

10th Street Chiller Plant Master Plan and Expansion



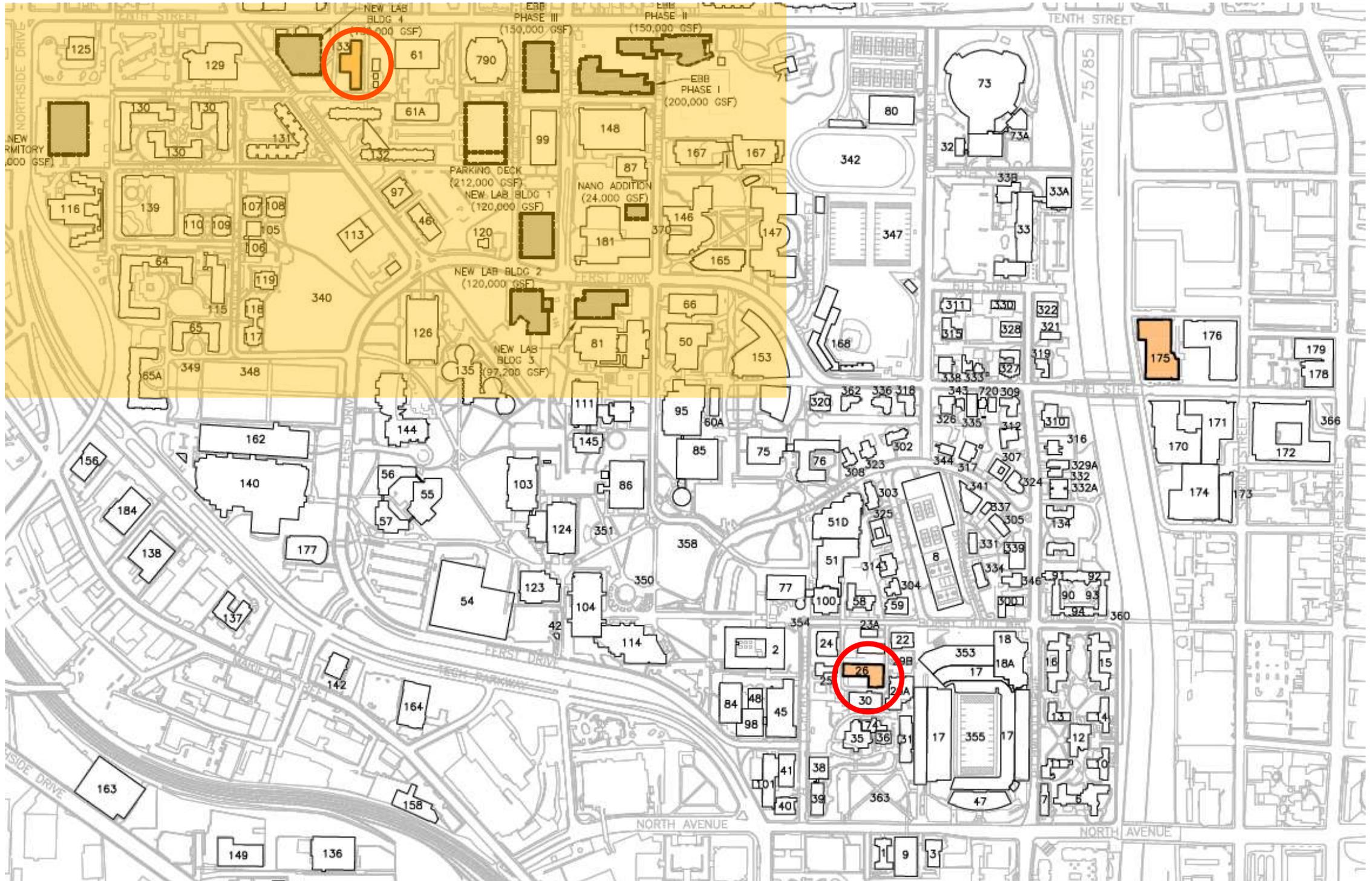
GT Commitment To District Energy & Sustainability

- **Downtown Atlanta Location**
- **21,000 Students**
- **15 Million SF of facilities**
- **District Heating – Holland Steam Plant**
- **District Cooling – Holland and 10th St. Chiller Plants**



Carbon Neutral Energy Solutions Lab

District Energy at GT

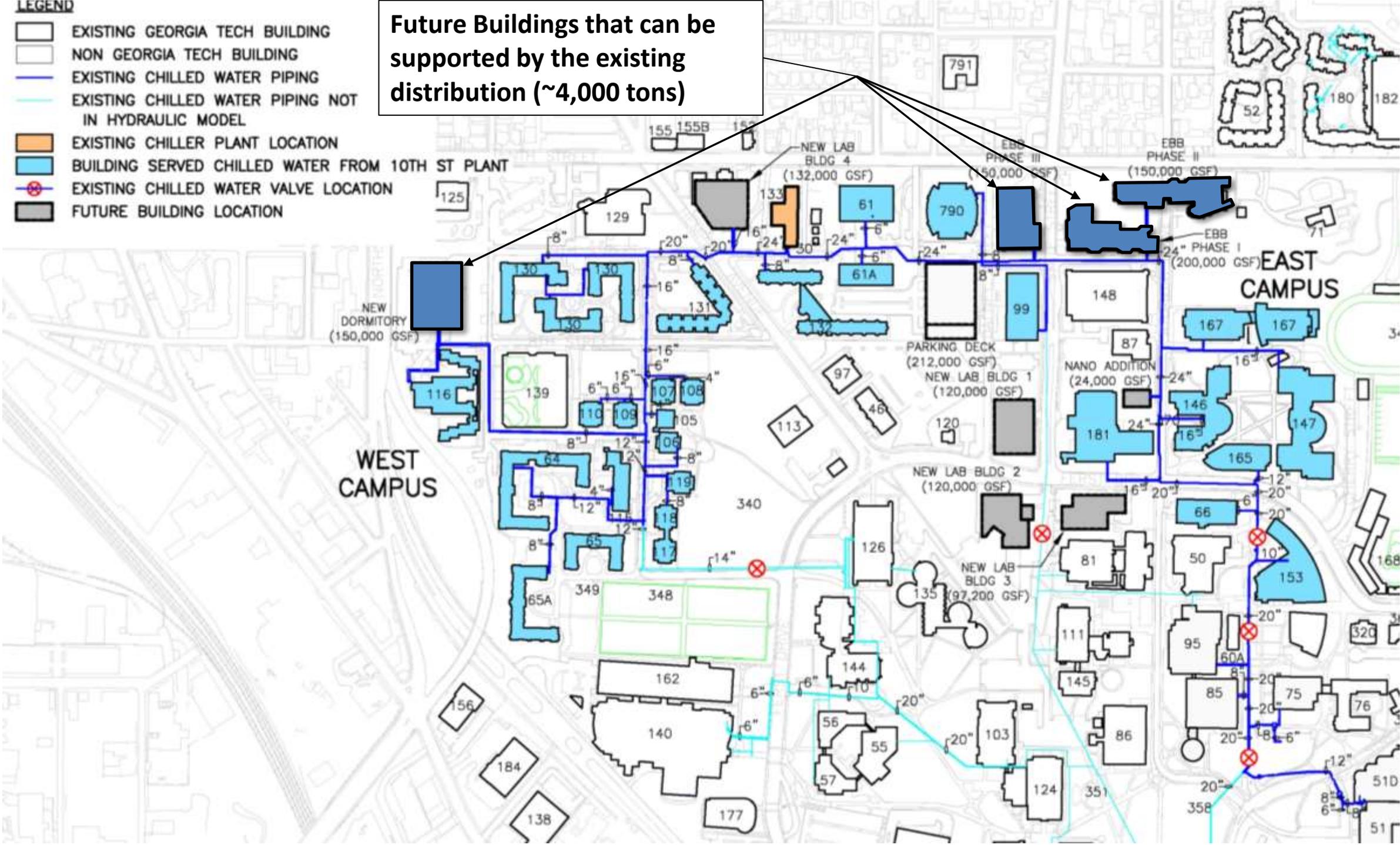


10th Street Campus CHW Service

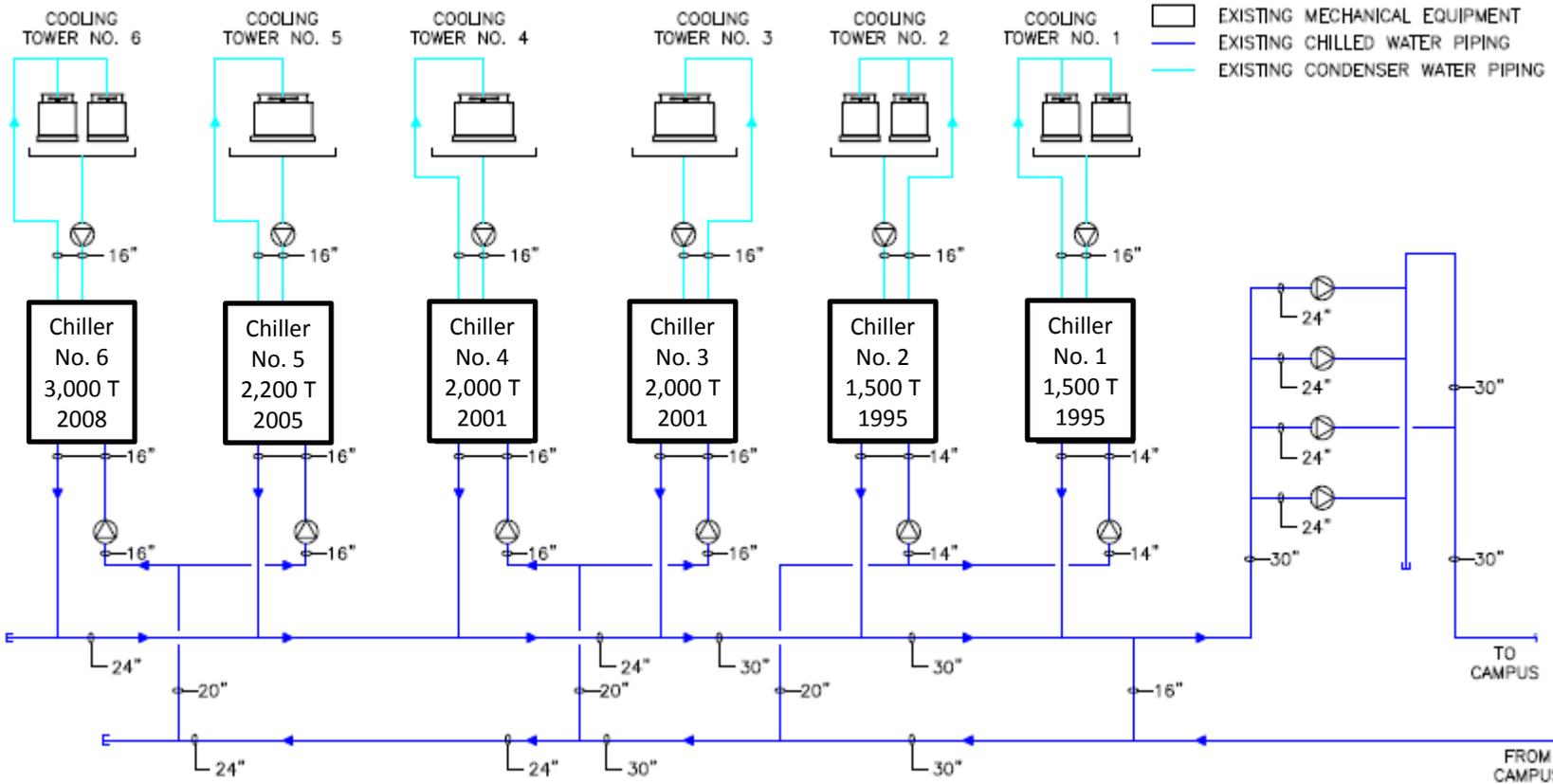
LEGEND

- EXISTING GEORGIA TECH BUILDING
- NON GEORGIA TECH BUILDING
- EXISTING CHILLED WATER PIPING
- EXISTING CHILLED WATER PIPING NOT IN HYDRAULIC MODEL
- EXISTING CHILLER PLANT LOCATION
- BUILDING SERVED CHILLED WATER FROM 10TH ST PLANT
- EXISTING CHILLED WATER VALVE LOCATION
- FUTURE BUILDING LOCATION

Future Buildings that can be supported by the existing distribution (~4,000 tons)



Existing Plant Summary



- Existing Plant Built in 4 phases (1995, 2001, 2005, 2008)
 - No redundancy for pumps / cooling towers
 - Inherent inefficiencies due to age
- Electrical System
 - System Efficiency ~0.90 kw/ton
 - Electric Costs \$1.3 million / year
 - Minimal Redundancy
 - New Systems ~0.75 kw/ton
- Cooling tower make-up
 - Current operation minimize make-up rate
 - \$8 / thousand gallon (water charges)
 - \$20 / thousand gallon (sewer charges)
 - **Water/ sewer costs \$500,000 / year**
- Designed for a 9,000 ton expansion

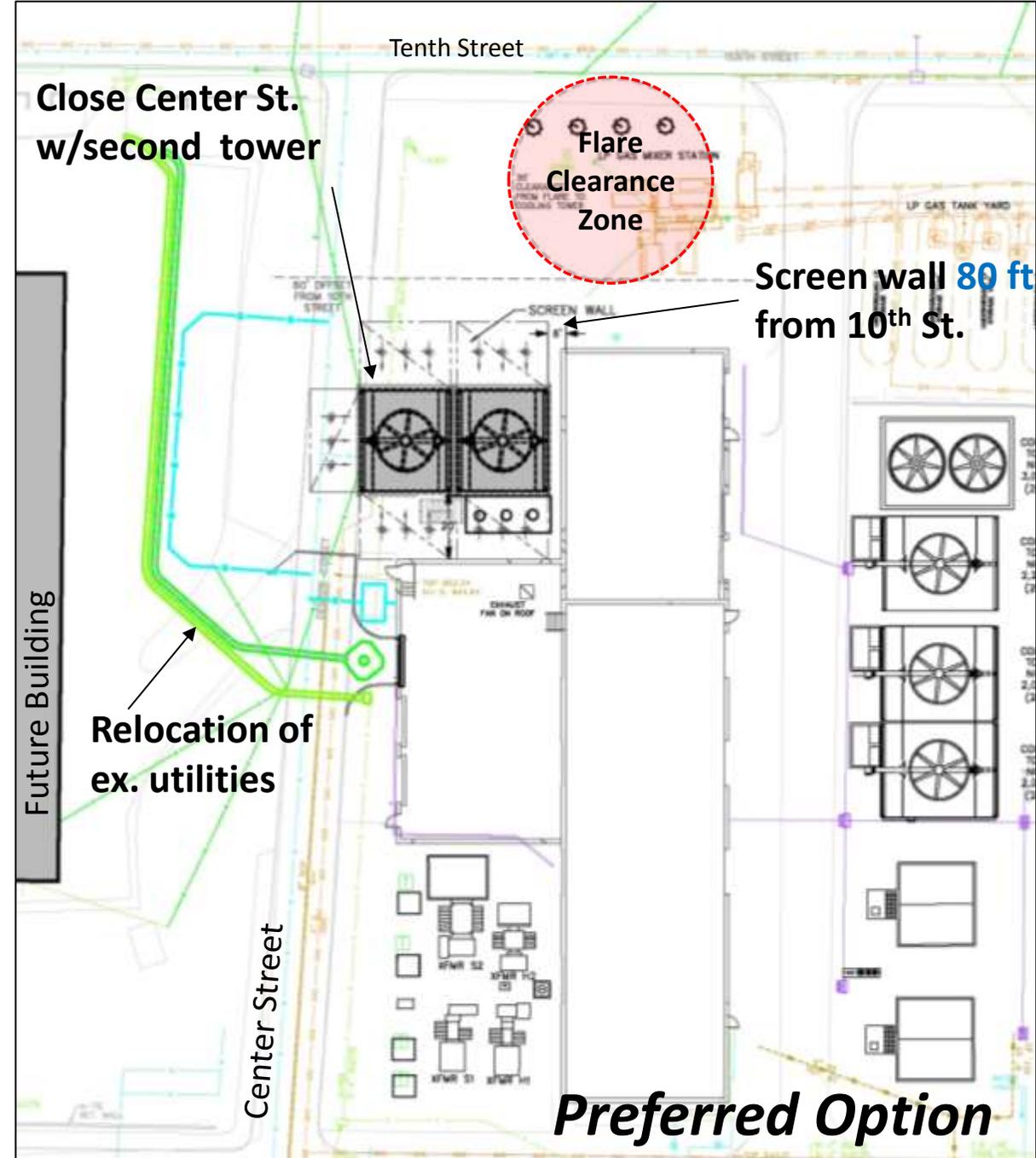
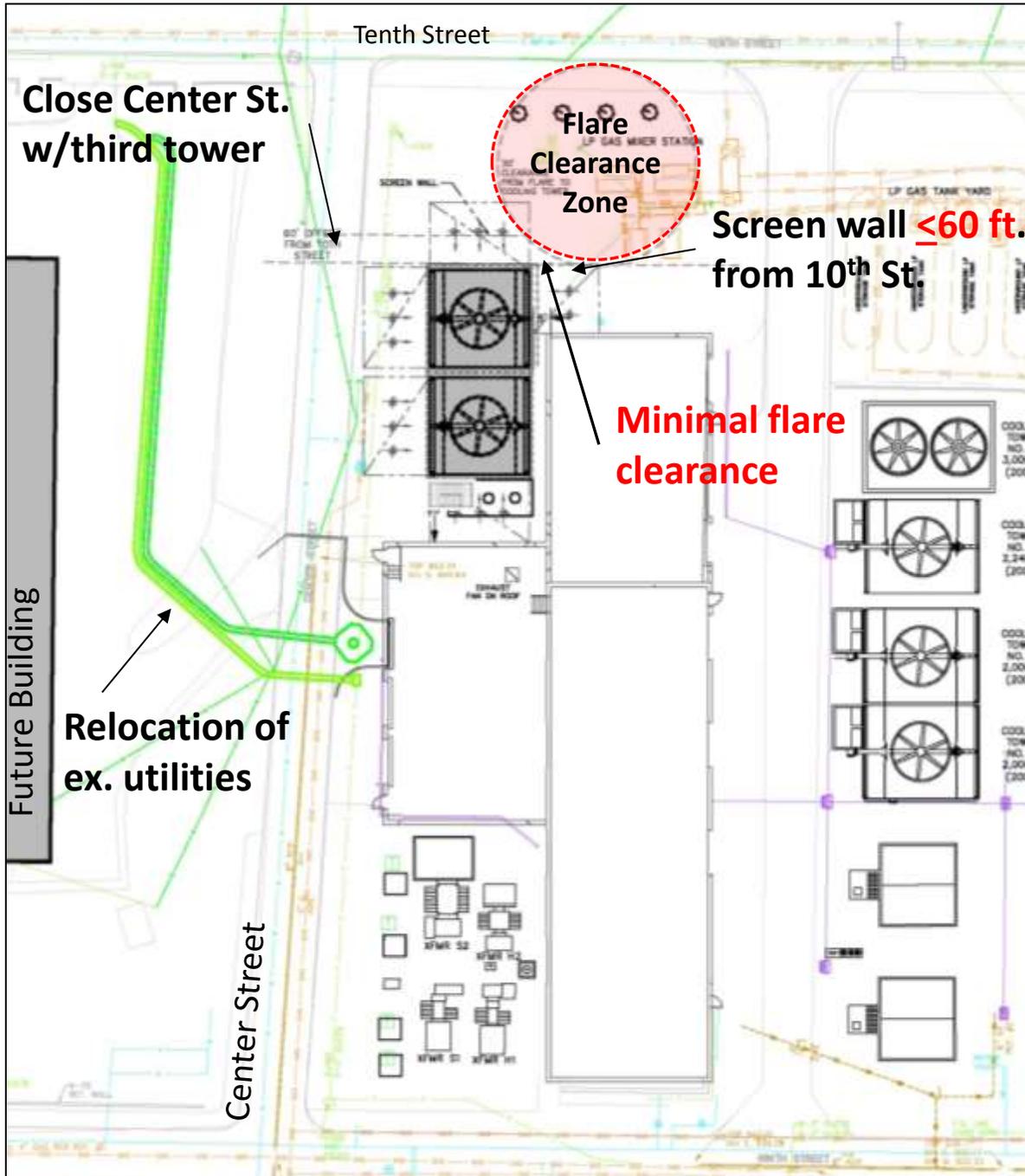
Project Objective

Develop a plan to add capacity and improve sustainability of the 10th Street Chiller Plant based on the following criteria:

- **Add 3,000 Tons**
- **Optimize Efficiency**
- **Reduce Water Use**
- **Improve Reliability, Operations & Maintenance**

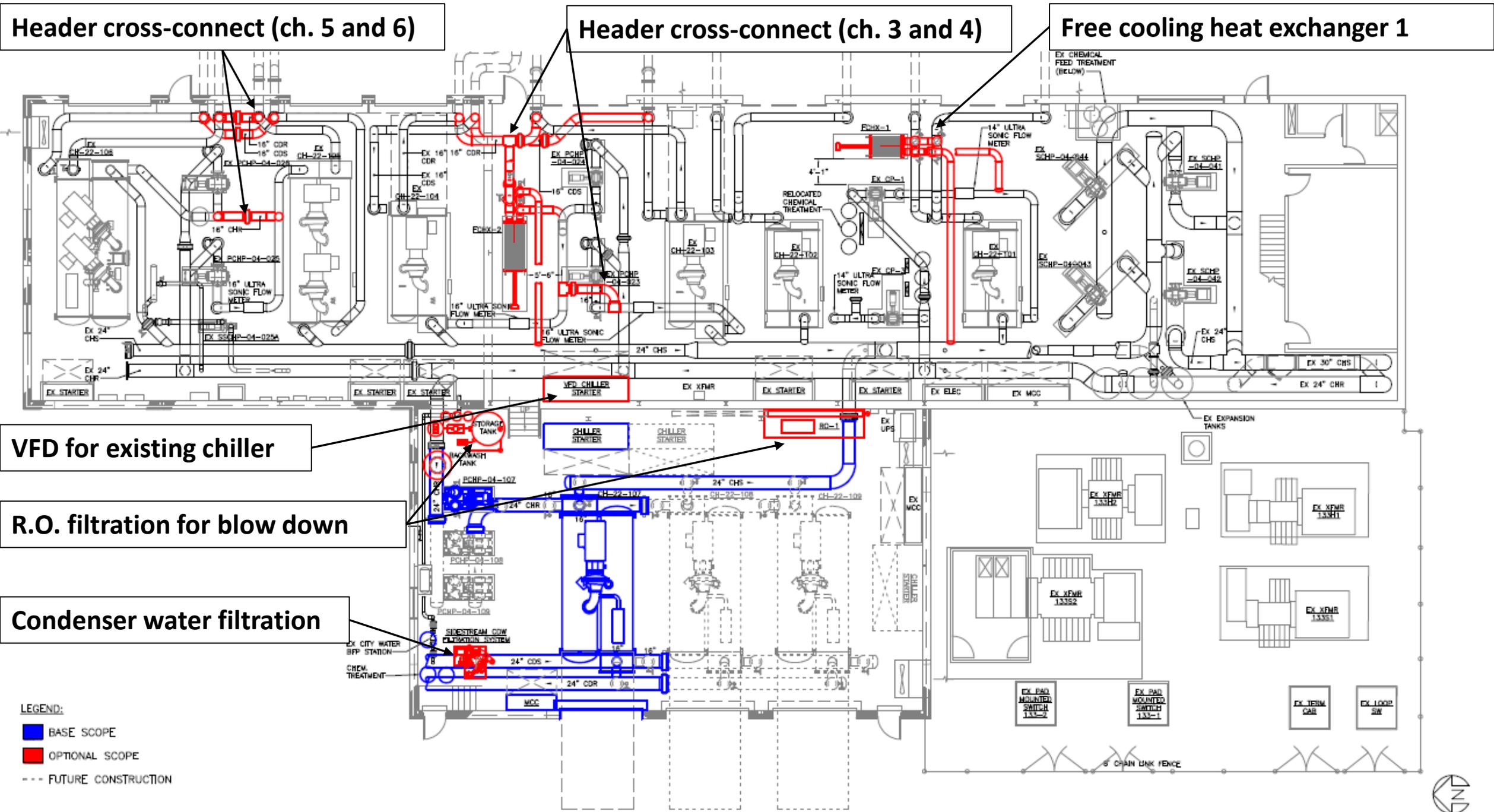


Primary Cooling Tower Options

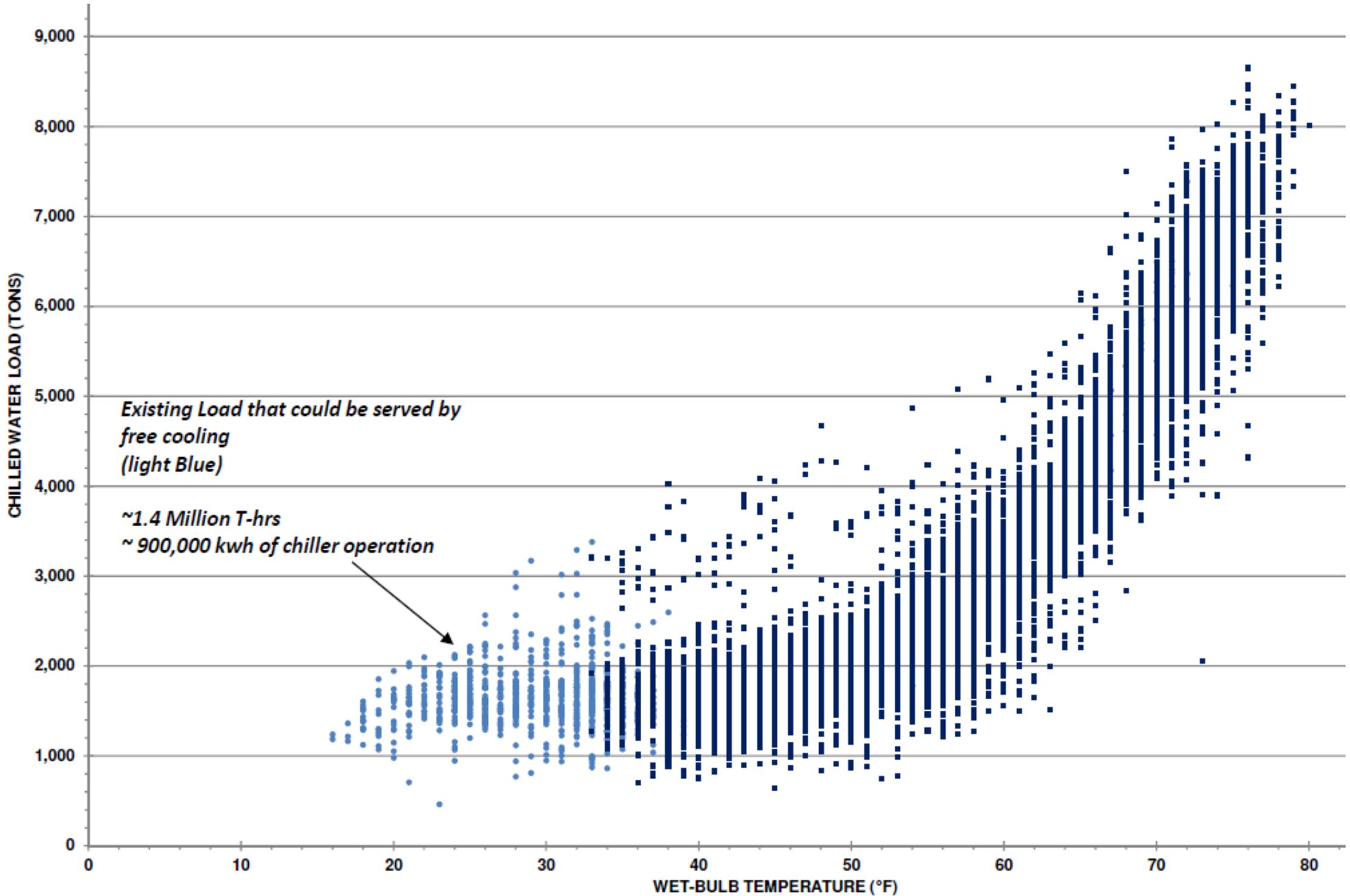


Note: Rooftop cooling towers were also evaluated, but resulted in significantly higher capital cost due to structural upgrades (+\$1.5 M per tower). In addition the on grade option has operational advantages.

Potential Chiller System Enhancements



Chilled Water Load vs Wet-Bulb



Cost Summary

Cost Reduction Enhancements	Base Cost*	Annual Savings	Simple Payback	ROI
3,000 ton chiller (base scenario)	\$4,620,000	\$125,000	---	---
Add VFD for new chiller	\$ 300,000	\$ 85,000	4	28%
Water Treatment System	\$ 400,000	\$300,000	<2	67%
Free cooling heat exchanger 1 (1,500 tons)	\$ 250,000	\$30,000	8	12%
VFD retrofit for existing chiller (no. 3 or no. 4)	\$ 540,000	\$45,000	12	8%
Thermal storage (30,000 ton-hrs)	\$3,450,000	\$185,000	19	5%
Free cooling heat exchanger 2 (1,700 tons)	\$ 400,000	\$10,000	40	3%
Reliability Enhancements	Base Cost			
Header cross-connect (chiller nos. 5 and 6)	\$ 100,000			
Header cross-connect (chiller nos. 3 and 4)	\$ 120,000			
Redundant condenser water pumps	\$ 130,000			
Double-ended transformer and switch	\$4,200,000			
Emergency generator	\$5,200,000			
Condenser water filtration (suspended sol.)	\$ 110,000	<i>For improved maintenance</i>		

Note: * Base Cost includes construction cost plus 20% soft costs

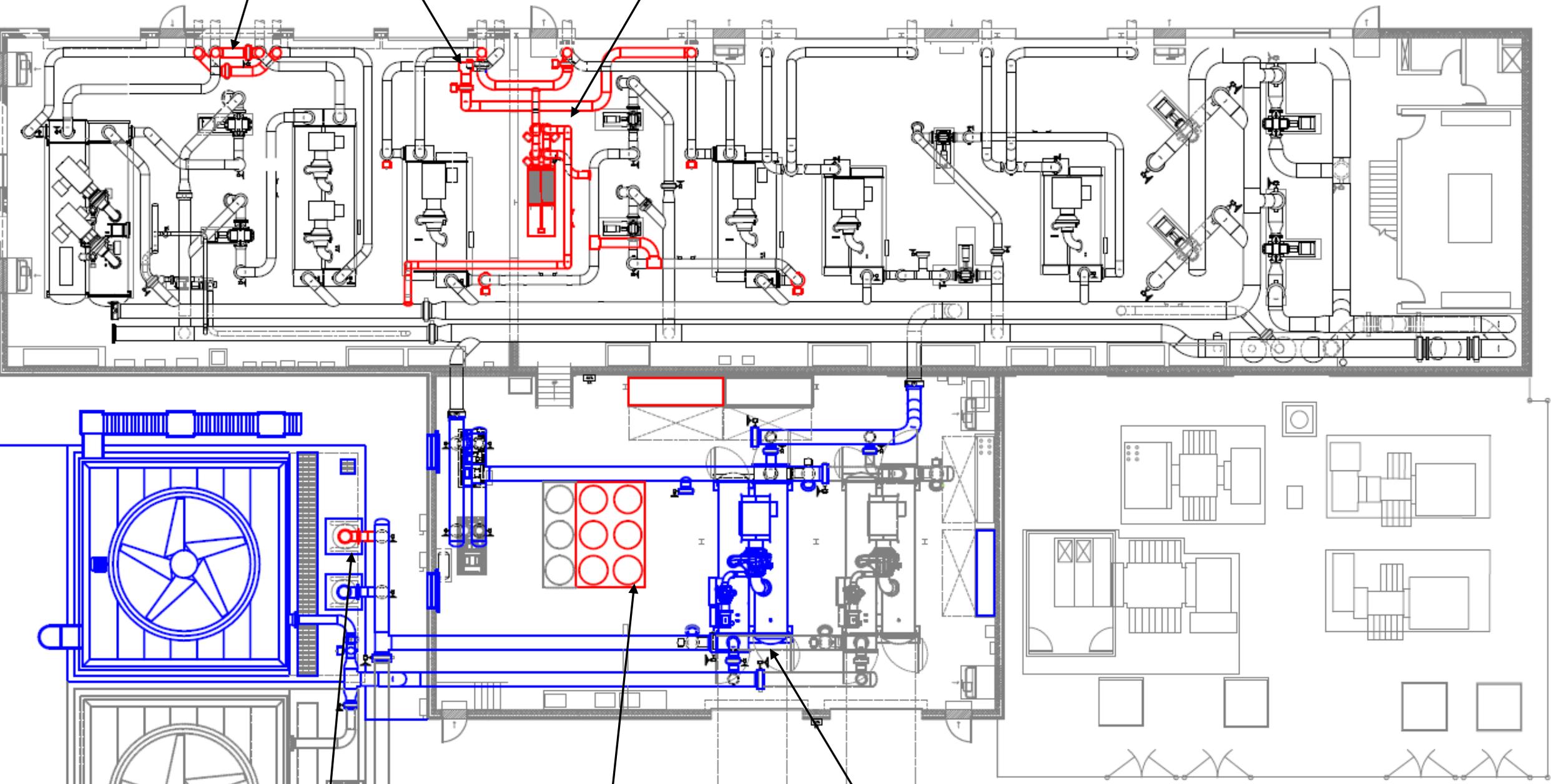
Selected Project

Well Water Treatment System



Header Cross-Connect

Free Cooling Heat Exchanger



Redundant VFD Pump

City Water Treatment System

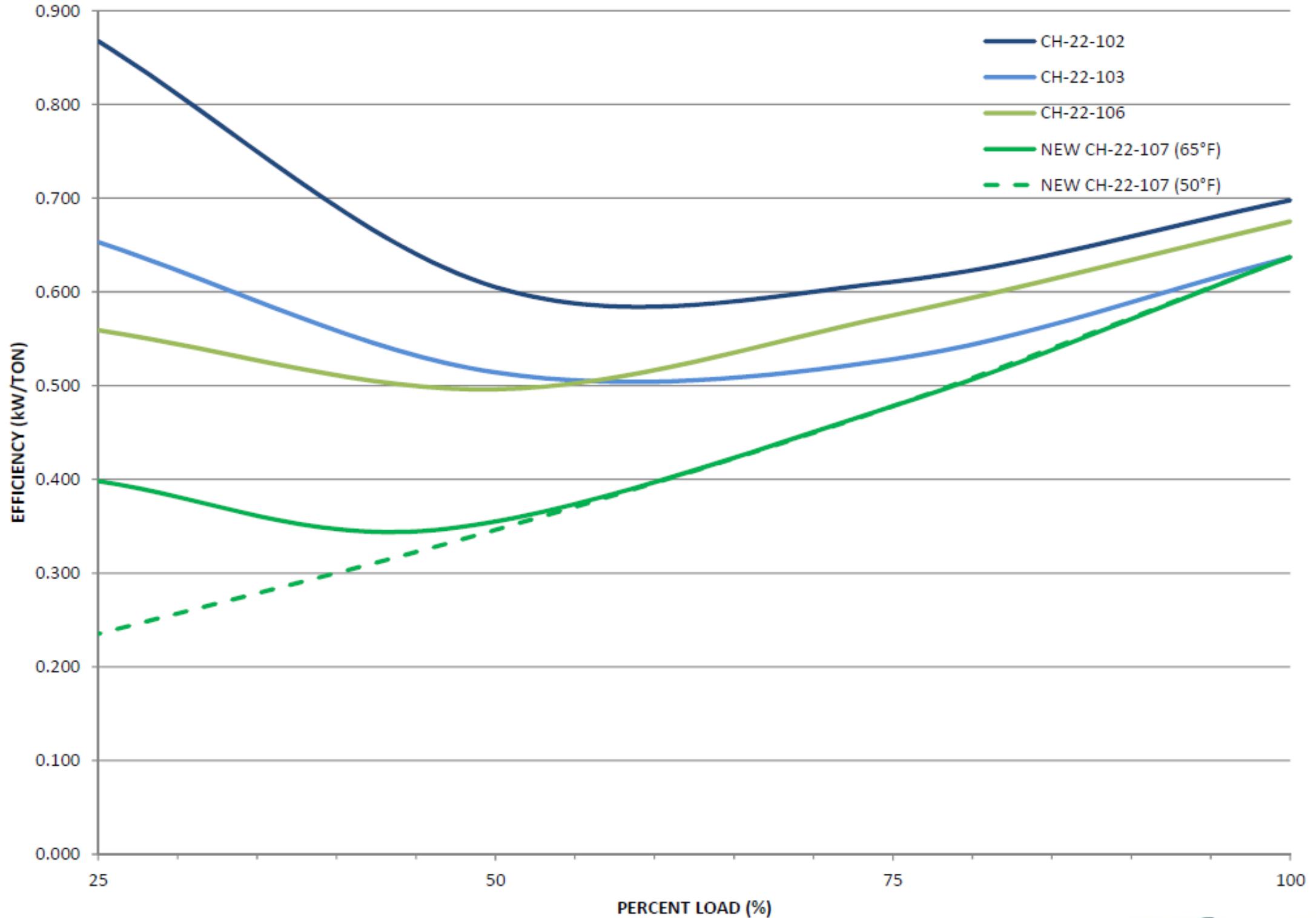
3,000T VFD Chiller

Chiller Selection

- R-134A
- Capacity vs Footprint
- First Medium Voltage VFD
- York YK-EP 3,000 T



Chiller Efficiency

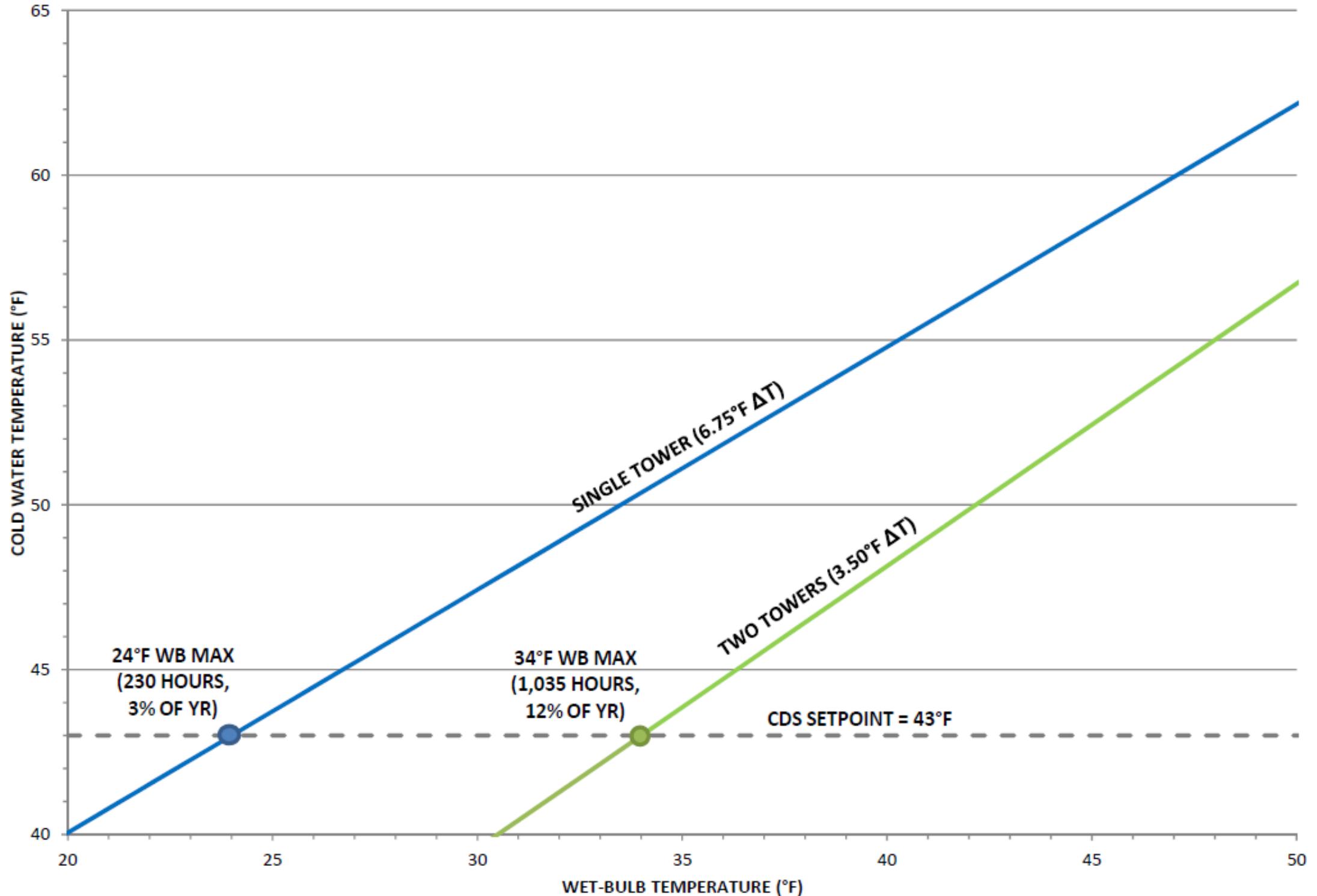


Free Cooling Design

- **Parallel or Stand-Alone Operation**
- **Designed for 10F Winter Delta-T**
- **Tower Capacity 4,000 Nominal Tons**
- **Free Clg Capacity 1,700 Tons**

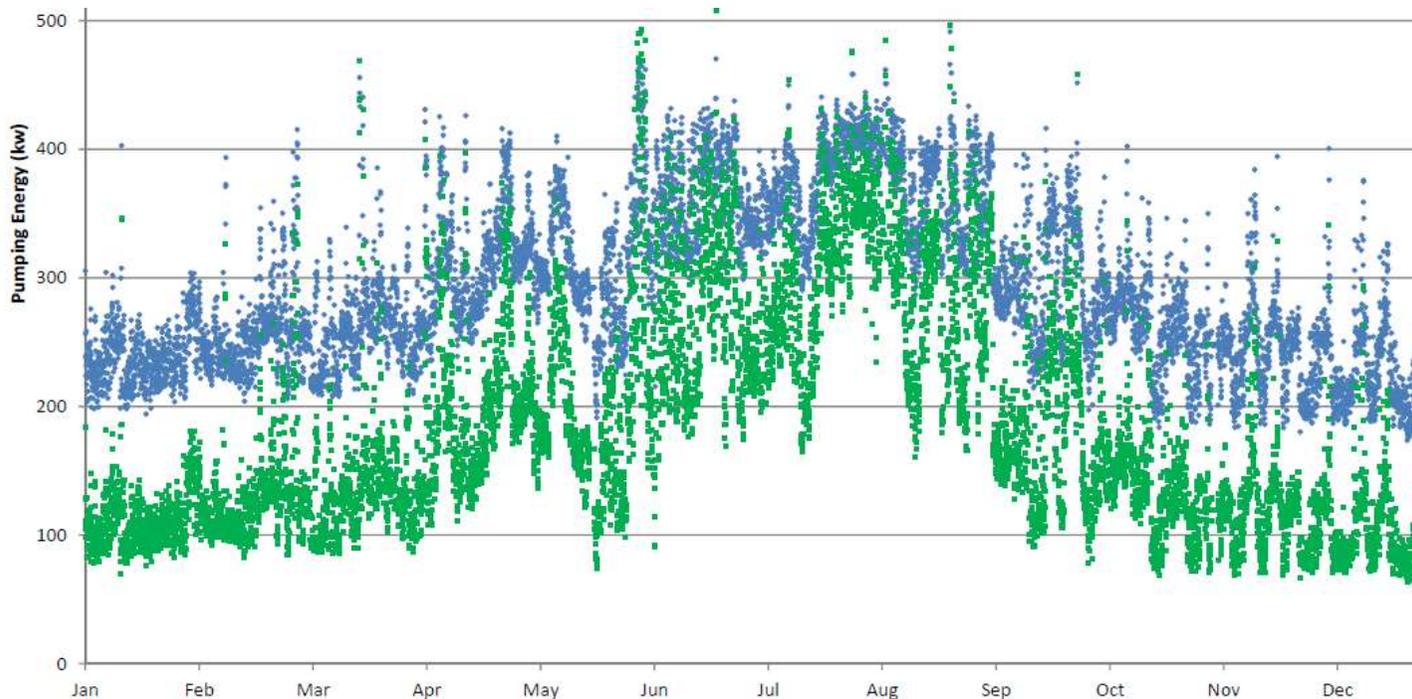


Free Cooling Design



Other Energy Savings Measures

- **Pumping & Controls**
 - VFD's on Primary
 - Control Head Reset on Secondary Pumps
 - Secondary Staging based on Flow Rate



Operation and Maintenance Improvements

- Tower Access Stairs
- FRP Grate and Lift-Out Screens



Operation and Maintenance Improvements

- Davited End Plates
- Removable Roof Panel



Saving Water and Money

- **Existing Systems**
 - 6 stand-alone traditional chemical systems
 - Targeting 10 Cycles of Concentration
 - Well Water
- **Ideas Considered**
 - RO Treatment of Blow-Down
 - Non-Traditional Zero Liquid Discharge Water Treatment



TABLE NO. 4-6: CONDENSER WATER CONSERVATION OPTIONS
GEORGIA INSTITUTE OF TECHNOLOGY

COMPARISON CRITERIA	BASE TREATMENT EXISTING SYSTEM	BASE + 2X RO BLOWDOWN TREATMENT	BASE + 2X RO BLOWDOWN & MK-UP TREATMENT	WCTI ³ ZLD SYSTEM CITY WATER	WCTI ³ ZLD SYSTEM CITY & WELL WATER
DESCRIPTION	TRADITIONAL WATER CHEMISTRY, BLOW-DOWN AT 10 COC	BASE + RECOVER 85% OF TOWER BLOWDOWN	BASE + RECOVER 85% OF WELL MK-UP & TOWER BLOWDOWN	WCTI TREATMENT OF CITY WATER	WCTI TREATMENT OF CITY & WELL WATER
SCALE CONTROL	PHOSPHATES OR POLYMERS SEQUESTER			LOW HARDNESS, SODIUM SILICATE	
CORROSION CONTROL (CS)	PHOSPHATE, MOLYBDATE			HIGH TDS, SODIUM SILICATE	
CORROSION CONTROL (CU)	TOLYTRIAZOLE			HIGH TDS, SODIUM SILICATE	
BIOLOGICAL CONTROL	OXIDIZERS (BROMINE, CHLORINE)			HIGH PH, BIOSTATIC	
TOWER BLOWDOWN	10%	10% (NET 1.5%)	10% (NET 1.5%)	ZLD (NET 1.8% w/ BACKWASH)	
CITY MAKE-UP USE (GPY)	64,000,000	58,560,000	41,806,500	57,465,600	37,835,600
SEWER USE (GPY)	6,400,000	960,000	3,916,500	320,000	400,000
SYSTEM FIRST COST	\$25,000	\$373,000	\$463,000	\$211,500	\$420,000
OPERATING COST (\$/YR)	\$40,000	\$75,000	\$85,000	\$56,000	\$65,000
WATER+SEWER COST (\$/YR)	\$640,000	\$487,680	\$412,782	\$466,125	\$310,685
TOTAL ANNUAL COST	\$680,000	\$562,680	\$497,782	\$522,125	\$375,685
ANNUAL SAVINGS	-	\$117,320	\$182,218	\$157,875	\$304,315
SIMPLE PAYBACK	-	3.2	2.5	1.3	1.4
ROI	-	31%	39%	75%	72%
KEY ADVANTAGES	LOW FIRST COST	GOOD RECV.	USES WELL WATER	SINGLE MK-UP TREATMENT, WATER SAVINGS, LESS CHEMICAL USE	
KEY DISADVANTAGES	7 SYSTEMS	COMPLICATED	COMPLICATED	LEADING EDGE, SOLE SOURCE, SALT WASH	

Non-Traditional Water Treatment

- Well Water
- Silica Preferred
- No / Limited Chemical Use
- No / Limited Blowdown
- Better Stability
- Better Corrosion Protection



Vetting Zero Blow-Down Claims

- **References**
 - Cypress College
 - Apple
 - Boeing
 - Verizon
- **Conference Calls**
- **Site Visits**
- **Discoveries:**
 - Data Centers Loved Stability
 - Well Water Used
 - Corrosion Reduced Substantially



Implementation & Challenges

- **Implementation**
 - Well Water System
 - City Water System
- **Challenges**
 - Proprietary
 - Salt For Regeneration (65,000 lbs/year @ 3,500 Tons avg load)
 - Requires Sodium Silicate
 - Soft Water Tower Fill Wash-Downs
 - Overspray Concerns
 - New In University Marketplace



Next Steps

- **Finish system startup and commissioning**
- **Metering blowdown and usage on WCTI system**
- **Measurement and verification of the first year of operation.**
- **Metered free cooling HX to provide verification**