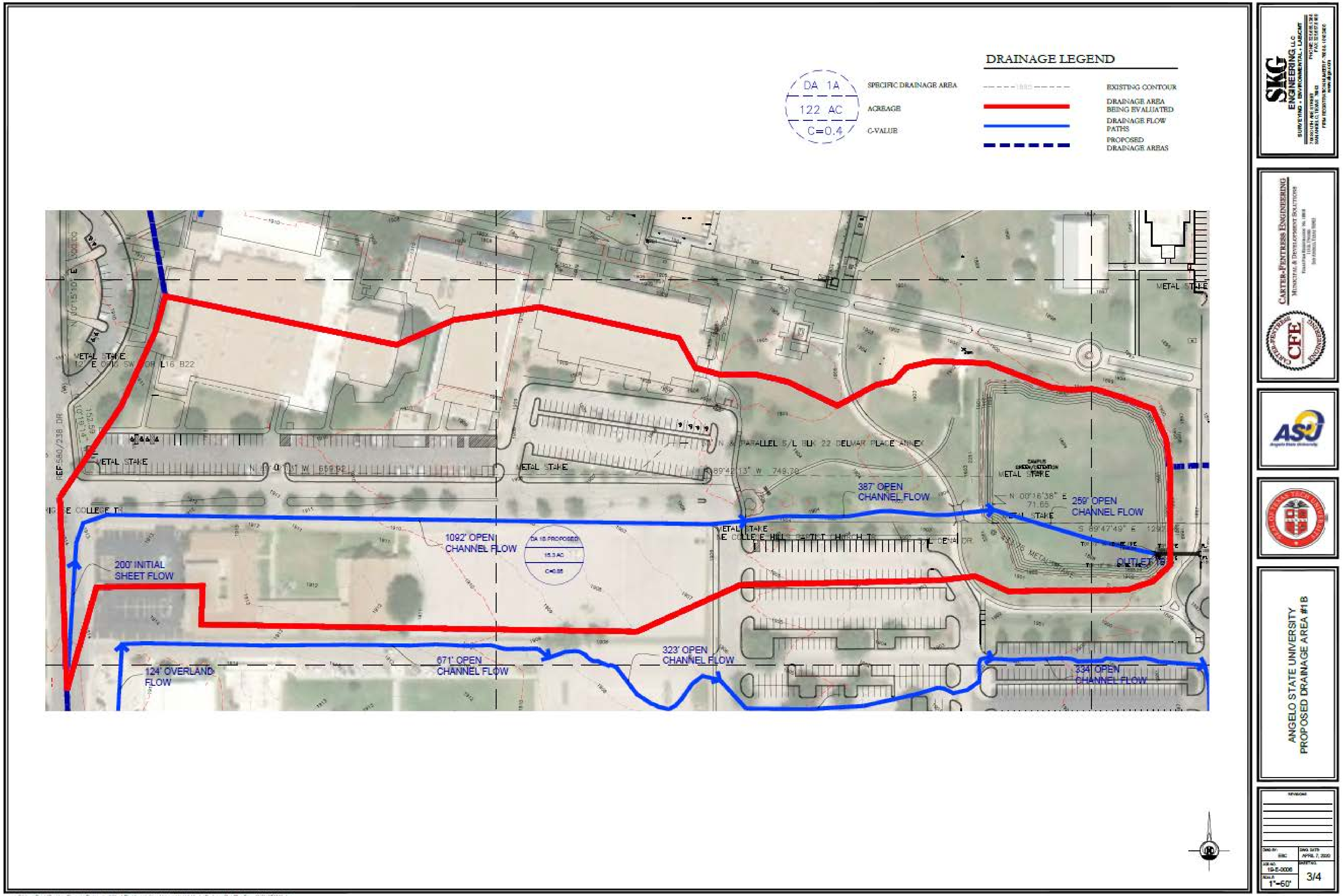
Design Scenario	Design Return Event	Target Peak Outflow (ft³/s)	Computed Peak Outflow (ft³/s)	Computed Peak Outflow vs. Target	Target Outflow Volume (ft³)	Computed Volume Outflow (ft³)	Computed Outflow Volume vs. Target	Routing Outlet Structure	Computed Max Water Elevation (ft)	Freeboard Depth	Maximum Storage (ft³)
Post-Development 2 year	2	128.81	103.02	Pass	87,120.001	366,607.512	Fail	Composite Outlet Structure - 1	1,864.54	Pass	263,747.000
Post-Development 100 year	100	291.16	273.90	Pass	217,800.003	909,884.496	Fail	Composite Outlet Structure - 1	1,868.32	Pass	548,454.000



ATTACHMENT III

PROPOSED CAMPUS GREEN/ DETENTION POND DESIGNS

CARTER-FENTRESS ENGINEERING



Due to large image file, some fonts may be illegible. For a higher resolution copy please contact Facilities Planning and Construction.

RATIONAL METHOD: DEVELOPED CONDITIONS

Project Description: Angelo State Univeristy
San Angelo, Texas

Project No.: 1110

* TAKEN FROM CITY OF SAN ANGELO DRAINAGE MANUAL
** REFER TO DRAINAGE AREA MAPS

	UNITS USED
LENGTH	FT
T_C	MINS
VELOCITY	FT/SEC

1) VELOCITY (OVERLAND FLOW) $V = C\sqrt{S}$

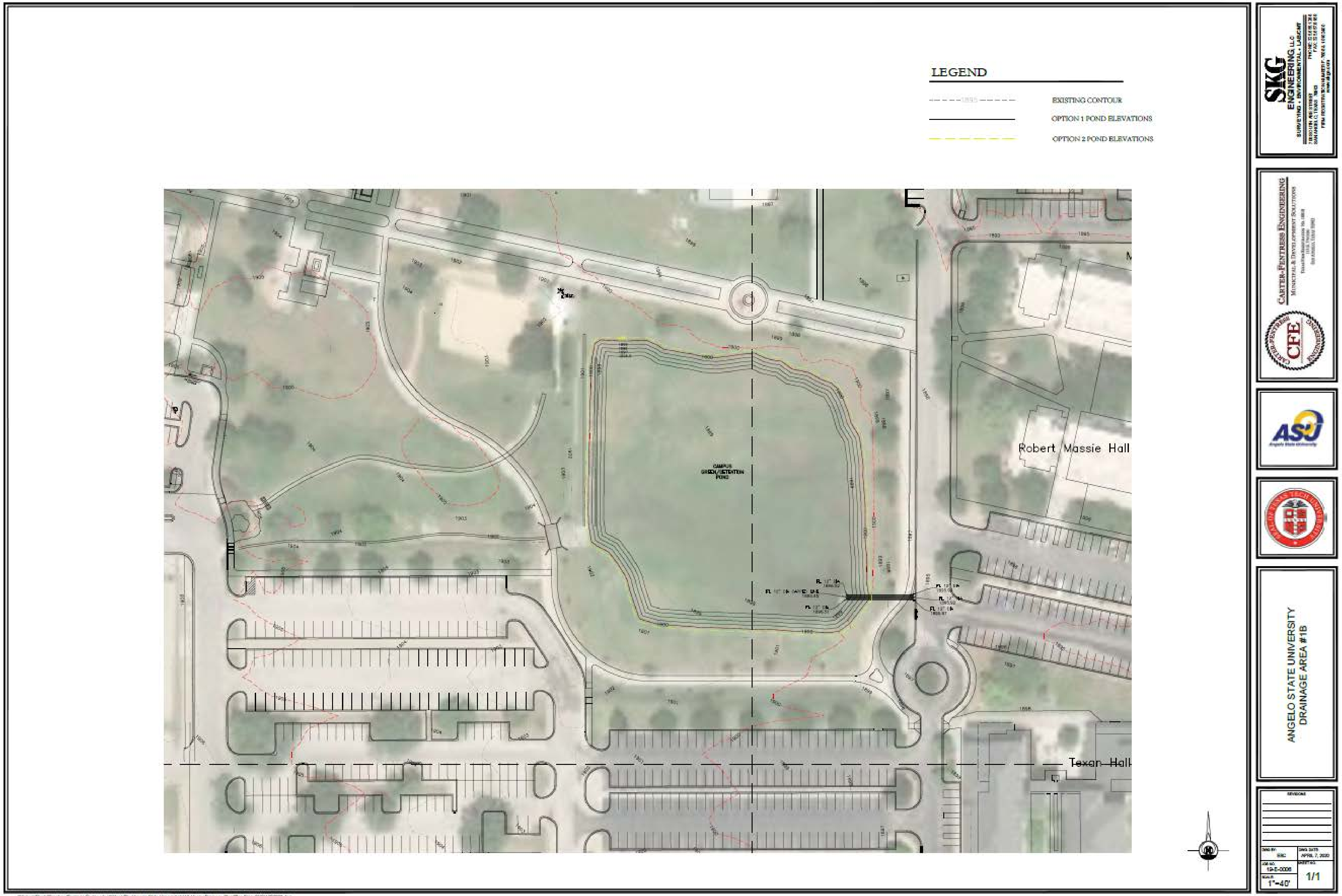
2) TIME OF CONCENTRATION $T_C = L/(V \times 60)$

3) VELOCITY (OPEN CHANNEL FLOW) $V = \frac{1.49 \times R^{\frac{2}{3}} \times \sqrt{S}}{n}$

TOTAL DA 1B

Step		K	C	Rainfall Intensity, I=b/(Td+d)^e					A	Qpeak
				b	d	e	Tc	I (in/hr)	(acres)	(cfs)
	2-YR	1.00	0.85	53.5	10.3	0.865	14.4	3.34	15.3	43.5
	100-YR	1.00	0.85	112.5	14.7	0.816	14.4	7.20	15.3	93.8

	INITIAL SHEET FLOW		OPEN CHANNEL FLOW						OPEN CHANNEL FLOW						OPEN CHANNEL FLOW							
	**HYDRAULIC LENGTH (L)	*TIME OF CONCENTRATION (T_c) (Table 5-6)	**HYDRAULIC LENGTH (L)	HYDRAULIC RADIUS (R) (Estimated)	**SLOPE (S)	*MANNING'S COEFFICIENT (n) (Table 9-2)	VELOCITY (V)	TIME OF CONCENTRATION (T_c)	**HYDRAULIC LENGTH (L)	HYDRAULIC RADIUS (R) (Estimated)	**SLOPE (S)	*MANNING'S COEFFICIENT (n) (Table 9-2)	VELOCITY (V)	TIME OF CONCENTRATION (T_c)	**HYDRAULIC LENGTH (L)	HYDRAULIC RADIUS (R) (Estimated)	**SLOPE (S)	*MANNING'S COEFFICIENT (n) (Table 9-2)	VELOCITY (V)	TIME OF CONCENTRATION (T_c)	Total Time of Concentration (MIN)	Total Time of Concentration (HRS)
DEVELOPED CONDITIONS	200	10	1092	0.75	0.008	0.016	6.88	2.6	387	0.75	0.016	0.016	9.72	0.7	259	0.75	0.01	0.03	4.10	1.1	14.4	0.2



Due to large image file, some fonts may be illegible. For a higher resolution copy please contact Facilities Planning and Construction.

PondMaker Worksheet Detailed Report: OPTION 1 - EXPANDING BOTTOM AREA

Element Details	
ID	43
Label	OPTION 1 - EXPANDING BOTTOM AREA
Select Pond to Design	PO-2
Flow Allowed Below Target	80.0
Flow Allowed Above Target	0.0
Flow Allowed Below Target	80.0
Flow Allowed Above Target	10.0
Volume Allowed Below Target	80.0
Volume Allowed Above Target	80.0
Tolerance Display	Display PASS for values within specified tolerance

Notes

Volume

Pond Type	Elevation-Volume	Use Void Space?	False

Elevation-Volume

Pond Elevation (ft)	Pond Volume (ft³)
1,896.45	0.000
1,898.00	5,117.150
1,899.00	35,705.910
1,900.00	100,526.140
1,901.00	177,397.990

Infiltration

Infiltration Method	No Infiltration

Output

Detention Time	None

Initial Conditions

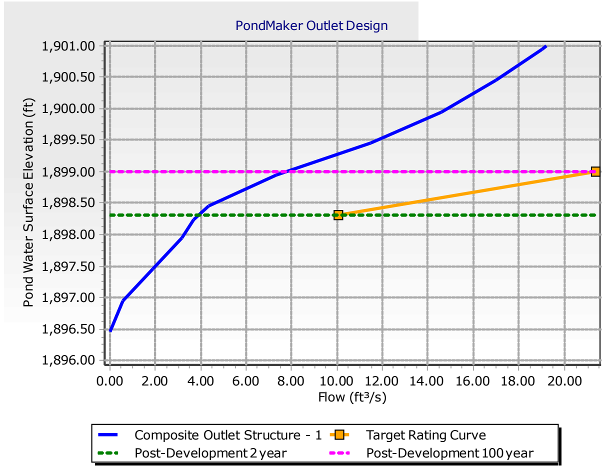
Is Outflow Averaging On?	False	Define Starting Water Surface Elevation	Pond Invert

PondMaker Worksheet Detailed Report: OPTION 1 - EXPANDING BOTTOM AREA

PondMaker Worksheet (Outlet Design)

Design Scenario	Design Return Event	Target Peak Outflow (ft³/s)	Target Outflow Volume (ft³)	Peak Pond Inflow (ft³/s)	Total Inflow Volume (ft³)
Post-Development 2 year	2	10.08	87,120.001	18.49	18,722.000
Post-Development 100 year	100	21.39	217,800.003	36.60	46,113.000

Estimated Storage (ft³)	Estimated Max Water Surface Elevation (ft)	Estimated Freeboard Depth	Design Outlet Structure	Estimated Peak Outflow (ft³/s)	Estimated Peak Outflow vs. Target
14,311.786	1,898.30	Pass	Composite Outlet Structure - 1	3.90	Pass
35,791.626	1,899.00	Pass	Composite Outlet Structure - 1	7.73	Pass

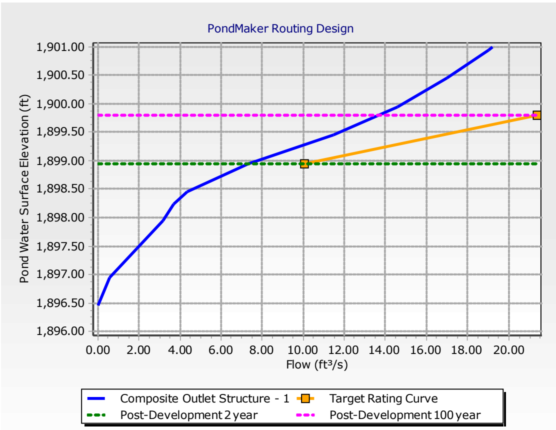


PondMaker Worksheet Detailed Report: OPTION 1 - EXPANDING BOTTOM AREA

PondMaker Worksheet (Routing Design)

Design Scenario	Design Return Event	Target Peak Outflow (ft^3/s)	Computed Peak Outflow (ft^3/s)	Computed Peak Outflow vs. Target	Target Outflow Volume (ft^3)
Post-Development 2 year	2	10.08	7.31	Pass	87,120.001
Post-Development 100 year	100	21.39	13.65	Pass	217,800.003

Computed Volume Outflow (ft^3)	Computed Outflow Volume vs. Target	Routing Outlet Structure	Computed Max Water Elevation (ft)	Freeboard Depth	Maximum Storage (ft^3)
42,317.386	Pass	Composite Outlet Structure - 1	1,898.95	Pass	34,230.000
105,491.856	Pass	Composite Outlet Structure - 1	1,899.80	Pass	87,419.000



PondMaker Worksheet Detailed Report: OPTION 2 - INCREASE POND HEIGHT

Element Details	
ID	43
Label	OPTION 2 - INCREASE POND HEIGHT
Select Pond to Design	PO-2
Flow Allowed Below Target	80.0
Flow Allowed Above Target	0.0
Flow Allowed Below Target	80.0
Flow Allowed Above Target	10.0
Volume Allowed Below Target	80.0
Volume Allowed Above Target	80.0
Tolerance Display	Display PASS for values within specified tolerance

Notes

Volume

Pond Type	Elevation-Volume	Use Void Space?	False

Elevation-Volume

Pond Elevation (ft)	Pond Volume (ft^3)
1,896.45	0.000
1,897.00	30,637.500
1,898.00	95,786.520
1,899.00	164,916.800
1,900.00	238,133.410

Infiltration

Infiltration Method	No Infiltration

Output

Detention Time	None

Initial Conditions

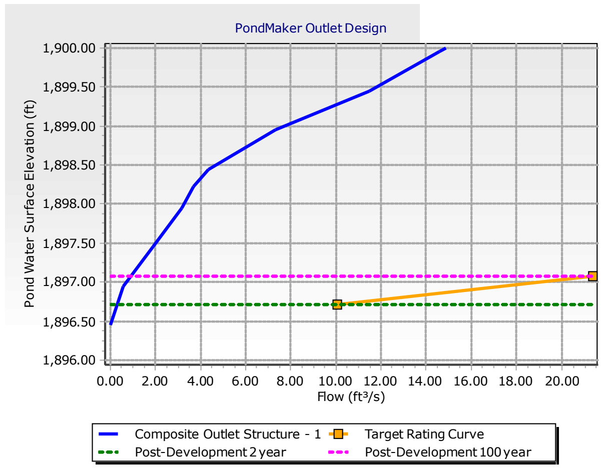
Is Outflow Averaging On?	False	Define Starting Water Surface Elevation	Pond Invert

PondMaker Worksheet Detailed Report: OPTION 2 - INCREASE POND HEIGHT

PondMaker Worksheet (Outlet Design)

Design Scenario	Design Return Event	Target Peak Outflow (ft^3/s)	Target Outflow Volume (ft^3)	Peak Pond Inflow (ft^3/s)	Total Inflow Volume (ft^3)
Post-Development 2 year	2	10.08	87,120.001	18.49	18,722.000
Post-Development 100 year	100	21.39	217,800.003	36.60	46,113.000

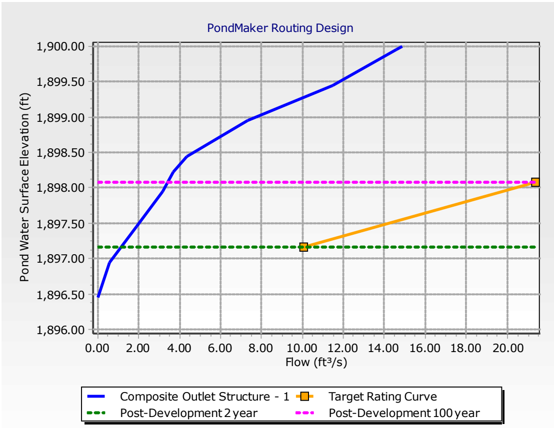
Estimated Storage (ft^3)	Estimated Max Water Surface Elevation (ft)	Estimated Freeboard Depth	Design Outlet Structure	Estimated Peak Outflow (ft^3/s)	Estimated Peak Outflow vs. Target
14,311.786	1,896.71	Pass	Composite Outlet Structure - 1	3.90	Pass
35,791.626	1,897.08	Pass	Composite Outlet Structure - 1	7.73	Pass



PondMaker Worksheet Detailed Report: OPTION 2 - INCREASE POND HEIGHT

PondMaker Worksheet (Routing Design)

Design Scenario	Design Return Event	Target Peak Outflow (ft³/s)	Computed Peak Outflow (ft³/s)	Computed Peak Outflow vs. Target	Target Outflow Volume (ft³)	Computed Volume Outflow (ft³)	Computed Outflow Volume vs. Target	Routing Outlet Structure	Computed Max Water Elevation (ft)	Freeboard Depth	Maximum Storage (ft³)
Post-Development 2 year	2	10.08	1.12	Fail	87,120.001	35,100.717	Pass	Composite Outlet Structure - 1	1,897.16	Pass	41,038.000
Post-Development 100 year	100	21.39	3.41	Fail	217,800.003	92,637.006	Pass	Composite Outlet Structure - 1	1,898.08	Pass	101,390.000

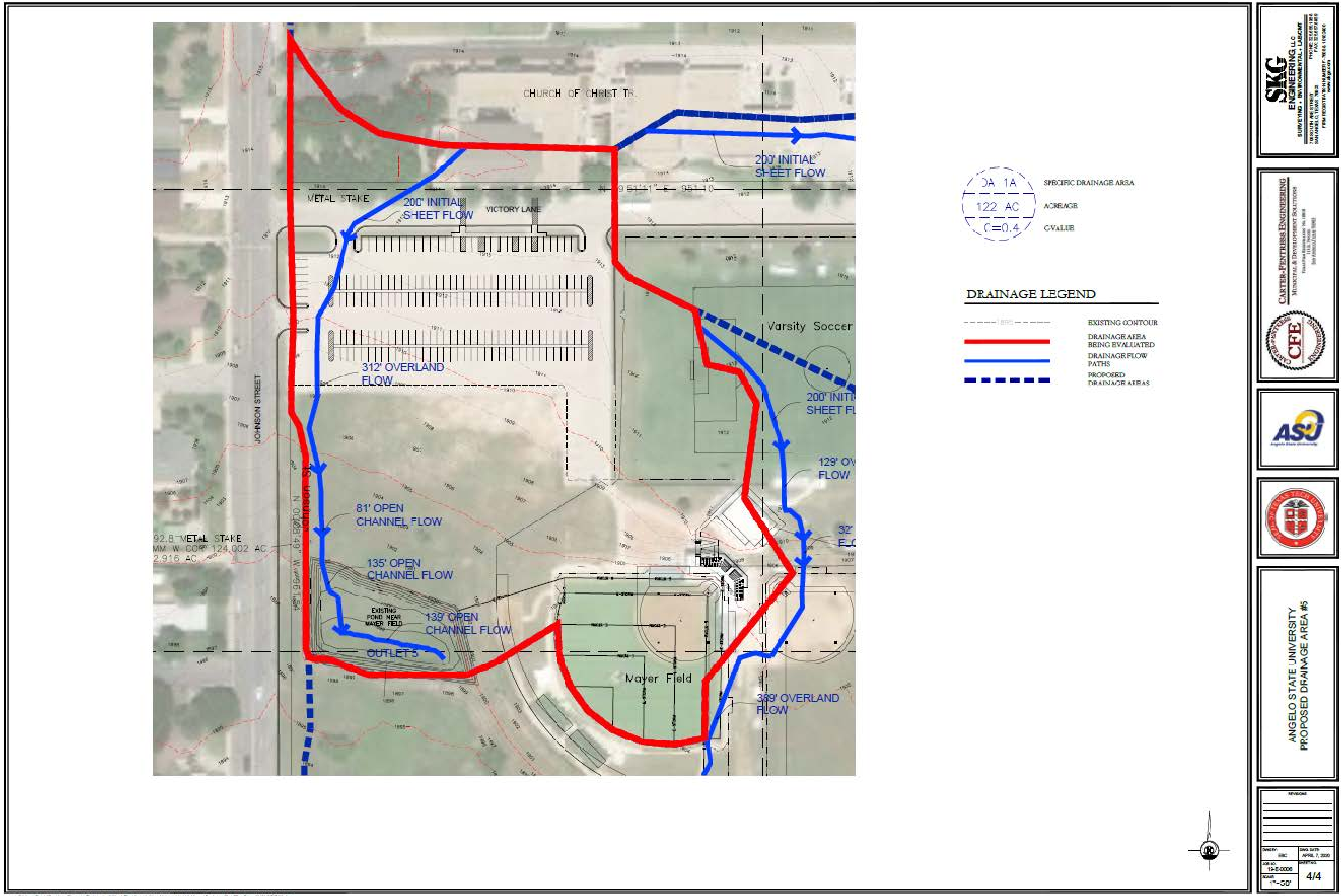


ATTACHMENT IV

PROPOSED DETENTION POND DESIGNS

NEAR MAYER FIELD

CARTER-FENTRESS ENGINEERING



Due to large image file, some fonts may be illegible. For a higher resolution copy please contact Facilities Planning and Construction.

RATIONAL METHOD: DEVELOPED CONDITIONS

Project Description: Angelo State Univeristy
San Angelo, Texas

Project No.: 1110

* TAKEN FROM CITY OF SAN ANGELO DRAINAGE MANUAL

** REFER TO DRAINAGE AREA MAPS

	UNITS USED
LENGTH	FT
T_C	MINS
VELOCITY	FT/SEC

1) VELOCITY (OVERLAND FLOW) $V = C\sqrt{S}$

2) TIME OF CONCENTRATION $T_C = L/(V \times 60)$

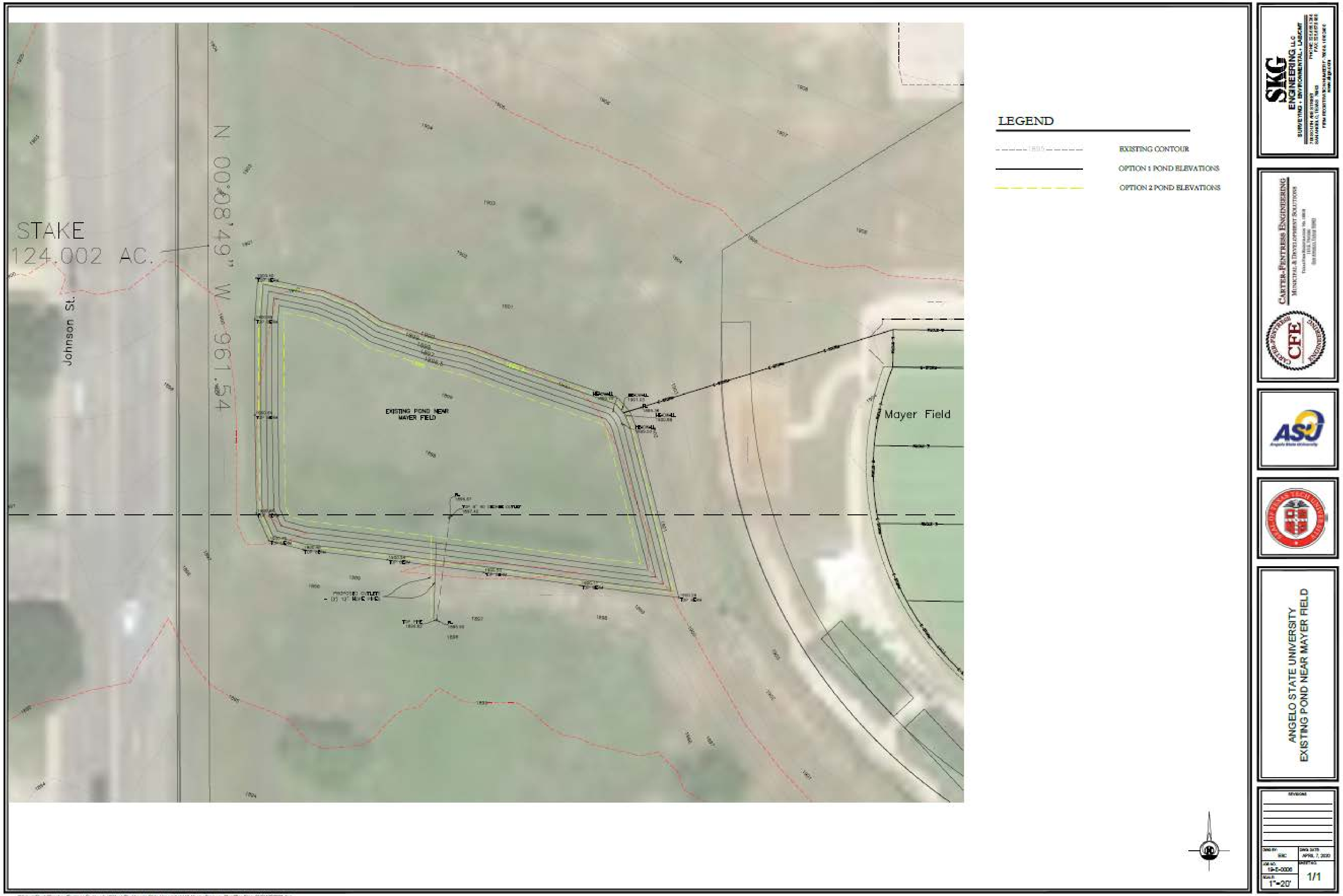
3) VELOCITY (OPEN CHANNEL FLOW) $V = \frac{1.49 \times R^{\frac{2}{3}} \times \sqrt{S}}{n}$

TOTAL DA 5

Step		K	C	Rainfall Intensity, I=b/(Td+d)^e					A	Qpeak
				b	d	e	Tc	I (in/hr)	(acres)	(cfs)
	2-YR	1.00	0.85	53.5	10.3	0.865	12.8	3.54	8.7	26.3
	100-YR	1.00	0.85	112.5	14.7	0.816	12.8	7.53	8.7	55.9

	INITIAL SHEET FLOW		OVERLAND FLOW					OPEN CHANNEL FLOW						OPEN CHANNEL FLOW					
	**HYDRAULIC LENGTH (L)	*TIME OF CONCENTRATION (T_c) (Table 5-6)	**HYDRAULIC LENGTH (L)	**SLOPE (S)	*VELOCITY COEFFICIENT(C) (Table 5-7)	VELOCITY (V)	TIME OF CONCENTRATION (T_c)	**HYDRAULIC LENGTH (L)	HYDRAULIC RADIUS (R) (Estimated)	**SLOPE (S)	*MANNING'S COEFFICIENT (n) (Table 9-2)	VELOCITY (V)	TIME OF CONCENTRATION (T_c)	**HYDRAULIC LENGTH (L)	HYDRAULIC RADIUS (R) (Estimated)	**SLOPE (S)	*MANNING'S COEFFICIENT (n) (Table 9-2)	VELOCITY (V)	TIME OF CONCENTRATION (T_c)
DEVELOPED CONDITIONS	200	10	312	0.027	20	3.29	1.6	81	0.75	0.037	0.03	7.89	0.2	135	0.75	0.023	0.03	6.22	0.4

	OPEN CHANNEL FLOW							
	**HYDRAULIC LENGTH (L)	HYDRAULIC RADIUS (R) (Estimated)	**SLOPE (S)	*MANNING'S COEFFICIENT (n) (Table 9-2)	VELOCITY (V)	TIME OF CONCENTRATION (T_c)	Total Time of Concentration (MIN)	Total Time of Concentration (HRS)
DEVELOPED CONDITIONS	139	0.75	0.007	0.03	3.43	0.7	12.8	0.2



Due to large image file, some fonts may be illegible. For a higher resolution copy please contact Facilities Planning and Construction.

PondMaker Worksheet Detailed Report: OPTION 1 - EXPAND BOTTOM ELEV.

Element Details	
ID	43
Label	OPTION 1 - EXPAND BOTTOM ELEV.
Select Pond to Design	PO-2
Flow Allowed Below Target	80.0
Flow Allowed Above Target	0.0
Flow Allowed Below Target	80.0
Flow Allowed Above Target	10.0
Volume Allowed Below Target	80.0
Volume Allowed Above Target	80.0
Tolerance Display	Display PASS for values within specified tolerance

Notes

Volume

Pond Type	Elevation-Volume	Use Void Space?	False

Elevation-Volume

Pond Elevation (ft)	Pond Volume (ft³)
1,896.50	0.000
1,897.00	7,774.180
1,898.00	24,907.900
1,899.00	43,690.810
1,900.00	64,186.730

Infiltration

Infiltration Method	No Infiltration

Output

Detention Time	None

Initial Conditions

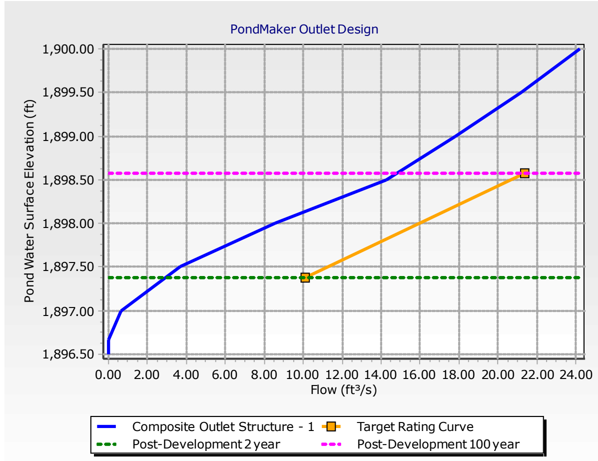
Is Outflow Averaging On?	False	Define Starting Water Surface Elevation	Pond Invert

PondMaker Worksheet Detailed Report: OPTION 1 - EXPAND BOTTOM ELEV.

PondMaker Worksheet (Outlet Design)

Design Scenario	Design Return Event	Target Peak Outflow (ft³/s)	Target Outflow Volume (ft³)	Peak Pond Inflow (ft³/s)	Total Inflow Volume (ft³)
Post-Development 2 year	2	10.08	87,120.001	18.49	18,722.000
Post-Development 100 year	100	21.39	217,800.003	36.60	46,113.000

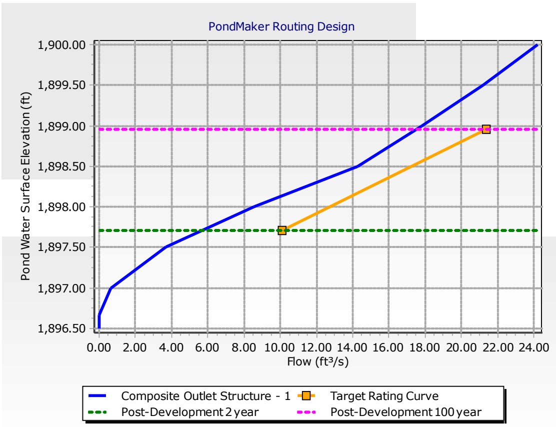
Estimated Storage (ft³)	Estimated Max Water Surface Elevation (ft)	Estimated Freeboard Depth	Design Outlet Structure	Estimated Peak Outflow (ft³/s)	Estimated Peak Outflow vs. Target
14,311.786	1,897.38	Pass	Composite Outlet Structure - 1	2.62	Pass
35,791.626	1,898.58	Pass	Composite Outlet Structure - 1	5.04	Pass



PondMaker Worksheet Detailed Report: OPTION 1 - EXPAND BOTTOM ELEV.

PondMaker Worksheet (Routing Design)

Design Scenario	Design Return Event	Target Peak Outflow (ft³/s)	Computed Peak Outflow (ft³/s)	Computed Peak Outflow vs. Target	Target Outflow Volume (ft³)	Computed Volume Outflow (ft³)	Computed Outflow Volume vs. Target	Routing Outlet Structure	Computed Max Water Elevation (ft)	Freeboard Depth	Maximum Storage (ft³)
Post-Development 2 year	2	10.08	5.77	Pass	87,120.001	21,529.957	Pass	Composite Outlet Structure - 1	1,897.71	Pass	20,001.000
Post-Development 100 year	100	21.39	17.51	Pass	217,800.003	57,399.028	Pass	Composite Outlet Structure - 1	1,898.96	Pass	42,944.000



detention pond design.ppc
2/28/2020

Bentley Systems, Inc. Haestad Methods Solution Center
27 Siemon Company Drive Suite 200 W
Watertown, CT 06795 USA +1-203-755-1666

Bentley PondPack V8i
[08.11.01.56]
Page 3 of 3

PondMaker Worksheet Detailed Report: OPTION 2 - INCREASE POND HEIGHT

Element Details	
ID	43
Label	OPTION 2 - INCREASE POND HEIGHT
Select Pond to Design	PO-2
Flow Allowed Below Target	80.0
Flow Allowed Above Target	0.0
Flow Allowed Below Target	80.0
Flow Allowed Above Target	10.0
Volume Allowed Below Target	80.0
Volume Allowed Above Target	80.0
Tolerance Display	Display PASS for values within specified tolerance

Notes

Volume

Pond Type	Elevation-Volume	Use Void Space?	False

Elevation-Volume

Pond Elevation (ft)	Pond Volume (ft³)
1,896.50	0.000
1,898.00	5,086.500
1,899.00	14,543.190
1,900.00	31,793.070
1,901.00	54,065.830
1,902.00	78,179.250

Infiltration

Infiltration Method	No Infiltration

Output

Detention Time	None

Initial Conditions

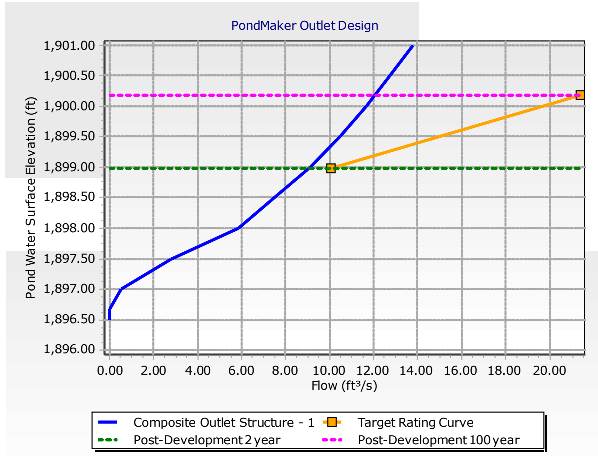
Is Outflow Averaging On?	False	Define Starting Water Surface Elevation	Pond Invert

PondMaker Worksheet Detailed Report: OPTION 2 - INCREASE POND HEIGHT

PondMaker Worksheet (Outlet Design)

Design Scenario	Design Return Event	Target Peak Outflow (ft³/s)	Target Outflow Volume (ft³)	Peak Pond Inflow (ft³/s)	Total Inflow Volume (ft³)
Post-Development 2 year	2	10.08	87,120.001	18.49	18,722.000
Post-Development 100 year	100	21.39	217,800.003	36.60	46,113.000

Estimated Storage (ft³)	Estimated Max Water Surface Elevation (ft)	Estimated Freeboard Depth	Design Outlet Structure	Estimated Peak Outflow (ft³/s)	Estimated Peak Outflow vs. Target
14,311.786	1,898.98	Pass	Composite Outlet Structure - 1	2.62	Pass
35,791.626	1,900.18	Fail	Composite Outlet Structure - 1	5.04	Pass

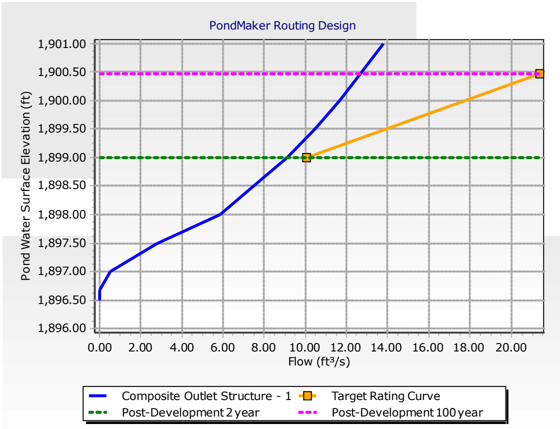


PondMaker Worksheet Detailed Report: OPTION 2 - INCREASE POND HEIGHT

PondMaker Worksheet (Routing Design)

Design Scenario	Design Return Event	Target Peak Outflow (ft³/s)	Computed Peak Outflow (ft³/s)	Computed Peak Outflow vs. Target	Target Outflow Volume (ft³)
Post-Development 2 year	2	10.08	9.13	Pass	87,120.001
Post-Development 100 year	100	21.39	12.72	Pass	217,800.003

Computed Volume Outflow (ft³)	Computed Outflow Volume vs. Target	Routing Outlet Structure	Computed Max Water Elevation (ft)	Freeboard Depth	Maximum Storage (ft³)
23,596.991	Pass	Composite Outlet Structure - 1	1,899.01	Pass	14,636.000
59,466.156	Pass	Composite Outlet Structure - 1	1,900.48	Pass	42,396.000



Student Housing Report

The Existing Residence Halls

The existing residence halls are in good condition with the exception of Concho Hall, which is scheduled for major renovation upon the completion of the Food Service Center renovation project. The three largest halls were built within the last 15 years, Texan Hall (2003), Centennial Village (2008) and Plaza Verde (2011). Additionally, 162 new beds were added to Centennial Village in the summer of 2018. Over 1,600 beds are in effectively new facilities. Unlike most peer institutions in the region, Angelo State University is able to provide a high quality program in generally consistently high quality facilities. The current inventory is well distributed between unit type and price point to meet current need with planned growth to meet anticipated demand and provide flexibility.

Both Texan Hall and Centennial Village offer private bedrooms for residents with Texan Hall offering two bedroom units and Centennial Village offering both two bedroom and four bedroom options. Between those two halls, over 1,300 students on the Angelo State University campus are able to have private bedroom residence hall assignments. Residents of Plaza Verde, Mary Massie and Robert Massie Halls share a double room and a single bathroom. Carr Hall residents share a double room suited by a bathroom to another double room. Once completed, Concho Hall will feature private bedrooms and a floor plan similar to Texan Hall or Centennial Village.

Vanderventer Apartments are two bedroom, one bathroom traditional apartments designed for upperclassmen or renewal students. They allow students to begin transitioning from living on campus to off-campus life while retaining all of the convenience and ties to campus that living on campus provides.

ASU Residential Programs are dedicated to providing several living learning communities (LLC) including Honors, Agriculture, Student Leadership, Outdoor Adventures, and Engineering. These specialized communities offer roommates with shared interests and extensive programming designed to assure student success and interaction. LLCs allow residents to move the knowledge they learn in the classroom into their living environment and into real world application.

Peer Institutions

All peers, with limited exception, require first-time students to reside on campus. On-campus requirements are very similar to ASU with age and commuting radius exemptions. As other peer institutions are planning new construction, designs are skewing toward student privacy and attempts to integrate technology.

San Angelo Housing Market Observations

The demographics of the area of San Angelo within a five-mile radius of the University suggest a stable, growing population. San Angelo has consistently been ranked by many publications and rankings as one of the best small cities for business and employment. San Angelo has a diverse economy for a city of its size and because of the strong ties to the oil industry the private housing market prices, particularly rentals, have rapidly increased over the past several years. There are private complexes marketed to oilfield workers, military or university students who keep their costs in line with on-campus housing prices.

University Goals

The University has set a goal to achieve an enrollment of 14,000 by the year 2028. In tandem with this University goal, there is an internal Housing goal to increase the retention of upperclassmen in on-campus housing as well as support the First-Year Experience initiative. Specific measurable goals include:

- Increase sophomore retention to 65%
- House 70% of all freshmen and sophomores on campus by 2028
- House 7% of all juniors on campus by 2028
- House 5% of all seniors on campus by 2028

Demand Analysis

Moving forward, upon the completion of the renovation of Concho Hall, the University administration has expressed interest in pursuing a two-year live-on requirement for ASU students. Concho Hall is scheduled to be renovated in stages and beds to be released in phases. This incremental increase in bed pace should meet anticipated enrollment increases but not necessarily allow for a mandatory two-year live-on requirement.

Financial Analysis

Careful analysis of debt service, fund balance and projected occupancy will be carried out prior to any new construction or renovation project.

Development Opportunities

Modifications to Existing Residence Halls

Renovate Concho Hall- Completely refurbish the plumbing, HVAC and electrical systems within the high-rise and then reconfigure the rooms to a private room floor plan that will provide a low-cost private bedroom option for students and maintain a University landmark building.

Construct "Connector" between Robert and Mary Massie Halls –Robert and Mary Massie Halls each offer a limited range of support areas. The construction of a connecting building between these halls could provide an opportunity to upgrade the package of amenities offered in these older buildings as well as potentially provide a location for additional rooms, an Area Coordinator apartment and an elevator that would address ADA compliance.

Additions to Existing Residence Halls

There is space and infrastructure to add 3 additional standalone buildings to the Plaza Verde complex. These buildings are to be supported by the Plaza Verde clubhouse and would each hold an additional 100 beds. These beds could be configured in the same manner as in existing Plaza Verde rooms or private rooms could be offered, reducing the number of beds added.

There is also space to add another separate wing to the Texan Hall complex between the existing complex and the Junell Center.

Acquisitions

The acquisition of existing housing properties presents several difficult dilemmas. The only mandated and historically significant demonstrated demand for housing is provided by freshman and sophomore students. However, these students require the most significant support from the University and are least suited to reside in a potential acquisition. Even if purchased at a favorable price, it would be difficult and expensive to provide a service level consistent with existing facilities offsite.

ANGELO STATE UNIVERSITY
MEMBER, TEXAS TECH UNIVERSITY SYSTEM

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