

# Reclaim Water Case Study for District Energy Plant

AT THE UNIVERSITY OF CENTRAL FLORIDA





# Presentation Overview

- *Scale*
- *District Chilled Water Portfolio*
- *Reclaim Water Transition*
- *Case Study*
- *Moving Forward*
- *Campus Impact*

# UCF

**66,000** Enrollment

**12,000** Employees

**\$1.5 billion** budget

**\$1.3 billion** net worth of  
building assets



**“New Semester Another  
Record Breaker for UCF”**

- UCF**TODAY**



## CAMPUS SIZE

Location	Net Assignable	Footage	Acreage	No. of
Main Campus (owned buildings)	5,039,704	8,217,095	1,415	165
Central Florida Research Park (owned buildings)	281,015	426,138	0.1	8



# Scale of Production

## Electrical Generation Assets

Combined Heat & Power

*5.5 MW of total  
generation capacity*



## Thermal Generation Assets

Thermal Storage Tank

*2 MW of load shifted  
from peak to off peak*



**Chilled Water Assets**  
Central Energy Plants  
*21,152 refrigerated tons  
of generation capacity*



# Scale of Demand

Commodity	FY 13-14	FY 14-15	FY 15-16	FY 16-17
Campus Size (sqft)	9,782,247	9,997,684 (+2%)	10,008,811 (+0%)	10,158,618 (+1%)
Enrollment (students)	59,770	60,821 (+2%)	63,016 (+4%)	64,335 (+2%)
Chilled Water Produced (ton-hours)	36,263,035	37,737,240 (+4%)	37,749,003 (+0%)	38,333,540 (+2%)
Water Produced (gal)	225,630,066	206,728,524 (-8%)	226,428,100 (+10%)	174,524,900 (-23%)
Water Purchased (gal)	0	49,091,000 (n/a)	38,285,000 (-22%)	101,460,000 (+165%)
Reclaimed Water Purchased (gal)	214,413,000	198,245,000 (-8%)	173,870,000 (-12%)	202,721,500 (+17%)

# District Chilled Water Portfolio

**4** central energy plants

**3.7 MG** of evaporative chilled water managed

**125 MG** of condenser chilled water managed

**36 M ton-hours** of cooling annually produced and delivered

**74%** of main campus square footage served

**25,152 refrigerated tons** of production capacity

**25,000 tons** of generation build out capacity, the largest connected district energy system in Central Florida

**.73 kW/ton** of aggregate plant efficiency

**.68 kW/ton** of efficiency District Energy Plant IV

**3.0** cycles of concentration

***Bulk Transportation Agreement with Seminole County:***

**2 MGD** allotment of reclaim water from the Iron Bridge WWTF.

**2007**

President Hitt pledges climate neutrality by 2050 via Climate Action Plan.

Campus irrigation switches to 100% reclaim water.

**2009**

**2016**

UCF Collective Impact Strategic Plan incorporates dedication to sustainability, including aggressive and measurable conservation strategies.

Reclaim pilot project begins August 1.

**2017**

# Reclaim Water Transition

# Historical Demands

## Main CHW Plant (Bldg 0003)

Period	Year	Month Total (Gallons)	Month Cost	Cost Per 1,000 Gals	Daily Total GPD
Jul	2016	6,290,000	\$20,666	\$3.29	202,903
Jun	2016	5,548,000	\$17,551	\$3.16	184,933
May	2016	4,502,000	\$14,414	\$3.20	145,226
Apr	2016	3,618,000	\$11,654	\$3.22	120,600
Mar	2016	4,624,000	\$14,548	\$3.15	149,161
Feb	2016	1,820,000	\$5,840	\$3.21	62,759
Jan	2016	1,891,000	\$6,058	\$3.20	61,000
Dec	2015	4,116,000	\$13,177	\$3.20	137,200
Nov	2015	4,322,000	\$13,635	\$3.15	144,067
Oct	2015	5,536,000	\$17,725	\$3.20	178,581
Sep	2015	7,012,000	\$22,417	\$3.20	233,733
Aug	2015	7,745,000	\$23,948	\$3.09	249,839
<b>Totals</b>		<b>57,024,000</b>	<b>\$181,633</b>	<b>\$3.19</b>	

## Satellite CHW Plant (Bldg 0072)

Period	Year	Month Total (Gallons)	Month Cost	Cost Per 1,000 Gals	Daily Total GPD
Jul	2016	8,937,002	\$28,861	\$3.23	288,290
Jun	2016	7,362,667	\$23,594	\$3.20	245,422
May	2016	7,162,918	\$23,477	\$3.28	231,062
Apr	2016	5,253,151	\$17,131	\$3.26	175,105
Mar	2016	4,726,162	\$16,096	\$3.41	152,457
Feb	2016	3,876,546	\$13,329	\$3.44	133,674
Jan	2016	3,188,317	\$10,578	\$3.32	102,849
Dec	2015	4,484,134	\$14,656	\$3.27	144,649
Nov	2015	4,763,052	\$15,318	\$3.22	158,768
Oct	2015	5,851,169	\$19,110	\$3.27	188,747
Sep	2015	6,704,557	\$22,062	\$3.29	223,485
Aug	2015	4,906,784	\$16,274	\$3.32	158,283
<b>Totals</b>		<b>67,216,459</b>	<b>\$220,485</b>	<b>\$3.28</b>	



# Current Demands

## UCF's Main Campus Total Reclaimed Water Use

	Gallons/Year	GPD
Main DEP	57,024,000	156,230
Satellite DEP	67,216,459	184,155
Future DEP	65,000,000	178,082 <i>(estimated)</i>
Irrigation	100,982,360	276,664
Totals	290,222,819	795,131

# Current Costs

## Potable Water Costs

Plant	Yearly Usage (Gallons)	Yearly	Per 1,000 Gal.
Satellite (Bldg. 0072)	67,216,459	\$220,485	\$3.97
Main (Bldg. 0003)	57,024,000	\$181,633	
Future DEP (Estimated)	65,000,000	\$213,215	
<b>Totals</b>	<b>122,024,000</b>	<b>\$394,848</b>	

## Reclaim Water Costs

Plant	Yearly Usage (Gallons)	Yearly	Per 1,000 Gal.
Satellite (Bldg. 0072)	67,216,459	\$48,396	\$0.97
Main (Bldg. 0003)	57,024,000	\$41,057	
Future DEP (Estimated)	65,000,000	\$46,800	
<b>Totals</b>	<b>122,024,000</b>	<b>\$87,857</b>	

# Added Costs

## **Equipment: \$1,094.42 / month**

Includes: New pH control system, board mounted with pH, ORP, Conductivity, Inhibitor, flow switch, sensors, NEMA 4 enclosure.

3-chemical pumps, acid dilution board mounted system NEMA 4 lockable enclosure, 3 -110 gal spill tanks, fully enclosed safety tubing.

63 GPM, auto backwash, 5 micron, media skid mounted Filtration System.

2 inch inlet and outlet tower water hookup with city water backwash supply inlet. 220 v.

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## **Chemicals: \$1,582.95 / month**

Includes: Sulfuric Acid for alkalinity removal, Increased Sodium Hypochlorite, added Proclean 502 dispersant, added monitoring and lab tests.

	Well Water (Baseline)	Reclaim Water	Reclaim with pH Adjustment
Cycles of Concentration	3	2.5	5
MU Water Gallons / Year	91,277,798	101,419,776	78,238,113
Total Reclaim Water Cost	-	\$281,942 / year	\$145,353 / year
Projected Water Cost (Make-up)	\$238,235 / year	\$73,002 / year	\$56,331 / year
Projected Sewer Charge (for Bleed)	\$156,688 / year	\$208,920 / year	\$89,022 / year
Total Cost	\$394,923 / year	\$281,942 / year	\$145,353 / year
Total Water & Sewer Savings	-	\$112,981 / year	\$249,570 / year
Gallons Saved	-	10,141,978 / year	23,181,663 / year
Equipment Added Cost	-	\$78,210	\$162,656
Chemical Added Cost	-	\$57,900	\$78,800
Savings with Chemical Cost Adjustment	-	<b>+\$55,081 / year</b>	<b>\$170,770 / year</b>



# The Pilot: Tower 7

Tonnage	2000
Estimated Percent Load	0.52
Operational Tonnage	1040
Operational Recirculation GPM	3120
Cycles Formerly Running	3
Projected Annual Savings	\$58,559.64

Calendar Year	CH-7 Run-Hours
2012	2715.45
2013	2593.76
2014	1024.58
2015	5956.50
2016	5074.03
2017	2427.60

# Partnership with US Water



- Evaluate Water Treatment Needs by Using Reclaim Water
- Modifications in Equipment, Automation and Monitoring
- Methods to Increase Cycles of Concentration
- Operate Systems within “Best Practices” When Treating Cooling Tower Systems

# Reclaim Water Concerns

TYPICAL PROBLEMS WITH USE OF RECLAIM WATER SOURCES	
High and <b>Fluctuating</b> Ortho Phosphate Levels	Promotes Calcium Phosphate Scale
Higher Hardness and Total Alkalinity	Promotes Calcium Carbonate Scale
Higher Chlorides	Increases Corrosion
Higher Sulfates	Increases Corrosion
Higher Organic Loading	Promotes Fouling and Higher Biological Loading
<b>Insure Interruptible Water Source</b>	<b>Minimize Changing Water Sources</b>

*Worked with Seminole County Water  
Multiple Samples Taken Over One Year  
Period*

**Higher Scaling Type Water**



## **Findings Were:**

- Higher Conductivity
- Higher Total Alkalinity
- Hardness about same
- Ortho Phosphate < 1.0 ppm
- Ortho Phosphate fluctuation < 2.0ppm
- Chlorides Higher – Still Okay
- Sulfates about the same

# Water Treatment Equipment and Chemical Modifications

## Added Safe Sulfuric Acid Feed System

- Secondary Containment Chemical Pump
- Double walled all tubing
- (2) Dilution Methods for injection of Acid
- Help control Calcium Phosphate
- Only need to adjust pH to 8.2
- Increased Cycles from 3.0 – 5.0 (16% reduction water)

Redundant pH probes – Feed and backup monitoring  
Still use Bromine-Chlorine/Isothiazoline based Biocide Program

Inhibitor / Polymer Program remained the same  
Added Sand Filtration for each tower System





# Water Treatment Chemical Monitoring

## Monitor Automatically 24/7

- pH (two probes)
- Conductivity
- Inhibitor – Traced Technology
- Water Usage
- Chemical Pump Activation
- ORP
- Flow – Temperature



Controller Cellular Gateway



WEB based Data Management Program



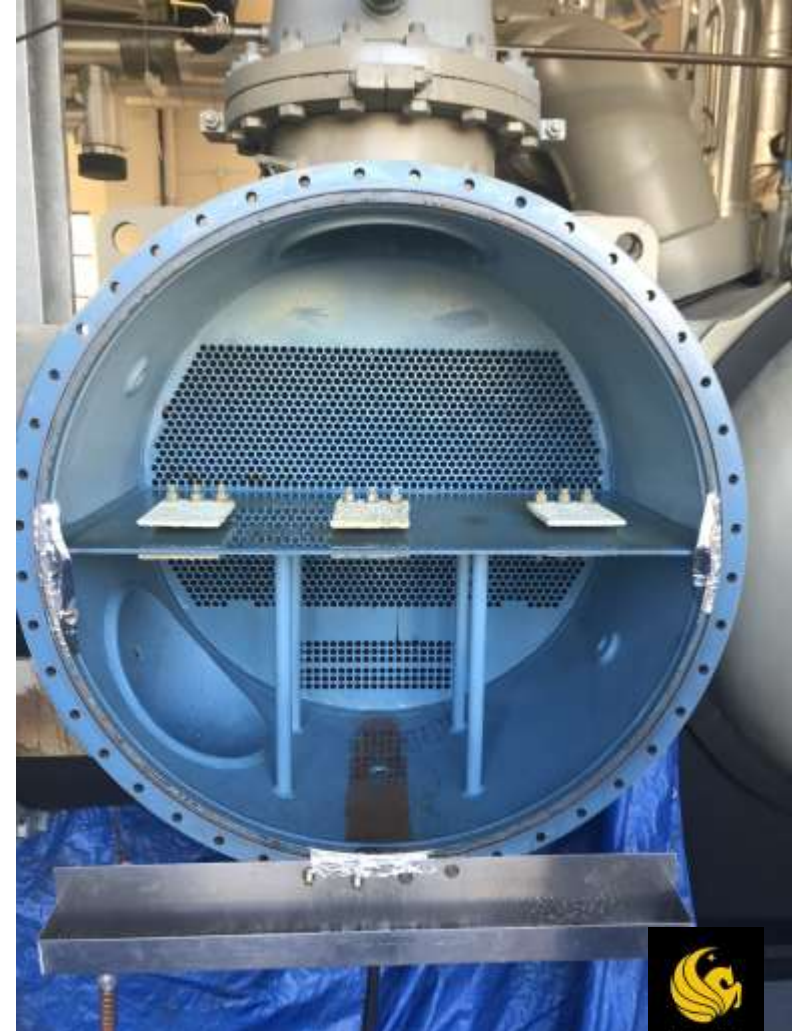
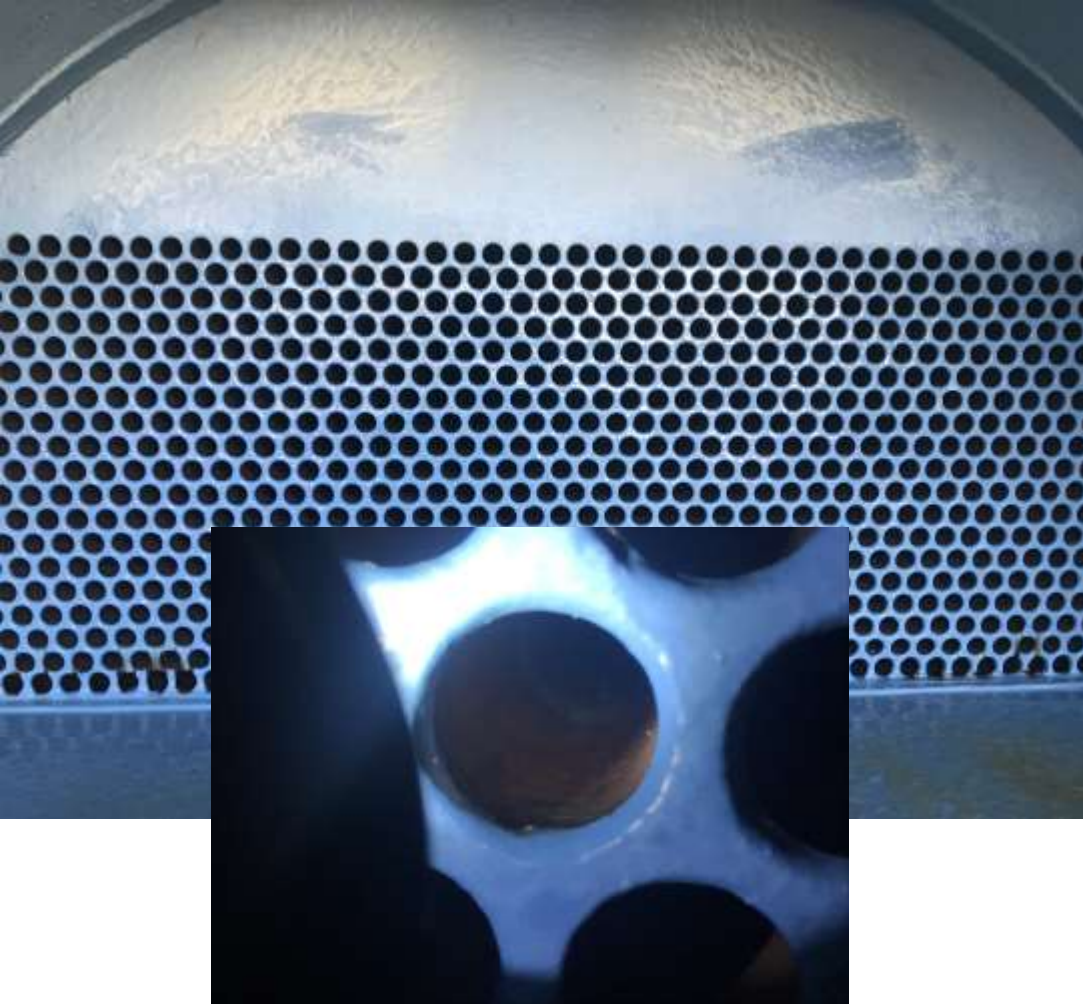
Daily dashboard with graphics

## Chemical Testing - Weekly + Ortho Phosphate Quarterly Lab Samples

Alarming and Direct Controller Access



UCF DOES NOT TEST OR MONITOR THE SYSTEMS

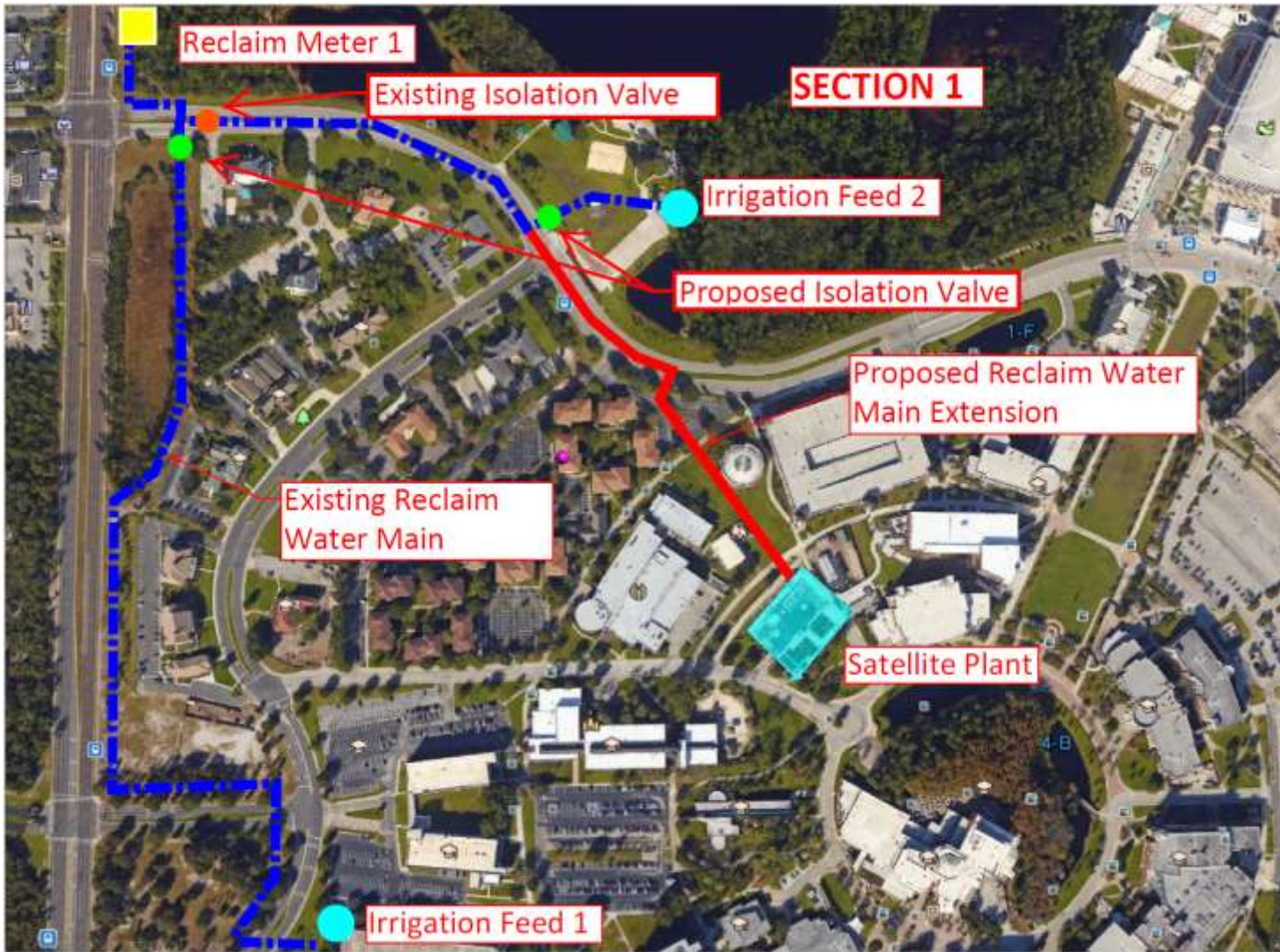


# What's Next

- Design of a dedicated DCS transmission system
- Payback time: 1.37 years
  - Total estimated construction costs for Sections 1, 2 & 3: **\$419,300**
  - One year savings for using reclaim water is **\$306,911**

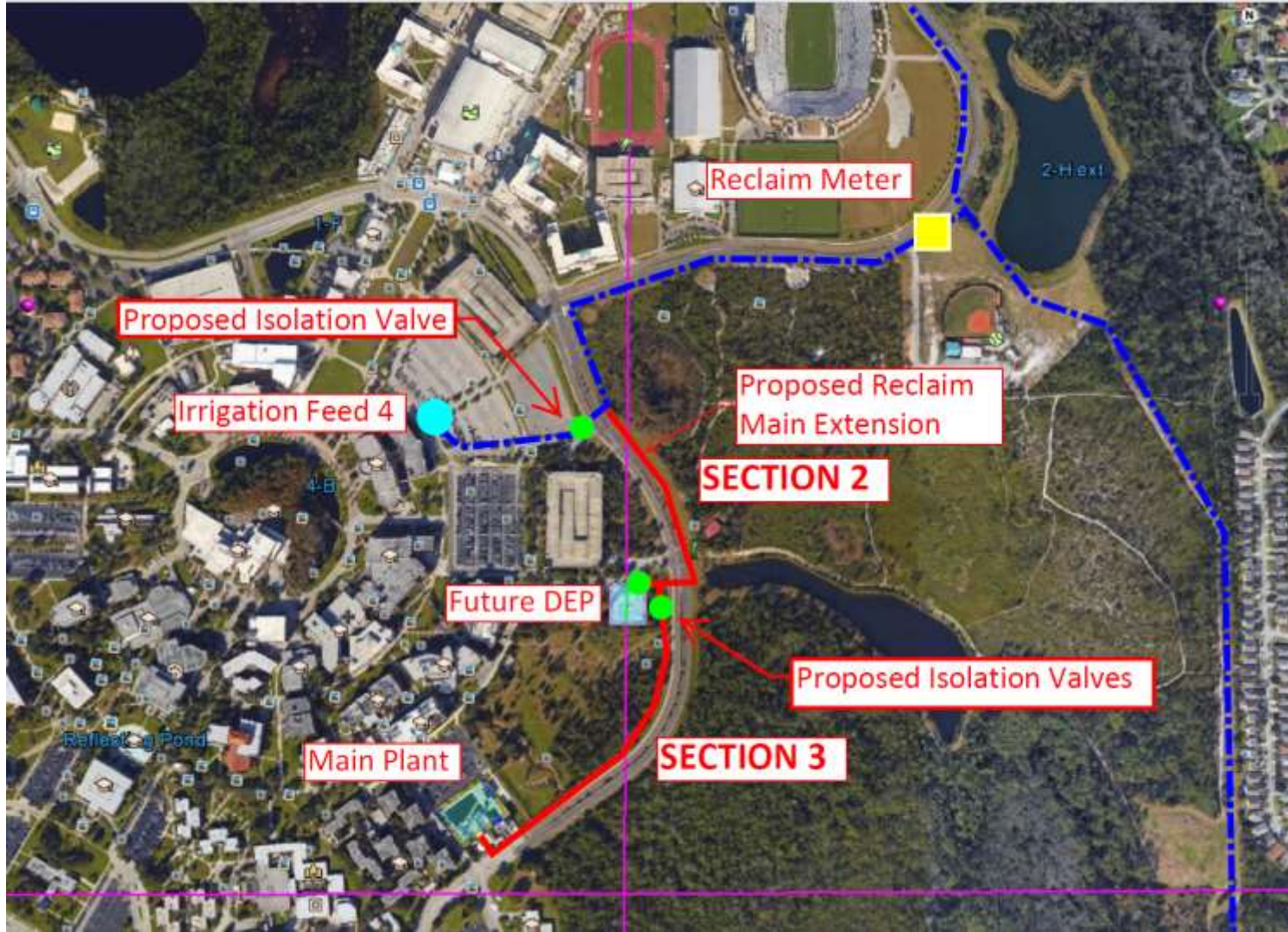


# Moving Forward: Infrastructure





# Moving Forward: Infrastructure



# Campus Impact



UCF Collective Strategic Impact

President's Climate Commitment

Demonstrate our commitment to LEED

Living Laboratory

Sustainability Working Advisory Team

Potential for sustainable growth



