UCF

UNIVERSITY OF CENTRAL FLORIDA

5.0 GENERAL INFRASTRUCTURE & UTILITIES

2020-30 CAMPUS MASTER PLAN UPDATE

CONTENTS

INTRODUCTION

NARRATIVE

The state land planning agency shall help communities find creative solutions to fostering vibrant, healthy communities, while protecting the functions of important state resources and facilities, in accordance with Florida's Growth Policy [Florida Statutes Title XI, Chapter 163, Part II – Growth Policy; County and Municipal Planning; Land Development Regulation (ss. 163.2511-163.3253)].

These plans are also intended to ensure that growth does not negatively impact the environment, and that infrastructure and University-provided utility services are not overwhelmed by unplanned development.

As such, future development at UCF shall be based on the provisions that optimizes the use of UCF's existing utility infrastructure and utility generation assets. Furthermore, conserving UCF's precious water resources through on-going collaborative and integrated planning will avoid technical and financial risks, and capacity constraints associated with overburdening the University's generation, distribution, and transmission systems.

Campus development shall adhere to higher-density development best practices, while meeting, or exceeding the University's prescriptive green-building requirements to effectively minimize heat gain and energy consumption, and reduce dependence on the region's potable water. These practices will inevitably reduce utility demands and the need for additional infrastructure and capacity.

UCF shall continue to follow ASHRAE high-performance building standards and apply engineering rigor to all design considerations for energy and water efficiency initiatives implemented in UCF's campus facilities. Therefore, all building systems shall be treated as "utility system assets" in all new expansion and renovation projects. This will result in more effective and efficient use of the University resources to reduce regional resource impacts, campus operational expenses, and UCF's overall environmental impact.

RELATED ELEMENTS

See 9.0 CONSERVATION for utility use reduction strategies (such as energy and water) and for information on the advanced microgrid technology.

See 10.0 CAPITAL IMPROVEMENTS & IMPLEMENTATION for projected capital improvements during the planning timeframe.

See 12.0 FACILITIES MAINTENANCE for indoor utility service and maintenance objectives.

STATUTE & REGULATION

5.0 GENERAL INFRASTRUCTURE & UTILITIES is a combined element. Combining related elements is permitted under BOG 21.202(1)(b); which states that "the campus master plan shall contain an explanation of such combinations." See 1.0 INTRODUCTION for the explanations of combined elements.

- The General Infrastructure Element is required by Florida Statue 1013.30(3). The element must follow the guidelines stated in Florida Board of Governors (BOG) Regulations, Chapter 21.

  BOG 21.207 states the purpose of the element as follows:

  > "This element ensures the provision of adequate capacity for stormwater management, potable water, sanitary sewer and treatment, and solid waste facilities required to meet the future needs of the university. The General Infrastructure Element shall consist of a Stormwater Management Sub-Element, a Sanitary Sewer Sub-Element, a Potable Water Sub-Element, and a Solid Waste Sub-Element."

- UTILITIES is an optional element. Optional elements are permitted under BOG 21.212, but are not subject to review under Chapter 21.

CONCURRENCY
Concurrency Management Systems, as defined in Florida Statute 163.3180, require systems for monitoring and ensuring adherence to the adopted level-of-service standards, including the schedule of capital improvements and the availability of public facility capacity. For the purpose of concurrency under F.S. 163.3180, public facilities (utilities) and services include sanitary sewer and potable water.

UCF has elected to make additional public facilities and services subject to the concurrency management system under Florida Statue that include chilled water, primary electric power, natural gas, and stormwater.

GENERAL INFRASTRUCTURE Goals, Objectives, & Policies

5.0 Utility Infrastructure Overview

NARRATIVE

The cost of utilities, and associated infrastructure to provide utility services, is significant and may even exceed the cost of the buildings themselves over their useful life.[1] The objective of utility system and infrastructure master planning is to guide decision-making to ensure that utility cost savings are realized over the life of buildings and systems.

According to the *UCF Collective Impact Five-Year Institutionalization Plan*[2], UCF must align its facilities planning, infrastructure development, and project prioritization to advance Collective Impact, per the UCF Collective Impact Strategic Plan[3]. This Plan launched a process to set UCF's trajectory for the next 20 years to make a greater impact on lives and livelihoods at UCF, throughout the region, and beyond.

GOALS, OBJECTIVES, & POLICIES

GOAL 1: Develop and manage UCF's utility production, distribution infrastructure, and associated capital assets to support campus needs.

OBJECTIVE 1.1: Ensure that there is adequate and reserve capacity and infrastructure for distribution, transmission, and generation to accommodate growth.

POLICY 1.1.1: Expansion of UCF's Utility Infrastructure

Utility infrastructure costs shall be considered as a component of a new building and renovation project budgets.

POLICY 1.1.2: Distribution, Transmission, and Generation Capacity Factor

No development may be permitted if utility generation, infrastructure, and/or capacity is not available concurrent with the impacts of the development.

Fiscal obligations for projects that increase campus capacity of infrastructure will be addressed in the "Utility Master Service-Level Disclosure."[4]

POLICY 1.1.3: Density Development

The University shall transition towards higher-density new construction and renovation practices, seeking to maximize existing space, reduce energy-intensive mixed-use space, and implement alternative lower-carbon and resource-efficient expansion to reduce the capital required to adequately expand utility infrastructure University generation capacity.

POLICY 1.1.4: Utility Infrastructure and Plant Capital Renewal Funding (CRF)

The University shall identify funding for utility infrastructure and plant capital renewal, as ongoing capital renewal is necessary to provide continued reliable utility distribution services to the campus.

POLICY 1.1.5: Utility Master Planning and Building Renewal Plans Should Refrain from Piecemeal or Response-based Projects

To reduce reconfiguration of existing utility distribution infrastructure in buildings, the University shall limit energy-intensive mixed-use spaces.

POLICY 1.1.6: First Right of Refusal to Provide University Utility Services

To reduce the impact on greenhouse gas emissions, building operations, and utility costs, Utilities and Energy Services (UES)[5] shall have first-right of refusal for utility services where production and infrastructure capacity is available, and to all categories of end users and public-private-partnerships. Commodities include natural gas, electric, water, wastewater, chilled water, and heating-hot water.

POLICY 1.1.7: Infrastructure Compatibility

UES is the single point of contact and liaison for all utility distribution design, interconnection, disconnection, expansion, and construction of utility facilities.

OBJECTIVE 1.2: Monitor and inventory infrastructure assets using smart technologies

POLICY 1.2.1: The University will use GIS mapping to track, maintain, and protect its infrastructure distribution systems.

POLICY 1.2.2: The University will implement and maintain smart infrastructure technologies to monitor reliability and efficiency of infrastructure distribution and production systems.

5.1 Stormwater Management Sub-Element

NARRATIVE

The University's stormwater system is located in the St. Johns River basin and is regulated by the St. Johns River Water Management District (SJRWMD). As defined by SJRWMD, stormwater is rainwater that runs off of hard surfaces into the nearest body of water, both natural lakes and/or man-made retention ponds. A stormwater system is a tool for managing that runoff.

As UCF continues to grow, stormwater management becomes exponentially crucial as new development increases the risk of disruption to natural hydrological systems and watersheds.

GOALS, OBJECTIVES, & POLICIES

GOAL 1: Manage stormwater by replicating natural site hydrology to protect campus populations and facilities, and remain sensitive to the environment.

OBJECTIVE 1.1: Pursue low-impact development practices to prevent increases to stormwater runoff.

POLICY 1.1.1: Stormwater management retention and detention features shall be incorporated into the design of parks, trails, commons and open spaces, and building roof tops where such features do not detract from the recreational or aesthetic value of a site.

POLICY 1.1.2: Native vegetation and/or xeriscaping shall be employed, where feasible, to reduce peak runoff downstream through infiltration and storage.

POLICY 1.1.3: Techniques such as infiltration, storage and reuse, bio retention, open-grid pavement, and the reduction of impervious areas shall be used in attempt to reduce runoff.

POLICY 1.1.4: Any future development which increases the amount of impervious surface shall report the change in total volume of runoff (in cubic feet) relative to the existing site performance of stormwater runoff, assuming the 95^{th} percentile of rainfall events.

POLICY 1.1.5: The University shall investigate funding mechanisms for stormwater infrastructure and environmental stewardship.

OBJECTIVE 1.2: Use Best Management Practices (BMPs) to minimize University-generated stormwater pollutants.

POLICY 1.2.1: The University shall use slow release fertilizers and/or carefully-managed and timed fertilizer applications to ensure maximum root uptake and minimal surface water runoff or leaching into groundwater.

POLICY 1.2.2: The University shall perform routine maintenance on its motor vehicle fleet to prevent oil, grease, and other fluids from leaking onto impervious surfaces, where they might be conveyed to surface and ground waters by runoff. The University shall regularly collect and properly dispose of yard debris.

POLICY 1.2.3: The University shall avoid the use of broad-spectrum pesticides, using the least-toxic and minimal applications, aimed at targeted species, when possible.

POLICY 1.2.4: The University shall coordinate pesticide application with irrigation schedules to reduce runoff and leaching into groundwater.

POLICY 1.2.5: The University shall incorporate features into the design of fertilizer and pesticide storage, mixing, and loading areas that are designed to prevent/minimize spillage.

OBJECTIVE 1.3: Oversee UCF's stormwater management.

POLICY 1.3.1: LNR shall maintain all rainwater management facilities, perform monthly inspections, and resolve any issues within three months of identification.

POLICY 1.3.2: UES shall perform all subsurface maintenance pertaining to stormwater management including, but not limited to, inlets, manholes, and pipes connecting stormwater movement and drainage.

POLICY 1.3.3: Landscape and Natural Resources (LNR) shall perform all above-ground maintenance pertaining to stormwater, including but not limited to areas of erosion, retention and detention ponds, storm inlets, and environmental permitting.

5.2 Sanitary Sewer Sub-Element

NARRATIVE

The University operates and maintains its own sanitary sewer collection facilities[6] and transportation network comprising basins, lift stations, force mains, gravity lines, pump stations, and appurtenant equipment to collect and transport effluent to the Iron Bridge Water Pollution Control Facility (Iron Bridge), a regional wastewater treatment plant in Seminole County.

GOALS, OBJECTIVES, & POLICIES

GOAL 1: Ensure that the sanitary sewer system adequately serves current and future campus needs.

OBJECTIVE 1.1: Maintain the sanitary sewer system and upgrade its mechanical and electrical components.

POLICY 1.1.1. The University shall design and construct sanitary sewer system improvements to eliminate system deficiencies, maintain and improve system characteristics, and expand the system to accommodate demand from proposed growth.

POLICY 1.1.2. The wastewater pumping stations shall employ backup systems in case of power or pump failures.

POLICY 1.1.3. Analyze future development to determine if current wastewater capacity is available. If capacity is not available, funding will be provided so that additional capacity can be purchased from Seminole County in advance of need.

5.3 Potable Water Sub-Element

NARRATIVE

When UCF was first constructed in the 1960s, no municipal water services or infrastructure were available in the area. Consequently, the University had to construct its own water treatment facilities, distribution infrastructure, and ground wells to meet its potable water needs.

While significant renovations have occurred as a result of more stringent drinking water standards mandated by Florida's Department of Environmental Protection (FDEP), UCF's elevated and ground water storage tanks are original, including much of the buried ductile iron distribution pipe on campus.

GOALS, OBJECTIVES, & POLICIES

GOAL 1: Provide quality potable water to the campus with reliable backup sources.

OBJECTIVE 1.1: Ensure that adequate potable water supply and distribution piping is available for new and renovated facilities.

POLICY 1.1.1: The University shall rely upon land uses, the Campus Master Plan (CMP), and Building Programs to address potable water capacity as limited by the SJRWMD. The concurrency management system establishes the statutory mechanism that ensures campus facilities and services needed to support development are available in relation to the impacts of such development.

POLICY 1.1.2: The campus water system shall have redundant supply and distribution networks. Supply redundancy can be achieved by multiple water plant sources, e.g., Orange County and the Central Florida Research Park, and by multiple raw water wells.

OBJECTIVE 1.2: Maintain the current quality and quantity of raw water available in the campus' potable water well field.

POLICY 1.2.1: The University shall perform annual reviews of major system components of the water supply and distribution system. Review shall include wells, well pumps, water treatment plant components, storage tanks, distribution pumps, backup generators, distribution piping and valves, etc. The University shall identify needed improvements on the Schedule of Capital Projects (SCP), and complete improvements as funds become available.

OBJECTIVE 1.3: Conserve potable water for human health and advancing research.

POLICY 1.3.1: Regardless of first cost, all new construction and renovations that increase water use shall adhere to the mandatory provisions in the latest *high-performance building standard*[7], and follow the appropriate compliance paths to ensure campus water efficiency and conservation measures are implemented.

POLICY 1.3.2: The University shall first use all available lower-quality sources of water, including reclaimed water, surface water, and stormwater, before using higher-quality water sources,[8] when possible, pursuant to SJRWMD rules and applicable state laws.[9]

5.4 Solid Waste Sub-Element

NARRATIVE

UCF Recycling has made tremendous strides, diverting more than 30% of solid waste from entering landfills, compared to baseline data of a 5% recycling rate in 2006. UCF implements a single-stream recycling program.

GOALS, OBJECTIVES, & POLICIES

GOAL 1: Plan future campus development to ensure that solid waste collection and disposal, and recycling efforts adequately serve campus needs.

OBJECTIVE 1.1: Ensure that future development is based on a finding of adequate solid waste collection and disposal capacity to accommodate future demand.

POLICY 1.1.1: The University shall continue to assume one or more of the following level-of-service standards:

- Multiple weekly waste collections
- Approximately 1 pound per day per person of landfill
- Approximately 3 pounds per day per person of recyclables

POLICY 1.1.2: Future increases in campus waste generation shall be approved only if existing solid waste disposal capacity is already on-line to accommodate the increased need, or additional capacity will be funded and on-line at the forecasted time of need.

POLICY 1.1.3: As necessary and appropriate, UCF shall continue to participate in the regional solid waste management and waste reduction strategies undertaken by Orange County.

POLICY 1.1.4: The University shall continue to use commercial vendors to collect and transfer solid waste to area disposal sites.

POLICY 1.1.5: UCF Recycling shall identify the location of waste and recycling areas, dumpster sizes, and pick-up schedules for new construction.

Goal 2: UCF will continue to develop a robust recycling program

OBJECTIVE 2.1: Promote recycling through education and outreach.

POLICY 2.1.1 The University shall promote ongoing education, awareness, and student involvement to establish practices that align with UCF's waste diversion and recycling initiatives, and the implementation of large-scale recycling programs.

POLICY 2.1.2: UCF Recycling shall continue to establish relationships with student working groups and organizations to brainstorm ideas, gather data, and create recycling initiatives.

POLICY 2.1.3: UCF Recycling shall continue to actively participate on UCF committees and engage with community groups to increase awareness and increase the campus recycling rate.

OBJECTIVE 2.2: The University shall strive to reach the statewide recycling goal of 75%[10] to reduce the volume of solid waste entering the landfill.

POLICY 2.2.1: The University shall continue to promote recycling by strategically placing receptacles inside and outside of campus facilities.

POLICY 2.2.1: UCF Recycling shall continue to work with departments to properly recycle or repurpose materials that would otherwise be discarded.

POLICY 2.2.3: The University shall construct a Recycling Center to increase the efficiency of the recycling collection process, as funding becomes available. The Center will centralize the University's recycling efforts and house compactors, equipment, and operational tools.

UTILITIES ELEMENT Goals, Objectives, & Policies

5.5 Chilled Water Production Sub-Element

NARRATIVE

Chilled water for campus cooling is produced at centralized district energy plants, rather than being produced on site at individual campus buildings. Chilled water produced in the district cooling system is distributed through over 15-miles of underground pipes to cool student residence halls, academic, research, administrative, and athletic facilities. UCF's district plants are strategically placed to efficiently service the needs of core campus buildings and reduce building energy consumption. The remaining campus buildings are currently supported by less-efficient, stand-alone chilled water systems, direct expansion HVAC units, and ground source heat pumps.

GOALS, OBJECTIVES, & POLICIES

GOAL 1: Promote district cooling with energy and economic efficiency where appropriate within the district energy loop.

OBJECTIVE 1.1. Invest in energy technologies that facilitate economies of scale, otherwise infeasible on a single-building basis.	POLICY 1.1.1: All new construction and renovation projects shall connect to UCF's thermal district energy systems based on the results of a life cycle cost analysis and where geographically feasible.

5.6 Electrical Power and Other Fuel Sub-Element

NARRATIVE

Primary power to the University is provided by Duke Energy Florida.

The University also produces cost-effective electricity to offset purchased electricity.

GOALS, OBJECTIVES, AND POLICIES

GOAL 1: Provide cost-effective, reliable, and resilient electric utilities.

OBJECTIVE 1.1. Maintain and extend reliability and resiliency of the University electric grid.	POLICY 1.1.1: The University will make every effort to collaborate with the utility service provider to configure the campus electric grid in ways to maintain and extend its reliability and resiliency.

POLICY 1.1.2: Investigate opportunities to implement distributed generation and smart grid technologies to provide reliable and resilient electrical services to campus buildings.

OBJECTIVE 1.2. Continue to evaluate and implement distributed technologies that provide the lowest cost of energy and achieve carbon targets.

POLICY 1.2.1: Reduce purchased energy cost through conservation, demand side management, fuel-switching and renewable energy initiatives.

POLICY 1.2.2: The University shall evaluate lower-carbon distributed generation technologies with higher efficiencies with intent to reduce energy costs, improve infrastructure efficiency, and provide portfolio diversity.

5.7 Natural Gas Sub-Element

NARRATIVE

Natural gas provides heating for building domestic water and HVAC systems, as well as fuel for electricity production. The University owns and maintains the natural gas infrastructure, and purchases wholesale natural gas on the open market.

GOALS, OBJECTIVES, & POLICIES

GOAL 1: Provide the campus with an eco-friendly fuel to reduce utility expenditure and achieve greater heating efficiencies.

OBJECTIVE 1.1. Provide a natural gas system to reliably serve the University.

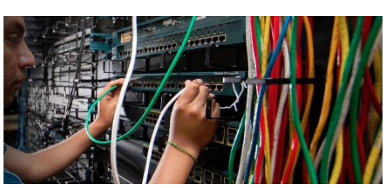
POLICY 1.1.1: Continue to reduce purchased natural gas costs by leveraging competition among natural gas marketers and suppliers through contract negotiations on the open market.

POLICY 1.1.2: The University shall use existing and developing technologies to provide additional safety and reliability for the campus systems.

5.8 Telecommunications Systems Sub-Element

NARRATIVE

UCF IT is an operating unit within the Information Technologies and Resources (IT&R) Division at UCF. The mission of UCF IT is to support our students, faculty, and staff in achieving their teaching, learning, research and service objectives by:



Providing innovative technology solutions and services.

Providing responsive and reliable IT infrastructure and support.

Continually assessing and improving our service offerings

As the main provider of information technology resources, UCF IT is responsible for providing all telecommunications services (voice and data), enterprise administrative systems, and support to the UCF community including:

- Campus telephone system
- Campus local area network
- Campus wide area network
- Campus wireless network
- Cable TV
- Computer labs
- Computer Store
- Web hosting services
- Email
- Document imaging services
- Enterprise administrative data processing services
- Online instruction support
- PeopleSoft Enterprise Resource Planning (ERP) development
- Identity management/ domain services
- Research computing
- Data Center operations and system administration

All telecommunications infrastructure systems shall comply with UCF Policies Section 4 – Technology and Communications, 4-001.1 through 4-017.
Link: http://policies.ucf.edu/

GOALS, OBJECTIVES, & POLICIES

GOAL 1: Provide an on-campus telecommunications system, which adequately serves future campus population needs.

OBJECTIVE 1.1: Through ongoing inspection and coordination efforts with service providers, UCF shall continue to identify and resolve deficiencies in telecommunications systems.

POLICY 1.1.1: 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 1.1.2: The timing and phasing requirements and priorities for the provision of future telecommunication system improvements shall be driven by element 10.0 Capital Improvements & Implementation.

OBJECTIVE 1.2: Ensure the provision of adequate telecommunications facility services through continued internal funding of improvements and coordination with external service providers.

POLICY 1.2.1: UCF IT 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 UCF IT and the Facilities Planning and Construction (FPC) department to determine jointly that service capacity is available to serve expanded needs in order to inform the University of any need for

UCF funding for maintenance, expansion, or replacement of such systems.

POLICY 1.2.2: The University shall establish the following overall implementation priorities:

(1) continued servicing of the existing built areas of campus,

(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 1.2.3: The University shall rely upon the land uses identified in the 2020-30 CMP, and Capital Project projections identified in the SCP and the Capital Improvements Plan (CIP), to coordinate a staged expansion of telecommunications systems to ensure that an adequate system is on-line at the time of projected increased demand.

This process shall be the shared responsibility of UCF IT, FPC, and the Office of the Vice President for Administration & Finance.

GENERAL INFRASTRUCTURE Data & Analysis

5.0 Utility Infrastructure Overview

NARRATIVE

To reduce utility distribution infrastructure re-work on existing buildings, the University shall limit energy-intensive mixed-use space, thus focusing on a transformation that delivers financial gains through aggregating energy and water efficiency beyond the sum of the project's space. This may require re-evaluating existing space, performing energy and water audits, investing in technology that maximizes space utilization, taking full advantage of distance learning initiatives to reduce on-campus headcounts, and amending infrastructure capital improvement beyond the minimum statutory requirements, to achieve economies of scale.

UES is the single point of contact and liaison for all campus utility distribution design, interconnection, disconnection, expansion, and construction of utility facilities. The University has the authority to prohibit or restrict external users from providing utility services within the campus based on regulations, adequate and reserve, flow, isolation, pressure, means, methods, size, make, materials, and available capacity. Utilities and interconnection to campus distribution or collection streams related to new building construction, renovations, remodels, additions, and alternations, whether performed by internal or external entities, must be reviewed and approved by the UES in writing prior to new construction, or renovation project charter approval.

In 2015, UES launched a 2D-mapping effort to better manage its assets and gain additional intelligence regarding the utility systems, and adopted pipe inventory and replacement planning and programming.

Portions of UCF's central core infrastructure and facilities are nearing 50 years old.[11] Conditional needs warrant for dedicated cost centers phased in over time to prevent a continuing increase in backlog of infrastructure deferred maintenance.[12] Funding for plant renewal (excluding considerations for non-building infrastructure needs) should be earmarked at 1.5% to 2.0% of the total plant replacement costs.[13] Capital Renewal Funding (CRF) is needed to keep the generation assets in good condition for its present use, based on facility life cycles. Plant adaptation funding (building code and standard compliance as well as changing programmatic requirements) should be planned at 1% to 1.5% of the total plant replacement cost.[14]

DATA & ANALYSIS

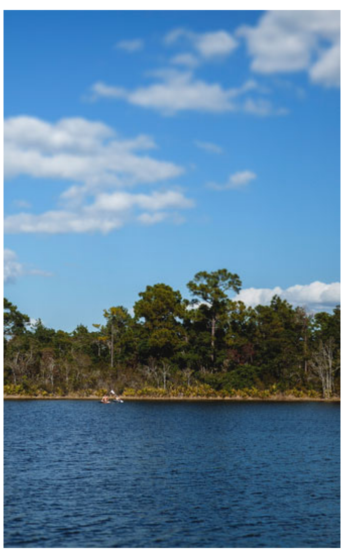
5.1 Stormwater Management Sub-Element

NARRATIVE

Stormwater is of concern for two main issues: one related to the volume and timing of runoff water and the other related to potential contaminants and high nutrient content within the water. Stormwater management is intended for flood prevention and water drainage, but also for managing water through efficient infrastructure and low-impact strategies.

Campus stormwater is currently managed by LNR (above ground) and UES (subsurface); and retention ponds are cleaned annually. In the first quarter of 2019, the condition of the campus stormwater system was evaluated, issues were repaired, and pipes were flushed. The basin and pond locations are currently maintained within the ArcGIS system. In the unlikely event that additional stormwater ponds are needed, alternative methods of storage may be used, such as the exfiltration system under Garage H.

STORMWATER ANALYSIS



The Stormwater Master Plan and subsequent stormwater permit were generated in the early 1990s based on projected development within the campus. The University is divided into four major drainage basins and three sub-basins, as shown on Figure 5.1-2. Modifications have been made to the master permit as a result of changes in projected growth and development.

The University currently maintains a master stormwater permit (No. 20026) from the SJRWMD. This master permit allows for development within designated stormwater basins as it relates to an approved additional impervious area within each basin. Currently, the permitted impervious impacts are monitored by the University and an independent consultant to ensure that permit capacities are not exceeded. The University maintains a current record in plan and table format of existing stormwater facilities and the current permitted impacts. These documents are available to review existing conditions and plan for future development. The drainage sub-basins and the available impervious area in each sub-basin that is still available for development is shown in Figure 5.1-4 and Figure 5.1-5. This information, along with plan data, is maintained by the University and updated as new development impacts the current data.

The stormwater system functions in accordance with the existing master permit. No adverse impacts have occurred as a result of discharges leaving University property through the stormwater management system.

The UCF stormwater system is in good condition, and its life expectancy is anticipated to exceed 25 years with routine maintenance.

The system's discharge points were selected to minimize impacts to adjacent natural resources. The University has made extensive efforts to reduce impacts to adjacent resources, including construction or stormwater ponds, maintaining and enhancing existing wetland systems by incorporating them into the master drainage system, restricting post development discharge to less than pre-1985 rates, and providing required water-quality treatment.

The University may need to modify the existing master permit to accommodate future expansion in several sub-basins, including the transfer of available impervious areas from one sub-basin to another. SJRWMD has been receptive to transfers, provided the final outfall conditions remain the same and additional treatment is provided in higher pollutant-loading areas.

The last major modification to the master stormwater permit was for the proposed widening of Libra Drive from two to four lanes; and created a new basin and pond 4-P and reconfigured the limits on Basins 4-L and 4-M. SJRWMD regulations require stormwater runoff to be treated prior to discharge into any natural wetland or water body, and to maintain a discharge rate less than pre-development condition.

The University has maintained a stormwater management facility which accommodates and exceeds SJRWMD criteria for preservation, except for Basin 4-F which is allowed to discharge directly into Wetland W-9. This condition was grandfathered by SJRWMD when the master stormwater system was developed and permitted in 1994. The stormwater system enhances the existing wetlands by providing natural hydration to each system to maintain its biological function. Because the biological function of the existing wetlands was considered in the original permitting design, the University should also consider habitat enhancements for wetlands and other transitional areas (buffers). Habitat enhancements may be part of an academic study program.

Stormwater Figures at the end of this element include:

- Figure 5.1-1 Stormwater Infrastructure Map
- Figure 5.1-2 Basins, Ponds, and Wetlands Map
- Figure 5.1-3 UCF 2012 Wetlands Map
- Figure 5.1-4 UCF 2014 Stormwater Master Plan
- Figure 5.1-5 Stormwater Master Plan Impervious Area Report

DATA & ANALYSIS

5.2 Sanitary Sewer Sub-Element

NARRATIVE

Wastewater on campus is collected through various-sized gravity sewer mains that feed from student residence halls, concessions, athletics, academic and research facilities, and retail establishments as well as campus thermal and electrical generation facilities. The effluent is then discharged into underground pumping or lift stations through dedicated force mains on campus, ultimately discharging to the Seminole County/City of Orlando Iron Bridge Water Pollution Control Facility (Iron Bridge).

Twenty-three pump stations collect and lift the effluent out of the low points on campus. The effluent is then pumped through 16" force mains to a demarcation point located at the corner of McCulloch Road and S.R. 434 prior to being pumped to Iron Bridge.

The University also has an extended wastewater collection service area,[15] collecting and transporting effluent outside of the main campus. Municipal wastewater services were not available in the early 1980's,[16] and as a result, the University provides sanitary sewer collection and transportation utility services to Central Florida Research Park (1200-acre campus), a subsidiary of the Orange County Research Development Authority (OCRDA) (1981),[17] and Siemens Quadrangle I (1983)[18].

The University has a bulk wholesale agreement (2018) with Seminole County to transfer an annual average limit of 1,100,000 gallons per day (GPD) of wastewater to Iron Bridge. UCF may also purchase up to an additional 700,000 GPD until December 31, 2040.[19]

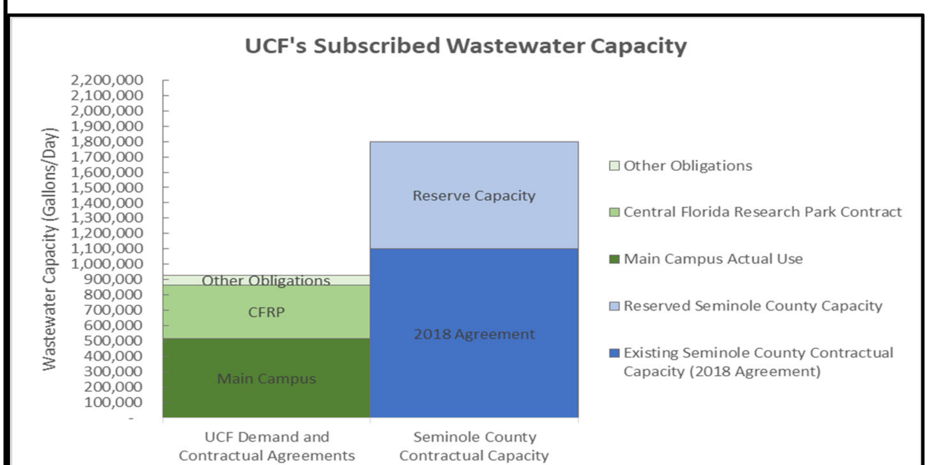
The expansion of the existing utility distribution network is directly influenced by the location of new buildings on campus. Because the final locations of proposed buildings are unknown, a sanitary sewer hydraulic study and resulting performance model will be necessary.[20] This model will allow the campus and future design engineering teams to evaluate the hydraulic performance of the campus under a variety of load scenarios and peak conditions.

Existing Conditions

Conditional needs warrant for dedicated cost centers, phased in over time, to prevent a continuing increase in backlog of deferred maintenance for sanitary sewer infrastructure.[21] In the event of a power grid interruption or loss of power, sanitary spills could occur, carrying negative risk and consequences from both regulatory and environmental perspectives, as well as public perception.

Funding for lift station renewal (excluding considerations for non-building infrastructure needs) should be earmarked at 1.5% to 2.0% of equipment replacement costs.[22] Capital Renewal Funding (CRF) is required to keep the infrastructure and lift station assets in good condition for its present use, based on facility life cycles.

Figure 5.2-1: Exclusive Bulk Wholesale Wastewater Capacity 2018



DATA & ANALYSIS

5.3 Potable Water Sub-Element

NARRATIVE

Today, the University owns and operates a water treatment plant that can process up to 3.2 million GPD. The existing system consists of four wells that pump from the Floridan aquifer to elevated storage tanks (200,000 gal) and ground water storage tanks (100,000 gal), with pump capacity of 2,200 gallons per minute (GPM). The maximum annual ground water withdrawal from the Floridan aquifer system for commercial, industrial, and institutional use is limited to 256.5 million gallons per year (MGPY).[23] The University is approaching the limit of its existing Consumptive Use Permit (CUP permit No. 2-095-3202-11) based on historical and permitted peak capacities.

UCF needs a larger groundwater storage tank for furnished water, due to potable water capacity constraints and increasingly-stringent regulation changes in water quality parameters, as monitored by the Environmental Protection Agency (EPA).

The domestic water system serving UCF is monitored, controlled, and maintained by the University, and is held to the same rigorous testing standards as municipal water systems under Florida Department of Environmental Protection (FDEP) drinking water standards. Each year, the University provides a Consumer Confidence Report to inform the public about water quality and services delivered.

As regulation requirements continue to become more stringent, the University must prepare for additional advanced treatment to meet the unfunded mandates from the EPA. Over the last several years, the EPA has required UCF to monitor unregulated contaminants through the *Unregulated Contaminant Monitoring Rule*[24]. This necessitates additional capital investment into infrastructure, technology, and treatment systems to monitor and collect data and fulfill these requirements.

The University employs an Inter-local Emergency Interconnection Agreement with Orange County Utilities. A control valve (24”) allows UCF to switch to Orange County potable water during emergencies.[25] Orange County water is then provided through the UCF-owned and -operated booster pumping station, to provide supplemental system pressure.

The University also purchases water from Orange County, with capacity charges paid for the use of up to 145,453 GPD. The Hercules and Nike residence halls are supplied by this municipal water service.[26]

Existing Conditions - Water Infrastructure

Campus water pipe distribution extends over 21 miles of the 1,415-acre campus, serving the majority of the University along with Siemen’s Quadrangle I, and as an emergency interconnection supply to the Central Florida Research Park.

The expansion of the existing utility distribution network is directly influenced by the location of new buildings on campus. Because the final locations of proposed buildings are unknown, a potable water hydraulic study and resulting performance model are recommended prior to approval of any new construction.[27]

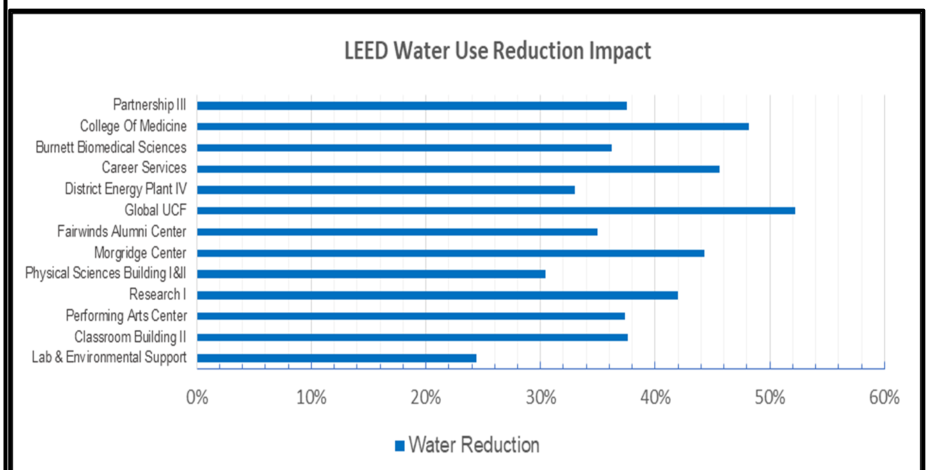
Environmental Stewardship and Sustainability

The University should continue to rely upon land use density[28], high-performance building programs as identified in the CMP, and ongoing implementation of Capital Plans and Programs to address the limited potable water capacity as constrained by SJRWMD. Strategic focus should adhere to the latest green building industry standards to treat water "efficiency first" with respect to conservation initiatives. UCF must holistically evaluate indoor, outdoor, and specialized water uses, while deploying advanced metering[29] to protect the Floridan Aquifer and the state's precious water resources.

Moreover, the SJRWMD has made an aggressive effort to conserve and protect the Floridan Aquifer since 2001. The University will have to continue to re-prioritize growth needs, and capital means to supply these future water demands,[30] as UCF and the Central Florida region have experienced rapid growth since the mid 2000's and the SJRWMD has reduced UCF's CUP capacity 37% since 2006.

Pursuant to the CUP, the SJRWMD authorizes UCF to use 256.5 MGPY of groundwater to be drawn from the Floridan Aquifer for commercial, industrial, and institutional use; 20.0 MGPY for aquaculture use; and 23.8 MGPY for back-up landscape irrigation use.[31]

Figure 5.3-1 LEED-Certified Projects demonstrating the Water Efficiency Credit reduction in water use over a code-compliant building[32]



Indoor Water Use Reduction

Potable water usage in buildings constitutes a large portion of freshwater consumption at the University. As campus growth continues to increase, existing campus buildings will require mechanical, electrical, and plumbing renovations and reprogramming in pursuit of pre-eminence. The installation of new plumbing fixtures (urinals, private lavatory faucets, and showerheads) that meet or exceed the EPA WaterSense Label[33] will significantly reduce consumption by as much as 20-50%, when compared to code compliant fixtures. [34]

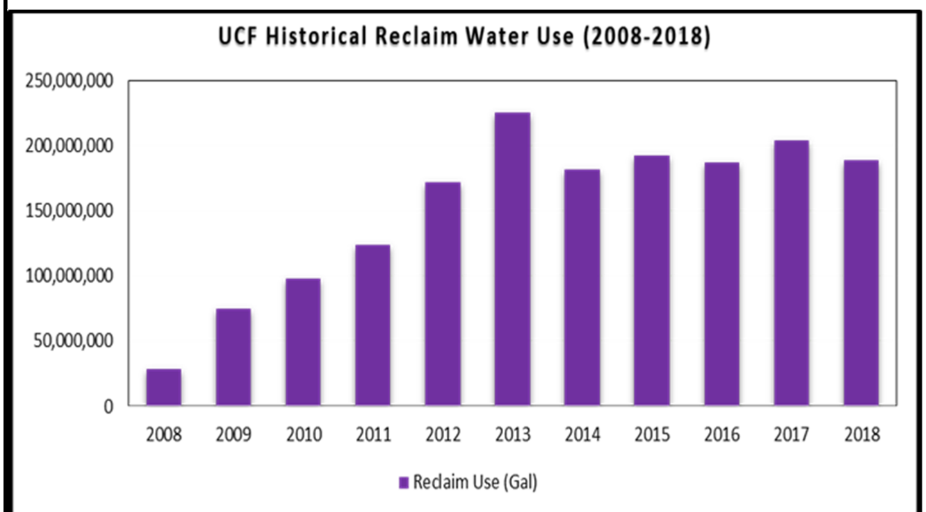
Since 2009, UCF has further reduced fixture and fitting water use from the calculated baseline (code-compliant building) adhering to the latest version of the U.S. Green Building Council's (USGBC) Leadership in Energy and Environment Design (LEED) Indoor Water Use Reduction Water Efficiency credit, achieving 20-52% reduction over the baseline in all new capital projects that are eligible to participate in the program requirements.

Outdoor Water Use Reduction (Irrigation)

The University has transitioned irrigation for much of the campus from potable to reclaimed water; with the exceptions of the Arboretum, where food is harvested for human consumption, and the Recreation and Wellness Center pool perimeter (as required by health codes). Irrigation practices had previously consumed large quantities of the campus's potable water.

LNR has adopted industry best management practices for landscaping. Responsible landscape designs and the use of native, adapted, and drought-tolerant plants have dramatically reduced, and in some cases eliminated, the need for irrigation, while integrating building sites into their surroundings more effectively. Native plants also tend to require less fertilizer and fewer chemical pesticides, which degrade water quality when carried away in stormwater runoff.

Figure 5.3-2
Main campus reclaimed water use (millions of gallons) dating back to 2008



Specialized Water Use Reduction (Cooling Tower Water Use)

The campus district energy network (chilled water) provides centralized cooling to 54 buildings on the main campus, servicing five million square feet of space. It employs a refrigeration system that removes heat by an evaporative process through the use of multiple cooling towers located at each of the generation facilities.[35] The water used in the cooling towers accounts for over 50% of the University's annual CUP allocation.

The University determined that reclaimed water can be used to augment the potable water supply required in the cooling towers, thus reducing water consumption against the CUP.[36]

With this intention, the Seminole County – UCF Bulk Wholesale Wastewater and Reclaimed Water Service Agreement was approved by the Seminole County Board of Commissioners. UCF can now receive up to two million gallons of reclaimed water per day for specialized uses (such as the evaporative cooling process) until December 31, 2040.

Water efficiency and conservation efforts at UCF will require continuous evaluation to identify and implement alternatives to potable water in response to stringent changes made by the Florida water management districts, FDEP's changes in drinking water quality standards, water conservation, changes to the Florida Building Codes, and aggressive reduction efforts championed by national green building standards. Most importantly, water conservation is a mandatory operating condition of the CUP that expires in 2036.

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5.4 Solid Waste Sub-Element

NARRATIVE

The University's goal is to develop an environmentally- and economically-sustainable materials-recovery program and become a Zero Waste Campus through campus-wide promotions and recycling opportunities. Although great progress has already been made, UCF has also partnered with Orange County to work toward a greater impact than just UCF.

Just the Facts…

The average person generates about 4 pounds of trash every day. The EPA estimates that 75% of waste is recyclable, and UCF currently recycles approximately 30%. Recycling one aluminum can saves enough energy to power a TV for 3 hours. One ton of recycled paper:

- Saves 7,000 gallons of water
- Saves between 17 and 31 trees
- Prevents 60 pounds of pollutants from entering the atmosphere

Several campus entities contribute to the effort to reach our recycling goals. UCF Recycling Services, Environmental Health and Safety (EHS), and UCF Surplus Property work together as follows:

Non-Hazardous Recycling

UCF Recycling Services, a unit of Facilities Operations, operates a robust recycling program. The UCF recycling program includes:

- Plastics #1 through #7 (tubs, jugs, jars, bottles, etc.)
- Mixed Paper (office paper, books, magazines, phonebooks, newspaper, cereal boxes, paper egg cartons, paper bags, milk cartons, juice cartons, etc.)
- Corrugated cardboard
- Glass (bottles and jars)
- Scrap metal (steel cans, aluminum cans, loose metal lids, steel bottle caps, clean balled aluminum foil, empty aerosol cans)

Hazardous Recycling

EHS recycles hazardous materials that are ignitable, corrosive, toxic, or reactive, specifically:

- Batteries
- Light bulbs and ballasts
- Chemicals (laboratory, housekeeping, landscaping, antifreeze)

Specialty Recycling

UCF Surplus Property handles the transfer or disposal of property, equipment, or other assets for which the originating department no longer has a justifiable use. UCF Surplus Property collects and repurposes:

- UCF Logo items
- Electronics (E-waste)
- Furniture and large items
- Burn boxes

Surplus property recycling is governed by statutes and regulations including three (3) Florida statutes (F.S. 273.04 Property Acquisition, F.S. 273.05 Surplus Property, and F.S. 273.055 Disposition of State-Owned Tangible Personal Property) and one UCF regulation (7.302 Surplus Property).

Figure 5.4-1 Recycling & Solid Waste Data FY July 2017- June 2018

UNIVERSITY OF CENTRAL FLORIDA	7/2/2018
Recycling & Solid Waste Figures FY July 2017- June 2018	Running Total Weight (lbs)
Mixed Recycling/Construction Debris (lbs)	607,860.00
Surplus (lbs sold)	427,165.38
Cardboard (lbs)	416,570.00
Scrapmetal - Tin (lbs)	66,440.00
Documents/Secured Media Destruction (lbs)	28,681.00
Scrapmetal - Mixed Iron (lbs)	20,820.00
Oils (lbs)	10,642.80
Antifreeze (lbs)	7,607.50
Batteries (lbs)	6,544.00
Lamps (lbs)	5,836.76
Pallets - Wood (lbs)	3,984.00
Printer Toner/Ink Cartridges (lbs)	3,481.74
Ballasts (lbs)	1,026.00

Figure 5.4-2 Monthly Recycling Rate FY 2017 - 2018

The recycling rate is the monthly percentage of solid waste diverted from the landfill and recycled.

July 2017	55.04%
August 2017	37.67%
September 2017	29.10%
October 2017	37.11%
November 2017	32.52%
December 2017	32.36%
January 2018	23.99%
February 2018	23.22%
March 2018	39.89%
April 2018	30.93%
May 2018	20.78%
June 2018	25.21%
Recycle percentage FY 2017-2018 (Rounded)	**32.50%**

UTILITIES ELEMENT Data & Analysis

DATA & ANALYSIS

5.5 Chilled Water Production Sub-Element

NARRATIVE

Chilled water demand is evaluated in terms of capacity (tons of refrigeration) and flow, measured in GPM. Historically, the peak summer demand (August and September) for refrigeration (cooling) of campus is approximately 20,000 GPM and 15,000 tons, serving the energy needs of 54 campus buildings with approximately five million gross square feet.

A prioritized program for long-term guidance for building, expanding, and upgrading the district system is dependent on additional campus load growth, as such District Energy Plant (DEP) IV cooling and heating capacity was built incrementally to add up to 4,000 tons of additional cooling capacity and 7,885 MBh[37] of heating capacity for future needs.[38]

Environmental Stewardship and Sustainability

A robust district energy system is both necessary and integral to UCF's Collective Impact Strategic Plan and Climate Action Plan, providing the necessary flexible platform to integrate multiple resources (renewable energy, combined heat and power, and thermal-energy storage) to provide the University with a more resilient, efficient, and sustainable campus and support the core missions of research and education.

The District Energy approach of generating chilled water centrally is more energy-efficient than using in-building equipment; thus, environmental impacts are reduced.[39] Greater efficiencies are possible when using larger, more efficient equipment and with the ability to stage equipment to match the load while remaining within its highest efficiency range. The district cooling system allows UCF to incorporate peak shifting technologies such as thermal energy storage, to reduce the cost of energy purchased from Duke Energy Florida.[40]

As UCF centralizes its approach to cooling campus buildings, and phases out in-building equipment, there will be less use of refrigerants that can potentially affect the ozone layer and contribute to global warming. Additionally, the University must inventory, manage, and track refrigerants for regulatory and compliance purposes. Many refrigerants are being commercially phased out as part of the Montreal Protocol.[41]

Economic Benefits

The University's district energy plants provide economic benefits, including, but not limited to:

- realizing fiscal economies of scale, when compared to the more conventional, decentralized approach;
- achieving higher thermal and emission efficiencies than stand-alone equipment;
- reducing and eliminating the need for building engineers and operators for in-building HVAC systems;
- reducing property and liability insurance costs with the elimination of in-building equipment;
- reducing noise associated with in-building equipment;
- freeing up space for the building's intended use; and
- providing asset redundancy to ensure campus cooling.

District energy operations at UCF function in an N+2 paradigm to provide greater asset availability. The criteria for evaluating this paradigm is to allow for one machine to be out of service for maintenance, and for a second machine to fail during campus peak cooling demand. 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. By having such redundancy, one chiller can fail, and one can be down for scheduled service at any time of year, without impacting cooling to the campus.

Figure 5.5-1
District Energy Plant (DEP) Capacities

Description	Plant Capacity	Build-Out Capacity
DEP I	8,000	8,000
DEP II	4,000	4,000
DEP III	4,000	4,000
DEP IV Cooling Capacity	4,000	8,000
DEP IV Heating Hot Water Capacity Installed	5,257MBh	10,514 MBh
DEP IV Heating Hot Water Capacity Available	2,628MBh	
Peak Cooling Demand	15,000	
Available Cooling Capacity (N+2)	490	
Subscribed Cooling Capacity	510	
Total Refrigerated Tons (RT)	20,000 RT	24,000 RT

Existing District Energy System

The campus is served by four (4) central chilled water generation facilities through a network of below-ground district chilled water piping systems that spans 15 miles on campus. District Energy Plants (DEP) I-IV were built in 1966, 1994, 2008, and 2018, respectively.

The district piping systems are circuitous in nature, following the circular configuration of the campus topography, roads, and walkways. Pipes are composed of high-density polyethylene (HDPE) and ductile iron, with the majority of the piping being asbestos-insulated wrapped concrete.

Cooling energy from the DEPs and thermal energy storage tank (TES) is distributed through district piping systems to the buildings on campus. The majority of campus buildings are also equipped with tertiary pumps, piped in series with the DEP distribution pumps. The tertiary (building) pumps respond through local controls unique to each respective building's piping circuit. Building pipe pressure is monitored to increase or decrease flow rates corresponding to the cooling demands of each building.

A small number of campus buildings are not equipped with tertiary pumps, but rely on the district piping system pressure, which is generated through the distribution pumps.

The University constructed a three-million-gallon thermal energy storage tank in 2009, which stores and cools water at less-costly off-peak electric rates (at night). The water is discharged during the on-peak hours. This allows the University to realize considerable savings by shifting approximately two megawatts of electricity from on- to off-peak, and storing 42-degree water for peak period campus cooling demands.[42]

In 2017, to improve the reliability metrics of chilled water distribution, UCF and Duke Energy Florida partnered to separate the distribution feeders at each chilled water generation facility into three (3) separate feeds. In the event of a momentary outage or power outage on the commercial grid, this reduces the negative risk associated with interruption of environmentally-sensitive cooling and dehumidification of campus buildings.

Infrastructure Improvements

The original underground system, much of which was built in the 1970s with additional phases added through the early 2000s, is connected through several underground vaults. The University will need to secure dedicated capital to move toward eliminating these vaults over the next five years, as they pose significant risk to operations (flooding) and the environment (asbestos). New technology has also evolved that allows for more robust and larger pipe-seated isolation valves, thus eliminating the need for the capital necessary to maintain the vaults.

Much of the original chilled water distribution from the 1970s contains asbestos-insulated wrapped concrete that should be phased out over the next five (5) years due to age, surface corrosion, operator safety,

and deterioration (see Figure 5.5-4 Chilled Water Infrastructure Map - Containing Asbestos).
Hydraulic modeling engineering illustrates the current water pressure challenges within the core of campus and northeastern quadrant during peak cooling demands (see Figure 5.5-2 Chilled Water Distribution Map – Pressure Challenges). Performance metrics include peak summer cooling demand, winter tank charge during peak, and winter tank discharge during peak.

To prevent HVAC equipment from fouling and organics from forming in the evaporative distribution network, distribution flow rate must be a minimum of 5 feet/sec. As illustrated in Figure 5.5-1 Chilled Water Infrastructure Map – Current Pressure Deficiencies, several portions of campus are well below the desired flow rate. To combat this issue, right-size piping[43] is necessary to replace existing pipe, in addition to adding hydraulic flow relief through new infrastructure to support the system's peak cooling loads.

Chilled Water Figures at the end of this element include:

- Figure 5.5-1 Chilled Water Infrastructure Map – Current Pressure Deficiencies
- Figure 5.5-2 Chilled Water Distribution Map -Pressure Challenges
- Figure 5.5-3 Chilled Water Infrastructure Map – Pipe Age
- Figure 5.5-4 Chilled Water Infrastructure Map – Mains Containing Asbestos

DATA & ANALYSIS

5.6 Electrical Power and Other Fuel Sub-Element

NARRATIVE

The University purchases electricity from Duke Energy Florida through a Time-of-Use (TOU) tariff for General Service Time of Use (GSDT-1) (a general service demand rate class) and Stand by Service (SS-1). As such, the energy and demand components of the University electric billing is further apportioned by an on-peak period and a base period, and is categorized according to season: April to October (summer) and November to March (winter).

An important operating characteristic of TOU rates is that electric utilities target or define certain hours by season, month, and period, with the intent to incentivize customers to reduce energy consumption and/or demand with tiered price signals (rates). Weekends and select holidays are considered base hours, the lowest rates.

The University owns and operates a 5.5 megawatt (MW) combined heat and power plant (CHP), employing a natural gas combustion reciprocating engine to provide on-site electrical and thermal generation. Due to overall efficiency of the CHP, lower (historic) natural gas price signals, and generation of power on campus (which reduces line loss), UCF has avoided purchasing more of its electricity from Duke Energy. At present, the CHP is electrically connected to the Duke Energy substation (UCF South), feeder W1016, reducing the purchased load from Duke Energy when the CHP is operating.

The rapid growth of distributed solar generation and utility-scale solar has the potential to influence retail electricity price structures. Prior to the emergence of renewable installations, rates were structured and designed to make utilities whole by relying on volumetric tariffs. UCF is a top-15 customer in the Duke Energy Florida Territory based on annual electric sales. With volumetric designs in mind, large customers such as UCF with higher consumption contribute more to recovery of utility infrastructure subsidized through the commercial rate base.

Existing Conditions of the Electrical Infrastructure

Duke Energy Florida feeds power to UCF through two of its owned and operated substations: UCF South (near Facilities and Safety) and North (near Spectrum Stadium). The high-side operating voltage of both substations is 69 kilovolts (kV) and voltage is transformed (stepped down) to 12.47 kV. From the substations, six UCF feeder lines distribute the power to all campus locations. UCF North feeds four circuits labeled as W0940, W0942, W0982 and W0989, while UCF South feeds the remaining two circuits, W1014 and W1016.

The UCF-Duke Energy commercial grid distribution system was designed with multiple redundancy features. Manual switching options allow for each substation (and its respective circuits) to carry the full UCF electric load. The switching capabilities also facilitate maintenance functions and minimize the duration of electrical outages.

The University leases equipment from Duke Energy, including approximately 70 medium voltage distribution switches and approximately 122 distribution transformers. Duke Energy charges UCF approximately $82k per month ($988k annually). The lease fee covers existing Duke Energy equipment (distribution switches and transformers) and new equipment as required (or as requested by UCF) to meet electrical power and distribution requirements. The lease is periodically adjusted based on equipment changes (new additions, replacement / repairs and removals).

Environmental Stewardship and Sustainability

The University must shift its paradigm toward carbon-free distributed generation facilities with higher efficiencies; thereby reducing energy cost; improving infrastructure resiliency through grid-strengthening projects; and providing portfolio flexibility with campus energy mixes deploying both smart and microgrid applications. More information on smart and microgrid applications can be found in element 9.0 CONSERVATION.

Peak demand on the Duke Energy commercial grid occurs during the summer months. Figure 5.6-1 illustrates each substation feeder's peak summer load compared to the rated capacity.

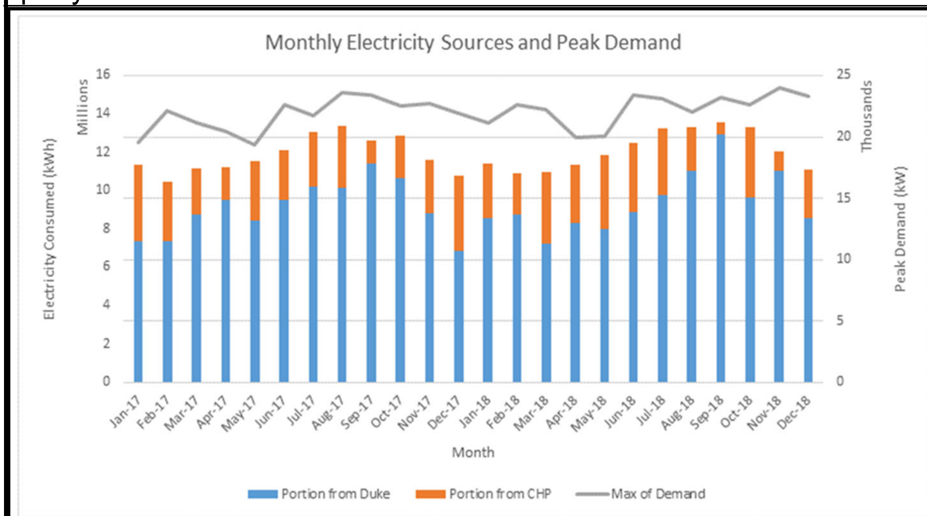
Both substations (South and North) also serve non-UCF feeder circuits, so the total capacity of the substation is not dedicated to UCF (see Rated Capacity). Therefore, all projections of available and excess capacity in this Section are dependent on Duke's forecasts for their rate base. It is certain that UCF's planning for future load growth must be conducted in concert with Duke Energy's planning staff.

Figure 5.6–1
Substation Peak Loading

Substation	Feeder	Summer Peak Load (MW)	Rated Capacity (MW)	Percent Utilized
UCF South	W1014	2.4	13.3	18%
UCF South	W1016	9.5	13.3	71%
UCF North	W0942	2.6	13.3	20%
UCF North	W0989	0.6	13.3	5%
UCF North	W0940	0.2	13.3	1%
UCF North	W0982	6.7	13.3	50%
UCF South	***TOTAL***	***11.9***	***26.6***	***45%***
UCF North	***TOTAL***	***10.1***	***53.2***	***19%***

The revenue forecast is based on UCF's conservative electrical load growth of 0.3% per year and an annual electric rate increase of 2.0% per year[44].

Figure 5.6–2
UCF's Purchased and Produced Energy and Demand Load Profile



DATA & ANALYSIS

5.7 Natural Gas Sub-Element

NARRATIVE

UCF owns, operates, and maintains a natural gas distribution network on campus, and distributes gas supplied by TECO Peoples Gas through more than 24,000 linear feet of low-, medium-, and high-pressured pipeline.[45] The system serves academic and research buildings, food service operations, and the combined heat and power plant.[46] A secondary service supplied, owned and operated by TECO Peoples Gas includes much of Greek Park, Knights Plaza, Towers I-IV, Additions Arena, and UCF Athletics on the north end of campus.

Because natural gas is deregulated in Florida, UCF has been able to reduce its natural gas costs by leveraging competition among natural gas marketers and suppliers through contract negotiations on the open market.

Natural gas provides greater efficiencies than electricity when comparing their use for the same applications. Due to its lower cost, natural gas is used as a primary fuel source to power UCF's combined heat and power plant; feed boilers for domestic hot water heating, building heating and dehumidification processes; and to operate gas appliances in kitchen and concession areas.

The University's natural gas system is designed and sized to service only the UCF campus, but may be expanded to serve the demands created by its future growth.[47] Based on a life cycle cost analysis and geographical location, it is strongly recommended that all future buildings and renovations on campus either employ hot water heating through hydronic means fueled by natural gas, or through the District Energy Plant IV's centralized hot water heating loop.[48]

The expansion of the existing gas utility distribution network is directly influenced by the location of new buildings on campus. Because the final locations of proposed buildings and renovations are unknown, a natural gas analysis shall be completed using GasWorks[49] to understand the distribution pressure relationships and system performance scenarios prior to approval of any new construction.

DATA & ANALYSIS

5.8 Telecommunications Sub-Element

NARRATIVE

A facility capacity analysis, by geographic service area indicates 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 all campuses, including but not limited to: Main Campus, Health Sciences Campus at Lake Nona, UCF Downtown, Rosen School of Hospitality Management, and several satellite campuses. This interconnection of Telecommunications utility pathways serves all buildings and major Nodes.

   All Telecommunications infrastructure and services are distributed over the campus fiber optic backbone throughout the encased duct bank system. Services such as Voice, CATV, emergency services, data network (wired and wireless) are all delivered over the fiber backbone along with associated network electronic equipment.

   These systems are maintained through a fiber mesh topology that terminates at several geographical nodes on all campuses. Each of these nodes connects to main entry points on each campus and they interconnect in a ring topology around the greater Orlando area.

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:

   In 2014, UCF IT Telecommunications created a master campus plan for all fiber optic and copper cabling on campus. This level of planning includes a secure and robust main backbone that accounted for ten to twenty years' worth of Telecommunications services growth. In addition, UCF IT created a formula-based system for all new buildings with regard to the amount of fiber, copper and other backbone cabling required for each building. This plan included the location or "Node area" that each building would cable back to on each campus. This design allowed other teams to be prepared for growth on systems and various telecommunications services as additional buildings interconnect to each node.

   UCF IT Telecommunications expects to continue the use of the existing fiber optic cabling and reduce the overall amount of copper cabling between a Node and building. However, technology advancements or new service requirements cannot always be predicted and may involve a change in current plans. The encased duct bank does allow for a low-cost change of cable media between buildings.

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.

UCF IT Telecommunications continues to design, install, and support this infrastructure throughout all campus locations. The level of service provided is high. With the addition of 811 service to UCF campus locations, Telecommunications remains the only owner-provided locator on campus and there is no reason to change this methodology in the foreseeable future.

In addition, UCF maintains detailed sub-system CAD and map drawings. Recently the department has been mapping GPS coordinates for maintenance holes and encased duct bank paths. UCF IT Telecommunications purchased locator equipment that maps each cable to which a device is connected. This locator equipment allows the department to continue mapping the campus in real time.

5.0 GENERAL INFRASTRUCTURE & UTILITIES

MAPS, TABLES, & ENDNOTES

The following UCF Maps are restricted for security purposes:

Figure 5.3-1 Potable Water Infrastructure Map - Distribution Layout & Age

Figure 5.8-1 Telecommunications Map

Figure 5.1-1
Stormwater Infrastructure Map

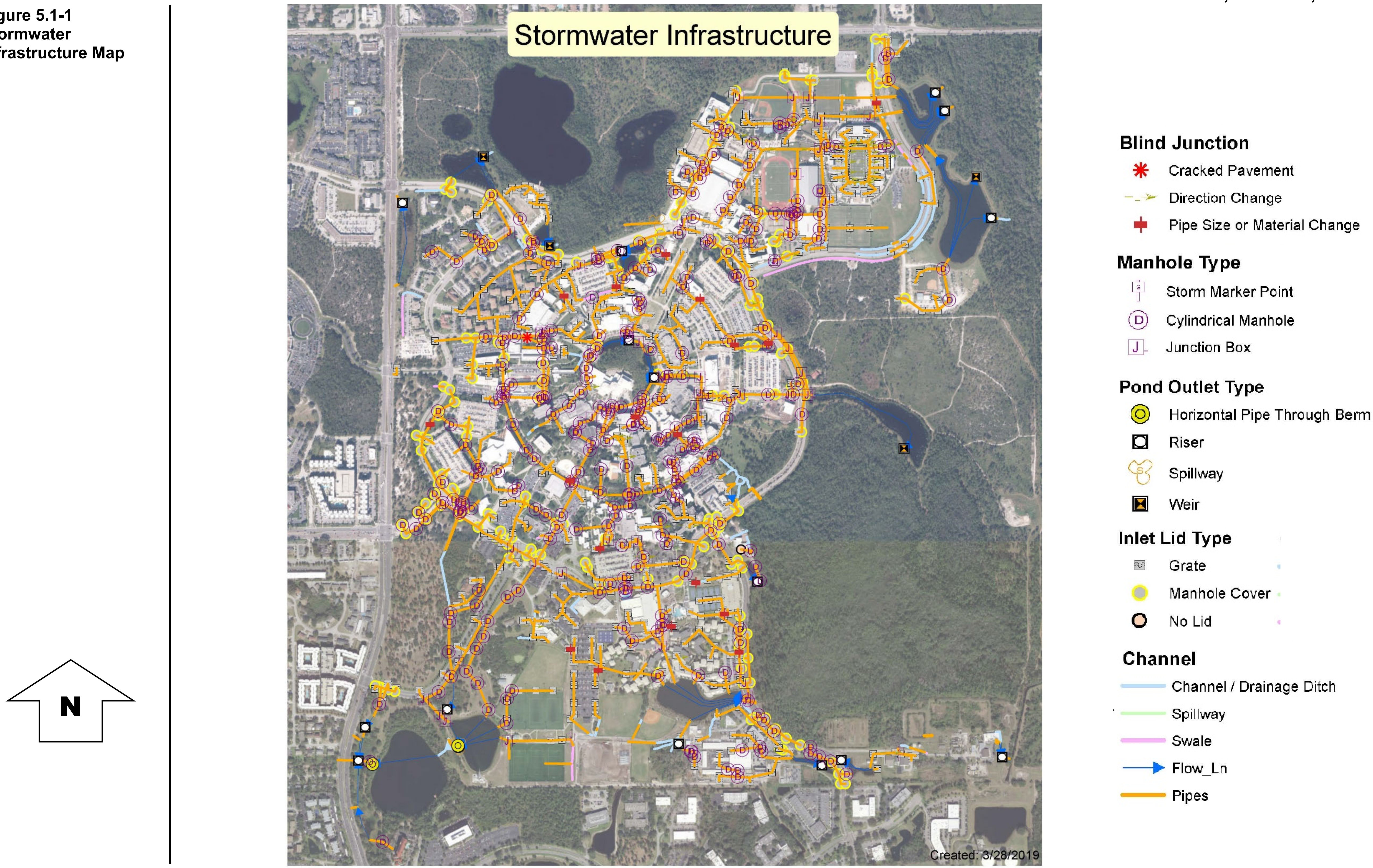


Figure 5.1-2
Stormwater Basins, Ponds & Wetlands Map

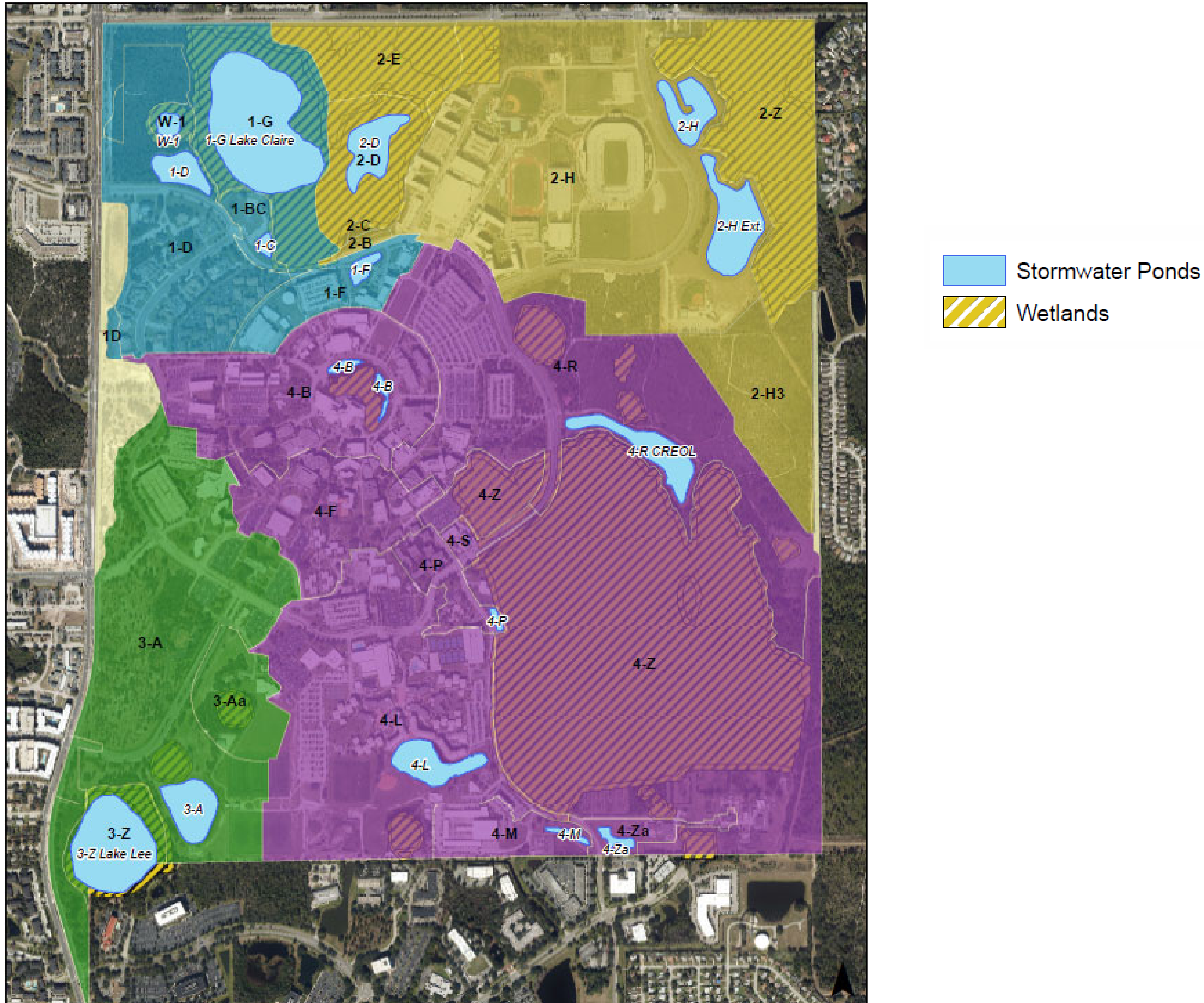


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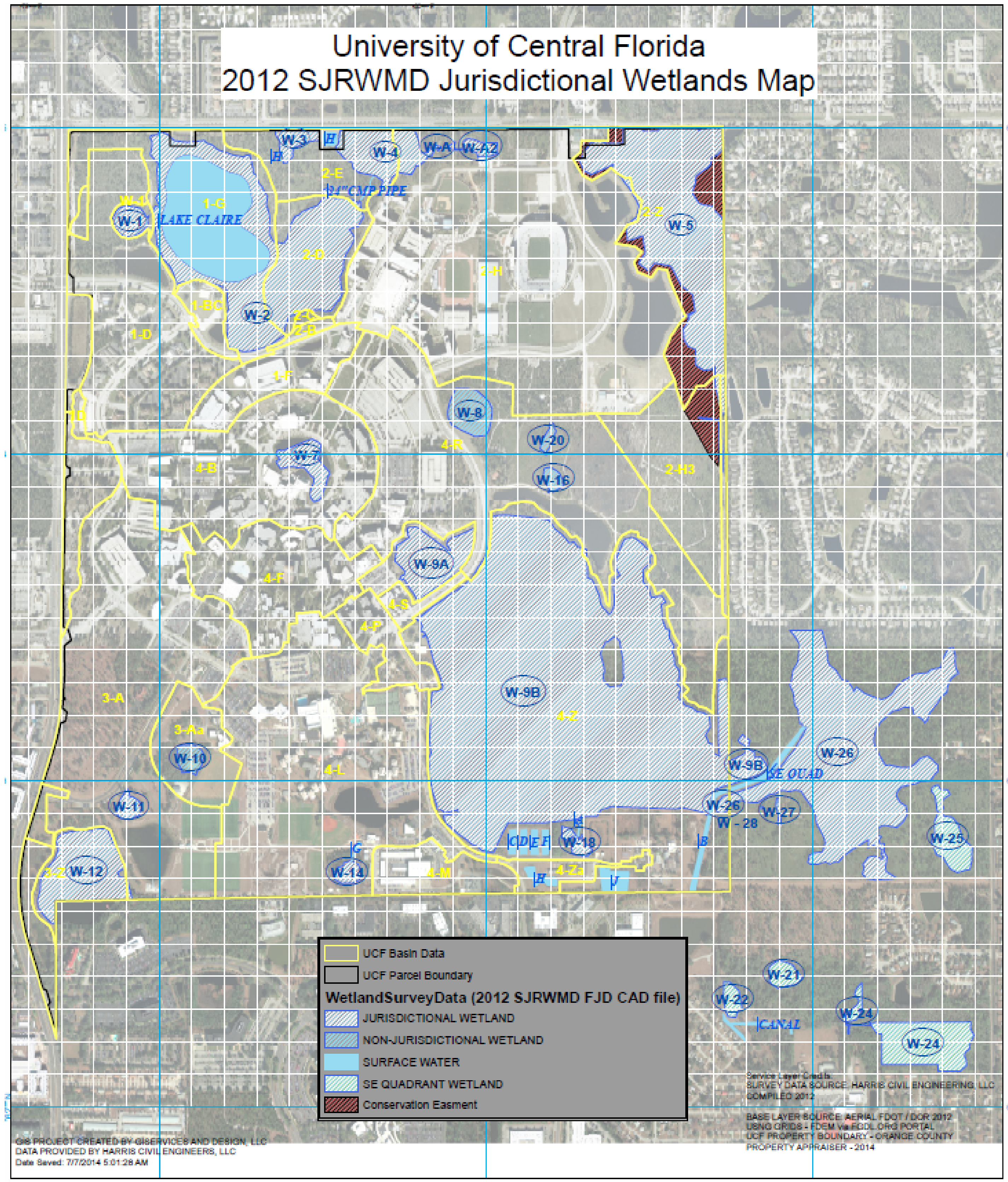
Figure 5.1-3
UCF 2012 Wetlands Map



WETLAND NUMBER	AREA (Ac)	
W-01	1.92	
W-02	61.56	
W-03	1.74	
W-04	8.10	
W-05	38.89	
W-07	3.39	
W-08	3.82	
W-09A	7.85	
W-09B	157.40	
W-10	1.44	
W-11	1.15	
W-12	12.34	
W-14	1.05	*
W-16	0.80	
W-18	0.93	
W-20	0.58	
W-21	1.50	*
W-22	1.12	*
W-24	0.63	*
W-25	4.16	*
W-26	0.41	
W-26	48.31	*
W-27	0.16	*
W-28	0.01	*
W-A	1.45	
W-A2	0.05	

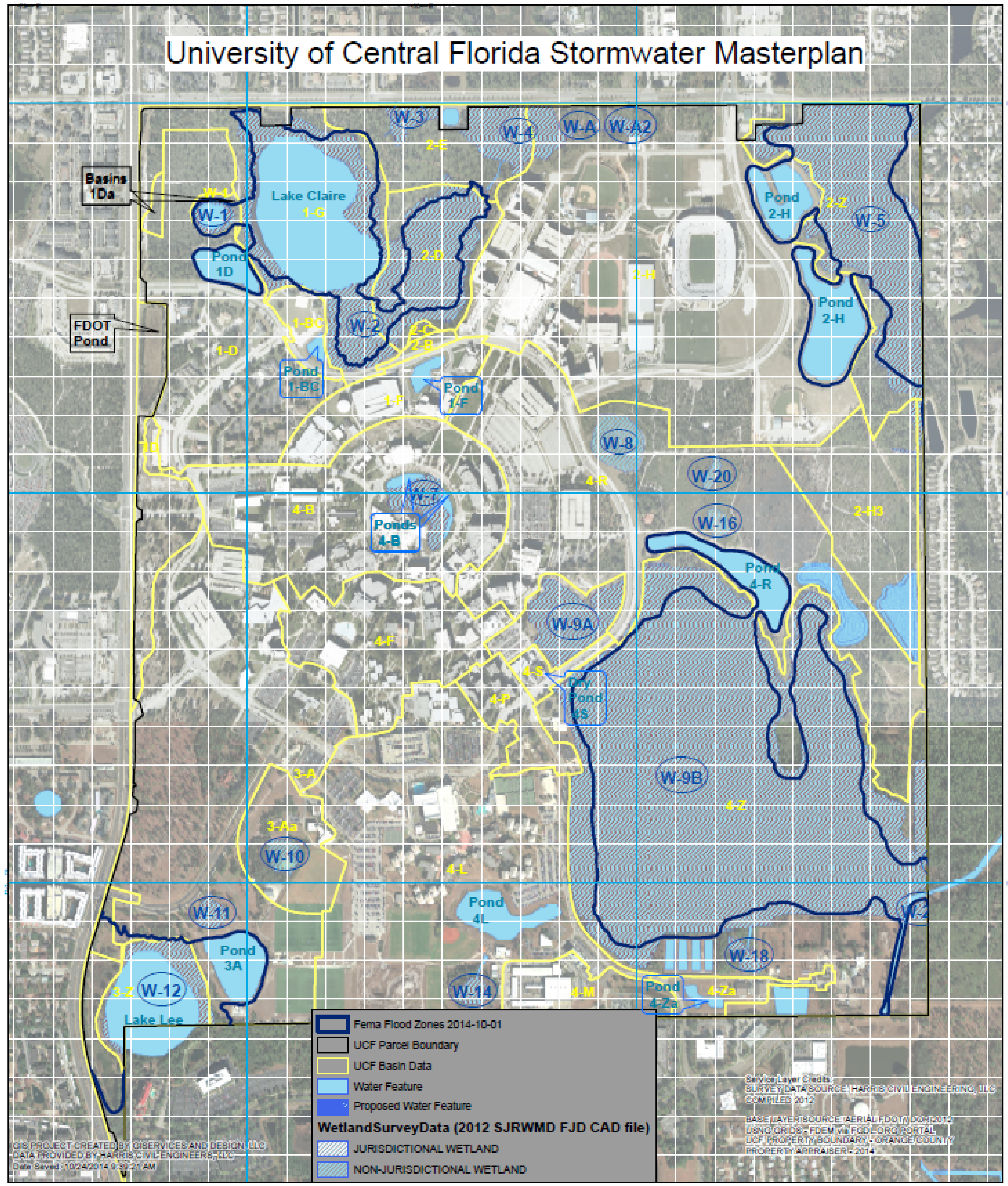
* - the area is calculated in ArcMap

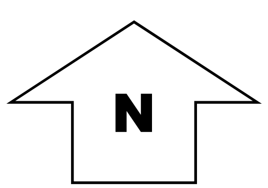
SURFACE WATER AREA TABLE

SURFACE WATER	AREA (SqFt)	AREA (Ac)
A	4,328	0.10
B	48,916	1.12
C	18,569	0.43
D	18,171	0.42
E	18,250	0.42
F	17,262	0.40
G	4,463	0.10
H1	1,902	0.04
H2	3,555	0.08
H3	3,665	0.08
I	17,323	0.40
J	292	0.01
LAKE CLAIRE	937,271	21.52

N

**Figure 5.1-4
UCF 2014 Stormwater Master Plan**





UCF STORMWATER MASTER PLAN DRAINAGE TABLE SUMMARY

BASIN	DRAINAGE AREA (AC.)	TOTAL PROPOSED IMPERVIOUS AREA (AC.)	TOTAL POND SIZE at NWL (AC.)	POND NWL ELEV. (FT.)	POND CONTROL ELEV. (FT.)	25YR/24YR DHW (FT.)	100YR/24HR DHW (FT.)	WATER QUALITY VOLUME (AC-FT)
1-BC	5.79	2.94	0.61	64.70	65.80	66.23	66.32	0.61
1-D	64.74	30.56	3.30	65.50	67.21	68.69	68.99	6.34 ***
1-F	16.81	11.11	1.03	66.00	68.10	69.33	70.06	3.01 **
1-G	57.82	0.00	23.20	63.70	-	65.28	65.53	-
2-B	1.81	1.80	0.10	66.90	67.80	69.16	69.31	-
2-C	0.57	0.00	0.10	64.70	66.50	66.58	66.59	-
2-D	23.24	0.00	-	-	-	64.24	64.27	-
2-E	23.57	0.00	-	-	-	62.61	62.65	-
2-H	164.52	74.00	13.10	50.00	51.40	53.49	54.09	19
2-H3	32.53	16.50	3.00	53.00	54.10	55.87	56.36	3.44
2-Z	50.62	0.00	-	-	-	46.52	47.79	-
3-A	130.04	51.00	5.00	65.00	67.10	68.13	68.56	10.93
3-Z	13.95	0.00	8.67	-	-	56.9	57.2	-
FDOT	2.50	1.20	*	*	*	*	*	*
4-B	65.34	37.15	2.00	68.00	70.42	72.06	72.7	7.11
4-F	35.24	26.61	-	-	-	-	-	-
4-L	116.14	53.09	4.44	58.00	60.30	61.43	61.87	11.06
4-M	13.80	8.17	0.69	57.75	59.92	61.07	61.74	1.7
4-P	10.37	8.10	0.50	60.00	62.00	62.69	62.82	0.98
4-R	115.84	56.00	8.00	58.93	60.42	62.3	62.67	14.49
4-S	3.75	3.10	-	61.00	N/A	64.79	64.91	0.51
4-Z	217.41	7.01	-	-	-	57	57.5	-
4-Za	6.85	3.50	0.70	58.00	59.00	60.02	60.49	0.73
TOTALS	1173.25	391.84	74.44					

* SEE CENTRAL FLORIDA BLVD. CALCULATIONS ON THE FILE WITH THE SJRWMD
** 0.61 AC-FT WQ VOLUME PROVIDED FOR BY UNDERGROUND EXFILTRATION VAULT
*** 0.31 AC-FT WQ VOLUME PROVIDED FOR BY DRY RETENTION POND.

OVERALL BASIN BREAKDOWN		
TOTAL DRAINAGE AREA	1173.25	acres
ONSITE AREA NOT INCLUDED	26.07	acres
OFFSITE AREA INCLUDED	(1.62)	acres
TOTAL UCF BOUNDARY AREA	1197.70	acres

Figure 5.1- 5 Stormwater Master Plan Impervious Area Status Report

UCF STORMWATER MASTER PLAN
IMPERVIOUS AREA STATUS REPORT

Date:	11/13/2013
Revised	**12/3/2013**
Revision No.:	2013-02
SJRWMD Permit No.:	40-095-20026-123

Proposed development this submission:

Project name:	UCF Building 154 MMAE Laboratory Expansion	
Project area:	0.32 Acres	
Drainage basin:	4-Z	
Imp. area increase:	0.153 acres	0.103 acres Impervious area for expansion previously permitted under Permit 40-095-20026-109

Information: Application is for a 5,560 +/- s.f. addition to Building 154 with associated hardscape.
0.103 ac. previously permitted so overall increase of 0.050 acres

Overall Plan Status:

Basin (1) I.D.	Drainage Area (2) (AC)	Existing Imperv. Area (3) (AC)	Impervious Area This Submittal (4) (AC)	Total Imperv. Area Allowed (5) (AC)	Remaining Imperv. Area Allowed (6) (AC)
1-BC	5.79	1.59		2.94	1.35
1-B (7)	-	-	-	-	-
1-C (7)	-	-	-	-	-
1-D	64.74	25.70		30.56	4.34
1-D Dry Pond	1.21	0.74		0.74	0.00
1-D Pond	63.53	25.48		29.82	4.34
1-F	16.81	11.01		11.11	0.10
1-F Vault	2.52	2.52		2.52	0.00
1-F Pond	14.29	8.49		8.59	0.10
1-G	57.82	0.00		0.00	0.00
2-B	1.81	0.87		1.80	0.93
2-C	0.57	0.00		0.00	0.00
2-D	23.24	0.00		0.00	0.00
2-E	23.57	0.00		0.00	0.00
2-H	164.52	71.34		74.00	2.66
2-H3	32.53	0.00		16.50	16.50
2-Z	50.62	0.00		0.00	0.00
3-A & 3-Aa	130.04	44.35		51.00	6.65
3-Z	13.95	0.00		0.00	0.00
4-B(Pond)				34.13	
4-B(provided in 4-R)				3.02	
4-B Totals	65.34	37.15		37.15	0.00
4-F	35.24	21.12		26.61	5.49
4-L	116.14	50.83		53.09	2.26
4-M	13.80	7.99		8.17	0.18
4-P	10.37	4.59		8.10	3.51
4-R	115.84	31.10		56.00	24.90
4-S	3.75	2.69		3.10	0.41
4-Z	215.33	5.66		7.01	1.35
4-Z Bldg 154	2.08	0.98	0.05	1.03	0.00
4Z-a	6.85	3.07		3.50	0.43
FDOT	2.50	1.20		1.20	0.00
TOTALS	**1173.25**	**321.24**	**0.05**	**392.87**	**71.06**

Completed ponds permitted and or proposed to be entirely constructed:

Ponds 1-F, 2-H, 4-B, 4-M, 4-S & 3-A have been completely constructed. Impervious areas may be constructed up to the amount noted, without additional permitting.

Pond 1-BC is proposed under this application.

Portions of Ponds Permitted and Completed or Under Construction:

Ponds 1-D & 4-R have been partially constructed. The area of each pond and impervious area allowed prior to additional expansion or permitting is as follows:

Pond 2-H3 has not been constructed and no improvements can be made in that basin until the pond is built.

Pond ID	Existing Pond Permitted Maximum Imp. Area (ft)	Existing Imp. Area Constructed (ac)	Imp. Area This Submittal (ac)	Revised Imp. Area (ac)	Future Imp. Area Allowed prior to Lake expansion (ac)
1-D (pond)	26.25	25.70	0.00	25.70	0.55
2-H3	0.00	0.00		0.00	0.00
4-R	43.83	31.10	0.00	31.10	
4-B(provided in 4-R)	3.02	3.02	0.00	3.02	
4-R Totals	46.85	34.12		34.12	12.73

Note: Existing impervious under basin 4R includes excess impervious area built in basin 4-B

Basin 4-L Underdrained Fields

Allowable (ac)	Existing (ac)	This Submittal (ac)	Remaining (ac)
5.96	0.00	0.00	5.96

Note: Basin 4-L underdrained fields will provide treatment volume on-site via soil storage between finished grade and underdrain elevations

NOTES:

(1) Basin I.D. as indicated in the Approved stormwater master plan permit dated 3/9/04 and as Amended on 4/2/09
(2) Proposed drainage area as indicated in Approved stormwater master plan permit dated 3/9/04 and ammended on 4/2/09
(3) Indicates the permitted impervious area which exist within each basin.
(4) Impervious area proposed (not to exceed values in Approved stormwater master plan permit and lattest ammendments)
(5) Total impervious area allowed for basin based on the stormwater master plan pond design.
(6) Remaining impervious area allowed within basin based on the 2010 stormwater pond design.
(7) Basins 1-B and 1-C will combined to form Basin 1-BC under permit 40-095-20026-105
(8) Dry Pond 1-D at Greek Park Expansion added under permit 40-095-20026-112
(9) Bain & Pond 4-P added under Permit 40-095-20026-121

1 of 1

PREPARED BY HARRIS CIVIL ENGINEERS

[illegible]

Figure 5.5-1 Chilled Water Infrastructure Map – Current Pressure Deficiencies

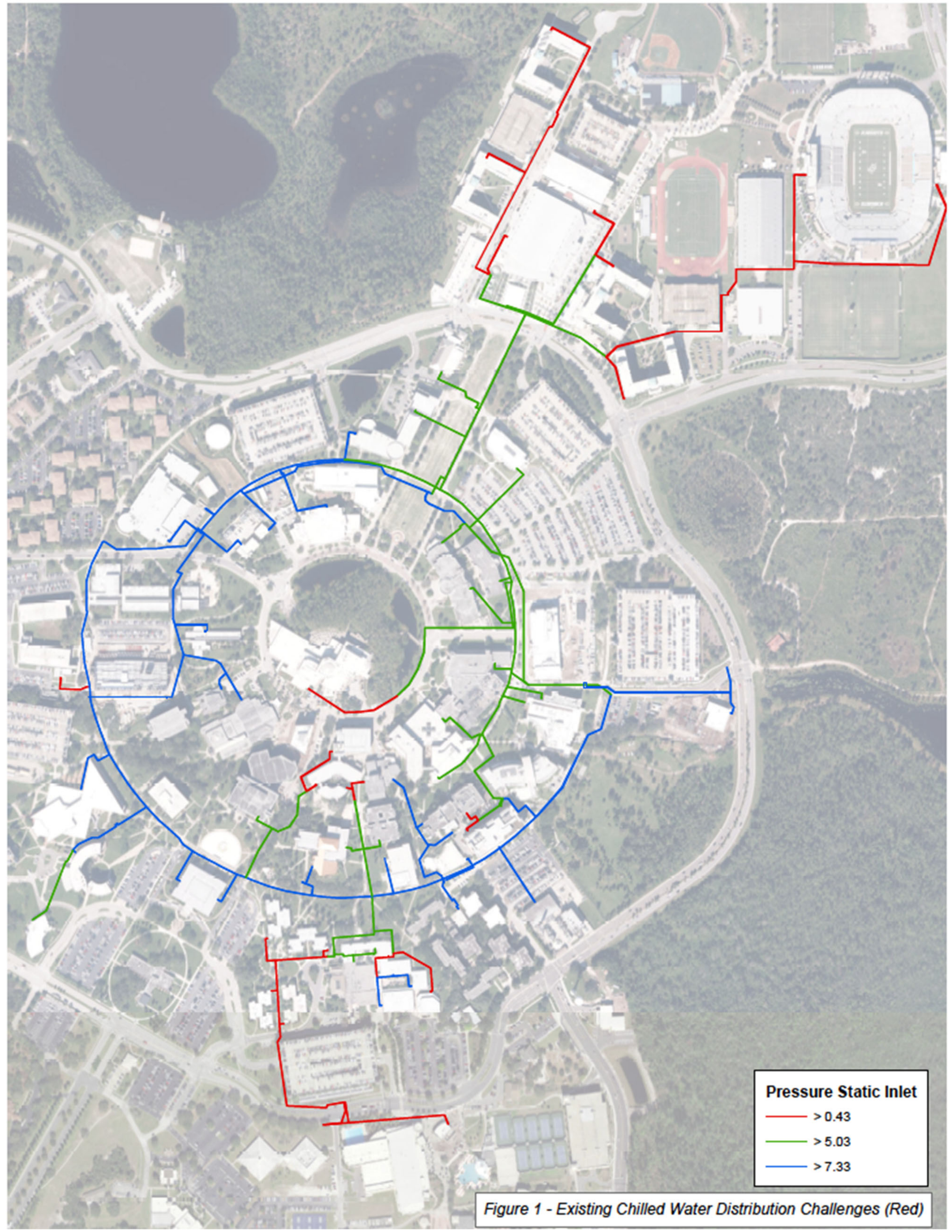


Figure 1 - Existing Chilled Water Distribution Challenges (Red)

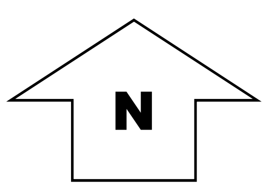


Figure 5.5-2 Chilled Water Distribution Map - Pressure Challenges

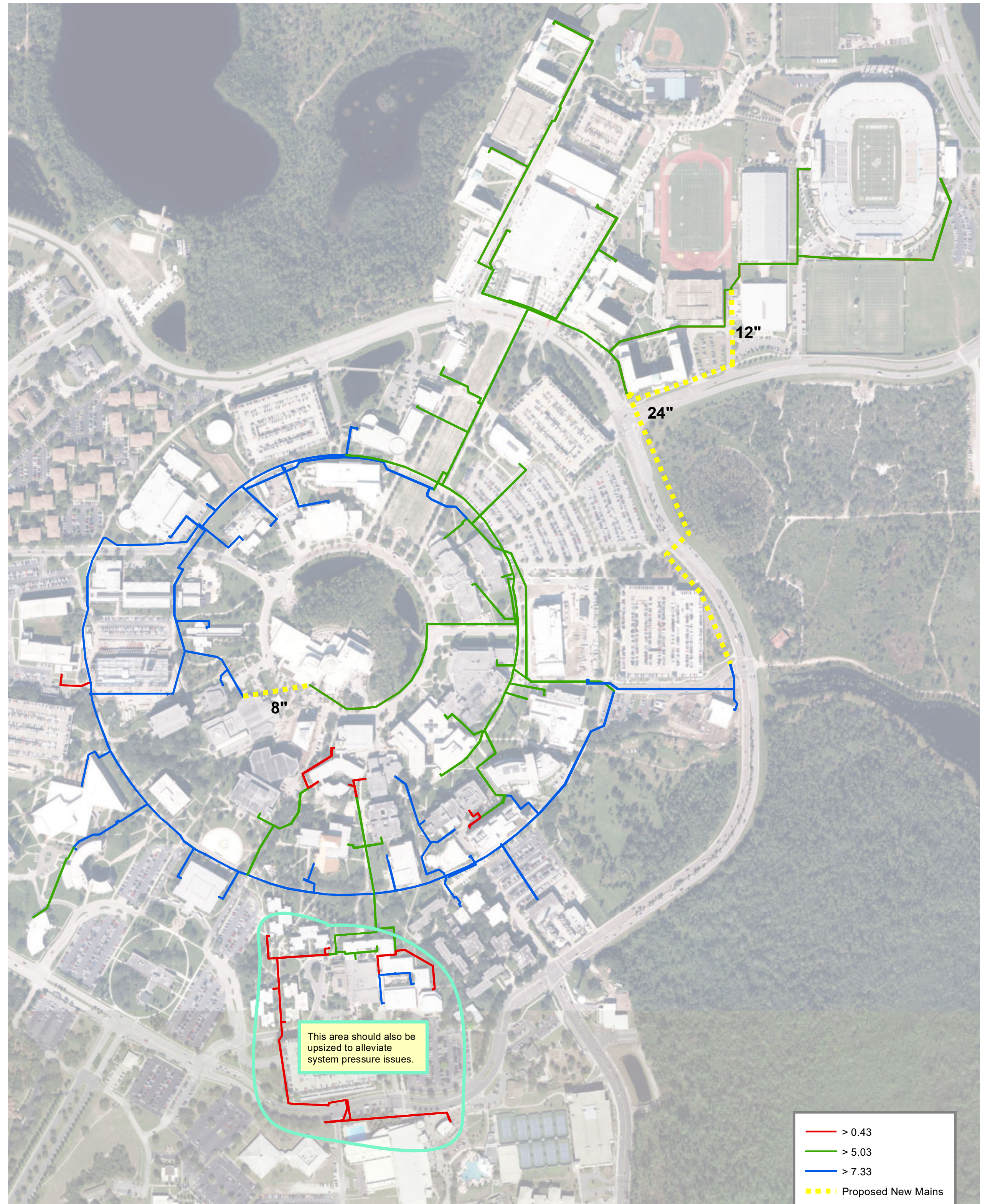


Figure 2 - New Chilled Water Supply & Return Infrastructure Recommended to Alleviate System Pressures (Approx 5,200 feet)

N

Figure 5.5-3 Chilled Water Infrastructure Map – Pipe Age

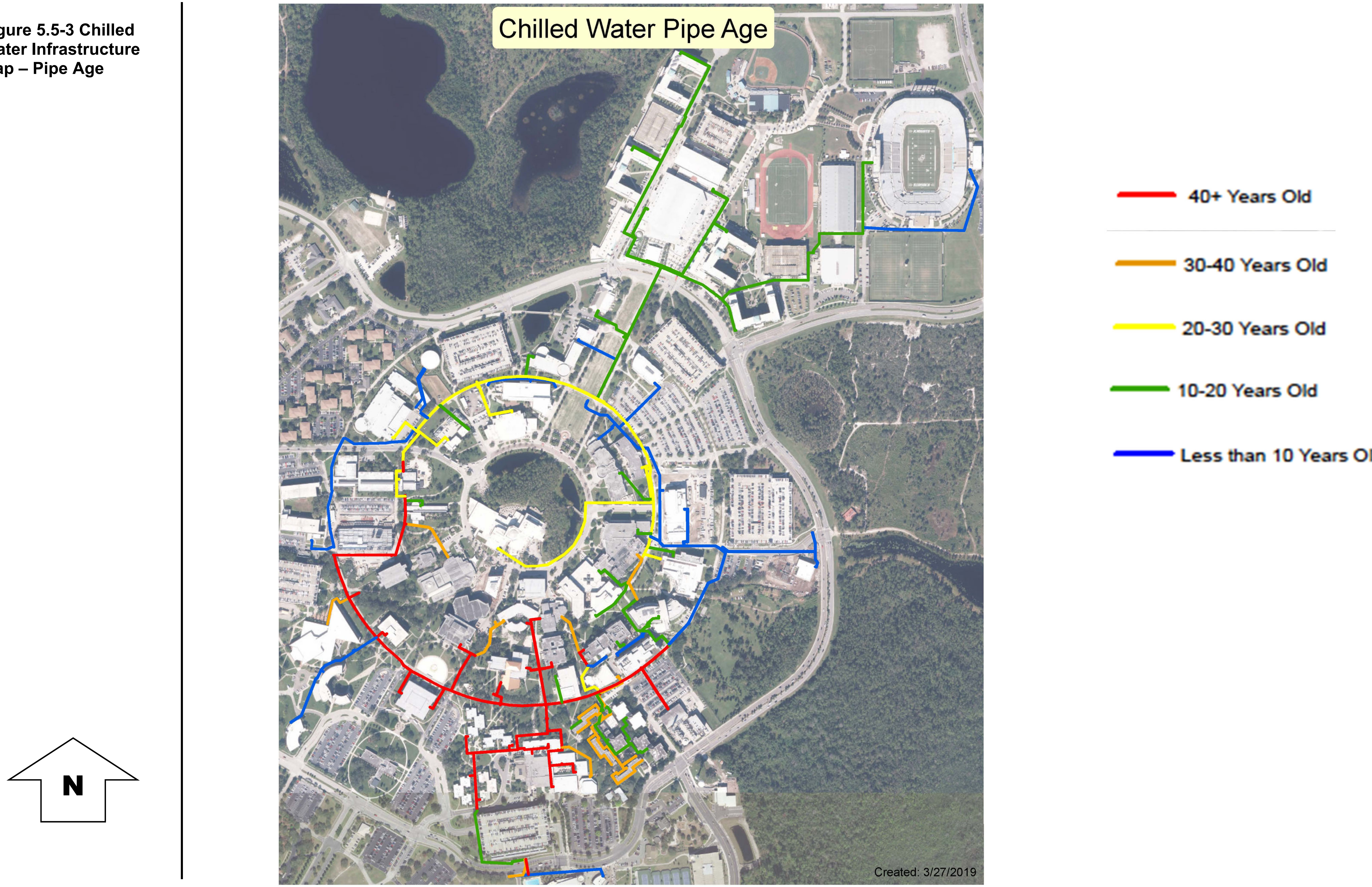


Figure 5.5-4 Chilled Water Infrastructure Map – Mains Containing Asbestos

Asbestos is to be phased out over the next five (5) years.

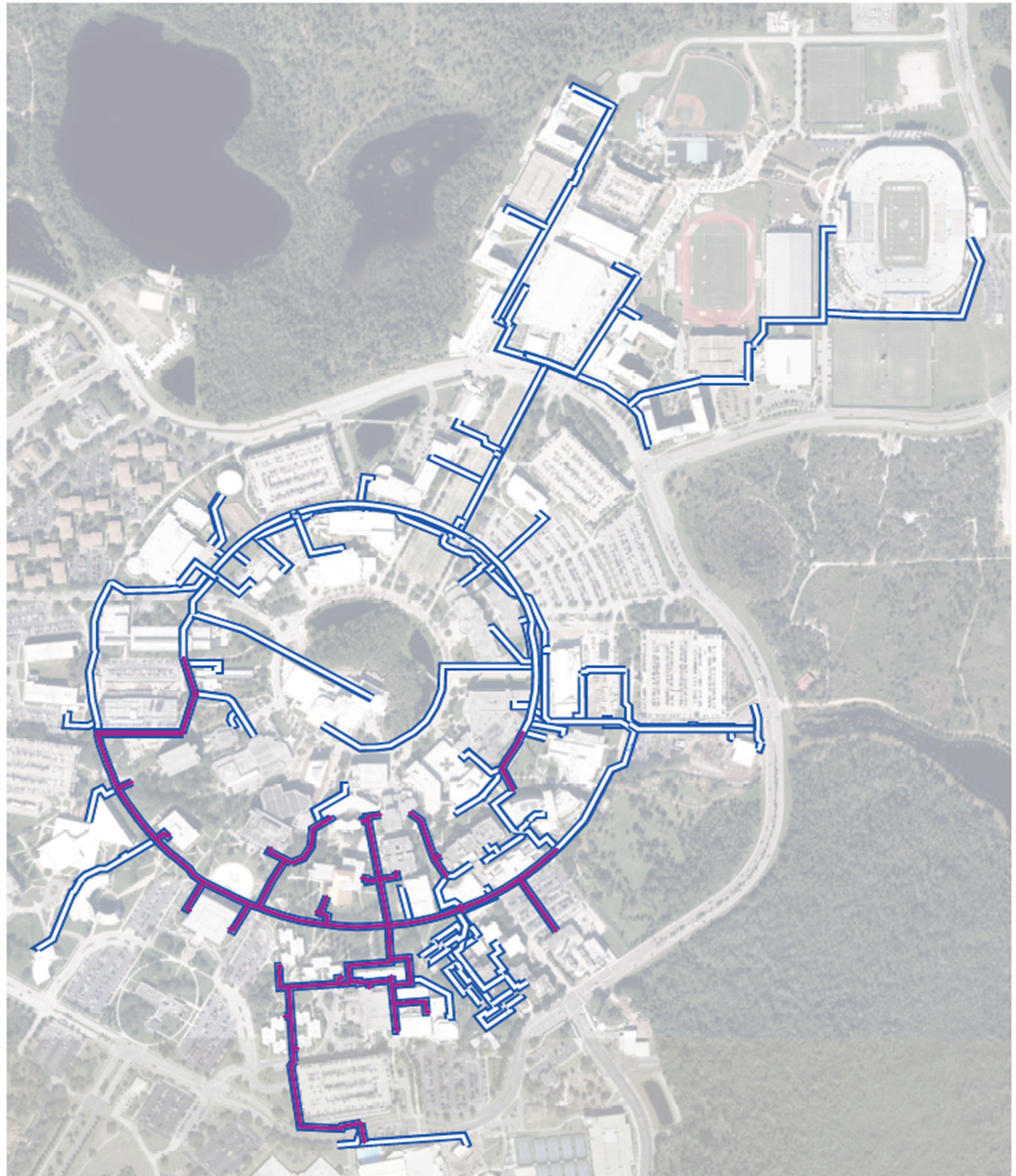
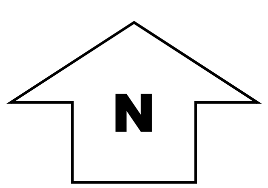


Figure 3 - Existing Chilled Water Infrastructure - Mains Containing Asbestos (Purple)



ENDNOTES – D&A Technical Information & References

[1] ASHRAE District Cooling Guide – Comprehensive Reference
[2] UCF Collective Impact 5-year Institutionalization Plan
[3] UCF Collective Impact Strategic Plan 2016
[4] The Utility Master Service-Level Disclosure is currently under review by UCF Administration.
[5] Per UCF Policy 3-303, University Controlled Utilities and Interconnection
[6] **UCF Collection Facilities** is defined in the Seminole County / University of Central Florida Exclusive Bulk Wholesale Wastewater and Reclaimed Water Service Agreement as the equalization basin, gravity lines, pipes, pump stations, force mains, meters, and appurtenant equipment owned, operated, and maintained by UCF to collect sewage and to transmit it to Iron Bridge.
[7] *ANSI / ASHRAE / USGBC /IES Standard 189.1 – Standard for the Design of High-Performance Green Buildings*
[8] Pursuant to Consumptive Use Permit Number 2-095-3202-11
[9] St. Johns River Water Management District Consumptive Use Permit Number 2-095-3202-11
[10] The Florida Legislature, through the Energy, Climate Change and Economic Security Act of 2008, established a statewide weight-based recycling goal of 75% by 2020. The Act instituted the 75% recycling goal, directed the Florida Department of Environmental Protection (DEP) to establish a reporting protocol and directed counties to report annually.

[11] Site corrosivity was evaluated in 2017 on the oldest sections of the water distribution system (~51 years old). Soil resistivity testing was conducted using the 4-pin Wenner method. Many of the selective samples were categorized as moderately to mildly corrosive (2,300 – 15,000 Ohm-cm). The soil statistical analysis conducted also yielded at 7.4% change of severely corrosive soil within the campus limits. Soils found deeper were more corrosive. Additionally, the predicted corrosion rate of metallic buried pipe in the soil of the UCF campus was generally low. Corrosion coupons (pre-weighed and measured metal strips mounted in the existing pipes) were used to evaluate the extent of corrosion, showing minimum corrosion after 15 years of service. Direct examination of the oldest pipe known (~49 years in service) showed general corrosion.
[12] As the UCF campus grows, an expanded distribution network will also be required to connect campus water utilities to the new building locations. The existing piping network is configured overall in a loop with some dead-end legs. A looped piping network is beneficial because it allows portion of the campus to receive potable water if part of the network is isolated or taken out of service.
[13] Source: ASHRAE District Cooling Guide – Comprehensive Reference 2.14
[14] Source: ASHRAE District Cooling Guide – Comprehensive Reference 2.14. Best management practices through the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASRHAE) suggest that 2.0% - 3.0% of the total energy cost is required to alter UCF's utility generation facilities to comply with changing regulations in order to meet new University expectations, and serve changing programmatic needs.
[15] **UCF Service Area** is defined in the Seminole County / University of Central Florida Exclusive Bulk Wholesale Wastewater and Reclaimed Water Service Agreement as the service area serving UCF and Central Florida Research Park, hereby referenced as the Orange County Research and Development Authority, and Siemens Corporation in the Quadrangle.
[16] These partnerships, established in the early 1980's, were determined critical to the success of UCF's strategic partnerships with the space program's research, optics, aerospace, and mechanical engineering disciplines. As a result, they were connected to UCF's sanitary system.
[17] **Utility Service Contract – Orange County Research Park Development Authority (ORDPA):** executed March 13 1981, with addenda in 1984, 1985, 1991, 1996, and 2004. *Note: several attempts to modify the contract have been considered since 2015 with no prevail. Perpetual term, OCRPDA load growth, and capacity is of concern.*
[18] The original 1983 agreement was terminated and a new **Service Level Water and Wastewater Agreement between University of Central Florida and Siemens Corporation and FT-Orlando Property LLC** was executed on 6/16/2017.
[19] 2018 Seminole County – UCF Bulk Wholesale Wastewater and Reclaimed Water Service Agreement

5.2 Sanitary Sewer Sub-Element
[20]UES strongly recommends that all future campus growth be entered into a hydraulic model such as SewerCAD, or a similar modeling program. This model would be used to further develop distribution design parameters, including the sizing of lift station pumps, and would serve as a baseline tool that the campus can use going forward as expansion continues. Hydraulic modeling will allow the campus to optimize the size and routing of the distribution system and provide the highest level of efficiency and operational flexibility possible. It will also identify distribution limitations in the sanitary sewer piping network, such as pinch points and capacity issues, and identify and model potential system improvements.
[21] As the UCF campus grows, expanding the wastewater transportation and collection network must be considered, including additional lift stations and back-up generators for additional resiliency and reliability in the event the commercial power grid goes down.
[22] Source: ASHRAE Fundamentals of Building Operation Maintenance and Management

5.3 Potable Water Sub-Element
[23] Maps of the potable water well locations have been removed from the CMP for security purposes.
[24] EPA uses the Unregulated Contaminant Monitoring Rule (UCMR) to collect data for contaminants that are suspected to be present in drinking water and do not have health-based standards set under the Safe Drinking Water Act (SDWA).
[25] Bona-fide emergency is classified as when the UCF water treatment plant suffers a loss of system pressure, and is unavailable, and/or unable to augment system campus fire suppression capacity. Additionally, a 16-inch looped water main system was connected to the Orange County Utilities (OCU) to provide fire suppression backup water.
[26] Capacity is expressed in the Emergency Potable Water Supply Interconnect Agreement between Orange County and University of Central Florida. Orange County Utilities stated in January 2019 that the east Orange County treatment facilities do not have additional CUP capacity to support any additional growth at UCF.

[28] Floor Area Ratio (FAR) is the ratio of a building's total floor area (gross floor area) to the size of the piece of land upon which it is built. Walkable urbanism and healthy transit require FARs to be at least 1.5 to 3.0.

[29] Advanced water metering supports the University's water management and identifies opportunities for additional water savings by tracking water consumption.
[30] Source: St. Johns River Water Management District -November 2006 CUP 2-095-3202-7, capacity of 440.14 MGPY
[31] St. Johns River Water Management District Consumptive Use Permit Number 2-095-3202-11
[32] Projects that are eligible for LEED BD&C Certification, includes LEED Versions 3.1 and 4.
[33] The WaterSense Label was developed by the U.S. Environmental Protection Agency.
[34] Water Efficiency is addressed in the LEED Reference Guide for Building Design and Construction and LEED Reference Guide for Operations and Maintenance.
[35] Evaporative cooling systems remove heat from air to cool interior building spaces. This heat is expelled into the atmosphere through campus cooling towers. A cooling tower or evaporative condenser removes heat in part by evaporating water; as the water absorbs heat it changes from a liquid to a vapor. As the water evaporates, however, dissolved solids become more concentrated in the remaining water and eventually begin to deposit scale on the cooling towers or evaporative condenser elements, making such systems less efficient. To prevent building of deposits, cooling tower and evaporative condenser systems remove a portion of the water through a process called blowdown. Make up water is then added to replace evaporative losses and blowdown volume. The University has third-party chemical treatment contract with U.S. Water Services Corporation which calls for ~ 3.0- 3.5 cycles of concentration before blowing down the cooling tower to the sanitary sewer.
[36] Source U.S. Water Services Corporation (2018): Reclaimed water requires advanced water treatment chemical monitoring to include pH adjustment to ~8.2, conductivity, inhibitors, autonomous chemical pump activation, injecting 50% acid to help control calcium phosphate, ORP control and flow monitoring for upset condition(s). Additionally, using reclaimed water will increase the cycles of concentration from 3 – 5 cycles using a 50% acid concentrate.

5.5 Chilled Water Production Sub-Element
[37] MBh is 1000 BTU / hr.
[38] ASHRAE District Cooling Guide: Energy Table 2.1 Approximate Unit-Area Cooling-Load Values for college campuses range from 400 (low) – 240 (high) ft^2/ ton (non-laboratory space).
[39] Water-cooled district energy systems employ cooling towers, resulting in higher efficiency than air-cooled chillers. Water-cooled chillers are more efficient because they condense depending on the ambient temperature bulb temperature, which is lower than the ambient dry bulb temperature. The lower the ambient temperature at which a chiller condenses, the more efficient it is.
[40] UCF's thermal energy storage tank provides an electrical peak shifting strategy based on its time-of-use (TOU) tariff with Duke Energy Florida. The GSDT-1 tariff is based on time of day, and includes seasonal peak periods (summer and winter) where the energy and demand charges are higher than off-peak. This serves to incentivize large customers, including UCF, to reduce peak demand and electrical production from Duke Energy Florida.
[41] The Montreal Protocol (MP) was established and ratified by the U.S. in 1988. The MP global agreement protects the stratospheric ozone layer by phasing out the production and consumption of ozone-depleting substances.
[42] 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 dependent on available capacity to charge on a daily basis.
[43] Same volumetric flow at larger diameter would reduce flow velocity

5.6 Electrical Power and Other Fuel Sub-Element
[44] Duke Energy Florida has filed for rate increases every four to five years to earn its allowed rate of return. The most recent filing was in 2017 for approximately 8.5%. Burns and McDonnel has conservatively assumed a 2% average annual base rate increase over the 25-year forecast; however, it is expected that rate increases will occur every four to five years. Fuel-related costs in Duke's tariffs are expected to increase 1% per year over the next five years, based on forward price curves for Florida.

5.7 Natural Gas Sub-Element
[45] Typical natural gas operating pressures are 5-130 pounds per square inch (PSI).
[46] Peoples Gas System Index of Rate Schedules. Interruptible Service – Rate Schedule (IS) -Seventh Revised Sheet No. 7.603 for customers using 4,000,000 – 49,999,999 Therms per year.

5.7 Natural Gas Sub-Element
[47] Source: Infrastructure Agreement between University of Central Florida and Peoples Gas System (2018)
[48] ASHRAE District Heating Guide Comprehensive Reference Guide: Generating heat in a central plant is normally more efficient that using in-building equipment, and thus, the environmental impact is normally reduced. Greater efficiencies are possible due to the larger equipment and the ability to stage that equipment to closely match the load, while remaining with the equipment range of highest efficiency. District heating systems may take advantage of diversity of demand across all users in the system, and may also implement technologies such as thermal storage more readily than individual building heating systems.
[49] GasWorks Model Development and Scenario Analyses – will prepare and model established parameters and data collection of existing operating conditions, provide verification and validation that additional demands will not disrupt peak system performance, and identify system and capital improvements necessary to support future load growth.