

CHILLED WATER SUB-ELEMENT

GOAL 1: To develop an on-campus chilled water generation and distribution system that adequately serves the future campus population needs.

OBJECTIVE 1.1: To ensure that there is an adequate chilled water generation and distribution system capacity to accommodate the proposed demand.

POLICY 1.1.1: Future development on the UCF campus, which increases the demand for chilled water generation and distribution capacity shall be approved under the provision of a system, which serves the future development under the following level of service standards:

1. under the existing campus-wide average service conditions, one (1) ton of plant capacity per 250 square feet of building floor area, or
2. a finding that future additional building design loads might be accommodated under the available generation and distribution system parameters.

POLICY 1.1.2: The University shall establish as overall implementation priorities the following: (1) continued servicing of the existing campus built areas;(2) the maintenance of 2,000 tons of residual plant capacity for emergency back-up purposes; (3) expansion of the existing plant generation and distribution system capacity in order to serve existing demand more efficiently; (4) maintenance of sufficient capacity to provide for the orderly and balanced equipment maintenance; and (5) expansion of a plant and distribution system capacity to serve new development areas/buildings.

POLICY 1.1.3: UCF shall be solely responsible for the provision, maintenance, and continued operation of a chilled water system to serve the campus building needs.

POLICY 1.1.4: The University shall rely upon the land use and building programs identified in the Comprehensive Master Plan, and ongoing implementing Capital Plans/Programs, to stage the construction of an expanded chilled water system, such that the expanded system is on-line at the time of the projected increased demand. This process shall be the shared responsibility of the Facilities Planning and Construction Department, Sustainability and Energy Management Department, and the University's Associate Vice President Administration and Finance (Facilities and Safety). It shall be the responsibility of the Facilities and Safety Chilled Water Production Unit to determine that sufficient plant and distribution system capacity is/will be available at the time any new building is proposed for construction.

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POLICY 1.1.6: The University shall implement improvements to the chilled water distribution system based on the timing and phasing requirements and priorities of Capital Improvements and additional facilities.

POLICY 1.1.7: Based on a balancing of other competing objectives, the University shall continue to subscribe to a variety of active and passive energy management/conservation strategies. As currently practiced, such strategies may include building site orientation design, stringent building insulation standards and, as appropriate, variable air volume systems within buildings. The responsibility for administering these strategies shall fall to the Facilities and Safety Departments of Sustainability and Energy Management and Facilities Planning and Construction.

POLICY 1.1.8: The Department of Sustainability and Energy Management shall be responsible for the oversight and maintenance of all utility distribution infrastructures rented or owned as well as the corresponding peak loads.

ELECTRICAL POWER AND OTHER FUELS SUB-ELEMENT

GOAL 2: To provide an on-campus electrical power and natural gas distribution system which adequately serves the future campus population needs.

OBJECTIVE 2.1: To continue ongoing inspection and coordination efforts with service providers, the University shall continue to identify and resolve any deficiencies in the servicing of electrical and natural gas power distribution systems.

POLICY 2.1.1: The University shall coordinate with Duke Energy (DE) and TECO People's Gas for the replacement of outmoded or deteriorating service lines and equipment. It will be the department of Sustainability and Energy Managements' responsibility to maintain adequate residual pressures on all UCF houseline natural gas distribution infrastructures and to require changes as required and/or necessary.

OBJECTIVE 2.2: To ensure the provision of adequate electrical and natural gas services through the continued internal funding and coordination with external service providers.

POLICY 2.2.1: The departments of Facilities Planning and Construction and Sustainability and Energy Management shall be responsible for the continued coordination of power supply services with Duke Energy and TECO People's Gas. To the extent feasible, it shall be the responsibility of these departments to determine whether adequate plant and distribution system capacity is available to serve expanded needs and to promptly inform the University funding officer of any needs for UCF funds for maintenance, expansion, or replacement.

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POLICY 2.2.2: Future development on the UCF campus which increases the demand for electrical power and/or natural gas or other fuels shall be monitored for maximum efficiency.

POLICY 2.2.3: The University shall establish as overall implementation priorities the following: (1) continued servicing of the existing campus built areas, (2) maintenance of UCF owned power manhole and conduit system, and (3) expansion of the existing line distribution system capacity, in order to serve existing demand more efficiently.

POLICY 2.2.4: The University shall rely upon the land use and building programs identified in the Comprehensive Master Plan, and those ongoing implementing Capital Plans/Programs, to coordinate a staged expanded electrical system such as the expanded system on-line at the time of the projected increased demand. This process shall be the shared responsibility of the Office of Facilities Planning and Construction, and the University's Associate Vice President of Administration and Finance (Facilities and Safety) programs. It shall be the responsibility of Facilities and Safety to determine that sufficient plant and distribution system capacity is/will be available at the time any new building is proposed for construction.

POLICY 2.2.5: The University shall implement improvements to the electrical power and natural gas distribution systems as additional facilities are added. The timing and phasing requirements and priorities for the provision of future electrical power and natural gas distribution system improvements are driven by elements identified in the Capital Improvements Element.

POLICY 2.2.6: Based on a balancing of other competing objectives and policies, the University shall, to the maximum extent feasible, continue to administer a variety of active and passive energy conservation strategies. As currently practiced, these strategies include appropriate building site design techniques, stringent building insulation standards and, as appropriate, zonal airflow and energy-efficient lighting systems. The responsibility for administering these strategies shall fall to Facilities Planning and Construction and Sustainability and Energy Management Departments.

POLICY 2.2.7: The University shall install energy-efficient equipment (i.e., electronic ballasts for fluorescent lighting fixtures, T-8 or T-5 lamps, etc.) in new buildings and when retrofitting existing buildings.

TELECOMMUNICATIONS SUB-ELEMENT

GOAL 3: To provide an on- campus telecommunications system, which adequately serves the future campus population needs.

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Goals, Objectives and Policies

OBJECTIVE 3.1: Through ongoing inspection and coordination efforts with service providers, the University shall continue to identify and resolve any deficiencies in the servicing of telecommunications systems.

POLICY 3.1.1: The University shall continue to identify, upgrade, repair, and/or replace existing Encased Duct Banks and telecommunications copper, fiber, and Coaxial cables as additional facilities are added or renovated.

POLICY 3.1.2: The timing and phasing requirements and priorities for the provision of future telecommunication system improvements shall be driven by the Capital Improvements Element.

OBJECTIVE 3.2: The University shall ensure the provision of adequate telecommunications facility services through continued internal funding of improvements and coordination with external service providers.

POLICY 3.2.1: The University's Offices of Computer Services and Telecommunications shall be responsible for the continued coordination of telecommunications infrastructure and services with off-site vendors and user groups. To the extent feasible, it shall be the responsibility of this office and the Facilities Planning and Construction department to determine jointly that service capacity is available to serve expanded needs and to inform the University funding officer promptly of any needs for UCF funds for maintenance, expansion, or replacement of such systems.

POLICY 3.2.2: The University shall establish as overall implementation priorities the following: (1) continued servicing of the existing campus built areas, (2) maintenance of the UCF owned Maintenance Holes and duct bank system, (3) expansion of the existing telecommunications distribution system capacity in order to more efficiently serve existing demand and (4) expansion of the telecommunications distribution system capacity, including the designation of future demarcation sites to link new development areas/buildings with on and off-campus systems.

POLICY 3.2.3: The University shall rely upon the land use and building programs identified in the Comprehensive Master Plan, and ongoing implementing Capital Plans/Programs, to coordinate a staged expanded telecommunications system such that the expanded system is on-line at the time of the projected increased demand. This process shall be the shared responsibility of the office of Computer Services and Telecommunications, the Facilities Planning and Construction department, and the University's Administrator of Capital Funding Programs.

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Goals, Objectives and Policies

All information or Policies on telecommunications infrastructure systems shall comply with the University of Central Florida Presidential Policies. These policies are located: <http://policies.ucf.edu/> Section 4-001.1 through 4-012.

CHILLED WATER PRODUCTION SUB-ELEMENT

The University of Central Florida employs three chilled water production plants combined with a three million gallon thermal energy storage tank to augment the chilled water district distribution-cooling loop. The total cooling capacity is approximately 17,000 tons. The campus distribution system is extensive and interconnects the vast majority of the buildings, generation and storage facilities. The plants are composed of:

- 1.) Main Plant (Building 003): 8000 tons of electrically driven refrigeration machines with additional 1000 tons of capacity recovered from the combined heat and power plant's absorption chiller that is directly coupled into the distribution infrastructure of the main plant.
- 2.) Satellite Plant One, (Building072) Plant two includes approximately 4000 tons of electrically driven refrigeration
- 3.) Satellite Plant Two (Building 072) Plant three includes approximately 4000 tons of electrically driven refrigeration.

Analysis:

The demand for chilled water is evaluated in terms of capacity (tons of refrigeration) and flow, measured in gallons per minute (gpm). The peak demand for refrigeration for the campus is currently estimated in excess of 12,000 tons and approximately 20,000gpm. The future addition of the proposed 368,000 square feet of educational facilities to the northeastern quadrant of campus is estimated to add approximately 1,500 tons of refrigeration and about 2,500 gpm of demand. Thus, the future peak demand for campus refrigeration during this planning period is currently estimated to be 13,500 tons and approximately 22,500 gimp.

Generation of refrigeration capacity should be evaluated with consideration for equipment failures and normal preventative and predictive periodic maintenance cycles when adding cooling demand to the district loop. The criterion for evaluation of this paradigm is to allow for one machine to be undergoing maintenance and for a second machine to fail. This is commonly referred to as having a firm capacity of N+2, where "N" is the number of machines available for use and N+2 is the total number of machines. With two refrigerant machines unavailable for chilled water production, the campus generation capacity is estimated to be about 12,000 tons. The additional 1,500 tons of demand is anticipated to compromise the redundant capacity.

The thermal energy storage tank is equivalent to approximately 2,000 tons of refrigeration while discharging and requires over 3,000 tons of refrigeration while charging. This capacity does supplement the available refrigeration capacity but is somewhat dependent on available capacity to charge, and is therefore less reliable.

Hydraulic distribution (flow) provides its own set of unique operational challenges to the current cooling district under specific operating scenarios, with or without the addition of the proposed northeastern quadrant utilizing the existing plants. These key performance

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metrics include peak summer cooling demand, winter tank charge during peak, and winter tank discharge during peak. Supporting hydraulic modeling engineering has been analyzed that illustrates the current challenges under each scenario, clearly defining what areas of campus are, and /or would be, affected by flow.

New demands added in the northeast quadrant should be accompanied with new generation capacity. The addition of capacity to offset the demands that are added is required, and the additional capacity in the new plant is strongly recommended since it helps resolve distribution challenges faced in the existing infrastructure.

ELECTRICAL POWER AND OTHER FUEL SUB-ELEMENT

a) A facility capacity analysis, by geographic service area, indicating capacity surpluses and deficiencies for:

1. Existing conditions, based on the facility design capacity and the current demand on facility capacity:

Duke Energy currently serves the majority of the campus via an underground loop system originating in the substations located at the south and east entrances of the campus.

Only a few buildings located on the northwest side of the campus (Lake Claire apartments and the fraternity/sorority houses) and the 475' tower located on the southwest side of campus are not on this loop system, and are fed from the existing overhead distribution lines that Duke Energy owns along Alafaya Trail (SR 434).

Duke Energy currently provides transmission power at 69 kilovolts (kV) to their owned and operated north and south substations located on campus. The Duke Energy electrical substations step down the voltage from 69kV into distribution power at 13 kV.

A combination of six distribution feeders, fed from both the north and south substation, provide 13 kV power that is stepped down by local station transformers near campus buildings and facilities to provide 480 volt power used for most UCF facilities campus-wide.

UCF's current demand outlined in our primary rental agreement between Duke Energy and UCF is 103,123kVa. Electric utilities measure demand in apparent power, known as Kilovolt Amperes (kVa).

The University of Central Florida's combined heat and power plant (CHP) provides the University with up to 5.5 megawatts of electrical generation at full load. This plant is behind Duke Energy's primary meter on feeder W1016, fed from the Duke Energy South Substation next to Facilities Operations. If the CHP plant is required to be removed from

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service for routine maintenance or is tripped offline due to commercial grid voltage issues, a Duke Energy Automatic Transfer switch (ATS W116793) will pick up 6MW of load if the CHP falls below full output without campus operation interruptions, regardless of time or day.

Analysis:

Under the existing campus-wide power requirements, 5 kilowatts (kW) of real power is required per 1000 square feet of floor area for academic facilities.

The current peak summer capacities (worst case electrical demand) for both the north and south substations are in the table provided below. Feeder W1016 is purposely loaded with more capacity to provide the most economic benefit to the University, as this demand is primarily met by generation from the combined heat and power plant while base loaded.

Substation	Bank	Feeder	Summer Peak Load (MW)	Rating	Percent Summer load
UCF South	1	W1014	2.4	13.3	18%
UCF South	1	W104 (*non-firm)	9.4	13.3	71%
UCF South	2	W1016	9.5	13.3	71%
UCF South	2	W1016 (*non-firm)	8.6	13.3	65%
UCF North	1	W0942	2.6	13.3	20%
UCF North	1	W0989	0.6	13.3	5%
UCF North	2	W0940	0.2	13.3	1%
UCF North	2	W0982	6.7	13.3	50%
UCF South	1	Bank 1	16.7	34	49%
UCF South	1	Bank 1 (*non firm)	23.7	40	59%
UCF South	2	Bank 2	32.2	40	78%
UCF South	2	Bank 2 (non-firm)	30.3	40	76%
UCF North	1	Bank 1	22.6	34	37%
UCF North	2	Bank 2	25.2	34	74%

* Non Firm – with UCF CHP Generation in parallel with commercial grid

2. **The general performance of existing electrical power and other fuel facilities, evaluating the adequacy of the current level of service provided by the facility, the general condition and expected life of the facility, and the impact of the facility upon adjacent natural resources will continue to be evaluated.**

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Duke Energy has adequate firm capacity to accommodate the proposed northeast quadrant's electrical demand. Currently, Duke Energy is operating and providing distribution power within the Florida Public Service Commission (FPSC) industry standard with regard to liability.

Duke Energy has had several noteworthy distribution outages, during the fall semester of 2013, that cause great concern to the University and its campus operations. Since these outages, Sustainability and Energy Management have partnered with Duke Energy to accommodate their operations to increase the frequency of the underground cable test, and to implement thermography reporting and switchgear inspections of all owned and operated distribution and transmission gear serving the Main Campus. Corrective action measures noted from the inspections have been prioritized by the utility, and Duke Energy has delivered an immediate action plan for capital replacement or field repair, depending on the criticality. These preventative measures have been deployed over the last several months and have positively impacted campus distribution electric reliability.

UCF has a five-year primary rental agreement in place that includes all distribution infrastructure repair and capital replacement owned and operated by Duke Energy. Each month, UCF pays a certain percentage of this rental cost in the monthly billing cycle based on a determination of a percentage multiplier. Equipment performance is evaluated by Duke Energy, through inspection, troubleshooting, and repair. Duke Energy uses a remaining life depreciation rate method, which takes into consideration salvage and cost of removal over the life of the asset. Duke Energy's return on investment is 7.362%, using an after-tax weighted average.

3. **An ongoing assessment of opportunities or available and practical technologies to reduce University energy consumption.**

UCF will continue to adhere to industry best practices based on continuing research and implementation by American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE), Illuminating Engineering Society of North America (IESNA), BACnet protocol, and Leadership in Energy and Environment Design (LEED) to reduce site energy consumption.

UCF will also continue to evaluate and investigate alternative, renewable, and traditional power generation options to reduce source energy.

NATURAL GAS SUB-ELEMENT:

Description of Facilities:

UCF's houseline system is comprised of 24,360 linear feet of high and intermediate pressure composed of 6", 4" and 2" carbon steel pipe and low pressure ¾" -1" Polyethylene pipe.

Four separate gas feeds from TECO People's Gas are located on the north, south, west and Ara Drive, that provides distribution high pressure gas into the campus through 22 internal meter points and 16 valves. The west pipeline system has nine meter points and eight valves. The south pipeline system has 28 meter points and 23 valves.

Existing Distribution System

The South Service and West Service are UCF-owned distribution systems with a single TECO master gas meter for each. The North Feed and Ara Drive Feed are owned by TECO. The North Feed has a TECO gas meter at each structure served. The Ara Drive feed has a master meter located adjacent to Building 92 and transitions to UCF-owned beyond the master meter.

South Service

This service consists of a 6" carbon steel distribution line originating near the South Duke Energy Substation and running along Libra Drive to the south half of the inner campus circle.

The buildings served from this service include the:

- South Academic Villages
- Recreation and Wellness
- Combined Heat and Power Plant (CHP)
- Central Energy Plant
- Ferrell Commons
- Physical Sciences
- Mathematical Sciences Building
- Chemistry Building
- Library
- Education Complex
- JT Washington Center

This gas line has the most demanding flow/pressure requirement on campus due to the flow and minimum inlet pressure requirements of the CHP Plant. A minimum residual pressure of approximately 77 PSI is needed in the line to meet the minimum inlet pressure requirement of the CHP Engine.

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West Service

This service consists of a 6” carbon steel distribution line originating at Alafaya Trail (just North of Centaurus Drive) and running along Aquarius Agora, then to follow around Pegasus Circle. This line serves the inner campus circle.

The buildings served from this service include the:

- Visual Arts
- Student Union
- Engineering II
- Health and Public Affairs

This gas line is lightly loaded with respect to its overall capacity. A residual pressure of approximately 20 PSI is adequate in the line to meet the minimum requirement inlet pressure of the appliances served from it.

North Feed

This feed consists of a 2” carbon steel distribution line originating at Alafaya Trail and running along Gemini Boulevard North to serve the north side of campus. The North Feed is owned by TECO and has TECO gas meters at each structure served. The buildings served from this service include the ones north of Gemini Boulevard North and various houses within Greek Park. This gas line appears to be adequate for the loads served.

Ara Drive Feed

This feed consists of a 2” carbon steel distribution line originating at Libra Drive and running east between the power line right-of-way and Ara Drive to serve structures along Ara Drive. The Ara Drive Feed is owned by TECO. The Ara Drive feed has a master meter located adjacent to Building 92 and transitions to UCF-owned beyond this master meter. This gas line appears to be adequate for the loads served.

Recommendations for Existing Gas Distribution Systems

- Interconnect the South and West Services with a new 6” carbon steel line.
This is intended to allow some of the loads currently on the South Service to be transferred to the West Service. This would reduce the occurrences of inadequate residual pressure at the CHP Plant that have occurred during a campus gas load peak.
- Add a UCF owned, networked gas meter at the South and West Services.
This is intended to allow measurement of instantaneous flow and pressure being delivered by TECO. It would be used to balance how much gas load should be on each of these services with the intent being to minimize, if not eliminate, inadequate residual pressure at the CHP Plant. Currently, only monthly consumption data is available from the metering provided by TECO.
- Add residual pressure monitoring at the far ends of the South and West Services.

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This is intended to allow monitoring of the available residual pressure available during periods of peak gas demand. Pressure sensors would be required at the far ends of each service. Having this residual pressure information along with data on the instantaneous flow and pressure coming from TECO into the system would allow a more accurate assessment of the available capacity in the gas distribution piping system.

Building	GSF	Estimated Gas Main Size
Interdisciplinary Research I	118,000	4"
Interdisciplinary Research II	61,000	2"
Simulation and Training	60,000	2"
Civil and Environmental Engineering	75,000	2"
Global UCF and Continuing Education	54,000	2"

Estimated Costs for Existing Infrastructure Upgrades:

- Interconnect the South and West Services with a new 6" carbon steel line. This would involve approximately 1500 lineal feet of pipe and has an estimated cost of \$250,000.00 to \$300,000.00.
- Add a UCF-owned, networked gas meter at the South and West Services. This work has an estimated cost of \$200,000.00
- Add residual pressure monitoring at the far ends of the South and West Services. This work has an estimated cost of \$40,000.00.

Gas Infrastructure for Future Buildings in the Northeastern Quadrant of the Academic Core

Currently five Buildings totaling approximately 368,000 Square Feet are proposed with the possibility of additional research buildings.

The closest UCF-owned source of gas for this area is the 6" line located in Pegasus Circle that is served from the West Service. A 6" line could be routed from Pegasus Circle to the Northeastern Development area. This line size was chosen to provide maximum capacity and flexibility. It is consistent with the existing maximum line size on campus and is likely not to represent a capacity constraint for the addition of additional research buildings that may be added in the area.

The construction cost for development of this gas infrastructure is estimated to be in the \$500,000 to \$750,000 range.

Gas Infrastructure for Second CHP Plant at North Substation

Based on the installation of 5-10 megawatts of natural gas fired generation capacity a 6" gas line would be required. That type of capacity is not present in the vicinity of the North Substation. The closest 6" line is at the intersection of McCulloch Road and Alafaya Trail. The new line would likely be routed along the south side of McCulloch

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Road. The construction cost for this line would likely be in the range of \$550,000 to \$800,000. Given the significant gas consumption that the second CHP Plant would represent, it is likely that a significant portion of the cost could be absorbed by TECO, based on a tariff for consumption.

TELECOMMUNICATIONS SYSTEMS SUB-ELEMENT

a) A facility capacity analysis, by geographic service area, indicating capacity surpluses and deficiencies:

1. Existing conditions, based on the facility design capacity and the current demand on facility

The telecommunications infrastructure consists of an underground network of encased duct banks and Maintenance Holes interconnecting the majority of the buildings on campus, as well as the satellite hubs or nodes.

The main copper telephone trunk originates from existing Siemens and VOIP telephone switches located in the Library Building and other buildings (nodes) to all the existing and new facilities. The data systems are connected to the Computer Science Building (CSB) and other buildings (nodes) via fiber optics cable.

2. The end of the planning time frame, based on the projected demand at current level of service standards for the facility, projected student populations and land use distributions, and any available existing surplus facility:

As the campus continues to grow, the demand for additional copper lines and fiber optic cables will rise, and the need for additional copper and fiber nodes throughout campus will have to be reviewed with the Computer Services and Telecommunications Department. Also as technology keeps constantly changing, the need to review standards increases in the same fashion.

b) The general performance of existing telecommunications systems and facilities, evaluating the adequacy of the current level of service provided by the facility, the general condition and expected life of the facility, and the impact of the facility upon adjacent natural resources, will continue to be evaluated.

The level of service provided by the telecommunications appears to be quite high. This is a great accomplishment considering the rapid changes in this field.

c) An assessment of potential electromagnetic hazards resulting from facilities required to meet future telecommunications needs of the University, and an analysis of practical ways to mitigate such:

No hazards are known at this time.

This map has been withheld for security reasons.

Figure 10-1

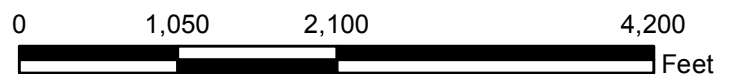
Chilled Water Facilities

Comprehensive Master Plan Update
University of Central Florida
Orlando, Florida
2015-2025



All maps are diagrammatic and conceptual. The various areas shown are approximate and not to survey accuracy. The intent of these maps is to illustrate general areas of existing or potential use.

Rev. 20140616



This map has been withheld for security reasons.

Figure 10-2

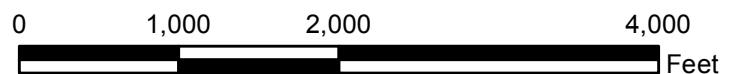
Electric Power Facilities

Comprehensive Master Plan Update
University of Central Florida
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2015-2025



All maps are diagrammatic and conceptual. The various areas shown are approximate and not to survey accuracy. The intent of these maps is to illustrate general areas of existing or potential use.

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Figure 10-3

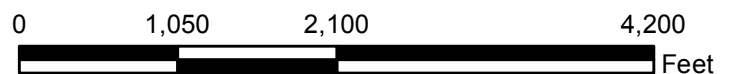
Natural Gas Facilities

Comprehensive Master Plan Update
University of Central Florida
Orlando, Florida
2015-2025



All maps are diagrammatic and conceptual. The various areas shown are approximate and not to survey accuracy. The intent of these maps is to illustrate general areas of existing or potential use.

Rev. 20140520



This map has been withheld for security reasons.

Figure 10-4

Telecommunications Facilities

Comprehensive Master Plan Update
University of Central Florida
Orlando, Florida
2015-2025



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