4 Appendix

Approach

To understand the impact of potential moves to UTSA, JLL employed the following approach

1 Update Demographic Analysis

- Review and update student enrollment and demographic trends
- Identify current on-campus residents from CACC programs, COEHD, and SDS
- Incorporate enrollment projections for these programs / colleges

2 Revise Housing Demand Projections

- Update main campus housing demand projections
- Quantify the number of beds freed up by COEHD, SDS, and CACC programs' student relocation

3 Evaluate College Relocation Impact

- Determine the number of students relocating to the downtown campus
- Analyze the effect of moving the COEHD and CACC programs to the downtown campus, including the impact on main campus housing demand

4 Refine Housing Master Plan

- Update proposed projects based on new demand projections
- Revise phasing framework from the 2022 master plan
- Align housing strategy with UTSA's downtown campus expansion goals

Housing Master Plan Framework

Target Market

Who is the intended target market and what are the drivers behind a live-on requirement?

- Improve student success in retention and graduation
- Foster campus community
- Support at-risk students
- **Prioritize housing for professional and graduate students downtown, including the College of Data Science and the College of Education and Human Development**

Residential Experience

How can UTSA integrate the academic and residential experiences?

- **Transform downtown to a residential campus by integrating the academic and residential experience**
- Place students in appropriate housing based on student levels
- **Create a consistent experience across all UTSA housing options and campuses**

Campus Context

How does student housing integrate with UTSA's campuses?

- Provide dining opportunities to support additional on-campus residents
- **Develop housing for students downtown to support program migration downtown and continued enrollment growth**

Finance

What are UTSA's financial objectives?

- Keep rent affordable to promote accessibility while balancing UTSA's financial stewardship objectives
- UT System finance for main campus
- **Explore partnership opportunities for downtown**

Key Questions and Summary of Findings

JLL

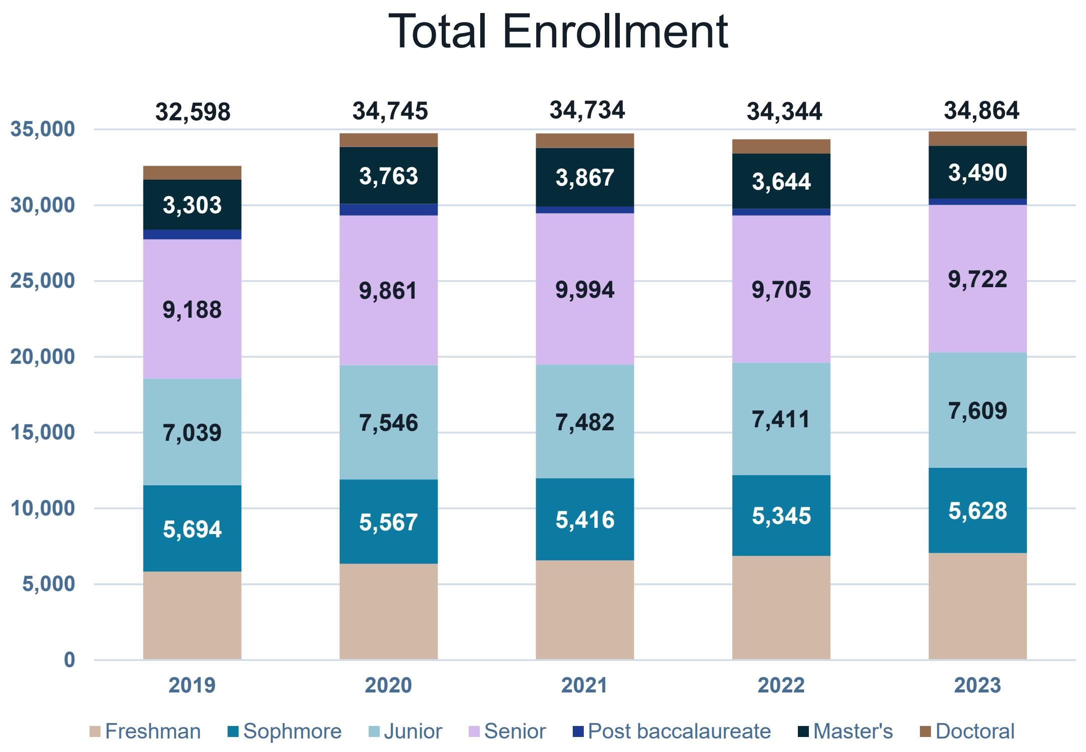
Is there enrollment growth to support additional housing?	What is UTSA doing to support additional housing on main campus and downtown?	Does the downtown housing market pose a risk to development of UTSA student housing?	What is the impact to demand for housing if the colleges are relocated?
UTSA is experiencing rapid growth, with enrollment up by over 2,000 students since 2019. This has sparked **increased demand for on-campus housing**, especially for first year students. The university is prioritizing housing development and **considering relocating two colleges to its downtown campus.**	**UTSA is expanding its student housing capacity in response to growing demand.** The university's 2021 multi-phase plan includes the 591-bed Blanco Hall, set to open in 2025. However, UTSA is now **prioritizing housing development for its downtown campus, which may alter the original plan's timeline** and scope as the university balances needs across both campuses.	UTSA's **downtown campus faces competition from nearby multifamily housing** developments, with over 2,700 new beds added since 2019. While this growth challenges on-campus housing demand**, the scarcity of purpose-built student accommodations presents an opportunity for UTSA to develop downtown student housing**.	The planned relocation to downtown has a significant impact on campus housing dynamics. With 8,930 students moving their primary academic activities downtown, 623 on-campus beds will be affected. This shift creates an immediate demand for 400-600 beds in the downtown area, while simultaneously freeing up space on the main campus. To foster a vibrant student presence downtown, it's **crucial to address this increased housing need.**

Housing Study

Enrollment Trends – 2019-2023

JLL

- UTSA has experienced 7% enrollment growth since 2019
- Among undergraduate students, Freshman enrollment has increased 21%
- Enrollment at the downtown campus increased to 1,079
- Consistent enrollment growth supports additional demand for on-campus housing



Campus	2019	2020	2021	2022	2023	Variance
Main	28,333	34,550	31,973	31,069	31,132	10%
Downtown	2,296	41	489	873	1,079	-53%
Both	1,965	151	2,272	2,402	2,653	35%
Total	**32,594**	**34,742**	**34,734**	**34,344**	**34,864**	**7%**

* 2020 numbers reflect the onset of the COVID-19 Pandemic

71%
Of Students are Enrolled Full Time

7%
Undergraduate Enrollment Growth (2019-2023)

21%
Freshman Enrollment Growth (2019-2023)

Enrollment By College

JLL

- Despite overall enrollment growth, only the Colleges of Business, Sciences, and Engineering have experienced growth since 2019

Enrollment by College

College	2019	2020	2021	2022	2023	Variance
Business	5,709	5,664	6,407	7,574	7,841	37%
Education and Human Development	2,364	2,365	2,311	2,185	1,956	-17%
Engineering and Integrated Design	4,003	4,278	4,241	4,149	4,199	5%
Health, Community and Policy	6,477	6,812	6,720	6,424	6,249	-4%
Liberal and Fine Arts	4,513	4,656	4,299	4,005	3,905	-13%
Other	251	263	208	199	193	-23%
Sciences	4,232	4,960	5,532	5,287	6,190	46%
University College	5,045	5,744	5,016	3,982	4,333	-14%
Total	**32,594**	**34,742**	**34,734**	**33,805**	**34,866**	**7%**

UTSA Housing Portfolio

- UTSA's housing portfolio provides a mix of unit types to accommodate a wide variety of students

- The high proportion of single-occupancy units, and the ability to gain more privacy and independence as one matriculates through housing, is a competitive advantage for UTSA

- The delivery of Blanco Hall in 2025 with 591 traditional units (293 singles and 298 doubles) will address the current shortage of accommodations best geared toward first-year students.

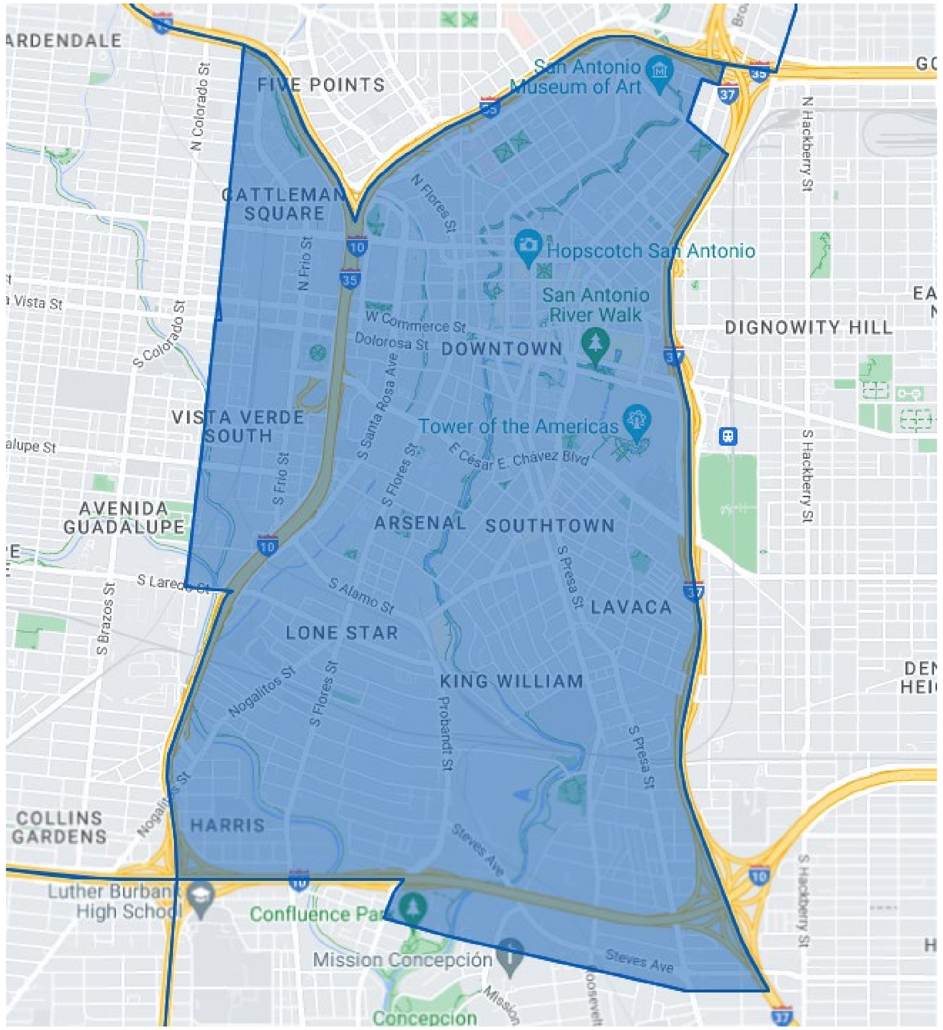
4,589
Total Beds

1.4m
GSF of Residential Space

590
Beds are currently under construction

Off-Campus Market Analysis

Downtown Market Area



7,077	$1,562	318
Total Units	Asking Rent / Unit	Units Under Construction
15%	**-1.4%**	**148**
Vacancy Rate	Average Rent Growth	Units Absorbed in Past 12 Months

The multi-family market in downtown San Antonio is soft due to new supply out pacing absorption

Competitive Projects / Pipeline

Downtown Market Area

- UTSA's downtown campus is situated near a substantial number of multifamily housing units, presenting a competitive challenge to on-campus student housing demand.
- Since 2019, nine "student competitive" multifamily projects have been completed in the downtown area, adding 2,754 beds to the market.
- Notable recent developments include 300 Main, offering 447 beds, and The Continental at 322 W Commerce, which will provide 290 mixed-income housing units.
- Despite this surge in downtown multifamily development potentially capturing some student housing demand, purpose-built student housing options in the area remain limited. This situation creates both challenges and opportunities for UTSA as it considers expanding its student housing offerings in the downtown campus area.

Housing Study

Housing Need with Anticipated Enrollment Growth

Blanco Hall
(Under Construction)

Project	First Year-Housing (Traditional)	First/Second-Year Housing (Semi-Suites)	First-Year Housing (Traditional)	First/Second-Year Housing (Semi-Suites)	Upper Class Housing (Apartments)
	1	2	3	4	5
Academic Year	2025	2027	2029	2031	2033
	+ 591 Beds $77.7M*	+ 400 Beds $68.8M*	+ 550 Beds $85.2M*	+ 350 Beds $70.3M*	+ 333 Beds $187.4M*

*Escalated to project year

Enrollment vs. On-Campus Supply

To quantify the impact on housing demand related to the potential move to the downtown campus, JLL completed the following tasks:

- Analysis of enrollment by College
- Analysis of on-campus residents by College
- Identification of on-campus residents by College

UTSA (2024)			
College / School	**2024 Enrollment**	**2024 On-Campus Residents**	**Capture Rate**
Data Science	320	12	4%
Business	7,645	410	5%
Education and Human Development	1,954	78	4%
Engineering and Integrated Design	3,296	281	9%
Architecture + Planning	902	73	8%
Health, Community and Policy	6,250	663	11%
Liberal and Fine Arts	3,904	363	9%
Sciences	6,190	716	12%
University College	4,210	659	16%
No College	193	1	1%
Total	**34,864**	**3,256**	**9%**

Colleges Moving Downtown

UTSA is expanding its downtown presence by relocating two colleges: the College of Education and Human Development (COEHD) and the newly formed College of AI, Cyber and Computing (CACC), which evolves from the School of Data Science. The CACC will incorporate programs from Information Systems & Cyber Security, Computer Science, Electrical & Computer Engineering, and Management Science and Statistics. This move affects 8,930 students, presenting both challenges and opportunities for student housing.

Current Colleges / Schools Downtown

- School of Architecture + Planning (SA+P)
- School of Data Science (SDS)

Locating to Downtown Campus

- COEHD *
- CACC
  - School of Data Science
  - Information Systems & Cyber Security
  - Computer Science
  - Electrical & Computer Engineering
  - Management Science and Statistics

Currently Located at Downtown Campus			
Schools / Colleges	Enrollment	On Campus	Capture
School of Architecture + Planning	902	73	8%
School of Data Science	193	12	6%
TOTAL	**1,095**	**85**	**8%**

Moving to Downtown Campus			
Schools / Colleges	Enrollment	On Campus	Capture
College of Education and Human Development	1,920	77	4%
Programs	**Enrollment**	**On Campus**	**Capture**
Information Systems & Cyber Security	2,425	153	6%
Computer Science	2,045	206	10%
Electrical & Computer Engineering	834	74	9%
Management Science and Statistics	611	28	5%
TOTAL	**7,835**	**538**	**7%**

* While a portion of the COEHD currently occupies the downtown campus, JLL has categorized COEHD as “Locating to Downtown Campus” for the purposes of this analysis

Impact

JLL

- With the addition of the COEHD and the newly formed CACC, 8,930 students will have their primary academic activities located at the Downtown campus.
- Out of 8,930 students enrolled in these colleges and programs moving downtown, 623 currently live on campus.
- Thus, their relocation will free up 623 beds in the main campus housing while creating an immediate demand for 400-600 beds downtown.

Currently Located at Downtown Campus			
Schools / Colleges	**Enrollment**	**On Campus**	**Capture**
School of Architecture + Planning	902	73	8%
School of Data Science	193	12	6%
TOTAL	**1,095**	**85**	**8%**

Moving to Downtown Campus			
Schools / Colleges	**Enrollment**	**On Campus**	**Capture**
College of Education and Human Development	1,920	77	4%
Programs	**Enrollment**	**On Campus**	**Capture**
Information Systems & Cyber Security	2,425	153	6%
Computer Science	2,045	206	10%
Electrical & Computer Engineering	834	74	9%
Management Science and Statistics	611	28	5%
TOTAL	**7,835**	**538**	**7%**

Net Impact			
Schools / Colleges / Programs	**Enrollment**	**On Campus**	**Capture**
TOTAL	**8,930**	**623**	**7%**

Capture Rate Projection

Using enrollment projection data for the four programs comprising UTSA's CACC, JLL analyzed the projected student population moving downtown and their on-campus housing needs. Important to note, the data provided for 2024 varies slightly from the other sources utilized in JLL's broader analysis.

- Enrollment projections for UTSA's Downtown Campus show a total increase from 8,737 students in 2024 to 9,871 students in 2026.
- On-campus living enrollment for these programs was calculated using a consistent capture rate from 2024, resulting in projections of 659 students in 2025 and 693 students in 2026.
- JLL recommends a project of 400-600 beds to accommodate the projected on-campus living demand from the relocating programs.

2024			
Moving Downtown	Enrollment	On Campus	Capture
Information Systems & Cyber Security	2,425	153	6%
Computer Science	2,045	206	10%
Electrical & Computer Engineering	834	74	9%
Management Science and Statistics	611	28	5%
Architecture + Planning	902	73	8%
Education and Human Development	1,920	77	4%
TOTAL:	**8,737**	**611**	**7%**

2025			
Moving Downtown	Enrollment	On Campus	Capture
Information Systems & Cyber Security	2,728	172	6%
Computer Science	2,282	230	10%
Electrical & Computer Engineering	848	75	9%
Management Science and Statistics	703	32	5%
Architecture + Planning	902	73	8%
Education and Human Development	1,920	77	4%
TOTAL:	**9,383**	**659**	**8%**

2026			
Moving Downtown	Enrollment	On Campus	Capture
Information Systems & Cyber Security	2,978	188	6%
Computer Science	2,401	242	10%
Electrical & Computer Engineering	854	76	9%
Management Science and Statistics	816	37	5%
Architecture + Planning	902	73	8%
Education and Human Development	1,920	77	4%
TOTAL:	**9,871**	**693**	**8%**

Note: Due to data constraints, 2025-2026 on-campus enrollment projections were unavailable for programs beyond the four CACC programs. Consequently, our analysis includes static 2024 figures for Architecture + Planning and Education and Human Development programs to project future demand.

20 |

Housing Need Considering Potential Moves

Potential Downtown Housing

	1	2	3	4	5
Project	First Year-Housing (Traditional)	Downtown Campus Housing (Mix of Unit Types)	First-Year Housing (Traditional)	First/Second-Year Housing (Semi-Suites)	Upper Class Housing (Apartments)
Academic Year	2025	2027	2029	2031	2033
	+ 591 Beds	+ 400-600 Beds	+ 550 Beds	+ 350 Beds	+ 333 Beds

JLL Recommendation: UTSA's next housing project should prioritize the Downtown Campus, developing 400-600 beds with a mix of unit types by 2027. This strategic focus addresses the immediate need for downtown student housing, aligning with UTSA's campus expansion plans and supporting the growing student population in the urban core.

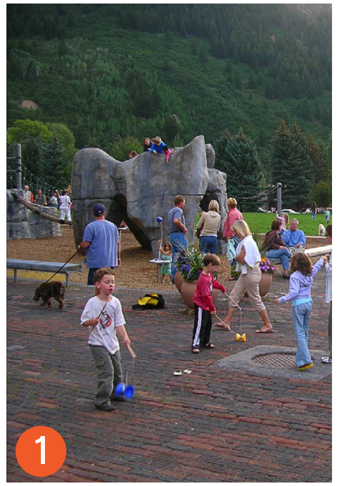
Next Steps

1. Align on which colleges are moving downtown
2. Determine appropriate housing types for downtown campus
3. Evaluate need for additional student services downtown (e.g., dining facilities)
4. Consider master-lease options to build immediate downtown community
5. Explore opportunities for UT Health students to reside downtown
6. Analyze transportation needs between main campus and downtown location
7. Begin the planning process to deliver the new beds

4.1 Downtown Campus

Downtown Placemaking Program Ideas

Buena Vista

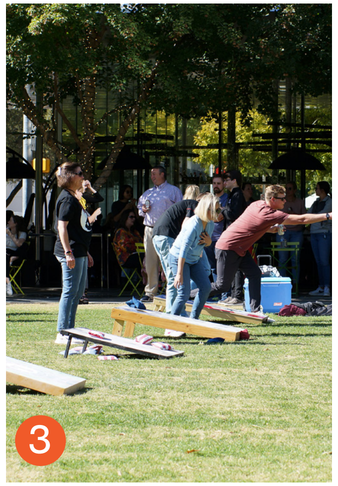


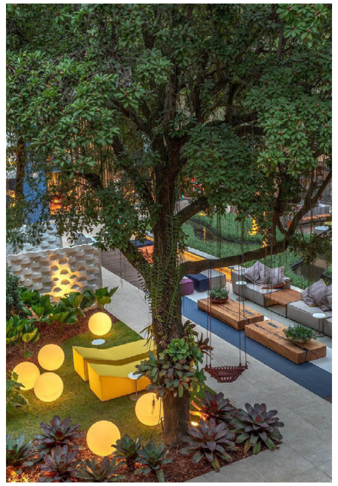
1. Family pocket park

- Bouldering play
- Kids Campus play area
- Photo booth
- Water play
- Ice cream
- Climbable Sculpture

2. Sanctuatry / Refuge

- Sheltered, quiet space
- Sensory Garden
- All ages
- Neuro divergence
- De-stress



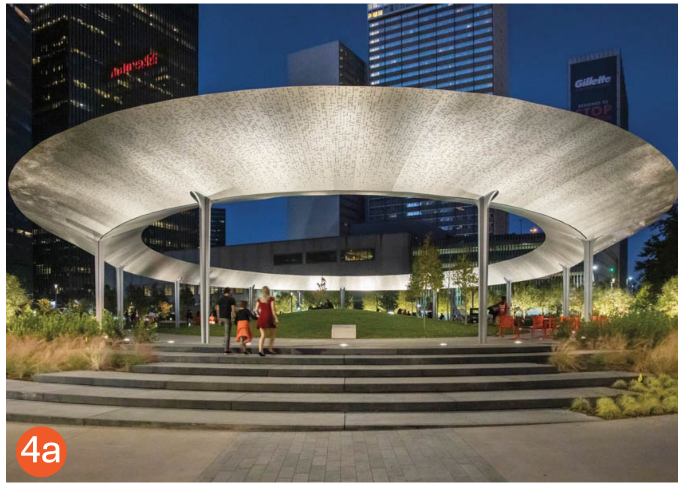


3. Central Cooling Plaza

- Refurnish existing terrace with better amenities
- Maximize areas under trees
- Coffee kiosk
- Art installations

Downtown Placemaking Program Ideas

Buena Vista



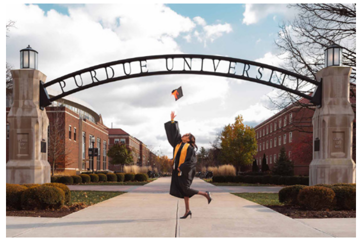
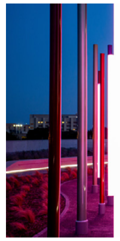


4a. Pavillion

- Rentable flexible space
- UTSA Welcome Desk
- Dramatic light treatment that reinforces sense of safety
- Pavilion integrated with Student Plaza

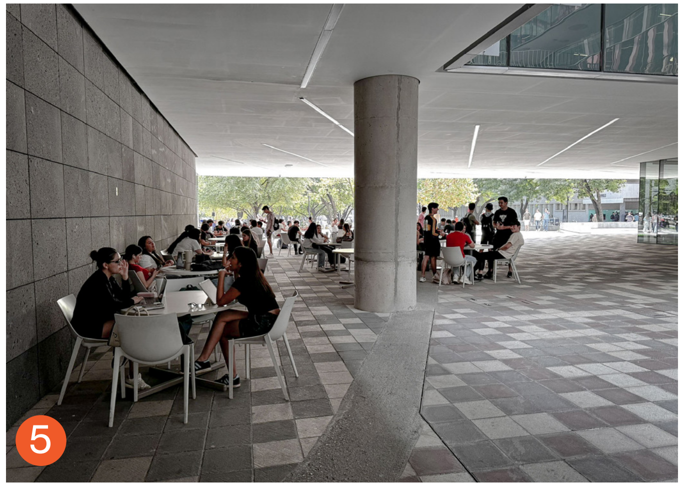




4b. Student Plaza

- Nighttime activity - reinforce safety
- Art lighting
- Bill Miller BBQ events
- Food kiosk/food truck
- Tabling promenade



5. Breezeway Plaza

- Utilize breezeway as protected outdoor lounge

Downtown Placemaking Program Ideas

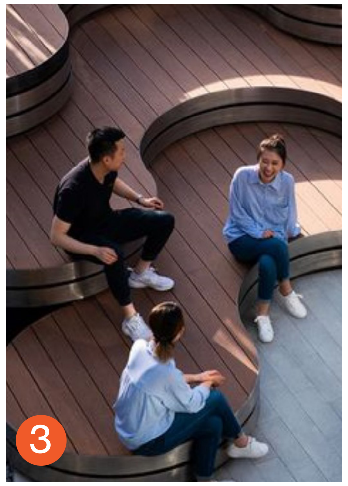
Buena Vista

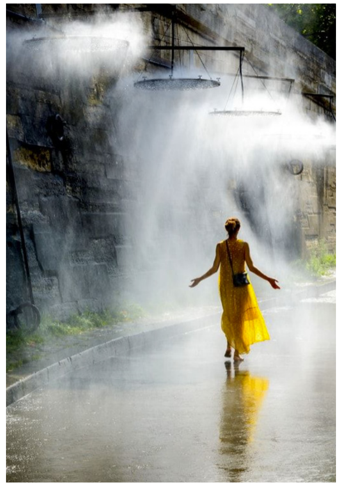
1. F&B Hub and Surrounding Gardens

- Indoor-outdoor F&B
- Maximize seating under trees
- Adjacent beer garden and pocket meeting rooms, mixing business with pleasure

2. Flex, Performance Lawn

- Flexible lawn for events, performance, movies, receptions
- Projection wall
- Weekly DJ party



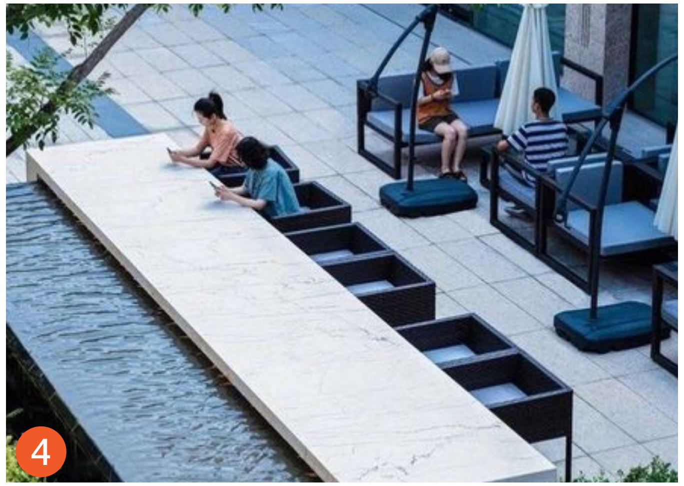


3. Quiet, Cooling Overlook to Creek

- Lounge seating
- Elevated bleacher seating
- Swings or swing benches
- Water you can touch
- Soothing soundscape
- Guided meditations

Downtown Placemaking Program Ideas

Buena Vista



4. Gateway & Pocket Study Area

- Furnished space oriented to outdoor classes and study nooks
- "Harry Potter" portal into space from plaza

5. Community Plaza

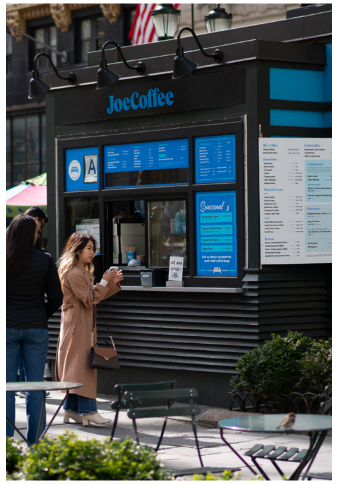
- Family friendly meeting spot
- Bright colors and umbrellas
- Hangout for chess club
- Games & kids' Reading Room
- Kids programs & stroller parking
- Bi-lingual story panels about UTSA students
- "Harry Potter" portal into pocket study area

6. Gateway

- Attractive gateway treatment leading down a pedestrian street
- Use of art and art lighting as an attraction

Downtown Placemaking Program Ideas

Buena Vista

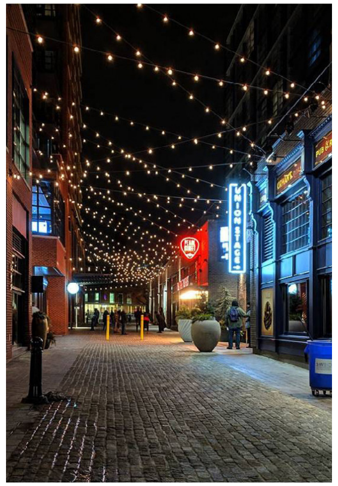


7. Welcome Center / Student Life hub

- Busy entrance to SP campus and student meeting place
- UTSA Welcome Center and tour starting point
- Student bulletin board
- Food trucks along street
- Interactive art wall

8. SPII Building Plaza

- Outdoor lounge oriented to building tenants and professionals, but open to anyone
- Fire pit to encourage lingering and conversation



9. Rec Alley

- Pocket-sized recreation amenity
- Putting green
- Ping pong and other games
- Artistic treatment to alley, possibly managed by Centro

Downtown Placemaking Program Ideas

Buena Vista

10. Creek "Beach"

- Beach-like amenities
- Reversible to ease approval by SARA/ COSA
- True college scene that attracts attention & sells UTSA Downtown

11. Santa Rosa Building

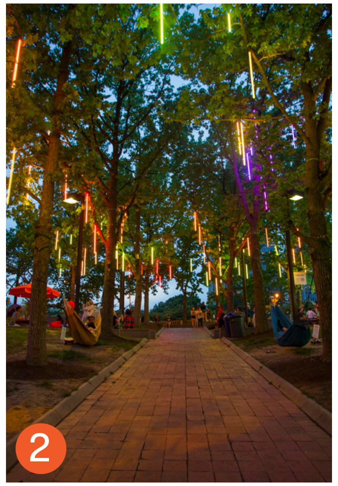
- Retail along entire Dolorosa frontage: bowling alley + Rowdy store, thrift store, or other retail
- Climbing wall on Dolorosa side
- On S. Laredo, at building entrance, a co-work space and art gallery

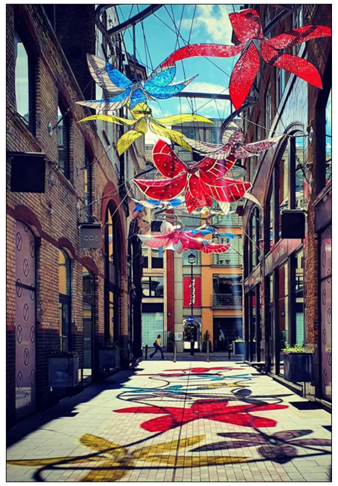
Downtown Placemaking Program Ideas

Buena Vista

1. Art Yard

- Outdoor hangout, studio, and space for events and games
- Activated by Pavilion offering food and gallery space
- Nighttime parties and performances





2. Frost Gardens

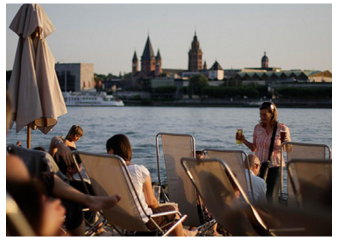
- Rentable for small events
- Used by students and student orgs
- Seasonal “Hammock Park” art installation
- Other rotating art installations

3. McNutt River Gardens

- Rentable by the community for weddings and other events
- Used by UTSA for graduations and events

Downtown Placemaking Program Ideas

Buena Vista

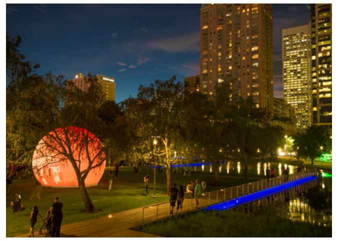



4. River Walk Frontage

- Activated with light-weight movable furniture
- Mister installation as student art project using inexpensive materials like PVC
- Expand steps down to River Walk








5. ORP Sculpture Garden

- Publicly accessible sculpture park with artistic seating
- Rotating artworks from the UTSA collection plus commissions
- UTSA branded “must-see” attraction in San Antonio

6. Mixed-Use Complex Navarro Plaza

- UTSA Film Center to support the film program and strengthen downtown student life
- Art supply store or other retail

Downtown MEP Assessment

The University of Texas at San Antonio Downtown Campus MEP Report September 05, 2025

Downtown Campus

The Downtown Campus currently consists of three districts: Buena Vista, San Pedro and Southwest. The long-term plan is not only to expand these districts, but to also increase the campus to include the relocation of the Institute of Texan Cultures (ITC) and the HEM program at the Convention Center.

Each of the districts and other areas listed have different methods to provide cooling, heating, and electricity to each of its' buildings. Each of these methods will be described below.

Executive Summary

Buena Vista District

Electrical – The current CPSE electrical service feeding the campus has enough spare capacity to handle the near-term and long-term expansions although additional medium voltage (MV) equipment and infrastructure will be required.

Mechanical - Provide an optimization module for the existing central plant building management system to have better controls, monitors, and data. Add Variable Speed drive(s) to phase 2 chiller to provide different capacity and unloading which will lead to energy savings.

Revise the hydronic header at the central plant and add motorized isolation valves for controlling the flow and isolation.

Theres is access capacity in the existing system to provide cooling for the Pavilion and Bill Miller Plaza 1.

Provide new hydronic piping connection, motorized valves, and cap for future to serve Academic Extension to Durango Building.

Provide and independent high efficiency chilled water and heating system to serve the housing and allow for future connections.

Expand the existing central plant and add New high efficiency heat rejection chillers with variable speed and associated pumps to serve the Academic Building at Bill Miller Plaza 2

During the design of the expansion, it is recommended to provide space for the future chillers and boilers and associated pumps to sever Buena Vista Academic at Cattleman Square Lot.

San Pedro District

Electrical - Currently, each of the two buildings is fed by a separate CPSE electrical service. Other than the expansion of one existing building, the rest of the expansion consists of non-adjacent spaces. Therefore, the most cost-effective and easiest approach is to provide a separate CPSE electrical service for each of the new buildings.

Mechanical – Provide a standalone high efficiency heat rejection air cooled chiller and a heating hot water boiler to support the cooling and heating system for the near-term Extension to San Pedro I Building. Provide a standalone high efficiency heat rejection air cooled chiller and a heating hot water boiler to support the cooling and heating system for the long -term San Pedro Mixed-Use Dolorosa and Santa Rosa Building. Provide a standalone direct expansion roof top unit to provide cooling and heating for the long -term Pavilion. Provide a standalone high efficiency heat rejection air cooled chiller and a heating hot water boiler to support the cooling and heating system for the long-term Academic Building at Kallison Block.

Southwest District

Electrical - Based on the size and potential electrical load of the planned mixed-use facility, a separate CPSE electrical service would be required. The new pavilion may require a new small electrical service if it cannot be fed from the existing Southwest School of Art.

Mechanical – Provide a standalone high efficiency heat rejection air cooled chiller and a heating hot water boiler to support the cooling and heating system for the near-term Southwest Mixed-Use Student housing and the Academic Building. Provide a standalone direct expansion roof top unit to provide cooling and heating for the long -term Pavilion.

Downtown MEP Assessment

Detailed Report

Electrical

Buena Vista District

The Bueno Vista campus is currently fed from one CPSE 15kV Switchgear that extends two 15kV CPSE utility feeders with two primary service meters into a campus owned medium voltage (MV) distribution system. The two MV feeders provide an electrical campus loop system with MV distribution switches that allow each building to be fed from either CPSE utility service. The current peak electrical campus load (per CPSE data) is **1682 kVA**. The maximum capacity of the system is **7473kVA** (15kV,300A).

Proposed near-term buildings

Per the study, the proposed near-term plan will consist of adding a student housing facility, an academic building, a parking garage, and a small pavilion while demolishing the existing parking garage. The new total estimated campus electrical load after the completion of the near-term plan will be approximately **3424kVA**.

Buena Vista Near Term					
Building Code	**Building Name**	**Primary Use**	**AREA (GSF.)**	**W/sq. ft**	**kW**
Existing	Durango Bldg/Frio Bldg/Buena Vista Bldg/CEP/Parking Garage	Academic/parking/Utility	**416830**		**1682.0**
Demolition	Existing Parking Garage	Parking Garage	-139900	1.00	**-139.9**
BV-G	Buena Vista Parking Garage	Parking Garage	416,000	1.00	**416.0**
BV-H	Buena Vista Student Housing (Monterey Lot)	Student Housing	455,000	2.00	**910.0**
BV-P	Buena Vista Pavilion and Mobility Hub	Pavilion	9,000	5.75	**51.8**
BV-A2	Academic Building at Bill Miller Plaza 1	Academic	155,000	3.25	**503.8**
		Total	**1,311,930**		**3423.6**

Based on existing drawings, there is only one spare MV connection available for future buildings. To add the future buildings to the campus MV electrical loop system, 15kV distribution switches will have to be added at various locations. For near-term plan, two 15kV distribution switches would probably be required: one of the new student parking and housing while another would be needed for the academic building and pavilion.

UTSA Downtown District: MEP Report September 05, 2025

Proposed long-term buildings

The proposed long-term plan will consist of adding two new academic buildings along with an expansion of the existing Durango building. This new electrical load will add approximately **1875 kVA** to the overall campus system. Therefore, the new total estimated campus electrical load after the completion of the long-term plan will be approximately **5299kVA.**

Buena Vista Long Term					
Building Code	**Building Name**	**Primary Use**	**AREA (GSF.)**	**W/sq. ft**	**kW**
Existing Near Term	Near Term Facilities	Miscellaneous	1,311,930		**3423.6**
BV-A1	Buena Vista Academic (at Cattleman Square Lot)	Academic	394000	3.25	**1280.5**
BV-A3	Academic Building at Bill Miller Plaza 2	Academic	155,000	3.25	**503.8**
BV-A4	Academic Extension to Durango Building	Academic	27,900	3.25	**90.7**
		Total	**1,888,830**		**5298.5**

If the 15kV switches that were proposed to be added during the near-term plan were installed, the smaller academic building and the Durango building addition scheduled to be built during the long-term plan should be able to connect to spare load break switch connections in the existing switchgear. However, the new larger academic building would require a new 15kV multi-way distribution switchgear adjacent to the building. All proposed expansions should not require the current CPSE service to be upgraded.

Bueno Vista Campus Electrical Service							
Utility Substation	**Circuit**	**Voltage**	**System Capacity (kW)**	**Current Peak (kW)**	**New Total Load(kW)**	**Spare Capacity (kW)**	**Comments**
CPSE	N/A	15kV	7473.6	1682	5298.5	2175.1	

San Pedro District

The Existing San Pedro District consists of two buildings: San Pedro I and San Pedro II. Currently, each one is fed by its' separate CPSE electrical service.

Proposed near-term buildings

The initial growth of the San Pedro District is to expand San Pedro I. It appears that this modest expansion should be able to be fed from the existing San Pedro I electrical service.

Downtown MEP Assessment

San Pedro Near Term					
Building Code	**Building Name**	**Primary Use**	**AREA (GSF.)**	**W/sq. ft**	**kW**
Existing	San Pedro Block I & II	Academic	**347467**	**3.25**	**1129.3**
SP-F2	Extension to San Pedro I	Future Development	73000	**3.25**	**237.3**
		Total	**420,467**		**1366.5**

Proposed long-term buildings

The long-term plan for San Pedro District will include adding an academic building with a parking garage, a mixed-use facility, and a small pavilion. Since these buildings are not adjacent to each other and the current buildings already have separate services, the most cost effective and easiest approach to providing electrical service to each of the new buildings would be their own CPSE service. Since the pavilion is small, it would be fed from one of the other buildings.

San Pedro Long Term					
Building Code	**Building Name**	**Primary Use**	**AREA (GSF.)**	**W/sq. ft**	**kW**
Existing Near Term	Near Term Facilities	Miscellaneous	420,467		**1366.5**
SP-F1	San Pedro Mixed-Use (Dolorosa + Santa Rosa Building)	Future Development	227000	**3.25**	**737.8**
SP-P	San Pedro Pavilion	Pavilion with interior café or dining space	6500	**5.75**	**37.4**
SP-F3	Academic Building at Kallison Block	Future Development	217500	**3.25**	**706.9**
SP-F4	Academic Building at Kallison Block	Parking Garage	120,000	1.00	**120.0**
		Total	**991,467**		**2968.5**

An alternate approach to having multiple electrical services at the San Pedro District would be to provide a single CPSE service that would feed all the buildings. This option would require a great deal of customer-owned and operated MV equipment/infrastructure which would be a large initial cost. However, this method would reduce CPSE monthly cost for maintaining multiple meters over the life of the district. If the plan is to possibly sell these buildings to individuals having a single system is not the best option.

Southwest District

The current Southwest District consists of a variety of spaces including multiples small independent buildings as well as several floors in One Riverwalk Place.

Proposed near-term buildings

The plan is to construct a mixed-use facility with academic, housing, structured parking, and amenities spaces as part of the near-term development. Based on the size and potential electrical load of the facility, a separate CPSE electrical service would be required.

Southwest Near Term					
Building Code	**Building Name**	**Primary Use**	**AREA (GSF.)**	**W/sq. ft**	**kW**
Existing					**0.0**
SW-MU	Southwest Mixed-Use	Student Housing	200000	**2.00**	**400.0**
SW-MU	Southwest Mixed-Use	Academic	140000	**3.25**	**455.0**
SW-MU	Southwest Mixed-Use	Parking Garage	120000	**1.00**	**120.0**
		Total	**460,000**		**975.0**

Proposed long-term buildings

After the large mixed-use facility is constructed during the near-term plan, only a small pavilion is planned for the long-term growth of Southwest. If possible, the pavilion will be fed from the CPSE service feeding the School of Arts. If not, a small service will be added.

Southwest Long Term					
Building Code	**Building Name**	**Primary Use**	**AREA (GSF.)**	**W/sq. ft**	**kW**
Existing Near Term	Near Term Facilities	Miscellaneous	460,000		**975.0**
SW-P	Southwest Pavilion	Pavilion with interior café and exhibition space	6000	**5.75**	**34.5**
		Total	**466,000**		**1009.5**

Downtown MEP Assessment

Mechanical

Buena Vista District

The Existing Buena Vista District consists of three buildings: the Frio building (Phase 1), the Buena Vista Building (Phase 2) and the Durango building (Phase 3). The Campus is served by a central plant with a water-cooled chiller system and heating hot water boilers located at Frio Building. The associated cooling towers are on the Buena Vista building. The plant was last expanded in 2001, recently the cooling towers and all pumps were replaced and in 2015 chiller one was replaced. Currently phase 2 chiller is operating during the summer season with 800 Tons of cooling and Chiller phase 1 operate during winter season

The Frio Building has a total of 550 tons of cooling served by chilled water system and 2,800 MBH heating served by boiler system.

The Buena Vista Building has a total of 800 tons of cooling served by chilled water system and 8,370 MBH heating served by two (2) boiler system.

The Durango Building has a total of 2,350 tons of cooling served by chilled water system and 19,540 MBH of heating served by boiler system.

Proposed near-term buildings

Buena Vista Student Housing (Monterey Lot) with an estimated 1,011 tons of cooling and 11,375 MBH of heating.

Buena Vista Pavilion and Mobility Hub with an estimated 30 tons of cooling and 270 MBH of heating.

Academic Building at Bill Miller Plaza 1 with an estimated 443 tons of cooling and 4,650 MBH of heating.

Buena Vista Near Term

				ESTIMATED COOLING LOADS			ESTIMATED HEATING & GAS LOADS		
Building Code	Building Name	Primary Use	AREA (GSF.)	Sq.Ft/Ton	Tons	GPM	BTU/Sq.Ft	Heating MBH	GAS CFH
BV-G	Buena Vista Parking Garage	Parking Garage	416,000	0	0	0	0	0	0
BV-H	Buena Vista Student Housing (Monterey Lot)	Student Housing	455,000	450	1,011	900	25	11,375	11,375
BV-P	Buena Vista Pavilion and Mobility Hub	Pavilion	9,000	300	30	600	30	270	270
BV-A2	Academic Building at Bill Miller Plaza 1	Academic	155,000	350	443	700	30	4,650	4,650
		Total	**1,035,000**		**1,484**	**2,200**	**85**	**16,295**	**16,295**

Proposed long-term buildings

Buena Vista Academic (at Cattleman Square Lot) with an estimated 1,126 tons of cooling and 11,820 MBH of heating.

Academic Building at Bill Miller Plaza 2 with an estimated 443 tons of cooling and 4,650 MBH of heating.

Academic Extension to Durango Building with an estimated 80 tons of cooling and 837 MBH of heating.

UTSA Downtown District: MEP Report September 05, 2025

Buena Vista Long Term

				ESTIMATED COOLING LOADS			ESTIMATED HEATING & GAS LOADS		
Building Code	Building Name	Primary Use	AREA (GSF.)	Sq.Ft/Ton	Tons	GPM	BTU/Sq.Ft	Heating MBH	GAS CFH
BV-A1	Buena Vista Academic (at Cattleman Square Lot)	Academic	394,000	350	1,126	700	30	11,820	11,820
BV-A3	Academic Building at Bill Miller Plaza 2	Academic	155,000	350	443	700	30	4,650	4,650
BV-A4	Academic Extension to Durango Building	Academic	27,900	350	80	700	30	837	837
		Total	**576,900**		**1,648**	**2,100**	**90**	**17,307**	**17,307**

Recommendation

Provide an optimization module for the existing central plant building management system to have better controls, monitors and data.

Track Trending load data for all year.

Add Variable Speed drive(s) to phase 2 chiller to provide different capacity and unloading which will lead to energy savings.

Analyze system and confirm Peak demand for the existing building will provide more accurate analytical data which will allow a better load diversity.

Revise the hydronic header at the central plant and add motorized isolation valves for controlling the flow and isolation.

Current estimated cooling load for the near term for Buena Vista Pavilion and Mobility Hub and Academic Building at Bill Miller Plaza 1 total to 473 tons. The current existing total cooling is at 1300 tons if phase 1 and phase 2 operate at the same time. Theres is access capacity in the existing system to provide cooling for the Pavilion and Bill Miller Plaza 1.

Provide new hydronic piping connection, motorized valves and cap for future to serve Academic Extension to Durango Building.

Depending on the time of building, the Buena Vista Student Housing (Monterey Lot) provides independent high efficiency chilled water and heating system to serve the housing and allow for future connections.

Expand the existing central plant and add New high efficiency heat rejection chillers with variable speed and associated pumps to serve the Academic Building at Bill Miller Plaza 2

During the design of the expansion, it is recommended to provide space for the future chillers and boilers and associated pumps to sever Buena Vista Academic at Cattleman Square Lot.

San Pedro District

The Existing San Pedro District consists of two buildings: San Pedro I building started operation 2023 and San Pedro II Building is under construction and will be completed in 2026. The hydronics for the two buildings are not connected.

San Pedro, I building has a total of 825 tons of cooling served by air cooled chilled water system and 5,700 MBH heating served by boiler system.

Downtown MEP Assessment

San Pedro II building has a total of 840 tons of cooling served by air cooled chilled water system and 5,766 MBH heating served by boiler system.

Proposed near-term buildings

Extension to San Pedro I (or San Pedro III) building with an estimated 243 tons of cooling and 2,190 MBH of heating.

San Pedro NearTerm									
				ESTIMATED COOLING LOADS			ESTIMATED HEATING & GAS LOADS		
Building Code	Building Name	Primary Use	AREA (GSF.)	Sq.Ft/Ton	Tons	GPM	BTU/Sq.Ft	Heating MBH	GAS CFH
SP-F2	Extension to San Pedro I (or San Pedro III)	Future Development	73,000	300	243	600	30	2,190	2,190
		Total	73000		243	600	30	2,190	2,190

Proposed long-term buildings

San Pedro Mixed-Use (Dolorosa + Santa Rosa Building) with an estimated 757 tons of cooling and 6,810 MBH of heating.

San Pedro Pavilion with an estimated 26 tons of cooling and 195 MBH of heating.

Academic Building at Kallison Block with an estimated 621 tons of cooling and 6,510 MBH of heating.

San Pedro Long Term									
				ESTIMATED COOLING LOADS			ESTIMATED HEATING & GAS LOADS		
Building Code	Building Name	Primary Use	AREA (GSF.)	Sq.Ft/Ton	Tons	GPM	BTU/Sq.Ft	Heating MBH	GAS CFH
SP-F1	San Pedro Mixed-Use (Dolorosa + Santa Rosa Building)	Future Development	227,000	300	757	600	30	6,810	6,810
SP-P	San Pedro Pavilion	Pavilion with interior café or dining space	6,500	250	26	500	30	195	195
SP-F3	Academic Building at Kallison Block	Future Development	217,500	350	621	700	30	6,525	6,525
SP-F3	Academic Building at Kallison Block	Parking Garage	120,000	0	0	0	0	0	0
		Total	571,000		647	1,200	60	6,720	6,720

Recommendation

Provide a standalone high efficiency heat rejection air cooled chiller and a heating hot water boiler to support the cooling and heating system for the near-term Extension to San Pedro I (or San Pedro III) building.

Provide a standalone high efficiency heat rejection air cooled chiller and a heating hot water boiler to support the cooling and heating system for the long-term San Pedro Mixed-Use Dolorosa and Santa Rosa Building.

Provide a standalone direct expansion roof top unit to provide cooling and heating for the long-term Pavilion.

Provide a standalone high efficiency heat rejection air cooled chiller and a heating hot water boiler to support the cooling and heating system for the long-term Academic Building at Kallison Block.

Southwest District

The Existing Southwest District consists of some historical buildings, Santikos building and One Riverwalk building. The historic Southwest school of arts have their own multiple packaged water-cooled heat pumps for cooling and heating system with a backup boiler to support the heating during winter months. The system was installed in 2004, and Part of the system was replaced in 2025, and the cooling towers has been replaced within the last 15 years. Santikos Building is served with 25 tons of packaged direct expansion (DX) roof top units for cooling with gas fired heat exchangers for heating the roof top units were installed about 15 years ago. One Riverwalk Place building is being served with a total of 900 tons of water-cooled chillers for cooling and 7,200 MBH gas boilers for heating.

Proposed near-term buildings

Southwest Mixed-Use student housing with an estimated 444 tons of cooling and 8,000 MBH of heating.

Southwest Mixed-Use Academic building with an estimated 400 tons of cooling and 4,200 MBH of heating.

Southwest Near Term									
				ESTIMATED COOLING LOADS			ESTIMATED HEATING & GAS LOADS		
Building Code	Building Name	Primary Use	AREA (GSF.)	Sq.Ft/Ton	Tons	GPM	BTU/Sq.Ft	Heating MBH	GAS CFH
SW-MU	Southwest Mixed-Use	Student Housing	200,000	450	444	900	40	8,000	8,000
SW-MU	Southwest Mixed-Use	Academic	140,000	350	400	700	30	4,200	4,200
SW-MU	Southwest Mixed-Use	Parking Garage	120,000	0	0	0	0	0	0
		Total	460,000		844	1,600	70	12,200	12,200

Proposed long-term buildings

Southwest Pavilion, with interior café and exhibition space, has an estimated 20 tons of cooling and 180 MBH of heating.

Southwest Long Term									
				ESTIMATED COOLING LOADS			ESTIMATED HEATING & GAS LOADS		
Building Code	Building Name	Primary Use	AREA (GSF.)	Sq.Ft/Ton	Tons	GPM	BTU/Sq.Ft	Heating MBH	GAS CFH
SW-P	Southwest Pavilion	Pavilion with interior café and exhibition space	6,000	300	20	600	30	180	180
		Total	6,000	Total	20	600	30	180	180

Downtown MEP Assessment

Recommendation

Provide a standalone high efficiency heat rejection air cooled chiller and a heating hot water boiler to support the cooling and heating system for the near-term Southwest Mixed-Use Student housing and the Academic Buildings

Provide a standalone direct expansion roof top unit to provide cooling and heating for the long-term Pavilion.

Building Occupancy - The office buildings, laboratories, and academic buildings require reliable cooling during the summer months and reliable heating during cool weather.

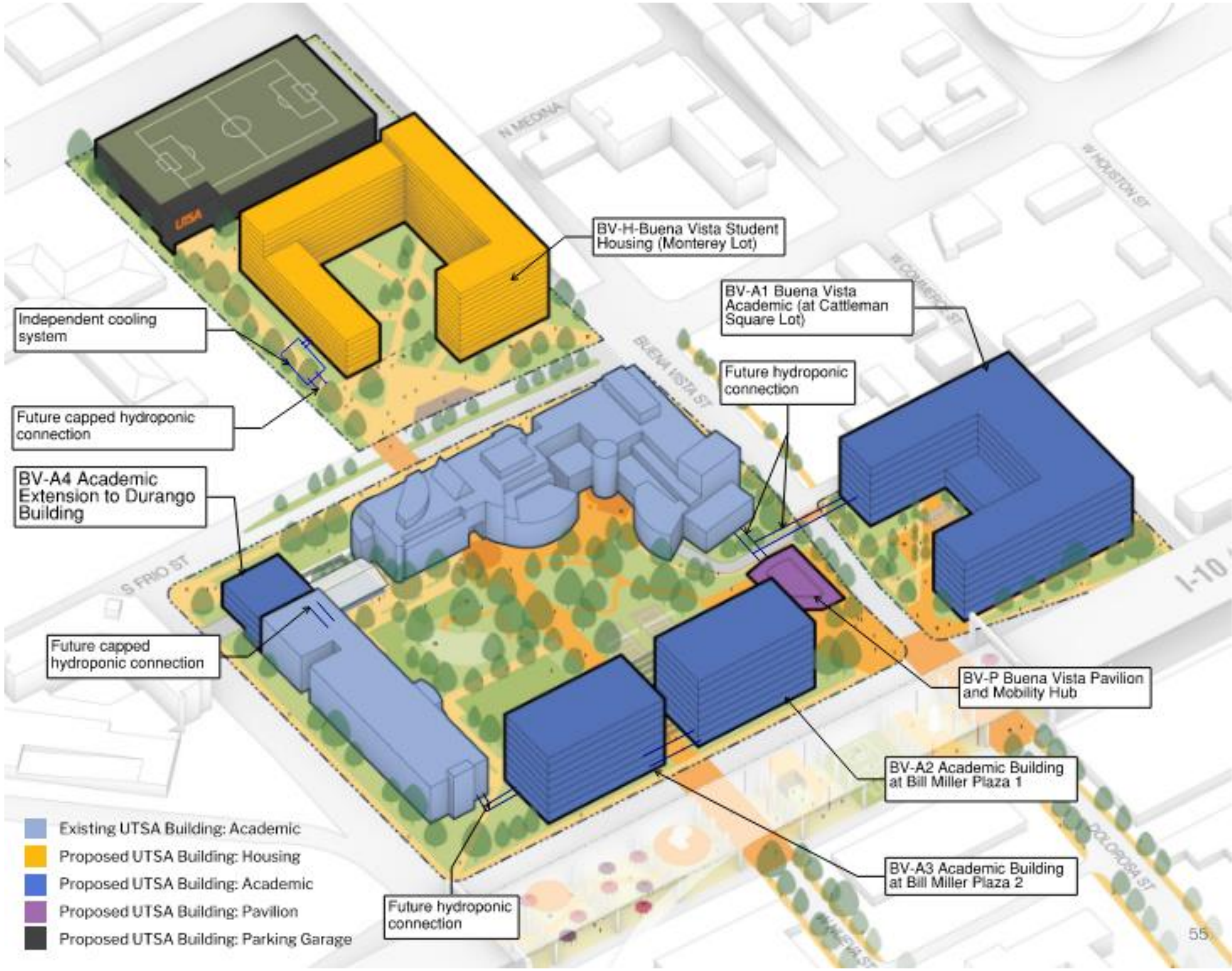
Expansion - It is recommended to evaluate the estimated building loads and compare the current capacity of each plant to the number of buildings they serve. This will help identify where building expansion is most ideal.

ASHRAE Equipment Life Expectancy and Average Operation - Per ASHRAE, the average life expectancy and good operation of assorted equipment are as follows:

- Chillers: 24 years
- Cooling towers: 20 years for the Galvanized metal and 34 Years for Ceramic
- Boilers: 20 years
- Heat exchangers: 24 years
- Pumps: 10 to 20 years
- Roof Top (DX) units: 20 years

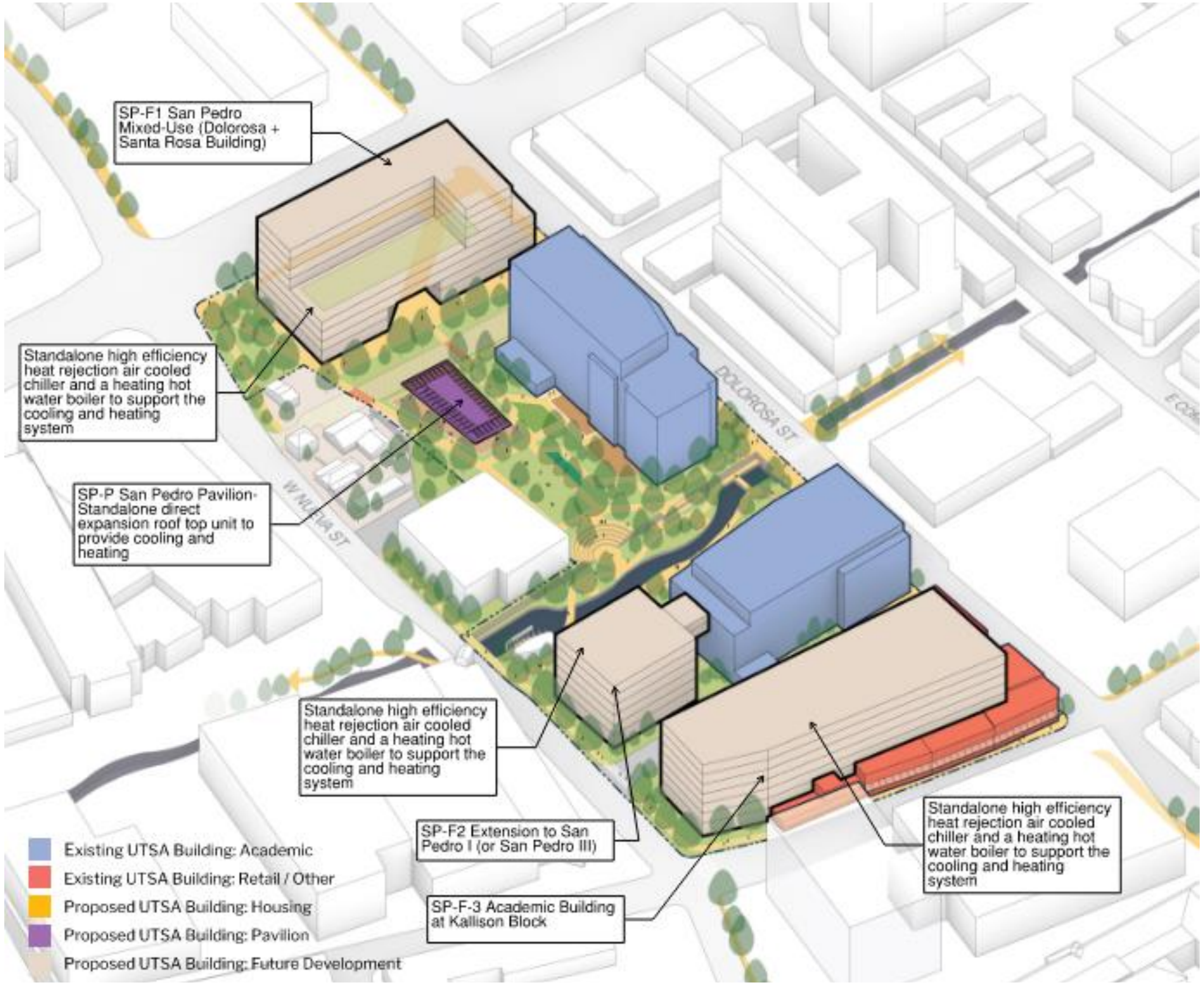
Downtown MEP Assessment

Buena Vista District



Downtown MEP Assessment

San Pedro District



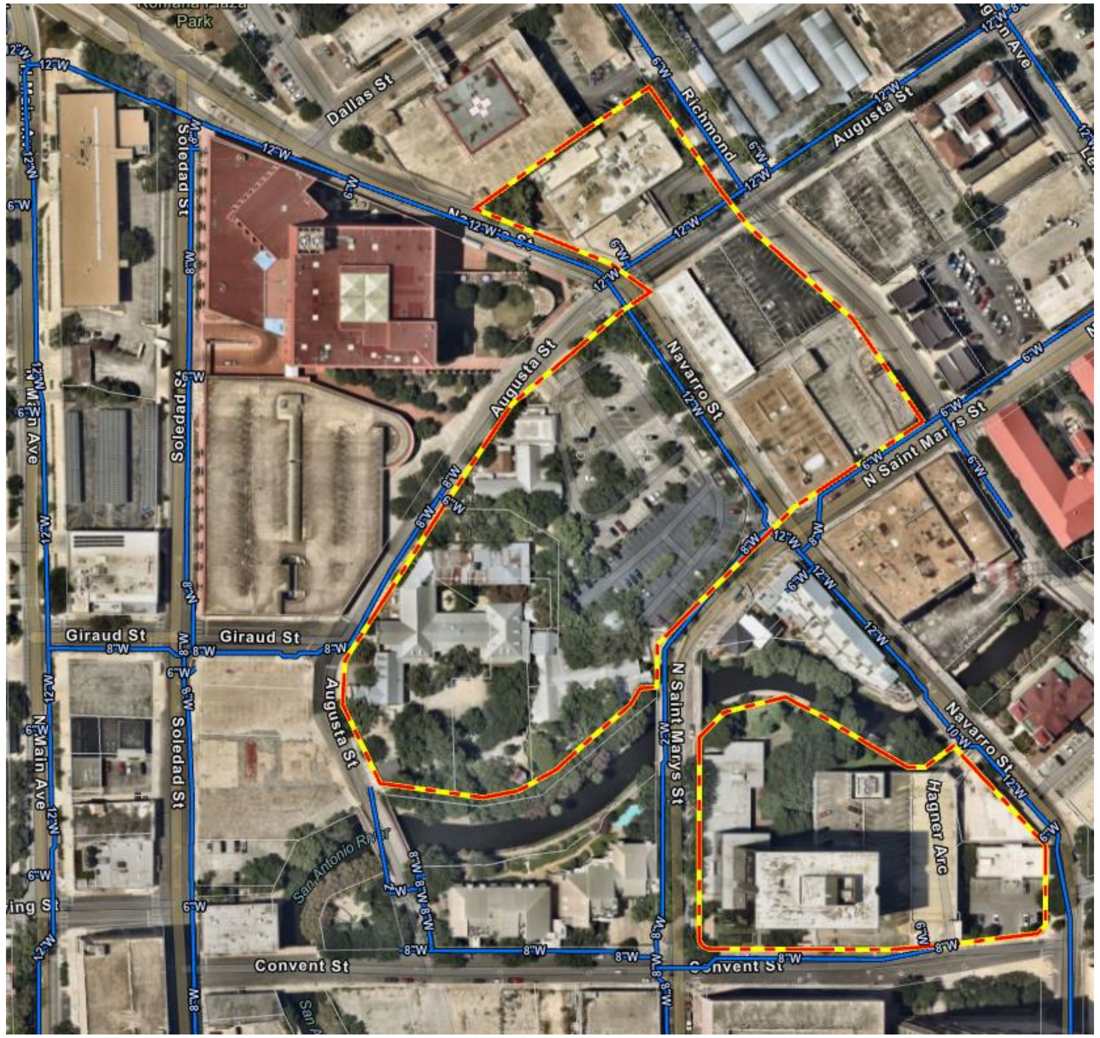
Downtown MEP Assessment

Southwest District

SOUTHWEST CAMPUS

PAPE–DAWSON

- **Existing Water Main**
  - 6”, 8”, and 12” water mains located adjacent to the sites
- **Existing EDUs : 14**
  - 400 existing students
- **Proposed EDUs : 155**
  - Expecting 4,500 students
  - EDUs may be reduced if existing flow usage is less than SAWS standard flows
- **Infrastructure Improvements**
  - Preliminary analysis do not anticipate infrastructure improvements.
    - Formal Utility Service Agreement will be required to verify any infrastructure improvements that may be required.
  - PD has requested service line reports from SAWS for all active services within the campus. Analysis of existing meters will determine need to set new meters for campus expansion or ability to consolidate existing meters.



SAN PEDRO BLOCK

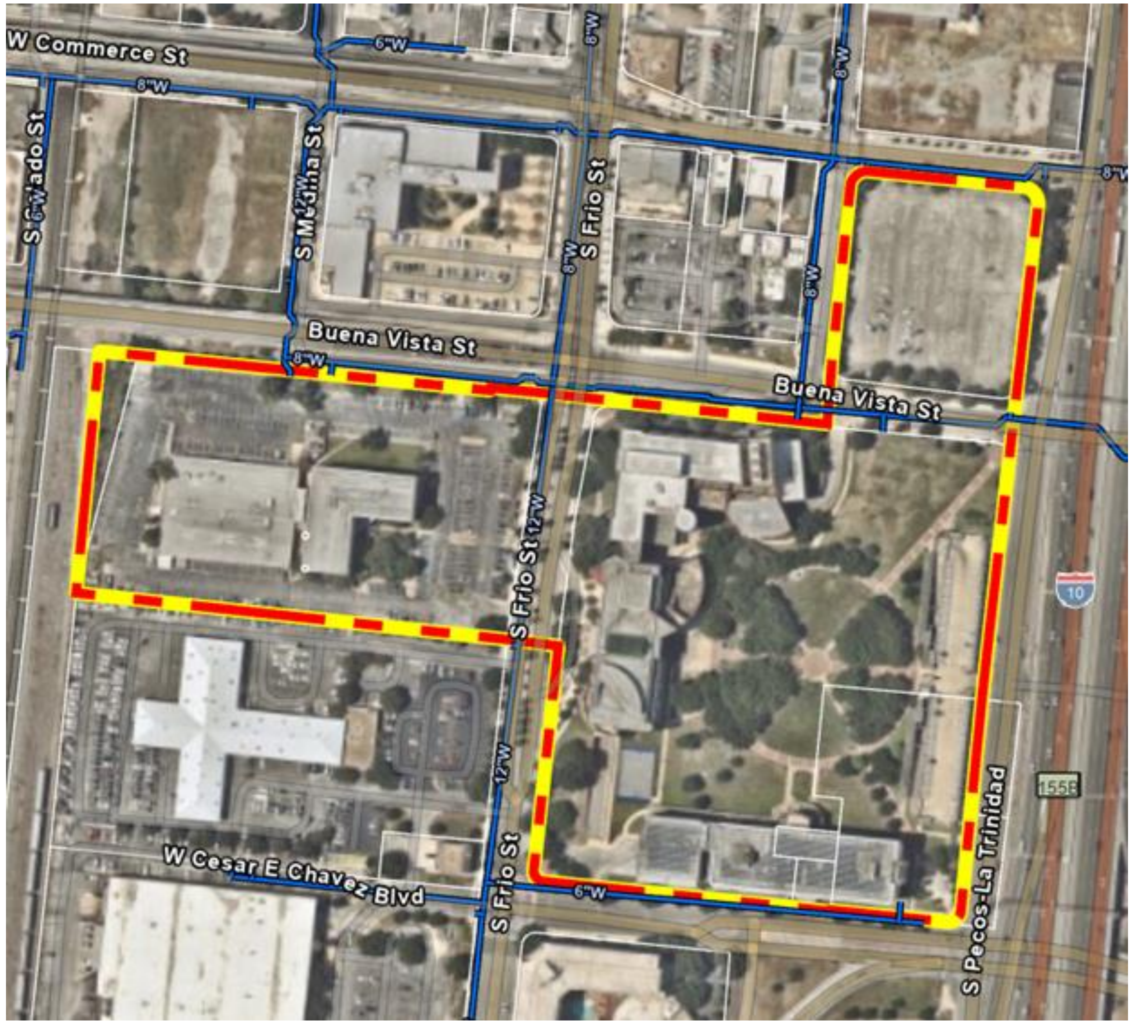
PAPE–DAWSON

- **Existing Water Main**
  - 8" water main to the north and east
  - 16" water main the south and west
- **Existing EDUs : 7**
  - 200 existing students
- **Proposed EDUs : 259**
  - Expecting 7,500 students
  - EDUs may be reduced if existing flow usage is less than SAWS standard flows
- **Infrastructure Improvements**
  - Preliminary analysis do not anticipate infrastructure improvements.
    - » Formal Utility Service Agreement will be required to verify any infrastructure improvements that may be required.
  - PD has requested service line reports from SAWS for all active services within the campus. Analysis of existing meters will determine need to set new meters for campus expansion or ability to consolidate existing meters.

BUENA VISTA BLOCK

PAPE–DAWSON

- **Existing Water Main**
  - 6”, 8”, and 12” water mains located adjacent to the sites
- **Existing EDUs : 41**
  - 1,200 existing students
- **Proposed EDUs : 103**
  - Expecting 3,000 students
  - EDUs may be reduced if existing flow usage is less than SAWS standard flows
- **Infrastructure Improvements**
  - Preliminary analysis do not anticipate infrastructure improvements.
    - Formal Utility Service Agreement will be required to verify any infrastructure improvements that may be required.
  - PD has requested service line reports from SAWS for all active services within the campus. Analysis of existing meters will determine need to set new meters for campus expansion or ability to consolidate existing meters.

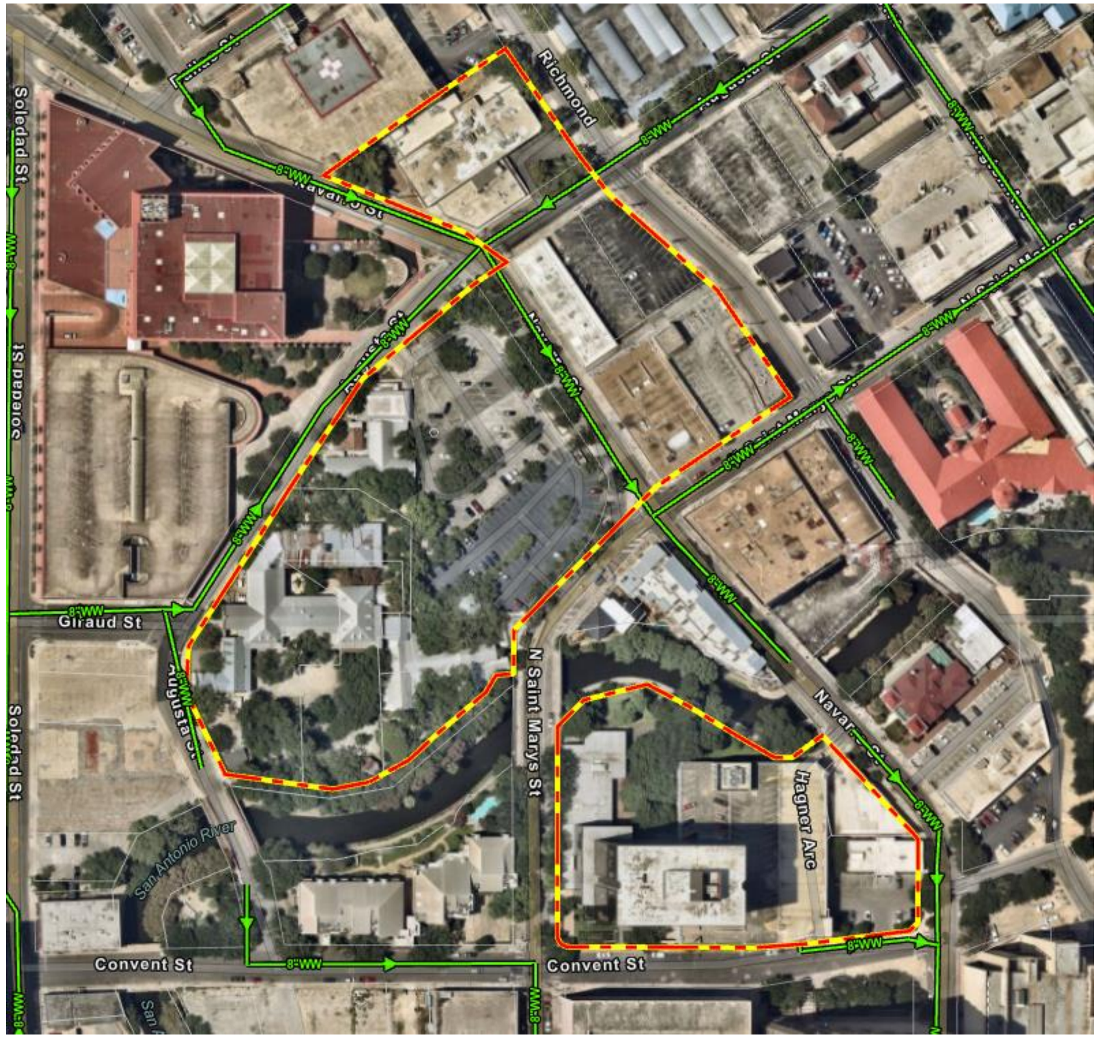


Downtown Water & Sewer Assessment

SOUTHWEST CAMPUS

PAPE–DAWSON

- **Existing 8" Sewer Main**
  - At least two (2) sewer mains located adjacent to each site
  - Southwest Campus sewer flows to two separate existing trunk lines, divided up by the San Antonio River
- **Existing EDUs : 20**
  - 400 existing students
- **Proposed EDUs : 225**
  - Expecting 4,500 students
  - SAWS indicated that proposed EDUs could be reduced if historical data regarding water/sewer flow rates from campus buildings were to be provided
- **Infrastructure Improvements**
  - Preliminary analysis indicates that sewer flows associated with the increase in number of students can be handled by the existing system. Pape-Dawson compared the capacity of the downstream sewer line to the known flows from existing development in the area. Results showed that the downstream line could take on the increased EDUs from the campus expansion
  - SAWS indicated in a call on 8/27 that although it seems that the infrastructure has capacity, a formal Utility Service Agreement will be required to verify any infrastructure improvements that may be required.

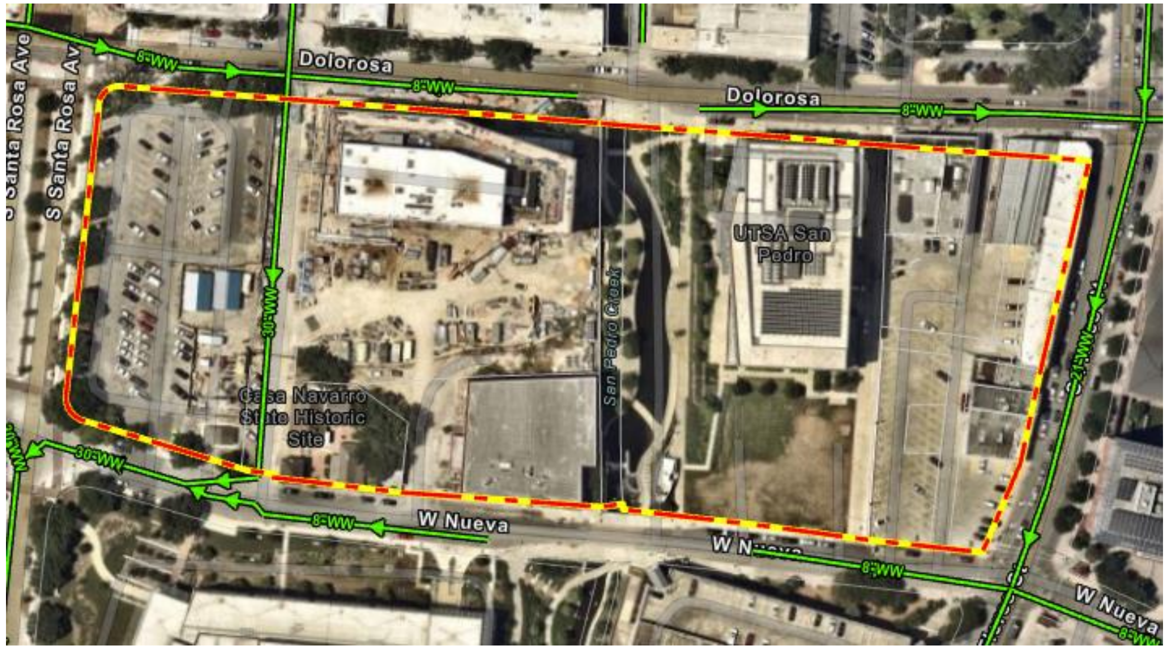


Downtown Water & Sewer Assessment

SAN PEDRO BLOCK

PAPE–DAWSON

- **Existing Sewer Main**
  - 8” sewer main to the north and south
  - 30” sewer main crossing the site
  - 30” sewer main on the SW corner
  - 21” sewer main to the east
- **Existing EDUs : 10**
  - 200 existing students
- **Proposed EDUs : 375**
  - Expecting 7,500 students
  - SAWS indicated that proposed EDUs could be reduced if historical data regarding water/sewer flow rates from campus buildings were to be provided
- **Infrastructure Improvements**
  - Preliminary analysis does not anticipate infrastructure improvements. The 8” lines surrounding the site appear to only service this campus block, meaning there is no upstream sewer flow to contend with for capacity. The increased flow from the additional students can be contained in the 8” lines.
    - Formal Utility Service Agreement will be required to verify any infrastructure improvements that may be required.

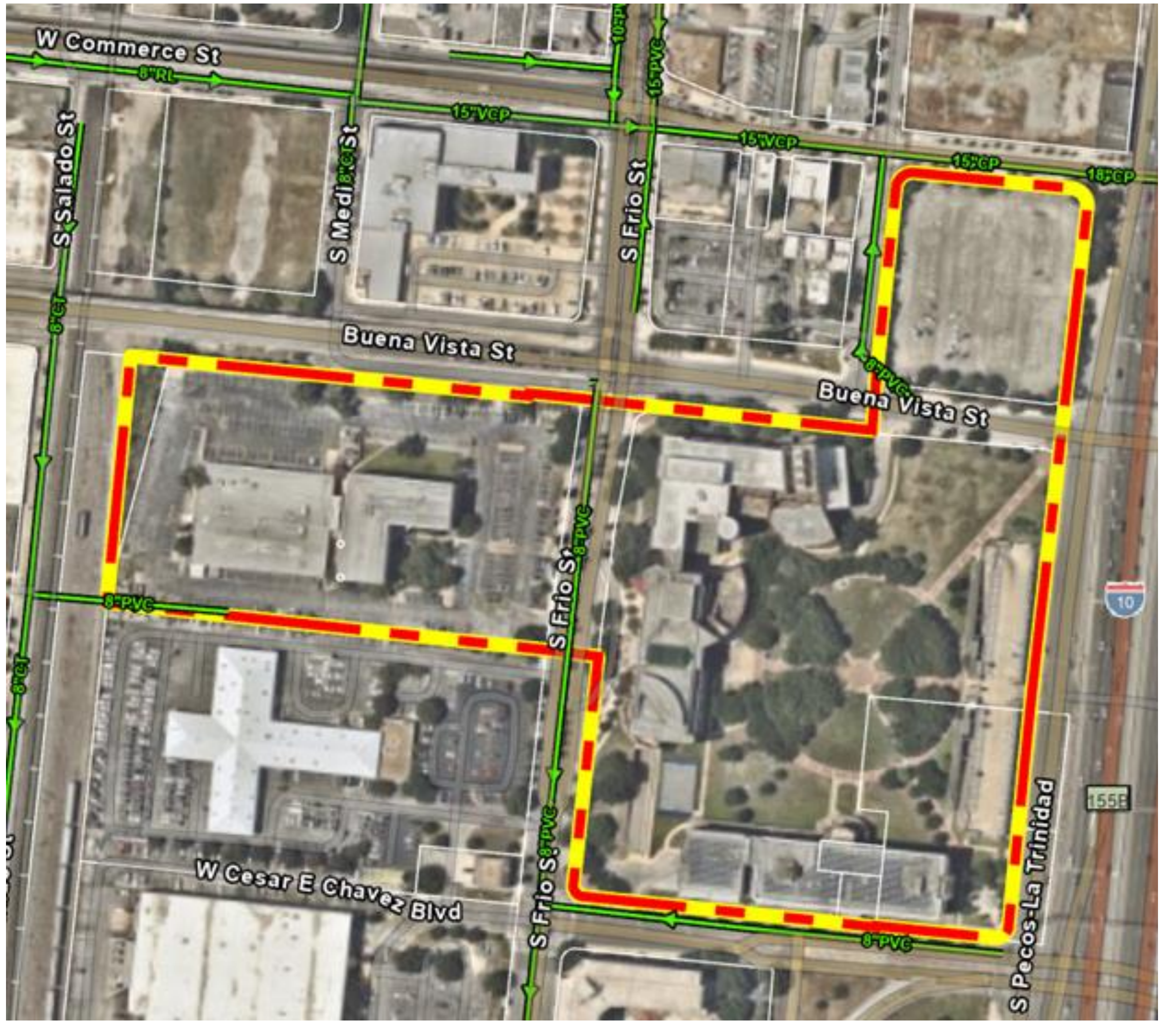


Downtown Water & Sewer Assessment

BUENA VISTA BLOCK

PAPE–DAWSON

- **Existing Sewer Main**
  - At least one (1) 8" sewer main adjacent to the sites
  - 15" sewer main adjacent to the northern site
- **Existing EDUs : 60**
  - 1,200 existing students
- **Proposed EDUs : 150**
  - Expecting 3,000 students
  - SAWS indicated that proposed EDUs could be reduced if historical data regarding water/sewer flow rates from campus buildings were to be provided
- **Infrastructure Improvements**
  - Preliminary analysis does not anticipate infrastructure improvements. The 8" lines surrounding the site appear to only service this campus block, meaning there is no upstream sewer flow to contend with for capacity. The increased flow from the additional students can be contained in the 8" lines.
    - Formal Utility Service Agreement will be required to verify any infrastructure improvements that may be required.

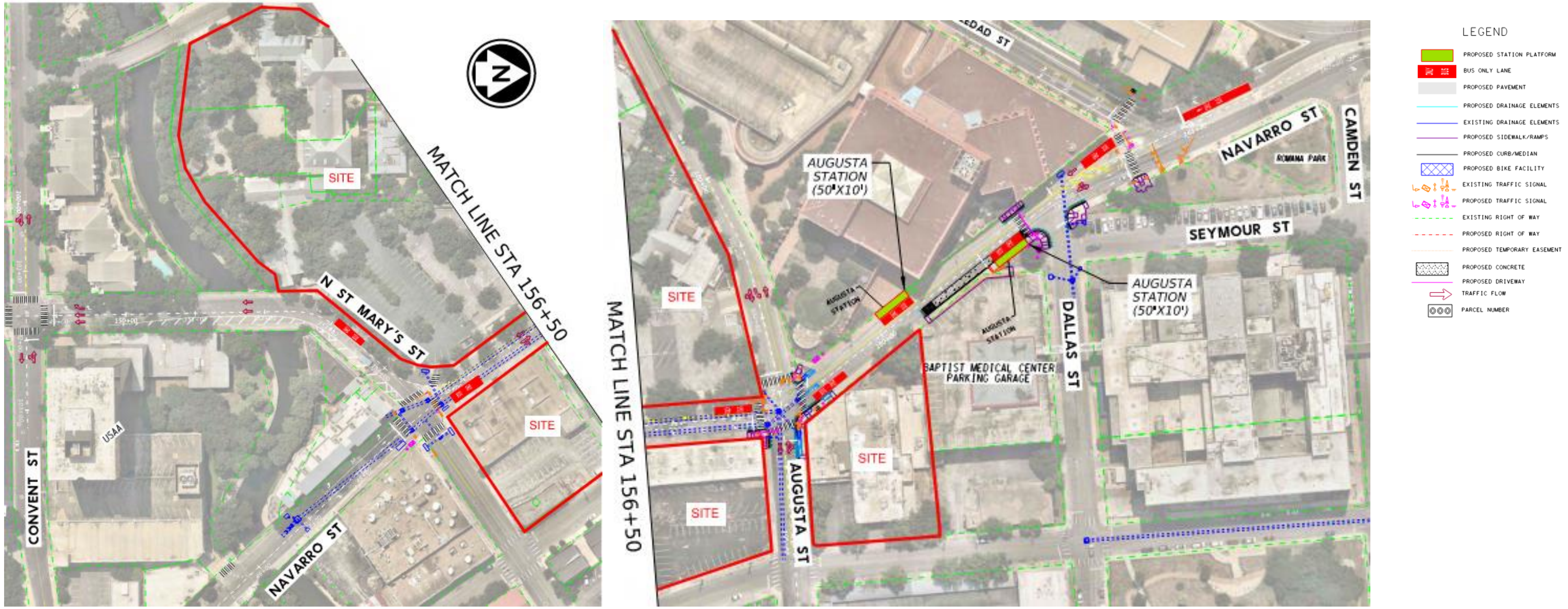


Downtown Traffic Analysis

SOUTHWEST CAMPUS

PAPE–DAWSON

- **Art Green Line Corridor**
  - The preliminary corridor plans will propose traffic signals near the Southwest Campus
  - Green Line to enhance VIA transit network north of Loop 410, through downtown, to south of IH-10 .

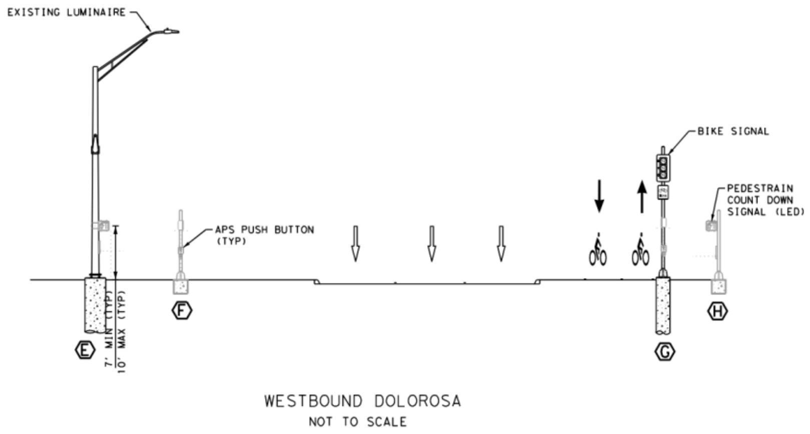


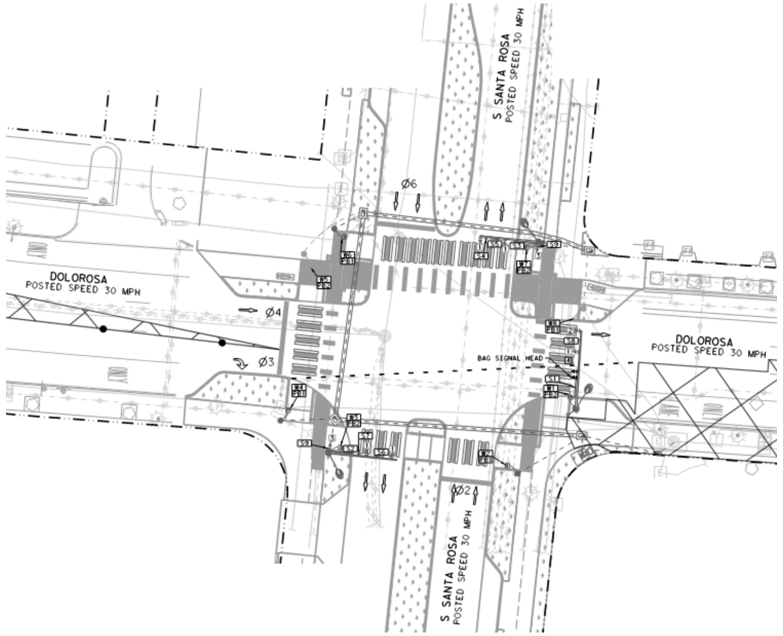
Downtown Traffic Analysis

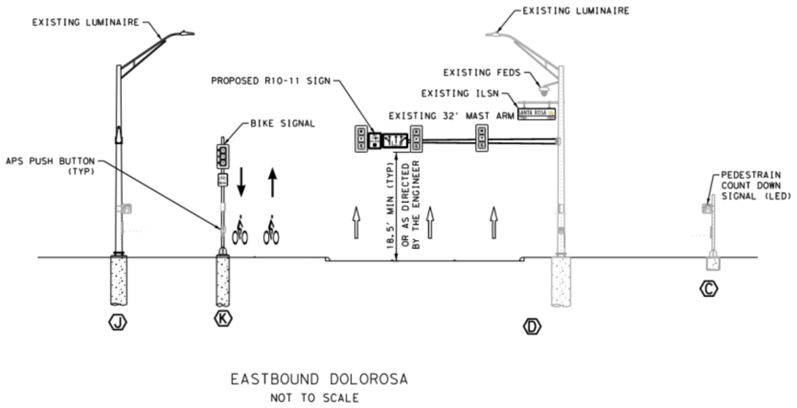
SAN PEDRO BLOCK

PAPE-DAWSON

- **Dolorosa and S Santa Rosa Proposed Intersection**
    - Proposed improvements to include vehicle signals, pedestrian signals, and bicycle signals.
    - Schematic street cross sections are pictured below



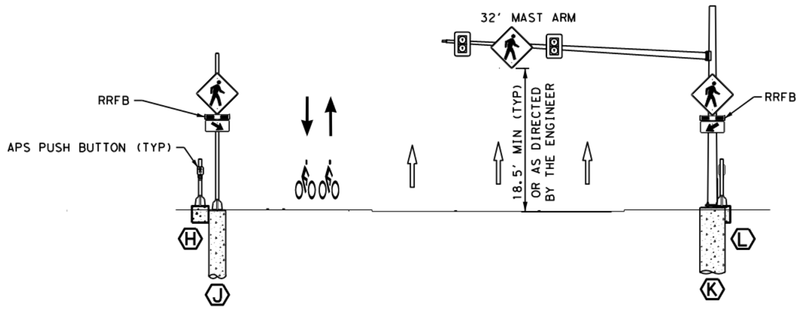




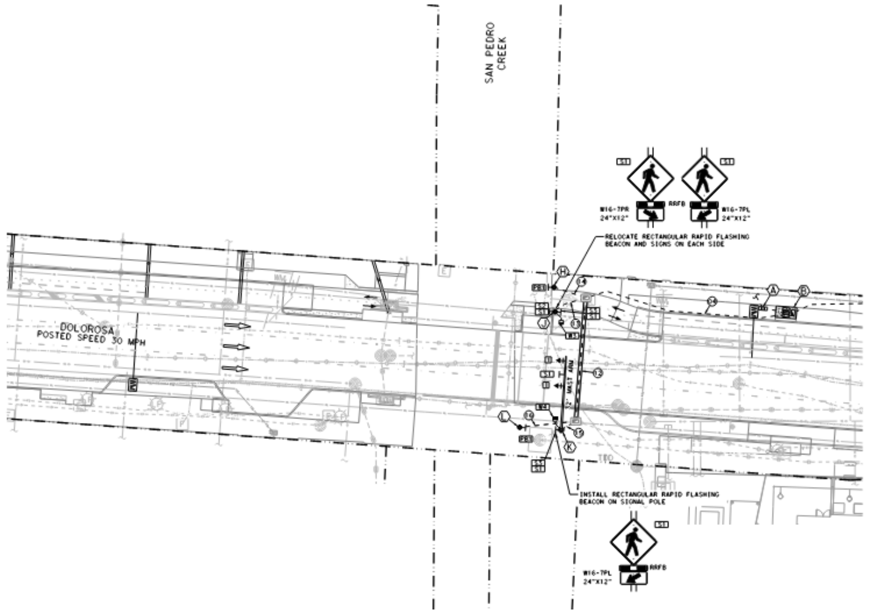
SAN PEDRO BLOCK

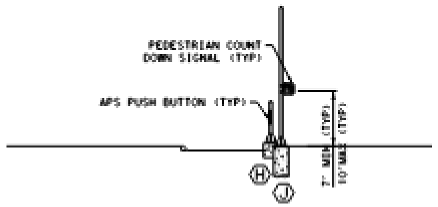
PAPE–DAWSON

- **Dolorosa and San Pedro Creek Proposed Intersection**
  - Proposed improvements to include vehicle signals, pedestrian signals, and bicycle signals.
  - Schematic street cross sections are pictured below

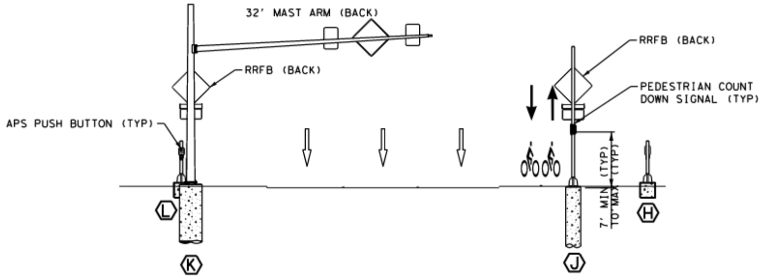


WESTBOUND DOLOROSA ST
NOT TO SCALE





NORTHBOUND SAN PEDRO CREEK
RRFB PEDESTRIAN CROSSING
NOT TO SCALE



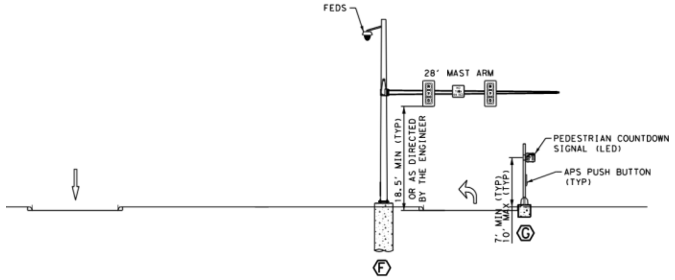
EASTBOUND DOLOROSA ST
NOT TO SCALE

Downtown Traffic Analysis

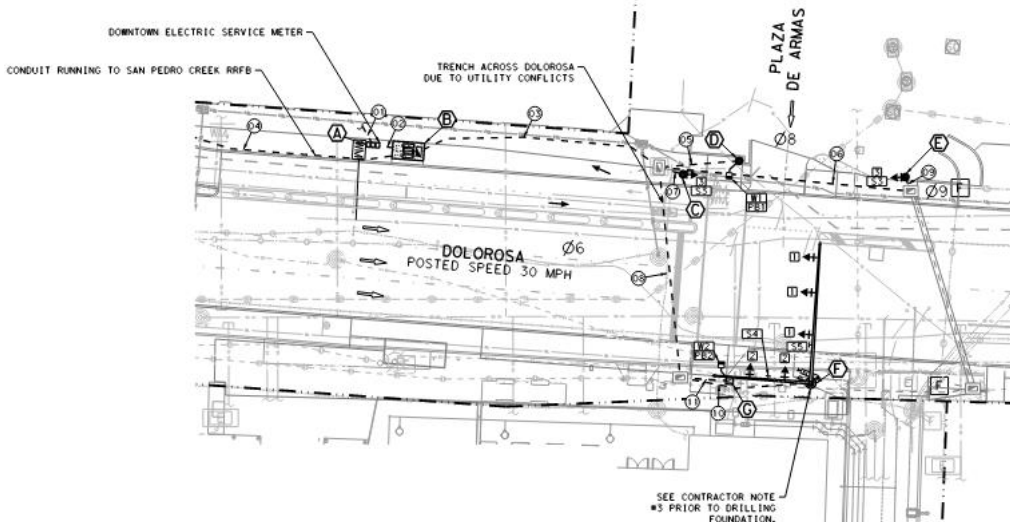
SAN PEDRO BLOCK

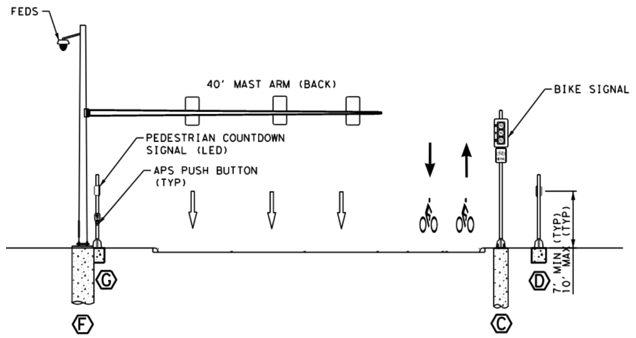
PAPE–DAWSON

- **Dolorosa and Plaza De Armas Proposed Intersection**
  - Proposed improvements to include vehicle signals, pedestrian signals, and bicycle signals.
  - Schematic street cross sections are pictured below



NORTHBOUND PLAZA DE ARMAS
NOT TO SCALE





EASTBOUND DOLOROSA ST
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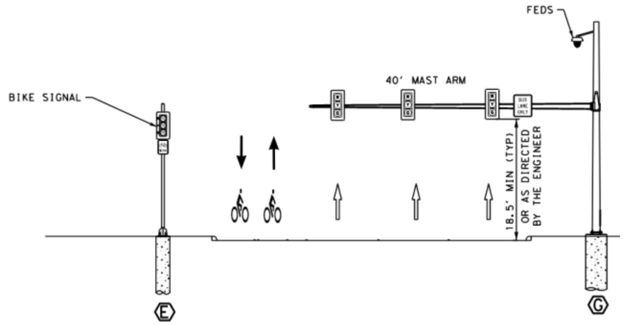
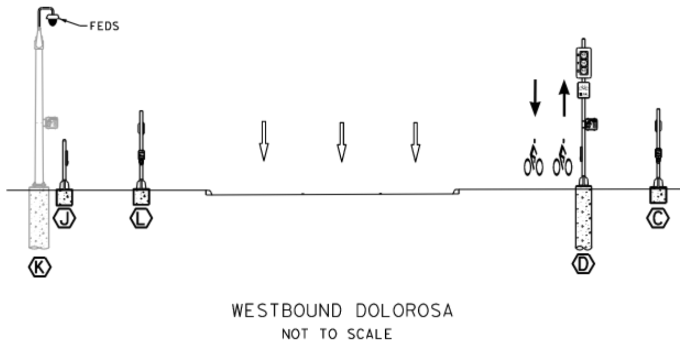


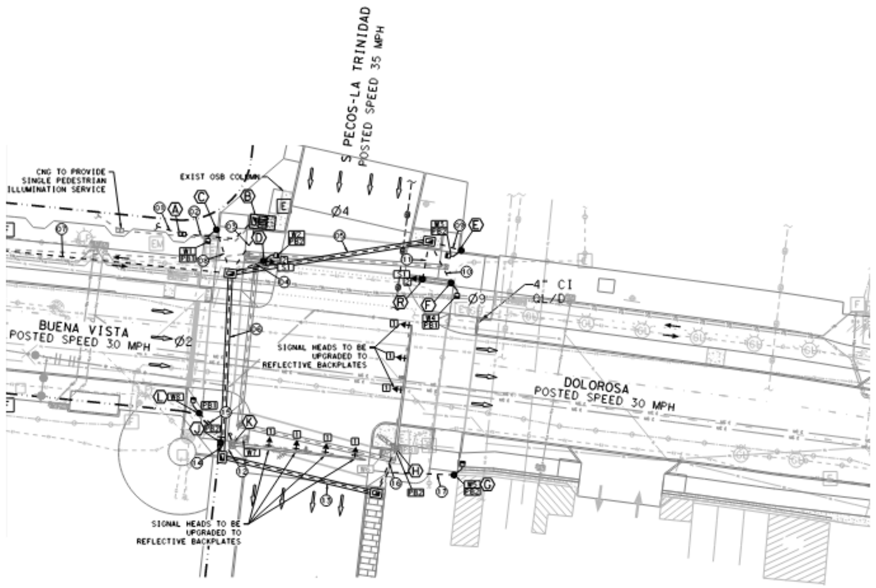
WESTBOUND DOLOROSA ST
NOT TO SCALE

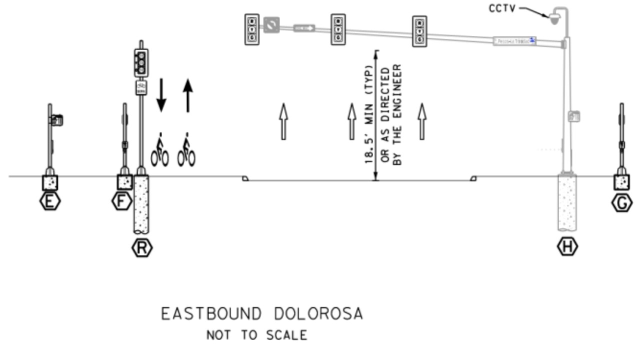
BUENA VISTA BLOCK

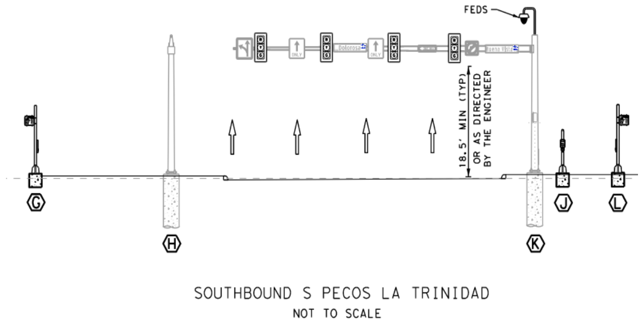
PAPE-DAWSON

- **Buena Vista and S Pecos-La Trinidad Proposed Intersection**
  - Proposed improvements to include vehicle signals, pedestrian signals, and bicycle signals.
  - Schematic street cross sections are pictured below







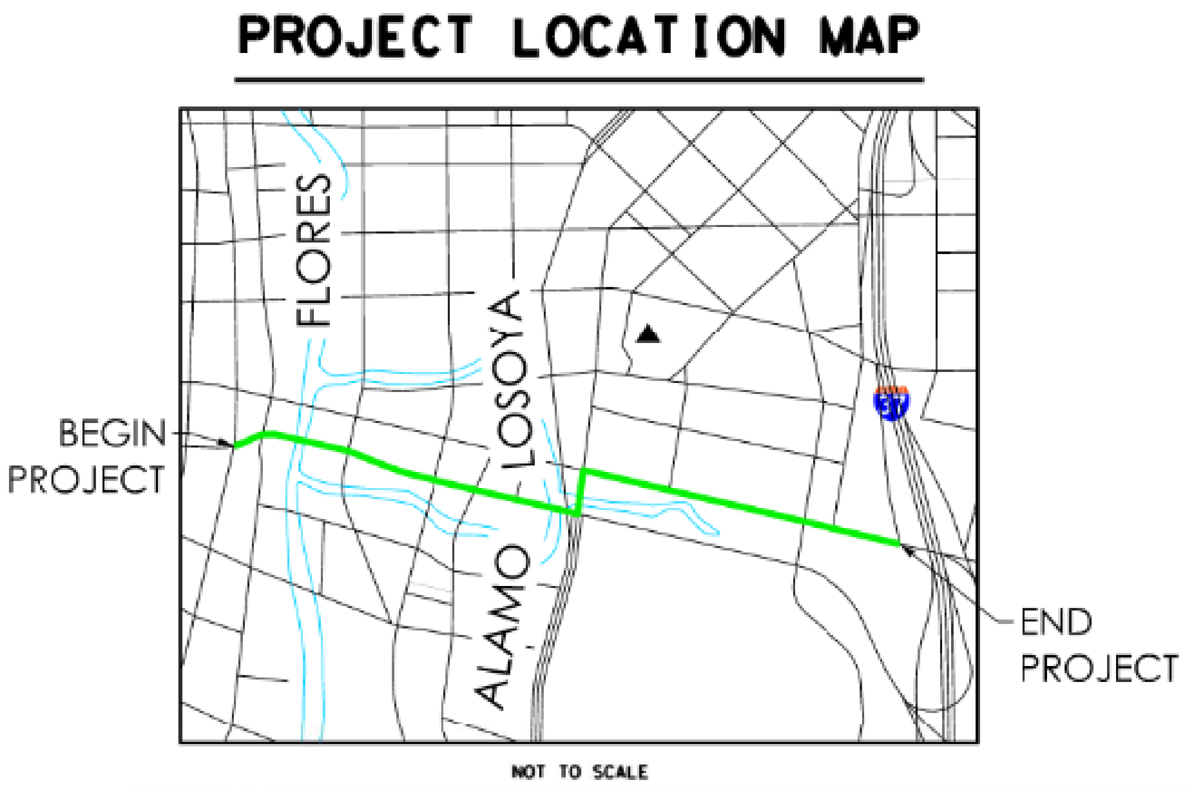


Downtown Traffic Analysis

MARKET STREET

PAPE–DAWSON

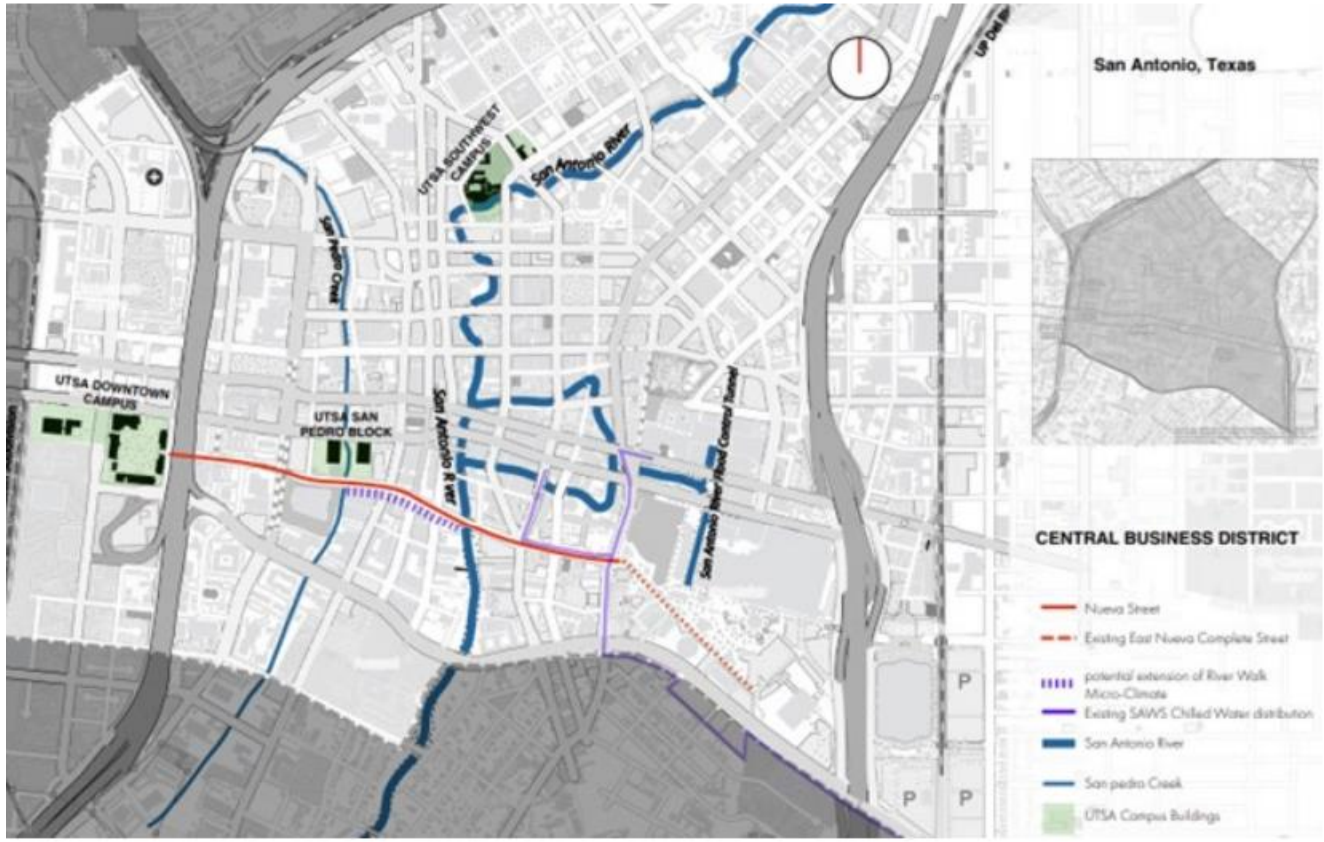
- **Market Street – Cycle Track Extension**
  - The proposed Market Street improvements is an extension of the Dolorosa project to improve pedestrian and bicycle access from S Flores St to the I 37 Access Rd.
  - Proposed improvements to include vehicle signals, pedestrian signals, bicycle signals, improved cycle track, and improved sidewalks.



NUEVA NUEVA PLANNING STUDY

PAPE–DAWSON

- **Climate-Resilient Cooling Corridor To Help Facilitate Movement Between The Campuses And Other Downtown Areas**
  - The study will be completed along Nueva Street from the Buena Vista Campus, along the San Pedro Campus, to the Hemisfair.



Key Findings

The University is a Driver of Economic Impact

Providing network effects, the university can provide leading thinkers, appropriate upskilling and reskilling training, and a pipeline of human talent to the commercial enterprise market. Powerhouse and established markets often have large and diverse company clusters, and higher concentrations of sector talent typically form around pre-eminent universities that invest in innovative programs.

San Antonio will Continue Robust Growth

San Antonio's growth in population and jobs is estimated to continue its above average statewide and nationwide growth. The top ten high-growth job classifications requiring a bachelor's degree over the next decade fall within four sectors: healthcare, computer sciences, management, and financial, aligning well with existing programs and offerings at UT San Antonio.

San Antonio is an Education Market

San Antonio stands out in terms of affordability and cost-effectiveness, providing higher favorability to larger, more established markets and is evolving from a startup city into a regional innovation hub. However, (in high-tech in particular) it is still considered an education market; those with more degree graduates than jobs.

The Downtown Districts provide a Collaborative Base for an Innovation Ecosystem

Innovation ecosystems work because they intentionally combine people, ideas, capital, and place. When curated with inclusive intent and supported by evidence-based design and governance, they become reliable engines for discovery; an outcome that can be realized through intentional strategies embedded in the university planning process.

Innovation Ecosystems

Innovation ecosystems combine *economic*, *physical*, and *networking* assets under a supportive, risk-tolerant culture, to accelerate idea generation and commercialization. This model has emerged globally in “innovation districts” typically anchored by universities, medical centers, research institutions, and industry. Practical, high-performing ecosystems are structured learning communities that intentionally mix anchor institutions, startups, corporates, capital, shared labs, test beds, and inclusive workforce programs, activated by year-round programming in vibrant, amenity-rich places. Interdependencies are the engine: dense, walkable settings heighten knowledge spillovers; shared infrastructure lowers barriers to experiment; curated programming builds strong/weak ties; capital providers plug into deal flow; and inclusive talent pipelines sustain growth. These purposefully planned and executed hubs drive faster discovery (open innovation, collisions, living labs), broader societal benefits (inclusive jobs, digital equity, neighborhood revitalization, sustainability), and measurable economic gains (job creation, higher productivity with density, firm formation, tax base growth).

System Dynamics - How the Parts Interrelate

- **Anchors** conduct research, generate intellectual property and talent; startups and spinouts emerge; corporates co-locate for open innovation.
- **Shared labs and test beds** lower capital barriers, enabling rapid prototyping and cross-disciplinary experimentation.
- **Physical density and walkability** amplify chance encounters and localized knowledge spillovers; proximity matters for both labs and people.
- **Programming** stitches communities: strong and weak ties accelerate information flow, partnerships, and team formation.
- **Capital providers** plug into the pipeline (accelerators → seed → venture → corporate partnerships) as deal flow becomes visible and de-risked.
- **Governance** (University, Government, Industry, and Integrators) coordinates zoning, infrastructure, brand, and inclusive growth commitments, keeping the ecosystem balanced.
- **Inclusive talent pipelines** supply skills for lab techs, digital roles, and operations—broadening participation and stabilizing growth.

Innovation Ecosystems

Summary Table – Components, Roles and Sample Indicators			
Component	**Role in the Ecosystem**	**Examples**	**Sample Indicators**
Anchors & Firms	*Generate Research, Talent, Demand; Co-Innovate*	*Universities, Academic Medical Centers, Corporates, Small-Medium Size Enterprises*	*Research & Development Spend, Patents, Spinouts, Knowledge Jobs Creation*
Cultivators	*De-risk and Accelerate Ideas*	*Incubators, Accelerators, Shared Labs*	*Startup Count, Survival Rate, Shared Lab Utilization, Time to Prototype*
Capital	*Finance Research, Startups, Place*	*Seed Funding, Venture Capital, Corporate Ventures, Grants, Tax Increment Financing, Philanthropy*	*Funding Invested by Stage, Leverage Ratios, Pipeline Conversion Rates*
Physical Realm	*Enable Proximity and Collisions*	*Active Ground Floors, Living Labs, Connectivity, Transit*	*Micromobility Share, Footfall, Collision Space Hours, Geofencing*
Networking & Programming	*Build Strong and Weak Ties*	*District Events, Meetups, Lectures, Hackathons, Competitions*	*Event Cadence, Network Density, Partnership MOU's*
Talent & Inclusion	*Grow and Diversify Workforce*	*Apprenticeships, Jobs, Educational Pathways*	*Local Hires, Credential Completions, Wage Gains, Degree Earning Import/Export Ratio*
Sustainability & Wellness	*Future Proof and Attract Talent*	*Electrification, Biophilia, Active Mobility*	*Energy Intensity, Greenhouse Gas Emissions, Indoor Air Quality, Open Space per Capita*

Downtown Partnerships Study

Partnership Approach

Unlocking Potential: Three Considerations that Reveal Opportunity

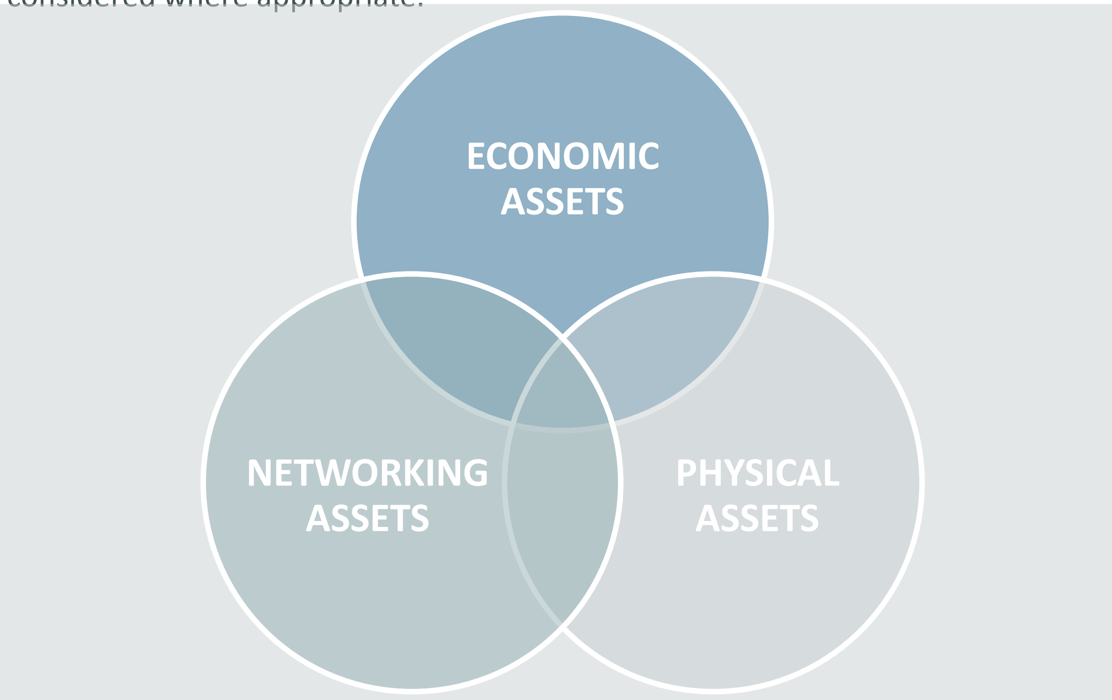
Discover Alignment Between the Real Estate Strategy and the Organizational Strategy	Strategic Planning Supports Shifting Priorities	Operational Framework for Strategic Risk-Adjusted Execution
Facilities should directly support the mission of the university, including partnering with and serving the local and global community.	Establishing a vibrant environment that strengthens the university's instructional and research foundation while enabling the campus to adapt to evolving research program needs.	Leveraging Public-Private Partnerships to distribute financial, operational and performance responsibilities, and enhancing flexibility for long-term requirements.

Recommendations and Prioritization

Strengthen the Collaborative Infrastructure

As the various Districts are integrated into the fabric of the downtown community, so should the opportunity to integrate the educational functions and university research with affiliated enterprises to form joint research, internship opportunities for students, scholarship and endowment funding and other cooperative relationships.

Co-located commercial enterprises should include functions of instruction or research that are currently conducted or desired on campus, and a diversity of anticipated activities such as research and product development, production, assembly and testing, pilot manufacturing along with related support services should be accommodated. Ancillary uses that support a community and campus environment such as retail, dining fitness or other related activities should be considered where appropriate.



Recommendations and Prioritization

Academic and Instructional Needs

Development of multi-use academic and research centers of excellence (#4, #8, #9)

- Provide accommodation for start-up creation: incubators, accelerators and graduate space.
- Avoid enterprise level commitments that would displace a disproportionate amount of availability.
- Consider partnerships with private firms to develop, lease and operate facilities on university property, leveraging their strategic innovation networks to draw from worldwide connections.

Colocation Data Center

- With the creation of the new College of AI, Cyber and Computing within the San Pedro District, providing data center infrastructure to accommodate commercial enterprise or extending the capabilities of the university capacity should be considered. Review utilizing a private partner to develop, lease and operate a facility within the San Pedro District that could provide a fifteen-to-twenty-megawatt facility - (#5).

Housing Options

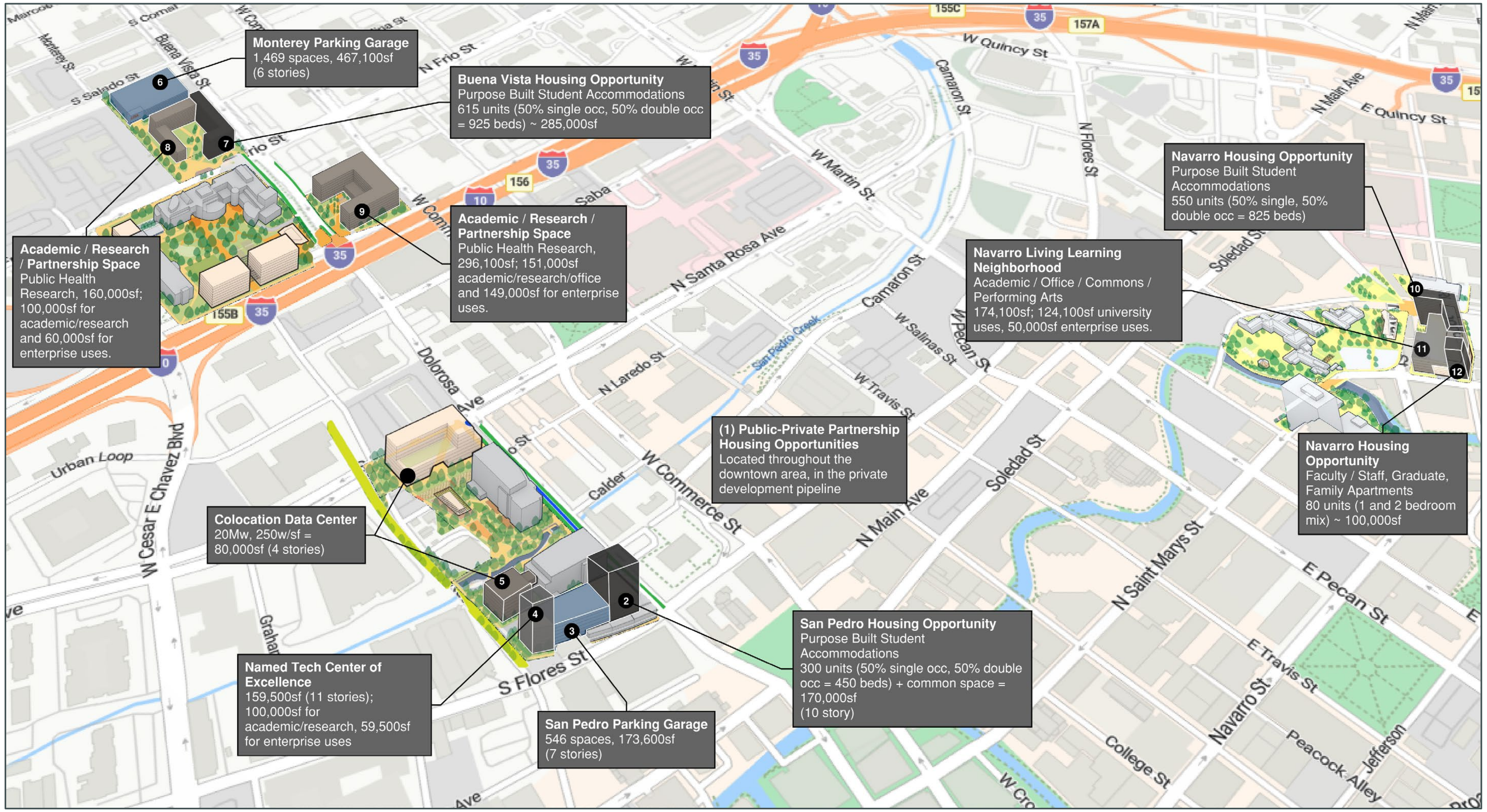
- Accommodate the immediate housing deficiency for purpose-built student housing as indicated in the JLL Housing Study of 400-600 beds utilizing private partners within the San Pedro and Southwest Districts - (#1, #2).
- Upon conclusion of a complete housing needs study, consider additional purpose-built student housing at the Southwest and Buena Vista Districts, providing for a variety of housing options within or near each District - (#7, #10, #12).

Parking Requirements

- As a capital-intensive necessity, study the potential for private infrastructure partnerships to develop and operate the new required parking structures at the San Pedro and Buena Vista Districts - (#3, #6).

Downtown Partnerships Study

Recommendations and Prioritization



Recommendations and Prioritization

Operational Considerations

- Provide a centralized portal for ecosystem participants, that will build visibility and connectivity to potential new connections and partnerships, as well as resources available to promote organizational advancement.
- Designate a lead for corporate strategy and engagement
- Connection of on-campus resources (faculty, research labs, and students) to compatible, committed industry partners with a formalized corporate affiliation program.
- Encourage and support connections between the programs and ecosystem infrastructure by building relationships with venture capital, specialty equipment, and supply chain resources.
- Foster community engagement with a collaborative platform for curated programming, outreach efforts and places to gather and produce intentional collisions of multi-disciplinary professionals.
- Determine a feedback architecture to determine how to regularly adjust and enhance instructional and research programs to efficiently partner with commercial enterprises and provide a climate that will enhance private support for university research, graduate fellowships, and classroom to career opportunities.

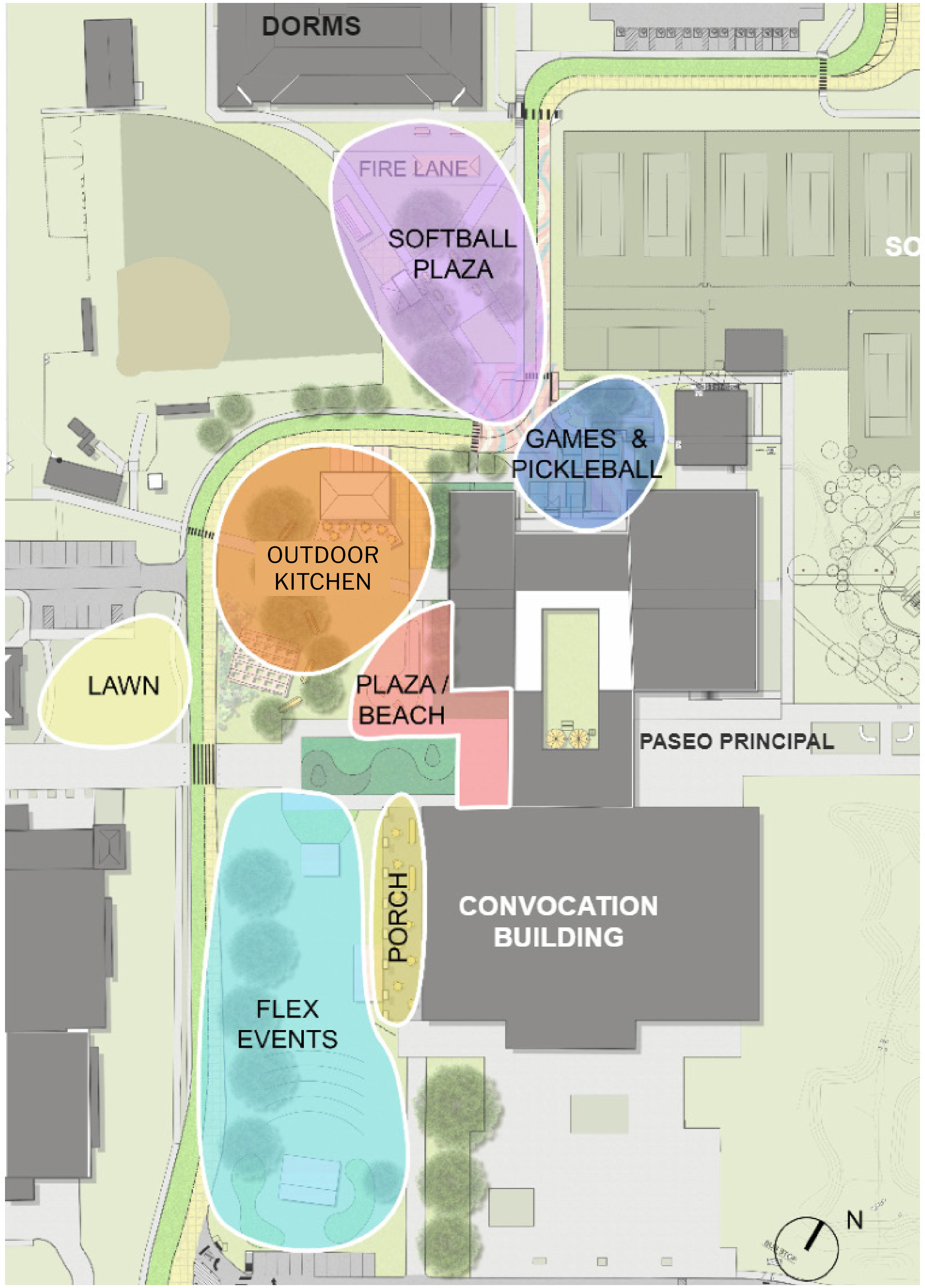
4.2 Main Campus

Main Campus Proposed Placemaking Interventions

These recurring themes from the engagement process formed the foundation for a set of clear goals to guide placemaking on the Main Campus. By translating community insights into actionable objectives, the project team was able to define a series of proposed interventions that reflect the values, needs, and aspirations of the UTSA community. The following concepts are designed not only to bring life to currently underutilized spaces, but also to foster a more connected, inclusive, and dynamic campus environment.

Placemaking projects have following goals:

1. Create places that build UTSA Campus Culture
2. Facilitate bonding & friendships
3. Provide therapeutic spaces that provide relief from campus hardscapes
4. Showcase student/faculty talent & programs
5. Offer a variety of passive & active spaces
6. Incorporate sustainable practices & materials
7. Emphasize fun, food and flexibility



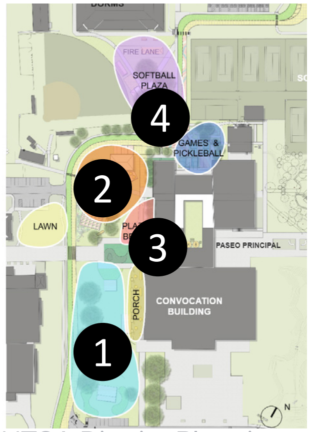
Main Campus Proposed Placemaking Interventions

1. The Event Lawn

Located west of the Convocation Center, this flexible lawn space and stage will host performances, movies, and events sponsored by both students and staff. The proposed improvements to enable the lawn to be better utilized are:

- a stage facing the lawn, so that the lawn itself can provide audience seating
- shaded lounge seating under “The Porch” (the Convocation Center overhang)
- projection capability for curated art on the Convocation Center wall

The Department of Music will a key programming partner, along with Student Services and student organizations.

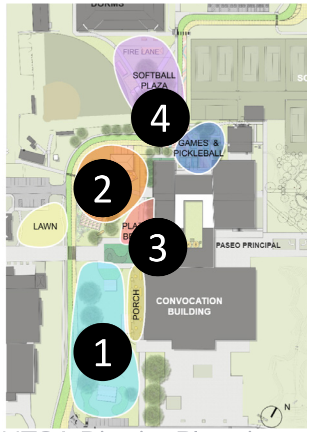


Main Campus Proposed Placemaking Interventions

2. Mom's Kitchen

Envisioned as a "home away from home," Mom's Kitchen offers comfort food, casual seating, and programming designed to build friendships. Programs will include small performances and lectures, game nights, speed-friending events, make-your-own pizza night, and other curated activities meant to facilitate the creation of new friendships.
Mom's surrounding environment will feature:

- communal table seating
- hammocks under the trees
- a large solar canopy providing shade and generate electricity

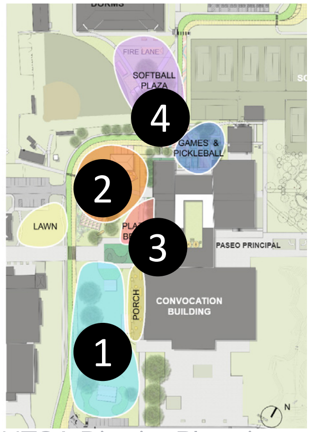


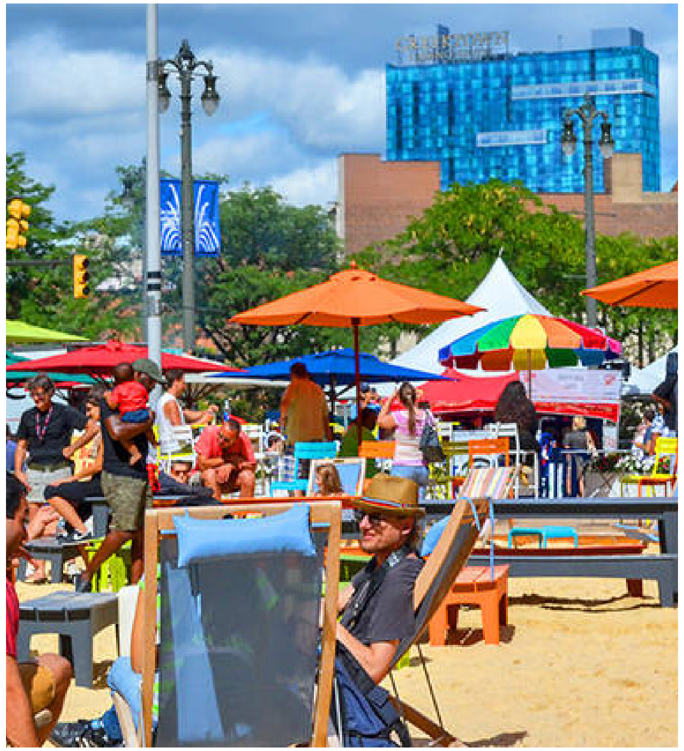
Main Campus Proposed Placemaking Interventions

3. The Beach

This informal, flexible gathering spot with support student-led events, installations, markets, outdoor classes, and parties. Features will include:

- beach area with lounge seating
- shade and waterspray elements
- power outlets for music, devices, and event equipment
- flexible layout for pop-ups, markets, classes, and parties





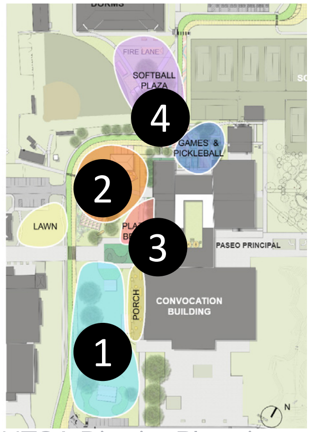
Main Campus Proposed Placemaking Interventions

4. Softball Field Popup

Adjacent to the softball field, this shaded lawn is envisioned as a multifunctional space that provides bleachers for ballgames, active exercise and games, and a study lounge on quieter days. Features should include:

- bleacher seating with options for a coffee or beer cart
- electric grills and picnic tables for informal gatherings and dinner parties, conveniently located next to the dorms.
- dual function as a study zone and game-day hangout

A nearby paved area across Brenan Avenue will be activated with pickleball courts and a garden, serving as a gateway to the Student Union shortcut



Institutionalizing Placemaking

Organizational Culture and Capacity

The Brenan Avenue project served as a catalyst to launch a broader cultural shift at UTSA. A new Placemaking Council has been formed to coordinate the activation and stewardship of the Brenan Avenue projects and to guide future placemaking initiatives. The Council will play a critical role in embedding placemaking practices into campus operations and strategic planning.

Benchmarking Excellence

One example of how another university has embedded Placemaking into its daily operations is Harvard university. Over the past decade, Harvard's Common Spaces Initiative has transformed key areas of campus into vibrant social environments. Through seasonal programming, flexible furniture, and curated cultural events, Harvard has created destinations that celebrate community life, improve well-being, and activate underused public space. UTSA's placemaking efforts build on these national best practices while responding to the unique culture and needs of its own campus community.

Wet Lab Study

Executive Summary

UTSA's wet and dry laboratory spaces currently face challenges related to long-term functionality, flexibility, and research support. Outdated layouts, mismatched lab typologies, and limited adaptability constrain many labs, despite their active and productive status. We conducted a comprehensive assessment through building walk throughs of 11 facilities (shown on slide 4), Principal Investigator (PI) and lab team surveys, and reviews with academic leadership, which highlighted opportunities to better align lab space with current and future research activity, considering UTSA's planned growth of about 25%.

We propose a strategic path forward built on three scalable planning scenarios:

- **Baseline Scenario**
  This will align space use with lab typologies while minimizing physical building reconfiguration. This scenario relocates office and write-up spaces out of high-cost single-pass air zones and requires some targeted mechanical system upgrades. This approach achieves adequate utilization and reduces some operating inefficiencies.

- **Strategic Optimization Scenario**
  This will enhance space efficiency, consolidate shared lab functions, and plan for an average lab team of PI+4. This scenario remains within the footprint of existing wet lab space while meeting benchmarking targets for assignable square footage per PI.

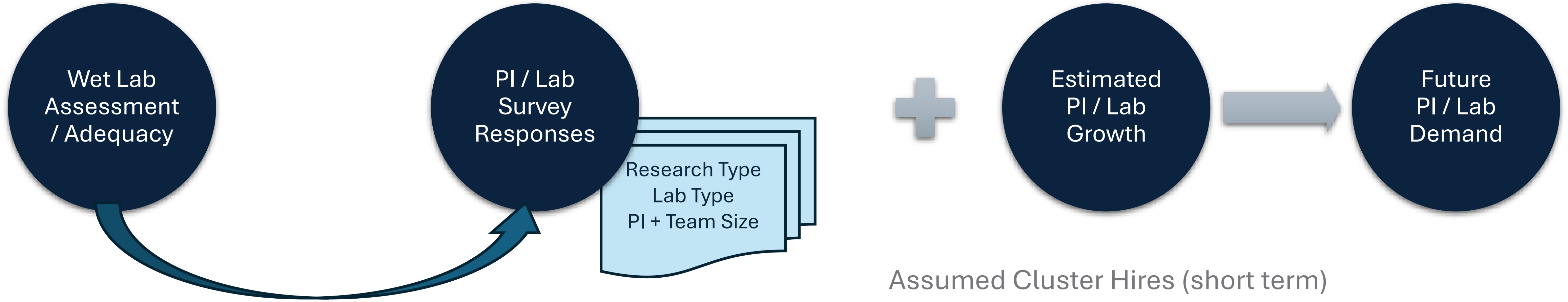
- **Visionary Expansion Scenario**
  This scenario aims for the most aggressive growth by expanding beyond existing lab footprints to maximize flexibility and future capacity. We will consolidate write-up areas and design 25% of the labs to accommodate larger research teams (PI+6), thus increasing density and functional adaptability in line with R1 status.

Across all scenarios, we project a need for 141 to 184 additional wet and dry PI labs, depending on investment levels. Each scenario includes strategic upgrades to core facilities, including but not limited to—fabrication, advanced microscopy, and BSL2/3 animal research—to support modern research functions.

Recommended Path Forward
We estimate the need for 250 to 340k GSF of new building space (equating to two or three new buildings) along with renovation of AET, BSE, and BSB over the next 10 years. AET emerges as the recommended starting point for renovation due to its structural grid and overall footprint, which best supports conversion to modern, open, flexible laboratory environments. It is important to note that there are short term optimization steps required to accommodate the initial growth of PI/labs until the first new building is completed and the AET is renovated. Subsequently, BSE and BSB would be renovated and the second new building completed by end of 2035.

Wet Lab Study

PI / Lab Counts & Future Projection



Current PI / Labs

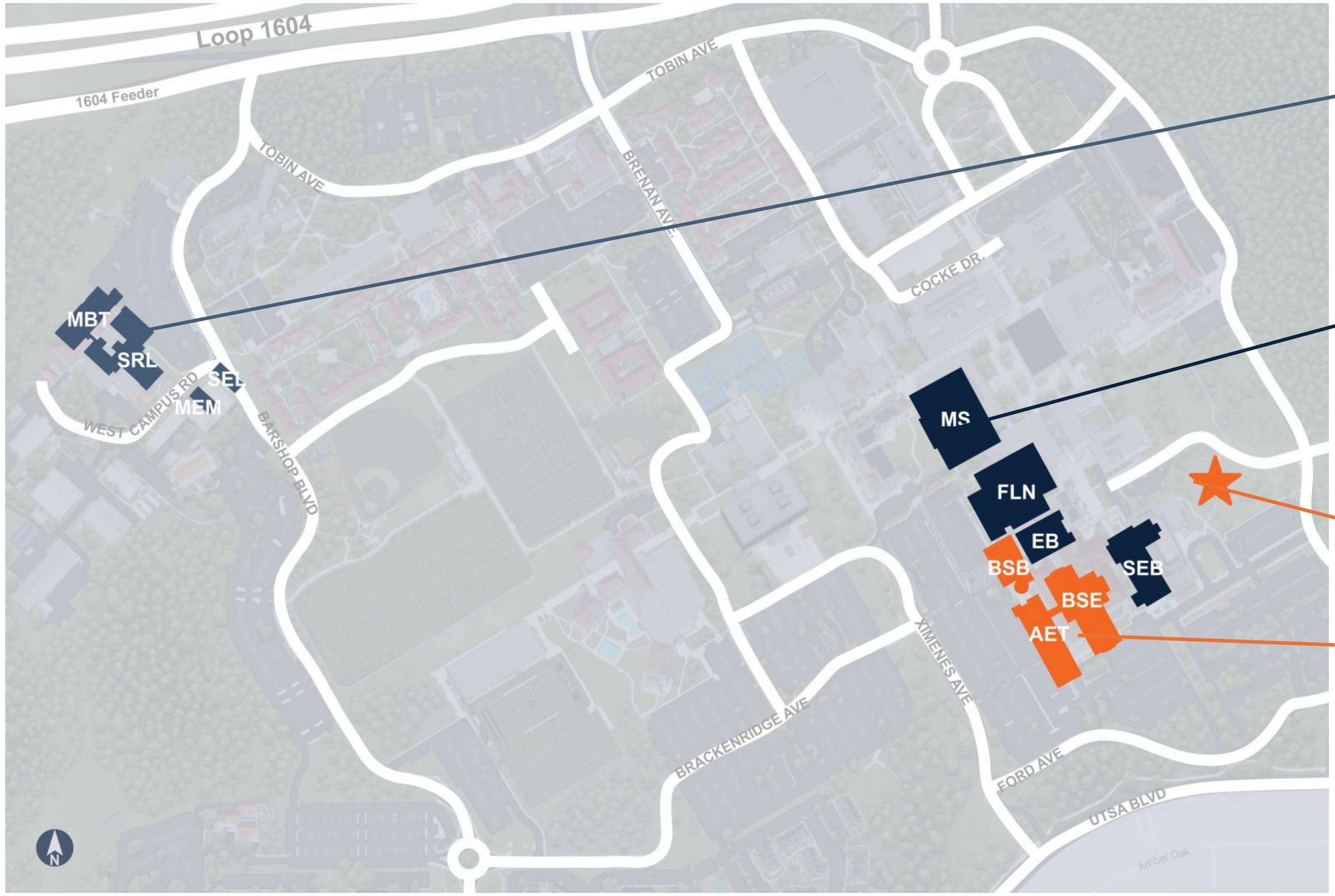
Assumed Cluster Hires (short term)
Growth 25% (long term)

Lab use	Lab type	COS	KCEID	Others	CORE	Growths	Future Demand
High chemistry usage Chem. / Biology use	A	54	11	0	0	26	**91**
Heavy instrumental Light Chemical use	B	64	38	4	0	36	**142**
"Dry" / Robotics Computational use	C	9	24	0	0	13	46
Specialty / LARC / CORE / unique use	X	3	2	0	13	4	**22**
Subtotals			**222**			**79**	**301**

3

Wet Lab Study

Lab Buildings Assessment | Main Campus



MBT & SRL
- Remove wet labs over time

MEM & SEL
- Specialty labs to remain

MS & FLN
- Remove wet labs over time, keep CORE

EB & SEB
- Good conditions / to remain

New Buildings

AET, BSB & BSE
- Building with highest potential addressed in scenarios studied

Wet Lab Study

Wet Lab space to be discontinued in select buildings

- FLN and MS: All wet lab use should be discontinued given the constraints of limited building infrastructure and limited structural floor to floor height. Only Core Facilities and Dry Labs use should be continued. That frees up space in the Campus Center for future non-wet lab uses (17,800 ASF).

- MEM: The makeshift clean room in the warehouse-like building should be moved into a new building with purpose-built clean room facilities. The building offers specialty project / short term / warehouse like non-wet lab space (4,000 ASF).
- SEL: This facility is recommended to continued use for specialty project / warehouse-like lab use (the current wave tank).

- MBT and SRL: Due to the aging building condition, infrastructure limits, and its remote location, all lab use should be discontinued. The building footprint lends itself to higher and better land use in the future (35,600 ASF). Additionally, the BSL lab certification expires 2028.

	Remain Type C	Remain Type X	Type A	Type B	Type X	Type C & Other	Subtotal Available	Subtotal Demo
FLN	6,000	4,000	10,600		3,700		**14,300**	
MS	6,400			3,500			**3,500**	
MEM					2,000	2,000	**4,000**	
MBT			5,500	5,800	950	3,650		**15,900**
SRL			4,600	6,100	5,300	3,700		**19,700**

5

Wet Lab Study

Renovation opportunities by Scenario – AET building

BASELINE UTILIZATION

AET - PI total: 8 PI's, 27 PI's

- Minimal wall changes
- **Move existing offices/write-up out of the wet labs** (into clean air)
- **Aligns use to the lab type**
- Requires building MEP upgrades

STRATEGIC OPTIMIZATION

AET - PI total: 6 PI's, 32 PI's

- **Aligns ASF with benchmarking**
- Stays within the bounds of existing wet labs
- **Creates flexible shared labs**
- Assumed 100% PI+4 group size
- Increases space efficiencies

VISIONARY EXPANSION

AET - PI total: 6 PI's, 48 PI's

- Maximizes lab space by pushing write-up outside the bounds of existing wet labs
- **Creates flexible shared labs**
- **Introduces 25% PI+6**
- Maximizes space efficiencies

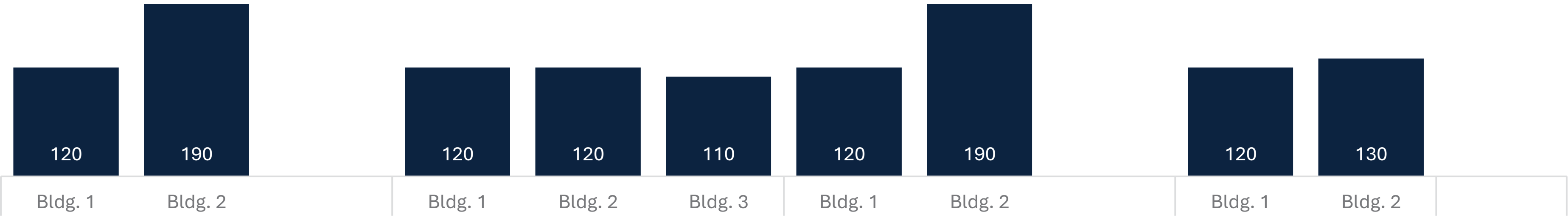
Wet Lab Study

Loss of opportunities – if no action taken

- Without strategic investment, UTSA risks continued inefficiencies and growing constraints on its research capacity. Researchers currently have limited spare research footprint available. Existing limitations in infrastructure, including outdated mechanical systems and inflexible lab layouts, increasingly hinder the support for modern research methods and interdisciplinary collaboration. Deferred action could lead to the loss of key research assets such as BSL3 research capacity and animal facilities, which researchers must upgrade or replace to remain compliant and operational. This scenario would not only reduce research competitiveness but limit the university's ability to attract and retain top-tier faculty and funding.
- Additionally, the lack of a clean room facility limits the university's ability to support a research and development arm that could collaborate directly with the engineering program and advance high precision, applied research initiatives.
- Each proposed scenario requires further evaluation of building suitability, infrastructure capacity, and system performance to ensure successful implementation and long-term viability.

Wet Lab Study

New Building Requirements



	PRE-BASELINE 153 Wet & Dry Labs	BASELINE SCENARIO 184 Wet & Dry Labs	OPTIMIZATION SCENARIO 160 Wet & Dry Labs	VISIONARY SCENARIO 141 Wet & Dry Labs
A&B :Wet Research Lab C: Dry / Computational Labs X: CORE: Fabrication, Adv. Microscopy Animal / BSL 2 &3	119k ASF 33k ASF 34k ASF	100k ASF 73k ASF 34k ASF	87k ASF 63k ASF 34k ASF	67k ASF 50k ASF 34k ASF
ASF Subtotal **GSF @ 60% ASF**	185k ASF **310k GSF**	205k ASF **340k GSF**	185k ASF **310k GSF**	150k ASF **250k GSF**
New Bldg. 1 (~200M TPC) * New Bldg. 2 (~200M+ TPC)* New Bldg. 3	120K GSF 190K GSF	120k GSF 110k GSF 110k GSF	120k GSF 190k GSF	120k GSF 130k GSF

Pre-Baseline represents the additional labs / buildings required if no renovation would take place, to accommodate the future growth

Current "wet" lab buildings to be addressed in Scenarios:
MBT and **SRL** to be vacated, enabling alternate land use in the future
SEL and **MEMS** only for specialty functions, alternate land use in the future
FLN and **MS** to remain, but remove all Wet Labs, except CORE facilities
SEB and **EB** to remain as is
AET, **BSB**, **BSE** to be renovated based on various scenarios

Assumptions:
* Building Gross Area is based on a potential TPC of 200M USD (in year 2025 dollars), ultimate GSF is driven by available / allocated funding.
Most CORE functions prefer ground level locations, and are likely in building 1, in addition consider some outdoor / yard and significant loading dock functionality.
Location of new buildings recommended in proximity to AET, BSB and BSE.
These figures have not been approved by leadership.

Wet Lab Study

New Building and Renovation Timeline for Optimized / Visionary

<table>
<tr><th>Year</th><th colspan="2">2025</th><th colspan="4">2026</th><th colspan="4">2027</th><th colspan="4">2028</th><th colspan="4">2029</th><th colspan="4">2030</th><th colspan="4">2031</th><th colspan="4">2032</th><th colspan="4">2033</th><th colspan="4">2034</th></tr>
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<tr><td>New Buildings</td><td colspan="38"></td></tr>
<tr><td>New Building 1 (120K GSF)</td><td colspan="7">AE RFQ, Programming, Design</td><td colspan="8">Construction</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>New Building 2 (190K GSF or 130K GSF)</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td colspan="6">AE RFQ, Programming, Design</td><td colspan="8">Construction</td><td colspan="2">Addtl. Time for 190K GSF</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Renovations</td><td colspan="38"></td></tr>
<tr><td>AET (~70k SF L1, L2, L3)</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td colspan="5">AE RFQ, Programming, Design</td><td colspan="5">Construction</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>BSE (~80k SF L2, L3, L4)</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td colspan="5">AE RFQ, Programming, Design</td><td colspan="5">Construction</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>BSB (~35k SF L1, L2, L3)</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td colspan="4">AE RFQ, Programming, Design</td><td colspan="4">Construction</td><td></td></tr>
<tr><td>Short Term Optimization Required</td><td colspan="38"></td></tr>
<tr><td>Accommodate changes/additions prior to New Building 1</td><td></td><td colspan="12">On-going Design and Construction</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

Notes

- New Building 1 must be completed before existing building occupants can move into it, which is necessary prior to commencing renovations.
- The optimized scenario anticipates that New Building 2, at 190K GSF, will have a longer timeline (as indicated by the hatched bar).
- Both New Buildings require approval by the Board of Regents at the end of Schematic Design (SD) and Design Development (DD) phases.
- Renovation projects require approval by the Board of Regents at SD and the President of UTSA at DD. Changes in approval requirements may impact design phases.
- There is a one-quarter lag between the completion of New Building 1 and the demolition and renovation of AET to accommodate occupant relocation and building readiness.
- AET is prioritized for renovation first due to the significant increase in PI/labs in the Visionary Renovation Option.
- The construction team is assumed to be onboarded during the design phase. Construction timelines may shorten if early packages are permitted.
- Due to the age of AET, BSE, and BSB, it is assumed no hazardous materials are present. If discovered, the construction timeline may extend.
- Construction of New Building Project 2 is assumed to commence after the completion of AET renovations to minimize campus disruption. New Building 2's timeline could be accelerated if desired, with design occurring concurrently with New Building 1 construction.
- The start of BSB renovation design is assumed to begin after New Building 2 occupancy, due to the potential impact of programs in the renovated AET and BSE, as well as New Buildings 1 & 2.
- To accommodate the ongoing PI/labs growth, short term optimization of existing labs are required to provide labs space for new PIs to start prior to new construction and some of the renovation been completed.

11

Main Campus MEP Utility Assessment

Stanley Consultants INC.

Connect. Create. Contribute.

Campus Utility Assessment Report

University of Texas at San Antonio

Final

January 31, 2024

UTSA

The University of Texas at San Antonio™

Section 1 Executive Summary

The University of Texas at San Antonio (UTSA) recognizes the importance of a robust and sustainable utility infrastructure to support its growth and development. In line with this vision, UTSA commissioned a comprehensive Campus Utility Assessment Report to evaluate the existing chilled water, heating hot water, steam, natural gas, and electric systems. This Executive Summary provides a concise overview of the findings and recommendations from the assessment, highlighting the current capacities, potential challenges, and opportunities for improvement in each utility system. By addressing these key areas, UTSA aims to ensure the reliability, efficiency, and resilience of its utility infrastructure, supporting its commitment to sustainability and meeting the evolving needs of its campus community.

1.1 Chilled Water System

Assessment of UTSA's chilled water capacity reveals that it is currently sufficient to meet both existing and near-future demands. The estimated peak design load of 12,287 tons for the chilled water system exceeds the firm capacity of 11,880 tons, but the actual campus chilled water peak load is 8,000 tons, which is well below the firm capacity. Additionally, the total chiller water plant capacity of 14,380 tons exceeds the estimated peak design load, indicating adequate redundancy and capacity.

At the NTEP, the firm chilled water capacity is 7,000 tons, and it can be met with the individual firm capacities of the chilled and condenser water pumps and cooling tower. The flexibility of these systems allows for adjustments based on specific requirements. At the STEP, the firm chilled water capacity is 2,880 tons, and it also can be met by the individual firm capacities of the chilled and condenser water pumps and cooling tower. However, the STEP's pumping systems are less flexible compared to the NTEP's systems.

The NTEP is equipped with 24-inch chilled water supply and return mains, limiting the maximum flow to 20,000 gallons per minute (gpm) to prevent damage to pipes and fittings. Standardizing on five 2,500-ton chillers is a potential solution to reach a cooling capacity of 12,500 tons, given that Chiller Nos. 1, 4, and 5 are nearing the end of their service life. Upsizing cooling towers will be necessary for full system build-out along with associated upgrades to pumps, piping, and electrical systems.

The STEP features 36-inch chilled water supply and return lines, accommodating a maximum flow of 58,000 gpm. The limiting factor is the cooling towers, which have a maximum capacity of 9,780 tons at full build-out. Standardizing on six 1,630-ton chillers is suggested to match this capacity, and the existing expansion bays allow for future growth.

Expanding the distribution network should involve pre-insulated direct-buried pipes organized into interconnected loops. These loops offer redundancy, ensuring continuous thermal utility supply during maintenance or repairs. It is recommended to maintain conservative sizing for the chilled water loops to prevent high water velocities and flow "choke" points.

1.2 Heating Hot Water System

The current heating hot water capacity within the STEP is adequate to fulfill the heating hot water demands of the campus, both presently and in the near future. The STEP is currently equipped with three heating hot water boilers capable of reaching a peak capacity of 66,970-MBH, with a firm capacity of 40,170-MBH.

Main Campus MEP Utility Assessment

Importantly, the existing heating hot water system incorporates sufficient redundancy, as the loss of one of the 26,780-MBH boilers would not impede the plant's capability to meet the current campus heating hot water peak load, which measures 36,659-MBH.

As the campus continues to expand and heating hot water demand increases, the immediate plan involves replacing Boiler No. 2 with an 800-BHP boiler, given that HWP No. 2 possesses the necessary capacity for such an upgrade. The service history of the STEP boilers is as follows: Boiler No. 1 has been in operation for 16 years, Boiler No. 2 for 19 years, and Boiler No. 3 is set to be commissioned later this year. With an expected service life of 25 years and ongoing maintenance, the boilers are anticipated to operate reliably until the end of their designated service life. The STEP firm heating hot water capacity is 40,170-MBH and can be met with the firm capacity of the heating hot water pumps.

STEP's heating hot water supply and return mains are 24 inches in diameter, enabling a maximum flow of approximately 20,000 gpm. These 24-inch mains have the capability to support a maximum STEP capacity of 201,733-MBH with a temperature differential (ΔT) of 20°F. Standardizing on three 2,000-BHP boilers to produce 200,828-MBH at a ΔT of 20°F is a potential solution if the campus heating hot water system continues to grow. However, such expansion would require increased space, along with upgrades to natural gas, pumping, and piping capacities.

At present, the heating hot water demand is relatively small, serving only three buildings. As the distribution network expands, it is advisable to construct new piping using direct-buried interconnected loops with sufficient insulation. This approach helps limit heat loss from the pipes, maintain system efficiency, and control construction costs. Interconnected heating water loops offer redundancy by providing two mains, ensuring the supply of thermal utilities remains uninterrupted during maintenance or repairs. It is crucial to size the heating hot water loops conservatively to avoid high water velocities and flow "choke" points.

Heating hot water generation is a favorable choice over steam systems for large university campuses due to its energy efficiency, lower emissions potential, and adaptability to renewable energy sources. However, it is imperative to assess the specific needs and constraints of the campus, align options with the University's sustainability goals, and consider financial considerations. Further investigation into the expansion of the heating hot water system is recommended as part of the utility master planning effort in the future.

1.3 Steam System

Steam needs are effectively met by the existing steam capacity at the NTEP. The plant operates three reliable steam boilers, each with a capacity of 26,780-MBH, resulting in a total plant capacity of 80,340-MBH. The firm steam capacity of 53,560-MBH ensures operational resilience, enabling UTSA to meet peak campus demand, which stands at 44,755-MBH, even in the event of a malfunction in one of the boilers. This system redundancy is a key asset in ensuring uninterrupted steam supply.

The steam distribution system at UTSA, consisting of utility tunnels, crawl spaces, and shallow trench boxes, is in good condition and effectively returns approximately 90% of the produced steam as condensate. This efficient utilization of steam is a testament to the well-maintained and reliable infrastructure in place. However, it is important to note that Condensate Pump No. 3 is currently beyond its service life and should be considered for replacement to maintain the system's reliability and efficiency.

While many universities are transitioning away from steam-based systems due to environmental concerns and cost savings, UTSA's legacy infrastructure and reliance on steam for various processes present unique challenges to complete replacement. The transition to more sustainable and energy-efficient alternatives will require careful planning, time, and allocation of resources. The specific strategies and technologies chosen for this transition should align with UTSA's goals, unique circumstances, and available resources. Furthermore, this transition should be integrated into a comprehensive sustainability plan for the entire campus, encompassing not only heating systems but also other steam-dependent processes.

Given the complexity and long-term implications of transitioning from steam systems, it is recommended that further investigation into the disposition of the steam system be conducted as part of the utility master planning effort in the future. This proactive approach will enable UTSA to make informed decisions regarding the future of its steam-based infrastructure and align it with the institution's evolving sustainability goals and energy needs.

1.4 Natural Gas System

The health of the natural gas system is of paramount importance due to its role as a vital source for other campus utilities (hot water, steam, and emergency generation). Currently, the existing natural gas distribution network can meet the campus's demands under normal day-to-day operations. The 8-inch gas main feeding the three meters (Meter No. 3, No. 4, and No. 10) can support an additional 55,575 CFH in building demands before exceeding a maximum recommended design velocity of 60 fps. Therefore, upgrading this pipeline is not currently necessary, unless future developments on campus increase demand beyond this limit. However, considering that this pipeline is the sole CPS Energy pipeline feeding these meters, it might be prudent to explore alternatives for increased redundancy.

In-depth analysis indicates that during worst case normal operation (Scenario 1) or under the extremely unlikely (yet still possible) event of a full campus power outage and peak demand (Scenario 3); certain areas of the campus may experience insufficient gas pressure. Considering recent events in Texas, which increase the likelihood of these situations occurring, it is advisable to conduct a review of these areas prior to future expansions. Conducting a review now would allow for a better understanding of the current system's limitations and potential vulnerabilities. This proactive approach will inform more strategic decision-making and planning for any future expansions or modifications, ensuring the long-term health and efficiency of the natural gas system on campus.

Regarding campus expansion, the western campus area near SRL can support up to an additional 1,200 CFH before putting significant stress on the buildings during peak conditions. Similarly, expansion in the southwestern campus area can only sustain an additional 4,200 CFH near RWC before encountering similar challenges. Therefore, careful engineering analysis and strategic decision-making are essential for any future system expansions or modifications to avoid unwanted impacts to existing areas.

1.5 Electrical System

The existing electrical system capacity adequately meets UTSA campus' current needs. The CPS Energy substation has two transformers with a rated capacity of 30/40/50 MVA each, ensuring reliable power supply with N+1 redundancy. The campus's peak electrical load in the summer of 2019 was 17.7 MW, well

Main Campus MEP Utility Assessment

within the capacity. The main 15 kV switchgear is in good condition and can be expanded with four vertical sections on each bus side for future needs.

The 13.8kV distribution system is designed with redundancy in mind, with 9 loop feeders divided into east and west loops. Redundant switches in both loops offer fault tolerance and isolation. While some feeder cables are over 35 years old and should be replaced soon, others are around 20 years old with no recent testing. Typically, medium voltage cables are tested every 5 years. It is recommended to utilize VLF testing as it is a non-destructive and effective means of assessing the condition of medium and high-voltage cables.

Most campus buildings have secondary unit substations and receive power from two different loops, providing redundancy. However, some buildings have radial feeders, which lack redundancy.

The NTEP receives power from Loop 4/4A, but the SWGR-3 switchgear is aging and needs upgrading to enhance reliability. The STEP receives power from Loop 8/8A, which also serves other buildings. The primary protection is disabled due to the loop arrangement, posing a risk if the main breaker trips, potentially affecting half of Loop 8 therefore, it is recommended to install dedicated Loop 10/10A to serve the STEP. However, existing electrical equipment is in good condition and sufficient for future STEP expansion.

The UTSA campus's electrical system is generally reliable, but it is recommended to replace aging cables, upgrade the SWGR-3 switchgear, and add dedicated feeder Loop 10/10A to address the vulnerability of the STEP's main breaker to ensure continued dependable power distribution.

1.6 Climate Vulnerability

The Climate Vulnerability Assessment for UTSA highlights the need for proactive adaptation in response to escalating climate challenges. It emphasizes key points such as the expectation of increased heat waves and higher temperatures, resulting in greater cooling demands and energy consumption. Our review utilizes advanced climate models and emphasizes the importance of incorporating these forecasts into future campus expansion and utility planning. Our analysis covers multiple campuses, focusing on energy use intensity and the impact of temperature changes on cooling systems. The study underscores the urgency for UTSA to adapt its infrastructure and operations to ensure resilience and sustainability in the face of ongoing climate change. This involves considering future energy demands, potential increases in cooling capacity requirements, and the need for efficient, adaptable, and robust utility systems.

1.7 Downtown Campus

The Downtown Campus is planning for future growth and expansion. To meet the increased demand, a new thermal energy plant will be constructed during Phase 2, interconnected with the existing plant. This new plant will accommodate additional chillers and boilers needed for the estimated loads.

During Phase 2, three 2,500-ton chillers will be added to serve the Main Block and Cattleman's Block. The existing plant will also be expanded and upgraded. The campus-wide chiller capacity will be 15,500-tons. New heating hot water boilers will be installed to meet the heating demand. Phase 2 will also see the addition of two boilers, and a third boiler will be added in Phase 4. The campus-wide boiler capacity will be 73,646-MBH. By implementing these recommendations, UTSA will have a reliable and efficient utility system to support the future growth and development of the Downtown Campus.

1.8 Opportunities

UTSA is well-positioned to enhance energy infrastructure through various opportunities, including Combined Heat and Power (CHP), Optimization, Demand Side Management, and Electric Vehicle Infrastructure (EVI). CHP efficiently generates power and process heating capacity, with Option 4, featuring a Wartsila 20V34SG reciprocating engine, being the most favorable due to its higher electrical efficiency and lower waste heat. Option 4 has an estimated simple payback of 7.3 years, making it economically feasible.

Optimization plays a crucial role in improving the efficiency of central plant operations, particularly in the production and distribution of chilled water. By treating components as interconnected elements and utilizing variable speed technologies, optimization maximizes overall system performance. Strategies like chiller sequencing and chilled water reset can lead to energy savings and improved efficiency without significant capital outlays.

Demand Side Energy Management (DSEM) strategies aim to manage and reduce energy consumption on the demand side. Techniques like optimizing HVAC systems, implementing building automation and energy management systems, and metering at the building level help identify high-consumption areas and develop energy reduction strategies. Retrofitting and upgrading infrastructure, promoting behavioral changes, and integrating renewable energy sources are also important components of DSEM.

To achieve peak efficiency, it is crucial to align the design objectives of central plant and building systems. This involves optimizing the ΔT between supply and return water and coordinating flow rates for seamless system integration. Integration of control systems, such as plant and building automation systems, enables more responsive and adaptive operations. Energy conservation measures (ECMs), like scheduling HVAC equipment and utilizing $CO2$ sensors for demand-controlled ventilation, contribute to sustainability goals.

Furthermore, our review recommends creating and expanding EVI on the UTSA campus to promote the adoption of electric vehicles and support environmental sustainability. Level 2 charging stations are favored for their cost effectiveness and relatively high charging rate. The initial installation costs for Level 2 EVI are affordable compared to DC charging stations. Implementing EVI can serve as a progressive example for institutions and organizations seeking sustainable transportation solutions.

Overall, these opportunities align with UTSA's commitment to energy efficiency, cost savings, and environmental responsibility, while meeting the growing demand for clean energy solutions and electric mobility options.

Main Campus MEP Utility Assessment

Section 2 Introduction

2.1 Background

In the process of campus master planning, universities often prioritize building development and population growth, sometimes neglecting the necessary utility infrastructure to sustain such growth. However, UTSA took a proactive approach by commissioning a Utility Master Plan (UMP) that aligned with their planned campus expansion and improvement goals outlined in their 2019 Campus Master Plan. Initially, the focus of the project was on analyzing the utility system for the proposed campus expansion. However, UTSA decided to defer this analysis temporarily due to ongoing updates to their campus master plan. As a result, the project shifted its focus to assessing the University's existing utility infrastructure.

2.2 Scope of the Assessment

The Campus Utility Assessment Report will primarily evaluate the existing utility system, including chilled water, heating hot water, steam, natural gas, and electric. We will assess the current utility systems and infrastructure, considering their condition and capacity in relation to the existing buildings and loads they support. This assessment will cover various aspects, such as identifying the number, location, type, and size of existing buildings, determining the capacities and locations of existing utilities, thermal energy plants, and distribution systems, evaluating the remaining useful life of these systems, estimating their remaining spare capacity, and analyzing the existing loads on these systems and their respective locations.

2.3 Objectives and Goals

Over the past several years, the University has been implementing and constructing projects to improve thermal energy infrastructure, guided by three main principles:

- **Enhance Reliability:** Improve system reliability and create redundancy to better manage risks.
- **Promote Sustainability:** Encourage responsible energy use.
- **Facilitate Growth:** Operate and expand thermal energy production and distribution systems to support future growth.

This assessment will serve as a strategic roadmap to help UTSA achieve these objectives and goals, ultimately contributing to the University's long-term success and sustainability.

Section 3 Methodology

3.1 Approach

The Campus Utility Assessment Report evaluates the existing chilled water, heating hot water, steam, natural gas, and electric systems, as well as their distribution systems. The analysis considered factors such as age, condition, capacity, and efficiency of the generation equipment, and age, condition, reliability, and capacity of the distribution systems. The assessment also examined the ability of these utility systems to meet current campus needs and accommodate future growth. Recommendations are provided to address any deficiencies or limitations in the existing infrastructure and ensure reliability.

3.2 Data Collection

Prior to the start of the assessment, we submitted a Request for Information to gather relevant data such as Thermal Energy Plant drawings, utility data, including metering and billing data, existing building utility consumption, monthly usage and peak demands, and load profiles, where available, utility maps, and basic one-line diagrams of all major utilities and their respective distribution systems.

3.3 Planning Criteria Development

After completing the data collection phase, we arranged a site visit, which encompassed a project kick-off meeting, a charrette involving both stakeholders and end users, and the collection of field data. Key University stakeholders and the Project Team attended to provide their input and get buy-in. The effort included review of available information provided during the Data Collection Phase.

Existing conditions were the state of all utilities at the start of a two-day charrette on May 3, 2023. The two-day charrette was a collaborative workshop that brought together key University stakeholders to examine the campus utilities. The goal of the charrette was to foster creativity, exchange ideas, and generate consensus among participants regarding the status quo of utility systems on campus.

3.3.1 Field Survey

The Project Team conducted surveys to gather key equipment and system information. They obtained nameplate and actual capacity ratings. They also investigated and documented vital data about the distribution system, including pipe sizes, valve specifics, cable details, circuit breaker info, transformer sizes, and switchgear data. Any missing data was collected in the field. The team also examined utility corridors and reviewed existing utility-related drawings.

3.3.2 Assessments

The system assessments calculated peak energy load estimates for every building and distribution system across the campus. These estimates consider various factors, such as the building's purpose, size, and the specific climate conditions in San Antonio. To ensure their accuracy, we cross-verified these estimates with the limited metering data we had on hand and compared them to energy load flow curves.

Main Campus MEP Utility Assessment

3.3.3 Utility Maps

The Assessment Report updated and corrected existing campus utility maps, including the tunnels, chilled water, heating hot water, steam, natural gas, and electrical systems. This information informed suggestions for enhancing each system. Refer to Appendix A for updated utility maps.

Section 4 Chilled Water System Assessment

4.1 System Overview

The UTSA campus is currently served by two thermal utility plants. Each thermal utility plant is operationally independent of the other, but their distribution systems are interconnected. Both the North Thermal Energy Plant (NTEP) and the South Thermal Energy Plant (STEP) provide chilled water to a dedicated set of buildings on the UTSA campus. At the end of the summer of 2023, approximately 2.94 million gross square feet of the main campus was connected to the centralized chilled water distribution system by way of 3.8 miles of distribution piping. The following is a general description of the plants, their chilled water generation equipment, and operating parameters.

4.2 North Thermal Energy Plant (NTEP)

The NTEP produces chilled water and distributes to eighteen (18) campus facilities comprising approximately 2.41 million gross square feet of the main campus.

4.2.1 Chillers

The chilled water system is comprised of five chillers with a total installed chilled water capacity of 9,500-tons at a targeted ΔT of 14°F (40°F supply and 54°F return). Design water temperature rise across the chiller condenser is 85°F to 95°F. Given the mix of chiller ΔT's, the goal for future is to meet an operating condition of 39°F supply and 54°F return (15°F ΔT); future chillers shall be selected for this goal. The NTEP has a firm plant capacity of 7,000-tons defined as the available plant capacity with the largest chiller out of service. The plant is at full build-out and does not have space for expansion. Refer to Table 4-1 for a summary of the chillers at the NTEP.

Table 4-1: Existing Chillers at the NTEP

Equipment Tag	Manufacturer	Year	Refrigerant	VFD (Y/N)	Efficiency (kW/Ton)	ΔT (°F)	Evaporator Flow (gpm)	Condenser Flow (gpm)	Capacity (Tons)
CH-1	York	2001	R-134a	N	0.680	12	2,000	3,000	1,000
CH-2[1]	York	2014	R-134a	Y	0.623	15	4,000	7,500	2,500
CH-3	York	2022	R-134a	N	0.5995	15	3,985	7,530	2,500
CH-4	York	2001	R-134a	N	0.660	12	4,000	6,000	2,000
CH-5	York	2001	R-134a	N	0.630	12	3,000	4,500	1,500
						Totals	**16,985**	**28,530**	**9,500**

[1]Variable Speed

Main Campus MEP Utility Assessment

4.2.2 Chilled Water Pumping Equipment

Six primary chilled water pumps circulate water through the chillers and the campus distribution system. The chilled water system is a variable primary system. All chilled water pumps are in the basement level. Pumps are piped to a common header where any pump can be utilized for any chiller or combination of chillers. Refer to Table 4-2 for information on the chilled water pumps.

Table 4-2: Existing Chilled Water Pumps at the NTEP

Equipment Tag	Manufacturer	Type	Year	Flow (gpm)	Head (ft)	VFD (Y/N)	Power (hp)
CHWP-1	Bell & Gossett	HSC	2022	2,000	112	Y	100
CHWP-2	Ingersoll-Rand	HSC	2017	2,000	112	Y	100
CHWP-3	Ingersoll-Rand	HSC	2017	2,000	112	Y	100
CHWP-4	Bell & Gossett	HSC	2020	4,000	112	Y	150
CHWP-5	Aurora	HSC	2001	4,000	112	Y	150
CHWP-6	Aurora	HSC	2001	3,000	112	Y	125
			Total	**17,000**			

4.2.3 Cooling Towers

The condenser water system at the NTEP is comprised of five counter-flow cooling tower cells, all of which are mounted on the roof. Cooling tower cells 1 and 5 have VSD-operated fan motors; remaining cells have two speed fan motors. Cooling towers are sized for 12°ΔT operation (97°F entering and 85°F leaving). The total flow required for all five cooling tower cells is 29,432 gpm. Refer to Table 4-3 for information on the cooling towers.

Table 4-3: Existing Cooling Tower Cells at the NTEP

Equipment Tag	Manufacturer	Year	Flow (gpm)	Design WB (°F)	EWT (°F)	LWT (°F)	VFD (Y/N)	Power (hp)
CT-1	Evapco	2008	5,733	78	97	85	Y	125
CT-2	Evapco	2008	5,733	78	97	85	N	125
CT-3	Evapco	2008	5,733	78	97	85	N	125
CT-4	Marley	2000	6,500	78	95	85	N	125
CT-5	Evapco	2012	5,733	78	97	85	Y	125
		Total	**29,432**					

4.2.4 Condenser Water Pumping Equipment

The five cooling tower cells are served by eight condenser water pumps. The Condenser water pumps are piped to a common header where any pump can be utilized for any cooling tower cell or combination of cooling tower cells. Condenser water pumps range from 3,000 gpm to 4,500 gpm flow capacity. All condenser water pumps are in the basement level. The condenser water pumps are constant speed. Refer to Table 4-4 for information on the condenser water pumps.

Table 4-4: Existing Condenser Water Pumps at the NTEP

Equipment Tag	Manufacturer	Type	Year	Flow (gpm)	Head (ft)	VFD (Y/N)	Power (hp)
CWP-1	Aurora	HSC	2017	3,000	90	N	100
CWP-2	Aurora	HSC	2017	3,000	90	N	100
CWP-3	Bell & Gossett	E-HSC	2014	4,500	90	N	100
CWP-4	Ingersoll-Rand	HSC	1978	4,500	90	N	125
CWP-5	Ingersoll-Rand	HSC	1978	4,500	90	N	125
CWP-6	Aurora	HSC	2000	3,000	94	N	100
CWP-7	Aurora	HSC	2000	3,000	94	N	100
CWP-8	Aurora	HSC	2000	4,500	94	N	150
			Total	**30,000**			

4.3 South Thermal Energy Plant (STEP)

The STEP generates chilled water and supplies it to three campus buildings, totaling around 527,000 gross square feet in size. These buildings are the closest to the STEP with respect to hydraulic connectivity. It's important to mention that while each thermal utility plant operates independently, their distribution networks are interconnected. Therefore, on cooler days, the STEP can provide cooling to most of the buildings connected to its chilled water distribution system.

4.3.1 Chillers

The chilled water system is comprised of three chillers with a total installed chilled water capacity of 4,880-tons at a ΔT of 12°F (40°F supply and 52°F return). Design water temperature rise across the chiller condenser is 85°F to 95°F. The STEP has a firm plant capacity of 2,880-Tons defined as the available plant capacity with the largest chiller out of service. The plant has expansion space for three (3) additional water-cooled chillers and one additional cooling tower. Refer to Table 4-5 for summary of the chillers at the STEP.

Main Campus MEP Utility Assessment

Table 4-5: Existing Chillers at the STEP

Equipment Tag	Manufacturer	Year	Refrigerant	VFD (Y/N)	Efficiency (kW/Ton)	ΔT	Evaporator Flow (gpm)	Condenser Flow (gpm)	Capacity (Tons)
CH-6[1]	York	2008	R-134a	Y	0.630	12	2,500	3,750	1,250
CH-7	York	2009	R-134a	Y	0.630	12	3,260	4,890	1,630
CH-8	York	2020	R-134a	Y	0.550	12	4,000	6,000	2,000
						Total	**9,760**	**14,640**	**4,880**

[1]Variable Speed

4.3.2 Chilled Water Pumping Equipment

Three primary chilled water pumps circulate water through the chillers and the campus distribution system. The chilled water system is a variable primary system. All chilled water pumps are on the operating level. Pumps are piped to a common header where any pump can be utilized for any chiller or combination of chillers. Refer to Table 4-6 for information on the chilled water pumps.

Table 4-6: Existing Chilled Water Pumps at the STEP

Equipment Tag	Manufacturer	Type	Year	Flow (gpm)	Head (ft)	VFD (Y/N)	Power (hp)
CHWP-1	Aurora	HSC	2008	3,260	110	Y	125
CHWP-2	Aurora	HSC	2009	3,260	110	Y	125
CHWP-3	Aurora	HSC	2008	3,260	110	Y	125
			Total	**9,780**			

4.3.3 Cooling Towers

The condenser water system at the NTEP is comprised of three counter-flow cooling tower cells, all of which are mounted on the roof. All three cooling tower have VSD-operated fan motors. Cooling towers are sized for 10°ΔT operation (95°F entering and 85°F leaving) at 79°F wet-bulb. The total flow required for all three cooling tower cells is 22,005 gpm. It's crucial to design cooling towers for higher wet-bulb temperatures (79°F – 80°F) in humid environments to maintain peak performance even on the hottest and most humid days. This ensures consistent, effective cooling and maximizes the system's efficiency. Refer to Table 4-7 for information on the cooling towers.

Table 4-7: Existing Cooling Tower Cells at the STEP

Equipment Tag	Manufacturer	Year	Flow (gpm)	Design WB (°F)	EWT (°F)	LWT (°F)	VFD (Y/N)	Power (hp)
CT-1	CCS	2008	7,335	79	95	85	Y	125
CT-2	CCS	2008	7,335	79	95	85	Y	125
CT-3	CCS	2020	7,335	79	95	85	Y	125
		Total	**22,005**					

4.3.4 Condenser Water Pumping Equipment

The three cooling tower cells are served by three condenser water pumps equipped with VSD-operated motors. The condenser water pumps are installed in a headered arrangement. This arrangement allows any cooling tower to serve any chiller with any condenser water pump. Refer to Table 4-8 for information on the condenser water pumps.

Table 4-8: Existing Condenser Water Pumps at the STEP

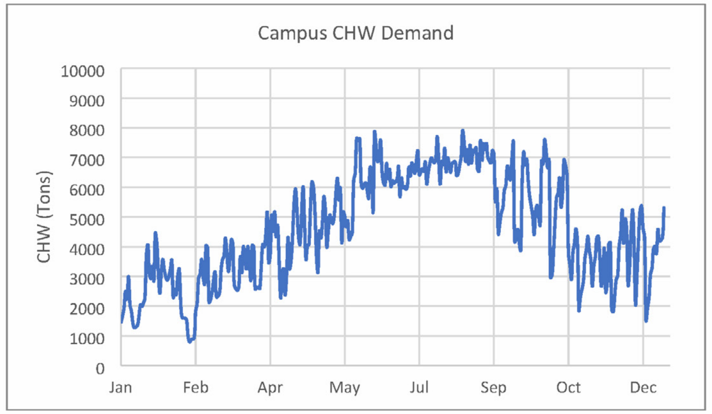
Equipment Tag	Manufacturer	Type	Year	Flow (gpm)	Head (ft)	VFD (Y/N)	Power (hp)
CWP-1	Aurora	HSC	2008	4,890	60	N	100
CWP-2	Aurora	HSC	2009	4,890	60	N	100
CWP-3	Aurora	HSC	2008	4,890	60	N	100
			Total	**14,670**			

4.4 Measured Peak Cooling Load

Data of existing chilled water loads from 2021 and 2022 were used to estimate the peak cooling load. Rolling one-hour averages for chilled water loads were calculated based on five-minute data to estimate peak demands. The peak cooling load for the NTEP and STEP plants is estimated to be 8,000-Tons with the annual load profile indicated in Figure 4-1.

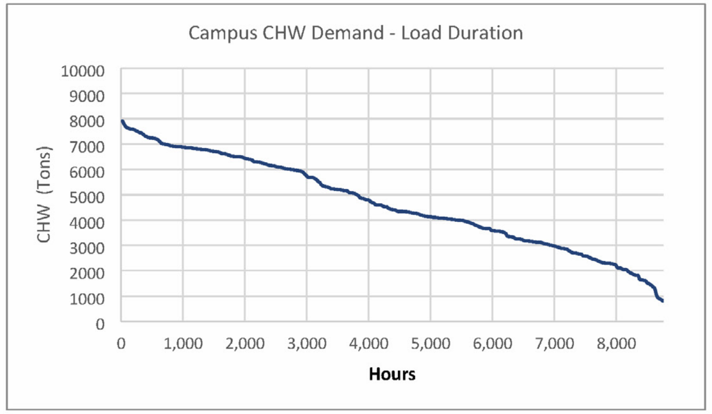
Main Campus MEP Utility Assessment

Figure 4-1: Annual Chilled Water Load Profile



A load duration curve for the chilled water load is presented in Figure 4-2. This figure indicates the number of hours in which the load profile is above a certain load.

Figure 4-2: Annual Chilled Water Load Duration Curve



4.5 Design Cooling Loads

The design cooling load is defined as the sum of all the building's design cooling loads. This design cooling loads assumes that all building lights and internal heat-generating devices are operating, the building is fully occupied, and ambient conditions are at maximum design conditions. To determine the cumulative design cooling load, each building on campus served by the NTEP and STEP was reviewed utilizing design cooling load ratios based on usable square footage (USF) per Ton. The USF per Ton were based on the ultimate use and type of building. Essentially, the design cooling loads in Table 4-9 are the worst-case

scenario for keeping the buildings cool. Review of the table indicates the cumulative design cooling load for the buildings served by the chilled water system is 12,287-Tons.

Table 4-9: Existing Building Estimated Cooling Peak Demand

Building	Abbreviation	Usable ft^2 (USF)	Design Cooling Load (Tons)	Design Cooling Ratio (SF/Ton)
Arts Building	ART	125,967	458	275
Alvarez Residence Hall	ARH	187,300	375	500
Applied Engineering & Tech	AET	145,440	529	275
Biosciences Building	BSB	58,426	390	150
Biotechnology Sciences & Engineering	BSE	221,440	1,476	150
Bosque Street Building	BOS	27,890	101	275
Business Building	BB	204,790	745	275
Convocation Center	CC	72,614	264	275
Engineering Building	EB	69,037	251	275
Graduate School & Research	GSR	75,327	274	275
HEB Student Union	HSU	59,078	215	275
Intercollegiate Athletics Building	IAB/PE	40,731	148	275
John Peace Library	JPL	225,891	821	275
Main Building	MB	219,000	796	275
McKinney Humanities Building	MH	180,855	658	275
Multidisciplinary Studies Building	MSB	157,926	611	275
North Paseo Building	NPB	180,050	655	275
Peter T. Flawn Building	FLN	185,362	1,236	150
Recreation Wellness Center	RWC	193,303	703	275
Science & Engineering Building	SEB	160,349	1,069	150
Student Union	SU	140,794	512	275
		Design Cooling Load	**12,287**	

Main Campus MEP Utility Assessment

4.6 Diversity Factor

Review of the data above indicates a measured peak cooling load of 8,000-Tons and a design cooling load of 12,287-Tons. The difference is due to the diversity factor of the campus buildings served by both the NTEP and STEP. The diversity factor is a recognized design technique that accounts for the reality that not all buildings will have simultaneous peak cooling loads. The diversity factor is calculated as follows:

$$Diversity\ Factor = \frac{Measured\ Peak\ Cooling\ Load}{Design\ Cooling\ Load} = \frac{8{,}000\ tons}{12{,}287\ tons} = 65\%$$

Load diversity is due to such elements as occupancy being less than design load, students being off-campus or otherwise out of the building, and the building equipment cooling load being less than the design cooling load in many areas. Diversity factors between 60%-80% are reasonable for campuses such as UTSA.

4.7 Chilled Water Distribution

Chilled water for the campus is produced in the NTEP and STEP and delivered through a supply and return piping system. The distribution piping is interconnected and consists of both direct-buried and tunnel-based piping. The NTEP has 24-inch chilled water mains, while the STEP has 36-inch mains.

4.7.1 System ΔT

The chilled water system experiences ΔT ranging from 12°F or more during peak cooling periods to 8°F or less in cool weather. Data analysis reveals that the system operates with ΔT values equal to or greater than 10°F for 85% of the year, with ΔT values less than 10°F occurring for 15% of the year and less than 8°F for only 2% of the year. It is anticipated that the system's ΔT will consistently remain at 10°F to 12°F or higher throughout the entire year.

4.7.2 Chilled Water Hydraulic Modeling

A computerized hydraulic model was developed using Pipe Flo Professional to simulate the distribution network and assess its current performance. The pipe material, diameter, segment length, and roughness factor for each pipe, as well as the peak flow demand for each building, were entered into the computer model. The results of the model indicate the flow, velocity, and pressure loss for each pipe segment, as well as the total distribution loss. The hydraulic model layout, pipe lengths, and dimensions were primarily developed using data from the utility distribution map from UTSA and the 2012 B&M UMP AFT Fathom hydraulic models. A factor of safety of 2.0 was applied to piping sections within the NTEP and STEP facilities to account for bends, tees, valves, and other appurtenances. Chiller, pump, and expansion tank data were derived from record drawings, as-built data, datasheets, and previous Fathom hydraulic models.

For the hydraulic model to converge to a solution, flow control valves (FCV) were modeled to balance flow across the chillers simulating that chilled water was efficiently utilized at the NTEP and STEP. Essentially, the FCVs were throttled automatically to guarantee the design ΔT across the chillers to meet the building demands. The building loads were modeled with flow demands to ensure that each building received the right amount of chilled water to meet its cooling requirements. The building demands were set to match the building loads as indicated in Table 4-9.

The model demonstrated a robust system with most sections of pipe reaching flow velocities under 10 ft/s and pressures exceeding 90-psig to the building connection points. The NTEP and STEP pumps are adequately sized and operate near their best efficiency point. As the University increases chilled water demands across campus, it's crucial to monitor how they affect flow velocities and pressure drops in the chilled water distribution system. Refer to Appendix B for detailed information.

4.8 Chilled Water System Assessment

The current chilled water capacity is sufficient to meet the University's existing and near future demands. Review of the campus chilled water capacity shows that UTSA's chilled water system estimated peak design load (12,287 tons) exceeds the chilled water system firm capacity (11,880-Tons). However, UTSA's chilled water data shows the campus chilled water peak load is 8,000-Tons which is less than the chilled water system firm capacity. Additionally, the total chiller water plant capacity (14,380-Tons) exceeds the estimated peak design load. Therefore, chilled water plant redundancy and capacity is sufficient.

With respect to the NTEP, the firm chilled water capacity is 7,000-Tons. This firm capacity can be met with the individual firm capacities of the chilled water pumps, cooling towers, and condenser water pumps, respectively. For example, with a firm chilled water pump capacity of 13,000 gpm, the chiller capacity is 7,500-Tons. Similarly, with a firm cooling tower capacity of 22,932 gpm, the chiller capacity is 7,500-Tons. Finally, with a firm condenser water pump capacity of 25,500 gpm, the chiller capacity is 8,000-Tons.

Along the same lines, with respect to the STEP, the firm chilled water capacity is 2,880-Tons. This firm capacity can be met with the individual firm capacities of the chilled water pumps, cooling towers, and condenser water pumps, respectively. For example, with a firm chilled water pump capacity of 6,520 gpm, the chiller capacity is 3,250-Tons. Similarly, with a firm cooling tower capacity of 14,670 gpm, the chiller capacity is 4,880-Tons. Finally, with a firm condenser water pump capacity of 9,780 gpm, the chiller capacity is 3,250-Tons. It should be noted that although the STEP can meet firm chilled water capacity with various systems' firm capacities, the chilled water and condenser water pumping systems are not as flexible as the NTEP's pumping systems.

The NTEP has 24-inch chilled water supply and return mains, which restrict the maximum flow from the NTEP to around 20,000 gallons per minute (gpm) at a velocity of 16 feet per second, as detailed in Table 4-10. Operating the plant above this 20,000 gpm threshold could lead to excessive fluid velocity, potentially causing damage to pipe and fittings. However, the 24-inch chilled water supply and return lines can support a maximum NTEP capacity of 12,608 tons with a ΔT of 15°F, as indicated in Table 4-10. Consequently, it is advisable for the NTEP to standardize on five 2,500-ton chillers, which would collectively provide a cooling capacity of 12,500 tons at a ΔT of 15°F. Considering that Chiller Nos. 1, 4, and 5 are nearing the end of their service life, standardization should be applied to these chillers. Additionally, it's important to note that cooling towers will need to be upsized accordingly when implementing chiller standardization and for the full build-out of the system.

The STEP has 36-inch chilled water supply and return lines. This allows a maximum flow of approximately 58,000 gpm at 20 fps as indicated in Table 4-10. The 36-inch chilled water supply and return lines will support a maximum STEP capacity of 36,422-Tons at a ΔT of 15°F as indicated in Table 4-10. However, the limiting factor at the STEP are the cooling towers with a maximum capacity of 9,780-Tons (nominal) at full build out. The original intent for the build-out of the STEP involved two chillers of 1,250-Tons each and four of 1,630-Tons each. But, owing to campus expansion, a 2,000-Ton Chiller No. 8 was chosen during the 2012 Utility Master Planning Process. Moving forward, chiller selections will need to similarly be determined based on campus growth projections. A potential approach is standardizing on six 1,630-Ton chillers yielding 9,780-Tons at 15°F ΔT as chillers are replaced and added. Currently the STEP has three future chiller expansion bays and one cooling tower bay which will allow for expansion.

As the distribution network continues to expand, it is recommended that the new piping be pre-insulated direct buried pipe arranged into interconnecting loops. Interconnected chilled water loops provide two redundant pipe mains that can continue to supply thermal utilities in the event part of the chilled water network is down for maintenance or repair. The chilled water loops should be conservatively sized without reducing the utility loop pipe down in size to the building service pipe size to prevent high water velocities and system flow "choke" points. To evaluate consolidation options and requirements for the campus chilled water distribution systems, it is important to evaluate loads and capacities of the existing distribution systems. To facilitate this, Table 4-10 tabulates recommended chilled water capacities for various pipe sizes at recommended ranges of pipe velocities and flow rates.

Table 4-10: Approximate Cooling and Heating Loads at Various Pipe Sizes

Pipe Size (in)	Recommended Max. Velocity (ft/s)	Approx. Max. Pressure Drop (ft/100ft)	Recommended Flow Rate (gpm)	Approx. Max. Cooling at 15°F ΔT (Tons)
4"	5.8	2.85	226	141
6"	7.0	2.63	639	400
8"	8.2	2.48	1,279	799
10"	9.3	2.46	2,310	1,444
12"	10.4	2.43	3,628	2,268
14"	11.4	2.59	4,807	3,004
16"	12.4	2.60	6,830	4,269
18"	13.4	2.62	9,342	5,839
20"	14.3	2.62	12,388	7,743
24"	16.1	2.65	20,173	12,608
30"	18.6	2.65	37,636	23,522
36"	20.0	2.47	58,275	36,422

Source: Cameron Hydraulic Data (Ingersoll-Rand); Stanley Consultants, Inc.

Section 5 Heating Hot Water Assessment

5.1 System Overview

The South Thermal Energy Plant (STEP) provides heating hot water to a dedicated set of buildings on the UTSA campus. At the end of summer of 2023, approximately 527,229 GSF of the main campus was connected to the centralized heating hot water distribution system by way of nearly half a mile of distribution piping. The following is a general description of the STEP, its heating hot water generation equipment and operating parameters.

5.1.1 Heating Hot Water Boilers

The heating hot water system is comprised of three boilers with a total installed heating hot water capacity of 66,950-MBH at a ΔT of 20°F (180°F supply and 160°F return). It's important to note that the hot water is blended to 160°F before being sent back to the boilers following its return from the campus distribution system at 130°F. The STEP has a firm plant capacity of 40,170-MBH defined as the available plant capacity assuming the largest boiler is out of service. The plant is at full build-out and does not have space for expansion. Refer to Table 5-1 for information on the heating hot water boilers.

Table 5-1: Existing Heating Hot Water Boilers at the STEP

Equipment Tag	Manufacturer	Year	Type	Fuel	ΔT (°F)	Flow (gpm)	Nominal Capacity (MBH)
BLR-1	Cleaver-Brooks	2007	Firetube	NG	20	2,680	26,780
BLR-2	Burnham	2004	Firetube	NG	20	1,340	13,390
BLR-3	Cleaver-Brooks	2023	Firetube	NG	20	2,680	26,780
					Total	**6,700**	**66,950**

5.1.2 Heating Hot Water Pumping Equipment

Three heating hot water pumps circulate water through the boilers and the campus distribution system. All heating hot water pumps are on the operating level. Pumps are piped to a common header where any pump can be utilized for any boiler or combination of boilers. Refer to Table 5-2 for information on the heating hot water pumps.

Main Campus MEP Utility Assessment

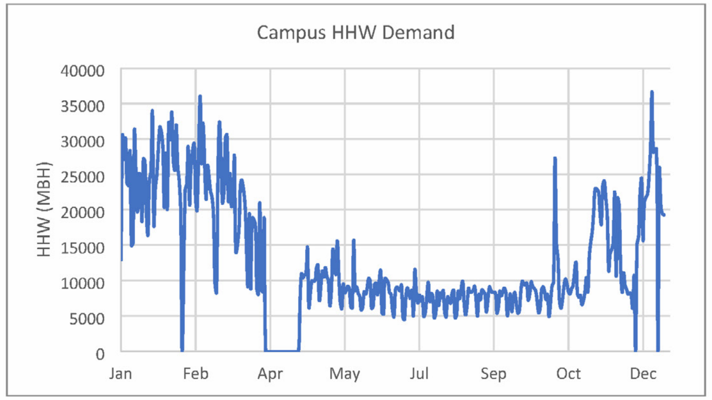
Table 5-2: Existing Heating Hot Water Pumps at the STEP

Equipment Tag	Manufacturer	Type	Year	Flow (gpm)	Head (ft)	VFD (Y/N)	Power (HP)
HWP-1	Aurora	HSC	2008	2,680	110	Y	100
HWP-2	Aurora	HSC	2008	2,680	110	Y	100
HWP-3	Aurora	HSC	2023	2,680	112	Y	100
			Total	**8,040**			

5.2 Measured Peak Heating Load

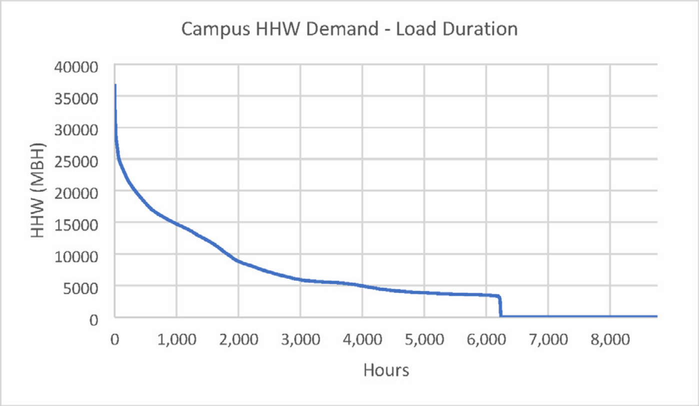
Data of existing heating hot water loads from 2021 and 2022 were used to estimate the peak heating load. Rolling one-hour averages for heating hot water loads were calculated based on five-minute data to estimate peak demands. The peak heating load for the STEP is estimated to be 36,659-MBH with the annual load profile indicated in Figure 5-1.

Figure 5-1: Annual Heating Hot Water Load Profile



A load duration curve for the heating hot water load is presented in Figure 5-2. This figure indicates the number of hours in which the load profile is above a certain load.

Figure 5-2: Annual Heating Hot Water Load Duration Curve



5.3 Design Heating Load

The design heating load is defined as the sum of all the building's design heating loads. This design heating loads assumes that all building lights and internal heat-generating devices are operating, the building is fully occupied, and ambient conditions are at maximum design conditions. To determine the cumulative design heating load, each building on campus served by the STEP was reviewed utilizing design cooling load ratios based on usable square footage BTU per SF. The BTU per SF were based on the ultimate use and type of building. Essentially, the design heating loads in Table 5-3 are the worst-case scenario for heating the buildings. Review of the table indicates the cumulative design heating load for the buildings served by the STEP is 42,700-MBH.

Table 5-3: Existing Building Estimated Heating Hot Water Demands (STEP)

Building	Abbreviation	Usable ft^2 (USF)	Heating Demand (MBH)	Design Heating Ratio (BTU/SF)
Applied Engineering & Tech	AET	145,440	9,000	62
Biotechnology Sciences & Engineering[1]	BSE	221,440	24,000	109
Science & Engineering Building	SEB	160,349	9,700	60
	STEP Design HHW Load		**42,700**	

[1] The BSE can be supplied with heating hot water or steam.

Main Campus MEP Utility Assessment

5.4 Diversity Factor

Review of the data above indicates a measure peak heating load of 36,659-MBH and design heating load of 36,700-MBH. The difference is due to the diversity factor of the campus buildings served by the STEP. The diversity factor is a recognized design technique that accounts for the reality that not all buildings will have simultaneous peak heating loads. The diversity factor is calculated as follows:

$$Diversity\ Factor = \frac{Measured\ Peak\ Heating\ Load}{Design\ Heating\ Load} = \frac{36{,}659\ MBH}{42{,}700\ MBH} = 85\%$$

Load diversity is due to such elements as ambient temperatures, solar heat gain, occupancy being less than design load, students being off-campus or otherwise out of the building, and internal equipment heat gains being less than the design heating load in many areas. Heating hot water systems generally have higher diversity factors due to their greater responsiveness to variable demands, more efficient distribution, and the nature of water as a heat transfer medium. As such, diversity factors between 75%-90% are reasonable for campuses such as UTSA.

5.5 Heating Hot Water Distribution System

Heating hot water is distributed to the campus via a direct-buried network of pipes. The heating hot water mains leaving the STEP have a diameter of 24 inches. Presently, the STEP mainly supplies heating hot water to three buildings: the Applied Engineering & Technology (AET) Building, the Biotechnology Science & Engineering (BSE) Building, and the Science & Engineering Building (SEB).

5.5.1 System ΔT

The heating hot water system experiences ΔT ranging from 20°F or more during peak heating periods to 10°F or less in hot weather conditions. Data analysis reveals that the system operates with ΔT values equal to or greater than 20°F for 20% of the year, with ΔT values less than 20°F occurring for 80% of the year and less than 10°F for 18% of the year. It is anticipated that the system's ΔT will consistently remain at 20°F or higher throughout the entire year.

5.5.2 Heating Hot Water Hydraulic Modeling

A Pipe-Flo Professional computerized hydraulic model was developed to simulate the distribution network and determine the capacity of the existing system. The pipe material, diameter, segment length, and roughness factor for each pipe, as well as the peak flow demand for each building, were entered into the computer model. The results of the model indicate the flow, velocity, and pressure loss for each pipe segment, as well as the total distribution loss. The hydraulic model layout, pipe lengths, and dimensions were primarily developed using data from the utility distribution map from UTSA and the 2012 B&M UMP AFT Fathom hydraulic models. A factor of safety of 2.0 was applied to piping sections within the STEP facility to account for bends, tees, valves, and other appurtenances. Additionally, heating hot water demands were based on ASHRAE 90.1 heating density per building type. Boiler and expansion tank data were derived from the Fathom hydraulic models and as-builts, whereas the pump curves were based on manufacturer-provided data.

The model demonstrated a healthy system with most sections of pipe reaching flow velocities under 10 ft/s and pressures exceeding 90-psig to the building connection points. The pumps are sized adequately with plenty of margin for additional capacity. As more heating hot water demands are added to campus, scrutiny of the impacts to the heating hot water distribution system flow velocities and pressure drops is imperative. Refer to Appendix C for detailed information.

5.6 Heating Hot Water System Assessment

The current heating hot water capacity in STEP is sufficient to meet the UTSA campus' existing and near future heating hot water demands. STEP currently has three heating hot water boilers capable of producing a peak capacity of 66,970-MBH and a firm capacity of 40,170-MBH. The current heating hot water system has adequate redundancy since a loss of one of the 26,780-MBH boilers would not impact the plant's ability to meet the current campus heating hot water measure peak load of 36,659-MBH. As the campus grows and the heating hot water demand is increased, the immediate plan would be to replace Boiler No. 2 with an 800-BHP boiler since HWP No. 2 has the capacity for an 800-BHP boiler. The STEP boilers have been in service as follows: Boiler No. 1 for 16 years, Boiler No. 2 for 19 years. Boiler No. 3 will be commissioned later this year. With an expected service life of 25 years and continued maintenance, the boilers are expected to run reliably until the end of their service life.

The firm heating hot water capacity is 40,170-MBH. This firm capacity can be met with the firm capacity of the heating hot water pumps. For example, with a firm heating hot water pump capacity of 5,360 gpm, the boiler capacity is 53,560-MBH.

The STEP has 24-inch heating hot water supply and return mains. This allows a maximum flow of approximately 20,000 gpm at 16.1 fps as indicated in Table 5-4. The 24-inch mains will support a maximum STEP capacity of 201,733-MBH at a ΔT of 20°F as indicated in Table 5-4. Therefore, standardizing on three 2,000-BHP boilers to produce 200,828-MBH at a ΔT of 20°F is a potential solution if the campus heating hot water system continues to grow. However, such expansion would require increased space, along with upgrades to natural gas, pumping, and piping capacities.

The current heating hot water demand is small and only serves three buildings. As the distribution network continues to expand, it is recommended that the new piping be direct buried interconnected loops with sufficient insulation to limit pipe heat loss, uphold system efficiency and to control construction costs. Interconnected heating water loops provide two redundant pipe mains that can continue to supply thermal utilities in the event part of the heating water network is down for maintenance or repair. The heating hot water loops should be conservatively sized without reducing the utility loop pipe down in size to the building service pipe size to prevent high water velocities and system flow "choke" points.To evaluate consolidation options and requirements for the campus heating hot water distribution systems, it is important to evaluate loads and capacities of the existing distribution systems. To facilitate this, Table 5-4 tabulates recommended heating hot water capacities for various pipe sizes at recommended ranges of pipe velocities and flow rates.

In summary, when looking to the future, heating hot water generation is generally a more favorable choice for large university campuses over steam generation. This preference is due to its energy efficiency, lower emissions potential, and compatibility with renewable energy sources. However, it's essential to assess the specific needs and constraints of the campus and evaluate options that align with the University's

Main Campus MEP Utility Assessment

sustainability goals and financial considerations. The expansion of the heating hot water system should be investigated further during the utility master planning effort in the future.

Table 5-4: Approximate Heating Loads at Various Pipe Sizes

Pipe Size (in)	Recommended Max. Velocity (ft/s)	Approx. Max. Pressure Drop (ft/100ft)	Recommended Flow Rate (gpm)	Approx. Max. Heating at 20ºF ΔT (MBH)
4"	5.8	2.85	226	2,262
6"	7.0	2.63	639	6,393
8"	8.2	2.48	1,279	12,786
10"	9.3	2.46	2,310	23,103
12"	10.4	2.43	3,628	36,283
14"	11.4	2.59	4,807	48,067
16"	12.4	2.60	6,830	68,299
18"	13.4	2.62	9,342	93,423
20"	14.3	2.62	12,388	123,885
24"	16.1	2.65	20,173	201,733
30"	18.6	2.65	37,636	376,358
36"	20.0	2.47	58,275	582,747

Source: Cameron Hydraulic Data (Ingersoll-Rand); Stanley Consultants, Inc.

Section 6 Steam System Assessment

6.1 System Overview

The NTEP produces steam and distributes to the campus facilities. Steam is supplied to the campus at 120 psig and 350ºF for building heating and other processes such as autoclaves. Steam is converted to heating hot water at local building heat exchangers and condensate is returned to the NTEP. Additionally, the steam is used to generate domestic hot water for dishwashing, laundry washers, and showers.

6.1.1 Steam Boilers

The steam system is comprised of three firetube steam boilers with a total installed steam capacity of 80,340-MBH. As mentioned, steam is supplied to the campus at 120 psig at 350°F. Normal fuel operation is with natural gas, but No. 2 fuel oil is available as backup fuel. NTEP has a firm plant capacity of 53,560-MBH defined as the available plant capacity assuming the largest boiler is out of service. Refer to Table 6-1 for a summary on the steam boilers.

Table 6-1: Existing NTEP Firetube Steam Boilers

Equipment Tag	Manufacturer	Year	Type	Fuel	Design Pressure (psig)	Operating Pressure (psig)	Nominal Capacity (MBH)
BLR-1	Hurst	2017	Firetube	NG/Oil	150	100	26,780
BLR-2	Hurst	2018	Firetube	NG/Oil	150	100	26,780
BLR-3	Hurst	2017	Firetube	NG/Oil	150	100	26,780
						Total	**80,340**

6.1.2 Feedwater System

The feedwater system is comprised of a packaged 100,000 lb/hr deaerator with four feedwater pumps to support the steam system operation. The deaerator is 6-foot diameter by 14.5-foot long with a storage capacity of 2,712 gallons. The deaerator is sized for 9.8 minutes of storage capacity. Refer to Table 6-2 for a summary of the feedwater pumps.

Table 6-2: Feedwater Pumps

Equipment Tag	Manufacturer	Year	Type	Capacity (gpm)	TDH (ft)	Motor (HP)
FWP-1	Goulds	2017	15ESV-7 VIL	80	155	15
FWP-2	Goulds	2017	15ESV-7 VIL	80	155	15

Equipment Tag	Manufacturer	Year	Type	Capacity (gpm)	TDH (ft)	Motor (HP)
FWP-3	Goulds	2017	15ESV-7 VIL	80	155	15
FWP-4	Goulds	2017	15ESV-7 VIL	80	155	15
			Total	320		

6.1.3 Condensate System

The condensate system is comprised of a condensate storage tank and three condensate pumps as indicated in Table 6-3. The existing condensate tank is 4.5-foot diameter by 10-foot long with a storage capacity of 1,059 gallons.

Table 6-3: Condensate Pumps

Equipment Tag	Manufacturer	Year	Type	Capacity (gpm)	Design Pressure (ft)	Motor (hp)
CNDP-1	Bell & Gossett	2017	VIL	120	100	7.5
CNDP-2	Bell & Gossett	2015	VIL	120	100	7.5
CNDP-3	Buffalo-GE	1978	HSC	26	120	3
			Total	266		

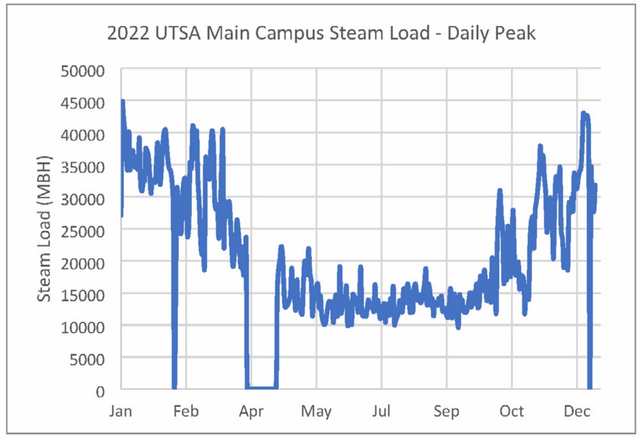
6.1.4 Distribution System

The steam distribution system consists of a 12-inch pipeline for carrying steam away from the NTEP, while an 8-inch pipeline handles the return of condensate to the same location, ensuring efficiency and reliability in the heating system. Local building heat exchangers convert steam into hot water for heating, with the resulting condensate being returned to the steam boilers for reuse.

6.2 Measured Peak Heating Load

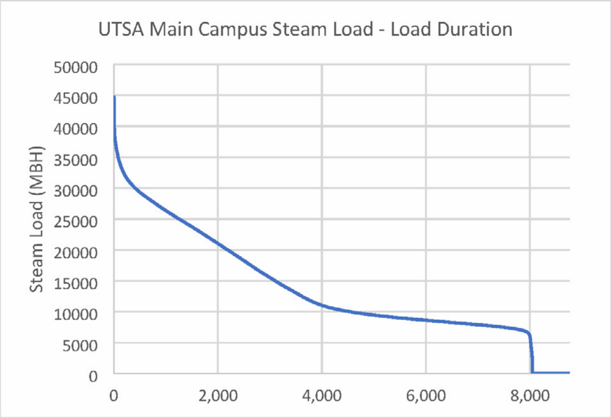
Based on the utility meter data provided, the measured campus peak steam demand is approximately 44,755 MBH indicated at Figure 6-1.

Figure 6-1: Annual Steam Load Profile



A load duration curve for the steam load is presented in Figure 6-2. This figure indicates the number of hours in which the load profile is above a certain load.

Figure 6-2: Annual Steam Load Duration Curve



6.3 Design Heating Load

The design heating load is defined as the sum of all the building's design heating loads. This design heating loads assumes that all building lights and internal heat-generating devices are operating, the building is fully occupied, and ambient conditions are at maximum design conditions. To determine the cumulative design heating load, each building on campus served by the NTEP was reviewed utilizing design cooling

Main Campus MEP Utility Assessment

load ratios based on usable square footage BTU per SF. The BTU per SF were based on the ultimate use and type of building. Steam is supplied to a total of sixteen (16) buildings on campus that utilize the steam for heating and process loads. Steam-to-water heat exchangers are used to convert steam to heating hot water to meet the building heating demand. Additionally, the campus steam is utilized by laboratory buildings to serve process loads such as autoclave sterilization, and humidification. Essentially, the design heating loads in Table 6-4 are the worst-case scenario for heating the buildings. Review of the table indicates the cumulative design heating load for the buildings served by the NTEP is 84,655-MBH.

Table 6-4: Existing Buildings Estimated Steam Heating Demand

Building	Abbreviation	Usable ft² (USF)	Design Heating Load (MBH)	Design Heating Ratio (BTU/SF)
Arts Building	ART	125,967	3,350	27
Biosciences Building	BSB	58,426	6,000	103
Biotechnology Sciences and Engineering Building	BSE	221,440	30,000	135
Bosque Street Building	BOS	27,890	418	15
Business Building	BB	204,790	3,072	15
Convocation Center	CC	72,614	2,541	35
Engineering Building	EB	69,037	6,000	87
HEB Student Union	HSU	59,078	886	15
Intercollegiate Athletics Building	IAB/PE	40,731	611	15
John Peace Library	JPL	225,891	4,518	20
Main Building	MB	219,000	4,380	20
McKinney Humanities Building	MH	180,855	2,713	15
Multidisciplinary Studies Building	MSB	157,926	2,369	15
Peter T. Flawn Building	FLN	185,362	12,785	69
Recreation Wellness Center	RWC	193,303	2,900	15
Student Union	SU	140,794	2,112	15
		NTEP Design Steam Load	**84,655**	

[1] The BSE can be supplied with heating hot water or steam.

6.4 Diversity Factor

Review of the data above indicates a measure peak heating load of 44,755-MBH and a design heating load of 84,655-MBH. The difference is due to the diversity factor of the campus buildings served by the NTEP. The diversity factor is a recognized design technique that accounts for the reality that not all buildings will have simultaneous peak heating loads. Load diversity is due to such elements as ambient temperatures, solar heat gain, occupancy being less than design load, students being off-campus or otherwise out of the building, and internal equipment heat gains being less than the design heating load in many areas. The diversity factor is calculated as follows:

$$Diversity\ Factor = \frac{Measured\ Peak\ Heating\ Load}{Design\ Heating\ Load} = \frac{44{,}755\ MBH}{84{,}655\ MBH} = 53\%$$

In general, Diversity Factors within the range of 70%-85% are considered reasonable for campuses like UTSA. A Diversity Factor on the lower end suggests a mix of varied steam usage patterns, including time-of-day variations, and process steam with diverse requirements. For example, since the steam system serves a variety of buildings with different usage schedules, the peak demand times may not coincide, leading to a lower diversity factor. Similarly, in cases where steam is used for both heating and other purposes (like process steam in laboratories or kitchens), the demand might vary significantly throughout the day. Finally, in environments where steam is used for various process requirements, the demands may be staggered or intermittent, contributing to a lower diversity factor. Regardless of the Diversity Factor, the NTEP must have firm capacity to meet the Design Heating Load. As it stands now, the NTEP does have firm capacity to meet the Design Heating Load.

6.5 Steam System Modeling

A Pipe-Flo Advantage fluid dynamic model was developed to simulate the distribution network and determine the capacity of the existing system. The pipe material, diameter, segment length, and roughness factor for each pipe, as well as the peak flow demand for each building, were entered into the computer model. The results of the model indicate the flow, velocity, and pressure loss for each pipe segment, as well as the total distribution loss. The model layout, pipe lengths, and dimensions were primarily developed using data from the utility distribution map from UTSA and the 2012 B&M UMP AFT Fathom/Arrow hydraulic models. A factor of safety of 2.0 was applied to piping sections within the NTEP and STEP facilities to account for bends, tees, valves, and other appurtenances. Additionally, steam demands/condensate were based on trend data and the 2012 B&M UMP AFT Fathom/Arrow hydraulic models. Boiler and expansion tank data were derived from the Fathom hydraulic models and as-Builts, whereas the condensate pumps are set as sizing pumps with a set discharge pressure.

The steam system is in good shape, with most pipe sections having acceptable flow velocities and a minimum delivered pressure of 118 psig at the building connection points. However, if the University elects to increase steam usage on campus, it's crucial to closely examine how this affects flow velocities and pressure drops in the steam and condensate systems. Refer to Appendix D for detailed information.

Main Campus MEP Utility Assessment

6.6 Steam System Assessment

The existing steam capacity at NTEP adequately meets UTSA campus' current needs. NTEP currently operates three steam boilers, each capable of generating 26,780-MBH of steam, resulting in a total plant capacity of 80,340-MBH. The plant's firm steam capacity stands at 53,560-MBH, ensuring that a malfunction in one boiler won't disrupt its ability to meet the peak demand of 44,755-MBH. The steam system has sufficient redundancy. The steam boilers have been in operation for 6 years and are expected to run reliably until their 25-year service life with regular maintenance.

Steam is distributed through utility tunnels, crawl spaces, and shallow trench boxes across campus. It's used for heating hot water in buildings using local heat exchangers and for various processes like air humidification and steam sterilization in laboratory buildings. The current steam distribution system is in good condition, returning approximately 90% of produced steam as condensate, as reported by UTSA. UTSA does not plan to expand the steam system or add new buildings to it. Condensate Pump No. 3 is beyond its service life and should be planned for replacement.

Finally, many universities are transitioning away from steam in favor of more sustainable and energy efficient alternatives due to environmental concerns and cost savings. However, UTSA has a legacy infrastructure, including steam-based systems and processes, which can be challenging to replace entirely. It's important to note that transitioning from existing steam systems to more sustainable alternatives may take time, planning, and resources. The specific strategies and technologies chosen will depend on the campus' unique circumstances, goals, and available resources. Additionally, the transition should be part of a broader sustainability plan for the entire campus encompassing not only heating systems but also other steam process.

Section 7 Natural Gas System Assessment

7.1 System Overview

Natural gas is provided by CPS Energy at 50 psig and distributed across Main Campus via three meters and regulators. The Chaparral Village area is served by a separate natural gas line coming in at 25 psig. Natural gas can be categorized into consumption by boilers at the NTEP and STEP, individual buildings, and emergency generators.

7.2 Natural Gas Distribution System

UTSA's natural gas is supplied by CPS Energy at 50 psig from an 8-inch gas main that runs parallel to the south side of Loop 1604. The main runs down Walter Brennan Avenue to the meter yard at the NTEP. The breakdown is as follows:

- **Meter Yard:** Contains three gas meters - Meter No. 3, Meter No. 4, and Meter No. 10. Each of these meters is responsible for measuring and controlling the flow of natural gas to specific areas of the UTSA campus.
- **Meter No. 3:** Supplies natural gas to most of the academic facilities on the Main Campus, including their respective emergency generators.
- **Meter No. 4:** Exclusively provides natural gas to the NTEP.
- **Meter No. 10:** Serves the STEP, H-E-B Student Union (HSU), Applied Engineering and Technology Library (AET), Biotechnology Sciences and Engineering Building (BSE), Science and Engineering Building (SEB), Engineering Building (EB), and Biosciences Building (BSB) on the campus.

Downstream of these three meters, the campus natural gas network operates at a reduced pressure of 20 psig. Further pressure regulation is done at the loads as needed by equipment. The pressure is adjusted to 5 inches water column (w.c), 1-2 psig, or 4-6 psig, depending on the requirements of the specific equipment being supplied with natural gas. Primary uses of natural gas are building heating, water heating, kitchen equipment, lab equipment, and emergency generators.

Additionally, there's a distinct natural gas supply to the Chaparral Village from the main supply line on Walter Brennan Avenue. The natural gas supply to Chaparral Village is provided through a 3-inch line and is delivered at a pressure of 25 psig. This supply line runs parallel between Barshop Boulevard and Walter Brennan Avenue. The breakdown is as follows:

- **Meter Yard:** Like the main campus, Chaparral Village has a meter yard that contains three gas meters: Meter No. 6, Meter No. 7, and Meter No. 9. These meters are used to measure and control the flow of natural gas to specific areas within Chaparral Village.
- **Meter No. 9:** Supplies natural gas to the Roadrunner Café (RRC) and the loop around Chaparral Village.
- **Meter No. 6 and Meter No. 7:** Branches off downstream of Meter No. 9 and serves the Activity Center (AC).

Main Campus MEP Utility Assessment

Downstream of Meter No. 9, the natural gas operates at a pressure of 5 psig and flows through 3-inch pipes. However, when it comes to Meter No. 6 and Meter No. 7, the pressure is reduced to 1 psig, and they use 2-inch pipes. These smaller pipes then lead to the HHW/DWH boilers, where the gas pressure is maintained at a range of 6-14 inches water column (w.c).

7.3 Measured Peak Natural Gas Demand

Based on utility meter data provided, the measured campus peak natural gas demand occurs in February and is approximately 59,398 CFH as summarized in Table 7-1.

Table 7-1: Building Peak Natural Gas Demand

Building	Meter No.	Natural Gas (CFH)	Building	Meter No.	Natural Gas (CFH)
AC	6,7, (9)	560	Laurel Village	3	133
AET	10	41	MB	3	388
ARH	3	420	MBT	3	847
BB	3	233	MH	3	4
BSA	3	29	MS	3	84
BSB	10	195	NTEP	4	35,441
BSE Lab	10	97	NPB	3	732
Chaparral Village	9	475	PDS	3	97
CNG Station	3	427	RACE	3	1,340
EB	10	0	RRC	9	822
FLN	3	1	RWC	3	1,111
FSB	3	97	SC	3	292
FWH	3	39	SCG	3	47
GDH	3	377	SEB	10	274
GHS	3	93	SRL	3	930
HSU	10	489	SU	3	133
JPL	3	130	XAG (STEP)	10	12,149
Kiln	3	872		**Total**	**59,398**

7.4 Design Natural Gas Demand

The design natural gas demand is the total of building loads, emergency generator loads, and thermal energy plant loads. The building loads are based on boilers, hot water heaters, and unit heaters, assuming all building lights and heat sources are on, buildings are fully occupied, and weather conditions are at the maximum. This demand is estimated at 87,024 CFH as summarized in Table 7-2.

Table 7-2: Design Natural Gas Demand

Building	Meter No.	Natural Gas (CFH)	Building	Meter No.	Natural Gas (CFH)
AC	6,7, (9)	2,889	Laurel Village	3	6,567
AET	10	17,709	MB	3	2,000
ARH	3	1,800	MBT	3	2,500
BB	3	1,200	MH	3	19
BSA	3	150	MS	3	435
BSB	10	254	NTEP	4	100,425
BSE Lab	10	500	NPB	3	3,000
Chaparral Village	9	9,062	PDS	3	500
CNG Station	3	2,200	RACE	3	6,910
EB	10	130	RRC	9	5,000
FLN	3	7	RWC	3	3,060
FSB	3	500	SC	3	1,505
FWH	3	200	SCG	3	1581
GDH	3	1944	SEB	10	1,412
GHS	3	480	SRL	3	4,078
HSU	10	2,520	SU	3	1,741
JPL	3	671	XAG (STEP)	10	83,688
Kiln	3	4,500		**Total**	**271,137**

Some buildings have emergency generators. The cumulative natural gas demand of building emergency generators is 91,506 CFH as summarized in Table 7-3. Note that emergency generators only run during power outages and their gas demands do not coincide with other natural gas demands. Prior studies and natural gas consumption trends were used to determine these loads.

Main Campus MEP Utility Assessment

Table 7-3: Design Natural Gas Demand for Building Emergency Generators

Building	Natural Gas (CFH)	Building	Natural Gas (CFH)
AA Generator	2,310	JPL Generator	2,016
ARH Generator	840	MB Generator	11,648
ART Generator	2,310	MBT Generator	2,800
BB Generator	3,472	MH Generator	1,120
BRG Generator	2,520	MS Generator	1,848
BSB Generator	7,700	NPB Generator	4,480
BSE Generator 1	770	RWC Generator	2,800
BSE Generator 2	18,200	SEB Generator	10,640
CC Generator	2,100	SRL Generator	2,200
FLN Generator	2,310	SU Generator	2,002
GDH Generator	3,500	TAG Generator	2,520
IAB Generator	1,400	**Total**	**91,506**

Thermal Energy Plant demands were determined from major plant equipment datasheets as summarized in Table 7-4 with an 80% boiler efficiency.

Table 7-4: Utility Plant Equipment Design Natural Gas Demand

Building	Natural Gas (CFH)
NTEP Boiler No. 1	33,475
NTEP Boiler No. 2	33,475
NTEP Boiler No. 3	33,475
STEP Boiler No. 1	33,475
STEP Boiler No. 2	16,738
STEP Boiler No. 3	33,475
Total	**184,113**

Therefore, the cumulative design natural gas demand including building design loads, their respective emergency generator loads, and thermal energy plant loads is 362,643 CFH.

7.5 Diversity Factor

The diversity factor is a recognized design technique that accounts for the reality that not all buildings will have simultaneous peak natural gas loads. Load diversity is due to such elements as varying occupancy patterns, different usage schedules, and distinct operational requirements across various buildings and systems. Separate diversity factors were calculated for the facilities served by the Meter Yard (Meters 3, 4, and 10) and for the facilities served by Meter No. 9 because they are served by distinct natural gas supply locations. Table 7-1 indicates a measured peak natural gas demand of 57,542 CFH and 1,856 CFH for the Meter Yard and Meter No. 9 respectively. Table 7-5 indicates a design natural gas demand of 345,692 CFH and 16,949 CFH for the Meter Yard and Meter No. 9 respectively. The diversity factors are calculated as follows:

$$Diversity\ Factor = \frac{Measured\ Peak\ NG\ Demand}{Design\ NG\ Demand}$$

Table 7-5: Natural Gas Diversity Factors

Meter No.	Diversity Factor
3	8.7%
4	35.3%
9	11.0%
10	22.1%

At first glance, the diversity factors might appear to be lower than expected. However, when one accounts for the fact that a significant portion of design natural gas demand comes from emergency generators, the relatively low calculated diversity factor is reasonable.

7.6 Natural Gas Flow Modeling

A Pipe-Flo Advantage fluid dynamic model was developed to simulate the distribution network and determine the capacity of the existing system. The pipe material, diameter, segment length, and roughness factor for each pipe, as well as the peak flow demand for each building, were entered into the computer model. The results of the model indicate the flow, velocity, and pressure loss for each pipe segment, as well as the total distribution loss. The model layout, pipe lengths, and dimensions were developed using data from the utility distribution map provided by UTSA and Cleary Zimmerman's 2021 "Campus Natural Gas Distribution Model and Study." The model was setup in a manner that allowed analysis that ranges from the CPS natural gas supply lines to the individual distribution networks served by each meter. Refer to Appendix E for detailed information. The natural gas demands are tabulated in the tables above. Three scenarios were modeled as described below.

Main Campus MEP Utility Assessment

7.6.1 Scenario 1

The first scenario simulated the campus' performance under worst case normal operation with all buildings operating at full capacity and no emergency generators in use. Provided that CPS energy delivers 50-psig of natural gas, it was determined that the natural gas pipelines are sized adequately to deliver a minimum of 15-psig inlet pressure to building regulators in most areas of the campus during normal operation.

Specifically, special attention should be given to the western and southwestern sections of the campus, where low inlet pressures were discovered. The west side of the campus experiences lower gas pressures due to the pressure drop through nearly 1,700-feet of 3-inch piping used to transport natural gas to buildings such as the FSB, FWH, and SCG. This could potentially pose challenges for pressure regulators in the west campus to maintain the downstream flow and pressure required to serve the loads requiring 5-psig. A similar situation is also observed on the southwest side of campus, where the athletics buildings, RACE, and Recreational Wellness Center are located. Potential solutions to address this issue include connecting to closer CPS Energy service points, connecting to larger trunk lines, or upsizing of the existing distribution piping.

7.6.2 Scenario 2

The second scenario simulated a campus-wide power outage, with all building loads off and all emergency generators in operation. The natural gas distribution network was determined to provide satisfactory pressure to emergency generators during a campus wide power outage. Cleary Zimmerman's 2021 report identified dangerously low pressures with the addition of an emergency generator at JPL and suggested decoupling the AET/BSE wing from meter No. 3. Our model verified that Cleary Zimmerman's recommendation to extend meter No. 10 piping from the AET to the BSE wing proved effective in alleviating the low pressures that would occur before the connection was made between AET and BSE.

7.6.3 Scenario 3

The third scenario simulated a highly improbable catastrophic power outage with all buildings running at full load and all emergency generators in operation. The same locations identified in Scenario 1 (western and southwestern portions of campus) experienced even lower pressures, dropping as low as 11.4-psig at the FSB Building.

7.6.4 Chaparral Village

CPS Energy provides 25-psig to the Chaparral Village area, which includes Roadrunner Café (RRC), Activity Center (AC), and Chaparral Village. This service pressure is adequate to supply natural gas at peak design load (16,949 CFH). The supply pressure is limited by meter No. 9 which regulates the 25-psig upstream to 5-psig downstream. Consequently, the lowest pressure experienced is 4.5-psig at the furthest connection point. Adjusting meter No. 9 would be the first step if low pressures are a problem within Chaparral Village.

7.7 Natural Gas System Assessment

The health of the natural gas system is of paramount importance due to its role as a vital source for other campus utilities (hot water, steam, and emergency generation). Currently, the existing natural gas

distribution network can meet the campus's demands under normal day-to-day operations. The 8-inch gas main feeding the three meters (Meter No. 3, No. 4, and No. 10) can support an additional 55,575 CFH in building demands before exceeding a maximum recommended design velocity of 60 fps. Therefore, upgrading this pipeline is not currently necessary, unless future developments on campus increase demand beyond this limit. However, considering that this pipeline is the sole CPS Energy pipeline feeding these meters, it might be prudent to explore alternatives for increased redundancy.

In-depth analysis indicates that during worst case normal operation (Scenario 1) or under the extremely unlikely (yet still possible) event of a full campus power outage and peak demand (Scenario 3); certain areas of the campus may experience insufficient gas pressure. Considering recent events in Texas, which increase the likelihood of these situations occurring, it is advisable to conduct a review of these areas prior to future expansions. Conducting a review now would allow for a better understanding of the current system's limitations and potential vulnerabilities. This proactive approach will inform more strategic decision-making and planning for any future expansions or modifications, ensuring the long-term health and efficiency of the natural gas system on campus.

Regarding campus expansion, the western campus area near SRL can support up to an additional 1,200 CFH before putting significant stress on the buildings during peak conditions. Similarly, expansion in the southwestern campus area can only sustain an additional 4,200 CFH near RWC before encountering similar challenges. Therefore, careful engineering analysis and strategic decision-making are essential for any future system expansions or modifications to avoid unwanted impacts to existing areas.

Main Campus MEP Utility Assessment

Section 8 Electrical System Assessment

8.1 System Overview

Electricity to the University is provided by CPS Energy at the 138 kV substation and then to 13.8 kV distribution in loop feeders configuration throughout the campus. Refer to the one-line diagram located in Appendix F.

8.1.1 CPS Energy Substation

The UTSA campus receives its electricity from a CPS Energy substation located on the northern part of the campus along Margaret Tobin Ave. This substation is connected to the campus through two dedicated 138kV overhead transmission lines, which cross Loop 1604 to the North. These lines supply power to the substation through two 138kV/13.8kV transformers with a capacity of 30/40/50 MVA each. The maximum power consumption for the UTSA campus is approximately 17.7 MVA based on the 2019 Summer Peak. This means that a single 30/40/50 MVA transformer can adequately support the campus' needs, providing redundancy in case of a CPS Energy power outage, thus ensuring reliable power supply (N+1 redundancy). Both transformers were manufactured in 2006 and are currently 17 years old. The secondary 13.8kV distribution from the CPS Energy substation is delivered underground through manholes to the UTSA main 15 kV switchgear building, with each transformer supplying four parallel sets of 750KCMIL cable to the switchgear during normal operation.

8.1.2 UTSA Main 15 kV Switchgear

The UTSA main 15 kV switchgear enclosure (E-house) contains two 15kV 2000A Powell metal-clad switchgear line-ups, split into east and west arrangements. They are set up in a main-tie-main configuration with the tie breaker typically open unless there's a failure. If a failure does occur in the campus loops or equipment, loads can be transferred during an outage. This switchgear, manufactured by Powell in 2006 are now 17 years old and are kept in a climate-controlled building above the existing cable vault. Each east and west switchgear has a main breaker, tie breaker, and 10 feeder breakers, but only 9 out of the 10 feeder breakers are in use currently. Campus distribution loops exit at the bottom of the switchgear and enter the cable vault, distributing 15 kV cables to associated ductbanks and manholes throughout the campus. The main 15 kV switchgear is in good conditions and can be expanded with four vertical sections on each bus side (east and west buses).

8.1.3 UTSA Campus 13.8 kV distribution

The UTSA campus has a distribution system with 13.8kV feeders organized in a primary loop. These feeders originate from the east and west main substation buses. The east feeders are designated from the corresponding east bus and are labeled 1 thru 9 with an "A" designation for East feeders. The corresponding west feeders are designated from the corresponding west bus and are labeled 1 thru 9 without any further designation for west feeders, refer to Table 8-1. There's a designated switch in both the east and west loops which is normally open. UTSA electrical maintenance electricians use this switch to isolate each loop, providing redundancy in case of a fault and allowing for fault isolation.

Table 8-1: Campus Loop Feeders

Feeder Loop	Size (AWG/KCMIL)	Year Installed	Conduit Size
1	4/0	1984	4"
2	4/0	1984	4"
3	4/0	1984	4"
4	350	2010	4"
5	4/0	1990	4"
6	4/0	2004	4"
7	750	2007	6"
8	750	2007	6"
9	4/0	2010	4"

8.2 North Thermal Energy Plant (NTEP) Electrical

The NTEP receives power from Loop 4/4A, a dedicated feeder originating from the main 15 kV switchgear. The feeder is 350KCMIL in size and was studied and determined to be adequate for future NTEP electrical modifications according to the 2010 Stanley report. The incoming 15 kV switchgear that serves the plant was replaced in 2020 and is housed in a climate-controlled, walk-in enclosure (E-house) located outdoors in the west equipment yard. Chiller No. 1 operates at 480V, while Chiller No. 2 is fed from incoming 15 kV switchgear via T-62. Chiller No. 4 is fed from SWGR-3 (Powell) via T-32, while Chillers Nos. 3 and 5 are powered at 4.16 kV via outdoor switchgear T-24 SWG located to the south of the plant. The 5 kV switchgear (T-24 SWGR) was replaced in 2018 and transformer T-24 was replaced in 2021. SWGR-3 (Powell) is original to the plant construction in 1984 and is of questionable reliability due to its age and unreliable breaker operation. To enhance the system's reliability, it is recommended to replace aging switchgear SWGR-3 to improve system reliability.

8.3 South Thermal Energy Plant (STEP) Electrical

The STEP receives power from Loop 8/8A, which also serves other buildings in the area, unlike the NTEP dedicated feeder. The STEP uses a medium-voltage draw-out switchgear for its main distribution equipment within the plant, featuring a 1200A main bus and spare breakers designed for the addition of three future chillers and their related mechanical equipment. There is no space in the electrical room for the addition of future sections on the main switchgear. The main switchgear's primary protection is disabled due to the loop arrangement philosophy. If the STEP's main breaker trips, it could de-energize half of Loop 8. Fortunately, the existing electrical equipment is in good condition and adequate for future STEP expansion. It is recommended to install dedicated feeder Loop 10/10A to serve the STEP. This will allow the primary protection to be enabled to protect downstream equipment and future expansion of the STEP.

Main Campus MEP Utility Assessment

8.4 Unit Substations

Most campus buildings have secondary unit substations. They use a main-tie-main configuration on the secondary side, with the tie normally open. These unit substations have two transformers, each rated for the full load of the building. In most cases, each transformer is powered from a separate loop, although sometimes they share a loop. This configuration provides redundancy and flexibility for various operating modes. However, it's worth noting that some buildings have radial feeders which offers no redundancy.

8.5 Campus Current Load

Based on trending data provided by UTSA, the campus electrical load from 2019 to 2022 is shown in figures 8-1 thru 8-4. The Campus electrical current load peaked at 17.7 MW in the summer of 2019.

Figure 8-1: 2019 Campus Electrical Load (kW)

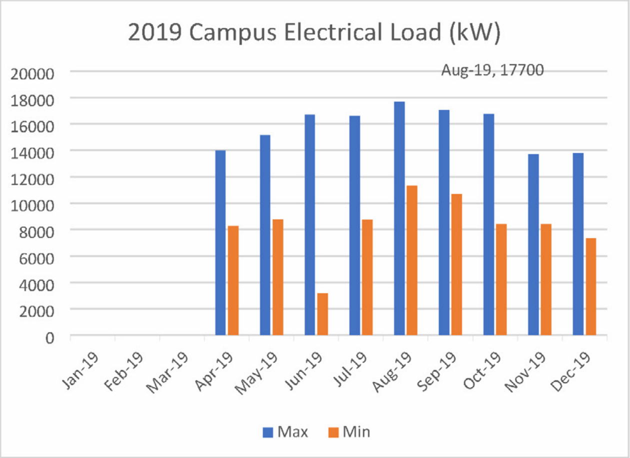


Figure 8-2: 2020 Campus Electrical Load (kW)

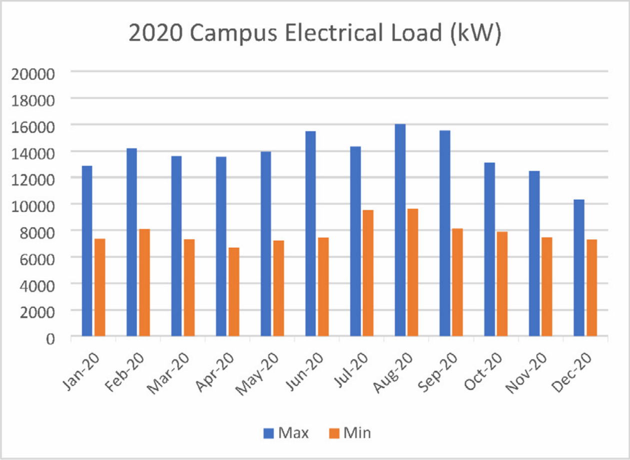
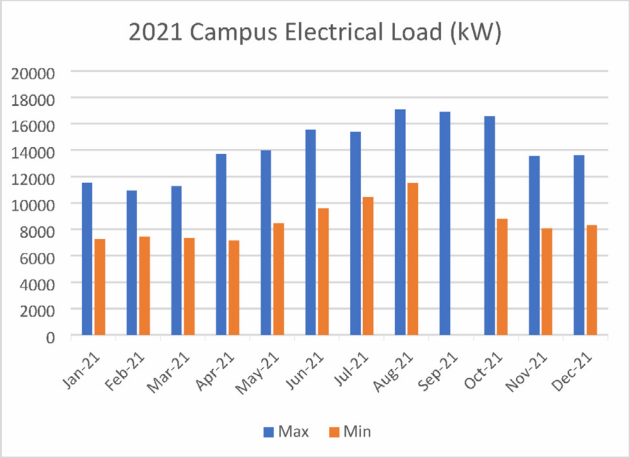
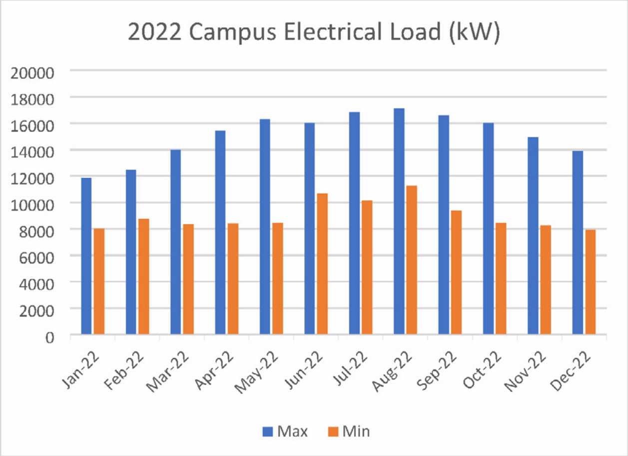


Figure 8-3: 2021 Campus Electrical Load (kW)



Main Campus MEP Utility Assessment

Figure 8-4: 2022 Campus Electrical Load (kW)



8.6 Electrical Distribution Model

8.6.1 Software

The UTSA electrical distribution model was done using AC Network Analysis, computer software package by SKM PowerTools.

8.6.2 System Input Data

The system input data used in this study was provided to Stanley Consultants from the Client via existing and record drawings as well as Stanley Consultants' own site observation visits.

8.6.3 Contribution Data

This section includes the incoming utility connections which provide fault current contribution. The maximum contribution condition occurs with the distribution connected to the incoming utility source (normal power).

8.6.4 Distribution System Load Data

UTSA provided the system load data recorded between 2019 to 2022 at the main 15 kV switchgear metering. The load flow analysis is based on system switching configurations under the maximum system load recorded. Refer to Section 8.5 for tables and graphs of load recorded data.

8.6.5 Feeder Input Data

This section includes cable feeders, which connect various buses, sources, and equipment included in the medium voltage distribution system. Refer to Appendix G for a detailed table of all the feeder input data.

8.6.6 Transformer Input Data

This section includes step-down transformers in the power system. Refer to Appendix G for information on transformer input data.

8.6.7 Equipment Data

This section includes switchboards, circuit breakers, fuses, panel boards, and motors. Refer to Appendix G for information on input data.

8.6.8 Assumptions

There were some assumptions made while gathering data for this Power System Analysis. The following general assumptions were made:

- The survey does not include the individual feeder loads at medium voltage switches except for those indicated in the scope of this report.
- If cable size was not available from drawings or could not be verified by field walk-down, an assumption is made per NEC.
- If medium voltage switches were not accessible or unable to be opened at the time of walk-down, an assumption is made based on other similar equipment installed at the campus.
- Building and Motor loads are lumped at each secondary bus however motor loads may be modeled in some cases. Motors that are connected to VFD are modeled in bypass mode even though the VFD limits the motor fault current contribution in normal operation mode.
- The single line is created based on normal operating scenario at the substation.
- The substation transformers T1 and T2 never run in parallel.

8.6.9 Utility Fault Current Data

The maximum available fault current at the incoming 138 kV bus was provided by the utility company, CPS Energy. The utility fault current contribution is based on one 138 kV feeder circuits. Refer to Appendix G for detailed information.

8.6.10 Short Circuit Analysis

The Short Circuit Study models the current that flows in the power system under abnormal conditions and determines the prospective fault currents in an electrical power system. These currents must be calculated to adequately specify electrical apparatus withstand and interrupting ratings. The Study results may also be used to selectively coordinate time current characteristics of electrical protective devices.

Main Campus MEP Utility Assessment

8.6.11 Load Flow Analysis

The load flow analysis models the current that flows in the power system under normal conditions and determines the prospective load currents in an electrical power system. These currents must be calculated to adequately specify electrical apparatus nominal ratings. The results may also be used to compare electrical power system performance and confirm or select equipment ratings to support the connected loads (bus ampacity ratings, cable sizes, transformer ratings), confirm adequate voltage regulation and select transformer tap settings and determine system operating characteristics including electrical demand of system, bus voltages, voltage drops, power factors, system loss, capacity limits and spare capacity margins.

8.6.12 Study Cases

Variations in utility voltages, system load and system switching configurations can impact the load flow analysis. Causes of these variations include seasonal load fluctuations, maintenance activities and facility operating modes. The system must be capable of accommodating these variations and continue to operate within acceptable criteria. The load flow analysis is based on system switching configurations under maximum system load recorded between 2019 to September 2022 at the main 15 kV switchgear metering as provided by UTSA.

To ensure that these performance criteria are met, multiple load flow cases are evaluated. Each case represents a different set of anticipated system switching configuration. These cases are described below.

- LF Case 0 – Normal Operation

Description: Each feeder loop has an open switch to equally share the building loads.

Table 8-2: Campus Loop Feeders Capacities

Feeder Loop	Cable Size (AWG/KCMIL)	*Rated Capacity (kW)	**Allowable Capacity (kW)	***Existing Peak Load (kW)	Available Capacity (kW)
1	4/0	4,900	4,165	2,472	1,693
2	4/0	4,900	4,165	3,484	681
3	4/0	4,900	4,165	2,341	1,824
4	350	6,334	5,639	5,131	508
5	4/0	4,900	4,165	2,837	1,328
6	4/0	4,900	4,165	1,662	2,503
7	750	8,963	7,619	1,312	6,307
8	750	8,963	7,619	2,918	4,701
9	4/0	4,900	4,165	650	3,515

Notes:
* Per NFPA-70 (NEC) Table 311.60(77).
** 85% Load Factor
*** Recorded August 2019

8.7 Electrical System Assessment

The existing electrical system capacity adequately meets UTSA campus' current needs. The CPS Energy substation has two transformers with rated capacity 30/40/50 MVA each thus ensuring reliable power supply (N+1 redundancy). The Campus electrical current load peaked at 17.7 MW in the summer of 2019. The main 15 kV switchgear is in good condition and can be expanded with four vertical sections on each bus side (east and west buses).

The 13.8kV distribution system consists of 9 loop feeders. Each feeder is divided into east and west loops. There is a designated switch in both the east and west loops which is normally open providing redundancy in case of a fault and allowing for fault isolation. Loops 1/1A, 2/2A, 3/3A and 5/5A feeder cables are the oldest (35+ years) on campus and were tested in 2022. The cables passed the tests however, it is recommended to replace the cables soon as they are reaching the end of their useful life. Loops 4/4A, 6/6A, 7/7A, 8/8A and 9/9A feeder cables are on average 20 years old however, no testing has been performed. Typically, medium voltage cables are tested every 5 years. It is recommended to utilize VLF testing as it is a non-destructive and effective means of assessing the condition of medium and high-voltage cables.

Most campus buildings have secondary unit substations and are fed from two different loops. This configuration provides redundancy and flexibility for various operating modes. However, it's worth noting that some buildings have radial feeders which do not offer redundancy.

The NTEP receives power from dedicated Loop 4/4A. Most of the electrical distribution switchgear in the NTEP has been replaced within the last 10 years, with the latest being the 15 kV incoming switchgear in 2020. However, SWGR-3 (Powell), which is original to the plant construction in 1984, is of questionable reliability due to its age and unreliable breaker operation. To enhance the system's reliability, it is recommended to consider upgrading this aging switchgear.

Unlike the NTEP's dedicated feeder, the STEP receives power from Loop 8/8A, which also serves other buildings in the area. The main switchgear's primary protection is disabled due to the loop arrangement philosophy. If the STEP's main breaker trips, it could de-energize half of Loop 8. Fortunately, the existing electrical equipment is in good condition and adequate for future STEP expansion. Implementing a dedicated feeder Loop 10/10A to serve the STEP is recommended. This would enable primary protection, safeguarding downstream equipment and supporting future expansion of the STEP.

The electrical distribution system equipment is adequately rated to interrupt the available short circuit current and currently meets the peak demand of UTSA campus with spare capacity for future expansion.

Section 9 Climate Vulnerability Assessment

In recent years, we've seen more frequent heat waves, record-high temperatures, and a prolonged and more intense cooling season at UTSA. This pattern is expected to persist, with climate projections indicating further temperature increases in the decades ahead. These higher temperatures will lead to increased cooling demands and greater energy consumption for cooling systems. Therefore, it is imperative that all future expansion plans account for these increases to ensure the resilience of UTSA's thermal utilities in the face of future climate changes.

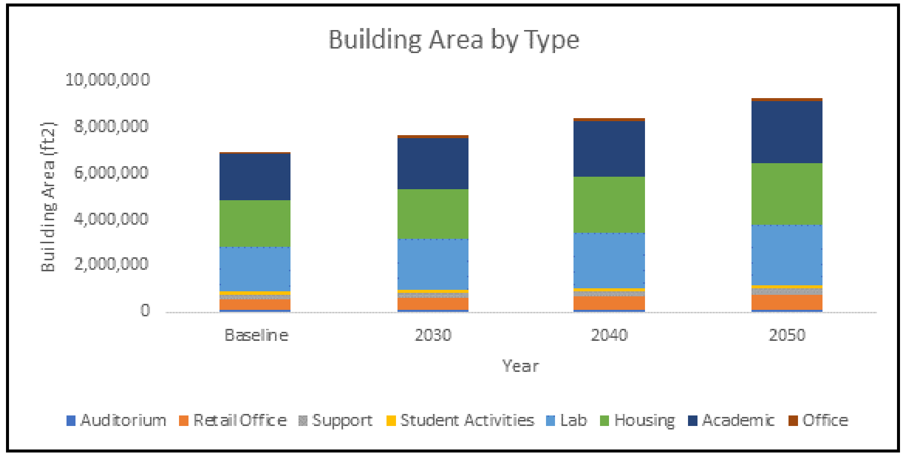
9.1 Climate Data

The UTSA analysis was conducted using the CMIP5 Localized Constructed Analogs (LOCA) dataset, which is downscaled across the United States to 16th degree grids (approximately 3 miles x 3 miles) (Pierce, 2015). The LOCA dataset contains climate projections from 32 climate models that are each generated by a global network of research institutions and are moderated by the Intergovernmental Panel on Climate Change (IPCC). Rather than present 32 separate sets of results, results from the 50th and 95th percentile models are presented to represent the median and near-worst-case outcomes from the 32-model suite.

Each model presents projections based on specific emissions scenarios set by the IPCC and known as Representative Concentration Pathways (RCPs), of which two are used in this analysis. RCP 8.5 is a high emissions scenario where emissions generation continues largely unabated into the future. RCP 4.5 is a lower emissions scenario that accounts for a future reduction in emissions. In addition to these scenarios, three future time periods are reported: 2020 to 2039 (2030), 2030 to 2049 (2040) and 2040 to 2059 (2050). Time period results represent the average value over the 20-year period. Future time periods are compared to a baseline model for 1990-2009, with input based on the Livneh dataset to ensure consistency with the LOCA training data (Livneh, et al., 2013).

9.2 Campus Context

Three UTSA campuses were considered as part of the analysis: Main, Park West, and Downtown. Each campuses' results are informed by climate projections unique to that campus. Each campus is expected to experience an increase in building area for each of a series of eight building types. The eight building types and baseline square footage values are as defined by the UTSA campus master plan. Projected results for each time period assume a 10% increase in building area relative to the prior time period. Building types and assumed growth are illustrated in Figure 9-1.



This growth will result in increased energy usage that is independent of temperature driven energy use increases. The energy use intensity results are on a per-ft^2 basis and so account for changes in energy usage due to temperature trends, but not due to campus growth.

9.3 Cooling Design Conditions

To evaluate the projected change in cooling system design conditions, the 0.4% cooling dry bulb design condition was calculated per ASHRAE standards (ASHRAE, 2017) for the baseline and projected datasets. Design condition results shown in Figure 9-2 represent the temperature that is projected to be exceeded 0.4% of the hours in a given year. For reference, per the UTSA construction standards (UTSA, 2018) campus cooling systems are typically designed to 100°F.

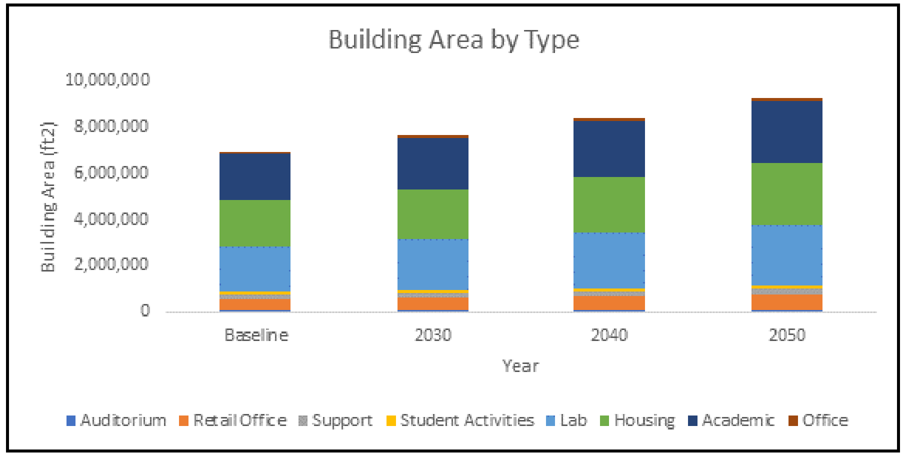
Additionally, Figure 9-3 shows that the average number of annual days with maximum temperature above the 100°F UTSA design condition is projected to increase from a three-campus-average of 8 days in the baseline time period to 29 days by 2030 according to the 50th percentile model under RCP 4.5, or an average of 45 days by 2050 according to the 50th percentile model under RCP 8.5.

It is important to note that all presented climate projection data, including that presented in Figure 9-3, represents the average of the 20-year time periods centered on 2000 (baseline), 2030, 2040 and 2050. Within each of these 20-year spans, individual years will inevitably exhibit values that exceed the average. So, for the period centered around 2030, while the average year from 2020 to 2039 is projected to have 29 days above 100°F, certain years within this period will experience significantly higher values. Such variability is also observed in short-term weather patterns when compared to long-term weather trends. For example, 2023 marked a record year for San Antonio with 74 days exceeding 100°F. However, when we look at the past two decades, we find that only 6 out of the last 20 years have recorded more than 31 days with temperatures over 100°F.

Main Campus MEP Utility Assessment

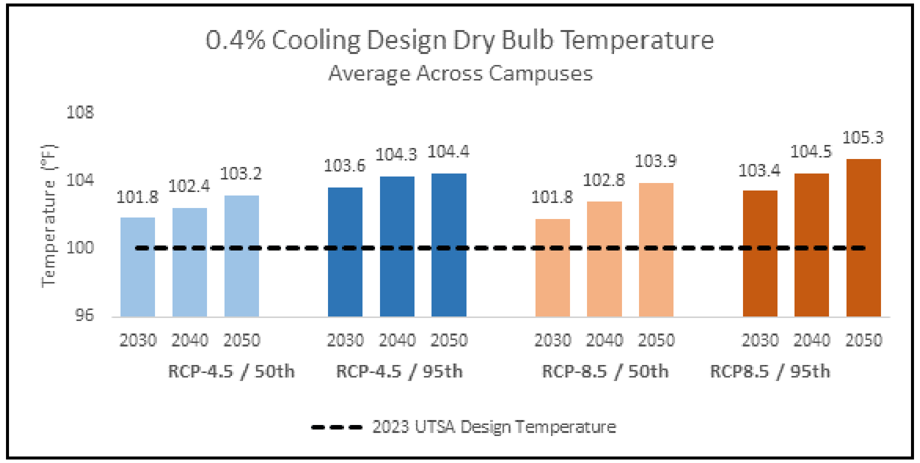
This variability underscores the point that climate models are more adept at identifying long-term trends rather than pinpointing short-term extremes. The choice of using 20-year averages in climate modeling is intentional; it mitigates the impact of anomalous years and focuses on the overarching direction of climate change. This approach allows for a clearer understanding of the general trend over time. To put this into perspective, if we compare these projections with the baseline period centered around 2000, UTSA is projected to experience, on average, an increase of 2.2 to 7.0 times more days per year exceeding 100°F by 2030. This range further escalates to an average of 3.2 to 11.0 times more such days by 2050. These figures illustrate the escalating nature of climate change and its potential impacts on local weather patterns over time.

Figure 9-1: Future Growth in Building Area Through 2050 By Building Type



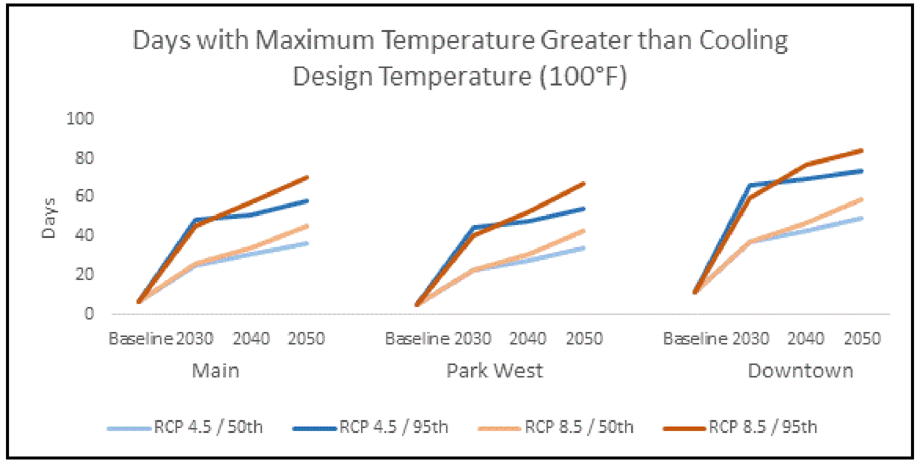
Note: A 10% increase in building area relative to the previous time period was assumed to occur for each building type.

Figure 9-2: Cooling Design Condition Projections for the Temperature that is Exceeded 0.4% of the Hour in a Given Year



Note: UTSA standard design temperature of 100ºF shown for reference.

Figure 9-3: Time Period Mean Number of Days Per Year with a Maximum Temperature Greater Than 100°F



Main Campus MEP Utility Assessment

9.4 Cooling Energy

Cooling system energy use intensity (EUI) is defined as the cooling system energy usage per square foot of building area served and is correlated to the environment within which the building operates. In this study, the correlation is quantified in terms of Cooling Degree Days with a base of 50°F (CDD50) versus the cooling system energy usage for a representative version of eight different building types prominent on the UTSA campuses.

Table 9-1: UTSA Building Types and the Corresponding DOE Energy Model That Was Used to Model Cooling Energy Usage Under Future Climatic Conditions

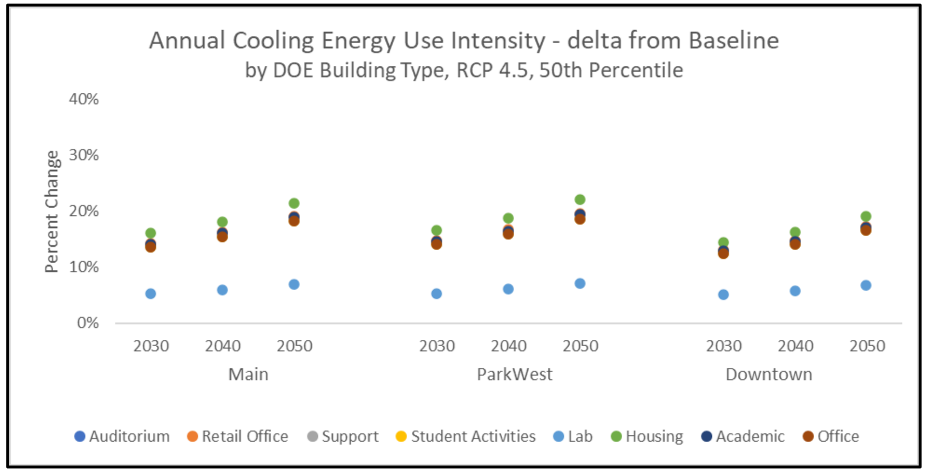
UTSA Building Type	DOE Reference Building Model
Auditorium	Secondary School
Retail Office	Small Office
Support	Medium Office
Student Activities	Medium Office
Lab	Hospital
Housing	Midrise Apartment
Academic	Secondary School
Office	Medium Office

The US DOE Commercial Reference Building models are used to define the characteristics of a representative building for each ASHRAE climate zone based on nationwide survey data (Commercial Reference Buildings, 2010). Each of the 8 UTSA building types are paired with the most similar DOE model type as outlined in Table 9-1. Models are available for buildings built pre-1980, post-1980 and new. Only the post-1980 models were used for the purposes of this study.

Cooling system energy usage and building square footage as defined by the DOE Reference Building Models were used to calculate cooling system energy use intensity (kWh / ft2) for each representative building type in each climate zone. A linear regression relationship was then established between the annual CDD50 reported in ASHRAE 90.1 2004 (ASHRAE, 2004) and the calculated cooling system energy use intensity for each representative building. Lastly, the cooling system energy use intensity for all building types was calculated using inputs of baseline and projected CDD50. CDD with a base of 50°F was used because it demonstrates a closer correlation to cooling energy use intensity than does CDD with a base of 65°F (it is worth noting that this doesn't mean that the building cooling system runs above 50°F).

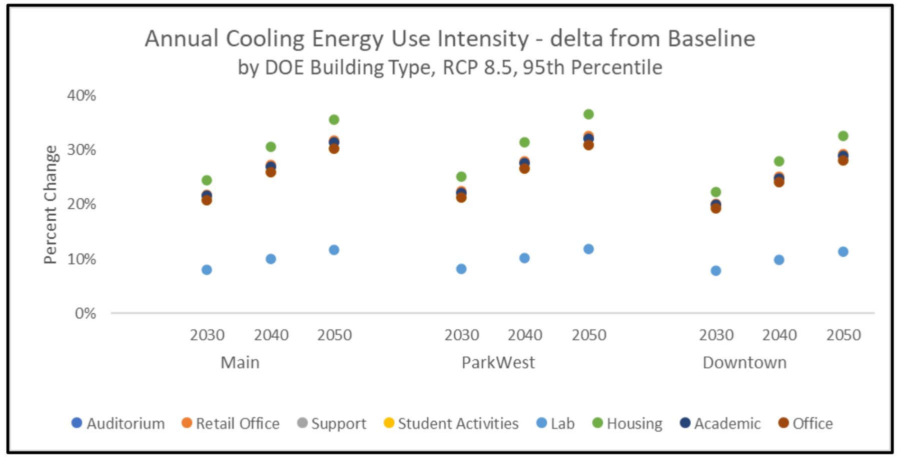
The change from baseline in cooling system EUI results are presented in Figure 9-4 for the 50th percentile model under RCP-4.5 and in Figure 9-5 for the 95th percentile model under RCP-8.5. Because the EUI results are on a per-square-foot basis, they communicate the change in a building type's energy usage solely due to the effects of temperature changes and do not account for any growth in campus building area.

Figure 9-4: Change in Cooling System Energy Use Intensity (EUI) According to the 50th Percentile Model Under RCP 4.5 for Each Campus, Building Type and Time Slice



Note: Values are based on a change in energy use per square foot of building area, and so are not dependent on building stock grown projections shown in Figure 9-1.

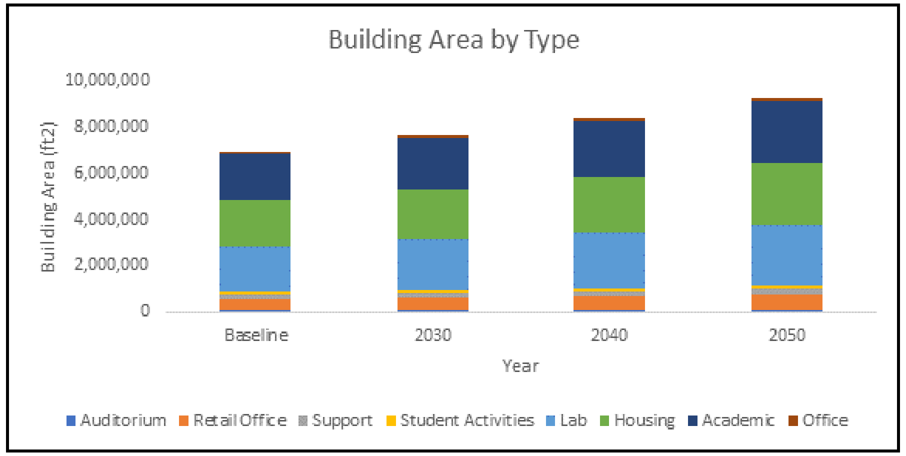
Figure 9-5: Change in Cooling System Energy Use Intensity (EUI) According to the 95th Percentile Model Under RCP 8.5 For Each Campus, Building Type and Time Slice



Note: Values are based on a change in energy use per square foot of building area, and so are not dependent on building stock grown projections shown in Figure 9-1.

Main Campus MEP Utility Assessment

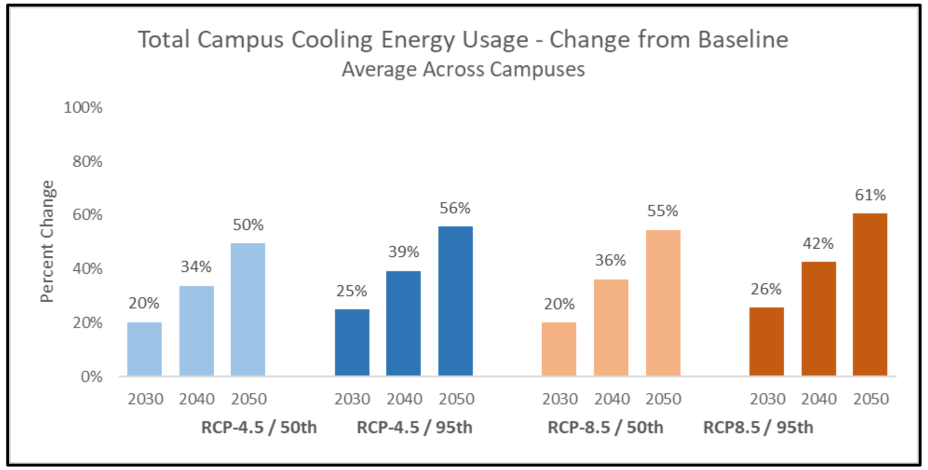
As opposed to cooling system EUI, cooling energy use is dependent on the area of the building or buildings under consideration, and results therefore reflect the change in energy usage due to growth in camps building square footage and due to changing temperatures. Total campus cooling energy use results are shown in Figure 9-6. The baseline results reflect square footage values as reported in the UTSA masterplan. Projected results for each time period assume a 10% increase in building square footage relative to the prior time period. Those increases are 700,000 ft^2 by 2030, 1.5 million ft^2 by 2040 and 2.3 million ft^2 by 2050 and are illustrated in .



The square footage values reported in the master plan are assumed to represent a cumulative square footage value across the three campuses. Therefore, the energy usage results also represent cumulative values across the three campuses.

EUI and energy use are also dependent on the CDD50 results for the baseline and projections. Almost 7,000 cooling degree days (base 50°F) are experienced according to the baseline model. This is projected to increase by 12% (RCP 4.5, 50th) to 18% (RCP 8.5, 95th) by 2030, 14% (RCP 4.5, 50th) to 23% (RCP 8.5, 95th) by 2040, and 16% (RCP 4.5, 50th) to 27% (RCP 8.5, 95th) by 2050. Climate data projections for the main campus are used to inform the energy usage calculations, while EUI results for each campus use climate data from the corresponding campus.

Figure 9-6: Average Change in Cooling System Energy Use Across All Building Types and Campuses Broken Down by Time Slice, Model Percentile and Scenario



Note: Values are based on a change in cooling energy use per square foot of building area combined with the building stock growth projections shown in Figure 9-1, and so are sensitive to the building areas that vary from those shown in Figure 9-1.

9.5 Heating Utilities

As the climate warms, milder winters are anticipated, resulting in reduced heating demand from natural gas and other sources. This may translate into financial savings for the university in terms of heating expenses during the colder months. However, in a cooling dominated climate such as San Antonio this will likely be outweighed by the increase in cooling energy costs. Although heating demand may diminish, it is still crucial for the university to focus on ensuring an energy efficient, well maintained, and fully capable heating system. This is especially pertinent considering recent extreme cold events that have plagued Texas in recent years, and which may become more common. Due to their extreme nature as climatic outliers such events cannot be described by the climate models utilized for this study, which instead specialize in general climatic trends, but the university should still be prepared for their occurrence. Preparing the utility systems for these climate change-driven fluctuations is essential to maintain cost-efficiency while keeping the campus functional and comfortable during shifting weather patterns in the future.

9.6 Next Steps

Numerous cooling system design and operational impacts may stem from a warming climate. Such impacts include those suggested by the results presented above – namely the consideration of additional cooling energy usage as well as the need for additional cooling capacity. Future capacity requirements may be more economically met in the future by designing present-day systems, like chillers, pumps and piping, for future modularity and growth. This same approach at the terminal units can help existing systems meet future demands without total redevelopment. Impacts also extend beyond cooling energy and capacity to things like equipment selection, where projected climate conditions can be used in addition to the historic ASHRAE conditions typically used in design. For example, conditions like future outdoor dry bulb and wet bulb temperature may need to be accounted for when selecting outdoor equipment like cooling towers and air-cooled chillers. Operational impacts are also important to consider, such as the possible increase in maintenance and reduction in lifespan for outdoor equipment due to warmer operating conditions.

This study is intended to identify the magnitude of the changes in energy use that may materialize due to climate change. It is not intended to serve as the final reference point for future design standards, future cooling energy use or cooling capacity. Rather, each of these areas should be investigated further using building- or campus-specific data (rather than representative DOE model data) to inform an enhanced climate resilience study of the campuses' utility system impacts. Useful tools for such a study include monitored energy use and cooling capacity production as well as load and energy models that utilize future weather profiles rather than present day profiles. Such a climate resilience study can inform campus-specific solutions to ensure the systems at UTSA are able to meet future operational requirements, and support the goals of the University, even in the face of a changed climate.

9.7 Assumptions

DOE Commercial Reference Building energy models were used for the cooling energy use analysis. Each building type's cooling system type, building area and cooling energy use is as reported in the DOE Commercial Reference Building models.

The relationship between building energy model energy usage and cooling degree days is assumed to hold true into the future time periods.

A 10% increase in building area is assumed to occur for every building type in every time period. This increase is relative to the previous time period.

9.8 Limitations

There is inherent uncertainty within climate model data, and therefore actual future conditions and results may vary from those shown in this report. Output from multiple models and RCP scenarios are used to give an understanding of the possible spread of outcomes, but outcomes outside of these spreads are still possible.

The building energy models used in this study are representative of the typical nationwide building stock and may vary from the UTSA building stock in energy use, area, cooling system type, and the effect that outdoor temperatures have on indoor temperatures. Because of this variation, EUI and energy use results are presented in terms of percent-change-from-baseline rather than in terms of change in kWh/ft2 or kWh.

9.9 References

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Main Campus MEP Utility Assessment

Section 10 Downtown Campus

10.1 Introduction

The University of Texas at San Antonio Downtown Campus has 516,991 ft² of existing building space which consists of the Main Block (Buena Vista Street Building, Frio Street Building, and Durango Building), the Monterey Block (Monterey Building), and the San Pedro Creek Culture Park (San Pedro 1). The Main Block campus is supplied with chilled water and hot water from the Thermal Energy Plant (TEP-1) located in the Buena Vista Street Building. TEP-1 currently has three chillers with capacities of 500-Tons, 800-Tons, and 1,000-Tons for a total capacity of 2,300-Tons (1,300-tons firm), and two 250-BHP hot water boilers with a total capacity of 16,750-MBH (8,375-MBH firm) and three roof-mounted cooling towers (700-Tons each). The Monterey Building is served by two 360-tons air-cooled chillers which are each sized at 100% of the building cooling load. San Pedro 1 is served by three 150-Tons air-cooled chillers which are each sized at 50% of the building cooling load. UTSA reported San Pedro 2 will start construction in the Fall of 2023 and will have the same arrangement as San Pedro 1.

UTSA has confirmed that the current cooling peak load for the Main Block is 800-Tons and estimated 300-Tons for the Monterey Building. Based on the Main Block peak cooling load, TEP-1 has an excess capacity of 1,500-Tons (500-Tons firm).

10.2 Phasing

The 2019 UTSA Campus Master Plan developed by Page includes four growth phases for the Downtown Campus. Phase timeframes are estimated as short-term (0-5 years), mid-term (5-15 years) and long-term (15-30 years) based on input from UTSA staff. Table 10-1 shows the planned growth phases including the estimated building heating and cooling loads. The four phases as presented in the 2019 Master Plan are as follows:

- Phase 1 – San Pedro Creek Culture Park
- Phase 2 – Cattleman's Square and Bill Miller Plaza Redevelopment
- Phase 3 – TxDOT Parcel Acquisition
- Phase 4 – City of San Antonio Parcel Acquisition

Table 10-1: Downtown Campus Planned Growth Phases

Phase	Term	Bldg Area (GSF)	Estimated Cooling Load (Tons)[1]	Estimated Heating Load (MBH)[2]
1 - San Pedro	Short	978,000	3,556	14,670
2 - Cattleman's	Mid	1,218,000	4,429	18,270
3 - TxDot	Long	418,000	1,520	6,272
4 - City of San Antonio	Long	1,671,000	6,076	25,065

Notes: [1] Based on 275 ft²/ton
[2] Based on 15 Btu/ft2

10.3 Utility System Growth

Phase 1 is the initial development phase that will expand the campus to recently acquired land parcels east of I-10/I-35. This phase is currently under design and construction. The San Pedro 1 building was completed in early 2023, and San Pedro 2 is under design with an anticipated construction start in the Fall of 2023. These buildings are served by stand-alone air-cooled chillers and heating water boilers. No changes are recommended.

Phase 2 through Phase 4 focuses on the Main Block and Monterey Block of the Downtown Campus. This plan aims to replace the Monterey Building with two housing buildings (Cattleman's Square) and add additional buildings on the Main Block campus, resulting in an additional 3,307,000 gross square feet. However, the existing TEP-1 lacks the capacity and space to accommodate future chillers or boilers required to serve the estimated additional loads. Therefore, it is recommended to construct a new thermal energy plant during Phase 2, interconnected with the existing TEP-1. Additionally, the existing TEP-1 equipment should be replaced across Phase 2 through Phase 4.

The new thermal energy plant construction would occur during Phase 2, with chiller/boiler additions continuing through Phase 4. Phase 2 would introduce three 2,500-ton chillers to serve the Main Block & Cattleman's Block during the Phase 2 development. The new TEP build-out would then progress during Phase 3 and Phase 4, adding one 2,500-ton chiller during each phase.

Expansion of the existing TEP-1 would take place from Phase 2 through Phase 4. The Phase 2 expansion would replace the 500-ton chiller with another 500-ton chiller. In Phase 3, the 800-ton chiller would be replaced with a 1,250-ton chiller. Finally, Phase 4 would involve replacing the 1,000-ton chiller with a 1,250-ton chiller. These expansions would enable the two TEPs to meet the estimated cooling demand of 12,825-tons with a firm capacity of 13,000-tons. In total, the campus-wide chiller capacity would consist of five 2,500-ton chillers, two 1,250-ton chillers, and one 500-ton chiller, resulting in a total capacity of 15,500-tons (13,000-tons firm capacity).

To meet the heating hot water demand, new heating hot water boilers would be installed, similar to the chiller build-out of the new TEP and existing TEP upgrades. Phase 2 would see the addition of two 500-BHP (16,738-MBH) heating water boilers to the new plant, providing a total capacity of 33,476-MBH (16,738-MBH firm). During Phase 4, a third 500-BHP heating water boiler would be added to meet the campus's firm capacity requirements. Expansion of the existing TEP-1 would occur during Phase 2 and 3, replacing a 250-BHP boiler with a 350-BHP (11,716-MBH) boiler in Phase 2 and replacing the other 250-BHP boiler with a 350-BHP boiler in Phase 3. In total, the campus-wide boiler capacity would consist of two 350-BHP boilers and three 500-BHP boilers, resulting in a total capacity of 73,646-MBH (56,908-MBH firm capacity).

Main Campus MEP Utility Assessment

Section 11 Opportunities

Considering the dynamic energy landscape and the need to adopt forward-thinking solutions, this utility assessment report additionally explored future options for enhancing UTSA's energy infrastructure. In contrast to the previous sections of the assessment, this section of the report will place a particular emphasis on forward-looking strategies, focusing on the potential integration of combined heat and power (CHP), Optimization, Demand Side Management, and electric vehicle (EV) infrastructure. By doing so, we aim to provide insights and recommendations that align with the University's commitment to energy efficiency, cost savings, and environmental responsibility while meeting the growing demand for clean energy solutions and electric mobility options.

11.1 Combined Heat and Power

Combined heat and power (CHP) is an effective method to simultaneously generate power and process heating capacity. By harnessing the waste heat from the prime mover for process demands, CHP offers an efficiency advantage over simple cycle plants or thermal power stations that release a significant amount of waste heat to the atmosphere. Various CHP options were compared to current operations, which includes purchasing power from the grid and generating steam or hot water utilizing gas-fired boilers.

11.1.1 Existing Loads

Data for year 2022 was reviewed to establish current power and heating demands. See Figures 10-1 and 10-2 for power and heating demand data. Heating demand included both steam and hot water loads from the NTEP and STEP. Note minimums and maximums are averages of daily values for each month and do not represent true minimum or maximum demands.

Figure 11-1: UTSA Main Campus Power Demand

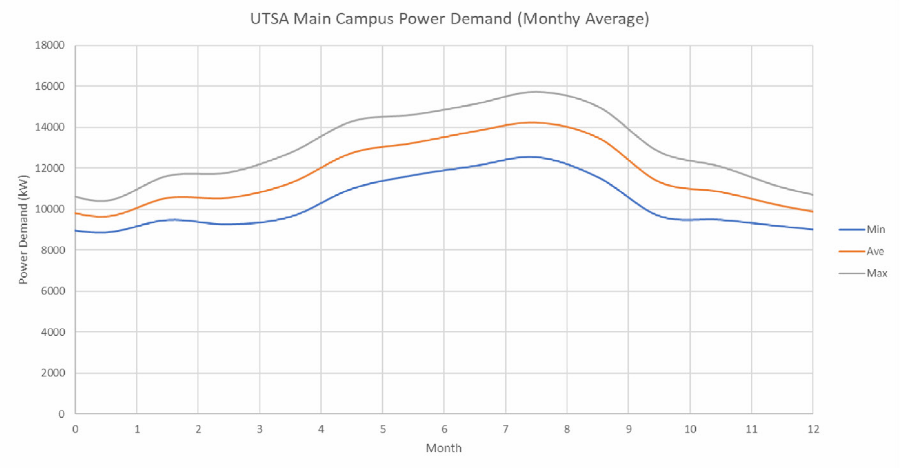
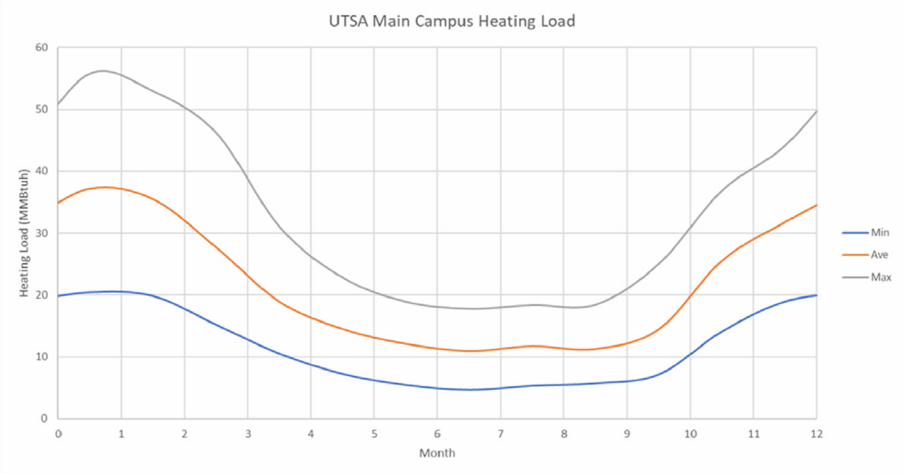


Figure 11-2: UTSA Main Campus Heating Demand



Based on the power demand curves, a maximum CHP power output of approximately 10 MW is recommended to accommodate a high-capacity factor. A maximum heating output of approximately 10 MMBtu/hr is preferred to prevent significant CHP operational limitations due to low heating demand. Analyses assume that the CHP system output would be reduced slightly, as needed, when power or heating demand is limited.

11.1.2 Analyses

Refer to Table 10-1 for a summary of the CHP Options Evaluated.

Table 11-1: CHP Options

	Option 1	Option 2	Option 3	Option 4
Prime Mover	Solar Saturn 20	Solar Centaur 40	Siemens SGT-A05	Wartsila 20V34SG
Unit Quantity	1	1	1	1
Unit Net Capacity (MW)	1.1	3.2	3.3	9.3
Net Heat Rate HHV (Btu/kWhr)	16,997	14,273	13,586	8,367
Thermal Output (MMBtu/hr)	8.9	19.1	23.9	10.8

Each option was modeled in GT Pro to estimate performance using natural gas as fuel and generating at a voltage of 13.8kV. Capital costs were estimated using GT Pro, adjusted based on current economic conditions. Capital costs for each option include a building to house the equipment. Note that it was

Main Campus MEP Utility Assessment

assumed that existing UTSA land would be used for the facility and no land acquisition costs were included. Connection costs for natural gas and electrical utilities are also not included. The CHP systems were assumed to operate in CHP mode only. Bypass stacks for simple cycle operation were not included. As noted above, output was reduced, as necessary, based on campus power and heating demand. For these analyses, each option was evaluated based on 125 psig heat recovery steam generator (HRSG) for heat recovery. Hot water would be generated by a converter to serve existing hot water loads. In the event existing steam loads are converted to hot water, a hot water heat recovery unit could be used instead of an HRSG.

Analyses are based on an average power cost of $0.085 per kWh and a fuel cost of $7 per MCF. An efficiency of 80% was used for existing steam and hot water boilers in the analyses. See Table 10-2 for a summary of analysis results.

Table 11-2: CHP Results

	Option 1	Option 2	Option 3	Option 4
Prime Mover	Solar Saturn 20	Solar Centaur 40	Siemens SGT-A05	Wartsila 20V34SG
Unit Quantity	1	1	1	1
Unit Net Capacity (MW)	1.1	3.2	3.6	9.3
Net Heat Rate HHV (Btu/kWh)	16,997	14,273	13,586	8,367
Thermal Output (MMBtu/hr)	8.9	19.1	23.9	10.8
CHP Availability	96%	79%	75%	96%
O&M ($/kW)	$0.01	$0.01	$0.01	$0.013
Capital Cost ($/kW)	$5365	$3082	$2843	$1452
Capital Cost ($)	$5,669,500	$9,896,302	$10,187,850	$13,488,100
Saving ($/Yr)	$262,467	$600,817	$862,025	$1,837,397
Simple Payback (Yrs)	21.6	16.5	11.8	7.3

The most favorable option is Option 4 with a Wartsila 20V34SG reciprocating engine. The higher electrical efficiency and lower waste heat is a better fit for the University's utility demands, which allows for a larger unit at a lower cost per kW. Low heating demand limits the capacity of the gas turbine options, resulting in smaller units, which tend to have higher cost per kW of electrical output. Option 4 with an estimated simple payback of 7.3 years may be economically feasible on a lifecycle cost basis. It is important to note that the payback periods presented are relative and indicative, as they are based on the available data and the scope of this initial assessment. Not all potential costs have been factored in at this stage, such as those for additional utility connections and land acquisition. These figures should thus be used for comparative purposes only, to guide future in-depth analyses. Should the University decide to proceed with onsite

generation, a comprehensive study including all associated costs is recommended to accurately determine the financial feasibility on a lifecycle basis.

11.2 Optimization

When considering the potential for improving the efficiency of central plant operations, especially in the production and distribution of chilled water, optimization emerges as a crucial strategy for the future. It acts as a sophisticated control system aimed at maximizing the overall system performance. Instead of treating components like chillers, cooling towers, and pumps in isolation, optimization views them as interconnected elements. This innovative control system utilizes variable speed technologies to ensure the system consistently operates as close as possible to the chiller "Natural Curve," a concept introduced by Tom Hartman and the Hartman Loop to represent the optimal operating point of chillers under different load conditions.

While we champion the concept of optimization, it is important to note the significant financial impact involved in implementing variable speed conversion, especially in existing thermal energy plants like the NTEP and STEP. For example, converting all the chillers, pumps, and cooling towers at both NTEP and STEP to variable speed would be necessary. Although some equipment, such as Chiller No. 2 at the NTEP and Chiller No. 6 at the STEP, are already equipped with variable speed capabilities, and there are some pumps and fan motors at both plants that have this technology, a substantial portion of the equipment still lacks variable speed drives, leading to a substantial financial burden.

In the interim, future opportunities for optimization should include the implementation of cost-effective measures, such as chiller sequencing, chilled water reset, and condenser water reset. These measures serve as steppingstones toward the broader goal of increasing system-wide efficiency. Retrofitting with Variable Speed Drives (VSD) for chillers and pumps offers significant energy savings but as mentioned, requires capital expenditures. However, optimizing chiller sequencing and adjusting supply water temperature using chilled water reset are practical strategies that can lead to energy savings and improved efficiency without substantial capital outlays.

Furthermore, integrating free cooling into the system when ambient conditions allow can be a valuable strategy, though it may involve additional equipment such as heat exchangers and control systems. Regular maintenance and cleaning practices also play a vital role in optimizing chiller plant performance, providing immediate benefits like reduced energy consumption and fewer unplanned outages.

While optimization in central chilled water plants presents an innovative approach to improving energy efficiency and overall performance, its successful implementation in existing plants without variable speed technologies requires careful consideration of the financial aspects and priorities. The long-term energy savings and improved reliability often justify the investment, but a phased approach, incorporating more affordable measures like chiller sequencing and maintenance, can serve as a logical path to system-wide efficiency. By treating the plant as an integrated system and leveraging both existing and new technologies, central chilled water plants can move closer to the goal of optimal operation and reduced environmental impact.

Main Campus MEP Utility Assessment

11.3 Demand Side Energy Management

Demand Side Energy Management (DSEM) involves strategies and practices aimed at managing and reducing energy consumption on the demand side, i.e., where energy is used as opposed to the supply side where energy is generated. For the UTSA campus, DSEM can encompass a variety of approaches:

- Optimization of Heating, Ventilation, and Air Conditioning (HVAC) Systems: This is crucial in managing the consumption of chilled water for cooling and hot water/steam for heating. Techniques include efficient scheduling, using energy-efficient equipment, and implementing control strategies like occupancy sensors and variable frequency drives. Refer to Section 11.4 for additional information.
- Building Automation and Energy Management Systems: These systems can monitor and control building environments, ensuring that energy is used only when needed and in the most efficient manner. They can automate the adjustment of temperature settings, lighting controls, and other energy-consuming services based on real-time data. Refer to Section 11.4 for additional information.
- Metering: Metering at the building level is a critical component of DSEM, especially when dealing with systems like chilled water, heating hot water, and steam. This practice involves installing meters in individual buildings to monitor and record energy usage in real-time. By metering at the building level, UTSA can obtain insights into where and how energy is being used. This data is critical for identifying high-consumption areas and for developing strategies to reduce energy use.
- Retrofitting and Upgrading Infrastructure: Older buildings can be significant energy consumers. Upgrading insulation, windows, and HVAC systems to more energy-efficient models can significantly reduce energy usage.
- Behavioral Changes and Awareness Programs: Encouraging students, faculty, and staff to adopt energy-saving habits like turning off lights and equipment when not in use can have a considerable impact on reducing energy demand.
- Renewable Energy Integration: Incorporating renewable energy sources, like solar panels, can offset the need for energy from traditional sources, especially for electricity.
- Data Analysis and Continuous Monitoring: Regular analysis of energy usage data helps in identifying inefficiencies and areas for improvement. Continuous monitoring allows for the quick detection of issues like energy leaks or malfunctioning equipment.
- Sustainable Design and Construction Practices: For new buildings or renovations, incorporating sustainable design principles can ensure that buildings are energy-efficient from the start.

11.4 Harmonizing Central Plant and Building Systems

For any upgrade to central plant or thermal distribution systems at UTSA, it's important to ensure compatibility with the building systems that utilize thermal energy. Achieving peak efficiency necessitates a concerted effort to align the design objectives of both the central plant and building systems through well-defined, practical strategies. Key to this alignment is the optimization of the temperature differential (ΔT) between supply and return water, enhancing thermal efficiency. Simultaneously, it is vital to coordinate flow rates to guarantee seamless system integration.

An integral part of this process is the integration of control systems, including plant and building automation systems. Such integration paves the way for more responsive and adaptive operations, efficiently adjusting to fluctuating load conditions. Incorporating energy conservation measures (ECMs) align with UTSA sustainability goals, contributing to broader environmental objectives. This collaborative design process, involving all stakeholders from the outset, ensures a comprehensive understanding of both systems' capabilities, leading to designs that are not only energy-efficient but also sustainable, cost-effective, and adaptable to future needs. This approach promises significant improvements in operational efficiency, energy savings, and reduced maintenance costs, while also offering greater flexibility in mechanical design. EMCs can include:

- Scheduling HVAC equipment to run only during occupied periods.
- Programming outside air dampers to close when buildings are unoccupied.
- Utilizing CO2 sensors for demand-controlled ventilation.
- Resetting the temperatures of chilled water, hot water, and supply air based on outdoor conditions.
- Adjusting hot/cold deck temperatures.
- Eliminating simultaneous heating and cooling.
- Re-commissioning HVAC systems.
- Cleaning air handler coils.
- Correctly sizing building pumps.
- Insulating building distribution piping.

11.5 Electric Vehicle Infrastructure

During the two-day charette, we met with the University's Director of Sustainability to identify future opportunities to create and expand electric vehicle infrastructure (EVI) on the campus. This initiative was met with enthusiasm, as it holds the potential to not only encourage the adoption of electric vehicles among the campus community but also to bolster the institution's commitment to environmental sustainability.

Plausible locations were identified for the installation of EVI on select parking areas throughout the campus. These locations were chosen to ensure accessibility and convenience for the campus population. The EVI implementation on campus can range from basic Level 1 charging plugs to more advanced level of DC charging. We primarily discussed the deployment of Level 2 dual port charging stations, each designed to operate at 208V, 30-50A, 7-20kW with J1772 charging connector which are compatible with all North American Electrical Vehicles meeting the SAE J1772 charging standard.

Level 2 charging stations are favored for their cost effectiveness, and relatively high charging rate of 20-40 miles per hour. Additionally, the initial installation costs for Level 2 EVI are relatively affordable compared to DC charging stations. Level 2 charging stations come equipped with features that can enable the University to manage them effectively. This includes the ability to schedule charging sessions during off peak times and the option to remotely initiate or halt charging sessions as needed. Additionally, the University will have access to historical energy usage data for each charging station, allowing for informed decision-making and resource management.

Main Campus MEP Utility Assessment

UTSA's effort to enhance electric vehicle infrastructure on its campus signifies not only a commitment to sustainability but also a commitment to the changing landscape of transportation. By planning charging station locations, opting for Level 2 stations, and preparing for potential DC stations in the future, the university sets a progressive example for institutions and organizations looking to embrace sustainable transportation solutions.

Main Campus 2023 Potable Water and Sanitary Sewer Study

PAPE-DAWSON ENGINEERS

MEMO

TO:	The University of Texas at San Antonio One UTSA Circle San Antonio, TX 78249	**DATE:**	8/2/2023
FROM:	Pape-Dawson Engineers	**PROJECT NO.:**	7194-58
RE:	UTSA Main Campus Utility Master Planning		

General

Pape-Dawson Engineers was hired to update the overall potable water and sanitary sewer study that was previously completed in 2011. The intent of this update was to analyze the existing private UTSA water and sanitary sewer system to determine the capacity available to campus under existing conditions and then also incorporate proposed development from the latest UTSA campus master plan to determine the level of service and capacity in the UTSA systems under ultimate development condition of the main campus. It is our understanding that UTSA is currently undergoing an update to their campus master plan, therefore the utility master planning has been placed on hold until the campus master planning is complete. Below is a summary of the status of the project. The associated draft exhibits and draft report are also included as attachments.

Utility Master Planning Status

This effort included analyzing improvements needed to the existing UTSA water and sanitary sewer system to support continued growth of the University. Pape-Dawson coordinated two sets of fire flow tests. The first set of fire flow tests were conducted on January 5, 2023 and the second set was conducted on May 3, 2023. The January tests were scheduled during the winter break to establish a static/base flow condition for the water model. The May tests were then scheduled to analyze the system during peak use while students were on campus and the irrigation system was in use. The flow tests were then used to calibrate the water model. In order to analyze the system under existing and future conditions, two separate water models were set up. The layout and results from the existing model are included as an attachment. The existing model was updated with the latest water mains constructed with the Guadalupe Hall, RACE, SEB and Large-Scale Testing Facility projects. The future conditions water model has been set up but will need additional information on planned future buildings and estimated demands to be completed. The master planning also included analyzing the existing and future sewer system. The 2011 study estimated existing and future sewer flows using flows that had been measured by GSWW, Inc and presented in their report dated January 2005. An updated sewer flows report has not been provided at this time. Sewer flows can be estimated based on building areas and utilizing the standard SAWS flow rate values. This process is ongoing and will need to be updated and confirmed. The exhibits and sewer spreadsheets are included as draft attachments. A draft preliminary engineering report has also been prepared summarizing the intent and results of the study. Additional information about the future water and sewer systems will be added once the analysis is completed.

END OF MEMO

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UNIVERSITY OF TEXAS AT SAN ANTONIO
2023 Potable Water and Sanitary Sewer Study

TABLE OF CONTENTS

ATTACHMENTS

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PAPE-DAWSON ENGINEERS

Main Campus 2023 Potable Water and Sanitary Sewer Study

UNIVERSITY OF TEXAS AT SAN ANTONIO
2023 Potable Water and Sanitary Sewer Study

UNIVERSITY OF TEXAS AT SAN ANTONIO
2023 Potable Water and Sanitary Sewer Study

I. INTRODUCTION

The University of Texas at San Antonio (UTSA) operates its own independent potable water and sanitary sewer systems. Both systems are connected to the utility infrastructure and offsite distribution systems operated by the San Antonio Water System (SAWS). The goal of this study is to assess the capacity of the existing on-site water and sanitary sewer systems and to evaluate needs and improvements to support continued growth of the University. This study was prepared for the UTSA Main Campus only.

II. EXECUTIVE SUMMARY

Potable Water

Pape-Dawson developed a Potable Water Master Plan illustrating the existing domestic water system on the UTSA Campus. Using this plan, a water system hydraulic model was created for Campus. Pipes with diameters of 6-inches or less cannot meet both the required fire flow and velocity requirements of the International Fire Code (IFC) regulations.

UTSA should be prepared for SAWS to require payment of impact fees from the University for in order to continue to provide for future development and future connections to the SAWS system. Impact fees are a one-time fee paid to a utility company to provide revenue necessary to support system expansion and maintenance.

A hydraulic model for the water system under future conditions after expansions and improvements are made was also developed by Pape-Dawson. It is recommended that UTSA consider system improvements and/or expansions to address future development and to correct areas that reflect lower pressures and/or higher velocities than desired by UTSA.

Sanitary Sewer

There are no known off-site sewer capacity issues in the SAWS system immediately downstream of the UTSA Main Campus.

Pape-Dawson has mapped the existing sanitary sewer system infrastructure on the Campus and has identified existing sewer main sections in the system with limited available capacity.

Main Campus 2023 Potable Water and Sanitary Sewer Study

UTSA should be prepared for SAWS to require payment of impact fees from the University for in order to continue to provide for future development and future connections to the SAWS system.

III. PROJECT DESCRIPTION

The UTSA Main Campus is located south of Loop 1604 and west of IH-10 in San Antonio, Texas. The campus is approximately 600 acres in size of which approximately 300 acres have been developed. The developed portions of the campus include approximately 24,300 linear feet (LF) of sanitary sewer ranging in size from 4-inch to 21-inch and approximately 46,200 LF of domestic and fire water mains and services ranging in size from 1.5-inches to 16 inches. The developed portions of the campus are bounded by Loop 1604 to the north, Babcock Road to the West, UTSA Blvd to the south, and James Bauerle Road and John Peace Blvd to the east.

UTSA receives water from the San Antonio Water System (SAWS) through an 8-inch water meter located on Babcock Road and a 10-inch meter located on UTSA Boulevard (See Attachment 1). Irrigation water for the campus is also provided through these two water meters. On campus, water use is measured through 34 sub-meters located throughout the campus. The sub-meters included in the study are tabulated in Attachment 2.

The western campus 8-inch meter draws water from an existing 24-inch SAWS water main located on the west side of Babcock Road. This SAWS water main extends north to Loop 1604 and south to UTSA Blvd. There is also an existing 30-inch water main located on the west side of Babcock Road. This meter is located in SAWS Pressure Zone 1170.

The southern campus 10-inch meter draws water from an existing 16-inch SAWS water main which is tied into a 20-inch SAWS water main in UTSA Blvd. The 20-inch SAWS main cross connects with the 24-inch water main in Babcock Road and continues east along UTSA Blvd. There is an 8-inch border main along the UTSA Blvd frontage with the University Oaks residential area. This meter also is located in Pressure Zone 1170.

UTSA discharges sanitary sewer to the SAWS system at Babcock Road and east of James Bauerle. There is a 12-inch UTSA sanitary sewer line discharging to a 24-inch SAWS sanitary sewer line east of Babcock Road. There are also two 6-inch UTSA sanitary sewer lines and a 4-inch UTSA sanitary sewer line from the West Campus/facilities area south of the 12-inch that connects to a SAWS main east of Babcock Road within Maverick Creek. On the east side of campus there are 10-inch and 21-inch sanitary sewer lines discharging to a manhole on the 21-inch SAWS line southwest of the James Bauerle/Rhoderick Key intersection. See Attachment 1 general connection locations from the UTSA system to the SAWS system.

The 24-inch SAWS sanitary sewer line is located just east of Babcock Road and flows north to south from Loop 1604 to UTSA Blvd. There is also an 8-inch SAWS sewer line in Babcock Road itself servicing the residential areas to the west.

The 21-inch sanitary sewer line on the east side of campus flows north to south from Loop 1604. It increases in size from a 12-inch line at Loop 1604 to a 21-inch line at the UTSA discharge point, then to a 24-inch line before crossing UTSA Blvd.

This study does not address the Park West Campus, the Child Development Center or the University Oaks residential area. Irrigation water and storm drainage are not included in this study.

IV. WATER SYSTEM

A. SAWS Water Sources

UTSA receives potable, fire, and irrigation water from two connection to the SAWS system. On campus, water use is measured through 34 sub-meters located throughout the campus.

Pape-Dawson has obtained SAWS block maps for the areas surrounding the campus (See Attachment 3). The 8-inch meter on Babcock Road pulls water from an existing 24-inch water main. This meter is located in SAWS Pressure Zone 1170. The 10-inch meter pulls water from an existing 16-inch SAWS water main in UTSA Blvd. This meter also is located in Pressure Zone 1170.

Main Campus 2023 Potable Water and Sanitary Sewer Study

The existing water connections appear to be adequate for existing needs of the campus. Additional connections would supplement and provide a potential option to relieve specific site limitations. These are discussed further in the report.

No known water supply agreements exist between UTSA and SAWS. UTSA falls within the SAWS Service Level 1170, which corresponds to a hydraulic grade line (HGL) elevation of 1170. This HGL elevation was utilized for the initial calibration of the water model along with fire flow test results. SAWS capacity on the adjacent water systems is estimated to be sufficient for current uses. South of Loop 1604 in the vicinity of UTSA, the SAWS system is operating effectively and is looped for redundancy. There have been limited water pressure issues in the La Cantera area to the north of Loop 1604.

A copy of a portion of the SAWS Water Master Plan is included in Attachment 4.

B. Existing Water System Infrastructure

Pape-Dawson developed a Potable Water Master Plan illustrating the existing domestic water system infrastructure on the UTSA campus (see Attachment 5). The Potable Water Master Plan was produced based upon available base mapping provided by UTSA and is prepared in AutoCAD format. Available data was confirmed and enhanced by field survey (addressed in greater detail in subsequent paragraphs).

The Potable Water Master Plan includes known individual water service connections (meters, size and locations) for all campus buildings including academic buildings, laboratory buildings, residential buildings, athletic facilities and administrative and support facilities. Where available, irrigation system components were identified.

Where available, Pape-Dawson obtained information from UTSA for existing irrigation systems (design flows, design pressures, proposed/recommended irrigation schedules, etc.). The irrigation demand was not specifically addressed in the water model. In some areas, irrigation demand/flow rate was identified independently from potable flows and was

removed from the model in those areas. In areas where irrigation demand/flow was not clearly defined separately from potable flow rate data, it was included by default.

C. Water System Hydraulic Model

Pape-Dawson developed a water system hydraulic model for the current campus water system and for future projected growth. The model utilizes Bentley WaterGEMS Connect A hard copy of the model map is included as Attachment 6.

The base-piping infrastructure used in the hydraulic model was based on information compiled during the development of the Potable Water System Master Plan.

The hydraulic model utilized flow data provided by UTSA for the 34 campus sub meters as well as master water meter summaries for the past several years. The flow data provided to Pape-Dawson was also broken down by building. Pape-Dawson correlated the flow data between buildings and meters and utilized these records to determine average daily flows.

Pape-Dawson coordinated and scheduled the fire flow tests of ten existing campus fire hydrants. The fire flow tests were conducted twice, once in January to establish a static flow condition and a second time in May during anticipated peak use. The fire flow tests were performed by Fire Protection Consulting Group, LLC, San Antonio, Texas. Copies of the flow tests and an exhibit locating the test hydrants are provided as Attachment 7. This recently obtained test data was used to calibrate the water system model. All test locations were calibrated to within 4 pounds per square inch (psi) in accordance with standard engineering practice. For copies of the calibration results see Attachment 8.

With input from UTSA staff and field survey data, Pape-Dawson identified locations and sizes of sub-metered connections on campus. A list of the sub-meters is included as Attachment 2. Pape-Dawson reviewed building water usage where sub-meter data was available and evaluated previously estimated flow consumption values provided by UTSA for non-metered buildings. Pape-Dawson identified consumption schedules based on number of hours of daily

Main Campus 2023 Potable Water and Sanitary Sewer Study

and weekend operations (for example academic and administrative uses were averaged over 5-day weeks and residential and energy plant uses were averaged over 7-day weeks. Campus demands and locations were developed based upon the provided meter data and input into the hydraulic model. Flow demands input into the water model are included as Attachment 9. Results of the hydraulic analyses with demands based upon the water meter data was compiled and tabulated. The tables are included as Attachment 10. The tables indicate no areas of concern based on domestic uses for flow capacity, pipe pressure or pipe velocity.

Pape-Dawson performed a system wide fire flow hydraulic analysis of the existing water system including pipe sizes, materials and valves. The water hydraulic analyses are prepared to confirm theoretically available fire flows to the campus under existing and future (long range) conditions. The long range construction is anticipated to require service from the existing and/or new water and sanitary sewer infrastructure and is addressed in subsequent paragraphs. The hydraulic analyses reflect use of the existing SAWS water mains along Babcock Road and UTSA Blvd as the water sources for the UTSA campus. The construction of future buildings will require future extensions and/or re-routing of existing campus water mains in some locations.

Currently, the 2009 International Building and Fire Codes govern construction of new buildings on the UTSA campus. Under these guidelines, the required fire flow within the public water mains varies with the size and use of the structures. Table B105.1, Minimum Required Fire Flow and Flow Duration for Buildings, specifies the performance standards for providing fire protection. The minimum required fire flows established in the 2009 IFC are based upon Building Type and area. Since the UTSA campus includes numerous different building types and sizes, the model was run under minimum fire flow conditions of 2,000 gallons per minute (gpm) at 20 psi in accordance with the requirements of the IFC and the SAWS Utility Service Regulations (USRs). SAWS USRs were used as a comparable default standard since they are based on industry standards and provide a comparable measure for the San Antonio region. A value of 3,500 gpm was set as the upper flow range in the model.

UNIVERSITY OF TEXAS AT SAN ANTONIO
2023 Potable Water and Sanitary Sewer Study

Note that the IFC allows a 50% reduction in required fire flows for sprinklered buildings. The results of the fire analyses are tabulated and included as Attachment 10.

A summary of junctions and hydrants with potentially low fire flow capacities (less than 2,000 gpm at 20 psi) is included as Attachment 11. Note that the SAWS USR require a maximum velocity of 10 feet per second (fps) under fire flow conditions. While this is a SAWS requirement, failure to maintain a peak design velocity of less than 10 fps during fire conditions does not necessarily indicate a conflict with reasonably accepted good engineering practice in water modeling. There are no State of Texas or industry mandated maximum velocity but 15 fps is often considered a good guideline for sustained allowable maximum velocities. In general, pipes 6-inches and smaller within the UTSA campus cannot provide fire flows of 2,000 gpm and meet the 10 fps maximum velocity.

In general, there are two areas on campus that appear to have low available flow and pressures under fire flow conditions. These are the north garage area and Chisholm Hall Student Activity Center/Road Runner Café area. The north garage area is the furthest point on campus from the SAWS connections and is at the end of the water mains and not in a looped system. Future connections to the proposed SAWS 24-inch water line adjacent to the campus in the Loop 1604 frontage road will be beneficial to improve the hydraulics in this area. See Attachment 15 for location of a proposed potential connection.

It is recommended that UTSA consider system improvements and/or expansions, such as future interconnecting of water mains, to address areas that reflect lower pressures and/or higher velocities than desired by UTSA. Pipes with lower pressures and/or higher velocities are indicated in Attachment 11. Pape-Dawson is available to review these recommendations with UTSA staff.

With the development of proposed system improvements, additional hydraulic analyses may be performed to evaluate the impacts the proposed system improvements and/or expansions

Main Campus 2023 Potable Water and Sanitary Sewer Study

have in alleviating pressure and capacity restrictions. This hydraulic model provides UTSA the ability to support and evaluate future growth of new buildings, landscaping and irrigation.

A prioritized list of recommended system improvements or expansions and estimated costs for design and construction of improvements is included in Attachment 12. These improvements include new mains and interconnections at various points on the campus. This list identifies recommended periods for construction and likely impacts of actual construction on water system infrastructure and campus activities.

D. SAWS Water Impact Fees for Future Expansion

An Impact Fee is a one-time charge imposed by public utilities on new development to help recover capital costs associated with providing the infrastructure and other required improvements to provide service to that new development. The level of impact fees allowed to be assessed by a utility is governed by the TCEQ and must be approved by the agency based on an analysis conducted by the public utility for their long range system plans. Impact fee studies are typically updated by utilities on a five year basis. SAWS levies both water and sanitary sewer impact fees. Impact fees are typically charged based upon date of water service connection for new developments and for subsequent increases in water or wastewater usage. For SAWS, impact fees are charged on a per unit basis. This unit is referred to as an Equivalent Dwelling Unit (EDU). An EDU is a standardized measure of consumption, use, generation, or discharge of water or wastewater attributable to a single-family residence. For commercial uses, flow rates are converted to EDUs.

The SAWS Capital Improvements Advisory Committee (CIAC) updated the water and wastewater impact fees in 2021 and submitted its recommendations to the SAWS Board. Impact fees will be assessed at the rate current at the time of payment of fees.

The UTSA campus is located in the Middle Elevation Service Area for calculating water impact fees (see Attachment 13). Water impact fees are broken into Supply, Delivery and System

Development Fees per EDU. The Middle Elevation Service Area has a maximum proposed supply fee of $2,706 per EDU, a proposed delivery fee of $1,188 per EDU and a system development fee of $1,014 per EDU for a total water supply impact fee of $4,908 per EDU. For reference, an 8-inch water meter is required to pay for 135 EDUs based on flow capacity through the meter; a 10-inch water meter is required to pay for 190 EDUs. Therefore, the impact fees for an 8-inch and 10-inch meter would be $662,580 and $932,520 respectively.

E. Master Plan for System Expansion and Improvements

Pape-Dawson developed a Future Potable Water Master Plan for system expansion and improvements that incorporate proposed water system improvements into the campus Future Potable Water Master Plan, reflecting recommended schedules for system improvements and/or expansions in advance of new buildings or facilities.

V. SANITARY SEWER

A. UTSA Maps, Studies and Other Related Sanitary Sewer Information

Pape-Dawson has reviewed maps, studies and other related sanitary sewer information provided by UTSA including recent televised records. In preparation of work product for this study, Pape-Dawson has maintained existing UTSA formats, manhole nomenclature schemes and attempted to reconcile discrepancies and/or variations in the provided data. Pape-Dawson also obtained and reviewed SAWS block maps for the campus and surrounding areas (See Attachment 3).

Based on the sewer information provided and available base maps of the UTSA campus (existing and long range) Pape-Dawson has mapped the existing sanitary sewer system infrastructure on campus. The result is a Sanitary Sewer Master Plan (see Attachment 19) that illustrates the existing sanitary sewer system with additional notes and data not included on available maps.

Main Campus 2023 Potable Water and Sanitary Sewer Study

B. Existing Sanitary Sewer Line Capacity

Pape-Dawson estimated existing sanitary sewer line capacity and evaluated information provided. Sewer flows were estimated based upon building areas and utilizing SAWS standard flow rate values and EDUS estimates (see Attachment 16). The sewer segments for each area were tabulated showing pipe capacity, actual/projected pipe flows, and excess capacity. Pipe capacity was based on calculations using known pipe size and an assumed minimum pipe slope of 0.5%. Infiltration was accounted for in the capacity calculations and was based on 300 gallons per acre. The values are reflected in EDUs for ease of reference. See Attachment 21 for the summary.

The Central Campus Area includes the main sanitary sewer trunk line on campus. The upper reaches of this area are the existing baseball fields and Laurel Village. It discharges to MH 4 on the SAWS main line southwest of the James Bauerle-Rhoderick Key intersection. As indicated in Attachment 22, two existing UTSA sanitary sewer lines are undersized and do not provide sufficient flow capacity. These two lines are the 12-inch line from MH 13 to 12 and the 8-inch line from MH 18A to 17. Note that there is a drop in segment flows as indicated by a drop in EDUs corresponding to the undersized lines. Replacement with 15-inch and 10-inch lines respectively would provide adequate capacity.

C. Master Plan for System Expansion And Improvement

Pape-Dawson evaluated future sewer needs with respect to the campus Long Range Plan.

D. Areas Of Capacity Concerns

As indicated above, Pape-Dawson has identified existing sewer main sections with limited available capacities.

E. SAWS Sewer Impact Fees for Future Expansion

An Impact Fee is a one-time charge imposed by public utilities on new development to help recover capital costs associated with providing the infrastructure and other required improvements to provide service to that new development. The level of impact fees allowed

UNIVERSITY OF TEXAS AT SAN ANTONIO
2023 Potable Water and Sanitary Sewer Study

to be assessed by a utility is governed by the TCEQ and must be approved by the agency based on an analysis conducted by the public utility for their long range system plans. Impact fee studies are typically updated by utilities on a five-year basis. SAWS levies both water and sanitary sewer impact fees. Impact fees are typically charged based upon date of water and/or sanitary sewer service connection for new developments and for subsequent increases in water or wastewater usage. For SAWS, impact fees are charged on a per unit basis. This unit is referred to as an Equivalent Dwelling Unit (EDU). An EDU is a standardized measure of consumption, use, generation, or discharge of water or wastewater attributable to a single-family residence. For commercial uses, flow rates are converted to EDUs.

The UTSA campus is located in the Upper Collection Zone for calculating sewer impact fees (see Attachment 13). Sewer impact fees are broken into Treatment and Collection Fees. The upper collection zone has a treatment fee of $651 per EDU as it is in the Dos Rios/Leon Creek treatment area and a proposed collection fee of $2,800 per EDU. For example, at typical 8-inch sewer main at 0.5% slope has 600 EDU capacity and would result in potential impact fee of $2,070,600.

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